

Package ‘kssa’

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Title Known Sub-Sequence Algorithm

Version 0.0.5

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Description Implements the Known Sub-Sequence Algorithm <[doi:10.1016/j.aaf.2021.12.013](https://doi.org/10.1016/j.aaf.2021.12.013)>, which helps to automatically identify and validate the best method for missing data imputation in a time series. Supports the comparison of multiple state-of-the-art algorithms.

License AGPL (>= 3)

Encoding UTF-8

RoxygenNote 7.3.2

URL <https://github.com/steffenmoritz/kssa>,
<https://steffenmoritz.github.io/kssa/>

BugReports <https://github.com/steffenmoritz/kssa/issues>

Depends R (>= 4.0)

Suggests covr, testthat (>= 3.0.0)

Config/testthat/edition 3

Imports magrittr, ggplot2, rlang, methods, forecast, imputeTS, stats,
zoo, Metrics, dplyr, missMethods

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get_imputations	<i>get_imputations function</i>
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Description

Function to get imputations from methods compared by kssa

Usage

```
get_imputations(x_ts, methods = "all", seed = 1234)
```

Arguments

x_ts	A ts object with missing data to be imputed
methods	A string or string vector indicating the method or methods You can choose between the following: <ul style="list-style-type: none"> • "all" - get imputed values for all methods - Default • "auto.arima" - State space representation of an ARIMA model • "StructTS" - State space representation of a structural model • "seadec" - Seasonal decomposition with Kalman smoothing • "linear_i" - Linear interpolation • "spline_i" - Spline interpolation • "stine_i" - Stineman interpolation • "simple_ma" - Simple moving average • "linear_ma" - Linear moving average • "exponential_ma" - Exponential moving average • "locf" - Last observation carried forward • "stl" - Seasonal and trend decomposition with Loess

For further details on these imputation methods please check packages **imputeTS** and **forecast**

seed	Numeric. Any number
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Value

A list of imputed time series with the selected methods

Examples

```
# Example 1: Get imputed values for airgap_na_ts with the methods of

library("imputeTS")
library("kssa")

# Create 20% random missing data in tsAirgapComplete time series from imputeTS
airgap_na <- missMethods::delete_MCAR(as.data.frame(tsAirgapComplete), 0.2)

# Convert to time series object
airgap_na_ts <- ts(airgap_na, start = c(1959, 1), end = c(1997, 12), frequency = 12)

my_imputations <- get_imputations(airgap_na_ts, methods = "all")

# my_imputations contains the imputed time series with all methods.
# Access it and choose the one from the best method for your purposes

my_imputations$seadec
plot.ts(my_imputations$seadec)

# Example 2: Get imputed values for airgap_na_ts using only a subset of algorithms

library("imputeTS")
library("kssa")

# Create 20% random missing data in tsAirgapComplete time series from imputeTS
airgap_na <- missMethods::delete_MCAR(as.data.frame(tsAirgapComplete), 0.2)

# Convert to time series object
airgap_na_ts <- ts(airgap_na, start = c(1959, 1), end = c(1997, 12), frequency = 12)

my_imputations <- get_imputations(airgap_na_ts, methods = c("linear_i", "locf"))

# my_imputations contains the imputed time series with all applied
# methods (locf and linear interpolation).
# Access it and choose the one from the best method for your purposes

my_imputations$locf
plot.ts(my_imputations$locf)
```

Description

Run the Known Sub-Sequence Algorithm to compare the performance of imputation methods on a time series of interest

Usage

```
kssa(
  x_ts,
  start_methods,
  actual_methods,
  segments = 5,
  iterations = 10,
  percentmd = 0.2,
  seed = 1234
)
```

Arguments

<code>x_ts</code>	Time series object <code>ts</code> containing missing data (NA)
<code>start_methods</code>	String vector. The method or methods to start the algorithm. Same as for <code>actual_methods</code>
<code>actual_methods</code>	The imputation methods to be compared and validated. It can be a string vector containing the following You can choose between the following: <ul style="list-style-type: none"> • "all" - compare among all methods automatically - Default • "auto.arima" - State space representation of an ARIMA model • "StructTS" - State space representation of a structural model • "seadec" - Seasonal decomposition with Kalman smoothing • "linear_i" - Linear interpolation • "spline_i" - Spline interpolation • "stine_i" - Stineman interpolation • "simple_ma" - Simple moving average • "linear_ma" - Linear moving average • "exponential_ma" - Exponential moving average • "locf" - Last observation carried forward • "stl" - Seasonal and trend decomposition with Loess For further details on these imputation methods please check packages imputeTS and forecast
<code>segments</code>	Integer. Into how many segments the time series will be divided
<code>iterations</code>	Integer. How many iterations to run
<code>percentmd</code>	Numeric. Percentage of missing data. Must match with the true percentage of missing data in <code>x_ts</code>
<code>seed</code>	Numeric. Random seed to choose

Value

A list of results to be plotted with function [kssa_plot](#) for easy interpretation

References

Benavides, I. F., Santacruz, M., Romero-Leiton, J. P., Barreto, C., & Selvaraj, J. J. (2022). Assessing methods for multiple imputation of systematic missing data in marine fisheries time series with a new validation algorithm. *Aquaculture and Fisheries*. [Full text publication](#).

