Practice Problems---The chi-square goodness of fit test.

In each problem determine the expected distribution of interest, then carry out a goodness-of-fit test. Find the value of the chi-square statistic, the p-value of the test, and the conclusion you reach.

1. Students at this university have the opportunity to evaluate their professors each semester. In the department of Mathematics, the distribution of ratings when the students were asked to give an overall rating of their professor's performance was as follows:

Rating (overall performance)	5	4	3, 2, or 1
Percentage answering	58%	24%	18%

In fall 2012, Dr. Smith had 61 students enrolled in his courses; 59 answered this question on the evaluation. His ratings on this question were:

Rating (overall performance)	5	4	3, 2, or 1
Number answering	37	9	13

Determine whether Smith's evaluations (at least on this question) differ significantly from the Math department as a whole, using $\alpha = .10$.

2. A drug company is developing a product which is intended to shorten the duration of colds. To determine if the product is effective, a study is done with two groups of physiologically similar people. The placebo group is given a sugar pill, the treatment group is given the cold remedy, and the results are given below.

Cold duration in days	**Placebo group (relative frequency)**	**Treatment group (frequency)**
5 days or less	40%	102
6-9 days	35%	70
10-12 days	15%	14
13 or more days	10%	14

Determine whether or not there is a significant difference between the placebo group and the control group using $\alpha = .01$.

3. Now that ASU and GHSU have merged, it is claimed that admission standards at the merged university will rise. To see what sort of effect (if any) the new admission standards have had, the grade distribution in English 1101 is examined in fall 2012 (the last incoming class before the merger) and fall 2013 (the first semester with the new admission standards). The data is below.

English 1101 grade	Fall 2012 class	Fall 2013 class
A	20%	230
B	25%	290
C	15%	200
D	10%	100
F	20%	175
W	10%	120

Determine if there is a significant difference between the two groups using $\alpha = .10$.

4. In 2012, Miguel Cabrera won baseball's coveted triple crown, and in doing so hit 44 home runs in the 161 played. Consider the problem of testing whether the number of home runs hit by Cabrera in a given game follows a Poisson distribution with $\lambda = 44/161$. Recall that in a Poisson process, the time between occurrences of an event (home runs here) is independent.

Fill in the table below and test whether or not the observed data differs significantly from what is predicted by the Poisson model, using $\alpha = .10$. The conclusion will hopefully be obvious.

HR's by Cabrera	Observed	Expected (Poisson model)
0	122	
1	34	
2 or more	5	

5. In the same vein as problem #4, Peyton Manning has played 224 NFL regular-season games, and in those 224 games, he has thrown 436 touchdown passes. The question is whether the number of touchdowns thrown by Manning in a given game follows a Poisson distribution with $\lambda = 436/224$. Give conclusions for $\alpha = .01$, $\alpha = .05$, $\alpha = .10$, and $\alpha = .15$.

Manning TD passes	Observed	Expected (Poisson model)
0		
1		
2		
3		
4 or more		

6. At

http://www.pewforum.org/Government/Faith-on-the-Hill--The-Religious-Composition-of-the-113th-Congress.aspx

you can find some data comparing the current congress to the US population at large. Specifically, the article gives data on the religious affiliation of these two groups. Use the chi-square test to determine if congress follows the same distribution as does the US population as a whole when it comes to religious identification.

Note: you will need to make some decisions on how to organize the data. Specifically, in the chi-square test, it causes great problems when the 'expected' data set contains small frequencies. In fact, the expected distribution should ideally not have any cells with size 5 or fewer. So, when you start organizing the data, you will not want to put, say, Restorationist Protestants in their own category of data!