Package ‘robustarima’

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Author Stephen Kaluzny [aut, cre], TIBCO Software Inc. [aut, cph]

Maintainer Stephen Kaluzny <spkaluzny@gmail.com>

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`arima.rob` *Robust Fit of a REGARIMA Model and Outliers Detection*

Description

Returns an object of class "arima.rob" that represents a robust fit of a linear regression model with ARIMA errors using a filtered tau-estimate. The error model may have seasonal differences and one seasonal moving average parameter. It also returns the detected outliers and level shifts.

Usage

```
arima.rob(formula, data, contrasts=NULL, start=NULL, end=NULL,
      p=0, q=0, d=0, sd=0, freq=1, sfreq=NULL, sma=FALSE,
      max.p=NULL, auto.ar=FALSE, n.predict=20, tol=10^(-6),
      max.fcal=2000, iter=FALSE, innov.outlier=FALSE, critv=NULL, ...)
```

Arguments

`formula`	a `formula` object, with the response on the left of a ~ operator, and the terms, separated by + operators, on the right.
`data`	a data frame or a "timeSeries" object with a data frame in the data slot, which is used to interpret the variables named in `formula`. If this is missing, then the variables in `formula` should be on the search list. Missing values are not allowed.
`contrasts`	the same as the `contrasts` argument for `lm` function.
`start`	a character string which can be passed to `timeDate` function to specify the starting date for the estimation. This can only be used if the `data` argument is a "timeSeries" data frame. The default is `NULL`.
`end`	a character string which can be passed to `timeDate` function to specify the ending date for the estimation. This can only be used if the `data` argument is a "timeSeries" data frame. The default is `NULL`.
`p`	the autoregressive order of the errors model. The default is `0`.
`q`	the moving average order of the errors model. The default is `0`.
`d`	the number of regular differences in the ARIMA model. It must be `0`, `1` or `2`. The default is `0`.
`sd`	the number of seasonal differences. It must be `0`, `1` or `2`. The default is `0`.

`freq`	the frequency of `data`. The default is `1`.
`sfreq`	the seasonality frequency of `data`. If `NULL`, it is set to be equal to `freq`. The default is `NULL`.
`sma`	logical flag: if `TRUE`, the errors model includes a seasonal moving average parameter. The default is `FALSE`.
`auto.ar`	logical flag: If `TRUE` an AR(p) model is selected automatically using a robust AIC criterion. The default is `FALSE`.
`max.p`	the maximum order of the autoregressive stationary model that approximates the ARMA stationary model. If `NULL`, `max.p=max(p+q,5)`. If `q=0`, then `max.p` is not necessary. The default is `NULL`.
`n.predict`	the maximum number of future periods for which we wish to compute the predictions. The default is `20`.
`tol`	the tolerance for convergence.
`max.fcal`	the maximum number of function evaluations.
`iter`	a logical flag or the number of iterations to execute `arima.rob` with.
`innov.outlier`	logical flag: if `TRUE`, the function `arima.rob` looks for innovation outliers in addition to additive outliers and level shifts; otherwise, `arima.rob` only looks for additive outliers and level shifts. The default is `FALSE`.
`critv`	the critical value for detecting outliers. If `NULL`, it assumes the following default values: `critv=3` if the length of the time series is less than 200; `critv=3.5` if it is between 200 and 500, and `critv=4` if it is greater than 500.
`...`	extra arguments passed to or from other methods.

Value

an object of class `"arima.rob"` representing the fit and the outliers detected. See `arima.rob.object` for details of the components of the object.

Warning

When either `d` or `sd` is greater than zero, the interpretation of the intercept in the `formula` is different from its usual interpretation: it represents the coefficient of the lowest order power of the time trend which can be identified. For example, if `d=2` and `sd=0`, the intercept represents the coefficient of the term `t^2`.

References

Bianco, A., Garcia Ben, M., Martinez, E., and Yohai, V. (1996). Robust procedures for regression models with ARIMA errors. *COMPSTAT 96, Proceedings in Computational Statistics*. Ed. Albert Prat, pages. 27-38. Physica-Verlag, Heidelberg.

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Chang, I., Tiao, G. C., and Chen, C. (1988). Estimation of time series parameters in the presence of outliers. *Technometrics*, 30:193-204.

Martin, R. D., Samarov, A., and Vandaele, W. (1983). Robust methods for ARIMA models. in *Applied Time Series Analysis of Economic Data*, E. Zellner, ed.

Yohai, V. Y., and Zamar, R. H. (1988). High breakdown-point estimates of regression by means of the minimization of an efficient scale. *Journal of the American Statistical Association*, 83:406-413.

