

Package ‘UPG’

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Type Package

Title Efficient Bayesian Models for Binary and Categorical Data

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Author Gregor Zens [aut, cre],
Sylvia Frühwirth-Schnatter [aut],
Helga Wagner [aut],
Daniel F. Schmidt [ctb],
Enes Makalic [ctb]

Maintainer Gregor Zens <gzens@wu.ac.at>

Description Highly efficient Bayesian implementations of probit, logit, multinomial logit and binomial logit models. Functions for plotting and tabulating the estimation output are available as well. Estimation is based on Gibbs sampling where the Markov chain Monte Carlo algorithms are based on the latent variable representations and boosting algorithms outlined in Frühwirth-Schnatter S., Zens G., Wagner H. (2020) <arXiv:2011.06898>. The underlying implementation is written in C++.

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coef.UPG.Binomial	<i>Extract coefficients from UPG.Binomial objects</i>
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Description

coef can be used to extract posterior means and credible intervals based on posterior quantiles from UPG.Binomial objects.

Usage

```
## S3 method for class 'UPG.Binomial'  
coef(object, ..., q = c(0.025, 0.975))
```

Arguments

object	an object of class UPG.Binomial.
...	other coef parameters.
q	a numerical vector of length two holding the posterior quantiles to be extracted. Default are 0.025 and 0.975 quantiles.

Value

Returns a matrix containing posterior means and the desired credible interval.

Author(s)

Gregor Zens

See Also

[summary.UPG.Binomial](#) to summarize the estimates of a discrete choice model from an UPG.Binomial object and create tables. [predict.UPG.Binomial](#) to predict probabilities from a discrete choice model from an UPG.Binomial object. [plot.UPG.Binomial](#) to plot the results of a discrete choice model from an UPG.Binomial object.

Examples

```
# estimate a binomial logit model using example data  
library(UPG)  
data(titanic)  
y = titanic[,1]  
Ni = titanic[,2]  
X = titanic[,-c(1,2)]  
results.binomial = UPG(y = y, X = X, Ni = Ni, type = "binomial")  
  
# extract posterior means and credible interval based on 0.025 and 0.975 quantiles  
coef(results.binomial, q = c(0.025, 0.975))
```

coef.UPG.Logit *Extract coefficients from UPG.Logit objects*

Description

coef can be used to extract posterior means and credible intervals based on posterior quantiles from UPG.Logit objects.

Usage

```
## S3 method for class 'UPG.Logit'  
coef(object, ..., q = c(0.025, 0.975))
```

Arguments

object	an object of class UPG.Logit.
...	other coef parameters.
q	a numerical vector of length two holding the posterior quantiles to be extracted. Default are 0.025 and 0.975 quantiles.

Value

Returns a matrix containing posterior means and the desired credible interval.

Author(s)

Gregor Zens

See Also

[summary.UPG.Logit](#) to summarize the estimates of a discrete choice model from an UPG.Logit object and create tables. [predict.UPG.Logit](#) to predict probabilities from a discrete choice model from an UPG.Logit object. [plot.UPG.Logit](#) to plot the results of a discrete choice model from an UPG.Logit object.

Examples

```
# estimate a logit model using example data  
library(UPG)  
data(lfp)  
y = lfp[,1]  
X = lfp[,-1]  
results.logit = UPG(y = y, X = X, type = "logit", verbose=TRUE)  
  
# extract posterior means and credible interval based on 0.025 and 0.975 quantiles  
coef(results.logit, q = c(0.025, 0.975))
```

coef.UPG.MNL	<i>Extract coefficients from UPG.MNL objects</i>
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Description

coef can be used to extract posterior means and credible intervals based on posterior quantiles from UPG.MNL objects.

Usage

```
## S3 method for class 'UPG.MNL'  
coef(object, ..., q = c(0.025, 0.975))
```

Arguments

object	an object of class UPG.MNL.
...	other coef parameters.
q	a numerical vector of length two holding the posterior quantiles to be extracted. Default are 0.025 and 0.975 quantiles.

Value

Returns a list containing posterior means and the desired credible interval.

Author(s)

Gregor Zens

See Also

[summary.UPG.MNL](#) to summarize the estimates of a discrete choice model from an UPG.MNL object and create tables. [predict.UPG.MNL](#) to predict probabilities from a discrete choice model from an UPG.MNL object. [plot.UPG.MNL](#) to plot the results of a discrete choice model from an UPG.MNL object.

Examples

```
# estimate a multinomial logit model using example data  
library(UPG)  
data(program)  
y = program[,1]  
X = program[,-1]  
results.mnl = UPG(y = y, X = X, type = "mnl")  
  
# extract posterior means and credible interval based on 0.025 and 0.975 quantiles  
coef(results.mnl, q = c(0.025, 0.975))
```

coef.UPG.Probit	<i>Extract coefficients from UPG.Probit objects</i>
-----------------	---

Description

coef can be used to extract posterior means and credible intervals based on posterior quantiles from UPG.Probit objects.

Usage

```
## S3 method for class 'UPG.Probit'  
coef(object, ..., q = c(0.025, 0.975))
```

Arguments

object	an object of class UPG.Probit.
...	other coef parameters.
q	a numerical vector of length two holding the posterior quantiles to be extracted. Default are 0.025 and 0.975 quantiles.

Value

Returns a matrix containing posterior means and the desired credible interval.

Author(s)

Gregor Zens

See Also

[summary.UPG.Probit](#) to summarize the estimates of a discrete choice model from an UPG.Probit object and create tables. [predict.UPG.Probit](#) to predict probabilities from a discrete choice model from an UPG.Probit object. [plot.UPG.Probit](#) to plot the results of a discrete choice model from an UPG.Probit object.

