**STATISTICS**
**Greeshma Gudhimalla**
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**Research question:** Is there a significant difference between the reflex times of people over the age of 40 vs people under the age of 40?

**Claim:** People under the age of 40 have a shorter reflex time than people over the age of 40.

**Experimental methods:**

We surveyed 12 people each - 6 under the age of 40 and 6 over the age of 40. We each made a list of 16 people (8 of each age group) and used a random number simulator to pick the subjects being surveyed. After doing so, we collected our data by measuring the reflexes through the reflex test on humanbenchmark.com. We performed three trials for each subject and the average reflex time was recorded as the data value for that subject.

- This is a Left-tailed test.
- Our samples are independent.

**Null hypothesis** – The mean reflex times for the people who are below 40 would be the same as the mean reflex time for people who are above 40.

**Alternative Hypothesis** - The mean reflex times for the people who are below 40 would be less than the mean reflex time for the people who are above 40.

**RAW data:**

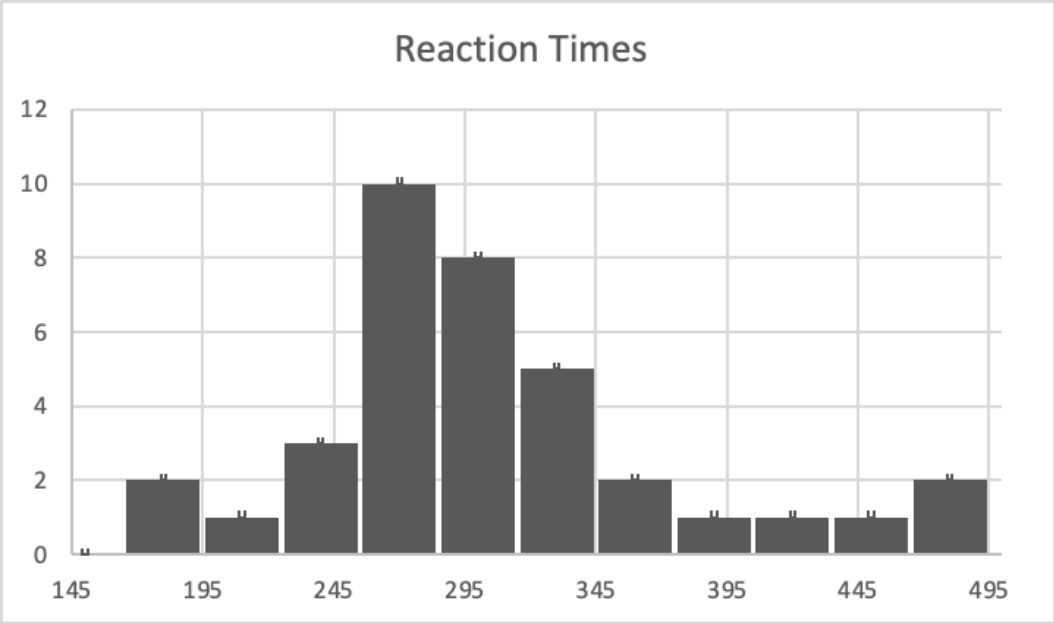
| **Subject Number** | **Subject Age** | **Subject Gender** | **Reaction Time (ms)** |
|---|---|---|---|
| 1 | 24 | Female | 177 ms |
| 2 | 19 | Female | 285 ms |
| 3 | 21 | Male | 235 ms |
| 4 | 22 | Female | 247 ms |
| 5 | 21 | Male | 278 ms |
| 6 | 20 | Female | 244 ms |

| | | | |
|---|---|---|---|
| 7 | 55 | Female | 329 ms |
| 8 | 60 | Female | 327 ms |
| 9 | 69 | Male | 450 ms |
| 10 | 45 | Male | 282 ms |
| 11 | 56 | Female | 290 ms |
| 12 | 63 | Female | 274 ms |
| 13 | 20 | Female | 350 ms |
| 14 | 16 | Male | 264 ms |
| 15 | 9 | Female | 212 ms |
| 16 | 15 | Male | 189 ms |
| 17 | 26 | Female | 329 ms |
| 18 | 12 | Female | 159 ms |
| 19 | 32 | Female | 274 ms |

