# FM 2555A

## Solutions to Assignment No. 1

## (Only for questions not assigned for submission)

**Problem [2/14]**

**Investment and financing decisions:** Which of the following are real assets, and which are financial?

a. A share of stock
b. A personal IOU
c. A trademark
d. A factory
e. Undeveloped land
f. The balanced in the firm's checking account
g. An experienced and hardworking sales force
h. A corporate bond.

**SOLUTION:**

A trademark, a factory, undeveloped land, and your work force (c, d, e, and g) are all real assets. Real assets are identifiable as items with intrinsic value. The others in the list are financial assets, that is, these assets derive value because of a contractual claim.

**Problem [3/15]**

**Investment and financing decisions:** Vocabulary test. Explain the differences between:

a. Real and financial assets
b. Capital budgeting and financing decisions
c. Closely held and public corporations
d. Limited and unlimited lieability

**SOLUTION:**

a. Financial assets, such as stocks or bank loans, are claims held by investors. Corporations sell financial assets to raise the cash to invest in real assets such as plant and equipment. Some real assets are intangible.

b. Capital budgeting means investment in real assets. Financing means raising the cash for this investment.

c. The shares of public corporations are traded on stock exchanges and can be purchased by a wide range of investors. The shares of closely held corporations are not publicly traded and are held by a small group of private investors.

d. Unlimited liability: Investors are responsible for all the firm's debts. A sole proprietor has unlimited liability. Investors in corporations have limited liability. They can lose their investment, but no more.

**Problem [6/15]**

**Opportunity cost of capital:** F&H Corp. continues to invest heavily in a declining industry. Here is an excerpt from a recent speech by F&H's CFO:

> We at F&H have of course noted the complaints of a few spineless investors and uninformed security analyst about the slow growth of profits and dividends. Unlike those confirmed doubters, we have confidence in the long-run demand for mechanical encabulators, despite compelling digital products. We are therefore determined to invest to maintain our share of the overall encabulator market. F&H has a rigorous CAPEX approval process, and we are confident of returns around 8% on investment. That's a far better return than F&H earns on its cash holdings.
>
> The CFO went on to explain that F&H invested excess cash in short-term U.S. government securities, which are almost entirely risk-free but offered only a 4% rate of return.

a. Is a forecasted 8% return in the encabulator business necessarily better than a 4% safe return on short-term U.S. government securities? Why or why not?
b. Is F&H's opportunity cost of capital 4%? How in principle should the CFO determine the cost of capital?

**SOLUTION:**

a. Assuming that the encabulator market is risky, an 8% expected return on the F&H encabulator investments may be inferior to a 4% return on U.S. government securities.
b. Unless their financial assets are as safe as U.S. government securities, their cost of capital would be higher. The CFO could consider what the expected return is on assets with similar risk.

**Problem [7/15]**

**Corporate goals:** We can imagine the financial manager doing several things on behalf of the firm's stockholders. For example, the manager might:

a. Make shareholders as wealthy as possible by investing in real assets.

b. Modify the firm's investment plan to help shareholders achieve a particular time pattern of consumption
c. Choose high- or low-risk assets to match shareholders' risk preferences.
d. Help balance shareholders' checkbooks.

But in well-functioning capital markets, shareholders will vote for *only one* of these goals. Which one? Why?

**SOLUTION:**

Shareholders will only vote to maximise shareholder wealth. Shareholders can modify their pattern of consumption through borrowing and lending, match risk preferences, and hopefully balance their own checkbooks (or hire a qualified professional to help them with these tasks).

**Problem [11/16]**

**Agency issues:** Many firms have devised defenses that make it more difficult or costly for other firms to take them over. How might such defenses affect firm's agency problems? Are managers of firms with formidable takeover defenses more or less likely to act in the shareholder's interests rather than their own? What would you expect to happen to the share price when management proposes to institute such defenses?

**SOLUTION:**

Managers that are insulated from takeovers may be more prone to agency problems and therefore more likely to act in their own interests rather than in shareholders'. If a firm instituted a new takeover defense, we might expect to see the value of its shares decline as agency problems increase and less shareholder value maximisation occurs. The counterargument is that defensive measures allow managers to negotiate for a higher purchase price in the face of a takeover bid—to the benefit of shareholder value.

**Problem [4/40]**

**Present values:** A project produces a cash flow of $432 in year 1, $137 in year 2, and $797 in year 3. If the cost of capital is 15%, what is the project's PV? If the project requires an investment of $1,200, what is its NV?

