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Feature-based Time Series Forecasting

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13 March 2019

Joint work with

Introduction

Big picture of the problem

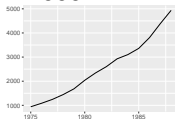
Time series features

- Transform a given time series $y = \{y_1, y_2, \dots, y_n\}$ to a feature vector $F = (f_1(y), f_2(y), \dots, f_p(y))'$.

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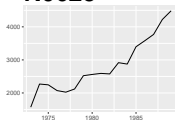
N0001



N0633



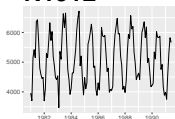
N0625



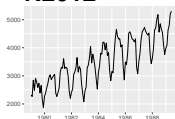
N0645



N1912



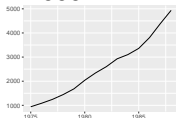
N2012



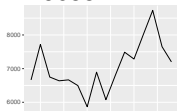
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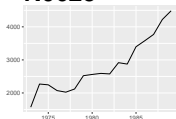
N0001



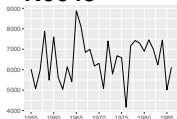
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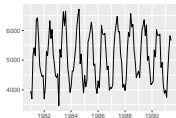
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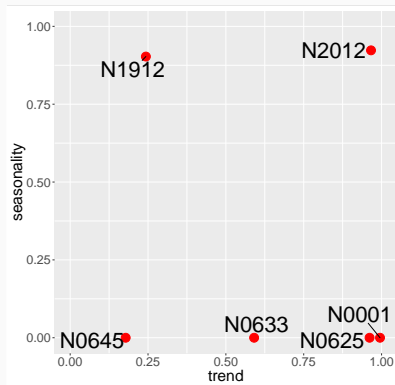
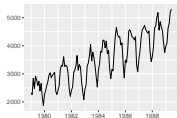
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N1912



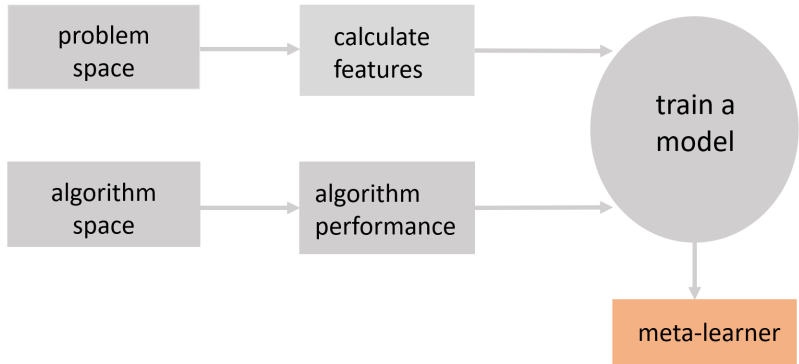
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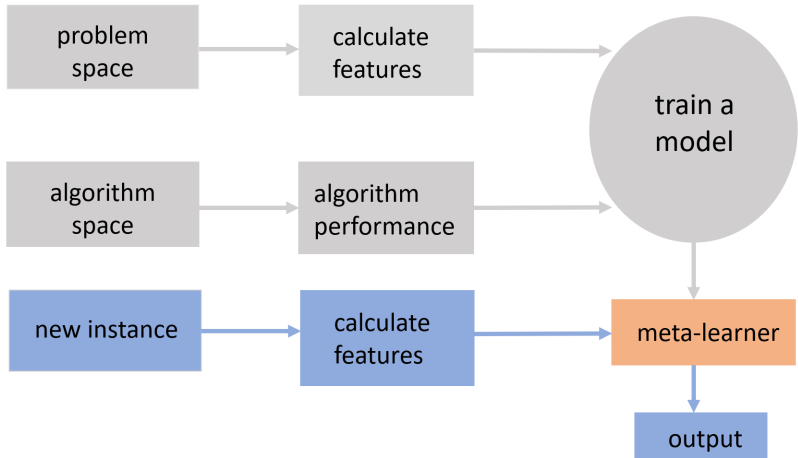
Features used to select a forecasting model

- length
- strength of seasonality
- strength of trend
- linearity
- curvature
- spikiness
- stability
- lumpiness
- parameter estimates of Holt's linear trend method
- spectral entropy
- Hurst exponent
- nonlinearity
- parameter estimates of Holt-Winters' additive method
- unit root test statistics
- crossing points, flat spots
- peaks, troughs
- ACF and PACF based features - calculated on raw, differenced, and remainder series.
- ARCH/GARCH statistics and ACF of squared series and residuals.

