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Quiz #4
Central Limit Theorem and Confidence Intervals

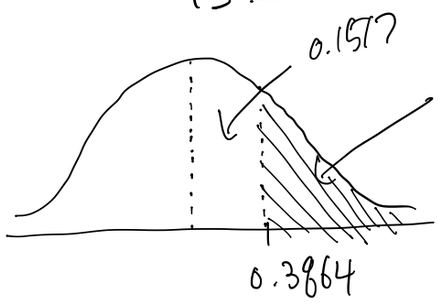
1. For women aged 18-24, systolic blood pressures (in mmHg) have a mean of 114.9 and a standard deviation of 13.2.

   a. If a woman aged 18-24 is selected at random, what is the probability her systolic blood pressure is above 120mmHg?

$\mu = 114.9$

$\sigma = 13.2$

$z = \frac{120 - 114.9}{13.2} = 0.3864$



$0.5 - 0.1517$

$= 0.3483$

$\therefore 34.83\%$

   b. If 41 women aged 18-24 are selected at random, what is the probability their mean systolic blood pressure is above 120 mmHg?

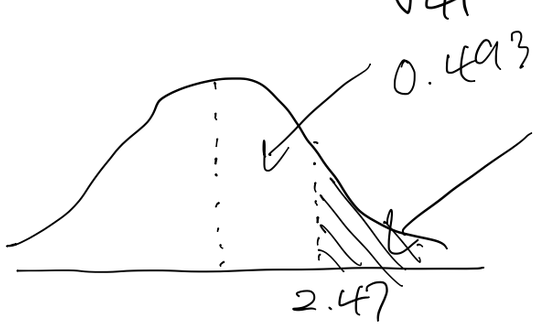
$\mu = 114.9, \mu_{\bar{x}} = 114.9$

$\sigma = 13.2$

$\bar{x} = 120$

$s_{\bar{x}} \approx \sigma_{\bar{x}} \approx 13.2$

$z = \frac{120 - 114.9}{\frac{13.2}{\sqrt{41}}} = 2.47$



$0.5 - 0.4932$

$= 0.0068$

$= 0.68\%$

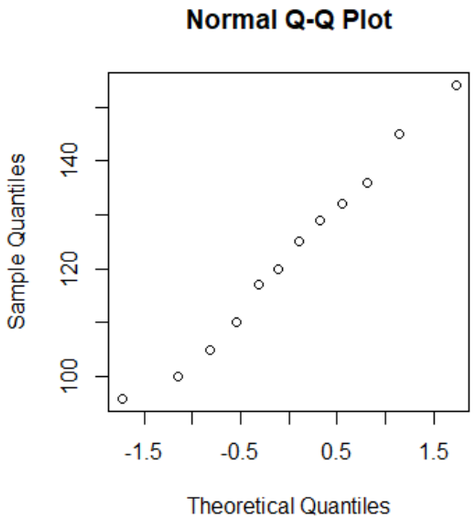
2. The lengths of twelve new movies, in minutes, are given in the table below:

110	96	125	105	132	120	136	154	143	110	117	129

a. Explain why, before producing a confidence interval for *this particular set of data*, you would create a Q-Q plot.

In order to see if the distribution is normal.

b. A Q-Q plot for this data set is given below:



What does the QQ plot tell you about the set of movie times? Explain briefly.

As the points on the plot lie on a straight diagonal line, we can say the data is normally distributed.

c. Construct a 98% confidence interval for the mean length of new movies. Include a sentence as part of your conclusion.

$n = 12 \Rightarrow$ need to use t-table.

$\bar{x} = 123.08$

$s = 16.75$

$df = 12 - 1 = 11$

$\alpha = 0.02$

$t_{\frac{\alpha}{2}} = 2.7181$

$CI = 123.08 \pm 2.7181 \times \frac{16.75}{\sqrt{12}}$

$= 123.08 \pm 13.14$

$= (109.94, 136.22)$

∴ We are 98% sure that the mean length of new movies is between 109.94 minutes and 136.22 minutes.

d. How large a sample of new movies would we need in order to estimate the mean length of new movies within 5 minutes with 95% confidence?

$\alpha = 0.05$

$E = 5$

$s = 16.75$

$z_{\frac{\alpha}{2}} = 1.96$

$n = \left(\frac{1.96 \cdot 16.75}{5}\right)^2 = 43.112.$

∴ the size of a sample should be at least 44.