

# Package ‘MultiplierDEA’

January 20, 2025

**Type** Package

**Title** Multiplier Data Envelopment Analysis and Cross Efficiency

**Version** 0.1.19

**Date** 2022-09-01

**Depends** lpSolveAPI

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## Description

Functions are provided for calculating efficiency using multiplier DEA (Data Envelopment Analysis): Measuring the efficiency of decision making units (Charnes et al., 1978 <doi:10.1016/0377-2217(78)90138-8>) and cross efficiency using single and two-phase approach. In addition, it includes some datasets for calculating efficiency and cross efficiency.

**License** LGPL-2

**Repository** CRAN

**Imports** dplyr, ROI, ROI.plugin.glpk, ompr, ompr.roi

**NeedsCompilation** no

**LazyData** true

**Date/Publication** 2022-09-01 22:10:02 UTC

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Bank\_Branch\_Operating\_Efficiency

*Data: Bank Branch Operating Efficiency data*

---

### Description

Bank Branch data for Operating Efficiency.

### Usage

Bank\_Branch\_Operating\_Efficiency

### Format

A data frame containing data for 17 Bank Branches.

Branch\_Code a character vector

PH a numeric vector

OE a numeric vector

SQM a numeric vector

A a numeric vector

B a numeric vector

C a numeric vector

D a numeric vector

### Source

Giokas DI (1991) Bank branch operating efficiency: A comparative application of DEA and the Loglinear model, OMEGA International Journal of Management Science, 19 (6) 549-557.

### References

Giokas DI (1991) Bank branch operating efficiency: A comparative application of DEA and the Loglinear model, OMEGA International Journal of Management Science, 19 (6) 549-557.

**Examples**

```
data(Bank_Branch_Operating_Efficiency)
attach(Bank_Branch_Operating_Efficiency)
x <- data.frame(PH, OE, SQM)
rownames(x) <- Branch_Code
colnames(x) <- colnames(Bank_Branch_Operating_Efficiency)[2:4]
y <- data.frame(A, B, C, D)
rownames(y) <- Branch_Code
colnames(y) <- colnames(Bank_Branch_Operating_Efficiency)[5:8]
detach(Bank_Branch_Operating_Efficiency)
# For CRS
result_CRS <- DeaMultiplierModel(x,y,"crs", "input")
# For VRS
result_VRS <- DeaMultiplierModel(x,y,"crs", "input")
```

---

BenchMark\_Tests\_And\_Microcomputer

*Data: Relationship between benchmark tests and Microcomputer price data*

---

**Description**

The Relationship between benchmark tests and Microcomputer price data.

**Usage**

BenchMark\_Tests\_And\_Microcomputer

**Format**

A data frame containing data for 22 Microcomputers.

System a character vector

Price a numeric vector

MemorySize a numeric vector

DiskCapacity a numeric vector

CPU a numeric vector

IO a numeric vector

RL1 a numeric vector

RL2 a numeric vector

RL3 a numeric vector

**Source**

Sircar S. and Dave D (1986) The relationship between benchmark tests and microcomputer price. Communications of the ACM, 29, 212-217.

## References

Sircar S. and Dave D (1986) The relationship between benchmark tests and microcomputer price. Communications of the ACM, 29, 212-217.

## Examples

```
data(BenchMark_Tests_And_Microcomputer)
attach(BenchMark_Tests_And_Microcomputer)

x <- BenchMark_Tests_And_Microcomputer

detach(BenchMark_Tests_And_Microcomputer)
```

---

CrossEfficiency	<i>Cross Efficiency Model</i>
-----------------	-------------------------------

---

## Description

Cross Efficiency uses DEA to do peer evaluation of DMUs. Single-phase cross efficiency approach.

## Usage

```
CrossEfficiency(x = x, y = y, rts = "crs", orientation = "input", weightRestriction)
```

## Arguments

x	Inputs or resources used by each decision making unit.
y	Outputs or resources used by each decision making unit.
rts	Returns to scale for the application, or industry studied. Note the default rts is crs. vrs Variable returns to scale. crs Constant returns to scale.
orientation	Orientation of the DEA model - primary emphasis on input-reduction input or output-augmentation output. Note that unlike the DEA functions, the default is input orientation.
weightRestriction	Weight restriction for the model. Optional parameter.

