In [ ]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
from scipy.io import loadmat       # Import function to read data.
data = loadmat('Ch3_d2.mat')
f = data['d']
print(f)
```

```
[[0 1 0 ... 1 0 0]
 [0 0 0 ... 0 0 0]
 [0 0 0 ... 0 0 0]
 ...
 [0 0 0 ... 0 0 0]
 [0 0 0 ... 1 0 0]
 [0 0 0 ... 0 0 0]]
```

In [ ]:
```
np.shape(f)
```

Out[ ]:
```
(1000, 500)
```

QUESTION 1: CALCULATE AVERAGE NUMBER OF SPIKES PER TRIAL

In [ ]:
```
n_trials = np.shape(f)[0]
T = np.shape(f)[1]
print(n_trials)
print(T)
```

```
1000
500
```

In [ ]:
```
n_spikes_per_trial = np.sum(f,1)
print(n_spikes_per_trial[0:2])
np.shape(n_spikes_per_trial)
```

```
[ 7 14]
```

Out[ ]:
```
(1000,)
```

In [ ]:
```
n_avg = np.mean(n_spikes_per_trial)
print("The average number of spikes per trial is", n_avg)
```

```
The average number of spikes per trial is 12.075
```

THE AVERAGE FIRING RATE:

In [ ]:
```
duration_of_a_trial_in_seconds = 0.5
avg_firing_rate = n_avg / duration_of_a_trial_in_seconds
print("The average firing rate is", avg_firing_rate, "HZ")
```

```
The average firing rate is 24.15 HZ
```

AVERAGE ISI:

In [ ]:
```
duration_of_a_trial_in_seconds = 0.5
avg_firing_rate = n_avg / duration_of_a_trial_in_seconds
print(avg_firing_rate)

ISI = [];                                   #Empty variable to hold ISIs
for k in range (n_trials):                  #For each trial:
    spike_times = np.where(f[k,:] == 1);    #.............. find indices where sp
    isi0 = np.diff(spike_times);            #.............. get the difference be
    ISI = np.concatenate([ISI, isi0[0]]);   #.............. and append this to li
```

```
24.15
```

In [ ]:
```
mean_ISI = np.mean(ISI)
print("The average ISI is", mean_ISI, "s.")
```

