Name: _____   **Instructor:** David Galvin

Math 20340: Statistics for Life Sciences
Fall 2009
Mid-semester Exam 1
Wednesday, September 23

This examination contains 7 problems on 8 pages (including the front cover). It is closed-book. You may use a calculator, up to 4 pages of hand-written notes, and the binomial and Poisson tables provided. **Show all your work** on the paper provided. The honor code is in effect for this examination.

Scores

Question	Score	Out of
1		10
2		10
3		10
4		10
5		10
6		10
7		10
Total		70

GOOD LUCK !!!

1. Nine busses stop outside my house. Three — the L7, L11 and L20 — are local, and six — the X3, X8, X13, X15, X17 and X18 — are express. The L20, X3 and X8 stop at the south end of my local mall, and the rest stop at the north end. At a particular moment, the next bus to arrive is equally likely to be any of the nine. I am interested in three events:

- A: the next bus is local
- B: the next bus is express
- C: the next bus stops at the south end of the mall.

1. Compute the probabilities of A, B and C.

2. Are the events A and B independent?

3. Are the events A and C independent?

4. Write down a pair of events (from among A, B and C) that are mutually exclusive.

2. I have 800 facebook friends, all of whom know that I will soon be taking part in a charity race. Exactly 200 of them have (unknown to me) decided that they will sponsor me if asked. I chose 12 facebook friends at random, and ask each of them if they will sponsor me. Let x be the number who say yes.

    1. What are the possible values for x?

    2. Compute the probability that x is between 2 and 5, inclusive. [The provided tables may be useful here.]

    3. Write down the expectation and variance of x.

3. Five runners, Adam, Beth, Charlie, Dana and Eric, take part in a running race. The runners are equally matched, so all finishing orders are equally likely. There are no ties. Prizes are given to the first two finishers.

1. How many possible finishing orders are there?

2. How many finishing orders are there in which neither Adam nor Beth get a prize?

3. What is the probability that neither Adam nor Beth get a prize?

4. 70% of the football team's plays are passing plays, and 30% are running plays. 30% of all passing plays result in a gain of 5 or more yards, and 50% of running plays do.

1. What is the probability that a play is BOTH a passing play AND a play that gains 5 or more yards? [You might find a tree diagram helpful here.]

2. What is the probability that a play gains 5 or more yards?

3. You missed the last play because you were buying a hot dog, but you see on the scoreboard that it gained 5 or more yards. What is the probability that it was a passing play?

5. When I perform a certain experiment in the lab to produce dihydrogen monoxide, I know from past experience that

- 10% of the time, the experiment yields nothing;
- 20% of the time, the experiment yields 1ml of dihydrogen monoxide;
- 40% of the time, the experiment yields 2ml;
- 20% of the time, the experiment yields 3ml; and
- 10% of the time, the experiment yields 4ml.

Let x be the amount of dihydrogen monoxide produced by a random experiment.

1. Compute the expectation of x.

2. Compute the variance of x.

3. For the experiment to be successful, I need at least 2.5ml of dihydrogen monoxide to be produced. What is the probability that the experiment is successful?

6. 9 women and 10 men are in a jury pool, from which a jury of 12 has to be selected. [For this question, you may leave all your answers in terms of symbols like $n!$, C_r^n and P_r^n.]

  1. How many juries can possibly be formed?

  2. How many juries can be formed that include exactly 6 women and 6 men?

  3. What is the probability that a randomly chosen jury includes exactly 6 women and 6 men?

7. A recent investigation showed that South Bend city water contains on average one giardia bacterium per 50ml. A random sample of 1 litre (1000ml) is tested. Let x be the number of giardia bacteria found in the sample. Use a Poisson distribution to model x.

    1. What value should you take for μ (using *liters* as the unit)?

    2. What is the probability that the sample has between 15 and 25 giardia bacteria?

    3. I have a suspicion that the presented sample is not in fact from South Bend. If the sample is found to contain 10 giardia bacteria, does this validate my suspicion?