Ethan Chang Problem Set 2 share

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1 BA222 Problem Set 2

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[1]:
```python
import pathlib
import numpy as np
import numpy.typing as npt
from typing import Any
import pandas as pd
import matplotlib.pyplot as plt
```

1.1 Part 1: Python Basics

1.1.1 Question 1: Compound Interest Calculator

[2]:
```python
# Question 1.a

def compound(K: float, r: float, T: float) -> float:
    """ Returns the dollar value of money (including the principal `K`),
        that will be had at the end of `T` years using rate `r`"""
    return round(K * (1 + r) ** T, 2)

assert(compound(1000, 0.05, 10) == 1628.89)
assert(compound(100, 0.04, 20) == 219.11)
```

[3]:
```python
# Question 1.b

if compound(5000, 0.06, 10) > compound(2500, 0.06, 25):
    print("$5,000 compounding for 10 years at a 6% interest rate is better")
else:
    print("$2,500 compounding for 25 years at a 6% interest rate is better")
```

```
$2,500 compounding for 25 years at a 6% interest rate is better
```

1.1.2 Question 2: Checking First and Last

[4]:

```
def first_last_same(arr: list) -> bool:
    """ Returns True if the first and last elements of `arr` are the same """
    return arr[0] == arr[-1]

assert(first_last_same([1, 0, 1]) == True)
assert(first_last_same([10, 9, 8, 7, 6]) == False)
```

1.2 Part 2: Numpy and Pandas

1.2.1 Question 3: Numpy Simulation and Drop-Shipping Business

[5]:

```
# Question 3.b-d
obs_price: np.ndarray = np.random.normal(20, 2, 1000)
obs_quant: np.ndarray = np.random.randint(100, 201, 1000)
obs_unit_cost: np.ndarray = np.random.normal(3, 0.5, 1000)
```

[6]:

```
def profit(price: Any, quantity: Any, unit_cost: Any, fixed_cost=500,␣
 ↪shipping=5) -> float | npt.ArrayLike:
    """ Returns the profit given the price, quantity, and unit cost """
    return price * quantity - (unit_cost + shipping) * quantity - fixed_cost
```

[7]:

```
# Question 3.e and f

profits = profit(obs_price, obs_quant, obs_unit_cost)

pd.DataFrame({'profits': profits}).describe()
```

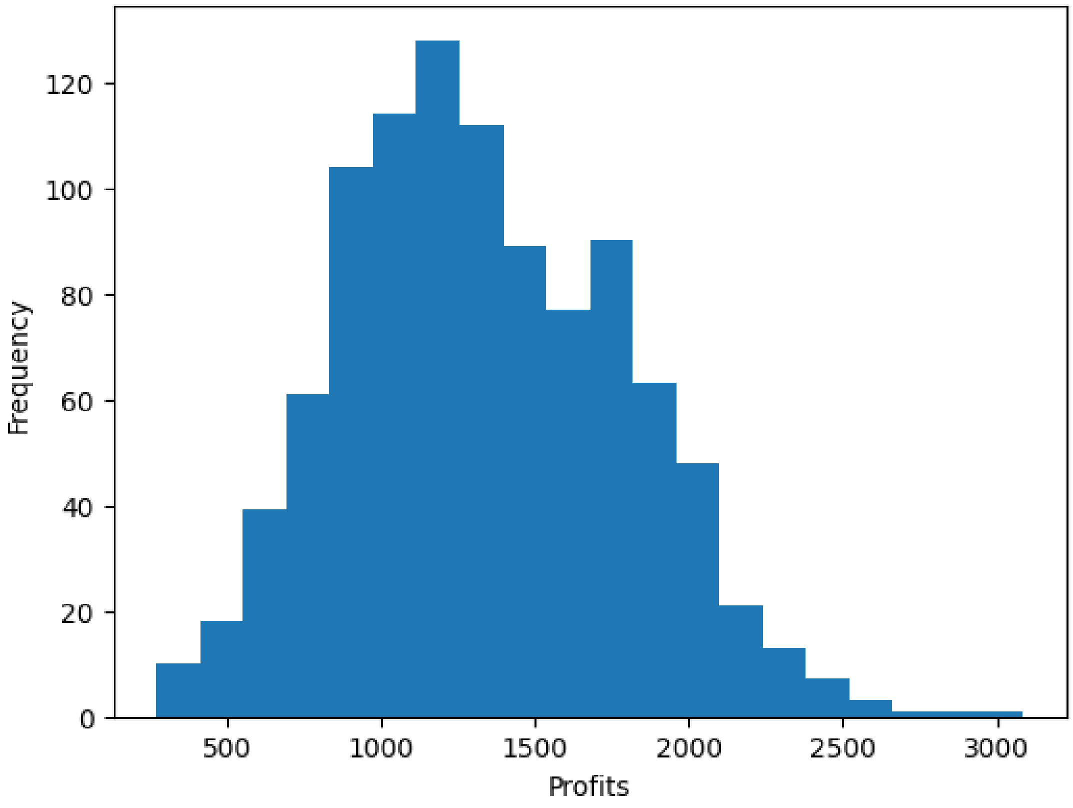
[7]:

```
           profits
count  1000.000000
mean   1331.593434
std     454.407492
min     268.080703
25%     994.621923
50%    1292.269149
75%    1674.082612
max    3084.858160
```

