

M.I.T.
Sloan School of Management

15.415-Fall 1998
Professor Denis Gromb

Problem Set 2

- 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. Circle **one or several** answers per question. You will get credit for a question only if you circle **all** the correct answers. Note: A calculator is not necessary[.

1) With today's US Treasury Yield Curve, you can compute exactly:

- a. The price at which a 5-year STRIP with \$1,000 face value will trade in two years
- b. The spot rates that will prevail in two years
- c. The price at which a 5-year T-bond with 7% coupon and \$1,000 face value trades today
- d. The forward rates that prevail today
- e. The forward rates that will prevail in two years

2) The yield curve is flat at 8%. Suppose you ranked the following bonds and portfolios by increasing durations. That is: 1st the bond with the shortest duration, 2nd a bond with a longer duration, 3rd a bond with an even longer duration, etc. Which one would come third?

- a. **Bond A:** 19-year T-bond with coupon rate 10%
- b. **Bond B:** 19-year STRIP with face value \$10,000
- c. **Bond C:** 20-year T-bond with coupon rate 10% and face value \$1,000
- d. **Bond D:** 20-year STRIP with face value \$100,000
- e. A portfolio with \$1,000 invested in Bond B and \$12,000 invested in Bond C

3) The yield curve is flat at 8%. Suppose you ranked the following US T-bonds by increasing prices. That is: 1st the bond with the lowest price, 2nd a bond with a higher price, etc. Which bond would come in fourth position? All bonds have a \$1,000 face value.

- a. 20-year bond with 7% coupon
- b. 20-year bond with 9% coupon
- c. 5-year bond with 7% coupon
- d. 5-year bond with 8% coupon
- e. 5-year bond with a 9% coupon rate

4) Which of the following bonds of XYZ Inc. do you expect to trade at the highest price? All bonds have a \$1,000 face value, a 10-year maturity and a 12% coupon rate.

- a. A callable bond
- b. A straight bond (i.e. with no particular feature)
- c. A convertible bond

Question 2

You are considering two mutually exclusive projects, A and B giving the following cash flows. The appropriate discount rate is 10% for either project.

Year	Project A	Project B
0	-\$520,000	-\$80,000
1	\$10,000	\$100,000
2	\$30,000	\$10,000
3	\$30,000	\$1,000
4	\$850,000	\$1,000

- a) If you applied the discounted payback period criterion with a 5 year threshold, which investment would you choose?
- b) If you applied the NPV criterion, which investment would you choose?
- c) If you applied the IRR criterion with a 20% threshold, which investment would you choose? What if the threshold were 10%? (Hint: You can but do not have to compute the projects' IRR).
- d) If you applied the PI criterion, which investment would you choose?
- e) Based on your answers in a) through d), which project would you actually choose?

Question 3

Sydney International (SI) is considering building a (single) new theme park in South America. Preliminary investigations have narrowed down the choice to two possible locations: Argentina and Brazil. In each case, SI plans to start developing the park on January 1, 1999, to open it on January 1, 2000 and run it for many years. In your computations, assume that the park will be run forever.

Argentina: An initial investment of \$20M will be necessary to buy the land, pay for the insurance etc...on January 1, 1999. From January 2000 on, the annual costs of operating the park should be

constant at \$5M. Starting January, 2000, the park will generate annual revenues of \$8M which will grow at an annual rate of g until January 2005. Then the revenues will be constant forever. The appropriate discount rate is 10%. The South American public's response to the opening of the park is still uncertain and so Sydney's managers consider that there are three equiprobable scenarios about the growth rate g : 3%, 7% and 10%.

Brazil: This project requires a greater initial investment (of \$27M) but, due to a favorable tax treatment by the Brazilian government, lower costs of operating the park (constant at \$4.5M). The various scenarios about the parks' revenues and the appropriate discount rate would be the same as in Argentina.

Should Sydney International open the park? If yes, where?

Question 4

Today is January 1, 1998. The yield curve is flat at 7%. As the manager of a pension fund, you are forecasting that you will need to pay \$2M to retirees every year on January 1 in perpetuity. The next payment is due one year from today.

- How would you immunize this liability against interest rate risk using a portfolio combining 5-year STRIPS and 20-year STRIPS?
- You have just formed your portfolio of STRIPS when the Yield Curve moves down by one basis point (in a parallel shift). What happens to the value of your liability? What happens to the value of your portfolio of STRIPS? How do you rebalance your portfolio in order to remain immunized?

Question 5

Assume that the following Treasury bonds are traded. They pay annual coupons.

	Bond A	Bond B
Face value	\$1,000	\$1,000
Annual coupon rate	6%	12%
Maturity in years	2	2
Price	\$981.92	\$1090.40

- What are the 1-year spot rate, the 2-year spot rate and the forward rate between year 1 and 2?
- What is the price of Bond C with 2-year maturity, 7% coupon rate and \$1,000 face value? What is its Yield to Maturity?