BIOL 300 Assignment 5, Spring 2012

Chapter 7

14. **(a)** 5 out of 12 notice the gorilla (5/12) = 0.417
    (b) The 95% confidence interval (calculated using the Agresti-Coull approximation): p' = 7 / 16 = 0.4375, so the confidence interval is: $0.194 < p < 0.681$.
    (c) The best estimate of the students who fail to notice the gorilla is 7/12, or 0.583.

19. $p = 10 / 200 = 0.05$. $p' = 12/ 204 = 0.06$. Confidence interval: $0.03 < p < 0.09$.

23. **(a)** On average 0.25 of 12 peas should be wrinkled, or 3.
    (b) The standard deviation of the proportion of wrinkled pea plants is the standard error, or 0.125.
    (c) The variance is the square of the standard deviation, or 0.015625
    (d) $\Pr[2 \text{ wrinkled peas}] = \Pr[2] = \binom{12}{2} 0.25^2 (1-0.25)^{10} = 0.23.$

Chapter 8

12. The probabilities that bound the test statistic are given below, along with the precise values calculated by Excel.

df	χ^2	*P* from Statistical Table A	*P* from computer
1	4.12	$P < 0.05$	0.042379
4	1.02	$P > 0.05$	0.906748
2	9.5	$P < 0.025$	0.008652
10	12.4	$P > 0.05$	0.259177
1	2.48	$P > 0.05$	0.115302

13. **(a)** Null hypothesis: windows will kill the same number of birds per time period at any angle.
    Alternate hypothesis: windows angled towards the ground will kill a different number of birds per time period than windows at the vertical.
    (b) 30 / 53 were killed by windows at the vertical, or 0.566.
    (c) We can use a goodness of fit test for the null hypothesis.
    (d) The null hypothesis implies windows at each angle should kill 33% of the birds.

window angle	obs deaths	exp deaths	$\frac{(Observed - Expected)^2}{Expected}$
0 (vertical)	30	17.67	8.6
20	15	17.67	0.4
40	8	17.67	5.3
total	53		14.3

We had three categories, no estimated parameters, so *df*= 2. χ^2 =14.3 > 13.92, the critical value for $P = 0.001$, so window angle does influence bird mortality ($P < 0.001$).
(e) Windows might be more or less likely to cause harm depending on location as well as angle, so assigning windows to different angles and changing them daily at random was important to ensure that it was angle, not some other factor, that was being tested.

18. **(a)** On average, the mean number of severe hurricanes is 0.65 per year.
(b) If hurricanes are random and independent, the distribution should be Poisson.
(c)

	Observed Frequency	Expected Frequency	$\frac{(Observed - Expected)^2}{Expected}$
0	50	52.20	0.09
1	39	33.93	0.76
2+	11	13.81	0.57

$\chi^2 = 1.42$
Because the expected value for 3 or more was less than 5, it was combined with the 2 category. It appears that hurricanes are approximately Poisson distributed: there are three categories, one estimated parameter, so one degree of freedom. The critical value for P = 0.05 is 3.84, and our test statistic is less than this, so we do not reject the null hypothesis of Poisson-distributed hurricanes.
(d) We cannot exclude the null hypothesis that hurricanes are randomly distributed, neither clumped nor dispersed. (So, what does this say about forecasts for "a bad hurricane year"?). (Note, however, that there is a slight trend in the direction of hurricanes being dispersed, not clumped, in time. You can see this because there are more observed than expected cases of 1 hurricane in a year and fewer observed than expected cases of 0 hurricanes and 2+ hurricanes in a year. In the observed data, the variance of the distribution is less than than the mean, whereas in the Poisson distribution the variance and mean are equal.)