High Integrity Systems Project
TSA Tasks 03

Prof. Dr. Matthias F. Wagner
Dr. Fatima Sajid Butt

Winter Semester 2024/2025

To streamline the work and sessions I suggest the following procedure:

1. A topic should only be presented once. Therefore the two groups should make selections of the topics they work on and inform the other group.

2. Everybody will get his or her own grade. Each student should take responsibility for subtopics of each group's selection and mark the contribution in the documentation and code.

Taking the next steps in *Time Series Analysis*.

1. Please summarize chapter 4 of the book *Modern time series forecasting with Python*! Explain the rationale of *Baseline Forecasts*. Especially explain:

   - the *ARIMA* model, and
   - the associated metrics!

2. Please run the corresponding code of chapter 4, comment the code and explain it! Please explain also errors and how you solved them!

3. Please summarize the foundational chapter 5 of the book *Modern time series forecasting with Python* with the basic understanding of ML!

4. Let us turning to the features! Please summarize chapter 6 of the book *Modern time series forecasting with Python*! Explain the necessary mathematics.

5. Please run the corresponding code of chapter 6, comment the code and explain it! Please explain also errors and how you solved them!

6. The next step introduces the principal characteristics of TSA: Please summarize the foundational chapter 7 of the book *Modern time series forecasting with Python*.

7. Please run the corresponding code of chapter 7, comment the code and explain it! Please explain also errors and how you solved them!

8. We need some mathematical background for the next future:

- Please go deeper into the *Kalman Filter* algorithms and provide an explanation!
- Describe *Fourier Analysis* in mathematical terms, and
- the *Fast Fourier Transform (FFT)* for practical use.
- Explain the *Wavelet Analysis* in mathematical terms.

9. Please start *Matlab* and search for
   - *Time Series Analysis* in the documentation.
   - Look for examples like *Arima* (cf. task 1 above) and run the code.
   - Analyze Matlab application examples of the FFT and explain with code!
   - Analyze Matlab application examples of the Wavelet Transform with code!
10. For both groups: Please start **in the group together** to document your work in the HIS project!