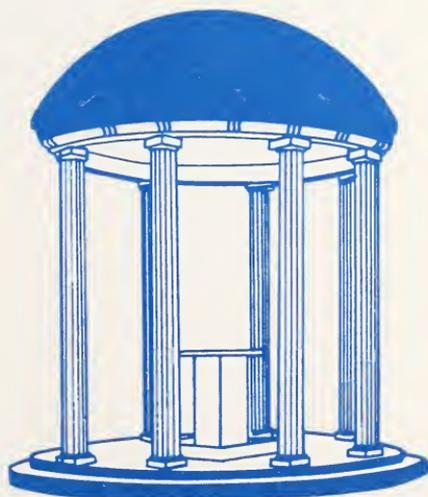


RECORD OF THE UNIVERSITY OF NORTH CAROLINA AT CHAPEL HILL

Department of Statistics



1986-1988 Issue



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The University of North Carolina at Chapel Hill is committed to equality of educational opportunity and does not discriminate against applicants, students, or employees based on race, color, national origin, religion, sex, age, or handicap. Any complaints alleging failure of this institution to follow this policy should be brought to the attention of the Assistant to the Chancellor. Moreover, The University of North Carolina at Chapel Hill is open to people of all races and actively seeks to promote racial integration by recruiting and enrolling a larger number of black students.

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RECORD OF
THE UNIVERSITY OF NORTH CAROLINA
AT CHAPEL HILL

August 1986

Number 993

DEPARTMENT OF
STATISTICS

(USPS 651-960)

**The University of North Carolina
at Chapel Hill**

**Announcements for 1986-1987 and
1987-1988**

THE UNIVERSITY OF NORTH CAROLINA

Sixteen Constituent Institutions

C. D. Spangler, Jr., B.S., M.B.A., LL.D., *President*

Raymond H. Dawson, B.A., M.A., Ph.D., *Vice President — Academic Affairs*

L. Felix Joyner, A.B., *Vice President — Finance*

Roy Carroll, B.A., M.A., Ph.D., *Vice President — Planning*

Lloyd V. Hackley, B.A., Ph.D., *Vice President — Student Services and Special Programs*

Jasper D. Memory, B.S., Ph.D., *Vice President — Research and Public Service*

Wyndham Robertson, A.B., *Acting Vice President — Communications*

Jay M. Robinson, B.S., M.A., Ed.D., *Vice President — Public Affairs*

R. D. McMillan, Jr., B.S., *Assistant to the President*

Richard H. Robinson, Jr., A.B., LL.B., *Assistant to the President*

John W. Dunlop, B.A., *Director, The University of North Carolina Center for Public Television*

History of the University

The University of North Carolina is comprised of all the public institutions of higher education in North Carolina that confer degrees at the baccalaureate level or higher. The University was authorized by the State Constitution in 1776, and it was chartered in 1789 by the General Assembly.

The University of North Carolina opened its doors to students at Chapel Hill in 1795. Thereafter, beginning in the latter part of the nineteenth century, the General Assembly of North Carolina has established and supported fifteen other public senior institutions in keeping with Article IX, Section 8, of the Constitution of North Carolina which provides that the "General Assembly shall maintain a public system of higher education, comprising The University of North Carolina and such other institutions of higher education as the General Assembly may deem wise."

By 1969 The University of North Carolina included six constituent institutions, governed by a single Board of Trustees. This multicampus University had its beginnings in legislation enacted in 1931 that defined The University of North Carolina to include The University of North Carolina at Chapel Hill, North Carolina State University at Raleigh, and The University of North Carolina at Greensboro. In the 1960s three additional campuses were added: The University of North Carolina at Charlotte, The University of North Carolina at Asheville, and The University of North Carolina at Wilmington.

Beginning in 1877, the General Assembly of North Carolina established or acquired ten additional separately governed state-supported senior institutions of higher education. They are: Appalachian State University, East Carolina University, Elizabeth City State University, Fayetteville State University, North Carolina Agricultural and Technical State University, North Carolina Central University, North Carolina School of the Arts, Pembroke State University, Western Carolina University, and Winston-Salem State

University. Then, in 1971, the General Assembly redefined The University of North Carolina, and under the terms of that legislation all sixteen public senior institutions became constituent institutions of The University of North Carolina.

The constitutionally authorized Board of Trustees of the six-campus University of North Carolina was designated the Board of Governors and this body is by law The University of North Carolina. The Board of Governors consists of thirty-two members elected by the General Assembly, and it is charged with "the general determination, control, supervision, management, and governance of all affairs of the constituent institutions." The chief executive officer of the University is the President.

Each constituent institution of the University has its own faculty and student body. The chief administrative officer of each institution is the chancellor, and the chancellors are responsible to the President.

Each constituent institution also has a board of trustees composed of thirteen members: eight elected by the Board of Governors, four appointed by the Governor, and the elected president of the student body *ex officio*. (The School of the Arts has two additional *ex officio* trustees.) The principal powers of these institutional boards are exercised under a delegation of authority from the Board of Governors.

OFFICERS OF ADMINISTRATION

THE UNIVERSITY OF NORTH CAROLINA AT CHAPEL HILL

Christopher Columbus Fordham III, M.D., *Chancellor*

Susan Haughton Ehringhaus, J.D., *Assistant to the Chancellor*

Douglass Hunt, LL.B., *Special Assistant to the Chancellor*

David D. Dill, Ph.D., *Assistant to the Chancellor for Planning*

Robert Joseph Cannon, Ph.D., *Affirmative Action Officer*

¹Maria A. Young, A.B., *Secretary to the University*

Donald Arthur Boulton, Ed.D., *Vice Chancellor and Dean of Student Affairs*

Howard Garland Hershey, Jr., D.D.S., *Vice Chancellor, Health Affairs*

George Philip Manire, Ph.D., *Vice Chancellor and Dean of the Graduate School*

Samuel Ruthven Williamson, Jr., Ph.D., *Provost*

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²Rollie Tillman, Jr., D.B.A., *Vice Chancellor, University Relations*

Harold Gene Wallace, M.Div., *Vice Chancellor, University Affairs*

Farris Wade Womack, Ed.D., *Vice Chancellor, Business and Finance*

INTRODUCTION

This brochure briefly describes the graduate programs offered by the Department of Statistics of The University of North Carolina at Chapel Hill.

The material in this brochure is a supplement to that found in the Graduate School Catalog of the University; some of the regulations of the Graduate School have been omitted here. Requests for a Graduate School Catalog should be sent to the Graduate School, The University of North Carolina at Chapel Hill, Chapel Hill, North Carolina 27514.

THE DEPARTMENT OF STATISTICS

The Department of Statistics was organized in 1946, at the instigation of Gertrude M. Cox, with Harold Hotelling as its first chairman. Through its emphasis on graduate training and research in the mathematical theory of statistics, the department has attained the stature of being one of the world's foremost centers of statistical research. Since 1948, over 170 Ph.D. degrees in Statistics have been awarded. Holders of these degrees have assumed positions of responsibility in many important statistical organizations, including the President, Executive Secretary and Program Secretary of the Institute of Mathematical Statistics, the Editor of the *Annals of Mathematical Statistics*, and the chairmen of the Departments of Statistics at several American universities. In addition, many professors at leading universities in the United

1. Effective December 3, 1984.

2. Resigned December 31, 1984.

States and abroad and senior statisticians in government and industry received their doctoral training in the Department of Statistics at The University of North Carolina at Chapel Hill.

Much fundamental work in experimental design, nonparametric inference, sequential analysis, renewal theory, stochastic processes (including point processes), coding theory, estimation, and hypothesis testing has originated here. The Institute of Statistics Mimeograph Series, which now includes over 1600 titles, contains the first results of many of the fundamental lines of research in the subject of mathematical statistics as it exists today.

An attractive feature of the department is its close connection with various other centers of statistical activity within the University. The Department of Statistics on the Raleigh campus, and the Department of Biostatistics at Chapel Hill, both offer a wide range of courses in applied statistics which may be combined with the more theoretically oriented courses in the Department of Statistics to suit individual needs and interests. The Departments of Mathematics, Computer Science, Economics, and the Curriculum in Operations Research and Systems Analysis, and the Psychometric Laboratory, among others, provide opportunities for further training in areas related to statistics.

In addition, various statistical research groups working in the nearby Research Triangle Park, such as the Research Triangle Institute, the Environmental Protection Agency, the Biometry Section of the National Institutes of Environmental Health Sciences, and SAS afford opportunities for scholarly work and summer employment.

Most of the department's offices for faculty, graduate students, and staff are located in Phillips Hall; a few graduate student and research faculty offices are in nearby Smith Building. Both of these buildings are air-conditioned.

The Brauer Library in Phillips Hall maintains an extensive collection of books and journals pertaining to statistics, mathematics, physics, and computer science. Additional materials in the main University Library are also available.

The University Computation Center, also in Phillips Hall, offers both batch and interactive computing services on its own computing system, as well as on the system of the Triangle Universities' Computation Center in nearby Research Triangle Park. Numerous computer terminals on campus, including several in the Statistics Department, provide access to these systems.

