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| UTD | **Course** | **STAT 7345.501 Advanced Probability & Stochastic Processes** |
| | **Professor** | Robert Serfling |
| | **Term** | Fall 2006 |
| | **Meetings** | TR 5:30-6:45 (*subject to change*), CB 1.124 |

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## Professor's Contact Information



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| **Office Phone** | 972-883-2361 |
| **Office Location** | ECSN 3.912 |
| **Email Address** | serfling@utdallas.edu |
| **Website** | www.utdallas.edu/~serfling |
| **Office Hours** | TBA |
| **Other Information** | I check my *email* much more regularly than my telephone. |



## General Course Information

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| **Prerequisite** | *STAT 6344* or the equivalent is required. |
| **Course Description** | This course is taught as a continuation of STAT 6344.<br><br>A. *Completion of Probability Foundations*: Measure Extensions, Lebesgue-Stieltjes Measure, Integration in a Measure Space, *n*-Dimensional Lebesgue-Stieltjes Measure, Infinite-Dimensional Product Measure Space, Kolmogorov Consistency Theorem, Product Spaces of General Form, Absolute Continuity of Measures and Distribution Functions, Radon-Nikodym Theorem, Conditional Expectation, Conditional Probabilities & Conditional Probability Measure, Marcinkiewicz-Zygmund Inequality, Dominated Ergodic Theorems, Infinitely Divisible Distributions, Limit Theorems in Euclidean Spaces, Martingales.<br><br>B. *Introduction to Stochastic Processes*: Bernoulli Trials, Discrete Time Markov Chains and Random Walk, Continuous Time Markov Chains, Birth and Death Processes, Poisson Processes, Point Processes, Cluster Point Processes, Renewal Processes, Gaussian Processes, Brownian Motion, Branching Processes, Stationary Processes |
| **Desired Learning Outcomes** | A working knowledge of the concepts and methods of modern measure-theoretic probability and stochastic processes. |
| **Required Text** | Chow, Y.S. and Teicher, H., *Probability Theory: Independence, Interchangeability, Martingales*, 3rd edition, Springer, 1997. |
| **Suggested Texts, Readings, & Materials** | Karlin, S. and Taylor, H. M., *A First Course in Stochastic Processes*, 2nd edition, Academic Press, 1975<br><br>Karlin, S. and Taylor, H. M., *A Second Course on Stochastic Processes*, Academic Press, 1981<br><br>Resnick, S., *Adventures in Stochastic Processes*, Birkhaeuser, 1992<br><br>Billingsley, P., *Probability and Measure*, 3rd edition, Wiley, 1995<br><br>Various other sources will be suggested during the course. |

**Course Policies**

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| **Grading Criteria** | The course grade will be based on *homework* (25%), a closed-book *midterm test* (25%), and the final exam (50%). Some homework assignments will be for written submission, some will be for classroom presentation. The final exam will be a ``mini-symposium'', with each student developing a handout on an assigned topic and making a 20-minute presentation to the class. |
| **Missed Exam or Late Homework** | In the case of a missed midterm exam, a makeup exam will be conducted if the absence is excused. In the case of late homework, a penalty will be applied unless the lateness is excused. |

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| **Student Conduct and Discipline** | The University of Texas System and The University of Texas at Dallas have rules and regulations for the orderly and efficient conduct of university business. It is the responsibility of each student to be knowledgeable about those which govern student conduct and activities. General information on student conduct and discipline is contained in the UTD publication, *A to Z Guide*, provided to all registered students each academic year. |
| **Academic Integrity** | The faculty expects from students a high level of responsibility and academic honesty. Because the value of an academic degree depends upon the absolute integrity of the work done by the student, each student must demonstrate a high standard of individual honor in his or her scholastic work. Scholastic dishonesty includes, but is not limited to, statements, acts, or omissions that are related to the submission as one's own work of material that is not one's own. This may include cheating, plagiarism, collusion, and falsifying of academic records. Students suspected of academic dishonesty are subject to disciplinary proceedings. |
| **Email** | The University of Texas at Dallas encourages faculty to consider email from students official only if it originates from a UTD student account. This allows the university to maintain a high degree of confidence in the identity of all individuals corresponding and in the security of the transmitted information. UTD furnishes each student with a free email account, and the Department of Information Resources at UTD provides a method for students to forward their UTD email to other accounts. |
| **Withdrawal** | Deadlines for withdrawal from courses are published in each semester's course catalog. A faculty member cannot drop or withdraw a student. Rather, it is the student's responsibility to handle withdrawal procedures from any class. The proper paperwork and procedure must be used to avoid receiving a final grade of "F" in a course in which the student remained enrolled but did not participate. |

