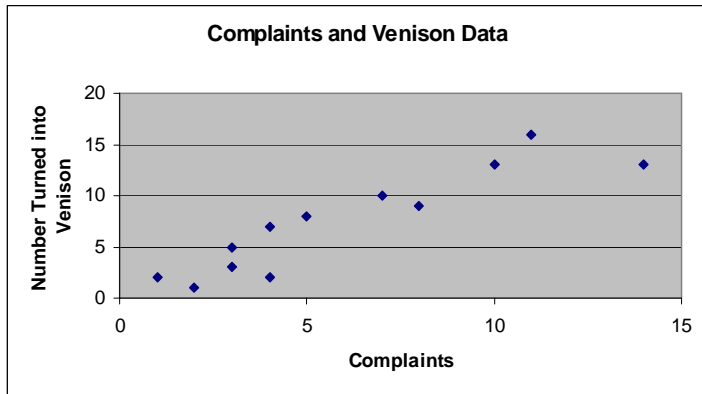


Homework 7 (Correlation) Answers

1.

a. Scatterplot / Scattergram



d. Correlation Calculations

| 1.d.     | X  | Y  | XY  | X <sup>2</sup> | Y <sub>2</sub> |
|----------|----|----|-----|----------------|----------------|
|          | 2  | 1  | 2   | 4              | 1              |
|          | 1  | 2  | 2   | 1              | 4              |
|          | 3  | 3  | 9   | 9              | 9              |
|          | 4  | 2  | 8   | 16             | 4              |
|          | 3  | 5  | 15  | 9              | 25             |
|          | 5  | 8  | 40  | 25             | 64             |
|          | 4  | 7  | 28  | 16             | 49             |
|          | 7  | 10 | 70  | 49             | 100            |
|          | 8  | 9  | 72  | 64             | 81             |
|          | 10 | 13 | 130 | 100            | 169            |
|          | 11 | 16 | 176 | 121            | 256            |
|          | 14 | 13 | 182 | 196            | 169            |
| $\Sigma$ | 72 | 89 | 734 | 610            | 931            |

$$r = \frac{\sum XY - \frac{(\sum X)(\sum Y)}{N}}{\sqrt{\sum X^2 - \frac{(\sum X)^2}{N}} \sqrt{\sum Y^2 - \frac{(\sum Y)^2}{N}}} =$$

$$= \frac{734 - \frac{(72)(89)}{12}}{\sqrt{610 - \frac{(72)^2}{12}} \sqrt{931 - \frac{(89)^2}{12}}} = \frac{734 - \frac{6,408}{12}}{\sqrt{610 - \frac{5,184}{12}} \sqrt{931 - \frac{7,921}{12}}}$$

$$= \frac{734 - 534}{\sqrt{610 - 432} \sqrt{931 - 660.0833}} = \frac{200}{\sqrt{178} \sqrt{270.9167}} = \frac{200}{(13.3417)(16.9595)} = \frac{200}{219.5977} = .9108$$

$$r^2 = .8296$$

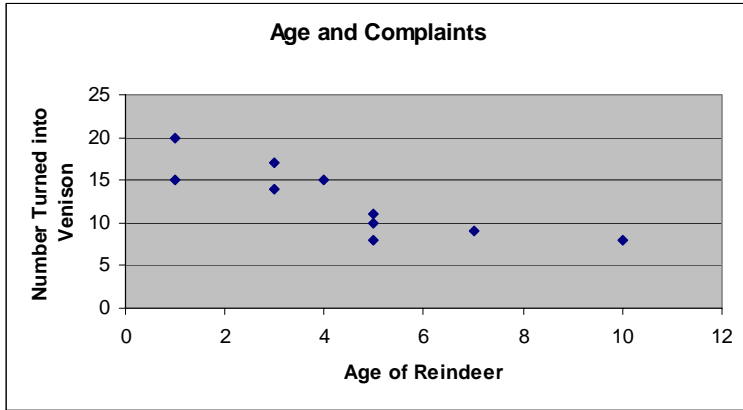
$$1 - r^2 = .1704$$

e.  $r(10) = .91, p < .01$ . Critical Value for  $r$  (@ .01, for  $df = 10$ ) = .708

f. There is a strong positive correlation between the number of complaints and the number of reindeer turned into venison. The more reindeer that complain, the more that are turned into venison.

