Ranking and Selection

Ranking and selection is the problem of choosing the best of two or more options (alternatives), according to some performance measure.

Linear Programming

Linear programming is used for obtaining the most optimal solution for a problem with given constraints

Single Criterion Decision Making

Decision Making based on one evaluating element

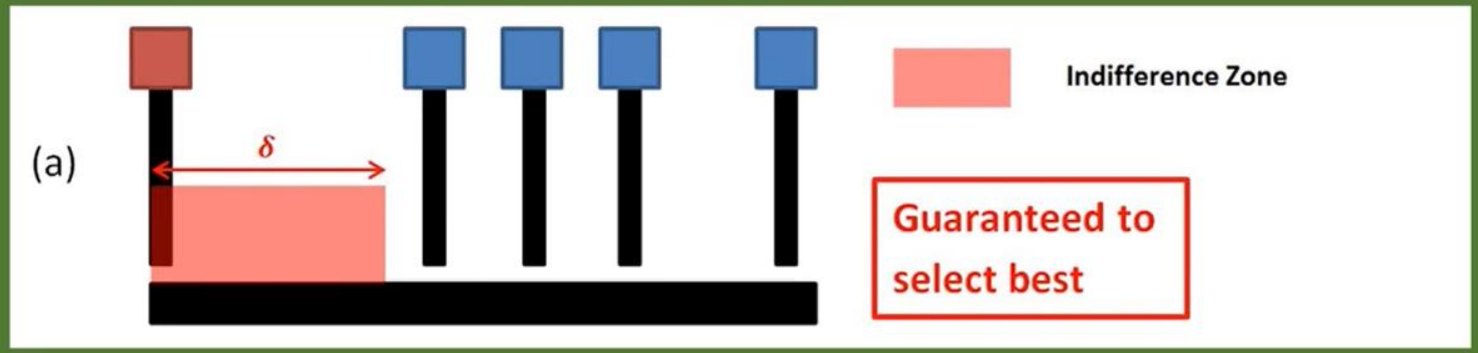
Eg: Minimum Cost

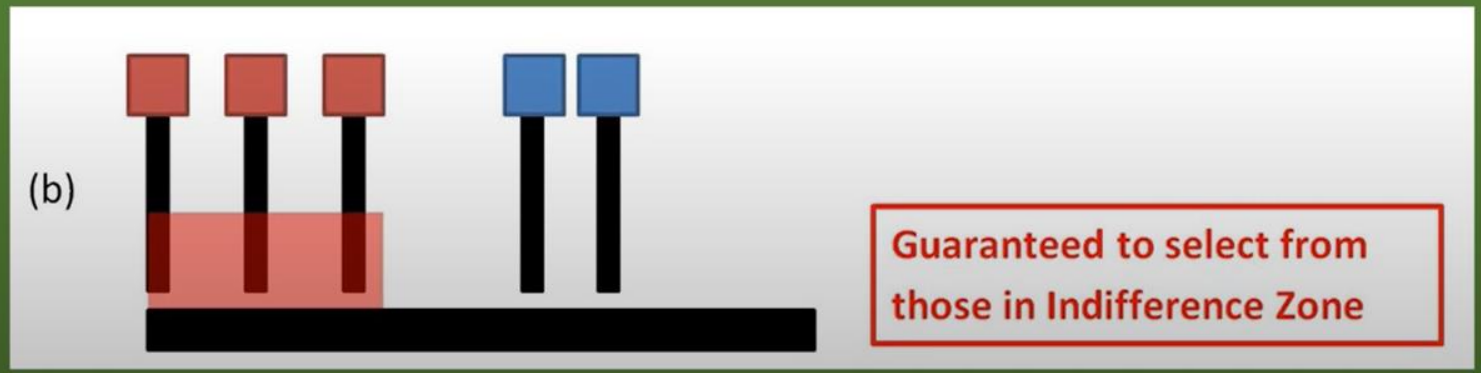
Indifference Zone

A system with a true mean within less than δ of the highest true mean with probability.

The idea of δ is an insignificant amount; we are indifferent in selecting the top alternative and alternatives with δ of it

IZ


(a)
δ
Indifference Zone
Guaranteed to select best


(b)
Guaranteed to select from those in Indifference Zone

Subset Selection

The basic goal is to divide the given set of k population into two identifiable groups or subsets of random size in such a way that there is a high probability (at least P*, where P* is pre-specified) that one (the selected subset) contains the best population and the other (the eliminated subset) does not

SS

- The subset-selection approach is particularly useful in screening problems [employee selection]
- It is also appropriate when population is very large, and we want to select a smaller number of populations to test further or to compare for secondary properties

IZ and SS

subset selection procedures give less precise information, but they do provide more flexibility

Multi-Criteria Decision Making

A Multiple-Criteria Decision Analysis (MCDA), or Multi-criteria decision making (MCDM), is a decision-making analysis that evaluates multiple (conflicting) criteria as part of the decision-making process.

Popular MCDM Methods

- Analytical Hierarchy Process
- Analytical Network Process
- TOPSIS
- ELECTRE
- PROMETHEE
- DEA

Pugh Matrix

The Pugh Matrix is a criteria-based decision matrix which uses criteria scoring to determine which of several potential solutions or alternatives should be selected.

Developed by Prof. Stuart Pugh, Strathclyde University

Alternative	Disciplined	Sarcastic	Emotional
Rachel	0	0	0
Phoebe	-2	+1	0
Joey	-2	+1	+1
Ross	+1	0	+1
Chandler	0	+2	+1
Monica	+2	0	+1

Alternative	Disciplined	Sarcastic	Emotional	TOTAL
Rachel	0	0	0	**0**
Phoebe	-2	+1	0	**-1**
Joey	-2	+1	+1	**0**
Ross	+1	0	+1	**+2**
Chandler	0	+2	+1	**+3**
Monica	+2	0	+1	**+3**

How much important is being ‘Disciplined’ than ‘Sarcastic’ or ‘Emotional’?

