Package 'BayesianReasoning'

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Type Package

Title Plot Positive and Negative Predictive Values for Medical Tests

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Description Functions to plot and help understand positive and negative predictive values (PPV and NPV), and their relationship with sensitivity, specificity, and prevalence. See Akobeng, A.K. (2007) <doi:10.1111/j.1651-2227.2006.00180.x> for a theoretical overview of the technical concepts and Navarrete et al. (2015) for a practical explanation about the importance of their understanding <doi:10.3389/fpsyg.2015.01327>.

LazyData TRUE

Depends R (>= 3.5.0)

Imports dplyr, reshape2, ggplot2, tidyr, magrittr, tibble, ggforce

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RoxygenNote 7.1.1

URL `https://github.com/gorkang/BayesianReasoning`

BugReports `https://github.com/gorkang/BayesianReasoning/issues`

Encoding UTF-8

Suggests testthat, knitr, rmarkdown, covr, patchwork

VignetteBuilder knitr

NeedsCompilation no

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R topics documented:

`.createPPVmatrix` *.createPPVmatrix*

Description

Create a PPV matrix helper function

Usage

```
.createPPVmatrix(
  Min_Prevalence = 1,
  Max_Prevalence = 1000,
  Sensitivity = 100,
  Min_FP = 0,
  Max_FP = 10,
  steps_matrix = 100
)
```

Arguments

`Min_Prevalence`	[x] out of y prevalence of disease
`Max_Prevalence`	x out of [y] prevalence of disease
`Sensitivity`	Sensitivity of test
`Min_FP`	Minimum False Positive ratio
`Max_FP`	Maximum False Positive ratio
`steps_matrix`	How big the matrix should be (probably better to leave as it is: 100)

Value

A DF called PPV

`.get_point_ppv_npv` *.get_point_ppv_npv*

Description

Get PPV or NPV for the overlay

Usage

```
.get_point_ppv_npv(
  PPV_melted,
  PPV_NPV = "PPV",
  Sensitivity,
  overlay_prevalence_1,
  overlay_prevalence_2,
  overlay_labels,
  overlay_position_FP,
  overlay_position_FN,
  point_Prevalence,
  prevalence_label,
  x_axis_label,
  y_axis_label,
  decimals_x,
  decimals_y
)
```

Arguments

`PPV_melted`	DF out of .createPPVmatrix()
`PPV_NPV`	Should calculate PPV or NPV?
`Sensitivity`	Sensitivity of the test
`overlay_prevalence_1`	[x] out of y prevalence of disease
`overlay_prevalence_2`	x out of [y] prevalence of disease
`overlay_labels`	.
`overlay_position_FP`	.
`overlay_position_FN`	.
`point_Prevalence`	.
`prevalence_label`	.
`x_axis_label`	.

`y_axis_label`	.
`decimals_x`	.
`decimals_y`	.

`.number_decimals_plot_axis`

.number_decimals_plot_axis

Description

The number of decimal places in the x and y axis label depends on how wide the range is.

Usage

```
.number_decimals_plot_axis(
  PPV_NPV = "PPV",
  Min_FP = 0,
  Max_FP,
  Min_FN,
  Max_FN,
  Min_Prevalence,
  Max_Prevalence
)
```

Arguments

`PPV_NPV`	.
`Min_FP`	.
`Max_FP`	.
`Min_FN`	.
`Max_FN`	.
`Min_Prevalence`	[x] out of y prevalence of disease
`Max_Prevalence`	x out of [y] prevalence of disease

`.plot_creation` *.plot_creation*

Description

Function to create the main heatmap plot

Usage

```
.plot_creation(
  PPV_melted,
  Min_Prevalence,
  Sensitivity,
  PPV_NPV = "PPV",
  Min_FP = 0,
  Max_FP,
  steps_matrix = 100,
  decimals_x,
  decimals_y,
  label_title = "",
  label_subtitle = "",
  label_caption = "",
  prevalence_label = "",
  legend_label = "",
  x_axis_label,
  y_axis_label
)
```

Arguments

`PPV_melted`	.
`Min_Prevalence`	.
`Sensitivity`	.
`PPV_NPV`	.
`Min_FP`	.
`Max_FP`	.
`steps_matrix`	.
`decimals_x`	.
`decimals_y`	.
`label_title`	.
`label_subtitle`	.
`label_caption`	.
`prevalence_label`	.

