AP Statistics
Sample Means Practice

Name ______________________

Period _____ Date ______________

1. **Pollution.** Carbon monoxide (CO) emissions for a certain kind of car vary with mean 2.9 g/mi and standard deviation 0.4 g/mi. A company has 80 of these cars in its fleet. Let $\bar{x}$ represent the mean CO level for the company's fleet.

   a. What's the approximate model for the distribution of $\bar{x}$? Explain.

   Since $n = 80 \geq 30$, then by CLT the distribution of $\bar{x}$ is approximately normal

   b. Estimate the probability that $\bar{x}$ is between 3.0 and 3.1 g/mi.

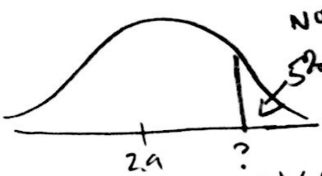
   $\mu_{\bar{x}} = 2.9$
   assume pop $\geq 10(80) = 800$
   so $\sigma_{\bar{x}} = .4/\sqrt{80}$

   $P(3 < \bar{x} < 3.1) = P\left(\frac{3-2.9}{.4/\sqrt{80}} < Z < \frac{3.1-2.9}{.4/\sqrt{80}}\right)$

   $= P(2.236 < Z < 4.472) = 1.27\%$. There is about a 1.27% chance the mean emissions of this fleet is between 3 and 3.1 g/mi

   c. There is only a 5% chance that the fleet's mean CO level is greater than what value?

   NOTE: you do not have to repeat the checks since n has not changed.



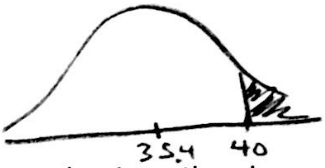
   $z = 1.645$

   $1.645 = \frac{x - 2.9}{.4/\sqrt{80}}$ $x = 2.97$ g/mi.

   A CO level greater than 2.97 g/mi has about a 5% chance of occuring.

2. **Rainfall.** Statistics from Cornell's Northeast Regional Climate Center indicate that Ithaca, NY, follows a normal distribution and gets an average of 35.4" of rain each year, with a standard deviation of 4.2".

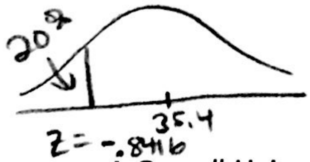
   a. During what percentage of years does Ithaca get more than 40" of rain? $n = 1$



   $P(x > 40) = P\left(Z > \frac{40-35.4}{4.2}\right) = P(Z > 1.095) = 13.67\%$

   Ithaca, NY gets more than 40 in of rain in about 13.67% of all years.

   b. Less than how much rain falls in the driest 20% of all years?



   $z = -.8416$

   $-.8416 = \frac{x - 35.4}{4.2}$

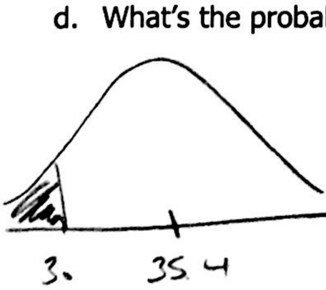
   $x = 31.87$

   In the driest 20% of all yrs, Ithaca recieves less than about 31.87" of rain.

   c. A Cornell University student is in Ithaca for 4 years. Let $\bar{x}$ represent the mean amount of rain for those 4 years. Describe the sampling distribution model of this sample mean $\bar{x}$.

   Since the population distribution is given as approximately normal, then so is the sampling distribution and since pop of years $\geq 10(4) = 40$ then $\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}} = \frac{4.2}{\sqrt{4}} = 2.1$ so therefore the distribution is approximately $N(35.4, 2.1)$.

   d. What's the probability that those 4 years average less than 30" of rain?



   $P(\bar{x} < 30) = P\left(Z < \frac{30-35.4}{2.1}\right)$

   $= P(Z < -2.57)$

   $= .51\%$

   There is about a 0.51% chance that the 4 year average rain fall in Ithaca, NY is less than 30".

3. Potato chips. The weight of potato chips in a medium-size bag is stated to be 10 ounces. The amount that the packaging machine puts in these bags is believed to have a Normal model with mean 10.2 ounces and standard deviation 0.12 ounces. $N(10.2, 0.12)$

a. What percent of all bags sold are underweight? <10 ounces

$P(x<10) = P\left(z < \frac{10-10.2}{.12}\right) = P(z < -1.67) = 4.78\%$

About 4.77% of all bags are underweight.

b. Some of the chips are sold in "bargain packs" of 3 bags. What's the probability that none of the 3 is underweight? NOT AVERAGE!!

$P(\text{None underweight}) = P(1^{st} \text{ is} \geq 10)$ and $P(2^{nd} \text{ is} \geq 10)$ and $P(3^{rd} \text{ is} \geq 10)$

$= (1-.0478)^3 = 86.33\%$

There is approximately an 86.33% chance that none of the 3 bags is underweight.

c. What's the probability that the mean weight of the 3 bags is below the stated amount?

Since pop $\geq 10(3) = 30$ then $\sigma_{\bar{x}} = \frac{0.12}{\sqrt{3}}$

$N(10.2, .12/\sqrt{3})$

$P(\bar{x}<10) = P\left(z < \frac{10-10.2}{.12/\sqrt{3}}\right)$

$= P(z < -2.887) = 1.95\%$

About 1.95% of 3 bag packs will have an average weight below 10 ounces.

d. What's the probability that the mean weight of a 24-bag case of potato chips is below 10 ounces?

Since pop $\geq 10(24) = 240$ then $\sigma_{\bar{x}} = 0.12/\sqrt{24}$ and $N(10.2, .12/\sqrt{24})$

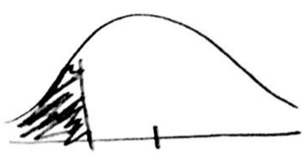
$P(\bar{x}<10) = P\left(z < \frac{10-10.2}{.12/\sqrt{24}}\right) = P(z < -8.165) \approx 0$

It is almost impossible (0% chance) for a 24-bag case to have an average bag weight below 10 ounces.

4. Pregnancy. Suppose that the duration of human pregnancies has a mean of 266 days and a standard deviation of 16 days. If an obstetrician is providing care to 60 pregnant women, what's the probability that the mean duration of these patients' pregnancies will be less than 260 days? (use the 4 step process) $N(266, 16)$

$\mu_{\bar{x}} = 266$ and since Pop $\geq 10(60) = 600$ then $\sigma_{\bar{x}} = \frac{16}{\sqrt{60}}$

Since $n = 60 \geq 30$, then by Central Limit Theorem the distribution is approximately $N(266, 16/\sqrt{60})$



$P(\bar{x} < 260) = P\left(z < \frac{260-266}{16/\sqrt{60}}\right) = P(z < -2.905)$

$= 0.18\%$

About .18% of all samples of 60 pregnant women will have a mean pregnancy duration of less than 260 days.