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5. Data fitting

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Problem Set A due Sep 13, 2021 20:30 IST Completed



Practice

7(a)

1/1 point (graded)
Use the method of least squares approximation to find the line that best fits the three points:

(1, 1), (1, 3), (2, 4).

y =

2*x

2 · x

✓ Answer: 2*x

Solution:

We solve for a line of the form $y = ax + b$.

We start by computing the necessary sums:

$$\sum_{i=1}^3 x_i = 1 + 1 + 2 = 4$$

(4.251)

$$\sum_{i=1}^3 x_i^2 = 1^2 + 1^2 + 2^2 = 6$$

(4.252)

$$\sum_{i=1}^3 x_i y_i = 1(1) + 1(3) + 2(4) = 12$$

(4.253)

$$\sum_{i=1}^3 y_i = 1 + 3 + 4 = 8$$

(4.254)

This gives rise to the following system that allows us to solve for a and b .

$$6a + 4b = 12$$

(4.255)

$$4a + 3b = 8$$

(4.256)

Multiplying the first equation by 2 and the second equation by 3 and subtracting, we get $b = 0$. Thus $a = 2$. The best fit line is $y = 2x$.

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You have used 1 of 10 attempts

Answers are displayed within the problem

7(b)

1.0/1 point (graded)
Sketch the best fit line and three data points as a check. (Sketch your fit for $0 \leq x \leq 2$.)

