1. (5 points) Software gives the chi-square statistic $\chi^2 = 325.459$. From the table of critical values, we can say that the p-value is

A. less than 0.0005.

B. between 0.001 and 0.0005.

C. between 0.0025 and 0.001.

2. (5 points) You are testing $H_0 : \mu = 10$ against $H_a : \mu < 10$ based on an SRS of 16 observations from a Normal population. The data give $\bar{x} = 8$ and $s = 4$. The value of the t statistic is

A. -8

B. -0.5

C. -2

3. (5 points) Data on the blood cholesterol levels of 10 rats (milligrams per deciliter of blood) give $\bar{x} = 85$ and $s = 12$. A 99% confidence interval for the mean blood cholesterol of rats is

A. 76.4 to 93.6

B. 72.7 to 97.3

C. 73.0 to 97.0

4. (5 points) The alternative hypothesis for the ANOVA F test is

A. all the means are not equal.

B. all the means are equal.

C. not all the means are equal.

5. (20 points) Can active learning improve knowledge retention? Two undergraduate calculus-based engineering statistics courses were taught in different academic quarters, with one employing active-learning methods and another using traditional learning methods. The traditional class was taught lecture-style with relatively little in-class interaction between peers and with the instructor. The active-learning course integrated four group projects into the curriculum, with in-class time devoted to group work on the projects and fewer homework assignments.

To assess knowledge retention, two five-question versions of a test were created. They had similar but not identical questions covering core statistics topics, worth a total of 18 possible points. All students in both sections were randomly given one version of the test as part of their final exam.

Then, eight months later, a volunteer subset of the original students were given the version that they had not taken previously. To encourage students to take the second version of the exam, a ten-dollar gift card to the university bookstore was given to each participant. The change in the score from the first version to the second is used to measure a students long-term ability to retain the course material. Here are the changes in exam scores for the 15 students in the Active group:

$$0 \quad 5 \quad 7 \quad 8 \quad 0 \quad 3 \quad 6 \quad 2 \quad 5 \quad 1$$
$$3 \quad 2 \quad 4 \quad 3 \quad 5$$

The changes in exam scores for the 23 students in the Traditional group are

$$7 \quad 0 \quad 8 \quad 2 \quad 4 \quad 3 \quad 1 \quad 2 \quad 5 \quad 8$$
$$5 \quad 6 \quad 3 \quad 12 \quad 1 \quad 6 \quad 3 \quad 6 \quad 7 \quad 7$$
$$5 \quad 6 \quad 2$$

Is there good evidence that active learning is superior to traditional lecturing?

6. (20 points) Hand disinfection is frequently recommended for prevention of transmission of the rhinovirus that causes the common cold. In particular, hand lotion containing 2% citric acid and 2% malic acid in 70% ethanol (HL+) has been found to have both immediate and persistent ability to inactivate rhinovirus (RV) on the hands in an experimental setting. Is hand disinfection effective in reducing the risk of infection in a natural setting? A total of 212 volunteers were assigned at random to either the HL+ group, which used the hand lotion every three hours or after hand washing, and a control group, which was asked to use routine hand washing but to avoid the use of alcohol-based hand sanitizers. Here are the data on the numbers of subjects with and without RV infection in the two groups over the 10-week study period:

	Infected	Not Infected
HL+	49	67
Control Group	49	47

(a) Is this an experiment or an observational study? Why?

(b) Do the data give good evidence that hand sanitizers reduce the chance of an RV infection?

7. (20 points) We suspect that people who rely entirely on cell phones will as a group be younger than those who have a landline telephone. Do data confirm this guess? Here is a two-way table that breaks down both of Pews samples by age group:

Age (years)	Landline sample	Cell-only sample
18 − 29	104	96
30 − 49	265	70
50 − 64	204	26
65 or older	179	8

8. (20 points) Bromeliads are tropical flowering plants. Many are epiphytes that attach to trees and obtain moisture and nutrients from air and rain. Their leaf bases form cups that collect water and are home to the larvae of many insects. As a preliminary to a study of changes in the nutrient cycle, Jacqueline Ngai and Diane Srivastava examined the effects of adding nitrogen, phosphorus, or both to the cups. They randomly assigned 8 bromeliads growing in Costa Rica to each of four treatment groups, including an unfertilized control group. A monkey destroyed one of the plants in the control group, leaving 7 bromeliads in that group. Here are the numbers of new leaves on each plant over the 7 months following fertilization:

Nitrogen	Phosphorus	Both	Neither
15	14	14	11
14	14	16	13
15	14	15	16
16	11	14	15
17	13	14	15
18	12	13	11
17	15	17	12
13	15	14	

Analyze these data and discuss the results. Does nitrogen or phosphorus have a greater effect on the growth of bromeliads?