Colloquia for presentation of research in both mathematical and applied statistics are held by the Departments of Statistics and Biostatistics. The Statistics Colloquium, which usually meets on alternate Monday afternoons throughout the academic year, is a forum for the presentation and discussion of recent developments and new ideas by visiting scholars and statistics faculty. All students are encouraged to attend the colloquia.

Also housed in the Department is the Center for Stochastic Processes, whose members include three of the Department's faculty and a number of visiting research faculty each year. The Center has its own seminar schedule and technical reports series, which now includes over 150 titles.

PH.D. PROGRAM

The statistics faculty offers a Ph.D. program for men and women who plan careers in university teaching and research, or in research with private or governmental organizations. The doctoral program is intended for individuals who have both the intellectual capacity and inclination for independent research and analytical thinking and who show promise of contributing to the further development of statistics and probability.

The philosophy of the department is that its Ph.D. graduates should be broadly based in statistical theory and practice, and at the same time be able to conduct basic research in some special area of mathematical statistics.

In order to achieve this, the Ph.D. course work normally involves eighteen courses of three credit hours each: eight first-year courses, seven advanced courses, and three courses forming a "supporting program," two of which must be from outside the Department of Statistics. It is possible for some of these course requirements to be waived, but only on the grounds of prior knowledge and demonstrated competence of the subject material, and with the approval of the Curriculum Committee.

The first-year courses are listed below. They are designed to provide a broad base in probability theory, mathematical methods, and statistical theory and practice.

In the second and later years a student takes seven advanced courses in at least three of the five areas of specialization listed below. At least two areas must be represented by two or more courses each. Typically four courses are taken in the student's major area, two are in another area, and the seventh course is in a third area.

Following are lists of the first-year courses and of typical advanced courses in the five areas. Other courses may be added in various areas with approval of the Curriculum Committee.

1. First year (all students):
Fall: 105, 112, 129, 134
Spring: 111, 132, 135, 150
2. Advanced and specialized courses (by area):
Inference: 220, 221, 222, 223, 232
Probability and stochastic processes: 231, 235, 237, 242, 280
Design of experiments: 210, 251, 254, 255
Multivariate analysis: 260, 261, 262, 263
Communication theory: 140, 142, 235, 242, 245, 252

All Ph.D. students are required to register for at least three semester hours of dissertation registration 394.

Nine hours of course work, at least six of which must be taken from courses in other departments, are required for all students as a "supporting program." Courses in statistics from outside departments will generally not fulfill this requirement unless such courses focus primarily on subject matter not available in our department. All courses must be approved by the curriculum committee. The supporting program may be regarded as a "formal minor" on approval of the minor department (or departments). Some of this work may be transferred from graduate work at another institution. In addition, three hours of credit may be applied to the supporting program if the student participates in an approved consulting project and writes a report to the curriculum committee summarizing his or her experience and the statistical lessons learned. The consulting project should ordinarily last a substantial period of time (e.g., summer employment), although each situation will be considered individually.

All graduate students in the Department of Statistics are required to perform some duties related to their academic program, such as grading, teaching, or consulting as part of their graduate education. Assignments are carefully controlled to avoid delaying academic progress.

Written Examinations

Doctoral students must pass the basic written examinations, consisting of three parts, each four hours in length, covering the material in the first-year courses. These are normally taken early in the fall semester of the second year. Parts I and II test a student's knowledge of theory and ability to solve mathematically formulated problems. Part III tests a student's ability to perform statistical calculations with data, and to work with practical problems which are not mathematically formulated. (Students with an undergraduate major in engineering, and with a sufficient background in complex variables and Fourier theory, may choose to be tested on Statistics 140, 142, and 252 instead of the first-year courses 111, 105, and 150.)

Oral Examinations

A doctoral candidate during the early stages of the research program must prepare an essay which shall include a description of the proposed dissertation topic, a review of the literature, and a bibliography connected with the proposed research and submit it to the doctoral examination committee for approval. Upon approval of the essay a preliminary oral examination (second doctoral examination) is arranged for the candidate. At this examination, the student may be questioned orally on his or her course work and particularly on any deficiencies disclosed by the written examinations. The student will then describe the thesis proposal and answer questions on it, and on

the literature reviewed. A Ph.D. student who has passed this oral examination and who wishes to obtain an M.S. degree may do so without having to take the final oral examination normally required for the M.S. degree.

Students are expected to complete the preliminary oral examination no later than the end of the sixth semester. Exceptions to this timing rule may occur with permission of the curriculum committee, but in ordinary circumstances failure to complete this requirement will be taken as a lack of normal progress on the student's part.

The candidate will submit the dissertation, when ready, to the members of his/her committee. At the final oral examination, the candidate will present research results and conclusions and will answer questions on these.

Language Requirements

Students may satisfy the foreign language requirements in one of the four following ways: Pass 102X in French, German, or Russian, and then pass a departmental examination designed to test ability to translate technical articles with the aid of dictionaries; or achieve the 60th percentile in the Graduate School Foreign Language Test and then pass a departmental translation test as described above; or achieve the 75th percentile in the Graduate School Foreign Language Test; or take course work in the Department of Computer Science as follows: two of COMP 114X, 116X, 118X, 120 or 131, 121, 151, or others approved by the curriculum committee (these two courses may not be used as part of the student's other course work).

Time Required

The time required to complete the Ph.D. varies, of course, depending on the student's background, qualifications, and initiative. A high percentage of students who complete the degree do so in four or five years. Students who hold jobs requiring more time than the Department's teaching and research assistantships often require five years or more.

M.S. PROGRAM

The department provides a wide variety of course sequences leading to the Master's (M.S.) degree. The basic philosophy is that this program should provide a broad training in statistical theory and practice, with the student being able to specialize in either applied or theoretical areas. Four semesters are regarded as normal time for the completion of all requirements for a degree.

Course Work for the M.S. Degree

The M.S. degree in statistics requires the satisfactory completion of 30 semester hours of course work. Each option in the M.S. programs consists of a core of required courses, broadening courses in statistics, and two courses to be taken outside the Department of Statistics. (These latter two must be approved by the Curriculum Committee; certain courses cross-listed with Statistics courses are acceptable).

I. *Applied Statistics option.*

The required courses are:

Track #1 (STAT 126 is a prerequisite) 105, 104 (BIOS 164), 127, 129, 133, and one of 160, BIOS 166, PSYCH 139, or

Track #2 105, 104 (BIOS 164), 133, 134, 135 and one of 160, BIOS 166, PSYCH 139.

The student will also be required to take two broadening courses in statistics which may be selected from 107, 129, 150, 210, 260. Other courses may be substituted with the permission of the Curriculum Committee.

Finally, students in the Applied Statistics option are expected to be familiar with a formal programming language (e.g., FORTRAN) as demonstrated by completion of approved graduate or undergraduate course work. Students requesting approval for course work at other institutions must provide official descriptions of the courses.

II. *Mathematical Statistics option.*

The required core courses are:

105, 129, 134, 135, and 150. The broadening course work consists of three additional courses in statistics chosen from either the list of broadening courses in the Applied Statistics option or:

112, 132 only as a sequence

140, 142 only as a sequence

Any 200-level statistics course

Other courses approved by the Curriculum Committee.

Examinations for the M.S. Degree

M.S. students in the Applied Statistics option must either pass (at the Master's level) Part III of doctoral written examinations or an examination covering courses 105, 127 (theory and practice), and one of 133 or 150. Students in the Mathematical Statistics option must pass an examination covering 129, 134, 135, and 150.

A "final oral" examination is given when a student's course work and thesis or essay are complete. This may involve questions on the student's course work or on the contents of the thesis or essay. The final oral examination is waived for a student who has passed a Ph.D. preliminary oral examination in statistics.

Thesis or Essay Requirement

All M.S. students must write either a (short) thesis or an essay. This is normally done during the student's fourth semester. The topic and scope of the work are decided in consultation with, and with the approval of, the student's adviser. Students in the Mathematical Statistics option should write a thesis or essay that demonstrates capability for research or understanding of recent research papers in some area of statistics. Students in the Applied Statistics option should write an essay or thesis that involves the analysis of a set of data.

CURRICULUM COMMITTEE

The Curriculum Committee of the Department reviews all students' degree programs and makes the final recommendations to the Graduate School on whether students have met the requirements for degrees. Usually during the second year of study, each student submits a proposed program in writing to the Curriculum Committee, listing the courses being offered to meet the degree requirements and stating how other requirements (language, essay, etc.) will be met.

ADMISSION, FINANCES, AND FINANCIAL AID

Prerequisites

Admission to the Graduate School is necessarily a selective process. Only applicants with academic records of high quality should seek admission. The minimal requirement is a Bachelor of Arts or Bachelor of Science degree from an accredited college or university in this country with an average grade of B or better, or its equivalent—based on a four-year curriculum—in a foreign institution.

The graduate curriculum in the Department of Statistics places strong emphasis on the mathematical theory of probability and statistics. A sound mathematical preparation is thus an essential prerequisite for admission. An applicant's mathematical background should include a one-year course in advanced (multivariable) calculus or real analysis, at least a one-semester course in matrix algebra, and introductory courses in probability and statistics.

