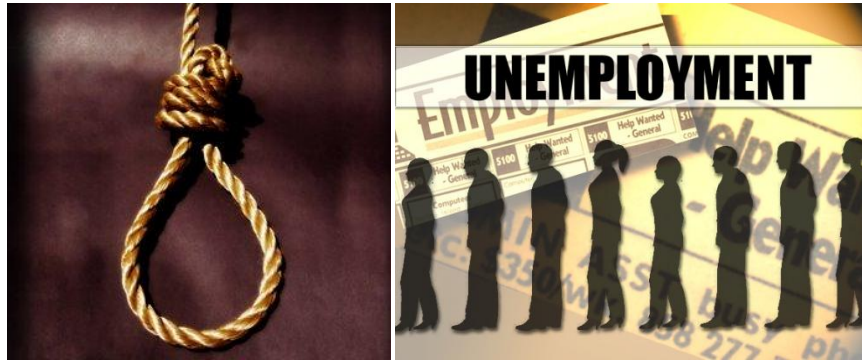


# The Suicide Note:

Do unemployment rates affect suicide rates?



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Course: A World View of Math and Data Analysis

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Date: July 17, 2010

## Abstract:

Committing suicide is one of the primary causes of death in the world. There are several deviating reasons as to why people of all ages commit suicide. Examples may be abundant amounts of stress, poverty, emotional upsets and setbacks, obscure relationships with others, and much more. Unemployment, one of the considerable factors that may cause suicidal thoughts and suicide, was chosen to analyze if there was a correlation between suicide rates and unemployment rates. Data collected from the WHO (World Health Organization) was calculated to see if there was any correlation in the state level (United States) suicide rates and unemployment rates, and again with the different countries and their suicide and unemployment rates around the world (chosen at random). The correlation coefficients proved that there was little, if any, correlation between the affects of unemployment and suicide rates in the 50 states and in the different countries over the world. The calculations led to a hypothesis that unemployment rates do not affect suicide rates.

## Background:

Suicide is the process of purposely ending one's own life. According to the W.H.O. (World Health Organization), it is examined to be among the top 20 leading causes of death globally for all ages. It is considered one of the three leading causes of death in the world among the ages of 15-44 in some countries throughout the world, and the second leading cause of death in the age range of 10-24. In the US, suicide is the third leading cause of death for 15-to-24-year-olds and the overall eleventh cause of death for the general population of Americans. Worldwide, there are more deaths caused by suicides rather than accidents, homicides, and war combined. Statistics from "*The Truth about Suicide*" prove that a person dies by suicide about every 18 minutes in the US.

There are several reasons as to why someone would commit suicide, however, the most immense factor that leads to someone committing suicide or even thinking about it is depression. Depression includes rage, hopelessness, abandonment, self-hatred, anxiety, or agony. Suffering from depression may lead to bipolar conditions and carry high risks of suicide. The top methods of suicide that are used are firearms, suffocation, and poisoning that account for 92.3% of all suicides committed. Between the 1950s-1970s, suicide rates had almost tripled in males and doubled in females. In the past 45 years, suicide rates have increased by 60% in some countries, especially in the eastern hemisphere. For every four males that commit suicide, one female commits suicide. For every three females that attempt committing suicide, one male attempts to commit suicide.

Unemployment is the condition in which one is able to work but unable to find a job. The economic standings of the government in this age and time make it hard for one to find a job and

leave people unemployed with nothing to do. Once assumed to be voluntary to be unemployed is now considered beyond the control of an individual worker due to technological changes in labor, seasonal layoffs, racial discrimination, and of course, economic fluctuation. Since the recession (a general slowdown of economic activity over a period of time) that began in March 2001, the US Labor Market has been in a slump, leaving employers jobless.

