Problems from Chapter 11

Short-answer

Use the following information to answer questions 1 through 3

You estimate that the expected return on Ford is 8% and on Sotheby's is 12%. You also estimate that the standard deviation of returns on Ford will be 24% and on Sotheby's will be 30%. In addition, you estimate that the correlation between Ford and Sotheby's is 0.1. Finally, assume that the risk-free rate is 3%.

1. Assume you short-sell $200,000 of Ford and buy $700,000 of Sotheby's. Set up to calculate the expected return on your portfolio.

$$x_F = \frac{-200{,}000}{-200{,}000 + 700{,}000}\,;\; x_S = \frac{700{,}000}{-200{,}000 + 700{,}000}$$
$$E(R_P) = x_F(8) + x_s(12)$$

2. Plot a reasonable set of expected returns and volatilities that you could achieve if you were to combine Ford and Sotheby's into portfolios. Identify on your graph the portfolio you created in #1.

3. How would your graph change if the correlation between Ford and Sotheby's jumped to +0.8? Draw your answer on the same graph you used to answer #2 clearly label which graph corresponds to the correlation of 0.1 and which corresponds to the correlation of 0.8.

   Note: see separate jpg file for answers to 2 and 3 (Note: the questions were originally numbered 4 and 5!)

Use the following information to answer questions 4 through 6.

	Unilever	Alcoa	Risk-free
Expected Return	15%	18%	5%
Volatility	31%	46%	0%

The correlation between Unilever and Alcoa is 0.2

4. If you short-sell $100,000 of Unilever and invest $600,000 in Alcoa, set up to calculate the expected return on your portfolio?

$$x_U = \frac{-100{,}000}{-100{,}000 + 600{,}000}\,;\; x_A = \frac{600{,}000}{-100{,}000 + 600{,}000}$$
$$E(R_P) = x_U(15) + x_A(18)$$

Combine 5 and 6 on same graph, clearly label which is which

5. Sketch a graph of the expected returns and volatilities you could achieve for combinations of Unilever and Alcoa (including short and long positions in each). Identify the portfolio you created in #4.

6. On the same graph you used to answer #5, identify the portfolio of Unilever and Alcoa that gives you the highest Sharpe ratio. Based on your graph, how would you need change your investments in Alcoa to achieve this portfolio?

   Note: See separate jpg file for answers to 5 and 6. Note that the questions were originally numbered 4 and 5.

7. Assume you own shares of Delta and are interesting an adding a second stock that would provide you the greatest amount of diversification. What would you calculate that would help you make your decision of which stock to buy?

   Correlation

Use the following information to answer questions 8 through 11.

Assume that the expected return on IBM is 14% and on Target is 8%. Assume also that the volatility of IBM's returns is 35% and on Target is 23% and that the correlation between the returns on IBM and Target is 0.4. Finally, assume that the risk-free rate is 4%.

8. Assuming that you invest $100,000 in IBM and $900,000 in Target, set up to calculate the expected return on your portfolio.

$$x_I = \frac{100{,}000}{100{,}000 + 900{,}000}; \ x_T = \frac{900{,}000}{100{,}000 + 900{,}000}$$
$$E(R_P) = x_I(14) + x_T(8)$$

9. Again assuming that you plan to invest $100,000 in IBM and $900,000 in Target, set up to calculate the volatility of your portfolio.

$$SD(R) = \sqrt{(x_I)^2(35)^2 + (x_T)^2(23)^2 + 2x_I x_T(.4)(35)(23)}$$

10. Sketch a graph that shows the expected return and volatility of all possible combinations of IBM and Target (including short-selling). Identify your portfolio from numbers 8 and 9.

11. Assume you invest $19,000,000 in T-bills and $1,000,000 in the combination of IBM and Target that gives you the highest Sharpe ratio. On the same graph you used to answer #10, show the expected return and volatility you can expect. Be sure to clearly label which part of the graph answers #10 and which part of the graph answers #11.

   Note: see separate jpg file for answers to 10 and 11. Note: The questions were originally numbered 4 and 5.

12. GreenWal has a beta of 0.3. Under the assumptions of the CAPM, what is the expected return on GreenWal if the market portfolio has an expected return of 11% and the risk-free rate is 3%?

   3 + .3(11 – 3)

13. Assume that the risk-free rate is 4% and that the expected return on the market portfolio is 11%. Assume also that the beta of GreenWal is 0.3. Sketch the security market line and GreenWal on a graph of risk and return. Be sure to identify on your graph the risk-free rate, the market portfolio, and the expected return on GreenWal. (Note: No calculations are required to solve this problem!)

    See jpg file. Note: originally labeled 1:00 #1.

14. Assume that the beta of Nationwide Financial is 2.37 and that the beta for Sure Win Williams Inc. is 0.87. What is the beta of your portfolio if you invest $100,000 in Nationwide and $900,000 in Sure Win?

$$\beta_P = \left(\frac{100}{100+900}\right)(2.37) + \left(\frac{900}{100+900}\right)(0.87)$$

15. What historical data would you need to collect to calculate Tiffany's beta?

    Returns on Tiffany and the market

16. Assume that the risk-free rate is 5%, that the expected return on the market portfolio is 12% and that the volatility of the market is 20%. Assume also that Circuit Town has an expected return of 11% and a volatility of 45%. Show graphically the alternative investment to Circuit Town that has the lowest possible volatility while having the same expected return as Circuit Town. Be sure to identify on your graph the risk-free rate, the market portfolio, Circuit Town, and the volatility of your alternative investment. (Note: No calculations are required to solve this problem!)

    See jpg file. Note: originally labeled 2:00 #1.

17. Assume that the risk-free rate is 6% and that the expected return on the market portfolio is 13%. Assume also that the beta of Tiffany is 1.4. Sketch the security market line and Tiffany on a graph of risk and return. Be sure to identify on your graph the risk-free rate, the market portfolio, and the expected return on Tiffany. (Note: No calculations are required to solve this problem!)

    See jpg file. Note: originally labeled 2:00 #2.

18. Assume that the beta of Verizon is 1.2 and that the beta for GreenWal is 0.3. What is the beta of your portfolio if you invest $400,000 in Verizon and $600,000 in GreenWal?

$$\beta_P = \left(\frac{400}{400+600}\right)(1.2) + \left(\frac{600}{400+600}\right)(0.3)$$

19. A year ago you invested $100,000 in ADM with a beta of 0.53 and $150,000 in Google with a beta of 1.57. The market value today of your investment in ADM is $60,000 and of your investment in Google is $70,000. Using the CAPM, calculate the expected return on your portfolio today if the expected return on the market is 8% and the risk-free rate is 0.2%.

$$\beta_P = \left(\frac{60{,}000}{60{,}000+70{,}000}\right)(0.53) + \left(\frac{70{,}000}{60{,}000+70{,}000}\right)(1.57)$$

E(r) = 0.2% + β_P(8 – 0.2)

Use the following information to answer questions 20 and 21. You should answer both questions on the same graph. Be sure to label which parts of your graph answer each question.

Stock	Expected Return	Volatility
Apple	20%	35%
Circuit City	10%	20%
Yahoo	15%	25%

20. Sketch a reasonable set of portfolios it would be possible to build (a) with only long positions in the three stocks and (b) with both long and short positions in the three stocks. Be sure to clearly label which is which on your graph.

21. Assume you want a portfolio with a standard deviation of 25%. Identify your optimal portfolio (a) if you invest only in long positions in the three stocks, (b) if you invest in long and short positions in the three stocks, and (c) if you can borrow or lend at the risk-free rate of 5%. Be sure to clearly label which is which on your graph.

See jpg file. Note: originally labeled 4 & 5.

Use the following information to answer questions 22 and 23. You should answer both questions on the same graph and should be sure to label which parts of your graph answer each question.

Stock	Expected Return	Volatility
Merck	7%	11%
Ford	11%	35%
Wal-Mart	15%	20%
HP	22%	43%

22. If you can buy or short-sell any of the four stocks, sketch a reasonable efficient frontier you could achieve by combining the four stocks. Identify (show where it is) the portfolio offering the highest expected return if you want a volatility of 20%. Note: you will need to show the four stocks on your graph.

23. Identify the portfolio offering the highest expected return if you want a volatility of 20% and the return on a risk-free investment is 2%.

See jpg file. Note: originally labeled 9 & 10.

24. Government Motors (GM) has just sold one of its divisions. Given the change, you now expect GM's stock returns to vary less with the market as a whole. If you are correct, what should happen to the risk premium on GM's stock?

Fall

Use the following information to answer questions 25 and 26. You should answer both questions on the same graph and should be sure to label which parts of your graph answer each question.

Stock	Expected Return	Volatility
Johnson & Johnson	7%	11%
Google	22%	43%
Target	15%	29%
Ford	1%	35%

25. If you can buy or short-sell any of the four stocks, sketch a reasonable efficient frontier you could achieve by combining the four stocks. Identify (show where it is) the portfolio of the four stocks offering the lowest volatility if you want an expected return of 7%. Note: you will need to show the four stocks on your graph.

26. Identify the portfolio offering the lowest volatility if you want an expected return of 7% and the return on a risk-free investment is 3%.

See jpg file. Note: originally labeled 9 & 10.

27. Six months ago you invested \$100,000 in Bank of America (BAC) which had a beta of 1.1 and \$300,000 in FedEx (FDX) which had a beta of 0.8. Today, BAC's beta has risen to 1.3 and the market value of your investment in BAC has fallen to \$47,000. In addition, FDX's beta has fallen to 0.6 and the market value of your investment in FDX has fallen to \$240,000. Calculate the current beta of your portfolio?

$$\beta_P = \left(\frac{47}{47+240}\right)(1.3) + \left(\frac{240}{47+240}\right)(0.6)$$

28. How would an increase in the correlation between the returns of two securities impact the volatility of a portfolio of those two securities if you have a positive investment in both?

Increase

Use the following information to answer questions 29 and 30.

You are considering building a portfolio of the following three stocks:

Stock	Expected Return	Volatility
Kellogg	6%	12%
Wal-Mart	11%	21%
Dell	14%	29%

The correlations between the three stocks all fall between 0.1 and 0.5.

29. Sketch a graph of the 3 stocks and of a reasonable efficient frontier you could construct from these three stocks. Also plot the best return you could expect to earn if you create a portfolio with a volatility of 21%.

30. On the same graph you used to answer 29, sketch how the efficient frontier and your expected return changes if you can also invest in or short-sell a risk-free asset earning 3%. Assume that you still plan to create a portfolio with a volatility of 21%. Be sure to label which part of the graph answers # 9 and which part answers #10.

See jpg file. Note: originally labeled 9 & 10.

31. Assume you invest \$450,000 in a Transportation ETF with a beta of 1.3 and \$150,000 in a AAA Bond ETF with a beta of 0.2. Calculate the beta of your portfolio.

$$\beta_P = \left(\frac{450{,}000}{450{,}000+150{,}000}\right)\times 1.3 + \left(\frac{150{,}000}{450{,}000+150{,}000}\right)\times 0.2$$

32. As a result of CountiGroup selling one of its divisions, you expect that the standard deviation of returns on CountiGroup to rise but you expect its beta to fall. If you are correct, should the expected return on CountiGroup rise, fall, or remain unchanged, or is it unclear what will happen to CountiGroup's expected return?

    Fall

33. Other things equal, what happens to the risk of a portfolio as the correlation between the returns on the stocks in the portfolio falls? Note: Assume you have no short positions in any of the stocks.