| | | | |
|---|---|---|---|
| 20 | 41 | Female | 464ms |
| 21 | 55 | Male | 458 ms |
| 22 | 68 | Male | 403 ms |
| 23 | 49 | Male | 309 ms |
| 24 | 52 | Female | 249 ms |
| 25 | 47 | Male | 350ms |
| 26 | 45 | Female | 372ms |
| 27 | 12 | Male | 289ms |
| 28 | 20 | Female | 329ms |

| | | | |
|---|---|---|---|
| 29 | 16 | Female | 242 ms |
| 30 | 45 | Female | 270 ms |
| 31 | 49 | Male | 263 ms |
| 32 | 19 | Female | 250ms |
| 33 | 57 | Female | 280ms |
| 34 | 19 | Female | 261ms |
| 35 | 23 | Male | 251ms |
| 36 | 58 | Male | 239ms |
| Descriptive Stats | Under 40 years old | Mean: 256.05 ms | Stdev: 50.18 ms |
| Descriptive Stats | Over 40 years old | Mean: 329.94 ms | Stdev: 74.65 ms |

The sample is representative of the population of interest because there are greater than 30 people (36 people total) in our sample. It is a simple random sample because our method of choosing the sample was randomly selected from a larger list of individuals. However, our sample may have been less than completely random simply due to our limited ability to sample individuals outside of the circle of people that we know.

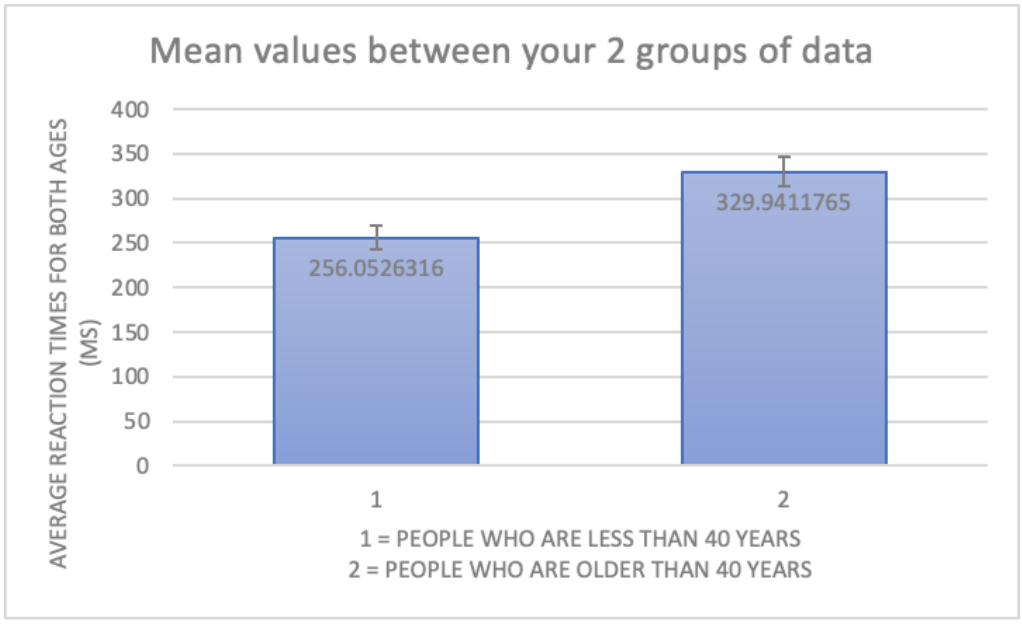



**X - axis = The mean values of people who are above and below 40.**

**Y- axis = Frequency**

The data does not fully appear to be normally distributed as the curve on the left tail does not look similar to the right one. The errors may occur because of the limited data set of 36 people. We could have taken the data from 100 people which will give us more diverse values and increase the chance of normality in a curve that would represent the population better.

