

***DOCTORAL EDUCATION AT THE UNIVERSITY OF CALIFORNIA
AND FACTORS AFFECTING TIME-TO-DEGREE***

Prepared by:

*Maresi Nerad, Ph.D.
Graduate Division
University of California
Berkeley, California*

*University of California
Office of the President
Oakland, California*

June 1991

TABLE OF CONTENTS

Executive Summary	e-i
Introduction	1
I. The Doctoral Degree Program: The Five Stages of a Doctoral Program.....	5
A. First Stage: Taking Courses.....	5
B. Second Stage: Preparing for and Taking the Qualifying Examination.....	6
C. Third Stage: Finding a Dissertation Topic and Adviser, and Writing a Dissertation Prospectus.....	6
D. Fourth Stage: Undertaking the Dissertation Research and Writing.....	7
E. Fifth Stage: Applying for Professional Employment...	8
II. Doctoral Degrees Awarded by the University of California: 1968, 1978, and 1989.....	10
A. Increase in Degree Production: 1968 - 1988.....	10
B. Distribution of Degrees Earned by Women, Ethnic Minorities, and Major Fields of Study.....	11
III. Characteristics of Doctoral Degree Recipients at the University of California: 1968, 1978, and 1988.....	15
A. Age.....	15
B. Marital Status.....	16
C. Dependents.....	16
D. Parents' Education.....	17
E. Type of Undergraduate School.....	17
IV. Time to Doctoral Degree: 1968 - 1988.....	20
A. Time Measures and Definitions.....	20
B. Time-to-Degree for Ethnic Minorities and Women: 1980 - 1988.....	22
C. Increases in Time-to-Degree: 1968 - 1988.....	23
V. Factors Contributing to Lengthened Time-to-Degree.....	27
A. Field-specific Factors.....	27
B. Institutional Factors.....	34
VI. Completion Rates (Attrition) -- UC Berkeley Study.....	51
VII. Principal Findings and Future Research.....	54
A. Recommendations.....	54
B. Future Research.....	60

Bibliography.....	62
Tables.....	65
Appendices.....	117
Appendix A: NRC Mapping of Major Disciplines.....	117
Appendix B: List of Doctoral Degrees Offered at UC.....	119
Appendix C: NRC Questionnaire.....	121
Appendix D: AGS Task Force on Institutional Policies Governing Doctoral Education.....	124
Appendix E: CGS Task Force on the Role and Nature of the Doctoral Dissertation: Recommendations...	136

LIST OF TABLES, GRAPHS, AND FIGURES

TABLES..... 65

Tables are for the University of California, nine campuses, unless otherwise labeled.

1.	Doctorate Recipients by Sex, Major Field, and Percent Change: 1968, 1978, 1988.....	65
1A.	Doctorate Recipients, Percentages by Sex.....	66
1B.	Doctorate Recipients by Ethnicity and Percent Change...	66
2.	Doctorate Recipients, by Ethnicity, Percentages by Field, 1978 and 1988.....	67
3.	Doctorate Recipients by Average Age at Degree Completion, 1968, 1978, 1988.....	68
4.	Doctorate Recipients, Percentages by Marital Status, 1968, 1978, 1988.....	69
5.	Doctorate Recipients, Percentage with One or More Dependents, 1968, 1978, 1988.....	70
5A.	Mean Time to Doctoral Degree Recipients, 1980-88 by Dependent and No Dependents Status.....	71
5B.	Doctoral Recipients, Percentage by Dependents/No Dependents, 1980-88.....	72
6.	Domestic Doctorate Recipients by Sex and Parents' Education Level, 1988.....	73
6A.	Domestic Doctorate Recipients by Ethnicity and Parents' Education Level, 1988.....	74
7.	Doctorate Recipients by Ethnicity: Institution where Bachelor's Degree Earned, 1978 and 1988.....	75
8.	Mean Time to Doctoral Degree, All Degree Recipients, 1968, 1978, 1988.....	76
8A.	Median Time to Doctoral Degree, All Degree Recipients, 1968, 1978, 1988.....	77
9.	Mean Time to Degree, Doctoral Recipients, 1980-88: Time from Entry to Graduate School to Completion of Doctoral Degree by Sex, Citizenship Status, and Ethnicity.....	78

10.	Mean Time to Degree, Doctorate Recipients, 1980-88 by Master's Degree Status.....	79
10A.	Median Time to Degree, Doctorate Recipients, 1980-88, by Master's Degree Status.....	80
10B.	Doctorate Recipients, 1968, 1978, 1988: Proportion of Doctoral Recipients by Master's Degree Status.....	81
11.	Mean Time to Degree at Doctorate Granting Institution, 1968, 1978, 1988: Time from Entry to Graduate School to Completion of Doctoral Degree by Major Field and Sex.....	82
11A.	Median Time to Degree at Doctorate Granting Institution, 1968, 1978, 1988: Time from Entry to Graduate School to Completion of Doctoral Degree by Major Field and Sex.....	83
12.	Mean Time to Doctoral Degree at Doctorate Granting Institution by Three Time Measures and by Major Field, 1968, 1978, 1988.....	84
12A.	Median Time to Doctoral Degree at Doctorate Granting Institution by Three Time Measures and by Major Field, 1968, 1978, 1988.....	85
12B.	Mean Time to Doctoral Degree at Doctorate Granting Institution by Three Time Measures, by Sex, and by Major Field, 1968, 1978, 1988.....	86
13.	Mean Time to Degree at Doctorate Granting Institution, 1978 and 1988, Time from Entry to Graduate School to Completion of Doctoral Degree by Major Field and Ethnicity/Race.....	87
13A.	Median Time to Degree at Doctorate Granting Institution, 1978 and 1988, Time from Entry to Graduate School to Completion of Doctoral Degree by Major Field and Ethnicity/Race.....	88
14.	Mean Time from Graduate Entry to Ph.D., Doctorates Awarded 1980-88 by Major Field, Type of Support, Sex, and Ethnicity/Race.....	89
14A.	Distribution of Primary Support, Doctorates Awarded 1980-88 by Major Field, Type of Support, Sex, and Ethnicity/Race.....	90

15.	Mean Time from Entry to Graduate School to Completion of Doctoral Degree by Major Field of Doctorate--Same or Different Baccalaureate Major, 1968, 1978, 1988.....	91
16.	Relationship between Years of Teaching Assistantship and Time to Degree, Doctorate Recipients, May 1986-May 1989, for Five Selected Departments in the Humanities and Social Sciences.....	92
17.	Student Expenses, Student Fees and Financial Support, in 1988 Constant Dollars.....	93
18.	Relationship between Time to Doctoral Degree and Years of Support During the First Five Years of Doctoral Studies by Sex, Doctorate Recipients, May 1986-May 1989.....	94
19.	Annual Expenses Covered by Financial Support During the First Five Years of Doctoral Studies, Doctorate Recipients, May 1986-May 1989.....	95
20.	Percent Accumulating Debt, Doctoral Recipients (U.S. Citizens and Permanent Residents), 1988.....	96
21.	On-campus Housing Expenses 1989-90 for Selected Campuses.....	97
22.	Average Single Off-campus Graduate Student Housing Expenses (Dollars/Month) for Four Academic Years by Campus.....	98
23.	Percent of Graduate Students Living On and Off Campus, 1988-89.....	99
24.	Campus Child Care: 1987-88.....	100
25.	Graduate Student Retention for Doctoral Students by Ethnicity, Cohort 1975-77.....	101
26.	Doctoral Progression Status for the 1975-77 Cohort, Total Campus.....	102
27.	Doctoral Progression Status for the 1975-77 Cohort, Eight Major Groups.....	103

FIGURES

1. Factors Determining Time to Degree and Attrition.....104
2. Doctoral Requirements UC Berkeley 1978-88.....105
3. Doctoral Requirements 1989-90: UCSB, UCLA, UCI.....106

GRAPHS

1. Number of Doctorate Degrees Awarded Universitywide by Discipline: 1968, 1978, and 1988.....107
2. Distribution of Doctoral Recipients by Discipline for Degrees Awarded 1980 to 1988.....108
3. Distribution of Doctoral Recipients by Major Field for Degrees Awarded 1980 to 1988 (U.S. Citizens & Permanent Residents).....109
4. Mean Time to Doctoral Degree, 1980-88, Asians/Non-Asian Minorities/Whites, Universitywide, By Discipline.....110
- 4A. Median Time to Doctoral Degree, 1980-88, Asians/Non-Asian Minorities/Whites, Universitywide, By Discipline.....111
5. Mean Time to Doctoral Degree, 1980-88, Men/Women by Discipline, Universitywide.....112
- 5A. Median Time to Doctoral Degree, 1980-88, Men/Women by Discipline, Universitywide.....113
6. Average Single Off-campus Housing Expenses by Campus and Graduate Status.....114
7. Doctoral Completion Rates, 1975-77 Cohort by Eight Fields of Study, as of November 1988.....115

EXECUTIVE SUMMARY

Executive Summary

DOCTORAL EDUCATION AT THE UNIVERSITY OF CALIFORNIA AND FACTORS AFFECTING TIME-TO-DEGREE

**Report to the Office of the President
October 1990**

Time-to-degree has become a major issue among graduate deans and at the University of California (UC), owing to the current need to diversify faculty and the impending shortage of doctorates. The following study examines time-to-degree at the University of California. It determines whether students took longer on average to complete their doctoral degrees than they did 20 years ago and presents factors that may have led to long time-to-degree. The analysis addresses underlying structural reasons for prolonged time-to-degree among all students and also examines whether or not these factors influence ethnic minorities and women in a special way.

To analyze doctoral degree production, time-to-degree, and student characteristics, this research relied on these sources: (1) a review of historical trends in data (1968, 1978, and 1988) provided by the National Research Council (NRC); (2) interviews with approximately 300 doctoral students on the nine UC campuses and from the major fields of study; (3) consultations with faculty members of the Graduate Council, the graduate deans, and their staff on each campus; and (4) relevant, available data from campus studies to illustrate specific findings.

The study begins with an overview of doctoral programs at UC (Part I), including the five stages of a doctoral program: taking courses; preparing for and taking the qualifying examination; finding a dissertation topic and adviser and writing a dissertation prospectus; undertaking the dissertation research and writing; and applying for professional employment. This section discusses the differences in requirements associated with doctoral programs in different groups of disciplines, including a comparison of those in academic programs and professional schools.

Part II presents a review of trends in doctoral degrees awarded by the University of California between 1968, 1978, and 1988 and of the distribution of degrees by field, gender, and ethnicity. It concludes that the number of doctorates awarded by UC between 1968 and 1988 increased by 59 percent (although not steadily) from 1,444 degrees awarded in 1968, to 1,975 in 1978, to 2,295 in 1988, mostly in engineering, arts and humanities, life sciences, and social sciences. The number of doctoral degrees awarded to women increased substantially from 166 or 13 percent of all degrees awarded (domestic and temporary visa degree recipients) in 1968, to 423 or 18 percent in 1978, to 653 or 31 percent in 1988. The

number of degrees awarded to ethnic minority students increased from 190 (or 11 percent of all domestic doctoral degrees awarded) in 1978 to 274 (or 15 percent) in 1988. During 1980-88 women received their degrees primarily in the life sciences, arts and humanities, and social sciences, while men received their degrees primarily in the physical sciences, life sciences, and engineering. Asian Americans earned degrees primarily in engineering, physical sciences, and life sciences. Non-Asian minorities were clustered in life sciences, social sciences, arts and humanities, and professional schools.

Part III describes doctoral degree recipients' age, marital status, dependents, parents' educations, and type of undergraduate school, and it examines changes over time. In 1988, on the average, doctoral students completed their degrees at 33.3 years of age, one year older than their counterparts in 1968. African American doctoral degree recipients were the oldest (37.3) of all degree recipients. Women as a group were two years older than men. In 1988, over half of all doctoral recipients reported that they were married when they completed their studies, fewer than in 1968, and 41 percent had one or more dependents. Fewer women than men reported themselves as married and having dependents. A larger proportion of minority students than white students had dependents. About 40 percent of all students had parents with some college education. Many African Americans, Chicanos, Latinos, and American Indians were the first in their family to attend college. In 1988, 50 percent of all UC domestic degree recipients received their undergraduate education in California; 32 percent from UC, 12 percent from CSU, and 6 percent from California private schools. Thirty percent of African Americans had undergraduate degrees from a CSU institution.

Part IV analyzes the amount of time students took to complete degrees beginning with the time they entered graduate school until the time they completed the UC doctorate. About two-thirds of all students, primarily in professional fields, arts and humanities (90 percent), engineering (85 percent), and social sciences (80 percent), acquired a master's degree before starting a doctoral program. Only half of the life science and physical science students did so. Students with no master's degree took the shortest time to complete the doctoral program; students with the master's degree from another institution took the longest time (two years longer), and students with a master's degree from the same institution took, on average, one year longer than those without a master's degree. Overall, time to the doctoral degree (mean and median time) at UC has increased by about one year over the last 20 years. Mean elapsed time increased from 6.7 years in 1968, to 7.2 years in 1978, to 7.7 years in 1988. Median time increased from 5.4 years in 1968, to 6.4 years in 1978, to 6.7 years in 1988. (Students with a master's degree from an institution other than the doctoral degree-granting institution were excluded from these time measures.) Time-to-degree has increased most in those disciplines

that traditionally have had a longer time-to-degree, most notably the humanities and social sciences. Since minorities and women tend to be clustered in these fields, they are disproportionately affected. Although women as a group and non-Asian minorities as a group in 1980-88 took, overall, 1.5 years and 0.9 year longer in mean time, respectively, and 1.3 and 1.6 years in median time, respectively, to complete the doctoral degree than did men as a group and whites as a group, when the data were disaggregated by disciplines, the time-to-degree for women and minorities was not substantially different from that for men and whites.

Part V, the core of this study, discusses the factors that influence time-to-degree (see Figure 1). This study concludes that field-specific and institutional factors contribute to long time-to-degree. The field-specific factors include: (1) how research is conducted and taught; (2) how research is funded; (3) how the doctoral program is structured; (4) whether or not foreign language competency is required; (5) what role the dissertation plays in doctoral training; (6) whether or not a post-doctoral study appointment follows the doctoral degree for those who aspire to an academic career; (7) what undergraduate training is accepted; and (8) whether or not a master's degree is required before entrance to the doctoral program. All these factors are interrelated.

Research Structure: Graduate students in the sciences and engineering acquired research skills through an apprenticeship model of research instruction and team-work in a laboratory setting where they benefited from frequent social interactions. The laboratory research and the dissertation work often coincided and frequently were supported by a research assistantship under the direction of a faculty investigator. The arts, humanities, social sciences, and professional fields do not have the same structure for involving students as active participants in the collective research process. In addition, these fields have fewer resources to pay for research assistants. Research skills in these fields are taught in seminars and students apply these skills in the end of term seminar paper.

Research Funding: Of the students who received their doctoral degrees at UC between 1980 and 1988, 2 percent in the arts and humanities, 8 percent in the professional schools, 11 percent in the social sciences, 29 percent in the life sciences, and 50 percent in engineering and the physical sciences reported that research assistantships were their primary means of support.

Role of the Dissertation: Science and engineering programs generally perceived the dissertation to be a test of future ability to do research; humanities and social science programs expected the dissertation to be a major contribution to the field.