```
The average ISI is 35.62446952595937 s.
```

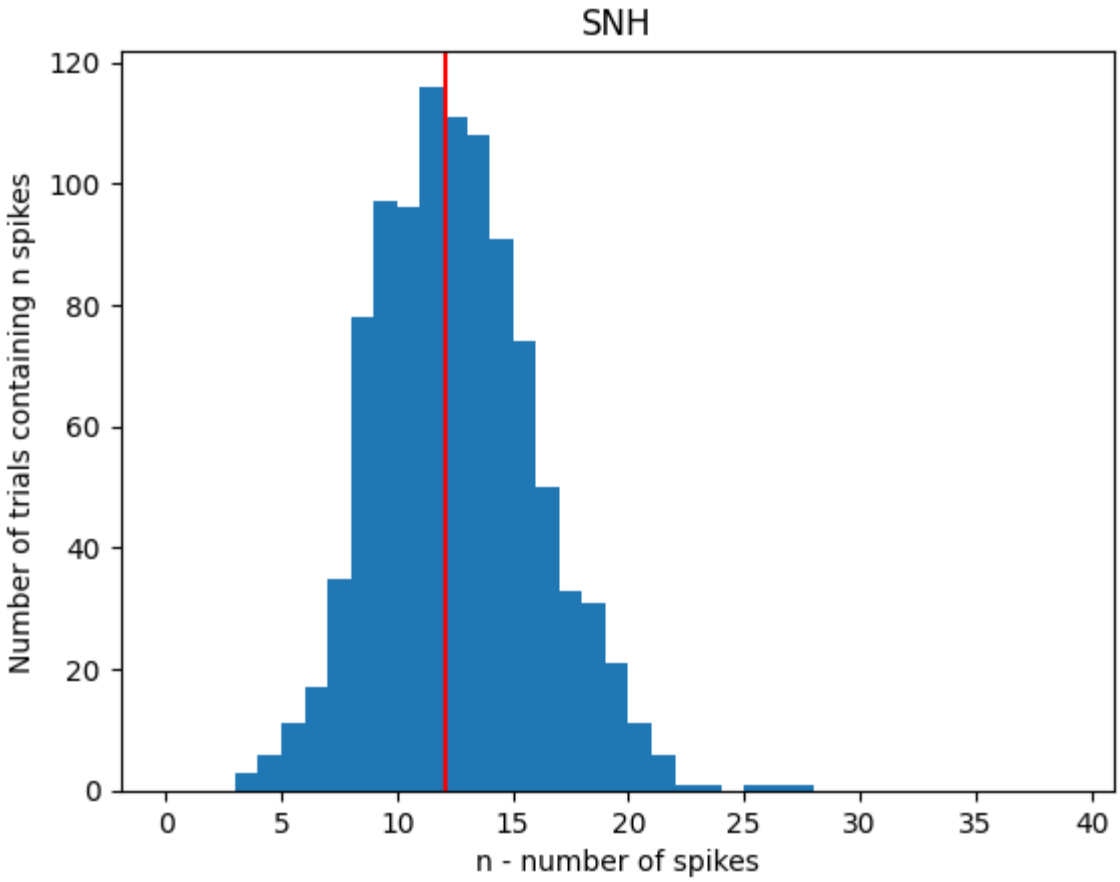
FANO:

In [ ]:
```
fano = np.var(n_spikes_per_trial)/ np.mean(n_spikes_per_trial)
print("The Fano factor is", fano)
```

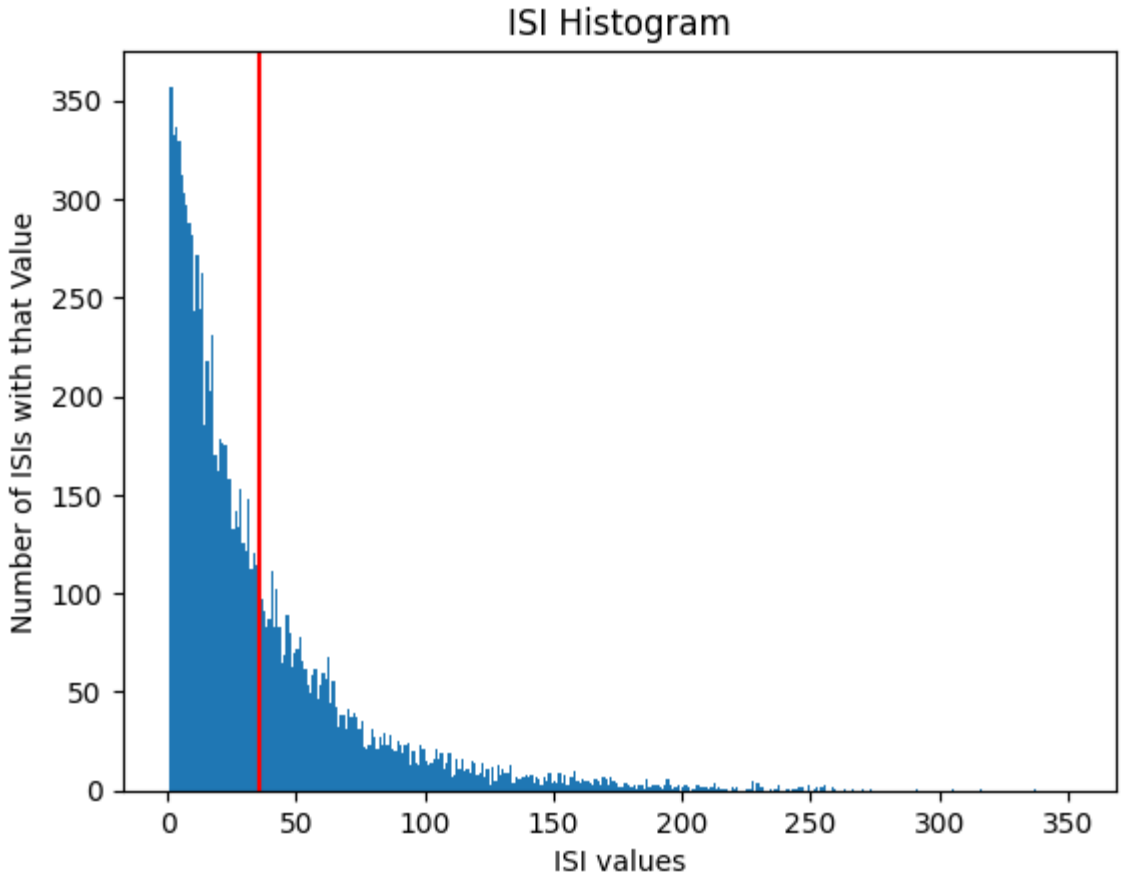
```
The Fano factor is 1.0084782608695653
```

QUESTION 2: Compute and plot SNH, ISI histogram, and PSTH. Mark the average on each plot.

In [ ]:
```
#THE SNH
plt.hist(n_spikes_per_trial, np.arange(40))
plt.xlabel('n - number of spikes')
plt.ylabel('Number of trials containing n spikes')
plt.title('SNH');
plt.axvline(n_avg, color='r');
plt.show()
```

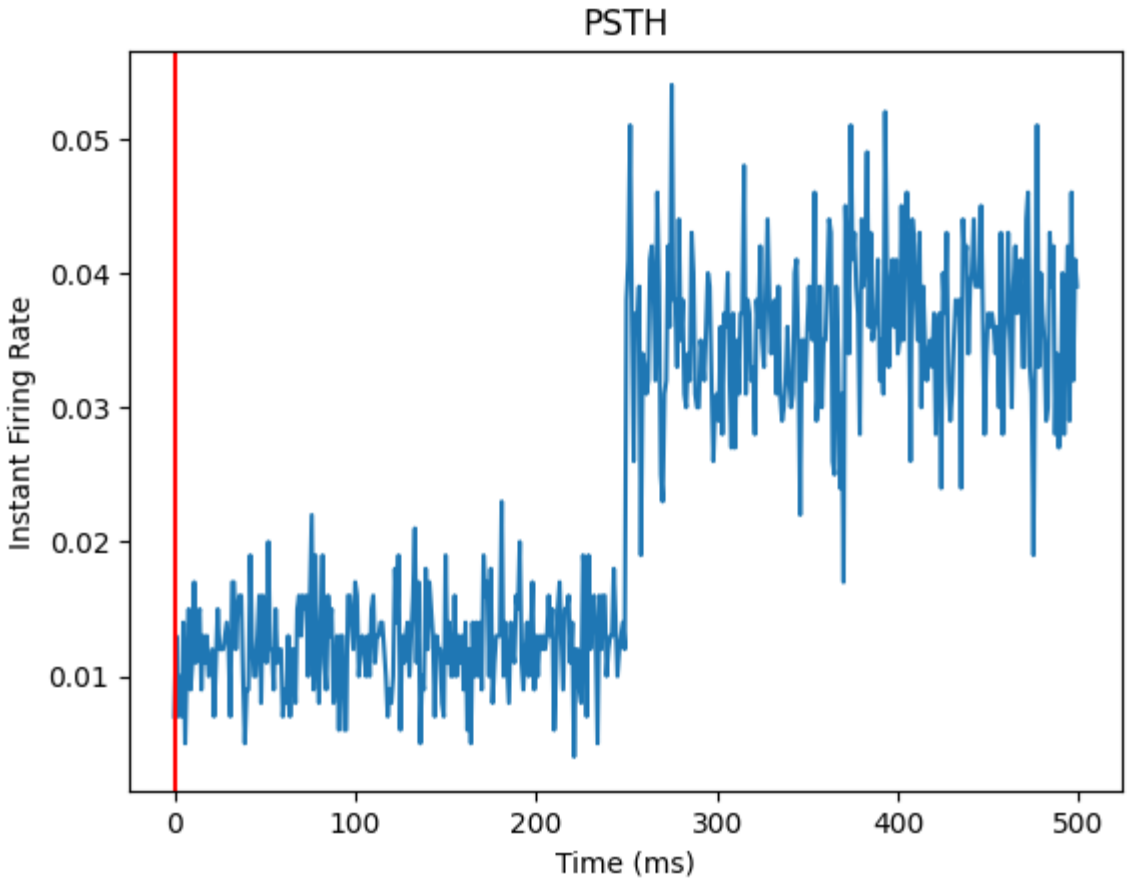


In [ ]:
```
#THE ISI
plt.hist(ISI, np.arange(np.max(ISI)));
plt.xlabel('ISI values')
plt.ylabel('Number of ISIs with that Value')
plt.title('ISI Histogram')
plt.axvline(mean_ISI, color='r');
plt.show()
```



In [ ]:
```
#PSTH
prob_spike = np.sum(f,0)/n_trials; #this will give us the probabiliy of a spike at
mean_prob_spike = np.mean(prob_spike)

dt = 00.1 #this is the uhhh time between samples in [s] == 1 ms
instant_firing_rate = prob_spike/dt
plt.plot(prob_spike)
#what is the firing rate approximately? what should the axes be?
plt.xlabel('Time (ms)')
plt.ylabel('Instant Firing Rate')
plt.title('PSTH')
plt.axvline(mean_prob_spike, color='r');
```


PSTH
Instant Firing Rate
0.05
0.04
0.03
0.02
0.01
0
100
200
300
400
500
Time (ms)