

# Package ‘rioplot’

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**Type** Package

**Title** Turn a Regression Model Inside Out

**Version** 1.1.2

**Maintainer** David Melamed <dmmelamed@gmail.com>

**Description**

Turns regression models inside out. Functions decompose variances and coefficients for various regression model types. Functions also visualize regression model objects using techniques developed in Schoon, Melamed, and Breiger (2024) <[doi:10.1017/9781108887205](https://doi.org/10.1017/9781108887205)>.

**VignetteBuilder** knitr

**Depends** R (>= 3.5.0), ggplot2, methods

**Suggests** dplyr, knitr, rmarkdown, ggrepel, MASS

**License** GPL-2 | GPL-3

**Encoding** UTF-8

**LazyData** true

**NeedsCompilation** no

**Author** David Melamed [aut, cre] (ORCID:  
<<https://orcid.org/0000-0002-8821-7698>>),  
Ronald L. Breiger [aut],  
Eric W. Schoon [aut]

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## Contents

Beckfield06 . . . . .	2
cosine . . . . .	3
decompose.model . . . . .	4
GSS.2016 . . . . .	5
GSS2018 . . . . .	6
Hilbe . . . . .	7
Kenworthy99 . . . . .	8

project.point . . . . .	9
RaginData . . . . .	10
rio.plot . . . . .	11
SchneiderAndMakszin06 . . . . .	13
Wimmer_et_al_EPR . . . . .	14

## Index 18

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Beckfield06	<i>Replication data for Beckfield (2006) as re-analyzed by Schoon, Melamed, and Breiger (2024)</i>
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### Description

Beckfield (2006) analyzed these data using fixed and random effects regression models. He showed that regional economic and political integration is associated with increased economic inequality. Schoon, Melamed, and Breiger (2024) turned these models inside out and decomposed the model coefficients.

### Usage

```
data("Beckfield06")
```

### Format

A data frame with 48 observations on the following 9 variables.

```
year a numeric vector
polint a numeric vector
ecoint a numeric vector
ecoints a numeric vector
gdp a numeric vector
trans a numeric vector
outflo a numeric vector
gini a numeric vector
countryid a character vector
```

### References

Beckfield, Jason. 2006. "European integration and income inequality." *American Sociological Review* 71(6): 964-985. Schoon, Eric W., David Melamed, and Ronald L. Breiger. 2024. *Regression Inside Out*. NY: Cambridge University Press.

### Examples

```
data(Beckfield06)
head(Beckfield06)
```

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cosine	<i>Compute the Cosine similarity between two points.</i>
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**Description**

Given two points, the function computes the cosine similarity between them.

**Usage**

```
cosine(x,y)
```

**Arguments**

x	Point 1
y	Point 2

**Value**

The cosine similarity, ranging between -1 and +1.

**Author(s)**

Ronald L. Breiger, David Melamed and Eric Schoon

**References**

Schoon, Eric, David Melamed, and Ronald L. Breiger. 2023. *Regression Inside Out*. NY: Cambridge University Press.

**Examples**

```
data(Kenworthy99)
m1 <- lm(scale(dv) ~ scale(gdp) + scale(pov) + scale(tran) -1, data=Kenworthy99)
rp1 <- rio.plot(m1, include.int="no", r1=1:15)
cosine(rp1$row.dimensions[15,], rp1$row.dimensions[8,])
# cosine similarity between USA and Ireland

cosine(rp1$row.dimensions[15,], rp1$row.dimensions[14,])
# cosine similarity between USA and United Kingdom
```

decompose.model

*Decompose the Results of a Regression Model by Cases***Description**

This function takes a regression model object and a vector of case assignments to groups (note, cases can be in their own group) and computes each cases' contribution to the overall regression coefficients.

**Usage**

```
decompose.model(m1, group.by=group.by, include.int="yes", model.type="OLS")
```

**Arguments**

m1	A regression model object. OLS, logistic, Poisson and negative binomial regression are supported.
group.by	A numeric vector denoting group membership. Should be the same length as the number of cases.
include.int	Whether the regression model included an intercept. Default is "yes."
model.type	Type of model to be decomposed. OLS via lm, logistic via glm ("logit"), Poisson via glm ("poisson"), and negative binomial via MASS ("nb") are supported.