## Value

The function returns a number of values per DMU.

\$ceva_matrix	Returns the cross efficiency matrix. Row is the Rating DMU and Column is the Rated DMU.
\$ce_ave	Returns the cross efficiency score for the DMU.
\$ceva_max	Returns the maximum cross efficiency score for the DMU.
\$ceva_min	Returns the minimum cross efficiency score for the DMU.

\$vx            Input weights from the model.  
 \$uy            Output weights from the model.  
 \$Model\_Status Returns the status of the LP model.

**Note**

ceva\_matrix - cross-evaluation matrix. ceva\_max - cross-evaluation maximum. ceva\_min - cross-evaluation minimum. ce\_ave - cross-efficiency scores.

**Examples**

#Example from Kenneth R. Baker: Optimization Modeling with Spreadsheets, Third Edition, p. 176,  
 #John Wiley and Sons, Inc.

```
dmu <- c("A", "B", "C", "D", "E", "F")
x <- data.frame(c(150,400,320,520,350,320),c(0.2,0.7,1.2,2.0,1.2,0.7))
rownames(x) <- dmu
colnames(x)[1] <- c("StartHours")
colnames(x)[2] <- c("Supplies")
```

```
y <- data.frame(c(14,14,42,28,19,14),c(3.5,21,10.5,42,25,15))
rownames(y) <- dmu
colnames(y)[1] <- c("Reimbursed")
colnames(y)[2] <- c("Private")
```

```
# Calculate the efficiency score
result <- CrossEfficiency(x,y,"crs", "input")
# Examine the cross efficiency score for DMUs
print(result$ce_ave)
```

---

 Data\_City

*Data: City data*


---

**Description**

City data for Operating Efficiency.

**Usage**

```
data("Data_City")
```

**Format**

A data frame containing data for 15 city observations

DMU a numeric vector

City a character vector

Houseprice a numeric vector

Rental a numeric vector  
 Violent a numeric vector  
 Income a numeric vector  
 B.Degree a numeric vector  
 Doctor a numeric vector

### Source

W.D. Cook, L. Liang, Y. Zha and J.Zhu (2009) A Modified Super-Efficiency DEA Model for Infeasibility, The Journal of the Operational Research Society Vol. 60, No. 2 (Feb., 2009), pp. 276-281.

### References

W.D. Cook, L. Liang, Y. Zha and J.Zhu (2009) A Modified Super-Efficiency DEA Model for Infeasibility, The Journal of the Operational Research Society Vol. 60, No. 2 (Feb., 2009), pp. 276-281.

### Examples

```
data(Data_City)
attach(Data_City)
```

---

DeaMultiplierModel      *DEA Multiplier Model*

---

### Description

DEA multiplier model calculates the efficiency and reference sets for each DMUs.

### Usage

```
DeaMultiplierModel(x = x, y = y, rts = "crs", orientation = "input", weightRestriction)
```

### Arguments

x	Inputs or resources used by each decision making unit.
y	Outputs or resources used by each decision making unit.
rts	Returns to scale for the application, or industry studied. Note the default rts is crs. vrs Variable returns to scale. crs Constant returns to scale. Available option: crs, vrs
orientation	Orientation of the DEA model - primary emphasis on input-reduction or output-augmentation output. Note that unlike the DEA functions, the default is input orientation. Available option: input, output.
weightRestriction	Weight restriction for the model. Optional parameter.

**Value**

The function returns a number of values per DMU. The standardized efficiency (all inefficiencies are between 0 and 1, for input and output orientation). Efficiency, and lambda values are returned.

