HW4 (60 Points)

Normal distribution problems

34. The article "Reliability of Domestic-Waste Biofilm Reactors" (*J. of Envir. Engr.*, 1995: 785–790) suggests that substrate concentration (mg/cm^3) of influent to a reactor is normally distributed with $\mu = .30$ and $\sigma = .06$.
    a. What is the probability that the concentration exceeds .25?
    b. What is the probability that the concentration is at most .10?
    c. How would you characterize the largest 5% of all concentration values?

35. Suppose the diameter at breast height (in.) of trees of a certain type is normally distributed with $\mu = 8.8$ and $\sigma = 2.8$, as suggested in the article "Simulating a Harvester-Forwarder Softwood Thinning" (*Forest Products J.*, May 1997: 36–41).
    a. What is the probability that the diameter of a randomly selected tree will be at least 10 in.? Will exceed 10 in.?
    b. What is the probability that the diameter of a randomly selected tree will exceed 20 in.?
    c. What is the probability that the diameter of a randomly selected tree will be between 5 and 10 in.?

37. Suppose that blood chloride concentration (mmol/L) has a normal distribution with mean 104 and standard deviation 5 (information in the article "Mathematical Model of Chloride Concentration in Human Blood," *J. of Med. Engr. and Tech.*, 2006: 25–30, including a normal probability plot as described in Section 4.6, supports this assumption).
    a. What is the probability that chloride concentration equals 105? Is less than 105? Is at most 105?
    b. What is the probability that chloride concentration differs from the mean by more than 1 standard deviation? Does this probability depend on the values of μ and σ?
    c. How would you characterize the most extreme .1% of chloride concentration values?

Exponential distribution problems

59. Let X = the time between two successive arrivals at the drive-up window of a local bank. If X has an exponential distribution with $\lambda = 1$ (which is identical to a standard gamma distribution with $\alpha = 1$), compute the following:

a. The expected time between two successive arrivals

b. The standard deviation of the time between successive arrivals

c. $P(X \leq 4)$ **d.** $P(2 \leq X \leq 5)$

60. Let X denote the distance (m) that an animal moves from its birth site to the first territorial vacancy it encounters. Suppose that for banner-tailed kangaroo rats, X has an exponential distribution with parameter $\lambda = .01386$ (as suggested in the article "Competition and Dispersal from Multiple Nests," *Ecology*, 1997: 873–883).

a. What is the probability that the distance is at most 100 m? At most 200 m? Between 100 and 200 m?

b. What is the probability that distance exceeds the mean distance by more than 2 standard deviations?

c. What is the value of the median distance?

61. Data collected at Toronto Pearson International Airport suggests that an exponential distribution with mean value 2.725 hours is a good model for rainfall duration (*Urban Stormwater Management Planning with Analytical Probabilistic Models*, 2000, p. 69).

a. What is the probability that the duration of a particular rainfall event at this location is at least 2 hours? At most 3 hours? Between 2 and 3 hours?

b. What is the probability that rainfall duration exceeds the mean value by more than 2 standard deviations? What is the probability that it is less than the mean value by more than one standard deviation?