Package ‘survSens’

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Type Package

Title Sensitivity Analysis with Time-to-Event Outcomes

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Description Performs a dual-parameter sensitivity analysis of treatment effect to unmeasured confounding in observational studies with either survival or competing risks outcomes. Huang, R., Xu, R. and Dulai, P.S.(2020) <doi:10.1002/sim.8672>.

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LazyData true

Depends R (>= 3.5.0)

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NeedsCompilation no

URL https://github.com/Rong0707/survSens

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Contents

comprdata *An example dataset with competing risks outcomes.*

Description

An example dataset with competing risks outcomes that can be used for `comprSensitivity`.

Usage

```
data("comprdata")
```

Format

The format is a list of 5, corresponding to `t`, `d`, `Z`, `X`, `U`, respectively.

References

Huang, R., Xu, R., & Dulai, P. S. (2019). Sensitivity Analysis of Treatment Effect to Unmeasured Confounding in Observational Studies with Survival and Competing Risks Outcomes. arXiv preprint arXiv:1908.01444.

Examples

```
data(comprdata)
```

comprSensitivity *Sensitivity analysis of treatment effect to unmeasured confounding with competing risks outcomes.*

Description

`comprSensitivity` performs a dual-parameter sensitivity analysis of treatment effect to unmeasured confounding in observational studies with competing risks outcomes.

Usage

```
comprSensitivity(t, d, Z, X, method, zetaT = seq(-2,2,by=0.5),
zetat2 = 0, zetaZ = seq(-2,2,by=0.5), theta = 0.5, B = 50, Bem = 200)
```

Arguments

`t`	survival outcomes with competing risks.
`d`	indicator of occurrence of event, with `d == 0` denotes right censoring, `d==1` denotes event of interest, `d==2` denotes competing risk.
`Z`	indicator of treatment.
`X`	pre-treatment covariates that will be included in the model as measured confounders.
`method`	needs to be one of `"stoEM_reg"`, `"stoEM_IPW"` and `"EM_reg"`.
`zetaT`	range of coefficient of U in the event of interest response model.
`zetat2`	value of coefficient of U in the competing risk response model
`zetaZ`	range of coefficient of U in the treatment model.
`theta`	marginal probability of $U = 1$.
`B`	iteration in the stochastic EM algorithm.
`Bem`	iteration used to estimate the variance-covariance matrix in the EM algorithm.

Details

This function performs a dual-parameter sensitivity analysis of treatment effect to unmeasured confounding by either drawing simulated potential confounders U from the conditional distribution of U given observed response, treatment and covariates or the Expectation-Maximization algorithm. We assume U is following $Bernoulli(\pi)$ (default 0.5). Given Z, X and U, the hazard rate of the jth type of failure is modeled using the Cox proportional hazards (PH) regression:

$$\lambda_j(t|Z,X,U) = \lambda_{j0}(t)exp(\tau_j Z + X'\beta_j + \zeta_j U).$$

Given X and U, Z follows a generalized linear model:

$$P(Z = 1|X,U) = \Phi(X'\beta_z + \zeta_z U).$$

Value

`tau1`	a data.frame with zetaz, zetat1, zetat2, tau1, tau1.se and t statistic in the event of interest response model.
`tau2`	a data.frame with zetaz, zetat, zetat2, tau2, tau2.se and t statistic in the competing risks response model.

Author(s)

Rong Huang

References

Huang, R., Xu, R., & Dulai, P. S. (2019). Sensitivity Analysis of Treatment Effect to Unmeasured Confounding in Observational Studies with Survival and Competing Risks Outcomes. arXiv preprint arXiv:1908.01444.

Examples

```
#load the dataset included in the package
data(comprdata)
#stochastic EM with regression
tau.sto = comprSensitivity(comprdata$t, comprdata$d, comprdata$Z, comprdata$X,
"stoEM_reg", zetaT = 0.5, zetaZ = 0.5, B = 3)

#EM with regression
tau.em = comprSensitivity(comprdata$t, comprdata$d, comprdata$Z, comprdata$X,
"EM_reg", zetaT = 0.5, zetaZ = 0.5, Bem = 50)
```

`plotsens` *A contour plot of sensitivity analysis results.*

Description

A contour plot of sensitivity analysis results.

Usage

```
plotsens(tau.res, coeff0, partialRsq = FALSE)
```

Arguments

`tau.res`	a data.frame that can be generated from either `survSensitivity` or `comprSensitivity`.
`coeff0`	the value of estimated treatment effect ignoring any confounding.
`partialRsq`	whether to use partial R^2 instead of coefficients in the contour plot.

