Cognitive Science 14
Homework Set 2 Questions

1. Suppose that a discrete random variable can take on only the values 1,2,3,4, and 5. The rule giving the probability for each of these values is:

$$p(x) = \begin{cases} \frac{x^2}{55} & \text{if } x = 1, 2, 3, 4, 5 \\ 0 & \text{else} \end{cases}$$

   (a) Plot the probability mass function (distribution function).
   (b) Determine the probability the variables takes on a value of 2, 3, or 4?
   (c) Determine the probability the variable takes on a value greater than 3.5?
   (d) Determine the probability the variable takes on some value?
   (e) If 110 samples of the variable were taken, on average how many would be 3's?

2. A theoretical random vairable is generated by flipping a fair coin three times. The value of the variable is the number of heads in three flips. What values can this variable take on, and what is the probability of each ..... i.e., determine its distribution function.

3. Compute the mean of the random variable defined in Problem 1.

4. Compute the mean of the random variable defined in Problem 2.

5. Compute the standard deviation of the random variable in Problem 1.

6. Compute the standard deviation of the random variable in Problem 2.

7. In a test of possible side effects of a new medication, a physician matched 20 pairs of persons on their physical characteristics. One member of each pair was given the medicine, and the pairmate was given a placebo. A success was recorded when the member receiving the medication showed more of the side effect than the pairmate, and a failure was recorded otherwise. There were 13 successes and 7 failures. If medication and placebo were equal in their tendency to produce the effect, how likely is a result this deviate or more deviant from what one would expect?

8. In a certain lottery, 40% of the tickets were purchased by men, and 60% by women. Each person purchased only one ticket. Ten tickets were drawn at random and with replacement. Determine the probability that

   (a) Four or more winners were women.
   (b) Two or fewer winners were women.
   (c) The winners were all the same sex.
   (d) Exactly four men and six women were winners.

9. A public health officer in a certain area suspects that 20% of children in that area are severely undernourished. When a sample of 20 children is taken at random, it is found that nine show severe malnutrition. Determine the probability on nine or more such children in the sample if the true proportion in the population is 20 %. What would the officer conclude?

10. In a developemental experiment, researchers were interested in whether newborn babies can already discriminate between colors. To test this, they presented newborns with a green and red patch adjacent to each other, and measured the baby's preference to look at one or the other. The red patch appears on the right side for half the subjects, and on the left for the other half. If a baby looked more at the red it was counted as a 1 and if it looked more at green as a 0. The two patches were matched in luminosity, only differing in their color. If babies can not see color then they should have equal chance at looking at either patch. Twenty babies were tested, N=20, and 15 preferred red. What is the probability we would get a result this deviant or more deviant from the expected value if babies could not tell? Do we have enough evidence to reject the idea babies can not tell the difference (two-sided test)?

11. Using the same information from the baby study, assume that researchers were instead interested in the directional hypothesis that babies have an instinct to prefer red over green. What is the chance we would get a value this far deviant in favor of red if babies did not prefer either? Do we have enough evidence to reject the idea that babies don't prefer either and instead favor red (one-sided test)?