Semester IV

Paper MHG 401: Population Genetics, Human Evolutionary Genetics and Behavior Genetics

Unit I
1. Concept and theories of evolution
2. Microevolution in Mendelian populations
   2.1 Mendelian Population
   2.2 Allele frequencies and genotype frequencies
   2.3 Hardy-Weinberg equilibrium and conditions for its maintenance
3. Elemental forces of evolution
   3.1 Mutation
   3.2 Selection
   3.3 Genetic drift
   3.4 Migration
4. Isolating mechanisms: Geographic and reproductive isolation

Unit II
5. Genetic variability in natural populations
   5.1 Chromosomal polymorphism
   5.2 Enzyme polymorphism
   5.3 DNA polymorphism
6. Genetic variability in natural populations II:
   6.1 Adaptive genetic polymorphism
   6.2 Balanced polymorphism
   6.3 Linkage disequilibrium
7. Concept of species and modes of speciation: sympatry, allopatry, stasis, and paraspeciation
8. Nonrandom and random breeding
   8.1 Inbreeding and assortative mating
   8.2 Heterosis

Unit III
9. Molecular population genetics
   9.1 Molecular evolution (neutral theory, punctuated equilibrium)
   9.2 Molecular clock
10. Molecular evolution and Phylogenetic tree
    10.1 Construction of phylogenetic tree using nucleotide sequence data
    10.2 Amino acid sequence and phylogeny (mitochondrial DNA, cytochrome b gene, etc.)
11. DNA-based phylogeny
    11.1 DNA-DNA hybridization
    11.2 Restriction enzyme sites
    11.3 Nucleotide sequence comparison and homologies
12. Concepts of Eugenics, inbreeding & eugenics

Unit IV
Human Evolution
13. Human phylogeny
    13.1 Human evolution: anatomical, geographical, cultural
    13.2 Molecular phylogenetics of Homo sapiens
14. Peopling of continents (Europe, Africa, Asia)
15. Adaptation:
    15.1 Meeting of human populations & its genetic imprint
    15.2 Detection of admixture (based on allele frequencies & DNA data)
    15.3 Y Chromosome & mitochondrial DNA markers in genealogical studies

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16. Culture and human evolution
   16.1 Learning, society and culture
   16.2 Relative rates of cultural and biological evolution
   16.3 Social Darwinism
   16.4 Sociobiology

Unit IV  
   Behaviour Genetics

17. Nature-nurture and behaviour
   17.1 Genetic experiments to investigate animal and human behaviour
   17.2 Identifying genes for behavior (induced mutations, QTL, synteny homology)
   17.3 Environmental influence—shared and non-shared environment
   17.4 Investigating genetics of human behaviour (twin & adoption study designs, interpreting heritability, linkage and association studies)

18. Psychopathology
   18.1 Signs and symptoms
   18.2 Schizophrenia
   18.3 Mood disorders
   18.4 Anxiety disorders
   18.5 Disorders of childhood
   18.6 Personality and personality disorders- antisocial personality, criminal behaviour

19. Cognitive abilities and Disabilities
   19.1 Mental retardation
   19.2 Learning disorders
   19.3 Communication disorders

20. Neurogenetics
   20.1 Study design: Genetic and environmental manipulations
   20.2 Circadian rhythms
   20.3 Learning & memory

Recommended Books
5. Organismic Evolution, Verne Grant, Freeman, 1977
10. Genetics of Population, 2nd Ed, Heidrick, Jones and Barlett, 2000
Paper MIG402. Biostatistics & Bioinformatics

Unit I
1. Biostatistics:
   1.1 Overview
   1.2 Measures of central tendency: Mean, Median, Mode
   1.3 Measures of dispersion: Standard deviation, standard error, Variance, Coefficient of variation
2. Tabulation and presentation of data
3. Hypothesis testing and Test of Hypothesis:
   3.1 Statistical & Scientific hypothesis
   3.2 The null and alternative hypothesis
   3.3 Procedure (steps) for Hypothesis testing
   3.4 F-tests & Chi square test
4. Test of significance: Student’s t-test

Unit II
5. General idea of Correlation and Regression Analysis
6. ANOVA: General idea of one way & two way analysis
7. Nonparametric methods for statistical inference
   7.1 Wilcoxon Rank-sum test
   7.2 Mann-Whitney test
8. Sampling: Types and methods of sampling

Unit III
9. Computers and computer languages:
   9.1 Introduction to computers,
   9.2 Components of a computer system (CPU, I/O units)
   9.3 Computer languages: Introductory concepts of computer languages;
10. Introduction to operating systems, Linux/UNIX
11. Elementary idea on the applications of common DOS- and WINDOWS based software packages
12. Computer networking:
    12.1 Introduction to: E-mail and Internet, WWW, HTTP, HTML, URLs, Websites, Web Pages, Web browser;
    12.2 Applications in library search & information retrieval

Unit IV
14. Biological databases I:
    14.1 Introduction
    14.2 Types of databases (Entrez, SRS or Sequence Retrieval System, PIR or Protein Identification Resource, GENE BANK, SWISS-PROT and other databases, etc.).
15. Biological databases II:
    15.1 Nucleotide and protein sequence databases,
    15.2 Major Bioinformatics databases,
16. Sequence analysis (Brief idea):
    16.1 Methods for alignment (dot matrices)
    16.2 Tools for sequence alignment – Fasta, BLAST, PSI-Blast,
    16.3 Multiple Sequence Alignment (MSA) – tools and applications

Unit V
17. Bioinformatics tools for phylogenetic analysis
18. Proteomics (Brief ideas):
    18.1 Proteome & Tools for proteome analysis,
    18.2 Protein function prediction,
19. Gene prediction (Brief ideas): Methods & gene prediction tools,
20. Elementary ideas on the analysis of genetic data: PHYLIP, haplotype analysis (Hep cervus),
    Linkage analysis,

**Recommended Books**

9. Internet and e-mail, 2nd Ed., Banga, Khanna, 2002
12. DNA Microarrays, Schein, Scion, 2008
22. Biostatistics, Dr. Rajeev Goswami, MD, 2009