Stroop Effect

1. What is our independent variable? What is our dependent variable?

- *Independent variable is: The color of the ink word "whether it matched the word name or not".*
- *Dependent variable is: Time consumed to name the ink word.*

2. What is an appropriate set of hypotheses for this task? What kind of statistical test do you expect to perform? Justify your choices.

- *Regarding the hypotheses we will have:*
  - ***H0 "Null Hypotheses"**: (**μi** = **μc**)*
    - *That the "**μc**" which is the average time consumed by the person to name the ink word on the congruent mode **is equal to** the "**μi**" which is the average time consumed by the person to name the ink word on the incongruent mode.*
  - ***H1 "Alternative Hypotheses**": , **μi!= μc / μi > μc** or/ **μi < μc***
    - *That the average time consumed by the person to name the ink word on the Congruent mode **is not equal to /greater/ less than** the average time consumed by the person to name the ink word on the Incongruent mode, which means the treatment has a measured effect on the sample*
- *I expect to perform a **dependent two-tailed T-test** as:*
  - *Our samples are less than 30 "n<30"*
  - *We are not aware of the population mean or the population standard deviation.*
  - *We have paired samples which we need to measure the changes "before/after" a particular treatment, that's why we are using dependent T-test.*
  - *I need to compare two samples and determine whether the average time in the congruent mode will be the same /less than or/ greater than the average time in the incongruent mode.*

3. Report some descriptive statistics regarding this dataset. Include at least one measure of central tendency and at least one measure of variability.

Measurement	**Congruent**	**Incongruent**
Mean	14.05	22.02
Mode	13	21
Median	14.36	21.02
Standard Deviation "Variability"	3.6	4.8

