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Influences on Running Pace

Visualization Testing

# Introduction

The purpose of this project is to create and evaluate the effectiveness of visualizations of the author’s running pace and confounding factors. Major factors include previous exercise (creating fatigue), distance, elevation changes, and weather. The most important weather factors include temperature and humidity (or dewpoint), but wind speed was also included in the study. With effective visualizations, the author and other runners in similar environments may learn more about how to adjust pace for different kinds of runs in different weather conditions.

## Data

The running and fitness data was retrieved from the author’s Garmin app and was recorded on a Garmin Forerunner 265s. All data that was not recorded in Houston, Texas or of running were not included in the dataset to increase consistency. Furthermore, weather data was provided by Weather Underground (retrieved July 23, 2025). The data includes the following:

* Time
  + Date
  + Time
* Activity Information
  + Distance (miles)
  + Duration (hours: minutes: seconds)
  + Average Heart Rate (bpm)
  + Elevation Gain (feet)
* Exercise Load Information
  + Acute Daily Training Load
  + Chronic Daily Training Load
* Daily Weather
  + Average Temperature (degrees Fahrenheit)
  + Average Humidity (percent)
  + Average Wind Speed (mph)

The time, activity information, and daily weather columns are self-explanatory. The exercise load columns are meant to estimate body fatigue from exercise, which can affect running performance. The Acute Daily Training Load is a weighted sum of the last seven days’ Excess Post-exercise Oxygen Consumption (EPOC). After exercise, humans tend to consume more exercise for several hours than they otherwise would. Therefore, measuring the EPOC is a good indicator of how stressful an activity was on one’s body. The higher it is, the more stress there is on the body. The Chronic Daily Training Load is the same as the Acute version, except it takes into account the last twenty-eight days, rather than just the last seven (Garmin, 2025).

Note there are a few anomalies in the data that may affect the relationships seen. The first is that the author was training for her first half marathon from before the data starts to January 19, 2025. Second, the author and runner had surgery on February 19, 2025, from which she had to recover and then try to get back running strength afterwards. Finally, the author/runner began training for her first marathon in May.

## Goals/Tasks

There are three goals for this project. The visualizations should provide insight into how exercise load/fatigue, the run parameters (distance, elevation changes, and time of day), and weather conditions (temperature and humidity) affect running pace. This is to help runners determine whether their pace is getting faster over time, despite other things that may be slowing them down.

# Methodology

Three images that are very similar were created relating to the three areas of exploration: exercise load, environmental factors, and run parameters. For each visualization the pace quantile was set on the y-axis. This is because it is the dependent variable in the question. Additionally, the pace is represented in quantiles rather than absolute values because the absolute scale was not friendly to teasing out larger relationships.

A graph with numbers and dots

AI-generated content may be incorrect.

Figure . First Visualization for Testing: Environmental Influences

The first image created visualized the relationship between running pace quantile and environmental factors, including temperature, humidity, and wind speed. Humidity was placed on the x-axis and temperature was shown with a diverging color scale. These two factors were the most important to stand out, so they got the more effective representation methods. Wind speed, a lesser factor, was shown by the size of the marks.

A graph with red dots

AI-generated content may be incorrect.

Figure . Second Visualization for Testing: Exercise Load Influences

A graph of a running function

AI-generated content may be incorrect.

Figure . Third Visualization for Testing: Running Parameters

# Discussion of Evaluation

Three testers were chosen due to their background as casual runners who track their runs either on a watch or through Strava on their phone. They varied in age, gender, and years of run experience. Each volunteer was emailed the images and told the data came from Garmin watch run data for a few months of exercise.

# References

Garmin. (2025). “What Is the Acute and Chronic Load Feature of My Device?” *Garmin*. <https://support.garmin.com/en-US/?faq=C6iHdy0SS05RkoSVbFz066>.

Weather Underground. (2025). “Houston, TX Weather History.” *Weather Underground*. <https://www.wunderground.com/history/monthly/us/tx/houston/KHOU/date/2024-10>.