Package 'auctionr'

July 22, 2025

Type Package

Title Estimate First-Price Auction Model

Version 0.1.0

Description Estimates a first-price auction model with conditionally independent private values as described in MacKay (2020) <doi:10.2139/ssrn.3096534>. The model allows for unobserved heterogeneity that is common to all bidders in addition to observable heterogeneity.

License GPL-3

URL https://github.com/ajmack/auctionr

BugReports https://github.com/ajmack/auctionr/issues

Depends R (>= 3.5.0)

Imports stats, parallel, numDeriv (>= 2016.8-1)

VignetteBuilder knitr

Encoding UTF-8

LazyData TRUE

RoxygenNote 7.1.0

Suggests testthat (>= 2.1.0), knitr, rmarkdown

NeedsCompilation no

Author Alex MacKay [aut, cre],
Bob Freeman [aut],
Paul Jonak [aut],
Victoria Prince [aut],
Ista Zahn [aut]

Maintainer Alex MacKay <amackay@hbs.edu>

Repository CRAN

Date/Publication 2020-06-25 10:00:07 UTC

Contents

`auction_generate_data` *Generates sample data for running* `auction_model`

Description

Generates sample data for running `auction_model`

Usage

```
auction_generate_data(
  obs = NULL,
  max_n_bids = 10,
  new_x_mean = NULL,
  new_x_sd = NULL,
  mu = NULL,
  alpha = NULL,
  sigma = NULL,
  beta = NULL
)
```

Arguments

`obs`	Number of observations (or auctions) to draw.
`max_n_bids`	Maximum number of bids per auction (must be 3 or greater). The routine generates a vector of length `obs` of random numbers between 2 and max_n_bids.
`new_x_mean`	Mean values for observable controls to be generated from a Normal distribution.
`new_x_sd`	Standard deviations for observable controls to be generated from a Normal distribution.
`mu`	Value for mu, or mean, of private value distribution (Weibull) to be generated.
`alpha`	Value for alpha, or shape parameter, of private value distribution (Weibull) to be generated.
`sigma`	Value for standard deviation of unobserved heterogeneity distribution. Note that the distribution is assumed to have mean 1.
`beta`	Coefficients for the generated observable controls. Must be of the same length as `new_x_mean` and `new_x_sd`.

Details

This function generates example data for feeding into auction_model(). Specifically, the winning bid, number of bids, and observed heterogeneity are sampled for the specified number of observations.

Value

A data frame with obs rows and the following columns:

winning_bid	numeric values of the winning bids for each observation
n_bids	number of bids for each observation
X#	X terms that represent observed heterogeneity

See Also

auction_model

Examples

```
dat <- auction_generate_data(obs = 100,
                             mu = 10,
                             new_x_mean= c(-1,1),
                             new_x_sd = c(0.5,0.8),
                             alpha = 2,
                             sigma = 0.2,
                             beta = c(-1,1))
dim(dat)
head(dat)
```

---

auction_model *Estimates a first-price auction model.*

Description

Estimates a first-price auction model.

Usage

```
auction_model(
  dat = NULL,
  init_param = NULL,
  num_cores = 1,
  method = "BFGS",
  control = list(),
  std_err = FALSE,
  hessian_args = list()
)
```

Arguments

dat	A data.frame containing input columns in the following order: the winning bids, number of bids, and X variables that represent observed heterogeneity.
init_param	Vector of initial values for mu, alpha, sigma, and beta vector, provided in order specified. Note that the Weibull distribution requires mu and alpha to be positive. The standard deviation of unobserved heterogeneity, sigma, must be positive as well. The Beta vector may take any values. If init_params is not provided, all values will be set to 1 by default.
num_cores	The number of cores for running the model in parallel. The default value is 1.
method	Optimization method to be used in optim() (see ?optim for details).
control	A list of control parameters to be passed to optim() (see ?optim for details).
std_err	If TRUE, the standard errors of the parameters will also be calculated. Note that it may significantly increase the computation time.
hessian_args	A list of arguments passed as the method.args argument of the hessian() function if standard errors are calculated (see ?hessian for details).

Details

This function estimates a first-price auction model with conditionally independent private values. This version of the package estimates a procurement auction, where the winning bid is the amount that a single buyer will pay to the top bidding supplier, and values correspond to costs. The model allows for unobserved heterogeneity that is common to all bidders in addition to observable heterogeneity. The winning bid (Y) takes the form

Y = B * U * h(X)

where B is the proportional winning bid, U is the unobserved heterogeneity, and h(X) controls for observed heterogeneity. The model is log-linear so that log(Y) = log(B) + log(U) + log(h(X)) and log(h(X)) = beta1 * X1 + beta2 * X2 + ...

The (conditionally) independent private costs are drawn from a Weibull distribution with parameters mu (mean) and alpha (shape). The CDF of this distribution is given by

F(c) = 1 - exp(- (c * 1/mu * Gamma(1 + 1/alpha))^(alpha))

The unobserved heterogeneity U is sampled from log-normal distribution with mean 1 and a free parameter sigma representing its standard deviation.

init_params, the initial guess for convergence, must be supplied.

This function utilizes the Rsnow framework within the Rparallel package. If numcores is not specified, this will be run using only one CPU/core. One can use parallel::detectCores() to determine how many are available on your system, but you are not advised to use all at once, as this may make your system unresponsive. Please see Rparallel and Rsnow for more details.

Note that the supplied data can not have missing values.

Value

A list returned by optim(). See ?optim for more details. If std_err was set to TRUE and the routine succeeded in inverting the estimated Hessian, the list will have an additional component:

std_err	A vector of standard errors for parameter estimates.

Author(s)

Mackay, Alexander. <amackay@hbs.edu>, HBS Research Computing <research@hbs.edu>.

References

Mackay, Alexander. 2020. "Contract Duration and the Costs of Market Transactions." Working paper, Appendix G.

See Also

auction_generate_data

Examples

```
##############################################################################
## Estimating parameters and standard errors with custom "control" argument
set.seed(100)
dat <- auction_generate_data(obs = 15, mu = 10, alpha = 2,
                             sigma = 0.2, beta = c(-1,1),
                             new_x_mean= c(-1,1),
                             new_x_sd = c(0.5,0.8))

res <- auction_model(dat, init_param =  c(8, 2, .5, .4, .6),
                     num_cores = 1,
                     control = list(parscale = c(1,0.1,0.1,1,1)),
                     std_err = TRUE)
res

## run vignette("auctionr") to view a more detailed example
```

---

print.auctionmodel *Print an auction model.*

Description

Print an auction model.

Usage

```
## S3 method for class 'auctionmodel'
print(x, digits = 6, ...)
```

Arguments

x	An object of class auctionmodel.
digits	Number of digits to display.
...	Additional arguments passed to other methods.

Value

x, invisibly.

Index