

Chapter 11

ANOVA

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- ANOVA test is a method used to determine the mean of two or more groups. By using Anova, you can find out about the difference in mean between groups.
 - ANOVA Single Factor;
 - ANOVA Two Factor Without Replication;
 - ANOVA Two Factor With Replication.

- The only difference between one-way and two-way ANOVA is the number of independent variables. A one-way ANOVA has one independent variable, while a two-way ANOVA has two.

- Example, ANOVA Single Factor (1)

Brand A	Brand B	Brand C
78	73	81
83	75	85
74	78	79
77	75	85
85	76	78
81	78	87
83	79	84
75	74	85
76	75	81
79	73	79

- Answer, ANOVA Single Factor (1)

SUMMARY

<i>Groups</i>	<i>Count</i>	<i>Sum</i>	<i>Average</i>	<i>Variance</i>
Brand A	10	791	79,1	14,1
Brand B	10	756	75,6	4,48888889
Brand C	10	824	82,4	10,0444444

ANOVA

<i>Source of Variation</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>	<i>F crit</i>
Between Groups	231,266667	2	115,633333	12,1152503	0,0001757	3,35413083
Within Groups	257,7	27	9,54444444			
Total	488,966667	29				

- Example, ANOVA Single Factor (2)

Brand A	Brand B	Brand C
8,5	8,3	8,5
7,8	8,5	8,3
8,7	7,9	7,9
8,4	8,5	8,5
8,5	8,1	8,5
8,3	8,3	7,8
7,9	7,9	8,7
7,4	7,4	8,5
7,5	7,5	8,1
7,9	7,3	7,9

- Answer, ANOVA Single Factor (2)

SUMMARY

<i>Groups</i>	<i>Count</i>	<i>Sum</i>	<i>Average</i>	<i>Variance</i>
Brand A	10	80,9	8,09	0,20322222
Brand B	10	79,7	7,97	0,20011111
Brand C	10	82,7	8,27	0,10233333

ANOVA

<i>Source of Variation</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>	<i>F crit</i>
Between Groups	0,456	2	0,228	1,35266974	0,27551471	3,35413083
Within Groups	4,551	27	0,16855556			
Total	5,007	29				

- Example, Anova Two Factori Without Replication (1)

INFO	BRANCH A	BRANCH B	BRANCH C
CONCEPT 1	3735	3945	3565
CONCEPT 2	3425	3590	3375
CONCEPT 3	3660	3785	3530

- Answer, Anova Two Factori Without Replication (1)

<i>SUMMARY</i>	<i>Count</i>	<i>Sum</i>	<i>Average</i>	<i>Variance</i>
CONCEPT 1	3	11245	3748,33333	36233,3333
CONCEPT 2	3	10390	3463,33333	12658,3333
CONCEPT 3	3	10975	3658,33333	16258,3333
BRANCH A	3	10820	3606,66667	26158,3333
BRANCH B	3	11320	3773,33333	31608,3333
BRANCH C	3	10470	3490	10225

ANOVA

<i>Source of Variation</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>	<i>F crit</i>
Rows	127350	2	63675	29,5019305	0,00403075	6,94427191
Columns	121666,667	2	60833,3333	28,1853282	0,00439004	6,94427191
Error	8633,33333	4	2158,33333			
Total	257650	8				

- Example, Anova Two Factori Without Replication (2)

INFO	BRANCH A	BRANCH B	BRANCH C
CONCEPT 1	250	390	340
CONCEPT 2	180	240	230
CONCEPT 3	350	320	350

- Answer, Anova Two Factori Without Replication (2)

<i>SUMMARY</i>	<i>Count</i>	<i>Sum</i>	<i>Average</i>	<i>Variance</i>
CONCEPT 1	3	980	326,666667	5033,33333
CONCEPT 2	3	650	216,666667	1033,33333
CONCEPT 3	3	1020	340	300
BRANCH A	3	780	260	7300
BRANCH B	3	950	316,666667	5633,33333
BRANCH C	3	920	306,666667	4433,33333

ANOVA

<i>Source of Variation</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>	<i>F crit</i>
Rows	27488,8889	2	13744,4444	7,58895706	0,0435028	6,94427191
Columns	5488,88889	2	2744,44444	1,51533742	0,32368752	6,94427191
Error	7244,44444	4	1811,11111			
Total	40222,2222	8				

- Example, Anova Two Factori With Replication (1)

INFO	BRANCH A	BRANCH B	BRANCH C
CONCEPT 1	29	32	38
	28	29	30
CONCEPT 2	25	27	31
	24	30	29
CONCEPT 3	30	35	36
	30	32	35

- Answer, Anova Two Factori With Replication (1)

CONCEPT 1						
Count	2	2	2	6		
Sum	57	61	68	186		
Average	28,5	30,5	34	31		
Variance	0,5	4,5	32	13,6		
CONCEPT 2						
Count	2	2	2	6		
Sum	49	57	60	166		
Average	24,5	28,5	30	27,6666667		
Variance	0,5	4,5	2	7,86666667		
CONCEPT 3						
Count	2	2	2	6		
Sum	60	67	71	198		
Average	30	33,5	35,5	33		
Variance	0	4,5	0,5	7,2		
Total						
Count	6	6	6			
Sum	166	185	199			
Average	27,6666667	30,8333333	33,16667			
Variance	6,66666667	7,7666667	13,36667			
ANOVA						
<i>Source of Variation</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>	<i>F crit</i>
Sample	87,1111111	2	43,55556	8	0,0100777	4,25649473
Columns	91,4444444	2	45,72222	8,39795918	0,00875209	4,25649473
Interaction	2,88888889	4	0,722222	0,13265306	0,96637048	3,63308851
Within	49	9	5,444444			
Total	230,444444	17				

- Example, Anova Two Factori With Replication (2)

INFO	BRANCH A	BRANCH B	BRANCH C
CONCEPT 1	156	150	178
	123	128	166
	100	116	155
CONCEPT 2	150	132	145
	120	187	131
	135	175	140
CONCEPT 3	180	138	206
	156	186	185
	146	176	165

- Answer, Anova Two Factori With Replication (2)

<i>CONCEPT 1</i>						
Count	3	3	3	9		
Sum	379	394	499	1272		
Average	126,3333	131,3	166,33333	141,333333		
Variance	792,3333	297,3	132,33333	661,75		
<i>CONCEPT 2</i>						
Count	3	3	3	9		
Sum	405	494	416	1315		
Average	135	164,7	138,66667	146,111111		
Variance	225	836,3	50,333333	474,111111		
<i>CONCEPT 3</i>						
Count	3	3	3	9		
Sum	482	500	556	1538		
Average	160,6667	166,7	185,33333	170,888889		
Variance	305,3333	641,3	420,33333	465,861111		
<i>Total</i>						
Count	9	9	9			
Sum	1266	1388	1471			
Average	140,6667	154,2	163,44444			
Variance	569,75	739,2	563,77778			
ANOVA						
<i>Source of Variation</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>	<i>F crit</i>
Sample	4530,889	2	2265,4444	5,50954783	0,01359245	3,55455715
Columns	2362,889	2	1181,4444	2,87326608	0,08261345	3,55455715
Interaction	3049,556	4	762,38889	1,85412538	0,16250283	2,92774417
Within	7401,333	18	411,18519			
Total	17344,67	26				