// Measure of central tendency

(1) Sample mean $\bar{x} = \frac{x_1 + x_2 \ldots + x_n}{n}$ n = sample size

Population mean $\mu = \frac{x_1 + x_2 \ldots + x_N}{N}$ N = pop. size

Adding c NM = OM + C

Multiply C NM = OM * C

* sensitive to outliers

(2) Median - data in increasing order (must have order ~~form~~ and ordinal or more not nominal)

Total no of observations

- odd M = $\frac{n+1}{2}$ th item
- even mean of ~~mena~~ $\frac{n}{2}$, $\frac{n}{2}+1$ th items

* not sensitive to outliers

~~(3. Mode)~~ adding c = NM = OM + C

multiply NM = OM * C

(3) Mode - most frequent

- No value occurs more than once no mode

add c NM = OM + C

mul C NM = OM * C

// Measure of dispersion

(4) Range = Max - Min

sensitive to outliers

(5) Variance

Pop $\sigma^2 = \frac{(x_1 - \mu)^2 + (x_2 - \mu)^2 + \ldots + (x_N - \mu)^2}{N}$

Sample $s^2 = \frac{(x_1 - \bar{x})^2 + (x_n - \bar{x})^2}{n-1}$

Adding c NewV = oldV multiply c = c^2 * old variance

(6) Std dev

Sample std dev = $\sqrt{\text{sample variance}}$

$$s = \sqrt{\frac{(x_1-\bar{x})^2+(x_2-\bar{x})^2 \dots + (x_n-\bar{x})^2}{n-1}}$$

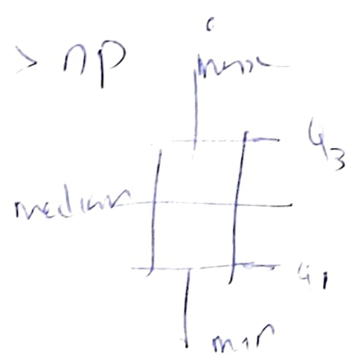
Popstd $= \sqrt{\frac{(x_1-\mu)^2 + \dots + (x_n-\mu)^2}{N}}$

Adding c
New = old

multiply c
New = c * old

(7) Percentile

- Arrange data in the order
- number percentile p $Q_1 = 25$ $Q_3 = 75$
- Find np i.e. $n \cdot 25$ — if int not int
  if np not integer — Pos is smallest int > np
  If np integer — if int value $\frac{np + np+1}{2}$



$IQR = Q_3 - Q_1$

outliers $< Q_1 - 1.5\,IQR$ or $> Q_3 + 1.5\,IQR$
min max

(8) Measure of correlation

Pop covariance : $\operatorname{cov}(x,y) = \frac{\sum_{i=1}^{N}(x_i-\mu)(y_i-\bar{y})}{N}$

Sample Cov $\frac{\sum_{i=1}^{n}(x_i-\bar{x})(y_i-\bar{y})}{n-1}$

(9) correlation

measure of linear correlation

$$r = \sum_{i=1}^{n} \frac{(x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_{i=1}^{n} (x_i - \bar{x})^2} \sqrt{\sum_{i=1}^{n} (y_i - \bar{y})^2}} = \frac{cov(x, y)}{S_x, S_y}$$

(10) weighted mean

$$M = \frac{M_m P_m + M_f P_f}{100} \qquad P_m + P_f = 100\%.$$

(11) point bi serial correlation coefficient

$$r_{pb} = \left(\frac{\bar{y}_0 - \bar{y}_1}{S_x} \right) \sqrt{P_0 P_1}$$

P_0 count / tot (mean$_0$) P_1 $\frac{\text{count}}{\text{tot}}$ (mean$_1$)

S_x sample std dev of all variable

D. Permutation & combination

(12) Addition rule: Action A n_1 different ways
Action B n_2 different ways
Total no of actions A or B is $n_1 + n_2$

(13) Multiplication rule:

r - actions performed in a definite order
n_1 - possibilities for 1st action
n_2 - " for 2nd action

Then $n_1 \times n_2 \times n_3 --- n_r$ possibilities together for r actions
total actions A and B = $n_1 \times n_2$

(14) Permutation: ordered arrangement of all or some of n objects

collection of n distinct objects

$$P(n,r) = \frac{n!}{(n-r)!}$$

(15) permutation, not distinct $\frac{n!}{p!}$

n objects P_1 is one kind
P_2 is another kind $\frac{n!}{P_1!\,P_2!}$ total arrangements.

(16) Permutations: circular.

no of ways n distinct objects can be arranged in circle (clockwise and anti are different) $= (n-1)!$

(17) when clockwise & Anti the same $\frac{(n-1)!}{2}$

(18) Combination

choose, select

no of possible combinations r from a n distinct objects

$${}^nC_r = \frac{n!}{(n-r)!\,r!} \text{ or } \binom{n}{r} \text{ binomial coefficient}$$

(19) Selecting r objects from n = rejecting n−r from n

(20) ${}^nC_n = 1$ ${}^nC_0 = 1$

$${}^nC_r = {}^{n-1}C_{r-1} + {}^{n-1}C_r \quad 1 \le r \le n$$

week 4 Probability

(21) probability of union of disjoint events

$$P(E_1 \cup E_2) = P(E_1) + P(E_2)$$

(22) $P(E^c) = 1 - P(E)$

$P(\phi) = 0$ as $S^c = \phi$

(23) Addition rule $P(A \cup B) = P(A) + P(B) - P(A \cap B)$

(24) $P(A \cup B)^c + P(A \cup B) = 1$

week 8: conditional Probability

(25) $P(E/F) = \dfrac{P(E \cap F)}{P(F)}$ $\quad P(F) > 0$

(26) CP- multiplication rule

$P(E \cap F) = P(F) \cdot P(E/F)$

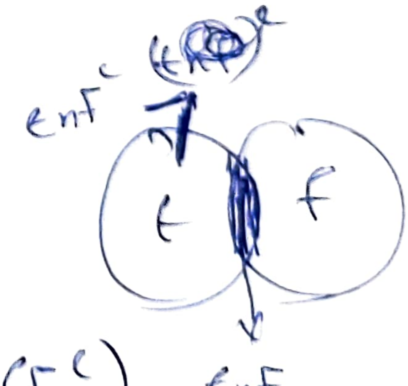
Gen multiplication rule

$P(E_1 \cap E_2 \cap E_3 \cdots \cap E_n) = P E_1 \times P(E_2/E_1) \times P(E_3/E_1 \cap E_2) \cdots \times P(E_n/E_1 \cap E_2 \cdots \cap E_{n-1})$

(27) If A & B events are Independent

$P(A \cap B) = P(A) * P(B)$

(28) Law of total Probability



$P(E) = P(E \cap F) + P(E \cap F^c)$

$P(E) = P(E/F) \cdot P(F) + P(E/F^c)\, P(F^c)$

If $F_1, F_2, F_3 \cdots F_n$ are mutually exclusive & exhaustive

$P(E) = P(E/F_1)\, P(F_1) + P(E/F_2)\, P(F_2) \cdots + P(E/F_k)\, P(F_k)$

(29) Baye's Rule

$$P(F|E) = \frac{P(E|F) \cdot P(F)}{P(E)}$$

$$P(F_i|E) = \frac{P(E|F_1)P(F_1)}{\sum_{i=1}^{k} P(E|F_1)\,P(F_i)}$$