

PBSmodelling 2.65: User's Guide

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ABSTRACT

Schnute, J.T., Couture-Beil, A., Haigh, R., and Kronlund, A.R. 2013. **PBSmodelling 2.65: user's guide** revised from Canadian Technical Report of Fisheries and Aquatic Sciences 2674: viii + 194 p. Last updated Mar 28, 2013.

This report describes the R package **PBSmodelling**, which contains software to facilitate the design, testing, and operation of computer models. The initials **PBS** refer to the Pacific Biological Station, a major fisheries laboratory on Canada's Pacific coast in Nanaimo, British Columbia. Initially designed for fisheries scientists, this package has broad potential application in many scientific fields. **PBSmodelling** focuses particularly on tools that make it easy to construct and edit a customized graphical user interface (GUI) appropriate for a particular problem. Although our package depends heavily on the R interface to Tcl/Tk, a user does not need to know Tcl/Tk. In addition to GUI design tools, **PBSmodelling** provides utilities to manage projects with multiple files, write lectures that use R interactively, support data exchange among model components, conduct specialized statistical analyses, and produce graphs useful in fisheries modelling and data analysis. Examples implement classical ideas from fishery literature, as well as our own published papers. The examples also provide templates for designing customized analyses using other R packages, such as **PBSmapping**, **PBSddesolve**, **odesolve**, and **BRugs**. Users interested in building new packages can use **PBSmodelling** and a simpler enclosed package **PBStry** as prototypes. An appendix describes this process completely, including the use of C code for efficient calculation.

Preface

After working with fishery models for more than 30 years, I’ve used a great variety of computer software and hardware. Currently, the free distribution of R (R Development Core Team 2011a) provides an excellent platform for software development in an environment designed to support multiple computers and operating systems. Furthermore, an associated network of contributed packages on the Comprehensive R Archive Network (CRAN: <http://cran.r-project.org/>) gives access to a wealth of algorithms from many users in various fields. This disciplined system allows users, like the authors of this package, to distribute software that extends the utility of R in new directions.

Previously I’ve used software in Basic (Schnute 1982), Fortran (Mittertreiner and Schnute 1985), Pascal, C, and C++ to implement ideas in published papers. Usually this software goes stale in time, due to minimal documentation, changing operating systems, the lack of portable libraries, and many other factors. Because R includes a rich library of statistical software that operates on multiple platforms, my colleagues and I can now distribute software that actually works when other people try it. The user community includes us, because we often find that we can’t remember how to operate our own software after a few weeks or months, let alone years. Although writing a good R package requires considerable effort, the result often pays off in portability, communication, and long term usage.

PBSmodelling tries to accomplish several goals. First, it anticipates the need for model exploration with a graphical user interface, a so-called GUI (pronounced gooey). We make this easy by encapsulating key features of Tcl/Tk into convenient tools fully documented here. A user need not learn Tcl/Tk to use this package. Everything required appears in Appendix A. You might want to start by running the function `testWidgets()`. Co-author Rowan Haigh likes the subtitle: “modelling the world with gooey substances.”

Second, we want to demonstrate interesting analyses related to our work in fishery management and other fields. The function `runExamples()` illustrates some of these, as described further in Section 7. The code for all of them appears in the R library directory `PBSmodelling/examples`. We demonstrate the power of other R packages, such as **BRugs** (to perform Bayesian posterior sample with the application **WinBUGS**), **odesolve** (to solve differential equations numerically), **PBSddesolve** (to solve delay differential equations), and **PBSmapping** (to draw maps and perform spatial analyses).

Third, **PBSmodelling** serves as a prototype for building a new R package, as summarized in Appendix B. We illustrate two methods of calling C code (`.C` and `.Call`), and discuss many other technical issues encountered while building this package. The functions `compileC` and `loadC` (added in 2008) give direct support for dynamically adding C functions to the working R environment.

Finally, to use R effectively, we’ve found it convenient to devise a number of “helper” functions that facilitate data exchange, graphics, function minimization, and other analyses. We include these here for the benefit of our users, who may choose to ignore them. We hope that

PBSmodelling inspires interest in interactive models that demonstrate applications in many fields.

As with our earlier package **PBSmapping**, Rowan and I employed a bright student who could learn quickly and implement creative ideas. Dr. Jim Uhl (Computing Science) and Dr. Lev Idels (Mathematics), both from Malaspina University-College (MUC) here in Nanaimo, drew my attention to the student Alex Couture-Beil, who has strong credentials in both fields. Rowan and I gave him a few initial specifications, and he quickly got ahead of us by extending our ideas in new and useful directions. This process continued in 2008, when we employed Anisa Egeli, another bright student from MUC. The current version of **PBSmodelling** represents the result of an evolutionary process, as we experimented with design concepts that would support our modelling goals. Users familiar with the earlier versions (starting with 0.60, posted on CRAN in August, 2006) may need to revise their code slightly to make it work with this version.

Since 1998, I have maintained a formal relationship with the Computing Science Department at MUC (now named Vancouver Island University – VIU), where I find kindred spirits in developing projects like this one. I particularly want to thank Dr. Jim Uhl for his suggestions and support on this project. Conversations with Dr. Peter Walsh have also stimulated my interest in the theory and application of computing science.

Fishery management depends on models with a great range of complexity, starting from some fairly simple ideas. Unfortunately from a coding perspective, “industrial strength” models can’t run exclusively in R. Algorithms with high computational requirements don’t run fast enough in R for practical application, due to interpretive code and other technical limitations. Examples in **PBSmodelling** often illustrate ideas at the simple end of the spectrum, although the package can certainly be used to manage external software designed to deal with greater complexity. The current version assists users in writing C code that can dramatically speed model performance.

Scientifically, I like to work from both ends of the spectrum. The behaviour of a complex model sometimes mimics a much simpler model, and it helps to become well versed in some of the simpler cases. I appreciate the motto of Canadian storyteller and humorist Stuart McLean, who hosts a CBC radio broadcast *The Vinyl Cafe* (<http://www.cbc.ca/vinylcafe/>), “We may not be big, but we’re small.”

Jon Schnute, December 2006; revised October 2008.

Update for Version 2.50

Our colleagues Rob Kronlund, Sean Cox, and Jaclyn Cleary used this package extensively for research on Management Strategy Evaluation. Their experiences led them to suggest a number of significant improvements. We thank Rob for providing written specifications and financial resources to implement their ideas. **PBSmodelling** now includes new widgets (`droplist`, `table`, `spinbox`, `include`), bug fixes, and other improvements that give users even greater control over GUIs designed for exploring and demonstrating analyses with R. Alex Couture-Beil, who now pursues graduate studies at Simon Fraser University, added the new programming code that contributes to this significant upgrade.

This update also includes greatly enhanced versions of our functions to support project development (Section 5) and interactive lectures (Section 6). Our colleague Andrew Edwards at PBS assisted this work with funding that allowed us, once again, to engage our intrepid graduate student Alex. Our code now includes modest use of S4 classes, such as the new `PBSOptions` class (Section 5.1). Furthermore, we now use XML scripts in the *talk description files* that enable users to give dynamic presentations about analyses in R (Section 6). Users who employed our function `presentTalk` in the past will need to revise their description files to operate with this update.

The scope of our R packages has grown considerably over the last few years. Thanks to prodding from Alex, we now use Google Code web sites for all our projects. The web site <http://code.google.com/p/pbs-software/> provides further information. In particular, this update supports our new package **PBSadmb** (<http://code.google.com/p/pbs-admb/>). It allows R users to tap into an open source package that can handle “industrial strength” assessment problems. We have a version that should soon be ready for posting on CRAN.

Jon Schnute, October 2009

Update for Version 2.60

Open source software often benefits greatly from unanticipated suggestions and participation by the user community. John Chambers (2008, p. 10), who designed the S language that underlies R, describes this phenomenon as “a cause for much gratitude and not a little amazement.” Eric Raymond (2000), speaking from his own experience with open source projects, puts it this way: “Treating your users as co-developers is your least-hassle route to rapid code improvement and effective debugging.” This is Raymond’s sixth lesson in a series of fundamental observations. The tenth is: “If you treat your beta-testers as if they’re your most valuable resource, they will respond by becoming your most valuable resource.”

In the previous update for version 2.50, I mentioned my long-time friend, colleague, and co-author Rob Kronlund. I was delighted by his interest in applying **PBSmodelling** to evaluate fishery management strategies (Kronlund et al. 2010). He quickly identified problems and helped design extensions that have greatly benefited the current version. In addition to many small changes and bug fixes, it includes three new widgets: `notebook`, `image`, and `progressbar`. Very significantly, the new `notebook` widget implements tabbed windows, in which distinct tabs correspond to different aspects of the GUI. This can help organize material for user interaction, and it potentially reduces the required size of a GUI so that it can fit on the small screens now popular on ultraportable computers.

We are delighted and grateful to welcome Rob as a coauthor of **PBSmodelling**. He has certainly become a valuable resource, although I’m not sure we always gave him the quality treatment suggested by Eric Raymond.

Jon Schmute, March 2010

Additional Notes:

Version 2.60 fixes an unfortunate bug in the `grid` widget. In earlier versions, the arguments `nrow` and `ncol` were reversed when `byrow=FALSE`. We realized that we had programmed around this bug in our previous window description files. Consequently, after the bug was fixed, we needed to make changes to every `grid` widget with `byrow=FALSE`. (These were relatively uncommon.) We encourage users of version 2.60 to check their own historical description files for this potential problem.

Starting in version 2.65, we implement accessor functions to comply with CRAN Repository Policy: <http://cran.r-project.org/web/packages/policies.html>, specifically “packages should not modify the global environment (user’s workspace).” This change should largely be invisible to users; however, be aware that control objects like `.PBSmod` are now located in a temporary environment called `.PBSmodEnv`. The accessor functions `tget`, `tput`, `tcall`, and `tprint` communicate with this environment, and we recommend that users become familiar with these functions (see the `tget` help file in R). Additionally, the accessor functions are implemented in all of the PBS packages that depend on **PBSmodelling**, invariably as wrappers to the original functions. For example, in **PBSadmb** the temporary workspace is called `.PBSadmbEnv` and the accessor functions are called `atget`, `atput`, `atcall`, and `atprint`, using the prefix “a” to designate **PBSadmb** wrappers to the **PBSmodelling** accessor functions. Similarly, we employ the wrapper prefixes “t” for accessing `.PBStoolEnv` in **PBStools**, “x” for `.PBSmapxEnv` in **PBSmapx**, and “d” for `.PBSdataEnv` in **PBSdata**.

We maintain development and distribution sites for a suite of PBS software packages on Google Code: <http://code.google.com/p/pbs-software/>, including one for **PBSmodelling**. Some of these appear on CRAN while others remain too specialised for mass appeal. The latter packages, however, contain interesting and complex functionality that individuals are welcome to explore.

1. Introduction

This report describes software to facilitate the design, testing, and operation of computer models. The package **PBSmodelling** is distributed as a freely available package for the popular statistical program R (R Development Core Team 2011a). The initials **PBS** refer to the Pacific Biological Station, a major fisheries laboratory on Canada’s Pacific coast in Nanaimo, British Columbia. Previously, we produced the R package **PBSmapping** (Schnute et al. 2004), which draws maps and performs various spatial operations. Although both packages (which can run separately or together) include examples relevant to fishery models and data analysis, they have broad potential application in many scientific fields.

Computer models allow us to speculate about reality, based on mathematical assumptions and available data. The full implications of a model usually require numerous runs with varying parameter values, data sets, and hypotheses. A customized graphical user interface (or GUI, pronounced “gooey”) facilitates this exploratory process. **PBSmodelling** focuses particularly on tools that make it easy to construct and edit a GUI appropriate for a particular problem. Some users may wish to use this package only for that purpose. Other users may want to explore the examples included, which demonstrate applications of likelihood inference, Bayesian analysis, differential equations, computational geometry, and other modern technologies. In constructing these examples, we take advantage of the diversity of algorithms available in other R packages.

In addition to GUI design tools, **PBSmodelling** provides utilities to support data exchange among model components, conduct specialized statistical analyses, and produce graphs useful in fisheries modelling and data analysis. Examples implement classical ideas from fishery literature, as well as our own published papers. The examples also provide templates for designing customized analyses using the R packages discussed here. In part, **PBSmodelling** provides a (very incomplete) guide to the variety of analyses possible with the R framework. We anticipate many revisions, as we find time to include more examples.

PBSmodelling depends heavily on Peter Dalgaard’s (2001, 2002) R interface to the Tcl/Tk package (Ousterhout 1994). This combines a scripting language (Tcl) with an associated GUI toolkit (**Tk**). We simplify GUI design with the aid of a “window description file” that specifies the layout of all GUI components and their relationship with variables in R. We support only a subset of the possibilities available in Tcl/Tk, but we customize them in ways intended specifically for model design and exploration (Appendix A). A user of **PBSmodelling** does not need to know Tcl/Tk.

Computer models typically involve a variety of components, such as code, data, documentation, and a user interface. Figure 1 illustrates the tangled relationships that sometimes accompany computer model design. **PBSmodelling** allows the GUI to become a device for organizing components, as well as running and testing software (Figure 2). The project might involve other applications, as well as R itself. In addition to its interactive role, the GUI becomes an archival tool that reminds the developer how components, functions, and data tie together. Consequently, it facilitates the process of restarting a project at a future date, when details of the design may have been forgotten.

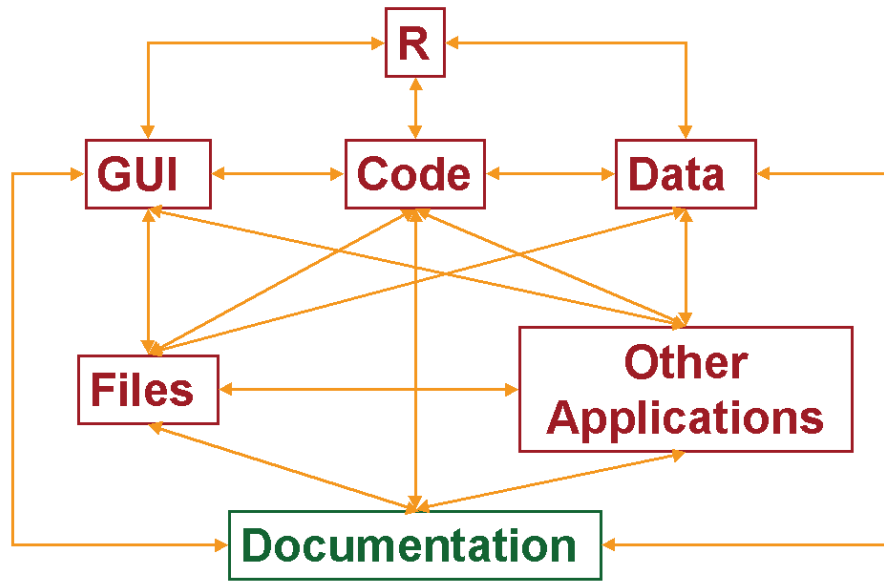


Figure 1. Tangled relationships among computer model components.

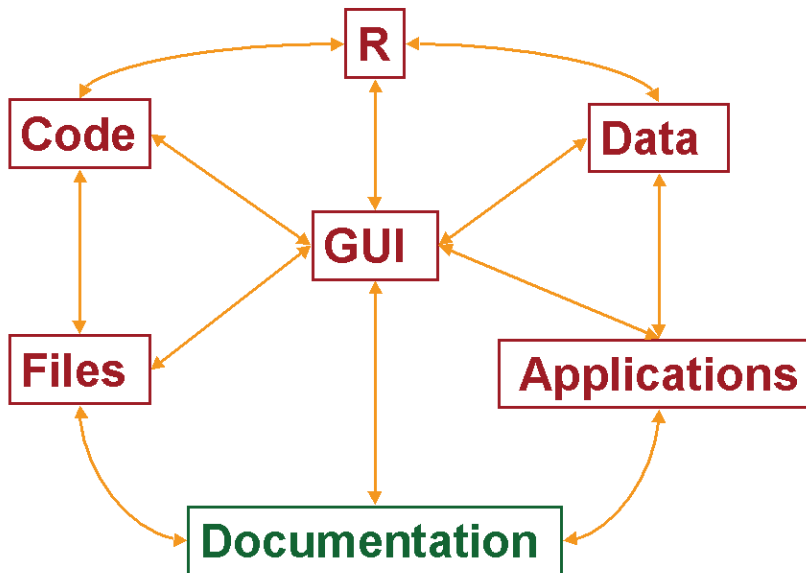


Figure 2. Computer model components organized with a graphical user interface (GUI).

In **PBSmodelling**, project design normally begins with a text file that describes the GUI. Additional files may contain code for R and other applications, which sometimes require languages other than R. For example, the R **BRugs** package (to perform Bayesian inference using Gibbs sampling) requires a file with the intended statistical model, written in the language of a separate program *WinBUGS*. In other contexts, a user might write C code to get acceptable performance from model components that require extensive computer calculations. This code might be compiled as a separate program or linked directly into a customized R package.

Section 2 of this report describes the process of designing a GUI to operate a computer model. Components can share data through text files in a specialized “PBS format” presented in Section 3. These correspond naturally to `list` objects within R. Section 4 describes additional tools for customized graphics and data analysis. Sections 5 and 6 discuss tools developed in 2008 for managing projects (like C code development) and writing lectures that use R interactively. In Section 7, we highlight briefly some of the examples in our initial release, although we expect the list to expand in future versions. This guide explains the context and general purpose of all functions in **PBSmodelling**. Consult the help files for complete technical details.

Appendix A gives the complete syntax for all visual components (called *widgets*) available for writing a window description file to construct a customized GUI. Appendix B provides syntax detail for talk description files. Appendix C describes the process of building **PBSmodelling** in a Windows environment. A simple enclosed package **PBStry** gives a prototype for building any R package, including the use of C code to speed calculations. Appendix D shows the help files included with the package.

To use **PBSmodelling**, run R and install the package from the R GUI (click “Packages”, “Install package(s)...”, select a mirror, and choose **PBSmodelling** from the list of packages). Windows users can also obtain an appropriate compressed file from the authors of this report or directly from the CRAN web site <http://cran.r-project.org/>.

The R GUI normally runs as a Multiple Document Interface (MDI), in which child windows like the R console and graphics screens all appear within the GUI itself and a menu item can be used to tile the sub-windows. Unfortunately, in this configuration, windows generated by Tcl/Tk sometimes disappear mysteriously when an application runs. They can be recovered by clicking the appropriate “TK” icon on the taskbar. You can avoid this problem by using the Single Document Interface (SDI), in which the operating system manages all R windows (console, graphics, Tcl/Tk, etc.) independently on the desktop. Set this configuration by running the R GUI, choosing the menu items ⟨Edit⟩ and ⟨GUI Preferences⟩, and then selecting and saving the SDI option. Alternatively, go to the master configuration file `Rconsole` in the `\etc` subdirectory of the R installation, and use a text editor to select the option `MDI = no`.

2. GUI tools for model exploration

The practical task of writing appropriate code for the R Tcl/Tk package can sometimes become daunting, particularly if the GUI window requires extensive design and change. For a restricted set of TK components (called *widgets*), **PBSmodelling** makes it much easier to design and use GUIs for exploring models in R. A user needs to supply two key parts of a GUI-driven analysis:

- a *window description file* (an ordinary text file) that completely specifies the desired layout of widgets and their relationship with functions and variables in R, and
- R code that defines relevant functions, variables, and data.

This section begins with an example to illustrate the main ideas, and then gives complete details for constructing window description files that can be used to generate GUIs.

2.1. Example: Lissajous curves

A Lissajous curve (<http://mathworld.wolfram.com/LissajousCurve.html>), named after one of its inventors Jules-Antoine Lissajous, represents the dynamics of the system

$$x = \sin(2\pi mt), \quad y = \sin[2\pi(nt + \phi)], \quad (1)$$

where time t varies from 0 to 1. During this time interval, the variables x and y go through m and n sinusoidal oscillations, respectively. The constant ϕ , which lies between 0 and 1, represents a cycle fraction of phase shift in y relative to x . We want to design a GUI that allows us to explore this model by plotting Lissajous curves (y vs. x) for various choices of the parameters (m, n, ϕ) . We also want to vary the number of time steps k and choose a plot that is either lines or points.

Table 1. Two text files associated with the “Lissajous Curve” project. The first gives a description of the GUI window used to manage the graphics. The second contains R code to draw a Lissajous curve.

File 1: LissajousCurve.txt

```
window title="Lissajous Curve"
vector length=4 names="m n phi k" \
  labels="'x cycles' 'y cycles' 'y phase' points" \
  values="2 3 0 1000"
radio name=ptype text=lines value="l" mode=character
radio name=ptype text=points value="p" mode=character
button text=Plot function=drawLiss
```

File 2: LissajousCurve.r

```
drawLiss <- function() {
  getWinVal(scope="L");
  tt <- 2*pi*(0:k)/k;
  x <- sin(2*pi*m*tt); y <- sin(2*pi*(n*tt+phi));
  plot(x,y,type=ptype);
  invisible(NULL); }
```

This analysis can be accomplished with the R code and window description file shown in Table 1. Assume that these two files reside in the current working directory and that **PBSmodelling** has been installed in R. Start an R session from this directory, and type the following three lines of code in the R command window:

```
> require(PBSmodelling)
> source("LissajousCurve.r")
> createWin("LissajousCurve.txt")
```

The first line assures that **PBSmodelling** is loaded, the second defines the function `drawLiss` for drawing Lissajous curves, and the third creates a window that can be used to draw curves corresponding to any choice of parameters. Figure 3 shows the resulting GUI window interface.

When the $\langle \text{Plot} \rangle$ button is clicked, the curve in Figure 4 appears in the R graphics window. This corresponds to the default parameter values:

$$m = 2, n = 3, \phi = 0, k = 1000. \quad (2)$$

The GUI allows different Lissajous figures to be drawn easily. Simply change parameter values in any of the four entry boxes, and click $\langle \text{Plot} \rangle$.

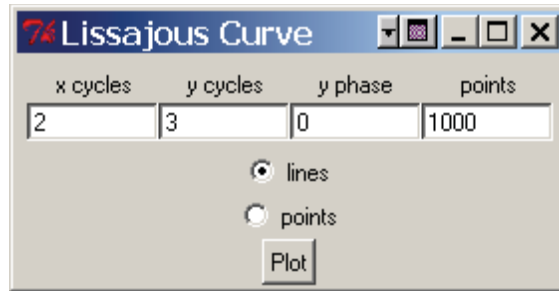


Figure 3. GUI generated by the description file `LissajousCurve.txt` in Table 1. It contains five widgets: the window titled “Lissajous Curve”, a vector of four entries, two linked radio buttons ($\langle \text{lines} \rangle$ and $\langle \text{points} \rangle$), and a $\langle \text{Plot} \rangle$ button.

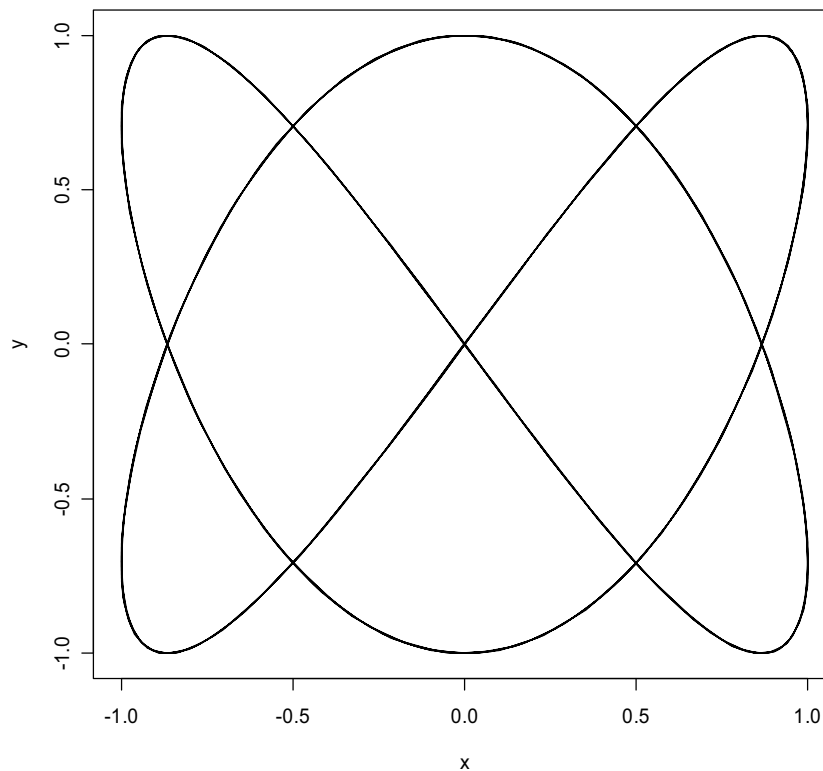


Figure 4. Default graph for the “Lissajous Curve” project, obtained by clicking the $\langle \text{Plot} \rangle$ button in Figure 3. The x variable goes through two cycles while the y variable goes through 3 cycles. A line graph is drawn through 1,000 points generated by the algorithm (1).

The window description file (Table 1) specifies a window titled “Lissajous Curve” with a vector of four entries. These correspond to quantities with the R variable names `m`, `n`, `phi`, and `k`. The corresponding window (Figure 3) will contain four entry boxes that allow these quantities to be changed. A label for each quantity emphasizes its conceptual role: the number of cycles for x or y , the phase shift for y , and the number of points plotted. Initial values correspond to those listed in (2). The backslash (`\`) character indicates that a widget description (in this case, a vector) continues on the next line. A pair of radio buttons, both corresponding to an R variable named `ptype`, allow selection between “lines” and “points” when drawing the plot. The graph (Figure 4) is actually drawn (i.e., the R function `drawLiss` is called) when the user presses a button that contains the text “Plot”. In, we use the symbols `<...>` to designate a button or keystroke, such as the `<Plot>` button or the radio buttons `<lines>` and `<points>`. These symbols are not to be confused with *talk description file* tags (`<>`) used later (Section 6).

The file of R code (Table 1) implements the algorithm (1) for computing k points on a Lissajous curve. The function `drawLiss` has no arguments, but gets values of the R variables `m`, `n`, `phi`, `k`, and `ptype` from the GUI window via a call to the **PBSmodelling** function `getWinVal`. The argument `scope="L"` implies that these variables have local scope within this function only. (Another choice `scope="G"` would give the variables global scope by writing them to the user’s global environment `.GlobalEnv`.)

2.2. Window description file

A window description file currently supports the following widgets:

1. `window` – an entire new window;
2. `grid` – a rectangular block for placing widgets;
3. `menu` – a menu grouping;
4. `menuitem` – an item in a menu;
5. `button` – a button linked to an R function that runs a particular analysis and generates a desired output, perhaps including graphics;
6. `check` – a check box used to turn a variable on or off, with corresponding values `TRUE` or `FALSE`;
7. `data` – an aligned set of entry fields for all components of a data frame, where columns can have different modes;
8. `droplist` – an entry widget with a drop down list of values;
9. `entry` – a field in which a scalar variable (number or string) can be altered;
10. `history` – a device for archiving parameter values corresponding to different model choices, so that a “slide show” of interesting choices can be preserved;
11. `image` – a graphical widget that displays a GIF image file;
12. `include` – a pseudo widget which embeds a specified window description file within the current window description file;
13. `label` – a text label;
14. `matrix` – an aligned set of entry fields for all components of a matrix;
15. `notebook` – a widget comprised of pages that can be selected by tabs, where each page is visible when the corresponding tab is selected;

16. `null` – a blank widget that can occupy an empty space in a grid;
17. `object` – an aligned set of entry fields defined by an existing R-object (vector, matrix, or data frame);
18. `progressbar` – a progress indicator widget;
19. `radio` – one of a set of mutually exclusive radio buttons for making a particular choice;
20. `slide` – a slide bar that sets the value of a variable;
21. `slideplus` – an extended slide bar that also displays a minimum, maximum, and current value;
22. `spinbox` – an entry widget for a numeric value within a given range which can be changed with the up and down arrows;
23. `table` – a spreadsheet widget with scrollbars for large tabular data;
24. `text` – an entry box that supports multiple lines of text;
25. `vector` – an aligned set of entry fields for all components of a vector.

The description file is an ordinary text file that specifies each widget on a separate line. However, any one widget description can span multiple lines by using a backslash character (`\`) to indicate the end of an incomplete line. For example, the single line:

```
label text="Hello World!"
```

is equivalent to:

```
label \  
  text="Hello World!"
```

Meaningful indentation is highly recommended, but not compulsory. The three-line description of a vector widget in Table 1 illustrates a readable style.

Each widget has named arguments that control its behaviour, analogous to the named arguments of a function in R. Some (required) arguments must be specified in the widget description. Others (not required) can take default values. All widgets have a `type` argument equal to one of the 25 names above, although the word `type` can be omitted in the description file. Appendix A gives an alphabetic list of all these widgets, along with detailed descriptions of all arguments. As in calls to R functions, argument names can be omitted as long as they conform to the order specified in the detailed widget descriptions given below. Nevertheless, we recommend that all argument names be specified, except possibly the name `type`, which is always the first argument for each widget. Unlike R functions, where commas separate arguments, the arguments in a widget description are separated by white space.

In a description file, all argument values are treated initially as strings. In addition to specifying a line break, the backslash can be used to indicate five special characters: single quote `\'`, double quote `\"`, tab `\t`, newline `\n`, and backslash `\\`. If an argument value does not include spaces or special characters, then quotes around the string are not required. Otherwise, double quotes must be used to delineate the value of an argument. Some arguments can take a `NULL` argument value; quotes are used to differentiate between a `NULL` object, and the text value `"NULL"`. Single quotes indicate strings nested within strings. For example, the `vector` in Table 1 has four labels specified by the string argument

```
labels="'x cycles' 'y cycles' 'y phase' points"
```

A hash mark (#) that is not within a string begins a comment, where everything on a line after the hash mark is ignored. As mentioned above, an isolated backslash (not part of a special character) indicates continuation onto the next line. A break can even occur in the middle of a string, such as the long label

```
label text="This long label with spaces \  
  spans two lines in the description file"
```

In this case, leading spaces in the second line are ignored, to allow meaningful formatting in the description file. Intentional spaces in a long string should appear prior to the backslash on the first line.

Although the `type` argument (like `vector`) for a widget can never be abbreviated, other arguments follow the convention used with named arguments in R function calls. For a given widget type, the available arguments can be abbreviated, as long as the abbreviations uniquely identify each argument. For example, the `vector` in Table 1 could be specified as:

```
vector len=4 nam="m n phi k" \  
  lab="'x cycles' 'y cycles' 'y phase' points" \  
  val="2 3 0 1000"
```

Unlike variable names in R, widget names and their arguments are not case sensitive. Some users may prefer to write all `type` variables in upper case or with an initial capital letter. For example, the names `WINDOW`, `VECTOR`, `RADIO`, and `BUTTON` could be used to emphasize the widgets in Table 1.

2.3. Window support functions

PBSmodelling includes functions designed to connect R code with GUI windows. Every window has a `name` argument (with default `name=window`), and windows with different names can coexist. Window names must use only letters and numbers; they cannot contain a period (dot) or any other punctuation. When running a program with multiple windows, only one window will be current (i.e., selected by the user) at any particular time. Normally, a user selects a window by clicking on it, but the function `focusWin` allows program control of the window currently in focus. Thus, activity in one window might be used to shift the focus to another.

The function `createWin` uses a description file to generate one or more windows, where each window has a distinct name (perhaps the default) taken from the file. If a window with the specified name already exists, it will be closed before the new window is opened. When designing and testing a GUI, this feature ensures that a new version automatically replaces the previous one. The function `closeWin`, which takes a vector of window names, closes all windows named in the vector. With no arguments, `closeWin()` closes all windows that are currently open.

Although `createWin` normally builds a GUI from a description file, it will also accept a vector of strings equivalent to such a file. Thus, a file of R source code can define a GUI directly, without the need for a separate description file. illustrates how this can be done in a simple case.

To see the character vectors equivalent to a given description file (say, `winDesc.txt`), type the R command:

```
scan("winDesc.txt", what=character(), sep="\n")
```

In particular, if the description file includes a backslash or double quote character, the corresponding R string must represent it as `\\` or `\"`, respectively. Despite this alternative of embedding window descriptions in R source files, we recommend writing separate files to define GUIs, except perhaps for very simple models.

Table 2. A simple file of R source code with character strings that define a GUI. No separate window description file is required.

File: Simple.r

```
# window description strings
winStr=c(
  "window title=Simple",
  "entry name=n value=5",
  "button function=myPlot text=\"Plot sinusoid\"");

# function to plot a sinusoid
myPlot <- function() {
  getWinVal(scope="L");
  x <- seq(0,500)*2*n*pi/500;
  plot(x,sin(x),type="l"); };

# commands to create the window
require(PBSmodelling); createWin(winStr,astext=TRUE)
```

Internally, **PBSmodelling** converts a description file into a `list` object that is used to generate the corresponding GUI. The functions `compileDescription` and `parseWinFile` give lists that correspond to description files. Just as `createWin` can act directly on a character vector, it can also act on a suitably defined list, rather than a file. This feature makes it possible to replace a description file with R code that defines the corresponding list, although we recommend against this practice in most cases.

R programs need to share data with a GUI window. **PBSmodelling** provides seven functions that deal with values of R variables named in a description file:

```
getWinVal.....returns values from the current window;
setWinVal.....sets values in the current window;
getWinAct.....returns all actions (to a maximum of 50) invoked in the current window;
setWinAct.....adds an action to the action vector for the current window;
getWinFun.....returns the names of all R functions referenced in the current window;
clearWinVal .....clears global values associated with the current window;
updateGUI.....updates the currently active GUI with values from R's memory.
```

Some models make use of a single parameter vector. In such cases the function `createVector` generates a GUI directly, without the need for a corresponding description file. We also offer a few “choosing” functions – `getChoice` and `chooseWinVal` – that invoke a prompting GUI offering string choices. The latter writes the choice to a variable in a GUI specified by the user.

After using `createWin` to produce a GUI, the functions `getWinVal` and `getWinFun` provide useful summaries of names declared in the current project. Furthermore, the function `getWinAct` provides a record of GUI actions taken by the user, starting with the most recent and working backwards. By default, the action associated with a widget is its type; for example a button has default `action=button`. In general, however, the description file could give a unique action name to each potential action, so that the vector would give an unambiguous record of user actions.

Alternatively, GUI widgets that support function arguments can take the **PBSmodelling** function `doAction`, which evaluates code specified as a string in the widget’s action argument. This code string can be a simple expression or a multi-line set of R-code. In essence, `doAction` allows the user to implement subroutines by clicking a widget (such as a button):

```
winStr=c("window title=\"doAction Demo\"",
"button text=\"See attached libraries\" width=30 pady=10 \
function=doAction action=\"x=search(); N=length(x);
mess=paste(paste(pad0(1:N,2),x), collapse=\"\\n\"); resetGraph();
addLabel(.2,.5,mess,adj=0)\"")
createWin(winStr,astext=TRUE)
```

Within the action string, substitute double quotation marks `" . . . "` with backtick characters `` . . . ``, and the function `doAction` will replace them with interpretable quotation marks. In most cases (not all), escaping the quotation marks `" . . . \"` will also work.

The package provides a function called `selectFile` for opening and saving files to directories using a GUI menu. Earlier functions (`promptOpenFile`, `promptSaveFile`) remain available, but should be deprecated in favour of `selectFile`. Files opened using programs external to R depend on file name extensions:

```
openFile.....opens a file using the default program for the file extension;
setPBSext.....overrides the default program associated with an extension;
getPBSext.....shows the overridden file extension and associated program.
clearPBSext .....clears file extensions added by setPBSext.
```

If a widget invokes the function `openFile`, the associated action should be the file name. By definition, `openFile` has the default argument `getWinAct()[1]`.

On a Windows platform, the native R function `shell.exec` (called by `openFile`) automatically chooses a default from the registry. For this reason, our distribution specifies an

empty list: `getPBSext()` returns `list()`. The default can, however, be overwritten by specifying explicit list components, such as:

```
setPBSext('html',  
  'c:/Program Files/Mozilla Firefox/firefox.exe' file://%f')
```

where `%f` denotes the file name in the string passed to the operating system. Unix platforms typically lack such generic file associations, and thus require a user to specify defaults this way.

PBSmodelling includes a `history` widget designed to collect interesting choices of GUI variables so that they can be redisplayed later, rather like a slide show. This widget has buttons to add and remove GUI settings from the current collection, to scroll backward and forward, and to clear all entries from the collection. Other buttons allow entire history files to be saved or loaded. The `history` widget defines and uses the list `PBS.history` in the global environment to store a saved history.

Normally, a user would invoke a `history` widget simply by including a reference to it in the description file. However, **PBSmodelling** includes some support functions for customized applications:

```
initHistory .....initializes data structures for holding a collection of history data;  
addHistory.....saves the current window settings to the current history record;  
rmHistory.....removes the current record from the history;  
backHistory .....and  
forwHistory .....move backward and forward between successive history records;  
firstHistory .....and  
lastHistory .....move to the first and last records in the history;  
jumpHistory .....moves to a specified record in the history;  
exportHistory .....and  
importHistory .....save and load histories from files;  
clearHistory .....removes all records from the current collection.
```

The help file for `initHistory` shows an example that uses these functions directly.

Since version 2.50, we have incorporated additional functionality for GUIs stemming from experience using this package in multi-stakeholder workshops. In particular, a new widget called `notebook` now allows tabbed pages within one GUI, where each page can contain whatever grid and widget combination the programmer wishes to present. This removes the problem of having too many GUIs on screen when situations require multiple inputs and outputs.

Other new widgets include drop lists and spin boxes (`droplist`, `spinbox`), scrollable objects for data with dimensions too large to fit on screen (`object`), a spreadsheet-like widget that can display and edit data in tabular format (`table`), an animated progress indicator (`progressbar`), and an image widget to add illustrations, logos, and other visual cues (GIF format only).

2.4. Internal data

PBSmodelling uses the hidden list variable `.PBSmod` in a temporary working environment called `.PBSmodEnv` to store current settings and internal information needed to communicate with the `tcl/tk` interface. This variable is intended for exclusive use by **PBSmodelling**, and users should not alter or delete it while **PBSmodelling** is active. We include the material in this section for advanced users and developers interested in further details about the internal data used to manage GUI windows.

The list `.PBSmod` contains a named component for each open window, where the component name matches the window name. Recall that, if a window is not named explicitly, it receives the default `name=window`. In addition to window names, `.PBSmod` contains two other named components: `$.activeWin` and `$.options`. These names do not conflict with the window names, because the latter cannot include a dot (`.`). The `$.activeWin` component stores the name of the window that has most recently received user input. The `$.options` component saves key values of interest to **PBSmodelling**, such as a component `$openfile` with information that links programs to file extensions for the function `openFile`. See Section 2.3 for further information.

Any named component of `.PBSmod` that does not start with a dot stores information related to the corresponding window. Each window uses a list with the following named components:

- `widgetPtrs`
A list containing widget pointers. Each component has a name that matches widget name. Only widgets with a `name` argument and a corresponding `tk` widget will appear in this list.
- `widgets`
A list containing information from the window description file relevant to each widget. This list includes every widget that has a `name` or `names` argument. Widgets without names will never be referenced again after the window has been created; consequently, information about them is not stored for later usage.
- `tkwindow`
A pointer to the window created by `tktoplevel()`.
- `functions`
A vector of all function names referenced in the window description.
- `actions`
A vector containing `action` strings corresponding to the most recent user actions in the window, up to a maximum of 50. (The internal constant `.maxActionSize` sets this upper limit. See the file `defs.R` in the distribution source code.)

Users can explore the contents of `.PBSmod` with the R structure command `str`. Remember that an accessor function is also needed to “see” this object. For example, from the R console, type `runExamples()` and select the example “CalcVor”. Then type the command `str(tcall(.PBSmod), 2)` to show the list structure to a depth of 2. This reveals all the list

components discussed above. Further details appear by exploring the structure to depths 3, 4, or more. Notice also how the contents change as different examples are selected.

The functions `getWinVal`, `setWinVal`, `getWinAct`, `setWinAct`, `getWinFun`, `getPBSext`, and `setPBSext` (discussed in Section 2.3) provide methods for manipulating and retrieving variables stored in `.PBSmod`. Use these, rather than direct access, to alter the internal data. Future design modifications to **PBSmodelling** might change the architecture for storing the data components, but the methods functions will continue to have their current effect.

Table 3. Sample data file for **PBSmodelling**. The function `readList` converts this file to a `list` object with six components: a scalar `$x`, a logical vector `$y`, two matrices (`$z`, `$a`), and two data frames (`$b1`, `$b2`). The matrix `$a` is read by column, and `$b1`=`$b2`.

```
$x
0

$y
T F TRUE FALSE

$z
11.1 12.2 13.3 14.4
15.5 16.6 17.7 1.88e+01

$a
$$matrix ncol=2 byrow=FALSE colnames="a b"
5 1 2 3

$b1
$$data ncol=3 modes="numeric logical character" \
  byrow=TRUE colnames="N L C"
5 T aa
3 F bb
8 T cc
10.5 F dd

$b2
$$data ncol=3 modes="numeric logical character" \
  byrow=FALSE colnames="a b c"
5 3 8 10.5
T F T F
aa bb cc dd
```

3. Functions for data exchange

Computer models usually require data exchange between model components. For example, as described above, the functions `getWinVal` and `setWinVal` move data between an R program and the GUI. Other applications, such as those written separately in C, may have the

ability to write data to files that R can read. In cases like this, it would be convenient to have variable names in the C code correspond to variables with the same names in R. **PBSmodelling** can facilitate this process with the functions `readList` and `writeList`, which convert a text file to an R `list` and vice-versa. Another function `unpackList` creates local or global variables with names that match the list components. Similarly a global or local list can be populated with objects by name through the function `packList`.