\$rts	Returns to scale of the model.
\$Orientation	Orientation of the model.
\$InputValues	Input Values (x) passed to the model.
\$OutputValues	Output Values (y) passed to the model.
\$Efficiency	Efficiency of each DMU in the model.
\$Lambda	Lambdas per DMU in the model.
\$HCU_Input	HCU data for inputs.
\$HCU_Output	HCU data for outputs.
\$vx	Input weights from the model.
\$uy	Output weights from the model.
\$Free_Weights	Free weights from the model. Applies only to vrs returns-to-scale.
\$Model_Status	Returns the status of the LP model.

**Examples**

#Example from Kenneth R. Baker: Optimization Modeling with Spreadsheets, Third Edition, p. 176,  
#John Wiley and Sons, Inc.

```
dmu <- c("A", "B", "C", "D", "E", "F")

x <- data.frame(c(150,400,320,520,350,320),c(0.2,0.7,1.2,2.0,1.2,0.7))
rownames(x) <- dmu
colnames(x)[1] <- c("StartHours")
colnames(x)[2] <- c("Supplies")

y <- data.frame(c(14,14,42,28,19,14),c(3.5,21,10.5,42,25,15))
rownames(y) <- dmu
colnames(y)[1] <- c("Reimbursed")
colnames(y)[2] <- c("Private")

#Creating the weight restriction data frame with Upper bound

weightRestriction<-data.frame(lower = c(1), numerator = c("StartHours"),
denominator = c("Supplies"), upper = c(2))

#Creating the weight restriction data frame without Upper bound
weightRestriction<-data.frame(lower = c(1), numerator = c("StartHours"),
denominator = c("Supplies"))

#Creating the weight restriction data frame with Upper bound and Na, Inf or NaN
weightRestriction<-data.frame(lower = c(1,2), numerator = c("StartHours","Reimbursed"),
denominator = c("Supplies","Private"), upper = c(2,Inf))
```

```
# Calculate the efficiency score without weight Restriction
result <- DeaMultiplierModel(x,y,"crs", "input")
# Examine the efficiency score for DMUs
print(result$Efficiency)

# Calculate the efficiency score with weight Restriction
result <- DeaMultiplierModel(x,y,"crs", "input", weightRestriction)
# Examine the efficiency score for DMUs
print(result$Efficiency)
```

---

Departments\_Of\_Accounting

*Data: UK University Departments Of Accounting Efficiency data.*

---

### **Description**

Evaluation the Efficiency of UK University Departments Of Accounting Efficiency.

### **Usage**

Departments\_Of\_Accounting

### **Format**

A data frame containing data for 20 UK University Departments Of Accounting.

Departments a numeric vector

Undergraduates a numeric vector

Research a numeric vector

Taught a numeric vector

Res.Co a numeric vector

OtherRes a numeric vector

OtherIncome a numeric vector

Publications a numeric vector

AcademicStaff a numeric vector

Salaries a numeric vector

OtherExp a numeric vector

### **Source**

Tomkins C and Green RH (1988) An experiment in the use of data envelopment analysis for evaluating the efficiency of UK university departments of accounting. *Financial Accounting and Management*, 4, 147-164.

## References

Tomkins C and Green RH (1988) An experiment in the use of data envelopment analysis for evaluating the efficiency of UK university departments of accounting. *Financial Accounting and Management*, 4, 147-164.

## Examples

```
data(Departments_Of_Accounting)
attach(Departments_Of_Accounting)

x <- data.frame(AcademicStaff)
rownames(x) <- Departments
colnames(x) <- colnames(Departments_Of_Accounting)[9]

y <- data.frame(Undergraduates, Research, Taught, (Res.Co + OtherRes + OtherIncome))
rownames(y) <- Departments
colnames(y)[1] <- colnames(Departments_Of_Accounting)[2]
colnames(y)[2] <- colnames(Departments_Of_Accounting)[3]
colnames(y)[3] <- colnames(Departments_Of_Accounting)[4]
colnames(y)[4] <- c("Total_Income")

detach(Departments_Of_Accounting)

result <- DeaMultiplierModel(x,y,"crs", "input")
```

---

dict.solveStatus      *Provides the solver status codes.*

---

## Description

Provides the solver status codes and description.

## Examples

```
#List status codes and description.

dict.solveStatus
```

---

Evaluations\_Of\_NonProfitOrganizations  
*Data: Evaluation of Non-Profit organizations data*

---

## Description

Evaluation of Non-Profit organizations efficiency.

**Usage**

Evaluations\_Of\_NonProfitOrganizations

**Format**

A data frame containing data for 16 Non-Profit organizations.

Hospital a numeric vector

H0 a numeric vector

PercentOccupancy a numeric vector

RevenuePerDay a numeric vector

A/RTurnover a numeric vector

CostPerDay a numeric vector

LengthOfStay a numeric vector

**Source**

Greenberg R and Nunamaker T (1987) A generalized multiple criteria model for control and evaluation of nonprofit organizations. *Financial Accountability and Management*, 3 (4), 331-342.

**References**

Greenberg R and Nunamaker T (1987) A generalized multiple criteria model for control and evaluation of nonprofit organizations. *Financial Accountability and Management*, 3 (4), 331-342.

**Examples**

```
data(Evaluations_Of_NonProfitOrganizations)
attach(Evaluations_Of_NonProfitOrganizations)

x <- Evaluations_Of_NonProfitOrganizations

detach(Evaluations_Of_NonProfitOrganizations)
```

---

Evaluation\_Educational\_Program

*Data: Educational program data*

---

**Description**

Evaluation of Educational program.

**Usage**

Evaluation\_Educational\_Program

**Format**

A data frame containing data for 22 educational programs.

Program a numeric vector

CCR\_EFF a numeric vector

Revenue\_Generated a numeric vector

Student\_Employed a numeric vector

Employer\_Satisfaction a numeric vector

Contact\_Hours a numeric vector

Number\_of\_FTE\_Staff a numeric vector

Facility\_Allocation a numeric vector

Expenditures a numeric vector

**Source**

Bessent A, Bessent W, Cbames A, Cooper WW and Thorgood N (1983) Evaluation of educational program proposals by means of data envelopment analysis. *Educational Administrative Quarterly*, 19, 82-107.

**References**

Bessent A, Bessent W, Cbames A, Cooper WW and Thorgood N (1983) Evaluation of educational program proposals by means of data envelopment analysis. *Educational Administrative Quarterly*, 19, 82-107.

**Examples**

```
data(Evaluation_Educational_Program)
attach(Evaluation_Educational_Program)

x <- data.frame(Contact_Hours, Number_of_FTE_Staff, Facility_Allocation, Expenditures)
rownames(x) <- Program
colnames(x) <- colnames(Evaluation_Educational_Program)[6:9]

y <- data.frame(Revenue_Generated, Student_Employed, Employer_Satisfaction)
rownames(y) <- Program
colnames(y) <- colnames(Evaluation_Educational_Program)[3:5]

detach(Evaluation_Educational_Program)

result <- DeaMultiplierModel(x,y,"crs", "input")
```

---

Japanese\_Companies      *Data: Japanese Companies data.*

---

**Description**

Japanese companies data for Operating Efficiency.

**Usage**

```
data("Japanese_Companies")
```

**Format**

A data frame with 0 observations on the following 2 variables.

DMU a numeric vector

Company a character vector

Asset a numeric vector

Equity a numeric vector

Employee a numeric vector

Revenue a numeric vector

**Source**

W.D. Cook, L. Liang, Y. Zha and J.Zhu (2009) A Modified Super-Efficiency DEA Model for Infeasibility, The Journal of the Operational Research Society Vol. 60, No. 2 (Feb., 2009), pp. 276-281.

**References**

W.D. Cook, L. Liang, Y. Zha and J.Zhu (2009) A Modified Super-Efficiency DEA Model for Infeasibility, The Journal of the Operational Research Society Vol. 60, No. 2 (Feb., 2009), pp. 276-281.

