`fit.partsm` *fit.partsm Class*

Description

This class contains information on the autoregressive or periodic autoregressive parameters estimated by `fit.ar.par`.

Slots

`type`: Object of class `"character"`: The type of the fitted model, an autoregressive model, `"AR"`, or a periodic autoregressive model, `"PAR"`.

`p`: Object of class `"numeric"`: The lag order parameter of the model.

`lm.ar`: Object of class `"ANY"`: The summary of a fitted AR model. When an AR type model is selected, it is of class `"lm"`, otherwise the slot is empty.

`lm.par`: Object of class `"ANY"`: The summary of a fitted PAR model. When a PAR type model is selected, it is of class `"lm"`, otherwise the slot is empty.

`ar.coeffs`: Object of class `"ANY"`: The autoregressive parameters estimates. When a PAR type model is selected, it is of class `"matrix"`, otherwise the slot is empty.

`par.coeffs`: Object of class `"ANY"`: The periodic autoregressive parameters estimates. When a PAR type model is selected, it is of class `"matrix"`, otherwise the slot is empty.

Methods

`show`: This method reports the autoregressive or periodic autoregressive estimates, depending whether the model is an AR model or a PAR model.

`summary`: In addition to the information reported by `show`, a summary of the fitted model is also added.

Author(s)

Javier López-de-Lacalle ⟨javlacalle@yahoo.es⟩.

References

P.H. Franses: Periodicity and Stochastic Trends in Economic Time Series (Oxford University Press, 1996).

See Also

`fit.ar.par`.

`fit.piartsm` *fit.piartsm Class*

Description

This class contains information on the periodic autoregressive parameters estimated by `fit.piar`.

Slots

`p`: Object of class `"numeric"`: The order of the PIAR model.

`nls.parameters`: Object of class `"matrix"`: Estimated coefficicents of the non-linear PIAR model.

`nls.res`: Object of class `"numeric"`: Residuals of the non-linear PIAR model.

`par.coeffs`: Object of class `"matrix"`: Periodic autoregressive parameters estimates.

`pdiff.data`: Object of class `"ts"`: Periodically differenced data.

Methods

`show`: Reports the periodic autoregressive coefficients estimates.

`summary`: Like show, the periodically differenced data are also displayed.

`plot`: Plot the the periodically differenced data, as well as the seasonal paths of the transformed data.

Author(s)

Javier López-de-Lacalle ⟨javlacalle@yahoo.es⟩.

References

P.H. Franses: Periodicity and Stochastic Trends in Economic Time Series (Oxford University Press, 1996).

See Also

`fit.piar`.

`LRur.partsm` *LRur.partsm Class*

Description

This class contains the information provided by `LRurpar.test`.

Slots

`test.label:` Object of class `"character"`: A label to identify the test.

`test.name:` Object of class `"character"`: A one-line descriptio of the test.

`p:` Object of class `"numeric"`: The lag order parameter of the model.

`LR:` Object of class `"numeric"`: The LR statistic.

`LRtau:` Object of class `"numeric"`: The one side test statistic.

`h0nls:` Object of class `"matrix"`: The estimated coefficients of the non-linear PIAR model.

`halm:` Object of class `"lm"`: The estimated PAR model for the alternative hypotheses.

Methods

`show:` Shows the LR statistics and a one-side test constructed as $sign(g(\hat{\alpha}) - 1) * LR^{1/2}$, where $g(\hat{\alpha})$ is the product of the periodic differencing filter parameters estimated under the alternative.

`summary:` Displays the same output as `show` but a summary of the null and the alternative hypotheses is also displayed.

Author(s)

Javier López-de-Lacalle ⟨javlacalle@yahoo.es⟩.

References

P.H. Franses: Periodicity and Stochastic Trends in Economic Time Series (Oxford University Press, 1996).

See Also

`LRurpar.test`.

`Ftest.partsm` *Ftest.partsm Class*

Description

This class contains the information provided by the F-tests available in the package `'partsm'`.

Slots

`test.label:` Object of class `"character"`: A label to identify the test that the information is related to.

`test.name:` Object of class `"character"`: A one-line description of the test.

`p:` Object of class `"numeric"`: The order of the AR or PAR model.

`Fstat:` Object of class `"numeric"`: The F-statistic.

`df:` Object of class `"numeric"`: The freedom degrees.

`pval:` Object of class `"numeric"`: The p-value.

`pvl:` Object of class `"character"`: A symbol indicating the significance of the F-statistic according to usual codes, *i.e.* Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1.

`h0md:` Object of class `"lm"`: The summary of the model fitted for the null hypothesis.

`hamd:` Object of class `"ANY"`: The summary of the model fitted for the alternative hypothesis.

Methods

`show:` This method reports the F-test statistic, the null and the alternative hypotheses entailed in the procedure, as well as the freedom degrees, the p-value and the codified p-value.

`summary:` In addition to the information reported by `show`, a summary of the fitted models for the null and the alternative hypotheses is also added.

Author(s)

Javier López-de-Lacalle ⟨javlacalle@yahoo.es⟩.

References

P.H. Franses: Periodicity and Stochastic Trends in Economic Time Series (Oxford University Press, 1996).

See Also

`Fnextp.test`, `Fpar.test`, `Fsh.test`, and `Fpari.piar.test`.

`pred.piartsm` *pred.piartsm Class*

Description

This class contains the information provided by `predictpiar`.