**SOLUTION:**

a. $PV = C_1 / (1 + r)^1 + C_2 / (1 + r)^2 + C_3 / (1 + r)^3$
$PV = \$432 / 1.15 + \$137 / 1.15^2 + \$797 / 1.15^3$
$PV = \$1{,}003.28$

b. $NPV = PV - \text{investment}$
$NPV = \$1{,}003.28 - 1{,}200 = -\$196.72$

**Problem [5/40]**

**Opportunity cost of capital:** Which of the following statements are true? The opportunity cost of capital:

a. Equals the interest rate at which the company can borrow.
b. Depends on the risk of the cash flows to be valued.
c. Depends on the rates of return that shareholders can expect to earn by investing on their own.
d. Equals zero if the firm has excess cash in its bank account and the bank account pays no interest.

**SOLUTION:**

a. False. The opportunity cost of capital varies with the risks associated with each individual project or investment. The cost of borrowing is unrelated to these risks.
b. True. The opportunity cost of capital depends on the risks associated with each project and its cash flows.
c. True. The opportunity cost of capital is dependent on the rates of returns shareholders can earn on the own by investing in projects with similar risks.
d. False. Bank accounts, within FDIC limits, are considered to be risk-free. Unless an investment is also risk-free, its opportunity cost of capital must be adjusted upward to account for the associated risks.

**Problem [8/40]**

**Perpetuities and annuities:** The interest rate is 10%.

a. What is the PV of an asset that pays $1 a year in perpetuity?
b. The value of an asset that appreciates at 10% per annum approximately doubles in seven years. What is the approximate PV of an asset that pays $1 in perpetuity beginning in year 8?
c. What is the approximate PV of an asset that pays $1 a year for each of the next seven years?
d. A piece of land produces an income that grows by 5% per annum. If the first year's income is $10,000, what is the value of the land?

**SOLUTION:**

a. $PV = C / r$
$PV = \$1 / .10$
$PV = \$10$

b. $PV_7 = (C_8 / r)$
$PV_{0\ approx} = (C_8 / r) / 2$

$PV_{0\ approx} = (\$1 / .10) / 2$
$PV_{0\ approx} = \$5$

c. A perpetuity paying \$1 starting now would be worth \$10 (part a), whereas a perpetuity starting in year 8 would be worth roughly \$5 (part b). Thus, a payment of \$1 for the next seven years would also be worth approximately \$5 (= \$10 – 5).

d. $PV = C / ( r - g)$
$PV = \$10{,}000 / (.10 - .05)$
$PV = \$200{,}000$

**Problem [11/41]**

**Compounding intervals:** You are quoted an interest rate of 6% on an investment of \$10 million. What is the value of your investment after four years if interest is compounded:

a. Annually?
b. Monthly? or
c. Continuously

**SOLUTION:**

a. $C_t = PV \times (1 + r)^t$
$C_t = \$10{,}000{,}000 \text{ x } (1.06)^4$
$C_t = \$12{,}624{,}770$

b. $C_t = PV \times [1 + (r / m)^{mt}$
$C_t = \$10{,}000{,}000 \times [1 + (.06 / 12)]^{12 \times 4}$
$C_t = \$12{,}704{,}892$

c. $C_t = PV \times e^{rt}$
$C_t = \$10{,}000{,}000 \times e^{.06 \times 4}$
$C_t = \$12{,}712{,}492$

**Problem [14/41]**

**Present values:** A factory costs \$800,000. You reckon that it will produce an inflow after operating costs of \$170,000 a year for 10 years. If the opportunity cost of capital is 14%, what is the net present value of the factory? What will the factory be worth at the end of five years?

**SOLUTION:**

a. $NPV = -\text{Investment} + C \times ((1 / r) - \{1 / [r(1 + r)^t]\})$

$$NPV = -\$800{,}000 + \$170{,}000 \times ((1 / .14) - \{1 / [.14(1.14)^{10}]\})$$

$$NPV = \$86{,}739.66$$

b. After five years, the factory's value will be the present value of the five remaining year's of cash flows.

$$PV = \$170{,}000 \times ((1 / .14) - \{1 / [.14(1.14)^{(10-5)}]\})$$

$$PV = \$583{,}623.76$$

**Problem [18/42]**

**Present values and opportunity cost of capital:** Halcyon Lines is considering the purchase of a new bulk carrier for $8 million. The forecasted revenues are $5 million a year and operating costs are $4 million. A major refit costing $2 million will be required after both the fifth and tenth years. After 15 years, the ship is expected to be sold for scrap at $1.5 million.

a. What is the NPV if the opportunity cost of capital is 8%?
b. Halcyon could finance the ship by borrowing the entire investment at an interest rate of 4.5%. How does this borrowing opportunity affect your calculation of NPV?

