Example A3.0: Random Variable Gaussian, Timber n=164

In [1]:
```
import OpenAIUQ as auq
import numpy as np
import pandas as pd
import matplotlib
import matplotlib.pyplot as plt
from scipy import stats
from scipy.stats import pearsonr

matplotlib.rcParams.update({'font.size':16})
```

Define Gaussian, m=39.32, v=24%

In [2]:
```
#=======================
#variable x1

#define mean
m1=39.32
#define standard deviation
s1=0.24*m1
#Define distribution: 'Gaussian','Lognormal'
x1=auq.dist('Gaussian')
#Evaluate the parameters through the method of the moments
x1.Momentfit(m1,s1)
```

Attributes

In [3]:
```
print(x1.mu)
print(x1.dev)
print(x1.cov)
```

```
39.32
9.4368
0.24
```

Generate samples

In [4]:
```
x1.gen_samples(num=100)
```

In [5]:
```
x1.samples
```

Out[5]:
```
array([53.80170229, 26.16574377, 28.37392651, 41.19999377, 44.14464268,
       22.66119987, 40.89014127, 33.20043603, 24.65509741, 38.9569011 ,
       32.09425949, 45.27244667, 36.71297927, 52.14795829, 64.35066548,
       44.51772545, 46.54164985, 26.47008878, 41.05622014, 39.83957752,
       45.50011343, 44.84703166, 40.77560082, 42.90662907, 35.78137779,
       25.9984161 , 42.87537356, 23.30759076, 29.97599519, 45.64360809,
       15.87978268, 38.52064653, 43.69241998, 42.84156811, 32.90800475,
       34.80002927, 26.43486208, 43.56039308, 21.06080445, 29.19168479,
       31.30114267, 35.1525561 , 35.14884796, 34.52351643, 59.05880974,
       17.85582665, 23.38206724, 46.77718907, 18.7688629 , 43.9331238 ,
       38.77661519, 43.37536172, 29.28363608, 33.23417912, 24.49403081,
       42.88420283, 33.88915392, 37.36708682, 31.59626072, 30.55821653,
       29.02683249, 33.28698286, 35.60519059, 44.44394497, 33.40472633,
       27.52055569, 46.62142037, 48.68749327, 54.388365  , 15.90954968,
       52.10712866, 43.39064865, 52.25590192, 28.3212193 , 50.18944223,
       35.9042858 , 39.6858367 , 34.43181771, 30.37696226, 42.74094409,
```

```
63.13801287, 50.38636647, 33.60146406, 41.31721798, 39.02249698,
26.99069447, 29.89149886, 39.56585102, 47.19815448, 40.41141768,
35.73696859, 33.88727603, 33.3186803 , 45.71336536, 44.36923386,
34.56244906, 43.44314624, 35.49134918, 51.37275365, 39.0634904 ])
```

Evaluate pdf, cdf, poe

In [6]:
```
x1.set_range(xiniz=0,xfin=80)
```

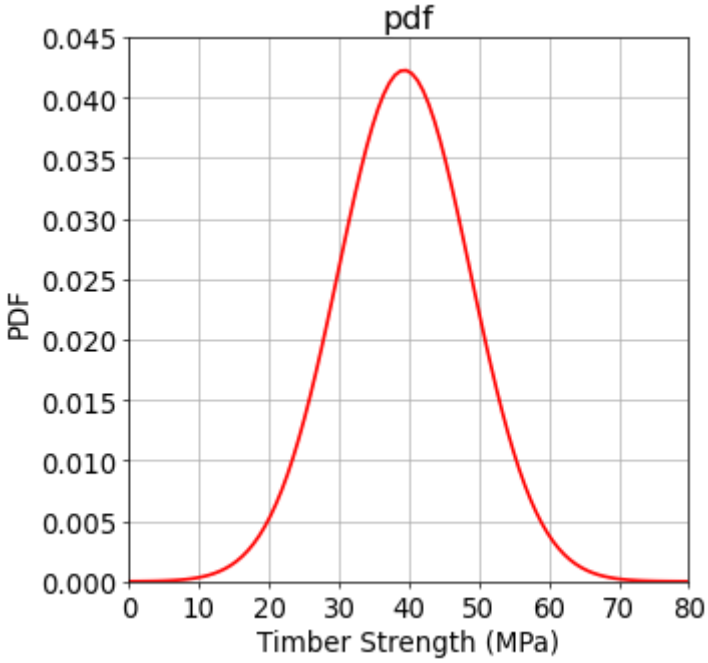
In [7]:
```
x1.pdf()
```

In [8]:
```
x1.cdf()
```

In [9]:
```
x1.poe()
```

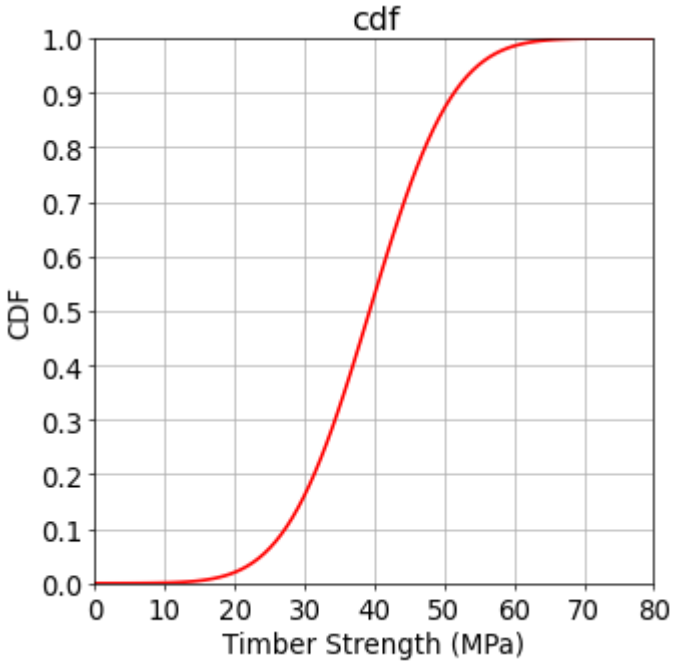
Plot pdf, cdf, poe

In [10]:
```
fig1=plt.figure(num=1,figsize=(6,6),dpi=60)
#num: figure number
#figsize: fugure dimension
#dpi

ax=fig1.add_subplot(1,1,1)

ax.plot(x1.xx,x1.f,'r',lw=2)

ax.set_title('pdf')
ax.set_xlabel('Timber Strength (MPa)')
ax.set_ylabel('PDF')
ax.grid(True)
ax.set_xlim(0,80)
ax.set_ylim(0)
ax.set_yticks(np.arange(0,0.05,0.005));
ax.set_xticks(np.arange(0,90,10));
```



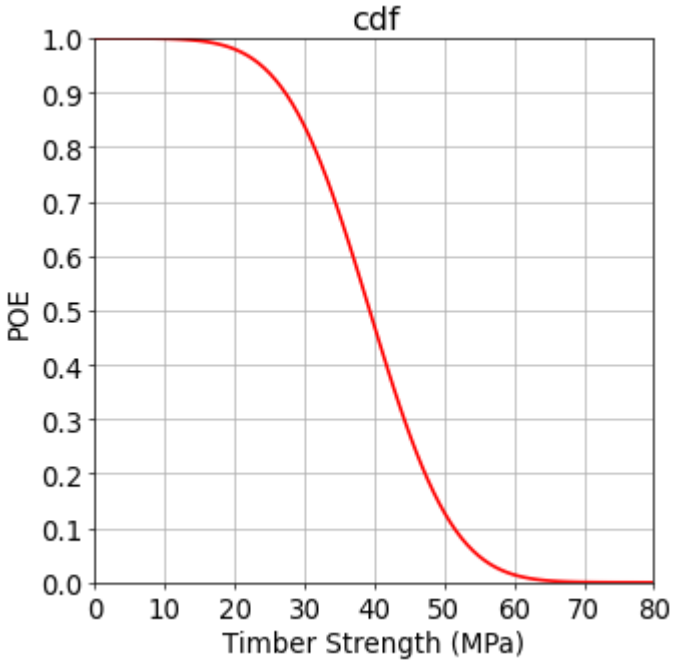
In [11]:
```
fig2=plt.figure(num=1,figsize=(6,6),dpi=60)
#num: figure number
#figsize: fugure dimension
#dpi
```

```
ax=fig2.add_subplot(1,1,1)

ax.plot(x1.xx,x1.F,'r',lw=2)

ax.set_title('cdf')
ax.set_xlabel('Timber Strength (MPa)')
ax.set_ylabel('CDF')
ax.grid(True)
ax.set_xlim(0,80)
ax.set_ylim(0,1)
ax.set_xticks(np.arange(0,90,10));
ax.set_yticks(np.arange(0,1.1,0.10));
```



In [12]:

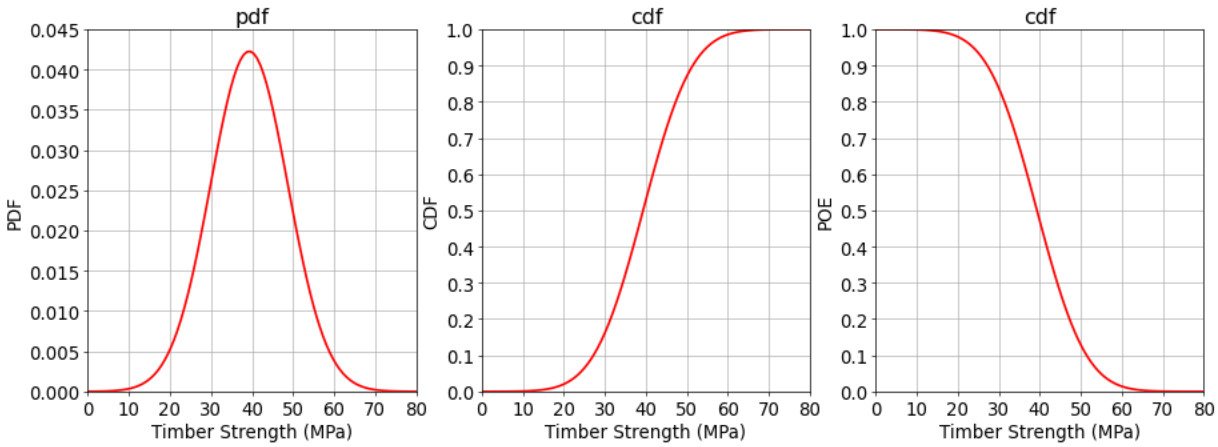
```
fig3=plt.figure(num=1,figsize=(6,6),dpi=60)
#num: figure number
#figsize: fugure dimension
#dpi

ax=fig3.add_subplot(1,1,1)

ax.plot(x1.xx,x1.P,'r',lw=2)

ax.set_title('cdf')
ax.set_xlabel('Timber Strength (MPa)')
ax.set_ylabel('POE')
ax.grid(True)
ax.set_xlim(0,80)
ax.set_ylim(0,1)
ax.set_xticks(np.arange(0,90,10));
ax.set_yticks(np.arange(0,1.1,0.10));
```



In [13]:

```
fig10=plt.figure(num=1,figsize=(18,6),dpi=60)
#num: figure number
#figsize: fugure dimension
#dpi

ax1=fig10.add_subplot(1,3,1)
ax2=fig10.add_subplot(1,3,2)
ax3=fig10.add_subplot(1,3,3)

#-----------------------------------------
ax1.plot(x1.xx,x1.f,'r',lw=2)

ax1.set_title('pdf')
ax1.set_xlabel('Timber Strength (MPa)')
ax1.set_ylabel('PDF')
ax1.grid(True)
ax1.set_xlim(0,80)
ax1.set_ylim(0)
ax1.set_yticks(np.arange(0,0.05,0.005));
ax1.set_xticks(np.arange(0,90,10));

#-----------------------------------------
ax2.plot(x1.xx,x1.F,'r',lw=2)

ax2.set_title('cdf')
ax2.set_xlabel('Timber Strength (MPa)')
ax2.set_ylabel('CDF')
ax2.grid(True)
ax2.set_xlim(0,80)
ax2.set_ylim(0,1)
ax2.set_xticks(np.arange(0,90,10));
ax2.set_yticks(np.arange(0,1.1,0.10));

#-----------------------------------------
ax3.plot(x1.xx,x1.P,'r',lw=2)

ax3.set_title('cdf')
ax3.set_xlabel('Timber Strength (MPa)')
ax3.set_ylabel('POE')
ax3.grid(True)
ax3.set_xlim(0,80)
ax3.set_ylim(0,1)
```

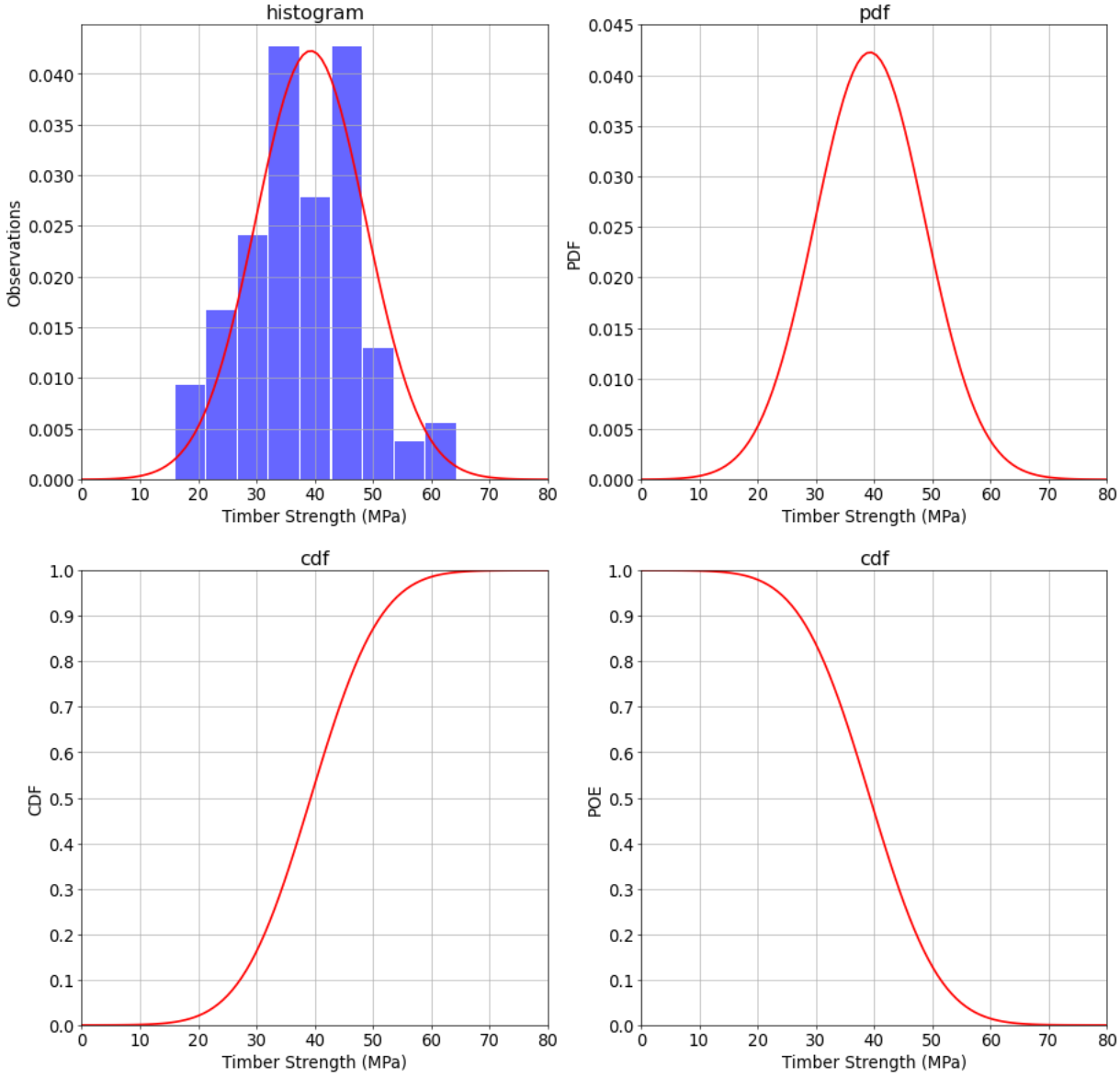
```
ax3.set_xticks(np.arange(0,90,10));
ax3.set_yticks(np.arange(0,1.1,0.10));
```



In [14]:

```
fig20=plt.figure(num=1,figsize=(18,18),dpi=60)
#num: figure number
#figsize: fugure dimension
#dpi

ax1=fig20.add_subplot(2,2,1)
ax2=fig20.add_subplot(2,2,2)
ax3=fig20.add_subplot(2,2,3)
ax4=fig20.add_subplot(2,2,4)

#-----------------------------------------
bin1='auto'

n,bin,patches=ax1.hist(x1.samples, bins=bin1, histtype='bar',facecolor='blue', densi
#bins: limits of the bins
#facecolor: color of the bar
#density: False, True
#alpha: transparency
#rwidth: distance between histograms
ax1.plot(x1.xx,x1.f,'r',lw=2)

ax1.set_title('histogram')
ax1.set_xlabel('Timber Strength (MPa)')
ax1.set_ylabel('Observations')
ax1.grid(True)
ax1.set_xlim(0,80)
ax1.set_ylim(0)
ax1.set_xticks(np.arange(0,90,10));
#ax1.set_yticks(np.arange(0,0.05,0.005));

#-----------------------------------------
ax2.plot(x1.xx,x1.f,'r',lw=2)

ax2.set_title('pdf')
ax2.set_xlabel('Timber Strength (MPa)')
ax2.set_ylabel('PDF')
ax2.grid(True)
ax2.set_xlim(0,80)
ax2.set_ylim(0)
ax2.set_yticks(np.arange(0,0.05,0.005));
ax2.set_xticks(np.arange(0,90,10));

#-----------------------------------------
ax3.plot(x1.xx,x1.F,'r',lw=2)

ax3.set_title('cdf')
ax3.set_xlabel('Timber Strength (MPa)')
```

```
ax3.set_ylabel('CDF')
ax3.grid(True)
ax3.set_xlim(0,80)
ax3.set_ylim(0,1)
ax3.set_xticks(np.arange(0,90,10));
ax3.set_yticks(np.arange(0,1.1,0.10));

#-----------------------------------------
ax4.plot(x1.xx,x1.P,'r',lw=2)

ax4.set_title('cdf')
ax4.set_xlabel('Timber Strength (MPa)')
ax4.set_ylabel('POE')
ax4.grid(True)
ax4.set_xlim(0,80)
ax4.set_ylim(0,1)
ax4.set_xticks(np.arange(0,90,10));
ax4.set_yticks(np.arange(0,1.1,0.10));
```

