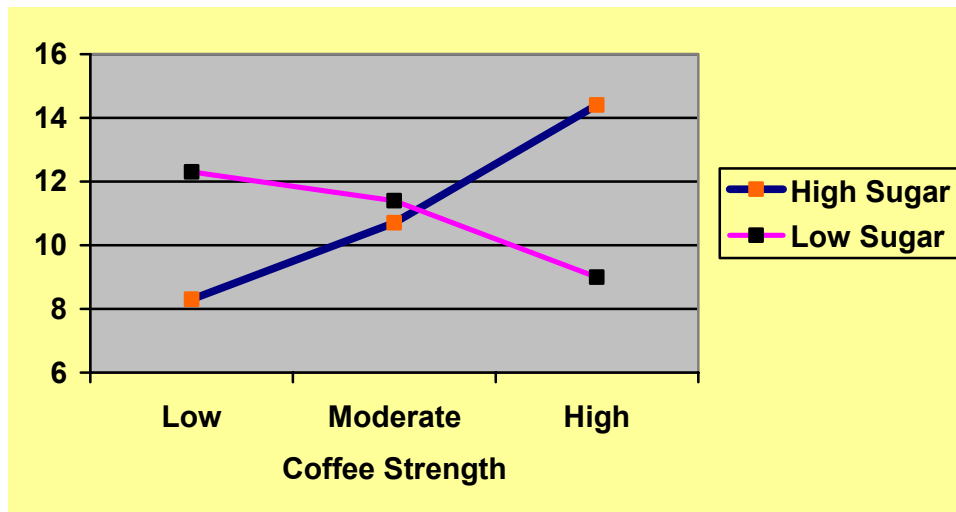


## FACTORIAL DESIGNS

1. Starr Bucke wanted to determine if coffee had an influence on how alert people were 30 minutes after sleeping. Bucke realized that sugar in the coffee might have an impact on the results so he designed a study in which people got low, medium, or strong coffee. He also varied the level of sugar in the coffee. The following table is a summary of her results. Plot the following table and answer the questions.

**Table 1. Mean ratings of coffee based on strength and sugar levels.**

	Low Strength	Moderate Strength	High Strength	Row Mean
High Sugar	8.3	10.7	14.4	11.13
Low Sugar	12.3	11.4	9.0	10.9
Column Mean	10.3	11.05	11.7	



- a. Does there appear to be a main effect for sugar level? Why?  
**Not really, the row means are approximately equal.**
- b. Does there appear to be a main effect for strength? Why?  
**Not really, the column means are approximately, equal.**
- c. Does there appear to be an interaction? Why?  
**Yes, the lines in the graph cross; they are not parallel.**
- d. How would you interpret this graph based on your answers to these questions?

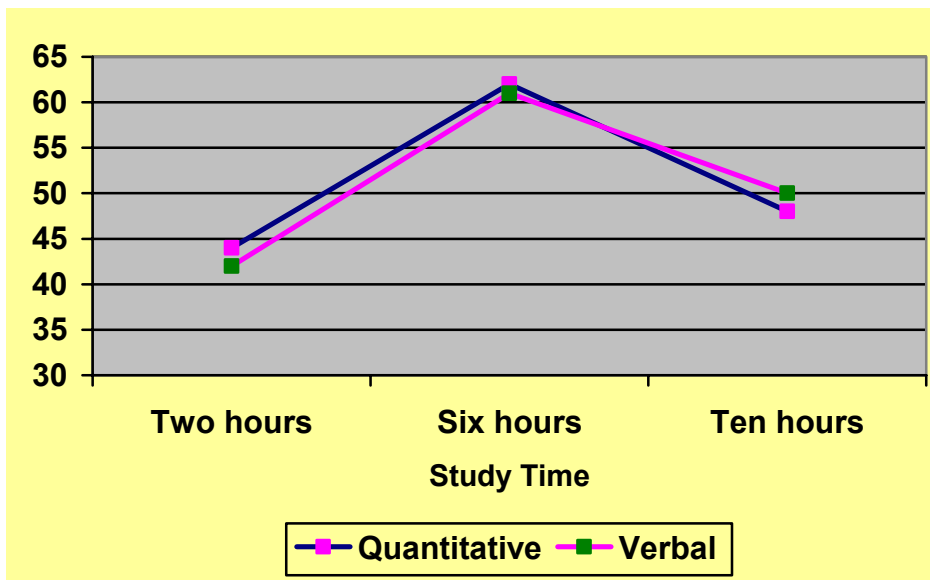
To determine how alert someone will be after drinking coffee you need to know both the coffee strength and the amount of sugar that was in the coffee.

2. Plot the following table and answer the following questions

Dr. C. Ramme was interested in assessing the effectiveness of study time on performance on a standardized measure of verbal and quantitative reasoning. One group studied for two hours starting two hours before the test, a second group studied two hours starting six hours before the test, and the third group studied two hours starting ten hours before the test. Each group was given a standardized measure of verbal and quantitative reasoning.

