Econ 252 - Financial Markets

Spring 2011

Professor Robert Shiller

Midterm Exam #1

Suggested Solution

Part I.

1. Lecture 7 on "Efficient Markets."

   Financial theory suggests that day-to-day changes are primarily due to news, and news is by definition unforecastable. This is so since other factors (changing interest rates, inflation rates, dividend payouts) are usually negligible on a day-to-day basis. If stock prices were AR-1, and if the autoregressive coefficient were far from one, then there would be a strong forecastable component to stock prices, a profit opportunity for traders, contrary to the Efficient Markets Hypothesis.

2. Fabozzi et al., pp. 5-6; assigned reading *Wall Street and the Country: A Study of Recent Financial Tendencies* by Charles Conant, pp. 92-93.

   Fabozzi et al. define the price discovery process as follows:
   "[…] the interactions of buyers and sellers in a financial market determine the price of a traded asset. Or, equivalently, they determine the required return on a financial asset. As the inducement for firms to acquire funds depends on the require return that investors demand, it is this feature of financial markets that signals how the funds in the economy should be allocated among financial assets. This is called the price discovery process."

Charles Conant in *Wall Street and the Country: A Study of Recent Financial Tendencies* describes the importance of price discovery as follows:

> Suppose for a moment that the stock markets of the world were closed, that it was no longer possible to learn what railways were paying dividends, what their stocks were worth, how industrial enterprises were faring,—whether they were loaded up with surplus goods or had orders ahead. Suppose that the information afforded by public quotations on the stock and produce exchanges were wiped from the slate of human knowledge. How would the average man, how even would a man with the intelligence and foresight of a Pierpont Morgan, determine how new capital should be invested? He would have no guide except the most isolated facts gathered here and there at great trouble and expense. A greater misdirection of capital and energy would result than has been possible since the organization of modern economic machinery. Mr. Morgan or any other capitalist might be expending millions of dollars in building new railways or cotton mills when there was no necessity for them, while a hundred other industries beneficial to the public were stagnant for lack of capital. There

3. Guest lecture by David Swensen.

   David Swensen emphasized the importance of the asset allocation decision in comparison with the market timing decision and the security selection decision.

   He was able to produce the high returns that he has achieved on Yale's portfolio in less efficiently priced asset classes. He compared the performance between the top quartile of institutional investment managers and the bottom quartile, for various investment categories (asset classes). The difference across quartiles was miniscule for bonds, small for public stocks. The differences were much greater for private equity and absolute return. He achieved those returns by those other asset classes.

4. Assigned reading *Slapped in the Face by the Invisible Hand: Banking and the Panic of 2007* by Gary Gorton, abstract.

   Gary Gorton writes in the abstract of "Slapped in the Face by the Invisible Hand: Banking and the Panic of 2007":

Abstract

The "shadow banking system," at the heart of the current credit crisis is, in fact, a real banking system – and is vulnerable to a banking panic. Indeed, the events starting in August 2007 are a banking panic. A banking panic is a systemic event because the banking *system* cannot honor its obligations and is *insolvent*. Unlike the historical banking panics of the 19th and early 20th centuries, the current banking panic is a wholesale panic, not a retail panic. In the earlier episodes, depositors ran to their banks and demanded cash in exchange for their checking accounts. Unable to meet those demands, the banking system became insolvent. The current panic involved financial firms "running" on other financial firms by not renewing sale and repurchase agreements (repo) or increasing the repo margin ("haircut"), forcing massive deleveraging, and resulting in the banking system being insolvent. The earlier episodes have many features in common with the current crisis, and examination of history can help understand the current situation and guide thoughts about reform of bank regulation. New regulation can facilitate the functioning of the shadow banking system, making it less vulnerable to panic.

5. Lecture 4 on "Portfolio Diversification and Supporting Financial Institutions."

   The old investing adage "don't put all your eggs in one basket" doesn't define what diversification really is. Putting one each of every stock in your portfolio might not be right, since some of the stocks are highly correlated with each other, some have more variance with another, etc.

