Package 'prais'

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Type Package

Title Prais-Winsten Estimator for AR(1) Serial Correlation

Version 1.1.4

Description The Prais-Winsten estimator (Prais & Winsten, 1954) takes into account AR(1) serial correlation of the errors in a linear regression model. The procedure recursively estimates the coefficients and the error autocorrelation of the specified model until sufficient convergence of the AR(1) coefficient is attained.

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Depends R (>= 3.2.0), sandwich, pcse

Imports stats

RoxygenNote 7.3.2

URL https://github.com/franzmohr/prais

BugReports https://github.com/franzmohr/prais/issues

Collate 'data.R' 'prais-package.R' 'prais_winsten.R' 'predict.prais.R' 'print.prais.R' 'summary.prais.R' 'print.summary.prais.R' 'pw_transform.R' 'vcovHC.R' 'vcovPC.R'

LazyData true

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Contents

`barium` *Barium*

Description

Monthly microeconomic data from the U.S. chemical industry from February 1978 to December 1988 as used in Krupp and Pollard (1996) and subsequently re-used by Wooldridge (2000) as a textbook dataset. Raw data was obtained from http://fmwww.bc.edu/ec-p/data/wooldridge/barium.dta.

Usage

```
data("barium")
```

Format

A data frame with 131 rows and 31 variables:

chnimp Chinese imports, bar. chl.

bchlimp Total imports, bar. chl.

befile6 Dummy varialbe, which is 1 for all six months before filing.

affile6 Dummy varialbe, which is 1 for all six months after filing.

afdec6 Dummy varialbe, which is 1 for all six months after decision

befile12 Dummy varialbe, which is 1 for all twelve months before filing.

affile12 Dummy varialbe, which is 1 for all twelve months after filing.

afdec12 Dummy varialbe, which is 1 for all twelve months after decision.

chempi Chemical production index.

gas Gasoline production.

rtwex Exchange rate index.

spr Dummy varialbe, which is 1 for spring months.

sum Dummy varialbe, which is 1 for summer months.

fall Dummy varialbe, which is 1 for fall months.

lchnimp Log of chnimp.

lgas Log of gas.

lrtwex Log of rtwex.

lchempi Log of chempi.

t Time trend.

feb Dummy varialbe for February.

mar Dummy varialbe for March.

apr Dummy varialbe for April.

may Dummy varialbe for May.

jun Dummy varialbe for June.

jul Dummy varialbe for July.

aug Dummy varialbe for August.

sep Dummy varialbe for September.

oct Dummy varialbe for October.

nov Dummy varialbe for November.

dec Dummy varialbe for December.

percchn Percent of imports from China.

References

Krupp, C.M., & Pollard, P.S., (1996). Market responses to antidumpting laws: Some evidence from the U.S. chemical industry. *Canadian Journal of Economics 29*(1), 199–227. doi:10.2307/136159

Wooldridge, J., (2000). *Instructional Stata datasets for econometrics*. [barium]. Boston College Department of Economics.

`prais_winsten` *Prais-Winsten Estimator for AR(1) Serial Correlation*

Description

The Prais-Winsten estimator takes into account AR(1) serial correlation of the errors in a linear regression model. The procedure recursively estimates the coefficients and the error autocorrelation of the specified model until sufficient convergence of the AR(1) coefficient is reached. All estimates are obtained by OLS.

Predicted values based on Prais-Winsten object.

