Engineering Statistics Lecture X

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Abstract

HW #2 is due October 15, 2019:

- Section 2.3 #23-37 odd
- Section 2.4 #49-65 odd
- Section 2.5 #73-93 odd

Opportunity #0 is given October 22, 2019 and due October 24, 2019.

1 Brad at the Best Buy

Spoz that Brad repairs computers at Best Buy:

- HP
- Toshiba
- ASUS

So:

- P(HP) = 0.1
- P(Toshiba) = 0.3
- P(ASUS) = 0.6

s.t. S is the set of people who buy a laptop at Best Buy. Let B be the event of needing repair s.t. the laptop was sold at Brad's particular store.

- P(B—HP) = 0.05
- P(B—Toshiba) = 0.25
- P(B—ASUS) = 0.15

The resulting tree extends into HP, Toshiba, ASUS, each of which extend into B and B'.

$$P(B) = \sum_{A_i \in Best\ Buy} P(B|A_i)P(A_i)$$

$$\begin{aligned} P(B) &= 0.05 * 0.10 + 0.25 * 0.3 + 0.6 * 0.15 \\ &= 0.005 + 0.075 + 0.240 \\ &= 0.32 \end{aligned}$$

2 Bayes's Theorem

$$\{A_1, A_2, A_3, ..., A_k\}\ \textit{is mutually exclusive}$$
$$\rightarrow P(B) = \sum_{i=1}^{k} P(B|A_i) * P(A_i)$$
$$\rightarrow P(B) = \sum_{i=1}^{k} P(B \cap A_i)$$
$$P(A_j|B) = \frac{P(A_j \cap B)}{P(B)}$$
$$\rightarrow P(A_j|B) = \frac{P(B|A_j)P(A_j)}{\sum_{i=1}^{k} P(B|A_i)P(A_i)}$$
$$\rightarrow P(A_j|B) = \frac{P(B \cap A_j)}{\sum_{i=1}^{k} (P(B \cap A_i))}$$

Or: The probability of a given event given B is equivalent to the chance of that event and B happening (or B given that event times its own inherent probability) divided by the sum of all cases of B happening given another event.

3 Medical company stuff

Spoz a medical company devises a new test for a medical condition. 1 out of 1,000 people has the condition. This test yields a positive result 99% of the time if the person has the condition. It yields a negative result 98% of the time if the person does NOT have the condition.

Let C be the chance that a person has a condition: P(C) = 0.001, P(C') = 0.999. Test result is positive (P), or negative (P').

- P(C) = 0.001, P(C') = 0.999
- P(P|C) = 0.99 (true positive), P(P'|C) = 0.01 (false negative)
- P(P|C') = 0.02 (false positive), P(P'|C') = 0.98 (true negative)

Therefore:

- $P(P \cap C) = P(P|C)P(C) = 0.00099$
- $P(P' \cap C) = P(P'|C)P(C) = 0.00001$
- $P(P \cap C') = P(P|C')P(C') = 0.01998$
- $P(P' \cap C') = P(P'|C')P(C') = 0.97902$

In application, we would want the chances of P(P'—C') to be as low as possible so that there are as few cases as possible of patients seeking restitution for falsely-implemented processes.