Package ‘tidycmprsk’

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Title Competing Risks Estimation

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License AGPL (>= 3)


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

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### `add_cuminc` Additional Functions for `tbl_cuminc()`

#### Description

*This is experimental and breaking changes may be made in a future release.*

- `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

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

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

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

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

Arguments

- **x**: object of class 'tbl_cuminc'
- **pvalue_fun**: function to style/format p-values. Default is `gtsummary::style_pvalue` ...
- **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

```r
# 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)
```
Description

Function uses the result from tidy(object) to create figure.

Usage

```r
## S3 method for class 'tidycuminc'
autoplot(
  object,
  outcomes = NULL,
  conf.int = FALSE,
  conf.level = 0.95,
  aes = NULL,
  ...
)
```

Arguments

- **object**: object of class 'cuminc'
- **outcomes**: character vector of outcomes to include in plot. Default is to include the first competing events.
- **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)
- **aes**: List of arguments that will be added or replace the existing arguments in ggplot2::aes(). Details below.
- **...**: not used

Value

- a ggplot object

aesthetics

The `aes=` argument accepts a named list of arguments that will be added to or replace existing arguments in the `ggplot2::aes()` call. The tibble used to create the figure is the output from tidy(). The default call to `ggplot2::aes()` includes, at most, the following: `ggplot2::aes(x = time, y = estimate, colour = strata, fill = strata, linetype = outcome, ymin = conf.low, ymax = conf.high)` Not all arguments appear in every plot, however.

See Also

Other cuminc() functions: `broom_methods_cuminc`, `cuminc()`
Examples

# Example 1 ----------------------------------
cuminc(Surv(ttdeath, death_cr) ~ trt, trial) %>%
  autoplot()

# Example 2 ----------------------------------
cuminc(Surv(ttdeath, death_cr) ~ 1, trial) %>%
  autoplot(outcomes = "death from cancer", conf.int = TRUE) +
  ggplot2::labs(
    x = "Months from Treatment",
    y = "Risk of Death"
  )

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

ccoef vector, model matrix, model frame, terms object
Examples

```r
mod <- crr(Surv(ttdeath, death_cr) ~ age + grade, trial)
coef(mod)
model.matrix(mod) %>% head()
model.frame(mod) %>% head()
terms(mod)
```

### Description

Functions for tidycuminc objects

### Usage

```r
## 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

```r
fit <- cuminc(Surv(ttdeath, death_cr) ~ trt, trial)
model.matrix(fit) %>% head()
model.frame(fit) %>% head()
```
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

```r
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**

```r
## 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:

<table>
<thead>
<tr>
<th>Column Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>outcome</td>
<td>Competing Event Outcome</td>
</tr>
<tr>
<td>time</td>
<td>Numeric follow-up time</td>
</tr>
<tr>
<td>estimate</td>
<td>Risk estimate</td>
</tr>
<tr>
<td>std.error</td>
<td>Standard Error</td>
</tr>
</tbody>
</table>
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 cumulative number of events that have occurred since the last time listed.
n.censor If the times= argument is missing, then the number of censored obs at time t. Otherwise, it is the cumulative number of censored observations that have occurred since the last time listed.
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 incidence of a competing risk, Annals of Statistics, 16:1141-1154.

Confidence intervals

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

\[ \exp(\hat{x} \pm z \times \text{se}/(\hat{x} \times \log(\hat{x}))) \]

where \( \hat{x} \) is the cumulative incidence estimate, \( \text{se} \) 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: autoplot.tidycuminc(), cuminc()

Examples

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

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

Competing Risks Cumulative Incidence

Usage

```r
## 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: autoplot.tidycuminc(), broom_methods_cuminc

Examples

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

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

---

### predict.tidycrr

*Estimate subdistribution functions for crr objects*

#### Description

Estimate subdistribution functions for crr objects

#### Usage

```r
## 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

This is experimental and breaking changes may be made in a future release.

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 \texttt{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 \texttt{\texttt{\texttt{\texttt{\texttt{gtsummary::style_sigfig(.x, scale = 100)}}}}}
conf.level Level of the confidence interval. Default matches that in \texttt{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
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