**The Pooled T-Test and ANOVA Connections**

Consider two populations, with two random samples one from each:

|  |  |  |
| --- | --- | --- |
|  | **Sample P1** | **Sample P2** |
| 1 | 22 | 52 |
| 2 | 34 | 71 |
| 3 | 52 | 76 |
| 4 | 62 | 54 |
| 5 | 30 | 67 |
| 6 | 40 | 83 |
| 7 | 64 | 66 |
| 8 | 84 | 90 |
| 9 | 56 | 77 |
| 10 | 59 | 84 |
| **n** | 10 | 10 |
| **Xbar** | 50.300 | 72.000 |
| **S** | 18.726 | 12.543 |

Table 1: Two Samples Each From Two populations With Summary Data

We wish to test the null hypothesis that the expected value parameters of the two populations are almost the same versus the alternative hypothesis that there significantly different at significance level of alpha = 0.05.

It is given that the variances of the two populations are almost the same.

**Method A: Solution to the Test of Hypothesis by Using the T-test with Pooled Variances:**

Under Equality of two populations variances, the Pooled Variance is:

 SP 2 = [ (n1 – 1) S1 2 + (n2 – 1) S2 2] / (n1 + n2 - 2) =

= [(10 – 1) (18.726) 2 + (10 – 1) (12.543) 2] / (10 + 10 - 2) = 254

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**T-statistic computed** = [(50.3 – 72) – 0.0] / [ 254 ( 1/10 + 1/10 )] 1 / 2

 = -21.7 /(50.801)1 / 2 = **-3.0446**

Since absolute value of computed T-statistic is larger than critical value of T 18, 0.025 = 2.1009, one must conclude that the null hypothesis that the expected values of the two populations are almost equal must be rejected.

**Method B: Solution to the Test of Hypothesis by Using the ANOVA**

After computing the necessary components of ANOVA method, we obtain the following ANOVA summary table:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Source** | **d.f.** | **SS** | **MS** | **F** |
| Treatments (Between) | 1 | 2354.450 | 2354.450 | 9.269 |
| Error(Within) | 18 | 4572.100 | 254.006 |
| Total | 19 | 6926.550 |

Table 2: ANOVA Table for the Numerical Example

Since Computed F = 9.269, then the critical value of F 1, 18, 0.05 = 4.41, one must conclude that the null hypothesis that the expected values of the two populations are almost equal must be rejected.

**Desirable Connectivity Result:** Notice the relationship between these seemingly two different statistical methodologies, that is, (-3.0446) 2= 9.269. In general:

 F 1, n, alpha = T 2 n, alpha/2

You may use the following link to perform ANOVA (friendly and easy to use):

By this numerical example we have demonstrated that under certain conditions T-pooled-variance test, is equivalent the Analysis Of Variance (ANOVA) test. This result is just one example for showing the wholeness of statistics (the Joyful Science).

Notice that, if we were supposed to check the equality of population mean between pairs of populations, it would have been resulted in a large type I error that is not desirable. For example for 5 populations and α = 0.05, the final error results in (5)(4)/2 =10, the overall type-I error will be 10(0.05) = 0.5 or 50%.

You may use the following link to perform ANOVA in easy, and friendly environment:

<http://turner.faculty.swau.edu/mathematics/math241/materials/anova>

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