

MATH 260 CALCULUS I

Limit and continuity of functions of several variables. Partial derivatives, differentials, composite, homogeneous and implicit functions. Jacobians, orthogonal curvilinear coordinates, multiple integral, transformation of multiple integrals. Mean value and Taylor's theorems for several variables. Maxima and minima with applications.

Recommended Literature

1. Spigle, M. R. (1991). *Advanced Calculus*; McGraw Hill, USA.
2. Hilberland, F. B. (1962). *Advanced Calculus for Application*; Prentice Hall, USA.
3. Courant, R. and John, F. (1974). *Introduction to Calculus and Analysis*; Vol. 2, John Wiley and Sons, USA.
4. De Lillo, N. J. (1982). *Advanced Calculus with Applications*; Macmillan Pub., USA.

MATH 168 DIFFERENTIAL EQUATIONS

Linear differential equation of order n with coefficients continuous on some interval J . Existence-uniqueness theorem for linear equations of order n . Determination of a particular solution of non-homogeneous equations by the method of variation of parameters. Wronskian matrix of n independent solutions of a homogeneous linear equation. Ordinary and singular points for linear equations of the second order. Solution near a singular point, method of Frobenius. Singularities at infinity. Simple examples of Boundary value problems for ordinary linear equation of the second order, Green's functions. Eigenvalues, eigenfunctions. Sturm-Liouville systems. Properties of the gamma and beta functions. Definition of the gamma function for negative values of the argument; Legendre, Bessel, Chebyshev, Hypergeometric functions. Orthogonality properties.

Recommended Literature

1. Ross, S. L. (1984). *Differential Equations*; John Wiley and Sons, Inc., USA.
2. Redheffer, R. (1992). *Introduction to Differential Equations*; Jones & Bartlett Pub., Inc.
3. McCann, R. C. *Introduction to Ordinary Differential Equations*; Harcourt Brace Janovich, USA.

PARTIAL DIFFERENTIAL EQUATIONS

First and second order partial differential equations. Classification of second order linear partial differential equations, derivation of standard equation. Methods of solution of initial and boundary value problems, separation of variables, Fourier series and their applications to boundary value problems in partial differential equation of engineering and physics. Internal transform methods; Fourier and Laplace transforms and their application to boundary value problems.

Recommended Literature

1. Petrovsky, I. G. (1954). *Lectures on Partial Differential Equations*; Dover, USA.
2. Broman, A. (1970). *Introduction to Partial Differential Equations*; Dover, USA.

MATH 261 LINEAR ALGEBRA

Commutative, associative and distributive properties of union and intersection of sets. De Morgan's laws. Cartesian product of sets. The real number system; natural numbers, integers, rational and irrational numbers. Properties of addition and multiplication on the set of real numbers. Relation of order in the system of real numbers. Linear, quadratic

and other polynomial functions, rational algebraic functions, absolute value functions, functions containing radicals and their graphical representation. Inequalities in one and two variables. Application to linear programming. Indices and logarithms, their laws and applications. Binomial theorem for integral and rational indices and their application. Linear and exponential series. Operations on matrices up to 3×3 . Inverse of a matrix. Determinants and their use in solving systems of linear equations. Circular functions of angles of any magnitude and their graphs. Trigonometric formula including multiple angles, half angles and identities. Solution to trigonometric equations.

Prerequisite: SSSCE Elective Mathematics

Recommended Literature

1. Morash, R. P. (1987). *A Bridge to Abstract Mathematics*; Random House Inc., New York.
2. Bick, T. A. (1971). *Introduction to Abstract Mathematics*; Academic Press.
3. Fraleigh, J. B. (1989). *A First Course in Abstract Algebra*.

MATH 283 LINEAR ALGEBRA

Direct sum of subspaces. Complement of subspace in a vector space. Dimension of the sum of two subspaces. One-to one, onto and bijective linear transformations. Isomorphism of vector spaces. Matrix of a linear transformation relative to a basis. Orthogonal transformations, rotations and reflections. Real quadratic forms, positive, definite forms. Cosets and index of a subgroup, Lagrange's theorem. Normal subgroups and quotient groups. The residual class ring. Ideals and quotient rings. Axioms for the integral domains, with examples. Subdomains and subfields. Ordered integral domains and fields. Polynomial rings. Field of quotients of an integral domain. Annihilating Polynomials. Cayley-Hamilton Theorem. Linear Functionals, Dual Spaces, Multilinear Forms. Determinant by Multilinear Form, Uniqueness Properties. Inner Product Spaces. Orthogonalization Process. Best Approximation. Adjoint, and Hermitian Unitary and Normal Transformations. Hermitian, Bilinear and Quadratic Forms, Reduction to a Canonical Form.

