Chapter 10 practice questions

Q1 Retinitis pigmentosa is a disease that manifests itself via different genetic modes of inheritance. Cases have been documented with a dominant, recessive, and sex-linked mode of inheritance. It has been conjectured that mode of inheritance is related to the ethnic origin of the individual. Cases of the disease have been surveyed in an English and a Swiss population with the following results: Of 131 English cases, 49 had sex-linked disease, 27 had recessive disease, and 55 had dominant disease. Of 115 Swiss cases, 1 had sex-linked disease, 98 had recessive disease, and 16 had dominant disease.

A. Construct the congincgy table for the data given.
B. Find the expected table.
C. Calculate the chi-sqaure test.
D. Find the degree of freedom.
E. What's your decision in terms of H0. Using α =0.05.

Q2 Determine if the statements below are true or false. For each false statement, suggest an alternative wording to make it a true statement.

a) The chi-square distribution, just like the normal distribution, has two parameters, mean and standard deviation.
b) The chi-square distribution is always right skewed, regardless of the value of the degrees of freedom parameter.
c) The chi-square statistic is always positive.
d) As the degrees of freedom increases, the shape of the chi-square distribution becomes more skewed.
e) If you found $\chi 2 = 10$ with df = 5 you would fail to reject H0 at the 5% significance level.
f) When finding the p-value of a chi-square test, we always shade the tail areas in both tails.

Q3 We consider an experiment for patients who underwent cardiopulmonary resuscitation (CPR) for a heart attack and were subsequently admitted to a hospital. These patients were randomly divided into a treatment group where they received blood thinner or the control group where they did not receive blood thinner. Check whether we can test the difference in sample proportions using the normal distribution.

	Survived	Died	Total
Control	11	39	50
Treatment	14	26	40
Total	25	65	90

Q4 The Stanford University Heart Transplant Study was conducted to determine whether an experimental heart transplant program increased lifespan. Each patient entering the program was officially designated a heart transplant candidate, meaning that he was gravely ill and might benefit from a new heart. Patients were randomly assigned into treatment and control groups. Patients in the treatment group received a transplant, and those in the control group did not. The table below displays how many patients survived and died in each group. Find the expected table.

	Control	Treatment
Alive	4	24
Dead	30	45

Q5 A survey asked 827 randomly sampled registered voters in California "Do you support? Or do you oppose? Drilling for oil and natural gas off the Coast of California? Or do you not know enough to say?" Below is the distribution of responses, separated based on whether or not the respondent graduated from college. Conduct a hypothesis test to determine if the data provide strong evidence that the proportion of college graduates who do not have an opinion on this issue is different than that of non-college graduates.

	College Grad	
	Yes	No
Support	154	132
Oppose	180	126
Do not know	104	131
Total	438	389

Q6 A local news survey asked 500 randomly sampled Los Angeles residents which shipping carrier they prefer to use for shipping holiday gifts. The table below shows the distribution of responses by age group as well as the expected counts for each cell (shown in parentheses). Test for independence of age and preferred shipping method for holiday gifts among Los Angeles residents. Using $\alpha = 0.01$

		Age					
		18-34		35-54		55+	Total
Shipping Method	USPS	72	(81)	97	(102)	76	(62)	245
	UPS	52	(53)	76	(68)	34	(41)	162
	FedEx	31	(21)	24	(27)	9	(16)	64
	Something else	7	(5)	6	(7)	3	(4)	16
	Not sure	3	(5)	6	(5)	4	(3)	13
	Total	165		209		126		500

Q7 An investigators obtained a frequency distribution of serum retinol at year 0 among males in the vitamin A group, with data, and their normal probabilities as shown in Table. Perform a statistical test to check on the normality assumption. Given your results, do you feel the assumption of normality is warranted? Why or why not? Using $\alpha = 0.05$

Class	f	Normal prob
≤ 1.40	6	0.0867
1.41 - 1.75	22	0.2575
1.76 – 2.10	22	0.3612
2.11 – 2.45	20	0.2107
≥ 2.46	3	0.0839

Q8 The following frequency table summarizes the intelligence quotient (IQ) scores for 200 students with the expected counts in each class. Use $\alpha = 0.05$ to test whether the IQ scores follow the normal distribution.

Classes	Frequency	Expected count
60-75	10	9.1
75-90	30	33.86
90-105	70	65.8
105-120	60	59.5
120-135	25	26.16
135-150	5	5.12

Q9 A random sample of 160 adults who are questioned regarding their gender and opinions on changing the elections rules is taken and the frequency distribution is described below. At 5% level of significance, test the claim that the proportion of males is the same at all opinion levels. The value in parenthesis represent the expected count for each cell.

Gender	favor	indifferent	opposed	Total
Male	25(28.13)	35(35.16)	15(11.72)	75
Female	35(31.88)	40(39.84)	10(13.28)	85
Total	60	75	25	160

Q1

a.

	sex linked	rec	dom	total
English	49	27	55	131
Swiss	1	98	16	115
total	50	125	71	246

b.

	sex linked	rec	dom.	
English	26.63	66.57	37.81	
Swiss	23.37	58.43	33.19	

$E_{11} = \frac{131 \times 50}{246} = 26.63$, $E_{12} = \frac{131 \times 125}{245} = 66.57$ ....

c. $\chi^2 = \sum \frac{(O_{ij} - E_{ij})^2}{E_{ij}} = \frac{(49 - 26.63)^2}{26.63} + \dots + \frac{(16 - 33.19)^2}{33.19}$

$= 107.244$

d. $d.f = (R-1)(C-1) = (2-1)(3-1) = 2.$

$\alpha = 0.05 \rightarrow \chi^2_{0.95}(2) = 5.99.$

e. we rej H_0

Q2

a) False , only one which d.f.

b) False, because chi-square dis. depends on d.f

c) True.

d) False , become less skewed.

e) $9.24 < 10 < 11.07.$

$1 - 0.90 < P\text{-value} < 1 - 0.95$

$0.10 > P\text{-value} > 0.05$ we don't rej H_0 True.

f) False, depends on the hypothesis tested.

