Corporate Finance Mod 20: Options, put call parity relation, Practice Problems

** Exercise 20.1: Put Call Parity Relation

- One year European put and call options trade on a stock with strike prices of $85.
- The risk-free rate is 11.9% per annum.
- The value of the put option is $1 more than the value of the call option.

A. Using the put call parity relation, what is the value of the put option minus the value of the call option?
B. What is the stock price in this exercise?

Part A: The put call parity relation is: *call + present value of exercise price = put + stock price*.

This gives: *put – call = present value of exercise price – stock price*

Part B: Rewriting the expression above gives

stock price = present value of exercise price – (put – call)

The put value – the call value = $1, so the stock price = $85 / 1.119 – 1 = $74.96 ≈ $75.

** Exercise 20.2: Stock Price

On January 1, at 10:00 am, the stock price is $68. Three month European call and put options on ABC stock sell at an exercise price of $65. (The exercise price is the strike price.)

! At 10:00 am, the call option is worth $10 and the put option is worth $2.
! At 11:00 am, the call option is worth $8 and the put option is worth $4.

Assume that the risk-free interest rate does not change between 10:00 am and 11:00 am.

A. Express the present value of the exercise price as a function of the call value, put value, and stock price.
B. Express the stock price as a function of the call value, put value, and exercise price.
C. What is the stock price at 11:00 am?

Part A: The put call parity relation is: *call* + *present value of exercise price = put* + *stock price*, so

present value of exercise price = stock price + put – call

Part B: The put call parity relation is: *call* + *present value of exercise price = put* + *stock price*, so

stock price = present value of exercise price + call – put

Part C: The present value of the exercise price does not change in one hour if the risk-free rate does not change, so the change in *call – put* is the change in the stock price. The change in *call – put* is –$4, so the new stock price is $68 – $4 = $64.

** Question 20.3: Put Call Parity Relation

A stock trades for $80, and the risk-free interest rate is 15%. A European *call option* that expires in six months and has a strike price of $90 is valued at $12. What is the value to the nearest dollar of a European *put option* that expires in six months and has a strike price of $90?

A. $8
B. $10
C. $12
D. $14
E. $16

Answer 20.3: E

Solution 20.3: We use the put call parity relation: c + PV(X) = p + S:

put + $80 = $12 + $90 × $1.15^{-½}$
or put = $90 × $1.15^{-½}$ – $68 = $15.93

Question: Can you explain the put call parity relation intuitively?

Answer: Suppose an investor buys and a put option with a strike price of $90, and sells a call option with a strike price of $90. At the expiration date, the stock price is either above or below $90.

~ If the stock price is above $90, the person who bought the call option exercises it, and the investor gets $90 but must give up the stock.
~ If the stock price is below $90, the investor exercises the put option and gives up the stock for $90.

Either way, the investor has $90 and no stock. This means that the investor's portfolio is now worth the present value of $90, or stock + put – call = present value ($90).

The $90 is the strike price. Substituting X for the $90 gives the put call parity relation.

** Question 20.4: Strike Price

One year European call and put options are trading on the ABC stock at the values shown below.

	Strike Price	
	$110	$115
call	$10.00	$7.50
put	$10.00	Z

The risk-free interest rate is 11% per annum. Find Z.

A. $12.00
B. $12.25
C. $12.50
D. $12.75
E. $13.00

Answer 20.4: A

Let the stock price be S. By the put call parity relation: *call + present value of exercise price = put + stock price*, so 1 put minus 1 call = the present value of the exercise price – the stock price.

For an exercise price (strike price) of $110, put – call = $0 = $110 / 1.11 – S ⇛ S = $110 / 1.11 = $99.10.

For an exercise price (strike price) of $115, put – call = put – $7.50 = $115 / 1.11 – $99.10 ⇛ put = $115 / 1.11 – $99.10 + $7.50 = $12.00.

We can simplify the solution as follows:

- The change in the exercise price is +$5.00.
- The change in the present value of the exercise price is $5.00 / 1.11 = $4.50.
- The change in the value of 1 put minus 1 call is $4.50.
- The call value decreases by $2.50, so the put value increases by $2 to $12.00.

The following explanation is another perspective:

The difference between the call and put prices at the two exercise prices is the difference in the present value of the exercise prices. This is the present value of ($115 – $110) = $5, for one year at an 11% discount rate: $5 / 1.11 = $4.50.

The change in(put – call) between the two exercise prices is $4.50 and the change in the call option price is $2.50, so the change in the put option price is $4.50 – $2.50 = $2. The put option price with a $115 exercise price is $10.00 + $2 = $12.00.