

# Package ‘Slick’

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**Type** Package

**Title** Interactive Visualization of MSE Results

**Version** 1.0.1

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**Description** A framework for visualizing and exploring results of a Management Strategy Evaluation (MSE). The publication quality figures and tables can be developed directly from the R console, or interactively explored with the 'Slick' App. For more details, see the 'Slick' website <<https://slick.bluematterscience.com>>.

**URL** <https://slick.bluematterscience.com/>,  
<https://github.com/Blue-Matter/Slick>

**License** GPL-2

**Depends** R (>= 4.1.0)

**Imports** cli, dplyr, DT, ggplot2, ggrepel, golem, graphics, grDevices, methods, scales, shiny, stats, tibble, utils

**Suggests** bookdown, colourpicker, colorspace, cowplot, esquisse, flextable, fresh, httr, kableExtra, knitr, MSEtool, openMSE, RColorBrewer, shiny.i18n, shinyalert, shinyBS, shinycssloaders, shinydashboard, shinydashboardPlus, shinyhelper, shinyjs, shinyWidgets, rmarkdown, testthat (>= 3.0.0), waiter

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'fct\_fix\_translations.R' 'fct\_load\_casestudies.R' 'fct\_misc.R'  
 'fct\_plotBoxplot.R' 'fct\_plotKobe.R' 'fct\_plotQuilt.R'  
 'fct\_plotSpider.R' 'fct\_plotTimeseries.R' 'fct\_plotTradeoff.R'  
 'fct\_translator.R' 'make\_Slick\_old.R' 'man\_functions.R'  
 'misc.R' 'mod\_About.R' 'mod\_Boxplot.R' 'mod\_Boxplot\_OM.R'  
 'mod\_Boxplot\_overall.R' 'mod\_Global\_Filters.R' 'mod\_Home.R'  
 'mod\_Kobe.R' 'mod\_Kobe\_overall.R' 'mod\_Kobe\_time.R'  
 'mod\_MP\_Color.R' 'mod\_MP\_Info.R' 'mod\_Metadata.R'  
 'mod\_OM\_Info.R' 'mod\_PM\_Info.R' 'mod\_Page\_Filter.R'  
 'mod\_Quilt.R' 'mod\_Report\_Add.R' 'mod\_Report\_Add\_Button.R'  
 'mod\_Report\_Page.R' 'mod\_Report\_Page\_plot.R' 'mod\_Resources.R'  
 'mod\_Sidebar.R' 'mod\_Spider.R' 'mod\_Spider\_MPR.R'  
 'mod\_Spider\_OM.R' 'mod\_Spider\_overall.R' 'mod\_Timeseries.R'  
 'mod\_Timeseries\_byMPR.R' 'mod\_Timeseries\_byOM.R'  
 'mod\_Timeseries\_overall.R' 'mod\_Tradeoff.R'  
 'mod\_filter\_selection.R' 'mod\_filter\_selection\_OM.R'  
 'mod\_subtitle.R' 'mod\_toplink.R' 'utils\_Table.R' 'utils\_util.R'

**BugReports** <https://github.com/Blue-Matter/Slick/issues>

**NeedsCompilation** no

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App

*Run the Slick App in the local browser*

---

## Description

An online hosted version of the Slick App is available [here](#)

## Usage

App(...)

## Arguments

... Additional arguments. To load a object directly in the App, use App(slick=myslick) where myslick is your `Slick-class()` object.

**Details**

App() runs the Slick Shiny Application

**Value**

None

---

Boxplot

*Methods for Creating, Accessing and Assigning Boxplot objects*

---

**Description**

The Boxplot function is used both to create and modify an `Boxplot-class()` object. and to access and assign Boxplot for an object of class `Slick-class()`. See Details.

**Usage**

```
Boxplot(
  Code = "",
  Label = "",
  Description = "",
  Value = array(),
  Preset = list(),
  Defaults = list("overall", "boxplot"),
  Misc = list()
)

Boxplot(Slick) <- value

## S4 method for signature 'missing'
Boxplot()

## S4 method for signature 'character_list'
Boxplot(
  Code = "",
  Label = "",
  Description = "",
  Value = array(),
  Preset = list(),
  Defaults = list("overall", "boxplot"),
  Misc = list()
)

## S4 method for signature 'Slick'
Boxplot(Code)

## S4 replacement method for signature 'Slick'
Boxplot(Slick) <- value
```

**Arguments**

Code	A <i>short</i> code for the Performance Indicators for this object. A character string length nPI or a named list for multi-language support. See Details
Label	A short label for the Performance Indicators for this object. Used to label axes on charts. Can be longer than Code but recommended to keep short as possible so it shows clearly in plots and tables. A character string length nPI or a named list for multi-language support. See Details
Description	A description for the Performance Indicators for this object. Can include Mark-down, see Examples. A character string length nPI or a named list for multi-language support. See Details
Value	A numeric array with the stochastic performance indicator values for each simulation (sim), operating model (OM), management procedure (MP), and performance indicator (PI). Dimensions: c(nsim, nOM, nMP, and nPI).
Preset	An optional named list for the preset buttons in the <code>App()</code> . The name of the list element will appear as a button in the <code>App()</code> .
Defaults	A list object with default selections for the Boxplot
Misc	A named list for additional miscellaneous information.
Slick	A <code>Slick-class()</code> object
value	A <code>Boxplot-class()</code> object

**Details**

Objects of class Boxplot are created with `Boxplot()`

Use `plotBoxplot()` to create the boxplot from the console.

Use the `Code()`, `Label()`, `Description()`, `Value()`, `Preset()` functions to access and assign the values for an existing Boxplot object, see Examples

**Multi-Language Support:**

Text with multi-language supported can be provided as a named list. Available languages:

- en: English (default)
- es: Spanish
- fr: French
- pt: Portuguese

**Note:**

Character strings in Code, Label, and Description must all be same length as the number of performance indicators (nPIs) in 'Value'

**Defaults:**

Defaults is used to select the plot options that are selected in the Boxplot. It is a list of length 2, with the following requirements for the list elements:

1. A character string. Options: 'overall' (default) or 'byom'
2. A character string. Options: 'boxplot' (default), 'violin', or 'both'

If unrecognized values are entered, the defaults will be used.

**Functions**

- `Boxplot(missing)`: Create an empty Boxplot object
- `Boxplot(character_list)`: Create a populated Boxplot object
- `Boxplot(Slick)`: Return Boxplot from a `Slick-class()` object
- `Boxplot(Slick) <- value`: Assign a `Boxplot-class()` object to a `Slick-class()` object

**See Also**

[Code\(\)](#), [Label\(\)](#), [Description\(\)](#), [Metadata\(\)](#), [Value\(\)](#), [Preset\(\)](#), [Defaults\(\)](#), [plotBoxplot\(\)](#)

**Examples**

```
# Generate dummy values
nsim <- 10
nOM <- 2
nMP <- 4
nPI <- 3

values <- array(NA, dim=c(nsim, nOM, nMP, nPI))
pi_means <- runif(nPI, 5, 50)
for (om in 1:nOM) {
  for (mp in 1:nMP) {
    for (pi in 1:nPI) {
      values[,om, mp, pi] <- rlnorm(nsim, log(pi_means[pi]), 0.4)
    }
  }
}

# Create and populate Object
boxplot <- Boxplot(Code=c('PI1', 'PI2', 'PI3'),
                  Label=c('Performance Indicator 1',
                          'Performance Indicator 2',
                          'Performance Indicator 3'),
                  Description = c('This is the description for PI 1',
                                  'This is the description for PI 2',
                                  'This is the description for PI 3'),
                  Value=values)

# Check
Check(boxplot)

# Add to `Slick` object
slick <- Slick()
Boxplot(slick) <- boxplot

# Plots
plotBoxplot(slick)

plotBoxplot(slick, type='violin')

plotBoxplot(slick, byOM=TRUE)
```

```
plotBoxplot(slick, 2, type='both', byOM=TRUE)
```

---

 Boxplot-class

 Boxplot *S4 Object Class*


---

## Description

Objects of class `Boxplot` are used to store information for the `Boxplot` and `Violin` plots. Like all `S4` objects in `Slick`, slots in this object can be accessed and assigned using functions corresponding to slot name. See [Boxplot\(\)](#) and the `See Also` section below.

## Details

Objects of class `Boxplot` are created with `Boxplot()`

### Multi-Language Support:

Text with multi-language supported can be provided as a named list. Available languages:

- en: English (default)
- es: Spanish
- fr: French
- pt: Portuguese

### Note:

Character strings in `Code`, `Label`, and `Description` must all be same length as the number of performance indicators (nPIs) in `Value`

## Slots

**Code** A *short* code for the Performance Indicators for this object. A character string length nPI or a named list for multi-language support. See [Details](#)

**Label** A short label for the Performance Indicators for this object. Used to label axes on charts. Can be longer than `Code` but recommended to keep short as possible so it shows clearly in plots and tables. A character string length nPI or a named list for multi-language support. See [Details](#)

**Description** A description for the Performance Indicators for this object. Can include Markdown, see [Examples](#). A character string length nPI or a named list for multi-language support. See [Details](#)

**Value** A numeric array with the stochastic performance indicator values for each simulation (sim), operating model (OM), management procedure (MP), and performance indicator (PI). Dimensions: `c(nsim, nOM, nMP, and nPI)`.

**Preset** An optional named list for the preset buttons in the [App\(\)](#). The name of the list element will appear as a button in the [App\(\)](#).

**Defaults** A list object with default selections for the `Boxplot`. See [Boxplot\(\)](#)

**Misc** A named list for additional miscellaneous information.

**See Also**

[Boxplot\(\)](#), [Code\(\)](#), [Label\(\)](#), [Description\(\)](#), [Metadata\(\)](#), [Value\(\)](#), [Preset\(\)](#)

**Examples**

```
# Generate dummy values
nsim <- 10
nOM <- 2
nMP <- 4
nPI <- 3

values <- array(NA, dim=c(nsim, nOM, nMP, nPI))
pi_means <- runif(nPI, 5, 50)
for (om in 1:nOM) {
  for (mp in 1:nMP) {
    for (pi in 1:nPI) {
      values[,om, mp, pi] <- rlnorm(nsim, log(pi_means[pi]), 0.4)
    }
  }
}

# Create and populate Object
boxplot <- Boxplot(Code=c('PI1', 'PI2', 'PI3'),
                  Label=c('Performance Indicator 1',
                          'Performance Indicator 2',
                          'Performance Indicator 3'),
                  Description = c('This is the description for PI 1',
                                  'This is the description for PI 2',
                                  'This is the description for PI 3'),
                  Value=values)

# Check
Check(boxplot)

# Add to `Slick` object
slick <- Slick()
Boxplot(slick) <- boxplot

# Plots
plotBoxplot(slick)

plotBoxplot(slick, type='violin')

plotBoxplot(slick, byOM=TRUE)

plotBoxplot(slick, 2, type='both', byOM=TRUE)
```

**Description**

Checks S4 objects to check for warnings and errors

**Usage**

```
Check(object, ...)  
  
## S4 method for signature 'Boxplot'  
Check(object, req_dims = c(NA, NA, NA, NA))  
  
## S4 method for signature 'Kobe'  
Check(object)  
  
## S4 method for signature 'MPs'  
Check(object)  
  
## S4 method for signature 'OMs'  
Check(object)  
  
## S4 method for signature 'Quilt'  
Check(object)  
  
## S4 method for signature 'Tradeoff'  
Check(object)  
  
## S4 method for signature 'Timeseries'  
Check(object)  
  
## S4 method for signature 'Spider'  
Check(object)  
  
## S4 method for signature 'Slick'  
Check(object)
```

**Arguments**

object	An object of class: <a href="#">Slick-class()</a> , <a href="#">MPs-class()</a> , <a href="#">OMs-class()</a> or the six chart types: <a href="#">Boxplot-class()</a> , <a href="#">Kobe-class()</a> , <a href="#">Quilt-class()</a> , <a href="#">Spider-class()</a> , <a href="#">Timeseries-class()</a> , and <a href="#">Tradeoff-class()</a> .
...	Additional arguments
req_dims	Required dimensions for Value slot. Used internally

**Value**

Prints messages to the console

**Methods (by class)**

- Check(Boxplot): Check `Boxplot-class()` objects for errors
- Check(Kobe): Check `Kobe-class()` objects for errors
- Check(MPs): Check `MPs-class()` objects for errors
- Check(OMs): Check `OMs-class()` objects for errors
- Check(Quilt): Check `Quilt-class()` objects for errors
- Check(Tradeoff): Check `Tradeoff-class()` objects for errors
- Check(Timeseries): Check `Timeseries-class()` objects for errors
- Check(Spider): Check `Spider-class()` objects for errors
- Check(Slick): Check `Slick-class()` objects for errors

**Examples**

```
slick <- Slick()
Check(slick)
```

---

Code	<i>Access or assign Code, Label, and Description for a valid object class</i>
------	---

---

**Description**

Access or assign Code, Label, and Description for a valid object class

**Usage**

```
Code(object, lang = "en")

Code(object) <- value

Description(object, lang = "en")

Description(object) <- value

Label(object, lang = "en")

Label(object) <- value

## S4 method for signature 'Boxplot'
Code(object, lang = "en")

## S4 replacement method for signature 'Boxplot'
Code(object) <- value
```

```
## S4 method for signature 'Boxplot'
Description(object, lang = "en")

## S4 method for signature 'Boxplot'
Label(object, lang = "en")

## S4 replacement method for signature 'Boxplot'
Label(object) <- value

## S4 replacement method for signature 'Boxplot'
Description(object) <- value

## S4 method for signature 'Boxplot'
Misc(object)

## S4 replacement method for signature 'Boxplot'
Misc(object) <- value

## S4 method for signature 'Kobe'
Code(object, lang = "en")

## S4 replacement method for signature 'Kobe'
Code(object) <- value

## S4 method for signature 'Kobe'
Description(object, lang = "en")

## S4 replacement method for signature 'Kobe'
Description(object) <- value

## S4 method for signature 'Kobe'
Label(object, lang = "en")

## S4 replacement method for signature 'Kobe'
Label(object) <- value

## S4 method for signature 'Kobe'
Misc(object)

## S4 replacement method for signature 'Kobe'
Misc(object) <- value

## S4 method for signature 'MPs'
Code(object, lang = "en")

## S4 replacement method for signature 'MPs'
Code(object) <- value
```

```
## S4 method for signature 'MPs'
Label(object, lang = "en")

## S4 replacement method for signature 'MPs'
Label(object) <- value

## S4 method for signature 'MPs'
Description(object, lang = "en")

## S4 replacement method for signature 'MPs'
Description(object) <- value

## S4 method for signature 'Quilt'
Code(object, lang = "en")

## S4 replacement method for signature 'Quilt'
Code(object) <- value

## S4 method for signature 'Quilt'
Description(object, lang = "en")

## S4 replacement method for signature 'Quilt'
Description(object) <- value

## S4 method for signature 'Quilt'
Label(object, lang = "en")

## S4 replacement method for signature 'Quilt'
Label(object) <- value

## S4 method for signature 'Quilt'
Misc(object)

## S4 replacement method for signature 'Quilt'
Misc(object) <- value

## S4 method for signature 'Tradeoff'
Code(object, lang = "en")

## S4 replacement method for signature 'Tradeoff'
Code(object) <- value

## S4 method for signature 'Tradeoff'
Description(object, lang = "en")

## S4 replacement method for signature 'Tradeoff'
Description(object) <- value
```

```
## S4 method for signature 'Tradeoff'
Misc(object)

## S4 replacement method for signature 'Tradeoff'
Misc(object) <- value

## S4 method for signature 'Tradeoff'
Label(object, lang = "en")

## S4 replacement method for signature 'Tradeoff'
Label(object) <- value

## S4 method for signature 'Timeseries'
Code(object, lang = "en")

## S4 replacement method for signature 'Timeseries'
Code(object) <- value

## S4 method for signature 'Timeseries'
Description(object, lang = "en")

## S4 replacement method for signature 'Timeseries'
Description(object) <- value

## S4 method for signature 'Timeseries'
Label(object, lang = "en")

## S4 replacement method for signature 'Timeseries'
Label(object) <- value

## S4 method for signature 'Timeseries'
Misc(object)

## S4 replacement method for signature 'Timeseries'
Misc(object) <- value

## S4 method for signature 'Spider'
Code(object, lang = "en")

## S4 replacement method for signature 'Spider'
Code(object) <- value

## S4 method for signature 'Spider'
Description(object, lang = "en")

## S4 replacement method for signature 'Spider'
Description(object) <- value
```

```
## S4 method for signature 'Spider'
Label(object, lang = "en")

## S4 replacement method for signature 'Spider'
Label(object) <- value

## S4 method for signature 'Spider'
Misc(object)

## S4 replacement method for signature 'Spider'
Misc(object) <- value
```

### Arguments

object	An object of class <code>MPs-class()</code> , <code>Boxplot-class()</code> , <code>Kobe-class()</code> , <code>Quilt-class()</code> , <code>Spider-class()</code> , <code>Timeseries-class()</code> , or <code>Tradeoff-class()</code>
lang	Optional text string specifying the language (if available). Either 'en', 'es', 'fr', or 'pt' for English, Spanish, French, or Portuguese respectively
value	A character vector or a named list for multi-language support

### Details

Code, Label, and Description must all be equal length.

