Math 156 – 03: HW Project #3
Due Wednesday, February 5, 2014

1. Light bulbs are measured in lumens (light output), watts (energy used), and hours (life). A standard white light bulb has a mean life of 675 hours and a standard deviation of 50 hours. A soft white light bulb has a mean life of 700 hours and a standard deviation of 35 hours. At a local science competition, both light bulbs lasted 750 hours. Which light bulb's life span was better? Explain using appropriate statistics measurements. (8 points)

\[
\text{Standard} \quad z = \frac{750 - 675}{50} = 1.5
\]

\[
\text{Soft} \quad z = \frac{750 - 700}{35} = 1.42
\]

The standard white bulb was more above average as seen by its higher z-score.

2. In a certain forest, the mean diameter of the trees is 10.4 inches with a standard deviation of 4.7 inches. (2 points each)

(a) A tree in this forest has diameter 21.68 inches, what is its z-score?

\[
\frac{21.68 - 10.4}{4.7} = 2.4
\]

(b) A tree in this forest has diameter 8.52 inches, what is its z-score?

\[
\frac{8.52 - 10.4}{4.7} = -0.4
\]

(c) A tree in this forest has a z-score of 1.6, what is its diameter?

\[
10.4 + 1.6(4.7) = 17.92 \text{ inches}
\]

(d) A tree in this forest has a z-score of -0.25, what is its diameter?

\[
10.4 - .25(4.7) = 9.225 \text{ inches}
\]

3. The Postmaster of a city's Post Office believes that a Normal model is useful in projecting the number of letters which will be mailed during the day. They use a mean of 20,000 letters and a standard deviation of 250 letters. Draw and clearly label this model. (8 points)

[Diagram of a normal distribution curve with labeled percentiles and values]
4. At a large business, employees must report to work at 7:30 A.M. Suppose that the arrival times of employees can be described by a normal model with mean of 7:22 A.M. (let's call this $\mu = 22$) and a standard deviation of 4 minutes. (4 points each)

(a) What percent of employees are late on a typical workday?

$$\text{normalcdf}\left(30, \infty, 22, 4\right) = 0.0228$$

$\approx 2.28\%$

(b) A psychological study determined that the typical worker needs five minutes to adjust to their surroundings before beginning their duties. What percent of this business' employees arrive early enough to make this adjustment?

$$\text{normalcdf}\left(-\infty, 25, 22, 4\right) = 0.7734$$

$\approx 77.34\%$

(c) Because late employees are a distraction and cost companies money, all employees need to be on time to work. If the mean arrival time of employees does not change, what standard deviation would the arrival times need to ensure virtually all employees are on time to work?

\[ \text{Need z-score for 30 to be } \geq 3 \]

\[ \Rightarrow \frac{30 - 22}{\sigma} \geq 3 \]

\[ \Rightarrow \sigma \leq \frac{30 - 22}{3} = 2.67 \text{ minutes} \]

(d) Explain what achieving a smaller standard deviation means in the context of this problem.

People would arrive at work more consistently about the same time, that is, there would need to be less variability in the arrival times.