

# CMEE Coursework

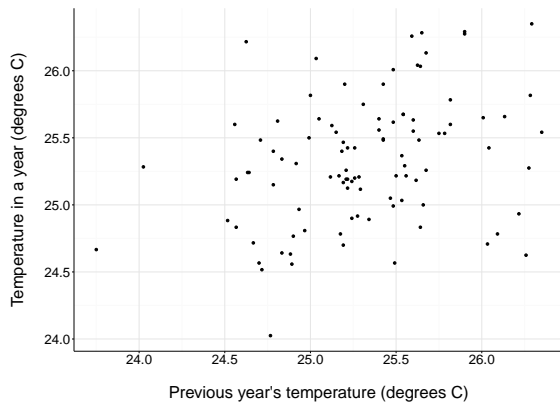
## Week 3, Practical 9.9.2

Calum Pennington

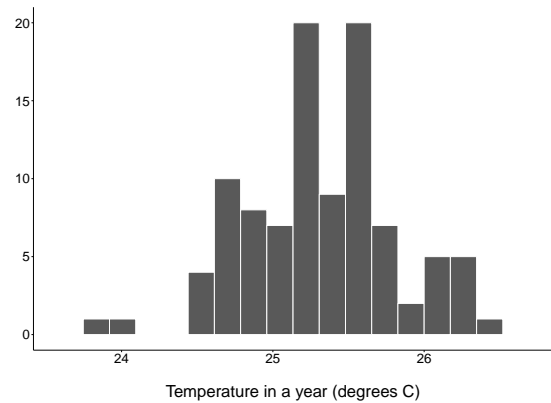
### Is the temperature of one year significantly correlated with the next year (successive years), across the years?

Spearman rank-order correlation indicates a significant positive association between the temperature of one year and the next year, across the years ( $r_s=0.33$ ,  $P<0.05$ ). A scatterplot summarises the result (Figure 1a). Overall, there is a moderate, positive correlation among temperatures in successive years. An increase on the previous year's temperature correlated with an increase the next year. The data seem to show a linear relationship: a constant increase.

'Standard' correlation (Pearson's product-moment correlation) assumes variables are normally distributed. I chose Spearman's rank-order correlation, not the Pearson, as the temperature data did not look normally distributed (Figure 1b). Climatic variables in successive time points are not independent. So, I did not use the standard p-value. Instead, I computed the correlation coefficient for successive years, and then ten thousand different randomly permuted sequences of years. The p-value is the fraction of coefficients greater than the original one.



(a) Positive correlation between the temperature of one year and the next year, across the years.



(b) The temperature data is not normally distributed.

Figure 1: Temperature in Key West, Florida, for each year of the 20<sup>th</sup> Century.

While there is high variability, this seems constant across the distribution and there are no outliers. This suggests there is a long term trend, independent of short term fluctuations.

Perhaps the temperature of a year is caused by the previous year. The direction of causality would be obvious: it makes no sense to think the temperature of a year affects previous years. But, at this stage, this is not a valid conclusion: correlation does not imply causality. The sample size is reasonably big: temperature for each year of the 20<sup>th</sup> Century. The result is unlikely to be coincidental, and suggests there is a constant factor affecting the variables.