`legend_label`	.
`x_axis_label`	.
`y_axis_label`	.

`.plot_overlay_area` *.plot_overlay_area*

Description

Add area overlay to PPV_heatmap plot

Usage

```
.plot_overlay_area(
  PPV_melted,
  uncertainty_prevalence = "low",
  Min_Prevalence,
  Max_Prevalence,
  Sensitivity,
  Min_FP = 0,
  Max_FP,
  overlay_labels = "",
  PPV_NPV = "PPV",
  overlay_prevalence_1,
  overlay_prevalence_2,
  overlay_position_FP,
  overlay_position_FN,
  decimals_x,
  decimals_y,
  prevalence_label,
  legend_label,
  label_title,
  label_subtitle,
  x_axis_label,
  y_axis_label
)
```

Arguments

`PPV_melted`	.
`uncertainty_prevalence`	.
`Min_Prevalence`	[x] out of y prevalence of disease
`Max_Prevalence`	x out of [y] prevalence of disease
`Sensitivity`	.

`Min_FP`	.
`Max_FP`	.
`overlay_labels`	.
`PPV_NPV`	.
`overlay_prevalence_1`	[x] out of y prevalence of disease for the overlay
`overlay_prevalence_2`	x out of [y] prevalence of disease for the overlay
`overlay_position_FP`	.
`overlay_position_FN`	.
`decimals_x`	.
`decimals_y`	.
`prevalence_label`	.
`legend_label`	.
`label_title`	.
`label_subtitle`	.
`x_axis_label`	.
`y_axis_label`	.

`.plot_overlay_line` *.plot_overlay_line*

Description

Add line overlay to PPV_heatmap plot

Usage

```
.plot_overlay_line(
  PPV_melted,
  uncertainty_prevalence = "low",
  PPV_NPV,
  Min_Prevalence,
  Max_Prevalence,
  Max_FP,
  Sensitivity,
  overlay_prevalence_1,
  overlay_prevalence_2,
  overlay_position_FP,
  overlay_position_FN,
```

```
  overlay_labels,
  label_title,
  label_subtitle,
  legend_label,
  decimals_x,
  decimals_y,
  prevalence_label,
  x_axis_label,
  y_axis_label
)
```

Arguments

`PPV_melted`	DF
`uncertainty_prevalence`	How big the uncertainty area should be: ["low" or "high"]
`PPV_NPV`	.
`Min_Prevalence`	[x] out of y prevalence of disease
`Max_Prevalence`	x out of [y] prevalence of disease
`Max_FP`	.
`Sensitivity`	.
`overlay_prevalence_1`	vector with [x] out of y prevalence of disease
`overlay_prevalence_2`	vector with x out of [y] prevalence of disease
`overlay_position_FP`	.
`overlay_position_FN`	.
`overlay_labels`	vector with labels for each overlay point
`label_title`	.
`label_subtitle`	.
`legend_label`	.
`decimals_x`	.
`decimals_y`	.
`prevalence_label`	.
`x_axis_label`	.
`y_axis_label`	.

`.translate_labels` *.translate_labels*

Description

Supports showing plot labels in Spanish (sp) or English (default)

Usage

```
.translate_labels(Language, Sensitivity, Max_FP, PPV_NPV = "PPV")
```

Arguments

`Language`	Can be Spanish "sp" or English (default)
`Sensitivity`	.
`Max_FP`	.
`PPV_NPV`	.

Value

A list with labels

`min_possible_prevalence` *Show minimum possible prevalence given the test characteristics*

Description

Given a FP and a desired PPV, what is the Minimum Prevalence of a Condition

Usage

```
min_possible_prevalence(Sensitivity, FP_test, min_PPV_desired)
```

Arguments

`Sensitivity`	Sensitivity of the test: [0-100]
`FP_test`	False positive rate (1-Specificity): [0-100]
`min_PPV_desired`	Which PPV is what you consider the minimum to trust a positive result in the test: [0-100]

Value

A description showing the minimum necessary prevalence.

Examples

```
# Example 1
min_possible_prevalence(Sensitivity = 99.9, FP_test = .1, min_PPV_desired = 70)
"To reach a PPV of 70 when using a test with 99.9 % Sensitivity and 0.1 % False Positive Rate,
you need a prevalence of at least 1 out of 429"

# Example 2
min_possible_prevalence(100, 0.1, 98)
"To reach a PPV of 98 when using a test with 100 % Sensitivity and 0.1 % False Positive Rate,
you need a prevalence of at least 1 out of 21"
```

`PPV_diagnostic_vs_screening` *Plot PPV values for a diagnostic and a screening group*

Description

Plot PPV associated to different levels of FP and a specific Sensitivity, for two different Prevalence groups.

