MF 796: Computational Methods of Mathematical Finance

Professors Christopher Kelliher and Eugene Sorets Spring 2024

Problem set # 2

Due: Tuesday, February 13, by 11 pm

1. **What areas of finance**
   are of most interest to you (e.g. big data, trading, portfolio management, risk management, derivative pricing, analyzing complex derivatives)?

2. **What is the primary reason for your interest in this course?**

3. **List all programming languages you have used**
   and your level of familiarity with each.

4. **Option traders often say that when buying options we get gamma at the expense of theta.**
   What do you think they mean?

5. **Evaluation of a known integral using various quadratures:**
   In this problem we are going to compute the price of a European call option using various quadrature methods and compare their properties.

   Let our European call option have 3 month expiry, strike 13, and implied vol 25%.

   Assume the underlying is 10 now and the interest rate is 5%.

   (a) Use Black-Scholes formula to compute the price of the call analytically.

   (b) Calculate the price of the call numerically using the following 3 quadrature methods applied to the normal cdf inside the Black-Sholes formula:

      i. Left Riemann rule

      ii. Midpoint rule

      iii. Gauss nodes of your choice (say explicitly why you made that choice)

      with the number of nodes $N = 5, 10, 20, 50$ and compute the calculation error as a function of N for each of the methods.

   (c) Estimate the experimental rate of convergence (i.e., as a function of N) of each method and compare it with the known theoretical estimate.

   (d) Which method is your favorite and why?