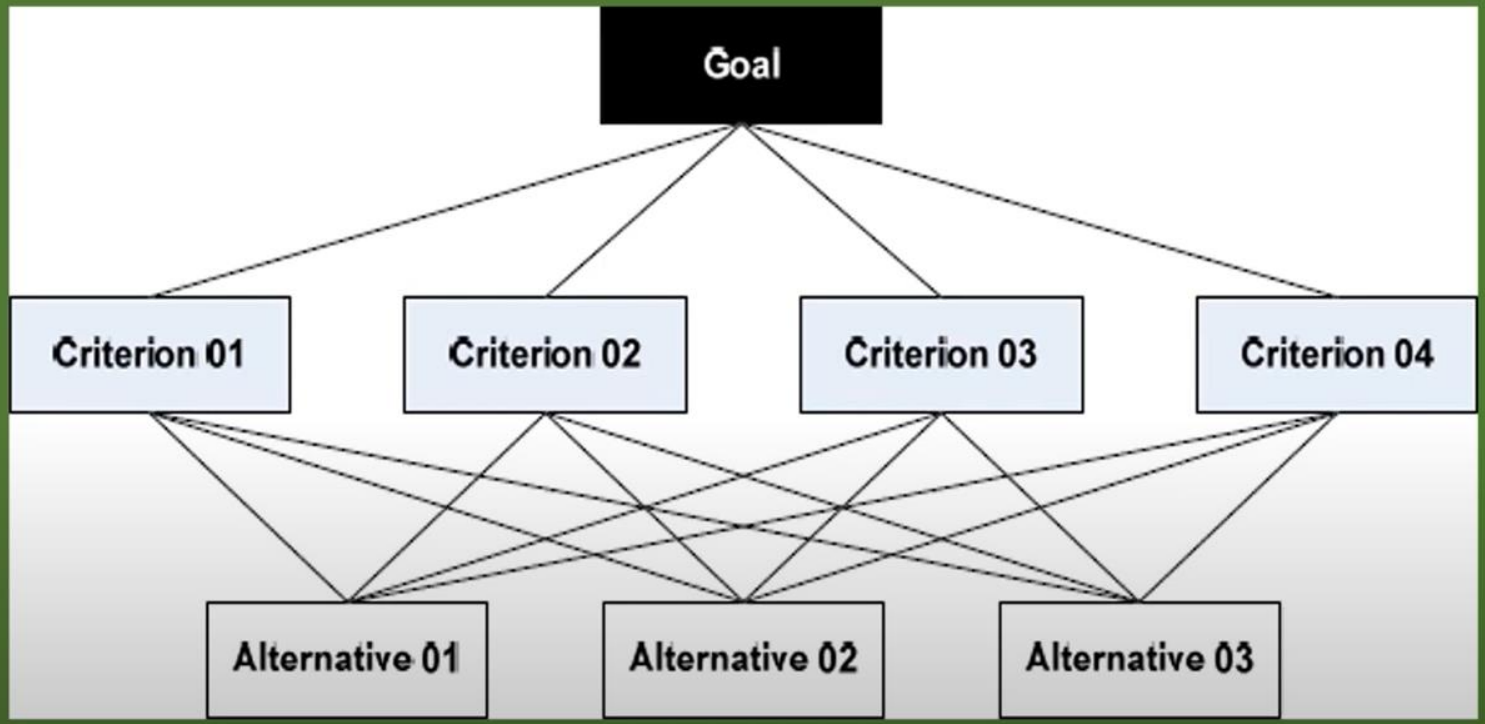
Weights of the criteria

Can be determined using AHP

Analytical Hierarchy Process

AHP was developed in the 1970s by Thomas L. Saaty and has since been extensively studied, and is currently used in decision making for complex scenarios, where people work together to make decisions when human perceptions, judgments, and consequences have long-term repercussions

AHP


Goal
Criterion 01
Criterion 02
Criterion 03
Criterion 04
Alternative 01
Alternative 02
Alternative 03

HR Analytics

Ranking and Selection using Analytical Hierarchy Process

Selecting Air Hostess

Air Hostess JD

Attend to Passenger Comfort and Safety

The main duty of an air hostess is to ensure the comfort and safety of a plane's passengers. Air hostesses review emergency and safety procedures prior to take-off, which includes demonstrating the use of any equipment. They also fill passenger requests, serve food and beverages, and tend to sick passengers, if needed.

Assist Passengers in Deplaning

It is up to air hostesses to instruct and assist passengers throughout the descent and deplaning process. They ensure that passengers are safely in their seats as the plane descends and that all garbage and loose objects have been removed and secured. Once the plane has landed, air hostesses assist passengers in removing all carry-on luggage and direct them to the exits to depart the plane.

Conduct Pre- and Post-Flight Checks

Air hostesses typically complete a pre-flight check that includes testing and ensuring that all safety equipment is in working condition. Following the deplaning process, air hostesses conduct a post-flight check to make sure all passenger items have been removed and seats and trays are placed in proper positions. They might do some light cleaning of an airplane's interior as part of their post-flight duties.

Air Hostess JS

- Communicating clearly with others
- Reassuring passengers in the event of an emergency, making sure they follow safety procedures
- Ensuring that passengers are made comfortable
- Maintaining a calm demeanor, positive outlook, and an empathetic nature
- Exhibiting excellent interpersonal skills
- Working with a culturally diverse population
- Looking and acting like a professional at all time

How do we arrive at JD and JS?

Scenario

Paramount Airways is planning to select candidates for Airhostess position. The JD and JS was advertised and applications were called for.

After the initial aptitude test candidates were shortlisted for work sample test, followed by an interview.

The work sample test and interview were based on 5 criteria.

What to look for?

Demeanour

Communication and Interpersonal Skills

Medical Training

Empathy

General Awareness

What to look for?

Demeanour

Communication and Interpersonal Skills

Medical Training

Empathy

General Awareness

Which of these are more important?

