Problem Set 8 Solutions

This file contains a guideline solution for the project and problems of the 7th & 8th problem set.

Project 8

Compute the returns

1. **Construct weekly simple total returns from the price data (use Adj Close to include dividends). Compute and report the weekly and annualized mean and standard deviation for each stock. Compute the correlation matrix.**

   Start with the standard deviation:

	msft	intc	luv	mcd	jnj
mean-1w	0.464	0.346	0.329	0.284	0.263
sd1w	4.057	4.883	4.767	3.089	2.812
mean-1y	27.208	19.702	18.653	15.901	14.637
sd-1y	29.253	35.213	34.379	22.278	20.278

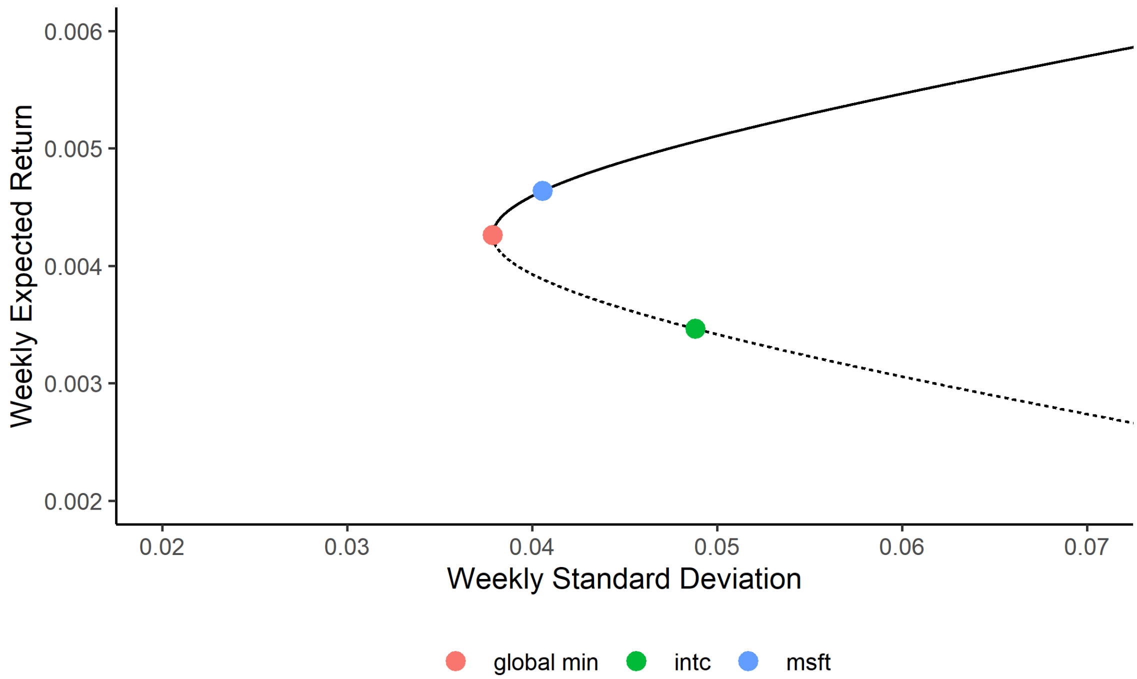
Now compute the correlation matrix:

	msft	intc	luv	mcd	jnj
msft	100.000	49.766	29.649	29.119	28.839
intc	49.766	100.000	29.297	25.661	20.904
luv	29.649	29.297	100.000	30.843	24.905
mcd	29.119	25.661	30.843	100.000	31.890
jnj	28.839	20.904	24.905	31.890	100.000

2. **Construct the mean-variance frontier for the Intel-Microsoft combination. Indicate the minimum-variance portfolio and the efficient frontier (the efficient frontier is a set of expected returns - risks that you would want to consider investing in).**

   Start by creating a some generic functions for computing the minimum variance frontier.

