# Lecture 2: Poisson Distribution

(1) Big batch of cookie dough w/ chocolate chips. How many chocolate chips in one cookie?

(2) Stand by highway. Count how many cars go by in one minute.
(times that cars come by are independent, happens w/ some given average frequency)

(3) Meteor strikes on the moon. How many new craters does moon develop every million years?

Common characteristics:
- Answer is non-neg integer
- Some average frequency/density/intensity $\lambda > 0$ (lambda

All these examples accurately modeled by Poisson dist.

---

We'll define Poisson as limit of Binomial distributions

Binomial $(n, p)$:
- $n$: positive integer
- $p$: probability in $(0,1)$

Have a coin that has prob $p$ of landing heads. Flip $n$ times, record number of heads. Flips are independent.

Eg. Binomial $(1, 1/2)$ is a single fair coin flip.

Binomial (10, 1/2) 10 fair coin flips,
# of heads
sum of 10 copies of randint(0,1).

---

Cookie dough analogy: Divide a FistFul of dough into $n$ equal sized pieces, each of which has either 0 or 1 chips. If one FistFul has, on average, $\lambda$ chips, then think of each of the $n$ pieces as having 1 chip w/ prob $\lambda/n$, and 0 chips otherwise

# Chips in one chunk: modeled by coin flip w/ prob $\lambda/n$

# Chips in cookie: Sum of $n$ independent instances of above
Binomial $(n, \lambda/n)$

Poisson $(\lambda)$ is limit of Binomial $(n, \lambda/n)$ as $n \to \infty$