Package ‘errint’

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Title Builds Error Intervals
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Description Builds and analyzes error intervals for a particular model predictions assuming different distributions for noise in the data.
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Description

`int_intervals` computes the real accuracy of a given error intervals for a particular set of errors and a particular error function.

Usage

```r
acc_intervals(interv, errors, f = function(x, y) { abs(x - y ) },
              tol = 10^-8)
```

Arguments

- `interv`: error interval.
- `errors`: set of errors.
- `f`: error function to be used to compute error between real `x (interv)` and predicted `y (errors)` values. See also ’Details’.
- `tol`: used to normalize residual values to (0,1) when beta is the assumed distribution. See also ’Details’.

Details

`f` must be a function that takes two arguments, `x` and `y`, and return a numeric value.

The formula used to normalize residual values to (0,1) when a Beta distribution is assumed is 
\[
\frac{|\phi|}{\max{|\phi| + tol}}.
\]

Value

Returns an object of class c("measure", "list") with information of the interval accuracy.

Author(s)

Jesus Prada, <jesus.prada@estudiante.uam.es>
**best_distribution**

**References**

Link to the scientific paper


with theoretical background for this package is provided below.

http://link.springer.com/chapter/10.1007/978-3-319-19222-2_47

**See Also**

measure error_interval

**Examples**

```r
interv<-int_gau(rnorm(10),0.1)
acc_intervals(interv,rnorm(10))
acc_intervals(interv,rnorm(10),function(x,y){x-y})
```

---

**best_distribution**

**Distribution with Best Error Intervals**

**Description**

best_distribution computes the distribution assumption that gives error intervals with the lower accuracy error for a given set of residuals.

**Usage**

```r
best_distribution(phi, errors, dists = c("n", "nm", "l", "lm", "w", "b", "moge"), ...)
```

**Arguments**

- `phi`: residual values used to compute the error interval.
- `errors`: set of real errors corresponding to the predictions of a particular model.
- `dists`: character vector with the distribution assumptions to test. See also 'Details'.
- `...`: additional arguments to be passed to functions error_interval and acc_intervals.

**Details**

Allowed distribution assumptions are:

- "n": Zero-mu Gaussian
- "nm": General Gaussian
- "l": Zero-mu Laplace
• "lm": General Laplace
• "b": Beta
• "w": Weibull
• "moge": Moge

Value

Returns an object of class c("df_intervals", "data.frame") with information of the distribution assumption with lower accuracy error.

Author(s)

Jesus Prada, <jesus.prada@estudiante.uam.es>

References

Link to the scientific paper

with theoretical background for this package is provided below.
http://link.springer.com/chapter/10.1007/978-3-319-19222-2_47

See Also

df_intervals error_interval acc_intervals

Examples

best_distribution(rnorm(10),rnorm(10),dists=c("n","b"))

---

df_intervals Data Frames of Intervals

Description

df_intervals creates an object of class c("df_intervals", "data.frame").
as.df_intervals attempts to coerce its argument x into an object of class c("df_intervals", class(x)).
If this is not possible x is returned unchanged.
is.df_intervals returns TRUE if x is an R object with "df_intervals" as one of its classes. It returns FALSE otherwise.
**Usage**

```r
df_intervals(distributions, errs)
```

```r
as.df_intervals(x)
```

```r
is.df_intervals(x)
```

**Arguments**

- `distributions` vector containing the names of the distribution corresponding to each error.
- `errs` vector of errors associated to intervals built under a particular distribution assumption indicated by 'distributions'.
- `x` an R object.

**Value**

- `df_intervals` returns an object of class `c("df_intervals", "data.frame")` with information regarding the error of intervals built under different distribution assumptions.
- `as.df_intervals` returns an object of class `c("df_intervals",class(x))` with information contained in x if possible. Returns x otherwise.
- `is.df_intervals` returns TRUE if x is an R object with "df_intervals" as one of its classes. FALSE otherwise.

**Author(s)**

Jesus Prada, <jesus.prada@estudiante.uam.es>

**References**

Link to the scientific paper


with theoretical background for this package is provided below.

