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Description Contains some important regression methods for interval-valued variables. For each method, it is available the fitted values, residuals and some goodness-of-fit measures.

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iRegression-package

Regression Methods for Interval-Valued Variables

Description

Contains some important regression methods for interval-valued variables. For each method, it is available the fitted values, residuals and some goodness-of-fit measures.

Details

Package: iRegression
Type: Package
Version: 1.2.1
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Some available functions: cm, MinMax,crm,ccrm,bivar

Author(s)

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References


bivar

Bivariate Symbolic Regression Method

Description

This function fits an bivariate regression model for interval-valued variables, based on bivariate exponential family of distributions, and return the fitted values, the residuals, rho, phi and the goodness-of-fit measure deviance

Usage

bivar(formula1, lig1, formula2, lig2, data, ...)

Arguments

formula1 an object of class "formula": the description of the first model to be fitted.
lig1 the link function to be considered in the first model: identity, inverse or log
formula2 an object of class "formula": the description of the second model to be fitted.
lig2 the link function to be considered in the second model: identity, inverse or log
data an optional data frame containing the variables in the model.
... other arguments.

Details

This function fits an bivariate regression model for interval-valued variables considering the bivariate Gaussian distribution in the random component \( Y = [Y_1, Y_2] \). It is possible consider any pair of interval features for the bivariate random vector \( Y \). For example, the lower and upper interval bounds or the midpoint and the range of intervals, respectively. It also possible to choice different link functions (identity, inverse or log) to connect the random variables \( Y_1 \) and \( Y_2 \) with the respective linear predictors.
Value

*bivar* returns an object of class "bivar" including at least the following elements:

- **coefficients1** a named vector of coefficients for the explanatory variables of the model "1".
- **coefficients2** a named vector of coefficients for the explanatory variables of the model "2".
- **fitted.values1** the fitted values for the response variable Y1.
- **fitted.values2** the fitted values for the response variable Y2.
- **residuals1** the ordinary residual for the response variable Y1.
- **residuals2** the ordinary residual for the response variable Y2.
- **residual.deviance** the global residual for the bivariate vector Y=[Y1, Y2].
- **Rho** the estimative for the correlation coefficient between Y1 and Y2.
- **Phi** the estimative of the dispersion parameter.
- **D** the goodness-of-fit measure deviance for the current model.

Note

lig1 and lig2 must be "identity", "inverse" or "log" for identity, inverse or logarithmic link functions, respectively.

Author(s)

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References


See Also

summary.bivar, coef.bivar, fitted.bivar, residuals.bivar, formula

Examples

data("soccer.bivar", package = "iRegression")
ex.bivar <- bivar("yMin-t1Min+t2Min", "identity", "yMax-t1Max+t2Max", "identity", data=soccer.bivar)
ex.bivar
Cardiological.CR  Cardiological Interval Data Set (Centre and Range)

Description
A real interval-valued data set represented in terms of the centre and the range of the intervals.

Usage
```R
data("Cardiological.CR")
```

Format
A data frame containing the following variables:

- **PulseC** The midpoint of the response interval-valued variable Pulse
- **SystC** The midpoint of the explanatory interval-valued variable Systolic Pressure
- **DiastC** The midpoint of the explanatory interval-valued variable Diastolic Pressure
- **PulseR** The range of the response interval-valued variable Pulse
- **SystR** The range of the explanatory interval-valued variable Systolic Pressure
- **DiastR** The range of the explanatory interval-valued variable Diastolic Pressure

Details
This data set concerns the record of the pulse rate (Y), systolic blood pressure (X1) and diastolic blood pressure (X2) from 11 patients.

Source
Billard and Diday (2000)

References

See Also
`crm`

Examples
```R
data("Cardiological.CR", package = "iRegression")

crm1 <- crm("PulseC~SystC+DiastC","PulseR~SystR+DiastR",data=Cardiological.CR)
summary(crm1)
```
Description

A real interval-valued data set.

Usage

data("Cardiological.CR")

Format

A data frame containing following variables:

- **PulseMin**: Lower bound of the response interval-valued variable Pulse
- **SystMin**: Lower bound of the explanatory interval-valued variable Systolic Pressure
- **DiastMin**: Lower bound of the explanatory interval-valued variable Diastolic Pressure
- **PulseMax**: Upper bound of the response interval-valued variable Pulse
- **SystMax**: Upper bound of the explanatory interval-valued variable Systolic Pressure
- **DiastMax**: Upper bound of the explanatory interval-valued variable Diastolic Pressure

Details

This data set concerns the record of the pulse rate (Y), systolic blood pressure (X1) and diastolic blood pressure (X2) from 11 patients.

