

Package ‘prais’

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

Version 1.2.0

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.

License GPL (>= 2)

Depends R (>= 3.2.0), sandwich, psc

Imports stats

Suggests haven, lmtest, testthat (>= 3.0.0)

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

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

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'print.prais.R' 'summary.prais.R' 'print.summary.prais.R'
'pw_transform.R' 'vcovHC.R' 'vcovPC.R'

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barium	<i>Barium</i>
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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 variable, which is 1 for all six months before filing.

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

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

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

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

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

chempi Chemical production index.

gas Gasoline production.

rtwex Exchange rate index.

spr Dummy variable, which is 1 for spring months.

sum Dummy variable, which is 1 for summer months.

fall Dummy variable, 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 variable for February.
mar Dummy variable for March.
apr Dummy variable for April.
may Dummy variable for May.
jun Dummy variable for June.
jul Dummy variable for July.
aug Dummy variable for August.
sep Dummy variable for September.
oct Dummy variable for October.
nov Dummy variable for November.
dec Dummy variable for December.
percchn Percent of imports from China.

References

Krupp, C.M., & Pollard, P.S., (1996). Market responses to antidumping 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.

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'
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. The specified variables must not contain NA values.
max_iter	integer specifying the maximum number of allowed iterations. Default is 50.
tol	numeric specifying the maximum absolute difference between the estimator of ρ 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'.
...	arguments passed to lm .
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

Observations with missing values in the variables of formula are dropped before estimation, as in [lm](#). Since the Prais-Winsten transformation uses the previous observation of a panel, the observations that surround a dropped one are treated as if they were consecutive.

Estimates of ρ are bounded to the interval $[-1, 1]$, because the transformation of the first observation of a panel requires $(1 - \rho^2)^{(1/2)}$ to be real. If ρ attains one of those bounds, the first observation of each panel becomes zero and does not contribute to the estimates, so that the estimator effectively becomes the Cochrane-Orcutt estimator.

The time variable is only used to order the observations. If it is not equally spaced, a warning is issued, because the observations that surround a gap are treated as if they were consecutive.

If panelwise = TRUE, twostep = FALSE and rhoweight = "none", each individual estimate of ρ 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:

<code>coefficients</code>	a named vector of coefficients.
<code>rho</code>	the values of the AR(1) coefficient ρ from all iterations.
<code>residuals</code>	the residuals, that is the response minus the fitted values.
<code>fitted.values</code>	the fitted mean values.
<code>rank</code>	the numeric rank of the fitted linear model.
<code>df.residual</code>	the residual degrees of freedom.
<code>call</code>	the matched call.
<code>terms</code>	the terms object used.
<code>model</code>	the original model frame, i.e., before the Prais-Winsten transformation.
<code>xlevels</code>	a record of the levels of the factors used in fitting.
<code>contrasts</code>	the contrasts used, if the model contains factors.
<code>index</code>	a character specifying the ID and time variables. Only added if panel data were used.

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.

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)

```

predict.prais

Predict Method for Objects of Class prais

Description

Predicted values based on Prais-Winsten object.

Usage

```

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

```

Arguments

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 which to predict. It must contain the variables that appear in formula, which do not have to be transformed beforehand. If omitted, the fitted values are used.
...	further arguments passed to or from other methods.

Details

The predictions are the conditional mean of the model, i.e. the product of the regressors and the coefficients. The AR(1) structure of the errors is not used, so the result does not contain the forecast of the serially correlated part of the error term.

Value

A vector of predictions.

References

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")

# 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 of the Prais-Winsten transformed model, i.e. the residuals the reported standard errors are based on. The residuals on the scale of the original data are available as residuals of the estimated object.
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',

$$R^2 = 1 - \frac{\sum (y_i - \hat{y}_i)^2}{\sum (y_i - \bar{y})^2},$$

where $\bar{y}$ is the mean of y_i for $y_i = 1, \dots, N$ if there is an intercept and zero otherwise.

adj.r.squared	the above R^2 statistic ' <i>adjusted</i> ', 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 <i>coef</i> [[j], $j=1, \dots, p$.
dw	a named 2-vector with the Durbin-Watson statistic of the original linear model and the Prais-Winsten estimator.
terms	the terms object used.

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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