

**BACHELOR OF SCIENCE MAJOR IN ACTUARIAL SCIENCE**  
**A Recommendation**

1. **Divisions and Departments:** Academic Affairs, College of Arts and Sciences, Department of Mathematics and Statistics, School of Business Administration, Department of Economics
  
2. **Introduction:** The Bachelor of Science Major in Actuarial Science is a degree program that will be offered by the College of Arts and Sciences' Department of Mathematics and Statistics, with participation from the Department of Economics in the School of Business Administration. Although the degree will be awarded by the College of Arts and Sciences, the School of Business Administration, in which the Department of Economics faculty reside, will take primary responsibility for administering the program, including academic advising, with the College providing secondary support in those areas. Each unit will provide approximately half of the courses that constitute the major.

To complete the Actuarial Sciences major, a student must earn 61-62 credits in courses in mathematics, statistics, economics, and finance. Also required are three cognate courses in financial accounting, computer problem-solving, and business writing, bringing the overall credit requirement to 73-74.

As described in the 2008-09 *Occupational Outlook Handbook* of the U.S. Department of Labor, students who pursue a degree in actuarial science will be qualified to

- assemble and analyze data to estimate the probability and likely cost of a an event such as death, sickness, injury, disability, or loss of property;
- address financial questions, including those involving the level of pension contributions required to produce a certain retirement income level;
- advise companies on how best to invest resources to maximize return on investments in light of potential risk; and
- help design insurance policies, pension plans, and other financial strategies in a manner that will help ensure that the plans are financially sound.

A number of Michigan's public universities offer programs in actuarial science, either as majors, concentrations or specializations. Oakland's, however, would be the only one offered in metropolitan Detroit, where most of the firms employing actuaries are located. This proximity will present excellent opportunities for cooperative ventures between the university and area businesses employing actuaries, and will position our students well for internships. Relationships will be developed and enhanced by creating a board of visitors made up of local practicing actuaries.

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Another strength of OU's actuarial science program is that it incorporates coursework in mathematics, statistics, economics, and finance. Traditional programs are typically based in Departments of Mathematics and are thus less interdisciplinary in focus. This updated curriculum reflects changes in the field that will give OU students an advantage over graduates of other programs.

Additionally, Oakland's program will prepare its students to take the first two of four qualifying exams offered by the Society of Actuaries in their junior and senior years. Successful completion of the exams will allow students to pursue a career in the field immediately upon graduation.

The market for actuaries is extremely positive. Well paying entry level positions are available in the insurance, consulting, and financial services industries that require such educational preparation. The curriculum is demanding, so the limited number of students who are able to complete this rigorous degree program are highly sought. According to the 2008-09 *Occupational Outlook Handbook* of the Bureau of Labor Statistics, U.S. Department of Labor, an approximate 24% increase in employment of actuaries within the 2006-2016 time period is predicted, a higher rate than for most other occupations.

**3. Previous Board Action: None**

**4. Budget Implications:** The Actuarial Science program will be particularly economical to implement since almost all of the courses that make up this major, with the exception of one, are currently taught within the Departments of Economics and Mathematics and Statistics. Modest enrollment projections for this major can be accommodated by the current class offerings. Of particular note is that no additional full-time faculty or faculty or staff positions will be needed in the foreseeable future; it is projected that one part-time instructor, to teach the single new course in risk management, will be required by year three.

This Actuarial Science program is expected to generate a positive net-revenue in the first year that will continue to grow in each subsequent year. Revenue projections have been based on enrollment of 5 students (2 net) per year over the next five. These numbers are based on information shared by comparable in-state programs and a student interest questionnaire administered by the Departments of Economics and Mathematics and Statistics. Given that this is a demanding program that will most likely attract a small, highly selective group of students, enrollment estimates are conservative.

Funds for supplies and services and administrative support have been included in the budget.

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The Senior Vice President for Academic Affairs and Provost will complete annual reviews of the Actuarial Science major program to evaluate academic quality and fiscal viability to determine whether the program should be continued.

