Assignment 3   **Prof. Hsu**

This assignment must be submitted by the beginning of class on **Thursday, Nov.** 6th, **2025**. No late submissions will be accepted. The assignment questions are to be completed in group. You may complete all the problems entirely in the MS Excel spreadsheet. You can also complete it using word documents with Excel spreadsheet attachments. Please HIGHLIGHT your final answers. The assignment will be marked based on (1) how you arrive at the solution, (2) is the solution correct or does it make sense? (3) the presentation of your results. Remember, you must present your work in a clear and concise manner. Show your work! **Please keep in mind that copying assignments from past years is considered a honor code violation, and it will hurt your ability to perform on the exams.**

1. *Utility and Risk Aversion - 10 points*

   Consider three investors with different levels of risk aversion: $A_1 = 2$, $A_2 = 3.5$, and $A_3 = 5$. Each investor evaluates three portfolios: **L** (Low-Risk), **M** (Moderate-Risk), and **H** (High-Risk). The risk-free rate is $r_f = 2\%$. Assume mean-variance utility function. The portfolios are summarized in the table below:

Portfolio	Expected Return	Standard Deviation
L	4%	5%
M	6%	10%
H	10%	20%

   a. Calculate the utility for each portfolio (**L**, **M**, and **H**) for all three investors $A_1 = 2$, $A_2 = 3.5$, and $A_3 = 5$. Identify the portfolio that maximizes each investor's utility.

   b. Discuss how the level of risk aversion affects the choice of portfolio. Why would a more risk-averse investor avoid higher-risk portfolios?

2. *CAL - 30 points*

   You manage a risky portfolio with an expected rate of return of 12% and a standard deviation of 28%. The T-bill rate is 2%.

   a. Your client chooses to invest 70% of a portfolio in your fund and 30% in an essentially risk-free money market fund. What are the expected value and standard deviation of the rate of return on her portfolio?

   b. Suppose that your risky portfolio includes the following investments in the given proportions:

Asset	Proportion
Stock A	25%
Stock B	32%
Stock C	43%

What are the investment proportions of each asset in your client's overall portfolio, including the position in T-bills?

c. What is the Sharpe ratio of:

  i. Your risky portfolio?

  ii. Your client's?

d. Draw the CAL of your portfolio on an expected return–standard deviation diagram. What is the slope of the CAL? Show the position of your client on your fund's CAL.

3. *Mean-Variance Portfolio - 30 points*

Greta has a risk aversion of $A = 3$ and a 1-year investment horizon. She is considering two portfolios: the S&P 500 and a hedge fund. (All rates are annual and continuously compounded.)

- The S&P 500 risk premium is estimated at 5% per year, with a standard deviation of 20%.

- The hedge fund's risk premium is estimated at 10% per year, with a standard deviation of 35%.

- The hedge fund claims the correlation between the annual returns of the S&P 500 and the hedge fund in the same year is zero, though Greta is skeptical.

Using the information above, answer the following questions:

a. Compute the Sharpe ratios for both portfolios (S&P 500 and hedge fund).

b. Assuming the correlation between the annual returns on the two portfolios is zero:

  i. What would be the optimal asset allocation?

  ii. What should Greta's capital allocation be? *(Hint: Capital allocation is deciding the allocation between risky and risk-free assets. The allocation depends on risk aversion.)*

c. If the correlation coefficient between the two portfolios' annual returns is 0.3:

  i. What is the covariance between the returns?

  ii. Recompute the optimal asset allocation and capital allocation with this new correlation. compare with part (b) and discuss the impact of correlation on optimal strategy for Greta.

4. *Black-Litterman - 30 points*

   Calculate the optimal weights, the expected excess return, standard deviation and Sharpe ratio of the optimal portfolio under these assumptions:

   - Use data from the Black-Litterman Excel template
   - Their current respective market weights are U.S. (50%), Foreign (40%), Emerging (10%)
   - The risk aversion parameter is 3
   - τ, the prior return covariance scalar is 0.10
   - τ_v, the scalar on Ω (uncertainty in manager's views) is 0.10
   - The views are: U.S. Equity will outperform Foreign Equity by 2% and Emerging Equity will earn an excess return of 1.5%

   Please turn in:

   - The Python code file
   - An output file that displays:
     - The market weights (prior)
     - The risk aversion parameter
     - The scalar on the uncertainty in the prior (τ)
     - The scalar on manager's views (τ_v)
     - The matrices which capture the manager's views
     - The posterior distribution of returns (expected returns and covariance matrix)
     - The optimal weight in each security
     - The expected excess return, standard deviation and Sharpe ratio of the maximum Sharpe ratio portfolio