Saaty's Scale

Intensity of importance	Definition
1	Equal importance
3	Weak importance of one over another
5	Essential or strong importance
7	Demonstrated importance
9	Absolute importance
2,4,6,8	Intermediate values between the two adjacent judgments

	Demeanour	Communication	Medical Training	Empathy	General awareness
Demeanour	1	1	3	1/3	7
Communication	1	1	4	2	5
Medical Training	1/3	1/4	1	1/2	3
Empathy	3	1/2	2	1	5
General awareness	1/7	1/5	1/3	1/5	1

Validity

Maximum Eigen Value =5.38549
C.I.=0.0963717
Weights (Eigen Vector)
0.235006
0.328158
0.0998404
0.293406
0.0435904

Consistency Ratio = CI/RI
CI – Consistency Index
RI – Random Index
RI is a standard value based on n

Matrix size	Random consistency index (RI)
1	0.00
2	0.00
3	0.58
4	0.90
5	1.12
6	1.24
7	1.32
8	1.41
9	1.45
10	1.49

Transitivity

If you prefer Apples to Oranges, but Bananas to Apples
Then you would prefer Bananas to Oranges

A>O and B>A, then B>O
B>O implies consistency
O>B implies inconsistency

a relation between three elements such that if it holds between the first and second and it also holds between the second and third it must necessarily hold between the first and third

	Demeanor	Communication	Medical Training	Empathy	General awareness	Eigen Vector
Demeanor	1	1	3	1/3	7	0.235
Communication	1	1	4	2	5	0.328
Medical Training	1/3	1/4	1	1/2	3	0.0999
Empathy	3	1/2	2	1	5	0.293
General awareness	1/9	1/5	1/3	1/5	1	0.044

The candidates

Five candidates were selected for the final interview, and after the completion of the interview their performance were compared.

The candidates are:

Xena

Zara

Qisa

Jikha

Fyla

The five candidates are compared against each other on each of the five criteria.

First, the candidates are compared pairwise against the criteria ‘Demeanour’

Compared against ‘Demeanour’

	Xena	Zara	Qiza	Jikha	Fyla
Xena	1	7	1/4	2	1
Zara		1	1/8	1/3	1/5
Qiza			1	5	7
Jikha				1	1/3
Fyla					1

Compared against 'Demeanour'

	Xena	Zara	Qiza	Jikha	Fyla	Eigen Vector
Xena	1	7	1/4	2	1	0.1640
Zara		1	1/8	1/3	1/5	0.0353
Qiza			1	5	7	0.5642
Jikha				1	1/3	0.0818
Fyla					1	0.1547

CR

Maximum Eigen Value =5.30819

C.I.=0.077048

Weights (Eigen Vector)

0.164005

0.0353181

0.564168

0.0817892

0.154719

Find CR

Matrix size	Random consistency index (RI)
1	0.00
2	0.00
3	0.58
4	0.90
5	1.12
6	1.24
7	1.32
8	1.41
9	1.45
10	1.49

CR

Maximum Eigen Value =5.30819

C.I.=0.077048

Weights (Eigen Vector)

0.164005

0.0353181

0.564168

0.0817892

0.154719

Find CR

Matrix size	Random consistency index (RI)
1	0.00
2	0.00
3	0.58
4	0.90
5	1.12
6	1.24
7	1.32
8	1.41
9	1.45
10	1.49

CR = CI/RI

RI = 1.12 [from table]

CR = 0.077/1.12

CR = 0.06875

	Demeanour	Communication	Medical Training	Empathy	General awareness
Xena	0.1640	0.2334	0.3879	0.4579	0.5095
Zara	0.0353	0.2109	0.0644	0.0845	0.1867
Qiza	0.5642	0.2984	0.3123	0.0287	0.1186
Jikha	0.0818	0.1984	0.2129	0.0316	0.0209
Fyla	0.1547	0.0589	0.0225	0.3973	0.1643

	Demeanour	Communication	Medical Training	Empathy	General awareness
WEIGHTS	0.235	0.328	0.0999	0.293	0.044
Xena	0.1640	0.2334	0.3879	0.4579	0.5095
Zara	0.0353	0.2109	0.0644	0.0845	0.1867
Qiza	0.5642	0.2984	0.3123	0.0287	0.1186
Jikha	0.0818	0.1984	0.2129	0.0316	0.0209
Fyla	0.1547	0.0589	0.0225	0.3973	0.1643

Weighted Sum of Each Row

$$\textit{Alternative } m = W_1X_{m1} + W_2X_{m2} + \ldots + W_nX_{mn}$$

$$\textit{Alternative } 1 = W_1X_{11} + W_2X_{12} + \ldots + W_nX_{1n}$$

n = number of criteria

m = number of alternatives

Xena = (0.235 x 0.1640) + (0.328 x 0.2334) + (0.0999 x 0.3879) + (0.293 x 0.4579) + (0.044 x 0.5095)

	Demeanour	Communication	Medical Training	Empathy	General awareness	TOTAL Score
WEIGHTS	0.235	0.328	0.0999	0.293	0.044	1
Xena	0.1640	0.2334	0.3879	0.4579	0.5095	0.31043
Zara	0.0353	0.2109	0.0644	0.0845	0.1867	0.116882
Qiza	0.5642	0.2984	0.3123	0.0287	0.1186	0.275281
Jikha	0.0818	0.1984	0.2129	0.0316	0.0209	0.115743
Fyla	0.1547	0.0589	0.0225	0.3973	0.1643	0.181562

The best performer

Oh I knew that..

Why AHP?

TOPSIS

Technique for Order of Preference by Similarity to Ideal Solution

Bouncy Shortlist

A dance bar in Madgao is planning to recruit a bouncer. They invited applications and out of 8, 5 were found to be suitable. The manager wanted to shortlist 3 of them to be called for a final interview.

Santa

Banta

Fanta

Zanta

Manta

MCDM - TOPSIS

Technique of Order Preference by Similarity to Ideal Solution

- Hwang and Yoon, 1981
- Positive Ideal
- Negative Ideal
- Closer to +ve
- Farther from -ve
- Cost-Benefit Analysis

Bouncer Selection based on

- Physique
- Previous Experience
- Languages Known
- Petty Crime

Weight Calculation using AHP

- Physique [0.3]
- Previous Experience [0.45]
- Languages Known [0.15]
- Petty Crime [0.1]

TOPSIS

	Physique	Prev Exp (Years)	Language	Petty Crimes
Santa	Good	3	3	2
Banta	Very Good	1	2	1
Fanta	Good	4	2	2
Zanta	Good	2	4	0
Manta	Excellent	2	4	1

TOPSIS - Step 1

	Physique	Prev Exp	Language	Petty Crimes
Weights	0.3	0.45	0.15	0.1
Santa	Good	3	3	2
Banta	Very Good	1	2	1
Fanta	Good	4	2	2
Zanta	Good	2	4	0
Manta	Excellent	2	4	1

Calculate weights for criteria

TOPSIS -Step2

	Physique	Prev Exp	Language	Petty Crimes
Weights	0.3	0.45	0.15	0.1
Santa	3	3	3	2
Banta	4	1	2	1
Fanta	3	4	2	2
Zanta	3	2	4	0
Manta	5	2	4	1

