EE239AS hw3 Cong Peng 904760493

1. (a) $Pr(N=n) \sim Poisson(\lambda s) = \dfrac{(\lambda s)^n e^{-\lambda s}}{n!}$

$$Pr(M=m \mid N=n) = \binom{n}{m} (1-p)^m p^{n-m}$$

$$Pr(M=m) = Pr(M=m \mid N=n)\, Pr(N=n)$$

$$= \frac{((1-p)\lambda s)^m e^{-(1-p)\lambda s}}{m!}$$

Hence, $M \sim Poisson((1-p)\lambda s)$

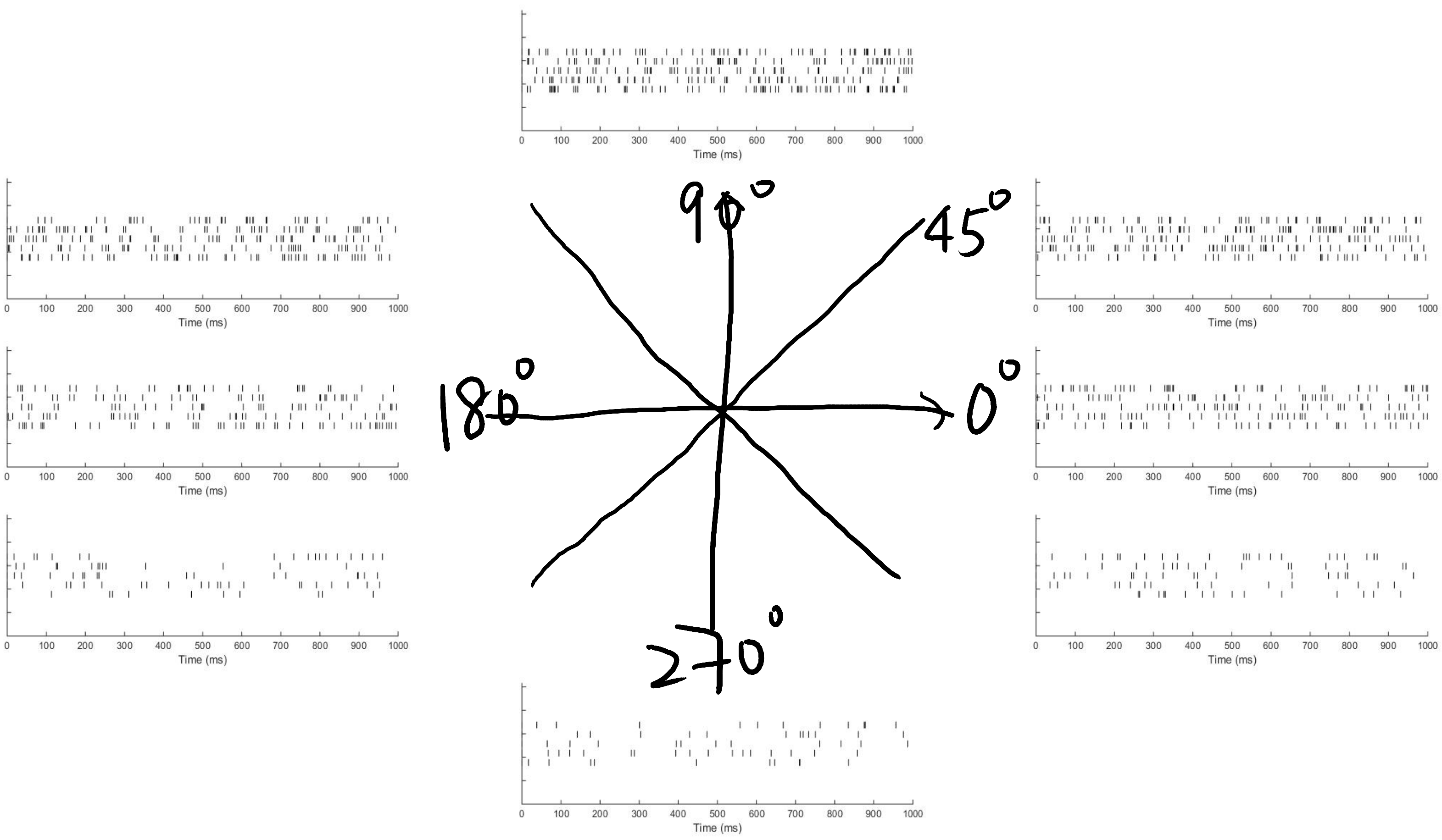
(b) rate : $(1-p)\lambda$

(c) Similarly, $N-M$ (# of spikes dropped within a T second is also a Poisson distribution at a rate of $p\lambda$

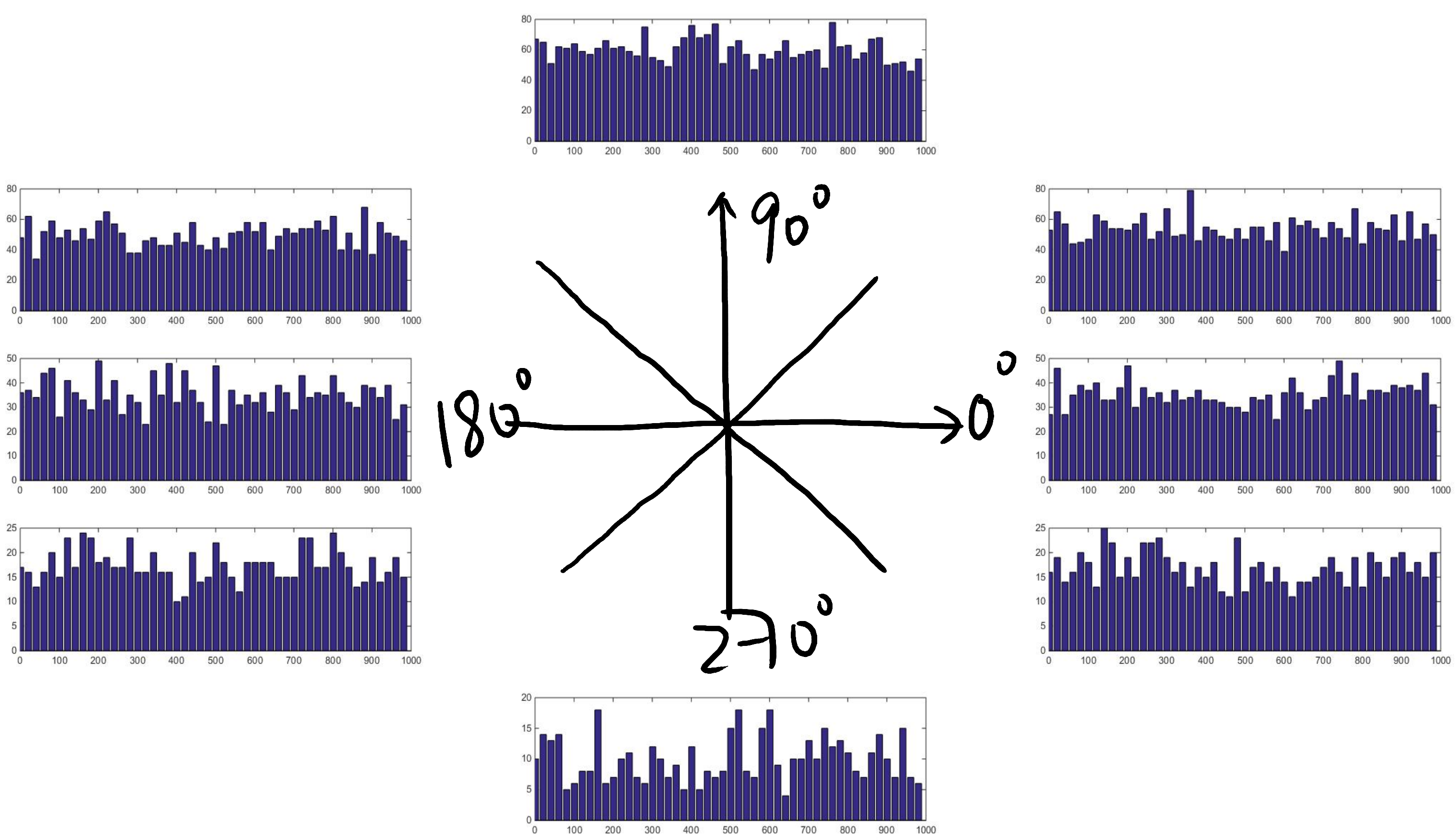
$$Pr(N-M=r) = \frac{(p\lambda s)^r e^{-p\lambda s}}{r!}$$

