1. Produce 100,000 Monte Carlo simulations or “paths” to price a call option with strike of 1365 and time to maturity of 1 month under the Black and Scholes assumptions. Assume that the short-term interest rate is 4.5%, the spot price is 1365, the dividend yield is 2% and the volatility ($\sigma$) is 30%. Use the antithetic control variate technique and the Milstein scheme. Use 1,000 increments (divide the 1-month period into 1,000 intervals). (This took less than 9 seconds to run on a 3.0 GHz laptop with 32GB of RAM; watch how the random Gaussian shocks are stored, I will explain in class)

2. This time compute the price of that same option by numerically integrating its Feynman-Kac expression, i.e. integrate the following expression:

$$C(S, K, r, t, T) \equiv e^{-r(T-t)} \int_{K}^{+\infty} (S_T - K) \rho^Q(S_T | S_t = S) dS_T$$

**Hint:** Get the density function from lecture notes # 3, and do not forget to incorporate the dividend yield in it. For the upper (infinite) bound, only go up to 5000, as it is more than enough to get an exact price.

3. Compute the theoretical option price by plugging in the inputs into the Black-Scholes option pricing formula. Verify/show me that your answer from part 1) is very close to the theoretical price (should easily be less than 50 cents apart) and that your numerical integration from part 2) is an exact match to the theoretical price.