Flowers cause joggers

A Martian Story

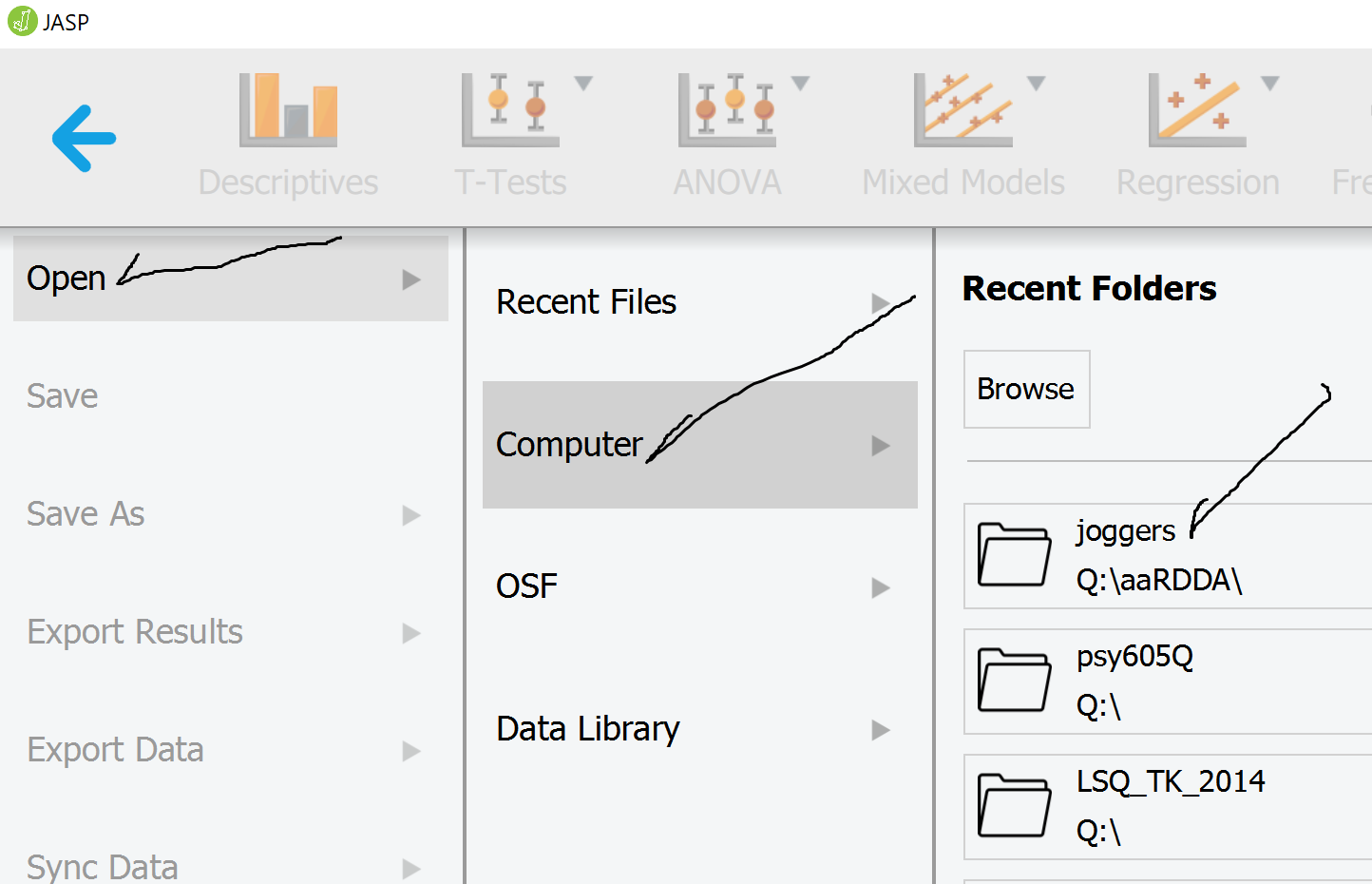
Fable by Merle Canfield

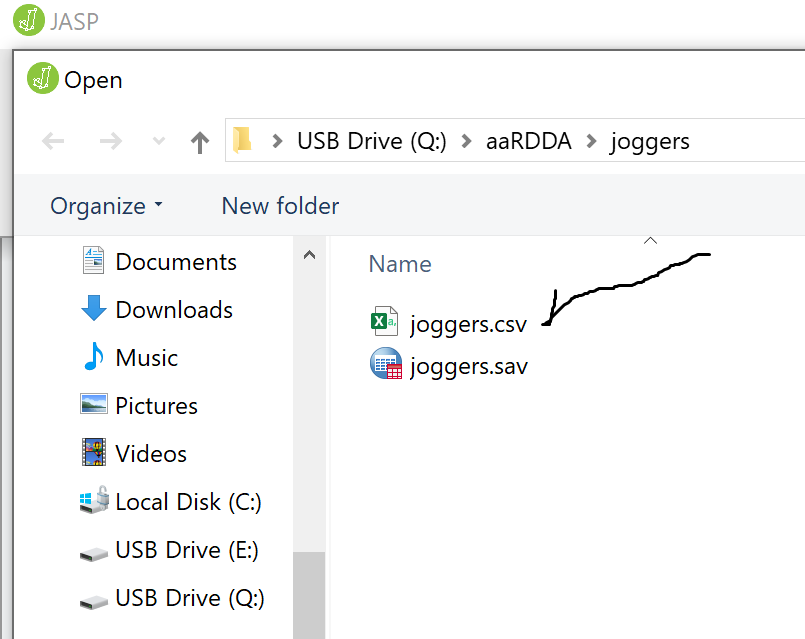
A Martian comes to earth to do a study of People. She notices that these People gather in “clumps” (that is Martian for towns and cities). She notices that People sometimes run up and down the streets in these clumps – she calls the running People Joggers (what a coincidence). She wonders why they do that since they don’t seem to be going anywhere in particular like the other People seem to be. She notices that there are often flowers where these joggers and decides maybe that is it. She sets up a data table like this.