**Examples**

```
data(Japanese_Companies)
attach(Japanese_Companies)
```

---

Mal_Ben	<i>Benevolent and Malevolent Model</i>
---------	----------------------------------------

---

### Description

Two-Phase Cross efficiency approach.

### Usage

```
Mal_Ben(x = x, y = y, rts = "crs", orientation = "input", phase = "mal",
weightRestriction, include = TRUE)
```

### Arguments

x	Inputs or resources used by each decision making unit.
y	Outputs or resources used by each decision making unit.
rts	Returns to scale for the application, or industry studied. Note the default rts is crs. vrs Variable returns to scale. crs Constant returns to scale. Available option: crs, vrs.
orientation	Orientation of the DEA model - primary emphasis on input-reduction input or output-augmentation output. Note that unlike the DEA functions, the default is input orientation. Available option: input, output.
weightRestriction	Weight restriction for the model. Optional parameter.
phase	Second phase of the model. Malevolent or Benevolent. Note the default is mal. Available option: mal, ben.
include	In the second phase include evaluating DMU in the calculation. Default is TRUE. Available option: TRUE, FALSE.

### Value

The function returns a number of values per DMU. The standardized efficiency (all inefficiencies are between 0 and 1, for input and output orientation) Efficiency, and the lambda values, lambda, are returned.

\$rts	Returns to scale of the model.
\$Orientation	Orientation of the model.
\$InputValues	Input Values (x) passed to the model.
\$OutputValues	Output Values (y) passed to the model.
\$Phase1_Efficiency	Efficiency of each DMU in the model from Phase 1.
\$Phase1_Lambda	Lambdas per DMU in the model from Phase 1.
\$Phase1_vx	Input weights from the model from Phase 1.
\$Phase1_uy	Output weights from the model from Phase 1.

\$Phase1\_Free\_Weights      Free weights from the model from Phase 1. Applies only to vrs returns-to-scale.

\$Phase1\_Model\_Status      Returns the status of the phase two LP model.

\$Phase2\_Efficiency      Efficiency of each DMU in the model from Phase 2.

\$Phase2\_Lambda      Lambdas per DMU in the model from Phase 2.

\$Phase2\_vx      Input weights from the model from Phase 2.

\$Phase2\_uy      Output weights from the model from Phase 2.

\$Phase2\_Free\_weights      Free weights from the model from Phase 2. Applies only to vrs returns-to-scale.

\$Phase2\_Model\_Status      Returns the status of the phase two LP model.

\$ceva\_matrix      Returns the cross efficiency matrix. Row is the Rating DMU and Column is the Rated DMU.

\$ce\_ave      Returns the cross efficiency score for the DMU.

\$ceva\_max      Returns the maximum cross efficiency score for the DMU.

\$ceva\_min      Returns the minimum cross efficiency score for the DMU.

### Note

ceva\_matrix - cross-evaluation matrix. ceva\_max - cross-evaluation maximum. ceva\_min - cross-evaluation minimum. ce\_ave - cross-efficiency scores.

### Examples

#Example from Kenneth R. Baker: Optimization Modeling with Spreadsheets, Third Edition,p. 176,  
#John Wiley and Sons, Inc.

```
dmu <- c("A", "B", "C", "D", "E", "F")
x <- data.frame(c(150,400,320,520,350,320),c(0.2,0.7,1.2,2.0,1.2,0.7))
rownames(x) <- dmu
colnames(x)[1] <- c("StartHours")
colnames(x)[2] <- c("Supplies")
y <- data.frame(c(14,14,42,28,19,14),c(3.5,21,10.5,42,25,15))
rownames(y) <- dmu
colnames(y)[1] <- c("Reimbursed")
colnames(y)[2] <- c("Private")

# Calculate the efficiency score
result <- Mal_Ben(x, y, rts = "crs", orientation = "input", phase = "mal", include = TRUE)
# Examine the cross efficiency score for DMUs
print(result$ce_ave)
```

---

Metropolitan\_And\_London\_Rates\_Departments

*Data: Metropolitan and London rates departments data*

---

### Description

Relative Efficiency Metropolitan and London rates departments.

