

You must show all work on this quiz for full credit. Each problem counts 5 points. Good luck!

I. Two methods, A and B , are available for teaching a certain industrial skill at a manufacturing plant. The failure rate for adequately learning the skill is 20% for method A and 10% for method B . However, because method B is more expensive it is only used for 30% of the training (method A is used for the remaining 70% of training). Let A be the event that a worker receives training method A , B be the event that a worker receives training method B , and L be the event that a worker adequately learns the skill. Use these events to answer the following. Please show how you use all probability rules in terms of these event names.

(a) What percent of workers at this plant will not adequately learn the skill?

$$\begin{aligned}
 P(L') &= P(L' \cap A) + P(L' \cap B) \\
 &= P(L' | A)P(A) + P(L' | B)P(B) \\
 &= (.20)(.70) + (.10)(.30) = .14 + .03 = .17
 \end{aligned}$$

17% will not adequately learn the skill.

(b) Given that a worker is adequately trained, what is the probability that the worker was trained using method B ?

$$\begin{aligned}
 P(B | L) &= \frac{P(B \cap L)}{P(L)} = \frac{P(L | B)P(B)}{1 - P(L')} \leftarrow \text{computed above} \\
 &= \frac{.1(.3)}{1 - .17} = \frac{.03}{.83} = .0361457 \approx .036
 \end{aligned}$$

II. Unknown to a quality control inspector, a shipment of 1000 parts contains 20 defective parts. The inspector randomly selects parts to test (assume the inspector's test always detects defective parts). Please answer the following:

(a) What is the probability the inspector will find at least one defective part in the first 10 tests.

$$\begin{aligned}
 1 - P(\text{no defectives}) &= 1 - \frac{\binom{980}{10}}{\binom{1000}{10}} \rightarrow \approx 1 - .81707 \\
 &= .1829
 \end{aligned}$$

Binomial Approx: $P(\text{no defects}) = \binom{10}{0} \left(\frac{20}{1000}\right)^0 \left(\frac{980}{1000}\right)^{10} = .81707$

(b) What is the probability that the 10th part tested is the 3rd defective part tested?

$$\begin{aligned}
 &P(2 \text{ defects in } 1^{\text{st}} 9 \cap \text{defect on } 10^{\text{th}}) \\
 &= P(2 \text{ defects in } 1^{\text{st}} 9) P(\text{defect on } 10^{\text{th}} | 2 \text{ defects in } 1^{\text{st}} 9) \\
 &= \frac{\binom{980}{2} \binom{20}{2}}{\binom{1000}{10}} \cdot \frac{18}{991} = .01479 \left(\frac{18}{991}\right) = .000268
 \end{aligned}$$