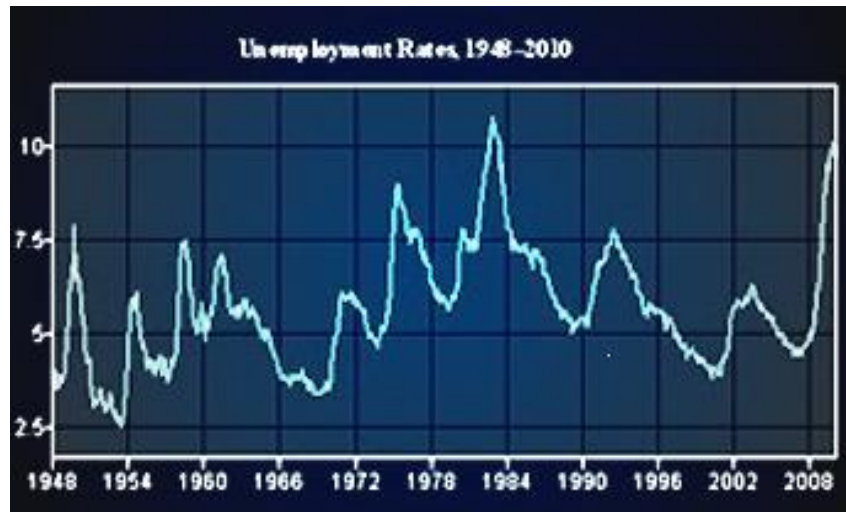


Figure 1. Unemployment Rate line graph 1948-2008

The recession has taken affect on most of the countries around the world and is circling around the globe with unemployed people and governments using different tactics to protect jobs. While doing so, some countries like Germany, cut shorter work weeks as a way to prevent mass layoffs and more money disappearing from already empty pockets.

### Research:

Suicide rates seem to be having different impacts on different states and countries. Is it because of the recession and the high unemployment rates, leaving people jobless and hopeless? Do unemployment rates have any effect on the suicide rates at all?

## Methods:

To see if there was any correlation between unemployment rates and suicide rates, data was collected for 50 states and 50 randomly selected countries around the world. The first table (see Appendix, [table 1](#)) was collected to see if there was any correlation between unemployment rates and suicide rates in the United States as a whole (Part1). The second table (see Appendix, [table 2](#)) was collected to see if there was any correlation between unemployment rates and suicide rates in the 50 randomly selected countries throughout the world (Part 2). The two tables were graphed using a scatter plot and can be seen using the tables below-