Slots

`wts:` Object of class `"wts"`: The observed time series.

`hpred:` Object of class `"numeric"`: The number of forecasts.

`p:` Object of class `"numeric"`: The lag order parameter of the PIAR model.

`fcast:` Object of class `"ts"`: The out-of-sample forescasts.

`fse:` Object of class `"ts"`: The forecast standard errors.

`ucb:` Object of class `"ts"`: The upper 95 per cent confidence bound.

`lcb:` Object of class `"ts"`: The lower 95 per cent confidence bound.

Methods

`show:` Shows out-of-sample forecasts and the corresponding standard errors, as well as the 95 per cent confidence intervals.

Author(s)

Javier López-de-Lacalle ⟨javlacalle@yahoo.es⟩.

References

P.H. Franses: Periodicity and Stochastic Trends in Economic Time Series (Oxford University Press, 1996).

See Also

`predictpiar`.

Description

This method shows the information provided by functions implemented in package 'partsm'.

Methods

object = "fit.partsm". Shows the estimates of the autoregressive or periodic autoregressive coefficients.

object = "Ftest.partsm". Shows the F-test statistic, the null and the alternative hypotheses entailed in the procedure, as well as the freedom degrees, the p-value and a symbol indicating the significance of the F-statistic according to usual codes, *i.e.* Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1.

object = "fit.piartsm". Shows the estimated periodic autoregressive coefficients in the restricted non-linear PIAR.

object = "LRur.partsm". Shows the LR statistics and a one-side test constructed as $sign(g(\hat{\alpha}) - 1) * LR^{1/2}$, where $g(\hat{\alpha})$ is the product of the periodic differencing filter parameters estimated under the alternative.

object = "pred.piartsm". Shows out-of-sample forecasts and the corresponding standard errors, as well as the 95 per cent confidence intervals.

Author(s)

Javier López-de-Lacalle ⟨javlacalle@yahoo.es⟩.

See Also

`fit.partsm-class`, `Ftest.partsm-class`, and `summary`.

Examples

```
## Load data and select the deterministic components.
data("gergnp")
lgergnp <- log(gergnp, base=exp(1))
detcomp <- list(regular=c(0,0,0), seasonal=c(1,0), regvar=0)

## Fit an AR(4) model with intercept and seasonal dummies.
dcar <- list(regular=c(1,0,c(1,2,3)), seasonal=c(0,0), regvar=0)
out.ar <- fit.ar.par(wts=lgergnp, type="AR", detcomp=dcar, p=4)
show(out.ar)

## Fit a PAR(2) model with seasonal intercepts.
out.par <- fit.ar.par(wts=lgergnp, type="PAR", detcomp=detcomp, p=2)
show(out.par)

## Fnextp.test
```

```
Fnextp.out <- Fnextp.test(wts=lgergnp, detcomp=detcomp, p=1, type="PAR")
show(Fnextp.out)

## Fpar.test
Fpar.out <- Fpar.test(wts=lgergnp, detcomp=detcomp, p=2)
show(Fpar.out)

## Fsh.test
ar4 <- fit.ar.par(wts=lgergnp, type="AR", p=4, detcomp=detcomp)
Fsh.out <- Fsh.test(res=residuals(ar4@lm.ar), s=frequency(lgergnp))
show(Fsh.out)

## Fit a PIAR(2) model with seasonal intercepts.
out.piar <- fit.piar(wts=lgergnp, detcomp=detcomp, p=2)
show(out.piar)

## Fpari.piar.test
Fpari1.out <- Fpari.piar.test(wts=lgergnp, detcomp=detcomp, p=2, type="PARI1")
show(Fpari1.out)

## Fit a PIAR(2) model with seasonal intercepts.
out.piar <- fit.piar(wts=lgergnp, detcomp=detcomp, p=2)
show(out.piar)

## Test for a single unit root in a PAR(2) model with seasonal intercepts.
out.LR <- LRurpar.test(wts=lgergnp, detcomp=detcomp, p=2)
show(out.LR)

## 24 step-ahead forecasts in a PIAR(2) model.
pred.out <- predictpiar(wts=lgergnp, p=2, hpred=24)
show(pred.out)
```

`summary-methods` *Methods for Function 'summary' in Package 'partsm'*

Description

This method summarises the information provided by functions implemented in package 'partsm'.

Methods

object = "fit.partsm". Displays the estimates of the autoregressive or periodic autoregressive coefficients, and a summary of the fitted model is also added.

object = "Ftest.partsm". Shows a summary of the information provided by the F-test statistics in package 'partsm'. The null and the alternative hypotheses entailed in the procedure, as well as the freedom degrees, the p-value and a symbol indicating the significance of the F-statistic according to usual codes, *i.e.* Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1.

In addition, a summary of the fitted models for the null and the alternative hypotheses is also added.

object = "fit.piartsm". Displays the estimated periodic autoregressive coefficients in the restricted non-linear PIAR, the other coefficients entailed in the selected model, and the periodically differenced data.

object = "fit.LRur.partsm". Reports the the LR statistics and a one-side test, and a summary of the fitted models under the null and the alternative hypotheses.

Author(s)

Javier López-de-Lacalle ⟨javlacalle@yahoo.es⟩.

See Also

`fit.partsm-class`, `Ftest.partsm-class`, and `show`.