#### Multi-Language Support:

Text with multi-language supported can be provided as a named list. Available languages:

- en: English (default)
- es: Spanish
- fr: French
- pt: Portuguese

### Value

Returns character string or named list with the contents of the Code, Label, or Description slot of object

### Methods (by class)

- `Code(Boxplot)`: Return Code from a `Boxplot-class()` object
- `Code(Boxplot) <- value`: Assign Code to a `Boxplot-class()` object
- `Description(Boxplot)`: Return Description from a `Boxplot-class()` object
- `Label(Boxplot)`: Return Label from a `Boxplot-class()` object
- `Label(Boxplot) <- value`: Assign Label to a `Boxplot-class()` object
- `Description(Boxplot) <- value`: Assign Description to a `Boxplot-class()` object
- `Misc(Boxplot)`: Return Misc from a `Boxplot-class()` object
- `Misc(Boxplot) <- value`: Assign Misc to a `Boxplot-class()` object

- Code(Kobe): Return Code from a `Kobe-class()` object
- Code(Kobe) <- value: Assign Code to a `Kobe-class()` object
- Description(Kobe): Return Description from a `Kobe-class()` object
- Description(Kobe) <- value: Assign Description to a `Kobe-class()` object
- Label(Kobe): Return Label from a `Kobe-class()` object
- Label(Kobe) <- value: Assign Label to a `Kobe-class()` object
- Misc(Kobe): Return Misc from a `Kobe-class()` object
- Misc(Kobe) <- value: Assign Misc to a `Kobe-class()` object
- Code(MPs): Return Code from a `MPs-class()` object
- Code(MPs) <- value: Assign Code to a `MPs-class()` object
- Label(MPs): Return Label from a `MPs-class()` object
- Label(MPs) <- value: Assign Label to a `MPs-class()` object
- Description(MPs): Return Description from a `MPs-class()` object
- Description(MPs) <- value: Assign Description to a `MPs-class()` object
- Code(Quilt): Return Code from a `Quilt-class()` object
- Code(Quilt) <- value: Assign Code to a `Quilt-class()` object
- Description(Quilt): Return Description from a `Quilt-class()` object
- Description(Quilt) <- value: Assign Description to a `Quilt-class()` object
- Label(Quilt): Return Label from a `Quilt-class()` object
- Label(Quilt) <- value: Assign Label to a `Quilt-class()` object
- Misc(Quilt): Return Misc from a `Quilt-class()` object
- Misc(Quilt) <- value: Assign Misc to a `Quilt-class()` object
- Code(Tradeoff): Return Code from a `Tradeoff-class()` object
- Code(Tradeoff) <- value: Assign Code to a `Tradeoff-class()` object
- Description(Tradeoff): Return Description from a `Tradeoff-class()` object
- Description(Tradeoff) <- value: Assign Description to a `Tradeoff-class()` object
- Misc(Tradeoff): Return Misc from a `Tradeoff-class()` object
- Misc(Tradeoff) <- value: Assign Misc to a `Tradeoff-class()` object
- Label(Tradeoff): Return Label from a `Tradeoff-class()` object
- Label(Tradeoff) <- value: Assign Label to a `Tradeoff-class()` object
- Code(Timeseries): Return Code from a `Timeseries-class()` object
- Code(Timeseries) <- value: Assign Code to a `Timeseries-class()` object
- Description(Timeseries): Return Description from a `Timeseries-class()` object
- Description(Timeseries) <- value: Assign Description to a `Timeseries-class()` object
- Label(Timeseries): Return Label from a `Timeseries-class()` object
- Label(Timeseries) <- value: Assign Label to a `Timeseries-class()` object

- `Misc(Timeseries)`: Return `Misc` from a `Timeseries-class()` object
- `Misc(Timeseries) <- value`: Assign `Misc` to a `Timeseries-class()` object
- `Code(Spider)`: Return `Code` from a `Spider-class()` object
- `Code(Spider) <- value`: Assign `Code` to a `Spider-class()` object
- `Description(Spider)`: Return `Description` from a `Spider-class()` object
- `Description(Spider) <- value`: Assign `Description` to a `Spider-class()` object
- `Label(Spider)`: Return `Label` from a `Spider-class()` object
- `Label(Spider) <- value`: Assign `Label` to a `Spider-class()` object
- `Misc(Spider)`: Return `Misc` from a `Spider-class()` object
- `Misc(Spider) <- value`: Assign `Misc` to a `Spider-class()` object

### See Also

[Label\(\)](#), [Description\(\)](#), [MPs-class\(\)](#), [Boxplot-class\(\)](#), [Kobe-class\(\)](#), [Quilt-class\(\)](#), [Spider-class\(\)](#), [Timeseries-class\(\)](#), [Tradeoff-class\(\)](#)

---

Color

*Access or assign Color for MPs and Quilt objects*

---

### Description

Access or assign Color for MPs and Quilt objects

### Usage

```
Color(object)
```

```
Color(object) <- value
```

```
## S4 method for signature 'MPs'
Color(object)
```

```
## S4 replacement method for signature 'MPs'
Color(object) <- value
```

```
## S4 method for signature 'Quilt'
Color(object)
```

```
## S4 replacement method for signature 'Quilt'
Color(object) <- value
```

### Arguments

<code>object</code>	An <code>MPs-class()</code> or <code>Quilt-class()</code> object
<code>value</code>	A character vector formatted to match the class of <code>object</code> . See the documentation for corresponding object class for more details.

**Value**

Returns a character string with the contents of the Color slot of object

**Methods (by class)**

- Color(MPs): Return Color from a [MPs-class\(\)](#) object
- Color(MPs) <- value: Preset Assign Color to a [MPs-class\(\)](#) object
- Color(Quilt): Return Color from a [Quilt-class\(\)](#) object
- Color(Quilt) <- value: Preset Assign Color to a [Quilt-class\(\)](#) object

---

 Defaults

*Access or assign the default selections for the plots in the App()*


---

**Description**

Access or assign the default selections for the plots in the App()

**Usage**

```
Defaults(object)
```

```
Defaults(object) <- value
```

```
## S4 method for signature 'Boxplot'
```

```
Defaults(object)
```

```
## S4 replacement method for signature 'Boxplot'
```

```
Defaults(object) <- value
```

```
## S4 method for signature 'Kobe'
```

```
Defaults(object)
```

```
## S4 replacement method for signature 'Kobe'
```

```
Defaults(object) <- value
```

**Arguments**

object            A [Boxplot\(\)](#) or [Kobe\(\)](#) object

value            A list of default selections for the [App\(\)](#)

**Value**

Returns a list object with default selections from the Defaults slot of [Boxplot\(\)](#) and [Kobe\(\)](#) objects.

**Methods (by class)**

- Defaults(Boxplot): Defaults Code from a `Boxplot-class()` object
- Defaults(Boxplot) <- value: Assign Defaults to a `Boxplot-class()` object
- Defaults(Kobe): Defaults Code from a `Kobe-class()` object
- Defaults(Kobe) <- value: Assign Defaults to a `Kobe-class()` object

---

`default_mp_colors`      *Set Default Colors for the MPs*

---

**Description**

Requires the colorspace package

**Usage**

```
default_mp_colors(nMP)
```

**Arguments**

`nMP`                      The number of management procedures

**Value**

A character vector of length `nMP` with color hex codes

**Examples**

```
cols <- default_mp_colors(4)
cols
```

---

`Design`                      *Return the Design matrix from an OMs object*

---

**Description**

Return the Design matrix from an OMs object

**Usage**

```

Design(object)

Design(object) <- value

## S4 method for signature 'OMs'
Design(object)

## S4 replacement method for signature 'OMs'
Design(object) <- value

## S4 method for signature 'Slick'
Design(object)

## S4 replacement method for signature 'Slick'
Design(object) <- value

```

**Arguments**

object	A <a href="#">Slick-class()</a> object
value	A <code>data.frame</code> with the Design matrix

**Value**

The Design matrix from an OMs object in a Slick object

**Methods (by class)**

- `Design(OMs)`: Return the operating model Design matrix from a [OMs-class\(\)](#) object
- `Design(OMs) <- value`: Assign the operating model Design matrix to a [OMs-class\(\)](#) object
- `Design(Slick)`: Access the operating model Design matrix from a [Slick-class\(\)](#) object
- `Design(Slick) <- value`: Assign the operating model Design matrix to a [Slick-class\(\)](#) object

---

Factors

*Return the Factors matrix from an OMs object*

---

**Description**

Return the Factors matrix from an OMs object

**Usage**

```

Factors(object, lang = "en")

Factors(object) <- value

## S4 method for signature 'OMs'
Factors(object, lang = "en")

## S4 replacement method for signature 'OMs'
Factors(object) <- value

## S4 method for signature 'Slick'
Factors(object, lang = "en")

## S4 replacement method for signature 'Slick'
Factors(object) <- value

```

**Arguments**

object	A <a href="#">Slick-class()</a> object
lang	Optional text string specifying the language (if available). Either 'en', 'es', 'fr', or 'pt' for English, Spanish, French, or Portuguese respectively
value	A data.frame with the Factors

**Value**

The Design matrix from an OMs object in a Slick object

**Methods (by class)**

- `Factors(OMs)`: Return the operating model Factors table from a [OMs-class\(\)](#) object
- `Factors(OMs) <- value`: Assign the operating model Factors table to a [OMs-class\(\)](#) object
- `Factors(Slick)`: Access the operating model Factors table from a [Slick-class\(\)](#) object
- `Factors(Slick) <- value`: Assign the operating model Factors table to a [Slick-class\(\)](#) object

---

FilterSlick

*FilterSlick*


---

**Description**

Filter a Slick Object

**Usage**

```
FilterSlick(slick = NULL, MPs = NULL, OMs = NULL, PIs = NULL, plot = NULL)
```

**Arguments**

slick	An object of class Slick
MPs	Numeric values of the MPs to keep. Default NULL keeps all MPs.
OMs	Numeric values of the OMs to keep (rows of OM@Design). Default NULL keeps all OMs.
PIs	Numeric values of the PIs in plot to keep. Default NULL keeps all PIs.
plot	The plot to filter the PIs. One of: Timeseries, Boxplot, Kobe, Quilt, Spider, orTradeoff

**Details**

Filter a Slick Object by management procedures (MPs), operating models (OMs), and performance indicators (PIs) for a given plot

**Value**

A filtered Slick Object

**Examples**

```

slick <- Slick() # a completed slick object
boxplot_OM_1 <- FilterSlick(slick, OMs=1, plot='boxplot')

```

---

get\_casestudies

*Get Case Studies from the SlickLibrary GitHub Repo*

---

**Description**

Get Case Studies from the SlickLibrary GitHub Repo

**Usage**

```

get_casestudies()

download_casestudy(
  name,
  case_studies = NULL,
  dir = NULL,
  silent = FALSE,
  object = TRUE,
  delete = object
)

```

**Arguments**

name	The name of the case study to download. Name column from <code>get_casestudies()</code>
case_studies	optional. Dataframe returned by <code>get_casestudies()</code>
dir	Optional. Directory to save the file. Defaults to a temporary directory
silent	Logical. Print out messages?
object	Logical. Return the Slick object? Default downloads Slick object to a temporary location, loads and returns the Slick object, and then deletes downloaded file.
delete	Logical. Delete the downloaded file after function finishes? Only useful if <code>object = TRUE</code>

**Value**

A data.frame for `get_casestudies` and a Slick object for `download_casestudy`  
 The downloaded Slick object if `object==TRUE`, otherwise nothing.

**Functions**

- `download_casestudy()`: download a case study file

**Examples**

```
case_studies <- get_casestudies()
slick <- download_casestudy(case_studies$Name[1])
```

---

 Kobe

---

*Methods for Creating, Accessing and Assigning Kobe objects*


---

**Description**

The Kobe function is used both to create and modify an `Kobe-class()` object. and to access and assign Kobe for an object of class `Slick-class()`. See Details.

**Usage**

```
Kobe(
  Code = "",
  Label = "",
  Description = "",
  Time = numeric(),
  TimeLab = "Year",
  Value = array(),
  Preset = list(),
  Target = 1,
  Limit = NULL,
```

```
    Defaults = list(),
    TimeTerminal = numeric(),
    Misc = list()
)

Kobe(Slick) <- value

## S4 method for signature 'missing'
Kobe()

## S4 method for signature 'character'
Kobe(
  Code = "",
  Label = "",
  Description = "",
  Time = numeric(),
  TimeLab = "Year",
  Value = array(),
  Preset = list(),
  Target = 1,
  Limit = NULL,
  Defaults = list(),
  TimeTerminal = numeric(),
  Misc = list()
)

## S4 method for signature 'list'
Kobe(
  Code = "",
  Label = "",
  Description = "",
  Time = numeric(),
  TimeLab = "Year",
  Value = array(),
  Preset = list(),
  Target = 1,
  Limit = NULL,
  Defaults = list(),
  TimeTerminal = numeric(),
  Misc = list()
)

## S4 method for signature 'Slick'
Kobe(Code)

## S4 replacement method for signature 'Slick'
Kobe(Slick) <- value
```

**Arguments**

Code	A <i>short</i> code for the Performance Indicators for this object. A character string length <code>nPI</code> or a named list for multi-language support. See <a href="#">Details</a>
Label	A short label for the Performance Indicators for this object. Used to label axes on charts. Can be longer than Code but recommended to keep short as possible so it shows clearly in plots and tables. A character string length <code>nPI</code> or a named list for multi-language support. See <a href="#">Details</a>
Description	A description for the Performance Indicators for this object. Can include Mark-down, see <a href="#">Examples</a> . A character string length <code>nPI</code> or a named list for multi-language support. See <a href="#">Details</a>
Time	A numeric vector with values for the projection time-steps. Must match length <code>nTS</code> in Value
TimeLab	Character string length 1. Name of the time step (e.g., 'Year'). Will be used as the label in the Kobe Time plot. Use a named list for multiple languages.
Value	A numeric array with the stochastic performance indicator values for each simulation (sim), operating model (OM), management procedure (MP), performance indicator (PI), and projection time-steps (nTS). Dimensions: <code>c(nsim, nOM, nMP, nPI, nTS)</code>
Preset	An optional named list for the preset buttons in the <a href="#">App()</a> . The name of the list element will appear as a button in the <a href="#">App()</a> .
Target	Numeric vector length <code>nPI</code> with the target value for the PIs. Defines the color quadrants on the Kobe plot. Defaults to <code>c(1,1)</code> .
Limit	Numeric vector length <code>nPI</code> with the limit value for the PIs. Shows as red line on Kobe plot. NULL to ignore.
Defaults	A list object with default selections for the Kobe See <a href="#">Kobe()</a>
TimeTerminal	Optional. By default the Kobe plot shows the terminal projection year. <code>TimeTerminal</code> can be used to override this. Use a numeric value indicating the time (must match a value in <code>Time</code> ) to use for the Kobe plot
Misc	A named list for additional miscellaneous information.
Slick	A <a href="#">Slick-class()</a> object
value	A <a href="#">Kobe-class()</a> object

**Details**

Objects of class `Kobe` are created with `Kobe()`

The Kobe plot typically shows B/BMSY (or something similar) on the x-axis, and F/FMSY (or something similar) on the y-axis.

**Performance Indicators:**

The first PI will be on the x-axis (usually B/BMSY or something similar) and the second on the y-axis (e.g., F/FMSY)

**Multi-Language Support:**

Text with multi-language supported can be provided as a named list. Available languages:

- en: English (default)
- es: Spanish
- fr: French
- pt: Portuguese

**Note:**

Character strings in Code, Label, and Description must all be same length as the number of performance indicators (nPIs) in Value

**Functions**

- `Kobe(missing)`: Create an empty Kobe object
- `Kobe(character)`: Create a populated Kobe object
- `Kobe(list)`: Create a populated Kobe object
- `Kobe(Slick)`: Return Kobe from a [Slick-class\(\)](#) object
- `Kobe(Slick) <- value`: Assign a [Kobe-class\(\)](#) object to a [Slick-class\(\)](#) object

**See Also**

[Code\(\)](#), [Label\(\)](#), [Description\(\)](#), [Time\(\)](#), [\[TimeLab\(\), Value\(\), Preset\(\), Target\(\) and Limit\(\)\]](#)

**Examples**

```
# Generate dummy values
nsim <- 10
nOM <- 2
nMP <- 4
nPI <- 2
nTS <- 30

values <- array(NA, dim=c(nsim, nOM, nMP, nPI, nTS))

pi_means <- c(1,1)

for (om in 1:nOM) {
  for (mp in 1:nMP) {
    for (pi in 1:nPI) {
      values[,om, mp, pi,] <- pi_means[pi] *
        matrix(
          cumprod(c(rlnorm(nTS*nsim, 0, 0.05))),
          nrow=nsim)
    }
  }
}

# Create and populate Object
kobe <- Kobe(Code=c('B/BMSY', 'F/FMSY'),
             Label=c('B/BMSY',
                    'F/FMSY'),
             Description = c('This is the description for PI 1',
```

```

                                'This is the description for PI 2'),
                                Value=values
)

# Add values for projection time steps
Time(kobe) <- seq(2025, by=1, length.out=nTS)

# Check
Check(kobe)

# Add to `Slick` object
slick <- Slick()
Kobe(slick) <- kobe

# Plots
plotKobe(slick)

plotKobe(slick, Time=TRUE)

```

---

Kobe-class

*S4 class Kobe*


---

## Description

Slots can be accessed and assigned using functions corresponding to slot name. See See Also section below.

## Details

Objects of class Kobe are created with `Kobe()`

### Performance Indicators:

By default, the first PI will be on the x-axis (usually B/BMSY or something similar) and the second on the y-axis (e.g., F/FMSY). The Slick `App()` provides drop down menus for selecting other PIs.

