QF627 Programming and Computational Finance

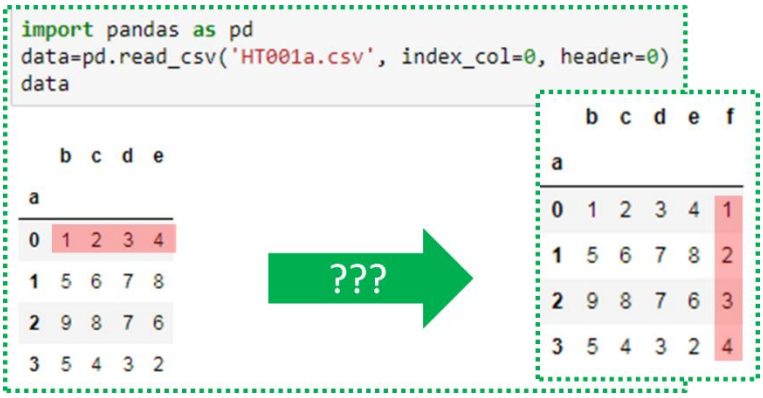
HWS0305: Data Manipulation and Visualization

(part 2)

In all the Python programs, we assume students will import Matplotlib, Pandas, Numpy and Scipy as the following:

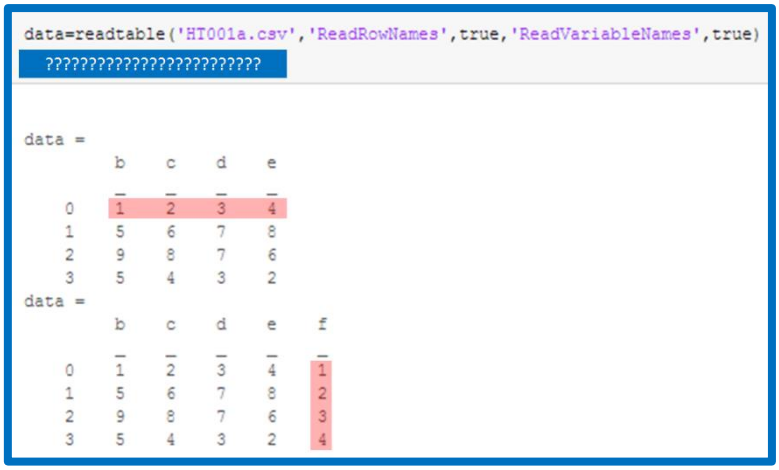
```
import matplotlib.pyplot as plt
import pandas as pd
import numpy as np
import scipy.stats as ss
```

Q1. (Python) Complete the following code **with one command** to add a column to **`data`** using the first row of **`data`**, and name this column **`f`**.




```
data['f']= pd.DataFrame(data.values[0, :])
```

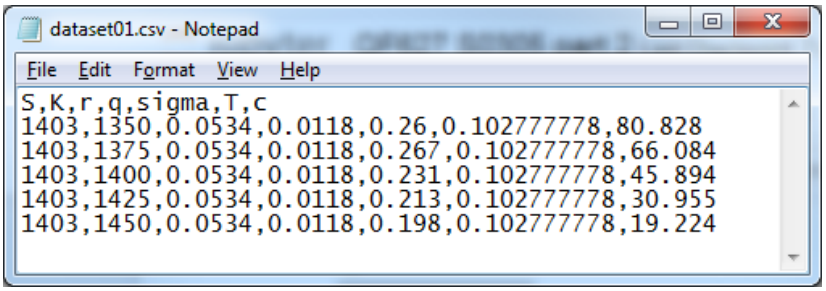
Q2. (MATLAB) Complete the following code **with one command** to add a column to **`data`** using the first row of **`data`**, and name this column **`f`**.




```
data.f=data{1,:}'
```

Q3. (Python) Follow the instructions to complete the computation.

1. **Use one command** with the Pandas library function **`pandas.read_csv`** to load data from the CSV file, **`dataset01.csv`**, using the first row as column names. Name the data as **`data`**.




```
data = pd.read_csv('dataset01.csv', header=0)
```

2. Define a function, **`option_BS`**, which computes and returns the European call option price using the following formula:

$$c = S \cdot e^{-q \cdot T} \cdot \Phi(d_1) - K \cdot e^{-r \cdot T} \cdot \Phi(d_2)$$

where

$$d_1 = \frac{\ln\left(\frac{S}{K}\right) + \left(r - q + \frac{\sigma^2}{2}\right)T}{\sigma\sqrt{T}} \text{ and } d_2 = d_1 - \sigma\sqrt{T}$$

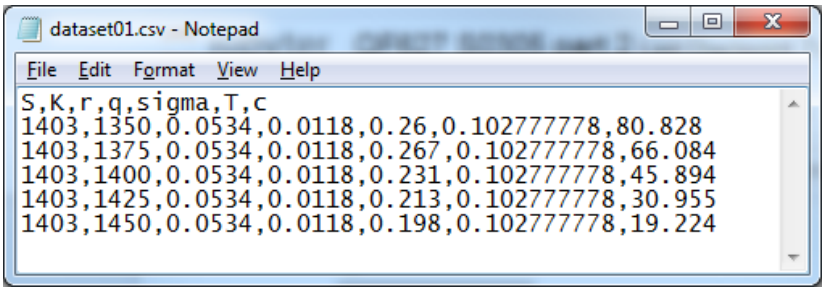
```
def option_BS(S,K,T,r,q,sigma):
    d1=(np.log(S/K)+(r-q+sigma**2/2)*T)/(sigma*np.sqrt(T))
    d2 = d1 - sigma*np.sqrt(T)
    return S*np.exp(-q*T)*ss.norm.cdf(
           d1)-K*np.exp(-r*T)*ss.norm.cdf(d2)
```

3. **Use one command** with the Pandas library function **`pandas.DataFrame.apply`** to compute the European call option price for each row of **`data`** and add the results to **`data`** as a new column, and name this column as **`BS`**.

```
data['BS'] = data.apply(lambda x: option_BS(x['S'],x['K'],x['T']
                        ,x['r'],x['q'], x['sigma']), axis=1)
```

Q4. (MATLAB) Follow the instructions to complete the computation.

1. **Use one command** to load data from the CSV file, **`dataset01.csv`**, using the first row as column names. Name the data as **`data`**.




```
data=readtable('dataset01.csv','ReadVariableNames',true)
```

2. Define a function, **`option_BS`**, which computes and returns the European call option price using the following formula:

$$c = S \cdot e^{-q \cdot T} \cdot \Phi(d_1) - K \cdot e^{-r \cdot T} \cdot \Phi(d_2)$$

where

$$d_1 = \frac{\ln\left(\frac{S}{K}\right) + \left(r - q + \frac{\sigma^2}{2}\right)T}{\sigma\sqrt{T}} \text{ and } d_2 = d_1 - \sigma\sqrt{T}$$

```
function [V]=option_bs(S, K, r,q,sigma,T,c)
d1=(log(S/K)+(r-q+sigma^2)*T)/(sigma*sqrt(T));
d2=d1-sigma*sqrt(T);
V=S*exp(-q*T)*normcdf(d1)-K*exp(-r*T)*normcdf(d2);
end
```

3. **Use one command** with library function **`rowfun`** to compute the European call option price for each row of **`data`** and add the results to **`data`** as a new column, and name this column as **`BS`**.

```
BS=rowfun(@option_bs,data)
data{:,'BS'}=BS{:,1}
```