Examples

```
## Load data and select the deterministic components.
data("gergnp")
lgergnp <- log(gergnp, base=exp(1))
detcomp <- list(regular=c(0,0,0), seasonal=c(1,0), regvar=0)

## Fit an AR(4) model with intercept and seasonal dummies.
dcar <- list(regular=c(1,0,c(1,2,3)), seasonal=c(0,0), regvar=0)
out.ar <- fit.ar.par(wts=lgergnp, type="AR", detcomp=dcar, p=4)
summary(out.ar)

## Fit a PAR(2) model with seasonal intercepts.
detcomp <- list(regular=c(0,0,0), seasonal=c(1,0), regvar=0)
out.par <- fit.ar.par(wts=lgergnp, type="PAR", detcomp=detcomp, p=2)
summary(out.par)

## Fnextp.test
Fnextp.out <- Fnextp.test(wts=lgergnp, detcomp=detcomp, p=1, type="PAR")
summary(Fnextp.out)

## Fpar.test
Fpar.out <- Fpar.test(wts=lgergnp, detcomp=detcomp, p=2)
summary(Fpar.out)

## Fsh.test
ar4 <- fit.ar.par(wts=lgergnp, type="AR", p=4, detcomp=detcomp)
Fsh.out <- Fsh.test(res=residuals(ar4@lm.ar), s=frequency(lgergnp))
summary(Fsh.out)

## Fit a PIAR(2) model.
out.piar <- fit.piar(wts=lgergnp, detcomp=detcomp, p=2)
summary(out.piar)

## Fpari.piar.test
Fpari1.out <- Fpari.piar.test(wts=lgergnp, detcomp=detcomp, p=2, type="PARI1")
```

```
summary(Fpari1.out)

## Fit a PIAR(2) model with seasonal intercepts.
out.piar <- fit.piar(wts=lgergnp, detcomp=detcomp, p=2)
summary(out.piar)

## Test for a single unit root in a PAR(2) model with seasonal intercepts.
out.LR <- LRurpar.test(wts=lgergnp, detcomp=detcomp, p=2)
summary(out.LR)
```

`PAR.MVrepr-methods` *Method for Building the Matrices for the Multivariate Representation of a PAR Model*

Description

This method provides the relevant matrices for the multivariate representation of a PAR or PIAR model fitted by the functions `fit.ar.par`, and `fit.piar`.

Details

In a quarterly time series, the periodic autoregressive model of order p less or equal to 4,

$$y_t = \psi_s + \phi_{1s} y_{t-1} + \phi_{2s} y_{t-2} + ... + \phi_{ps} y_{t-p} + \epsilon_t,$$

with $s = 1, 2, 3, 4$, can be written as a multivariate model as follows,

$$\Phi_0 y_t = \Psi + \Phi_1 Y_{T-1} + \epsilon_T,$$

where Φ_0 and Φ_1 are $S \times S$ matrices containing the $\phi_{is} parameters$.

$\Phi_0 =$

$$\begin{array}{cccc} 1 & 0 & 0 & 0 \\ -\phi_{12} & 1 & 0 & 0 \\ -\phi_{23} & -\phi_{13} & 1 & 0 \\ -\phi_{34} & -\phi_{24} & -\phi_{14} & 1 \end{array}$$

$\Phi_1 =$

$$\begin{array}{cccc} \phi_{41} & \phi_{31} & \phi_{21} & \phi_{11} \\ 0 & \phi_{42} & \phi_{32} & \phi_{22} \\ 0 & 0 & \phi_{43} & \phi_{33} \\ 0 & 0 & 0 & \phi_{44} \end{array}$$

The periodically integrated model of order 2,

$$y_t - \alpha_s y_{t-1} = \mu_s + \beta_s(y_{t-1} - \alpha_{s-1} y_{t-2}) + \epsilon_t,$$

with $s = 1, 2, 3, 4$, can be written as a multivariate model as follows,

$$\Phi_0 y_t = \Psi + \Phi_1 Y_{T-1} + \epsilon_T,$$

where the matrix Φ_0 and Φ_1 are defined below

$\Phi_0 =$

$$\begin{array}{cccc} 1 & 0 & 0 & 0 \\ -\alpha_2 & 1 & 0 & 0 \\ 0 & -\alpha_3 & 1 & 0 \\ 0 & 0 & -\alpha_4 & 1 \end{array}$$

$\Phi_1 =$

$$\begin{array}{cccc} 0 & 0 & 0 & \alpha_1 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{array}$$

The Φ_0 and Φ_1 matrices can be used to compute the impact of accumulation of the shocks ϵ_t. The impact matrix is defined as $\Gamma\Phi_0^{-1}$, where Γ is $\Phi_0^{-1}\Phi_0$.

That row in which the values of the impact matrix are the highest, entails that the corresponding season undergoes more severe impacts from the accumulation of all shocks. Hence, it is more likely to display fluctuations in the stochastic trend. Put in other words, the impact matrix allow the practitioner to get an idea about how the stochastic trend and the seasonal fluctuations are related.

Methods

object = "fit.partsm". Provides a list object containing the estimated matrices $Phi0$, $Phi1$, the eigen values of $Phi0^{-1}\% * \%Phi1$, and the time-varing impact of accumulation of shocks calculated as $Phi0^{-1}\% * \%Phi1\% * \%Phi0^{-1}$. See details below.

object = "fit.piartsm". Provides the same list as in the latter case. See details below.

