

# Autocorrelation of Annual Temperature in Key West, Florida for the 20th Century

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## Abstract

This study concerns whether temperatures of years are autocorrelated. Temperatures in Key West, Florida for 20th century were used. Lag 1 autocorrelation was tested, and  $p$ -value was estimated using a simulation approach. The results showed a weak but significant correlation between temperature of one year and its successive year.

# 1 Introduction

Autocorrelation refers to correlation between current values of a variable and its past values. If autocorrelation is found between values that are  $k$  time periods apart, it is called a lag  $k$  autocorrelation. In this paper, autocorrelation in temperatures of Key West, Florida in 20th century was tested and  $p$ -value was estimated, showing a weak but significant lag 1 autocorrelation.

## 2 Materials & Methods

### 2.1 Data of Temperatures

The raw data file of temperatures is named as KeyWestAnnualMeanTemperature.Rdata, which is accessible in <https://github.com/mhasoba/TheMulQuaBio/tree/master/content/data>. It was plotted by a R script.

### 2.2 Autocorrelation Test

A R script was used to calculate Pearson's correlation coefficient between temperatures that are 1 year apart.

### 2.3 Estimation of $p$ -value

A R script is used to estimate  $p$ -value. To begin with, values of temperature were rearranged randomly, and Pearson's correlation coefficient of lag 1 autocorrelation was calculated. This process was repeated 10,000 times, and the fraction of correlation coefficients whose absolute values are larger than that from raw data is approximate  $p$ -value.

## 3 Results

### 3.1 Plot of Raw Data

Figure 1 illustrates temperatures in Key West, Florida for 20th century.

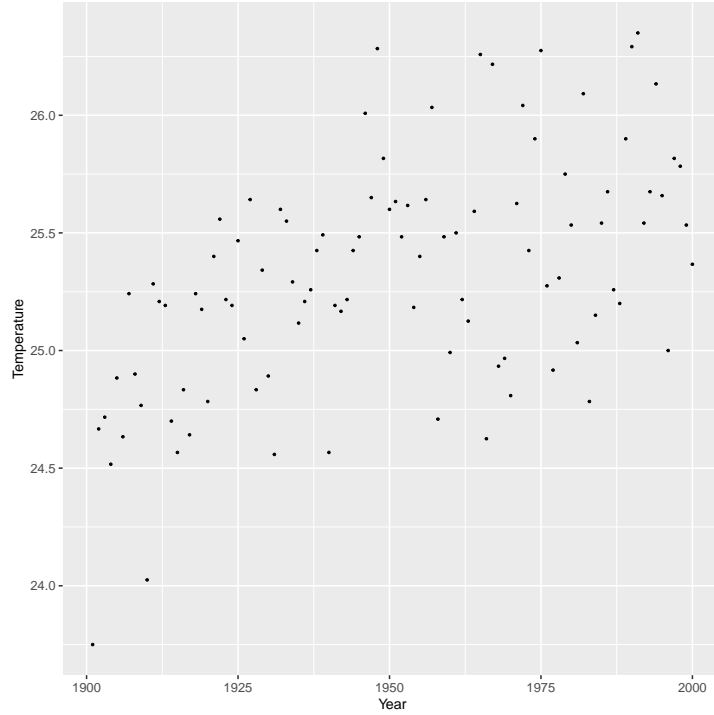


Figure 1: Temperature in Key West, Florida

### 3.2 Test of Autocorrelation

The correlation coefficient of temperatures 1 year apart is 0.3262, and approximate  $p$ -value was 0.0013.

## 4 Discussion

Correlation coefficient measures the extent that two variables are linearly correlated. A positive correlation coefficient means positive correlation between two variables. If the correlation coefficient is negative, then there is a negative correlation. The closer the absolute value of correlation coefficient to 1, the stronger the correlation is. Here, the correlation coefficient between one-year-apart temperatures is 0.3262, showing that there is a weak positive correlation between the temperatures of one year and its successive year. The statistical significance is measured by  $p$ -value. It is defined as the proba-

bility that null hypothesis is rejected while it is true, namely, the false positive probability. A small  $p$ -value means high significance. Here, the estimated  $p$ -value was 0.0013, indicating the correlation is significant.

## 5 Conclusion

Overall, a weak but significant lag 1 autocorrelation was found in temperatures of Key West, Florida for 20th century.

## 6 Supplement

All codes are wrapped in TAutoCorr.R, which is accessible in <https://github.com/CongLiu37/CMEECourseWork/tree/main/Week3/Code>