Package 'mlf'

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Type Package

Title Machine Learning Foundations

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Description Offers a gentle introduction to machine learning concepts for practitioners with a statistical pedigree: decomposition of model error (bias-variance trade-off), nonlinear correlations, information theory and functional permutation/bootstrap simulations. Székely GJ, Rizzo ML, Bakirov NK. (2007). <doi:10.1214/009053607000000505>. Reshef DN, Reshef YA, Finucane HK, Grossman SR, McVean G, Turnbaugh PJ, Lander ES, Mitzenmacher M, Sabeti PC. (2011). <doi:10.1126/science.1205438>.

Imports stats, utils

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R topics documented:

`boot` *Bootstrap Confidence Intervals via Resampling*

Description

Provides nonparametric confidence intervals via percentile-based resampling for given `mlf` function.

Usage

```
boot(x, y, func, reps, conf.int)
```

Arguments

`x, y`	numeric vectors of data values
`func`	specify `mlf` function
`reps`	(optional) number of resamples. Defaults to 500
`conf.int`	(optional) numeric value indicating level of confidence. Defaults to `0.90`.

Examples

```
# Sample data
a <- rnorm(25, 80, 35)
b <- rnorm(25, 100, 50)

mlf::mic(a, b)
mlf::boot(a, b, mic)
```

bvto *Bias-Variance Trade-Off*

Description

Provides estimated error decomposition from model predictions (mse, bias, variance).

Usage

```
bvto(truth, estimate)
```

Arguments

truth	test data vector or baseline accuractruth to test against.
estimate	predicted vector

Examples

```
# Sample data
test <- rnorm(25, 80, 35)
predicted <- rnorm(25, 80, 50)

mlf::bvto(test, predicted)
```

distcorr *Distance Correlation*

Description

Provides pairwise correlation via distance covariance normalized by distance standard deviation. Allows for non-linear dependencies.

Usage

```
distcorr(x, y)
```

Arguments

x, y	numeric vectors of data values

References

Székely GJ, Rizzo ML, Bakirov NK. Measuring and testing dependence by correlation of distances. Ann Stat. 2007. 35(6):2769-2794.

Examples

```
# Sample data
a <- rnorm(25, 80, 35)
b <- rnorm(25, 100, 50)

mlf::distcorr(a, b)
```

`entropy` *Entropy*

Description

Estimates uncertainty in univariate probability distribution.

Usage

```
entropy(x, bins)
```

Arguments

`x`	numeric or discrete data vector
`bins`	specify number of bins if numeric or integer data class.

Examples

```
# Sample numeric vector
a <- rnorm(25, 80, 35)
mlf::entropy(a, bins = 2)

# Sample discrete vector
b <- as.factor(c(1,1,1,2))
mlf::entropy(b)
```

`get_bias` *Bias*

Description

Estimates squared bias by decomposing model prediction error.

Usage

```
get_bias(truth, estimate)
```

Arguments

truth	test data vector or baseline accuracy to test against.
estimate	predicted vector

Examples

```
# Sample data
test <- rnorm(25, 80, 35)
predicted <- rnorm(25, 80, 50)

mlf::get_bias(test, predicted)
```

---

get_mse *Mean Squared Error*

Description

Estimates mean squared error from model predictions.

Usage

```
get_mse(truth, estimate)
```

Arguments

truth	test data vector or baseline accuracy to test against.
estimate	predicted vector

Examples

```
# Sample data
test <- rnorm(25, 80, 35)
predicted <- rnorm(25, 80, 50)

mlf::get_mse(test, predicted)
```

get_var *Variance*

Description

Estimates squared variance by decomposing model prediction error.

Usage

```
get_var(estimate)
```

Arguments

estimate	predicted vector

Examples

```
# Sample data
test <- rnorm(25, 80, 35)
predicted <- rnorm(25, 80, 50)

mlf::get_var(predicted)
```

jointentropy *Joint Entropy*

Description

Estimated difference between two probability distributions.

Usage

```
jointentropy(x, y, bins)
```

Arguments

x, y	numeric or discrete data vectors
bins	specify number of bins

Examples

```
# Sample numeric vector
a <- rnorm(25, 80, 35)
b <- rnorm(25, 90, 35)
mlf::jointentropy(a, b, bins = 2)

# Sample discrete vector
a <- as.factor(c(1,1,2,2))
b <- as.factor(c(1,1,1,2))
mlf::jointentropy(a, b)
```

---

kld *Kullback-Leibler Divergence*

Description

Provides estimated difference between individual entropy and cross-entropy of two probability distributions.

Usage

```
kld(x, y, bins)
```

Arguments

x, y	numeric or discrete data vectors
bins	specify number of bins

Examples

```
# Sample numeric vector
a <- rnorm(25, 80, 35)
b <- rnorm(25, 90, 35)
mlf::kld(a, b, bins = 2)

# Sample discrete vector
a <- as.factor(c(1,1,2,2))
b <- as.factor(c(1,1,1,2))
mlf::kld(a, b)
```

mi *Mutual Information*

Description

Estimates Kullback-Leibler divergence of joint distribution and the product of two respective marginal distributions. Roughly speaking, the amount of information one variable provides about another.

Usage

```
mi(x, y)
```

Arguments

x, y	numeric or discrete data vectors

Examples

```
# Sample data
a <- rnorm(25, 80, 35)
b <- rnorm(25, 100, 50)

mlf::mi(a, b)
```

mic *Maximal Information Criterion*

Description

Information-theoretic approach for detecting non-linear pairwise dependencies. Employs heuristic discretization to achieve highest normalized mutual information.

Usage

```
mic(x, y)
```

Arguments

x, y	numeric or discrete data vectors

References

Reshef DN, Reshef YA, Finucane HK, Grossman SR, McVean G, Turnbaugh PJ, Lander ES, Mitzenmacher M, Sabeti PC. Detecting novel associations in large data sets. Science. 2011. 334(6062):1518-1524.

Examples

```
# Sample data
a <- rnorm(25, 80, 35)
b <- rnorm(25, 100, 50)

mlf::mic(a, b)
```

---

perm *Permutation Test*

Description

Provides nonparametric statistical significance via sample randomization.

Usage

```
perm(x, y, func, reps)
```

Arguments

x, y	numeric vectors of data values
func	specify mlf function: (distcorr or mic).
reps	(optional) number of resamples. Defaults to 500.

Examples

```
# Sample data
a <- rnorm(25, 80, 35)
b <- rnorm(25, 100, 50)

mlf::mic(a, b)
mlf::perm(a, b, mic)
```

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