2. Homogeneous Poisson process

(a) Spike trains

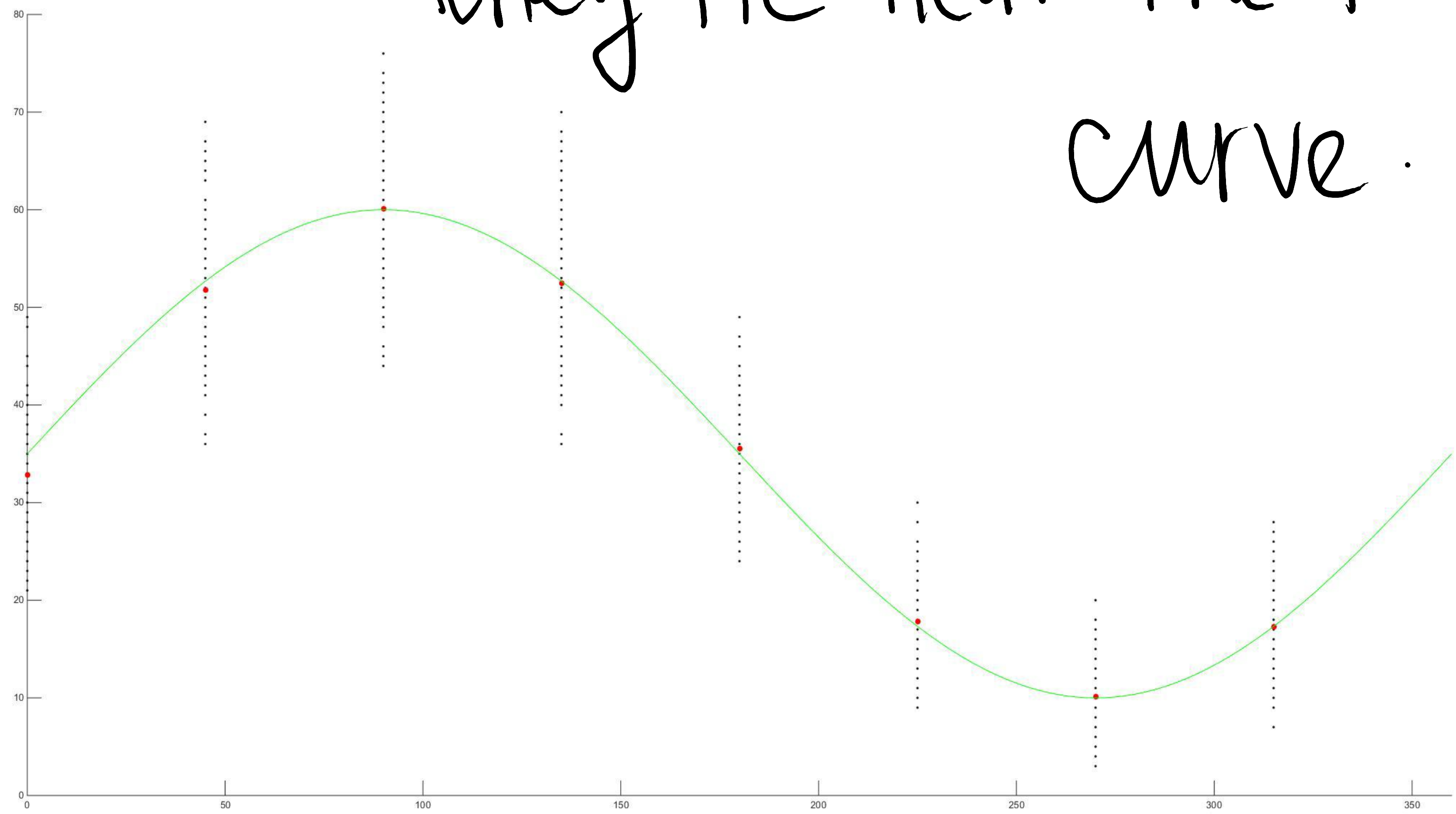


(b) Spike histogram



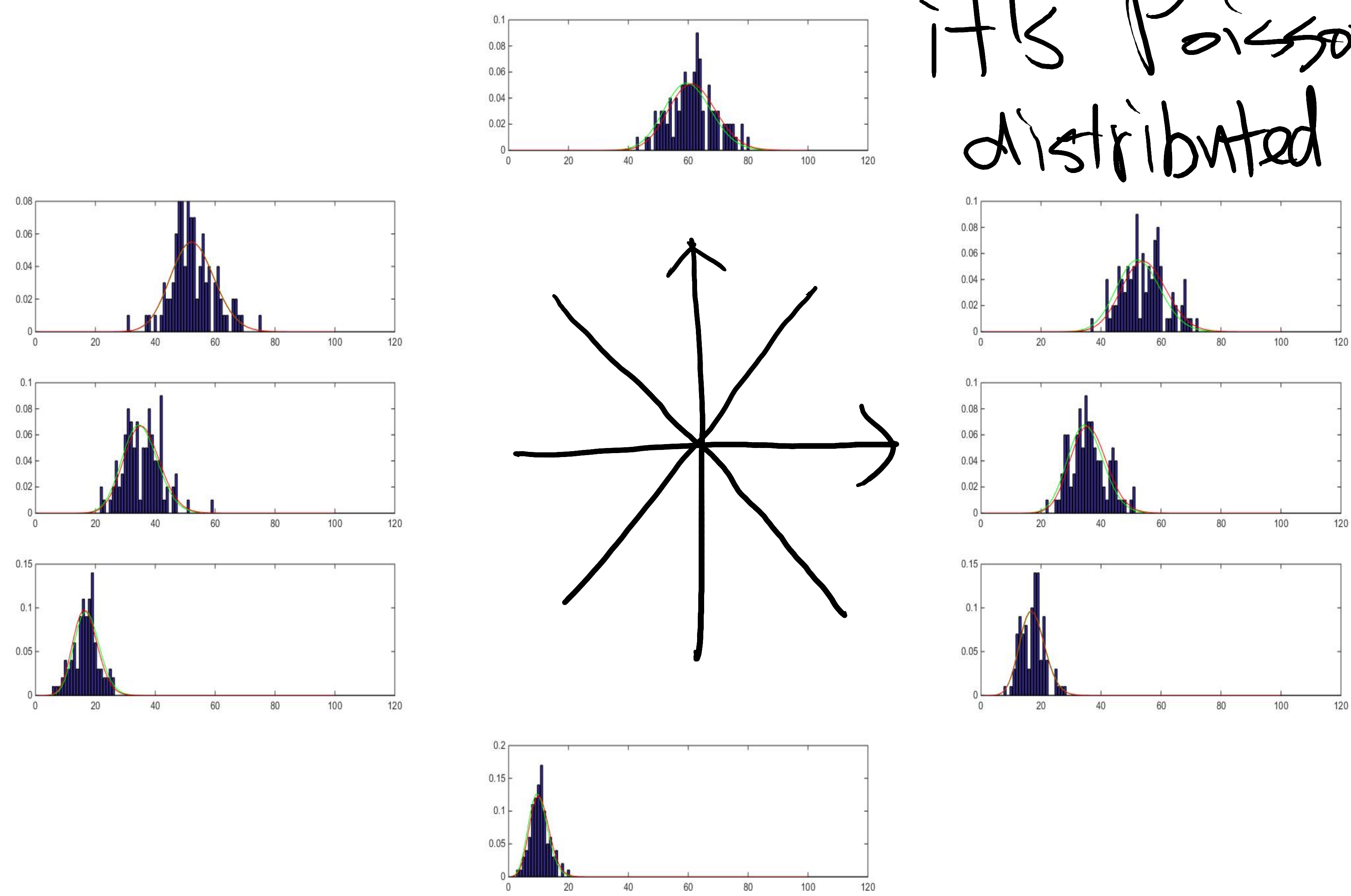
(c) Tuning curve

they lie near the tuning curve.