See Also

`arima.rob.object`.

Examples

```
frip.rr <- arima.rob(log(frip.dat) ~ 1, p=2, d=1)
```

`arima.rob.object` *Robust REGARIMA Model and Outliers Detection Objects*

Description

These are objects of class `"arima.rob"` which represent the robust fit of a regression model with ARIMA errors. It also contains information about the detected outliers.

Arguments

	The following components must be included in a legitimate `"arima.rob"` object:
	the model matrix.
`x` `y`	the response variable.
`model`	a list with the following named components: `"freq"` which is the frequency of the original data, `"sfreq"` which is the seasonal frequency of the original data, `"d"` which is the number of regular differences, `"sd"` which is the number of seasonal differences, `"ar"` which is the estimated AR coefficients, `"ma"` which is the estimated MA coefficients, `"sma"` which is the seasonal MA coefficient if estimated.
`regcoef`	the estimates of regression coefficients.
`regcoef.cov`	the estimated covariance matrix of the regression coefficients.
`innov`	the estimated innovations.
`innov.acf`	a series whose autocorrelations or partial autocorrelations are the robust estimates of the innovation autocorrelations or partial autocorrelations.
`regresid`	the estimated regression residuals cleaned of additive outliers by the robust filter.
`regresid.acf`	a series whose autocorrelations or partial autocorrelations are the robust estimates of the autocorrelations or partial autocorrelations of the differenced regression residuals.
`sigma.innov`	a robust estimate of the innovation scale.
`sigma.regresid`	an estimate of the scale of the differenced regression residuals.

`sigma.first`	the first estimate of the innovation scale based only on the scale of the differenced model and the ARMA parameters.
`tuning.c`	the bandwidth of the robust filter.
`y.robust`	the response series cleaned of outliers by the robust filter.
`y.cleaned`	the response series cleaned of additive outliers and level shifts after the outliers detection procedure.
`predict.error`	the fitted and predicted regression errors.
`predict.scales`	the standard deviations of the fitted and predicted regression errors.
`n.predict`	the number of predicted observations, which is equal to the `n.predict` argument passed to the `arima.rob` function that produced the `"arima.rob"` object.
`tauef`	the inverse of the estimated efficiency factor of the tau-estimate with respect to the LS-estimate.
`inf`	information about the outcome of the last optimization procedure: `inf=1` indicates that the procedure converged, and `inf=0` that the procedure did not converge.
`innov.outlier`	logical flag, the same as the `innov.outlier` argument passed to the `arima.rob` function that produced the `"arima.rob"` object.
`outliers`	an object of class `"outliers"`, which contains all the detected outliers (and level shifts).
`outliers.iter`	optionally a list of objects of class `"outliers"`, if the `iter` argument passed to the `arima.rob` function that produced the `"arima.rob"` object is non-zero.
`n0`	the number of missing innovations at the beginning.
`call`	an image of the call that produced the object, but with the arguments all named and with the actual formula included as the `formula` argument.
`assign`	the same as the `assign` component of an `"lm"` object.
`contrasts`	the same as the `contrasts` component of an `"lm"` object.
`terms`	the same as the `terms` component of an `"lm"` object.
`rank`	the same as the `rank` component of an `"lm"` object.

Generation

This class of objects is returned from the `arima.rob` function.

Methods

`coef`, `formula`, `outliers`, `predict`, `print`, `summary`.

See Also

`arima.rob`, `outliers`, `outliers.object`.

coef.arima.rob *Use coef on an arima.rob Object*

Description

This is a method for the function `coef()` for objects inheriting from class `"arima.rob"`. See `coef` or `coef.default` for the general behavior of this function and for the interpretation of object.

Usage

```
## S3 method for class 'arima.rob'
coef(object, ...)
```

Arguments

`object`	an object of class `"arima.rob"`.
`...`	extra arguments passed to or from other methods. The coef method here ignore these arguments.

frip.dat *Monthly Industrial Production of France*

Description

A `"timeSeries"` vector containing the monthly industrial production of France from January 1960 to December 1989.

Usage

```
frip.dat
```

Format

A `"timeSeries"` vector

import.dat — *Monthly Imports and Import Taxes of Argentina*

Description

The `import.dat` data frame has 96 rows and 2 columns. The sample runs from January 1983 to December 1990.

Usage

```
import.dat
```

Format

A data frame with 96 observations and 2 columns:

taxes monthly import taxes of Argentina.

import monthly imports of Argentina.

newtaxes.dat — *Monthly Import Taxes of Argentina*

Description

The `newtaxes.dat` data frame has 10 rows and 1 column. The sample runs from January to October 1992.