Author(s)

Javier López-de-Lacalle ⟨javlacalle@yahoo.es⟩.

See Also

`fit.partsm-class`, and `fit.piartsm-class`.

Examples

```
## Load data and select the deterministic components.
data("gergnp")
lgergnp <- log(gergnp, base=exp(1))
detcomp <- list(regular=c(0,0,0), seasonal=c(1,0), regvar=0)

## Multivariate representation of a PAR(2) model with sesonal intercepts.
out.par <- fit.ar.par(wts=lgergnp, type="PAR", detcomp=detcomp, p=2)
PAR.MVrepr(out.par)

## Multivariate representation of a PIAR(2) model with sesonal intercepts.
out.piar <- fit.piar(wts=lgergnp, detcomp=detcomp, p=2)
PAR.MVrepr(out.piar)
```

`acf.ext1` *Autocorrelation function for several transformations of the original data*

Description

This function is based on the acf function and extends it by allowing for some transformations of the data before computing the autocovariance or autocorrelation function.

Usage

```
acf.ext1 (wts, transf.type, perdiff.coeffs, type, lag.max, showcat, plot)
```

Arguments

`wts`	a univariate time series object.
`transf.type`	a character string indicating what transformation should be applied to the data. Allowed values are ”orig”, ”fdiff”, ”sdiff”, ”fsdiff”, ”fdiffsd”, ”perdiff”, and ””perdiffsd. See details.
`perdiff.coeffs`	a vector with the estimates coefficients for the periodic difference filter. This argument is only required when the periodic difference transformation must be applied to the data. See details.
`type`	a character string giving the type of acf to be computed. Allowed values are ”correlation”, ”covariance” or ”partial”.
`lag.max`	maximum number of lags at which to calculate the acf.
`showcat`	a logical. If TRUE, the results are printed in detail. If FALSE, the results are stored as a list object.
`plot`	a logical. If TRUE, a plot of the acf is showed.

Details

The implemented transformations are the following:

- "orig": Original series.
- "fdiff": First differences of the original series.
- "sdiff": Seasonal differences of the original series.
- "fsdiff": Fisrt and seasonal differences of the original series.
- "fdiffsd": Residuals of the first differences on four seasonal dummy variables.
- "perdiff": Periodic differences of the original series.
- "perdiffsd": Residuals of the periodic differences on four seasonal dummy variables.

Value

Lags at which the acf is computed, estimates of the acf, and p-values for the significance of the acf at each lag.

Author(s)

Javier López-de-Lacalle ⟨javlacalle@yahoo.es⟩.

See Also

`acf`.

Examples

```
## Logarithms of the Real GNP in Germany
data("gergnp")
lgergnp <- log(gergnp, base=exp(1))

out <- acf.ext1(wts=lgergnp, transf.type="orig",
                type="correlation", lag.max=12, showcat=TRUE, plot=FALSE)

out <- acf.ext1(wts=lgergnp, transf.type="perdiffsd", perdiff.coeff = c(1.004, 0.981, 1.047, 0.969)
                type="correlation", lag.max=12, showcat=TRUE, plot=FALSE)
```

`fit.ar.par` *Fit an Autoregressive or Periodic Autoregressive Model*

Description

This function fits either an autoregressive (AR) or a periodic autoregressive (PAR) model and extract the estimates for the autoregressive or periodic autoregressive coefficients.

Usage

```
fit.ar.par (wts, type, detcomp, p)
```

Arguments

`wts`	a univariate time series object.
`type`	A character string indicating whether the model to fit is an autoregressive model, `"AR"`, or a periodic autoregressive model, `"PAR"`.
`detcomp`	deterministic components to include in the model. Three types of regressors can be included: regular deterministic components, seasonal deterministic components, and any regressor variable previously defined by the user. This argument must be a list object with the following elements: `regular=c(0,0,0)`, if the first and second element are set equal to 1, it indicates that an intercept, and/or linear trend, respectively, are included. The third element in `regular` is a vector indicating which seasonal dummies should be included. If no seasonal dummies are desired it must be set equal to zero. For example, `regular=c(1,0,c(1,2,3))` would include an intercept, no trend, and the first three seasonal dummies; `seasonal=c(0,0)`, if an element is set equal to 1, it indicates that seasonal intercepts, and/or seasonal trends, respectively, are included in the model; `regvar=0`, if none regressor variables are considered, this object must be set equal to zero, otherwise, the names of a matrix object previously defined should be indicated.
`p`	the lag order of the model.

Details

If `type` is `"AR"` the following model is estimated by ordinary least squares:

$$y_t = \phi_1 y_{t-1} + \phi_2 y_{t-2} + ... + \phi_p y_{t-p} + \epsilon_t.$$

If `type` is `"PAR"`, the following model is estimated by ordinary least squares:

$$y_t = \alpha_{1s} y_{t-1} + \alpha_{2s} y_{t-2} + ... + \alpha_{ps} y_{t-p} + \epsilon_t,$$

for $s = 1, ..., S$, where `S` is the periodicity of the time series.
Deterministic components can be added to models above. Be careful when defining the `detcomp` argument. To include an intercept and seasonal intercepts, or a regular trend with seasonal trends, will cause multicollinearity problems.

Value

A `fit.partsm-class` class object reporting the estimates of the autoregressive or periodic autoregressive coefficients. See `fit.partsm-class` to check further information available from this class via the methods `show` and `summary`.

