Exercise 7: Adjustment Calculation - part II

- Linear adjustment problem -

Group:	Surname, First name:	Matriculation number:	Signature*:

* With my signature I declare that I was involved in the elaboration of this homework.

Submission until: **15.12.2024**

Objective

This exercise deals with the adjustment of the parameters of a straight line which is represented by four measured points as depicted in Figure 1 and the adjustment of the parameters of a parabola which is represented by five measured points as depicted in Figure 2.

Table 1: Coordinates of the four points

Point	*x* [m]	*y* [m]
1	1.0	0.1
2	2.0	1.1
3	3.0	1.8
4	4.0	2.4

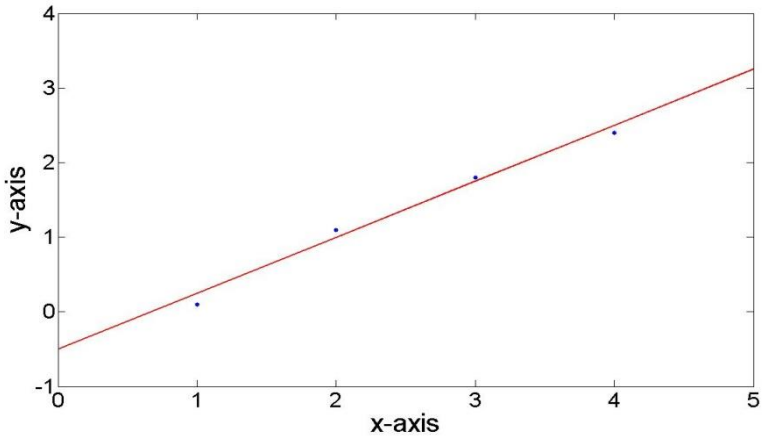

Figure 1: Four given points and adjusted straight line

Task 1:

Table 1 contains the coordinates of four points, where the x-coordinates are error free (fixed values) and the y-coordinates are measurements which are subject to random errors. The objective of this task is the determination of the unknown parameters of the straight line via least-squares adjustment using matrix notation. The measurements are uncorrelated and were obtained with the standard deviations listed in Table 2.

1. Set up an appropriate functional model as well as the observation equations.
2. Set up the stochastic model.
3. Determine the normal equations for the condition $\sum p_i v_i^2 \rightarrow \min.$
4. Solve the normal equation system and determine the estimated parameters of the straight line.
5. Calculate the residuals.

Table 2: Standard deviations for the y-coordinates

Point	σ_{y_i} [cm]
1	2
2	1
3	4
4	2

Task 2 (Homework):

Table 3 contains the coordinates of five points, where the x-coordinates are error free (fixed values) and the y-coordinates are measurements which are subject to random errors. The objective of this task is the determination of the unknown parameters of the parabola as depicted in Figure 2 via least-squares adjustment applying matrix notation. The measurements are uncorrelated and were obtained with the a standard deviation of $\sigma_{y_i} = 0.02$ m.

1. Set up an appropriate functional model as well as the observation equations.
2. Set up the stochastic model.
3. Why is it a linear adjustment problem? Please give a short explanation.
4. Solve the normal equation system and determine the estimated parameters of the parabola as well as their standard deviations.
5. Plot the five points and the resulting estimated parabola.
6. Calculate the residuals as well as their standard deviations.
7. Calculate the adjusted observations as well as their standard deviations.

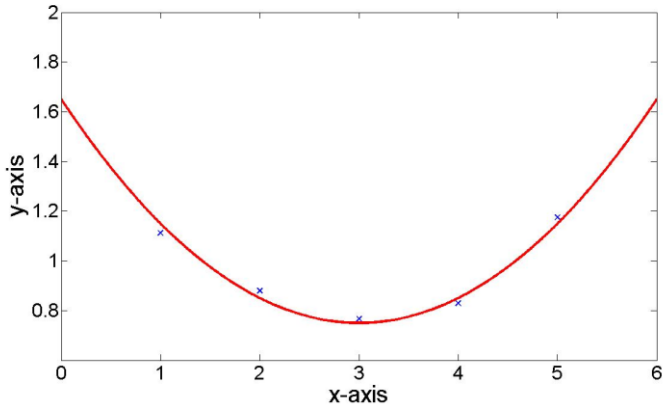

Figure 2: Five given points and adjusted parabola

Table 3: Coordinates of the five points

Point	x [m]	y [m]
1	1.000	1.112
2	2.000	0.880
3	3.000	0.768
4	4.000	0.830
5	5.000	1.175