Chi Square Practice Problems Solutions

1. A U.S. based internet company offers an on-line proficiency course in basic accounting. Completion of this course satisfies the "Fundamentals of Accounting" requirement in many MBA programs. In the first semester, 315 students enrolled in the course. The marketing manager divided the country into 7 regions of roughly equal populations with the enrollments in each of the regions given below. Management wants to know if there is equal interest in the course across all regions.

Region	Enrollment
1	45
2	60
3	30
4	40
5	50
6	55
7	35

a) Calculate the expected enrollment for all 7 regions (hint: $p_1 = p_2 = p_3 = p_4 = p_5 = p_6 = p_7$).
Soln: 45 = 315/7

b) At a significance level of 0.05, test H_0: the probabilities are equal for all seven regions.
Soln: Reject H_0 because the p-value for this (from Excel) is 0.016.

c) At a significance level of 0.01, test H_0: the probabilities are equal for all seven regions.
Soln: Failed to reject H_0 because the p-value for this (from Excel) is 0.016.

d) State a one sentence managerial conclusion.
Soln: It appears that the enrollment for the Internet course in "Fundamentals of Accounting" is equal among all of the seven regions at a significance level of 0.01.

2. In the past, of all the students enrolled in "Basic Business Statistics," 10% earned A's 20% earned B's, 30% earned C's, 20% earned D's and the rest either failed or withdrew from the course. Dr Johnson is a new professor teaching "Basic Business Statistics" for the first time this semester. At the conclusion of the semester, in Dr. Johnson's class of 60 students, there were 10 A's, 20 B's, 20 C's, 5 D's and 5 W's or F's. Assume that Dr. Johnson's class constitutes a random sample. Dr Johnson wants to know if there is sufficient evidence to conclude that the grade distribution of his class is different than the historical grade distribution.

a) What are the null and alternative hypotheses for this situation?
Soln: H_0: $p_A = 0.1$, $p_B = 0.2$, $p_C = 0.3$, $p_D = 0.2$, $p_F = 0.2$. vs H_a: H_0 does not hold.

b) Calculate the expected values for all categories.
Soln: Expected frequencies are 6, 12, 18, 12, 12 for As, Bs, Cs, Ds and Ws or Fs respectively.

c) At $\alpha = 0.01$, test to determine if the grade distribution for Dr. Johnson's class is different than

the historical grade distribution and make a one-sentence managerial conclusion.
Soln: Reject H_0 because the p-value (from Excel) is only 0.0025. It seems the grade distribution of Dr. Johnson's class is different (higher) than the historical course grade distribution.

3. On the most recent tax cut proposal, a random sample of democrats and republicans in the Congress cast their votes as follows:

	Favor	Oppose	Abstain
Democrats	85	78	37
Republicans	118	61	25

a) What are the null and alternative hypotheses for this situation?
Soln: H_0: party membership is not related to how one votes on the tax cut proposal.
Ha: party membership is related to how one votes on the tax cut proposal.

b) What are the expected frequencies for each cell for the chi-square test of independence?

Expected	Favor	Oppose	Abstain
Democrats	100.495	68.812	30.693
Republicans	102.505	70.188	31.307

c) At a significance level of 0.01, what is your conclusion?
Soln: Reject H_0 because the p-value (from Excel) is 0.0077. Therefore, I believe party membership is related to how one votes on the tax cut proposal.

4. At a recent meeting of educational researchers, comparisons were made between the type of school college freshmen attend and the numbers who drop out. A random sample of freshmen show the following results:

	4Yr public	4 Yr Private	2 Yr Public	2 Yr Private
Freshmen drop out	10	9	15	9
Freshmen who stay	26	28	18	27

a) What are the null and alternative hypotheses for this situation?
Soln: H_o: Dropout rate is not related to school type vs. H_a: Dropout rate is related to type.

b) Determine the expected frequencies for the chi-square test of independence.

Expected	4Yr public	4 Yr Private	2 Yr Public	2 Yr Private
Freshmen drop out	10.901	11.204	9.993	10.901
Freshmen who stay	25.099	25.796	23.007	25.099

c) At $\alpha = 0.05$, determine if the type of school and the dropout rate are independent.
Soln: Failed to reject H_o: dropout rate and type of school are independent because the p-value (from Excel) is 0.1868.