Procedures

Application forms for admission and/or financial aid may be obtained by writing either to the Department of Statistics or to the Graduate School. A complete application must include at least the following:

1. The completed application forms in duplicate.

2. Two official transcripts of all previous undergraduate and graduate work.
3. Three references in duplicate (forms provided) from people familiar with the applicant's academic achievement and potential.
4. A nonrefundable application fee of \$25.00. An applicant who has been offered admission reserves his place by the payment of a \$25.00 nonrefundable deposit which is credited toward the first semester's tuition.

In addition to the above, the Department of Statistics strongly recommends that applicants submit the following material:

5. Test scores for both the Aptitude and Advanced Mathematics Graduate Record Examination. (This is most strongly recommended for students applying for financial aid.)
6. A supplementary sheet providing brief course descriptions, including text titles where applicable, of all previous undergraduate and graduate courses in (a) probability and statistics, (b) mathematics above the level of elementary calculus, and (c) other courses of a mathematical nature, such as computer science, mathematical physics, etc.
7. A statement of areas of interest in probability and statistics, and of career goals.

The Graduate Record Examination is given at regular intervals throughout the academic year at most universities in this country and in many countries abroad. Information about this examination can usually be obtained from the dean's office of colleges or universities in this country, or by writing to Educational Testing Service, Princeton, New Jersey. Applicants for financial aid should take the examination no later than December for admission in the succeeding fall semester.

Students whose native language is not English are required to take the Test of English as a Foreign Language examination (TOEFL) administered by the Educational Testing Service.

Financial Assistance

The Department of Statistics offers a number of graduate assistantships to graduate students each year. According to current University practice, these awards carry eligibility for in-state tuition status. Assistantships are renewable each academic year, contingent on satisfactory progress toward a degree and availability of funds. Assistantships are usually available only to students entering the Ph.D. program, either directly from a bachelor's degree program or after graduate study elsewhere. Normally assistantships are not awarded to a student beyond the fifth academic year. The stipend in 1986-87 is \$6,800.

Applicants for financial aid are considered also for various fellowships and limited service awards for which recipients are selected on a competitive university-wide basis by the Graduate School. These awards include University Graduate Fellowships, National Science Foundation Fellowships, George E. Nicholson, Jr. Fellowships, and Pogue Fellowships. Stipends range from \$6,800 to \$8,500 for the academic year with tuition included in most cases.

Under the Board of Governors' general Minority Presence Grant Program, black students may be eligible for special financial assistance if they are residents of North Carolina, enrolled for at least three hours of degree-credit coursework, and demonstrate financial need.

The Minority Presence Grant Program for Doctoral Study provides stipends of up to \$6,000 for the academic year, with an option of \$600 in additional support for study in the summer session, for black residents of North Carolina who are selected to participate. Recipients must be full-time students pursuing doctoral degrees at The University of North Carolina at Chapel Hill.

Application for admission and financial aid may be made simultaneously simply by indicating on the admission application form a desire to be considered for financial aid.

Tuition and Fees

For full-time graduate students the current in-state rate for tuition and fees is \$790.00 for the academic year. Recipients of certain appointments may be entitled to pay tuition at a lower rate at the discretion of the Board of Trustees. Tuition and fees for out-of-state students are presently \$3,710.00 per year. Tuition and fees are due at registration. Accounts not paid in full by the last day of registration are subject to a late payment fee and the student's possible disenrollment.

Notice is given that upon proper authorization tuition and fees may be changed at any time.

Deadlines

The Department of Statistics does not admit students in the summer sessions and rarely admits students in the spring semester. The deadlines for application for admission in the fall semester are:

- (a) February 1 for admission and financial aid. Applications after February 1 can be considered for assistantships, if funds are still available, but not for Graduate School awards.
- (b) July 1 for admission only.

Further Information

For further information about graduate programs, admission procedures, and financial aid, address inquiries to:

Director of Graduate Admissions
 Department of Statistics
 The University of North Carolina at Chapel Hill
 Chapel Hill, North Carolina 27514

The Department of Statistics welcomes applications for admission and aid from members of minorities. Admission and aid are awarded without consideration of race, sex, or creed.

Placement

Students in both the Ph.D. and M.S. programs will receive assistance with placement. The faculty, through their many professional contacts, are able to help students identify appropriate positions. The Chairman is often contacted by various academic, industrial and government organizations with job opportunities. These job opportunities are made available to all prospective graduates. Also, the university maintains an Office of Career Planning and Placement which is available to all prospective graduates.

DEGREES AWARDED

	M.S.	Ph.D.		M.S.	Ph.D.
1948-68	24	90	1977-78	7	1
1968-69	5	8	1978-79	5	8
1969-70	2	4	1979-80	6	2
1970-71	3	5	1980-81	2	7
1971-72	4	5	1981-82	2	3
1972-73	2	3	1982-83	4	5
1973-74	4	6	1983-84	3	3
1974-75	5	2	1984-85	3	4
1975-76	4	6	1985-86	3	3
1976-77	5	7			

RECENT DISSERTATIONS

On Construction of Sequential Age Replacement Policies via Stochastic Approximation (Advisers: G. Simons and D. Ruppert).

Nonparametric Density and Moment Estimation in a Random Coefficients Regression Model (Adviser: D. Ruppert).

Asymptotic Behavior of Degenerate U-Statistics (Advisers: W. Hoeffding and P. K. Sen).

Bounded Influence Estimation in Heteroscedastic Linear Models (Advisers: D. Ruppert and R. J. Carroll).

Influence and Measurement Error in Logistic Regression (Advisers: R. J. Carroll and D. Ruppert).

Studies in Multinomial Mixture Models (Adviser: B. Margolin).

Point Processes Associated with Extreme Value Theory (Adviser: M. R. Leadbetter).

Product Stochastic Measures, Multiple Stochastic Integrals and Their Extensions to Nuclear Space Valued Processes (Adviser: G. Kallianpur).

Linear Stochastic Differential Equations on the Dual of a Countably Hilbert Space with Applications to Neurophysiology (Adviser: G. Kallianpur).

Some Contributions to Robust Inference for Discrete Probability Models (Advisers: R. J. Carroll and D. Ruppert).

Estimation of Continuous Time Markov Processes in a Finitely Additive White Noise Model (Adviser: G. Kallianpur).

Coding for T-User Binary Adder Channel (Adviser: I. M. Chakravarti).

The Algebra of a Multi-Stratum Design and the Application of its Structure to Analysis (Adviser: I. M. Chakravarti).

OPERATIONS RESEARCH AND SYSTEMS ANALYSIS CURRICULUM

The Department of Statistics is one of the core departments supporting the Operations Research and Systems Analysis (O.R.S.A.) Curriculum at the University. This Curriculum is a separate program offering the M.S. and Ph.D. degrees. In addition, degree candidates in statistics may elect a minor or supporting program in O.R.S.A.

The study of O.R.S.A. involves the application of diverse topics in mathematics and statistics to problems of resource allocation. At Chapel Hill, specialization is possible in theoretic areas (for example, Mathematical Programming, Stochastic Processes) or through specific applications (such as Urban and Environmental Systems, Population Studies, Biological Sciences).

For further information and/or applications for admission and financial aid, please write to:

Chairman

Operations Research and Systems Analysis Curriculum

Smith Building 128A

The University of North Carolina at Chapel Hill

Chapel Hill, North Carolina 27514

COURSES^{1,2}**Courses for Undergraduates**

- *11 **BASIC CONCEPTS OF STATISTICS AND DATA ANALYSIS I (3).** No prerequisite. Elementary introduction to statistical reasoning, sampling, elementary probability, statistical inference, and data analysis. *Fall and spring.* Staff.
- *Course 11 may not be taken for credit by students who have credit for Statistics 23, Economics 70, or Psychology 30. Students with a grade of C or better for either Mathematics 22 or Mathematics 31 may not take 11, unless their major requires 11, but may take 23.
- 14 **BASIC CONCEPTS OF STATISTICS AND DATA ANALYSIS II (3).** Prerequisite, Statistics 11. Elementary introduction to further topics in statistical reasoning, including correlation, regression, analysis of variance. Use of statistical computer packages. *Offered on sufficient demand.* Staff.
- 23 **ELEMENTARY PROBABILITY AND STATISTICS FOR BUSINESS (3).** Prerequisite, Math 22 or 31. An introduction to probability and statistics with a special emphasis on applications in business. Handling of data, probability distributions, sampling, estimation, hypothesis testing. *Fall and spring.* Staff.

Courses for Graduates and Advanced Undergraduates

- 101 **STATISTICAL METHODS I (Biostatistics 150) (3).** Prerequisite, integral calculus. Basic probability; descriptive statistics; introduction to statistical inference, including estimation, hypothesis testing, simple linear regression, nonparametric tests, contingency tables. Use of statistical computer packages. *Fall and spring.* Chakravarti, Marron.
- 102 **STATISTICAL METHODS II (3).** Prerequisite, Statistics 101. Linear regression; experimental designs; multivariate analysis; statistical computer packages. *Spring.* Chakravarti, Ruppert.
- 104 **SAMPLE SURVEY METHODOLOGY (Biostatistics 164) (3).** Prerequisite, Biostatistics 150 or equivalent or permission of instructor. Fundamental principles and methods associated with survey sampling, giving primary attention to as nonmathematical as possible a treatment of simple random sampling, stratified sampling, and cluster sampling. Also, techniques of questionnaire design, the problems of nonresponse, and sources of nonsampling errors. Practical experience in the applied aspects of sampling is provided by student participation in the design, execution, and analysis of an actual survey. Three lecture hours a week, *spring.* Kalsbeek.