[8]:

```
# Question 3.g

plt.hist(profits, bins=20)
plt.xlabel('Profits')
plt.ylabel('Frequency')
plt.show()
```



The distribution is roughly normal, with a possible minor skew to the right due to the fixed costs.

1.2.2 Question 4: Real Data Analysis in Pandas

```
[9]: # Question 4.a

     # just in case you run the notebooks
     path = f'{pathlib.Path.cwd().parents[1]}/CSVs/CongressTerms.csv' if 'ethan' in␣
       ↪pathlib.Path.cwd().parts else 'CongressTerms.csv'

     congress = pd.read_csv(path)
     congress.head()
```

```
[9]:    congress chamber firstname lastname   birthday state party
     0       107   house  Benjamin   Gilman  12/6/1922    NY     R  \
     1       107   house     Ralph     Hall   5/3/1923    TX     D
     2       107   house     Henry     Hyde  4/18/1924    IL     R
     3       107   house     Ralph   Regula  12/3/1924    OH     R
     4       107   house    Carrie     Meek  4/29/1926    FL     D

        Incumbent(Dummy) termstart   age
```

```
0                  1  1/3/2001  78.1
1                  1  1/3/2001  77.7
2                  1  1/3/2001  76.7
3                  1  1/3/2001  76.1
4                  1  1/3/2001  74.7
```

[10]:

```
# Question 4.b

num_obs = len(congress)
print(f'There are {num_obs} observations in the dataset')

num_house = len(congress[congress['chamber'] == 'house'])
print(f'There are {num_house} House observations and {num_obs - num_house}␣
  ↪Senate observations')
```

```
There are 3822 observations in the dataset
There are 3098 House observations and 724 Senate observations
```

[11]:

```
# Question 4.c

# mean age of senators in the 107th session of congress
congress[(congress['congress'] == 107) & (congress['chamber'] ==␣
  ↪'senate')]['age'].mean()
```

[11]:

```
58.89903846153846
```

[12]:

```
# from congress['ages'] grab the index of max val, then loc to grab the row
congress.loc[congress['age'].idxmax()]
```

[12]:

```
congress                   107
chamber                 senate
firstname                   J.
lastname              Thurmond
birthday             12/5/1902
state                       SC
party                        R
Incumbent(Dummy)             1
termstart             1/3/2001
age                       98.1
Name: 442, dtype: object
```

Question 4.d

The value seems reasonable as James Strom Thurmond Sr. lived until he was 100.

[13]:

```
# Question 4.e

congress.query("(chamber == 'house') & (congress == 110)")['firstname'].
  ↪value_counts().head(1)
```

```
[13]: firstname
      John    30
      Name: count, dtype: int64
```