In [ ]:
```
import numpy as np
import matplotlib.pyplot as plt
from scipy import stats
```

Problem 2

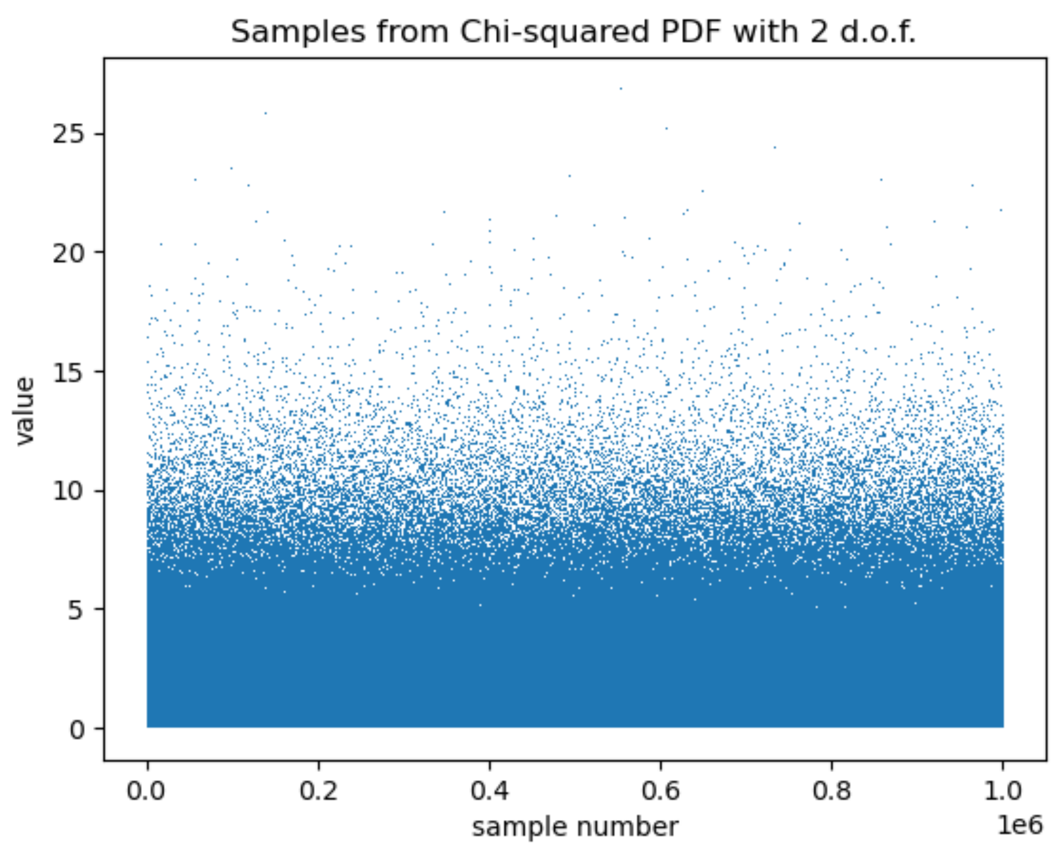
Generate a realization of the chi-squared distribution for 2 degrees of freedom.

1. Present a plot of a realization of samples drawn from this distribution
2. Plot a histogram of this realization, choose the number of samples to be sufficiently high that the shape of the distribution can be seen with limited noise.
3. Compute the mean, standard deviation, skewness, and kurtosis

1. Present a plot of a realization of samples drawn from this distribution

In [ ]:
```
N = 1_000_000
data = stats.chi2.rvs(2, size=N)
plt.plot(data, ',')
plt.title("Samples from Chi-squared PDF with 2 d.o.f.")
plt.xlabel("sample number")
plt.ylabel("value")
```

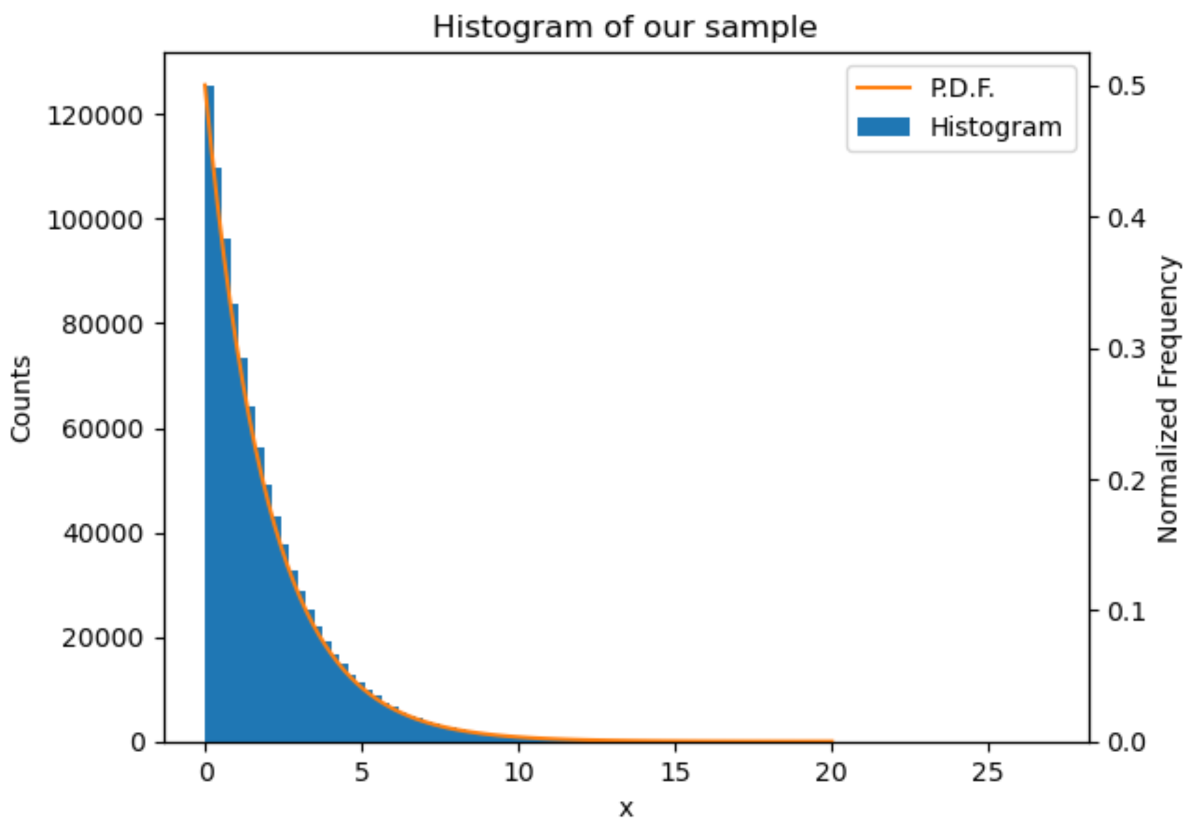
Out[ ]:
```
Text(0, 0.5, 'value')
```



2. Plot a histogram of this realization, choose the number of samples to be sufficiently high that the shape of the distribution can be seen with limited noise.

In [ ]:
```
fig, ax = plt.subplots()
ax2 = ax.twinx()

# Normalized Histogram:
ax2.hist(data, bins=100, density=True, label='Histogram')

# Counts Histogram:
ax.hist(data, bins=100, density=False)

# P.D.F. to see if fit is o.k.:
x = np.linspace(0, 20, 100)
p_x = stats.chi2.pdf(x, 2)
ax2.plot(x, p_x, label="P.D.F.")

# Plot stuff:
plt.title('Histogram of our sample')
ax.set_xlabel("x")
ax2.set_ylabel("Normalized Frequency")
ax.set_ylabel("Counts")
ax2.legend()
```

Out[ ]:
```
<matplotlib.legend.Legend at 0x7f0b15ad4460>
```



3. Compute the mean, standard deviation, skewness, and kurtosis

In [ ]:
```
# Calculate from sample
mean = stats.tmean(data)
std = stats.tstd(data)
skewness = stats.skew(data)
kurtosis_fisher = stats.kurtosis(data, fisher=True)

print("Stats from sample: \n"
      f" - Mean: \t {mean} \n",
      f"- Standard Deviation: \t {std} \n",
      f"- Skewness (Fisher-Pearson coefficient): {skewness} \n",
      f"- Kurtosis (Fisher's definition): {kurtosis_fisher} \n"
      )
```

```
Stats from sample:
 - Mean:         2.0002648945850954
 - Standard Deviation:   1.998631479865362
 - Skewness (Fisher-Pearson coefficient): 1.9827355708453183
 - Kurtosis (Fisher's definition): 5.820588762113152
```

In [ ]:
```
# True distribution parameters:
m, v, s, k = stats.chi2.stats(2, moments='mvsk')
print("True distribution parameters: \n"
      f" - Mean: \t {m} \n",
      f"- Standard Deviation: \t {np.sqrt(v)} \n",
      f"- Skewness (Fisher-Pearson coefficient): {s} \n",
      f"- Kurtosis (Fisher's definition): {k} \n"
      )
```

```
True distribution parameters:
 - Mean:         2.0
 - Standard Deviation:   2.0
 - Skewness (Fisher-Pearson coefficient): 2.0
 - Kurtosis (Fisher's definition): 6.0
```