Package 'Rcess'

December 14, 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). This package is currently hosted on Github. Please click this link (https://github.com/LiangCZhang/Rcess) for how to use and install it

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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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R topics documented:

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

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

Estimates of scale and scope economies including their standard errors (SE), lower interval(Lo) and upper interval(Hi)

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

Zhang, L.-C., & Worthington, A. C. (2015). Evaluating the accuracy of scope economies: comparisons among delta method, bootstrap, and Bayesian approach. Paper presented at Australian Conference of Economists PhD Colloquium. Retrieved from

Examples

```
##Reproduce results of Zhang et al. (in press)
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(unidat)[12:24], model=model, vcovCL=vcovCL)
```

`clusterEst` *Calculate coefficients and covariance with clusting standard deviations*

Description

Calculate coefficients and covariance with clusting 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. (in press)
data(unidat)
library(minpack.lm)
```

```
model <- nlsLM(costFunction(costName=colnames(unidat)[3],outputName = colnames(unidat)[7:11],priceName = col
            , 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,b1
               ,data=unidat,trace=F)
clusterEst(model = model , cluster = unidat$unicode)$model #extract summary results
clusterEst(model = model , cluster = unidat$unicode)$vcovCL #extract covariance
```

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

Description

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

Usage

```
costFunction(costName, outputName, priceName, controlName, form = c("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).

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

Examples

```
##Specifiy 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",

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

`intervalPlot` *Generate interval plot for inferring the existence of economies of scale or scope*

Description

Generate interval plot for inferring the existence of economies of scale or scope

Usage

```
intervalPlot(intervalData = intervalData, estimates,
  meanLevels = intervalData$meanLevels, lowerLevel = intervalData$Lo_GSE,
  UpperLevel = intervalData$Hi_GSE, ylab, h, ylim = c(-1, 1))
```

Arguments

`intervalData`	The data used for plotting intervals.
`estimates`	A vector of estimates which you want to plot with.
`meanLevels`	A vector of percentage of output mean.
`lowerLevel`	A vector of lower confidence intervals.
`ylab`	Y axis label.
`h`	A horizontal red line for inferring the existence of economies of scale (=1) or scope (=0).
`ylim`	Y axis limit.
`upperLevel`	A vector of upper confidence intervals.

Details

This function generates a interval plot to infer the existence of scale and scope economies. If the intervals of point estimates do not include one for scale economies or zero for the scope economies, it suggests that these estimates are significantly different from the thresholds (one and zero, respectively) at the 5 and scope economies (if their intervals are higher than the threshold) or diseconomies (if their intervals are lower than the threshold).

Value

A interval plot

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

Examples

```
#interval plot for GSE
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
##interval plot for GSE
intervalPlot(intervalData = intervalData, estimates = intervalData$GSE, meanLevels = intervalData$meanLevels
          lowerLevel = intervalData$Lo_GSE,UpperLevel = intervalData$Hi_GSE, ylab = "Degree of economies of
##interval plot for SRAY
intervalPlot(intervalData = intervalData, estimates = intervalData$SRAY, meanLevels = intervalData$meanLevel
          lowerLevel = intervalData$Lo_SRAY,UpperLevel = intervalData$Hi_SRAY, ylab = "Degree of economies o
            h = 1,ylim = c(min(intervalData$Lo_SRAY,1),max(intervalData$Hi_SRAY)))
```

`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

Details

This data is formatted based on Zhang et al. (in press) and collected from multiple sources. For outputs and control variables (y, q, z, and g), they are from Australian Government Department of Education and Training (n.d.-b) For Total operating expenditure and price variables (c and w), they are from Australian Government Department of Education and Training (n.d.-a). Please see the data copyright here

Source

Australian Government Department of Education and Training. (n.d.-a). Higher education publications: Finance publication. Retrieved from https://www.education.gov.au/finance-publication

Australian Government Department of Education and Training. (n.d.-b). uCube - Higher education statistics. Retrieved from http://highereducationstatistics.education.gov.au/Default.aspx

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

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