## PDE pricer tests

We have conducted a series of tests for PDE pricer, mostly in form of automated tests in python. Some basic unit tests check how PDE pricer initially fills the grid, asserts common as of date, etc. More advanced tests check fundamental pricing relationships hold.

All tests mentioned below can be found in tests/pde\_pricer\_test.py.

* call\_price\_has\_correct\_dynamics  
  This test checks a call with lower strike has greater price, as an option to buy cheaper is worth more than an option to buy at a higher price.
* put\_price\_has\_correct\_dynamics  
  This test checks a put with lower strike has lower price, as an option to sell cheaper is worth less than an option to sell at a higher price.
* higher\_vol\_means\_more\_expensive\_option  
  Using mocked constant volatilities of 10% and 11% this test checks than an option price is higher when the volatility is higher, i.e., vega risk is positive for (long) American options.
* higher\_rates\_mean\_less\_expensive\_option  
  Using mocked interest rates this test checks an option becomes cheaper if interest rates go up. This would happen for all future payoffs – if rates go up, cashflows in the future are worth less at present moment in time.
* deep\_otm\_price\_is\_0  
  Deeply out of the money option (a put with a very low strike in our case) is worthless, as it has no chance to be exercised, thus its price has to be 0
* deep\_itm\_put\_price\_is\_k\_minus\_s  
  A deep in the money put is sure to be exercised and thus its price is the same as a price of a forward. Given we deal with American options and interest rates are positive, we will always choose to exercise a deep ITM put immediately, as we would get (K-S) payoff right now in this situation. If we were to do it later, we would get (K-S/df)\*df = df\*K-S < K-S, where df is a discount factor for the expiry date, 0< df < 1. Thus, as we would exercise immediately, the price should be exactly K-S.
* call\_with\_const\_vol\_roughly\_matches\_Black\_Scholes  
  We compare an American call option price to a European call option price with constant volatility and rates, because without dividends and with positive interest rates early exercise is not feasible for American call options. We do see a bit of numerical noise, but get a good match of Black-Scholes European call price vs our PDE price for an American Call option.