Author(s)

Javier López-de-Lacalle ⟨javlacalle@yahoo.es⟩.

References

P.H. Franses: Periodicity and Stochastic Trends in Economic Time Series (Oxford University Press, 1996).

See Also

`fit.piartsm-class`, `fit.partsm-class`, and `PAR.MVrepr-methods`.

Examples

```
## Models for the the logarithms of the Real GNP in Germany.
data("gergnp")
lgergnp <- log(gergnp, base=exp(1))

## Fit an AR(4) model with intercept and seasonal dummies.
detcomp <- list(regular=c(1,0,c(1,2,3)), seasonal=c(0,0), regvar=0)
out.ar <- fit.ar.par(wts=lgergnp, type="AR", detcomp=detcomp, p=4)

## Fit a PAR(2) model with seasonal intercepts.
detcomp <- list(regular=c(0,0,0), seasonal=c(1,0), regvar=0)
out.par <- fit.ar.par(wts=lgergnp, type="PAR", detcomp=detcomp, p=2)
```

`fit.piar` *Fit a Periodically Integrated Autoregressive Model.*

Description

Fit a periodically integrated periodic autoregressive model.

Usage

```
fit.piar (wts, detcomp, p, initvalues=NULL)
```

Arguments

`wts`	a univariate time series object.
`detcomp`	a vector indicating the deterministic components included in the auxiliar regression. See the corresponding item in `fit.ar.par`.
`p`	the order of the PAR model. In this version first and second order are considered.
`initvalues`	by default, initial values are computed for the non-linear modeal. However, in this version there may be cases in which the estimates do not converge, giving an error message. In this case, a numeric vector with initial values guessed by the user can be included.

Details

The following equation is estimated by non-linear least squares

$$y_t = \alpha_s y_{t-1} + \beta_s(y_{t-1} - \alpha_{s-1} y_{t-2}) + \epsilon_t,$$

under the restriction $\Pi_{i=1}^{S} \alpha_i = 1$ for $s = 1, ..., S$, where S denotes the number of seasons. Regressors defined in `detcomp` can also be included. Obviously, for a first order PIAR process β parameters are equal to zero.

Value

An object of class `fit.piartsm-class` containing the estimated coefficients in the restricted non-linear model, the residuals, and the periodic autoregressive coefficients. On the basis of the estimated *alpha* parameters, the periodically differenced data are also computed. See `fit.piartsm-class` for methods that display this information.

Author(s)

Javier López-de-Lacalle ⟨javlacalle@yahoo.es⟩.

References

P.H. Franses: Periodicity and Stochastic Trends in Economic Time Series (Oxford University Press, 1996).

See Also

`nls`, `fit.ar.par`, and `fit.piartsm-class`.

Examples

```
## Fit a PIAR(2) model for the logarithms of the Real GNP in Germany.
data("gergnp")
lgergnp <- log(gergnp, base=exp(1))
detcomp <- list(regular=c(0,0,0), seasonal=c(1,0), regvar=0)
out <- fit.piar(wts=lgergnp, detcomp=detcomp, p=2, initvalues=NULL)
```

`Fnextp.test` *Test for the Significance of the p+1 Autoregressive Parameters in an AR(p) or PAR(p) Model*

Description

Test for the significance of prospective autoregressive parameters of order $p+1$ in an AR(p) or PAR(p) model. It is performed as an F-statistic that sets the parameters of order $p+1$ equal to zero.

Usage

```
Fnextp.test (wts, detcomp, p, type)
```

Arguments

`wts`	a univariate time series object.
`detcomp`	a vector indicating the deterministic components included in the auxiliar regression. See the corresponding item in `fit.ar.par`.
`p`	the order of the initial AR or PAR model.
`type`	a character string indicating whether the model to fit is an autoregressive model, `"AR"`, or a periodic autoregressive model, `"PAR"`.

Value

An object of class `Ftest.partsm-class` containing the F-test statistic, the freedom degrees an the corresponding p-value.

Author(s)

Javier López-de-Lacalle ⟨javlacalle@yahoo.es⟩.

References

P.H. Franses: Periodicity and Stochastic Trends in Economic Time Series (Oxford University Press, 1996).

See Also

`fit.ar.par`, and `Ftest.partsm-class`.

Examples

```
## Test the significance of a second order lag in a PAR model for the Real GNP in Germany.
## Including seasonal intercepts.
data("gergnp")
lgergnp <- log(gergnp, base=exp(1))
detcomp <- list(regular=c(0,0,0), seasonal=c(1,0), regvar=0)
out <- Fnextp.test(wts=lgergnp, detcomp=detcomp, p=1, type="PAR")
```

Description

Test for periodic variation in the autoregressive parameters.

Usage

```
Fpar.test (wts, detcomp, p)
```

Arguments

`wts`	a univariate time series object.
`detcomp`	a vector indicating the deterministic components included in the auxiliar regression. See the corresponding item in `fit.ar.par`.
`p`	the order of the initial AR or PAR model.

Details

An F-test based on the residual sum of squares is performed to test for periodic variation in the autoregressive parameters.

On the basis of the following model,

$$y_t = \phi_{1s} y_{t-1} + ... + \phi_{ps} y_{t-p} + \epsilon_t,$$

for $s = 1, ..., S$, where `S` is the periodicity of the time series,

the null-hypothesis is non-periodicity: $\phi_{is} = \phi_i$, for $s = 1, ..., S$ and $i = 1, 2, ..., p$. When the null hypothesis is imposed an AR(p) is estimated, whereas the alternative is a PAR(p) model.

