STAT 605: David B. Dahl
Advanced Statistical Computations Spring 2010

WRITTEN EXAMINATION

26 April 2010

Answer each question on a separate sheet of paper. Put your name and question number at the top of each sheet. You may use a basic (non-graphing) calculator.

1) {40 pts.} Consider the following integral:

$$\int_0^4 \frac{4^{(x-1)}}{(x+1)^3} dx.$$

(a) Using the composite trapezoidal rule with $M = 4$ equally-sized intervals of width $h = 1$, calculate the approximate value of this integral. Show your work.

(b) Write a function (in R or pseudo-code) to approximate this integral using Monte Carlo integration.

2) {10 pts.} In the space below, provide the binary representation of a 32-bit IEEE-754 floating point number having the decimal value 20.375. Show your work on another sheet of paper. Under the boxes, label which bits are associated with the sign, mantissa, and exponent. Put your name of this page.

3) {20 pts.}

Consider the 8×8 matrix to the right. You are tasked with testing the null hypothesis that the distribution of the ones is random versus the alternative hypothesis that the ones tend to be adjacent to each other. A pair of ones is adjacent if either: i) they are in the same row and are in adjacent columns, or ii) they are in the same column and are in adjacent rows. So the one in $(2, 3)$ is adjacent to the one in $(3, 3)$ but not the one in $(3, 2)$. Propose a nonparametric test statistic and describe how to compute its p-value.

0	1	1	0	0	0	1	0
0	0	1	0	1	0	1	1
0	1	1	0	1	0	0	0
0	0	0	0	0	0	1	1
0	0	0	0	0	1	1	0
0	1	1	0	0	1	0	0
0	0	0	0	0	1	1	1
1	0	0	0	0	0	0	0

4) {10 pts.} Write a paragraph discussing the likely uses, benefits, and weaknesses of: (i) low-level programming languages (e.g. C, C++, Fortan, Java), (ii) high-level programming languages (e.g., R, MATLAB, etc.), and (iii) scripting languages (Ruby, Python, Perl, etc.) from the perspective of a research statistician.