

# Problem Solving - Part 2

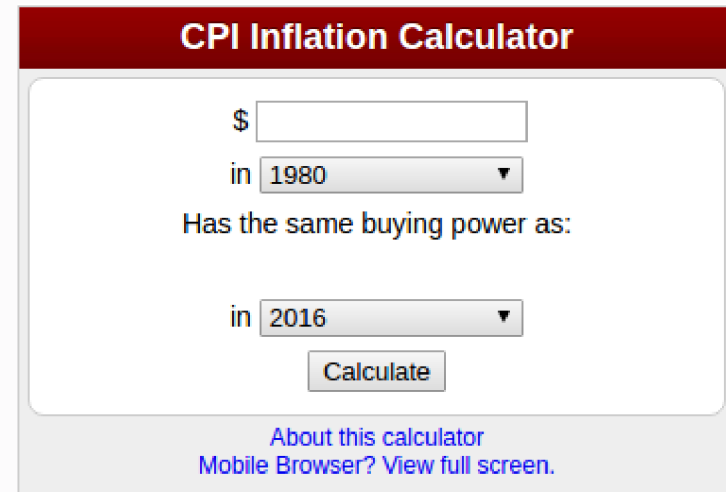
CORE-UA 109.01, Joanna Klukowska

**inflation**

# inflation

or what is your money going to be worth tomorrow?

- Each year things cost more than a year before.
- This is called **inflation**.
- U.S. Bureau of Labor Statistics provides the inflation calculator  
[http://www.bls.gov/data/inflation\\_calculator.htm](http://www.bls.gov/data/inflation_calculator.htm)



The image shows a screenshot of the 'CPI Inflation Calculator' interface. It features a dark red header with the title 'CPI Inflation Calculator'. Below the header, there is a text input field for a dollar amount, followed by a dropdown menu set to 'in 1980'. The text 'Has the same buying power as:' is displayed below. Another dropdown menu is set to 'in 2016'. A 'Calculate' button is positioned below the second dropdown. At the bottom of the interface, there are two blue links: 'About this calculator' and 'Mobile Browser? View full screen.'

- Using the inflation calculator we can find out what \$100 of some past year is worth these days.
- For the inflation rate data see *Current US Inflation Rates: 2006-2017* at  
<http://www.usinflationcalculator.com/inflation/current-inflation-rates/>

# inflation

- If you bought an item that cost \$100.00 ten years ago, how much would you need to spend today for an equivalent item? (or what amount of money has the same **buying power** as the \$100.00 from a decade ago)
- Guess:
  - Can you guess what \$100 from 2014 would be *equivalent to* in 2017?
  - How about \$100 from 1998 (this is roughly when you were born, isn't it)?
  - How about 1913 (the earliest year in the calculator)?

# why do we care about inflation?

- Say you are one of the college graduates of 2015 and you get a job paying \$50,000 a year with the guaranteed annual increase of 2%.
- Are you really making \$51,000 the following year?
- Nominally yes, but it is not worth the same as \$51,000 in the year that you were hired.

# correcting for inflation

(this is a simple approximation; for a more complete analysis we would need to use the consumer price index)

What is the inflation rate?

- If the \$100 in 2016 is equivalent to \$101.63 in 2017 (according to the inflation calculator from June 2016 to June 2017), then how can we figure out the inflation rate from 2016 to 2017?

$$\frac{\$101.63 - \$100.00}{\$100.00} = \frac{\$1.63}{\$100} = 0.0163$$

inflation rate: 1.63%

Inflation is a negative rate, it decreases the value of money.

- Your salary of \$51,000 in 2017 is worth only

$$\$51,000 \times (1 - 0.0163) = \$50,168.70$$

(if we think of 2016 as a baseline for the buying power of money).

Not a 2% increase!

# inflation summary

If the annual increase in one's salary is

- less than the inflation rate, the income effectively decreases
- more than the inflation rate, the income effectively increases

If an interest rate offered by a bank is

- below the inflation rate, the bank account is effectively losing value
- above the inflation rate, the bank account is effectively gaining value

# electricity bills



# electricity bills

- You may or may not be paying electricity bills, but one day you will and it is interesting to know how they work.
- If you use twice as much electricity in June as you did in February is your bill twice as big (assume that the price is still the same)?
- If so, we could calculate the amount of the bill as follows (note that electricity consumption is calculated in kilo-watt-hours, kwh):

*cost in a given month = price per one kwh × number of kwh used*

$$b(k) = \text{price} \times k$$

- (Note that the above formula will need to be adjusted to really represent the function that models electricity bills.)

# electricity bills

- Lane Electric is a power supplier company. Their website has a nifty calculator that allows one to estimate the amount of the monthly bill (see <http://laneelectric.com/tools/bill-estimator/>). Let's try to figure out if we can actually come up with a pattern.

kWh used	monthly price
25	\$14.05
50	\$16.10
75	\$18.15
100	\$20.20

- Can you figure out how much a single kWh of electricity costs?

