Test a Perceptual Phenomenon

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

The independent variable is list of words and dependent variable is time taken to read out the color of the ink of those words.

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

- In null hypothesis, the difference of population means of congruent condition μ_c and Incongruent condition μ_I would be zero i.e. H_0: $\mu_c - \mu_{I\,-} = 0$
- In Alternative hypothesis, the difference of population means of congruent condition μ_c and Incongruent condition μ_I would not be zero i.e. H_0: $\mu_c - \mu_{I\,-} \neq 0$
- As population parameters are not available, we cannot use Z-test.
- As per the info mentioned, same participants (sample) have gone through congruent task initially and incongruent task later so we should use paired t-test or dependent t-test to analyze.
- Commonly used confidence level 95% is being considered to perform the statistical test
- As per alternative hypothesis, it is a two-tailed test.

Assumptions:

- Sample is randomly selected
- Sample data is continuous
- Sample is adequate large to represent population
- Sampling distribution of mean difference is normal

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

Descriptive statistics for congruent, incongruent conditions and for their difference.

	N	Mean	Median	Range	Variance	Std. Deviation
Congruent condition	24	14.051125	14.3565	13.698	12.66902907	3.559357958
Incongruent condition	24	22.01591667	21.0175	19.568	23.01175704	4.797057122
Difference	24	7.964791667	7.6665	19.969	23.66654087	4.86482691

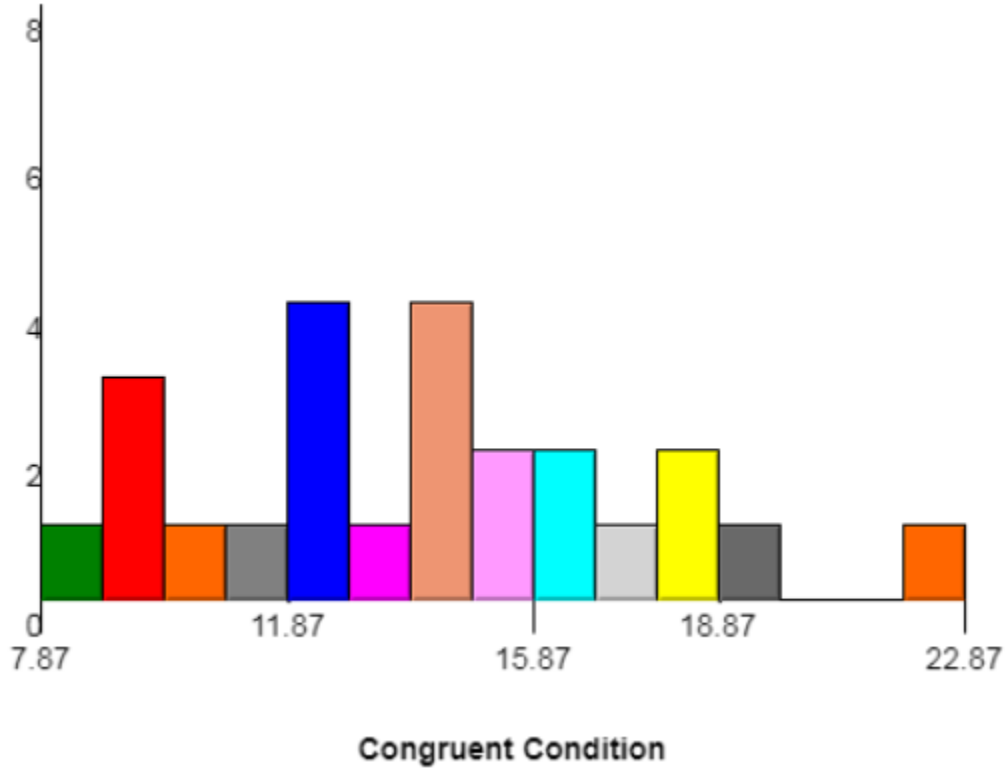
4. Provide one or two visualizations that show the distribution of the sample data. Write one or two sentences noting what you observe about the plot or plots.

The following are the visualizations for congruent and incongruent conditons represented in histograms. The Bin sizes used for congruent condition is 1 and 2 for incongruent one for the sake of proper representation.

