# Assignment No : 1

**Course : CS-513-A : Knowledge Discrete and DataMining**
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**Purpose : Probability**

**Note:**
intersection is represented as “&&”
Union is represented as “U”
Not is represented as ^
Not equals to is represented as !=
Equals to is represented as ==

**Homework 1.1**

Jerry and Susan have a joint bank account.
Jerry goes to the bank 20% of the days.
Susan goes there 30% of the days.
Together they are at the bank 8% of the days.
a.Susan was at the bank last Monday. What's the probability that Jerry was there too?
b.Last Friday, Susan wasn't at the bank. What's the probability that Jerry was there?
c.Last Wednesday at least one of them was at the bank. What is the probability that both of them were there?

**Solution:**

| | Susan at bank (S) | Not Susan at bank (^S) | |
|---|---|---|---|
| Jerry at bank (J) | 0.08 | 0.12 | 0.20 |
| Not Jerry at bank (^J) | 0.22 | 0.58 | 0.8 |
| | 0.3 | 0.7 | 1 |

a- P( J / S ) = P( J && S ) / P( S ) = 0.08 / 0.3 = 0.27 = 27%

b- P( J / ^S ) = P( J && ^S) / P( ^S ) = 0.12 / 0.7 = 0.17 = 17%

c- P( ^S / J ) + P( ^J / S ) + P( J && S)
= (P( ^ S && J)/ P(J)) + (P(^ J && S) / P(S)) + (0.08)
= (0.12 / 0.20) + ( 0.22 / 0.3 ) + ( 0.08 )
= 1.41

P( P && S) / (P(P( ^S / J ) + P( ^J / S ) + P( J && S))
= 0.08 / 1.41
= 0.057= 5.7 %

## Homework 1.2

Harold and Sharon are studying for a test.
Harold's chances of getting a "B" are 80%. Sharon's chances of getting a "B" are 90%.
The probability of at least one of them getting a "B" is 91%.

a.What is the probability that only Harold gets a "B"?
b.What is the probability that only Sharon gets a "B"?
c.What is the probability that both won't get a "B"?

**Solution:**

| | SHARON GETS B (S) | SHARON NOT GET B (^S) | |
|---|---|---|---|
| HAROLD GETS B (H) | 0.79 | 0.01 | 0.8 |
| HAROLD NOT GET B (^H) | 0.11 | 0.09 | 0.2 |
| | 0.9 | 0.1 | 1 |

Given:

P( ^H && S) + P( H && ^S) + P( H && S) = 0.91 – EQN1

From given information we have ,

P( H && S) + P ( H && ^S) = 0.8 – EQN2

Substituting EQN2 in EQN1 we get,

P(^H && S ) = 0.91 – 0.8 = 0.11

Now we can fill up remaining values in table.

A- P( Only H will gets B) = 0.01 = 1%
B- P(Only S will gets B) = 0.11 = 11%
C- P(H and S wont get B) = 0.09 = 9%

**Homework 1.3**

Jerry and Susan have a joint bank account.
Jerry goes to the bank 20% of the days.
Susan goes there 30% of the days.
Together they are at the bank 8% of the days.
Are the events “Jerry is at the bank” and “Susan is at the bank” independent?

**Solution:**

For events to be independent
P(A) * P(B) = P( A&&B )

Let A = Jerry at bank
B = Susan at bank

P(A) * P(B) = 0.20 * 0.30 = 0.06
P(A && B) = 0.08

Since, P(A) * P(B) != P(A && B)
The events “Jerry is at the bank” and “Susan is at the bank” are dependent.

**Homework 1.4**

You roll 2 dice.

a.Are the events “the sum is 6” and “the second die shows 5” independent?

b.Are the events “the sum is 7” and “the first die shows 5” independent?

**Solution :**

**Second dice**

| **First dice** | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| 6 | 7 | 8 | 9 | 10 | 11 | 12 |

For events to be independent

P(A) * P(B) = P( A&&B )

A – Let A = the sum is 6

Let B = the second die shows 5

P(A) * P(B) = 5/36 * 1/ 6 = 5/216 = 0.0231

P( A && B) = The sum is 6 and second die is 5 = 1/36 = 0.027

Since, P(A) * P(B) != P(A && B)

“the sum is 6” and “the second die shows 5” are dependent.

B - Let A = the sum is 7

Let B = the first die shows 5

P(A) * P(B) = 1/6 * 1/ 6 = 1/36

P( A && B) = The sum is 7 and first die is 5 = 1/36

Since, P(A) * P(B) == P(A && B)

“the sum is 7” and “the first die shows 5” are independent.

**Homework 1.5**

An oil company is considering drilling in either TX, AK and NJ. The company may operate in only one state. There is 60% chance the company will choose TX and 10% chance NJ.

There is 30% chance of finding oil in TX, 20% in AK, and 10% -in NJ.

1.What's the probability of finding oil?

2.The company decided to drill and found oil. What is the probability that they drilled in TX?

| | CHOOSE CITY | FOUND OIL | FOUND OIL (%) OF CITY |
|---|---|---|---|
| TX | 0.60 | 0.30 | 0.18 (30% OF 0.60) |
| AK | 0.30 | 0.20 | 0.06 (20% OF 0.30) |
| NJ | 0.10 | 0.10 | 0.01 (10% OF 0.10) |

1-P(FINDING OIL) = P(FIND OIL IN TX) + P(FIND OIL IN AK) + P(FIND OIL IN NJ)

= 0.18 + 0.06 + 0.01

= 0.25 = 25%

2- P( TX / FOUND OIL) = P( TX && FOUND OIL) / P(FOUND OIL)

= 0.18 / 0.25

= 0.72 = 72%

**Homework 1.6**

The following slide shows the survival status of Individual passengers on the Titanic. Use this information to answer the following questions:

a. What is the probability that a passenger did not survive?

b. What is the probability that a passenger was staying in the first class?

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

d. Are survival and staying in the first class independent?

e. Given that a passenger survived, what is the probability that the passenger was staying in the first class and the passenger was a child?

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

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

## Survived

| | 1st | 2nd | 3rd | Crew | Sub Total |
|---|---|---|---|---|---|
| Adult | 197 | 94 | 151 | 212 | 654 |
| Child | 6 | 24 | 27 | - | 57 |
| Sub Total | 203 | 118 | 178 | 212 | 711 |

## Not Survived

Cabin

| | 1st | 2nd | 3rd | Crew | Sub Total |
|---|---|---|---|---|---|
| Adult | 122 | 167 | 476 | 673 | 1,438 |
| Child | | | 52 | | 52 |
| Sub Total | 122 | 167 | 528 | 673 | 1,490 |

# Total

Cabin

| | 1st | 2nd | 3rd | Crew | Grand Total |
|---|---|---|---|---|---|
| Adult | 319 | 261 | 627 | 885 | 2,092 |
| Child | 6 | 24 | 79 | | 109 |
| Grand Total | 325 | 285 | 706 | 885 | 2,201 |

**Solution**

a-P(passenger did not survived)
= P (total did not survived) /
P(total count)
= 1490 / 2201 = 0.67 = 67.69%

b-P(passenger stays at first class) = P(total stays at first class) / P(total count)
= 325 / 2201 = 0.14 = 14.76%

c- P(stays at first class/ survived) = P(stays at first class && survived)/ P(survived)

= 203 / 711 = 0.28 = 28.55%

d- For events to be independent
P(A) * P(B) = P( A&&B )

Let A = survived
Let B = stays at first class
P(A) * P(B) = (711 / 2201) * (325/ 2201) = 0.048
P( A && B) = 203/711 = 0.28
Since, P(A) * P(B) != P(A && B)
Survival and Staying in the first class are dependent.

e- P(stays at first class and child/ survived) =
P(stays at first class and child && survived) / P(survived)
= 6 / 711 = 0.0084 = 0.84%

f- P(stays at first class and adult/ survived) =
P(stays at first class and adult && survived) / P(survived)
= 654 / 711 = 0.91 = 91.98%

g- For events to be conditionally independent
P(A/C) * P(B/C) = P( A&&B /C)

Let A2 = age child, A1 = age adult , A = A1 + A2
Let B = stays at first class
Let C = survived

P(A1/C) * P(B/C) = (654 / 711) * (203/ 711) = 26.26%
P( A1 && B / C) = 197/711 = 27.70%

P(A2/C) * P(B/C) = (57 / 711) * (203/ 711) = 2.28%
P( A2 && B / C) =  6/711 = 0.84%

Therefore,
P(A/C) * P(B/C) = P(A1/C) * P(B/C) + P(A2/C) * P(B/C)
P( A&&B /C) = P( A1 && B / C) + P( A2 && B / C)

P(A1/C) * P(B/C) + P(A2/C) * P(B/C) =  26.26% + 2.28% = 28.54%
P( A1 && B / C) + P( A2 && B / C) = 28.54%

Since P(A/C) * P(B/C) == P( A&&B /C),
The age and staying in the first class is independent.