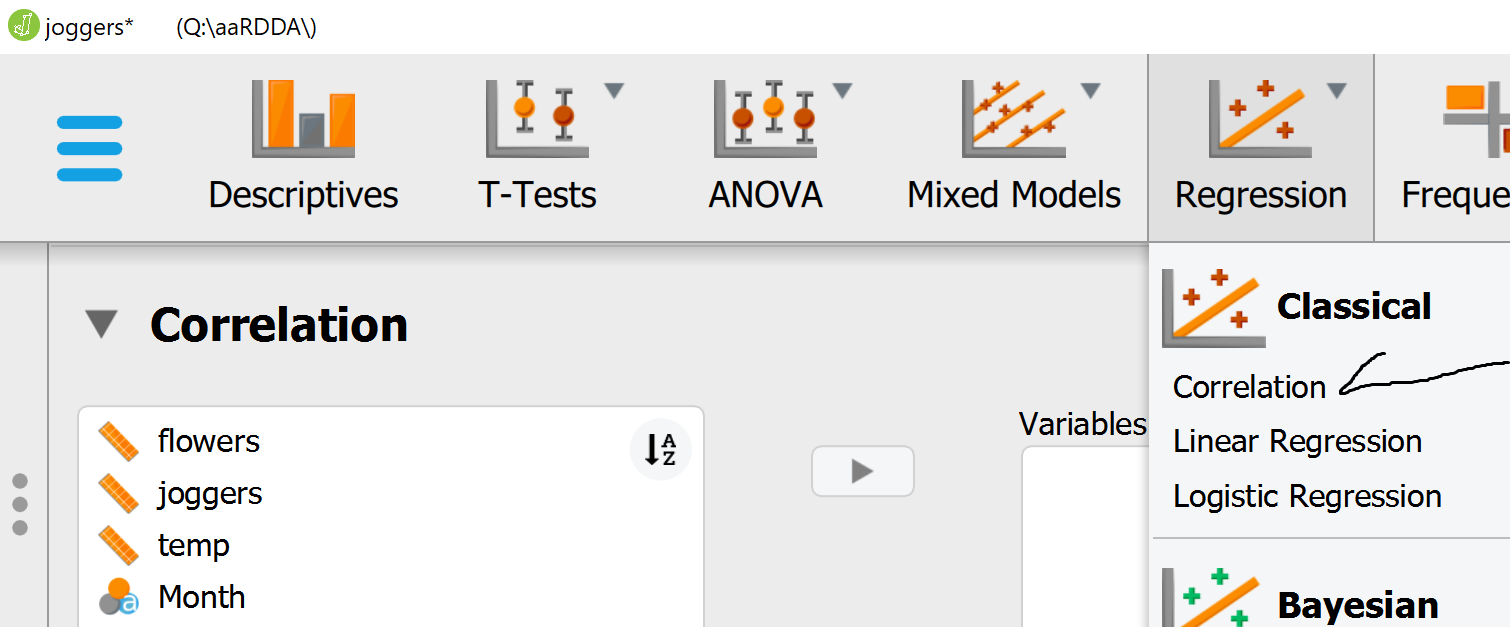
|  |  |  |  |
| --- | --- | --- | --- |
| number flowers | number joggers | Temperature | Month |
| 0 | 0 | 1 | jan |
| 0 | 1 | 4 | jan |
| 0 | 0 | 6 | jan |
| 30 | 2 | 19 | jan |
| 50 | 7 | 21 | feb |
| 50 | 12 | 20 | feb |
| 50 | 15 | 26 | feb |
| 50 | 12 | 24 | feb |
| 300 | 19 | 42 | mar |
| 305 | 20 | 45 | mar |
| 308 | 23 | 47 | mar |
| 309 | 20 | 45 | mar |
| 4000 | 49 | 65 | apr |
| 4021 | 50 | 66 | apr |
| 4000 | 53 | 67 | apr |
| 4078 | 50 | 68 | apr |
| 4030 | 101 | 72 | may |
| 4000 | 108 | 73 | may |
| 4016 | 156 | 70 | may |
| 4000 | 104 | 72 | may |
| 4500 | 199 | 93 | jun |
| 4545 | 200 | 94 | jun |
| 4500 | 223 | 92 | jun |
| 4599 | 200 | 96 | jun |
| 4004 | 245 | 94 | jul |
| 4000 | 207 | 90 | jul |
| 4043 | 200 | 90 | jul |
| 4000 | 203 | 93 | jul |
| 3500 | 150 | 86 | aug |
| 3500 | 150 | 86 | aug |
| 3500 | 150 | 86 | aug |
| 3567 | 150 | 86 | aug |
| 2030 | 100 | 84 | sep |
| 2032 | 106 | 83 | sep |
| 2023 | 100 | 82 | sep |
| 2000 | 102 | 83 | sep |
| 1500 | 100 | 76 | oct |
| 1500 | 99 | 76 | oct |
| 1500 | 100 | 76 | oct |
| 1543 | 89 | 76 | oct |
| 402 | 50 | 53 | nov |
| 460 | 55 | 51 | nov |
| 400 | 50 | 49 | nov |
| 400 | 54 | 46 | nov |
| 300 | 31 | 53 | dec |
| 300 | 25 | 40 | dec |
| 304 | 23 | 28 | dec |
| 300 | 25 | 34 | dec |

