University of Kentucky, Physics 335
Laboratory #4, Rev. A, due Tuesday, 2022-09-20

This lab explores two more examples of the Poisson distribution analyzed numerically using Python.

1. Random distribution of **primes**.

a) Write a Python function `is_prime(n)` to determine if the number n is a prime. Use this function inside another function `count_primes(k,d)` to count the number of primes with the interval $kd \leq n < (k+1)d$.

b) Histogram the number of primes in $N = 1000$ sucessive intervals of $d = 100$ integers starting at $kd = 1,000,000$, ie. $10,000 \leq k < 10,000 + N$ and plot with error bars in each bin.

c) Calculate the mean $\bar{x}$ and standared deviation s of this population. What is the probability of a number in the vicinity of kd being a prime?

d) Estimate λ of the Poisson distribution, and graph it as a stair plot.

e) Estimate μ and σ of the Gaussian distribution and graph it as a continuous curve. From these two values, is the distribution approximately Poisson?

f) Calculate χ^2 assuming a Poisson distribution. What is the likelihood of these data following this distribution?

2. [bonus: Dark photons on astronomical **image plates**.

a) Record a dark image plate on the telescope camera at the MacAdam Observatory. Open the file as an array of photons per pixel, and plot the image using Python.

b) Group pixels together such that the average number of dark photons in each group is 10, and histogram the number of dark photons counted in each group.

c–f) Repeat steps 1c)–1f) for this distribution.]