Problem set 2

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FIN-503 Advanced Derivatives
EPFL

September 24, 2018

Exercise 1

Matlab codes for this problem set can be found on moodle. You need to download two codes : 'BlackScholes.m' and 'PBSet2_solutions.m'.
The current value of equity is found by using Black-Scholes formula. It is E = 75.38.
Using the compound option formula, we can find the values of the compound option with different strikes and maturities. These are shown in table 1. Finally, we can get the implied volatilies using fminsearch in matlab. These are shown in table 2. The volatility surface can be plotted using the surf function. It is shown in Figure 1. It is not flat because the underlying of the compound option (equity) is not log-normal.

Table 1: Numerical values of the compound option

	2 years	5 years	7 years	9 years
60% * E	39.09	49.53	54.78	59.28
80% * E	30.65	43.69	50.01	55.32
100% * E	23.98	38.75	45.86	51.8
120% * E	18.78	34.53	42.22	48.65

Table 2: Implied volatilities of equity

	2 years	5 years	7 years	9 years
60% * E	0.5281	0.5502	0.57	0.5972
80% * E	0.5176	0.5374	0.5547	0.5777
100% * E	0.5097	0.5278	0.5433	0.5632
120% * E	0.5035	0.5202	0.5342	0.5518

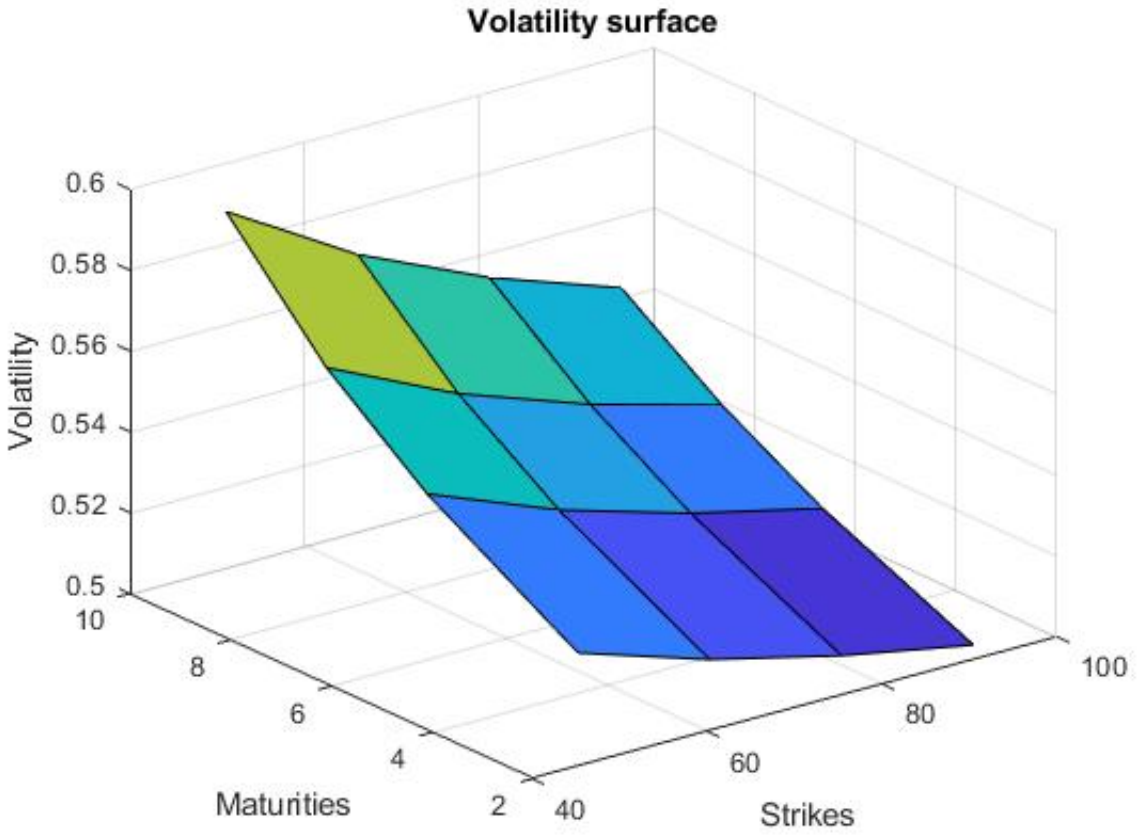

Figure 1: Volatility Surface

Exercise 2

The Merton formula to price an option in the jump-diffusion case is basically a weighted average of Black-Scholes prices with the weights being the probability of occurence of n jumps. Obviously, as n increases, the probability decreases and it actually converges to zero very fast. This is why in practive we can use a finite number of jumps in the formula. You can try to set n to a higher number and see that the option prices do not move that much.