    Falls

Problems

1. Given the following returns, calculate the correlation of returns between Eli Lilly and Circuit City.

		Return on:	
Year	Eli Lilly	Circuit City	S&P500
1	-1%	60%	-15%
2	18%	105%	21%
3	-19%	36%	4%
4	-7%	83%	13%
5	15%	-39%	13%

$\overline{R}_{EL} = \frac{1}{5}(-1+18-19-7+15)$; eq [+4]; R[+1x5]; 5[+2]

$Var(R_{EL}) = \frac{1}{4}\left[(-1-\overline{R}_{EL})^2 + (18-\overline{R}_{EL})^2 + (-19-\overline{R}_{EL})^2 + (-7-\overline{R}_{EL})^2 + (15-\overline{R}_{EL})^2\right]$; $SD(R_{EL}) = \sqrt{Var(R_{EL})}$

eq [+4]; R[+1x5]; 4[+2]

$\overline{R}_{CC} = \frac{1}{5}(60+105+36+83-39)$; eq [+4]; R[+1x5]; 5[+2]

$Var(R_{CC}) = \frac{1}{4}\left[(60-\overline{R}_{CC})^2 + (105-\overline{R}_{CC})^2 + (36-\overline{R}_{CC})^2 + (83-\overline{R}_{CC})^2 + (-39-\overline{R}_{CC})^2\right]$;

$SD(R_{CC}) = \sqrt{Var(R_{CC})}$ eq [+4]; R[+1x5]; 4[+2]

$Cov(R_{EL}, R_{CC}) = \frac{1}{4}\left[(-1-\overline{R}_{EL})(60-\overline{R}_{CC}) + (18-\overline{R}_{EL})(105-\overline{R}_{CC}) + (-19-\overline{R}_{EL})(36-\overline{R}_{CC}) + (-7-\overline{R}_{EL})(83-\overline{R}_{CC}) + (15-\overline{R}_{EL})(-39-\overline{R}_{CC})\right]$

eq [+9]; R[+1x10]; 4[+2]

$Corr(R_{EL}, R_{CC}) = \frac{Cov(R_{EL}, R_{CC})}{SD(R_{EL})SD(R_{CC})}$; eq [+10]

2. When answering parts a, b, and c below, assume that you can borrow or lend at a risk-free rate of 4% and that Baxter International (BAX) and American International Group (AIG) have earned the returns given below over the past 3 years.

	Return on:	
Year	BAX	AIG
1	11%	5%
2	25%	6%
3	27%	-17%
Average	21%	-2%
Volatility	9%	13%

a. Calculate the covariance between BAX and AIG.
b. Calculate the expected return and volatility of a portfolio created by purchasing $140,000 of BAX stock and by short-selling $40,000 in AIG stock.
c. Calculate the Sharpe ratio for the portfolio in b.

a. $Cov(R_{BAX}, R_{AIG}) = \frac{1}{2}\left((11-21)(5-(-2)) + (25-21)(6-(-2)) + (27-21)(-17-(-2))\right)$

b. $x_{BAX} = \frac{140{,}000}{140{,}000-40{,}000}$; $x_{AIG} = \frac{-40{,}000}{140{,}000-40{,}000}$

$E(R_P) = x_{BAX}(21) + x_{AIG}(-2)$

$SD(R_P) = \sqrt{(x_{BAX})^2(9)^2 + (x_{AIG})^2(13)^2 + 2(x_{BAX})(x_{AIG})Cov(R_{BAX}, R_{AIG})}$

c. $SR = \frac{E(R_P)-4}{SD(R_P)}$

3. When answering parts a, b, and c below, assume that you can borrow or lend at a risk-free rate of 5% and that FPL Group (FPL) and Microsoft (MSFT) have earned the following returns over the past 3 years.

	Return on:	
Year	FPL	MSFT
1	15%	-1%
2	35%	16%
3	28%	21%
Average	26%	12%
Volatility	10%	?%

a. Calculate the covariance between FPL and MSFT.
b. Calculate the volatility of MSFT and of a portfolio created by purchasing $60,000 of FPL stock and $40,000 of MSFT stock.
c. Calculate the volatility of a portfolio if you borrow $25,000 of your $100,000 investment.

a. $Cov(R_{FPL}, R_{MSFT}) = \frac{1}{2}\left((15-26)(-1-12) + (35-26)(16-12) + (28-26)(21-12)\right)$

b. $Var(R_{MSFT}) = \frac{1}{2}\left((-1-12)^2 + (16-12)^2 + (21-12)^2\right)$; $SD(R_{MSFT}) = \sqrt{Var(R_{MSFT})}$

$x_{FPL} = \frac{60{,}000}{60{,}000+40{,}000}$; $x_{MSFT} = \frac{40{,}000}{60{,}000+40{,}000}$

$SD(R_P) = \sqrt{(x_{FPL})^2(10)^2 + (x_{MSFT})^2(Var(R_{MSFT})) + 2(x_{FPL})(x_{MSFT})Cov(R_{FPL}, R_{MSFT})}$

c. $SD(R_{xP}) = \left(\frac{100{,}000}{100{,}000-25{,}000}\right)(SD(R_P))$

4. You are planning to invest $300,000 in a portfolio of RedRock and BlackStone. Of the total, $200,000 will come from the proceeds of selling your lawn business and $100,000 will come from borrowing at a 4% interest rate. The expected return on RedRock is 9% while the expected return on BlackStone is 15%. The volatility of RedRock is 19% while the volatility of BlackStone is 29%. The correlation between BlackStone and RedRock is 0.2. Note: combine your answers to “a” and “b” on the same graph, but clearly label what part of the graph answers a and what part of the graph answers part b.

   a. Sketch a reasonable set of efficient portfolios that you might construct from RedRock and BlackStone if you are willing to hold short and long positions in the stocks.
   b. Given the assumptions, identify the specific portfolio that gives you the highest return for the risk you will face.

   => See jpg file. Note: originally labeled 9:00 #8

5. Because current production exceeds normal capacity at their existing facilities, Proctor Gambler Inc. is considering building an additional manufacturing site in Dallas. Since the new facility will use new quality control techniques, Gambler estimates that production costs will be far more predictable than in the past. As a result, the standard deviation of returns on the new site will be 29% which is lower than the 35% standard deviation of returns on a new facility Gambler just finished building in Wisconsin and also lower than the 40% standard deviation of returns on the firm’s other existing facilities. The beta of the new facility will be 1.1 compared to the 1.2 beta of the Wisconsin facility and the 1.4 beta of Gambler’s other existing facilities. The new facility will be built on land that was purchased a year ago for $750,000 that could be sold today for an after-tax cash flow of $650,000. The new facility will require an investment of $3 million today and $2 million three months from today. Six months from today, the new facility will generate an initial net, after-tax cash flow of $13,000. After this initial cash flow, net cash flows from the new facility will grow by 0.5% per month through 5 years from today (when the facility will be closed). Should Gambler build the new factory if the risk-free rate is 4.5% and the market risk premium is 7.5%?

$$r(1) = .045 + 1.1(.075)$$
$$r\left(\tfrac{1}{12}\right) = \left(1 + r(1)\right)^{1/12} - 1$$

Costs: $V_0(C) = 650{,}000 + 3{,}000{,}000 + \dfrac{2{,}000{,}000}{\left(1 + r\left(\frac{1}{12}\right)\right)^3}$

Inflows: $V_0(I) = \left(\dfrac{13{,}000}{r\left(\frac{1}{12}\right) - .005}\right)\left(1 - \left(\dfrac{1.005}{1 + r\left(\frac{1}{12}\right)}\right)^{55}\right)\left(\dfrac{1}{1 + r\left(\frac{1}{12}\right)}\right)^5$

NPV = $V_0(I) - V_0(C)$
If NPV > 0, build

6. Given the following returns for Barnes & Noble (BKS) and the Standard & Poor's 500 (S&P500), calculate the volatility and beta of Barnes & Noble.