Source

Billard and Diday (2000)

References


See Also

- `cm`, `MinMax`
**Examples**

```r
data("Cardiological.MinMax", package = "iRegression")

cm1 <- cm(PulseMin~SystMin+DiastMin, PulseMax~SystMax+DiastMax, data=Cardiological.MinMax)
summary(cm1)

##
data("Cardiological.MinMax", package = "iRegression")

MinMax1 <- MinMax(PulseMin~SystMin+DiastMin, PulseMax~SystMax+DiastMax, data=Cardiological.MinMax)
summary(MinMax1)
```

---

**ccrm**  
*Constrained Centre and Range Method*

**Description**

`ccrm` is used to fit a linear regression model to symbolic interval-valued variables based on the inequality constraints over the range variables (Lima Neto and De Carvalho, 2010).

**Usage**

```r
ccrm(formula1, formula2, data, ...)
```

**Arguments**

- `formula1`: an object of class "formula": the description of the first model to be fitted.
- `formula2`: an object of class "formula": the description of the second model to be fitted.
- `data`: an optional data frame containing the variables in the model.
- `...`: other arguments.

**Details**

The Constrained Centre and Range method (CCRM) was proposed by Lima Neto and De Carvalho (2010) and fits two independent linear regression models on the midpoint and range of the intervals. In the Constrained Centre and Range Method, the estimative of the parameters of the range’s model is based on inequality constraints. There is no constraints over the parameters estimates for the midpoint regression equation. The aim is to guarantee mathematical coherence between the predicted values of the lower and upper bounds of the response interval-valued variable Y, i.e., \( y_L < y_U \).

**Value**

`ccrm` returns an object of class "ccrm" including at least the following elements:

- `coefficients.C`: a named vector of coefficients for the Centre’s explanatory variables.
- `coefficients.R`: a named vector of coefficients for the Range’s explanatory variables.
- `sigma.C`: an estimative of the standard deviation for the Centre’s response variable.
sigma.R  
an estimative of the standard deviation for the Range’s response variable.
df.C  
the degrees of freedom for the Centre residuals
df.R  
the degrees of freedom for the Range residuals
fitted.values.l  
the fitted values for the lower interval bound.
fitted.values.u  
the fitted values for the upper interval bound.
residuals.l  
the ordinary residuals for the lower interval bound.
residuals.u  
the ordinary residuals for the upper interval bound.

Note

formula1 must contain the midpoint of the symbolic interval-valued variables. formula2 contain the range (upper limit minus lower limit) of the symbolic interval-valued variables.

Author(s)

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References


See Also

summary.ccrm, coef.ccrm, fitted.ccrm, residuals.ccrm, formula

Examples

data("Cardiological.CR", package = "iRegression")
ex.ccrm <- ccrm("PulseC=SystC+DiastC","PulseR=SystR+DiastR",data=Cardiological.CR)
ex.ccrm

---

cm  
Centre Method

description

cm is used to fit a linear regression model to symbolic interval-valued variables based on the centre method (Billard and Diday, 2000).

Usage

cm(formula1, formula2, data, ...)

---
Arguments

- **formula1**: an object of class `formula`: a symbolic description of the model to be fitted.
- **formula2**: an object of class `formula`: a symbolic description of the model to be fitted.
- **data**: an optional data frame containing the variables in the model.
- **...**: other arguments.

Details

Billard and Diday (2000) presented the first approach to fitting a linear regression model to symbolic interval data sets from a SDA of view. Their approach consists on fitting a linear regression model to the mid-points of the interval values assumed by the symbolic interval variables in the learning set and applies this model to the lower and upper bounds of the interval values of the independent symbolic interval variables to be predicted, respectively, the lower and upper bounds of the interval value of the dependent variable. The Centre Method is based on the minimization of the midpoint error. The lower and upper bounds of the dependent variable are predicted, respectively, from the lower and upper bounds of the independent variable using the same vector of parameters `beta`.

