

# Package ‘landpred’

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**Type** Package

**Title** Landmark Prediction of a Survival Outcome

**Version** 1.0

**Author** Layla Parast

**Maintainer** Layla Parast <parast@rand.org>

**Description** This package includes functions for landmark prediction of a survival outcome incorporating covariate and short-term event information. For more information about landmark prediction please see: Parast, Layla, Su-Chun Cheng, and Tianxi Cai. Incorporating short-term outcome information to predict long-term survival with discrete markers. *Biometrical Journal* 53.2 (2011): 294-307.

**License** GPL

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landpred-package	<i>Landmark Prediction of a Survival Outcome</i>
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## Description

This package includes functions for landmark prediction of a survival outcome incorporating covariate and short-term event information. For more information about landmark prediction please see: Parast, Layla, Su-Chun Cheng, and Tianxi Cai. Incorporating short-term outcome information to predict long-term survival with discrete markers. *Biometrical Journal* 53.2 (2011): 294-307.

## Details

Package: landpred  
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 Version: 1.0  
 License: GPL

## Author(s)

Layla Parast

## References

Parast, Layla, Su-Chun Cheng, and Tianxi Cai. Incorporating short-term outcome information to predict long-term survival with discrete markers. *Biometrical Journal* 53.2 (2011): 294-307.

## Examples

```
data(data_example_landpred)
t0=2
tau = 8

####Landmark prediction with no covariate or short term information
Prob.Null(t0=t0,tau=tau,data=data_example_landpred)
out = Prob.Null(t0=t0,tau=tau,data=data_example_landpred)
out$Prob
out$data
```

```

newdata = matrix(c(1,1,3,0,4,1,10,1,11,0), ncol = 2, byrow=TRUE)
out = Prob.Null(t0=t0,tau=tau,data=data_example_landpred,newdata=newdata)
out$Prob
out$newdata

#Landmark prediction with covariate information only
Prob.Covariate(t0=t0,tau=tau,data=data_example_landpred)
out = Prob.Covariate(t0=t0,tau=tau,data=data_example_landpred)
out$Prob
out$data

newdata = matrix(c(1,1,1, 3,0,1, 4,1,1, 10,1,0, 11,0,1), ncol = 3, byrow=TRUE)
out = Prob.Covariate(t0=t0,tau=tau,data=data_example_landpred,newdata=newdata)
out$Prob
out$newdata

#Landmark prediction with covariate information and short term event information
#note: computationally intensive commands below
#Prob.Covariate.ShortEvent(t0=t0,tau=tau,data=data_example_landpred)
#out = Prob.Covariate.ShortEvent(t0=t0,tau=tau,data=data_example_landpred)
#out$data
#data.plot = out$data
#plot(data.plot$XS[data.plot$Z ==1], data.plot$Probability[data.plot$Z ==1],
#pch = 20, xlim = c(0,t0))
#points(data.plot$XS[data.plot$Z ==0], data.plot$Probability[data.plot$Z ==0],
#pch = 20, col = 2)

newdata = matrix(c(1,1,0.5,1,0,
3,0,1,1,1,
4,1,1.5,1,0,
10,1,5,1,0,
11,0,11,0,1), ncol = 5, byrow=TRUE)
#note: computationally intensive command below
#out=Prob.Covariate.ShortEvent(t0=t0,tau=tau,data=data_example_landpred,newdata=newdata)
#out$newdata

```

---

AUC.landmark

*Estimates the area under the ROC curve (AUC).*


---

### Description

This function calculates the AUC given the data (truth) and corresponding estimated probabilities; uses a continuity correction.

### Usage

```
AUC.landmark(t0, tau, data, short = TRUE, weight=NULL)
```

**Arguments**

<code>t0</code>	the landmark time.
<code>tau</code>	the residual survival time of interest.
<code>data</code>	n by k matrix, where k = 4 or 6. A data matrix where the first column is $XL = \min(TL, C)$ where TL is the time of the long term event, C is the censoring time, and the second column is $DL = 1*(TL < C)$ , the second to last column is the covariate vector (can be NULL) and the last column is the estimated probability $P(TL < t_0 + \tau \mid TL > t_0)$ .
<code>short</code>	logical value indicating whether data includes short term event information. Should be TRUE if short term XS and DS are includes as third and fourth columns of data matrix, FALSE if not. Default is TRUE.
<code>weight</code>	an optional weight to be incorporated in all estimation.