	Return on:	
Year	BKS	S&P500
1	-23%	-18%
2	40%	13%
3	13%	11%
4	50%	6%
5	1%	14%

$\overline{R}_{BKS} = \frac{1}{5}(-23+40+13+50+1)$; eq [+4]; R[+1x5]; 5[+2]

$$Var(R_{BKS}) = \frac{1}{4}\left[(-23-\overline{r}_{BKS})^2 + (40-\overline{r}_{BKS})^2 + (13-\overline{r}_{BKS})^2 + (50-\overline{r}_{BKS})^2 + (1-\overline{r}_{BKS})^2\right];$$

$$SD(R_{BKS}) = \sqrt{Var(R_{BKS})}$$

eq [+4]; R[+1x5]; 4[+2]

$$\overline{R}_{S\&P} = \frac{1}{5}(-18+13+11+6+14)$$

$$Var(R_{S\&P}) = \frac{1}{4}\left[(-18-\overline{r}_{S\&P})^2 + (13-\overline{r}_{S\&P})^2 + (11-\overline{r}_{S\&P})^2 + (6-\overline{r}_{S\&P})^2 + (14-\overline{r}_{S\&P})^2\right];$$

eq [+4]; R[+1x5]; 4[+2]

$$Cov(R_{BKS}, R_{S\&P}) = \frac{1}{4}\left[(-23-\overline{r}_{BKS})(-18-\overline{r}_{S\&P}) + (40-\overline{r}_{BKS})(13-\overline{r}_{S\&P}) + (13-\overline{r}_{BKS})(11-\overline{r}_{S\&P}) + (50-\overline{r}_{BKS})(6-\overline{r}_{S\&P}) + (1-\overline{r}_{BKS})(14-\overline{r}_{S\&P})\right]$$

eq [+9]; R[+1x10]; 4[+2]

$\beta = \frac{Cov(R_{BKS}, R_{S\&P})}{Var(R_{S\&P})}$; eq [+10]

7. Given the following returns for Proctor & Gamble (PG), Motorola (MOT), and the Standard & Poor's 500 (S&P500), calculate the volatility and beta of Motorola.

		Return on:	
Year	PG	MOT	S&P500
1	2%	-48%	-15%
2	20%	134%	21%
3	4%	-5%	4%
4	10%	42%	13%
5	13%	-19%	14%

$\overline{R}_{MOT} = \frac{1}{5}(-48 + 134 - 5 + 42 - 19)$; eq [+4]; R[+1x5]; 5[+2]

$$Var(R_{MOT}) = \frac{1}{4}\left[(-48 - \overline{R}_{MOT})^2 + (134 - \overline{R}_{MOT})^2 + (-5 - \overline{R}_{MOT})^2 + (42 - \overline{R}_{MOT})^2 + (-19 - \overline{R}_{MOT})^2\right]$$

$$SD(R_{MOT}) = \sqrt{Var(R_{MOT})}$$

eq [+4]; R[+1x5]; 4[+2]

$$\overline{R}_{S\&P} = \frac{1}{5}(-15 + 21 + 4 + 13 + 14)$$

$$Var(R_{S\&P}) = \frac{1}{4}\left[(-15 - \overline{R}_{S\&P})^2 + (21 - \overline{R}_{S\&P})^2 + (4 - \overline{R}_{S\&P})^2 + (13 - \overline{R}_{S\&P})^2 + (14 - \overline{R}_{S\&P})^2\right]$$

eq [+4]; R[+1x5]; 4[+2]

$$Cov(R_M, R_{S\&P}) = \frac{1}{4}\left[(-48 - \overline{R}_M)(-15 - \overline{R}_{S\&P}) + (134 - \overline{R}_M)(21 - \overline{R}_{S\&P}) + (-5 - \overline{R}_M)(4 - \overline{R}_{S\&P}) + (42 - \overline{R}_M)(13 - \overline{R}_{S\&P}) + (-19 - \overline{R}_M)(14 - \overline{R}_{S\&P})\right]$$

eq [+9]; R[+1x10]; 4[+2]

$\beta = \frac{Cov(R_{MOT}, R_{S\&P})}{Var(R_{S\&P})}$; eq [+10]

8. You are planning to invest $600,000 in a portfolio of RedRock, BlackStone, and GreenPebble, and an additional $200,000 in T-bills earning 4% per year. The expected return on RedRock is 9%, on BlackStone is 15%, and on GreenPebble is 19%. The volatility of RedRock is 17%, of BlackStone is 29%, and of GreenPebble is 38%. All of the correlations between the stocks are between 0.1 and 0.3. Note: combine your answers to "a" and "b" on the same graph, but clearly label what part of the graph answers a and what part of the graph answers part b.

a. Sketch a reasonable set of efficient portfolios you might construct from RedRock, BlackStone, and GreenPebble if you are willing to hold short and long positions in the stocks.

b. Given the assumptions, identify the specific portfolio that gives you the highest return for the risk you will face.

=> See jpg file. Note: originally labeled 2:00 #8

9. Assume you have short sold $200,000 of Dean Foods (DF) stock, and that you have purchased $600,000 of Marvel Entertainment (MVL) stock. Assume also that you have also invested $100,000 at the risk-free rate of 3%.

