**PRACTICAL: 11**

*Test of Significance based on t-Distribution.*

**FORMULA USED:**

1. **TWO SAMPLE : T STATISTIC: FOR EQUAL VARIANCES:**
2. **TWO SAMPLE : T STATISTIC: FOR UNEQUAL VARIANCES:**
3. **HYPOTHESIS STEPS :**

The Null Hypothesis for two samples: test on means:

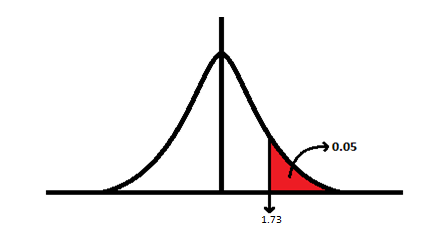
**Question:** To find out whether a new serum will arrest leukemia, 20 mice with an advance stage of the disease are selected.10 mice receive the treatment and 10 did not. Survival Times from the experiment commenced are as:

|  |  |
| --- | --- |
| TEN MICE WITH TREATMENT | TEN MICE WITHOUT TREATMENT |
| 2.1 | 1.9 |
| 5.3 | 0.5 |
| 4.1 | 2.8 |
| 1.4 | 3.1 |
| 4.6 | 4.5 |
| 0.9 | 2.3 |
| 6.4 | 1.3 |
| 2.3 | 3.4 |
| 5.6 | 3.6 |
| 5.5 | 0.6 |

At 0.05, level of significance, can the serum be said to be effective. Assume the two populations to be normally distributed with equal variances.

**Answer:** Using Hypothesis Testing, We know that when the sample variances and mean are known then we can apply T test. Here we should apply Z test for two samples.

1. As indicated by the alternative hypothesis, it is a one tailed problem, in fact a right tailed problem.



Hence, Critical Region is given as:

**T > 1.73**

1. Using Data Analysis Tool:

|  |  |  |
| --- | --- | --- |
|  | *Variable 1* | *Variable 2* |
| Mean | 2.4 | 3.82 |
| Variance | 1.757777778 | 3.908444 |
| Observations | 10 | 10 |
| Pooled Variance | 2.833111111 |  |
| Hypothesized Mean Difference | 0 |  |
| df | 18 |  |
| t Stat | -1.886433685 |  |
| P(T<=t) one-tail | 0.037738094 |  |
| t Critical one-tail | 1.734063592 |  |
| P(T<=t) two-tail | 0.075476188 |  |
| t Critical two-tail | 2.100922037 |  |

1. Using the above table we can see that P (Z<=z) is 0.037 (p value).

Since

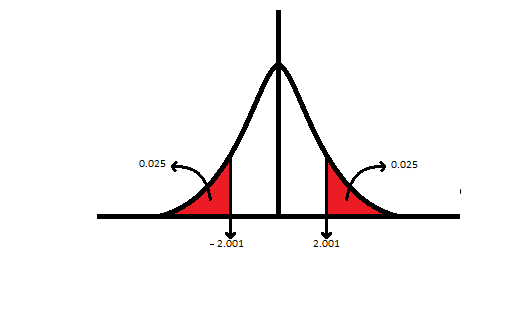
We can strongly say that we should reject the Null Hypothesis in favor of Alternative Hypothesis.

**Question 2:** To find out whether Male and Females dedicate on an average equal time to study hours. 30 Males and 30 Females are observed and their study hours are recorded. The population variances are equal. Recorded Study Hours are as follows:

|  |  |
| --- | --- |
| MALE | FEMALE |
| 2 | 4.50 |
| 6 | 5.00 |
| 3.4 | 2.20 |
| 3 | 6.50 |
| 5 | 6.80 |
| 1 | 5.40 |
| 4 | 3.00 |
| 7 | 8.00 |
| 4.5 | 2.00 |
| 4 | 5.00 |
| 9 | 1.00 |
| 4.5 | 0.10 |
| 5 | 0.90 |
| 2.1 | 1.70 |
| 0.9 | 1.20 |
| 3 | 6.00 |
| 5 | 7.00 |
| 1.2 | 2.30 |
| 4 | 3.40 |
| 3.2 | 7.80 |
| 8.3 | 5.30 |
| 7 | 3.30 |
| 3 | 2.40 |
| 5 | 1.20 |
| 7.6 | 2.30 |
| 3.4 | 6.70 |
| 2.3 | 9.80 |
| 9.4 | 3.00 |
| 2 | 2.00 |
| 1 | 5.00 |

**Answer:** Using Hypothesis Testing, We know that when the sample variances and mean are known then we can apply T test. Here we should apply T test for two samples.

