

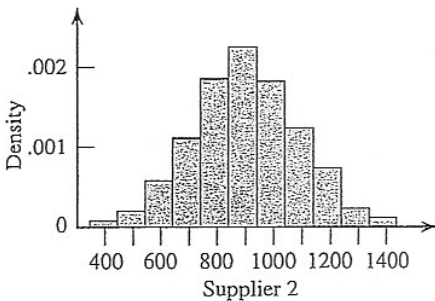
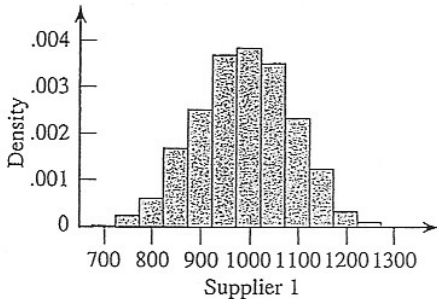
# AP Statistics - Chapter 2 Review (DeJore/Peck)

6.9 A company receives light bulbs from two different suppliers. Define the variables  $x$  and  $y$  by

$x$  = lifetime of a bulb from supplier 1

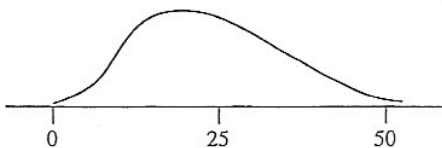
$y$  = lifetime of a bulb from supplier 2

Five hundred bulbs from each supplier are tested, and the lifetime of each bulb is recorded. The accompanying density histograms are constructed from these two sets of observations. Although these histograms are constructed using data from only 500 bulbs, they can be considered as approximations to the corresponding population distributions.



- Which population distribution has the larger mean?
- Which population distribution has the larger standard deviation?
- Assuming the cost of the bulbs is the same for both suppliers, which supplier would you recommend? Explain.

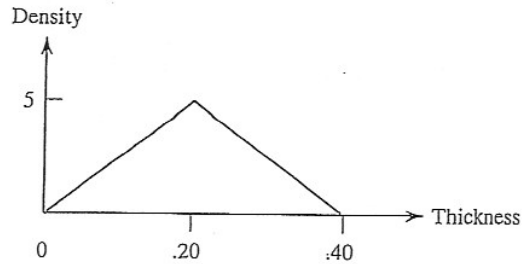
6.11 Consider the population of batteries made by a particular manufacturer. The accompanying density curve represents the probability distribution for the variable  $x$  = lifetime (hours).



Shade the region under the curve corresponding to each of the following probabilities (draw a new curve for each part).

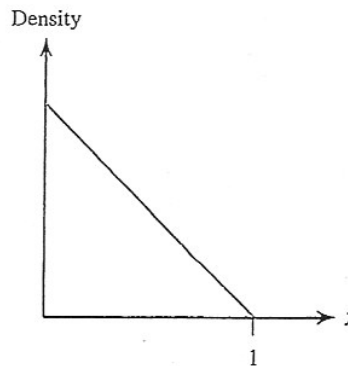
- $P(10 < x < 25)$
- $P(10 \leq x \leq 25)$
- $P(x < 30)$
- The probability that the lifetime is at least 25 hours
- The probability that the lifetime exceeds 30 hours

6.13 Consider the population that consists of all soft contact lenses made by a particular manufacturer and define the variable  $x$  = thickness (in mm). Suppose that a reasonable model for the population distribution is the one shown in the accompanying figure.



- Verify that the total area under the density curve is equal to 1. (*Hint:* The area of a triangle is  $.5(\text{base})(\text{height})$ .)
- What is the probability that  $x$  is less than .20? Less than .10? More than .30?
- What is the probability that  $x$  is between .10 and .20? (*Hint:* First find the probability that  $x$  is *not* between .10 and .20.)
- Since the density curve is symmetric, the mean of the distribution is .20. What is the probability that thickness is within .05 mm of the mean thickness?

6.15 Let  $x$  denote the time (sec) necessary for an individual to react to a certain stimulus. The probability distribution of  $x$  is specified by the accompanying density curve.



