18785-Assignment 1

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Programming Language Used: Python

Libraries Used: csv, pandas, matplotlib, numpy, math

Question 1

A piece of paper is 1mm thick. Assuming you can fold it as many times as you want, how many folds would it take to exceed the height of Mount Everest at 8,848 m?

> Source Code : hw1_python_source.py -> q1_sol()

```
Number of folds: 24
```

Description: Use recursive function to calculate the thickness until it reaches the height.

Question 2

The volume of water in a reservoir decreases at an exponential rate, following v(t) = v(0)exp(-at) with a=0.1. How much time, t, does it take for the volume to decrease to less than one half of its initial volume, v(0)?

> Source Code : hw1_python_source.py -> q2_sol()

```
Time to take: 6.931471805599452 Time Units
Round to integer: 7 Time Units
```

Description: Simply solve the function $\frac{time=(ln(1/2)}{(-0.1))}$

Question 3

If you deposit $100 in a bank account that offers an annualized interest rate of 5) after one, two, three, four and five years?

> Source Code : hw1_python_source.py -> q3_sol()

```
year 1: $ 105
year 2: $ 110
year 3: $ 116
year 4: $ 122
year 5: $ 128
```

Description: New balance is depended on previous year balance.

Question 4

Suppose you want to buy a car worth $20,000. A financial institution can provide a loan with a monthly interest rate of 1%. What is the monthly payment to pay off the debt in one, two and three years (rounded to the nearest $)?

> Source Code : hw1_python_source.py -> q4_sol()

```
Monthly payment for one year: $1684
Monthly payment for two years: $842
Monthly payment for three years: $562
```

Description: Loan payment formula : $\frac{P=r(PV)}{1-(1+r)^{-n}}$

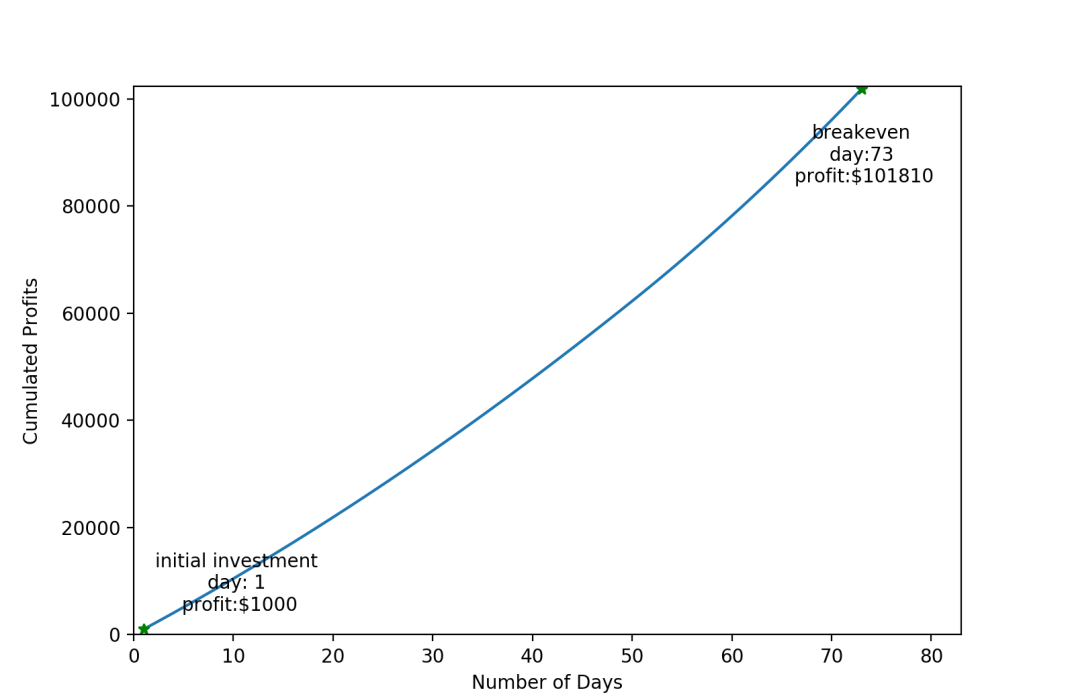
- P = payment
- PV = Present Value
- r= rate per period
- n=number of periods

