Quantitative Finance – Home Assignment 1

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In a frictionless market a stock-market index is traded at a price of EUR 4600. In addition, there is a risk-free money market account with an annualized rate of 1.9% (with continuous compounding). The volatility of the stock price is given on the table below. In addition, there are six options traded in the market, each with a time to expiry of two years and the following payoff structures:

Option 1:   European call with strike price 4800

Option 2:   American put with strike price 4000

Option 3:   Power option

Option 4:   Bermudan put

Option 5:   Down-and-out-put with strike price 4800

Option 6:   Binary option

Each student is assigned to compute the value of options 1 and 2 and one of the other options (see table below). Compute the arbitrage-free prices for all options using a Cox-Ross-Rubinstein binomial tree with 40 time-steps.

Student ID	Option 3	Power Cap	Bermudan Strike	Barrier	Lower	Upper	Volatility
12234772	3	5400					10%
12319124	3	5450					11%
12321013	3	5500					12%
12217747	3	5550					13%
12312460	3	5600					14%
12321078	4		3800				10%
12219257	4		3900				11%
12500180	4		4000				12%
12313572	4		4100				13%
12220513	4		4200				14%
12500107	5			2800			10%
12235839	5			2900			11%
12306407	5			3000			12%
12140322	5			3100			13%
12316295	5			3200			14%
12500736	6				4800	6800	10%
12312432	6				4801	6801	11%
12500603	6				4802	6802	12%
12316432	6				4803	6803	13%
12329171	6				4804	6804	14%

Glossary:

Power option: A power option with power γ pays at expiry S^γ if, and only if the final stock price does not exceed a given cap value given above. Use $\gamma = 2$.

Bermudan put: A Bermudan put gives the owner of the option to exercise the option every six months during the lifetime of the option (i.e., similar to an American option but exercise is not allowed at any point in time).

Down-and-out put: A down-and-out put option is a European put option with a given strike price which expires worthlessly if the stock price breaches a certain barrier from above whenever during the lifetime of the option (i.e., the terminal payoff of the option is zero if the stock price breaches the barrier whenever during the lifetime of the option).

Binary option: This option pays a fixed cash flow at expiry if the stock price after two years lies between the lower and the upper boundary of the interval given above.