Usage

```
newtaxes.dat
```

Format

A data frame with 10 rows and 1 column:

taxes monthly import taxes of Argentina.

outliers — *Outliers Extraction for an <code>arima.rob</code> Object*

Description

Returns an object of class "outliers".

Usage

```
outliers(object, iter=NULL)
```

Arguments

object	an object of class "arima.rob".
iter	a number specifying from which iteration to extract the detected outliers, if the iter argument passed to the function arima.rob that produced object is non-zero. The default is set to NULL.

Value

an object of class "outliers". If iter is NULL, the object contains all the detected outliers (and level shifts). If iter is not NULL, the object contains the outliers (and level shifts) detected in iteration iter. See outliers.object for components of the returned object.

See Also

outliers.object, arima.rob, arima.rob.object.

Examples

```
frip.rr <- arima.rob(log(frip.dat) ~ 1, p=2, d=1, iter=2)
frip.outliers.all <- outliers(frip.rr)
frip.outliers.2 <- outliers(frip.rr, iter=2)
```

outliers.object — *Outliers Objects Extracted from <code>arima.rob</code> Objects*

Description

These are objects of class "outliers" extracted an object of class "arima.rob", which contain information about the detected outliers (and level shifts).

Arguments

The following components must be included in a legitimate "outliers" object:

nout — the number of outliers (and level shifts) detected.

`outlier.index` the index of each detected outlier (or level shift).

`outlier.type` the type of each detected outlier (or level shift): 1=innovation outlier, 2=additive outlier, 3=level shift.

`outlier.impact` the size of each detected outlier (or level shift).

`outlier.t.statistics` the t-statistics for each detected outlier (or level shift).

`outlier.positions` the "timeDate" objects associated with the detected outliers if the original data is a "timeSeries" object.

`sigma0` the estimate of the innovation scale before correcting the outliers.

`sigma` the estimate of the innovation scale after correcting the outliers.

`ierror` the error indicator: if `ierror > 0` the search for outliers was stopped, the algorithm detected too many outliers.

Generation

This class of objects is returned from the `outliers` function.

Methods

`print`, `summary`.

See Also

`outliers` `arima.rob`, `arima.rob.object`.

---

predict.arima.rob *Use predict on an arima.rob Object*

Description

Predicts from a fitted "arima.rob" object.

Usage

```
## S3 method for class 'arima.rob'
predict(object, n.predict=1, newdata=NULL,
                  olddata=NULL, se.fit=FALSE, ...)
```

Arguments

`object`	an object of class `"arima.rob"`.
`n.predict`	the number of predictions to be returned.
`newdata`	a data frame containing the future values of exogenous variables, if any, at which predictions are required.
`olddata`	a data frame containing the original data used to fit `object`. This is only required if `tslag` is used to create distributed lags of exogenous variables in the original call that generated `object`.
`se.fit`	logical flag: if `TRUE`, pointwise standard errors are computed along with the predictions.
`...`	extra arguments passed to or from other methods. The predict method here ignore these arguments.

Details

This function is a method for the generic function `predict` for class `"arima.rob"`. It can be invoked by calling `predict` for an object of the appropriate class, or directly by calling `predict.arima.rob` regardless of the class of the object.

Value

a list containing the following components:

`values`	the predicted values.
`std.err`	the pointwise standard errors for the predictions (if `se.fit=TRUE`).

See Also

`arima.rob`

Examples

```
import.rr <- arima.rob(import ~ taxes-1, data=import.dat, p=2, d=1)
import.hat <- predict(import.rr, 5, newdata=newtaxes.dat, se=TRUE)
```

`print.arima.rob` *Use print on an arima.rob Object*

Description

This is a method for the function `print()` for objects inheriting from class `"arima.rob"`. See `print` or `print.default` for the general behavior of this function and for the interpretation of `x`.

Usage

```
## S3 method for class 'arima.rob'
print(x, digits = 4, ...)
```

Arguments

`x`	an object of class `"arima.rob"`.
`digits`	the number of digits to display.
`...`	extra arguments passed to or from other methods.

See Also

`print`.

`print.outliers` *Use print on an outliers Object*

Description

This is a method for the function `print` for objects inheriting from class `"outliers"`. See `print` or `print.default` for the general behavior of this function and for the interpretation of `x`.

Usage

```
## S3 method for class 'outliers'
print(x, digits = 4, ...)
```

Arguments

`x`	an object of class `"outliers"`.
`digits`	the number of digits to display.
`...`	extra arguments passed to or from other methods.

See Also

`outliers`, `print`.

`print.summary.arima.rob`
Use print on a summary.arima.rob Object

Description

This is a method for the function `print` for objects inheriting from class `"summary.arima.rob"`. See `print` or `print.default` for the general behavior of this function and for the interpretation of `x`.