Table 3 illustrates a data file in PBS format, legible by `readList`. The file contains lines with an initial dollar sign (like `$x` in Table 3) that specify a list component name in R, followed by one or more lines of data. Data items are separated by white space. A single item of data corresponds to a scalar in R, multiple items on a single line correspond to a vector, and multiple lines of data correspond to a matrix with the number of columns determined by the first line of data. Thus, in Table 3, `$x` is a scalar, `$y` is a vector of length 4, and `$z` is a 2×4 matrix. The format also supports four possible data type definitions on a line preceded by `$$`:

```
$$ vector mode=numeric names=""
$$ matrix mode=numeric ncol rownames="" colnames="" byrow=TRUE
$$ data modes=numeric ncol rownames="" colnames byrow=TRUE
$$ array mode=numeric dim fromright=TRUE dimnames
```

Table 3 illustrates their use in specifying `$a`, `$b1`, and `$b2`. Matrices and data frames can be read by row or column. This choice determines the order of reading the data, and white space (including line breaks) merely signifies breaks between data items. Array objects with three or more dimensions can be read in two ways, with indices varying first from the right or from the left. For example, data for an array indexed by `[i, j, k]` are read by varying `i` first with fixed `j` and `k` if `fromright=TRUE`. Similarly, `k` varies first if `fromright=FALSE`.

As in widget descriptions, arguments may be omitted in favour of their defaults, and the `$$` line may be continued across multiple lines by using a backslash character `\`. For a `matrix`, the argument `ncol` is required. Similarly, a data object (i.e., a data frame) must specify `ncol` and a vector `colnames` of length `ncol`. Also, `modes` must have length 1 (so that all entries in the data frame have the same mode) or length `ncol`. An array must have a complete `dim` argument, a vector giving the number of dimensions for each index, and a `dimnames` argument, which is a collapsed vector; the first element is the name of the first dimension, followed by each index label in that dimension; each dimension is appended to end of the vector.

As indicated earlier, **PBSmodelling** can use this specialized data format as a convenient means of capturing data from other programs. For example, to export data from an external C program, write C code that generates a data file in PBS format, where component names in the file match the C variable names. Then read the resulting file into an R session with the function `readList`, and use `unpackList` to produce local or global R variables. At this point, both R and C share data with the same variable names. This method works well with programs written for *AD Model Builder* (<http://otter-rsch.ca/admodel.htm>), a package used extensively in fishery research and other fields. It uses reverse automatic differentiation (AD; Griewank 2000) for highly efficient calculation of maximum likelihood estimates.

To considerable extent, R has native support for reading and writing a variety of text files, including the functions `scan`, `cat`, `source`, `dump`, `dget`, `dput`, `read`, `write`, `read.table`, and `write.table`. External programs sometimes utilize R formats for their input data. For example, the program *WinBUGS* (Speigelhalter et al., 2004), which implements Bayesian inference using Gibbs sampling, uses data files written in a list format closely related to the R syntax produced by the `dput` function. If the file `myData.txt` has `dput` format, then either of the two R commands

```
myData <- dget("myData.txt");  
myData <- eval(parse("myData.txt"));
```

produces a corresponding R list object named `myData`.

We should, however, add a word of caution here. When R saves array data in `dput` format, it converts the array to a vector by varying the indices from left to right. For example, a matrix with indices $[i, j]$ is saved as a vector in which i varies for each fixed j . In effect, the data are stored by column. This sometimes gives an unnatural visual appearance. In English, the eye reads naturally from left to right, then down. Matrices are normally displayed by row, with column index j varying for each fixed i . *WinBUGS*, supported by the R package **BRugs** (Thomas 2004), requires input data formatted in this visually meaningful way. More generally, *WinBUGS* reads arrays by varying the indices from right to left. The **BRugs** function `bugsData` writes data in this format, but users must take special care in reading *WinBUGS* data with the `dget` function.

4. Support functions for graphics and analysis

As mentioned in the preface, we have devised a number of functions that make it easier for us to work in R. Some of them, such as `plotBubbles`, relate to techniques discussed in our published work (e.g., Richards et al. 1997; Schnute and Haigh 2007). Others just provide convenient utilities. For example, `testCol("red")` shows all colours in the palette `colors()` that contain the string "red". We also provide support for a few analytical methods, such as function minimization. This section gives a brief description of **PBSmodelling** support functions. See the help files for further information.

4.1. Graphics utilities

In many of the graphical functions, we utilize a **PBSmodelling** function called `evalCall`. The functionality of `evalCall` is similar to that of `do.call` in the base package; however, we have geared our function towards rationalising arguments passed through the dots (`...`) argument so that no conflicts occur with formal arguments. This way the user can override predefined arguments in functions embedded within functions without the parent function having to recognize all the arguments in the embedded function.

`resetGraph.....`Reset various graphics parameters to defaults, with `mfrow=c(1,1)`.

`expandGraph`Set various graphics parameters to make graphs fill out available space.

`drawBars`Draw a linear bar plot on the current graph.

`genMatrix`Generate a test matrix for use in `plotBubbles`.

`plotACF`Plot autocorrelation bars (ACF) from a data frame, matrix, or vector.

`plotAsp`Plot a graph with a prescribed aspect ratio, preserving `xlim` and `ylim`.

`plotBubbles`Construct a bubble plot for a matrix.

`plotCsum`Plot cumulative sum of a vector, with value added.

`plotDens`Plot density curves from a data frame, matrix, or vector.

`plotFriedEggs`Render a pairs plot as fried eggs (density contours) and beer (correlations).
.....(Code courtesy of Dr. Steve Martell, Fisheries Science Centre, UBC.)

`plotTrace`Plot trace lines from a data frame, matrix, or vector.

`addArrows`Call the `arrows` function using relative (0:1) coordinates.

`addLegend`Add a legend using relative (0:1) coordinates.

`addLabel`Add a panel label using relative (0:1) coordinates.

`pickCol`Pick a colour from a complete palette and get the hexadecimal code.

`testAlpha`Display various alpha transparency values.

`testCol`Display named colours available based on a set of strings.

`testLty`Display line types available.

`testLwd`Display line widths.

`testPch`Display plotting symbols and backslash characters.

4.2. Data management

`clearAll`Function to clear all data in the global environment.

`pad0`Pad numbers with leading zeroes (string).

`show0`Show decimal places including zeroes (string).

`unpackList`Unpack the objects in a list and make them available locally or globally.

`view`View the first/last/random n rows of a data frame or matrix.

4.3. Function minimization and maximum likelihood

Three functions in the `stat` package support function minimization in R: `nlm`, `nlminb`, and `optim`. These tend to perform slowly compared with other software alternatives, due partly to R's interpretive function evaluation. Nevertheless, for small problems they offer a convenient means of analysis, based entirely on code written in R. Our examples illustrate some of the possibilities. For large problems coded in other software, we still like to write independent code for a function in R, based only on the model documentation. If both versions of the software produce the same function values at selected values of the function arguments, then we have greater confidence that we have represented our model correctly in code. In that context, R serves as a valuable debugging tool.

PBSmodelling provides a support function `calcMin` that can use any method available in the `stat` package to find the vector $(\hat{x}_1, \dots, \hat{x}_n)$ of length n that minimizes the function $y = f(x_1, \dots, x_n)$. In practice, we usually apply this to the negative log likelihood for a statistical model, where the variables x_i are parameters. We define a new class `parVec`, which is a data frame with four columns:

- `val` – the actual value of parameter x_i ;
- `min` – a minimum allowable value of x_i ;
- `max` – a maximum allowable value of x_i ; and
- `active` – a logical value that determines whether or not the minimization algorithm should vary the value of x_i . If `active=F`, then x_i remains unchanged at the value `val`.

Internally, `calcMin` scales active variables x to surrogate variable s in the range $[0,1]$, where x and s are related by the inverse formulas (Schnute and Richards 1995, p. 2072):

$$x = x_{\min} + (x_{\max} - x_{\min}) \frac{1 - \cos(\pi s)}{2} = x_{\min} + (x_{\max} - x_{\min}) \sin^2\left(\frac{\pi s}{2}\right), \quad (4.3a)$$

$$s = \frac{1}{\pi} \arccos\left(\frac{x_{\max} + x_{\min} - 2x}{x_{\max} - x_{\min}}\right) = \frac{2}{\pi} \arcsin\sqrt{\frac{x - x_{\min}}{x_{\max} - x_{\min}}}. \quad (4.3b)$$

All these formulas represent equivalent forms of a one-to-one relationship $x \leftrightarrow s$, where $x_{\min} \leq x \leq x_{\max}$ and $0 \leq s \leq 1$. Readers may find the second versions of (4.3a) and (4.3b) more intuitive (with a familiar “arc sine square root” transformation in (4.3b)), but the code uses the first versions for a possible improvement in computational efficiency by avoiding square and square root functions. The minimization algorithm works entirely with surrogate variables, which may have dimension smaller than n if some variables x_i are not active. The function `scalePar` scales an object x of class `parVec` to a vector s of surrogates via the formula (4.3b). Similarly, `restorePar` recovers x from s via (4.3a).

We also provide a convenient function `GT0` that restricts a numeric variable x to a positive value defined by

$$\text{GT0}(x, \varepsilon) = \begin{cases} x, & x \geq \varepsilon \\ \frac{\varepsilon}{2} \left[1 + \left(\frac{x}{\varepsilon} \right)^2 \right], & 0 < x < \varepsilon \\ \frac{\varepsilon}{2}, & x \leq 0 \end{cases} \quad (4.3c)$$

The notation `GT0` denotes “greater than zero”. This function preserves the value of x if $x \geq \varepsilon$, and for smaller values x it is always true that $\text{GT0}(x, \varepsilon) \geq \frac{\varepsilon}{2}$. The function (4.3c) also has a continuous first derivative that makes sense locally on a small scale of size ε . This property makes it useful for avoiding unrealistic numbers that might be negative or zero, particularly when the minimization algorithm uses derivatives of the objective function.

In summary, **PBSmodelling** has four functions that facilitate function minimization.

<code>calcMin</code>	Calculate the minimum of a user-defined function.
<code>scalePar</code>	Scale parameters to surrogates in the range [0,1].
<code>restorePar</code>	Restore actual parameters from surrogate values.
<code>GT0</code>	Restrict a numeric variable to a positive value (“Greater Than 0”).

4.4. Handy utilities

<code>calcFib</code>	Calculate Fibonacci numbers (included to illustrate the use of C code).
<code>calcGM</code>	Calculate the geometric mean of a vector of numbers.
<code>clearRcon</code>	Clear the R console (code that executes ‘Ctrl L’).
<code>convSlashes</code>	Convert pathway slashes from UNIX ‘/’ to DOS ‘\’ format.
<code>findPat</code>	Find all strings that include any string in a vector of patterns.
<code>getYes</code>	Prompt the user with a GUI to choose yes or no.
<code>isWhat</code>	Identify an object by its class and attributes
<code>pause</code>	Pause, typically between graphics displays.
<code>showAlert</code>	Display a message in an alert window.
<code>showArgs</code>	Show the arguments for a specified widget in Appendix A.
<code>showHelp</code>	Display the Help Page for specified packages installed on user’s system.
<code>showPacks</code>	Show packages required, but not installed on a user’s system.
<code>testWidgets</code>	GUI to test all widgets listed in Appendix A.
<code>view</code>	View the first/last/random n lines of a (potentially large) object.
<code>viewCode</code>	View R code for all functions in a specified package on the user’s system.

5. Functions for project management

A project to design and write software typically involves keeping track of numerous component files that contain material at various stages of progress. Some contain input, such as source code, data, or documentation. Others contain various stages of output, such as compiled code, processed documents, graphs, and other analytic results. Specialized software, such as C compilers, text processors (like TeX), database utilities, and R itself play a role in converting the input to the output. Along the way, intermediate files often get created that ultimately need to be removed to give a clean result. GUI tools in **PBSmodelling** can assist a user in managing such projects.

For simplicity, we envisage a project as a collection of files in the current working directory that typically share a common prefix but also have various possible extensions, such as

.c, .h, .o, .so, .dll, and .exe. We provide a GUI that illustrates a special case of project management. It allows a user to create and compile a C function, load it into R, run it, and compare the results with a similar function coded entirely in R. See the companion functions:

loadC.....Launch a GUI for compiling and loading C code.
compileC.....Compile a C file into a shared library object.

5.1. Project options

Projects commonly involve specific paths and filenames associated with applications and binary libraries. To preserve information about these and other settings, **PBSmodelling** provides an S4 class `PBSoptions` for defining options, editing them in a GUI, and saving them to a local file. Instances of `PBSoptions` are independent of each other. We recommend that users create a distinct `PBSoptions` object for each distinct project.

Internally, an object of class `PBSoptions` contains (1) the options themselves as a (possibly empty) list, (2) a default file name in which to save the options, and (3) a default prefix for recognizing entries in a GUI that correspond to options. For example, the following code creates and displays a `PBSoptions` object called `myOpts`:

```
> # Create myOpts
> myOpts <- new("PBSoptions", filename="myOpts.txt",
+ initial.options=list(a="a", b="b"), gui.prefix="PBSopt")

> # Display myOpts
> myOpts
filename: myOpts.txt
gui.prefix: PBSopt
Options:
 $ a: chr "a"
 $ b: chr "b"
```

More generally, the `new` command (via the `initialize` method for class `PBSoptions`) first attempts to load previously saved values from the file `filename`. If the attempt fails or any options are missing, `new` assigns default options from `initial.options`. Users should generally save the newly created `PBSoptions` object in the global environment to facilitate the retrieval and modification of options from various functions in different scopes. For more details on object initialization, consult the `PBSoptions` class documentation.

The following functions allow users to retrieve or modify the values stored in a `PBSoptions` object:

getOptions.....retrieve options from the object;
setOptions.....add or modify options in the object;

getOptionsPrefixretrieve the prefix that identifies widget variable names;
setOptionsPrefixmodify the prefix value;

```
getOptionsFileName.....retrieve the default filename;  
setOptionsFileName.....modify the default filename.
```

Potentially, options can exist at three levels: a GUI window, internal R memory, or a file. They become active when they exist in internal memory as part of a `PBOptions` object. In a GUI window with numerous entry fields, the `gui.prefix` identifies those fields that correspond to options. In the example above, where `gui.prefix="PBSopt"`, an entry field with `name=PBSoptCpath` would correspond to the option `Cpath` in a `PBOptions` object. This naming convention allows options to be displayed and modified in a GUI. The following support functions allow a user to move options between a `PBOptions` object and GUIs or files:

```
loadOptionsGUI.....load options from the object into a GUI;  
saveOptionsGUI.....save options from a GUI in the object;  
  
loadOptions .....load options from a file into the object;  
saveOptions .....save options from the object into a file.
```

The structures and methods described above make it easy to prescribe options, modify them in a GUI, and save their values in files. A user typically develops a project in a directory where a particular file preserves the options between R sessions. More generally, files with distinct names can preserve distinct sets of options. An R function can automatically initialize the project by creating `PBOptions` objects from the corresponding files.

From a technical perspective, `PBOptions` objects have a single slot `instance`. This contains a hidden environment that is created on object initialization and preserved when objects are copied. Effectively, the class definition allows objects to be passed by reference, rather than by value. The methods can manipulate the original object and avoid the need for returning a new modified `PBOptions` object.

5.2. Project management utilities

Sometimes projects have an association with an R package. For this reason, we include functions that can open files and examples from an R package installed on the user's computer:

```
openPackageFile.....Open a file from a package subdirectory  
..... (deprecated, use openFile);  
openExamples .....Open files from the examples subdirectory of a package.
```

As discussed above, a project typically includes multiple files with the same prefix and a potential set of suffixes. (A suffix doesn't necessarily have to be a file extension. For example, you can use the prefix `foo` and the suffix `-bar.xxx` to match the file `foo-bar.xxx` where the extension is `.xxx`.) We provide a utility to open these files, provided that their extensions have associated applications. We also allow a user to search the current working directory for potential prefixes, or to browse for a working directory and find such prefixes. Furthermore, a project can be "cleaned" by removing files with specified suffixes. See the functions:

openProjFiles.....open files with a common prefix;
findPrefix.....find a prefix based on names of existing files;
findSuffix.....find suffix of system files with specified prefix;
setwdGUI.....browse for a working directory;
cleanProj.....launch a GUI for project file deletion;
cleanWD.....launch a GUI to delete files from the current working directory.

6. Support for lectures and workshops

Speakers giving lectures and workshops about R often want their audience to experience the consequences of running some R code. Participants sometimes find themselves scrambling to copy code from the visual presentation, related web sites, or files distributed by the speaker. During this process, the actual point of the lecture can get lost. Focus shifts from R concepts to typing, other mechanical issues, and a struggle to keep up with the speaker's activity.

PBSmodelling offers a potential solution to this problem that preserves an interactive spirit while ensuring that participants easily see the results from planned segments of R code. We encapsulate our approach in the two functions:

showRes.....display a string of R code and show results on the R console;
presentTalk.....present a talk on the R console, based on a talk description file.

The first provides a minor tool that sometimes comes in handy. The second implements a much more general idea. Just as a *window description file* defines a GUI window, a *talk description file* defines a talk that runs on the R console. A small GUI makes it easy to step through the talk interactively, with easy movement forward or backward. Planned results appear on the R console, and yet the console remains available for additional spontaneous code entry.

The author of a talk writes a text file that contemplates a sequence of actions, such as displaying text, running R code, and opening files. If audience members receive this file in advance, they can readily follow every step during the talk by simple mouse clicks on the GUI. The file also gives them an opportunity to review the concepts at a convenient later time. We anticipate R tutorials written as talk description files, and we may eventually add some to **PBSmodelling**.

For simplicity, our talk description files conform to the XML specifications (<http://en.wikipedia.org/wiki/XML>), and the R package XML is required to read them. We support the following five XML elements:

<talk> ... </talk> to delimit an entire talk;
<section> ... </section> to delimit a section within a talk;
<text> ... </text> to delimit text that should appear in the R console;
<file> ... </file> to delimit names of files that should be opened;
<code> ... </code> to delimit code that should run in the R console.

Consistent with the standard format, each element has an initial tag in angle brackets, intermediate material (indicated here by . . .), and a final tag with a backslash character (/) prefixed to the initial tag. Each initial tag must be closed with a corresponding final tag.

Initial tags can include arguments, for which the values must appear in double or single quotes. Appendix B lists the complete syntax for all five tags. For example, the element

```
<code show="TRUE" print="TRUE" break="all"> plot(cars) </code>
```

would show the string `plot(cars)` on the R console, pause (i.e., break), generate the plot, print any related output on the R console, and then pause again.

As illustrated in Table 1, a talk description file must contain exactly one `<talk>` element as the root of a branching tree. The `<talk>` can contain one or more `<section>` branches. In turn, each `<section>` can contain any mixture of leaf nodes: `<text>`, `<file>`, or `<code>`. The `<talk>` and `<section>` elements play organizational roles, whereas the leaf nodes correspond to concrete actions. A `<text>` element specifies ordinary text, such as lecture notes, that should appear in the R console. A `<file>` element causes one or more files to open at this point of the talk. For example, it might be desirable to display a file of R code or open a PowerPoint file. A `<code>` element causes code to be displayed and run in the R console. Appendix B gives complete syntax details for talk description files.

Comments within a talk description file follow the standard XML format:

```
<!-- . . . -->
```

where . . . denotes the text of the comment. XML has five standard reserved characters as shown in the list below, where “&” serves as an escape character that allows these characters to be interrupted as ordinary text.

Character	Escaped Character	Description
<	<	Less-than character starts an element tag
>	>	Greater-than character ends an element tag
&	&	Ampersand is used for escaping characters
"	"	Used for argument values in a leading tag
'	'	Used for argument values in a leading tag

If `<text>` or `<code>` elements contain numerous characters that must be escaped, then the syntax:

```
<![CDATA[ . . . ]>
```

allows any raw character data (. . .) to be included.

Table 4. A talk description file `swisstalk.xml` designed for use with the `PBSmodelling` function `presentTalk`. This talk examines method dispatch for the `summary` function and illustrates how it applies to the `swiss` data set, which has class `data.frame`.

File: `swisstalk.xml`

```
<!-- We will use xml comments. There must be only ONE document root. -->
<talk name="Swiss">

  <!-- SECTION 1. summary method -->
  <section name="Methods" button="TRUE">

    <text break="T">
      This short talk examines the "summary" method
      and applies it to the "swiss" dataset.</text>.
    <text break="T">
      The talk itself comes from a talk description file.
      The next step should open that file (swisstalk.xml),
      provided that a program is associated with xml files. </text>

    <file name="swisstalk" button="TRUE">swisstalk.xml</file>

    <text break="F">
      "summary" is a function (class function). </text>

    <code break="print">
      isWhat(summary) # isWhat() from PBSmodelling</code>
    <text break="F">"summary" is generic:</text>
    <code break="print">summary</code>
    <text break="F">"summary" has many methods:</text>
    <code break="print"> methods(summary)</code>

  </section>

  <!-- SECTION 2. The "swiss" data -->
  <section name="Data" button="TRUE">

    <text break="F"> "swiss" is a data frame (class data.frame):</text>
    <code> isWhat(swiss)</code>
    <text break="F"> You can read about the data here:</text>
    <code> help(swiss) # open the help file</code>
    <text break="F"> Apply "summary" to Swiss:</text>
    <code break="print"> summary(swiss)</code>
    <text break="F"> Print the first 3 records:</text>
    <code break="print"> head(swiss,3)</code>
    <text break="F"> Display the data with the "plot" method . . .</text>
    <code print="F"> plot(swiss,gap=0)</code>
    <text> THE END .. THANKS FOR WATCHING!</text>

  </section>
</talk>
```

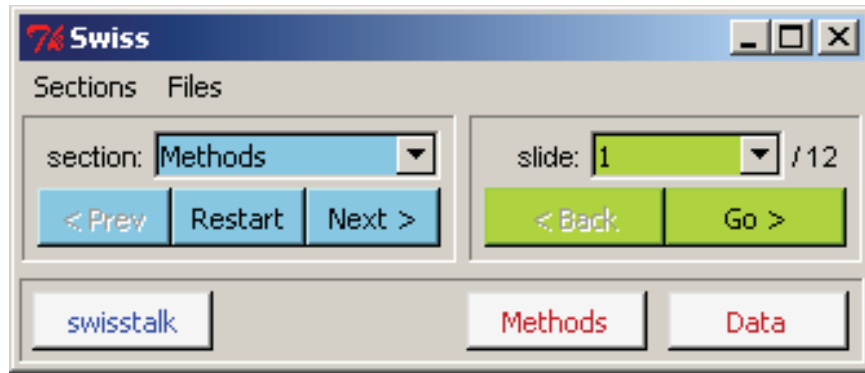


Figure 5. The GUI generated by `presentTalk` from the talk description file in Table 4.

The “Swiss Talk” example in **PBSmodelling** allows a user to view the results from the short talk description file in Table 4. The first section (named “Methods”) starts with a brief text message in the R console. The next step displays the description file itself (`swisstalk.xml`), as an illustration of how `presentTalk` works. Then the audience sees aspects of R’s polymorphic function `summary`. The `isWhat` function (from **PBSmodelling**) shows its properties, and the `methods` function reveals the diverse ways in which `summary` has been overloaded. The second section (named “Data”) shows properties of the data frame `swiss`, as well as the consequences of applying `summary` and `plot` to this object. The talk closes with a classic message showing “THE END”.

The code elements supported by `presentTalk` give an author considerable scope for introducing breaks and other features into the presentation. Furthermore, the root `<talk>` block in the description file produces a corresponding GUI, similar to the one shown in Figure 5. This enables the speaker to move stepwise through the presentation, via the “Go” button, analogous to moving through slides in a conventional talk. After each step, the R console remains open for additional code written on the spur of the moment. Furthermore, the menu items (“Sections”, “Files”) allow for quick movement among sections, as well as spontaneous opening of files. For example, the speaker might choose to open and close the same file several times during a presentation. This can be programmed into the talk description or done spontaneously through the “Files” menu.

In addition to the automatic menu items, a user can add buttons to the GUI that accomplish similar purposes. For example, Figure 5 shows buttons that will move to the start of the sections “Methods” and “Data” or open the “swisstalk” description file. The “Back” button moves back to the previous slide, and individual slides can be selected via a droplist widget. The blue buttons allow movement among sections – “Prev” to the previous section, “Restart” to the start of the current section, and “Next” to the next section.

Code executed during a talk presentation potentially changes objects in the current global environment. Although the GUI allows quick jumps among slide and sections of talks, the speaker needs to remain aware of objects currently in the global environment. For example, if the first section of the talk creates objects needed by the second section, it makes no sense to skip to the second before the first has done its work. In some cases, it may help to start a talk or section

with `clearAll()` to ensure that previous objects in the environment don't conflict with those now being created. On the other hand, depending on the author's intent, this could be entirely the wrong thing to do.

In practice, a speaker would present his or her talk from a laptop connected to a digital projector. In this context, it is almost essential to choose large fonts in the R console. When writing a talk, it helps to view it with font sizes and R console dimensions chosen with the final presentation in mind.

7. Examples

As mentioned in the Preface, **PBSmodelling** includes a variety of examples that illustrate applications based on this and other packages. Generally, each example contains documentation, R code, a window description file, and (if required) other supporting files. All relevant files appear in the R library directory `PBSmodelling\Examples`. An example named `xxx` typically has corresponding files `xxxDoc.txt` or `xxxDoc.pdf` (documentation), `xxx.r` (R code), and `xxxWin.txt` (a window description). In the GUI for each example, buttons labelled `Docs`, `R Code`, and `Window` open these files **provided that suitable programs have been associated with the file extensions `*.txt`, `*.pdf`, and `*.r`**. In particular, a suitable program (such as the Acrobat Reader) must be installed for reading `*.pdf` files, and you may need to associate a text file editor with `*.r`. On some systems, it may be necessary to use the function `setPBSext` to define these associations, as discussed earlier in Section 2.3.

Use the function `runExamples()` to view all examples currently available in **PBSmodelling**. This procedure copies all relevant files to a temporary directory located on the path defined by the environment variable `Temp`. It then opens a window in which radio buttons allow you to select any particular case. Closing the menu window causes the temporary files and related data to be cleaned up, and returns to the initial working directory.

Alternatively, you can copy all the files from `PBSmodelling\Examples` to a directory of your choice and open R in that working directory. To run example `xxx`, type `source("xxx.r")` on the R command line. For instance, `source("LissFig.r")` creates a window (from the description file `LissFigWin.txt`) that can be used to draw the Lissajous figures described in Section 2.1. The built-in example also includes a history widget for collecting settings that the user wishes to retain.

The examples documented here illustrate only some of those available in version 1 of **PBSmodelling**. For instance, we also include a `TestFuns` GUI that we have used as a tool for debugging various functions in the package. In future versions, we plan to add more examples that illustrate important modelling concepts and provide convenient supplementary materials for university courses in fisheries, biology, ecology, statistics, and mathematics. The function `runExamples()` should always represent the complete list currently available, and the `Docs` button for each case should link to the appropriate documentation.

The nine examples presented in this section illustrate some of the possibilities available in **PBSmodelling**, although the documentation may be somewhat out of date. For example, the figures in this report may not correctly represent current versions of the GUIs and their associated graphical output. Use the `Docs` button to read the most current information for each example. If this seems rather primitive, please wait for improvements in future versions.

7.1. Random variables

7.1.1. RanVars – Random variables

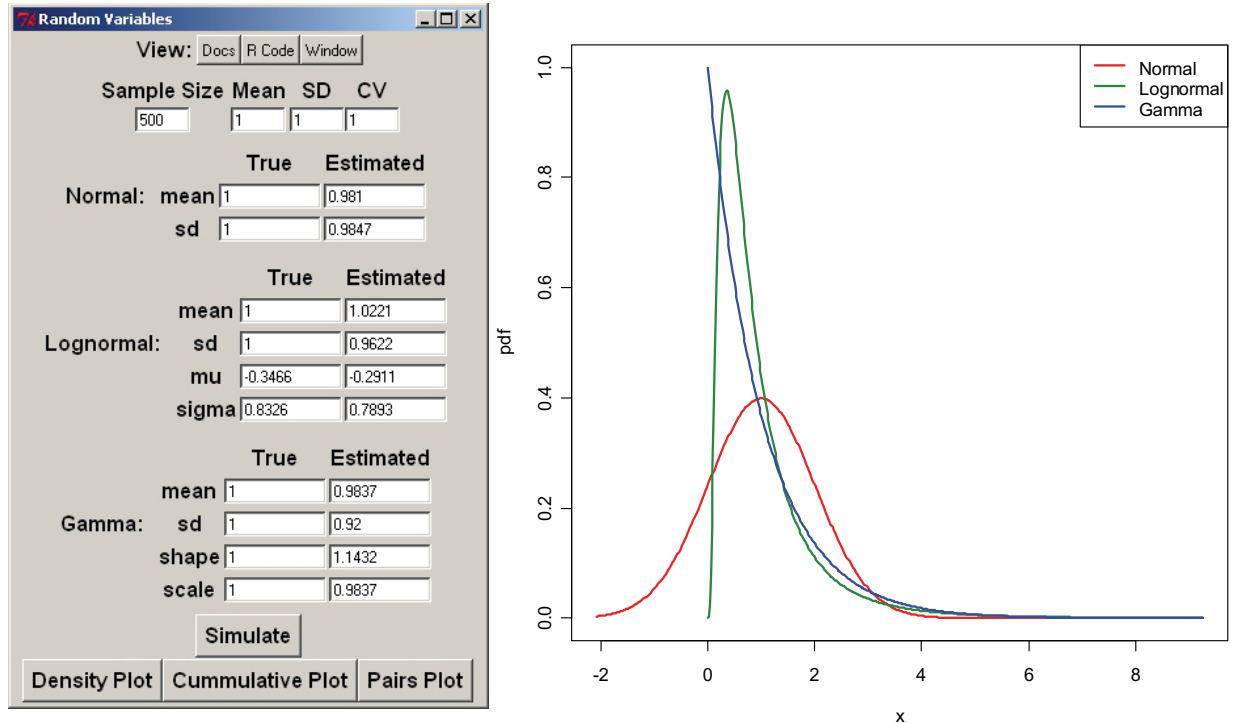


Figure 6. RanVars GUI (left) and density plot (right). Simulations are based on 500 random draws with mean =1 and SD = 1.

The RanVars example draws samples from three continuous random distributions (normal, lognormal, and gamma) with a common mean μ and standard deviation σ . The documentation (“Docs” button) shows relevant formulas that connect distribution parameters with the moments μ and σ . Estimated parameter values from a simulation (invoked by “Simulate”) are displayed in the GUI alongside the true values (Figure 6). We use only the straightforward moment formulas in the documentation, without sample bias correction formulas like those described by Aitchison and Brown (1969). Three buttons at the bottom of the GUI portray the data visually as density curves, cumulative proportions, and paired scatter plots.

7.1.2. RanProp – Random proportions

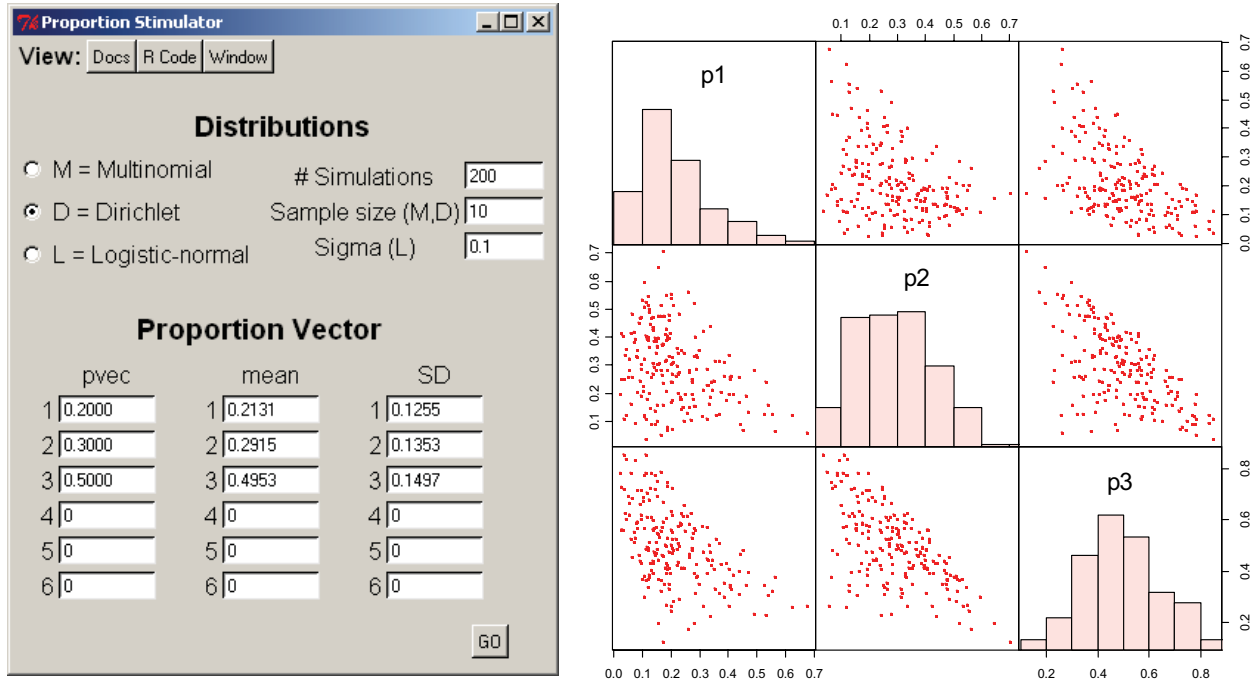


Figure 7. RanProp GUI (left) and pairs plot (right). Simulations are based on 200 random draws where $n = 10$ for the multinomial and Dirichlet distributions and $\sigma = 0.1$ for the logistic-normal distribution. The pairs plot portrays results for the Dirichlet.

The RanProp example simulates up to five random proportions drawn from one of three distributions – multinomial, Dirichlet, and logistic-normal. The observed proportion means and standard deviations are reported in the GUI (Figure 7), and a graphical display renders the points as a paired scatter plot. After defining options in the GUI, including the vector “pvec” of true underlying proportions, press “Go”. Schnute and Haigh (2007) provide further technical details about these three distributions.

7.1.3. SineNorm – Sine normal

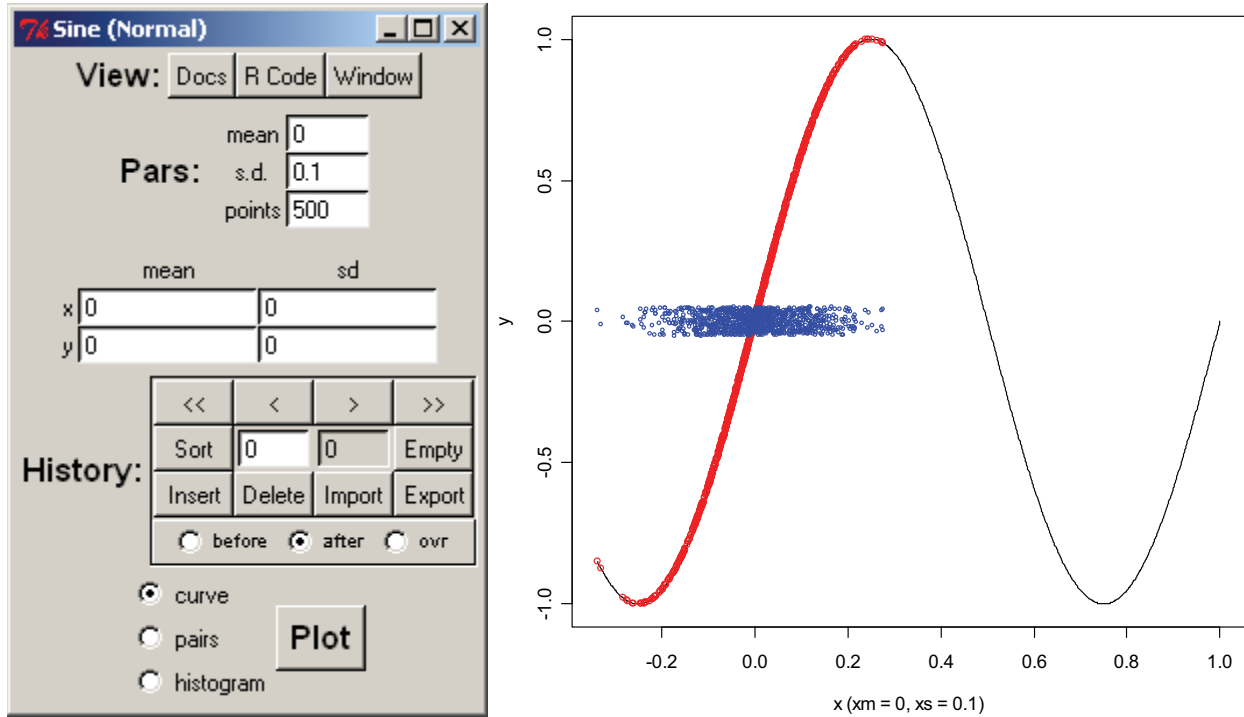


Figure 8. SineNorm GUI (left) and plot (right). Simulations are based on 500 random draws of $y = \sin(2\pi x)$, where x is normal with mean $\mu = 0$ and standard deviation $\sigma = 0.1$. Blue points portray jittered values of x , and red points show corresponding values of y .

The SineNorm example illustrates a somewhat unconventional random variable $y = \sin(2\pi x)$, where x is normal. The GUI allows you to specify the mean μ and standard deviation σ of x . If $\mu = 0$ and σ is small, the transformation is nearly linear, so that y is approximately normal. If σ is large, the transformation concentrates y near -1 and 1. Figure 8 illustrates the transformation when σ has the moderate value 0.1. Try $\sigma = 10$ to see how values y tend to occur near the peaks and troughs of the sine function, where the slope is relatively flat.

7.1.4. CalcVor – Calculate Voronoi tessellations

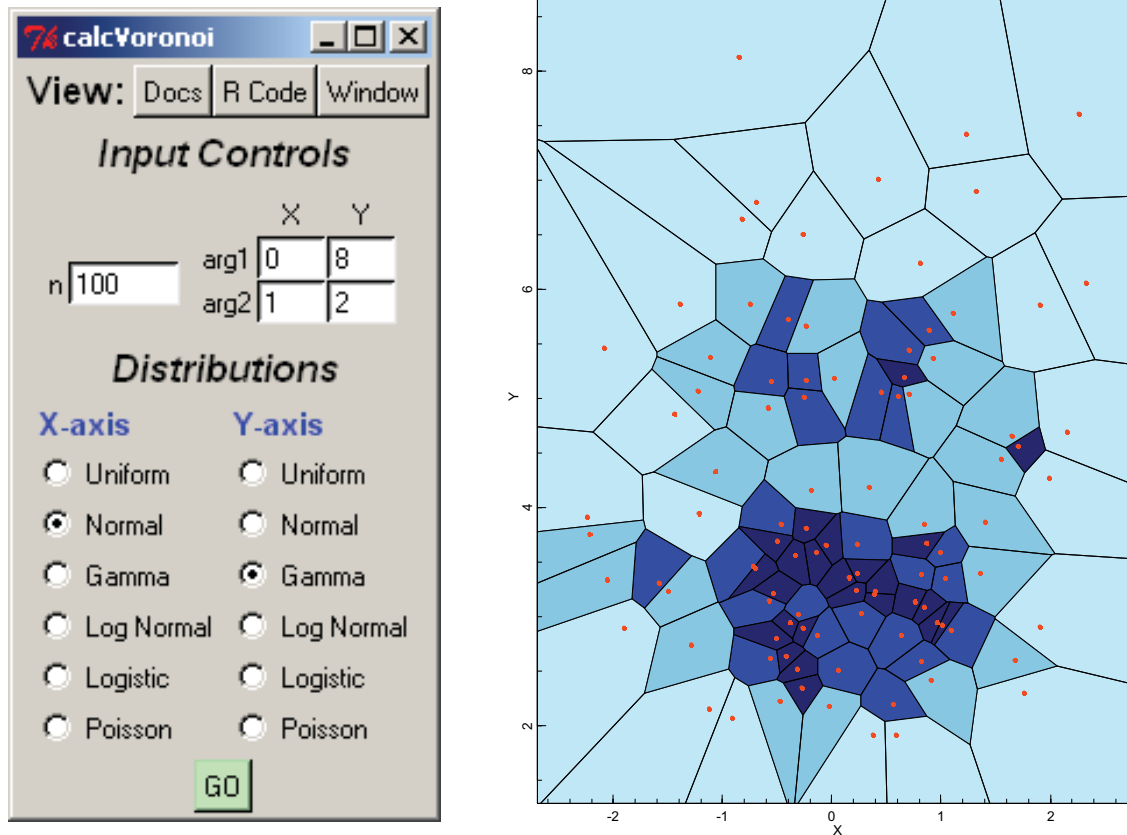


Figure 9. CalcVor GUI (left) and plot (right). Tessellation of random points (red) that are normally distributed on the x-axis (mean=0, sd=1) and gamma-distributed on the y-axis (shape=8, rate=2).

