University of Toronto - Rotman School of Management

RSM 332 Midterm Exam

Duration: Two hours

February 24, 2015

- Please **do not open** this exam until you get the go-ahead.
- This is a closed book exam. A non-programmable calculator is allowed.
- You may use a self-prepared crib sheet. On one side of a regular sized paper, i.e., 1-sided $8.5'' \times 11''$, you can print or write anything you'd like.
- Show the main steps used to obtain your answers. The steps and/or explanations may be **more important** than the numerical values that you present.
- Write clearly. Otherwise, if it is hard to figure out your handwriting, you may not get as many marks as you could with clear handwriting. Read the questions carefully. Double-check your answers if you have time.
- All questions, with 100 marks in total, are required. Marks for each question are indicated. It is your responsibility to check out whether there is any missing page and whether the marks sum up to 100. There are a total of **13 pages** (including this cover page).
- **Do not write this test with a pencil/pen such that your answers can be easily erased.** Otherwise, you may not request a re-mark of the test later on.
- In any case, **do not take your exam paper away** with you when leaving.
- Good luck!

Your Full Name:

Student ID Number:

Your section (Monday/Tuesday, morning/evening):
(Your exam paper will be brought to the indicated section.)

1. A loan of $100,000 is being repaid in 60 monthly payments, with the first payment starting in a month from today. The interest rate is 10%/year, continuously compounded.

   (a) What is the effective monthly rate? (4 marks)

   (b) What is monthly payment? (5 marks)

(c) For the 20th payment, how of much of it is for interest, and how much of it is for principal repayment? (8 marks)

2. Suppose you have the following utility function

$$U(C_0, C_1) = \ln(C_0 C_1),$$

where C_0 is today's consumption and C_1 is tomorrow's consumption. You are endowed with $Y_0 = 1000$ today and nothing tomorrow. There is a production opportunity that if I_0 is invested today, then the output tomorrow would be $f(I_0) = 40\sqrt{I_0}$. There is also a capital market where lending and borrowing rate of interest is $r = 100\%$, i.e., if you borrow (or lend) 1 unit of good today, you will pay (or be paid) 2 units of good tomorrow.

(a) If you have access to the capital market but you do not have access to the production opportunity, what is your optimal consumption plan? How much do you need to borrow or lend today? (8 marks)

(b) Now suppose you have access to both the production opportunity and the capital market and your endowment is $Y_0 = 1000$ today and nothing tomorrow, what is your optimal consumption plan? How much do you invest in the production opportunity? How much do you borrow or lend in the capital market? (9 marks)

(c) Suppose your friend Jack, whose utility function is $U(C_0, C_1) = \min(C_0, C_1)$, wants to buy the production opportunity from you. However, his endowment today is 100 and he has nothing tomorrow. He wants to save 50 for food and is willing to pay 50 for the production opportunity. Using the information in part (c), would you be willing to sell the production opportunity to him? Explain why. (3 marks)

3. You have just finished high school and are debating two career paths. Regardless of the path chosen, you plan to maintain the same lifestyle, interest rates are the same, and you retire 40 years after leaving high school under either alternative. All incomes below are after-tax.

   Alternative 1: Get a job. Under this alternative, you make $25,000 per year (paid out monthly) for the first 10 years, then receive a 30% raise every 10 years (1-10, 11-20, 21-30, 31-40).

   Alternative 2: Go to university. Under this alternative, you incur loans of $20,000 to cover the costs of living plus tuition each year (for four years). You take these loans out at the beginning of each year. Thankfully, they incur no interest while you are in school but repayment is expected to begin the month after graduation (when, quite conveniently, your new job starts paying you). Your after-tax starting salary is expected to be $40,000 with a 25% raise every six years (5-10, 11-16, 17-22, etc). Repayment of the loan total is made over a 10 year period with monthly payments and monthly compounding (quoted rate of 8%).

   Assuming a monthly discount rate of 0.66667% to future cash flows and that all the other

conditions above apply, calculate the present values of both career paths. (20 marks)

4. Assume that you have the following information. Use it to answer all parts below.

   - A 6 year zero coupon bond with the face value of $1,000 trades at $657.08.
   - A 4 year zero coupon bond with the face value of $1,000 trades at $777.32.
   - A 2 year zero coupon bond with the face value of $1,000 trades at $892.52.
   - A 3-year 8% annual coupon bond with the face value of $1,000 trades at $1,050.22.
   - The forward rate for the year starting in one year from now is 6.25%.

   (a) What should the price be for a 2 year 5% annual coupon bond with a face value of $1,000? (5 marks)

(b) What would the price a 4 year 6% annual coupon bond be if it was issued today? ($1000 par value) (8 marks)

(c) Assume that for some reason you can buy or sell the 4 year 6% annual coupon bond for \$934.25. If you are restricted to using only the bonds listed above and a \$1000 face value 1 year zero coupon bond, explain in details how you would profit from this arbitrage opportunity (You need to point out numerically how many of each bond you would buy or sell - keep 4 decimal places). (10 marks)

5. Consider the common stocks of two companies:

   - Pratchett's Ratchets is a mature firm in a mature industry. Dividends per share are expected to be $1.25 next year out of projected earnings of $2.85 - the same payout ratio it has maintained for several years. Its return on equity is stable at 11%.
   - Ultra High-Tech is a start-up firm in a mature industry where it will be deploying new technological solutions to long-standing challenges. It plans to re-invest all its net income for the first 4 years into capital intense, high growth projects but anticipates that it will be able to pay a $1.00 dividend starting in year 5. Dividends will grow by roughly 40% per year for the following 6 years before slowing to an annual sustainable growth rate of 8% from that point forward.

   (a) Given only the information above, which of the two firms should be evaluated with the higher discount rate? Why? (2 marks) If you observe the share prices of the two firms, can you tell from the share prices which firm is larger? Why or why not? (2 marks)

(b) For simplicity, we assume a 12% discount rate for both firms. Calculate the share price of each company. (10 marks)

(c) Suppose instead that Ultra High-Tech's growth permanently slowed to 4% in its 11th year and that it will not pay dividends in years 9 and 10. Year 11's dividend is expected to be 4% higher than year 8's dividend. What is its new stock price? (6 marks)