BIO 300 ASSIGNMENT #5

NOTE: This assignment is due Friday, October 22nd.

1. A normally-distributed population of fishes has a mean length of 115 cm and a standard deviation of 22 cm. Calculate the probability that a randomly chosen fish would be found in the following length intervals:

   a) $X < 90$ cm
   b) $X > 70$ cm
   c) 75 cm $< X < 95$ cm
   d) 85 cm $< X < 122$ cm
   e) $X < 92$ cm or $X > 130$ cm
   f) $X < 92$ cm and $X > 130$ cm

   If a random sample of 20 fish were taken from this population, what is the probability that the sample mean, $\overline{X}$, would be:

   g) < 106 cm
   h) > 119 cm

2. Answer briefly:

   a) Outline the steps you would take to assess whether a variable has a normal distribution in a population, based on a random sample from that population.
   b) State the central limit theorem and give an example of its use.

3. In a study of mutation and its consequences, researchers propagated a random sample of 8 lines taken from a clone of the RNA bacteriophage Φ6 carrying one new deleterious mutation. After 100 generations of propagation, the researchers measured the fitness of each of the 8 lines relative to the baseline (starting) population. Fitness was measured in log units, such that a value greater than zero represents an increase in fitness over the baseline, whereas a negative number represents a decrease in fitness relative to baseline. Fitness measurements after 100 generations were as follows: 0.35, 0.21, 0.13, 0.32, 0.26, − 0.01, -0.15, 0.18.

   a) With these data, test whether the mean fitness of bacteriophage lines changed over 100 generations.
   b) Provide a 95% confidence interval for mean fitness after 100 generations.
   c) What assumptions are you making in (a) and (b)?

4. A study of anorexia examined weight change, in lbs, in young female patients randomly assigned to two treatment groups listed below. The change in weight was recorded for each patient as her weight at the end of the study minus her weight at the start. Results are summarized below.

Treatment	N	Sample mean weight change	Sample variance	Sample median weight change
Cognitive Behaviour Therapy	27	4.01	53.41	1.40
Control	25	-1.45	63.82	-0.35

   a) For each treatment group test whether a significant change in mean weight took place over the course of the study.
   b) Calculate a 95% confidence interval for mean weight change in each treatment group.
   c) Provide an interpretation of the 95% confidence interval.
   d) What assumption(s) are you making in (a) and (b)?

5. A recent survey of mitochondrial DNA variation in smelts of Lake Utopia revealed that two haplotypes (genotypes) were present. Forty percent of individual fish in the population were haplotype A. The remaining 60 percent were haplotype B. If an experimenter were to sample 400 fish from this population, what is the probability that:

   a) at least 170 are haplotype A?
   b) at least 250 are haplotype B?
   c) between 155 and 165 (inclusive) are haplotype A?