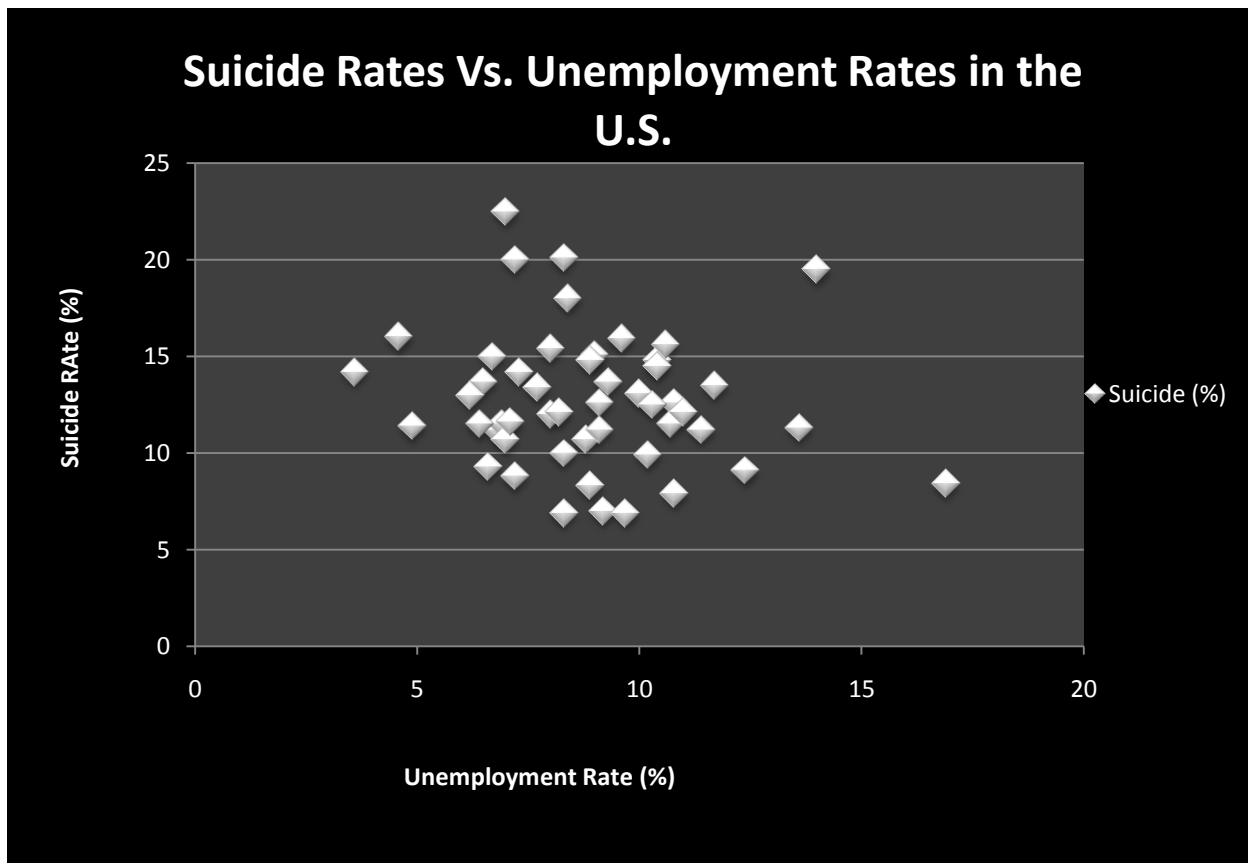


Figure 1- Scatter plot of the "Suicide Rates vs. Unemployment Rates in the U.S." table

