Knowledge Discovery & Data Mining

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Assignment - II → Probability

HomeWork 1.1

Jerry goes bank → 20% of the time.
Susan goes bank → 30% of the time.

Jerry & Susan together at bank → 8% of time.

	Susan (at Bank)	Susan (Not At Bank)	Total
Jerry at Bank	8	12	20%
Jerry (Not at Bank)	22	58	80%
Total	30%	70%	

(a) $P(J = \text{at Bank} \mid S = \text{was at bank}) = \dfrac{P(\text{Jerry at Bank} \cap \text{Susan at B})}{P(S = \text{at the Bank})}$

$= \dfrac{8}{30} = 0.267$

(b) $P(J = \text{at the Bank} \mid S = \text{Not at Bank})$

$= \dfrac{P(\text{J at Bank} \cap \text{Suman not at Bank})}{P(\text{Suman not at Bank})}$

$= \dfrac{12}{70} = 0.171$

(c) $P(J = \text{at Bank} \,\&\, S = \text{at Bank} \mid P = \text{At least one of them})$

$= \dfrac{P(\text{Both at Bank})}{1 - P(\text{No one at Bank})} = \dfrac{8}{1-58}$

$= \dfrac{8}{42} = \dfrac{4}{21} = 0.19$

Q HomeWork 1.2

Chances of Harold getting B ~~are~~ = 80%
Chances of Sharon — " — = 90%

Chances of Atleast getting B = 91%

Chances of Noone getting B = 100 − atleast 1 getting B
= 9%

	Harold getting B	Harold not getting B	Total
Sharon getting B	79%	11%	90%
Sharon not getting B	1%	9%	10%
Total	80%	20%	

ⓐ

P(Harold gets B & Sharon not getting B)

$= \cancel{\dfrac{P(\text{Harold get B and Sharon not get B})}{P(\text{Sharon not getting B})}}$

$= \dfrac{1}{100} = \boxed{0.01}$

$= \cancel{\dfrac{1}{10}}$

ⓑ P(Sharon get B & Harold not get B)

$= P(S_B \cap \overline{H}_B)$

$= \dfrac{11\cancel{8}}{100} = \dfrac{11}{100} = \boxed{0.11}$

ⓒ P(No one got B) = 1 − P(at least one got B)

$= 1 - \dfrac{91}{100} = \dfrac{9}{100} = \boxed{0.09}$

Q HomeWork 1.3 :-

Are the events Jerry is at the Bank & Susan is at the bank independent?

Two events A & B are independent if

$$P(A|B) = P(A)$$

Therefore,

$P($Jerry at Bank $|$ Susan at Bank$)$

$= \dfrac{P(\text{Jerry at Bank \& Susan at Bank})}{P(\text{Susan at Bank})}$

$= \dfrac{8}{30}$

Also,

$P($Jerry is at Bank$) = \dfrac{20}{100}$

As the both of the above events are not equal in probability

So, the events are dependent that is not independent.

Q HomeWork 1.4 :-

Are the events "the sum is 6" and "the second die shows 5" independent?

$P($the sum is 6 $|$ the second die shows 5$) =$

$\dfrac{P(\text{sum is 6 \& the second shows 5})}{P(\text{second shows 5})}$

$= \dfrac{(1/36)}{(1/6)} = \dfrac{1}{6}$

P(~~die~~ sum is 5) = $\frac{5}{36}$.

As both events are not equal in probability. So, both the events are **dependent** i.e **not independent**.

(b)

probability sum is 7 & the first die shows 5 independent?

P(sum is 7 | first die shows 5)

$= \frac{(\text{Sum is 7 \& first die shows 5})}{P(\text{first die show 5})}$

$= \frac{(1/36)}{(1/6)} = \frac{1}{6}$.

& P(sum is 7) = $\frac{6}{36} = \frac{1}{6}$.

As both events are ~~same~~ equal in probabilities. So, the events **are independent**.

