kernhaz for MATLAB

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1 Introduction

Kernhaz for MATLAB is the package of M-functions created as an alternative to R package kernhaz [1] for MATLAB users. This package implements estimates of hazard function for right-censored data. These estimates are smooth functions based on kernel methods. The risk of an event (death, relapse,...) is estimated as time-dependent or moreover depending on some covariate (age, tumor volume,...). The package includes also two bandwidth selection methods.

2 Unconditional hazard function

Kernel estimate of (unconditional) hazard function for right-censored data can be created using M-function `khazard`.

Syntax

```
[timepoints,haz]=khazard(time,delta)

[timepoints,haz,h]=khazard(time,delta,plot_out,h,t,type,kernel
   ,parallel,tol)
```

Description

Kernel estimate of (unconditional) hazard function for right-censored data. Options include two types of kernel estimator [2] and two methods for bandwidth selection.

External type of kernel estimator is defined as the ratio of kernel estimator of the subdensity of the uncensored observations to the survival function of the observable time. Internal type of kernel estimator is based on a convolution of the kernel function with a nonparametric estimator of the cumulative hazard function (Nelson-Aalen estimator).

Input

`time` vector of observed times.

`delta` vector of censoring indicator. 0 - censored, 1 - uncensored (dead).

`plot_out` provides graphical output, default is true.

`h` bandwidth (scalar or vector) or string of method for bandwidth selection (`'crossval'` (default), `'maxlike'`). If missing, `h` is found using some bandwidth selection method.

`t` vector of time points at which estimate is evaluated.

`type` specifies type of kernel estimate. Possible types are: `'exterior'`, `'interior'` (default).

`kernel` specifies kernel function, possible values are: `'epanechnikov'` (default), `'gaussian'`, `'rectangular'`, `'quartic'`.

`parallel` allows parallel computation. Default is false.

`tol` the desired accuracy of optimization algorithm.

Output

`timepoints` vector of time points at which estimate is evaluated.

`haz` vector of hazard function values.

`h` used bandwidth.

3 Conditional hazard function

Kernel estimate of conditional hazard function for right-censored data can be created using M-function `khazardcond`.

Syntax

```
[timepoints,covariatepoints,haz]=khazardcond(time,covariate,
   delta)

[timepoints,covariatepoints,haz,h]=khazardcond(time,covariate,
   delta,plot_out,h,t,x,type,typew,kernel,parallel,tol)
```

Description

Kernel estimate of conditional hazard function for right-censored data with one covariate. Options include two types of kernel estimator [2] and two methods for bandwidth selection.

External type of kernel estimator is defined as the ratio of kernel estimator of the conditional subdensity of the uncensored observations to the conditional survival function of the observable time. Internal type of kernel estimator is based on a convolution of the kernel function with a nonparametric estimator of the cumulative conditional hazard function.

Input

`time` vector of observed times.

`covariate` vector of observed covariate values.

`delta` vector of censoring indicator. 0 - censored, 1 - uncensored (dead).

`plot_out` provides graphical output, default is true.

`h` bandwidth vector of length 2 (first element is bandwidth for time and second for covariate) or string of method for bandwidth selection (`'crossval'` (default), `'maxlike'`). If missing, `h` is found using some bandwidth selection method.

`t` vector of time points at which estimate is evaluated.

`x` vector of covariate points at which estimate is evaluated.

`type` specifies type of kernel estimate. Possible types are: `'exterior'`, `'interior'` (default).

`typew` specifies type of weights. Default are Nadaraya–Watson weights.

`kernel` specifies kernel function, possible values are: `'epanechnikov'` (default), `'gaussian'`, `'rectangular'`, `'quartic'`.

`parallel` allows parallel computation. Default is false.

`tol` the desired accuracy of optimization algorithm.

Output

`timepoints` vector of time points at which estimate is evaluated

`covariatepoints` vector of covariate points at which estimate is evaluated

`haz` matrix of hazard function values

`h` vector of used bandwidths

References

[1] Selingerova, I., Langrova, M., *kernhaz: Kernel Estimation of Hazard Function in Survival Analysis*, CRAN, 2018, `https://cran.r-project.org/package=kernhaz`.

[2] Selingerova, I., Dolezelova, H., Horova, I., Katina, S., Zelinka, J., *Survival of Patients with Primary Brain Tumors: Comparison of Two Statistical Approaches*, 2016, PloS one, 11(2), e0148733.