Recommended Literature

1. Ayres, F. (1965). *Modern Abstract Algebra*; McGraw Hill Inc.,
2. Kolman, B. (1984). *Introductory Linear Algebra with Applications*; Macmillan Publishing Company,
3. Nicholson, K. W. (1986). *Elementary Linear Algebra with Applications*; PWS-KENT, Canada

Axioms for vector spaces over the field of real and complex numbers, with examples. Subspaces, linear independence, bases and dimension. Matrices, determinants and systems of linear equations. Linear transformation, Kernel and range of a linear transformation as subspaces. Eigenvalues and eigenvectors. Axioms for groups, with examples. Subgroups. Simple properties of groups. Cyclic groups. Homomorphism and Isomorphism. Axioms for rings, and fields, with examples. Simple properties of rings.

Recommended Literature

1. Kolman, B. (1984). *Introductory Linear Algebra with Applications*; Macmillan Publishing Company,
2. Nicholson, K. W. (1986). *Elementary Linear Algebra with Applications*; PWS-KENT, Canada

MATH 265 MATHEMATICAL METHODS I

Curve fitting and function approximation. Approximation formulae for k^{th} derivatives. Composite rules and Romberg integration, Gauss quadrature, multiple integration. Numerical methods for ordinary differential equations. Eigenvalues, the power method for finding dominant eigenvalues, the inverse power method for finding smallest eigenvalues. Partial Differentiation of Function of Several Variables. Differentiation of Implicit Functions, Theorem and Applications of Jacobians. Differentiation of a Vector Function of Several Variables. The Tangent Vector. Curvilinear Co-ordinates. Plane Polar, Cylindrical and Spherical Co-ordinates. Multiple Integrals. Line Integrals, Multiple Surface and Volume Integral Gradient, Divergence and Curl. The Theorems of Green, Gauss, and Stokes. Applications to Physical and Geometrical Problems.

Recommended Literature

1. Gerald, C. F. and Wheatley, P.O. *Applied Numerical Analysis*; Addison & Wesley, USA.
2. Froberg *Introduction to Numerical Analysis*; Addison and Wesley, USA.
3. Scheid, F. *Numerical Analysis (Schaum Series)*; McGraw Hill, USA.

MATH 263 CALCULUS I

Improper Integrals. Integrals depending on a Parameter. Differentiation and Integration

MATH 266 MATHEMATICAL METHODS II

Under the Integral Sign. Gamma and Beta Functions; Stirling's Formula. Basic Properties and use of the Laplace Transform. Fourier Series. Fourier Transforms. Fourier series and their applications to boundary value problems in partial differential equation of engineering and physics.

Recommended Literature

1. Petrovsky, I. G.(1954). *Lectures on Partial Differential Equations*; Dover, USA.
2. Broman, A. (1970). *Introduction to Partial Differential Equations*; Dover, USA.

STAT270 PROBABILITY AND STATISTICS

Further distribution of random variables – expectations and variances; discrete and continuous cases, namely geometric, hypergeometric, negative binomial, rectangular, exponential, beta etc: moment generating functions. Bivariate distributions-marginal and conditional distributions; expectations, variances and moment generating functions; bivariate normal distributions. Functions of random variables-functions of one and two random variables transformation and change of variable techniques (the gamma, chi-square t -distribution and F -distribution as examples). Moments of functions of random variables. some theorems on limiting distributions e.g. the central limit theorem; the law of large numbers.

Recommended Literature

1. Freund, J.E.(1992). *Mathematical Statistics*; 5th Ed.; Prentice-Hall Int. Inc., Lond., UK.
2. Hogg, R.V. and Craig, A.T. (1978). *Introduction to Mathematical Statistics*; 4th Ed.; Macmillan Publishing Co., Inc. New York, USA.

STAT361 STATISTICAL COMPUTING AND DATA ANALYSIS I

Introduction to programming within the statistical package R. Various computer intensive statistical algorithm will be discussed and their implementation in R will be investigated. Basic commands of R (including plotting of graphics using ggplot), data structures and data manipulation, writing functions and scripts, optimising functions in R, and programming statistical techniques and interpreting the results.

Recommended Literature

1. Crawley, M., (2013). *The R Book* (2nd Edition). Wiley.
2. Venables, W.N. and Ripley, B. D., (2002). *Modern Applied Statistics with R* (4th Edition). Springer.

STAT369 STOCHASTIC PROCESSES I

Preliminary concepts: the nature of a stochastic process, parameter space and state space. Markov processes and Markov chains. Renewal processes. Stationary processes. Markov chains: First order and higher order transition probabilities. Direct computation for two-state Markov chains. The Chapman-Kolmogorov equations. Unconditional state probabilities. Limiting distribution of a two-state chain. Classification of states. Closed sets and irreducible chains. Various criteria for classification of states. Queuing processes: characteristics and examples. Differential equations for a generalised queuing model. M/M/1 and M/M/S queues: characteristics of queue length, serving times and waiting time distributions. Interarrival times and traffic intensity. Applications to traffic flow and other congestion problems.

Recommended Literature

1. Feller, W. (1968). *An Introduction to Probability Theory and its Applications*, Vol. 1, 3rd Ed., John Wiley, London, U. K.
2. Parzen, E. (1962). *Stochastic Processes*, Holden-Day, U.S.A.
3. Ross, S.M. (1970). *Applied Probability Models with Optimisation Applications*, Holden-Day, U.S.A.

STAT261 STATISTICAL INFERENCE I

Estimation theory - unbiased estimators; efficiency; consistency; sufficiency; robustness. The method of moments. The method of maximum likelihood. Bayesian estimation - prior and posterior distributions; Bayes' theorem; Bayesian significant testing and confidence intervals. Applications - point and intervals. Estimations of means, variances, differences between means etc. Hypothesis testing theory - test functions; the Neyman - Pearson Lemma; the power function of tests, Likelihood ratio test.

Recommended Literature

1. Cox, D.R. and Hinkley, D.V. (1974) *Theoretical Statistics*, Chapman & Hall, London
2. Hogg, R.V. and Craig, A.T. (1978). *Introduction to Mathematical Statistics*, 4th Ed., Macmillan Publishing Co. New York, U.S.A.
3. Silvey, S.D. (1978). *Statistical Inference*, Chapman & Hall, London

STAT367 INTRODUCTION TO REGRESSION ANALYSIS

Review of the basic concepts from probability and statistics, Introduction to Linear Models: Simple Linear Regression and examples, Assumptions for the Linear Models, Ordinary Least Squares (OLS) estimators R² Residuals, Inference in Linear Regression: Inference for the slope and the intercept, interpretation of results, prediction, F-Tests, Regression Diagnostics: outliers, influential points, graphical diagnostics, remedies,

weighted least squares, Regression in the matrix notation, multiple regression: estimation, prediction, diagnostics, nested models, multi-collinearity, ridge regression, qualitative predictors, mixture of continuous and categorical variables, model building/selection and model validation, Regression models with binary response, simple and multiple logistic regression, inference goodness of fit test.

Recommended Literature

1. Cohen, J., Cohen, P., West, S.G. & Aiken, L. (2003). *Applied Multiple Regression/Correlation Analysis for the Behavioral Sciences*, 3rd Ed) New York: Taylor and Francis Group, Routledge Publishers.

STAT362 STATISTICAL COMPUTING AND DATA ANALYSIS II

These are R Basics, The R environment, Descriptive statistics and graphics, One- and two-sample tests, Analysis of variance, the Kruskal -Wallis test and the Friedman test.

Recommended literature

1. Introductory Statistics with R by Peter Dalgaard.
2. D.G. Altman (1991), Practical Statistics for Medical Research.
3. K. Kleinman and N.J Horton (2010), SAS and R: data management, statistical analysis, and graphics.
4. N. Horton and K. Kleinman (2010), Using R for data management, statistical analysis and graphics.

STAT366 SAMPLE SURVEY THEORY AND METHODS II

Types of survey e.g. household, demographic, health etc. Planning of surveys-objective; target populations; questionnaire design; pilot survey. Simple random sampling (with or without replacement)-estimation of sample size; estimation of population parameters e.g. total and proportion; ratio estimators of population means, totals etc. Stratified random sampling - proportional and optimum allocations. Cluster sampling, systematic sampling, multi-stage sampling.

