Package 'rGrSPTT'

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Type Package

Title Group Sampling Inspection Plan for Time Truncated Life Test

Version 0.1.0

Description Designing group acceptance sampling
inspection plans under time-truncated life tests. The package
calculates the required minimum number of groups subject to a consumer's
risk constraint on the probability of acceptance. Users can supply
failure probabilities obtained from any lifetime distribution,
allowing the methodology to be applied without restricting the
analysis to a particular probability model. The package also
provides a function for plotting the required minimum number of groups against
the termination ratio.
Saha et al. (2025) <doi:10.1007/s41872-025-00305-w>;
Tripathi et al. (2020) <doi:10.1080/02664763.2020.1759031>;
Tripathi and Aslam (2024) <doi:10.1285/i20705948v17n3p636>.

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Suggests testthat (>= 3.0.0)

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`group_asip` *Group Acceptance Sampling Inspection Plan*

Description

Calculates the minimum required number of groups for a group acceptance sampling inspection plan under a time-truncated life test.

Usage

```
group_asip(p, a, b, r, be = 0.25, c = 0)
```

Arguments

`p`	User-defined probability of failure before the termination time. It must lie between 0 and 1.
`a`	Termination ratio, defined as a = t/theta0. It must be a positive numeric value.
`b`	Quality ratio, defined as b = theta/theta0. It must be a positive numeric value.
`r`	Number of items inspected in each group. It must be a positive integer.
`be`	Producer's risk. It must be a value between 0 and 1.
`c`	Acceptance number, representing the maximum number of failures allowed in each group. It must be a non-negative integer.

Details

The probability of failure before the termination time is supplied by the user through the argument 'p'. Therefore, the function is distribution-free and can be used with different lifetime distributions.

Each group consists of 'r' items. A group is accepted if it contains at most 'c' failures before the termination time.

If the probability of failure for an individual item is 'p', the probability that a group contains at most 'c' failures is

$$P_g = \sum_{i=0}^{c} \binom{r}{i} p^i (1-p)^{r-i}$$

which is equivalent to

$$P_g = P(X \leq c)$$

where X follows a Binomial distribution with parameters 'r' and 'p'.

If 'g' groups are inspected, the probability of acceptance is

$$P_a = (P_g)^g$$

The function determines the minimum number of groups ‘g‘ satisfying the producer’s risk condition

$$P_a \leq be$$

The total number of inspected items is

$$n = gr.$$

The lifetime distribution is not embedded in the function. The user calculates the probability ‘p‘ from the required lifetime distribution and supplies it to the function.

Value

A data frame containing ‘a‘, ‘b‘, ‘p‘, ‘r‘, ‘be‘, ‘c‘, the probability of accepting a group ‘pg‘, the required number of groups ‘g‘, the total sample size ‘n‘, and the probability of acceptance ‘Pa‘.

Examples

```
# ------------------------------------------------------------
# Example 1: User-defined failure probabilities
# ------------------------------------------------------------

p <- c(0.05, 0.10, 0.15, 0.20)

group_asip(
  p = p,
  a = c(0.5, 1, 1.5, 2),
  b = 1,
  r = 5,
  be = 0.25,
  c = 0
)


# ------------------------------------------------------------
# Example 2: Weibull distribution
# ------------------------------------------------------------

# For a Weibull distribution,
#
# F(t) = 1 - exp[-(t/theta)^beta]
#
# Using a = t/theta0 and b = theta/theta0,
#
# p = 1 - exp[-(a/b)^beta].

beta <- 2
b <- 1

a <- c(
  0.5, 0.75, 1, 1.25,
  1.5, 1.75, 2
```

```
)

p <- 1 - exp(
  -((a / b)^beta)
)

group_asip(
  p = p,
  a = a,
  b = b,
  r = 5,
  be = 0.25,
  c = 0
)
```

`group_oc` *Operating Characteristic Values for a Group Acceptance Sampling Plan*

Description

Calculates the probability of acceptance for different quality ratios using the number of groups obtained from a group acceptance sampling plan designed at b = 1.

Usage

```
group_oc(p_design, a, p_oc, b_oc, r, be = 0.25, c = 0)
```

Arguments

`p_design`	Probability of failure used to determine the sampling plan at b = 1.
`a`	Termination ratio corresponding to each value of 'p_design'.
`p_oc`	Matrix of failure probabilities for different quality ratios. Each row corresponds to a value of 'a', and each column corresponds to a value of 'b_oc'.
`b_oc`	Numeric vector of quality ratios corresponding to the columns of 'p_oc'.
`r`	Number of items inspected in each group.
`be`	Producer's risk.
`c`	Acceptance number.

Value

A data frame containing the termination ratio, quality ratio, failure probability, required number of groups, total sample size, and probability of acceptance.

Examples

```
beta <- 2

a <- c(0.5, 1, 1.5, 2)

# Failure probabilities at b = 1
p_design <- 1 - exp(-(a / 1)^beta)

# Quality ratios for OC calculation
b_oc <- 2:12

# Failure probabilities for each a and b
p_oc <- sapply(
  b_oc,
  function(b)
    1 - exp(-((a / b)^beta))
)

# The output contains:
# pg = probability of accepting a single group
# Pa = probability of accepting the complete sampling plan.
# The Pa values represent the OC values for the specified
# quality ratios (b = 2, 3, ..., 12).
group_oc(
  p_design = p_design,
  a = a,
  p_oc = p_oc,
  b_oc = b_oc,
  r = 5,
  be = 0.25,
  c = 0
)
```

`plot_group_asip` *Plot Total Sample Size Against Termination Ratio*

Description

Calculates the minimum required number of groups and total sample size for different termination ratios, and aslo plots the required minimum number of groups against the termination ratio.

Usage

```
plot_group_asip(p, a, b = 1, r, be = 0.25, c = 0, ylim = NULL)
```

Arguments

p	User-defined probability of failure corresponding to each termination ratio.

a	Numeric vector of termination ratios.
b	Quality ratio. It may be a single value or a vector having the same length as ‘a‘.
r	Number of items inspected in each group.
be	Producer’s risk.
c	Acceptance number.
ylim	Numeric vector of length two specifying the limits of the y-axis. Default is ‘NULL‘.

Details

The user supplies the corresponding values of ‘p‘ calculated from any lifetime distribution.

Value

A data frame containing ‘a‘, ‘b‘, ‘p‘, ‘r‘, ‘g‘ and the total sample size ‘n‘.

Examples

```
#-----------------------------------------------------------
# Example 1: User-defined failure probabilities
#-----------------------------------------------------------

p <- c(0.05, 0.10, 0.15, 0.20)

plot_group_asip(
  p = p,
  a = c(0.5, 1, 1.5, 2),
  b = 1,
  r = 5,
  be = 0.25,
  c = 0,
  ylim=c(0,1000)
)


# Weibull example

beta <- 2
b <- 1

a <- c(
  0.5, 0.75, 1, 1.25,
  1.5, 1.75, 2
)

p <- 1 - exp(
  -((a / b)^beta)
)

plot_group_asip(
```

```
    p = p,
    a = a,
    b = b,
    r = 5,
    be = 0.25,
    c = 0,
    ylim=c(0,1000)
  )
```

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