Package 'gageRR'

October 6, 2025

Title Calculate Gauge Repeatability and Reproducibility

Version 0.1.0

Description Procedures for calculating variance components, study variation, percent study variation, and percent tolerance for gauge repeatability and reproducibility study. Methods included are ANOVA and Average / Range methods. Requires balanced study.

License GPL (>= 3)

Encoding UTF-8

RoxygenNote 7.3.3

Imports dplyr

Suggests knitr, rmarkdown, testthat (>= 3.0.0), readxl, shiny

VignetteBuilder knitr

Config/testthat/edition 3

Depends R (>= 3.5)

LazyData true

NeedsCompilation no

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Repository CRAN

Date/Publication 2025-10-06 06:00:08 UTC

Contents

`anova_table` *ANOVA Table Calculation*

Description

ANOVA Table Calculation

Usage

```
anova_table(data, part, operator, meas)
```

Arguments

`data`	An R dataframe or tibble.
`part`	A column in data specifying the unique ID of the part being measured
`operator`	A column in data specifying the operator for the recorded measurement
`meas`	A column in data where the measurement value is recorded.

Value

An anova table of meas ~ operator x part

Examples

```
data = data.frame(
SN = c(
'SerialNumber_01',
'SerialNumber_01',
'SerialNumber_02',
'SerialNumber_02',
'SerialNumber_01',
'SerialNumber_01',
'SerialNumber_02',
'SerialNumber_02'),

Operator = c(
'Operator_01',
'Operator_01',
'Operator_01',
'Operator_01',
'Operator_02',
'Operator_02',
'Operator_02',
'Operator_02'),

Measure = c(
0.0172,
```

```
0.0177,
0.0155,
0.0159,
0.0174,
0.0181,
0.0152,
0.0176))

anova_table(data, part = 'SN', operator = 'Operator', meas = 'Measure')
```

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anova_var_calcs *ANOVA Variance Component Calculations*

Description

ANOVA Variance Component Calculations

Usage

```
anova_var_calcs(data, part, operator, meas)
```

Arguments

data	An R dataframe or tibble.
part	A column in data specifying the unique ID of the part being measured
operator	A column in data specifying the operator for the recorded measurement
meas	A column in data where the measurement value is recorded.

Value

A list of numeric values for repeatability, reproducibility, total GRR, part-to-part, and total variance components.

Examples

```
data = data.frame(
SN = c(
'SerialNumber_01',
'SerialNumber_01',
'SerialNumber_02',
'SerialNumber_02',
'SerialNumber_01',
'SerialNumber_01',
'SerialNumber_02',
'SerialNumber_02'),

Operator = c(
'Operator_01',
```

```
'Operator_01',
'Operator_01',
'Operator_01',
'Operator_02',
'Operator_02',
'Operator_02',
'Operator_02'),

Measure = c(
0.0172,
0.0177,
0.0155,
0.0159,
0.0174,
0.0181,
0.0152,
0.0176))

anova_var_calcs(data, part = 'SN', operator = 'Operator', meas = 'Measure')
```

`d2_integral` *d2 and c4 Constants for Gage R&R*

Description

Functions to calculate the d_2 constant (expected range of a normal subgroup), the chi-square bias correction factor c_4, and a Minitab-style adjusted d_2 that incorporates the number of subgroups.

Usage

```
d2_integral(m, rel.tol = .Machine$double.eps^0.5)

c4(n)

d2_minitab_df(m, g)
```

Arguments

`m`	Integer. Subgroup size (must be ≥ 2).
`rel.tol`	Relative tolerance for integration (passed to `integrate()`).
`n`	Integer. Degrees of freedom argument for `c4`.
`g`	Integer. Number of subgroups (must be ≥ 1).

