Assignment Details

Consider summer temperatures in Bloomington; sketch a probability distribution of Bloomington summer temperatures. Justify why you sketched it the way you did. The justification can be written (1-2 paragraphs) or it can be a media upload (2-3 mins).

Brief Introduction

This assignment aims to obtain Bloomington summer temperature data, visualize the data, and discuss it. The objectives are to answer/discussion the following three questions: (1) why it is high in some region (or regions) and low in others, (2) the axes are well labeled and named, and (3) the justification draws on concepts from the readings.

Data and Method

The Bloomington summer temperature data is sourced from the National Oceanic and Atmospheric Administration (https://www.weather.gov/). This study obtained monthly average temperature data from the Indiana University Station for the years 1960 to 2024. The exact latitude and longitude of this station are not specified.

This study compiled the data using Jupyter. To illustrate the probability distribution of summer temperatures in Bloomington, I plotted a histogram of temperature data collected over the summer months. This distribution provides insight into the frequency and variability of summer temperatures, reflecting the central tendency and dispersion of the data. By including a kernel density estimate overlay, the plot also smooths out the histogram bars to better visualize the underlying distribution and identify potential patterns or trends.

The choice of a histogram with kernel density estimate was made to offer a clear representation of the temperature distribution while preserving the granularity of the data. The histogram bins allow for a detailed view of temperature frequency, whereas the KDE curve highlights the distribution’s shape, revealing whether the temperatures are symmetrically distributed, skewed, or exhibit multiple modes. This combined approach aids in understanding both the specific range of temperatures experienced and the overall distribution pattern, which is crucial for assessing the typical summer climate and identifying any anomalies or significant trends in Bloomington's summer temperatures.

Result

The figure below illustrates the probability distribution of summer temperatures in Bloomington. June exhibits the smallest temperature range among the three summer months, indicating fewer instances of extreme high or low temperatures, with a median temperature of approximately 72°F. In contrast, July shows a broader temperature range from 70°F to 82°F, reflecting greater temperature variability and a higher likelihood of extreme high temperatures, which may be attributed to the longer daylight hours. August's distribution is similar to that of July but with a slightly lower peak, suggesting a decrease in the occurrence of extreme temperatures towards the end of the summer. Overall, Bloomington's summer temperatures range from approximately 70°F to 77°F, with a median temperature of around 73°F.

To date, the question of why temperatures are high in some regions and low in others remains unanswered. Since this dataset includes only one station in Bloomington, it is not possible to visualize the spatial distribution of summer temperatures within Bloomington. However, based on previous research, factors influencing spatial temperature distribution are generally categorized into anthropogenic factors (e.g., land clearing (Findell et al., 2017), industrial activities/greenhouse gas emissions (Eskander et al., 2020)) and natural factors (e.g., elevation (Palazzi et al., 2019)).

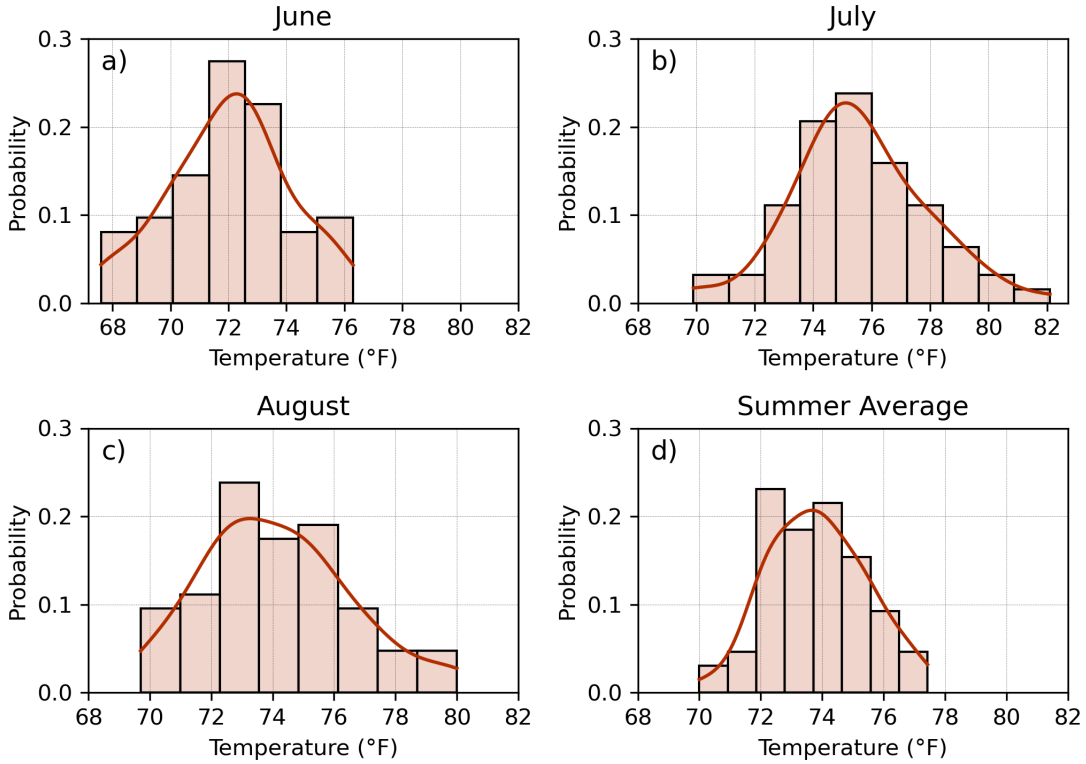

Figure 1. Probability distributions of Bloomington summer temperatures. a) June, b) July, c) August, and d) Summer average. Each subplot presents a histogram with an overlaid KDE to show the temperature distribution for each month.

Reference

Eskander, Shaikh MSU, and Sam Fankhauser. "Reduction in greenhouse gas emissions from national climate legislation." *Nature Climate Change* 10.8 (2020): 750-756.

Findell, Kirsten L., et al. "The impact of anthropogenic land use and land cover change on regional climate extremes." *Nature communications* 8.1 (2017): 989.

Palazzi, Elisa, et al. "Elevation-dependent warming in global climate model simulations at high spatial resolution." *Climate Dynamics* 52.5 (2019): 2685-2702.

Code and data can be found at https://github.com/Gong001/EAS-G-577