Returns on DF and MVL over the past 4 years:

	Return on:	
Year	DF	MVL
4	-21%	31%
3	-3%	-2%
2	17%	44%
1	43%	15%
Average	9%	22%
Volatility	27%	20%

a. Calculate the correlation between the returns on Marvel and Dean Foods.
b. Calculate the Sharpe Ratio of your portfolio of Dean Foods and Marvel Entertainment.

a. $Corr(R_{MVL,DF}) = \frac{Cov(R_{MVL,DF})}{(27)(20)}$

$$Cov(R_{MVL,DF}) = \frac{(-21-9)(31-22)+(-3-9)(-2-22)+(17-9)(44-22)+(43-9)(15-22)}{3}$$

b. $SR = \frac{E(R_p)-3}{SD(R_p)}$

$E(R_p) = X_{DF}(9) + X_{MVL}(22)$

$$SD(R_P) = \sqrt{(X_{DF})^2(27)^2 + (X_{XML})^2(20)^2 + 2(X_{DF})(X_{XML})Corr(R_{MVL,DF})(27)(20)}$$

$$X_{DF} = \frac{-200}{-200+600}$$

$$X_{MVL} = \frac{600}{-200+600}$$

10. Assume you have sold $200,000 of GE short, that you have purchased $700,000 of security General Mills (GIS).

Returns on securities GE and GIS over the past 4 years:

	Return on:	
Year	GE	GIS
1	7%	21%
2	21%	5%
3	-35%	22%
4	-31%	-3%

The average annual return on GE over the past 4 years = R
The standard deviation of returns (volatility) of GE over the past 4 years = S

Note: For parts a and b, you do not need to show any calculations for the average annual return or volatility of GE. You may simply use R and S.

a. Calculate the correlation between the returns on securities GE and GIS.
b. Calculate the volatility of the portfolio you have created with GE and GIS.

a. $\bar{R}_{GIS} = \frac{1}{4}(21 + 5 + 22 - 3) = G$

$SD(\bar{R}_{GIS}) = \sqrt{\frac{1}{3}((21 - G)^2 + (5 - G)^2 + (22 - G)^2 + (-3 - G)^2)} = SD_{GIS}$

$Corr(R_{GIS}, R_{GE}) = \frac{Cov(R_{GIS}, R_{GE})}{SD(R_{GIS}) \times S}$

$Cov(R_{GIS}, R_{GE}) = \frac{1}{3}\left((7 - R)(21 - G) + (21 - R)(5 - G) + (-35 - R)(22 - G) + (-31 - R)(-3 - G)\right)$

b. $X_{GE} = \frac{-200}{-200+700}$; $X_{Gis} = \frac{700}{-200+700}$

$SD(R_P) = \sqrt{X_{GE}^2 \times S^2 + X_{GIS}^2 \times SD_{GIS}^2 + 2X_{GE}X_{GIS}Cov(R_{GIS}, R_{GE})}$

11. Your firm is considering spending \$4,000,000 to build a new factory to build netbook computers. At the end of the factory's life 4 years and 5 months from today, environmental clean-up costs are expected to equal the proceeds of selling the factory and machinery. The factory's first net after-tax cash flows is expected to equal \$300,000 eight months from today. After this initial cash flow, quarterly cash flows are expected to grow by 1% per quarter through the plant's closing. Not included in these figures is a required investment today in net working capital of \$500,000. Net working capital is not expected to change over the life of the project but will fall to \$0 at the end of the factory's life. Should the factory be built if it has a beta of 1.1, the risk-free rate is 2%, and the market risk premium is 9%?

<u>Outflows</u>

CF_0 = – 4,000,000 – 500,000

<u>Inflows</u>

$$PV_{5mo} = \left(\frac{300{,}000}{r\left(\frac{1}{4}\right) - .01}\right)\left(1 - \left(\frac{1.01}{1 + r\left(\frac{1}{4}\right)}\right)^{16}\right)$$

$$PV_0 = \frac{PV}{(1+r)^{\frac{5}{12}}} + \frac{500{,}000}{(1+r)^{4\frac{5}{12}}}$$

r = .02 + 1.1(.09)

$$r\left(\frac{1}{4}\right) = (1+r)^{\frac{1}{4}} - 1$$

NPV = CF_0 – PV_0

=> build if NPV > 0

12. Given a covariance between the returns on Motorola (MOT) and Kellogg (K) of +717 and the following returns, calculate the correlation between the returns on Motorola and Kellogg and the standard deviation (volatility) you can expect if you build a portfolio by investing \$50,000 in Motorola and short-selling \$10,000 of Kellogg.

	Return on:	
Year	MOT	K
2008	-72%	-18%
2007	-27%	11%
2006	17%	16%
2005	43%	15%

$$SD(R_P) = \sqrt{X_{MOT}^2 \times SD(R_{MOT})^2 + X_K^2 \times SD(R_K)^2 + 2X_{MOT}X_K Corr(R_{MOT}, R_K) SD(R_{MOT}) SD(R_K)}$$

$$X_{MOT} = \frac{50}{50-10}\,;\ X_K = \frac{-10}{50-10}$$

$$SD(\bar{R}_{MOT}) = \sqrt{\frac{1}{3}\left((-72 - \bar{R}_{MOT})^2 + (-27 - \bar{R}_{MOT})^2 + (17 - \bar{R}_{MOT})^2 + (43 - \bar{R}_{MOT})^2\right)}$$

$$SD(\bar{R}_K) = \sqrt{\frac{1}{3}\left((-18 - \bar{R}_K)^2 + (11 - \bar{R}_K)^2 + (16 - \bar{R}_K)^2 + (15 - \bar{R}_K)^2\right)}$$

$$Corr(R_{MOT}, R_K) = \frac{717}{SD(R_{MOT}) \times SD(R_K)}$$

$$\bar{R}_{MOT} = \frac{1}{4}(-72 - 27 + 17 + 43)$$

$$\bar{R}_K = \frac{1}{4}(-18 + 11 + 16 + 15)$$

13. Assume you have short sold $300,000 of security B, that you have purchased $800,000 of security A, and that you have invested $200,000 in T-bills earning 3%.

