Accuracy and Precision of a Handheld GPS unit for the Location of a Stationary Object
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Objective
The objective of this study was to determine the accuracy and precision of a handheld GPS unit for the location of the selected man hole in the Virginia Tech campus.

Null Hypothesis
The position of the selected man hole according to the GPS unit using the UTM coordinate system will not vary significantly from day to day or from morning to evening, i.e. the linear deviation will not be more than 10m for the day.

Alternate Hypothesis
The position of the selected man hole according to the GPS unit using the UTM coordinate system will vary significantly from day to day and from morning to evening, i.e. the linear deviation will be more than 10m for the day.

Experimental Unit
A single GPS reading.

Factor
Time of the day (Qualitative)
Level 1. Morning
Level 2. Night

Response variable: Accuracy of GPS unit as measured in deviation from the true reading in meters.

This was an experimental and prospective study because we had control on assigning factor levels and we had to measure response variables. The data collected were continuous response variables because they were numeric in a specific range. The data was analyzed statistically for mean and variance.

Materials and Methods
A man hole at the junction of West Campus Dr. and Washington Street on the Virginia Tech campus, Blacksburg, VA was used as the object of study. The same object and location was used for the entire study. The position of the man hole was recorded with a handheld Global Positioning Unit (GPS) using the UTM coordinate system. The same GPS receiver was used throughout the study. Readings were taken twice daily at approximately 9:15 AM and 9:15 PM starting from September 13th to September 26th, 2005 for 10 days. True reading was the average of morning readings in the first day of the study. Readings were recorded every two minutes over a ten minute period. All readings from the ten-minute period were averaged, and the average reading for the day and time
was recorded. No extraneous factors were noted during the study, but weather data for the area for the days of the study will be examined to see if weather was a factor.

Results

The average deviation from true was 2.37m. The greatest deviation from true was 5.3m, while the smallest deviation from true was 0.0m. A full record of data is given in Table 1. The morning readings were, on average, 2.69 meter deviation from true reading. The afternoon readings were, on average, a 2.04 meter deviation from true reading.

Table 1: Average GPS readings and its deviation from true reading for the man hole.

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<tr>
<th>Date</th>
<th>Morning Easting</th>
<th>Morning Northing</th>
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<th>Afternoon Easting</th>
<th>Afternoon Northing</th>
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</table>

Discussion

Based on the average deviation of 2.37 m, the GPS unit was accurate and precise. Fig.1. represents the deviation of the readings in meters for morning and evening from September 13 to 26. There was no significant difference in readings that were taken in the morning and afternoon. The deviations above 10m were considered as significant for this study. None of the deviations were close to this value. The results supported the observations of Spilker (1978). Therefore null hypothesis is accepted.
Fig: 1. Linear deviation of GPS readings (m) from true GPS reading of man hole by day and time

Conclusion
The null hypothesis is accepted. The day and time of day do not significantly affect the accuracy of the receiver.

Acknowledgement
I’m greatful to the valuable suggestions and timely directions of Dr. Brewster for the conduct of the study and analysis of the data.

Reference: