Rules of Stat. and Prob.

* measures of Central tendency

→ mean (avg) = Sum of all Values / No. of Values

Population (μ) ↔ Sample ($\bar{x}$)

→ median ← ترتيب الارقام الاول

عدد الارقام ← $\frac{n+1}{2}$

* لو طلعلي رقمين بجيب ليهم الـ mean

يعني مثلاً لو طلعلي الـ median = 33,38

→ median = $\frac{33+38}{2} = 35.5$

→ mode القيمة الاكثر تكرار

* measures of dispersion

→ Range = Largest Value - Smallest Value

→ Variance

Population (σ^2) ↔ Sample (s^2)

$$\sigma^2 = \frac{\Sigma(x-\mu)^2}{n}$$

$$s^2 = \frac{\Sigma(x-\bar{x})^2}{n-1}$$

→ Stander deviations = $\sqrt{\text{Variance}}$

* ANY Probability $1 \geq P(A) \geq 0$

* Σ Probabilities of 's → all sample space = 1

* P(A or B) = P(A ∪ B) = P(A) + P(B) - P(A ∩ B)

* P(A and B) = P(A ∩ B) = P(A) + P(B) - P(A ∪ B)

= P(A) × P(B/A) = P(B) × P(A/B)

→ $P(\bar{A}) = 1 - P(A)$

→ $\bar{\bar{A}} = A$

→ $P(A-B) \neq P(B-A)$

→ $P(A \cup B) = P(B \cup A)$

→ $P(A \cap B) = P(B \cap A)$

→ $P(A-B) = P(A) - P(A \cap B) = P(A \cap \bar{B})$

→ $P(B-A) = P(B) - P(A \cap B) = P(\bar{A} \cap B)$

→ A and B are mutually exclusive

$\therefore A \cap B = \emptyset \rightarrow P(A \cap B) = 0$

→ $P(A \cup B) = P(A) + P(B)$

* Condition Probab.

→ $P(A/B) = \frac{P(A \cap B)}{P(B)}$, $P(B/A) = \frac{P(A \cap B)}{P(A)}$

given or if ∴ Condition Probab. ← لما يقولي

* Dependent event → بيتغير مع الوقت

* ex: without replacement

Independent event → لا يتغير مع الوقت

← لو قولت (g) يعني (n) يعني نفس الحدث

$P(A \cap_g B) = P(A) \times P(B)$

Deck كوتشينة [52 outcomes]

- 13 Cards ♥ Hearts
- 13 Cards ♦ Diamonds
- 13 Cards ♣ Spades
- 13 Cards clubs

Red Cards → 26 outcomes

Black Cards → 26 outcomes

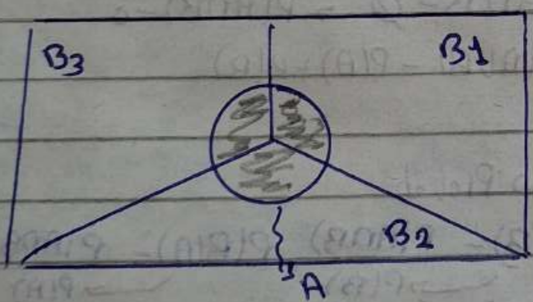
→ each 13 Cards → 1 Ace + 10 من 2 الى 10 + Jack + King + Queen

∴ In deck → 4 Aces, 4 Jacks, 4 King, 4 Queen

* لما يقولي If you roll two dice يبقى عندي 36 احتمال

Baye's Rule

* الـ (Sample space) هو (Partition) لكن متقسم كله على عدد معين من الـ [Events] الغير فارغة يعني لازم مجموعهم يكون 1، 100%



$*P_0 = P(A \cap B_1) + P(A \cap B_2) + P(A \cap B_3)$

$= P(B_1) \times P(A/B_1) + P(B_2) \times P(A/B_2) + P(B_3) \times P(A/B_3)$

* Probability distribution

→ آتي

* at most → $P(X \leq n)$
* at least → $P(X \geq n)$
* more than → $P(X > n)$
* less than → $P(X < n)$
* no, none → $P(X = 0)$
* mean = μ, $E(x) = \sum x P(x)$
* Variance = $\sigma^2 = \sum x^2 P(x) - \mu^2$
* Stander D. = $\sqrt{\text{Variance}}$

* Binomial distrib. → Discrete random Variable

n, p, q, x $q = 1 - p$

p نجاح، q فشل

← يعرفه لما الاقي رقم صحيح ورقم كسر في المسألة (p, n)