Examples

```
# estimate a probit model using example data  
library(UPG)  
data(lfp)  
y = lfp[,1]  
X = lfp[,-1]  
results.probit = UPG(y = y, X = X, type = "probit", verbose=TRUE)  
  
# extract posterior means and credible interval based on 0.025 and 0.975 quantiles  
coef(results.probit, q = c(0.025, 0.975))
```

lfp	<i>Female labor force participation data.</i>
-----	---

Description

A dataset containing socio-economic characteristics as well as a labor force participation dummy for 753 married women from the panel study of income dynamics.

Usage

lfp

Format

A data frame with 753 rows and 9 variables:

lfp binary indicator for participating in the labor force (=1) or not (=0)

intercept intercept

k5 number of children 5 years old or younger

k618 number of children 6 to 18 years old

age in years

wc wife went to college dummy

hc husband went to college dummy

lwg log expected wage rate; for women in the labor force, the actual wage rate; for women not in the labor force, an imputed value based on the regression of lwg on the other variables

inc family income exclusive of wife's income

Source

Data taken from 'carData' package. Also known as the 'Mroz' dataset. Mroz, T. A. (1987) The sensitivity of an empirical model of married women's hours of work to economic and statistical assumptions. *Econometrica* 55, 765-799.

logLik.UPG.Binomial	<i>Compute log-likelihoods from UPG.Binomial objects</i>
---------------------	--

Description

logLik can be used to compute log-likelihoods from UPG.Binomial objects. The log-likelihood is based on the posterior mean of the coefficients and can be used for model selection when combined with, e.g., BIC or other model selection criteria.

Usage

```
## S3 method for class 'UPG.Binomial'  
logLik(object = NULL, ...)
```

Arguments

object an object of class UPG.Binomial.
... other logLik parameters.

Value

Returns a numeric of class logLik with attributes containing the number of estimated parameters and the number of observations. Note that the number of observations in binomial models is equal to N_i and not equal to the sample size.

Author(s)

Gregor Zens

See Also

[summary.UPG.Binomial](#) to summarize the estimates of a discrete choice model from an UPG.Binomial object and create tables. [plot.UPG.Binomial](#) to plot the results of a discrete choice model from an UPG.Binomial object. [coef.UPG.Binomial](#) to extract coefficients from an UPG.Binomial object.

Examples

```
# estimate a binomial logit model using example data  
library(UPG)  
data(titanic)  
y = titanic[,1]  
Ni = titanic[,2]  
X = titanic[,-c(1,2)]  
results.binomial = UPG(y = y, X = X, Ni = Ni, type = "binomial")  
  
# extract log-likelihood  
ll.binomial = logLik(results.binomial)  
  
# compute BIC  
BIC(ll.binomial)
```

logLik.UPG.Logit	<i>Compute log-likelihoods from UPG.Logit objects</i>
------------------	---

Description

logLik can be used to compute log-likelihoods from UPG.Logit objects. The log-likelihood is based on the posterior mean of the coefficients and can be used for model selection when combined with, e.g., BIC or other model selection criteria.

Usage

```
## S3 method for class 'UPG.Logit'  
logLik(object = NULL, ...)
```

Arguments

object	an object of class UPG.Logit.
...	other logLik parameters.

Value

Returns a numeric of class logLik with attributes containing the number of estimated parameters and the number of observations.

Author(s)

Gregor Zens

See Also

[summary.UPG.Logit](#) to summarize the estimates of a discrete choice model from an UPG.Logit object and create tables. [plot.UPG.Logit](#) to plot the results of a discrete choice model from an UPG.Logit object. [coef.UPG.Logit](#) to extract coefficients from an UPG.Logit object.

Examples

```
# estimate a logit model using example data  
library(UPG)  
data(lfp)  
y = lfp[,1]  
X = lfp[,-1]  
results.logit = UPG(y = y, X = X, type = "logit", verbose=TRUE)  
  
# extract log-likelihood  
ll.logit = logLik(results.logit)  
  
# compute BIC
```

```
BIC(ll.logit)
```

```
logLik.UPG.MNL
```

```
Compute log-likelihoods from UPG.MNL objects
```

Description

logLik can be used to compute log-likelihoods from UPG.MNL objects. The log-likelihood is based on the posterior mean of the coefficients and can be used for model selection when combined with, e.g., BIC or other model selection criteria.

Usage

```
## S3 method for class 'UPG.MNL'  
logLik(object = NULL, ...)
```

Arguments

object	an object of class UPG.MNL.
...	other logLik parameters.

Value

Returns a numeric of class logLik with attributes containing the number of estimated parameters and the number of observations.

Author(s)

Gregor Zens

See Also

[summary.UPG.MNL](#) to summarize the estimates of a discrete choice model from an UPG.MNL object and create tables. [plot.UPG.MNL](#) to plot the results of a discrete choice model from an UPG.MNL object. [coef.UPG.MNL](#) to extract coefficients from an UPG.MNL object.

Examples

```
# estimate a multinomial logit model using example data  
library(UPG)  
data(program)  
y = program[,1]  
X = program[,-1]  
results.mnl = UPG(y = y, X = X, type = "mnl")  
  
# extract log-likelihood  
ll.mnl = logLik(results.mnl)
```

```
# compute BIC
BIC(l1.mnl)
```

logLik.UPG.Probit *Compute log-likelihoods from UPG.Probit objects*

Description

logLik can be used to compute log-likelihoods from UPG.Probit objects. The log-likelihood is based on the posterior mean of the coefficients and can be used for model selection when combined with, e.g., BIC or other model selection criteria.

Usage

```
## S3 method for class 'UPG.Probit'
logLik(object = NULL, ...)
```

Arguments

object an object of class UPG.Probit.
 ... other logLik parameters.

Value

Returns a numeric of class logLik with attributes containing the number of estimated parameters and the number of observations.

Author(s)

Gregor Zens

See Also

[summary.UPG.Probit](#) to summarize the estimates of a discrete choice model from an UPG.Probit object and create tables. [plot.UPG.Probit](#) to plot the results of a discrete choice model from an UPG.Probit object. [coef.UPG.Probit](#) to extract coefficients from an UPG.Probit object.

