

derivatives1_assignment_2018

March 30, 2018

1 Instructions

1. Due: 12:00 PM 02/04/2018.
2. Answers (pdf) must be
 - named as assignment1.(pdf/ipynb)
 - uploaded directly to Google drive, under **students/YourName** folder.
 - do not forget to change the share settings of this folder: only share with the instructor and TA.

2 Questions

Q1. (Payoff and profit) For a given derivative, **payoff** is the value at the time of expiration, but for the **profit** one needs to take into account the initial investment, for instance, the derivative's cost. Payoff/profit at the expiration time in function of the underlying price are payoff/profit diagram.

- a. Recall the payoff of a Call option with price at maturity S_T and strike price K .
- b. If the option cost at $t = 0$ is c , what would be the profit of the option buyer at $t = T$.
- c. Use Python to draw the payoff and profit diagrams for: $S_T = 100$, $K = 100$, $c = 1$ (currency unit), $T = 1$ (year) and either $r = 0$ or $r = 7$ (% per annum).

Q2. (Intrinsic and time value) The price of a derivative can be decomposed into two components, **intrinsic value** (value of the derivative if exercised immediately), the rest is called the **time value**.

- a. Use the option data sample (AAPL 01/06/2017), calculate the time value of each option.
- b. Show that time values are always positive for European/American Call/Put, i.e.,

$$C(S_t, t; K; T) \geq \max(S_t - K, 0) \quad \text{and} \quad P(S_t, t; K; T) \geq \max(K - S_t, 0).$$

Verify numerically this fact in the data sample.

- c. Verify if time value increases with time to maturity using the same data sample.

Q3. (Moneyness) The **moneyness** of a given derivative is referred to the relation of the strike price and the current underlying price. If exercising immediately leads to a positive/negative/null payoff then the derivative is said to be in-the-money (ITM)/out-of-the-money (OTM)/at-the-money (ATM), respectively.

- a. What's the intrinsic and time value of ATM and OTM options?
- b. Show that the time value of ATM/OTM European Call/Put options indeed increases with the option's time to maturity.
- c. Verify how time value evolves with respect to the log-moneyness ($\log S_t/K$) using the data sample.