The F-statistic when four seasonal intercepts are included follows an F((S-1)*p, n-(S+S*p)) distribution, where `S` is the periodicity of the series and `n` the number of observations.

Value

An object of class `Ftest.partsm-class` containing the F-test statistic, the freedom degrees an the corresponding p-value.

Author(s)

Javier López-de-Lacalle ⟨javlacalle@yahoo.es⟩.

See Also

`fit.ar.par`, and `Ftest.partsm-class`.

Examples

```
## Test for periodicity in a second order PAR model for
## the logarithms of the Real GNP in Germany time series.
data("gergnp")
lgergnp <- log(gergnp, base=exp(1))
detcomp <- list(regular=c(0,0,0), seasonal=c(1,0), regvar=0)
out <- Fpar.test(wts=lgergnp, detcomp=detcomp, p=2)
```

`Fsh.test` *Test for Seasonal Heteroskedasticity*

Description

Test for seasonal heteroskedasticity.

Usage

```
Fsh.test (res, s)
```

Arguments

`res`	a vector containing the data to be tested.
`s`	the periodicity of the data.

Details

On the basis of the following model,

$$x_t^2 = \omega_0 + \omega_1 D_{1,t} + ... + \omega_{S-1} D_{S-1,t} + \epsilon_t,$$

where `S` is the periodicity of the data, the null hypothesis of

the null-hypothesis $\omega_i = 0$, for $i = 1, ..., S-1$ is tested.

The F-statistic follows an F((S-1), n-k) distribution, where `n` is the number of observations and `k` the number of parameters.

Value

An object of class `Ftest.partsm-class` containing the F-test statistic, the freedom degrees an the corresponding p-value.

Author(s)

Javier López-de-Lacalle ⟨javlacalle@yahoo.es⟩.

See Also

`Ftest.partsm-class`.

Examples

```
## Fsh test for the residuals of the first differences
## of the logarithms of the Real GNP in Germany
## on an AR(4) model with seasonal intercepts.
data("gergnp")
lgergnp <- log(gergnp, base=exp(1))
wts <- ts(c(NA, diff(gergnp, lag=1)), frequency=4, start=start(lgergnp))

detcomp=list(regular=c(0,0,0), seasonal=c(1,0), regvar=0)
ar4 <- fit.ar.par(wts=lgergnp, type="AR", p=4, detcomp=detcomp)
out <- Fsh.test(res=residuals(ar4@lm.ar), s=frequency(wts))
```

`Fpari.piar.test` *Test for a Parameter Restriction in a PAR Model.*

Description

This function performs a test for a parameter restriction in a PAR model. Two restrictions can be considered and entail that the process contain either the unit root 1 or the seasonal unit root -1. In this version PAR models up to order 2 can be considered.

Usage

```
Fpari.piar.test (wts, detcomp, p, type)
```

Arguments

`wts`	a univariate time series object.
`detcomp`	a vector indicating the deterministic components included in the auxiliar regression. See the corresponding item in `fit.ar.par`.
`p`	the order of the initial AR or PAR model. In this version PAR models up to order 2 with seasonal intercepts are considered.
`type`	a character string indicating which restriction should be tested. `"PARI1"` inidicates that the unit root is tested whereas `"PARI-1"` test for the unit root -1.

Details

On the basis of the following PAR model (in this version PAR models up to order 2 are considered and seasonal intercepts are included default),

$$y_t = \mu_s + \alpha_s y_{t-1} + \beta_s(y_{t-1} - \alpha_{s-1} y_{t-2}) + \epsilon_t,$$

for $s = 1, ..., S$, two different hypotheses can be tested:

- $H0 : \alpha_s = 1, fors = 1, ...S - 1,$
- $H0 : \alpha_s = -1, fors = 1, ...S - 1.$

For S=4, if the hypothesis $\alpha_1 * \alpha_2 * \alpha_3 * \alpha_4 = 1$ cannot be rejected (see LRurpar.test), the null hypotheses above entails that either $\alpha_4 = 1$ or $\alpha_4 = -1$.

When the first H0 is not rejected, the PAR model contains the unit root 1, and the periodic difference filter is just the first order difference, $(1 - L)$, where L is the lag operator.

When the second H0 is not rejected, the PAR model contains the unit root -1, and the periodic difference filter is simplified as $(1 + L)$.

In both null hypotheses it is said that the data behave as a PAR model for an integrated series, known as PARI. If those null hypotheses are rejected, the corresponding model is called a periodically integrated autoregressive model, PIAR.

The asymptotic distribution of the F-statistic is $F(S - 1, n - k)$, where n is the number of observations and k the number of regressors.

In this version PAR models up to order 2 can be considered.

Value

An object of class `Ftest.partsm-class` containing the F-test statistic, the freedom degrees an the corresponding p-value.

Author(s)

Javier López-de-Lacalle ⟨javlacalle@yahoo.es⟩.

See Also

`Ftest.partsm-class`, and `LRurpar.test`.

