Package ‘bibs’

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Type Package

Title Bayesian Inference for the Birnbaum-Saunders Distribution

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Description Developed for the following tasks. 1- Simulating and computing the maximum likelihood estimator for the Birnbaum-Saunders (BS) distribution, 2- Computing the Bayesian estimator for the parameters of the BS distribution based on reference prior proposed by Xu and Tang (2010) <doi:10.1016/j.csda.2009.08.004> and conjugate prior. 3- Computing the Bayesian estimator for the BS distribution based on conjugate prior. 4- Computing the Bayesian estimator for the BS distribution based on Jeffrey prior given by Achcar (1993) <doi:10.1016/0167-9473(93)90170-X> 5- Computing the Bayesian estimator for the BS distribution under progressive type-II censoring scheme.

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R topics documented:

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bone *Bone mineral content data*

Description

The mineral density of three dominant and nondominant of bones measured in g/cm^2 *johnson1999*.

Usage

```
data(bone)
```

Format

A text file with 6 columns.

References

R. A. ArnoldJohnson and D. W. Wichern 1999. *Applied Multivariate Analysis*, Prentice-Hall, New Jersey.

Examples

```
data(bone)
```

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conjugatebs *Computing the Bayesian estimators of the Birnbaum-Saunders (BS) distribution.*

Description

Computing the Bayesian estimators of the BS distribution using conjugate prior, that is, conjugate and reference priors. The probability density function of generalized inverse Gaussian (GIG) distribution is given by *good1953population*

$$f_{GIG}(x|\lambda,\chi,\psi) = \frac{1}{2K_\lambda(\sqrt{\psi\chi})}\left(\frac{\psi}{\lambda}\right)^{\lambda/2} x^{\lambda-1}\exp\left\{-\frac{\chi}{2x}-\frac{\psi x}{2}\right\},$$

where $x > 0$, $-\infty < \lambda < +\infty$, $\psi > 0$, and $\chi > 0$ are parameters of this family. The pdf of a inverse gamma (IG) distribution denoted as $IG(\gamma,\theta)$ is given by

$$f_{IG}(x|\gamma,\theta) = \frac{\theta^\gamma x^{-\gamma-1}}{\Gamma(\gamma)}\exp\left\{-\frac{\theta}{x}\right\},$$

where $x > 0$, $\gamma > 0$, and $\theta > 0$ are the shape and scale parameters, respectively.

Usage

```
conjugatebs(x,gamma0=1,theta0=1,lambda0=0.001,chi0=0.001,psi0=0.001,CI=0.95,M0=800,M=1000)
```

Arguments

`x`	Vector of observations.
`gamma0`	The first hyperparameter of the IG conjugate prior.
`theta0`	The second hyperparameter of the IG conjugate prior.
`lambda0`	The first hyperparameter of the GIG conjugate prior.
`chi0`	The second hyperparameter of the GIG conjugate prior.
`psi0`	The third hyperparameter of the GIG conjugate prior.
`CI`	Confidence level for constructing percentile and asymptotic confidence intervals. That is 0.95 by default.
`M0`	The number of sampler runs considered as burn-in.
`M`	The number of total sampler runs.

Value

A list including summary statistics of a Gibbs sampler for Bayesian inference including point estimation for the parameter, its standard error, and the corresponding $100(1-\alpha)\%$ credible interval, goodness-of-fit measures, asymptotic $100(1-\alpha)\%$ confidence interval (CI) and corresponding standard errors, and Fisher information matix.

Author(s)

Mahdi Teimouri

References

I. J. Good 1953. The population frequencies of species and the estimation of population parameters. *Biometrika*, 40(3-4):237-264.

Examples

```
data(fatigue)
x <- fatigue
conjugatebs(x,gamma0=1,theta0=1,lambda0=0.001,chi0=0.001,psi0=0.001,CI=0.95,M0=800,M=1000)
```

fatigue — *Fatigue data*

Description

A set of 101 observations obtained by Birnbaum and Saunders(1969) from fatigue life of 6061-T6 aluminum coupons cut parallel to the direction of rolling and oscillated at 18 cycles per second (cps).

Usage

```
data(fatigue)
```

Format

A text file with 1 column.

References

Z. W. Birnbaum and S. C. Saunders 1969. Estimation for a family of life distributions with applications to fatigue. *Journal of Applied Probability*, 328-347.

