

## Paper :- Research Methodology

### 1. Discuss different types of research. Add a note on formulation and genesis of a research problem.

#### Fundamental research

Fundamental, also known as basic or theoretical, research is designed to help researchers better understand certain phenomena in the world. It looks at how things work but does not seek to find how to make them work better. This research attempts to broaden your understanding and expand scientific theories and explanations.

Example: A company studies how different product placements affect product sales. This study provides information and is knowledge-based.

#### Applied research

Applied research is designed to identify solutions to specific problems or find answers to particular questions. It offers knowledge that is applicable and implementable.

#### Types of applied research include:

Technological: This research looks for ways to improve efficiency in products, processes and production.  
Scientific: This research measures certain variables to predict behaviors, outcomes and impact.  
Example: A student working on a doctorate in education studies ways to increase student involvement in the classroom. This research focuses on a defined problem and is solution-based.

OR

### Write short notes on :-

#### (i) Sampling methods

Sampling is a technique of selecting individual members or a subset of the population to make statistical inferences from them and estimate the characteristics of the whole population. Different sampling methods are widely used by researchers in [market research](#) so that they do not need to research the entire population to collect actionable insights.

It is also a time-convenient and a cost-effective method and hence forms the basis of any [research design](#). Sampling techniques can be used in a research survey software for optimum derivation.

- **Probability sampling:** [Probability sampling](#) is a sampling technique where a researcher sets a selection of a few criteria and chooses members of a population randomly. All the members have an equal opportunity to be a part of the sample with this selection parameter.
- **Non-probability sampling:** In [non-probability](#) sampling, the researcher chooses members for research at random. This sampling method is not a fixed or predefined selection process. This makes it difficult for all elements of a population to have equal opportunities to be included in a sample.

## (ii) Hypothesis testing

Hypothesis testing is a formal procedure for investigating our ideas about the world using statistics. It is most often used by scientists to test specific predictions, called hypotheses, that arise from theories. There are 5 main steps in hypothesis testing:

1. State your research hypothesis as a null hypothesis and alternate hypothesis ( $H_0$ ) and ( $H_a$  or  $H_1$ ).
2. Collect data in a way designed to test the hypothesis.
3. Perform an appropriate statistical test.
4. Decide whether to reject or fail to reject your null hypothesis.
5. Present the findings in your results and discussion section.

Though the specific details might vary, the procedure you will use when testing a hypothesis will always follow some version of these steps.

## 2. Discuss role and responsibility of research Ethical committees. What are unethical problems which research suffers from ? How can they be overcome ?

Research ethics refers to the values and the norms an institution has put in place to help regulate scientific activities. It is a collection of scientific morals in the line of duty. This guideline specifies the traits or behaviors that are recognized by the research community based on the general ethics of science and society at large.

### **Role and responsibility :**

Research ethics committees have an important role to play in ensuring the ethical standards and scientific merit of research involving human subjects. There are three important obligations placed on the ethics committee. Firstly, and most importantly, the ethics committee must ensure that the rights of research participants are protected. This is achieved by ensuring that individuals receive sufficient information, which can be easily understood, and ensuring that appropriate strategies are in place to protect participants from potential adverse consequences of the research. Secondly, the research ethics committee has an obligation to society which provides the resources for research and will ultimately be affected by the results. Thirdly, the research ethics committee has an obligation to the researcher. The research proposal should be treated with respect and consideration. The research ethics committee should strive to meet each of these obligations. All researchers should welcome the contribution made by research ethics committees to the research process because they help to ensure that research meets the high ethical and scientific standards expected by society.

### **Duplicate publication**

It is unethical for a researcher to submit a research paper or publication that has two or more seminal journals which could be with or without acknowledgment of these other journals. This practice is known as duplicate submission or duplicate publication.

### **Research data falsification**

the falsification or fabrication of research data occurs when a researcher tries to manipulate the procedures used in conducting research or the important findings just to have the researcher's desired result.

### **Plagiarism**

Plagiarism is a huge offense in the research community. It is the practice of taking another person's research or work or even idea and inculcating it in your own writing without giving them the dual credit. In some cases, just for recognition, the researcher can even use another person's research as their own publication journal.

### **Authorship Conflict**

ICMJE (The International Committee of Medical Journal Editors) guidelines provided that anyone who has contributed to the conception, the designing of research data, contributed to the data analysis, helped to draft or revise the journal and seek approval before the journal is published has an authorship claim to the journal.

### **Conflict of interest**

Conflict of interest arises in research when the author or the researcher gets influenced by financial reasons or personal issues that ultimately affect the quality of the outcome of the study. When these conflicts of interest arise, which could be personal conditions and financial consideration or other types of conflicts, the researcher should truthfully disclose the current situation to the editorial team, and do so completely without leaving out a detail.

### **How to overcome problems**

#### **Establish straightforward guidelines**

You should develop an easily understood yet comprehensive code of conduct that outlines company expectations for ethical behavior at work. Identify common missteps and how to avoid them while unambiguously relating the consequences of ethical failings.

#### **Promote knowledge**

Don't just offer code of conduct or ethics training to new hires as one of the ways to prevent unethical behavior in the workplace. Routinely provide refresher courses to your existing staff. Bring in guest speakers to help employees build problem-solving skills so that they can react appropriately to employee misconduct.

#### **Provide tools**

Consider implementing a reporting system that allows your employees to disclose conduct violations anonymously, and identify procedures for staff to request private meetings with supervisors responsible for ethics oversight.

#### **Be proactive**

According to the ACFE study previously mentioned, organizations that lacked anti-fraud controls suffered greater average losses—often twice as much—from ethics violations.

#### **Employ data monitoring**

Another effective way to prevent unethical behavior in the workplace is to establish management review boards to investigate possible violations to the code of conduct. Set up reporting hotlines or email accounts that are capable of capturing relevant details including corresponding documentation or the names of potential witnesses.

## Foster ethical behavior

When evaluating candidates during the hiring process, you should consider their values and whether they fit into the company's vision. Distribute responsibilities across employees and departments, creating a system of checks and balances that reduce the risk of unethical behavior.

OR

## Write short notes on :-

### (i) Importance and forms of consent

Research involving human participants needs to be scientifically valid and should be conducted according to accepted ethical standards. Research ethics provides guidelines for responsible conduct of research on human participants. It primarily protects the human participants of research and also educates and monitors researchers conducting health research to ensure a high quality of ethical standard. Consent is a research process of information exchange between the researcher and the human participants of research. Information provided to the human participants of research should be adequate, clearly understood by the participant of research with decision-making capacity and the research participant should voluntarily decide to participate. Respect for persons requires that the participants of research should be allowed to make choices about whether to participate or not in the research.

### (ii) Privacy and confidentiality.

BASIS FOR COMPARISON	PRIVACY	CONFIDENTIALITY
Meaning	The state of being secluded is known as Privacy.	Confidentiality refers to the the situation when it is expected from someone that he will not divulge the information to any other person.
What is it?	It is the right to be let alone.	It is an agreement between the persons standing in fiduciary to maintain the secrecy of sensitive information and documents.
Concept	Limits the access of the public.	Prevents information and documents from unauthorized access.
Applies to	Individual	Information
Obligatory	No, it is the personal choice of an individual	Yes, when the information is professional and legal.

BASIS FOR COMPARISON	PRIVACY	CONFIDENTIALITY
Disallowed	Everyone is disallowed from involving the personal affairs of an individual.	Only unauthorized persons are disallowed from using the information.

### 3. What is normal distribution ? Discuss its properties.

Normal distribution, also known as the Gaussian distribution, is a probability distribution that is symmetric about the mean, showing that data near the mean are more frequent in occurrence than data far from the mean.

#### Properties

All forms of distribution share the following characteristics:

##### 1. It is symmetric

A normal distribution comes with a perfectly symmetrical shape. This means that the distribution curve can be divided in the middle to produce two equal halves. The symmetric shape occurs when one-half of the observations fall on each side of the curve.

##### 2. The mean, median, and mode are equal

The middle point of a normal distribution is the point with the maximum frequency, which means that it possesses the most observations of the variable. The midpoint is also the point where these three measures fall. The measures are usually equal in a perfectly (normal) distribution.

##### 3. Empirical rule

In normally distributed data, there is a constant proportion of distance lying under the curve between the mean and specific number of standard deviations from the mean. For example, 68.25% of all cases fall within +/- one standard deviation from the mean. 95% of all cases fall within +/- two standard deviations from the mean, while 99% of all cases fall within +/- three standard deviations from the mean.

##### 4. Skewness and kurtosis

Skewness and kurtosis are coefficients that measure how different a distribution is from a normal distribution. Skewness measures the symmetry of a normal distribution while kurtosis measures the thickness of the tail ends relative to the tails of a normal distribution.

OR

## Write short notes on :-

### (i) Representation of data

Data representation is a technique for analysing numerical data. The relationship between facts, ideas, information, and concepts is depicted in a diagram via data representation. It is a fundamental learning strategy that is simple and easy to understand. It is always determined by the data type in a specific domain. Graphical representations are available in many different shapes and sizes.

Any information gathered may be organised in a frequency distribution table, and then shown using pictographs or bar graphs. A bar graph is a representation of numbers made up of equally wide bars whose lengths are determined by the frequency and scale you choose.

The collected raw data can be placed in any one of the given ways:

1. Serial order of alphabetical order
2. Ascending order
3. Descending order

### (ii) Probability

Probability can be defined as the ratio of the number of favorable outcomes to the total number of outcomes of an event. For an experiment having 'n' number of outcomes, the number of favorable outcomes can be denoted by x. The formula to calculate the probability of an event is as follows.

$$\text{Probability(Event)} = \text{Favorable Outcomes/Total Outcomes} = x/n$$

## 4. What is bioinformatics ? Discuss its past, present and future.

Bioinformatics is defined as the application of tools of computation and analysis to the capture and interpretation of biological data. It is an interdisciplinary field, which harnesses computer science, mathematics, physics, and biology.

**PAST:** Bioinformatics emerged in mid 1990s. From 1965-78 Margaret O. Dayhoff established first database of protein sequences, published annually as series of volume entitled "Atlas of protein sequence and structure". During 1977 DNA sequences began to accumulate slowly in literature and it became more common to predict protein sequences by translating sequenced genes than by direct sequencing of proteins. Thus number of uncharacterised proteins began to increase. In 1980, there were enough DNA sequences to justify the establishment of the first nucleotide sequence database, GenBank at National Centre for Biotechnology Information (NCBI), USA. NCBI served as primary databank provider for information. The European Molecular Biology Laboratory (EMBL) established at European Bioinformatics Institute (EBI) in 1980. The aim of this data library was to collect, organize and distribute nucleotide sequence data and related information. In 1986 DNA Data Bank was established by GemonNet, Japan. In 1984, the National Biomedical Research Foundation (NBRF) established the protein information Resource (PIR). All these data banks operate in close collaboration and regularly exchange data. Management and analysis of the rapidly accumulating sequence data required new computer software and statistical tools. This attracted scientists from computer science and mathematics to the fast emerging field of bioinformatics.

**PRESENT:** Nowadays bioinformatics is used for evolutionary studies and phylogenetics. Phylogenetic trees are constructed based on the sequence alignment using various algorithms in bioinformatics . These phylogenetic trees help to identify the close ancestors of a species. Bioinformatics help in climate change studies. Due to global climatic change ice is lost, both in north & south poles, causing the rise of sea level and ultimately leading to the fluctuation of temperature across the world. To address the issue, bioinformatics may help by sequencing microbial genomes which are able to reduce levels of CO<sub>2</sub> and other greenhouse gases (which are also responsible for this temperature raising) from the atmosphere . Bioinformatics and genomics combinedly shape personalized medicine . Molecular medicine is a combination of traditional knowledge worldwide, modern science and technology. Human genome will have profound effects on the fields of biomedical research and clinical medicine. Every disease has a genetic component and inherited to body's response to an environmental stress which causes alterations in the genome (e.g., Cancers, heart disease, and diabetes). The completion of the human genome sequence means that we can search for the genes directly associated with different diseases and begin to understand the molecular basis of these diseases more clearly. Moreover, with the development of pharmacogenomics, clinical medicine became more personalized. First, computers translate a particular patient's genome into digital data which is then processed, stored and retrieved as and when required. Doctors use those genomic data to find the best suitable drug to treat a particular patient .

**FUTURE:** It is almost impossible to determine the future of any scientific disciplines, especially for one as young as bioinformatics. According to Janet M. Thornton, the future of biology will increasingly be shaped by the interplay of bioinformatics and 'classical' biology. Bioinformatics tools need to be improved for better analysis of pangenomics, metagenomics, proteomics, and metabolomics related data. It is also important to develop more sensitive powerful devices for high throughput data collection and new software to rapidly analyze those big data in better ways. In future biotechnology become more developed based on bioinformatics [103]. In near future, we will be able to fight against various types of infectious diseases with the help of bioinformatics. Genetic disorders may be identified more vividly by bioinformatics.

**OR**

**Write short notes on :-**

**(a) Drug designing**

Drug design is the inventive process of finding new medications based on the knowledge of a biological target. In the most basic sense, drug design involves the design of molecules that are complementary in shape and charge to the molecular target with which they interact and bind. Drug development and discovery includes preclinical research on cell-based and animal models and clinical trials on humans, and finally move forward to the step of obtaining regulatory approval in order to market the drug. Modern drug discovery involves the identification of screening hits, medicinal chemistry and optimization of those hits to increase the affinity, selectivity (to reduce the potential of side effects), efficacy/potency, metabolic stability (to increase the half-life), and oral bioavailability.

**(b) Sequence alignment**

*Sequence alignment* is the process of comparing and detecting similarities between biological sequences. What “similarities” are being detected will depend on the goals of the particular alignment process. Sequence alignment appears to be extremely useful in a number of bioinformatics applications.

For example, the simplest way to compare two sequences of the same length is to calculate the number of matching symbols. The value that measures the degree of sequence similarity is called the *alignment score* of two sequences. The opposite value, corresponding to the level of dissimilarity between sequences, is usually referred to as the *distance* between sequences. The number of non-matching characters is called the *Hamming distance*.

**5. Discuss blotting techniques and their application.**

Blotting is the technique in which nucleic acids or proteins are immobilized onto a solid support generally nylon or nitrocellulose membranes. Blotting of nucleic acid is the central technique for hybridization studies. Nucleic acid labeling and hybridization on membranes have formed the basis for a range of experimental techniques involving understanding of gene expression, organization, etc. Identifying and measuring specific proteins in complex biological mixtures, such as blood, have long been important goals in scientific and diagnostic practice. More recently the identification of abnormal genes in genomic DNA has become increasingly important in clinical research and genetic counseling. Blotting techniques are used to identify unique proteins and nucleic acid sequences. They have been developed to be highly specific and sensitive and have become important tools in both molecular biology and clinical research

Applications of Blotting Techniques

**Southern Blotting**

Southern blotting has many applications in molecular biology, including the identification of one or more restriction fragments that contain a gene or other DNA sequence of interest and in the detection of RFLPs used in construction of genomic maps.

**Northern blotting**

Northern blotting allows in observing a particular gene's expression pattern between tissues, organs, developmental stages, environmental stress levels, pathogen infection. The technique has been used to show over expression of oncogenes and down regulation of tumor-suppressor genes in cancerous cells when compared to 'normal' tissue, as well as the gene expression in the rejection of transplanted organs.

**Western blotting**

The western blot (alternatively, immunoblot) is used to detect specific proteins in a given sample of tissue homogenate or extract. The method originated from the laboratory of George Stark at Stanford. The name western blot was given to the technique by W. Neal Burnette.



### **Dot Blotting Techniques**

The drawbacks of blotting techniques have led to the development of dot blotting technique which is more advanced, less time consuming, accurate and applicable to a wide variety of gene/source simultaneously. The dot or slot blotting technique is the most widely used of all techniques for analysing. None of the blot methods require electrophoresis prior to blotting and hybridization. Hybridization of cloned DNA without electrophoretic separation is called as dot blotting.

### **Plaque or Colony Blotting Techniques**

This method was first developed by Granstiens and Hogness (1975). This method is used to identify which colony of bacteria contains the DNA of interest among thousands. In this procedure, the bacterial colonies to be screened are transferred onto nitrocellulose or nylon membrane by using replica plating.

### **Dot Plot Assay Techniques**

This method is widely used to hybridize DNA from a single cell type against a wide variety of probes, for example, for a viral infection which cannot be identified by normal conventional methods or if we want to know what all genes are expressed in a single cell type (e.g. brain cell)