* $P(x) = \frac{n!}{x!(n-x)!} p^x q^{n-x}$

mean = $\mu = np$

Variance = $\sigma^2 = npq$

Stander dev. $\sigma = \sqrt{npq}$

* Poisson Distrib. → Discrete

$P(x) = \frac{\mu^x e^{-\mu}}{x!}$

* يعرفه لما الاقي معدل في المسألة
* no او non → X = 0 فقط

→ mean = μ

→ Variance = μ

→ SD = $\sqrt{\mu}$

* two per week: $\mu = 2/\text{week}$

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ارقام كسور

* Continuous Random Variable

*

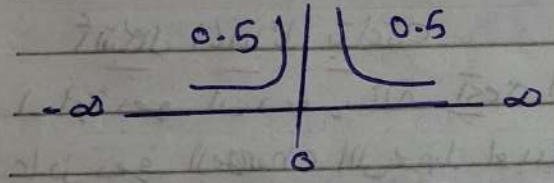
Normal distribution (X)
depends on μ, σ

* Standard normal dist. (z)
→ $\mu = 0, \sigma = 1$

* قانون التحويل من Normal dist. → Standard normal dist

*

$$Z = \frac{X - \mu}{\sigma}$$



لازم بدايتي تبقى من Zero

* Sample distribution

* Frequency dist. → معدل التكرار
* Probability dist → $\frac{f}{\text{عدد القيم}}$

* Sampling dist. of $\bar{X}$
* Sample of size "2" → اثبت كل رقم وافرد واحد معاه
* Sample of size "3" → اثبت كل رقمين وافرد واحد معاهم

mean of Population <- $\mu = \bar{\bar{X}}$ -> Mean of sample mean

* Central limit theorem → شبه الـ normal dist.
↳ approximatly Normal dist.

*

$$\text{Rule} : Z = \frac{\bar{X} - \mu}{\sigma/\sqrt{n}}$$

* الي بيسألني عليه في السؤال بيبقى $\bar{X}$

* Confidence interval
* وعلاقة % في السؤال ← رقم Z

*

$$\bar{X} \pm Z \times \frac{s \text{ or } \sigma}{\sqrt{n}}$$

Sample → Population

* الـ upper بيبقى (+)
والـ lower بيبقى (-)

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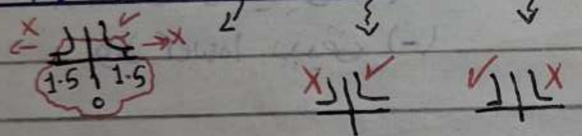
* Test of hypothesis

Null hypothesis (H_0) عكس Alternative hypothesis (H_1)

	H_0 is True	H_0 is false
Don't reject	H_0 is correct desicion	type II error or β error
Reject H_0	type I error or α error	Correct decision

	two Tailed	Left Tailed	Right Tailed
sign in H_0	=	≥	≤
sign in H_1	≠	<	>
Rejection region	In Both	In Left	In Right



* Steps of Testing Hypothesis

1- State H_0, H_1
2- Select α → significance level
3- Select Test
4- formulate desicion rule بقارن
5- State Desicion

* Select test

1- Z for large sample

$$Z = \frac{\bar{X} - \mu}{\sigma/\sqrt{n}}$$

او n>30 ← يعرف ان النوع ده لما يكون

2) T for small sample

$$T = \frac{\bar{X} - \mu}{s/\sqrt{n}}$$

← يعرف ان النوع ده لما يكون n<30 s

3) $\hat{P}$ for proportion large sample

يستبدل $\bar{X} \to \hat{P}$ و $\mu \to P$

$q = 1 - P$

$$Z = \frac{\hat{P} - P}{\sqrt{Pq/n}}$$

أشكال المسائل بتاعته

1- اولاً يعرف ان دى مسألة Test لما يقولى عايز يعرف العوامل charge اللى حصل او بيقارن حاجة قديمة بحاجة حاليًا

2- Reject H_0 ← $Z_{calc} > Z_{Tab}$

Don't reject H_0 ← $Z_{calc} < Z_{Tab}$

3- Z_{Tab} ساعات بيدهانى فى المسألة وساعات لا فى مسائل الـ Z, $\hat{P}$

لو (=) يبقى $\to Z_{Tab} = 0.5 - \frac{\alpha}{2}$

لو > او < يبقى $\to Z_{Tab} = 0.5 - \alpha$

* فى مسائل الـ T لو H_1 ≠ وقولت $\frac{\alpha}{2}$ يبقى (one-Tail Table) لو مقسمتش يبقى (two-Tail Table)

لو H_1 > << يبقى (one-Tail Table)

$T_{Tab} \to \alpha, df = n-1$

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ANOVA

→ is a procedure used to test the null hypothesis that the means of three or more population are equal

ANOVA Table

Source of Variance	Sum of Squares (SS)	Degree of freedom (df)	mean square (MS)	Fcalc
Between	SSB	K-1	MSB	$F = \frac{MSB}{MSW}$
Within	SSW	n-K	MSW	
Total	SST	n-1		

* $SSB = \left[\frac{T_1^2}{n} + \frac{T_2^2}{n} + \frac{T_3^2}{n}\right] - \frac{(\Sigma x)^2}{n}$

* $SSW = \Sigma x^2 -$ ↳

* $SST = SSB + SSW$

* $MSB = \frac{SSB}{K-1}$, * $MSW = \frac{SSW}{n-K}$, * $F = \frac{MSB}{MSW}$

* Numerator ⇝ Between * Denominator ⇝ Within