Package ‘RESTK’

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**compute_maxk**

*Compute the maximum k for a given sample*

**Description**

compute_maxk returns the estimated quantiles for the chosen probabilities from the input sample. This method uses the sample quantile method number 8 from the default quantile function.

**Usage**

```
compute_maxk(samp = NULL, probs = NULL, quants = NULL, k_range = c(1, 120))
```

**Arguments**

- **samp**: Sample of data to model
- **probs**: Probabilities of interest to generate the max_k line
- **quants**: Estimated quantiles of interest to generate the max_k line
- **k_range**: Range of k values for the optimization function

**Value**

Returns estimated maxk for the sample and quantiles given.

**Examples**

```
samp <- rnorm(1e3, mean = 100, sd = 10)
probs <- c(1-1e-1, 1-0.5e-1, 1-1e-2)
quants <- c(100, 125, 150)
estimated_max_k <- compute_maxk(samp = samp, probs = probs, quants = quants, k_range = c(1,100))
```

**estimate_quantiles_maxk**

*Estimate Quantiles with Maxk*

**Description**

estimate_quantiles_maxk use the maxk line obtained to estimate quantiles with MIK

**Usage**

```
estimate_quantiles_maxk(samp = NULL, maxk_line = NULL, probs_interest = NULL)
```
**get_min_maxk**

**Description**

get_min_maxk get the minimum maxk from a set of maxks and tightness

**Usage**

```
get_min_maxk(samp_tightness = NULL, k_seq = NULL)
```

**Arguments**

- samp_tightness tightness from a given sample and maxk
- k_seq sequence of maxk to evaluate

**Value**

Returns the minimum maxk

**Examples**

```
get_min_maxk(samp_tightness = c(1.5, 1.2, 0.98),
            k_seq = c(20, 30, 40))
```
linear_adjust  
*Linear adjust*

**Description**

`linear_adjust` function used to project the max_k line into the probabilities of interest

**Usage**

```r
linear_adjust(min_maxk = NULL, probs = NULL, probs_interest)
```

**Arguments**

- `min_maxk` minimum maxk found for each probability of interest
- `probs` Probabilities where maxk was evaluated
- `probs_interest` Probabilities of interest to estimate

**Value**

Returns the maxk line for the probabilities of interest

**Examples**

```r
linear_adjust(min_maxk = c(10, 15, 20),
              probs = c(1-1e-1, 1-1e-2, 1-1e-3),
              probs_interest = c(1-1e-6, 1-1e-7, 1-1e-8))
```

---

RESTK  
*RESTK*

**Description**

`RESTK` function used to project the maxk line into the probabilities of interest

**Usage**

```r
RESTK(
    training_data = NULL,
    validation_data = NULL,
    probs = NULL,
    probs_interest = NULL,
    bootstrap_size = NULL,
    bootstrap_training_sims = NULL,
    bootstrap_validation_sims = NULL
)
```
**RESTK_training**

**Arguments**

- `training_data` training data
- `validation_data` validation data
- `probs` Probabilities where maxk was evaluated
- `probs_interest` Probabilities of interest to estimate
- `bootstrap_size` size of bootstrap simulations on the training data
- `bootstrap_training_sims` number of bootstrap simulations on the training data
- `bootstrap_validation_sims` number of bootstrap simulations on the validation data

**Value**

Returns the maxk line for the probabilities of interest

**Examples**

```r
training_data <- rnorm(1e3, mean = 100, sd = 10)
validation_data <- rnorm(1e3, mean = 100, sd = 10)
bootstrap_size <- 1000
bootstrap_training_sims <- 10
bootstrap_validation_sims <- 10
probs <- c(1-1e-1, 1-0.5e-1, 1-1e-2)
probs_interest <- c(1-1e-6, 1-1e-7)
maxk_line <- c(100, 125, 150)

estimated_quants <- RESTK(training_data = training_data,
                          validation_data = validation_data,
                          probs = probs,
                          probs_interest = probs_interest,
                          bootstrap_size = bootstrap_size,
                          bootstrap_training_sims = bootstrap_training_sims,
                          bootstrap_validation_sims = bootstrap_validation_sims)
```

