

Package ‘bewrs’

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Type Package

Title Bayesian Early-Warning Risk Surveillance for Healthcare
Performance Monitoring

Version 0.1.1

Description Provides Bayesian early-warning surveillance methods for monitoring healthcare performance and patient safety outcomes. The package draws on risk-adjusted monitoring frameworks developed by Steiner et al. (2000) <[doi:10.1093/biostatistics/1.4.441](https://doi.org/10.1093/biostatistics/1.4.441)>, Spiegelhalter et al. (2003) <[doi:10.1002/sim.1546](https://doi.org/10.1002/sim.1546)>, Cook et al. (2011) <[doi:10.1136/bmjqs.2008.031831](https://doi.org/10.1136/bmjqs.2008.031831)>, and Neuburger et al. (2017) <[doi:10.1136/bmjqs-2016-005511](https://doi.org/10.1136/bmjqs-2016-005511)>. The package implements Bayesian predictive modelling, risk-adjusted monitoring, early-warning signal detection, and graphical tools for continuous quality improvement and healthcare performance assessment.

License GPL-3

Encoding UTF-8

RoxygenNote 7.3.3

Depends R (>= 4.2.0)

Imports ggplot2, pROC

Suggests testthat (>= 3.0.0)

Config/testthat/edition 3

URL <https://github.com/zerish12/bewrs>

BugReports <https://github.com/zerish12/bewrs/issues>

NeedsCompilation no

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compute_dynamic_bewrs *Compute Dynamic BEWRS*

Description

Computes the Bayesian Dynamic Early-Warning Risk Score using current posterior underperformance probability, persistence, and deterioration.

Usage

```
compute_dynamic_bewrs(
  up,
  persistence,
  deterioration,
  alpha = 0,
  beta_up = 1,
  beta_persistence = 1,
  beta_deterioration = 1
)
```

Arguments

up	Numeric vector of posterior underperformance probabilities.
persistence	Numeric vector measuring persistence of elevated risk.
deterioration	Numeric vector measuring recent deterioration.
alpha	Intercept parameter.
beta_up	Coefficient for logit-transformed posterior risk.
beta_persistence	Coefficient for persistence.
beta_deterioration	Coefficient for deterioration.

Value

Numeric vector of Dynamic BEWRS probabilities.

Examples

```
compute_dynamic_bewrs(
  up = c(0.2, 0.5, 0.8),
  persistence = c(0.1, 0.4, 0.7),
  deterioration = c(0.0, 0.1, 0.2)
)
```

 compute_evi

Compute Expected Value of Intervention

Description

Computes the Expected Value of Intervention (EVI) as the reduction in expected loss from no action to the selected intervention.

Usage

```
compute_evi(loss_no_action, loss_intervention)
```

Arguments

loss_no_action Numeric vector of expected loss under no action.
 loss_intervention Numeric vector of expected loss under intervention.

Value

Numeric vector of EVI values.

Examples

```
compute_evi(c(10, 5, 2), c(7, 4, 3))
```

 optimal_intervention

Select optimal intervention

Description

Selects the intervention with the lowest expected loss.

Usage

```
optimal_intervention(loss_matrix)
```

Arguments

`loss_matrix` Numeric matrix or data.frame of expected losses. Rows represent observational units and columns represent intervention options.

Value

A data.frame containing optimal action and minimum expected loss.

Examples

```
losses <- data.frame(  
  no_action = c(10, 5, 2),  
  monitor = c(8, 4, 3),  
  review = c(7, 6, 4)  
)  
optimal_intervention(losses)
```

`plot_calibration` *Plot calibration curve*

Description

Plot calibration curve

Usage

```
plot_calibration(observed, predicted, groups = 10)
```

Arguments

`observed` Binary observed outcome, coded 0/1.
`predicted` Predicted probabilities.
`groups` Number of quantile groups.

Value

A ggplot object.

plot_risk_groups	<i>Plot risk group event rates</i>
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Description

Plot risk group event rates

Usage

```
plot_risk_groups(observed, risk_group)
```

Arguments

observed	Binary observed outcome, coded 0/1.
risk_group	Ordered risk group factor.

Value

A ggplot object.

risk_stratify	<i>Stratify Dynamic BEWRS risk</i>
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Description

Classifies risk probabilities into Low, Watchlist, High, and Critical groups.

Usage

```
risk_stratify(risk, cutoffs = c(0.25, 0.5, 0.75))
```

Arguments

risk	Numeric vector of predicted risk probabilities.
cutoffs	Numeric vector of three cutoffs. Default is c(0.25, 0.50, 0.75).

Value

Ordered factor of risk categories.

Examples

```
risk_stratify(c(0.1, 0.4, 0.6, 0.9))
```

validate_bewrs	<i>Validate BEWRS predictions</i>
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Description

Computes AUC, Brier score, calibration intercept, and calibration slope.

Usage

```
validate_bewrs(observed, predicted)
```

Arguments

observed	Binary vector of observed outcomes, coded 0/1.
predicted	Numeric vector of predicted probabilities.

Value

A data.frame containing validation metrics.

Examples

```
validate_bewrs(c(0, 1, 1, 0), c(0.1, 0.8, 0.7, 0.3))
```

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