

## **GESTÃO FINANCEIRA II / CORPORATE FINANCE II**

### **Problem Set 4**

**Licenciatura – Undergraduate Course**

**1<sup>st</sup> Semester, 2020-2021**

## GESTÃO FINANCEIRA II - PROBLEM SET 4

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### Chapter 21 & 22 – Options and Real Options

*- Identify your assumptions whenever you deem necessary –*

Pfizer, Inc. (Pfizer or PFE) shares closed on November 20<sup>th</sup>, 2020, at USD 36.70 (Nyse). On the same date the Yahoo Finance website had the following information regarding Pfizer options with the maturity date on June 18<sup>th</sup>, 2021:

Call   Strike	Last Price	Bid	Ask	Open Interest	Implied Volatility	Put   Strike	Last Price	Bid	Ask	Open Interest	Implied Volatility
18.00	18.95	-	-	0	-	18.00	0.06	-	-	0	25.00%
20.00	17.07	-	-	0	-	20.00	0.07	-	-	0	25.00%
23.00	17.10	-	-	0	-	23.00	0.14	-	-	0	12.50%
25.00	12.25	11.70	12.00	0	36.04%	25.00	0.26	0.28	0.34	38	37.21%
28.00	9.15	8.90	9.15	2,289	30.66%	28.00	0.59	0.61	0.66	20	34.67%
29.00	8.15	8.05	8.35	1	31.25%	29.00	0.80	0.79	0.86	20	34.62%
30.00	7.40	7.30	7.45	69	29.59%	30.00	1.03	1.01	1.05	81	33.91%
31.00	6.85	6.45	6.70	5	29.76%	31.00	1.25	1.19	1.36	327	34.30%
32.00	5.90	5.80	5.95	53	29.32%	32.00	1.57	1.58	1.66	46	34.03%
33.00	5.25	5.05	5.30	22	29.52%	33.00	1.90	1.82	2.07	10	34.50%
34.00	4.78	4.50	4.65	35	29.19%	34.00	2.30	2.24	2.39	63	33.57%
35.00	4.05	4.00	4.10	297	29.35%	35.00	2.76	2.80	2.86	200	33.73%
36.00	3.56	3.45	3.60	1,145	29.49%	36.00	3.25	3.30	3.40	68	34.11%
37.00	3.05	3.00	3.10	710	29.18%	37.00	3.69	3.85	3.95	206	34.17%
38.00	2.67	2.54	2.69	460	29.25%	38.00	4.10	4.45	4.60	0	34.77%
39.00	2.43	2.29	2.35	1,295	29.54%	39.00	4.25	5.10	5.25	0	35.01%
40.00	1.99	1.97	2.04	3,519	29.72%	40.00	5.80	5.80	5.90	17	34.92%
41.00	1.74	1.70	1.76	568	29.83%	41.00	6.45	6.50	6.75	0	36.40%
42.00	1.46	1.46	1.51	1,580	29.91%	42.00	6.25	7.20	7.50	0	36.68%
43.00	1.30	1.24	1.31	196	30.15%	43.00	7.08	8.05	8.30	0	37.21%
44.00	1.13	1.02	1.17	2192	30.79%	44.00	9.40	8.65	9.10	2	37.50%
45.00	0.95	0.91	0.99	1,434	30.69%	45.00	9.25	9.45	9.95	7	38.09%
50.00	0.49	0.48	0.50	1,085	32.03%	50.00	14.35	14.25	14.55	0	42.75%
55.00	0.24	0.00	-	0	12.50%	55.00	18.60	-	-	0	0.00%

The annual risk-free interest rate on November 20<sup>th</sup>, 2020 was 0.11%.

- a) Assume that you consider the market volatility will cause a change in the Pfizer's price level. Define two strategies to profit from your view. The strike price range must be [USD 34; USD 38]. Plot them and show the expected payoffs. Explain your strategy.
- b) Construct a binomial tree for June 18<sup>th</sup>, 2021 assuming the stock price moves just once and determine the European call option value for a strike price of USD 37?
- c) Construct a more realistic binomial tree for June 18<sup>th</sup>, 2021, assuming the stock price moves 6 times (i.e., every 35 days or 840 hours) and determine the European call option value for a strike price of USD 37?
- d) If the standard deviation was 29.44%, determine the European call option value for a strike price of USD 37 with the binomial tree with price moves every 35 days. Explain.
- e) Use the Black-Scholes model to determine the value of an European Call option with a strike of USD 37.
- f) Use the Black-Scholes model to determine the implicit volatility on an European Call option with a strike of USD 37. Explain.
- g) Apply the Call-Put parity to check the value of the European Put option with a strike of USD 37. Should you buy or sell the Put option. Explain.
- h) Assume Pfizer will pay a dividend of USD 0.36053 per share on January 29<sup>th</sup>, 2021, and May 14<sup>th</sup>, 2021. Construct a binomial tree for June 18<sup>th</sup>, 2021, assuming again that the stock price moves 6 times (i.e. every 35 days) and determine the American call option value for a strike price of USD 37?