Post-Doctoral Studies: Life sciences, physical sciences, and some engineering doctorates who intend to pursue an academic career

undertake at least two years of post-doctoral study. This is not the case in the arts, humanities, and professional schools and is only rarely the case in the social sciences. Examining time-to-degree from this angle, the study concludes that the time difference between the above-contrasted disciplines disappears.

Undergraduate Training: Time-to-degree for students who changed fields upon entering a doctoral program was on the average two years longer than for those who remained in their undergraduate field. These students most likely acquired a master's degree before pursuing the doctorate. This step, when required, adds an average of one year to the doctoral degree time.

Other Factors: Natural science students who took a long time to complete their degrees typically did so because they had to rebuild the set-up of a failed experiment and because of unforeseen natural events that delayed their research.

Although field-specific factors play an important role in students' staying in a doctoral program and completing it in a timely manner, institutional factors, determined within the institutions and the department, also have an effect and are outside of the purview of the administration. However, these factors are interrelated. Institutional factors are: (1) degree requirements; (2) teaching requirements and the system of evaluating student progress; (3) faculty advising and departmental guidance; (4) students' financial burden/financial support and their debt accumulation; (5) the campus facilities; and (6) the availability of professional job opportunities and placement support offered by the department and the campus.

Degree Requirements: Most faculty members interviewed argued that the increase in time-to-degree is due, at least in part, to an increase in the requirements for the doctoral degree. Altogether, this study found that a time decrease coincided with flexibility in preliminary examination requirements and tightening of the program structure, and a time increase with an additional acquisition of new research methods. Overall, the life sciences, engineering, and physical sciences programs (with the exception of mathematics) not only seemed more tightly structured, but also the program requirements were more likely to reflect the present requisites in their professional fields, such as grant writing, publishing, and frequent presentation of research results. A Berkeley survey found that programs that require a dissertation prospectus as part of the qualifying examination tend to have shorter time-to-degree. Life science programs had students write this prospectus in the form of a grant proposal. Programs with a structure that calls for an early start to dissertation research tended to have shorter degree time. Programs that evaluate their students' progress annually and suggest improvements seemed to inspire students' confidence about completing the degree. Students especially appreciated the regular progress meetings with dissertation committees after advancement to

candidacy. Students in these programs seemed to "drift" less. Students also favored the custom of a dissertation defense.

Teaching: A Berkeley study showed that students who taught three or more years took an average of one year longer to complete the degree than students who taught less than three years. The NRC data (1980-1988) showed that students who supported themselves primarily by teaching took on the average 1.3 years longer than those who depended on research assistantships.

Advising: Although most of the interviewed students reported having good personal relationships with their advisers, many did not receive enough professional support. Students expected an adviser to be a mentor who would set standards, help them to develop their skills, advise them on appropriate and feasible dissertation topics, and treat them as junior colleagues. Results from a Berkeley doctoral student exit questionnaire showed that although, overall, a majority of students were satisfied with their professional relationship with their advisers, women were less satisfied than men. Minority students particularly wished for a faculty mentor. Science departments with laboratory rotations seemed to be particularly successful in securing a good match between faculty advisers and students. In these departments few students lost time as a result of having to change advisers halfway through their studies.

Funding: According to students, faculty, and graduate deans, one of the key factors influencing longer time-to-degree is insufficient financial support for doctoral students. Minority students and students in the arts, humanities, education, and social sciences were particularly vocal about the rising fees, soaring housing costs, and the expenses of health insurance, car insurance, and raising a family. They were deeply affected by the increasing discrepancy between expenses and financial support. The average graduate student's expenses during the last ten years increased at a higher rate than the financial support awarded (35 percent versus 17 percent). Students whose major financial support came from their own earnings took the longest average time to complete their degrees (11 years), followed by students supported by loans (9.4 years), and students supported by teaching assistantships (8.3 years). The most advantageous correlation of support in terms of time-to-degree proved to be research assistantships (7.0 years) followed by multi-year fellowships (7.9 years). Although, overall, an equal or larger proportion of women and non-Asian minorities than men and whites reported that they were funded by multi-year fellowships, women and minorities were supported less often than men and whites by research assistantships. A Berkeley study of five social sciences and humanities departments found that students with no support took twice as long as students with four and five years of support. The department offering the most financial support had the shortest time-to-degree; the department offering the most financial support

in the form of teaching assistantships had a fairly long time-to-degree, and the department with the shortest time-to-degree not only provided the most financial support, but also distributed the support most evenly among research assistantships, teaching assistantships, and fellowships. The study concluded that time-to-degree is related to the amount of support, the type of support, the time at which the support is awarded, and the overall structure of the program. The analysis of student financial support also found that more than half of all doctoral degree recipients accumulated debts during their years as students. Women had smaller accumulated debts than men, and African Americans had the greatest average debts among ethnic groups.

Campus Facilities: The increase in student expenses was partly owing to the increased cost of on- and off-campus housing. Overall, about 84 percent of students lived off-campus. Half of a research or teaching assistantship salary could be spent on housing alone. Since 42 percent of all doctoral recipients reported having one or more dependents, and the time of these students was 1.3 years longer than those without dependents, this study also considered child-care facilities and expenses. Although all campuses had child-care facilities, there was an inadequate number. Since more minority than white degree recipients reported responsibilities for dependents, their financial burden is greater (an extra \$350 - \$495 per month). The campus infrastructure was also reported to be less than adequate in these ways: not enough public transportation; lack of office space for teaching assistants; and too few library hours during the summer.

Professional Job Opportunities: Faculty most often cited the lack of academic jobs as a major reason for the lengthening time-to-degree. Although an objective examination of this argument was beyond the scope of this study, half of the interviewed students in the sciences and engineering were interested in industry careers rather than in academic careers. While traditionally many students in engineering, physical sciences, and life sciences have sought employment in industry, the proportion of these students has substantially increased. Students cited the long hours required of junior faculty, the increased difficulty in receiving grant money, and the relatively low pay of post-doctoral and assistant professor positions as reasons.

Part VI examines completion rates of doctoral students. While attrition rates for all nine UC campuses are not available at this time, studies conducted at Berkeley and UCLA give some results. Doctoral completion rates varied substantially among major fields. Low completion rates positively correlated with long time-to-degree. More than 50percent of students who began studying for a doctorate in 1975 - 1977 had reached their degree goal by November 1988. An additional 25 percent earned a master's degree before leaving the program, bringing the total number of all students who earned a graduate degree as of November 1988 to more than 75

percent. At Berkeley the majority of doctoral students who did not complete the doctorate left during their first three years, before advancing to candidacy. These students cited personal reasons and institutional factors as reasons for leaving. A slightly higher percentage of minority students than whites left during the first three years. Slightly more women (14 percent) than men (10 percent) left after advancement to candidacy, and the degrees of more women were still pending (8 percent) after 12 years of study.

Part VII suggests findings with respect to the timely completion of degrees.

- (1) UC faculty are one key to timely completion of the doctorate, particularly in the humanities and social sciences. Among other activities, faculty contribute to timely completion through (a) mentoring and advising of graduate students, integrating students into the activities of the department and the discipline in all phases of their doctoral programs, and promoting a campus environment that supports diversity; (b) developing policies and practices on teaching assistantships that contribute to educational goals without slowing progress to degree completion; (c) ensuring that students have apprenticeship opportunities in research; (d) reviewing requirements; and (e) reviewing expectations of graduate student performance and disseminating information about these expectations to students.
- (2) Adequate graduate student support is the other key to timely completion. UC is considering how to work with other doctoral institutions to influence federal and state policy in securing increased support, particularly in the form of research assistantships and other graduate assistantships, for all graduate students.
- (3) Recruitment and timely degree completion among minority and women students are enhanced by the University's ability to offer comprehensive support packages. The Office of the President, Chancellors, and the Graduate Divisions have as a high priority to provide to as many minority and women students as possible packages of comprehensive support at a level competitive with other major universities.

Such support is most effective when it comes in forms to serve educational and training goals, as well as to provide financial assistance. These effective combinations of financial and academic support include mentored fellowships for beginning doctoral students, research assistantships, teaching assistantships, and fellowships to support dissertation studies.

- (4) Availability of non-academic support services, such as low-cost housing, child care facilities, and office space; the Office of the President, Chancellors, and the campuses are considering how to work together to increase access to non-academic services that benefit graduate students.

INTRODUCTION

INTRODUCTION

Time-to-degree has become a major issue among graduate deans nationally and at the University of California, because of the current need to diversify faculty and the impending shortage of doctorates.¹ The following study examined time-to-degree at the University of California by considering whether students take longer to complete their doctoral degrees than they did 20 years ago and, if so, what factors may have led to the increase in time.

During the preliminary stages of this study, it became clear that many factors which promote timely and successful completion of a doctoral program impact all students, regardless of race, ethnicity, sex, or age. Factors such as a student's field, the circumstances under which research is practiced and taught, and student financial support influence time-to-degree and completion of the doctoral program. To ascertain whether ethnic minorities and women face particular problems, this study first addressed the underlying structural factors influencing time-to-degree among all students. This study then examined at each stage how these factors particularly influenced ethnic minorities and women.

Data Sources and Method

This study used three sets of sources: (1) Historical UC data from the National Research Council (NRC), collected annually from a nationally distributed questionnaire of recently completed doctorates, were used to analyze degree production, time-to-degree, and student characteristics.² This source gives information about students who successfully completed the degree program. (2) Interviews with approximately 300 current doctoral students from the nine UC campuses and from every major field of study were conducted. In addition faculty, members of the campus divisions of the Coordinating Committee on Graduate Affairs, the graduate deans, and their staff on each campus were consulted. (3) Selected data from individual campuses were added to illustrate specific conclusions. The format of the student interviews was guided by the five major stages of the doctoral program: course work; preparation for and taking the qualifying exam; finding a dissertation topic; selecting an adviser; writing a prospectus; the actual dissertation research and writing; and applying for professional employment. Students were asked to describe what the departmental requirements were, how they moved from one stage to

¹If the time-to-degree issue were to be viewed from an employer's perspective, the question to ask would be: How long does it take to train a full-fledged professional in a field? Other considerations would be such things as practice, internships, and postdoctoral studies.

²Jim Litrownik and Joyce Travlos from the Office of the President, Academic Affairs, produced the NRC data and constructed the NRC tables and graphs.

the next, what financial and moral support they had, and what would have helped them at each stage. They were also asked for their recommendations on what the University could do to help students finish more quickly. Only at the very end of the interview was their opinion solicited on the reasons for long time-to-degree in their programs. In all, the study included a period of four months of intensive consultation with faculty and doctoral students by the researcher.

Report Structure

The goal of this study is to investigate whether time-to-degree has increased over time. A twenty-year period from 1968 until 1988 was chosen, and three years in ten-year intervals were selected--1968, 1978, and 1988. However, only since 1975 has the federal government required the reporting of race and ethnicity, and therefore analysis involving ethnic minority students is limited to the period between 1978 and 1988. Sometimes, when numbers are small or when a global picture is presented, data from 1980 to 1988 are combined. Because time-to-degree is such a complex problem, Part I of this report begins with a description of the five stages of a doctoral program. Part II presents the production of doctorates awarded by the University of California to all students and includes as a special focus, women and ethnic minorities. The increase of degrees awarded over time and the clustering of minorities in certain fields are shown. Part III illustrates the characteristics of the doctoral student body by age, marital status, dependents, and type of undergraduate school. Part IV analyzes the length of time students took, on the average, in 1968, 1978, and 1988, to obtain a doctoral degree. The major factors influencing time-to-degree, such as research training and funding, degree and teaching requirements, faculty advising, financial burdens and financial support, and post-doctoral career paths are analyzed in Part V. Doctoral student attrition is addressed in Part VI. The study concludes with recommendations concerning advising, program structure and staff services, teaching, research, evaluating student progress, funding, and campus facilities in Part VII.

Definitions

Brief definitions are in order: Ethnic minorities include Asian Americans, African Americans, American Indians, Chicanos, and Latinos. The term non-Asian minorities has been used to refer to all of the above, except Asian Americans. When describing the ethnicity of students (including minorities and whites), this study has excluded foreign students or non-U.S. residents. If this study refers to women or men doctoral students, foreign students are included, unless otherwise noted. The various doctoral programs were grouped into six major fields of study: arts and humanities, engineering, life sciences, physical sciences, professional fields, and social sciences. Appendix A lists programs included in each

major field. The University of California offers both the academic (Ph.D.) and the professional doctorate. Appendix B lists the professional doctorates offered. Very few students pursue the professional doctorate. For example in 1988, the ten professional doctorates accounted for less than 9 percent of the total doctoral degrees awarded.

Acknowledgments

Many people have contributed to this study. The staff of the Graduate Divisions organized effective campus visits. Special thanks should go to Laura Gardner at Davis, Mark Warner at Irvine, Ellen Benkin at Los Angeles, Yvonne Katzenstein at Riverside, Paula Rudolph and Lavelle Ure at Santa Barbara, Jim Newman and Terry Townsend at Santa Cruz, Jean Fort and Roberta Weil at San Diego, and Carol Landa at San Francisco. Judi Sui at Berkeley produced the Berkeley completion data, and Carol Lynn Stewart compiled the student expense, housing, and child care information. Jennifer Collins assisted throughout the study and edited the manuscript. Debra Sands Miller edited the revisions. Sandria Freitag, Kate Jeffrey, Mark Langberg, Jim Litrownik, Cherly Lofton-Brown, Karen Merritt, Leann Parker, and Susan Scudder from the Office of the President were always available for questions and advice.

PART I:

**THE DOCTORAL DEGREE PROGRAM:
THE FIVE STAGES OF A DOCTORAL PROGRAM**

I. THE DOCTORAL DEGREE PROGRAM: THE FIVE STAGES OF A DOCTORAL PROGRAM

Strictly speaking, a doctoral degree program consists of four distinct stages: (1) taking courses; (2) preparing for and taking the qualifying examination; (3) finding a dissertation topic and adviser and writing a dissertation prospectus; and (4) undertaking the research and writing the dissertation. For this study, however, a fifth stage--(5) applying for a professional position--has been added, given that the majority of students look for jobs while in graduate school and given that interviewed faculty and students agreed that the absence or presence of a job offer has an impact on the time to completion of a degree. The stages are a logical progression toward the degree. In practice, however, some of them may overlap.

A. First Stage: Taking Courses

In the first stage of a doctoral program, students develop an advanced level of familiarity with their fields. During this stage, students specialize within the field and make connections with areas outside the field. For the most part, students study in seminars or reading courses, through independent study, or on laboratory research projects led by faculty. Graduate students rarely take large lecture courses, unless they need an overview of a new area or a review of a minor subject area.

Each doctoral program establishes its own set of requirements, including the number of courses and their content, as well as the form, sequence, and number of examinations. For example, many engineering and physical science programs require a series of written or oral examinations, known as the "prelims," at the end of the first year. The social sciences, humanities, and professional schools rarely require examinations at the end of the first year. Another distinction among the programs, even in the same disciplines across the UC campuses, is the flexibility of course requirements. For example, Electrical Engineering at Davis requires a fixed sequence of courses. In contrast, Electrical Engineering and Computer Sciences (EECS) at Berkeley has no specified course requirements at all; instead, a group of Electrical Engineering faculty determines what particular set of courses will be useful for each student. In contrast, most social science programs not only require many courses within the field, including methodology courses, but also demand that courses be taken in other fields.