Examples

```
# estimate a probit model using example data
library(UPG)
data(lfp)
y = lfp[,1]
X = lfp[,-1]
results.probit = UPG(y = y, X = X, type = "probit", verbose=TRUE)
```

```
# extract log-likelihood
ll.probit = logLik(results.probit)

# compute BIC
BIC(ll.probit)
```

plot.UPG.Binomial *Coefficient plots for UPG.Binomial objects*

Description

plot generates plots from UPG.Binomial objects using ggplot2. Coefficient plots show point estimates for all coefficients as well as their credible intervals.

Usage

```
## S3 method for class 'UPG.Binomial'
plot(
  x = NULL,
  ...,
  sort = FALSE,
  names = NULL,
  xlab = NULL,
  ylab = NULL,
  q = c(0.025, 0.975),
  include = NULL
)
```

Arguments

x	an object of class UPG.Binomial.
...	other plot parameters.
sort	a logical variable indicating whether the plotted coefficients should be sorted according to effect sizes. Default is FALSE.
names	a character vector indicating names for the variables used in the plots.
xlab	a character vector of length 1 indicating a title for the x-axis.
ylab	a character vector of length 1 indicating a title for the y-axis.
q	a numerical vector of length two holding the posterior quantiles to be extracted. Default are 0.025 and 0.975 quantiles.
include	can be used to plot only a subset of variables. Specify the columns of X that should be kept in the plot. See examples for further information.

Value

Returns a ggplot2 object.

Author(s)

Gregor Zens

See Also

[summary.UPG.Binomial](#) to summarize the estimates of a discrete choice model from an UPG.Binomial object and create tables. [predict.UPG.Binomial](#) to predict probabilities from a discrete choice model from an UPG.Binomial object. [coef.UPG.Binomial](#) to extract coefficients from an UPG.Binomial object.

Examples

```
# estimate a binomial logit model using example data
library(UPG)
data(titanic)
y = titanic[,1]
Ni = titanic[,2]
X = titanic[,-c(1,2)]
results.binomial = UPG(y = y, X = X, Ni = Ni, type = "binomial")

# plot the results and sort coefficients by effect size
plot(results.binomial, sort = TRUE)

# plot only variables 1 and 3 with custom names, credible intervals and axis labels
plot(results.binomial,
      include = c(1,3),
      names = c("Custom 1", "Custom 2"),
      q = c(0.1, 0.9),
      xlab = c("Custom X"),
      ylab = c("Custom Y"))
```

plot.UPG.Logit

Coefficient plots for UPG.Logit objects

Description

plot generates plots from UPG.Logit objects using ggplot2. Coefficient plots show point estimates for all coefficients as well as their credible intervals.

Usage

```
## S3 method for class 'UPG.Logit'
plot(
  x = NULL,
  ...,
  sort = FALSE,
```

```

names = NULL,
xlab = NULL,
ylab = NULL,
q = c(0.025, 0.975),
include = NULL
)

```

Arguments

<code>x</code>	an object of class <code>UPG.Logit</code> .
<code>...</code>	other plot parameters.
<code>sort</code>	a logical variable indicating whether the plotted coefficients should be sorted according to effect sizes. Default is <code>FALSE</code> .
<code>names</code>	a character vector indicating names for the variables used in the plots.
<code>xlab</code>	a character vector of length 1 indicating a title for the x-axis.
<code>ylab</code>	a character vector of length 1 indicating a title for the y-axis.
<code>q</code>	a numerical vector of length two holding the posterior quantiles to be extracted. Default are 0.025 and 0.975 quantiles.
<code>include</code>	can be used to plot only a subset of variables. Specify the columns of X that should be kept in the plot. See examples for further information.

Value

Returns a `ggplot2` object.

Author(s)

Gregor Zens

See Also

[summary.UPG.Logit](#) to summarize the estimates of a discrete choice model from an `UPG.Logit` object and create tables. [predict.UPG.Logit](#) to predict probabilities from a discrete choice model from an `UPG.Logit` object. [coef.UPG.Logit](#) to extract coefficients from an `UPG.Logit` object.

Examples

```

# estimate a logit model using example data
library(UPG)
data(lfp)
y = lfp[,1]
X = lfp[,-1]
results.logit = UPG(y = y, X = X, type = "logit", verbose=TRUE)

# plot the results and sort coefficients by effect size
plot(results.logit, sort = TRUE)

```

```
# plot only variables 1 and 3 with custom names, credible intervals and axis labels
plot(results.logit,
      include = c(1,3),
      names   = c("Custom 1", "Custom 2"),
      q       = c(0.1, 0.9),
      xlab    = c("Custom X"),
      ylab    = c("Custom Y"))
```

plot.UPG.MNL

Coefficient plots for UPG.MNL objects

Description

plot generates plots from UPG.MNL objects using ggplot2. Coefficient plots show point estimates for all coefficients in all groups except the baseline as well as their credible intervals.

Usage

```
## S3 method for class 'UPG.MNL'
plot(
  x = NULL,
  ...,
  sort = FALSE,
  names = NULL,
  groups = NULL,
  xlab = NULL,
  ylab = NULL,
  q = c(0.025, 0.975),
  include = NULL
)
```

Arguments

x	an object of class UPG.MNL.
...	other plot parameters.
sort	a logical variable indicating whether the plotted coefficients should be sorted according to average effect sizes across groups. Default is FALSE.
names	a character vector indicating names for the variables used in the plots.
groups	a character vector indicating names for the groups excluding the baseline. The group names must correspond to the ordering in the dependent variable used for estimation.
xlab	a character vector of length 1 indicating a title for the x-axis.
ylab	a character vector of length 1 indicating a title for the y-axis.
q	a numerical vector of length two holding the posterior quantiles to be extracted. Default are 0.025 and 0.975 quantiles.
include	can be used to plot only a subset of variables. Specify the columns of X that should be kept in the plot. See examples for further information.

