Py 이론적 확률분포 2

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Ⅰ. 균등분포

- 연속형 확률변수 X가 실수구간 [a,b]에서 나타날 가능성이 균등할 때, X는 균등분포를 따른다고 하며 X~U(a,b)
- 확률밀도함수는 다음과 같음

$$f(x)=\begin{cases}\frac{1}{b-a}, & a \le X \le b \\ 0, & \text{다른 곳에서}\end{cases}$$

- X가 X~U(a,b)라고 할 때,
  X의 평균은 $\frac{b+a}{2}$, 분산은 $\frac{1}{12}(b-a)^2$

b1-ch4-8.py

```
import numpy as np
import seaborn as sns # seaborn package를 이용
import matplotlib.pyplot as plt # matplotlib.pyplot package를 이용
from numpy import random
# set the random seed:
np.random.seed(12345)
r=10000
unif1 = random.uniform(1,2,size=r)
unif2 = random.uniform(2,4,size=r)
unif3 = random.uniform(4,8,size=r)
unif4 = random.uniform(5,10,size=r)
np.mean(unif1)
np.mean(unif2)
np.mean(unif3)
np.mean(unif4)
print("Mean of Uniform Distribution between min=1 & max=2 is : ", np.mean(unif1))
print("Mean of Uniform Distribution between min=2 & max=4 is : ", np.mean(unif2))
print("Mean of Uniform Distribution between min=4 & max=8 is : ", np.mean(unif3))
print("Mean of Uniform Distribution between min=5 & max=10 is : ", np.mean(unif4))
```

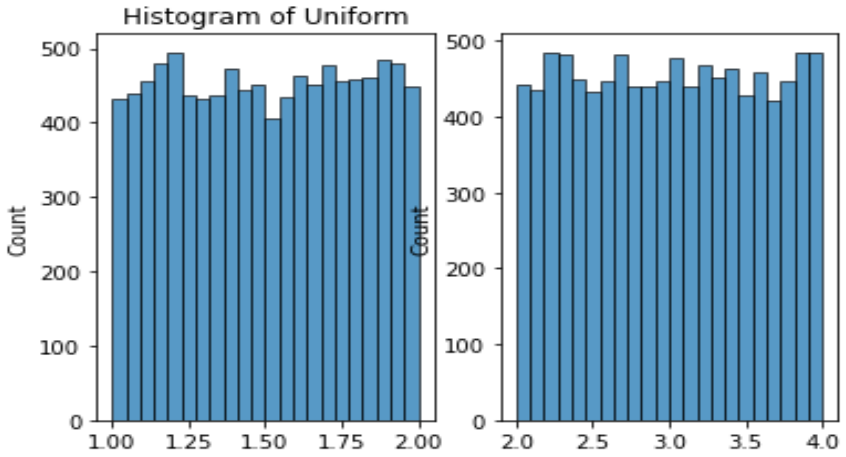
```
Mean of Uniform Distribution between min=1 & max=2 is :  1.5031220585307234
Mean of Uniform Distribution between min=2 & max=4 is :  3.0020447843769222
Mean of Uniform Distribution between min=4 & max=8 is :  5.9983054837535965
Mean of Uniform Distribution between min=5 & max=10 is :  7.503076188560819
```

