

Homework 3: Adjustment Calculation – part I

- Linear and non-linear functional models -

Surname, Given Name:	Matriculation number:	Deadline: 06.02.2017
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Objective

This exercise deals with the least-squares adjustment of linear and non-linear functional models.

Task 1:

In the file *"Homework3-1.txt"* is given the time series of an inclinometer, where the first column represents the time axis and the second column the measured inclination in [gon]. The measurements are uncorrelated and where obtained with the same standard deviation. The time t is regarded as error free.

- Determine the unknown parameters of a polynomial of 4th degree via least-squares adjustment
 - Setup the functional model.
 - Which parameters are observations, error-free or unknown parameters?
 - Is it a linear or non-linear adjustment problem? Please give a short explanation.
 - Plot the residuals and evaluate the adjustment results.

Task 2:

In the file “Homework3-2.txt” is given a series of measurements, where the first column represents the x values and the second column the $y(x)$ values. The $y(x)$ values were observed with the same standard deviation and are uncorrelated. The x values are regarded as error free.

- Setup a functional model that describes the behaviour of the measurements.
- Which parameters are observations, error-free or unknown parameters?
- Is it a linear or non-linear adjustment problem? Please give a short explanation.
- Determine the unknown parameters via least-squares adjustment.
- Plot the residuals and evaluate the adjustment results.

Task 3:

The side length a and the mass m of a cube of copper were measured. The density $\rho = 8.93 \text{ g/cm}^3$ of copper is error free and the temperature effect can be neglected.

- Calculate the adjusted volume V of the cube.
 - Setup the functional model.
 - Which parameters are observations, error-free or unknown parameters?
 - Is it a linear or non-linear adjustment problem? Please give a short explanation.

Table 1: Measurements

	L_i	σ_{L_i}
a	11.60 mm	0.05 mm
m	15.15 g	0.05 g

Task 4:

The centre of an ellipse lies in the origin of an x, y coordinate system, where its semi-major and minor axes are aligned as depicted in Figure 1.

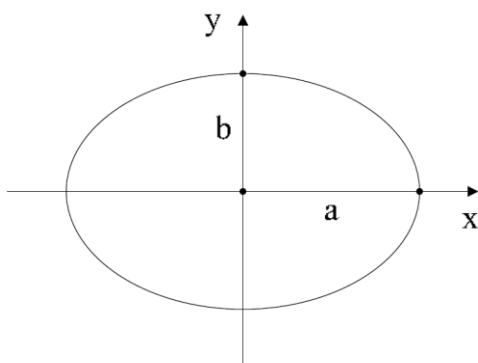


Figure 1: Ellipse

Table 2: Observed points on the ellipse

Point	Y [m]	X [m]
1	0.673	-3
2	-2.080	-1
3	-2.200	0
4	2.088	1
5	-0.669	3

Such an ellipse can be described by

$$\left(\frac{x}{a}\right)^2 + \left(\frac{y}{b}\right)^2 = 1.$$

In order to determine the parameters of this ellipse five points have been observed and are listed in Table 2. The x values are regarded as error free and the y values are uncorrelated and have been observed with the same standard deviation.

- Determine the unknown parameters of this ellipse.
 - Setup the functional model.
 - Which parameters are observations, error-free or unknown parameters?
 - Is it a linear or non-linear adjustment problem? Please give a short explanation.
 - Plot the residuals and evaluate the adjustment results.