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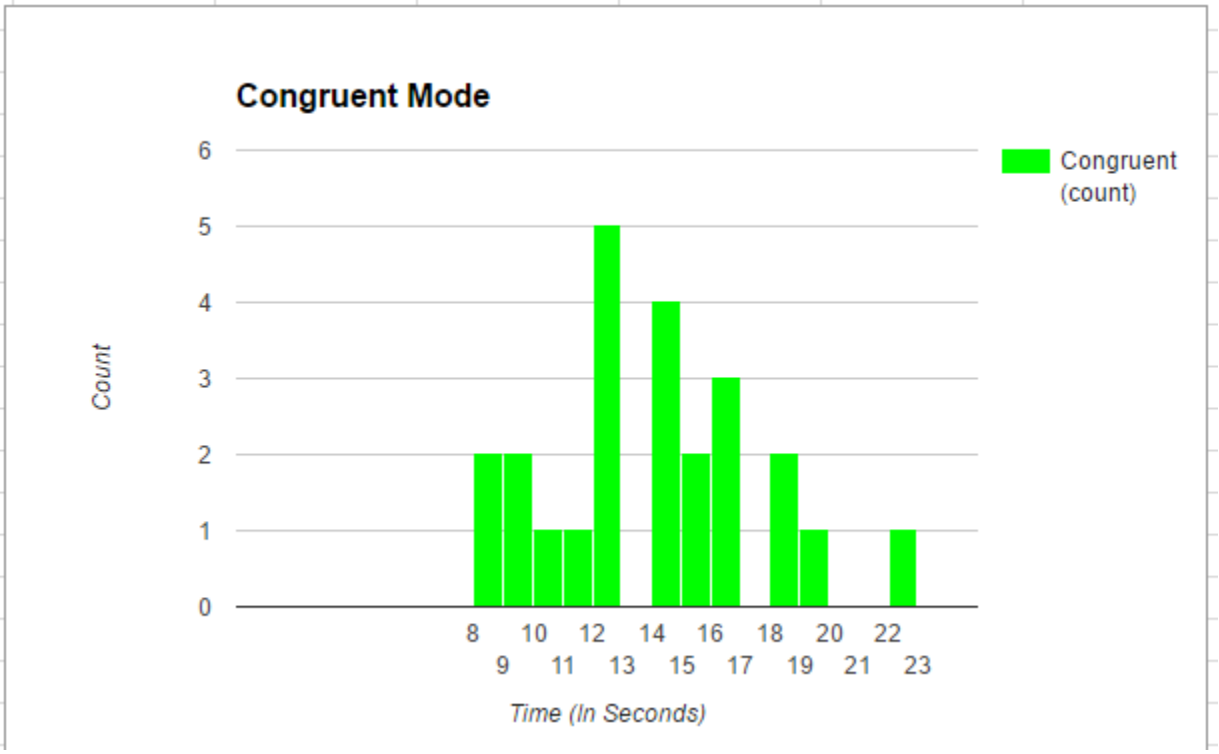
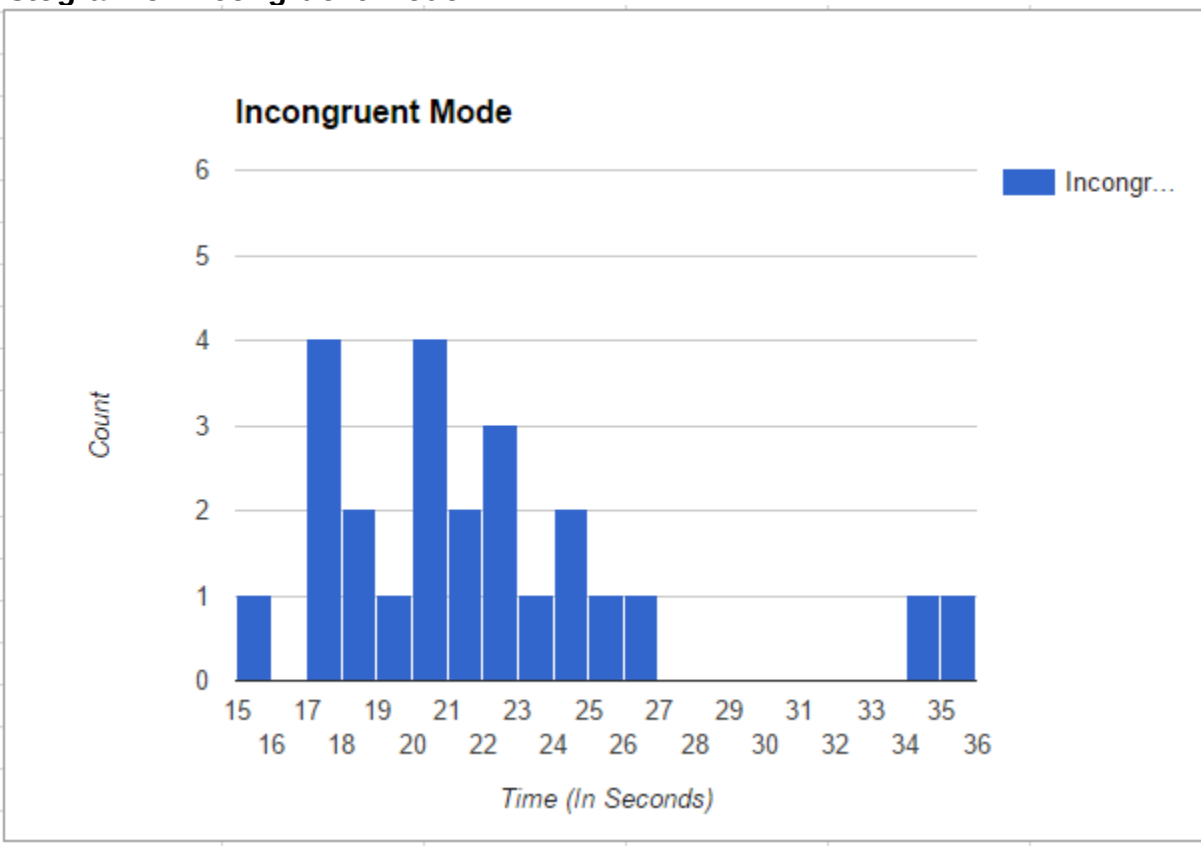
4. Provide one or two visualizations that show the distribution of the sample data. Write one or two sentences noting what you observe about the plot or plots.

