Stat 441 Winter 2009
Assignment #1

The following two problems are due TODAY.

1. Make sure that you know your username and password in order to log on to the computers in the Undergraduate Computer Lab (CW 307.37). We will meet in the lab for class on Friday, January 9. Check with Sarah TODAY if you have forgotten either.

2. Send me an email to say "Hello" so that I can create a class mailing list. (Even though I have taught everyone before, this makes it much easier for me to create a mailing list.)

The rest of this assignment is due at the beginning of class on Wednesday, January 14, 2009.

3. Read the Preface, pages xvii–xxi, and Chapter 1, pages 1–10, of Higham.

- Pay particular attention to formulas (1.1) and (1.2), as well as the associated payoff diagrams.
- Complete Exercises 1.1 through 1.4. They are all pretty easy.

4. Read Chapter 2, pages 11–19, of Higham.

- Complete Exercises 2.1, 2.2, and 2.5.
- Re-read the argument in Section 2.6 that derives upper and lower bounds on option values. The logic is not always easily grasped.
- Try Exercises 2.3 and 2.4.
- Try Exercise 2.6 on pricing a futures contract. It is extremely instructive, though not so easy.

5. The following exercises are from the printed lecture notes.

- Exercise 1.1
- Exercises 4.1, 4.3, 4.4, and 4.5
- Exercises 4.6 and 4.7 are extremely important. Do them!
- Exercises 4.16, and 4.18
- Exercises 4.25 and 4.27

6. Consider a European call option and a European put option on a (nondividend-paying) stock. You are given: (i) The current price of the stock is $60. (ii) The call option currently sells for $0.15 more than the put option. (iii) Both the call option and put option will expire in 4 years. (iv) Both the call option and put option have a strike price of $70. Calculate the continuously compounded risk-free interest rate. *Hint: Use the put-call parity for European options.*

(continued)

7. In numerical analysis, the so-called *error function* is used instead of Φ. It is defined as

$$\operatorname{erf}(z) = \frac{2}{\sqrt{\pi}} \int_0^z e^{-x^2}\, dx.$$

Show that if $-\infty < z < \infty$, then $\operatorname{erf}(z) = 2\,\Phi(\sqrt{2}\,z) - 1$.

8. Let $Y_1, Y_2, \ldots$ be independent and identically distributed random variables with $\mathbf{P}\{Y_1 = 1\} = \mathbf{P}\{Y_1 = -1\} = \frac{1}{2}$, set $S_0 = 0$, and for $n = 1, 2, 3, \ldots$, define the random variable S_n by $S_n = Y_1 + \cdots + Y_n$ so that $\{S_n, n = 0, 1, 2, \ldots\}$ is a simple random walk starting at 0. Consider the filtration $\{\mathcal{F}_n, n = 0, 1, 2, \ldots\}$ given by $\mathcal{F}_n = \sigma(S_0, \ldots, S_n)$. Define the process $\{M_n, n = 0, 1, 2, \ldots\}$ by setting

$$M_n = S_n^4 - 6nS_n^2 + 3n^2 + 2n.$$

Show that $\{M_n, n = 0, 1, 2, \ldots\}$ is a martingale with respect to $\{\mathcal{F}_n, n = 0, 1, 2, \ldots\}$.

9. Go visit the website of the Chicago Board Options Exchange at

`http://www.cboe.com`

and take a look at their Online Tutorials

`http://www.cboe.com/LearnCenter/Tutorials.aspx`

which include several lessons on Options Basics. These five lessons will take approximately 95 minutes to complete.