NAME - SHIVANI RAJENDRA RAYKAR

CWID - 10474706

Dept - COMPUTER SCIENCE

HW-0-2 - Probability

1.1 Let A and B are random effects

A be the event that Jerry will be at Bank

B be the event that Susan will be at Bank

$P(A) = 0.2$ ... 20%

$P(B) = 0.3$ 30%

$P(A \cap B) = 0.08$ ... 8%

(a) Susan was at the bank last Monday. What's the probability that Jerry was there too?

$$P[A/B] = \frac{P(A \cap B)}{P(B)} = \frac{0.08}{0.3} = 0.267$$

b) Given, Last Friday Susan wasn't at the Bank. Whats the Probability that Jerry was there too.

$$P[A/B^c] = \frac{P[A] - P[A \cap B]}{1 - P[B]} = \frac{0.2 - 0.08}{1 - 0.3} = 0.1714$$

c) Given, Last Wednesday at least one of them was at the Bank. What is the Probability that Both of them were there?

$$P(A \cup B) = P(A] + P(B] - P[A \cap B)$$

$$= 0.2 + 0.3 - 0.08$$

$$= 0.42$$

$$P[(A \cap B)/(A \cup B)] = \frac{P[(A \cap B) \cap (A \cup B))]}{P(A \cup B)}$$

$$= \frac{P[A \cap B]}{P[A \cup B]}$$

$$= \frac{0.08}{0.42}$$

$$= \underline{\underline{0.19}}.$$

Ans 1.1]

a) 0.267

b) 0.1714

c) 0.19

[1.2]

Let $H \rightarrow$ event for Harold

$S \rightarrow$ event for Sharon

$P(H) = 0.8$ ← ---- 80%

$P(S) = 0.9$

$P(H \cup S) = 0.91$

$P(H \cap B) = P(H) + P(S) - P(H \cup B)$

$= 0.8 + 0.9 - 0.91$

$P(H \cap B) = 0.79$

a] Probability that only Harold gets a "B"?

$P[H \cap S^c] = P[H) - P(H \cap S)$

$= 0.8 - 0.79$

$(H \cap S^c) = 0.01$

b] Probability that only Sharon gets a "B".

$P(H^c \cap S) = P(S) - P(H \cap S)$

$= 0.9 - 0.79$

$= 0.11$

$P(H^c \cap S) = 0.11$

c) Probability that both wont get a "B"

$P(H^c \cap S^c) = P[H \cup S]^c$

$= 1 - P(H \cup S)$

$P(H^c \cap S^c) = 1 - 0.91$

$= 0.09$

Answer :-

a) Probability that only Harold gets a B is 0.01

b) Probability that only Sharon gets a "B" is 0.11

c) Probability that both wont get a "B" is 0.09

[1.3] Let J & S be the random events

Let J be the event that Jery will be at Bank.

Let S be the event that Susan will be at Bank.

$P(J) = 0.2$

$P(S) = 0.3$

$P(J \cap S) = 0.08$

ie $P(J \cap S) = P(J)\,P(S)$

$= 0.2 \times 0.3$

$P(J \cap S) = 0.06 \neq 0.08$

$\therefore$ J & S are not independent events.

[1.4] You roll two dice

Sample $(S) = \{(1,1)\ (1,2)\ (1,3)\ (1,4)\ (1,5)\ (1,6)$
$(2,1)\ (2,2)\ (2,3)\ (2,4)\ (2,5)\ (2,6)$
$(3,1)\ (3,2)\ (3,3)\ (3,4)\ (3,5)\ (3,6)$
$(4,1)\ (4,2)\ (4,3)\ (4,4)\ (4,5)\ (4,6)$
$(5,1)\ (5,2)\ (5,3)\ (5,4)\ (5,5)\ (5,6)$
$(6,1)\ (6,2)\ (6,3)\ (6,4)\ (6,5)\ (6,6)\}$

$n(S) = 36$

a) Are the event " the sum is 6" and the " second die shows 5 " independent ?

A be the event that sum is 6

$A = \{(1,5)\ (2,4)\ (3,3)\ (4,2)\ (5,1)\}$

$n(A) = 5$

B be the event that the second die shows 5

$B = \{ (1,5)\ (2,5)\ (3,5)\ (4,5)\ (5,5)\ (6,5) \}$

$n(B) = 6$

$$P(A) = \frac{n(A)}{n(S)} = \frac{5}{36}$$

$$P(B) = \frac{6}{36} = \frac{1}{6}$$

$$P(A) \cdot P(B) = \frac{5}{36} \times \frac{1}{6} = \frac{5}{216} \quad \text{—— } ①$$

$P(A \cap B) = \{ (1,5) \}$

$n(A \cap B) = 1$

$$P(A \cap B) = \frac{1}{36} \quad \text{—— } ②$$

Comparing eq^n's ① & ②

$P(A \cap B) \neq P(A)\, P(B)$

$\therefore$ A and B are not independent events.

b) Are the events "the sum is 7" and "the first die shows 5" independent?