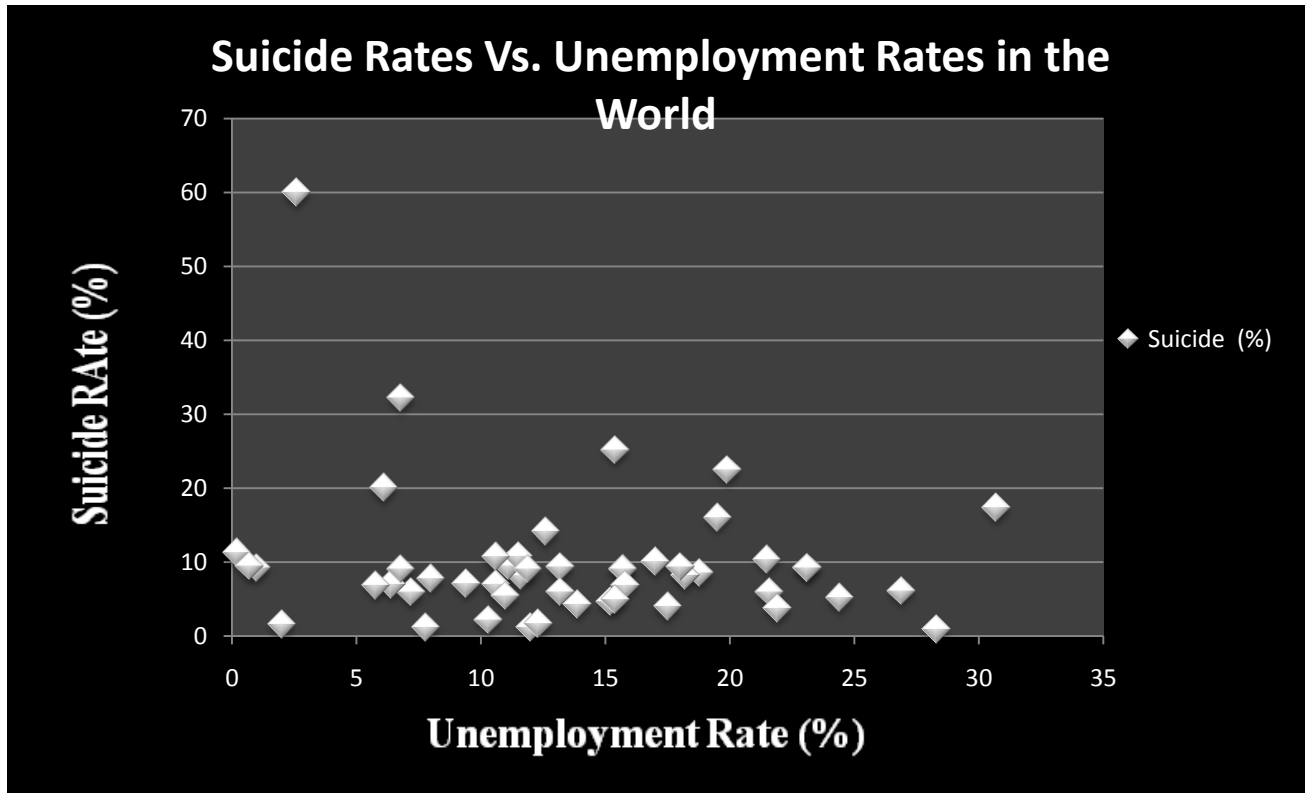


Figure 2- Scatter plot of the “Suicide Rates vs. Unemployment Rates in the World” table

To analyze and interpret the data the best way, a scatter plot was used (as seen above, in the Methods section) to evaluate a linear regression.

**Part One:** Suicide Rates vs. Unemployment Rates in the U.S.

The equation  $r = \frac{n \sum xy - (\sum x)(\sum y)}{\sqrt{n \sum x^2 - (\sum x)^2} \sqrt{n \sum y^2 - (\sum y)^2}}$  was used to find the linear correlation

coefficient ( $r$ ), which determines how well the data points correlate with the line of best fit ( $x$  &  $y$ ). The  $r$  value should be between  $-1 \leq r \leq 1$ , where the closer to -1 (negative correlation) or 1 (positive correlation), the stronger the correlation.

$n = 50$ $\sum x = 635.6$ $\sum x^2 = 8,667.18$ $\sum y = 444$ $\sum y^2 = 4,233.84$ $\sum xy = 5,580.52$
Preliminary data for Part 1

$$r = \frac{50(5,580.52) - (635.6)(444)}{\sqrt{50(8,667.18) - (635.6)^2} \sqrt{50(4,233.84) - (444)^2}}$$

$r = -.153814268$  ← very weak negative correlation

$r^2 = .03658829$  ← very weak  $r^2$  value.

The regression linear equation ( $\hat{y} = a + bx$ ) was found by finding the  $a$  value ( $\frac{\sum y}{n} - b \frac{\sum x}{n}$ )

and  $b$  value ( $b = \frac{ssxy}{ssxx}$ ,  $\frac{\sum xy - \frac{(\sum x)(\sum y)}{n}}{\sum x^2 - \frac{(\sum x)^2}{n}}$ ).