Usage

```
prais_winsten(
  formula,
  data,
  index,
  max_iter = 50L,
  tol = 1e-06,
  twostep = FALSE,
  panelwise = FALSE,
  rhoweight = c("none", "T", "T1"),
  ...
```

```
)

## S3 method for class 'prais'
predict(object, ..., newdata = NULL)

## S3 method for class 'prais'
print(x, digits = max(3L, getOption("digits") - 3L), ...)
```

Arguments

formula	an object of class "formula" (or one that can be coerced to that class): a symbolic description of the model to be fitted.
data	a data frame containing the variables in the model. If panel data is used, it must also contain the ID and time variables.
index	a character vector specifying the ID and time variables. If only one variable is provided, it is assumed to be the time variable and the data will be reordered accordingly.
max_iter	integer specifying the maximum number of allowed iterations. Default is 50.
tol	numeric specifying the maximum absolute difference between the estimator of rho in the current and the previous iteration that has to be attained to reach convergence. Default is 1e-6.
twostep	logical. If TRUE, the estimation will stop after the first iteration.
panelwise	logical. If TRUE, ρ will be calculated for each panel separately. Default is FALSE. Only used for panel data. See 'Details'.
rhoweight	character specifying how ρ should be calculated if panelwise = TRUE. See 'Details'.
...	further arguments passed to or from other methods.
object	an object of class "prais", usually, a result of a call to prais_winsten.
newdata	an optional data frame in which to look for variables with with to predict. If omitted, fitted values are used.
x	an object of class "prais", usually, a result of a call to prais_winsten.
digits	the number of significant digits to use when printing.

Details

If ρ takes a value above 1 during the estimation process, the Prais-Winsten transformation cannot be applied to the first observations, because $(1 - \rho^2)^{(1/2)}$ is not real. These observations are dropped during the respective iteration and the estimator effectively becomes the Cochrane-Orcutt estimator.

If panelwise = TRUE, twostep = FALSE and rhoweight = "none", each individual estimate of rho is re-estimated until convergence is achieved for all coefficients.

If panelwise = TRUE, the calculation of ρ can be further specified in argument rhoweight. If rhoweight = "none", ρ is assumed to be panel-specific. If rhoweight = "T", ρ is calculated as a weighted mean of panel-specific estimates, where the number of available observations per panel, i.e. T_i, is used as weight. If rhoweight = "T1", ρ is calculated as a weighted mean of panel-specific estimates, where the number of available observations per panel minus one, i.e. $T_i - 1$, is used as weight.

Value

A list of class "prais" containing the following components:

coefficients	a named vector of coefficients.
rho	the values of the AR(1) coefficient ρ from all iterations.
residuals	the residuals, that is the response minus the fitted values.
fitted.values	the fitted mean values.
rank	the numeric rank of the fitted linear model.
df.residual	the residual degrees of freedom.
call	the matched call.
terms	the terms object used.
model	the original model frame, i.e., before the Prais-Winsten transformation.
index	a character specifying the ID and time variables.

A vector of or predictions.

References

Beck, N. L. and Katz, J. N. (1995): What to do (and not to do) with time-series cross-section data. American Political Science Review 89, 634-647.

Prais, S. J. and Winsten, C. B. (1954): Trend Estimators and Serial Correlation. Cowles Commission Discussion Paper, 383 (Chicago).

Wooldridge, J. M. (2013): Introductory Econometrics. A Modern Approach. 5th ed. Mason, OH: South-Western Cengage Learning Cengage.

Prais, S. J. and Winsten, C. B. (1954): Trend Estimators and Serial Correlation. Cowles Commission Discussion Paper, 383 (Chicago).

Examples

```
# Generate an artificial sample
set.seed(1234567)
n <- 100
x <- sample(20:40, n, replace = TRUE)
rho <- .5

# AR(1) errors
u <- rnorm(n, 0, 5)
for (i in 2:n) {
  u[i] <- u[i] + rho * u[i - 1]
}
pw_sample <- data.frame("x" = x, "y" = 10 + 1.5 * x + u, "time" = 1:n)

# Estimate
pw <- prais_winsten(y ~ x, data = pw_sample, index = "time")
summary(pw)

# Generate an artificial sample
```

```
set.seed(1234567)
n <- 100
x <- sample(20:40, n, replace = TRUE)
rho <- .5

# AR(1) errors
u <- rnorm(n, 0, 5)
for (i in 2:n) {
  u[i] <- u[i] + rho * u[i - 1]
}
pw_sample <- data.frame("x" = x, "y" = 10 + 1.5 * x + u, "time" = 1:n)

# Estimate
pw <- prais_winsten(y ~ x, data = pw_sample, index = "time")

# Predict
fcst <- predict(pw)
```

`summary.prais` *Summarising the Prais-Winsten Estimator*

Description

Summary method for class "prais".

