

Group Members:

- 1) Khor Yong Xin (A19E00061)
- 2) Ham Jing Yi (A19E00048)
- 3) Tee Hui You (A19E00170)

Question 1

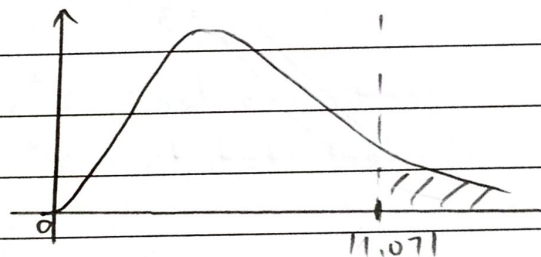
a) $k=6, n=36, \alpha=0.05$

$H_0: p_1 = p_2 = p_3 = p_4 = p_5 = p_6$

H_1 : At least 1 of the 6 proportions is different from others

Card	O	$E = \frac{n}{k}$	O-E	$(O-E)^2$	$(O-E)^2/E$	$df = k-1$
1	8	6	2	4	$\frac{2}{3}$	= 5
2	5	6	-1	1	$\frac{1}{6}$	
3	9	6	3	9	$\frac{3}{2}$	
4	2	6	-4	16	$\frac{8}{3}$	
5	7	6	1	1	$\frac{1}{6}$	
6	5	6	-1	1	$\frac{1}{6}$	

critical value: $\chi^2_{5,0.05} = 11.071$



$$\begin{aligned} \text{test statistic, } \chi^2 &= \sum \frac{(O-E)^2}{E} \\ &= \frac{2}{3} + \frac{1}{6} + \frac{3}{2} + \frac{8}{3} + \frac{1}{6} + \frac{1}{6} \\ &= 5.3333 \end{aligned}$$

Decision:

Test statistic (5.3333) < critical value (11.701). Test statistic does not lie in critical region. H_0 is failed to be rejected.

Conclusion:

There is sufficient evidence to prove that the device is not biased at significance level, $\alpha = 0.05$.

$$b) i) n = 9 + 60 + 17 + 19$$

$$= 105$$

Range	Proportion	O	E = np
Above 1	0.159	9	16.695
0 to 1	0.341	60	35.805
-1 to 0	0.341	17	35.805
Below -1	0.159	19	16.695

$$ii) H_0: p_1 = 0.159, p_2 = 0.341, p_3 = 0.341, p_4 = 0.159$$

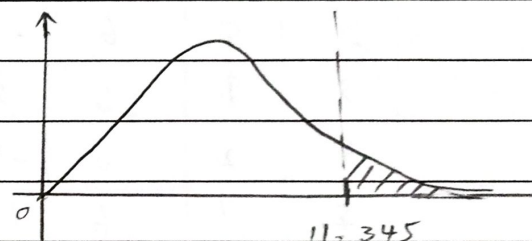
H_1 : At least one of the four proportions is different from the claimed value

$$k = 4, df = 4 - 1, \alpha = 0.01$$

$$= 3$$

$$\text{critical value: } \chi^2_{3, 0.01} = 11.345$$

$$\text{test statistic: } \chi^2 = 12.156$$



Decision:

test statistic (12.156) > critical value (11.345). Test statistic lies in the critical region. Hence, H_0 is rejected.

Conclusion:

There is sufficient evidence to reject that CGPA distribution of the final year students is normally distributed at $\alpha = 0.01$.

c) H_0 : No relationship between texture and colour

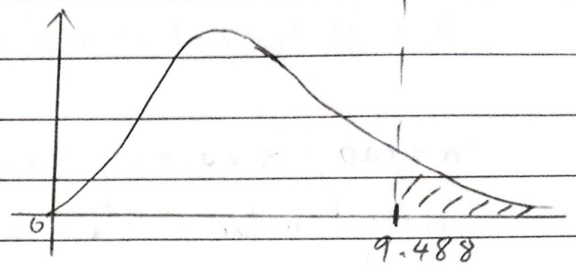
H_1 : Relationship exist between texture and colour

$$\alpha = 0.05, df = (r-1)(c-1)$$

$$= (3-1)(3-1)$$

$$= 4$$

$$\text{critical value : } \chi^2_{4,0.05} = 9.488$$



	Colour			
Texture	Light	Medium	Dark	Total
Fine	4	20	8	32
Medium	5	23	12	40
Coarse	21	23	4	48
Total	30	66	24	120

