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

ANS:

    Independent variable: the words condition (congruent words or incongruent words).

    Dependent variable: the time it takes to name the ink colors in equally-sized lists.

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

ANS:

Ho - **Null Hypothesis**: ($\mu_i - \mu_c = 0$) There is **no** significant difference in the population average response time in viewing the congruent(c) words vs viewing the incongruent (i) words.
Ha - **Alternative Hypothesis**: ($\mu_i - \mu_c \neq 0$) there is a significant difference, positive or negative, in the population average response times.

The Dependent Samples t-Test is the appropriate statistical test as the same subjects are assigned two different conditions. The different conditions are dependent because, in theory, by doing the first test you have some practice doing it and you might have an unfair advantage due to this learning effect in doing the similar type of test second. In addition, we don't have any population parameters provided (so a z-test would not be appropriate here).

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

ANS:

  A.   The number of results for each condition:
          Congruent   24
          Incongruent   24

  B.   The median result for each condition:
          Congruent   14.3565
          Incongruent   21.0175

  C.   The mean of the results for each condition:
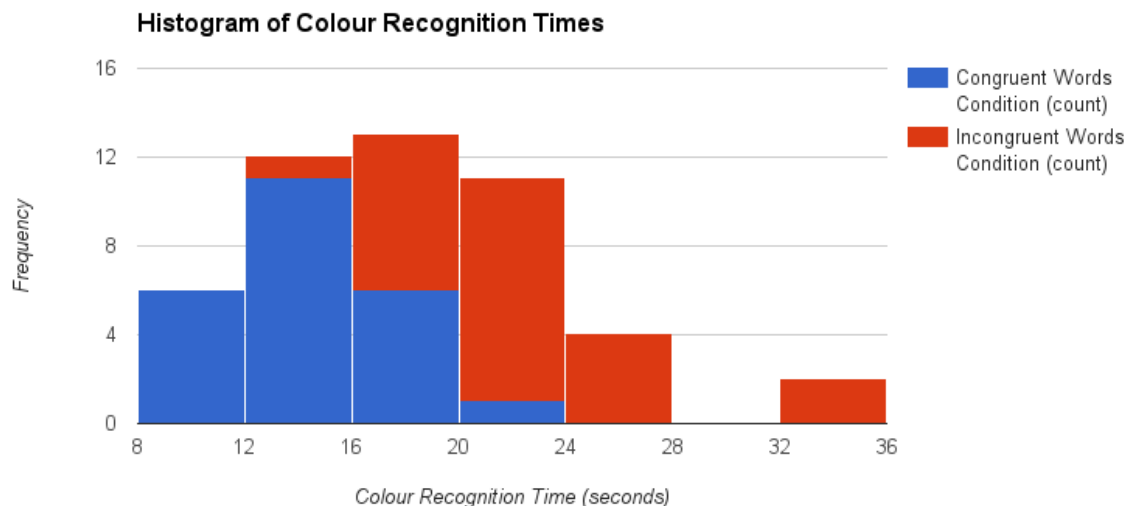   Congruent   14.0511
          Incongruent   22.0159

  D.   The standard deviation of the results for each condition:
          Congruent   3.5593
          Incongruent   4.7970

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.
ANS:

Histogram of Colour Recognition Times

The bucket range of the congruent words condition data is 8 seconds to 24 seconds. The bucket range of the incongruent words condition data is 12 seconds to 36 seconds, i.e., noticeably to the right of the congruent words condition 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?

ANS:

$\alpha = .01$

$df = 23$

$t_{crit} = -2.50$

$t = -8.02$

p-value = < .0001

At the 99% confidence level ($\alpha = .01$) and 23 degrees of freedom, the critical statistic value for a one-tailed test in the negative direction is -2.5. The calculated t-statistic for the difference in colour recognition time means of the congruent and incongruent word data is -8.02. Since the t-statistic is in the critical region, the null hypothesis is rejected. With the data presented, it is very unlikely that the 7.96 second difference in mean time for colour recognition for the congruent data vs. the incongruent data is obtained if the two means are

actually the same (or if $\mu_c > \mu_i$). By conventional criteria, this difference is considered to be extremely statistically significant.

There is sufficient evidence at the $\alpha = .01$ level of significance to support the claim that it takes less time to recognize the colour of words with the congruent condition compared to words with the incongruent condition.