[http://link.springer.com/chapter/10.1007/978-3-319-19222-2_47](http://link.springer.com/chapter/10.1007/978-3-319-19222-2_47)

**Examples**

```r
df_intervals("l",0.1)
```

```r
df_intervals(c("l","lm","n","nm","b","w"),rep(0.1,6))
```

```r
df<-data.frame(distribution=rnorm(10),error=rnorm(10))
as.df_intervals(df)
```

```r
v<-c("a","b")
as.df_intervals(v)
```
df<-data.frame(distribution=rnorm(10),error=rnorm(10))
is.df_intervals(df)
res<-as.df_intervals(df)
is.df_intervals(res)

---

df_intervals.default  Data Frames of Intervals

Description

df_intervals creates an object of class c("df_intervals", "data.frame").

Usage

## default S3 method:
df_intervals(distributions, errs)

Arguments

distributions vector containing the names of the distribution corresponding to each error.
errs vector of errors associated to intervals built under a particular distribution assumption indicated by 'distributions'.

Value

Returns an object of class c("df_intervals", "data.frame") with information regarding the error of intervals built under different distribution assumptions.

Author(s)

Jesus Prada, <jesus.prada@estudiante.uam.es>

References

Link to the scientific paper

with theoretical background for this package is provided below.
http://link.springer.com/chapter/10.1007/978-3-319-19222-2_47

Examples

df_intervals("l",0.1)

df_intervals(c("l","lm","n","nm","b","w"),rep(0.1,6))
Error Intervals

Description

error_interval creates an object of class c("error_interval", "list").
as.error_interval attempts to coerce its argument x into an object of class c("error_interval", class(x)). If this is not possible x is returned unchanged.
is.error_interval returns TRUE if x is an R object with "error_interval" as one of its classes. It returns FALSE otherwise.

Usage

error_interval(phi, s = 0.05, dist = "n", tol = 10^-6, ...)
as.error_interval(x)
is.error_interval(x)

Arguments

phi a vector with residual values used to compute the error interval.
s confidence level, e.g. s=0.05 for the standard 95 percent confidence interval.
dist assumed distribution for the noise in the data.
tol used to normalize residual values to (0,1) when beta is the assumed distribution. The formula used is abs(phi)/(max(abs(phi))+tol).
... additional arguments to be passed to the low level error_interval building functions (see below).
x an R object.

Value

error_interval returns an object of class c("error_interval","list") with information regarding the error intervals built.
as.error_interval returns an object of class c("error_interval",class(x)) with information contained in x if possible. Returns x otherwise.
is.error_interval returns TRUE if x is an R object with "error_interval" as one of its classes. FALSE otherwise.

Author(s)

Jesus Prada, <jesus.prada@estudiante.uam.es>
error_interval.default

Error Intervals

Description

error_interval.default creates an object of class c("error_interval", "list").

Usage

## Default S3 method:
error_interval(phi, s = 0.05, dist = "n", tol = 10^-6, ...

Arguments

phi a vector with residual values used to compute the error interval.
s confidence level, e.g. s=0.05 for the standard 95 percent confidence interval.
dist assumed distribution for the noise in the data.

Examples

error_interval(rnorm(10))
error_interval(rnorm(10), s=0.1, dist="lm")

l<-list(min=-1, max=1, err=0.05, s=0.1, dist="n", phi=rnorm(10))
as.error_interval(l)

v<-c("a", "b")
as.error_interval(v)

l<-list(min=-1, max=1, err=0.05, s=0.1, dist="n", phi=rnorm(10))
is.error_interval(l)
res<-as.error_interval(l)
is.error_interval(res)
tol used to normalize residual values to (0,1) when beta is the assumed distribution. The formula used is abs(phi)/(max(abs(phi))+tol).

... additional arguments to be passed to the low level error_interval building functions (see below).

Value

Returns an object of class c("error_interval", "list") with information regarding the error intervals built.