Work with a partner (or two) to see if you can come up with a formula.

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Work with a partner (or two) to see if you can come up with a formula.

- The answer does not seem to be straight forward, does it?

But what if you knew that the same company will issue a bill for \$12.00 per month even if you do not use any electricity?

# electricity bills

- Here is the table again with the added column:

<b>kWh used</b>	<b>monthly price</b>	<b>monthly price - \$12.00</b>
25	\$14.05	\$2.05
50	\$16.20	\$4.10
75	\$18.15	\$6.15
100	\$20.20	\$8.20

- Can you figure out the pattern now?
- It seems that each 25 kWh of electricity costs exactly \$2.05.
- This means that 1 kW costs  $\$2.05/25$  or  $\$0.082$  or 8.2¢.
- And the bill can be calculated as

$$b(k) = 0.082 \times k + 12.00$$

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What other bills *behave* this way?

# try it yourself: car rental

- You are about to move and you need to rent a truck to transfer all your things from the old place to the new place. You did your research regarding available rental places. Here is the information you collected:

	<b>Watertown</b>	<b>U-Haul</b>	<b>Budget</b>	<b>Enterprise</b>
fixed cost	\$79.00	\$29.95	\$29.95	\$59.95
\$ per mile	0.00	\$1.39	\$0.99	\$0.59 (after the first 100 miles)

- Which company should you use?
  - for a very short move (just couple of blocks)?
  - for a very long move (the East Coast to Alaska)?
  - what about a medium size move, let's say 35 miles
- What is the function for price for each of those companies (this should be a function of miles driven).

**a picture is worth ...**

# example 1 - a simple plot

```
# these lines import plotting tools that
# we will need for this problem
import numpy as np
import matplotlib.pyplot as plt

# think of plt as our drawing canvas
# or a whiteboard

# first draw the plot
plt.plot([1,2,3,2,3,4,3,4,5])
# then show it to have a window pop-up with
# the actual plot
plt.show()
```

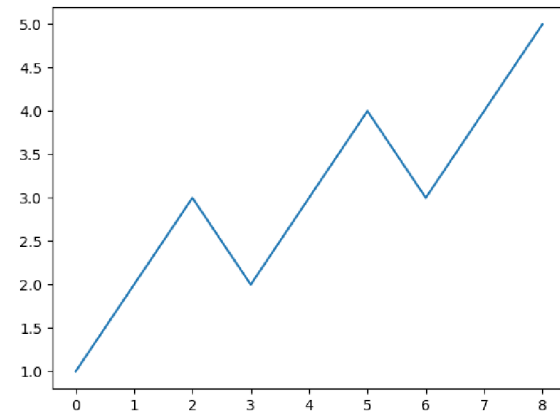


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```



# example 2 - quadratic function

```
import numpy as np
import matplotlib.pyplot as plt

# let's try to plot a quadratic function  $y = (x-3)^2 - 25$ 

# first let's get some points for the x axis np.linspace works similar to the range()
# function, but 1) both end points are included, 2) the last parameter states
# how many values we want, not the interval
x = np.linspace(0, 10.0, 6)

# now we calculate the corresponding y values
y = (x-3)**2 - 25

#finally, plot the graph and show it
plt.plot(x, y)
plt.show()
```

