Module 2 Assessment - Part 1

Bookmark this page

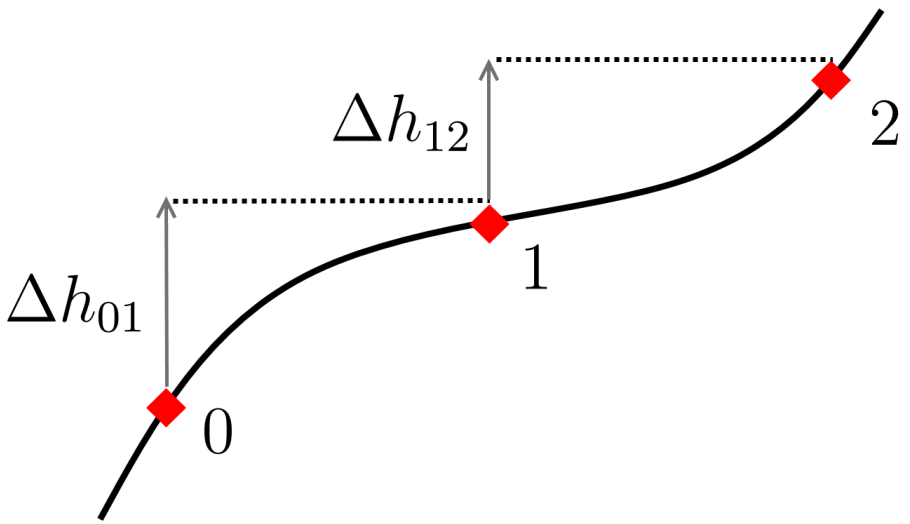
The following questions are part of the graded assignments for the assessment of module 2. The number of points per question is indicated. The total number of points you can earn in this module is 14.

Note, the second part of the assessment includes a MATLAB exercise (next unit).

Mathematical model of levelling

4.0/4.0 points (graded)

- 4. Best Linear Unbiased Estimation (BLUE)
- 5. How precise is the estimate?
- Pre-knowledge Mathematics
- MATLAB Learning Content



With a technique called levelling we can measure the height differences between points, as can be seen in the figure above. The heights of points 0, 1 and 2 are unknown and denoted as h_i, $i = 0, 1, 2$.

The notation of the height differences is: $\Delta h_{ij} = h_j - h_i$.

The measurements are independent of each other and each have a precision of $\sigma_{h_{ij}} = 2$ mm.

Specify the functional model in the form $E\{\underline{y}\} = Ax$. What is A?

- $A = \begin{bmatrix} -1 & 1 & 0 \\ 0 & -1 & 1 \end{bmatrix}$ ✔

- $A = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$
- $A = \begin{bmatrix} -1 & 1 & 0 \\ -1 & 0 & 1 \end{bmatrix}$
- $A = \begin{bmatrix} 1 & 0 & -1 \\ 1 & -1 & 0 \end{bmatrix}$

What is the stochastic model?

- A 2x2 diagonal matrix with 2's on diagonal
- A 2x2 diagonal matrix with 4's on diagonal ✔
- A 3x3 diagonal matrix with 2's on diagonal
- A 3x3 diagonal matrix with 4's on diagonal

The system is consistent. Is this statement true or false?

- True ✔

- False

This system is ...

- Determined
- Overdetermined
- Underdetermined ✔
- Overdetermined and underdetermined

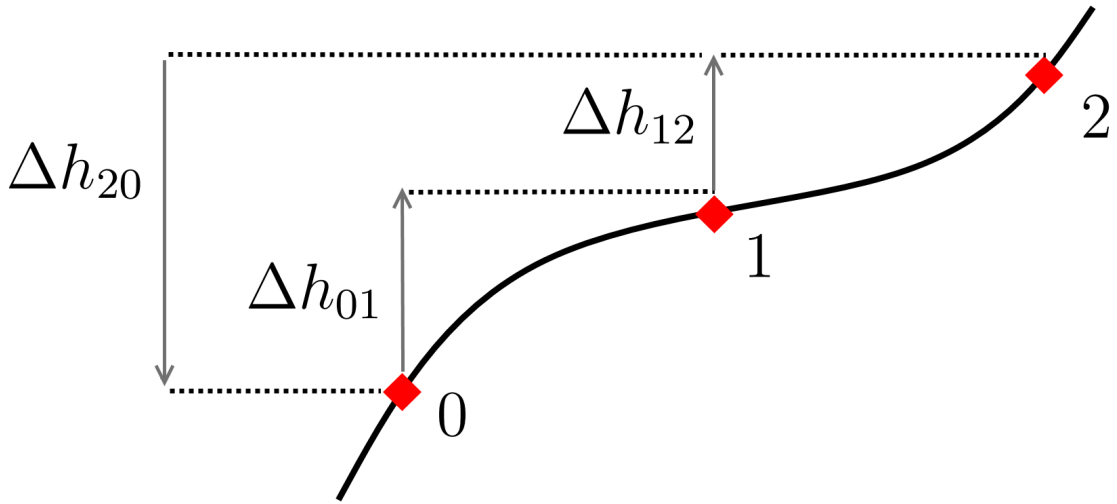
What is the significance of this type of system?

- The system has no solution
- The system has an infinite number of solutions ✔
- The system has a unique solution

Submit You have used 1 of 3 attempts

Mathematical model of levelling (continued)

3.3333333333333335/4 points (graded)



For the same problem as in the previous exercise, an additional observation Δh_{20} is made. This has been illustrated in the figure above.

The A-matrix will now need to be changed. It is now a 3 by 3 matrix of the form

$$A = \begin{bmatrix} -1 & 1 & 0 \\ 0 & -1 & 1 \\ a_{31} & a_{32} & a_{33} \end{bmatrix}.$$

Fill in the missing values of the additional elements in matrix A.

$a_{31} =$

1

✔ **Answer:** 1

1

$a_{32} =$

0

✔ **Answer:** 0

0

$a_{33} =$

-1

✔ **Answer:** -1

-1

This system is:

Note that more than one option may be correct

- [ ] Determined
- [x] Underdetermined
- [ ] Overdetermined

✖

Feedback

$rank(A) = 2$ is smaller than $m = 3$ and $n = 3$. Therefore this system is underdetermined and may or may not be consistent.

What is the redundancy of this system?

1 ✔ **Answer:** 1

1

Feedback
The redundancy of a system is equal to: $m - rank(A) = 1$

For which y is this system consistent (more answers might be correct)?

- ☐ $y = [2 \quad 1 \quad -2]^T$
- ☑ $y = [2 \quad 1 \quad -3]^T$
- ☐ $y = [1 \quad 2 \quad -4]^T$
- ☑ $y = [0 \quad 1 \quad -1]^T$

✔

Feedback
In this case the system will be consistent if the sum of the height differences is zero, since we must have $\Delta h_{01} + \Delta h_{12} + \Delta h_{20} = (h_1 - h_0) + (h_2 - h_1) + (h_0 - h_2) = 0.$

Submit You have used 3 of 3 attempts

✱ Partially correct (3.33/4 points)