1. Names represent recent and anticipated instructors of these courses.

2. Advanced courses are taught in alternate years depending on demand.

- 105 ELEMENTS OF STATISTICAL ANALYSIS (3). Prerequisite, permission of instructor. Various topics in statistical methods, including applied regression analysis, analysis of simple experimental designs, data analysis, discrete multivariate data. *Fall*. Carlstein.
- 107 LIFE CONTINGENCIES (Mathematics 167) (3). Prerequisite, Mathematics 32. (Previous knowledge of the material in Math 165 is strongly recommended.) A detailed study of various actuarial functions. Single-life functions, multiple-life functions, and some population problems. *Fall*. Dunn.
- 111 METHODS OF MATHEMATICAL STATISTICS (3) Prerequisite, advanced calculus. Introductory treatment of special mathematical techniques of particular importance in probability and statistics, including complex variables, Fourier and Laplace transforms, elements of finite difference equations. *Spring*. Baker, Smith.
- 112 MEASURE AND INTEGRATION (3). Prerequisite, advanced calculus. Lebesgue and abstract measure and integration, convergence theorems, differentiation. Radon-Nikodym theorem, product measures. Fubini theorems. L_p spaces. *Fall*. Baker, Cambanis, Kallianpur, Leadbetter.
- 126 INTRODUCTION TO PROBABILITY (Mathematics 146) (3). Prerequisite, Mathematics 34. Introduction to mathematical theory of probability covering random variables, moments, binomial, Poisson, normal and related distributions, generating functions, sums and sequences of random variables, and statistical applications. *Fall and spring*. Baker, Cambanis, Marron, Simons.
- 127 MATHEMATICAL STATISTICS (3). Prerequisite, Statistics 126 or equivalent. Functions of random samples and their probability distributions; introductory theory of point and interval estimation, and of hypothesis testing; elementary decision theory. *Fall and spring*. Carlstein, Carroll, Kelly, Richards, Simons.
- 129 INTRODUCTION TO STOCHASTIC PROCESSES (3). Prerequisite for nonstatistics majors, Statistics 126, and, in fall, permission of instructor. Elementary theory and application of random process models; recurrent events, random walk. Markov chains. Poisson processes, birth-and-death processes, queueing processes, branching processes, Brownian motion, stationary processes. *Fall*, Kelly, Leadbetter Simons.
- 132 INTERMEDIATE PROBABILITY (Mathematics 195) (3). Prerequisite, Statistics 112 or permission of instructor. Foundations of probability. Basic classical theorems. Modes of probabilistic convergence. Central limit problem. Generating functions, characteristic functions. Conditional probability and expectation. *Spring*. Cambanis, Kelly, Leadbetter.

- 133 INTRODUCTION TO TIME SERIES ANALYSIS (3). Prerequisite, Statistics 126. Topics chosen from: Time series data analysis. Fitting parametric models, such as autoregressive models to time series. Spectral analysis. Filtering. *Spring*. Leadbetter, Ruppert.
- 134 INTERMEDIATE STATISTICAL THEORY I (3). Prerequisite, two semesters of advanced calculus. Fundamentals of probability and distribution theory including: axiomatic treatment of probability, independence, random variables, characteristic functions, convergence and approximation, common distributions. *Fall*. Cambanis, Kelly, Simons.
- 135 INTERMEDIATE STATISTICAL THEORY II (3). Prerequisite, Statistics 134 or equivalent. Fundamentals of statistical inference including: sufficient statistics, estimation, hypothesis testing, decision theory, various classical tests. Linear estimation, analysis of variance and regression are largely excluded (see Statistics 150). *Spring*. Carroll, Ruppert, Simons.
- 140 LINEAR SYSTEMS (3). Prerequisites, advanced calculus, elements of Fourier transforms theory; linear algebra and Lebesgue integration helpful. Introduction to linear spaces, including basic results on normed linear spaces, Hilbert space geometry, bounded linear operators. Linear system theory, including signal representations, impulse response, transfer functions, dynamical systems, state variable methods, elementary modern control theory. (Offered on sufficient demand.) *Fall*. Cambanis, Leadbetter.
- 141 LINEAR OPERATORS AND OPTIMIZATION (3). Prerequisite, Statistics 140 or a knowledge of the basic theory of normed linear spaces and linear operators. Basic properties of compact operators. Dual spaces. Optimization in linear spaces, especially algorithmic methods. Optimization of functions and constrained optimization. (Offered on sufficient demand.) *Spring*. Baker.
- 142 INTRODUCTION TO ESTIMATION AND DETECTION THEORY (3). Prerequisites, Statistics 129, 134, and 140. The Wiener-Kolmogorov and the Kalman-Bucy filtering theories. Modulation theory. Basic problems of detection theory. (Offered on sufficient demand.) *Spring*. Cambanis.
- 150 ANALYSIS OF VARIANCE WITH APPLICATION TO EXPERIMENTAL DESIGNS (3). Corequisite, Statistics 135. Linear estimation. Gauss-Markoff theorem. Sums of squares. Analysis of variance and simple factorial designs. Intrablock analysis of incomplete block designs. Balanced, lattice and Latin square designs. *Spring*. Chakravarti, Marron.
- 156 COMBINATORIAL MATHEMATICS (Mathematics 148) (3). Prerequisite, Mathematics 81 or equivalent, or permission of the instructor. Topics chosen from: generating functions, Polya's theory of count-

ing, partial orderings and incidence algebras, principle of inclusion-exclusion, Moebius inversion, combinatorial problems in physics and other branches of science. *Fall*. Brylawski.

- 158 INTRODUCTION TO GRAPH THEORY (Mathematics 149) (3). Prerequisite, Mathematics 116, 137, or 147. Basic concepts of directed and undirected graphs, partitions and distances in graphs. Planar and nonplanar graphs. Matrix representation of graphs, network flows, applications of graph theory. *Spring of odd numbered years*. Staff.
- 160 APPLIED MULTIVARIATE ANALYSIS I (Biostatistics 166) (3). Prerequisite, Statistics 102. Application of multivariate techniques, with emphasis on the use of computer programs. Multivariate analysis of variance, multivariate multiple regression, weighted least squares, principal component analysis, canonical correlation and related techniques. Three lecture hours a week, *Spring*. Muller.
- 171 INTRODUCTION TO NONPARAMETRIC STATISTICS (Biostatistics 256) (3). Prerequisites, Statistics 105, and basic courses in statistical theory. Theory and application of nonparametric methods for various problems in statistical analysis. Includes procedures based on randomization, ranks, and U-statistics. A knowledge of elementary computer programming is assumed. Three lecture hours a week. *Fall*. Bangdiwala.
- 180 STOCHASTIC MODELS (ORSA 180) (3). Prerequisite, Statistics 126. Introduction to queueing theory (substantial). Markovian sequential decision process, inventory theory and topics from stochastic linear programming, simulation, scheduling, game theory. Applications. *Spring*. Kulkarni, Smith.
- 181 DETERMINISTIC MODELS IN OPERATIONS RESEARCH (MATH 151, ORSA 181) (3). Prerequisite, Mathematics 147. Linear, integer, nonlinear and dynamic programming, classical optimization problems, network theory. *Fall and spring*. Kelly, Provan, Smith.

Courses for Graduates Only

- 200 APPLIED MULTIVARIATE ANALYSIS II (2). Prerequisite, Statistics 105 or 135. Relations between multiple regression, analysis of variance, multivariate analysis and factor analysis. Principal components. Discriminant analysis. Canonical analysis. Scaling methods. Classification problems. Cluster analysis. *Spring*. Richards.
- 210 DESIGN AND ANALYSIS OF EXPERIMENTS (3). Prerequisites, Statistics 105 and 150. The principles of the design and analysis of experiments. Randomized blocks. Latin and Graeco-Latin squares, factorial experiments. Confounding, fractional factorials, split plots, missing plots. Interblock analysis. Covariance analysis. Response surfaces. *Fall*. Chakravarti.