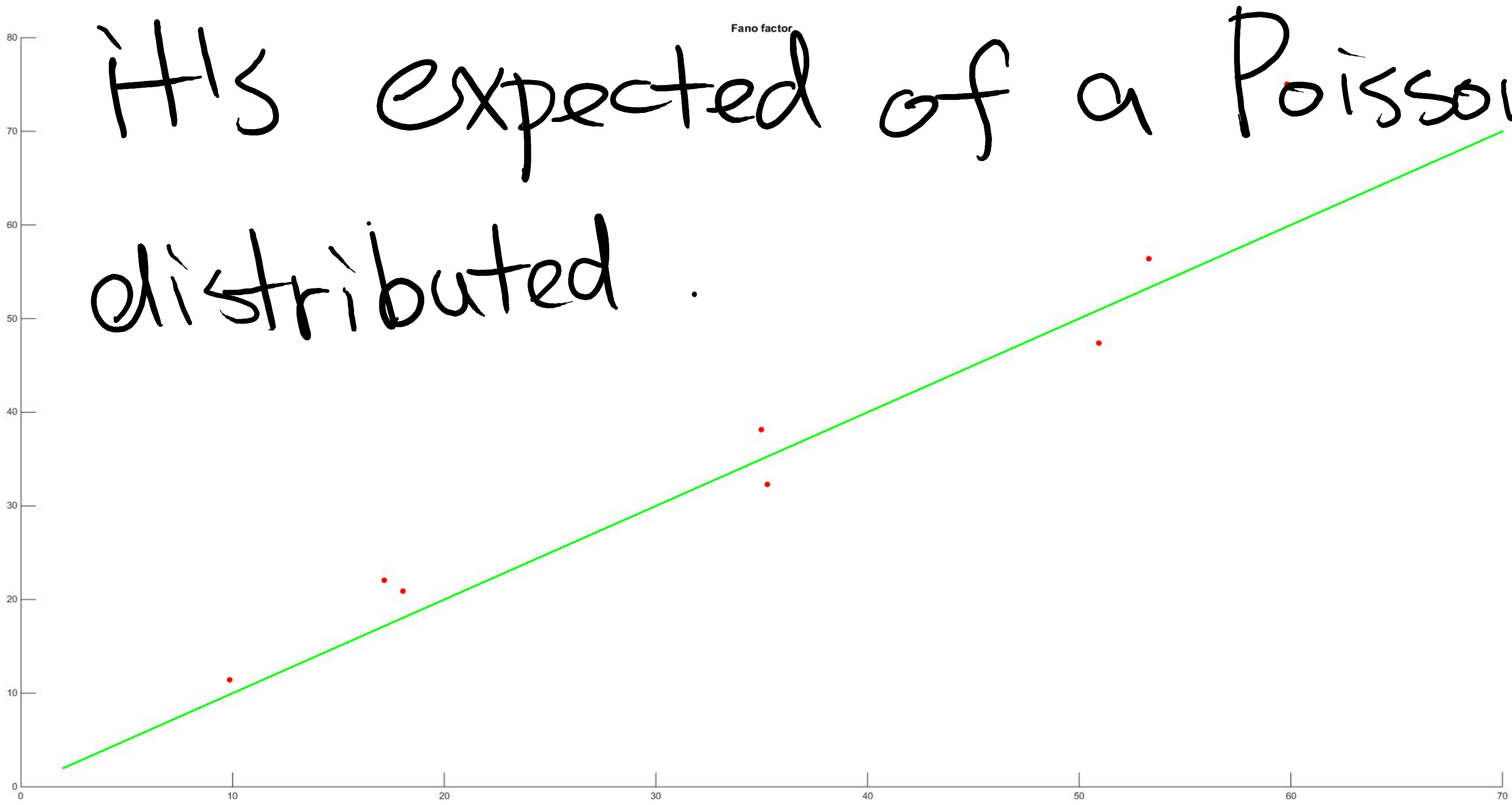
(d) Count distribution

it's Poisson distributed



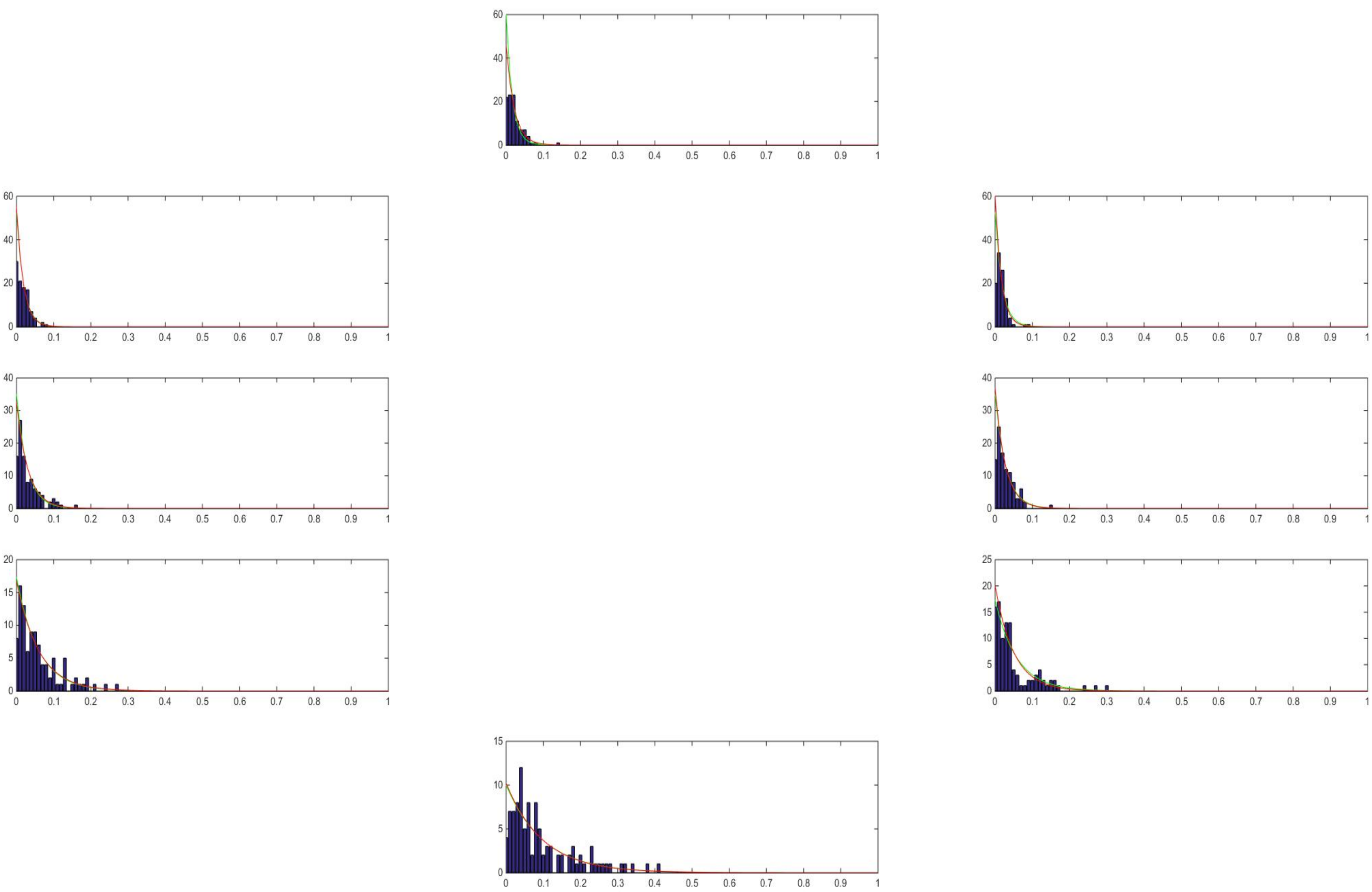
(e) Fano Factor

it's expected of a Poisson distributed.



