In [5]:

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#                                          Session 16  -Statistics 2 Assignment
#*********************************************************************************************************
#
#                     Program1 : To Determine the Probability of Person answering exactly 5 questions wrong
#
#*********************************************************************************************************
#Problem Statement : A test is conducted which is consisting of 20 MCQs (multiple choices questions) with
# every MCQ having its four options out of which only one is correct. Determine the probability that a
# person undertaking that test has answered exactly 5 questions wrong.

# importing the packages and setting the alias
import numpy as np
import scipy.stats
from scipy.special import factorial
import matplotlib.pyplot as plt
% matplotlib inline

# Twenty MCQ's
n = 20


# probability of answering the Question right and wrong
# P(S) = 1/4 = 0.25
# P(F) = 3/4 = 0.75
ps = 0.25
pf = 0.75

# This is example of binomial(multiple bernolis) , where in only two options right and wrong

# Probability P(X=r) = n!/r!(n-r)! * p**r * (1-p)**(n-r)

#NCr = 20! / (5!*15!)
NCr = factorial(20)/(factorial(5)*factorial(15))
Ps = 0.25**15

Pf = 0.75**5


# Probability of anwering 5 questions wrong is nCr (p(F)**r *P(S)**(n-r))
ProFail = (NCr * Ps * Pf)
print("The Value of Probability of anwering exactly 5 questions wrong is :\n")
print(ProFail)

#******************************************************************************
# here as we are getting the probability of 5 questions wrong , so p will be wrong questions answered probaility = 0.75
n,p = 20, 0.75
x = np.arange(20)

# probability mass function
#http://www.statisticshowto.com/probability-mass-function-pmf/
pmf= scipy.stats.binom.pmf(x,n,p)
print(80*'-')
print(" The Probability mass function Values are :\n")
print(pmf)
print(80*'-')

plt.bar(x,pmf)
plt.show()

mean, var, skewness, kurtosis = scipy.stats.binom.stats(n, p, moments='mvsk')

print("The mean value of PMF = %.2f "%mean)
print("The Variance value is = %.2f "%var)
print("The skewness = %.2f "%skewness)
print("The Kurtosis = %.2f "%kurtosis)

#*******************************************************************************************************
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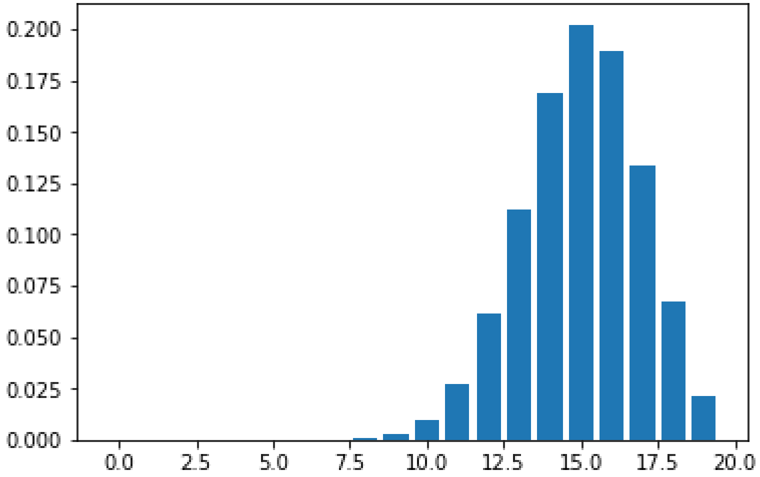
The Value of Probability of anwering exactly 5 questions wrong is :

3.4264958230778575e-06
--------------------------------------------------------------------------------
 The Probability mass function Values are :

[9.09494702e-13 5.45696821e-11 1.55523594e-09 2.79942469e-08
 3.56926648e-07 3.42649582e-06 2.56987187e-05 1.54192312e-04
 7.51687521e-04 3.00675008e-03 9.92227528e-03 2.70607508e-02
 6.08866892e-02 1.12406195e-01 1.68609293e-01 2.02331152e-01
 1.89685455e-01 1.33895615e-01 6.69478076e-02 2.11414129e-02]
--------------------------------------------------------------------------------
```



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The mean value of PMF = 15.00
The Variance value is = 3.75
The skewness = -0.26
The Kurtosis = -0.03
```

In [6]:

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#******************************************************************************************************
#
#                     Program2 : To Determine the Probability of getting 'D' exactly 5 times
#
#*****************************************************************************************************
#Problem Statement : A die marked A to E is rolled 50 times. Find the probability of getting a “D” exactly 5 times.

