June 2013 (R) Question 5

a)

$$S_{yy} = \sum y^2 - \frac{(\sum y)^2}{n} = 393 - \frac{61^2}{10} = \mathbf{20.9} \text{ and } S_{xy} = \sum xy - \frac{\sum x \sum y}{n} = 382 - \frac{60 \times 61}{10} = \mathbf{16}$$

b)

$$r = \frac{S_{xy}}{\sqrt{S_{xx}S_{yy}}} = \frac{16}{\sqrt{28 \times 20.9}} = \mathbf{0.661}$$

c)

Contrary to the researcher's suspicion, the lengths of first names and surnames seem to be positively correlated.

d)

Since the name "Turner" has 6 letters the mean of x is unchanged. Consequently all the existing terms of the sum $\sum(x - \bar{x})^2$ are unchanged and as the 11th term in the sum is zero, S_{xx} is unchanged. $S_{xx} = \mathbf{28}$.

e)

$$S_{xy} = \sum(x - \bar{x})(y - \bar{y}) = \sum(x - \bar{x})y - \bar{y}\sum(x - \bar{x}) = \sum(x - \bar{x})y$$

As all the original terms are unchanged and the 11th term is zero the value of S_{xy} is unchanged. Given that S_{xx} and S_{xy} are unchanged and S_{yy} increases it is clear that $\boldsymbol{r = \frac{S_{xy}}{\sqrt{S_{xx}S_{yy}}}}$ **decreases**.