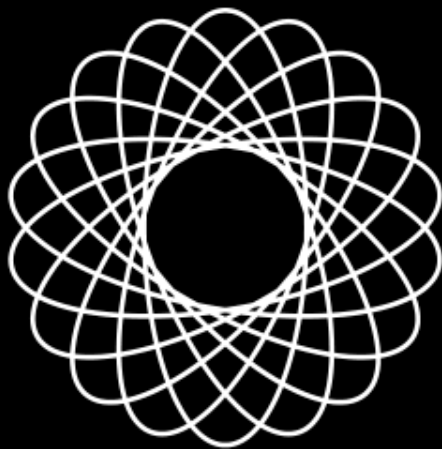


DATA SCIENCE



Agenda

Anova

- **One Way**
- Two Way
- Post Hoc Tests

Chi Square

- Association Tests
- Goodness-of-fit Tests

Chi Square Parametric

- Tests of Variance



Anova Calculations



Anova Calculations

How do we calculate the within group variations?

- Calculate the variance for each group, and then calculate an average across groups



Anova Calculations

How do we calculate the within group variations?

- Calculate the variance for each group, and then calculate an average across groups

Between group variation?

- Calculate the average of the square variations of each population mean from the mean for all the data (**Grand Mean**)



Anova Calculations

Within Group Variance



Anova Calculations

Within Group Variance

1. Calculate the Mean for each group



Anova Calculations

Within Group Variance

1. Calculate the Mean for each group
2. Subtract each sample mean from every score in that group



Anova Calculations

Within Group Variance

1. Calculate the Mean for each group
2. Subtract each sample mean from every score in that group
3. Square the difference



Anova Calculations

Within Group Variance

1. Calculate the Mean for each group
2. Subtract each sample mean from every score in that group
3. Square the difference
4. Add up all the squared Differences



Anova Calculations

Within Group Variance

1. Calculate the Mean for each group
2. Subtract each sample mean from every score in that group
3. Square the difference
4. Add up all the squared Differences

The SSW (Sum of Squares, Within) can be written as

$$SSW = \sum_K \sum_J (Y_{jk} - \bar{Y}_K)^2$$



Anova Calculations

Between Group Variance



Anova Calculations

Between Group Variance

1. Calculate a Grand Mean for all observations across all groups



Anova Calculations

Between Group Variance

1. Calculate a Grand Mean for all observations across all groups
2. Subtract each grand mean from each sample mean



Anova Calculations

Between Group Variance

1. Calculate a Grand Mean for all observations across all groups
2. Subtract each grand mean from each sample mean
3. Square these differences



Anova Calculations

Between Group Variance

1. Calculate a Grand Mean for all observations across all groups
2. Subtract each grand mean from each sample mean
3. Square these differences
4. Multiply each squared score by sample size



Anova Calculations

Between Group Variance

1. Calculate a Grand Mean for all observations across all groups
2. Subtract each grand mean from each sample mean
3. Square these differences
4. Multiply each squared score by sample size
5. Add them all up



Anova Calculations

Between Group Variance

1. Calculate a Grand Mean for all observations across all groups
2. Subtract each grand mean from each sample mean
3. Square these differences
4. Multiply each squared score by sample size
5. Add them all up

The SSW (Sum of Squares, Within) can be written as

$$SSB = \sum_{k=1}^K N_k (\bar{Y}_k - \bar{Y})^2$$



Anova Calculations

We have:

SSW (Sum of squares, within)

SSB (Sum of squares, between)

We need to divide each quantity by the appropriate degrees of freedom:



Anova Calculations

We have:

SSW (Sum of squares, within)

SSB (Sum of squares, between)

We need to divide each quantity by the appropriate degrees of freedom:

$MSW = SSW/DFW$, where $DFW = n - k$



Anova Calculations

We have:

SSW (Sum of squares, within)

SSB (Sum of squares, between)

We need to divide each quantity by the appropriate degrees of freedom:

$MSW = SSW/DFW$, where $DFW = n-k$

$MSB = SSB/DFB$, where $DFB = k-1$



Anova Calculations

Retail example

Data				
Shelf 1	Shelf 2	Shelf 3	Shelf 4	Shelf 5
210.5	198.1	170.5	167.1	188.5
198.1	189	225.5	167.9	177.7
145.3	210.3	158	175.5	176.5
185.5	254.4	139.4	175	158
189.1	210.3	156.4	149.1	174.5
135.9	160.9	217.1	189.3	181.7
180	120.8	189.1	198.2	176.2
149.4	167.8	158.2	205	177.9
176.4	148.9	218.1	233.5	189.1
229	190.4	178.9	167.9	187.1
179.92	185.09	181.12	182.85	178.72
Total sum of squared differences: Within				34735.02



Anova Calculations

Retail example

$$SSW = 34735$$

Data				
Shelf 1	Shelf 2	Shelf 3	Shelf 4	Shelf 5
210.5	198.1	170.5	167.1	188.5
198.1	189	225.5	167.9	177.7
145.3	210.3	158	175.5	176.5
185.5	254.4	139.4	175	158
189.1	210.3	156.4	149.1	174.5
135.9	160.9	217.1	189.3	181.7
180	120.8	189.1	198.2	176.2
149.4	167.8	158.2	205	177.9
176.4	148.9	218.1	233.5	189.1
229	190.4	178.9	167.9	187.1
179.92	185.09	181.12	182.85	178.72
Total sum of squared differences: Within				34735.02



Anova Calculations

Retail example

$$SSW = 34735$$

$$DFW = (50 - 5) = 45$$

Data				
Shelf 1	Shelf 2	Shelf 3	Shelf 4	Shelf 5
210.5	198.1	170.5	167.1	188.5
198.1	189	225.5	167.9	177.7
145.3	210.3	158	175.5	176.5
185.5	254.4	139.4	175	158
189.1	210.3	156.4	149.1	174.5
135.9	160.9	217.1	189.3	181.7
180	120.8	189.1	198.2	176.2
149.4	167.8	158.2	205	177.9
176.4	148.9	218.1	233.5	189.1
229	190.4	178.9	167.9	187.1
179.92	185.09	181.12	182.85	178.72
Total sum of squared differences: Within				34735.02



Anova Calculations

Retail example

$$SSW = 34735$$

$$DFW = (50 - 5) = 45$$

$$MSW = 34735/45 = 771.88$$

Data				
Shelf 1	Shelf 2	Shelf 3	Shelf 4	Shelf 5
210.5	198.1	170.5	167.1	188.5
198.1	189	225.5	167.9	177.7
145.3	210.3	158	175.5	176.5
185.5	254.4	139.4	175	158
189.1	210.3	156.4	149.1	174.5
135.9	160.9	217.1	189.3	181.7
180	120.8	189.1	198.2	176.2
149.4	167.8	158.2	205	177.9
176.4	148.9	218.1	233.5	189.1
229	190.4	178.9	167.9	187.1
179.92	185.09	181.12	182.85	178.72
Total sum of squared differences: Within				34735.02



Anova Calculations

SSB = 250.71	Shelf 1	Shelf 2	Shelf 3	Shelf 4	Shelf 5
	210.5	198.1	170.5	167.1	188.5
	198.1	189	225.5	167.9	177.7
	145.3	210.3	158	175.5	176.5
	185.5	254.4	139.4	175	158
	189.1	210.3	156.4	149.1	174.5
	135.9	160.9	217.1	189.3	181.7
	180	120.8	189.1	198.2	176.2
	149.4	167.8	158.2	205	177.9
	176.4	148.9	218.1	233.5	189.1
	229	190.4	178.9	167.9	187.1
	179.92	185.09	181.12	182.85	178.72
Grand Mean	181.54				
Squared Difference	2.6244	12.6025	0.1764	1.7161	7.9524
Squared Difference * Sample Size	26.244	126.025	1.764	17.161	79.524
Sum of total squared diff * Sample Size	250.718				



