Plot Poisson fits

- For *in vitro* data (results presented in figure 1), this script loads .csv files containing the median fluorescence values of granules measured using ImageJ.
- For *In vivo* data (result presented in supplementary files), this script loads the burst amplitude data collected using the standard data analysis pipeline.
- The fluorescence data is fitted to a modified Poisson distribution of the form:

$$p(I) = \frac{\lambda^{\frac{I}{k_0}} e^{-\lambda}}{\left(\frac{I}{k_0}\right)!}$$

Where λ is the Poisson rate, and k_0 is a normalization factor which can be regarded as the fluorescence level of a single molecule.

Principle of operation

- The fluorescence intensity data is first binned into bins of equal width to construct a counting process. For each λ value, a theoretical Poisson distribution is generated to compare against.
- For each k_0 value, the fluorescence data and the bin edges are normalized by it to get an x-axis on which a Poisson distribution is defined (i.e., [0-10]). The mean squared error (MSE) between the theoretical Poisson distribution and the experimental, normalized counts is computed.
- The output is the λ and k_0 values which minimize the MSE to the theoretical Poisson distribution.

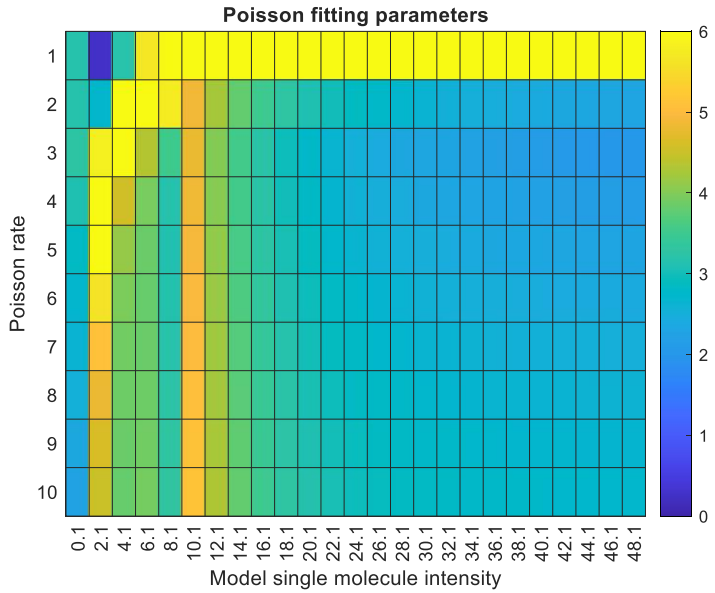
Parameter settings

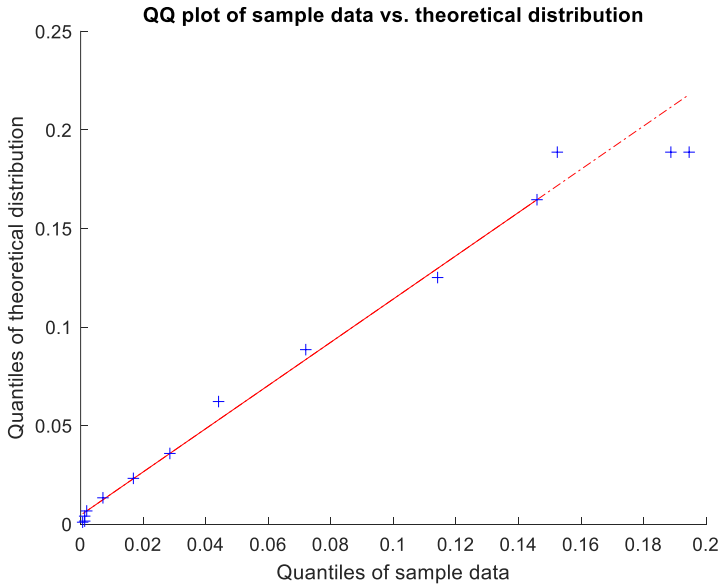
- For each data set the following parameters are required:
  - Lambda – an array of lambda values to iterate on
  - K0 – an array of K0 values to iterate on
  - binWidth – width of the bins to divide the data into
  - String to be used as a title on the generated plot

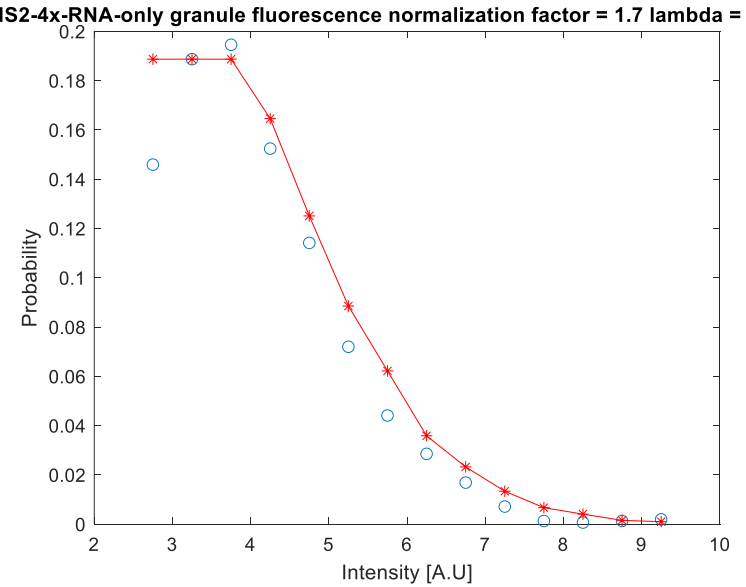
Script demo results

The script is provided with all the data required to generate the plots appearing in figure 1.

Running the script as provided results in 30 figures like the following:







From left to right: heatmap of mean squared error values per lambda and K0, QQ-plot of the best fit, scatter plot of the theoretical data overlaid with the best fit, title shows lambda and K0 values of the fit.

Notes

- Finetuning of the parameters is almost always necessary when analyzing new data.
- Visual inspection of the QQ-plot is needed when changing the parameters to ensure goodness of fit.