The CalcVor example calls **PBSmapping**'s `calcVoronoi` function, which calculates the Voronoi (Dirichlet) tessellation for a set of points using the `deldir` function in the CRAN package *deldir*. The GUI accepts two arguments for each random distribution represented on each axis. The underlying functions and their arguments are:

Distribution	Function	Argument 1	Argument 2
Uniform	<code>runif</code>	min	max
Normal	<code>rnorm</code>	mean	sd
Gamma	<code>rgamma</code>	shape	rate
Log normal	<code>rlnorm</code>	meanlog	sdlog
Logistic	<code>rlogis</code>	location	scale
Poisson	<code>rpois</code>	lambda	---

7.2. Statistical analyses

7.2.1. LinReg – Linear regression

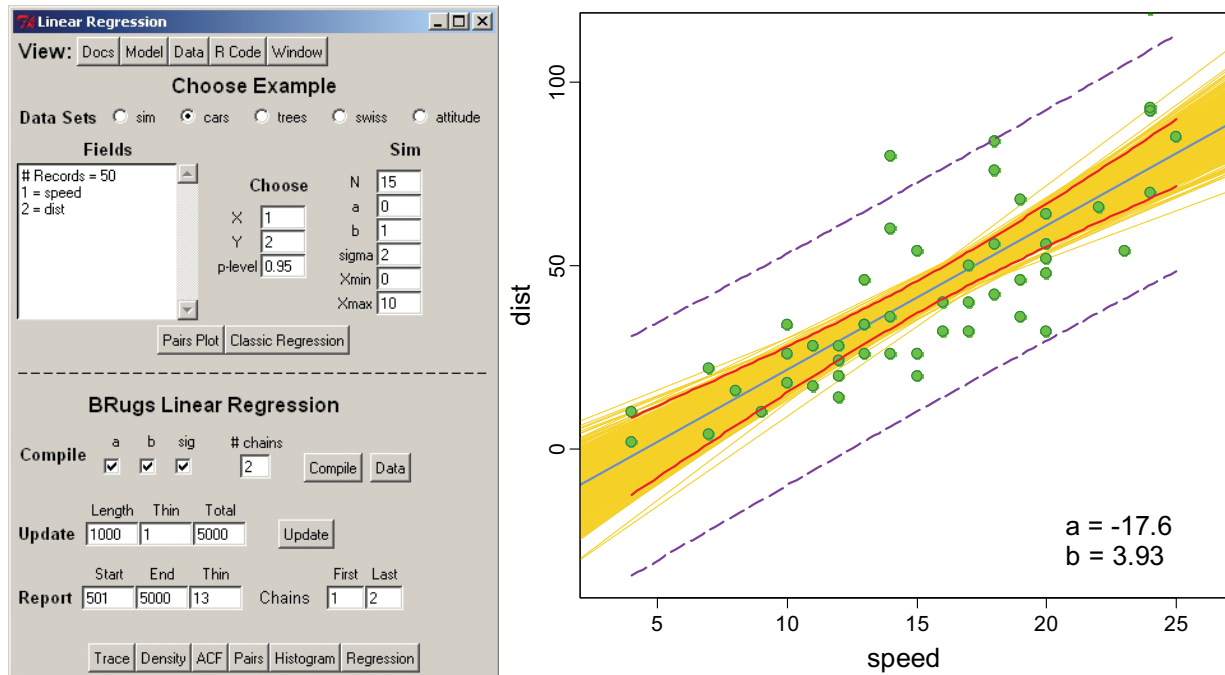


Figure 10. LinReg GUI (left) and regression plot (right). The linear regression uses the *cars* dataset ($n=50$) to predict *dist* vs. *speed*. The plot shows observations (green circles), fitted line (solid blue line), the 95% confidence limits of the fitted model (solid red lines), the 95% CL of the data (dashed purple lines), and the fits using the Bayes posterior estimates of (a, b) (gold lines).

The example LinReg estimates parameters in a linear regression $y = a + bx$ using either simulated data or data objects that come with the R-package. We compare a classical frequentist regression with results from Bayesian analysis, using the **BRugs** package to interface with the program WinBUGS. After selecting various data options, “Pairs Plot” shows a pairs plot (x, y) and “Classic Regression” adds confidence limits (at “p-level”) from regression theory. Red and violet curves show bounds for a prediction or a new observation, respectively, each conditional on x . If the data came from simulation, a blue line portrays the truth, with specified values a and b , that must be estimated from the data.

A corresponding Bayesian analysis uses the WinBUGS model shown by pressing “Model”. Choose parameters to monitor (normally all of them): the intercept a , the slope b , and the predictive standard deviation σ . After specifying a number of sample chains for the MCMC sample, press “Compile” to compile the model with these settings. “Update” generates samples in “Length” increments. Additional buttons at the bottom of the GUI allow you to explore the MCMC output. Posterior samples of (a, b) correspond to sample lines. The “Regression” button illustrates these in relationship to confidence limits from a frequentist analysis (Figure 10).

7.2.2. MarkRec – Mark-recovery

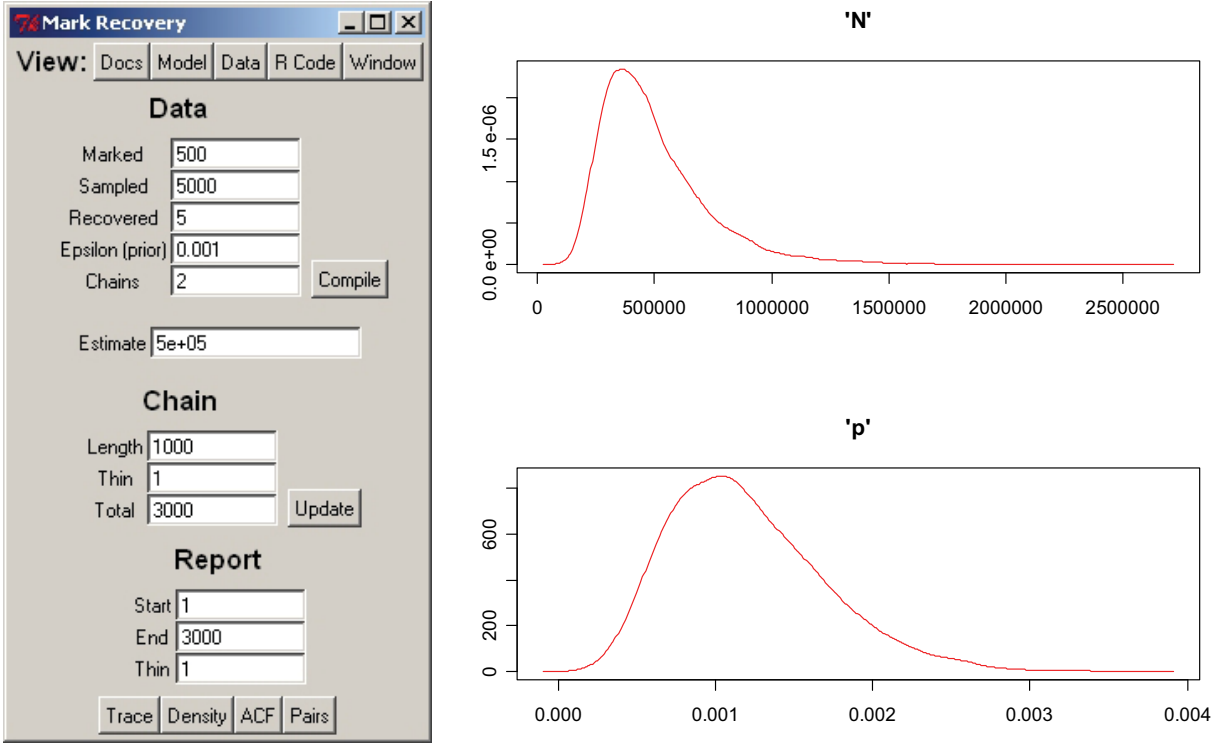


Figure 11. MarkRec GUI (left) and density plots (right). A low recovery of marked fish can lead to fat tails in N due to occasional large spikes in the population estimate.

The example MarkRec performs a Bayesian analysis of a mark-recovery experiment in which M fish are marked and allowed to disperse randomly in the population. Later, a sample of size S is removed from the population and R marks are recovered. Both the total population N and the marked proportion p are unknown, where

$$p = \frac{M}{N} \cong \frac{R}{S}.$$

In one version of the theory, R is binomially distributed with probability p in a sample of size S , and the above approximation suggests the estimate

$$\hat{N} = \frac{S}{R} M = \frac{M}{R} S.$$

When recoveries are low ($R \approx 0$), the posterior distribution of N exhibits a fat tail (Figure 11).

As in LinReg, “Model” shows the MarkRec model for WinBUGS, which (deliberately) includes an illegitimate prior that depends on the data. By increasing an initially small quantity ε , this fake prior allows the tail of N values to be arbitrarily clipped. Schnute (2006) gives some historical perspective to this analysis, in the context of work by W.E. Ricker.

7.2.3. CCA – Catch-curve analysis

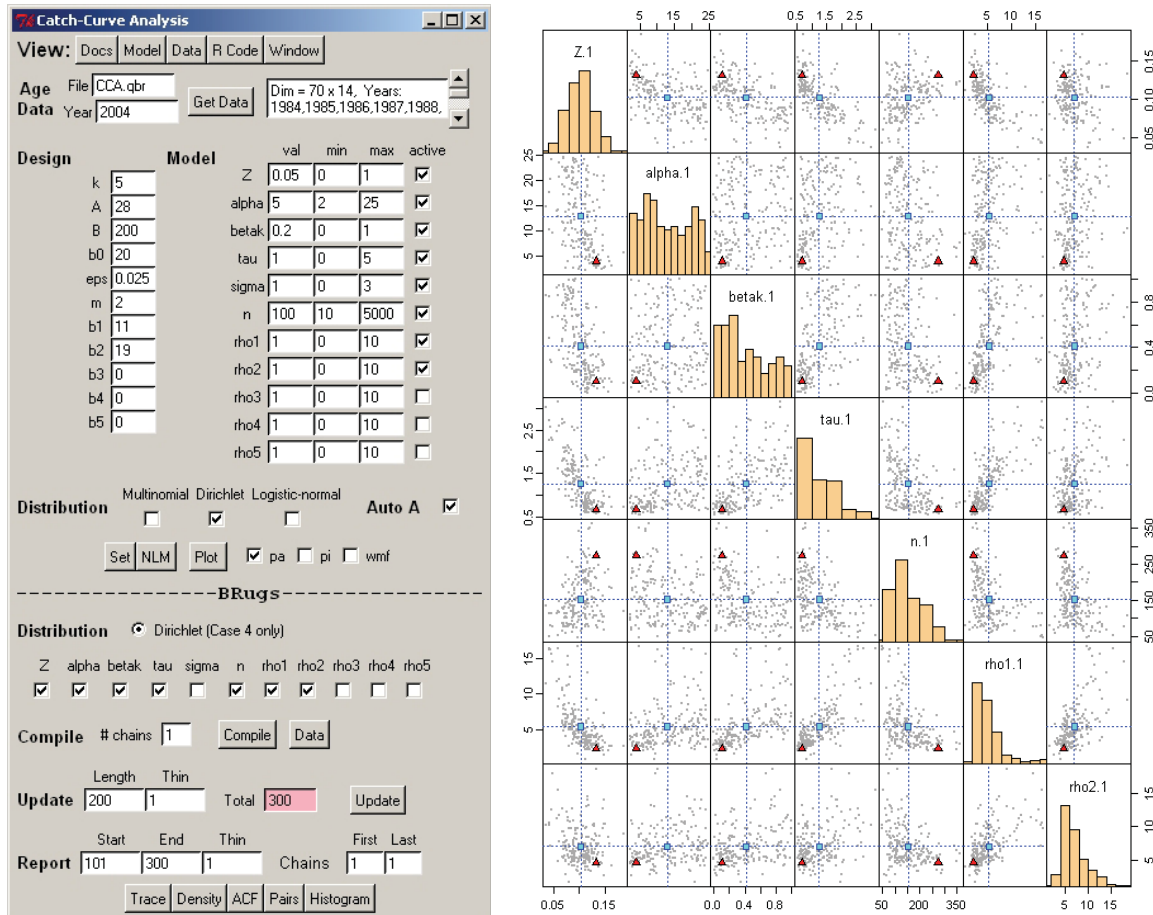


Figure 12. CCA GUI (left) and parameter pairs plot (right). Comparison of Bayes posterior distribution of CCA model parameter estimates from chain 1 ($N=100$). Symbols indicate means (blue squares) and modes (red triangles). Diagonal shows parameter estimate distributions.

The example CCA illustrates a catch-curve model proposed by Schnute and Haigh (2007). It incorporates effects of survival, selectivity, and recruitment anomalies on age structure data from a single year. After making various model choices, press “Set”, “NLM” (which may take several seconds), and “Plot” to view the maximum likelihood estimates and their relationship with the data. A WinBUGS model (“Model”) allows us to calculate posterior distributions. (See the last few lines of “Model”.) As in *MarkRec*, select parameters to monitor, specify a number of chains, and “Compile” the model. “Update”s may be slow, but eventually they produce interesting posterior samples (Figure 12). “Docs” gives details of the deterministic model, and the Dirichlet distribution is used to describe error in the observed proportion.

We include this example to illustrate a somewhat realistic WinBUGS model that can be used to estimate parameters for a population dynamics model. Further information can be found in Schnute and Haigh (2007). **PBSmodelling** includes the data for this example as the matrix `CCA.qbr`.

7.3. Other applications

7.3.1. FishRes – Fishery reserve

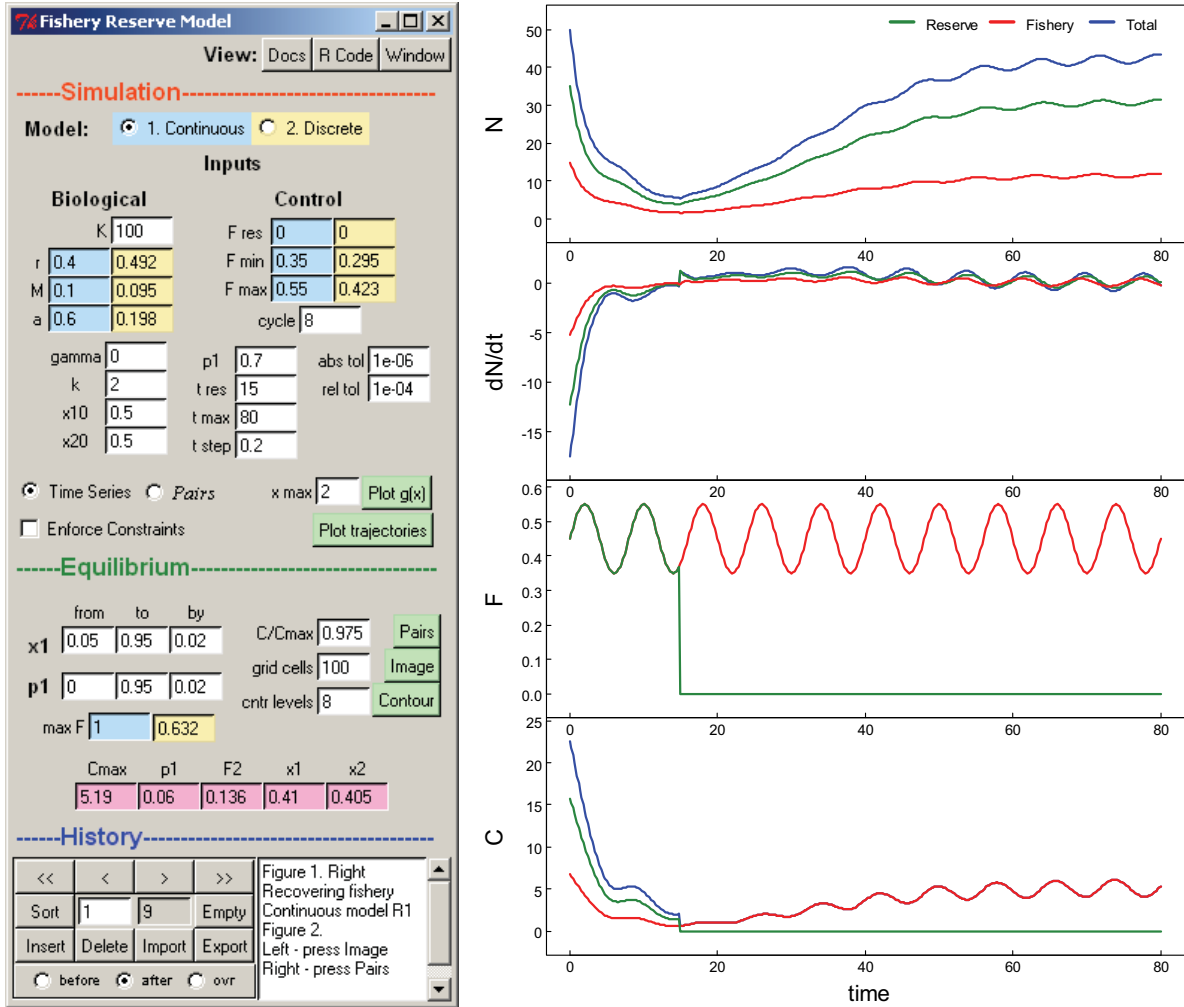


Figure 13. FishRes – Recovery of a heavily fished population after establishing a reserve. The GUI (left) shows all input values (parameters and controls). The selected continuous time model uses input values common to both models (white background) and values specific to the continuous model (blue background). Corresponding values are computed for the discrete model (yellow background). Output trajectories (right) trace various results (N = population, dN/dt = instantaneous change in population, F = instantaneous fishing mortality, C = instantaneous catch) for the reserve and fishery. Fishing mortality follows a sinusoid determined by F_{\min} , F_{\max} , and the cycle length n .

The example FishRes (Figure 13) models a fish population associated with a marine reserve in continuous or discrete time (delay differential or difference equations, respectively). For details see Schnute et al. (2007), which can be viewed by pressing the **Docs** button in the GUI. The R packages **akima**, **PBSddesolve**, and **odesolve** are required.

7.3.2. FishTows – Fishery tows



Figure 14. FishTows GUI (left) and simulated tow track (right). Tow track plots show 40 random tows in a square with side length 100. Each tow has width 2, and the rectangle encompasses 10,000 square units. *Top:* The individual rectangles, with 160 vertices, have areas that sum to 4,445 square units. *Bottom:* The union includes a complex polygon (red) and three isolated rectangles (blue, green, yellow) that cover only 3,455 square units. The complex polygon (red) has 547 vertices and 91 holes.

The example `FishTows` provides a simulator of fishery tow tracks using the **PBSmapping** package. The example demonstrates the difference between swept area and area impacted by trawls that often cover the same ground repeatedly. This application can be regarded as an exotic random number generator, where tows initially join two points picked from a uniform random distribution within a square of a given side length. Three parameters (the number of tows, the tow width, the side length) determine several random variables, including the mean tow length, the areas swept and impacted, the numbers of polygons and holes in the union set of tows, and the number of vertices in the union. Each of these would also have a variance and an overall distribution generated by many runs of this example.

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Appendix A. Widget descriptions

This appendix lists **PBSmodelling** widgets in alphabetical order, except for “Window” which must exist before other widgets can be placed within it. Following a Tcl/Tk standard, we use a recursive grid design that allows grids within grids for flexible widget arrangement. The `grid` widget makes this possible. Furthermore, the `notebook` widget allows parts of a window to be selected by tabs, as in many other GUI applications.

For each widget, we include a brief description, a usage line showing the default arguments, a detailed list of arguments, and an illustrated example. In specifying a widget, the user can arrange named arguments in any order. If arguments are not named, they must appear in the order specified by the argument list, similar to named arguments in an R function.

The particular argument `sticky` needs a bit of explanation. It must be a string with zero or more of the characters N, E, W, or S that ‘stick’ the widget to the top, right, left, or bottom of its grid cell. These letters can have either upper or lower case and can appear in any order. The empty string (`sticky=""`) puts the widget in a central position of the cell. A string of length 1 binds the widget to the corresponding side (north, east, west, or south). The combinations NE, SE, SW, or NW will bind the widget to one of the corners. The combinations NS or EW will stretch the widget vertically or horizontally to the limits of its grid cell, while NEWS will stretch the widget in all directions to fill the cell.

Window


Description

Create a new window. Windows are used as a palette upon which widgets are placed. Each open window has a unique name. The function `closeWin` closes all windows unless a specific name (or vector of names) is provided by the user. Also, if `createWin` opens a window with a name already in use, the older window is closed before the new window is opened.

Usage

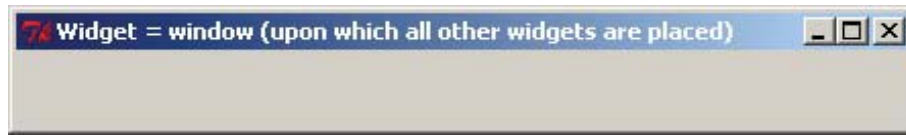
```
type=window name="window" title="" vertical=TRUE bg="#D4D0C8"
fg="#000000" onclose="" remove=FALSE
```

Arguments

name.....unique name identifying an open window
title.....text to display in the window’s title line
vertical.....if TRUE, arrange widgets vertically, top to bottom, within the window
bg.....background colour for window
fg.....colour for label fonts
onclose.....name of function called when user closes the window by pressing 
remove.....if TRUE, remove from .PBSmod on closing

Example

```
window title="Widget = window (upon which all other widgets are placed)"
```



Button

Description

A button linked to an R function that runs a particular analysis and generates a desired output, perhaps including graphics.

Usage

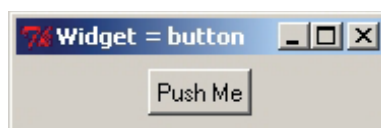
```
type=button text="Calculate" font="" fg="black" bg="" disablefg=NULL  
width=0 name=NULL function="" action="button" sticky="" padx=0  
pady=0
```

Arguments

text.....text to display on the button
font.....font for labels – specify family (Times, Helvetica, or Courier), size (as point size), and style (bold, italic, underline, overstrike), in any order
fg.....colour for label fonts
bg.....background colour for widget
disablefg.....colour for label fonts when state is disabled
width.....button width, the default 0 will adjust the width to the minimum required
name.....unique name to identify button for use with `setWidgetState`
function.....R function to call when the button is pushed (i.e., clicked by the mouse)
action.....string value associated whenever this widget is engaged
sticky.....option for placing the widget in its available space, as discussed in the introductory paragraphs for Appendix A on page 37
padx.....space used to pad the widget on the left and right; two values can be used to specify padding on the left and right separately
pady.....space used to pad the widget on the top and bottom; two values can be used to specify padding on the top and bottom separately

Example

```
window title="Widget = button"  
button text="Push Me"
```



Check

Description

A check box to turn a variable off or on, with corresponding values FALSE or TRUE (0 / 1).

Usage

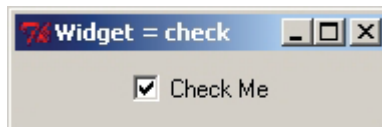
```
type=check name mode="logical" checked=FALSE text="" font=""  
fg="black" bg="" disablefg=NULL function="" action="check"  
edit=TRUE sticky="" padx=0 pady=0
```

Arguments

name.....name of R variable altered by this check box (required)
mode.....R mode for the associated variable, where valid modes are
 logical or numeric
checked.....if TRUE, the box is checked initially and the variable is set to TRUE or 1
text.....identifying text placed to the right of this check box
font.....font for labels – specify family (Times, Helvetica, or Courier), size
 (as point size), and style (bold, italic, underline, overstrike), in
 any order
fg.....colour for label fonts
bg.....background colour for widget
disablefg.....colour for label fonts when state is disabled
function.....R function to call when the check box is changed
action.....string value associated whenever this widget is engaged
edit.....if TRUE, the box's state can be modified by the user; if FALSE, the box is
 read-only
sticky.....option for placing the widget in its available space, as discussed in the
 introductory paragraphs for Appendix A on page 37
padx.....space used to pad the widget on the left and right; two values can be used
 to specify padding on the left and right separately
pady.....space used to pad the widget on the top and bottom; two values can be
 used to specify padding on the top and bottom separately

Example

```
window title="Widget = check"  
check name=junk checked=T text="Check Me"
```



Data

Description

An aligned set of entry fields for all components of a data frame. The data widget can accept a variety of modes. The user must keep in mind that `rowlabels` and `collabels` should conform to R naming conventions (no spaces, no special characters, etc.). If mode is logical, fields appear as a set of check boxes that can be turned on or off using mouse clicks.

Usage

```
type=data nrow ncol names modes="numeric" rowlabels="" collabels=""
rownames="X" colnames="Y" font="" fg="black" bg=""
entryfont="" entryfg="black" entrybg="white" noeditfg="black"
noeditbg="gray" values="" byrow=TRUE function="" enter=TRUE
action="data" edit=TRUE width=6 borderwidth=0 sticky="" padx=0
pady=0
```

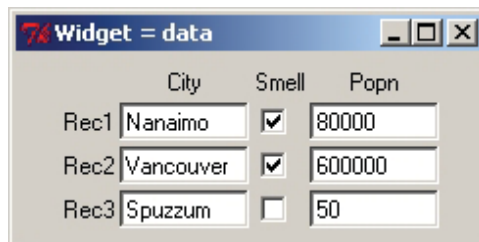
Arguments

`nrow`.....number of rows (required)
`ncol`.....number of columns(required)
`names`.....either one name or a set of `nrow*ncol` names used to store the data frame in R (required)
`modes`.....R modes for the data frame, where valid modes are:
 numeric, integer, complex, logical, character
`rowlabels`.....one of NULL, a single label, or a vector of `nrow` labels. The NULL label displays no labels and minimizes space. A single label displays a label to the left of the widget, and numbers each row (an empty label "" only numbers each row). A vector of `nrow` labels is used to specify a label for each row.
`collabels`.....one of NULL, a single label, or a vector of `ncol` labels. The NULL label displays no labels and minimizes space. A single label displays a label above the widget, and numbers each column (an empty label "" only numbers each column). A vector of `ncol` labels is used to specify a label for each column.
`rownames`.....string scalar or vector of length `nrow` to name the rows of the data frame
`colnames`.....string scalar or vector of length `ncol` to name the columns of the data frame
`font`.....font for labels – specify family (Times, Helvetica, or Courier), size (as point size), and style (bold, italic, underline, overstrike), in any order
`fg`.....colour for label fonts
`bg`.....background colour for widget
`entryfont`.....font of entries appearing in input/output boxes
`entryfg`.....font colour of entries appearing in input/output boxes
`entrybg`.....background colour of input/output boxes
`noeditfg`.....font colour of entries appearing in input/output boxes when `edit=FALSE`

noeditbg.....background colour of input/output boxes when edit=FALSE
valuesdefault values (either one value for all data frame components or a set of
nrow*ncol values)
byrow.....if TRUE and nrow*ncol names are used, interpret the names by row;
otherwise by column. Similarly, interpret nrow*ncol initial values.
function.....R function to call when any entry in the data frame is changed
enter.....if TRUE, call the function only after the <Enter> key is pressed
actionstring value associated whenever this widget is engaged
edit.....if TRUE, the values can be modified by the user; if FALSE, the values are
read-only
width.....character width to reserve for the each entry in the data frame
borderwidtha non-negative value specifying the amount of space to use for drawing a
border (or margin) around the widget; the background colour of the space
is determined by the bg value
stickyoption for placing the widget in its available space, as discussed in the
introductory paragraphs for Appendix A on page 37
padx.....space used to pad the widget on the left and right; two values can be used
to specify padding on the left and right separately
pady.....space used to pad the widget on the top and bottom; two values can be
used to specify padding on the top and bottom separately

Example

```
window title="Widget = data"
data nrow=3 ncol=3 names=Census byrow=FALSE \
  modes="character logical numeric" width=10 \
  rowlabels="Rec1 Rec2 Rec3" collabels="City Smell Popn" \
  values="Nanaimo Vancouver Spuzzum T T F 80000 600000 50"
```



Droplist

Description

A field in which a scalar variable (number or string) can be selected from a drop-down list.

Usage

```
type=droplist name values=NULL choices=NULL labels=NULL selected=1
add=FALSE font="" fg="black" bg="white" function="" enter=TRUE
action="droplist" edit=TRUE mode="character" width=20
sticky="" padx=0 pady=0
```

Arguments

name.....	name (required) of the R variable that will receive the selected choices from either values or choices
values	vector of values to populate the drop-down selection; if NULL the values are taken from the R object named in choices
choices	name of an R character vector object where elements will be the choices to populate the drop-down selection; if NULL the values are taken from the character vector specified by names
labels	if supplied, labels is a vector with the same length as values, and is used as the contents of the drop-down list; however, values are return by getWinVal
selected.....	the index of the pre-selected item in drop-down list
add.....	if TRUE, the user can type in any text in addition to selecting a pre-defined item
font.....	font for drop-down list items – specify family (Times, Helvetica, or Courier), size (as point size), and style (bold, italic, underline, overstrike), in any order
fg	colour for drop-down list items
bg	background colour for widget
function.....	R function to call when the entry is changed
enter.....	if TRUE, call the function only after the <Enter> key is pressed when add=TRUE; enter=FALSE, is not implemented.
action	string value associated whenever this widget is engaged
edit.....	if TRUE, the selected item can be changed by the user; if FALSE, the selected value is read-only and no other items can be selected
mode.....	R mode for the value entered, where valid modes are: numeric, integer, complex, logical, character
width.....	character width to reserve for the droplist
sticky	option for placing the widget in its available space, as discussed in the introductory paragraphs for Appendix A on page 37
padx.....	space used to pad the widget on the left and right; two values can be used to specify padding on the left and right separately
pady.....	space used to pad the widget on the top and bottom; two values can be used to specify padding on the top and bottom separately

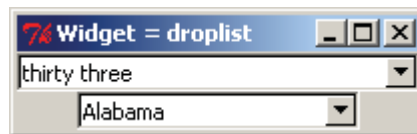
Note

To facilitate retrieving the index of the selected item, two additional variables are created by suffixing ".id" and ".values" to the given name. The "name.id" variable is only returned by `getWinVal`; the "name.values" variable can be retrieved with `getWinVal`, and can be set with `setWinVal` to change the selectable values dynamically after window creation.

Limitation: when `setWinVal` is used to modify the droplist "name.values", the labels are reset to NULL

Example

```
window title="Widget = droplist"
droplist name=junk values="one two 'thirty three'" mode=character
      selected=3 width=30
droplist name=punk choices=state.name
```



Entry

Description

A field in which a scalar variable (number or string) can be altered.

Usage

```
type=entry name value="" width=20 label=NULL font="" fg="" bg=""
      entryfont="" entryfg="black" entrybg="white" noeditfg="black"
      noeditbg="gray" edit=TRUE password=FALSE function=""
      enter=TRUE action="entry" mode="numeric" sticky="" padx=0
      pady=0
```

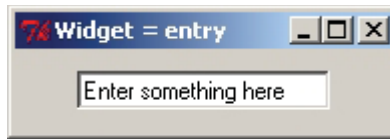
Arguments

name.....name of R variable corresponding to this entry (required)
value.....default value to display in the entry
width.....character width to reserve for the entry
label.....text to display above the entry box
font.....font for labels – specify family (Times, Helvetica, or Courier), size
 (as point size), and style (bold, italic, underline, overstrike), in
 any order
fgcolour for label fonts
bgbackground colour for widget

entryfont.....font of entries appearing in input/output boxes
entryfgfont colour of entries appearing in input/output boxes
entrybgbackground colour of input/output boxes
noeditfgfont colour of input/output boxes when edit=FALSE
noeditbgbackground colour of input/output boxes when edit=FALSE
edit.....if TRUE, the entry value can be modified by the user; otherwise, the value is read-only
password.....if TRUE, the value displayed in the GUI is masked with asterisks (****) to protect sensitive information; otherwise, the value is displayed as normal text
function.....R function to call when the entry is changed
enter.....if TRUE, call the function only after the <Enter> key is pressed
actionstring value associated whenever this widget is engaged
mode.....R mode for the value entered, where valid modes are:
 numeric, integer, complex, logical, character
stickyoption for placing the widget in its available space, as discussed in the introductory paragraphs for Appendix A on page 37
padx.....space used to pad the widget on the left and right; two values can be used to specify padding on the left and right separately
pady.....space used to pad the widget on the top and bottom; two values can be used to specify padding on the top and bottom separately

Example

```
window title="Widget = entry"  
entry name=junk value="Enter something here" width=20 mode=character
```



Grid

Description

Creates space for a rectangular block of widgets. Spaces must be filled. Widgets can be any combination of available widgets, including grid.

Usage

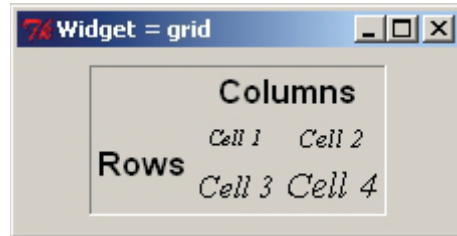
```
type=grid nrow=1 ncol=1 toptitle="" sidetitle="" topfont=""
      sidefont="" topfg=NULL sidefg=NULL fg="black" topbg=NULL
      sidebg=NULL bg="" byrow=TRUE borderwidth=1 relief="flat"
      sticky="" padx=0 pady=0
```

Arguments

nrow.....number of rows in the grid
ncol.....number of columns in the grid
toptitle.....title to place above grid
sidetitle.....title to place on the left side of the grid
topfontfont for top labels – specify family (Times, Helvetica, or Courier),
size (as point size), and style (bold, italic, underline,
overstrike), in any order
sidefontfont for side labels – specify family (Times, Helvetica, or Courier),
size (as point size), and style (bold, italic, underline,
overstrike), in any order
topfg.....colour for top title font
sidefgcolour for side title font
fgcolour for both top and side title fonts if topfg and sidefg are NULL
topbg.....background color of the top title
sidebgbackground color of the side title
bgbackground colour of grid including top and side titles when topbg and
sidebg are NULL
byrow.....if TRUE, create widgets across rows, otherwise down columns
borderwidthwidth of the border around the grid
relieftype of border around the grid, where valid styles are:
raised, sunken, flat, ridge, groove, solid
stickyoption for placing the widget in its available space, as discussed in the
introductory paragraphs for Appendix A on page 37
padx.....space used to pad the widget on the left and right; two values can be used
to specify padding on the left and right separately
pady.....space used to pad the widget on the top and bottom; two values can be
used to specify padding on the top and bottom separately

Example

```
grid 2 2 relief=groove toptitle=Columns sidetitle=Rows \  
topfont="Helvetica 12 bold" sidefont="Helvetica 12 bold" \  
label text="Cell 1" font="times 8 italic" \  
label text="Cell 2" font="times 10 italic" \  
label text="Cell 3" font="times 12 italic" \  
label text="Cell 4" font="times 14 italic"
```



History

Description

Allows the user to manage a temporary archive (history) of widget settings (records) through a panel of buttons:

<<	Go directly to the first record of the history.
<	Go to the previous record in the history.
>	Go to the next record in the history.
>>	Go directly to the last record in the history.
Sort	Sort the order of the records in the history.
<i>n</i>	Display window (white background) shows the current record.
<i>N</i>	Display window (grey background) shows total number of records in the history.
Empty	Remove all records from the history.
Insert	Add a new record (current widget settings) to the history, either before, after or overtop the current record.
Delete	Remove the current record from the history.
Import	Import a previously saved history (text file) to the history, either before or after the current record.
Export	Export the history to a text file.

Usage

```
type=history name="default" function="" import="" fg="black" bg="" \  
entryfg="black" entrybg="white" text=NULL textsize=0 sticky="" \  
padx=0 pady=0
```

Arguments

name.....	name of history archive
function.....	R function to call when the history record counter is changed
import	file name of a saved history to load when the widget is called

fgcolour for label fonts
bgbackground colour for widget
entryfgfont colour of entries appearing in input/output boxes
entrybgbackground colour of input/output boxes
textembed a text box for captions in the widget; the location of the text box is controlled by one of the following values: N, E, S, W or NULL for none
textsizesize of text box to display; if text=N or S, textsize controls the height; if text=E or W, the width is adjusted
stickyoption for placing the widget in its available space, as discussed in the introductory paragraphs for Appendix A on page 37
padxspace used to pad the widget on the left and right; two values can be used to specify padding on the left and right separately
padyspace used to pad the widget on the top and bottom; two values can be used to specify padding on the top and bottom separately

Example

```
window title="Widget = history"
vector length=3 names="alpha beta gamma" values="2 5 15"
history padx=20 pady=5
```



Image

Description

Embeds a graphics image in the current window. Support for GIF files only.

Usage

```
type=image file=NULL varname=NULL subsample=1 sticky="" padx=0
pady=0
```

Arguments

filefilename and path (if required) of GIF image to embed
varnameinterpret the value of an R variable, identified by varname, as the filename of the image to embed; only one of the file or varname arguments can be supplied


```
include file=child.txt

# child.txt contents:
window title="include - child"
vector name="a b c d e"
```



Label

Description

Creates a text label. If the `text` argument is left blank, `label` emulates the `null` widget.

Usage

```
type=label text="" name="" mode="character" font="" fg="black" bg=""
      sticky="" justify="left" anchor="center" wraplength=0 width=0
      padx=0 pady=0
```

Arguments

`text`.....text to display in the label

`name`.....name of R variable corresponding to the label value; if `name=""`, label is static and cannot be changed with `setWinVal`

`mode`.....R mode for the label value where valid modes are:
numeric, integer, complex, logical, character

`font`.....font for labels – specify family (Times, Helvetica, or Courier), size (as point size), and style (bold, italic, underline, overstrike), in any order

`fg`.....colour for label fonts

`bg`.....background colour for widget

`sticky`.....option for placing the widget in its available space, as discussed in the introductory paragraphs for Appendix A on page 37

`justify`.....if there are multiple lines, then text is aligned to the left, center, or right.

`anchor`.....if a width is specified, anchor the text to the one of n, ne, e, se, s, sw, w, nw, or center locations of the widget. "w" for example, would anchor the text on the left side of the widget.

`wraplength`.....maximum number of characters to fit per line; text which is longer is split over multiple lines.

`width`.....width of the label widget

`padx`.....space used to pad the widget on the left and right; two values can be used to specify padding on the left and right separately

`pady`.....space used to pad the widget on the top and bottom; two values can be used to specify padding on the top and bottom separately

Example

```
window title="Widget = label"
label text="Information Label"
```



Matrix

Description

An aligned set of entry fields for all components of a matrix. If the mode is logical, the matrix appears as a set of check boxes that can be turned on or off using mouse clicks.

Usage

```
type=matrix nrow ncol names rowlabels="" collabels="" rownames=""
             colnames="" font="" fg="black" bg="" entryfont=""
             entryfg="black" entrybg="white" noeditfg="black"
             noeditbg="gray" values="" byrow=TRUE function="" enter=TRUE
             action="matrix" edit=TRUE mode="numeric" width=6 borderwidth=0
             sticky="" padx=0 pady=0
```

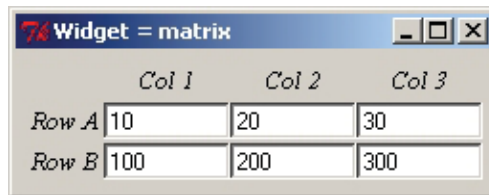
Arguments

`nrow`.....number of rows (required)
`ncol`.....number of columns(required)
`names`.....either one name or a set of `nrow*ncol` names used to store the matrix in R (required)
`rowlabels`.....one of NULL, a single label, or a vector of `nrow` labels. The NULL label displays no labels and minimizes space. A single label displays a label to the left of the widget, and numbers each row (an empty label "" only numbers each row). A vector of `nrow` labels is used to specify a label for each row.
`collabels`.....one of NULL, a single label, or a vector of `ncol` labels. The NULL label displays no labels and minimizes space. A single label displays a label above the widget, and numbers each column (an empty label "" only numbers each column). A vector of `ncol` labels is used to specify a label for each column.
`rownames`string scalar or vector of length `nrow` to name the rows of the matrix
`colnames`string scalar or vector of length `ncol` to name the columns of the matrix
`font`.....font for labels – specify family (Times, Helvetica, or Courier), size (as point size), and style (bold, italic, underline, overstrike), in any order

fgcolour for label fonts
bgbackground colour for widget
entryfontfont of entries appearing in input/output boxes
entryfgfont colour of entries appearing in input/output boxes
entrybgbackground colour of input/output boxes
noeditfgfont colour of entries appearing in input/output boxes when edit=FALSE
noeditbgbackground colour of input/output boxes when edit=FALSE
valuesdefault values (either one value for all matrix components or a set of
nrow*ncol values)
byrowif TRUE and nrow*ncol names are used, interpret the names by row;
otherwise by column. Similarly, interpret nrow*ncol initial values.
functionR function to call when any entry in the matrix is changed
enterif TRUE, call the function only after the <Enter> key is pressed
actionstring value associated whenever this widget is engaged
editif TRUE, matrix value can be modified by the user; if FALSE, the matrix is
read-only
modeR mode for the matrix, where valid modes are:
numeric, integer, complex, logical, character
widthcharacter width to reserve for the each entry in the matrix
borderwidthwidth of the border around the matrix widget
stickyoption for placing the widget in its available space, as discussed in the
introductory paragraphs for Appendix A on page 37
padxspace used to pad the widget on the left and right; two values can be used
to specify padding on the left and right separately
padyspace used to pad the widget on the top and bottom; two values can be
used to specify padding on the top and bottom separately

Example

```
window title="Widget = matrix"
matrix nrow=2 ncol=3 rowlabels="'Row A' 'Row B'" \
      collabels="'Col 1' 'Col 2' 'Col 3'" names="a b c d e f" \
      values="10 20 30 100 200 300" font="times 10 italic"
```



Menu

Description

A menu grouping. Submenus can either be menu or menuitem.

Usage

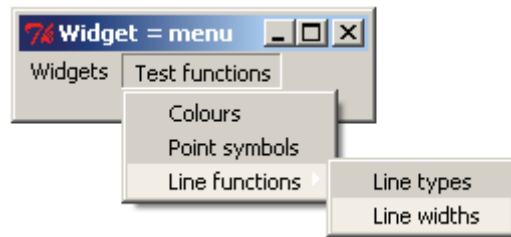
```
type=menu nitems=1 label font="" fg="" bg=""
```

Arguments

nitemsnumber of items or submenus to include in the menu
label.....text to display as the menu label (required)
font.....font for labels – specify family (Times, Helvetica, or Courier), size (as point size), and style (bold, italic, underline, overstrike), in any order
fgcolour for menu fonts (only applicable for sub-menus)
bgbackground colour for menu (only applicable for sub-menus)

Example (assuming that the R functions have been defined)

```
window title="Widget = menu"  
menu nitems=1 label="Widgets"  
  menuitem label="Show arguments" func=showArgs  
menu nitems=3 label="Test functions"  
  menuitem label="Colours" func=testCol  
  menuitem label="Line types" func=testLty  
menu nitems=2 label="Line functions"  
  menuitem label="Line widths" func=testLwd  
  menuitem label="Point symbols" func=testPch
```



MenuItem

Description

One of nitems following a menu command.

