Are consecutive annual mean temperatures in a given location significantly correlated?

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4 Results

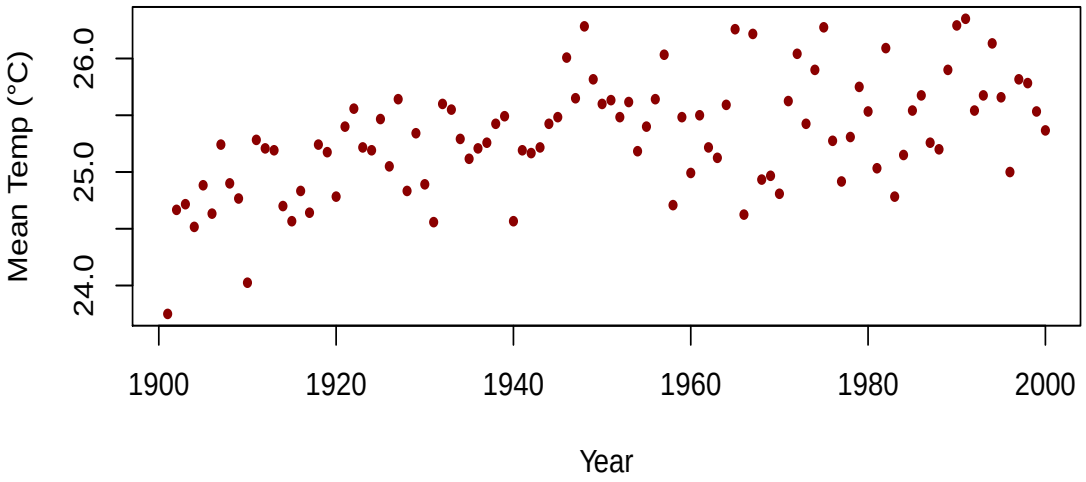
We used mean annual temperatures from 100 years, 1901-2000, in Key West, Florida. The mean of the mean temperatures across all years was 25.31, with a range of 23.75-36.35 and SD of 0.50 (Fig. 1a). There is a clear positive correlation between year and mean annual temperature.

When mean temperature of one year is plotted against the mean temperature of the next, any correlation that may exist is less clear (Fig. 1b). The aim of this study was to determine if there was a such a correlation, and if so was it statistically significant. Therefore, the null hypothesis is that the correlation coefficient is not significantly more than 0, and the alternate hypothesis is that it is.

We wanted to test this hypothesis at the 5significance level, but unfortunately the lab's statistical tables book set on fire in a horrific accident, and the WiFi was down. Hence, we needed to estimate the p-value from first principles.

Having calculated the Pearson's auto- correlation coefficient (ACC) of the data in Fig. 1b, 0.326, this required us to randomise the data by 'shuffling' the measured temperatures associated with each year, find the autocorrelation coefficient of that randomised data, repeat the process 10,000 times, and compare the 10,000 ACCs with the ACC of the real data.

In order to ensure reproducibility, the seed was set to 294 prior to the random sampling. This lead to the distribution of 10,000 ACC values shown in Fig. 2.



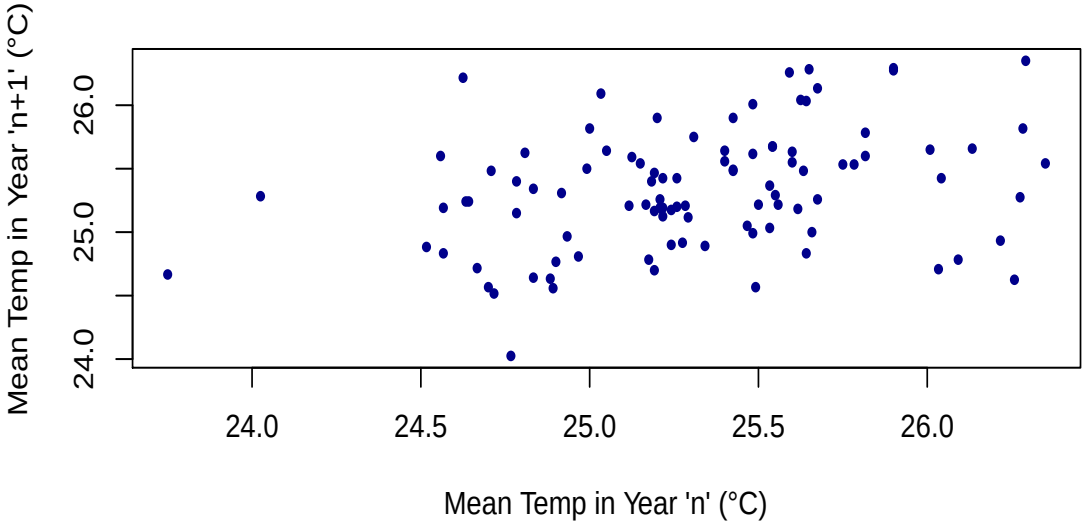


Figure 1: Scatterplots plotting mean annual Temperature against the year it was measured (a, above), and the mean temperature of one year against the mean temperature of the next (b, below). All temperatures were measured in degrees celsius, at a site in Key West, Florida.

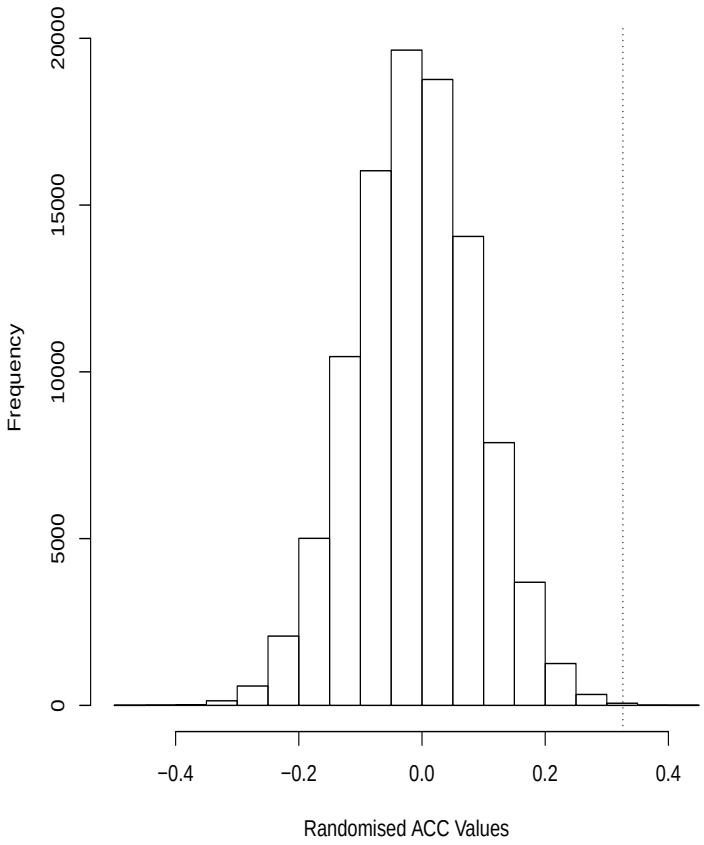


Figure 2: A histogram showing the distribution of autocorrelation coefficients from 10,000 randomly reordered versions of our original dataset. The vertical dotted line denotes where 0.326, the true autocorrelation coefficient of the data, would lie on the distribution.

Of the 10,000 ACC values based on shuffled data, only 18 were larger than the ACC of the real data, 0.326. This gives us an estimated p-value of less than 0.01.

We can therefore reject the null hyothesis, and accept that the autocorrelation of temperature between successive years is significant.