- What is the height of the density curve above  $x = 0$ ? (*Hint:* Total area = 1.)
- What is the probability that reaction time exceeds .5 sec?
- What is the probability that reaction time is at most .25 sec?

6.17 Determine each of the areas under the standard normal ( $z$ ) curve.

- To the left of  $-1.28$
- To the right of  $1.28$
- Between  $-1$  and  $2$
- To the right of  $0$
- To the right of  $-5$
- Between  $-1.6$  and  $2.5$
- To the left of  $2.3$

6.19 Let  $z$  denote a random variable having a normal distribution with  $\mu = 0$  and  $\sigma = 1$ . Determine each of the following probabilities.

- a.  $P(z < .10)$                       b.  $P(z < -.10)$   
 c.  $P(.40 < z < .85)$                 d.  $P(-.85 < z < -.40)$   
 e.  $P(-.40 < z < .85)$                 f.  $P(z > -1.25)$   
 g.  $P(z < -1.50 \text{ or } z > 2.50)$

6.21 Determine the value  $z^*$  that

- a. Separates the largest 3% of all  $z$  values from the others  
 b. Separates the largest 1% of all  $z$  values from the others  
 c. Separates the smallest 4% of all  $z$  values from the others  
 d. Separates the smallest 10% of all  $z$  values from the others

6.23 Because  $P(z < 0.44) = .67$ , sixty-seven percent of all  $z$  values are less than .44, and .44 is the 67th percentile of the standard normal distribution. Determine the value of each of the following percentiles for the standard normal distribution. (If the cumulative area that you must look for does not appear in the  $z$  table, use the closest entry.)

- a. The 91st percentile (*Hint*: Look for area .9100.)  
 b. The 77th percentile  
 c. The 50th percentile  
 d. The 9th percentile  
 e. What is the relationship between the 70th  $z$  percentile and the 30th  $z$  percentile?

6.25 Let  $x$  denote the systolic blood pressure (mm Hg) of an individual selected at random from a certain population. Suppose that the normal distribution with mean  $\mu = 120$  mm and standard deviation  $\sigma = 10$  mm is a reasonable model for describing the population distribution of  $x$ .

- a. Calculate  $P(110 < x < 140)$ . How does this compare to  $P(110 \leq x \leq 140)$ , and why?  
 b. Calculate  $P(x < 75)$ .  
 c. Calculate  $P(x < 95 \text{ or } x > 145)$ , the probability that  $x$  is more than 2.5 standard deviations from its mean value.

6.26 A machine that cuts corks for wine bottles operates in such a way that the distribution of the diameter of the corks produced is well approximated by a normal distribution with mean 3 cm and standard deviation .1 cm. The specifications call for corks with diameters between 2.9 and 3.1 cm. A cork not meeting the specifications is considered defective. (A cork that is too small leaks and causes the wine to deteriorate; a cork that is too large doesn't fit in the bottle.) What proportion of corks produced by this machine are defective?

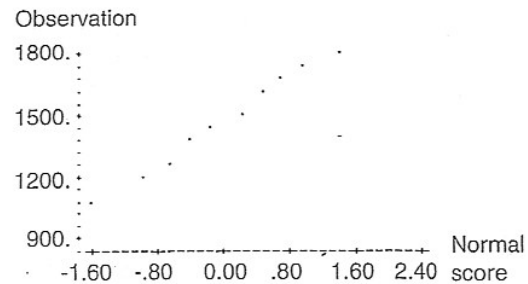
6.27 Refer to Exercise 6.26. Suppose that there are two machines available for cutting corks. The one described in the preceding problem produces corks with diameters that are approximately normally distributed with mean 3 cm and standard deviation .1 cm. The second machine produces corks with diameters that are approximately normally distributed with mean 3.05 cm and standard deviation .01 cm. Which machine would you recommend? (*Hint*: Which machine would produce the fewest defective corks?)

6.29 The time that it takes a randomly selected job applicant to perform a certain task has a distribution that can be approximated by a normal distribution with a mean value of 120 sec and a standard deviation of 20 sec. The fastest 10% are to be given advanced training. What task times qualify individuals for such training?

