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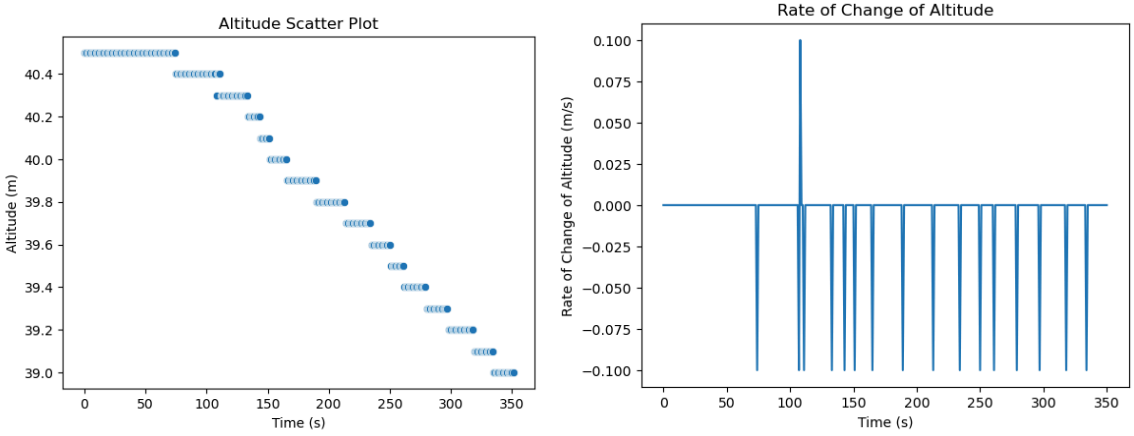
Lab 1: GPS Driver

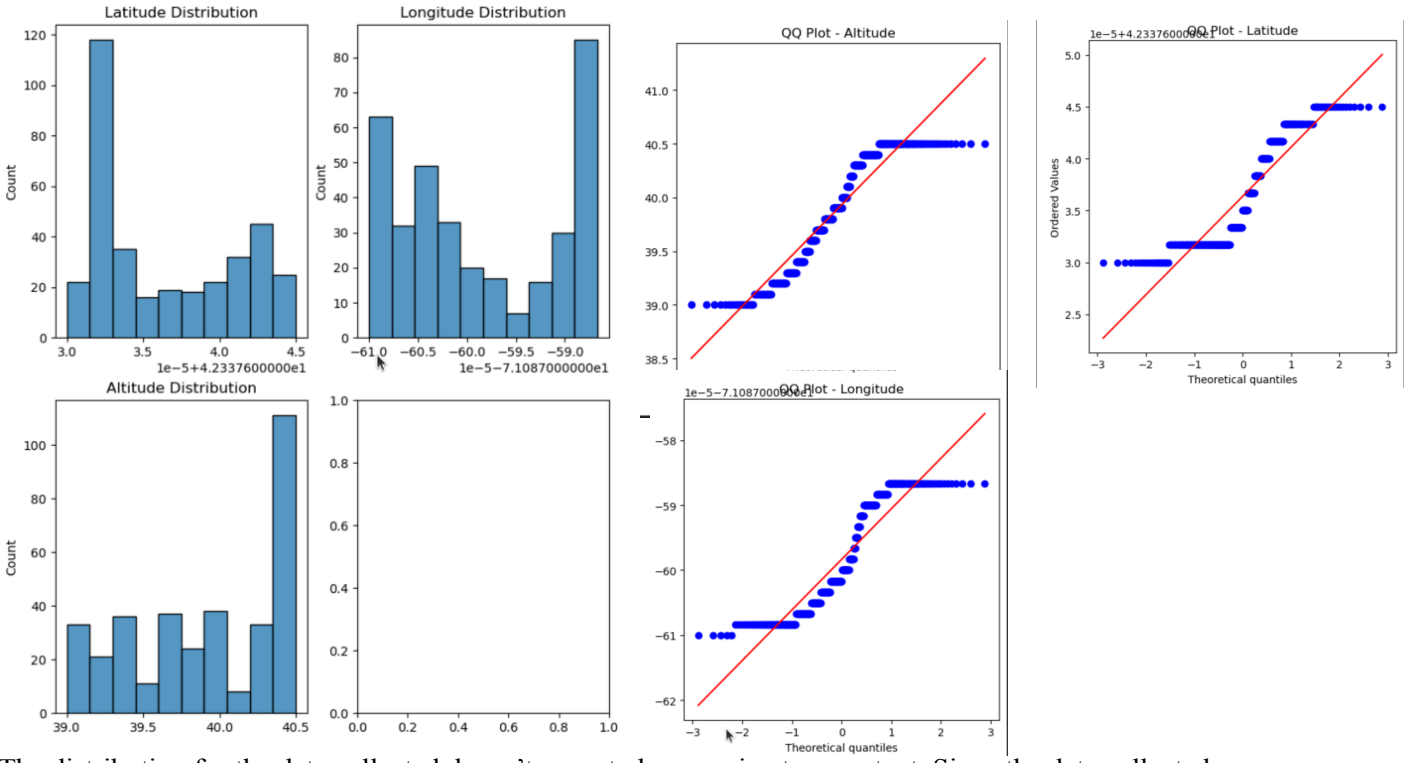
Stationary Data

Stationary data was collected for around 7 minutes. The location of the data collection is shown below for context. The google maps GPS location was (42.3376390, -71.0875307)

The calculated standard deviation was shown to be *Latitude: 5.100781315377349e-06, Longitude: 8.306288706385021e-06, Altitude: 0.5073322784978151*. While the Mean Error showed *Latitude: 5.211174245193946e-06, Longitude: 6.764753787737796e-05.* These values indicate that the changer in the GPS readings is not extremely significant.
While reflecting on the values of the **Altitude**, an interesting pattern was shown.