$$\hat{y} = 10.25 - .023658824 x$$

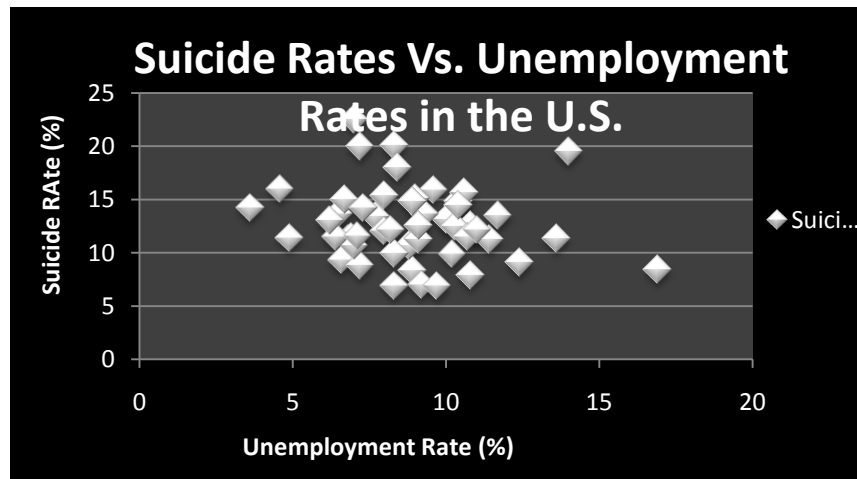


Figure 3. Suicide Rates vs. Unemployment Rates in the US

A hypothesis test was done, using the Null Hypothesis ( $H_0$ ) and Alternative Hypothesis ( $H_a$ ). The claim that there was a negative linear correlation at the alpha level of 0.05 ( $\alpha = 0.05$ ) was conducted.

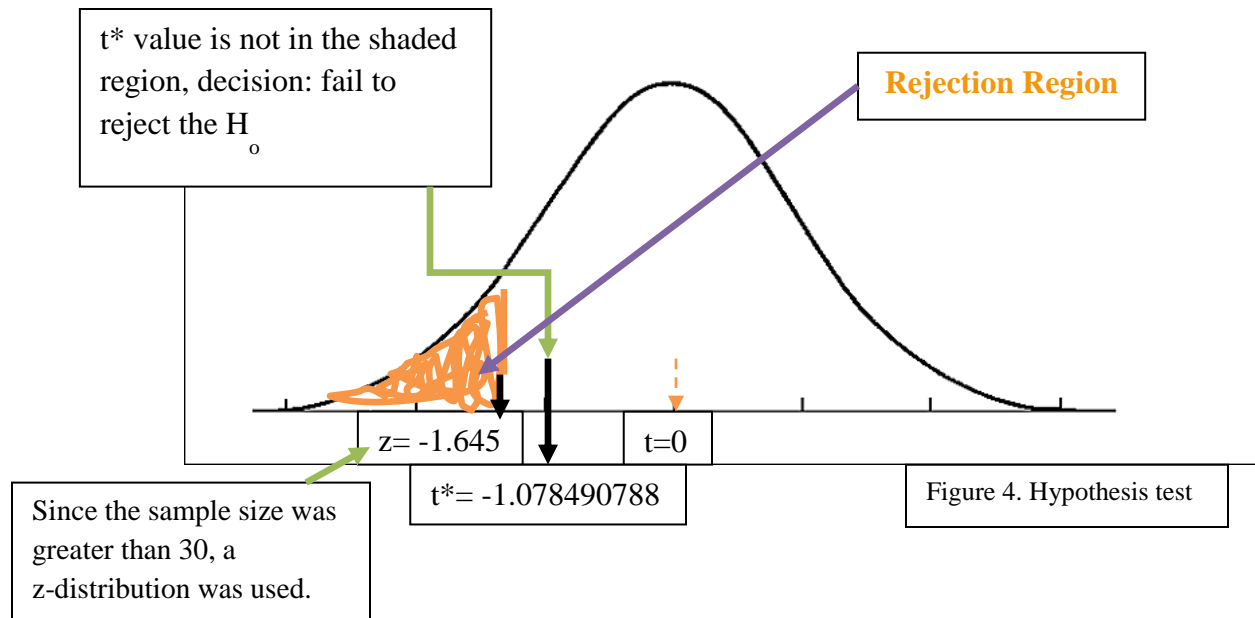
$$H_0 : \rho \geq 0$$

$$H_a : \rho < 0 \text{ (claim)}$$

The test statistic ( $t^*$ ) was calculated to see if the data fell in the rejection region.