6.31 Suppose that the distribution of net typing rate in words per minute (wpm) for experienced typists can be approximated by a normal curve with mean 60 wpm and standard deviation 15 wpm. (The paper "Effects of Age and Skill in Typing" (J. of Exper. Psych. (1984): 345–371) describes how net rate is obtained from gross rate by using a correction for errors.)

- a. What is the probability that a randomly selected typist's net rate is at most 60 wpm? Less than 60 wpm?  
 b. What is the probability that a randomly selected typist's net rate is between 45 and 90 wpm?  
 c. Would you be surprised to find a typist in this population whose net rate exceeded 105 wpm? (Note: The largest net rate in a sample described in the paper cited is 104 wpm.)  
 d. Suppose that two typists are independently selected. What is the probability that both their typing rates exceed 75 wpm?  
 e. Suppose that special training is to be made available to the slowest 20% of the typists. What typing speeds would qualify individuals for this training?

6.33 Ten measurements of the steam rate (lb/hr) of a distillation tower were used to construct the given normal



probability plot ("A Self-Descaling Distillation Tower" (Chem. Eng. Process (1968): 79–84)). Based on the accompanying plot, do you think it is reasonable to assume that the normal distribution provides an adequate description of the steam rate distribution? Explain.

6.35 Consider the following ten observations on the lifetime (hr) for a certain type of component: 152.7, 172.0, 172.5, 173.3, 193.0, 204.7, 216.5, 234.9, 262.6, 422.6. Construct a normal probability plot, and comment on the plausibility of a normal distribution as a model for component lifetime.

6.37 The accompanying observations are DDT concentrations in the blood of 20 people.

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24	26	30	35	35	38	39	40	40	41
42	42	52	56	58	61	75	79	88	102

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Use the normal scores from Exercise 6.36 to construct a normal probability plot, and comment on the appropriateness of a normal probability model.

6.39 A machine producing vitamin E capsules operates in such a way that the distribution of  $x = \text{actual amount of vitamin E in a capsule}$  can be modeled by a normal curve with mean 5 mg and standard deviation .05 mg. What is the probability that a randomly selected capsule contains less than 4.9 mg of vitamin E? At least 5.2 mg?

6.41 The *Wall Street Journal* (Feb. 15, 1972) reported that General Electric was being sued in Texas for sex discrimination because of a minimum height requirement of 5 ft 7 in. The suit claimed that this restriction eliminated more than 94% of adult females from consideration. Let  $x$  represent the height of a randomly selected adult woman. Suppose that the probability distribution of  $x$  is approximately normal with mean 66 in. and standard deviation 2 in.

- Is the claim that 94% of all women are shorter than 5 ft 7 in. correct?
- What proportion of adult women would be excluded from employment due to the height restriction?

6.43 Suppose the distribution of pH readings for soil samples taken in a certain geographical region can be approximated by a normal distribution with mean 6.00 and standard deviation .10. The pH of a randomly selected soil sample from this region is to be determined.

- What is the probability that the resulting pH is between 5.90 and 6.15?
- What is the probability that the resulting pH exceeds 6.10?
- What is the probability that the resulting pH is at most 5.95?
- Describe the largest 5% of the pH distribution.

6.45 Let  $x$  denote the duration of a randomly selected pregnancy (the time elapsed between conception and birth). Accepted values for the mean value and standard deviation of  $x$  are 266 days and 16 days, respectively. Suppose that a normal distribution is an appropriate model for the probability distribution of  $x$ .

- What is the probability that the duration of pregnancy is between 250 and 300 days?
- What is the probability that the duration of pregnancy is at most 240 days?
- What is the probability that the duration of pregnancy is within 16 days of the mean duration?
- A *Dear Abby* column dated Jan. 20, 1973 contained a letter from a woman who stated that the duration of her pregnancy was exactly 310 days. (She wrote that the last visit with her husband, who was in the Navy, occurred 310 days prior to birth.) What is the probability that the duration of a pregnancy is at least 310 days? Does this probability make you a bit skeptical of the claim?