Usage

```
## S3 method for class 'summary.arima.rob'
print(x, digits = 4, ...)
```

Arguments

x	an object of class "summary.arima.rob".
digits	the number of digits to display.
...	extra arguments passed to or from other methods.

See Also

print summary.arima.rob.

---

print.summary.outliers

Use print on a summary.outliers Object

Description

This is a method for the function print() for objects inheriting from class "summary.outliers". See print or print.default for the general behavior of this function and for the interpretation of x.

Usage

```
## S3 method for class 'summary.outliers'
print(x, digits = 4, ...)
```

Arguments

x	an object of class "summary.outliers".
digits	the number of digits to display.
...	extra arguments passed to or from other methods.

See Also

print, summary.outliers.

summary.arima.rob — *Summary Method for arima.rob Objects*

Description

Returns a summary list for an "arima.rob" object.

Usage

```
## S3 method for class 'arima.rob'
summary(object, correlation = FALSE, ...)
```

Arguments

`object`	an object of class "arima.rob".
`correlation`	a logical flag: if `TRUE`, correlation matrices of regression coefficients and ARIMA coefficients are also produced. The default is `FALSE`.
`...`	extra arguments passed to or from other methods. The summary method here ignore these arguments.

Details

This function is a method for the generic function `summary` for class "arima.rob". It can be invoked by calling `summary` for an object of the appropriate class, or directly by calling `summary.arima.rob` regardless of the class of the object.

Value

an object of class "summary.arima.rob" which must contain the following components:

`ARIMA.model`	the same list as the `model` component of `object`. See `arima.rob.object` for details.
`reg.coef`	a matrix with four columns, containing the regression coefficients, their standard errors, the t-statistics and the corresponding p-values.
`regcoef.cov`	the estimated covariance matrix for the regression coefficients.
`regcoef.corr`	the estimated correlation matrix for the regression coefficients. This is only present if `corr=T`.
`AR.coef`	a matrix with four columns, containing the AR coefficients, their standard errors, the t-statistics and the p-values.
`MA.coef`	a matrix with four columns, containing the MA coefficients, their standard errors, the t-statistics and the p-values.
`sMA.coef`	an array which contains the seasonal moving average parameter, its standard error, the t-statistic and the p-value.
`ARIMA.cov`	the estimated covariance matrix of the ARMA coefficients.

ARIMA.corr	the estimated correlation matrix of the ARMA coefficients. This is only present if corr=T.
n	the length of the time series.
df	the number of degrees of freedom for the model.
sigma	the estimate of the innovations scale.
call	the image of the original call to arima.rob.
outliers	an object of class "summary.outliers".

See Also

arima.rob, arima.rob.object, summary.

Examples

```
frip.rr <- arima.rob(log(frip.dat) ~ 1, p=2, d=1)
summary(frip.rr)
```

---

summary.outliers *Summary Method for outliers Objects*

Description

Returns an object of class "summary.outliers" containing a summary list for an "outliers" object. A null value will be returned if printing is invoked.

Usage

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

Arguments

object	an object of class "outliers".
...	extra arguments passed to or from other methods. The summary method here ignore these arguments.

Details

This function is a method for the generic function summary for class "outliers". It can be invoked by calling summary for an object of the appropriate class, or directly by calling summary.outliers regardless of the class of the object.

Value

a list is returned with the following components:

nout	number of outliers (and level shifts) detected.
outliers.table	the index (or "timeDate" information if the argument data passed to arima.rob is of class "timeSeries"), type, impact and t value for each of the detected outlier (or level shift).
sigma0	the estimate of the innovation scale before correcting outliers.
sigma	the estimate of the innovation scale after correcting outliers.

See Also

outliers, outliers.object, summary.

Examples

```
frip.rr <- arima.rob(log(frip.dat) ~ 1, p=2, d=1)
frip.outliers <- outliers(frip.rr)
summary(frip.outliers)
```

---

vcov.arima.rob *Use <code>vcov()</code> on an <code>arima.rob</code> Model Object*

Description

This is a method for the function vcov() for objects inheriting from class "arima.rob". See vcov for the general behavior of this function and for the interpretation of object.

Usage

```
## S3 method for class 'arima.rob'
vcov(object, nterm=1000, ...)
```

Arguments

object	an object inheriting from class "arima.rob".
nterm	an interger specifying the number of terms.
...	extra arguments passed to or from other methods. The method here ignore these arguments.

Value

the variance-covariance matrix of fitted arima.rob model returned from a call arima.rob.

See Also

arima.rob.object, vcov.

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