$$t^* = \frac{r}{\sqrt{\frac{1-r^2}{n-2}}} \text{ with } d.f. = n-2 \rightarrow t^* = \frac{-0.153814268}{\sqrt{\frac{1-0.023658829}{50-2}}} \rightarrow t^* = -1.078490788$$

Degrees of freedom



Fail to reject the  $H_0$

Conclusion: There is insufficient evidence at the alpha level of 0.05 to conclude that there is a negative linear between the unemployment rate and suicide rate in the US.



**Part Two:** Suicide Rates vs. Unemployment Rates in the World

Since there was a very weak correlation between suicide rates and unemployment rates in the U.S. alone, a linear regression on suicide rates and unemployment rates in the world was conducted to see if there was any difference. The same formula

$$\frac{n\sum xy - (\sum x)(\sum y)}{\sqrt{n\sum x^2 - (\sum x)^2} \sqrt{n\sum y^2 - (\sum y)^2}}$$

was used with the new data (see chart below).

$n = 50$ $\sum x = 678.6$ $\sum x^2 = 11,794$ $\sum y = 494.45$ $\sum y^2 = 9,261.8425$ $\sum xy = 6,122.315$
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Preliminary data for Part 2

$$r = \frac{50(6,122.315) - (678.6)(494.45)}{\sqrt{50(11,794) - (678.6)^2} \sqrt{50(9,261.8425) - (494.45)^2}}$$