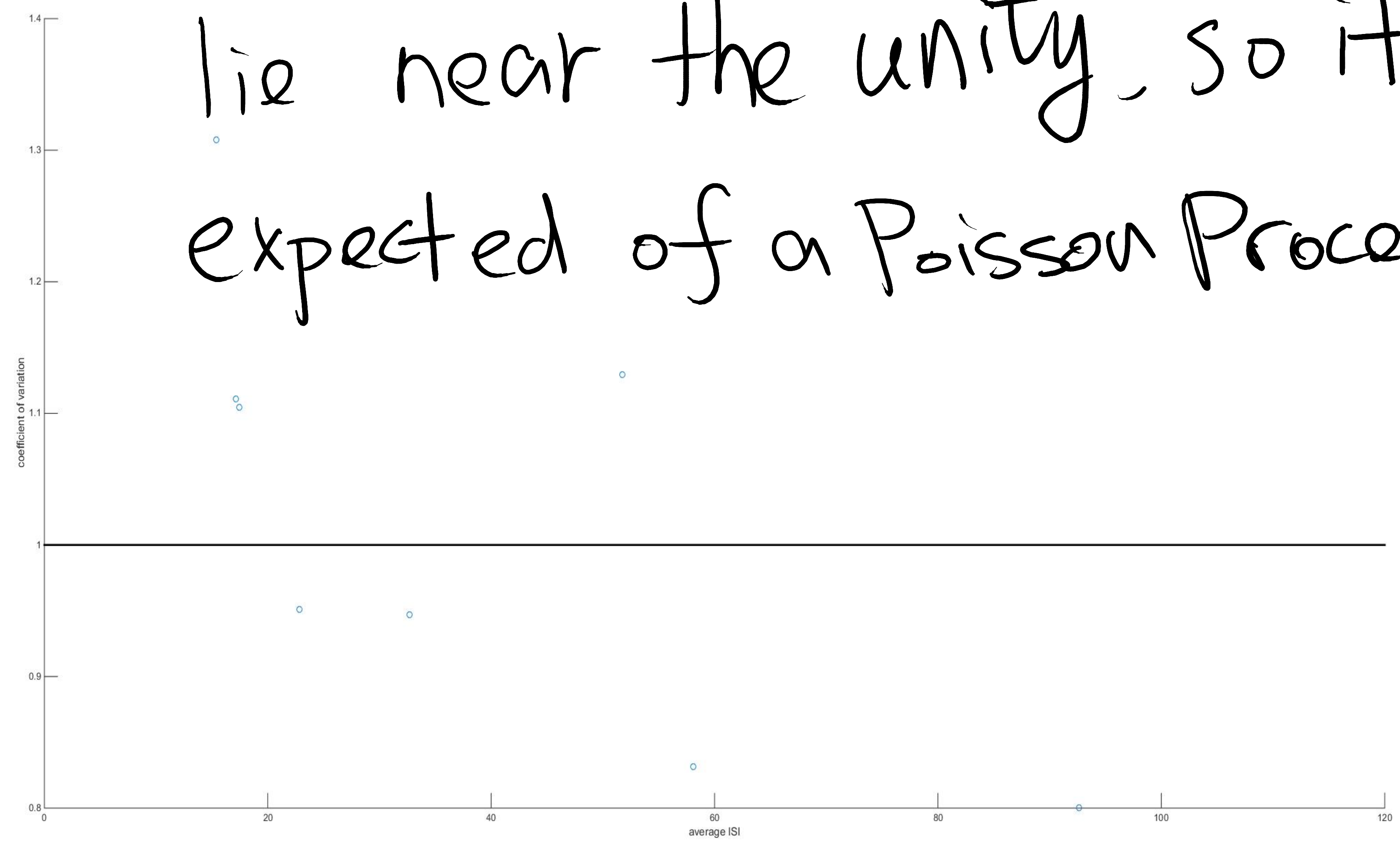
(f) ISI distribution

it's exponential distributed.



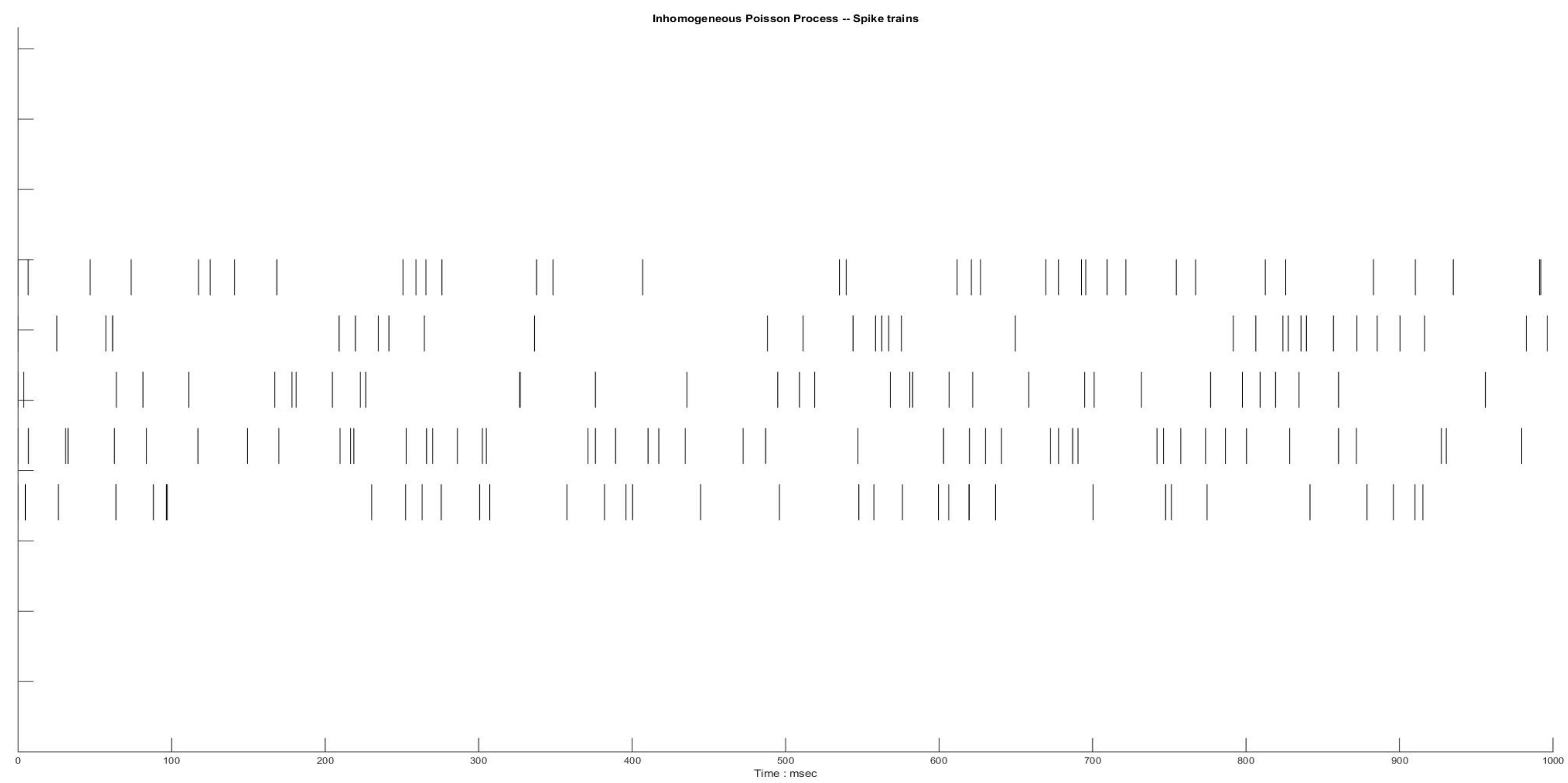
(g) Coefficient of variation

lie near the unity, so it's expected of a Poisson Process.



