Comparisons and Type 1 Errors

1. Errors
   1. Type 1
   2. Type 2
2. Why do you get these errors (mostly Type 1)
   1. Simultaneous testing/comparisons
   2. Type 1 and Type 2 are a seesaw
3. Research questions and type 1
   1. Family of tests
      1. Familywise type 1 error rate – alpha fw –
      2. Experimentwise error rate – alpha ew –
   2. Alpha fw = 1 – (1-alpha)c
   3. The typical experiment
      1. Testing primary questions
      2. Special families of hypotheses
      3. Fishing! Exploring data for unexpected relationships
   4. What to do?
4. Planned comparisons
5. Restricted sets of contrasts
   1. Bonferroni
   2. Sidak Bonferroni
   3. Dunnett’s Test
6. Pairwise comparisons
   1. Tukey’s HSD
   2. Fisher – Hayter
   3. Newman-Keuls – SNK
   4. Ryan – Einot – Gabriel – Welsch (REGW)

|  |  |  |  |
| --- | --- | --- | --- |
| Test | When to Use | Cut off table | Formula |
| Bonferroni |  |  |  |
| Sidak Bonferroni |  |  |  |
| Dunnett’s |  |  |  |
| Tukey’s HSD |  |  |  |
| Fisher-Hayter |  |  |  |
| SNK |  |  |  |
| REGW |  |  |  |
| Scheffe |  |  |  |

1. Recommendations
2. Post – Hoc error correction
   1. Scheffe

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | (I) group | (J) group | Mean Difference (I-J) | Std. Error | Sig. |
|  |
| Tukey HSD | right | left | -1.5000 | .72060 | .113 |
| equal | -3.1000\* | .72060 | .001 |
| left | right | 1.5000 | .72060 | .113 |
| equal | -1.6000 | .72060 | .086 |
| equal | right | 3.1000\* | .72060 | .001 |
| left | 1.6000 | .72060 | .086 |
| Scheffe | right | left | -1.5000 | .72060 | .134 |
| equal | -3.1000\* | .72060 | .001 |
| left | right | 1.5000 | .72060 | .134 |
| equal | -1.6000 | .72060 | .104 |
| equal | right | 3.1000\* | .72060 | .001 |
| left | 1.6000 | .72060 | .104 |
| Bonferroni | right | left | -1.5000 | .72060 | .141 |
| equal | -3.1000\* | .72060 | .001 |
| left | right | 1.5000 | .72060 | .141 |
| equal | -1.6000 | .72060 | .105 |
| equal | right | 3.1000\* | .72060 | .001 |
| left | 1.6000 | .72060 | .105 |
| Sidak | right | left | -1.5000 | .72060 | .134 |
| equal | -3.1000\* | .72060 | .001 |
| left | right | 1.5000 | .72060 | .134 |
| equal | -1.6000 | .72060 | .101 |
| equal | right | 3.1000\* | .72060 | .001 |
| left | 1.6000 | .72060 | .101 |
| Dunnett t (2-sided)b | right | equal | -3.1000\* | .72060 | .000 |
| left | equal | -1.6000 | .72060 | .064 |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **pleasant** | | | | | |
|  | group | N | Subset | | |
|  | 1 | 2 | 3 |
| Student-Newman-Keulsa,b | right | 10 | 4.3000 |  |  |
| left | 10 |  | 5.8000 |  |
| equal | 10 |  |  | 7.4000 |
| Sig. |  | 1.000 | 1.000 | 1.000 |
| Tukey HSDa,b | right | 10 | 4.3000 |  |  |
| left | 10 | 5.8000 | 5.8000 |  |
| equal | 10 |  | 7.4000 |  |
| Sig. |  | .113 | .086 |  |
| Scheffea,b | right | 10 | 4.3000 |  |  |
| left | 10 | 5.8000 | 5.8000 |  |
| equal | 10 |  | 7.4000 |  |
| Sig. |  | .134 | .104 |  |
| Ryan-Einot-Gabriel-Welsch Fb | right | 10 | 4.3000 |  |  |
| left | 10 |  | 5.8000 |  |
| equal | 10 |  |  | 7.4000 |
| Sig. |  | 1.000 | 1.000 | 1.000 |
| Means for groups in homogeneous subsets are displayed.  Based on observed means.  The error term is Mean Square(Error) = 2.596. | | | | | |
| a. Uses Harmonic Mean Sample Size = 10.000. | | | | | |
| b. Alpha = | | | | | |