

Syllabus Structure of Ph.D. Course Work, 2021

Sl. No.	Paper Code	Sessional / Non-sessional Classification	Paper Title	No. of Credits	Marks
1	STATC1	Non-sessional	Research Methodology including Quantitative Methods	4	50
2	STATC2	Sessional	Research and Publication Ethics (RPE)	2	50
3	STATC3	Sessional	Review Work on Contemporary Research and Seminar Presentation	4	50
4	STATE1	Sessional	Statistical Computing and Useful Document Processing Software	3	50
5	STATE2	Non-sessional	Advanced Statistical Methods Related to Contemporary Research	3	50
Total Credit / Total Marks				16	250

Note: All five papers of Ph.D. course work in Statistics mentioned above are covered in one-semester duration.



DETAILED SYLLABUS OF Ph.D. COURSE WORK

[ACADEMIC SESSION: 2020-2021]

1. STATC1: Research Methodology including Quantitative Methods (4 Credits) [Total marks: 50] (Non-sessional paper)

Module 1: Preliminaries of a research method

Meaning and objectives of research, definition and formulation of a research problem, need for and important concepts relating to research design, developing a research plan, preparation of a research proposal, census and sample survey, questionnaire for data collection, selection of sampling procedure, drawing of a random sample, interpretation and report writing, roles of computer in research.

Module 2: Quantitative methods

Data analysis, Measures of location, dispersion, qualitative and quantitative variables, univariate and multivariate data, association measures among dependent characters, various prediction formulae, different classical and Bayesian estimation procedures, standard hypothesis testing procedures in parametric and nonparametric set-up, ANOVA and ANCOVA.

Module 3: Advanced quantitative methods

Generalized linear model, Principal component analysis, Canonical correlation, Clustering, Fisher's method of combining p-values, Classical and Bayesian meta-analysis for combining the results of several independent random experiments.

Module 4: Computer software

MS-Word, MS-Excel, MS-Power point presentation, computing algorithms and coding, R-software for computation and simulation.

References:

- Kothari, C.R.: Research Methodology: Methods & Techniques, New Age Publication, New Delhi, 2004.
- Pandey, P. and Pandey, M.M.: Research Methodology: Tools and Techniques, Bridge Center, Romania, European Union, 2015.
- Walliman, N.: Research Methods the basics, Routledge, Taylor & Francis, London and New York, 2011.
- Rao, C.R.: Linear Statistical Inference and Its Applications, J. Wiley & Sons. NY, 1973.
- Rohatgi, V.K. and Saleh, A.K.M.E.: An Introduction to Probability and Statistics, J. Wiley & Sons., New Jersey, 2015.
- Casella, G. and Berger, R.L.: Statistical Inference, DUXBURY, USA, 2002.
- John, R.A. and Wichern, D.W.: Applied Multivariate Statistical Analysis, Pearson Prentice Hall, New Jersey, 2007.
- Härdle, W. and Simar, L.: Applied Multivariate Statistical Analysis, Springer, NY, 2007.
- Khattree, R. and Naik, D.N.: Applied Multivariate Statistics, J. Wiley & Sons. NY, 1999.
- Hurtung, J., Knapp, G. and Sinha, B.K.: Statistical Meta-Analysis with Applications, J. Wiley & Sons. NY, 2008.
- R Core Team: R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria, 2017, URL <https://www.R-project.org/>

2. **STATC2: Research and Publication Ethics (RPE)** (2 Credits) [Total marks: 50] (Sesssional paper)

Module 1: Ethical issues in research and publication

- i. Publication Ethics: Introduction, Definition, & Importance
- ii. Authorship: Introduction and Definition; Issues in authorship- Ghost, Guest and Gifted authorship
- iii. Publication misconduct
 - a. Falsification and Fabrication of Data, Image and Results

- b. Plagiarism/Self-plagiarism
- c. Redundant publications- Salami slicing, duplicate publications
- d. Conflict of Interest
- e. Examples of research misconducts from India and abroad;
- f. Online tools like ‘Retraction watch’, Pubpeer, etc.
- iv. Remedies
 - a. Standards Setting Initiatives and guidelines; COPE, WAME, etc.
 - b. Software tools for checking similarities- Urkund/Turnitin/Ithenticate/Grammarly.com/ Open source Tools.
 - c. Reference Management tools like Mendeley/Zotero/Endnote

References:

- Oliver, P. (2010). The student’s guide to research ethics. McGraw-Hill Open University Press
- Koepsell, D. (2017). Scientific Integrity and Research Ethics: An Approach from the Ethos of Science, Springer.
- Case Study Collection of Ethics Education Library available at <http://ethics.iit.edu/eelibrary/case-study-collection>
- Ethics in Research and Publication: Elsevier ethics Toolkit at <https://www.elsevier.com/authors/policies-and-guidelines>
- Mission Directorate- CSIR. (2019). CSIR Guidelines for Ethics in Research and in Governance available at https://www.ccmb.res.in/newsfiles/year-2020/csir_ethics_2020.pdf
- Purdue Online Writing Lab <https://owl.purdue.edu/>
- Research – General Guide at <http://www.presiuniv.ac.in/web/library/generalguide.php>

