The Effect of Incubation Temperature and Salinity on Seed Germination:
A Two Factor Design of Experiment

Table 1
Factors used in Experiment

(T) Incubation Temperature (° C)			(S) Salinity (percent solution)		
(-)	Standard	(+)	(-)	Standard	(+)
35.5	37	38.5	0.125%	0.800%	1.500%

Table 2
Data for Three Runs

First Run			Second Run			Third Run		
Order	Trial	Result (amount germinated)	Order	Trial	Result (amount germinated)	Order	Trial	Result (amount germinated)
1	Standard	20	1	Standard	40	1	Standard	25
	(+,+)	31		(+,+)	30		(+,+)	5
	(-,-)	7		(-,-)	7		(-,-)	37
4	Standard	27	4	Standard	42	4	Standard	34
	(+,-)	18		(+,-)	34		(+,-)	28
	(-,+)	42		(-,+)	14		(-,+)	11
7	Standard	25	7	Standard	30	7	Standard	29

Table 3
Average Number of Seeds Germinated Data

trials		First Run	Second Run	Third Run	Averages
T	S				
(+)	(+)	31	30	5	22
(-)	(-)	7	7	37	17
(+)	(-)	18	34	28	26 2/3
(-)	(+)	42	14	11	22 1/3

Use table three to find the averages of highs and lows.

What is the grand average of this data set?

$$\frac{22 + 17 + 26\,2/3 + 22\,1/3}{4} = 22$$

22 seeds

Use the tables below to find each of the three effect values now. Be sure to label the figures and tables.

Table 4
Effect of

TEMPERATURE (°C)	
35.5 −	38.5 +
17	22
22⅓	26⅔
AVGs: 19⅔	24⅓

$$24⅓ - 19⅔ = 4⅔$$

$$\approx 5 \text{ seeds}$$
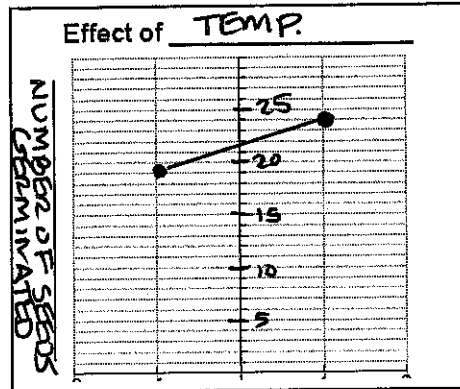
Effect of __TEMP.__

Figure 1. Effect of __TEMP.__

Table 5
Effect of

SALINITY (% SOLUTION)	
.125% −	1.500% +
17	22
26⅔	22⅓
AVGs: 21⅚	22⅙

$$22⅙ - 21⅚ = ⅓$$

$$\approx 0 \text{ seeds}$$
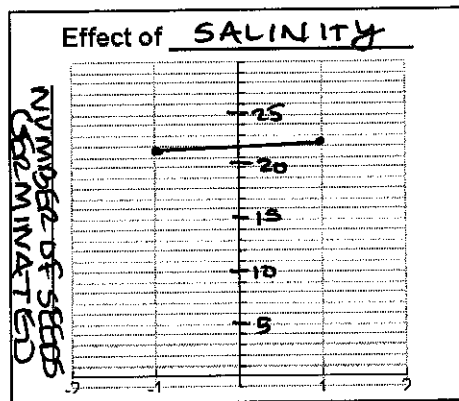
Effect of __SALINITY__

Figure 2. Effect of __SALINITY__

Table 6
Interaction Effect.

			TEMP.	
			(−)	(+)
SALINITY	Solid Segment	(+)	22⅓	22
	Dotted Segment	(−)	17	26⅔

HIGH SLOPE − LOW SLOPE

$$\frac{22 - 22⅓}{2} - \frac{26⅔ - 17}{2}$$

$$-⅙ - (-4⅚) = -5$$

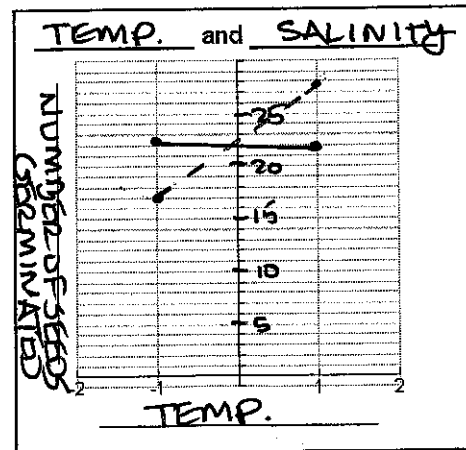__TEMP.__ and __SALINITY__

TEMP.

Figure 3. Interaction effect of __TEMP. & SALINITY__

Now that you have found the three effects, take a look at the standards. Write them in the chart below.

