## Multinomial Problems – from Chapter 5, pp. 282-3 of Wackerly, *et al.*

**5.119** A learning experiment requires a rat to run a maze (a network of pathways) until it locates one of three possible exits. Exit 1 presents a reward of food, but exits 2 and 3 do not. (If the rat eventually selects exit 1 almost every time, learning may have taken place.) Let $Y_i$ denote number of times exit $i$ is chosen in successive runnings. For the following, assume that the rat chooses an exit at random on each run.

**a.** Find the probability that $n = 6$ runs result in $Y_1 = 3$, $Y_2 = 1$, and $Y_3 = 2$.

**b.** For general $n$, find $E(Y_1)$ and $V(Y_1)$.

**c.** Find $Cov(Y_2, Y_3)$ for general $n$.

**d.** To check for the rat's preference between exits 2 and 3, we may look at $Y_2 - Y_3$. Find $E(Y_2 - Y_3)$ and $V(Y_2 - Y_3)$ for general $n$.

**5.122** The weights of a population of mice fed on a certain diet since birth are assumed to be normally distributed with $\mu = 100$ and $\sigma = 20$ (measurement in grams). Suppose that a random sample of $n = 4$ mice is taken from this population. Find the probability that

**a.** exactly two weigh between 80 and 100 grams and exactly one weighs more than 100 grams.

**b.** all four mice weigh more than 100 grams.

**5.126** A large lot of manufactured items contains 10% with exactly one defect, 5% with more than one defect, and the remainder with no defects. Ten items are randomly selected from this lot for sale. If $Y_1$ denotes the number of items with one defect and $Y_2$, the number with more than one defect, the repair costs are $Y_1 + 3Y_2$. Find the mean and variance of the repair costs.