Examples

```
## Test for the unit root 1 in a PAR(2) with seasonal intercepts for
## the logarithms of the Real GNP in Germany.
data("gergnp")
lgergnp <- log(gergnp, base=exp(1))
detcomp <- list(regular=c(0,0,0), seasonal=c(1,0), regvar=0)
out <- Fpari.piar.test(wts=lgergnp, detcomp=detcomp, p=2, type="PARI1")
```

`LRurpar.test` *Likelihood Ratio Test for a Single Unit Root in a PAR(p) Model*

Description

This function performs the likelihood ratio test for a single unit root in a PAR(p) model up to order 2.

Usage

```
LRurpar.test (wts, detcomp, p)
```

Arguments

`wts`	a univariate time series object.
`detcomp`	a vector indicating the deterministic components included in the auxiliar regression. See the corresponding item in `fit.ar.par`.
`p`	the order of the PAR model. In this version first and second order models are considered.

Details

In a quarterly time series, the PAR(1) model, $y_t = \alpha_{s,1} y_{t-1} + \epsilon_t$ with $\epsilon_t ID(0,1)$, contains a unit root if $g(\alpha) = \Pi_{s=1}^{4} \alpha_{s,1} = 1$. To test this hypothesis, a likelihood ratio test, `LR`, is built as the logarithm of the ratio beteween the residual sum of squares in the unrestricted and the restricted model, weighted by the number of observations.

The unrestricted PAR model is estimated by OLS, whereas the model in which the null hypothesis is imposed, *i.e.* $\Pi_{s=1}^{4} \alpha_{s,1} = 1$, is estimated by nonlinear least squares.

The critical values are reported in Osterwald-Lenum (1992), table 1.1 (for the case where $p - r = 1$).

In this version, PAR models up to order 2 with seasonal intercepts are considered, since the function `fit.piar` does not allow for higher orders.

Value

An object of class `LRur.partsm-class` containing the LR statistics and a one-side test constructed as $sign(g(\hat{\alpha}) - 1) * LR^{1/2}$, where $g(\hat{\alpha})$ is the product of the periodic differencing filter parameters estimated under the alternative.

Author(s)

Javier López-de-Lacalle ⟨javlacalle@yahoo.es⟩.

References

H.P. Boswijk and P.H. Franses (1996), Unit roots in periodic autorregressions. *Journal of Time series Analysis*, **17**, pp. 221-245.

P.H. Franses: Periodicity and Stochastic Trends in Economic Time Series (Oxford University Press, 1996).

Osterwald-Lenum, M. (1992), A Note with Quantiles of the Asymptotic Distribution of the Maximum Likelihood Cointegration Rank Test Statistics: Four Cases. *Oxford Bulletin of Economics and Statistics*, **54**, pp.461-472.

See Also

`fit.ar.par`, `fit.piar`, and `LRur.partsm-class`.

Examples

```
## Test for a single unit root in a PAR(2) model with seasonal intercepts for the
## logarithms of the Real GNP in Germany.
data("gergnp")
lgergnp <- log(gergnp, base=exp(1))
detcomp <- list(regular=c(0,0,0), seasonal=c(1,0), regvar=0)
out <- LRurpar.test(wts=lgergnp, detcomp=detcomp, p=2)
```

`predictpiar` *Predictions for a Restricted Periodic Autoregressive Model*

Description

This function performs predictions for a restricted periodic autoregressive model. This version considers PIAR models up to order 2 with seasonal intercepts. It is implemented for quarterly oberved data.

Usage

```
predictpiar (wts, p, hpred)
```

Arguments

`wts`	a univariate time series object.
`p`	the order of the PAR model. At present first and second order are considered.
`hpred`	number of out-of-sample observations to forecast. It must be a multiple of 4.

Details

Upon the multivariate representation,

$$\Phi_0 y_t = \Psi + \Phi_1 Y_{T-1} + ... + \Phi_P y_{T-P} + \epsilon_T,$$

where the $\Phi_i, i = 1, 2, ..., P$ are $s \times s$ matrices containing the $\phi_{is} parameters.$, the one-step-ahead forecasts for the year $T + 1$ is straightforward,

$$y_t = \Phi_0^{-1}\Psi + \Phi_0^{-1}\Phi_1 Y_{T-1} + ... + \Phi_0^{-1}\Phi_P y_{T-P} + \Phi_0^{-1} + \epsilon_T.$$

Multi-step-ahead forecasts are obtained recursively.

The prediction errors variances for the one-step-ahead forecast are the diagonal elements of

$$\sigma^2 \Phi_0^{-1}(\Phi_0^{-1})',$$

whereas for $h = 2, 3, ...$ years ahead forecasts it becomes

$$\sigma^2 \Phi_0^{-1}(\Phi_0^{-1})' + (h-1)(\Gamma\Phi_0^{-1})(\Gamma\Phi_0^{-1})',$$

where $\Gamma = \Phi_0^{-1}\Phi_1$.

This version considers PIAR models up to order 2 for quarterly observed data. By default, seasonal intercepts are included in the model as deterministic components.

The number of observations to forecast, `hpred` must be a multiple of 4.

Value

An object of class `pred.piartsm-class` containing the forecasts and the corresponding standard errors, as well as the 95 per cent confidence intervals.

Author(s)

Javier López-de-Lacalle ⟨javlacalle@yahoo.es⟩.

References

P.H. Franses: Periodicity and Stochastic Trends in Economic Time Series (Oxford University Press, 1996).

See Also

`fit.piar`, `PAR.MVrepr-methods`, and `pred.piartsm-class`.