**A graph comparing the mean values between your 2 groups of data:**



The confidence interval is 95% and the degrees of freedom for each:

The reaction time of 19 values for ages below 40:

- The mean value = 256.05 ms
- Standard deviation = 50.18 ms
- $CI = \bar{x} + t(\alpha/2) * (S/\sqrt{n}) = 259.7 + (1.7341) * (50.18/\sqrt{19})$
- **Confidence Interval = 239.74 < x < 279.66**

The reaction time of 17 values for ages above 40 :

- The mean value = 329.94 ms
- Standard deviation = 74.64 ms
- $CI = \bar{x} + t(\alpha/2) * (S/\sqrt{n}) = 329.94 + (1.7459) * (64.45/\sqrt{17})$
- **Confidence Interval = 302.65 < x < 357.23**

**Calculating test statistic:**

$s_p = \sqrt{\frac{(s1^2)(n1-1)+(s2^2)(n2-1)}{n1+n2-2}} = \sqrt{\frac{(50.18^2)(19-1)+(74.65^2)(17-1)}{19+17-2}}$ = 62.89 ms

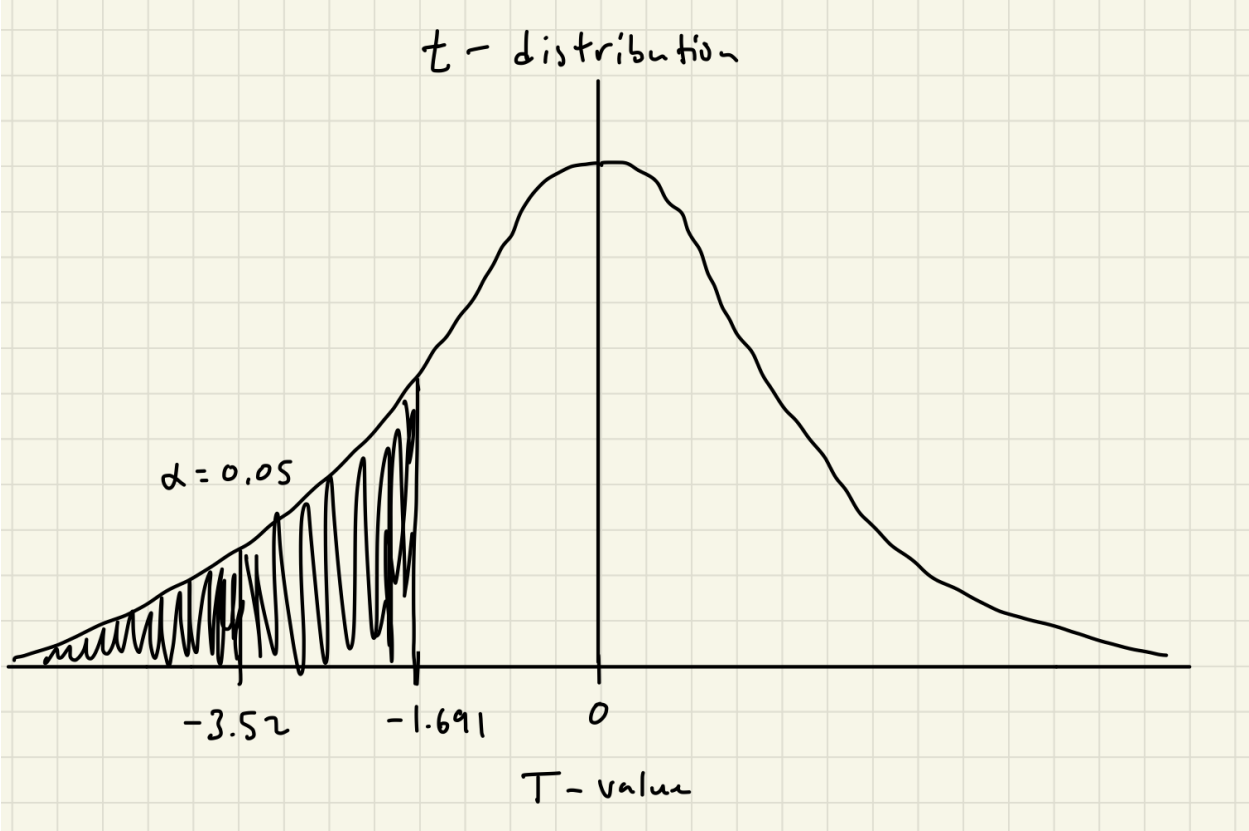
$t_{stat} = \frac{(\overline{x1}-\overline{x2})}{Sp\sqrt{\frac{1}{n1}+\frac{1}{n2}}}$ = -3.52

**Identifying the critical value(s) :**

Degrees of freedom = 34

$t_{.05}$ = -1.691

**A graph of the t-distribution with the critical region(s) shaded:**




**Do we "reject $H_0$" or "fail to reject $H_0$"?**

Reject $H_0$.

