# *Trend Analysis Lab*

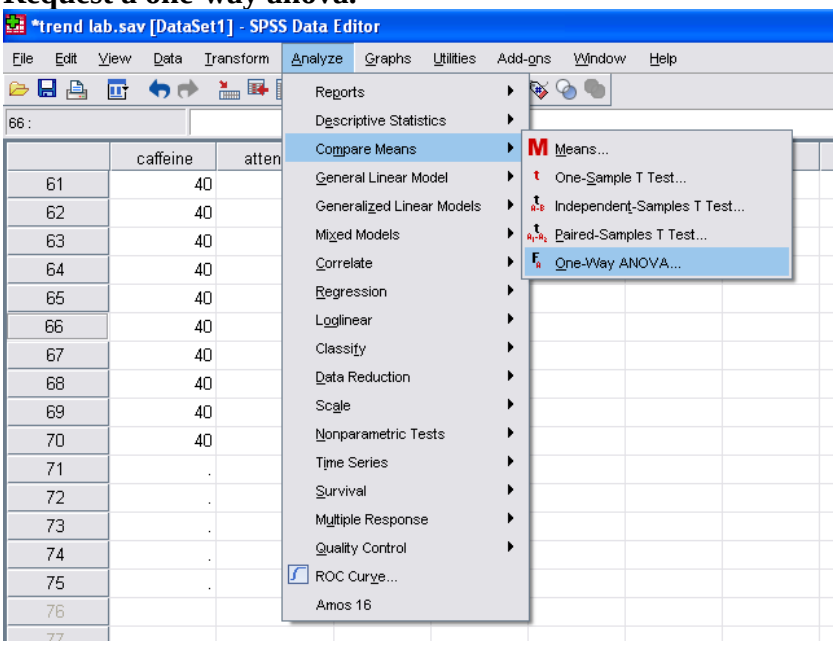
A researcher is interested in studying the effect that caffeine has on the attention spans of graduate students. Students were randomly assigned to one of the caffeine conditions shown below and their attention spans were measured using a computer task. Attention span was measured in minutes. Use a familywise alpha of .05 to conduct a trend analysis.

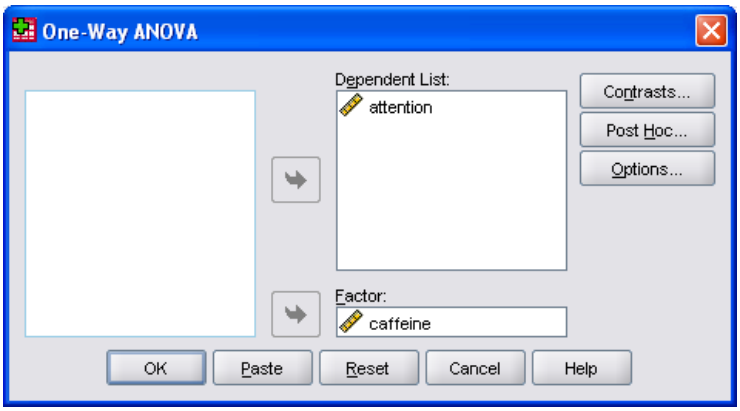
| **0 mg Caffeine** | **10mg Caffeine** | **20mg Caffeine** | **30mg Caffeine** | **40mg Caffeine** |
|---|---|---|---|---|
| 31 | 54 | 66 | 44 | 34 |
| 46 | 49 | 53 | 55 | 20 |
| 21 | 48 | 58 | 54 | 44 |
| 28 | 56 | 48 | 50 | 46 |
| 34 | 33 | 31 | 58 | 40 |
| 31 | 44 | 71 | 49 | 36 |
| 17 | 62 | 64 | 66 | 32 |
| 32 | 45 | 68 | 35 | 32 |
| 24 | 45 | 51 | 40 | 31 |
| 40 | 31 | 71 | 50 | 25 |
| 35 | 29 | 75 | 62 | 28 |
| 17 | 67 | 46 | 64 | 37 |
| 40 | 39 | 65 | 49 | 43 |
| 38 | 39 | 74 | 56 | 21 |
| 24 | 69 | 55 | 63 | 47 |