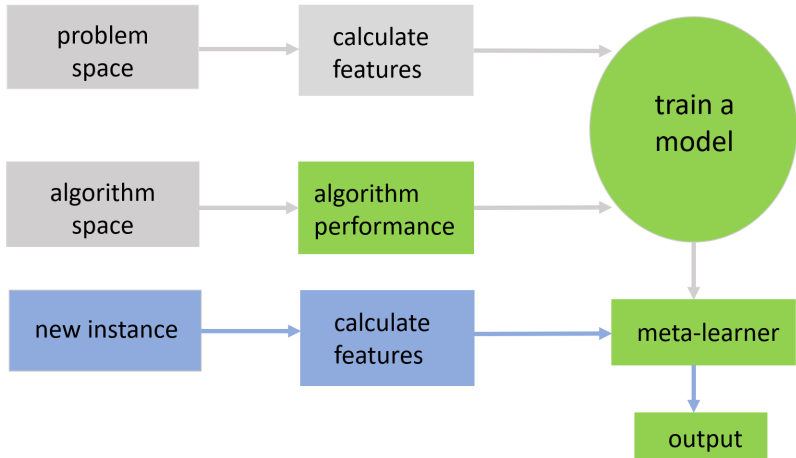
Meta-learning



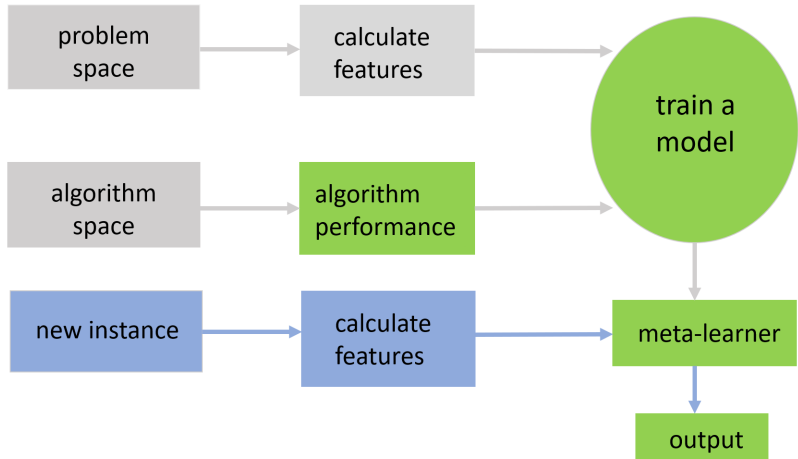
Meta-learning



Feature-based forecasting algorithms



Feature-based forecasting algorithms



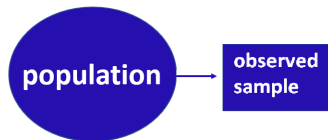
■ three algorithms: **FFORMS**, **FFORMA**, **FFORMPP**