Value

Returns a ggplot2 object.

Author(s)

Gregor Zens

See Also

[summary.UPG.MNL](#) to summarize the estimates of a discrete choice model from an UPG.MNL object and create tables. [predict.UPG.MNL](#) to predict probabilities from a discrete choice model from an UPG.MNL object. [coef.UPG.MNL](#) to extract coefficients from an UPG.MNL object.

Examples

```
# estimate a multinomial logit model using example data
library(UPG)
data(program)
y = program[,1]
X = program[,-1]
results.mnl = UPG(y = y, X = X, type = "mnl")

# plot the results and sort coefficients by average effect size
plot(results.mnl, sort = TRUE)

# plot only variables 1 and 3 with custom group and variable names
# also, customize credible intervals and axis labels
plot(results.mnl,
      include = c(1,3),
      names = c("Custom 1", "Custom 2"),
      groups = c("Alpha", "Beta"),
      q = c(0.1, 0.9),
      xlab = c("Custom X"),
      ylab = c("Custom Y"))
```

plot.UPG.Probit

Coefficient plots for UPG.Probit objects

Description

plot generates plots from UPG.Probit objects using ggplot2. Coefficient plots show point estimates for all coefficients as well as their credible intervals.

Usage

```
## S3 method for class 'UPG.Probit'
plot(
  x = NULL,
  ...,
  sort = FALSE,
  names = NULL,
  xlab = NULL,
  ylab = NULL,
  q = c(0.025, 0.975),
  include = NULL
)
```

Arguments

x	an object of class UPG.Probit.
...	other plot parameters.
sort	a logical variable indicating whether the plotted coefficients should be sorted according to effect sizes. Default is FALSE.
names	a character vector indicating names for the variables used in the plots.
xlab	a character vector of length 1 indicating a title for the x-axis.
ylab	a character vector of length 1 indicating a title for the y-axis.
q	a numerical vector of length two holding the posterior quantiles to be extracted. Default are 0.025 and 0.975 quantiles.
include	can be used to plot only a subset of variables. Specify the columns of X that should be kept in the plot. See examples for further information.

Value

Returns a ggplot2 object.

Author(s)

Gregor Zens

See Also

[summary.UPG.Probit](#) to summarize the estimates of a discrete choice model from an UPG.Probit object and create tables. [predict.UPG.Probit](#) to predict probabilities from a discrete choice model from an UPG.Probit object. [coef.UPG.Probit](#) to extract coefficients from an UPG.Probit object.

Examples

```
# estimate a probit model using example data
library(UPG)
data(lfp)
```

```

y = lfp[,1]
X = lfp[,-1]
results.probit = UPG(y = y, X = X, type = "probit", verbose=TRUE)

# plot the results and sort coefficients by effect size
plot(results.probit, sort = TRUE)

# plot only variables 1 and 3 with custom names, credible intervals and axis labels
plot(results.probit,
      include = c(1, 3),
      names = c("Custom 1", "Custom 2"),
      q = c(0.1, 0.9),
      xlab = c("Custom X"),
      ylab = c("Custom Y"))

```

predict.UPG.Binomial *Predicted probabilities from UPG.Binomial objects*

Description

predict generates predicted probabilities from estimated discrete choice models in an UPG.Binomial object. In addition, credible intervals for these probabilities are computed. Probabilities can be predicted from the data used for estimating the model or for a new data set with the same structure.

Usage

```

## S3 method for class 'UPG.Binomial'
predict(object = NULL, ..., newdata = NULL, q = c(0.025, 0.975))

```

Arguments

object	an object of class UPG.Binomial.
...	other predict parameters.
newdata	a matrix or a data.frame containing new explanatory data. The number of columns and the variable ordering must be the same as in the explanatory data used for estimation to generate valid predictions. If no new data is provided, predict will return predicted probabilities for the data used for estimating the model.
q	a numerical vector of length two holding the posterior quantiles to be extracted. Default are 0.025 and 0.975 quantiles.

Value

Returns a list containing posterior means of predicted probabilities as well as the desired credible interval.

Author(s)

Gregor Zens

See Also

[summary.UPG.Binomial](#) to summarize the estimates of a discrete choice model from an UPG.Binomial object and create tables. [plot.UPG.Binomial](#) to plot the results of a discrete choice model from an UPG.Binomial object. [coef.UPG.Binomial](#) to extract coefficients from an UPG.Binomial object.

Examples

```
# estimate a binomial logit model using example data
library(UPG)
data(titanic)
y = titanic[,1]
Ni = titanic[,2]
X = titanic[,-c(1,2)]
results.binomial = UPG(y = y, X = X, Ni = Ni, type = "binomial")

# extract predicted probabilities
predict(results.binomial)
```

predict.UPG.Logit *Predicted probabilities from UPG.Logit objects*

Description

predict generates predicted probabilities from estimated discrete choice models in an UPG.Logit object. In addition, credible intervals for these probabilities are computed. Probabilities can be predicted from the data used for estimating the model or for a new data set with the same structure.

Usage

```
## S3 method for class 'UPG.Logit'
predict(object = NULL, ..., newdata = NULL, q = c(0.025, 0.975))
```

Arguments

object	an object of class UPG.Logit.
...	other predict parameters.
newdata	a matrix or a data.frame containing new explanatory data. The number of columns and the variable ordering must be the same as in the explanatory data used for estimation to generate valid predictions. If no new data is provided, predict will return predicted probabilities for the data used for estimating the model.
q	a numerical vector of length two holding the posterior quantiles to be extracted. Default are 0.025 and 0.975 quantiles.

Value

Returns a list containing posterior means of predicted probabilities as well as the desired credible interval.