Returns on securities A and B over the past 4 years:

	Return on:	
Year	A	B
1	19%	15%
2	17%	5%
3	15%	4%
4	0%	8%

The average annual return on security A over the past 4 years = R
The standard deviation of returns (volatility) of security A over the past 4 years = S

Note: For parts a and b, you do not need to show any calculations for the average annual return or volatility of security A. You may simply use R and S.

a. Calculate the correlation between the returns on securities A and B.
b. Calculate the Sharpe Ratio of the portfolio of risky assets you have created with A and B.

a. $\bar{R}_B = \frac{1}{4}(15 + 5 + 4 + 8)$

$$SD(\bar{R}_B) = \sqrt{\frac{1}{3}((15 - \bar{R}_B)^2 + (5 - \bar{R}_B)^2 + (4 - \bar{R}_B)^2 + (8 - \bar{R}_B)^2)}$$

$$Corr(R_A, R_B) = \frac{Cov(R_A, R_B)}{S \times SD(\bar{R}_G)}$$

$$Cov(R_A, R_B) = \frac{1}{3}\left((19 - R)(15 - \bar{R}_B) + (17 - R)(5 - \bar{R}_B) + (15 - R)(4 - \bar{R}_B) + (0 - R)(8 - \bar{R}_B)\right)$$

b. $X_A = \frac{800{,}000}{800{,}000 - 300{,}000}$; $X_B = \frac{-300{,}000}{800{,}000 - 300{,}000}$

$$SD(R_P) = \sqrt{X_A^2 \times S^2 + X_B^2 \times SD_B^2 + 2X_A X_B Cov(R_A, R_B)}$$

$$E(R_P) = X_A(R) + X_B(\bar{R}_B)$$

$$Sharpe_P = \frac{E(R_P) - 3}{SD(R_P)}$$

14. Use the following information to answer questions a through d.

Year	Return on: Hewlett Packard (HPQ)	Amgen (AMGN)
1	13	11
2	36	8
3	42	-15
4	1	-12

a. Calculate the average return on HPQ and AMGN over the past 4 years.
b. Calculate the volatility (standard deviation of returns) on HPQ and AMGN over the past 4 years.
c. Calculate the correlation between HPQ and AMGN over the past 4 years.
d. Assume you believe that in the future, the volatility of and correlation between HPQ and AMGN will be the same as over the past 4 years. Assume also that you create a portfolio by short-selling $100,000 of Amgen and investing $500,000 in HPQ. What is your estimate of the volatility of your portfolio?

a. $\overline{R}_{HPQ} = \frac{1}{4}(13+36+42+1)$; $\overline{R}_{AMGN} = \frac{1}{4}(11+8-15-12)$

b. $SD(R_{HPQ}) = \sqrt{\left(\frac{1}{3}\right)\left((13-\overline{R}_{HPQ})^2 + (36-\overline{R}_{HPQ})^2 + (42-\overline{R}_{HPQ})^2 + (1-\overline{R}_{HPQ})^2\right)}$

$$SD(R_{AMGN}) = \sqrt{\left(\frac{1}{3}\right)\left((11-\overline{R}_{AMGN})^2 + (8-\overline{R}_{AMGN})^2 + (-15-\overline{R}_{AMGN})^2 + (-12-\overline{R}_{AMGN})^2\right)}$$

c. $Cov(R_{HPQ}, R_{AMGN}) = \frac{1}{3}\left((13-\overline{R}_{HPQ})(11-\overline{R}_{AMGN}) + (36-\overline{R}_{HPQ})(8-\overline{R}_{AMGN}) + (42-\overline{R}_{HPQ})(-15-\overline{R}_{AMGN}) + (1-\overline{R}_{HPQ})(-12-\overline{R}_{AMGN})\right)$

$$Corr(R_{HPQ}, R_{AIG}) = \frac{Cov(R_{HPQ}, R_{AIG})}{SD(R_{HPQ})SD(R_{AMGN})}$$

d. $SD(R_P) = \sqrt{\left(\frac{-100}{400}\right)^2 (SD(R_{AMGN}))^2 + \left(\frac{500}{400}\right)^2 (SD(R_{HPQ}))^2 + 2\left(\frac{-100}{400}\right)\left(\frac{500}{400}\right)Cov(R_{HPQ}, R_{AMGN})}$

15. Assume that you have collected the following past returns for AMD, Sysco (SYY), and the market portfolio (MKT). Assume also that the market portfolio is efficient, that the risk-free rate is 1.8%, and that the market risk premium is 6%. Calculate the expected and required return on Sysco (SYY).

		Return on:	
Year	AMD	SYY	MKT
5	-69%	-9%	-12%
4	-30%	11%	14%
3	-3%	-14%	5%
2	61%	6%	15%
1	71%	16%	13%

$$\overline{R}_{SYY} = \frac{1}{5}(-9+11-14+6+16) = S$$

$$\overline{R}_{MKT} = \frac{1}{5}(-12+14+5+15+13) = M$$

$$Cov(R_{SYY,MKT}) = \frac{1}{4}\left[(-9-S)(-12-M)+(11-S)(14-M)+(-14-S)(5-M)+(6-S)(15-M)+(16-S)(13-M)\right]$$

$$Var(R_{MKT}) = \frac{1}{4}\left[(-12-M)^2+(14-M)^2+(5-M)^2+(15-M)^2+(13-M)^2\right]$$

$$\beta_{SYY} = \frac{Cov(R_{SYY,MKT})}{Var(R_{MKT})}$$

$$E(R_{SYY}) = r_{SYY} = .018+\beta_{SYY}(.06)$$

16. Given the following returns for Barnes & Noble (BKS) and the Standard & Poor's 500 (S&P500), calculate the volatility and beta of Barnes & Noble.

