

Package ‘Rcess’

December 13, 2016

Type Package

Title Rcess: An R package for calculating estimates of costs and economies of scale and scope

Version 0.0.1

Description This package utilize the theory of economies of scale and scope (developed by Baumol, Panzar, & Willig (1982)) to calculate the average output costs, economies of scale, and economies of scope for different types of multi-output production industries. So far, this package can reproduce the estimates using FFCQ-M cost function (see Zhang, Worthington, and Hu (in press) for details)

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Encoding UTF-8

LazyData true

RoxygenNote 5.0.1

Imports minpack.lm, sandwich, lmtest, car

Suggests knitr, rmarkdown, testthat

VignetteBuilder knitr

NeedsCompilation no

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cess	<i>Calculate estimates of costs and economies of scale and scope from 25 to 200 % levels at means</i>
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Description

Calculate estimates of costs and economies of scale and scope from 25 to 200 % levels at means

Usage

```
cess(data, outputName, priceName, controlName, model,
      vcovCL = clusterEst(model = model, cluster = unidat$unicode)$vcovCL)
```

Arguments

data	The data used for calculating the estimates.
outputName	A vector of strings containing the names of the independent (output) variables.
priceName	A vector of strings containing the names of the independent (price) variables.
controlName	A vector of strings containing the names of the control variables.
model	The estimated model(nls class object).
vcovCL	A variance matrix provided by clusterEst function
form	A cost function character.

Value

An CSV file in your working directory containing estimates of average costs,

Author(s)

Liang-Cheng Zhang

References

Zhang, L.-C., Worthington, A. C., & Hu, M. (in press). Cost economies in the provision of higher education for international students: Australian evidence. Higher Education. doi: [10.1007/s10734-016-0078-9](https://doi.org/10.1007/s10734-016-0078-9)

Examples

```
##Reproduce results of Zhang et al. (2016)
data(unidat)
data = unidat
library(minpack.lm)
model <- nlsLM(costFunction(costName = colnames(unidat)[3], outputName = colnames(unidat)[7:11],
priceName = colnames(unidat)[4:6], controlName = colnames(unidat)[12:24],
form = "FFCQ-M"), start = list(b0 = 600, b1 = 0, b2 = 0,
                                b3 = 0, b4 = 0, b5 = 0, b11 = 0, b22 = 0, b33 = 0, b44 = 0,
                                b55 = 0, b12 = 0, b13 = 0, b14 = 0, b15 = 0, b23 = 0, b24 = 0,
                                b25 = 0, b34 = 0, b35 = 0, b45 = 0, bp2 = 0, bp3 = 0, bz1 = 0,
                                bz2 = 0, bz3 = 0, bz4 = 0, bz5 = 0, bz6 = 0, bz7 = 0, bz8 = 0,
```

```

      bz9 = 0, bz10 = 0, bz11 = 0, bz12 = 0, bz13 = 0), data = unidat,
      trace = F)
vcovCL <- clusterEst(model = model , cluster = unidat$unicode)$vcovCL
cess(data=data, outputName = colnames(unidat)[7:11],priceName = colnames(unidat)[4:6],controlName = colnames

```

clusterEst	<i>Calculate coefficients and covariance with clustering standard deviations</i>
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Description

Calculate coefficients and covariance with clustering standard deviations

Usage

```
clusterEst(model, dfcw = 1, cluster)
```

Arguments

model	The estimated model(nls class object).
cluster	A vector, matrix, or data.frame of cluster variables, where each column is a separate variable.

Value

An list of estimation results and clustering variance

Author(s)

Liang-Cheng Zhang

References

Arai, M. (2015). Cluster-robust standard errors using R. Retrieved from http://www.ne.su.se/polopoly_fs/1.216115.14262

Petersen, M. A. (2009). Estimating standard errors in finance panel data sets: Comparing approaches. *Review of Financial Studies*, 22(1), 435-480.

Examples

```

##Simple example
data(unidat)
m1 = nls(c ~ b0+b1*y1,start=list(b0=1,b1=0), data = unidat)
cluster.vcov(m2, petersen$firmid)

##Reproduce results of Table 4 in Zhang et al. (2016)
data(unidat)
library(minpack.lm)
model <- nlsLM(costFunction(costName=colnames(unidat)[3],outputName = colnames(unidat)[7:11],priceName = colnames(unidat)[4:6],controlName = colnames(unidat)[1:3],
, start=list(b0=600,b1=0,b2=0,b3=0,b4=0,b5=0,b11=0,b22=0,b33=0,b44=0,b55=0,b12=0,b13=0,b14=0,b15=0),
,data=unidat,trace=F)
clusterEst(model = model , cluster = unidat$unicode)$model #extract summary results
clusterEst(model = model , cluster = unidat$unicode)$vcovCL #extract covariance

```

costFunction	<i>Generate the right format of cost function for calculating economies of scale and scope.</i>
--------------	---

Description

Generate the right format of cost function for calculating economies of scale and scope.

Usage

```
costFunction(costName, outputName, priceName, controlName, form = c("FFCQ-A",
  "FFCQ-M"))
```

Arguments

costName	A character string containing the name of the dependent (cost) variable.
outputName	A vector of strings containing the names of the independent (output) variables.
priceName	A vector of strings containing the names of the independent (price) variables.
controlName	A vector of strings containing the names of the control variables.
form	A cost function character.