FFORMS: Feature-based FORecast Model Selection

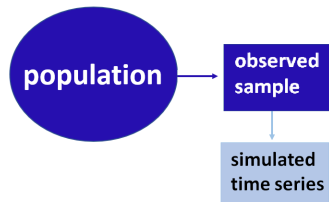


population

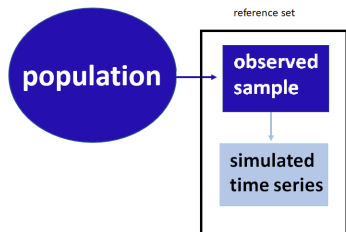
FFORMS: observed sample



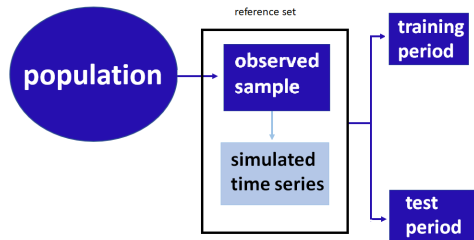
FFORMS: simulated time series



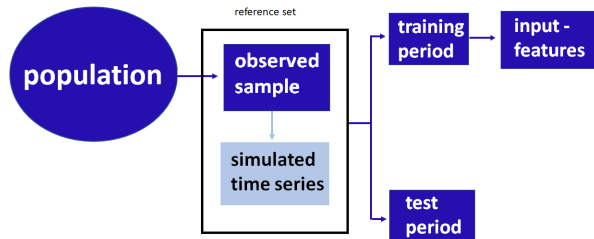
FFORMS: reference set



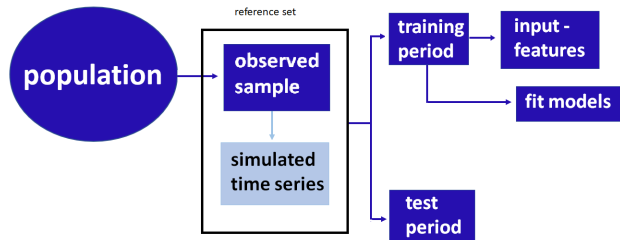
FFORMS: Meta-data



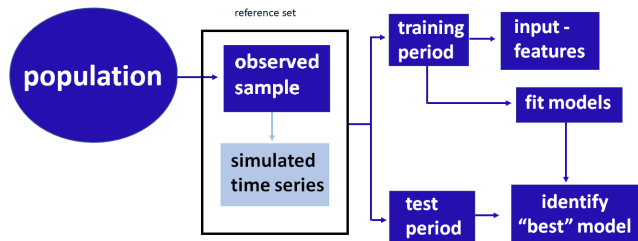
