

15.433 INVESTMENTS

Assignment 4: Option Simulation

Spring 2003

The current spot exchange for British Pounds (£) is 0.620£/US\$. This rate follows a normal distribution with daily mean zero and daily standard deviation 2.5 basis points. There are 252 business days in the coming year.

Price the following OTC options:

1. binary option: pays \$100mm if the rate is below 0.600£/US\$ exactly one year from now.
2. barrier option: pays \$100mm if the rate crosses below 0.600£/US\$ at any point before one year.
3. step option: pays \$100mm if the rate ends between 0.590-0.600£/US\$, \$200mm if the rate ends 0.575-0.590£/US\$, and \$5mm if the rate ends below 0.550£/US\$.

Hint: these questions are not easily solved analytically. Therefore, do a Monte-Carlo simulation (with minimum 10,000 iterations) to simulate the path of the exchange rate. BIG HINT: explore the `norminv()` and `rand()` functions in Microsoft Excel, though feel free to use other programming languages.

Since we cannot look your program code, make sure briefly summarize your program methodology and problem-solving methodology to get partial credit in case your numerical solution is wrong.

The following questions address possible errors in our model of exchange rates. Use short answers (no calculations necessary):

4. Price estimation

- (a) What will happen to our price estimates if the true mean change in exchange rates is actually positive? Negative?
- (b) What will happen to our price estimates if the true standard deviation is higher than we model? Lower?

5. Distribution

- (a) What if the true distribution of exchange rate changes is positively skewed? Negatively skewed?
- (b) What if the kurtosis is greater than that of normal distribution?

BONUS (Not graded) Another more difficult but realistic spin is the following. Create a histogram of the daily changes in the exchange rate for the past 3 years. Apply this empirical distribution to price the series of options again using simulations. Although possible in Excel, this would be considerably more difficult to do and calls for more advanced programming skills.