9 – A2. An investor would like to sell short ABC company's stock, currently valued at $100, and will close out this position in one year. Assume the investor does not want to lose more than $100 on this transaction when she closes out her position at the end of the year. Further assume a European options market exists for ABC stock. Given the following table, what is the expected cost of this insurance? Assume a risk-free interest rate of 10% per year, and ignore transaction costs and potential broker margin calls.

Term: One-Year Strike Price	Value of Put	
50	5	
75	10	
100	15	
125	30	
150	50	
175	72	
200	95	(94S–5B–29–1/1/1.5)

Put-call Parity:

$$(C - P) = S_0 - Ke^{-rT}$$

9 – A16. Consider the following information about European stock options on stock ABC:

i) The strike price is \$95.
ii) The current stock price is \$100.
iii) Time to expiration is two years.
iv) The stock pays no dividends.
v) The price of a put is \$.75. This price is calculated using a two-step binomial model, where each step is one year in length.

The stock price tree is shown below.

		121
	110	
100		99
	90	
		81

Calculate the price of the call on stock ABC with strike price \$95 if the risk-free rate is 5%. Show all work. (06–8–25–2)

(Put - Call) parity

9 – A13. A four-month European call option with a strike price of \$60 is selling for \$5. The underlying price of stock ABC is currently \$61, and the risk-free rate is 12% per annum, compounded continuously.

a. Calculate the value of a four-month European put option with a strike price of \$60.
b. If the put is currently selling for \$2, describe the transactions that could be used to capitalize on the arbitrage opportunities that exist.
c. Calculate the present value of the profit that would be earned on a per-share basis, if the strategy described in b. was followed.
d. There are three scenarios as regards the relationship of the price of stock ABC in four months and strike price (X):

i) ABC > X ii) ABC = X iii) ABC < X

For each scenario, describe the final transactions that bring the deal to closure.

a) Put-Call parity

$$P = C - S_0 + Ke^{-rT}$$

$$= 5 - 61 + 60 \cdot e^{-.12 \frac{1}{3}} = 1.647$$

b)

$$P + S_0 = C + Ke^{-rT}$$

$$2 + 61 > 5 + 60 \cdot e^{-.12(\frac{1}{3})}$$

↑ sell these

			t=0	
short	put	(k=60)	+2	
long	call	(k=60)	-5	-K
short	stock		$+S_0 \Rightarrow (S_T)$	

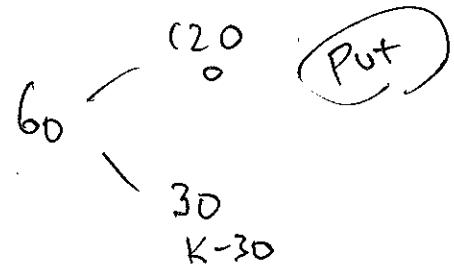
c)

$$P + S_0 - C - Ke^{-rT} = .35$$

10— A2. In six months time, the value of a twelve-month call option will either be \$22.63 or \$465.91. The underlying stock price will either be \$25.00 or \$512.50. The risk free interest rate is 10% per semiannual period. What is the option delta for this option?

$$\Delta = \frac{465.91 - 22.63}{512 - 25} = .909$$

10 – B1. A share of Flybinite Air stock sells for \$60. Analysts predict that twelve months from now the stock could increase to \$120 or decrease to \$30. The required annual return is 10%. You own a one-year European put option on Flybinite Air that is worth \$20. Assuming that investors are unconcerned about risk, what is the exercise price for this put option?



risk-neutral.

$$u = e^{(r-\delta)h + \sigma\sqrt{h}} \qquad p^* = \frac{e^{(r-\delta)h} - d}{u - d}$$

$$d = e^{(r-\delta)h - \sigma\sqrt{h}}$$

$e^{(r-\delta)h} = 1.10$

$= .4$

$$u = \frac{120}{60} = 2$$

$$d = \frac{30}{60} = .5$$

$$C_0 = e^{-rh}\left[0 + (1-p^*)(K-30)\right]$$

$C_0 = 20$, $e^{-rh} = 1/1.10$

$K = 66.67$

10 – B6. You may buy or sell one share of a stock for \$200, borrow or lend as much as you would like at a 10% annual risk-free interest rate, and buy or sell as many European calls as you would like for \$20 each. The calls have an exercise price of \$220 exercisable in one year. In one year the stock price will be either \$250 or \$160.

