Package ‘tidycmprsk’

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**Title**  Competing Risks Estimation

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**License**  AGPL (>= 3)

**URL**  https://mskcc-epi-bio.github.io/tidycmprsk/

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

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**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>

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## 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

```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, ...)
```

## 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**


**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

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

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**

```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()
```

---

**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. De-
               faults 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 pre-
               dictors 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)
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>
<tr>
<td>n.risk</td>
<td>Number at risk at the specified time</td>
</tr>
<tr>
<td>n.event</td>
<td>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.</td>
</tr>
<tr>
<td>n.censor</td>
<td>If the times= argument is missing, then the number of censored obs at time t. Otherwise, it is the cumulative number of censored observations at specified time</td>
</tr>
<tr>
<td>cum.event</td>
<td>Cumulative number of events at specified time</td>
</tr>
<tr>
<td>cum.censor</td>
<td>Cumulative number of censored observations at specified time</td>
</tr>
</tbody>
</table>

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.cuminc() 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.

\[ \exp\left(\frac{z \times se}{x \times \log(x)}\right) \]

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
%>%
tidyr::pivot_longer(
  everything(),
  names_to = c(".value", "outcome_id"),
  names_pattern = "(.*)_(.*)"
)

crr Competing Risks Regression

Description

Competing Risks Regression
Usage

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

```r
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.

\[ x \exp(z \times se/(x \times \log(x))) \]

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`
predict.tidycrr

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)

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

```r
## 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

```r
# Example 1 ----------------------------------
trial

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

# Example 2 ----------------------------------
trial

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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