### Multi-Language Support:

Text with multi-language supported can be provided as a named list. Available languages:

- en: English (default)
- es: Spanish
- fr: French
- pt: Portuguese

### Note:

Character strings in Code, Label, and Description must all be same length as the number of performance indicators (nPIs) in Value

**Slots**

- Code** A *short* code for the Performance Indicators for this object. A character string length nPI or a named list for multi-language support. See [Details](#)
- Label** A short label for the Performance Indicators for this object. Used to label axes on charts. Can be longer than Code but recommended to keep short as possible so it shows clearly in plots and tables. A character string length nPI or a named list for multi-language support. See [Details](#)
- Description** A description for the Performance Indicators for this object. Can include Markdown, see [Examples](#). A character string length nPI or a named list for multi-language support. See [Details](#)
- Time** A numeric vector with values for the projection time-steps. Must match length nTS in Value
- TimeLab** Character string length 1. Name of the time step (e.g., 'Year'). Will be used as the label in the Kobe Time plot. Use a named list for multiple languages.
- Value** A numeric array with the stochastic performance indicator values for each simulation (sim), operating model (OM), management procedure (MP), performance indicator (PI), and projection time-steps (nTS) Dimensions: c(nsim, nOM, nMP, nPI, nTS)
- Preset** An optional named list for the preset buttons in the [App\(\)](#). The name of the list element will appear as a button in the [App\(\)](#).
- Target** Numeric vector length nPI with the target value for the PIs. Defines the color quadrants on the Kobe plot. Defaults to 1.
- Limit** Numeric vector length nPI with the limit value for the two PIs. Shows as red line on Kobe plot. NULL to ignore.
- Defaults** A list object with default selections for the Kobe See [Kobe\(\)](#)
- TimeTerminal** Optional. By default the Kobe plot shows the terminal projection year. TimeTerminal can be used to override this. Use a numeric value indicating the time (must match a value in Time) to use for the Kobe plot
- Misc** A named list for additional miscellaneous information.

**See Also**

[Kobe\(\)](#), [Code\(\)](#), [Label\(\)](#), [Description\(\)](#), [Value\(\)](#), [Preset\(\)](#)

**Examples**

```
# Generate dummy values
nsim <- 10
nOM <- 2
nMP <- 4
nPI <- 2
nTS <- 30

values <- array(NA, dim=c(nsim, nOM, nMP, nPI, nTS))

pi_means <- c(1,1)

for (om in 1:nOM) {
```

```

for (mp in 1:nMP) {
  for (pi in 1:nPI) {
    values[,om, mp, pi,] <- pi_means[pi] *
      matrix(
        cumprod(c(rlnorm(nTS*nsim, 0, 0.05))),
        nrow=nsim)
  }
}

# Create and populate Object
kobe <- Kobe(Code=c('B/BMSY', 'F/FMSY'),
             Label=c('B/BMSY',
                    'F/FMSY'),
             Description = c('This is the description for PI 1',
                            'This is the description for PI 2'),
             Value=values
)

# Add values for projection time steps
Time(kobe) <- seq(2025, by=1, length.out=nTS)

# Check
Check(kobe)

# Add to `Slick` object
slick <- Slick()
Kobe(slick) <- kobe

# Plots
plotKobe(slick)

plotKobe(slick, Time=TRUE)

```

---

Limit	<i>Access or assign Target and Limit for object of class Kobe or Timeseries</i>
-------	---

---

### Description

Access or assign Target and Limit for object of class Kobe or Timeseries

### Usage

Limit(object)

Limit(object) <- value

Target(object)

```

Target(object) <- value

## S4 method for signature 'Kobe'
Limit(object)

## S4 replacement method for signature 'Kobe'
Limit(object) <- value

## S4 method for signature 'Kobe'
Target(object)

## S4 replacement method for signature 'Kobe'
Target(object) <- value

## S4 method for signature 'Timeseries'
Limit(object)

## S4 replacement method for signature 'Timeseries'
Limit(object) <- value

## S4 method for signature 'Timeseries'
Target(object)

## S4 replacement method for signature 'Timeseries'
Target(object) <- value

```

### Arguments

object	A <a href="#">Kobe-class()</a> or <a href="#">Timeseries()</a> class object
value	Value to assign to Target

### Value

Returns a numeric vector with the contents of the Target or Limit slots of [Kobe\(\)](#) and [Timeseries\(\)](#) objects

### Methods (by class)

- [Limit\(Kobe\)](#): Return Limit from a [Kobe-class\(\)](#) object
- [Limit\(Kobe\) <- value](#): Assign Limit to a [Kobe-class\(\)](#) object
- [Target\(Kobe\)](#): Return Target from a [Kobe-class\(\)](#) object
- [Target\(Kobe\) <- value](#): Assign Target to a [Kobe-class\(\)](#) object
- [Limit\(Timeseries\)](#): Return Limit from a [Timeseries-class\(\)](#) object
- [Limit\(Timeseries\) <- value](#): Assign Limit to a [Timeseries-class\(\)](#) object
- [Target\(Timeseries\)](#): Return Target from a [Timeseries-class\(\)](#) object
- [Target\(Timeseries\) <- value](#): Assign Target to a [Timeseries-class\(\)](#) object

**Functions**

- `Target(object) <- value`: Assign value to `object@Target`

---

 Make\_Slick

*Make an example Slick object*


---

**Description**

A function that creates an example Slick data object

**Usage**

```
Make_Slick(
  name = "Unnamed Slick object",
  OM = NULL,
  MPs = c("DCAC", "AvC", "Fratio", "FMSYref", "FMSYref50", "matlenlim"),
  MP_Desc = NULL,
  PMs = c("AAVE", "AAVY", "LTY", "P10", "P50", "P100", "PNOF", "STY", "Yield"),
  Design = as.data.frame(cbind(rbind(as.matrix(expand.grid(1:2, 1:3, 1:2)), matrix(1,
    nrow = 5, ncol = 3)), c(rep(1, 12), 2:6))),
  SN = list(Factor_Labels = c("Natural Mortality", "Resilience", "Stock Depletion",
    "Robustness"), Labels = list(c("M=0.2", "M=0.3"), c("h=0.5", "h=0.7", "h=0.9"),
    c("Dep=0.1", "Dep=0.3"), c("Ref_Case", "L50=0.5", "Vmaxlen=0.1", "Cobs=0.5",
    "Perr=0.5", "AC=0.95")), Codes = list(c("M2", "M3"), c("h5", "h7", "h9"), c("D1",
    "D3"), c("Ref_case", "mat_low", "dome", "h_Cerr", "h_Perr", "h_AC")), Description =
    list(c("M=0.2", "M=0.3"), c("h=0.5", "h=0.7", "h=0.9"), c("Dep=0.1", "Dep=0.3"),
    c("Reference Case",
    "L50=0.5", "Vmaxlen=0.1", "Cobs=0.5", "Perr=0.5",
    "AC=0.95"))),
  mods = list(function(OM, lev) {
    if (lev == 1) OM@M <- c(0.2, 0.2)
    if (lev ==
    2) OM@M <- c(0.3, 0.3)
    OM
  }, function(OM, lev) {
    if (lev == 1) OM@h <-
    c(0.5, 0.5)
    if (lev == 2) OM@h = c(0.7, 0.7)
    if (lev == 3) OM@h = c(0.9,
    0.9)
    OM
  }, function(OM, lev) {
    if (lev == 1) OM@D <- c(0.1, 0.1)
    if
    (lev == 2) OM@D <- c(0.3, 0.3)
    OM
  })
```

```

    }, function(OM, lev) {
      if (lev == 2)
        OM@L50 <- c(0.5, 0.5)
      if (lev == 3) OM@Vmaxlen = c(0.1, 0.1)
      if (lev == 4)
        OM@Cobs = c(0.5, 0.5)
      if (lev == 5) OM@Perr = c(0.5, 0.5)
      if (lev == 6)
        OM@AC = c(0.9, 0.9)
      OM
    }
  ),
  nsim = 48,
  MSElist = NULL,
  fstYr = NULL,
  returnMSEs = FALSE
)

```

### Arguments

name	Character string that is the object name (abbreviated for use in menus etc)
OM	An operating model object (class 'OM')
MPs	A vector of methods (character string) of class MP
MP_Desc	A vector method descriptions (character string) nMPs long
PMs	A vector of performance metrics of class PM
Design	A design matrix of OM runs
SN	A list of Labels, Codes and Descriptions of the factor levels. Each list item is a factor containing a vector of factor levels.
mods	A nested list of mods
nsim	Integer, the number of simulations
MSElist	An optional list of prerun MSEs
fstYr	An optional numeric value for first projection year. Otherwise current year is used
returnMSEs	Logical, rather than the Slick object should the list of MSEs be returned?

### Value

An object of class [Slick](#)

### Author(s)

T. Carruthers

---

Metadata	<i>Return Code, Label, Description and other information from an object</i>
----------	---

---

**Description**

Return Code, Label, Description and other information from an object

**Usage**

```
Metadata(object, lang = "en")

Metadata(object) <- value

## S4 method for signature 'Boxplot'
Metadata(object, lang = "en")

## S4 replacement method for signature 'Boxplot'
Metadata(object) <- value

## S4 method for signature 'Kobe'
Metadata(object, lang = "en")

## S4 replacement method for signature 'Kobe'
Metadata(object) <- value

## S4 method for signature 'MPs'
Metadata(object, lang = "en")

## S4 replacement method for signature 'MPs'
Metadata(object) <- value

## S4 method for signature 'Quilt'
Metadata(object, lang = "en")

## S4 replacement method for signature 'Quilt'
Metadata(object) <- value

## S4 method for signature 'Tradeoff'
Metadata(object, lang = "en")

## S4 replacement method for signature 'Tradeoff'
Metadata(object) <- value

## S4 method for signature 'Timeseries'
Metadata(object, lang = "en")
```

```
## S4 replacement method for signature 'Timeseries'
Metadata(object) <- value

## S4 method for signature 'Spider'
Metadata(object, lang = "en")

## S4 replacement method for signature 'Spider'
Metadata(object) <- value

## S4 method for signature 'Slick'
Metadata(object, lang = "en")
```

### Arguments

object	A <a href="#">Slick-class()</a> , <a href="#">MPs-class()</a> , <a href="#">Boxplot-class()</a> , <a href="#">Kobe-class()</a> , <a href="#">Quilt-class()</a> , <a href="#">Spider-class()</a> , <a href="#">Timeseries-class()</a> , or <a href="#">Tradeoff-class()</a> object
lang	Optional text string specifying the language (if available). Either 'en', 'es', 'fr', or 'pt' for English, Spanish, French, or Portuguese respectively
value	Replacement value for <code>Metadata()</code> in the corresponding object. See help documentation for the relevant object class for details.

### Value

A data.frame  
A data.frame

### Methods (by class)

- `Metadata(Boxplot)`: Return Metadata for [Boxplot-class\(\)](#) objects
- `Metadata(Boxplot) <- value`: Assign Metadata for [Boxplot-class\(\)](#) objects
- `Metadata(Kobe)`: Return Metadata for [Kobe-class\(\)](#) objects
- `Metadata(Kobe) <- value`: Assign Metadata for [Kobe-class\(\)](#) objects
- `Metadata(MPs)`: Return Metadata for [MPs-class\(\)](#) objects
- `Metadata(MPs) <- value`: Assign Metadata for [MPs-class\(\)](#) objects
- `Metadata(Quilt)`: Return Metadata for [Quilt-class\(\)](#) objects
- `Metadata(Quilt) <- value`: Assign Metadata for [Quilt-class\(\)](#) objects
- `Metadata(Tradeoff)`: Return Metadata for [Tradeoff-class\(\)](#) objects
- `Metadata(Tradeoff) <- value`: Assign Metadata for [Tradeoff-class\(\)](#) objects
- `Metadata(Timeseries)`: Return Metadata for [Timeseries-class\(\)](#) objects
- `Metadata(Timeseries) <- value`: Assign Metadata for [Timeseries-class\(\)](#) objects
- `Metadata(Spider)`: Return Metadata for [Spider-class\(\)](#) objects
- `Metadata(Spider) <- value`: Assign Metadata for [Spider-class\(\)](#) objects
- `Metadata(Slick)`: Return Author, Email, and Institution from [Slick\(\)](#) objects

---

MinValue

*Assign and access MinValue and MaxValue for a Quilt object*

---

### Description

Assign and access MinValue and MaxValue for a Quilt object

### Usage

```
MinValue(Quilt)
```

```
MinValue(Quilt) <- value
```

```
MaxValue(Quilt)
```

```
MaxValue(Quilt) <- value
```

### Arguments

Quilt            A [Quilt-class\(\)](#) object

value            A numeric vector with minimum or maximum values for the Performance Indicators.

### Value

A numeric value

### Functions

- `MinValue()`: Return MinValue from a [Quilt-class\(\)](#) object
- `MinValue(Quilt) <- value`: Assign MinValue to a [Quilt-class\(\)](#) object
- `MaxValue()`: Return MaxValue from a [Quilt-class\(\)](#) object
- `MaxValue(Quilt) <- value`: Assign MaxValue to a [Quilt-class\(\)](#) object

### See Also

[Quilt\(\)](#)

---

Misc *Access or assign Misc for a valid object class*

---

### Description

Access or assign Misc for a valid object class

### Usage

```
Misc(object)
```

```
Misc(object) <- value
```

### Arguments

object	A <a href="#">Slick-class()</a> , <a href="#">MPs-class()</a> , <a href="#">Boxplot-class()</a> , <a href="#">Kobe-class()</a> , <a href="#">Quilt-class()</a> , <a href="#">Spider-class()</a> , <a href="#">Timeseries-class()</a> , or <a href="#">Tradeoff-class()</a> object
value	A named list

---

MPs *Methods for Creating, Accessing and Assigning MPs objects*

---

### Description

The MPs function is used both to create and modify an [MPs-class\(\)](#) object. and to access and assign MPs for an object of class [Slick-class\(\)](#). See Details.

### Usage

```
MPs(Code = "", Label = "", Description = "", Color = "", Preset = list())
```

```
MPs(object) <- value
```

```
## S4 method for signature 'missing'
MPs()
```

```
## S4 method for signature 'character_list'
MPs(Code = "", Label = "", Description = "", Color = "", Preset = list())
```

```
## S4 method for signature 'Slick'
MPs(Code)
```

```
## S4 replacement method for signature 'Slick'
MPs(object) <- value
```

**Arguments**

Code	A <i>short</i> code for the Management Procedures in this Slick object. A character string length nMP or a named list for multi-language support. See Details
Label	A short label for the Management Procedures in this Slick object. Can be longer than Code but recommended to keep short as possible so it shows clearly in plots and tables. A character string length nMP or a named list for multi-language support. See Details
Description	A description for the Management Procedures in this Slick object. Can include Markdown, see Examples. A character string length nMP or a named list for multi-language support. See Details
Color	A character vector of colors for the MPs.
Preset	An optional named list for the preset buttons in the <code>App()</code> . The name of the list element will appear as a button in the <code>App()</code> . Use <code>Code()</code> , <code>Label()</code> , <code>Description()</code> , and <code>Preset()</code> to access and assign the values for an existing MPs object, see Examples.
object	A <code>Slick-class()</code> object
value	A <code>MPs-class()</code> object

**Details**

Objects of class MPs are created with `MPs()`

**Functions**

- `MPs(missing)`: Create an empty MPs object
- `MPs(character_list)`: Create a populated MPs object
- `MPs(Slick)`: Return an `MPs-class()` object from a `Slick()` object
- `MPs(Slick) <- value`: Assign an `MPs-class()` object to a `Slick()` object

**See Also**

`Code()`, `Label()`, `Description()`, `Color()`, `Metadata()`, `Preset()`

**Examples**

```
myMPs <- MPs()
Code(myMPs) <- c('MP1', 'MP2', 'MP3')
Label(myMPs) <- c('Management Procedure 1',
                 'Management Procedure 2',
                 'Management Procedure 3')
Description(myMPs) <- c('This is the description for Management Procedure 1',
                       'This is the description for Management Procedure 2',
                       'This is the description for Management Procedure 3')

Preset(myMPs) <- list(All=1:3, FirstTwo=1:2)
```

```

myMPs

# Multi-language
Description(myMPs) <- list(en=c('This is the English description for Management Procedure 1',
                              'This is the English description for Management Procedure 2',
                              'This is the English description for Management Procedure 3'),
                          es=c("This is the Spanish description for Management Procedure 1",
                              "This is the Spanish description for Management Procedure 2",
                              "This is the Spanish description for Management Procedure 3"),
                          fr=c("This is the French description for Management Procedure 1",
                              "This is the French description for Management Procedure 2",
                              "This is the French description for Management Procedure 3"),
                          pt=c("This is the Portuguese description for Management Procedure 1",
                              "This is the Portuguese description for Management Procedure 2",
                              "This is the Portuguese description for Management Procedure 3")
                          )

Metadata(myMPs)
Metadata(myMPs, 'es')
Metadata(myMPs, 'fr')
Metadata(myMPs, 'pt')

```

---

MPs-class

MPs S4 class and functions

---

## Description

An object of class MPs contains information about the management procedures (MPs) in a [Slick-class\(\)](#) object. Like all S4 objects in Slick, slots in this object can be accessed and assigned using functions corresponding to slot name. See [MPs\(\)](#) and the the See Also section below.

## Details

Objects of class MPs are created with `MPs()`

### Multi-Language Support:

Text with multi-language supported can be provided as a named list. Available languages:

- en: English (default)
- es: Spanish
- fr: French
- pt: Portuguese

### Note:

Character strings in Code, Label, and Description must all be same length as the number of management procedures (nMPs) in the plot objects Boxplot, Kobe, Quilt, Spider, Timeseries, and Tradeoff.