### Usage

Metropolitan\_And\_London\_Rates\_Departments

### Format

A data frame containing data for 62 rates department authority.

Authority a character vector

TotalCost a numeric vector

Non-cn1 a numeric vector

Rate a numeric vector

Summons a numeric vector

NPV a numeric vector

### Source

Dyson RG and Thanassoulis E (1988) Reducing weight flexibility in Data Envelopment Analysis, Journal of the Operational Research Society, 39 (6), 563-576.

### References

Dyson RG and Thanassoulis E (1988) Reducing weight flexibility in Data Envelopment Analysis, Journal of the Operational Research Society, 39 (6), 563-576.

### Examples

```
data(Metropolitan_And_London_Rates_Departments)
attach(Metropolitan_And_London_Rates_Departments)

x <- data.frame(TotalCost)
rownames(x) <- Authority
colnames(x) <- colnames(Metropolitan_And_London_Rates_Departments)[2]

y <- data.frame(`Non-cn1`, Rate, Summons, NPV)
rownames(y) <- Authority
colnames(y) <- colnames(Metropolitan_And_London_Rates_Departments)[3:6]
```

```
detach(Metropolitan_And_London_Rates_Departments)

result <- DeaMultiplierModel(x,y,"crs", "input")
```

---

MPI *Malmquist Productivity Index.*

---

### Description

MPI model to calculate MPI, Technical change, Efficiency change and Scale efficiency change.

### Usage

```
MPI(Dataset = Dataset, DMU_colName = DMU_colName, IP_colNames = IP_colNames,
OP_ColNames = OP_ColNames, Period_ColName = Period_ColName, Periods = Periods,
rts = "crs", orientation = "input", scale = FALSE)
```

### Arguments

Dataset	The data required for the model.
DMU_colName	Column name for the DMUs in the dataset.
IP_colNames	Column name(s) for all input data in the dataset.
OP_ColNames	Column name(s) for all output data in the dataset.
Period_ColName	Column name for the period number in the dataset.
Periods	Unique periods numbers in the dataset in ascending order.
rts	Returns to scale for the application, or industry studied. Note the default rts is crs. vrs Variable returns to scale. crs Constant returns to scale.
orientation	Orientation of the DEA model - primary emphasis on input-reduction input or output-augmentation output. Note the default is input orientation.
scale	Note default value is FALSE.

### Value

DMU	DMUs
et1t1.crs	The efficiencies for period 1 with reference technology from period 1 for crs returns to scale. Note: available if returns to scale is crs or scale is TRUE.
et2t2.crs	The efficiencies for period 2 with reference technology from period 2 for crs returns to scale. Note: available if returns to scale is crs or scale is TRUE.
et1t2.crs	The efficiencies for period 2 with reference technology from period 1 for crs returns to scale. Note: available if returns to scale is crs or scale is TRUE.
et2t1.crs	The efficiencies for period 1 with reference technology from period 2 for crs returns to scale. Note: available if returns to scale is crs or scale is TRUE.
et1t1.vrs	The efficiencies for period 1 with reference technology from period 1 for vrs returns to scale. Note: available if returns to scale is vrs.

et2t2.vrs	The efficiencies for period 2 with reference technology from period 2 for vrs returns to scale. Note: available if returns to scale is vrs.
et1t2.vrs	The efficiencies for period 2 with reference technology from period 1 for vrs returns to scale. Note: available if returns to scale is vrs.
et2t1.vrs	The efficiencies for period 1 with reference technology from period 2 for vrs returns to scale. Note: available if returns to scale is vrs
sec1	First componenet of the scale efficiency change. $(et1t2.crs/et1t2.vrs)/(et1t1.crs/et1t1.vrs)$
sec2	Second componenet of the scale efficiency change. $(et2t2.crs/et2t2.vrs)/(et2t1.crs/et2t1.vrs)$
sec	Scale efficiency change. $(sec1 * sec2) ^ 0.5$
tc1	First component of technical change. For crs, $(et1t2.crs/et2t2.crs)$ and $(et1t2.vrs/et2t2.vrs)$ for vrs.
tc2	Second component of technical change. For crs, $(et1t1.crs/et2t1.crs)$ and $(et1t1.vrs/et2t1.vrs)$ for vrs.
tc	Technical change. $(tc1 * tc2) ^ 0.5$
tec or ptec	Efficiency change. Note: tec for crs and ptec for vrs returns to scale.
m.crs or m.vrs	Malmquist Productivity index for the DMUs and periods.
Year	Time period underconsideration for MPI.