Usage

```
type=menuitem label font="" fg="" bg="" function action="menuitem"
```

Arguments

label.....text to display as the menu item label (required)
font.....font for labels – specify family (Times, Helvetica, or Courier), size (as point size), and style (bold, italic, underline, overstrike), in any order
fgcolour for menu item fonts

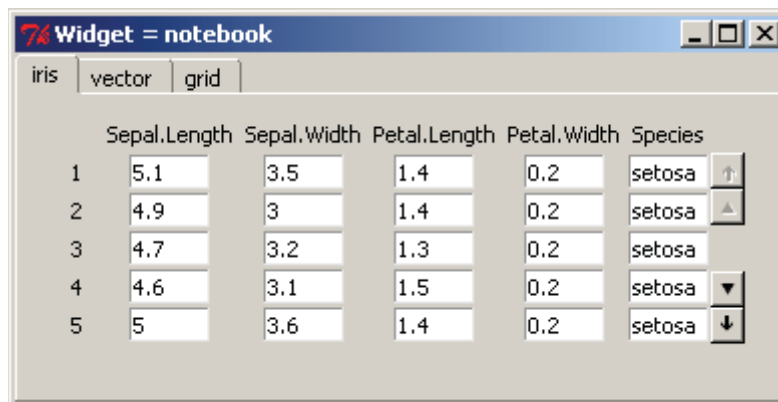
heightheight of the notebook
homogeneousif TRUE, all tabs have the same width, otherwise, each tab has a width determined by the length of the tab name
arcradius.....an integer in the range 0 to 8, specifying the rounding effect of the tab corners
tabbevelsize ...an integer in the range 0 to 8, specifying the amount of bevel the tabs should have; 0 effectively draws a rectangle, otherwise tabs have a trapezoidal look
function.....R function to call when a page is raised by selecting a tab
actionstring value associated whenever this widget is engaged
stickyoption for placing the widget in its available space, as discussed in the introductory paragraphs for Appendix A on page 37
padx.....space used to pad the widget on the left and right; two values can be used to specify padding on the left and right separately
pady.....space used to pad the widget on the top and bottom

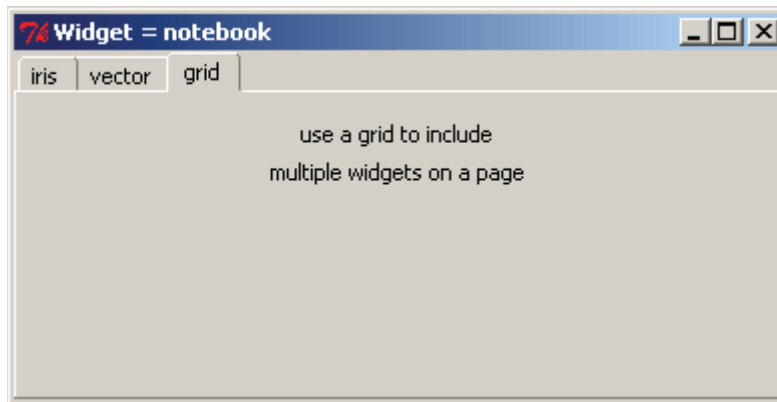
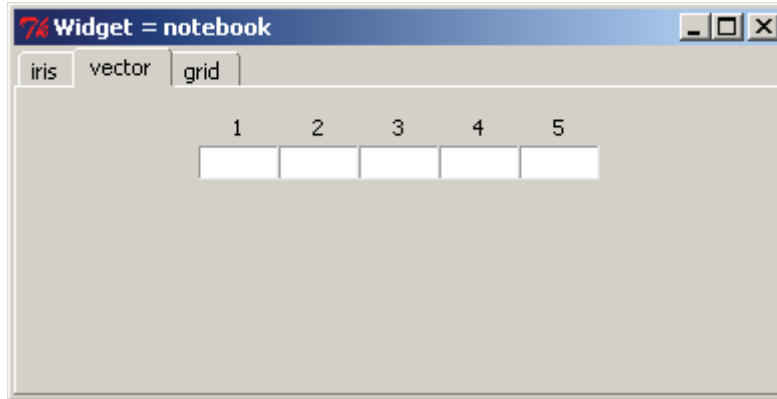
Note

Colour support is limited due to the underlying Tk/Tcl library implementation. It is not possible to specify colours for the tab font or background.

Example

```
window title="Widget = notebook"
notebook tabs="iris vector grid" name=nb width=380 height=150
  object iris rowshow=5
  vector length=5 name=vec
  grid 2 1
    label "use a grid to include"
    label "multiple widgets on a page"
```





Null

Description

Creates a null widget, useful for padding a grid with blank cells that appear as empty space.

Usage

```
type=null bg="" padx=0 pady=0
```

Arguments

bgbackground colour

padx.....space used to pad the widget on the left and right; two values can be used
to specify padding on the left and right separately

pady.....space used to pad the label on the top and bottom

Example

```
grid 2 2 relief=raised toptitle=Top sidetitle=Side \  
topfont="Courier 10 bold" sidefont="courier 10 bold"  
label text="Here" font="courier 8"  
null  
null  
label text="There" font="courier 8"
```



Object

Description

A widget that represents the R-object specified – a vector becomes a vector widget, a matrix becomes a matrix widget, and a data frame becomes a data widget.

Usage

```
type=object name rowshow=0 font="" fg="black" bg="" entryfont=""
  entryfg="black" entrybg="white" noeditfg="black"
  noeditbg="gray" vertical=FALSE collabels=TRUE rowlabels=TRUE
  function="" enter=TRUE action="data" edit=TRUE width=6
  borderwidth=0 sticky="" padx=0 pady=0
```

Arguments

name.....name of object (vector, matrix, or data frame) to convert to a widget
(required)

rowshownumber of rows to display on the screen; if rowshow=0 or
rowshow>=rows (name) then all rows will be displayed

font.....font for labels – specify family (Times, Helvetica, or Courier), size
(as point size), and style (bold, italic, underline, overstrike), in
any order

fgcolour for label fonts

bgbackground colour for widget

entryfontfont of entries appearing in input/output boxes

entryfgfont colour of entries appearing in input/output boxes

entrybgbackground colour of input/output boxes

noeditfgfont colour of entries appearing in input/output boxes when edit=FALSE

noeditbgbackground colour of input/output boxes when edit=FALSE

verticalonly applicable when the R-object is a vector; if TRUE , display the vector
as a vertical column with labels on the left; otherwise display it as a
horizontal row with labels above

collabels.....if TRUE, display the object's column names, if FALSE, no column labels
are displayed

rowlabels.....if TRUE, display the object's row names, if FALSE, no row labels are
displayed

function.....R function to call when any entry in the vector is changed

enter.....if TRUE, call the function only after the <Enter> key is pressed

actionstring value associated whenever this widget is engaged

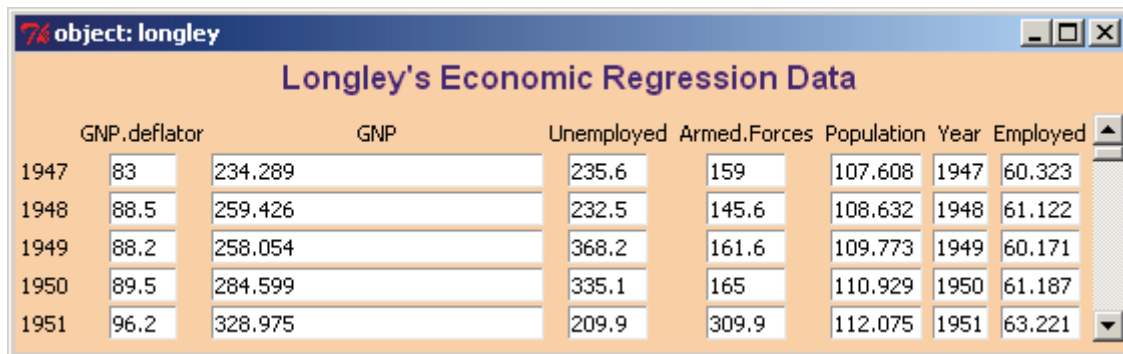
edit.....if TRUE, the object's values can be changed by the user; otherwise, the values are read-only
width.....character width to reserve for the each entry in the vector
borderwidth.....width of the border around the text box
stickyoption for placing the widget in its available space, as discussed in the introductory paragraphs for Appendix A on page 37
padx.....space used to pad the widget on the left and right; two values can be used to specify padding on the left and right separately
pady.....space used to pad the widget on the top and bottom; two values can be used to specify padding on the top and bottom separately

Note

When scrolling is enabled, the up, down, page up, and page down keys can be used to scroll. The keys are only enabled when some entry box in the object is selected.

Example

```
window bg="#ffd2a6" title="Object: longley"
label text="Longley\'s Economic Regression Data" font="bold 12" \
      fg="#400080" pady=0 sticky=S
object name=longley rowshow=5 width="5 27 6 6 7 4 6" pady=5
```



	GNP.deflator	GNP	Unemployed	Armed.Forces	Population	Year	Employed
1947	83	234.289	235.6	159	107.608	1947	60.323
1948	88.5	259.426	232.5	145.6	108.632	1948	61.122
1949	88.2	258.054	368.2	161.6	109.773	1949	60.171
1950	89.5	284.599	335.1	165	110.929	1950	61.187
1951	96.2	328.975	209.9	309.9	112.075	1951	63.221

Progressbar

Description

A progress indicator widget. The progressbar status can be animated by updating the widget state using `setWinVal`.

Usage

```
type=progressbar name value=0 maximum=100 style="normal" width=NULL
height=NULL vertical=FALSE fg=NULL bg=NULL relief="sunken"
borderwidth=2 sticky="" padx=0 pady=0
```

Arguments

name.....name of the progressbar
value.....initial value of the widget variable
maximum.....the maximum value of the widget variable (must be greater than zero)
style.....one of normal, incremental, infinite or
nonincremental_infinite

if normal, a bar is displayed within a framed area with length proportional to value scaled to maximum. Updates of the widget state using setWinVal adjust the bar length to the passed positive value

if incremental, the widget behaves like the normal style with one exception: the positive value passed with setWinVal is added to the bar length rather than being used to set the bar length

if infinite, a bar segment is displayed within a framed area. Updating of the bar value using setWinVal advances the bar segment first from left to right and then from right to left by the specified positive integer increment.

if nonincremental_infinite, the widget behaves like the infinite style with one exception: the positive integer value passed with setWinVal is used to set the position of the bar segment. The bar segment moves from left to right if variable value (modulo maximum) is less than maximum/2 and from right to left if value is greater than maximum/2

width.....the width of the progressbar widget
heightthe height of the progressbar widget
verticalif TRUE, orient the progressbar vertically starting at the bottom for zero, moving upwards until maximum is reached, otherwise, orient the widget horizontally and move from left to right
fgforeground colour of the progress indicator
bgbackground colour for widget
relieftype of border around the text, where valid styles are:
raised, sunken, flat, ridge, groove, solid
borderwidthwidth of the border around the widget
stickyoption for placing the widget in its available space, as discussed in the introductory paragraphs for Appendix A on page 37
padx.....space used to pad the widget on the left and right; two values can be used to specify padding on the left and right separately
pady.....space used to pad the widget on the top and bottom; two values can be used to specify padding on the top and bottom separately

Note

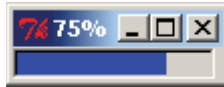
Animation of the progressbar widget to indicate the state of ongoing calculations can be achieved by repeated calls to `setWinVal` that reference the progressbar name.

If the value set with `setWinVal` is negative the progressbar is not displayed (i.e., it is hidden by drawing it “flat” using the background color), if the value is 0, the progressbar is reinitialized. Positive values work as described by the style argument and `infinite` and `nonincremental_infinite` styles only accept integers.

Run the `testWidgets()` function and select "progressbar" for an example of how to programmatically manipulate the progressbar widget for each of the style options.

Example

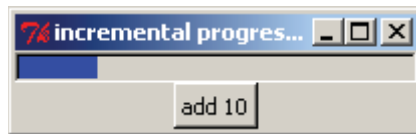
```
window title="75%"
progressbar name=status fg=blue value=0.75 maximum=1.0
```



```
window title="infinite"
progressbar name=status style=infinite fg=blue value=80
```



```
window title="incremental progressbar"
progressbar name=status style=incremental \
    value=20 maximum=100 fg=blue width=200
button text="add 10" function=doAction \
    action=setWinVal(c(status=10))
```



Radio

Description

One of a set of mutually exclusive radio buttons for making a particular choice. Buttons with the same value for name act collectively to define a single choice among the alternatives.

Usage

```
type=radio name value text="" font="" fg="black" bg="" function=""
action="radio" edit=TRUE mode="numeric" selected=FALSE
sticky="" padx=0 pady=0
```

Arguments

name.....name of R variable altered by this radio button, where radio buttons with the same name define a mutually exclusive set (required)

value.....value of the variable when this radio button is selected (required)

text.....identifying text placed to the right of this radio button

font.....font for labels – specify family (Times, Helvetica, or Courier), size (as point size), and style (bold, italic, underline, overstrike), in any order

fgcolour for label fonts

bgbackground colour for widget

function.....R function to call when this radio button is selected

actionstring value associated whenever this widget is engaged

edit.....if TRUE, the selected radio options can be changed; otherwise, the radio values are read-only

mode.....R mode for the value associated with this button, where valid modes are: numeric, integer, complex, logical, character

selected.....if TRUE, the radio button is selected (switched on)

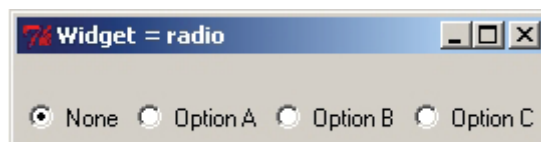
stickyoption for placing the widget in its available space, as discussed in the introductory paragraphs for Appendix A on page 37

padx.....space used to pad the widget on the left and right; two values can be used to specify padding on the left and right separately

pady.....space used to pad the widget on the top and bottom; two values can be used to specify padding on the top and bottom separately

Example

```
window title="Widget = radio"
grid 1 4
  radio name=junk value=0 text="None"
  radio name=junk value=1 text="Option A"
  radio name=junk value=2 text="Option B"
  radio name=junk value=3 text="Option C"
```



Slide

Description

A slide bar that sets the value of a variable. This widget only accepts integer values.

Usage

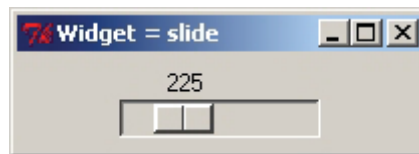
```
type=slide name from=0 to=100 value=NA showvalue=FALSE
orientation="horizontal" font="" fg="black" bg="" function=""
action="slide" sticky="" padx=0 pady=0
```

Arguments

name.....name of the numeric R variable corresponding to this slide bar (required)
from.....minimum value of the variable (must be an integer)
to.....maximum value of the variable (must be an integer)
value.....initial slide value, where the default is the specified from value
showvalue.....if TRUE, display the current slide value above the slide bar
orientation.....direction for orienting the slide bar: horizontal or vertical
font.....font for labels – specify family (Times, Helvetica, or Courier), size
(as point size), and style (bold, italic, underline, overstrike), in
any order
fg.....colour for label fonts
bg.....background colour for widget
function.....R function to call when the slide value is changed
action.....string value associated whenever this widget is engaged
sticky.....option for placing the widget in its available space, as discussed in the
introductory paragraphs for Appendix A on page 37
padx.....space used to pad the widget on the left and right; two values can be used
to specify padding on the left and right separately
pady.....space used to pad the widget on the top and bottom; two values can be
used to specify padding on the top and bottom separately

Example

```
window title="Widget = slide"
slide name=junk from=1 to=1000 value=225 showvalue=T
```



SlidePlus

Description

An extended slide bar that also displays a minimum, maximum, and current value. This widget accepts real numbers.

Usage

```
type=slideplus name from=0 to=1 by=0.01 value=NA font="" fg="black"
      bg="" entryfont="" entryfg="black" entrybg="white" function=""
      enter=FALSE action="slideplus" sticky="" padx=0 pady=0
```

Arguments

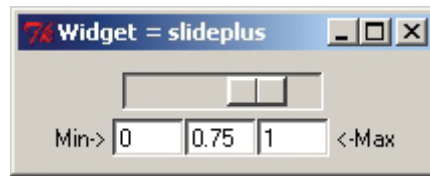
name.....	name of the numeric R variable corresponding to this slide bar (required)
from.....	minimum value of the variable
to.....	maximum value of the variable
by.....	minimum amount for changing the variable's value
value.....	initial slide value, where the default is the specified from value
font.....	font for min/max labels – specify family (Times, Helvetica, or Courier), size (as point size), and style (bold, italic, underline, overstrike), in any order
fg.....	colour for min/max label fonts
bg.....	background colour for widget
entryfont.....	font for entry widgets – specify family (Times, Helvetica, or Courier), size (as point size), and style (bold, italic, underline, overstrike), in any order
entryfg.....	colour for entry widget fonts
entrybg.....	background colour for entry widgets
function.....	R function to call when the slide value is changed
enter.....	if TRUE, call the function only after the <Enter> key is pressed while the focus is within one of the text boxes
action.....	string value associated whenever this widget is engaged
sticky.....	option for placing the widget in its available space, as discussed in the introductory paragraphs for Appendix A on page 37
padx.....	space used to pad the widget on the left and right; two values can be used to specify padding on the left and right separately
pady.....	space used to pad the widget on the top and bottom; two values can be used to specify padding on the top and bottom separately

Note

To facilitate retrieving and setting the minimum and maximum values, two additional variables are created by suffixing ".max" and ".min" to the given name.

Example

```
window title="Widget = slideplus"
slideplus name=junk from=0 to=1 by=0.01 value=0.75
```

Spinbox

Description

A field in which a scalar variable can be incremented or decremented by a fixed value within a range of values.

Usage

```
type=spinbox name from to by=1 value=NA label="" font="" fg="black"
             bg="" entryfont="" entryfg="black" entrybg="white" function=""
             enter=TRUE edit=TRUE action="spinbox" width=20 sticky=""
             padx=0 pady=0
```

Arguments

name.....name of the R variable containing the text (required)
from.....minimum value of the variable
tomaximum value of the variable
byminimum amount for changing the variable's value
value.....initial value; if NA, set the initial value to from
label.....text to display to the right of this spinbox
font.....font for labels – specify family (Times, Helvetica, or Courier), size
 (as point size), and style (bold, italic, underline, overstrike), in
 any order
fgcolour for label fonts
bgbackground colour for label
entryfont.....font for labels – specify family (Times, Helvetica, or Courier), size
 (as point size), and style (bold, italic, underline, overstrike), in
 any order
entryfgcolour for spinbox entry value and arrows
entrybgbackground colour for spinbox
function.....R function to call when the slide value is changed
enter.....if TRUE, call the function only after the <Enter> key is pressed while the
 focus is within the text box
edit.....if TRUE, the value can be changed by the user; otherwise, the value is
 read-only
actionstring value associated whenever this widget is engaged
width.....character width to reserve for the entry

`sticky`option for placing the widget in its available space, as discussed in the introductory paragraphs for Appendix A on page 37

`padx`space used to pad the widget on the left and right; two values can be used to specify padding on the left and right separately

`pady`space used to pad the widget on the top and bottom; two values can be used to specify padding on the top and bottom separately

Note

The values of the `spinbox` can be adjusted up and down with the up and down arrows on the keyboard.

Example

```
window title="Widget = spinbox"
spinbox name=spun from=0 to=100 by=12.5 value=50 label="Showcase
showdown" bg=lightyellow font=bold entryfg=purple
```



Table

Description

A spreadsheet-like widget that can display and edit data in tabular format.

Usage

```
type=table name rowshow=0 font="" fg="black" bg="white" rowlabels=""
collabels="" function="" action="table" edit=TRUE width=10
sticky="" padx=0 pady=0
```

Arguments

`name`name of object (vector, matrix, or data frame) to convert to a widget (required)

`rowshow`number of rows to display on the screen; if `rowshow=0` then the table height is maximized and the number is determined automatically

`font`font for labels – specify family (Times, Helvetica, or Courier), size (as point size), and style (bold, italic, underline, overstrike), in any order

`fg`colour for label fonts

`bg`background colour for widget

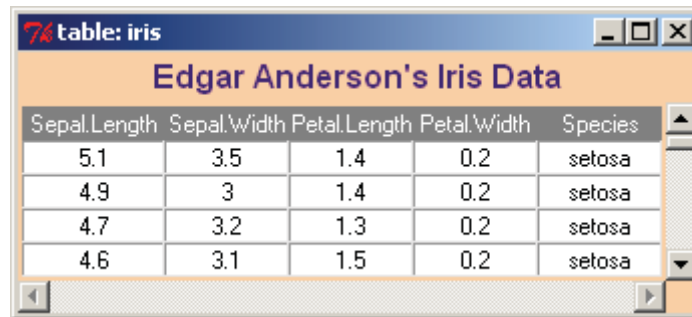
`rowlabels`a vector of `nrow` labels used to label rows; if `rowlabels=""`, then the object's row names are used; if `NULL`, no labels are displayed

`collabels`a vector of `ncol` labels used to label columns; if `collabels=""`, then the object's column names are used; if `NULL`, no labels are displayed

function.....R function to call when any entry in the vector is changed
actionstring value associated whenever this widget is engaged
edit.....if TRUE, the object's values can be changed by the user; otherwise, the values are read-only
width.....character width to reserve for the each entry; if a vector of widths is given, then each element corresponds to a different column
stickyoption for placing the widget in its available space, as discussed in the introductory paragraphs for Appendix A on page 37
padx.....space used to pad the widget on the left and right; two values can be used to specify padding on the left and right separately
pady.....space used to pad the widget on the top and bottom; two values can be used to specify padding on the top and bottom separately

Example

```
window bg="#fffd2a6" title="table: iris"
label text="Longley\'s Economic Regression Data" font="bold 12" \
fg="#400080" pady=0 sticky=S
table name=iris rowshow=5 rowlabels=NULL
```



Sepal.Length	Sepal.Width	Petal.Length	Petal.Width	Species
5.1	3.5	1.4	0.2	setosa
4.9	3	1.4	0.2	setosa
4.7	3.2	1.3	0.2	setosa
4.6	3.1	1.5	0.2	setosa

Text

Description

An information text box that can display messages, results, or whatever the user desires. The displayed information can be either fixed or editable.

Usage

```
type=text name height=8 width=30 edit=FALSE scrollbar=TRUE
fg="black" bg="white" mode="character" font="" value=""
borderwidth=1 relief="sunken" sticky="" padx=0 pady=0
```

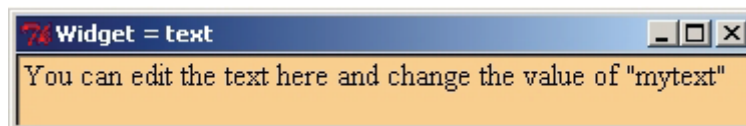
Arguments

name.....name of the R variable containing the text (required)
heighttext box height
width.....text box width
edit.....if TRUE, the user can edit the value stored in name

scrollbar.....if TRUE, a scroll bar is added to the right of the text box
fgcolour for label fonts
bgbackground colour specified in hexadecimal format; e.g.,
 rgb(255,209,143,maxColorValue=255) yields "#FFD18F"
mode.....R mode for the value associated with this widget, where valid modes are:
 numeric, integer, complex, logical, character
font.....font for labels – specify family (Times, Helvetica, or Courier), size
 (as point size), and style (bold, italic, underline, overstrike), in
 any order
value.....default value to display in the text
borderwidthwidth of the border around the text box
relieftype of border around the text, where valid styles are:
 raised, sunken, flat, ridge, groove, solid
stickyoption for placing the widget in its available space, as discussed in the
 introductory paragraphs for Appendix A on page 37
padx.....space used to pad the widget on the left and right; two values can be used
 to specify padding on the left and right separately
pady.....space used to pad the widget on the top and bottom; two values can be
 used to specify padding on the top and bottom separately

Example

```
window title="Widget = text"
text name=mytext height=2 width=55 bg="#FFD18F" font="times 11"
  borderwidth=1 relief="sunken" edit=TRUE \
  value="You can edit text here & change value of \"mytext\""
```



Vector

Description

An aligned set of entry fields for all components of a vector. If the mode is logical, the vector appears as a set of check boxes that can be turned on or off using mouse clicks.

Usage

```
type=vector names length=0 labels="" values="" vecnames="" font=""  
  fg="black" bg="" entryfont="" entryfg="black" entrybg="white"  
  noeditfg="black" noeditbg="gray" vertical=FALSE function=""  
  enter=TRUE action="vector" edit=TRUE mode="numeric" width=6  
  borderwidth=0 sticky="" padx=0 pady=0
```

Arguments

names.....either one name (for a whole vector) or a vector of names for individual variables used to store the values in R (required)

lengthrequired only if a single name is given for a vector of length greater than 1

labelsone of "", NULL, a single label, or a vector of length labels. The "" label uses the value of names as labels, if names only contains a single name, then elements are numbered. The NULL label displays no labels and minimizes space. A single label displays a label for the entire widget, and numbers elements. A vector of labels displays a label for each element of the array.

valuesdefault values (either one value for all vector components or a vector of length values)

vecnamesstring vector of length length to name the scalars or vector

fontfont for labels – specify family (Times, Helvetica, or Courier), size (as point size), and style (bold, italic, underline, overstrike), in any order

fgcolour for label fonts

bgbackground colour for widget

entryfontfont of entries appearing in input/output boxes

entryfgfont colour of entries appearing in input/output boxes

entrybgbackground colour of input/output boxes

noeditfgfont colour of entries appearing in input/output boxes when edit=FALSE

noeditbgbackground colour of input/output boxes when edit=FALSE

verticalif TRUE, display the vector as a vertical column with labels on the left; otherwise display it as a horizontal row with labels above

functionR function to call when any entry in the vector is changed

enterif TRUE, call the function only after the <Enter> key is pressed

actionstring value associated whenever this widget is engaged

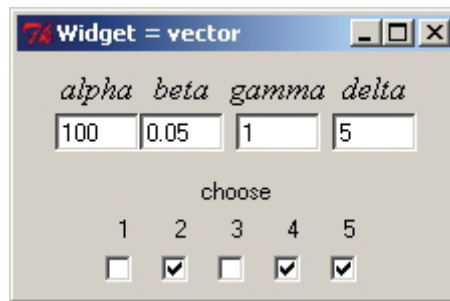
editif TRUE, the vector's values can be changed by the user; otherwise, the values are read-only

modeR mode for the vector, where valid modes are:
numeric, integer, complex, logical, character

`width`.....character width to reserve for the each entry in the vector
`borderwidth`.....a non-negative value specifying the amount of space to use for drawing a border (or margin) around the widget; the background colour of the space is determined by the `bg` value
`sticky`option for placing the widget in its available space, as discussed in the introductory paragraphs for Appendix A on page 37
`padx`.....space used to pad the widget on the left and right; two values can be used to specify padding on the left and right separately
`pady`.....space used to pad the widget on the top and bottom; two values can be used to specify padding on the top and bottom separately

Example

```
window title="Widget = vector"
vector length=4 names="a b g d" labels="alpha beta gamma delta" \
    values="100 0.05 1 5" font="times italic" width=6
vector length=5 mode=logical names=chosen labels=choose \
    values="F T F T T"
```



Appendix B. Talk description files

This appendix specifies the structure and syntax for talk description files discussed in Section 6. Formally, such a file contains the five code elements listed there. A valid file must have one root `<talk>` element that contains one or more `<section>` elements. One `<talk>` element defines the root and the name of the corresponding GUI. This can include one or more `<section>` elements. Each `<section>` contains a mixture of the three *primitive* elements `<text>`, `<file>`, and `<code>`. These primitive elements occur in isolation; they cannot contain any other elements. Thus, we support only two levels of nesting: sections within a talk and primitives within a section. (Think of a talk root with section branches and primitive leaves.)

When `presentTalk()` runs a description file, it produces a control GUI like the one shown in Figure 5. Any declared `<section>`s, or `<file>`s automatically generate menu items in the GUI. These links can also appear as buttons within columns of the GUI’s lower section. By default, `<section>` buttons appear in the first column, and `<file>` buttons in the second column, although an author can overwrite these defaults. In this way, a talk description file allows an author to design both the talk’s content and the GUI used to present it.

Some tags allow the presentation to break at specified places. Specifically, a break produces a message in the R console indicating that the speaker must press the “Go” button in the GUI to continue on to the next step of the presentation. During a break, the speaker can spontaneously type code into the R console to illustrate points of immediate interest. A conceptual *slide* consists of all material between one break and the next.

We end this appendix with a precise description of the purpose and syntax for each code element. Instead of alphabetical order, we use the more logical order: `<talk>`, `<section>`, `<text>`, `<file>`, and `<code>`. In particular, we identify the arguments (also called *attributes* in the XML literature) that are supported in the initial tag.

`<talk> ... </talk>`

Description

A code element that constitutes a talk

Usage

`<talk name=(required)>`

Arguments

name.....A string giving the name of the talk (required). It appears as the title of the control GUI. It must start with a letter and contain only alphanumeric characters and underscores.

Notes

A file must have exactly one `<talk>` element that contains at least one `<section>` element.

<section> ... </section>

Description

A code element that defines a section of a talk

Usage

```
<section name=(required) button="FALSE" col="1">
```

Arguments

name.....A string giving the name of the section (required). It appears in the control GUI as a menu item (under “Sections”) and possibly also as a button. It must start with a letter and contain only alphanumeric characters and underscores.

buttonA Boolean variable (TRUE or FALSE) that determines whether or not the GUI should add a button that selects the section, in addition to access by the menu.

colIf a button is used, the column within which to place it in lower section of the GUI.

Notes

A <talk> must include at least one <section>, and each section must have a unique name. Although a <talk> tag is commonly followed by a <section> tag (the first section), this may not always be true. See the description of <file> below.

<text> ... </text>

Description

A primitive that specifies text to be printed (displayed) on the R console

Usage

```
<text break="TRUE">
```

Arguments

break.....A Boolean value (TRUE or FALSE) that specifies whether or not to break the presentation after displaying the text specified.

Notes

Line breaks in the description file correspond to line breaks in the displayed text. Keep lines short enough that they will fit into the R console with the large font size required for presentation (Section 6).

<file> ... </file>

Description

A primitive that specifies files to be opened by the operating system with `openFile()`

Usage

```
<file name=(required) button="FALSE" col="2" break="TRUE">
```

Arguments

name.....A string giving the name for this group of files (required). It appears in the control GUI as a menu item (under “Files”) and possibly also as a button. It must start with a letter and contain only alphanumeric characters and underscores.

buttonA Boolean variable (TRUE or FALSE) that determines whether or not the GUI should add a button that opens this group of files, in addition to the available menu item.

colIf a button is used, the column within which to place it in lower section of the GUI.

break.....A Boolean value (TRUE or FALSE) that specifies whether or not to break the presentation after opening the group of files.

Notes

File names between `<file>` and `</file>` must appear as individual strings (separated by spaces or line breaks) that are suitable arguments for `openFile()`. Files without explicit paths are presumed to lie in the user’s working directory. As usual, the operating system must have an associated application or the **PBSmodelling** options must be set to associate extensions and applications (Sections 2.3 and 5.1 above).

Although a speaker may commonly introduce only one file at a time, it can sometimes be convenient to open several files in a single step. For example, they may all appear in a single text editor window, with tabs for selecting individual files.

If a `<file>` element appears between `<talk>` and the talk’s first `<section>`, the file group name will be added to the talk’s GUI. However, because the segment doesn’t belong to any section, it will not cause files to be opened at this point. The feature allows files to become part of a talk without having to open them at an explicit point.

<code> ... </code>

Description

A primitive that specifies R code to be executed on the R console

Usage

```
<code show="TRUE" print="TRUE" break="print">
```

Arguments

- `show`.....A Boolean value (TRUE or FALSE) that specifies whether or not to show the code snippet in the R console. If shown, each line of the intended code will be prefixed by the usual R command prompt “> ”.
- `print`.....A Boolean value (TRUE or FALSE) that specifies whether or not to print the results of running the R code.
- `break`.....A string (`show`, `print`, `all`, or `none`) describing where to introduce breaks in the code segment:
- `show` – break only after showing the R code;
 - `print` – break only after printing the results;
 - `all` – break after showing the R code and again after printing the results;
 - `none` – do not break during this code segment.

Notes

The text between `<code>` and `</code>` normally consists of valid R code, although a speaker may choose to demonstrate the consequences of invalid code.

Line breaks in the text correspond to individual lines of R code. Keep lines short enough that they will fit into the R console with the large font size required for presentation, as discussed in Section 6.

Implementing a `<code>` element involves a **two-step process**. First, if `show=TRUE`, the code is shown on the R console. Second, regardless of argument settings, the code is executed. If `print=TRUE`, the results are printed on the R console. Notice particularly that **code execution takes place in the second step**.

The `break` argument acts independently from the `show` and `print` arguments. For example, an author might use both `print=FALSE` and `break=print` if the R calculation takes notable time and produces extensive output that should be suppressed. In this case, the break would indicate that the calculation is complete. Similarly, the arguments `show=FALSE` and `break=show` allow an author to suppress the display of a large block of R code, but still to introduce a break before the code is executed.

* Reminder: XML characters must be ‘escaped’ (i.e., ‘<’ becomes ‘<’). Since this is ugly, users will probably want to wrap code with `<![CDATA[...]]>`

Appendix C. Building PBSmodelling and other packages

The R project defines a standard for creating a package of functions, data, and documentation. You can obtain a comprehensive guide to “Writing R Extensions” (R Development Core Team 2011b, `R-exts.pdf`) from the CRAN web site or the R GUI (see the References above). Ligges (2003) and Ligges and Murdoch (2005) provide useful introductions. We have designed **PBSmodelling** and a very simple enclosed package **PBStr** as prototypes for package development. This Appendix summarizes the steps needed to:

- C.1. install the required software;
- C.2. build **PBSmodelling** from source materials;
- C.3. write source materials for a new package and compile them;
- C.4. include C code in a package.

Our discussion applies only to package development on a computer running Microsoft Windows 2000, XP, or (maybe) later. We particularly highlight issues that have proved troublesome for us. The R library directory `PBSmodelling\PBStools` contains batch files that can assist the process. For example, you might locate this directory as `C:\Utils\R\R-2.15.3\library\PBSmodelling\PBStools`.

C.1. Installing required software

Building R packages requires four pieces of free software. Duncan Murdoch currently maintains their availability and installation instructions at:

<http://www.murdoch-sutherland.com/Rtools/>

Users should periodically check this website for changes to the various software packages. We recommend installing each package on a path that does *not* include spaces. For example, avoid using `C:\Program Files`, even if that happens to be part of a package’s default path. In this appendix, we use `C:\Utils` as a root directory for all required software. The list below gives a brief summary of the required software (Murdoch provides links to these products).

1. **R** itself, currently version 2.15.3 (`C:\Utils\R\R-2.15.3`). We assume that R is already installed from the CRAN web site <http://cran.r-project.org/> and that it runs correctly on your computer. (See ‘Upgrading to the latest version of R’ below.) We also assume that the package **PBSmodelling** is installed in R.
2. **Rtools installer**: Command line tools, GCC compilers, etc. (`C:\Utils\Rtools\`). Download and run the file `Rtools30.exe`. The installation should create the subdirectories `\bin` for command line programs and `\gcc-4.6.3` for the GNU C compiler for Windows. These tools are *essential*. DO NOT plan to use programs with the same name in an installation of Cygwin or any other UNIX emulator that happens to be installed on your computer.
3. **MiKTeX**: a LaTeX and pdftex package (`C:\Utils\MiKTeX`). The link takes the user to <http://www.miktex.org/>. This processor for TeX and LaTeX files helps typeset help files within a package. Download the “basic” installation file, and install these components only. You can add more LaTeX packages from the Internet later, as required. (MiKTeX often does

this automatically.) Take some time to investigate the MiKTeX package manager (`mpm.exe` or go to the “Programs” menu and select “MiKTeX 2.9”, “Browse Packages”).

We recommend enhancing MiKTeX slightly, so that it can independently process the LaTeX files produced from R documentation files.

- a) Create a new subdirectory `\R` under the MiKTeX’s directory for storing LaTeX styles and font definitions (e.g., `C:\Utils\MiKTeX\tex\latex`).
- b) Copy into it all files from `\texmf` in the R installation tree (e.g., `C:\WinApps\R\R-2.15.2\share\texmf`). These should include `Rd.sty`.
- c) Go to the “Start” menu, select “Programs” then “MiKTeX 2.9”, and run the program “Settings”. In the “General” tab, click the button marked “Refresh FNDB”. This refreshes MiKTeX’s file name database, so that it recognizes files in the new `\R` subdirectory.

Every user has a preferred editor; however, if you are still using `Notepad.exe`, you may wish to explore the freely available, open-source software called **Notepad++** available at <http://notepad-plus-plus.org/>. **Notepad++** is described as “a free (as in ‘free speech’ and also as in ‘free beer’) source code editor ... that supports several languages.” Alternatively, the text editor **WinEdt** (available from <http://www.winedt.com/>) provides a convenient GUI for editing LaTeX files and operating MiKTeX. Combined with the R package `RWinEdt`, it can also serve as an editor and interface for R. However, it is available only as shareware that requires a fee for long-term use, unlike any other software mentioned here.

Upgrading to the latest version of R

1. Download the new `R-x.y.z` binary from a local CRAN mirror, such as the one at SFU: <http://cran.stat.sfu.ca/bin/windows/base/>
2. Uninstall the old version `R-a.b.c` (`<Start>`, `<Programs>`, `<R>`, `<Uninstall R-a.b.c>`). If you cannot find an uninstall program in the `<Programs>` menu, use the Control Panel in the usual way (slightly different between Windows XP and Windows VISTA).
3. Install the new version `R-x.y.z` to a new folder. Our default would be:
`C:\Utils\R\R-x.y.z\`
4. Find the library files for both versions of R in the directories:
`C:\Utils\R\R-a.b.c\library\`
`C:\Utils\R\R-x.y.z\library\`
Copy all subdirectories (packages) from version `a.b.c` to version `x.y.z`; but press `<Shift><No>` to avoid overwriting packages just installed as part of the new version. You want to copy the optional packages, but not those that come with the standard installation.
5. Run the new GUI for `R-x.y.z`. From the menu, click `<Packages>`, `<Update packages ...>`, select a local mirror, and wait for any installed packages to be updated. To stay current, repeat this update step every week or two.
6. Remove the old R installation directory (`C:\Utils\R\R-a.b.c\`).

At the time of writing, the program to uninstall `R-a.b.c` has a small bug, because it does not actually remove all of the packages that come with the base distribution.

PBStools for building R packages

After the above pieces of software are installed, you're ready to start building R packages. For this purpose, create a new directory (e.g., `D:\Rdevel\`) that will contain your packages. Within the R library directory (`C:\Utils\R\R-2.15.3\library\`), find the subdirectory `PBSmodelling\PBStools` (not to be confused with the R package `PBStools`). Copy all the batch files there into your new packages directory. You should have these 11 files:

- `RPaths.bat`, `RPathCheck.bat` related to the installation;
- `unpackPBS.bat`, `checkPBS.bat`, `buildPBS.bat`, `packPBS.bat`, related to **PBSmodelling**;
- `Runpack.bat`, `Rcheck.bat`, `Rbuild.bat`, `Rpack.bat`, `RmakePDF.bat` related to the construction of new packages.

IMPORTANT: You need to change `RPaths.bat` so that it reflects the paths you chose in the above six installations. For example, your version of this batch file might contain the lines

```
set R_PATH=C:\Utils\R\R-2.15.3\bin\i386
or
set R_PATH=C:\Utils\R\R-2.15.3\bin\x64
set TOOLS_PATH=C:\Utils\Rtools\bin
set GCC_PATH=C:\Utils\Rtools\gcc-4.6.3\bin
set TEX_PATH=C:\Utils\MiKTeX\miktex\bin
```

Notice that each path, except `R_Path`, ends in a `bin` subdirectory.

Hopefully, your installation is now complete. In your new packages directory, run `RPathCheck.bat` from a command line or double-click the icon. This script verifies that a few essential files lie on the indicated paths. If everything is correct, you should see the message “All program paths look good”. Otherwise, you’ll see a warning about software that doesn’t appear on your specified paths.

If you view all the batch files with a text editor, you will see that they don’t use your system `PATH` environment variable. Instead, each one defines a new local path appropriate for building R packages (via `RPathCheck.bat`). A `SETLOCAL` command ensures that this change doesn’t alter your system’s permanent environment.

C.2. Building PBSmodelling

Once all the required software is installed, the batch files discussed above make it fairly easy to build **PBSmodelling**. We assume that you have already created the directory discussed in Appendix C.1, say `D:\Rdevel`, for building R packages and that it contains the relevant eight batch files. In particular, `RPaths.bat` should reflect your installation paths and `RPathCheck.bat` should report the message that “All program paths look good”. Then follow these steps:

1. On the CRAN web site <http://cran.r-project.org/>, go to “Packages” on the left and find **PBSmodelling**. Download the file `PBSmodelling_x.xx.tar.gz` into `D:\Rdevel`. Then rename this file (or copy it and rename the copy) so that the version number is removed. You should now have the file `PBSmodelling.tar.gz` in `D:\Rdevel`.
2. In the development directory `D:\Rdevel`, double-click the icon for `unpackPBS.bat` or type the command `unpackPBS` in a corresponding command window. This should extract the contents of `PBSmodelling.tar.gz`, preserving directory structure, into a subdirectory `\PBSmodelling` with five subdirectories: `\data`, `\inst`, `\man`, `\R`, and `\src`.
3. Our batch file uses the command `tar -xzf PBSmodelling.tar.gz`, where `tar.exe` appears in the `\Rtools` directory (Section C.1, step 3). The command line parameters specify a verbose (`v`) extraction (`x`) of the given file (`f`), after filtering with `gzip` (`z`).

