Detailed descriptions of courses offered at the University of Alberta towards the A.Stat designation

- **Mathematics module**

  1. MATH 215 (Intermediate Calculus II)
     First order and second order linear differential equations with constant coefficients. Curves, tangent vectors, arc length, integration in two and three dimensions, polar cylindrical and spherical coordinates, line and surface integrals. Green's divergence and Stokes' theorems.
  2. MATH 225 (Linear Algebra II)
     Vector spaces. Inner product spaces. Examples of n-space and the space of continuous functions. Gram-Schmidt process, QR factorization of a matrix and least squares. Linear transformations, change of basis, similarity and diagonalization. Orthogonal diagonalization, quadratic forms. Applications in a variety of fields, numerical methods.
  3. STAT 512 (Techniques of Mathematics for Statistics)
     Introduction to mathematical techniques commonly used in theoretical Statistics, with applications. Applications of diagonalization results for real symmetric matrices, and of continuity, differentiation, Riemann-Stieltjes integration and multivariable calculus to the theory of Statistics including least squares estimation, generating functions, distribution theory.

- **Statistics and Probability modules**

  1. Mathematical Statistics: one of
     (a) STAT 372 (Mathematical Statistics)
     Laws of large numbers, weak convergence, some asymptotic results, delta method, maximum likelihood estimation, testing, Uniformly Most Powerful tests, Likelihood Ratio tests, nonparametric methods (sign test, rank tests), robustness, statistics and their sensitivity properties, prior and posterior distributions, Bayesian inference, conjugate priors, Bayes estimators.
     (b) STAT 566 (Methods of Statistical Inference)
     An introduction to the theory of statistical inference. Topics to include exponential families and general linear models, likelihood, sufficiency, ancillarity, interval and point estimation, asymptotic approximations. Optional topics as time allows, may include Bayesian methods, Robustness, resampling techniques.
  2. Linear Regression: one of
     (a) STAT 378 (Applied Regression Analysis)
     Simple linear regression analysis, inference on regression parameters, residual analysis, prediction intervals, weighted least squares. Multiple regression analysis, inference about regression parameters, multicollinearity and its effects, indicator variables, selection of independent variables. Non-linear regression.

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(b) STAT 502 (Directed Study II)
This course is identical to STAT 378 but is available only to graduate students in departments other than ours.

(c) STAT 578 (Regression Analysis)
Multiple linear regression, ordinary and generalized least squares, partial and multiple correlation. Regression diagnostics, collinearity, model building. Nonlinear regression. Selected topics: robust and nonparametric regression, measurement error models.

3. Design and Analysis of Experiments: one of

(a) STAT 368 (Introduction to Design and Analysis of Experiments)
Basic principles of experimental design, completely randomized design - one way ANOVA and ANCOVA, randomized block design, Latin square design, Multiple comparisons. Nested designs. Factorial experiments.

(b) STAT 501 (Directed Study I)
This course is identical to STAT 368 but is available only to graduate students in departments other than ours.

(c) STAT 568 (Design and Analysis of Experiments)
The general linear model. Fully randomized designs, one-way layout, multiple comparisons. Block designs, Latin squares. Factorial designs confounding, fractions. Nested designs, randomization restrictions. Response surface methodology. Analysis of covariance.

4. Survey Sampling: one of

(a) STAT 361 (Sampling Techniques)
Simple random sampling from finite populations, stratified sampling, regression estimators, cluster sampling.

(b) STAT 504 (Directed Study IV)
This course is identical to STAT 361 but is available only to graduate students in departments other than ours.

(c) STAT 561 (Sample Survey Methodology)
Review of basic sampling schemes: simple random sampling, and stratified random sampling, and systematic sampling. Multistage sampling schemes. Estimation of nonlinear parameters: ratios, regression coefficients, and correlation coefficients. Variance estimation techniques: linearization, BRR, jackknife, and bootstrap. Selected topics: model-based estimation, regression analysis from complex survey data. Relevant computer packages.

5. Other Statistics modules. Three courses may be chosen from the following list, or four with one of them replacing either Survey Sampling or Design and Analysis of Experiments.