Foreign language requirements differ considerably from field to field. Humanities fields usually require between two and three foreign languages, as is the case in most English programs, Asian History, Art History, and Music. The social science fields, on the average, require one foreign language. Most life sciences, engineering, and physical science programs require no foreign

language. Mathematics, an exception, requires at least one, if not two, foreign languages.

B. Second Stage: Preparing for and Taking the Qualifying Examination

All programs have the qualifying examination as a common element. This series of examinations, however, varies widely in form, length, and time at which it is taken. Most qualifying examinations include an oral component.

In the humanities, social sciences, and professional schools, these examinations usually consist of two parts: (a) written examinations or three major papers, and (b) a one-and-one-half- to three-hour oral, ranging in subject from any area possible in the field to specific questions on the area of the dissertation in those fields where students are already working on their dissertation research. Science and engineering students are often required to design one or two research proposals other than their dissertation for this examination. The oral portion is usually a presentation of dissertation work that the student has already accomplished.

After passing the qualifying examination, often no later than the semester following the examination, students are advanced to candidacy. After this point, students take no more required courses, or they take only those directly related to their dissertation research.

C. Third Stage: Finding a Dissertation Topic and Adviser and Writing a Dissertation Prospectus

This stage of the doctoral program has two parts: (a) deciding on a dissertation topic and selecting a faculty major adviser--a choice that must be made before advancement to candidacy, but may already be determined during the first year--and (b) writing a dissertation proposal or prospectus.

For most students the processes of deciding on a topic and selecting an adviser go hand in hand. Some students enter a doctoral program with a precise idea of both topic and faculty adviser. Others develop their specific interests while taking courses, and students who are part of a laboratory research team may select a portion of the larger project to be their dissertation research. Still others select an adviser before choosing a topic. These students base their decision on the anticipation of a good working relationship with this faculty member, regardless of whether their interest matches that of the faculty member. Their choice of topic afterwards may or may not reflect the interest of that faculty member. Others, more pragmatically, choose the faculty member who has enough grant money to support students. In

addition, some students are invited by certain faculty to study under them.

Many programs require that a dissertation prospectus be presented at the time of the qualifying examination or shortly thereafter. A prospectus is usually an outline of the proposed dissertation research. It includes a statement of the problem, a review of the literature, and a discussion of the methodology used. It can vary in length from five to forty pages.

D. Fourth Stage: Undertaking the Dissertation Research and Writing

The actual research stage is predetermined by the discipline, since each major field has its distinct way of conducting research. In the physical sciences, engineering, and molecular and cellular life sciences, research is practiced in a laboratory, usually on campus. Some physics or chemistry students may have to travel to major national laboratories for the use of specific facilities such as accelerators or light sources. The work in these disciplines is often done in a team. Students in theoretical physics, mathematics, and statistics, who study alone without laboratories or highly technical equipment, are exceptions.

Students in the life sciences who study entire organisms often observe plants or animals in their natural habitats, which may be at distant locations. Their research may also be limited to certain seasonal conditions and is often an individualistic process. Many social sciences and professional discipline students may do research in the field, at home or abroad, normally spending a year on field research. They usually work alone. Humanities students typically do research in libraries and archives, reading and analyzing texts. They may take occasional trips to major libraries or archives, but today, many texts are available on microfilm in the campus libraries. Their research mode is an individualistic one.

The dissertation writing stage is a difficult period for students in all fields. The dissertation, the most crucial requirement for the doctoral program, demands consistent and continual attention. The writing process itself is time-consuming and all-absorbing; moreover, successful organization and presentation of the author's original ideas depends especially on a significant amount of time thinking about and analyzing the research material before a word can be written. During this critical stage, the availability of funds to cover both the research expenses and the cost of living while writing are essential. In the humanities, social sciences, and professional fields, financial support for the dissertation writing stage is the exception rather than the rule: the availability of such funding is currently very limited.

E. Fifth Stage: Applying for Professional Employment

During the final stage of the dissertation, the student begins the search for professional employment. In many fields, students make their first academic job contacts at annual national conferences. The large professional associations, such as the Modern Language Association (MLA), the American Educational Research Association (AERA), or the Federation of American Societies for Experimental Biology (FASEB), list job openings and provide space for the conduct of initial job interviews at the conference site.

This stage comprises several components: the search for open positions; the writing and presentation of a research talk; the construction of a curriculum vitae and the forming of a dossier; and preparation for an on-site job interview. For academic positions, a campus interview for a faculty position is often a three-day event.

Traditionally, for many life science and physical science students, the next step is a post-doctoral research position. The impact of the post-doctorate is discussed in more detail below. In placement for all positions, particularly academic positions, the letter of recommendation from the dissertation adviser plays an essential role in the hiring process.

* * * * *

These five stages move a graduate student through a series of roles and related levels of expertise and, like all learning situations, occasion some anxiety and difficult adjustments, as well as positive rewards from the excitement of research and teaching. These five stages, then, are common to all graduate students earning doctoral degrees. Consequently, this study will continue to refer to these five stages throughout the report, particularly in the recommendations section.

PART II:

**DOCTORAL DEGREES AWARDED BY THE UNIVERSITY OF CALIFORNIA:
1968, 1978, AND 1988**

II. DOCTORAL DEGREES AWARDED BY THE UNIVERSITY OF CALIFORNIA: 1968, 1978, AND 1988

A. Increase in Degree Production: 1968-1988

According to the NRC data, the number of doctorates awarded by the University of California between 1968 and 1988 increased by 59 percent, from 1,444 in 1968 to 2,295 in 1988. The increase was not steady. In the first ten years, the number of doctorates rose by 37 percent, but in the second ten years, this number rose only by 16 percent (Graph 1 and Table 1). This trend at the University of California follows the national trend wherein the number of students earning doctoral degrees increased rapidly in the 1960s, peaked in the early 1970s, declined through the late 1970s, stabilized until the mid-1980s, and is rising now.

Although the number of UC doctorates rose 59 percent over the 20 year period, it did not increase proportionally in all major fields of study. The increase in number of doctorates was most pronounced in engineering (136 percent), next in the arts and humanities (113 percent), followed by social sciences (61 percent), and life sciences (63 percent). Physical sciences had the smallest increase, at 29 percent, and the professional fields showed a decrease in the number of degrees awarded (-8 percent), entirely owing to a decrease in Education degrees (-26 percent) (Table 1 and Graph 1).

Although doctoral degrees awarded in engineering, physical sciences, and life sciences increased in both decades, the number of degrees awarded in other disciplinary groups declined slightly in the second decade, 1978-88. In engineering and computer sciences, however, degree production accelerated from a 46 percent increase between 1968 and 1978, to a 61 percent increase between 1978 and 1988. The physical sciences experienced a change of 7 percent from 1968 to 1978, and a 21 percent change from 1978 to 1988. Nearly all the increase in the arts and humanities occurred between 1968 and 1978 (a 97 percent increase), followed by an 8 percent gain between 1978 and 1988.

During the 20-year period, the number of doctoral degrees awarded to women rose substantially, up 293 percent from 1968, while the number for men rose only 31 percent. Both men and women showed a greater percentage increase in earned doctorates from 1968 to 1978 (women at 155 percent and men at 28 percent) than during the 1978 to 1988 period (women at 54 percent and men at 2 percent). The number of men earning doctorates stayed almost the same between 1978 and 1988. Women earned 166 out of 1,260 degrees, or 13 percent of all degrees of doctoral recipients whose gender was known in 1968. In 1978, they earned 423 out of 1,828 degrees (23 percent), and 653 out of 2,083 degrees (31 percent) in 1988 (Table 1A).

The number of degrees awarded to minority students in 1988 (274) rose substantially, 44 percent from 1978 (190) (Table 1B). The increase in number of degrees awarded to white students during the same period was only 7 percent. Doctoral degrees awarded to American Indian students increased from one to nine doctorates, and doctorates awarded to Chicano and Latino students increased 49 percent from 53 to 79. African Americans earned 40 degrees in 1988, an increase of 21 percent from 1978 (33 degrees). In 1978, ethnic minorities earned 11 percent (190) of all domestic (U.S. citizens and permanent residents) doctoral degrees awarded (1,654), and in 1988 they earned 15 percent (274) of all domestic doctoral degrees (1,787).

B. Distribution of Degrees Earned by Women, Ethnic Minorities, and Major Fields of Study

Changes over Time

In 1968, 1978, and 1988, the majority of UC doctoral degrees were awarded in life sciences, physical sciences, and engineering programs. The proportion declined from 1968 (62 percent) to 1978 (59 percent), followed by an increase to 64 percent by 1988 in these three fields. While proportionally fewer students earned a degree in the physical sciences in 1988 (21 percent) than did students in 1968 (26 percent), proportionally more students earned engineering degrees in 1988 (18 percent) than in 1968 (12 percent) (Table 1).

Within the remaining fields, a change occurred principally in the professional degrees conferred. Fewer students earned degrees in professional fields in 1988 than in 1968, and proportionally more students earned degrees in the arts and humanities in 1988 than in 1968, a 4 percent increase. The proportion of students earning doctoral degrees in the social sciences remained the same.

Distribution of Degrees by Women

Men and women were concentrated in different fields of study. During the period 1980 through 1988, the majority of women, including minority women, earned doctorates in relatively equal proportions in the life sciences (28 percent), arts and humanities (22 percent), and social sciences (22 percent). Smaller proportions of women doctoral recipients earned their degrees in the physical sciences (11 percent) and engineering and computer sciences (3 percent), and the remaining 14 percent in the professional programs (Graph 2).

Men, including minority men, in contrast, earned the majority of their degrees in the physical sciences (26 percent), the life sciences (24 percent), and engineering and computer sciences (19 percent). Men in lesser proportions earned degrees in the social sciences (14 percent), arts and humanities (11 percent), and

professional field programs (6 percent).

In all areas of study, there were increases between 1968 and 1988 in the number of women earning doctoral degrees. The proportions shifted toward science and engineering, and away from professional fields. In the three disciplines--life sciences, physical sciences, and engineering combined--the proportion of women rose from 36 percent (59 degrees) in 1968 to 46 percent (299 degrees) in 1988. Nevertheless, the number of women in the physical sciences and engineering remained low, at 106 degrees in 1988. The percentage of women earning doctorates in the professional fields, including education, fell by one-half, from 21 percent of women (34 degrees) in 1968 to 11 percent (69 degrees) in 1988. For men, there was a near-doubling in the proportion earning engineering degrees, from 13 percent (145 degrees) in 1968 to 24 percent (341 degrees) in 1988. In the professional fields, the percentage of men fell by one-half, from 12 percent (128 degrees) in 1968 to 6 percent (82 degrees) in 1988 (Table 1).

Distribution of Degrees by Ethnic Minorities

During the nine years 1980 through 1988, two thirds or more of the degrees earned by American Indians, African Americans, Chicanos, and Latinos were clustered in the life sciences, social sciences, arts, and humanities. African Americans and Chicanos also earned a high proportion of their degrees in professional fields, 24 percent and 20 percent, respectively, while American Indians and Latinos earned a higher proportion of their degrees in the physical sciences, 22 percent and 15 percent respectively. During 1980-88, Asian Americans earned degrees largely in engineering (29 percent), physical sciences (23 percent), and life sciences (25 percent) (Graph 3).

Over the last ten year period, American Indian, African American, Chicano, and Latino students shifted their areas of study. In 1988, proportionally more non-Asian minority students earned their degrees in the life sciences and physical sciences (37 percent or 47 degrees) than in 1978 (22 percent or 19 degrees) and proportionally fewer students earned their degrees in the social sciences, professional fields, and arts and humanities. The number of non-Asian minority doctorates in engineering remained small. In 1988, more Asian Americans earned doctoral degrees in social sciences and arts and humanities (19 percent) than in 1978 (10 percent). They earned proportionally fewer degrees in the life sciences and physical sciences (43 percent) than in 1978 (54 percent) (Table 2).

In summary, women and minorities steadily earned more degrees across all fields during this time period. Women, including non-Asian and Asian minority women, tend to be more concentrated in the life sciences, the social sciences, and arts and humanities, while men, including non-Asian and Asian minority men, tend to be more

concentrated in the physical sciences, engineering, and life sciences. However, women and minorities increased their proportions of degrees in those fields in which they have been traditionally underrepresented.

PART III:

**CHARACTERISTICS OF DOCTORAL DEGREE RECIPIENTS
AT THE UNIVERSITY OF CALIFORNIA:
1968, 1978, AND 1988**

III. CHARACTERISTICS OF DOCTORAL DEGREE RECIPIENTS AT THE UNIVERSITY OF CALIFORNIA: 1968, 1978, AND 1988

As background information on factors influencing time-to-degree, this study will describe characteristics of doctoral degree recipients and examine the changes in those characteristics over time. This section will provide an overview of changes in age, marital status, dependents, parents' education, and type of undergraduate school of UC graduate students.

A. Age

In 1988, the average doctoral recipient completed the degree at 33.3 years of age. Degree recipients in 1988 were an average of one year older than their 1968 counterparts. Those in professional fields were the oldest (38.0 years on average in 1988), followed by recipients in the arts and humanities (36.5 years in 1988). Degree recipients in both fields had the longest average break between their undergraduate and graduate studies (professional fields, 2.5 years in 1988; arts and humanities 1.5 years in 1988). In addition, both fields of study traditionally have had the longest time-to-degree, as will be discussed later in detail. Degree recipients in the physical sciences and engineering were the youngest on average (30.9 years and 31.3 years). Students in physical sciences tended to enter graduate school immediately after completing the bachelor's degree, and students in both fields traditionally have had a fairly short time to completion (Tables 3 and 12).

Although women in 1988 were on the average two years older (34.6 years) than men (32.6 years), this represents a small decrease in age difference over time. In 1968, women deferred their graduate studies after the bachelor's degree for 2.1 years on average, while in 1988 they did so for only 1.4 years. Men in both years deferred their studies after the bachelor's degree for only one year on average (Table 12B).

The differences in the exit ages of ethnic minority doctoral recipients reflect both the traditional length of time-to-degree of the field they study and the tendencies of students in these fields to work for some time before entering graduate school. The same age variation among fields that existed for all degree recipients was apparent for minority degree recipients. Therefore, Asian Americans, clustered in engineering and physical sciences, were, in 1988, on the average slightly younger than white degree recipients (32.5 years versus 33.3 years). African American degree recipients, clustered in professional schools and social sciences, were the oldest on average, at 37.3 years, and Chicanos and Latinos, clustered in the social sciences and life sciences, were on the average 34.1 years old. Compared to 1978, Asian American degree recipients were an average of 0.7 years older at completion of the doctorate in 1988, African Americans were 2.2 years older, and Chicano and Latino doctoral degree recipients 1.1 years younger.

B. Marital Status

In 1988, 56 percent of all doctoral recipients reported that they were married when they completed their studies. This was a slightly smaller proportion than in 1978 (59 percent). However, in 1968, over three quarters of all degree recipients (76 percent) reported themselves as married (Table 4).

Among major fields, degree recipients in the professional fields had the largest proportion of married students (70 percent in 1988). This is not a surprise, since this group also had the oldest average age. In the physical and life sciences, about half of all degree recipients were married, and in the social sciences and humanities, the proportions were 56 percent and 58 percent. Over the last 20 years, proportionally fewer degree recipients in all fields were married.