**Value**

decomp.coef	Each case's or subset of cases' contribution to the estimated slope or regression coefficient.
decomp.var	Each case's or subset of cases' contribution to the variance of the estimated slope or regression coefficient.

**Author(s)**

David Melamed, Ronald L. Breiger, and Eric Schoon

**References**

Schoon, Eric, David Melamed, and Ronald L. Breiger. 2024. Regression Inside Out. NY: Cambridge University Press.

**Examples**

```
data(Kenworthy99)
m1 <- lm(scale(dv) ~ scale(gdp) + scale(pov) + scale(tran) -1, data=Kenworthy99)
decompose.model(m1, group.by=c("Liberal", "Corp", "Liberal",
" SocDem", " SocDem", "Corp", "Corp", "Corp", "Corp", "Corp", "SocDem",
" SocDem", "Liberal", "Liberal", "Liberal"), include.int="no")
```

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GSS.2016

*Subset of data from the General Social Survey from 2016. Data were analyzed in Schoon, Melamed, and Breiger (2024).*

---

**Description**

Subset of data from the General Social Survey from 2016. Data were analyzed in Schoon, Melamed, and Breiger (2024). Full details on the variable selection and source information is available therein.

**Usage**

```
data("GSS.2016")
```

**Format**

A data frame with 2867 observations on the following 27 variables.

```
sclass a numeric vector  
fulltime a numeric vector  
retired a numeric vector  
hrsworked a numeric vector  
occprestige a numeric vector  
occprestige_partner a numeric vector  
occprestige_mother a numeric vector  
occprestige_father a numeric vector  
children a numeric vector  
age a numeric vector  
educ a numeric vector  
paeduc a numeric vector  
maeduc a numeric vector  
speduc a numeric vector  
babs a numeric vector  
female a numeric vector  
white a numeric vector  
black a numeric vector  
other a numeric vector  
income a numeric vector  
republican a numeric vector  
conservative a numeric vector  
environment a numeric vector  
helpblackpeople a numeric vector  
science a numeric vector  
govequalwealth a numeric vector  
pclass a numeric vector
```

**References**

Schoon, Eric W., David Melamed, and Ronald L. Breiger. 2024. *Regression Inside Out*. NY: Cambridge University Press.

**Examples**

```
data(GSS.2016)
head(GSS.2016)
```

---

GSS2018	<i>Subset of the General Social Survey analyzed by Schoon, Melamed, and Breiger (2024)</i>
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**Description**

Subset of the General Social Survey analyzed by Schoon, Melamed, and Breiger (2024). Full details on the variable selection and source information is available therein.

**Usage**

```
data("GSS2018")
```

**Format**

A data frame with 558 observations on the following 7 variables.

```
dog a numeric vector
race a numeric vector
sex a numeric vector
children a numeric vector
married a numeric vector
age a numeric vector
income a numeric vector
```

**References**

Schoon, Eric W., David Melamed, and Ronald L. Breiger. 2024. *Regression Inside Out*. NY: Cambridge University Press.

**Examples**

```
data(GSS2018)
head(GSS2018)
```

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Hilbe	<i>Replication data for regression models with a count dependent variable.</i>
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**Description**

Data analyzed by Hilbe (2011), and used here to illustrate model visualization and coefficient decomposition for count models.

**Usage**

```
data("Hilbe")
```

**Format**

A data frame with 601 observations on the following 9 variables.

naffairs a numeric vector

avgmarr a numeric vector

hapavg a numeric vector

vryhap a numeric vector

smerel a numeric vector

vryrel a numeric vector

yrsmarr4 a numeric vector

yrsmarr5 a numeric vector

yrsmarr6 a numeric vector

**Source**

Hilbe, Joseph M., 2011. Negative binomial regression. NY: Cambridge University Press.

**Examples**

```
data(Hilbe)
head(Hilbe)
```

---

Kenworthy99	<i>Data to replicate OLS regression models reported in Kenworthy (1999).</i>
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### Description

Data to replicate OLS regression models reported in Kenworthy (1999). Data were analyzed in Schoon, Melamed, and Breiger (2024). Full details on the variable selection and source information is available therein.

