HW 11 Due : Friday, Nov. 8

(1) (30 pts) Sec 12.2 Problem 32
Suppose that one parent is of genotype AA and the other is of genotype Aa. What is the probability that their offspring is of genotype AA? (Assume Mendels first law.)
Solution: The possible outcomes of a cross between AA and Aa are $\Omega = \{AA, Aa, AA, Aa\}$. All outcomes are equally probable. So the probability that their offspring is of genotype AA is $\frac{2}{4} = 0.5$

(2) (30 pts) Sec 12.2 Problem 36
If a woman with normal vision who carries the color blindness gene on one of her X chromosomes has a child with a man who has normal vision, what is the probability that their child will be color blind?
Solution: Let the woman's chromosomes be represented by $X1f$ and $X2f$. Let the man's chromosomes be represented by $X1m$ and $X2m$. The possible outcomes of the chromosomes of their son are $\Omega = \{X1fX1m, X1fX2m, X2fX1m, X2fX2m\}$. All outcomes are equally probable. The son because he is male will be color blind in case 1 and case 2 (X1fX1m ,X1fX2m. A male is color blind if he carries the gene on his X only chromosome). So the probability that their child will be color blind is $\frac{2}{4} = 0.5$.

(3) (40 pts) Sec 12.3 Problem 16
A screening test for a disease shows a positive result in 92% of all cases when the disease is actually present and in 7% of all cases when it is not. Assume that the prevalence of the disease is 1 in 600. If the test is administered to a randomly chosen individual, what is the probability that the result is positive?
Solution: Let A be the event that the test is positive, B_1 be the event that a person is infected and B_2 be the event that a person is not infected. From the condition that the prevalence of the disease is 1 in 600, we have $P(B_1) = \frac{1}{600}$ and $P(B_2) = 1 - P(B_1) = 1 - \frac{1}{600} = \frac{599}{600}$. From the condition that a positive result in 92% of all cases when the disease is actually present , we have $P(A|B_1) = \frac{92}{100}$. From the condition that a positive result in 7% of all cases when the disease is not present , we have $P(A|B_2) = \frac{7}{100}$. Since B_1 and B_2 is a partition, we have $P(A) = P(A|B_1)P(B_1) + P(A|B_2)P(B_2) = \frac{92}{100} \cdot \frac{1}{600} + \frac{7}{100} \cdot \frac{599}{600} = \frac{92+7\cdot 599}{60000} = \frac{4285}{60000} \cong 0.07141666666$. So the probability that the result is positive is about 0.07141666666.