Package ‘UPG’

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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  
  *Extract coefficients from UPG.Binomial objects*

**Description**

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

```r
## 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

```r
# 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

```r
## 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

```r
# 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.UMP.MNL

---

Extract coefficients from UPG.MNL objects

Description

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

Usage

```r
## 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

```r
# 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")

deferentially means and credible interval based on 0.025 and 0.975 quantiles
coef(results.mnl, q = c(0.025, 0.975))
```
coef.UPG.Probit

Extract coefficients from UPG.Probit objects

**Description**

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

**Usage**

```r
## S3 method for class 'UPG.Probit'
c 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**

```r
# 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
c coef(results.probit, q = c(0.025, 0.975))
```
**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**


---

**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

```r
## 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

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

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

# compute BIC
BIC(ll.binomial)
```
\textbf{logLik.UPG.Logit} 

\textit{Compute log-likelihoods from UPG.Logit objects}

\section*{Description}

\texttt{logLik} can be used to compute log-likelihoods from \texttt{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.

\section*{Usage}

\begin{verbatim}
## S3 method for class 'UPG.Logit'
logLik(object = NULL, ...)
\end{verbatim}

\section*{Arguments}

\begin{description}
\item[object] an object of class \texttt{UPG.Logit}.
\item[...] other \texttt{logLik} parameters.
\end{description}

\section*{Value}

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

\section*{Author(s)}

Gregor Zens

\section*{See Also}

\texttt{summary.UPG.Logit} to summarize the estimates of a discrete choice model from an \texttt{UPG.Logit} object and create tables. \texttt{plot.UPG.Logit} to plot the results of a discrete choice model from an \texttt{UPG.Logit} object. \texttt{coef.UPG.Logit} to extract coefficients from an \texttt{UPG.Logit} object.

\section*{Examples}

\begin{verbatim}
# 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
\end{verbatim}
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(ll.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**

```r
## 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**

```r
# 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**

```r
## 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"))

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,
Arguments

- `x`: an object of class `UPG.Logit`.
- `...`: 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.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

```r
# 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"))

## 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
)

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"))
Usage

```r
## 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

```r
# 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)

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

```r
# 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

```r
## 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

```r
# 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)
```

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

```r
## 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

```r
# estimate a probit model using example data
library(UPG)
data(lfp)
y = lfp[,1]
X = lfp[,2]
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)
Description

print provides some basic information about an \texttt{UPG.Logit} object.

Usage

\begin{verbatim}
## S3 method for class 'UPG.Logit'
print(x, ...)
\end{verbatim}

Arguments

\begin{verbatim}
x an object of class \texttt{UPG.Logit}.
...
other print parameters.
\end{verbatim}

Author(s)

Gregor Zens

See Also

\texttt{summary.UPG.Logit} to summarize the estimates of a discrete choice model from an \texttt{UPG.Logit} object and create tables. \texttt{predict.UPG.Logit} to predict probabilities from a discrete choice model from an \texttt{UPG.Logit} object. \texttt{plot.UPG.Logit} to plot the results of a discrete choice model from an \texttt{UPG.Logit} object.

Examples

\begin{verbatim}
# 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)
\end{verbatim}
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
calendar load('UPG')
data(program)
y = program[,1]
X = program[,2]
results.mnl = UPG(y = y, X = X, type = "mnl")
print(results.mnl)
print.UPG.Probit

Print information for UPG.Probit objects

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)
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](https://stats.idre.ucla.edu/stat/data/hsbdemo.dta).

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.
summary.UPG.Binomial

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

```r
# 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")
```

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

```r
## 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.
summary.UPG.Logit

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 \texttt{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 (\texttt{latex}), a Word table (\texttt{pandoc}) and HTML tables (\texttt{html}) via \texttt{knitr}. Include package \texttt{booktabs} in \LaTeX{} preamble for \LaTeX{} tables.

cap

character vector that can be used to specify the table caption is returned.

Value

Returns a \texttt{knitr_kable} object containing the summary table.

Author(s)

Gregor Zens

See Also

\texttt{plot.UPG.Logit} to plot the results of a discrete choice model from an \texttt{UPG.Logit} object. \texttt{predict.UPG.Logit} to predict probabilities from a discrete choice model from an \texttt{UPG.Logit} object. \texttt{coef.UPG.Logit} to extract coefficients from an \texttt{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

```r
## 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

```r
# 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")
```
Usage

```r
## 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

Grouped Titanic survival data.

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

UPG  
Gibbs Sampling for Bayesian discrete choice models

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.
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

MCMC Diagnostics for UPG.Probit, UPG.Logit, UPG.MNL and UPG.Binomial objects using coda

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  \textit{MCMC Diagnostics for UPG.Binomial objects}

\textbf{Description}

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

\textbf{Usage}

\texttt{UPG.Diag.Binomial(object = NULL)}

\textbf{Arguments}

\begin{itemize}
  \item \texttt{object} \hspace{1cm} an object of class UPG.Binomial.
\end{itemize}

\textbf{Value}

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

\textbf{Author(s)}

Gregor Zens

UPG.Diag.Logit \textit{MCMC Diagnostics for UPG.Logit objects}

\textbf{Description}

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

\textbf{Usage}

\texttt{UPG.Diag.Logit(object = NULL)}

\textbf{Arguments}

\begin{itemize}
  \item \texttt{object} \hspace{1cm} an object of class UPG.Logit.
\end{itemize}

\textbf{Value}

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

Author(s)
Gregor Zens

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

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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