Bodie, Kane, Marcus, Perrakis and Ryan, Chapter 2

Answers to Selected Problems

1. The following multiple-choice problems are based on questions that have appeared in past CFA examinations.

   a A firm's preferred stock often sells at yields below its bonds because

   i. A referred stock generally carries a higher agency rating.
   Note: This cannot be the right answer. Since interest payments to bond-holders have to be paid and dividends don't, preferred stocks cannot have a better rating than bonds.

   ii. Owners of preferred stocks have a prior claim on the firm's earnings.
   Note: This cannot be the right answer. The statement refers to common stocks, not bonds.

   iii. Owners of preferred stocks have a prior claim on a firm's assets in the event of liquidation.
   Note: This cannot be the right answer. Bondholders get paid before preferred stock holders in the event of liquidation.

   iv. Corporations owning stocks may exclude from income taxes most of the dividend income they receive.
   This is the right answer. Tax rates on dividends are less than tax rates on interest income for anybody, not only corporations. However corporation benefits from huge tax credit on dividend payments, which can go up to 100% if

the dividend comes from domestic corporation. This makes preferred stocks very attractive for corporations, and this explains why they can be sold with a much lower yield than comparable bonds.

b Which is the *most risky* transaction to undertake in the stock index option markets if the stock market is expected to increase substantially after the transaction is completed?

  (i) Write a call option.

 (ii) Write a put option.

(iii) Buy a call option.

(iv) Buy a put option.

Answer: Risk is what we can't control. When buying options, call or put, there is some risk that the option ends up worthless but the fact that it will be exercised or not entirely depends on the option holder and thus does not constitute risk. When writing an option, the risk surrounding the underlying asset still remains but whether or not the option will be exercised is out of control of the writer. Hence writing a call (put) option can only be more risky than buying a put (call) option (note that writing a call and buying a put involves similar expectations about the market trend). We thus need only consider (i) and (ii) in the present example. Since the market is expected to rise, writing a call option is more risky than writing a put option since a call option is more likely to be exercised.

2. The investment manager of a corporate pension fund has purchased a Treasury bill with 180 days to maturity at a price of \$9,600 per \$10,000 face value. The manager has computed the bank discount yield at 8 percent.

  a. Calculate the bond equivalent yield for the Treasury bill. Show your calculations.

  Answer: The bank discount yield, d, is obtained as follows.

$$d = \frac{10,000 - 9,600}{10,000} \times \frac{360}{180} = 0.08.$$

On the other hand, the bond equivalent yield r_{bey}, is calculated using a 365-day year and the price of the bond as a divisor. That is,

$$r_{bey} = \frac{10,000 - 9,600}{9,600} \times \frac{365}{180} = 8.45\%.$$

b. Briefly state two reasons why a Treasury bill's bond equivalent yield is always different from the bank discount yield.

Answer: There are two differences in calculating the two yields: (i) The number of days to represent a year; (ii) The bond equivalent yield expresses a return on the bond price whereas the bank discount yield expresses a return on the face value of the bond.

3. A bill has a bank discount yield of 6.81 percent based on the ask price, and 6.90 percent based on the bid price. The maturity of the bill (already accounting for skip-day settlement) is 60 days. Find the bid and ask prices of the bill.

Answer: Let A denote the asked price and let B denote the bid price. So we have

$$\frac{1,000 - A}{1,000} \times \frac{360}{60} = 0.0681 \quad \text{and} \quad \frac{1,000 - B}{1,000} \times \frac{360}{60} = 0.069.$$

This gives us

$$A = 1,000 - 1,000 \times \tfrac{60}{360} \times 0.0681 = 988.65$$
$$B = 1,000 - 1,000 \times \tfrac{60}{360} \times 0.069 = 988.50$$

4. Reconsider the T-bill of problem 3. Calculate its bond equivalent yield and effective annual yield on the basis of the ask price. Confirm that these yields exceed the discount yield.

Answer: The bond equivalent yield, using the ask price, is calculated as

$$\frac{1,000 - A}{A} \times \frac{365}{60} = \frac{1,000 - 988.65}{988.65} \times \frac{365}{60} = 0.0698 = 6.98\%.$$

The effective annual yield, on the other hand, is calculated as

$$\left(1 + \frac{1,000 - 988.65}{988.65}\right)^{365/60} - 1 = 0.0719 = 7.19\%.$$

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5. The following questions deal with yields.

   a. Which security offers a higher effective annual yield?

      i. A three-month bill selling at $9,764

      ii. A six-month bill selling at $9,539

   Answer: Assume the three-month bill has a maturity of 91 days and the six-month bill has a maturity of 182 days. The effective annual yield for the first security is

   $$\left(1 + \frac{10,000 - 9,764}{9,764}\right)^{365/91} - 1 = 0.1005 = 10.05\%.$$

   For the second security, the effective annual yield is

   $$\left(1 + \frac{10,000 - 9,539}{9,539}\right)^{365/182} - 1 = 0.0993 = 9.93\%.$$

   Thus the first security has a higher effective annual yield.

   b. Calculate the bank discount yield on each bill.

