1. 10.47. Herpes simplex virus type 2 (HSV-2) is a sexually transmitted disease. As part of the third National Health and Nutrition Examination Survey (NHANES III), prevalence of HSV-2 was determined in four regions of the United States. The data are given in the following table.

Note, this is a slightly rearranged version of the table given in the text.

<table>
<thead>
<tr>
<th></th>
<th>HSV-2</th>
<th>No HSV-2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northeast</td>
<td>323</td>
<td>1165</td>
</tr>
<tr>
<td>Midwest</td>
<td>381</td>
<td>1689</td>
</tr>
<tr>
<td>South</td>
<td>1320</td>
<td>4003</td>
</tr>
<tr>
<td>West</td>
<td>712</td>
<td>1986</td>
</tr>
</tbody>
</table>

a. Use a chi-square test to compare the prevalence rates at $\alpha = 0.01$.

Correct:

(1) $\alpha = 0.01$
(2) $H_0$: HSV-2 prevalence is the same in the four regions
$H_A$: HSV-2 prevalence differs across the four regions
(3) $X^2_s = 49.77$
(4) $P = 8.95E-11 = 0.0000000000895$ which we interpret as $P < 0.001$
(5) $P < \alpha$, reject $H_0$
(6) There is significant evidence to conclude that HSV-2 prevalence differs across the four regions

2. 10.51. A randomized, double-blind, placebo-controlled experiment was conducted in which patients with Alzheimer's disease were given either extract of Ginkgo biloba (EGb) or a placebo for one year. The change in each patient's Alzheimer's Disease Assessment Scale–Cognitive subscale (ADAS-Cog) score was measured. The results are given in the table. Note: If the ADAS-Cog went down, then the patient improved.

<table>
<thead>
<tr>
<th>Change in ADAS-Cog Score</th>
<th>-4 or better</th>
<th>-2 to -3</th>
<th>-1 to 1</th>
<th>2 to 3</th>
<th>3 to 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>EGb</td>
<td>22</td>
<td>18</td>
<td>12</td>
<td>7</td>
<td>16</td>
</tr>
<tr>
<td>Placebo</td>
<td>10</td>
<td>11</td>
<td>19</td>
<td>11</td>
<td>24</td>
</tr>
</tbody>
</table>

a. Use a chi-square test to compare the prevalence rates at $\alpha = 0.05$

Correct:

(1) $\alpha = 0.05$
(2) $H_0$: Distribution of change in ADAS-Cog score is same for EGb or placebo
$H_A$: Distribution of change in ADAS-Cog score is different for EGb or placebo
(3) $X^2_s = 10.26$
(4) $P = 0.0363$ (DoStat calculator)
(5) $P < \alpha$, so reject $H_0$
(6) There is significant evidence to conclude that EGb and placebo are not equally effective.

b. Perhaps a more interesting question is whether ADAS-Cog tends to be better when taking EGb. Can you carry out the Chi-Square test for this hypothesis using the contingency table above? Why or why not?

Correct:

No, directional alternative hypotheses using the Chi-square test are only valid when we have a 2 x 2 contingency table - any larger than that and the Chi-Square test is testing compound hypotheses.
3. A group of patients with a binge-eating disorder were randomly assigned to take either the experimental drug fluvoxamine or a placebo in a nine-week-long double-blind clinical trial. At the end of the trial the condition of each patient was classified into one of four categories: no response, moderate response, marked response, or remission. The following table shows a cross-classification of the data.

<table>
<thead>
<tr>
<th></th>
<th>No Response</th>
<th>Moderate Response</th>
<th>Marked Response</th>
<th>Remission</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluvoxamine</td>
<td>15</td>
<td>7</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td>Placebo</td>
<td>22</td>
<td>7</td>
<td>3</td>
<td>11</td>
</tr>
</tbody>
</table>

Is there statistically significant evidence, at the 0.10 significance level, to conclude that there is an association between treatment group (fluvoxamine versus placebo) and condition?

**Correct:**

(1) $\alpha = 0.10$

(2) $H_0$: There is no association between treatment group (fluvoxamine versus placebo) and condition.

$H_A$: There is an association between treatment group (fluvoxamine versus placebo) and condition.

(3) $X^2_s = 1.8325$

(4) $P = 0.608$

(5) $P > \alpha$, so fail to reject $H_0$

(6) There is not significant evidence to conclude that there is an association between treatment group (fluvoxamine versus placebo) and condition.

4. Are mice right-handed or left-handed? In a study of this question, 320 mice of a highly inbred strain were tested for paw preference by observing which forepaw—right or left—they used to retrieve food from a narrow tube. Each animal was tested 50 times, for a total of $320 \times 50 = 16,000$ observations. The results were as follows:

<table>
<thead>
<tr>
<th>Left</th>
<th>Right</th>
</tr>
</thead>
<tbody>
<tr>
<td>8,129</td>
<td>7,871</td>
</tr>
</tbody>
</table>

Suppose we assign an expected frequency of 8,000 to each category and perform a goodness-of-fit test; we find that $X^2_s = 4.19$ so that at $\alpha = 0.05$ we would reject the hypothesis of a 1:1 ratio and find that there is sufficient evidence to conclude that mice of this strain are (slightly) biased toward use of the left paw. This analysis contains a fatal flaw; what is it?

