

Math 5621 Financial Math II
Fall 2012
Final Exam
December 7 to December 12, 2012

This is an open book take-home exam. You may consult any books, notes, websites or other printed material that you wish. Having so consulted then submit your own answers as written by you.

Do NOT under any circumstances consult with any other person. Do NOT under any circumstances cut and paste any material from another source electronically into your answer. Do NOT under any circumstances electronically copy from a spreadsheet that was not created by you. Failure to follow these rules will be grounds for a failing grade for the course.

Put your name on all papers submitted and please show all of your work so that I can see your reasoning. The eight questions will be equally weighted in the grading. Please return the completed exams by 5 PM Wednesday, December 12 to my mailbox in the department office, under my office door MSB408, or by email.

1. A company is financed 100% equity with a cost of capital of 18%. It has an effective marginal tax rate of 42%. It decides to restructure its capital to 40% debt and 60% equity (on a market value basis) and finds that the market rate on its debt at that level is 10%. What are the after-tax WAAC and the cost of equity after the restructuring? If you need to make simplifying assumptions, do so but say exactly what they are.
2. Your nuclear research department just discovered a way to turn lead into gold. With the price of gold at \$1700 per ounce this week you are quite excited and are making plans. You've already learned, for example, that you'll need to plan on annual spending of 1% of the value of any gold you produce just to store it safely and insure it. It's going to take you 12 years and a lot of money to implement the nuclear technology before you get your first output of gold, however, so you need to make an assumption about the price of gold 12 years from now in order to evaluate whether to go ahead with the investment. Best expert opinion is that the price of gold has a beta of 0, will be flat for the next two years while the market digests its recent run-up, but then it will advance 10% a year for 3 years reflecting the inflation of the dollar that must come sooner or later, followed by a steady 5% annual increase thereafter. The risk free rate for a 12 year horizon is 1.75%. What is the present value today of an ounce of gold produced 12 years from now?
3. Consider a put option with an exercise price of 25, expiring two years from today, on an underlying asset which pays no dividends, has a value of 20 today, and a standard deviation of annual return equal to .40. Use a binomial model with $N = 8$ steps and probabilities $q_u = q_d = \frac{1}{2}$ at each

step. (Do **NOT** use a binomial model with u and d determined by the formulas in the textbook.) Use a risk-free annual rate of return of 0.25% for a two-year horizon.

- (a) What would be wrong with using u and d determined by the formulas in the textbook, given the other requirements in this question?
- (b) What is the value of the put option today if it is an American put option?
- (c) Logically, why is the value in **(b)** greater than 5, the amount I could realize by exercising the option immediately?
- (d) What is the first time that it might possibly be optimal to exercise this American put option, according to this binomial model?
- (e) At time $t = .5$, if you are at the up-then-down node of the tree will the value of the risk-free bonds in the replicating portfolio for a put option, after rebalancing the portfolio, be larger for an American put option or for a European put option? By how much?
- (f) Logically, why is the value of the risk-free bonds in the replicating portfolio in **(e)** larger for whichever option you chose in the answer?

4. The Black-Scholes formula for the price of a call option is

$$c = S\Phi(d_1) - e^{-rT}\Phi(d_2)$$

where d_1 and d_2 are expressions that you can evaluate. Once you know d_1 the value of $\Phi(d_1)$ can be obtained from a spreadsheet function of normal probability values (or a published table of them.) Presumably, then, $\Phi(d_1)$ must be the probability of some event. Explain what that event is and why $\Phi(d_1)$ is its probability.

5. Consider the situation of exercise 5.14 in the textbook. If the expected returns on each balance sheet category are as follows:

short term assets 0.2%
U.S. Treasury bonds 2%
loans 5%
short term liabilities 1%
deposits 0.2%

what is the Sharpe ratio of the equity holders' position before and after taking the recommended T-Bond futures position as a hedge? If you need to make assumptions specify clearly what you are assuming.

6. How would each of the following actions affect a firm's current ratio?
- (a) Sell inventory for cash
 - (b) Borrow short term from a bank to pay a supplier
 - (c) Collect an old bill from a customer that has been overdue for 2 years
 - (d) Buy more inventory for cash
7. Hannibal Inc., with a WAAC of 16.65%, is growing both its earnings and its dividends at 5.55% per year. Assume that it can do that forever. Scipio Inc., with a WACC of 7%, is growing both its earnings and its dividends at 3.33% per year. Assume it can do that forever. The two companies have exactly the same values for assets, earnings and dividends this year. Can you tell whether Hannibal's stock price or Scipio's stock price benefits more from the assumed growth rate? Why or why not? Explain your conclusion with specific formula(s). (There might be more than one correct explanation . . . you only need to give one.)
8. A cell phone manufacturing plant that costs \$400 million to build can produce a new line of voice recognition sets that will generate PV of future cash flow equal to \$560 million if successful in the market, but only \$200 million if market acceptance of the new gimmick is low. You believe that the probability of success is 50%. Would you build the plant? Would your decision change if you were certain that, if market acceptance turned out

to be low, you could sell the plant to a competitor for an amount whose PV today is \$250 million? Give quantitative reason for your answers. Why might you want to be suspicious about the \$250 million assumptions? What sort of facts or reasons might alleviate your suspicions?