(a) Discrete Data Anlysis: STAT 562 (Discrete Data Analysis)
Sampling models and methods of inference for discrete data. Maximum likelihood estimation for complete contingency tables, measures of association and agreement. Goodness-of-fit. Incomplete tables. Analysis of square tables;

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symmetry and marginal homogeneity. Model selection and closeness of fit; practical aspects. Chi-square tests for categorical data from complex surveys.

(b) Statistical Consulting: STAT 590 (Statistical Consulting)
Data analysis, problem solving, oral communication with clients, issues in planning experiments and collecting data; practical aspects of consulting and report writing.

(c) Data Mining: one of

i. STAT 441 (Applied Statistical Methods for Data Mining)
Principles of statistical model building and analysis applied in linear and generalized linear models and illustrated through multivariate methods such as repeated measures, principal components, and supervised and unsupervised classification.

ii. STAT 505 (Directed Study V)
This course is identical to STAT 441 but is available only to graduate students (in all departments *including* ours).

(d) Quality Control: STAT 335 (Statistical Quality Control and Industrial Statistics)
Control charts for variables and attributes. Process capability analysis. Acceptance sampling: single and multiple attribute and variable acceptance plans.

(e) Time Series: one of

i. STAT 479 (Time Series Analysis)
Stationary series, spectral analysis, models in time series: autoregressive, moving average, ARMA and ARIMA. Smoothing series, computational techniques and computer packages for time series.

ii. STAT 503 (Directed Study III)
This course is identical to STAT 479 but is available only to graduate students (in all departments *including* ours).

(f) Survival Analysis: one of

i. STAT 432 (Survival Analysis)
Survival models, model estimation from complete and incomplete data samples, parametric survival models with concomitant variables, estimation of life tables from general population data.

ii. STAT 532 (Survival Analysis)
Survival and hazard functions, censoring, truncation. Non-parametric, parametric and semi-parametric approaches to survival analysis including Kaplan-Meier estimation and Cox's proportional hazards model.

(g) Multivariate Methods: STAT 575 (Multivariate Analysis)
The multivariate normal distribution, multivariate regression and analysis of variance, classification, canonical correlation, principal components, factor analysis.

(h) Stochastic Processes: one of

i. STAT 371 (Probability and Stochastic Processes)
Problem solving of classical probability questions, random walk, gambler's ruin, Markov chains, branching processes. Selected topics of the instructor's choice.

ii. STAT 580 (Stochastic Processes)
Elements of stochastic processes. Discrete and continuous time Markov Chains; Birth and Death processes. Branching processes. Brownian Motion. General Stationary and Markov processes. Examples.

(i) Risk Theory: STAT 453 or STAT 553[1] (Risk Theory)
Classical ruin theory, individual risk models, collective risk models, models for loss severity: parametric models, tail behavior, models for loss frequency, mixed Poisson models; compound Poisson models, convolutions and recursive methods, probability and moment generating functions.

- **Computer skills** Students in Honours or Specialization in Statistics are required to take CMPUT174 and 175, and therefore, this module will be satisfied through taking one course from each of the groups {STAT 368, 378, 568, 575, 578}, {STAT 432, 479, 503, 532, 562, 590}. These make use of R, SAS and SPSS, both for standard analyses and for innovative programming.

- **Communication skills**

  1. Written communication: Students may demonstrate their abilities in this area by submitting written reports directly to the Accreditation Committee with their A.Stat. application. As a possibility, such reports would normally be prepared in STAT 590 (Statistical Consulting) and as a component of service in the Training Consulting Centre.
  2. Oral communication: The A.Stat. applicant's references will be contacted for information about the applicant's oral communication skills.

- **Substantive area** This three course requirement will be met outside of our Statistics programs, and can be fulfilled in a number of ways. Possibilities are undergraduate minors in applicable mathematics (Operations Research, Applied Mathematics, etc.) or in Biological Sciences, Actuarial Sciences, etc. Students are encouraged to consult the A.Stat. Application Instructions on the web site of the Statistical Society of Canada for further information in this regard. Students may also contact the Accreditation Committee.

[1] STAT 553 is identical to STAT 453; the cross-listing serves to allow 553 to be taken for graduate credit..