Name: Janmejay Mohanty **Course:** CS 513 B **Homework1:** Probability
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Solutions

Ans1:

Given: $P(J) = 20\% = 0.2$

$P(S) = 30\% = 0.3$

$P(J \cap S) = 8\% = 0.08$

(a) Probability of Jerry in the bank when Susan is also present in the bank,

$$P(J|S) = \frac{P(J \cap S)}{P(S)} = \frac{0.08}{0.3} = 26.67\%$$

(b) Probability of Jerry in the bank when Susan is not present in the bank,

$$P(J|\bar{S}) = \frac{P(J \cap \bar{S})}{P(\bar{S})} = \frac{P(J) - P(J \cap S)}{P(\bar{S})} = \frac{0.2 - 0.08}{0.7} = \frac{0.12}{0.7} = 17.14\%$$

(c) Probability of Jerry or Susan either one of them are present in the bank,

$$P(J|S) = \frac{P(J \cap S)}{P(J \cup S)} = \frac{P(J \cap S)}{P(J) + P(S) - P(J \cap S)} = \frac{0.08}{0.2 + 0.3 - 0.08} = \frac{0.08}{0.42} = 19.05\%$$

Ans2:

Given: $P(H) = 80\% = 0.8$

$P(S) = 90\% = 0.9$

$P(H \cup S) = 91\% = 0.91$

$P(H \cap S) = P(H) + P(S) - P(H \cup S) = 0.8 + 0.9 - 0.91 = 0.79$

(a) Probability of only Harold gets a "B",

$$P(H \cap S) = P(H) + P(S) - P(H \cup S) = 0.8 + 0.9 - 0.91 = 0.79$$
$$P(H|\bar{S}) = P(H) - P(H \cap S) = 0.8 - 0.79 = 0.01 = 1\%$$

(b) Probability of only Sharon gets a "B",

$$P(S|\bar{H}) = P(S) - P(H \cap S) = 0.9 - 0.79 = 0.11 = 11\%$$

(c) Probability of both Harold and Sharon not getting a "B",

$$1 - P(H \cup S) = 1 - 0.91 = 0.09 = 9\%$$

Ans3:

Given: $P(J) = 20\% = 0.2$

$P(S) = 60\% = 0.6$

If the events are independent, both of Jerry and Susan go to bank individually will be the same.

In that case:

$$P(J|S) = P(J) * P(S) = 0.2 * 0.3 = 0.6 = 60\%$$

Hence, the two events are not independent.

Ans4: Rolling 2 dices.

(a) If the events are independent,
$Getting\ sum = 6$
Cases: $[(1,5),(2,4),(3,3),(4,2),(5,1)]$
Total no of cases: 5

$$P(Getting\ sum = 6) = \frac{5}{6^2} = \frac{5}{36}$$
$$P(Second\ dice = 5) = \frac{6}{6} * \frac{1}{6} = \frac{1}{6}$$
$$P(Getting\ sum = 6 \cap Second\ dice = 5) = \frac{1}{36}$$
$$P(Getting\ sum = 6) * P(Second\ dice = 5) = \frac{5}{36} * \frac{1}{6} = \frac{5}{216}$$

Hence, both events are not independent.

(b) $Getting\ sum = 7$
Cases: $[(1,6),(2,5),(3,4),(4,3),(5,2),(6,1)]$
Total no of cases: 6

$$P(First\ dice = 5) = \frac{1}{6}$$
$$P(Getting\ sum = 7) = \frac{6}{36} = \frac{1}{6}$$
$$P(Getting\ sum = 7 \cap First\ dice = 5) = \frac{1}{36}$$
$$P(Getting\ sum = 7) * P(First\ dice = 5) = \frac{1}{6} * \frac{1}{6} = \frac{1}{36}$$

Hence, both events are independent.

Ans5:

(a) $P(TX) = 60\% = 0.6$
$P(NJ) = 10\% = 0.1$
$P(AK) = 30\% = 0.3$

$P(Oil|TX) = 30\% = 0.3$
$P(Oil|NJ) = 10\% = 0.1$
$P(Oil|AK) = 20\% = 0.2$

$$\begin{aligned} P(Finding\ oil) &= P(Oil|TX) * P(TX) + P(Oil|NJ) * P(NJ) + P(Oil|AK) * P(AK) \\ &= 0.3 * 0.6 + 0.1 * 0.1 + 0.2 * 0.3 \\ &= 0.18 + 0.01 + 0.06 \\ &= 0.25 \\ &= 25\% \end{aligned}$$

(b) Using Bayes Theorem,
$$P(TX|Oil) = \frac{P(Oil|TX) * P(TX)}{P(Oil)} = \frac{0.3 * 0.6}{0.25} = 0.72 = 72\%$$

Ans6: As per instructions we had not include crew members as Passengers.

(a) Total people $= 2201 - 885 = 1316$,
Not survived total people $= 1490$,

$$P(Not\ Survived) = \frac{1490 - 673}{2201 - 885} = \frac{817}{1316} = 0.6208 = 62.08\%$$

(b) Total people in 1st Class $= 319 + 6 = 325$

$$P(Staying\ in\ 1\text{st}\ Class) = \frac{325}{1316} = 0.2469 = 24.69\%$$

(c) $P(Staying\ in\ 1st\ Class|Survived) = \frac{P(Staying\ in\ 1st\ Class \cap Survived)}{P(Survived)} = \frac{203}{711-212} = \frac{203}{499}$
$= 0.4068 = 40.68\%$

(d) $P(Survived) = 1 - P(Not\ Survived) = 1 - 0.6208 = 0.3792 = 37.92\%$
$P(Staying\ in\ 1\text{st}\ Class) = 0.2469 = 24.69\%$
$P(Survived) * P(Staying\ in\ 1\text{st}\ Class) = 0.3792 * 0.2469 = 0.0936 = 9.36\%$
$P(Staying\ in\ 1st\ Class \cap Survived) = \frac{203}{1316} = 0.1542 = 15.42\%$
Hence, they're not independent.

(e) $P(Staying\ in\ 1st\ Class\ \cap Child|Survived) = \frac{P(Staying\ in\ 1st\ Class \cap Child \cap Survived)}{P(Survived)}$

$$= \frac{6}{499} \approx 0.0120 = 1.2\%$$

(f) $P(Adult|Survived) = \frac{P(Adult \cap Survived)}{P(Survived)} = \frac{442}{499} = 0.8857 = 88.57\%$

(g) $P(Age\ given\ passenger\ survived) = P(Adult|Survived) + P(Child|Survived)$

$$= \frac{442}{499} + \frac{57}{499} = 1$$

$$P(Staying\ in\ 1st\ Class) = \frac{203}{499} = 0.4068 = 40.68\%$$

$P(Age\ and\ Staying\ in\ 1st\ Class) = P(Age\ given\ passenger\ survived) *$
$P(Staying\ in\ 1st\ Class)$

$$= 1 * 40.68\% = 40.68\%$$

For age and staying in 1st Class to be independent, probability of age and first class must be equal to the product of their individual probabilities, clearly both are equal, and the events are conditional independent.