Final Exam, Version A (3:30 lecture)
Econ 134A, March 22, 2013
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(a) (10 points) Maya buys three put options with an exercise price of $150 (per share) today, and four call options with an exercise price of $100 (per share). The expiration date of all of these options is six months from now. Each option is for buying or selling one share. For simplicity in this problem, you can assume that the discount rate is 0%. Draw a well-labeled graph that shows the value of a combination of the seven options as a function of the value of the stock at expiration.
**Answer:**
(a)(2 points) Mia’s Tortillas will pay dividends of $5 per share every year, starting two years from today. If we assume an effective annual discount rate of 9% and assume that dividends are paid forever, what is the present value of each share of stock?

- **Answer:**

\[
PV = \frac{1}{1.09} \cdot \frac{5}{0.09} = 50.97
\]

(b)(3 points) A zero-coupon bond has a face value of $800 and will mature 4.5 years from today. The bond is currently trading at a price of $700. What is the yield to maturity of this bond (expressed as an effective annual rate)?

- **Answer:**

\[
700(1 + x)^{4.5} = 800
\]
\[
1 + x = 1.0301183
\]
\[
x = 3.01183\%
\]
(c)(3 points) If markets have the strong form of efficiency all of the time, will they have the weak form of efficiency all of the time, some of the time, or never? If this question cannot be answered then state that as your answer. Justify in 30 words or less.

- **Answer:** All of the time. Strong form of efficiency implies weak form of efficiency.

(d)(5 points) Shannon deposits $100 into a bank today. Each subsequent deposit made monthly is 10% higher. The effective annual discount rate is 15%. If it is assumed that the first deposit is made today, find the present value of the nth deposit.

- **Answer:**

  \[
  \begin{align*}
  \text{PV of 1st deposit} & = \$100 \\
  \text{PV of 2nd deposit} & = \frac{\$100(1.1)}{1.011715} \\
  \text{PV of 3rd deposit} & = \frac{\$100(1.1)^2}{1.011715^2} \\
  \text{PV of nth deposit} & = \frac{\$100(1.1)^{n-1}}{1.011715^{n-1}} = \$100(1.087263)^{n-1}
  \end{align*}
  \]
(e) (6 points) You buy a stock for $55 per share today. The stock’s value moves every 3 months, either up by $2 or down by $2. The expected value of the stock at any time in the future is the same as the current value of the stock. The effective annual discount rate is 9%. What is the present value of an option purchased today that has an exercise price of $61 one year from today. (Note: the option is for buying one share at the expiration date.)

**Answer:**

\[
Pr(up) = Pr(down) = \frac{1}{2}
\]

To have a value of more than $61 in 1 year need \((up, up, up, up) \rightarrow 63\) value.

\[
Pr(up, up, up, up) = \left(\frac{1}{2}\right)^4 = \frac{1}{16}
\]

\[
PV = \frac{(63 - 61)/1.09}{16} = 0.1147
\]
(f) (5 points) A stock pays a $1 dividend today, and will pay a dividend once per year forever. Each dividend payment in the future will be 3% higher than the previous dividend payment. If you buy the stock just before it makes its dividend payment one year from today, what will the price be if the effective annual discount rate is 14%?

- Answer:

\[
FV_{1 \text{ year in the future}} = 1.03 + \frac{1.03^2}{.14 - .03} = $10.67
\]
(g)(4 points) Why do firms with high operating leverage have higher beta values than a comparable firm with low operating leverage? Answer this question in 50 words or less.

- **Some possible answers:**
  - Fixed costs lead to the possibility of large gains or losses, due to relatively low marginal cost of production.
  - High leverage leads to greater cyclicality in profits due to low marginal cost of production.
  - $R_S = R_0 + \frac{B}{S}(R_0 - R_B)$. As $B$ gets larger, $R_S$ gets larger $\rightarrow \beta$ is higher also.
(11 points) Chloe is operating a rapidly growing company and needs to figure out what to invest in this year. She has five potential investments, she has $100,000 that she needs to invest in today, and she assumes an effective annual discount rate of 25%.

A. She invests $50,000 today and receives $80,000 two years from today.
B. She invests $30,000 today and receives $50,000 one year from today.
C. She invests $20,000 today and receives $24,000 one year from today.
D. She invests $10,000 today and receives $18,000 one year from today.
E. She invests $X today and receives $(1.25*X) one year from today.