### Usage

```
data("Kenworthy99")
```

### Format

A data frame with 15 observations on the following 6 variables.

dv a numeric vector

gdp a numeric vector

pov a numeric vector

tran a numeric vector

IS03 a character vector

nation.long a character vector

### References

Kenworthy, Lane. 1999. "Do social-welfare policies reduce poverty? A cross-national assessment." *Social Forces* 77(3): 1119-1139. Schoon, Eric W., David Melamed, and Ronald L. Breiger. 2024. *Regression Inside Out*. NY: Cambridge University Press.

### Examples

```
data(Kenworthy99)  
head(Kenworthy99)
```

---

project.point	<i>Project point 1 onto the line (at 90 degrees) running through point 2 and the origin (0,0).</i>
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### Description

Given two points, p1 and p2, this function identifies the point at which p1 is projected onto the line connecting p2 and the origin (0,0). The projection occurs at a right angle.

### Usage

```
project.point(p1,p2)
```

### Arguments

p1	First point, the one that is to be projected onto point 2.
p2	Second point, the one that is projected to the origin. This is the outcome or dependent variable in our book. See reference below.

### Details

The output is just a single point. This is implemented as the point to which lines are drawn in many graphs.

### Value

Two values which correspond to the x and y co-ordinates in the graph.

### Author(s)

David Melamed, Ronald L. Breiger, and Eric Schoon

### References

Schoon, Eric, David Melamed, and Ronald L. Breiger. 2024. Regression Inside Out. NY: Cambridge University Press.

### Examples

```
data(Kenworthy99)
m1 <- lm(scale(dv) ~ scale(gdp) + scale(pov) + scale(tran) -1, data=Kenworthy99)
rp1 <- rio.plot(m1, include.int="no", r1=1:15)
project.point(as.numeric(rp1$col.dimensions[1,]), as.numeric(rp1$row.dimensions[1,]))
```

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RaginData

*Subset of replication data from Ragin and Fiss (2017).*

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### **Description**

Subset of replication data from Ragin and Fiss (2017). Data were analyzed in Schoon, Melamed, and Breiger (2024). Full details on the variable selection and source information is available therein.

### **Usage**

```
data("RaginData")
```

### **Format**

A data frame with 4185 observations on the following 10 variables.

```
incrat a numeric  
pinc a numeric  
ped a numeric  
resp_ed a numeric  
afqt a numeric  
kids a numeric  
married a numeric  
black a numeric  
male a numeric  
povd a numeric
```

### **References**

Ragin, Charles C. and Peer C. Fiss. 2017. Intersectional inequality: Race, class, test scores, and poverty. Chicago, IL: University of Chicago Press. Schoon, Eric W., David Melamed, and Ronald L. Breiger. 2024. Regression Inside Out. NY: Cambridge University Press.

### **Examples**

```
data(RaginData)  
head(RaginData)
```

rio.plot

*Regression Inside Out: Plotting Regression Models***Description**

rio.plot is used to generate a reduced rank image of a regression model. The function computes row and column dimensions for both cases and variables, and generates an image of the model based on those scores.

**Usage**

```
rio.plot(m1, exclude.vars="no", r1="none", case.names="", col.names="no",
h.just=-.2, v.just=0, case.col="blue", var.name.col="black",
include.int="yes", group.cases=1, model.type="OLS")
```

**Arguments**

m1	a regression model object. Supported models include OLS, Logistic, Poisson, and Negative Binomial Regression.
exclude.vars	an optional numerical vector indicating variables from the model to exclude from the plot of the model.
r1	an optional numerical vector indicating cases to include in the plot. By default, all cases are excluded from the plot.
case.names	a character string of names to label the cases. Should be the same length as 'r1.'
col.names	whether to include the variable names in the plot. Default is "no"
h.just	horizontal justification in the plot. Default is -.2
v.just	vertical justification in the plot. Default is 0
case.col	if cases are added to the plot, this is their color. Default is "blue"
var.name.col	Color of the names of variables in the plot. Default is "black"
include.int	Whether the underlying model included a model intercept. Default is "yes"
group.cases	Whether to aggregate cases into clusters or subsets. If yes, provide a numeric vector of memberships. It will aggregate over them by summing.
model.type	The type of regression model. OLS is supported via the lm function. Logistic and Poisson regression are supported via the glm function. Negative Binomial regression is supported via the MASS package. Default is "OLS." For logistic regression, use "logit." For Poisson regression, use "poisson." For negative binomial regression, use "nb."