**Slots**

**Code** A *short* code for the Management Procedures in this Slick object. A character string length nMP or a named list for multi-language support. See *Details Required*

**Label** A short label for the Management Procedures in this Slick object. Can be longer than Code but recommended to keep short as possible so it shows clearly in plots and tables. A character string length nMP or a named list for multi-language support. See *Details Required*

**Description** A description for the Management Procedures in this Slick object. Can include Markdown, see *Examples*. A character string length nMP or a named list for multi-language support. See *Details*

**Color** A character vector of colors for the MPs. Defaults will be used if not populated

**Preset** An optional named list for the preset buttons in the `App()`. The name of the list element will appear as a button in the `App()`.

**See Also**

`Code()`, `Label()`, `Description()`, `Preset()`

**Examples**

```
myMPs <- MPs()
Code(myMPs) <- c('MP1', 'MP2', 'MP3')
Label(myMPs) <- c('Management Procedure 1',
                 'Management Procedure 2',
                 'Management Procedure 3')
Description(myMPs) <- c('This is the description for Management Procedure 1',
                       'This is the description for Management Procedure 2',
                       'This is the description for Management Procedure 3')

Preset(myMPs) <- list(All=1:3, FirstTwo=1:2)

myMPs

# Multi-language
Description(myMPs) <- list(en=c('This is the English description for Management Procedure 1',
                              'This is the English description for Management Procedure 2',
                              'This is the English description for Management Procedure 3'),
                          es=c("This is the Spanish description for Management Procedure 1",
                              "This is the Spanish description for Management Procedure 2",
                              "This is the Spanish description for Management Procedure 3"),
                          fr=c("This is the French description for Management Procedure 1",
                              "This is the French description for Management Procedure 2",
                              "This is the French description for Management Procedure 3"),
                          pt=c("This is the Portuguese description for Management Procedure 1",
                              "This is the Portuguese description for Management Procedure 2",
                              "This is the Portuguese description for Management Procedure 3")
                          )

Metadata(myMPs)
Metadata(myMPs, 'es')
```

```

Metadata(myMPs, 'fr')
Metadata(myMPs, 'pt')

```

---

NewSlick	<i>Creates a blank Slick object</i>
----------	-------------------------------------

---

### Description

Creates a blank Slick object

### Usage

```

NewSlick(
  name = "Unnamed Slick Object",
  nPerf = list(nD = 5, nS = 6, nP = 7),
  nMPs = 5,
  nsim = 10,
  nProjYr = 50,
  nStateVar = 2,
  nHistYr = 55,
  Design = expand.grid(1:2, 1:2)
)

```

### Arguments

name	Character string that is the object name (shortened for use in menus etc.)
nPerf	An integer vector of the number of deterministic (nD), stochastic (nS) and projected (nP) performance metrics
nMPs	Integer, the number of management options (aka management procedures).
nsim	Integer, the number of simulations (stochastic replicates per state of nature)
nProjYr	Integer, the number of projected years
nStateVar	Integer, the number of state variables
nHistYr	Integer, the number of historical years for state variables
Design	A design matrix of factor levels SN, factor

### Value

An object of class [Slick](#)

### Author(s)

T. Carruthers

OMs

*Methods for Creating, Accessing and Assigning OMs objects***Description**

The OMs function is used both to create and modify an `OMs-class()` object. and to access and assign OMs for an object of class `Slick-class()`. See Details.

**Usage**

```
OMs(Factors = data.frame(), Design = data.frame(), Preset = list())
```

```
OMs(object) <- value
```

```
## S4 method for signature 'missing'
OMs()
```

```
## S4 method for signature 'dataframe_list'
OMs(Factors = data.frame(), Design = data.frame(), Preset = list())
```

```
## S4 method for signature 'Slick'
OMs(Factors)
```

```
## S4 replacement method for signature 'Slick'
OMs(object) <- value
```

**Arguments**

Factors	A data.frame with column headings Factor, Level, and Description. See Details
Design	A data.frame with nFactor columns (i.e., length(unique(Factors\$Factor))), and nOM rows. See Details
Preset	An optional named list for the preset buttons in the <code>App()</code> . The name of the list element will appear as a button in the <code>App()</code> .. See Details and ‘Examples
object	A <code>Slick-class()</code> object
value	A <code>OMs-class()</code> object

**Details****Factors:**

Factors can be accessed and assigned using `Factors(myslick)` and `Factors(myslick) <- data.frame()` respectively.

The Factor column should be character strings with the name of each factor, while the Level column is a numeric or character value with the level for the corresponding factor.

The Description column is a description for each row, i.e., a unique factor and level. See Examples.

**Design:**

The Design matrix is nOM rows and nFactor columns. The values in each column should either be numeric values indicating the levels for the corresponding factor, or the actual level values (i.e., Factors\$Level) that correspond to each OM. See Examples.

**Preset:**

For OMs objects, Preset should be a named list, where each list element represents a different preset button to be shown in the app by the name of the list element, and each named list element should be a list of length nFactors, with the list elements for each Factor containing numeric values indicating the levels to include for that factor. See Examples

Use [Factors\(\)](#), [Design\(\)](#), and [Preset\(\)](#) to access and assign the values for an existing OMs object, see Examples.

**Functions**

- `OMs(missing)`: Create an empty OMs object
- `OMs(dataframe_list)`: Create a populated OMs object
- `OMs(Slick)`: Return an [OMs-class\(\)](#) object from a [Slick\(\)](#) object
- `OMs(Slick) <- value`: Assign an [OMs-class\(\)](#) object to a [Slick\(\)](#) object

**See Also**

[OMs-class\(\)](#), [Factors\(\)](#), [Design\(\)](#), [Preset\(\)](#)

**Examples**

```
# Create Object
oms <- OMs()

# Specify Factors
Factors(oms) <- data.frame(Factor='M',
                           Level=c('Base', 'Low M', 'High M'),
                           Description=c('Base Case',
                                          'Lower Natural Mortality',
                                          'Higher Natural Mortality')
)

Factors(oms)

# OM Design

Design(oms) <- data.frame(M=c('Base', 'Low M', 'High M'))

# Add names for OMs
rownames(Design(oms)) <- c('Base Case', 'Less Productive', 'More Productive')

Design(oms)

# Preset
```

```

Preset(oms) <- list('Base Case'=list(1),
                  'Low M' = list(2),
                  'High M' = list(3),
                  'All'= list(1:3)
)

# Create Slick Object
myslick <- Slick()

# Add OMs to Slick Object
OMs(myslick) <- oms

```

---

OMs-class

OMs S4 class and functions

---

## Description

An object of class OMs contains information about the operating models (MPs) in the `Slick()` object. Like all S4 objects in `Slick`, slots in this object can be accessed and assigned using functions corresponding to slot name. See `OMs()` and the the See Also section below.

## Details

### Multi-Language Support:

Use a named list to use multi-languages in Factors

### Factors:

Factors can be accessed and assigned using `Factors(myslick)` and `Factors(myslick) <- data.frame()` respectively.

The Factor column should be character strings with the name of each factor, while the Level column is a numeric or character value with the level for the corresponding factor.

The Description column is a description for each row, i.e., a unique factor and level. See Examples.

### Design:

The Design matrix is `nOM` rows and `nFactor` columns. The values in each column should either be numeric values indicating the levels for the corresponding factor, or the actual level values (i.e., `Factors$Level`) that correspond to each OM. See Examples.

### Preset:

For OMs objects, `Preset` should be a named list, where each list element represents a different preset button to be shown in the app by the name of the list element, and each named list element should be a list of length `nFactors`, with the list elements for each Factor containing numeric values indicating the levels to include for that factor. See Examples

**Slots**

**Factors** A data.frame with column headings Factor, Level, and Description. See Details

**Design** A data.frame with nFactor columns (i.e., length(unique(Factors\$Factor))), and nOM rows. See Details

**Preset** An optional named list for the preset buttons in the `App()`. The name of the list element will appear as a button in the `App()`.. See Details and Examples

**See Also**

`OMs()`, `Factors()`, `Design()`, `Preset()`

**Examples**

```
# Create Object
oms <- OMs()

# Specify Factors
Factors(oms) <- data.frame(Factor='M',
                           Level=c('Base', 'Low M', 'High M'),
                           Description=c('Base Case',
                                          'Lower Natural Mortality',
                                          'Higher Natural Mortality'))

)

Factors(oms)

# OM Design

Design(oms) <- data.frame(M=c('Base', 'Low M', 'High M'))

# Add names for OMs
rownames(Design(oms)) <- c('Base Case', 'Less Productive', 'More Productive')

Design(oms)

# Preset

Preset(oms) <- list('Base Case'=list(1),
                   'Low M' = list(2),
                   'High M' = list(3),
                   'All'= list(1:3))

)

# Create Slick Object
myslick <- Slick()

# Add OMs to Slick Object
OMs(myslick) <- oms
```

---

plotBoxplot	<i>Plot</i> Boxplot
-------------	---------------------

---

### Description

Plots boxplot, violin plot, or a combined box+violin plot for information stored in a [Boxplot](#) object

### Usage

```
plotBoxplot(
  slick,
  PI = NULL,
  type = c("boxplot", "violin", "both", "all"),
  byOM = FALSE,
  OMs = NA,
  ncol = 4,
  MP_label = "Code",
  PI_label = "Code"
)
```

### Arguments

<code>slick</code>	A <a href="#">Slick-class()</a> object
<code>PI</code>	Numeric value indicating the Performance Indicator(s) to plot from the <code>Boxplot-class</code> object. If <code>NULL</code> , it will <code>facet_wrap</code> all PIs
<code>type</code>	Character string specifying the plot type.
<code>byOM</code>	Logical. Facet the plots by operating model? PI must be a single value
<code>OMs</code>	Integers representing the OMs to include in the plot. Defaults to all.
<code>ncol</code>	Numeric. Number of columns
<code>MP_label</code>	Label to use for the MPs. Either <code>Code</code> or <code>Label</code> . <code>Description</code> works as well, but you probably don't want to do that.
<code>PI_label</code>	Label to use for the PIs. Either <code>Code</code> or <code>Label</code> . <code>Description</code> works as well, but you probably don't want to do that.

### Value

A `ggplot2` object, or a list of `ggplot2` objects

### Examples

```
# Generate dummy values
nsim <- 10
nOM <- 2
nMP <- 4
nPI <- 3
```

```

values <- array(NA, dim=c(nsim, nOM, nMP, nPI))
pi_means <- runif(nPI, 5, 50)
for (om in 1:nOM) {
  for (mp in 1:nMP) {
    for (pi in 1:nPI) {
      values[,om, mp, pi] <- rlnorm(nsim, log(pi_means[pi]), 0.4)
    }
  }
}

# Create and populate Object
boxplot <- Boxplot(Code=c('PI1', 'PI2', 'PI3'),
                  Label=c('Performance Indicator 1',
                          'Performance Indicator 2',
                          'Performance Indicator 3'),
                  Description = c('This is the description for PI 1',
                                  'This is the description for PI 2',
                                  'This is the description for PI 3'),
                  Value=values)

# Check
Check(boxplot)

# Add to `Slick` object
slick <- Slick()
Boxplot(slick) <- boxplot

# Plots
plotBoxplot(slick)

plotBoxplot(slick, type='violin')

plotBoxplot(slick, byOM=TRUE)

plotBoxplot(slick, 2, type='both', byOM=TRUE)

```

---

plotKobe

*Plot Kobe*


---

## Description

Plots a Kobe plot for a given projection year, or a Kobe Time plot.

## Usage

```

plotKobe(
  slick,
  xPI = 1,
  yPI = 2,

```

```

Time = FALSE,
OMs = NA,
BLcol = "#F8DC7A",
TLcol = "#D8775D",
TRcol = "#FDBD56",
BRcol = "#67C18B",
axis_label = "Code",
percentile = 0.75,
axis.text.size = 14,
axis.title.size = 16,
strip.text.size = 16,
strip.text.color = "#D6501C",
incMP_label = TRUE,
mp.text.size = 7,
mp.point.size = 4,
mp.init.point.size = 2,
xmax = 2,
ymax = 2,
hist_traj = FALSE,
ncol = 4,
lang = "en",
MP_label = "Code"
)

```

### Arguments

<code>slick</code>	A <code>Slick-class()</code> object
<code>xPI</code>	Numeric value specifying the performance indicator for the x-axis
<code>yPI</code>	Numeric value specifying the performance indicator for the y-axis
<code>Time</code>	Logical. Kobe Time plot?
<code>OMs</code>	Integers representing the OMs to include in the plot. Defaults to all.
<code>BLcol</code>	Color for the bottom left quadrant
<code>TLcol</code>	Color for the top left quadrant
<code>TRcol</code>	Color for the top right quadrant
<code>BRcol</code>	Color for the bottom right quadrant
<code>axis_label</code>	Label to use for the axes. Either Code or Label. Description works as well, but you probably don't want to do that.
<code>percentile</code>	Numeric value specifying the percentile for the x and y percentile bars. Use NULL to remove percentile lines.
<code>axis.text.size</code>	Font size for axis text
<code>axis.title.size</code>	Font size for axis title
<code>strip.text.size</code>	Font size for facet strip text
<code>strip.text.color</code>	Color for facet strip text

incMP_label	Logical. Include MP labels?
mp.text.size	Font size for MP labels
mp.point.size	Point size for MP labels
mp.init.point.size	Point size for start of trajectory. If hist_traj==TRUE
xmax	Maximum value for the x-axis. Values greater than xmax will be shown at xmax
ymax	Maximum value for the yx-axis. Values greater than ymax will be shown at ymax
hist_traj	Logical. Plot the historical trajectories?
ncol	Numeric. Number of columns for Kobe Time
lang	Optional. Language (if supported in Slick Object). Either 'en', 'es', 'fr', or 'pt'
MP_label	Label to use for the MPs. Either Code or Label. Description works as well, but you probably don't want to do that.

### Details

By default plotKobe shows the terminal projection year. TimeTerminal(Kobe) can be used to override this. Use a numeric value indicating the time (must match a value in Time(Kobe)) to use for the Kobe plot.

### Value

A ggplot2 object

### See Also

[Kobe\(\)](#), [Kobe-class\(\)](#)

### Examples

```
# Generate dummy values
nsim <- 10
nOM <- 2
nMP <- 4
nPI <- 2
nTS <- 30

values <- array(NA, dim=c(nsim, nOM, nMP, nPI, nTS))

pi_means <- c(1,1)

for (om in 1:nOM) {
  for (mp in 1:nMP) {
    for (pi in 1:nPI) {
      values[,om, mp, pi,] <- pi_means[pi] *
        matrix(
          cumprod(c(rlnorm(nTS*nsim, 0, 0.05))),
          nrow=nsim)
    }
  }
}
```

```

    }
  }

  # Create and populate Object
  kobe <- Kobe(Code=c('B/BMSY', 'F/FMSY'),
              Label=c('B/BMSY',
                     'F/FMSY'),
              Description = c('This is the description for PI 1',
                             'This is the description for PI 2'),
              Value=values
  )

  # Add values for projection time steps
  Time(kobe) <- seq(2025, by=1, length.out=nTS)

  # Check
  Check(kobe)

  # Add to `Slick` object
  slick <- Slick()
  Kobe(slick) <- kobe

  # Plots
  plotKobe(slick)

  plotKobe(slick, Time=TRUE)

```

---

 plotQuilt

*Plot Quilt*


---

## Description

Create a Quilt plot (unless shading==FALSE in which case it's just a table)

## Usage

```

plotQuilt(
  slick,
  MP_label = "Code",
  OMs = NA,
  minmax = FALSE,
  shading = TRUE,
  kable = FALSE,
  signif = 3,
  alpha = 0.5
)

```

**Arguments**

slick	A <a href="#">Slick-class()</a> object
MP_label	Label to use for the MPs. Either Code or Label. Description works as well, but you probably don't want to do that.
OMs	Integers representing the OMs to include in the plot. Defaults to all.
minmax	Logical. Color shading from min to max values in each column? If TRUE, ignores <code>MinValue(quilt)</code> and <code>MaxValue(quilt)</code>
shading	Logical. Color shading for the columns?
kable	Logical. Return a kable object?
signif	Numeric Number of significant figures
alpha	Numeric value. Transparency for color shading

**Details**

The columns are color shaded from light (lowest values) to dark (highest values).

Colors are set in `Color(quilt)`.

The color shading has 10 steps, from `MinValue(quilt)` to `MaxValue(quilt)` for each Performance Indicator. If those values are missing (NA) for a given PI, colors are shaded from lowest to highest values. If `minmax==TRUE`, `MinValue(quilt)` and `MaxValue(quilt)` are ignored.

