Review for Quiz 3

1) In this study[1] mice were raised in a strong magnetic field to see if this affected their weight. There are 20 cages, each containing the same number of mice. 10 cages were placed in a strong magnetic field. The other 10 were not in a magnetic field. After 12 days the mice were weighed and the weight gains (in grams) were recorded (giving 20 numbers). The standard deviations of these samples was $S_M = 5.67$, $S_N = 3.18$ where M, N stand for magnetic and non-magnetic.

Are these standard deviations significantly different?

Assuming that the population standard deviations are the same ($\sigma_M = \sigma_N$), how would you proceed to determine whether the magnetic field affected the mice? (Calculate S_p^2, find the critical value of t and explain how you would get a conclusion if you were given the numbers $\overline{X}_M, \overline{X}_N$.)

2) Find a multiple of the sample variance S_2 which is χ^2_ν distributed. What is ν?

A company makes precision metal parts. To keep control of the production process samples are regularly taken.

a) On a small sample of 10 metal parts the diameter of the hole drilled into each part has a sample mean of 2.25 mm and a sample variance of .0004 mm^2. Using the t-distribution and χ^2-distribution find the 99% confidence interval for

(1) the actual mean of the diameters and
(2) an upper bound for the standard error (σ) of the diameter.

b) If we assume that the actual mean is 2.24 mm then find with 99% confidence an upper bound for the standard error.

[1]Data from *Introduction to Mathematical Statistics and Its Applications* by Larsen and Marx.

In this experiment, the effectiveness of an antibacterial agent is being tested in various concentrations. The number of surviving cells can be counted by spreading the bacterial culture on a Petri dish with agar on it. (Then each cell produces a circle and you can count the circles.) But, the statistical study that I am doing is just to test the hypothesis that the number of surviving cells fits a Poisson distribution.

A	B	C	D	E	F	G
No of cells	Concen. 1	Observed frequency	$A*C$	Poisson	Expected	Chi squared
0	213	0.5325	0	0.505352032	202.1408127	0.583365364
1	128	0.32	0.32	0.344902762	137.9611047	0.71921435
2	37	0.0925	0.185	0.117698067	47.07922697	2.157869252
3	18	0.045	0.135			
4	3	0.0075	0.03			
5	1	0.0025	0.0125			
6	0	0	0			
7	0	0	0			
8	0	0	0			
9	0	0	0			
10	0	0	0			
11	0	0	0			
12	0	0	0			
> 2	22	0.055	0.1775	0.032047139	12.81885567	6.575736041
Total	400	1	0.6825	1	400	10.03618501

I was supposed to leave some spaces blank. Here was the set of instructions.

A) Column A has the observed values of X. It is important that the numbers are evenly spaced. (They differ by 1)

B) Column B has the observed number of occurrences of each value of X. These are called O_i.

C) The third column (C) is not data. It is Column B divided by 400. These numbers are approximately equal to the probability of obtaining the numbers in Column A. Thus for example the probability that $X = 1$ should be about 1/3.

D) If we multiply the numbers x (in Column A) by their actual probabilities and add we would get the expected value of X. ($\mathbb{E}(X) = \lambda$) If we multiply the numbers x by the observed frequencies (the numbers in Column C) then we get the sample mean: $= 0.6825$

E) The Poisson distribution with $\lambda = 0.6825$ is calculated in Column E. These numbers are approximately equal to the numbers in C.

F) Multiply the Poisson probabilities by 400 to get the expected numbers of occurrences of each outcome.

G) Finally, we do the chi-squared test. Note that the data for $x \geq 3$ is added together in the subtotal so that the expected numbers are at least 5. (The rule is that all E_i must be at least 5. If they are < 5 you are supposed to combine categories in a suitable way.) $df = 4 - 1 - 1 = 2$. Does the data support the hypothesis?