Author(s)

Gregor Zens

See Also

[summary.UPG.Logit](#) to summarize the estimates of a discrete choice model from an UPG.Logit object and create tables. [plot.UPG.Logit](#) to plot the results of a discrete choice model from an UPG.Logit object. [coef.UPG.Logit](#) to extract coefficients from an UPG.Logit object.

Examples

```
# estimate a logit model using example data
library(UPG)
data(lfp)
y = lfp[,1]
X = lfp[,-1]
results.logit = UPG(y = y, X = X, type = "logit", verbose=TRUE)

# extract predicted probabilities
predict(results.logit)
```

predict.UPG.MNL

Predicted probabilities from UPG.MNL objects

Description

predict generates predicted probabilities from estimated discrete choice models in an UPG.MNL object. In addition, credible intervals for these probabilities are computed. Probabilities can be predicted from the data used for estimating the model or for a new data set with the same structure.

Usage

```
## S3 method for class 'UPG.MNL'
predict(object = NULL, ..., newdata = NULL, q = c(0.025, 0.975))
```

Arguments

object an object of class UPG.MNL.
 ... other predict parameters.

newdata	a matrix or a data.frame containing new explanatory data. The number of columns and the variable ordering must be the same as in the explanatory data used for estimation to generate valid predictions. If no new data is provided, predict will return predicted probabilities for the data used for estimating the model.
q	a numerical vector of length two holding the posterior quantiles to be extracted. Default are 0.025 and 0.975 quantiles.

Value

Returns a list containing posterior means of predicted probabilities as well as the desired credible interval.

Author(s)

Gregor Zens

See Also

[summary.UPG.MNL](#) to summarize the estimates of a discrete choice model from an UPG.MNL object and create tables. [plot.UPG.MNL](#) to plot the results of a discrete choice model from an UPG.Logit object. [coef.UPG.MNL](#) to extract coefficients from an UPG.MNL object.

Examples

```
# estimate a multinomial logit model using example data
library(UPG)
data(program)
y = program[,1]
X = program[,-1]
results.mnl = UPG(y = y, X = X, type = "mnl")

# extract predicted probabilities
predict(results.mnl)
```

predict.UPG.Probit *Predicted probabilities from UPG.Probit objects*

Description

predict generates predicted probabilities from estimated discrete choice models in an UPG.Probit object. In addition, credible intervals for these probabilities are computed. Probabilities can be predicted from the data used for estimating the model or for a new data set with the same structure.

Usage

```
## S3 method for class 'UPG.Probit'  
predict(object = NULL, ..., newdata = NULL, q = c(0.025, 0.975))
```

Arguments

object	an object of class UPG.Probit.
...	other predict parameters.
newdata	a matrix or a data.frame containing new explanatory data. The number of columns and the variable ordering must be the same as in the explanatory data used for estimation to generate valid predictions. If no new data is provided, predict will return predicted probabilities for the data used for estimating the model.
q	a numerical vector of length two holding the posterior quantiles to be extracted. Default are 0.025 and 0.975 quantiles.

Value

Returns a list containing posterior means of predicted probabilities as well as the desired credible interval.

Author(s)

Gregor Zens

See Also

[summary.UPG.Probit](#) to summarize the estimates of a discrete choice model from an UPG.Probit object and create tables. [plot.UPG.Probit](#) to plot the results of a discrete choice model from an UPG.Probit object. [coef.UPG.Probit](#) to extract coefficients from an UPG.Probit object.

Examples

```
# estimate a probit model using example data  
library(UPG)  
data(lfp)  
y = lfp[,1]  
X = lfp[,-1]  
results.probit = UPG(y = y, X = X, type = "probit", verbose=TRUE)  
  
# extract predicted probabilities  
predict(results.probit)
```

print.UPG.Binomial *Print information for UPG.Binomial objects*

Description

print provides some basic information about an UPG.Binomial object.

Usage

```
## S3 method for class 'UPG.Binomial'  
print(x, ...)
```

Arguments

x an object of class UPG.Binomial.
... other print parameters.

Author(s)

Gregor Zens

See Also

[summary.UPG.Binomial](#) to summarize the estimates of a discrete choice model from an UPG.Binomial object and create tables. [predict.UPG.Binomial](#) to predict probabilities from a discrete choice model from an UPG.Binomial object. [plot.UPG.Binomial](#) to plot the results of a discrete choice model from an UPG.Binomial object.

Examples

```
# estimate a binomial logit model using example data  
library(UPG)  
data(titanic)  
y = titanic[,1]  
Ni = titanic[,2]  
X = titanic[,-c(1,2)]  
results.binomial = UPG(y = y, X = X, Ni = Ni, type = "binomial")  
print(results.binomial)
```

print.UPG.Logit	<i>Print information for UPG.Logit objects</i>
-----------------	--

Description

print provides some basic information about an UPG.Logit object.

Usage

```
## S3 method for class 'UPG.Logit'  
print(x, ...)
```

Arguments

x	an object of class UPG.Logit.
...	other print parameters.

Author(s)

Gregor Zens

See Also

[summary.UPG.Logit](#) to summarize the estimates of a discrete choice model from an UPG.Logit object and create tables. [predict.UPG.Logit](#) to predict probabilities from a discrete choice model from an UPG.Logit object. [plot.UPG.Logit](#) to plot the results of a discrete choice model from an UPG.Logit object.

Examples

```
# estimate a logit model using example data  
library(UPG)  
data(lfp)  
y = lfp[,1]  
X = lfp[,-1]  
results.logit = UPG(y = y, X = X, type = "logit", verbose=TRUE)  
print(results.logit)
```

print.UPG.MNL	<i>Print information for UPG.MNL objects</i>
---------------	--

Description

print provides some basic information about an UPG.MNL object.

Usage

```
## S3 method for class 'UPG.MNL'  
print(x, ...)
```

Arguments

x	an object of class UPG.MNL.
...	other print parameters.

