Stat 134: Section 6

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Problem 1

A cereal company advertises a prize in every box of its cereal. In fact, only about 95% of their boxes have prizes in them. If a family buys one box of this cereal every week for a year, estimate the chance that they will collect more than 45 prizes. What assumptions are you making?
Ex 2.4.9 in Pitman's Probability

Problem 2: Fisher's Exact Test

Suppose I am interested in determining whether or not taking a drug might cause a harmful side effect in its users. I sample 200 patients, and note whether they took the drug and whether they experienced the side effect. (The results are displayed below). Assuming there is no causal relationship, what is the chance that at least 16 of the 52 patients taking the drug experienced the side effect due to chance/random assortment?

	Side effect	No side effect
Taking drug	16	36
Not taking drug	25	123

Problem 3

Twelve cards are drawn from a well-shuffled deck of 52 cards. What is the probability the 12 cards contain:

a. 4 aces;

b. 4 aces and 4 kings;

c. exactly 2 sets of four of a kind.

Adapted from 2.rev.16 in Pitman's Probability

Problem 4: The Multinomial Distribution

A natural extension to the binomial, the **multinomial** distribution arises when there are multiple possible outcomes in a series of i.i.d. trials. (E.g., the distribution of counts of students' majors in a discussion section at a large school.) Suppose that we have m possible classes/outcomes, where each individual is of a class i with probability p_i (where $p_i \geq 0$ for all i, and $\sum_{i=1}^{m} p_i = 1$). Let N_i represent the number of individuals of class i in a sample of size n. Using what we know about the binomial distribution and appropriate conditioning, show that:

$$P(N_1 = n_1, N_2 = n_2, \ldots, N_m = n_m) = \frac{n!}{n_1! n_2! \ldots n_m!} p_1^{n_1} p_2^{n_2} \ldots p_m^{n_m}$$

Prepared by Brian Thorsen