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| **Incomplete Grades** | As per university policy, incomplete grades are granted only in the case of work unavoidably missed (and excused) by the semester's an d not already covered by the professor's policy on missed work or activities, and only if 70% of the course work has been completed. An incomplete grade must be resolved within eight weeks from the first day of the subsequent long semester. Otherwise the incomplete grade becomes changed automatically to the grade of F. |

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| **Disability Services** | Disability Services seeks to provide students with disabilities educational opportunities equivalent to those of their non-disabled peers. The Office of Disability Services is located in room 1.610 in the Student Union, and its hours are Monday and Thursday, 8:30 a.m. to 6:30 p.m.; Tuesday and Wednesday, 8:30 a.m. to 7:30 p.m.; and Friday, 8:30 a.m. to 5:30 p.m.<br><br>Essentially, the law requires colleges and universities to make reasonable adjustments necessary to eliminate discrimination on the basis of disability. For example, it may be necessary to remove classroom prohibitions against tape recorders or animals (in the case of dog guides) for students who are blind. Occasionally, an assignment requirement may be modified (for example, a research paper versus an oral presentation for a student who is hearing impaired). Classes including students with mobility impairments may have to be rescheduled in accessible facilities. The college or university may need to provide special services such as registration, note-taking, or mobility assistance. It is the student's responsibility to notify his or her professors of the need for such accommodations. Disability Services provides students with letters to present to faculty members. |
| **Religious Holy Days** | The University of Texas at Dallas excuses students from class or other required activities for the purpose of travel to and observance of a religious holy day for a religion whose places of worship are exempt from property tax under Section 11.20, Tax Code, Texas Code Annotated. In the case of such an absence, the student is encouraged to notify the instructor as soon as possible, preferably in advance. Regarding missed assignments, quizzes, tests, or exams, the student excused for such a purpose will be covered by the professor's above-described policy for missed or late work. |

**COURSE PLAN -- STAT 7345 -- Fall 2006 (subject to revision)**

A. *Completion of Probability Foundations*

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| 8/17 | Sigma-algebras, orbits, measurability, invariance, sub-sigma-algebras, smoothing<br>Sub-sigma-algebras as "information"<br>6.1 Measure Extensions, Lebesgue-Stieltjes Measure |
| 8/22 | 6.2 Integration in a Measure Space |
| 8/24 | 6.5 Absolute Continuity of Measures and Distribution Functions,<br>Radon-Nikodym Thm |
| 8/29 | 7.1 Conditional Expectation<br>7.2 Conditional Probabilities & Conditional Probability Measure |
| 8/31 | 10.3 Marcinkiewicz-Zygmund Inequality, Dominated Ergodic Theorems<br>Infinitely Divisible Distributions |
| 9/5, 9/7, 9/12<br>9/14, 9/19 | Martingales & Applications |

Additional topics if time permits or to be covered in the "mini-symposium":

6.3 *n*-Dimensional Lebesgue-Stieltjes Measure

6.4 Infinite-Dimensional Product Measure Space
6.4 Kolmogorov Consistency Thm
Product Spaces of Form $R^T$, Arbitrary $T$
Limit Theorems in Euclidean Spaces

B. *Introduction to Stochastic Processes*

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| 9/21, 9/26, 9/28 | 3.4 Bernoulli Trials |
| 10/3, 10/5 | Discrete Time Markov Chains and Random Walk |
| 10/10, 10/12 | Continuous Time Markov Chains<br>Birth and Death Processes |
| | TAKE-HOME MIDTERM TEST – on Martingales and Discrete Time Markov Chains |
| 10/17, 10/19, 10/24 | Poisson Processes |
| 10/26, 10/31, 11/2 | Renewal Processes |
| 11/7, 11/9, 11/14, 11/16 | Brownian Motion |
| 11/21 | Branching Processes |

Additional topics if time permits or to be covered in the "mini-symposium":
Point Processes
Cluster Point Processes
Gaussian Processes
Stationary Processes