Anova Calculations

SSB = 250.71	Shelf 1	Shelf 2	Shelf 3	Shelf 4	Shelf 5
DFB = (5-1) = 4	210.5	198.1	170.5	167.1	188.5
	198.1	189	225.5	167.9	177.7
	145.3	210.3	158	175.5	176.5
	185.5	254.4	139.4	175	158
	189.1	210.3	156.4	149.1	174.5
	135.9	160.9	217.1	189.3	181.7
	180	120.8	189.1	198.2	176.2
	149.4	167.8	158.2	205	177.9
	176.4	148.9	218.1	233.5	189.1
	229	190.4	178.9	167.9	187.1
	179.92	185.09	181.12	182.85	178.72
Grand Mean	181.54				
Squared Difference	2.6244	12.6025	0.1764	1.7161	7.9524
Squared Difference * Sample Size	26.244	126.025	1.764	17.161	79.524
Sum of total squared diff * Sample Size	250.718				



Anova Calculations

SSB = 250.71	Shelf 1	Shelf 2	Shelf 3	Shelf 4	Shelf 5
DFB = (5-1) = 4	210.5	198.1	170.5	167.1	188.5
	198.1	189	225.5	167.9	177.7
	145.3	210.3	158	175.5	176.5
MSB = 250.71/4 = 62.7	185.5	254.4	139.4	175	158
	189.1	210.3	156.4	149.1	174.5
	135.9	160.9	217.1	189.3	181.7
	180	120.8	189.1	198.2	176.2
	149.4	167.8	158.2	205	177.9
	176.4	148.9	218.1	233.5	189.1
	229	190.4	178.9	167.9	187.1
	179.92	185.09	181.12	182.85	178.72
Grand Mean	181.54				
Squared Difference	2.6244	12.6025	0.1764	1.7161	7.9524
Squared Difference * Sample Size	26.244	126.025	1.764	17.161	79.524
Sum of total squared diff * Sample Size	250.718				



Anova Calculations

$$\begin{aligned} F - \text{Stat} &= \text{MSB}/\text{MSW} \\ &= 62.7/771.8 = 0.08 \end{aligned}$$



