

Package ‘afttest’

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Type Package

Title Model Diagnostics for Accelerated Failure Time Models

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Description A collection of model checking methods for semiparametric accelerated failure time (AFT) models under the rank-based approach. For the (computational) efficiency, Gehan's weight is used. It provides functions to verify whether the observed data fit the specific model assumptions such as a functional form of each covariate, a link function, and an omnibus test. The p-value offered in this package is based on the Kolmogorov-type supremum test and the variance of the proposed test statistics is estimated through the re-sampling method. Furthermore, a graphical technique to compare the shape of the observed residual to a number of the approximated realizations is provided. See the following references; A general model-checking procedure for semiparametric accelerated failure time models, *Statistics and Computing*, 34 (3), 117 <doi:10.1007/s11222-024-10431-7>; Diagnostics for semiparametric accelerated failure time models with R package 'afttest', arXiv, <doi:10.48550/arXiv.2511.09823>.

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Imports survival, aftgee, ggplot2, gridExtra

LinkingTo Rcpp, RcppArmadillo

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License GPL (>= 3)

URL <https://github.com/WooJungBae/afttest>

BugReports <https://github.com/WooJungBae/afttest/issues>

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afttest	<i>Model Diagnostics for Semiparametric AFT Models</i>
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Description

Performs model-checking procedures for a semiparametric AFT model. This is a generic function with methods for formulas and fitted objects from the **aftgee** package.

Usage

```
afttest(object, ...)
```

Arguments

object	A formula or a fitted model object (e.g., from <code>aftsrr</code> or <code>aftgee</code>).
...	Other arguments passed to methods. See the documentation for <code>afttest.formula</code> and <code>afttest.aftsrr</code> for details.

Value

An object of class `afttest` or `hctest`. An object is a list containing at least the following components:

beta a vector of beta estimates based on `estMethod`

hypothesis null hypothesis for each `testType`

SE_process estimated standard error of the observed process

obs_process observed process
apprx_process approximated process
obs_std_process standardized observed process
apprx_std_process standardized approximated processes
p_value obtained by the unstandardized test
p_std_value obtained by the standardized test
DF a data frame of observed failure time, right censoring indicator, covariates (scaled), time-transformed residual based on beta estimates
npath the number of sample paths
testType testType
eqType eqType
estMethod estMethod
npathsave npathsave

For an omnibus test, the observed process and the realizations are composed of the n by n matrix where rows represent the t and columns represent the x in the time-transformed residual order. The observed process and the simulated processes for checking a functional form and a link function are given by the n by 1 vector which is a function of x in the time-transformed residual order.

Examples

```
library(survival)
library(aftgee)
library(aftttest)

datgen <- function(n = 100) {
  z1 <- rbinom(n, 1, 0.5)
  z2 <- rnorm(n)
  e <- rnorm(n)
  tt <- exp(2 + z1 + z2 + 0.5 * z2^2 + e)
  cen <- runif(n, 0, 100)
  data.frame(Time = pmin(tt, cen), status = 1 * (tt < cen),
             z1 = z1, z2 = z2, id = 1:n)
}
set.seed(1)
simdata <- datgen(300)

# -----
# Method 1: Formula (Runs quickly for CRAN tests)
# -----
result_form <- aftttest(Surv(Time, status) ~ z1 + z2, data = simdata,
                      npath = 50, testType = "covForm", estMethod = "rr",
                      eqType = "ns", covTested = "z2", npathsave = 50,
                      linApprox = TRUE, seed = 1)

print(result_form)
plot(result_form, std = TRUE)
```

```

# -----
# Method 2: Fitted aftsrr object (Induced Smoothing)
# -----
fit_srr <- aftsrr(Surv(Time, status) ~ z1 + z2, data = simdata,
                 eqType = "is", rankWeights = "gehan")
result_srr <- aftttest(fit_srr, data = simdata, npath = 100, testType = "covForm",
                     covTested = "z2", npathsave = 50,
                     linApprox = TRUE, seed = 1)
summary(result_srr)
plot(result_srr, std = FALSE)

# -----
# Method 3: Fitted aftgee object (Least Squares)
# -----
fit_gee <- aftgee(Surv(Time, status) ~ z1 + z2, data = simdata)
result_gee <- aftttest(fit_gee, data = simdata, npath = 100, testType = "covForm",
                     covTested = "z2", npathsave = 50,
                     linApprox = TRUE, seed = 1)
print(result_gee)

# -----
# Method 4: Standard Resampling (linApprox = FALSE)
# -----
result_resamp <- aftttest(Surv(Time, status) ~ z1 + z2, data = simdata,
                        npath = 100, testType = "covForm", estMethod = "rr",
                        eqType = "ns", covTested = "z2", npathsave = 50,
                        linApprox = FALSE, seed = 1)
summary(result_resamp)