**Details**

The function take a regression model object (OLS, logistic, Poisson, or negative binomial) and computes the corresponding row (case) and column (variables) scores. The scores are part of the output, as is a ggplot object of the model.

**Value**

rio.plot returns several objects.

p1	a ggplot object of the model space, given the terms in the function
row.dimensions	the scores assigned to each case, or each subset of cases if they were aggregated using the 'group.cases' option. These are the co-ordinates in the plot.
col.dimensions	the scores assigned to each variable. These are the co-ordinates in the plot.
case.variances	each cases' contribution (or each subsets' contribution) to the variance of the estimated regression coefficient
U	The orthogonalized column space matrix from the Singular Value Decomposition of the predictor matrix and fitted values.
UUt	The orthogonalized column space matrix from the Singular Value Decomposition of the predictor matrix and fitted values, post-multiplied by its transpose.

**Author(s)**

David Melamed, Ronald L. Breiger, and Eric Schoon

**References**

Schoon, Eric, David Melamed, and Ronald L. Breiger. 2024. Regression Inside Out. NY: Cambridge University Press.

**Examples**

```
data(Kenworthy99)
m1 <- lm(scale(dv) ~ scale(gdp) + scale(pov) + scale(tran) -1, data=Kenworthy99)
rp1 <- rio.plot(m1, include.int="no")
names(rp1)
rp1$gg.obj
# rp1$gg.obj + ggplot2::scale_x_continuous(limits=c(-.55,1)) # useful option

rp2 <- rio.plot(m1, r1=1:15, case.names=paste(1:15), include.int="no")
rp2$gg.obj

Kenworthy99 <- data.frame(Kenworthy99, type=c("Liberal", "Corp", "Liberal",
"SocDem", "SocDem", "Corp", "Corp", "Corp", "Corp", "Corp", "Corp", "SocDem", "SocDem",
"Liberal", "Liberal", "Liberal"))

rp3 <- rio.plot(m1, r1=1:15, group.cases=Kenworthy99$type, include.int="no")
rp3$gg.obj
# rp3$gg.obj + ggplot2::scale_x_continuous(limits=c(-1,20))
```

---

SchneiderAndMakszin06 *Subset of replication data from Schneider and Makszin (2014).*

---

**Description**

Subset of replication data from Schneider and Makszin (2014). Data were analyzed in Schoon, Melamed, and Breiger (2024). Full details on the variable selection and source information is available therein.

**Usage**

```
data("SchneiderAndMakszin06")
```

**Format**

A data frame with 30 observations on the following 36 variables.

id a character vector  
country a character vector  
year a numeric vector  
fde a numeric vector  
fde\_cilb a numeric vector  
fde\_ciub a numeric vector  
wcoord a numeric vector  
govint a numeric vector  
ud a numeric vector  
ep1 a numeric vector  
socexp a numeric vector  
eduexp a numeric vector  
vet\_un a numeric vector  
lmexp a numeric vector  
wagecov a numeric vector  
vet\_isced3 a numeric vector  
eduexp\_pri a numeric vector  
edu\_terenr a numeric vector  
vt\_reg a numeric vector  
vt\_vap a numeric vector  
compvote a numeric vector  
fde2 a numeric vector  
low\_fde\_1 a numeric vector

high\_fde\_l a numeric vector  
high\_wc\_l a numeric vector  
high\_int\_l a numeric vector  
high\_ud\_l a numeric vector  
high\_epl\_l a numeric vector  
high\_socx\_l a numeric vector  
high\_edux\_l a numeric vector  
high\_lmx\_l a numeric vector  
high\_vet\_l a numeric vector  
p1\_y a numeric vector  
p2\_y a numeric vector  
p3\_y a numeric vector  
sol\_y a numeric vector

## References

Schneider, Carsten Q., and Kristin Makszin. 2014. "Forms of welfare capitalism and education-based participatory inequality." *Socio-Economic Review* 12(2): 437-462. Schoon, Eric W., David Melamed, and Ronald L. Breiger. 2024. *Regression Inside Out*. NY: Cambridge University Press.