Anova Calculations

$$F - \text{Stat} = \text{MSB}/\text{MSW}$$

$$= 62.7/771.8 = 0.08$$

	Degrees of Freedom for Numerator											
	1	2	3	4	5	6	7	8	9	10	11	12
27	4.21 7.68	3.35 5.49	2.96 4.60	2.73 4.11	2.57 3.79	2.46 3.56	2.37 3.39	2.30 3.26	2.25 3.14	2.20 3.06	2.16 2.98	2.13 2.93
28	4.20 7.64	3.34 5.45	2.95 4.57	2.71 4.07	2.56 3.76	2.44 3.53	2.36 3.36	2.29 3.23	2.24 3.11	2.19 3.03	2.15 2.95	2.12 2.90
29	4.18 7.60	3.33 5.52	2.93 4.54	2.70 4.04	2.54 3.73	2.43 3.50	2.35 3.32	2.28 3.20	2.22 3.08	2.18 3.00	2.14 2.92	2.10 2.87
30	4.17 7.56	3.32 5.39	2.92 4.51	2.69 4.02	2.53 3.70	2.42 3.47	2.34 3.30	2.27 3.17	2.21 3.06	2.16 2.98	2.12 2.90	2.09 2.84
32	4.15 7.50	3.30 5.34	2.90 4.46	2.67 3.97	2.51 3.66	2.40 3.42	2.32 3.25	2.25 3.12	2.19 3.01	2.14 2.94	2.10 2.86	2.07 2.80
34	4.13 7.44	3.28 5.29	2.88 4.42	2.65 3.93	2.49 3.61	2.38 3.38	2.30 3.21	2.23 3.08	2.17 2.97	2.12 2.89	2.08 2.82	2.05 2.76
36	4.11 7.39	3.26 5.25	2.86 4.38	2.63 3.89	2.48 3.58	2.36 3.35	2.28 3.18	2.21 3.04	2.15 2.94	2.10 2.86	2.06 2.78	2.03 2.72
38	4.10 7.35	3.25 5.21	2.85 4.34	2.62 3.86	2.46 3.54	2.35 3.32	2.26 3.15	2.19 3.02	2.14 2.91	2.09 2.82	2.05 2.75	2.02 2.69
40	4.08 7.31	3.23 5.18	2.84 4.31	2.61 3.83	2.45 3.51	2.34 3.29	2.25 3.12	2.18 2.99	2.12 2.88	2.07 2.80	2.04 2.73	2.00 2.66
42	4.07 7.27	3.22 5.15	2.83 4.29	2.59 3.80	2.44 3.49	2.32 3.26	2.24 3.10	2.17 2.96	2.11 2.86	2.06 2.77	2.02 2.70	1.90 2.64
44	4.06 7.24	3.21 5.12	2.82 4.26	2.58 3.78	2.43 3.46	2.31 3.24	2.23 3.07	2.16 2.94	2.10 2.84	2.05 2.75	2.01 2.68	1.98 2.62
46	4.05 7.21	3.20 5.10	2.81 4.24	2.57 3.76	2.42 3.44	2.30 3.22	2.22 3.05	2.14 2.92	2.09 2.82	2.04 2.73	2.00 2.66	1.97 2.60
48	4.04 7.19	3.19 5.08	2.80 4.22	2.56 3.74	2.41 3.42	2.30 3.20	2.21 3.04	2.14 2.90	2.08 2.80	2.03 2.71	1.99 2.64	1.96 2.58
50	4.03 7.17	3.18 5.06	2.79 4.20	2.56 3.72	2.40 3.41	2.29 3.18	2.20 3.02	2.13 2.88	2.07 2.78	2.02 2.70	1.98 2.62	1.95 2.56
55	4.02 7.12	3.17 5.01	2.78 4.16	2.54 3.68	2.38 3.37	2.27 3.15	2.18 2.98	2.11 2.85	2.05 2.75	2.00 2.66	1.97 2.59	1.93 2.53
60	4.00 7.08	3.15 4.98	2.76 4.13	2.52 3.65	2.37 3.34	2.25 3.12	2.17 2.95	2.10 2.82	2.04 2.72	1.99 2.63	1.95 2.56	1.92 2.50
65	3.99 7.04	3.14 4.94	2.75 4.10	2.51 3.62	2.36 3.31	2.24 3.11	2.15 2.94	2.08 2.80	2.02 2.69	1.98 2.60	1.94 2.52	1.90 2.46