6. Fabozzi et al., p. 100.

   "Because of the insurance wrapper, discussed below, the annuity is treated as an insurance product and as a result receives a preferential tax treatment. Specifically, the income and realized gains are not taxable if not withdrawn from the annuity product. Thus, the 'inside buildup' of returns is not taxable on an annuity, as it is also not on other cash value insurance products. At the time of withdrawal, however, all the gains are taxed at ordinary income rates.

   The 'insurance wrapper' on the mutual fund that makes it an annuity can be of various forms. The most common 'wrapper' is the guarantee by the insurance company that the annuity policyholder will gte back no less than the amount invested in the annuity (there may also be a minimum period before withdrawal to get this benefit)."

7. Lecture 3 on "Technology and Invention in Finance"; Fabozzi et al., pp. 261-263.

   "Fat tails" are a property of probability distributions. They refer to the fact that events in the tails of the distributions (extreme events) occur with higher frequency than, for example, predicted by the normal distribution.

   Fat tails may mean that there is no finite variance to do mean-variance analysis on. They make the data unreliable guides to the future, as there may have been no past jump in the data that reveals the risk to the portfolio. Fabozzi et al., on p. 262, state that there are ways to modify the CAPM for fat tails.

8. Lecture 4 on "Portfolio Diversification and Supporting Financial Institutions."

   In a sense yes, for if the stock has a strong negative covariance with other stocks, then it might serve to insure the rest of the portfolio against loss. But, in another sense, no, since according to this model all people hold the same risky portfolio, and so everyone would want to be short this stock, and everyone can't be short, because all stocks exist in positive supply.

9. Lecture 2 on "Risk and Financial Crises"; Shiller manuscript, chapter 11.

   Systemic risk is risk of collapse of the entire financial system, because of interdependencies that make each financial institution vulnerable if bankruptcies of other such institutions threaten their balance sheet, and because of panic among the general public that destroys trust in the system.

   Institutions:

   - In the U.S., the Financial Stability Oversight Council and its advisory wing, the Office of Financial Research.
   - In Europe, the European Systemic Risk Board, and its Advisory Technical Committee.
   - For the world, the G-20 nations, the Financial Stability Board, and the Basel Committee.

10. Lecture 2 on "Risk and Financial Crises."

    VaR captures the risk of a big loss of a particular position. The VaR at a specific probability value p is a threshold-value such that the loss on your portfolio position exceeds the threshold only with probability p.

    VaR did not take proper account of crisis-induced changes in covariance.

Part II.

Question 1

(a) Denote the Honest Abe bond by A. It pays \$100 with probability 1. Therefore,

$$E[A] = 1 \cdot 100 = 100.$$

Denote the Bonnie bond by B. It pays \$100 with probability .4+.1=.5 and pays nothing with probability .1+.4=.35. Therefore,

$$E[B] = .5 \cdot 100 + .5 \cdot 0 = 50.$$

Denote the Clyde bond by C. It pays \$100 with probability .4+.1=.5 and pays nothing with probability .1+.4=.5. Therefore,

$$E[C] = .5 \cdot 100 + .5 \cdot 0 = 50.$$

(b) As the Honest Abe bond pays a fixed amount for sure, its variance equals \$0.

The variance of the Bonnie bond equals

$$Var(B) = E[B^2] - E[B]^2 = .5 \cdot (100)^2 + .5 \cdot (0)^2 - (50)^2 = 2{,}500.$$

The variance of the Clyde bond equals

$$Var(C) = E[C^2] - E[C]^2 = .5 \cdot (100)^2 + .5 \cdot (0)^2 - (50)^2 = 2{,}500.$$

(c) The covariance of the Bonnie bond and the Clyde bond equals

$$Cov(B,C) = E[B \cdot C] - E[B]E[C]$$
$$= .4 \cdot 100 \cdot 100 + .1 \cdot 100 \cdot 0 + .1 \cdot 0 \cdot 100 + .4 \cdot 0 \cdot 0 - 50 \cdot 50 = 1{,}500.$$

(d) The random variable of interest is .5 • A + .25 • B + .25 • C.

