

**Department of Mathematical Sciences**  
**PG 3<sup>rd</sup> Semester Syllabi**

**Statistical Inference (MST901)**

**Credits 5**

**Unit I** Rao-Blackwell and Lehmann-Scheffe theorems, Fisher information function. Cramer-Rao inequality. Uniformly Minimum Variance Unbiased (UMVU) Estimation. Fisher information matrix, illustration with one and two parameters. Method of Maximum Likelihood and Method of Minimum Chi-Square and Method of Moments. confidence intervals

**Unit II** Testing of hypotheses, null and alternative, simple and composite. Type I and Type II errors, Test function, size and power function. Concept of p-value. Review of standard one and two-sample significance tests. Most powerful tests, Neyman-Pearson lemma, MLR property, UMP tests.

**Unit III** Likelihood Ratio (LR) Test. Construction of LR tests for normal mean and variance, one and two sample problems. Asymptotic distribution of LR test statistic. Application to an  $r \times c$  contingency table, Wald test and Rao's score test. Nonparametric tests: Mann-Whitney-Wilcoxon test, Wilcoxon signed-rank test, Sign test, test for quantile, Chi-square test of goodness of fit. Kolmogorov-Smirnov test. Wald-Wolfowitz run test. Test for randomness.

**Unit IV** Bayes paradigm. Prior and posterior distributions. Predictive distributions. Conjugate and non-informative priors. Construction of Bayes estimators relative to squared error, weighted squared error, absolute error and LINEX loss functions. Bayesian credible intervals. Minimax estimation.

**References:**

1. Casella G, Berger R. L. (2001). *Statistical Inference*, 2/e, Cengage Learning Pvt. Ltd.
2. Kale B.K. (2005). *A First Course on Parametric Inference*, (2nd Narosa Publishing House).
3. Rohatgi V.K. and Ehsanes Saleh A.K.MD. (2003). *An Introduction to Probability Theory and Mathematical Statistics*, 2/e, Wiley Eastern.
4. Dudewicz, E.J. and Mishra, S.N. (1988). *Modern Mathematical Statistics*, Wiley Sons
5. Lehmann E.L. (1986). *Theory of Point Estimation*, (Student Edition).
6. Lehmann, E.L. (1986). *Testing Statistical Hypotheses*, (Student Edition)
7. Rao, C.R. (2002). *Linear Statistical Inference and its Applications*, 2/e, Wiley.
8. J.K. Ghosh, D. Delampady and T. Samanta. (2006). *Introduction to Bayesian Inference, Theory & Methods*, Springer
9. Berger, J. O. (1985): *Statistical Decision: Theory and Bayesian Analysis*, 2/e, Springer-Verlag

## Survival Analysis (MTH 902)

Credits 5

**Unit I:** Survival function, hazard rate, cumulative hazard function, and mean residual life.

Parametric models for study of event time data: Exponential, Weibull, extreme value, gamma, Pareto, logistic, log-logistic, normal, log-normal and mixture models -their survival characteristics. Longitudinal studies. Censoring mechanisms- type I, type II and left right and interval censoring. Likelihood function under censoring. Fitting parametric models to survival data with right censoring. Large sample tests with censored data. The E-M algorithm.

**Unit II** Actuarial and Kaplan-Meier estimators. Treatment of ties. Self consistency property and asymptotic properties of K-M estimator (statement). Pointwise confidence interval for  $S(t)$ . Nelson-Aalen estimator of cumulative hazard function and estimation of  $S(t)$  based on it. Two-sample methods. Comparison of survival functions: Log rank and Tarone-Ware tests. Competing risks model; Kaplan-Meier estimator of survival function, Nelson-Aalen estimator.

**Unit III** Explanatory variables- factors and variates. Cox proportional hazards model. The partial likelihood and estimation of regression coefficients and their standard errors. Breslow's estimator of the baseline hazard function; estimation of cumulative hazard rate and  $S(t)$ . Statement of asymptotic properties of the estimator. Confidence interval for regression coefficients. Wald, Rao and likelihood tests for  $\beta$ . Accelerated life model. Model selection criteria and comparison of nested models ( $-2\log L$  and AIC). Using information on prognostic variables in a competing risks model.

**Unit IV.** Parametric regression-Weibull and Gompertz models. Residuals and model checking under Cox and parametric models. Comparing two survival curves. Hazard plots, Survival plots. Comparing alternative models, AIC criterion. Comparing observed and fitted survival models. Testing proportional hazards hypothesis in the Weibull model of cumulative incidence function.

### References:

1. Klien, J.P. and Moeschberger, M.L. (2003). *Survival Analysis: Techniques for censored and Truncated Data*. 2/e. Springer
2. Kalbfleisch, J.D. and Prentice, R. L (2002), *The Statistical Analysis of Failure Time Data*, 2nd edition, J. Wiley, New York.
3. Nelson, W (1982), *Applied Life Data Analysis*, J. Wiley, New York.
4. Miller, J (1980), *Survival Analysis*, J. Wiley, New York.
5. Elandt-Johnson, Regina C; Johnson, Norman L.(1999). *Survival models and data analysis*. Classics Library ed. – John Wiley & Sons.
6. Macdonald A S, *An Actuarial Survey of Statistical Models for Decrement and Transition Data*, British Actuarial Journal 2 (1996), (Research paper)
7. Klein, J.P (2003): *Survival Analysis*, Springer Verlag.
8. Kleinbaum, D.G. (1997): *Survival Analysis*, Springer Verlag.

## **Financial Derivatives (MTH 903)**

**Credits 4**

**Unit I:** - Types of Options, Option positions, Underlying Assets , Specification of stock options, Stock option pricing, Factors affecting option prices , Upper and lower bounds for option prices. Trading strategies involving options , Binomial model: One-step and two-step models, Binomial trees. Risk neutral valuation.

**Unit II:** Brownian Motion, Arithmetic and Geometric Brownian motion, Markov property of Brownian Motion, Ito Lemma, Ito integral, Applying Ito Lemma.

**Unit III:** Black-Scholes model: Distribution of rate of returns, volatility, risk neutral pricing, Discrete and Continuous Martingale pricing. Idea underlying the Black-Scholes-Merton differential equation. Estimating volatility The exponential weighted moving average models

**Unit IV:** Value at Risk (Var), The GARCH(1,1) models, Maximum likelihood methods , Greek Letters and hedging. Interest rate derivatives, Black model

### **References:**

1. *Hull John C. and Basu S. (2010) Options, Futures and Other derivatives, 3<sup>rd</sup> Prentice hall of India Private Ltd., New Delhi.*
2. *Sheldon M Ross (2005): An elementary Introduction to Mathematical Finance, Cambridge University Press.*
3. *Joshi M.S. (2010): The Concept and Practice of Mathematical Finance, Cambridge University Press.*
4. *Shreve Steven E.(2009) Stochastic Calculus for Finance I: The Binomial Asset Pricing models, Springer*

## **Principles of Insurance (MTH904)**

**Credits 4**

**Unit I:** The concept of risk, kinds and classification of risk, assessment, transfer risk, appraisal risk selection, underwriting risk appraisal, Mortality tables, physical and moral hazards, representations, warranties, conditions.

**Unit II:** The business of insurance-risk managed by individuals, risk managed by insurers, premium fixing, reinsurance and its important role of insurance in economic development, the insurance market, role of intermediaries, specialists regulators.

**Unit III:** Insurance customers, types of customers, customer mindset and customer satisfaction, importance of ethical behaviour

**Unit IV:** Basic principles of Insurance, utmost good faith, insurable Interest- material facts, economic principles of Insurance Sharing, Subrogation, contribution, Legal principles of Insurance, Actuarial principles.

**Unit V:** Insurance terminology-terms that are specific to life insurance, traditional product offered by life insurance companies, features of MODULE linked policies, features of annuities and group policies, Insurance terminology specific to general insurance, products offered by non-life insurance companies.

### **References:**

1. Neelam C Gulati “Principles of Insurance Management” (2007). Excel Books, New Delhi.
2. Harriett E Jones “Principles of Insurance “FLMI Insurance Education Program. Life Management Institute LOMA, (Dec 1995).
3. Robert I Mehr “Principles of Insurance” Richard Irwin edition, ( 8th Edition, 1985).
4. Ben G Baldwin (2002).*The New Life Insurance Investment Advisor” 2nd Edition. Mc Graw Hill.*
5. Black and Skipper (2000). “Life and Health Insurance”, Pearson Education

## Sampling Theory

PG Elective

Credits: 4

### Unit I

Simple Random Sampling: Concept of sampling design, expected value and sampling variance of the sample mean, expected value of the sample mean square and estimation of the variance. Determination of sample size. Stratified random Sampling: Estimation of the population mean/total and its variance, choice of sample sizes in different strata, variance under different allocations. Comparison with unstratified sampling. Estimation of the gain in precision due to stratification, construction of strata.

### Unit II

Ratio and Regression methods of Estimation: Variance of the estimates, estimation of variances, optimum property of ratio and regression estimator. Ratio and regression estimator in stratified random sampling. Some modifications of ratio and regression estimators. Comparison among regression, ratio and simple unbiased estimates. Unbiased ratio type estimates.

### Unit III

Systematic Sampling: Sample mean and its variances. Comparison of systematic with simple random and stratified sampling in the general case and also in the case of linear trend. Cluster sampling with equal and unequal cluster sizes, relative efficiency with SRS and optimum cluster size.

### Unit IV

Double Sampling: Double Sampling for Stratification including estimation of variance. Variance of ratio and regression estimates in double sampling. Double sampling for pps estimation. Sampling on successive occasions: Sampling on two occasions, estimation of current population mean. Two-stage sampling: (a) Equal first stage unit; estimation of population mean and its variance and estimates of variance. Comparison with one stage sampling (b) Unequal first stage unit; estimation of population mean. Expected values and variance of different estimates including the case of probability proportional to size

### References:

1. Sukhatme, P.V., Sukhatme, B.V., Sukhatme,S. and Asok, C. (1984): Sampling Theory of Surveys with Applications, Iowa State University Press and Indian Society of Agricultural Statistics.
2. Cochran, W. G: Sampling Techniques, 3rd edition, John Wiley and Sons.
3. Mukhopadhyay, P. (2000): Theory and Methods of Survey Sampling, Prentice Hall of India, Private limited, New Delhi
4. Des Raj & Chandak(1998): Sampling Theory, Narosa.
5. Murthy, M. N. (1977): Sampling Theory and Methods, Statistical Publishing Society, Calcutta.
6. Skate teal (1984): Sampling Theory of Surveys with Applications, Iowa State University Press, & IARS.
7. S.C. Gupta and V.K. Kapoor (1984): Fundamentals of Applied Statistics, Sultan Chand & Sons, New Delhi.
8. Singh, D and Chaudhary, F. S. (1986): Theory and Analysis of Sample Survey Design, New Age International Publisher.

**Course Title** : **International Language (Arabic)**  
**Course Code** : **IL/AB901**  
**Credit hrs.** : **2**

**For 3<sup>rd</sup> Sem. (PG)**

This course is designed to provide basic knowledge of written and spoken Arabic to the beginners who want to interact with the Arab world as business men and women, tourists and employment seekers. The course will enhance employment opportunities for engineers, technocrats, business managers and tourism operators. The course is also capable of providing basis for further studies in Arabic.

- A. The course will consist of two components;  
Text (2 Credits = 50 Marks)  
B. Conversation and Translation (2 Credits = 50 Marks)

**Unit-1 A:** (Text with Applied Grammar) (معالقاعدةالتطبيقية)

Chapter one الدرسالأول

Chapter two الدرسالثاني

Chapter three الدرسالثالث

Chapter four الدرسالرابع

Chapter five الدرسالخامس

**B:** (Conversation and Translation)

Interrogatives: whose ,who, what, where etc with the help of examples .

(أدواتالاستفهام : ما – من – أين (بالكامل) ( مععشر كلمات / مفرداتجديدةفيكلدرس

Demonstrative pronouns: This, That, These ,Those etc.

أسماءالإشارة: هذا – هذه – هؤلاء – ذلك،تلك،أولئك

**Unit-2 A:** (Text with Applied Grammar)

Chapter six الدرسالسادس

Chapter seven الدرسالسابع

Chapter eight الدرسالثامن

Chapter nine الدرسالتاسع

Chapter ten الدرسالعاشر

Chapter eleven الدرسالحادي عشر

**B:** (Conversation & Translation) Conversation with the help of pronouns:

المحادثةالمبنيةعلللاضمانر المنفصلة / الشخصيةمثلاً،نحنالخب

المحادثة المبنيّة على الضمائر المتصلة مثل كتابي، كتابنا وغير ذلك

### **Unit-3 A: (Text with Applied Grammar)**

Chapter twelve الدرس الثاني عشر

Chapter thirteen الدرس الثالث عشر

Chapter fourteen الدرس الرابع عشر

Chapter fifteen الدرس الخامس عشر

Chapter sixteen الدرس السادس عشر

### **B: (Conversation & Translation)**

Usage of have /has with the help of examples.

(استخدام العبار اتمثل عندي، عندنا وغير ذلك ( مع عشر كلمات جديدة

Negative sentences with the help of examples

الجملا المنفية باستخدام ليس وماو غير ذلك

Usage of can, could etc

استخدام العبار اتعلنا استعماله لتقدر؟ ... وغير ذلك

### **Unit-4 A: (Text with Applied Grammar)**

Chapter seventeen الدرس السابع عشر

Chapter eighteen الدرس الثامن عشر

Chapter nineteen الدرس التاسع عشر

Chapter twenty الدرس العشرون

Chapter twenty one الدرس الواحد والعشرون

### **B: (Conversation & Translation)**

Introduction to Arabic numerals and their usage with examples

المحادثة المبنيّة على استخدام الأعداد الوصفية

Usage of Arabic prepositions with the help of examples

المحادثة المبنيّة على استخدام حرف الجر

الكتاب المقرر

### **Prescribed Books:**

الجزء الأول القراءة الواضحة :

وحيد الزمان قاسم كيران

:الكتاب المقترحة

- Teach Yourself Arabic by Z.A.Farooqi and Habibullah Khan
- The Essential Arabic by R.I. Faynan
- New Arabic Course by V. Abdul Rahim