

multiCalibration

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calibrationTesting	<i>Function to test the calibration (i.e. overall - calibration intercepts - calibration slopes).</i>
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Description

Function to test the calibration (i.e. overall - calibration intercepts - calibration slopes).

Usage

```
calibrationTesting(outcome, k, LP, interceptVGAM, slopesVGAM)
```

Arguments

outcome	column vector containing the outcome for every case, with values 1 to k
k	number of outcome categories
LP	matrix with all the linear predictors with respect to the chosen reference category, ordered (e.g. LP2vs1 and LP3vs1)
interceptVGAM	vgam of estimation calibration intercepts
slopesVGAM	vgam of estimation calibration slopes

Value

list with deviances and p-values for overall calibration intercepts and calibration slopes

Author(s)

Kirsten Van Hoorde

ECI

Quantification of the lack of calibration via the estimated calibration index (ECI) with theoretical range between 0 and 100.

Description

Quantification of the lack of calibration via the estimated calibration index (ECI) with theoretical range between 0 and 100.

Usage

ECI(predictions, observations)

Arguments

predictions matrix with predicted probabilities for k outcome categories (nSamples x k)
 observations matrix with observed probabilities (not observed outcomes) for k outcome categories (nSamples x k; based on a generic multiclass risk model)

Value

estimated calibration index (ECI)

Author(s)

Kirsten Van Hoorde

References

"Van Hoorde, K. et al. A spline-based tool to assess and visualize the calibration of multiclass risk predictions. *Journal of Biomedical Informatics* 2015 Apr; 54: 283-293. doi: 10.1016/j.jbi.2014.12.016."

 estimationCalibrationIntercept

Estimation of calibration intercept with CI (default 95% CI).

Description

Estimation of calibration intercept with CI (default 95% CI).

Usage

```
estimationCalibrationIntercept(outcome, LP, r, ciLevel = 0.95)
```

Arguments

outcome	column vector containing the outcome for every case, with values 1 to k
LP	matrix with all the linear predictors with respect to the chosen reference category, ordered (e.g. LP2vs1 and LP3vs1)
r	reference category (default: category 1)
ciLevel	desired confidence level (default: 0.95)

Value

vgam model and estimate of calibration intercept with (95%) CI

Author(s)

Kirsten Van Hoorde

estimationCalibrationSlope

Estimation of calibration slopes with CI (default 95% CI).

Description

Estimation of calibration slopes with CI (default 95% CI).

Usage

```
estimationCalibrationSlope(outcome, k, LP, r, ciLevel = 0.95)
```

Arguments

outcome	column vector containing the outcome for every case, with values 1 to k
k	number of outcome categories
LP	matrix with all the linear predictors with respect to the chosen reference category, ordered (e.g. LP2vs1 and LP3vs1)
r	reference category (default: category 1)
ciLevel	desired confidence level (default: 0.95)

Value

vgam model and estimate of calibration intercept with (95%) CI

Author(s)

Kirsten Van Hoorde

multiCalibration	<i>Function to assess the calibration of multinomial probabilities (i.e. the reliability/accuracy of multinomial probabilities).</i>
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Description

Function to assess the calibration of multinomial probabilities (i.e. the reliability/accuracy of multinomial probabilities).

Usage

```
multiCalibration(outcome, k, p = NULL, LP, r = 1, estimates = FALSE,
  dfr = 2, parametric = TRUE, generic = TRUE, plotseparate = TRUE,
  plotoverall = TRUE, datapoints = TRUE, smoothing = TRUE,
  smoothpar = 1, eci = TRUE, intercept = FALSE, slope = FALSE,
  test = FALSE, legendOutcome = NULL, pathGraphs = "./")
```

Arguments

outcome	column vector containing the outcome for every case, with values 1 to k (e.g. k=3)
k	number of outcome categories (e.g. 3)
p	matrix with the probabilities of the prediction model, ordered from prob(cat. 1) to prob(cat. k)
LP	matrix with all the linear predictors with respect to the chosen reference category, ordered (e.g. LP2vs1, LP3vs1, ..., LPkvs1)
r	reference category (default: category 1)
estimates	logical indicating whether the coefficients of the parametric recalibration framework are desired (default: FALSE)
dfr	degrees of freedom for the non-parametric/generic calibration (default: 2)
parametric	logical indicating whether the parametric framework should be considered (default: TRUE)
generic	logical indicating whether the generic framework should be considered (default: TRUE)
plotseparate	logical indicating whether separate (non-)parametric calibration plots are constructed (default: TRUE)
plotoverall	logical indicating whether overall (non-)parametric calibration plots are constructed (default: TRUE)
datapoints	logical indicating whether the individual datapoints are shown in the overall (non-)parametric calibration plots (default: TRUE)