Proportionally fewer women were married than men in both 1968 and 1988. In 1988, 53 percent of women students reported that they were married, as compared to 57 percent of men. However, this proportional difference has changed markedly during the last 20 years. In 1968, 79 percent of men degree recipients were married, but only 58 percent of the women. In 1978, 61 percent of men were married as compared to 55 percent of women.

Among minority students, Asian Americans were the most likely to be married, both in 1978 and 1988 (68 percent in 1978 and 60 percent in 1988). Next followed Chicanos and Latinos, with 57 percent married in 1988. Asians, Chicanos, and Latinos reported higher proportions married in 1988 than did white students, of whom 55 percent reported themselves as married, while African American degree recipients were least likely to be married (45 percent).

C. Dependents

In 1988, 41 percent of all degree recipients reported having one or more dependents.³ About two-thirds (67 percent) of all degree recipients in professional fields reported having one or more dependents (Table 5). This finding is consistent with other average characteristics of the group--oldest age, highest proportion married, longest time-to-degree. It is likely that these students take extra time owing to family responsibilities, as it will be reported later.

Fewer women than men reported having dependents. In 1978, 55

³ NRC defines "dependent" as someone receiving at least half of all financial support from the degree recipient. Given the age, gender, and marital status profile of graduate students described above, dependents should include large proportions of children and spouses.

percent of men, but only 33 percent of women had one or more dependents. In 1988, the difference was still pronounced, but had diminished (46 percent to 29 percent).

Chicanos and Latinos were the minority group with the largest proportion of degree recipients with dependents. In 1988, 60 percent of them had one or more dependents. Of Asian Americans, 43 percent had dependents. Of African American students, 41 percent had dependents, while 35 percent of whites reported having one or more dependents. These statistics are especially significant in light of UC plans to increase minority participation in graduate education and will need to be taken into account in planning for adequate levels of support.

D. Parents' Education

Fewer than half (38 percent) of all domestic degree recipients reported having a mother without some college education, and 30 percent had a father without some college education. Compared to men, women had on average better educated parents. Degree recipients in the life sciences, engineering, and physical sciences had on average the most highly educated fathers: close to 15 percent of all students in these fields had fathers with doctorates. The proportion of students who had mothers with doctorates was quite small across fields (2 percent) (Table 6).

The parents of Afro-Americans, Chicanos, Latinos, and American Indians had on average the least college experience. Sixty percent of the Chicano and Latino degree recipients reported that their mothers had no college experience. Fifty-eight percent of African Americans and 53 percent of Asians reported the same as compared with only 35 percent of whites. Also 53 percent of the fathers of Chicano and Latino degree recipients had no college experience. This was also true for 49 percent of African Americans, 33 percent of Asians, and 27 percent of whites (Table 6A).

E. Type of Undergraduate School

In 1988, 32 percent of all domestic UC doctoral degree recipients (U.S. citizens and permanent residents) received their undergraduate education at one of the nine University of California campuses. Twelve percent received their bachelor's degree from a California State University (CSU), and another 6 percent from California private schools. In all, about 50 percent received their undergraduate education in California (Table 7). The remaining 50 percent completed their undergraduate studies at other U.S. colleges and universities.

Except for engineering and the professional fields, there were few significant differences in undergraduate education among the fields. The proportion of engineering degree recipients receiving their undergraduate education in California (38 percent) including

CSU institutions (6 percent) was small. In contrast, of professional degree recipients, 58 percent were California baccalaureates including 19 percent who came to UC with an undergraduate degree from a CSU institution.

In 1988, a notable proportion of minority doctoral degree recipients had undergraduate degrees from a CSU institution, 30 percent of African Americans, and 21 percent of Chicanos and Latinos. The arts, humanities, and professional fields had even larger proportions of minority students with undergraduate degrees from CSU--African American (57 percent) and Chicanos and Latinos (31 percent). This suggests the success of recruitment efforts by UC and the individual campuses, particularly in using the CSU "pipeline" in these fields.

* * * * *

Since UC plans to increase the participation of minorities and women in graduate school, the following factors should be considered. First, since a notable proportion of minorities come from CSU institutions, the UC "pipeline" recruitment efforts should be expanded in order to increase the number of minority students in doctoral programs. Second, given that a greater proportion of minority students than whites have dependents, sufficient support for family housing, child care, and other family responsibilities will be necessary. Third, along with the financial hardships of caring for families, non-Asian minority students are more likely to be first generation college students and thus might benefit from special orientations and faculty mentorship programs.

PART IV:

**TIME TO DOCTORAL DEGREE:
1968-1988**

IV. TIME TO DOCTORAL DEGREE: 1968-1988

A. Time Measures and Definitions

Time-to-degree can be measured in three different ways: total time, elapsed time, and registered time. Traditionally, NRC uses the first two measures in reporting national figures on doctoral recipients. (1) Total time (B.A.-Ph.D.) measures the time elapsed from the year that a student receives an undergraduate degree to the year that he or she completes a doctorate.⁴ It includes the time a student may have worked after receiving the bachelor's degree and before entering graduate school. (2) Registered time-to-degree is defined as the time spent enrolled in graduate school. This is not a measure of minimum time, because it may also include time enrolled in a master's program. (3) Elapsed time is defined as the time from entrance to graduate school until the completion of the degree. This measure includes the time when students are not registered and perhaps away from the campus. It also includes the time it takes to earn a master's degree. This study uses elapsed time, that is, time from entrance to graduate school to completion of degree, as a focus for time-to-degree in the University of California. Unless otherwise specified, this third measure will be used throughout this report. This report uses both mean and median time-to-the-doctorate.

Overall, mean total time and elapsed time-to-the-doctorate at the University of California increased by about one year over the last 20 years. Median total time increased by 1.4 years, median elapsed time by 1.3 years. Neither the period of time from completion of the bachelor's degree to entrance to graduate school nor the time necessary to receive the master's degree has increased. The average length of time for which degree recipients withdraw has decreased, a result of the establishment in 1978 of more restrictive policies on leaves of absence. Therefore, the registered time has increased by 1.5 years for both mean and median time (Tables 8 and 8A). The mean elapsed time in the 1980-88 period was 8.7 years for the total number of degree recipients, or one year longer than the median time of 7.6 years (Table 9).

Master's Degree

In order to measure time-to-degree at the University of California, it is important to distinguish whether a master's degree is acquired in the course of receiving a doctorate and, if so, whether this master's degree was acquired at the same institution as the doctorate. Aggregate NRC data, in all three time measures, do not distinguish whether the students received a master's degree on the way to the doctorate, or whether this degree was received at the same institution as the doctoral-granting one (Table 9). NRC data

⁴Howard Tuckman (1989) argues that this measure is useful in determining how quickly the supply of new doctorates can potentially respond to changes in demand.

always show longer time-to-degree than the campuses' own data. This section of the report presents time-to-degree that reflects only the time spent at the doctoral-granting institution. Therefore, for the University of California, the NRC data for 1980 to 1988 have been rearranged into three groups: (1) students who did not receive a master's; (2) students who received master's degrees at an institution other than the doctoral-granting institution; and (3) students who received the master's and the doctorate at the same institution (Tables 10 and 10A).

The findings are not surprising. Students with no master's degree take the shortest time (7.5 mean years, 6.0 median years of elapsed time); students with the master's from another institution take the longest time (11.4 mean years, 9.8 median years), since the doctoral-granting institution rarely accepts a substantial portion of the prior course work in lieu of its own program. Students with a master's degree from the same institution complete the program in less time than those with a master's degree from another institution, but take longer than those with no master's degree (8.9 mean years, 7.4 median years). In this, all campuses were similar. Even for students transferring from one UC campus to another, few required courses are waived. Students who came with a master's degree from elsewhere will often take more courses voluntarily in order to become familiar with the faculty they want to serve on their qualifying examination committee.

About two-thirds (70 percent) of all students who earned doctoral degrees in 1968, 1978, and 1988 acquired a master's degree before the doctorate. In 1988, half of these (35 percent) received a master's degree at the same institution as that from which they received the doctorate and the other half (35 percent) from a different institution (Table 10B).

The proportion of students with or without a master's varied by major fields of study. About 90 percent of all degree recipients in professional fields and the arts and humanities, 85 percent in engineering, and 80 percent in social sciences acquired a master's degree, while about half of all life sciences and physical sciences students received the Ph.D. without acquiring a master's degree along the way (Table 10B).

Since the existing data do not specify the amount of time that the individual student spent elsewhere, this report will largely exclude the group of doctorates who received their master's degree at another institution.

B. Time-to-degree for Ethnic Minorities and Women: 1980-1988

This section pertains to total degree recipients in the years 1980 through 1988, by ethnicity and gender.⁵ Overall, Asian Americans finished their doctoral programs faster than white students (mean time: 8.0 years vs. 8.8 years; median time: 7.3 years vs. 7.6 years). Although Asian Americans were clustered in fields with short time-to-degree, they also had shorter time-to-degree than whites in the professional fields (mean time: by 2.6 years; median time: by 2.0 years). They had longer time-to-degree in the arts and humanities (mean time: by 1.3 years; median time: by 2.4 years) (Graphs 4 and 4A).

Non-Asian minorities, on the average, took longer than white students (mean time: 9.7 years vs. 8.8 years; median time: 9.2 years vs. 7.6 years) to complete their degrees. They were, however, clustered in fields with long times to degree. It is not surprising, then, that when the data were disaggregated by discipline, the time-to-degree of non-Asian minority degree recipients was only about half a year longer than that for whites in the arts and humanities, engineering, life sciences, and physical sciences (both mean and median times). In the professional fields and social sciences, the median time for non-Asian minorities was 1.1 years and 0.8 years longer than whites.

Women, overall, took longer than men (mean time: 9.8 years vs. 8.3 years; median time: 8.5 years vs. 7.3 years). Like non-Asian minorities, women were clustered in fields with long times-to-degree. In a comparison with men, across disciplines, women in the physical sciences completed their degrees slightly faster on average than men and in engineering, life sciences and social sciences, they took longer than men by a half a year or less in mean or median time. Women in the professional fields and arts and humanities took about a year longer on average than men (Graph 5 and 5A).

These findings, by discipline, show time-to-degree levels for women and ethnic minorities that are not substantially different from those of men and whites. In fields where there are still proportionally fewer women or minority students, the data show that

⁵Because the number of minorities who received doctorates in 1978 was small, all minorities who earned doctoral degrees between 1980 and 1988 were combined and mean time was calculated. It is important to remember that Asian Americans are clustered in different fields than other ethnic minority student groups. Therefore, in comparison with whites, Asian Americans were treated as a separate group from African Americans, American Indians, Chicanos, and Latinos.

they do have comparable or slightly shorter average times-to-degree than men or white students.

C. Increases in Time-to-degree: 1968 - 1988

This section pertains to the 70 percent who received a master's degree at the same campus at which they earned their doctorate or who received no master's degree. To ascertain whether the time-to-degree has increased over time, the time to the doctorate at the doctoral-granting institution was analyzed for 1968, 1978, and 1988. Overall, time to the doctorate at the University of California increased over the last 20 years (mean time: by one year; median time: by 1.3 years). Mean elapsed time increased from 6.7 years in 1968, to 7.2 years in 1978, to 7.7 years in 1988. Median time rose from 5.4 years in 1968, to 6.4 years in 1978, to 6.7 years in 1988 (Tables 11 and 11A).

1. Time Differences between Major Fields of Study

A substantial difference in time-to-degree among the major fields of study has existed historically. In 1968, the most substantial difference in mean elapsed time occurred between the shorter time in the physical sciences (mean time: 5.4 years; median time: 4.9 years) and life sciences (mean time: 6.0 years; median time: 5.2 years) versus the longer time in professional fields (mean time: 11.3 years; median time: 8.3 years) and the arts and humanities (mean time: 8.2 years; median time: 7.5 years). These differences in length of time between the fields increased over time. The gap widened most for the arts, humanities, and social sciences, and least for engineering (Table 11 and 11A).

2. Time Increases by Major Fields of Study

Over the two decades from 1968 to 1988, changes in time-to-degree varied widely by major fields of study. The mean time-to-degree in engineering rose from 6.4 years in 1968 to 6.8 years in 1978, followed by a drop to 6.3 years in 1988. The median time in engineering rose from 5.6 years in 1968 to 6.1 years in 1978, and dropped to 5.9 years in 1988. During the same periods, the mean time-to-degree in the professional fields decreased sharply from 11.3 years in 1968 to 9.2 years in 1978, followed by an increase to 10.4 years in 1988. The median time in the professional fields was the same (8.3 years) in 1968 and 1978; it rose to 9.5 years in 1988.

The smallest overall increase occurred in the life sciences, with about one year for both mean and median time (mean time: 6.0 years in 1968, 6.4 years in 1978, 7.1 years in 1988; median time: 5.2 years in 1968, 5.7 years in 1978, 6.4 years in 1988), and the physical sciences (mean time: 5.4 years in 1968, 6.3 years in 1978, 6.6 years in 1988; median time: 4.9 in 1968, 5.8 years in 1978, 6.0 in 1988). The largest increase occurred in the arts and

humanities (mean time: by 2.1 years; median time: by 1.8 years; the mean time: 8.2 years in 1968, 10.3 years in 1988; median time: 7.5 in 1968 to 9.2 in 1988). The next largest increase was in the social sciences (mean time: by 1.7 years; median time: by 1.8 years). (The mean time: 7.1 years in 1968, 8.8 years in 1988; median time: 6.2 in 1968, 8.0 in 1988.) These trends closely resemble the national trends in the same major fields.

As stated in Section IV.A., the differentiation between time measures revealed that the largest increase in time occurred in the registered time, not in the time away from campus when students were withdrawn or not registered. Between 1968 and 1988, non-registered time declined in most fields and held steady in others. Nevertheless, much more time was spent in non-registered status in some fields than others. The range (mean years, 1988 degree recipients) was 2.4 years in professional fields to 0.3 years in physical sciences. Humanities graduates spent 1.7 years on withdrawn status, and social science graduates 1.4 years, usually after advancement to candidacy. In contrast, students in the sciences spent only half a year on withdrawn status (Tables 12 and 12A).

A study at Berkeley on reasons for withdrawal⁶ shows that students interrupted their studies primarily for financial reasons (60 percent), secondly for personal reasons (30 percent) such as family problems or health or maternity leave, and thirdly, for job commitments (15 percent).⁷ Information gathered from the interviews reinforced the Berkeley findings that, because of limited research funds, humanities and social sciences students are forced to spend more time away from dissertation work to earn a living. This phenomenon was also reported by a recent national study, On Time to the Doctorate, by Tuckman et al.⁸

3. Time Increases for Women

Between 1968 and 1988, the overall mean time to doctoral degree for women increased slightly less than for men (mean time: 0.5 vs. 0.9 years; median time: 1.0 vs. 1.1 years). Women took substantially less time in 1988 than in 1968 to complete their degrees in engineering (mean time: -2.3 years; median time: -2.75 years) and in the professional fields (mean time: -2.3 years; median time: -6.0 years). However, the numbers of women involved are very

⁶UC Berkeley, Graduate Division: Withdrawal statistics, 1987-88.

⁷Students often cited more than one reason. Thus, these figures add up to 105 percent.

⁸Tuckman, Howard, Susan Coyle, and Yupin Bae, On Time to the Doctorate (Washington: National Academy Press, 1990).

small. The time increased in the life sciences (mean time: 0.7 years; median time: 1.1 years), the social sciences (mean time: 1.0 years; median time: 1.4 years), and the arts and humanities (mean time: 2.6 years; median time: 1.9 years).