Question 5

You are about to set up a new business and will invest $100,000. On day one you expect to have 100 customers and the number of customers will grow at a rate of 1% per day. If each customer provides profits of $10, how many days will it take to repay your initial investment based on cumulated profits? Plot cumulated profits per day, show initial investment and mark breakeven day.

> Source Code : hw1_python_source.py -> q5_sol()

```
Number of days: 73 days
```

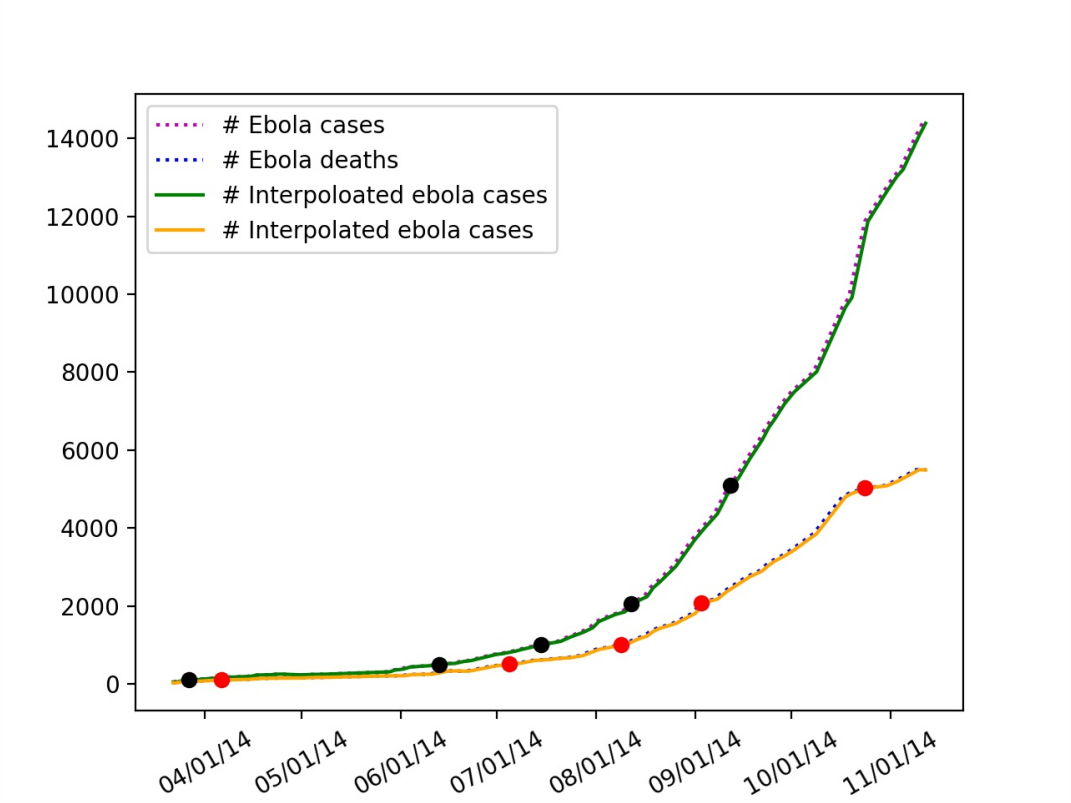


Description: Simply calculate everyday profit by giving grow rate and profits provided by each customer

Question 6

Using data from http://bit.ly/1JJyf29 and linear interpolation, estimate the dates when the number of cases and deaths due to Ebola exceeded 100, 500, 1000, 2000 and 5000. Graph the cases and deaths (observations and interpolations) and mark the dates when thresholds were exceeded with a circle.