As indicated by the diagram on the left the altitude kept constantly decreasing in a step form. Upon inspection of the rate of change a constant rate of change of the altitude can be seen in the diagram on the left of a -0.004273504273504274 m/s.
The source of this drift could be the changing positions of the satellites causing different calculations to take place.
The distance calculated was 7.18m which shows the error of the GPS.
Distributions

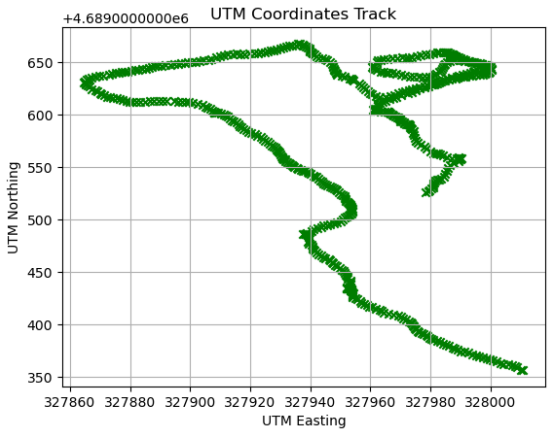


The distribution for the data collected doesn't seem to be gaussian to an extent. Since the data collected doesn't show a specific pattern and doesn't align with the QQ(quantile-quantile) Plot that shows if the data fits a normal distribution.

Note: Attached in the submission is an html file. When downloaded and opened it will show the exact location the readings were taken at that looks like this.

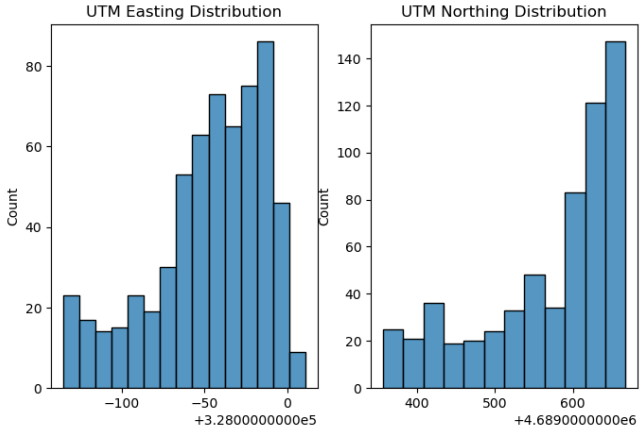
Moving Data

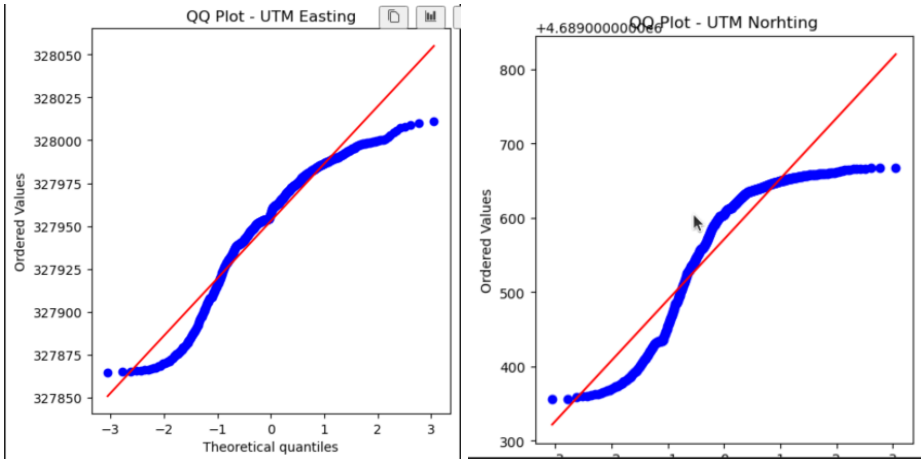
Context: The data wasn't collected in a perfect straight line with some turns and circles in the end of the data that I have collected out of curiosity. The UTM data was visualized as follows.
The **accuracy** while walking has shown significant enhancement than the stationary data collection.



Statistics: *Standard Deviation: UTM Easting: 34.4509797204328, UTM Northing: 87.58980972120033*
Distance Calculation: The distance calculated was 825.3m while the actual distance calculated using mapmyrun was 824m leaving us with an error of 1.3m which is an acceptable number.

Visualization of the Distribution:





Interestingly enough, the values seem to be gaussian/normally distributed which indicates that the GPS puck might have a Kalman filter. Although there is some noise in the distribution, the noise came from the imperfect straight lines as well as the last bit of the data which was free walking.

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Stationary vs Moving Data

Moving data was shown to be more accurate than the stationary data for multiple possible reasons. One reason could be that in the stationary task, the puck is located at a place that might have specific noise but it will keep reading the data regardless. Meanwhile in walking, the noise is distributed and there could be areas that have less noise than others while walking, distributing the possibility of errors.