Package 'tidycmprsk'

August 17, 2024

Title Competing Risks Estimation

Version 1.1.0

Description Provides an intuitive interface for working with the
competing risk endpoints. The package wraps the 'cmprsk' package, and
exports functions for univariate cumulative incidence estimates and
competing risk regression. Methods follow those introduced in Fine and
Gray (1999) <doi:10.1002/sim.7501>.

License AGPL (>= 3)

URL https://mskcc-epi-bio.github.io/tidycmprsk/,
https://github.com/MSKCC-Epi-Bio/tidycmprsk

BugReports https://github.com/MSKCC-Epi-Bio/tidycmprsk/issues

Depends R (>= 4.2)

Imports broom (>= 1.0.1), cli (>= 3.1.0), cmprsk (>= 2.2.10), dplyr
(>= 1.0.7), ggplot2 (>= 3.3.5), gtsummary (>= 2.0.0), hardhat
(>= 1.3.0), purrr (>= 0.3.4), rlang (>= 1.0.0), stringr (>=
1.4.0), survival, tibble (>= 3.1.6), tidyr (>= 1.1.4)

Suggests aod, broom.helpers (>= 1.15.0), cardx (>= 0.2.0), covr (>=
3.5.1), ggsurvfit, knitr (>= 1.36), spelling, testthat (>=
3.2.0)

Config/testthat/edition 3

Encoding UTF-8

Language en-US

LazyData true

RoxygenNote 7.3.2

NeedsCompilation no

Author Daniel D. Sjoberg [aut, cre, cph]
(<https://orcid.org/0000-0003-0862-2018>),
Teng Fei [aut] (<https://orcid.org/0000-0001-7888-1715>)

Maintainer Daniel D. Sjoberg <danield.sjoberg@gmail.com>

Repository CRAN

Date/Publication 2024-08-17 04:10:02 UTC

Contents

---

add_cuminc   *Additional Functions for* tbl_cuminc()

Description

- add_p() Add column with p-value comparing incidence across stratum

- add_n() Add column with the total N, or N within stratum

- add_nevent() Add column with the total number of events, or number of events within stratum

- inline_text() Report statistics from a tbl_cuminc() table inline

Usage

```
## S3 method for class 'tbl_cuminc'
add_p(x, pvalue_fun = gtsummary::style_pvalue, ...)

## S3 method for class 'tbl_cuminc'
add_n(x, location = NULL, ...)

## S3 method for class 'tbl_cuminc'
add_nevent(x, location = NULL, ...)

## S3 method for class 'tbl_cuminc'
inline_text(x, time = NULL, column = NULL, outcome = NULL, level = NULL, ...)
```

Arguments

x	object of class 'tbl_cuminc'
pvalue_fun	function to style/format p-values. Default is gtsummary::style_pvalue
...	These dots are for future extensions and must be empty.

location	location to place Ns. When "label" total Ns are placed on each variable's label row. When "level" level counts are placed on the variable level for categorical variables, and total N on the variable's label row for continuous.
time	time of statistic to report
column	column name of the statistic to report
outcome	string indicating the outcome to select from. If NULL, the first outcome is used.
level	if estimates are stratified, level of the stratum to report

Example Output

p-values

The p-values reported in cuminc(), glance.tidycuminc() and add_p.tbl_cuminc() are Gray's test as described in Gray RJ (1988) *A class of K-sample tests for comparing the cumulative incidence of a competing risk*, Annals of Statistics, 16:1141-1154.

See Also

Other tbl_cuminc tools: tbl_cuminc()

Examples

```
# Example 1 ---------------------------------
add_cuminc_ex1 <-
  cuminc(Surv(ttdeath, death_cr) ~ 1, trial) %>%
  tbl_cuminc(times = c(12, 24), label_header = "**Month {time}**") %>%
  add_nevent() %>%
  add_n()

# Example 2 ---------------------------------
add_cuminc_ex2 <-
  cuminc(Surv(ttdeath, death_cr) ~ trt, trial) %>%
  tbl_cuminc(times = c(12, 24),
             outcomes = c("death from cancer", "death other causes"),
             label_header = "**Month {time}**") %>%
  add_p() %>%
  add_nevent(location = c("label", "level")) %>%
  add_n(location = c("label", "level"))

# inline_text() -----------------------------
inline_text(add_cuminc_ex2, time = 12, level = "Drug A")
inline_text(add_cuminc_ex2, column = p.value)
```

base_methods_crr   *Functions for tidycrr objects*

Description

Functions for tidycrr objects

Usage

```
## S3 method for class 'tidycrr'
coef(object, ...)

## S3 method for class 'tidycrr'
vcov(object, ...)

## S3 method for class 'tidycrr'
model.matrix(object, ...)

## S3 method for class 'tidycrr'
model.frame(formula, ...)

## S3 method for class 'tidycrr'
terms(x, ...)
```

Arguments

`...`	not used
`formula`	a formula
`x, object`	a tidycrr object

Value

coef vector, model matrix, model frame, terms object

Examples

```
mod <- crr(Surv(ttdeath, death_cr) ~ age + grade, trial)

coef(mod)

model.matrix(mod) %>% head()

model.frame(mod) %>% head()

terms(mod)
```

---

base_methods_cuminc *Functions for tidycuminc objects*

Description

Functions for tidycuminc objects

Usage

```
## S3 method for class 'tidycuminc'
model.frame(formula, ...)

## S3 method for class 'tidycuminc'
model.matrix(object, ...)
```

Arguments

formula	a formula
...	not used
object	a tidycuminc object

Value

a model frame, or model matrix

Examples

```
fit <- cuminc(Surv(ttdeath, death_cr) ~ trt, trial)

model.matrix(fit) %>% head()

model.frame(fit) %>% head()
```

---

broom_methods_crr *Broom methods for tidycrr objects*

Description

Broom methods for tidycrr objects

Usage

```
## S3 method for class 'tidycrr'
tidy(x, exponentiate = FALSE, conf.int = FALSE, conf.level = x$conf.level, ...)

## S3 method for class 'tidycrr'
glance(x, ...)

## S3 method for class 'tidycrr'
augment(x, times = NULL, probs = NULL, newdata = NULL, ...)
```

Arguments

x	a tidycrr object
exponentiate	Logical indicating whether or not to exponentiate the coefficient estimates. Defaults to FALSE.
conf.int	Logical indicating whether or not to include a confidence interval in the tidied output. Defaults to FALSE.
conf.level	Level of the confidence interval. Default matches that in crr(conf.level=) (typically, 0.95)
...	not used
times	Numeric vector of times to obtain risk estimates at
probs	Numeric vector of quantiles to obtain estimates at
newdata	A base::data.frame() or tibble::tibble() containing all the original predictors used to create x. Defaults to NULL.

Value

a tibble

See Also

Other crr() functions: crr(), predict.tidycrr()

Examples

```
crr <- crr(Surv(ttdeath, death_cr) ~ age + grade, trial)

tidy(crr)

glance(crr)

augment(crr, times = 12)
```

broom_methods_cuminc   *Broom methods for tidy cuminc objects*

Description

Broom methods for tidy cuminc objects

Usage

```
## S3 method for class 'tidycuminc'
tidy(x, times = NULL, conf.int = TRUE, conf.level = x$conf.level, ...)

## S3 method for class 'tidycuminc'
glance(x, ...)
```

Arguments

x	object of class 'tidycuminc'
times	Numeric vector of times to obtain risk estimates at
conf.int	Logical indicating whether or not to include a confidence interval in the tidied output. Defaults to FALSE.
conf.level	Level of the confidence interval. Default matches that in cuminc(conf.level=) (typically, 0.95)
...	not used

Value

a tibble

tidy() **data frame**

The returned tidy() data frame returns the following columns:

Column Name	Description
outcome	Competing Event Outcome
time	Numeric follow-up time
estimate	Risk estimate
std.error	Standard Error
n.risk	Number at risk at the specified time
n.event	If the times= argument is missing, then the number of events that occurred at time t. Otherwise, it is the cur
n.censor	If the times= argument is missing, then the number of censored obs at time t. Otherwise, it is the cumulativ
cum.event	Cumulative number of events at specified time
cum.censor	Cumulative number of censored observations at specified time

If tidy(time=) is specified, then n.event and n.censor are the cumulative number of events/censored in the interval. For example, if tidy(time = c(0, 12, 18)) is passed, n.event and n.censor at time = 18 are the cumulative number of events/censored in the interval (12, 18].

p-values

The p-values reported in `cuminc()`, `glance.tidycuminc()` and `add_p.tbl_cuminc()` are Gray's
test as described in Gray RJ (1988) *A class of K-sample tests for comparing the cumulative inci-
dence of a competing risk*, Annals of Statistics, 16:1141-1154.