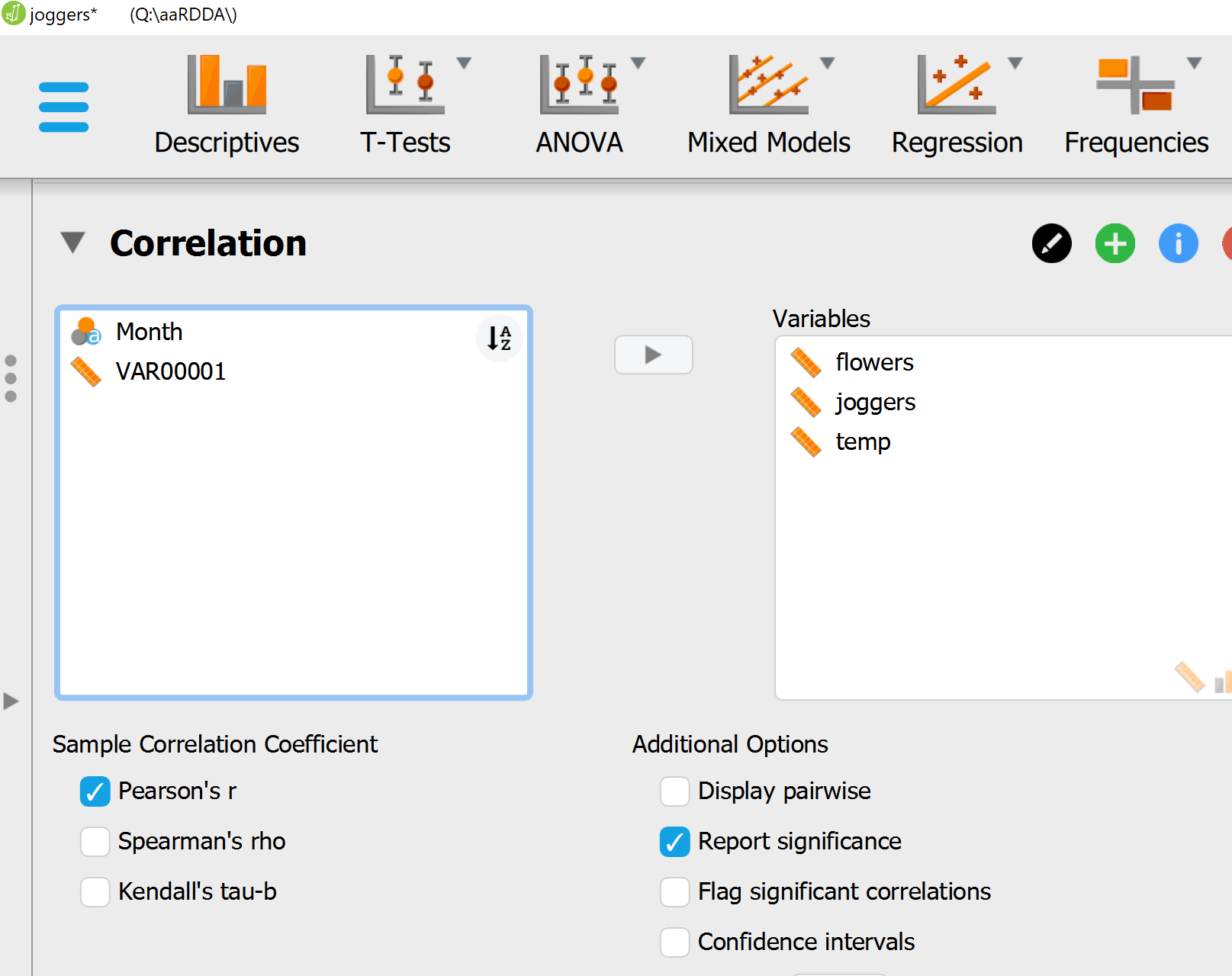
[We will pretend that she did not gather the temperature data here. Save space.]









