Due Wednesday, July 27, 2005
MATH 1012-200

Project 2

Choose one of the following three projects.

You are welcome (and in fact encouraged) to work with one or two other classmates and submit one paper with two or three names for credit.

You must type this project (nothing should be handwritten). It should be double spaced and in paragraph format. This assignment is long and involved, so do not attempt the project the day before it is due! Make sure to get an early start so that you can ask questions before it is too late.

I. (Finance) Suppose that Clark Kent has had some financial difficulty recently. He has very quickly accumulated a debt of \$2100 on his credit card. Luckily, his APR is a low rate of 13.99% and his debt is compounded monthly.

1. Find out how much Clark's monthly payment should be if he wants to pay off the entire debt in 1 year, 2 years, 5 years, and 10 years. Then find the total amount that Clark had to pay for each of these time periods. Also, find the interest paid as a dollar amount (absolute difference), and find the relative difference of the total amount paid to the initial debt. Explain these results.
2. Now assume that the minimum payment on Clark's account is \$50 per month. How long would it take to pay off the debt? What if the minimum payment was \$25 per month? \$15 per month? Also, find the interest paid as a dollar amount (absolute difference), and find the relative difference of the total amount paid to the initial debt. Explain these results. To do this part, you can use Excel (or a similar spreadsheet), trial & error (include a reasonable number of trials), or logarithms (the most accurate and generally better method).
3. (Extra Credit, 20 pts) In reality, credit card companies compound interest **daily** (those blood sucking swine!). So replace the term $\frac{\text{APR}}{n}$ (in the savings plan formula) with the monthly yield (like the annual percentage yield, but for a month, not a year) in order to give a formula we could use to more accurately compute the monthly payments.

II. (Statistics) In this project, you will apply your knowledge of statistics to a real world data set. You should use a spreadsheet to make tables and charts, but you must do all calculations yourself.

1. You first need to choose three (possibly related) data sets that are of interest to you. Each data set must have at least 30 data points. Some suggestions are:
   - www.mlb.com (You can sort baseball statistics by team. A possible data set would be Team Batting Average (AVG) or Team Earned Run Average (ERA) for each team in the 2005 season. Wins would be a good choice as one of your data sets.)
   - www.cdc.gov has many statistics related to public health.
   - www.aw.com/bennett-briggs/ has many links to data sets on the web (follow the links to Chapter 6)
   - You could do a hand poll of CU students, asking a few questions to each student. For example, "How often do you drink?" and "How many hours per week do you study?"

   You must clear your data sets with me beforehand so that I can make sure they are acceptable! Be sure to explain what type of data set you chose and cite the source for all data, as well as explain how it was gathered (if this explanation is available).
2. Make a table listing all the data from each data set. Create two different graphs or charts for each data set (A histogram, frequency chart, pie chart, etc. Use your judgment to determine the best way to represent the data.) Clearly label all parts of your graphs and charts. Are your data sets unimodal? bimodal? Are they symmetric? left or right skewed? Explain. Are your distributions normal? Explain.
3. Now make a smooth curve which approximates the shape of the distribution. Determine the mean, median, and mode for the data set and show your calculations.
4. Examine the variation of each distribution. Determine the range of each data set. Next determine the five number summary for your data. Finally, calculate the standard deviation for each data set. How well does each measure characterize the variation of your data sets?
5. (Extra Credit, 20 pts) (See section 5E) Finally, make three scatter diagrams, one comparing each of the three pairs of data sets. Is there a positive or negative correlation? Strong or weak? Explain these findings. Can you determine any causality? Explain.

III. (Probability) In this project, you will do an analysis of the game of Roulette as played in most U.S. casinos. In order to do this, you will first have to understand the rules of the game and how you can bet on the outcome.

Note that there is quite a bit of information out there regarding playing Roulette and the odds of winning. You certainly may do some research to help you better understand what is going on and to verify that your results are correct. However, this is NOT just a research project and you are expected to do the computations yourself.

Roulette has a wheel with slots for 38 numbers (1-36, 0, and 00). The wheel is spun and a ball is launched around the wheel. When the ball lands in a slot, that number is designated the winning number. In other words, a number is chosen at random from a field of 38 numbers.

A player may bet on a single number or a group of numbers. If the single number or any number in the group that the player has chosen comes up as the winner, then the player is paid. The possible bets and payoffs are indicated in the table below.

