

Exercise Set 1

1. Consider the table below. It contains the returns for stocks X, Y and Z under event i, and P\_i stands for the probability of event i.

|  |  |  |  |
| --- | --- | --- | --- |
| **P\_i** | **X** | **Y** | **Z** |
| 30% | -9% | 20% | -23% |
| 50% | 2% | -1% | 30% |
| 20% | 15% | -8% | -15% |

* 1. What is the expected return of stocks X, Y and Z, respectively?
  2. What is the variance of returns for the stocks X, Y and Z, respectively?

1. Consider the information in the previous question. If you want to invest in one of the three stocks, which one would you choose if you want to maximize your risk-adjusted return? Assume a risk-free rate equal to 1%.
2. You bought 40 shares of a company called GoldenCompany for $250 each. After one year the stock is up 20% and the company pays a dividend of $15. Six months later the company does a stock split 5:1, and you sell all your shares the day after for $49 each. What was your holding period return?
3. A stock that is trading at $20 just paid out a dividend of $1. Dividends are paid annually. If the expected return per year is 10%, what is the dividend growth rate implied by the current valuation?
4. A stock will generate per-share dividends of $10 in years 1 through 5, dividends of $15 in years 6 through 10, and grow at 2% p.a. thereafter. Assume that the risk-free rate equals 1% and the risk premium is 5%.
   1. What is the stock’s fair price?
   2. Imagine that you bought the stock at the price you calculated above. Now suppose that bad news come out right after your purchase suggesting that expected growth rate of dividends after year 10 should be revised downwards to 0.5%. What is your return on the stock after the news?
5. Consider a stock A that offers the following returns in the 3 different states of the world:

|  |  |  |  |
| --- | --- | --- | --- |
|  | Bear Market | Normal Market | Bull Market |
| Probability | 20% | 50% | 30% |
| Return | -10% | 8% | 35% |

If the stock has a Sharpe Ratio equal to 0.6, what is the implied risk-free rate?

1. The returns of Stock X are normally distributed, with mean equal to 4.0% and standard deviation equal to 10.5%. The returns of Stock Y are not normally distributed, but you know that the 95% VaR (Value-at-Risk) of Stock Y is equal to -12%. Using the 95% VaR as a measure of risk, which of the two stocks is riskier?
2. Use the following scenario analysis for stocks X and Y and compute the Sharpe Ratio for both stocks, assuming that the annual risk-free is 2%.

|  |  |  |  |
| --- | --- | --- | --- |
|  | Bear Market | Normal Market | Bull Market |
| Probability | 0.2 | 0.5 | 0.3 |
| Stock X | -30% | 23% | 40% |
| Stock Y | -10% | 10% | 25% |

1. Consider the return series in the Excel file ‘DataExerciseSet1’, in spreadsheet ‘Data\_Q9-Q10’, and compute the annualized arithmetic average and the standard deviation of the returns.
2. Consider the data from the previous question. Suppose the above sequence of returns was generated by a Normal distribution and assume that the point estimates made in the previous exercise correctly characterize this distribution.
   1. What is the probability that next month’s return will be below -5%?
   2. Do you think the Normal distribution is an appropriate model for this return time-series? Why?

For questions **11** through **15**, consider the data contained in the Excel file ‘DataExerciseSetWeek1’, in spreadsheet ‘Data\_FRED’. For simplicity, consider the percentage return of the S&P 500 as being representative of U.S. stock returns, and the 1-Year Treasury Constant Maturity Rate as being a good proxy for the risk-free rate. Assume that each year contains 260 trading days.

1. Considering the full sample available in the dataset, estimate the equity risk premium.
2. Estimate the equity risk premium for each year, starting in 2012 and ending in 2021.
3. Suppose that you must decide how to invest in the S&P 500 at the start of the sample. If your expectation was that the equity risk premium was 5% going forward, plot the cumulative return of the following investment strategy:

* If the equity risk premium of year t is greater than your expectation (i.e., 5%), assume a long position in the S&P 500 in year t+1.
* If the equity risk premium of year t is smaller than your expectation (i.e., 5%), assume a short position in the S&P 500 in year t+1.

Then, plot the cumulative return of a buy-and-hold strategy starting in 2013, and compare both plots. **Note**: To answer this exercise, assume that it is possible to invest directly in the S&P 500. To address the limitations of this last assumption, it would be more practical to consider an ETF or back-adjusted future contracts of the said equity index.

1. Compute the daily 95% value-at-risk (VaR) and the corresponding expected shortfall (ES) for the S&P 500’s returns under the following assumptions.
   1. The return series is not normally distributed.
   2. The return series is normally distributed. Under a normal distribution, the ES can be calculated in excel with the following exact formula: Average-NORMDIST(NORMSINV(1- 5%),0,1,FALSE)/(5%)\*StandardDeviation. As an approximation, you can also estimate the ES as an average of VAR’s for a range of confidence levels ≤5% (e.g., using the 95%, 96%, 97%, 98%, 99%, and 99.9% VAR). Why is the approximated ES always bigger than the exact ES?
   3. Comment on the difference between 14.a and 14.b.
2. When assessing tail risk by looking at the 5% worst-case scenario, the VaR (compared to the ES) is the:
   1. most realistic as it is the most complete measure of risk.
   2. most optimistic as it takes the highest return (smallest loss) of all the case
   3. most pessimistic as it is the most complete measure of risk.
   4. most optimistic as it is the most complete measure of risk.