Recommended Literature

1. Raj, D. (1981). *Design of Sample Surveys*. McGraw-Hill, New York, USA.
2. Kish, L. (1972). *Survey Sampling*. J. Wiley, New York, USA.
3. Cochran, W.G. (1963). *Sampling Techniques*. 2nd Ed., J. Wiley, New York, USA.
4. Barnett, V. (1974). *Elements of Sampling Theory*. English Univ. Press, London. UK.

STAT370 STOCHASTIC PROCESSES II

Measure and Probability, Sigma Field, Measurable Functions and Random Variables, Set Theory, Point Set Topology, Conditional Expectation, Expectation, Martingales, Stochastic Process, Optional Stopping Time, Brownian Motion, Stochastic Continuity, Differentiation, Integration, Stochastic Continuity, Linearity, Martingale, Quadratic Variation.

STAT262 STATISTICAL INFERENCE II

Methods of Point Estimation of Parameters, Interval Estimation(Construction of Confidence Interval), Hypothesis Testing, Tests of parameters from Normal Population, Analysis of Variance, Non-parametric Statistics.

STAT463 INTRODUCTION TO MEASURE AND PROBABILITY THEORY

Introduction to Sets, Mapping, and Cardinality, Topology Spaces and Continuous Mapping, Measure Spaces Lebesgue Integration, Application of Measure and Integration to Probability.

Recommended Literature

LOEVE, MICHEAL: Probability Theory; D. Van Nostrand Company, 1963.

ROSS, SHELDON: A First Course in Probability; Prentice Hall, 1994.

STAT467 DESIGN AND ANALYSIS OF EXPERIMENTS I

Basic concepts/terminologies – e.g. units, treatments, factors. Completely randomized designs. Randomized block designs-efficiency, missing data. Latin squares. Sensitivity of randomized block and Latin square experiment. Factorial experiments-several factors at two levels; effects and interactions; complete and partial confounding of 2^n factorial experiments. Split-plot experiments-efficiency; missing data; split-plot confounding.

Recommended Literature

1. Barker, T.B. (1985). *Quality by Experimental Design*. Dekker, New York, USA.
2. Brook, R.J. and Arnold, G.C. (1985). *Applied Regression Analysis and Experimental Design*. Dekker, New York, USA.
3. Pearce, S.C. (1983). *The Agricultural Field Experiment*. J. Wiley, New York, USA.

STAT471 APPLIED TIME SERIES ANALYSIS

Stationary and non-stationary of series: removal of trend and seasonality by differencing. Moments and auto-correlation. Models: simple AR and MA models (mainly AR(1), MA(1)): moments and auto-correlations; the conditions of stationarity: invertibility. Mixed (ARMA) models, and the AR representation of MA and ARMA models. Yule- Walker equations and partial auto-correlations (showing forms for simple AR, MA models). Examples showing simulated series from such processes, and sample auto-correlations and partial auto-correlations.

Recommended Literature

1. Box, G. E. P. and Jenkins, G. (1970). *Series Analysis Forecasting and Control*, Holden-Day, U.K.
2. Chatfield, C. (1984). *The analysis of Time Series*, Chapman & Hall, London, U.K.
3. Cryer, J.D. (1986). *Time Series analysis (with MINITAB)*, Duxburg, U.K.

STAT475 ACTUARIAL STATISTICS

Principles of General Insurance. Theory of Interest and Decremental Rates. Life Contingencies, Social Security and Pension Schemes. Risk Analysis and associated statistical problems. General Insurance Principles: The Economics of Insurance. The Risk elements. General concepts and practices; Contingency, Risk, Exposure, Premium. Portfolio, Claims. The Theory of Interest Rates: Basic Compound interest Functions. Equations of Value. Effective Rates of Interest, and Force of Interest. Annuities Certain. Increasing and decreasing annuities Perpetuities. Life Contingencies: Single-Life Annuities and Assurances. The determination of values and premiums. Construction of Mortality, Sickness, Multiple decrement and similar tables from graduated data. Determination and Use of probability and monetary Functions based on such tables. Survival Probabilities and Expectation of Life. Mortality: Mortality Rates and other Indices. Analysis of Experience Data. Calculation of mortality and other decremental rates (including multiple decrement rates). Relevant Demographic Statistics: Evaluation of demographic data and their

application to actuarial work. Population projections. Demographic characteristics in Ghana.