**Value**

<code>AUC.est</code>	Estimated AUC
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**Author(s)**

Layla Parast

**References**

Parast, Layla, Su-Chun Cheng, and Tianxi Cai. Incorporating short-term outcome information to predict long-term survival with discrete markers. *Biometrical Journal* 53.2 (2011): 294-307.

**Examples**

```
data(data_example_landpred)
t0=2
tau = 8
Prob.Null(t0=t0, tau=tau, data=data_example_landpred)

out = Prob.Null(t0=t0, tau=tau, data=data_example_landpred)
out$Prob
out$data

AUC.landmark(t0=t0, tau=tau, data = out$data)
```

---

BS.landmark

*Estimates the Brier score.*

---

**Description**

This function calculates the Brier score given the data (truth) and corresponding estimated probabilities.

**Usage**

```
BS.landmark(t0, tau, data, short = TRUE, weight=NULL)
```

**Arguments**

t0	the landmark time.
tau	the residual survival time of interest.
data	n by k matrix, where k = 4 or 6. A data matrix where the first column is $XL = \min(TL, C)$ where TL is the time of the long term event, C is the censoring time, and the second column is $DL = 1*(TL < C)$ , the second to last column is the covariate vector (can be NULL) and the last column is the estimated probability $P(TL < t_0 + \tau \mid TL > t_0)$ .
short	logical value indicating whether data includes short term event information. Should be TRUE if short term XS and DS are includes as third and fourth columns of data matrix, FALSE if not. Default is TRUE.
weight	an optional weight to be incorporated in all estimation.

**Value**

Brier.score	Estimated Brier score
-------------	-----------------------

**Author(s)**

Layla Parast

**References**

Parast, Layla, Su-Chun Cheng, and Tianxi Cai. Incorporating short-term outcome information to predict long-term survival with discrete markers. *Biometrical Journal* 53.2 (2011): 294-307.

**Examples**

```
data(data_example_landpred)
t0=2
tau = 8
Prob.Null(t0=t0, tau=tau, data=data_example_landpred)

out = Prob.Null(t0=t0, tau=tau, data=data_example_landpred)
out$Prob
out$data

BS.landmark(t0=t0, tau=tau, data = out$data)
```

---

 cumsum2

*Helper function for AUC.landmark*


---

**Description**

Helper function for AUC.landmark; should not be called directly by user.

**Usage**

```
cumsum2(mydat)
```

**Arguments**

mydat	mydat
-------	-------

**Value**

out	matrix
-----	--------

**Author(s)**

Layla Parast

---

data\_example\_landpred *Hypothetical data to be used in examples.*

---

**Description**

Hypothetical data to be used in examples.

**Usage**

```
data(data_example_landpred)
```

**Format**

A data frame with 4868 observations on the following 5 variables.

XL a numeric vector.  $XL = \min(TL, C)$  where TL is the time of the long term event, C is the censoring time.

DL a 0/1 vector.  $DL = 1*(TL < C)$  where TL is the time of the long term event, C is the censoring time.

XS a numeric vector.  $XS = \min(TS, C)$  where TS is the time of the long term event, C is the censoring time.

DS a 0/1 vector.  $DS = 1*(TS < C)$  where TS is the time of the long term event, C is the censoring time.

Z a 0/1 vector of discrete covariate values.

**Examples**

```
data(data_example_landpred)
```

---

Ghat.FUN

*Calculates the Kaplan Meier survival probability for censoring*

---

**Description**

Calculates the survival probability for censoring i.e.  $P(C > tt)$  where  $C$  is censoring; used in inverse probability of censoring weights (IPCW). This function is called by `Wi.FUN`; this function should not be called on its own.

