

Package ‘SMOARIMA’

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Type Package

Title Automatic ARIMA Order Selection Using Spider Monkey Optimization

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Imports forecast, stats

Description Implements automatic autoregressive integrated moving average order selection using the Spider Monkey Optimization algorithm. Candidate orders are evaluated using a weighted objective function that combines the Akaike information criterion and root mean square error. Functions support model fitting, forecasting, and forecast accuracy evaluation.

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accuracy_smo

*Accuracy Measures for SMO-ARIMA Model***Description**

The `accuracy_smo` function computes forecast accuracy measures for a fitted SMO-ARIMA model using the observed values of the test series and the corresponding forecasts.

Usage

```
accuracy_smo(
  object,
  test
)
```

Arguments

<code>object</code>	An object of class "smoarima" returned by <code>fit_smo()</code> .
<code>test</code>	A univariate test time series (ts) containing the observed values corresponding to the forecast horizon. For the internal holdout evaluation created by <code>fit_smo()</code> , use <code>object\$test</code> .

Details

The `accuracy_smo` function compares the forecasts generated by the fitted SMO-ARIMA model with the observed test data and computes commonly used forecast accuracy measures. The function returns Mean Absolute Error (MAE), Mean Absolute Percentage Error (MAPE), Mean Squared Error (MSE), Root Mean Square Error (RMSE), and Mean Absolute Scaled Error (MASE).

Value

MAE	Mean Absolute Error.
MAPE	Mean Absolute Percentage Error.
MSE	Mean Squared Error.
RMSE	Root Mean Square Error.
MASE	Mean Absolute Scaled Error.
AIC	Akaike information criterion of the fitted model.
BIC	Bayesian information criterion of the fitted model.

References

Hyndman, R. J. and Koehler, A. B. (2006). Another look at measures of forecast accuracy. *International Journal of Forecasting*, 22(4), 679–688.

See Also

fit_smo, forecast_smo

Examples

```
data(AirPassengers)

fit <- fit_smo(
  AirPassengers,
  population = 4,
  groups = 2,
  max.iter = 2,
  p.max = 1,
  d.max = 1,
  q.max = 1,
  local.limit = 2,
  global.limit = 2
)

acc <- accuracy_smo(
  fit,
  fit$test
)

acc
```

fit_smo

Spider Monkey Optimization based ARIMA Model Fitting

Description

The `fit_smo` function automatically identifies the optimal ARIMA (p, d, q) model using the Spider Monkey Optimization (SMO) algorithm. The selected model is fitted to the input time series and returned as an object of class "smoarima".

Usage

```
fit_smo(
  data,
  population = 30,
  groups = 5,
  max.iter = 80,
  p.max = 3,
  d.max = 2,
  q.max = 3,
  alpha = 0.7,
  local.limit = 10,
```

```

    global.limit = 15,
    train.prop = 0.80,
    seed = 42
)

```

Arguments

<code>data</code>	Input univariate time series (ts) object.
<code>population</code>	Population size of the Spider Monkey Optimization algorithm. Default is 30.
<code>groups</code>	Number of spider monkey groups. Default is 5.
<code>max.iter</code>	Maximum number of optimization iterations. Default is 80.
<code>p.max</code>	Maximum autoregressive (AR) order. Default is 3.
<code>d.max</code>	Maximum differencing order. Default is 2.
<code>q.max</code>	Maximum moving average (MA) order. Default is 3.
<code>alpha</code>	Weight assigned to the normalized AIC in the objective function. The remaining weight (1-alpha) is assigned to the normalized RMSE. Default is 0.7.
<code>local.limit</code>	Maximum number of consecutive non-improving iterations allowed for a local leader before the corresponding group is reinitialized. Default is 10.
<code>global.limit</code>	Maximum number of consecutive non-improving iterations allowed for the global leader before group membership is reorganized. Default is 15.
<code>train.prop</code>	Proportion of observations assigned to the training sample used for model estimation during order selection. It must be strictly between 0 and 1. Default is 0.80.
<code>seed</code>	Random seed for reproducibility. Default is 42.

Details

The Spider Monkey Optimization (SMO) algorithm searches for the optimal ARIMA order (p,d,q) by minimizing a weighted objective function based on normalized Akaike Information Criterion (AIC) and Root Mean Square Error (RMSE).

Value

<code>model</code>	Fitted ARIMA model.
<code>order</code>	Selected ARIMA order (p,d,q).
<code>coefficients</code>	Estimated ARIMA coefficients.
<code>fitted</code>	Fitted values.
<code>residuals</code>	Model residuals.
<code>AIC</code>	Akaike Information Criterion.
<code>BIC</code>	Bayesian Information Criterion.
<code>logLik</code>	Log-likelihood of the fitted model.
<code>runtime</code>	Execution time (seconds).
<code>convergence</code>	Optimization convergence history.

References

- Bansal, J. C., Sharma, H., Jadon, S. S. and Clerc, M. (2014). Spider Monkey Optimization Algorithm for Numerical Optimization. *Memetic Computing*, 6, 31–47.
- Box, G. E. P., Jenkins, G. M., Reinsel, G. C. and Ljung, G. M. (2016). *Time Series Analysis: Forecasting and Control*. 5th Edition. Wiley.

See Also

accuracy_smo, forecast_smo

Examples

```
data(AirPassengers)

fit <- fit_smo(
  data = AirPassengers,
  population = 4,
  groups = 2,
  max.iter = 2,
  p.max = 1,
  d.max = 1,
  q.max = 1,
  local.limit = 2,
  global.limit = 2
)

fit$order

fit$AIC
```

forecast_smo

Forecasting using Spider Monkey Optimized ARIMA Model

Description

The forecast_smo function generates forecasts from a fitted SMO-ARIMA model obtained using the fit_smo function. Point forecasts together with the corresponding prediction intervals are returned for the specified forecast horizon.

Usage

```
forecast_smo(
  object,
  h = 10,
  level = c(80, 95)
)
```

Arguments

object	An object of class "smoarima" returned by fit_smo().
h	Forecast horizon. Default is 10.
level	Confidence level(s) for prediction intervals. Default is c(80, 95).

Details

The forecast_smo function generates forecasts from the fitted ARIMA model selected using the Spider Monkey Optimization (SMO) algorithm. Forecasts are produced for the specified forecast horizon, along with lower and upper prediction intervals corresponding to the requested confidence level(s).

Value

method	Forecasting method used.
model	Fitted SMO-ARIMA model.
mean	Point forecasts.
lower	Lower prediction limits.
upper	Upper prediction limits.
level	Confidence level(s) used for prediction intervals.

References

Hyndman, R. J. and Athanasopoulos, G. (2021). *Forecasting: Principles and Practice*. 3rd Edition. OTexts, Melbourne, Australia.

See Also

fit_smo, accuracy_smo

Examples

```
data(AirPassengers)

fit <- fit_smo(
  AirPassengers,
  population = 4,
  groups = 2,
  max.iter = 2,
  p.max = 1,
  d.max = 1,
  q.max = 1,
  local.limit = 2,
  global.limit = 2
)

fc <- forecast_smo(
  fit,
```

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```
    h = 12,  
    level = c(80, 95)  
)
```

fc

plot(fc)

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