Select

Linear fit

Data points

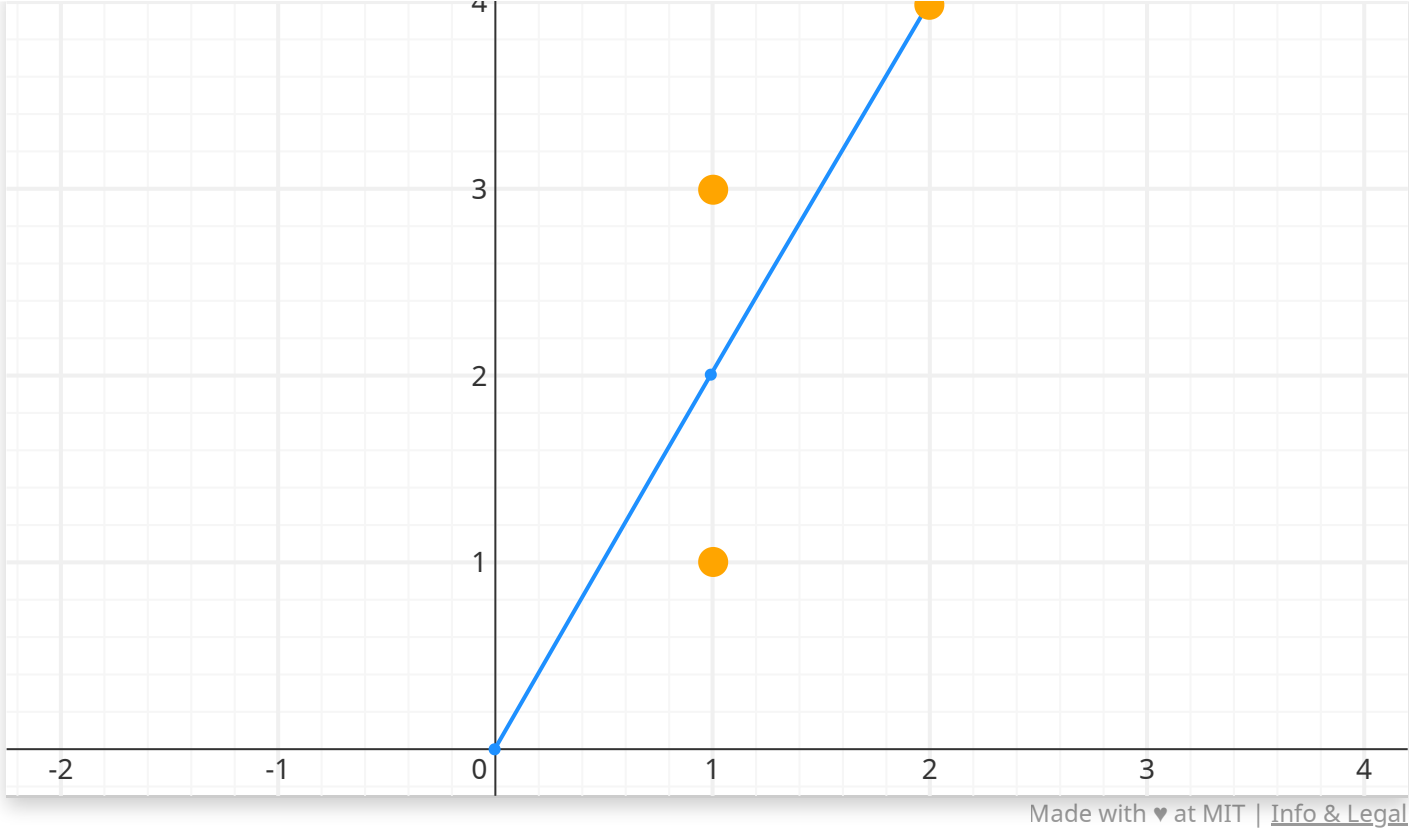
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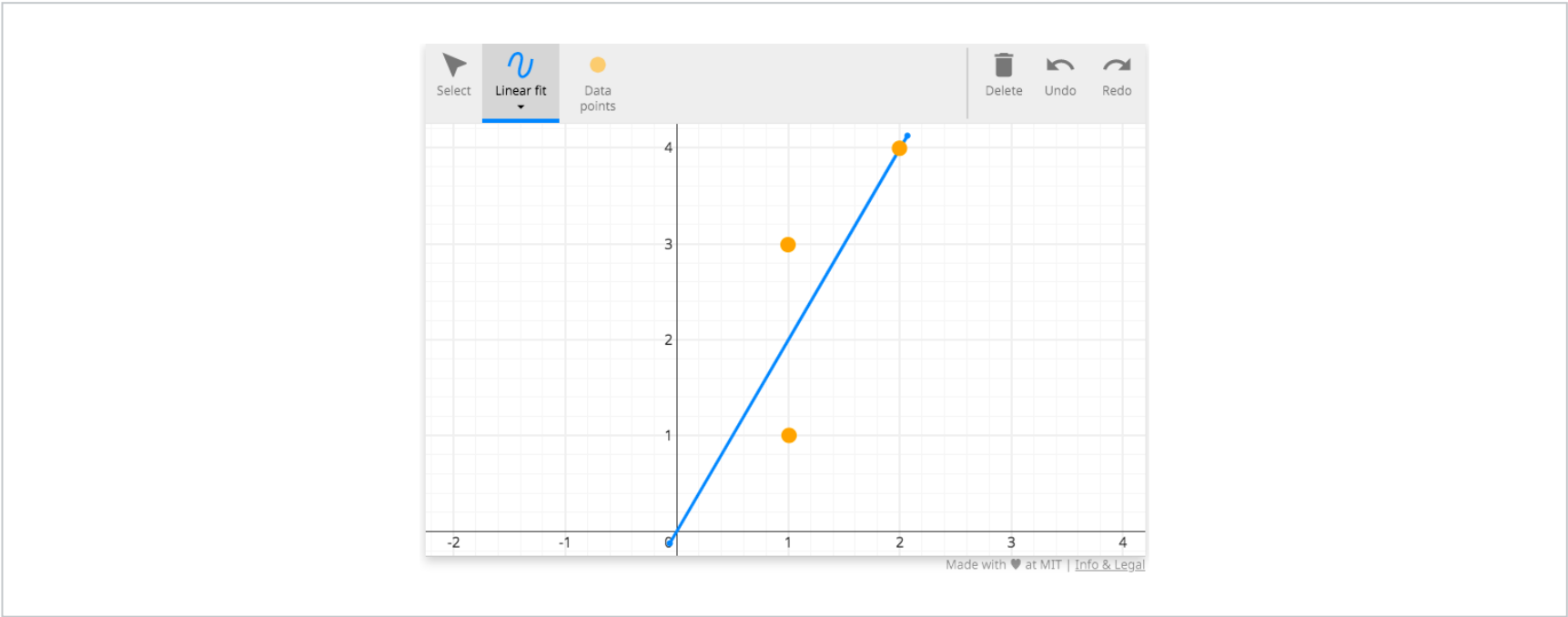


Answer: See solution.

Well done.

Solution:

The sketch of the three points and the line $y = 2x$ is shown below.



Submit

You have used 1 of 25 attempts

i Answers are displayed within the problem

7(c)

2.0/2 points (graded)
Transform the data to find the best fit power law of the form $y = cx^d$ for the same data: (1, 1), (1, 3), (2, 4).

Find c and d .

$c =$

1.732051

✓ Answer: sqrt(3)

$d =$

1.2075187

✓ Answer: 2-ln(3)/ln(4)

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Solution:

Trying to fit a power law to this data gives us a new set of data

$(\ln(1), \ln(1)) = (0, 0)$

(4.257)

$(\ln(1), \ln(3)) = (0, \ln(3))$

(4.258)

$(\ln(2), \ln(4)) = (\ln(2), 2\ln(2))$

(4.259)