Between 1968 and 1988, men's time-to-degree remained about the same in engineering. In the social sciences, men's time increase was double that of women (mean time: 2 years; median time: 2.1 years). The arts and humanities showed an increase of 1.9 years (both mean and median time) for men (Table 11 and Table 11A).

Clearly, men and women both experienced increases in time-to-degree. Although change occurred at different rates, time-to-degree for both men and women in the arts, humanities, social sciences, life sciences, and physical sciences increased between one and two-and-one-half years.

4. Time Increase for Ethnic Minorities

The number of Asian Americans, African Americans, American Indians, Chicanos, and Latinos in some major fields is too small to produce meaningful comparisons of changes in time-to-degree in detail, although these are shown (Tables 13 and 13A).

Between 1978 and 1988, mean time-to-degree rose by 0.5 years for Asians, 0.8 years for non-Asian minorities, and 0.6 years for whites, while median time-to-degree increased by 0.7, 0.6, and 0.3 years, respectively, in the three subgroups.

* * * * *

In summary, time-to-degree increased for both men (including minority men) and women (including minority women) very little over the last decade from 1978 to 1988 (mean time: 0.4 years; median time: 0.2 years for men and 0.0 years for women). Over the two decades from 1968 to 1988, time-to-degree for men increased by 0.9 years in mean time or 1.1 years in median time, time-to-degree for women increased 0.5 years in mean time and 1.0 years in median. Mean time-to-degree for Asians, non-Asian minorities, and whites increased by approximately one-half year over the last decade. Neither gender nor ethnicity/race explains the overall increase in time to the doctorate.

It is important to look at field-specific reasons in order to explain the observed time increase for all students. In the following section, this study will examine why time-to-degree has increased at a higher rate in the arts, humanities, and social sciences than in engineering, life sciences, and physical sciences. In addition, this study will explore the reasons for lengthy time-to-degree in the professional fields.

PART V:

**FACTORS CONTRIBUTING TO LENGTHENED
TIME-TO-DEGREE**

V. FACTORS CONTRIBUTING TO LENGTHENED TIME-TO-DEGREE

A series of factors, rather than a single factor, contributes to the lengthening in time-to-degree both overall and by field of study. These factors can be divided into two groups, (a) field-specific factors and (b) institutional factors. This division is also based on the findings from a study on time-to-degree and attrition of doctoral students at UCLA by Ellen Benkin (1984). The author concluded that the factor labeled students' "field of study" was more important than the students' demographic variables in determining degree completion.⁹ Figure 1 shows in summary how each of these factors can affect both high and low time-to-degree and attrition.

A. Field-Specific Factors

Results from the interviews showed that there were distinct differences between the physical sciences, engineering, and life sciences on the one hand, and the arts, humanities, social sciences, and professional fields on the other that impact time-to-degree: (1) how research is conducted and taught; (2) how research is funded; (3) how the doctoral program is structured; (4) whether foreign language competence is required; (5) what role the dissertation plays in doctoral training; (6) whether post-doctoral employment follows the Ph.D; (7) what undergraduate training is accepted; and (8) whether a master's degree is required before entrance to the doctoral program. All these factors are interrelated. There are, of course, always exceptions to the following generalizations.

1. Research Training

An apprenticeship model for research training is typical in the sciences. Graduate students acquire skills by working in a laboratory where they generally work as members of research groups. The laboratory setting frequently provides them with an intense social structure in which to undertake dissertation research. Under this structure, students must attend weekly laboratory meetings at which they periodically present results of their recent work.

In contrast, students in the arts, humanities, and social sciences receive research training in methodology and theory seminars. Students practice their research skills by writing end-of-term seminar papers. They further obtain training from the written and

⁹Ellen Benkin, "Where Have All the Doctoral Students Gone: A Study of Doctoral Student Attrition at UCLA," Doctoral Dissertation, University of California, Los Angeles, 1984.

verbal guidance of individual faculty members.¹⁰ Aside from discussions in seminars on the research process and feed-back on their research papers, humanities students are unlikely to work with groups of students and faculty. Their dissertation research is usually conducted alone, in the library or off-campus. These modes of conducting and teaching research are traditional to particular fields, because they have proven to be educationally suitable over the years.

2. Research Funding

Since World War II, science and engineering fields have received vastly more federal and private funding than the humanities and social sciences. In the 1980s, funding both from private foundations and public agencies for the humanities and many social sciences areas was particularly scarce. Students in the various disciplines have different experiences and problems as a result of the availability or lack of money for research. In 1980-88, students whose primary financial support came from research assistantships took an average of 7.0 years to complete their degrees, while students whose primary support came from teaching took 8.3 years to complete their degrees (Table 14).

For the most part, students in the natural sciences and engineering are regularly employed as research assistants. Their dissertation work is normally identical to their paid work as research assistants. Thus, their dissertation research is part of a larger research project, funded, organized, and supervised by their major adviser. Nearly 50 percent of all degree recipients in engineering and the physical sciences reported that their primary source of support was a research assistantship (RAship) (Table 14A). In addition, students supported by fellowships and training grants have similar opportunities to do their research. Another 15 percent-18 percent of engineers and physical scientists were primarily supported by fellowships. In the life sciences 29 percent were primarily supported by RAships and another 37 percent were primarily supported by fellowships.

Social sciences and professional field students have some opportunity to work as research assistants. When they do, this paid work rarely overlaps with their dissertation work. In 1980-88, only 11 percent of all degree recipients in the social sciences and 8 percent in the professional fields reported that their primary support was a research assistantship. The teaching assistantship is the primary source of support for 25 percent of the degree recipients in social sciences.

¹⁰See Patricia Gumpert, "Basic Research and the Nature of Graduate Education: Preliminary Results from a Micro Study," presented at the AAAS meeting at San Francisco, January 14-19, 1989.

Arts and humanities students have fewer opportunities to work as research assistants. In 1980-88, for example, only 2 percent of all UC arts and humanities degree recipients reported that a research assistantship was the primary financial support during their doctoral study. The teaching assistantship, instead, is the primary form of support for 45 percent of degree recipients in arts and humanities and 25 percent of degree recipients in the social sciences.

The presence of research money not only contributes to financial security during graduate studies, but also to more frequent interactions between faculty advisers and graduate students. This situation creates the potential for a desirable mentor relationship, which means the student is more likely to have a role model, academic advice, and assistance in gaining access to the profession.

Humanities faculty rarely have enough research money to employ their graduate students as research assistants. Thus, after advancement to candidacy, there are few opportunities for programmatic interactions between faculty and students, unless a department has an explicit policy of regular meetings between faculty and students or unless individual faculty take it upon themselves to meet frequently with their advisees. On several campuses the Graduate Councils have adopted policies requiring such meetings so that students receive feed-back on their work during the dissertation writing stage of the doctoral program. Where this was not the case, interviewed students in the arts, humanities, social sciences, and professional fields seemed to suffer from the isolation they experienced doing their dissertation research alone in the library or in the field. However, students more frequently mentioned the lack of financial support during this stage as a problem. When writing the dissertation, students in these fields stated that working as teaching assistants or in unrelated jobs on or off campus was counterproductive. They preferred having dissertation fellowships or research assistantships related to their field.

3. Structure of the Doctoral Program

On the average, students in the sciences begin to participate in actual research immediately upon entrance to graduate studies. Their dissertation research is usually under way by the second year. The difference between student life before the qualifying examination and after the qualifying examination is not as pronounced in the sciences and engineering as it is in the humanities, social sciences, and many professional fields.

Interviewed students in these latter three areas often started their dissertation research after the third or sometimes the fourth year. Humanities and social science students reported that they found the transition from taking courses and preparing for the

qualifying examination to conducting individual research a difficult one. They often feel lost after advancement to candidacy, when they must make the transition from being a "class-taking person to a book-writing person." Since these students often conduct their research away from the department, they often withdraw from departmental activities, deepening their isolation.

Programs that are structured in such a way that students must start to think about their dissertation early in the program and that require a dissertation proposal as part of the qualifying exam tend to have a shorter time-to-degree than programs in which students have to fulfill three or four years of course requirements before they are allowed to begin their dissertation work: such is the case in many humanities departments that require a master's degree and additional courses for the doctoral degree.

4. Foreign Language Requirements

Students in programs with foreign language requirements seem to take about half a year longer on average to complete the degree. Many science programs have dropped these requirements during the last 10-15 years. This is not so for the many humanities and social sciences programs for which students must have reading and speaking knowledge of a foreign language for the successful accomplishment of their research.

Student interviews point to the conclusion that where the foreign language requirement was not integrated into the curriculum, it became an extra hurdle. Some departments, primarily those in the social sciences, give students a choice between fulfilling the foreign language requirements or learning another professional skill, such as statistics or a computer language.

While it is appropriate and necessary for an American doctorate to know at least one foreign language, the interviewed students commented that learning becomes superficial and the skills are easily forgotten if the language is not used during the course of doctoral study.

5. The Role of the Dissertation

Science and engineering programs generally perceive the dissertation as a test of future ability to do research and as a starting point of a scholarly career. Humanities and social sciences programs expect the dissertation to be a major contribution to the field, possibly a book. As mentioned earlier, these programs tend to have a longer time-to-degree than science and engineering programs. A study at UCLA comparing the time from entry to graduate school to advancement to candidacy with the time from advancement to candidacy to degree completion found that

humanities students took one year longer than science students.¹¹ On those campuses where similar data were available (Riverside, Santa Cruz, and Berkeley), the same pattern was observed.

The role of the dissertation has sparked a national debate among deans of graduate divisions and within the Council of Graduate Schools¹² and the Association of Graduate Schools Task Force, under the Association of American Universities.¹³ Is a magnum opus still useful, when most fields rely on published journal articles for reporting research findings? Should candidates be required to conduct original research on their own, and publish results as single authors? Some science and engineering fields already accept a series of published articles, written by one author or a team of authors, as a dissertation. On the other hand, this study has identified no humanities and few social science departments (with the exception of economics), that would accept a series of submitted articles. Many faculty in these fields argue that several journal articles demand more work than a single-topic dissertation. Others, such as the Dean of the Graduate Division at Princeton University, a scholar of German literature, advocate that humanities programs emulate the sciences in determining thesis form and length.¹⁴ These questions must be addressed and answered by the disciplines at the national level. Only a change in the collective determination of what constitutes doctoral-level work would encourage departments to change traditional methods and requirements for the future.

6. Post-Doctoral Study

The role and function of post-doctoral studies is an important factor in explaining the differences between the sciences and engineering on the one hand and the social sciences and humanities on the other. It has become a tradition for life sciences, physical sciences, and for some engineering doctorates who intend to pursue an academic career, to undertake at least two years of post-doctoral study. This is not the case in the arts, humanities, and professional fields and is only rarely the case in the social sciences. The maturation process is increasingly calculated into the degree expectations of the humanities, some social sciences,

¹¹UCLA Graduate Division, Institutional Research Office, "Time to ATC & Doctorate from Date of Admission to UCLA: Graduate Division Degrees Awarded 1981-82 through 1987-1988," March 27, 1990.

¹²Peter Monaghan, "Some Fields are Reassessing the Value of the Traditional Doctoral Dissertation," The Chronicle of Higher Education, March 29, 1990, p. 1.

¹³AAU, AGS Task Force on the Role and Nature of the Doctoral Education.

¹⁴Theodore Ziolkowski, "The Ph.D. Squid," The Academic Scholar, Spring, 1990, pp. 177-195.

and professional fields.¹⁵ In the sciences, however, new Ph.D.'s are expected to mature in post-doctoral positions. For example, a study on the placement of doctoral students at Berkeley (1980-87) found that of all of the students who pursued post-doctoral study after completing the Ph.D., 48 percent came from the life sciences, 26 percent from the physical sciences, 8 percent from engineering, and 13 percent from the social sciences. Only 4 percent came from humanities and 0.5 percent from the professional schools.¹⁶ Information on student placement for UC as a whole, based on a newly established reporting system, will be forthcoming from the Office of the President.

The question, then, when considering time-to-degree and subsequent employment, is not how long it takes to train doctoral students, but rather how long it takes to train a professional in a field. Examining time-to-degree from this angle, one concludes that the time difference between the sciences and humanities disappears. To train a full-fledged professional in both fields takes then, on the average, between nine and ten years.

7. Undergraduate Training

Graduate engineering, life sciences, and physical sciences departments only occasionally accept a student whose undergraduate major was in a field similar to the doctoral field. For example, engineering programs do not often accept physical science majors. In 1988, among doctoral degree recipients, 80 percent of engineering graduates, 75 percent of physical science graduates, and 70 percent of life science graduates had received their baccalaureates in the same major (Table 15).

On the other hand, social science and professional field faculty report, for example, that a student with a bachelor's degree in anthropology may be admitted to sociology, or that a sociology student may be admitted to economics. In 1988, 61 percent of social science students received a bachelor's degree in the same major as the one in which they earned their doctorate. UC's NRC data were separated into two groups: those who received an undergraduate degree in a field other than the doctoral field, and those who stayed in the same field. When the mean time for each group was calculated for 1988, for example, mean elapsed time-to-degree for social sciences doctorates who had changed fields was on the average two years longer than for those who remained in the same field. These students also most likely acquired a master's degree before pursuing the doctorate. Similarly, mean elapsed

¹⁵Theodore Ziolkowski, "The Ph.D. Squid," The Academic Scholar, Spring, 1990.

¹⁶Ann MacLachlan, UCB Placement Project 1990, Table 10, "Post Doctoral Appointments by Year and Field, 1980-1987."

time-to-degree was 1.6 - 1.7 years longer for field switchers in engineering and physical sciences. The difference is that there are fewer of them (Table 15).

All professional fields admit students from other disciplines. Graduate professional schools rarely have undergraduate programs, and if they do, they offer only a minor specialization. Doctoral students in education, social welfare, and library sciences come with varied undergraduate preparation. In 1988, only 20 percent of professional field students received bachelor's degrees in the same field as the doctorate. Those that switched fields took 2.4 years longer to earn their doctorates.

8. Master's Requirements

The requirement of a master's degree as a stepping-stone to the doctoral degree has differing effects on time-to-degree, depending on the discipline, as discussed below. Nearly all professional fields require that a student earn a master's degree before being accepted to the doctoral program. Since many professional fields do not have undergraduate programs, students in professional fields often acquire a master's degree, work for some years in the field, and then apply to a doctoral program at an institution other than the one where they studied for the master's. This step added 1.6 mean years to the doctoral degree time in professional fields. Furthermore, nearly 70 percent of professional field doctoral recipients who earned a master's degree earned the degree at an institution other than the one where they received the doctorate. This increased the mean time by another 2.2 years for this group (Tables 10, 10A, and 10B).

Most humanities programs also require a master's degree, correlating with an additional 1.5 years for those who acquire the master's at the same institution, and with an additional four years for those who acquired the master's elsewhere. In contrast, only half of all students in the life sciences and physical sciences acquired a master's. (When the students took a master's degree at the doctoral institution, this step added, on the average, 1.7 years in the life sciences and one year in the physical sciences. It added, for those who received the master's elsewhere, 3.5 years in the life sciences and 3.2 years in the physical sciences.)