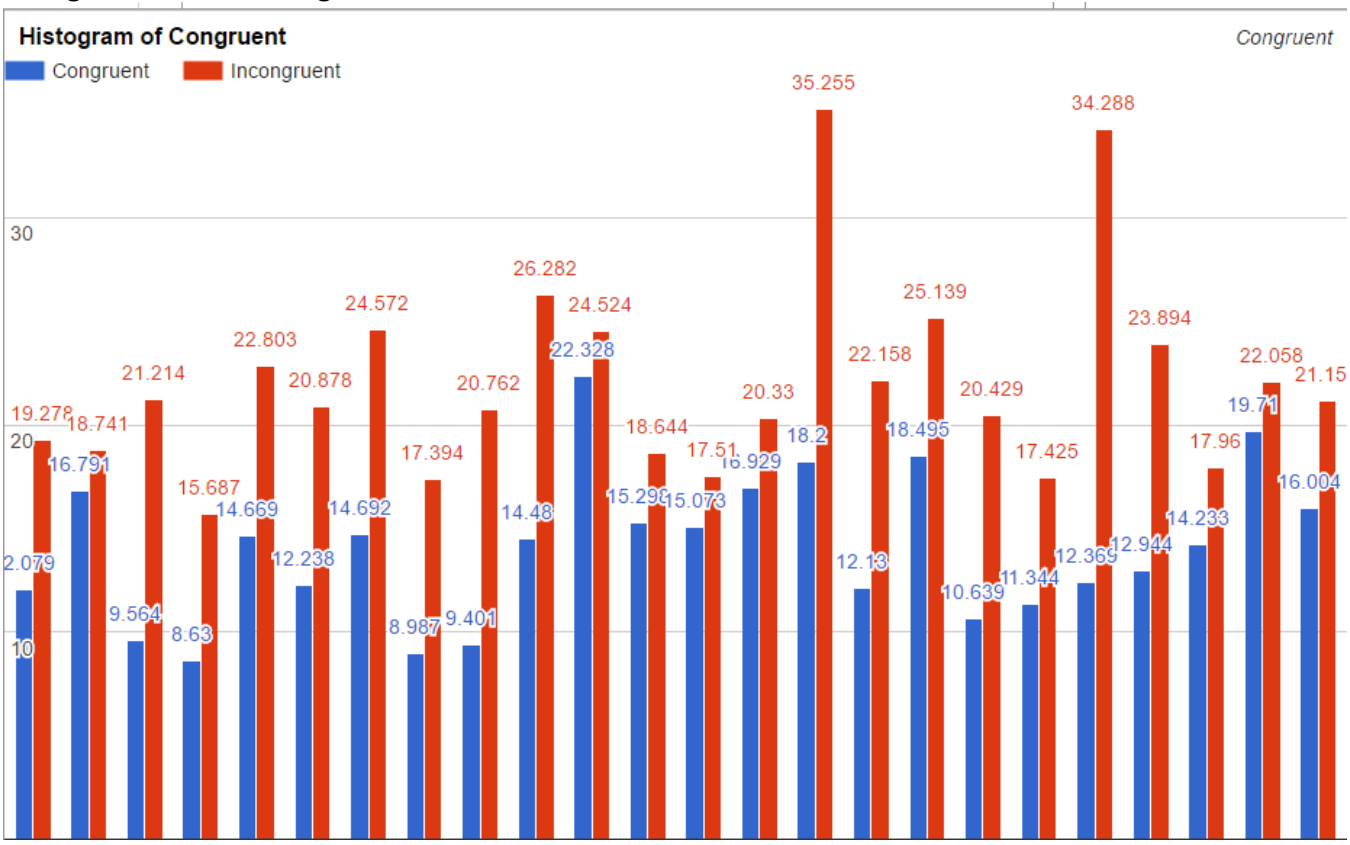
- **Histogram of Incongruent mode**

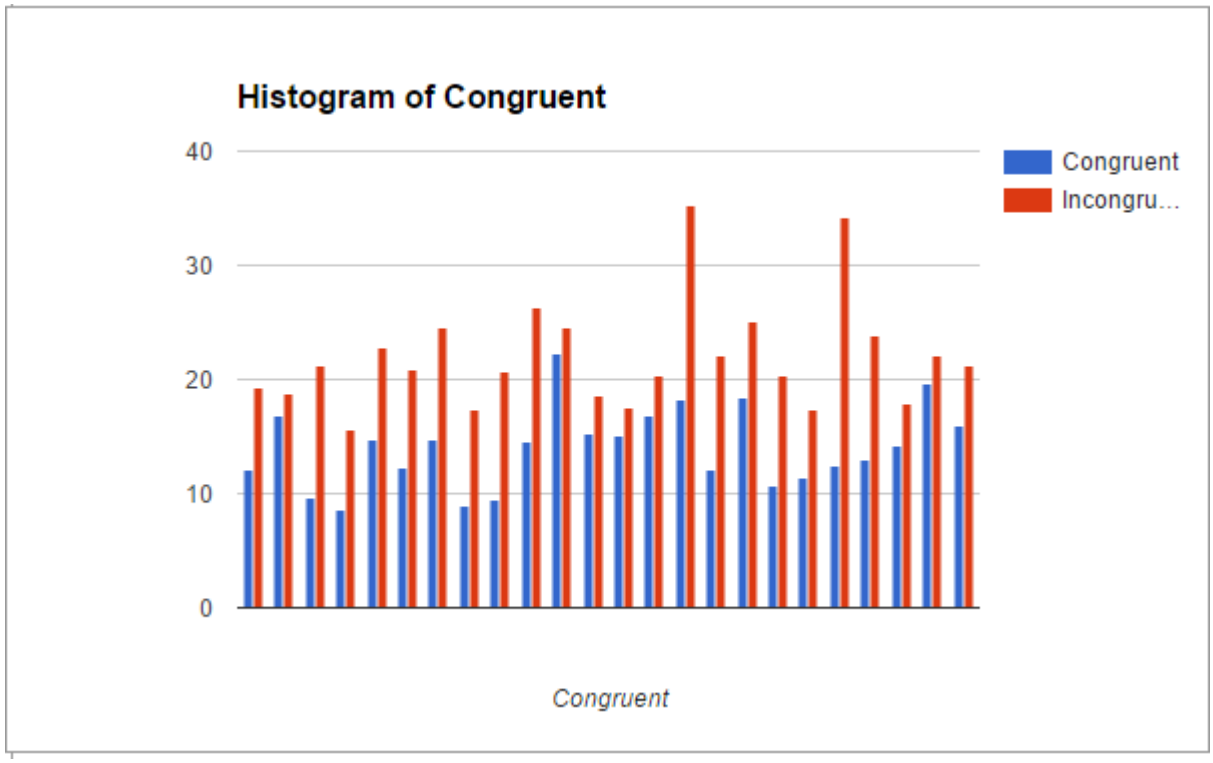


- **Histogram of Incongruent mode**



- **Congruent Vs. Incongruent mode**





- **My Observations**:
  - *All the central tendency variables are tending to be less in the congruent mode than the incongruent mode, **however**, the variability, is near in both modes.*
  - *We can easily observe that people tends to take more time in the incongruent mode than they took in the congruent mode.*

5. Now, perform the statistical test and report your results. What is your confidence level and your critical statistic value? Do you reject the null hypothesis or fail to reject it? Come to a conclusion in terms of the experiment task. Did the results match up with your expectations?

- *I'm going to use two-tailed T-test to compare the **μ"incongruent" Vs the μ"Congruent"** in order to check whether changing the ink word color than its name has an effect or not, we will have the following:*
  - ***H0 "Null Hypotheses"**: (**μi** = **μc**)*
    - *That the "**μc**" which is the average time consumed by the person to name the ink word on the congruent mode **is equal to** the "**μi**" which is the average time consumed by the person to name the ink word on the incongruent mode.*
  - ***H1 "Alternative Hypotheses"**: , **μi!= μc / μi > μc** or/ **μi < μc***
    - *That the average time consumed by the person to name the ink word on the Congruent mode **is not equal to /greater/ less than** the average time consumed by the person to name the ink word on the Incongruent mode, which means the treatment has a measured effect on the sample*
  - *Since we have sample of "**n=24**", so the **degrees of freedom will= n-1=23.***
  - *And since we are using two-tailed test so we will have t-critical value of "**0.025**" on both sides.*
  - ***Using n=23, and t-critic value= 0.025, so the t-probability is +/- 2.069.***
  - *so, the t-critical value should be less than +/-*
  - We will use the T-test Formula t = **(Xbar1 – Xbar2)/(S/sqrt (n))** where:
    - $\bar{x}_1$= Mean incongruent mode set
      $\bar{x}_2$ = Mean Congruent mode set
      n = number of samples
      S= standard deviation of the vector of congruent and incongruent samples difference