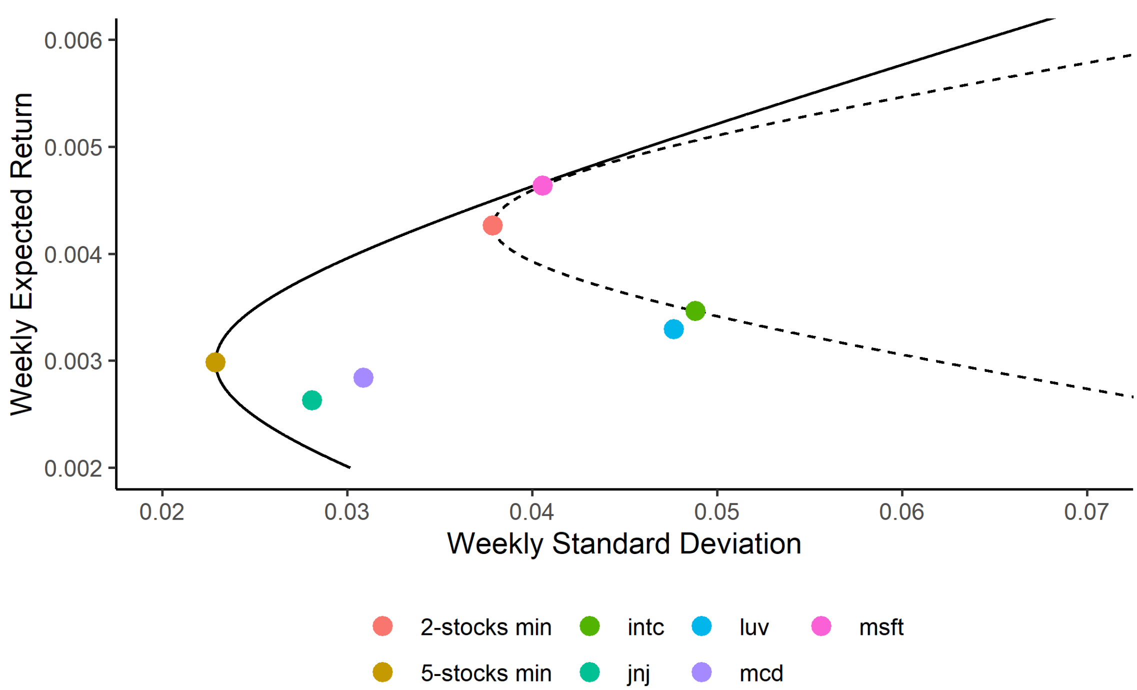
Next, run the functions for the two focal stocks and plot the results:



3. **Add remaining stocks to the mix. Compute the mean-variance frontier and plot it on the same chart with the one from the previous question. Indicate the minimum-variance portfolio and the efficient frontier. How do they compare to those of the previous question?**

   We already did most of the workin in the previous question. Adding more assets is just a matter of calling the functions for more stocks.

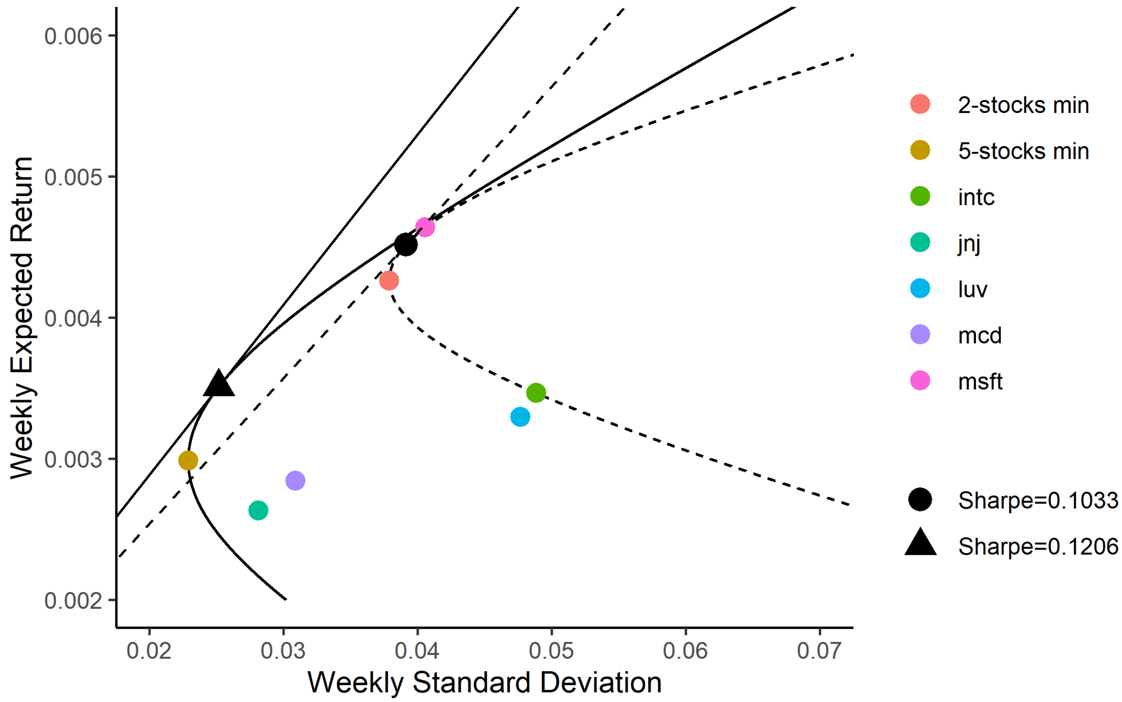
   The additional stocks move the minimum frontier upward and inward. Of course, the marginal effect declines as the number of assets increases.



4. **Add the riskless asset and construct the tangent portfolio for the Intel-Microsoft case. Next,**

construct the tangent portfolio for the full set of stocks. Compare the Sharpe ratios of the two tangent portfolios.

Construct the tangency portfolios given the risk free rate of 0.0476%.