Module 2: Research databases, Metrics and Publication evaluation

- i. Methods of Research evaluation- Peer review and Evaluative bibliometrics
- ii. Indexing Databases and Citation databases- Web of Science, Scopus, Google Scholar, Dimension, Lens, etc.
- iii. Citation metrics – Journal Impact Factor, Cite Score, Eigen factor, SNIP, SJR, h-index, g-index, etc.
- iv. Altmetrics and DORA declaration
- v. Misleading metrics and Predatory publishing
- vi. Ensuring Quality publication
 - a. UGC-CARE list
 - b. Think.Check.Attend. checklist
 - c. Recommended Practices to Ensure Conference Content Quality
 - d. Principles of Transparency and Best Practice in Scholarly Publishing

References:

- Babor, T *et al.* (2017). How to Choose a Journal: Scientific and Practical Considerations. In: Babor, T *et al.* (eds.), *Publishing Addiction Science*. London: Ubiquity Press. DOI: <https://doi.org/10.5334/bbd.c>
- Springer Handbook of Science and Technology Indicators/ Edited by Wolfgang Glänzel, Henk F. Moed, Ulrich Schmoch & Mike Thelwall (eds.) Springer Verlag (2019).
- **Sugimoto, C. R. and Larivière, V. (2018).** *Measuring Research: What Everyone Needs to Know*. New York: Oxford University Press. .
- Waltman, L. (2016). A review of the literature on citation impact indicators. *Journal of Informetrics*, 10(2), 365–391. <https://doi.org/10.1016/j.joi.2016.02.007>.
- Aksnes, D. W., Langfeldt, L., & Wouters, P. (2019). Citations, Citation Indicators, and Research Quality: An Overview of Basic Concepts and Theories. *SAGE Open*. <https://doi.org/10.1177/2158244019829575>
- Giri, R. (2019). Influence of selected factors in journals' citations. *Aslib Journal of Information Management*, 71(1), 90–104. <https://doi.org/10.1108/AJIM-07-2017-0170>.
- Giri, R. and Choudhury, S. K. (2021). Ranking journals through the lens of active visibility. *Scientometrics*.126(3), 2189-2208. <https://doi.org/10.1007/s11192-020-03850-6>

Module 3: Open access publishing

- i. Open access publications and initiatives
 - a. Open Access Overview
 - b. Types of Open Access
 - c. Open Access Databases and Resources
 - d. Creative Commons
- ii. SHERPA/RoMEO online resource to check publisher copyright & self-archiving policies
- iii. Journal finder / journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer Journal Suggested, etc.

References:

- Suber, P. (2012). Open access. MIT Press
- DOAJ at <https://doaj.org/>
- <https://www.openaccess.nl/>
- <https://oaspa.org/>
- [Scholarly Kitchen - Open Access](#)
- <https://v2.sherpa.ac.uk/romeo/>

Module 4: Practical / Hands on Training

- i. Use of plagiarism software like Urkund/Turnitin and other open-source software tools.
- ii. Use of Reference Management tools – Zotero/ Mendeley/ Endnote and other subject specific tools
- iii. Online Search tools – Citation indexes- Web of Science/ Scopus/ Dimension/ Lens
- iv. Online bibliographic and full text Search – Subject specific gateway-like Pubmed, NASA [ADS Astrophysics Data System](#); etc.; Open access gateway like BASE, Core-UK, NDLI, ETD Global search, etc.; Patent Search – USPTO, Patentscope, etc

References:

- <https://www.ouriginal.com/guides-tutorials/>
- <https://help.turnitin.com/feedback-studio/turnitin-website/student/quickstart.htm>
- <https://www.mendeley.com/guides>
- <https://blog.scopus.com/posts/scopus-tip-trick-search-smarter-find-faster>
- https://www.uspto.gov/sites/default/files/documents/TMEP_Search_Help.pdf

3. STATC3: Review Work on Contemporary Research and Seminar Presentation

(4 Credits) [Total Marks: 50] (Sesssional paper)

Term paper (on review work) evaluation: 30 Marks

Seminar presentation: 20 Marks

4. STATE1: Statistical Computing and Useful Document Processing Software

(3 Credits) [Total Marks: 50] (Sesssional paper)

Module 1: Jackknife and Bootstrap methods:

Need for re-sampling, Boot-strap principle, Parametric and Non-parametric Boot-strap, Estimation of unknown functional, Estimation of standard error and bias of the estimator of functional, Boot-strap confidence interval, Boot-strap in regression analysis, Applications of Boot-strap methods. Jack-knife principle, Jack-knife estimation of unknown functional, Justification of Jack-knife estimator of bias and variance of the estimator, Comparison between Jack-knife and Boot-strap methods, Consistency of Jack-knife variance estimator, Applications of Jack-knife methods.

References:

- Efron, B.: The Jackknife, the Bootstrap and Other Resampling Plans, Society for Industrial and applied Mathematics, Philadelphia, Pennsylvania, 1982.
- Shao, J. and Tu, D.: The Jackknife and Bootstrap, Springer series in Statistics, NY, 1995.
- Efron, B., Tibshirani, R.J.: An Introduction to the Bootstrap, CRC, NY, 1994.

Module 2: Markov Chain Monte Carlo (MCMC) Methods:

Importance of MCMC, Properties and Stationary distribution of a Markov Chain, Detailed balance, Metropolis-Hastings algorithm, Hasting's ratio, Random walk Metropolis and its lagging diagnostics, Burn-in MCMC, Convergence diagnostics of MCMC, Some applications of MCMC methods. Gibb's Sampler – Full conditional distributions, Gibbs sampling algorithms, Stationary distribution for Gibbs, Estimation of unknown functional, Examples including Variance component model in ANOVA.

References:

- Owen, A. and Glynn, P.W.: Monte Carlo and Quasi-Monte Carlo Methods, Springer proceedings in Mathematics & Statistics, Stanford, 2016.
- Gentle, G.E., Härdle, W.K. and Mori, Y.: Handbook of Computational Statistics: Concepts and Methods, Springer-Verlag, 2012.

Module 3: LaTeX software for document processing and slide presentation

Introduction, Structure of a LaTeX document, Basic formatting tools, Layout of the page, Tabular Material, Mastering Floats, Fonts and encoding, Higher mathematical typesetting, Graphics insertion, Managing citation, Bibliography generation, Slide creation and presentation.

References:

- Kunth, D.E. and Bibby, D.R.: The TEXbook, Addison-Wesley Publishing Company, Tokyo, Japan, 1984.

- Mittelbach, F. and Gussens, M.: The Latex Companion, Addison-Wesley Series on Tools and Techniques for Computer Typesetting, San-Francisco, USA, 2004.

5. STATE2: Advanced Statistical Methods Related to Contemporary Research

(3 Credits) [Total Marks: 50] (Non-sessional paper)

Module 1: Advanced survey sampling

Stratified Sampling, Stratification variable, Method of formation of strata with some examples, Ranked set sampling (RSS) – Judgment variable, Perfect and Imperfect ranking mechanism, Balanced RSS, Unbalanced RSS and optimal designs, Estimation of unknown functional including population quantile and density function, Usual nonparametric tests with RSS, Efficiency comparison between ranked set and simple random samplings.

References:

- Thomson, S.K.: Sampling, Third edition, John Wiley & Sons, Inc., NY, 2012
- Cochran, W.G.: Sampling Techniques, Third edition, John Wiley & Sons, NY, 1977
- Arnab, R.: Survey Sampling: Theory and Applications, Academic Press, U.K., 2017
- Chen, Z., Bai, Z. and Sinha, B.K.: Ranked Set Sampling: Theory and Application, Springer, N.Y., 2003
- Ahmad, M., Hanif, M. and Muttlak, H.A.: Ranked Set Sampling, Cambridge Scholars Publishing, U.K., 2010.
- Bouza-Herrera, C.N. and Al-Omari, A.I.F.: Ranked Set Sampling: 65 years Improving the Accuracy in Data Gathering, Academic Press, U.K., 2019

Module 2: Advanced nonparametric approaches

Generalized U-statistics, H-decomposition of U-statistics, General linear rank statistics, Hájek's theorem and Noether's condition for convergence in distribution, Single-sample and two-sample location problem, Unbiasedness and consistency of Mann-Whitney test, Wilcoxon rank sum test, Sign test, Signed rank test and Kolmogorov-Smirnov test for Goodness-of-Fit, Pitman's local alternatives, Asymptotic power and Asymptotic relative efficiency (ARE).



References:

- Lee, A.J.: U-Statistics: Theory and Practice, Marcel and Dekker, NY, 1990.
- Hájek, J., Šidák, Z. and Sen, P.K.: Theory of Rank Tests, Academic Press, San Diego, 1999
- Gibbons, J.D. and Chakraborti, S.: Nonparametric Statistical Methods, Taylor & Francis/ CRC Press, NY, 2010.

Module 3: Some useful asymptotic results

Brief review of convergence almost surely, in probability, in distribution and in r^{th} mean of a sequence of random variables, Stochastic $O(\cdot)$ and $o(\cdot)$, Relationship among different modes of convergence, Some useful probability limit theorems, Convergence properties on transformed sequences, Donsker theorem (statement and applications only), Kolmogorov-Smirnov distance with related asymptotic properties, Asymptotic representations of sample quantile, order statistics and distribution function, Sample distribution function process, On functions of asymptotically normal statistics with examples, Quadratic forms in asymptotically multivariate normal vectors, Asymptotic theory in parametric set-up, Asymptotic normality of MLE in univariate and multivariate cases, Asymptotic test procedures.

References:

- Serfling, R.J.: Approximation Theorems of Mathematical Statistics, John Wiley & Sons, Canada, 1980.
- DasGupta, A.: Asymptotic Theory of Statistics and Probability, Springer, NY, 2008.
- Ferguson, T.A.: A Course in Large Sample Theory, Chapman & Hall, London, 1996.

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