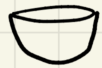
PROBABILITY (RAPID) REVIEW

- **(Deterministic) variables** : X



X

- **Random variables** : $X =$ maybe
maybe
⋮
maybe

$$X = \begin{bmatrix} 1 \\ 2 \\ 3 \\ 4 \\ 5 \end{bmatrix} \Bigg\} \text{ of R.V. } X$$

- **Expectation** : $E[X] = E\left[\, X = \quad \right] = \sum_i (X = x_i)$

$$\Rightarrow \quad E[X] = [\qquad] \begin{bmatrix} \\ \\ \end{bmatrix}$$

- **Conditional Probability** : $P(X|Y)$

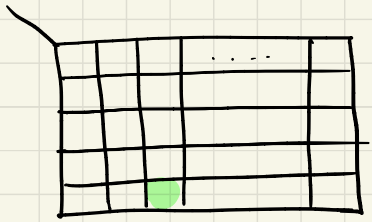
↳ that you know Y has happened ... what does this say about of occurrence ?

$$P(X|Y) = P(\, X = \qquad |\; Y = \qquad)$$

Bayes' Rule :

$P(X|Y) = \quad = \dfrac{P(X=[\ \ ]\ Y=[\ \ ])}{P(Y=[\ \ ])}$

=



$[\quad\quad]$

Now, $P(X=5 \mid Y=28) =$

Joint probability distribution :

Posterior and likelihood :

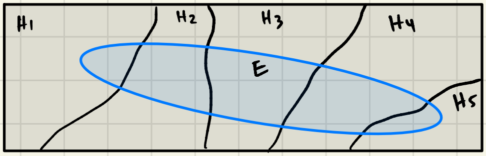
P(hypothesis | evidence)   P(evidence | hypothesis)

P(Murderer = John | weapon = knife)

Vs

P(weapon = knife | murderer = John)

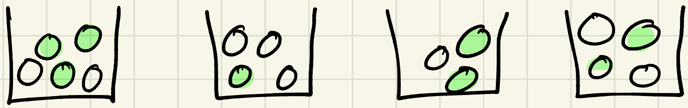
} which one is and which is ?



All the hypotheses should

Evidence need not.

Example :



Bucket 1 2 3 4

Q1. P(Chosen Ball = | bucket =)

(a) Is this posterior or likelihood ?

(b) What is the probability ?

Q2. P(Bucket = 3 | Chosen ball = green)

(a) Posterior or likelihood ?

(b) What is the probability ?

$$P(X|Y) = \frac{P(XY)}{P(Y)} = \frac{\quad}{P(Y)}$$

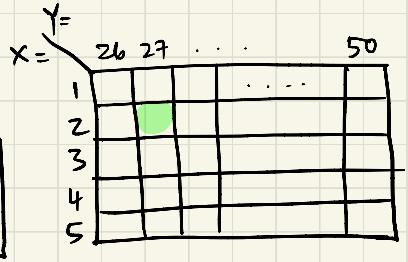
Now what is $P(Y)$? i.e., P(chosen ball = green) ?

Marginalization :

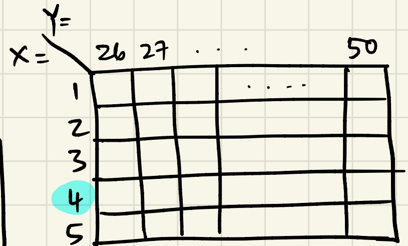
$$P(X) = \Sigma_1$$

$$P(X = \quad) = \Sigma_1 \; P(\qquad)$$

$$P\left(X=\begin{bmatrix}1\\2\\ \vdots\\5\end{bmatrix}\right) = \sum_{Y=\begin{bmatrix}26\\27\\ \vdots\\50\end{bmatrix}}$$

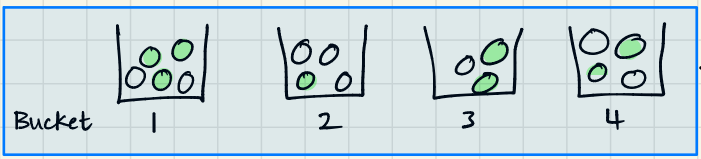


$$\therefore \quad P(\qquad) = \sum_{Y=\begin{bmatrix}26\\27\\ \vdots\\50\end{bmatrix}}$$



$$= P(X=4, \qquad) + P(X=4, \qquad) + \cdots P(X=4, \qquad)$$

■ Given $P(X) = \sum_{Y} P(XY)$,



$\rightarrow P(\text{Bucket}=3 \mid \text{chosen ball}=\text{green})$

$$\therefore \quad P(X|Y) = \frac{P(Y|X)\,P(X)}{P(Y)} = \frac{P(Y|X)\,P(X)}{\qquad}$$

$$P(X|Y) = \frac{P(Y|X)\,P(X)}{\qquad}$$

Posterior

Chain Rule :

$P(A\,B\,C) =$

$=$

Useful when we talk about of events A, B, C happening in time.