If you use other software for this extraction, please ensure that it is configured to handle UNIX files correctly. For example, “WinZip” has an option to extract a “TAR file with smart CR/LF conversion”. This must be turned off.
4. In the base directory `D:\Rdevel`, double-click the icon for `checkPBS.bat` or type the command `checkPBS` in a corresponding command window. If all software is installed correctly and `D:\Rdevel\PBSmodelling` correctly represents the contents of the `.tar.gz` file, you should see a series of DOS messages reporting “OK” to various tests. A distinct pause might accompany the message: “checking whether package 'PBSmodelling' can be installed ...”.
5. You might also encounter a delay as MiKTeX downloads the LaTeX package `lmodern`, part of a larger package `lm`. If this is really slow, you can abort the process and install `lm` with the MiKTeX package manager, as discussed in step 5 of Section C.1. Choose a remote server near you. You only need to do this once. When it’s finished, run `checkPBS.bat` again.
6. Examine the new directory `D:\Rdevel\PBSmodelling.Rcheck` created by the `check` process in step 2. The text files `00check.log` and `00install.out` show detailed results.
7. In the base directory `D:\Rdevel`, double-click the icon for `buildPBS.bat` or type the command `buildPBS` in a corresponding command window. This creates the file `D:\Rdevel\PBSmodelling.zip`, which could be used to install **PBSmodelling** from a local zip file.
8. Again in the base directory `D:\Rdevel`, double-click the icon for `packPBS.bat` or type the command `packPBS` in a corresponding command window. This creates a new package distribution file `PBSmodelling_x.xx.tar.gz` that replaces the one downloaded from CRAN in step 1.
9. Finally, type the command `RmakePDF PBSmodelling` in a command window for `D:\Rdevel`. This generates an indexed documentation file `PBSmodelling.pdf`. See Appendix D.2 for further details about the use of this file for producing this report.

If these steps all work without problems, you can feel confident that the requisite software is installed correctly and that you understand the basic steps needed to build R packages.

C.3. Creating a new R package

R packages require a special directory structure. The R function `package.skeleton` automatically creates this structure, but (without further work) it does not produce a package that can be compiled. Although `PBSmodelling` has the requisite structure, it is perhaps too complicated to serve as a convenient prototype. For this reason, we include a small subset **PBStr** that illustrates the key details. You can make a new package simply by editing the files in **PBStr**. You need a suitable editor (e.g., Notepad++, WinEdt, or UltraEdit) to view and change various text files.

1. Start by locating the file `PBStr_x.xx.tar.gz` in the R library directory `\PBSmodelling\PBStools`. Copy this file into your development directory (`D:\Rdevel`), and rename it (or copy and rename the copy) to obtain the file `PBStr.tar.gz`.
2. Remove any previous traces of **PBStr** in your development directory, such as subdirectories `PBStr`, `PBStr.Rcheck`, and `.Rd2pdf$`, along with the documentation file `PBStr.pdf`.
3. Follow steps similar to those in Section C.2 to unpack, check, build, re-package, and document **PBStr**. You must now use a DOS command window in `D:\Rdevel` to issue the five commands
`Runpack PBStr`
`Rcheck PBStr`
`Rbuild PBStr`
`Rpack PBStr`
`RmakePDF PBStr`
which invoke the batch files `Runpack.bat`, `Rcheck.bat`, `Rbuild.bat`, `Rpack.bat` and `RmakePDF.bat`. The first command should give you a new subdirectory `\PBStr`, along with its five subdirectories: `\data`, `\inst`, `\man`, `\R`, and `\src`.
4. Use your editor to open the file `DESCRIPTION` in the root directory `\PBStr`. This file, essential in every R package, contains key information in a special format (RDCT 2011b, Section 1.1.1). The following example illustrates a minimal set of required fields.
5.

```
Package: MyPack
Version: 1.00
Date: 2008-12-31
Title: My R Package
Author: User of PBS Modelling
Maintainer: User of PBS Modelling
Depends: R (>= 2.6.0)
Description: My customized R functions
License: GPL (>= 2)
```
6. The package name in `DESCRIPTION` must agree with the directory name in which this file lies. For example, if you change `PBStr` to `MyPack` in `DESCRIPTION` and rename the directory from `\PBStr` to `\MyPack`, you have effectively changed the package name.

Similarly, if you change the version to 1.01, you have effectively changed the version number that appears in the file names for distributing your package.

7. The subdirectory `\PBStry\R` contains all R code used by the package. For example, **PBStry** includes seven R functions (`calcFib`, `calcFib2`, `calcGM`, `calcSum`, `findPat`, `pause`, and `view`). The seven files could be combined into a single file (such as `PBStry.R`), but we use separate files here for clarity. The functions all have relatively simple code, hopefully comprehensible to users with limited R experience. Five of them come from **PBSmodelling**. Three of them (`calcFib`, `calcFib2`, `calcSum`) call compiled C code, as we discuss more completely in Section C.4 below.
8. By convention, the distinct file `zzz.r` defines code for initializing the package. In this case the function `.First.lib`, calls `library.dynam` to load a dynamic link library (`PBStry.dll`) created from compiled C code during the build process.
9. When a version number changes, the `DESCRIPTION` file must be changed accordingly. We also like to make a corresponding change in `zzz.r`, so that the version number appears on the R console when the library is loaded. **PBStry** illustrates this possibility for `zzz.r`.
10. The subdirectory `\PBStry\data` contains all data objects that come with the package. Here, the binary file `QBR.rda` holds a matrix of quillback rockfish (*Sebastes maliger*) sample data used in the CCA example above (Section 7.2.3). The same data matrix is called `CCA.qbr.hl` in **PBSmodelling**.
11. If you want to add data to a new package, first create the object (e.g., `myData`) in R and then execute the command:

```
save(myData, file="myData.rda")
```

The object name must match the prefix in the file name, and the suffix must be `.rda`. Include the resulting file in your package's `\data` subdirectory.
12. The subdirectory `\PBStry\man` contains a documentation file for every object in the package. **PBStry** has six functions and one data set, so the `\man` subdirectory has seven corresponding R documentation files (`*.Rd`). An additional file `PBStry.Rd` documents the package as a whole. `Rd` files use a rather complex scripting language (RDCT 2011b, Section 2) that can be converted to help files in several formats (PDF, HTML, text). For many packages, the examples in **PBStry** may provide adequate prototypes. They represent three distinct cases: functions (e.g., `calcGM.Rd`, `findPat.Rd`), data sets (`QBR.Rd`), and complete packages (`PBStry.Rd`).
13. The subdirectory `\PBStry\src` contains source code for C code to be compiled into the dynamic link library `PBStry.dll`. We include sample files to calculate Fibonacci numbers iteratively (`fib.c`, `fib2.c`) and to add the components of a numeric vector (`sum.c`). In Section C.4, we discuss the linkage between R code and compiled C functions.
14. Finally, the subdirectory `\PBStry\inst` contains files that are to be included directly in the R library tree for **PBStry** when the package is installed. The file `PBStry-Info.txt` briefly describes the context and purpose of the trial package.

If you have successfully followed the steps above, you have actually built two R packages, **PBSmodelling** and **PBStry**. Furthermore, you're reasonably familiar with the contents

of **PBStry**. You can use the files in that small package as prototypes for writing your own R package, which might contain R code in the subdirectory `\R`, data in `\data`, C source code in `\src`, and R documentation in `\man`.

The larger package **PBSmodelling** offers more prototypes and uses a somewhat different style. The main directory includes the required `DESCRIPTION` file, plus a second file `NAMESPACE` that lists all objects available to a user of the package. Effectively, the namespace mechanism distinguishes between objects provided by the package and other (hidden) objects required for the implementation, but not intended for public use. Our `NAMESPACE` file contains the rather cryptic instruction: `exportPattern("^^[^\\.]")`. The R string `"^[^\\.]"` translates to the regular expression `^[^\\.]` that designates any pattern not starting with a period (`.`). We also export “dot” objects (with names in R that start with a period) using explicit patterns, for example: `exportPattern("^\\.\\.add")`. The `NAMESPACE` file must also import functions required from other packages. Because **PBSmodelling** relies on **tccltk**, the file includes the command: `import(tccltk)`.

In **PBStry**, without a namespace, the file `zzz.r` defines the initializing function `.First.lib`, as mentioned in step 8 above. By contrast, the namespace protocol in **PBSmodelling** requires a different name for the initializing function: `.onLoad` in `zzz.r`. Note that all R packages now require a `NAMESPACE` file.

In summary, we recommend building a new package by editing, adding, and deleting prototype files in **PBStry**. Our batch files can facilitate tests and debugging. For more advanced work, particularly packages with a namespace protocol, look at **PBSmodelling**. Have a current version of RDCT (2011b) available, and consult that manual when necessary. We find it useful to keep the PDF file open and to use Acrobat’s search feature (Ctrl-F) to find topics of interest.

C.4. Embedding C code

R provides two functions, `.C()` and `.Call()`, for invoking compiled C code. **PBStry** includes two simple examples that use `.C()`, probably the method of choice for simple packages. The `.Call()` function uses a more complex interface that offers better support for R objects, and another example illustrate that calling convention.

Table C1. C representations of R data types.

R Object	C Type
logical	int *
integer	int *
double	double *
complex	Rcomplex * ¹
character	char **

¹ Rcomplex is defined in `Complex.h`.

Calling C functions from R using `.C()`

The `.C()` calling convention uses the following key concepts:

- R must allocate the appropriate length and type of variables before calling a C function.
- R objects are transformed into an equivalent C type (Table C1), and a pointer to the value is passed into the C function. All values are returned by modifying the original values passed in.
- A C function called by `.C()` must have return type `void`, because values are returned only by accessing the predefined R function arguments.
- C code written for the shared DLL must not contain a `main` function.
- Within a C function, dynamically allocated memory must be de-allocated by the programmer before the function returns. Otherwise a memory leak will likely occur.
- `.C()` returns a list similar to the `'...'` list of arguments passed in, but reflecting any changes made by the C code. (See the help file for `.C`)

The function `calcFib` in **PBStr** illustrates an application of these concepts (Table C2). The R function uses C code to calculate the first `n` Fibonacci numbers iteratively, where a vector holds the last `len` numbers calculated. After ensuring that `n` and `len` satisfy obvious constraints, the R code creates a return array `retArr` of the appropriate length. The `.C` call passes `n`, `len`, and `retArr` by reference to the C function `fibonacci`. On exit, the vector `out` contains a list corresponding to the input variables `n`, `len`, and `retArr`, so that the third component `out[[3]]` holds the modified vector of values calculated by `fibonacci`. We encourage you also to examine a second example in **PBStr**, associated the files `calcSum.R` and `sum.c`.

Table C2. Two text files associated with a `.C()` call in **PBStry**. R code in the first file calls C code in the second.

File 1: calcFib.R

```
calcFib <- function(n, len=1) {  
  if (n<0) return(NA);  
  if (len>n) len <- n;  
  retArr <- numeric(len);  
  out <- .C("fibonacci", as.integer(n), as.integer(len),  
            as.numeric(retArr), PACKAGE="PBStry")  
  x <- out[[3]]  
  return(x) }
```

File 2: fib.c

```
void fibonacci(int *n, int *len, double *retArr) {  
  double xa=0, xb=1, xn=-1; int i,j;  
  /* iterative loop */  
  for(i=0;i<=*n;i++) {  
    /* initial conditions: fib(0)=0, fib(1)=1 */  
    if (i <= 1) { xn = i; }  
    /* fib(n) = fib(n-1) + fib(n-2) */  
    else {xn = xa + xb; xa = xb; xb = xn; }  
    /* save results if iteration i is within the range from n-len to n */  
    j = i - *n + *len - 1;  
    if (j >= 0) retArr[j] = xn;  
  } /* end loop */  
} /* end function */
```

Table C3. `.Call()` example adapted from **PBStry**, with two associated text files. R code in the first file calls C code in the second.

File 1: calcFib2.R

```
calcFib2 <- function(n, len=1) {  
  out <- .Call("fibonacci2", as.integer(n), as.integer(len),  
  PACKAGE="PBStry")  
  return(out) }
```

File 2: fib2.c

```
#include <R.h>  
#include <Rdefines.h>  
SEXP fibonacci2(SEXP sexp_n, SEXP sexp_len) {  
  /* ptr to output vector that we will create */  
  SEXP retVals;  
  double *p_retVals, xa=0, xb=1, xn;  
  int n, len, i, j;  
  /* convert R variables into C 'int's */  
  len = INTEGER_VALUE(sexp_len);  
  n = INTEGER_VALUE(sexp_n);  
  /* Allocate space for the output vector */  
  PROTECT(retVals = NEW_NUMERIC(len));  
  p_retVals = NUMERIC_POINTER(retVals);  
  /* iterative loop */  
  for(i=0; i<=n; i++) {  
    /* initial conditions: fib(0)=0, fib(1)=1 */  
    if (i <= 1) { xn = i; }  
    /* fib(n) = fib(n-1) + fib(n-2) */  
    else { xn = xa + xb; xa = xb; xb = xn; }  
    /* save results if iteration i is within the range from n-len to n */  
    j = i - n + len - 1;  
    if (j >= 0) p_retVals[j] = xn;  
  } /* end loop */  
  UNPROTECT(1);  
  return retVals;  
} /* end fibonacci2 */
```

Calling C functions from R using `.Call()`

The `.C()` convention requires a fairly simple conversion of R objects into C types (Table C1). By contrast, `.Call()` provides extra structure that enables C to handle R objects directly (RDCT 2011b, Section 4.7). This function uses “S-expression” `SEXP` types defined in `rinternals.h`, a file in the `\include` directory of the R installation. An `SEXP` pointer can reference any type of R object. The `.Call()` convention uses the following key concepts:

- C functions called by R must accept only `SEXP` typed arguments. These arguments should be treated as read only.
- Similarly, C functions called by R must have `SEXP` return types.
- The Programmer must protect R objects from the R garbage collector, and must release protected objects before the function terminates. R provides macros for this task.
- C code written for the shared DLL must not contain a `main` function.
- Within a C function, dynamically allocated memory must be de-allocated by the programmer before the function returns. Otherwise a memory leak will likely occur.

The function `calcFib2` in Table C3 illustrates an application of these concepts. As before, the R function uses C code to calculate the first `n` Fibonacci numbers iteratively, where a vector holds the last `len` numbers calculated. (To save space, we’ve removed R code that checks constraints on `n` and `len`). The simple `.Call` to `fibonacci2` looks very natural. Input values `n` and `len` produce the output vector `out`, where the C code must somehow determine what `out` should be. Not surprisingly, it requires more complicated C code to make this happen.

The C function `fibonacci2` (Table C3) first loads header files that include the required definitions from R. All input and output variables belong to type `SEXP`. Other internal variables have the standard C types `double` and `int`. Functions like `INTEGER_VALUE()` convert R types into C types. The `SEXP` vector `retVals` of return values is created by the R constructor `NEW_NUMERIC()` and then protected from garbage collection by `PROTECT()`. After all required variables are defined and type cast correctly, the iterative loop of calculations follows the earlier example in Table B2. Finally, the only protected vector `retVals` is released by `UNPROTECT(1)`, and the standard closing command `return retVals` returns the output vector from `fibonacci2`.

Obviously, it takes some time and effort to become familiar with the specialized R types, constructors, and conversion functions. For this reason, it’s probably easier at first to use `.C()`, rather than `.Call()`.

Appendix D. PBSmodelling functions and data

Section 1 of this appendix summarises the functions currently available in **PBSmodelling**. Additionally, there are possible hidden or ‘dot’ functions (not presented here) that reside in R’s `NAMESPACE`. These can be seen either using the triple colon convention on the command line (e.g., `PBSmodelling:::function`) or through our function `viewCode`, which gathers function code for a specified package installed on the user’s computer. (R also provides a utility called `fixInNamespace()` for modifying `NAMESPACE` objects.) Section 2 of this appendix details how a user can generate a standard R manual for **PBSmodelling**, that includes a Table of Contents, help pages for all objects, and an index. The manual itself is also appended.

D.1. Objects in PBSmodelling

<code>addArrows</code>	Add Arrows to a Plot Using Relative (0:1) Coordinates
<code>addHistory</code>	Create Structures for a New History Widget
<code>addLabel</code>	Add a Label to a Plot Using Relative (0:1) Coordinates
<code>addLegend</code>	Add a Legend to a Plot Using Relative (0:1) Coordinates
<code>backHistory</code>	Create Structures for a New History Widget
<code>calcFib</code>	Calculate Fibonacci Numbers by Several Methods
<code>calcGM</code>	Calculate the Geometric Mean, Allowing for Zeroes
<code>calcMin</code>	Calculate the Minimum of a User-Defined Function
<code>chooseWinVal</code>	Choose and Set a String Item in a GUI
<code>cleanProj</code>	Launch a GUI for Project File Deletion
<code>cleanWD</code>	Launch a GUI for File Deletion
<code>clearAll</code>	Remove all R Objects From the Global Environment
<code>clearHistory</code>	Create Structures for a New History Widget
<code>clearPBSext</code>	Clear File Extension Associations
<code>clearRcon</code>	Clear the R Console
<code>clearWinVal</code>	Remove all Current Widget Variables
<code>clipVector</code>	Clip a Vector at One or Both Ends
<code>closeWin</code>	Close GUI Window(s)
<code>compileC</code>	Compile a C File into a Shared Library Object
<code>compileDescription</code>	Convert and Save a Window Description as a List
<code>convSlashes</code>	Convert Slashes from UNIX to DOS
<code>createVector</code>	Create a GUI with a Vector Widget
<code>createWin</code>	Create a GUI Window
<code>declareGUIoptions</code>	Declare Option Names that Correspond with Widget Names
<code>doAction</code>	Execute Action Created by a Widget
<code>drawBars</code>	Draw a Linear Barplot on the Current Plot
<code>evalCall</code>	Evaluate a Function Call
<code>expandGraph</code>	Expand the Plot Area by Adjusting Margins
<code>exportHistory</code>	Export a Saved History
<code>findPat</code>	Search a Character Vector to Find Multiple Patterns
<code>findPrefix</code>	Find a Prefix Based on Names of Existing Files

findProgram.....Locates a program in the PATH environment variable
findSuffix.....Find a Prefix Based on Names of Existing Files
firstHistory.....Create Structures for a New History Widget
focusRgui.....Focus on the RGui Window
focusWin.....Set the Focus on a Particular Window
forwHistory.....Create Structures for a New History Widget
genMatrix.....Generate Test Matrices for plotBubbles
getChoice.....Choose One String Item from a List of Choices
getGUIOptions.....Get PBS Options for Widgets
getOptions.....get and set user options
getOptionsFileName.....get and set filename used for saving and loading of options
getOptionsPrefix.....get and set GUI prefix of options class
getPBSext.....Get a Command Associated With a File Name
getPBSoptions.....Retrieve A User Option
getWinAct.....Retrieve the Last Window Action
getWinFun.....Retrieve Names of Functions Referenced in a Window
getWinVal.....Retrieve Widget Values for Use in R Code
getYes.....Prompt the User to Choose Yes or No
GT0.....Restrict a Numeric Variable to a Positive Value
importHistory.....Import a History List from a File
initHistory.....Create Structures for a New History Widget
isWhat.....Identify an Object and Print Information
jumpHistory.....Create Structures for a New History Widget
lastHistory.....Create Structures for a New History Widget
lisp.....List Objects in .PBSmodEnv Workspace
loadC.....Launch a GUI for Compiling and Loading C Code
loadOptions.....save and load options to and from disk
loadOptionsGUI.....load and save options values to and from a GUI
lucent.....Convert Solid Colours to Translucence
openExamples.....Open Example Files from a Package
openFile.....Open a File with an Associated Program
openUG.....Open Package User Guide
packList.....Pack a List with Objects
pad0.....Pad Numbers with Leading Zeroes
parseWinFile.....Convert a Window Description File into a List Object
pause.....Pause Between Graphics Displays or Other Calculations
pickCol.....Pick a Colour From a Palette and get the Hexadecimal Code
plotACF.....Plot Autocorrelation Bars From a Data Frame, Matrix, or Vector
plotAsp.....Construct a Plot with a Specified Aspect Ratio
plotBubbles.....Construct a Bubble Plot from a Matrix
plotCsum.....Plot Cumulative Sum of Data
plotDens.....Plot Density Curves from a Data Frame, Matrix, or Vector
plotFriedEggs.....Render a Pairs Plot as Fried Eggs and Beer

plotSidebars.....Plot Table as Horizontal Sidebars
plotTrace.....Plot Trace Lines from a Data Frame, Matrix, or Vector
presentTalk.....Run an R Presentation
promptWriteOptionsPrompt the User to Write Changed Options
readList.....Read a List from a File in PBS Modelling Format
readPBSOptions.....Read PBS Options from an External File
resetGraph.....Reset par Values for a Plot
restorePar.....Get Actual Parameters from Scaled Values
rmHistory.....Create Structures for a New History Widget
runDemos.....Interactive GUI for R Demos
runExample.....Run a Single GUI Example Included with PBS Modelling
runExamples.....Run GUI Examples Included with PBS Modelling
saveOptions.....save and load options to and from disk
saveOptionsGUI.....load and save options values to and from a GUI
scalePar.....Scale Parameters to [0,1]
selectDir.....Display Dialogue: Select directory
selectFile.....Display Dialogue: Open or Save File
setFileOption.....Set a PBS File Path Option Interactively
setGUIOptions.....Set PBS Options from Widget Values
setOptions.....get and set user options
setOptionsFileNameget and set filename used for saving and loading of options
setOptionsPrefix.....get and set GUI prefix of options class
setPathOption.....Set a PBS Path Option Interactively
setPBSext.....Set a Command Associated with a File Name Extension
setPBSOptions.....Set A User Option
setwdGUI.....Browse for Working Directory and Optionally Find Prefix
setWidgetColor.....Update Widget Colour
setWidgetState.....Update Widget State
setWinAct.....Add a Window Action to the Saved Action Vector
setWinVal.....Update Widget Values
show0.....Convert Numbers into Text with Specified Decimal Places
showAlert.....Display a Message in an Alert Window
showArgs.....Display Expected Widget Arguments
showHelp.....Display HTML Help Pages for Packages in Browser
showPacks.....Show Packages Required But Not Installed
showRes.....Show Results of Expression Represented by Text
showVignettes.....Display Vignettes for Packages
sortHistory.....Sort an Active or Saved History
tcall.....Call Objects From Temporary Work Environment
testAlpha.....Test Various Alpha Transparency Values
testCol.....Display Named Colours Available Based on a Set of Strings
testLty.....Display Line Types Available
testLwd.....Display Line Widths

testPch.....	Display Plotting Symbols and Backslash Characters
testWidgets	Display Sample GUIs and their Source Code
tget	Get Objects From Temporary Work Environment
tprint	Print Objects From Temporary Work Environment
tput	Put Objects Into Temporary Work Environment
unpackList.....	Unpack List Elements into Variables
updateGUI	Update Active GUI With Local Values
view.....	View First/Last/Random n Elements/Rows of an Object
viewCode	View Package R Code
writeList	Write a List to a File in PBS Modelling Format
writePBSoptions.....	Write PBS Options to an External File

D.2. PBSmodelling manual

The following pages show the standard R manual for **PBSmodelling**, including help pages for all objects, a table of contents, and an index. This manual also appears on the CRAN web site:

<http://cran.r-project.org/web/packages/PBSmodelling/index.html>

To generate the pages that follow, the user should first ensure that R's style and font files have been copied to MiKTeX (see steps 5a-c in Section C.1). This enhancement may be necessary for the successful creation of a PDF manual.

Next we provide a batch file `RmakePDF.bat` to assist the user in building the manual. This method uses R's temporary latex output `Rd2.tex` and alters it using system and MiKTeX commands (e.g., `sed`, `latex`, `makeindex`, `dvips`, `ps2pdf`). The final result yields a PDF manual with letter-size (8.5" × 11") pages rather than A4, and page numbering beginning at a specified odd number to ensure that the next page becomes the front of a two-sided copy. Currently, R CMD `Rd2pdf` has no way to start page numbering at an arbitrary integer. (Note that the control file `Rd2dvi` has been removed by the CRAN mandarins.)

Method: On a command line, type the command:

```
RmakePDF PBSmodelling 89
```

which automatically generates the PDF manual `PBSmodelling.pdf` from the package's `*.Rd` files. Page numbering for this PDF begins with the number specified by the second argument of the above command. If the argument is not supplied, it defaults to 1.

The batch file issues the following command:

```
%R_PATH%\R CMD Rd2pdf --no-clean --no-preview %1
```

This command creates a temporary directory called `.Rd2pdfNNNN\` (where `NNNN` comprise an arbitrary set of four integers) containing `Rd2.tex` with the initial lines:

```
\documentclass[letterpaper]{book}
\usepackage[times,inconsolata,hyper]{Rd}
\usepackage{makeidx}
\usepackage[utf8,latin1]{inputenc}
\makeindex{}
\topmargin -0.25in \oddsidemargin 0in \evensidemargin 0in
\textheight 9in \textwidth 6.5in
\begin{document}
\setcounter{page}{89}
```

where a boldface red font indicates new lines added by `RmakePDF.bat` to the file `Rd2.tex` in the temporary folder. The altered `tex` file is saved as `PBSmodelling.tex` in the current working directory, and the following MiKTeX commands are issued:

```
latex -interaction=nonstopmode %1.tex
makeindex %1.idx
latex -interaction=nonstopmode %1.tex
makeindex %1.idx
latex -interaction=nonstopmode %1.tex
latex -interaction=nonstopmode %1.tex
dvips -q %1.dvi
ps2pdf %1.ps
```

The repetitive calls to `latex` and `makeindex` are a byproduct of a non-dynamic system where index references need to be updated several times. You should now have the PDF manual called `PBSmodelling.pdf`, which can be appended to the first 88 pages of this report.

The technique presented in this appendix can be applied to any package to produce a manual based on the `*.Rd` files. Readers may wish to go further and append their manual to more detailed instructions to produce a comprehensive User's Guide such as this one.

Package ‘PBSmodelling’

March 28, 2013

Version 2.65

Date 2013-03-27

Title GUI Tools Made Easy: Interact with Models, Explore Data, Give Dynamic Presentations

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Depends R (>= 2.15.0), methods, tcltk

Suggests PBSmapping, PBSddesolve, deSolve, KernSmooth, XML

Description PBS Modelling provides software to facilitate the design, testing, and operation of computer models. It focuses particularly on tools that make it easy to construct and edit a customized graphical user interface (GUI). Although it depends heavily on the R interface to the Tcl/Tk package, a user does not need to know Tcl/Tk. The package contains examples that illustrate models built with other R packages, including PBSmapping, deSolve, PBSddesolve, and BRugs. It also serves as a convenient prototype for building new R packages, along with instructions and batch files to facilitate that process. The R directory ‘.../library/PBSmodelling/doc’ offers a complete user guide PBSmodelling-UG.pdf. To use this package effectively, please consult the guide.

License GPL (>= 2)

URL <http://code.google.com/p/pbs-modelling/>, <http://code.google.com/p/pbs-tools/>

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addArrows

Add Arrows to a Plot Using Relative (0:1) Coordinates

Description

Call the arrows function using relative (0:1) coordinates.

Usage

```
addArrows(x1, y1, x2, y2, ...)
```

Arguments

x1	x-coordinate (0:1) at base of arrow.
y1	y-coordinate (0:1) at base of arrow.
x2	x-coordinate (0:1) at tip of arrow.
y2	y-coordinate (0:1) at tip of arrow.
...	additional parameters for the function arrows.

Details

Lines will be drawn from (x1[i],y1[i]) to (x2[i],y2[i])

Author(s)

Jon T. Schnute, Pacific Biological Station, Fisheries and Oceans Canada , Nanaimo BC

See Also

[addLabel](#), [addLegend](#)

Examples

```
local(envir=.PBSmodEnv,expr={
  oldpar = par(no.readonly=TRUE)
  tt=seq(from=-5,to=5,by=0.01)
  plot(sin(tt), cos(tt)*(1-sin(tt)), type="l")
  addArrows(0.2,0.5,0.8,0.5)
  addArrows(0.8,0.95,0.95,0.55, col="#FF0066")
  par(oldpar)
})
```

addLabel

Add a Label to a Plot Using Relative (0:1) Coordinates

Description

Place a label in a plot using relative (0:1) coordinates

Usage

```
addLabel(x, y, txt, ...)
```

Arguments

x	x-axis coordinate in the range (0:1); can step outside.
y	y-axis coordinate in the range (0:1); can step outside.
txt	desired label at (x,y).
...	additional arguments passed to the function text.

Author(s)

Jon T. Schnute, Pacific Biological Station, Fisheries and Oceans Canada, Nanaimo BC

See Also

[addArrows](#), [addLegend](#)

Examples

```
local(envir=.PBSmodEnv,expr={
  oldpar = par(no.readonly=TRUE)
  resetGraph()
  addLabel(0.75,seq(from=0.9,to=0.1,by=-0.10),c('a','b','c'), col="#0033AA")
  par(oldpar)
})
```

addLegend

Add a Legend to a Plot Using Relative (0:1) Coordinates

Description

Place a legend in a plot using relative (0:1) coordinates.

Usage

```
addLegend(x, y, ...)
```

Arguments

x	x-axis coordinate in the range (0:1); can step outside.
y	y-axis coordinate in the range (0:1); can step outside.
...	arguments used by the function legend, such as lines, text, or rectangle.

Author(s)

Jon T. Schnute, Pacific Biological Station, Fisheries and Oceans Canada, Nanaimo BC

See Also

[addArrows](#), [addLabel](#)

Examples

```
local(envir=.PBSmodEnv,expr={
  oldpar = par(no.readonly=TRUE)
  resetGraph()
  n <- sample(1:length(colors()),15); clr <- colors()[n]
  addLegend(.2,1,fill=clr,leg=clr,cex=1.5)
  par(oldpar)
})
```

calcFib

Calculate Fibonacci Numbers by Several Methods

Description

Compute Fibonacci numbers using four different methods: 1) iteratively using R code, 2) via the closed function in R code, 3) iteratively in C using the `.C` function, and 4) iteratively in C using the `.Call` function.

Usage

```
calcFib(n, len=1, method="C")
```

Arguments

<code>n</code>	nth fibonacci number to calculate
<code>len</code>	a vector of length <code>len</code> showing previous fibonacci numbers
<code>method</code>	select method to use: C, Call, R, closed

Value

Vector of the last `len` Fibonacci numbers calculated.

Author(s)

Jon T. Schnute, Pacific Biological Station, Fisheries and Oceans Canada, Nanaimo BC

calcGM

Calculate the Geometric Mean, Allowing for Zeroes

Description

Calculate the geometric mean of a numeric vector, possibly excluding zeroes and/or adding an offset to compensate for zero values.

Usage

```
calcGM(x, offset = 0, exzero = TRUE)
```

Arguments

x	vector of numbers
offset	value to add to all components, including zeroes
exzero	if TRUE, exclude zeroes (but still add the offset)

Value

Geometric mean of the modified vector $x + \text{offset}$

Note

NA values are automatically removed from x

Author(s)

Rowan Haigh, Pacific Biological Station, Fisheries and Oceans Canada, Nanaimo BC

Examples

```
local(envir=.PBSmodEnv,expr={
  calcGM(c(0,1,100))
  calcGM(c(0,1,100),offset=0.01,exzero=FALSE)
})
```

calcMin

Calculate the Minimum of a User-Defined Function

Description

Minimization based on the R-stat functions nlm, nlminb, and optim. Model parameters are scaled and can be active or not in the minimization.

Usage

```
calcMin(pvec, func, method="nlm", trace=0, maxit=1000, reltol=1e-8,
  steptol=1e-6, temp=10, repN=0, ...)
```

Arguments

pvec	Initial values of the model parameters to be optimized. pvec is a data frame comprising four columns ("val", "min", "max", "active") and as many rows as there are model parameters. The "active" field (logical) determines whether the parameters are estimated (T) or remain fixed (F).
func	The user-defined function to be minimized (or maximized). The function should return a scalar result.
method	The minimization method to use: one of nlm, nlminb, Nelder-Mead, BFGS, CG, L-BFGS-B, or SANN. Default is nlm.
trace	Non-negative integer. If positive, tracing information on the progress of the minimization is produced. Higher values may produce more tracing information: for method "L-BFGS-B" there are six levels of tracing. Default is 0.
maxit	The maximum number of iterations. Default is 1000.
reltol	Relative convergence tolerance. The algorithm stops if it is unable to reduce the value by a factor of reltol*(abs(val)+reltol) at a step. Default is 1e-8.
steptol	A positive scalar providing the minimum allowable relative step length. Default is 1e-6.
temp	Temperature controlling the "SANN" method. It is the starting temperature for the cooling schedule. Default is 10.
repN	Reports the parameter and objective function values on the R-console every repN evaluations. Default is 0 for no reporting.
...	Further arguments to be passed to the optimizing function chosen: nlm, nlminb, or optim. Beware of partial matching to earlier arguments.

Details

See optim for details on the following methods: Nelder-Mead, BFGS, CG, L-BFGS-B, and SANN.

Value

A list with components:

fout	The output list from the optimizer function chosen through method.
iters	Number of iterations.
evals	Number of evaluations.
cpuTime	The user CPU time to execute the minimization.
elapsedTime	The total elapsed time to execute the minimization.
fminS	The objective function value calculated at the start of the minimization.
fminE	The objective function value calculated at the end of the minimization.
Pstart	Starting values for the model parameters.
Pend	Final values estimated for the model parameters from the minimization.
AIC	Akaike's Information Criterion
message	Convergence message from the minimization routine.

Note

Some arguments to calcMin have no effect depending on the method chosen.

Author(s)

Jon T. Schnute, Pacific Biological Station, Fisheries and Oceans Canada, Nanaimo BC

See Also

[scalePar](#), [restorePar](#), [calcMin](#), [GT0](#)

In the stats package: [nlm](#), [nlminb](#), and [optim](#).

Examples

```
local(envir=.PBSmodEnv,expr={
  Ufun <- function(P) {
    Linf <- P[1]; K <- P[2]; t0 <- P[3]; obs <- afile$len;
    pred <- Linf * (1 - exp(-K*(afile$age-t0)));
    n <- length(obs); ssq <- sum((obs-pred)^2 );
    return(n*log(ssq)); };

  oldpar = par(no.readonly = TRUE)
  afile <- data.frame(age=1:16,len=c(7.36,14.3,21.8,27.6,31.5,35.3,39,
    41.1,43.8,45.1,47.4,48.9,50.1,51.7,51.7,54.1));
  pvec <- data.frame(val=c(70,0.5,0),min=c(40,0.01,-2),max=c(100,2,2),
    active=c(TRUE,TRUE,TRUE),row.names=c("Linf","K","t0"),
    stringsAsFactors=FALSE);
  alist <- calcMin(pvec=pvec,func=Ufun,method="nlm",steptol=1e-4,repN=10);
  print(alist[-1]); P <- alist$Pend;
  #resetGraph();
  expandGraph();
  xnew <- seq(afile$age[1],afile$age[nrow(afile)],len=100);
  ynew <- P[1] * (1 - exp(-P[2]*(xnew-P[3]))) );
  plot(afile); lines(xnew,ynew,col="red",lwd=2);
  addLabel(.05,.88,paste(paste(c("Linf","K","t0"),round(P,c(2,4,4)),
    sep=" " ),collapse="\n"),adj=0,cex=0.9);
  par(oldpar)
})
```

 CCA.qbr

Data: Sampled Counts of Quillback Rockfish (Sebastes maliger)

Description

Count of sampled fish-at-age for quillback rockfish (*Sebastes maliger*) in Johnstone Strait, British Columbia, from 1984 to 2004.

Usage

```
data(CCA.qbr)
```

Format

A matrix with 70 rows (ages) and 14 columns (years). Attributes “syrs” and “cyrs” specify years of survey and commercial data, respectively.

```
[,c(3:5,9,13,14)]    Counts-at-age from research survey samples
[,c(1,2,6:8,10:12)]  Counts-at-age from commercial fishery samples
```

All elements represent sampled counts-at-age in year. Zero-value entries indicate no observations.

Details

Handline surveys for rockfish have been conducted in Johnstone Strait (British Columbia) and adjacent waterways (126°37'W to 126°53'W, 50°32'N to 50°39'N) since 1986. Yamanaka and Richards (1993) describe surveys conducted in 1986, 1987, 1988, and 1992. In 2001, the Rockfish Selective Fishery Study (Berry 2001) targeted quillback rockfish *Sebastes maliger* for experiments on improving survival after capture by hook and line gear. The resulting data subsequently have been incorporated into the survey data series. The most recent survey in 2004 essentially repeated the 1992 survey design. Fish samples from surveys have been supplemented by commercial handline fishery samples taken from a larger region (126°35'W to 127°39'W, 50°32'N to 50°59'N) in the years 1984-1985, 1989-1991, 1993, 1996, and 2000 (Schnute and Haigh 2007).

Note

Years 1994, 1997-1999, and 2002-2003 do not have data.

Source

Fisheries and Oceans Canada - GFBio database:

http://www-sci.pac.dfo-mpo.gc.ca/sa-mfpd/statsamp/StatSamp_GFBio.htm

References

Berry, M.D. (2001) *Area 12 (Inside) Rockfish Selective Fishery Study*. Science Council of British Columbia, Project Number **FS00-05**.

Schnute, J.T. and Haigh, R. (2007) Compositional analysis of catch curve data with an application to *Sebastes maliger*. *ICES Journal of Marine Science* **64**, 218–233.

Yamanaka, K.L. and Richards, L.J. (1993) 1992 Research catch and effort data on nearshore reef-fishes in British Columbia Statistical Area 12. *Canadian Manuscript Report of Fisheries and Aquatic Sciences* **2184**, 77 pp.

Examples

```
local(envir=.PBSmodEnv,expr={
  oldpar = par(no.readonly=TRUE)
  # Plot age proportions (blue bubbles = survey data, red = commercial)
  data(CCA.qbr,envir=.PBSmodEnv); clrs=c("cornflowerblue","orangered")
  z <- CCA.qbr; cyr <- attributes(z)$cyr;
  z <- apply(z,2,function(x){x/sum(x)}); z[,cyr] <- -z[,cyr];
  x <- as.numeric(dimnames(z)[[2]]); xlim <- range(x) + c(-.5,.5);
  y <- as.numeric(dimnames(z)[[1]]); ylim <- range(y) + c(-1,1);
  expandGraph(mgp=c(2,.5,0),las=1)
  plotBubbles(z,xval=x,yval=y,powr=.5,size=0.15,clrs=clrs,
    xlim=xlim,ylim=ylim,xlab="Year",ylab="Age",cex.lab=1.5)
  addLegend(.5,1,bty="n",pch=1,cex=1.2,col=clrs,
    legend=c("Survey","Commercial"),horiz=TRUE,xjust=.5)
  par(oldpar)
})
```

chooseWinVal

Choose and Set a String Item in a GUI

Description

Prompts the user to choose one string item from a list of choices displayed in a GUI, then sets a specified variable in a target GUI.

Usage

```
chooseWinVal(choice, varname, winname="window")
```

Arguments

choice	vector of strings from which to choose
varname	variable name to which choice is assigned in the target GUI
winname	window name for the target GUI

Details

chooseWinVal activates a setWinVal command through an onClose function created by the getChoice command and modified by chooseWinVal.

Value

No value is returned directly. The choice is written to the PBS options workspace, accessible through getPBSoptions("getChoice"). Also set in PBS options is the window name from which the choice was activated.

Note

Microsoft Windows users may experience difficulties switching focus between the R console and GUI windows. The latter frequently disappear from the screen and need to be reselected (either clicking on the task bar or pressing <Alt><Tab>. This issue can be resolved by switching from MDI to SDI mode. From the R console menu bar, select <Edit> and <GUI preferences>, then change the value of “single or multiple windows” to SDI.

Author(s)

Rowan Haigh, Pacific Biological Station, Fisheries and Oceans Canada, Nanaimo BC

See Also

[getChoice](#), [getWinVal](#), [setWinVal](#)

Examples

```
## Not run:
local(envir=.PBSmodEnv,expr={
dfnam <-
  c("airquality","attitude","ChickWeight","faithful","freeny",
    "iris","LifeCycleSavings","longley","morley","Orange",
    "quakes","randu","rock","stackloss","swiss","trees")

wlist <- c(
  "window name=choisir title=\"Test chooseWinVal\"",
  "label text=\"Press <ENTER> in the green entry box\n\nto choose a file, then press <GO>\" sticky=W pady=5",
  "grid 1 3 sticky=W",
  "label text=File: sticky=W",
  "entry name=fnam mode=character width=23 value=\"\"",
  func=chFile entrybg=darkolivegreen1 pady=5",
  "button text=GO bg=green sticky=W func=test",
  "")

chFile <- function(ch=dfnam,fn="fnam")
```

```

    {chooseWinVal(ch,fn,winname="choisir")});

#-- Example 1 GUI test
test <- function() {
  oldpar = par(no.readonly=TRUE); on.exit(par(oldpar))
  getWinVal(winName="choisir",scope="L")
  if (fnam!="" && any(fnam==dfnam)) {
    file <- get(fnam);
    pairs(file,gap=0); }
  else {
    resetGraph();
    addLabel(.5,.5,"Press <ENTER> in the green entry box
    \nto choose a file, then press <GO>", col="red",cex=1.5)
  }
}
}
#-- Example 2 Non-GUI test
#To try the non-GUI version, type 'test2()' on the command line
test2 <- function(fnames=dfnam) {
  oldpar = par(no.readonly=TRUE); on.exit(par(oldpar))
  frame();resetGraph()
  again <- TRUE;
  while (again) {
    fnam <- sample(fnames,1); file <- get(fnam);
    flds <- names(file);
    xfld <- getChoice(paste("Pick x-field from",fnam),flds,gui=FALSE);
    yfld <- getChoice(paste("Pick y-field from",fnam),flds,gui=FALSE)
    plot(file[,xfld],file[,yfld],xlab=xfld,ylab=yfld,
         pch=16,cex=1.2,col="red");
    again <- getChoice("Plot another pair?",gui=FALSE)
  }
}
require(PBSmodelling)
createWin(wlist,astext=TRUE); test();
})

## End(Not run)

```

cleanProj

Launch a GUI for Project File Deletion

Description

Launches a new window which contains an interface for deleting junk files associated with a prefix and a set of suffixes (e.g., PBSadmb project) from the working directory.

