**12. NYPD and gender.** The table below shows the rank attained by male and female officers in the New York City Police Department. Do these data indicate that men and women are equitably represented at all levels of the department?

| Rank | Male | Female |
|---|---|---|
| Officer | 21,900 | 4,281 |
| Detective | 4,058 | 806 |
| Sergeant | 3,898 | 415 |
| Lieutenant | 1,333 | 89 |
| Captain | 359 | 12 |
| Higher ranks | 218 | 10 |

a) What's the probability that a person selected at random from the NYPD is a female?
b) What's the probability that a person selected at random from the NYPD is a detective?
c) Assuming no bias in promotions, how many female detectives would you expect the NYPD to have?
d) To see if there is evidence of differences in ranks attained by males and females, will you test goodness-of-fit, homogeneity, or independence?
e) State the hypotheses.
f) Test the conditions.
g) How many degrees of freedom are there?
h) Find $\chi^2$ and the P-value.
i) State your conclusion.
j) If you concluded that the distributions are not the same, analyze the differences using the standardized residuals of your calculations.

2. **Which test again?** For each of the following situations, state whether you'd use a chi-square goodness-of-fit test, a chi-square test of homogeneity, a chi-square test of independence, or some other statistical test.
   a) Is the quality of a car affected by what day it was built? A car manufacturer examines a random sample of the warranty claims filed over the past two years to test whether defects are randomly distributed across days of the work week.
   b) A medical researcher wants to know if blood cholesterol level is related to heart disease. She examines a database of 10,000 patients, testing whether the cholesterol level (in milligrams) is related to whether a person has heart disease or not.
   c) A student wants to find out whether political leaning (liberal, moderate, or conservative) is related to choice of major. He surveys 500 randomly chosen students and performs a test.

3. **Dice.** After getting trounced by your little brother in a children's game, you suspect the die he gave you to roll may be unfair. To check, you roll it 60 times, recording the number of times each face appears. Do these results cast doubt on the die's fairness?
   a) If the die is fair, how many times would you expect each face to show?
   b) To see if these results are unusual, will you test goodness-of-fit, homogeneity, or independence?
   c) State your hypotheses.
   d) Check the conditions.

| Face | Count |
|---|---|
| 1 | 11 |
| 2 | 7 |
| 3 | 9 |
| 4 | 15 |
| 5 | 12 |
| 6 | 6 |

   e) How many degrees of freedom are there?
   f) Find $\chi^2$ and the P-value.
   g) State your conclusion.

**15. Cranberry juice.** It's common folk wisdom that drinking cranberry juice can help prevent urinary tract infections in women. In 2001 the *British Medical Journal* reported the results of a Finnish study in which three groups of 50 women were monitored for these infections over 6 months. One group drank cranberry juice daily, another group drank a lactobacillus drink, and the third drank neither of those beverages, serving as a control group. In the control group, 18 women developed at least one infection compared with 20 of those who consumed the lactobacillus drink and only 8 of those who drank cranberry juice. Does this study provide supporting evidence for the value of cranberry juice in warding off urinary tract infections?

a) Is this a survey, a retrospective study, a prospective study, or an experiment? Explain.
b) Will you test goodness-of-fit, homogeneity, or independence?
c) State the hypotheses.
d) Test the conditions.
e) How many degrees of freedom are there?
f) Find $\chi^2$ and the P-value.
g) State your conclusion.
h) If you concluded that the groups are not the same, analyze the differences using the standardized residuals of your calculations.

## Chapter 26 Practice Quiz

***Practice Quiz - Chapter 26*** ***Name*** _____

1. A biology professor reports that historically grades in her introductory biology course have been distributed as follows: 15% A's, 30% B's, 40% C's, 10% D's, and 5% F's. Grades in her most recent course were distributed as follows:

| Grade | A | B | C | D | F |
|---|---|---|---|---|---|
| Frequency | 89 | 121 | 78 | 25 | 12 |

   a. Test an appropriate hypothesis to decide if the professor's most recent grade distribution matches the historical distribution. Give statistical evidence to support your conclusion.

   b. Which grade impacted your decision the most? Explain what this means in the context of the problem.

2. As part of a survey, students in a large statistics class were asked whether or not they ate breakfast that morning. The data appears in the following table:

| | | Breakfast | | |
|---|---|---|---|---|
| | | Yes | No | Total |
| Sex | Male | 66 | 66 | 132 |
| | Female | 125 | 74 | 199 |
| | Total | 191 | 140 | 331 |

Is there evidence that eating breakfast is independent of the student's sex? Test an appropriate hypothesis. Give statistical evidence to support your conclusion.

3. A manufacturing plant for recreational vehicles receives shipments from three different parts vendors. There has been a defect issue with some of the electrical wiring in the recreational vehicles manufactured at the plant. The plant manager wonders if all of the vendors might be contributing equally to the defect issue. The plant manager reviews a sample of quality assurance inspections from the last six months. The data are shown in the table below.

| | Purrfect Parts Co. | Made-4-U Co. | 25 Hour Parts Co. |
|---|---|---|---|
| Rejected | 53 | 48 | 70 |
| Perfect | 93 | 71 | 88 |
| Not perfect but acceptable | 22 | 31 | 22 |

Test an appropriate hypothesis to decide if the plant manager is correct. Give statistical evidence to support your conclusion.