

### Problem Statement 1:

Is gender independent of education level? A random sample of 395 people were surveyed and each person was asked to report the highest education level they obtained. The data that resulted from the survey is summarized in the following table:

High School Bachelors Masters Ph.d. Total

Female 60 54 46 41 201

Male 40 44 53 57 194

Total 100 98 99 98 395

Question: Are gender and education level dependent at 5% level of significance? In other words, given the data collected above, is there a relationship between the gender of an individual and the level of education that they have obtained?

To check if the variables gender and education are independent or not, we need to use chi-square test to find it.

**Null hypothesis H0=Gender and education are independent**

**H1= Gender and education are dependent**

Observed	High School	Bachelors	Masters	Ph.d.	Total
Female	60	54	46	41	201
Male	40	44	53	57	194
Total	100	98	99	98	395

The above table are details of observed data. To find the expected data, the expected data is the total sum of each gender divided by total sum of each education divided by the total number of samples

Expected	High School	Bachelors	Masters	Ph.d.	Total
Female	50.88607595	49.86835	50.3772152	49.86835443	
Male	49.11392405	48.13165	48.6227848	48.13164557	

So,chi square formula is

$$\chi^2 = \sum \frac{(\text{observed} - \text{expected})^2}{\text{expected}}$$

Hence value is =  $(60-50.86)^2/50.86 + (54-49.86)^2/49.86 + (46-50.37)^2/50.37 + (41-49.86)^2/49.86 + (49.11-40)^2/49.11 + (44-48.13)^2/48.13 + (48.62-53)^2/48.67 + (48.13-57)^2/48.13$

Chi square  $\chi^2 = 8.006$

At 5% significance level ,degree of freedom=4-1=3,chi square critical value is 7.815  
Hence chi square test value > chi square critical value and hence the null hypothesis can be rejected.Gender and education are dependent at a significance level of 5%

**Problem Statement 2:**

Using the following data, perform a oneway analysis of variance using  $\alpha=.05$ . Write up the results in APA format.

[Group1: 51, 45, 33, 45, 67]

[Group2: 23, 43, 23, 43, 45]

[Group3: 56, 76, 74, 87, 56]

$H_0$ = All means are equal

$H_1 \neq$  all means are equal

Group 1	51	45	33	45	67
Group 2	23	43	23	43	45
Group 3	56	76	74	87	56

	Group1	Group 2	Group 3	G1- G1mean	(G1- G1Mean) <sup>2</sup>	G2- G2Mean	(G2- G2Mean) <sup>2</sup>	G3- G3Mean	(G3- G3Mean) <sup>2</sup>
	51	23	56	2.8	7.84	-12.4	153.76	-13.8	190.44
	45	43	76	-3.2	10.24	7.6	57.76	6.2	38.44
	33	23	74	-15.2	231.04	-12.4	153.76	4.2	17.64
	45	43	87	-3.2	10.24	7.6	57.76	17.2	295.84
	67	45	56	18.8	353.44	9.6	92.16	-13.8	190.44
<b>Total</b>	241	177	349		<b>612.8</b>		<b>515.2</b>		<b>732.8</b>
<b>Mean</b>	<b>48.2</b>	<b>35.4</b>	<b>69.8</b>						
<b>Grand Mean</b>	<b>51.13</b>								

$K=2$

$$SS_{\text{between}} = 5 \cdot (48.2 - 51.13)^2 + 5 \cdot (35.4 - 51.13)^2 + 5 \cdot (69.8 - 51.13)^2$$

$$= 3022.93$$

$$MS_{\text{ST}} = SS_{\text{between}} / 2 = 4861714.2 / 2$$

$$= 1511.46$$

$$SS_{\text{Within}} = 612.8 + 515.2 + 732.8 = 1860.8$$

$$MS_{\text{SE}} = SS_{\text{Within}} / (N - k) = 1860.8 / (15 - 3) = 155.067$$

$$F_{\text{stats}} = MS_{\text{ST}} / MS_{\text{SE}}$$

$$F \text{ stat} = 1511.46 / 155.067 = \mathbf{9.74}$$

For  $\alpha=0.05$ , to find f table

Degree of freedom =  $15-3 = 12$

F(critical)for (12,3)=3.4903

**F critical < F test ,hence reject the null hypothesis H0 . All the groups are not the same.**

### Problem Statement 3:

Calculate F Test for given 10, 20, 30, 40, 50 and 5,10,15, 20, 25.

For 10, 20, 30, 40, 50:

	Group 1	Group 2	G1-G1mean	(G1-(G1Mean) <sup>2</sup>	G2-G2Mean	(G2-G2Mean) <sup>2</sup>
	10	5	-20	400	-10	100
	20	10	-10	100	-5	25
	30	15	0	0	0	0
	40	20	10	100	5	25
	50	25	20	400	10	100
<b>Total</b>	150	75		1000		250
<b>Mean</b>	30	15				
<b>Grand Mean</b>	22.5					

$$SS_{\text{between}} = 5 \cdot (30 - 22.5)^2 + 5 \cdot (15 - 22.5)^2$$

$$= 562.5$$

$$MS_{\text{ST}} = 562.5 / 1 = 562.5$$

$$SS_{\text{within}} = 1000 + 250 = 1250$$

$$MS_{\text{SE}} = 1250 / (10 - 2) = 1250 / 8 = 156.25$$

$$F(\text{test}) = MS_{\text{ST}} / MS_{\text{SE}} = 562.5 / 156.25$$

$$= \mathbf{3.6}$$

The F value for this group of values is 3.6