Author(s)

Jesus Prada, <jesus.prada@estudiante.uam.es>

References

Link to the scientific paper
Prada, Jesus, and Jose Ramon Dorronsoro. "SVRs and Uncertainty Estimates in Wind Energy Prediction." Advances in Computational Intelligence. Springer International Publishing, 2015. 564-577, with theoretical background for this package is provided below.
http://link.springer.com/chapter/10.1007/978-3-319-19222-2_47

Examples

```r
  error_interval(rnorm(10))
  error_interval(rnorm(10), s=0.1, dist="lm")
```

Description

`int_lap` computes the error interval of a set of residuals assuming a Laplace distribution with zero location for the noise.

`int_gau` computes the error interval of a set of residuals assuming a Gaussian distribution with zero mean for the noise.

`int_lap_mu` computes the error interval of a set of residuals assuming a Laplace distribution.

`int_gau_mu` computes the error interval of a set of residuals assuming a Gaussian distribution.

`int_beta` computes the error interval of a set of residuals assuming a Beta distribution.

`int_weibull` computes the error interval of a set of residuals assuming a Weibull distribution.

See also 'Details'.

`int_moge` computes the error interval of a set of residuals assuming a MOGE distribution.
Usage

\texttt{int_lap(\phi, s)}

\texttt{int_gau(\phi, s, ps = 0, threshold = 10^{-2}, upper = 10^6)}

\texttt{int_lap_mu(\phi, s, ps = stats::median(\phi, na.rm = T), threshold = 10^{-2}, upper = 10^6)}

\texttt{int_gau_mu(\phi, s, ps = mean(\phi, na.rm = T), threshold = 10^{-2}, upper = 10^6)}

\texttt{int_beta(\phi, s, original_\phi = \phi, ps = 10^{-4}, threshold = 10^{-4}, upper = 1, m1 = mean(\phi, na.rm = T), m2 = mean(\phi^2, na.rm = T), alpha_0 = (m1 * (m1 - m2))/(m2 - m1^2), beta_0 = (alpha_0 * (1 - m1)/m1))}

\texttt{int_weibull(\phi, s, ps = 10^{-4}, threshold = 10^{-2}, upper = 10^6, k_0 = 1)}

\texttt{int_moge(\phi, s, ps = 10^{-4}, threshold = 10^{-4}, upper = 10^6, lambda_0 = 1, alpha_0 = 1, theta_0 = 1)}

Arguments

\texttt{\phi} residual values used to compute the error interval.

\texttt{s} confidence level, e.g. \texttt{s=0.05} for the standard 95 percent confidence interval.

\texttt{ps} minimum value to search for solution of the integral equation to solve. See also 'Details'.

\texttt{threshold} step size to increase \texttt{ps} after each iteration. See also 'Details'.

\texttt{upper} maximum value to search for solution of the integral equation to solve. See also 'Details'.

\texttt{original_\phi} original \{\phi_i\} values. Only used for beta distribution.

\texttt{m1} first moment of the residuals. Used to compute \texttt{alpha_0}.

\texttt{m2} second moment of the residuals. Used to compute \texttt{beta_0}.

\texttt{alpha_0} initial value for Newton-Raphson method for the parameter \alpha. See also 'Details' and \texttt{multiroot}.

\texttt{beta_0} initial value for Newton-Raphson method for the parameter \beta. See also 'Details' and \texttt{multiroot}.

\texttt{k_0} initial value for Newton-Raphson method for the parameter \kappa. See also 'Details' and \texttt{multiroot}.

\texttt{lambda_0} initial value for Newton-Raphson method for the parameter \lambda.

\texttt{theta_0} initial value for Newton-Raphson method for the parameter \theta.
Details

For the Zero-$\mu$ Laplace distribution the value of the corresponding integral equation has a closed solution of the form $ps = -\sigma \log 2s$.

For the other distributions, starting with the initial value of $ps$ passed as argument, the value, integral, of the corresponding integral expression is computed (see also 'References' for an in-depth explanation of this integral expression). If integral is smaller than $1-s$ then $ps$ is increased by a step size of threshold value and integral is recomputed. If integral is greater or equal than 0 or if $ps$ gets bigger than upper, the loop stops and the last value of $ps$ will be its final value.

