**Technische Universität Berlin**　　　　Adjustment Theory I

Chair of Geodesy and　　　　　　　　　　Winter Term 2023/24
Adjustment Theory

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| \multicolumn{4}{c}{**Exercise 10: Adjustment Calculation - part V**} | | | |

**Exercise 10: Adjustment Calculation - part V**

- Levelling network -

| Group: | Surname, First name: | Matriculation number: | Signature*: |
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| * With my signature I declare that I was involved in the elaboration of this homework. |
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| Submission until: **26.01.2024** |
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## Objective

This exercise deals with the adjustment of levelling networks.
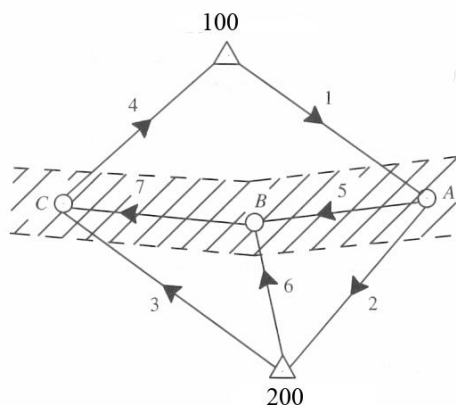


Figure 1: Interlocking levelling network

Table 1: Measured height differences

| Line | Height differences [m] |
|---|---|
| 1 | 5.10 |
| 2 | 2.34 |
| 3 | -1.25 |
| 4 | -6.13 |
| 5 | -0.68 |
| 6 | -3.00 |
| 7 | 1.70 |

Table 2: Benchmarks

| Point | Height [m] |
|---|---|
| 100 | 100.00 |
| 200 | 107.50 |

**Task 1:**

The measurements of the levelling network depicted in Figure 1 are listed in Table 1. The points 100 and 200 are benchmarks (error free) and their heights are given in Table 2. Calculate the adjusted heights of points $A$, $B$ and $C$ using least-squares adjustment.

- The measurements are uncorrelated and were obtained with the same standard deviation.
- Set up an appropriate functional model as well as the observation equations.
- Set up the stochastic model.
- Solve the normal equation system and determine the heights of points $A$, $B$ and $C$ as well as their standard deviations.
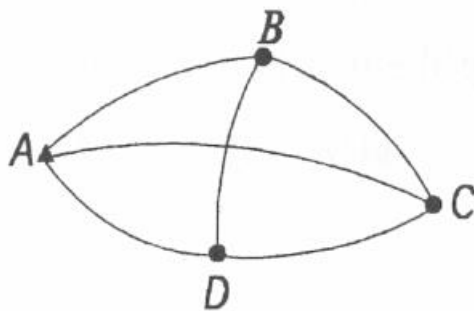- Calculate the residuals and the adjusted observations as well as their standard deviations.



Figure 2: Levelling network

Table 3: Measured height differences and their standard deviations

| From | To | $\Delta h_i$ [m] | $\sigma_{\Delta h_i}$ [mm] |
|------|------|--------|-----|
| A | B | 10.509 | 6 |
| B | C | 5.360 | 4 |
| C | D | -8.523 | 5 |
| D | A | -7.348 | 3 |
| B | D | -3.167 | 4 |
| A | C | 15.881 | 12 |

**Task 2 (Homework):**

A levelling network is depicted in Figure 2 and the related measurements as well as their standard deviations are listed in Table 3. The measurements are uncorrelated.

- Perform two different adjustments for the given levelling network:
  - 1. Adjustment: Use point $A$ as a benchmark and all other points as new points.
  - 2. Adjustment: Use point $B$ as a benchmark and all other points as new points.
- The error free height for each benchmark is derived from your matriculation number (one per group)
  - e.g., Matr.-No.: 123456
    - 1. Adjustment (number forward): $H_A = 123.456$ m.
    - 2. Adjustment (number backward): $H_B = 654.321$ m.
- Set up an appropriate functional model as well as the observation equations.
- Set up the stochastic model.
- For the final check choose an appropriate value $\delta$ and justify your decision.
- Solve the normal equation system and determine the heights for the remaining points as well as their standard deviations.
- Calculate the residuals and the adjusted observations as well as their standard deviations.
- Compare the adjusted unknowns, adjusted observations and residuals as well as their standard deviations of both adjustments. Present all results in one table and comment them.