

DelftX: OT.1x Observation theory: Estimating the Unknown

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Graded Assignment due Feb 8, 2017 17:30 IST

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Exercises: Solvability of a system of equations

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Consistency of the functional model

1/1 point (ungraded)

We observe an unknown distance m times. Construct the functional model (i.e., a system of observation-equations) in order to estimate the unknown distance. Which of the following statements is true? (more than one statement may be true!).

- $\hspace{0.1in} \square \hspace{0.1in}$ A: if m>1 the system cannot be consistent
- lacksquare B: if m>1 the system is consistent
- $ule{\hspace{-0.1cm} \hspace{-0.1cm} \hspace{-0.1cm}$



Explanation

The rank of the A-matrix is 1.

If m>1 the system may or may not be consistent depending on the actual observations: only if all observations are identical, the system is consistent.

- 4. Best Linear Unbiased Estimation (BLUE)
- Pre-knowledgeMathematics
- MATLAB Learning Content

If m=1, the rank is equal to m, and the system is thus consistent.

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✓ Correct (1/1 point)

Consistency

1/1 point (ungraded)

Which of the following systems of equations is always consistent?

$$egin{bmatrix} igcup y_1 \ y_2 \end{bmatrix} = egin{bmatrix} 1 & 1 \ 1 & 1 \end{bmatrix} x$$

$$egin{array}{c} igg[egin{array}{c} y_1 \ y_2 \ \end{bmatrix} = egin{bmatrix} 1 & 2 \ 3 & 6 \ \end{bmatrix} x \end{array}$$

$$egin{array}{c} egin{array}{c} egin{array}{c} y_1 \ y_2 \end{array} \end{bmatrix} = egin{bmatrix} 1 & 0 \ 3 & 1 \end{bmatrix} x$$

$$egin{bmatrix} igcup_{y_1} \ y_2 \end{bmatrix} = egin{bmatrix} 1.5 & 4.5 \ 1.1 & 3.3 \end{bmatrix} x$$

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Α	n	SI	w	е	r

Correct: $\operatorname{rank}(A) = 2 = m$, so the consistency is guaranteed.

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✓ Correct (1/1 point)

Rank and Consistency

2/2 points (ungraded)

$$egin{bmatrix} y_1 \ y_2 \ y_3 \end{bmatrix} = egin{bmatrix} 3 & 6 \ 1 & 2 \ 3 & 4 \end{bmatrix} egin{bmatrix} x_1 \ x_2 \end{bmatrix}$$

What is rank(A)?

Does this mean the system is inconsistent?

yes

no, e.g.
$$\begin{bmatrix} y_1 \\ y_2 \\ y_3 \end{bmatrix} = \begin{bmatrix} 15 \\ 5 \\ 11 \end{bmatrix}$$
 results in a consistent system \checkmark

ono, it is always consistent

Answer

Correct: $x_1=1$ and $x_2=2$ is the solution for this system, so the system is consistent.

Submit

✓ Correct (2/2 points)

A-matrix

1/1 point (ungraded)

An object is travelling with constant speed along a straight line. The distance to the object measured at t_1 = 0 s: y_1 = 1 m, and at t_2 = 1 s: y_2 = 2 m. We would like to know the position on the line at t_1 and the velocity, x_0 and v respectively. What is the correct A-matrix?

$$^{\odot} \quad A = \begin{bmatrix} 1 & 0 \\ 1 & 1 \end{bmatrix} \checkmark$$

 $A = egin{bmatrix} 1 & 1 \ 1 & 2 \end{bmatrix}$

 $egin{array}{c} A = egin{bmatrix} 1 \ 2 \end{bmatrix}$

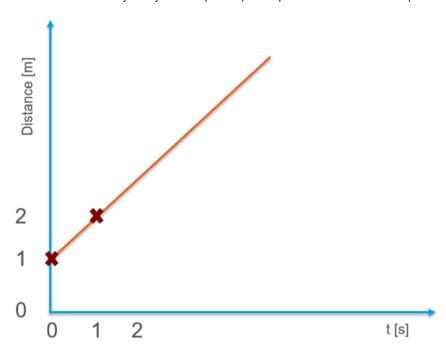
 $A = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$

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✓ Correct (1/1 point)

Consistency

5/5 points (ungraded)



The figure shows the two distance observations corresponding to the previous problem.

Is this system consistent?

No



 $\mathrm{Explanation} \ \mathrm{rank}(A) = 2 = m$

What is the solution for $oldsymbol{x} = \left[egin{array}{c} oldsymbol{x}_0 \\ v \end{array}
ight]$

 x_0 :

1

✓ Answer: 1

1

v:

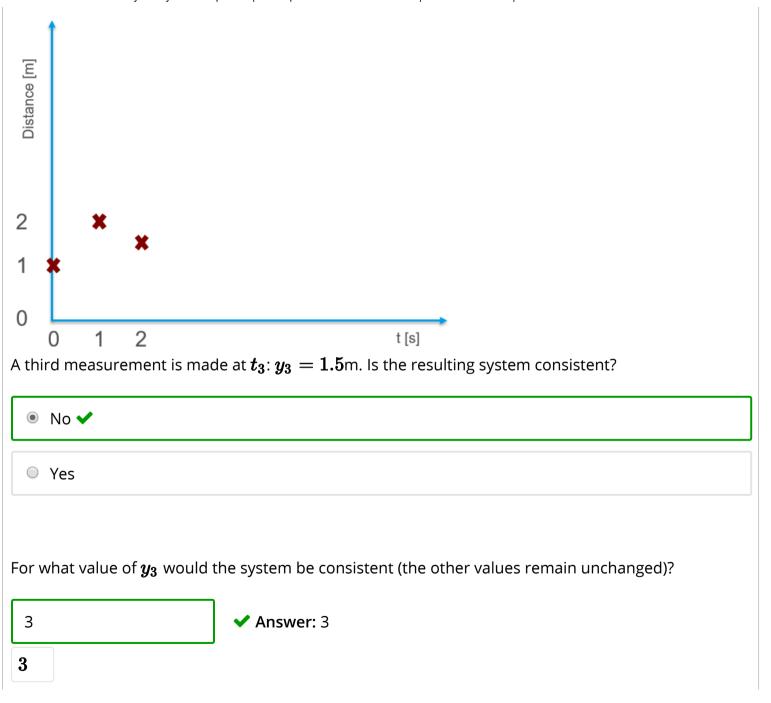
1

✓ Answer: 1

1

Explanation

To see this, fill in $m{x}=egin{bmatrix}1\\1\end{bmatrix}$ in the system of equations! (This solution can be simply computed as $m{A^{-1}y}$.)



Explanation

For $y_3=3$ the 3 observations would be on a line, and the system would be indeed consistent.

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Correct (5/5 points)

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