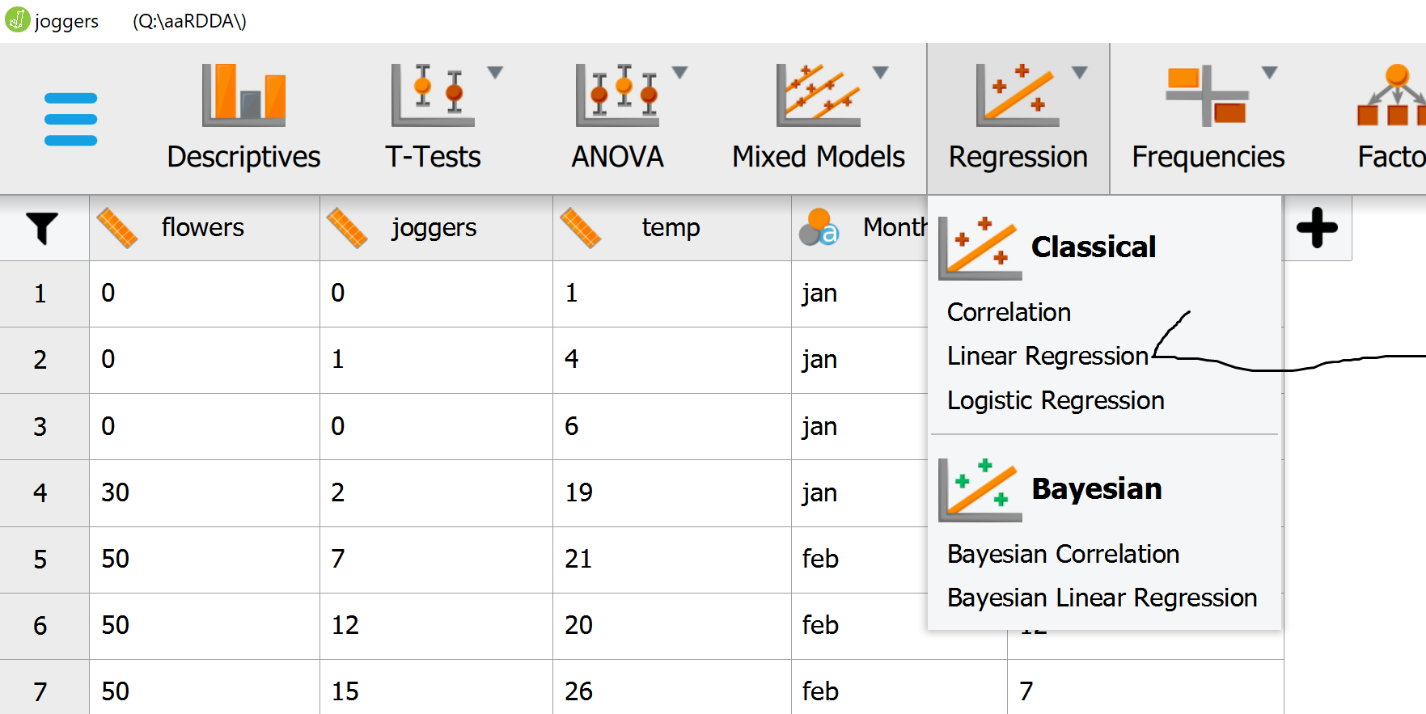


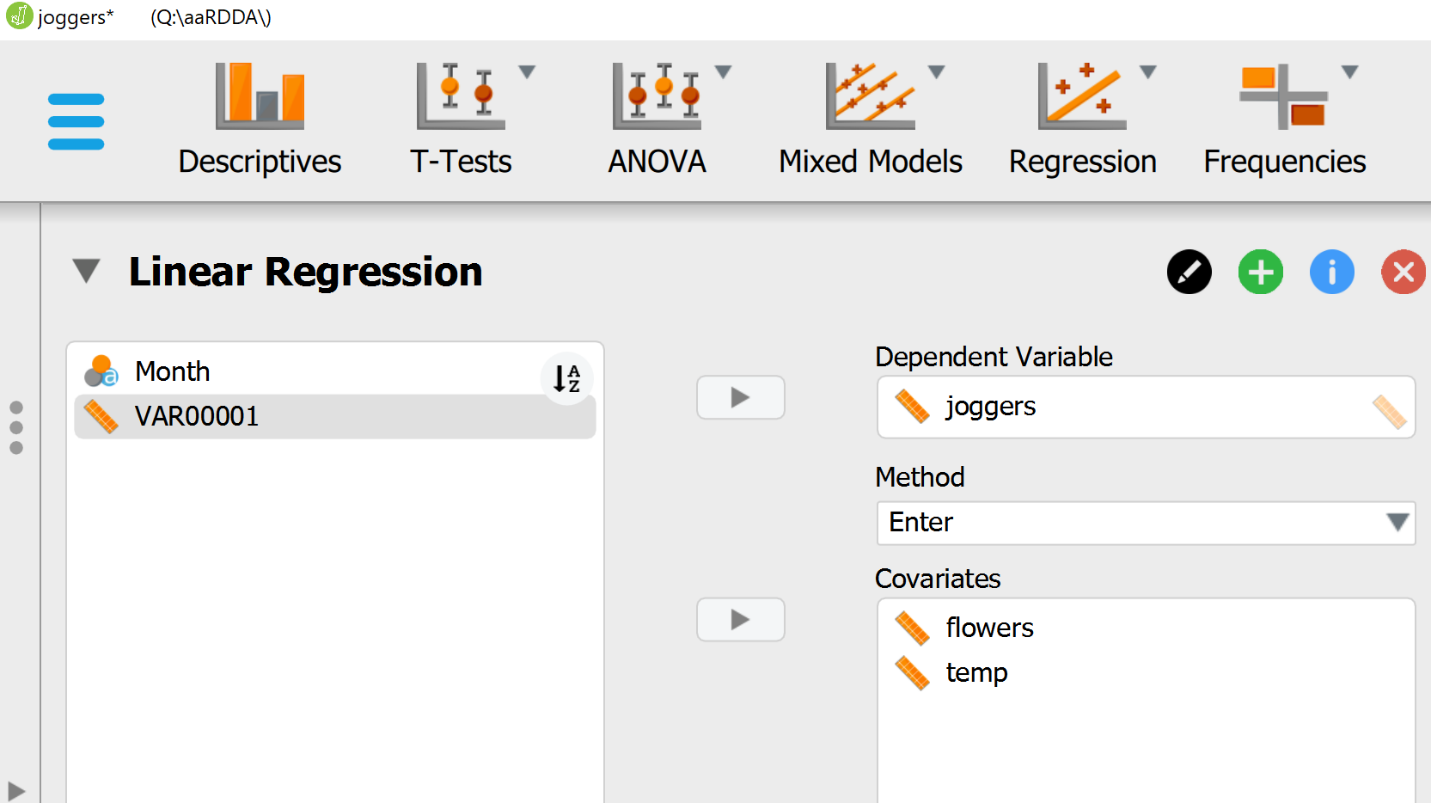
**Correlation**

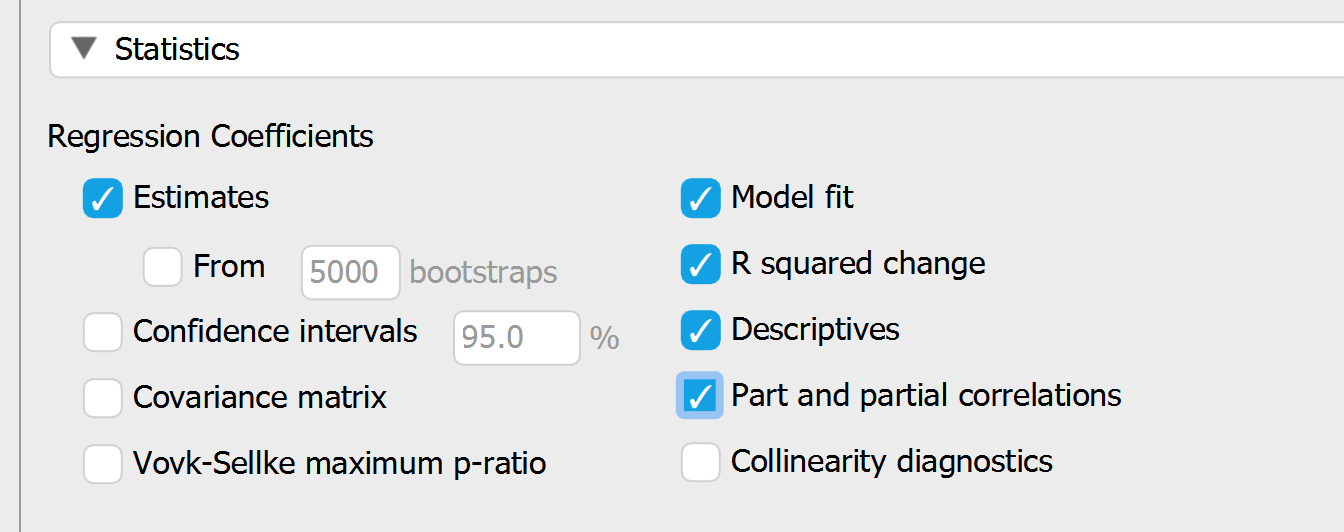
| **Pearson's Correlations** | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Variable** | |  | | **flowers** | | **joggers** | | **temp** | |
| 1. flowers |  | Pearson's r |  | — |  |  |  |  |  |
|  |  | p-value |  | — |  |  |  |  |  |
| 2. joggers |  | Pearson's r |  | 0.818 |  | — |  |  |  |
|  |  | p-value |  | < .001 |  | — |  |  |  |
| 3. temp |  | Pearson's r |  | 0.824 |  | 0.880 |  | — |  |
|  |  | p-value |  | < .001 |  | < .001 |  | — |  |
|  | | | | | | | | | |

[Nor have the temperature correlations here.]

* She finds a correlation of .81 accounting for .66% of the variance. Takes these data and presents at the “Mars Research on the Activities of the Earth People.” At the conference guy announces: “You dummy it is probably the outside temperature that is causing both. You should be banned from MRAEP.” [Those male Martians have a way with words.] She goes back to Earth and collects additional data.