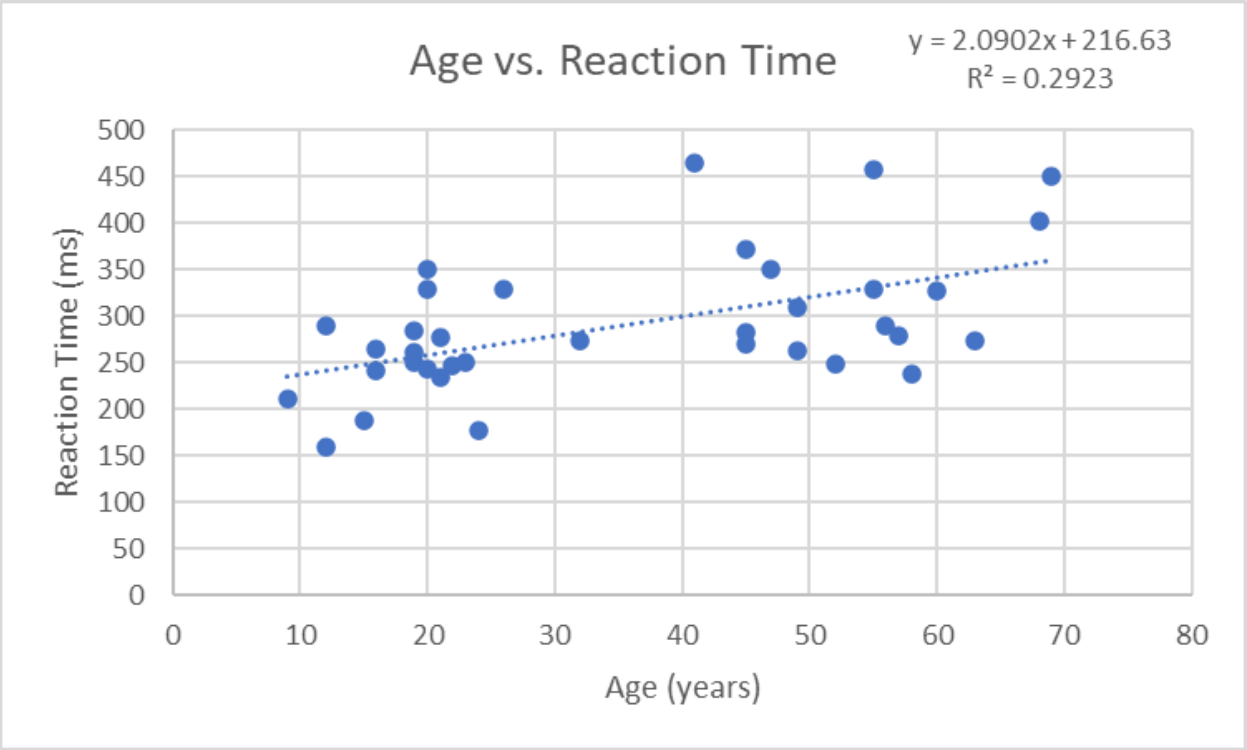
**Conclusion:** There is sufficient evidence to warrant the claim that people under the age of 40 have a shorter reflex time than people over the age of 40.

**Linear regression equation**:

$y = 2.0902x + 216.63$

$r^2 = 0.2923$

**A plot of the linear regression:**




There is not sufficient evidence to support the claim that a linear correlation exists between age and reflex time because the $r^2$ value is 0.2923, which is low, and thus does not suggest a strong linear correlation.

**Example: The value of your dependent variable collected from somebody who is 45 years old:**

Linear regression equation:

y=2.0902x+216.63

For someone who is 45 years old, the linear regression model predicts that the reaction time is 2.0902(45)+216.63 = 310.69 ms.