BIO 300 ASSIGNMENT #2

NOTE: This assignment is due Friday October 1st

1. A medical researcher tested the effects of a new antibiotic on bacterial counts in tissue cultures. Twenty randomly selected cultures were placed in vials and infected with a low quantity of bacterial cells. Of these twenty, 10 were randomly selected and given a dose of antibiotic (A). The other 10 were given a similar quantity of distilled water (-). On completion of the experiment, full bacterial counts were made in each vial. The following results were recorded. Summarize these data succinctly in a frequency table. (That's all; you don't need to test anything.)

Culture #	Treatment	Bacterial count
1	-	5
2	-	1011
3	-	2971
4	-	10
5	-	1536
6	-	7015
7	-	2998
8	-	4118
9	-	8990
10	-	2592
11	A	15
12	A	0
13	A	1530
14	A	7
15	A	1
16	A	2
17	A	4885
18	A	0
19	A	12
20	A	2

2. Many people of all ages suffer the debilitating effects of arthritis. Researchers compared the effectiveness of gelatin (derived from animal collagen and used in foods as Knox's gelatin) in preventing these effects was compared with that of a standard drug Celebrex. Each of 19 randomly-chosen patients was given both substances (without knowing which was which) and asked to rate their preference. Of the 19 patients, 15 preferred gelatin and 4 preferred Celebrex.

   (a) With these data, determine whether patients preferring the two treatments are equally frequent in the population. Provide an exact *P*-value for your test. (*Here and forever after, report clearly the null and alternate hypotheses, the P-value, and your decision)*.
   (b) Estimate the proportion of patients preferring gelatin in the population. Provide a standard error for your estimate.

3. The sex ratio of newborn human infants is not exactly 1:1, but is slightly biased in favour of females, such that 95 males are born for every 110 females. If four infants are chosen randomly, what is the probability that

   (a) 2 are male and 2 are female?
   (b) at least one is a male?
   (c) all 4 are the same sex?

4. Answer **briefly:**

   (a) Explain in words the difference between parameter and statistic.
   (b) What does it mean for a statistic to be biased? Provide an example of a biased estimate of the parameter σ^2. Provide an example of an unbiased estimate of σ^2.
   (c) Define random sample.
   (d) A wildlife manager wished to determine the relative frequency of individuals in different age classes of deer in British Columbia. All accidental highway kills were used as sample. Would you expect this to be a random sample? Why or why not?
   (e) Define significance level.
   (f) Define Type I and Type II errors.
   (g) If an experimenter set $\alpha = 0.05$ for a given statistical test, what is the probability of committing a Type I error? Can you calculate the probability of committing a Type II error?
   (h) For a sample of a given size, if you reduce α (e.g. from 0.05 to 0.01) how does the probability of committing a Type II error change?
   (i) What is the difference between independent events and mutually exclusive events? Illustrate using a coin flipping example.

5. In a human population, the fraction of individuals that are carriers of a genetic disorder named "X" is known to be 0.015. If a person is a carrier, he or she will test positive for it in a clinical test, with probability 0.95 (*i.e.* the clinical test is not perfect). Unfortunately, a person **not** carrying the disorder may also test positive for it, with probability 0.07.

   (a) What is the probability that a randomly chosen person from the population will both have the disorder and test positive for it?
   (b) What is the probability that a randomly chosen person from the population will test positive for the disorder?
   (c) Are the events “person carries the disorder” and “person tests positive” independent events? Show how you decided this.
   (d) Among those people that test positive, what fraction actually have the disorder?