# Probability

Probability is the branch of mathematics concerning numerical descriptions of how likely an event is to occur, or how likely it is that a proposition is true. The probability of an event is a number between 0 and 1, where, roughly speaking, 0 indicates impossibility of the event and 1 indicates certainty. The higher the probability of an event, the more likely it is that the event will occur.

Q: What is the probability of getting 3 when a fair, six-sided die is rolled?

In [1]:
```
# Probability of getting 3 when a die is rolled
ns={1,2,3,4,5,6}
na={3}
pa=len(na)/len(ns)
print("Probability of getting 3 is:",pa)
```

```
Probability of getting 3 is: 0.16666666666666666
```

Q: Calculate the probability of atleast getting one head when a coin is tossed thrice.

In [2]:
```
# Calculate the probabillity of atleast getting one head when coin is tossed thrice
ns={'HHH','THH','HTH','HHT','TTH','THT','HTT','TTT'}
na={'HHH','THH','HTH','HHT','TTH','THT','HTT'}
pa=len(na)/len(ns)
print("Probability of atleast getting one head is:",pa)
```

```
Probability of atleast getting one head is: 0.875
```

Q: A glass jar contains 5 red, 3 blue and and 2 green jelly beans. If a jelly bean is chosen at random from the jar, what is the probability that it is not blue?

In [3]:
```
# Glass of jar contain 5 red,3 blue and 2 green jelly beans. If a jelly is chosen at random from jar, what is probability that it is not a blue
ns=10
na=7
pa=na/ns
print("Probability of not getting blue jar is:",pa)
```

```
Probability of not getting blue jar is: 0.7
```

# Independent and Dependent events

Independence is a fundamental notion in probability theory, as in statistics and the theory of stochastic processes. Two events are independent, statistically independent, or stochastically independent if the occurrence of one does not affect the probability of occurrence of the other (equivalently, does not affect the odds). Similarly, two random variables are independent if the realization of one does not affect the probability distribution of the other

Q: If the probability that a person A will be alive after 20 years is 0.7 and the probability that person B will be alive after 20 years is 0.5, what is the probability that they will both be alive after 20 years?

In [4]:
```
P=0.7*0.5
print("Probability that they will be alive after 20 years is:",P)
```

```
Probability that they will be alive after 20 years is: 0.35
```

In [5]:
```
def probability(number_of_events,samplespace):
 return number_of_events/samplespace
```

Q: A fair die is tossed twice. Find the probability of getting a 4 or 5 on first toss and a 1, 2 or 3 in the second toss.

In [6]:
```
pa=probability(2,6)
pb=probability(3,6)
P=pa*pb
print("Probability of getting a 4 or 5 on the first toss and 1, 2 or 3 on second toss is:", P)
```

```
Probability of getting a 4 or 5 on the first toss and 1, 2 or 3 on second toss is: 0.16666666666666666
```

Q: A bag contains 5 white marbles, 3 black marbles and 2 green marbles. In each draw, a marble is drawn from the bag and not replaced. In three draws, find the probability of obtaining white, black and green in that order.

In [7]:
```
pa=probability(5,10)
pb=probability(3,9)
pc=probability(2,8)
P=pa*pb*pc
print("The probability of obtaining white, black and green in the order is:",P)
```

```
The probability of obtaining white, black and green in the order is: 0.041666666666666664
```

Q: Find the probability of drawing a heart or a club from a shuffled deck of cards.

In [9]:
```
cards=52
hearts=13
clubs=13
heart_or_club=probability(13,52)+probability(13,52)
print('Probability fo drawing heart or club in a deck of 52 cards is',heart_or_club)
```

```
Probability fo drawing heart or club in a deck of 52 cards is 0.5
```

Q: Find the probability of drawing an ace, a king or a queen from a deck of cards

In [10]:
```
cards=52
ace=4
king=4
queen=4
ace_or_king_or_queen=probability(4,52)+probability(4,52)+probability(4,52)
print("Probability of drawing ace, king or queen cards from deck is:",ace_or_king_or_queen)
```

```
Probability of drawing ace, king or queen cards from deck is: 0.23076923076923078
```

Q: Find the probability of drawing an heart or an ace from a deck of cards.