**The data should be entered in two columns:**

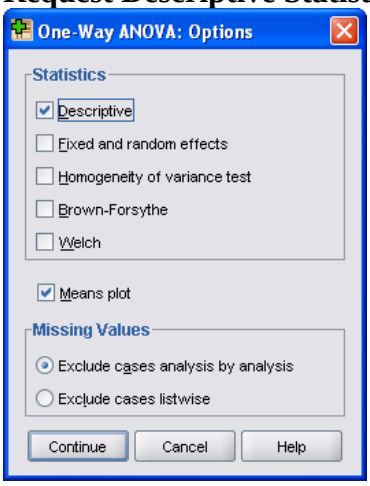
| *Caffeine* | *Attention* |
|---|---|
| 0 | 31 |
| 0 | 46 |
| … | |
| 10 | 54 |
| 10 | 49 |
| … | |
| 20 | 66 |
| 20 | 53 |
| … | |
| 30 | 44 |
| 30 | 55 |
| … | |
| 40 | 34 |
| 40 | 20 |
| … | |

**Request a one-way anova.**

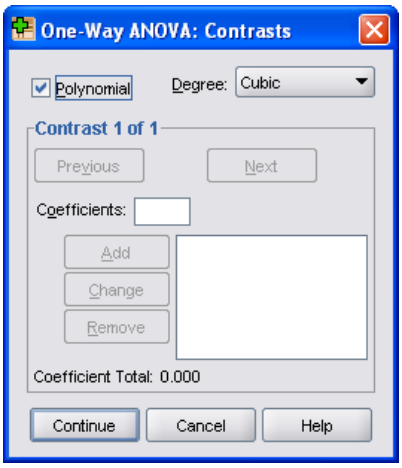



**Request Descriptive Statistics AND a graph of the means.**



Request polynomial tests of trend. You must also specify the highest degree to be tested. **Cubic** was chosen for this example.




## Oneway

**Descriptives**

attention

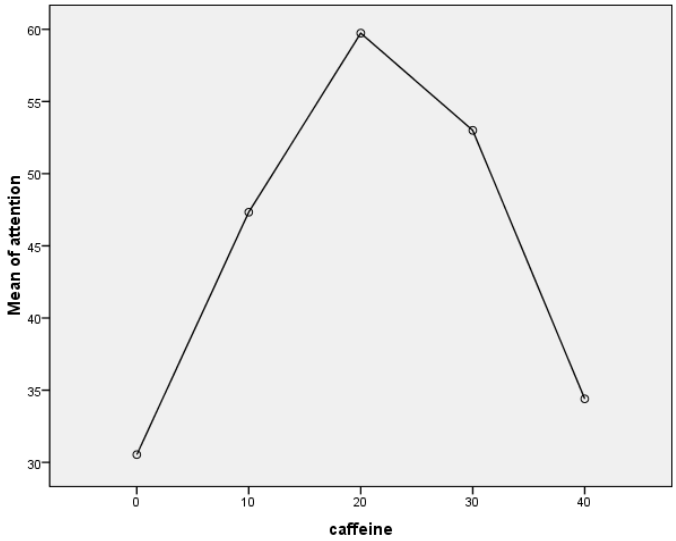
| | N | Mean | Std. Deviation | Std. Error | 95% Confidence Interval for Mean | | Minimum | Maximum |
|---|---|---|---|---|---|---|---|---|
| | | | | | Lower Bound | Upper Bound | | |
| 0 | 15 | 30.53 | 8.692 | 2.244 | 25.72 | 35.35 | 17 | 46 |
| 10 | 15 | 47.33 | 12.431 | 3.210 | 40.45 | 54.22 | 29 | 69 |
| 20 | 15 | 59.73 | 12.372 | 3.194 | 52.88 | 66.58 | 31 | 75 |
| 30 | 15 | 53.00 | 9.000 | 2.324 | 48.02 | 57.98 | 35 | 66 |
| 40 | 15 | 34.40 | 8.617 | 2.225 | 29.63 | 39.17 | 20 | 47 |
| Total | 75 | 45.00 | 15.005 | 1.733 | 41.55 | 48.45 | 17 | 75 |

**ANOVA**

attention

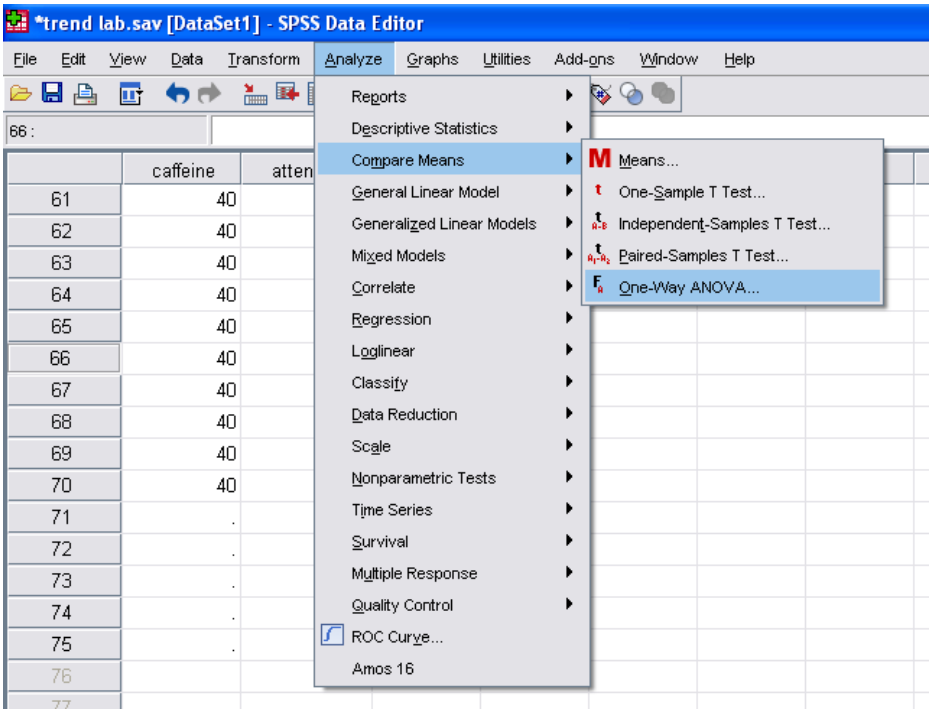
| | | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|---|
| Between Groups | (Combined) | | 9122.400 | 4 | 2280.600 | 21.179 | .000 |
| | Linear Term | Contrast | 269.340 | 1 | 269.340 | 2.501 | .118 |
| | | Deviation | 8853.060 | 3 | 2951.020 | 27.405 | .000 |
| | Quadratic Term | Contrast | 8665.719 | 1 | 8665.719 | 80.477 | .000 |
| | | Deviation | 187.341 | 2 | 93.670 | .870 | .423 |
| | Cubic Term | Contrast | 83.627 | 1 | 83.627 | .777 | .381 |
| | | Deviation | 103.714 | 1 | 103.714 | .963 | .330 |
| | Within Groups | | 7537.600 | 70 | 107.680 | | |
| | Total | | 16660.000 | 74 | | | |

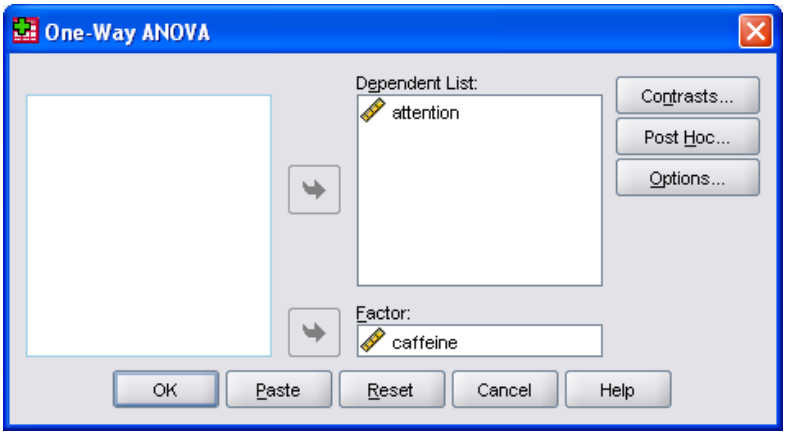
## Means Plots




## *Interpretation*

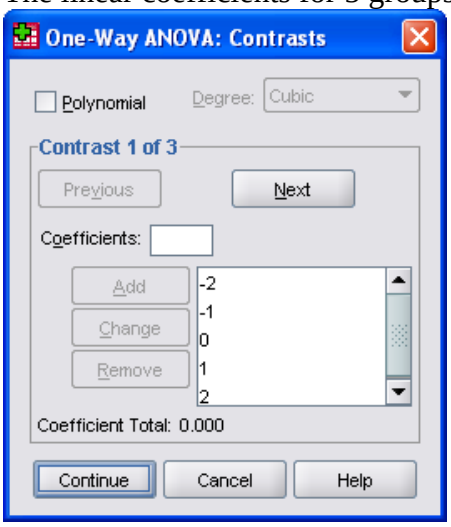
The last 5 observations for the 40mg Caffeine condition were deleted to create a data set that has unequal sample sizes. When there are unequal sample sizes, it may be desirable to conduct a trend analysis that does not assume equal population variances.



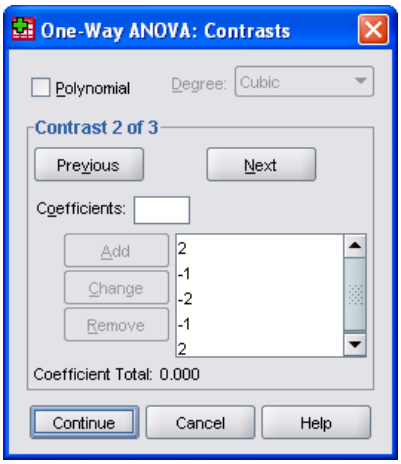




The Coefficients of Orthogonal Polynomials table was used to determine the appropriate coefficients for the trend analysis. See Maxwell and Delaney's Table A.10.

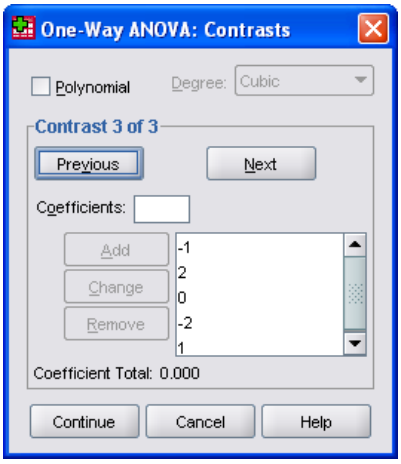
The linear coefficients for 5 groups are: -2, -1, 0, 1 and 2.



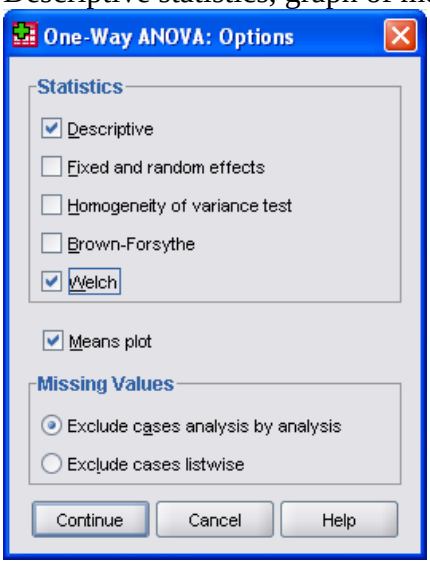

Press the NEXT button to enter the coefficients for the quadratic test: 2, -1, -2, -1, and 2.




