M.I.T.
Sloan School of Management

15.415-Fall 1998
Professor Denis Gromb

Problem Set 9

- **Please, make sure to work in a team (3 to 5 students) and hand in only one homework per team**
- **To ease and speed up grading, please:**
  - **Answer one question per page following the questions' order**
  - **Staple all pages of the problem set together (use staples, not paper clips)**
  - **Write the names of all team members very clearly**

Question 1

No explanations needed. Choose **one or several** answers per question. You will get credit for a question only if you circle **all** the correct answers.

1) XYZ Inc. has debt outstanding with face value $K = \$100,000$ maturing in $T = 3$ months. This debt can be seen as:

a. A call on XYZ's assets with strike price K and maturity T

b. A written put on XYZ's assets with strike price K and maturity T

c. A claim on XYZ's assets and a written call on XYZ's assets with strike price K

d. A put and a written call on XYZ's assets both with strike price K

e. None of the above

2) Which of the following statements are correct?

a. Similar firms can have different business risks but will always have similar financial risks

b. Absent taxes, there is no financial risk

c. Absent debt, there is no business risk

d. It is correct to use a firm's WACC to value its investment projects as long as they are in the same business as the firm

e. None of the above

3) Which of the following statements are correct?

a. The binomial model of option pricing is limited because it assumes that all investors are risk-neutral

b. For an underlying asset that does not pay dividends, it is never optimal to exercise an American put before maturity

c. The value of a European put option should decrease following an unexpected cash dividend by the underlying asset

d. It is optimal to exercise an American option as soon as it is in the money

e. None of the above

4) Security A has an expected rate of return of -1.5% and a beta of -0.8. The risk-free rate is 5% and the expected rate of return on the market portfolio is 13.8%. According to CAPM, security A is:

a. Fairly priced

b. Underpriced

c. Overpriced

d. None of the above

5) "XYZ Inc.'s third quarter dividend was greater than expected. Yet, XYZ's stock price decreased on the ex-dividend date". This violates:

a. The weak form market efficiency hypothesis

b. The semi-strong form market efficiency hypothesis

c. The strong form market efficiency hypothesis

d. The Modigliani-Miller Theorem

e. None of the above

6) If one could realize superior profits by buying stocks in firms which have just announced unexpectedly high earnings, this would violate:

a. The weak form market efficiency hypothesis

b. The semi-strong form market efficiency hypothesis

c. The strong form market efficiency hypothesis

d. None of the above

Question 2

Assume that the following Treasury bonds are traded today (May 1998).

	Bond A	Bond B	Bond C
Face value	$\$1,000$	$\$1,000$	$\$1,000$
Annual coupon rate	5%	0%	10%
Maturity in years	2	3	3
YTM	8.9745%	9.000%	8.9670%

a) What are the prices B_A, B_B and B_C of bonds A, B and C? (Give three decimals: e.g. $\$1,000.453$)

b) What are the 1-year, 2-year and 3-year spot rates? (Give two decimals: e.g. 6.65%)

c) What is today's price of the contract that delivers in one year (May 1999) a T-bond with 9% coupon rate and $\$1,000$ face value which matures two years later (May 2001)?

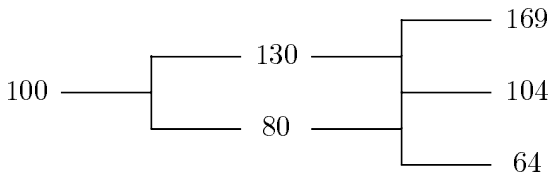
d) What are this contract's Yield to Maturity and its duration? (You can use "trial and error" if needed).

Question 3

European *Contingent Premium* Call Options are derivative securities similar to standard European calls except that, instead of being paid initially, the premium is paid at maturity if and only if the call is in the money (i.e., if the underlying asset's price exceeds the option's strike price).

a) Represent on a graph the payoff at maturity (including the premium) for a European Contingent Call on one share of XYZ Inc. with strike price $K = \$50$ and premium $c = \$5$. Indicate the coordinates of each point at which the graph's slope changes. No explanations needed.

From now on, we make the following assumptions. The stock of XYZ Inc. trades currently for $\$100$. Assume that each of the next two years, it will either go up by 30% or down by 20% as represented on the tree below. XYZ will not pay any dividend over the next two years. The Treasury yield curve is flat at 10%.



b) What is the premium of a standard European call on one XYZ share with maturity 2 years and strike price $\$95$?

c) Now, consider a European contingent premium call on one XYZ share with maturity 2 years and strike price $\$95$. Without computation, do you expect its premium to be greater or smaller than the one you computed in b)? Explain your reasoning.

d) What is the premium of the European contingent premium call described in c)?