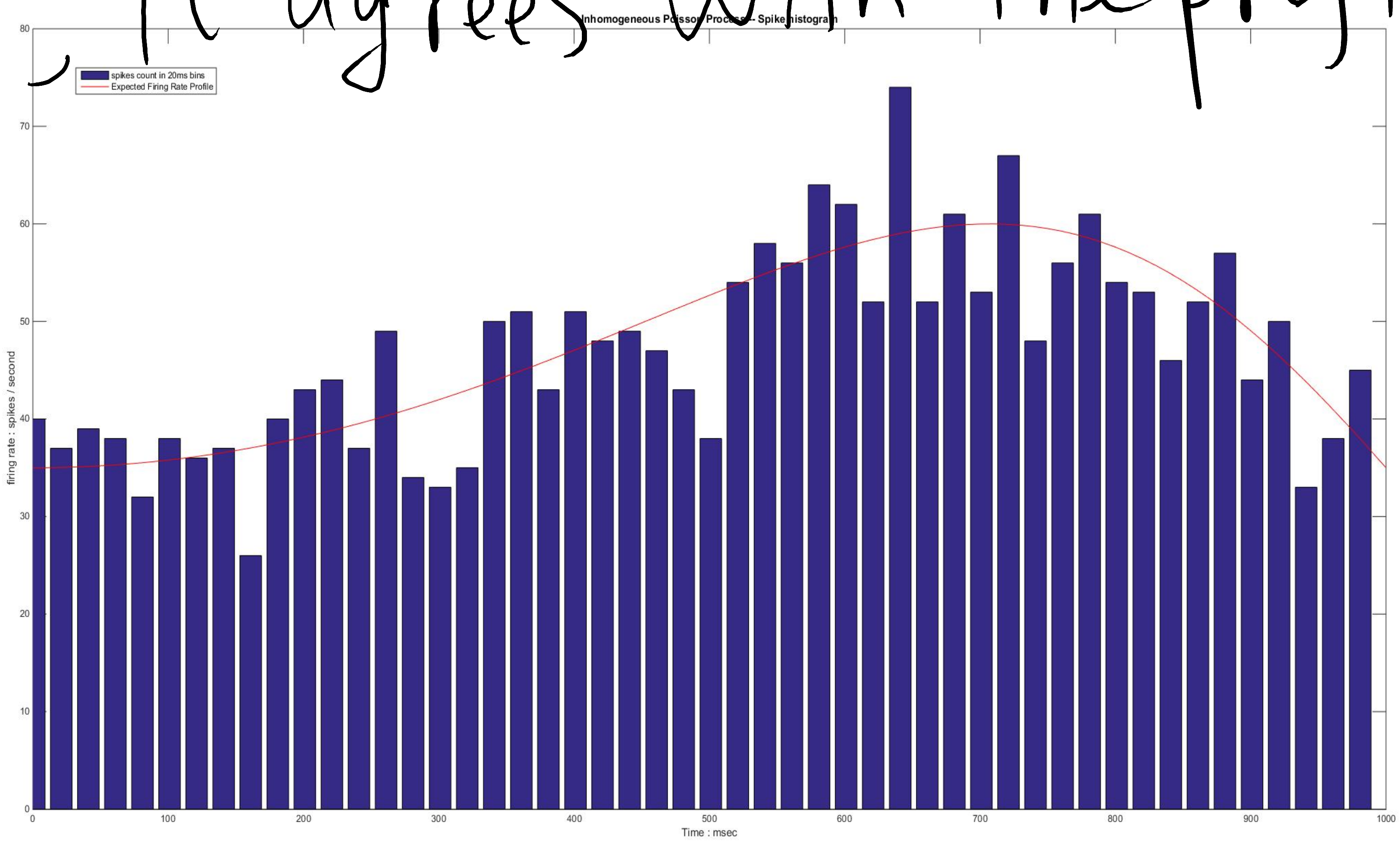
3. Inhomogenous Poisson Process

(a) Spike Trains



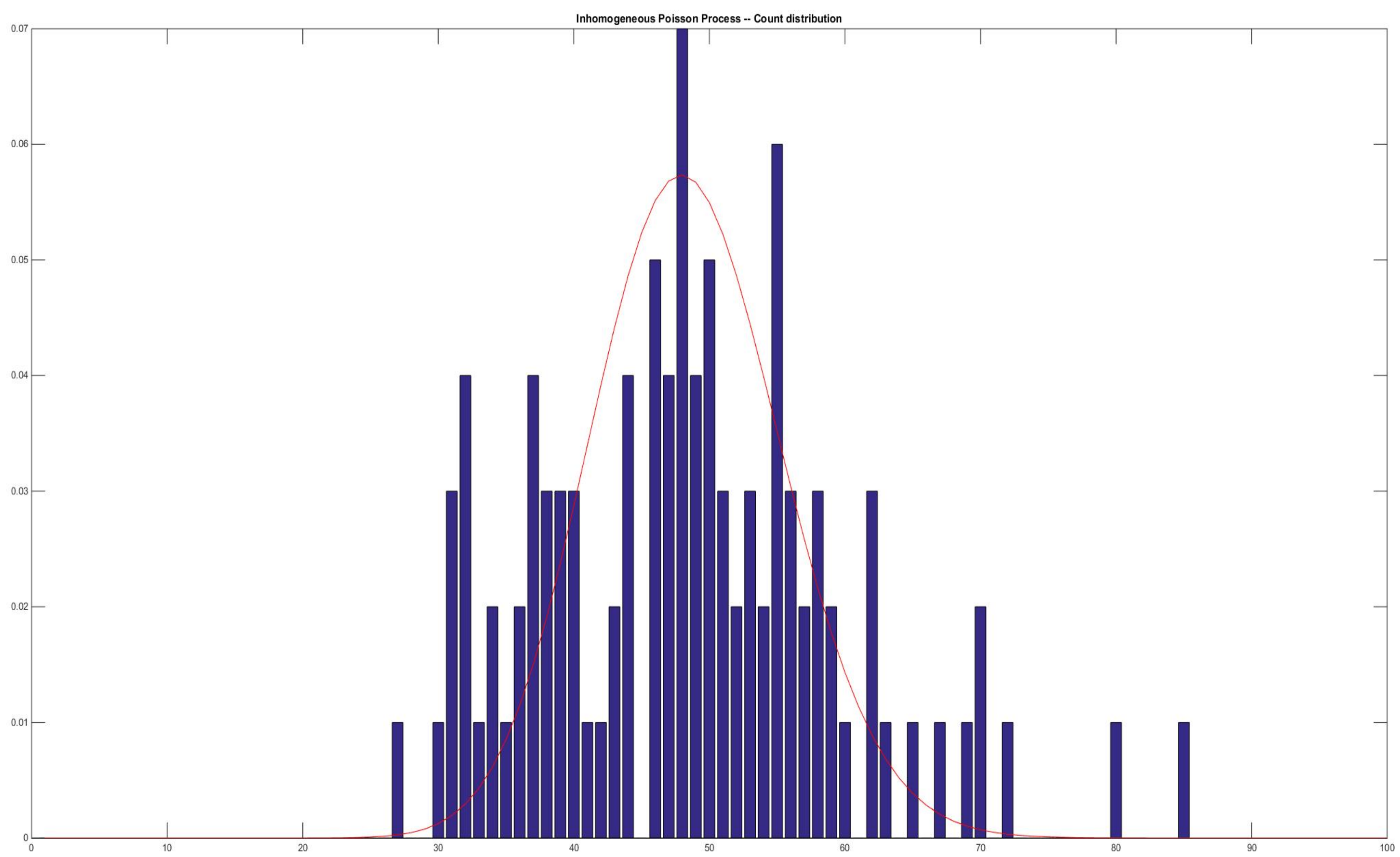
(b) Spike histogram

yes, it agrees with the profile

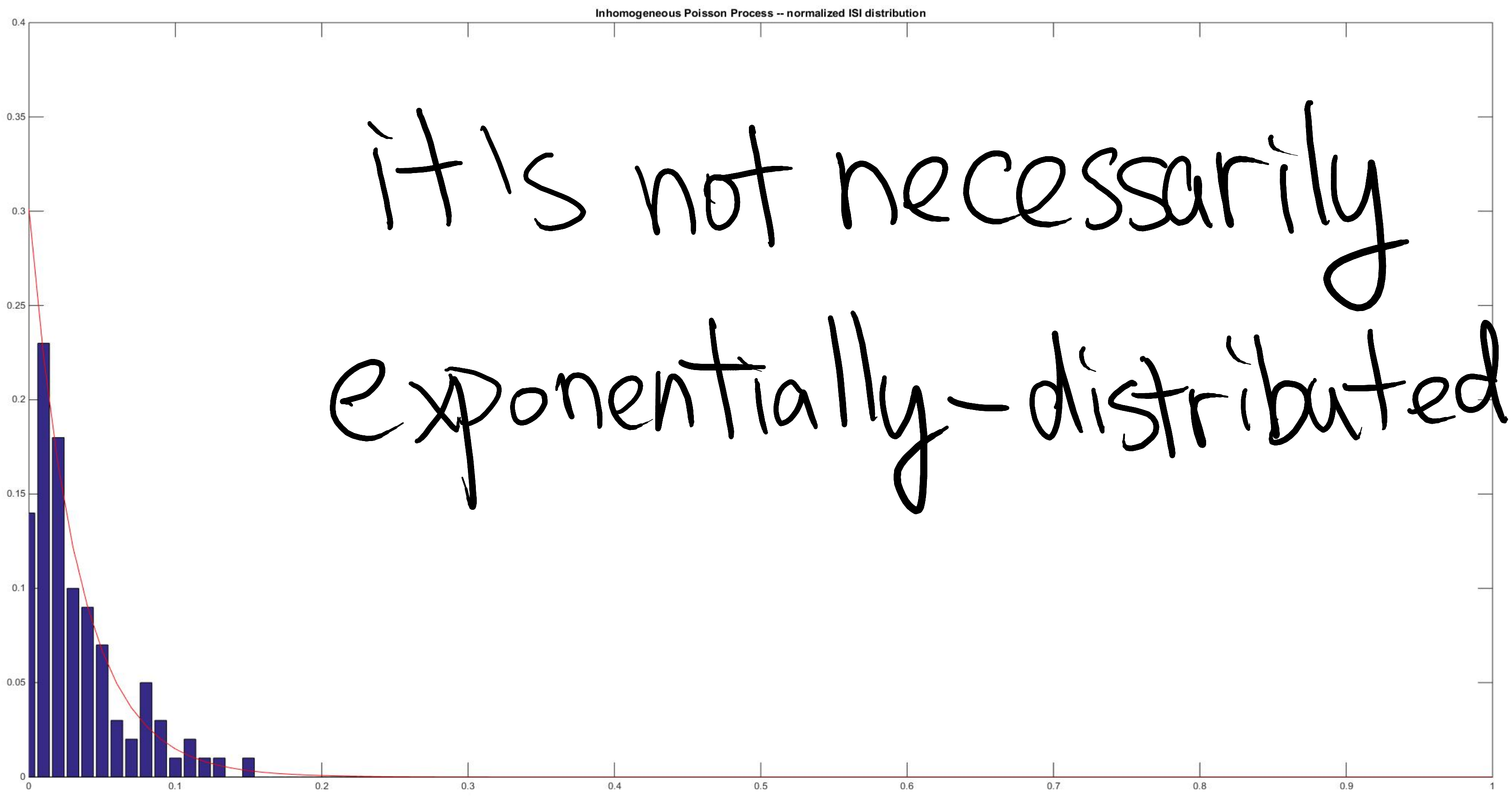


