Package 'double.truncation'

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Title Analysis of Doubly-Truncated Data

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Description Likelihood-based inference methods with doubly-truncated data are developed under various models. Nonparametric models are based on Efron and Petrosian (1999) <doi:10.1080/01621459.1999.10474187> and Emura, Konno, and Michimae (2015) <doi:10.1007/s10985-014-9297-5>. Parametric models from the special exponential family (SEF) are based on Hu and Emura (2015) <doi:10.1007/s00180-015-0564-z> and Emura, Hu and Konno (2017) <doi:10.1007/s00362-015-0730-y>. The parametric location-scale models are based on Dorre et al. (2021) <doi:10.1007/s00180-020-01027-6>.

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Contents

`double.truncation-package` *Analysis of Doubly-Truncated Data*

Description

Likelihood-based inference methods with doubly-truncated data are developed under various models. Nonparametric models are based on Efron and Petrosian (1999) <doi:10.1080/01621459.1999.10474187> and Emura, Konno, and Michimae (2015) <doi:10.1007/s10985-014-9297-5>. Parametric models from the special exponential family (SEF) are based on Hu and Emura (2015) <doi:10.1007/s00180-015-0564-z> and Emura, Hu and Konno (2017) <doi:10.1007/s00362-015-0730-y>. The parametric location-scale models are based on Dorre et al. (2021) <doi:10.1007/s00180-020-01027-6>.

Details

Details are seen from the references.

Author(s)

Takeshi Emura, Ya-Hsuan Hu, Chung-Yan Huang Maintainer: Takeshi Emura <takeshiemura@gmail.com>

References

Dorre A, Emura T (2019) Analysis of Doubly Truncated Data, An Introduction, JSS Research Series in Statistics, Springer

Dorre A, Huang CY, Tseng YK, Emura T (2021) Likelihood-based analysis of doubly-truncated data under the location-scale and AFT model, Computation Stat 36(1): 375-408

Efron B, Petrosian V (1999). Nonparametric methods for doubly truncated data. J Am Stat Assoc 94: 824-834

Emura T, Konno Y, Michimae H (2015). Statistical inference based on the nonparametric maximum likelihood estimator under double-truncation. Lifetime Data Analysis 21: 397-418

Emura T, Hu YH, Konno Y (2017) Asymptotic inference for maximum likelihood estimators under the special exponential family with double-truncation, Stat Pap 58 (3): 877-909

Hu YH, Emura T (2015) Maximum likelihood estimation for a special exponential family under random double-truncation, Computation Stat 30 (4): 1199-229

GoF *Goodness-of-fit test based on the CvM and KS statistics*

Description

Goodness-of-fit test statistics are computed based on the Cramér–von Mises (CvM) and Kolmogorov–Smirnov (KS) test statistics proposed in Emura et al. (2015). P-value and critical values with significance levels of 0.01, 0.05 and 0.10 are also computed.

Usage

```
GoF(u.trunc, y.trunc, v.trunc,epsilon=1e-08,F0,B=500,F.plot = TRUE)
```

Arguments

`u.trunc`	lower truncation limit
`y.trunc`	variable of interest
`v.trunc`	upper truncation limit
`epsilon`	error tolerance for the self-consistency algorithm
`F0`	a function for the null distribution function
`B`	the number of bootstrap resamples (B=500 is the default)
`F.plot`	model diagnostic plot

Details

Details are seen from Emura et al.(2015).

Value

`CvM`	Test statistics, P-value, and critical values for the Cramér–von Mises (CvM) test
`KS`	Test statistics, P-value, and critical values for the Kolmogorov–Smirnov (KS) test

Author(s)

Takeshi Emura

References

Emura T, Konno Y, Michimae H (2015). Statistical inference based on the nonparametric maximum likelihood estimator under double-truncation. Lifetime Data Analysis 21: 397-418

Examples

```
## A data example from Efron and Petrosian (1999) ##
y.trunc=c(0.75, 1.25, 1.50, 1.05, 2.40, 2.50, 2.25)
u.trunc=c(0.4, 0.8, 0.0, 0.3, 1.1, 2.3, 1.3)
v.trunc=c(2.0, 1.8, 2.3, 1.4, 3.0, 3.4, 2.6)
F0=function(x){x/3}
GoF(u.trunc,y.trunc,v.trunc,F0=F0)
```

NPMLE *Nonparametric inference based on the self-consistency method*

Description

Nonparametric maximum likelihood estimates are computed based on the self-consistency method (Efron and Petrosian 1999). The SE is computed from the asymptotic variance derived in Emura et al. (2015).

Usage

```
NPMLE(u.trunc, y.trunc, v.trunc,epsilon=1e-08,detail=FALSE)
```

Arguments

`u.trunc`	lower truncation limit
`y.trunc`	variable of interest
`v.trunc`	upper truncation limit
`epsilon`	error tolerance for the self-consistency algorithm
`detail`	if TRUE, show the details including the covariate matrix

Details

Details are seen from the references.

Value

`f`	density
`F`	cumulative distribution
`SE`	standard error
`convergence`	Log-likelihood, and the number of iterations
`V`	covariance matrix for the NPMLE

Author(s)

Takeshi Emura

References

Efron B, Petrosian V (1999). Nonparametric methods for doubly truncated data. J Am Stat Assoc 94: 824-834

Emura T, Konno Y, Michimae H (2015). Statistical inference based on the nonparametric maximum likelihood estimator under double-truncation. Lifetime Data Analysis 21: 397-418

Dorre A, Emura T (2019) Analysis of Doubly Truncated Data, An Introduction, JSS Research Series in Statistics, Springer

Examples

```
## A data example from Efron and Petrosian (1999) ##
y.trunc=c(0.75, 1.25, 1.50, 1.05, 2.40, 2.50, 2.25)
u.trunc=c(0.4, 0.8, 0.0, 0.3, 1.1, 2.3, 1.3)
v.trunc=c(2.0, 1.8, 2.3, 1.4, 3.0, 3.4, 2.6)
NPMLE(u.trunc,y.trunc,v.trunc)
NPMLE(u.trunc,y.trunc,v.trunc,detail=TRUE)
```

`PMLE.loglogistic` *Parametric Inference for the log-logistic model*

Description

Maximum likelihood estimates (MLEs) and their standard errors (SEs) are computed for the log-logistic model based on doubly-truncated data (Dorre et al. 2021). Also computed are the likelihood value, AIC, and other qnantities.

Usage

```
PMLE.loglogistic(u.trunc, y.trunc, v.trunc,epsilon = 1e-5,D1=2,D2=2,d1=2,d2=2)
```

Arguments

`u.trunc`	a vector of lower truncation limits
`y.trunc`	a vector of variables of interest
`v.trunc`	a vector of upper truncation limits
`epsilon`	a small positive number for the error tolerance for Newton-Raphson iterations
`D1`	a positive number: Randomize the intial value for a divergent iteration (the updated amount for mu is greater than D1)
`D2`	a positive number: Randomize the intial value for a divergent iteration (the updated amount for sigma is greater than D2)
`d1`	a positive number: For a divergent iteration, U(-d1,d1) is added to the intial value of mu
`d2`	a positive number: For a divergent iteration, U(-d2,d2) is added to the intial value of log(sigma)

Details

A randomized Newton–Raphson algorithm (Section 3.2 of Dorre et al.(2021)) was employed to compute the MLE.

Value

eta	estimates
SE	standard errors
convergence	Log-likelihood, degree of freedom, AIC, the number of iterations
Score	score vector at the converged value
Hessian	Hessian matrix at the converged value

Author(s)

Takeshi Emura

References

Dorre A, Huang CY, Tseng YK, Emura T (2021) Likelihood-based analysis of doubly-truncated data under the location-scale and AFT model, Computation Stat 36(1): 375-408

Examples

```
## A data example from Efron and Petrosian (1999) ##
y.trunc=c(0.75, 1.25, 1.50, 1.05, 2.40, 2.50, 2.25)
u.trunc=c(0.4, 0.8, 0.0, 0.3, 1.1, 2.3, 1.3)
v.trunc=c(2.0, 1.8, 2.3, 1.4, 3.0, 3.4, 2.6)
PMLE.loglogistic(u.trunc,y.trunc,v.trunc)
```

PMLE.lognormal *Parametric Inference for the lognormal model*

Description

Maximum likelihood estimates (MLEs) and their standard errors (SEs) are computed for the log-normal model based on doubly-truncated data (Dorre et al. 2021). Also computed are the likelihood value, AIC, and other qnantities.

Usage

```
PMLE.lognormal(u.trunc, y.trunc, v.trunc,epsilon = 1e-5,D1=2,D2=2,d1=2,d2=2)
```

Arguments

`u.trunc`	a vector of lower truncation limits
`y.trunc`	a vector of variables of interest
`v.trunc`	a vector of upper truncation limits
`epsilon`	a small positive number for the error tolerance for Newton-Raphson iterations
`D1`	a positive number: Randomize the intial value for a divergent iteration (the updated amount for mu is greater than D1)
`D2`	a positive number: Randomize the intial value for a divergent iteration (the updated amount for sigma is greater than D2)
`d1`	a positive number: For a divergent iteration, U(-d1,d1) is added to the intial value of mu
`d2`	a positive number: For a divergent iteration, U(-d2,d2) is added to the intial value of log(sigma)

Details

A randomized Newton–Raphson algorithm (Section 3.2 of Dorre et al.(2021)) was employed to compute the MLE.

Value

`eta`	estimates
`SE`	standard errors
`convergence`	Log-likelihood, degree of freedom, AIC, the number of iterations
`Score`	score vector at the converged value
`Hessian`	Hessian matrix at the converged value

Author(s)

Takeshi Emura

References

Dorre A, Huang CY, Tseng YK, Emura T (2021) Likelihood-based analysis of doubly-truncated data under the location-scale and AFT model, Computation Stat 36(1): 375-408

Examples

```
## A data example from Efron and Petrosian (1999) ##
y.trunc=c(0.75, 1.25, 1.50, 1.05, 2.40, 2.50, 2.25)
u.trunc=c(0.4, 0.8, 0.0, 0.3, 1.1, 2.3, 1.3)
v.trunc=c(2.0, 1.8, 2.3, 1.4, 3.0, 3.4, 2.6)
PMLE.lognormal(u.trunc,y.trunc,v.trunc)
```

PMLE.SEF1.free *Parametric inference for the one-parameter SEF model (free parameter space)*

Description

Maximum likelihood estimates and their standard errors (SEs) are computed. Also computed are the likelihood value, AIC, and other qnantities.

Usage

```
PMLE.SEF1.free(u.trunc, y.trunc, v.trunc,
 tau1 = min(y.trunc), tau2 = max(y.trunc), epsilon = 1e-04)
```

Arguments

`u.trunc`	lower truncation limit
`y.trunc`	variable of interest
`v.trunc`	upper truncation limit
`tau1`	lower support
`tau2`	upper support
`epsilon`	error tolerance for Newton-Raphson

Details

Details are seen from the references.

Value

`eta`	estimates
`SE`	standard errors
`convergence`	Log-likelihood, degree of freedom, AIC, the number of iterations
`Score`	score at the converged value
`Hessian`	Hessian at the converged value

Author(s)

Takeshi Emura

References

Hu YH, Emura T (2015) Maximum likelihood estimation for a special exponential family under random double-truncation, Computation Stat 30 (4): 1199-229

Emura T, Hu YH, Konno Y (2017) Asymptotic inference for maximum likelihood estimators under the special exponential family with double-truncation, Stat Pap 58 (3): 877-909

Dorre A, Emura T (2019) Analysis of Doubly Truncated Data, An Introduction, JSS Research Series in Statistics, Springer

Examples

```
### Data generation: see Appendix of Hu and Emura (2015) ###
eta_true=-3
eta_u=-9
eta_v=-1
tau=10
n=300

a=u=v=y=c()

j=1
repeat{
  u1=runif(1,0,1)
  u[j]=tau+(1/eta_u)*log(1-u1)
  u2=runif(1,0,1)
  v[j]=tau+(1/eta_v)*log(1-u2)
  u3=runif(1,0,1)
  y[j]=tau+(1/eta_true)*log(1-u3)
  if(u[j]<=y[j]&&y[j]<=v[j]) a[j]=1 else a[j]=0
  if(sum(a)==n) break
  j=j+1
}
mean(a) ## inclusion probability around 0.5

v.trunc=v[a==1]
u.trunc=u[a==1]
y.trunc=y[a==1]

PMLE.SEF1.free(u.trunc,y.trunc,v.trunc)
```

`PMLE.SEF1.negative` *Parametric inference for the one-parameter SEF model (negative parameter space)*

Description

Maximum likelihood estimates and their standard errors (SEs) are computed. Also computed are the likelihood value, AIC, and other qnantities.

Usage

```
PMLE.SEF1.negative(u.trunc, y.trunc, v.trunc, tau1 = min(y.trunc), epsilon = 1e-04)
```

Arguments

`u.trunc`	lower truncation limit
`y.trunc`	variable of interest
`v.trunc`	upper truncation limit
`tau1`	lower support
`epsilon`	error tolerance for Newton-Raphson

Details

Details are seen from the references.

Value

eta	estimates
SE	standard errors
convergence	Log-likelihood, degree of freedom, AIC, the number of iterations
Score	score at the converged value
Hessian	Hessian at the converged value

Author(s)

Takeshi Emura, Ya-Hsuan Hu

References

Hu YH, Emura T (2015) Maximum likelihood estimation for a special exponential family under random double-truncation, Computation Stat 30 (4): 1199-229

Emura T, Hu YH, Konno Y (2017) Asymptotic inference for maximum likelihood estimators under the special exponential family with double-truncation, Stat Pap 58 (3): 877-909

Dorre A, Emura T (2019) Analysis of Doubly Truncated Data, An Introduction, JSS Research Series in Statistics, Springer

Examples

```
### Data generation: see Appendix of Hu and Emura (2015) ###
eta_true=-3
eta_u=-9
eta_v=-1
tau=10
n=300

a=u=v=y=c()

j=1
repeat{
  u1=runif(1,0,1)
  u[j]=tau+(1/eta_u)*log(1-u1)
  u2=runif(1,0,1)
  v[j]=tau+(1/eta_v)*log(1-u2)
  u3=runif(1,0,1)
  y[j]=tau+(1/eta_true)*log(1-u3)
  if(u[j]<=y[j]&&y[j]<=v[j]) a[j]=1 else a[j]=0
  if(sum(a)==n) break
  j=j+1
}
mean(a) ## inclusion probability around 0.5
```

```
v.trunc=v[a==1]
u.trunc=u[a==1]
y.trunc=y[a==1]

PMLE.SEF1.negative(u.trunc,y.trunc,v.trunc)
```

PMLE.SEF1.positive   *Parametric Inference for the one-parameter SEF model (positive parameter space)*

Description

Maximum likelihood estimates and their standard errors (SEs) are computed. Also computed are the likelihood value, AIC, and other qnantities.

Usage

```
PMLE.SEF1.positive(u.trunc, y.trunc, v.trunc, tau2 = max(y.trunc), epsilon = 1e-04)
```

Arguments

`u.trunc`	lower truncation limit
`y.trunc`	variable of interest
`v.trunc`	upper truncation limit
`tau2`	upper support
`epsilon`	error tolerance for Newton-Raphson

Details

Details are seen from the references.

Value

`eta`	estimates
`SE`	standard errors
`convergence`	Log-likelihood, degree of freedom, AIC, the number of iterations
`Score`	score at the converged value
`Hessian`	Hessian at the converged value

Author(s)

Takeshi Emura, Ya-Hsuan Hu

References

Hu YH, Emura T (2015) Maximum likelihood estimation for a special exponential family under random double-truncation, Computation Stat 30 (4): 1199-229

Emura T, Hu YH, Konno Y (2017) Asymptotic inference for maximum likelihood estimators under the special exponential family with double-truncation, Stat Pap 58 (3): 877-909

Dorre A, Emura T (2019) Analysis of Doubly Truncated Data, An Introduction, JSS Research Series in Statistics, Springer

Examples

```
#### Data generation: Appendix of Hu and Emura (2015)
eta_true=3
eta_u=1
eta_v=9
tau=10
n=300

a=u=v=y=c()

j=1
repeat{
  u1=runif(1,0,1)
  u[j]=tau+(1/eta_u)*log(u1)
  u2=runif(1,0,1)
  v[j]=tau+(1/eta_v)*log(u2)
  u3=runif(1,0,1)
  y[j]=tau+(1/eta_true)*log(u3)
  if(u[j]<=y[j]&&y[j]<=v[j]) a[j]=1 else a[j]=0
  if(sum(a)==n) break
  j=j+1
}
mean(a) ## inclusion probability around 0.5

v.trunc=v[a==1]
u.trunc=u[a==1]
y.trunc=y[a==1]

PMLE.SEF1.positive(u.trunc,y.trunc,v.trunc)
```

`PMLE.SEF2.negative` *Parametric Inference for the two-parameter SEF model (negative parameter space for eta_2)*

Description

Maximum likelihood estimates and their standard errors (SEs) are computed. Also computed are the likelihood value, AIC, and other qnantities. Since this is the model, estimates for the mean and SD are also computed.

Usage

```
PMLE.SEF2.negative(u.trunc, y.trunc, v.trunc, epsilon = 1e-04)
```

Arguments

u.trunc	lower truncation limit
y.trunc	variable of interest
v.trunc	upper truncation limit
epsilon	error tolerance for Newton-Raphson

Details

Details are seen from the references.

Value

eta	estimates
SE	standard errors
convergence	Log-likelihood, degree of freedom, AIC, the number of iterations
Score	score vector at the converged value
Hessian	Hessian matrix at the converged value

Author(s)

Takeshi Emura, Ya-Hsuan Hu

References

Hu YH, Emura T (2015) Maximum likelihood estimation for a special exponential family under random double-truncation, Computation Stat 30 (4): 1199-229

Emura T, Hu YH, Konno Y (2017) Asymptotic inference for maximum likelihood estimators under the special exponential family with double-truncation, Stat Pap 58 (3): 877-909

Dorre A, Emura T (2019) Analysis of Doubly Truncated Data, An Introduction, JSS Research Series in Statistics, Springer

Examples

```
### Data generation: see Appendix of Hu and Emura (2015)
n=300
eta1_true=30
eta2_true=-0.5
mu_true=30
mu_u=29.09
mu_v=30.91

a=u=v=y=c()
```

```
###generate n samples of (ui,yi,vi) subject to ui<=yi<=vi###
j=1
repeat{
  u[j]=rnorm(1,mu_u,1)
  v[j]=rnorm(1,mu_v,1)
  y[j]=rnorm(1,mu_true,1)
  if(u[j]<=y[j]&&y[j]<=v[j]) a[j]=1 else a[j]=0
  if(sum(a)==n) break ###we need n data set###
  j=j+1
}
mean(a) ### inclusion probability around 0.5 ###

v.trunc=v[a==1]
y.trunc=y[a==1]
u.trunc=u[a==1]

PMLE.SEF2.negative(u.trunc,y.trunc,v.trunc)
```

PMLE.SEF3.free   *Parametric Inference for the three-parameter SEF model (free parameter space for eta_3)*

Description

Maximum likelihood estimates and their standard errors (SEs) are computed. Also computed are the likelihood value, AIC, and other qnantities.

Usage

```
PMLE.SEF3.free(u.trunc, y.trunc, v.trunc,
 tau1 = min(y.trunc), tau2 = max(y.trunc),
 epsilon = 1e-04, D1=20, D2=10, D3=1, d1=6, d2=0.5)
```

Arguments

u.trunc	lower truncation limit
y.trunc	variable of interest
v.trunc	upper truncation limit
tau1	lower support
tau2	upper support
epsilon	error tolerance for Newton-Raphson
D1	Divergence condition for eta_1
D2	Divergence condition of eta_2
D3	Divergence condition of eta_3
d1	Range of randomization for eta_1
d2	Range of randomization for eta_2

Details

Details are seen from the references.

Value

eta	estimates
SE	standard errors
convergence	Log-likelihood, degree of freedom, AIC, the number of iterations
Score	score vector at the converged value
Hessian	Hessian matrix at the converged value

Author(s)

Takeshi Emura, Ya-Hsuan Hu

References

Hu YH, Emura T (2015) Maximum likelihood estimation for a special exponential family under random double-truncation, Computation Stat 30 (4): 1199-229

Emura T, Hu YH, Konno Y (2017) Asymptotic inference for maximum likelihood estimators under the special exponential family with double-truncation, Stat Pap 58 (3): 877-909

Dorre A, Emura T (2019) Analysis of Doubly Truncated Data, An Introduction, JSS Research Series in Statistics, Springer

Examples

```
## The first 10 samples of the childhood cancer data ##
y.trunc=c(6,7,15,43,85,92,96,104,108,123)
u.trunc=c(-1643,-24,-532,-1508,-691,-1235,-786,-261,-108,-120)
v.trunc=u.trunc+1825
PMLE.SEF3.free(u.trunc,y.trunc,v.trunc)
```

PMLE.SEF3.negative *Parametric Inference for the three-parameter SEF model (negative parameter space for eta_3)*

Description

Maximum likelihood estimates and their standard errors (SEs) are computed. Also computed are the likelihood value, AIC, and other qnantities.

Usage

```
PMLE.SEF3.negative(u.trunc, y.trunc, v.trunc, tau1 = min(y.trunc),
 epsilon = 1e-04, D1=20, D2=10, D3=1, d1=6, d2=0.5)
```

Arguments

`u.trunc`	lower truncation limit
`y.trunc`	variable of interest
`v.trunc`	upper truncation limit
`tau1`	lower support
`epsilon`	error tolerance for Newton-Raphson
`D1`	Divergence condition for eta_1
`D2`	Divergence condition of eta_2
`D3`	Divergence condition of eta_3
`d1`	Range of randomization for eta_1
`d2`	Range of randomization for eta_2

Details

Details are seen from the references.

Value

`eta`	estimates
`SE`	standard errors
`convergence`	Log-likelihood, degree of freedom, AIC, the number of iterations
`Score`	score vector at the converged value
`Hessian`	Hessian matrix at the converged value

Author(s)

Takeshi Emura, Ya-Hsuan Hu

References

Hu YH, Emura T (2015) Maximum likelihood estimation for a special exponential family under random double-truncation, Computation Stat 30 (4): 1199-229

Emura T, Hu YH, Konno Y (2017) Asymptotic inference for maximum likelihood estimators under the special exponential family with double-truncation, Stat Pap 58 (3): 877-909

Dorre A, Emura T (2019) Analysis of Doubly Truncated Data, An Introduction, JSS Research Series in Statistics, Springer

Examples

```
## The first 10 samples of the childhood cancer data ##
y.trunc=c(6,7,15,43,85,92,96,104,108,123)
u.trunc=c(-1643,-24,-532,-1508,-691,-1235,-786,-261,-108,-120)
v.trunc=u.trunc+1825
PMLE.SEF3.negative(u.trunc,y.trunc,v.trunc)
```

`PMLE.SEF3.positive` *Parametric Inference for the three-parameter SEF model (positive parameter space for eta_3)*

Description

Maximum likelihood estimates and their standard errors (SEs) are computed. Also computed are the likelihood value, AIC, and other qnantities.

Usage

```
PMLE.SEF3.positive(u.trunc, y.trunc, v.trunc, tau2 = max(y.trunc),
 epsilon = 1e-04, D1=20, D2=10, D3=1, d1=6, d2=0.5)
```

Arguments

`u.trunc`	lower truncation limit
`y.trunc`	variable of interest
`v.trunc`	upper truncation limit
`tau2`	upper support
`epsilon`	error tolerance for Newton-Raphson
`D1`	Divergence condition for eta_1
`D2`	Divergence condition of eta_2
`D3`	Divergence condition of eta_3
`d1`	Range of randomization for eta_1
`d2`	Range of randomization for eta_2

Details

Details are seen from the references.

