# Package 'esback'

June 9, 2020

**Type** Package

**Title** Expected Shortfall Backtesting

**Version** 0.3.0

**Date** 2020-05-22

**Description** Implementations of the expected shortfall backtests of Bayer and Dimitriadis (2020) <doi:10.1093/jjfinec/nbaa013>
as well as other well known backtests from the literature. Can be used to assess the correctness of forecasts of the
expected shortfall risk measure which is e.g. used in the banking and finance industry for quantifying the market risk
of investments. A special feature of the backtests of Bayer and Dimitriadis (2020) <doi:10.1093/jjfinec/nbaa013>
is that they only require forecasts of the expected shortfall, which is in striking contrast to all other existing
backtests, making them particularly attractive for practitioners.

**License** GPL-3

**Encoding** UTF-8

**LazyData** true

**Depends** R(>= 2.10.0)

**Imports** esreg

**RoxygenNote** 7.1.0

**NeedsCompilation** no

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**Repository** CRAN

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## R topics documented:

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`cc_backtest` *Conditional Calibration Backtest*

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## Description

The simple and general conditional calibration backtests of Nolde & Ziegel (2007).

## Usage

```
cc_backtest(r, q, e, s = NULL, alpha, hommel = TRUE)
```

## Arguments

| | |
|---|---|
| `r` | A vector of returns. |
| `q` | A vector of Value-at-Risk forecasts. |
| `e` | A vector of Expected Shortfall forecasts. |
| `s` | A vector of volatility forecasts. |
| `alpha` | Scalar probability level in (0, 1). |
| `hommel` | If TRUE, use Hommels correction, otherwise use the classical Bonferroni correction. |

## Value

Returns a list with the following components:

- pvalue_twosided_simple
- pvalue_onesided_simple
- pvalue_twosided_general
- pvalue_onesided_general

## References

Nolde & Ziegel (2007)

## Examples

```
data(risk_forecasts)
r <- risk_forecasts$r
q <- risk_forecasts$q
e <- risk_forecasts$e
s <- risk_forecasts$s
cc_backtest(r = r, q = q, e = e, s = s, alpha = 0.025)
```

er_backtest *Exceedance Residuals Backtest*

## Description

Tests whether the mean of the exceedance residuals, respectively the mean of the standardized exceedance residuals is zero.

## Usage

```
er_backtest(r, q, e, s = NULL, B = 1000)
```

## Arguments

| | |
|---|---|
| r | A vector of returns. |
| q | A vector of Value-at-Risk forecasts. |
| e | A vector of Expected Shortfall forecasts. |
| s | A vector of volatility forecasts. |
| B | Number of bootstrap iterations |

## Value

Returns a list with the following components:

- pvalue_twosided_simple
- pvalue_onesided_simple
- pvalue_twosided_standardized
- pvalue_onesided_standardized

## References

McNeil & Frey (2000)

## Examples

```
data(risk_forecasts)
r <- risk_forecasts$r
q <- risk_forecasts$q
e <- risk_forecasts$e
s <- risk_forecasts$s
er_backtest(r = r, q = q, e = e, s = s)
```

## esback *esback: A package for backtesting expected shortfall forecasts*

### Description

The esback package contains functions for backtesting expected shortfall forecasts.

### Available backtest functions

- Exceedance Residuals Backtest (McNeil & Frey, 2000)
- Conditional Calibration Backtest (Nolde & Ziegel, 2017)
- Expeced Shortfall Regression Backtests (Bayer & Dimitriadis, 2018)

## esr_backtest *Expected Shortfall Regression Backtest*

### Description

This function implements multiple expected shortfall regression (esreg) based backtests. Using the `version` argument, the following backtests are available:

1. ("Strict ESR") Regresses the returns on the expected shortfall forecasts and tests the ES coefficients for (0, 1).
2. ("Auxiliary ESR") Regresses the returns on the quantile and the expected shortfall forecasts and tests the ES coefficients for (0, 1).
3. ("Strict Intercept") Tests whether the expected shortfall of the forecast error r - e is zero.

### Usage

```
esr_backtest(
  r,
  q,
  e,
  alpha,
  version,
  B = 0,
  cov_config = list(sparsity = "nid", sigma_est = "scl_sp", misspec = TRUE)
)
```

### Arguments

| | |
|---|---|
| r | A vector of returns. |
| q | A vector of Value-at-Risk forecasts. |
| e | A vector of Expected Shortfall forecasts. |
| alpha | Scalar probability level in (0, 1). |
| version | Version of the backtest to be used |
| B | Number of bootstrap samples. Set to 0 to disable bootstrapping. |
| cov_config | a list with three components: sparsity, sigma_est, and misspec, see vcovA |

### Value

Returns a list with the following components:

- pvalue_two_sided_asymptotic
- pvalue_one_sided_asymptotic (for version 3)
- pvalue_two_sided_bootstrap
- pvalue_one_sided_bootstrap (for version 3)

### References

Bayer & Dimitriadis (2020)

### Examples

```
data(risk_forecasts)
r <- risk_forecasts$r
q <- risk_forecasts$q
e <- risk_forecasts$e
esr_backtest(r = r, q = q, e = e, alpha = 0.025, version = 1)
```

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## risk_forecasts *Returns and risk forecasts for the S&P 500 index*

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### Description

A dataset containing the daily log returns and risk forecasts for the S&P 500 index. The quantile and expected shortfall forecasts are for the probability level 2.5%.

### Usage

```
data(risk_forecasts)
```

### Format

A data.frame with 4396 rows and 4 variables

## Details

Description of the variables:

**r** Daily log returns from January 3, 2000 to September 29, 2017 (4465 days)

**q** Value-at-Risk forecasts of the Historical Simulation approach

**e** Expected shortfall forecasts of the Historical Simulation approach

**s** Volatility forecasts of the Historical Simulation approach

# Index