**Usage**

```
Ghat.FUN(tt, data, type = "fl", weight.given)
```

**Arguments**

<code>tt</code>	the time (or vector of times) at which the survival probability should be estimated.
<code>data</code>	$n$ by $k$ matrix, where $k \geq 2$ . A data matrix where the first column is $XL = \min(TL, C)$ where $TL$ is the time of the long term event, $C$ is the censoring time, and the second column is $DL = 1*(TL < C)$
<code>type</code>	type sent to survfit function, default is "fl".
<code>weight.given</code>	a weight to be used in estimation.

**Value**

survival probability for censoring at time `tt`

**Author(s)**

Layla Parast

`helper.si`*Helper function for AUC.landmark*

---

**Description**

Helper function for AUC.landmark; should not be called directly by user.

**Usage**`helper.si(yy,FUN,Yi,Vi=NULL)`**Arguments**

<code>yy</code>	<code>yy</code>
<code>FUN</code>	<code>FUN</code>
<code>Yi</code>	<code>Yi</code>
<code>Vi</code>	<code>Vi</code>

**Value**

<code>out</code>	<code>matrix</code>
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**Author(s)**

Layla Parast

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`Kern.FUN`*Calculates kernel matrix*

---

**Description**

This calculates the kernel matrix needed for estimating the probability incorporating short term event information

**Usage**`Kern.FUN(zz, zi, bw)`**Arguments**

<code>zz</code>	<code>zz</code>
<code>zi</code>	<code>zi</code>
<code>bw</code>	<code>bandwidth</code>



**Value**

the kernel matrix

**Author(s)**

Layla Parast

---

mse.BW

*Helper function for optimize.mse.BW.*

---

**Description**

Helper function for optimize.mse.BW.

**Usage**

```
mse.BW(data, t0, tau, h, folds = 3, reps=2)
```

**Arguments**

data	n by 5 matrix. A data matrix where the first column is $XL = \min(TL, C)$ where $TL$ is the time of the long term event, $C$ is the censoring time, and the second column is $DL = 1*(TL < C)$ , the third column is $XS = \min(TS, C)$ where $TS$ is the time of the short term event, $C$ is the censoring time, the fourth column is $DS = 1*(TS < C)$ , and the fifth column is the covariate. These are the data used to calculate the estimated probability.
t0	the landmark time.
tau	the residual survival time of interest.
h	bandwidth
folds	Number of folds wanted for K-fold cross-validation. Default is 3.
reps	Number of repetitions wanted of K-fold cross-validation. Default is 2.

**Value**

mean of MSE

**Author(s)**

Layla Parast

**References**

Parast, Layla, Su-Chun Cheng, and Tianxi Cai. Incorporating short-term outcome information to predict long-term survival with discrete markers. *Biometrical Journal* 53.2 (2011): 294-307.

---

optimize.mse.BW      *Calculates initial optimal bandwidth.*

---

### Description

Calculates initial optimal bandwidth with respect to mean squared error using K-fold cross-validation.

### Usage

```
optimize.mse.BW(data, t0, tau, h.grid=seq(.01,2,length=50), folds=3, reps=2)
```

### Arguments

data	n by 5 matrix. A data matrix where the first column is $XL = \min(TL, C)$ where TL is the time of the long term event, C is the censoring time, and the second column is $DL = 1*(TL < C)$ , the third column is $XS = \min(TS, C)$ where TS is the time of the short term event, C is the censoring time, the fourth column is $DS = 1*(TS < C)$ , and the fifth column is the covariate. These are the data used to calculate the estimated probability.
t0	the landmark time.
tau	the residual survival time of interest.
h.grid	The grid of possible bandwidths that the user would like the function to search through. Default is <code>h.grid = seq(.01,2,length=50)</code> .
folds	Number of folds wanted for K-fold cross-validation. Default is 3.
reps	Number of repetitions wanted of K-fold cross-validation. Default is 2.

### Value

h	Selected bandwidth.
---	---------------------

### Author(s)

Layla Parast

### References

Parast, Layla, Su-Chun Cheng, and Tianxi Cai. Incorporating short-term outcome information to predict long-term survival with discrete markers. *Biometrical Journal* 53.2 (2011): 294-307.