Details

- `d2_integral(m)` computes the exact $d_2(m)$ by numerical integration.
- `c4(n)` computes the chi-square bias correction factor $c_4(n)$.
- `d2_minitab_df(m, g)` computes a finite-sample adjusted constant $d_2^{adj}(m, g) = d_2(m)/c_4(df)$, with $df = g \times (m - 1)$ degrees of freedom, consistent with Minitab/AIAG tables.

Value

- `d2_integral()` returns a numeric scalar (expected range for subgroup size `m`).
- `c4()` returns a numeric scalar (bias correction factor).
- `d2_minitab_df()` returns a numeric scalar (adjusted constant).

See Also

`integrate`, `gamma`

Examples

```
# Exact d2 for subgroup size 5
d2_integral(5)

# Chi-square bias correction for df = 8
c4(8)

# Minitab-style adjusted constant for m = 5, g = 2
d2_minitab_df(5, 2)
```

`data` *Measurement System Analysis Data*

Description

A collection of sample data to analyze for reproducibility and repeatability measurement error.

Usage

```
data
```

Format

`data`**:**

A data frame with 27 rows and 3 columns:

SN Serial Number

Operator Operator or Measurement Technician

Measure Measured Value ...

grr_calc *Gage R&R Evaluation*

Description

Gage R&R Evaluation

Usage

```
grr_calc(data, part, operator, meas, LSL = NULL, USL = NULL, method = "anova")
```

Arguments

data	An R dataframe or tibble containing the required identifier and measurement columns.
part	A string giving the column name specifying the unique ID of the part being measured. The column should be a character or factor.
operator	A string giving the column name specifying the operator for the recorded measurement. The column should be a character or factor.
meas	A string giving the column name where the measurement value is recorded. The column must be numeric and contain no missing or infinite values.
LSL	A number specifying the lower specification limit.
USL	A number specifying the upper specification limit.
method	A string specifying "anova" or "xbar_r".

Value

A list containing:

- VarianceComponents: Data frame of variance components and percent contribution
- GageEval: Data frame of study variation metrics
- AnovaTable: ANOVA table (if method = "anova")

Examples

```
data <- data.frame(
  SN = rep(c("SerialNumber_01","SerialNumber_02"), each = 4),
  Operator = rep(c("Operator_01","Operator_02"), each = 2, times = 2),
  Measure = c(0.0172,0.0177,0.0155,0.0159,0.0174,0.0181,0.0152,0.0176)
)

grr_calc(data, part = "SN", operator = "Operator",
         meas = "Measure", LSL = 0, USL = 0.040, method = "xbar_r")
```

part_to_part *Average and Range Method Part-to-Part Variance Calculation*

Description

Average and Range Method Part-to-Part Variance Calculation

Usage

```
part_to_part(data, part, meas)
```

Arguments

data	An R dataframe or tibble containing the required identifier and measurement columns.
part	Column name (unquoted) specifying the unique ID of the part being measured. The column should be a character or factor vector.
meas	Column name (unquoted) where the measurement value is recorded. The column must be numeric and contain no missing or infinite values.

Value

A number. The measure of part-to-part variation for the given data.

Examples

```
data <- data.frame(
  SN = rep(c("SerialNumber_01","SerialNumber_02"), each = 4),
  Operator = rep(c("Operator_01","Operator_02"), each = 2, times = 2),
  Measure = c(0.0172,0.0177,0.0155,0.0159,0.0174,0.0181,0.0152,0.0176)
)
part_to_part(data, part = 'SN', meas = 'Measure')
```

ss_calcs *ANOVA Sum of Squares Calculations*

Description

ANOVA Sum of Squares Calculations

Usage

```
ss_calcs(data, part, operator, meas)
```

Arguments

data	An R dataframe or tibble containing the required identifier and measurement columns.
part	A column in data specifying the unique ID of the part being measured. The column should be a character or factor vector.
operator	A column in data specifying the operator for the recorded measurement. The column should be a character or factor vector.
meas	A column in data where the measurement value is recorded. The column must be numeric and contain no missing or infinite values.

