Package: CRBHSF (via r-universe)

June 25, 2026

Type Package

Title Cyber-Resilient Bayesian Healthcare Surveillance Framework

Version 0.1.0

Description Provides methods for cyber-resilient healthcare performance surveillance using Bayesian risk estimation, latent organisational trust modelling, cyber-resilience assessment, external validation, decision-theoretic optimisation, and digital-twin deployment simulation. The package supports prospective deterioration monitoring, uncertainty-aware risk assessment, intervention prioritisation, ablation analysis, and operational evaluation for healthcare performance management and health system resilience research. The methodological framework is informed by contemporary guidance on prediction model development and validation (Efthimiou et al., 2024 <doi:10.1136/bmj-2023-078276>), transparent reporting of prediction models (Collins et al., 2024 <doi:10.1136/bmj-2023-078378>), and decision-analytic model evaluation (Vickers and Elkin, 2006 <doi:10.1177/0272989X06295361>).

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Encoding UTF-8

LazyData true

Roxygen list(markdown = TRUE)

RoxygenNote 7.3.3

URL https://github.com/zerish12/CRBHSF

BugReports https://github.com/zerish12/CRBHSF/issues

Imports dplyr, ggplot2, pROC, purrr, tibble

Suggests testthat (>= 3.0.0), knitr, rmarkdown

Config/testthat/edition 3

Repository https://zerish12.r-universe.dev

Date/Publication 2026-06-14 15:54:56 UTC

RemoteUrl https://github.com/zerish12/crbhsf

RemoteRef HEAD

RemoteSha fcf9b200583c2f2e977bcb8370a46a80057642da

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`clean_health_data` *Clean healthcare surveillance data*

Description

Clean healthcare surveillance data

Usage

```
clean_health_data(data, provider_col, time_col)
```

Arguments

`data`	A data frame.
`provider_col`	Character string giving the column name.
`time_col`	Character string giving the column name.

compare_ml_benchmarks *Compare simple machine-learning benchmarks*

Description

Compare simple machine-learning benchmarks

Usage

```
compare_ml_benchmarks(data, outcome_col, predictor_cols)
```

Arguments

data	A data frame.
outcome_col	Character string giving the column name.
predictor_cols	Character vector of predictor column names.

compute_crbhsf_risk *Compute CRBHSF risk score*

Description

Compute CRBHSF risk score

Usage

```
compute_crbhsf_risk(
  data,
  bayes_risk_col = "risk_bayes",
  trust_col = "latent_trust",
  lambda = 0.2
)
```

Arguments

data	A data frame.
bayes_risk_col	Character string giving the column name.
trust_col	Character string giving the column name.
lambda	Numeric parameter.

compute_crpr *Compute Cyber-Resilience Pressure Ratio*

Description

Compute Cyber-Resilience Pressure Ratio

Usage

```
compute_crpr(data, bayes_risk_col = "risk_bayes", trust_col = "latent_trust")
```

Arguments

data	A data frame.
bayes_risk_col	Character string giving the column name.
trust_col	Character string giving the column name.

create_deterioration_outcome *Create future deterioration outcome*

Description

Create future deterioration outcome

Usage

```
create_deterioration_outcome(
  data,
  provider_col,
  time_col,
  value_col,
  threshold = 1
)
```

Arguments

data	A data frame.
provider_col	Character string giving the column name.
time_col	Character string giving the column name.
value_col	Character string giving the column name.
threshold	Numeric parameter.

estimate_evib *Estimate expected value of intervention benefit*

Description

Estimate expected value of intervention benefit

Usage

```
estimate_evib(
  data,
  risk_col = "risk_crbhsf",
  review_cost = 1,
  miss_cost = 10,
  threshold = 0.5
)
```

Arguments

data	A data frame.
risk_col	Character string giving the column name.
review_cost	Numeric parameter.
miss_cost	Numeric parameter.
threshold	Numeric parameter.

estimate_latent_trust *Estimate latent organisational trust*

Description

Estimate latent organisational trust

Usage

```
estimate_latent_trust(
  data,
  anomaly_col = NULL,
  corruption_col = NULL,
  cyber_col = NULL,
  missing_col = NULL,
  delay_col = NULL
)
```

Arguments

data	A data frame.
anomaly_col	Character string giving the column name.
corruption_col	Character string giving the column name.
cyber_col	Character string giving the column name.
missing_col	Character string giving the column name.
delay_col	Character string giving the column name.