Details

This function gives a contour plot in order to visualize results from either `survSensitivity` or `comprSensitivity`. The name of sensitivity parameter in the treatment model needs to be "zetaz", the name of sensitivity parameter in the response model needs to be "zetat1", and the name of estimated treatment effect needs to be "tau1".

Value

A contour plot corresponding to the output from either `survSensitivity` or `comprSensitivity`.

Author(s)

Rong Huang

Examples

```
data(tau.res) #an example output
plotsens(tau.res, coeff0 = 1.131)
```

survdata *An example dataset with survival outcomes.*

Description

An example dataset with survival outcomes that can be used for `survSensitivity`.

Usage

```
data("survdata")
```

Format

The format is a list of 5, corresponding to `t`, `d`, `Z`, `X`, `U`, respectively.

References

Huang, R., Xu, R., & Dulai, P. S. (2019). Sensitivity Analysis of Treatment Effect to Unmeasured Confounding in Observational Studies with Survival and Competing Risks Outcomes. arXiv preprint arXiv:1908.01444.

Examples

```
data(survdata)
```

survSensitivity *Sensitivity analysis of treatment effect to unmeasured confounding with survival outcomes.*

Description

`survSensitivity` performs a dual-parameter sensitivity analysis of treatment effect to unmeasured confounding in observational studies with survival outcomes.

Usage

```
survSensitivity(t, d, Z, X, method, zetaT = seq(-2,2,by=0.5),
zetaZ = seq(-2,2,by=0.5), theta = 0.5, B = 50, Bem = 200)
```

Arguments

`t`	survival outcomes.
`d`	indicator of occurrence of event, with `d == 0` denotes right censoring.
`Z`	indicator of treatment.
`X`	pre-treatment covariates that will be included in the model as measured confounders.
`method`	needs to be one of `"stoEM_reg"`, `"stoEM_IPW"`, and `"EM_reg"`.
`zetaT`	range of coefficient of U in the response model.
`zetaZ`	range of coefficient of U in the treatment model.
`theta`	marginal probability of $U = 1$.
`B`	iteration in the stochastic EM algorithm.
`Bem`	iteration used to estimate the variance-covariance matrix in the EM algorithm.

Details

This function performs a dual-parameter sensitivity analysis of treatment effect to unmeasured confounding by either drawing simulated potential confounders U from the conditional distribution of U given observed response, treatment and covariates or the Expectation-Maximization algorithm. We assume U is following $Bernoulli(\pi)$ (default 0.5). Given Z, X and U, the hazard rate is modeled using the Cox proportional hazards (PH) regression:

$$\lambda(t|Z, X, U) = \lambda_0(t)exp(\tau Z + X'\beta + \zeta U).$$

Given X and U, Z follows a generalized linear model:

$$P(Z = 1|X, U) = \Phi(X'\beta_z + \zeta_z U).$$

Value

`tau`	a data.frame with zetaz, zetat, tau1, tau1.se and t statistic.

Author(s)

Rong Huang

References

Huang, R., Xu, R., & Dulai, P. S. (2019). Sensitivity Analysis of Treatment Effect to Unmeasured Confounding in Observational Studies with Survival and Competing Risks Outcomes. arXiv preprint arXiv:1908.01444.

Examples

```
#load the dataset included in the package.
data(survdata)
#stochastic EM with regression
tau.sto = survSensitivity(survdata$t, survdata$d, survdata$Z, survdata$X,
"stoEM_reg", zetaT = 0.5, zetaZ = 0.5, B = 3)

#EM with regression
tau.em = survSensitivity(survdata$t, survdata$d, survdata$Z, survdata$X,
"EM_reg", zetaT = 0.5, zetaZ = 0.5, Bem = 50)
```

`tau.res` *Sensitivity analysis output example*

Description

An example output from `survSensitivity`.

Usage

```
data("tau.res")
```

Format

A data frame with 81 observations on the following 7 variables.

`zetaz` a numeric vector, corresponding to the sensitivity parameter in the treatment model.

`zetat1` a numeric vector, corresponding to the sensitivity parameter in the response model.

`tau1` a numeric vector, corresponding to the estimated treatment effect.

`tau1.se` a numeric vector, corresponding to the standard error of the estimated treatment effect.

`pR2z` a numeric vector, corresponding to the Rsquared in the treatment model.

`pR2t1` a numeric vector, corresponding to the Rsquared in the response model.

`t` a numeric vector, corresponding to the `t` statistic.

Examples

```
data(tau.res)
```

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