Examples

```
data(fatigue)
```

Jeffreysbs — *Computing the Bayesian estimators of the Birnbaum-Saunders (BS) distribution.*

Description

Computing the Bayesian estimators of the BS distribution based on approximated Jeffreys prior proposed by Achcar (1993). The approximated Jeffreys piors is $\pi_j(\alpha,\beta) \propto \frac{1}{\alpha\beta}\sqrt{\frac{1}{\alpha^2}+\frac{1}{4}}$.

Usage

```
Jeffreysbs(x, CI = 0.95, M0 = 800, M = 1000)
```

Arguments

`x`	Vector of observations.
`CI`	Confidence level for constructing percentile and asymptotic confidence intervals. That is 0.95 by default.
`M0`	The number of sampler runs considered as burn-in.
`M`	The number of total sampler runs.

Value

A list including summary statistics of a Gibbs sampler for the Bayesian inference including point estimation for the parameter, its standard error, and the corresponding $100(1-\alpha)\%$ credible interval, goodness-of-fit measures, asymptotic $100(1-\alpha)\%$ confidence interval (CI) and corresponding standard errors, and Fisher information matix.

Author(s)

Mahdi Teimouri

References

J. A. Achcar 1993. Inferences for the Birnbaum-Saunders fatigue life model using Bayesian methods, *Computational Statistics \& Data Analysis*, 15 (4), 367-380.

Examples

```
data(fatigue)
x <- fatigue
Jeffreysbs(x, CI = 0.95, M0 = 800, M = 1000)
```

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mlebs — *Computing the maximum likelihood (ML) estimator for the generalized Birnbaum-Saunders (GBS) distribution.*

Description

Computing the ML estimator for the GBS distribution proposed by Owen (2006) whose density function is given by

$$f_{GBS}(t|\alpha,\beta,\nu)=\frac{(1-\nu)t+\nu\beta}{\sqrt{2\pi}\alpha\sqrt{\beta}t^{\nu+1}}\exp\left\{-\frac{(t-\beta)^2}{2\alpha^2\beta t^{2\nu}}\right\},$$

where $t>0$. The parameters of GBS distribution are $\alpha>0$, $\beta>0$, and $0<\nu<1$. For $\nu=0.5$, the GBS distribution turns into the ordinary Birnbaum-Saunders distribution.

Usage

```
mlebs(x, start, method = "Nelder-Mead", CI = 0.95)
```

Arguments

`x`	Vector of observations.
`start`	Vector of the initial values.
`method`	The method for the numerically optimization that includes one of `CG`,`Nelder-Mead`, `BFGS`, `L-BFGS-B`, and `SANN`.
`CI`	Confidence level for constructing asymptotic confidence intervals. That is 0.95 by default.

Value

A list including the ML estimator, goodness-of-fit measures, asymptotic $100(1-\alpha)\%$ confidence interval (CI) and corresponding standard errors, and Fisher information matix.

Author(s)

Mahdi Teimouri

Examples

```
data(fatigue)
x <- fatigue
mlebs(x, start = c(1, 29), method = "Nelder-Mead", CI = 0.95)
```

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plasma *Plasma survival data*

Description

The plasma survival data contains the Survival times of plasma cell myeloma for 112 patients, see Carbone et al. (1967).

Usage

```
data(plasma)
```

Format

A text file with 4 columns.

References

P. P. Carbone, L. E. Kellerhouse, and E. A. Gehan 1967. Plasmacytic myeloma: A study of the relationship of survival to various clinical manifestations and anomalous protein type in 112 patients. *The American Journal of Medicine*, 42 (6), 937-48.

Examples

```
data(plasma)
```

`rbs` *Simulating from Birnbaum-Saunders (BS) distribution.*

Description

Simulating from BS distribution whose density function is given by

$$f_{BS}(t|\alpha,\beta)=\frac{0.5t+0.5\beta}{\sqrt{2\pi}\alpha\sqrt{\beta}t^{\frac{3}{2}}}\exp\left\{-\frac{(t-\beta)^2}{2\alpha^2\beta t}\right\},$$

where t>0. The parameters of GBS distribution are α>0 and β>0.

Usage

```
rbs(n, alpha, beta)
```

Arguments

`n`	Size of required realizations.
`alpha`	Parameter $alpha$.
`beta`	Parameter $beta$.

Value

A vector of n realizations from distribution.

