

4-Week Online Workshop on Biostatistics for Biological Research

For Undergraduate Students in Biology, Biotechnology, Biochemistry, and Life Sciences

Workshop Overview

This **4-week online workshop** is designed to introduce students to **biostatistical tools and techniques essential for biological research**. Participants will learn **data collection, statistical hypothesis testing, regression analysis, ANOVA, and multivariate analysis**. The workshop includes **theoretical lectures, hands-on training using R, Python, and SPSS, and case studies** to help students **analyze and interpret biological data effectively**.

Workshop Structure & Study Design

Week 1: Fundamentals of Biostatistics & Data Collection

✦ **Objective:** Understanding basic statistical concepts and experimental design in biological research.

Topics Covered

- **Introduction to Biostatistics:**
 - Importance of biostatistics in biological research.
 - Types of biological data: **Qualitative vs. Quantitative**.
- **Descriptive Statistics:**
 - Measures of central tendency (Mean, Median, Mode).
 - Measures of dispersion (Variance, Standard Deviation, Range).
- **Experimental Design & Sampling Methods:**
 - Randomized controlled trials and observational studies.
 - Sample size determination and bias reduction techniques.

Hands-on Activities:

- ✓ **Data visualization using Excel and R (Histograms, Boxplots, Scatterplots).**
 - ✓ **Computing mean, variance, and standard deviation in R/Python.**
 - ✓ **Assignment:** Analyze a biological dataset and generate summary statistics.
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Week 2: Probability Distributions & Hypothesis Testing

★ **Objective:** Learning probability distributions and performing statistical hypothesis testing.

Topics Covered

- **Probability & Distributions:**
 - Normal, Binomial, and Poisson distributions.
 - Applications in biological data analysis.
- **Statistical Hypothesis Testing:**
 - Null & Alternative hypotheses, P-value, and Significance levels.
 - T-test (Independent and Paired), Chi-square test, and Z-test.
- **Correlation & Regression Analysis:**
 - Pearson and Spearman correlation.
 - Linear regression for biological data modeling.

Hands-on Activities:

- ✓ **Performing normality tests and probability distribution analysis in R/Python.**
 - ✓ **Conducting hypothesis testing using t-tests and chi-square tests in SPSS.**
 - ✓ **Assignment:** Apply correlation analysis to a biological dataset.
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Week 3: Advanced Statistical Methods in Biological Research

★ **Objective:** Applying advanced statistical methods to biological datasets.

Topics Covered

- **Analysis of Variance (ANOVA):**
 - One-way and Two-way ANOVA for comparing multiple groups.
 - Applications in clinical trials and experimental biology.
- **Multivariate Statistical Analysis:**
 - Principal Component Analysis (PCA) and clustering techniques.
 - Hierarchical and k-means clustering for biological classification.
- **Survival Analysis & Epidemiological Statistics:**
 - Kaplan-Meier survival curves and hazard ratios.
 - Applications in medical research and cancer studies.

Hands-on Activities:

- ✓ **Performing ANOVA and post-hoc tests in R/Python/SPSS.**
 - ✓ **Conducting PCA and clustering analysis for biological datasets.**
 - ✓ **Assignment:** Interpret survival data from a clinical dataset.
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Week 4: Biostatistics in Omics Research & Machine Learning Applications

★ **Objective:** Understanding statistical approaches in genomics, proteomics, and AI-driven biological data analysis.

Topics Covered

- **Statistical Analysis in Genomics & Proteomics:**
 - RNA-Seq data normalization and differential gene expression analysis.
 - Proteomics data handling using statistical approaches.
- **Introduction to Machine Learning for Biostatistics:**
 - Supervised vs. Unsupervised learning in biological research.
 - Logistic regression and decision trees for biological classification.
- **Ethical Considerations & Future Trends in Biostatistics.**

Hands-on Activities:

- ✓ **Analyzing RNA-Seq data using R (DESeq2, EdgeR).**
 - ✓ **Building a simple machine learning model for classification of biological samples using Python.**
 - ✓ **Final Project:** Perform a complete statistical analysis on a biological dataset and present findings.
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Expected Outcomes of the Workshop

Technical & Computational Skills:

- ✓ Understanding of **biostatistical methods (descriptive statistics, hypothesis testing, regression, ANOVA, PCA, clustering).**
- ✓ Hands-on experience with **R, Python, and SPSS for biological data analysis.**
- ✓ Ability to **perform statistical analysis for genomics, proteomics, and clinical data.**

Research & Analytical Skills:

- ✓ Capability to **design experiments and analyze biological datasets.**
- ✓ Knowledge of **machine learning applications in biostatistics.**
- ✓ Exposure to **real-world biological research case studies.**

Industry Readiness & Career Advancement:

- ✓ Training in **modern biostatistical tools used in biological and medical research.**
 - ✓ Certification for career enhancement in **biostatistics, bioinformatics, and clinical research.**
 - ✓ Networking opportunities with **biostatisticians, AI researchers, and industry professionals.**
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How to Register?

- Submit an application via [**Your Institution/Organization Link**].
- Provide an updated CV and a statement of interest.
- Limited seats available! Apply before [**Deadline Date**].

For more details, contact:

✉ Email: **[Your Email]**

☎ Phone: **[Your Contact Number]**

🌐 Website: **[Your Website]**