Cell (i,j)	O	$E = np$	$(O-E)$	$(O-E)^2$	$(O-E)^2/E$	test statistic, χ^2
1, 1	4	$\frac{32(30)}{120} = 8$	-4	16	2.0000	$= \sum \frac{(O-E)^2}{E}$
1, 2	20	$\frac{32(66)}{120} = 17.6$	2.4	5.76	0.3273	$= 2 + 0.3273 + 0.4$
1, 3	8	$\frac{32(24)}{120} = 6.4$	1.6	2.56	0.4000	$+ 2.5 + 0.0455 + 2$
2, 1	5	$\frac{40(30)}{120} = 10$	-5	25	2.5000	$+ 6.75 + 0.4379 +$
2, 2	23	$\frac{40(66)}{120} = 22$	1	1	0.0455	3.2667
2, 3	12	$\frac{40(24)}{120} = 8$	4	16	2.0000	$= 17.7274$
3, 1	21	$\frac{48(30)}{120} = 12$	9	81	6.7500	
3, 2	23	$\frac{48(66)}{120} = 26.4$	-3.4	11.56	0.4379	
3, 3	4	$\frac{48(24)}{120} = 9.6$	-5.6	31.36	3.2667	

Decision:

Test statistic (17.7274) > critical value (9.488). Test statistic lies in the critical region. Hence, H_0 is rejected.

Conclusion:

There is sufficient evidence to conclude that relationship exist between colour and texture for these waste materials at $\alpha = 0.05$.

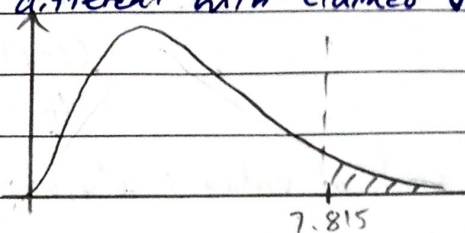
Question 2

a) $H_0: p_1 = 0.56, p_2 = 0.19, p_3 = 0.19, p_4 = 0.06$

H_1 : At least 1 of the 4 proportions is different with claimed value

$\alpha = 0.05, k = 4, df = 3$

critical value: $\chi^2_{3,0.05} = 7.815$



Mice	O	E = np	(O-E)	(O-E) ²	(O-E) ² /E
Brown, pink	120	0.56 (217) = 121.52	-1.52	2.3104	0.01900
Brown, brown	48	0.19 (217) = 41.23	6.77	45.8329	1.11160
White, pink	36	0.19 (217) = 41.23	-5.23	27.3529	0.66340
White, brown	13	0.06 (217) = 13.02	-0.02	0.0004	0.00003

$n = 120 + 48 + 36 + 13$

$= 217$

test statistic, $\chi^2 = \sum \frac{(O-E)^2}{E}$

$= 0.01900 + 1.11160 + 0.66340 + 0.00003$

$= 1.79403$

Decision:

Test statistic (1.79403) < Critical value (7.815). Test statistic does not lies in the critical region. Hence, H_0 failed to be rejected.

Conclusion:

At $\alpha = 0.05$, there is sufficient evidence to conclude the compatibility of data with claimed theory. These types of mice should be obtained with genetic percentage of 56%, 19%, 19% and 6% respectively.

- b) H_0 : There is no homogeneity among the shops' repair distribution
 H_1 : There is homogeneity among the shops' repair distribution

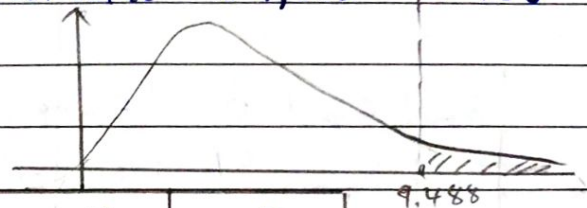
	Shop			
Repair	1	2	3	Total
Complete	78	56	54	188
Adjustment	15	30	31	76
Incomplete	7	14	15	36
Total	100	100	100	300

$$\alpha = 0.05, df = (r-1)(c-1)$$

$$= (3-1)(3-1)$$

$$= 4$$

$$\text{critical value: } \chi^2_{4,0.05} = 9.488$$



Cell (i,j)	O	$E = np$	$(O-E)$	$(O-E)^2$	$(O-E)^2/E$
1,1	78	$\frac{(100)(188)}{300} = 62.67$	15.33	235.0089	3.7499
1,2	56	$\frac{100(188)}{300} = 62.67$	-6.67	44.4444	0.7092
1,3	54	$\frac{100(188)}{300} = 62.67$	-8.67	75.1689	1.1994
2,1	15	$\frac{100(76)}{300} = 25.33$	-10.33	106.7089	4.2127
2,2	30	$\frac{100(76)}{300} = 25.33$	4.67	21.8089	0.8610
2,3	31	$\frac{100(76)}{300} = 25.33$	5.67	32.1489	1.2692
3,1	7	$\frac{100(36)}{300} = 12.00$	-5.00	25.0000	2.0833
3,2	14	$\frac{100(36)}{300} = 12.00$	2.00	4.0000	0.3333
3,3	15	$\frac{100(36)}{300} = 12.00$	3.00	9.0000	0.7500

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

$$= 3.7499 + 0.7092 + 1.1994 + 4.2127 + 0.8610 + 1.2692$$

$$+ 2.0833 + 0.3333 + 0.7500$$

$$= 15.168$$

Decision:

Test statistic (15.168) > Critical value (9.488). Test statistic lies in the critical region. Hence, H_0 is rejected.

