Math 302 Section 101– First Midterm – October 13, 2010

1. (*10 points*) The probability that an apparently healthy individual from a certain population has Ross's Disease is 1/100. The screening test for Ross's Disease gives a positive result with probability 96/100 for any person who has the disease, and with probability 8/100 for any person who doesn't have the disease. An apparently healthy individual from the population is tested, and the test result is positive. What is the probability that this person has the disease?

2. (*12 points*) An urn contains three red balls (with numbers 1, 2, and 3), two green balls (with numbers 1 and 2), and one yellow ball (with number 1). Two balls are removed randomly, without replacement. Find

(a) The probability that the two balls have the same colour.

(b) The conditional probability that the two balls have the same number, given that they have different colours.

3. (*9 points*) A and B are events such that $P(A) = \frac{1}{3}$ and $P(B) = \frac{1}{2}$. Find $P(A \cup B)$ under each of the following assumptions:

(a) A and B are mutually exclusive

(b) $P(A|B) = \frac{1}{4}$.

4. (*8 points*) If the letters of "MOOSOMIN" are arranged in random order, what is the probability that both M's come before the first O? *Hint:* we don't care where the S, I and N are.

5. (*11 points*) Suppose that we have three events A, B, and C, all with nonzero probabilities, that are pairwise independent (i.e. A and B are independent, A and C are independent, and B and C are independent), but the intersection of any two is a subset of the third (i.e. $A \cap B \subset C$, $A \cap C \subset B$, $B \cap C \subset A$).

(a) Show that $P(A) = P(B) = P(C)$. *Hint:* express $P(A \cap B \cap C)$ in three different ways.

(b) Express $P(A \cup B \cup C)$ in terms of $P(A)$. *Hint:* inclusion-exclusion.