Autocorrelation in Florida Weather

Group 3 Cool Coatis

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Introduction

In this project, we looked at whether Florida's annual mean temperatures show any year-to-year dependence. This allows us to discover whether warm years tend to be followed by warm years more often than expected by chance.

Methods

We analysed the dataset `florida_weather.csv`. This dataset contains annual mean temperatures from 1901 to 2000 in Florida.

To quantify temporal dependence, we used the Pearson correlation to calculate between temperature in year t and year $t + 1$:

$$r_{\text{obs}} = \text{cor}(\text{Temp}_t, \text{Temp}_{t+1}).$$

Because temperature data over time may not satisfy the assumptions of the usual correlation test, we used a permutation test instead. We randomly permuted the temperature values 5000 times. This recalculated the successive-year autocorrelation for each permuted sequence to construct a null distribution.

Results

The observed autocorrelation was

$$r_{\text{obs}} = 0.3262.$$

The null distribution of correlations obtained from 5000 permutations was near zero. Only 0.0002 of the permuted correlation values were greater than or equal to the observed value, resulting in a one-sided p-value of 0.0002.

$$p = 0.0002.$$

This provides strong evidence for positive temporal autocorrelation in Florida's annual temperatures. This successfully supports that warm years tend to be followed by warm years more often than expected under a random ordering of the same values.

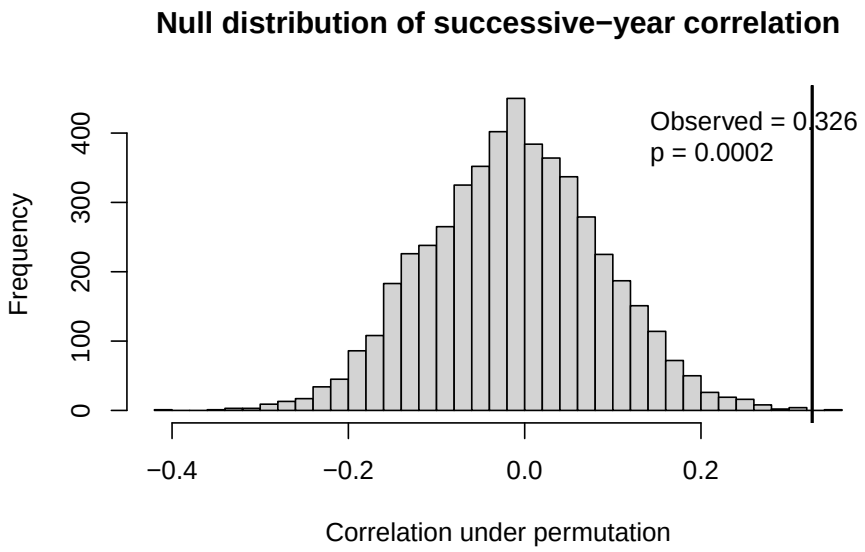

Figure 1: Null distribution of lag-1 autocorrelation coefficients generated from 5000 random permutations of annual mean temperatures.

Conclusion

This analysis shows significant successive-year autocorrelation in the Florida temperature time series. The vertical line shows the observed correlation $r_obs = 0.3262$.