**Value**

A `DT::datatable` or a `knitr::kable` object

**See Also**

[Quilt\(\)](#), [Quilt-class\(\)](#)

**Examples**

```
# Generate dummy values
nOM <- 2
nMP <- 4
nPI <- 4

values <- array(NA, dim=c(nOM, nMP, nPI))

pi_means <- runif(nPI, 5, 50)
for (om in 1:nOM) {
  for (mp in 1:nMP) {
    for (pi in 1:nPI) {
      values[om, mp, pi] <- rlnorm(1, log(pi_means[pi]), 0.4)
    }
  }
}

# Create and populate Object
```

```

quilt <- Quilt(Code=c('PI1', 'PI2', 'PI3', 'PI4'),
              Label=c('Performance Indicator 1',
                      'Performance Indicator 2',
                      'Performance Indicator 3',
                      'Performance Indicator 4'),
              Description = c('This is the description for PI 1',
                              'This is the description for PI 2',
                              'This is the description for PI 3',
                              'This is the description for PI 4'),
              Value=values)

# Check
Check(quilt)

# Add to `Slick` object
slick <- Slick()
Quilt(slick) <- quilt

# Plots
plotQuilt(slick)

# Alternative - include Simulation dimension

# Generate dummy values
nSim <- 3
nOM <- 2
nMP <- 4
nPI <- 4

values <- array(NA, dim=c(nSim, nOM, nMP, nPI))

pi_means <- runif(nPI, 5, 50)
for (om in 1:nOM) {
  for (mp in 1:nMP) {
    for (pi in 1:nPI) {
      values[, om, mp, pi] <- rlnorm(nSim, log(pi_means[pi]), 0.4)
    }
  }
}

# Create and populate Object
quilt <- Quilt(Code=c('PI1', 'PI2', 'PI3', 'PI4'),
              Label=c('Performance Indicator 1',
                      'Performance Indicator 2',
                      'Performance Indicator 3',
                      'Performance Indicator 4'),
              Description = c('This is the description for PI 1',
                              'This is the description for PI 2',
                              'This is the description for PI 3',
                              'This is the description for PI 4'),
              Value=values)

```

```
# Add to `Slick` object
slick <- Slick()
Quilt(slick) <- quilt

# Plots
plotQuilt(slick)
apply(quilt@Value, 3:4, mean) |> round(1)
```

---

plotSpider

*Plot Spider*

---

### Description

A Spider or Radar plot

### Usage

```
plotSpider(
  slick,
  byOM = FALSE,
  byMP = FALSE,
  OMs = NA,
  incMean = TRUE,
  incMax = TRUE,
  relScale = FALSE,
  col.om.title = "#D6501C",
  cex.om.title = 2,
  col.Mean = "white",
  bg.Mean = "black",
  grid.fill = "#f2f3f5",
  grid.line = "black",
  fill = byMP | all(byOM),
  inc.grid = TRUE,
  PI.labels = !(byMP | all(byOM)),
  MP_label = "Code",
  mp.lwd = 3,
  alpha = 0.3,
  ncol = 4,
  PI.mean.cex = 2.2,
  incMPtitle = byMP,
  mplab.cex = 2.2,
  max.pt.cex = 2,
  max.pt.col = "darkred"
)
```

**Arguments**

<code>slick</code>	A <code>Slick-class()</code> object
<code>byOM</code>	Logical Plot by OM? Otherwise mean over OMs
<code>byMP</code>	Logical. Plot by MP? Otherwise all MPs together on one plot
<code>OMs</code>	Integers representing the OMs to include in the plot. Defaults to all.
<code>incMean</code>	Logical. Include mean PI score in center?
<code>incMax</code>	Logical. Include colored points indicating maximum PI values?
<code>relScale</code>	Logical. Scale PI values between minimum (0) and maximum (1)?
<code>col.om.title</code>	Color of the OM names/labels
<code>cex.om.title</code>	Size of OM names/labels
<code>col.Mean</code>	Color of mean value text
<code>bg.Mean</code>	Background color of mean value text
<code>grid.fill</code>	Color of fill for the spider grid
<code>grid.line</code>	Color of lines for the spider grid
<code>fill</code>	Logical Fill the spider plot?
<code>inc.grid</code>	Logical. Include the grid?
<code>PI.labels</code>	Logical Show PI labels?
<code>MP_label</code>	Label to use for the MPs. Either Code or Label. Description works as well, but you probably don't want to do that.
<code>mp.lwd</code>	Line width
<code>alpha</code>	Alpha value for the fill
<code>ncol</code>	Number of columns
<code>PI.mean.cex</code>	Size of PI mean score text
<code>incMPtitle</code>	Logical. Include MP label?
<code>mplab.cex</code>	MP label size
<code>max.pt.cex</code>	Max value point size
<code>max.pt.col</code>	Max value point color

**Value**

A `ggplot2` object

**Examples**

```
# Generate dummy values
nOM <- 2
nMP <- 4
nPI <- 4

values <- array(NA, dim=c(nOM, nMP, nPI))

# Note: PI values must be between 0 and 1, with 1 indicating better performance
```

```

pi_means <- runif(nPI, 0, 1)
for (om in 1:nOM) {
  for (mp in 1:nMP) {
    for (pi in 1:nPI) {
      values[om, mp, pi] <- runif(1, pi_means[pi])
    }
  }
}

# Create and populate Object
spider <- Spider(Code=c('PI1', 'PI2', 'PI3', 'PI4'),
  Label=c('Performance Indicator 1',
    'Performance Indicator 2',
    'Performance Indicator 3',
    'Performance Indicator 4'),
  Description = c('This is the description for PI 1',
    'This is the description for PI 2',
    'This is the description for PI 3',
    'This is the description for PI 4'),
  Value=values)

# Check
Check(spider)

# Add to `Slick` object
slick <- Slick()
Spider(slick) <- spider

# Plots
plotSpider(slick)

plotSpider(slick, fill=TRUE)

plotSpider(slick, byMP=TRUE)

plotSpider(slick, byOM=TRUE)

```

---

plotTimeseries

*Plot Timeseries*


---

## Description

Plot the historical and projected values for a performance indicator.

## Usage

```

plotTimeseries(
  slick,
  PI = 1,

```

```

byMP = FALSE,
byOM = FALSE,
OMs = NA,
includeHist = TRUE,
ncol = 4,
col_line = "darkgray",
includeQuants = TRUE,
includeLabels = TRUE,
MeanMed = c("mean", "median"),
fill_ribbon1 = "#ededed",
col_ribbon1 = "#ededed",
quants1 = c(0.25, 0.75),
alpha1 = 0.3,
fill_ribbon2 = "white",
col_ribbon2 = "#c9c9c9",
linetype_ribbon2 = "dashed",
quants2 = c(0.1, 0.9),
alpha2 = 0.1,
MP_label = "Code",
col_title = "#D6501C",
size.title = 18,
size.axis.title = 18,
size.axis.text = 16,
size.mp.label = 6,
linewidth.median.line = 0.5,
targ_color = "green",
targ_name = "Target",
lim_color = "red",
lim_name = "Limit",
inc_y_label = TRUE,
sims = NULL,
lang = "en"
)

```

### Arguments

slick	A <a href="#">Slick-class()</a> object
PI	A numeric value specifying the performance indicator to plot
byMP	Logical. Facet by MP? Defaults to FALSE, where all MPs are shown on the same plot
byOM	Logical. Facet by OM? Defaults to FALSE where values are calculated as mean across OMs
OMs	Integers representing the OMs to include in the plot. Defaults to all.
includeHist	Logical. Include the historical period in the projections?
ncol	Numeric. Number of columns if faceting by MP or OM
col_line	Color for the median line (historical)

includeQuants	Logical. Include quantile shading for the projections?
includeLabels	Logical. Include MP labels?
MeanMed	Character. Plot the 'mean' (default) or 'median'.
fill_ribbon1	Fill color for the inner ribbon
col_ribbon1	Color of the line for inner ribbon
quants1	Quantiles for the inner ribbon. Numeric length 2
alpha1	Alpha for the colored MPs inner shading
fill_ribbon2	Fill color for the outer ribbon
col_ribbon2	Color of the line for outer ribbon
linetype_ribbon2	Line type for outer ribbon
quants2	Quantiles for the outer ribbon. Numeric length 2.
alpha2	Alpha for the colored MPs outer shading
MP_label	Label to use for the MPs. Either Code or Label. Description works as well, but you probably don't want to do that.
col_title	Color of the MP title (if byMP==TRUE)
size.title	Numeric length 1. Size for plot title
size.axis.title	Numeric length 1. Size for axis title
size.axis.text	Numeric length 1. Size for axis text
size.mp.label	Numeric length 1. Size of MP labels. Set to NULL for no MP labels
linewidth.median.line	Width of the mean/median line
targ_color	Color for the target line (if it exists in Target(Timeseries(slick)))
targ_name	Label for the target line
lim_color	Color for the limit line (if it exists in Limit(Timeseries(slick)))
lim_name	Label for the limit line
inc_y_label	Include the label for the y-axis?
sims	Optional. Numeric values indicating the simulations to include. Defaults to all.
lang	Optional. Language (if supported in Slick Object). Either 'en', 'es', 'fr', or 'pt'

### Details

If byOM==FALSE the results are shown as the mean across operating models.

### Value

A ggplot2 object

### See Also

[Timeseries\(\)](#), [Timeseries-class\(\)](#)

**Examples**

```

# Generate dummy values
nsim <- 10
nOM <- 2
nMP <- 4
nPI <- 3
nHistTS <- 50
nProjTS <- 30
nTS <- nHistTS + nProjTS

set.seed(101)

values <- array(NA, dim=c(nsim, nOM, nMP, nPI, nTS))

pi_means <- c(1,1, 1000)

for (om in 1:nOM) {
  for (pi in 1:nPI) {
    # PI identical for historical
    histVals <- matrix(
      pi_means[pi] *
      cumprod(c(rlnorm(nHistTS*nsim, 0, 0.05))),
      nrow=nsim, ncol=nHistTS, byrow=TRUE)
    histVals <- replicate(nMP, histVals)
    values[,om, , pi,1:nHistTS] <- aperm(histVals, c(1,3,2))

    for (mp in 1:nMP) {
      values[,om, mp, pi,(nHistTS+1):nTS] <- matrix(
        pi_means[pi] *
        cumprod(c(rlnorm(nProjTS*nsim, 0, 0.05))),
        nrow=nsim, ncol=nProjTS, byrow=FALSE)
    }
  }
}

# Create and populate Object
timeseries <- Timeseries(Code=c('B/BMSY', 'F/FMSY', 'TAC'),
                        Label=c('B/BMSY',
                                'F/FMSY',
                                'TAC'),
                        Description = c('This is the description for PI 1',
                                        'This is the description for PI 2',
                                        'This is the description for PI 3'),
                        Value=values
)

# Last historical time step
TimeNow(timeseries) <- 2024

# Add values for time steps
Time(timeseries) <- c(rev(seq(TimeNow(timeseries), by=-1, length.out=nHistTS)),
                    seq(TimeNow(timeseries)+1, by=1, length.out=nProjTS))

```

```
# Check
Check(timeseries)

# Add to `Slick` object
slick <- Slick()
Timeseries(slick) <- timeseries

# Plots
plotTimeseries(slick)
plotTimeseries(slick, 2)
plotTimeseries(slick, 3)

plotTimeseries(slick, byMP=TRUE)

plotTimeseries(slick, byOM=TRUE)

# Custom Reference Points
RefPoints(timeseries) <- list(
  list(Name=c('0.5 BMSY', 'BMSY', '1.5 BMSY'),
        Value=c(0.5, 1, 1.5),
        Color=c('red', 'orange', 'green')),
  list(Name=c('0.8 FMSY', 'FMSY'),
        Value=c(0.8,1),
        Color=c('orange', 'red')),
  list(Name='Target Catch',
        Value=1200,
        Color='blue')
)

Timeseries(slick) <- timeseries
plotTimeseries(slick)
plotTimeseries(slick, 2)
plotTimeseries(slick, 3)
```

---

plotTradeoff

*Plot Tradeoff*

---

## Description

Plot Tradeoff

## Usage

```
plotTradeoff(
  slick,
  xPI = NULL,
  yPI = NULL,
```

```

OMs = NA,
MP_label = "Code",
lab_size = 6,
point_size = 2,
size.axis.title = 14,
size.axis.text = 12
)

```

### Arguments

slick	A <code>Slick-class()</code> object
xPI	Numeric value indicating the PI to plot on the x-axis. Multiple values are accepted. Recycled if $xPI < yPI$
yPI	Numeric value indicating the PI to plot on the y-axis. Multiple values are accepted. Recycled if $yPI < xPI$
OMs	Integers representing the OMs to include in the plot. Defaults to all.
MP_label	Label to use for the MPs. Either Code or Label. Description works as well, but you probably don't want to do that.
lab_size	Size of the MP labels
point_size	Size of the points
size.axis.title	Size of axis title
size.axis.text	Size of axis text

### Value

A ggplot2 object

### Examples

```

# Generate dummy values
nOM <- 2
nMP <- 4
nPI <- 4

values <- array(NA, dim=c(nOM, nMP, nPI))

pi_means <- runif(nPI, 5, 50)
for (om in 1:nOM) {
  for (mp in 1:nMP) {
    for (pi in 1:nPI) {
      values[om, mp, pi] <- rlnorm(1, log(pi_means[pi]), 0.4)
    }
  }
}

# Create and populate Object
tradeoff <- Tradeoff(Code=c('PI1', 'PI2', 'PI3', 'PI4'),

```

```

Label=c('Performance Indicator 1',
        'Performance Indicator 2',
        'Performance Indicator 3',
        'Performance Indicator 4'),
Description = c('This is the description for PI 1',
               'This is the description for PI 2',
               'This is the description for PI 3',
               'This is the description for PI 4'),
Value=values)

# Check
Check(tradeoff)

# Add to `Slick` object
slick <- Slick()
Tradeoff(slick) <- tradeoff

# Plots
plotTradeoff(slick)

plotTradeoff(slick, c(1,1,2), c(2,3,3))

```

---

PMnorm

*Normalize performance metric values in a Slick object*


---

### Description

A function that converts deterministic or stochastic performance metrics to the range 0-100 and optionally inverts these

### Usage

```
PMnorm(obj, det = TRUE, inv = NULL)
```

### Arguments

obj	An object of class `slick`
det	logical, should the normalization be applied to the deterministic performance metrics (or, if false the stochastic ones)
inv	A logical vector nPM long. If true, the PM will be inverted (100-value).

### Value

An object of class [Slick](#)

### Author(s)

T. Carruthers

---

Preset	<i>Assign or access Preset for a valid object class</i>
--------	---

---

**Description**

Assign or access Preset for a valid object class

**Usage**

```
Preset(object)

Preset(object) <- value

## S4 method for signature 'Boxplot'
Preset(object)

## S4 replacement method for signature 'Boxplot'
Preset(object) <- value

## S4 method for signature 'Kobe'
Preset(object)

## S4 replacement method for signature 'Kobe'
Preset(object) <- value

## S4 method for signature 'MPs'
Preset(object)

## S4 replacement method for signature 'MPs'
Preset(object) <- value

## S4 method for signature 'OMs'
Preset(object)

## S4 replacement method for signature 'OMs'
Preset(object) <- value

## S4 method for signature 'Quilt'
Preset(object)

## S4 replacement method for signature 'Quilt'
Preset(object) <- value

## S4 method for signature 'Tradeoff'
Preset(object)

## S4 replacement method for signature 'Tradeoff'
```

```

Preset(object) <- value

## S4 method for signature 'Timeseries'
Preset(object)

## S4 replacement method for signature 'Timeseries'
Preset(object) <- value

## S4 method for signature 'Spider'
Preset(object)

## S4 replacement method for signature 'Spider'
Preset(object) <- value

```

### Arguments

object	An object of class <a href="#">Boxplot-class()</a> , <a href="#">Kobe-class()</a> , <a href="#">Quilt-class()</a> , <a href="#">Spider-class()</a> , <a href="#">Timeseries-class()</a> , or <a href="#">Tradeoff-class()</a>
value	A list, formatted to match the class of object. See the documentation for corresponding object class for more details.

### Value

Returns a list object from the Preset slot in object

### Methods (by class)

- `Preset(Boxplot)`: Return Preset from a [Boxplot-class\(\)](#) object
- `Preset(Boxplot) <- value`: Assign Preset slot from a [Boxplot-class\(\)](#) object
- `Preset(Kobe)`: Return Preset from a [Kobe-class\(\)](#) object
- `Preset(Kobe) <- value`: Assign Preset to a [Kobe-class\(\)](#) object
- `Preset(MPs)`: Return Preset from a [MPs-class\(\)](#) object
- `Preset(MPs) <- value`: Assign Preset to a [MPs-class\(\)](#) object
- `Preset(OMs)`: Return Preset from a [OMs-class\(\)](#) object
- `Preset(OMs) <- value`: Assign Preset to an [OMs-class\(\)](#) object
- `Preset(Quilt)`: Return Preset from a [Quilt-class\(\)](#) object
- `Preset(Quilt) <- value`: Assign Preset to a [Quilt-class\(\)](#) object
- `Preset(Tradeoff)`: Return Preset from a [Tradeoff-class\(\)](#) object
- `Preset(Tradeoff) <- value`: Assign Preset to a [Tradeoff-class\(\)](#) object
- `Preset(Timeseries)`: Return Preset from a [Timeseries-class\(\)](#) object
- `Preset(Timeseries) <- value`: Assign Preset to a [Timeseries-class\(\)](#) object
- `Preset(Spider)`: Return Preset from a [Spider-class\(\)](#) object
- `Preset(Spider) <- value`: Assign Preset slot from a [Spider-class\(\)](#) object

**Description**

The `Quilt` function is used both to create and modify an `Quilt-class()` object, and to access and assign `Quilt` for an object of class `Slick-class()`. See Details.

