

Package ‘wastee’

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Type Package

Title Testing under loss of identifiability

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Description Provide a method to calculate p-value of the test statistic for subgroup detecting in the framework of general estimating equation (EE). In the paper Liu (2022), we propose a novel U-like statistic by taking the weighted average over the nuisance parametric space. The proposed test statistics not only improve power, but also save dramatically computational time. Many common and useful models are considered, including mixture models and models with change point or change plane. We propose a novel U-like test statistic to detect multiple change planes in the framework of EE.

License GPL (>= 2)

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R topics documented:

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wastee-package

Testing under loss of identifiability

Description

Provide a method to calculate p-value of the test statistic for subgroup detecting in the framework of general estimating equation (EE). In the paper Liu (2022), we propose a novel U-like statistic by taking the weighted average over the nuisance parametric space. The proposed test statistics not only improve power, but also save dramatically computational time. Many common and useful models are considered, including mixture models and models with change point or change plane. We propose a novel U-like test statistic to detect multiple change planes in the framework of EE.

Details

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References

- Andrews, D. W. K. and Ploberger, W. (1994). Optimal tests when a nuisance parameter is present only under the alternative. *Econometrica*, 62(6):1383-1414.
- Davies, R. B. (1977). Hypothesis testing when a nuisance parameter is present only under the alternative. *Biometrika*, 64(2):247-254.
- Davies, R. B. (1987). Hypothesis testing when a nuisance parameter is present only under the alternative. *Biometrika*, 74(1):33-43.
- Fan, A., Rui, S., and Lu, W. (2017). Change-plane analysis for subgroup detection and sample size calculation. *Journal of the American Statistical Association*, 112(518):769-778.
- Huang, Y., Cho, J., and Fong, Y. (2021). Threshold-based subgroup testing in logistic regression models in two phase sampling designs. *Journal of the Royal Statistical Society: Series C*. 291-311.
- LEE, S., SEO, M. H. and SHIN, Y. (2011). Testing for Threshold Effects in Regression Models. *Journal of the American Statistical Association* 106, 220-231.
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exams

Examples for subgroup test in the framework of general estimating equation

Description

Examples of p-value of test statistics for 'Gaussian mixture', 'Exponential mixture', 'Poisson mixture', 'Quantile regression', 'Probit regression', and 'Semiparametric models'.

Usage

```
exams(family = "mixexp", method = "wast", M = 1000, K = 1000, tau = 0.5)
```

Arguments

family	Family for the general estimating equation, including Gaussian mixture ('mixnorm'), Exponential mixture ('mixexp'), Poisson mixture ('mixpoiss'), Quantile regression ('quantile'), Probit regression ('probit'), and Semiparametric models ('semiparam').
method	There are two methods, including the proposed 'wast' and 'sst'.
M	An integer, the number of bootstrap samples.
K	An integer, the number of threshold values for 'sst'.
tau	The given quantile τ , a scale in the unit interval. It is only available if family="quantile".

Value

pvals	P-value of the corresponding test statistic.
-------	--

References

- Andrews, D. W. K. and Ploberger, W. (1994). Optimal tests when a nuisance parameter is present only under the alternative. *Econometrica*, 62(6):1383-1414.
- Davies, R. B. (1977). Hypothesis testing when a nuisance parameter is present only under the alternative. *Biometrika*, 64(2):247-254.
- Davies, R. B. (1987). Hypothesis testing when a nuisance parameter is present only under the alternative. *Biometrika*, 74(1):33-43.
- Fan, A., Rui, S., and Lu, W. (2017). Change-plane analysis for subgroup detection and sample size calculation. *Journal of the American Statistical Association*, 112(518):769-778.
- Huang, Y., Cho, J., and Fong, Y. (2021). Threshold-based subgroup testing in logistic regression models in two phase sampling designs. *Journal of the Royal Statistical Society: Series C*. 291-311.
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Examples

```
pvals <- exams(family = "mixnorm", method = "wast")
pvals

pvals <- exams(family = "mixexp", method = "wast")
pvals

pvals <- exams(family = "mixpoiss", method = "wast")
pvals

pvals <- exams(family = "quantile", method = "wast", tau = 0.5)
pvals

pvals <- exams(family = "probit", method = "wast")
pvals

pvals <- exams(family = "semiparam", method = "wast")
pvals
```

pval_mixexp

*P-value for subgroup test in Exponential mixture models***Description**

Provide p-value for subgroup test in Exponential mixture models, including two methods 'wast' and 'sst'.

