Instructions:
Be verbose. Explain clearly your reasoning, methods, and results in your written work.

No code is necessary, but including it in your answer could result in partial credit.

Written answers are worth 10 points per question. 4 questions total – 40 possible points.

1 extra credit problem at the end is worth 10 points.

Total available points on this exam is 50.

1. Answers should be formatted as a PDF. You may convert your Python notebook, if you use one, directly to PDF.
2. At the top of your response, please type your name exactly as you call it in the data generation script (see below). Also copy and paste the "Hashed Name" value output.
3. Restate the question along with the question number before each answer
4. When finished, email your PDF directly to me along with your code.
5. Do not check code or answers into your repository until after the exam is completed by all.

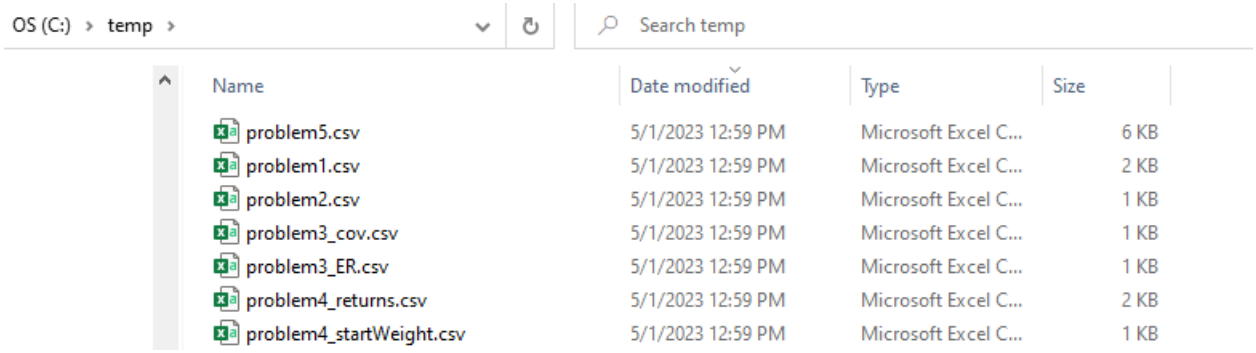
Data for problems is generated by script. The script is available in my Github Repository in Final/datageneration.py. Use your name and a location on your file system to save CSV files as inputs to the program.

For example:

python .\generatedata.py "Dominic Pazzula" "c:\\temp"

```
PS C:\Users\dpazzula\OneDrive - dumac.duke.edu\Documents\FinTech-545-Spring2023\Final> python .\datageneration.py "Dominic Pazzula" "c:\\temp"
Writing Random Values for Dominic Pazzula into c:\\temp
Hashed Name:  68d54ad2b374ba4a8649e1390fa99d1665500b68
Problem1 written successfully.
Problem2 written successfully.
Problem3 written successfully.
Problem4 written successfully.
Problem5 written successfully.
```

Each problem has 1-2 CSV files to use as inputs.



Because the data is keyed to you and you alone, make sure you put your name, exactly how you called the function, in your answer. Failure to do so will result in me generating incorrect data to grade your responses. I recommend keeping a copy of the input files until after grades are released – if a question comes up, I might need to look at those files.

You may use your notes and the internet. You may not work with other students – all work must be your own. You may not copy an answer directly from an internet source. Any reference to a source outside the notes must be attributed.

All students will be held to the Duke Community Standard

Duke's Community Standard:

Duke University is a community dedicated to scholarship, leadership, and service and to the principles of honesty, fairness, respect, and accountability. Citizens of this community commit to reflect upon and uphold these principles in all academic and non-academic endeavors, and to protect and promote a culture of integrity.

To uphold the Duke Community Standard:

1. I will not lie, cheat, or steal in my academic endeavors,
2. I will conduct myself honorably in all my endeavors; and
3. I will act if the Standard is compromised.

1. Using the data in “problem1.csv”
    a. Calculate Log Returns (2pts)
    b. Calculate Pairwise Covariance (4pt)
    c. Is this Matrix PSD? If not, fix it with the “near_psd” method (2pt)
    d. Discuss when you might see data like this in the real world. (2pt)

2. “problem2.csv” contains data about a call option. Time to maturity is given in days. Assume 255 days in a year.
    a. Calculate the call price (1pt)
    b. Calculate Delta (1pt)
    c. Calculate Gamma (1pt)
    d. Calculate Vega (1pt)
    e. Calculate Rho (1pt)

    Assume you are long 1 share of underlying and are short 1 call option. Using Monte Carlo assuming a Normal distribution of arithmetic returns where the implied volatility is the annual volatility and 0 mean
    f. Calculate VaR at 5% (2pt)
    g. Calculate ES at 5% (2pt)
    h. This portfolio’s payoff structure most closely resembles what? (1pt)

3. Data in “problem2_cov.csv” is the covariance for 3 assets. “problem3_ER.csv” is the expected return for each asset as well as the risk free rate.
    a. Calculate the Maximum Sharpe Ratio Portfolio (4pt)
    b. Calculate the Risk Parity Portfolio (4pt)
    c. Compare the differences between the portfolio and explain why. (2pt)

4. Data in “problem4_returns.csv” is a series of returns for 3 assets. “problem4_startWeight.csv” is the starting weights of a portfolio of these assets as of the first day in the return series.
    a. Calculate the new weights for the start of each time period (2pt)
    b. Calculate the ex-post return attribution of the portfolio on each asset (4pt)
    c. Calculate the ex-post risk attribution of the portfolio on each asset (2pt)

5. Input prices in “problem5.csv” are for a portfolio. You hold 1 share of each asset. Using arithmetic returns, fit a generalized T distribution to each asset return series. Using a Gaussian Copula:
    a. Calculate VaR (5%) for each asset (3pt)
    b. Calculate VaR (5%) for a portfolio of Asset 1 &2 and a portfolio of Asset 3&4 (4pt)
    c. Calculate VaR (5%) for a portfolio of all 4 assets. (3pt)