MATH 180A: INTRO TO PROBABILITY (FOR DATA SCIENCE)

www.math.ucsd.edu/~tkemp/180Å

- Today: §3.3 Lab3.2 due Monday. Next: §3.4
- * Regrade requests for HWZ: windew Tuesday, 10/22 La separate request for each problem La detailed, polite responses please.
- * Midterm 1: Wednesday, 10/23, 8-10 pm, PCYNH 109 Assigned seats (see Triton Ed) 1 double sided sheet of (hand-written) notes allowed Practize Midterms posted on webpage



A random variable X has the Poisson(X) distribution if

 $P(X=k) = e^{-\lambda} \frac{\lambda^k}{k!}, k=0,1,2,...$

Eg. A 100 year storm is a storm magnitude expected to occur in any given year with probability 1/100. Over the course of a century, how likely is it to see at least 4 100 year storms?



- Sampling independent trials, the most important (discrete) probability distributions are:
- $Ber(p): P(X=1)=p, P(X=0)=1-p \quad 0 \le p \le 1$
 - (single trial with success probability p)
- Bins(n,p): P(Sn=k) = (n)pk(1-p)^{n-k} osksn
 (number of successes in n independent trials with nate p)
- Geom(p) $P(N=k) = (1-p)^{k-1}p$ k=0,1,2,...
 - (first successful trial in repeated independent trials with rate p)
- Poisson(λ) $P(X=k) = e^{\lambda} \frac{\lambda^k}{k!} \quad k=0,1,2,\dots,\lambda>0.$
 - (Approximates Bin(n, Nn); number of rare events in many trials)



Toss a fair coin 1000 times, and record the sequence of outcomes.

Average them.

what size do you expect this number to have?

What if the coin is biased $P(x_j=1)=p$, $P(x_j=0)=1-p$.

Definition: Let X be a discrete random variable with possible values titzta. The expectation or expected value of X is E(X) :=

Question: Is the expectation E(X) the value X is equal to most often?

(a) Yes, always. (b) No, not generally.

Eg. Let X be the number rolled on a fair die.

Eg. Let Y be Ber(p).

Eg. You toss a biased coins (Y) repeatedly until the first heads. How long do you expect it to take?

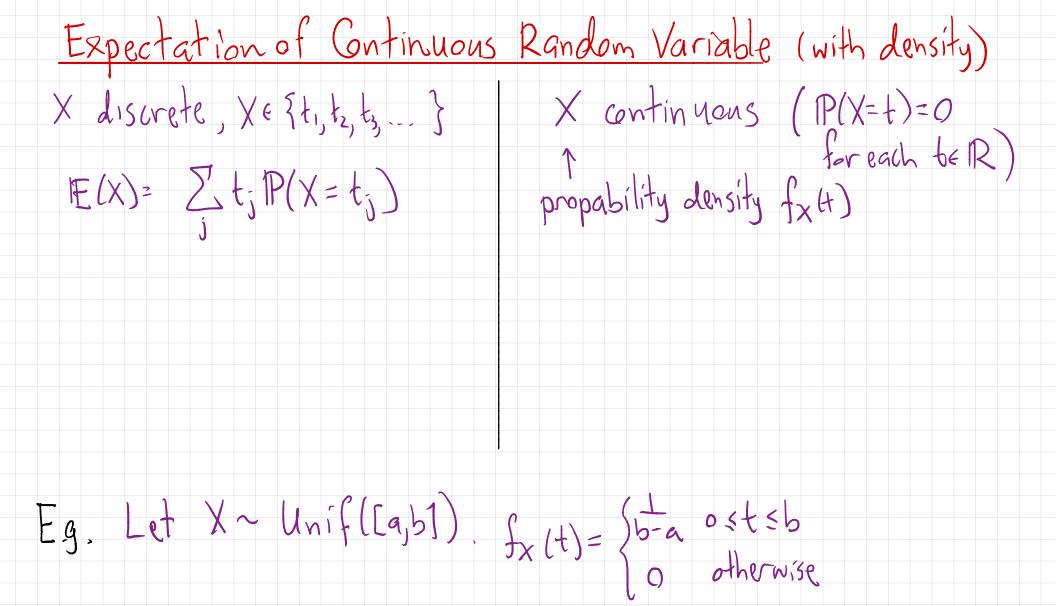
E.g. S. ~ Bin(n,p) (S_=X,+X_+-+X_n for X; independent Ber(p)) $\mathbb{E}(S_n) = \sum_{k=0}^{T} k \cdot \mathbb{P}(S_n = k) = \sum_{k=0}^{T} k \cdot \binom{n}{k} p^k (1-p)^{n-k}$





L> Eg. A factory has, on average, 3 accidents per month. Estimate the probability that there will be exactly 2 accidents this month.

- E.g. Toss a fair coin until tails comes up. If this is on the first toss, yeu win \$2 and stop. If heads comes up, the pot deubles, and yeu continue. That is, if the first tails is on the Kth toss, you win I dollars.
 - What is your expected winnings?



Question:

Shoot an arrow at a circular target of radius 1. What is the expected distance of the arrow from the center P

(a) 1 (b) 2/3

(c) 1/2

(d) 1/4

E.g. f(t)={0 t≤1 is a probability density. 1/t2 t>1

If X is a continuous random variable with fx=f, what is E(x)?