	Return on:	
Year	BKS	S&P500
1	-23%	-18%
2	40%	13%
3	13%	11%
4	50%	6%
5	1%	14%

$\overline{R}_{BKS} = \frac{1}{5}(-23+40+13+50+1)$; eq [+4]; R[+1x5]; 5[+2]

$$Var(R_{BKS}) = \frac{1}{4}\left[(-23-\overline{r}_{BKS})^2 + (40-\overline{r}_{BKS})^2 + (13-\overline{r}_{BKS})^2 + (50-\overline{r}_{BKS})^2 + (1-\overline{r}_{BKS})^2\right]$$

$$SD(R_{BKS}) = \sqrt{Var(R_{BKS})}$$

eq [+4]; R[+1x5]; 4[+2]

$$\overline{R}_{S\&P} = \frac{1}{5}(-18+13+11+6+14)$$

$$Var(R_{S\&P}) = \frac{1}{4}\left[(-18-\overline{r}_{S\&P})^2 + (13-\overline{r}_{S\&P})^2 + (11-\overline{r}_{S\&P})^2 + (6-\overline{r}_{S\&P})^2 + (14-\overline{r}_{S\&P})^2\right]$$

eq [+4]; R[+1x5]; 4[+2]

$$Cov(R_{BKS}, R_{S\&P}) = \frac{1}{4}\left[(-23-\overline{r}_{BKS})(-18-\overline{r}_{S\&P}) + (40-\overline{r}_{BKS})(13-\overline{r}_{S\&P}) + (13-\overline{r}_{BKS})(11-\overline{r}_{S\&P}) + (50-\overline{r}_{BKS})(6-\overline{r}_{S\&P}) + (1-\overline{r}_{BKS})(14-\overline{r}_{S\&P})\right]$$

eq [+9]; R[+1x10]; 4[+2]

$\beta = \frac{Cov(R_{BKS}, R_{S\&P})}{Var(R_{S\&P})}$; eq [+10]

17. You are planning to invest $800,000 in T-bills earning 4% per year and to invest another $200,000 in a portfolio of UnitedHealth, Coca Cola, and National Semiconductor. The expected return on UnitedHealth is 9%, on Coca Cola is 15%, and on National Semiconductor is 19%. The volatility of UnitedHealth is 19%, of Coca Cola is 29%, and of National Semiconductor is 38%. The correlations between the stocks are between 0.1 and 0.3. Note: combine your answers to "a" and "b" on the same graph, but clearly label what part of the graph answers "a" and what part answers "b".

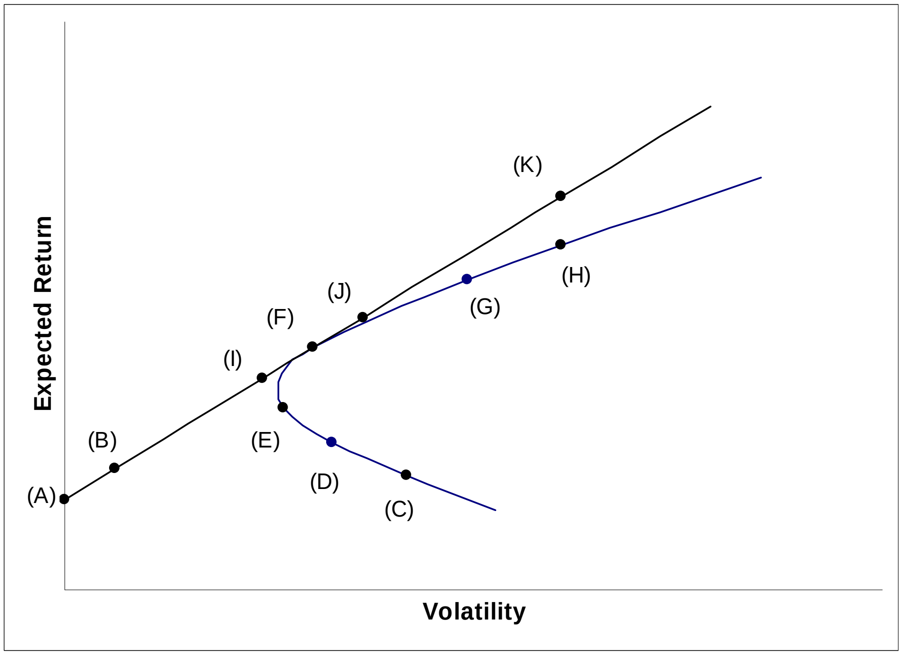
a. Sketch a reasonable set of efficient portfolios you might construct from UnitedHealth, Coca Cola, and National Semiconductor if you are willing to hold short and long positions in the stocks.

b. Given the assumptions, identify the specific portfolio that gives you the highest return for the risk you will face.

=> See jpg file. Note: originally Fall 2007, Problem 2

Multiple-Choice

Use the following graph to answer questions 1 through 4. In the graph, assume you are combining Delta (D) and General Motors (G) into a risky portfolio. You can also buy or short-sell Treasuries (lend or borrow at the risk-free rate).



1. How would you move from (J) to (K)?
   a. buy Treasuries, sell Delta, buy General Motors
   b. buy Treasuries, buy Delta, buy General Motors
   c. sell Treasuries, buy General Motors, sell Delta
   D. sell Treasuries, buy Delta, buy General Motors
   e. buy Treasuries, sell Delta, sell General Motors

2. Assume you are currently at (C) and want to move to (J). Which of the following sets transactions would allow you to make this move?
   a. buy shares of Delta, buy shares of General Motors
   b. sell shares of Delta, sell shares of General Motors, buy Treasuries
   C. sell shares of Delta, buy shares of General Motors, short-sell Treasuries (borrow)
   d. sell shares of Delta, buy shares of General Motors, buy Treasuries
   e. buy shares of Delta, sell shares of General Motors, short-sell Treasuries (borrow)

3. Which of the points involves investing 80% of your money in Treasuries and 20% of your money in the best possible combination of Delta and General Motors?
   a. (K)
   b. (H)
   c. (F)
   D. (B)
   e. (I)

4. Which of the points would involve short-selling Delta and buying shares of General Motors?
   A. (H)
   b. (B)
   c. (C)
   d. (K)
   e. (E)

5. Assume that the standard deviation of returns on Alcoa is 38%, that the standard deviation of returns on the market is 28%, and that the correlation between Alcoa and the market is +0.65. Assume also that the return on Treasuries is 1.5%, that the expected return on the market is 8%, and that the expected return on Alcoa is 6.5%. Given the information, which of the following statements is correct?

   a. the market is not efficient because the expected return on Alcoa should equal 8%
   b. the market is not efficient because the expected return on Alcoa should equal 10.3%
   C. the market is not efficient because the expected return on Alcoa should equal 7.2%
   d. the market is efficient
   e. the market is not efficient because the expected return on Alcoa should equal 5.7%

Use the following information to answer questions 6 and 7.

