**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?**

Event A = On that day Jerry will be at the bank

Event B = On the day Susan is at the bank

P(A) = 0.2, P(B) = 0.3, P(A ꓵ B) = 0.08

1. Last Monday Susan is at the bank, so the probability that Jerry was there too

P(A | B) = P(A ∩ B) / P(B) =0.08 / 0.3= 0.267

1. Last Friday Susan wasn't at the bank, so the probability that Jerry was there is,

P(A|B') = P(A) − P(A∩B) / 1− P(B) = 0.2−0.08 / 1−0.3 = 0.1714

1. Last Wednesday at least one of them was at the bank, then the probability of both of them at the bank is,

P[(A∩B) | (A∪B)] = P [(A ∩ B ) ∩ (A∪B) ] / P(A∪B) = P(A ∩B) / P(A∪B)

P(A∪B) = P(A)+P(B)-P(A∩B) = 0.2 + 0.3 - 0.08 = 0.42

Probability =0.08 / 0.42 = 0.19

**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"?**EventH **=** Harold’s chances of getting “B”

Event S = Sharon’s chances of getting “B”P(H) = 0.8, P(S) = 0.9, P(H∪S) = 0.91  
P(H∩S) = P(H) + P(S) - P(H∪S) = 0.8 + 0.9 - 0.91 = 0.79

1. Probability that only Harold gets a "B",  
   P(H∩S') = P(H) - P(H∩S) = 0.8 - 0.79 = 0.01
2. Probability that only Sharon gets a "B",

P(H'∩S) = 0.9 - 0.79 = 0.11

1. Probability that both won't get "B",

P(H∪S)' = 1 - P(H∪S) = 1 - 0.91 =0.09

**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?**

Event A = On the day Jerry will be at the bank  
Event B = On the day Susan is at the bank

P(A) = 0.2, P(B) = 0.3, P(A∩B) = 0.08  
  
P(A∩B) = P(A) \* P(B) = 0.2 \* 0.3 = 0.06 ≠ 0.08  
Here, P(A∩B) ≠ P(A) \* P(B)   
So, these two events are not independent.  
  
**1.4 You roll 2 dice.**

1. **Are the events "the sum is 6" and "the second die shows 5" independent?**
2. **Are the events "the sum is 7" and "the first die shows 5" independent?**
3. Event A = The sum is 6  
   Event B = The second die shows 5

P(A) = 5 / 36

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

P(A∩B) ≠ P(A) \* P(B)   
So, these events are not independent.

1. Event A = The sum is 7  
   Event B = The first die shows 5  
   P(A) = 6 / 36 = 1/6

P(B) = 6 / 36 = 1/6  
P(The sum is 7 & The first die shows 5) = P(A∩B) = 1 / 36 = P(A) \* P(B)  
Here, P(A∩B) = P(A) \* P(B). So, these events are independent.

**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?**

Event A = Company choose TX

Event B = Company choose AK

Event C = Company choose NJ

Event D = Find oil in TX

Event E = Find oil in AK

Event F = Find oil in NJ  
P(A) = 0.6, P(C) = 0.1, P(B) = 1 – 0.6 – 0.1 = 0.3, P(D) = 0.3, P(E) = 0.2, P(F) = 0.1

1. P (Finding oil) = 0.6 \* 0.3 + 0.3 \* 0.2 + 0.1 \* 0.1 = 0.25
2. P (Drill and find oil in TX) = 0.6 \* 0.3 / 0.25 = 0.72

**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?**

1. Event A = Passenger did not survive

P(A) = (1490 – 673) / (2201 – 885) = 0.620

1. Event B = Person in 1st Class

P(B) = 325 / (2201 – 885) = 0.246

1. Event C = Passenger is survived and that was an adult

P(C) = 203 / (711 – 212) = 0.406

1. Event D = All Survived

Event E = Staying in 1st Class  
P(D) = 711 / 2201 = 0.323

P(E) = 325 / 2201 = 0.147

P (D ∩ E) = 203 / 2201 = 0.092

Hence, P (D ∩ E) ≠ P(D) \* P(E). Therefore, these events are not independent.

1. Event F = Passenger is survived, Staying in 1st Class and that was child

P(F) = 6 / (711 – 212) = 0.012

1. Event G = Passenger is survived and that was an adult

P(G) = (654 – 212) / (711 – 212) = 0.885

1. Event H = Passenger are age and Survived

Event I = Staying in 1st class and Survived

P (Adult and Survived) = (442 / 499) = 0.886

P (Child and Survived) = (57 / 499 ) = 0.114

P(H) = P (Adult and Survived) + P (Child and Survived)

= 0.886 + 0.114

= 1

P(I) = 203 / 499 = 0.406

P (Adult Survived & Staying in 1st class) = 197 / 499 = 0.394  
P (Child Survived & Staying in 1st class) = 6 / 499 = 0.012

P(H∩I) = P (Adult Survived & Staying in 1st class) + P (Child Survived & Staying in 1st class)

= 0.394 + 0.012 = 0.406  
P(H∩I) = P(H) \* P(I) = 1 \* 0.406 = 0.406  
Hence, P(H∩I) = P(H) \* P(I).  
Therefore, these two events are independent.

**1.7 A developer claims that her app can distinguish AI-generated documents from human generated ones. To assess its performance, we have submitted 1000 AI-generated and 1000 human-generated documents to the app.**

**• The app misclassified 70 human-generated documents as AI-generated**

**• and 30 AI generated documents as human- generated.**

**Build the confusion matrix for the above app and calculate the following:**

**Accuracy, precision, recall and F1**

True Positive (TP): The number of human-generated documents correctly classified as human-generated.

True Negative (TN): The number of AI-generated documents correctly classified as AI-generated.

False Positive (FP): The number of AI-generated documents misclassified as human-generated.

False Negative (FN): The number of human-generated documents misclassified as AI-generated.

Total human-generated documents: 1000

Total AI-generated documents: 1000

Predicted AI-Generated Predicted Human-Generated

Actual AI-Generated TN = 970 FP = 30

Actual Human-Generated FN = 70 TP = 930

Accuracy = TP + TN / Total = (930 + 970) / 2000 = 0.95

Precision = TP / (TP + FP) = 930 / (930 + 30) = 0.968

Recall = TP / (TP + FN) = 930 / (930 + 70) = 0.93

F1 = 2 \* Precision \* Recall / (Precision + Recall)

= 2 \* 0.968 \* 0.93 / (0.968 + 0.93)

= 0.948