STAT465 SURVIVAL ANALYSIS

Tabular Survival Models – Estimates from complete data samples, Estimates from incomplete data samples (sample design, moments procedures, maximum likelihood procedures). Parametric Survival Models.

Recommended Literature

Survival Models and Their Estimation by Dick London, Actex Publication 1988 .

STAT469 OPERATION RESEARCH

Introduction to linear programming, the simplex method, duality and sensitivity analysis. Integer programming and non-linear programming and dynamic programming. The theory of games. Queuing theory and decision analysis.

Recommended Literature

1. Hillier, F. S. and Lieberman, G. J. *Introduction to Operations Research*; 4th Ed., McGraw Hill, Inc., USA.
2. Daellenbach, H. G., George, J. A. and McNicke, D.C. (1983). *Introduction to Operations Research Techniques*; 2nd Ed., Allyn and Bacon, Inc., USA.
3. Anderson, D. R., Sweeney, D. J. and Williams, T. A. (1988). *An Introduction to Management Science: Quantitative Approaches to Decision Making*; 5th Ed., West Pub. Co., USA.

STAT473 FURTHER TOPICS IN REGRESSION ANALYSIS

Regression Diagnosis: Detection of Violations, Quantitative Variables as Predictors, Transformation of Variables, Weighted Least Squares, The Problem of Collinear Data, Biased Estimation of Regression Coefficients and Variable Selection Procedures.

Recommended Literature

- Fox, J. (2008). car: Companion to Applied Regression. R package version 1.2-8.
- Faraway, J.J (2006). Extending the linear model with R: Generalised linear, mixed effects and nonparametric regression models. Boca Raton, FL: Chapman and Hall/CRC.
- Hoaglin, D.C, Monstetter, F. & Turkey, J.W. (eds) (2006). Understanding robust and exploratory data analysis . New York: John Wiley & Sons.
- Maronna, R. A., Martin, R.D. & Yohai, V. J. (2006). Robust statistics: Theory and methods. Chichester, UK: Wiley.
- Venables, W.N., & Ripley, B.D. (2002). Modern applied statistics with S/S-Plus (4th ed.). New York: Springer.
- Chattefuee S. and Hadi A. Regression analysis by example (4th ed.). John Wiley & Sons.

STAT462 PROJECT

Modelling the risk factors of birth Asphyxia in Neonates at the Neonatal Intensive Care Unit (NICU) Korle Bu Teaching Hospital.

STAT466 MULTIVARIATE DATA ANALYSIS

Structure of multivariate data. Multivariate normal distribution - properties; maximum likelihood estimates; sampling distribution of \bar{X} and S . Inferences about multivariate means - Hotelling's T^2 ; likelihood ratio tests etc. Comparisons of several multivariate means - paired comparisons; one-way MANOVA; profile analysis. Principal component analysis -

graphing; summarizing sample variation etc. Factor analysis. Discriminant analysis - separation and classification for two populations; Fisher's discriminant function; Fisher's method for discriminating among several populations Cluster analysis - hierarchical clustering; non-hierarchical clustering; multi-dimensional scaling.

Recommended Literature

1. Johnson, R. A. and Wichern, D. W. (1992). *Applied Multivariate Statistical Analysis*, 3rd Ed., Prentice-Hall International, Inc. London, U. K.
2. Anderson, T.W. (1984). *An Introduction to Multivariate Statistical Analysis*, 2nd Ed., John Wiley, New York. U. S. A.
3. Chatfield, C. and Collins, A. J. (1980). *Introduction to Multivariate Analysis*, 1st Ed., Chapman & Hall, London U. K.
4. Healy, M. J. R. (1986). *Matrices for Statistics*, 1st Ed., Oxford Univ. Press, Oxford, UK.
5. Sharma, S. (1996). *Applied Multivariate Techniques*, 1st Ed., John Wiley, N.Y., U SA.

