Research Methods in Psychology

Layam Institute

Syllabus

- Total Block = 4
- Units in Each Block = 4
- Total Units = 16

- **Block-1 Introduction to Research Methods in Psychology**
  - Unit-1 Basic Process/Concept in Research
  - Unit-2 Reliability and Validity (External and Internal)
  - Unit-3 Variables and Constructs
  - Unit-4 Hypothesis Formulation and Sampling
- **Block-2 Types of Research**
  - Unit-1 Survey Research
  - Unit-2 Ex-Post Facto Research
  - Unit-3 Experimental Research (Field Experiment)
  - Unit-4 Case Study

- **Block-3 Research Design**
  - Unit-1 Single Factor Design
  - Unit-2 Factorial Design
  - Unit-3 Quasi Experimental Design
  - Unit-4 Other Designs (Correlational Design and Comparative Design)
- **Block-4 Qualitative Research in Psychology**
  - Unit-1 Introduction Including Ethnography
  - Unit-2 Grounded Theory
  - Unit-3 Discourse Analysis
  - Unit-4 Reporting and Evaluating in Qualitative Research

INTRODUCTION TO RESEARCH METHODS IN PSYCHOLOGY

BLOCK 1

BLOCK 1

- Unit-1 Basic Process/Concept in Research
- Unit-2 Reliability and Validity (External and Internal)
- Unit-3 Variables and Constructs
- Unit-4 Hypothesis Formulation and Sampling

What is Research?

- **Simple Definition:** Research = Re + Search = Searching again and again
- **In Psychology:** A systematic and scientific way to find answers to questions about human behavior and mental processes.

Example:

- When you're buying a new phone, you compare features, read reviews, ask friends - **that's informal research!**
- Scientific research is the same but **more systematic, organized, and unbiased**.

Why Do We Need Research in Psychology?

- **Real-Life Scenario:** Imagine your friend says: *"Watching Instagram reels makes babies weaker!"*
- **Without Research:** We just believe it or disbelieve it based on opinion
- **With Research:** We can scientifically test if it's true or false
- **Benefits:**
  - Gets us **FACTS**, not opinions
  - Helps solve **real problems** (mental health, learning difficulties)
  - Improves **treatments and therapies**
  - Predicts **human behavior**

Criteria of GOOD Research

- **Think of Research Like Cooking!**
- A good recipe should be:
  - **Clear -** Anyone can understand it
  - **Replicable -** Anyone can follow it and get similar results
  - **Systematic -** Step-by-step process
  - **Objective -** Not influenced by personal biases
- **Similarly, Good Research Should Be: ✓ Purpose clearly defined ✓ Research process detailed** (so others can repeat) **✓ Research design thoroughly planned ✓ Limitations frankly revealed ✓ Adequate analysis for decision-making ✓ Findings presented unambiguously ✓ Conclusions justified ✓ Researcher's experience reflected**

Qualities of a Good Researcher

Think of a Detective:

- **Curious** - Always asking "Why?"
- **Patient** - Research takes time
- **Objective** - No personal bias
- **Open-minded** - Ready to accept unexpected results
- **Critical thinker** - Questions everything
- **Ethical** - Follows moral principles
- **Detail-oriented** - Notices small things

- **Example:** Sherlock Holmes is a good researcher! He observes, collects evidence systematically, doesn't jump to conclusions.

Two Contexts of Research

1. CONTEXT OF DISCOVERY (Getting an Idea)

"Aha!" moment
Observing something interesting
Reading previous research
Personal experience

2. CONTEXT OF JUSTIFICATION (Testing the Idea)

Scientifically testing if the idea is correct
Collecting data
Analyzing results

Daily Life Example:

Discovery: You notice students who study with music seem happier

Justification: You conduct a proper study to test if music actually improves mood while studying

Role of Theory, Hypothesis & Paradigm

- **Let's Understand with a Story:**
- **THEORY** = Big explanation
  - *"Regular exercise improves mental health"*
  - Like a complete story that explains many things
- **HYPOTHESIS** = Specific testable prediction
  - *"Students who exercise 30 minutes daily will have lower anxiety than those who don't"*
  - Like a specific chapter you want to test
- **PARADIGM** = Way of thinking
  - *How we view and study mental health (biological vs. behavioral approach)*
  - Like the lens through which you read the story
- **Simple Analogy:**
- **Paradigm** = Your eyeglasses
- **Theory** = A book
- **Hypothesis** = One page you want to verify

Research Biases

- **What is Bias?** When your personal preferences, beliefs, or expectations influence your research results.
- **Types of Biases:**
  - **1. PERSONAL BIAS**
    - *Example:* A researcher who loves coffee might unconsciously find only positive effects of coffee
  - **2. OBSERVER BIAS**
    - *Example:* A teacher expecting certain students to perform well might give them higher ratings
  - **3. EXPECTANCY BIAS**
    - *Example:* Participants change behavior because they know what's expected
    - *(Remember Hawthorne Effect?)*
  - **4. PLACEBO EFFECT**
    - *Example:* People feel better just because they think they're getting treatment (even if it's fake medicine)
- **Daily Life Example:** When you buy something expensive, you tend to praise it more - that's bias!

