3. Trains carry bauxite ore from a mine in Canada to an aluminum processing plant in northern New York state in hopper cars. Filling equipment is used to load ore into the hopper cars. When functioning properly, the actual weights of ore loaded into each car by the filling equipment at the mine are approximately normally distributed with a mean of 70 tons and a standard deviation of 0.9 ton. If the mean is greater than 70 tons, the loading mechanism is overfilling.

(a) If the filling equipment is functioning properly, what is the probability that the weight of the ore in a randomly selected car will be 70.7 tons or more? Show your work.

\[
P(Z > 70.7) = P(Z > \frac{70.7 - 70}{0.9}) = P(Z > 0.78) \approx 0.2177;\]

(b) Suppose that the weight of ore in a randomly selected car is 70.7 tons. Would that fact make you suspect that the loading mechanism is overfilling the cars? Justify your answer.

\[\text{The probability of obtaining such result (weight: 70.7 tons) is 21.77% (see part a)) } \Rightarrow \text{ this is not an unusual result as it lies within 1.6 away from the mean.}\]

(c) If the filling equipment is functioning properly, what is the probability that a random sample of 10 cars will have a mean ore weight of 70.7 tons or more? Show your work.

\[
P(X > 70.7) = P \left( Z > \frac{\mu - 70}{\sigma / \sqrt{n}} \right) = P \left( Z > 2.85 \right) \approx 0.0022;\]

(d) Based on your answer in part (c), if a random sample of 10 cars had a mean ore weight of 70.7 tons, would you suspect that the loading mechanism was overfilling the cars? Justify your answer.

\[\text{The probability of obtaining such result (mean ore weight in a random sample of 10 cars > 70.7 tons) is only 0.0022% (approx.) } \Rightarrow \text{ this is a rather unlikely result as it lies more than 2.85 away from the mean in the sampling distribution of means of ore weights } \Rightarrow \text{ we would suspect that the loading mechanism was overfilling the cars.}\]
3. Trains carry bauxite ore from a mine in Canada to an aluminum processing plant in northern New York state in hopper cars. Filling equipment is used to load ore into the hopper cars. When functioning properly, the actual weights of ore loaded into each car by the filling equipment at the mine are approximately normally distributed with a mean of 70 tons and a standard deviation of 0.9 ton. If the mean is greater than 70 tons, the loading mechanism is overfilling.

(a) If the filling equipment is functioning properly, what is the probability that the weight of the ore in a randomly selected car will be 70.7 tons or more? Show your work.

\[ z = \frac{70.7 - 70}{0.9} = \frac{70.7}{0.9} \approx 78 \]

The probability that the weight of the ore in a randomly selected car will be 70.7 tons or more is about 0.2177.

(b) Suppose that the weight of ore in a randomly selected car is 70.7 tons. Would that fact make you suspect that the loading mechanism is overfilling the cars? Justify your answer.

\[ H_0: \mu = 70 \quad H_1: \mu > 70 \]

Since the \( z \)-value is 78, which is far from the critical value, we cannot reject the null hypothesis. Therefore, the fact will not make us suspect that the loading mechanism is overfilling the cars.

(c) If the filling equipment is functioning properly, what is the probability that a random sample of 10 cars will have a mean ore weight of 70.7 tons or more? Show your work.

\[ z = \frac{70.7 - 70}{\left(\frac{0.9}{\sqrt{10}}\right)} \approx 2.96 \]

The probability that a random sample of 10 cars will have a mean ore weight of 70.7 tons or more is about 0.0069.

(d) Based on your answer in part (c), if a random sample of 10 cars had a mean ore weight of 70.7 tons, would you suspect that the loading mechanism was overfilling the cars? Justify your answer.

\[ H_0: \mu = 70 \quad H_1: \mu > 70 \]

Since the \( z \)-value is 2.96, which is far from the critical value, we cannot reject the null hypothesis. Therefore, I will not suspect that the loading mechanism was overfilling the cars.
3. Trains carry bauxite ore from a mine in Canada to an aluminum processing plant in northern New York state in hopper cars. Filling equipment is used to load ore into the hopper cars. When functioning properly, the actual weights of ore loaded into each car by the filling equipment at the mine are approximately normally distributed with a mean of 70 tons and a standard deviation of 0.9 ton. If the mean is greater than 70 tons, the loading mechanism is overfilling.

(a) If the filling equipment is functioning properly, what is the probability that the weight of the ore in a randomly selected car will be 70.7 tons or more? Show your work.

\[
z_0 = \frac{70.7 - 70}{0.9} = \frac{x - \mu}{\sigma} = \frac{70.7 - 70}{0.9} = 0.78
\]

\[
P(x \geq 70.7) = P(z \geq 0.78) \approx 0.218
\]

(b) Suppose that the weight of ore in a randomly selected car is 70.7 tons. Would that fact make you suspect that the loading mechanism is overfilling the cars? Justify your answer.

Justify your answer that would not provide sufficient evidence that the cars are overfilled. Because the probability that a single car weighs more than 70.7 is rather large (0.78), and, moreover, it is natural that the weight of ore in one car deviates from the sample mean (70.7-70 = 0.7, which is less than the standard deviation)

(c) If the filling equipment is functioning properly, what is the probability that a random sample of 10 cars will have a mean ore weight of 70.7 tons or more? Show your work.

\[
n = 10
\]

\[
z = \frac{70.7 - 70}{0.9/\sqrt{10}} = 2.46
\]

\[
P(z \geq 2.46) = 0.0069 \quad \text{probability that a sample of 10 cars will have a mean weight of 70.7 or more tons.}
\]

(d) Based on your answer in part (c), if a random sample of 10 cars had a mean ore weight of 70.7 tons, would you suspect that the loading mechanism was overfilling the cars? Justify your answer.

\[
n = 10
\]

\[
K_0 : \mu = 70 \quad (\text{no overfilling})
\]

\[
K_1 : \mu > 70 \quad (\text{overfilling})
\]

If \( \bar{X} = 70.7 \), I will use a 1-sample T-test (small sample)

To check \( K_0 \), I will use a 1-sample T-test (small sample)

\[t\text{-statistic} = \frac{70.7 - 70}{0.9/\sqrt{10}} = 0.018\]

At a significance level of 0.05, \( K_0 \) may be rejected ( p-value < error level), so at these significance levels, we can state that the true mean exceeds 70 (the mechanism is overfilling the cars).

GO ON TO THE NEXT PAGE.