Author(s)

Gregor Zens

See Also

[summary.UPG.MNL](#) to summarize the estimates of a discrete choice model from an UPG.MNL object and create tables. [predict.UPG.MNL](#) to predict probabilities from a discrete choice model from an UPG.Logit object. [plot.UPG.MNL](#) to plot the results of a discrete choice model from an UPG.MNL object.

Examples

```
# estimate a multinomial logit model using example data  
library(UPG)  
data(program)  
y = program[,1]  
X = program[,-1]  
results.mnl = UPG(y = y, X = X, type = "mnl")  
print(results.mnl)
```

print.UPG.Probit	<i>Print information for UPG.Probit objects</i>
------------------	---

Description

print provides some basic information about an UPG.Probit object.

Usage

```
## S3 method for class 'UPG.Probit'  
print(x, ...)
```

Arguments

x	an object of class UPG.Probit.
...	other print parameters.

Author(s)

Gregor Zens

See Also

[summary.UPG.Probit](#) to summarize the estimates of a discrete choice model from an UPG.Probit object and create tables. [predict.UPG.Probit](#) to predict probabilities from a discrete choice model from an UPG.Probit object. [plot.UPG.Probit](#) to plot the results of a discrete choice model from an UPG.Probit object.

Examples

```
# estimate a probit model using example data  
library(UPG)  
data(lfp)  
y = lfp[,1]  
X = lfp[,-1]  
results.probit = UPG(y = y, X = X, type = "probit", verbose=TRUE)  
print(results.probit)
```

program	<i>Students program choices.</i>
---------	----------------------------------

Description

A dataset containing the choice among general program, vocational program and academic program for 200 high school students as well as some explanatory variables.

Usage

```
program
```

Format

A data frame with 200 rows and 5 variables:

program a vector of program choices

intercept an intercept

female dummy for female students

ses socioeconomic status, 1 is lowest

write writing score of student

Source

Original dataset is known as 'hsbdemo' and has been sourced from <https://stats.idre.ucla.edu/stat/data/hsbdemo.dta>.

summary.UPG.Binomial	<i>Estimation results and tables for UPG.Binomial objects</i>
----------------------	---

Description

summary generates a summary of estimation results for UPG.Binomial objects. Point estimates, estimated standard deviation as well as credible intervals for each variable are tabulated. In addition, an indicator quickly shows whether the credible interval includes zero or not. In addition, LaTeX, HTML and pandoc tables can be quickly generated via knitr.

Usage

```
## S3 method for class 'UPG.Binomial'
summary(
  object = NULL,
  ...,
  q = c(0.025, 0.975),
  names = NULL,
  digits = 2,
  include = NULL,
  table = NULL,
  cap = NULL
)
```

Arguments

object	an object of class UPG.Binomial.
...	other summary parameters.
q	a numerical vector of length two holding the posterior quantiles to be extracted. Default are 0.025 and 0.975 quantiles.
names	a character vector indicating names for the variables used in the output.
digits	number of digits to be included in output. Last digit will be rounded using round.
include	can be used to summarize and tabulate only a subset of variables. Specify the columns of X that should be kept in the plot. See examples for further information.
table	can be used to return a LaTeX table ('latex'), a Word table ('pandoc') and HTML tables ('html') via knitr. Include package "booktabs" in LaTeX preamble for LaTeX tables.
cap	character vector that can be used to specify the table caption is returned.

Value

Returns a knitr_kable object containing the summary table.

Author(s)

Gregor Zens

See Also

[plot.UPG.Binomial](#) to plot the results of a discrete choice model from an UPG.Binomial object. [predict.UPG.Binomial](#) to predict probabilities from a discrete choice model from an UPG.Binomial object. [coef.UPG.Binomial](#) to extract coefficients from an UPG.Binomial object.

Examples

```
# estimate a binomial logit model using example data
library(UPG)
data(titanic)
y = titanic[,1]
Ni = titanic[,2]
X = titanic[,-c(1,2)]
results.binomial = UPG(y = y, X = X, Ni = Ni, type = "binomial")

# basic summary of regression results
summary(results.binomial)

# generate a LaTeX table with subset of variables and custom names
summary(results.binomial,
        include=c(1,3),
        names=c("V. kept 1", "V. kept 3"),
        table="latex")
```

summary.UPG.Logit

Estimation results and tables for UPG.Logit objects

Description

summary generates a summary of estimation results for UPG.Logit objects. Point estimates, estimated standard deviation as well as credible intervals for each variable are tabulated. In addition, an indicator quickly shows whether the credible interval includes zero or not. In addition, LaTeX, HTML and pandoc tables can be quickly generated via knitr.

Usage

```
## S3 method for class 'UPG.Logit'
summary(
  object = NULL,
  ...,
  q = c(0.025, 0.975),
  names = NULL,
  digits = 2,
  include = NULL,
  table = NULL,
  cap = NULL
)
```

Arguments

object an object of class UPG.Logit.
... other summary parameters.

q	a numerical vector of length two holding the posterior quantiles to be extracted. Default are 0.025 and 0.975 quantiles.
names	a character vector indicating names for the variables used in the output.
digits	number of digits to be included in output. Last digit will be rounded using round.
include	can be used to summarize and tabulate only a subset of variables. Specify the columns of X that should be kept in the plot. See examples for further information.
table	can be used to return a LaTeX table ('latex'), a Word table ('pandoc') and HTML tables ('html') via knitr. Include package "booktabs" in LaTeX preamble for LaTeX tables.
cap	character vector that can be used to specify the table caption is returned.

Value

Returns a knitr_kable object containing the summary table.

Author(s)

Gregor Zens

See Also

[plot.UPG.Logit](#) to plot the results of a discrete choice model from an UPG.Logit object. [predict.UPG.Logit](#) to predict probabilities from a discrete choice model from an UPG.Logit object. [coef.UPG.Logit](#) to extract coefficients from an UPG.Logit object.

