Instructions. Solve the following two exercises. Return both the code written for MATLAB and figures, properly labeled. Answer the questions and justify your claims with clear and logical explanations. The data needed to solve exercise 2 can be downloaded from the web page:

`http://www.caam.rice.edu/~caam415/lec_gab/ex1`

1 Binomial and Poisson distribution

1. Plot a bar histogram of the binomial probability distribution for $n = 200$ release sites and single release site probabilities $p = 0.01, 0.05$ and 0.1. What are the parameters of the associated Poisson limit distribution? Add to each of these 3 graphs a bar histogram of the corresponding Poisson distribution. Label the axes properly. Compute in each case the maximal relative absolute error between both distributions for probability values of the binomial distribution exceeding 0.05 (i.e., if p_k is the probability of k vesicles being released under the binomial distribution and q_k the corresponding value for the Poisson distribution, compute $\max_{\{k\,|\,p_k \geq 0.05\}} |p_k - q_k|/p_k$). Explain the results.

2. Repeat in the case of $n = 4$ and $p = 0.1, 0.5$ and 0.75. Compare the results in both cases.

Hints

Take advantage of the following MATLAB functions: `poisspdf`, `binopdf`, `bar`.

2 Distribution of end-plate potentials at the cat neuromuscular junction

Following the work of del Castillo and Katz (1954) described in the lecture notes at the frog neuromuscular junction, Boyd and Martin(1956) repeated similar experiments at the cat neuromuscular junction. Their data for spontaneous and evoked endplate potentials and fits with the compound Poisson model are illustrated in the lecture notes. The raw data is contained in two files called `spont_data` and `stim_data` that can be downloaded from the exercise web page.

1. Fit the spontaneous data histogram to a normal distribution and reproduce the inset of the lecture notes.

2. Estimate the quantal size using the standard method (eq. 7.5 in the lecture notes) and the method of failures (eq. 7.6). What is the relative error of the method of failures (with respect to the standard method)? Which one of those two methods would you expect to be more accurate? Explain.

3. Fit the evoked activity histogram using the results of 1 and 2 and reproduce the main plot of the figure in the lecture notes.

Hints

1. Take advantage of the following MATLAB functions: `normfit, normpdf, poisspdf, bar`.

2. The probability density functions of the normal distribution and the continous part of the compound Poisson distribution should be normalized so that the *area* under these curves match the area under the corresponding raw data histograms.

References

Del Castillo J. and Katz B. (1954). Quantal components of the end-plate potential. J. Physiol. 124:560-573.

Boyd I.A. and Martin A.R. (1956). The end-plate potential in mammalian muscle. J. Physiol. 132:74-91.