Convert Qualitative to Quantitative

TOPSIS - Step 3

	Physique	Prev Exp	Language	Petty Crimes
Weights	0.3	0.45	0.15	0.1
Santa	9	9	9	4
Banta	16	1	4	1
Fanta	9	16	4	4
Zanta	9	4	16	0
Manta	25	4	16	1
Sum	68	34	49	10
Sq. Root	8.24	5.83	7	3.16

Squares of each cell

Square root of sum of squares for each column

TOPSIS - Step 4

	Physique	Prev Exp	Language	Petty Crimes
Weights	0.3	0.45	0.15	0.1
Santa	0.36	0.51	0.43	0.63
Banta	0.48	0.17	0.28	0.31
Fanta	0.36	0.68	0.28	0.63
Zanta	0.36	0.34	0.57	0
Manta	0.60	0.34	0.57	0.31

Divide each cell by sq. root value. Eg. 9/8.24

TOPSIS - Step 5

	Physique	Prev Exp	Language	Petty Crimes
Weights	0.3	0.45	0.15	0.1
Santa	0.108	0.23	0.06	0.063
Banta	0.144	0.08	0.04	0.031
Fanta	0.108	0.31	0.04	0.063
Zanta	0.108	0.15	0.09	0
Manta	0.18	0.15	0.09	0.031

Multiply each cell by corresponding weights

TOPSIS - Step 6

	Physique	Prev Exp	Language	Petty Crimes
Santa	0.118	0.23	0.06	0.063
Banta	0.144	0.08	0.04	0.031
Fanta	0.108	0.31	0.04	0.063
Zanta	0.108	0.15	0.09	0
Manta	0.18	0.15	0.09	0.031

- Positive Ideal Solution: A* = {0.18, 0.31, 0.09, 0}
- Negative Ideal Solution: A' = {0.108, 0.08, 0.04, 0.063}

TOPSIS- Step 7

	Physique	Prev Exp	Language	Petty Crimes
Santa	$[0.118 - 0.18]^2$	$[0.23 - 0.31]^2$	$[0.06 - 0.09]^2$	$[0.063 - 0]^2$
Banta	$[0.144 - 0.18]^2$	$[0.08 - 0.31]^2$	$[0.04 - 0.09]^2$	$[0.031 - 0]^2$
Fanta	$[0.108 - 0.18]^2$	$[0.31 - 0.31]^2$	$[0.04 - 0.09]^2$	$[0.063 - 0]^2$
Zanta	$[0.108 - 0.18]^2$	$[0.15 - 0.31]^2$	$[0.09 - 0.09]^2$	$[0 - 0]^2$
Manta	$[0.18 - 0.18]^2$	$[0.15 - 0.31]^2$	$[0.09 - 0.09]^2$	$[0.031 - 0]^2$

Subtract positive ideal from each cell value per column and square

TOPSIS - 9

	Physique	Prev Exp	Language	Petty Crimes	Total
Santa	0.0038	$[0.23 - 0.31]^2$	$[0.06 - 0.09]^2$	$[0.063 - 0]^2$	
Banta	0.0013	$[0.08 - 0.31]^2$	$[0.04 - 0.09]^2$	$[0.031 - 0]^2$	
Fanta	0.0052	$[0.31 - 0.31]^2$	$[0.04 - 0.09]^2$	$[0.063 - 0]^2$	
Zanta	$[0.108 - 0.18]^2$	$[0.15 - 0.31]^2$	$[0.09 - 0.09]^2$	$[0 - 0]^2$	
Manta	$[0.18 - 0.18]^2$	$[0.15 - 0.31]^2$	$[0.09 - 0.09]^2$	$[0.031 - 0]^2$	

Find row total

TOPSIS- Step 10

	Total	S* = Sqr root (Total)
Santa	0.1760	0.030976
Banta	0.2310	0.053361
Fanta	0.1326	0.017583
Zanta	0.0965	0.009312
Manta	0.0675	0.004556

Calculate S*

TOPSIS - Step 11

	Physique	Prev Exp	Language	Petty Crimes
Santa	[0.118 - 0.108]^2	[0.23 - 0.08]^2	[0.06 - 0.04]^2	[0.063 - 0.063]^2
Banta	[0.144 - 0.108]^2	[0.08 - 0.08]^2	[0.04 - 0.04]^2	[0.031 - 0.063]^2
Fanta	[0.108 - 0.108]^2	[0.31 - 0.08]^2	[0.04 - 0.04]^2	[0.063 - 0.063]^2
Zanta	[0.108 - 0.108]^2	[0.15 - 0.08]^2	[0.09 - 0.04]^2	[0 - 0.063]^2
Manta	[0.18 - 0.108]^2	[0.15 - 0.08]^2	[0.09 - 0.04]^2	[0.031 - 0.063]^2

Subtract negative ideal from each cell value per column and square

TOPSIS - Step 12

	Physique	Prev Exp	Language	Petty Crimes	Total
Santa	[0.118 - 0.108]^2	[0.23 - 0.08]^2	[0.06 - 0.04]^2	[0.063 - 0.063]^2	
Banta	[0.144 - 0.108]^2	[0.08 - 0.08]^2	[0.04 - 0.04]^2	[0.031 - 0.063]^2	
Fanta	[0.108 - 0.108]^2	[0.31 - 0.08]^2	[0.04 - 0.04]^2	[0.063 - 0.063]^2	
Zanta	[0.108 - 0.108]^2	[0.15 - 0.08]^2	[0.09 - 0.04]^2	[0 - 0.063]^2	
Manta	[0.18 - 0.108]^2	[0.15 - 0.08]^2	[0.09 - 0.04]^2	[0.031 - 0.063]^2	

Calculate Row Total

TOPSIS - Step 13

	Total	S' = Sqr root (Total)
Santa	0.0554	0.003069
Banta	0.0926	0.008575
Fanta	0.105	0.011025
Zanta	0.0653	0.004264
Manta	0.0711	0.005055

Calculate S'

TOPSIS - Step 14

	C*
Santa	0.09015
Banta	
Fanta	
Zanta	
Manta	

Calculate C* for each candidate

$C^* = S'/(S^*+S')$

Decision

Utilizing AHP and TOPSIS the the following candidates are shortlisted for the position of Bouncer in the rank order of their score:

1. Manta
2. Fanta
3. Zanta

The above candidates may be considered for interview.

