Discussion Section 4

quiz 3 due by 11.59 pm on Fri 6 Jul (tomorrow)

AMS 131 5 Jul 18

quiz 4 due by 11.59 pm on Mon 9 Jul

Case study: Cromwell's Rule (CR)

D = (true/false proposition) representing data

ex. ELISA: D = (ELISA says +)

A = (T/F prop.) representing unknown

ex. ELISA A = (blood really is HIV +)

~~approach~~

prior prob. that A is true

$$P(A \mid D) = \frac{P(A)\, P(D \mid A)}{P(D)} \quad (\text{assumes } P(D) > 0)$$

posterior prob. that A is true given data D

(CR) part 1: if we assume $P(A) = 0$ then $P(A \mid D) = 0$ no matter how D comes out (no learning about A from D is possible)

CR part 2: if we assume $P(A) = 1$ ②

then $P(A \mid D) = 1$ no matter how D comes out

no learning about A from D is possible

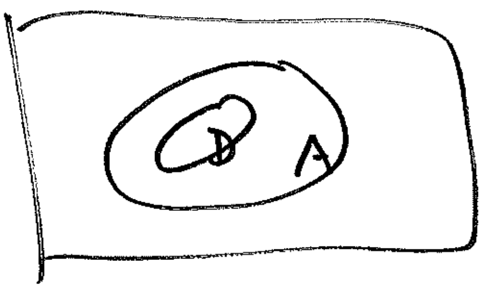
proof of part 1: if $P(A) = 0$

$$P(A \mid D) = \frac{\cancel{P(A)}^{0}\, P(D \mid A)}{P(D)} = 0$$

proof of part 2: if $P(A) = 1$ then

$$P(A \mid D) = \frac{\cancel{P(A)}^{1}\, P(D \mid A)}{P(D)} = \frac{P(D \mid A)}{P(D)}$$

$$= \cancel{\frac{P(D)\, P(A \mid D)}{P(A)\, P(D)}} = \frac{P(D \text{ and } A)}{\cancel{P(A)}^{1}\, P(D)} = \frac{\cancel{P(D)}}{\cancel{P(D)}} = 1$$



prior

$P(A) \xrightarrow{\text{Bayes's Thm}} P(A \mid D)$

$\longrightarrow$ time

data D arrives

Bayes's Thm is the optimal way to learn from data

$\boxed{\text{punch line:}}$ try hard not to put prior prob. $\begin{Bmatrix} 0 \\ 1 \end{Bmatrix}$ on anything that might turn out to have posterior prob. other than $\begin{Bmatrix} 0 \\ 1 \end{Bmatrix}$ (based on the data)

before seeing data suppose I assume data-generating process looks like  ; this is like putting prior prob. 1 on ↗ for data

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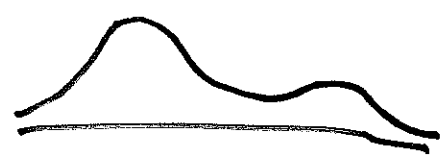
now data arrives & looks like 

DV Lindley

Oliver Cromwell

R

<u>binomial</u>

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dbinom ← PMF of discrete rv (math)

