Package ‘prais’

October 14, 2022

Encoding UTF-8
Type Package
Title Prais-Winsten Estimator for AR(1) Serial Correlation
Version 1.1.2
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, pcse
Imports lmtest, stats
RoxygenNote 7.1.2
URL https://github.com/franzmohr/prais
BugReports https://github.com/franzmohr/prais/issues
Collate 'prais_winsten.R' 'print.prais.R' 'summary.prais.R'
               'print.summary.prais.R' 'pw_transform.R' 'vcovHC.R' 'vcovPC.R'
               'zzz.R'
NeedsCompilation no
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Repository CRAN
Date/Publication 2021-11-01 15:50:02 UTC

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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.
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, \( \rho \) will be calculated for each panel separately. Default is FALSE. Only used for panel data. See 'Details'.
rhoweight character specifying how \( \rho \) should be calculated if panelwise = TRUE. See 'Details'.

### S3 method for class 'prais'
print(x, digits = max(3L, getOption("digits") - 3L), ...)
... arguments passed to \texttt{lm}.
\begin{itemize}
  \item \texttt{x} an object of class "\texttt{prais}" usualy, a result of a call to \texttt{prais_winsten}.
  \item \texttt{digits} the number of significant digits to use when printing.
\end{itemize}

\textbf{Details}

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

If \texttt{panelwise = TRUE}, the calculation of $\rho$ can be further specified in argument \texttt{rhoweight}. If \texttt{rhoweight = "none"}, $\rho$ is assumed to be panel-specific. If \texttt{rhoweight = "T"}, $\rho$ 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 \texttt{rhoweight = "T1"}, $\rho$ 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.

\textbf{Value}

A list of class "\texttt{prais}" containing the following components:

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

\textbf{References}


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)

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 $\rho$ 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 $y_i = 1, \ldots, N$ 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

```r
## 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.
vcovPC.prais

Details

vcovPC 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

vcovPC.prais

See Also

vcovPC
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