

P1: Test a Perceptual Phenomenon

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

Independent variable: type of tasks (a congruent and an incongruent tasks)

Dependent variable: a time for the performance of the two tasks

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

Null hypothesis H_0 The difference between the congruent task and incongruent task population means is zero. ($\mu_2 - \mu_1 = \mu_0 = 0$)

Alternative hypothesis H_1 : The difference between the congruent task and incongruent task population means are different. ($\mu_2 - \mu_1 = \mu_0 \neq 0$)

A z-test and a t-test are both used in hypothesis testing. But, in this case, a t-test is used.

First, we cannot use a z-test because we don't know the population mean and the population standard deviation. Second, a t-test is used if we have a small sample size (less than 30). For this reason, I decided to use a t-test.

I use two-tailed test because we want to ensure that two means in hypothesis are the same or different.

I choose a dependent sample test. Since the congruent task and incongruent task is jointly performed in a trial, two tasks are dependent.

Time to Complete Word Set 1: 17.226

106788		
5-10 sec	20932	19.60%
10-15 sec	42617	39.91%
15-20 sec	25709	24.07%
20-25 sec	9757	9.14%
25-30 sec	3516	3.29%
30-35 sec	1482	1.39%
35-40 sec	862	0.81%
More than 40 sec	1913	1.79%

Time to Complete Word Set 2: 33.794

107304		
5-10 sec	7508	7.00%
10-15 sec	8569	7.99%
15-20 sec	16717	15.58%
20-25 sec	27555	25.68%
25-30 sec	20088	18.72%
30-35 sec	12428	11.58%
35-40 sec	6422	5.98%
More than 40 sec	8017	7.47%

What is the difference between your Word Set 2 time and Word Set 1 time? (To calculate the difference: Word 2 time - Word 1 time = Difference Time) 16.5

183531		
Word set 2 time is LESS than word set 1 time	12713	6.93%
0-5 sec	35941	19.58%
5-10 sec	46893	25.55%
10-15 sec	44024	23.99%
15-20 sec	20828	11.35%
20-25 sec	10751	5.86%
25-30 sec	4376	2.38%
30-35 sec	2705	1.47%
35-40 sec	1720	0.94%
More than 40 sec	3580	1.95%

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

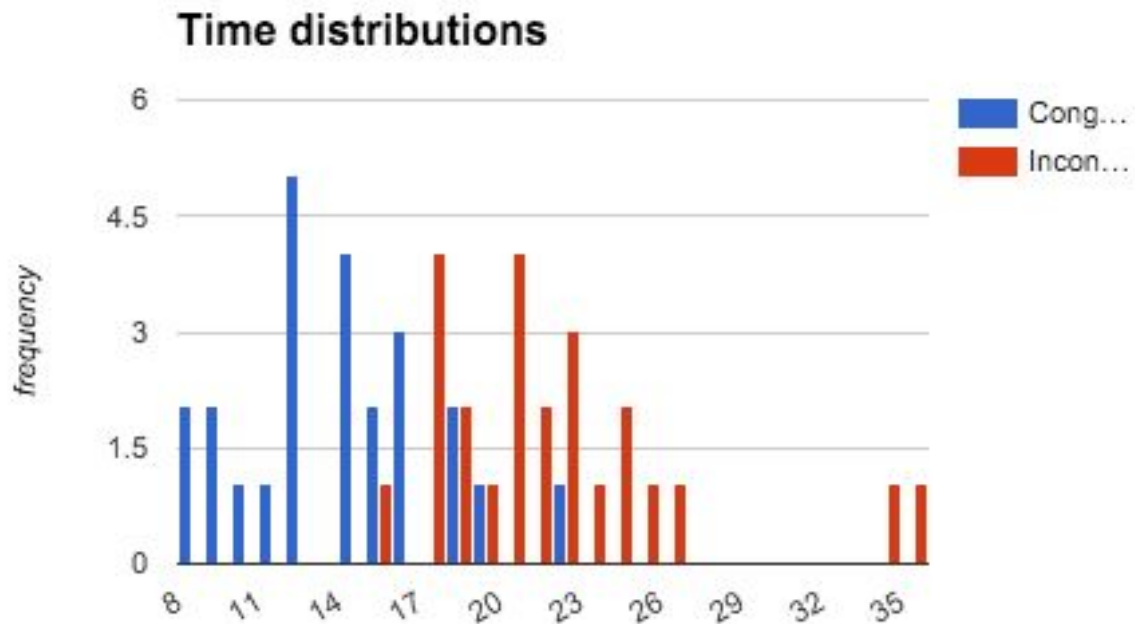
Dataset

Congruent	Incongruent	diff
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

The sample averages of a congruent task and an incongruent task, X_1 and X_2 , equal 14.05 sec and 22.02 sec, respectively. the sample standard deviations of the congruent task and the incongruent task, s_1 and s_2 , equal 3.56 sec and 4.80 sec, respectively. What interests me is the average and the standard deviation of the difference, which equal 7.96($X_d=X_2-X_1$) and 4.86 ($sd=s_2-s_1$), respectively.

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 figure shows distributions of times received on congruent tasks and incongruent tasks. The bars in blue are for a congruent task, while, the bars in red are for an incongruent task. As can be seen, the congruent task takes less time than the incongruent task.

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?

My confidence level is 95%. Since we want to know that the two population means are the same or not, two-tailed test is followed. The t-score is calculated as follows:

$t = \frac{(\bar{X}_d - \mu_0)}{\frac{s_d}{\sqrt{n}}}$, where n is difference sample size. So, t-score is approximately 8.021.

The degree of freedom (df) is 23 (=48/2-1). From the t-table, the critical statistic value is approximately 2.069.

Since we have a two-tailed test, the p-value is the probability that a t-score having 40 degrees of freedom is extremely less than -8.021 or greater than 8.021. The p-value is close to 0.

Since t-score (8.021) is much greater than t-critical value (2.069), we declare statistical significance and reject the null hypothesis. In other words, the the congruent task population mean is different from the incongruent task population mean; the incongruent task takes more time than the congruent task.