> Source Code : hw1_python_source.py -> q6_sol()



# **Incidents**	**100**	**500**	**1000**	**2000**	**5000**
Day for Cases	2014-03-27	2014-06-13	2014-07-15	2014-08-12	2014-09-12
Day for Deaths	2014-04-06	2014-07-05	2014-08-19	2014-09-03	2014-10-24

Description: Used numpy libary with linear interpolation function and matplotlib.

Question 7

Using data from 2014, downloaded in previous question, what is the average growth rate per day, as a percentage, in the number of Ebola cases and deaths?

> Source Code : hw1_python_source.py -> q7_sol()

```
Average growth rate for cases: 2.50563%
Average growth rate for deathes: 2.33014%
```

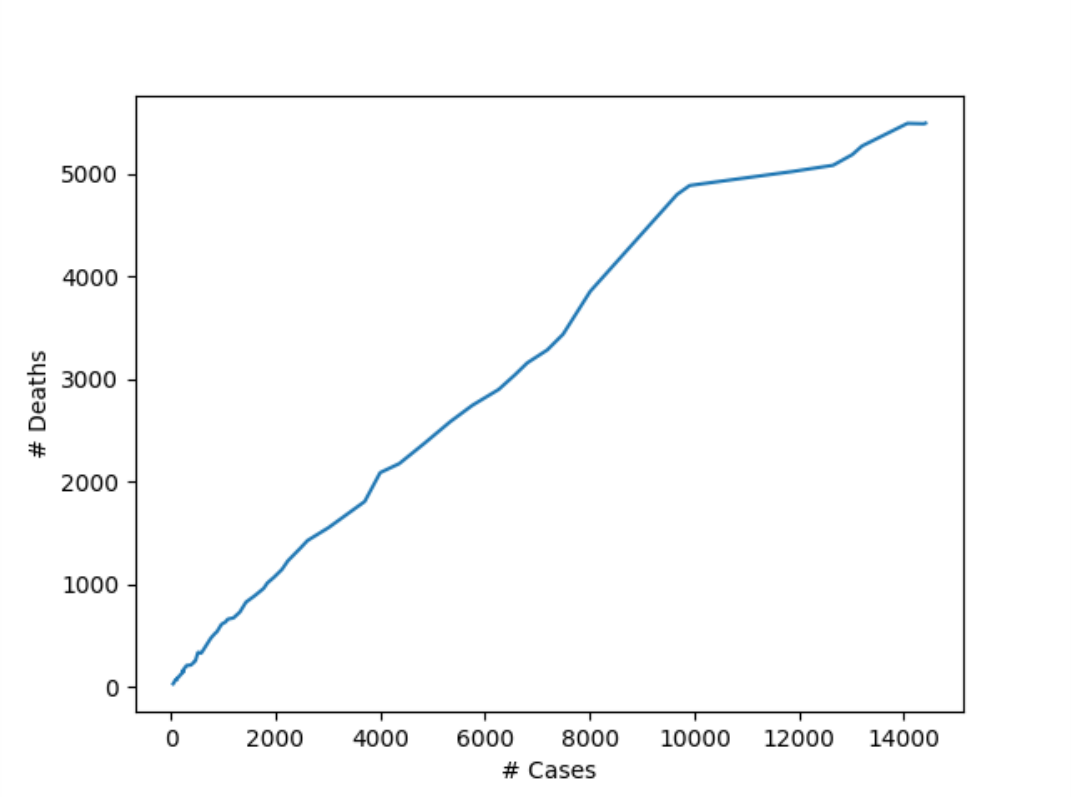
Description: Used the interploated data from `Question 6` to obtian everyday estimated data and calculate the average after summing up the increse rate.

Question 8

Using the same date, plot the number of deaths versus the number of cases and estimate the average ratio of Ebola deaths to cases.