Details

This function returns flexible fixed cost quadratic (FFCQ) function formula based on the classification of Mayo (1984). You can find the applications in Zhang et al. (in press). The FFCQ-A function is as follows

$$\begin{aligned} C^{FFCQ-A}(\mathbf{y}, \mathbf{w}; \boldsymbol{\beta}) &= F(\mathbf{y}; \boldsymbol{\beta}) + A(\mathbf{w}; \boldsymbol{\beta}) \\ &= \left(\beta_0 + \sum_{i=1} \beta_{0i} F_i + \sum_{i=1} \beta_i y_i + 0.5 \sum_{i=1} \sum_{j=1} \beta_{ij} y_i y_j \right) + \sum_{l=1} \beta_{wl} w_l \end{aligned}$$

Value

An object of class "formula" consisting of costName, outputName and priceName based on varied functional forms.

Author(s)

Liang-Cheng Zhang

References

- Mayo, J. W. (1984). Multiproduct monopoly, regulation, and firm costs. *Southern Economic Journal*, 51(1), 208-218. doi:10.2307/1058333
- Zhang, L.-C., Worthington, A. C., & Hu, M. (in press). Cost economies in the provision of higher education for international students: Australian evidence. *Higher Education*. doi: [10.1007/s10734-016-0078-9](https://doi.org/10.1007/s10734-016-0078-9)

Examples

```
##Specify arguments with user-identified names
costFunction(costName="c",outputName = c("y1","y2"))
costFunction(costName="c",outputName = c("y1","y2","y3"),priceName = c("w1","w2","w3"),controlName = c("z1",

##Specify arguments with data' column names
costFunction(costName=colnames(unidat)[3],outputName = colnames(unidat)[7:11],priceName = colnames(unidat)[
```

intervalPlot	<i>Generate interval plot for evaluate whether there are economies of scale or scope</i>
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Description

Generate interval plot for evaluate whether there are economies of scale or scope

Usage

```
intervalPlot(intervalData, outputName, priceName, controlName, model,
  vcovCL = clusterEst(model = model, cluster = unidat$unicode)$vcovCL)
```

Arguments

outputName	A vector of strings containing the names of the independent (output) variables.
priceName	A vector of strings containing the names of the independent (price) variables.
controlName	A vector of strings containing the names of the control variables.
model	The estimated model(nls class object).
vcovCL	A variance matrix provided by clusterEst function
data	The data used for calculating the estimates.
form	A cost function character.

Value

An CSV file in your working directory containing estimates of average costs,

Author(s)

Liang-Cheng Zhang

References

Zhang, L.-C., Worthington, A. C., & Hu, M. (in press). Cost economies in the provision of higher education for international students: Australian evidence. Higher Education. doi: [10.1007/s10734-016-0078-9](https://doi.org/10.1007/s10734-016-0078-9)

Examples

```
##Reproduce results of Zhang et al. (2016)
data(unidat)
data = unidat
library(minpack.lm)
model <- nlsLM(costFunction(costName=colnames(unidat)[3],outputName = colnames(unidat)[7:11],priceName = colnames(unidat)[4:6],
, start=list(b0=600,b1=0,b2=0,b3=0,b4=0,b5=0,b11=0,b22=0,b33=0,b44=0,b55=0,b12=0,b13=0,b14=0,b15=0),
, data=unidat, trace=F)
vcovCL <- clusterEst(model = model , cluster = unidat$unicode)$vcovCL
plot(costFunction(data=unidat, outputName = colnames(unidat)[7:11],priceName = colnames(unidat)[4:6],controlName = colnames(unidat)[3],
, start=list(b0=600,b1=0,b2=0,b3=0,b4=0,b5=0,b11=0,b22=0,b33=0,b44=0,b55=0,b12=0,b13=0,b14=0,b15=0),
, data=unidat, trace=F))
```

unidat

Data of 37 Australian public universities

Description

A panel data containing the cost, outputs, and prices of 37 Australian public universities over the period from 2003 to 2012

Usage

unidat

Format

A data frame with 370 rows and 24 variables:

- year** Data collection time point
- unicode** Index of Australian universities
- c** Total operating expenditure, in thousands of AUD (2003 = 100)
- w1** Price of academic labour, in thousands of AUD (2003 = 100)
- w2** Price of non-academic labour, in thousands of AUD (2003 = 100)
- w3** Price of non-labour, in thousands of AUD (2003 = 100)
- y1** Domestic science completions
- y2** Domestic non-science completions
- y3** Overseas science completions
- y4** Overseas non-science completions
- y5** Number of publications
- q** Attrition rate, in percentages
- z1** One for ATN institutions, otherwise zero
- z2** One for Go8 institutions, otherwise zero
- z3** One for IRU institutions, otherwise zero
- z4** One for RUN institutions, otherwise zero
- g1** One for Institutions located in NSW, otherwise zero
- g2** One for Institutions located in VIC, otherwise zero

- g3** One for Institutions located in QLD, otherwise zero
- g4** One for Institutions located in WA, otherwise zero
- g5** One for Institutions located in SA, otherwise zero
- g6** One for Institutions located in ACT, otherwise zero
- g7** One for Institutions located in TAS, otherwise zero
- g8** One for Institutions located in NT, otherwise zero

Source

Zhang, L.-C., Worthington, A. C., & Hu, M. (in press). Cost economies in the provision of higher education for international students: Australian evidence. Higher Education. doi: [10.1007/s10734-016-0078-9](https://doi.org/10.1007/s10734-016-0078-9)

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