## Solutions to Exercises on Chapter 10

**Exercise 1**: 1. 10

2. Goodness-of-fit.

3.  $H_0$ : The die is fair (all faces have p = 1/6),  $H_A$ : The die is not fair.

4. Count data; rolls are random and independent; expected frequencies are all bigger than 5.

5.5

6.  $\chi^2 = 5.600$ , *p*-value = 0.3471

7. Because the *p*-value is high, do not reject  $H_0$ . The data show no evidence that the die is unfair.

## Exercise 2: 1. Homogeneity

2.  $H_0$ : The grade distribution is the same for both professors.  $H_A$ : The grade distributions are different.

3. Three cells have expected frequencies less than 5.

	Prof. Alpha	Prof. Beta
Α	6.667	5.333
В	12.778	10.222
$\mathbf{C}$	12.222	9.778
D	6.111	4.889
$\mathbf{F}$	2.222	1.778

Exercise 3: All expected frequencies are now larger than 5.

	Prof. Alpha	Prof. Beta
$\mathbf{A}$	6.667	5.333
в	12.778	10.222
$\mathbf{C}$	12.222	9.778
Below C	8.333	6.667

2. Decreased from 4 to 3.

3.  $\chi^2 = 9.306$ ; *p*-value = 0.0255. Because the *p*-value is so low, we reject  $H_0$  at  $\alpha = 0.05$ . The grade distributions for the two professors are different. Dr. Alpha gives fewer As and more grades below C than Dr. Beta.

**Exercise 4**:  $\chi^2 = 14.058$ ; df = 1; *p*-value = 0.0002. With a *p*-value this low, we reject  $H_0$  at  $\alpha = 0.001$ . There is evidence of racial steering. Blacks are much less likely to rent in Section A than Section B.

**Exercise 5**: We conduct a chi-square test for goodness-of-fit. We test the following hypotheses:  $H_0$ : 50% of the candies are orange, 25% are brown, 25% are yellow;

 $H_A$ : the three colors arise in some other proportions.

In a bag containing 200 candies, we expect 100 to be orange, 50 to be brown, and 50 to be yellow. Therefore, our chi-square statistic is

$$\chi^2 = \sum_{\text{all colors}} \frac{(Observed - Expected)^2}{Expected} = \frac{(112 - 100)^2}{100} + \frac{(49 - 50)^2}{50} + \frac{(39 - 50)^2}{50} = 3.88.$$

If  $H_0$  is true, then this test statistic has approximately a chi-square distribution with df = 3-1=2 degrees of freedom. From a calculator, we obtain that the *p*-value is 0.144 (or from the table, we can see that the *p*-value is greater than 0.10).

Therefore, we fail to reject  $H_0$  and conclude that we do not have sufficient evidence that the colors arise in proportions that are different from what the company claimed. That is, the data are consistent with Hershey's claim.