```

afttest.aftgee	<i>Model Diagnostics for Generalized Estimating Equation (aftgee) Objects</i>
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Description

Model Diagnostics for Generalized Estimating Equation (aftgee) Objects

Usage

```

## S3 method for class 'aftgee'
aftttest(
  object,
  data,
  npath = 200,
  testType = "omnibus",
  eqType = "ls",
  covTested = 1,
  npathsave = 50,

```

```

    linApprox = TRUE,
    seed = NULL,
    ...
)

```

Arguments

object	A fitted model object of class <code>aftgee</code> from the aftgee package.
data	An optional data frame in which to interpret the variables occurring in the formula.
npath	An integer value specifying the number of approximated processes. The default is given by 200.
testType	A character string specifying the type of the test. The following are permitted: omnibus an omnibus test link a link function test covForm a functional form of a covariate
eqType	A character string specifying the type of the estimating equation used to obtain the regression parameters. The readers are referred to the aftgee package for details. The following are permitted: ns Regression parameters are estimated by directly solving the nonsmooth estimating equations. is Regression parameters are estimated by directly solving the induced-smoothing estimating equations.
covTested	A character string specifying the covariate which will be tested. The argument <code>covTested</code> is necessary only if <code>testType</code> is <code>covForm</code> . The default option for <code>covTested</code> is given by "1", which represents the first covariate in the formula argument.
npathsave	An integer value specifying the number of paths saved among all the paths. The default is given by 50. Note that it requires a lot of memory if saving all sampled paths (N by N matrix for each <code>npath</code> , and so <code>npath*N*N</code> elements).
linApprox	A logical value. If TRUE, the multiplier bootstrap is computed using the asymptotic linear approximation, which is significantly faster. If FALSE, the estimating equations are solved numerically for each bootstrap replication. Defaults to TRUE.
seed	An optional integer specifying the random seed for reproducibility.
...	Other arguments passed to methods.

afttest.aftsrr

Model Diagnostics for Smooth Rank Regression (aftsrr) Objects

Description

Model Diagnostics for Smooth Rank Regression (aftsrr) Objects

Usage

```
## S3 method for class 'aftsrr'
afttest(
  object,
  data,
  npath = 200,
  testType = "omnibus",
  eqType = "ns",
  covTested = 1,
  npathsave = 50,
  linApprox = TRUE,
  seed = NULL,
  ...
)
```

Arguments

object	A fitted model object of class <code>aftsrr</code> from the aftgee package.
data	An optional data frame in which to interpret the variables occurring in the formula.
npath	An integer value specifying the number of approximated processes. The default is given by 200.
testType	A character string specifying the type of the test. The following are permitted: omnibus an omnibus test link a link function test covForm a functional form of a covariate
eqType	A character string specifying the type of the estimating equation used to obtain the regression parameters. The readers are referred to the aftgee package for details. The following are permitted: ns Regression parameters are estimated by directly solving the nonsmooth estimating equations. is Regression parameters are estimated by directly solving the induced-smoothing estimating equations.
covTested	A character string specifying the covariate which will be tested. The argument <code>covTested</code> is necessary only if <code>testType</code> is <code>covForm</code> . The default option for <code>covTested</code> is given by "1", which represents the first covariate in the formula argument.
npathsave	An integer value specifying the number of paths saved among all the paths. The default is given by 50. Note that it requires a lot of memory if saving all sampled paths (N by N matrix for each <code>npath</code> , and so <code>npath*N*N</code> elements).
linApprox	A logical value. If <code>TRUE</code> , the multiplier bootstrap is computed using the asymptotic linear approximation, which is significantly faster. If <code>FALSE</code> , the estimating equations are solved numerically for each bootstrap replication. Defaults to <code>TRUE</code> .
seed	An optional integer specifying the random seed for reproducibility.

