This is the second part of the three-part class project. The grading for the course project will be 80% correctness, 20% clarity of presentation. Be sure that you do the problems of *both* sides of this paper.

I. FIRST PROJECT, REPRISE.

1. A fair coin is randomly flipped twice. We wish to count the number of heads that appear in the two flips.

(a) Verify the five conditions that make this a binomial experiment. What are the values of n and p?

(b) Calculate $P(r)$, the probability that exactly r of the 2 flips will land heads, for all possible values of r. You *must* use the formula

$$P(r) = \binom{n}{r} p^r q^{n-r}, \qquad \text{where } q = 1 - p,$$

to find these probabilities. Show your work. (*Note:* Of course, you can check your work by comparing your answers to the values in the table in the back of the book.)

(c) Draw a histogram to geometrically display these probabilities.

(d) Find the mean and standard deviation for this distribution.

2. Repeat parts (b), (c) and (d), except for a fair coin randomly flipped three times.

3. Repeat parts (b) and (c), except for a fair coin randomly flipped four times.

4. From the first part of your project, rewrite the observed relative frequencies, sample mean, and sample standard deviation for Data Sets A and B. Compare the *theoretical* results from Problems 1 and 2 with these *experimental* results. Are the above theoretical predictions (probabilities, mean, and standard deviation) reasonably close to the experimental results (relative frequencies, sample mean, and sample standard deviation)? Why aren't the theoretical results *exactly* the same as the experimental results? Discuss these issues in five sentences or less.

Note: If you didn't correctly obtain the sample mean and/or sample standard deviation, you can use the results found in the solution set handed out in class.

II. RELATIVE FREQUENCIES FAR FROM THE MEAN.

During the 1996-97 NBA season, Dennis Rodman of the Chicago Bulls made 60% of his free throws. Assume that all of the free throws that he attempts are independent.

5. Assume that he shoots four free throws in a game. Find the probability that he makes at least three-quarters of his free throws — that is, find the probability that he makes at least three of his four free throws. Also, find the probability that he makes no more than half of his free throws. (*Note:* You will probably want to use the table in the back of the book.)

6. Repeat, except assuming that he shoots eight free throws in a game (that is, find the probability that he makes six or more, and find the probability that he makes four or less.)

7. Repeat for 12 free throws.

8. Repeat for 16 free throws.

9. Repeat for 20 free throws.

10. Comment on the behavior of these probabilities of these events — that the observed relative frequency (i.e., 75% or more, 50% or less) will be "far away" from the actual mean (i.e., 60%) — as the number of free throws increases.

III. LEAVING LAS VEGAS (COMPLETELY BROKE).

A gambler in Las Vegas plays red in roulette multiple times. The probability that the gambler wins on a given attempt is 9/19, which is slightly less than 50%. To either come out ahead or break even for the day, he must win on at least half of his attempts.

11. Assume the gambler plays 12 times. Use the normal approximation to find the probability that he wins at least 6 times. (*Note:* Don't forget to use the continuity correction to the normal approximation. Also, do *not* use a decimal approximation to 9/19.)

12. Assume the gambler plays 400 times. Use the normal approximation to find the probability that he wins at least 200 times.

13. Assume the gambler plays 4000 times. Use the normal approximation to find the probability that he wins at least 2000 times.