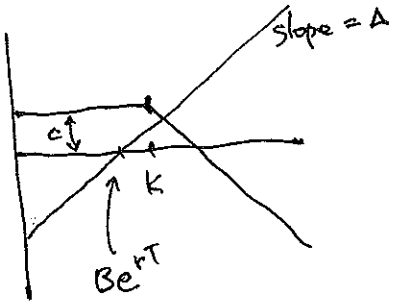
a. What transactions would you make to maximize your certain gain in one year? Specify whether you would borrow or lend, buy or sell, and in what quantity.

b. What would the present value of your certain gain be at time 0 under a.? Show all work. (94F–5B–27–1.5/.5)

a) $\Delta = \frac{30-0}{250-160} = \frac{1}{3} \rightarrow \Delta S + B = C$

b)

		d	u
Sell 3 call (220 − S_T)	20 × 3	0	−90
buy 1 stock	−200	160	250
borrow 140	140	−154	−154
	0	6	6



10-39.

A share of stock in ABC Corporation is currently selling for $40, and the current price of one of its calls, exercisable in six months, is $8. The current annual risk-free rate is 6%. Assume that the stock price at the end of six months can either fall by 25% or rise by a fixed percentage (p), which is unknown to you. Using the binomial pricing model, what is the option delta? Show all work. (96F–5B–35–1.5)

$S = 40$

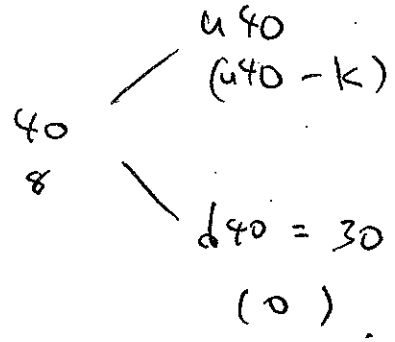
$T = .5$

Call = 8 $k = ?$

$e^{r\frac{1}{2}} = 1.03$

$u = ?$

$d = 1 - .25 = .75$



$$8 = \underbrace{e^{-r\frac{1}{2}}}_{1/1.03}\left[p^*(u40 - k) + (1-p^*)\,0\right]$$

$40(u-d)$

$$(u40 - k) = 8(1.03)/p^*$$

$$\Delta = \frac{u40 - K}{u40 - 30} = \frac{8.24/p^*}{11.2/p^*}$$

risk-neutral

$$(40)(1.03) = p^* u\$0 + (1-p^*)30$$

10 - B10

ABC Company's stock is currently priced at $40. Your broker's projections for the next quarter are that the stock will either increase to $50 or decrease to $25. The current annual risk-free interest rate is 6% and your broker's projection for the annual return on ABC is 25%.

a. Compute the value of a three-month put option with an exercise price of $35, using the risk-neutral method of valuation. Show all work.

b. What probability does your broker estimate for a rise in the stock price to $50 in three months? Explain the difference, if any, between this answer and the probability calculated as part of the risk-neutral method. (96F–5B–36–1.5/1.5)

$S_0 = 40$ → 50 or 25 @ 6% risk-free 25% return.

a) $K = 35$ 3-mo. put:

$$P_{ut} = \frac{1}{1+.06/4}\left[p^*(0) + (1-p^*)(10)\right]$$

$$p^* = \frac{e^{(r-\delta)h} - d}{u-d} \qquad e^{(r-\delta)h} \approx 1.015$$

$u = 50/40 = 1.25$

$d = 25/40 = .625$

$= .624$

b) $25\%/4 = .0625$ $\qquad p^* = \dfrac{1.0625 - d}{u-d} = .70$

risk-neutral → grows at risk-free rate

$p^* = .624$

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