Anova Calculations

$$F - \text{Stat} = \text{MSB}/\text{MSW}$$

$$= 62.7/771.8 = 0.08$$

F-Critical: 2.57

Degrees of Freedom for Numerator												
	1	2	3	4	5	6	7	8	9	10	11	12
27	4.21 7.68	3.35 5.49	2.96 4.60	2.73 4.11	2.57 3.79	2.46 3.56	2.37 3.39	2.30 3.26	2.25 3.14	2.20 3.06	2.16 2.98	2.13 2.93
28	4.20 7.64	3.34 5.45	2.95 4.57	2.71 4.07	2.56 3.76	2.44 3.53	2.36 3.36	2.29 3.23	2.24 3.11	2.19 3.03	2.15 2.95	2.12 2.90
29	4.18 7.60	3.33 5.52	2.93 4.54	2.70 4.04	2.54 3.73	2.43 3.50	2.35 3.32	2.28 3.20	2.22 3.08	2.18 3.00	2.14 2.92	2.10 2.87
30	4.17 7.56	3.32 5.39	2.92 4.51	2.69 4.02	2.53 3.70	2.42 3.47	2.34 3.30	2.27 3.17	2.21 3.06	2.16 2.98	2.12 2.90	2.09 2.84
32	4.15 7.50	3.30 5.34	2.90 4.46	2.67 3.97	2.51 3.66	2.40 3.42	2.32 3.25	2.25 3.12	2.19 3.01	2.14 2.94	2.10 2.86	2.07 2.80
34	4.13 7.44	3.28 5.29	2.88 4.42	2.65 3.93	2.49 3.61	2.38 3.38	2.30 3.21	2.23 3.08	2.17 2.97	2.12 2.89	2.08 2.82	2.05 2.76
36	4.11 7.39	3.26 5.25	2.86 4.38	2.63 3.89	2.48 3.58	2.36 3.35	2.28 3.18	2.21 3.04	2.15 2.94	2.10 2.86	2.06 2.78	2.03 2.72
38	4.10 7.35	3.25 5.21	2.85 4.34	2.62 3.86	2.46 3.54	2.35 3.32	2.26 3.15	2.19 3.02	2.14 2.91	2.09 2.82	2.05 2.75	2.02 2.69
40	4.08 7.31	3.23 5.18	2.84 4.31	2.61 3.83	2.45 3.51	2.34 3.29	2.25 3.12	2.18 2.99	2.12 2.88	2.07 2.80	2.04 2.73	2.00 2.66
42	4.07 7.27	3.22 5.15	2.83 4.29	2.59 3.80	2.44 3.49	2.32 3.26	2.24 3.10	2.17 2.96	2.11 2.86	2.06 2.77	2.02 2.70	1.90 2.64
44	4.06 7.24	3.21 5.12	2.82 4.26	2.58 3.78	2.43 3.46	2.31 3.24	2.23 3.07	2.16 2.94	2.10 2.84	2.05 2.75	2.01 2.68	1.98 2.62
46	4.05 7.21	3.20 5.10	2.81 4.24	2.57 3.76	2.42 3.44	2.30 3.22	2.22 3.05	2.14 2.92	2.09 2.82	2.04 2.73	2.00 2.66	1.97 2.60
48	4.04 7.19	3.19 5.08	2.80 4.22	2.56 3.74	2.41 3.42	2.30 3.20	2.21 3.04	2.14 2.90	2.08 2.80	2.03 2.71	1.99 2.64	1.96 2.58
50	4.03 7.17	3.18 5.06	2.79 4.20	2.56 3.72	2.40 3.41	2.29 3.18	2.20 3.02	2.13 2.88	2.07 2.78	2.02 2.70	1.98 2.62	1.95 2.56
55	4.02 7.12	3.17 5.01	2.78 4.16	2.54 3.68	2.38 3.37	2.27 3.15	2.18 2.98	2.11 2.85	2.05 2.75	2.00 2.66	1.97 2.59	1.93 2.53
60	4.00 7.08	3.15 4.98	2.76 4.13	2.52 3.65	2.37 3.34	2.25 3.12	2.17 2.95	2.10 2.82	2.04 2.72	1.99 2.63	1.95 2.56	1.92 2.50
65	3.99 7.04	3.14 4.94	2.75 4.10	2.51 3.62	2.36 3.31	2.24 3.11	2.15 2.94	2.08 2.80	2.02 2.69	1.98 2.60	1.94 2.52	1.90 2.46