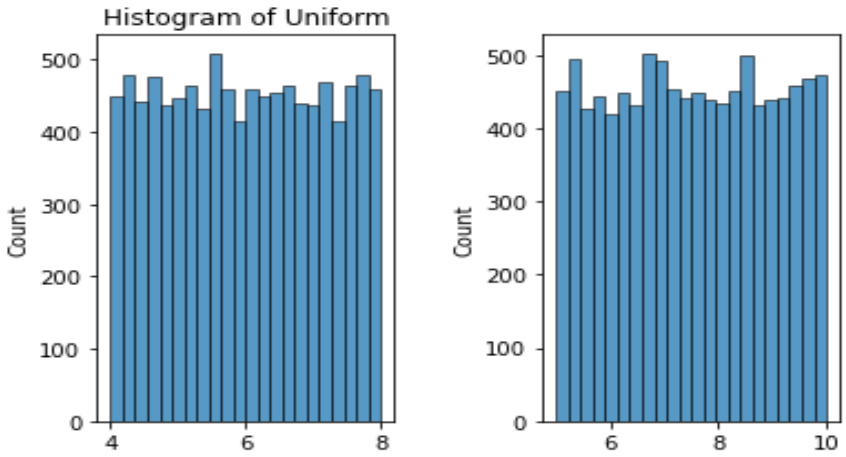
b1-ch4-8.py

(앞에서 계속)

```
np.var(unif1, ddof=1)
np.var(unif2, ddof=1)
np.var(unif3, ddof=1)
np.var(unif4, ddof=1)
print("Variance of Uniform Distribution between min=1 & max=2 is : ", np.var(unif1, ddof=1))
print("Variance of Uniform Distribution between min=2 & max=4 is : ", np.var(unif2, ddof=1))
print("Variance of Uniform Distribution between min=4 & max=8 is : ", np.var(unif3, ddof=1))
print("Variance of Uniform Distribution between min=5 & max=10 is : ", np.var(unif4, ddof=1))
sns.histplot(data=unif1, x=None).set(title='Histogram of Uniform(min=1, max=2)')
plt.show()
sns.histplot(data=unif2, x=None).set(title='Histogram of Uniform(min=2, max=4)')
plt.show()
sns.histplot(data=unif3, x=None).set(title='Histogram of Uniform(min=4, max=8)')
plt.show()
sns.histplot(data=unif4, x=None).set(title='Histogram of Uniform(min=5, max=10)')
plt.show()
fig = plt.figure(figsize=(14,7))
# 두 개의 그래프를 한 페이지에 그림
fig, axs = plt.subplots(ncols=2)
fig, ays = plt.subplots(ncols=2)
sns.histplot(data=unif1, x=None, ax=axs[0]).set(title='Histogram of Uniform')
sns.histplot(data=unif2, x=None, ax=axs[1])
fig.subplots_adjust(wspace=0.5) # 우측그림의 좌우 간격을 조정
#plt.savefig('C:/BOOK/PyBasics/PyStat/code/unif-1.png')
sns.histplot(data=unif3, x=None, ax=ays[0]).set(title='Histogram of Uniform')
sns.histplot(data=unif4, x=None, ax=ays[1])
fig.subplots_adjust(wspace=0.5) # 우측그림의 좌우 간격을 조정
#plt.savefig('C:/BOOK/PyBasics/PyStat/code/unif-2.png')
```

```
Variance of Uniform Distribution between min=1 & max=2 is :  0.08398100601670004
Variance of Uniform Distribution between min=2 & max=4 is :  0.33578608935688303
Variance of Uniform Distribution between min=4 & max=8 is :  1.3396146098936437
Variance of Uniform Distribution between min=5 & max=10 is :  2.092270467562026
```