---

Prob.Covariate	<i>Estimates <math>P(TL &lt; t_0 + \tau \mid TL &gt; t_0, Z)</math>, i.e. given discrete covariate.</i>
----------------	---

---

### Description

This function calculates the probability that the an individual has the event of interest before  $t_0 + \tau$  given the discrete covariate and given the event has not yet occurred and the individual is still at risk at time  $t_0$ ; this estimated probability does not incorporate any information about the short term event information.

### Usage

```
Prob.Covariate(t0, tau, data, weight = NULL, short = TRUE, newdata = NULL)
```

### Arguments

t0	the landmark time.
tau	the residual survival time for which probabilities are calculated. Specifically, this function estimates the probability that the an individual has the event of interest before $t_0 + \tau$ given the event has not yet occurred and the individual is still at risk at time $t_0$ .
data	n by k matrix, where $k = 3$ or $k = 5$ . A data matrix where the first column is $XL = \min(TL, C)$ where TL is the time of the long term event, C is the censoring time, and the second column is $DL = 1 * (TL < C)$ . If short term event information is included in this dataset then the third column is $XS = \min(TS, C)$ where TS is the time of the short term event, C is the censoring time, and the fourth column is $DS = 1 * (TS < C)$ , and the fifth column is the covariate. If short term event information is not included then the third column is the covariates (see "short" parameter). These are the data used to calculate the estimated probabilities.
weight	an optional weight to be incorporated in all estimation.
short	logical value indicating whether data includes short term event information. Should be TRUE if short term XS and DS are includes as third and fourth columns of data matrix meaning that the covariates is in the fifth column, FALSE if not meaning that the covariate is in the third column. Default is TRUE.
newdata	n by k matrix, where $k = 3$ or $k = 5$ . A data matrix where the first column is $XL = \min(TL, C)$ where TL is the time of the long term event, C is the censoring time, and the second column is $DL = 1 * (TL < C)$ , and the last column (either 3rd or 5th) contains covariate values. Predicted probabilities are estimated for these data.

### Value

Prob	matrix of estimated probability for each value of the covariate; first column shows all covariate values and second column contains predicted probability at that covariate value
------	---

data	the data matrix with an additional column with the estimated individual probabilities; note that the predicted probability is NA if $TL < t_0$ since it is only defined for individuals with $TL > t_0$
newdata	the newdata matrix with an additional column with the estimated individual probabilities; note that the predicted probability is NA if $TL < t_0$ since it is only defined for individuals with $TL > t_0$ ; if newdata is not supplied then this returns NULL

**Author(s)**

Layla Parast

**References**

Parast, Layla, Su-Chun Cheng, and Tianxi Cai. Incorporating short-term outcome information to predict long-term survival with discrete markers. *Biometrical Journal* 53.2 (2011): 294-307.

**Examples**

```
data(data_example_landpred)
t0=2
tau = 8
Prob.Covariate(t0=t0,tau=tau,data=data_example_landpred)

out = Prob.Covariate(t0=t0,tau=tau,data=data_example_landpred)
out$Prob
out$data

newdata = matrix(c(1,1,1, 3,0,1, 4,1,1, 10,1,0, 11,0,1), ncol = 3, byrow=TRUE)
out = Prob.Covariate(t0=t0,tau=tau,data=data_example_landpred,newdata=newdata)
out$Prob
out$newdata
```

---

 Prob.Covariate.ShortEvent

*Estimates  $P(TL < t_0 + \tau \mid TL > t_0, Z, \min(TS, t_0), I(TS \leq t_0))$ , i.e. given discrete covariate and TS information.*

---

**Description**

This function calculates the probability that the an individual has the event of interest before  $t_0 + \tau$  given the discrete covariate, given short term event information, and given the event has not yet occurred and the individual is still at risk at time  $t_0$ .