2.

a. Scatterplot / Scattergram



| 2.d. | X        | Y         | XY         | X <sup>2</sup> | Y <sup>2</sup> |             |
|------|----------|-----------|------------|----------------|----------------|-------------|
|      | 1        | 20        | 20         | 1              | 400            |             |
|      | 1        | 15        | 15         | 1              | 225            |             |
|      | 3        | 17        | 51         | 9              | 289            |             |
|      | 3        | 14        | 42         | 9              | 196            |             |
|      | 4        | 15        | 60         | 16             | 225            |             |
|      | 5        | 11        | 55         | 25             | 121            |             |
|      | 5        | 8         | 40         | 25             | 64             |             |
|      | 5        | 10        | 50         | 25             | 100            |             |
|      | 7        | 9         | 63         | 49             | 81             |             |
|      | 10       | 8         | 80         | 100            | 64             |             |
|      | <b>Σ</b> | <b>44</b> | <b>127</b> | <b>476</b>     | <b>260</b>     | <b>1765</b> |

b. Correlation Calculations

$$r = \frac{\sum XY - \frac{(\sum X)(\sum Y)}{N}}{\sqrt{\sum X^2 - \frac{(\sum X)^2}{N}} \sqrt{\sum Y^2 - \frac{(\sum Y)^2}{N}}} =$$

$$= \frac{476 - \frac{(44)(127)}{10}}{\sqrt{260 - \frac{(44)^2}{10}} \sqrt{1765 - \frac{(127)^2}{10}}} = \frac{734 - \frac{5,588}{10}}{\sqrt{260 - \frac{1,936}{10}} \sqrt{1765 - \frac{16,129}{10}}}$$

$$= \frac{476 - 588.8}{\sqrt{260 - 193.6} \sqrt{1765 - 1,112.9}} = \frac{-82.8}{\sqrt{66.4} \sqrt{152.1}} = \frac{-82.8}{(8.1486)(12.3329)} = \frac{-82.8}{100.4959} = -.8239$$

$$r^2 = .6788$$

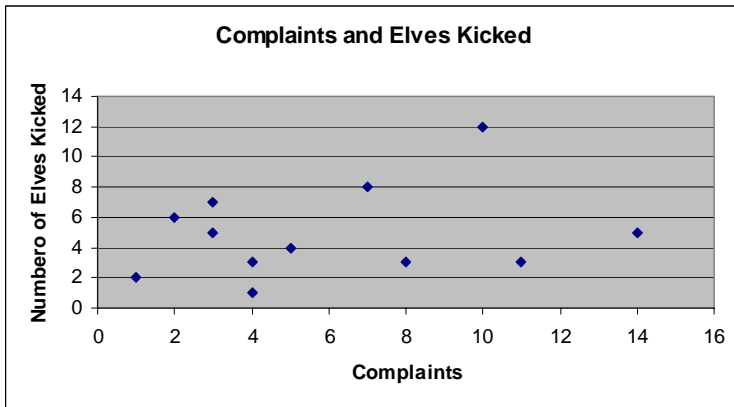
$$1 - r^2 = .3212$$

e.  $r(8) = -.82, p < .01$ . Critical Value for  $r$  (@ .01, for  $df = 8$ ) = .765

f. There is a strong negative correlation between the age of reindeer and the number of complaints each reindeer made in a year. The older reindeer complain complained less.

3.

a. Scatterplot / Scattergram



b. Correlation Calculations

3.d.

|          | X  | Y  | XY  | X <sup>2</sup> | Y <sub>2</sub> |
|----------|----|----|-----|----------------|----------------|
|          | 2  | 6  | 12  | 4              | 36             |
|          | 1  | 2  | 2   | 1              | 4              |
|          | 3  | 5  | 15  | 9              | 25             |
|          | 4  | 1  | 4   | 16             | 1              |
|          | 3  | 7  | 21  | 9              | 49             |
|          | 5  | 4  | 20  | 25             | 16             |
|          | 4  | 3  | 12  | 16             | 9              |
|          | 7  | 8  | 56  | 49             | 64             |
|          | 8  | 3  | 24  | 64             | 9              |
|          | 10 | 12 | 120 | 100            | 144            |
|          | 11 | 3  | 33  | 121            | 9              |
|          | 14 | 5  | 70  | 196            | 25             |
| $\Sigma$ | 72 | 59 | 389 | 610            | 391            |

$$r = \frac{\sum XY - \frac{(\sum X)(\sum Y)}{N}}{\sqrt{\sum X^2 - \frac{(\sum X)^2}{N}} \sqrt{\sum Y^2 - \frac{(\sum Y)^2}{N}}} =$$

$$= \frac{389 - \frac{(72)(59)}{12}}{\sqrt{610 - \frac{(72)^2}{12}} \sqrt{391 - \frac{(59)^2}{12}}} = \frac{389 - \frac{4,248}{12}}{\sqrt{610 - \frac{5184}{12}} \sqrt{391 - \frac{3481}{12}}}$$