Ⅱ. 정규분포

1. 확률함수

- 확률변수 X가 평균 μ, 분산 σ^2을 갖는 정규분포를 따른다고 하면

  $X \sim N(\mu, \sigma^2)$

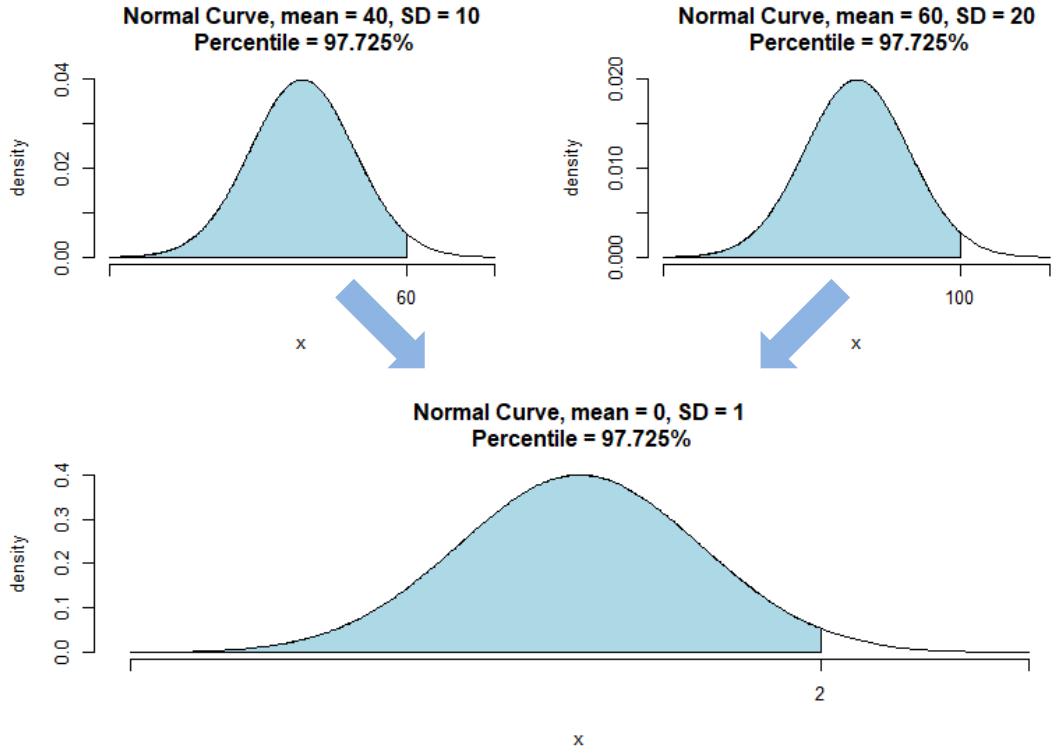
- 확률밀도함수는 다음과 같음

$$f(x) = \frac{1}{\sqrt{2\pi}\sigma} e^{-\frac{1}{2\sigma^2}(x-\mu)^2} \quad , \quad -\infty < x < \infty$$

2. 정규화

- 확률변수 X에서 X의 평균 μ을 빼주고 표준편차 σ로 나누어 줌

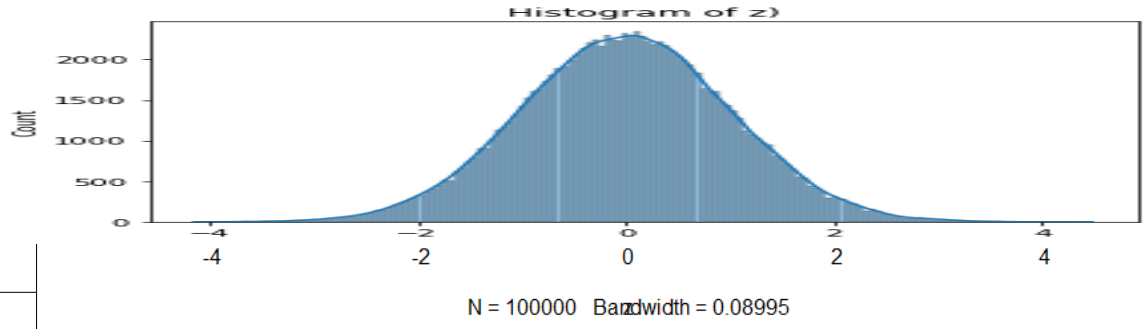
  $Z = \frac{X-\mu}{\sigma}$



1. 확률함수

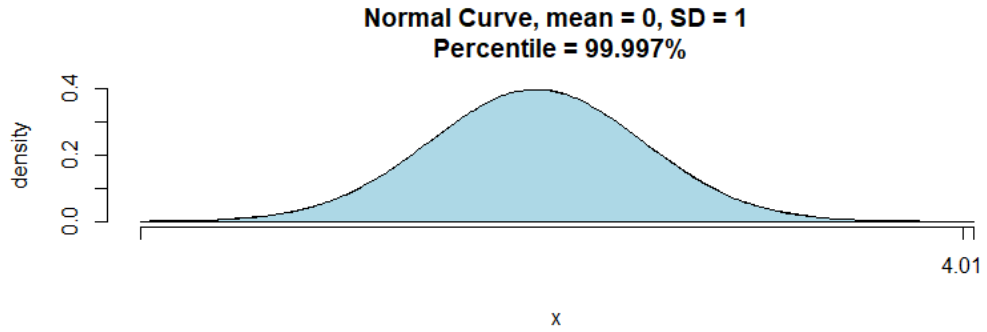
- 확률변수 X가 평균 0과 표준편차 1을 갖는 정규분포 즉, 표준정규분포를 따른다고 하면 X~N(0, 1)
- 확률밀도함수는 다음과 같음

