# Package 'JMdesign'

June 7, 2022

**Type** Package

**Title** Joint Modeling of Longitudinal and Survival Data - Power
Calculation

**Version** 1.3

**Date** 2022-06-05

**Author** Emil A. Cornea, Liddy M. Chen, Bahjat F. Qaqish, Haitao Chu, and
Joseph G. Ibrahim

**Maintainer** Shannon T. Holloway <shannon.t.holloway@gmail.com>

**Description** Performs power calculations for joint modeling of longitudinal
and survival data with k-th order trajectories when the variance-covariance
matrix, Sigma_theta, is unknown.

**License** GPL-2

**Depends** methods

**NeedsCompilation** no

**Repository** CRAN

**Date/Publication** 2022-06-06 23:10:33 UTC

## R topics documented:

---

JMdesign-package            *Joint Modeling of Longitudinal and Survival Data - Power Calculation*

---

**Description**

R function for power determination in joint modeling of longitudinal and survival data with k-th order trajectories and unknown variance-covariance matrix Sigma_theta.

**Details**

| | |
|---|---|
| Package: | JMdesign |
| Type: | Package |
| Version: | 1.1 |
| Date: | 2014-10-21 |
| License: | GPL-2 |

The package contains the R-function `powerLongSurv` to perform power calculations for joint modeling of longitudinal and survival data when trajectories are of k-th order and the variance-covariance matrix Sigma_theta is unknown.

**Author(s)**

Emil A. Cornea, Liddy M. Chen, Bahjat F. Qaqish, Haitao Chu, and Joseph G. Ibrahim

Maintainer: Shannon T. Holloway <sthollow@ncsu.edu>

**References**

L. M. Chen, J. G. Ibrahim, and H. Chu. Sample size and power determination in joint modeling of longitudinal and survival data. Statist. Med. 2011, 30 2295-2309

**See Also**

powerLongSurv, powerLongSurv-class, show-methods

**Examples**

```
## Example 1.
## **********
## Input elements of Sigma_theta in forumula 4.6;
SigmaTheta <- matrix(c(1.2,0.0,0.0,0.0,0.7,0.0,0.0,0.0,0.8),nrow=3,ncol=3)

N       <-  200; # Total sample size;
nevents <-  140; # Number of events;
tmedian <-  0.7; # median survival;
meantf  <-  1.4; # mean follow-up time;
beta    <-  0.2; # Effect of the trajectory;
```

```
alpha    <-  0.05;# Type-I Error (2-sided);
sigmae_2 <-  0.09; # measurement error;

## schedule of measurement;
t <- c(0.4, 0.8, 1.2, 1.6, 2) ; # maximum 2 year follow-up;

## Input estimated proportion subjects with 2,3,4,5,6 measurements;
## This is \xi in formula 4.6;
## The data is obtained from the simulated data for the calculation in table 2;
p <- c(0.3, 0.4, 0.15, 0.1, 0.05);

## Input the order of trajectories
ordtraj <- 1 ## linear trajectories

## Call function
## Linear Trajectories
pLSl <- powerLongSurv(N, nevents, tmedian, meantf, p, t, SigmaTheta,
                      sigmae_2, ordtraj, beta, alpha=0.05)
pLSl
show(pLSl)
unclass(pLSl)

## Constant Trajectories
powerLongSurv(N, nevents, tmedian, meantf, p, t, SigmaTheta, sigmae_2,
              ordtraj=0, beta, alpha=0.05)

## Quadratic Trajectories
powerLongSurv(N, nevents, tmedian, meantf, p, t, SigmaTheta,sigmae_2,
              ordtraj=2, beta, alpha=0.05)

## ****************************************************************************

## Example 2.
## **********
## Input elements of Sigma_theta in forumula 4.6;
SigmaTheta <- matrix(c(1.2,0.0,0.0,0.0,0.7,0.0,0.0,0.0,0.8),nrow=3,ncol=3)

N        <-  200; # Total sample size;
nevents  <-  140; # Number of events;
tmedian  <-  0.7; # median survival;
meantf   <-  1.4; # mean follow-up time;
beta     <-  0.2; # Effect of the trajectory;
alpha    <-  0.05;# Type-I Error (2-sided);
sigmae_2 <-  0.09; # measurement error;

## schedule of measurement;
t <- c(0.4, 0.8, 1.2, 1.6);

## Input estimated proportion subjects with 2,3,4,5,6 measurements;
## This is \xi in formula 4.6;
## The data is obtained from the simulated data for the calculation in table 2;
p  <-  c(0.3, 0.4, 0.2, 0.1);
```

```
## Input the order of trajectories
ordtraj <- 2 ## quadratic trajectories

## Call function
## Quadratic Trajectories
pLSq <- powerLongSurv(N, nevents, tmedian, meantf, p, t, SigmaTheta,
                      sigmae_2, ordtraj, beta, alpha=0.05)
pLSq
show(pLSq)
unclass(pLSq)

## Constant Trajectories
powerLongSurv(N, nevents, tmedian, meantf, p, t, SigmaTheta, sigmae_2,
              ordtraj=0, beta, alpha=0.05)

## Linear Trajectories
powerLongSurv(N, nevents, tmedian, meantf, p, t, SigmaTheta, sigmae_2,
              ordtraj=1, beta, alpha=0.05)
```

