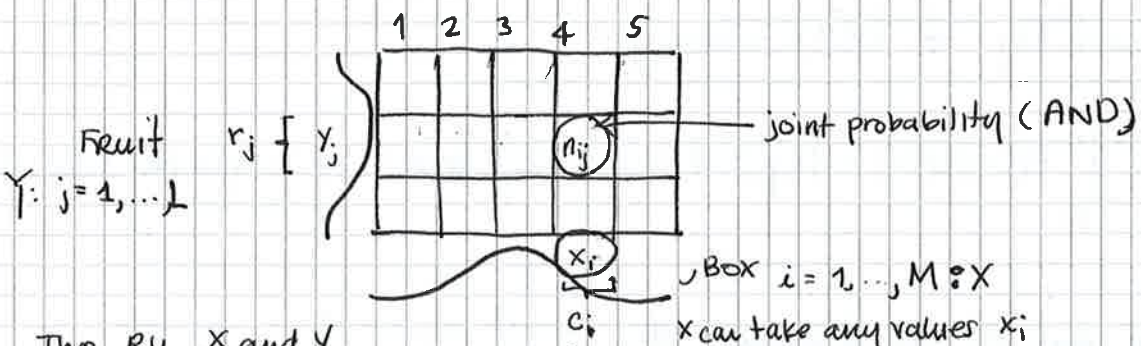


X can take any values $x_i$

$P(X = x_i) = \frac{c_i}{N}$ probability that X takes $x_i$ value irrespective of Y, that fall into a particular column.

Two RV X and Y

total N trials

$n_{ij}$ when we sample from both RV

$C_i$ = # of trails $X_i$ takes irrespective of Y

Joint probability: that X will take $x_i$ value and Y will take $y_i$ value

$$P(X = x_i, Y = y_j) = \frac{n_{ij}}{N}$$

(*) We take a bayesian view-point to quantitavely estimate the uncertainty. Bayesian
consider $\beta$ as a RV determined by nature.

Joint probability between X, Y, and $\beta$:

$$P((x,y), \beta) = P(x,y \mid \beta) \cdot P(\beta)$$

marginal prob = $P((x,y))$

Joint prob = $P((x,y), \beta)$

observations = $P(x,y)$

We apply bayes formula:

$$P((x,y), \beta) = P(\beta \mid (x,y)) \cdot P((x,y))$$

$$\frac{P((x,y), \beta)}{P((x,y))} = P(\beta \mid (x,y))$$

posterior probability ⇒ the conditional probability that is assigned when the relevant evidence is taken into account.

"posterior" term = relative future tense.

$$P(\beta \mid (x,y)) = \frac{\overbrace{P((x,y) \mid \beta)}^{\text{likelihood fxN}} \cdot \overbrace{P(\beta)}^{\text{prior, previous knowledge}}}{\underbrace{P((x,y))}_{\text{Evidence}}}$$