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Bachelor's Thesis
Datenbanktechnologie

Topic: Implementation and Evaluation of Forecasting using variants of Exponential Smoothing

Time is a vital factor of everything that is measurable or observable and that's why time series data is everywhere. Time series data can be found in economics, social sciences, finance, epidemiology, medicine, physical sciences and much more. Models for time series data are used for several purposes – forecasting future outcomes, understanding past records, and so on. For example, retail sales usually exhibit a clear seasonal trend over the course of a year. Many stores register a significant amount of their annual sales during the busy Christmas selling season. All this information could be explored from historical sales data and a suitable forecasting method could be used to predict future sales.

The goal of this Bachelor's thesis is to understand, design, implement and evaluate an appropriate exponential smoothing model for forecasting a given real world data set (e.g., weather data). The student will learn to develop a data processing pipeline that involves data preparation, time series decomposition, time series forecasting and forecasting performance evaluation.

Tasks:

1. **Literature Study:** Study relevant literature on exponential smoothing [1] and familiarize yourself with algorithms and applications. You are expected to demonstrate a full understanding of the exponential smoothing algorithm by explaining the mechanisms and procedure through small examples. Moreover, the task includes explaining the advan-

tages, drawbacks and typical scenarios where exponential smoothing is applied. Study the properties of time series [2] components such as trend, seasonality, cyclic behaviors and residuals. These components combine in an additive or multiplicative way to make up the original time series signal. Acquire a deep understanding of what the time series components represent, in which cases they are useful, and the complexity of the decomposition process.

2. **Implementation of time series decomposition method.** Implement an algorithm that decomposes an input time series into its characteristic components (trend, seasonality, residuals).
3. **Implement Exponential Smoothing:** Consider the properties of the input time series to implement an appropriate exponential smoothing algorithm that best fits and forecasts the input data.
4. **Forecasting performance evaluation:** Assess the prediction performance by using appropriate evaluation metrics with other forecasting methods like seasonal ARIMA.
5. **Visualize and explain the results:** Demonstrate and explain the results through visual representation of the outputs of each step of the implemented pipeline (i.e., data acquisition, data preprocessing, time series decomposition, time series forecasting and evaluation).

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End date: 22.8.2021

References

- [1] Everette S.Gardner Jr. Exponential smoothing: The state of the art—Part II . Bauer College of Business, 334 Melcher Hall, University of Houston, Houston, TX 77204-6021, United States, June 2006.
- [2] Rob J Hyndman, George Athanasopoulos.(2018). Forecasting principles, <https://otexts.com/fpp2/>

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