Q. Homework 1.5 :-

a) P(choosing Texas) = 0.6 | P(finding Oil in Tx) = 0.3
P(choosing NJ) = 0.1 | P(finding Oil in Ak) = 0.2
P(choosing AK) = 0.3 | P(finding Oil in NJ) = 0.1

P(find Oil) = $\sum_{\text{state}}$ P(~~P~~ find oil, for all state)

$= P(\text{finding Oil}, \text{Texas}) + P(\text{finding Oil}, NJ) + P(\text{finding Oil}, AK)$

(By using Sum Rule)
$$p(X) = \sum_{y} p(X, y).$$

$= P(O|Tx)P(Tx) + P(O|AJ)P(AJ) + P(O|NJ)P(NJ)$

(Product Rule
$$P(X, Y) = P(Y|X)P(X)$$
)

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

$= 0.18 + 0.\cancel{6} + 0.2$

$= 0.25 = \frac{1}{4}$

b)

$$P(Tx \mid \text{Oil found \& drilled}) = \frac{P(\text{Oil} \mid Tx)P(Tx)}{P(\text{oil})}$$

$$= \frac{P(Tx, \text{Oil})}{p(\text{Oil})}$$

$$= \frac{0.6 \times 0.3}{0.25} = \frac{0.18}{0.25}$$

$$= \frac{18}{25} = 0.72.$$

Homework 1.6 :-

a) $P(\text{passenger didnot survived}) = \frac{1490}{\text{Total passenger}} = \frac{1490}{2201}$

$= 0.6769.$

b) $P(\text{passenger in } 1^{st} \text{ class}) = \frac{\text{Total } 1^{st} \text{ class passenger}}{\text{total passenger}}$

$= \frac{325}{2201} = 0.1476$

(c)

P(Passenger in first class | P = Survived)

$= \frac{\text{Total } 1^{st} \text{ class passenger}}{\text{Total passenger survived}} = \frac{203}{711}$

$= 0.2855$

(d) Are survival & staying in 1^{st} class independent?

P(passenger survived | Passenger in 1^{st} Class) -i

should be equal to P(passenger survived) -ii

Solving,

$P(P\text{=Survived} \mid P \text{ in } 1^{st} \text{ class}) = \frac{P(\text{survived} \& 1^{st} \text{ class})}{P(1^{st} \text{ class})}$

$= \frac{203}{325} = 0.6246$

And,

$P(\text{passenger Survived}) = \frac{711}{2201} = 0.3230$

As $0.6246 \neq 0.3230$,

The events are dependent

(e)

P(Passenger staying in 1^{st} class & Child | passenger Survived)

$= \frac{\text{Total children in } 1^{st} \text{ class that survived}}{\text{total passenger survived}}$

$$= \frac{6}{711} = 0.00843$$

(f) P(Passenger is adult | Passenger Survived)

$$= \frac{\text{Total Adult survived passengers}}{\text{Total passenger Survived}}$$

$$= \frac{654}{711} = 0.9198$$

(f) Given that a passenger survived, are age and staying independent.

To check independency, we need ~~to~~ compute for two cases of age ie adult and child.

So, probability of adult and staying in 1^{st} class given that passenger survived ~~will be~~ are dependent / independent can be proved from

$P(\text{passenger is adult} / \text{staying in } 1^{st} \text{ class})_{\text{survived}}$

$$\left(\frac{P(\text{Adult and } 1^{st} \text{ class})}{P(1^{st} \text{ class})} \right)_{\text{survived}}$$

$$= \frac{197}{203}$$

Ily, $P(\text{Adult})_{\text{survived}} = \frac{654}{711} \neq \frac{197}{203}$

Therefore in this case they are dependent.

Also,

probability of child & staying in 1^{st} class given that passenger survived :-

~~P(child~~

P(passenger is child / staying in 1st class)
survived

= survived{ = $\dfrac{P(\text{passenger is child \& stayed in 1st cl.})}{P(\text{staying in 1st class})}$

= $\dfrac{6}{203}$

P(child survived) = $\dfrac{57}{711} \neq \dfrac{6}{203}$

Therefore, these events are also dependent.

Hence, both the event for both case are dependent.