Numbers are items in my wiki.

1 random experiment: toss coin
outcomes: {H,T}
assign a number to each outcome.
Call that a random variable.
H-> 1 T->0

2 outcomes: { TTT, TTH, THT, ...}
X(TTT) = 0 X(TTH) =1 ....
from 1st experiment (3 tosses)x=0
next: x=3
next: x=1 ..

3 Y(HHH) = 8 Y(HTH) = 2 Y (HTT) = 0

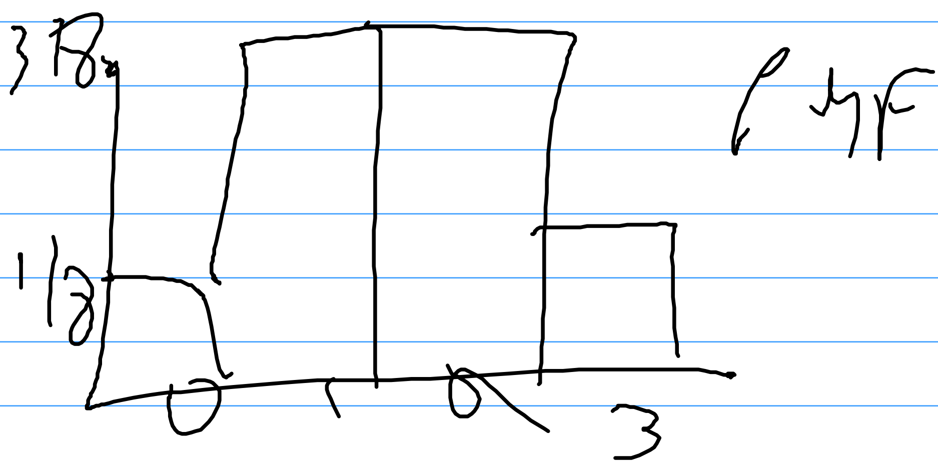
6 Outcomes have probs. p(HTT) = 1/8

Random variable has probs.
X: # heads
P(X=0) = 1/8
P(X=1) = 3/8
P(X=2) = 3/8 prob mass function (PMF)
P(X=3) = 1/8

Can now do math. E.g. expected value.
0*1/8 + 1*3/8 + 2*3/8 +3*1/8 = 1.5

10

probs



possible values of random var

12 another uniform random var: toss a 6-sides die
p(1) = 1/6 p (7)=0 p(3)=1/6

uniform integer from 1 to 6

13 Bernoulli: unfair coin.
2 choices. prob p.

14.1 pX(k): probability that the random var X has value k

In this particular case, X is a random variable following a geometric distribution with parameter p.

The random variable X in 14.1 is unrelated to X in 12.3 for example.

Geometric dist example. Fair coin p=1/2
q defined = 1-p

pX(k) q^(k-1) p = 2^(-k)

p_X(1) = 1/2
P(2) = 1/4
p(10) = 1/1024
X is the random variable that gives the number of tosses until the 1st head.

another geometric dist example. black pixels on page
Y = random var for number of pixels along line until 1st black pixel.
App: run-length encoding for fax.
p= .01
Y(k) = q^(k-1) p = .99^(k-1) * .01

p_Y(1) = .01 p_Y(2) = .99 * .01 = .0099

In these examples, geom probs decrease towards 0.

15 binomial r.v.

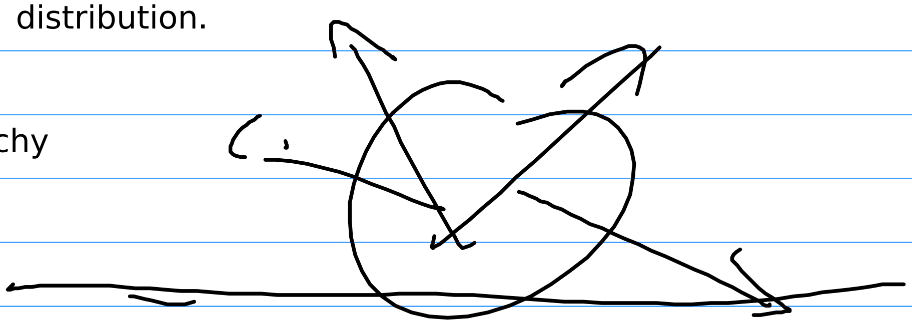
ex. toss coin twice $n=2$ $p=1/2$

here X is r.v. of # heads from 2 tosses.

p_X(1) = (2 choose 1) p^1 q^1 = 1/2

16 as n increases graphs becomes similar a 'normal' distribution.

Cauchy



spin a spinner. r.v. is where the projected pointer hits x-axis.

p(x) = c / (1+x^2) (I think)

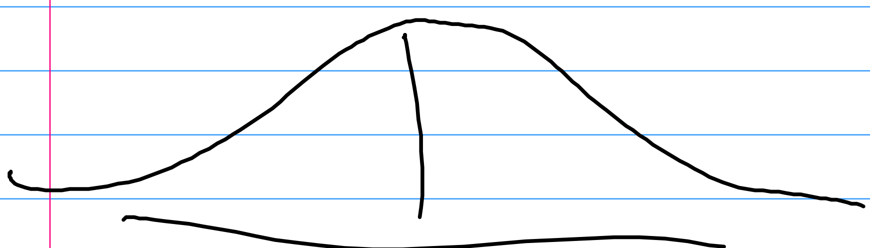
integral is 1. always nonnegative.

however

$$c \int \frac{x}{1+x^2} dx$$

diverges.

Cauchy dist does not have a mean or any other moment.



tails don't converge to 0 quickly enough.

Physical meaning of not having a mean. This is getting ahead a little but it's important.

Think about tossing coin n times and recording number of heads. About n/2 but fluctuates every time you toss n coins.

Toss coin 10 times, and do this several times.
heads fluctuates around 5.
Next, toss coin 100 times and repeat.
heads fluctuates around 50. But, as a fraction of 100, these observations are more tightly clustered around 50.

The larger n gets, the smaller the percentage fluctuation from the mean is.
called a law of large numbers.

NOT TRUE for Cauchy.

Perhaps not true for stock market.
Tails of distribution are too fat.

St Petersburg paradox: bet until you win, doubling each time. When you win, that win pays all previous losses and still gives a profit.
What's wrong?

18 Mean of Bernoulli, for p=1/2
p(0) = p(1) = 1/2 mean = 1/2*0 + 1/2*1 = 1/2

Mean of uniform [1.6]:
p(1) = p(2) = 1/6
mean = 1/6*1 + 1/6*2 .... = 3.5

19 Mean of binomial for n=3, p = . 1
mean = (3 choose 0) .9^ 3 *0

(3 choose 1) .9^2 .1 1 +
(3 choose 2) .9 .1^2 2
+ (3 choose 3) .1^3 3

= 0 + .243 + .054 + .003 = .3 (makes sense)

general rule for binomial. mean = np

25 do Mon.