**Usage**

```

Quilt(
  Code = "",
  Label = "",
  Description = "",
  Value = array(),
  Preset = list(),
  Color = c("darkblue", "lightblue"),
  MinValue = as.numeric(NA),
  MaxValue = as.numeric(NA),
  Misc = list()
)

Quilt(Slick) <- value

## S4 method for signature 'missing'
Quilt()

## S4 method for signature 'character_list'
Quilt(
  Code = "",
  Label = "",
  Description = "",
  Value = array(),
  Preset = list(),
  Color = c("darkblue", "lightblue"),
  MinValue = as.numeric(NA),
  MaxValue = as.numeric(NA),
  Misc = list()
)

## S4 method for signature 'Slick'
Quilt(Code)

## S4 replacement method for signature 'Slick'
Quilt(Slick) <- value

```

**Arguments**

Code	A <i>short</i> code for the Performance Indicators for this object. A character string length <code>nPI</code> or a named list for multi-language support. See <a href="#">Details</a>
Label	A short label for the Performance Indicators for this object. Used to label axes on charts. Can be longer than <code>Code</code> but recommended to keep short as possible so it shows clearly in plots and tables. A character string length <code>nPI</code> or a named list for multi-language support. See <a href="#">Details</a>
Description	A description for the Performance Indicators for this object. Can include <a href="#">Mark-down</a> , see <a href="#">Examples</a> . A character string length <code>nPI</code> or a named list for multi-language support. See <a href="#">Details</a>
Value	A numeric array with the stochastic performance indicator values for each operating model (OM), management procedure (MP), and performance indicator (PI). Dimensions: <code>c(nOM, nMP, and nPI)</code> . Alternatively, to calculate average over both simulations and Operating Models, <code>Value</code> can be a 4-dimensional array with dimensions: <code>c(nSim, nOM, nMP, and nPI)</code> .
Preset	An optional named list for the preset buttons in the <a href="#">App()</a> . The name of the list element will appear as a button in the <a href="#">App()</a> .
Color	A character vector length 2 of colors for the maximum and minimum values in the chart.
MinValue	Numeric vector length <code>nPI</code> with the minimum possible value for the respective PIs. Defaults to minimum PI value in <code>Value</code> (averaged across OMs in some cases)
MaxValue	Numeric vector length <code>nPI</code> with the maximum possible value (i.e., best performance) for the respective PIs. Defaults to maximum PI value in <code>Value</code> (averaged across OMs in some cases).
Misc	A named list for additional miscellaneous information.
Slick	A <a href="#">Slick-class()</a> object
value	A <a href="#">Quilt-class()</a> object

**Details**

Objects of class `Quilt` are created with `Quilt()`

Use the [Code\(\)](#), [Label\(\)](#), [Description\(\)](#), [Value\(\)](#), [Preset\(\)](#), [Color\(\)](#), [MinValue\(\)](#), and [MaxValue\(\)](#) functions to access and assign the values for an existing `Quilt` object, see [Examples](#)

**Multi-Language Support:**

Text with multi-language supported can be provided as a named list. Available languages:

- en: English (default)
- es: Spanish
- fr: French
- pt: Portuguese

**Note:**

Character strings in `Code`, `Label`, and `Description` must all be same length as the number of performance indicators (`nPIs`) in `Value`

**Functions**

- `Quilt(missing)`: Create an empty Quilt object
- `Quilt(character_list)`: Create a populated Quilt object
- `Quilt(Slick)`: Return Quilt from a [Slick-class\(\)](#) object
- `Quilt(Slick) <- value`: Assign a [Quilt-class\(\)](#) object to a [Slick-class\(\)](#) object

**See Also**

[Code\(\)](#), [Label\(\)](#), [Description\(\)](#), [Color\(\)](#), [Metadata\(\)](#), [Preset\(\)](#), [Color\(\)](#), [MinValue\(\)](#), [MaxValue\(\)](#)

**Examples**

```
# Generate dummy values
nOM <- 2
nMP <- 4
nPI <- 4

values <- array(NA, dim=c(nOM, nMP, nPI))

pi_means <- runif(nPI, 5, 50)
for (om in 1:nOM) {
  for (mp in 1:nMP) {
    for (pi in 1:nPI) {
      values[om, mp, pi] <- rlnorm(1, log(pi_means[pi]), 0.4)
    }
  }
}

# Create and populate Object
quilt <- Quilt(Code=c('PI1', 'PI2', 'PI3', 'PI4'),
              Label=c('Performance Indicator 1',
                     'Performance Indicator 2',
                     'Performance Indicator 3',
                     'Performance Indicator 4'),
              Description = c('This is the description for PI 1',
                             'This is the description for PI 2',
                             'This is the description for PI 3',
                             'This is the description for PI 4'),
              Value=values)

# Check
Check(quilt)

# Add to `Slick` object
slick <- Slick()
Quilt(slick) <- quilt

# Plots
plotQuilt(slick)
```

```

# Alternative - include Simulation dimension

# Generate dummy values
nSim <- 3
nOM <- 2
nMP <- 4
nPI <- 4

values <- array(NA, dim=c(nSim, nOM, nMP, nPI))

pi_means <- runif(nPI, 5, 50)
for (om in 1:nOM) {
  for (mp in 1:nMP) {
    for (pi in 1:nPI) {
      values[, om, mp, pi] <- rlnorm(nSim, log(pi_means[pi]), 0.4)
    }
  }
}

# Create and populate Object
quilt <- Quilt(Code=c('PI1', 'PI2', 'PI3', 'PI4'),
              Label=c('Performance Indicator 1',
                     'Performance Indicator 2',
                     'Performance Indicator 3',
                     'Performance Indicator 4'),
              Description = c('This is the description for PI 1',
                             'This is the description for PI 2',
                             'This is the description for PI 3',
                             'This is the description for PI 4'),
              Value=values)

# Add to `Slick` object
slick <- Slick()
Quilt(slick) <- quilt

# Plots
plotQuilt(slick)
apply(quilt@Value, 3:4, mean) |> round(1)

```

---

Quilt-class

*S4 class* Quilt

---

### Description

Objects of class `Quilt` are used to store information for the Quilt chart. Like all S4 objects in `Slick`, slots in this object can be accessed and assigned using functions corresponding to slot name. See

[Quilt\(\)](#) and the the See Also section below.

## Details

Objects of class `Quilt` are created with `Quilt()`

### Multi-Language Support:

Text with multi-language supported can be provided as a named list. Available languages:

- en: English (default)
- es: Spanish
- fr: French
- pt: Portuguese

### Note:

Character strings in `Code`, `Label`, and `Description` must all be same length as the number of performance indicators (nPIs) in `Value`

## Slots

**Code** A *short* code for the Performance Indicators for this object. A character string length nPI or a named list for multi-language support. See [Details](#)

**Label** A short label for the Performance Indicators for this object. Used to label axes on charts. Can be longer than `Code` but recommended to keep short as possible so it shows clearly in plots and tables. A character string length nPI or a named list for multi-language support. See [Details](#)

**Description** A description for the Performance Indicators for this object. Can include Markdown, see [Examples](#). A character string length nPI or a named list for multi-language support. See [Details](#)

**Value** A numeric array with the stochastic performance indicator values for each operating model (OM), management procedure (MP), and performance indicator (PI). Dimensions:  $c(nOM, nMP, \text{and } nPI)$ . Alternatively, to calculate average over both simulations and Operating Models, `Value` can be a 4-dimensional array with dimensions:  $c(nSim, nOM, nMP, \text{and } nPI)$ .

**Preset** An optional named list for the preset buttons in the [App\(\)](#). The name of the list element will appear as a button in the [App\(\)](#).

**Color** A character vector length 2 of colors for the maximum and minimum values in the chart.

**MinValue** Numeric vector length nPI with the minimum possible value for the respective PIs. Defaults to minimum PI value in `Value` (averaged across OMs in some cases)

**MaxValue** Numeric vector length nPI with the maximum possible value (i.e., best performance) for the respective PIs. Defaults to maximum PI value in `Value` (averaged across OMs in some cases).

**Misc** A named list for additional miscellaneous information.

## See Also

[Quilt\(\)](#), [Code\(\)](#), [Label\(\)](#), [Description\(\)](#), [Value\(\)](#), [Preset\(\)](#)

**Examples**

```

# Generate dummy values
nOM <- 2
nMP <- 4
nPI <- 4

values <- array(NA, dim=c(nOM, nMP, nPI))

pi_means <- runif(nPI, 5, 50)
for (om in 1:nOM) {
  for (mp in 1:nMP) {
    for (pi in 1:nPI) {
      values[om, mp, pi] <- rlnorm(1, log(pi_means[pi]), 0.4)
    }
  }
}

# Create and populate Object
quilt <- Quilt(Code=c('PI1', 'PI2', 'PI3', 'PI4'),
               Label=c('Performance Indicator 1',
                       'Performance Indicator 2',
                       'Performance Indicator 3',
                       'Performance Indicator 4'),
               Description = c('This is the description for PI 1',
                               'This is the description for PI 2',
                               'This is the description for PI 3',
                               'This is the description for PI 4'),
               Value=values)

# Check
Check(quilt)

# Add to `Slick` object
slick <- Slick()
Quilt(slick) <- quilt

# Plots
plotQuilt(slick)

# Alternative - include Simulation dimension

# Generate dummy values
nSim <- 3
nOM <- 2
nMP <- 4
nPI <- 4

values <- array(NA, dim=c(nSim, nOM, nMP, nPI))

pi_means <- runif(nPI, 5, 50)
for (om in 1:nOM) {

```

```

    for (mp in 1:nMP) {
      for (pi in 1:nPI) {
        values[, om, mp, pi] <- rlnorm(nSim, log(pi_means[pi]), 0.4)
      }
    }
  }

# Create and populate Object
quilt <- Quilt(Code=c('PI1', 'PI2', 'PI3', 'PI4'),
              Label=c('Performance Indicator 1',
                     'Performance Indicator 2',
                     'Performance Indicator 3',
                     'Performance Indicator 4'),
              Description = c('This is the description for PI 1',
                              'This is the description for PI 2',
                              'This is the description for PI 3',
                              'This is the description for PI 4'),
              Value=values)

# Add to `Slick` object
slick <- Slick()
Quilt(slick) <- quilt

# Plots
plotQuilt(slick)
apply(quilt@Value, 3:4, mean) |> round(1)

```

---

RefPoints

*Assign or access RefPoints for a valid object class*


---

### Description

Assign or access RefPoints for a valid object class

### Usage

```
RefPoints(object)
```

```
RefPoints(object) <- value
```

```
## S4 method for signature 'Timeseries'
RefPoints(object)
```

```
## S4 replacement method for signature 'Timeseries'
RefPoints(object) <- value
```

**Arguments**

object	An object of class <code>Timeseries-class()</code>
value	A list, formatted to match the class of object. See the documentation for corresponding object class for more details.

**Value**

Returns a list object with the contents of the `RefPoints` slot of `Timeseries()` objects

**Methods (by class)**

- `RefPoints(Timeseries)`: Return `RefPoints` from a `Timeseries-class()` object
- `RefPoints(Timeseries) <- value`: Assign `RefPoints` to a `Timeseries-class()` object

---

show	<i>Generic show method</i>
------	----------------------------

---

**Description**

A copy of `methods::show()`

**Usage**

```
show(object)

## S4 method for signature 'Boxplot'
show(object)

## S4 method for signature 'CheckList'
show(object)

## S4 method for signature 'Kobe'
show(object)

## S4 method for signature 'MPs'
show(object)

## S4 method for signature 'OMs'
show(object)

## S4 method for signature 'Quilt'
show(object)

## S4 method for signature 'Tradeoff'
show(object)
```

```
## S4 method for signature 'Timeseries'  
show(object)  
  
## S4 method for signature 'Spider'  
show(object)  
  
## S4 method for signature 'Slick'  
show(object)
```

### Arguments

object            Object to print to console

### Value

show returns an invisible NULL

### Methods (by class)

- show(Boxplot): Print a [Boxplot-class\(\)](#) object
- show(CheckList): Print a CheckList object
- show(Kobe): Print a [Kobe-class\(\)](#) object
- show(MPs): Print a [MPs-class\(\)](#) object
- show(OMs): Print a [OMs-class\(\)](#) object
- show(Quilt): Print a [Quilt-class\(\)](#) object
- show(Tradeoff): Print a [Tradeoff-class\(\)](#) object
- show(Timeseries): Print a [Timeseries-class\(\)](#) object
- show(Spider): Print a [Spider-class\(\)](#) object
- show(Slick): Print a [Slick-class\(\)](#) object

---

Slick-class

*Create a Slick class object*

---

### Description

The Slick class is the main object class used in the Slick package. It contains sub-objects for the management procedures [MPs\(\)](#), operating models [OMs\(\)](#), and the six chart types: [Boxplot\(\)](#), [Kobe\(\)](#), [Quilt\(\)](#), [Spider\(\)](#), [Timeseries\(\)](#), and [Tradeoff\(\)](#), as well as metadata information for the Slick object such as Title, Author, and Introduction.

**Usage**

```
Slick(  
  Title = "",  
  Subtitle = "",  
  Date = Sys.Date(),  
  Author = "",  
  Email = "",  
  Institution = "",  
  Introduction = "",  
  MPs = NULL,  
  OMs = NULL,  
  Boxplot = NULL,  
  Kobe = NULL,  
  Quilt = NULL,  
  Spider = NULL,  
  Timeseries = NULL,  
  Tradeoff = NULL  
)  
  
Title(object, lang = "en", markdown = FALSE)  
  
Title(object) <- value  
  
Subtitle(object, lang = "en", markdown = FALSE)  
  
Subtitle(object) <- value  
  
Date(object)  
  
Date(object) <- value  
  
Author(object, markdown = FALSE)  
  
Author(object) <- value  
  
Email(object, markdown = FALSE)  
  
Email(object) <- value  
  
Institution(object, lang = "en", markdown = FALSE)  
  
Institution(object) <- value  
  
Introduction(object, lang = "en", markdown = FALSE)  
  
Introduction(object) <- value
```

**Arguments**

Title	Title for the Slick object. A character string. For multiple languages, use a named list with names: en, es, fr, or pt for the supported languages.
Subtitle	Subtitle for the Slick object. A character string or a named list with languages: en, es, fr, pt
Date	Date the Slick object was created. Text in format 'YYYY-MM-DD' or class Date e.g., Sys.Date()
Author	A character vector with Author(s) names. The length of the vector should equal the number of authors.
Email	A character vector with email addresses for the author(s). Must be same length as Author. Can include Markdown.
Institution	A character vector with institution details for the author(s). Must be same length as Author. Can include Markdown.
Introduction	Introduction text for the Slick object. Supports all markdown formatting. Character string, must be length 1. For multiple languages, use a named list with names: en, es, fr, pt for the supported languages.
MPs	An object of class <code>MPs-class()</code>
OMs	An object of class <code>OMs-class()</code>
Boxplot	An object of class <code>Boxplot-class()</code>
Kobe	An object of class <code>Kobe-class()</code>
Quilt	An object of class <code>Quilt-class()</code>
Spider	An object of class <code>Spider-class()</code>
Timeseries	An object of class <code>Timeseries-class()</code>
Tradeoff	An object of class <code>Tradeoff-class()</code>
object	A <code>Slick-class()</code> object
lang	Optional text string specifying the language (if available). Either 'en', 'es', 'fr', or 'pt' for English, Spanish, French, or Portuguese respectively
markdown	Logical. Process markdown?
value	The value to assign to the object. See Slots for format of the relevant object class

**Details**

Objects of class Slick are created with `Slick()`.

Like all S4 objects in Slick, slots in this object can be accessed and assigned using functions corresponding to slot name. See Usage and Functions section.

**Multi-Language Support:**

Text with multi-language supported can be provided as a named list. Available languages:

- en: English (default)
- es: Spanish
- fr: French
- pt: Portuguese

All functions with the exception of Date support Markdown.

**Value**

A Slick object

**Functions**

- `Slick()`: Create a `Slick-class()` object
- `Title()`: Access Title, Multi-language support
- `Title(object) <- value`: Assign Title, Multi-language support
- `Subtitle()`: Access Subtitle, Multi-language support
- `Subtitle(object) <- value`: Assign Subtitle, Multi-language support
- `Date()`: Access Date
- `Date(object) <- value`: Assign Date
- `Author()`: Access Author
- `Author(object) <- value`: Assign Author
- `Email()`: Access Email
- `Email(object) <- value`: Assign Email
- `Institution()`: Access Institution
- `Institution(object) <- value`: Assign Institution
- `Introduction()`: Access Introduction
- `Introduction(object) <- value`: Assign Introduction, can include Markdown. See Examples

**Slots**

**Title** Title for the Slick object. A character string. For multiple languages, use a named list with names: en, es, fr, or pt for the supported languages.

**Subtitle** Subtitle for the Slick object. A character string or a named list with languages: en, es, fr, pt

**Date** Date the Slick object was created. Text in format 'YYYY-MM-DD' or class Date e.g., `Sys.Date()`

**Author** A character vector with Author(s) names. The length of the vector should equal the number of authors.

**Email** A character vector with email addresses for the author(s). Must be same length as Author. Can include Markdown.

**Institution** A character vector with institution details for the author(s). Must be same length as Author. Can include Markdown.

**Introduction** Introduction text for the Slick object. Supports all markdown formatting. Character string, must be length 1. For multiple languages, use a named list with names: en, es, fr, pt for the supported languages.