$r = -.076914388$  ← very weak negative correlation

$r^2 = .0059158231$  ← very weak negative correlation

$$\hat{y} = 12.9792 - .22769x$$

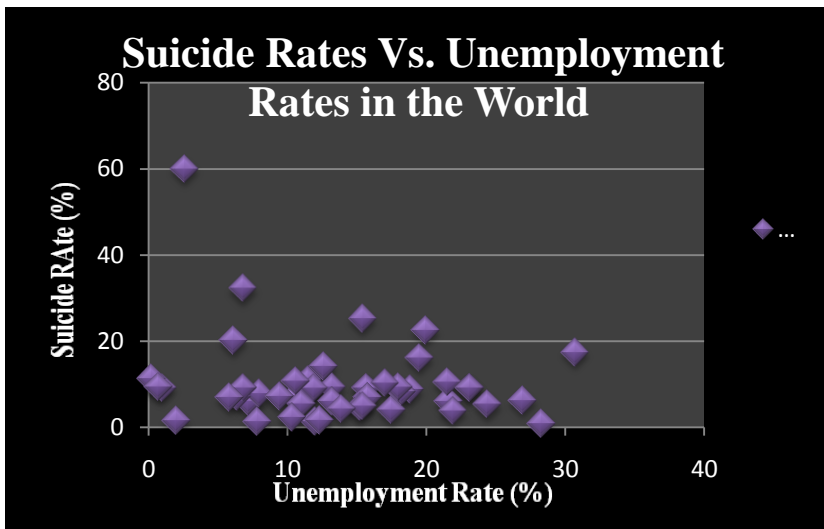


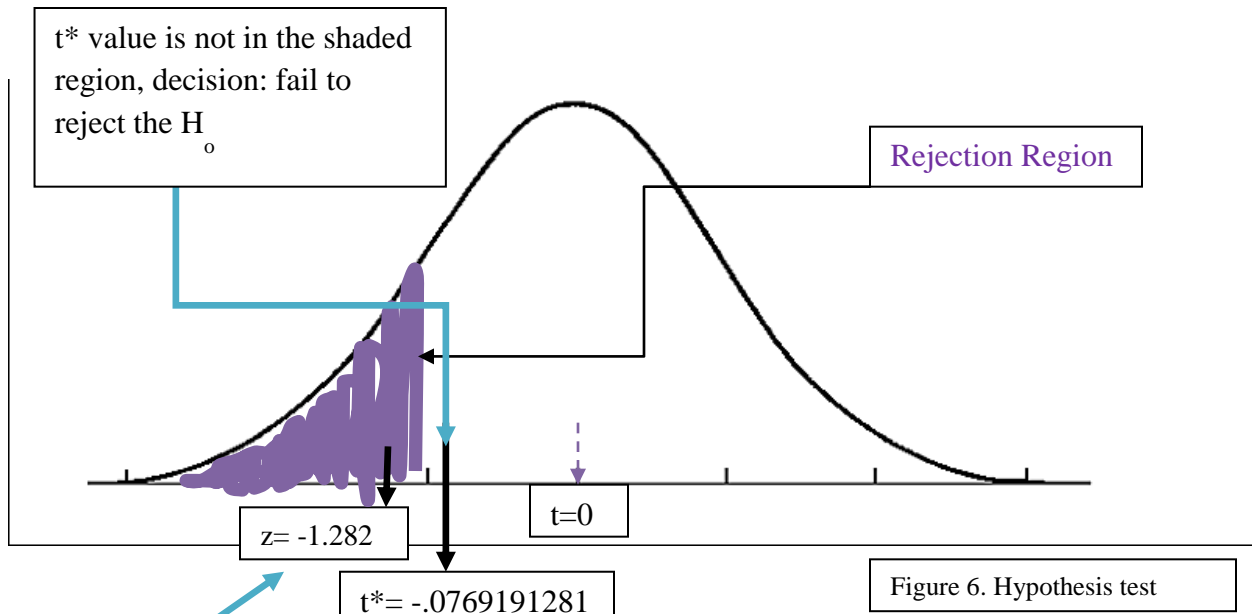
Figure 5. Hypothesis test

Another hypothesis testing was conducted with the data from the global level to claim that there was a negative linear correlation at the alpha level of 0.10 ( $\alpha = 0.10$ ).

$$H_0 : \rho \geq 0$$

$$H_a : \rho < 0 \text{ (claim)}$$

$$t^* = \frac{r}{\sqrt{\frac{1-r^2}{n-2}}} \text{ with } d.f. = n-2 \rightarrow t^* = \frac{-0.076914388}{\sqrt{\frac{1-0.0059158231}{50-2}}} \rightarrow t^* = -0.0769191281$$



Since the sample size was greater than 30, a z-distribution was used.

Fail to reject the  $H_0$

Conclusion: There is insufficient evidence at the alpha level of 0.10 to conclude that there is a negative linear between the unemployment rate and suicide rate in the U.S.

## Results:

**Part One:** Conclusion: There is insufficient evidence at the alpha level of 0.05 to conclude that there is a negative linear between the unemployment rate and suicide rate in the U.S.

**Part Two:** Conclusion: There is insufficient evidence at the alpha level of 0.10 to conclude that there is a negative linear between the unemployment rate and suicide rate in the world.

## Conclusion:

The results from the hypothesis testing and linear correlation equations show that the rates of unemployment and suicide do not have a strong connection between them to conclude that unemployment is a factor that causes people to commit suicide. The data and work shows that there was almost no correlation between the unemployment and suicide rates due to the fact that the  $r$  value for both the U.S. and global data were very close to 0. Hypothesis testing allowed us to see that there was no negative correlation; hence the decision made was to reject the null hypothesis in both trials. The fact that the data shows no correlation is relevant to the satisfaction of people when realizing that unemployment rates do not affect suicide rates. It is appealing to the general populations' minds when considering that just because you are unemployed will mean you will certainly go through depression and have high rates of suicide being committed. Further explanations that could be tested to see what correlates with suicide rates would be to find out the rates of people being treated for depression and the rates of suicide, to analyze if therapy actually helps people from committing suicide.