$$= \frac{389 - 354}{\sqrt{610 - 432} \sqrt{391 - 290.0833}} = \frac{35}{\sqrt{178} \sqrt{100.9167}} = \frac{35}{(13.3417)(10.0457)} = \frac{35}{134.0267} = .2611$$

$$r^2 = .0682$$

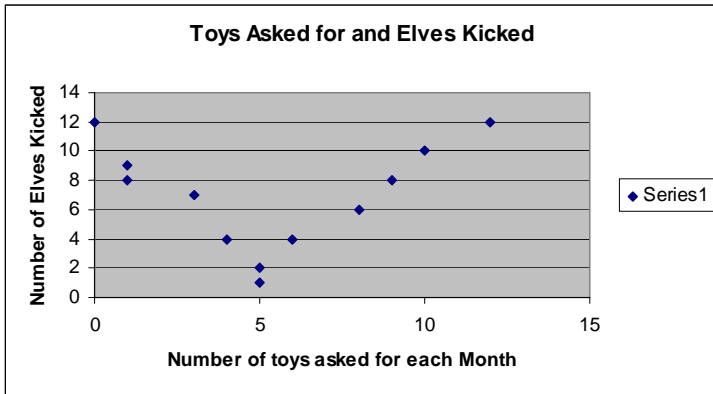
$$1 - r^2 = .9318$$

e.  $r(8) = .26, p > .05, NS$ . Critical Value for  $r$  (@ .05, for  $df = 10$ ) = .576

f. Though non significant, there is a moderate positive correlation between the the number of complaints Santa recieves in a month and the number of elves that he kicks.

4.

a. Scatterplot / Scattergram



d. Correlation Calculations

| 4.d.     | X  | Y  | XY  | X <sup>2</sup> | Y <sub>2</sub> |
|----------|----|----|-----|----------------|----------------|
|          | 0  | 12 | 0   | 0              | 144            |
|          | 1  | 9  | 9   | 1              | 81             |
|          | 1  | 8  | 8   | 1              | 64             |
|          | 3  | 7  | 21  | 9              | 49             |
|          | 4  | 4  | 16  | 16             | 16             |
|          | 5  | 2  | 10  | 25             | 4              |
|          | 5  | 1  | 5   | 25             | 1              |
|          | 6  | 4  | 24  | 36             | 16             |
|          | 8  | 6  | 48  | 64             | 36             |
|          | 9  | 8  | 72  | 81             | 64             |
|          | 10 | 10 | 100 | 100            | 100            |
|          | 12 | 12 | 144 | 144            | 144            |
| $\Sigma$ | 64 | 83 | 457 | 502            | 719            |

$$r = \frac{\sum XY - \frac{(\sum X)(\sum Y)}{N}}{\sqrt{\sum X^2 - \frac{(\sum X)^2}{N}} \sqrt{\sum Y^2 - \frac{(\sum Y)^2}{N}}} =$$

$$= \frac{457 - \frac{(64)(83)}{12}}{\sqrt{502 - \frac{(64)^2}{12}} \sqrt{719 - \frac{(83)^2}{12}}} = \frac{457 - \frac{5,312}{12}}{\sqrt{502 - \frac{4,096}{12}} \sqrt{719 - \frac{6,889}{12}}}$$

$$= \frac{457 - 442.6667}{\sqrt{502 - 314.3333} \sqrt{719 - 574.0388}} = \frac{14.3333}{\sqrt{160.6667} \sqrt{144.9167}} = \frac{14.3333}{(12.6754)(12.0381)} = \frac{14.3333}{152.5877} = .0939$$

$$r^2 = .0088$$

$$1 - r^2 = .9912$$

e.  $r(8) = .09, p > .05, NS$ . Critical Value for  $r$  (@ .05, for  $df = 10$ ) = .576

f. Though non significant, there is a very small positive correlation between the the number of complaints Santa recieves in a month and the number of elves that he kicks. For a correlation this small, with so few subjects we have almost no confidence that this association is meaningful.

5. Problem 3 and Problem 4 had non-significant correlations.

- For Problem 3, a correlation of .2611 would be significant at the .05 level if we had approximately 60 degrees of freedom (df) and therefore 62 subjects.

- For Problem 4, a correlation of .0939 would be significant at the .05 level if we had substantially more than 100 degrees of freedom (df), however we don't know for sure as, the table does not report critical values for more than 100 degrees of freedom. (A rough estimate would be about 300 subjects would be needed).