Value

`cm` returns an object of class "cm" including at least the following elements:

- **coefficients**: a named vector of coefficients.
- **sigma**: an estimate of standard deviation.
- **df**: the residual degrees of freedom.
- **fitted.values.l**: the fitted values for the lower interval bound.
- **fitted.values.u**: the fitted values for the upper interval bound.
- **residuals.l**: the ordinary residuals for the lower interval bound.
- **residuals.u**: the ordinary residuals for the upper interval bound.

Note

`formula1` must contain the lower limit of the symbolic interval-valued variables. `formula2` contains the upper limit of the symbolic interval-valued variables.

Author(s)

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References


**See Also**

summary.cm, coef, fitted.cm, residuals.cm, formula

**Examples**

```r
data("Cardiological.MinMax", package = "iRegression") ## see Billard and Diday (2000)
ex.cm <- cm(PulseMin~SystMin+DiastMin,PulseMax~SystMax+DiastMax,data=Cardiological.MinMax)
ex.cm
```

---

**coef.bivar**

*Extract the Coefficients for the Bivariate Symbolic Regression Method*

**Description**

Returns the coefficients from an object class bivar.

**Usage**

```r
## S3 method for class 'bivar'
coef(object, ...)
```

**Arguments**

- `object` an object class bivar.
- `...` other arguments.

**Value**

Coefficients extracted from an object class bivar.

**See Also**

bivar
coef.ccrm

Extract the Coefficients for the Constrained Centre and Range Method

Description
Returns the coefficients from an object class ccrm.

Usage
## S3 method for class 'ccrm'
coef(object, ...)

Arguments

object an object class ccrm.
...
other arguments.

Value
Coefficients extracted from an object class object.

See Also
ccrm

coef.crm

Extract the Coefficients for the Centre and Range Method

Description
Returns the coefficients from an object class crm.

Usage
## S3 method for class 'crm'
coef(object, ...)

Arguments

object an object class crm.
...
other arguments.

Value
Coefficients extracted from an object class object.
See Also

coef.MinMax

Extract Coefficients for the MinMax Method

Description

Returns the coefficients from an object class MinMax.

Usage

```r
## S3 method for class 'MinMax'
coef(object, ...)
```

Arguments

- `object` an object class MinMax.
- `...` other arguments.

Value

Coefficients extracted from an object class MinMax.

See Also

MinMax


crm

Centre and Range Method

Description

`crm` is used to fit a linear regression model to symbolic interval-valued variables based on the Centre and Range method (Lima Neto and De Carvalho, 2008).

Usage

`crm(formula1, formula2, data, ...)`

Arguments

- `formula1` an object of class "formula": a symbolic description of the model to be fitted.
- `formula2` an object of class "formula": a symbolic description of the model to be fitted.
- `data` an optional data frame containing the variables in the model.
- `...` other arguments.
In the Center Method, the estimate of the parameters $\beta$ is based only on the midpoint of the intervals. However, the Centre and Range Method proposed by Lima Neto and De Carvalho (2008) consider suitable to include both the information given by the center and by the range of an interval-valued variable on a linear regression model to improve the model prediction performance. The Centre and Range Method fits two independent linear regression models on the midpoint and range of the intervals, respectively, and minimizes the error of the midpoint plus the error of the range.

Value

`cm` returns an object of class "crm" including at least the following elements:
- `coefficients.C` a named vector of coefficients for the Centre variables.
- `coefficients.R` a named vector of coefficients for the Range variables.
- `sigma.C` an estimate of standard deviation for the Centre response variable.
- `df.C` the degrees of freedom for the centre residuals
- `df.R` the degrees of freedom for the range residuals
- `fitted.values.l` the fitted mean values for the lower interval bound.
- `fitted.values.u` the fitted mean values for the upper interval bound.
- `residuals.l` the residuals for the lower interval bound (that is response minus fitted values).
- `residuals.u` the residuals for the upper interval bound (that is response minus fitted values).

Note

`formula1` must contain the midpoint of the symbolic interval-valued variables. `formula2` contain the range (upper limit minus lower limit) of the symbolic interval-valued variables.

