Stat 280 Self-test Oct 1, 2001

1. At a rifle range, the shooter usually hits the bulls-eye only 5% of the time. In one target practice, 20 shots are fired. For parts a)-c) below, it is not necessary to simplify your solution. The questions relate to one practice set of 20 shots.

a) What is the chance that the first bullseye occurs on the 5^{th} shot?
b) What is the chance that the second bullseye occurs on the 20^{th} shot?
c) What is the chance that two bulls-eyes are obtained in these 20 shots?
d) Name the probability models for each of parts a)-c)

A1. a) (.95^4)*.05 (Geometric)
b) 19C1 ((.05)^2)*((.95)^18) (Negative Binomial)
c) 20C2 ((.05)^2)*((.95)^18) (Binomial)

2. At an election site, officials check the 1000 ballots cast to make sure they are valid and to count the votes for each of five candidates. It is expected from past experience that about one percent of the ballots will be spoiled.
a) Write an expression for the numerical value of a Poisson probability that more than 13 ballots will be spoiled.
b) Guess the numerical value for part a)
c) How many ballots would you likely have to count between spoiled ballots?

A2.
a) 1% of 1000 is 10, the mean of the Poisson. Expression should be the sum over k from 14 to infinity of exp(-10) (10^k)/k!

b) The SD of this Poisson is 10^(.5) = 3.2 so 14 is a bit larger than 1 SD above the mean. A bit less than 16% would be a good guess, say 15%. (It is actually 13.6%) To use this SD trick, you have to know that the Poisson for m=10 looks like a normal distribution.

c) The number had a geometric distribution (less 1) with parameter .05. The mean and SD
of this geometric is 20 and 19.5, but the distribution is very right skewed, so between about 15 and 50 ballots would be usual.

3. A game show asks you to select from a bin a random sample of 12 coloured balls. There are four different colours of balls: red, blue, yellow and green and each colour occurs with the same large frequency in the bin. You win a money prize equal to the product of the number of balls drawn in each category. For example, if you draw 1 red, 4 blue, 5 yellow and 2 green, you win 1x4x5x2 = $40. How would you figure out the mean and standard deviation of the possible winnings from this game?

A3. Simulation of the multinomial distribution (using a MINITAB macro, for example).

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