---

fit_bayesian_surveillance

Fit lightweight Bayesian surveillance model

Description

Fit lightweight Bayesian surveillance model

Usage

```
fit_bayesian_surveillance(data, y_col, n_col, alpha0 = 2, beta0 = 2)
```

Arguments

data	A data frame.
y_col	Character string giving the column name.
n_col	Character string giving the column name.
alpha0	Numeric parameter.
beta0	Numeric parameter.

---

generate_surveillance_report

Generate simple surveillance report

Description

Generate simple surveillance report

Usage

```
generate_surveillance_report(validation_results, deployment_results = NULL)
```

Arguments

validation_results	Validation results returned by validate_surveillance().
deployment_results	Optional deployment results returned by simulate_digital_twin().

plot_ablation_auc *Plot ablation AUC*

Description

Plot ablation AUC

Usage

```
plot_ablation_auc(ablation_results)
```

Arguments

ablation_results	Function argument.

plot_deployment_impact *Plot digital-twin deployment impact*

Description

Plot digital-twin deployment impact

Usage

```
plot_deployment_impact(deployment_results)
```

Arguments

deployment_results	Optional deployment results returned by simulate_digital_twin().

plot_risk_distribution *Plot risk distribution*

Description

Plot risk distribution

Usage

```
plot_risk_distribution(data, risk_col = "risk_crbhsf")
```

Arguments

data	A data frame.
risk_col	Character string giving the column name.

run_ablation_study *Run CRBHSF ablation study*

Description

Evaluates the incremental predictive contribution of multiple surveillance risk scores by calculating validation metrics for each score against a common binary outcome.

Usage

```
run_ablation_study(
  data,
  outcome_col,
  score_cols = c("risk_bayes", "latent_trust", "crpr", "risk_crbhsf")
)
```

Arguments

data	A data frame containing the outcome and score columns.
outcome_col	Character string giving the binary outcome column.
score_cols	Character vector giving the surveillance score columns to evaluate. Defaults to risk_bayes, latent_trust, crpr, and risk_crbhsf.

Value

A tibble containing validation metrics for each score column, including sample size, event count, event rate, AUC, and Brier score.

simulate_digital_twin *Simulate digital-twin deployment*

Description

Simulate digital-twin deployment

Usage

```
simulate_digital_twin(
  data,
  outcome_col,
  score_col,
  capacity = 0.1,
  intervention_effect = 0.6,
  miss_cost = 15,
  review_cost = 1
)
```

Arguments

data	A data frame containing outcome and score columns.
outcome_col	Character string giving the binary deterioration outcome column.
score_col	Character string giving the risk score column used for prioritisation.
capacity	Proportion of observations selected for review.
intervention_effect	Proportion of reviewed deterioration events assumed preventable.
miss_cost	Cost assigned to a missed deterioration event.
review_cost	Cost assigned to each review.

Value

A tibble summarising reviews, prevented deteriorations, losses, and loss reduction.

validate_surveillance *Validate surveillance score*

Description

Validate surveillance score

Usage

```
validate_surveillance(data, outcome_col, score_col)
```

Arguments

`data`	A data frame containing the outcome and score columns.
`outcome_col`	Character string giving the binary outcome column.
`score_col`	Character string giving the risk score column.

Value

A tibble containing sample size, event count, event rate, AUC, and Brier score.

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