Conclusion:

There sufficient evidence to conclude that there is homogeneity among the shops' repair distribution at $\alpha = 0.05$.

Question 3

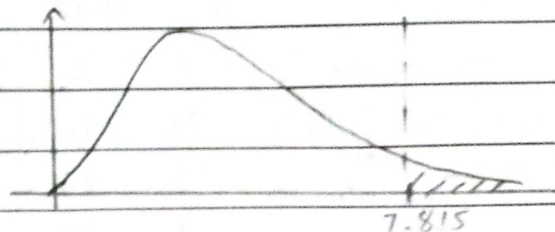
a) i) $H_0: P_0 = 0.44, P_A = 0.45, P_B = 0.08, P_{AB} = 0.03$

H_1 : At least 1 of the 4 proportions is different with the claimed value

$$1 - \alpha = 0.95$$

$$n = 187, k = 4, df = 3, \alpha = 0.05$$

$$\text{critical value: } \chi^2_{3, 0.05} = 7.815$$



Blood Grp	O	E = np	(O-E)	(O-E) ²	(O-E) ² /E
O	67	$187(0.44) = 82.28$	-15.28	233.4784	2.8376
A	83	$187(0.45) = 84.15$	-1.15	1.3225	0.0157
B	29	$187(0.08) = 14.96$	14.04	197.1216	13.1766
AB	8	$187(0.03) = 5.61$	2.39	5.7121	1.0182
Total	187				

$$\begin{aligned} \text{Test statistic, } \chi^2 &= \sum \frac{(O-E)^2}{E} \\ &= 2.8376 + 0.0157 + 13.1766 + 1.0182 \\ &= 17.0481 \end{aligned}$$

Decision:

Test statistic (17.0481) > Critical value (7.815) - Test statistic lies in critical region. Hence, H_0 is rejected.

ii) Conclusion:

There is sufficient evidence to conclude that the distribution of blood group is different from the claimed value at 95% confidence level.

b) i) H_0 : There is no relationship between students' achievement in Mathematics and Science subjects.

H_1 : There is relationship between students' achievement in Mathematics and Science subjects.

ii)

Subject	Achievement (%)				Total
	A	B	C	D	
Math	14.7	18.3	18.4	27.0	78.4
Sci	6.8	32.0	36.2	19.4	94.4
Total	21.5	50.3	54.6	46.4	172.8

Cell (i, j)	O	$E = np$	$(O-E)$	$(O-E)^2$	$(O-E)^2/E$
1, 1	14.7	$\frac{78.4(21.5)}{172.8} = 9.75$	4.95	24.5025	2.5131
1, 2	18.3	$\frac{78.4(50.3)}{172.8} = 22.82$	-4.52	20.4303	0.8953
1, 3	18.4	$\frac{78.4(54.6)}{172.8} = 24.77$	-6.37	40.5769	1.6381
1, 4	27.0	$\frac{78.4(46.4)}{172.8} = 21.05$	5.95	35.4025	1.6818
2, 1	6.8	$\frac{94.4(21.5)}{172.8} = 11.75$	-4.95	24.5025	2.0853
2, 2	32.0	$\frac{94.4(50.3)}{172.8} = 27.48$	4.52	20.4303	0.7435
2, 3	36.2	$\frac{94.4(54.6)}{172.8} = 29.83$	6.37	40.5769	1.3603
2, 4	19.4	$\frac{94.4(46.4)}{172.8} = 25.35$	-5.95	35.4025	1.3965

Test statistic: $\chi^2 = \sum \frac{(O-E)^2}{E}$

$$= 2.5131 + 0.8953 + 1.6381 + 1.6818 + 2.0853 + 0.7435 + 1.3603 + 1.3965$$

$$= 12.3139$$

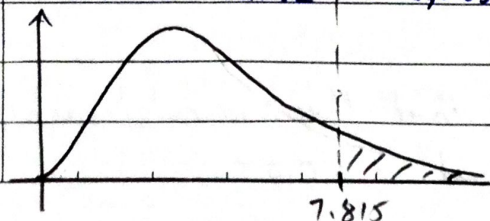
iii) $df = (r-1)(c-1)$, $\alpha = 0.05$

$$= (2-1)(4-1)$$

$$= 3$$

Decision: Test statistic > critical value
Test statistic lies in critical region
 H_0 is rejected.

critical value: $\chi^2_{3,0.05} = 7.815$



Conclusion:

There is sufficient evidence to conclude that there is relationship between achievements of Mathematics and Science subjects at $\alpha = 0.05$.