Usage

```
pval_mixexp(y, method = "wast", M = 1000, K = 1000, lambda = 1, alpha = NULL)
```

Arguments

y	The data.
method	There are three methods, including the proposed 'wast', 'sst', and 'davies'. Refer method 'davies' to Davies (1977, 1987) which is only available for known true parameter $\alpha = \alpha_0$.
M	An integer, the number of bootstrap samples.
K	An integer, the number of threshold values for 'sst' and 'davies'.
lambda	The rate parameter of weight that is a Exponential distribution.
alpha	Rate parameter of Exponential distribution under the null. Default is NULL, in which the rate parameter α is estimated by the reciprocal of sample mean, that is $\hat{\alpha} = \frac{1}{\bar{y}}$.

Details

Exponential mixture model

$$f(y) = (1 - \beta)\alpha \exp(-\alpha y) + \beta\theta \exp(-\theta y),$$

where $\beta \in [0, 1]$, $\alpha \in \mathbf{R}$ and $\theta \in \mathbf{R}$ are unknown parameters.

Value

pvals P-value of the corresponding test statistic.

References

- Andrews, D. W. K. and Ploberger, W. (1994). Optimal tests when a nuisance parameter is present only under the alternative. *Econometrica*, 62(6):1383-1414.
- Davies, R. B. (1977). Hypothesis testing when a nuisance parameter is present only under the alternative. *Biometrika*, 64(2):247-254.
- Davies, R. B. (1987). Hypothesis testing when a nuisance parameter is present only under the alternative. *Biometrika*, 74(1):33-43.
- Fan, A., Rui, S., and Lu, W. (2017). Change-plane analysis for subgroup detection and sample size calculation. *Journal of the American Statistical Association*, 112(518):769-778.
- Huang, Y., Cho, J., and Fong, Y. (2021). Threshold-based subgroup testing in logistic regression models in two phase sampling designs. *Journal of the Royal Statistical Society: Series C*. 291-311.

LEE, S., SEO, M. H. and SHIN, Y. (2011). Testing for Threshold Effects in Regression Models. Journal of the American Statistical Association 106, 220-231.

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Examples

```
data(simulatedData_mixexp)
pvals <- pval_mixexp(y = data_mixexp, method = "wast")
pvals

pvals <- pval_mixexp(y = data_mixexp, method = "sst")
pvals

pvals <- pval_mixexp(y = data_mixexp, method = "davies", alpha = 1)
pvals
```

pval_mixnorm	<i>P-value for subgroup test in Gaussian mixture models</i>
--------------	---

Description

Provide p-value for subgroup test in Gaussian mixture models, including two methods 'wast' and 'sst'.

Usage

```
pval_mixnorm(y, method = "wast", M = 1000, K = 1000,
             mu = 0, sigma2 = 1, alpha = NULL)
```

Arguments

y	The data.
method	There are three methods, including the proposed 'wast', 'sst', and 'davies'. Refer method 'davies' to Davies (1977, 1987), which is only available for known true parameter $\alpha = \alpha_0$.
M	An integer, the number of bootstrap samples.
K	An integer, the number of threshold values for 'sst' and 'davies'.
mu	The mean μ of weight that is a normal distribution.
sigma2	The variance σ^2 of weight that is a normal distribution.
alpha	Mean under the null. Default is NULL, in which the mean α is estimated by the sample mean.

Details

Gaussian mixture model

$$f(y) = (1 - \beta)\phi(y - \alpha) + \beta\phi(y - \theta),$$

where $\phi(\cdot)$ is the density of standard normal distribution, and $\beta \in [0, 1]$, $\alpha \in \mathbf{R}$ and $\theta \in \mathbf{R}$ are unknown parameters.

Value

pvals P-value of the corresponding test statistic.

References

- Andrews, D. W. K. and Ploberger, W. (1994). Optimal tests when a nuisance parameter is present only under the alternative. *Econometrica*, 62(6):1383-1414.
- Davies, R. B. (1977). Hypothesis testing when a nuisance parameter is present only under the alternative. *Biometrika*, 64(2):247-254.
- Davies, R. B. (1987). Hypothesis testing when a nuisance parameter is present only under the alternative. *Biometrika*, 74(1):33-43.
- Fan, A., Rui, S., and Lu, W. (2017). Change-plane analysis for subgroup detection and sample size calculation. *Journal of the American Statistical Association*, 112(518):769-778.
- Huang, Y., Cho, J., and Fong, Y. (2021). Threshold-based subgroup testing in logistic regression models in two phase sampling designs. *Journal of the Royal Statistical Society: Series C*. 291-311.
- LEE, S., SEO, M. H. and SHIN, Y. (2011). Testing for Threshold Effects in Regression Models. *Journal of the American Statistical Association* 106, 220-231.
- Liu, X. (2022). Testing under loss of identifiability. Manuscript.