Examples

```
# estimate a logit model using example data
library(UPG)
data(lfp)
y = lfp[,1]
X = lfp[,-1]
results.logit = UPG(y = y, X = X, type = "logit", verbose=TRUE)

# basic summary of regression results
summary(results.logit)

# generate a LaTeX table with subset of variables and custom names
summary(results.logit,
  include=c(1,3),
  names=c("V. kept 1", "V. kept 3"),
  table="latex")
```

Description

summary generates a summary of estimation results for UPG.MNL objects. Point estimates, estimated standard deviation as well as credible intervals for each variable are tabulated. In addition, an indicator quickly shows whether the credible interval includes zero or not. In addition, LaTeX, HTML and pandoc tables can be quickly generated via knitr.

Usage

```
## S3 method for class 'UPG.MNL'
summary(
  object = NULL,
  ...,
  q = c(0.025, 0.975),
  groups = NULL,
  names = NULL,
  digits = 2,
  include = NULL,
  table = NULL,
  cap = NULL
)
```

Arguments

object	an object of class UPG.MNL.
...	other summary parameters.
q	a numerical vector of length two holding the posterior quantiles to be extracted. Default are 0.025 and 0.975 quantiles.
groups	a character vector indicating names for the groups, excluding the baseline. The group names must correspond to the ordering in the dependent variable used for estimation.
names	a character vector indicating names for the variables used in the output.
digits	number of digits to be included in output. Last digit will be rounded using round.
include	can be used to summarize and tabulate only a subset of variables. Specify the columns of X that should be kept in the plot. See examples for further information.
table	can be used to return a LaTeX table ('latex'), a Word table ('pandoc') and HTML tables ('html') via knitr. Include package "booktabs" in LaTeX preamble for LaTeX tables.
cap	character vector that can be used to specify the table caption is returned.

Value

Returns a knitr_kable object containing the summary table.

Author(s)

Gregor Zens

See Also

[plot.UPG.MNL](#) to plot the results of a discrete choice model from an UPG.MNL object. [predict.UPG.MNL](#) to predict probabilities from a discrete choice model from an UPG.MNL object. [coef.UPG.MNL](#) to extract coefficients from an UPG.MNL object.

Examples

```
# estimate a multinomial logit model using example data
library(UPG)
data(program)
y = program[,1]
X = program[,-1]
results.mnl = UPG(y = y, X = X, type = "mnl")

# basic summary of regression results
summary(results.mnl)

# generate a LaTeX table with subset of variables and custom names
summary(results.mnl,
  include=c(1,3),
  groups=c("Alpha", "Beta"),
  names=c("V. kept 1", "V. kept 3"),
  table="latex")
```

summary.UPG.Probit *Estimation results and tables for UPG.Probit objects*

Description

summary generates a summary of estimation results for UPG.Probit objects. Point estimates, estimated standard deviation as well as credible intervals for each variable are tabulated. In addition, an indicator quickly shows whether the credible interval includes zero or not. In addition, LaTeX, HTML and pandoc tables can be quickly generated via knitr.

Usage

```
## S3 method for class 'UPG.Probit'
summary(
  object = NULL,
  ...,
  q = c(0.025, 0.975),
  names = NULL,
  digits = 2,
  include = NULL,
  table = NULL,
  cap = NULL
)
```

Arguments

object	an object of class UPG.Probit.
...	other summary parameters.
q	a numerical vector of length two holding the posterior quantiles to be extracted. Default are 0.025 and 0.975 quantiles.
names	a character vector indicating names for the variables used in the output.
digits	number of digits to be included in output. Last digit will be rounded using round.
include	can be used to summarize and tabulate only a subset of variables. Specify the columns of X that should be kept in the plot. See examples for further information.
table	can be used to return a LaTeX table ('latex'), a Word table ('pandoc') and HTML tables ('html') via knitr. Include package "booktabs" in LaTeX preamble for LaTeX tables.
cap	character vector that can be used to specify the table caption is returned.

Value

Returns a knitr_kable object containing the summary table.

Author(s)

Gregor Zens

See Also

[plot.UPG.Probit](#) to plot the results of a discrete choice model from an UPG.Probit object. [predict.UPG.Probit](#) to predict probabilities from a discrete choice model from an UPG.Probit object. [coef.UPG.Probit](#) to extract coefficients from an UPG.Probit object.

Examples

```
# estimate a probit model using example data
library(UPG)
data(lfp)
y = lfp[,1]
X = lfp[,-1]
results.probit = UPG(y = y, X = X, type = "probit", verbose=TRUE)

# basic summary of regression results
summary(results.probit)

# generate a LaTeX table with subset of variables and custom names
summary(results.probit,
         include=c(1,3),
         names=c("V. kept 1", "V. kept 3"),
         table="latex")
```

titanic	<i>Grouped Titanic survival data.</i>
---------	---------------------------------------

Description

A dataset containing the number of survivals and the total number of persons by passenger class, age group and gender.

Usage

```
titanic
```

Format

A data frame with 78 rows and 6 variables:

survived number of passengers that survived

total number of total passengers

intercept an intercept

pclass passenger class (1 highest, 3 lowest)

female dummy for females

age.group age group indicator (0-5yrs, 5-10yrs, ...)

Source

Data originally sourced from <https://web.stanford.edu/class/archive/cs/cs109/cs109.1166/stuff/titanic.csv>. See also <https://towardsdatascience.com/the-binomial-regression-model-everything-you-need-to-know>

Description

UPG estimates Bayesian discrete choice models and returns the full posterior distribution for all parameters that can be used for further analysis and inference.

