Technische Universität Berlin

Chair of Geodesy and
Adjustment Theory

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Exercise 14: Adjustment Calculation - part IX

- Adjustment with constraints -

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

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

Submission until: **16.02.2025**

Objective

The exercise deals with the adjustment of non-linear adjustment problems while introducing constraints between the unknown parameters.

Task 1:

Solve the following over-determined, non-linear equation system via least-squares adjustment.

$$-4.0 = x + y - 2y^2$$

$$8.0 = x^2 + y^2$$

$$7.7 = 3x^2 - y^2$$

- The values -4.0, 8.0 and 7.7 are equally weighted and uncorrelated measurements.
- The parameters x and y are unknowns.
- Solve the normal equation system and determine the adjusted parameters as well as their standard deviations while introducing the constraint (two different adjustments).
    1. $x^3 + \sqrt[3]{y} = 9.0$
    2. $\frac{1}{x} + y^2 = 5.0$
- Compare and interpret the results for both constraints.

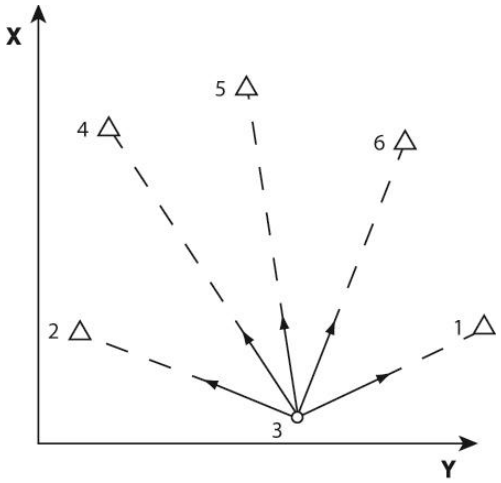

Figure 1: Triangulation network

Table 1: 2D coordinates of control stations

Point	*Y* [m]	*X* [m]
1	682.415	321.052
2	203.526	310.527
4	251.992	506.222
5	420.028	522.646
6	594.553	501.494
7	485.959	219.089

Table 2: Observed directions

Instrument station	Foresight station	Direction [gon]
3	1	206.9094
	2	46.5027
	4	84.6449
	5	115.5251
	6	155.5891

Task 2 (Homework):

The observed directions of the triangulation network depicted in Figure 1 are listed in Table 2. The points 1, 2, 4, 5 and 6 are control points (error free) and their 2D coordinates are given in Table 1.

The new point 3 and the fixed point 7 (error free) are representing the starting resp. ending point of a new small bridge, which will be constructed within this year. Therefore the distance between these two points is fixed and must be exactly $s_3^7 = 25.000\ \mathrm{m}$. Calculate the adjusted coordinates of point 3 under the consideration of the constraint.

- The observed directions are uncorrelated and were obtained with an accuracy of $1\ \mathrm{mgon}$.
- Set up an appropriate functional model as well as the observation equations.
- Set up the stochastic model.
- Choose appropriate values for the break-off conditions ϵ and δ and justify your decision.
- Solve the normal equation system and determine the 2D coordinates of point 3 as well as their standard deviations.
- Calculate the residuals and the adjusted observations as well as their standard deviations.