FFORMS: Meta-data



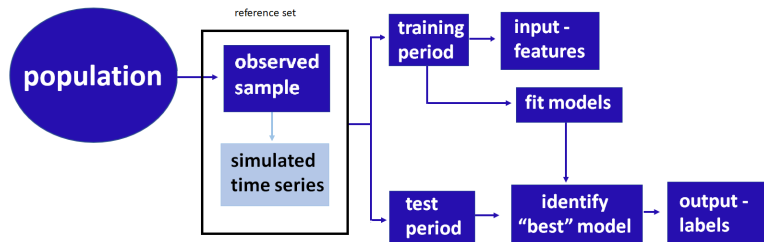
FFORMS: Meta-data



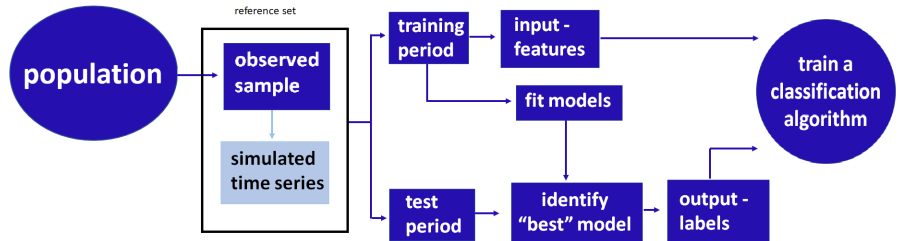
FFORMS: Meta-data



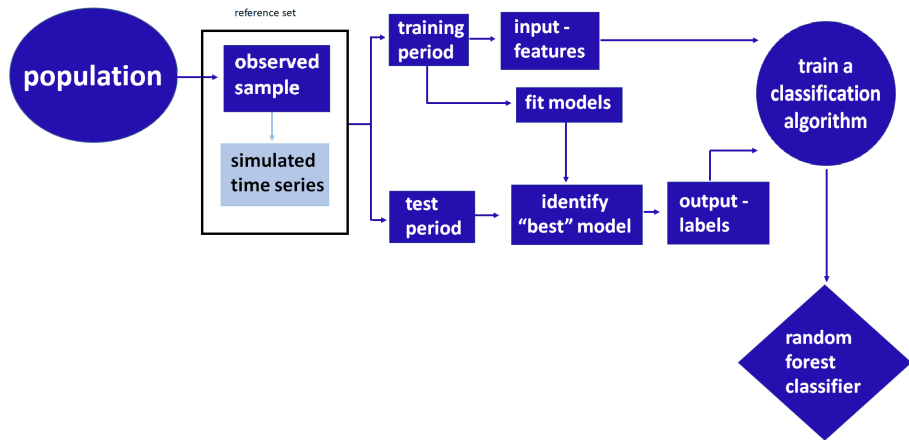
FFORMS: Meta-data



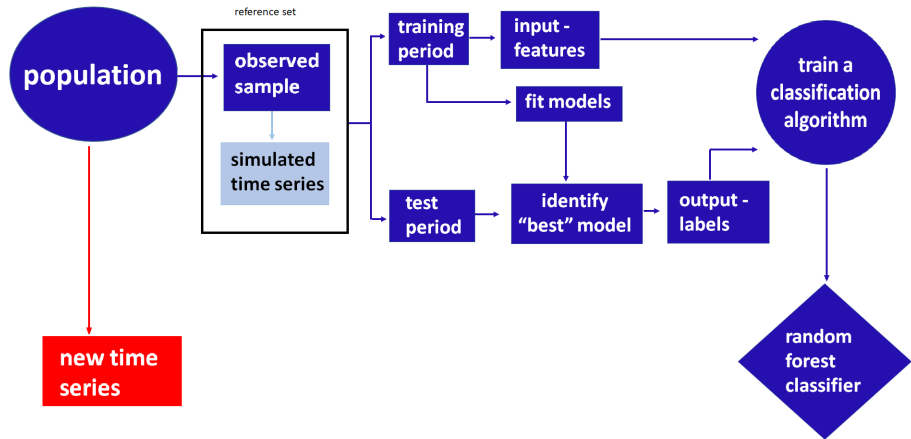
FFORMS: Meta-data



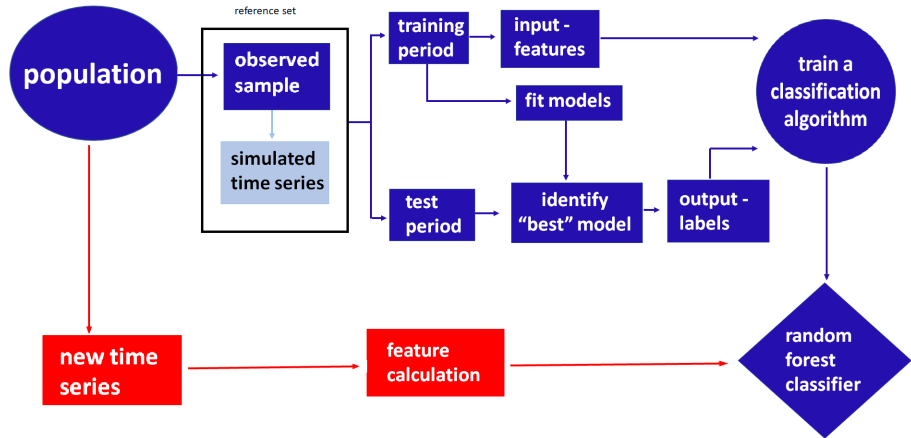
FFORMS: Random-forest classifier



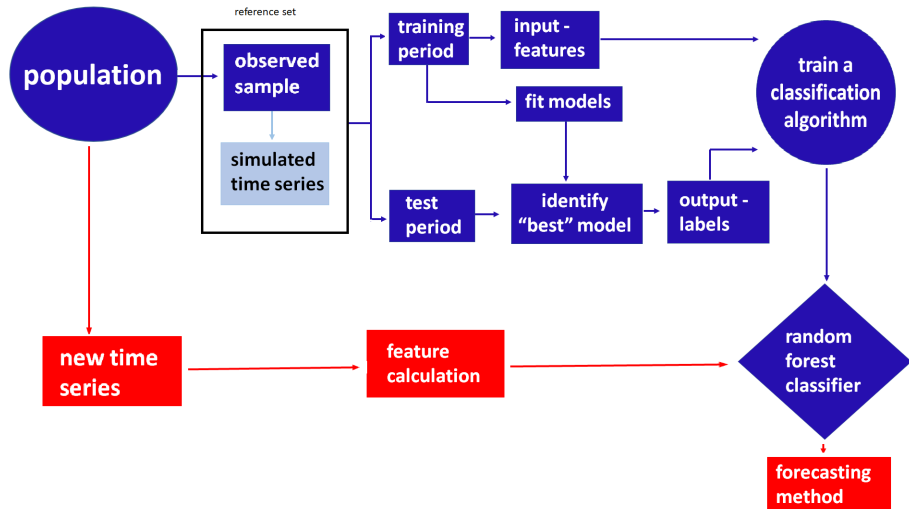
FFORMS: “online” part of the algorithm