1. As indicated by the alternative hypothesis, it is a two- tailed problem.



Hence the Critical Region is given as:

**t < -2.00**

**t > 2.00**

1. Using Data Analysis Tool:

|  |  |  |
| --- | --- | --- |
|  | *Variable 1* | *Variable 2* |
| Mean | 4.226667 | 4.026667 |
| Variance | 5.685471 | 6.295126 |
| Observations | 30 | 30 |
| Pooled Variance | 5.990299 |  |
| Hypothesized Mean Difference | 0 |  |
| df | 58 |  |
| t Stat | 0.316484 |  |
| P(T<=t) one-tail | 0.376386 |  |
| t Critical one-tail | 1.671553 |  |
| P(T<=t) two-tail | 0.752772 |  |
| t Critical two-tail | 2.001717 |  |

1. Using the above table we can see that P (Z<=z) is 0.75 (p value).

Since

We can strongly say that we fail to reject the Null Hypothesis.

***Consider the same two cases for Unequal Population Variances:***

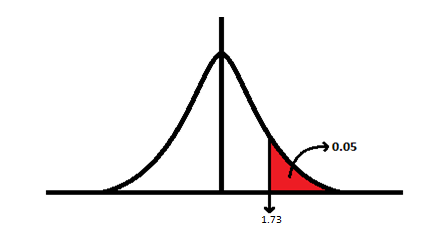
**Question 3:** To find out whether a new serum will arrest leukemia, 20 mice with an advance stage of the disease are selected.10 mice receive the treatment and 10 did not. Survival Times from the experiment commenced are as:

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At 0.05, level of significance, can the serum be said to be effective. Assume the two populations to be normally distributed with unequal variances.

**Answer:** Using Hypothesis Testing, We know that when the sample variances and mean are known then we can apply T test. Here we should apply T test for two samples.

1. As indicated by the alternative hypothesis, it is a one tailed problem, in fact a right tailed problem.



Hence, Critical Region is given as:

**T > 1.73**

1. Using Data Analysis Tool:

|  |  |  |
| --- | --- | --- |
|  | *Variable 1* | *Variable 2* |
| Mean | 2.4 | 3.82 |
| Variance | 1.757778 | 3.908444 |
| Observations | 10 | 10 |
| Hypothesized Mean Difference | 0 |  |
| df | 16 |  |
| t Stat | -1.88643 |  |
| P(T<=t) one-tail | 0.03876 |  |
| t Critical one-tail | 1.745884 |  |
| P(T<=t) two-tail | 0.077521 |  |
| t Critical two-tail | 2.119905 |  |

1. Using the above table we can see that P (Z<=z) is 0.04 (p value).

Since

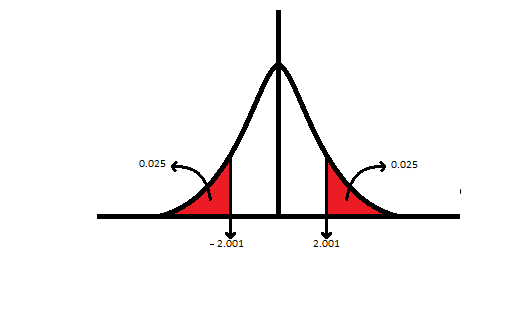
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**Answer:** Using Hypothesis Testing, We know that when the sample variances and mean are known then we can apply T test. Here we should apply T test for two samples.

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Hence the Critical Region is given as:

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| t Critical two-tail | 2.001717 |  |

1. Using the above table we can see that P (Z<=z) is 0.75 (p value).

Since

We can strongly say that we fail to reject the Null Hypothesis.

**INFERENCE:**

1. In the first and Third Question, we rejected the Null Hypothesis in favor of Alternative Hypothesis; hence we can infer that the new serum is effective in arresting the leukemia disease.
2. In the Second and Fourth Question we fail to reject the Null Hypothesis; hence we can infer that Males and Females spend equal hours in study.