

# FINM3405 Derivatives and risk management

## Tutorial Sheet 8: Options - American and path dependent

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In the following questions let  $S = 50$ ,  $K = 50$ ,  $r = 5\%$ ,  $T = \frac{1}{2}$ ,  $\sigma = 25\%$  and the continuously compounded dividend yield  $y = 0$  unless otherwise indicated.

### American options

**Question 1.** Calculate by hand the prices of ATM American calls and puts using a 2 layer binomial tree. Then do the same for when  $y = 7\%$ . Also calculate the deltas. Again, you're welcome to use the CRR or JR schemes.

**Question 2.** Modify your Excel spreadsheet for using a 7 layer binomial model to price European options to calculate American option prices and deltas, including for the case of  $y = 7\%$ .

**Question 3.** Let the USD:EUR exchange rate be 0.9. Use your 7 layer binomial models to calculate the prices of 6 month ATM USD:EUR FX American and European options. Let  $\sigma = 15\%$ , Euribor be 3.38%, and Term SOFR be 4.62%.

### Path dependent options

**Question 4.** Modify your excel code to price an ATM chooser option via a 6 layer binomial tree, so each date or layer of the tree coincides with the end of a month, with choice date in 3 months. Also do the same for the case of  $y = 7\%$ .

**Question 5.** Use Excel to create 100 asset price paths over 10 time steps to calculate the prices of the lookback and Asian path dependent options.

**Question 6.** How might you incorporate a continuous dividend yield of  $y = 7\%$  into Monte Carlo option pricing? Do this first for European calls and puts, and compare the prices to the Black-Scholes European prices to check that you've got things right. Then do it for the European FX and lookback, barrier and Asian path dependent options. *Hint:* It's much simpler than one may think.