- 220 THEORY OF ESTIMATION AND HYPOTHESIS TESTING (3). Prerequisites, Statistics 132, 135. Bayes procedures for estimation and testing. Minimax procedures. Unbiased estimators. Unbiased tests and similar tests. Invariant procedures. Sufficient statistics. Confidence sets. Large sample theory. *Fall*. Simons.
- 221 SEQUENTIAL ANALYSIS (3). Prerequisites, Statistics 132 and 135. Hypothesis testing and estimation when the sample size depends on the observations. Sequential probability ratio tests. Sequential design of experiments. Optimal stopping. Stochastic approximation. *Spring*. Simons.
- 222 NONPARAMETRIC INFERENCE (3). Prerequisites, Statistics 132, 135, and 112. Estimation and testing when the functional form of the population distribution is unknown. Rank, sign, and permutation tests. Optimum nonparametric tests and estimators, Robust procedures. *Spring*. Ruppert.
- 223 STATISTICAL LARGE-SAMPLE THEORY (3). Prerequisites, Statistics 132 and 135. Asymptotically efficient estimators; maximum likelihood estimators. Asymptotically optimal tests; likelihood ratio tests. *Spring*. Ruppert.
- 231 ADVANCED PROBABILITY (3). Prerequisites, Statistics 132, 112. Advanced theoretic course, covering topics selected from: weak convergence theory, central limit theorems, laws of large numbers, stable laws, infinitely divisible laws, random walks, martingales. *Fall*. Kallianpur, Simons.
- 232 GENERAL THEORY OF STATISTICAL DECISION (3). Prerequisites, Statistics 135 and 112. Selected topics in the general theory of statistical decisions, based on the work of Abraham Wald. *Spring*. Staff.
- 235 STOCHASTIC PROCESSES (3). Prerequisites, Statistics 112 and 132. Advanced theoretic course including topics selected from: Foundations of stochastic processes. Renewal processes. Stationary processes. Markov processes, martingales, point processes. *Fall*. Cambanis, Leadbetter.
- 237 TIME SERIES ANALYSIS (3). Prerequisites, Statistics 112, 132. Analysis of time series data by means of particular models such as autogressive and moving average schemes. Spectral theory for stationary processes and associated methods for inference. Stationarity testing. *Spring*. Leadbetter.
- 242 PROBABILITY IN LINEAR SPACES (3). Prerequisites, Statistics 112, elements of theory of normed linear spaces. Results from linear topology. Borel structures. Probability measures on Borel sets of separable Banach spaces. Characteristic functionals. Extension of cylinder set measures. Gaussian measures. Orthogonality and equivalence of measures. *Spring*. Baker.

- 245 ADVANCED TOPICS IN STATISTICAL COMMUNICATION THEORY (3). Prerequisite, Statistics 242. Applications of probability in linear spaces to problems in information theory, signal detection, and sample path analysis of stochastic processes. *Fall*. Baker.
- 251 COMBINATORIAL PROBLEMS OF THE DESIGN OF EXPERIMENTS (3). Prerequisite, Statistics 150. Finite fields and finite geometries. Construction of orthogonal Latin square and balanced incomplete block designs. Difference sets. *Fall*. Chakravarti.
- 252 INFORMATION THEORY (3). Prerequisite, Statistics 134. Transmission of information, entropy, message ensembles, discrete sources, transmission channels, channel encoding and decoding for discrete channels. *Spring*. Chakravarti.
- 253 ERROR CORRECTING CODES (3). Prerequisite, Statistics 251, or permission of the instructor. Linear codes and their error-correcting capabilities. Hamming codes. Reed-Miller codes. Cyclic codes. Bose-Chaudhuri codes. Goppa codes. Burst error corrections. Majority logic decoding. *Fall*. Chakravarti.
- 254 SPECIAL TOPICS IN THE DESIGN OF EXPERIMENTS I (3). Prerequisite, Statistics 150. Factorial experiments. Confounding, construction and analysis of symmetrical and fractional factorial designs. Orthogonal arrays. Asymmetrical factorial designs. Response surface designs, second and third order rotatable designs. Mixture designs. Recent developments. *Fall*. Chakravarti.
- 255 SPECIAL TOPICS IN THE DESIGN OF EXPERIMENTS II (3). Prerequisite, Statistics 251. Combinatorial properties and construction of balanced group divisible and partially balanced designs. Impossibility proofs. Orthogonal Latin squares of nonprime power orders. Orthogonal arrays. Asymmetrical fractionally replicated designs. Recent developments. *Spring*. Chakravarti.
- 260 MULTIVARIATE ANALYSIS (3). Prerequisite, Statistics 135 and matrices. Multivariate normal distributions. Related distributions. Tests and confidence intervals. Multivariate analysis of variance, covariance and regression. Association between subsets of a multivariate normal set. Theory of discriminant, canonical, and factor analysis. *Fall*. Chakravarti, Richards.
- 261 ADVANCED PARAMETRIC MULTIVARIATE ANALYSIS (3). Prerequisite, Statistics 260. Distribution problems involved in the normal theory analysis of general multivariate linear models including the growth curves. Roy's union-intersection principle and its role in multivariate analysis. An introduction to zonal polynomials and orthogonal groups. *Spring*. Sen, Chakravarti, Richards.
- 262 INTRODUCTORY NONPARAMETRIC MULTIVARIATE ANALYSIS (3). The problem of symmetry in the multivariate case. Nonparametric MANOVA in one-way classifications. Robust rank order estimation in MANOVA. Large sample properties of the tests and estimates. Tests of independence. *Fall*. Sen.

- 263 ADVANCED NONPARAMETRIC MULTIVARIATE ANALYSIS (3). Prerequisite, Statistics 262. Nonparametric inference in multifactor multiresponse experiments. Robust procedures in general linear models including the growth curves. Nonparametric classification problems. *Spring*. Sen.
- 280 ADVANCED STOCHASTIC METHODS OF OPERATIONS RESEARCH (3). Prerequisites, Statistics 132 and 180. Topics chosen from: renewal theory; queues with random arrivals; in equalities for queues; priority systems; theory of reservoirs; stochastic inventory problems. *Spring*. Smith.
- 300 SEMINAR IN STATISTICAL LITERATURE (1 each). Prerequisite, Statistics 135. *Fall and spring*. Staff.
- 302 SEMINAR IN STATISTICAL DATA ANALYSIS (Var.) Prerequisite, Statistics 105. *Spring*. Staff.
- 310 SEMINAR IN THEORETICAL STATISTICS (3 each). Prerequisite, Statistics 135. *Fall and spring*. Staff.
- 321 SPECIAL PROBLEMS (3 each). Prerequisite, permission of the instructor. *Fall and spring*. Staff.
- 331 ADVANCED RESEARCH (3 each) Prerequisite, permission of the instructor. *Fall and spring*. Staff.
- 332 MASTER'S THESIS (3 or more). Prerequisite, permission of the student's adviser. *Fall and spring*. Staff.
- 394 DOCTORAL DISSERTATION (3 or more). Prerequisite, permission of the student's adviser. *Fall and spring*. Staff.
- 400 GENERAL REGISTRATION.

THE GRADUATE FACULTY

CHARLES R. BAKER, *Professor*. B.S. (1957), University of Southwestern Louisiana; M.S. (1963), Ph.D. (1967), University of California at Los Angeles.

Major Areas of Interest: Statistical Communication Theory, Stochastic Processes.

RAJ CHANDRA BOSE, *Kenan Professor Emeritus*. B.A. (Hons., 1922), Punjab University; M.A. (1924), Delhi University; M.A. (1927), D. Litt. (1947), Calcutta University. Member, National Academy of Sciences, International Statistical Institute. Fellow, Institute of Mathematical Statistics, National Institute of Science (India); Honorary Fellow, Royal Statistical Society.

STAMATIS CAMBANIS, *Professor and Chairman*. B.S. (1966), National Technical University (Athens, Greece); M.A. (1968), Ph.D. (1969), Princeton University. Fellow, Institute of Mathematical Statistics.

Major Areas of Interest: Statistical Communication Theory, Stochastic Processes.

- EDWARD CARLSTEIN, *Assistant Professor*. B.Sc. (1979), Cornell University; M.A. (1980), M. Phil. (1983), Ph.D. (1984), Yale University. *Major Areas of Interest*: Stationary Processes, Nonparametric Estimation.
- RAYMOND J. CARROLL, *Professor*. B.A. (1971), University of Texas at Austin; M.A. (1972), Ph.D. (1974), Purdue University; Fellow American Statistical Association. Fellow, Institute of Mathematical Statistics. *Major Areas of Interest*: Regression, Errors-in-Variables, Calibration, Weighted Methods, Data Transformations.
- INDRA MOHAN CHAKRAVARTI, *Professor*. B.Sc. (1948), M.Sc. (1950), D. Phil. (1958), University of Calcutta. Fellow, Institute of Mathematical Statistics; Member, International Statistical Institute. *Major Areas of Interest*: Design of Experiments, Combinatorics, Information and Coding Theory.
- WASSILY HOEFFDING, *Kenan Professor Emeritus*. Ph.D. (1940), University of Berlin. Member, National Academy of Sciences, International Statistical Institute. Fellow, Institute of Mathematical Statistics, American Statistical Association. *Major Area of Interest*: Statistical Inference.
- NORMAN LLOYD JOHNSON, *Alumni Distinguished Professor Emeritus*. B.Sc. (Math., 1936), B.Sc. (Stat., 1937), M.Sc. (1938), Ph.D. (1948), D.Sc. (1963), University College, London. Fellow, Institute of Mathematical Statistics, Institute of Actuaries, American Statistical Association. Member, International Statistical Institute. *Major Areas of Interest*: Multivariate Analysis, Statistical Inference.
- GOPINATH KALLIANPUR, *Alumni Distinguished Professor*. B.A. (1945), M.A. (1946), University of Madras; Ph.D. (1951), The University of North Carolina. Fellow, Institute of Mathematical Statistics. Member, International Statistical Institute, Fellow, Indian Academy of Sciences. *Major Areas of Interest*: Probability, Stochastic Processes, Filtering and Control Theory.
- DOUGLAS G. KELLY, *Professor*. A.B. (1961), Princeton University; A.M. (1964), Ph.D. (1967), Indiana University. *Major Areas of Interest*: Probability, Combinatorics, Modeling of Biological Processes.
- MALCOLM ROSS LEADBETTER, *Professor*. B.Sc. (1953), M.Sc. (1955), University of Otago (New Zealand); B.A. (1958), M.A. (1962), University of Cambridge; Ph.D. (1963), The University of North Carolina at Chapel Hill. Member, International Statistical Institute. Fellow, American Statistical Association, Institute of Mathematical Statistics. *Major Areas of Interest*: Probability, Stochastic Processes.
- BARRY MARGOLIN, *Adjunct Professor*, B.S. (1963), City College of New York; M.A. (1964), Ph.D. (1967), Harvard University. Fellow, American Statistical Association; Member, International Statistical Institute.

