

FINA 3103: Intermediate Investment

Solution to Homework Assignment 1

Fall 2025

Assigned: September 25 (Thursday), 2025
Due Date: October 3 (Friday), 2025 (11:59pm)

Note

- Download the excel file (HW01data2025F.csv) from Canvas. The file includes the weekly prices of Apple Inc. (AAPL), Amazon.com Inc. (AMZN), and Netflix Inc. (NFLX) from 16/2/2015 through 14/2/2022. You can ignore dividend payments and assume that the weekly risk-free rate is fixed at 0.5%. Note that weekly returns (and other statistics) can be small due to their weekly frequency. For questions involving calculations, please choose the closest answer.
- We will not accept any submissions past the deadline (no exceptions).

Computing Return and Risk (14 points)

1. (2pt) Suppose that you are a mean-variance investor. You collected historical data on the stock price and computed the sample statistics. Assuming that your sample size is large, which one of the following statements is correct?
 - (a) The actual expected return is perfectly measurable from the historical data.
 - (b) You compute and incorporate the Kurtosis measure in your investment decision to capture the risk of tail events.
 - (c) To evaluate the risk of receiving very low returns, such as those below the 5-th percentile, the VaR measure can be used regardless of the distribution of returns.

- (d) It is not possible to compute the sample mean return from the historical price data.
- (e) None of the answers are correct.
2. (2pt) By using the dataset, the sample means of weekly returns of three stocks are $(\bar{r}_{AAPL}, \bar{r}_{AMZN}, \bar{r}_{NFLX}) =$
- (a) (0.12%, 1.25%, 4.24%)
- (b) (0.53%, 0.65%, 0.66%)
- (c) (0.81%, 1.35%, 2.24%)
- (d) (0.81%, 0.15%, 2.26%)
3. (2pt) Compute the sample standard deviation (SD). Which one of the following is the correct combination of the stock with the most volatile return and its SD?
- (a) (Apple, 8.7%)
- (b) (Amazon, 13%)
- (c) (Netflix, 19%)
- (d) (Netflix, 22%)
4. (2pt) Compute the Sharpe Ratio of three stocks. Which one of three stocks exhibits the lowest Sharpe Ratio?
- (a) Apple Inc.
- (b) Amazon.com Inc.
- (c) Netflix Inc.
- (d) Cannot conclude from the data provided.
5. (2pt) In the sample, the weekly returns of Amazon have the Value at Risk (5th percentile) of
- (a) 18%
- (b) 20%
- (c) -20%
- (d) -18%

6. (2pt) If you construct a price-weighted index of three stocks (use constant divisor of $D_t = 3$ for all t), the sample mean of the index weekly returns is
- (a) 3.1%
 - (b) 0.6%
 - (c) 0.01%
 - (d) 1.2%
7. (2pt) Assume that the numbers of shares of Apple, Amazon, and Netflix traded in the market are 80,000, 30,000, and 10,000, respectively, and these numbers do not change over time. Compute the value-weighted index by setting the first week of the data set as the benchmark date ($t = 0$). The sample mean of the index weekly returns is
- (a) 1.2%
 - (b) 4.0%
 - (c) 0.01%
 - (d) -2.3%

Mean-Variance Investment (12 points)

Part I. Suppose that you have mean-variance utility with risk aversion parameter $\gamma = 4$ and have \$1 budget. That is, if you invest your \$1 and receive the (net) return r , your end-of-period wealth is $\$(1 + r)$, and it generates utility of $U = \mathbb{E}[1 + r] - \frac{\gamma}{2} \text{Var}(1 + r)$.

8. (2pt) Investment A has annual return r_A with expected value $\mu_A = 0.14$ and variance $\sigma^2 = 0.02$. You will receive the following utility level (after one year) by investing all of your budget (\$1) into A .

