

(Total)

Chi-Square Test - Assignment

①

Cards	1600 cards	Equally likely (mean): $1600/4 = 400$
Spades	404	400
Hearts	420	400
Diamonds	400	400
Clubs	376	400

$$\text{Chi-Square } \chi^2 \text{ value} = \frac{(\text{Observed} - \text{Expected})^2}{\text{Expected}}$$

$$(404-400)^2 + (420-400)^2 + (400-400)^2 + (376-400)^2 / 400 \\ = 16 + 400 + 0 + 576 / 400 \\ = 992 / 400 = 2.48$$

Null Hypothesis: Equally likely all cards ^(number) when drawn random

Alternate hypothesis: All cards randomly picked when randomly drawn

From Chi-Square distribution table

$$df = 4-1 = 3, \text{ assume } p=0.05$$

χ^2 -value is 7.81

Obtained critical value is $2.48 < 7.81$

Null Hypothesis is not rejected; without discrepancies
the cards can be equally likely by the machine.

②

From above, jokers included

	Observed	Expected	Total Cards = 1662
Jokers	82	62	
Spades	404	400	
Hearts	420	400	
Diamonds	400	400	
Clubs	356	400	

a) Show many Jokers out of 1662? How many from each suit?

$$\frac{62}{400} = \frac{\text{No of Jokers}}{\text{out of each suit}} \\ = 31/200 = 0.155$$

5) Null hypothesis: Equally likely
Alternate hypothesis: Discrepancies (ⁱⁿ cards)

$$\sum \frac{(O-E)^2}{E}$$

$$\frac{(404-400)^2}{400} + \frac{(409-400)^2}{400} + \frac{(409-400)^2}{400} + \frac{(400-386)^2}{400} + \frac{(82-62)^2}{62}$$

$$= \frac{16}{400} + \frac{400}{400} + 0 + \frac{400}{400} + \frac{400}{62}$$

$$= 0.04 + 1 + 0 + 4.84 + 6.451 = 12.331$$

At $df = 5 - 1 = 4$, assume if $\alpha = 0.05$, χ^2 value is 9.49

Obtained value $12.33 > 9.49$ (critical)
we reject Null Hypothesis; No cards are equally drawn
Machine picks cards randomly.

(3)

Null hypo \rightarrow she got predicted outcome as per data
 Alternative hypo \rightarrow No predicted o/p

Strips	Spots	Both	Cot
4	3	9	16
50	41	85	176

$$\text{Expected for Strips} = \frac{4}{16} \times 176$$

$$\text{Expected for Spots} = \frac{3}{16} \times 176 = 33$$

$$\text{Expected for Both} = \frac{9}{16} \times 176 = 99$$

$$\text{Calculating } \chi^2 = \frac{\sum (O-E)^2}{E}$$

$$= \frac{(50-44)^2}{44} + \frac{(41-33)^2}{33} + \frac{(85-99)^2}{99}$$

$$= \frac{36}{44} + \frac{64}{33} + \frac{196}{99}$$

$$= 0.81 + 1.93 + 1.979$$

$$= 4.71$$

χ^2 at df = (3-1) = 2 at p = 0.05, Chi-square value is 5.99

Obtained χ^2 -value $4.71 < 5.99$,

Hence, we accept Null Hypothesis; genetic engineer got predicted outcome.

(Q)

Null hypothesis: Genes assort independently in the pea garden

Alternate hypothesis: Not independent

9: 3: 3: 1

Green Inflated \rightarrow 193

Yellow Constit \rightarrow 184

Yellow Syytal \rightarrow 556

Green Const \rightarrow 61 Total: 994

Calculating Expected value

$$Y \text{ or } E_{\text{all}} = \frac{9}{16} \times 994 = 559.125$$

$$\text{Yellow Count} = \frac{3}{16} \times 994 = 186.375$$

$$\text{Green Yellow Inflat} = \frac{3}{16} \times 994 = 186.375$$

$$\text{Green Const} = \frac{1}{16} \times 994 = 62.125$$

Calculating χ^2 value = $\frac{\sum (O-E)^2}{E}$

= 193

$$\approx \frac{(186.375 - 193)^2}{186.375} + \frac{(184 - 186.375)^2}{186.375} +$$

$$\frac{(556 - 559.125)^2}{559.125} + \frac{(62.125 - 61)^2}{62.125}$$

$$= 0.014 + 0.235 + 0.030 + 0.017 + 0.020$$

$$\chi^2 = 0.3$$

χ^2 at $df=3$, $p=0.05$, from table $\rightarrow \chi^2 = 7.81$

Calculated obtained χ^2 value 0.3 < 7.81, we accept Null Hypothesis, i.e. genes assort independently in the pea garden

⑤

Given:

Store	A	B	C	D	E
No. of shoppers	262	234	204	190	210

Null hypothesis: All stores same visitors / shoppers number

(expected = observed)

Alternate hypothesis: unequal no. of visitors to stores
i.e. expected ≠ observed.

$$\frac{\sum (O - E)^2}{E}$$

$$1100 \text{ shoppers } 5 \text{ stores } 1100/5 = 220$$

$$\frac{(262-220)^2}{220} + \frac{(234-220)^2}{220} + \frac{(204-220)^2}{220} +$$

$$\frac{(190-220)^2}{220} + \frac{(210-220)^2}{220}$$

$$= \frac{1164}{220} + \frac{196}{220} + \frac{256}{220} + \frac{900}{220} + \frac{100}{220}$$

$$= 3216/220 = 14.618$$

χ^2 at df = 5-1 = 4, $\alpha = 0.05$, Chi-Square critical value is 9.488

Obtained Chi-square > critical value, we reject Null hypothesis; Shoppers preference to each store is different.