Author(s)

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References


See Also

`summary.crm`, `coef.crm`, `fitted.crm`, `residuals.crm`, `formula`
Examples

data("Cardiological.CR", package = "iRegression")
ex.crm <- crm("PulseC~SystC+DiastC","PulseR~SystR+DiastR",data=Cardiological.CR)
ex.crm

fitted.bivar Extract Bivariate Symbolic Regression Method Fitted Values

Description

Returns the fitted values from an object class bivar.

Usage

## S3 method for class 'bivar'
fitted(object, ...)

Arguments

object an object class bivar.
...
other arguments.

Value

Fitted values extracted from the object class bivar.

See Also

bivar

fitted.ccrm Extract Constrained Centre and Range Method Fitted Values

Description

Returns the fitted values from an object class ccrm.

Usage

## S3 method for class 'ccrm'
fitted(object, ...)

Arguments

object an object class ccrm.
...
other arguments.
Value
Fitted values extracted from the object class object.

See Also
ccrm

fitted.cm

Extract Centre Method Fitted Values

Description
Returns the fitted values from an object class cm.

Usage
## S3 method for class 'cm'
fitted(object, ...)

Arguments
object an object class cm.
... other arguments.

Value
Fitted values extracted from an object class cm.

See Also
cm

fitted.crm

Extract Centre and Range Method Fitted Values

Description
Returns the fitted values from an object class crm.

Usage
## S3 method for class 'crm'
fitted(object, ...)

Arguments

object an object class crm.
...

other arguments.

Value

Fitted values extracted from the object class object.

See Also

crm

fitted.MinMax

Extract MinMax Method Fitted Values

Description

Returns the fitted values from an object class MinMax.

Usage

# S3 method for class 'MinMax'
fitted(object, ...)

Arguments

object an object class MinMax.
...

other arguments.

Value

Fitted values extracted from the object class MinMax.

See Also

MinMax
**MinMax**

**MinMax Method**

**Description**

MinMax is used to fit a linear regression model to symbolic interval-valued variables based on the MinMax method (Lima Neto and De Carvalho, 2008).

**Usage**

MinMax(formula1, formula2, data, ...)

**Arguments**

- formula1: an object of class "formula": a symbolic description of the model to be fitted.
- formula2: an object of class "formula": a symbolic description of the model to be fitted.
- data: an optional data frame containing the variables in the model.
- ...: other arguments.

**Details**

The Min-Max Method suggests to estimate the lower and upper bounds of the intervals using different vectors of parameters. This is equivalent to supposing independence between the values of lower and upper bounds of the intervals. The MinMax Method fits two independent linear regression models on the lower and upper bounds of the intervals, respectively, and minimizes the error of the lower bounds plus the error of the upper bounds.

**Value**

MinMax returns an object of class "MinMax" including at least the following elements:

- coefficients.l: a named vector of coefficients for the Minimum explanatory variables.
- coefficients.u: a named vector of coefficients for the Maximum explanatory variables.
- sigma.l: an estimate of standard deviation for the Minimum response variable.
- sigma.u: an estimate of standard deviation for the Maximum response variable.
- df.l: the degrees of freedom for the lower residuals.
- df.u: the degrees of freedom for the upper residuals.
- fitted.values.l: the fitted values for the lower interval bound.
- fitted.values.u: the fitted values for the upper interval bound.
- residuals.l: the ordinary residuals for the lower interval bound.
- residuals.u: the ordinary residuals for the upper interval bound.
print-iRegression

Note

formula1 must contain the lower limit of the symbolic interval-valued variables. formula2 contain the upper limit of the symbolic interval-valued variables.

Author(s)

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References


See Also

summary.MinMax, coef.MinMax, fitted.MinMax, residuals.MinMax, formula

Examples

data("Cardiological.MinMax", package = "iRegression") ## see Billard, L. and Diday, E. (2000)
ex.MinMax <- MinMax(PulseMin~SystMin+DiastMin,PulseMax~SystMax+DiastMax, data=Cardiological.MinMax)
ex.MinMax

print-iRegression  Print Values for various iRegression methods

Description

print prints its argument.