**MPs** An object of class `MPs-class()`

**OMs** An object of class `OMs-class()`

**Boxplot** An object of class `Boxplot-class()`

Kobe An object of class `Kobe-class()`  
 Quilt An object of class `Quilt-class()`  
 Spider An object of class `Spider-class()`  
 Timeseries An object of class `Timeseries-class()`  
 Tradeoff An object of class `Tradeoff-class()`

### See Also

`MPs()`, `OMs()`, `Boxplot()`, `Kobe()`, `Quilt()`, `Spider()`, `Timeseries()`, `Tradeoff()`, `Check()`, `Title()`, `Subtitle()`, `Date()`, `Author()`, `Email()`, `Institution()`, `Introduction()`

### Examples

```
# Assign values to a new `Slick` object
slick <- Slick()

Title(slick) <- 'An Example Slick Object'
Subtitle(slick) <- ""
Date(slick) <- Sys.Date()
Author(slick) <- 'Adrian Hordyk'
Email(slick) <- "[mailto:adrian@bluematterscience.com](mailto:adrian@bluematterscience.com)"
Institution(slick) <- "[Blue Matter Science](bluematterscience.com)"

Introduction(slick) <- "This is the Introduction text"

# Access values from `Slick` object
Title(slick)
Subtitle(slick)
Date(slick)
Author(slick)
Email(slick)
Institution(slick)
Introduction(slick)
```

---

Spider

*Methods for Creating, Accessing and Assigning Spider objects*

---

### Description

The Spider function is used both to create and modify an `Spider-class()` object. and to access and assign Spider for an object of class `Slick-class()`. See Details.

**Usage**

```

Spider(
  Code = "",
  Label = "",
  Description = "",
  Value = array(),
  Preset = list(),
  Misc = list()
)

Spider(Slick) <- value

## S4 method for signature 'missing'
Spider()

## S4 method for signature 'character'
Spider(
  Code = "",
  Label = "",
  Description = "",
  Value = array(),
  Preset = list(),
  Misc = list()
)

## S4 method for signature 'list'
Spider(
  Code = "",
  Label = "",
  Description = "",
  Value = array(),
  Preset = list(),
  Misc = list()
)

## S4 method for signature 'Slick'
Spider(Code)

## S4 replacement method for signature 'Slick'
Spider(Slick) <- value

```

**Arguments**

Code	A <i>short</i> code for the Performance Indicators for this object. A character string length nPI or a named list for multi-language support. See Details
Label	A short label for the Performance Indicators for this object. Used to label axes on charts. Can be longer than Code but recommended to keep short as possible so it shows clearly in plots and tables. A character string length nPI or a named

	list for multi-language support. See <a href="#">Details</a>
Description	A description for the Performance Indicators for this object. Can include Markdown, see <a href="#">Examples</a> . A character string length <code>nPI</code> or a named list for multi-language support. See <a href="#">Details</a>
Value	A numeric array with the stochastic performance indicator values for each operating model (OM), management procedure (MP), and performance indicator (PI). Dimensions: <code>c(nOM, nMP, and nPI)</code> . All PI values must range between 0 and 1 or 0 and 100. If all values are <code>&lt;= 1</code> , they will be multiplied by 100 in the plot.
Preset	An optional named list for the preset buttons in the <a href="#">App()</a> . The name of the list element will appear as a button in the <a href="#">App()</a> .
Misc	A named list for additional miscellaneous information.
Slick	A <a href="#">Slick-class()</a> object
value	A <a href="#">Spider-class()</a> object

### Details

Objects of class `Spider` are created with `Spider()`

Use the [Code\(\)](#), [Label\(\)](#), [Description\(\)](#), [Value\(\)](#), [Preset\(\)](#) functions to access and assign the values for an existing `Spider` object, see [Examples](#)

#### Multi-Language Support:

Text with multi-language supported can be provided as a named list. Available languages:

- `en`: English (default)
- `es`: Spanish
- `fr`: French
- `pt`: Portuguese

#### Note:

Character strings in `Code`, `Label`, and `Description` must all be same length as the number of performance indicators (`nPIs`) in `'Value'`

### Functions

- `Spider(missing)`: Create an empty `Spider` object
- `Spider(character)`: Create a populated `Spider` object
- `Spider(list)`: Create a populated `Spider` object
- `Spider(Slick)`: Return `Spider` from a [Slick-class\(\)](#) object
- `Spider(Slick) <- value`: Assign a [Spider-class\(\)](#) object to a [Slick-class\(\)](#) object

### See Also

[Code\(\)](#), [Label\(\)](#), [Description\(\)](#), [Metadata\(\)](#), [Value\(\)](#), [Preset\(\)](#)

**Examples**

```

# Generate dummy values
nOM <- 2
nMP <- 4
nPI <- 4

values <- array(NA, dim=c(nOM, nMP, nPI))

# Note: PI values must be between 0 and 1, with 1 indicating better performance
pi_means <- runif(nPI, 0, 1)
for (om in 1:nOM) {
  for (mp in 1:nMP) {
    for (pi in 1:nPI) {
      values[om, mp, pi] <- runif(1, pi_means[pi])
    }
  }
}

# Create and populate Object
spider <- Spider(Code=c('PI1', 'PI2', 'PI3', 'PI4'),
  Label=c('Performance Indicator 1',
          'Performance Indicator 2',
          'Performance Indicator 3',
          'Performance Indicator 4'),
  Description = c('This is the description for PI 1',
                 'This is the description for PI 2',
                 'This is the description for PI 3',
                 'This is the description for PI 4'),
  Value=values)

# Check
Check(spider)

# Add to `Slick` object
slick <- Slick()
Spider(slick) <- spider

# Plots
plotSpider(slick)

plotSpider(slick, fill=TRUE)

plotSpider(slick, byMP=TRUE)

plotSpider(slick, byOM=TRUE)

```

## Description

Objects of class `Spider` are used to store information for the Spider plots. Like all S4 objects in `Slick`, slots in this object can be accessed and assigned using functions corresponding to slot name. See [Spider](#) and the `See Also` section below.

## Details

Objects of class `Spider` are created with `Spider()`

### Multi-Language Support:

Text with multi-language supported can be provided as a named list. Available languages:

- en: English (default)
- es: Spanish
- fr: French
- pt: Portuguese

### Note:

Character strings in `Code`, `Label`, and `Description` must all be same length as the number of performance indicators (nPIs) in `Value`

## Slots

**Code** A *short* code for the Performance Indicators for this object. A character string length nPI or a named list for multi-language support. See [Details](#)

**Label** A short label for the Performance Indicators for this object. Used to label axes on charts. Can be longer than `Code` but recommended to keep short as possible so it shows clearly in plots and tables. A character string length nPI or a named list for multi-language support. See [Details](#)

**Description** A description for the Performance Indicators for this object. Can include Markdown, see [Examples](#). A character string length nPI or a named list for multi-language support. See [Details](#)

**Value** A numeric array with the stochastic performance indicator values for each operating model (OM), management procedure (MP), and performance indicator (PI). Dimensions:  $c(nOM, nMP, \text{and } nPI)$ . All PI values must range between 0 and 1 or 0 and 100. If all values are  $\leq 1$ , they will be multiplied by 100 in the plot. Dimensions:  $c(nOM, nMP, \text{and } nPI)$

**Preset** An optional named list for the preset buttons in the [App\(\)](#). The name of the list element will appear as a button in the [App\(\)](#).

**Misc** A named list for additional miscellaneous information.

## See Also

[Spider](#), [Code\(\)](#), [Label\(\)](#), [Description\(\)](#), [Value\(\)](#), [Preset\(\)](#)

**Examples**

```

# Generate dummy values
nOM <- 2
nMP <- 4
nPI <- 4

values <- array(NA, dim=c(nOM, nMP, nPI))

# Note: PI values must be between 0 and 1, with 1 indicating better performance
pi_means <- runif(nPI, 0, 1)
for (om in 1:nOM) {
  for (mp in 1:nMP) {
    for (pi in 1:nPI) {
      values[om, mp, pi] <- runif(1, pi_means[pi])
    }
  }
}

# Create and populate Object
spider <- Spider(Code=c('PI1', 'PI2', 'PI3', 'PI4'),
  Label=c('Performance Indicator 1',
    'Performance Indicator 2',
    'Performance Indicator 3',
    'Performance Indicator 4'),
  Description = c('This is the description for PI 1',
    'This is the description for PI 2',
    'This is the description for PI 3',
    'This is the description for PI 4'),
  Value=values)

# Check
Check(spider)

# Add to `Slick` object
slick <- Slick()
Spider(slick) <- spider

# Plots
plotSpider(slick)

plotSpider(slick, fill=TRUE)

plotSpider(slick, byMP=TRUE)

plotSpider(slick, byOM=TRUE)

```

**Description**

Access or assign Time for object of class `Kobe` or `Timeseries`

**Usage**

```
Time(object)

Time(object) <- value

## S4 method for signature 'Kobe'
Time(object)

## S4 replacement method for signature 'Kobe'
Time(object) <- value

## S4 method for signature 'Timeseries'
Time(object)

## S4 replacement method for signature 'Timeseries'
Time(object) <- value
```

**Arguments**

<code>object</code>	A <code>Kobe-class()</code> or <code>Timeseries()</code> class object
<code>value</code>	Value to assign to Time

**Value**

Returns a numeric vector with values from the Time slot in `Kobe()` and `Timeseries()` objects

**Methods (by class)**

- `Time(Kobe)`: Return Time from a `Kobe-class()` object
- `Time(Kobe) <- value`: Assign Time to a `Kobe-class()` object
- `Time(Timeseries)`: Return Time from a `Timeseries-class()` object
- `Time(Timeseries) <- value`: Assign Time to a `Timeseries-class()` object

**Functions**

- `Time(object) <- value`: Assign value to `object@Time`

---

TimeLab	<i>Access or assign TimeLab in a Kobe or Timeseries object</i>
---------	--

---

**Description**

Access or assign TimeLab in a Kobe or Timeseries object

**Usage**

```
TimeLab(object, lang = "en")

TimeLab(object) <- value

## S4 method for signature 'Kobe'
TimeLab(object, lang = "en")

## S4 replacement method for signature 'Kobe'
TimeLab(object) <- value

## S4 method for signature 'Timeseries'
TimeLab(object, lang = "en")

## S4 replacement method for signature 'Timeseries'
TimeLab(object) <- value
```

**Arguments**

object	A <a href="#">Kobe-class()</a> or <a href="#">Timeseries</a> object
lang	Optional text string specifying the language (if available). Either 'en', 'es', 'fr', or 'pt' for English, Spanish, French, or Portuguese respectively
value	A character string to assign to TimeLab in object.

**Value**

Returns a character string from the TimeLab slot in [Kobe\(\)](#) and [Timeseries\(\)](#) objects

**Methods (by class)**

- `TimeLab(Kobe)`: Return TimeLab from a [Kobe-class\(\)](#) object
- `TimeLab(Kobe) <- value`: Assign TimeLab to a [Kobe-class\(\)](#) object
- `TimeLab(Timeseries)`: Return TimeLab from a [Timeseries-class\(\)](#) object
- `TimeLab(Timeseries) <- value`: Assign TimeLab to a [Timeseries-class\(\)](#) object

---

TimeNow	<i>Access and return TimeNow from a <a href="#">Timeseries-class()</a> object</i>
---------	---

---

**Description**

Access and return TimeNow from a [Timeseries-class\(\)](#) object

**Usage**

```
TimeNow(Timeseries)
```

```
TimeNow(Timeseries) <- value
```

**Arguments**

Timeseries      A [Timeseries-class\(\)](#) object

value            A character string label for the time axis. Use a named list for multiple languages

**Value**

A numeric value

**Functions**

- TimeNow(Timeseries) <- value: Assign TimeNow to a [Timeseries-class\(\)](#) object

---

Timeseries	<i>Methods for Creating, Accessing and Assigning Timeseries objects</i>
------------	---

---

**Description**

An object of class Timeseries contains information for the Time Series chart. The Timeseries function is used both to create and modify an [Timeseries-class\(\)](#) object, and to access and assign Timeseries for an object of class [Slick-class\(\)](#). See Details.

**Usage**

```
Timeseries(
  Code = "",
  Label = "",
  Description = "",
  Time = numeric(),
  TimeNow = numeric(),
  TimeLab = "Year",
  Value = array(),
```

```
    Preset = list(),
    Target = NULL,
    Limit = NULL,
    RefPoints = list(),
    Misc = list()
)

Timeseries(Slick) <- value

## S4 method for signature 'missing'
Timeseries()

## S4 method for signature 'character'
Timeseries(
  Code = "",
  Label = "",
  Description = "",
  Time = numeric(),
  TimeNow = numeric(),
  TimeLab = "Year",
  Value = array(),
  Preset = list(),
  Target = NULL,
  Limit = NULL,
  RefPoints = list(),
  Misc = list()
)

## S4 method for signature 'list'
Timeseries(
  Code = "",
  Label = "",
  Description = "",
  Time = numeric(),
  TimeNow = numeric(),
  TimeLab = "Year",
  Value = array(),
  Preset = list(),
  Target = NULL,
  Limit = NULL,
  RefPoints = list(),
  Misc = list()
)

## S4 method for signature 'Slick'
Timeseries(Code)

## S4 replacement method for signature 'Slick'
```

```
Timeseries(Slick) <- value
```

### Arguments

Code	A <i>short</i> code for the Performance Indicators for this object. A character string length nPI or a named list for multi-language support. See <a href="#">Details</a>
Label	A short label for the Performance Indicators for this object. Used to label axes on charts. Can be longer than Code but recommended to keep short as possible so it shows clearly in plots and tables. A character string length nPI or a named list for multi-language support. See <a href="#">Details</a>
Description	A description for the Performance Indicators for this object. Can include Mark-down, see <a href="#">Examples</a> . A character string length nPI or a named list for multi-language support. See <a href="#">Details</a>
Time	A numeric vector with values for the historical and projection time-steps. Must match length nTS in Value
TimeNow	A numeric value matching the last historical timestep in Time
TimeLab	Character string length 1. Name of the time step (e.g., 'Year'). Will be used as the label in the <code>Timeseries</code> plot. Use a named list for multiple languages.
Value	A numeric array with the stochastic performance indicator values for each simulation (sim), operating model (OM), management procedure (MP), performance indicator (PI), and historical + projection timestep (nTS). Dimensions: c(nsim, nOM, nMP, nPI, nTS)
Preset	An optional named list for the preset buttons in the <code>App()</code> . The name of the list element will appear as a button in the <code>App()</code> .
Target	Numeric vector length nPI with the target value for the PIs.
Limit	Numeric vector length nPI with the limit value for the PIs.
RefPoints	List for setting custom Reference Points. Overrides Target and Limit. See <a href="#">Details</a>
Misc	A named list for additional miscellaneous information.
Slick	A <code>Slick-class()</code> object
value	A <code>Timeseries-class()</code> object

### Details

Use `plotTimeseries()` to create the time series plots from the console.

#### Note:

Character strings in Code, Label, and Description must all be same length as the number of performance indicators (nPIs) in Value

Objects of class `Timeseries` are created with `Timeseries()`

#### Multi-Language Support:

Text with multi-language supported can be provided as a named list. Available languages:

- en: English (default)
- es: Spanish

- fr: French
- pt: Portuguese

#### Custom Reference Points with RefPoints:

RefPoints provides more options than the default Target and Limit reference points. It can be used to control the name and color of the reference point lines, or to add additional reference point lines to the Timeseries plot.

Note: If RefPoints is included, Target and Limit are ignored.

RefPoints must be a list of length  $\leq$  length(Code) (i.e., the number of performance indicators). Each element in RefPoints should be a named list:

- Name character vector with name(s) of reference point(s)
- Value numeric vector length Name with value(s) for the reference point(s)
- Color character vector length Name with color(s) for the reference point(s)

#### Summary Statistic:

The default behaviour for the Time Series plot (see [plotTimeseries\(\)](#)) is to show the mean value (over operating models and simulations). If the distribution is skewed, the mean value can sometimes be misleading, falling close to or outside of the percentiles shown in the plot. In such cases, it may be preferable to show the median value instead.