The majority of engineering programs require a master's degree before entrance to the doctoral program. However, the added time is less than in the professional fields and social sciences (0.7 years added with master's degree from the same institution, and an additional 2.6 years with master's degree from elsewhere). Since engineering doctoral training is tightly structured, students move along relatively quickly.

9. Other Factors

When students in the natural sciences (particularly in physics, engineering, and molecular biology) take a long time to complete their degrees, it is often because of a failed experiment. When a student must rebuild the entire set-up, it can add between six months and a year to the time-to-degree.

In those life sciences programs that study organisms, length of time-to-degree depends on nature and its many unforeseen events. Unusual weather, an animal plague, or housing and industrial development projects may wipe out an entire breeding season of insects and beetles or destroy the flowering season of a rare plant.

* * * * *

Altogether, various factors contributed to a longer time in the humanities, social sciences, and professional fields, as compared to the sciences and engineering fields. Among the factors described above, students and faculty in humanities, social sciences, and professional fields cited loosely structured research training, the nature of independent dissertation work, and lack of research money as key reasons for long time-to-degree. While a general change of research requirements and practice can only occur through the profession on a national level, the funding for research, especially that for graduate student research assistantships, could be improved by the state and federal governments, by extramural funding agencies, and by the University itself.

B. Institutional Factors

Institutional and field-specific factors that cause lengthy time to the doctorate are partly interrelated. Yet there are factors that are contained solely within the institution and department. These are: (1) degree requirements, including teaching requirements and the system of evaluating graduate student progress; (2) faculty advising and departmental guidance; (3) financial burden/financial support for students and debt accumulation; (4) the campus facilities; and (5) the professional job opportunities and placement support offered by the department and campus. Figure 1 shows in summary form how each of these factors can affect both high or low time-to-degree and attrition. The following discussion focuses on selected factors and highlights those with particular impact on women and minorities.

1. Degree Requirements

Most faculty members interviewed argued that the increase in time-

to-degree is due, at least in part, to an increase in the requirements for the doctoral degree. Recent publications on time-to-degree have also suggested this explanation.¹⁷ According to this argument, the expanding knowledge base demands more learning time, and doctoral students are expected to produce higher quality work than in the past. A social science faculty member illustrated this point by saying, "Theories may go out of fashion, but they never disappear, and there are always new theories that emerge."

To judge whether a "knowledge explosion" has occurred in each field and whether students must absorb more information and learn more theory and methodology, UC would need objective measures of the expansion of both knowledge and curricula in each field--information which is not currently available. Even with such measures, however, UC would still be limited in determining if the increase in time is due to increased requirements, given the fact that students progress at different rates.¹⁸ Considering these methodological difficulties, this study approached the issue from two angles. First, this study examined whether degree requirements had changed over time and whether or not these changes would have an impact on lengthening time. Secondly, this study investigated degree requirements for 1989-90 in the same disciplines at three different campuses to define how much the degree requirements vary within the same field. The results are summarized in Figures 2 and 3.

To examine how requirements have changed over time, this study inspected the stated requirements for the doctoral degree (in graduate program handbooks, bulletins, etc.) of five departments from Berkeley: Biochemistry, Electrical Engineering and Computer Sciences (EECS), English, History, and Sociology.¹⁹ A ten-year interval was selected to measure changes in program requirements, comparing requirements for students entering in 1978 to requirements for those entering in 1988. This time interval was based on the availability of adequate documentation and on requirements from the departments, and it captured changes which actually predated the year 1988.

The study found that nearly all departments either reduced course requirements (English, History); created more flexibility (EECS); implemented means to help students stay on track, such as annual reviews after advancement to candidacy (Biochemistry); or required a dissertation prospectus of specified length by a certain time (History, English). The exception was Sociology, where students

¹⁷Tuckman, Coyle, and Bae, 1990, Ziolkowski, 1990.

¹⁸Tuckman, et al., 1990, p. 97.

¹⁹Carol Lynn Stewart, from the Graduate Division at Berkeley, undertook this survey.

had to take one additional methods course. An added requirement in one department (EECS) was that students serve as teaching assistants; the added teaching requirement is considered by the department as a positive addition to the student's program, since teaching skills are essential to a faculty position. Altogether, this study found that a time decrease coincided with flexibility or tightening of structure, and a time increase with an additional acquisition of new research methods.

It should be repeated that these results do not give an exact measure of time increases due to changed degree requirements. Furthermore, the requirements examined here represent formal requirements and do not present a total picture of graduate study. Future research should explore the informal or "understood" requirements that do not appear in print. More detailed research which covers a larger sample over more years is required. This sample survey, however, illustrates that many departments are reconsidering their requirements in an awareness of the problem of long time-to-degree.

For the second step, the study compared the official degree requirements, extracted from the general campus catalog, for the departments of Biochemistry, Electrical Engineering, English, History, and Sociology at Irvine, Los Angeles, and Santa Barbara. Since each program is unique and diversity among the campuses is a goal of the University of California, this study anticipated some variations and found them. See Figure 2 for summary results. It was surprising to find substantial differences in the foreign language and teaching requirements, as well as differences in the requirement of a dissertation and final defense. Again, any clear cause-effect relationship between these requirements and time-to-degree cannot be established. For example, the explicit master's requirements might be implicitly contained in the doctoral program. Or a department may have only a small number of undergraduates in a program, which leaves graduate students with few teaching opportunities. These departments, therefore, may have no formal teaching requirements. This comparison of degree requirements is not very informative in drawing conclusions about increases in time-to-degree. This study concluded more from the interviews with students and faculty. By contrasting the steps students actually took and what requirements they fulfilled, this study was able to detect the following patterns. Overall, the life sciences, engineering, and physical sciences programs (with the exception of mathematics) not only seem more tightly structured, but the program requirements are more likely to reflect the present requisites in their professional fields, such as grant writing, publishing, and frequent presentation of research results. Characteristic of these programs is that, by the second year at the latest, students begin research for their theses.

The biochemistry and molecular biology departments on all campuses seem to have taken the lead in developing timely and adequate

structures that depend less on whether the student's adviser is a "good citizen," as one professor put it, and more on the departmental structure and a collaborative learning effort. Such features provide a safety net if the delicate student/adviser relationship fails.

Evaluating Student Progress

Most often in such programs students write their dissertation prospectus in the form of a grant proposal. They are evaluated on their progress and given feedback on their accomplishments at least once a year. Commonly, there are journal clubs where students discuss recent articles and learn how to criticize published research. These programs require that students present their research for the entire department at least twice during their advanced study career. Students in these departments are assigned the task of choosing a number of speakers for the departmental colloquia and arranging for their visits. This allows students to make professional contact with off-campus people in the field.

Programs that required a dissertation prospectus as part of the qualifying examination tended to have shorter time-to-degree. Students, as a result, perceived the requirements as stepping stones toward the completion of the dissertation rather than as hurdles to be overcome. A Berkeley survey (1989) of all departments' dissertation prospectus policies found that in arts, humanities, and social sciences departments that required a dissertation prospectus as part of the qualifying exam, time-to-degree was shorter than in the departments that lacked such a requirement.

Teaching Requirements

It has been popularly assumed, in recent years, that graduate students teach "more students for more hours for more years" than in the past,²⁰ and that this expanded work load has contributed to lengthening time-to-degree. Although true in some cases, this assumption cannot be made about all departments. The complicated question of teaching and time-to-degree deserves in-depth investigation.

Teaching serves two functions in a doctoral program. First, by working as teaching assistants (TAs), students learn the skills and gain the experience necessary to compete for and acquire a faculty position. Second, a teaching assistantship provides crucial financial support for many students. As mentioned earlier, students in the arts, humanities, and some social science

²⁰John D'Arms, "Universities Must Lead the Effort to Avert Impending National Shortages of Ph.D.'s," The Chronicle of Higher Education, January 27, 1990.

departments especially depend upon these positions. Life science students studying organisms also rely on teaching assistantships for support. In a discussion of time-to-degree and teaching, the question that should be asked is not whether teaching requirements should exist, but how much teaching should be required for adequate professional training.

At least two years of teaching experience, along with training workshops and efficient supervision, form a solid basis for future teaching positions, according to teaching assistant supervisors. All nine campuses now offer formal teaching assistant training and supervision.²¹ Since many students depend on teaching for the majority of their financial support, they will often teach for more than two years, often extending their teaching appointment to the permitted four-year limit and sometimes for two years beyond that, with special permission. In contrast, departments with no undergraduates, in health and related sciences or in some professional fields, can offer no teaching opportunities to prepare students for faculty positions.

A Berkeley study examined the relationship between time-to-degree and financial support in five humanities and social science departments. The study showed that students who taught three or more years took on average one year longer to complete the degree than students who taught less than three years (Table 16). The NRC data (1980-88) on the relationship between source of primary support and time-to-degree indicate that, overall, students who supported themselves primarily by teaching took an average of 1.3 years longer than those who depended on research assistantships. These same students took 0.4 years longer than those who were supported by fellowships. However, in fields where few students had the opportunity to work as research assistants, the difference in time-to-degree between those whose primary support was a teaching assistantship and those whose primary support was a research assistantship was minimal (arts and humanities and social sciences.) Students in the life sciences had similar time-to-degree on average as follows: 7.3 years with research assistantship, 7.6 years with teaching assistantship, 7.4 with fellowship (Table 14).

* * * * *

In summary, programs with a structure that calls for an early start to dissertation research will tend to have a short time-to-degree. In addition, programs that evaluate their students' progress annually and suggest improvements seem to inspire students'

²¹These recent developments are partly the result of a Universitywide study on TA training (1987-88).

confidence about completing the degree. Students especially appreciated the progress meetings with dissertation committees after advancement to candidacy. This interaction gave them a sense of security and certainty on the path to the doctorate. Students in these programs seem to "drift" less.

Students also favored the custom of a dissertation defense. They said that this presentation, usually conducted before the entire department, was their sole opportunity to present their research. It also served as a useful preparation for job talks. They valued the ritual aspect of a formal closure and felt that it was a time during which they received attention and acknowledgment from the entire dissertation committee.²²

The findings relating to teaching led to the following suggestions. All students should have some teaching experience during graduate study, even if they have fellowship support. In order to be competitive for academic positions, students must be able to acquire teaching skills. In departments with few openings for undergraduate teaching, students should participate in teaching training sessions and assist with major courses in related disciplines. Though not teaching, these students should be asked to develop a course syllabus for their field.

2. Faculty Advising and Departmental Guidance

Most of the interviewed students on all campuses discussed their relationship with their principal dissertation adviser. They either praised their major adviser as being a wonderful mentor, or expressed the need for such an adviser. What do students expect from an adviser who is also their mentor?

From sources including student interviews the study arrived at the following characteristics that students expect in an adviser. An ideal adviser should be a mentor who helps students set goals and standards, develops students' skills, protects students from failures, and advises them on appropriate and feasible dissertation topics. The adviser should facilitate students' entry into academic and professional circles.²³ The relationship between student and adviser should be based on mutual acceptance and

²²A task force on Institutional Policies Governing Doctoral Education of the Association of American Universities, which consists of graduate deans from major research universities, found that scientists especially favor the oral defense, as it is an assurance, in "this age of collaboration," that the work is the student's own (Washington, D.C., January 1990).

²³Refugio I. Rochin, "Mentor/Mentoring: What It Is and What It Means to Me," paper presented at the UC President's Post-Doctoral Fellowship Orientation, Berkeley, October, 1989.

respect.

While it may be true that students in some cases have unrealistic expectations of faculty members, too often during the interviews students described their total isolation from faculty advisers. In many cases, they were forced to gain access to professional circles by themselves, received minimal concrete help with their dissertation work, and obtained little advice on professional development. Even students who had good personal relationships with their advisers said that they did not receive enough professional support.

Since it is difficult to quantify how many students were satisfied with the guidance and advising they received, this report includes results from the Berkeley doctoral student exit questionnaire. Students complete this questionnaire when they file their dissertation with the Graduate Division. The results reported are based on responses from 1,141 students who completed their degrees between Fall 1987 and Fall 1988.²⁴

The majority of the Berkeley students were satisfied with the professional relationship with their advisers. Sixty percent were very satisfied, 30 percent were satisfied, and 9 percent reported that they had problems. A slightly lower percentage of women than men reported that they were satisfied with their advisers, and, a larger percentage of women than men (13 percent versus 7 percent) were dissatisfied.²⁵ Do these results reflect the absence or presence of women faculty in these fields? More research on advising and mentoring is necessary.

The recent literature on mentoring and faculty advising of graduate students is still relatively sparse.²⁶ Several publications state that women and minority students may be most in need of mentoring.²⁷ These groups lack the knowledge of "how the system works," especially in terms of informal operations, since many minority students may often be the first generation in their

²⁴This study has not yet been analyzed for minority students.

²⁵Maresi Nerad and Carol Lynn Stewart, "Gender and Departmental Culture," paper in progress.

²⁶See Project on the Status and Education of Women.

²⁷Sheila Widnall, "Voices from the Pipeline," *Science*, Vol. 241, Sept. 1988; Richard Duran and Paula Rudolph, "Mentorship and Support Services for Women and Minority Graduate Students," UC, All-University Faculty Conference on Graduate Student and Faculty Affirmative Action, Pala Mesa, California, 1990; Michael Nettles, "Black, Hispanic, and White Doctoral Students: Before, During, and After Enrolling in Graduate School," ETS, 1990. Earlier work: Birt Duncan, "Minority Students," in Joseph Katz and Rodney Harnett, *Scholars in the Making*. Cambridge, Mass: Ballinger Publishing Co., 1976.

families to go to college. The literature reports that faculty often tend to select students who are similar to themselves for mentoring. Given the small number of minorities and women on the faculty, these groups may indeed end up without faculty members to take them "under their wings."

It can be argued that faculty members do not formally acquire advising and mentoring skills and seldom receive formal recognition for these skills. Without opportunities to evaluate their own mentoring skills, faculty often carry on indifferent advising habits passed down from their own dissertation advisers. With the increase of women and minorities in graduate school, new demands are placed on the mentor relationship. Interviewed faculty supported the idea of the university offering assistance in acquiring advising skills and rewarding faculty for good mentoring by taking these criteria into account in promotions and tenure evaluations.

Mentoring and advising require student and faculty to make a mutual effort. In order to enter a successful dissertation-advising relationship, students should carefully choose the dissertation adviser. Departments can facilitate this process and improve communication between faculty and students. Some departments offer a first-year seminar at which a different faculty member presents his or her latest research project each session. By the end of the seminar, the first-year students have met all the faculty in their department and know what each is working on. Departments experimenting with such a format reported that the best results came from meetings that took place in a faculty member's home or in a location where a social atmosphere can develop and where students can get to know the faculty in a more relaxed context.

In some science departments, the process of choosing an adviser takes place during the required laboratory rotations. On the average, students undergo three laboratory rotations of ten weeks duration each. Since laboratory rotations require careful administrative planning and pooling of departmental funds to support the students during the first year, departments often cannot afford such efforts. However, in departments where these rotations were organized, both students and faculty felt that these rotations were very successful in the long run, giving the students a broad picture of the field and helping them to make rational decisions about the choice of an adviser and a laboratory for their dissertation research. This is a means to protect students from losing time as a result of having to change advisers half-way through their studies.