**Usage**

```
Prob.Covariate.ShortEvent(t0, tau, data, weight = NULL, bandwidth = NULL, newdata=NULL)
```

**Arguments**

<code>t0</code>	the landmark time.
<code>tau</code>	the residual survival time for which probabilities are calculated. Specifically, this function estimates the probability that the an individual has the event of interest before $t0 + \tau$ given the event has not yet occurred and the individual is still at risk at time $t0$ .
<code>data</code>	$n$ by 5 matrix. A data matrix where the first column is $XL = \min(TL, C)$ where $TL$ is the time of the long term event, $C$ is the censoring time, and the second column is $DL = 1*(TL < C)$ , the third column is $XS = \min(TS, C)$ where $TS$ is the time of the short term event, $C$ is the censoring time, the fourth column is $DS = 1*(TS < C)$ , and the fifth column is the covariate. These are the data used to calculate the estimated probability.
<code>weight</code>	a weight to be incorporated in all estimation.
<code>bandwidth</code>	an optional bandwidth to be used in kernel smoothing; is not provided then function calculates an appropriate bandwidth using <code>bw.nrd</code> and then undersmoothing with <code>c = .10</code> (See reference)
<code>newdata</code>	an optional $n$ by 5 matrix where the first column is $XL = \min(TL, C)$ where $TL$ is the time of the long term event, $C$ is the censoring time, and the second column is $DL = 1*(TL < C)$ , the third column is $XS = \min(TS, C)$ where $TS$ is the time of the short term event, $C$ is the censoring time, the fourth column is $DS = 1*(TS < C)$ , and the fifth column is the covariate. Predicted probabilities are estimated for these data.

**Value**

<code>data</code>	the data matrix with an additional column with the estimated individual probabilities; note that the predicted probability is NA if $TL < t0$ since it is only defined for individuals with $TL > t0$
<code>newdata</code>	the newdata matrix with an additional column with the estimated individual probabilities; note that the predicted probability is NA if $TL < t0$ since it is only defined for individuals with $TL > t0$ ; if newdata is not supplied then this returns NULL

**Author(s)**

Layla Parast

**References**

Parast, Layla, Su-Chun Cheng, and Tianxi Cai. Incorporating short-term outcome information to predict long-term survival with discrete markers. *Biometrical Journal* 53.2 (2011): 294-307.

**Examples**

```
data(data_example_landpred)
t0=2
tau = 8
```

```

#note: computationally intensive command below
#Prob.Covariate.ShortEvent(t0=t0,tau=tau,data=data_example_landpred)

#out = Prob.Covariate.ShortEvent(t0=t0,tau=tau,data=data_example_landpred)
#out$data
#data.plot = out$data
#plot(data.plot$XS[data.plot$Z ==1], data.plot$Probability[data.plot$Z ==1],
#pch = 20, xlim = c(0,t0))
#points(data.plot$XS[data.plot$Z ==0], data.plot$Probability[data.plot$Z ==0],
#pch = 20, col = 2)

newdata = matrix(c(1,1,0.5,1,0,
3,0,1,1,1,
4,1,1.5,1,0,
10,1,5,1,0,
11,0,11,0,1), ncol = 5, byrow=TRUE)
#note: computationally intensive command below
#out = Prob.Covariate.ShortEvent(t0=t0,tau=tau,data=data_example_landpred,newdata=newdata)
#out$newdata

```

---

 Prob.Null

*Estimates  $P(TL < t_0 + \tau \mid TL > t_0)$ .*


---

## Description

This function calculates the probability that an individual has the event of interest before  $t_0 + \tau$  given the event has not yet occurred and the individual is still at risk at time  $t_0$ ; this estimated probability does not incorporate any information about the covariate or short term event information.

## Usage

```
Prob.Null(t0, tau, data, weight = NULL, newdata=NULL)
```

## Arguments

<code>t0</code>	the landmark time.
<code>tau</code>	the residual survival time for which probabilities are calculated. Specifically, this function estimates the probability that the an individual has the event of interest before $t_0 + \tau$ given the event has not yet occurred and the individual is still at risk at time $t_0$ .
<code>data</code>	n by k matrix, where $k \geq 2$ . A data matrix where the first column is $XL = \min(TL, C)$ where TL is the time of the long term event, C is the censoring time, and the second column is $DL = 1*(TL < C)$ . These are the data used to calculate the estimated probability.
<code>weight</code>	an optional weight to be incorporated in all estimation.

`newdata` an optional  $n$  by  $k$  matrix, where  $k \geq 2$ . A data matrix where the first column is  $XL = \min(TL, C)$  where  $TL$  is the time of the long term event,  $C$  is the censoring time, and the second column is  $DL = 1*(TL < C)$ . Predicted probabilities are estimated for these data.

