

Xác suất và thống kê với ngôn ngữ Python

Discrete Uniform Distribution:

Bài toán:

4) Let X be a discrete uniform random variable on the interval $[2; 20]$.

a) Find $P(X < 13)$.

b) Find the mean and standard deviation of X .

A) 0 & 30

B) 11 & 30

C) 11 & 5.477

D) None of the others

Code:

```
import math
print("input interval [a,b]")
a = int(input("input a:"))
b = int(input("input b:"))
choice = int(input("Choose: 1,P(X<k)    2,P(X >= k) "))
if choice == 1:
    k = int(input("P(X<k) replace k:"))
    prob = 1/(k-a)
    mean = (a+b)/2
    sd = math.sqrt(((b-a+1)**2-1)/12)
    print(f'P(X<{k})={round(prob, 2)}, Mean: {mean}, Standard deviation: {sd}')
else:
    k = int(input("P(X>=k) replace k:"))
    prob = 1 -(1 / (k - a))
    mean = (a + b) / 2
    sd = math.sqrt(((b - a + 1) ** 2 - 1) / 12)
    print(f'P(X>={k})={round(prob, 2)}, Mean: {mean}, Standard deviation: {sd}')
```

Output:

```
input interval [a,b]
input a:2
input b:20
Choose: 1,P(X<k)    2,P(X >= k) 1
P(X<k) replace k:13
P(X<13)=0.09, Mean: 11.0, Standard deviation: 5.477225575051661
```

Binomial Distribution:

1:

Bài toán:

5) A total of 12 cells are replicated. Freshly-synthesized DNA cannot be replicated again until mitosis is completed. Two control mechanisms have been identified- one positive and one negative- that are used with equal probability. Assume that each cell independently uses a control mechanism.

What is the mean and variance of the number of cells use a positive control mechanism?

A) 5 and 6 B) 5 and 4.64 C) 6 and 3 D) 4 and 1.73

Code:

```
n = int(input("Enter numbers of random experiment:"))
p = float(input("Enter the probability:"))
mean = n*p
variance = n*p*(1-p)
print("the mean and variance is:",mean,"and",variance,"respectively.")
```

Output:

```
Enter numbers of random experiment:12
Enter the probability:0.5
the mean and variance is: 6.0 and 3.0 respectively.
```

2:

Bài toán:

6) Bill Price is a sales rep in northern California representing a line of athletic socks. Each day, he makes 10 sales calls. The chance of making sale on each call is thought to be 0.30. What is the probability that he will make exactly two sales?.

A) 0.009 B) 0.5002 C) 0.300 D) 0.2335

Code:

```
import math
n = int(input("Enter numbers of random experiment:"))
p = float(input("Enter the probability:"))
x = int(input(f"Number of event in {n} random experiment:"))
result = math.comb(n,x)*p**x*(1-p)**(n-x)
print("The probability is:", round(result,4))
```

Output:

```
Enter the probability:0.3
Number of event in 10 random experiment:2
The probability is: 0.2335
```

Geometric Distribution:

Bài toán:

7) Bill Price is a sales rep in northern California representing a line of athletic socks. Each day, he makes 10 sales calls. The chance of making sale on each call is thought to be 0.30. Find the probability that the first sale call is the fourth call.

A) 0.1029 B) 0.4116 C) 0.4570 D) None of the others.

Code:

```
k = int(input("Number of the random experiment until having the event:"))
p = float(input("Probability of the event:"))
result = (1-p)**(k-1) * p
print(f"The probability that the the event appear after {k} times is: {round(result,4)}")
```

Output:

```
Number of the random experiment until having the event:4
Probability of the event:0.3
The probability that the the event appear after 4 times is: 0.1029
```

- **Negative Binomial Distribution:**

Bài toán:

12. Each sample of water has a 10% chance of containing a particular organic pollutant. Assume that the samples are independent with regard to the presence of the pollutant. Find the probability that in the next 18 samples, exactly 2 contain the pollutant.

Code:

```
import math
p = float(input("Probability of the event:"))
r = int(input("Number of events:"))
k = int(input(f"Number of the random experiment until having {r} event:"))
result = math.comb(k-1,r-1)*p**r*(1-p)**(k-r)
```

```
print(f"Probability that in the next {k} samples, there is  
{r} events is: {round(result,4)}")
```

Output:

```
Probability of the event:0.1  
Number of events:2  
Number of the random experiment until having 2 event:18  
Probability that in the next 18 samples, there is 2 events is: 0.0315
```

- **Poisson Distribution:**

Bài toán:

2) The number of customers that arrive at a fast-food business during a one-hour period is known to be Poisson distributed with a mean equal to 8.60. What is the probability that 2 or 3 customers will arrive in one hour?