**Correct:**

The validity of the analysis depends on the condition that the 16,000 observations are independent of each other. Because of the hierarchical structure in the data (50 observation per mouse), the observations are not independent of each other.
5. 10.79. The appearance of leaf pigment glands in the seedling stage of cotton plants is genetically controlled. According to one theory of the control mechanism, the population ratio of glandular to glandless plants resulting from a certain cross should be 11:5; according to another theory it should be 13:3. In one experiment, the cross produced 89 glandular and 36 glandless plants. Use goodness-of-fit tests (at $\alpha = 0.10$) to determine whether these data are consistent with
a. the 11:5 theory

**Correct:**
(1) $\alpha = 0.10$
(2) $H_0$: The 11:5 theory is correct
$H_A$: The 11:5 theory is not correct

<table>
<thead>
<tr>
<th>Glandular</th>
<th>Glandless</th>
</tr>
</thead>
<tbody>
<tr>
<td>89 (85.938)</td>
<td>36 (39.063)</td>
</tr>
</tbody>
</table>

(3) $X^2 = \frac{(89-85.938)^2}{85.938} + \frac{(36-39.063)^2}{39.063} = 0.109 + 0.240 = 0.349$
(4) $P = 0.5541$
(5) $P > \alpha$, fail to reject $H_0$
(6) There is not significant evidence that the 11:5 theory is incorrect; the data are consistent with the 11:5 theory.

b. the 13:3 theory

**Correct:**
(1) $\alpha = 0.10$
(2) $H_0$: The 13:3 theory is correct
$H_A$: The 13:3 theory is not correct

<table>
<thead>
<tr>
<th>Glandular</th>
<th>Glandless</th>
</tr>
</thead>
<tbody>
<tr>
<td>89 (101.563)</td>
<td>36 (23.438)</td>
</tr>
</tbody>
</table>

(3) $X^2 = \frac{(89-101.563)^2}{101.563} + \frac{(36-23.438)^2}{23.438} = 1.554 + 6.733 = 8.288$
(4) $P = 0.004$
(5) $P < \alpha$, reject $H_0$
(6) There is significant evidence that the 13:3 theory is incorrect; the data are not consistent with the 13:3 theory.

6. 10.97. Each of 36 men was asked to touch the backs of the hands of three women, one of whom was the man's romantic partner, while blindfolded. The two “decoy” women were the same age, height, and weight as the man's partner. Of the 36 men tested, 16 were able to correctly identify their partner. Are these data consistent with the claim that the men were guessing? (Is there evidence the men have some ability to detect their partner by touching the back of the hand?) Conduct a goodness-of-fit test of the data, using $\alpha = 0.05$

**Correct:**
(1) $\alpha = 0.05$
(2) $H_0$: The men are guessing ($Pr\{\text{correct}\} = 1/3$)
$H_A$: The men have some ability to detect their partners ($Pr\{\text{correct}\} > 1/3$)

<table>
<thead>
<tr>
<th>Correct</th>
<th>Wrong</th>
</tr>
</thead>
<tbody>
<tr>
<td>16 (12)</td>
<td>20 (24)</td>
</tr>
</tbody>
</table>

(3) $X^2 = \frac{(16-12)^2}{12} + \frac{(20-24)^2}{24} = 2$
(4) $P = 0.5(0.1573) = 0.07865$
(5) $P > \alpha$, fail to reject $H_0$
(6) There is not significant evidence to conclude that the men have some ability to detect their partners by
touching the backs of their hands.

7. 10.98. Consider Exercise 10.97. The romantic partners of the 36 men discussed in Exercise 10.97 were also tested, in the same manner as the men (i.e., they were blindfolded and asked to identify their partner by touching the backs of the hands of three men, one of whom was their partner). Among the women, 25 were successful and 11 were not. Are these data consistent with the hypothesis that men and women are equally good at identifying their partners?

**Correct:**

1. $\alpha = 0.05$
2. $H_0$: Men and women are equally good at identifying their partners
   $H_A$: Men and women are not equally good at identifying their partners

<table>
<thead>
<tr>
<th></th>
<th>Men</th>
<th>Women</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correct</td>
<td>16</td>
<td>25</td>
</tr>
<tr>
<td>Incorrect</td>
<td>20</td>
<td>11</td>
</tr>
</tbody>
</table>

3. $X^2 = 4.59$
4. $P = 0.0322$
5. $P < \alpha$, reject $H_0$
6. There is significant evidence that men and women are not equally as good at detecting their partners (by touching the back of partner's hand when blindfolded).

*Actually, if you were to have tested the directional hypothesis that women are better than men at detecting their partners by touching the back of the hand, the test still rejects and we find women are better at this than men. Just thought that was interesting...*