Press the NEXT button to enter the coefficients for the cubic test: -1, 2, 0, -2, and 1.



Descriptive statistics, graph of means, and the Welch Anova are requested.




## Oneway

**Descriptives**

attention

| | N | Mean | Std. Deviation | Std. Error | 95% Confidence Interval for Mean | | Minimum | Maximum |
|---|---|---|---|---|---|---|---|---|
| | | | | | Lower Bound | Upper Bound | | |
| 0 | 15 | 30.53 | 8.692 | 2.244 | 25.72 | 35.35 | 17 | 46 |
| 10 | 15 | 47.33 | 12.431 | 3.210 | 40.45 | 54.22 | 29 | 69 |
| 20 | 15 | 59.73 | 12.372 | 3.194 | 52.88 | 66.58 | 31 | 75 |
| 30 | 15 | 53.00 | 9.000 | 2.324 | 48.02 | 57.98 | 35 | 66 |
| 40 | 10 | 34.00 | 8.014 | 2.534 | 28.27 | 39.73 | 20 | 46 |
| Total | 70 | 45.70 | 15.079 | 1.802 | 42.10 | 49.30 | 17 | 75 |

**ANOVA**

attention

| | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Between Groups | 8612.700 | 4 | 2153.175 | 19.779 | .000 |
| Within Groups | 7076.000 | 65 | 108.862 | | |
| Total | 15688.700 | 69 | | | |

**Robust Tests of Equality of Means**

attention

| | Statistic[a] | df1 | df2 | Sig. |
|---|---|---|---|---|
| Welch | 21.448 | 4 | 31.445 | .000 |

a. Asymptotically F distributed.

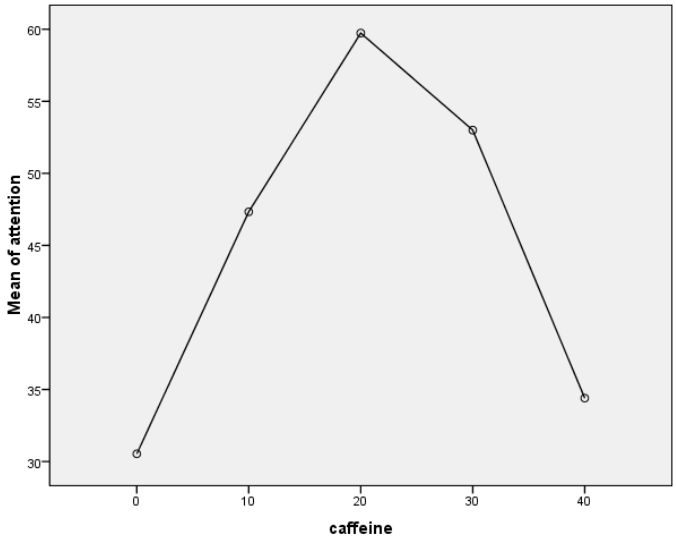
**Contrast Coefficients**

| Contrast | caffeine | | | | |
|---|---|---|---|---|---|
| | 0 | 10 | 20 | 30 | 40 |
| 1 | -2 | -1 | 0 | 1 | 2 |
| 2 | 2 | -1 | -2 | -1 | 2 |
| 3 | -1 | 2 | 0 | -2 | 1 |

**Contrast Tests**

| | | Contrast | Value of Contrast | Std. Error | t | df | Sig. (2-tailed) |
|---|---|---|---|---|---|---|---|
| attention | Assume equal variances | 1 | 12.60 | 9.332 | 1.350 | 65 | .182 |
| | | 2 | -90.73 | 10.776 | -8.420 | 65 | .000 |
| | | 3 | -7.87 | 8.729 | -.901 | 65 | .371 |
| | Does not assume equal variances | 1 | 12.60 | 7.845 | 1.606 | 33.817 | .118 |
| | | 2 | -90.73 | 10.117 | -8.968 | 45.356 | .000 |
| | | 3 | -7.87 | 8.618 | -.913 | 34.256 | .368 |

## Means Plots




***Interpretation***