

# Practice Questions

## Session 9 and 10

### Question 1: True or False

1. Ceteris paribus, the higher the price of a stock the higher the price of the European call associated to this stock.
2. Ceteris paribus, a European put option with a lower strike has a higher price.
3. Ceteris paribus, the price of a European call option on a dividend paying stock is higher than the price of a European call option on a non-dividend paying stock.
4. A trader is long delta when he has a long position on options.
5. A trader is long gamma when he has a long position on options.
6. A trader decides to be long vega when he thinks that that the volatility on the markets will decrease.
7. The delta of an ATM option is higher than the delta of an ITM option.
8. The delta is increasing in the market volatility.
9. The gamma of a deep ITM option is nil.
10. The gamma is increasing in the maturity of an option.
11. A short options position is long gamma.

### Question 2

The following table is obtained with the function <OVME> on Bloomberg.

Asset	Actions	Products	Views	Settings	Option Valuation Equity/IR		
12) Solver (Vol)	13) Load	14) Save	16) Trade	17) Ticket	18) Send		
21) Deal 1	22) +						
31) Pricing	32) Scenario	33) Matrix	34) Volatility	35) Backtest			
Underlying	AAPL US Equity	APPLE I...	Exercise	European	Trade		
Und. Price	145 USD		Direction	Buy	Call		
				03/26/2017	23:23		
				99) Export to Excel	97) Reset Settings		
Y-Axis X-Axis							
Strike Maturity		1M	2M	3M	4M	5M	6M
135	Price (Total)	10.75	11.11	11.88	12.61	13.46	14.20
	Delta	87.31	79.93	76.89	74.82	70.97	70.02
	Gamma	3.1843	3.2390	2.9779	2.7450	2.4410	2.2696
140	Price (Total)	6.46	7.35	8.28	9.18	10.17	10.96
	Delta	74.38	67.01	65.29	64.22	61.78	61.57
	Gamma	5.5931	4.4180	3.7726	3.3077	2.8106	2.5713
145	Price (Total)	3.22	4.41	5.38	6.33	7.40	8.22
	Delta	51.79	50.40	51.31	52.08	51.62	52.25
	Gamma	7.3201	5.0382	4.2055	3.6252	3.0169	2.7478
150	Price (Total)	1.23	2.35	3.21	4.15	5.17	5.95
	Delta	27.24	33.33	36.85	39.69	41.18	42.77
	Gamma	6.3686	4.7249	4.0979	3.5686	3.0179	2.7686
155	Price (Total)	0.38	1.16	1.79	2.60	3.46	4.15
	Delta	10.80	19.49	24.12	28.42	31.30	33.60
	Gamma	3.5663	3.5964	3.4335	3.1669	2.8017	2.6263
160	Price (Total)	0.12	0.54	0.96	1.58	2.20	2.81
	Delta	3.90	10.37	14.72	19.32	22.52	25.32
	Gamma	1.5494	2.3303	2.5308	2.5600	2.4226	2.3428

1. The screenshot above displays the prices, deltas and gammas of different options on Apple stock with different strikes and different maturities. Answer the following questions:

- a. Based on the deltas of those options, what is the (approximate) actual price of Apple stock?
  - b. Explain intuitively why the price of an option is increasing in its maturity.
2. You manage an options portfolio. You are currently long 50 options with a strike of 135\$ and a maturity of 1 month and short 25 options with a strike of 145\$ and a maturity of 3 month. You also have a short position on 3,000 shares of Apple stock.
  - a. Compute the delta and the gamma of your portfolio including your positions in Apple stock.
  - b. Which transactions do you have to do to make your portfolio delta-neutral?
  - c. Considering b, is your portfolio gamma-neutral? If yes, explain why. If not, which transactions do you have to do to make your portfolio gamma-neutral. Use Apple shares and options with a strike of 150 and a maturity of 1 month only.
  - d. Considering b and c, is your portfolio still delta-neutral. If yes, explain why. If not, which transactions do you have to do to make your portfolio delta-neutral.
  - e. Considering, b, c and d, is your portfolio still gamma-neutral? If yes, explain why. If not, which transactions do you have to do to make your portfolio gamma-neutral.

## Solutions

### Question 1:

1. True
2. False
3. False
4. False
5. True
6. False
7. False
8. True
9. True
10. False
11. False

### Question 2 :

1.
  - a. 145\$ because the delta of the options with a strike price of 145\$ is around 50%.
  - b. The price of an option is increasing in its maturity because its probability to be ITM increases. Thus, this options is more valuable, i.e. has a higher price.

2.

- a. Long 50 options with a delta of  $50 * 100 * 87.31\% = 4365.5$   
Short 25 options with a delta of  $- 25 * 100 * 51.31\% = - 1282.75$   
Short position on 3,000 shares with a delta of  $- 3\ 000$ .  
The net position has a delta of  $4365.5 - 1282.75 - 3000 = \underline{\underline{82.75}}$

- b. Sell 82.75 shares

- c. The portfolio in a is not gamma-neutral. The transactions in b do not change the gamma of the position because the gamma of a share is 0.

Our portfolio in a. gamma position:

Long 50 options at a gamma of  $50*100*3.1843\%=159.215$

Short 25 options with gamma of  $-25*100*4.2055\% = -105.1375$

Shares always have a gamma equal to 0.

Net gamma position =  $159.215 - 105.1375 = 54.0775$

To make the portfolio gamma neutral with options with strike of 150\$ and maturity of 1 month – the gamma is thus equal to 6.3686 -, you have to take a short position on 9 options ( $54.07/6.3686$ ).

- d. The portfolio is no longer delta-neutral because we took a position on 9 units with a delta of 27.24%.

To make the portfolio delta-neutral - it now has a delta of  $-9 * 100 * 27.24\% = -245.16$ -, you have to take a long position on 245 shares.

- e. Yes, because the position in d does not change the gamma of the portfolio.