Value

A list of numeric values for the sum of squares error for operator, part, equipment, operator and part interaction, and total error.

Examples

```
data = data.frame(
SN = c(
'SerialNumber_01',
'SerialNumber_01',
'SerialNumber_02',
'SerialNumber_02',
'SerialNumber_01',
'SerialNumber_01',
'SerialNumber_02',
'SerialNumber_02'),

Operator = c(
'Operator_01',
'Operator_01',
'Operator_01',
'Operator_01',
'Operator_02',
'Operator_02',
'Operator_02',
'Operator_02'),

Measure = c(
0.0172,
0.0177,
0.0155,
0.0159,
0.0174,
0.0181,
0.0152,
0.0176))

ss_calcs(data, part = 'SN', operator = 'Operator', meas = 'Measure')
```

xbar_repeat *Average and Range Method Repeatability Calculation*

Description

Average and Range Method Repeatability Calculation

Usage

```
xbar_repeat(data, part, operator, meas)
```

Arguments

data	An R dataframe or tibble containing the required identifier and measurement columns.
part	Column name (unquoted) specifying the unique ID of the part being measured. The column should be a character or factor vector.
operator	Column name (unquoted) specifying the operator for the recorded measurement. The column should be a character or factor vector.
meas	Column name (unquoted) where the measurement value is recorded. The column must be numeric and contain no missing or infinite values.

Value

A number. The measure of repeatability for the given data.

Examples

```
data <- data.frame(
  SN = rep(c("SerialNumber_01","SerialNumber_02"), each = 4),
  Operator = rep(c("Operator_01","Operator_02"), each = 2, times = 2),
  Measure = c(0.0172,0.0177,0.0155,0.0159,0.0174,0.0181,0.0152,0.0176)
)
xbar_repeat(data, part = 'SN', operator = 'Operator', meas = 'Measure')
```

xbar_reproduce *Average and Range Method Reproducibility Calculation*

Description

Average and Range Method Reproducibility Calculation

Usage

```
xbar_reproduce(data, part, operator, meas)
```

Arguments

data	An R dataframe or tibble containing the required identifier and measurement columns.
part	Column name (unquoted) specifying the unique ID of the part being measured. The column should be a character or factor vector.
operator	Column name (unquoted) specifying the operator for the recorded measurement. The column should be a character or factor vector.
meas	Column name (unquoted) where the measurement value is recorded. The column must be numeric and contain no missing or infinite values.

Value

A number. The measure of reproducibility for the given data.

Examples

```
data <- data.frame(
  SN = rep(c("SerialNumber_01","SerialNumber_02"), each = 4),
  Operator = rep(c("Operator_01","Operator_02"), each = 2, times = 2),
  Measure = c(0.0172,0.0177,0.0155,0.0159,0.0174,0.0181,0.0152,0.0176)
)
xbar_reproduce(data, part = 'SN', operator = 'Operator', meas = 'Measure')
```

---

xbar_varcomps *Average and Range Method Variance Component Summary*

Description

Average and Range Method Variance Component Summary

Usage

```
xbar_varcomps(data, part, operator, meas)
```

Arguments

data	An R dataframe or tibble.
part	Column name (unquoted) specifying the unique ID of the part being measured.
operator	Column name (unquoted) specifying the operator for the recorded measurement.
meas	Column name (unquoted) where the measurement value is recorded.

Value

A list of numeric values for repeatability, reproducibility, total GRR, part-to-part, and total variance components.

Examples

```
data <- data.frame(
  SN = rep(c("SerialNumber_01","SerialNumber_02"), each = 4),
  Operator = rep(c("Operator_01","Operator_02"), each = 2, times = 2),
  Measure = c(0.0172,0.0177,0.0155,0.0159,0.0174,0.0181,0.0152,0.0176)
)
xbar_varcomps(data, part = 'SN', operator = 'Operator', meas = 'Measure')
```

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