Usage

```
cleanProj(prefix, suffix, files)
```

Arguments

prefix	default prefix for file names.
suffix	character vector of suffixes used for clean options.
files	character vector of file names used for clean options.

Details

All arguments may contain wildcard characters ("*" to match 0 or more characters, "?" to match any single character).

The GUI includes the following:

- 1 An entry box for the prefix.
The default value of this entry box is taken from `prefix`.
- 2 Check boxes for each suffix in the `suffix` argument and for each file name in the `files` argument.
- 3 Buttons marked "Select All" and "Select None" for selecting and clearing all the check boxes, respectively.
- 4 A "Clean" button that deletes files in the working directory matching one of the following criteria:
 - (i) file name matches both an expansion of a concatenation of a prefix in the entry box and a suffix chosen with a check box; or
 - (ii) file name matches an expansion of a file chosen with a check box.

Author(s)

Anisa Egeli, Vancouver Island University, Nanaimo BC

Examples

```
## Not run:
local(envir=.PBSmodEnv,expr={
  cleanProj(prefix="foo",suffix=c(".a*",".b?",".c","-old.d"),files=c("red","blue"))
})

## End(Not run)
```

cleanWD

Launch a GUI for File Deletion

Description

Launches a new window which contains an interface for deleting specified files from the working directory.

Usage

```
cleanWD(files)
```

Arguments

`files` character vector of file names used for clean options.

Details

All arguments may contain wildcard characters ("*" to match 0 or more characters, "?" to match any single character).

The GUI includes the following:

- 1 Check boxes for each suffix in the `suffix` argument and for each file name in the `files` argument.

- 2 Buttons marked "Select All" and "Select None" for selecting and clearing all the check boxes, respectively.
- 3 A "Clean" button that deletes files in the working directory matching file name expansion of files chosen with a check box.

Author(s)

Rowan Haigh, Pacific Biological Station, Fisheries and Oceans Canada, Nanaimo BC

Examples

```
## Not run:
local(envir=.PBSmodEnv,expr={
  cleanWD(c("*bak","*.tmp","junk*"))
})

## End(Not run)
```

clearAll

Remove all R Objects From a Specified Environment

Description

Generic function to clear all objects from .RData in R

Usage

```
clearAll(hidden=TRUE, verbose=TRUE, PBSSave=TRUE, pos=".PBSmodEnv")
```

Arguments

hidden	if TRUE, remove variables that start with a dot(.).
verbose	if TRUE, report all removed items.
PBSSave	if TRUE, do not remove .PBSmod.
pos	The pos argument can specify the environment in which to look for the object in any of several ways: as an integer (the position in the search list); as the character string name of an element in the search list; or as an environment (including using <code>sys.frame</code> to access the currently active function calls).

Author(s)

Jon T. Schnute, Pacific Biological Station, Fisheries and Oceans Canada, Nanaimo BC

clearPBSext	<i>Clear File Extension Associations</i>
-------------	--

Description

Disassociate any number of file extensions from commands previously saved with setPBSext.

Usage

```
clearPBSext(ext)
```

Arguments

ext optional character vector of file extensions to clear; if unspecified, all associations are removed

Author(s)

Alex Couture-Beil, Vancouver Island University, Nanaimo BC

See Also

[setPBSext](#), [getPBSext](#), [openFile](#)

clearRcon	<i>Clear the R Console / Focus on the RGui Window</i>
-----------	---

Description

Clear the R console window or focus on the RGui window using Visual Basic shell scripts.

Usage

```
clearRcon(os=.Platform$OS.type)
focusRgui(os=.Platform$OS.type)
```

Arguments

os operating system (e.g., "windows", "unix").

Details

Creates a VB shell script file called clearRcon.vbs or focusRgui.vbs in R's temporary working directory, then executes the script using the shell command.

While clearRcon clears the R console, focusRgui returns the desktop focus back to the RGui window.

These commands will only work on Windows operating platforms, using the system's executable %SystemRoot%\system32\cscript.exe.

Author(s)

Norm Olsen, Pacific Biological Station, Fisheries and Oceans Canada, Nanaimo BC

See Also

[cleanWD](#), [clearPBSext](#), [clearWinVal](#)

Examples

```
## Not run:
local(envir=.PBSmodEnv,expr={
  createWin( c("window title=Focus",
    "button text=\"Go to RGui\" width=20 bg=aliceblue func=focusRgui"), astext=T)
})

## End(Not run)
```

clearWinVal	<i>Remove all Current Widget Variables</i>
-------------	--

Description

Remove all global variables that share a name in common with any widget variable name defined in `names(getWinVal())`. Use this function with caution.

Usage

```
clearWinVal()
```

Author(s)

Alex Couture-Beil, Vancouver Island University, Nanaimo BC

See Also

[getWinVal](#)

clipVector	<i>Clip a Vector at One or Both Ends</i>
------------	--

Description

Clip a vector at one or both ends using the specified clip pattern to match.

Usage

```
clipVector(vec, clip, end=0)
```

Arguments

vec	vector object to clip
clip	value or string specifying repeated values to clip from ends
end	end to clip clip from: 0=both, 1=front, 2=back

Details

If the vector is named, the names are retained. Otherwise, element positions are assigned as the vector's names.

Value

Clipped vector with names.

Author(s)

Rowan Haigh, Pacific Biological Station, Fisheries and Oceans Canada, Nanaimo BC

See Also

[createVector](#)

Examples

```
local(envir=.PBSmodEnv,expr={
  x=c(0,0,0,0,1,1,1,1,0,0)
  print(clipVector(x,0))

  x=c(TRUE,TRUE,FALSE,TRUE)
  print(clipVector(x,TRUE))

  x=c("red","tide","red","red")
  print(clipVector(x,"red",2))
})
```

closeWin

Close GUI Window(s)

Description

Close (destroy) one or more windows made with createWin.

Usage

```
closeWin(name)
```

Arguments

name	a vector of window names that indicate which windows to close. These names appear in the <i>window description file(s)</i> on the line(s) defining WINDOW widgets. If name is omitted, all active windows will be closed.
------	---

Author(s)

Alex Couture-Beil, Vancouver Island University, Nanaimo BC

See Also

[createWin](#)

compileC

Compile a C File into a Shared Library Object

Description

This function provides an alternative to using R's SHLIB command to compile C code into a shared library object.

Usage

```
compileC(file, lib="", options="", logWindow=TRUE, logFile=TRUE)
```

Arguments

file	name of the file to compile.
lib	name of shared library object (without extension).
options	linker options (in one string) to prepend to a compilation command.
logWindow	if TRUE, a log window containing the compiler output will be displayed.
logFile	if TRUE, a log file containing the compiler output will be created.

Details

If lib="", it will take the same name as file (with a different extension).

If an object with the same name has already been dynamically loaded in R, it will be unloaded automatically for recompilation.

The name of the log file, if created, uses the string value from lib concatenated with ".log".

Author(s)

Anisa Egeli, Vancouver Island University, Nanaimo BC

See Also

[loadC](#)

Examples

```
## Not run:
local(envir=.PBSmodEnv,expr={
  cwd = getwd()
  edir <- system.file("examples", package = "PBSmodelling" )
  file.copy(paste(edir,"fib.c",sep="/"), tempdir(), overwrite=TRUE)
  setwd(tempdir())
  compileC("fib.c", lib="myLib", options="myObj.o", logWindow=FALSE)
  print(list.files())
  setwd(cwd)
})

## End(Not run)
```

compileDescription	<i>Convert and Save a Window Description as a List</i>
--------------------	--

Description

Convert a *window description file* (ASCII markup file) to an equivalent *window description list*. The output list (an ASCII file containing R-source code) is complete, i.e., all default values have been added.

Usage

```
compileDescription(descFile, outFile)
```

Arguments

descFile	name of <i>window description file</i> (markup file).
outFile	name of output file containing R source code.

Details

The *window description file* descFile is converted to a list, which is then converted to R code, and saved to outFile.

Author(s)

Alex Couture-Beil, Vancouver Island University, Nanaimo BC

See Also

[parseWinFile](#), [createWin](#)

convSlashes	<i>Convert Slashes from UNIX to DOS</i>
-------------	---

Description

Convert slashes in a string from '/' to '\\' if the operating system is 'windows'. Do the reverse if the OS is 'unix'.

Usage

```
convSlashes(expr, os=.Platform$OS.type, addQuotes=FALSE)
```

Arguments

expr	String value (usually a system pathway).
os	operating system (either "windows" or "unix").
addQuotes	logical: if TRUE, enclose the string expression in escaped double quotation marks.

Value

Returns the input string modified to have the appropriate slashes for the specified operating system.

Author(s)

Rowan Haigh, Pacific Biological Station, Fisheries and Oceans Canada, Nanaimo BC

createVector

Create a GUI with a Vector Widget

Description

Create a basic window containing a vector and a submit button. This provides a quick way to create a window without the need for a *window description file*.

Usage

```
createVector(vec, vectorLabels=NULL, func="",
             windowname="vectorwindow", env=NULL)
```

Arguments

vec	a vector of strings representing widget variables. The values in vec become the default values for the widget. If vec is named, the names are used as the variable names.
vectorLabels	an optional vector of strings to use as labels above each widget.
func	string name of function to call when new data are entered in widget boxes or when "GO" is pressed.
windowname	unique window name, required if multiple vector windows are created.
env	an environment in which to evaluate widget callback functions.

Author(s)

Alex Couture-Beil, Vancouver Island University, Nanaimo BC

See Also

[createWin](#)

Examples

```
## Not run:
local(envir=.PBSmodEnv,expr={
#user defined function which is called on new data
drawLiss <- function() {
  oldpar = par(no.readonly=TRUE); on.exit(par(oldpar))
  getWinVal(scope="L");
  tt <- 2*pi*(0:k)/k; x <- sin(2*pi*m*tt); y <- sin(2*pi*(n*tt+phi));
  plot(x,y,type="p"); invisible(NULL); };

#create the vector window
createVector(c(m=2, n=3, phi=0, k=1000), func="drawLiss",
             vectorLabels=c("x cycles","y cycles", "y phase", "points"));
})

## End(Not run)
```

`createWin`*Create a GUI Window*

Description

Create a GUI window with widgets using instructions from a Window Description File (aka mark-up file) .

Usage

```
createWin( fname, astext=FALSE, env=NULL )
```

Arguments

<code>fname</code>	name of <i>window description file</i> or list returned from <code>parseWinFile</code> .
<code>astext</code>	logical: if TRUE, interpret <code>fname</code> as a vector of strings with each element representing a line in a <i>window description file</i> .
<code>env</code>	an environment in which to evaluate widget callback functions; see example.

Details

Generally, the markup file contains a single widget per line. However, widgets can span multiple lines by including a backslash (`\`) character at the end of a line, prompting the suppression of the newline character.

For more details on widget types and markup file, see “PBSModelling-UG.pdf” in the R directory `.../library/PBSmodelling/doc`.

It is possible to use a Window Description List produced by `compileDescription` rather than a file name for `fname`.

Another alternative is to pass a vector of characters to `fname` and set `astext=T`. This vector represents the file contents where each element is equivalent to a new line in the *window description file*.

Note

Microsoft Windows users may experience difficulties switching focus between the R console and GUI windows. The latter frequently disappear from the screen and need to be reselected (either clicking on the task bar or pressing `<Alt><Tab>`). This issue can be resolved by switching from MDI to SDI mode. From the R console menu bar, select `<Edit>` and `<GUI preferences>`, then change the value of “single or multiple windows” to SDI.

Author(s)

Alex Couture-Beil, Vancouver Island University, Nanaimo BC

See Also

[parseWinFile](#), [getWinVal](#), [setWinVal](#)
[closeWin](#), [compileDescription](#), [createVector](#)
[initHistory](#) for an example of using `astext=TRUE`
[environment](#)

Examples

```
## Not run:
# See file ../library/PBSmodelling/testWidgets/LissWin.txt
# Calculate and draw the Lissajous figure
local(envir=.PBSmodEnv,expr={
  drawLiss <- function() {
    oldpar = par(no.readonly=TRUE); on.exit(par(oldpar))
    getWinVal(scope="L"); ti=2*pi*(0:k)/k;
    x=sin(2*pi*m*ti); y=sin(2*pi*(n*ti+phi));
    plot(x,y,type=ptype); invisible(NULL); };
  createWin(system.file("testWidgets/LissWin.txt",package="PBSmodelling"));
})

#####
# Environment example:
# function in global
local(envir=.PBSmodEnv,expr={
  hello <- function() {
    stop( "I shouldn't be called" )
  }

  newNameGreeter <- function( name ) {
    # method to display window
    greet <- function() {
      createWin(c("button \"Say hello\" func=hello"), astatic=TRUE,
        env=parent.env(environment()))
    }
    # hello method will refer to the name in this local scope
    hello <- function() {
      cat( "Hello", name, "\n" )
    }
    # return functions which the user can call directly
    return( list( greet=greet, hello=hello ) )
  }
  alex <- newNameGreeter( "Alex" )
  jon <- newNameGreeter( "Jon" )

  alex$hello() # prints hello Alex
  jon$hello() # prints hello Jon
  alex$greet() # creates a GUI with a button, which will print "hello Alex" when pushed
})

## End(Not run)
```

declareGUIoptions

Declare Option Names that Correspond with Widget Names

Description

This function allows a GUI creator to specify widget names that correspond to names in PBS options. These widgets can then be used to load and set PBS options using `getGUIoptions` and `setGUIoptions`.

Usage

```
declareGUIoptions(newOptions)
```


Arguments

newOptions a character vector of option names

Details

declareGUIOptions is typically called in a GUI initialization function. The option names are remembered and used for the functions getGUIOptions, setGUIOptions, and promptSave.

Author(s)

Anisa Egeli, Vancouver Island University, Nanaimo BC

See Also

[getGUIOptions](#), [setGUIOptions](#), [promptWriteOptions](#)

Examples

```
## Not run:
local(envir=.PBSmodEnv,expr={
  declareGUIOptions("editor")
})

## End(Not run)
```

doAction

Execute Action Created by a Widget

Description

Executes the action expression formulated by the user and written as an ‘action’ by a widget.

Usage

```
doAction(act)
```

Arguments

act string representing an expression that can be executed

Details

If act is missing, doAction looks for it in the action directory of the window’s widget directory in .PBSmod. This action can be accessed through getWinAct()[1].

Due to parsing complications, the expression act translates various symbols.
The function translates:

1. The back tick character ‘`’ to a double quote ‘”’ character. For example,

```
"openFile(paste(getWinVal()$prefix, '.tpl', sep='`'))"
```

2. Underscore period ‘_.’ to four back slashes and one period ‘\\\\.’. For example,

```
"poop=strsplit('some.thing.else',split='_.')"
```

Value

Invisibly returns the string expression `expr`.

Author(s)

Rowan Haigh, Pacific Biological Station, Fisheries and Oceans Canada, Nanaimo BC

See Also

[createWin](#), [evalCall](#), [getWinAct](#)

Examples

```
local(envir=.PBSmodEnv,expr={
  createWin("button text=\"list objects\" func=doAction action=print(ls(all.names=TRUE))",
    astext=TRUE)
})
```

drawBars

Draw a Linear Barplot on the Current Plot

Description

Draw a linear barplot on the current plot.

Usage

```
drawBars(x, y, width, base = 0, ...)
```

Arguments

<code>x</code>	x-coordinates
<code>y</code>	y-coordinates
<code>width</code>	bar width, computed if missing
<code>base</code>	y-value of the base of each bar
<code>...</code>	further graphical parameters (see <code>par</code>) may also be supplied as arguments

Author(s)

Jon T. Schnute, Pacific Biological Station, Fisheries and Oceans Canada, Nanaimo BC

Examples

```
local(envir=.PBSmodEnv,expr={
  oldpar = par(no.readonly=TRUE)
  plot(0:10,0:10,type="n")
  drawBars(x=1:9,y=9:1,col="deepskyblue4",lwd=3)
  par(oldpar)
})
```

evalCall

*Evaluate a Function Call***Description**

Evaluates a function call after resolving potential argument conflicts.

Usage

```
evalCall(fn, argu, ..., envir = parent.frame(),
         checkdef=FALSE, checkpar=FALSE)
```

Arguments

fn	R function
argu	list of explicitly named arguments and their values to pass to fn.
...	additional arguments that a user might wish to pass to fn.
envir	environment from which the call originates (currently has no use or effect).
checkdef	logical: if TRUE, gather additional formal arguments from the functions default function.
checkpar	logical: if TRUE, gather additional graphical arguments from the list object par.

Details

This function builds a call to the specified function and executes it. During the build, optional arguments (...) are checked for

- (i) duplication with explicit arguments argu: if any are duplicated, the user-supplied arguments supersede the explicit ones;
- (ii) availability as usable arguments in fn, fn.default if checkdef=TRUE, and par if checkpar=TRUE.

Value

Invisibly returns the string expression of the function call that is passed to eval(parse(text=expr)).

Author(s)

Rowan Haigh, Pacific Biological Station, Fisheries and Oceans Canada, Nanaimo BC

See Also

[doAction](#), [plotAsp](#)

Examples

```
local(envir=.PBSmodEnv,expr={
  oldpar = par(no.readonly=TRUE)
  # A user may have a function that calls other functions
  # using specific defaults (e.g., blue triangles)
  #-----
  pbsfun = function(..., use.evalCall=TRUE) {
    plotAsp(0,0,type="n",xlim=c(-1.5,1.5),ylim=c(-1.5,1.5),
            axes=FALSE, frame.plot=TRUE, xlab="",ylab="")
    if (use.evalCall)
      evalCall(polygon, ...,
```

```

    argu=list(x=c(-1,1,0),y=c(1,1,-1), col="dodgerblue", border="grey"))
  else
    polygon(x=c(-1,1,0),y=c(1,1,-1),col="dodgerblue",border="grey",...)
}
par(mfrow=c(2,1))
pbsfun(lwd=4,use.evalCall=FALSE)
#-----
# But what if the user wants pink triangles?
pbsfun(col="pink",lwd=4,use.evalCall=TRUE,checkpar=TRUE)
par(oldpar)
})

# Without 'evalCall' an error occurs due to duplicated arguments
## Not run: pbsfun(col="pink",lwd=4,use.evalCall=FALSE)

```

expandGraph

Expand the Plot Area by Adjusting Margins

Description

Optimize the plotting region(s) by minimizing margins.

Usage

```
expandGraph(mar=c(4,3,1.2,0.5), mgp=c(1.6,.5,0),...)
```

Arguments

mar	numerical vector of the form 'c(bottom, left, top, right)' specifying the margins of the plot
mgp	numerical vector of the form 'c(axis title, axis labels, axis line)' specifying the margins for axis title, axis labels, and axis line
...	additional graphical parameters to be passed to par

Author(s)

Jon T. Schnute, Pacific Biological Station, Fisheries and Oceans Canada, Nanaimo BC

See Also

[resetGraph](#)

Examples

```

local(envir=.PBSmodEnv,expr={
  oldpar = par(no.readonly=TRUE)
  expandGraph(mfrow=c(2,1));
  tt=seq(from=-10, to=10, by=0.05);

  plot(tt,sin(tt), xlab="this is the x label", ylab="this is the y label",
        main="main title", sub="sometimes there is a \"sub\" title")
  plot(cos(tt),sin(tt*2), xlab="cos(t)", ylab="sin(2 t)", main="main title",
        sub="sometimes there is a \"sub\" title")
  par(oldpar)
})

```

exportHistory	<i>Export a Saved History</i>
---------------	-------------------------------

Description

Export the current history list.

Usage

```
exportHistory(hisname="", fname="")
```

Arguments

hisname	name of the history list to export. If set to "", the value from <code>getWinAct()[1]</code> will be used instead.
fname	file name where history will be saved. If it is set to "", a <Save As> window will be displayed.

Author(s)

Alex Couture-Beil, Vancouver Island University, Nanaimo BC

See Also

[importHistory](#), [initHistory](#)

findPat	<i>Search a Character Vector to Find Multiple Patterns</i>
---------	--

Description

Use all available patterns in `pat` to search in `vec`, and return the matched elements in `vec`.

Usage

```
findPat(pat, vec)
```

Arguments

pat	character vector of patterns to match in <code>vec</code>
vec	character vector where matches are sought

Value

A character vector of all matched strings.

Author(s)

Rowan Haigh, Pacific Biological Station, Fisheries and Oceans Canada, Nanaimo BC

Examples

```
local(envir=.PBSmodEnv,expr={
  #find all strings with a vowel, or that start with a number
  print(findPat(c("[aeiou]", "^[0-9]"), c("hello", "WORLD", "1over")))
})
```

findPrefix

Find a Prefix Based on Names of Existing Files

Description

Find the prefixes or suffixes of files with a given suffix or prefix in a directory.

Usage

```
findPrefix(suffix,path=".")
findSuffix(prefix,path=".")
```

Arguments

suffix	character vector of suffixes
prefix	character vector of prefixes
path	directory to look for files in

Details

The function findPrefix locates all files in a directory that end with one of the provided suffixes; where as findSuffix locates all files that start with the given prefixes.

Value

A character vector of all the prefixes or suffixes of files in the working directory that matched to one of the given suffixes.

Author(s)

Anisa Egeli, Vancouver Island University, Nanaimo BC

Examples

```
local(envir=.PBSmodEnv,expr={
  edir = system.file("examples", package="PBSmodelling")
  print(findPrefix(suffix=c(".txt", ".r"),path=edir)); cat("\n")

  #or use R's dir for similar functionality
  print(dir(pattern="txt$",path=edir)); cat("\n")
  print(dir(pattern="^[a-h]",path=edir)); cat("\n")
})
```

findProgram	<i>Locates a program in the PATH environment variable</i>
-------------	---

Description

Returns the complete filename and path of a program in the PATH environment variable. This is a wrapper for `Sys.which`, and may be deprecated in the future.

Usage

```
findProgram( name, includename=FALSE )
```

Arguments

name	name of a program to locate
includename	boolean: if true, include the filename in the path returned, otherwise just the directory.

Value

A string containing the location of the program. NULL is returned if the program is not located.

Author(s)

Alex Couture-Beil, Vancouver Island University, Nanaimo BC

See Also

[Sys.which](#)

Examples

```
local(envir=.PBSmodEnv,expr={
  print(list(
    gcc = findProgram( "gcc" ),
    notepad = findProgram( "notepad" ),
    R = findProgram( "R", includename=TRUE ) ))
})
```

focusWin	<i>Set the Focus on a Particular Window</i>
----------	---

Description

Bring the specified window into focus, and set it as the active window. `focusWin` will fail to bring the window into focus if it is called from the R console, since the R console returns focus to itself once a function returns. However, it will work if `focusWin` is called as a result of calling a function from the GUI window. (i.e., pushing a button or any other widget that has a function argument).

Usage

```
focusWin(winName, winVal=TRUE)
```

Arguments

winName	name of window to focus
winVal	if TRUE, associate winName with the default window for setWinVal and getWinVal

Author(s)

Alex Couture-Beil, Vancouver Island University, Nanaimo BC

Examples

```
## Not run:
local(envir=.PBSmodEnv,expr={
focus <- function() {
  winName <- getWinVal()$select;
  focusWin(winName);
  mess = paste("Calling focusWin(\"", winName, "\")\n",
    "getWinVal()$myvar = ", getWinVal()$myvar, "\n\n", sep="",collapse="")
  cat(mess); invisible()
}
#create three windows named win1, win2, win3
#each having three radio buttons, which are used to change the focus
for(i in 1:3) {
  winDesc <- c(
    paste('window onclose=closeWin name=win',i,' title="Win',i,'" ', sep=''),
    paste('entry myvar ', i, sep=''),
    'radio name=select value=win1 text="one" function=focus mode=character',
    'radio name=select value=win2 text="two" function=focus mode=character',
    'radio name=select value=win3 text="three" function=focus mode=character');
  createWin(winDesc, astext=TRUE); };
})

## End(Not run)
```

genMatrix

Generate Test Matrices for plotBubbles

Description

Generate a test matrix of random numbers (μ = mean and σ = standard deviation), primarily for plotBubbles.

Usage

```
genMatrix(m,n,mu=0,sigma=1)
```

Arguments

m	number of rows
n	number of columns
mu	mean of normal distribution
sigma	standard deviation of normal distribution

Value

An m by n matrix with normally distributed random values.

Author(s)

Jon T. Schnute, Pacific Biological Station, Fisheries and Oceans Canada, Nanaimo BC

See Also

[plotBubbles](#)

Examples

```
local(envir=.PBSmodEnv,expr={
  plotBubbles(genMatrix(20,6))
})
```

getChoice

Choose One String Item from a List of Choices

Description

Prompts the user to choose one string item from a list of choices displayed in a GUI. The simplest case `getChoice()` yields TRUE or FALSE.

Usage

```
getChoice(choice=c("Yes","No"), question="Make a choice: ",
  winname="getChoice", horizontal=TRUE, radio=FALSE,
  qcolor="blue", gui=FALSE, quiet=FALSE)
```

Arguments

choice	vector of strings from which to choose.
question	question or prompting statement.
winname	window name for the getChoice GUI.
horizontal	logical: if TRUE, display the choices horizontally, else vertically.
radio	logical: if TRUE, display the choices as radio buttons, else as buttons.
qcolor	colour for question.
gui	logical: if TRUE, getChoice is functional when called from a GUI, else it is functional from command line programs.
quiet	logical: if TRUE, don't print the choice on the command line.

Details

The user's choice is stored in `.PBSmod$options$getChoice` (or whatever winname is supplied).

`getChoice` generates an `onClose` function that returns focus to the calling window (if applicable) and prints out the choice.

Value

If called from a GUI (`gui=TRUE`), no value is returned directly. Rather, the choice is written to the PBS options workspace, accessible through `getPBSoptions("getChoice")` (or whatever winname was supplied).

If called from a command line program (`gui=FALSE`), the choice is returned directly as a string scalar (e.g., `answer <- getChoice(gui=F)`).

Note

Microsoft Windows users may experience difficulties switching focus between the R console and GUI windows. The latter frequently disappear from the screen and need to be reselected (either clicking on the task bar or pressing <Alt><Tab>. This issue can be resolved by switching from MDI to SDI mode. From the R console menu bar, select <Edit> and <GUI preferences>, then change the value of “single or multiple windows” to SDI.

Author(s)

Rowan Haigh, Pacific Biological Station, Fisheries and Oceans Canada, Nanaimo BC

See Also

[chooseWinVal](#), [getWinVal](#), [setWinVal](#)

Examples

```
## Not run:
#-- Example 1
local(envir=.PBSmodEnv,expr={
  getChoice(c("Fame", "Fortune", "Health", "Beauty", "Lunch"),
    "What do you want?", qcolor="red", gui=FALSE)
})

#-- Example 2
local(envir=.PBSmodEnv,expr={
  getChoice(c("Homer Simpson", "Wilberforce Humphries", "Miss Marple", "Gary Numan"),
    "Who's your idol?", horiz=FALSE, radio=TRUE, gui=FALSE)
})

## End(Not run)
```

getGUIOptions

Get PBS Options for Widgets

Description

Get the PBS options declared for GUI usage and set their corresponding widget values.

Usage

```
getGUIOptions()
```

Details

The options declared using `declareGUIOptions` are copied from the R environment into widget values. These widgets should have names that match the names of their corresponding options.

Author(s)

Anisa Egeli, Vancouver Island University, Nanaimo BC

See Also

[declareGUIOptions](#), [setGUIOptions](#), [promptWriteOptions](#), [readPBSOptions](#)

Examples

```
## Not run:
local(envir=.PBSmodEnv,expr={
  getPBSOptions() #loads from default PBSoptions.txt
})

## End(Not run)
```

getOptions

Get and Set User Options

Description

Functions to get and set user options within an option class object.

Usage

```
getOptions(option.object, key)
setOptions(option.object, ...)
```

Arguments

option.object	options class object used for storing package options
...	any number of user options to set where either (a) the named argument is the option key and the value is the option value or (b) the single unnamed argument is a list object where each named list element is the option key and the value is the element's value
key	name of option to retrieve; if missing, all options are returned

Value

Value of the option specified by key (if specified) or a list of all options (if missing).

Author(s)

Alex Couture-Beil, Vancouver Island University, Nanaimo BC

See Also

See [PBSOptions-class](#) for more details and an example that uses **PBSmodelling**'s option management functions.

getOptionsFileName	<i>Get and Set File Name for Saving and Loading of Options</i>
--------------------	--

Description

Functions for retrieving and setting the default file name used by loadOptions and saveOptions.

Usage

```
getOptionsFileName(option.object)
setOptionsFileName(option.object, name)
```

Arguments

option.object	options class object used for storing package options
name	new name for default file name

Value

getOptionsFileName: the default file name

Author(s)

Alex Couture-Beil, Vancouver Island University, Nanaimo BC

See Also

[loadOptions](#), [saveOptions](#)

See [PBSoptions-class](#) for more details and an example using **PBSmodelling**'s option management functions.

getOptionsPrefix	<i>Get and Set GUI Prefix of Options Class</i>
------------------	--

Description

The GUI prefix is used for determining which GUI variables are associated with a user option.

Usage

```
getOptionsPrefix(option.object)
setOptionsPrefix(option.object, prefix)
```

Arguments

option.object	options class object used for storing package options
prefix	new prefix to use

Value

getOptionsPrefix: a prefix string used to reference GUI variables

Author(s)

Alex Couture-Beil, Vancouver Island University, Nanaimo BC

See Also

See [PBSoptions-class](#) for more details and an example using **PBSmodelling**'s option management functions.

Examples

```
local(envir=.PBSmodEnv,expr={
  # For the example, the options object is saved to the temporary environment;
  # however, a user would normally create the object in his/her workspace.
  .mypkg <- new( "PBSoptions", filename="my_pkg.txt",
    initial.options=list(pi=3.14), gui.prefix="opt" )

  #prefix the option "pi" with "opt" to get "optpi"
  createWin( "entry name=optpi", astext = TRUE )

  #the GUI variable "optpi" will be loaded with the option "pi"
  loadOptionsGUI( .mypkg )
})
```

getPBSext

Get a Command Associated With a File Name

Description

Display all locally defined file extensions and their associated commands, or search for the command associated with a specific file extension ext.

Usage

```
getPBSext(ext)
```

Arguments

ext optional string specifying a file extension.

Value

Command associated with file extension.

Note

These file associations are not saved from one *PBS Modelling* session to the next unless explicitly saved and loaded (see `writePBSoptions` and `readPBSoptions`).

Author(s)

Alex Couture-Beil, Vancouver Island University, Nanaimo BC

See Also

[setPBSext](#), [openFile](#), [clearPBSext](#)

getPBSoptions	<i>Retrieve A User Option</i>
---------------	-------------------------------

Description

Get a previously defined user option.

Usage

```
getPBSoptions(option)
```

Arguments

option	name of option to retrieve. If omitted, a list containing all options is returned.
--------	--

Value

Value of the specified option, or NULL if the specified option is not found.

Author(s)

Alex Couture-Beil, Vancouver Island University, Nanaimo BC

See Also

[getPBSext](#), [readPBSoptions](#)

getWinAct	<i>Retrieve the Last Window Action</i>
-----------	--

Description

Get a string vector of actions (latest to earliest).

Usage

```
getWinAct(winName)
```

Arguments

winName	name of window to retrieve action from
---------	--

Details

When a function is called from a GUI, a string descriptor associated with the action of the function is stored internally (appended to the first position of the action vector). A user can utilize this action as a type of argument for programming purposes. The command `getWinAct()[1]` yields the latest action.

Value

String vector of recorded actions (latest first).

Author(s)

Alex Couture-Beil, Vancouver Island University, Nanaimo BC

getWinFun

Retrieve Names of Functions Referenced in a Window

Description

Get a vector of all function names referenced by a window.

Usage

```
getWinFun(winName)
```

Arguments

winName name of window, to retrieve its function list

Value

A vector of function names referenced by a window.

Author(s)

Alex Couture-Beil, Vancouver Island University, Nanaimo BC

getWinVal

Retrieve Widget Values for Use in R Code

Description

Get a list of variables defined and set by the GUI widgets. An optional argument scope directs the function to create local or global variables based on the list that is returned.

Usage

```
getWinVal(v=NULL, scope="", asvector=FALSE, winName="")
```

Arguments

v	vector of variable names to retrieve from the GUI widgets. If NULL, v retrieves all variables from all GUI widgets.
scope	scope of the retrieval. The default sets no variables in the non-GUI environment; scope="L" creates variables locally in relation to the parent frame that called the function; scope="P" creates variables in the temporary package workspace called .PBSmodEnv; and scope="G" creates global variables (pos=1).
asvector	return a vector instead of a list. WARNING: if a widget variable defines a true vector or matrix, this will not work.
winName	window from which to select GUI widget values. The default takes the window that has most recently received new user input.

Details

TODO: talk about scope=G/P/L and side effects of overwriting existing variables

Value

A list (or vector) with named components, where names and values are defined by GUI widgets.

Author(s)

Alex Couture-Beil, Vancouver Island University, Nanaimo BC

See Also

[parseWinFile](#), [setWinVal](#), [clearWinVal](#)

getYes

Prompt the User to Choose Yes or No

Description

Display a message prompt with "Yes" and "No" buttons.

Usage

```
getYes(message, title="Choice", icon="question")
```

Arguments

message	message to display in prompt window.
title	title of prompt window.
icon	icon to display in prompt window; options are "error", "info", "question", or "warning".

Value

Returns TRUE if the "Yes" button is clicked, FALSE if the "No" button is clicked.

Author(s)

Anisa Egeli, Vancouver Island University, Nanaimo BC

See Also

[showAlert](#), [getChoice](#), [chooseWinVal](#)

Examples

```
## Not run:
local(envir=.PBSmodEnv,expr={
  if(getYes("Print the number 1?"))
    print(1) else print("hallucination")
})

## End(Not run)
```


GT0

*Restrict a Numeric Variable to a Positive Value***Description**

Restrict a numeric value x to a positive value using a differentiable function. GT0 stands for “greater than zero”.

Usage

```
GT0(x,eps=1e-4)
```

Arguments

<code>x</code>	vector of values
<code>eps</code>	minimum value greater than zero.

Details

```
if (x >= eps).....GT0 = x
if (0 < x < eps).....GT0 = (eps/2) * (1 + (x/eps)^2)
if (x <= 0).....GT0 = eps/2
```

Author(s)

Jon T. Schnute, Pacific Biological Station, Fisheries and Oceans Canada, Nanaimo BC

See Also

[scalePar](#), [restorePar](#), [calcMin](#)

Examples

```
local(envir=.PBSmodEnv,expr={
  oldpar = par(no.readonly=TRUE)
  plotGT0 <- function(eps=1,x1=-2,x2=10,n=1000,col="black") {
    x <- seq(x1,x2,len=n); y <- GT0(x,eps);
    lines(x,y,col=col,lwd=2); invisible(list(x=x,y=y)); }

  testGT0 <- function(eps=c(7,5,3,1,.1),x1=-2,x2=10,n=1000) {
    x <- seq(x1,x2,len=n); y <- x;
    plot(x,y,type="l");
    mycol <- c("red","blue","green","brown","violet","orange","pink");
    for (i in 1:length(eps))
      plotGT0(eps=eps[i],x1=x1,x2=x2,n=n,col=mycol[i]);
    invisible(); };

  testGT0()
  par(oldpar)
})
```

importHistory	<i>Import a History List from a File</i>
---------------	--

Description

Import a history list from file `fname`, and place it into the history list `hisname`.

Usage

```
importHistory(hisname="", fname="", updateHis=TRUE)
```

Arguments

<code>hisname</code>	name of the history list to be populated. The default ("") uses the value from <code>getWinAct()[1]</code> .
<code>fname</code>	file name of history file to import. The default ("") causes an open-file window to be displayed.
<code>updateHis</code>	logical: if TRUE, update the history widget to reflect the change in size and index.

Author(s)

Alex Couture-Beil, Vancouver Island University, Nanaimo BC

See Also

[exportHistory](#), [initHistory](#)

initHistory	<i>Create Structures for a New History Widget</i>
-------------	---

Description

PBS history functions (below) are available to those who would like to use the package's history functionality, without using the pre-defined history widget. These functions allow users to create customized history widgets.

Usage

```
initHistory(hisname, indexname=NULL, sizename=NULL,
            buttonnames=NULL, modenname=NULL, func=NULL, overwrite=TRUE)
rmHistory(hisname="", index="")
addHistory(hisname="")
forwHistory(hisname="")
backHistory(hisname="")
lastHistory(hisname="")
firstHistory(hisname="")
jumpHistory(hisname="", index="")
clearHistory(hisname="")
```

Arguments

hisname	name of the history "list" to manipulate. If it is omitted, the function uses the value of <code>getWinAct()[1]</code> as the history name. This allows the calling of functions directly from the <i>window description file</i> (except <code>initHistory</code> , which must be called before <code>createWin()</code>).
indexname	name of the index entry widget in the <i>window description file</i> . If NULL, then the current index feature will be disabled.
size name	name of the current size entry widget. If NULL, then the current size feature will be disabled.
buttonnames	named list of names of the first, prev, next, and last buttons. If NULL, then the buttons are not disabled ever
modename	name of the radio widgets used to change <code>addHistory</code> 's mode. If NULL, then the default mode will be to insert after the current index.
index	index to the history item. The default ("") causes the value to be extracted from the widget identified by <code>indexname</code> .
func	name of user supplied function to call when viewing history items.
overwrite	if TRUE, history (matching <code>hisname</code>) will be cleared. Otherwise, the imported history will be merged with the current one.

Details

PBS Modelling includes a pre-built history widget designed to collect interesting choices of GUI variables so that they can be redisplayed later, rather like a slide show.

Normally, a user would invoke a history widget simply by including a reference to it in the *window description file*. However, PBS Modelling includes support functions (above) for customized applications.

To create a customized history, each button must be described separately in the *window description file* rather than making reference to the history widget.

The history "List" must be initialized before any other functions may be called. The use of a unique history name (`hisname`) is used to associate a unique history session with the supporting functions.

The `indexname` and `size name` arguments correspond to the given names of entry widgets in the *window description file*, which will be used to display the current index and total size of the list. The `indexname` entry widget can also be used by `jumpHistory` to retrieve a target index.

Author(s)

Alex Couture-Beil, Vancouver Island University, Nanaimo BC

See Also

[importHistory](#), [exporthHistory](#)

Examples

```
## Not run:
# ***** THIS CODE DOES NOT RUN. NEEDS FIXING *****
# Example of creating a custom history widget that saves values
# whenever the "Plot" button is pressed. The user can tweak the
# inputs "a", "b", and "points" before each "Plot" and see the
# "Index" increase. After sufficient archiving, the user can review
# scenarios using the "Back" and "Next" buttons.
# A custom history is needed to achieve this functionality since
# the packages pre-defined history widget does not update plots.

# To start, create a Window Description to be used with createWin
```

```

# using astext=TRUE. P.S. Watch out for special characters which
# must be "escaped" twice (first for R, then PBSmodelling).

local(envir=.PBSmodEnv,expr={
  oldpar = par(no.readonly=TRUE)

winDesc <- '
  window title="Custom History"
  vector names="a b k" labels="a b points" font="bold" \\
  values="1 1 1000" function=myPlot
  grid 1 3
    button function=myHistoryBack text="<- Back"
    button function=myPlot text="Plot"
    button function=myHistoryForw text="Next ->"
  grid 2 2
    label "Index"
    entry name="myHistoryIndex" width=5
    label "Size"
    entry name="myHistorySize" width=5
  ,
# Convert text to vector with each line represented as a new element
winDesc <- strsplit(winDesc, "\n")[[1]]

# Custom functions to update plots after restoring history values
myHistoryBack <- function() {
  backHistory("myHistory");
  myPlot(saveVal=FALSE); # show the plot with saved values
}
myHistoryForw <- function() {
  forwHistory("myHistory");
  myPlot(saveVal=FALSE); # show the plot with saved values
}
myPlot <- function(saveVal=TRUE) {
  # save all data whenever plot is called (directly)
  if (saveVal) addHistory("myHistory");
  getWinVal(scope="L");
  tt <- 2*pi*(0:k)/k;
  x <- (1+sin(a*tt)); y <- cos(tt)*(1+sin(b*tt));
  plot(x, y);
}

  iHistory("myHistory", "myHistoryIndex", "myHistorySize")
  createWin(winDesc, astext=TRUE)
  par(oldpar)
})

## End(Not run)

```

Description

Identify an object by class, mode, typeof, and attributes.

Usage

```
isWhat(x)
```

Arguments

`x` an R object

Value

No value is returned. The function prints the object's characteristics on the command line.

Author(s)

Jon T. Schnute, Pacific Biological Station, Fisheries and Oceans Canada, Nanaimo BC

lisp

List Objects in .PBSmodEnv Workspace

Description

The function `lisp` returns a vector of character strings giving the names of the objects in `.PBSmodEnv`. It is only a wrapper for the base function [ls](#).