Next we compute the necessary sums:

$$\sum_{i=1}^3 x_i = 0 + 0 + \ln(2) = \ln(2)$$

(4.260)

$$\sum_{i=1}^3 x_i^2 = 0 + 0 + (\ln(2))^2 = (\ln(2))^2$$

(4.261)

$$\sum_{i=1}^3 x_i y_i = 0(0) + 0(\ln(3)) + \ln(2)(2\ln(2)) = 2(\ln(2))^2$$

(4.262)

$$\sum_{i=1}^3 y_i = 0 + \ln(3) + \ln(4) = \ln(3) + \ln(4)$$

(4.263)

We solve the system:

$(\ln(2))^2 a + \ln(2) b = 2(\ln(2))^2$

(4.264)

$\ln(2) a + 3b = \ln(3) + \ln(4)$

(4.265)

We divide through the first equation by $\ln(2)$ and subtract from the second equation to get

$2b = \ln(3) \quad \longrightarrow \quad b = \ln(3)/2.$

Solving for a this gives $a = (2 - \frac{\ln 3}{\ln 4})$.

This gives the best fit line $\ln(y) = (2 - \frac{\ln 3}{\ln 4}) \ln(x) + \ln(3)/2$. Exponentiating we get $y = \pm \sqrt{3} x^{2 - \ln 3 / \ln 4}$. Because all of our data is positive, we can assume the best fit is with the positive multiplicative constant $\sqrt{3}$.

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You have used 1 of 15 attempts

i Answers are displayed within the problem

7(d)

2.0/2 points (graded)

Transform the data to find the best fit exponential curve of the form $y = ce^{kx}$ for the same data: $(1, 1), (1, 3), (2, 4)$.

Find c and k .

$c =$

0.750000

✓ Answer: 3/4

$k =$

0.8369882

✓ Answer: ln(4)-ln(3)/2

Solution:

Trying to fit a power law to this data gives us a new set of data

$$(1, \ln(1)) = (1, 0)$$

(4.266)

$$(1, \ln(3)) = (1, \ln(3))$$

(4.267)

$$(2, \ln(4)) = (2, 2 \ln(2))$$

(4.268)

Next we compute the necessary sums:

$$\sum_{i=1}^3 x_i = 1 + 1 + 2 = 4$$

(4.269)

$$\sum_{i=1}^3 x_i^2 = 1^2 + 1^2 + 2^2 = 6$$

(4.270)

$$\sum_{i=1}^3 x_i y_i = 1(0) + 1(\ln(3)) + 2(\ln(4)) = \ln(3) + 2 \ln(4)$$

(4.271)

$$\sum_{i=1}^3 y_i = 0 + \ln(3) + \ln(4) = \ln(3) + \ln(4)$$

(4.272)

We solve the system:

$$6a + 4b = \ln(3) + 2 \ln(4)$$

(4.273)

$$4a + 3b = \ln(3) + \ln(4)$$

(4.274)

Multiplying the first equation by 2 and the second equation by 3 and subtracting, we get

$$12a + 8b = 2 \ln(3) + 4 \ln(4)$$

(4.275)

$$12a + 9b = 3 \ln(3) + 3 \ln(4)$$

(4.276)

$$b = \ln(3) - \ln(4) = \ln(3/4)$$

(4.277)

Solving for *a* this gives

$$4a + 3(\ln 3 - \ln 4) = \ln(3) + \ln(4)$$

(4.278)

$$4a = -2 \ln(3) + 4 \ln(4)$$

(4.279)

$$a = \ln(4) - \ln(3)/2$$


(4.280)

Transforming back we get *a* = *k*, and *b* = ln(3/4) = ln(*c*). Thus *c* = 3/4.

This gives the best fit exponential using this method is *y* = 3/4*e*^{ln(4/√3)*x*}.

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You have used 1 of 15 attempts

 Answers are displayed within the problem

5. Data fitting


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 Z(b).

Please reformulate the question statement to state that the "best fit" to sketch is within the domain shown

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<input checked="" type="checkbox"/>	Q2-3 Can someone please explain the exact method for finding c and d in power law and c and k in exponential cause I've read about it on...	2
<input checked="" type="checkbox"/>	[STAFF] question about explanation in answer to 7(c).	3
	Matlab So I tried to throw all those data points into matlab and try to find the coefficients using curve fitting toolbox, somehow, the value ob...	7
	Deadline extension Is it possible to get maybe 2 more days extension on the deadline for Unit 3? We are starting both grade school and university right ...	4
	[Staff] Acknowledgment/Question about final exam. Thanks to RStudio IDE, I was able to avoid having to solve the last two questions-- 7c and 7d-- by hand. I believe I'd be willing to try...	3
	SketchInput not loading in Firefox If the same happens to you try Chrome - it worked there for me.	2
<input checked="" type="checkbox"/>	Stumped on 7c Are we supposed to take the sum of squares of logarithms? I'm not sure if I'm doing it right.	8
	[Staff] Garbled Equation	2
<input checked="" type="checkbox"/>	[Staff] 7.(c) Grader for coeff d Community TA	5

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1 min + 4 activities

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