Comparing Several Means (one-way ANOVA)

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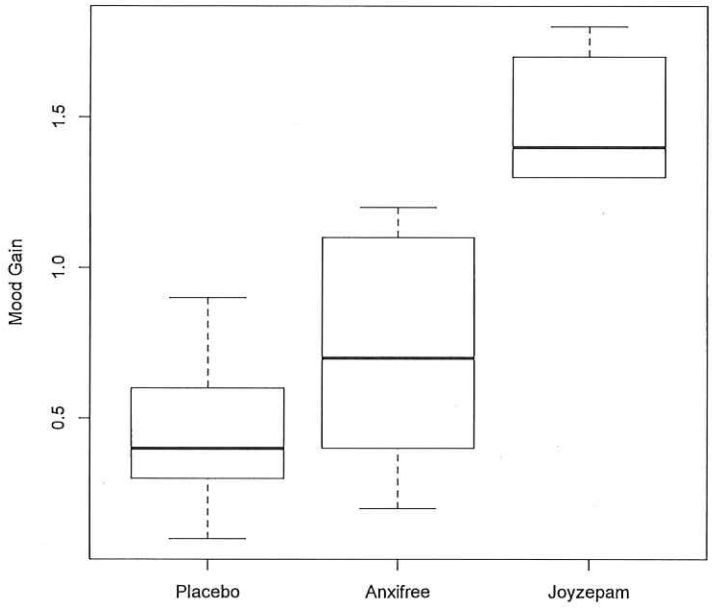
Example: Suppose you've become involved in a clinical trial in which you are testing a new antidepressant drug called Joyzepam. The study involves three separate drugs to be administered: A) a placebo, B) an existing antidepressant/anti-anxiety drug called *Anxifree*, and C) this new drug *Joyzepam*.

18 participants with moderate to severe depression are recruited for your initial testing. Participants are randomly assigned a treatment, such that there are 6 people assigned to each of the 3 drugs. A psychologist assesses the mood of each person after a 3-month run with each drug: and the overall improvement in each person's mood is assessed on a scale ranging from -5 to +5.

Below is the box-plot of the mood gain observed after the 3-month run.



Joyzepam appears to perform better than the other two treatments, and the Anxifree shows a slightly larger mood gain than the placebo group. *Are these differences "real", or are they due to chance?*

Data for those who would like to crunch the numbers...

Table 1: Mood Gain results for each observation, averages, and residuals

Drug	Mood Gain	Grand Average $\overline{Y}$	Group Average $\overline{Y}_k$	Within Group Residual $(Y_{ik}-\overline{Y}_k)$	Between Group Residual $(\overline{Y}_k-\overline{Y})$
Placebo	0.5	0.88	0.45	0.05	-0.43
Placebo	0.3			-0.15	
Placebo	0.1			-0.35	
Placebo	0.6			0.15	
Placebo	0.9			0.45	
Placebo	0.3			-0.15	
Anxifree	0.6		0.72	-0.02	-0.16
Anxifree	0.4			-0.22	
Anxifree	0.2			-0.42	
Anxifree	1.1			0.48	
Anxifree	0.8			0.18	
Anxifree	1.2			0.58	
Joyzepam	1.4		1.48	-0.08	0.60
Joyzepam	1.7			0.22	
Joyzepam	1.3			-0.18	
Joyzepam	1.8			0.32	
Joyzepam	1.3			-0.18	
Joyzepam	1.4			-0.08	

this is N for each group.

$SS_{BG} = (-0.43)^2 \cdot 6 + (-0.16)^2 \cdot 6 + (0.60)^2 \cdot 6 = 3.45$

Table 2: The Standard ANOVA Table

	Degrees of freedom	Sum of Squares	Mean Squares	F-ratio	p-value
Between Groups	3-1 = 2	3.45	SS_{BG}/df_{BG} = 3.45/2 = 1.73	MS_{BG}/MS_{WG} 1.73/0.09 = 18.6	8.67×10^{-5}
Within Groups	18-3 = 15	1.39	SS_{WG}/df_{WG} = 1.39/15 = 0.09		

↳ from a computational tool

↳ SS_{WG} = sum up the squared values of all $(Y_{ik} - \overline{Y}_k)$ values

Table 3A: post-hoc test "raw" p-values

	Placebo	Anxifree
Anxifree	0.15021	
Joyzpam	3×10^{-5}	0.00056

× 3 for all values. ⇒

Table 3B: post-hoc Bonferroni Corrected p-values

	Placebo	Anxifree
Anxifree	0.4506	
Joyzpam	9.1×10^{-5}	0.0017