**AP Statistics AP Exam Review Homework #4**

**Question 1 is a regular AP question---12 minutes to complete while #2 is a #6 –type question ---25 minutes to complete)**

1. A local arcade is hosting a tournament in which contestants play an arcade game with possible scores ranging from 0 to 20. The arcade has set up multiple game tables so that all contestants can play the game at the same time; thus contestant scores are independent. Each contestant's score will be recorded as he or she finishes, and the contestant with the highest score is the winner.

After practicing the game many times, Josephine, one of the contestants, has established the probability distribution of her scores, shown in the table below.

Josephine's Distribution

| Score | 16 | 17 | 18 | 19 |
|---|---|---|---|---|
| Probability | 0.1 | 0.3 | 0.3 | 0.2 |

Crystal, another contestant, has also practiced many times. The probability distribution for her scores is shown in the table below.

Crystal's Distribution

| Score | 17 | 18 | 19 |
|---|---|---|---|
| Probability | 0.45 | 0.4 | 0.15 |

(a) Calculate the expected score for each player.

(b) Suppose that Josephine scores 16 and Crystal scores 17. The difference (Josephine minus Crystal) of their scores is -1. List all combinations of possible scores for Josephine and Crystal that will produce a difference (Josephine minus Crystal) of -1, and calculate the probability for each combination.

(c) Find the probability that the difference (Josephine minus Crystal) on their scores is -1.

(d) The table below lists all the possible differences in the scores between Josephine and Crystal and some associated probabilities.

Distribution (Josephine minus Crystal)

| Difference | -3 | -2 | -1 | 0 | 1 | 2 |
|---|---|---|---|---|---|---|
| Probability | 0.015 | | | 0.325 | 0.26 | 0.09 |

Complete the table and calculate the probability that Crystal's score will be higher than Josephine's score.

2. Scientists interested in preserving natural habitats and minimizing the possible extinction of certain bird species conducted a study to determine if it is better for conservation groups to purchase a few large nature preserves or many small preserves in order to meet these goals.

The scientists studied 13 randomly selected islands of different sizes to determine the risk of extinction for bird species. Islands are thought to be a good imitation of what would happen in a nature preserve because of their isolation. If a species lived on only one island, it was considered to be at risk. Scientists have determined that whether or not one species becomes extinct is independent of whether or not another species becomes extinct.

In 190 scientists counted the number of at-risk species on each of the selected islands. They returned to each of these islands in the year 2000 to see whether the species still existed on the islands. Species that were present in 190 but absent in 2000 were considered extinct. Data collected by the scientists are given in the table below.

| Island | Area (in sq km) | Species at Risk in 1990 | Species Extinct by 2000 | Proportion Extinct |
|---|---|---|---|---|
| 1 | 46 | 75 | 8 | 0.11 |
| 2 | 36 | 67 | 3 | 0.04 |
| 3 | 31 | 66 | 8 | 0.12 |
| 4 | 9 | 51 | 8 | 0.16 |
| 5 | 5 | 28 | 5 | 0.18 |
| 6 | 5 | 20 | 6 | 0.30 |
| 7 | 4 | 43 | 10 | 0.23 |
| 8 | 4 | 31 | 5 | 0.16 |
| 9 | 3 | 28 | 7 | 0.25 |
| 10 | 2 | 32 | 8 | 0.25 |
| 11 | 1 | 30 | 8 | 0.27 |
| 12 | 1 | 20 | 4 | 0.20 |
| 13 | 1 | 16 | 5 | 0.31 |

(a) One scientist involved in the study believes that large islands (those with areas greater than 25 sq. kilometers) are more effective than small islands (those with areas no more than 25 sq kilometers) for protecting at-risk species. The scientist noted that for this study, a total of 19 of the 208 species on the large islands became extinct, whereas a total of 66 of 299 species on the small islands became extinct. Assume that the probability of extinction is the same for all at-risk species on large islands and the same for all at-risk species on small islands. Do these data support the scientist's belief? Give appropriate statistical justification for your answer.

(b) Another scientist who worked on this study thinks that the proportion of species that become extinct is more directly related to the size of the islands than simply to whether the islands are grouped as large or small. This scientist investigated the relationship between the proportion of extinct birds and the area, in square kilometers, of islands. A least squares analysis was conducted on the proportion extinct and ln(area). The regression analysis output, the scatterplot, and the residual plot are shown below.

| Predictor | Coef | StDev | T | P |
|---|---|---|---|---|
| Constant | 0.28996 | 0.01269 | 22.85 | 0.000 |
| ln(area) | -0.05323 | 0.00618 | -8.61 | 0.000 |
| | | | | |
| S=0.02863 | R-Sq=87.1% | | | |

Estimate the slope of the least squares regression line using a 95 percent confidence interval. Interpret your answer in the context of this situation.

(c) In part (a), the scientist assumed that the probability of a species becoming extinct is the same for each of the large islands. Similarly, the scientist assumed that the probability is the same for each of the small islands. Based on your answer in part (b), do you think this is a reasonable assumption? Why?

(d) A conservation group with a long-term goal of preserving species believes that all at-risk species will disappear whenever land inhabited by those species is developed. It has an opportunity to purchase land in an area about to be developed. The group has a choice of creating one large nature preserve with an area of 45 sq kilometers and containing 70 at-risk species, or 5 small nature preserves, each with an area of 3 sq kilometers and each containing 16 at-risk species unique to that preserve. Which choice would you recommend and why?