### Value

`Prob` Estimated probability that the an individual has the event of interest before  $t_0 + \tau$  given the event has not yet occurred and the individual is still at risk at time  $t_0$ ; this estimated probability does not incorporate any information about the covariate or short term event information.

`data` the data matrix with an additional column with the estimated individual probabilities; note that the predicted probability is NA if  $TL < t_0$  since it is only defined for individuals with  $TL > t_0$

`newdata` the newdata matrix with an additional column with the estimated individual probabilities; note that the predicted probability is NA if  $TL < t_0$  since it is only defined for individuals with  $TL > t_0$ ; if newdata is not supplied then this returns NULL

### Author(s)

Layla Parast

### References

Parast, Layla, Su-Chun Cheng, and Tianxi Cai. Incorporating short-term outcome information to predict long-term survival with discrete markers. *Biometrical Journal* 53.2 (2011): 294-307.

### Examples

```
data(data_example_landpred)
t0=2
tau = 8
Prob.Null(t0=t0, tau=tau, data=data_example_landpred)

out = Prob.Null(t0=t0, tau=tau, data=data_example_landpred)
out$Prob
out$data

newdata = matrix(c(1,1,3,0,4,1,10,1,11,0), ncol = 2, byrow=TRUE)
out = Prob.Null(t0=t0, tau=tau, data=data_example_landpred, newdata=newdata)
out$Prob
out$newdata
```

---

 Prob2

*Estimates  $P(TL < t_0 + \tau \mid TL > t_0, Z, TS > t_0)$ .*


---

**Description**

This function calculates the probability that the an individual has the event of interest before  $t_0 + \tau$  given the discrete covariate, given the short term event has not yet occurred by  $t_0$ , and given the long term event has not yet occurred and the individual is still at risk at time  $t_0$ . This function is called by Prob.Covariate.ShortEvent; this function should not be called on its own.

**Usage**

```
Prob2(t0, tau, data, covariate.value, weight = NULL)
```

**Arguments**

<code>t0</code>	the landmark time.
<code>tau</code>	the residual survival time for which probabilities are calculated. Specifically, this function estimates the probability that the an individual has the event of interest before $t_0 + \tau$ given the event has not yet occurred and the individual is still at risk at time $t_0$ .
<code>data</code>	n by 5 matrix. A data matrix where the first column is $XL = \min(TL, C)$ where $TL$ is the time of the long term event, $C$ is the censoring time, and the second column is $DL = 1*(TL < C)$ , the third column is $\log(XS) = \log(\min(TS, C))$ where $TS$ is the time of the short term event, $C$ is the censoring time, the fourth column is $DS = 1*(TS < C)$ , and the fifth column is the covariate. These are the data used to calculate the estimated probability.
<code>covariate.value</code>	the discrete covariate value at which to calculate the estimated probability.
<code>weight</code>	an optional weight to be incorporated in all estimation.

**Value**

Estimated probability =  $P(TL < t_0 + \tau \mid TL > t_0, Z, TS > t_0)$ .

**Author(s)**

Layla Parast

**References**

Parast, Layla, Su-Chun Cheng, and Tianxi Cai. Incorporating short-term outcome information to predict long-term survival with discrete markers. *Biometrical Journal* 53.2 (2011): 294-307.



---

 Prob2.k.t

*Estimates  $P(TL < t_0 + \tau \mid TL > t_0, Z, TS = ts)$ .*


---

**Description**

This function calculates the probability that the an individual has the event of interest before  $t_0 + \tau$  given the discrete covariate, given the short term event occurred before  $t_0$  and occurred at time  $ts$ , and given the long term event has not yet occurred and the individual is still at risk at time  $t_0$ . This function is called by Prob.Covariate.ShortEvent; this function should not be called on its own.