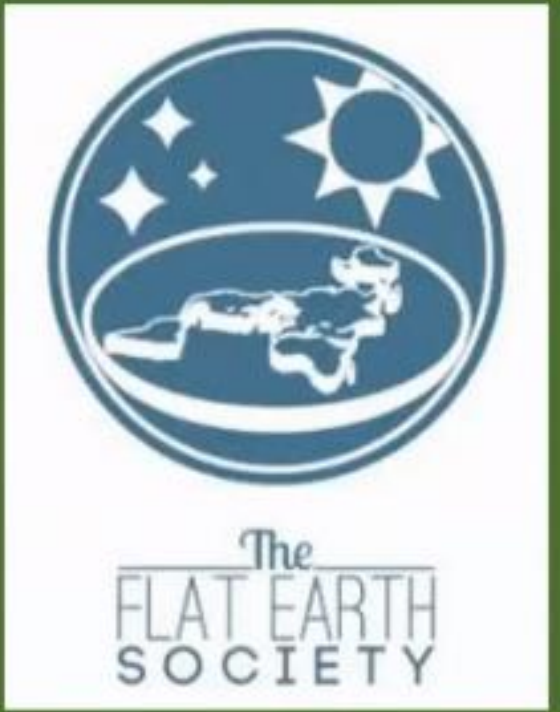
Heuristics in HR

- Heuristics are problem solving methods that does not guarantee rational or optimal solutions.

HR Operations

There is negligible application of 'Operations' principles in HR.

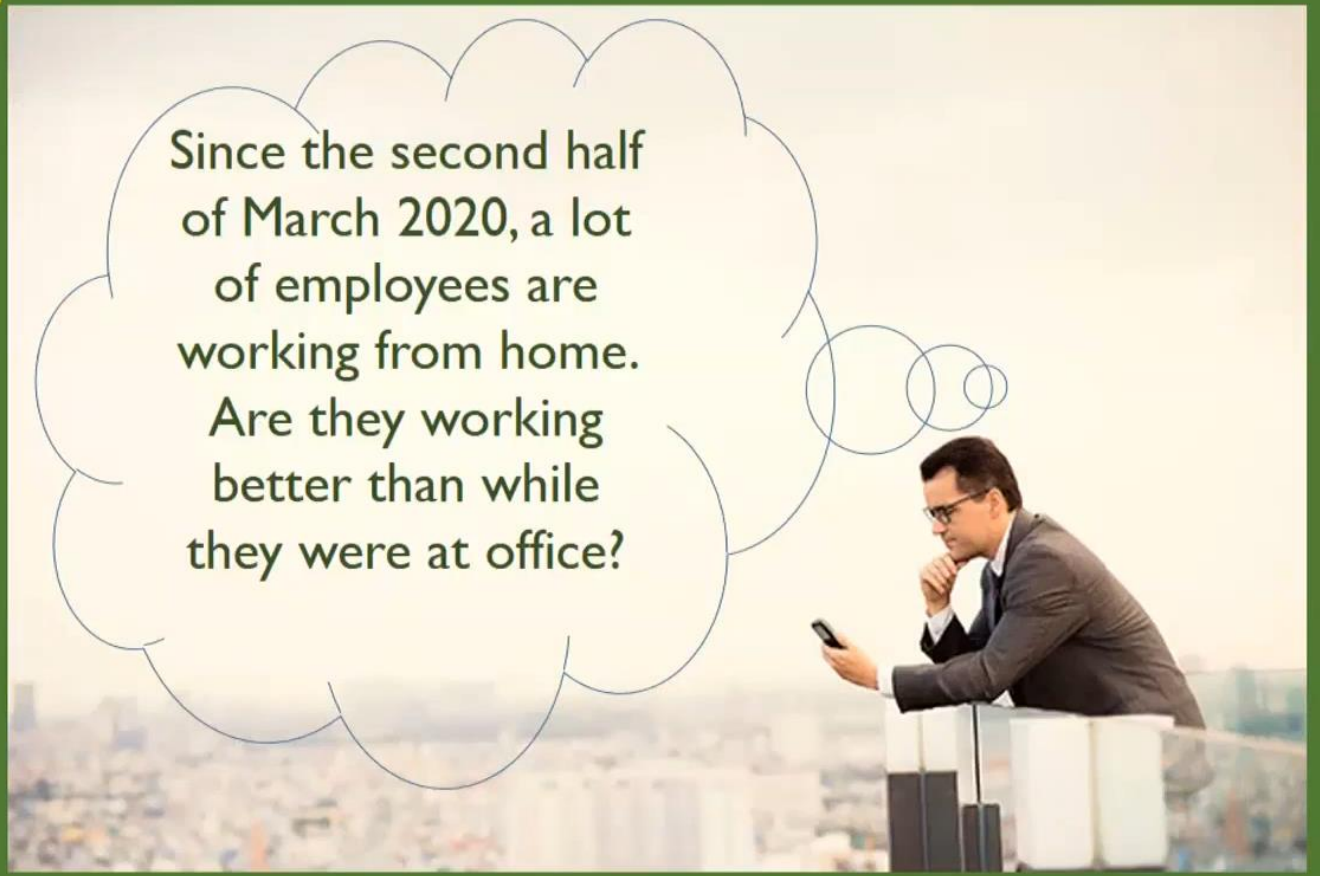
The Flat Earth Society



They say…

I claim that the earth is flat.

Hmm…


Since the second half of March 2020, a lot of employees are working from home. Are they working better than while they were at office?

Are they working better than while they were at office?

Claim

The performance of employees who WFH has increased than while they were working from office.

Claim vs Status-quo

The performance of employees who WFH has increased than when they were working from office.

There is no difference in performance of employees whether working from home or working from office

This is null hypothesis

Claim vs Status-quo

Ho: Performance WFH = Performance WFO

Ha: Performance WFH > Performance WFO

Claim vs Status-quo

Ho: Performance WFH = Performance WFO

Ha: Performance WFH > Performance WFO

Ho: Performance WFH ≤ Performance WFO

What to test?

- It is the responsibility of the Ha proposer to test the claim
- Ha cannot be tested
- It is always the Ho that will be tested for significance
- The statistical analysis indicates that there is enough evidence to either reject or not to reject the Ho.
- Rejecting Ho doesn't mean blindly accepting Ha, but rather there could be a possibility of Ha. [*The chance of Ha appears to be too significant enough to ignore; The Ha might not be just a fluke*]

Jurisprudence

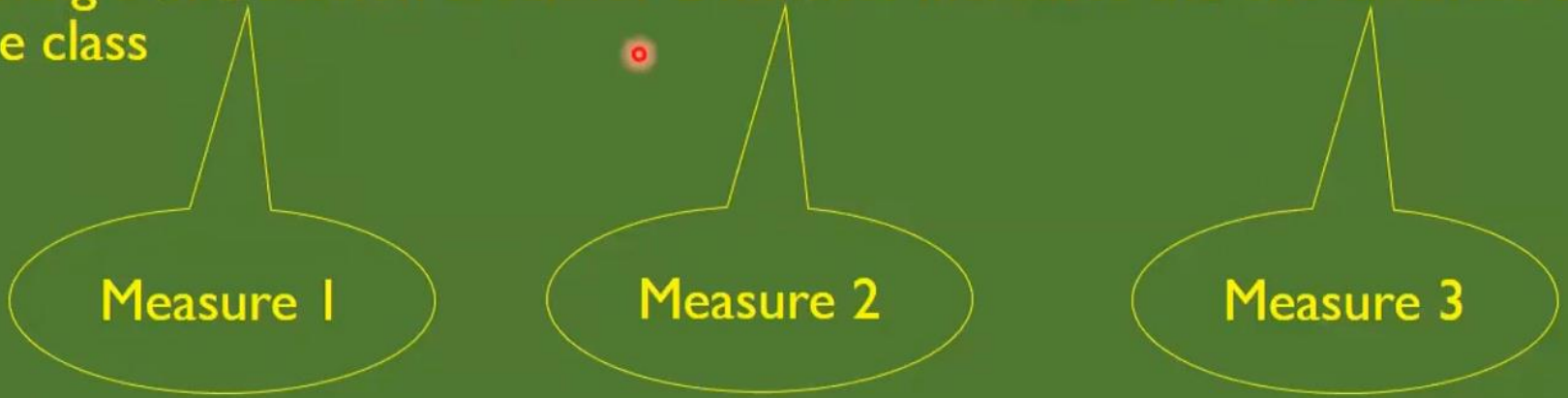
A convicted is innocent until proven guilty

Claim

Giving a mid-session break for 2 minutes increases the effectiveness of the class

Claim

Giving a mid-session break for 2 minutes increases the effectiveness of the class



The significance of

19

Why 19?

If 19 times out of 20 are found to be true, then its generally scientifically and statistically valid.

How?

What's the big deal about

95%

Why 95?

If an observation is repeated 95 times out of 100, then it is statistically accepted to be ok (as expected)

We can live with 5% uncertainty

the probability of rejecting the null hypothesis when it is true

COVID – No

Test says - Yes

Decision Matrix

	Do not reject Ho	Reject Ho
Ho is true	Correct Decision	
Ho is false		Correct Decision

Decision Matrix

	Do not reject Ho	Reject Ho
Ho is true	Correct Decision	Incorrect Decision (Type I error α)
Ho is false	Incorrect Decision (Type II error β)	Correct Decision

Decision Matrix

	Do not reject Ho	Reject Ho
Ho is true	Correct Decision	Incorrect Decision (Type I error α)
Ho is false	Incorrect Decision (Type II error β)	Correct Decision

It's all a chance

Chance of raining

+

Chance of not raining

=

Chance of raining = 1-(Chance of not raining)

Probability of making an incorrect decision + Probability of making a correct decision = 1

Probability of making an incorrect decision

$\alpha + (1-\alpha) = 1$

When α is more, the probability of correct decision is less

So what is an optimum α?

Optimal α level

- Depends on the seriousness of the issue
- How sensitive is the decision
- Who will be affected by the decision
- What will be the implication
- Can we afford to make some mistakes

Looking back

A 65-year-old relative of yours suffers from a serious disease. It makes her life miserable, but does not pose an immediate risk to her life. She can go through an operation that, if successful, will cure her. Although, the operation is risky; 70% of the patients undergoing it survive.

Would you recommend that she undergoes it?

- Probability of an event happening = p
- The event here is that the expected output falls within an interval
- Confidence level: 95%
- α=5%
- If the probability of the event is less than or equal to α (say 5%), reject Ho

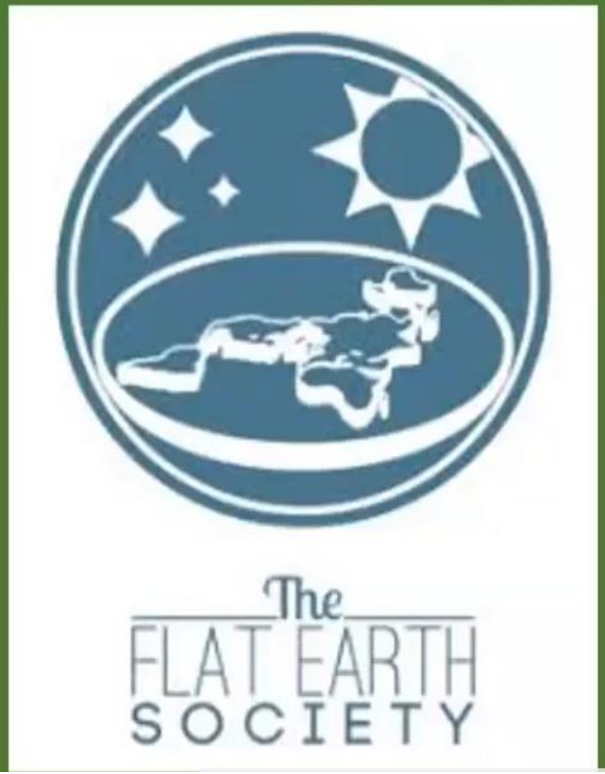
Drill it down..

If $p \leq \alpha$, reject Ho

Data Analysis Process

- Problem Definition / Scenario Comprehension
- Hypothesis
- Data Collection
- Analysis
- Inference
- Recommendation

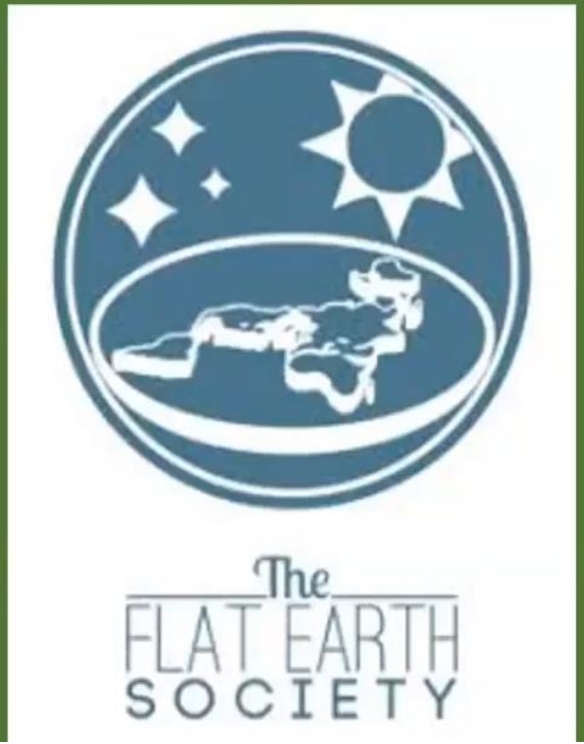
The Flat Earth Society



Ha: The earth is flat.

Ho: The earth is not flat.

The Flat Earth Society



It is the responsibility of Flat Earth Society members to prove that the earth is flat.

They could test this by providing enough evidence that the earth is not spherical or cube or any other shape.

Selection at Moon

Moon Pharma is carrying out a selection process for the position of Operations Manager. There are 14 positions to be filled across the country. They usually go through two interviews – technical followed by HR (if qualified in technical).

The candidates have completed the technical interview and awaiting results.

Possibilities

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Sample Space

Random Variable

Given a sample space S, the probability of choosing any element is equal.

Back to Moon

Typically 25% of all candidates clear both the HR and technical interviews, and 42% pass only the technical interview.

What is the chance of a candidate passing the HR interview given that she has already passed the technical interview?

Conditional Probability

$P(B|A) = \frac{P(A \cap B)}{P(A)}, P(A)>0$

Moon again

A: Panel Interview; B: HR Interview

Probability of candidates clearing panel interviews: 42%

P(A) = 0.42

Probability of candidates clearing both the HR and panel interviews: 25%

$P(A \cap B) = 0.25$

Moon walk

A: Panel Interview; B: HR Interview

Probability of candidates clearing panel interviews: 42%

Probability of candidates clearing both the HR and panel interviews: 25%

According to conditional probability, this is equal to the probability of successfully passing both interviews (.25), divided by the probability of passing the panel interview (.42)

$$\frac{P(A \cap B)}{P(A)} = \frac{0.25}{0.42}$$

Baye's Theorem

$$P(B|A) = \frac{P(A \cap B)}{P(A)}$$

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

$$P(B|A) = \frac{P(A|B)P(B)}{P(A)}$$

In English:
Probability of event B gets refined as new and additional information is provided

Expectation

The best (calculated) guess

$E(X) = x1.P(x1) + x2.P(x2) + x3.P(x3) + \ldots. + xn.P(xn)$

$E(X) = \sum_{i=1}^{n} xi.P(xi)$

Variation and Deviation

Shifts from the expected value

How do we standardize this shift. Have a value that is equal on both sides of the expected value.

This is standard deviation.

P and S

- Population and Sample
- Parameter and Statistic

Revisiting the Moon

The monthly mean salary demanded by candidates who were interviewed for a manager position was Rs. 120000 with a standard deviation of Rs 20000. Calculate the proportion of candidates who expect salaries between Rs 80000 and Rs 160000.

μ= 120000

σ= 20000

$\mu \pm 1\sigma$ = 120000-20000, 120000+20000 = 100000, 1400000

$\mu \pm 2\sigma$ = 120000-2(20000), 120000+2(20000) = 80000, 160000

Chebyshev's Inequality

$p(\mu - k\sigma \leq x \leq \mu + k\sigma) \geq 1 - \frac{1}{k^2}$

$\mu \pm 2\sigma$ = 120000-2(20000), 120000+2(20000) = 80000, 160000

k = 2

$1 - \frac{1}{k^2} = 0.75$

The proportion of candidates who expect salaries between Rs 80000 and Rs 160000 is atleast 75%

Recruiting Yield Pyramid at Moon

70% acceptance rate

How many candidates should Moon Pharma offer so as to fill the 14 vacancies?

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How many candidates should Moon Pharma offer so as to fill the 14 vacancies?

Sample Space: { Accept, Reject}
Binomial Distribution [E(x) = n * p]
n is the number of offers to be made
p is the acceptance rate (or probability of acceptance)
E(x) = 14
n * p = 14
n= 14 / 0.7
n = 20
Moon Pharma needs to make atleast 20 offers to fill 14 vacancies

How many would join?

If 10 offers are made what is the probability that more than 5 and less than 8 candidates would accept the offer?

$P(5<x<8) = P(x=6) + P(x=7)$

Binomial Distribution: $P(X) = {}^{n}C_{x}.p^{x}.q^{n-x}$

$n = 10$
$X = 6$
$p = 0.7$
$q = 1-p = 0.3$

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$P(x) = 0.2001 + 0.2668 \approx 0.467$

There is approximately 47% chance that more than 5 and less than 8 candidates would accept the offer

Moon Pharma is 47% confident that 6 or 7 candidates would join if 10 were offered

Confidence Interval

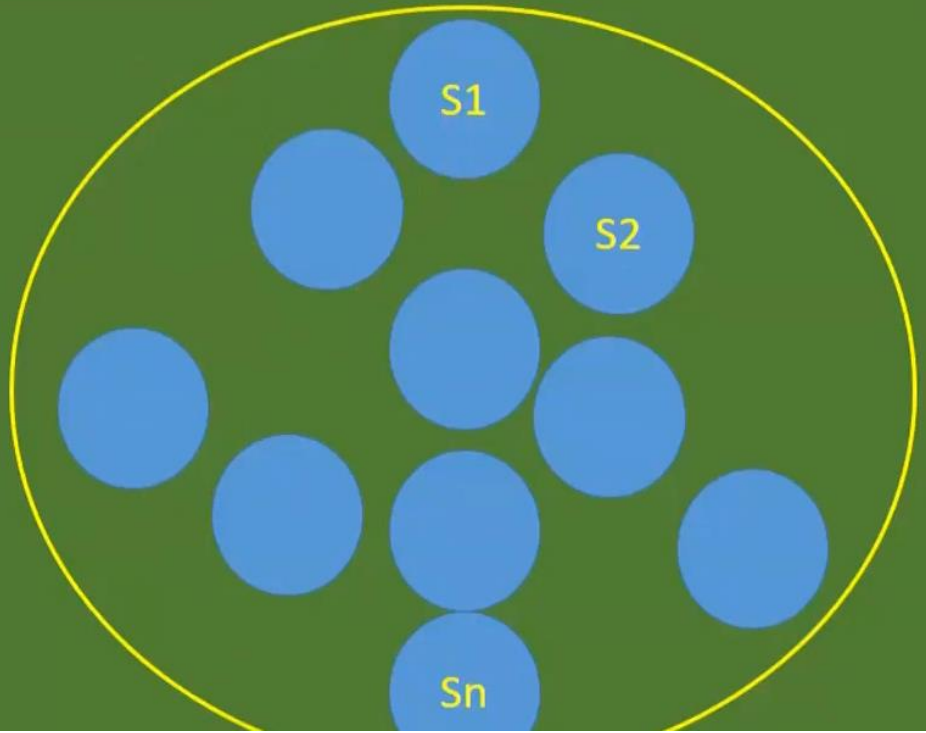
The confidence with which I know that atleast 95% of students would join between 7.59 and 8.06 am

Normal

- As usual, typically
- independent and identically distributed [iid]

Central Limit Theorem

μ, σ
$\bar{X}, s$



Central Limit Theorem

Mean of S1 is $\overline{X1}$

Mean of S2 is $\overline{X2}$

…

Mean of Sn is $\overline{Xn}$

Distribution of $\overline{X1}, \overline{X2}, \ldots, \overline{Xn}$ follows a normal distribution, with mean $\mu, and\ sd\ \sigma$

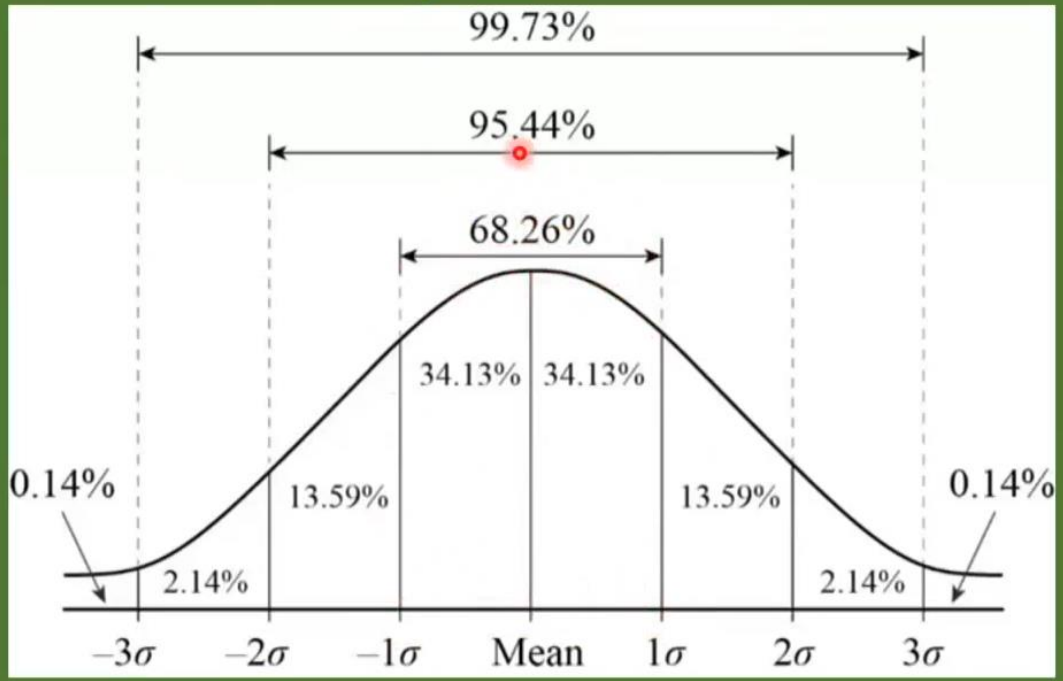
Central Limit Theorem

Central limit theorem states that for a large sample drawn from a population with mean μ, and standard deviation σ, the sampling distribution of mean, X, follows an approximate normal distribution with mean μ and standard deviation (standard error) $\sigma / \sqrt{n}$ irrespective of the distribution of the population

Assumption of NORMALITY

Normal Distribution

Normal distribution with mean μ and standard deviation σ is denoted as $N(\mu, \sigma^2)$.



Zzz…

$$z = \frac{x - \mu}{\sigma}$$

Standard Normal: when $\mu = 0$ and $\sigma = 1$

Z Distribution for sample

$$z = \frac{x - \mu}{(\sigma/\sqrt{n})}$$

$$z = \frac{x - X'}{(\sigma/\sqrt{n})}$$

Sample Size

$$n = [\frac{Z.\sigma}{D}]^2$$

Confidence Level

Confidence Interval [Margin of Error]

Sample size determination

- A hospital is interested in estimating the average time it takes to discharge a patient after the clearance (discharge note) by the doctor. Calculate the required sample size at a confidence of 95% and maximum error in estimation of 5 minutes. Assume that the population standard deviation is 30 minutes.

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$D = 5$, $\sigma = 30$, $\alpha = 0.05$, and $|Z_{a/2}| = 1.96$ for $\alpha = 0.05$.

$$n = [\frac{Z.\sigma}{D}]^2$$

Sample size determination

Waiting time at a bank follows a normal distribution with mean 16 minutes and standard deviation 6 minutes. Calculate the sample size required to estimate the mean at a confidence of 95% and maximum error in estimation of 2 minutes.

Sampling Error

Occurs when the researcher does not select a sample that represents the entire population of data and the results found in the sample do not represent the results that would be obtained from the entire population

Assumptions in Parametric Tests

- Normality
- Homogeneity of Variance [Homo/Heteroscedasticity]
- Independence