Some departments also alleviate the burden placed on individual advisers. They offer seminars and workshops that socialize students into the professional world or the discipline. In these seminars faculty present an overview of the current research in the field. They explain to their students where the department stands

in a national context; they teach their students how to present research; and they discuss the ethics of their field. Further, they actively assist their students in the job search by teaching students how to write an effective curriculum vitae and application letter, and they prepare them for job interviews by setting up mock job interviews. In these departments, students feel they are treated as junior colleagues and as future scholars, and they have high self-confidence and enthusiasm about their studies.

According to the interviewed students, however, not enough departments offer such activities. Rather, departments seem to leave the task of socializing their students into the professional world to the major adviser. This, as one student said, often means that "things occur accidentally or not at all."

According to the Berkeley exit questionnaire, nearly one-quarter of the students were dissatisfied with the departmental advising and guidance. This suggests that more thought should be given in the future to the role of the dissertation adviser, the role of a faculty mentor, and the system of guidance and advising within departments. Faculty and department chairs can learn from the many constructive measures that have been implemented on all campuses. The University of California has devoted itself to developing a mentorship program for minority students and women in fields in which they are underrepresented. These programs can become models for serving more students.

3. Financial Burdens and Financial Support

According to students, faculty, and graduate deans, one of the key factors in long time-to-degree is insufficient financial support for doctoral students. Minority students and students in the arts and humanities, education, and social sciences are particularly vocal about the rising fees, soaring housing costs, and the expenses of health insurance, car insurance, and raising a family. They were deeply affected by the increasing discrepancy between expenses and financial support. These students asserted that the uncertainty about future income sources, particularly after the fourth year in graduate school²⁸, had an impact on their academic performance.

In response to these comments, this study examined the relationship between financial support and student expenses for all UC graduates students, including doctoral and master's students combined (Table 17). For the years 1980 through 1988, Office of the President Student Financial Support has compared the expense budgets of UC graduate students to the financial support they received.

²⁸The Regents Graduate Opportunity Program, The Academic Career Development Program for Minorities and Women, and individual campus programs provide minority students with multi-year support packages.

Unfortunately, the data could not be separated by master's and doctoral students. The expense budgets are based on campus estimates of living expenses plus both nonresident tuition (prorated to reflect the fact that only a portion of the students pay this charge) and fees. The expense budget for a student was \$12,007 in 1988, \$3,098 more than the 1980-81 budget of \$8,909 (in 1988 constant dollars). The financial support that a student in 1988 could expect on the average was \$7,671 as compared to \$6,537 in 1980. This means that between 1980 and 1988, average expenses have increased by 35 percent, while average financial support increased only by 17 percent. Thus, in 1980, a graduate student could expect 73 percent of expenses to be covered for nine months by some kind of financial support (fellowships, teaching or research assistantships, loans, etc.). In 1988, a graduate student could expect only 64 percent of expenses to be covered.

In addition to the remaining 36 percent of expenses that were not covered by institutional support, students with dependents (41 percent) had to pay the additional costs incurred by their families. Between 1980 and 1988, tuition and fees increased by 42 percent from \$4,480 to \$6,365 (Table 17). Furthermore, financial support such as teaching assistantships, readerships, and research assistantships may not be equally available from department to department. Fellowships are strictly merit-based and small in number compared to the total student population. In addition, foreign students had to pay out-of-state tuition for the duration of their graduate careers.

A Berkeley study on the relationship between time-to-degree²⁹ and financial support considered the above-mentioned expenses in its calculations.³⁰ For this study, the unit of analysis was the actual expenses and financial support of each UC Berkeley student (222) who completed a degree between May 1986 and May 1989 in two social science and three humanities departments.³¹ The first step was the calculation of financial support during the first five years by length and amount of support. These figures were correlated with the time the students took to complete their degrees. Students who received between four and five years of support had an average 7.9 years to degree, while those who received no support took twice as long at 16.6 years (Table 18). Of the 222 students in the sample, 13 did not receive any financial

²⁹These times include students who received the master's elsewhere.

³⁰Francis Chan and Maresi Nerad, "The Berkeley Study on Financial Support in Selected Departments," Spring 1990.

³¹The files of individual students were pulled from the Graduate Division, and all recorded employment, fellowship, and grant monies were compiled both by the amount of money and by the length of time and the date the support was provided. Loan money was excluded. Student employment was categorized by teaching assistantship, research assistantship, reader, and other employment.

support. As expected, the time decreased with an increase in support.

The second step was to divide the annual 12-month financial support by the annual 12-month expenses of the appropriate year (Table 19). The findings showed that on the average, the student could cover between a range of 30 percent to 90 percent of expenses during the first five years in the program. Departments varied in the type of support they gave to students, as well as in the length of time the support was provided. Not surprisingly, the department offering the most financial support had the shortest time-to-degree (Department D). The department that offered the most financial support in the form of teaching assistantships had a fairly long time-to-degree (Department A). However, the department with the longest time-to-degree did not offer the lowest amount of financial support to its students. Significantly, the department with shortest time-to-degree (Department D) not only provided the most financial support, but distributed the support the most equally between research assistantships, teaching assistantships, and fellowships.

Assuming that these five departments had an equal proportion of outstanding students,³² the Berkeley findings suggest the following conclusions. First, time-to-degree is related to amount of support. Second, it is related to type of support. Third, factors other than financial support (Department E), such as structure of the program, influence time-to-degree.

Results from the 1980-88 NRC data for all nine campuses support these conclusions. UC's analysis has shown that time-to-degree is related to amount and type of support. Students whose primary support came from their own funds³³ took the longest to complete their degrees (11 years on average), followed by students whose primary support came from loans (9.4 years). In most fields students who took the shortest time (7.0 years) were those who depended primarily upon research assistantships. Students who lived primarily on teaching assistantships took 8.3 years. These data applied to both men and women (Table 14).

It has to be understood that these are rough measures: NRC questionnaires asked students to estimate the proportion of funds coming from the various sources from which they funded their studies (see Appendix D).

³²All five departments rank among the top seven graduate programs in the nation, according to the Associate Research Councils, 1983.

³³Own earnings, spouse's earnings, and family contributions fall under own funds.

Non-Asian minorities who were funded primarily by fellowships, research assistantships, or teaching assistantships had shorter times-to-degree than those whose primary support came from loans and their own earnings. In order to maximize the effect of a fellowship, the UC minority programs for underrepresented minorities and women are linking the fellowship with faculty mentoring to insure that minority students benefit from the same level of attention that research assistants receive. A larger proportion of women than men (38 percent versus 27 percent) reported that their primary support came from their own sources of funds. For women, this was true in all fields except the physical sciences. Concerning those with a primary support of fellowships, proportionally fewer women in the professional fields and arts and humanities reported that their primary support came from fellowships (Table 14A). Finding reasons for these differences will require further research.

Within the category of "own funding," the majority of doctoral recipients reported their own earnings as the source of primary support. For example, in 1980-88, 16 percent of the men and 21 percent of the women reported that they were funded primarily by their own earnings. In addition, 5 percent of men and 13 percent of women were supported by their spouses' earnings. Only 2 percent of men and 2 percent of women reported family contributions as primary support (Table 14A). The most common source of support for non-Asian minorities was fellowships (33 percent), followed by their own earning (27 percent). Similar findings were reported by Benkin (1984) at UCLA, and Tuckman (1990).

In all fields, a larger proportion of minorities than whites reported that they were funded primarily by fellowships. The only exception was Asian American students in engineering and computer sciences. A smaller proportion of Asian Americans received primary support through fellowships, but more were funded primarily by research assistantships. Women were supported less often than men by research assistantships in all fields except the physical sciences. Non-Asian minority students held more multi-year fellowships than whites, but were supported less often by research assistantships in all areas except the life sciences.

Interviewed minority students reported that a fellowship without accompanying faculty mentoring during the first and second years does not help integrate students into the department. Therefore a fellowship alone early in the degree program did not necessarily result in students completing the degree in a short time.

In 1978 a Regents' policy, the In-Candidacy Fee Offset Grant (IFOG), was established to alleviate some of the students' financial burden while simultaneously encouraging them to finish earlier. After advancement to candidacy, the Education Fee is waived for a determined amount of time. This policy was meant to entice students to advance to candidacy earlier and thereby finish

earlier. Most interviewed students appreciated the fee reduction³⁴ but commented that, in light of the increased financial burden, the amount was too little to make a substantial difference. On most campuses they also pointed out that the present normative time limits for completion of the degree are based on ideal time, not on actual time.³⁵

Another aspect of students' financial burden was examined by analyzing the amount of debt students accumulated during their undergraduate and graduate studies. According to the 1988 survey,³⁶ more than half of all doctoral degree recipients (59 percent) accumulated debts during their years as students; 12 percent of these had debts over \$20,000, 23 percent between \$10,000 and \$20,000, and the remaining below \$10,000 (Table 20).

The largest proportion of degree recipients with debts was in the social sciences (67 percent). Next followed those in the life sciences (65 percent), the professional fields (58 percent), and the arts and humanities (56 percent). Interestingly, with the exception of the professional schools, the amount of debt that degree recipients accumulated did not vary much by field. Although doctoral students in some fields are supported by research assistantships during most of their studies and therefore did not need to take out loans, they might have carried over debts from their undergraduate study. About the same proportion of women and men accumulated some amount of debt (59 percent of men and 60 percent of women). However, women generally had smaller accumulated debts than men.

A larger proportion of non-Asian minority degree recipients (77 percent) accumulated debts compared to whites (58 percent) or Asian Americans (54 percent). Nearly 80 percent of African American degree recipients reported having accumulated the largest amount of debts: 26 percent reported debts over \$20,000, compared with 11 percent of whites and 12 percent of Asian Americans reporting this amount of debt. Few findings illustrate more clearly how essential financial support is for African Americans, Chicanos/Latinos, and American Indians for successful completion of their studies. The small number of non-Asian minority doctorates may be due, among other reasons, to lack of financial resources. For example, students often would prefer not to be supported solely by loans, and minority students who have debts from their undergraduate

³⁴At Berkeley in 1990 this fee reduction amounted to \$451 per semester.

³⁵The Graduate Council at San Diego has already reexamined normative time and has established what the Council considers to be more realistic time limits for each doctoral program.

³⁶This question was only recently included into the NRC questionnaire. Therefore, only 1988 data are available.

degree programs may, as a result, refrain from pursuing doctoral degrees.

* * * * *

In summary, average graduate student expenses during the last ten years increased at a higher rate than the financial support awarded. Students whose major financial support came from their own earnings took the longest time to complete their degrees, followed by students supported by teaching. The most advantageous correlation in terms of time-to-degree proved to be a research assistantship. The second most advantageous correlation was multi-year fellowships.

4. Campus Facilities

Housing

To address further the question of rising graduate student expenses, this study collected information on the cost of on- and off-campus housing and campus child care facilities. The cost of housing varied from campus to campus. In 1989-90, single graduate student on-campus housing ranged from \$245 a month in San Francisco to \$435 a month in San Diego (Table 21). According to the campus housing offices, Davis, Irvine, and San Francisco have the least expensive housing. Berkeley offers no targeted student housing for single graduate students. Data for Los Angeles and Riverside are not included in this study. The average cost of family student housing ranges from \$290 a month to \$570 a month. The cost of off-campus, single student housing ranged from \$366 in Davis (in 1988-89) to \$570 in Los Angeles in the same year. During the last decade increases in the cost of off-campus housing ranged from a low of 20 percent in Irvine to a high of 57 percent in Santa Barbara (Table 22 and Graph 6). With 84 percent of graduate students living off-campus, housing becomes a major financial burden to graduate students (Table 23). According to the figures for on- and off-campus housing costs, half of a research assistant or teaching assistant salary could be spent on housing alone.

Dependents and Time-to-Degree

Between 1980-88, 42 percent of doctoral degree recipients had one or more dependents (Table 5B). When time-to-degree was calculated separately for doctoral recipients with dependents and those without dependents among the 1980-88 doctoral recipients, doctoral recipients with dependents took, on the average, 1.3 years longer to complete their degrees than those who did not need to care for one or more dependents (Table 5A). Women with dependents took, on the average, 2.2 years longer than women without dependents, while men with dependents took only 1.5 years longer than men without dependents.

The average difference in time-to-degree (0.7 years) between men and women with dependents varied by fields. In the arts, humanities, social sciences, and professional fields, women and men with dependents took about the same amount of time to complete their degrees. However, in the life sciences, physical sciences, and engineering, women who had dependents took longer (1.3 years, 1.1 years, and 0.5 years, respectively) than men with dependents, in the same fields. Assuming that dependent care would result in equal additional time for men and women, the difference in results for men and women may be interpreted in the following way: it is more difficult for women to manage childcare and studying when in a field that requires full-day presence in a laboratory than it is for men.

Overall, African American, Chicano, and Latino doctoral recipients with dependents (with the exception of students in the social sciences) completed their degrees in less time than whites. Asian American doctoral recipients took slightly longer (1.7 years) than whites (1.5 years), especially in the life sciences, social sciences, and professional fields.

While dependent care cannot be considered an institutional factor contributing time to prolonged time-to-degree, the campuses can assist with childcare. Since 42 percent of all doctoral recipients reported having one or more dependents and since these students' time-to-degree was 1.3 years longer than for those students without dependents, this study considered it important to examine the availability of campus childcare facilities.

In 1987-88, all campuses offered childcare but, with the exception of Berkeley and Santa Cruz, the facilities served faculty, staff, undergraduates, and the community as well as graduate students. In 1987-88 in Los Angeles, only 2.5 percent of all graduate student parents found space in the campus childcare facilities for their children (Table 24). These students had to add between \$72 (Davis) to \$495 (San Francisco) a month to their living expenses. It is worth noting that in 1988, proportionally more minority students than whites had responsibility for dependents.

In the interviews, students brought up other issues relating to the campus infrastructure such as the lack of efficient public transportation, the consistent lack of study space, and not enough library hours during the summer. For example, Los Angeles students complain about poor public transportation and very limited on-campus day parking. In addition, on most campuses, libraries close at 10:00 p.m. or 5:00 p.m. on weekends and are open fewer hours during the summer--a major research period for graduate students.

Social sciences, humanities, and education students suffer from the lack of adequate office space. Even teaching assistants often have to share a desk with another graduate student, and their office hours, during which they advise undergraduate students, are held in

large, noisy rooms shared with up to ten other graduate students.

5. The Professional Job Market

When faculty were asked to identify reasons for the lengthening of time-to-degree, many named the lack of academic jobs as a major factor. They argued that the prospect of a good job is a strong incentive for many students to complete the degree in a timely fashion. Interviewed students confirmed this statement on occasion. Conversely, the lack of job prospects has, in the past, often made it seem logical for students to spend more time polishing their dissertations in order to be more competitive. This situation will probably change as the job market continues to expand over the next decade. An objective examination of this argument, however, was beyond the scope of this study.

All nine campuses have an academic placement service for doctoral students. In particular, students who get little help from their major advisers depend on this outside service in the professional job search. However, often one academic career counselor is responsible for all doctoral students--both alumni and enrolled students.

One totally unexpected aspect of the professional career search emerged from the interviews with students. About half of the interviewed biological sciences, physical sciences, and engineering students did not intend to enter an academic career. They said that they were "worn out." The prospect of another two to four years of post-doctoral study demanding an 80 hour workweek and an additional five to seven years as an assistant professor with uncertainty of tenure, led them to prefer industry positions instead.

