NOTES ON log-LINEAR AND log-log PLOTS

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1. log-LINEAR PLOTS

When analyzing data, more often than not, the generic pattern represented by the data not directly clear, unless the data is clearly linear. If this is not the case, a natural next step is to plot the $\log y$ instead of the y value directly. Such a plot is called the *log-linear* or semilog plot.

Let's imagine the data does in fact fit an exponential function of the form $f(x) = y = ab^x$. Then when we plot $\log y$, we are actually plotting:

$$\log y = \log (ab^x) = \log (a) + x \log (b)$$

Now since a and b are just constants, $c_1 = \log a$ and $c_2 = \log b$ are just constants as well, and this means when we plot $\log y$, we are plotting the linear function $c_1 + c_2 x$.

This tells us that if we plot the data on a semilog plot, and it seems to look linear, the original plot was likely an exponential.

2. log-log PLOTS

Another alternative way to plot data which doesn't immediately look linear, is a log-log plot. This means we plot $\log x$ on the x-axis, and $\log y$ on the y-axis.

To see why we might want to do this, we imagine that the data does happen to be represented by the power function $y = ax^b$. Then we can calculate:

$$\log y = \log \left(ax^b\right) = \log a + b \log x$$

and since a is a constant, $c = \log a$ is also a constant, so we have written $\log y = c + b \log x$ for two constants c and b, which means $\log y$ is a linear function of $\log x$, so when we plot these against one another, we get a linear plot.

In summary:

1. **If the semilog plot looks linear: the data is modeled by an exponential.**
2. **If the log-log plot looks linear: the data is modeled by a power function.**

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