**SOLUTION:**

a. $NPV = -\text{Investment} + PVA_{\text{operating cash flows}} - PV_{\text{refits}} + PV_{\text{scrap value}}$

$$NPV = -\$8{,}000{,}000 + (\$5{,}000{,}000 - 4{,}000{,}000) \times ((1 / .08) - \{1 / [.08(1.08)^{15}]\}) -$$

$$(\$2{,}000{,}000 / 1.08^5 + \$2{,}000{,}000 / 1.08^{10}) + \$1{,}500{,}000 / 1.08^{15}$$

$$NPV = -\$8{,}000{,}000 + 8{,}559{,}479 - 2{,}287{,}553 + 472{,}863$$

$$NPV = -\$1{,}255{,}212$$

**b.** The cost of borrowing does not affect the NPV because the opportunity cost of capital depends on the use of the funds, not the source.

**Problem [22/42]**

**Annuities:** Kangaroo Autos is offering free credit on a new $10,000 car. You pay $1,000 down and then $300 a month for the next 30 months. Turtle Motors next door does not offer free credit but will give you $1,000 off the list price. If the rate of interest is .83% a month, which company is offering the better deal?

**SOLUTION:**

The fact that Kangaroo Autos is offering "free credit" tells us what the cash payments are; it does not change the fact that money has time value.

Present value of payments to Kangaroo Auto:
PV = Down payment + C × ((1 / *r*) – {1 / [*r*(1 + *r*)$^t$]})
PV = \$1,000 + \$300 × ((1 + .0083) – {1 / [.0083(1 + .0083)$^{30}$]})
PV= \$8,938.02

Present value of car at Turtle Motors:
PV = price of car – discount
PV = \$10,000 – 1,000
PV = \$9,000

Kangaroo Autos offers the best deal because it has the lower present value of costs.

**Problem [25/42]**

If the rate of interest is 8% rather than 10%, how much would you need to set aside to provide each of the following?

a. \$1 billion at the end of each year in perpetuity.
b. A perpetuity that pays \$1 billion at the end of the first year and that grows at 4% a year.
c. \$1 billion at the end of each year for 20 years.
d. \$1 billion a year spread evenly over 20 years.

**SOLUTION:**

a. PV = *C* / *r*
PV = \$1 billion / .08
PV = \$12.5 billion

b. PV = *C* / (*r* – *g*)
PV = \$1 billion / (.08 – .04)
PV = \$25.0 billion

c. PV = *C* × ((1 / *r*) – {1 / [*r* (1 + *r*)$^t$]})
PV = \$1 billion × ((1 / .08) – {1 / [.08(1 + .08)$^{20}$]})
PV = \$9.818 billion

d. The continuously compounded equivalent to an annually compounded rate of 8% is approximately 7.7%, which is computed as:

$\ln(1.08) = .077$, or 7.7%

$PV = C \times \{(1 / r) - [1 / (r \times e^{rt})]\}$

$PV = \$1 \text{ billion} \times \{(1 / .077) - [1 / (.077 - e^{.077 \times 20})]\}$

$PV = \$10.206 \text{ billion}$

This result is greater than the answer in Part (c) because the endowment is now earning interest during the entire year.

**Problem [5/71]**

**Prices and yields:** Construct some simple examples to illustrate your answers to the following:

a. If interest rates rise, do bond prices rise or fall?
b. If the bond yield to maturity is greater than the coupon, is the price of the bond greater or less than 100?
c. If the price of a bond exceeds 100, is the yield to maturity greater or less than the coupon?
d. Do high-coupon bonds sell at higher or lower prices than low-coupon bonds?
e. If interest rates change, do the prices of high-coupon bonds change proportionately more than that of low-coupon bonds?

**SOLUTION:**

a. Fall. Assume a one-year, 10 percent bond. If the interest rate is 10 percent, the bond is worth \$110 / 1.1 = \$100. If the interest rate rises to 15 percent, the bond is worth \$110 / 1.15 = \$95.65.
b. Less. Using the example in part a, if the bond yield to maturity is 15 percent but the coupon rate is lower at 10 percent, the price of the bond is less than \$100.
c. Less. If $r$ = 5 percent, then a 1-year 10 percent bond is worth \$110 / 1.05 = \$104.76.
d. Higher. If $r$ = 10 percent, a 1-year 10 percent bond is worth \$110 / 1.1 = \$100, whilst a 1-year 8 percent bond is worth \$108 / 1.1 = \$98.18.
e. No. Low-coupon bonds have longer durations (unless there is only one period to maturity) and are therefore more volatile. For example, if $r$ falls from 10 percent to 5 percent, the value of a 2-year 10 percent annual coupon bond rises from \$100 to \$109.30, which is an increase of 9.3 percent. The value of a 2-year 5 percent annual coupon bond rises from \$91.32 to \$100, which is an increase of 9.5 percent.

