CHI-SQUARE ASSIGNMENT

POKER MACHINE

(1) A poker m/c deal with cards at random, as if from an infinite deck.

Counted 1600 cards,

Spades = 404 ♠

Hearts = 420 ♡

Diamonds = 400 ♢

Clubs = 376 ♣

Could it be that the suits are equally likely? Or are these discrepancies too much to be random?

Sol^n 1. H_0 : Suits are equally likely

H_1 :- These discrepancies are too much to be random.

2. $\alpha = 0.05$

3. dof = $4 - 1 = 3$

4. χ^2 critical value with $(0.05, 3) = 7.814$

Scanned with CamScanner

If $\chi^2 > 7.81$, reject H_0.

Step - 5 $\chi^2 = \sum \frac{(O_i - E_i)^2}{E_i}$

O_i	E_i	$O_i - E_i$	$(O_i - E_i)^2$
404	400	4	16
420	400	20	400
400	400	0	0
376	400	24	576
			$\Sigma = 992$

$$\chi_i^2 = \sum \frac{(O_i - E_i)^2}{E_i} = \frac{992}{400} = 2.48$$

Step - 6 Results

As $\chi^2_{calc} = 2.48 < \chi^2_{critical} = 7.81$, hence we accept null hypothesis. Hence the suits are equally likely to be drawn.

JOKERS

(2) Same as Prob St 1, jokers are included. Counted 1662 cards.

Spades ♤ = 404 Diamonds = 400

Hearts ♡ = 420 Clubs = 356

Jokers = 82.

a) How many jokers would you expect out of 1662 cards? How many of each suit?

b) Is it possible that cards are really random? Or discrepancies too large?

Sol^n :- Step-1 H_0 :- Cards are not random

H_1 :- Cards are random.

Step-2 : $\alpha = 0.05$

Step-3 dof = 4

Step 4 $\chi^2_{critical} (0.05, 4) = 9.487$

If $\chi^2 > 9.48$, reject H_0.

No. of jokers for a suite of 54 is 2

Hence for 1662 cards $= \frac{2}{54} \times 1662$

$= 61.55 \approx 62$ jokers

Step 5

$$\chi^2 = \sum \frac{(O_i - E_i)^2}{E_i}$$

	O_i	E_i	$O_i - E_i$	$(O_i - E_i)^2$	$\frac{(O_i-E_i)^2}{E_i}$
♠	404	400	4	16	0.04
♡	420	400	20	400	$\frac{400}{400} = 1$
♢	400	400	0	0	0
♣	356	400	44	1936	$\frac{1936}{400} = 4.84$
Jokers	82	62	20	400	$\frac{400}{62} = 6.45$
					$\Sigma = 12.3316$

$\chi^2 = 12.33$

As $\chi^2_{calculated} = 12.33 > \chi^2_{critical} = 9.487$, hence we are rejecting H_0. Therefore the discrepancies are too large for the cards to be random. We can also infer that there are too many jokers instead of clubs.

③ GENETICS

Cross a tiger & cheetah.
She predicted a phenotypic outcome

Ratio:
- Stripes : 4
- Spots : 3
- Both : 9

Total = 4+3+9 = 16

After cross was performed, she found

- Stripes : 50
- Spots : 41
- Both : 85

Acc to χ^2, did she get predicted outcome?

Soln

1) H_0 :- She got predicted outcome
H_1 :- She didn't get predicted outcome

2) $\alpha = 0.05$

3) $df = 3 - 1 = 2$

4) $\chi^2_{critical} = 5.99$ (for $\alpha = 0.05$, $df = 2$

3) Expected

Expected	Observed counts	Expected counts	$(O-E)^2$	$\frac{(O-E)^2}{E}$
4 stripes	50	$\frac{4}{16} \times 176 = 44$	$(6)^2 = 36$	0.82
3 spots	41	$\frac{3}{16} \times 176 = 33$	$(8)^2 = 64$	1.94
9 both	85	$\frac{9}{16} \times 176 = 99$	$(-14)^2 = 196$	1.98
Total → 16 total	176		Sum	4.74

4) As $\left(X^2_{calc} = 4.74 < X^2_{critical} = 5.99\right)$, hence we can accept null hypothesis. The genetics engineer did get the predicted outcome.

5) GARDEN PEA

Yellow cotyledon is dominant to green.

Inflated pod is dominant to constricted.

SELF fertilized hybrids:

$\boxed{\text{Genes } (9:3:3:1)}$

Green inflated	193
Yellow constricted	184
Yellow inflated	556
Green constricted	61

Expected values

	Observed	Ratio	Expected counts	$(O-E)^2$	$\frac{(O-E)^2}{E}$
GI	193	3	$\frac{3}{16} \times 994 = 186$	$(7)^2 = 49$	$\frac{49}{186} = 0.26$
YC	184	3	186	$(-2)^2 = 4$	$\frac{4}{186} = 0.02$
YI	556	9	$\frac{9}{16} \times 994 = 559$	$(-3)^2 = 9$	$\frac{9}{559} = 0.016$
GC	61	1	$\frac{1}{16} \times 994 = 62$	$(-1)^2 = 1$	$\frac{1}{62} = 0.016$
Total	994			Sum	$= 0.312$

$X_{critical}\ (df = 3,\ \alpha = 0.05) = 7.81$

As here $X_{calc} = 0.312 < X_{critical} = 7.81$, so we accept null hypothesis. The genes assort independently according to 9:3:3:1 ratio and are not on same chromosome.

5) DEPARTMENT STORE

- A dept. store has 4 competitors B, C, D, E.
Store A hires a consultant to determine "% of shoppers who prefer each of 5 stores is same."
A survey of 1100 randomly people, and the results :

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

Total = 1100

Is there enough evidence using $\alpha = 0.05$, to conclude that the proportions are really the same ?

Step 1

H_0 : The proportions are the same

H_1 : the proportions are not the same.

Step-2. $\alpha = 0.05$

Step-3 : $df = 5 - 1 = 4$

Step-4 : $\chi^2_{critical} (\alpha = 0.05, df = 4) = 9.488$

Step-5

Preference	% of shoppers.	Expected	Observed	$(O-E)^2$	$\frac{(O-E)^2}{E}$
A	20%	$0.2 \times 1100 = 220$	262	$(42)^2$	$\frac{1764}{220} = 8.018$
B	20%	220	234	$(14)^2$	0.891
C	20%	220	204	$(-16)^2$	1.163
D	20%	220	190	$(-30)^2$	4.091
E	20%	220	210	$(-10)^2$	0.455
				Sum	14.618

Step-6 Results.

As $\chi^2_{(calculated)} = 14.61 > \chi^2_{(critical)} = 9.488$,

hence we reject null hypothesis. Hence it is proved that customers do not prefer ~~all~~ each stores equally.