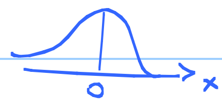
Lecture 4 (Ch. 1)

We are talking about dists ($f(x)$ and $p(x)$) :
continuous categorical

Example (x = cont.) $f(x) = \frac{1}{\sqrt{2\pi}} e^{-\frac{1}{2}x^2}$ $-\infty < x < \infty$ $\int f\,dx = 1$ ✓ $f \geq 0$ ✓



Called "standard normal distr."

Examples (x = categorical)

x = 3 food items.

E.g.

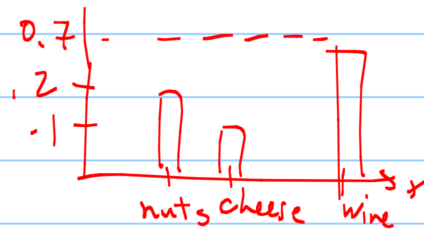
x	nuts	cheese	wine
$p(x)$	0.2	0.1	0.7

$\Sigma \to 1$.

Table

$p(x) \geq 0$

$\sum_x p(x) = 1$



Note: There is no data anywhere here. These are <u>not</u> histograms

Chart

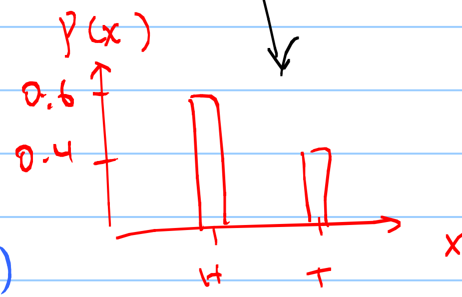
or formula

E.g. x = "state of a fair coin"

Then,

x	H	T
$p(x)$	0.6	0.4

(Bernoulli distr.)



E.g. x = "number of heads out of n tosses of a fair coin."

Then,

$$p(x) = \frac{n!}{x!(n-x)!} \left(\frac{1}{2}\right)^x \left(\frac{1}{2}\right)^{n-x}$$

(Binomial distr.)

we will derive this $p(x)$, later.

This $p(x)$ can be used to describe the <u>population of x</u>

Later, we will replace the $\frac{1}{2}$ with other values.

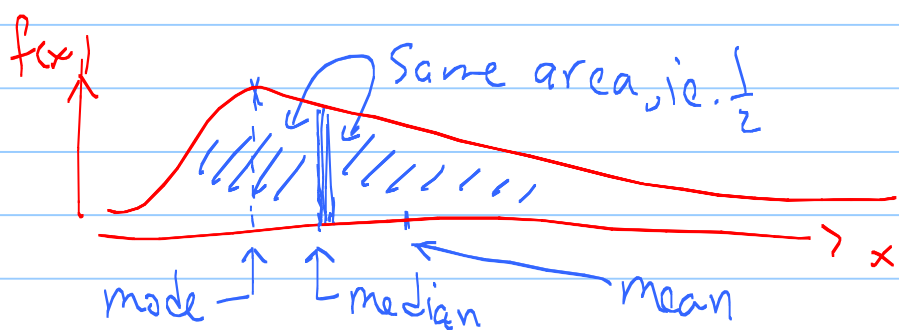
Dists. have some of the same properties as hists.
For example, the area between 2 x-values is the proportion of times that those x-values occur. But hists $\neq$ dists.

We even talk about mean (and median, ---) of a variable, x, whose distr. is $f(x)$, but even those have nothing to do (yet) with mean (and median...) of data.

mean of x (or of $f(x)$) $= \int_{-\infty}^{\infty} x\, f(x)\, dx$

median of x (---) : $\int_{-\infty}^{\text{median}} f(x)\, dx = \frac{1}{2} = \int_{\text{median}}^{\infty} f(x)\, dx$

mode --- : $\left.\frac{df(x)}{dx}\right|_{\text{mode}} = 0$



Again, the computation of these quantities requires $f(x)$, or $p(x)$, ie. the density/mass functions.

The corresponding quantities for data are computed differently, but are called by the same names, a poor but common practice.

Once again: histograms $\longleftrightarrow$ sample / data
$\neq$ distributions $\longleftrightarrow$ population.

clicker Questions (not recorded yet, until wed).

Once again, hists describe data, dists represent pops.

Q1: Suppose we have a continuous random variable (r.v.). Which of The below dists is most appropriate to use in our "Theory" for The population. (A)

A) Standard Normal B) Binomial C) Bernoulli

D) Insufficient info. provided

Q2: Suppose we are interested in a r.v. that Takes only 2 levels. Which of The above dists is most appropriate? (C)

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hw_lect 4-1

Consider The density function $f(x) = \begin{cases} 0 & \text{else} \\ a(-x^3 + x^2 + x + 2), & 0 < x < 2 \end{cases}$

a) First, determine a to make sure f(x) is a density function.

b) Compute The mean, mode, and TRY finding The median!

[Explain why it's too hard to do!

This problem is basically an exercise in claculus.

hw_lect 4-2

The Bernoulli dist. discussed in The lecture does have a formula:

$p(x) = \pi^x (1-\pi)^{1-x}$, where π is some parameter between 0,1, and $x = 0, 1$.

a) Show That it's a mass function.

b) What proportion of time do we expect to get $x = 1$