Examples

```
## 24 step-ahead forecasts in a PIAR(2) model for the
## logarithms of the Real GNP in Germany.
data("gergnp")
lgergnp <- log(gergnp, base=exp(1))
pred.out <- predictpiar(wts=lgergnp, p=2, hpred=24)
```

`plotpredpiar` *Plot of the Out-of-Sample Forecasts in a PIAR Model*

Description

This function displays a plot of the predictions and the corresponding 95 per cent confidence intervals based on a PIAR model. In this version, this function is implemeted for quarterly observed data, PIAR models up to order 2 are considered, and seasonal intercepts are included by default.

Usage

```
plotpredpiar (x)
```

Arguments

`x`	Object of class 'pred.piartsm'.

Author(s)

Javier López-de-Lacalle ⟨javlacalle@yahoo.es⟩.

References

P.H. Franses: Periodicity and Stochastic Trends in Economic Time Series (Oxford University Press, 1996).

See Also

`pred.piartsm-class`, and `predictpiar`.

Examples

```
## Load data and select the deterministic components.
data("gergnp")
lgergnp <- log(gergnp, base=exp(1))

## Fit a PIAR(2) model with seasonal intercepts.
out.pred <- predictpiar(wts=lgergnp, p=2, hpred=24)
plotpredpiar(out.pred)
```

Description

On the basis of the estimated parameters in a PIAR model, this function displays the periodically differenced data, as well as two different representations of the seasonal paths for the transformed data.

Usage

```
plotpdiff (x)
```

Arguments

x	Object of class 'fir.piartsm'.

Author(s)

Javier López-de-Lacalle ⟨javlacalle@yahoo.es⟩.

References

P.H. Franses: Periodicity and Stochastic Trends in Economic Time Series (Oxford University Press, 1996).

See Also

`fit.piartsm-class`, and `fit.piar`.

Examples

```
## Load data and select the deterministic components.
data("gergnp")
lgergnp <- log(gergnp, base=exp(1))
detcomp <- list(regular=c(0,0,0), seasonal=c(1,0), regvar=0)

## Fit a PIAR(2) model with seasonal intercepts.
out.piar <- fit.piar(wts=lgergnp, detcomp=detcomp, p=2)
plotpdiff(out.piar)
```

`data` *Quarterly macroeconomic time series data sets*

Description

This data set contains the macroeconomic time series used in the book Franses (1996).

Usage

```
data(label)
```

Arguments

`label`	a character string with the label of the time series. See details.

Format

A .csv file. The delimiter is a white space.

Details

Available time series. (Each corresponding `label` appears in quotes):

- "usaipi": Total Industrial Production Index for the United States. Sample: 1960.1 - 1991.4. Source: OECD Main Economic Indicators. Remark: (1985=100).
- "canun": Unemployment in Canada. Sample: 1960.1 - 1987.4. Source: OECD Main Economic Indicators. Remark: measured in 1000 persons.
- "gergnp": Real GNP in Germany. Sample: 1960.1 - 1990.4. Source: Wolters (1992, p.424, note 4).
- "ukinvest": Table DA.3.4: Real Total Investment in the United Kindom. Sample: 1955.1 - 1988.4. Source: Osborn (1990).
- "usaipisa": Total Industrial Production Index for the United States. Sample: 1960.1 - 1991.4. Source: OECD Main Economic Indicators. Remark: (1985=100), Seasonally Adjusted.
- "canunsa": Unemployment in Canada. Sample: 1960.1 - 1987.4. Source: OECD Main Economic Indicators. Remark: Seasonally Adjusted.
- "gergnpsa": Real GNP in Germany. Sample: 1960.1 - 1990.4. Source: Wolters (1992, p.424, note 4). Remark: Seasonally Adjusted.
- "ukgdp": United Kingdom gross domestic product. Sample: 1955.1 - 1988.4. Source: Osborn (1990). Remark: at 1985 prices.
- "ukcons": United Kingdom total consumption. Sample: 1955.1 - 1988.4. Source: Osborn (1990). Remark: at 1985 prices.
- "ukndcons": United Kindom nondurables consumption. Sample: 1955.1 - 1988.4. Source: Osborn (1990). Remark: at 1985 prices.

- "ukexp": United Kindom exports of goods and services. Sample: 1955.1 - 1988.4. Source: Osborn (1990). Remark: at 1985 prices.
- "ukimp": United Kindom imports of goods and services. Sample: 1955.1 - 1988.4. Source: Osborn (1990). Remark: at 1985 prices.
- "ukpinvest": United Kindom public investment. Sample: 1962.1 - 1988.4. Source: Osborn (1990). Remark: at 1985 prices.
- "ukwf": United Kindom workforce. Sample: 1955.1 - 1988.4. Source: Osborn (1990). Remark: consisting of workforce in employment and unemployment.
- "swndcpc": Real per capita non-durables consumption in Sweden. Sample: 1963.1 - 1988.1. Source: Assarsson (1991). Remark: measured in logs.
- "swdipc": Real per capita disposable income in Sweden. Sample: 1963.1 - 1988.1. Source: Assarsson (1991). Remark: measured in logs.

Source

P.H. Franses's homepage: `http://www.few.eur.nl/few/people/franses/`.

References

P.H. Franses: Periodicity and Stochastic Trends in Economic Time Series (Oxford University Press, 1996).