## References

Rolf, Fare; Grosskopf, Shawna; Norris, Mary and Zhang, Zhongyang (1994) Productivity Growth, Technical Progress, and Efficiency Change in Industrialized Countries, The American Economic Review Vol. 84, No. 1, pp. 66-83.

## Examples

```
da_f <- data.frame(x= c(11, 29, 31, 61, 13, 27, 17, 61), y=c(6, 8, 11, 16, 7, 9, 10, 16),
d= c(1,2,3,4, 1,2,3,4), p=c(1,1,1,1,2,2,2,2))

mpi_r <- MPI(Dataset = da_f, DMU_colName = "d", IP_colNames = "x", OP_colNames = "y",
Period_colName = "p", Periods = c(1,2),rts = "vrs", orientation = "input", scale = TRUE)

# Examine the MPI for DMUs
mpi_r$m.vrs
```

---

options.orientation.1 *Provides the orientation option.*

---

## Description

Provides the orientation option values.

**Examples**

```
# List the orientation option used as arguments.
options.orientation.1
```

---

```
options.phase.1      Provides the second phase options.
```

---

**Description**

Provides the second phase options available for Mal\_Ben function.

**Examples**

```
# List the phase option used as arguments.
options.phase.1
```

---

```
options.rts.1      Provides the rts (returns to scale) option.
```

---

**Description**

Provides the rts (returns to scale) option values.

**Examples**

```
# List the returns to scale option used as arguments.
options.rts.1
```

---

```
SDEA      Super-Efficiency DEA
```

---

**Description**

SDEA model to calculate the efficiency for each DMUs.

**Usage**

```
SDEA(x=x, y=y, orientation = "input", rts = "crs", Cook = FALSE)
```

**Arguments**

x	Inputs or resources used by each decision making unit.
y	Outputs or resources used by each decision making unit.
orientation	Orientation of the DEA model - primary emphasis on input-reduction input or output-augmentation output. Note the default is input orientation.
rts	Returns to scale for the application, or industry studied. Note the default rts is crs. vrs Variable returns to scale. crs Constant returns to scale.
Cook	Used with variable returns to scale to address infeasibility in efficiency. Note the default is FALSE. Use TRUE when using vrs rts.

**Value**

Input	Input Values (x) passed to the model.
Output	Output Values (y) passed to the model.
Orientation	Orientation of the model.
RTS	Returns to scale of the model.
Efficiency	Efficiency of each DMU in the model.
Theta	Used to calculate efficiency if the model is infeasible. Note: Available only when Cook is set to TRUE.
Beta	Used to calculate efficiency if the model is infeasible. Note: Available only when Cook is set to TRUE.
Lambda	Lambdas per DMU in the model.
StatusData	Returns the status of the LP model.

**References**

W.D. Cook, L. Liang, Y. Zha and J.Zhu (2009) A Modified Super-Efficiency DEA Model for Infeasibility, The Journal of the Operational Research Society Vol. 60, No. 2 (Feb., 2009), pp. 276-281.

**Examples**

```
x <- data.frame(matrix(c(12, 26, 16, 60), ncol=1))
rownames(x) <- c('a', 'b', 'c', 'd')
y <- data.frame(matrix(c(6, 8, 9, 15), ncol=1))
rownames(y) <- c('a', 'b', 'c', 'd')

result <- SDEA(x=x, y=y, orientation = "input", rts = "crs", Cook = FALSE)
# Examine the efficiency score for DMUs
print(result$Efficiency)
```

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