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Variable types and inferential tools

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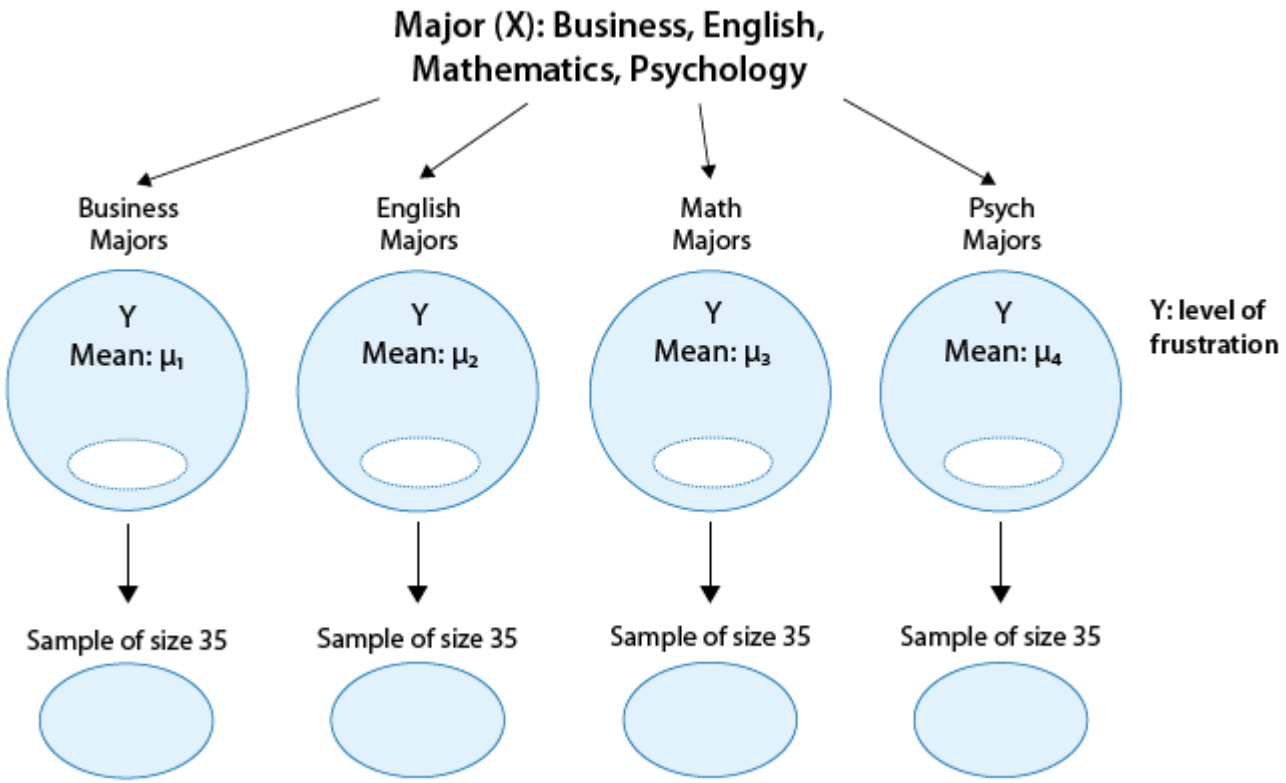
Analysis of Variance

		Response	
		Categorical	Quantitative
Explanatory	Categorical	C → C	C → Q
	Quatitative	Q → C	Q → Q

Is “academic frustration” related to major?



Step 1 and 2: Stating hypotheses and identifying the sample

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$$H_0 : \mu_1 = \mu_2 = \mu_3 = \mu_4$$
$$H_a : \textit{not all the } \mu\textit{'s are equal}$$

It turns out that:

