

## AP Statistics – Sampling Distributions with Means

- 1. MAKING AUTO PARTS** A grinding machine in an auto parts plant prepares axles with a target diameter  $\mu = 40.125$  mm. The machine has some variability, so the standard deviation of the diameters is  $\sigma = 0.002$  mm. The shape of the distribution is unknown. The machine operator inspects a random sample of 4 axles each hour for quality control purposes and records the sample mean diameter  $\bar{x}$ .
  - a) Assuming that the process is working properly, what are the mean and standard deviation of the sampling distribution of  $\bar{x}$ ?
  - b) Do we know the shape of the sampling distribution of  $\bar{x}$ ?
  - c) How many axles would you need to sample if you wanted the standard deviation of the sampling distribution of  $\bar{x}$  to be 0.0005 mm? Justify your answer (show your work).
- 2. BOTTLING COLA** A bottling company uses a filling machine to fill plastic bottles with cola. The bottles are supposed to contain 300 ml. In fact the contents vary according to a Normal distribution with mean  $\mu = 298$  ml and standard deviation  $\sigma = 3$  ml.
  - a) What is the probability that an individual bottle contains less than 295 ml? Show your work.
  - b) What is the probability that the mean contents of six randomly selected bottles is less than 295 ml? Show your work.
  - c) Suppose that the contents of these cola bottles were NOT normally distributed, and were instead highly skewed. Would this affect either of the probabilities that were calculated in parts (a) or (b)? Explain.
- 3. ACT SCORES** The composite scores of individual students on the ACT college entrance examination in 2009 followed a Normal distribution with mean 21.1 and standard deviation 5.1.
  - a) What is the probability that a single student randomly chosen from all those taking the test has a score of 23 or higher?
  - b) Describe the sampling distribution of mean ACT scores for samples of 50 students. Include a description of the shape, center (mean), and spread (standard deviation).
  - c) What is the probability that the mean score in a random sample of 50 students is at least a 23?
  - d) Suppose that the distribution of ACT scores in 2009 were in fact NOT normally distributed, and were instead moderately skewed towards the lower numbers. Would this affect either of the probabilities that were calculated in parts (a) or (c)? Explain.
  - e) Let's return to the original assumption that the ACT scores are normally distributed.

**Without performing any calculations**, which of the following is LESS likely? Explain. You may use sketches/diagrams to help aid your explanation.

    - I. A random sample of 10 students has a mean score of at least 25.
    - II. A random sample of 40 students has a mean score of at least 25.