Usage

```
lisp(name, pos = .PBSmodEnv, envir = as.environment(pos),
     all.names = TRUE, pattern)
```

Arguments

<code>name</code>	which environment to use in listing the available objects. See the details section of ls .
<code>pos</code>	an alternative argument to <code>name</code> for specifying the environment as a position in the search list.
<code>envir</code>	an alternative argument to <code>name</code> for specifying the environment.
<code>all.names</code>	a logical value. If <code>TRUE</code> , all object names are returned. If <code>FALSE</code> , names which begin with a <code>'.'</code> are omitted.
<code>pattern</code>	an optional regular expression . Only names matching <code>pattern</code> are returned. See ls for additional details.

Details

See the base function [ls](#) for details.

Author(s)

Copyright 1995–2012 R Core Development Team; distributed under GPL 2 or later.

See Also

[ls](#), [tget](#)
[glob2rx](#) for converting wildcard patterns to regular expressions.

loadC

*Launch a GUI for Compiling and Loading C Code***Description**

A GUI interface allows users to edit, compile, and embed C functions in the R environment.

Usage

```
loadC()
```

Details

The function `loadC()` launches an interactive GUI that can be used to manage the construction of C functions intended to be called from R. The GUI provides tools to edit, compile, load, and run C functions in the R environment.

The `loadC` GUI also includes a tool for comparison between the running times and return values of R and C functions. It is assumed that the R and C functions are named `prefix.r` and `prefix.c`, respectively, where `prefix` can be any user-chosen prefix. If an initialization function `prefix.init` exists, it is called before the start of the comparison.

The GUI controls:

File Prefix	Prefix for .c and .r files.
Lib Prefix	Prefix for shared library object.
Set WD	Set the working directory.
Open Log	Open the log file.
Open.c File	Open the file <code>prefix.c</code> from the working directory.
Open .r File	Open the file <code>prefix.r</code> from the working directory.
COMPILE	Compile <code>prefix.c</code> into a shared library object.
LOAD	Load the shared library object.
SOURCE R	Source the file <code>prefix.r</code> .
UNLOAD	Unload the shared library object.
Options	
Editor	Text editor to use.
Update	Commit option changes.
Browse	Browse for a text editor.
Clean Options	
Select All	Select all check boxes specifying file types.
Select None	Select none of the check boxes.
Clean Proj	Clean the project of selected file types.
Clean All	Clean the directory of selected file types.
Comparison	
Times to Run	Number of times to run the R and C functions.
RUN	Run the comparison between R and C functions.
R Time	Computing time to run the R function multiple times.
C Time	Computing time to run the C function multiple times.
Ratio	Ratio of R/C run times.

Author(s)

Anisa Egeli, Vancouver Island University, Nanaimo BC

See Also[compileC](#)

loadOptions*Save and Load Options to and from Disk*

Description

Save and load options for use from one R session to another. If no file name is given, then the default file name (specified when the option object was created) is used.

Usage

```
loadOptions(option.object, fname, prompt = FALSE)
saveOptions(option.object, fname, prompt = FALSE)
```

Arguments

option.object	options class object used for storing package options
fname	file name to use: if missing the default file name is used; if given, file name becomes the default.
prompt	logical: if TRUE, prompt the user to select a file from an interactive GUI. If fname is given, then the value appears as the default selected file.

Details

If fname is given (or selected when prompt=TRUE), then that file becomes the default file name for subsequent loading and saving.

See Also

See [PBSoptions-class](#) for more details and an example using **PBSmodelling**'s option management functions.

loadOptionsGUI*Load and Save Options Values to and from a GUI*

Description

These functions are used to move option values to and from a GUI. Option values are stored within an R object (as referenced by the option.object).

loadOptionsGUI copies the values from the R object to the GUI.

saveOptionsGUI copies the GUI values from the tcltk GUI to the R object.

Usage

```
loadOptionsGUI(option.object)
saveOptionsGUI(option.object)
```

Arguments

option.object	options class object used for storing package options
---------------	---

See Also

See [PBSoptions-class](#) for more details and an example using **PBSmodelling**'s option management functions.

lucent

Convert Solid Colours to Translucence

Description

Convert a vector of solid colours to a vector of translucent ones (or vice versa)

Usage

```
lucent(col.pal=1, a=1)
```

Arguments

<code>col.pal</code>	vector of colours
<code>a</code>	alpha transparency value (0 = fully transparent, 1 = opaque)

Details

The function acts as a small wrapper to the `rgb` function.

Value

Vector of transformed colours depending on the alpha transparency value `a`.

Author(s)

Steve Martell, International Pacific Halibut Commission, Seattle WA

See Also

[pickCol](#), [testCol](#), [col2rgb](#), [rgb](#)

Examples

```
local(envir=.PBSmodEnv,expr={
  oldpar = par(no.readonly=TRUE)
  pbsfun = function(clrs=c("moccasin",rainbow(3))){
    clrs = c(clrs,lucent(clrs,a=0.25))
    testCol(clrs); invisible() }
  pbsfun()
  par(oldpar)
})
```

openExamples

Open Example Files from a Package

Description

Open examples from the examples subdirectory of a given package.

Usage

```
openExamples(package, prefix, suffix)
```

Arguments

package	name of the package that contains the examples.
prefix	prefix of the example file(s).
suffix	character vector of suffixes for the example files.

Details

Copies of each example file are placed in the working directory and opened. If files with the same name already exist, the user is prompted with a choice to overwrite.

To use this function in a *window description file*, the package, prefix and suffix arguments must be specified as the action of the widget that calls openExamples. Furthermore, package, prefix, and each suffix must be separated by commas. For example, action=myPackage,example1,.r,.c will copy example1.r and example2.c from the examples directory of the package **myPackage** to the working directory and open these files. If the function was called by a widget, a widget named prefix will be set to the specified prefix.

Note

If all the required arguments are missing, it is assumed that the function is being called by a GUI widget.

Author(s)

Anisa Egeli, Vancouver Island University, Nanaimo BC

See Also

[openFile](#)

Examples

```
## Not run:
# Copies fib.c and fib.r from the examples directory in
# PBSmodelling to the temporary working directory, and opens these files.
local(envir=.PBSmodEnv,expr={
  cwd = getwd(); setwd(tempdir())
  openExamples("PBSmodelling", c("fib"), c(".r", ".c"))
  setwd(cwd)
})

## End(Not run)
```

openFile

Open a File with an Associated Program

Description

Open a file using the program that the operating system (Windows/Mac OS X/Linux) associates with its type. Users wishing to override the default application can specify a program association using `setPBSext`.

Usage

```
openFile(fname, package=NULL)
```

Arguments

`fname` character vector, containing file names to open.
`package` (optional) open files relative to this package.

Value

An invisible string vector of the file names and/or commands with file names.

Note

If a command is registered with `setPBSext`, then `openFile` will replace all occurrences of "%f" with the absolute path of the filename before executing the command.

Author(s)

Alex Couture-Beil, Vancouver Island University, Nanaimo BC

See Also

[getPBSext](#), [setPBSext](#), [clearPBSext](#), [writePBSoptions](#)

Examples

```
## Not run:
local(envir=.PBSmodEnv,expr={
  # use openFile directly:
  openFile( "doc/PBSmodelling-UG.pdf", package="PBSmodelling" )
})
local(envir=.PBSmodEnv,expr={
  # via doAction in a window description file:
  createWin( "button text=help func=doAction action=\"openFile( 'doc/PBSmodelling-UG.pdf', package='PBSmodelling' )\" )
})
local(envir=.PBSmodEnv,expr={
  # Set up Firefox to open .html files (only applicable if Firefox is NOT the default web browser)
  setPBSext("html", '"c:/Program Files/Mozilla Firefox/firefox.exe" file://%f')
  openFile("foo.html")
})

## End(Not run)
```

openUG

*Open Package User Guide***Description**

Open package User's Guide 'pkg-UG.pdf' if it exists. This function is essentially a wrapper for `codeopenFile`.

Usage

```
openUG(pkg = "PBSmodelling")
```

Arguments

pkg Full name (with or without quotes) of a package installed on the user's system.

Details

We assume that the name of the User's Guide follows 'PBS' conventions. This means a user's guide in PDF format with extension pdf. The name of the PDF file will be '<pkg>-UG.pdf' (e.g., PBSmodelling-UG.pdf).

Author(s)

Rowan Haigh, Pacific Biological Station, Fisheries and Oceans Canada, Nanaimo BC

See Also

[openFile](#), [showHelp](#), [viewCode](#)

packList

*Pack a List with Objects***Description**

Pack a list with existing objects using names only.

Usage

```
packList(stuff, target="PBSlist", value, tenv=.PBSmodEnv)
```

Arguments

stuff	string vector of object names
target	target list object
value	an optional explicit value to assign to stuff
tenv	target environment where target list is or will be located

Details

A list object called `target` will be located in the `tenv` environment. The objects named in `stuff` and located in the `tenv` environment will appear as named components within the list object `target`.

If an explicit value is specified, the function uses this value instead of looking for local objects. Essentially, `stuff=value` which is then packed into `target`.

Value

No value is returned

Note

The function determines the parent environment from within. This environment contains the objects from which the function copies to the target environment.

Author(s)

Rowan Haigh, Pacific Biological Station, Fisheries and Oceans Canada, Nanaimo BC

See Also

[unpackList](#), [readList](#), [writeList](#)

Examples

```
local(envir=.PBSmodEnv,expr={
  fn = function() {
    alpha=rnorm(10)
    beta=letters
    gamma=mean
    delta=longley
    packList(c("alpha","beta","gamma","delta")) }
  fn(); tprint(PBSlist)
})
```

pad0

Pad Values with Leading Zeroes

Description

Pad numbers and/or text with leading and/or trailing zeroes.

Usage

```
pad0(x, n, f = 0)
```

Arguments

x	vector of numbers and/or strings
n	number of text characters representing a padded integer
f	factor of 10 transformation on x before padding

Details

Converts numbers (or text coerced to numeric) to integers and then to text, and pads them with leading zeroes. If the factor f is >0, then trailing zeroes are also added.

Value

If `length(f)==1` or `length(x)==1`, the function returns a character vector representing x with leading zeroes. If both f and x have lengths >1, then a list of character vectors indexed by f is returned.

Author(s)

Rowan Haigh, Pacific Biological Station, Fisheries and Oceans Canada, Nanaimo BC

See Also

[show0](#), [GT0](#)

Examples

```
local(envir=.PBSmodEnv,expr={
  resetGraph(); x <- pad0(x=123,n=10,f=0:7);
  addLabel(.5,.5,paste(x,collapse="\n"),cex=1.5);
})
```

parseWinFile

Convert a Window Description File into a List Object

Description

Parse a *window description file* (markup file) into the list format expected by createWin.

Usage

```
parseWinFile(fname, astext=FALSE)
```

Arguments

fname	file name of the <i>window description file</i> .
astext	if TRUE, fname is interpreted as a vector of strings, with each element representing a line of code in a <i>window description file</i> .

Value

A list representing a parsed *window description file* that can be directly passed to createWin.

Note

All widgets are forced into a 1-column by N-row grid.

Author(s)

Alex Couture-Beil, Vancouver Island University, Nanaimo BC

See Also

[createWin](#), [compileDescription](#)

Examples

```
## Not run:
local(envir=.PBSmodEnv,expr={
  x <- parseWinFile(system.file("examples/LissFigWin.txt",package="PBSmodelling"))
  createWin(x)
})

## End(Not run)
```

pause

Pause Between Graphics Displays or Other Calculations

Description

Pause, typically between graphics displays. Useful for demo purposes.

Usage

```
pause(s = "Press <Enter> to continue")
```

Arguments

`s` text issued on the command line when pause is invoked.

Author(s)

Jon T. Schnute, Pacific Biological Station, Fisheries and Oceans Canada, Nanaimo BC

PBSmodelling

PBS Modelling

Description

PBS Modelling provides software to facilitate the design, testing, and operation of computer models. It focuses particularly on tools that make it easy to construct and edit a customized graphical user interface (GUI). Although it depends heavily on the R interface to the Tcl/Tk package, a user does not need to know Tcl/Tk.

PBSmodelling contains examples that illustrate models built using other R packages, including PBSmapping, odesolve, PBSddesolve, and BRugs. It also serves as a convenient prototype for building new R packages, along with instructions and batch files to facilitate that process.

The R directory `.../library/PBSmodelling/doc` includes a complete user guide ‘PBSmodelling-UG.pdf’. To use this package effectively, please consult the guide.

PBS Modelling comes packaged with interesting examples accessed through the function `runExamples()`. Additionally, users can view *PBS Modelling* widgets through the function `testWidgets()`. More generally, a user can run any available demos in his/her locally installed packages through the function `runDemos()`.

PBSoptions-class

S4: Project Options Class

Description

Projects commonly involve various settings or options such as paths to C compilers or other third-party tools. **PBSmodelling** provides a set of option management functions for managing user specific options. Options can be modified through the provided set of functions on the command line, or through a custom GUI. These options can be saved to disk for use in subsequent R sessions.

To use **PBSmodelling**’s suite of option management functions, a `PBSoptions` object must be created for each of your projects. Each `PBSoptions` object contains a distinct R environment where option values are stored; this allows different projects to use overlapping option names without conflicts (provided each project has its own `PBSoptions` class object).

Details

When a PBSoptions object is created with the new function, the `initial.options` list, if supplied, is stored as initial user options in the object. The initialization routine then attempts to load user set options from the `filename` file. If such a file exists, these values are stored in the PBSoptions object overwriting any initial values as specified by `initial.options`

Option values are not directly stored in the object, but rather in an environment stored in the `instance` slot. Using an environment rather than slots for storing options allows us to pass option object by reference rather than value; that is, we can save options in the object without the need of returning a new modified class object. It is therefore necessary that users use the functions listed in the "see also" section to effectively manage user options.

Objects from the Class

Objects can be created by calls of the form

```
new("PBSoptions", filename, initial.options=list(), gui.prefix="option").
```

`filename`: default file name to use when saving and loading options to and from disk

`initial.options`: a list with distinctly named initial options to use if no previously saved file exists

`gui.prefix`: a prefix used to identify GUI variables which correspond to user options

Slots

`instance`: The R environment used to store options. Please do not use this directly; use the functions listed under the "see also" section.

Methods

print `signature(x = "PBSoptions")`: prints the list of options

Warning

Do not use the slots directly – use the access functions instead.

Author(s)

Alex Couture-Beil, Vancouver Island University, Nanaimo BC

See Also

[getOptions](#) for retrieving and modifying user options

[getOptionsFileName](#) for retrieving and modifying the default options file name

[loadOptions](#) for loading and saving options from and to disk

[getOptionsPrefix](#) for retrieving and modifying the GUI prefix (for custom GUI interfaces)

[loadOptionsGUI](#) for setting GUI values to reflect user options and vice-versa

Examples

```
local(envir=.PBSmodEnv,expr={
  #initialize an option manager with a single logical option
  .mypkg <- new( "PBSoptions", filename="my_pkg.txt",
    initial.options=list( sillyhatday=FALSE ) )

  #retrieving an option
  silly <- getOptions( .mypkg, "sillyhatday" )
  cat( "today is", ifelse( silly, "silly hat day!", "monday" ), "\n" )
})
```

```

#set an option
setOptions( .mypkg, sillyhatday = TRUE, photos = "/shares/silly_hat_photos" )

#create a GUI which works with options
createWin( c(
  "check name=optionsillyhatday text=\"silly hat day\"",
  "entry name=optionsphotos width=22 mode=character label=\"photos directory\"",
  "button func=doAction text=save action=saveOptionsGUI(.mypkg)" ), astext = TRUE )

#update GUI values based on values stored in .mypkg's options
loadOptionsGUI( .mypkg )
print(getOptions( .mypkg ))
})

```

pickCol

Pick a Colour From a Palette and get the Hexadecimal Code

Description

Display an interactive colour palette from which the user can choose a colour.

Usage

```
pickCol(returnValue=TRUE)
```

Arguments

returnValue	If TRUE, display the full colour palette, choose a colour, and return the hex value to the R session. If FALSE, use an intermediate GUI to interact with the palette and display the hex value of the chosen colour.
-------------	---

Value

A hexadecimal colour value.

Author(s)

Alex Couture-Beil, Vancouver Island University, Nanaimo BC

See Also

[testCol](#)

Examples

```

## Not run:
local(envir=.PBSmodEnv,expr={
  junk<-pickCol(); resetGraph()
  addLabel(.5,.5,junk,cex=4,col=junk)
})

## End(Not run)

```

plotACF

Plot Autocorrelation Bars From a Data Frame, Matrix, or Vector

Description

Plot autocorrelation bars (ACF) from a data frame, matrix, or vector.

Usage

```
plotACF(file, lags=20,
        clr=c("blue","red","green","magenta","navy"), ...)
```

Arguments

file	data frame, matrix, or vector of numeric values.
lags	maximum number of lags to use in the ACF calculation.
clr	vector of colours. Patterns are repeated if the number of fields exceed the length of clr.
...	additional arguments for plot or lines.

Details

This function is designed primarily to give greater flexibility when viewing results from the R-package BRugs. Use plotACF in conjunction with samplesHistory("*",beg=0,plot=FALSE) rather than samplesAutoC which calls plotAutoC.

Author(s)

Rowan Haigh, Pacific Biological Station, Fisheries and Oceans Canada, Nanaimo BC

Examples

```
local(envir=.PBSmodEnv,expr={
  oldpar = par(no.readonly=TRUE)
  resetGraph(); plotACF(trees,lwd=2,lags=30)
  par(oldpar)
})
```

plotAsp

Construct a Plot with a Specified Aspect Ratio

Description

Plot x and y coordinates using a specified aspect ratio.

Usage

```
plotAsp(x, y, asp=1, ...)
```

Arguments

x	vector of x-coordinate points in the plot.
y	vector of y-coordinate points in the plot.
asp	y/x aspect ratio.
...	additional arguments for plot.

Details

The function `plotAsp` differs from `plot(x,y,asp=1)` in the way axis limits are handled. Rather than expand the range, `plotAsp` expands the margins through padding to keep the aspect ratio accurate.

Author(s)

Alex Couture-Beil, Vancouver Island University, Nanaimo BC

Examples

```
local(envir=.PBSmodEnv,expr={
  oldpar = par(no.readonly=TRUE)
  x <- seq(0,10,0.1)
  y <- sin(x)
  par(mfrow=2:1)
  plotAsp(x,y,asp=1,xlim=c(0,10),ylim=c(-2,2), main="sin(x)")
  plotAsp(x,y^2,asp=1,xlim=c(0,10),ylim=c(-2,2), main="sin^2(x)")
  par(oldpar)
})
```

plotBubbles

Construct a Bubble Plot from a Matrix

Description

Construct a bubble plot for a matrix `z`.

Usage

```
plotBubbles(z, xval=FALSE, yval=FALSE, dnam=FALSE, rpro=FALSE,
  cpro=FALSE, rres=FALSE, cres=FALSE, powr=0.5, size=0.2, lwd=1,
  clrs=c("black","red","blue"), hide0=FALSE, frange=0.1, prettyaxis=FALSE, ...)
```

Arguments

z	input matrix, array (2 dimensions) or data frame.
xval	x-values and/or labels for the columns of <code>z</code> . if <code>xval=TRUE</code> , the first row contains x-values for the columns.
yval	y-values and/or labels for the rows of <code>z</code> . If <code>yval=TRUE</code> , the first column contains y-values for the rows.
dnam	logical: if <code>TRUE</code> , attempt to use dimnames of input matrix <code>z</code> as <code>xval</code> and <code>yval</code> . The dimnames are converted to numeric values and must be strictly increasing or decreasing. If successful, these values will overwrite previously specified values of <code>xval</code> and <code>yval</code> or any default indices.
rpro	logical: if <code>TRUE</code> , convert rows to proportions.

cpro	logical: if TRUE, convert columns to proportions.
rres	logical: if TRUE, use row residuals (subtract row means).
cres	logical: if TRUE, use column residuals (subtract column means).
powr	power transform. Radii are proportional to z^{powr} . Note: $\text{powr}=0.5$ yields bubble areas proportional to z .
size	size (inches) of the largest bubble.
lwd	line width for drawing circles.
clrs	colours (3-element vector) used for positive, negative, and zero values, respectively.
hide0	logical: if TRUE, hide zero-value bubbles.
frange	number specifying the fraction by which the range of the axes should be extended.
prettyaxis	logical: if TRUE, apply the pretty function to both axes.
...	additional arguments for plotting functions.

Details

The function `plotBubbles` essentially flips the z matrix visually. The columns of z become the x -values while the rows of z become the y -values, where the first row is displayed as the bottom y -value and the last row is displayed as the top y -value. The function's original intention was to display proportions-at-age vs. year.

Author(s)

Jon T. Schnute, Pacific Biological Station, Fisheries and Oceans Canada, Nanaimo BC

See Also

[genMatrix](#)

Examples

```
local(envir=.PBSmodEnv,expr={
  oldpar = par(no.readonly=TRUE)
  plotBubbles(round(genMatrix(40,20),0),clrs=c("green","grey","red"));
  data(CCA.qbr,envir=.PBSmodEnv)
  plotBubbles(CCA.qbr,cpro=TRUE,powr=.5,dnam=TRUE,size=.15,
    ylim=c(0,70),xlab="Year",ylab="Quillback Rockfish Age")
  par(oldpar)
})
```

plotCsum

Plot Cumulative Sum of Data

Description

Plot the cumulative frequency of a data vector or matrix, showing the median and mean of the distribution.

Usage

```
plotCsum(x, add = FALSE, ylim = c(0, 1), xlab = "Measure",
  ylab = "Cumulative Proportion", ...)
```

Arguments

x	vector or matrix of numeric values.
add	logical: if TRUE, add the cumulative frequency curve to a current plot.
ylim	limits for the y-axis.
xlab	label for the x-axis.
ylab	label for the y-axis.
...	additional arguments for the plot function.

Author(s)

Rowan Haigh, Pacific Biological Station, Fisheries and Oceans Canada, Nanaimo BC

Examples

```
local(envir=.PBSmodEnv,expr={
  oldpar = par(no.readonly=TRUE)
  x <- rgamma(n=1000,shape=2)
  plotCsum(x)
  par(oldpar)
})
```

plotDens

Plot Density Curves from a Data Frame, Matrix, or Vector

Description

Plot the density curves from a data frame, matrix, or vector. The mean density curve of the data combined is also shown.

Usage

```
plotDens(file, clr=c("blue","red","green","magenta","navy"), ...)
```

Arguments

file	data frame, matrix, or vector of numeric values.
clr	vector of colours. Patterns are repeated if the number of fields exceed the length of clr.
...	additional arguments for plot or lines.

Details

This function is designed primarily to give greater flexibility when viewing results from the R-package BRugs. Use plotDens in conjunction with samplesHistory("*",beg=0,plot=FALSE) rather than samplesDensity which calls plotDensity.

Author(s)

Rowan Haigh, Pacific Biological Station, Fisheries and Oceans Canada, Nanaimo BC

Examples

```
local(envir=.PBSmodEnv,expr={
  oldpar = par(no.readonly=TRUE)
  z <- data.frame(y1=rnorm(50,sd=2),y2=rnorm(50,sd=1),y3=rnorm(50,sd=.5))
  plotDens(z,lwd=3)
  par(oldpar)
})
```

plotFriedEggs

Render a Pairs Plot as Fried Eggs and Beer

Description

Create a pairs plot where the lower left half comprises either fried egg contours or smoke ring contours, the upper right half comprises glasses of beer filled to the correlation point, and the diagonals show frequency histograms of the input data.

Usage

```
plotFriedEggs(A, eggs=TRUE, rings=TRUE, levs=c(0.01,0.1,0.5,0.75,0.95),
  pepper=200, replace=FALSE, jitt=c(1,1), bw=25, histclr=NULL)
```

Arguments

A	data frame or matrix for use in a pairs plot.
eggs	logical: if TRUE, fry eggs in the lower panels.
rings	logical: if TRUE, blow smoke rings in the lower panels.
levs	explicit contour levels expressed as quantiles.
pepper	number of samples to draw from A to pepper the plots.
replace	logical: if TRUE, sample A with replacement.
jitt	argument factor used by function <code>base::jitter</code> when peppering. If user supplies two numbers, the first will jitter x, the second will jitter y.
bw	argument bandwidth used by function <code>KernSmooth::bkde2D</code> .
histclr	user-specified colour(s) for histogram bars along the diagonal.

Details

This function comes to us from Dr. Steve Martell of the Fisheries Science Centre at UBC. Obviously many hours of contemplation with his students at the local pub have contributed to this unique rendition of a pairs plot.

Note

If `eggs=TRUE` and `rings=FALSE`, fried eggs are served.
 If `eggs=FALSE` and `rings=TRUE`, smoke rings are blown.
 If `eggs=TRUE` and `rings=TRUE`, only fried eggs are served.
 If `eggs=FALSE` and `rings=FALSE`, only pepper is sprinkled.

Author(s)

Steve Martell, International Pacific Halibut Commission, Seattle WA

See Also

[plotBubbles](#), [scalePar](#)

KernSmooth::bkde2D, grDevices::contourLines, graphics::contour

Examples

```
local(envir=.PBSmodEnv,expr={
  oldpar = par(no.readonly=TRUE)
  x=rnorm(5000,10,3); y=-x+rnorm(5000,1,4); z=x+rnorm(5000,1,3)
  A=data.frame(x=x,y=y,z=z)
  for (i in 1:3)
    switch(i,
      {plotFriedEggs(A,eggs=TRUE,rings=FALSE);
        pause("Here are the eggs...(Press Enter for next)"}),
      {plotFriedEggs(A,eggs=FALSE,rings=TRUE);
        pause("Here are the rings...(Press Enter for next)"}),
      {plotFriedEggs(A,eggs=FALSE,rings=FALSE);
        cat("Here is the pepper alone.\n")})
  par(oldpar)
})
```

plotSidebars

Plot Table as Horizontal Sidebars

Description

Plot (x,y) table (matrix or data frame) as horizontal sidebars.

Usage

```
plotSidebars(z, scale = 1, col = lucent("blue", 0.25), ...)
```

Arguments

z	data frame or matrix of z-values (e.g., age frequencies) where rows form the plot's y-values and columns describe the grouping variable along the x-axis.
scale	numeric scale factor controlling the leftward expansion of z-value bars.
col	colour to fill bars.
...	additional parameters used by par and polygon. The user can also pass in two non-formal arguments to control the function: lbl – labels for the x- and y-axis; margin – function to report margin summaries.

Details

Plots z-data as horizontal bars arising from an x-coordinate controlled by the column names of z. The bars extend left along the y-coordinate by $z \times \text{scale}$ from the central x-coordinate.

Author(s)

Steve Martell, International Pacific Halibut Commission, Seattle WA

See Also

[plotBubbles](#), [plotFriedEggs](#), [evalCall](#)

Examples

```
local(envir=.PBSmodEnv,expr={
  oldpar = par(no.readonly=TRUE)
  pbsfun = function () {
    meanmarg = function(x){x=x[!is.na(x)];
      if (length(x)==0 | all(x==0)) NA else sum((x/sum(x))*as.numeric(names(x)))}
    data(CCA.qbr,envir=.PBSmodEnv)
    plotSidebars(CCA.qbr,scale=4,las=1,border="navyblue",mar=c(4,4,1,1),
      lbl=c("Year","Quillback Rockfish Age"),margin=function(x){round(meanmarg(x),0)})
    invisible() }
  pbsfun()
  par(oldpar)
})
```

plotTrace

Plot Trace Lines from a Data Frame, Matrix, or Vector

Description

Plot trace lines from a data frame or matrix where the first field contains x-values, and subsequent fields give y-values to be traced over x. If input is a vector, this is traced over the number of observations.

Usage

```
plotTrace(file, clr=c("blue","red","green","magenta","navy"), ...)
```

Arguments

file	data frame or matrix of x and y-values, or a vector of y-values.
clr	vector of colours. Patterns are repeated if the number of traces (y-fields) exceed the length of clr.
...	additional arguments for plot or lines.

Details

This function is designed primarily to give greater flexibility when viewing results from the R-package BRugs. Use plotTrace in conjunction with samplesHistory("*",beg=0,plot=FALSE) rather than samplesHistory which calls plotHistory.

Author(s)

Rowan Haigh, Pacific Biological Station, Fisheries and Oceans Canada, Nanaimo BC

Examples

```
local(envir=.PBSmodEnv,expr={
  oldpar = par(no.readonly=TRUE)
  z <- data.frame(x=1:50,y1=rnorm(50,sd=3),y2=rnorm(50,sd=1),y3=rnorm(50,sd=.25))
  plotTrace(z,lwd=3)
  par(oldpar)
})
```

presentTalk

Run a Presentation in R

Description

Start an R talk from a *talk description file* that launches a control GUI.

Usage

```
presentTalk(talk)
```

Arguments

talk name of file containing XML code (e.g., `swisstalk.xml`).

Details

The function `presentTalk` is a tool that facilitates lectures and workshops in R. The function allows the presenter to show code snippets alongside their execution, making use of R's graphical capabilities. When `presentTalk` is called, a graphical user interface (GUI) is launched that allows the user to control the flow of the talk (e.g., switching between talks or skipping to various sections of a talk).

The automatic control buttons allow the user to move forward or backward in the talk. The GO button moves forward one tag segment, the Back button moves back to the previous tag segment. The blue buttons allow movement among sections – Prev to the previous section, Restart to the start of the current section, and Next to the next section. Drop down lists are provided for both indicating the current section and slide number and as an additional interface for jumping between different sections or slide numbers.

In addition to the automatic menu items, a user can add buttons to the GUI that accomplish similar purposes.

Note

See the *PBSmodelling User's Guide* for more information.

Author(s)

Alex Couture-Beil, Vancouver Island University, Nanaimo BC

See Also

See [PBStalk-class](#) for more details on **PBSmodelling**'s talk presentation classes.

Examples

```
local(envir=.PBSmodEnv,expr={
  cwd = getwd()
  talk_dir <- system.file("examples", package = "PBSmodelling" )
  setwd(talk_dir)
  presentTalk( "swisstalk.xml" ) # closing the GUI should restore cwd
})
```

promptWriteOptions	<i>Prompt the User to Write Changed Options</i>
--------------------	---

Description

If changes have been made to PBS options, this function allows the user to choose whether to write PBS options to an external file that can be loaded later by readPBSOptions.

Usage

```
promptWriteOptions(fname="")
```

Arguments

fname	name of file where options will be saved.
-------	---

Details

If there are options that have been changed in the GUI but have not been committed to PBSmodelling memory in the global R environment, the user is prompted to choose whether or not to commit these options.

Then, if any PBS options have been changed, the user is prompted to choose whether to save these options to the file fname. (When a new R session is started or when a call to readPBSOptions or writePBSOptions is made, PBS options are considered to be unchanged; when an option is set, the options are considered to be changed).

If fname="", the user is prompted to save under the file name last used by a call to readPBSOptions or writePBSOptions if available. Otherwise, the default file name "PBSOptions.txt" is used.

Author(s)

Anisa Egeli, Vancouver Island University, Nanaimo BC

See Also

[writePBSOptions](#), [readPBSOptions](#), [setPBSOptions](#)

Examples

```
## Not run:
local(envir=.PBSmodEnv,expr={
  promptWriteOptions() #uses default filename PBSOptions.txt
})

## End(Not run)
```

readList

Read a List from a File in PBS Modelling Format

Description

Read in a list previously saved to a file by writeList. At present, only two formats are supported: R's native format used by the dput function and an ad hoc PBSmodelling format. The function readList detects the format automatically.

For information about the PBSmodelling format, see writeList.

Usage

```
readList(fname)
```

Arguments

fname file name of the text file containing the list.

Value

List obtained from the file.

Warning

When importing a list in the PBSmodelling ("P") format, if two list elements share the same name, the list will import incorrectly.

Author(s)

Alex Couture-Beil, Vancouver Island University, Nanaimo BC

See Also

[packList](#), [unpackList](#), [writeList](#)

readPBSoptions*Read PBS Options from an External File*

Description

Load options that were saved using writePBSoptions, for use with openFile, getPBSoptions or interfaces such as loadC.

Usage

```
readPBSoptions(fname="PBSoptions.txt")
```

Arguments

fname file name or full path of file from which the options will be loaded.

Note

If an option exists in R memory but not in the saved file, the option is not cleared from memory.

Author(s)

Anisa Egeli, Vancouver Island University, Nanaimo BC

See Also

[writePBSoptions](#), [getGUIoptions](#), [openFile](#), [getPBSoptions](#)

resetGraph

Reset par Values for a Plot

Description

Reset `par()` to default values to ensure that a new plot utilizes a full figure region. This function helps manage the device surface, especially after previous plotting has altered it.

Usage

```
resetGraph(reset.mf=TRUE)
```

Arguments

`reset.mf` if TRUE reset the multi-frame status; otherwise preserve `mfrow`, `mfcol`, and `mfg`

Details

This function resets `par()` to its default values. If `reset.mf=TRUE`, it also clears the graphics device with `frame()`. Otherwise, the values of `mfrow`, `mfcol`, and `mfg` are preserved, and graphics continues as usual in the current plot. Use `resetGraph` only before a high level command that would routinely advance to a new frame.

Value

invisible return of the reset value `par()`

Author(s)

Jon T. Schnute, Pacific Biological Station, Fisheries and Oceans Canada, Nanaimo BC

restorePar

Get Actual Parameters from Scaled Values

Description

Restore scaled parameters to their original units. Used in minimization by calcMin.

Usage

```
restorePar(S,pvec)
```

Arguments

S	scaled parameter vector.
pvec	a data frame comprising four columns - c("val", "min", "max", "active") and as many rows as there are model parameters. The "active" field (logical) determines whether the parameters are estimated (TRUE) or remain fixed (FALSE).

Details

Restoration algorithm: $P = P_{min} + (P_{max} - P_{min})(\sin(\frac{\pi S}{2}))^2$

Value

Parameter vector converted from scaled units to original units specified by pvec.

Author(s)

Jon T. Schnute, Pacific Biological Station, Fisheries and Oceans Canada, Nanaimo BC

See Also

[scalePar](#), [calcMin](#), [GT0](#)

Examples

```
local(envir=.PBSmodEnv,expr={
  pvec <- data.frame(val=c(1,100,10000),min=c(0,0,0),max=c(5,500,50000),
    active=c(TRUE,TRUE,TRUE))
  S    <- c(.5,.5,.5)
  P    <- restorePar(S,pvec)
  print(cbind(pvec,S,P))
})
```

`runDemos`*Interactive GUI for R Demos*

Description

An interactive GUI for accessing demos from any R package installed on the user's system. `runDemos` is a convenient alternative to R's `demo` function.

Usage

```
runDemos(package)
```

Arguments

`package` display demos from a particular package (optional).

Details

If the argument `package` is not specified, the function will look for demos in all packages installed on the user's system.

Note

The `runDemos` GUI attempts to retain the user's objects and restore the working directory. However, pre-existing objects will be overwritten if their names coincide with names used by the various demos. Also, depending on conditions, the user may lose working directory focus. We suggest that cautious users run this demo from a project where data objects are not critical.

Author(s)

Alex Couture-Beil, Vancouver Island University, Nanaimo BC

See Also

[runExamples](#) for examples specific to **PBSmodelling**.

`runExample`*Run a Single GUI Example Included with PBS Modelling*

Description

Display a GUI to demonstrate one PBS Modelling example.

The example source files can be found in the R directory `.../library/PBSmodelling/examples`.

Usage

```
runExample(ex, pkg="PBSmodelling")
```

Arguments

`ex` string specifying an example in the `pkg` directory `examples`.
`pkg` package with an `examples` subdirectory.

Details

If no example is specified or if the example does not exist, a GUI pops up informing you of potential choices. Note that the string choice is case-sensitive.

Some examples use external packages which must be installed to work correctly:

BRugs - LinReg, MarkRec, and CCA;
 odesolve/PBSddesolve - FishRes;
 PBSmapping - FishTows.

Note

The examples are copied from `.../library/PBSmodelling/examples` to R's current temporary working directory and run from there.

Author(s)

Rowan Haigh, Pacific Biological Station, Fisheries and Oceans Canada, Nanaimo BC

See Also

[runDemos](#), [runExamples](#)

runExamples

Run GUI Examples Included with PBS Modelling

Description

Display an interactive GUI to demonstrate PBS Modelling examples.

The example source files can be found in the R directory `.../library/PBSmodelling/examples`.

Usage

```
runExamples()
```

Details

Some examples use external packages which must be installed to work correctly:

BRugs - LinReg, MarkRec, and CCA;
 odesolve/PBSddesolve - FishRes;
 PBSmapping - FishTows.

Note

The examples are copied from `.../library/PBSmodelling/examples` to R's current temporary working directory and run from there.

Author(s)

Alex Couture-Beil, Vancouver Island University, Nanaimo BC

See Also

[runDemos](#), [runExample](#)

scalePar

Scale Parameters to [0,1]

Description

Scale parameters for function minimization by calcMin.

Usage

```
scalePar(pvec)
```

Arguments

pvec a data frame comprising four columns - c("val", "min", "max", "active") and as many rows as there are model parameters. The "active" field (logical) determines whether the parameters are estimated (TRUE) or remain fixed (FALSE).

Details

Scaling algorithm: $S = \frac{2}{\pi} \sin \sqrt{\frac{P - P_{min}}{P_{max} - P_{min}}}$

Value

Parameter vector scaled between 0 and 1.

Author(s)

Jon T. Schnute, Pacific Biological Station, Fisheries and Oceans Canada, Nanaimo BC

See Also

[restorePar](#), [calcMin](#), [GT0](#)

Examples

```
local(envir=.PBSmodEnv,expr={
  pvec <- data.frame(val=c(1,100,10000),min=c(0,0,0),max=c(5,500,50000),
    active=c(TRUE,TRUE,TRUE))
  S <- scalePar(pvec)
  print(cbind(pvec,S))
})
```

selectDir

Display Dialogue: Select directory

Description

Display the default directory chooser prompt provided by the Operating System.

Usage

```
selectDir(initialdir=getwd(), mustexist=TRUE, title="",
          usewidget=NULL)
```

Arguments

initialdir	initially selected directory
mustexist	if logical value is TRUE, only a existing directory can be selected
title	title for the prompt window
usewidget	store the selected directory in the named entry widget

Value

The directory path selected by the user

Author(s)

Alex Couture-Beil, Vancouver Island University, Nanaimo BC

See Also

[selectFile](#)

Examples

```
## Not run:
local(envir=.PBSmodEnv,expr={
  dir(selectDir(title="select a directory to list contents of"))

  #integration with widget via doAction
  createWin( c( "entry foo mode=character",
    "button text=\"select dir\"
    func=doAction action=\"selectDir(usewidget='foo')\""), astext=TRUE )
})

## End(Not run)
```

selectFile	<i>Display Dialogue: Open or Save File</i>
------------	--

Description

Display the default **Open** or **Save** prompt provided by the Operating System.

Usage

```
selectFile(initialfile="", initialdir=getwd(),
  filetype=list(c("*","All Files")), mode="open", multiple=FALSE,
  title="", defaulttextension="", usewidget=NULL)
```

Arguments

initialfile	initially selected file
initialdir	initially directory the dialog opens
filetype	a list of character vectors indicating file types made available to users of the GUI. Each vector is of length one or two. The first element specifies either the file extension or "*" for all file types. The second element gives an optional descriptor name for the file type. The supplied filetype list appears as a set of choices in the pull-down box labelled "Files of type:".
mode	string: if "save" display Save As prompt, if "open" display Open prompt.
multiple	if TRUE the open prompt can select multiple files. This has no effect for the save prompt.
title	title for the prompt window
defaulttextension	default file extension if none is provided by the user
usewidget	store the selected file in the named entry widget

Value

The file name and path of the file(s) selected by the user.

Author(s)

Alex Couture-Beil, Vancouver Island University, Nanaimo BC

See Also

[selectDir](#)

Examples

```
## Not run:
local(envir=.PBSmodEnv,expr={
  #integration with widget via doAction
  createWin( c( "entry foo mode=character width=60",
    "button text=\"select file\""
    func=doAction action=\"selectFile(usewidget='foo')\" ), astext=TRUE )
})

## End(Not run)
```

setFileOption	<i>Set a PBS File Path Option Interactively</i>
---------------	---

Description

Set a PBS option by browsing for a file. This function provides an alternative to using `setPBSOptions` when setting an option that has a path to a file as its value.

Usage

```
setFileOption(option)
```

Arguments

option	name PBS option to change
--------	---------------------------

Note

If all the required arguments are missing, it is assumed that the function is being called by a GUI widget.

Author(s)

Anisa Egeli, Vancouver Island University, Nanaimo BC

See Also

[setPathOption](#), [setPBSOptions](#)

Examples

```
## Not run:
local(envir=.PBSmodEnv,expr={
  setPathOption("editor")
})

## End(Not run)
```

setGUIOptions	<i>Set PBS Options from Widget Values</i>
---------------	---

Description

Set PBS options from corresponding values of widgets in a GUI.

Usage

```
setGUIOptions(option)
```

Arguments

option	the name of a single option or the string "*".
--------	--

Details

A GUI may have PBS options that it uses, which have corresponding widgets that are used for entering values for these options. These are declared by `declareGUIOptions`.

If the option argument is the name of an option, `setGUIOptions` transfers the value of this option from a same-named widget into PBS options global R environment database.

If the option argument is "*", then all the options that have been declared by `declareGUIOptions` will be transferred in this fashion.

To use this function in a *window description file*, the option argument must be specified as the action of the widget that calls `setGUIOptions` – `action=editor` or `action=*` for example.

Note

If all the required arguments are missing, it is assumed that the function is being called by a GUI widget.

Author(s)

Anisa Egeli, Vancouver Island University, Nanaimo BC

See Also

[declareGUIOptions](#), [getGUIOptions](#), [setPBSOptions](#),

Examples

```
## Not run:
local(envir=.PBSmodEnv,expr={
  setGUIOptions("editor")
})

## End(Not run)
```

setPathOption

Set a PBS Path Option Interactively

Description

Set a PBS option by browsing for a directory. This function provides an alternative to using `setPBSOptions` when setting an option that has a path as its value.