Examples

```
data(simulatedData_mixnorm)
pvals <- pval_mixnorm(y = data_mixnorm, method = "wast")
pvals

pvals <- pval_mixnorm(y = data_mixnorm, method = "sst")
pvals

pvals <- pval_mixnorm(y = data_mixnorm, method = "davies", alpha = 0)
pvals
```

pval_mixpoiss	<i>P-value for subgroup test in Poission mixture models</i>
---------------	---

Description

Provide p-value for subgroup test in Poission mixture models, including two methods 'wast' and 'sst'.

Usage

```
pval_mixpoiss(y, method = "wast", M = 1000, K = 1000,
              lambda = 1, tau = 2, alpha = NULL)
```

Arguments

y	The data.
method	There are three methods, including the proposed 'wast', 'sst', and 'davies'. Refer method 'davies' to Davies (1977, 1987) which is only available for known true parameter $\alpha = \alpha_0$.
M	An integer, the number of bootstrap samples.
K	An integer, the number of threshold values for 'sst' and 'davies'.
lambda	The rate parameter λ of weight that is a Gamma distribution.
tau	The shape parameter τ of weight that is a Gamma distribution.
alpha	Mean under the null. Default is NULL, in which the mean α is estimated by the sample mean.

Details

Poisson mixture model

$$f(y) = (1 - \beta) \frac{\alpha^y \exp(-\alpha)}{y!} + \beta \frac{\theta^y \exp(-\theta)}{y!},$$

where $\beta \in [0, 1]$, $\alpha \in \mathbf{R}$ and $\theta \in \mathbf{R}$ are unknown parameters.

Value

pvals P-value of the corresponding test statistic.

References

- Andrews, D. W. K. and Ploberger, W. (1994). Optimal tests when a nuisance parameter is present only under the alternative. *Econometrica*, 62(6):1383-1414.
- Davies, R. B. (1977). Hypothesis testing when a nuisance parameter is present only under the alternative. *Biometrika*, 64(2):247-254.
- Davies, R. B. (1987). Hypothesis testing when a nuisance parameter is present only under the alternative. *Biometrika*, 74(1):33-43.
- Fan, A., Rui, S., and Lu, W. (2017). Change-plane analysis for subgroup detection and sample size calculation. *Journal of the American Statistical Association*, 112(518):769-778.
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- Liu, X. (2022). Testing under loss of identifiability. Manuscript.

Examples

```
data(simulatedData_mixpoiss)
pvals <- pval_mixpoiss(y = data_mixpoiss, method = "wast")
pvals

pvals <- pval_mixpoiss(y = data_mixpoiss, method = "sst")
pvals
```

```
pvals <- pval_mixpoiss(y = data_mixpoiss, method = "davies", alpha = 1)
pvals
```

pval_probit

P-value for subgroup test in probit regression models

Description

Provide p-value for subgroup test in probit regression models, including two methods 'wast' and 'sst'.

Usage

```
pval_probit(data, method = "wast", M = 1000, K = 2000,
            isBeta = FALSE, shape1 = 1, shape2 = 1)
```

Arguments

data	A list, including Y (response), X (baseline variable), Z (grouping difference variable), and U (grouping variable).
method	There are two methods, including the proposed 'wast' and 'sst'.
M	An integer, the number of bootstrap samples.
K	An integer, the number of threshold values for 'sst'.
isBeta	A bool value. The weight $w(\gamma)$ is chosen to be Beta distribution if isBeta=TRUE, which can be used if the grouping difference variable is bounded in $[0, 1]$. Default is FALSE.
shape1	The first parameter of Beta distribution if isBeta = TRUE.
shape2	The second parameter of Beta distribution if isBeta = TRUE.