**Linear Regression**

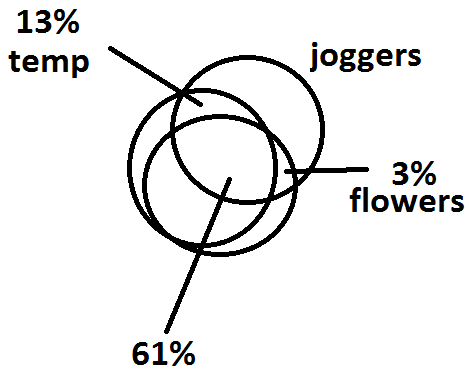
| **Model Summary – joggers** | | | | | | | | | | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Model** | | **R** | | **R²** | | **Adjusted R²** | | **RMSE** | | **R² Change** | | **F Change** | | **df1** | | **df2** | | **p** | |
| H₀ |  | 0.000 |  | 0.000 |  | 0.000 |  | 71.539 |  | 0.000 |  |  |  | 0 |  | 47 |  |  |  |
| H₁ |  | 0.895 |  | 0.801 |  | 0.792 |  | 32.595 |  | 0.801 |  | 90.704 |  | 2 |  | 45 |  | < .001 |  |
|  | | | | | | | | | | | | | | | | | | | |

| **ANOVA** | | | | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Model** | |  | | **Sum of Squares** | | **df** | | **Mean Square** | | **F** | | **p** | |
| H₁ |  | Regression |  | 192728.616 |  | 2 |  | 96364.308 |  | 90.704 |  | < .001 |  |
|  |  | Residual |  | 47808.384 |  | 45 |  | 1062.409 |  |  |  |  |  |
|  |  | Total |  | 240537.000 |  | 47 |  |  |  |  |  |  |  |
|  | | | | | | | | | | | | | |
| *Note.*  The intercept model is omitted, as no meaningful information can be shown. | | | | | | | | | | | | | |