Usage

```
setPathOption(option)
```

Arguments

option name PBS option to change

Note

If all the required arguments are missing, it is assumed that the function is being called by a GUI widget.

Author(s)

Anisa Egeli, Vancouver Island University, Nanaimo BC

See Also

[setFileOption](#), [setPBSoptions](#)

Examples

```
## Not run:
local(envir=.PBSmodEnv,expr={
  setPathOption("myPath")
})

## End(Not run)
```

setPBSext

Set a Command Associated with a File Name Extension

Description

Set a command with an associated extension, for use in `openFile`. The command must specify where the target file name is inserted by indicating a "%f".

Usage

```
setPBSext(ext, cmd)
```

Arguments

ext	string specifying the extension suffix.
cmd	command string to associate with the extension.

Note

These values are not saved from one *PBS Modelling* session to the next.

Author(s)

Alex Couture-Beil, Vancouver Island University, Nanaimo BC

See Also

[getPBSext](#), [openFile](#), [clearPBSext](#)

setPBSOptions

*Set A User Option***Description**

Options set by the user for use by other functions.

Usage

```
setPBSOptions(option, value, sublist=FALSE)
```

Arguments

option	name of the option to set.
value	new value to assign this option.
sublist	if value is a sublist (list component) of option, this list component can be changed individually using sublist=TRUE.

Details

Objects can be placed into the PBS options manager (see [PBSOptions-class](#)).

If the user wishes to change the object associated with an option, issue the command:

```
setPBSOptions("someOldOption", someNewOption)
```

If an option comprises a list object, a user can alter specific components of the list by activating the sublist argument:

```
setPBSOptions(option="myList", value=list(gamma=130), sublist=TRUE)
```

See example below.

Note

A value `.PBSmod$.options$.optionsChanged` is set to TRUE when an option is changed, so that the user doesn't always have to be prompted to save the options file.

By default, `.PBSmod$.options$.optionsChanged` is not set or NULL.

Also, if an option is set to "" or NULL then it is removed.

`.initPBSOptions()` is now called first (options starting with a dot "." do not set `.optionsChanged`).

Author(s)

Alex Couture-Beil, Vancouver Island University, Nanaimo BC

See Also

[getPBSOptions](#), [writePBSOptions](#), [readPBSOptions](#)

Examples

```

local(envir=.PBSmodEnv,expr={
  myList=list(alpha=1,beta=2,gamma=3,delta=4)
  setPBSOptions(option="myList", myList)
  cat("Original myList:\n-----\n")
  print(getPBSOptions("myList"))
  setPBSOptions(option="myList", value=list(gamma=130), sublist=TRUE)
  cat("Revised myList:\n-----\n")
  print(getPBSOptions("myList"))
})

```

setwdGUI

*Browse for Working Directory and Optionally Find Prefix***Description**

Allows the user to browse a directory tree to set the working directory. Optionally, files with given suffixes can be located in the new directory.

Usage

```
setwdGUI()
```

Examples

```

local(envir=.PBSmodEnv,expr={
  createWin( "button text=\"Change working directory\" func=setwdGUI", astatic=TRUE )
})

```

setWidgetColor

*Update Widget Color***Description**

Update the foreground and background colors of a widget

Usage

```
setWidgetColor(name, radioValue, winName = .PBSmodEnv$.PBSmod$.activeWin, ...)
```

Arguments

name	the name of the widget
radioValue	if specified, modify a particular radio option, as identified by the value, rather than the complete set (identified by the common name)
winName	window from which to select the GUI widget. The window that most recently receive user input is used by default if winname is not supplied
...	any combination of "fg", "bg", "disablefg", "disablebg", "entryfg", "entrybg", "noeditfg", "noeditbg" arguments, depending on type of widget - see details

Details

The setWidgetColor function allows dynamic updating of widget colors during program execution. However, two factors determine whether dynamic color updating is possible for a particular widget: (i) the type of widget, and (ii) the nature of the Tk implementation in the underlying widget library. Thus, a given widget may not support all combinations of colour variables. The following widgets support the corresponding options:

button: fg, bg, disablefg

check: fg, bg, disablefg, entryfg, entrybg

data: entryfg, entrybg, noeditfg, noeditbg

droplist: fg, bg

entry: entryfg, entrybg, noeditfg, noeditbg

label: fg, bg

matrix: entryfg, entrybg, noeditfg, noeditbg

object: entryfg, entrybg, noeditfg, noeditbg

progressbar: fg, bg

radio: fg, bg

slide: fg, bg

spinbox: entryfg, entrybg

text: fg, bg

vector: entryfg, entrybg, noeditfg, noeditbg

These options are described in the PBSmodelling User Guide under Appendix A.

Be aware that Tk uses gray for the highlight color during a selection operation. This means that when the background colour is also gray, there is no visual clue that the value has been selected for a copy operation.

Author(s)

Alex Couture-Beil (VIU, Nanaimo BC) and Allen R. Kronlund (PBS, Nanaimo BC)

Examples

```
local(envir=.PBSmodEnv,expr={
  createWin("label \"hello world\" name=hello", astext=TRUE)
  setWidgetColor( "hello", bg="lightgreen", fg="purple" )
})
local(envir=.PBSmodEnv,expr={
  createWin("vector names=v length=3 values=\"1 2 3\"", astext=TRUE)
  setWidgetColor( "v[1]", entrybg="lightgreen", entryfg="purple" )
  setWidgetColor( "v[2]", entrybg="green", entryfg="purple" )
  setWidgetColor( "v[3]", entrybg="forestgreen", entryfg="purple" )
})
```

setWidgetState

Update Widget State

Description

Update the read-only state of a widget.

Usage

```
setWidgetState( varname, state, radiovalue, winname, warn=TRUE )
```

Arguments

varname	the name of the widget
state	"normal" or "disabled" and for some widgets "readonly" as described under Details below.
radiovalue	if specified, disable a particular radio option, as identified by the value, rather than the complete set (identified by the common name)
winname	window from which to select the GUI widget. The window that most recently receive user input is used by default if winname is not supplied.
warn	if TRUE, display a warning if readonly is converted to disabled (only applies for widgets that don't accept readonly)

Details

The setWidgetState function allows dynamic control of widget functioning during program execution. The function serves as a wrapper for the tkconfigure function available in the underlying Tk libraries used by PBS Modelling. Thus, setWidgetState is only available for those widgets that use Tk library widgets.

The state of the following PBS Modelling widgets can be set to "normal" or "disabled": button, check, data, droplist, entry, matrix, object, radio, slide, spinbox, table, text, and vector. When the state variable is set to "disabled", values displayed in the widget cannot be changed or copied except in the case of the object and table widgets which permit the values to be copied.

The data, entry, matrix, and vector widgets support a "readonly" state that allows values displayed in the widget to be copied but not changed. The displayed value can be selected using the keyboard or mouse. However, the copy and paste operations can only be accomplished via Ctrl-C and Ctrl-V, respectively, not the mouse.

Be aware that Tk uses gray for the highlight color during a selection operation. This means that when the background colour is also gray, there is no visual clue that the value has been selected for a copy operation.

Exceptions to the behaviour determined by state include the object, table and text widgets. There is no "read-only" state applicable to these widgets. Nevertheless, the values displayed can be copied even when the state is "disabled".

Individual radio widgets grouped by the name variable of a radio declaration can be updated by specifying radiovalue in the call to setWidgetState.

The state of individual elements in the data, matrix, and vector widgets can be updated by indexing. For the vector and matrix widgets any element can be addressed by appending the desired index to the widget name using square brackets (e.g., "myVec[2]" or "myMatrix[2,3]"). The data widget is indexed differently than the matrix widget by adding "d" after the brackets (e.g., "myData[1,1]d"). This change in syntax is required for internal coding of PBS Modelling.

Author(s)

Alex Couture-Beil (VIU, Nanaimo BC) and Allen R. Kronlund (PBS, Nanaimo BC)

Examples

```
## Not run:
local(envir=.PBSmodEnv,expr={
  winDesc <- c('vector length=3 name=vec labels="normal disabled readonly" values="1 2 3"',
    "matrix nrow=2 ncol=2 name=mat", "button name=but_name" );
  createWin(winDesc, astext=TRUE)

  setWidgetState( "vec[1]", "normal" )
  setWidgetState( "vec[2]", "disabled" )
  setWidgetState( "vec[3]", "readonly" )

  setWidgetState( "mat", "readonly" )
  setWinVal( list( mat = matrix( 1:4, 2, 2 ) ) )

  #works for buttons too
  setWidgetState( "but_name", "disabled" )
})

## End(Not run)
```

setWinAct

Add a Window Action to the Saved Action Vector

Description

Append a string value specifying an action to the first position of an action vector.

Usage

```
setWinAct(winName, action)
```

Arguments

winName	window name where action is taking place.
action	string value describing an action.

Details

When a function is called from a GUI, a string descriptor associated with the action of the function is stored internally (appended to the first position of the action vector). A user can utilize this action as a type of argument for programming purposes. The command `getWinAct()[1]` yields the latest action.

Sometimes it is useful to “fake” an action. Calling `setWinAct` allows the recording of an action, even if a button has not been pressed.

Author(s)

Alex Couture-Beil, Vancouver Island University, Nanaimo BC

setWinVal

*Update Widget Values***Description**

Update a widget with a new value.

Usage

```
setWinVal(vars, winName)
```

Arguments

vars	a list or vector with named components.
winName	window from which to select GUI widget values. The default takes the window that has most recently received new user input.

Details

The vars argument expects a list or vector with named elements. Every element name corresponds to the widget name which will be updated with the supplied element value.

The vector, matrix, and data widgets can be updated in several ways. If more than one name is specified for the names argument of these widgets, each element is treated like an entry widget.

If however, a single name describes any of these three widgets, the entire widget can be updated by passing an appropriately sized object.

Alternatively, any element can be updated by appending its index in square brackets to the end of the name. The data widget is indexed differently than the matrix widget by adding "d" after the brackets. This tweak is necessary for the internal coding (bookkeeping) of *PBS Modelling*. Example: "foo[1,1]d".

Author(s)

Alex Couture-Beil, Vancouver Island University, Nanaimo BC

See Also

[getWinVal](#), [createWin](#)

Examples

```
## Not run:
local(envir=.PBSmodEnv,expr={
  winDesc <- c("vector length=3 name=vec",
    "matrix nrow=2 ncol=2 name=mat", "slideplus name=foo");
  createWin(winDesc, astext=TRUE)
  setWinVal(list(vec=1:3, "mat[1,1]"=123, foo.max=1.5, foo.min=0.25, foo=0.7))
})

## End(Not run)
```

show0

*Convert Numbers into Text with Specified Decimal Places***Description**

Return a character representation of a number with added zeroes out to a specified number of decimal places.

Usage

```
show0(x, n, add2int=FALSE, round2n=FALSE)
```

Arguments

x	numeric data (scalar, vector, or matrix).
n	number of decimal places to show, including zeroes.
add2int	if TRUE, add zeroes to integers after the decimal.
round2n	if TRUE, round x first to n decimal places.

Value

A scalar/vector of strings representing numbers. Useful for labelling purposes.

Note

By default, this function does not round or truncate numbers. It simply adds zeroes if n is greater than the available digits in the decimal part of a number. The user can choose to round the numbers first by setting argument round2n = TRUE.

Author(s)

Rowan Haigh, Pacific Biological Station, Fisheries and Oceans Canada, Nanaimo BC

See Also

[pad0](#), [GT0](#)

Examples

```
local(envir=.PBSmodEnv,expr={
  oldpar = par(no.readonly=TRUE)
  frame()

  #do not show decimals on integers
  addLabel(0.25,0.75,show0(15.2,4))
  addLabel(0.25,0.7,show0(15.1,4))
  addLabel(0.25,0.65,show0(15,4))

  #show decimals on integers
  addLabel(0.25,0.55,show0(15.2,4,TRUE))
  addLabel(0.25,0.5,show0(15.1,4,TRUE))
  addLabel(0.25,0.45,show0(15,4,TRUE))
  par(oldpar)
})
```

showAlert	<i>Display a Message in an Alert Window</i>
-----------	---

Description

Display an alert window that contains a specified message and an OK button for dismissing the window.

Usage

```
showAlert(message, title="Alert", icon="warning")
```

Arguments

message	message to display in alert window
title	title of alert window
icon	icon to display in alert window; options are "error", "info", "question", or "warning".

Author(s)

Anisa Egeli, Vancouver Island University, Nanaimo BC

See Also

[getYes](#)

Examples

```
## Not run:
local(envir=.PBSmodEnv,expr={
  showAlert("Hello World!")
})

## End(Not run)
```

showArgs	<i>Display Expected Widget Arguments</i>
----------	--

Description

For each widget specified, display its arguments in order with their default values. The display list can be expanded to report each argument on a single line.

Usage

```
showArgs(widget, width=70, showargs=FALSE)
```

Arguments

widget	vector string of widget names; if not specified (default), the function displays information about all widgets in alphabetical order.
width	numeric width used by <code>strwrap</code> to wrap lines of the widget usage section.
showargs	logical; if TRUE, the display also lists each argument on single line after the widget usage section.

Value

A text stream to the R console. Invisibly returns the widget usage lines.

Author(s)

Alex Couture-Beil, Vancouver Island University, Nanaimo BC

showHelp

Display HTML Help Pages for Packages in Browser

Description

Display the help pages for installed packages that match the supplied pattern in an HTML browser window.

Usage

```
showHelp(pattern="methods", ...)
```

Arguments

pattern	string pattern to match to package names
...	allows user to specify two additional arguments: remote - character string giving a valid URL for the R_HOME directory on a remote location; update - logical: if TRUE, attempt to update the package index to reflect the currently available packages. (Not attempted if remote is non-NULL.)

Details

The specified pattern is matched to R-packages installed on the user's system. The code uses the `utils` function `browseURL` to display the HTML Help Pages using a browser that the system associates with `html` extensions. (See help for `browseURL` for other operating systems.)

Value

A list is invisibly returned, comprising:

Apacks	all packages installed on user's system
Spacks	selected packages based on specified pattern
URLs	path and file name of HTML Help Page

Help pages are displayed in a separate browser window.

Note

The connection time for browsers (at least in Windows OS) is slow. If the HTML browser program is not already running, multiple matching pages will most likely not be displayed. However, subsequent calls to `showHelp` should show all matches.

Author(s)

Rowan Haigh, Pacific Biological Station, Fisheries and Oceans Canada, Nanaimo BC

See Also

[viewCode](#), [showPacks](#)

showPacks

Show Packages Required But Not Installed

Description

Show the packages specified by the user and compare these to the installed packages on the user's system. Display packages not installed.

Usage

```
showPacks(packs=c("PBSmodelling", "PBSmapping", "PBSddesolve",
  "rgl", "deSolve", "akima", "deldir", "sp", "maptools", "KernSmooth"))
```

Arguments

packs string vector of package names that are compared to installed packages.

Value

Invisibly returns a list of Apacks (all packages installed on user's system), Ipacks (packages in packs that are installed), and Mpacks (packages that are missing).

Author(s)

Jon T. Schnute, Pacific Biological Station, Fisheries and Oceans Canada, Nanaimo BC

showRes

Show Results of Expression Represented by Text

Description

Evaluate the supplied expression, reflect it on the command line, and show the results of the evaluation.

Usage

```
showRes(x, cr=TRUE, pau=TRUE)
```

Arguments

x an R expression to evaluate
cr logical: if TRUE, introduce extra carriage returns
pau logical: if TRUE, pause after expression reflection and execution

Value

The results of the expression are return invisibly.

Author(s)

Jon T. Schnute, Pacific Biological Station, Fisheries and Oceans Canada, Nanaimo BC

Examples

```
local(envir=.PBSmodEnv,expr={
  showRes("x=rnorm(100)",pau=FALSE)
})
```

showVignettes

Display Vignettes for Packages

Description

Create a GUI that displays all vignettes for installed packages. The user can choose to view the source file for building the vignette or the final .pdf file.

Usage

```
showVignettes(package)
```

Arguments

package character string specifying package name that exists in the user's R library

Details

If the argument package is not specified, the function will look for vignettes in all packages installed on the user's system. The user can choose to view the source file for building the vignette (usually *.Rnw or *.Snw files) or the final build from the source code (*.pdf).

showVignettes uses the **PBSmodelling** function openFile to display the .Rnw and .pdf files using programs that the system associates with these extensions. On systems that do not support file extension associations, the function setPBSext can temporarily set a command to associate with an extension.

Author(s)

Anisa Egeli, Vancouver Island University, Nanaimo BC

See Also

[showHelp](#), [openFile](#), [setPBSext](#), [getPBSext](#)

sortHistory

Sort an Active or Saved History

Description

Utility to sort history. When called without any arguments, an interactive GUI is used to pick which history to sort. When called with hisname, sort this active history widget. When called with file and outfile, sort the history located in file and save to outfile.

Usage

```
sortHistory(file="", outfile=file, hisname="")
```

Arguments

file	file name of saved history to sort.
outfile	file to save sorted history to.
hisname	name of active history widget and window it is located in, given in the form WINDOW.HISTORY.

Details

After selecting a history to sort (either from given arguments, or interactive GUI) the R data editor window will be displayed. The editor will have one column named \"new\" which will have numbers 1,2,3,...,n. This represents the current ordering of the history. You may change the numbers around to define a new order. The list is sorted by reassigning the index in row *i* as index *i*.

For example, if the history had three items 1,2,3. Reordering this to 3,2,1 will reverse the order; changing the list to 1,2,1,1 will remove entry 3 and create two duplicates of entry 1.

Author(s)

Alex Couture-Beil, Vancouver Island University, Nanaimo BC

See Also

[importHistory](#), [initHistory](#)

talk-class

S4: Present Talk Classes

Description

The function `presentTalk` is a tool that facilitates lectures and workshops in R. It allows the presenter to show code snippets alongside their execution, making use of R's graphical capabilities.

For `presentTalk` to work, six S4 class objects are created:

talk. root element that constitutes a talk;
 section. branch element that defines a section within a talk;
 text. leaf element that specifies text to be printed on the R console;
 file. leaf element that specifies files to be opened by the OS;
 code. leaf element that specifies R code to be executed;
 break. leaf element that specifies where to allow a break in the talk.

The leaf elements, also termed *primitive* elements, occur in isolation and cannot contain other elements. Therefore, only two levels of nesting are supported: sections within a talk and primitives within a section.

See Appendix B in the **PBSmodelling** User's Guide for more information.

Details

This function uses a convenience function called `xmlGetAttr` (from the package **XML**) that retrieves the value of a named attribute in an XML node.

The function `presentTalk` translates the XML code into a list structure called `.presentTalk` below the global object `.PBSmod`. The GUI is represented as a list structure called `presentwin` under `.PBSmod`, as for all GUI objects in **PBSmodelling**.

Slots Available

talk		
name	character	string giving the name of the talk (required)
sections	list	list of sections within the talk
files	list	list of files within the talk
section		
name	character	string giving the name of the section (required)
items	list	list of the four primitive (leaf-element) S4 classes
button	logical	should GUI have a button that selects section?
col	integer	column in lower section of GUI to place button
section_id	integer	specify if section does not immediately follow a talk
text		
text	character	text to display on the R console
"break"	logical	break the presentation after displaying the text specified?
file		
name	character	string giving the name in the GUI for a group of files to open (required)
filename	character	individual file names associated with the group name in the GUI
"break"	logical	break the presentation after opening the group of files?
button	logical	should GUI add a button that opens this group of files?
col	integer	column in lower section of GUI to place button
code		
show	logical	show the code snippet in the R console?
print	logical	print the results of running the R code?
code	character	the actual chunk of R code
"break"	character	string describing where to introduce breaks in the code segment
eval	logical	evaluate the R code?
break		
.xData	NULL	allows a break in the talk for user interaction on the R console.

Creating S4 Objects

Objects can be created by calls of the form:

```
new("talk", name=name)
new("section",
  name      = node$attributes["name"],
  button    = as.logical(xmlGetAttr(node,"button",FALSE)),
  col       = as.integer(xmlGetAttr(node,"col",2)))
new("text",
  text      = xmlValue(node),
  "break"   = as.logical(xmlGetAttr(node,"break",TRUE)))
new("file",
  name      = xmlGetAttr(node,"name",""),
  "break"   = as.logical(xmlGetAttr(node,"break",TRUE)),
  filename  = xmlValue(node),
  button    = as.logical(xmlGetAttr(node,"button",FALSE)),
  col       = as.integer(xmlGetAttr(node,"col",3)))
new("code",
  show      = as.logical(xmlGetAttr(node,"show",TRUE)),
  print     = as.logical(xmlGetAttr(node,"print",TRUE)),
  code      = xmlValue(node),
```

```
"break" = tolower(xmlGetAttr(node,"break","print"))
new("break")
```

Author(s)

Alex Couture-Beil, Vancouver Island University, Nanaimo BC

See Also

[presentTalk](#) for presenting a talk in R.
[xmlGetAttr](#) for retrieving the value of a named attribute in an XML node.
[setClass](#) for creating a class definition.
[PBSoptions-class](#) for a complicated S4 class implementation.

testAlpha

Test Various Alpha Transparency Values

Description

Display how the alpha transparency for `rgb()` varies.

Usage

```
testAlpha(alpha=seq(0,1,len=25), fg="blue", bg="yellow",
          border="black", grid=FALSE, ...)
```

Arguments

<code>alpha</code>	numeric vector of alpha transparency values values from 0 to 1.
<code>fg</code>	foreground colour of the top shape that varies in transparency.
<code>bg</code>	background colour (remains constant) of the underlying shape.
<code>border</code>	border colour (which also changes in transparency) of the foreground polygon.
<code>grid</code>	logical: if TRUE, lay a grey grid on the background colour.
<code>...</code>	additional graphical arguments to send to the the plotting functions.

Value

Invisibly returns the compound RGB matrix for `fg`, `alpha`, `bg`, and `border`.

Author(s)

Jon T. Schnute, Pacific Biological Station, Fisheries and Oceans Canada, Nanaimo BC

See Also

[testCol](#), [testPch](#), [testLty](#), [testLwd](#)

testCol

Display Colours Available Using a Set of Strings

Description

Display colours as round patches in a plot. Useful for programming purposes. Colours can be specified in any of 3 different ways:

- (i) by colour name,
- (ii) by hexadecimal colour code created by `rgb()`, or
- (iii) by calling one of the colour palettes.

Usage

```
testCol(cnam=colors()[sample(length(colors()), 15)])
```

Arguments

cnam vector of colour names to display. Defaults to 15 random names from the color palette to use as patterns.

Author(s)

Rowan Haigh, Pacific Biological Station, Fisheries and Oceans Canada, Nanaimo BC

See Also

[pickCol](#), [testAlpha](#), [testPch](#), [palettes](#)

Examples

```
local(envir=.PBSmodEnv,expr={
  # mix and match patterns
  testCol(c("sky", "fire", "sea", "wood"))
})
local(envir=.PBSmodEnv,expr={
  # display transparencies of blue
  testCol(rgb(0,0,1,seq(0.05,1,0.05)))
})
local(envir=.PBSmodEnv,expr={
  # display colours of the rainbow
  testCol(rainbow(64,end=0.75))
})
local(envir=.PBSmodEnv,expr={
  # display basic palette colours
  testCol(1:length(palette()))
})
local(envir=.PBSmodEnv,expr={
  # mix colour types
  testCol(c("#9e7ad3", "purple", 6))
})
```

testLty	<i>Display Line Types Available</i>
---------	-------------------------------------

Description

Display line types available.

Usage

```
testLty(newframe=TRUE, n=1:18, ...)
```

Arguments

newframe	if TRUE, create a new blank frame, otherwise overlay current frame.
n	vector of line type numbers.
...	additional arguments for function lines.

Note

Quick representation of line types for reference purposes.

Author(s)

Rowan Haigh, Pacific Biological Station, Fisheries and Oceans Canada, Nanaimo BC

See Also

[testLwd](#), [testPch](#), [testCol](#)

testLwd	<i>Display Line Widths</i>
---------	----------------------------

Description

Display line widths. User can specify particular ranges for lwd. Colours can also be specified and are internally repeated as necessary.

Usage

```
testLwd(lwd=1:20, col=c("black","blue"), newframe=TRUE)
```

Arguments

lwd	line widths to display. Ranges can be specified.
col	colours to use for lines. Patterns are repeated if <code>length(lwd) > length(col)</code> .
newframe	if TRUE, create a new blank frame, otherwise overlay current frame.

Author(s)

Rowan Haigh, Pacific Biological Station, Fisheries and Oceans Canada, Nanaimo BC

Examples

```
local(envir=.PBSmodEnv,expr={
  testLwd(3:15,col=c("salmon","aquamarine","gold"))
})
```

testPch	<i>Display Plotting Symbols or Octal Strings</i>
---------	--

Description

Display plotting symbols or octal strings. User can specify particular ranges (increasing continuous integer) for pch.

Usage

```
testPch(pch=1:100, ncol=10, grid=TRUE, newframe=TRUE, octal=FALSE, ...)
```

Arguments

pch	symbol codes or octal string numbers.
ncol	number of columns in display (can only be 2, 5, or 10). Most sensibly this is set to 10.
grid	logical: if TRUE, grid lines are plotted for visual aid.
newframe	logical: if TRUE reset the graph, otherwise overlay on top of the current graph.
octal	logical: if TRUE, show octal strings (backslash characters) used in text statements (e.g., "30\272C" = 30°C).
...	additional arguments for functions points or text.

Author(s)

Rowan Haigh, Pacific Biological Station, Fisheries and Oceans Canada, Nanaimo BC

See Also

[testLty](#), [testLwd](#), [addLabel](#)

Examples

```
local(envir=.PBSmodEnv,expr={
  testPch(123:255)
})
local(envir=.PBSmodEnv,expr={
  testPch(1:25,ncol=5)
})
local(envir=.PBSmodEnv,expr={
  testPch(41:277,octal=TRUE)
})
```

Description

Display an interactive GUI to demonstrate the available widgets in PBS Modelling. A text window displays the *window description file* source code. The user can modify this sample code and recreate the test GUI by pressing the button below.

The *Window Description Files* can be found in the R directory
`.../library/PBSmodelling/testWidgets`.

Usage

```
testWidgets()
```

Details

Following are the widgets and default values supported by PBS Modelling. For detailed descriptions, see Appendix A in ‘PBSModelling-UG.pdf’ located in the R directory `.../library/PBSmodelling/doc`.

```
button text="Calculate" font="" fg="black" bg="" disablefg=NULL
      width=0 name=NULL function="" action="button" sticky=""
      padx=0 pady=0
```

```
check name mode="logical" checked=FALSE text="" font="" fg="black"
      bg="" disablefg=NULL function="" action="check" edit=TRUE
      sticky="" padx=0 pady=0
```

```
data nrow ncol names modes="numeric" rowlabels="" collabels=""
      rownames="X" colnames="Y" font="" fg="black" bg="" entryfont=""
      entryfg="black" entrybg="white" noeditfg="black" noeditbg="gray"
      values="" byrow=TRUE function="" enter=TRUE action="data"
      edit=TRUE width=6 borderwidth=0 sticky="" padx=0 pady=0
```

```
droplist name values=NULL choices=NULL labels=NULL selected=1
      add=FALSE font="" fg="black" bg="white" function="" enter=TRUE
      action="droplist" edit=TRUE mode="character" width=20
      sticky="" padx=0 pady=0
```

```
entry name value="" width=20 label=NULL font="" fg="" bg=""
      entryfont="" entryfg="black" entrybg="white" noeditfg="black"
      noeditbg="gray" edit=TRUE password=FALSE function="" enter=TRUE
      action="entry" mode="numeric" sticky="" padx=0 pady=0
```

```
grid nrow=1 ncol=1 toptitle="" sidetitle="" topfont="" sidefont=""
      topfg=NULL sidefg=NULL fg="black" topbg=NULL sidebg=NULL bg=""
      byrow=TRUE borderwidth=1 relief="flat" sticky="" padx=0 pady=0
```

```
history name="default" function="" import="" fg="black" bg=""
      entryfg="black" entrybg="white" text=NULL textsize=0 sticky=""
      padx=0 pady=0
```

```

image file=NULL varname=NULL subsample=NULL sticky="" padx=0 pady=0

include file=NULL name=NULL

label text="" name="" mode="character" font="" fg="black" bg=""
    sticky="" justify="left" anchor="center" wraplength=0 width=0
    padx=0 pady=0

matrix nrow ncol names rowlabels="" collabels="" rownames=""
    colnames="" font="" fg="black" bg="" entryfont="" entryfg="black"
    entrybg="white" noeditfg="black" noeditbg="gray" values=""
    byrow=TRUE function="" enter=TRUE action="matrix" edit=TRUE
    mode="numeric" width=6 borderwidth=0 sticky="" padx=0 pady=0

menu nitems=1 label font="" fg="" bg=""

menuitem label font="" fg="" bg="" function action="menuitem"

notebook tabs name=NULL selected=1 tabpos="top" font="" fg=NULL
    bg=NULL width=0 height=0 homogeneous=FALSE arcradius=2
    tabbevelsize=0 function=NULL action="notebook" sticky="we"
    padx=0 pady=0

null bg="" padx=0 pady=0

object name rowshow=0 font="" fg="black" bg="" entryfont=""
    entryfg="black" entrybg="white" noeditfg="black" noeditbg="gray"
    vertical=FALSE collabels=TRUE rowlabels=TRUE function=""
    enter=TRUE action="data" edit=TRUE width=6 borderwidth=0
    sticky="" padx=0 pady=0

progressbar name value=0 maximum=100 style="normal" width=NULL
    height=NULL vertical=FALSE fg=NULL bg=NULL relief="sunken"
    borderwidth=2 sticky="" padx=0 pady=0

radio name value text="" font="" fg="black" bg="" function=""
    action="radio" edit=TRUE mode="numeric" selected=FALSE
    sticky="" padx=0 pady=0

slide name from=0 to=100 value=NA showvalue=FALSE
    orientation="horizontal" font="" fg="black" bg="" function=""
    action="slide" sticky="" padx=0 pady=0

slideplus name from=0 to=1 by=0.01 value=NA font="" fg="black"
    bg="" entryfont="" entryfg="black" entrybg="white" function=""
    enter=FALSE action="slideplus" sticky="" padx=0 pady=0

spinbox name from to by=1 value=NA label="" font="" fg="black"
    bg="" entryfont="" entryfg="black" entrybg="white" function=""
    enter=TRUE edit=TRUE action="droplist" width=20 sticky=""
    padx=0 pady=0

table name rowshow=0 font="" fg="black" bg="white" rowlabels=""
    collabels="" function="" action="table" edit=TRUE width=10

```

```

        sticky="" padx=0 pady=0

text name height=8 width=30 edit=FALSE scrollbar=TRUE fg="black"
      bg="white" mode="character" font="" value="" borderwidth=1
      relief="sunken" sticky="" padx=0 pady=0

vector names length=0 labels="" values="" vecnames="" font=""
      fg="black" bg="" entryfont="" entryfg="black" entrybg="white"
      noeditfg="black" noeditbg="gray" vertical=FALSE function=""
      enter=TRUE action="vector" edit=TRUE mode="numeric" width=6
      borderwidth=0 sticky="" padx=0 pady=0

window name="window" title="" vertical=TRUE bg="#D4D0C8"
      fg="#000000" onclose="" remove=FALSE

```

Author(s)

Alex Couture-Beil, Vancouver Island University, Nanaimo BC

See Also

[createWin](#), [showArgs](#)

tget

Get/Print Objects From or Put Objects Into Temporary Work Environment

Description

Get/print objects from or put objects into a temporary work environment called `.PBSmodEnv`. These objects include `.PBSmod`, which controls the GUI system.

Usage

```

tget(x, penv=NULL, tenv=.PBSmodEnv)
tcall(x, penv=NULL, tenv=.PBSmodEnv)
tprint(x, penv=NULL, tenv=.PBSmodEnv)
tput(x, penv=NULL, tenv=.PBSmodEnv)

```

Arguments

<code>x</code>	name (with or without quotes) of an object to retrieve or store in the temporary environment.
<code>penv</code>	parent environment, defaults to <code>parent.frame()</code> called from within the function.
<code>tenv</code>	temporary working environment, defaults to <code>.PBSmodEnv</code> .

Details

These accessor functions were developed as a response to the CRAN repository policy statement: “Packages should not modify the global environment (user’s workspace).”

There are also wrapper functions called `.win.tget`, `.win.tcall`, and `.win.tprint` that can be used in *window description files* to launch functions or print objects from the `.PBSmodEnv` workspace. The wrapper uses `getWinAct` to get the function (or object) name that a user specifies in the `action` argument of a widget command.

Value

Objects are retrieved from or sent to the temporary working environment to/from the place where the function(s) are called. Additionally, `tcall` invisibly returns the object without transferring, which is useful when the object is a function that the user may wish to call, for example, `tcall(myfunc)()`.

Note

Additional wrapper functions to access functions in `.PBSmodEnv` are named with the prefix `.win`.

Author(s)

Rowan Haigh, Pacific Biological Station, Fisheries and Oceans Canada, Nanaimo BC

References

CRAN Repository Policy: <http://cran.r-project.org/web/packages/policies.html>

Examples

```
local(envir=.PBSmodEnv,expr={
  str(tcall(.PBSmod),2)
})
```

unpackList

Unpack List Elements into Variables

Description

Make local or global variables (depending on the scope specified) from the named components of a list.

Usage

```
unpackList(x, scope="L")
```

Arguments

<code>x</code>	named list to unpack.
<code>scope</code>	If "L", create variables local to the parent frame that called the function. If "P", create variables in the temporary package workspace called <code>.PBSmodEnv</code> . If "G", create global variables.

Value

A character vector of unpacked variable names.

Author(s)

Alex Couture-Beil, Vancouver Island University, Nanaimo BC

See Also

[packList](#), [readList](#), [writeList](#)

Examples

```
local(envir=.PBSmodEnv,expr={
  x <- list(a=21,b=23);
  unpackList(x);
  print(a);
})
```

updateGUI

Update Active GUI With Local Values

Description

Update the currently active GUI with values from R's memory at the specified location.

Usage

```
updateGUI(scope = "L")
```

Arguments

scope either "L" for the parent frame, "P" for the temporary work environment .PBSmodEnv, "G" for the global environment, or an explicit R environment.

Details

If the characteristics of the local R objects do not match those of the GUI objects, the update will fail.

Value

Invisibly returns a Boolean vector that specifies whether the objects in the local R environment match items in the active GUI.

Author(s)

Rob Kronlund, Pacific Biological Station, Fisheries and Oceans Canada, Nanaimo BC

See Also

[getWinVal](#), [setWinVal](#)

Examples

```
local(envir=.PBSmodEnv,expr={
  #law of free food: http://www.phdcomics.com/comics.php?f=1223
  createWin( c(
    "vector names=\"foodquality hunger cost\" values=\"0.6 0.8 0.1\" width=10",
    "entry name=taste edit=F label=taste:" ), astext=TRUE )
  getWinVal( scope="P" )
  taste <- foodquality * hunger / cost
  updateGUI()
})
```

vbdata

*Data: Lengths-at-Age for von Bertalanffy Curve***Description**

Lengths-at-age for freshwater mussels (*Anodonta kennerlyi*).

Usage

```
data(vbdata)
```

Format

A data frame with 16 rows and 2 columns c("age", "len").

Details

Data for demonstration of the von Bertalanffy model used in the [calcMin](#) example.

Source

Fisheries and Oceans Canada - Mittertreiner and Schnute (1985)

References

Mittertreiner, A. and Schnute, J. (1985) Simplex: a manual and software package for easy nonlinear parameter estimation and interpretation in fishery research. *Canadian Technical Report of Fisheries and Aquatic Sciences* **1384**, xi + 90 pp.

vbpars

*Data: Initial Parameters for a von Bertalanffy Curve***Description**

Starting parameter values for Linf, K, and t0 for von Bertalanffy minimization using length-at-age data ([vbdata](#)) for freshwater mussels (*Anodonta kennerlyi*).

Usage

```
data(vbpars)
```

Format

A matrix with 3 rows and 3 columns c("Linf", "K", "t0"). Each row contains the starting values, minima, and maxima, respectively, for the three parameters.

Details

Data for demonstration of the von Bertalanffy model used in the [calcMin](#) example.

References

Mittertreiner, A. and Schnute, J. (1985) Simplex: a manual and software package for easy nonlinear parameter estimation and interpretation in fishery research. *Canadian Technical Report of Fisheries and Aquatic Sciences* **1384**, xi + 90 pp.

view

View First/Last/Random n Elements/Rows of an Object

Description

View the first or last or random n elements or rows of an object. Components of lists will be subset using iterative calls to view.

Usage

```
view(obj, n=5, last=FALSE, random=FALSE, print.console=TRUE, ...)
```

Arguments

obj	object to view.
n	first (default)/last/random n elements/rows of obj to view.
last	logical: if TRUE, last n elements/rows of obj are displayed.
random	logical: if TRUE, n random elements/rows (without replacement) of obj are displayed.
print.console	logical: if TRUE, print the results to the console (default). The results are also returned invisibly should the user wish to assign the output to an object.
...	additional arguments (e.g., replace=TRUE if specifying random=TRUE).

Value

Invisibly returns the results of the call to view.

Note

If random=TRUE, random sampling will take place before the last operator is applied.

Author(s)

Rowan Haigh, Pacific Biological Station, Fisheries and Oceans Canada, Nanaimo BC

See Also

Generic functions [head](#) and [tail](#) exist in the package **utils**.

viewCode*View Package R Code*

Description

View the R code of all functions in a specified package installed on the user's system.

Usage

```
viewCode(pkg="PBSmodelling", funs, output=4, ...)
```

Arguments

pkg	string name of a package installed on the user's computer.
funs	string vector of explicit function names from pkg to view.
output	numeric value: 1 = function names only, 2 = function names with brief description, 3 = functions and their arguments, and 4 = function R-code (default).
...	allows user to specify two additional arguments for output=2: remote - character string giving a valid URL for the R_HOME directory on a remote location; update - logical: if TRUE, attempt to update the package index to reflect the currently available packages. (Not attempted if remote is non-NULL.)

Also, if user specifies pat=TRUE, then funs, if specified, are treated like patterns.

Details

If funs is not specified, then all functions, including hidden (dot) functions are displayed.

If the package has a namespace, functions there are also displayed.

Value

Invisibly returns source code of all functions in the specified package. The function invokes openFile to display the results.

Author(s)

Rowan Haigh, Pacific Biological Station, Fisheries and Oceans Canada, Nanaimo BC

See Also

[showHelp](#), [view](#)

writeList

*Write a List to a File in PBS Modelling Format***Description**

Write an ASCII text representation in either "D" format or "P" format. The "D" format makes use of `dput` and `dget` and produces an R representation of the list. The "P" format represents a simple list in an easy-to-read, ad hoc PBSmodelling format.

Usage

```
writeList(x, fname, format="D", comments="")
```

Arguments

<code>x</code>	R list object to write to an ASCII text file.
<code>fname</code>	file name of the text file to create.
<code>format</code>	format of the file to create: "D" or "P".
<code>comments</code>	vector of character strings to use as initial-line comments in the file.

Details

The D Format: The "D" format is equivalent to using R's base functions `dput` and `dget`, which support all R objects.

The P Format:

The "P" format only supports a list that may contain lists, vectors, matrices, arrays, and data frames. Scalars are treated like vectors. It writes each list element using the following conventions:

1. `$` denotes the start of a list element, and the element's name follows this character; for nested lists, `$` separates each nesting level;
2. `$$`, on the next line, denotes a line used to describe the element's structure, which includes object type, mode(s), names (if vector), rownames (if matrix or data), and colnames (if matrix or data); and
3. subsequent lines contain data (one line for a vector and multiple lines for a matrix or other data).

If a list's elements are unnamed, have the name NA, or have the empty string as a name, this function generates names ("P" format only). If two list elements share the same name, the list will export correctly, but it will import incorrectly.

Arrays with three or more dimensions have `dim` and `dimnames` arguments. `dim` describes the dimension of the data (a vector as returned by `dim(some_array)`) and `dimnames` is a vector of length `sum(dim(some_array)+1)` and is constructed as follows:

```
foreach dimension d,           first append the name of the dimension d and           then append all
```

Multiple rows of data for matrices or data frames must have equal numbers of entries (separated by whitespace).

Note that array data are written the same format as they are displayed in the R console:

```
nrow=dim()[1], ncol=dim()[2]
```

repeated by scrolling through successively higher dimensions, increasing the index from left to right within each dimension. The flattened table will have `dim()[2]` columns.

For complete details, see "PBSmodelling-UG.pdf" at the location described when loading this package.

Value

String containing the file name.

Author(s)

Alex Couture-Beil, Vancouver Island University, Nanaimo BC

See Also

[packList](#), [readList](#), [unpackList](#)

Examples

```
## Not run:
local(envir=.PBSmodEnv,expr={
  cwd = getwd(); setwd(tempdir())
  test <- list(a=10,b=euro,c=view(WorldPhones),d=view(USArrests))
  writeList(test,"test.txt",format="P",
    comments=" Scalar, Vector, Matrix, Data Frame")
  openFile("test.txt")
  setwd(cwd)
})

## End(Not run)
local(envir=.PBSmodEnv,expr={
  cwd = getwd(); setwd(tempdir())
  ##Example of dimnames for Arrays
  dimnames(Titanic)
  writeList( list( Titanic ), format="P")
  setwd(cwd)
})
```

writePBSoptions

Write PBS Options to an External File

Description

Save options that were set using setPBSoptions, setPBSext, or interfaces such as loadC. These options can be reloaded using readPBSoptions.

Usage

```
writePBSoptions(fname="PBSoptions.txt")
```

Arguments

fname file name or full path of file to which the options will be saved.

Note

Options with names starting with "." will not be saved.

Author(s)

Anisa Egeli, Vancouver Island University, Nanaimo BC

See Also

[readPBSoptions](#), [setPBSoptions](#), [setPBSext](#), [promptWriteOptions](#)

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