Let A be the event that sum is 7

$A = \{ (1,6)\ (2,5)\ (3,4)\ (4,3)\ (5,2)\ (6,1) \}$

$n(A) = 6$

$$P(A) = \frac{n(A)}{n(S)} = \frac{6}{36} = \frac{1}{6} \quad \text{—— } ①$$

Let B be the event that "the first die shows 5"

$B = \{ (5,1)\ (5,2)\ (5,3)\ (5,4)\ (5,5)\ (5,6) \}$

$n(B) = 6$

$$P(B) = \frac{n(B)}{n(S)} = \frac{6}{36} = \frac{1}{6}$$

$$P(A) \cdot P(B) = \frac{1}{6} \times \frac{1}{6} = \frac{1}{36} \quad \text{—— } ②.$$

$P(A \cap B) = \{(5,2)\}$

$n(A \cap B) = 1$

$P(A \cap B) = \frac{n(A \cap B)}{n(S)} = \frac{1}{36}$ — (3).

Comparing eq^n (2) & (3).

$P(A \cap B) = P(A) \cdot P(B)$

$\therefore$ A & B are independent events.

[1-5]

Let A be the event that oil company is considering drilling in TX

B be the event that oil company is considering drilling in AK

C be the event that oil company is considering drilling in NJ

O be the event that finding oil.

$P(A) = 0.6$ --- 60%.

$P(C) = 0.1$ --- 10%.

$P(B) = 1 - P(A) - P(C)$

$= 1 - 0.6 - 0.1$

$= 1 - 0.7 = 0.3$

finding oil in TX

$P(O/A) = 0.3$

finding oil in AK

$P(O/B) = 0.2$

finding oil in NJ

$P(O/C) = 0.1$.

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1. whats the probability of finding oil ?

$$P(O) = P(O/A)\,P(A) + P(O/B)\,P(B) + P(O/C)\,P(C)$$

$$= 0.3 \times 0.6 + 0.2 \times 0.3 + 0.1 \times 0.1$$

$$P(O) = 0.25$$

2. Probability that they drilled in TX ?

$$TX = P(A/O)$$

According to Bayes theorem

$$\frac{P(A \cap O)}{P(O)} = \frac{P(O/A) \cdot P(A)}{P(O/A) \cdot P(A) + P(O/B)\,P(B) + P(O/C)\,P(C)}$$

$$= \frac{0.6 \times 0.3}{0.25}$$

$$\frac{P(A \cap O)}{P(O)} = 0.72$$

Answers

1) Probability of finding oil is 0.25
2) Probability of drilling & found oil in TX is 0.72

[1.6] a) Probability that a passenger did not survive.

P(Passenger did not survived)

$$= \frac{\text{Number of passengers did not survive}}{\text{Total}}$$

$$= \frac{1490}{2201}$$

$$= 0.676$$

b) Probability that a passenger was staying in first class.

$$P(\text{Passenger staying in first class}) = \frac{325}{2201}$$

$$= 0.147$$

c) Given that a passenger survived, what is the probability was staying in first class.

Let A → passenger survived

B → passenger staying in first class

$$P(B/A) = \frac{P(B \cap A)}{P(A)} = \frac{203/2201}{711/2201}$$

$$= \underline{\underline{0.285}}.$$

d) Are survival & staying in first class independent.

Let A → survival passengers

B → first class passengers

Two events are independent if

$$P(A \cap B) = P(A).P(B)$$

$$P(A \cap B) = \frac{203}{2201} = 0.092 \quad \text{—— (1)}$$

$$P(A) = \frac{711}{2201} = 0.323$$

$$P(B) = \frac{325}{2201} = 0.147$$

$$P(A).P(B) = 0.323 \times 0.147$$

$$= 0.047 \quad \text{—— (2)}$$

from eq^n (1) & (2)

$$P(A \cap B) \neq P(A).P(B)$$

∴ Thus the two events are not independent.

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e) Given that passenger survived, [what is the probability that] the passenger was staying in the first class & the passenger was a child.

$P \rightarrow$ Passenger was staying in the first class
$Q \rightarrow$ Passenger was a child
$R \rightarrow$ passenger survived.

$$P\left(\frac{P \cap Q}{R}\right) = \frac{P(P \cap Q \cap R)}{P(R)} = \frac{6/2201}{711/2201}$$

$$= \underline{\underline{0.0084}}.$$

f) Given that a passenger survived, what is the probability that the passenger was an adult.

Let $A \rightarrow$ passenger survived
$B \rightarrow$ passenger was an adult

$$P(B/A) = \frac{P(A \cap B)}{P(A)} = \frac{654/2201}{711/2201}$$

$$= \frac{654}{711} = 0.919$$

g) Given that the passenger survived, are age and staying in the first class independent?

Let $A \rightarrow$ Passengers survived
$B \rightarrow$ Passengers who are adult
$C \rightarrow$ Passengers who are children
$D \rightarrow$ first class.

$$P(B \cap D) = \frac{197}{2201} = 0.089 \quad \text{--- (1)}$$

$$P(C \cap D) = \frac{6}{2201} = 0.0027 \quad \text{--- (2)}$$

$$P(B) = \frac{654}{2201} = 0.2971$$

$$P(D) = \frac{203}{2201} = 0.092.$$

$$P(C) = \frac{57}{2201} = 0.0258$$

$$P(B) \times P(D) = 0.2971 \times 0.092$$
$$= 0.0023 \quad \text{--- (3)}$$

$$P(C) \times P(D) = 0.0258 \times 0.092$$
$$= 0.0023 \quad \text{--- (4)}$$

from eq^n (1) & (3)

$$P(B \cap D) \neq P(B)\, P(D)$$

Thus, adult age & staying in first class are not independent.