Anova Calculations

$$F - \text{Stat} = \text{MSB}/\text{MSW}$$

$$= 62.7/771.8 = 0.08$$

F-Critical: 2.57

We fail to reject the null hypothesis -

Degrees of Freedom for Numerator												
	1	2	3	4	5	6	7	8	9	10	11	12
27	4.21	3.35	2.96	2.73	2.57	2.46	2.37	2.30	2.25	2.20	2.16	2.13
	7.68	5.49	4.60	4.11	3.79	3.56	3.39	3.26	3.14	3.06	2.98	2.93
28	4.20	3.34	2.95	2.71	2.56	2.44	2.36	2.29	2.24	2.19	2.15	2.12
	7.64	5.45	4.57	4.07	3.76	3.53	3.36	3.23	3.11	3.03	2.95	2.90
29	4.18	3.33	2.93	2.70	2.54	2.43	2.35	2.28	2.22	2.18	2.14	2.10
	7.60	5.52	4.54	4.04	3.73	3.50	3.32	3.20	3.08	3.00	2.92	2.87
30	4.17	3.32	2.92	2.69	2.53	2.42	2.34	2.27	2.21	2.16	2.12	2.09
	7.56	5.39	4.51	4.02	3.70	3.47	3.30	3.17	3.06	2.98	2.90	2.84
32	4.15	3.30	2.90	2.67	2.51	2.40	2.32	2.25	2.19	2.14	2.10	2.07
	7.50	5.34	4.46	3.97	3.66	3.42	3.25	3.12	3.01	2.94	2.86	2.80
34	4.13	3.28	2.88	2.65	2.49	2.38	2.30	2.23	2.17	2.12	2.08	2.05
	7.44	5.29	4.42	3.93	3.61	3.38	3.21	3.08	2.97	2.89	2.82	2.76
36	4.11	3.26	2.86	2.63	2.48	2.36	2.28	2.21	2.15	2.10	2.06	2.03
	7.39	5.25	4.38	3.89	3.58	3.35	3.18	3.04	2.94	2.86	2.78	2.72
38	4.10	3.25	2.85	2.62	2.46	2.35	2.26	2.19	2.14	2.09	2.05	2.02
	7.35	5.21	4.34	3.86	3.54	3.32	3.15	3.02	2.91	2.82	2.75	2.69
40	4.08	3.23	2.84	2.61	2.45	2.34	2.25	2.18	2.12	2.07	2.04	2.00
	7.31	5.18	4.31	3.83	3.51	3.29	3.12	2.99	2.88	2.80	2.73	2.66
42	4.07	3.22	2.83	2.59	2.44	2.32	2.24	2.17	2.11	2.06	2.02	1.90
	7.27	5.15	4.29	3.80	3.49	3.26	3.10	2.96	2.86	2.77	2.70	2.64
44	4.06	3.21	2.82	2.58	2.43	2.31	2.23	2.16	2.10	2.05	2.01	1.98
	7.24	5.12	4.26	3.78	3.46	3.24	3.07	2.94	2.84	2.75	2.68	2.62
46	4.05	3.20	2.81	2.57	2.42	2.30	2.22	2.14	2.09	2.04	2.00	1.97
	7.21	5.10	4.24	3.76	3.44	3.22	3.05	2.92	2.82	2.73	2.66	2.60
48	4.04	3.19	2.80	2.56	2.41	2.30	2.21	2.14	2.08	2.03	1.99	1.96
	7.19	5.08	4.22	3.74	3.42	3.20	3.04	2.90	2.80	2.71	2.64	2.58
50	4.03	3.18	2.79	2.56	2.40	2.29	2.20	2.13	2.07	2.02	1.98	1.95
	7.17	5.06	4.20	3.72	3.41	3.18	3.02	2.88	2.78	2.70	2.62	2.56
55	4.02	3.17	2.78	2.54	2.38	2.27	2.18	2.11	2.05	2.00	1.97	1.93
	7.12	5.01	4.16	3.68	3.37	3.15	2.98	2.85	2.75	2.66	2.59	2.53
60	4.00	3.15	2.76	2.52	2.37	2.25	2.17	2.10	2.04	1.99	1.95	1.92
	7.08	4.98	4.13	3.65	3.34	3.12	2.95	2.82	2.72	2.63	2.56	2.50
65	3.99	3.14	2.75	2.51	2.36	2.24	2.15	2.08	2.02	1.98	1.94	1.90



Anova Calculations

$$F - \text{Stat} = \text{MSB}/\text{MSW}$$

$$= 62.7/771.8 = 0.08$$

F-Critical: 2.57

We fail to reject the null hypothesis -

the variation we see is simply due to random chance, and therefore we cannot conclude that shelf height has any impact on sales

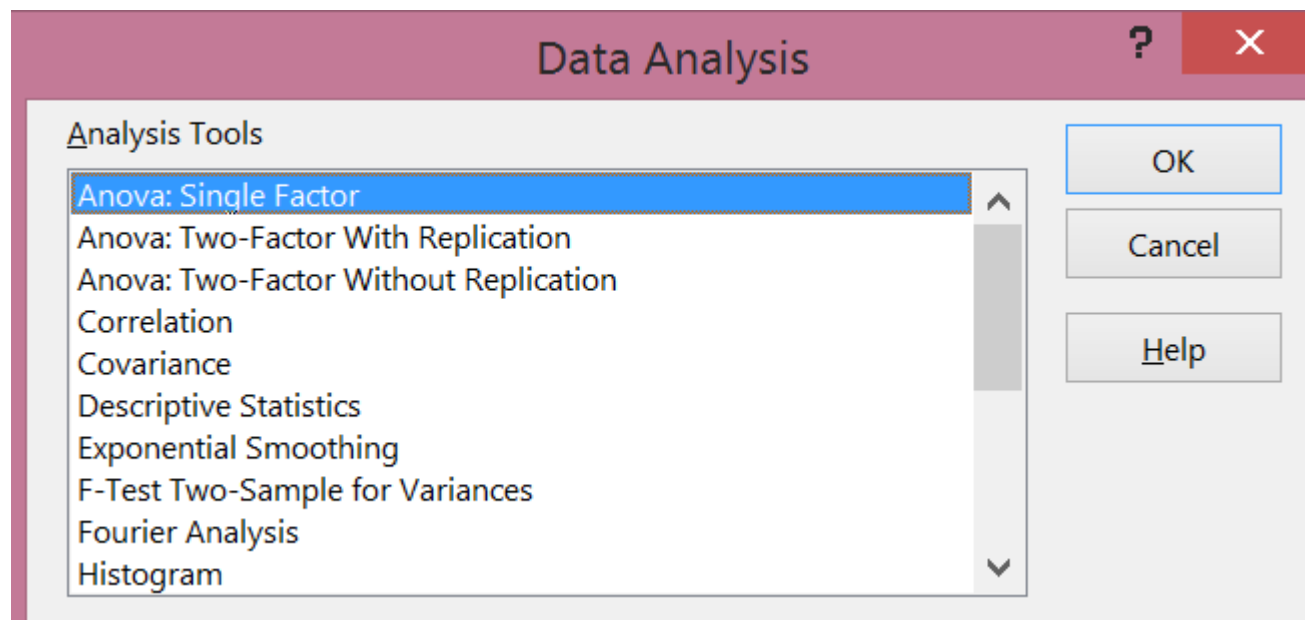
Degrees of Freedom for Numerator												
	1	2	3	4	5	6	7	8	9	10	11	12
27	4.21	3.35	2.96	2.73	2.57	2.46	2.37	2.30	2.25	2.20	2.16	2.13
	7.68	5.49	4.60	4.11	3.79	3.56	3.39	3.26	3.14	3.06	2.98	2.93
28	4.20	3.34	2.95	2.71	2.56	2.44	2.36	2.29	2.24	2.19	2.15	2.12
	7.64	5.45	4.57	4.07	3.76	3.53	3.36	3.23	3.11	3.03	2.95	2.90
29	4.18	3.33	2.93	2.70	2.54	2.43	2.35	2.28	2.22	2.18	2.14	2.10
	7.60	5.52	4.54	4.04	3.73	3.50	3.32	3.20	3.08	3.00	2.92	2.87
30	4.17	3.32	2.92	2.69	2.53	2.42	2.34	2.27	2.21	2.16	2.12	2.09
	7.56	5.39	4.51	4.02	3.70	3.47	3.30	3.17	3.06	2.98	2.90	2.84
32	4.15	3.30	2.90	2.67	2.51	2.40	2.32	2.25	2.19	2.14	2.10	2.07
	7.50	5.34	4.46	3.97	3.66	3.42	3.25	3.12	3.01	2.94	2.86	2.80
34	4.13	3.28	2.88	2.65	2.49	2.38	2.30	2.23	2.17	2.12	2.08	2.05
	7.44	5.29	4.42	3.93	3.61	3.38	3.21	3.08	2.97	2.89	2.82	2.76
36	4.11	3.26	2.86	2.63	2.48	2.36	2.28	2.21	2.15	2.10	2.06	2.03
	7.39	5.25	4.38	3.89	3.58	3.35	3.18	3.04	2.94	2.86	2.78	2.72
38	4.10	3.25	2.85	2.62	2.46	2.35	2.26	2.19	2.14	2.09	2.05	2.02
	7.35	5.21	4.34	3.86	3.54	3.32	3.15	3.02	2.91	2.82	2.75	2.69
40	4.08	3.23	2.84	2.61	2.45	2.34	2.25	2.18	2.12	2.07	2.04	2.00
	7.31	5.18	4.31	3.83	3.51	3.29	3.12	2.99	2.88	2.80	2.73	2.66
42	4.07	3.22	2.83	2.59	2.44	2.32	2.24	2.17	2.11	2.06	2.02	1.90
	7.27	5.15	4.29	3.80	3.49	3.26	3.10	2.96	2.86	2.77	2.70	2.64
44	4.06	3.21	2.82	2.58	2.43	2.31	2.23	2.16	2.10	2.05	2.01	1.98
	7.24	5.12	4.26	3.78	3.46	3.24	3.07	2.94	2.84	2.75	2.68	2.62
46	4.05	3.20	2.81	2.57	2.42	2.30	2.22	2.14	2.09	2.04	2.00	1.97
	7.21	5.10	4.24	3.76	3.44	3.22	3.05	2.92	2.82	2.73	2.66	2.60
48	4.04	3.19	2.80	2.56	2.41	2.30	2.21	2.14	2.08	2.03	1.99	1.96
	7.19	5.08	4.22	3.74	3.42	3.20	3.04	2.90	2.80	2.71	2.64	2.58
50	4.03	3.18	2.79	2.56	2.40	2.29	2.20	2.13	2.07	2.02	1.98	1.95
	7.17	5.06	4.20	3.72	3.41	3.18	3.02	2.88	2.78	2.70	2.62	2.56
55	4.02	3.17	2.78	2.54	2.38	2.27	2.18	2.11	2.05	2.00	1.97	1.93
	7.12	5.01	4.16	3.68	3.37	3.15	2.98	2.85	2.75	2.66	2.59	2.53
60	4.00	3.15	2.76	2.52	2.37	2.25	2.17	2.10	2.04	1.99	1.95	1.92
	7.08	4.98	4.13	3.65	3.34	3.12	2.95	2.82	2.72	2.63	2.56	2.50
65	3.99	3.14	2.75	2.51	2.36	2.24	2.15	2.08	2.02	1.98	1.94	1.90