(c) Count distribution

yes, it's Poisson distributed.



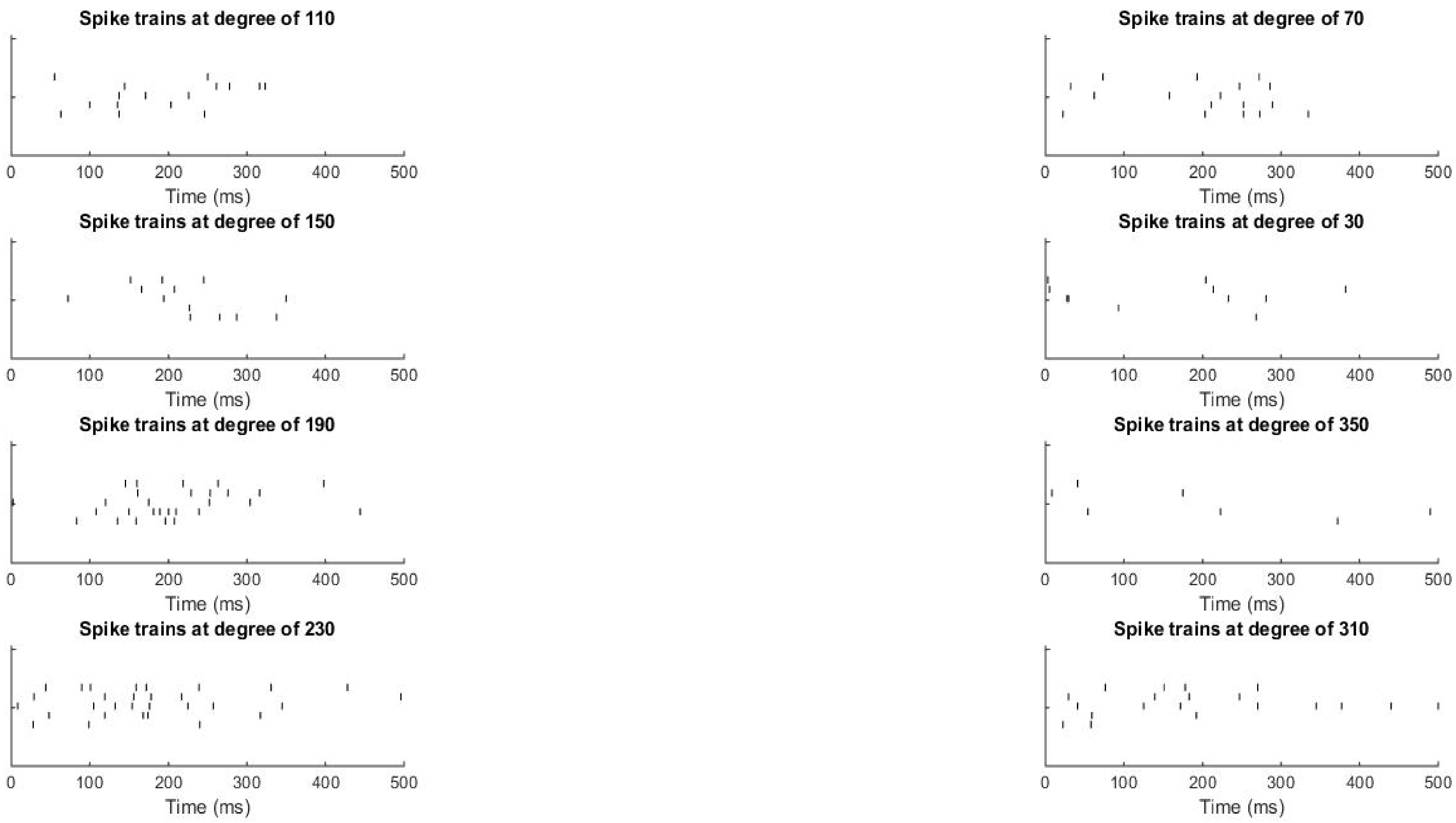
(d) ISI distribution



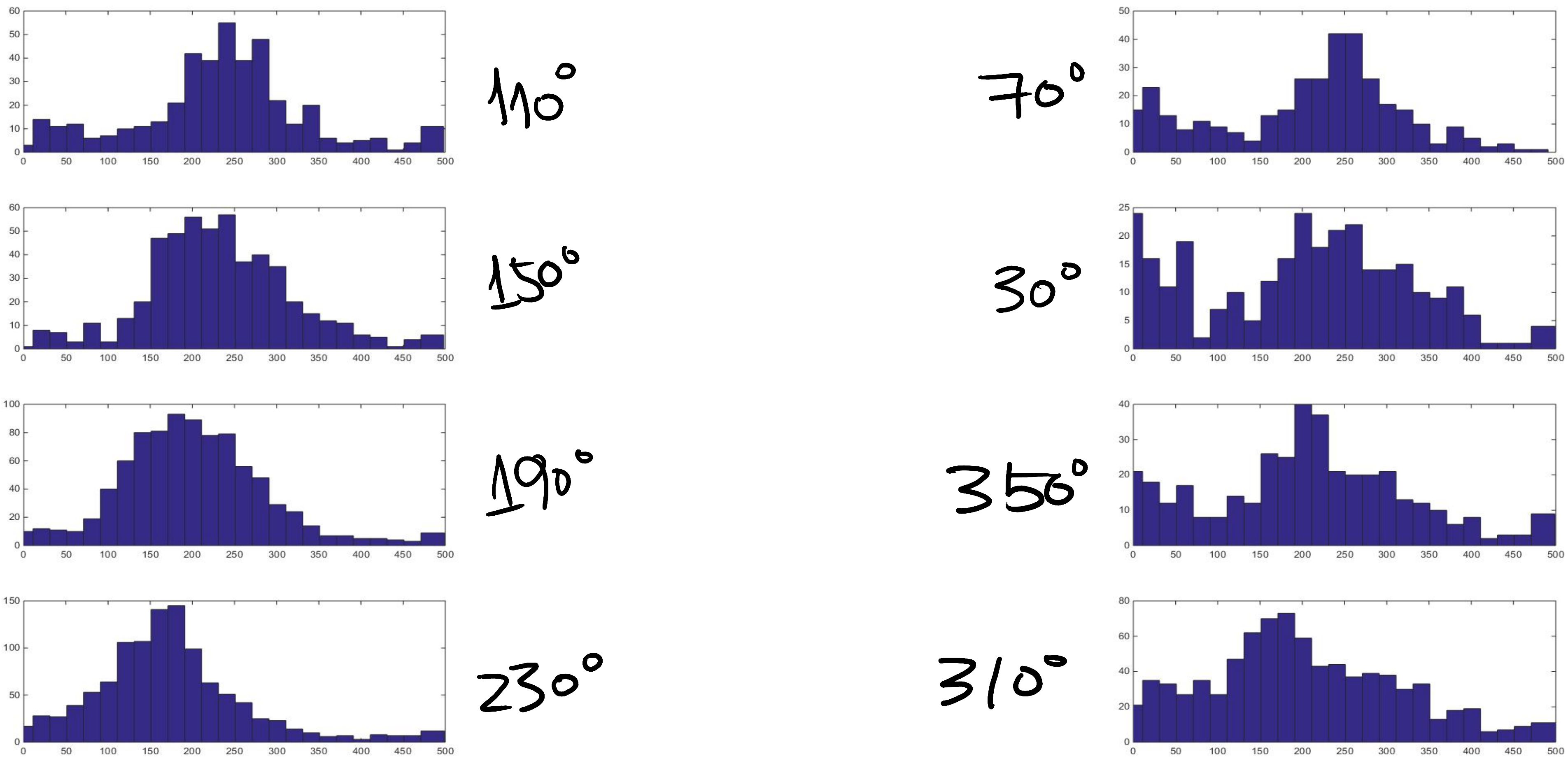
it's not necessarily exponentially-distributed