Students also commented on how hard the faculty work and how it is increasingly more difficult to secure sufficient outside research funding, particularly for junior faculty who do not yet have a reputation. Consequently, these students do not aspire to an academic life-style.

If these comments represent a widespread perception, it will be a difficult task for the University to try to draw more students, particularly more minority and women students, into doctoral programs with the hope of creating a greater pool from which to hire for faculty positions.

PART VI:
COMPLETION RATES (ATTRITION)--
UC BERKELEY STUDY

VI. COMPLETION RATES (ATTRITION)--UC BERKELEY STUDY

It is often believed that students who draw out their time-to-degree may not complete their dissertation and may become drop-outs. How many students complete their doctoral programs? If they leave before receiving the doctorate, when do they leave?

These questions cannot yet be answered for the entire University of California. The Systemwide Graduate Longitudinal Database System, which tracks students over time, does not have enough years of data to analyze completion rates for UC. At this point, only data from a recent Berkeley study of the 1975, 1976, and 1977 cohorts and the results of a doctoral dissertation study of the 1969, 1970, 1971 cohorts at UCLA are available for UC. Both studies showed similar results: over 50 percent of students who began studying for a doctorate reached the degree goal. However, it is not correct to conclude that the remaining students left the university without a degree. At Berkeley, 24 percent of the non-doctoral recipients earned a master's degree before leaving, and thus 76 percent of all students who started a doctoral program in 1975, 1976, and 1977 received a graduate degree of some kind by November 1988 (Table 25).

The majority of the doctoral students (31 percent) who did not complete a doctorate left during their first three years of graduate study, before advancement to candidacy, not afterwards, as is commonly believed. Another 11 percent left after advancement to candidacy, and another 6 percent were pending at the time these data were analyzed (Table 26). Benkin's 1984 study of UCLA doctoral students found similar results. Although women had a ten percent lower overall completion rate than men, in natural resources and professional fields they had a higher completion rate than men.

Doctoral completion rates at Berkeley also varied substantially among major fields of study (Graph 7). Low completion rates correlated with long time-to-degree. The biological sciences (68 percent) and physical sciences (67 percent) had the highest completion rates and also short time to doctoral degree; languages and literature (30 percent) and arts (42 percent) had low completion rates and long time-to-degree. Ethnic minority students were concentrated in the professional fields and social sciences--fields that have lengthy time-to-degree and low completion rates. Thus, as a group, minority students had lower completion rates than whites, who studied in a wider variety of fields.

A higher percentage of minority students (36 percent) than whites (29 percent) left during the first three years (Table 26). The percentage of minorities awarded master's degrees (26 percent) was higher than of whites (23 percent) (Table 25). Slightly more women (14 percent) than men (10 percent) left after advancement to candidacy, and more were still pending after 12 years (8 percent of women versus 5 percent of men) (Table 27). The variation by field was the greatest after advancement to candidacy. Between 14

percent and 23 percent of students in languages and literature, the arts, and the professional fields left after the third year, as compared to the biological sciences, engineering, and the physical sciences, where only 4 percent to 8 percent left after advancement to candidacy (Table 27). Informal meetings with deans at major research universities confirm that the situation at Berkeley resembles that at other top-ranking research universities.

It must be understood that students leave for many reasons, some personal and some institutional. Frequently, students who left graduate school after one or two years reported that their expectations were not met regarding the general field of study, graduate student life, or the focus of the program. In particular, students in the professional fields and engineering who already have a master's degree rethink their career goals and often choose to leave after the first year. These students often have, as an alternative, a well-paying job.

The literature (Berelson 1961, Tucker 1964) clarifies that there will always be students who leave before advancement to candidacy, because of unmet expectations, regardless of guaranteed financial support. In the cohort Berkeley has studied, it is estimated that about 10 percent to 15 percent will inevitably leave. The Berkeley findings, however, bring up further concerns. Why does a higher proportion of minority students than white students leave during the first three years? Why do more women than men leave after advancement to candidacy? More research, with a larger sample than that of the Berkeley study, will be necessary to verify and explain these trends. The Systemwide Graduate Longitudinal Database System will eventually allow UC to analyze the basic attrition patterns at the University of California, and the discussions under way at many UC campuses will supplement this quantitative data. Thus the description in this report should be regarded as the beginning of the University's consideration of this issue. Increasing changes and Universitywide attention devoted to graduate retention issues are likely to result in new intervention strategies and other policy changes.

PART VII:
PRINCIPAL FINDINGS AND FUTURE RESEARCH

VII. PRINCIPAL FINDINGS AND FUTURE RESEARCH

This study concluded that doctoral fields of study differ in disciplinary ethos, programmatic requirements, and funding patterns. Consequently, students in the various fields complete their degrees in differing lengths of time. The overall length of time spent earning a doctorate at UC has increased during the past 20 years by approximately one year. Time-to-degree has increased most in those disciplines that traditionally have had a longer time-to-degree, most notably the humanities and social sciences. Since minorities and women are clustered in fields with long time-to-degree, high attrition rate, and lower levels of institutional support, they are affected disproportionately.

The following findings represent a comprehensive set of conclusions concerning effective activities that contribute to shortening time-to-degree, in the areas of advising, program structure, teaching, research, student progress assessment, funding, and campus facilities.

The Association of Graduate Schools (AGS) Task Force on Institutional Policies Governing Doctoral Education, under the Association of American Universities, developed a report on institutional policies to improve doctoral education. The Task Force consisted of eight graduate deans of major public and private research universities; Berkeley's graduate dean was among them.³⁷ Their recommendations, as well as the recommendations of the Council of Graduate Schools' (CGS) study of the Role and Nature of the Doctoral Dissertation,³⁸ are attached as Appendices D and E.

While the findings presented within this report were arranged to correspond with the stages of the doctoral degree program, the following summary findings are presented in a different order. They are directed at the target audiences that can best address the institutional factors. Pertinent recommendations from the AGS and CGS reports have been integrated in this section.

A. Findings

1. Faculty Advising and Departmental Guidance

Guidance and advice, both from the department and the faculty members, are crucial to students' timely completion of the doctoral program. Students can progress more quickly when:

³⁷Association of American Universities, AGS Task Force on Institutional Policies Governing Doctoral Education, "Institutional Policies to Improve Doctoral Education," Washington, D.C., November 1990.

³⁸Council of Graduate Schools, "Draft: The Role and Nature of Doctoral Dissertation," Washington, D.C., December 10, 1990.

- * Departmental graduate advisers ensure that all doctoral students have a designated faculty adviser at all stages in their programs. They inform students that it is important to choose a dissertation adviser carefully. Both the major adviser and the student enter the working relationship with a clear concept of their respective roles.

Faculty can fill their advisory roles more effectively when:

- * The divisional Graduate Councils and Graduate Divisions develop a handbook for dissertation advisers and offer assistance to faculty in acquiring advising skills. Faculty advising includes assisting and preparing the students for the job search. (Such activity, in turn, will motivate students to complete their dissertations in a timely way.) The Graduate Councils or other appropriate campus body broaden the academic program review criteria to include departmental advising, faculty teaching, and mentoring.
- * The Coordinating Council on Graduate Affairs (CCGA), in consultation with the divisional Graduate Councils, recommends mechanisms that appropriately reward faculty advising and teaching in promotion and tenure evaluations.

Related AGS recommendations:³⁹

- * Departments should establish explicit expectations and enforce explicit requirements for those faculty who advise graduate students (p. 12).
- * Department chairs should ensure that the schedule of anticipated faculty leaves and absences be publicized within the graduate student community, and departmental graduate advisers should assure the continuity of advising during faculty absences as well as publicize schedule for the teaching of "key" graduate courses (p. 13).

Related CGS recommendation:

- * New doctoral students should be advised to meet all prospective dissertation advisers and talk with other students in the program about the attributes of various advisers. To facilitate this practice, departments

³⁹The page numbers after the AGS or CGS recommendations refer to the page numbers in the original reports as presented in Appendices D and E.

should provide students with (1) an annually updated list of graduate students with their dissertation topics and the names of their advisers, and (2) a similar list of departmental members of the graduate faculty with information about their areas of research, selected references to their publications, and indication of their availability to supervise dissertation (p. 6).

2. Program Structure

Doctoral programs most effectively contribute to timely degree completion when they are structured to insure that students graduate from the program well trained to function in the professional world of the future. While curriculum requirements must undergo frequent changes in order to incorporate the latest findings in the field, simply adding on requirements can lengthen time-to-degree. Students can progress more quickly when:

- * Departments offer extended student orientations, including sessions after the first quarter or semester⁴⁰ to make implicit departmental requirements and expectations explicit, to advise about preparations for qualifying examinations, and to facilitate student-run study groups. Departments develop a handbook detailing the formal and informal program requirements and realistic expectations for student performance, including maximum time-to-candidacy and time-to-degree.
- * Departments rethink their program structures and integrate a seminar or workshops to socialize students into the professional world of the discipline; to teach them how to write a grant proposal, how to present research, and how to prepare for a job search in the field; and to discuss the ethics of the field.
- * Since a well-trained departmental staff insures that graduate students move through the doctoral program in a smooth and timely manner, Graduate Divisions and the departments not only train graduate assistants (good training includes work on basic counseling skills), but also make sure that their salaries are commensurate with their work.

Related AGS recommendations:

- * New courses should be appropriately integrated rather than simply added to the existing curriculum; where

⁴⁰At this point students will have experienced the daily functioning of the university and will know what questions to ask.

possible, new courses and seminars should displace other components of the curriculum (p. 14).

- * Students should be adequately advised about preparation for qualifying examinations; the examinations should not be so open-ended that students are driven into excessive coursework in preparation for them (p. 15).

3. Teaching

Whether or not doctoral students enter the academic sector, the skills acquired while learning how to teach are likely to be valuable for future work. However, more than four years of teaching assistantships lengthens the time-to-degree. Students can progress more quickly when:

- * The CCGA and the GCs, in consultation with departments, develop a coherent policy for graduate student teaching, which considers the financial support situation for students, the necessity of teaching experience for future job placements, and time-to-degree.

Related AGS recommendation:

- * Departments and programs which do not require teaching should review the objectives of their graduate programs and seriously ask themselves why some teaching should not be required of all students (p. 6).

4. Research

The central purpose of doctoral education is to train students to perform research and to apply these research skills to the dissertation. In the natural sciences and engineering, students acquire these skills by apprenticeship to faculty investigators. A student may simultaneously hold a research assistantship which provides financial support. The arts, humanities, social sciences, and professional fields have a different structure. Students learn research skills in seminars and by writing research papers. These fields typically lack the financial support to pay students as research assistants, and therefore these students tend to be less involved in faculty research efforts. Students will progress more quickly when:

- * Departments structure their programs to assure students' early involvement in actual research and their early development of dissertation topics. Faculty advisers assist students in choosing a dissertation topic. Departments offer work-in-progress sessions for students during the dissertation research and writing stage.

- * The faculty/student research relationship is symbiotic: it does not unnecessarily prolong the time-to-degree.
- * The divisional Graduate Councils have policies to require a dissertation proposal at the time of the qualifying examination and a dissertation defense as a closing procedure. (A dissertation defense will give students an occasion to present their work before the entire department and to practice for job talks.)

Note: UC has a unique opportunity to organize and finance Universitywide conferences in California at which graduate students, who may not have support to attend national conferences, may be able to present their research. This will inspire students to complete their research.

Related AGS recommendations:

- * Advisers must assume more responsibility in certifying that the dissertation topic is a realistic project that can be completed in a reasonable period of time (p. 10).
- * Departments and interdisciplinary programs in the humanities and related disciplines should develop ways for faculty to involve their students actively and early in research projects or comparable initiatives that will provide apprenticeship research training analogous to that provided in natural sciences and engineering fields (p. 10).

5. Evaluating Student Progress

Selecting doctoral students who have the ability, motivation, and discipline to complete a doctoral program is a difficult task, which departments take seriously. Prior activities or quantitative indicators (GRE tests) of the student's ability are only weak predictors of whether a student will be able to make independent contributions to a field. For this reason, students progress more quickly when they are evaluated continuously so that they can be given advice and support on how to improve their academic progress, be assured that they are "on track," or be advised to make other career choices. Students progress more quickly when:

- * The Graduate Councils establish policies requiring that each student's performance be evaluated at the end of the first year.
- * Departments conduct and Graduate Divisions monitor the evaluations of progress throughout the student's doctoral career. These assessments are shared with the students

and appropriate action is taken so that a student's actual performance accords with expectations.

- * The CCGA develops (in consultation with GCs and departments) realistic, maximum time-to-candidacy and time-to-degree limits, and normative times.

6. Funding

More than any other single factor, the lack of sustained and appropriate financial support contributes to extended time-to-degree and to attrition. A heavy reliance on loans and work outside the doctoral programs places extra strain on the students, especially those with dependents. Beyond finite limits, reliance on teaching assistantships for financial support also lengthens time to completion. However, in fields with few available research assistantships for students, support through a teaching assistantship is more advantageous than reliance on loans or own earnings. The most advantageous correlation in terms of time-to-degree proved to be a research assistantship, followed by multi-year fellowships placed at crucial points of the doctoral degree program. Expenses such as housing, transportation, and childcare often put extra strain on some doctoral students. Students can progress more quickly when:

- * The Office of the President, the Chancellors, the Graduate Divisions, and the departments work together to make it possible to offer a comprehensive, yet flexible, multi-year package of financial support targeted to various stages of the doctoral program and based on satisfactory student progress through the program. These support packages include fellowships, research and teaching assistantships, and accompanying faculty mentorship programs. Specifically, humanities and social sciences departments offer fellowships at the beginning of the dissertation process (proposal-writing stage) and during the final stage of dissertation writing (final year).
- * Campuses assure sufficient numbers of affordable campus housing and childcare facilities; extend library evening and summer hours; and provide office work space for teaching assistants.

7. Special Recommendations for Ethnic Minority and Women Students

The University's success in aiding in diversifying the faculties of the next decade will depend on the successful and timely completion of degrees by ethnic minority and women students. Since many ethnic minority students come from families with limited income, have an accumulated indebtedness from their undergraduate degree

programs, and have obligations to support their own families, they need consistent and predictable financial support throughout their graduate careers. In addition, faculty mentoring is another important factor for degree completion for these students. The Office of the President and the campuses need to continue to seek funds to expand current outreach and recruitment efforts to attract minorities and women into doctoral programs in all fields. Minority students and women progress more quickly when:

- * The Office of the President, the Chancellors, and the Graduate Divisions work together to provide minority and women students with comprehensive financial support at a level competitive with other major universities. This support is given in such a form and at such a time in the program so as to serve educational and training goals, as well as to provide financial assistance. The support packages combine academic and financial support and include mentored fellowships for beginning doctoral students, research assistantships and teaching assistantships for the middle years, and fellowships to support dissertation writing.
- * The Graduate Divisions and departments offer special orientation programs for entering minority students.

Note: UC might take advantage of the nine-campus system to help build a critical mass for ethnic minority students by organizing and financing Universitywide conferences for these students, who are often the only ones in their fields on a particular campus.

B. Future Research

The need for further research has been mentioned in various sections in this report. Most important at this point is research on attrition of doctoral students. Specifically, Graduate Divisions should systematically track time-to-degree and completion rates of doctoral students. Qualitative research should be conducted to explore the reasons for early and late attrition, and evaluative research should be done to assess the impact of current policy changes on time-to-degree and attrition.