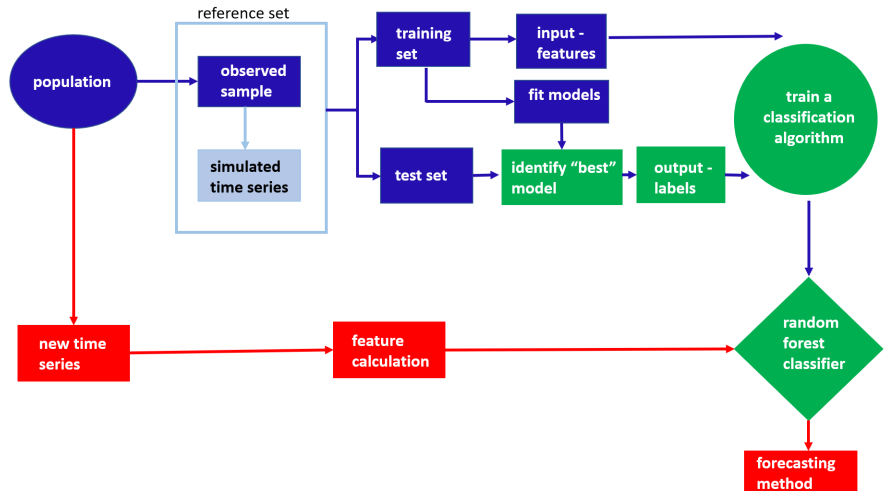
FFORMS: “online” part of the algorithm



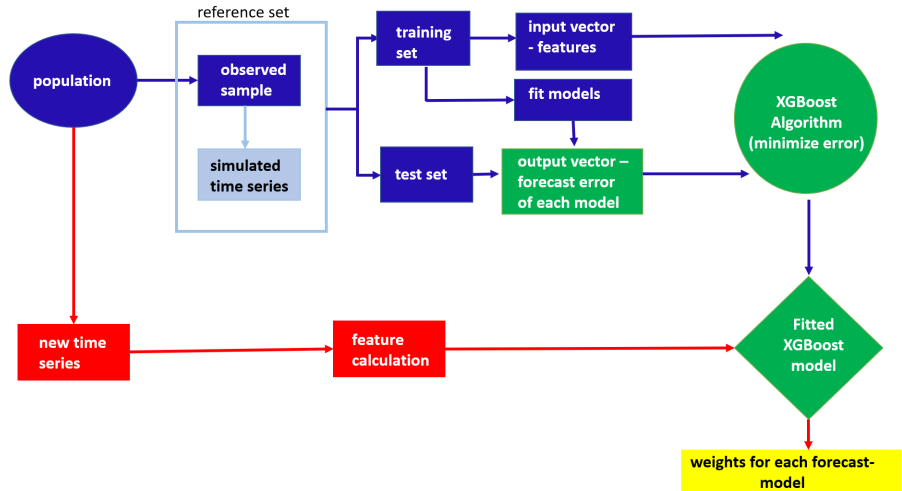
FFORMS: “online” part of the algorithm



FFORMS: Feature-based FOREcast Model Selection



FFORMA: Feature-based FOfrecast Model Averaging



Peeking inside FFORMS

Feature-based FOfRecast Model Averaging

Feature-based FOfRecast Model Performance Prediction

R packages

References