X can be any amount that Chloe wants. Which investments should Chloe invest in? What is X?
**Answer:**

\[
NPV_A = -50,000 + \frac{80,000}{1.25^2} = $1,200
\]

\[
NPV_B = -30,000 + \frac{50,000}{1.25} = $10,000
\]

\[
NPV_C = -20,000 + \frac{24,000}{1.25} = -$800
\]

\[
NPV_D = -10,000 + \frac{18,000}{1.25} = $4,400
\]

\[
NPV_E = -X + \frac{1.25X}{1.25} = 0
\]

Choose A, B, and D, and invest the rest in E \( \rightarrow X = $10,000 \)
(12 points) Joe is celebrating his 45th birthday today. He has just received a $1,000,000 inheritance from his Aunt Maude. He will deposit this into an account today that will earn 7% effective annual interest forever. He will also deposit $A on each of his 50th birthday, 55th birthday, 60th birthday, and 65th birthday. He will then withdraw $400,000 each year, starting with his 66th birthday until his 90th birthday. After the last withdrawal, the balance of the account will be zero. What is A?

**Answer:** In $1000s,

\[
1,000 + \frac{A}{1.07^5} + \frac{A}{1.07^{10}} + \frac{A}{1.07^{15}} + \frac{A}{1.07^{20}} = \left[\frac{400}{.07} \left(1 - \frac{1}{1.07^{25}}\right)\right] \frac{1}{1.07^{20}}
\]

\[
1,000 + 1.84220A = 1,204.60
\]

\[
1.8422A = 204.60
\]

\[
A = 111.062
\]

In dollars, $A = $111,062
(7 points) Gabba and Mabba are two stocks with a correlation coefficient of 0. Gabba’s expected return is 5% and variance is 0.01. Mabba’s expected return is 8% and variance is 0.0225. Draw a well-labeled graph that shows the standard deviation of the return of all possible portfolios on the horizontal axis and the expected return on these possible portfolios on the vertical axis. On the graph, clearly show and explain where the opportunity set and the efficient set are for portfolios possible from investing in these two stocks.

Answer:
Torino Toe Soccer is ready to invest in a new machine that manufactures new soccer balls. There are two mutually exclusive possibilities: The Black Spot and the Scorpion Star. The Black Spot costs $500,000 today, and will lead to yearly profits of $100,000. The Scorpion Star costs $250,000 today, and will lead to yearly profits of $55,000. For both machines, the profits are received at the end of each year starting 1 year from today and ending 10 years from today. The effective annual discount rate is 10%.

(a)(3 points) What is the profitability index of the Black Spot?

**Answer:** In $1000s,

\[
PV \text{ of benefits} = \frac{100}{.1} \left(1 - \frac{1}{1.1^{10}}\right) = 614.457
\]

\[
P.I. = \frac{614.457}{500} = 1.22891
\]
(b) (3 points) What is the profitability index of the Scorpion Star?

- **Answer:** In $1000s,

\[
\text{PV of benefits} = \frac{55}{.1} \left(1 - \frac{1}{1.1^{10}}\right) = 337.951
\]

\[
P.I. = \frac{337.951}{250} = 1.35180
\]

(c) (5 points) Which machine should be purchased? Explain your answer with math, graphs, and/or an explanation of 30 words or less.

- **Answer:** In $1000s,

\[
NPV_{B.s.} = 614.457 - 500 = 114.457
\]

\[
NPV_{S.s.} = 337.951 - 250 = 87.951
\]

Choose Black Spot due to higher NPV.
Alan Albert Alexander has just finalized buying his first house in Alabaster, AL. He buys the house for $150,000, with a 20% down payment. The mortgage has a 12% effective annual interest rate. Interest is compounded monthly since payments are made monthly. Alan will pay $1,500 per month for the next 5 years, and will pay off the loan 61 months from today. What will be the total of the final payment that will be made 61 months from today?

**Answer:**

Loan = .8(150,000) = $120,000.

Monthly rate: \( \sqrt[12]{1.12} - 1 = 0.00948879. \)

PV of 1st 60 payments = \( \frac{1,500}{0.00948879} \left(1 - \frac{1}{1.00948879^{60}}\right) = $68,381.70 \)

PV of 61st payment = 120,000 – 68,381.70 = 51,618.30

FV of 61st payment = 51,618.30(1.12^{61/12}) = $91,832.27