Statistics and Sensor Data Fusion

– Winter Term 2023/2024 –

Worksheet 3

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Exercise 1. A time series of sales figures of 60 months was recorded (from January 2019 to December 2023). Analysis of the time series has revealed that the **smooth component** $G = T + C$ can be represented by the function

$$G(t) = 50 \cdot \cos\left(\frac{2\pi}{30} \cdot (t - 5)\right) + 5 \cdot (20 + t)$$

where $t = 1$ corresponds to January 2019 and $t = 60$ to December 2023.

The **seasonal pattern** $S = (S_1, \ldots, S_{12})$ of the time series was determined to be

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-40	-50	-30	-30	0	10	50	80	50	10	-20	-30

(a) Determine the components T and C.

(b) Compute the wavelength of the component C in months.

(c) Forecast the sales for the months of the first quarter of 2024.

Exercise 2. The quarterly production volumes of a garment factory (in mio. pieces) are available for the three consecutive years 2021, 2022 and 2023:

2021	2022	2023
10—12—8—14	14—16—12—18	18—20—16—22

The time series model $x = T + C + S + R$ is assumed to have a seasonal wavelength of one year (four quarters). Compute the corresponding moving averages, the seasonal pattern, and the seasonally adjusted time series. How strong is the component C?

Exercise 3. Apply **exponential smoothing** to the time series of Exercise 2 with $\alpha = 0.2$ in order to give a forecast on the first quarter of 2024.