**5. Educational Implications:** The proposed new Actuarial Science major is consistent with Oakland University in 2020 in several areas, including:

- offering a major that prepares students for jobs in a high demand field;
- providing the educational background that will allow students to pursue an advanced degree in economics, mathematics, statistics, or business administration;
- implementing a student-centered learning experience that fosters students' abilities to think critically and creatively, communicate effectively, and manage and use technology; and
- producing students who have the analytical and reasoning skills to pass the first two exams in actuarial science offered by the Society of Actuaries during their junior and senior years, positioning students to be employable in the field upon graduation.

**6. Personnel Implications:** The Department of Economics and the Department of Mathematics and Statistics have many faculty who are highly qualified to teach the courses that comprise the Actuarial Science major. As noted previously, all but one of those classes are currently taught by these faculty members. One part-time instructor will be needed in year three to teach the single new course in risk management.

**7. University Reviews/Approvals:** The proposal for a Bachelor of Science Major in Actuarial Science was reviewed and approved by the College of Arts and Sciences Assembly, the Oakland University Senate, and the Senior Vice President for Academic Affairs and Provost.

**8. Recommendation:**

WHEREAS, the Bachelor of Science Major in Actuarial Science is consistent with several objectives contained in Oakland University in 2020; and

WHEREAS, the Bachelor of Science Major in Actuarial Science will respond to industry demand for actuaries in Michigan, and that the major is consistent with Oakland University's objectives for 2020; now, therefore, be it

RESOLVED, that the Board of Trustees authorizes the College of Arts and Sciences' Department of Mathematics and Statistics to offer a Bachelor of Science Major in Actuarial Science; and, be it further

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RESOLVED, that the Senior Vice President for Academic Affairs and Provost will complete annual reviews of the Bachelor of Science Major in Actuarial Science to evaluate academic quality and fiscal viability to determine whether the program should be continued.

**9. Attachments:** Attachment A – Proposal for a Bachelor of Science Major in Actuarial Science (with Addenda).

Submitted to the President

on 2/26, 2010 by



Virinder K. Moudgil  
Senior Vice President for  
Academic Affairs and Provost

Recommended on 2/26, 2010  
to the Board for approval by



Gary D. Russi  
President

**Proposal for  
Bachelor of Science  
in Actuarial Science**

**Department of Mathematics and Statistics  
Department of Economics  
College of Arts and Sciences  
Oakland University**

College of Arts and Sciences Committee on Instruction  
Submitted: March 12, 2009  
Approved: March 16, 2009

College of Arts and Sciences Assembly  
Submitted: April 8, 2009  
Approved: April 14, 2009

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## Abstract

A career in actuarial science is one of the best options that a student with talents and interests in statistics, mathematics, economics and finance can pursue. The job market is very good for actuaries, and high-paying entry jobs are available in the insurance, consulting, and financial services industries according to the **2008-09 Occupational Outlook Handbook** of the United States Department of Labor. "Actuaries assemble and analyze data to estimate the probability and likely cost of an event such as death, sickness, injury, disability, or loss of property. Actuaries also address financial questions, including those involving the level of pension contributions required to produce a certain retirement income level and the way in which a company should invest resources to maximize return on investments in light of potential risk. Using their broad knowledge of statistics, finance, and business, actuaries help design insurance policies, pension plans, and other financial strategies in a manner which will help ensure that the plans are maintained on a sound financial basis."

This major will be offered *jointly* by the Department of Mathematics and Statistics and the Department of Economics in the College of Arts and Sciences. If a student takes one more finance course, he/she will also earn a minor in finance. Currently the Department of Mathematics and Statistics offers course work leading to three different degrees: a B.S. in mathematics, a B.S. in applied statistics, and a B.A. in mathematics. The Department of Economics offers course work leading to three different degrees: a B.S. in Economics (offered through the School of Business Administration), a B.A. in Economics (offered through the College of Arts and Sciences), and a B.S. in Business Economics (offered through the School of Business Administration).

The proposed major in Actuarial Science will differ significantly from these other majors by meeting three important goals:

- To offer a major that prepares students for jobs in actuarial science as well as provides them with the educational background necessary to pursue an advanced degree in economics, mathematics, statistics, or business administration.
- To offer a major that integrates two distinctly different disciplines, thereby providing students with a breadth of knowledge that is needed in our fast changing world.
- To produce students who have the analytical and reasoning skills to take and pass the first two exams in actuarial science offered by the Society of Actuaries.

