7. Exponential law

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Lecture due Sep 13, 2021 20:30 IST Completed

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The world is full of relationships that are not linear, nor power laws.

Another common relationship between data is exponential fits.

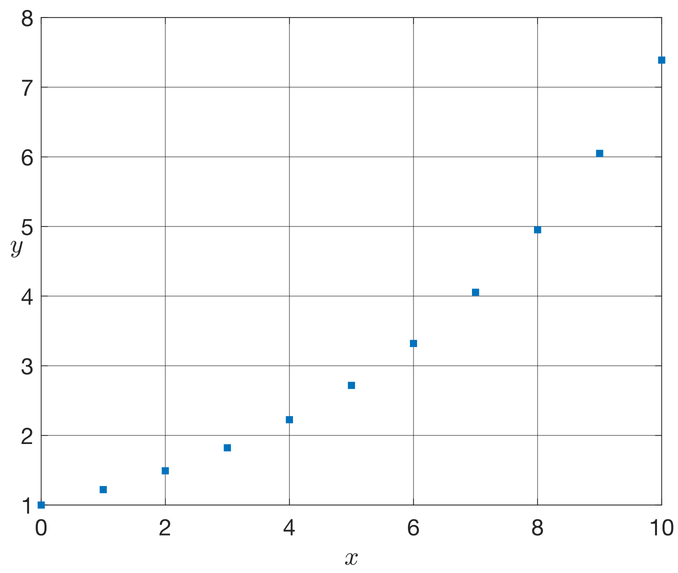
Examples 7.1

- Populations of bacteria and animals commonly grow and decay exponentially.
- For many years, computer processing speeds and memory have been growing exponentially (recently limits due to the laws of physics have slowed this growth).

Exponential fitting

1/1 point (graded)

How can you transform data that satisfies a relationship $y_i = ce^{kx_i}$ to use least squares approximation to find the constant k?



Use least squares linear fitting on the data:

- ( ) x and y
- ( ) $\ln x$ and $\ln y$
- (•) x and $\ln y$
- ( ) $\ln x$ and y

✔

Solution:

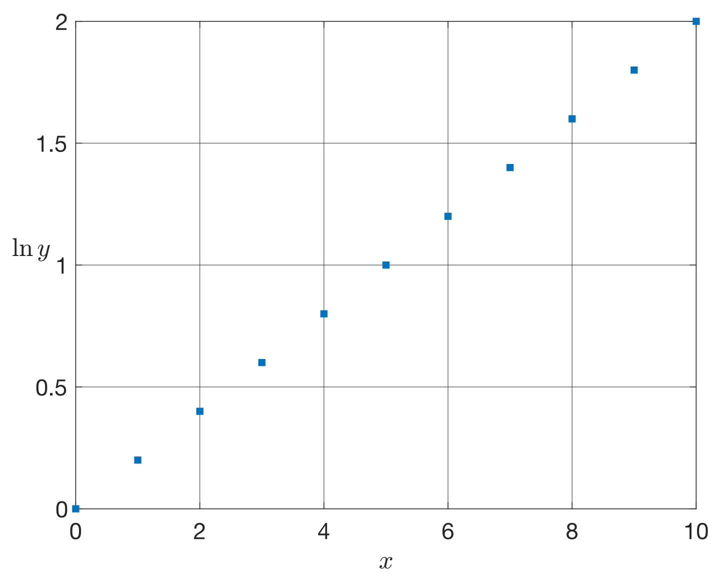
Taking the natural logarithm of the expected relationship, we get the following:

$$\begin{aligned} \ln(y_i) &= \ln(ce^{kx_i}) \quad (4.215) \\ &= \ln c + \ln e^{kx_i} \end{aligned}$$

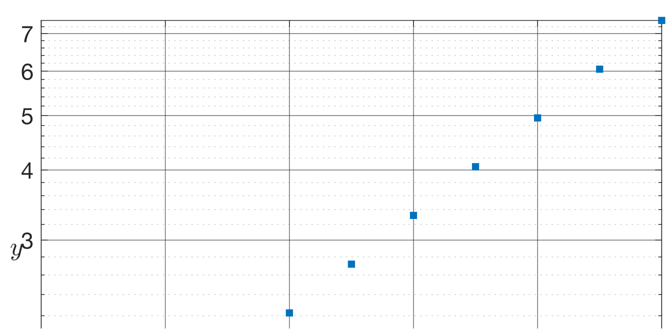
Calculator Hide Notes

$$= \ln c + kx_i \tag{4.217}$$

Note that $\ln y_i$ and x_i have a linear relationship, and the multiple in the exponential rule is the slope.



Note that you can visually see this relationship by changing the axes and plotting x linearly and plotting y on log scale. Such a plot is called a semi-log plot.



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