Value

`eta`	estimates
`SE`	standard errors
`convergence`	Log-likelihood, degree of freedom, AIC, the number of iterations
`Score`	score vector at the converged value
`Hessian`	Hessian matrix at the converged value

Author(s)

Takeshi Emura, Ya-Hsuan Hu

References

Hu YH, Emura T (2015) Maximum likelihood estimation for a special exponential family under random double-truncation, Computation Stat 30 (4): 1199-229

Emura T, Hu YH, Konno Y (2017) Asymptotic inference for maximum likelihood estimators under the special exponential family with double-truncation, Stat Pap 58 (3): 877-909

Dorre A, Emura T (2019) Analysis of Doubly Truncated Data, An Introduction, JSS Research Series in Statistics, Springer

Examples

```
## The first 10 samples of the childhood cancer data ##
y.trunc=c(6,7,15,43,85,92,96,104,108,123)
u.trunc=c(-1643,-24,-532,-1508,-691,-1235,-786,-261,-108,-120)
v.trunc=u.trunc+1825
PMLE.SEF3.positive(u.trunc,y.trunc,v.trunc)
```

PMLE.Weibull *Parametric Inference for the Weibull model*

Description

Maximum likelihood estimates (MLEs) and their standard errors (SEs) are computed for the Weibull model based on doubly-truncated data (Dorre et al. 2021). Also computed are the likelihood value, AIC, and other qnantities.

Usage

```
PMLE.Weibull(u.trunc, y.trunc, v.trunc,epsilon = 1e-5,D1=2,D2=2,d1=2,d2=2)
```

Arguments

u.trunc	a vector of lower truncation limits
y.trunc	a vector of variables of interest
v.trunc	a vector of upper truncation limits
epsilon	a small positive number for the error tolerance for Newton-Raphson iterations
D1	a positive number: Randomize the intial value for a divergent iteration (the updated amount for mu is greater than D1)
D2	a positive number: Randomize the intial value for a divergent iteration (the updated amount for sigma is greater than D2)
d1	a positive number: For a divergent iteration, U(-d1,d1) is added to the intial value of mu
d2	a positive number: For a divergent iteration, U(-d2,d2) is added to the intial value of log(sigma)

Details

A randomized Newton–Raphson algorithm (Section 3.2 of Dorre et al.(2021)) was employed to compute the MLE.

Value

`eta`	estimates
`SE`	standard errors
`convergence`	Log-likelihood, degrees of freedom, AIC, the number of iterations
`Score`	score vector at the converged value
`Hessian`	Hessian matrix at the converged value

Author(s)

Takeshi Emura

References

Dorre A, Huang CY, Tseng YK, Emura T (2021) Likelihood-based analysis of doubly-truncated data under the location-scale and AFT model, Computation Stat 36(1): 375-408

Examples

```
## A data example from Efron and Petrosian (1999) ##
y.trunc=c(0.75, 1.25, 1.50, 1.05, 2.40, 2.50, 2.25)
u.trunc=c(0.4, 0.8, 0.0, 0.3, 1.1, 2.3, 1.3)
v.trunc=c(2.0, 1.8, 2.3, 1.4, 3.0, 3.4, 2.6)
PMLE.Weibull(u.trunc,y.trunc,v.trunc)
```

`simu.Weibull` *Simulating doubly-truncated data from the Weibull model*

Description

A data frame is generated by simulated data from the Weibull model.

Usage

```
simu.Weibull(n,mu,sigma,delta)
```

Arguments

`n`	sample size
`mu`	location parameter
`sigma`	scale parameter
`delta`	a positive parameter controlling the inclusion probability

Details

The data are generated from the random vector (U,Y,V) subject to the inclusion criterion U<=Y<=V. The random vector are defined as U=mu-delta+sigma*W, Y=mu+sigma*W, and U=mu+delta+sigma*W, where P(W>w)=exp(-exp(w)). See Section 5.1 of Dorre et al. (2021) for details. The inclusion probability is P(U<=Y<=V).

Value

u	lower truncation limits
y	log-transformed lifetimes
v	upper truncation limits

Author(s)

Takeshi Emura

References

Dorre A, Huang CY, Tseng YK, Emura T (2021) Likelihood-based analysis of doubly-truncated data under the location-scale and AFT model, Computation Stat 36(1): 375-408

Examples

```
## A simulation from Dorre et al.(2021) ##
simu.Weibull(n=100,mu=5,sigma=2,delta=2.08)

Dat=simu.Weibull(n=100,mu=5,sigma=2,delta=2.08)
PMLE.Weibull(Dat$u,Dat$y,Dat$v)
```

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