Anova in Excel

Of course, we can also use tools for ANOVA.


In Excel: Data\Data Analysis\ANOVA Single Factor



Anova in Excel

Shelf 1	Shelf 2	Shelf 3	Shelf 4	Shelf 5
210.5	198.1	170.5	167.1	188.5
198.1	189	225.5	167.9	177.7
145.3	210.3	158	175.5	176.5
185.5	254.4	139.4	175	158
189.1	210.3	156.4	149.1	174.5
135.9	160.9	217.1	189.3	181.7
180	120.8	189.1	198.2	176.2
149.4	167.8	158.2	205	177.9
176.4	148.9	218.1	233.5	189.1
229	190.4	178.9	167.9	187.1


Anova: Single Factor

Input
 Input Range: 

Grouped By: ☒ Columns ☐ Rows

☒ Labels in First Row

Alpha:

Output options
☐ Output Range: 
☒ New Worksheet Ply:
☐ New Workbook

OK Cancel Help



Anova in Excel

Anova: Single Factor						
SUMMARY						
<i>Groups</i>	<i>Count</i>	<i>Sum</i>	<i>Average</i>	<i>Variance</i>		
Shelf 1	10	1799.2	179.92	874.4529		
Shelf 2	10	1850.9	185.09	1401.637		
Shelf 3	10	1811.2	181.12	913.8396		
Shelf 4	10	1828.5	182.85	587.005		
Shelf 5	10	1787.2	178.72	82.51289		
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	250.718	4	62.6795	0.081203	0.987743	2.578739
Within Groups	34735.02	45	771.8894			
Total	34985.74	49				



Anova

Conclusion:

- Fail to reject the Null Hypothesis
 - Shelf height has no impact on sales



Coming Up

Anova:

Two Way Tests

Post Hoc Tests



THANK YOU



END OF VIDEO: 10 MINS

