In class exercise: Let's play with exponential growth

Jesse Brunner

I'd like for you to get comfortable playing with the exponential and difference equations we saw in the reading. There is nothing like trying to apply something you read about to see how well you understood things!

Imagine you invested $1000 in a mutual fund with an average 8% annual yield[1]), how much would you have in 50 years?

[1] For simplicity, assume the 8% is added to the principle at the end of each year. Also, you want to remember that 100% implies $\lambda = 1$ in our calculations, so what would 8% growth be?

How much less would you have if the yield were only 7.5%?

How much less would you have if the yield were 8% but you waited five years before investing your $1000 (i.e., you only had 45 years of time for your investment to grow)?

Imagine you spent $1000 on a terrific holiday with friends and put it on your credit card with a 19.99% APR. How long would it take you to pay off[2] the trip if you paid $100 per month? How much would that $1000 trip cost you overall?

[2] For this and the following questions, use the shiny app at https://brunnerlab.shinyapps.io/Payoff/

What if you only paid $50 per month? The minimum balance of $25 per month?

Why does the green "balance" line get steeper towards the end while the orange "cumulative interest" line flatten out?

Imagine you buy a house and takeout a 20 year loan for $100,000 at 4.5% APR. How much would your monthly payments have to be to finish paying in 240 months? How much interest would you have paid in total?

What if you were able to reduce the rate to 4.25%, and kept the 240 month time line? How much would your monthly payments be? How much money would you save?

What if you had a 4.5% APR, as before, but decided to increase your payments by $50 per month? How much sooner would you pay off the loan? How much interest would you save?

Given these results and your budding intuition for exponential growth, consider this scenario: A population of 100 zebra mussels is introduced into Moses lake without notice until three years later when the population has reached 1000! If you were able to remove 250 mussels per year, how many years from their discovery would it take to eradicate the mussels?