# example 2 - quadratic function

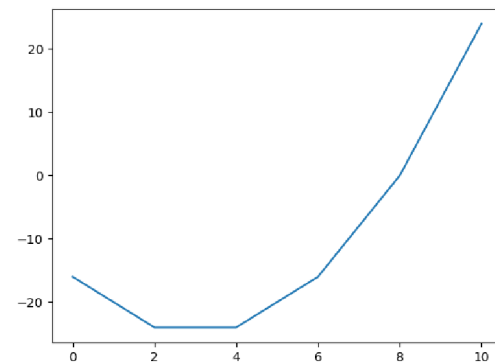
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plt.plot(x, y)
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# example 3 - electric bill

```
import numpy as np
import matplotlib.pyplot as plt

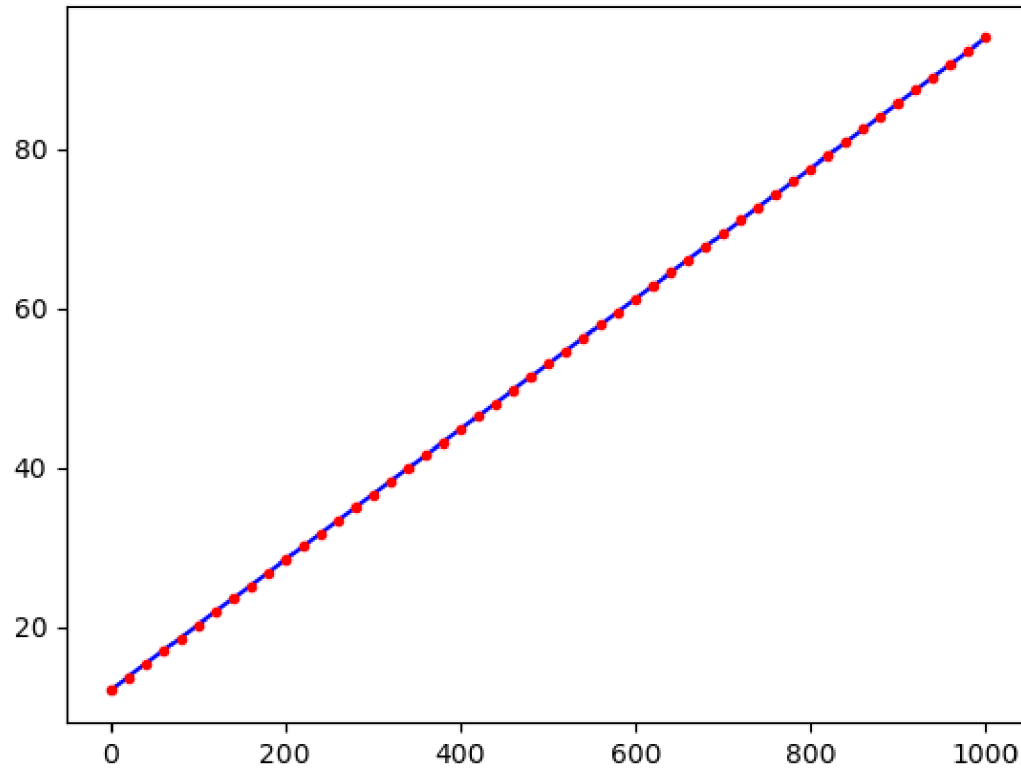
# let's try to plot the values of our electric bill from Lane
# Electric  $b(k)=0.082 * k + 12.00$ 

# we want the plot for number of kilo-watt-hours ranging from 0 to 1000,
# in increments of 20 kilo-watt-hours (so we need 51 points between 0 and 1000)
k = np.linspace(0, 1000.0, 51)

# we calculate the corresponding bill amount
b = 0.082 * k + 12

#finally, plot the graph and show it
plt.plot(k, b, 'b') # plot a blue line
plt.plot(k, b, 'r.') # mark each point with a red dot
plt.show()
```