Because only one new course is needed (which will also be cross-listed as an MBA elective) the program has minimal additional costs, although it is likely to generate net revenue to the University.



## I. Rationale

### a. Need for the program

The following is excerpted from the 2008-09 *Occupational Outlook Handbook* of the Bureau of Labor Statistics, U.S. Department of Labor:

Actuaries assemble and analyze data to estimate the probability and likely cost of an event such as death, sickness, injury, disability, or loss of property. Actuaries also address financial questions, including those involving the level of pension contributions required to produce a certain retirement income level and the way in which a company should invest resources to maximize return on investments in light of potential risk. Using their broad knowledge of statistics, finance, and business, actuaries help design insurance policies, pension plans, and other financial strategies in a manner which will help ensure that the plans are maintained on a sound financial.

Thus an actuary needs a blend of mathematics, statistics, economics, and finance. The necessary skills can be obtained with degrees in these areas. Unfortunately the cost of completing multiple majors is unappealing to students. The proposed program reduces this cost by selecting the aspects of all areas that are needed to enter the actuarial field. See Appendix H for a more detailed description of the actuarial profession.

This handbook goes on to say the following about the job outlook in the actuarial profession:

Employment of actuaries is expected to increase by about 24% over the 2006-16 period, which is much faster than the average for all other occupations. Employment growth in the insurance industry—the largest employer of actuaries—is expected to continue at a stable pace, while more significant job growth is likely in other industries, such as health care and consulting firms.

Steady demand by the insurance industry should ensure that actuarial jobs in this key industry will remain stable during the projection period. Although relatively few new jobs will be created, actuaries will continue to be needed to develop, price, and evaluate a variety of insurance products and calculate the costs of new risks.

Opportunities for actuaries should be good, particularly for those who have passed at least one or two of the initial exams. In addition, a small number of jobs will open up each year to replace actuaries who leave the occupation to retire or transfer new jobs. Candidates with additional knowledge or experience, such as computer programming skills, will be particularly attractive to employers. Most jobs in this occupation are located in urban areas, but opportunities vary by geographic location.

The Society of Actuaries (SOA) and the Casualty Actuarial Society (CAS) administer a demanding series of exams that serves as an entry and advancement device for the profession, as a gatekeeper for the profession, and as an indicator of directions in the actuarial field. Advancement in the actuarial profession includes passage of additional exams, Validation by Educational Experience (VEE) requirement in the areas of applied statistical models, corporate finance, and/or economics, and special short courses given by the professional societies.

The coursework for the proposed program is selected to provide sufficient background to enable students to take and pass the Financial Mathematics (FM/2) exam during their junior year, and the Probability (P/1) exam during their senior year, and thus OU students will be well positioned for this job market. (For exams common to both societies, the literal designation is that of the SOA and the numerical designation is that of the CAS.) In addition, the proposed major includes a programming course that the interested student can build upon using elective credits. The program also includes courses that serve as preparation for subsequent actuarial exams and as satisfaction of VEE.

The proposed program recognizes the changes that have occurred in actuarial science. Traditional programs in actuarial science are located in Departments of Mathematics. The proposed program incorporates coursework in statistics, economics, and finance that reflects the changes in the field, and will give our students an advantage relative to graduates of other programs.

The proposed degree also provides the graduate with numerous alternatives if he/she decides to pursue a graduate degree. The student has the background to pursue an M.S. in actuarial science, an M.S. in applied mathematics, an M.S. in statistics, M.S. in economics, or an MBA degree. In latter two areas, the graduate will have the advantage of taking many upper level mathematics and statistics courses that may enhance the work in their own areas.

The Department of Mathematics and Statistics and the Department of Economics administered a survey in most mathematics, statistics, and economics classes in the Fall semester of 2004 to ascertain current students' interest in a degree program in actuarial sciences. Appendix F provides the survey form, a list of the classes surveyed, and tables listing the responses. The survey reveals students' interest before seeing details of this demanding program. The results suggest that a large number of students will take a second look at the proposed major upon entering the University and that there will be a base among students at Oakland University who will pursue this program, particularly considering the unique location of Oakland University.