Bet	Description	Payoff
1 Number	Choose one single number by placing your chip on that number	35 to 1
2 Numbers	Choose two numbers by placing your chip on the line between two numbers	17 to 1
3 Numbers	Choose three numbers (in a single row) by placing your chip at that end of the row	11 to 1
4 Numbers	Choose four numbers (in a square) by placing your chip on the corner common to all four numbers	8 to 1
5 Numbers	Choose the five numbers 1, 2, 3, 0, 00 (only)	6 to 1
6 Numbers	Choose six numbers in two consecutive rows by placing your chip on the corner at the end of the rows	5 to 1
12 Numbers	Choose a column of 12 numbers	2 to 1
12 Numbers	Choose the first dozen (1-12), the second dozen (13-24), or the third dozen (25-36)	2 to 1
Even/Odd	Choose all 18 even numbers (excluding 0 and 00) or all 18 odd numbers	1 to 1
Red/Black	Choose all 18 red numbers or all 18 black numbers (0 and 00 are neither)	1 to 1
Low/High	Choose the first 18 numbers (1-18) or the last 18 numbers (19-36)	1 to 1

1. As a first step, determine the "best" bet and the "worst" bet to make. In other words, calculate the expected value of each bet and determine which has the highest expected value and which the lowest. (Hint: There may not be a single "best" or "worst" bet, more than one may have the highest or lowest expected value.)
2. How would the payoff odds have to be changed to make all of the bets have the same expected value? (Make a change that results in the smallest amount of work possible.)
3. In some European casinos, there is only 1 zero (rather than both 0 and 00) on the wheel making a total of 37 numbers on the wheel. However, the payoffs remain the same for all of the above bets, except there is no longer a 5 number bet. What is the expected value of each bet in this case?
4. What would happen to the expected values if both 0 and 00 were eliminated from the wheel making a total 36 numbers possible and all the payoffs remain the same (except for the 5 number bet that no longer would exist)? Why would a casino never allow that?
5. Lastly, consider a different (but somewhat similar game) found in many casinos, often called the "Wheel of Fortune". This game has a big wheel with 54 slots. Each slot is marked with either a \$1, \$2, \$5, \$10, or a \$20 bill, or a casino logo. To bet, you choose any one of those 6 distinct outcomes.

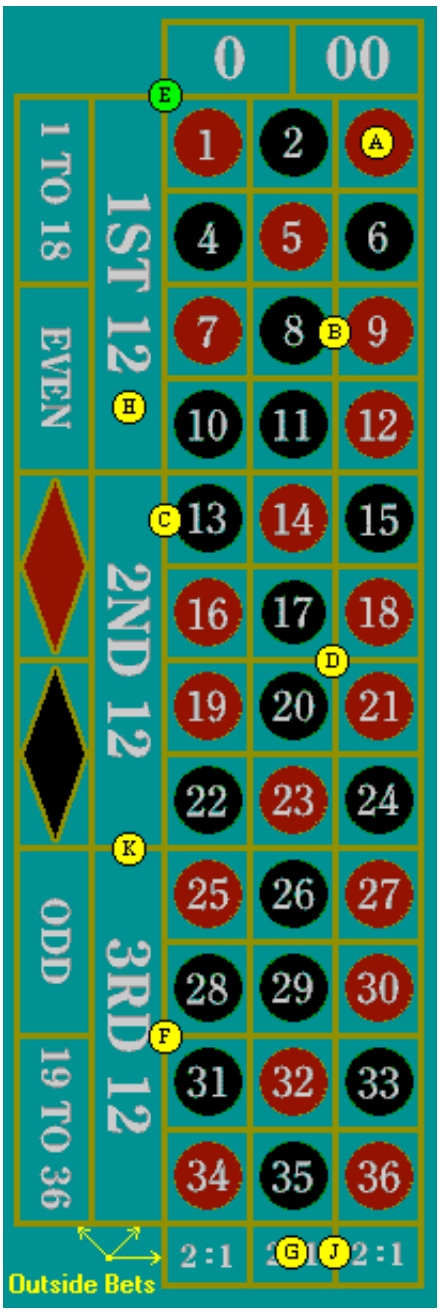
   If the distribution of outcomes and the payoff odds for the "Wheel of Fortune" are as indicated in the table below, explain (using quantitative evidence) which bets are the "best" and which are the "worst" for the player (assuming the player is in the business of winning money). Also, comment on whether you would follow this betting advice when you played this game. Why or why not?

Outcome	Number of slots on the wheel	Payoff
\$1	24	1 to 1
\$2	16	2 to 1
\$5	7	5 to 1
\$10	4	10 to 1
\$20	2	20 to 1
Casino Logo	1	40 to 1

   Note that payoffs and distribution of outcomes can vary depending on the casino. This is just one possible example.

The possible bets in Roulette:

Roulette table layout, bets, odds and payoffs:



Inside bets: (also called layout bets)

A - 1 number, Straight up 35:1

B - 2 numbers, Split 17:1

C - 3 numbers, 3 Line 11:1

D - 4 numbers, Corner 8:1

E - 5 numbers, 1st Five 6:1 (double zero roulette table)

*** E** - 4 numbers, 1st Four 8:1 (single zero roulette table - not shown)

F - 6 numbers, 6 Line 5:1

Outside bets:

G - 12 numbers, Column 2:1

H - 12 numbers, Dozen 2:1

J - 24 numbers, Split Columns 1:2
(Allowed in UK casinos. Some casinos may not allow it.)

K - 24 numbers, Split Dozens 1:2
(Allowed in UK casinos. Some casinos may not allow it.)

Even/Odd - Pays even money 1:1

Red/Black - Pays even money 1:1

1-18/19-36 (also called Low/High) - Pays even money 1:1

(Taken from http://www.ildado.com/roulette_table_layout.html)