**Description**

RESTK_training function used to project the maxk line into the probabilities of interest
RESTK_validation

Usage

RESTK_training(
  training_data = NULL,
  probs = NULL,
  probs_interest = NULL,
  bootstrap_size = NULL,
  bootstrap_training_sims = NULL
)

Arguments

  training_data  training data
  probs          Probabilities where maxk was evaluated
  probs_interest Probabilities of interest to estimate
  bootstrap_size size of bootstrap simulations on the training data
  bootstrap_training_sims number of bootstrap simulations on the training data

Value

  Returns the estimated maxk line from the probabilities of interest

Examples

  training_data <- rnorm(1e3, mean = 100, sd = 10)
  probs <- c(1-1e-1, 1-0.5e-1, 1-1e-2)
  probs_interest <- c(1-1e-6, 1-1e-7)
  bootstrap_size <- 1000
  bootstrap_training_sims <- 100

  maxk_line <- RESTK_training(training_data = training_data,
                             probs = probs,
                             probs_interest = probs_interest,
                             bootstrap_size = bootstrap_size,
                             bootstrap_training_sims = bootstrap_training_sims)

Description

  RESTK_validation main function for the validation of the RESTK methodology by using the maxk
  line
sample_quantile_estimation

Usage

RESTK_validation(
  validation_data = NULL,
  maxk_line = NULL,
  probs_interest = NULL,
  bootstrap_size = NULL,
  bootstrap_validation_sims = NULL
)

Arguments

validation_data
  validation data
maxk_line
  maxk line obtained from RESTK_training
probs_interest
  Probabilities of interest to estimate
bootstrap_size
  size of bootstrap simulations on the validation data
bootstrap_validation_sims
  number of bootstrap simulations on the validation data

Value

Returns the estimated quantiles from the probabilities of interest

Examples

validation_data <- rnorm(1e3, mean = 100, sd = 10)
probs_interest <- c(1-1e-6, 1-1e-7)
bootstrap_size <- 1000
bootstrap_validation_sims <- 100
maxk_line <- c(100, 125, 150)
estimated_quants <- RESTK_validation(validation_data = validation_data,
  maxk_line = maxk_line,
  probs_interest = probs_interest,
  bootstrap_size = bootstrap_size,
  bootstrap_validation_sims = bootstrap_validation_sims)

Description

sample_quantile_estimation returns the estimated quantiles for the chosen probabilities from the input sample. This method uses the sample quantile method number 8 from the default quantile function.
Usage

```r
tightness_estimation(samp = NULL, probs = NULL, bootstrap_sims = NULL)
```

Arguments

- `samp`: Sample of data to model
- `probs`: Probabilities of interest to generate the max_k line
- `bootstrap_sims`: Number of bootstrap simulations to estimate the quantiles

Value

Returns estimated quantiles for the chosen probabilities.

Examples

```r
samp <- rnorm(1e3, mean = 100, sd = 10)
probs <- c(1-1e-1, 1-0.5e-1, 1-1e-2)
bootstrap_training_sims <- 100
estimated_quantiles <- tightness_estimation(samp = samp,
                                          probs = probs,
                                          bootstrap_sims = bootstrap_training_sims)
```

tightness

**Tightness function**

Description

tightness function used to minimized the tightness as a function of the value of k

Usage

```r
tightness(samp = NULL, prob = NULL, quant = NULL, k = NULL)
```

Arguments

- `samp`: Sample of data to model
- `prob`: Probability of interest
- `quant`: Quantile of interest
- `k`: value of k to check tightness

Value

Returns the squared difference between the tightness and 1
Examples

samp <- rnorm(1e3, mean = 100, sd = 10)
prob <- c(1-1e-2)
k <- 1:100
quant <- qnorm(p = prob, mean = 100, sd = 10)
tightness(samp = samp, prob = prob, quant = quant, k = k)
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