ANOVA Test

Stats Project

Purpose & Why it’s needed

- ANOVA (Analysis of Variance)
- A way to find out if the results of a survey or experiment are significant
- Compare the means of two or more groups
- Helps resolve the need to reject a null hypothesis or accept an alternate hypothesis
- See whether the independent variable causes effect, or just randomness
- Form of statistical hypothesis testing

Assumptions

- Assumption #1: Continuous dependent variable
- Assumption #2: Two or more levels in the IV
- Assumption #3: Independence of Observations
- Assumption #4: No significant outliers
- Assumption #5: Dependent variable is normally distributed
- Assumption #6: Homogeneity of Variances

General Terminology

- Null Hypothesis - No significant differences among groups, and changes are caused only by randomness
- Alternate Hypothesis - Assumes at least one significant difference among the groups, and changes are caused by the IVs
- P value - Area under bell curve that is right of the 2nd variance
- Levels - Different independent variables

Conditions of Use

One Way ANOVA Test

- One independent variable
- Two levels

Two Way ANOVA Test

- Two independent variables
- Multiple levels

Manova Test

- Multiple Dependent variables
- One way vs. Two Way

Procedure & Math (Overview)

- Antidepressant efficacy
- 3 Levels (2 Experimental + Control)
- IV: Treatment Type
- DV: Beck Depression Inventory Score (Score ↑ = Depression ↑)
- One-Way ANOVA (1 IV, 1 DV)

Placebo	Low Dose	Moderate Dose
38	22	14
47	19	26
39	8	11
25	23	18
42	31	5

Analysis of Variance Results

F-statistic value = 11.26657

P-value = 0.00176

Critical F-Value: 6.93
($F_{(2,12)}$ for p = 0.01)

Data Summary				
Groups	**N**	**Mean**	**Std. Dev.**	**Std. Error**
Group 1	5	38.2	8.167	3.6524
Group 2	5	20.6	8.3247	3.7229
Group 3	5	14.8	7.8549	3.5128

ANOVA Summary					
Source	**Degrees of Freedom** **DF**	**Sum of Squares** **SS**	**Mean Square** **MS**	**F-Stat**	**P-Value**
Between Groups	2	**2** 1484.9333	**3** 742.4667	**4** 11.2666	0.0018
Within Groups	12	**2** 790.7999	**3** 65.9		
Total:	14	**1** 2275.7332			

Interpret the Test

- F-statistic is calculated
- Represents ratio of SSB to SSW
- Larger the number represents more difference between groups
- Small number represents more variance in a group
- Tells you if the independent variable is causing significant change
- Significance test also needs to be conducted

How to Present

- APA format for reporting an ANOVA test
- You have to report IV, DV, degrees of freedom, F stat and P Value
- Reporting goes in Results Section
- Interpretation goes in Discussion or Conclusion
- “There was a significant (not a significant) effect of IV _____ on DV _____ at the p<.05 level for the three conditions [F(___, ___) = ___, p = ____]”
- If significant Results are found, have to conduct a post hoc test
  - Post Hoc - Explores differences between multiple group means
- Helps find where the condition had effect

Use in a Journal Article

- *ANOVA Analysis of Student Daily Test Scores in Multi-Day Test Periods*
- Link: https://eric.ed.gov/?id=EJ1139744

IV: Test day (Out of a 4-day exam block)

DV: Test score

Controls: Cumulative GPA
# of Tests Taken

Exhibit 4
Mean Test Percent Score
ANOVA Results and Brown Forsyth for Non-homogeneity of Variance

Descriptives

Day	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean	
					Lower Bound	Upper Bound
1	174	.851935	.1332764	.0101037	.831993	.871877
2	207	.822888	.1571310	.0109214	.801356	.844420
3	338	.799901	.1418721	.0077168	.784722	.815080
4	738	.713808	.1708646	.0062896	.701460	.726155
Total	1457	.765773	.1674227	.0043862	.757169	.774377

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	4.354	3	1.451	57.835	.000
Within Groups	36.459	1453	.025		
Total	40.812	1456			

Interpretation of Journal Data

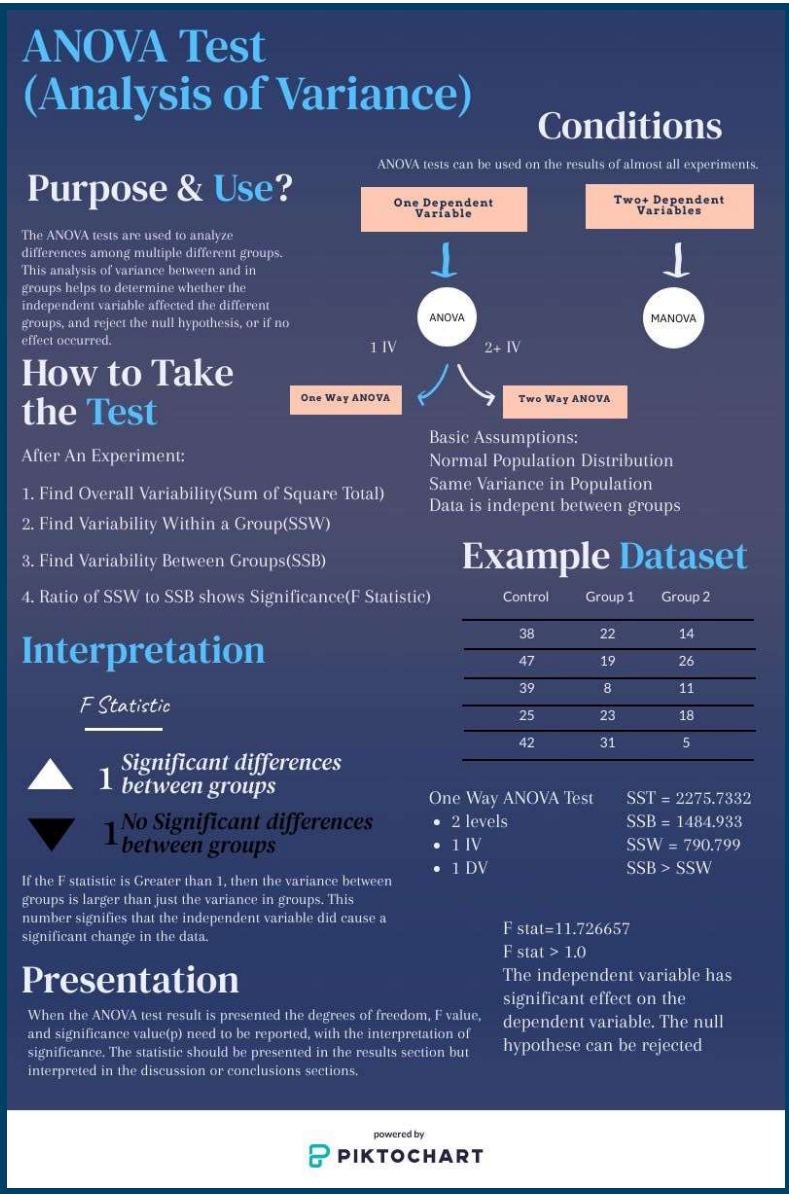
“There was a significant effect of test day on test scores at the p<.05 level for the three conditions [F(3, 1453) = 113.07, p = .000]”

To Note:

- Post-hoc tests required to determine specific effect
- (p=.000) is APA format to report (p < 0.001)

Infographic

https://create.piktochart.com/output/42427406-stats-project



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