5. **Assume your risk aversion is A = 3.5: What is your optimal mix of assets?**

   Use the formula:

$$w_{risky} = \frac{E(R_{tang}) - R_f}{A \cdot V(R_{tang})}$$

Compute the portfolio weight as the product of the tangency weights and the weight on the tangency portfolio. The risk-free portfolio weight is the residual. The negative weight implies borrowing, while a positive rate would have implied a risk-free bond investment.

	wtangent	w(A=3.5)
msft	38.694	53.003
intc	0.696	0.954
luv	6.639	9.094
mcd	25.083	34.358
jnj	28.889	39.572
RFR	NA	-36.980

The weight on the risky portfolio is 136.98, implying a weight of -36.98 on the risk-free asset.

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. **Regress excess stock returns on excess market returns to obtain estimates of the betas of the five stocks. Compute the standard errors of your estimates.**

Run the regressions. Specifically I run the following:

$$R_i - R_f = \beta_i \times (R_m - R_f) + \alpha_i + \epsilon$$

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By running the regressions this way, I can interpret the intercept as $\alpha$ in excess of the risk free r
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Now just format and print the tables:
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	beta	error (Mod-White)
msft	0.984	0.034
intc	1.168	0.041
luv	1.062	0.041
mcd	0.639	0.027
jnj	0.553	0.025

7. **What are the estimates of the alphas, and the standard deviation of these estimates? Further estimate the idiosyncratic risk.**

   This is just reading off different parts of the regression results. The idiosyncratic risk is the standard deviation of the residuals.

	alpha (bp)	alpha se (bp)	idiosync. risk (bp)
msft	25.474	8.041	331.041
intc	10.723	9.751	401.424
luv	10.757	9.818	404.217
mcd	13.179	6.534	269.007
jnj	12.464	6.032	248.326

8. **Compute the sample average excess return and compare the value with the return predicted by the CAPM. Based on the data, how well does the CAPM predict the level returns? How well does the CAPM predict relative performance?**

Again, the work is already complete. Since we used excess returns on the LHS of the regression, the expected CAPM return is just the expected realized return less the expected alpha. Plug in the means to get the estimates:

	beta	predicted r (bp)	actual r (bp)	predicted excess (bp)	actual excess (bp)
msft	0.984	20.912	46.386	16.153	41.627
intc	1.168	23.921	34.644	19.162	29.885
luv	1.062	22.188	32.945	17.429	28.186
mcd	0.639	15.240	28.419	10.481	23.660
jnj	0.553	13.840	26.304	9.081	21.545

```
The CAPM predicts a high return for INTC and a low return for MCD and JNJ. This is indeed the case, though
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Problems

This file contains a guideline solution for project 7 in markdown format. All code is available in the Rmd file.

1. **A security has a price of \$50 and a beta of 1.3. The risk-free rate is 1% and the market risk premium is 4%.**
    a. **According to the CAPM, what return do investors expect on the security?**
    Plug into the following equation:

$$E(R) = R_f + \beta RP$$

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##         Plugging in gives an expected return of 6.2%.\
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b. **Investors expect the security not to pay any dividend next year. At what price do investors expect the security to trade next year?**

Solve for $E(P_1)$ price from the expected return formula:

$$E(R) = \frac{E(D_1) + (E(P_1) - P_0)}{P_0}$$
$$\implies E(P_1) = (1 + E(R))\, P_0 - E(D_1)$$

```
## Plugging in, the expected price in one year is 53.1.
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c. **At what price do investors expect the security to trade next year, if the expected dividend next year is \$2 instead of zero?**

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## Plugging into the same formula as in b),
##     the expected price in one year is 51.1.
```

2. **Consider the following table, which gives a security analyst's expected return on two stocks for two particular market returns:**

Market Return	DangerCo.	SteadyInc.
-8%	-19%	-1%
12%	20%	7.5%

a. *What are the betas of the two stocks?*

Let 's' designate the stock. Then plug into a conditional version of the formula from 1a:

$$E(R_s|R_m\%) = R_f + \beta_s(R_m - R_f)$$
$$E(R_s|R_m = 12\%) - E(R_i|R_m = -8\%) = beta_s(12\% - -8\%)$$
$$\implies beta_s = \frac{E(R_s|R_m = 12\%) - E(R_s|R_m = -8\%)}{12\% - -8\%}$$

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## Plugging in, DangerCo. has a beta of 1.95
##     while SteadyCo. has a beta of 0.425.
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b. **What is the expected rate of return on each stock if both market outcomes are equally likely?**

Just weight the two outcomes by 0.5.

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##  Then the expected return of DangerCo. is 0.5% while the expected return for SteadyCo. is 3.25%.
```

c. **Draw the SML for this economy if the T-bill rate is 2%.**
d. **Plot the two securities on the SML graph. What are the alphas of each?**

The SML is given by:

$$E(R) = R_f + \beta_i(E(R_m) - R_f)$$

Next compute the CAPM expected return. The difference between this and the "true" expected return is the alpha. In particular, the CAPM expected return of DangerCo. is 2% while the expected return for SteadyCo. is 2% which implies an alpha for DangerCo. of -1.5% and an alpha for SteadyCo. of 1.25%. As a graph: