Statistical Inference — Lab 5

Date of issue: January, 10^{th} 2019 Due Date: January, 24^{th} 2019, 6:00 pm

Family Name: _____

First Name: _____

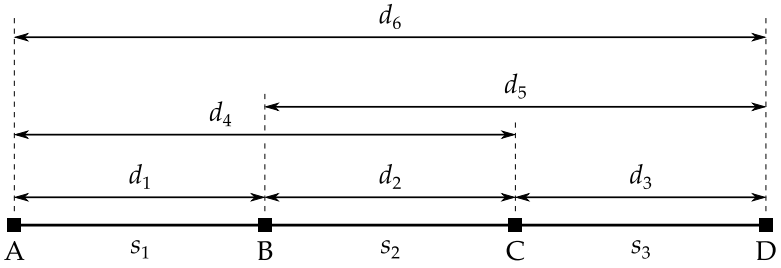
Student ID: _____

Condition adjustment and linearization

Part 1: As sketched in the figure below, the line AD is divided into three, approximately equal segments. Measurements of various distances over the line AD are also given in the table below:

Distanz	in [m]
d_1	$100.04 + \frac{k}{1000}$
d_2	100.01
d_3	99.98
d_4	200.0
d_5	200.02
d_6	$299.96 + \frac{k}{1000}$

where the variable parametre k corresponds to the last two digits of your student ID number.



a) Determine the linear system of observation equations (that is, the equations for the A-Model) and the linear system of condition equations (that is, the equations for the B-Model). Check the orthogonality of the design matrix A of the A-model and the condition matrix B of the B-model.

b) Compute for both A- and B-model

- the least-squares solutions for the lengths s_1, s_2 and s_3,
- the adjusted observation vector and
- the adjusted inconsistencies.

c) Comment on the differences or absence of differences in the obtained results.

Part 2: In the year 1619, Johannes Kepler published his 3rd law of planetary motion in *Harmonices mundi* (The Harmony of the World):

> The ratio of the square of a planet's orbital period T to the cube of its semi-major axis a is constant for all orbits.

E. g. for Earth and Mars it holds

$$\frac{T^2_{\text{Earth}}}{a^3_{\text{Earth}}} = \frac{T^2_{\text{Mars}}}{a^3_{\text{Mars}}}.$$

The following measurements for the above mentioned quantities are given:

	orbital period T	semi-major axis a
Earth	365.256 d	$149.5980 \cdot 10^6$ km
Mars	686.971 d	$227.9392 \cdot 10^6$ km

Task: Apply the B-model adjustment to the above formulation of Kepler's 3rd law. In particular describe the linearisation and the method (code) used to solve the equation.