$$f(z)=\frac{1}{\sqrt{2\pi}}e^{-\frac{1}{2}z^2} \quad , \quad -\infty < z < \infty$$



b1-ch4-9-new.py

```
import numpy as np
import seaborn as sns # seaborn package를 이용
import matplotlib.pyplot as plt
from numpy import random
# set the random seed:
np.random.seed(12345)
r=100000
z = random.normal(loc=0, scale=1, size=r)
np.mean(z)
print("Mean of Standard Normal Distribution is : ", np.mean(z))
np.var(z)
print("Variance of Standard Normal Distribution is : ", np.var(z))
sns.histplot(data=z, x=None, kde=True).set(title='Histogram of z)')
plt.show()
```




```
Mean of Standard Normal Distribution is :  -0.000991717923903336
```

```
Variance of Standard Normal Distribution is :  1.0021304899810273
```

2. 확률분포표

b1-ch4-9.py

```
import pandas as pd
import numpy as np
from scipy.stats import norm
r = 50
z_00 = np.empty(r)
for j in range(r):
  z_00[j] = norm.cdf(j/100, loc=0, scale=1)-0.5
  j=j+1
#print(z_00)
i_1 = np.arange(0,10)
i_2 = np.arange(10,20)
i_3 = np.arange(20,30)
i_4 = np.arange(30,40)
i_5 = np.arange(40,50)
z_0 = z_00[i_1]
z_1 = z_00[i_2]
z_2 = z_00[i_3]
z_3 = z_00[i_4]
z_4 = z_00[i_5]
z_0_0 = pd.Series(z_0)
z_1_0 = pd.Series(z_1)
z_2_0 = pd.Series(z_2)
z_3_0 = pd.Series(z_3)
z_4_0 = pd.Series(z_4)
```

b1-ch4-9.py

(앞에서 계속)]

```
z = pd.DataFrame({'0.0':z_0_0, '0.1':z_1_0,'0.2':z_2_0,'0.3':z_3_0,'0.4':z_4_0})
z=z.T
z = z.rename(columns={z.columns[0]: '0.00'})
z = z.rename(columns={z.columns[1]: '0.01'})
z = z.rename(columns={z.columns[2]: '0.02'})
z = z.rename(columns={z.columns[3]: '0.03'})
z = z.rename(columns={z.columns[4]: '0.04'})
z = z.rename(columns={z.columns[5]: '0.05'})
z = z.rename(columns={z.columns[6]: '0.06'})
z = z.rename(columns={z.columns[7]: '0.07'})
z = z.rename(columns={z.columns[8]: '0.08'})
z = z.rename(columns={z.columns[9]: '0.09'})
#print(z)
round(z,4)
print("Standard Normal Distribution Table : ", f'\n{round(z,4)}\n')
```

z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.0000	0.0040	0.0080	0.0120	0.0160	0.0199	0.0239	0.0279	0.0319	0.0359
0.1	0.0398	0.0438	0.0478	0.0517	0.0557	0.0596	0.0636	0.0675	0.0714	0.0753
0.2	0.0793	0.0832	0.0871	0.0910	0.0948	0.0987	0.1026	0.1064	0.1103	0.1141
0.3	0.1179	0.1217	0.1255	0.1293	0.1331	0.1368	0.1406	0.1443	0.1480	0.1517
0.4	0.1554	0.1591	0.1628	0.1664	0.1700	0.1736	0.1772	0.1808	0.1844	0.1879

```
Standard Normal Distribution Table :
      0.00    0.01    0.02    0.03  ...    0.06    0.07    0.08    0.09
0.0  0.0000  0.0040  0.0080  0.0120  ...  0.0239  0.0279  0.0319  0.0359
0.1  0.0398  0.0438  0.0478  0.0517  ...  0.0636  0.0675  0.0714  0.0753
0.2  0.0793  0.0832  0.0871  0.0910  ...  0.1026  0.1064  0.1103  0.1141
0.3  0.1179  0.1217  0.1255  0.1293  ...  0.1406  0.1443  0.1480  0.1517
0.4  0.1554  0.1591  0.1628  0.1664  ...  0.1772  0.1808  0.1844  0.1879
```