

Capstone Two: Project Proposal

Predicting Snow Depth in the Wasatch Mountain Range, UT, USA

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Problem/Context:

The goal of this project is to develop a predictive model for snow depth across the Wasatch Mountain Range in Utah, using key environmental factors such as wind speed, temperature, and precipitation. By accessing these parameters, we can estimate snow depth under varying climate conditions. Snow plays a critical role in maintaining a healthy ecosystem and adding vital moisture to the arid environment of Northern Utah. Additionally, snowmelt is essential for regional watersheds dependent on runoffs during summer months. In particular, the Wasatch Range is a critical water source for major metropolitan areas like Salt Lake City. Snow is also a key economic resource, with the ski industry a main driver for tourism. For instance, Utah's 2023-24 ski season attracted 6.7 million visitors. Given the rising interest in winter recreation, changes in the snow depth may significantly impact local communities, industries, and governments. Thus, accurately predicting snow levels can help develop strategies for water allocation, mitigate the potential risks from snowpack variability, and inform stakeholders in the region with better insight for decision making.

Criteria for Success:

The success of this project hinges on achieving an accurate snow depth prediction model. This includes constructing a robust model that is scalable across different geographic regions and time events. Additionally, the model should be presented as a user-friendly interface or dashboard to facilitate easy access for stakeholders and future participants of the project. This would ensure the predictions and model is both actionable and accessible.

Scope of Solution Space/Constraints:

The collection and preprocess of historical environmental data will allow us to explore and engineer features that are highly correlated with snow depth. By training and validating multiple machine learning models, we will identify the best performing and robust model. Evaluating these results will accomplish the objectives and goals for this project of estimating snow depth. However, there are several constraints to consider, including the availability and quality of data. Inaccurate or incomplete data where due to human error or limitation in the data sources could compromise the model's accuracy. Margins of error in data processing will be acknowledged, but minimizing these risks is important in achieving the project's objectives.

Stakeholders:

This predictive model will be valuable to a wide range of stakeholders. Since snow is critical for the ski industry, ski resort management will be invested in accurate snow depth predictions to optimize operations. Transportation authorities rely on allocating resources in regards to weather conditions, the snow depth data will be vital. Lastly, local governments and municipalities will benefit from the final model for assessing snowpack health, managing water resources, and planning for seasonal variation in water availability.

Data Sources:

Data for this project is collected from SNOWpack TELemetry (SNOTEL) stations, which are managed by the National Snow and Ice Data Center. This dataset includes measurements of snow depth (m), snow-water equivalent (m), and the corresponding standard errors, along with timestamps for each data point. Additional information to consider from these stations are available data of the elevation, and geographic location. To enhance the model's domain and scope of understanding, we will incorporate additional sensor resources, such as air temperature, precipitation, and wind speed, which will help refine predictions of snow depth across the Wasatch Mountain Range. Descriptive statistics of the sensor factors as well as time windowing will derive a multitude of features for the machine learning models.