In addition, for the Beta distribution values of parameters $\alpha$ and $\beta$ are estimated using Newton-Raphson method.

For the Weibull distribution value of parameter $\kappa$ is estimated using Newton-Raphson method and then estimated value of $\lambda$ is computed using a closed form that depends on $\kappa$.

For the MOGE distribution values of parameters $\lambda$, $\alpha$ and $\theta$ are estimated using Newton-Raphson method.

See also 'References'.

Value

Returns an object of class c("error_interval","list") with information of the corresponding error interval.

Author(s)

Jesus Prada, <jesus.prada@estudiante.uam.es>

References

Link to the scientific paper


with theoretical background for this package is provided below.

http://link.springer.com/chapter/10.1007/978-3-319-19222-2_47

See Also

error_interval
p_laplace
p_gaussian
p_beta
p_weibull
multiroot
p_moge
Examples

```r
int_lap(rnorm(10), 0.1)
int_gau(rnorm(10), 0.1, 0.1, 10^-3, 10^2)
int_lap_mu(rnorm(10), 0.1, 0.1, 10^-3, 10^2)
int_gau_mu(rnorm(10), 0.1, 0.1, 10^-3, 10^2)
int_beta(runif(10, 0, 0.99), 0.1, alpha_0=1, beta_0=1)
int_weibull(abs(rnorm(10)), 0.1, k_0=2)
int_moge(runif(10, 0.01, 0.99), 0.1, lambda_0=2, alpha_0=3, theta_0=4)
```

Description

`measure` creates an object of class `c("measure", "list")`. `as.measure` attempts to coerce its argument `x` into an object of class `c("measure", class(x))`. If this is not possible `x` is returned unchanged. `is.measure` returns TRUE if `x` is an R object with "measure" as one of its classes. It returns FALSE otherwise.

Usage

```r
measure(s, acc, f = function(x, y) { abs(x - y) })
```

Arguments

- `s` confidence level, e.g. `s=0.05` for the standard 95 percent confidence interval.
- `acc` accuracy achieved by error intervals.
- `f` function used to compute error of intervals. See also 'Details'.
- `x` an R object.
Value

measure returns an object of class c("measure","list") with information regarding the error of a set of intervals.

as.measure returns an object of class c("measure",class(x)) with information contained in x if possible. Returns x otherwise.

is.measure returns TRUE if x is an R object with "measure" as one of its classes. FALSE otherwise.

Author(s)

Jesus Prada, <jesus.prada@estudiante.uam.es>

References

Link to the scientific paper


with theoretical background for this package is provided below.

http://link.springer.com/chapter/10.1007/978-3-319-19222-2_47

Examples

measure(0.1,0.7)

measure(0.1,0.7,function(x,y){y-x})

l<-list(s=0.1,acc=0.78,f=function(x,y){abs(x-y)},err=0.02)
as.measure(l)

v<-c("a","b")
as.measure(v)

l<-list(s=0.1,acc=0.78,f=function(x,y){abs(x-y)},err=0.02)
is.measure(l)
res<-as.measure(l)
is.measure(res)

measure.default  Measure

Description

measure creates an object of class c("measure", "list").
Usage

## default S3 method:
measure(s, acc, f = function(x, y) { abs(x - y) })

Arguments

- `s`: confidence level, e.g. `s=0.05` for the standard 95 percent confidence interval.
- `acc`: accuracy achieved by error intervals.
- `f`: function used to compute error of intervals. See also 'Details'.

Value

Returns an object of class `c("measure","list")` with information regarding the error of a set of intervals.

Author(s)

Jesus Prada, <jesus.prada@estudiante.uam.es>

References

Link to the scientific paper
with theoretical background for this package is provided below.
http://link.springer.com/chapter/10.1007/978-3-319-19222-2_47

Examples

```r
measure(0.1,0.7)
measure(0.1,0.7,function(x,y){y-x})
```

---

print.df_intervals  Printing Data Frames of Intervals

Description

print objects of class df_interval.

