Problem set 8-4

Normal Cumulative Density Function
Continued

1. Assume that nationally SAT scores are normally distributed with a mean of 1500 and standard deviation of 300. (This cannot be true strictly speaking because the maximum SAT score is 2400; normally distributed data have no maximum or minimum.) If an SAT score is chosen at random:

a) what is the probability that the score is below 2000?

b) what is the probability that the score is below 1800?

c) what is the probability that the score is between 1800 and 2000?

d) what is the probability that the score is between 1979 and 2018?

2. Blood alcohol content or BAC is typically measured in mg of alcohol /ml of blood. Adults over 21 in most states will be arrested for DUI if they have 80 mg/ 100 ml (0.08% BAC) or more. Many handheld BAC meters like the AlcoHAWK Elite Digital by Breathalyzer and the Alco-Sensor III by Intoximeters give a readout to three decimal places. According to a Clinical Chemistry article, the standard deviation for a new Model 1000 Breathalyzer is 0.0037. Let's say you are on a jury in which the defendant is charged for DUI and the BAC was measured to be exactly 0.080 which is the minimum amount necessary for a conviction.

a) What is the probability that the defendant would have a measured BAC of 0.080 or greater if in fact the defendant's actual BAC was 0.079?

b) What is the probability that the defendant would have a measured BAC of 0.080 or greater if in fact the defendant's actual BAC was 0.075?

c) What is the probability that the defendant would have a measured BAC of 0.080 or greater if in fact the defendant's actual BAC was 0.070?

Sources:

- Breath-tester. Breath Alcohol Testers, http://www.breath-tester.com/, 3/17/2009
- Wikipedia, BAC, http://en.wikipedia.org/wiki/Blood_alcohol_content, 3/17/2009
- G. Simpson, Accuracy and ZPresicion of Breath-Alcohol Measurements for a Random Suject in the Postabsorptive State, Clinical Chemistry, 33/2, 261-268, 1987 (http://www.clinchem.org/cgi/reprint/33/2/261.pdf)

Note: In most states the BAC limit for persons under the age of 21 is 0.000 - 0.020. The majority of countries in the world convict for DUI at BAC of 0.05.

3. Going back to SAT scores that are normally distributed with a mean of 1500 and standard deviation of 300:

a) What SAT score is at the 25th percentile?

b) What SAT score is at the 75th percentile?

c) What SAT score puts you in the top 10%?