Caroline Cutter

NSCI 1230

January 13, 2022

**Homework 3: Fano Factor & CV**

**Group 1 with Diana Xu**

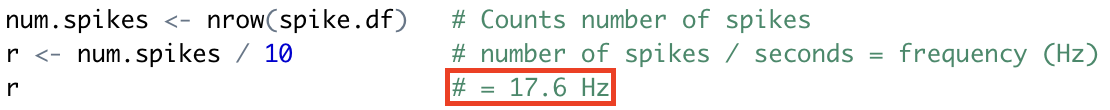
**Worksheet 2: Fano Factor**

**Question 2:** Plot spike times like the last assignment. What do you notice about the spike train?

This plot shows that the spike train fires continuously with a regular and high firing rate. However, with such a large time scale and how many spikes there are, it is hard to tell specific details about this firing neuron from the plot.



**Question 3:** Compute the average firing rate, r.



**Question 4 & 5:** Bin the spikes using cut(). Create a data frame that contains spike counts per bin. Add a column to the data frame that contains firing rate in Hz.

Text

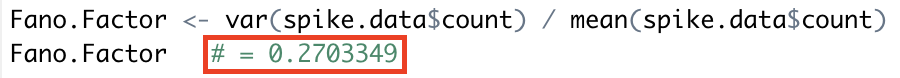
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**Question 6:** Use geom\_col to create a histogram of firing rates.



**Question 7:** Compute the Fano Factor for this spike train. What does it say about the variability in the spike count?

The Fano factor of this spike train is 0.2703349. This tells us that this spike train is more regular than a Poisson distribution, which means there is a similar firing rate throughout the spike train.

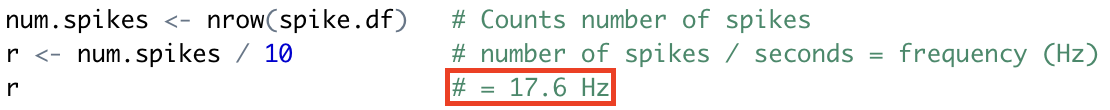


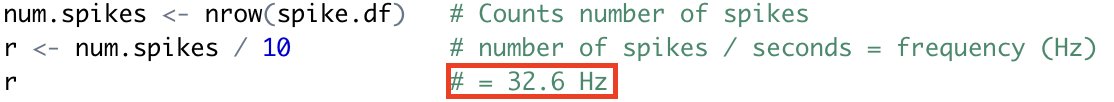
**Question 8:** Repeat 1-7 for “spikeTimes\_example5\_FR.csv” and compare. Explain similarities/differences between spike trains by the Fano Factor. Put them side to side for a better comparison.

**KEY:** spikeTime\_sim5.csv and spikeTimes\_example5\_FR.csv

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It can be seen in this graph that the sim5 spike train has a lower firing rate than the example5 graph, because the example5 is much denser, meaning it fires more frequently than the sim5 neuron.

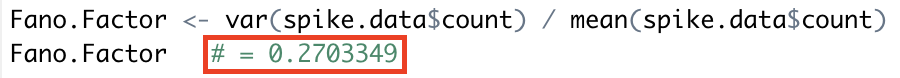


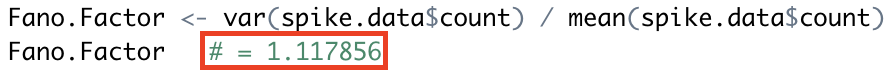
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The example5 neuron fires at almost x2 the average frequency than the sim5. This supports the observation above and is why the example5 has a denser look to it.

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Overall, the example5 and sim5 data look very similar in terms of shape of the firing rate distributions over a period of 10,000 ms, however if you look closely, you can see that the y-scale of the example5 data is twice the size of the sim5 data, which means it has a higher frequency of firing across the different bins of time. This also supports the two observations above. The sim5 data looks to have a more regular firing rate across the whole time because the bins of data (the bars) are more similar in height than the example5 data.

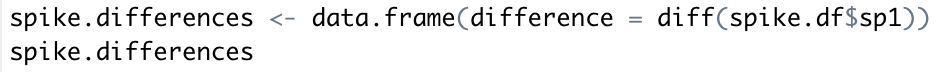


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The Fano Factor’s support the observation above that the sim5 data has a more regular firing rate throughout the whole spike train. We can see that the example5 data is less regular than a Poisson because it’s Fano Factor is > 1.

**Worksheet 3: ISI & CV**

**Question 2:** Create a new data frame that holds successive spike time differences for the spike train (use the function diff() )



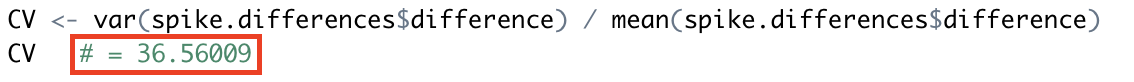
**Question 3:** Create an ISI plot. What does this plot tell us about the spike train? What kinds of conclusions can we draw?

This plot tells us about the regularity of Interspike intervals. We can see that the most common time between spikes was around 10 – 20 ms long, because this is where the highest number of Interspike intervals was recorded. We can also see that the Interspike intervals ranged from about 0 ms to 220 ms, but has a large right skew towards lower intervals



**Question 4:** Compute the coefficient of variation (CV). Discuss what this means about your spike train.

This means that there is high variability between the Interspike intervals and that the graph is much less regular than Poisson

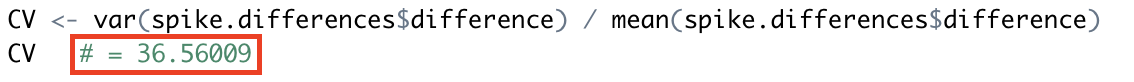


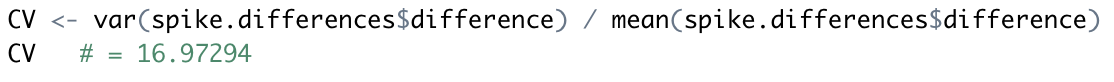
**Question 5:** Repeat 1-4 for the data “spikeTime\_sim5\_FR.csv” and compare. Explain similarities/differences between these two spike trains as illustrated by the ISI and CV.

**KEY:** spikeTime\_sim5.csv and spikeTimes\_example5\_FR.csv



These graphs look similar in their shape because they are both right skewed, however there are a few key differences. First, the y-axis scale is a lot larger in the example5 data than the sim5 data because it had more spikes to record. Another, is that the most common firing time for the sim5 was around 40 - 50 ms while the example5 was around 10 – 20 ms, which means also shows that the example5 had a higher average firing rate. Both graphs show a lack of Interspike intervals in the higher ranges (100 – 200 ms), but both graphs had a few that were very high (example5 ~215 ms, sim5 ~200)





Both Coefficient of Variations (CV) show that the neuron in example5 and sim5 were much less regular than Poisson. However, it is interesting to note that sim5 was about 2x as regular as example5. This tells us that both neurons had a high variability in Interspike interval times.