Evolutionary Statistics

Name: _____

Objective-Convert a data set from a table of numbers that reflect a change in the genetic makeup of a population over time and to apply mathematical methods and conceptual understandings to investigate the cause(s) and effect(s) of this change.

Until approximately 1850, the most common form of Peppered moth in the Manchester area was the light, recessive color. Dark form of Peppered moths was considered rare. After 1850, the number of dark moths greatly increased, while the light form of the moth became increasingly rare. As the Industrial Revolution progressed through this time period, more and more dark soot coated trees and buildings.

In 1954, an ecologist, H. B. D. Kettlewell set out to determine what had caused the drastic change in peppered moth (*Biston betularia*) populations in England. He found a location with dark, soot colored trees. He released a total of 450 peppered moths in one location, with equal numbers of each color. Before the next generation, 76% of the population were dark moths.

1. **Perform** a chi-square test on the data.
   Specify the null hypothesis (H_o) that you are testing

   H_o=

   and **enter** the values from your calculations in the table below.

Moth Color	Observed (o)	Expected (e)	$(o-e)^2/e$
Light			
Dark			
Total			

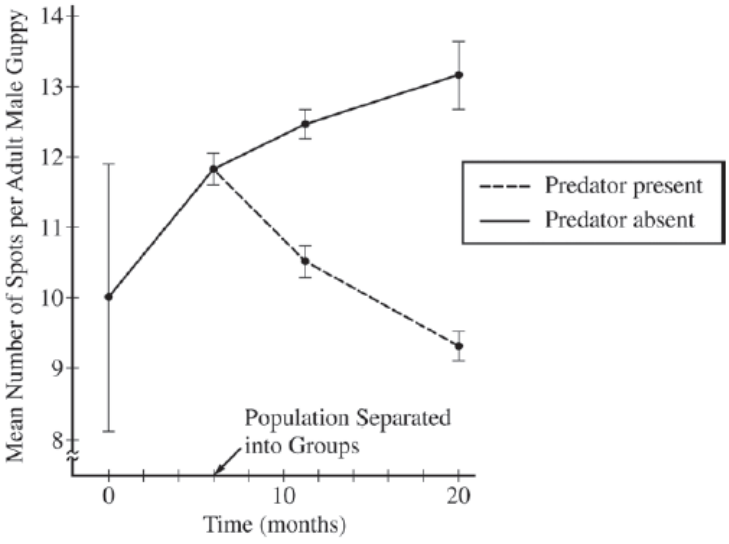
2. **Explain** whether or not your hypothesis is supported by the chi-square test and **justify** your explanation.

3. **Identify** the pattern of selection that occurred in the original peppered moth population after 1850 and **explain** a specific evolutionary mechanism that could have caused this change.

4. **Predict** how peppered moth population would change after clean air regulations were passed.

Objective -Evaluate evidence provided by data to qualitatively and/or quantitatively investigate the role of natural selection in evolution.

Adult male guppies (Poecilia reticulata) exhibit genetically determined spots, while juvenile and adult female guppies lack spots. In a study of selection, male and female guppies from genetically diverse populations were collected from different mountain streams and placed together in an isolated environment containing no predators.
The study population was maintained for several generations in the isolated area before being separated into two groups. One group was moved to an artificial pond containing a fish predator, while a second group was moved to an artificial pond containing no predators. The two groups went through several generations in their new environments. At different times during the experiment, the mean number of spots per adult male guppy was determined as shown in the figure below. Vertical bars in the figure represent two standard errors of the mean (SEM).



1. **Describe** the change in genetic variation in the population between 0 and 6 months and provide reasoning for your description based on the means and SEM.

2. **Propose** ONE type of mating behavior that could have resulted in the observed change in the number of spots per adult male guppy between 6 and 20 months in the absence of the predator.

3. **Propose** an evolutionary mechanism that explains the change in average number of spots between 6 and 20 months in the presence of the predator.

Objective - Use data from mathematical models based on the Hardy-Weinberg equilibrium to analyze genetic drift and effects of selection in the evolution of specific populations.

In a certain population of snakes, being poisonous (P) is dominant over not being poisonous (p). You count 200 snakes, and 8 are not poisonous. Assume the population is at Hardy-Weinberg equilibrium.

1. **Describe** at least three conditions that are necessary for a population or allele to be in Hardy-Weinberg equilibrium.

2. What are the frequencies of the dominant and recessive allele in the population?