**b. How the program will promote the role and mission of the university**

The Vision Statement of Oakland University in 2020 is as follows:

Oakland University fulfills its distinctive role among Michigan public universities by steadily enhancing an intellectual and ethical environment that prepares students to lead and serve in the local and world communities.

The University Principal Objective states:

Oakland University offers individualized academic student experiences linking theory and research with community engagement to produce graduates whose critical thinking skills and problem-solving spirit make them highly valued in the workplace and society.

The Department of Mathematics and Statistics and the Department of Economics propose a high quality program that will appeal to those students who are willing and able to address the academic demands of the actuarial discipline and the actuarial exams. In addition, the proposed program will provide professional education for careers that have an extremely positive outlook for the students and will provide future leaders. See the quotations from the 2008-2009 *Occupational Outlook Handbook* of the Bureau of Labor Statistics, U.S. Department of Labor in Section I.a.

The Engaged/Partnership statement is as follows:

Oakland University will engage with communities to develop partnerships that form solutions to community needs, will resonate in the business and philanthropic communities, and will create and expand experiential opportunities for OU students. Through a multitude of partnerships with hospitals, Fortune 500 companies, individuals, cities, government agencies and educational institutions, Oakland will continue to help the community solve problems and build thriving sustainable businesses. These associations also reward students with internship opportunities and university researchers with access to the latest technology resources.

The proposed program in actuarial science will address the need of some students with intended careers in the insurance and pension industries, and will provide part of a talented workforce in Oakland County as well as the greater Detroit area. In the past, some Oakland University students who pursued the actuarial profession and secured summer employment working in an actuarial role after having passed the first exam. It is expected that students of the proposed program will also be in demand for internships, thereby establishing a bridge between Oakland University and local business.

**c. Program goals**

The program is designed to produce students who have the analytical and reasoning skills and general education associated with both a mathematics major and an economics major. Students taking the program will be qualified to take the first two exams offered by the Society of Actuaries (SOA) and the Casualty Actuarial Society (CAS) before they graduate from the program. This will prepare them to pursue a career in actuarial science upon graduation. They will also be prepared to pursue advanced degrees in economics, mathematics, statistics, or business administration and will have a major that integrates two distinctly different disciplines, thereby providing students with a breadth of knowledge that is needed in our fast changing world. There are no current plans to establish a graduate program in actuarial science.

**d. Comparison to similar programs**

A number of public universities in Michigan offer bachelors degrees with a major in actuarial science or majors in other areas (usually mathematics) with a concentration, specialization, or option in actuarial science. A list of these programs with brief descriptions is given below. Course requirements are given in Appendix D. The proposed program is most similar to those at EMU, CMU, and the UM-Flint in that the required curriculum is a genuine blend of mathematics, statistics, economics, business, and computing. Directors of these three actuarial programs were contacted informally and asked to comment on the number of students in their respective programs. There is some year-to-year variation in the number of graduates with an average of roughly 5 per year. Two of the directors noted that it is common for students to carry a double major with actuarial science, and mathematics or economics. In addition, some students take significant course work toward a major in actuarial science, take the first two actuarial exams, but major only in mathematics or economics. It is expected that this program will produce more students with expertise in actuarial science than just those given by official enrollments. The coursework and interdisciplinary nature of these programs reflect the changes in the actuarial exams that have taken place over the last ten years. The actuarial program at the University of Michigan-Ann Arbor is a well-established program that has been in existence for decades that includes graduate programs.

The proposed program has a number of advantages over other programs in the state. One advantage is location in that the proposed program would be the only actuarial degree program in metropolitan Detroit, which is the location of the vast majority of firms in the state of Michigan employing actuaries. In order to take advantage of Oakland University's unique location in Michigan, we will create a board of advisors for the program from practicing actuaries in the area. Location would also serve the interests of actuarial students at Oakland University in that they may have an upper hand at securing internships while in school, and this may also serve the University in that cooperative ventures between OU and companies may emerge. As indicated in Section I.a., the proposed program reflects recent trends in the actuarial profession and changes in the actuarial exams more than all but three of the existing programs in the state and thus better serves the current student base at OU.