STAT470 OPERATIONS RESEARCH

Methods of solving unconstrained and constrained optimization problems in

R1: Unconstrained Problems, Derivative of objective function available, Derivative of objective function not available, The Davies, Swann and Campey's (DSC) Method Fibonacci search algorithm, Calculus, Taylor's expansion, Powell's algorithm, Coggin's algorithm

Search Methods: Cubic search, Random search method, Sequential search methods, Equal interval search algorithm, Two point equal interval search, Three-point equal search algorithm, Golden section search method

STAT464 INTRODUCTION TO BAYESIAN ANALYSIS

Rules of Probability, Important Quantities in Probability Distributions, Multivariate distributions, Some important Probability distribution, Likelihood principles, Estimation by the method of Maximum Likelihood, Features of Bayesian statistics, Bayesian Theorem: applied to simple events, Baye'ss Theorem: applied to probability distribution, Specification of the Prior, Alternatives Model for the Polling data: A gamma prior or Poisson Likelihood approach, Baye's Theorem, the Likelihood and the Prior Distribution, Components of Bayesian Inference, How to perform Bayesian inference, The Beta Distribution prior, The Gamma Distribution Prior, Posterior distribution, Markov Chain Monte Carlo simulation, Baye's Theorem via Accept- Reject Method, Bayes Theorem via Metropolis- Hastings Algorithm, Importance Sampling, Implementing the Accept-Reject methods in R, Implementing the Metropolis-Hastings algorithm in R.

Recommended literature

1. Congdon P (2003) *Applied Bayesian modelling*. Wiley Series in Probability and Statistics, John Wiley & Sons Ltd., Chichester.
2. Gelman A, Carlin JB, Stern HS, Rubin DB (2004) *Bayesian data analysis*, 2nd edn. Text in Statistical Science Series, Chapman & Hall/CRC, Boca Raton, FL.
3. Gelman et al.'s (1995) book *Bayesian Data Analysis*, and Gilks et al.'s (1996) book, *Markov Chain Monte Carlo in Practice*.
4. Scott M. Lynch (2007), *Introduction to Applied Bayesian Statistics and Estimation for social scientist*, Springer.

STAT468 DESIGN AND ANALYSIS OF EXPERIMENT II

Analysis of Variance for some Unbalanced Designs, Latin Square Design, Factorial Experiments, Confounding, Nested, Split plot and Crossover Designs, Analysis of Covariance (ANCOVA)

1. R. Lyman Ott & Micheal Longnecker (2010), An Introduction to Statistical Methods and Data Analysis 6th Edition.
2. Shirley Dowdy & Stanley Weardon (2004), Statistics for Research 3rd Edition.
3. Douglas C. Montgomery (1997), Design and Analysis of Experiment 5th Edition.

STAT472 STATISTICAL QUALITY CONTROL

Quality Improvement in the Modern Business Environment, DMAIC Process, Modeling Process Quality, Inferences about Process Quality, Methods and Philosophy of Statistical Process Control, Control Charts for Attributes, Process and Measurement System Capability Analysis, Cumulative Sum and Exponentially Weighted Moving Average Controls Charts, Acceptance Samplings for Attributes.

Recommended Literature

1. Engineering Statistics by Douglas C. Montgomery, George C. Runger , and Norma F.Hubele, John Wiley & Sons, Inc., New York
2. Applied Statistics and Probability for Engineers Second Edition by Douglas C. Montgomery and George C. Runger, 1999, John Wiley & Sons, Inc., New York.

STAT364 NON-PARAMETRIC STATISTICS

Nonparametric vs. Parametric Statistical test, The one-sample case (binomial test, Chi-Square test for goodness of fit, Kolmogorov-Smirnov test, runs test), The case of two related samples (McNemar, Sign, Wilcoxon, Walsh tests), The case of two related samples (fisher exact-probability test, Mann-Whitney U-test, Kolmogorov-Smirnov test, Wald Wol Fowitz test), The case of k independent samples#9Chi-Square test for k independent samples, Kruskal-Wallis one-way analysis of variance by ranks), Nonparametric correlation (the contingency coefficient C, Spearman rank correlation, Kendall rank correlation, Kendal partial correlation coefficient.

Recommended Literature

1. Siegel, Nonparametric Statistics for the Behavioral Sciences
2. Higgins, Introduction to Modern Nonparametric Statistics
3. SAS, SPSS, MATLAB, R(Computational Software)

STAT368 TIME SERIES ANALYSIS