Usage

## S3 method for class 'cm'
print(x, ...)
## S3 method for class 'crm'
print(x, ...)
## S3 method for class 'ccrm'
print(x, ...)
## S3 method for class 'MinMax'
print(x, ...)
## S3 method for class 'bivar'
print(x, ...)

residuals.bivar

## S3 method for class 'summary.cm'
print(x, ...)

## S3 method for class 'summary.crm'
print(x, ...)

## S3 method for class 'summary.ccrm'
print(x, ...)

## S3 method for class 'summary.MinMax'
print(x, ...)

## S3 method for class 'summary.bivar'
print(x, ...)

## S3 method for class 'coef.crm'
print(x, ...)

## S3 method for class 'coef.ccrm'
print(x, ...)

## S3 method for class 'coef.MinMax'
print(x, ...)

## S3 method for class 'coef.bivar'
print(x, ...)

**Arguments**

- **x**
  - an object used to select a method.

- **...**
  - further arguments passed to or from other methods.

**See Also**

- print

---

### Description

Returns the residuals from an object class bivar.

### Usage

```r
## S3 method for class 'bivar'
residuals(object, ...)
```

### Arguments

- **object**
  - an object class bivar.

- **...**
  - other arguments.

### Value

Residuals extracted from the object class bivar.
See Also
   bivar

residuals.ccrm

Extract Constrained Centre and Range Method Residuals

Description
   Returns the residuals from an object class ccrm.

Usage
   # S3 method for class 'ccrm'
   residuals(object, ...)

Arguments
   object            an object class ccrm.
   ...               other arguments.

Value
   Residuals extracted from the object class ccrm.

See Also
   ccrm

residuals.cm

Extract Centre Method Residuals

Description
   Returns the residuals from an object class cm.

Usage
   # S3 method for class 'cm'
   residuals(object, ...)

Arguments
   object            an object class cm.
   ...               other arguments.
residuals.crm

Value
Residuals extracted from the object class cm.

See Also

cm

residuals.crm Extract Centre and Range Method Residuals

Description
Returns the residuals from an object class cm.

Usage

## S3 method for class 'crm'
residuals(object, ...)

Arguments

object an object class cm.
...
other arguments.

Value
Residuals extracted from the object class cm.

See Also

crm

residuals.MinMax Extract MinMax Method Residuals

Description
Returns the residuals from an object class MinMax.

Usage

## S3 method for class 'MinMax'
residuals(object, ...)

Arguments

object an object class MinMax.
... other arguments.
soccer.bivar

Arguments

object an object class MinMax.
... other arguments.

Value

Residuals extracted from the object class MinMax.

See Also

MinMax

soccer.bivar Soccer Interval Data Set

Description

A real interval-valued data set.

Usage

data("soccer.bivar")

Format

A data frame containing following variables:

yMin Minimum of the response variable Y (weight)
t1Min Minimum of the explanatory variable T1 (height)
t2Min Minimum of the explanatory variable T2 (age)
yMax Maximum of the response variable Y (weight)
t1Max Maximum of the explanatory variable T1 (height)
t2Max Maximum of the explanatory variable T2 (age)

Details

This data set concerns the record of the Weight (Y), Height (T1) and Age (T2) from 20 soccer teams of the premiere French championship.

Source

Lima Neto et. al. (2011)
summary.bivar

References

See Also
*cm, MinMax, bivar*

Examples
data("soccer.bivar", package = "iRegression")

bivar1 <- bivar(yMin~t1Min+t2Min, "identity", yMax~t1Max+t2Max, "identity", data=soccer.bivar)
summary(bivar1)

summary.bivar  

**Summarizing Bivariate Symbolic Regression Method Fits**

Description
summary method for class `bivar`.

Usage
## S3 method for class 'bivar'

summary(object, ...)

Arguments

object an object of class "bivar", usually, a result of a call to `bivar`.

... other arguments.

Value

The function `summary.bivar` returns the following elements, given an object of the class "bivar",

- **Coefficients1**: a named vector of coefficients for the explanatory variables of the model "1".
- **Coefficients2**: a named vector of coefficients for the explanatory variables of the model "2".
- **RMSE1**: root mean square error for the model "1".
- **RMSE2**: root mean square error for the model "2".
- **Rho**: the estimative for the correlation coefficient between Y1 and Y2.
- **Phi**: the estimative of the dispersion parameter.
- **D**: the goodness-of-fit measure deviance for the current model.
Summary of the CCRM Method

**Summary**

The function `summary.ccrm` is a method specifically designed for objects of the class `ccrm`. It provides a concise summary of the model fit, including coefficients for the Centre and Range explanatory variables, root mean square errors for the lower and upper bounds, and other relevant statistics.