# importing the packages and setting the alias
import numpy as np
import scipy.stats
from scipy.special import factorial
import matplotlib.pyplot as plt
%matplotlib inline

# Number of times the Die rolled
n = 50


# Probability of D coming is P(D)=ps = 1/5 =  0.2
# Probability of D not coming is P(X!=D) = 4/5 = 0.8
ps = 0.2
pf = (1-ps)


# This is example of binomial(multiple bernolis) , where in only two options D coming and not coming
# AS per Binomial Theorem , P(S) = n!/r!(n-r)! * p**r *(1-p)**(n-r)
#NCr = 50! / (5!*45!)

NCr = round(factorial(50) / (factorial(5)*factorial(45)) ,2)
Ps = ps**5
Pf = pf**45

# Probability of anwering 5 questions wrong is nCr (p(F)**r *P(S)**n-r)
ProSuc = round((NCr * Ps * Pf),4)
print("The Value of Probability of 'D' coming exactly 5 times is :\n")
print(ProSuc)

#******************************************************************************
n,p = 50, 0.2
x = np.arange(50)
```

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# probability mass function
#http://www.statisticshowto.com/probability-mass-function-pmf/
pmf= scipy.stats.binom.pmf(x,n,p)
print(80*'-')
print("The Probability mass function values are \n ")
print(pmf)
print(80*'-')

plt.bar(x,pmf)
plt.show()

mean, var, skewness, kurtosis = scipy.stats.binom.stats(n, p, moments='mvsk')

print("The mean value of PMF = %.2f "%mean)
print("The variance value of PMF = %.2f "%var)
print("The skewness of PMF = %.2f "%skewness)
print("The kurtosis value of PMF = %.2f "%kurtosis)

#****************************************************************************************************
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The Value of Probability of 'D' coming exactly 5 times is :

0.0295
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The Probability mass function values are

[1.42724769e-05 1.78405962e-04 1.09273651e-03 4.37094606e-03
 1.28396540e-02 2.95312043e-02 5.53710081e-02 8.70115841e-02
 1.16921816e-01 1.36408786e-01 1.39819005e-01 1.27108187e-01
 1.03275402e-01 7.54704857e-02 4.98644281e-02 2.99186568e-02
 1.63617655e-02 8.18088273e-03 3.74957125e-03 1.57876684e-03
 6.11772152e-04 2.18490054e-04 7.20024042e-05 2.19137752e-05
 6.16324927e-06 1.60244481e-06 3.85203080e-07 8.56006844e-08
 1.75787120e-08 3.33389365e-09 5.83431389e-10 9.41018369e-11
 1.39682414e-11 1.90476019e-12 2.38095024e-13 2.72108599e-14
 2.83446457e-15 2.68125027e-16 2.29317457e-17 1.76398044e-18
 1.21273655e-19 7.39473508e-21 3.96146522e-22 1.84254196e-23
 7.32829190e-25 2.44276397e-26 6.63794556e-28 1.41232884e-29


 2.20676382e-31 2.25179981e-33]
 2.20676382e-31 2.23179981e-33]
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```

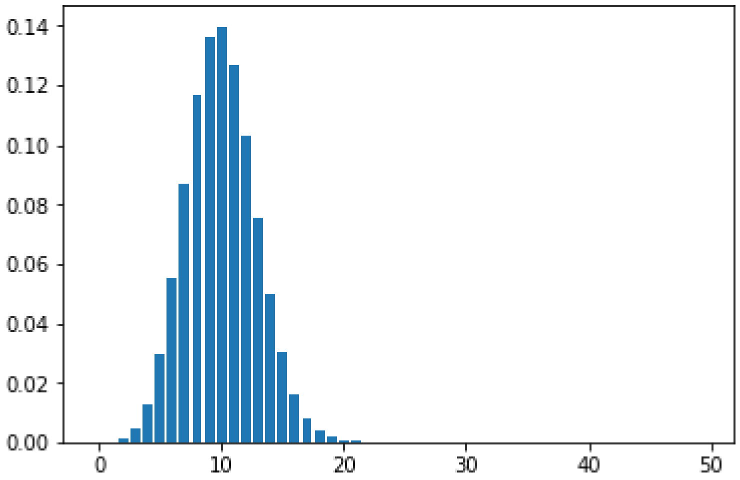

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The mean value of PMF = 10.00
The variance value of PMF = 8.00
The skewness of PMF = 0.21
The kurtosis value of PMF = 0.00
```