The expected value of this random variable is

$$E[.5\cdot A+.25\cdot B+.25\cdot C]=.5E[A]+.25E[B]+.25E[C]$$
$$=.50\cdot 100+.25\cdot 50+.25\cdot 50=75.$$

In order to compute the variance of .5 • A + .25 • B + .25 • C, observe that

$$Var(.5\cdot A+.25\cdot B+.25\cdot C)=Var(.25\cdot B+.25\cdot C),$$

as .5 • A is a constant. It follows that

$$Var(.5\cdot A+.25\cdot B+.25\cdot C)=Var(.25\cdot B+.25\cdot C)$$
$$=Var(.25\cdot B)+Var(25\cdot C)+2\cdot Cov(.25\cdot B,.25\cdot C)$$
$$=(.25)^2 Var(B)+(.25)^2 Var(C)+2\cdot .25\cdot .25\cdot Cov(B,C)$$
$$=(.25)^2\cdot 2{,}500+(.25)^2\cdot 2{,}500+2\cdot .25\cdot .25\cdot 1{,}500=500.$$

Question 2

(a) The return variance satisfies

$$Var(r_P) = Var(w\cdot r_A + (1-w)\cdot r_B)$$
$$= (w)^2\cdot Var(r_A) + (1-w)^2\cdot Var(r_B) + 2\cdot w\cdot (1-w)\cdot Corr(r_A, r_B)\cdot Std(r_A)\cdot Std(r_B).$$

Using w=0.9 and the information provided for assets A and B, it follows that

$$Var(r_P) = Var(w\cdot r_A + (1-w)\cdot r_B)$$
$$= (0.9)^2\cdot (0.31)^2 + (0.1)^2\cdot (0.55)^2 + 2\cdot 0.9\cdot 0.1\cdot 0.2\cdot 0.31\cdot 0.55 \approx 0.087.$$

It follows that the return standard deviation for w=0.9 satisfies

$$Std(r_P) = \sqrt{Var(r_P)} = \sqrt{0.0087} \approx 0.295 = 29.5\%.$$

The expected return satisfies

$$E[r_P] = E[w\cdot r_A + (1-w)\cdot r_B] = w\cdot E[r_A] + (1-w)\cdot E[r_B].$$

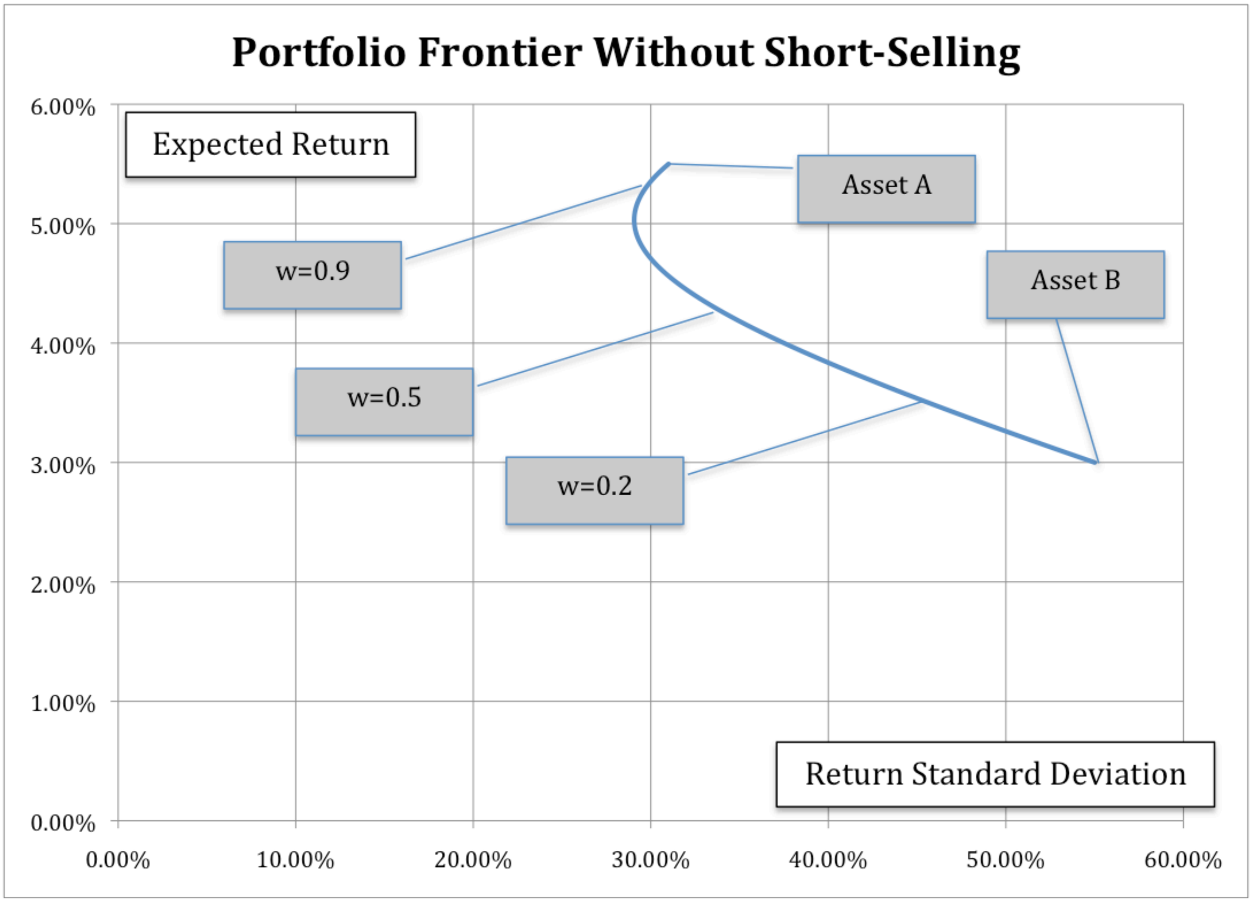
Using $E[r_P]$=0.035 and the information provided for assets A and B, it follows that