---

powerLongSurv            *Power calculation in joint modeling of longitudinal and survival data*
                         *- k-th Order Trajectories and Unknown Sigma*

---

### Description

Compute the power in joint modeling of longitudinal and survival data when the variance-covariance matrix Sigma_Theta is unknown and the trajectories are order k.

The function computes power for a one-sided test, either

$$H_0 : \beta = 0 \quad \text{and} \quad H_{1A} : \beta > 0$$

or

$$H_0 : \beta = 0 \quad \text{and} \quad H_{1B} : \beta < 0$$

with Type I error $\alpha$. The choice of the alternative is determined by the sign of $\beta$. Negative values for $\beta$ indicate that the alternative hypothesis is $H_{1B}$, while $\beta \geq 0$ indicates that it is $H_{1A}$.

It creates a powerLongSurv object.

### Usage

```
powerLongSurv(N, nevents, tmedian, meantf, p, t, SigmaTheta, sigmae_2, ordtraj,
              beta = 0, alpha = 0.05, tol = 1.5e-8)
```

### Arguments

| | |
|---|---|
| N | numeric specifying the total sample size; minimum 20. |
| nevents | numeric specifying the number of events; at least 20 and at most N. |
| tmedian | numeric specifying the median survival time; positive |

| | |
|---|---|
| meantf | numeric specifying the mean follow-up time; positive and no greater than max(t). |
| p | numeric vector of estimated subject proportions with 2,3,... measurements, respectively, zero proportions allowed. |
| t | numeric vector of measurement times, distinct positive components; same length as p. |
| SigmaTheta | numeric matrix specifying the covariance matrix Sigma_Theta |
| sigmae_2 | numeric specifying the measurement error; positive. |
| ordtraj | integer specifying the order of trajectories, must be less the order of Sigma_Theta |
| beta | numeric specifying the effect of the trajectory; default value 0. |
| alpha | numeric, strictly between 0.0 and 1.0, specifying the Type-I Error (2-sided), default value 0.05. |
| tol | numeric, For floating point objects x and y, if |x-y| <= tol, x==y. Passed to R function all.equal. |

## Details

The function powerLongSurv is used to calculate the power in joint modeling of longitudinal and survival data.

## Value

An object of S4 class powerLongSurv, which has the following 12 components

| | |
|---|---|
| title | character string |
| subtitle | character string |
| t | numeric vector |
| p | numeric vector |
| N | integer |
| nevents | integer |
| censr | numeric |
| tmedian | numeric |
| meantf | numeric |
| SigmaTheta | numeric matrix |
| ordtraj | integer |
| BSigma | numeric matrix |
| beta | numeric |
| alpha | numeric |
| power | numeric |

## Author(s)

Emil A. Cornea, Liddy M. Chen, Bahjat F. Qaqish, Haitao Chu, and Joseph G. Ibrahim

Maintainer: Shannon T. Holloway <sthollow@ncsu.edu>

**References**

L. M. Chen, J. G. Ibrahim, and H. Chu. Sample size and power determination in joint modeling of longitudinal and survival data. Statist. Med. 2011, 30 2295-2309

