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

A. **Independent variable**: Choosing a word to be either congruent or incongruent with the ink colours.
Dependent variable: The response time of the user, i.e. amount of time it takes to respond with the name of colour which are used to display the 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.**

A. **Null Hypothesis:** Mean response time for congruent words are similar to that of incongruent words. $\mu_c \geq \mu_i$
Alternative Hypothesis: Mean response time for congruent words are less than that of incongruent words. $\mu_c < \mu_i$

B. We need a *dependent samples t-test* in this case. It has to be a *t-test* because we don't have access to the whole population data. We're only operating on a small sample of size 24. It's *dependent* because each subject is taking the test twice. So, this is a *within subject* design. We're considering *one-tailed* test because from the charts below, we'll see that incongruent words are associated with higher response time for all subjects, hence the expectation from the analysis is also the same. Also, by plotting the histogram for both tests, it doesn't exactly fit Normal distribution.

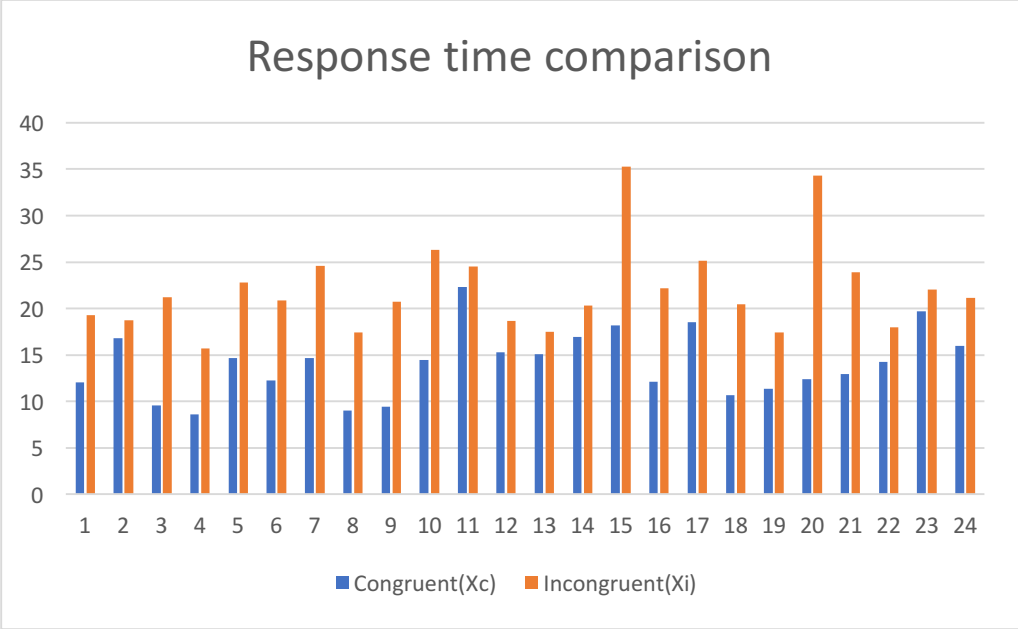
3. **Report some descriptive statistics regarding this dataset. Include at least one measure of central tendency and at least one measure of variability.**