**Problem [6/71]**

**Spot interest rates and yields:** Which comes first in the market for U.S. Treasury bonds:

a. Spot interest rates or yields to maturity?
b. Bond prices or yields to maturity?

**SOLUTION:**

a. Spot interest rates. Yield to maturity is a "complicated" average of the separate spot rates of interest.

b. Bond prices. The bond price is determined by the bond's cash flows and the spot rates of interest. Once you know the bond price and the bond's cash flows, it is possible to calculate the yield to maturity.

**Problem [11/72]**

**Duration:** True or False? Explain

a. Long-maturity bonds necessarily have longer durations.
b. The longer a bond's duration, the lower its volatility.
c. Other things equal, the lower the bond coupon, the higher its volatility.
d. If interest rates rise, bond durations rise also.

**SOLUTION:**

**a.** False. Duration depends on the coupon as well as the maturity.

b. False. Given the yield to maturity, volatility is proportional to duration.

**c.** True. A lower coupon rate means longer duration and therefore higher volatility.

d. False. A higher interest rate reduces the relative present value of distant principal repayments.

**Problem [14/73]**

**Real interest rates:** The one-year interest rate is 10% and the expected annual inflation rate is 5%.

a. What is the expected real interest rate?
b. If the expected rate of inflation suddenly rises to 7%, what does Fisher's theory say about how the real interest rate will change? What about the nominal rate?

**SOLUTION:**

a. $r = (1.10 / 1\ .05) - 1$, where $r$ is the real interest rate.
$r = .0476$, or 4.76%

b-1. The real rate does not change.
b-2. The nominal rate increases to:

$r_{\text{Nominal}} = 1.0476 \times 1.07 - 1$

$r_{\text{Nominal}} = .1210$, or 12.10%

**Problem [15/73]**

**Prices and yields:** Here are the prices of three bonds with 10-year maturities:

| Bond Coupon (%) | Price (%) |
|---|---|
| 2 | 81.62 |
| 4 | 98.39 |
| 8 | 133.42 |

If coupons are paid annually, which bond offered the highest yield to maturity? Which had the lowest? Which bonds had the longest and shortest durations?

**SOLUTION:**

Using Excel:

Bond 1 YTM = 4.30%
Bond 2 YTM = 4.20%
Bond 3 YTM = 3.90%

Bond 1 Duration = 9.05
Bond 2 Duration = 8.42
Bond 3 Duration = 7.65

**Problem [27/74]**

**Term-structure theories:** Suppose the spot interest rates constitute a *downward-sloping* term structure: $r_1 = 4.6\%$, $r_2 = 4.4\%$, $r_3 = 4.2\%$, and $r_4 = 4.0\%$. What can you deduce about the one-year spot interest rate in three years if

a. The expectations theory of term structure is right?
b. Investing in long-term bonds carries additional risks?

**SOLUTION:**

a. Based on a $100 investment:

$\$100 \times (1 + .042)^3 = \$113.137$

$\$100 \times (1 + .04)^4 = \$116.986$

1-year spot rate in three years:

($116.986 – 113.137) / $113.137 = .034, or 3.4%

b. If investing in long-term bonds carries additional risks, then the risk equivalent of a one-year spot rate in three years would be less that the 3.4 percent, reflecting the fact that some risk premium must be built into this 3.4 percent spot rate.

**Problem [28/74]**

**Nominal and real returns:** Suppose that you buy a two-year 8% bond at its face value.

a. What will be your total nominal return over the two years if inflation is 3% in the first year and 5% in the second? What will be your real return?

b. Now suppose that the bond is a TIPS. What will be your total 2-year real and nominal returns?

**SOLUTION:**

a. Nominal 2-year return:
$1.08^2 - 1 = .1664$, or 16.64%
Real 2-year return:
$(1.08 / 1.03) \times (1.08 / 1.05) - 1 = .0785$, or 7.85%

b. Nominal 2-year return:
$1.08^2 - 1 = .1664$, or 16.64%
Real 2-year return:
$(1.08 \times 1.03) \times (1.08 \times 1.05) - 1 = .2615$, or 26.15%