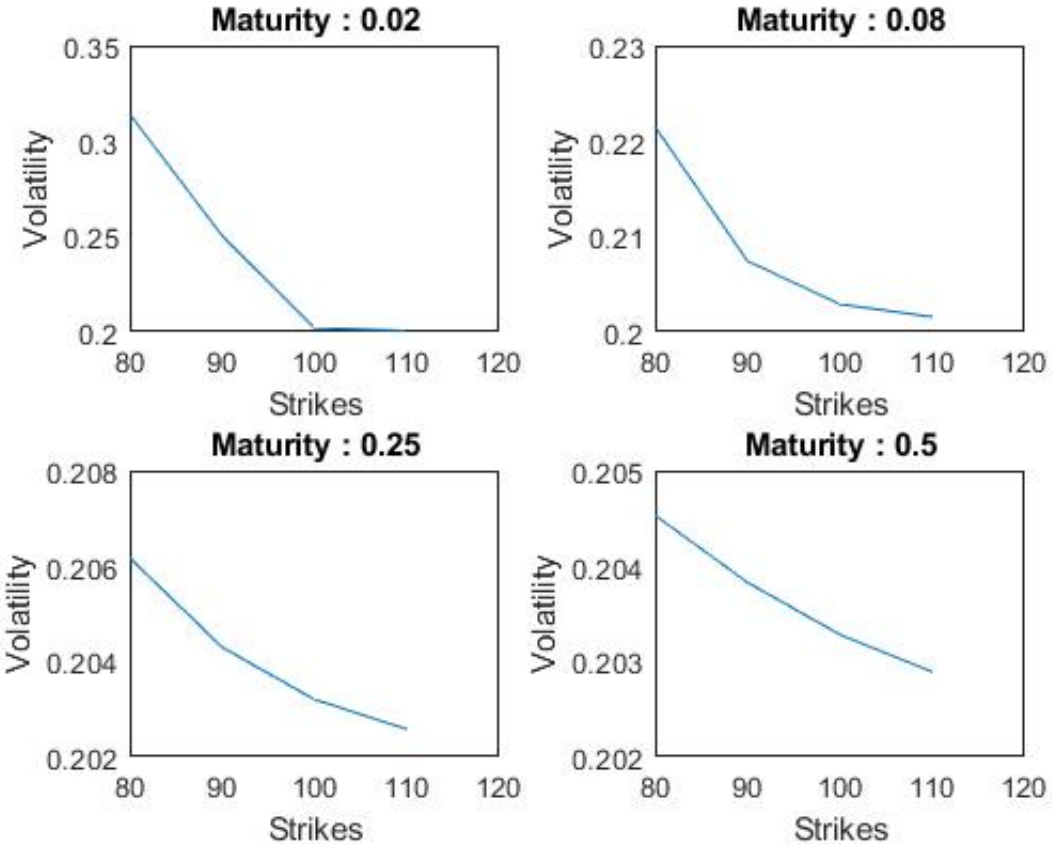

Figure 2: Implied Volatilities

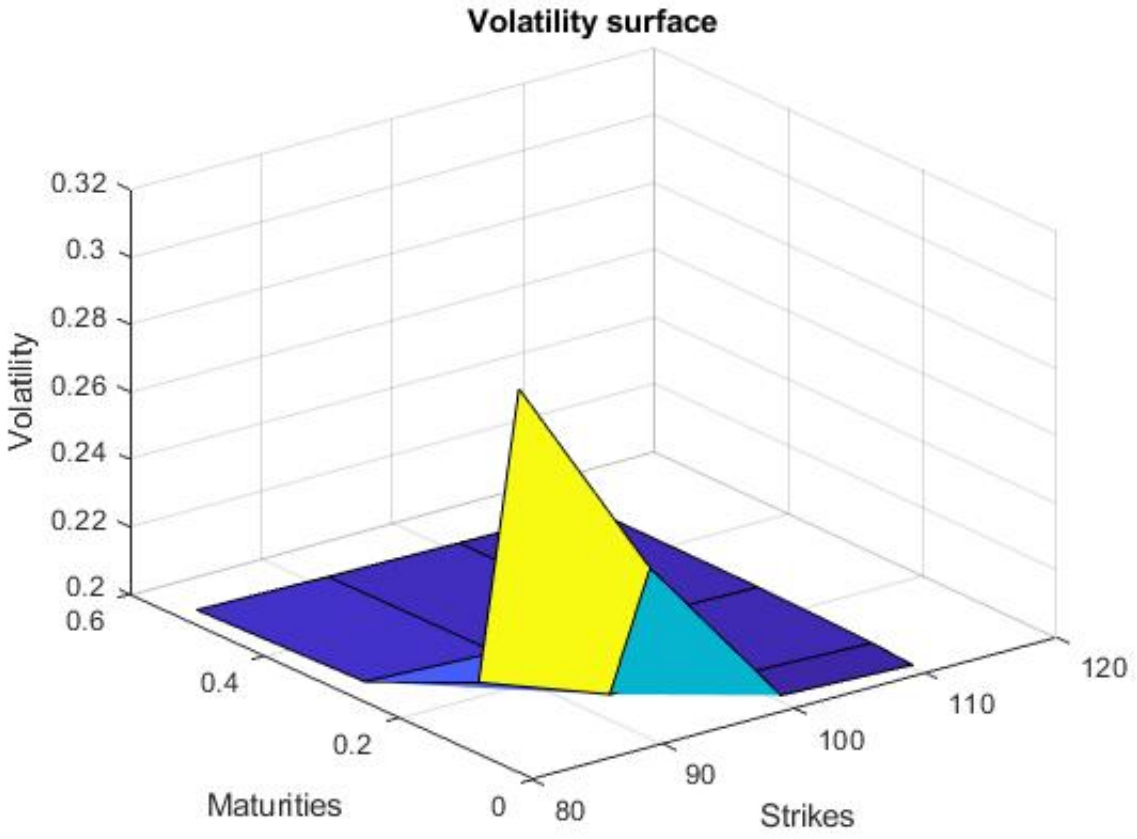

Figure 3: Volatility Surface