Masters Theory I
Homework #1

Out: Thursday
Due / Quiz following Thursday

1. (Deb Glueck's problem from BIOS 160, UNC-Chapel Hill, 1989):
A population of 300 males is cross-classified based on the presence of absence of the following 3 factors:

   - HIV carrier (C) or not (C^C).
   - Haitian (H) or not (H^C).
   - IV drug user (D) or not (D^C).

   The data appear in tabular form below:

   Haitian men ($N = 200$)

	D	D^C
C	100	10
C^C	50	40

   Non-Haitian men ($N = 100$)

	D	D^C
C	40	10
C^C	20	30

   Using these tabulated data, find the exact numerical values for the following probabilities:

   (a) $Pr(C|H \cap D)$
   (b) $Pr(C \cup D|H)$
   (c) $Pr(H|C^C)$
   (d) $Pr((C \cap H)^C|D)$
   (e) $Pr(C \cup D \cup H)$
   (f) $Pr(C \cup (D \cap H))$

2. (Deb Glueck's problem from BIOS 160, UNC-Chapel Hill, 1989):
Mice used for laboratory studies on cancer are typically specially bred to be highly susceptible to particular types of cancer. Suppose that three quarters of all mice from a particular hybrid strain are highly susceptible to bladder cancer. A cancer researcher who needs such highly susceptible mice for his laboratory experiements is interested in ordering a batch of such bladder cancer-susceptible mice from a certain breeding facility. You can assume that this breeding facility fills any such order with mice chosen randomly from its entire stock of this hybrid strain, so that each mouse in any specific order has $\frac{3}{4}$ of being highly susceptible to bladder cancer.

   (a) What is the smallest number of mice that the cancer researcher should order if he wishes to be at least 98% sure of getting at least one highly susceptible mouse?

   (b) A particular cancer experiment requires at least two highly susceptible mice. What is the probability than an order of 10 mice from the breeding facility will suffice?

(c) Suppose that a particular batch of 7 mice actually contains exactly 3 highly susceptible ones. If the cancer researcher chooses three mice at random from this batch for a particular experiement, what is the probability that at least two of the three mice chosen will be highly susceptible ones?

(d) Suppose that the probability of developing bladder cancer for highly susceptible mice is 0.15, as opposed to 0.05 for non-highly susceptible mice. Under the conditions of part (c) if two of the three mice chosen for the experiement develop bladder cancer, what is the probability that exactly one of the three mice chosen was a highly susceptible one?

- C&B 1.2a (Notation: $A \setminus B$ is $x \in A$ and $x \notin B$.) Make a Venn Diagram as well.
- C&B 1.3 Make a Venn Diagram of these as well.
- C&B 1.6
- C&B 1.10 (Use a proof by induction and results from problem 1.3)
- C&B 1.11
- C&B 1.33
- C&B 1.34
- C&B 1.37

Review problems (won't be on quiz, but could be on exam)

- C&B 1.23
- C&B 1.38
- C&B 1.39