**See Also**

powerLongSurv-class, show-methods

**Examples**

```
## Example 1.
## **********
## Input elements of Sigma_theta in forumula 4.6;
SigmaTheta <- matrix(c(1.2,0.0,0.0,0.0,0.7,0.0,0.0,0.0,0.8),nrow=3,ncol=3)

N        <-  200; # Total sample size;
nevents  <-  140; # Number of events;
tmedian  <-  0.7; # median survival;
meantf   <-  1.4; # mean follow-up time;
beta     <-  0.2; # Effect of the trajectory;
alpha    <-  0.05;# Type-I Error (2-sided);
sigmae_2 <-  0.09; # measurement error;

## schedule of measurement;
t <- c(0.4, 0.8, 1.2, 1.6, 2) ; # maximum 2 year follow-up;

## Input estimated proportion subjects with 2,3,4,5,6 measurements;
## This is \xi in formula 4.6;
## The data is obtained from the simulated data for the calculation in table 2;
p <- c(0.3, 0.4, 0.15, 0.1, 0.05);

## Input the order of trajectories
ordtraj <- 1 ## linear trajectories

## Call function
## Linear Trajectories
pLSl <- powerLongSurv(N, nevents, tmedian, meantf, p, t, SigmaTheta,
                      sigmae_2, ordtraj, beta, alpha=0.05)
pLSl
show(pLSl)
unclass(pLSl)

## Constant Trajectories
powerLongSurv(N, nevents, tmedian, meantf, p, t, SigmaTheta, sigmae_2,
              ordtraj=0, beta, alpha=0.05)

## Quadratic Trajectories
powerLongSurv(N, nevents, tmedian, meantf, p, t, SigmaTheta, sigmae_2,
              ordtraj=2, beta, alpha=0.05)

## ************************************************************************
```

```
## Example 2.
## **********
## Input elements of Sigma_theta in forumula 4.6;
SigmaTheta <- matrix(c(1.2,0.0,0.0,0.0,0.7,0.0,0.0,0.0,0.8),nrow=3,ncol=3)

N        <-  200; # Total sample size;
nevents  <-  140; # Number of events;
tmedian  <-  0.7; # median survival;
meantf   <-  1.4; # mean follow-up time;
beta     <-  0.2; # Effect of the trajectory;
alpha    <-  0.05;# Type-I Error (2-sided);
sigmae_2 <-  0.09; # measurement error;

## schedule of measurement;
t <- c(0.4, 0.8, 1.2, 1.6);

## Input estimated proportion subjects with 2,3,4,5,6 measurements;
## This is \xi in formula 4.6;
## The data is obtained from the simulated data for the calculation in table 2;
p <- c(0.3, 0.4, 0.2, 0.1);

## Input the order of trajectories
ordtraj <- 2 ## quadratic trajectories

## Call function
## Quadratic Trajectories
pLSq <- powerLongSurv(N,nevents,tmedian,meantf,p,t,SigmaTheta,sigmae_2,ordtraj,beta, alpha = 0.05)
pLSq
show(pLSq)
unclass(pLSq)

## Constant Trajectories
powerLongSurv(N, nevents, tmedian, meantf, p, t, SigmaTheta, sigmae_2,
              ordtraj=0, beta, alpha=0.05)

## Linear Trajectories
powerLongSurv(N, nevents, tmedian, meantf, p, t, SigmaTheta, sigmae_2,
              ordtraj=1, beta, alpha=0.05)
```

---

powerLongSurv-class    *Class* "powerLongSurv"

---

### Description

Class of objects like the output of function "powerLongSurv()".

### Objects from the Class

Objects can be created by calls of the form new("powerLongSurv", ...).

**Slots**

title: Object of class "character"

subtitle: Object of class "character"

t: Object of class "vector"

p: Object of class "vector"

N: Object of class "integer"

nevents: Object of class "integer"

censr: Object of class "numeric"

tmedian: Object of class "numeric"

meantf: Object of class "numeric"

SigmaTheta: Object of class "matrix"

ordtraj: Object of class "integer"

BSigma: Object of class "matrix"

beta: Object of class "numeric"

alpha: Object of class "numeric"

power: Object of class "numeric"

**Methods**

**show** signature(object = "powerLongSurv")

**Author(s)**

Emil A. Cornea, Liddy M. Chen, Bahjat F. Qaqish, Haitao Chu, and Joseph G. Ibrahim

Maintainer: Shannon T. Holloway <sthollow@ncsu.edu>

**See Also**

powerLongSurv, show-methods

**Examples**

```
showClass("powerLongSurv")
```

---

| show-methods | *Methods for Function* show |
|---|---|

---

**Description**

Methods for function show

**Methods**

signature(object = "powerLongSurv")

# Index