A) 0.0263 B) 0.1023 C)0.0679 D) none of the other choices is true

Code:

```
import math  
mean = float(input("Enter the mean:"))  
n = int(input("Numbers of k:"))  
ask = input("Relationship of k(or/and):")  
if ask == "or":  
    result = 0  
    for i in range (0,n):  
        k = int(input("Enter k:"))  
        result = (math.exp(-mean)*mean**k)/math.factorial(k)  
    + result  
else:  
    result = 0  
    for i in range(0, n):  
        k = int(input("Enter k:"))  
        result = (math.exp(-mean) * mean ** k) / math.factorial(k) * result  
print(result)
```

Output:

```
Enter the mean:8.6
Numbers of k:2
Relationship of k(or/and):or
Enter k:2
Enter k:3
0.02632516469933137
```

Continuous Uniform Distribution:

Bài toán:

3. If the time it takes for a customer to be served at a fast-food chain business is thought to be uniformly distributed between 3 and 8 minutes, what is the probability that the time it takes for a randomly selected customer will be less than 5 minutes?

A) 0.30 B) 0.80 C) 0.40 D) 0.20

b) Find the mean and standard deviation of the time it takes for a customer to be served.

Code:

```
import math
print("input interval [a,b] and x where a < b")
a = int(input("input a:"))
b = int(input("input b:"))
x = int(input("input x:"))
if a <= x <= b:
    p = 1/(b-a)
else:
    p = 0
mean = (a+b)/2
sd = math.sqrt(((b-a)**2)/12)
print(f"The probability is: {p}. The mean is: {mean}. The standard deviation is: {sd}")
```

Output:

```
input interval [a,b] and x where a < b
input a:3
input b:8
input x:5
The probability is: 0.2. The mean is: 5.5. The standard deviation is: 1.4433756729740645
```

Standard Normal Distribution:

Bài toán:

1. The time it takes to assemble a children's bicycle by a parent has been shown to be normally distributed with a mean equal to 295 minutes with a standard deviation equal to 45 minutes. Given this information, what is the probability that it will take a randomly selected parent between 300 and 340 minutes?. Let $P(Z < 0) = 0.5000$, $P(Z < 0.11) = 0.5438$, $P(Z < 1) = 0.8413$

A) 0.0438 B) 0.2975 C) 0.3413 D) 1.000

Code:

```
from statistics import NormalDist
mean = float(input("Enter your mean:"))
sd = float(input("Enter your standard deviation:"))
choice = int(input("Choose: 1, P(X < a) 2, P(X > a) 3, P(a < X < B)"))
if choice == 1:
    a = int(input("input a:"))
    result = NormalDist(mu=mean, sigma=sd).cdf(a)
elif choice == 2:
    a = int(input("input a:"))
    result = 1 - NormalDist(mu=mean, sigma=sd).cdf(a)
else:
    a = int(input("input a:"))
    b = int(input("input b:"))
    result = NormalDist(mu=mean, sigma=sd).cdf(b) - NormalDist(mu=mean, sigma=sd).cdf(a)
print("The probability is:", result)
```

Output:

```
Enter your mean:295
Enter your standard deviation:45
Choose: 1, P(X < a) 2, P(X > a) 3,P(a < X < B)3
input a:300
input b:340
The probability is: 0.2971088650232314
```

Central Limit Theorem:

Bài toán:

2) The monthly electrical utility bills of all customers for the Far East Power and Light Company are known to be distributed as a normal distribution with mean equal to \$87 a month and standard deviation of \$36. If a statistical sample of $n = 100$ customers is selected at random, what is the probability that the mean bill for those sampled will exceed \$75? Let $P(Z < -3.33) = 0$, $P(Z < 0.33) = 0.63$ and $P(Z < -0.44) = 0.33$.

A) 0.33 B) Approximately 0.63 C) About 1.00 D) None of the others.

Code:

```
import math
from statistics import NormalDist
mean = float(input("Enter your mean:"))
sd = float(input("Enter your standard deviation:"))
n = int(input("Enter your statistical sample number:"))
choice = int(input("Choose: 1, P(X < a) 2, P(X > a)"))
if choice == 1:
    a = int(input("input a:"))
    ssd = sd/math.sqrt(n) #sample standard deviation
    result = NormalDist(mu=mean, sigma=ssd).cdf(a)
elif choice == 2:
    a = int(input("input a:"))
    ssd = sd / math.sqrt(n)
    result = 1 - NormalDist(mu=mean, sigma=ssd).cdf(a)
print("The probability is:", result)
```


Output:

```
Enter your mean:87
Enter your standard deviation:36
Enter your statistical sample number:100
Choose: 1, P(X < a) 2, P(X > a)2
input a:75
The probability is: 0.9995709396668031
```