... Other arguments passed to methods.

afttest.formula *Model Diagnostics for AFT Models using Formulas*

Description

Model Diagnostics for AFT Models using Formulas

Usage

```
## S3 method for class 'formula'
afttest(
  object,
  data,
  npath = 200,
  testType = "omnibus",
  estMethod = "rr",
  eqType = "ns",
  covTested = 1,
  npathsave = 50,
  linApprox = TRUE,
  seed = NULL,
  ...
)
```

Arguments

object	A formula expression, of the form response ~ predictors. The response is a Surv object with right censoring. See the documentation of lm, coxph and formula for details.
data	An optional data frame in which to interpret the variables occurring in the formula.
npath	An integer value specifying the number of approximated processes. The default is given by 200.
testType	A character string specifying the type of the test. The following are permitted: omnibus an omnibus test link a link function test covForm a functional form of a covariate
estMethod	A character string specifying the type of the estimator used. The readers are referred to the aftgee package for details. The following are permitted: ls Least-Squares Approach for Accelerated Failure Time with Generalized Estimating Equation rr Accelerated Failure Time with Smooth Rank Regression

eqType	A character string specifying the type of the estimating equation used to obtain the regression parameters. The readers are referred to the aftgee package for details. The following are permitted: ns Regression parameters are estimated by directly solving the nonsmooth estimating equations. is Regression parameters are estimated by directly solving the induced-smoothing estimating equations.
covTested	A character string specifying the covariate which will be tested. The argument covTested is necessary only if testType is covForm. The default option for covTested is given by "1", which represents the first covariate in the formula argument.
npathsave	An integer value specifying the number of paths saved among all the paths. The default is given by 50. Note that it requires a lot of memory if saving all sampled paths (N by N matrix for each npath, and so npath*N*N elements).
linApprox	A logical value. If TRUE, the multiplier bootstrap is computed using the asymptotic linear approximation, which is significantly faster. If FALSE, the estimating equations are solved numerically for each bootstrap replication. Defaults to TRUE.
seed	An optional integer specifying the random seed for reproducibility.
...	Other arguments passed to methods.

 plot.afttest

Plotting Method for Semiparametric AFT Model Diagnostics

Description

Plotting Method for Semiparametric AFT Model Diagnostics

Usage

```
## S3 method for class 'afttest'
plot(x, npath = 50, std = TRUE, quantile = NULL, ...)
```

Arguments

x	An object of class afttest.
npath	A numeric value specifying the number of approximated processes to plot. The default is set to 50.
std	A logical value specifying if the graph is based on the standardized test statistics (TRUE) or unstandardized (FALSE). The default is TRUE.
quantile	A numeric vector specifying 5 quantiles within the range [0,1]. The default is set to c(0.1, 0.25, 0.5, 0.75, 0.9).
...	Other arguments passed to methods for future extension.

Value

plot.afttest returns a plot based on the testType:

omnibus an x of the omnibus test is the form of n by n matrix, some quantiles of x , which are used in weight, are plotted for graphs, i.e. 10%, 25%, 50%, 75%, and 90% are used by default.

link an x of the link function test is the form of n by 1 matrix

covForm an x of the functional form test is the form of n by 1 matrix

See the documentation of **ggplot2** and **gridExtra** for details.

Examples

```
library(survival)
library(aftgee)
library(afttest)

datgen <- function(n = 100) {
  z1 <- rbinom(n, 1, 0.5)
  z2 <- rnorm(n)
  e <- rnorm(n)
  tt <- exp(2 + z1 + z2 + 0.5 * z2^2 + e)
  cen <- runif(n, 0, 100)
  data.frame(Time = pmin(tt, cen), status = 1 * (tt < cen),
             z1 = z1, z2 = z2, id = 1:n)
}
set.seed(1)
simdata <- datgen(300)

# -----
# Method 1: Formula (Runs quickly for CRAN tests)
# -----
result_form <- afttest(Surv(Time, status) ~ z1 + z2, data = simdata,
                      npath = 50, testType = "covForm", estMethod = "rr",
                      eqType = "ns", covTested = "z2", npathsave = 50,
                      linApprox = TRUE, seed = 1)

print(result_form)
plot(result_form, std = TRUE)

# -----
# Method 2: Fitted aftsrr object (Induced Smoothing)
# -----
fit_srr <- aftsrr(Surv(Time, status) ~ z1 + z2, data = simdata,
                 eqType = "is", rankWeights = "gehan")
result_srr <- afttest(fit_srr, data = simdata, npath = 100, testType = "covForm",
                     covTested = "z2", npathsave = 50,
                     linApprox = TRUE, seed = 1)

summary(result_srr)
plot(result_srr, std = FALSE)

# -----
# Method 3: Fitted aftgee object (Least Squares)
```

```

# -----
fit_gee <- aftgee(Surv(Time, status) ~ z1 + z2, data = simdata)
result_gee <- aftttest(fit_gee, data = simdata, npath = 100, testType = "covForm",
                      covTested = "z2", npathsave = 50,
                      linApprox = TRUE, seed = 1)
print(result_gee)

# -----
# Method 4: Standard Resampling (linApprox = FALSE)
# -----
result_resamp <- aftttest(Surv(Time, status) ~ z1 + z2, data = simdata,
                          npath = 100, testType = "covForm", estMethod = "rr",
                          eqType = "ns", covTested = "z2", npathsave = 50,
                          linApprox = FALSE, seed = 1)
summary(result_resamp)