smoothing	logical indicating whether a smoothed line (using cubic splines) is added to the calibration plots (default: TRUE)
smoothpar	smoothing parameter for the smoothed line (default: 1)
eci	logical indicating whether the estimated calibration index (ECI) should be computed (default: TRUE)
intercept	logical indicating whether calibration intercepts are desired (default: FALSE)
slope	logical indicating whether calibration slopes are desired (default: FALSE)
test	logical indicating whether statistical tests for calibration are desired (default: FALSE)
legendOutcome	for the different outcome categories (if not specified cat 1, cat 2, ... cat k)
pathGraphs	location to save the graphs

Value

list with requested output (i.e. "ECI", "Coefficients of parametric recalibration framework", "Calibration Intercepts with 95% CI", "Calibration Slopes with 95% CI", "Deviances", "P-values") and calibration plots

Author(s)

Kirsten Van Hoorde

References

"Van Hoorde, K. et al Assessing calibration of multinomial risk prediction models. *Statistics in Medicine* 2014 Jul 10; 33 (15): 2585-96. doi: 10.1002/sim.6114."

Examples

```
library(VGAMdata)
library(VGAM)
data(xs.nz)
marital.nz <- xs.nz[,c("marital", "sex", "age", "height", "weight")]
marital.nz <- marital.nz[complete.cases(marital.nz),]
fit.ms <- vglm(marital ~ sex + age + height + weight,
multinomial(refLevel = 1), data = marital.nz)
predictions <- predict(fit.ms, newdata = marital.nz)
multiCalibration(outcome = as.numeric(marital.nz$marital), k = 4,
p = fitted(fit.ms), LP = predictors(fit.ms), estimates = TRUE,
intercept = TRUE, slope = TRUE, test = TRUE)
multiCalibration(outcome = as.numeric(marital.nz$marital), k = 4,
LP = predictions, estimates = TRUE, intercept = TRUE,
slope = TRUE, test = TRUE)
multiCalibration(outcome = as.numeric(marital.nz$marital), k = 4,
LP = predictions, estimates = TRUE, intercept = TRUE,
slope = TRUE, test = TRUE,
legendOutcome = c("single", "married", "divorced", "widowed"))
```

multiCalibrationGeneric

Function to assess the calibration of multinomial probabilities (i.e. the reliability/accuracy of multinomial probabilities based on a GENERIC multiclass risk model).

Description

Function to assess the calibration of multinomial probabilities (i.e. the reliability/accuracy of multinomial probabilities based on a GENERIC multiclass risk model).

Usage

```
multiCalibrationGeneric(outcome, k, p, r = 1, dfr = 2, generic = TRUE,
  plotseparate = TRUE, plotoverall = TRUE, datapoints = TRUE,
  smoothing = TRUE, smoothpar = 1, eci = TRUE, legendOutcome = NULL,
  pathGraphs = "./")
```

Arguments

outcome	column vector containing the outcome for every case, with values 1 to k (e.g. k=3)
k	number of outcome categories (e.g. 3)
p	matrix with the probabilities of the prediction model, ordered from prob(cat. 1) to prob(cat. k)
r	reference category (default: category 1)
dfr	degrees of freedom for the non-parametric/generic calibration (default: 2)
generic	logical indicating whether the generic framework should be considered (default: TRUE)
plotseparate	logical indicating whether separate (non-)parametric calibration plots are constructed (default: TRUE)
plotoverall	logical indicating whether overall (non-)parametric calibration plots are constructed (default: TRUE)
datapoints	logical indicating whether the individual datapoints are shown in the overall (non-)parametric calibration plots (default: TRUE)
smoothing	logical indicating whether a smoothed line (using cubic splines) is added to the calibration plots (default: TRUE)
smoothpar	smoothing parameter for the smoothed line (default: 1)
eci	logical indicating whether the estimated calibration index (ECI) should be computed (default: TRUE)
legendOutcome	for the different outcome categories (if not specified cat 1, cat 2, ... cat k)
pathGraphs	location to save the graphs

Value

calibration plots

Author(s)

Kirsten Van Hoorde

References

"Van Hoorde, K. et al. Assessing calibration of multinomial risk prediction models. *Statistics in Medicine* 2014 Jul 10; 33 (15): 2585-96. doi: 10.1002/sim.6114."