Details

Probit regression models

$$f(\mathbf{V}_i) = \Phi(h(\mathbf{V}_i, \boldsymbol{\alpha}, \boldsymbol{\beta}, \boldsymbol{\theta}))^{Y_i} + \Phi(-h(\mathbf{V}_i, \boldsymbol{\alpha}, \boldsymbol{\beta}, \boldsymbol{\theta}))^{1-Y_i},$$

where $\Phi(\cdot)$ is the cumulative distribution function of standard normal distribution, and

$$h(\mathbf{V}_i, \boldsymbol{\alpha}, \boldsymbol{\beta}, \boldsymbol{\theta}) = \mathbf{X}_i \boldsymbol{\alpha} + \mathbf{Z}_i^T \boldsymbol{\beta} \mathbf{1}(U_i^T \boldsymbol{\theta} \geq 0).$$

Value

pvals P-value of the corresponding test statistic.

References

- Andrews, D. W. K. and Ploberger, W. (1994). Optimal tests when a nuisance parameter is present only under the alternative. *Econometrica*, 62(6):1383-1414.
- Fan, A., Rui, S., and Lu, W. (2017). Change-plane analysis for subgroup detection and sample size calculation. *Journal of the American Statistical Association*, 112(518):769-778.
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- LEE, S., SEO, M. H. and SHIN, Y. (2011). Testing for Threshold Effects in Regression Models. *Journal of the American Statistical Association* 106, 220-231.
- Liu, X. (2022). Testing under loss of identifiability. Manuscript.

Examples

```
data(simulatedData_probit)
pvals <- pval_probit(data = data_probit, method = "wast")
pvals

pvals <- pval_probit(data = data_probit, method = "sst")
pvals
```

pval_quantile	<i>P-value for subgroup test in quantile regression models</i>
---------------	--

Description

Provide p-value for subgroup test in quantile regression models, including two methods 'wast' and 'sst'.

Usage

```
pval_quantile(data, method = "wast", tau = 0.5, M = 1000, K = 2000,
              isBeta = FALSE, shape1 = 1, shape2 = 1)
```

Arguments

data	A list, including Y (response), X (baseline variable), Z (grouping difference variable), and U (grouping variable).
method	There are two methods, including the proposed 'wast' and 'sst'.
tau	The given quantile τ , a scale in the unit interval.
M	An integer, the number of bootstrap samples.
K	An integer, the number of threshold values for 'sst'.
isBeta	A bool value. The weight $w(\gamma)$ is chosen to be Beta distribution if isBeta=TRUE, which can be used if the grouping difference variable is bounded in $[0, 1]$. Default is FALSE.
shape1	The first parameter of Best distribution if isBeta = TRUE.
shape2	The second parameter of Best distribution if isBeta = TRUE.

Details

Quantile regression models

$$Q_{Y_i}(\tau|\mathbf{X}_i, \mathbf{Z}_i, \mathbf{U}_i) = \mathbf{X}_i^T \boldsymbol{\alpha}(\tau) + \mathbf{Z}_i^T \boldsymbol{\beta}(\tau) \mathbf{1}(\mathbf{U}_i^T \boldsymbol{\theta}(\tau) \geq 0).$$

Value

pvals P-value of the corresponding test statistic.

References

- Andrews, D. W. K. and Ploberger, W. (1994). Optimal tests when a nuisance parameter is present only under the alternative. *Econometrica*, 62(6):1383-1414.
- Fan, A., Rui, S., and Lu, W. (2017). Change-plane analysis for subgroup detection and sample size calculation. *Journal of the American Statistical Association*, 112(518):769-778.
- Huang, Y., Cho, J., and Fong, Y. (2021). Threshold-based subgroup testing in logistic regression models in two phase sampling designs. *Journal of the Royal Statistical Society: Series C*. 291-311.
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- Liu, X. (2022). Testing under loss of identifiability. Manuscript.

Examples

```
data(simulatedData_quantile)
pvals <- pval_quantile(data = data_quantile, tau = 0.5, method = "wast")
pvals

pvals <- pval_quantile(data = data_quantile, tau = 0.3, method = "wast")
pvals
```

pval_semiparam	<i>P-value for subgroup test in semiparamtric models</i>
----------------	--

Description

Provide p-value for subgroup test in semiparamtric models, including two methods 'wast' and 'sst'.

Usage

```
pval_semiparam(data, method = "wast", M = 1000, K = 2000,
               isBeta = FALSE, shape1 = 1, shape2 = 1)
```

Arguments

data	A list, including Y (response), A (treatment indicator), X_1 and X_2 (baseline variables), Z (grouping difference variable), and U (grouping variable).
method	There are two methods, including the proposed 'wast' and 'sst'.
M	An integer, the number of bootstrap samples.
K	An integer, the number of threshold values for 'sst'.
isBeta	A bool value. The weight $w(\gamma)$ is chosen to be Beta distribution if isBeta=TRUE, which can be used if the grouping difference variable is bounded in $[0, 1]$. Default is FALSE.
shape1	The first parameter of Best distribution if isBeta = TRUE.
shape2	The second parameter of Best distribution if isBeta = TRUE.