## Examples

```
data(SchneiderAndMakszin06)  
head(SchneiderAndMakszin06)
```

---

Wimmer\_et\_al\_EPR

*Subset of replication data from Wimmer, Cederman, and Min (2009).*

---

## Description

Subset of replication data from Wimmer, Cederman, and Min (2009). Data were analyzed in Schoon, Melamed, and Breiger (2024). Full details on the variable selection and source information is available therein.

## Usage

```
data("Wimmer_et_al_EPR")
```

**Format**

A data frame with 7908 observations on the following 80 variables.

yearc a numeric  
year a numeric  
cowcode a numeric  
country a character  
gdpcap a numeric  
gdpcapl a numeric  
oilpc a numeric  
oilpcl a numeric  
popavg a numeric  
lpopl a numeric  
ethfrac a numeric  
western a numeric  
eeurop a numeric  
lamerica a numeric  
ssafrica a numeric  
asia a numeric  
nafrme a numeric  
lmtnest a numeric  
polity2 a numeric  
polity a numeric  
anoc a numeric  
anocl a numeric  
democ a numeric  
democl a numeric  
regchg3 a numeric  
pimppast a numeric  
groups a numeric  
egipgrps a numeric  
exclgrps a numeric  
exclpop a numeric  
lrexclpop a numeric  
ttlpop a numeric  
discpop a numeric  
pwrpop a numeric  
olppop a numeric

olpspop a numeric  
jppop a numeric  
sppop a numeric  
dompop a numeric  
monpop a numeric  
maxexclpop a numeric  
maxegipop a numeric  
maxpop a numeric  
newonset a numeric  
newethonset a numeric  
newhionset a numeric  
newethhionset a numeric  
onsetstatus a numeric  
onsetstatus2 a numeric  
actoraim a numeric  
actoraim2 a numeric  
ongoingwar1 a numeric  
ongoinghiwar1 a numeric  
newonset2 a numeric  
newhionset2 a numeric  
newethonset2 a numeric  
war1f1 a numeric  
onsetf1 a numeric  
ethonsetf1 a numeric  
onsetf12 a numeric  
ethonsetf12 a numeric  
warstns2 a numeric  
warstns1 a numeric  
atwarns1 a numeric  
npeaceyears a numeric  
nspline1 a numeric  
nspline2 a numeric  
nspline3 a numeric  
hpeaceyears a numeric  
hspline1 a numeric  
hspline2 a numeric  
hspline3 a numeric

```
fpeaceyears a numeric
fspline1 a numeric
fspline2 a numeric
fspline3 a numeric
speaceyears a numeric
sspline1 a numeric
sspline2 a numeric
sspline3 a numeric
```

### References

Wimmer, Andreas, Lars-Erik Cederman, and Brian Min. 2009. "Ethnic politics and armed conflict: A configurational analysis of a new global data set." *American Sociological Review* 74(2): 316-337.

### Examples

```
data(Wimmer_et_al_EPR)
head(Wimmer_et_al_EPR)
```

# Index

## \* datasets

- Beckfield06, [2](#)
- GSS.2016, [5](#)
- GSS2018, [6](#)
- Hilbe, [7](#)
- Kenworthy99, [8](#)
- RaginData, [10](#)
- SchneiderAndMakszin06, [13](#)
- Wimmer\_et\_al\_EPR, [14](#)

Beckfield06, [2](#)

cosine, [3](#)

decompose.model, [4](#)

GSS.2016, [5](#)

GSS2018, [6](#)

Hilbe, [7](#)

Kenworthy99, [8](#)

project.point, [9](#)

RaginData, [10](#)

rio.plot, [11](#)

SchneiderAndMakszin06, [13](#)

Wimmer\_et\_al\_EPR, [14](#)