Examples

```
# Example 1: Compare all imputation methods

library("kssa")
library("imputeTS")

# Create 20% random missing data in tsAirgapComplete time series from imputeTS
airgap_na <- missMethods::delete_MCAR(as.data.frame(tsAirgapComplete), 0.2)

# Convert to time series object
airgap_na_ts <- ts(airgap_na, start = c(1959, 1), end = c(1997, 12), frequency = 12)

# Apply the kssa algorithm with 5 segments, 10 iterations, 20% of missing data,
# compare among all available methods in the package.
# Remember that percentmd must match with
# the real percentage of missing data in the input time series

results_kssa <- kssa(airgap_na_ts,
  start_methods = "all",
  actual_methods = "all",
  segments = 5,
  iterations = 10,
  percentmd = 0.2
)

# Print and check results
results_kssa

# For an easy interpretation of kssa results
# please use function kssa_plot

# Example 2: Compare only locf and linear imputation

library("kssa")
library("imputeTS")

# Create 20% random missing data in tsAirgapComplete time series from imputeTS
airgap_na <- missMethods::delete_MCAR(as.data.frame(tsAirgapComplete), 0.2)
```

```

# Convert to time series object
airgap_na_ts <- ts(airgap_na, start = c(1959, 1), end = c(1997, 12), frequency = 12)

# Apply the kssa algorithm with 5 segments, 10 iterations, 20% of missing data,
# compare among all applied methods (locf and linear interpolation).
# Remember that percentmd must match with
# the real percentage of missing data in the input time series

results_kssa <- kssa(airgap_na_ts,
  start_methods = c("locf", "linear_i"),
  actual_methods = c("locf", "linear_i"),
  segments = 5,
  iterations = 10,
  percentmd = 0.2
)

# Print and check results
results_kssa

# For an easy interpretation of kssa results
# please use function kssa_plot

```

kssa_plot

kssa_plot function

Description

Function to plot the results of kssa for easy interpretation

Usage

```
kssa_plot(results, type, metric)
```

Arguments

results	An object with results produced with function kssa
type	A character value with the type of plot to show. It can be "summary" or "complete".
metric	A character with the performance metric to be plotted. It can be "rmse", "mase", "cor", or "smape" <ul style="list-style-type: none"> • "rmse" - Root Mean Squared Error (default choice) • "mase" - Mean Absolute Scaled Error • "smape" - Symmetric Mean Absolute Percentage Error • "cor" - Pearson correlation coefficient

For further details on these metrics please check package Metrics

Value

A plot of kssa results in which imputation methods are ordered from lower to higher (left to right) error.

Examples

```
# Example 1: Plot the results from comparing all imputation methods

library("kssa")
library("imputeTS")

# Create 20% random missing data in tsAirgapComplete time series from imputeTS
airgap_na <- missMethods::delete_MCAR(as.data.frame(tsAirgapComplete), 0.2)

# Convert to time series object
airgap_na_ts <- ts(airgap_na, start = c(1959, 1), end = c(1997, 12), frequency = 12)

# Apply the kssa algorithm with 5 segments,
# 10 iterations, 20% of missing data, and
# compare among all available methods in the package.
# Remember that percentmd must match with
# the real percentage of missing data in the input time series

results_kssa <- kssa(airgap_na_ts,
  start_methods = "all",
  actual_methods = "all",
  segments = 5,
  iterations = 10,
  percentmd = 0.2
)

kssa_plot(results_kssa, type = "complete", metric = "rmse")

# Conclusion: Since kssa_plot is ordered from lower to
# higher error (left to right), method 'linear_i' is the best to
# impute missing data in airgap_na_ts. Notice that method 'locf' is the worst

# To obtain imputations with the best method, or any method of preference
# please use function get_imputations

# Example 2: Plot the results when only applying locf and linear interpolation

library("kssa")
library("imputeTS")

# Create 20% random missing data in tsAirgapComplete time series from imputeTS
airgap_na <- missMethods::delete_MCAR(as.data.frame(tsAirgapComplete), 0.2)

# Convert to time series object
```

```
airgap_na_ts <- ts(airgap_na, start = c(1959, 1), end = c(1997, 12), frequency = 12)

# Apply the kssa algorithm with 5 segments,
# 10 iterations, 20% of missing data, and compare among all
# applied methods (locf and linear interpolation).
# Remember that percentmd must match with
# the real percentage of missing data in the input time series

results_kssa <- kssa(airgap_na_ts,
  start_methods = c("linear_i", "locf"),
  actual_methods = c("linear_i", "locf"),
  segments = 5,
  iterations = 10,
  percentmd = 0.2
)

kssa_plot(results_kssa, type = "complete", metric = "rmse")
```

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