M.I.T.
Sloan School of Management

15.415-Fall 1998
Professor Denis Gromb

Problem Set 5

- **Please, 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

Multiple choice. Pick **one** answer per question. No explanations needed.

1. The price of an American call option on a non-dividend paying stock is **not** positively correlated with
   (a) The stock price.
   (b) The time to maturity.
   (c) The stock volatility.
   (d) The exercise price.
   (e) None of the above.
2. Suppose you take a long position on one European IBM May call contract with strike price $\$100$ at a $\$5$ rpemium and take a short position on one European IBM May call contract with strike $\$105$ at a $\$3$ premium. The maximum profit of your strategy is
   (a) $\$600$
   (b) $\$500$
   (c) $\$200$
   (d) $\$300$
   (e) None of the above

Question 2

BM chapter 20, question 21

Question 3

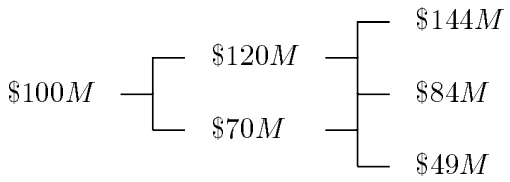
BM chapter 20, question 29

Question 4 (H10.9)

A stock price is currently $\$25$. It is known that at the end of two months it will be either $\$23$ or $\$27$. The risk-free interest rate is 10% per year (with continuous compounding). Suppose S_T is the stock price at the end of the two months. What is the value of the derivative that pays $(S_T)^2$ at this time?

Question 5

The evolution of the value of firm X's assets can be represented by the following binomial tree with two periods.



The risk-free rate per period is $r = 7\%$ per period. You are holding one $\$1,000$-face value bond issued by firm X. Compute the value of your bond in each of the following situations.

a) Firm X's debt consists of one class of bonds: they all are $\$1,000$-face value, non-callable and of equal seniority bonds. The total face value of firm X's debt is $\$30M$.

b) Firm X's debt consists of one class of bonds: they all are $\$1,000$-face value, non-callable and of equal seniority bonds. The total face value of firm X's debt is $\$100M$. Compare to the price you found in a). Explain (two sentences maximum).

c) Firm X's debt consists of one class of bonds: they all are $\$1,000$-face value, callable at $t = 1$ with call price per bond of $c = \$850$ and of equal seniority. The total face value of firm X's debt is $\$100M$. Compare to the price you found in b). Explain (two sentences maximum).

d) Firm X's debt consists of two classes of $1,000$ face value bonds, A-bonds and B-bonds. Both are non-callable but A-bonds are senior with respect to B-bonds. The total face value of A-bonds is $\$30M$ while that of B-bonds is $\$70M$. What is the price of an A-bond? Yours is a B-bond. What is its price? Compare it to the price you found in b). Explain (two sentences maximum).