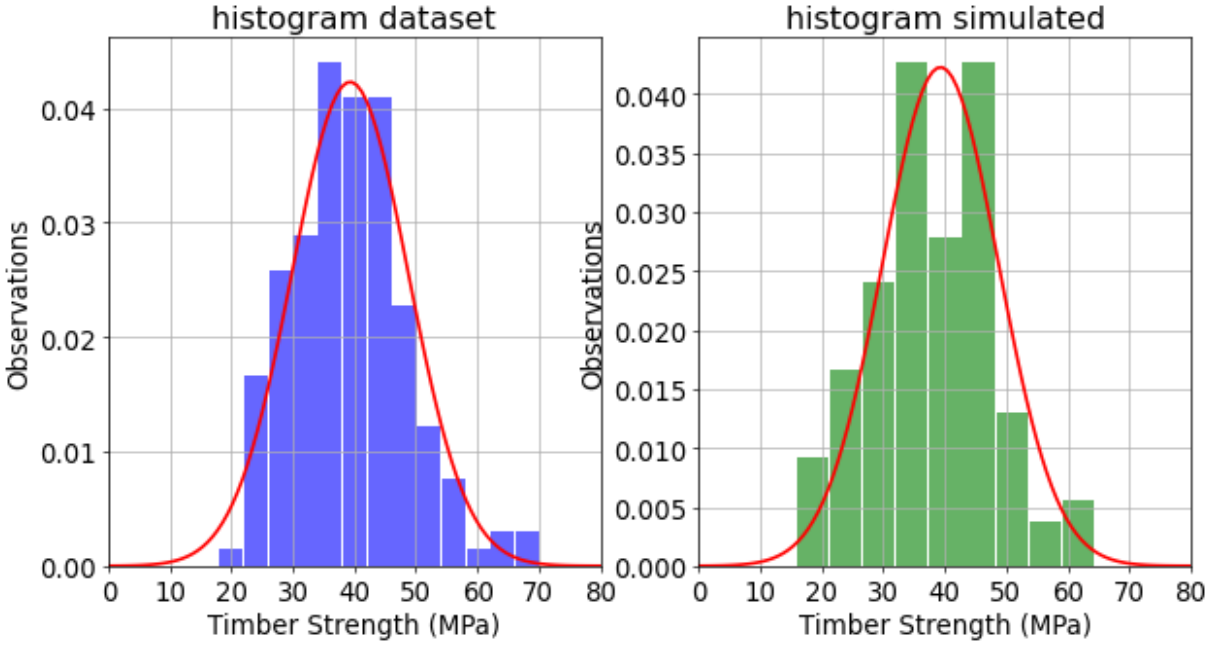


Compare data with simulated samples

In [16]:

```
data=np.loadtxt('timber164.dat')

fig30=plt.figure(num=1,figsize=(12,6),dpi=60)
#num: figure number
#figsize: fugure dimension
#dpi
```

```
ax1=fig30.add_subplot(1,2,1)
ax2=fig30.add_subplot(1,2,2)

#-----------------------------------------
bin1='auto'

n,bin,patches=ax1.hist(data, bins=bin1, histtype='bar',facecolor='blue', density=Tru
#bins: limits of the bins
#facecolor: color of the bar
#density: False, True
#alpha: transparency
#rwidth: distance between histograms
ax1.plot(x1.xx,x1.f,'r',lw=2)

ax1.set_title('histogram dataset')
ax1.set_xlabel('Timber Strength (MPa)')
ax1.set_ylabel('Observations')
ax1.grid(True)
ax1.set_xlim(0,80)
ax1.set_ylim(0)
ax1.set_xticks(np.arange(0,90,10));
#ax1.set_yticks(np.arange(0,0.05,0.005));

#-----------------------------------------
bin1='auto'

n,bin,patches=ax2.hist(x1.samples, bins=bin1, histtype='bar',facecolor='green', dens
#bins: limits of the bins
#facecolor: color of the bar
#density: False, True
#alpha: transparency
#rwidth: distance between histograms
ax2.plot(x1.xx,x1.f,'r',lw=2)

ax2.set_title('histogram simulated')
ax2.set_xlabel('Timber Strength (MPa)')
ax2.set_ylabel('Observations')
ax2.grid(True)
ax2.set_xlim(0,80)
ax2.set_ylim(0)
ax2.set_xticks(np.arange(0,90,10));
#ax1.set_yticks(np.arange(0,0.05,0.005));
```



In [ ]: