

Problem on one criterion classification

P - In hypothetical experiment of 48 subjects are assigned at random to groups of 6 subjects each. These groups are tested under 8 different experimental conditions, designed respectively A, B, C, D, E, F, G and H

Conditions										
A	B	C	D	E	F	G	H			
64	73	77	78	63	73	78	55			
72	61	83	91	65	93	46	66			
68	90	97	97	44	78	41	49			
77	80	69	82	77	71	50	64			
56	97	79	85	63	63	69	70			
95	67	87	77	76	76	82	68			

Prepare the table of analysis of variance to test the significance of difference among 8 condition means

Solution: We set up the null hypothesis that there is no significant difference among the conditions means.

Since we have to test of significance of difference among 8 conditions means so we take these 8 conditions as 8 classes (groups) and the calculation of variance between and within classes are made according the following table by taking origin at $x = 69$

Conditional

							S_i	$\frac{S_i^2}{n}$	$\sum x_{ij}^2$
A	64	72	68	77	56	95	18	54	944
	-5	3	-1	8	-13	26			
	25	9	1	64	169	676			
B	73	61	90	80	97	67	54	486	1430
	4	-8	21	11	28	-2			
	16	64	441	121	784	4			
C	77	83	97	69	79	87	78	1014	468
	8	14	28	0	10	18			
	64	196	784	0	100	324			
D	78	91	97	82	85	77	96	1536	1838
	9	22	29	13	16	8			
	81	484	784	169	256	64			
E	63	65	44	77	63	76	-26	112.67	826
	-6	-4	-25	8	-6	7			
	36	16	625	64	36	49			
F	73	93	78	71	63	76	40	266.67	662
	4	24	9	2	-6	7			
	16	476	81	4	36	49			
G	78	46	41	56	69	82	-48	384	1924
	9	-23	-28	-19	0	13			
	81	529	784	361	0	169			
H	55	66	49	64	70	68	-42	294	642
	-14	-3	-20	-5	1	-1			
	196	9	400	25	1	1			
	$\frac{S^2}{N} = 602.08$						$S=170$	$\frac{\sum (S_i^2)}{n} = 4147.34$	$\sum \sum x_{ij}^2 = 9734$

Sum of square between conditions

$$= \sum \left(\frac{\sum x_i}{n} \right)^2 - \frac{S^2}{N} = 4147.34 - 602.08$$

$$= 3545.26$$

$$\text{Total sum of square} = \sum \sum x_{ij}^2 - \frac{S^2}{N}$$

$$= 9734 - 602.08$$

$$= 9131.92$$

∴ Sum of squares within conditions

$$= \text{Total sum of square} - \text{Sum of squares between conditions}$$

$$= 9131.92 - 3545.26 = 5586.66$$

ANOVA Table

Source of variation	Sum of Square	Degree of freedom	Mean Square	F
Between conditions	SSC = 3545.26	k-1 = 7	MSC = $\frac{SSC}{k-1}$ = 506.46	F = $\frac{MSC}{MSE}$ = $\frac{506.46}{139.66}$ = 3.63
Within conditions	SSE = 5586.66	N-k = 40	MSE = $\frac{SSE}{N-k}$ = 139.66	
Total	SST = 9131.92	N-1 = 47		

From table the value of F for $\nu_1 = 7$ and $\nu_2 = 40$ at 5% level is 2.24 which is less than the calculated value i.e. 3.63. Hence the difference is significant.