Confidence intervals

The confidence intervals for cumulative incidence estimates use the recommended method in *Com-
peting Risks: A Practical Perspective* by Melania Pintilie.

$$x^{exp(z*se/(x*log(x)))}$$

where x is the cumulative incidence estimate, se is the standard error estimate, and z is the z-score
associated with the confidence level of the interval, e.g. $z = 1.96$ for a 95% CI.

See Also

Other cuminc() functions: cuminc()

Examples

```
cuminc <- cuminc(Surv(ttdeath, death_cr) ~ trt, trial)

tidy(cuminc)

glance(cuminc)

# restructure glance to one line per outcome
glance(cuminc) %>%
  tidyr::pivot_longer(
    everything(),
    names_to = c(".value", "outcome_id"),
    names_pattern = "(.*)_(.*)"
  )
```

---

crr   *Competing Risks Regression*

Description

Competing Risks Regression

Usage

```
## S3 method for class 'formula'
crr(formula, data, failcode = NULL, conf.level = 0.95, ...)

crr(x, ...)

## Default S3 method:
crr(x, ...)
```

Arguments

formula	formula with Surv() on LHS and covariates on RHS. The event status variable must be a factor, with the first level indicating 'censor' and subsequent levels the competing risks. The Surv(time2=) argument cannot be used.
data	data frame
failcode	Indicates event of interest. If failcode= is NULL, the first competing event will be used as the event of interest. Default is NULL.
conf.level	confidence level. Default is 0.95.
...	passed to methods
x	input object

Value

tidycrr object

See Also

Other crr() functions: broom_methods_crr, predict.tidycrr()

Examples

```
crr(Surv(ttdeath, death_cr) ~ age + grade, trial)
```

---

cuminc	*Competing Risks Cumulative Incidence*

Description

Competing Risks Cumulative Incidence

Usage

```
## S3 method for class 'formula'
cuminc(formula, data, strata, rho = 0, conf.level = 0.95, ...)

cuminc(x, ...)

## Default S3 method:
cuminc(x, ...)
```

Arguments

formula	formula with `Surv()` on LHS and covariates on RHS. The event status variable must be a factor, with the first level indicating 'censor' and subsequent levels the competing risks. The `Surv(time2=)` argument cannot be used.
data	data frame
strata	stratification variable. Has no effect on estimates. Tests will be stratified on this variable. (all data in 1 stratum, if missing)
rho	Power of the weight function used in the tests.
conf.level	confidence level. Default is 0.95.
...	passed to methods
x	input object

Value

tidycuminc object

Confidence intervals

The confidence intervals for cumulative incidence estimates use the recommended method in *Competing Risks: A Practical Perspective* by Melania Pintilie.

$$x^{exp(z*se/(x*log(x)))}$$

where x is the cumulative incidence estimate, se is the standard error estimate, and z is the z-score associated with the confidence level of the interval, e.g. $z = 1.96$ for a 95% CI.

p-values

The p-values reported in `cuminc()`, `glance.tidycuminc()` and `add_p.tbl_cuminc()` are Gray's test as described in Gray RJ (1988) *A class of K-sample tests for comparing the cumulative incidence of a competing risk*, Annals of Statistics, 16:1141-1154.

See Also

Other cuminc() functions: broom_methods_cuminc

Examples

```
# calculate risk for entire cohort ----------
cuminc(Surv(ttdeath, death_cr) ~ 1, trial)

# calculate risk by treatment group ----------
cuminc(Surv(ttdeath, death_cr) ~ trt, trial)
```

---

gtsummary_s3_methods   *gtsummary methods*

Description

These functions are S3 methods for working with [crr()](crr()) model results.

- `tbl_regression.tidycrr()`: This function sets the tidycmprsk tidier for `crr()` models.