   Answer: The bank discount yield on the first security is

   $$\frac{10,000 - 9,764}{10,000} \times \frac{360}{91} = 9.34\%.$$

   For the second security, we have

   $$\frac{10,000 - 9,539}{10,000} \times \frac{360}{182} = 9.12\%.$$

6. A U.S. Treasury bill with 90-day maturity sells at a bank discount yield of 3 percent.

   a. What is the price of the bill?

   Answer: Let P denote the price of the bill. The bank discount yield being 3%, we have

   $$\frac{1,000 - P}{1,000} \times \frac{360}{90} = 0.03$$

   and thus

   $$P = 1,000 - 1,000 \times \frac{1}{4} \times 0.03 = \$992.50$$

b. What is the 90-day holding period return of the bill?

The 90-day holding period return is

$$\frac{10,000 - 9,925}{9,925} = 0.756\%.$$

c. What is the bond equivalent yield of the bill?

Answer: It is calculated as

$$\frac{10,000 - 9,925}{9,925} \times \frac{365}{90} = 0.00756 \times \frac{365}{90} = 3.066\%.$$

d. What is the effective annual yield of the bill?

Answer: Well, let's calculate it.

$$\left(1 + \frac{10,000 - 9,925}{9,925}\right)^{365/90} - 1 = (1 + 0.00756)^{365/90} = 0.0310 = 3.1\%.$$

7. Find the after-tax return to a corporation that buys a share of preferred stock at $40, sells it at year-end at $40, and receives a $4 year-end dividend. The firm is in the 30 percent tax bracket.

Answer: If the dividend is 100% tax-deductible, the after-tax return to the corporation is $\frac{4}{40} = 10\%$.

8. Consider the three stocks in Table 1. P_t represents price at time t, and Q_t represents shares outstanding at time t. Stock C splits two for one in the last period.

	P_0	Q_0	P_1	Q_1	P_2	Q_2
A	90	100	95	100	95	100
B	50	200	45	200	45	200
C	100	200	110	200	55	400

Table 1: Table for question 9.

a. Calculate the rate of return on a price-weighted index of the three stocks for the first period ($t = 0$ to $t = 1$).

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Answer: The value of the price-weighted index in period 0 is $\frac{90+50+100}{3} = 80$. The value of the index at time $t = 1$ is $\frac{95+45+110}{3} = 83.33$. Thus the return on the price-weighted index from time $t = 0$ to time $t = 1$ is

$$\frac{83.33 - 80}{80} = 4.17\%.$$

b. What must happen to the divisor for the price-weighted index in year 2?

Answer: There is no change in prices from period 1 to 2 since $55 = 110/2$, and the prices of asset A and asset B are the same in both periods. Hence the value of the price-weighted index should be the same in periods 1 and 2. Let D represent the divisor in period 2. Then we have

$$\frac{95 + 45 + 110}{3} = \frac{95 + 45 + 55}{D} \implies D = \frac{95 + 45 + 55}{95 + 45 + 110} \times 3 = 2.34 .$$

c. Calculate the rate of return of the price-weighted index for the second period.

Answer: The index has not changed, thus its return is zero.

9. Using the data in problem 9, calculate the first period rates of return on the following indices of the three stocks:

a. A market-value weighted index.

Answer: The return of such an index from period 0 to 1

$$\frac{95 \times 100 + 45 \times 200 + 110 \times 200 - (90 \times 100 + 50 \times 200 + 100 \times 200)}{90 \times 100 + 50 \times 200 + 100 \times 200}$$

$$= \frac{40,500 - 39,000}{39,000} = 3.85\% .$$

b. An equally weighted index.

Answer: In an equally weighted index, the amount of money invested in each stock is the same. Let $S_{A,0}$, $S_{B,0}$ and $S_{C,0}$ denote the number of shares of asset A, B and C that such a portfolio would hold at the beginning of period 0. The dollar value of each investment being the same, we have

$$90 \times S_{A,0} = 50 \times S_{B,0} = 100 \times S_{C,0}.$$

The return of such a portfolio from period 0 to 1 is then given by

$$\frac{95 \times S_{A,0} \ + \ 45 \times S_{B,0} \ + \ 110 \times S_{C,0} \ - \ (\ 90 \times S_{A,0} \ + \ 50 \times S_{B,0} \ + \ 100 \times S_{C,0} \ )}{90 \times S_{A,0} \ + \ 50 \times S_{B,0} \ + \ 100 \times S_{C,0}}$$

$$= \ \frac{(95 - 90) \times S_{A,0} \ + \ (45 - 50) \times S_{B,0} \ + \ (110 - 100) \times S_{C,0}}{90 \times S_{A,0} \ + \ 50 \times S_{B,0} \ + \ 100 \times S_{C,0}} \ .$$

Since

$$90 \times S_{A,0} + 50 \times S_{B,0} + 100 \times S_{C,0} \ = \ 3 \times 90 \times S_{A,0} \ = \ 3 \times 50 \times S_{B,0} \ = \ 3 \times 100 \times S_{C,0},$$

the return on the equally weighted index is

$$\frac{1}{3} \left(\frac{95 - 90}{90} \ + \ \frac{45 - 50}{50} \ + \ \frac{110 - 100}{100} \right) \ = \ 1.85\% \ .$$