(1) a) \( \bar{X} = 98.44 \)

Sample median using average of \( \frac{n}{2} \) th and \( \frac{n}{2}+1 \)th observations after sorting = 97.85

Sample median using \( q(0.5) \) definition
\[ q(0.5) = 0.5 \times 30 = 15 \]th element after sorting = 97.5

both acceptable

b) \( S^2 = 104.621 \) so \( S = \sqrt{104.621} = 10.23 \)

c)

\[
\begin{array}{cccccc}
70 & 80 & 90 & 100 & 110 & 120 & 130 \\
2 & 4 & 3 & 1 & 9 & & \\
\end{array}
\]

\[ x \]

d) The normal-quantile plot looks approximately linear so we can say the sample came from a normal distribution.

(2) a) 

b) 

panel \((1,500)\) panel \(\log(n\ (1,500))\)
3) a) \( n \leq 30 \) and the underlying population distribution is unknown, so we can't use the central limit theorem.

b) \( n \leq 30 \), but underlying population distribution is approximately normal so ok to use central limit theorem:

\[ \mu_X = \mu = 200 \quad \sigma_X = \frac{\sigma}{\sqrt{n}} = \frac{12}{3} = 4 \]

\[ P \left( 190 \leq X \leq 210 \right) = P \left( \frac{190 - \mu_X}{\sigma_X} \leq z \leq \frac{210 - \mu_X}{\sigma_X} \right) \]

\[ = P \left( \frac{190 - 200}{4} \leq z \leq \frac{210 - 200}{4} \right) \]

\[ = P \left( -2.5 \leq z \leq 2.5 \right) = P(z \leq 2.5) - P(z \leq -2.5) \]

\[ \begin{align*}
\text{Table A.3} & = 0.9938 - 0.0062 = 0.9876
\end{align*} \]

c) \( n \geq 30 \) so ok to use central limit theorem even though \( f(x) \) the population distribution is not normal. We first need the population \( \mu \) and \( \sigma \):

\[ \mu = \sum x f(x) = 0 \cdot \frac{3}{8} + 1 \cdot \frac{3}{8} + 2 \cdot \frac{1}{8} + 3 \cdot \frac{1}{8} = 1 \]

\[ \sigma^2 = \text{E}[X^2] - \mu^2 = \left( 0 \cdot \frac{3}{8} + 1 \cdot \frac{3}{8} + 4 \cdot \frac{1}{8} + 9 \cdot \frac{1}{8} \right) - 1^2 = 1 \]

\[ \mu_X = \mu = 1 \quad \sigma_X = \frac{\sigma}{\sqrt{n}} = \frac{1}{\sqrt{80}} = 0.1 \]

\[ P(X > 1.2) = P(z > \frac{1.2 - \mu_X}{\sigma_X}) = P(z > \frac{1.2 - 1}{0.1}) = P(z > 2) \]

\[ = 1 - P(z \leq 2) \]

\[ = 1 - 0.9772 = 0.0228 \]

\[ \begin{align*}
\text{Table A.3} & = 0.0228
\end{align*} \]
4) a) \[ P(1.6 \leq X_A \leq 2.4) \]
\[ = P(2 - 2 \times 0.2 \leq X_A \leq 2 + 2 \times 0.2) \]
\[ = P(\mu_A - 2 \sigma_A \leq X_A \leq \mu_A + 2 \sigma_A) \]
\[ \geq 1 - \frac{1}{2^2} = 0.75 \quad \text{Using Chebychev's theorem with } k = 2 \]

Notice there is no sample in this part of the question.

b) \( n = 64 \geq 30 \) can use central limit theorem

\[ \mu_{\bar{X}_A} = \mu_A = 2 \quad \sigma_{\bar{X}_A} = \frac{\sigma_A}{\sqrt{n}} = \frac{0.2}{8} = 0.025 \]

\[ P(\bar{X}_A \leq 1.9575) = P\left( z \leq \frac{1.9575 - 2}{0.025} \right) \]
\[ = P(z \leq -1.7) = 0.0446 \]

c) Since both samples greater than 30 observations

\[ z = \frac{(\bar{X}_A - \bar{X}_B) - (\mu_{\bar{X}_A} - \mu_{\bar{X}_B})}{\sqrt{\frac{\sigma^2_A}{n_A} + \frac{\sigma^2_B}{n_B}}} \]
\[ = \frac{(\bar{X}_A - \bar{X}_B) - (2 - 1.9)}{\sqrt{\frac{0.04}{64} + \frac{0.0975}{100}}} \]
\[ z = \frac{(\bar{X}_A - \bar{X}_B) - 0.1}{0.04} \]

So \[ P(0.094 \leq \bar{X}_A - \bar{X}_B \leq 0.162) = P\left( \frac{0.094 - 0.1}{0.04} \leq z \leq \frac{0.162 - 0.1}{0.04} \right) \]
\[ = P(-0.15 \leq z \leq 1.55) = P(z \leq 1.55) - P(z \leq -0.15) \]
\[ = 0.9394 - 0.4404 = 0.499 \]
2) 

a) \[ P(X^2 > \chi^2_{\alpha}) = 0.01 \quad \alpha = 0.01 \]

Row \( v = 21 \) column \( \alpha = 0.01 \) Table A.5

\[ \chi^2_{\alpha} = \chi^2_{0.01} = 38.932 \]

b) \[ P(X^2 < \chi^2_{\alpha}) = 0.95 \quad \alpha = 1 - 0.95 = 0.05 \]

Row \( v = 6 \) column \( \alpha = 0.05 \) Table A.5

\[ \chi^2_{\alpha} = 12.592 \]

c) \[ P(\chi^2_{\alpha} < X^2 < 23.209) = 0.015 \quad \alpha = 0.01 \]

From row \( v = 10 \) of table A.5

Notice that this is \( \alpha = 0.01 \)

So we need to find \( \chi^2 \)

\[ \chi^2_{0.015} = 20.483 \]

Row \( v = 10 \) Table A.5