4. Real Neural data

(a) Spike trains

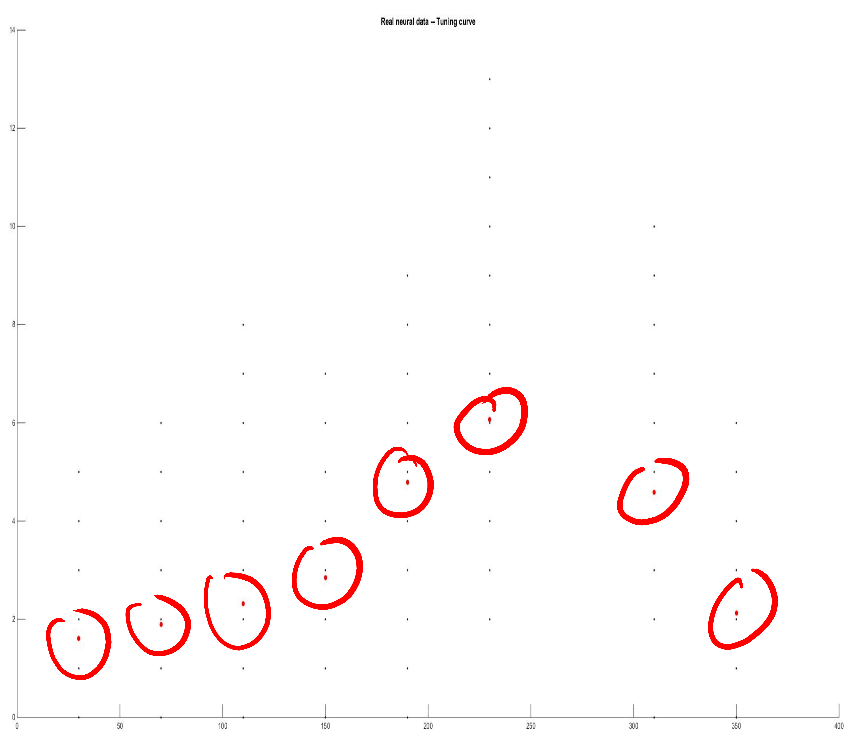


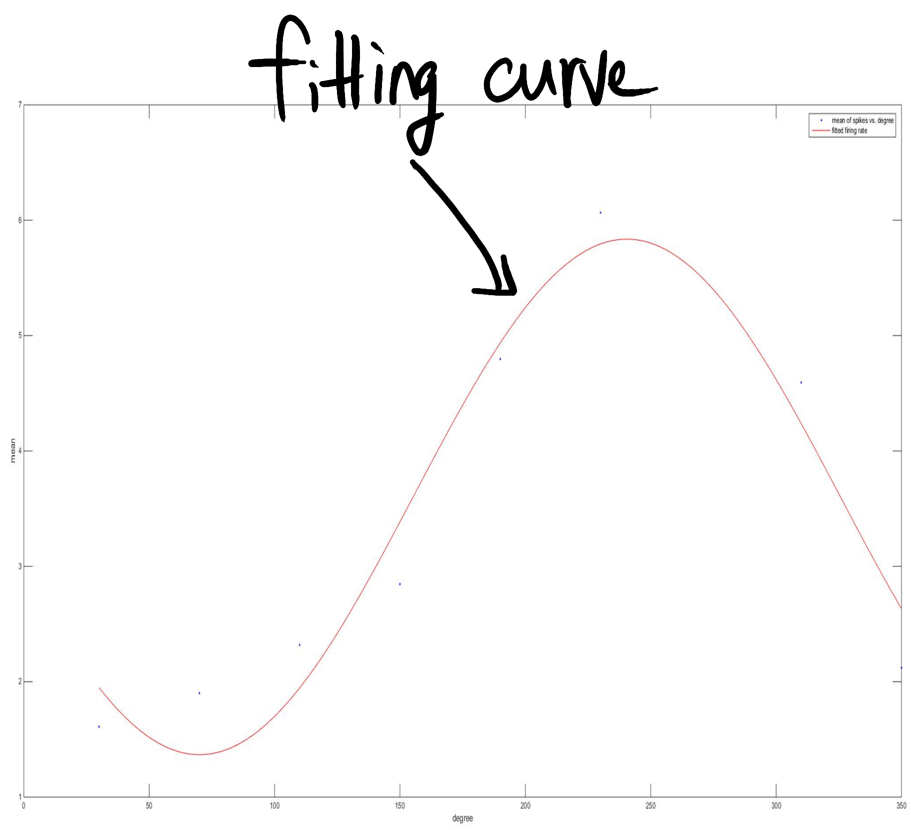
(b) Spike histogram



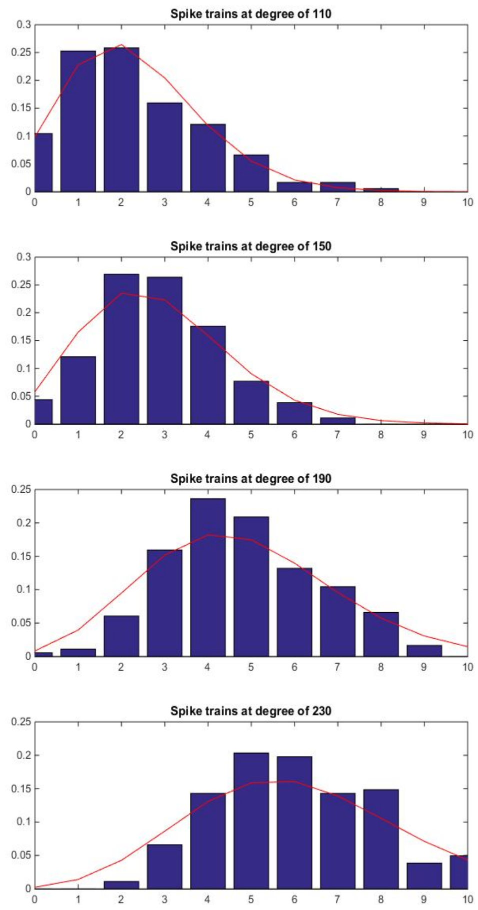
(c) Tuning curve

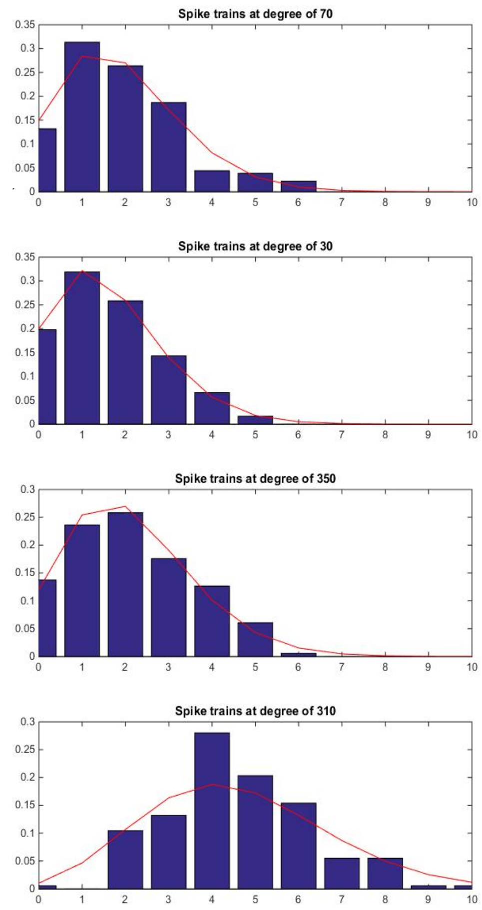
redpoints — mean of spikes



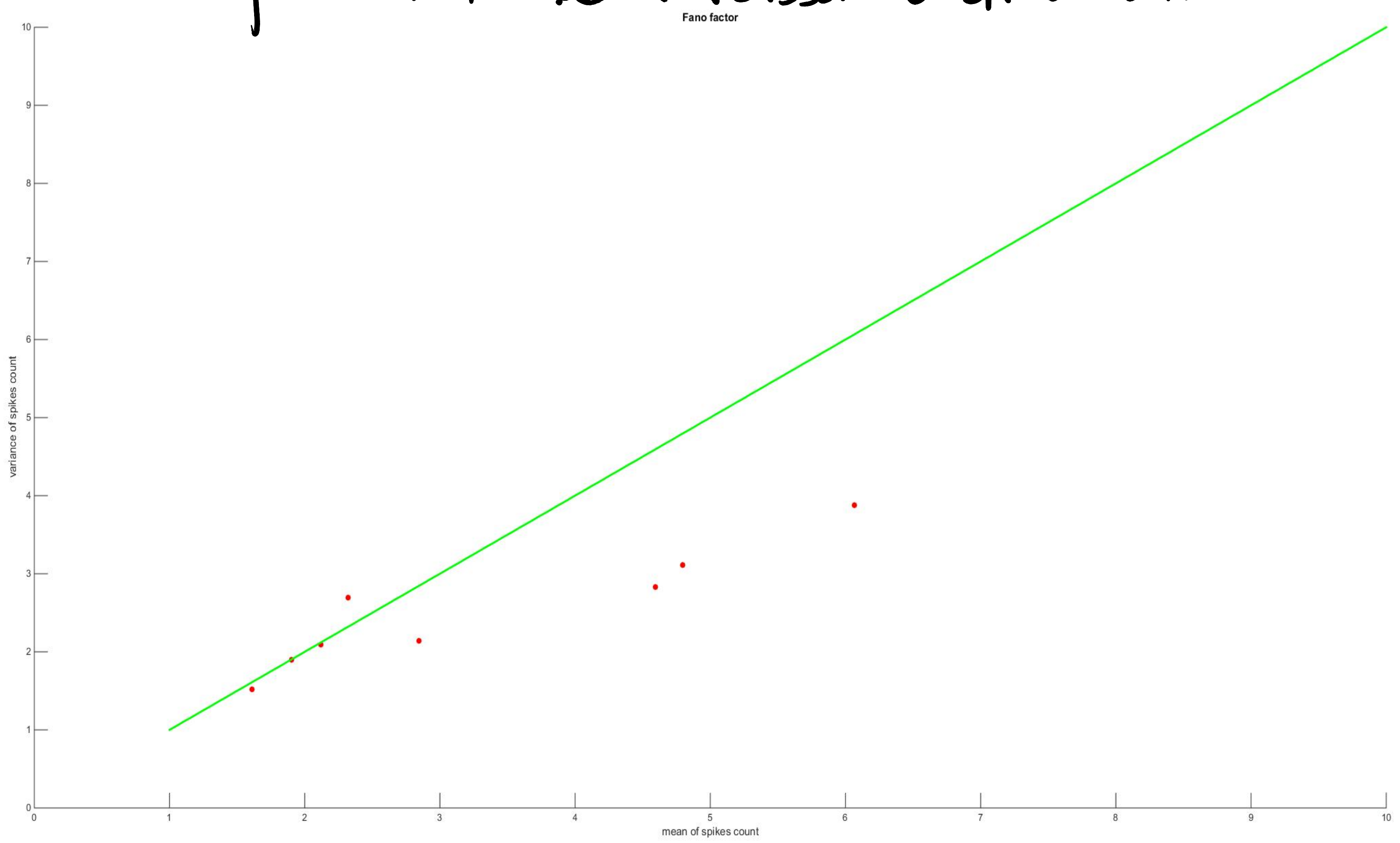


(d) Count distribution due to refractory period, it differs from idealized Poisson distribution

