Test a Perceptual Phenomenon

1. What is our independent variable? What is our dependent variable?
The word condition is the independent variable i.e. conditions: a congruent words condition, and an incongruent words condition

The time it takes to name the ink colors in the list is the dependent variable.

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

My hypothesis will be time difference between non-congruent and the congruent phase Is more than half of the congruent phase time, i.e. in the $\mu(\text{incongruent}) - \mu(\text{congruent}) > 0.5*\mu(\text{congruent})$

Null hypothesis will be: $\mu(\text{incongruent}) - \mu(\text{congruent}) <= 0.5*\mu(\text{congruent})$
Alternative hypothesis will be: $\mu(\text{incongruent}) - \mu(\text{congruent}) > 0.5*\mu(\text{congruent})$

For the above hypothesis, I will be using dependent samples t-test because of following reasons,
* Both of the two samples (for congruent and incongruent word condition) are same, so dependent samples will be appropriate for this,
* Don't have access to the population parameters, so t-test will be appropriate for that.

3. Report some descriptive statistics regarding this dataset. Include at least one measure of central tendency and at least one measure of variability.
For the data provided for the tests, following are the means and standard deviations for each word condition,
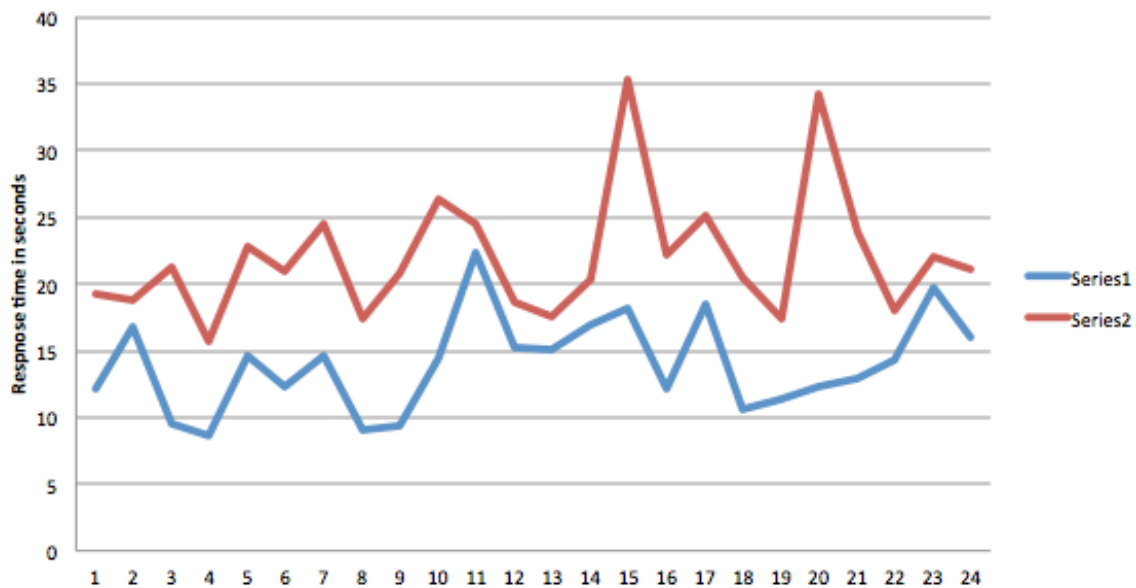
	Congruent	Incongruent
Mean	14.05	22.02
Standard deviation	3.48	4.69

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.

Below is the box plot for each of the word conditions,
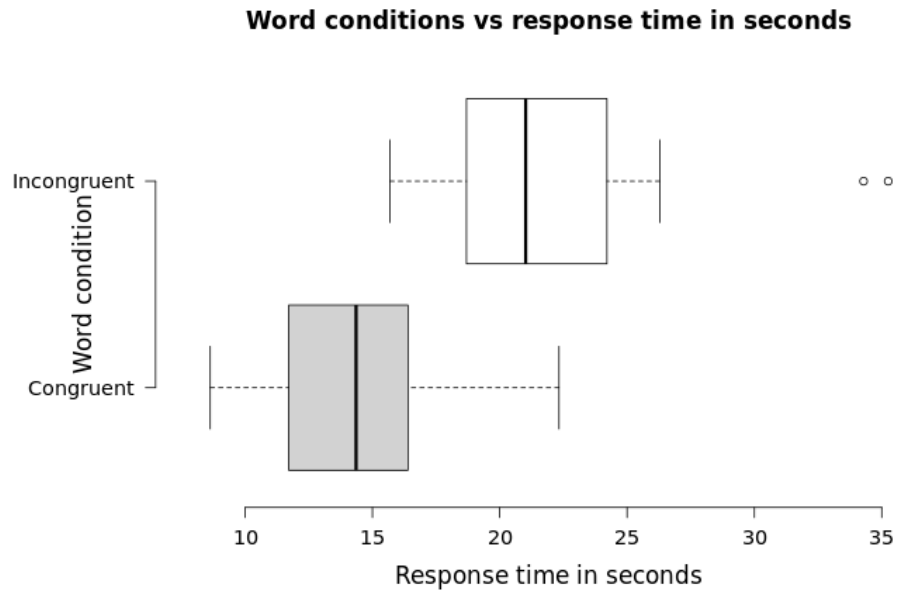
And below graph shows distribution of response times in sequence

Although it looks that the response time for the incongruent phase will be significantly different form the congruent phase, but it will further be confirmed in the next dependent samples t-test.

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?

The alpha value for the t-test will be 0.05 and the test will be one tail with positive direction. Corresponding t-critical value will be 1.684. And preforming the t-test for the above data will yields following results,

Congruent	Incongruent	Difference	SSE
12.079	19.278	1.1595	0.04851924
16.791	18.741	-6.4455	54.53422487
9.564	21.214	6.868	35.15032359
8.63	15.687	2.742	3.249982678
14.669	22.803	0.7995	0.01952424
12.238	20.878	2.521	2.501998969
14.692	24.572	2.534	2.543294011
8.987	17.394	3.9135	8.84628699
9.401	20.762	6.6605	32.73293995
14.48	26.282	4.562	13.12446851
22.328	24.524	-8.968	98.15318976
15.298	18.644	-4.303	27.48096664
15.073	17.51	-5.0995	36.46624995
16.929	20.33	-5.0635	36.03275745
18.2	35.255	7.955	49.22104039
12.13	22.158	3.963	9.143190053
18.495	25.139	-2.6035	12.55092995
10.639	20.429	4.4705	12.4698737
11.344	17.425	0.409	0.281142969
12.369	34.288	15.7345	218.900039
12.944	23.894	4.478	12.52289901
14.233	17.96	-3.3895	18.7378962
19.71	22.058	-7.507	71.33878714
16.004	21.157	-2.849	14.35068022

Calculated SD of population: 5.79
μ(incongruent) – 1.5*μ(congruent): 0.94

t-score :   0.79

Based on the result for the above test compared to the t-critical value for the test, it failed to reject the null hypothesis.

For better approximation, it will be better to have different samples for each of the test, as it will eradicate carryover effect and the more samples we have, the more will be accurate for out results. Well, it does not match to my expectation, I expected that the difference in the means response times for incongruent and congruent scores will roughly more than half of the congruent score, but the t-test failed to

reject the null hypothesis and difference comes up to be lesser than half of the congruent response time.