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## Appendix:

	State	Suicide Rate	Unemployment Rate
1	Alabama	12.6	10.8
2	Alaska	20.1	8.3
3	Arizona	15.9	9.6
4	Arkansas	13.4	7.7
5	California	9.1	12.4
6	Colorado	15.4	8.0
7	Connecticut	8.3	8.9
8	Delaware	10.7	8.8
9	Florida	13.5	11.7
10	Georgia	9.9	10.2
11	Hawaii	9.3	6.6
12	Idaho	15.1	9.0
13	Illinois	7.9	10.8
14	Indiana	13.1	10.0
15	Iowa	11.2	6.8
16	Kansas	13.7	6.5
17	Kentucky	14.8	10.4
18	Louisiana	11.5	6.9
19	Maine	12.0	8.0
20	Maryland	8.8	7.2
21	Massachusetts	7.0	9.2
22	Michigan	11.3	13.6
23	Minnesota	10.7	7.0
24	Mississippi	11.2	11.4
25	Missouri	13.7	9.3
26	Montana	20.0	7.2
27	Nebraska	11.4	4.9
28	Nevada	19.5	14.0
29	New Hampshire	11.5	6.4
30	New Jersey	6.9	9.7
31	New Mexico	18.0	8.4
32	New York	6.9	8.3
33	North Carolina	12.5	10.3
34	North Dakota	14.2	3.6
35	Ohio	11.5	10.7
36	Oklahoma	15.0	6.7
37	Oregon	15.6	10.6
38	Pennsylvania	11.2	9.1

39	Rhode Island	8.4	16.9
40	South Carolina	12.1	11.0
41	South Dakota	16.0	4.6
42	Tennessee	14.5	10.4
43	Texas	10.0	8.3
44	Utah	14.2	7.3
45	Vermont	13.0	6.2
46	Virginia	11.6	7.1
47	Washington	12.6	9.1
48	West Virginia	14.8	8.9
49	Wisconsin	12.1	8.2
50	Wyoming	22.5	7.0

**Table 1**

	Country	Suicide Rate	Unemployment Rate
1	South Africa	15.4	25.2
2	Nicaragua	7.2	5.9
3	Moldova	15.7	9.1
4	Sri Lanka	21.6	5.9
5	Costa Rica	8.0	7.8
6	Bahamas	1.0	9.2
7	Latria	19.9	22.5
8	Finland	18.8	8.6
9	Tajikistan	2.6	60.0
10	Malta	6.4	7.0
11	Denmark	10.6	7.0
12	Iran	0.2	11.3
13	Germany	9.4	7.1
14	South Korea	21.9	3.7
15	Kuwait	2.0	1.5
16	Barbados	0.7	9.4
17	Canada	11.6	8.1
18	Switzerland	17.5	4.0
19	United States	9.5	9.5
20	Moldova	15.7	9.1
21	Lithuania	30.7	17.4

22	Russia	23.1	9.2
23	Hungary	21.5	10.4
24	Spain	6.1	20.05
25	Ecuador	6.8	9.1
26	Serbia	19.5	16.1
27	Israel	5.8	6.9
28	Macedonia	6.8	32.2
29	Belgium	18.2	8.2
30	Japan	24.4	5.2
31	Belarus	28.3	0.9
32	Kazakhstan	26.9	6.1
33	Uruguay	15.8	6.9
34	Russia	23.1	9.2
35	Sweden	13.2	9.3
36	Slovakia	12.6	14.1
37	New Zealand	13.2	6.0
38	Hong Kong	15.2	4.6
39	Luxembourg	11.0	5.4
40	Portugal	11.5	10.8
41	Iceland	11.9	9.0
42	Trinidad	12.0	1.2
43	India	10.6	10.7
44	Austria	15.4	4.9
45	Cuba	12.3	1.6
46	Croatia	18.0	9.3
47	Singapore	10.3	2.2
48	China	13.9	4.3
49	Thailand	7.8	1.2
50	France	17.0	10.1

**Table 2**