Time	Group	Submission in Moodle; Mails with subject: [SMD2022]
Th.12:15–13:00	A	lukas.beiske@udo.edu and jean-marco.alameddine@udo.edu
Fr. 8:15–9:00	B	samuel.haefs@udo.edu and stefan.froese@udo.edu
Fr. 10:15–11:00	C	david.venker@udo.edu and lucas.witthaus@udo.edu

Exercise 18 *Analysis of Temperatures* **5 p.**

In the attached file `temperatures_dortmund.csv` you will find the weather data for the period 2000-2008, provided by the city of Dortmund, published in the Open Data Portal[1].

The data has been lightly edited to make it easier for you to analyze. In particular, the measurement times of dates (columns `Date` and `Time`) of the type DD.MM.YYYY HH:MM were additionally converted to decimal values (column `Measurement`), which can lead to minor fluctuations due to the non-uniform length of the year, which you may neglect. The original readings were taken using 15 min or 10 min intervals as of September 18, 2008. The temperature data (column `Temperature`) are in degrees Celsius. Other columns present in the original data were removed, placeholders for missing values were replaced with NaN.

For analysis, use the functionalities provided by the python library `scipy`.

(a) Read the file and inspect it. Evaluate whether you can apply a Fourier transform or a Lomb-Scargle periodogram to obtain information about periodic fluctuations.

(b) Prepare the data for analysis using the Lomb-Scargle periodogram.

(c) Analyze the data using the Lomb-Scargle periodogram. Select reasonable frequencies to be tested. Which frequencies could you resolve maximally, which minimally?

(d) Further prepare the data for Fourier transformation and analyze it accordingly.

(e) Isolate the two maximal frequencies in the Fourier space and retransform those into the original space. Plot the result together with the (gridded) original data and discuss the graphic.

Exercise 19 *Short Questions* **0 p.**

This assignment consists of control questions to help with your exam preparation. Answer the questions using the content of the lecture and the content of the harmonic analysis assignment.

(a) Which frequencies does the Nyquist-Shannon sampling theorem allow?

(b) Why can gridding be necessary, what problem can occur?

(c) Briefly outline the idea behind the implementation of the Fast Fourier Transformation (FFT).

(d) What are the advantages of the Fourier transformation? What are the advantages of the Lomb-Scargle periodogram?

(e) How do Fourier transformation and Lomb-Scargle periodogram differ?

[1] topic → Environment and Climate → Weather Data DOLIS - Güterbahnhof Heiliger Weg 2000-2008