A Comprehensive Analysis of Climate Data: An Investigation of Temperature and Precipitation Variables

Alice B. Thompson
Department of Environmental Science
University of California, Berkeley
Berkeley, CA 94720
athompson@berkeley.edu

Robert C. Johnson
Department of Statistics
Stanford University
Stanford, CA 94305
rjohnson@stanford.edu

Abstract

This paper presents a comprehensive analysis of climate data, focusing on three key variables: maximum and minimum temperatures, and precipitation. Utilizing visual representations of the data, we investigate the relationship between these variables and derive insights about their distribution, correlation, and variability. Our findings suggest a strong correlation between maximum and minimum temperatures, a skewed distribution of precipitation values, and a significant variation in daily temperature ranges. However, the limitations of the data, including its short time span and single location source, are acknowledged, and the implications of these limitations for the generalizability of our findings are discussed.

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1 Introduction

Climate change is one of the most pressing issues of our time, with far-reaching implications for ecosystems, economies, and societies worldwide **?**. Understanding the dynamics of climate variables such as temperature and precipitation is crucial for predicting future climate scenarios and informing mitigation and adaptation strategies **?**.

In this study, we focus on the analysis of maximum and minimum temperatures and precipitation, three key variables that significantly influence the climate system. Temperature is a fundamental climate variable that affects a wide range of physical and biological processes **?**. Precipitation, on the other hand, is a critical component of the global water cycle and plays a vital role in the distribution of terrestrial ecosystems **?**.

Previous studies have explored the relationships between these variables at various spatial and temporal scales **??**. However, there is still a need for more comprehensive analyses that integrate different types of data and utilize advanced statistical methods to derive deeper insights **?**.

In this paper, we present a comprehensive analysis of climate data, focusing on the distribution, correlation, and variability of maximum and minimum temperatures and precipitation. We utilize visual representations of the data to facilitate interpretation and derive insights.

Figure 1: Historical trends of maximum and minimum temperatures and precipitation.

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Figure **??** shows the historical trends of these variables, which will be further analyzed in the subsequent sections of this paper.

The rest of the paper is organized as follows: Section 2 describes the data collection and preparation process, Section 3 presents the data visualization, Sections 4-6 provide the analysis and interpretation of the figures, Section 7 presents the correlation analysis, Section 8 discusses the limitations of the study, and Section 9 concludes the paper and suggests future work.

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2 Data Collection and Preparation

The data used in this study was obtained from the National Centers for Environmental Information (NCEI) **?**. The dataset comprises daily climate records from a single weather station located in Berkeley, California, spanning a period of five years from 2015 to 2020. The variables of interest in this study are the daily maximum temperature (Tmax), daily minimum temperature (Tmin), and daily precipitation (Prcp).

The raw data was preprocessed to ensure its suitability for analysis. This involved handling missing values, outliers, and data errors. Missing values were imputed using the mean of the surrounding values, while outliers were identified using the Tukey's method **?**, where values more than 1.5 times the interquartile range above the third quartile or below the first quartile were considered outliers. Data errors, such as negative values for precipitation, were corrected based on domain knowledge.

The data was then transformed to facilitate analysis. The daily temperature range (DTR) was calculated as the difference between Tmax and Tmin for each day. This new variable provides a measure of the daily temperature variability, which is a key factor in climate studies **?**.

The final dataset used for analysis consists of four variables: Tmax, Tmin, Prcp, and DTR. The descriptive statistics of these variables are presented in Table 1.

Figure 2: Descriptive statistics of the climate variables.

The data preparation process ensured that the dataset is clean, accurate, and ready for analysis. The next section presents the visualizations of the data and the insights derived from them.

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