**Usage**

```r
summary(object, ...) 
```

**Arguments**

- `object` is an object of class `ccrm`, typically resulting from a call to `ccrm`.
- `...` represents other arguments that can be passed to the function.

**Value**

The returned object contains several components:
- `coef.C`: a named vector of coefficients for the Centre explanatory variables.
- `coef.R`: a named vector of coefficients for the Range explanatory variables.
- `rmse.l`: root mean square error for the lower bound.
- `rmse.u`: root mean square error for the upper bound.

**References**


**Examples**

```r
#-- Continuing the bivar() example:
data("soccer.bivar", package = "iRegression")
ex.bivar <- bivar(yMin~t1Min+t2Min, "identity", yMax~t1Max+t2Max, "identity", data=soccer.bivar)
ex.sum <- summary(ex.bivar)
ex.sum
```

---

**References**

**summary.cm**

**See Also**

`ccrm`

**Examples**

```r
##-- Continuing the ccrm() example:
data("Cardiological.CR", package = "iRegression")
ex.ccrm <- ccrm(Pulse~SystC+DiastC,PulseR~SystR+DiastR, data=Cardiological.CR)
ex.sum <- summary(ex.ccrm)
ex.sum
```

---

**summary.cm**  
**Summarizing Centre Method Fits**

**Description**

summary method for class `cm`.

**Usage**

```r
## S3 method for class 'cm'
summary(object, ...)
```

**Arguments**

- `object`: an object of class "cm", usually, a result of a call to `cm`.
- `...`: other arguments.

**Value**

The function `summary.cm` returns the following elements, given an object of the class "cm",

- `coefficients`: a named vector of coefficients.
- `RMSE.1`: root mean square error for the lower interval bound.
- `RMSE.u`: root mean square error for the upper interval bound.

**References**


**See Also**

`cm`
Examples

```r
## -- Continuing the cm() example:
data("Cardiological.MinMax", package = "iRegression")
ex.cm <- cm(PulseMin~SystMin+DiastMin,PulseMax~SystMax+DiastMax,data=Cardiological.MinMax)
ex.sum <- summary(ex.cm)
ex.sum
```

Description

summary method for class `crm`.

Usage

```r
## S3 method for class 'crm'
summary(object, ...)
```

Arguments

- `object`: an object of class "crm", usually, a result of a call to `crm`.
- `...`: other arguments.

Value

The function `summary.crm` returns the following elements, given an object of the class "crm",

- `Coef.C`: a named vector of coefficients for the Centre explanatory variables.
- `Coef.R`: a named vector of coefficients for the Range explanatory variables.
- `RMSE.l`: root mean square error for the lower bound.
- `RMSE.u`: root mean square error for the upper bound.

References


See Also

`crm`
### Examples

```r
#-- Continuing the crm() example:
data("Cardiological.CR", package = "iRegression")
ex.crm <- crm(Pulse~SystC+DiastC,PulseR~SystR+DiastR,data=Cardiological.CR)
ex.sum <- summary(ex.crm)
ex.sum
```

```r
#-- Continuing the crm() example:
data("Cardiological.CR", package = "iRegression")
ex.crm <- crm(Pulse~SystC+DiastC,PulseR~SystR+DiastR,data=Cardiological.CR)
ex.sum <- summary(ex.crm)
ex.sum
```

### Description

summary method for class `MinMax`.

### Usage

```r
## S3 method for class 'MinMax'
summary(object, ...)  
```

#### Arguments

- `object` an object of class "MinMax", usually, a result of a call to `MinMax`.
- `...` other arguments.

### Value

The function `summary.MinMax` returns the following elements, given an object of the class "MinMax",

- `Coef.L` a named vector of coefficients for the Min explanatory variables.
- `Coef.U` a named vector of coefficients for the Max explanatory variables.
- `RMSE.L` root mean square error for the lower bound.
- `RMSE.U` root mean square error for the upper bound.

### References


### See Also

- `MinMax`
Examples

```R
#-- Continuing the MinMax() example:
data("Cardiological.MinMax", package = "iRegression")
ex.MinMax <- MinMax(PulseMin~SystMin+DiastMin,PulseMax~SystMax+DiastMax,data=Cardiological.MinMax)
ex.sum <- summary(ex.MinMax)
ex.sum
```
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