pbinom   or   continuous rv

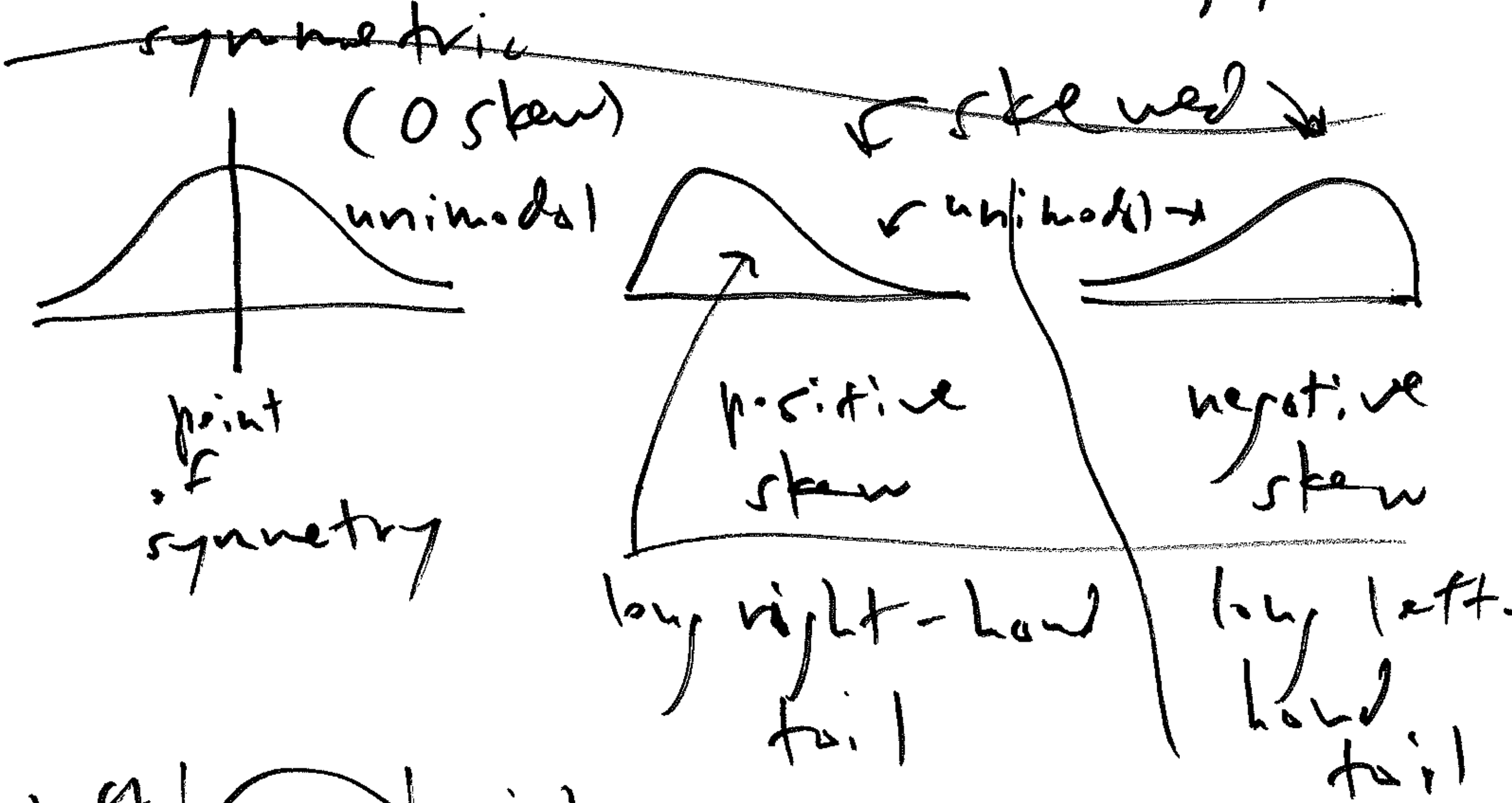
qbinom

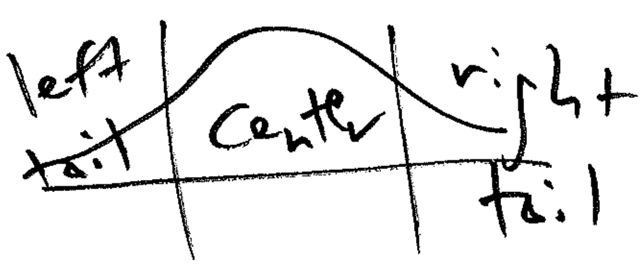
rbinom ← random samples (simulation)

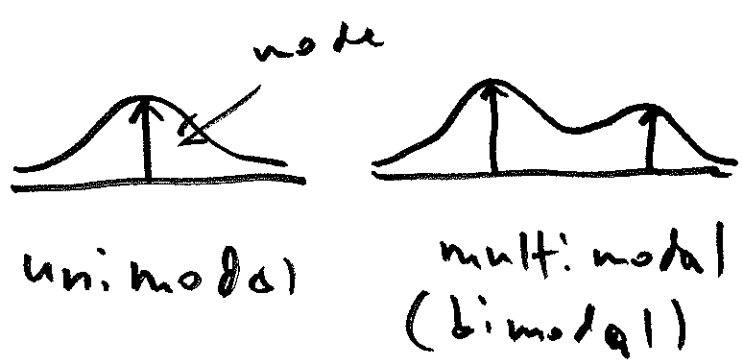
math	R
n	size
p	prob
$f_Y(y)$	p(x) (PMF)

$$\binom{n}{y} = \text{"n choose y"}$$

choose(n, y)







4

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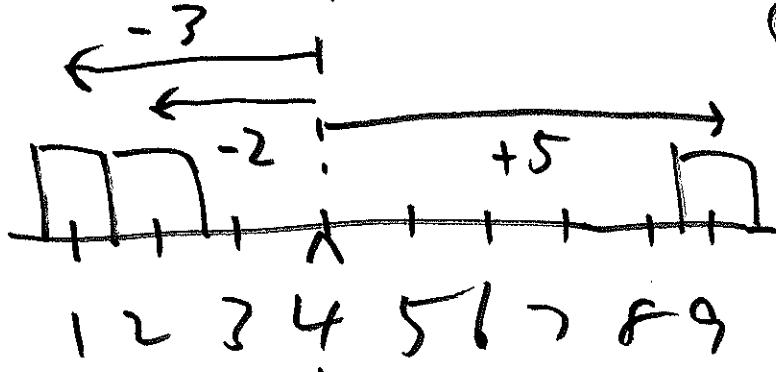
geometric interpretation of mean = balance point

center?



$$\begin{bmatrix} y_1 \\ \vdots \\ y_n \end{bmatrix}$$

$$\begin{array}{c} y_1 \\ \vdots \\ y_n \end{array} \begin{bmatrix} 1 \\ 2 \\ 9 \end{bmatrix} \quad n = 3$$

mean $\bar{y} = 4$

mean $\bar{y} = \frac{1}{n} \sum_{i=1}^{n} y_i$