Major Area of Interest: Design and Analysis of Experiments, Categorical Data and Genetic Toxicology.

J. STEPHEN MARRON, *Assistant Professor*. B.Sc. (1977), University of California, Davis; M.A. (1980), Ph.D. (1982), University of California, Los Angeles.

Major Areas of Interest: Nonparametric Statistics, Density Estimation, Statistical Inference.

DONALD ST. P. RICHARDS, *Associate Professor*. B.Sc. (1976), Ph.D. (1978), University of the West Indies.

Major Areas of Interest: Multivariate Analysis, Harmonic Analysis, Special Functions.

ROBERT N. RODRIGUEZ, *Adjunct Associate Professor*. B.S. (1972), Case Institute of Technology; M.S. (1976), Ph.D. (1977), The University of North Carolina at Chapel Hill.

Major Areas of Interest: Statistical Quality Control, Statistical Computer Graphics.

DAVID RUPPERT, *Associate Professor*. A.B. (1970), Cornell University; M.A. (1973), University of Vermont; Ph.D. (1977), Michigan State University. Fellow, Institute of Mathematical Statistics.

Major Areas of Interest: Stochastic Approximation, Large-Sample Theory, Regression Modeling.

PRANAB KUMAR SEN, *Adjunct Professor*. M.Sc. (1957), Ph.D. (1962), Calcutta University. Fellow, American Statistical Association, Institute of Mathematical Statistics; Member, International Statistical Institute.

Major Area of Interest: Multivariate Analysis.

GORDON D. SIMONS, *Professor*. B.A. (1960), M.A. (1964), Ph.D. (1966), University of Minnesota. Fellow, Institute of Mathematical Statistics.

Major Areas of Interest: Sequential Analysis, Statistical Inference, Probability Theory.

WALTER LAWS SMITH, *Professor*. B.A. (1947), M.A. (1951), Ph.D. (1953), University of Cambridge. Fellow, Cambridge Philosophical Society, Institute of Mathematical Statistics, American Statistical Association.

Member of International Statistical Institute.

Major Areas of Interest: Probability, Stochastic Processes.

LIVING IN CHAPEL HILL

The University and Chapel Hill

The University of North Carolina at Chapel Hill is the oldest state supported university in the United States, first opening its doors in 1795. It is part of The University of North Carolina, which has 16 campuses across the state. Chapel Hill—a cosmopolitan town of about 36,000—blends a mild climate, a relaxed southern atmosphere, pine-covered hills, and the charm of a college town with such cultural advantages as an excellent theater, a

symphony orchestra, a planetarium, and an art museum. Most of the larger cities in North Carolina are nearby; the Carolina beaches, the Cape Hatteras National Seashore, the Great Smoky Mountains National Park, and the Blue Ridge Mountains are but a few hours drive away. Basketball, football, year-round golf, tennis, swimming, and other athletic attractions are always in abundance in Chapel Hill.

Graduate students frequently participate in professional, cultural, and intellectual activities involving the three major universities in the area—UNC-CH, Duke University, and North Carolina State University at Raleigh. It is not unusual for students to attend plays, concerts, or sports events in Durham and Raleigh, to go for hikes along the Eno and Little Rivers near Durham, or to attend seminars at one of the universities that involve participants from all three and from the Research Triangle.

The University, which now has about 20,000 students, is one of the South's leading academic institutions and prides itself on being among the front rank of American universities. Students come to Chapel Hill from all over the world. Within the University, several departments, including the Department of Statistics, have received international recognition.

Housing

The University maintains housing for single graduate students in Craige Graduate Center, a seven-story coeducational residence hall on South Campus. Craige has single and double rooms arranged by a suite system. Kitchens and lounges are located on each floor. Its other facilities include a laundry, game rooms, coffeehouse, snack bar, computer terminals, and seminar/study rooms.

Meals are served in Lenior Hall Cafeteria. Many restaurants are within walking distance of the residence halls and the main campus.

The University also operates apartments for student family housing at modest cost in Odum Village, one mile south from the center of the campus. The University owns 76 one-bedroom unfurnished apartments, 180 two-bedroom unfurnished apartments, and 50 two-bedroom furnished apartments. Early application for these apartments is essential.

Information about Craige Graduate Center may be obtained by writing the Department of University Housing, Contracts Office, Carr Building, The University of North Carolina at Chapel Hill, Chapel Hill, NC 27514.

Information about Odum Village may be obtained from the Manager, UNC Student Family Housing, Odum Village, Branson Street, Chapel Hill, NC 27514.

Firearms and Other Weapons

The possession of any gun, rifle, pistol, dynamite cartridge, bomb, grenade, mine, explosive, bowie knife, dirk, dagger, slingshot, leaded cane, switchblade knife, blackjack, metallic knuckles, or any other weapons of like kind upon any University campus or in any University owned or operated facility is unlawful and contrary to University policy. Violation of this prohibition is a misdemeanor punishable by a fine not to exceed \$500 and/or six months' imprisonment, and may constitute a violation of the Campus Code.

Immunization Requirement

Effective July 1, 1986, North Carolina State law requires that no person shall attend a college or university in North Carolina unless a certificate of immunization indicating that the person has received the immunizations required by the law is presented to the college or university on or before the first day of matriculation. Students enrolled at UNC-CH on July 1, 1986 are exempt from this requirement.

If the UNC-CH Medical History Form containing the certificate of immunization is not in the possession of the UNC-CH Student Health Service ten (10) days prior to the registration date, the University shall present a notice of deficiency to the person. The person shall have 30 calendar days from the first day of attendance to obtain the required immunizations. Those persons who have not complied with the immunization requirements by the end of 30 calendar days will be *administratively withdrawn* from the University.

Health Services and Athletic Facilities

The University Health service offers medical and psychological services and maintains a well-appointed infirmary. Students who require specialized services may receive them at N.C. Memorial Hospital, located on campus, at standard charges.

Students may use the University athletic facilities at no additional charge. These include indoor and outdoor swimming pools, tennis, handball and basketball courts, fields for softball and touch football, and an 18-hole golf course.

NOTICE ON "DIRECTORY INFORMATION" TO ALL STUDENTS OF THE UNIVERSITY OF NORTH CAROLINA AT CHAPEL HILL

The University of North Carolina at Chapel Hill has routinely made public certain information about its students. Some typical ways this has been done include the following: names of students who are selected by the various honorary societies, who receive scholarships, who make the Dean's List, who hold offices, or who are members of athletic teams are frequently made public. To facilitate campus communication the University annually publishes the *Campus Directory*. Some professional and graduate school student groups publish directories of students in their departments or schools. The annual commencement program publishes the names of persons who have received degrees during the year.

The Family Educational Rights and Privacy Act defines the term "directory information" to include the following categories of information: the student's name, address, telephone listing, date and place of birth, major field of study, participation in officially recognized activities and sports, weight and height of members of athletic teams, dates of attendance, degrees and awards received, and the most recent previous educational agency or institution attended by the student. The University will make public information about each student *limited* to these categories in ways such as those described above. Of course, information from all these categories is not made public in every listing. The *Campus Directory*, for example, publishes only names, addresses, and telephone numbers.

Under the FERPA regulations, the University will also disclose personally identifiable information from the education records of a student without the student's prior written consent, to officials of another school or school system in which the student seeks or intends to enroll.

Students who do not wish to have any or all "directory information" made public and who do not want information about them to be disclosed to other schools, as set forth above, without their prior consent must notify the Office of Records and Registration, The University of North Carolina at Chapel Hill, of this fact in a signed and dated statement specifying items that are not to be published. This notice must be received by the Office of Records and Registration by the end of the registration period for the semester or session of first enrollment or, after an absence, of re-enrollment, and by the end of *each* fall registration period thereafter.

Appendix A

RESIDENCE STATUS FOR TUITION PURPOSES¹

The following sections summarize important aspects of the residency law. A complete explanation of the Statute and the procedures under the Statute is contained in *A Manual to Assist the Public Higher Education Institutions of North Carolina in the Matter of Student Residence Classification for Tuition Purposes*. This *Manual* and other information concerning the application of this law are available for inspection in the Admissions Offices of the University. Copies of the *Manual* are also on reserve at the Robert B. House Undergraduate Library.

All students are responsible for knowledge of the contents of the Statute and the *Manual*.