Usage

```r
## S3 method for class 'df_intervals'
print(x, ...)
```
**print.error_interval**

Arguments

- `x` object of class `df_interval` to be printed.
- `...` optional arguments.

Author(s)

Jesus Prada, <jesus.prada@estudiante.uam.es>

References

Link to the scientific paper

with theoretical background for this package is provided below.
http://link.springer.com/chapter/10.1007/978-3-319-19222-2_47

See Also

- `df_intervals`

Examples

```r
res <- df_intervals(c("l","lm","n","nm","b","w"), rep(0.1, 6))
print(res)
```

---

**print.error_interval**  Printing Error Intervals

Description

print objects of class `error_interval`.

Usage

```r
## S3 method for class 'error_interval'
print(x, ...)
```

Arguments

- `x` object of class `error_interval` to be printed.
- `...` optional arguments.

Author(s)

Jesus Prada, <jesus.prada@estudiante.uam.es>
References

Link to the scientific paper

with theoretical background for this package is provided below.
http://link.springer.com/chapter/10.1007/978-3-319-19222-2_47

See Also

error_interval

Examples

res<-error_interval(rnorm(10))
print(res)

print.measure  Printing Measures

Description

print objects of class measure.

Usage

## S3 method for class 'measure'
print(x, ...)

Arguments

x  object of class measure to be printed.
...
optional arguments.

Author(s)

Jesus Prada,<jesus.prada@estudiante.uam.es>

References

Link to the scientific paper

with theoretical background for this package is provided below.
http://link.springer.com/chapter/10.1007/978-3-319-19222-2_47
See Also

measure

Examples

res<-measure(0.1,0.7)
print(res)

res<-error_interval(rnorm(10))
summary(res)
Description

print objects of class `summary.measure`.

Usage

```r
## S3 method for class 'summary.measure'
print(x, ...)
```

Arguments

- `x`   object of class `summary.measure` to be printed.
- `...` optional arguments.

Author(s)

Jesus Prada, <jesus.prada@estudiante.uam.es>

References

Link to the scientific paper


with theoretical background for this package is provided below.

[http://link.springer.com/chapter/10.1007/978-3-319-19222-2_47](http://link.springer.com/chapter/10.1007/978-3-319-19222-2_47)

See Also

- `summary.measure`

Examples

```r
res<-measure(0.1,0.7)
summary(res)
```
Description

\texttt{p_laplace} computes the probability density function of a random variable that has a Laplace distribution with parameters \( \mu \) and \( \sigma \).

\texttt{p_gaussian} computes the probability density function of a random variable that has a Gaussian distribution with parameters \( \mu \) and \( \sigma^2 \).

\texttt{p_beta} computes the probability density function of a random variable that has a Beta distribution with parameters \( \alpha \) and \( \beta \).

\texttt{p_weibull} computes the probability density function of a random variable that has a Weibull distribution with parameters \( \kappa \) and \( \lambda \).

\texttt{p_moge} computes the probability density function of a random variable that has a MOGE distribution with parameters \( \lambda, \alpha \) and \( \theta \).

Usage

\begin{align*}
\texttt{p_laplace}(x, \; \text{mu} = 0, \; \text{sigma} = 1) \\
\texttt{p_gaussian}(x, \; \text{mu} = 0, \; \text{sigma_cuad} = 1) \\
\texttt{p_beta}(x, \; \text{alpha} = 1, \; \text{beta} = 1) \\
\texttt{p_weibull}(x, \; k = 1, \; \lambdaambda = 1) \\
\texttt{p_moge}(x, \; \lambdaambda = 1, \; \text{alpha} = 1, \; \theta = 1)
\end{align*}

Arguments

- \texttt{x}: vector of points which values we want to compute.
- \texttt{mu}: location or mean parameter of the Laplace or Gaussian distribution, respectively.
- \texttt{sigma}: scale parameter of the Laplace distribution.
- \texttt{sigma_cuad}: variance parameter of the Gaussian distribution.
- \texttt{alpha}: shape1 parameter of the Beta distribution or second parameter of the MOGE distribution.
- \texttt{beta}: shape2 parameter of the Beta distribution.
- \texttt{k}: shape parameter of the Weibull distribution.
- \texttt{lambda}: scale parameter of the Weibull distribution or first parameter of the MOGE distribution.
- \texttt{theta}: third parameter of the MOGE distribution.
Value

Returns a numeric object corresponding to the value of the probability density function for the given x and distribution parameters.

