Solution / Calculating Basic Probabilities

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Answer to 6 Assuming an overall incidence rate of cancer of 1000 in 100,000 (from American Cancer Society), the probability that someone has cancer if they test negative is 0.00081 or 0.08%.

Answer to 7 The empirical probability of an event is calculated as the number of times the event occurs divided by the total number of observations. In this case, the total number of coffees sold is 180 (Espresso) + 150 (Cappuccino) + 230 (Latte) + 140 (Americano) = 700.

So, the probability distribution is as follows:

- Espresso: 180 / 700 = 0.257
- Cappuccino: 150 / 700 = 0.214
- Latte: 230 / 700 = 0.329
- Americano: 140 / 700 = 0.200

The expected value (E) of a discrete random variable is calculated by summing the product of each outcome and its corresponding probability. Here, we treat the prices for each type of coffee as outcomes:

$$E = \sum_{i=1}^{n} (p(x_i)x_i)$$

Substituting the values:

$$E = (1.5 \times 0.257) + (2.75 \times 0.214) + (3.00 \times 0.329) + (2.20 \times 0.200) = 2.63$$

The expected value represents the average outcome if this experiment (a customer buying a cup of coffee) were to be repeated many times. In this case, the expected value of 2.63 suggests that, on average, a cup of coffee sold has a revenue of 2.63.