```

print.afttest

Print Method for Semiparametric AFT Model Diagnostics

Description

Print Method for Semiparametric AFT Model Diagnostics

Usage

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

Arguments

x An object of class aftttest.
... Other arguments passed to methods.

Value

print.afttest returns a summary of an aftttest fit.

Examples

```

library(survival)
library(aftgee)
library(aftttest)

datgen <- function(n = 100) {
  z1 <- rbinom(n, 1, 0.5)
  z2 <- rnorm(n)
  e <- rnorm(n)
  tt <- exp(2 + z1 + z2 + 0.5 * z2^2 + e)

```

```

cen <- runif(n, 0, 100)
data.frame(Time = pmin(tt, cen), status = 1 * (tt < cen),
            z1 = z1, z2 = z2, id = 1:n)
}
set.seed(1)
simdata <- datgen(300)

# -----
# Method 1: Formula (Runs quickly for CRAN tests)
# -----
result_form <- aftttest(Surv(Time, status) ~ z1 + z2, data = simdata,
                       npath = 50, testType = "covForm", estMethod = "rr",
                       eqType = "ns", covTested = "z2", npathsave = 50,
                       linApprox = TRUE, seed = 1)
print(result_form)
plot(result_form, std = TRUE)

# -----
# Method 2: Fitted aftsrr object (Induced Smoothing)
# -----
fit_srr <- aftsrr(Surv(Time, status) ~ z1 + z2, data = simdata,
                 eqType = "is", rankWeights = "gehan")
result_srr <- aftttest(fit_srr, data = simdata, npath = 100, testType = "covForm",
                      covTested = "z2", npathsave = 50,
                      linApprox = TRUE, seed = 1)
summary(result_srr)
plot(result_srr, std = FALSE)

# -----
# Method 3: Fitted aftgee object (Least Squares)
# -----
fit_gee <- aftgee(Surv(Time, status) ~ z1 + z2, data = simdata)
result_gee <- aftttest(fit_gee, data = simdata, npath = 100, testType = "covForm",
                      covTested = "z2", npathsave = 50,
                      linApprox = TRUE, seed = 1)
print(result_gee)

# -----
# Method 4: Standard Resampling (linApprox = FALSE)
# -----
result_resamp <- aftttest(Surv(Time, status) ~ z1 + z2, data = simdata,
                         npath = 100, testType = "covForm", estMethod = "rr",
                         eqType = "ns", covTested = "z2", npathsave = 50,
                         linApprox = FALSE, seed = 1)
summary(result_resamp)

```



```
result_srr <- aftttest(fit_srr, data = simdata, npath = 100, testType = "covForm",
                     covTested = "z2", npathsave = 50,
                     linApprox = TRUE, seed = 1)
summary(result_srr)
plot(result_srr, std = FALSE)

# -----
# Method 3: Fitted aftgee object (Least Squares)
# -----
fit_gee <- aftgee(Surv(Time, status) ~ z1 + z2, data = simdata)
result_gee <- aftttest(fit_gee, data = simdata, npath = 100, testType = "covForm",
                     covTested = "z2", npathsave = 50,
                     linApprox = TRUE, seed = 1)
print(result_gee)

# -----
# Method 4: Standard Resampling (linApprox = FALSE)
# -----
result_resamp <- aftttest(Surv(Time, status) ~ z1 + z2, data = simdata,
                        npath = 100, testType = "covForm", estMethod = "rr",
                        eqType = "ns", covTested = "z2", npathsave = 50,
                        linApprox = FALSE, seed = 1)
summary(result_resamp)
```

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