Do Storks Deliver Babies?

Question 1:

In this paper (*Matthews, 2000*), Matthews achieves a correlation of 0.62 and a t-statistic of 3.06 which for data with 15 degrees of freedom results in a p-value of 0.008. Under the definition of p-values, he is therefore stating that there is only an 0.8% chance of obtaining a value this extreme (a correlation of 0.62 and t-statistic of 3.06) if the null hypothesis is true. Therefore, he is statistically able to reject the null hypothesis that there is no relation between storks and birth rates and accept the alternative hypothesis that there is a relationship.
However, this p-value does not truly imply that there is a 99.2% probability that storks deliver babies and a more logical explanation for this value is the existence of a confounding variable. That is, an external variable that affects both storks numbers and birth rate which makes them appear correlated. The p-value of this test is only relating to the correlation coefficient, this is not causation and while these two variables are correlated this is different to causation and so we cannot state that a high number of storks results in a higher birth rate.

Question 2:

The correlation coefficient is used to test whether variables have a relationship and the strength of this relationship. It exists in a range of -1 to 1, with -1 being negatively correlated and indicating that as one variable increases, the other decreases. 1 is positively correlated and indicates that as one variable increases, the other increases. A correlation coefficient of 0 indicates no correlation and if plotted on a scatter graph there would be no obvious pattern. Highly correlated variables should lead to a good regression fit as most of the variance within the target variable should be predicted by the predictor variable.

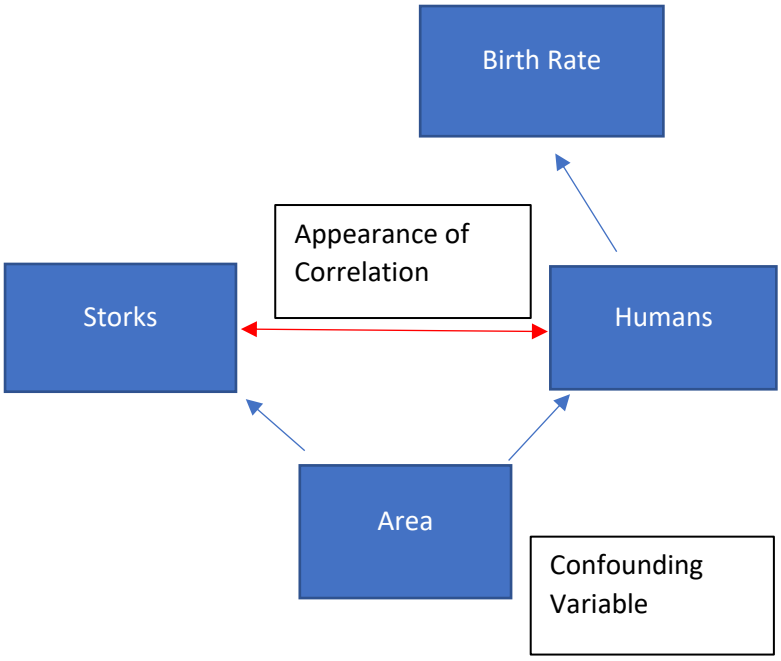
P-values display the probability that you would receive results of this extremity (from a statistical test) if the null value was true. If you reject the null hypothesis, then you are claiming that your results are statistically significant. However, this is set by a threshold decided by a human and therefore may in some circumstances be considered arbitrary. If you have a threshold of 95% and a low p-value of 0.03, you are claiming that there is only a 3% chance of obtaining a value this extreme and because of the threshold you have set, this is classed as statistically significant. A p-value cannot tell you whether your regression is a good fit, it is more an indicator of repeatability. If you repeated this experiment many times (for the values set above), you would expect your value to be this extreme 3% of the time if the null hypothesis is correct.

Question 3:

The example in the paper of storks and birth rates describes how correlation and causation can be confused with one another. In this case, Matthews is making the fallacy that if the number of storks is positively correlated with the birth rate, then the storks must cause the birth rate. Whilst we cannot deny that storks and birth rate are correlated, we cannot prove that storks cause births. The simple definition of causation is that of cause and effect, that A leads to B. For example, if you stub your toe (cause), your toe will hurt (effect). This does not work the other way around; your toe will not start to hurt *before* you stub it on a table leg. Correlation, on the other hand, can work both ways. A high number of storks relates to a high number of births and vice versa but does not prove that one *causes* the other.

Question 4:

A confounding variable is an external variable that makes two variables appear to be correlated. In this case, the confounding variable is the Area of the countries. It affects both birth rate and stork populations as a higher area usually means high human population which will also mean a higher birth rate. A high area will also mean more space for storks so there will be a higher stork population. Due to this, it will appear that as birth rate increases, so does stork population. However, it is in fact the increase of Area that causes both to rise so that they appear correlated.



References:

Robert Matthews. “Storks Deliver Babies (p = 0.008)”. Teaching Statistics. Volume 22, Number 2, Summer 2000, p36-8