General. Every applicant for admission is required to make a statement as to his or her length of residence in North Carolina. The tuition charge for legal residents of North Carolina is less than for nonresidents. To qualify for in-state tuition, a legal resident must have maintained his or her domicile in North Carolina for at least twelve months immediately prior to the beginning of the term for which classification as a resident for tuition purposes is sought. The student must also establish that his or her presence in the State during such twelve-month period was for purposes of maintaining a bona fide domicile rather than for purposes of mere temporary residence incident to enrollment in an institution of higher education. A student seeking classification as a resident for tuition purposes must complete an application for resident status (obtainable at his or her admissions office) and return it to the proper admissions office before the end of the term for which resident status for tuition purposes is sought. The last day of the final examination period is considered the last day of the term. Every student must be classified either resident or nonresident before enrolling. Unless the student supplies enough information to allow the admissions officer to classify the student as a resident for tuition purposes, the student will be classified a nonresident for tuition purposes.

When an enrolled student has applied to be classified a resident for tuition purposes and receives an institutional request for more information in connection with that application before the end of the term for which classification is sought, the student must respond to that request no later than three weeks after the end of the term. If the student does not receive the request for supplemental information until after the end of the term in question, he or she must supply the requested information within three weeks of receipt of the request. Failure to supply the requested information within the specified time limit will result in a continuation of the student's "nonresident" classification unless good cause is shown for such failure.

Domicile. Domicile means one's permanent dwelling place of indefinite duration, as distinguished from a temporary place of abode; synonymous with "legal residence."

Burden of Proof and Statutory Prima Facie Evidence. The student has the burden of establishing facts which justify his or her classification as a resident for tuition purposes. The balancing of all the evidence must produce a preponderance of evidence supporting the assertion of in-state residence. Under the statute proof of resident status is controlled initially by one of two evidentiary beginning points which are stated in terms of prima facie evidence.

a. Even if the student is an adult, if his or her parents (or court-appointed guardian in the case of some minors) are not legal residents of North Carolina, this is prima facie evidence that the student is not a legal resident of North Carolina unless the student has lived in this state the five consecutive years prior to enrolling or re-registering. To overcome this prima facie showing of nonresidence, the student must produce evidence that he or she is a North Carolina domiciliary despite the parents' nonresident status.

b. Conversely, if the parents of the student are domiciliaries of North Carolina under the Statute, this fact constitutes prima facie evidence that the student is a domiciliary of North Carolina. This prima facie evidence may also be overcome by other evidence of legal residence. If the student has neither living parents nor legal guardian, the prescribed prima facie evidence rule cannot and does not apply.

¹The information in this section comes from three sources: (i) North Carolina General Statutes, §116.143.1, (ii) *A Manual to Assist the Public Higher Education Institutions of North Carolina in the Matter of Student Residence Classification for Tuition Purposes*, Revised September 1985, (iii) Chancellor's Rules and Procedures for Residence Classification of Students for Tuition Purposes.

Statutory Exceptions

a. *Grace Period.* If a student has been properly classified as a resident for tuition purposes and, thereafter, his or her state of legal residence changes, the student does not automatically lose the benefit of the in-state tuition rate immediately. Instead the statute provides for a grace period if the following conditions are satisfied:

1. The student must have been properly classified as a resident for tuition purposes, on the basis of a valid finding that the student in fact was a legal resident of North Carolina and had been such for the requisite twelve-month period prior to classification;

2. At the time of subsequent change of legal residence to a state other than North Carolina, the student must have been enrolled in a public institution of higher education in North Carolina.

The extent of this grace period (during which the in-state rate is applicable in spite of the fact that the student is not a legal resident of North Carolina) is twelve months from the date of change in legal residence plus any portion of a semester or academic term remaining, as of the expiration date of the twelve-month period, in which the student is enrolled.

b. *Qualifying Periods for Spouses.* By virtue of the provisions of G.S. §116.143.1, if a student otherwise can demonstrate compliance with the fundamental statutory requirement that he or she be a legal resident of North Carolina before the beginning of the term for which resident status is sought, the second statutory requirement relating to duration of residence may be satisfied derivatively in less than twelve months, by reference to the length of the legal residence of the student's spouse, if the spouse has been a legal resident of the State for the requisite twelve-month period.

c. *Reacquisition of Resident Tuition Status.* The prescribed twelve-month period of legal residence may also be shortened if the person seeking to be classified as a resident for tuition purposes was formerly classified a North Carolina resident for tuition purposes, abandoned North Carolina domicile, and re-established North Carolina domicile within twelve months after abandoning it. Students should consult their admissions offices for a detailed explanation of the conditions which must be met to qualify under this section.

Married Persons. The domicile of a married person, irrespective of sex, is determined by reference to all relevant evidence of domiciliary intent. No person is precluded, solely by reason of marriage to a person domiciled outside of North Carolina, from establishing or maintaining legal residence in North Carolina. No person is deemed, solely by reason of marriage to a person domiciled in North Carolina, to have established or maintained a legal residence in North Carolina. The fact of marriage and the place of the domicile of his or her spouse are deemed relevant evidence to be considered in ascertaining domiciliary intent.

Minors. A minor is any person who has not reached the age of eighteen years. The domicile of a minor is presumed under the common law to be that of the father, subject to rebutting evidence. If the father is deceased, the domicile of the minor is that of the surviving mother. If the parents are divorced or legally separated, the domicile of the minor is that of the parent having custody by virtue of a court order; or, if no custody has been granted by virtue of court order, the domicile of the minor is that of the parent with whom he or she lives; or, if the minor lives with neither parent, in the absence of a custody award, the domicile of the minor is presumed to remain that of the father. If the minor lives for part of the year with each parent, in the absence of a custody award, the minor's domicile is presumed to remain that of the father. These common law presumptions control even if the minor has lived in North Carolina for five years as set forth above in **Burden of Proof and Statutory Prima Facie Evidence**, subsection a.

In determining residence status for tuition purposes, there are two exceptions to the above provisions:

1. If a minor's parents are divorced, separated, or otherwise living apart and one parent is a legal resident of North Carolina, during the time period when that parent is entitled to claim, and does claim, the minor as a dependent on the North Carolina individual income tax return, the minor is deemed to be a legal resident of North Carolina for tuition purposes, notwithstanding any judicially determined custody award with respect to the minor.

If, immediately prior to his or her eighteenth birthday, a person would have been deemed to be a North Carolina legal resident under this provision but he or she achieves majority before enrolling in an institution of higher education, that person will not lose the benefit of this provision if the following conditions are met:

a. Upon achieving majority the person must act, as much as possible, in a manner consistent with bona fide legal residence in North Carolina; and

b. The person must begin enrollment at an institution of higher education not later than the fall academic term next following completion of education prerequisite to admission at the institution.

2. If, immediately prior to beginning an enrolled term, the minor has lived in North Carolina for five or more consecutive years in the home of an adult relative (other than a parent) who is a legal resident of North Carolina, and if the adult relative, during those years, has functioned as a de facto guardian of the minor, then the minor is considered a legal resident of North Carolina for tuition purposes. If a minor qualified for resident status for tuition purposes under this provision immediately prior to his or her eighteenth birthday, then, upon becoming eighteen, he or she will be deemed to be a legal resident of North Carolina of at least twelve months' duration.

Even though a person is a minor, under certain circumstances the person may be treated by the law as being sufficiently independent from his or her parents as to enjoy a species of adulthood for legal purposes. If the minor marries or obtains a judicial decree of emancipation under N.C. Gen. Stat. §7A. 717, *et seq.*, he or she is emancipated. The consequence, for present purposes, of such emancipation is that the affected person is presumed to be capable of establishing a domicile independent of that of the parents; it remains for that person to demonstrate that a separate domicile in fact has been established.

Aliens. Aliens who are permanent residents of the U.S., or who hold a visa which will permit eventual permanent residence in the U.S., are subject to the same considerations with respect to determination of legal residence as citizens. An alien abiding in the United States under a visa conditioned at least in part upon intent not to abandon a foreign domicile (B, F, H, and J visas) cannot be classified a resident. An alien abiding in the United States under a visa issued for a purpose which is so restricted as to be fundamentally incompatible with an assertion by the alien of bona fide intent to establish a legal residence (C, D, and M visas) cannot be classified a resident.

Possession of certain other immigration documents may also allow an alien to be considered for in-state tuition status. For more details aliens should consult their admissions offices and the *Manual*. Aliens must file a Residence Status Supplemental Form in addition to the forms normally required of applicants for resident status for tuition purposes.

Military Personnel. The domicile of a person employed by the Federal government is not necessarily affected by assignment in or reassignment out of North Carolina. Such a person may establish domicile by the usual requirements of residential act plus intent. No person loses his or her in-state resident status solely by serving in the armed forces outside of the State of North Carolina.

Prisoners. There are special provisions concerning domicile of prisoners. For more information, persons to whom these provisions may apply should consult the *Manual*.

Property and Taxes. Ownership of property in or payment of taxes to the State of North Carolina apart from legal residence will not qualify one for the in-state tuition rate.

Change of Status. A student admitted to initial enrollment in an institution (or permitted to re-enroll following an absence from the institutional program which involved a formal withdrawal from enrollment) is classified by the admitting institution either as a resident or as a nonresident for tuition purposes prior to actual matriculation. In the absence of a current and final determination of the student's residence prior to matriculation, the student is classified a nonresident for tuition purposes. The institution will thereafter reach a final determination of the student's residence status. A residence classification once assigned (and confirmed pursuant to any appellate process invoked) may be changed thereafter (with a corresponding change in billing rates) only at intervals corresponding with the established primary divisions of the academic calendar.