Question 4

Firms X, Y and Z are publicly traded companies with the following characteristics.

Firm	Number of shares	Stock price
Firm X	$1,500,000$	$\$50$
Firm Y	$2,000,000$	$\$30$
Firm Z	$3,000,000$	$\$6$

Consider the covariance matrix of their equity and the market portfolio:

$$\begin{pmatrix} & r_X & r_Y & r_Z & r_m \\ r_X & 0.12 & 0.03 & 0.08 & 0.06 \\ r_Y & & 0.21 & 0.09 & 0.01 \\ r_Z & & & 0.227 & 0.03 \\ r_m & & & & 0.04 \end{pmatrix}$$

The risk-free rate and the market risk premium are $r_f = 5\%$ and $(r_m - r_f) = 8\%$.

a) What are the equity betas and the required return on equity of firms X, Y, and Z?

b) Consider portfolio P combining $1,000$ shares of X, $2,000$ shares of Y and $3,000$ shares of Z. What is its idiosyncratic risk (as measured by variance)?

Question 5

ABC Inc. has no debt and 1 million shares outstanding trading for $\$30$. Its equity beta is $\beta^E_{ABC} = 0.92$. ABC Inc. has two divisions, ABChem and ABChew. ABChem produces a variety of chemicals while ABChew operates a chain of restaurants. Four other firms in businesses similar to those of ABChem and ABChew have the following characteristics.

Firm	Business	Debt	Debt Beta	Equity	Equity Beta
Firm 1	Chemicals	$\$300M$	$\beta^D_1 = 0.02$	$\$1,000M$	$\beta^E_1 = 1.16$
Firm 2	Chemicals	$\$150M$	$\beta^D_2 = 0.10$	$\$150M$	$\beta^E_2 = 1.70$
Firm 3	Restaurants	$\$30M$	$\beta^D_3 = 0.15$	$\$100M$	$\beta^E_3 = 1.38$
Firm 4	Restaurants	$\$70M$	$\beta^D_4 = 0.18$	$\$200$	$\beta^E_4 = 1.42$

Assume no taxes. The risk-free rate and the market risk premium are $r_f = 5\%$ and $(r_m - r_f) = 8\%$. Assume that CAPM holds.

a) What is ABC's asset beta?

b) What is ABC's WACC?

c) ABC issues debt to finance the repurchase of $100,000$ shares. What is its new WACC?

d) Should ABC open a new set of restaurants that would cost $\$38M$ today and generate an annual expected cash flow of $\$5M$ in perpetuity (starting next year)?

Question 6

XYZ Inc. has $100,000$ shares outstanding and current earnings of $\$150,000$. The market values of its debt and equity are $D = \$400,000$ and $E = \$1.5M$. Assume no taxes.

a) What are XYZ's stock price, EPS and P/E ratio?

Now, XYZ is considering making a $\$300,000$ payout to its shareholders. You are called in to report to XYZ's Board of Directors on the payout method they should use: a one time cash dividend or an open market share repurchase program.

b) Method 1: Suppose that XYZ use the cash dividend method. What is the impact on its equity market capitalization, stock price, EPS and P/E?

c) Method 2: Suppose that XYZ use the share repurchase method. What is the impact on its equity market capitalization, stock price, EPS and P/E?

d. What is your one-sentence report to the Board?

Question 7

After spending $\$15M$ on prospecting, XYZ Inc.'s exploration division has identified a potential off-shore oil field. Now XYZ has to decide whether to develop and exploit it.

Developing the field would involve a further one-time development cost of $\$35M$ (in May 1998) as well as regular exploitation costs the extent of which is still uncertain but would be measured once exploitation starts. Two equiprobable scenarios are possible depending on the nature of the soil: exploitation's annual cost (from May 1999 onwards) can turn out to be constant at either $c_1 = \$2M$ or $c_2 = \$9M$.

The field's annual production will be $B = 600,000$ barrels in its first year and, from then on, will decline at rate of $g = 5\%$ until the field is shut down.

The price of oil is constant at $\$18$ per barrel and the risk-free rate of interest constant at $r = 10\%$.

Assume that CAPM holds and ignore taxes.

a) Under each scenario, determine the year (T_1 and T_2) at the end of which the field should be shut down as well as the value of the field (V_1 and V_2) once development costs have been spent.

b) Should XYZ go ahead and develop the field? Explain carefully. (Partial credit will be given if you explain how you would proceed to determine the correct decision).