Usage

```
UPG(y,
    X,
    type,
    Ni      = NULL,
    baseline = NULL,
    draws   = 1000,
    burnin  = 1000,
    A0      = 1,
    d0      = 0.5,
    D0      = 0.5,
    G0      = 99,
    verbose = TRUE,
    BOOST   = TRUE,
    beta.start = NULL)
```

Arguments

y	a binary vector for probit and logit models. A character, factor or numeric vector for multinomial logit models. A vector of the number of successes for the binomial model.
X	a matrix of explanatory variables including an intercept in the first column. Rows are individuals, columns are variables.
type	indicates the model to be estimated. 'probit' for the probit model, 'logit' for the logit model, 'mnl' for the multinomial logit model or 'binomial' for the binomial logit model.
Ni	a vector containing the number of trials when estimating a binomial logit model.
baseline	a string that can be used to change the baseline category in MNL models. Default baseline is the most common category.
draws	number of saved Gibbs sampler iterations. Default is 1000 for illustration purposes, you should use more when estimating a model (e.g. 10,000)!
burnin	number of burned Gibbs sampler iterations. Default is 1000 for illustration purposes, you should probably use more when estimating a model (e.g. 2,000)!
A0	prior variance for coefficients, 1 is the default.
d0	prior shape for working parameter delta, 0.5 is the default.

D0	prior rate for working parameter delta, 0.5 is the default.
G0	prior variance for the intercept, 99 is the default.
verbose	logical variable indicating whether model output and progress should be printed during estimation.
BOOST	logical variable indicating whether MCMC boosting should be used.
beta.start	provide starting values for beta (e.g. for use within Gibbs sampler)

Value

Depending on the type of the model, UPG() returns an UPG.Probit, UPG.Logit, UPG.MNL or UPG.Binomial object.

Author(s)

Gregor Zens

See Also

[summary.UPG.Probit](#) to summarize the estimates of a discrete choice model from an UPG.Probit object and to create tables. [predict.UPG.Logit](#) to predict probabilities from a discrete choice model from an UPG.Logit object. [plot.UPG.MNL](#) to plot the results of a discrete choice model from an UPG.MNL object.

Examples

```
# load package
library(UPG)

# estimate a probit model using example data
# warning: use more burn-ins, burnin = 100 is just for demonstration purposes
data(lfp)
y = lfp[,1]
X = lfp[,-1]
results.probit = UPG(y = y, X = X, type = "probit", verbose=TRUE, burnin = 100)

# estimate a logit model using example data
# warning: use more burn-ins, burnin = 100 is just for demonstration purposes
data(lfp)
y = lfp[,1]
X = lfp[,-1]
results.logit = UPG(y = y, X = X, type = "logit", verbose=TRUE, burnin = 100)

# estimate a MNL model using example data
# warning: use more burn-ins, burnin = 100 is just for demonstration purposes
data(program)
y = program[,1]
X = program[,-1]
results.mnl = UPG(y = y, X = X, type = "mnl", burnin = 100)
```

```
# estimate a binomial logit model using example data
# warning: use more burn-ins, burnin = 100 is just for demonstration purposes
data(titanic)
y = titanic[,1]
Ni = titanic[,2]
X = titanic[,-c(1,2)]
results.binomial = UPG(y = y, X = X, Ni = Ni, type = "binomial", burnin = 100)
```

UPG.Diag	<i>MCMC Diagnostics for UPG.Probit, UPG.Logit, UPG.MNL and UPG.Binomial objects using coda</i>
----------	--

Description

UPG.Diag computes a number of MCMC diagnostics based on the Markov chains that are contained in the model output returned by UPG.

Usage

```
UPG.Diag(object = NULL)
```

Arguments

object an object of class UPG.Probit, UPG.Logit, UPG.MNL or UPG.Binomial.

Value

Returns a list containing effective sample size, effective sampling rate and inefficiency factors for each coefficient. Specifically, maximum, minimum and median as well as detailed results for each coefficient are returned.

Author(s)

Gregor Zens

Examples

```
# estimate a probit model using example data
library(UPG)
data(lfp)
y = lfp[,1]
X = lfp[,-1]
results.probit = UPG(y = y, X = X, type = "probit", verbose=TRUE)

# compute MCMC diagnostics
UPG.Diag(results.probit)
```

UPG.Diag.Binomial *MCMC Diagnostics for UPG.Binomial objects*

Description

UPG.Diag.Binomial computes inefficiency factors, effective sample size and effective sampling rate based on the posterior distributions in an UPG.Binomial object.

Usage

```
UPG.Diag.Binomial(object = NULL)
```

Arguments

object an object of class UPG.Binomial.

Value

Returns a list containing effective sample size, effective sampling rate and inefficiency factors for each coefficient.

Author(s)

Gregor Zens

UPG.Diag.Logit *MCMC Diagnostics for UPG.Logit objects*

Description

UPG.Diag.Logit computes inefficiency factors, effective sample size and effective sampling rate based on the posterior distributions in an UPG.Logit object.

Usage

```
UPG.Diag.Logit(object = NULL)
```

Arguments

object an object of class UPG.Logit.

Value

Returns a list containing effective sample size, effective sampling rate and inefficiency factors for each coefficient.

Author(s)

Gregor Zens

`UPG.Diag.MNL`*MCMC Diagnostics for UPG.MNL objects*

Description

UPG.Diag.MNL computes inefficiency factors, effective sample size and effective sampling rate based on the posterior distributions in an UPG.MNL object.

Usage`UPG.Diag.MNL(object = NULL)`**Arguments**

`object` an object of class UPG.MNL.

Value

Returns a list containing effective sample size, effective sampling rate and inefficiency factors for each coefficient.

Author(s)

Gregor Zens

`UPG.Diag.Probit`*MCMC Diagnostics for UPG.Probit objects*

Description

UPG.Diag.Probit computes inefficiency factors, effective sample size and effective sampling rate based on the posterior distributions in an UPG.Probit object.

Usage`UPG.Diag.Probit(object = NULL)`**Arguments**

`object` an object of class UPG.Probit.

Value

Returns a list containing effective sample size, effective sampling rate and inefficiency factors for each coefficient.

Author(s)

Gregor Zens

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