Transfer Students. When a student transfers from one North Carolina public institution of higher education to another, he or she is required to be treated as a new student by the institution to which he or she is transferring and must be assigned an initial residence classification for tuition purposes. The residence classification of a student by one institution is not binding on another institution. The North Carolina institutions of higher education will assist each other by supplying residency information and classification records concerning a student to another classifying institution upon request.

The transfer into or admission to a different component of the same institution (e.g., from an undergraduate to a graduate or professional program) is not construed as a transfer from one institution to another and thus does not by itself require a reclassification inquiry unless (1) the affected student requests a reclassification inquiry or (2) the transfer or enrollment occurs following the lapse of more than one quarter, semester, or term during which the individual was not enrolled as a student.

Responsibility of Students. Any student or prospective student in doubt concerning his or her residence status bears the responsibility for securing a ruling by completing an application for resident status and filing it with the admissions officer. The student who, due to subsequent events, becomes eligible for a change in classification, whether from out-of-state to in-state or the reverse, has the responsibility of immediately informing the Office of Admissions of these circumstances in writing. Failure to give complete and correct information regarding residence constitutes grounds for disciplinary action.

It is the responsibility of the student to pay tuition at the rate charged and billed while an appeal is

pending. In effect, the student who is classified a nonresident at the time of tuition billing pays the nonresident rate. Conversely, if a student is classified as a resident at the time of billing, he or she pays the resident rate. Any necessary adjustments in the rate paid will be made at the conclusion of the appeal.

If a student, who has been found to be a nonresident for tuition purposes, receives an erroneous notice from an institutional officer identifying the student as a resident for tuition purposes, the student is not responsible for paying the out-of-state tuition differential for any enrolled term beginning before the classifying institution notifies the student that the prior notice was erroneous.

If a student is classified a resident for tuition purposes after submitting falsified residency information or after knowingly withholding residency information, the student's application for in-state tuition status is fraudulent. The institution may re-examine any application suspected of being fraudulent and, if warranted, will change the student's residence status retroactively to the beginning of the term with respect to which the student originally made the fraudulent application. If this occurs the student must pay the out-of-state tuition differential for all the enrolled terms intervening between the fraudulent application and its discovery. Further, knowing falsification of responses on a resident status application may subject the applicant to disciplinary consequences, including dismissal from the institution.

Appeals of Rulings of Admissions Officers. A student appeal of a classification decision made by any admissions officer must be in writing and signed by the student and must be filed by the student with that officer within fifteen working days after the student receives notice of the classification decision. The appeal is transmitted to the Residence Status Committee by that officer, who does not vote in that Committee on the disposition of such appeal. The student is notified of the date set for consideration of the appeal, and, on request of the student, he or she is afforded the opportunity to appear and be heard by the Committee. Any student desiring to appeal a decision of the Residence Status Committee must give notice in writing of that fact, within ten days of receipt by the student of the Committee's decision, to the Chairman of the Residence Status Committee, and the Chairman promptly processes the appeal for transmittal to the State Residence Committee.

Students or prospective students who believe that they are entitled to be classified residents for tuition purposes should be aware that the processing of requests and appeals can take a considerable amount of time and that applications for classification should not be delayed until registration, when the number of applications makes accelerated handling impossible.

MILITARY TUITION BENEFIT¹

Certain members of the Armed Services, and their dependent relatives, who are not residents for tuition purposes may become eligible to be charged less than the out-of-state tuition rate under N.C. Gen. Stat. §116-143.3, the military tuition benefit provision. Any person seeking the military tuition benefit must qualify for admission to UNC-CH and must file an application for the benefit with his or her admissions office before the first day of classes of the term for which he or she initially seeks the benefit. To remain eligible to receive the military tuition benefit, he or she must file another application for the benefit before the first day of classes of the first term in which he or she is enrolled in each academic year. The burden of proving eligibility for the military tuition benefit lies with the applicant for the benefit, and the application and all required supporting affidavits must be complete and in proper order before the first day of classes of the term in question.

Eligibility of Members of the Armed Services. Eligible members of the Armed Services pay a rate of tuition (less than the out-of-state rate) computed by applying a statutory formula which is dependent, in part, on the amount of money payable by their Service employer to them or to the institution by reason of their enrollment. To be eligible for this military tuition benefit, the individual must

- 1) be a member of the United States Air Force, Army, Coast Guard, Marine Corps, Navy, North Carolina National Guard, or a reserve component of one of these services; and
- 2) be abiding in North Carolina incident to active military duty which is performed at or from a duty station in North Carolina.

Eligibility of Dependent Relatives of Service Members. If the service member meets the conditions set forth above, his or her dependent relatives may be eligible to pay the in-state tuition rate if they share the service member's North Carolina abode and if they have complied with the requirements of the Selective Service System, if applicable.

¹The information in this section comes from three sources: (i) North Carolina General Statutes, §116-143.3, (ii) *A Manual to Assist the Public Higher Education Institutions of North Carolina in the Matter of Student Residence Classification for Tuition Purposes*, Revised September 1985, (iii) Chancellor's Rules and Procedures for Residence Classification of Students for Tuition Purposes and Determination of Eligibility for the Special Military Tuition Benefit.

If the service member voluntarily ceases to live in North Carolina or is involuntarily absent from the state on military orders (other than absences on routine maneuvers and temporary assignments), he or she is deemed to have moved his or her abode from North Carolina. If a dependent relative of a service member has become eligible for the military tuition benefit and, after the beginning of the term of eligibility, the service member moves his abode from North Carolina, the dependent relative will continue to be eligible for the military tuition benefit only for the remainder of that academic year. An academic year runs from the first day of classes of the fall semester through the last day of exams of the following summer session, second term.

For a detailed explanation of the military tuition benefit provision, a complete list of categories of persons who are considered "dependent relatives" for purposes of establishing eligibility for the military tuition benefit, and information about the registration requirements of the Selective Service System, applicants should consult *A Manual to Assist the Public Higher Education Institutions of North Carolina in the Matter of Student Residence Classification for Tuition Purposes* (as amended September 1985). This *Manual* is available for inspection in the Admissions Offices of the University. Copies of the *Manual* are also on reserve at the Robert B. House Undergraduate Library.

Appeals of Eligibility Determinations of Admissions Officers. A student appeal of an eligibility determination made by any admissions officer must be in writing and signed by the student and must be filed by the student with that officer within fifteen working days after the student receives notice of the eligibility determination. The appeal is transmitted to the Residence Status Committee by that officer, who does not vote in that Committee on the disposition of such appeal. The student is notified of the date set for consideration of the appeal, and, on request of the student, he or she is afforded an opportunity to appear and be heard by the Committee.

Any student desiring to appeal a determination of the Residence Status Committee must give notice in writing of that fact to the Chairman of the Residence Status Committee within ten days of receipt by the student of the Committee's decision. The Chairman will promptly process the appeal for transmittal to the State Residence Committee.

UNIVERSITY CALENDAR

1986-1987

Fall Semester 1986

August 18-20, Monday-Wednesday	Registration.
August 21, Thursday	Classes begin.
September 1, Monday	Holiday.
October 3, Friday	Last day for submitting an application for a degree and an application for admission to candidacy for the master's degree and last day for submitting an application for doctoral degree for December graduation.
October 12, Sunday	University Day.
October 22, Wednesday	Fall recess begins at 5 p.m.
October 27, Monday	Classes resume at 8 a.m.
November 15, Saturday	Written examinations for master's candidates for December graduation may not be taken after this date.
November 21, Friday	Last day to <i>drop</i> a course.
November 26, Wednesday	Thanksgiving recess begins at 1 p.m.
December 1, Monday	Classes resume at 8 a.m.
December 3, Wednesday	Last class day.
December 4, Thursday	Reading day.
December 5, Friday	Final signed copies of doctoral dissertations and master's theses for candidates for the December graduation must be filed in the Graduate School by this date.
December 5-16	Final course examinations.
Friday-Tuesday	

Spring Semester, 1987

January 5-6, Monday-Tuesday

January 7, Wednesday

January 30, Friday

March 6, Friday

March 16, Monday

March 28, Saturday

April 9, Thursday

April 20, Monday

April 24, Friday

April 23, Thursday

April 24, Friday

April 27-May 6

Monday-Wednesday

May 10, Sunday

Registration.

Classes begin.

Last day for submitting an application for a degree and an application for admission to candidacy for the master's degree and last day for submitting an application for doctoral degree for May Commencement.

Spring recess begins at 5 p.m.

Classes resume at 8 a.m.

Written examinations for master's candidates for May Commencement may not be taken after this date.

Last day to *drop* a course.

Holiday.

Final signed copies of doctoral dissertations and master's theses for candidates for the May Commencement must be filed in the Graduate School by this date.

Last class day.

Reading day.

Final course examinations.

Commencement.

Special Deadlines for Admission Applications

July 1

Last day for submitting application for admission to the Fall Semester.

November 1

Last day for submitting application for admission to the Spring Semester.

February 1

Last day for submitting application to qualify for fellowship or assistantship consideration for the Fall Semester.