Table 2. ANOVA summary table.

	Two hours	Six hours	Ten hours	Row means
Quantitative	44	62	48	51.33
Verbal	42	61	50	51.0
Column Means	43	61.5	49.0	



a. What is/are the null hypotheses?

**There will be no significant differences in the cell means (lazy way to say it).**

b. Do there appear to be main effects? Where and why did you make this decision?

Looking at the row and column means it appears that there is no difference on the test type but it appears that the mean for six hour study time is higher than the other two column means.

- c. Does there appear to be an interaction? Why?

Nope, the lines are roughly parallel.

- d. How would you interpret this graph based on your answers to these questions?

Looks like studying six hours before the test was the most effective.

2. S. N. Orre wanted to study the effects of water deprivation on the random activity of young and adult rats. After either 6, 12 or 18 hours of deprivation, the rats were placed individually in a small cage and the number of times the rat crossed from one side to the other during a 20-minute period was counted. The scores are summarized below.

**Mean number of crossings by condition.**

	Six hours	Twelve hours	Eighteen hours
Young	3	7	12
Old	6	6	13

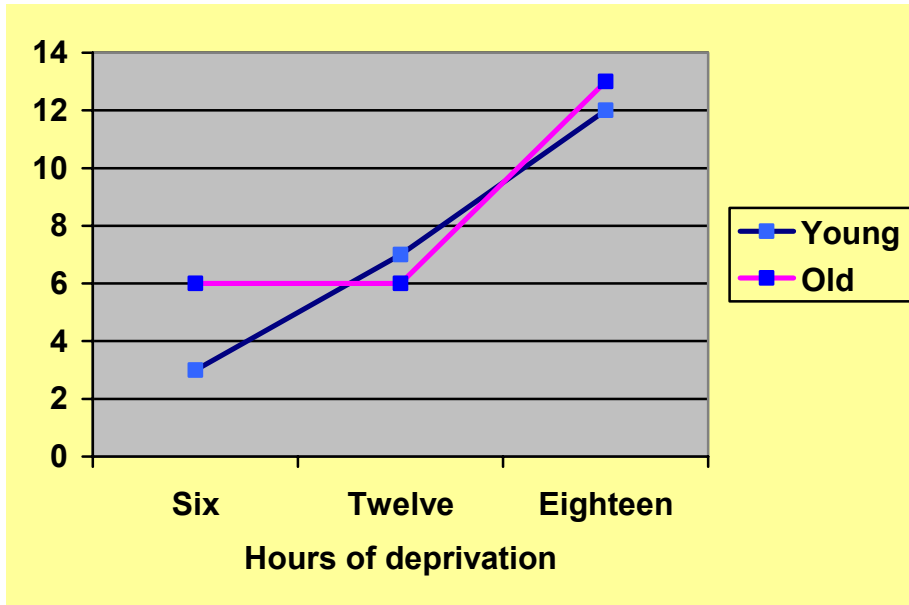
- a. What is/are the null hypotheses?

The cell means will be equal, or There will be no significant differences in crossing behavior on the basis of water deprivation or age.

- b. Complete the ANOVA summary table.

**Table 2. Analysis of variance summary table**

Source	SS	df	MS	F
<i>Between Groups</i>	374.17	5		
<i>A. Age</i>	7.50	1	7.50	3.10
<i>B. Hours of deprivation</i>	346.67	2	173.33	71.63
<i>AxB interaction</i>	20.00	2	10.00	4.13
<i>Within Groups</i>	58.00	24	2.42	
<i>Total</i>	432.17	29		



a. *What is the critical value of F for each of the following?*

i. *Age*

$$CV(.05) = 4.26$$

$$F(1,24) = 3.10, n.s.$$

ii. *Hours of Deprivation*

$$CV .05 = 3.40; .01 = 5.61$$

$$F(2,24) = 71.63, p < .01$$

iii. *Age x deprivation interaction*

$$CV .05 = 3.40; .01 = 5.61$$

$$F(2,24) = 4.13, p < .05$$

b. *What is your conclusion regarding*

i. *Age*

F was not statistically significant. Fail to reject the null hypothesis. Age does not seem to be a factor in activity following water deprivation.

ii. *Hours of deprivation*

F was statistically significant. Reject the null hypothesis. Hours of deprivation plays a significant role in activity.

iii. *Age x deprivation interaction*

F was statistically significant. Reject the null hypothesis of no interaction. To determine activity level you need to know both the hours of water deprivation and the age of the animal.

c. *What effects did you find and how strong are they?*

**Eta<sup>2</sup> for the interaction was .05. Only five percent of the variability in activity can be explained by knowing both age and hours of deprivation. This is a relatively weak effect.**

**Eta<sup>2</sup> hours of deprivation was .80. Eighty percent of the variability in activity can be explained by knowing hours of deprivation alone. Water deprivation plays a large role in influencing activity.**