"Van Hoorde, K. et al. A spline-based tool to assess and visualize the calibration of multiclass risk predictions. *Journal of Biomedical Informatics* 2015 Apr; 54: 283-293. doi: 10.1016/j.jbi.2014.12.016."

overallGenericCalibrationPlot

Function to plot separate generic / non-parametric calibration plots.

Description

Function to plot separate generic / non-parametric calibration plots.

Usage

```
overallGenericCalibrationPlot(k, probs, fitnp, datapoints = TRUE,
  smoothing = TRUE, smoothpar = 1, legendOutcome = NULL,
  title = "Generic calibration plot", lwd = 4)
```

Arguments

k	number of outcome categories
probs	list of probabilities
fitnp	observed probabilities fitted/obtained via the non-parametric or generic logistic recalibration framework (vgam call)
datapoints	indicates whether the individual datapoints are shown in the overall (non-)parametric calibration plots (default: TRUE)
smoothing	indicates whether a smoothed line (using cubic splines) is added to the calibration plots (default: TRUE)
smoothpar	smoothing parameter for the smoothed line (default: 1)
legendOutcome	for the different outcome categories (if not specified cat 1, cat 2, ... cat k)
title	main title of the calibration plot
lwd	linewidth of smoothed line

Value

generic / non-parametric calibration plot for each outcome category separately

Author(s)

Kirsten Van Hoorde

overallParametricCalibrationPlot

Function to plot overall parametric calibration plots.

Description

Function to plot overall parametric calibration plots.

Usage

```
overallParametricCalibrationPlot(k, probs, fitp, datapoints = TRUE,
  smoothing = TRUE, smoothpar = 1, legendOutcome = NULL,
  title = "Parametric calibration plot", lwd = 4)
```

Arguments

k	number of outcome categories
probs	list of probabilities
fitp	observed probabilities fitted/obtained via the parametric logistic recalibration framework (vglm call)
datapoints	indicates whether the individual datapoints are shown in the overall (non-)parametric calibration plots (default: TRUE)
smoothing	indicates whether a smoothed line (using cubic splines) is added to the calibration plots (default: TRUE)
smoothpar	smoothing parameter for the smoothed line (default: 1)
legendOutcome	for the different outcome categories (if not specified cat 1, cat 2, ... cat k)
title	main title of the calibration plot
lwd	linewidth of smoothed line

Value

overall parametric calibration plot

Author(s)

Kirsten Van Hoorde

separateGenericCalibrationPlot

Function to plot separate generic / non-parametric calibration plots.

Description

Function to plot separate generic / non-parametric calibration plots.

Usage

```
separateGenericCalibrationPlot(k, probs, fitnp, smoothing = TRUE,
  smoothpar = 1, legendOutcome = NULL, title = "Generic calibration plot",
  lwd = 4)
```

Arguments

k	number of outcome categories
probs	list of probabilities
fitnp	observed probabilities fitted/obtained via the non-parametric or generic logistic recalibration framework (vgam call)
smoothing	indicates whether a smoothed line (using cubic splines) is added to the calibration plots (default: TRUE)
smoothpar	smoothing parameter for the smoothed line (default: 1)
legendOutcome	for the different outcome categories (if not specified cat 1, cat 2, ... cat k)
title	main title of the calibration plot
lwd	linewidth of smoothed line

Value

generic / non-parametric calibration plot for each outcome category separately

Author(s)

Kirsten Van Hoorde

separateParametricCalibrationPlot

Function to plot separate parametric calibration plots.

Description

Function to plot separate parametric calibration plots.

Usage

```
separateParametricCalibrationPlot(k, probs, fitp, smoothing = TRUE,
  smoothpar = 1, legendOutcome = NULL,
  title = "Parametric calibration plot", lwd = 4)
```

Arguments

k	number of outcome categories
probs	list of probabilities
fitp	observed probabilities fitted/obtained via the parametric logistic recalibration framework (vglm call)
smoothing	indicates whether a smoothed line (using cubic splines) is added to the calibration plots (default: TRUE)

<code>smoothpar</code>	smoothing parameter for the smoothed line (default: 1)
<code>legendOutcome</code>	for the different outcome categories (if not specified cat 1, cat 2, ... cat k)
<code>title</code>	main title of the calibration plot
<code>lwd</code>	linewidth of smoothed line

Value

parametric calibration plot for each outcome category separately

Author(s)

Kirsten Van Hoorde

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