1) Modern techniques allow us to determine the size of a brain region known as the hippocampus within the brain. These sizes were calculated for a population of patients within a hospital and are tabulated below:

<table>
<thead>
<tr>
<th>Group</th>
<th>Hippocampus Size (in cm³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1</td>
<td>3.15 3.3 3.35 3.45 3.35 3.25 3.25</td>
</tr>
<tr>
<td>Group 2</td>
<td>3.05 3.35 3.15 3.2 3.15 3.25 3.25</td>
</tr>
</tbody>
</table>

a) Compute the sample means of Group 1 and Group 2. Can you use these values to compute this population’s mean?

\[
\bar{X}_1 = 3.3, \bar{X}_2 = 3.2, \mu = \frac{\bar{X}_1 + \bar{X}_2}{2} = 3.25
\]

b) The sum of squares, symbolized by \( SS \), merits special attention because it’s a major component in calculations for the variance, and other statistical measures. It is simply the square of the deviations from the mean. It can be calculated for both populations and samples, using a more interpretable definition formula, or an easier computation formula.

c) Refer to Table 4.3 on pg. 87 of the book for help computing the sample sum of squares of Group 2 using the definition formula:

\[
SS_s = \sum (X - \bar{X})^2 = 0.055
\]

d) Refer to Table 4.2 on pg. 84 of the book for help computing the population sum of squares using the easier, computation formula:

\[
SS_p = \sum X^2 - \left( \frac{\Sigma X}{N} \right)^2 = 0.145
\]

e) From the population sum of squares, compute the population variance and standard deviation. From the Group 2 sample sum of squares, compute this sample’s variance and standard deviation.

\[
\sigma = \frac{SS_p}{N} = \frac{0.145}{14} = 0.10177
\]

\[
s = \sqrt{\frac{SS_s}{n-1}} = \sqrt{\frac{0.055}{6}} = 0.095743
\]

f) Is the above data set normally distributed? Why?
Yes, because $\mu = \text{Median} = \text{Mode}$.

g) Suppose the size of one patient’s hippocampus was $3.15 \text{ cm}^2$. Compute the z-score to determine how many standard deviations this observation lies away from the population mean. What percentile does this correspond to?

$$z = \frac{X - \mu}{\sigma} = -0.98261.$$ This means the observation lies 0.98261 standard deviations away from the population mean. This corresponds to the $16^{th}$ percentile.

h) (Optional) Suppose Group 1 consisted of otherwise normal patients and Group 2 consisted of patients diagnosed with depression. A common research hypothesis today is that depression decreases the size of the hippocampus. Considering the sample mean and standard deviations of both groups, would you guess these data support this hypothesis?

Yes, but we cannot verify this without inferential statistics. It turns out that an equal variance Student’s paired t-test of these data verifies this.

2) An IQ test measures intelligence as a normal distribution with mean 100 and standard deviation 15. Jake’s IQ score is 120.

a) What is Jake’s z-score?

$$z = \frac{X - \mu}{\sigma} = 1.33$$

b) What is the percentage of people having an IQ higher than a person whose z-score is 0.58?

$$\% = (0.2810) \times 100 = 28.1\%$$

c) What percentile corresponds to a z-score of 1.35?

$$\% = (0.5 + .4115) \times 100 = 91.15\%$$

e) What is the proportion of area under the standard normal curve for the following range of z.

$0.1 < z < 0.5$

$$Area = (0.4602 - 0.3085) = 0.1517$$