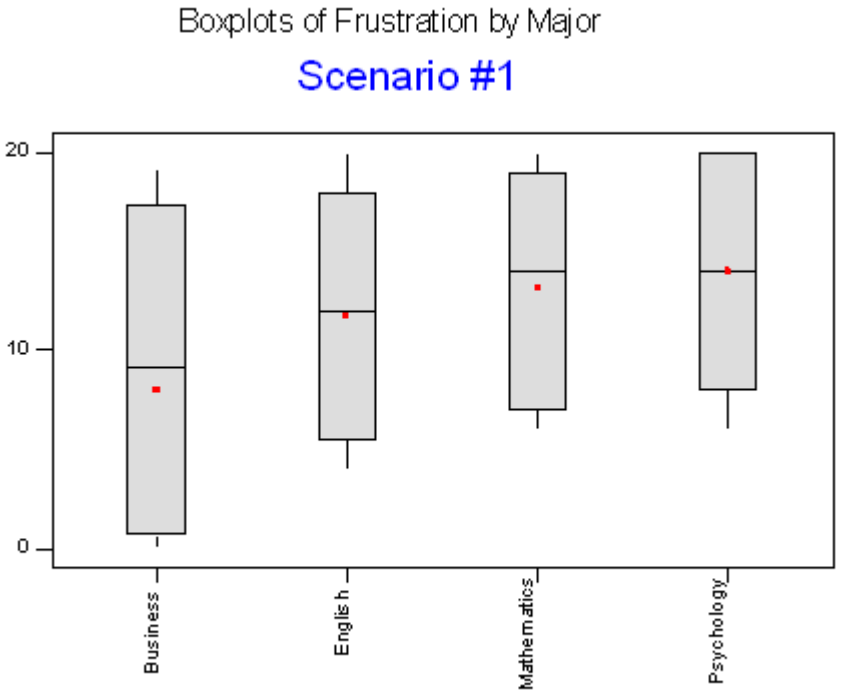
* The sample mean frustration score of the 35 business majors is: $\overline{y_1} = 7.3$

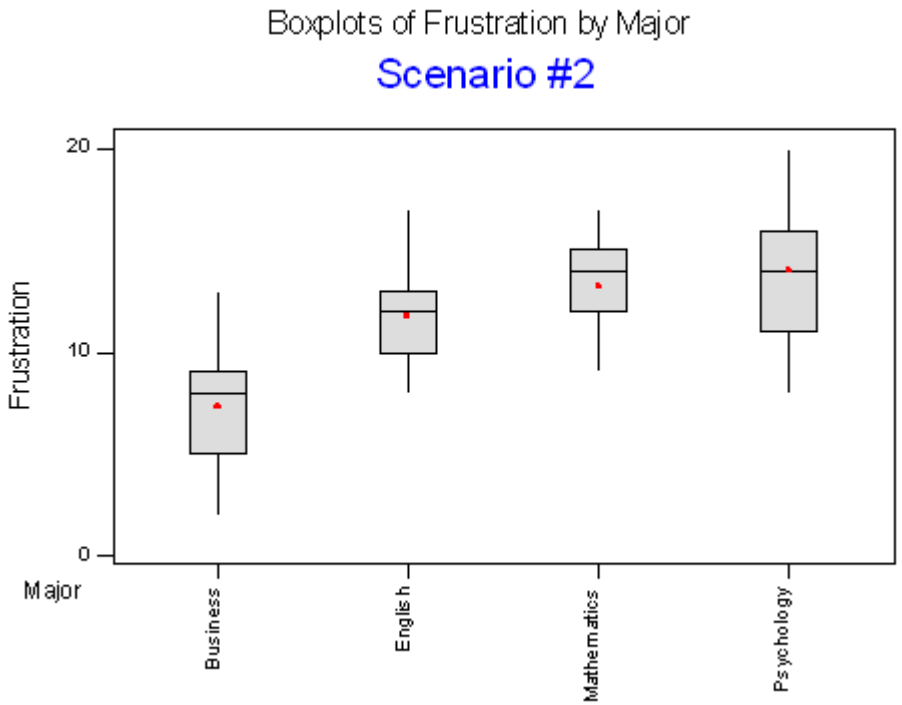
* The sample mean frustration score of the 35 English majors is: $\overline{y_2} = 11.8$

* The sample mean frustration score of the 35 math majors is: $\overline{y_3} = 13.2$

* The sample mean frustration score of the 35 psychology majors is: $\overline{y_4} = 14.0$

Same mean differences, difference variability





F statistic

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$$F = \frac{\text{VARIATION AMONG SAMPLE MEANS}}{\text{VARIATION WITHIN GROUPS}}$$

Step 3 and 4: Assessing the evidence and drawing conclusions

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One-way ANOVA: Frustration Score versus Major

Source	DF	SS	MS	F	P
Major	3	939.85	313.28	46.60	0.0001
Error	136	914.29	6.72		
Total	139	1854.14			

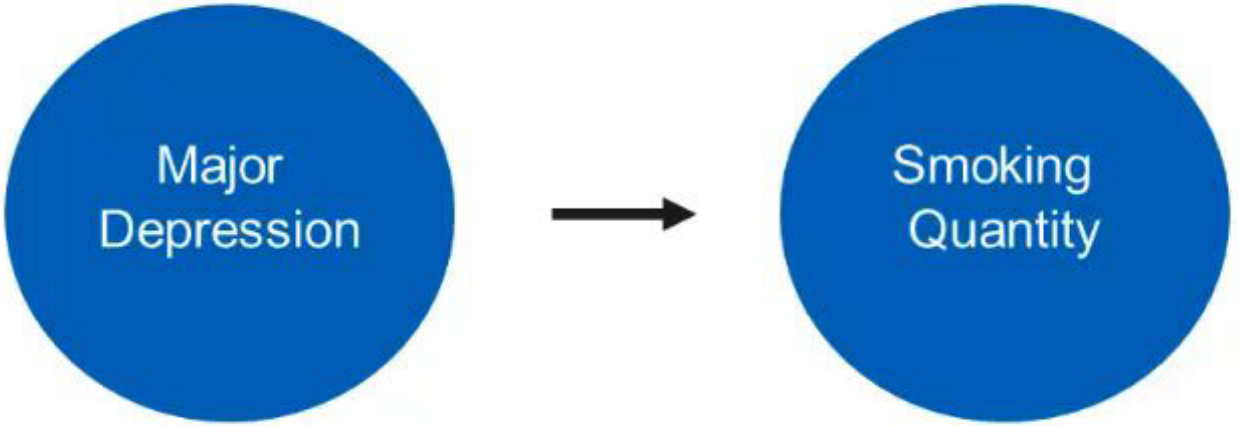
S = 2.593 R-Sq = 50.69% R-Sq(adj) = 49.60%

Level	N	Mean	StDev
Business	35	7.314	2.898
English	35	11.771	2.088
Mathematics	35	13.200	2.153
Psychology	35	14.029	3.082

H_a : *not all the* μ*'s are equal*

Categorical
(1=Present/0=Absent)

Quantitative
(Range 1-2940)



$$H_0 : \mu_1 = \mu_2 = \mu_3 = \mu_4$$

$$H_a : \text{not all the } \mu\text{'s are equal}$$

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When do I need a post hoc test?

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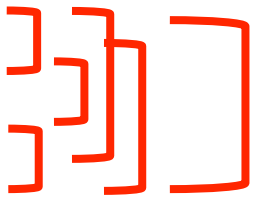
H_a: $\mu 1, \mu 2, \mu 3, \mu 4$ not all equal

1. μ1≠μ2≠μ3≠μ4
2. μ1=μ2=μ3≠μ4
3. μ1=μ2≠μ3=μ4

Level	N	Mean	StDev
Business	35	7.314	2.898
English	35	11.771	2.088
Mathematics	35	13.200	2.153
Psychology	35	14.029	3.082



Why not test multiple ANOVAs examining each pair?

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Remember that we accept 'significance' and reject the null hypothesis at $P \leq 0.05$ (i.e. a 5% chance that we are wrong)

Performing multiple tests therefore means that our overall chance of committing a type I error is >5%.

# Tests	Comparison α	Familywise α
1	.05	.05
3	.05	.14
6	.05	.26
10	.05	.40
15	.05	.54

Which post hoc test do I use within ANOVA?

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Protection against Type I error

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	Critical Difference
LSD	Low
Tukey	Moderate
Scheffe	High

Bonferroni Adjustment

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Bonferroni adjustment) is to divide 0.05/c (number of comparisons)

3 comparisons is 0.05/3, so that alpha for each test = 0.017.

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