Usage

```
PPV_diagnostic_vs_screening(
  Max_FP = 10,
  Sensitivity = 100,
  prevalence_screening_group = 100,
  prevalence_diagnostic_group = 2,
  labels_prevalence = c("Screening", "Diagnostic"),
  folder = ""
)
```

Arguments

`Max_FP`	False positive rate (1-Specificity) [0-100].
`Sensitivity`	Sensitivity of the test [0-100].
`prevalence_screening_group`	Prevalence of the screening group, 1 out of x [1-Inf].
`prevalence_diagnostic_group`	Prevalence of the diagnostic group, 1 out of x [1-Inf].
`labels_prevalence`	Labels to use for both groups.
`folder`	Where to save the plot (the filename would be automatically created using the plot parameters)

Value

Shows a plot or, if given a folder argument, saves a .png version of the plot

Examples

```
# Example 1
PPV_diagnostic_vs_screening(Max_FP = 10, Sensitivity = 100,
                            prevalence_screening_group = 1500,
                            prevalence_diagnostic_group = 3)

# Example 2. QWith custom labels
PPV_diagnostic_vs_screening(Max_FP = 10, Sensitivity = 100,
                            prevalence_screening_group = 1667,
                            prevalence_diagnostic_group = 44,
                           labels_prevalence = c("20 y.o.", "50 y.o."))
```

`PPV_heatmap` *Plot PPV and NPV heatmaps*

Description

Plot heatmaps showing the PPV for a given Sensitivity and a range of Prevalences and False Positive values or NPV values for a given Specificity and a range of Prevalences and True Positive values

Usage

```
PPV_heatmap(
  Min_Prevalence,
  Max_Prevalence,
  Sensitivity,
  Min_FP = 0,
  Max_FP,
  overlay = "no",
  overlay_labels = "",
  overlay_position_FP = 1,
  overlay_position_FN = 1,
  overlay_prevalence_1 = 1,
  overlay_prevalence_2 = 100,
  uncertainty_prevalence = "high",
  label_title = "",
  label_subtitle = "",
  Language = "en",
  folder = "",
  PPV_NPV = "PPV",
  DEBUG = 0
)
```

Arguments

`Min_Prevalence`	x in the "x out of y" prevalence (y-axis): 1-Inf
`Max_Prevalence`	y in the "x out of y" prevalence (y-axis): 1-Inf
`Sensitivity`	Sensitivity of the test: 0-100
`Min_FP`	Minimum False Positives ratio to show in plot (x-axis): 1-100
`Max_FP`	Maximum False Positives ratio to show in plot (x-axis): 1-100
`overlay`	Show overlay: TRUE / FALSE
`overlay_labels`	Labels for each point in the overlay. For example: c("80", "70", "60", "50", "40", "30", "20 y.o.")
`overlay_position_FP`	FP value (position in the x-axis) for each point in the overlay. For example: c(7, 8, 9, 12, 14, 14)
`overlay_position_FN`	FN value (position in the x-axis) for each point in the overlay. For example: c(7, 8, 9, 12, 14, 14)
`overlay_prevalence_1`	Prevalence value (position in the y-axis) for each point in the overlay. For example: c(1, 1, 1, 2, 1, 1)
`overlay_prevalence_2`	Prevalence value (position in the y-axis) for each point in the overlay. For example: c(26, 29, 44, 69, 227, 1667)
`uncertainty_prevalence`	How much certainty we have about the prevalence ["high"/"low"]
`label_title`	Title for the plot
`label_subtitle`	Subtitle for the plot
`Language`	Language for the plot labels: "sp" / "en"
`folder`	Where to save the plot (the filename would be automatically created using the plot parameters)
`PPV_NPV`	Should show PPV or NPV [PPV/NPV]
`DEBUG`	Shows debug warnings [0/1]

Value

Shows a plot or, if given a folder argument, saves a .png version of the plot

Examples

```
PPV_heatmap(Min_Prevalence = 1,
Max_Prevalence = 1000,
Sensitivity = 100,
Max_FP = 2,
Language = "en")
```

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