M.I.T. **Fall 1998**
Sloan School of Management **15.415**

Prof. Denis Gromb

MIDTERM 1

Section A

Thursday, October 8, 1998

The exam is between **08:10am** and **09:50am**. Books and lecture notes are not allowed. One double-sided sheet of personal notes written reasonably large is allowed. There are 5 independent questions. Do not line up equations without explanation: **No Explanations, No Points** (except for Question 1).

- Please, write your name at the top of **each** page **NOW!**
- Answer each question in the corresponding space
- Keep the package stapled together
- **To avoid chaos and ensure equity among the students:**
  - If you finish before 09:35am, you can hand in your exam and leave the room
  - **If you finish after 09:35am, please STAY SEATED UNTIL YOUR EXAM IS COLLECTED AT YOUR DESK**
  - **Once your exam is collected, please leave the room in silence**

GOOD LUCK!

Question 1 (20 pts)	
Question 2 (20 pts)	
Question 3 (20 pts)	
Question 4 (20 pts)	
Question 5 (20 pts)	
Total (100 pts)	

Question 1 [20 points]

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.

1. In which of the following account would you prefer to deposit your money for 2 years?
   (a) An account with an 5.1% APR compounded every 2 months
   (b) An account with an 5.2% APR compounded every 2 months
   (c) An account with an 5.2% APR compounded every 6 months
   (d) An account with an 5.3% EAR
   (e) An account with an 5.4% EAR

2. Which of the following statements are correct?
   (a) The IRR rule always gives the same result as the NPV rule as long as one is not trying to compare mutually exclusive projects.
   (b) The PI rule always gives the same result as the NPV rule as long as one is not trying to compare mutually exclusive projects.
   (c) Given the choice between two projects, it is always preferable to pick the one with the longest discounted payback period
   (d) Given the choice between two projects, it is always preferable to pick the one with the shortest discounted payback period
   (e) None of the above statements is true

3. One defines the YTM of a callable bond as its YTM computed assuming that the bond will not be called. Similarly, one defines the YTM of a convertible bond as its YTM computed assuming that the bond will not be converted. Which of the following bonds issued by XYZ Inc. do you expect to have the lowest YTM? All bonds have a 10-year maturity and a 12% semi-annual coupon rate.
   (a) The callable bond with face value $\$10,000$ and call price $\$11,000$
   (b) The callable bond with face value $\$1,000$ and call price $\$1,150$
   (c) The straight bond (i.e. with no particular feature) with face value $\$1,000$
   (d) The convertible bond with convertibility ratio 5 and face value $\$10,000$
   (e) The convertible bond with convertibility ratio 7 and face value $\$1,000$

4. The yield curve is flat at 8%. Suppose you ranked the following US T-bonds and portfolios by decreasing durations. That is: 1st the bond with the highest duration, 2nd a bond with a lower duration, etc. Which bond would come second?
   (a) The 19-year bond with a 8% annual coupon rate and face value $\$1,000$
   (b) The 19-year bond with a 9% annual coupon rate and face value $\$10,000$
   (c) The 20-year bond with a 7% annual coupon rate and face value $\$1,000$
   (d) The 20-year bond with a 8% annual coupon rate and face value $\$10,000$
   (e) The 20-year bond with a 9% annual coupon rate and face value $\$1,000$

Question 2 [20 points]

You are considering the following mutually exclusive projects. The appropriate rate to discount all cash flows is $r = 10\%$.

	$-I_0$	C_1	C_2	C_3	C_4
Project A	-100	50	50	30	30
Project B	-150	30	40	50	60
Project C	-245	80	80	80	120

In each of the following questions, show your computations and explain them.

a) Which project, if any, should you undertake?

b) Which one, if any, would you undertake if you followed the simple IRR rule with a 20% hurdle? [Hint: You can but need not compute the projects' IRR].

c) Which one, if any, would you undertake if you followed the simple PI rule?

d) Which one, if any, would you undertake if you followed the PI rule with incremental projects?

Question 3 [20 points]

Today is January 1, 1999. Argmax Industries is considering the following two mutually exclusive investment opportunities.

- **Project A** requires an initial investment today of $\$8M$ and will generate a safe 30-year annuity of $\$1.2M$, with first cash flow in one year (January 1, 2000).
- **Project B** can only be started two years from today. It will require an initial investment of $\$8M$ in two years (January 1, 2001) and will generate a safe growing perpetuity with first payment of $\$1.2M$ in four years (January 1, 2003) and growth rate $g = 2\%$.

Assume that financial markets are perfect and that the appropriate rates to discount safe cash flows are $r_1 = 7\%$ for a 1-year maturity, $r_2 = 8\%$ for a 2-year maturity and $r = 10\%$ for all longer maturities. Which project, if any, should Argmax undertake?

Question 4 [20 points]

The yield curve is flat at 6%. The following US Treasury securities are traded:

- Bond A is a 2-year bond with annual coupon rate 6% and face value $\$1,000$
- Bond B is a 20-year STRIP with face value $\$1,000$

a) What is bond A's Macaulay duration?

b) You put together a portfolio by:

- Short selling one bond A
- Purchasing five bond B

How much of your own money is required to acquire this portfolio?

c) What is the portfolio's Macaulay duration?

d) Suppose that the yield curve shifts downwards by one basis point. What is (approximately) the value of your portfolio?

Question 5 [20 points]

Assume that the following US Treasury bonds are traded. There are no arbitrage opportunities.

	Bond A	Bond B	Bond C
Face value	$\$1,000$	$\$1,000$	$\$1,000$
Annual coupon rate	5%	10%	8%
Maturity in years	1	2	3
Price as % of par	98.59	103.70	102.53

a) What are the 1-year spot rate, the 2-year spot rate, the 3-year spot rate and the forward rate between year 2 and 3?

b) Bond D is a 2-year bond with face value $\$1,000$ and annual coupon rate 3%. Construct a portfolio of bonds A, B and C that replicates bond D.