Usage

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

## S3 method for class 'summary.prais'
print(
  x,
  digits = max(3L, getOption("digits") - 3L),
  signif.stars = getOption("show.signif.stars"),
  ...
)
```

Arguments

object	an object of class "prais", usually, a result of a call to prais_winsten.
...	further arguments passed to or from other methods.
x	an object of class "summary.prais", usually, a result of a call to summary.prais.
digits	the number of significant digits to use when printing.
signif.stars	logical. If TRUE, 'significance stars' are printed for each coefficient.

Value

summary.prais returns a list of class "summary.prais", which contains the following components:

call	the matched call.
residuals	the residuals, that is the response minus the fitted values.
coefficients	a named vector of coefficients.
rho	the values of the AR(1) coefficient ρ from all iterations.
sigma	the square root of the estimated variance of the random error.
df	degrees of freedom, a 3-vector *(p, n-p, p*)*, the first being the number of non-aliased coefficients, the last being the total number of coefficients.
r.squared	R^2, the 'fraction of variance explained by the model', $$R^2 = 1 - \frac{\sum (y_i - \hat{y}_i)^2}{\sum (y_i - \overline{y})^2},$$ where $\overline{y}$ is the mean of y_i for $y_i = 1, ..., N$ if there is an intercept and zero otherwise.
adj.r.squared	the above *R^2* statistic *'adjusted'*, penalising for higher *p*.
fstatistic	(for models including non-intercept terms) a 3-vector with the value of the F-statistic with its numerator and denominator degrees of freedom.
cov.unscaled	a $p \times p$ matrix of (unscaled) covariances of the *coef[j], j=1, ..., p*.
dw	a named 2-vector with the Durbin-Watson statistic of the original linear model and the Prais-Winsten estimator.
index	a character specifying the ID and time variables.

---

vcovHC.prais *Semirobust Covariance Matrix Estimators*

Description

Semirobust covariance matrix estimators for models of class "prais".

Usage

```
## S3 method for class 'prais'
vcovHC(x, type = c("const", "HC1", "HC0"), ...)
```

Arguments

x	an object of class "prais", usually, the result of a call to prais_winsten.
type	a character string specifying the estimation type.
...	not used.

Details

vcovHC is a function for estimating a robust covariance matrix of parameters for the Prais-Winsten estimator. The weighting schemes specified by type are analogous to those in vcovHC in package sandwich with the caveat that only "const", "HC0" and "HC1" are available.

Value

An object of class "matrix" containing the estimate of the asymptotic covariance matrix of coefficients.

See Also

vcovHC

---

vcovPC.prais *Extract Panel-Corrected Variance Covariance Matrix*

Description

Panel-corrected covariance matrix estimators for models of class "prais".

Usage

```
## S3 method for class 'prais'
vcovPC(x, pairwise = FALSE, ...)
```

Arguments

x	an object of class "prais", usually, the result of a call to prais_winsten.
pairwise	logical. If FALSE (default), only those residuals from periods that are common to all panels are used to computed the covariances. If TRUE all observations that can be matched by period between two panels are used.
...	not used.

Details

vcovPC is a function for estimating a panel-corrected covariance matrix of parameters for the Prais-Winsten estimator.

Value

An object of class "matrix".

References

Beck, N. L. and Katz, J. N. (1995): What to do (and not to do) with time-series cross-section data. American Political Science Review 89, 634-647.

See Also

vcovPC

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