Objectivity Safeguards

How to Keep Research Unbiased:

1. STANDARDIZATION

- Use same procedures for everyone
- *Example:* Give same instructions to all participants

2. COMPLETE RECORDS

- Document everything - procedures, observations, results
- *Example:* Video recording experiments

3. OPERATIONAL DEFINITIONS

- Define concepts in measurable terms
- *Example:* Instead of "anxiety," say "score on Hamilton Anxiety Scale"

4. CONTROL GROUPS

- Compare treatment group with no-treatment group
- *Example:* Test new therapy against no therapy

5. BLIND & DOUBLE-BLIND PROCEDURES

- Participants don't know which group they're in (Blind)
- Even researchers don't know (Double-blind)

6. REPLICATION

- Repeat the study to verify results

STEPS IN RESEARCH PROCESS

- **(MOST IMPORTANT - ASKED IN EXAMS REPEATEDLY!)**
- **The 7-Step Journey of Research 🚶‍♂️➡️🎯**
- Think of Research as Planning a Trip:
- **STEP 1:** PROBLEM IDENTIFICATION **STEP 2:** HYPOTHESIS FORMULATION 💡 **STEP 3:** IDENTIFYING, MANIPULATING & CONTROLLING VARIABLES **STEP 4:** RESEARCH DESIGN 📐 **STEP 5:** DATA ANALYSIS & INTERPRETATION 📊 **STEP 6:** DRAWING CONCLUSIONS ✅ **STEP 7:** REPORT PREPARATION & PUBLICATION 📝
- *Let's understand each step in detail...*

STEP 1 - Problem Identification

What is it? Finding a specific, researchable question

- **Sources of Research Problems:**
  - Personal experience
  - Previous research (literature review)
  - Theories
  - Social issues
  - Observation of behavior
- **Daily Life Example:**
- ✕ **BAD Research Question:** *"Why do students fail?"* (Too broad, vague)
- ✓ **GOOD Research Question:** *"Does sleep deprivation affect memory performance in college students?"* (Specific, measurable, researchable)
- **Tips for Good Problem:**
- Should be **FINER**:
  - **F**easible
  - **I**nteresting
  - **N**ovel
  - **E**thical
  - **R**elevant

STEP 2 - Formulating Hypothesis

- **What is Hypothesis?** An educated guess about the relationship between variables *(We'll study this in detail in Unit 4)*
- **Example:**
  - **Observation:** Students who sleep well seem to remember better
  - **Hypothesis:** "Students who sleep 7-8 hours will score higher on memory tests than students who sleep less than 5 hours"
- **Key Point:** Hypothesis must be:
  - Testable
  - Specific
  - Based on theory or observation

STEP 3 - Variables

- **What are Variables?** Anything that can change or vary *(We'll study this in detail in Unit 3)*
- **Quick Example:**
  - **Research Question:** Does noise affect concentration?
  - **Independent Variable (IV):** Noise level (What you manipulate)
  - **Dependent Variable (DV):** Concentration score (What you measure)
  - **Extraneous Variables:** Room temperature, time of day, participant's mood
- **Daily Life Example:** You want to know if drinking coffee (IV) improves your alertness (DV). But you must control: sleep, hunger, stress (Extraneous variables)

Researc h Design

- **What is Research Design?** The blueprint/plan for conducting your research
- **Components:**
- **1. Constructing Measurement Tools**
  - Questionnaires
  - Tests
  - Observation checklists
  - Physiological measures
- **2. Sample Selection**
  - Who will participate?
  - How many participants?
  - How to select them?
- **3. Data Collection Procedure**
  - When and where to collect data?
  - How to ensure standardization?
- **Real Example:** Planning a wedding = Research Design (Venue, guest list, budget, timeline, decorations)

Data Analysis

- **What happens here?** Making sense of collected data using statistical methods
- **Two Types:**

1. QUANTITATIVE Analysis

  - Numbers, statistics
  - Example: Average score, correlation, t-test
  - Used for surveys, experiments

2. QUALITATIVE Analysis

  - Words, themes, patterns
  - Example: Interview transcripts, observations
  - Used for case studies, ethnography

- **Daily Life Example:** After a party, you ask guests to rate food (1-10) = Quantitative You also ask "What did you like most?" = Qualitative

STEP 6 - Drawing Conclusions

What do researchers do?

- **Accept or Reject Hypothesis**
  - Was your prediction correct?
- **Interpret Results**
  - What do these findings mean?
  - Do they support existing theories?
- **Discuss Implications**
  - How can these findings be used?
  - What's the practical application?
- **Acknowledge Limitations**
  - What went wrong or could be improved?
- **Suggest Future Research**
  - What questions remain unanswered?

Example: If you found that music improves study performance, you conclude: "Background music may be beneficial for learning, but more research needed on music type."

STEP 7 - Report & Publication

- **Why Write a Report?**
  - **Transparency** - Others can see what you did
  - **Replication** - Others can repeat your study
  - **Knowledge Sharing** - Contributes to science
  - **Accountability** - You're responsible for your findings
- **Standard Research Report Format:**
  - **Title**
  - **Abstract** (Summary)
  - **Introduction** (Background & problem)
  - **Method** (What you did)
  - **Results** (What you found)
  - **Discussion** (What it means)
  - **References**
- **Where Published?**
  - Academic journals
  - Conferences
  - Books
  - Thesis/Dissertation

Summary - Steps in Research Process

1. IDENTIFY PROBLEM 🔍
↓
2. FORMULATE HYPOTHESIS 💡
↓
3. IDENTIFY VARIABLES
↓
4. DESIGN RESEARCH 📐
↓
5. COLLECT DATA → ANALYZE DATA 📊
↓
6. DRAW CONCLUSIONS ✓
↓
7. WRITE REPORT 📝
↓
PUBLISH 📰

Practice Questions

- What is the difference between context of discovery and context of justification?
- List any 5 criteria of good research.
- Explain with examples: Personal bias, Observer bias, Expectancy bias.
- ⋆ **EXAM IMPORTANT:** Describe the steps involved in the research process (10 marks)
- Why is objectivity important in research? How can we maintain it?

Objective of Research

Gain familiarity or new insights

Type of Research: Exploratory Research

Accurately describe characteristics of individuals, groups, or situations

Type of Research: Descriptive Research

Determine frequency of occurrence or relationship between factors

Type of Research: Diagnostic Research

Test causal relationships between variables

Type of Research: Hypothesis-Testing / Experimental Research

RELIABILITY AND VALIDITY

UNIT 2

What is Reliability?

Simple Definition: Reliability = **CONSISTENCY** = Getting similar results repeatedly

Daily Life Example:

Weighting Machine:

- You step on it → Shows 65 kg
- You step off and on again → Shows 65 kg
- Next day → Shows 65 kg

This scale is RELIABLE ✓

Unreliable Scale:

- Morning: 65 kg
- Afternoon: 70 kg
- Evening: 62 kg

This scale is UNRELIABLE ✗

In Research: A reliable test/measurement gives **consistent scores** when:

- Used at different times
- Used by different researchers
- Used with similar people

Why is Reliability Important?

Imagine This Scenario:

- You take an **IQ test** today → Score: 120 You take the **same test** next week → Score: 85
- **Question:** Which score is your real IQ? 😕
- **Problem:** The test is UNRELIABLE!

In Research:

- Unreliable measures = Meaningless results
- Can't trust your findings
- Can't replicate the study
- Waste of time, money, and effort

Key Point: Without reliability, there is NO validity! (Like building a house on shaky ground)

Methods of Estimating Reliability

(EXAM IMPORTANT - Asked June 2021,2022 & 2023!)

Explain the Methods of Estimating Reliability – 6 marks

Two Main Categories:

- **A. EXTERNAL CONSISTENCY** (Same test, different times)
  - Test-Retest Reliability
  - Parallel Forms Reliability
- **B. INTERNAL CONSISTENCY** (Within the same test)
  - Split-Half Reliability
  - Kuder-Richardson (KR-20)
  - Cronbach's Alpha (α)

Let's understand each one with simple examples...

Student	Test 1 (Monday)	Test 2 (Friday)
Amit	85	87
Priya	70	72
Raj	95	93

1. Test-Retest Reliability

- **What is it?** Give the **same test** to the **same people** at **two different times**
- **How to Calculate:** Correlate scores from Time 1 with scores from Time 2
- **Example:**
- If scores are **similar** → High correlation → **Good reliability** ✅
- **Daily Life Example:** Taking your blood pressure twice - both readings should be similar
- **Limitations:**
  - ⚠️ **Memory effect:** People remember answers
  - ⚠️ **Practice effect:** People improve with practice
  - ⚠️ **Time gap issues:** Too short = memory; Too long = people change
- **Good For:** Stable traits (personality, intelligence) **Not Good For:** Changing states (mood, anxiety)

2. Parallel Forms Reliability

What is it? Create **two similar but different versions** of the same test

How it Works:

- Form A and Form B measure the same thing
- Different questions but same difficulty
- Give both forms to same people
- Correlate the scores

Example:

Form A: *Math Test*

- Q1: 5 + 7 = ?
- Q2: 12 - 4 = ?
- Q3: 3 × 6 = ?

Form B: *Math Test*

- Q1: 6 + 8 = ?
- Q2: 15 - 5 = ?
- Q3: 4 × 5 = ?

Daily Life Example: Two different weighing machines measuring your weight - both should give similar readings

Advantage: ✓ No memory/practice effect **Disadvantage:** ✗ Difficult to create truly equivalent forms

3. Split-Half Reliability

- Divide one test into two halves and comparescores
- How to Do It:
- Method 1: Odd-Even Split
  - Odd items (1, 3, 5, 7...) = Half 1
  - Even items (2, 4, 6, 8...) = Half 2
- Method 2: First-Second Half
  - Items 1-10 = Half 1
  - Items 11-20 = Half 2
- Example:
  - Anxiety Questionnaire (10 items):
  - Correlate both halves → High correlation = Good reliability
  - Spearman-Brown Formula: Used to adjust reliabilitybecause we'reonly using half the test
- Daily Life Example: Like checking if first 5 questions of anexam matchwith last 5 questions in difficulty
- Advantage: Only one test administrationneeded Limitation: ✕Different splitting methods give differentresults

4. Kuder-Richardson (KR-20)

What is it? Used for tests with **right/wrong answers** (dichotomous items)

- **Example:** True/False, Yes/No, Correct/Incorrect

How it Works:

  - Examines **all possible** split-half combinations
  - Gives average reliability of all splits
  - Formula considers item difficulty

When to Use:

  - Multiple choice tests
  - True/False questionnaires
  - Achievement tests

Daily Life Example: Like checking if all questions in your driving test are equally good at measuring driving knowledge

Formula (Don't worry about memorizing!): $KR\text{-}20 = (k/(k-1)) \times (1 - \Sigma pq/\sigma^2)$

- Where:
  - k = number of items
  - p = proportion correct
  - q = proportion incorrect
  - σ^2 = variance
- **Important:** Only for **dichotomous** items (0 or 1 scoring)

5. Cronbach's Alpha (α)

- **What is it?** Most commonly used reliability measure for **multiple-choice** or **rating scale** items
- **Example Use:**
  - Likert scales (1-5, Strongly Disagree to Strongly Agree)
  - Rating scales
  - Any test with multiple possible answers
- **Daily Life Example:** Like having 10 friends rate a movie (1-5 stars). If all give similar ratings, their opinions are reliable (consistent).
- **Difference from KR-20:**
  - KR-20 = For right/wrong items
  - Cronbach's α = For rating scale items

Interpretation:

α Value	Interpretation
$\alpha < 0.5$	Unacceptable
$0.5 \leqslant \alpha < 0.6$	Poor
$0.6 \leqslant \alpha < 0.7$	Questionable
$0.7 \leqslant \alpha < 0.8$	Acceptable
$0.8 \leqslant \alpha < 0.9$	Good
$\alpha \geqslant 0.9$	Excellent

Comparison of Reliability Methods

Method	When to Use	Advantage	Disadvantage
Test-Retest	Stable traits	Simple	Memory/practice effect
Parallel Forms	Achievement tests	No memory effect	Hard to create
Split-Half	Any test	One administration	Multiple splitting methods
KR-20	Right/wrong items	Considers all splits	Only dichotomous
Cronbach's α	Rating scales	Most versatile	Needs statistical software

Exam Tip: Know when to use which method!

Validity

Define Validity . Explain Various threats in to internal validity? (2+4)

Aked in December 2022 Exam

What is Validity?

Simple Definition: Validity = **ACCURACY** = Measuring what you're supposed to measure

Daily Life Example:

- **Thermometer:**
  - **Reliable** = Always shows 98.6°F ✓
  - **But Valid?** = Only if your actual temperature IS 98.6°F ✓
- **Bathroom Scale:**
  - Always shows 65 kg (Reliable)
  - But you actually weigh 70 kg
  - Scale is **RELIABLE but NOT VALID** ✗
- **Key Difference:**
  - **RELIABILITY** = Consistency **VALIDITY** = Accuracy
- **Important Point:**
  - You can have **reliability WITHOUT validity**
  - But you **CANNOT** have **validity WITHOUT reliability**

Types of Validity

Main Categories:

1. **CONTENT VALIDITY :**Does the test cover all aspects?
2. **CRITERION-RELATED VALIDITY**
    a. Concurrent Validity b.
    b. Predictive Validity
3. **CONSTRUCT VALIDITY**
    a. Convergent Validity
    b. Discriminant Validity
4. **FACE VALIDITY :** Does it look like it measures what it should?
5. **INTERNAL VALIDITY :** Are results due to what we think?
6. **EXTERNAL VALIDITY :** Can we generalize results?

1. Content Validity

- **What is it?** Does the test include **ALL important aspects** of what you're measuring?
- **Example:**
- **Driving Test** should include: ✓ Road signs knowledge ✓ Traffic rules ✓ Actual driving skills ✓ Parking ✓ Highway driving
- **Poor Content Validity:** Testing ONLY parking ✗ (Misses other important skills)
- **Another Example:**
- **Depression Test** should cover: ✓ Mood changes ✓ Sleep problems ✓ Appetite changes ✓ Loss of interest ✓ Suicidal thoughts
- **How to Establish:**
  - Expert judgment
  - Review by panel of specialists
  - Compare with existing standards
- **Daily Life:** University exam should cover entire syllabus, not just 2 chapters!

2. Criterion-Related Validity

What is it? How well does your test predict or relate to some **external criterion** (outcome)?

Two Types:

A. CONCURRENT VALIDITY (Present relationship)

- Test and criterion measured at **same time**
- Example: New depression scale scores should correlate with established depression scale scores **now**

B. PREDICTIVE VALIDITY (Future relationship)

- Test predicts **future** performance
- Example: Entrance exam scores should predict first-year college performance

Simple Example:

- **Concurrent Validity:** New IQ test score ↔ Established IQ test score (measured today)
- **Predictive Validity:** Entrance exam score → Future job performance (measured later)

3. Construct Validity

What is it? Does your test actually measure the **theoretical concept** you think it measures?

Two Sub-types:

A. CONVERGENT VALIDITY →□ ← Tests measuring **same construct** should **correlate highly**

Example:

- Your new anxiety test should correlate with established anxiety tests
- Both measure ANXIETY = Should show similar results

B. DISCRIMINANT VALIDITY →□ ↔ ← Tests measuring **different constructs** should **NOT correlate**

Example:

- Your anxiety test should NOT correlate highly with intelligence test
- ANXIETY ≠ INTELLIGENCE = Should show different results

Daily Life Example:

- **Convergent:** Two fitness trackers should show similar step counts
- **Discriminant:** Step counter should NOT correlate with your mood!

4. Face Validity

What is it? Does the test **LOOK LIKE** it measures what it's supposed to?

Important: This is the **weakest** form of validity!

Example 1: ✅ Good Face Validity **Math Test** has math problems = Looks like it measures math ability

Example 2: ❌ Poor Face Validity Asking "Do you like ice cream?" to measure intelligence = Doesn't look relevant

Why It Matters:

- If test doesn't have face validity, participants may not take it seriously
- May refuse to participate
- May give careless answers

But Remember: Just because something **looks** valid doesn't mean it **is** valid!

Daily Life Example: A horoscope **looks like** it describes you accurately, but it's not scientifically valid!

5. Internal Validity

- **What is it?** Can we be **confident** that changes in DV are **actually caused** by IV?
- **Or are there other explanations?**
- **Example:**
  - **You find:** Students who attend coaching classes score higher
  - **Question:** Is it because of coaching? OR...
  - Smarter students join coaching?
  - Coaching students are more motivated?
  - They study more hours at home?

Threats to Internal Validity: (June 25)

- **History** - External events during study
- **Maturation** - Participants naturally change over time
- **Testing** - Practice effect from repeated testing
- **Instrumentation** - Changes in measurement tool
- **Selection** - Groups were different from the start
- **Mortality** - Participants drop out
- **Regression to mean** - Extreme scores become average
- **Confounding**
- **Experimenter Bias :** Researcher encourages one group
- **Diffusion** : Control group unintentionally receiving or copying the treatment.

- We'll study these threats in detail in Block 3!

- **Compensatory rivalry/resentful demoralisation:**
  - **Compensatory rivalry** : Control group works extra hard to compete
  - **Resentful Demoralisation**
    - Control group becomes sad/demotivated and performs worse
    - Control group gives up because they didn’t get special training

6. External Validity

- **What is it?** Can we **generalize** findings to other:
  - People (populations)?
  - Settings (places)?
  - Times?
- **Example:**
- **Study:** Memory experiment on college students in a lab
- **External Validity Questions:**
  - Does it apply to children? ✓
  - Does it apply to elderly? ✓
  - Does it work in real classrooms? ✓
  - Does it work in other countries? ✓
- **Threats to External Validity:**
  - **Sample not representative** - Only male participants
  - **Artificial setting** - Lab ≠ Real life
  - **Specific time period** - Results true only in 2020s
  - **Hawthorne effect** - People behave differently when observed

Aptitude–Treatment Interaction

- The **sample has unique characteristics** that interact with the treatment,
  so the results **may not apply to other populations**.
- **Easy Example:**
- A therapy study is done on:
  - only highly depressed patients
  - or only volunteers
  - or only prisoners
  - or only top-performing students
- Result : The findings **may not apply** to the general population.

Situational Factors : If the study situation is special, results may not generalize to other settings.

Pre-Test Effects

- If students take a **stress awareness pre-test**, they become more aware of their stress.

Rosenthal Effects (Experimenter Effects)

- The **researcher's behavior, expectations, or style** influence results.

Summary - Reliability & Validity

- **RELIABILITY** = Consistency
  - Test-Retest (same test, different times)
  - Parallel Forms (different forms, same trait)
  - Split-Half (divide test in halves)
  - KR-20 (for right/wrong items)
  - Cronbach's α (for rating scales)
- **VALIDITY** = Accuracy
  - Content (covers all aspects)
  - Criterion-Related (predicts outcomes)
    - Concurrent & Predictive
  - Construct (measures theoretical concept)
    - Convergent & Discriminant
  - Face (looks valid)
  - Internal (cause-effect confidence)
  - External (generalizability)
- **Remember: Reliability is NECESSARY but NOT SUFFICIENT for validity!**

VARIABLES AND CONSTRUCTS

UNIT 3

Variable

Exam Important (June 2023) & December 2021

Define Variable , Discuss various types of Variables (2+4)

Difference between variable and construct. Explain different types of Variables (2+4) (June 2022)

What is a Variable?

- **Simple Definition:** Variable = Anything that can **CHANGE** or **VARY**
- **Daily Life Examples:**
  - Your weight (varies day to day) ✓
  - Your mood (happy, sad, angry) ✓
  - Temperature (hot, cold) ✓
  - Number of friends (1, 2, 3...) ✓
- **NOT Variables:**
  - Your date of birth (Fixed)
  - Your blood type (Fixed)
  - The value of π (3.14159...) (Constant)
- **In Research:** Variables are the **building blocks** of research
  - We study relationships BETWEEN variables
  - We manipulate variables to see effects
  - We measure variables to collect data

Types of Variables

(EXAM IMPORTANT - Asked Multiple Times!)

Classification of Variables:

Category 1: By Research Role

1. Independent Variable (IV)
2. Dependent Variable (DV)
3. Extraneous Variable
4. Confounding Variable

Category 2: By Manipulation 5. Active Variable 6. Attribute Variable

Category 3: By Nature of Data

7. Quantitative Variable 8. Categorical/Qualitative Variable 9. Continuous Variable 10. Discrete Variable

Category 4: By Theory

11. Stimulus, Organism, Response (S-O-R)

Independent Variable (IV)

- The **cause** or **input** in a study
- The variable the researcher **manipulates** or **selects**
- Predicts or influences the outcome
- *Examples:* teaching method, drug dosage, gender, age

Dependent Variable

- The **effect**, **outcome**, or **result**
- The variable that **changes because of the IV**
- Measured to see the impact
- *Examples:* test scores, stress level, memory performance

IV and DV - More Examples

- **Practice Identifying:**
- **Example 1:** "Does exercise improve mood?"
  - **IV:** Exercise (Yes/No or Amount)
  - **DV:** Mood score
- **Example 2:** "Does class size affect learning?"
  - **IV:** Class size (Small: 20, Medium: 40, Large: 60)
  - **DV:** Learning outcome (Test score)
- **Example 3:** "Does social media use affect self-esteem?"
  - **IV:** Hours on social media (1hr, 3hrs, 5hrs)
  - **DV:** Self-esteem score
- **Memory Trick: "IV comes first, DV follows" "I Vary (IV) to see the Difference (DV)"**
- **Graphing Convention:**
  - X-axis (horizontal) = IV
  - Y-axis (vertical) = DV

Extraneous Variables

What are they? Variables that **might affect** DV but are **NOT** the focus of study

Problem: They can **confuse** or **mask** the true relationship between IV and DV

Example:

Research: Does noise affect concentration?

- **IV:** Noise level
- **DV:** Concentration score

Extraneous Variables:

- Room temperature
- Time of day
- Participant's hunger
- Fatigue
- Intelligence level
- Mood

All these can affect concentration but are NOT what we're studying!

Solution: CONTROL them!

- Keep room temperature same for all
- Test everyone at same time
- Ensure participants are not hungry
- Use participants with similar intelligence

Confounding Variables

- A variable that **actually influences both the IV and DV**, creating a **false or misleading relationship**
- It **has already affected** the results.
- It **changes the outcome** in such a way that you can't tell whether the DV changed due to the IV **or** the confound
- **Example**
  - You study the effect of **exercise** (IV) on **stress reduction** (DV).
    But participants who exercise more also **sleep better**.
- All Confounding Variables are Extraneous Variables.

- Difference between Extraneous and Confounding Variables ? (June 2025)

Active vs Attribute Variables

- **ACTIVE VARIABLES:** Variables that can be **MANIPULATED** by researcher
- **Examples:**
  - Teaching method (can assign students to different methods)
  - Drug dosage (can give different amounts)
  - Amount of practice (can control how much)
  - Type of therapy (can assign different therapies)
- **ATTRIBUTE VARIABLES:** Variables that **CANNOT be manipulated** - they're inherent characteristics
- **Examples:**
  - Gender (male/female) - can't change
  - Age - can't manipulate
  - Personality type - can't assign
  - Socioeconomic status - existing
  - Intelligence - existing trait
- **Key Difference:**
- **Active:** Researcher **creates** the groups **Attribute:** Researcher **selects** existing groups

Quantitative vs Categorical Variables

- **QUANTITATIVE VARIABLES:** Measured in **numbers** (How much?)
- **Examples:**
  - Age (25 years)
  - Height (170 cm)
  - Income (₹50,000)
  - IQ score (120)
  - Reaction time (2.5 seconds)
- **CATEGORICAL VARIABLES:** Measured in **categories/groups** (What type?)
- **Examples:**
  - Gender (Male, Female, Other)
  - Religion (Hindu, Muslim, Christian...)
  - Blood type (A, B, AB, O)
  - Education (High school, Graduate, Postgraduate)
  - Diagnosis (Depressed, Anxious, Healthy)
- **Key Difference:**
- **Quantitative:** Can do math (addition, average)
  - Average age = 25 years ✓
- **Categorical:** Can't do math
  - Average of Male + Female = ??? ✗

Continuous vs Discrete Variables

- **CONTINUOUS VARIABLES:** Can take **ANY value** within a range (infinite possibilities)
- **Examples:**
  - Height: 170.5 cm, 170.51 cm, 170.512 cm...
  - Weight: 65.3 kg, 65.35 kg, 65.352 kg...
  - Time: 2.5 sec, 2.54 sec, 2.543 sec...
  - Temperature: 37.2°C, 37.25°C...
- **Think:** Can be measured with decimals
- **DISCRETE VARIABLES:** Can take only **SPECIFIC values** (countable, no in-between)
- **Examples:**
  - Number of children: 1, 2, 3 (NOT 2.5!)
  - Number of questions correct: 15, 16, 17 (NOT 15.3!)
  - Number of students: 50, 51, 52 (NOT 50.7!)
  - Gender categories: 1, 2 (codes)
- **Think:** Whole numbers, no decimals possible
- **Daily Life Example:**
  - Continuous: How much water you drink (1.5 liters)
  - Discrete: How many children you have(1, 2, 3)

S-O-R Variables

Classification by Behavioral Theory:

S = STIMULUS Variables

- Environmental inputs
- What we present to participants
- Examples: Light, sound, words, pictures

O = ORGANISM Variables

- Individual characteristics
- Internal states
- Examples: Motivation, arousal, attention, personality

R = RESPONSE Variables

- Behavioral outputs
- What participants do
- Examples: Reaction time, accuracy, verbal response

What are Constructs?

Simple Definition: Constructs = **Abstract concepts** used for scientific purposes

Difference from Variables:

Variables:

- Directly observable
- Can be measured easily
- Example: Height, weight, reaction time

Constructs:

- Abstract, theoretical
- Cannot be directly observed
- Need to be **operationalized**
- Examples: Intelligence, anxiety, motivation, self-esteem

Daily Life Example:

- You can't **see** intelligence, but you can measure it through:
- IQ test scores
- Problem-solving ability
- Academic performance

Key Point: Constructs must be converted into **measurable variables**!

Types of Constructs

Two Main Types:

1. INTERVENING VARIABLES

- Summary term for group of variables
- Not directly real, just useful
- Shorthand for explaining behavior

Example: "Hunger" is an intervening variable that summarizes:

- Time since last meal
- Empty stomach
- Low blood sugar
- Motivation to eat

2. HYPOTHETICAL CONSTRUCTS

- Describes something **real but unobservable**
- Theoretical entity
- Has actual existence (we believe)

Example: "Intelligence" is a hypothetical construct:

- We believe it exists in the brain
- Can't see it directly
- Inferred from behavior

Intervening Variables Explained

What are they? Labels we use to **summarize** relationships between S and R

Formula: Stimulus → Intervening Variable → Response

Example 1: THIRST

- Stimuli → **THIRST** → Responses
- No water for 24 hrs → **THIRST** → Drink water
- Eating salty food → **THIRST** → Search for water
- Dry mouth → **THIRST** → Feel uncomfortable
- **"Thirst"** is just a convenient label!

Example 2: MOTIVATION

- Stimuli → **MOTIVATION** → Responses
- Good grades → **MOTIVATION** → Study more
- Praise from teacher → **MOTIVATION** → Participate in class
- Competition → **MOTIVATION** → Work harder

- **Key Point:** Intervening variables have **no meaning on their own** They just **represent** a pattern

Hypothetical Constructs Explained

What are they? Theoretical concepts that describe something **real** in the world

Examples:

1. INTELLIGENCE

- We believe brains have different capacities
- Can't see intelligence directly
- Measure through IQ tests, problem-solving

2. ANXIETY

- Real neurological state
- Can't directly observe
- Measure through: physiological signs, self-reports, behavior

3. MEMORY

- Real cognitive process
- Can't see memories
- Measure through: recall tests, recognition tasks

Summary - Variables & Constructs

VARIABLES (Things that vary):

- **IV** - What you manipulate (cause)
- **DV** - What you measure (effect)
- **Extraneous** - Other factors that might affect DV
- **Confounding** - Extraneous that varies with IV ⚠
- **Active** - Can be manipulated
- **Attribute** - Cannot be manipulated
- **Quantitative** - Numbers
- **Categorical** - Categories
- **Continuous** - Any value in range
- **Discrete** - Specific values only

CONSTRUCTS (Abstract concepts):

- **Intervening** - Summary labels
- **Hypothetical** - Real but unobservable

HYPOTHESIS AND SAMPLING

UNIT 4

What is a Hypothesis?

Simple Definition: A **testable** prediction about the relationship between variables

Think of it as: An "educated guess" based on theory/observation

Example:

Observation: Students who sleep well seem to perform better

Hypothesis: "Students who sleep 8 hours will score higher on memory tests than students who sleep 4 hours"

- **Key Features of Good Hypothesis:**
  - ✓ **Testable** - Can be proven right or wrong
  - ✓ **Specific** - Clear and precise
  - ✓ **States relationship** - Between variables
  - ✓ **Based on theory** - Not random guess
  - ✓ **Falsifiable** - Can be disproven
- **Daily Life Example:** "If I study for 3 hours daily, I will score above 80%"
  - Testable ✓
  - Specific ✓
  - Can be proven wrong ✓

Characteristics of Good Hypothesis

1. CONCEPTUALLY CLEAR

- Use precise terms
- Avoid vague language
- Bad: "Happy people do better" Good: "People with high life satisfaction scores perform better on cognitive tasks"

2. TESTABLE

- Can be empirically verified
- Must be measurable
- Bad: "Souls influence behavior" Good: "Meditation reduces stress levels"

3. GROUNDED IN THEORY

- Based on existing knowledge
- Not pulled from thin air

4. OPERATIONALIZABLE

- Variables can be measured
- Clear definitions
- Bad: "Anxiety affects performance" Good: "Students scoring >40 on Hamilton Anxiety Scale will score lower on math tests"

5. PARSIMONIOUS

- Simple and straightforward
- Not overly complex

6. SPECIFIC

- Mentions specific variables
- States direction (if possible)

Types of Hypotheses (December 2021) 3

Two Main Types:

1. NULL HYPOTHESIS (H_0)

- States there is **NO** relationship/difference
- Symbolized as **H_0**
- Assumes nothing happens
- What we try to **reject**

2. ALTERNATIVE HYPOTHESIS (H_1 or H_a)

- States there **IS** a relationship/difference
- Symbolized as **H_1** or **H_a**
- What we hope to **support**

- **Example:**
- **Research Question:** Does coffee improve alertness?
- **H_0:** Coffee has **NO effect** on alertness (Mean alertness with coffee = Mean alertness without coffee)
- **H_1:** Coffee **improves** alertness (Mean alertness with coffee > Mean alertness without coffee)

Alternative Hypothesis (H_1) Explained

What is it? What the researcher **actually believes** to be true

Two Types:

A. DIRECTIONAL (One-tailed)

- Predicts **specific direction**
- Uses words: greater than, less than, increase, decrease
- **Example:** H_1: Coffee **increases** alertness H_1: $\mu_1 > \mu_2$

B. NON-DIRECTIONAL (Two-tailed)

- Predicts **difference** but not direction
- Uses words: different, not equal

Example: H_1: Coffee **affects** alertness (could increase or decrease)
H_1: $\mu_1 \neq \mu_2$

More Examples:

- **Directional:**
  - "Exercise **reduces** anxiety"
  - "Rewards **improve** performance"
- **Non-Directional:**
  - "Gender **affects** aggression"
  - "Age **relates to** memory"

Errors in Hypothesis Testing

Two Types of Errors:

TYPE I ERROR (α - Alpha Error)

- **Rejecting** H_0 when it's actually **TRUE**
- False Positive
- "False Alarm"
- **Example:**
- Reality: Medicine doesn't work
- Your conclusion: Medicine works ✕

TYPE II ERROR (β - Beta Error)

- **Accepting** H_0 when it's actually **FALSE**
- False Negative
- "Miss"
- **Example:**
- Reality: Medicine works
- Your conclusion: Medicine doesn't work ✕

	H_0 is Actually TRUE	**H_0 is Actually FALSE**
Reject H_0	TYPE I ERROR ❌	Correct Decision ✅
Accept H_0	Correct Decision ✅	TYPE II ERROR ❌

What is Sampling? (sampling & its types JUNE 2021)

Simple Definition: Selecting a **subset** (sample) from a **larger group** (population) for study

Why NOT study everyone?

Problems with studying entire population:

- **Too expensive**
- **Too time-consuming**
- **Population is dynamic** (people die, born, move)
- **Sometimes destructive** (testing drug side effects)
- **Geographically scattered**

- **Solution: SAMPLING!**
- **Key Terms:**
- **POPULATION** = Everyone you're interested in
- Example: All college students in India
- **SAMPLE** = Subset you actually study
  - Example: 500 college students from 5 cities
  - **Goal:** Sample should **represent** the population

Sampling Terminology

Important Terms:

1. POPULATION

- Total group of interest
- Symbol: N

2. SAMPLE

- Subset selected for study
- Symbol: n

3. SAMPLING UNIT

- Individual member
- Example: One student, one patient

4. SAMPLING FRAME

- List of all population members
- Example: Student enrollment list

5. PARAMETER

- Population characteristic
- Symbol: μ (mu), σ (sigma)

6. STATISTIC

- Sample characteristic
- Symbol: $\bar{X}$ (x-bar), s

7. SAMPLING ERROR

- Difference between sample and population values
- **Example:**
- **Population:** All IGNOU MAPC students (N = 10,000)
- **Sampling Frame:** IGNOU student database
- **Sample:** 500 randomly selected students (n = 500)
- **Sampling Unit:** Each individual student

Purpose of Sampling

Why do we sample?

1. PRACTICAL REASONS

- Saves **money**
- Saves **time**
- Saves **effort**

2. ACCURACY

- Can ensure better quality data
- More control over data collection

3. NECESSITY

- Destructive testing (can't test everyone)
- Infinite populations

4. REPRESENTATIVENESS

- Proper sampling gives accurate picture of population
- Better than poorly conducted census

Example:

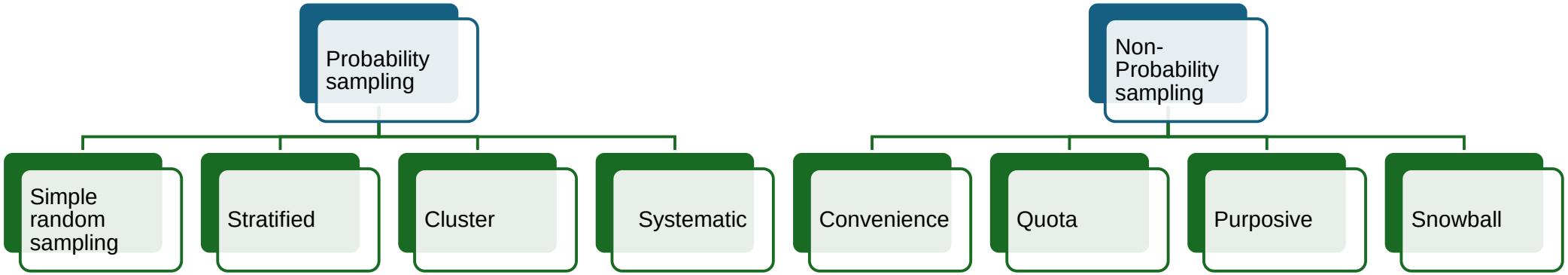
Testing Blood:

- Doctor takes small sample
- Not entire blood!
- Small sample represents whole

Quality Control:

- Factory tests sample of products
- Not ALL products
- Infers quality of entire batch

Sampling Method



Key Difference

PROBABILITY or RANDOM

- Each unit has **known chance** of selection
- More representative ✓
- Can estimate error
- Expensive

NON-PROBABILITY or NON-RANDOM

- **Unknown** selection probability
- Quick and cheap ✓
- Less representative
- Cannot estimate error

Non-Probability Sampling Methods

1. CONVENIENCE/ACCIDENTAL SAMPLING

- **What:** Select whoever is easily available
- **Example:**
- Interviewing people at shopping mall
- Using students from your own college
- Asking your friends
- **Advantage:** Quick and cheap **Disadvantage:** Highly biased

2. QUOTA SAMPLING

- **What:** Ensure certain numbers from each category
- **Example:** Need 100 participants:
- 50 males, 50 females
- 25 from each age group (20-30, 31-40, 41-50, 51-60)
- **Advantage:** Somerepresentation **Disadvantage:** Within quota, selection is convenience ✕

3. PURPOSIVE SAMPLING

- **What:** Deliberately select specific cases
- **Example:**
- Selecting experts for interview
- Choosing "typical" cases
- Selecting extreme cases
- **Advantage:** Gets specific information ✓ **Disadvantage:** Not representative ✗

4. SNOWBALL SAMPLING

- **What:** Participants recruit more participants
- **Example:**
- Studying drug users
- One drug user introduces you to others
- They introduce to more...
- **Advantage:** Reaches hidden populations ✓ **Disadvantage:** Network bias ✗

Probability Sampling Methods

1. SIMPLE RANDOM SAMPLING (SRS)

- **What:** Every unit has **equal chance** of selection
- **How to do:**
  - Make list of all population members
  - Use random number table / computer
  - Select required number
- **Example:**
  - 1000 students in college
  - Number them 1-1000
  - Use lottery method or random number generator
  - Select 100 students

- **Advantage:** Unbiased , Simple to understand , Representative
- **Disadvantage:** Need complete list , May not represent subgroups well
- **Daily Life Example:** Lucky draw - everyone's name in box, pick randomly

2. Stratified Random Sampling

- **What:** Divide population into **strata** (groups), then randomly sample from each
- **Steps:**
  - Divide population into homogeneous groups (strata)
  - Randomly sample from each stratum
  - Number from each stratum proportional to size
- **Example:**
- **Population:** 1000 college students
- **Stratify by Year:**
  - 1st year: 400 students → Sample 40 (10%)
  - 2nd year: 300 students → Sample 30 (10%)
  - 3rd year: 200 students → Sample 20 (10%)
  - 4th year: 100 students → Sample 10 (10%)
- **Total Sample:** 100 students
- **Advantage:** ✓ More representative of subgroups ✓ Can compare strata ✓ More precise
- **Disadvantage:** ✗ Need information about strata ✗ More complex ✗ More expensive

Cluster/Multistage Sampling

What: Select **groups** (clusters) randomly, then sample within clusters

When to use: Large geographic areas

Steps:

- Divide population into clusters
- Randomly select some clusters
- Study ALL in selected clusters OR sample within clusters

Example:

- **Study: Indian college students**
- **Stage 1:** Randomly select 5 states **Stage 2:** Randomly select 3 cities from each state **Stage 3:** Randomly select 2 colleges from each city **Stage 4:** Randomly select students from each college
- **Advantage:** ✓ Cost-effective for large areas ✓ Feasible when population list unavailable
- **Disadvantage:** ✗ Less accurate than SRS ✗ Clusters may not be homogeneous
- **Daily Life Example:** Inspecting oranges: Don't check every orange, check few boxes (clusters)

4. Systematic Random Sampling

- select participants using a **fixed interval** from a list.
- Every Nth units from the population

Comparison of Sampling Methods

Method	Representativeness	Cost	Time	When to Use
Simple Random	High	High	High	Small population with complete list
Stratified	Very High	High	High	When subgroups important
Cluster	Moderate	Low	Low	Large geographic area
Convenience	Low	Very Low	Very Low	Exploratory studies
Quota	Moderate	Moderate	Moderate	Quick surveys
Purposive	Depends	Low	Low	Expert opinions needed
Snowball	Low	Low	Moderate	Hidden populations

Importance of Sampling (Important)

Why is Sampling Important?

1. Practical Necessity

- Impossible to study everyone
- Example: Can't test all COVID patients

2. Economic Efficiency

- Census of 130 crore Indians = ₹1000s of crores
- Sample of 10,000 = Much cheaper

3. Greater Accuracy

- Better quality control
- Trained staff
- Standardized procedures

4. Time-Saving

- Quick results
- Timely decisions

5. Greater Scope

- Can study more variables in depth
- Detailed information

6. Feasibility

- Only way for infinite/inaccessible populations

Modern Application:

- Election polls (sample 10,000 → predict for crores)
- TV ratings (sample households → viewership)
- Quality control (sample products → batch quality)

Exam Tips for Block 1

- ⭐ ⭐ ⭐ **Steps in Research Process** (10 marks)
- ⭐ ⭐ ⭐ **Methods of Estimating Reliability** (6-8 marks)
- ⭐ ⭐ ⭐ **Types of Variables** (6 marks)
- ⭐ ⭐ Research Biases (3 marks - short note)
- ⭐ ⭐ Objectivity Safeguards (3 marks - short note)

Practice Questions – UNIT 2-UNIT 4

- **Reliability & Validity:**
  1. ⭐ Explain methods of estimating reliability with examples (Asked in exam!)
  2. Differentiate between reliability and validity
  3. What are threats to internal validity?
- **Variables:**
  1. ⭐ Define variable. Discuss types of variables (Asked in exam!)
  2. Differentiate between independent and dependent variables with examples
  3. What are confounding variables? Why are they problematic?

- **Hypothesis:**
  1. What are characteristics of a good hypothesis?
  2. Differentiate between null and alternative hypothesis
  3. Explain Type I and Type II errors with examples
- **Sampling:**
  1. What is sampling? Discuss importance
  2. Differentiate between probability and non-probability sampling
  3. Explain stratified random sampling with example

Summary

Unit 2: Reliability & Validity

- Reliability = Consistency
- Validity = Accuracy
- 5 Methods of estimating reliability
- 6 Types of validity

Unit 3: Variables & Constructs

- 10+ types of variables
- IV vs DV (most important!)
- Confounding variables
- Constructs: Intervening & Hypothetical

Unit 4: Hypothesis & Sampling

- Characteristics of good hypothesis
- Null vs Alternative hypothesis
- Type I & II errors
- Probability & Non-probability sampling

Thank You