In [17]:

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#******************************************************************************************************
#
#                     Program3 : To find probabilites for all possible outcomes of selecting the balls
#
#*****************************************************************************************************
#Problem Statement : Two balls are drawn at random in succession without replacement from an urn containing
#                    4 red balls and 6 black balls.


# importing packages and setting as alias
import numpy as np
import matplotlib.pyplot as plt
from scipy.special import factorial
% matplotlib inline

# two turns
n = 2

#Probability of red ball first time
# P(X=R) = 4/10 = 0.4
# P(X=B) = 6/10 = 0.6

# Following is all possible outcomes , when two balls are selected w/o replacement
X = ['RR','RB','BB']

# Probabilities for all possible outcomes Out1...Out3

print("The Probability both balls being  Red :\n",'-'*80)
#P(RR) = 4C2/10C2 = 4!/2!*2! / 10!/8!2!
Num  = factorial(4)/(factorial(2)*factorial(2))
Den = factorial(10)/(factorial(8)*factorial(2))
PRR = Num/Den

print(round(PRR,2),"\n")
print("The Probability one ball being Red and another Black :\n",'-'*80)
# PRB = 4C1*6C1/10C2
Num = (factorial(4)/(factorial(3)*factorial(1)))*(factorial(6)/(factorial(5)*factorial(1)))
Den = factorial(10)/(factorial(8)*factorial(2))
PRB = Num/Den
print(round(PRB,2),"\n")
```

```python
print("The Probability both balls being Black :\n",'-'*80)
# PBB = 6C2/10C2
Num = factorial(6)/(factorial(2)*factorial(4))
Den = factorial(10)/(factorial(8)*factorial(2))
PBB = Num/Den
print(round(PBB,2),"\n")

print("All the possible outcomes , when two balls are selected are :\n",'-'*80)
print(X)
print('-'*80)

# plotting the Probabilities for the outcomes

plt.bar(X,[PRR,PRB,PBB])
plt.show()
```

```
The Probability both balls being  Red :
 --------------------------------------------------------------------------------
0.13

The Probability one ball being Red and another Black :
 --------------------------------------------------------------------------------
0.53

The Probability both balls being Black :
 --------------------------------------------------------------------------------
0.33

All the possible outcomes , when two balls are selected are :
 --------------------------------------------------------------------------------
['RR', 'RB', 'BB']
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```

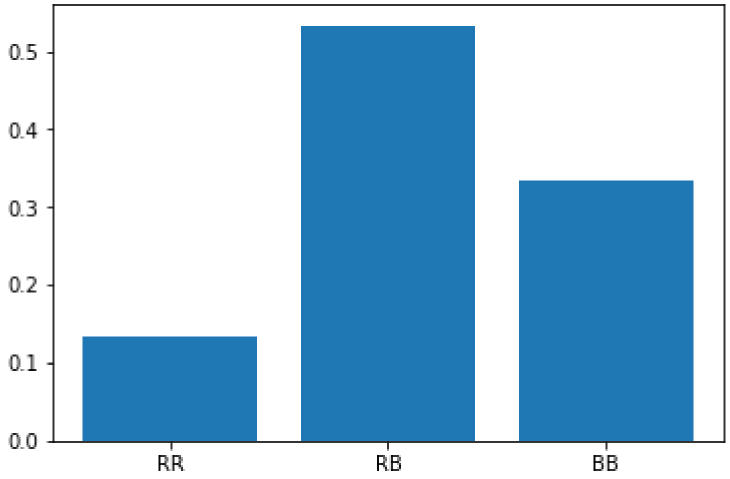
0.0
0.1
0.2
0.3
0.4
0.5
RR
RB
BB