Table 7
Data of Standards

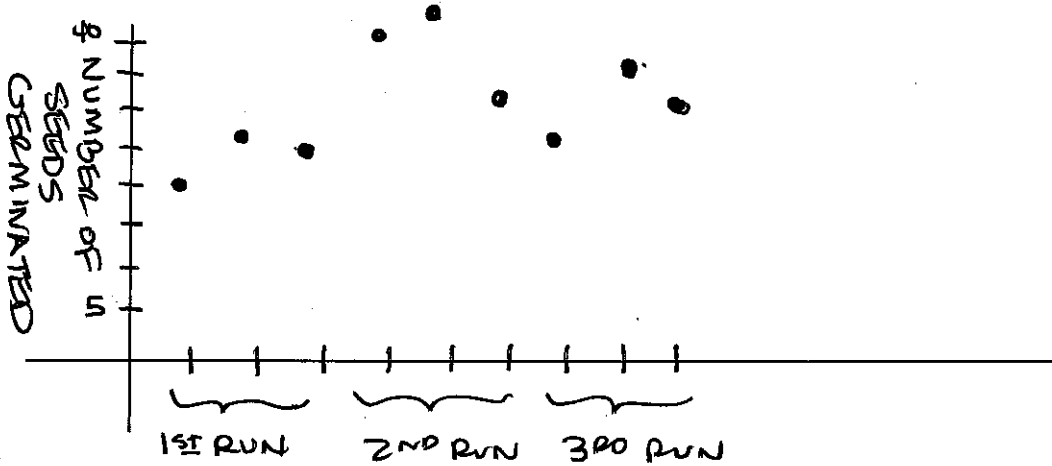| Standard (Number of Seeds Germinated)								
20	27	25	40	42	30	25	34	29

What is the range of standards? What is the range of the entire data set?

$42 - 20 = 22$ $42 - 5 = 37$

since ROS×2 is less than overall range there may have been some lurking variables. (Perhaps, redo experiment?)

Create a scatterplot of the standards below. Be sure to block by run. Look for trends. Discuss any that you see. Don't forget your labels.

Figure 4. Scatterplot of Standards

NOTE: 2ND RUN HAD HIGHEST STANDARDS

Now it is time for your dot plot of effects. Plot the three effect values. Include a legend. Set up fences for double the range of standards. Which effect(s) are deemed "statistically significant?"
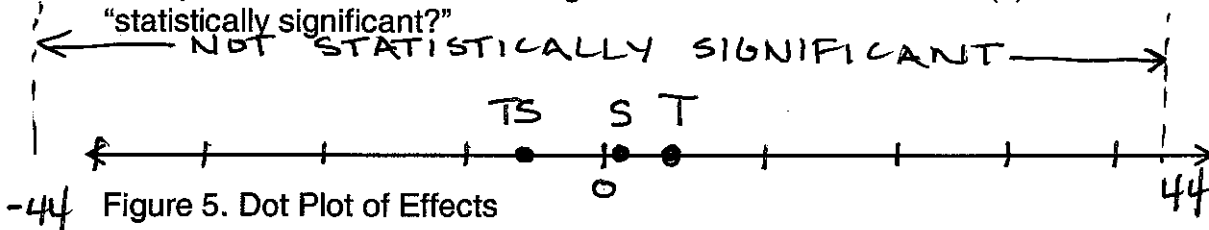

-44   Figure 5. Dot Plot of Effects   44

ROS×2
= 22×2
= 44

KEY
T (TEMP) = 4⅔
S (SALINITY) = ⅓
TS (INTERACTION OF TEMP & SALINITY) = -5

SO NOTHING IS STATISTICALLY SIGNIFICANT, BUT BOTH Temp & the interaction effect affected the results, practically speaking

Last but not least, it is time to create your two equations.

Write the prediction equation below. Be sure to include your grand average.

$$Y = 22 + \frac{4\frac{2}{3}}{2} \cdot T + \frac{\frac{1}{3}}{2} \cdot S + \frac{-5}{2} \cdot TS + \text{"noise"}$$

Show a check of your work. Use the low, high average (-, +)

$$Y = 22 + \frac{4\frac{2}{3}}{2}(-1) + \frac{\frac{1}{3}}{2}(1) + \frac{-5}{2}(-1)(+1)$$
$$= 22 - 2\frac{1}{3} + \frac{1}{6} + 2\frac{1}{2} = 22\frac{1}{3} \quad \text{THIS CHECKS AS IT IS THE } (-, +) \text{ AVG.}$$

Make an interpolated prediction of (0.5, -0.5). Be sure to include an explanation of what these values mean. T   S

$$Y = 22 + \frac{4\frac{2}{3}}{2}(\frac{1}{2}) + \frac{\frac{1}{3}}{2}(-\frac{1}{2}) + \frac{-5}{2}(\frac{1}{2})(-\frac{1}{2})$$
$$= 22 + \frac{14}{12} - \frac{1}{12} + \frac{5}{8} \approx 23.708 \text{ or } 24 \text{ seeds}$$
$$\text{(if temp is } 37.75°C \text{ \& salinity is } .4625\% \text{ soluti} \ldots$$

Finally, what is the parsimonious prediction equation? Write it below.

$$Y = 22 + \text{"noise"}$$

Do the same interpolated prediction (0.5, -0.5) using only parsimonious prediction equation. Write it below. Compare and contrast the two predictions

$$Y = 22 \quad \text{so } 22 \text{ seeds}$$

since nothing was deemed statistically signifant only the grand avg. is used in the parsimonious prediction equation, while ALL three effects are used in the prediction equation. They both estimate how many seeds might germinate if the experiment were run using a temp of 37.75°C & .4625% solution.