Author(s)

Mahdi Teimouri

Examples

```
rbs(n = 100, alpha = 1, beta = 2)
```

`referencebs` *Computing the Bayesian estimators of the Birnbaum-Saunders (BS) distribution.*

Description

Computing the Bayesian estimators of the BS distribution using reference prior proposed by Berger and Bernardo(1989). The joint distribution of the priors is $\pi(\alpha,\beta)=1/(\alpha,\beta)$.

Usage

```
referencebs(x, CI = 0.95, M0 = 800, M = 1000)
```

Arguments

`x`	Vector of observations.
`CI`	Confidence level for constructing percentile and asymptotic confidence intervals. That is 0.95 by default.
`M0`	The number of sampler runs considered as burn-in.
`M`	The number of total sampler runs.

Value

A list including summary statistics of a Gibbs sampler for Bayesian inference including point estimation for the parameter, its standard error, and the corresponding $100(1-\alpha)\%$ credible interval, goodness-of-fit measures, asymptotic $100(1-\alpha)\%$ confidence interval (CI) and corresponding standard errors, and Fisher information matix.

Author(s)

Mahdi Teimouri

References

J. O. Berger and J. M. Bernardo 1989. Estimating a product of means: Bayesian analysis with reference priors. *Journal of the American Statistical Association*, 84(405), 200-207.

Examples

```
data(fatigue)
x <- fatigue
referencebs(x, CI = 0.95, M0 = 800, M = 1000)
```

`typeIIbs` *Bayesian estimator for the Birnbaum-Saunders family under progressive type-II censoring scheme.*

Description

Estimates parameters of the Birnbaum-Saunders family in a Bayesian framework through the Metropolis-Hasting algorithm when subjects are placed on progressive type-II censoring scheme with likelihood function

$$l(\alpha,\beta|x_{1:m:n},\dots,x_{m:m:n}) = \log L(\Theta) \propto C\sum_{i=1}^{m}\log f(x_{i:m:n};|\alpha,\beta)+\sum_{i=1}^{m}R_i\log\bigl[1-F(x_{i:m:n};|\alpha,\beta)\bigr],$$

in which $F(.|\alpha,\beta)$ is cumulative distribution function of the Birnbaum-Saunders family with $C = n(n-R_1-1)(n-R_1-R_2-2)\dots(n-R_1-R_2-\dots-R_{m-1}-m+1)$. The acceptance for each new sample of α and β, respectively, becomes

$$A_\alpha = \min\left\{1, \prod_{i=1}^{m}\frac{\bigl[1-F_{BS}(t_{i:m:n}|1/(\alpha^{new})^2,\beta)\bigr]^{R_i}}{\bigl[1-F_{BS}(t_{i:m:n}|1/(\alpha_{old})^2,\beta)\bigr]^{R_i}}\right\}$$

,

$$A_\beta = \min\left\{1, \prod_{i=1}^{m} \frac{\left[1 - F_{BS}(t_{i:m:n}|\alpha, \beta^{new})\right]^{R_i}}{\left[1 - F_{BS}(t_{i:m:n}|\alpha, \beta_{old})\right]^{R_i}}\right\}.$$

Usage

```
typeIIbs(plan, M0 = 4000, M = 6000, CI = 0.95)
```

Arguments

`plan`	Censoring plan for progressive type-II censoring scheme. It must be given as a `data.frame` including: number of item placed on the test at time zero and a vector that contains number `R`, of the removed alive items.
`M0`	The number of sampler runs considered as burn-in.
`M`	The number of total sampler runs.
`CI`	Confidence or coverage level for constructing percentile confidence interval. That is 0.95 by default.

Value

A list including summary statistics after burn-in point including: mean, median, standard deviation, 100(1 - `CI`)/2 percentile, 100(1/2 + `CI`/2) percentile.

Author(s)

Mahdi Teimouri

References

M. Teimouri and S. Nadarajah 2016. Bias corrected MLEs under progressive type-II censoring scheme, *Journal of Statistical Computation and Simulation*, 86 (14), 2714-2726.

N. Balakrishnan and R. Aggarwala 2000. *Progressive Censoring: Theory, Methods, and Applications*. Springer Science & Business Media, New York.

Examples

```
data(plasma)
typeIIbs(plan = plasma, M0 = 100, M = 200, CI = 0.95)
```

`welcome` *Starting message when loading package bibs*

Description

It contains a welcome message for user of package bibs.

Value

Welcome message for user of bibs package.

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