ASEN 5090 HW 1 Due Monday, Sept 9, 2013

1. Book Problem 1-1
2. Book Problem 1-4
3. Book Problem 1-5
4. Compute the mean and standard deviation of the data in each of the two columns of the attached data file. Report your results with the appropriate number of significant figures and explain your choice of digits.

If you don't have the book yet:

Homework Problems

1-1. Given that 1 minute of latitude is approximately equal to 1 nautical mile (1852 meters), how many significant digits after the decimal must be included for a latitude represented in *degrees* to describe a fix that is accurate to 1 cm? How many significant digits are required after the decimal in the *arc-seconds* field if the latitude is represented in degrees, arc-minutes, and arc-seconds to describe a fix that is accurate to 1 cm? Note: 1 degree = 60 arc-minutes, 1 arc-minute = 60 arc-seconds (you may find arc-minutes referred to as 'minutes' and arc-seconds referred to as 'seconds').

1-4. A *pseudolite* (short for pseudo-satellite) consists of a generator of a GPS-like signal and a transmitter. Pseudolites are used to augment the GPS signals. Suppose an observer is constrained to be on the line joining two pseudolites PL1 and PL2, which are separated by 1 km. The pseudolite clocks are perfectly synchronized but the observer's clock may have an unknown bias with respect to the pseudolite clocks. Estimate the observer's position and clock bias given that the pseudoranges to PL1 and PL2 are (a) 550 m and 500 m, respectively, and (b) 400 m and 1400 m, respectively.

1-5. You set out from town A and head east to town B 120 km away. Your vehicle has an odometer that is not particularly accurate (it could be off by 1–2 km, or more, after driving 50 km). You carry a decent watch, which is great at keeping time over short intervals, but it has been months since you last reset it. In other words, you can measure time intervals accurately, but do not know exactly what time it is. A short time into your journey, the car breaks down.

(a) According to your odometer, you have traveled 56 km. Estimate your position.

(b) As you push your car to the shoulder of the road, a red bus zooms by heading from A to B. You glance at your watch and notice that it is exactly 21 minutes past the hour. You know that the red buses are prompt, and they leave town A every hour on the hour traveling at exactly 3 km/min. Can you estimate your position without using the odometer information?

(c) Estimate your position and clock bias based on all the information so far. (Hint: Write two equations that relate your position and clock bias to the available information. These equations are sometimes referred to as navigation equations.)

(d) At 25 minutes past the hour by your watch, you observe a blue bus zoom past at 2.5 km/min, going from B to A. Blue buses leave town B every hour on the hour promptly and drive to town A at a constant speed. Estimate your position and clock bias based on all the information so far. (Hint: Recall that your watch can measure time intervals accurately.)

(e) How would your solution be affected if your watch were exactly five minutes faster and all the clocks in town A and town B were running five minutes fast?

(f) Now suppose that your odometer never worked and the only vehicles you see are the identical yellow cabs of carrier L1. These cabs leave town A every minute on the minute and travel at exactly 1 km/min to town B. Can you estimate your position and clock error? Would it help if there were identical green cabs of carrier L2 leaving town B every minute on the minute and traveling at 1 km/min to town A? Explain briefly.