In [11]:
```
heart=13
ace=4
ace_of_hearts=1
ha=probability(13,52)+probability(ace,52)-probability(ace_of_hearts,cards) # Additive rule
print(ha)
```

```
0.3076923076923077
```

# Complementary Events

In probability theory, the complement of any event A is the event (not A), i.e. the event that A does not occur.The event A and its complement (not A) are mutually exclusive and exhaustive. Generally, there is only one event B such that A and B are both mutually exclusive and exhaustive; that event is the complement of A. The complement of an event A is usually denoted as A', Ac.

Q: What is the probability of not getting 5 when a fair die is thrown?

In [12]:
```
ns=6 #n(s)= {1,2,3,4,5,6}
na=1 #n(a)={5}
pa=na/ns
print('probability of not getting 5 is ', 1-pa)
```

```
probability of not getting 5 is  0.8333333333333334
```

# Conditional Probability

In probability theory, conditional probability is a measure of the probability of an event occurring, given that another event (by assumption, presumption, assertion or evidence) has already occurred. If the event of interest is A and the event B is known or assumed to have occurred, "the conditional probability of A given B", or "the probability of A under the condition B", is usually written as P(A|B) or occasionally PB(A). This can also be understood as the fraction of probability B that intersects with A

Q: Determine the probability of a student getting 80% or more marks given that he/she has been absent for more than 10 classes. Use the student-mat.csv file for the data. (Consider subject G3)

In [13]:
```
import pandas as pd
import numpy as np
df=pd.read_csv('D:\Fds DataSet\student-mat.csv') #Student-mat.csv file
df.head(3)
```

Out[13]:

| | school | sex | age | address | famsize | Pstatus | Medu | Fedu | Mjob | Fjob | ... | famrel | freetime | goout | Dalc | Walc | health | absences | G1 | G2 | G3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **0** | GP | F | 18 | U | GT3 | A | 4 | 4 | at_home | teacher | ... | 4 | 3 | 4 | 1 | 1 | 3 | 6 | 5 | 6 | 6 |
| **1** | GP | F | 17 | U | GT3 | T | 1 | 1 | at_home | other | ... | 5 | 3 | 3 | 1 | 1 | 3 | 4 | 5 | 5 | 6 |
| **2** | GP | F | 15 | U | LE3 | T | 1 | 1 | at_home | other | ... | 4 | 3 | 2 | 2 | 3 | 3 | 10 | 7 | 8 | 10 |

3 rows × 33 columns

In [14]:
```
len(df)
```

Out[14]:
```
395
```

In [16]:
```
df['grade_A']=np.where(df['G3']*5 >= 80 , 1, 0)
```

In [17]:
```
df['high_absences']=np.where(df['absences']>=10,1,0)
```

In [20]:
```
df['count']=1
```

In [21]:
```
df=df[['grade_A','high_absences','count']]
df.head()
```

Out[21]:

| | grade_A | high_absences | count |
|---|---|---|---|
| **0** | 0 | 0 | 1 |
| **1** | 0 | 0 | 1 |
| **2** | 0 | 1 | 1 |
| **3** | 0 | 0 | 1 |
| **4** | 0 | 0 | 1 |

In [22]:
```
final=pd.pivot_table(df,values='count',index=['grade_A'],columns=['high_absences'],
 aggfunc=np.size,fill_value=0)
```

In [23]:
```
print(final)
```

```
high_absences    0   1
grade_A
0              277  78
1               35   5
```

In [1]:
```
Pa = (35 + 5) / (35 + 5 + 277 + 78)
print(Pa)
```

```
0.10126582278481013
```

In [2]:
```
Pb = (78 + 5) / (35 + 5 + 277 + 78)
print(Pb)
```

```
0.21012658227848102
```

In [3]:
```
PaAndb = 5 / (35 + 5 + 277 + 78)
print(PaAndb)
```

```
0.012658227848101266
```

In [4]:
```
print(PaAndb / Pb)
```

```
0.060240963855421686
```

In [ ]:
```
```