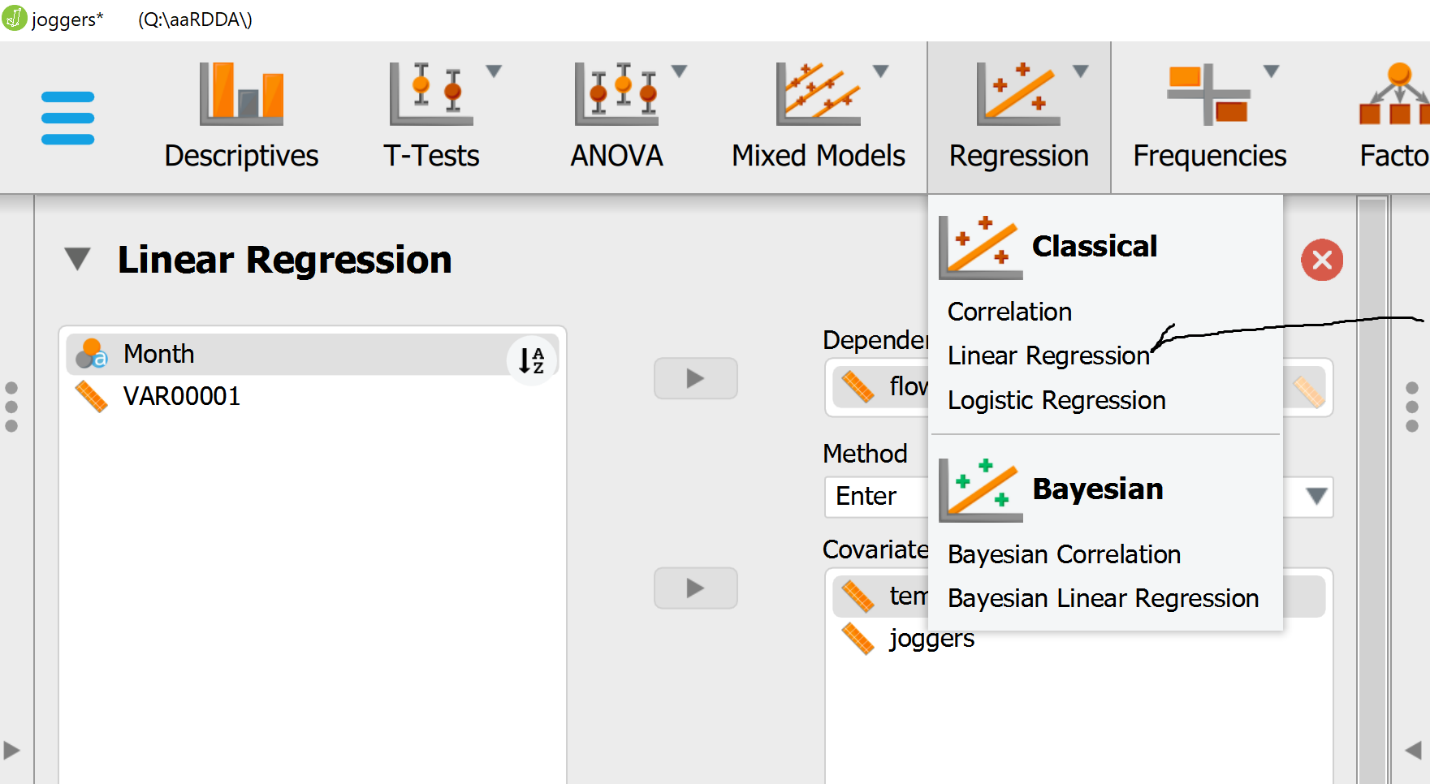
| **Coefficients** | | | | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Model** | |  | | **Unstandardized** | | **Standard Error** | | **Standardized** | | **t** | | **p** | |
| H₀ |  | (Intercept) |  | 87.250 |  | 10.326 |  |  |  | 8.450 |  | < .001 |  |
| H₁ |  | (Intercept) |  | -38.623 |  | 12.872 |  |  |  | -3.001 |  | 0.004 |  |
|  |  | flowers |  | 0.012 |  | 0.005 |  | 0.290 |  | 2.470 |  | 0.017 |  |
|  |  | temp |  | 1.669 |  | 0.306 |  | 0.641 |  | 5.459 |  | < .001 |  |
|  | | | | | | | | | | | | | |

