Problem 2, Part b, c

The rule of 72 gives *annual* growth rates, so there is no need to divide by the number of years. I fumbled that part a bit.

Problem 2, Part d

To standardize a random variable, you subtract the mean and divide by the *standard deviation*. But the problem tells us to divide by the variance instead. The mean is

$$\begin{aligned} E[z] &= E\left[\frac{x-6}{4}\right] \\ &= E[x/4] - E[6/4] \\ &= \frac{1}{4}E[X] - \frac{6}{4} \\ &= \frac{6}{4} - \frac{6}{4} \\ &= 0. \end{aligned}$$

Then for variance,

$$\begin{aligned} Var(z) &= Var\left(\frac{x-6}{4}\right) \\ &= \frac{1}{4^2}\left[Var(x) + \underbrace{Var(6)}_{0}\right] \\ &= \frac{4}{16} \\ &= 1/4 \\ \implies \quad \sigma &= 1/2. \end{aligned}$$

The moral of the story is this: to find the new standard deviation, just take the old standard deviation (2) and divide it by whatever is in the denominator. For example,

$$SD\left(\frac{x-6}{4}\right) = \frac{2}{4},$$
$$SD\left(\frac{x-6}{2}\right) = \frac{2}{2},$$
$$SD\left(\frac{x-6}{7}\right) = \frac{2}{7}.$$

This problem asks for the top one. Therefore the standard deviation is $\sigma = 1/2$.

Question 3, part a

So freduse doesn't work for everyone. Here's how you can import it manually. First, download SPASTT01USM661 from at `https://fred.stlouisfed.org/series/SPASTT01USM661N` and import it into Stata (use the csv). Then type in the following:

```
generate date2 = date(date, "YMD")
generate months = mofd(date2)
tsset months, monthly
```

Now you should be able to do the time series stuff, e.g. `tsline spastt01usm661n`.

Question 3, part f

The canonical way: look at the difference in logs. It's about 3.5. That's over a span of about 58 years, so the answer is $3.8/58 \approx 6\%$.

The alternative way: remember how I repeated "the slope of `lnSPA` is the growth rate" like, six times? Yeah, well, If we find the line of best fit, then that gives the approximate monthly growth rate (since data is in terms months). So if you enter the command `regress spastt01usm661n months`, the coefficient for months gives the average monthly rate, which can bee seen as the slope of `twoway line lnSPA months || lfit lnSPA months` So that'll be a better answer than "some nonsense." Take the coefficient of .0057797, which is monthly, times 12 months, to get around 6.9% annual. The two approaches differ a bit because both are approximations. Also, *use the canonical approach.*