Author(s)

Jesus Prada, <jesus.prada@estudiante.uam.es>

References

Link to the scientific paper


with theoretical background for this package is provided below.

http://link.springer.com/chapter/10.1007/978-3-319-19222-2_47

See Also

dlaplace
dnorm
dbeta
dweibull

Examples

p_laplace(0.3)
p_laplace(0.3,mu=0.35,sigma=0.2)

p_gaussian(0.3)
p_gaussian(0.3,mu=0.35,sigma_cuad=0.2)

p_beta(0.3)
p_beta(0.3,alpha=0.35,beta=0.2)

p_weibull(0.3)
p_weibull(0.3,k=0.35,lambda=0.2)

p_moge(0.3)
p_moge(0.3,lambda=0.2,alpha=0.3,theta=0.4)
sort_distributions

Sort Distributions by Better Error Intervals

Description

sort_distributions orders a given set of distribution assumptions in order of intervals accuracy error in ascending or descending order.

Usage

sort_distributions(phi, errors, dists = c("n", "nm", "l", "lm", "w", "b", "moge"), decreasing = FALSE, ...)

Arguments

phi residual values used to compute the error interval.
errors set of real errors corresponding to the predictions of a particular model.
dists character vector with the distribution assumptions to test. See also 'Details'.
decreasing logical, indicating whether or not distributions should be ordered by decreasing accuracy error.
... additional arguments to be passed to functions error_interval and acc_intervals.

Details

Allowed distribution assumptions are:

- "n": Zero-mu Gaussian
- "nm": General Gaussian
- "l": Zero-mu Laplace
- "lm": General Laplace
- "b": Beta
- "w": Weibull
- "moge": Moge

Value

Returns an object of class c("df_intervals", "data.frame") with information of the distribution assumptions ordered by accuracy error.

Author(s)

Jesus Prada, <jesus.prada@estudiante.uam.es>
References

Link to the scientific paper

with theoretical background for this package is provided below.
http://link.springer.com/chapter/10.1007/978-3-319-19222-2_47

See Also
df_intervals error_interval acc_intervals order

Examples

sort_distributions(rnorm(10),rnorm(10),decreasing=TRUE)

summary.error_interval

Plain text representation:

**summary.error_interval**

*Error Intervals Summaries*

**Description**

summary produces summaries for objects of class error_interval.

**Usage**

summary.error_interval(object, ...)

**Arguments**

object object of class error_interval to be printed.

... optional arguments.

**Value**

Object of class c("summary.error_interval","list") corresponding to the summary of x.

**Author(s)**

Jesus Prada, <jesus.prada@estudiante.uam.es>
References

Link to the scientific paper

with theoretical background for this package is provided below.
http://link.springer.com/chapter/10.1007/978-3-319-19222-2_47

See Also

error_interval

Examples

res<-error_interval(rnorm(10))
summary(res)

summary.measure

Measures Summaries

Description

summary produces summaries for objects of class measure.

Usage

summary.measure(object, ...)

Arguments

object object of class measure to be printed.
...
optional arguments.

Value

Object of class c("summary.measure","list") corresponding to the summary of x.

Author(s)

Jesus Prada, <jesus.prada@estudiante.uam.es>
References

Link to the scientific paper

with theoretical background for this package is provided below.
http://link.springer.com/chapter/10.1007/978-3-319-19222-2_47

See Also

measure

Examples

res<-measure(0.1,0.7)
summary(res)
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