Final Project

Due: December 11, 2017

Directions: Choose one project from the list below. Your write-up should include all calculations/graphs/tables/images that you used or made.

(1) **Gambling/Probability**: The information for all current Connecticut scratch tickets are posted on the CT Lottery website: https://www.ctlottery.org/Modules/Scratch/scratch-table.aspx. For each part below, use the "Total Prizes" column.
   (a) Choose a $1, $3, $5, $10, $20, and $30 scratch ticket from the list on the website (in other words, you should choose a total of six scratch tickets; one scratch ticket for each dollar amount given above).
   (b) For each scratch ticket, determine the number of tickets in which you do not win a prize.
   (c) For each scratch ticket, calculate the probability of buying one ticket and winning **any** prize.
   (d) Calculate the expected value for each scratch ticket.
   (e) Based on what you found in Parts (a)-(d), if you had to purchase a scratch ticket which scratch ticket would you buy and why?

(2) **Voting Methods**: There are many other types of ballots used in real-life elections, ranging from the simple (winner only) to the exotic (each voter has a fixed number of points to divide among the candidates any way he or she sees fit).
   (a) Research other types of ballots; how, where, and when they are used; and what are the arguments for and against their use.
   (b) Based on your research in Part (a) and what you learned in class, decide on a type of ballot and voting method you would choose to have for the presidential election. Make sure to explain your choices.

(3) **Traveling Salesman Problem:** For this project you will solve the TSP of visiting certain WCSU buildings. The WCSU campus map can be found here: http://www.wcsu.edu/campustour/
   (a) Create a graph from the campus map (like those we used in all of the TSP problems), where the nodes are the buildings listed below and the edges are the distance between each building. To do this, follow these steps:
      i. Draw the K6 graph (I suggest drawing it large to make labeling easier). You can choose to draw either the standard K6 graph shown in Example 2 (top of Pg. 195) or the modified K6 graph shown in Problem 38 (Pg. 218).
      ii. The nodes on your graph will be the following six buildings: Ives Concert Hall, Haas Library, Higgins Hall, Berkshire Hall, Science Building, and Litchfield Hall.
      iii. Use Google Maps to calculate the walking distance between each pair of buildings.
      iv. Fill in these distances on the edges of your graph.
   (b) Find the *repetitive nearest-neighbor* tour.

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(4) **Music & Math**: The idea of this project is to roughly go through an example of the analog to digital conversion process that your computer performs when recording audio. Suppose you want to digitally convert a pure tone with amplitude 40dB and frequency 5Hz.
   (a) Right down the sine function that mathematically represents this pure tone.
   (b) Plot the function found in Part (a) over a 2 second interval. You can do this either by hand or by using wolframalpha.com. [If you choose to use Wolframalpha then type in the box: "plot (insert function here), t=0..2"]
   (c) Suppose that you want to record this pure tone for 2 seconds with a sampling rate of f_s = 32 samples/second.
   (d) The first column in excel will represent the time at which each sample is recorded. In order to create this column:
      i. Click the box A1. Type the following into the formula bar (recall that $1/f_s$ is just the time between each sample):
      $$= (Row(A1) - 1) * (1/f_s) = (Row(A1) - 1) * (1/32)$$
      ii. Drag the box A1 down 64 rows. **Why 64 rows?**
   (e) The second column will represent the actual samples values of the pure tone.
      i. Click the box B1. Type the following function into the formula bar: =40*sin(2*3.14159*5*A1)
      ii. Drag the box B1 down 64 rows.
      iii. You should now have two columns each with 64 rows. The first column are the times at which each sample is recorded and the second column are the actual sample values of the pure tone.
   (f) Plot your data. To do this, highlight both columns of data, click insert at the top, click charts, and then choose "Scatter with Lines". For more detailed instructions, see: https://support.office.com/en-us/article/Present-your-data-in-a-scatter-chart-or-a-line-chart-4570a80f-599a-4d6b-a155-104a9018b86e or YouTube has many instructional videos.
   (g) Explain the plot of your sound data. Compare this plot to the original plot of the function you found in Part (b). Do you think this is a good or bad representation of the pure tone? What could you have done to improve your digital signal?

(5) **Population Modeling**: When covering this chapter in class we skipped the last section on Logistic Growth Modeling.
   (a) Read through this section (Section 9.4 Pg. 308).
   (b) Explain in your own words what logistic growth modeling is and why it is important.
   (c) Complete exercises 53, 54, and 64.

(6) **Population Modeling**: How do demographers model world population? Is this different from how they model, say, the population of the United States? How does this process compare with that used by biologists in determining the size of a future salmon spawn? Compare and contrast the process demographers use to model human population growth with that which biologists use to model animal populations.