$$E[r_P] = w\cdot E[r_A] + (1-w)\cdot E[r_B]$$
$$\Leftrightarrow 0.035 = w\cdot 0.055 + (1-w)\cdot 0.03$$
$$\Leftrightarrow w = 0.2.$$

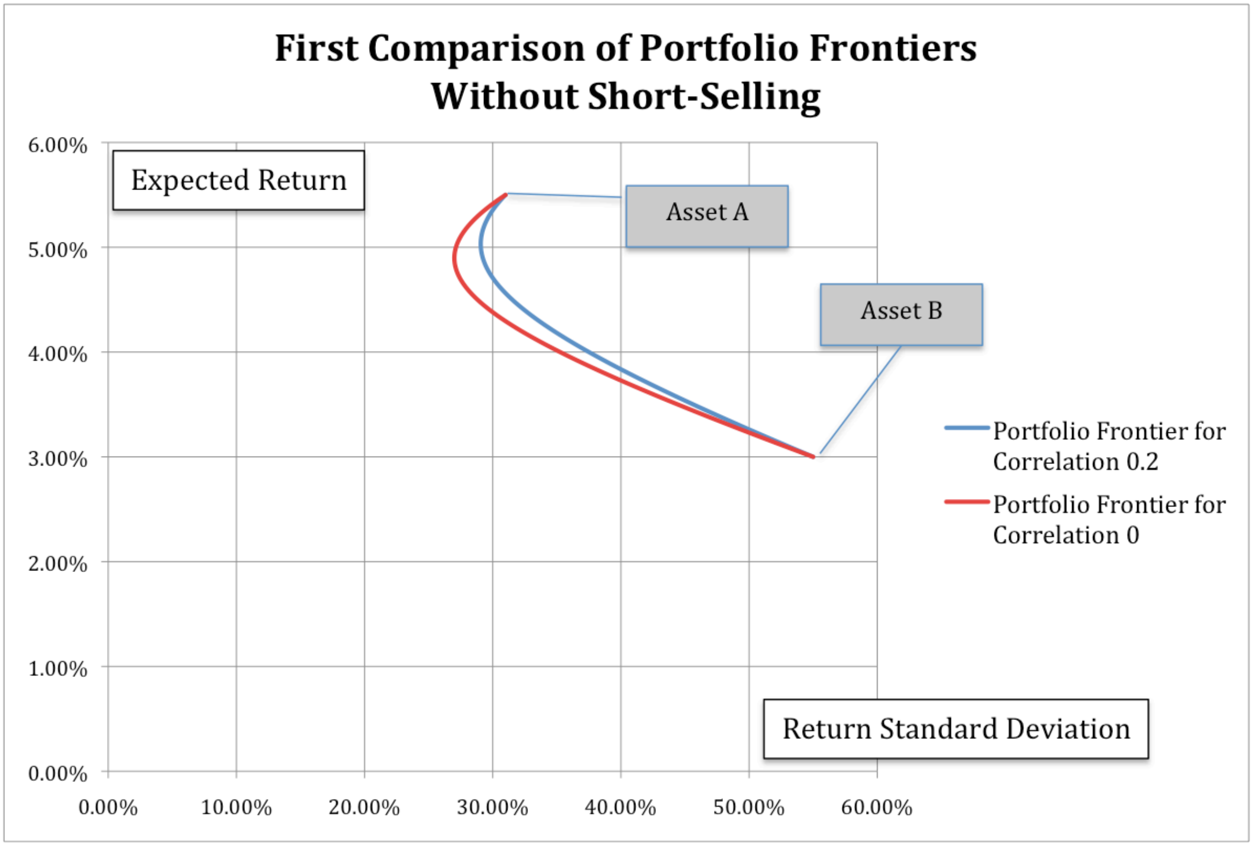
In summary, the completed table looks as follows:

Weight	Expected Return	Return Standard Deviation
w=0.9	5.25%	29.50%
w=0.5	4.25%	34.16%
w=0.2	3.50%	45.65%

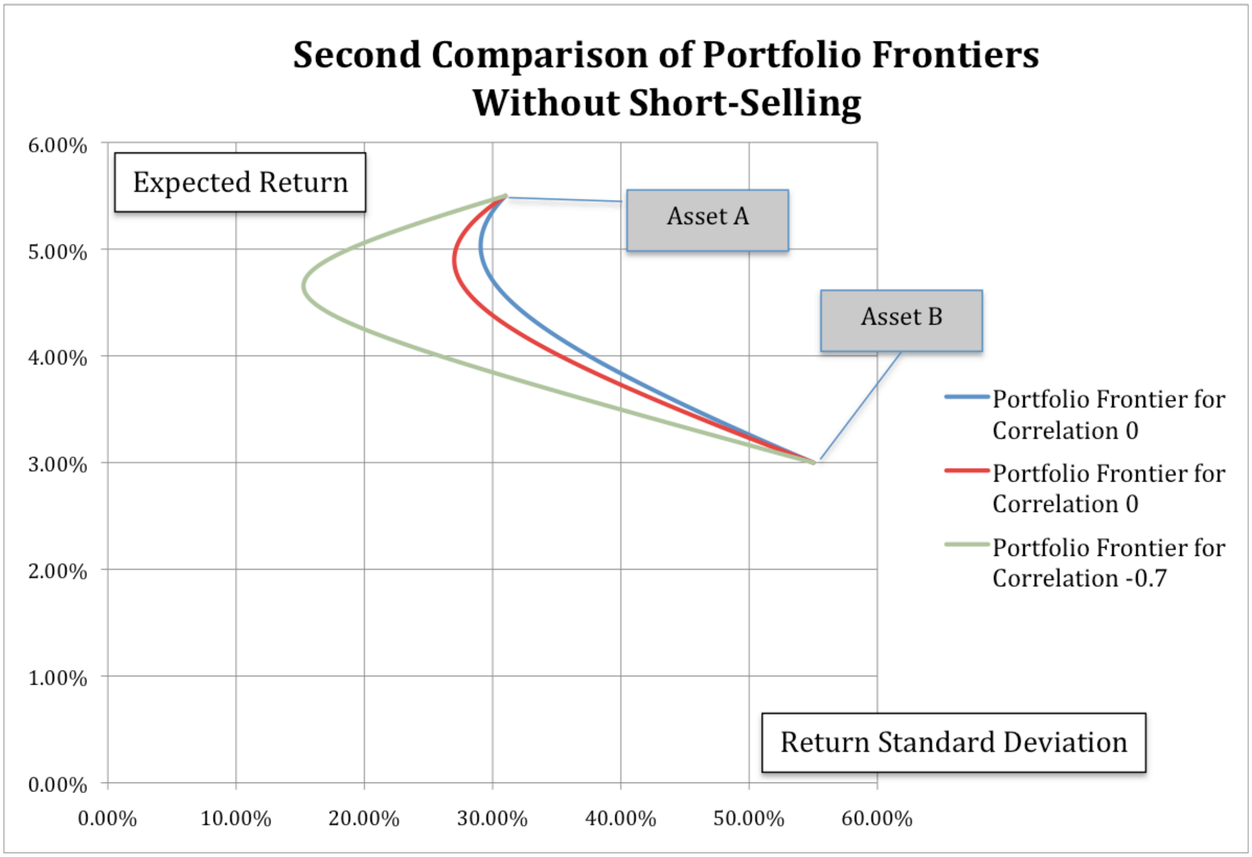
(b)