# example 3 - electric bill



# example 4 - track rental <100 mi

```
import numpy as np
import matplotlib.pyplot as plt

# let's try to plot the cost of renting a track from each of the four
# companies - the price is a function of the milage driven

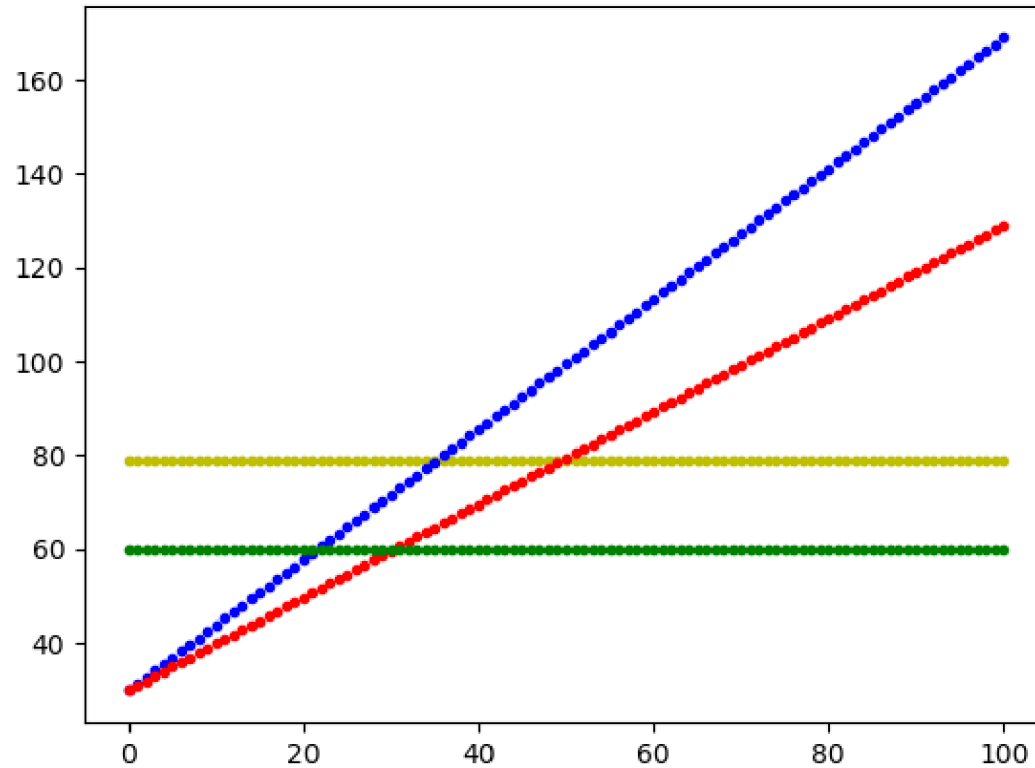
# we want the plot for number of miles ranging from 0 to 100
num_of_points = 101
miles = np.linspace(0, 100, num_of_points )

# we calculate the corresponding prices for each company
watertown = 79.0 * np.ones(num_of_points)
ahal = miles * 1.39 + 29.95
budget = miles * 0.99 + 29.95
enterprise100 = 59.95 * np.ones(num_of_points)

#finally, plot the graph and show it
plt.plot(miles, watertown, 'y.')
plt.plot(miles, ahal, 'b.')
plt.plot(miles, budget, 'r.')
plt.plot(miles, enterprise100, 'g.')
plt.show()

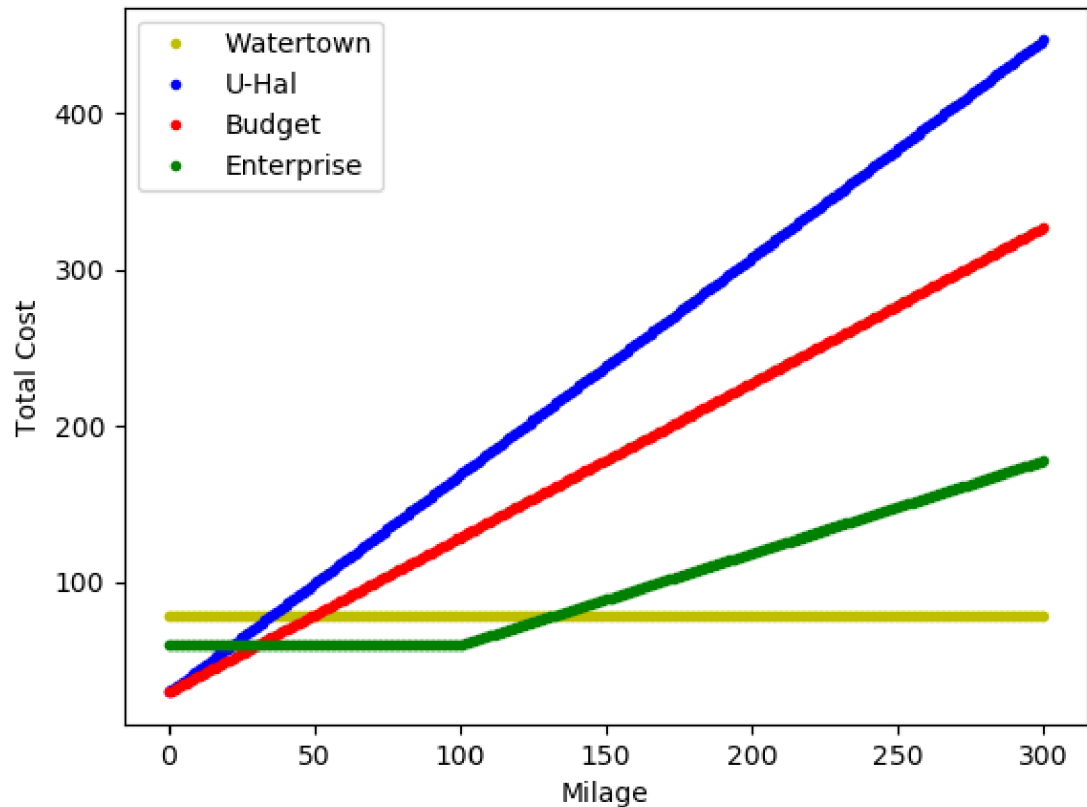
# save plot to file
plt.savefig('/home/asia/Data/NYU_Teaching/core109/code/plotting/CarRental_100.png')
```

# example 4 - track rental <100 mi



# example 5 - track rental >100 mi

There is too much code to see it on the slide: [example5.py](#).





# Programming challenge

Revisit the salaries of graduates from 2016.

- assume starting salary of \$50,000
- assume annual percentage increase of 2% Plot the salaries at the end of each year in the range 1 - 10. Hint: you will need to figure out the function that calculates that salary based on the given year number (we did that on the board last week).

Now consider inflation.

- assume that the inflation for the next ten years will be 1.6% a year Plot both, the salaries as calculated above and the salaries reduced by inflation.