CFCS1: Practical 7
Continuous distributions

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Introduction

In this practical you will use the exponential distribution to model the firing pattern of a neuron. This requires familiarity with the lecture material on continuous probability distributions.

1 Confirming the model

Under certain laboratory conditions, a neuron is found to have a mean firing rate of 10Hz – in other words, it fires on average once every 0.1 seconds.

We say that T is the random variable measuring gap between successive firing times Data on neuron firing times have been collected in the laboratory. You will use this data to check that the exponential distribution is a good model for the random variable T.

Load the vector `firingData` from `lab7_data.mat`. This contains 1000 recordings of gaps between successive firing times, ie. samples of T.

1. Write down the probability density function for T, assuming that it has an exponential distribution.

2. Given that we know the mean firing rate to be 10Hz, what is the best choice of the parameter, θ, of the exponential distribution model?

You can use a histogram to plot the probability density of the sample firing data. To produce a histogram, use the following Matlab commands:

```
>> n=histc(firingData,0:0.025:1);
>> bar(0:0.025:1, n/(1000*0.025),'histc')
```

The first command divides the samples into 'bins', each with width 0.025, and produces a count, `n`, of how many samples are in each bin. The second line calculates the probability of each bin, by diving the count by the total number of samples (1000) and the width of the bin, and then plots this as a bar chart.

3. Produce the probability histogram, as described above.

4. On the same plot, display the probability density function for the exponential distribution with your parameter chosen in Question 2 (use Matlab's `fplot` function). How well does it fit the experimental data?

2 Using the model

Use your exponential model to compute:

5. $p(T \leq 0.15)$

6. $p(T > 0.1)$

7. $p(T > 0.15 \,|\, T > 0.05)$. This is the probability that the neuron waits more than 0.15s before firing, given we have observed that it has already waited 0.05s.

8. Can you explain the connection between your last two answers?