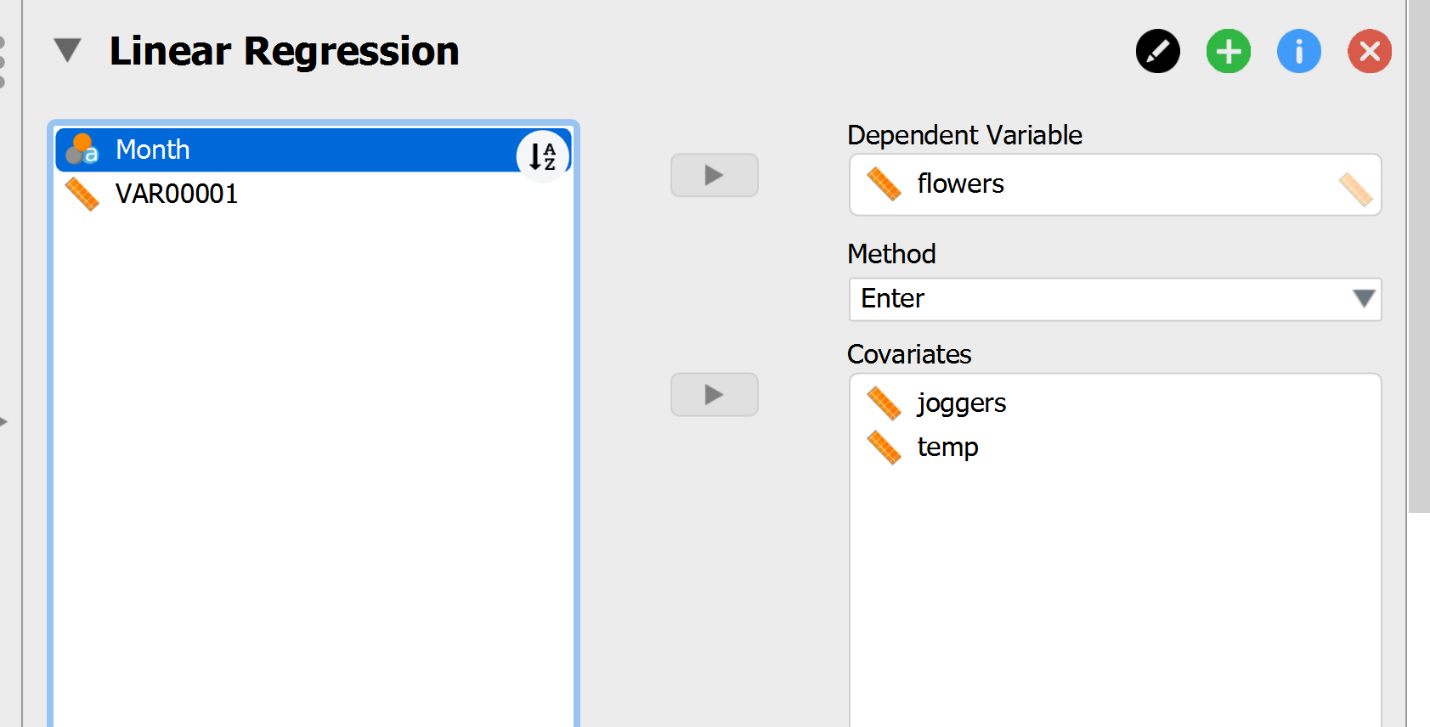
| **Descriptives** | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | **N** | | **Mean** | | **SD** | | **SE** | |
| joggers |  | 48 |  | 87.250 |  | 71.539 |  | 10.326 |  |
| flowers |  | 48 |  | 2059.354 |  | 1778.566 |  | 256.714 |  |
| temp |  | 48 |  | 61.021 |  | 27.469 |  | 3.965 |  |
|  | | | | | | | | | |

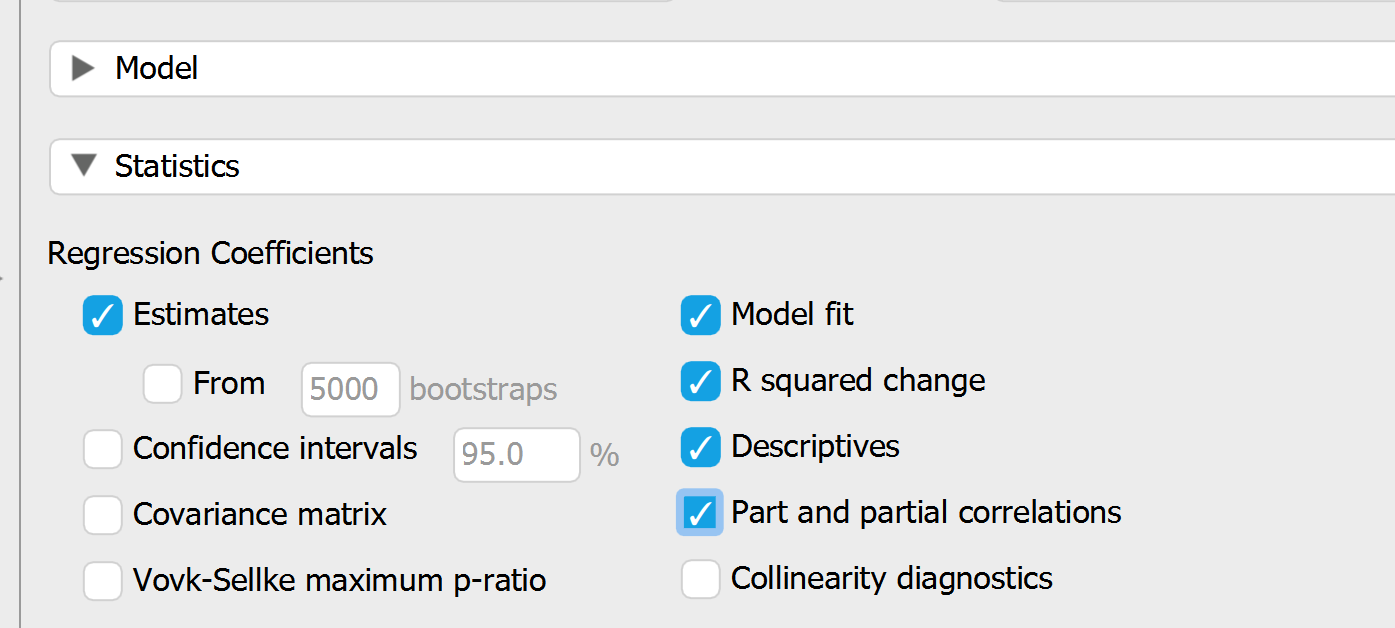
| **Part And Partial Correlations** | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Model** | |  | | **Partial** | | **Part** | |
| H₁ |  | flowers |  | 0.345 |  | 0.164 |  |
|  |  | temp |  | 0.631 |  | 0.363 |  |
|  | | | | | | | |
| *Note.*  The intercept model is omitted, as no meaningful information can be shown. | | | | | | | |
| * The critic was right. The outdoor temperature assessed by the part correlation (unique variance) of the outdoor temperature is .88 accounting for 77% of the variance. However, the part correlations indicate that when they are entered together the temperature part correlation is .36 (accounting for 13% of the variance and the part correlation for flowers is still significant at .16 and accounting for 3% of the variacne. So the flowers still have potential effect. However, she thinks that there might be other influences. | | | | | | | |



