STATISTICS
SECTION II
Part A
Questions 1-5
Spend about 65 minutes on this part of the exam.
Percent of Section II score—75

Directions: Show all your work. Indicate clearly the methods you use, because you will be scored on the correctness of your methods as well as on the accuracy and completeness of your results and explanations.

1. Agricultural experts are trying to develop a bird deterrent to reduce costly damage to crops in the United States. An experiment is to be conducted using garlic oil to study its effectiveness as a nontoxic, environmentally safe bird repellant. The experiment will use European starlings, a bird species that causes considerable damage annually to the corn crop in the United States. Food granules made from corn are to be infused with garlic oil in each of five concentrations of garlic —0 percent, 2 percent, 10 percent, 25 percent, and 50 percent. The researchers will determine the adverse reaction of the birds to the repellant by measuring the number of food granules consumed during a two-hour period following overnight food deprivation. There are forty birds available for the experiment, and the researchers will use eight birds for each concentration of garlic. Each bird will be kept in a separate cage and provided with the same number of food granules.

   (a) For the experiment, identify

       i. the treatments
       ii. the experimental units
       iii. the response that will be measured

   (b) After performing the experiment, the researchers recorded the data shown in the table below.

Garlic oil concentration	0%	2%	10%	25%	50%
Mean number of food granules consumed	58	48	29	24	20
Number of birds	8	8	8	8	8

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    i. Construct a graph of the data that could be used to investigate the appropriateness of a linear regression model for analyzing the results of the experiment.
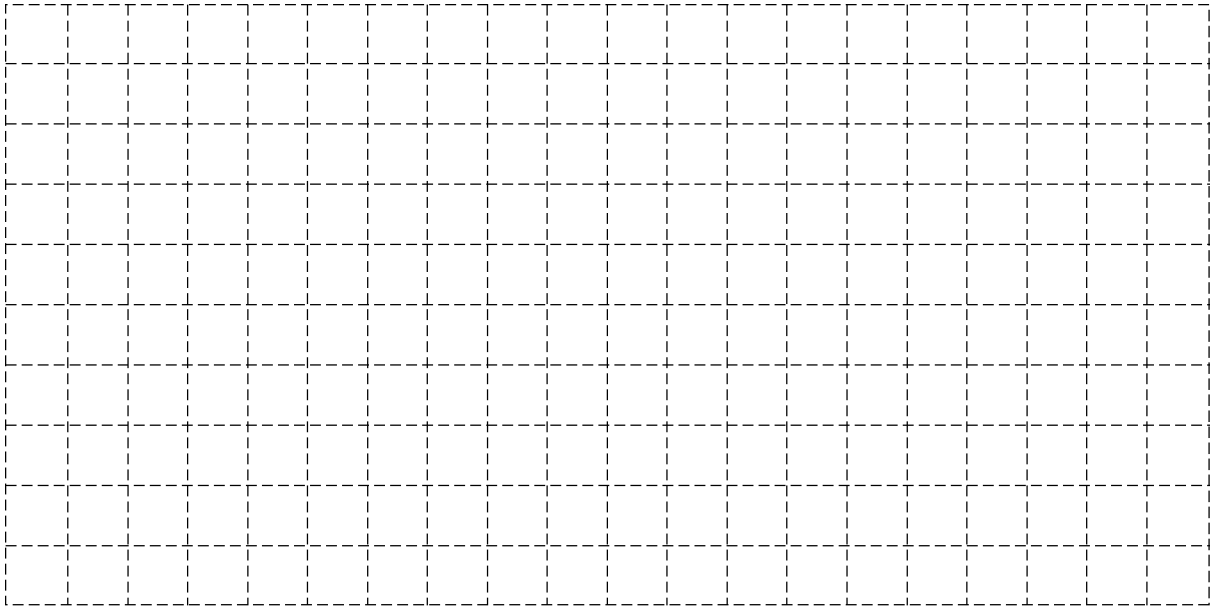
   ii. Based on your graph, do you think a linear regression model is appropriate? Explain.

2. A local radio station plays 40 rock-and-roll songs during each 4-hour show. The program director at the station needs to know the total amount of airtime for the 40 songs so that time can also be programmed during the show for news and advertisements. The distribution of the lengths of rock-and-roll songs, in minutes, is roughly symmetric with a mean length of 3.9 minutes and a standard deviation of 1.1 minutes.

   (a) Describe the sampling distribution of the sample mean song lengths for random samples of 40 rock-and-roll songs.

   (b) If the program manager schedules 80 minutes of news and advertisements for the 4-hour (240-minute) show, only 160 minutes are available for music. Approximately what is the probability that the total amount of time needed to play 40 randomly selected rock-and-roll songs exceeds the available airtime?

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3. A humane society wanted to estimate with 95 percent confidence the proportion of households in its county that own at least one dog.

   (a) Interpret the 95 percent confidence level in this context.

   The humane society selected a random sample of households in its county and used the sample to estimate the proportion of all households that own at least one dog. The conditions for calculating a 95 percent confidence interval for the proportion of households in this county that own at least one dog were checked and verified, and the resulting confidence interval was 0.417 ± 0.119.

   (b) A national pet products association claimed that 39 percent of all American households owned at least one dog. Does the humane society's interval estimate provide evidence that the proportion of dog owners in its county is different from the claimed national proportion? Explain.

   (c) How many households were selected in the humane society's sample? Show how you obtained your answer.

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2010 SCORING GUIDELINES

Question 1

Intent of Question

The primary goals of this question were to assess students' ability to (1) apply terminology related to designing experiments; (2) construct an appropriate plot that could be used to investigate the fit of a linear model; (3) decide, from a graphical display, whether a linear regression model is appropriate for a set of data.

Solution

Part (a):

   i. The treatments are the different concentrations of garlic in the food granules. Specifically, there are five treatments: 0 percent, 2 percent, 10 percent, 25 percent and 50 percent.
   ii. The experimental units are the birds (starlings), each placed in an individual cage.
   iii. The response is the number of food granules consumed by the bird.

Part (b):

   i. The following scatterplot results from these data.
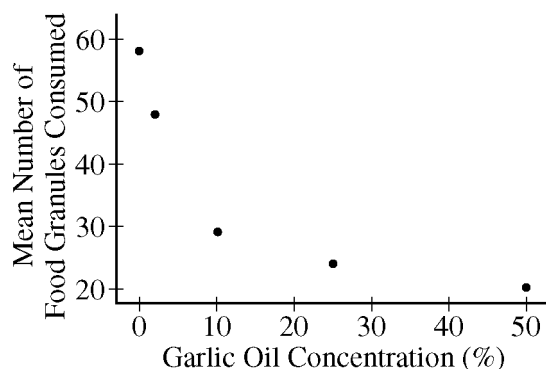
   ii. The curved pattern in this scatterplot reveals that a linear regression model would not be appropriate for modeling the relationship between these variables.

Scoring

Parts (a) and (b) are scored as essentially correct (E), partially correct (P) or incorrect (I).

Part (a) is scored as follows:

Essentially correct (E) if the student correctly identifies all three subparts—the treatments, the experimental units and the response that will be measured.

Partially correct (P) if the student identifies two subparts correctly.

Incorrect (I) otherwise.