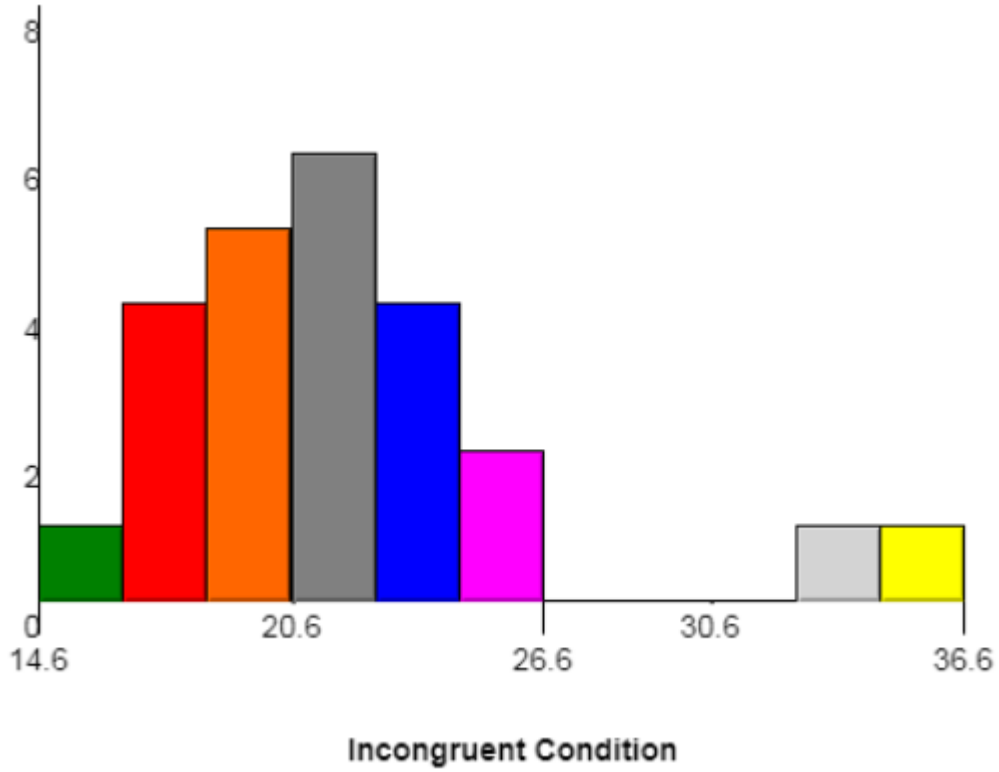
- **Congruent condition:** Most of the participants have taken time between 12 to 15 seconds with a minimum of time of around 8 seconds and maximun time of around 22 seconds**.**
- **Incongruent condition:** Most of the participants have taken time between 20 to 22 seconds with a minimum of time of around 17 seconds and maximun time of around 36 seconds.

It has been observed that participants have taken more duration in incongruent condition than in congruent condition supporing alternative hypothesis

Congruent condition with bin size 1



Incongruent condition with bin size 2



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?

For the confidence level of 95%, the alpha level would 0.05 and for sample size of 24, the degrees of freedom would be 23.

	α level	df	2 tailed	t critical	t statistic	95% CI		P value
						Lower	Higher	
Paired Differences	0.05	23	Yes	2.069	8.020706944	5.910215421	10.01936791	0.0001

- t-critical = ±2.069
- Standard error mean (SEM) = S/√n i.e. 4.86482691/√24 = 0.9930286348
- t-statistic = μ_d/SEM i.e. 7.964791667/0.9930286348 = 8.020706944

- Margin of error = t-critical*SEM i.e. 2.069*0.9930286348 = 2.054576245
- Effect size based on Cohen's d = μ_d/S i.e. 7.964791667/4.86482691 = 1.637219949
- Coefficient of determination = t^2/t^2+df i.e. 0.7366364161

Results:

- t(23) = 8.02, P= 0.0001 , two-tailed
- Confidence interval on the means difference; 95% CI (5.91, 10.01)

Conclusion: As the t-statistic value is greater than t-critical value, its falling in critical region. P-value is 0.0001, which is less than 0.05 and it is extremely significant to reject null hypothesis. The co-efficient of determination is around .73(73%), which signifies that time different between, congruent and incongruent conditions is due to the non-sync between color of ink and displayed words.