- `global_pvalue_fun.tidycrr()`: This function ensures that `gtsummary::add_global_p(anova_fun)` uses the Wald test by default (instead of `car::Anova()`, which does not support this model type). The Wald test is executed with `cardx::ard_aod_wald_test()`, which wraps `aod::wald.test()`.

Usage

```
## S3 method for class 'tidycrr'
tbl_regression(x, tidy_fun = tidycmprsk::tidy, ...)

## S3 method for class 'tidycrr'
global_pvalue_fun(x, type, ...)
```

Arguments

x	(tidycrr) tidycmprsk::crr() regression object
tidy_fun	(function) Tidier function for the model. Default is tidycmprsk::tidy().
...	Additional arguments passed to broom.helpers::tidy_plus_plus().
type	not used

Value

gtsummary table or data frame of results

Examples

```
crr(Surv(ttdeath, death_cr) ~ age + grade, trial) |>
  gtsummary::tbl_regression() |>
  gtsummary::add_global_p() |>
  gtsummary::as_gt()
```

---

predict.tidycrr   *Estimate subdistribution functions for crr objects*

Description

Estimate subdistribution functions for crr objects

Usage

```
## S3 method for class 'tidycrr'
predict(object, times = NULL, probs = NULL, newdata = NULL, ...)
```

Arguments

object	a tidycrr object
times	Numeric vector of times to obtain risk estimates at
probs	Numeric vector of quantiles to obtain estimates at
newdata	A base::data.frame() or tibble::tibble() containing all the original predictors used to create x. Defaults to NULL.
...	not used

Value

named list of prediction estimates

See Also

Other crr() functions: broom_methods_crr, crr()

Examples

```
crr(Surv(ttdeath, death_cr) ~ age, trial) %>%
  predict(times = 12, newdata = trial[1:10, ])
```

---

tbl_cuminc   *Tabular Summary of Cumulative Incidence*

Description

Tabular Summary of Cumulative Incidence

Usage

```
## S3 method for class 'tidycuminc'
tbl_cuminc(
  x,
  times = NULL,
  outcomes = NULL,
  statistic = "{estimate}% ({conf.low}%, {conf.high}%)",
  label = NULL,
  label_header = "**Time {time}**",
  estimate_fun = NULL,
  conf.level = x$conf.level,
  missing = NULL,
  ...
)

tbl_cuminc(x, ...)
```

Arguments

x	a 'tidycuminc' object created with cuminc()
times	Numeric vector of times to obtain risk estimates at
outcomes	character vector of outcomes to include. Default is to include the first outcome.
statistic	string of statistic to report. Default is "{estimate}% ({conf.low}%, {conf.high}%)"
label	string indicating the variable label
label_header	string for the header labels; uses glue syntax. Default is "**Time {time}**"
estimate_fun	function that styles and formats the statistics. Default is ~gtsummary::style_sigfig(.x, scale = 100)
conf.level	Level of the confidence interval. Default matches that in cuminc(conf.level=) (typically, 0.95)
missing	string to replace missing values with. Default is an em-dash, "\U2014"
...	not used

Example Output

See Also

Other tbl_cuminc tools: [add_cuminc](#)

Examples

```
# Example 1 --------------------------------
tbl_cuminc_ex1 <-
  cuminc(Surv(ttdeath, death_cr) ~ 1, trial) %>%
  tbl_cuminc(times = c(12, 24), label_header = "**Month {time}**")
```

```
# Example 2 --------------------------------
tbl_cuminc_ex2 <-
  cuminc(Surv(ttdeath, death_cr) ~ trt, trial) %>%
  tbl_cuminc(times = c(12, 24),
             outcomes = c("death from cancer", "death other causes"),
             label_header = "**Month {time}**")
```

---

trial	*Results from a simulated study of two chemotherapy agents*

Description

A dataset containing the baseline characteristics of 200 patients who received Drug A or Drug B. Dataset also contains the outcome of tumor response to the treatment.

Usage

```
trial
```

Format

A data frame with 200 rows–one row per patient

trt Chemotherapy Treatment

age Age

marker Marker Level (ng/mL)

stage T Stage

grade Grade

response Tumor Response

death Patient Died

death_cr Death Status

ttdeath Months to Death/Censor

Index