[Solution] By applying MV utility,

$$U = 1 + 0.14 - \frac{4}{2}0.02 = 1.1$$

- (a) 1.06
- (b) 1.08
- (c) 1.10

(d) 1.12

9. (2pt) In addition to investment option A , a risk-free saving opportunity with $r_f = 8\%$ is available (you can ignore compounding). It is optimal for you to invest $\$x$ in A (and $1 - x$ in saving), where x is

[Solution]

$$U = x(1 + \mu) + (1 - x)(1 + r_f) - \frac{\gamma}{2}x^2\sigma^2 = 1 + r_f + (\mu - r_f)x - \frac{\gamma}{2}x^2\sigma^2$$

$$\text{Hence, } x = \frac{\mu - r_f}{\gamma\sigma^2} = \frac{0.14 - 0.08}{4 * 0.02} = \frac{0.06}{0.08} = 0.75$$

(a) \$0.25

(b) \$0.50

(c) **\$0.75**

(d) \$1.00

10. (2pt) Suppose that your risk-aversion parameter has increased to $\gamma = 12$. Now it is optimal for you to invest $\$x$ in A , where x is

$$\text{[Solution]} \quad x = \frac{\mu - r_f}{\gamma\sigma^2} = \frac{0.06}{12 * 0.02} = 1/4$$

(a) **\$0.25**

(b) \$0.50

(c) \$0.75

(d) \$1.00

Part II. Your initial budget is $\$W$. By using this budget, you bought stock B at price P_0 per share and made deposit with the remaining money with risk-free rate r_f . You anticipate that the stock will pay out dividend D_1 per share and will be sold at price P_1 in the end of investment period. We denote the (net) holding period return as r . Assume that P_1 and D_1 are uncertain, and the expected holding period return and its variance are $\mu (> r_f)$ and σ^2 .

11. (2pt) Suppose that you invest y fraction of your budget into stock B (and save the remaining $1 - y$ fraction). Which one of the following is the correct expression of your end-of-period wealth? [Solution] You buy x units of stocks, where x satisfies $xP_0 = yW$. Saving is $(1 - y)W$. The end-of-period wealth is then $V = x(P_1 + D_1) + (1 + r_f)(1 - y)W = yW(P_1 + D_1)/P_0 + (1 + r_f)(1 - y)W = W[y(1 + r) + (1 - y)(1 + r_f)] = W(1 + r_f) + Wy(r - r_f)$

- (a) $1 + r_f + yWP_1(r - r_f)$
 (b) $P_1(1 + r_f) + y(r - r_f)$
 (c) $W[y(1 + r) + (1 - y)(1 + r_f)]$
 (d) $W(1 + r_f) + y(r - P_0r_f)$
 (e) None of the answers are correct.
12. (4pt) Compute your optimal stock holding B . Which one of the following statements is correct?

[Solution] The MV utility is

$$U = W(1 + r_f) + yW(\mu - r_f) - \frac{\gamma}{2}y^2W^2\sigma^2$$

Then the optimal \$ investment is $y^*W = \frac{\mu - r_f}{\gamma\sigma^2}$. This means that the dollar-value of investment is independent of W (though the fraction of risky investment, y^* , is decreasing in W). Also, the # of shares you buy is $x = y^*W/P_0 = \frac{\mu - r_f}{P_0\gamma\sigma^2}$.

- (a) If the budget W increases, the dollar value of stock B investment also increases.
 (b) If W increases, you allocate a larger fraction of your budget to buy stock B .
 (c) Even if W increases, the number of shares (units) of stock B you purchase remains the same.
 (d) If W increases, you become more risk tolerant and invest more into stock B .
 (e) None of the answers are correct.

Limit Order Book (4 points)

Figure 1: Initial LOB

Sell (ask)		Buy (bid)
100	\$118	
90	\$117	
50	\$116	
100	\$115	
	\$114	
	\$113	120
	\$112	110

Figure 1 shows the initial state of the limit-order book (LOB) for a stock. Answer the following questions.

13. (2pt) If you place a limit buy order for 200 shares with bid price \$116, you immediately buy X shares at average price Y , where (X, Y) are

[Solution] The first 100 shares are bought at \$115 and the second 50 shares are bought at \$116. Remaining orders stay on the book as there is no counterparty willing to sell below or equal to 116. So, $X = 150$ and $Y = 115 * 2/3 + 116 * 1/3 = 115.33$

- (a) (200, 116)
 - (b) (150, 116)
 - (c) (150, 115.33)
 - (d) (100, 115.5)
 - (e) (150, 115.5)
14. (2pt) You place a limit sell order for 30 shares with ask price \$116. One minute later, there is an incoming market buy order for 130 shares. Which one of the following statement is correct?
- (a) Your limit order is fully executed at price \$116.
 - (b) Your limit order is partially executed at price \$116, while the remainder must stay on the book.
 - (c) Your limit order is fully executed at price \$115.
 - (d) Your limit order is not executed.
 - (e) None of the answers are correct.