* But Wait! Maybe joggers cause flowers.
* We changed the flowers to the dependent variable







## Correlation

| **Pearson's Correlations** | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Variable** | |  | | **flowers** | | **joggers** | | **temp** | |
| 1. flowers |  | Pearson's r |  | — |  |  |  |  |  |
|  |  | p-value |  | — |  |  |  |  |  |
| 2. joggers |  | Pearson's r |  | 0.818 |  | — |  |  |  |
|  |  | p-value |  | < .001 |  | — |  |  |  |
| 3. temp |  | Pearson's r |  | 0.824 |  | 0.880 |  | — |  |
|  |  | p-value |  | < .001 |  | < .001 |  | — |  |
|  | | | | | | | | | |

## Linear Regression

| **Model Summary - flowers** | | | | | | | | | | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Model** | | **R** | | **R²** | | **Adjusted R²** | | **RMSE** | | **R² Change** | | **F Change** | | **df1** | | **df2** | | **p** | |
| H₀ |  | 0.000 |  | 0.000 |  | 0.000 |  | 1778.566 |  | 0.000 |  |  |  | 0 |  | 47 |  |  |  |
| H₁ |  | 0.847 |  | 0.718 |  | 0.705 |  | 965.541 |  | 0.718 |  | 57.238 |  | 2 |  | 45 |  | < .001 |  |
|  | | | | | | | | | | | | | | | | | | | |

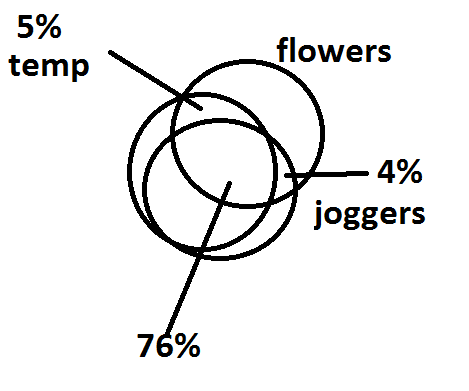
| **ANOVA** | | | | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Model** | |  | | **Sum of Squares** | | **df** | | **Mean Square** | | **F** | | **p** | |
| H₁ |  | Regression |  | 1.067e +8 |  | 2 |  | 5.336e +7 |  | 57.238 |  | < .001 |  |
|  |  | Residual |  | 4.195e +7 |  | 45 |  | 932269.754 |  |  |  |  |  |
|  |  | Total |  | 1.487e +8 |  | 47 |  |  |  |  |  |  |  |
|  | | | | | | | | | | | | | |
| Note.  The intercept model is omitted, as no meaningful information can be shown. | | | | | | | | | | | | | |

| **Coefficients** | | | | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Model** | |  | | **Unstandardized** | | **Standard Error** | | **Standardized** | | **t** | | **p** | |
| H₀ |  | (Intercept) |  | 2059.354 |  | 256.714 |  |  |  | 8.022 |  | < .001 |  |
| H₁ |  | (Intercept) |  | -659.500 |  | 405.964 |  |  |  | -1.625 |  | 0.111 |  |
|  |  | joggers |  | 10.234 |  | 4.144 |  | 0.412 |  | 2.470 |  | 0.017 |  |
|  |  | temp |  | 29.923 |  | 10.792 |  | 0.462 |  | 2.773 |  | 0.008 |  |
|  | | | | | | | | | | | | | |

| **Descriptives** | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | **N** | | **Mean** | | **SD** | | **SE** | |
| flowers |  | 48 |  | 2059.354 |  | 1778.566 |  | 256.714 |  |
| joggers |  | 48 |  | 87.250 |  | 71.539 |  | 10.326 |  |
| temp |  | 48 |  | 61.021 |  | 27.469 |  | 3.965 |  |
|  | | | | | | | | | |

| **Part And Partial Correlations** | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Model** | |  | | **Partial** | | **Part** | |
| H₁ |  | joggers |  | 0.345 |  | 0.196 |  |
|  |  | temp |  | 0.382 |  | 0.220 |  |
|  | | | | | | | |
| Note.  The intercept model is omitted, as no meaningful information can be shown. | | | | | | | |

* Only the part correlations are of interest here. Total variance accounted for by both variables is72% (multiple correlation is .85. In this instance we see that both temperature and joggers cause more flowers. However, to get at the real cause we probably need more data in both cases. It is probably sunlight that causes both the temperature and the flowers. However, the flowers were probably planted by some other person (not joggers – but maybe). Further, the planter probably planted the flowers for himself/herself to enjoy but also for other people to enjoy and here we have joggers. Temp part correlation is .22 (5%) and joggers is .20 (4%).



Hummm……

**HOWEVER:**

When the people who planted the flowers were asked why they planted them the responses were varied. Some said that they enjoyed the process of gardening. Some said so that people going by can enjoy them. So in this latter sense the joggers did cause the flowers to be planted through a mediating variable of the planter.

When the joggers were asked why they were jogging their answers were variad. Some said for health reasons. And addtionally to shape their body and look good. When asked “why here?” they said it was pleasant with the trees and flowers.

So her research was not done there were many other “3rd” variables that could be causal. Or part of the combination of causal variables.