> Source Code : hw1_python_source.py -> q8_sol()

```
Average ratio of Ebola deaths to cases: 55.86907%
```

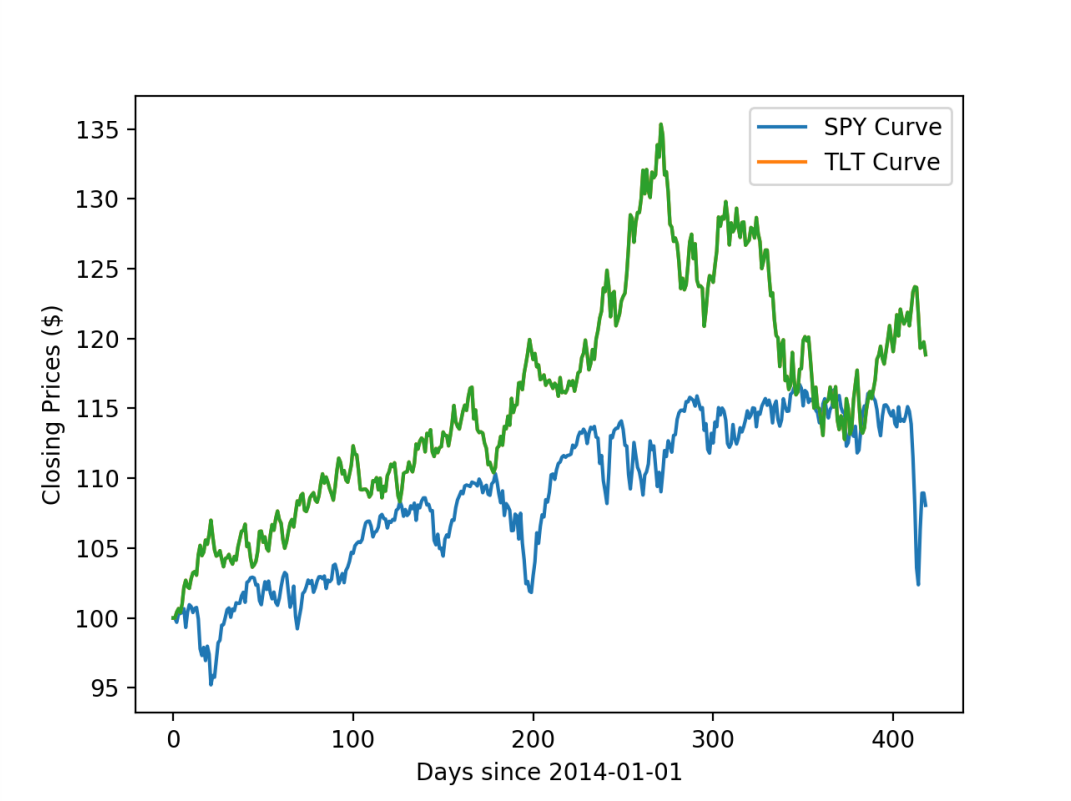


Description: Used the interploated data from `Question 6` to obtian everyday estimated everyday case data and death data.

Question 9

Obtain daily prices for two ETFs called 'SPY' and 'TLT' which track the S&P500 index and long-term Treasury Bond. Select the adjusted closing prices. Plot the two time series during 01/01/2014 08/31/2015 and make them comparable by starting from prices of $100 on the first day in 01/01/2014 – 08/31/2015.

> Source Code : hw1_python_source.py -> q9_sol()



Description: Calculate the normalization scale to SPY file and TLT file then make the plot.

Question 10

For the ETFs on previous question, calculate daily returns, r(t) = p(t)/p(t-1)-1, for each trading day in the same time period as above. Calculate the average, min and max daily return for each of the two ETFs during the time period and express these as percentages.

> Source Code : hw1_python_source.py -> q10_sol()

	Average Retrun(%)	**Minimum Return(%)**	**Maximum Return(%)**
SPY	3.8394	-4.2107	0.0217
TLT	2.5861	2.4325	0.0448

Description: Basic operations on array to get max, min and average.