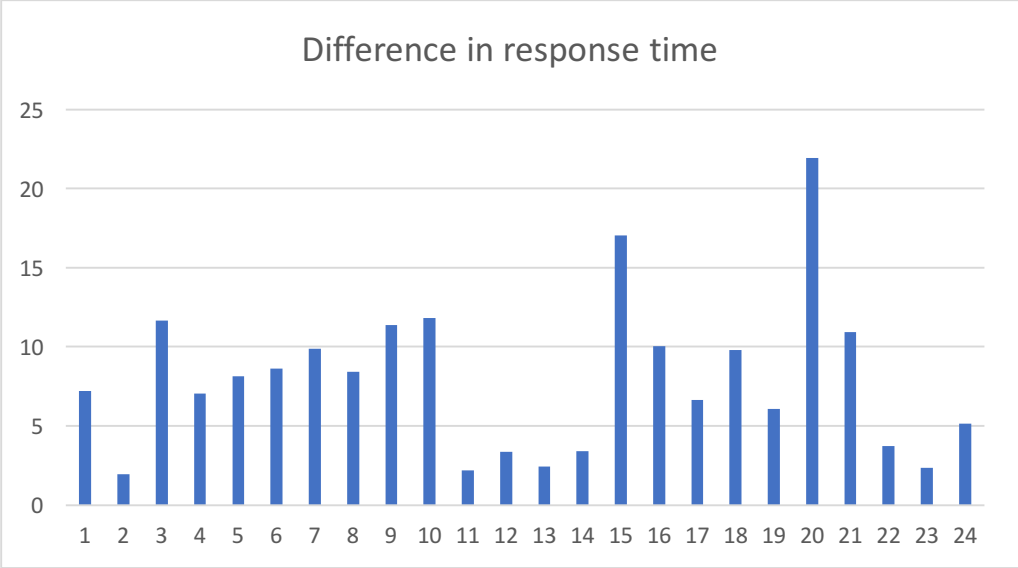
Congruent(X_c)	**Incongruent(X_i)**	$X_D = X_i - X_c$
12.079	19.278	7.199
16.791	18.741	1.95
9.564	21.214	11.65
8.63	15.687	7.057
14.669	22.803	8.134
12.238	20.878	8.64
14.692	24.572	9.88
8.987	17.394	8.407
9.401	20.762	11.361
14.48	26.282	11.802
22.328	24.524	2.196
15.298	18.644	3.346
15.073	17.51	2.437
16.929	20.33	3.401
18.2	35.255	17.055
12.13	22.158	10.028
18.495	25.139	6.644
10.639	20.429	9.79
11.344	17.425	6.081
12.369	34.288	21.919
12.944	23.894	10.95
14.233	17.96	3.727

19.71	22.058	2.348
16.004	21.157	5.153
Mean of (X_c) = 14.051125	Mean of (X_i) = 22.01591667	Mean of (X_i - X_c) = 7.964791667
Sample SD_c = 3.559357958	Sample SD_i = 4.797057122	Sample SD = 4.86482691

A. For the congruent words, mean $\bar{X}_c$ = 14.05 and for the incongruent words, mean $\bar{X}_i$ = 22.02.
B. For the congruent words, sample standard deviation SD_c = 3.56 and for the incongruent words, sample standard deviation SD_i = 4.80

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.





A. As seen from the charts above, for each user the response time is much higher for incongruent words compared to congruent words. We hope to capture the same information from statistical analysis of the given data.

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?

A. We're taking **95%** confidence level for the *one-tailed* test. So, the critical statistic value t_c **= 2.069**. As seen from the above table, we got the mean difference $\bar{X}_D = \bar{X}_i - \bar{X}_c$ **= 7.96** and the standard deviation of $X_i - X_c$: SD_D = **4.86**. Putting this value in the equation of t-statistic we get t_s **= 8.03** which is way above the critical value. Hence, we reject the null hypothesis, i.e. we conclude the mean response time for congruent words are not at all similar to that of incongruent words. This behaviour was kind of expected, as we saw the nature of the distribution of both congruent and incongruent words in the previous chart.

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!

A. I think, it's human nature to speak out the actual colour which is used to print the word, not the other way around. So, it takes a little more time to suppress that spontaneous reaction and give the correct answer. A quick Wikipedia search reveals the causality in much more depth, which I'm omitting here to avoid duplication.

There is something called Emotional Stroop Test[1] which works by examining the response time of the participant to name colours of negative emotional words (e.g., "war", "cancer", "kill") rather than non-depressing words (e.g., "clock", "lift", "windy"). It's similar to Stroop effect, but apparently "*it involves only emotional and neutral words—colour does not affect slowing because it does not conflict with word meaning*".

Link 1. *https://en.wikipedia.org/wiki/Emotional_Stroop_test*