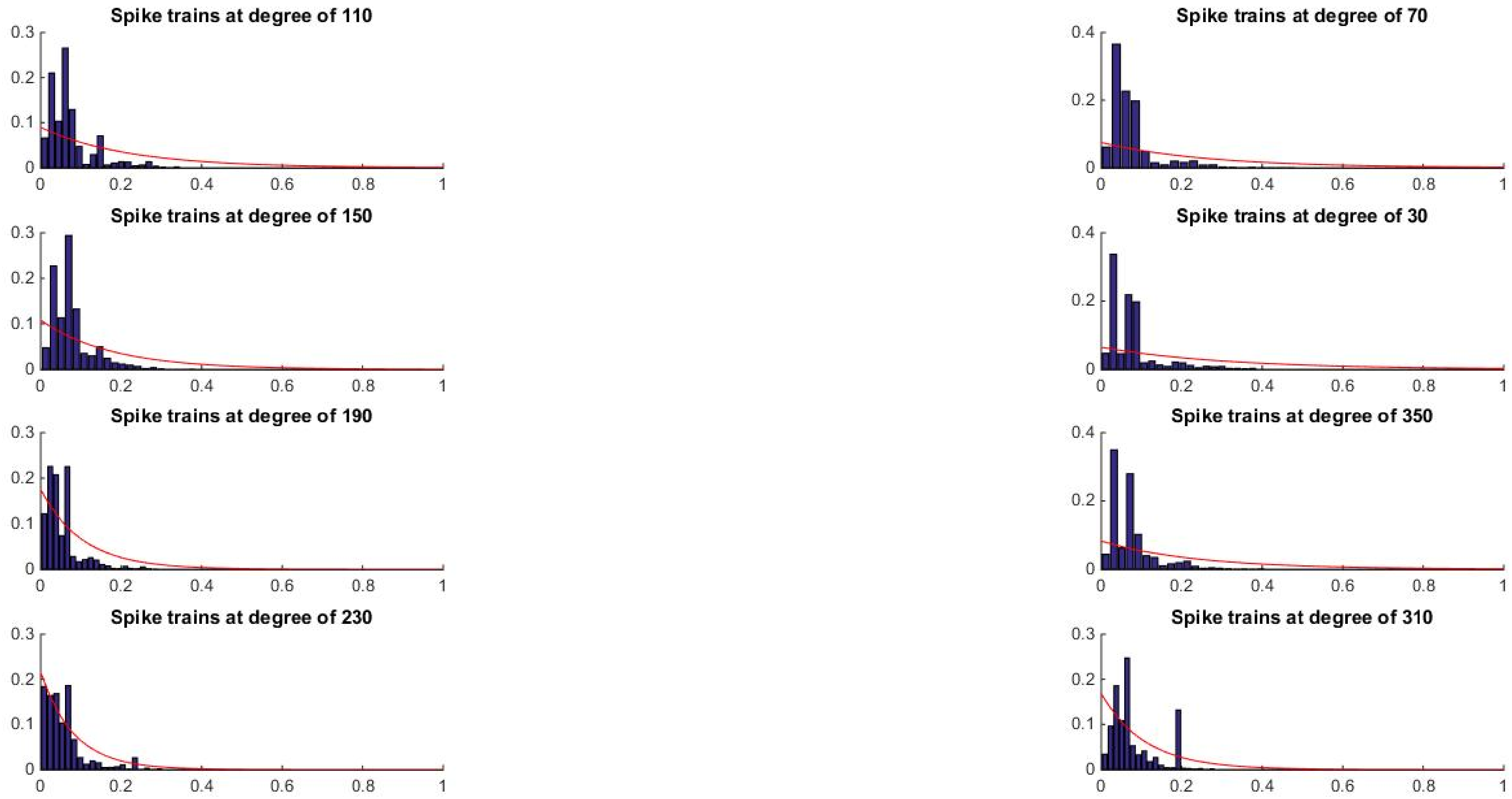




(e) Fano factor they lie near 45° diagonal, and it is expected to be a Poisson distribution.



(f) ISI distribution



Q: Why empirical distributions differ from the idealized exponential distribution?

① Firing rate varies over time

② Because it is a real neural data analysis, we have to consider refractory period.