      $$= \sqrt{\frac{\sum x^2 - \frac{(\sum x)^2}{n}}{n-1}}$$

      (computed using n-1) "***Computed in details below***"
    - *So, our T value will be = **~8.02 "detailed calculations below in the last page"***
- *So, it's very obvious that the t value we got is so far away than the t-critical value "-2.069", so, we will **reject the H0 "Null Hypotheses"** that the average time consumed by the person to name the ink word on the congruent mode **is equal to** the average time consumed by the person to name the ink word on the incongruent mode.*

6. Optional: What do you think is responsible for the effects observed? Can you think of an alternative or similar task that would result in a similar effect? Some research about the problem will be helpful for thinking about these two questions!

- *The effect observed is because of people are more practiced at word reading than naming colors, there is less interference with word reading than there is with naming colors.*
- *Interference occurs when you look at one of the words, you see both its color and its meaning. These two different bits of information begin to confuse the brain, which then causes a conflict, forcing you to make a choice; Our experiences and stored memories has taught us that word meaning is more important than the color a word is written in; Interference occurs when you try to pay attention only to the color. The interference that happens suggests that you are not always in control of what you can pay attention to.*
- *We can approach the same effect of the Stroop effect but applying it on numbers, so that:*
    - *The Congruent mode will be that the displayed number name is the same as the count of number words. "e.g. (one) or (Two Two)"*
    - *The Incongruent mode will be that the displayed number name will be different than the count of number words "e.g. (Three Three) or "Four".*
    - *There is also a common experiment called the "Reversed Stroop Effect"*

Calculation of T-Value:

A	B	C	D	E	F
Congruent	Incongruent	Diff "X"	Diff ^2 "X^2"	Congruent avergae=	Incongruent avergae=
12.079	19.278	7.199	51.825601	14.051125	22.01591667
16.791	18.741	1.95	3.8025	Congruent SE=	Incongruent SE=
9.564	21.214	11.65	135.7225	3.559357958	4.797057122
8.63	15.687	7.057	49.801249	Congruent Median=	Incongruent Median=
14.669	22.803	8.134	66.161956	14.3565	21.0175
12.238	20.878	8.64	74.6496		Incong_SE^2=
14.692	24.572	9.88	97.6144		23.01175704
8.987	17.394	8.407	70.677649		Incong_SE^2/n-incong=
9.401	20.762	11.361	129.072321		0.9588232098
14.48	26.282	11.802	139.287204		
22.328	24.524	2.196	4.822416		
15.298	18.644	3.346	11.195716		
15.073	17.51	2.437	5.938969		
16.929	20.33	3.401	11.566801	Means-Diff=	
18.2	35.255	17.055	290.873025	7.964791667	
12.13	22.158	10.028	100.560784	T Value=	
18.495	25.139	6.644	44.142736	8.020706944	
10.639	20.429	9.79	95.8441		
11.344	17.425	6.081	36.978561		
12.369	34.288	21.919	480.442561		
12.944	23.894	10.95	119.9025		
14.233	17.96	3.727	13.890529		
19.71	22.058	2.348	5.513104		
16.004	21.157	5.153	26.553409		
		Mean "Differences" =	Sum(X^2)=		
		7.964791667	2066.840191		
		SD "Difference"=	Nominator=		
		4.86482691	544.33044		
		Sum(X)=	Nominator/ Denominator=		
		191.155	23.66654087		
		(Sum(X)) ^2=	SD=		
		36540.23403	4.86482691		
		((Sum(X)) ^2)/n=	SD/sqrt(n)=		
		1522.509751	0.9930286348		