Q_3 we are intersted in proportion of people who survived

control: $n = 50$, $x = 11$

Treatment: $m = 40$, $y = 14$

$$p^* = \frac{x+y}{n+m} = \frac{11+14}{50+40} = 0.2778.$$

$$q^* = 1 - p^* = 1 - 0.2778 = 0.7222.$$

Normal conditions:

$$n\,p^*q^* = 50\,(0.2778)\,(0.7222) = 10.03 \geq 5$$
$$m\,p^*q^* = 40\,(0.2778)\,(0.7222) = 8.03 \geq 5$$

yes satisfied.

Q_4

	control		treatment		total
alive	4	9.24	24	18.76	28
Dead	30	24.76	45	50.24	75
total	34		69		103

$$E_{11} = \frac{28 \times 34}{103} = 9.24 \qquad E_{21} = \frac{34 \times 75}{103} = 24.76$$

$$E_{12} = \frac{28 \times 69}{103} = 18.76 \qquad E_{22} = \frac{75 \times 69}{103} = 50.24$$

Q_5

	yes		NO		
support	154	151.47	132	134.53	286
oppese	180	162.07	126	143.93	306
Do not know	104	124.46	131	110.54	235
total	438		389		827.

H_0: there's no association.
H_1: there's an association.

$\alpha = 0.05$.

$$\chi^2 = \sum \frac{(O_{ij} - E_{ij})^2}{E_{ij}} = \frac{(154 - 151.47)^2}{151.47} + \dots + \frac{(131 - 110.54)^2}{110.54} = 11.46$$

$$d.f = (3-1)(2-1) = 2 \rightarrow \chi^2_{0.95}(2) = 5.99 \rightarrow \text{rej } H_0\text{, there's an association.}$$

Q 6 $\chi^2 = \sum \frac{(O_{ij} - E_{ij})^2}{E_{ij}} = \frac{(72-81)^2}{81} + \frac{(97-102)^2}{102} + \cdots + \frac{(4-3)^2}{3}$

$= 16.2995$

$d.f = (R-1)(C-1) = (5-1)(3-1) = 4 \times 2 = 8.$

$15.51 < 16.2995 < 17.53 \Rightarrow 1 - 0.95 > p\text{-value} > 1 - 0.975$

$0.05 > p\text{-value} > 0.025$

since $0.025 > 0.01 \Rightarrow p\text{-value} > 0.01$

∴ we don't rej H_0. ⇒ There's no association ....

Q 7

O	6	22	22	20	3
E	6.63	18.798	26.368	15.381	6.125

$\chi^2 = \sum \frac{(Oi - Ei)^2}{Ei}$

$= \frac{(6-6.63)^2}{6.63} + \frac{(22-18.798)^2}{18.798} + \cdots + \frac{(3-6.125)^2}{6.125}$

$= 0.0594 + 0.545 + 0.724 + 1.387 + 1.594$

$= 5.90$

$d.f = \#$ of categories $- 3 = 3 - 3 = 2.$

$\alpha = 0.05 \rightarrow \chi^2_{0.95}(2) = 5.99$ ⇒ we don't rej H_0.

Data is normally dis.

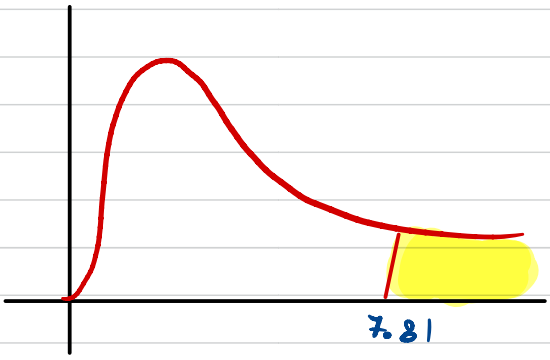
Q8 $\chi^2 = \sum \frac{(O_{ij} - E_{ij})^2}{E_{ij}}$

$= \frac{(10 - 9.1)^2}{9.1} + \frac{(30 - 33.86)^2}{33.86} + \dots + \frac{(5 - 5.12)^2}{5.12} = 0.852.$

d.f $= 6 - 1 - 2 = 3.$

$\chi^2_{0.95}(3) = 7.81$

∴ we don't rej H_0.



Q9 $\chi^2 = \sum \frac{(O_{ij} - E_{ij})^2}{E_{ij}}$

$= \frac{(25 - 28.13)^2}{28.13} + \frac{(35 - 35.16)^2}{35.16} + \dots + \frac{(10 - 13.28)^2}{13.28} = 2.39$

d.f $= (R-1)(C-1) = (2-1)(3-1) = 2.$

$\chi^2_{0.95}(2) = 5.99$

∴ we don't rej H_0.