Assume that the optimal risky portfolio has an expected return of 15% and a standard deviation of returns of 26%. Assume also that you can borrow or lend at a risk-free interest rate of 4%. Finally, assume that you plan to invest $200,000 of your own funds.

6. Calculate your expected return if you borrow $100,000 and invest these borrowed funds plus your $200,000 in the optimal risky portfolio.

   a. $\left(\frac{300{,}000}{200{,}000}\right)\times 15+\left(\frac{100{,}000}{200{,}000}\right)\times 4$
   b. $\left(\frac{300{,}000}{200{,}000}\right)\times 15$
   C. $\left(\frac{300{,}000}{200{,}000}\right)\times 15+\left(\frac{-100{,}000}{200{,}000}\right)\times 4$
   d. $\left(\frac{200{,}000}{300{,}000}\right)\times 15+\left(\frac{100{,}000}{300{,}000}\right)\times 4$
   e. 15

7. Calculate the standard deviation of returns you can expect if you borrow $100,000 and invest these borrowed funds plus your $200,000 in the optimal risky portfolio.

   a. $\left(\frac{200{,}000}{300{,}000}\right)\times 26$
   b. $\left(\frac{100{,}000}{200{,}000}\right)\times 26$
   C. $\left(\frac{300{,}000}{200{,}000}\right)\times 26$
   d. $\left(\frac{200{,}000}{100{,}000}\right)\times 26$
   e. none of the above

8. Which of the following statements about correlation and covariance are incorrect?

(1) correlation ranges between -1 and +1
(2) a drop in the correlation between the two stocks in a portfolio reduces the expected return on the portfolio
(3) covariance ranges between -1 and + 1
(4) correlation ranges between negative infinity and positive infinity
(5) if you know the standard deviations of two stocks and the covariance between them, you can calculate correlation
(6) if you know the standard deviation of two stocks and the correlation between them, you can calculate covariance
(7) covariance ranges between negative infinity and positive infinity
(8) a drop in the correlation between two stocks in a portfolio increases the expected return on the portfolio

a. 1, 2, 3, 4
b. 2, 3, 4, 6
c. 1, 3, 4, 5
D. 2, 3, 4, 8
e. 1, 2, 4, 6

9. Assume you have short-sold $100,000 in DryShips which has a beta of 4.5, bought $400,000 in Eddie Bauer which has a beta of 1.5, and bought $700,000 in CF Industries which has a beta of 1.3. Assuming that the total value of your portfolio is P, calculate the beta of your portfolio.

a. $\left(\frac{100{,}000}{P}\right)\times 4.5+\left(\frac{400{,}000}{P}\right)\times 1.5+\left(\frac{700{,}000}{P}\right)\times 1.3$

B. $\left(\frac{-100{,}000}{P}\right)\times 4.5+\left(\frac{400{,}000}{P}\right)\times 1.5+\left(\frac{700{,}000}{P}\right)\times 1.3$

c. $\frac{-4.5+1.5+1.3}{3}$

d. $\left(\frac{100{,}000}{P}\right)\times 4.5+\left(\frac{-400{,}000}{P}\right)\times 1.5+\left(\frac{-700{,}000}{P}\right)\times 1.3$

e. $\frac{4.5+1.5+1.3}{3}$

Use the following information to answer questions 10 and 11.

> Assume you have invested \$30,000 in Dell (D) and \$70,000 in Caterpillar (C). The expected return on Dell is 12% and on Caterpillar is 5%. The volatility of returns on Dell is 35% and on Caterpillar is 28%. The correlation between the returns on Dell and Caterpillar is +0.20.

10. Which of the following calculates the volatility (standard deviation) of returns on your portfolio?

a. $\sqrt{\left(\frac{30{,}000}{30{,}000+70{,}000}\right)^2\times .12^2+\left(\frac{70{,}000}{30{,}000+70{,}000}\right)^2\times .05^2+2\times\left(\frac{30{,}000}{30{,}000+70{,}000}\right)\times\left(\frac{70{,}000}{30{,}000+70{,}000}\right)\times .2}$

b. $\sqrt{\left(\frac{30{,}000}{30{,}000+70{,}000}\right)\times .35+\left(\frac{70{,}000}{30{,}000+70{,}000}\right)\times .28}$

c. $\left(\frac{30{,}000}{30{,}000+70{,}000}\right)\times .35+\left(\frac{70{,}000}{30{,}000+70{,}000}\right)\times .28$

d. $\sqrt{\left(\frac{30{,}000}{30{,}000+70{,}000}\right)^2\times .35^2+\left(\frac{70{,}000}{30{,}000+70{,}000}\right)^2\times .28^2+2\times\left(\frac{30{,}000}{30{,}000+70{,}000}\right)\times\left(\frac{70{,}000}{30{,}000+70{,}000}\right)\times .2}$

E. $\sqrt{\left(\frac{30{,}000}{30{,}000+70{,}000}\right)^2\times .35^2+\left(\frac{70{,}000}{30{,}000+70{,}000}\right)^2\times .28^2+2\times\left(\frac{30{,}000}{30{,}000+70{,}000}\right)\times\left(\frac{70{,}000}{30{,}000+70{,}000}\right)\times .2\times .35\times .28}$

11. Which of the following will calculate the expected return on your portfolio?

a. $\left(\frac{30{,}000}{30{,}000+70{,}000}\right)\times .12+\left(\frac{70{,}000}{30{,}000+70{,}000}\right)\times .05+2\times\left(\frac{30{,}000}{30{,}000+70{,}000}\right)\times\left(\frac{70{,}000}{30{,}000+70{,}000}\right)\times .2\times .12\times .05$

b. $\left(\frac{70{,}000}{30{,}000+70{,}000}\right)\times .12+\left(\frac{30{,}000}{30{,}000+70{,}000}\right)\times .05$

c. $\left(\frac{30{,}000}{70{,}000}\right)\times .12+\left(\frac{70{,}000}{30{,}000}\right)\times .05$

d. $\left(\frac{12+5}{2}\right)$

E. $\left(\frac{30{,}000}{30{,}000+70{,}000}\right)\times .12+\left(\frac{70{,}000}{30{,}000+70{,}000}\right)\times .05$