This course will provide a basic, yet thorough introduction to probability theory and mathematical statistics that underlie many of the commonly used techniques in public health research. The emphasis of this course will be on basic concepts of the mathematical and probabilistic foundations that form the basis for statistical inference. The course will cover fundamental ideas of probability, some simple statistical models (normal, binomial, exponential, and Poisson), sample and population moments, finite and approximate sampling distributions, point and interval estimation, hypothesis testing, and applications to linear and logistic regression. Properties and comparison of estimators, hypothesis tests, and confidence intervals will be an important part of the course.

This course is aimed towards second year doctoral students in fields other than Biostatistics and first year Masterâ€™s students in Biostatistics, CBQG, HDS.

Course Objectives: At the end of this course, the student will be able to: (1) understand discrete and continuous random variables, density functions, joint, marginal, and conditional distributions; (2) understand key concepts of statistical modeling, and apply general methods for estimation, hypothesis testing and confidence intervals to practical problems (3) understand basic principles for evaluating statistical methods, and asymptotic theories (4) apply regression methods to analyze continuous and count data.

Course Note: Elementary calculus (differentiation and integration of polynomial, log, and exponential functions, limits) and algebra skills (manipulation of formulas, summation notation) are required. Partial differentiation, multiple integration, or matrix methods will be used during the lectures. A calculus review will be incorporated into the labs and where needed.

Course Instructor: Rui Duan, rduan@hsph.harvard.edu (office hour TBD, or by appointment).

Teaching Assistants: Ellen Considine, Michael Cork, Larry Han, and Daniel Xu,

Labs: Once per week.

Grading: Midterm exam (in class, open book and notes) 30%; Final exam (in class, open book and notes) 30%; Homework (approximately 12 assignments) 20%; Course project (15%); Class participation and surveys 5%.

Recommended Textbooks:

- Statistical Inference, 2nd edition George Casella and Roger L. Berger (Required, Online Access through HOLLIS).
- Essential statistical inference: theory and methods, Dennis D. Boos and L A Stefanski (Optional, Online Access through HOLLIS).
- All of Statistics by Larry Wasserman (Optional, Online Access through HOLLIS).