**Usage**

```
Prob2.k.t(t, t0, tau, data.use, bandwidth, covariate.value, weight = NULL)
```

**Arguments**

t	time of the short term event, $ts$ , on the log scale.
$t_0$	the landmark time.
tau	the residual survival time for which probabilities are calculated. Specifically, this function estimates the probability that the an individual has the event of interest before $t_0 + \tau$ given the event has not yet occurred and the individual is still at risk at time $t_0$ .
data.use	n by 5 matrix. A data matrix where the first column is $XL = \min(TL, C)$ where $TL$ is the time of the long term event, $C$ is the censoring time, and the second column is $DL = 1*(TL < C)$ , the third column is $\log(XS) = \log(\min(TS, C))$ where $TS$ is the time of the short term event, $C$ is the censoring time, the fourth column is $DS = 1*(TS < C)$ , and the fifth column is the covariate.
bandwidth	bandwidth to be used.
covariate.value	covariate value at which to calculate probability.
weight	an optional weight to be incorporated in all estimation.

**Value**

returns estimated probabilities for each  $ts$  value (parameter  $t$ ) at the specified covariate value; returns NA if  $ts > t_0$ .

**Author(s)**

Layla Parast

**References**

Parast, Layla, Su-Chun Cheng, and Tianxi Cai. Incorporating short-term outcome information to predict long-term survival with discrete markers. *Biometrical Journal* 53.2 (2011): 294-307.

---

 prob2.single

*Estimates  $P(TL < t_0 + \tau \mid TL > t_0, Z, TS = ts)$  for a single  $t$ .*


---

**Description**

Helper function for Prob2.k.t; should not be called directly.

**Usage**

```
prob2.single(K, W2i, Xi.long, tau, Di.short, Xi.short, Zi, t0, covariate.value)
```

**Arguments**

K	Kernel matrix.
W2i	inverse probability of censoring weights.
Xi.long	$XL = \min(TL, C)$ where TL is the time of the long term event, C is the censoring time.
tau	the residual survival time for which probabilities are calculated. Specifically, this function estimates the probability that the an individual has the event of interest before $t_0 + \tau$ given the event has not yet occurred and the individual is still at risk at time $t_0$ .
Di.short	$DS = 1 * (TS < C)$ , where TS is the time of the short term event, C is the censoring time.
Xi.short	$\log(XS) = \log(\min(TS, C))$ where TS is the time of the short term event, C is the censoring time.
Zi	covariate vector.
t0	landmark time.
covariate.value	specific covariate at which to estimate the conditional probability.

**Value**

returns estimated probability for values corresponding to the kernel matrix at the specified covariate value;

**Author(s)**

Layla Parast

---

VTM *Helper function, repeats a row.*

---

### Description

This function creates a matrix that repeats vc, dm times where each row is equal to the vc vector.

### Usage

VTM(vc, dm)

### Arguments

vc                    the vector to repeat.  
dm                    number of rows.

### Value

a matrix that repeats vc, dm times where each row is equal to the vc vector

---

Wi.FUN *Computes the inverse probability of censoring weights for a specific t0 and tau*

---

### Description

Computes the inverse probability of censoring weights for a specific t0 and tau i.e. this computes  $I(t_0 < XL < t_0 + \tau) * DL / G(XL) + I(XL > t_0 + \tau) / G(t_0 + \tau)$  where  $XL = \min(TL, C)$ , TL is the time of the long term event, C is the censoring time,  $DL = 1 * (TL < C)$  and G() is the estimate survival probability for censoring estimated using the Kaplan Meier estimator (see Ghat.FUN)

### Usage

Wi.FUN(data, t0, tau, weight.given = NULL)

### Arguments

data                    n by k matrix, where  $k \geq 2$ . A data matrix where the first column is  $XL = \min(TL, C)$  where TL is the time of the long term event, C is the censoring time, and the second column is  $DL = 1 * (TL < C)$   
t0                    the landmark time..  
tau                    the residual survival time for which probabilities are calculated.  
weight.given        an optional weight to be incorporated in estimation of this weight

**Value**

Inverse probability of censoring weight.

**Author(s)**

Layla Parast

**Examples**

```
data(data_example_landpred)
t0=2
tau = 8
```

```
W2i <- Wi.FUN(data_example_landpred[,1],data = data_example_landpred[,c(1:2)],t0=t0,tau=tau)
```

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