Details

Semiparamtric models (see details in my paper Liu (2022))

$$Y_i = h(\mathbf{X}_{1i}) + A_i \mathbf{Z}_i^T \beta \mathbf{1}(U_i^T \boldsymbol{\theta} \geq 0) + \epsilon_i,$$

where $h(\mathbf{X}_1)$ is an unknown baseline mean function for patients in treatment $A = 0$ which can be set a linear function $h(\mathbf{X}_1) = \mathbf{X}_1^T \boldsymbol{\alpha}_1$, and $P(A = 1|\mathbf{X}_2)$ can be modeled by a logistic regression model

$$P(A = 1|\mathbf{X}_2) = \pi(\mathbf{X}_2, \boldsymbol{\alpha}_2) = \frac{\exp\{\mathbf{X}_2^T \boldsymbol{\alpha}_2\}}{1 + \exp\{\mathbf{X}_2^T \boldsymbol{\alpha}_2\}}.$$

Value

pvals	P-value of the corresponding test statistic.
-------	--

References

- Andrews, D. W. K. and Ploberger, W. (1994). Optimal tests when a nuisance parameter is present only under the alternative. *Econometrica*, 62(6):1383-1414.
- Fan, A., Rui, S., and Lu, W. (2017). Change-plane analysis for subgroup detection and sample size calculation. *Journal of the American Statistical Association*, 112(518):769-778.
- Huang, Y., Cho, J., and Fong, Y. (2021). Threshold-based subgroup testing in logistic regression models in two phase sampling designs. *Journal of the Royal Statistical Society: Series C*. 291-311.
- LEE, S., SEO, M. H. and SHIN, Y. (2011). Testing for Threshold Effects in Regression Models. *Journal of the American Statistical Association* 106, 220-231.
- Liu, X. (2022). Testing under loss of identifiability. Manuscript.

Examples

```
data(simulatedData_semiparam)
pvals <- pval_semiparam(data = data_semiparam, method = "wast")
pvals

pvals <- pval_semiparam(data = data_semiparam, method = "sst")
pvals
```

simulatedData	<i>Simulated data from the framework of general estimating equations</i>
---------------	--

Description

Simulated data from the framework of general estimating equations, including model

- 'Gaussian mixture' (simulatedData_mixnorm),
- 'Exponential mixture' (simulatedData_mixexp),
- 'Poisson mixture' (simulatedData_mixpoiss),
- 'Quantile regression' (simulatedData_quantile),
- 'Probit regression' (simulatedData_probit), and
- 'Semiparamtric models' (simulatedData_semiparam).

Usage

```
data(simulatedData_probit)
```

Details

We simulated data generated from general estimating equations, for instance, Probit regression models

$$f(\mathbf{V}_i) = \Phi(h(\mathbf{V}_i, \boldsymbol{\alpha}, \boldsymbol{\beta}, \boldsymbol{\theta}))^{Y_i} + \Phi(-h(\mathbf{V}_i, \boldsymbol{\alpha}, \boldsymbol{\beta}, \boldsymbol{\theta}))^{1-Y_i},$$

where $\Phi(\cdot)$ is the cumulative distribution function of standard normal distribution, and

$$h(\mathbf{V}_i, \boldsymbol{\alpha}, \boldsymbol{\beta}, \boldsymbol{\theta}) = \mathbf{X}_i \boldsymbol{\alpha} + \mathbf{Z}_i^T \boldsymbol{\beta} \mathbf{1}(\mathbf{U}_i^T \boldsymbol{\theta} \geq 0).$$

- Y: the response, an n -vector
- X: the baseline variable with dimension $n \times p$
- Z: the grouping difference variable with dimension $n \times q$
- U: the grouping variable with dimension $n \times r$

References

Liu, X. (2022). Testing under loss of identifiability. Manuscript.

Examples

```
data(simulatedData_probit)
y <- data_probit$Y[1:5]
x <- dim(data_probit$X)
z <- dim(data_probit$Z)
u <- dim(data_probit$U)

data(simulatedData_semiparam)
y <- data_semiparam$Y[1:5]
x1 <- dim(data_semiparam$X1)
x2 <- dim(data_semiparam$X2)
z <- dim(data_semiparam$Z)
u <- dim(data_semiparam$U)
```

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