Portfolio Frontier Without Short-Selling
Expected Return
6.00%
5.00%
4.00%
3.00%
2.00%
1.00%
0.00%
Asset A
Asset B
w=0.9
w=0.5
w=0.2
Return Standard Deviation
0.00%
10.00%
20.00%
30.00%
40.00%
50.00%
60.00%

(c)


First Comparison of Portfolio Frontiers
Without Short-Selling
Expected Return
Asset A
Asset B
Return Standard Deviation
Portfolio Frontier for Correlation 0.2
Portfolio Frontier for Correlation 0
6.00%
5.00%
4.00%
3.00%
2.00%
1.00%
0.00%
0.00%
10.00%
20.00%
30.00%
40.00%
50.00%
60.00%

(d)



(e) The lower the correlation of two assets, the lower the resulting return standard deviation, if the weight on each of the two assets is positive. The weight on each of the two assets is always positive under the assumption that short-selling is prohibited.

So, diversifying between two assets, i.e. putting positive weights on each asset in a portfolio, is more advantageous (in the sense of lower return standard deviation) for lower correlation values.

Question 3

(a) Making use of the fact that the Sharpe-ratio of the Tangency Portfolio is the slope of the Tangency Line, one can compute the Sharpe-ratio of the Tangency Portfolio as

$$SR_{TP} = \frac{\mu_{P2} - \mu_{P1}}{\sigma_{P2} - \sigma_{P1}} = \frac{0.085 - 0.055}{0.25 - 0.15} = 0.3.$$

(b) As all portfolios on the Tangency Line have identical Sharpe-ratio, it follows that portfolio 1 (as well as portfolio 2) have Sharpe-ratio 0.3. Then, it follows from the formula of the Sharpe-ratio that

$$0.3 = \frac{\mu_{P1} - r_f}{\sigma_{P1}} \Leftrightarrow 0.3 = \frac{0.055 - r_f}{0.15},$$

implying that r_f=0.01=1%.

If the hint is used, one obtains

$$0.25 = \frac{\mu_{P1} - r_f}{\sigma_{P1}} \Leftrightarrow 0.25 = \frac{0.055 - r_f}{0.15},$$

implying that r_f=0.0175=1.75%.

(c) The Sharpe-ratio of the Tangency Portfolio is equal to

$$SR_{TP} = \frac{\mu_{TP} - r_f}{\sigma_{TP}} \Leftrightarrow SR_{TP} = \frac{0.06 - 0.02}{0.2} = 0.2.$$

With the risk-free rate of 2%, the maximum expected return that you can generate given 25% return standard deviation corresponds to a portfolio on the second Tangency Line. Hence, the Sharpe-ratio of this portfolio equals 0.2. One therefore obtains the maximum expected return as

$$0.2 = \frac{\mu_P - r_f}{\sigma_P} \Leftrightarrow 0.2 = \frac{\mu_P - 0.02}{0.25} \Leftrightarrow \mu_P = 0.07.$$

So, the maximum expected return is 7%.

(d) In the context of the original tangency line, one can achieve 8.5% expected return for 25% return standard deviation (which is exactly Portfolio 2). In the context of the second tangency line, one can only achieve 7% expected return for 25% return standard deviation. Therefore, the original tangency line is preferable.