The Time Series page in the Slick App provides users with an option to show the median value. To show the median value by default, add a named element to the Misc slot:

```
slick |> Timeseries() |> Misc() <- list(MeanMed='median')
```

#### Accessing Slots:

Use the [Code\(\)](#), [Label\(\)](#), [Description\(\)](#), [Value\(\)](#), [Preset\(\)](#) functions to access and assign the values for an existing Timeseries object, see Examples

## Functions

- Timeseries(missing): Create an empty Timeseries object
- Timeseries(character): Create a populated Timeseries object
- Timeseries(list): Create a populated Timeseries object
- Timeseries(Slick): Return Timeseries from a [Slick-class\(\)](#) object
- Timeseries(Slick) <- value: Assign a [Timeseries-class\(\)](#) object to a [Slick-class\(\)](#) object

## See Also

[Timeseries-class\(\)](#), [Code\(\)](#), [Label\(\)](#), [Description\(\)](#), [Metadata\(\)](#), [Value\(\)](#), [Preset\(\)](#), [plotTimeseries\(\)](#)  
[Code\(\)](#), [Label\(\)](#), [Description\(\)](#), [Metadata\(\)](#), [Value\(\)](#), [Preset\(\)](#)

**Examples**

```

# Generate dummy values
nsim <- 10
nOM <- 2
nMP <- 4
nPI <- 3
nHistTS <- 50
nProjTS <- 30
nTS <- nHistTS + nProjTS

set.seed(101)

values <- array(NA, dim=c(nsim, nOM, nMP, nPI, nTS))

pi_means <- c(1,1, 1000)

for (om in 1:nOM) {
  for (pi in 1:nPI) {
    # PI identical for historical
    histVals <- matrix(
      pi_means[pi] *
      cumprod(c(rlnorm(nHistTS*nsim, 0, 0.05))),
      nrow=nsim, ncol=nHistTS, byrow=TRUE)
    histVals <- replicate(nMP, histVals)
    values[,om, , pi,1:nHistTS] <- aperm(histVals, c(1,3,2))

    for (mp in 1:nMP) {
      values[,om, mp, pi,(nHistTS+1):nTS] <- matrix(
        pi_means[pi] *
        cumprod(c(rlnorm(nProjTS*nsim, 0, 0.05))),
        nrow=nsim, ncol=nProjTS, byrow=FALSE)
    }
  }
}

# Create and populate Object
timeseries <- Timeseries(Code=c('B/BMSY', 'F/FMSY', 'TAC'),
                        Label=c('B/BMSY',
                                'F/FMSY',
                                'TAC'),
                        Description = c('This is the description for PI 1',
                                        'This is the description for PI 2',
                                        'This is the description for PI 3'),
                        Value=values
)

# Last historical time step
TimeNow(timeseries) <- 2024

# Add values for time steps
Time(timeseries) <- c(rev(seq(TimeNow(timeseries), by=-1, length.out=nHistTS)),
                    seq(TimeNow(timeseries)+1, by=1, length.out=nProjTS))

```

```

# Check
Check(timeseries)

# Add to `Slick` object
slick <- Slick()
Timeseries(slick) <- timeseries

# Plots
plotTimeseries(slick)
plotTimeseries(slick, 2)
plotTimeseries(slick, 3)

plotTimeseries(slick, byMP=TRUE)

plotTimeseries(slick, byOM=TRUE)

# Custom Reference Points
RefPoints(timeseries) <- list(
  list(Name=c('0.5 BMSY', 'BMSY', '1.5 BMSY'),
        Value=c(0.5, 1, 1.5),
        Color=c('red', 'orange', 'green')),
  list(Name=c('0.8 FMSY', 'FMSY'),
        Value=c(0.8,1),
        Color=c('orange', 'red')),
  list(Name='Target Catch',
        Value=1200,
        Color='blue')
)

Timeseries(slick) <- timeseries
plotTimeseries(slick)
plotTimeseries(slick, 2)
plotTimeseries(slick, 3)

```

---

Timeseries-class      *S4 class* Timeseries

---

### Description

Objects of class `Timeseries` are used to store information for the Time Series plots. Like all S4 objects in `Slick`, slots in this object can be accessed and assigned using functions corresponding to slot name. See [Timeseries\(\)](#) and the the See Also section below.

### Details

Objects of class `Timeseries` are created with `Timeseries()`

**Multi-Language Support:**

Text with multi-language supported can be provided as a named list. Available languages:

- en: English (default)
- es: Spanish
- fr: French
- pt: Portuguese

**Note:**

Character strings in `Code`, `Label`, and `Description` must all be same length as the number of performance indicators (nPIs) in `Value`

**Slots**

**Code** A *short* code for the Performance Indicators for this object. A character string length nPI or a named list for multi-language support. See [Details](#)

**Label** A short label for the Performance Indicators for this object. Used to label axes on charts. Can be longer than `Code` but recommended to keep short as possible so it shows clearly in plots and tables. A character string length nPI or a named list for multi-language support. See [Details](#)

**Description** A description for the Performance Indicators for this object. Can include Markdown, see [Examples](#). A character string length nPI or a named list for multi-language support. See [Details](#)

**Time** A numeric vector with values for the historical and projection time-steps. Must match length nTS in `Value`. Can also be class `Date`, `POSIXct` or `POSIXt`

**TimeNow** A numeric value matching the last historical timestep in `Time`

**TimeLab** Character string length 1. Name of the time step (e.g., 'Year'). Will be used as the label in the plots. Use a named list for multiple languages.

**Value** A numeric array with the stochastic performance indicator values for each simulation (sim), operating model (OM), management procedure (MP), performance indicator (PI), and historical + projection timestep (nTS). Dimensions: c(nsim, nOM, nMP, nPI, nTS)

**Preset** An optional named list for the preset buttons in the [App\(\)](#). The name of the list element will appear as a button in the [App\(\)](#).

**Target** Numeric vector length nPI with the target value for the PIs.

**Limit** Numeric vector length nPI with the limit value for the PIs.

**RefPoints** List for setting custom Reference Points. Overrides `Target` and `Limit`. See [Details](#) section in [Timeseries\(\)](#).

**Misc** A named list for additional miscellaneous information.

**See Also**

[Timeseries\(\)](#), [Code\(\)](#), [Label\(\)](#), [Description\(\)](#), [Value\(\)](#), [Preset\(\)](#)

**Examples**

```

# Generate dummy values
nsim <- 10
nOM <- 2
nMP <- 4
nPI <- 3
nHistTS <- 50
nProjTS <- 30
nTS <- nHistTS + nProjTS

set.seed(101)

values <- array(NA, dim=c(nsim, nOM, nMP, nPI, nTS))

pi_means <- c(1,1, 1000)

for (om in 1:nOM) {
  for (pi in 1:nPI) {
    # PI identical for historical
    histVals <- matrix(
      pi_means[pi] *
      cumprod(c(rlnorm(nHistTS*nsim, 0, 0.05))),
      nrow=nsim, ncol=nHistTS, byrow=TRUE)
    histVals <- replicate(nMP, histVals)
    values[,om, , pi,1:nHistTS] <- aperm(histVals, c(1,3,2))

    for (mp in 1:nMP) {
      values[,om, mp, pi,(nHistTS+1):nTS] <- matrix(
        pi_means[pi] *
        cumprod(c(rlnorm(nProjTS*nsim, 0, 0.05))),
        nrow=nsim, ncol=nProjTS, byrow=FALSE)
    }
  }
}

# Create and populate Object
timeseries <- Timeseries(Code=c('B/BMSY', 'F/FMSY', 'TAC'),
                        Label=c('B/BMSY',
                                'F/FMSY',
                                'TAC'),
                        Description = c('This is the description for PI 1',
                                        'This is the description for PI 2',
                                        'This is the description for PI 3'),
                        Value=values
)

# Last historical time step
TimeNow(timeseries) <- 2024

# Add values for time steps
Time(timeseries) <- c(rev(seq(TimeNow(timeseries), by=-1, length.out=nHistTS)),
                     seq(TimeNow(timeseries)+1, by=1, length.out=nProjTS))

```

```

# Check
Check(timeseries)

# Add to `Slick` object
slick <- Slick()
Timeseries(slick) <- timeseries

# Plots
plotTimeseries(slick)
plotTimeseries(slick, 2)
plotTimeseries(slick, 3)

plotTimeseries(slick, byMP=TRUE)

plotTimeseries(slick, byOM=TRUE)

# Custom Reference Points
RefPoints(timeseries) <- list(
  list(Name=c('0.5 BMSY', 'BMSY', '1.5 BMSY'),
        Value=c(0.5, 1, 1.5),
        Color=c('red', 'orange', 'green')),
  list(Name=c('0.8 FMSY', 'FMSY'),
        Value=c(0.8,1),
        Color=c('orange', 'red')),
  list(Name='Target Catch',
        Value=1200,
        Color='blue')
)

Timeseries(slick) <- timeseries
plotTimeseries(slick)
plotTimeseries(slick, 2)
plotTimeseries(slick, 3)

```

---

TimeTerminal

*Assign or access TimeTerminal for a valid object class*


---

### Description

Assign or access TimeTerminal for a valid object class

### Usage

TimeTerminal(object)

TimeTerminal(object) <- value

```
## S4 method for signature 'Kobe'
TimeTerminal(object)

## S4 replacement method for signature 'Kobe'
TimeTerminal(object) <- value
```

### Arguments

object	An object of class <a href="#">Kobe-class()</a>
value	A numeric value with a value matching one in <code>Kobe@Time</code> <a href="#">Kobe-class()</a> for details.

### Value

Returns a numeric values from the `TimeTerminal` slot in [Kobe\(\)](#) objects

### Methods (by class)

- `TimeTerminal(Kobe)`: Return `TimeTerminal` from a [Kobe-class\(\)](#) object
- `TimeTerminal(Kobe) <- value`: Assign `TimeTerminal` to a [Kobe-class\(\)](#) object

---

 Tradeoff

---

*Methods for Creating, Accessing and Assigning Tradeoff objects*


---

### Description

The `Tradeoff` function is used both to create and modify an [Tradeoff-class\(\)](#) object. and to access and assign `Tradeoff` for an object of class [Slick-class\(\)](#). See Details.

### Usage

```
Tradeoff(
  Code = "",
  Label = "",
  Description = "",
  Value = array(),
  Preset = list(),
  Misc = list()
)

Tradeoff(Slick) <- value

## S4 method for signature 'missing'
Tradeoff()

## S4 method for signature 'character'
Tradeoff(
```

```

Code = "",
Label = "",
Description = "",
Value = array(),
Preset = list(),
Misc = list()
)

## S4 method for signature 'list'
Tradeoff(
  Code = "",
  Label = "",
  Description = "",
  Value = array(),
  Preset = list(),
  Misc = list()
)

## S4 method for signature 'Slick'
Tradeoff(Code)

## S4 replacement method for signature 'Slick'
Tradeoff(Slick) <- value

```

## Arguments

Code	A <i>short</i> code for the Performance Indicators for this object. A character string length nPI or a named list for multi-language support. See <a href="#">Details</a>
Label	A short label for the Performance Indicators for this object. Used to label axes on charts. Can be longer than Code but recommended to keep short as possible so it shows clearly in plots and tables. A character string length nPI or a named list for multi-language support. See <a href="#">Details</a>
Description	A description for the Performance Indicators for this object. Can include Markdown, see <a href="#">Examples</a> . A character string length nPI or a named list for multi-language support. See <a href="#">Details</a>
Value	A numeric array with the stochastic performance indicator values for each operating model (OM), management procedure (MP), and performance indicator (PI) Dimensions: c(nOM, nMP, nPI)
Preset	An optional named list for the preset buttons in the <a href="#">App()</a> . The name of the list element will appear as a button in the <a href="#">App()</a> .
Misc	A named list for additional miscellaneous information.
Slick	A <a href="#">Slick-class()</a> object
value	A <a href="#">Tradeoff-class()</a> object

## Details

Objects of class `Tradeoff` are created with `Tradeoff()`

**Multi-Language Support:**

Text with multi-language supported can be provided as a named list. Available languages:

- en: English (default)
- es: Spanish
- fr: French
- pt: Portuguese

**Note:**

Character strings in Code, Label, and Description must all be same length as the number of performance indicators (nPIs) in Value

**Functions**

- Tradeoff(missing): Create an empty Tradeoff object
- Tradeoff(character): Create a populated Tradeoff object
- Tradeoff(list): Create a populated Tradeoff object
- Tradeoff(Slick): Return Tradeoff from a [Slick-class\(\)](#) object
- Tradeoff(Slick) <- value: Assign a [Tradeoff-class\(\)](#) object to a [Slick-class\(\)](#) object

**See Also**

[Code\(\)](#), [Label\(\)](#), [Description\(\)](#), [Metadata\(\)](#), [Value\(\)](#), [Preset\(\)](#)

**Examples**

```
# Generate dummy values
nOM <- 2
nMP <- 4
nPI <- 4

values <- array(NA, dim=c(nOM, nMP, nPI))

pi_means <- runif(nPI, 5, 50)
for (om in 1:nOM) {
  for (mp in 1:nMP) {
    for (pi in 1:nPI) {
      values[om, mp, pi] <- rlnorm(1, log(pi_means[pi]), 0.4)
    }
  }
}

# Create and populate Object
tradeoff <- Tradeoff(Code=c('PI1', 'PI2', 'PI3', 'PI4'),
  Label=c('Performance Indicator 1',
    'Performance Indicator 2',
    'Performance Indicator 3',
    'Performance Indicator 4'),
  Description = c('This is the description for PI 1',
    'This is the description for PI 2',
```

```

                                'This is the description for PI 3',
                                'This is the description for PI 4'),
                                Value=values)

# Check
Check(tradeoff)

# Add to `Slick` object
slick <- Slick()
Tradeoff(slick) <- tradeoff

# Plots
plotTradeoff(slick)

plotTradeoff(slick, c(1,1,2), c(2,3,3))

```

---

Tradeoff-class	<i>S4 class</i> Tradeoff
----------------	--------------------------

---

## Description

Objects of class `Tradeoff` are used to store information for the Tradeoff plot. Like all S4 objects in `Slick`, slots in this object can be accessed and assigned using functions corresponding to slot name. See [Tradeoff\(\)](#) and the the See Also section below.

## Details

Objects of class `Tradeoff` are created with `Tradeoff()`

### Multi-Language Support:

Text with multi-language supported can be provided as a named list. Available languages:

- en: English (default)
- es: Spanish
- fr: French
- pt: Portuguese

### Note:

Character strings in `Code`, `Label`, and `Description` must all be same length as the number of performance indicators (nPIs) in `Value`

## Slots

**Code** A *short* code for the Performance Indicators for this object. A character string length nPI or a named list for multi-language support. See [Details](#)

**Label** A short label for the Performance Indicators for this object. Used to label axes on charts. Can be longer than `Code` but recommended to keep short as possible so it shows clearly in plots and tables. A character string length nPI or a named list for multi-language support. See [Details](#)

**Description** A description for the Performance Indicators for this object. Can include Markdown, see Examples. A character string length nPI or a named list for multi-language support. See Details

**Value** A 3 dimensional numeric array with the stochastic performance indicator values for operating model (OM), management procedure (MP), and performance indicator (PI). Dimensions: c(nOM, nMP, and nPI)

**Preset** An optional named list for the preset buttons in the `App()`. The name of the list element will appear as a button in the `App()`.

**Misc** A named list for additional miscellaneous information.

### See Also

[Tradeoff\(\)](#), [Code\(\)](#), [Label\(\)](#), [Description\(\)](#), [Value\(\)](#), [Preset\(\)](#)

### Examples

```
# Generate dummy values
nOM <- 2
nMP <- 4
nPI <- 4

values <- array(NA, dim=c(nOM, nMP, nPI))

pi_means <- runif(nPI, 5, 50)
for (om in 1:nOM) {
  for (mp in 1:nMP) {
    for (pi in 1:nPI) {
      values[om, mp, pi] <- rlnorm(1, log(pi_means[pi]), 0.4)
    }
  }
}

# Create and populate Object
tradeoff <- Tradeoff(Code=c('PI1', 'PI2', 'PI3', 'PI4'),
  Label=c('Performance Indicator 1',
    'Performance Indicator 2',
    'Performance Indicator 3',
    'Performance Indicator 4'),
  Description = c('This is the description for PI 1',
    'This is the description for PI 2',
    'This is the description for PI 3',
    'This is the description for PI 4'),
  Value=values)

# Check
Check(tradeoff)

# Add to `Slick` object
slick <- Slick()
Tradeoff(slick) <- tradeoff
```

```
# Plots
plotTradeoff(slick)

plotTradeoff(slick, c(1,1,2), c(2,3,3))
```

---

Update	<i>Updates an old object of class Slick to new S4 class Slick</i>
--------	---

---

**Description**

Updates an old object of class Slick to new S4 class Slick

**Usage**

```
Update(slick)
```

**Arguments**

slick            An S3 object of class Slick

**Value**

An S4 object of class Slick

**Examples**

```
slick <- Slick() # a dummy old Slick object
slick <- Update(slick) # updated to S4 object
```

---

Value	<i>Assign or access Value for a valid object class</i>
-------	--

---

**Description**

Assign or access Value for a valid object class

**Usage**

```
Value(object)

Value(object) <- value

## S4 method for signature 'Boxplot'
Value(object)

## S4 replacement method for signature 'Boxplot'
```

```

Value(object) <- value

## S4 method for signature 'Kobe'
Value(object)

## S4 replacement method for signature 'Kobe'
Value(object) <- value

## S4 method for signature 'Quilt'
Value(object)

## S4 replacement method for signature 'Quilt'
Value(object) <- value

## S4 method for signature 'Tradeoff'
Value(object)

## S4 replacement method for signature 'Tradeoff'
Value(object) <- value

## S4 method for signature 'Timeseries'
Value(object)

## S4 replacement method for signature 'Timeseries'
Value(object) <- value

## S4 method for signature 'Spider'
Value(object)

## S4 replacement method for signature 'Spider'
Value(object) <- value

```

### Arguments

object	An object of class <a href="#">Boxplot-class()</a> , <a href="#">Kobe-class()</a> , <a href="#">Quilt-class()</a> , <a href="#">Spider-class()</a> , <a href="#">Timeseries-class()</a> , or <a href="#">Tradeoff-class()</a>
value	An array, formatted to match the class of object. See the documentation for corresponding object class for more details.

### Value

Returns a numeric array with the contents of the Value slot of object

### Methods (by class)

- Value(Boxplot): Return Value from a [Boxplot-class\(\)](#) object
- Value(Boxplot) <- value: Assign Value to a [Boxplot-class\(\)](#) object
- Value(Kobe): Return Value from a [Kobe-class\(\)](#) object

- Value(Kobe) <- value: Assign Value to a [Kobe-class\(\)](#) object
- Value(Quilt): Return Value from a [Quilt-class\(\)](#) object
- Value(Quilt) <- value: Assign Value to a [Quilt-class\(\)](#) object
- Value(Tradeoff): Return Value from a [Tradeoff-class\(\)](#) object
- Value(Tradeoff) <- value: Assign Value to a [Tradeoff-class\(\)](#) object
- Value(Timeseries): Return Value from a [Timeseries-class\(\)](#) object
- Value(Timeseries) <- value: Assign Value to a [Timeseries-class\(\)](#) object
- Value(Spider): Return Value from a [Spider-class\(\)](#) object
- Value(Spider) <- value: Assign Value to a [Spider-class\(\)](#) object

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