Eastern Michigan University—Actuarial Science and Economics Major. This is a joint program with the Mathematics and Economics Departments.

Central Michigan University—Actuarial Science Major. This is an interdisciplinary or interdepartmental major administered by the Department of Mathematics.

University of Michigan-Flint—Major in Mathematics with a concentration in Actuarial Mathematics. This program is administered by the Department of Mathematics but involves coursework outside the Department of Mathematics.

University of Michigan-Ann Arbor—Actuarial/Financial Mathematics Program. The Department of Mathematics provides extensive course work in actuarial science and offers an actuarial option in an applied mathematics masters degree program.

Lake Superior State University—Mathematics—Actuarial and Business Applications. This is a program in the Department of Mathematics, and a minor in Accounting or Finance is required.

Michigan Technological University—B.S. in Mathematics, Actuarial Science Concentration. This program is entirely in the Department of Mathematics.

Ferris State University—Applied Mathematics/Actuarial Science Concentration—program in the Department of Mathematics.

Michigan State University—Actuarial Science Specialization. The Specialization in Actuarial Science is available to all students who are enrolled in any bachelor's degree program at MSU and is administered by the Department of Mathematics. This program is essentially a minor.

Wayne State University—Major in Mathematics with a concentration in Actuarial Science. This option provides mathematics course work covered by some actuarial exams.

Western Michigan University—Mathematics Minor-Actuarial Sciences Option. This minor is intended for mathematics or statistics majors but is available to all students.

## **II. Self-Study of the Academic Units**

### **a. How the goals of the units are served**

The proposed program helps fulfill the mission and goals of the University, the College of Arts and Sciences, the Department of Economics, and the Department of Mathematics and Statistics. The OU Mission (2008–2009 Undergraduate Catalog, p. 10) speaks to “excellent and relevant instruction.” In particular, it emphasizes instruction that:

- Provides students with courses and experiences to ensure an enriched life along with superior career preparation and enhancement.
- Prepares students for a post-baccalaureate education, professional schools or careers directly after graduation.

Proposed is a high quality program that will appeal to those students who are willing and able to address the academic demands of the actuarial discipline and the actuarial exams.

The following excerpt is taken from the Department of Mathematics and Statistics Teaching Mission statement in the Department's Handbook:

The Department is committed to offering excellent undergraduate degree programs and concentrations in the mathematical sciences to fit the specific career needs of Oakland students, whether these be in government, industry, teaching, or the pursuit of higher education in the mathematical sciences or in other areas that require a high level of mathematical competence. Toward this end, the Department cooperates fully with other units in the development of programs such as those in Computer Science, Operations Research, and Applied Statistics, in addition to its own programs.

In addition, among the Long Term Goals listed in the Handbook is "To develop and expand cooperative ventures." The proposed program in actuarial science will address the need of some students with intended careers in the insurance and pension industries. In addition, this program furthers the Department's cooperation with the School of Business Administration as it is a joint program. In addition, the fact that the students enrolled in the proposed program would take the first two actuarial exams during their undergraduate years provides a means for them to secure internships and positions upon graduation. This feature may also foster cooperative ventures for the Department outside the University.

The SBA mission is to "advance knowledge and enhance students' abilities to manage in a global business environment." Consistent with this mission, the goals of the economics department (OU 2008–2009 Undergraduate Catalog, p. 181) include instruction that provides students with the ability to apply economic analysis to major problems facing individuals, businesses, the nation and the world today, be flexible workers and adaptable to change, and propose practical solutions to solve problems quickly.

The Department of Economics is also committed to instruction and programs that enable students to succeed in law school and graduate programs in economics, business, or public administration.

Consistent with both departments' missions, a Board of Advisors consisting of professional actuaries will be established.

**b. Staffing needs**

Both the Department of Mathematics and Statistics and the Department of Economics have sufficient room in their courses to accommodate up to ten new students per year. Since we anticipate about five students per year (based on surveys of directors of similar programs in Michigan) in total or a net gain of two per year, no new full-time faculty positions are expected.

One new course in Risk Management (ECN 450/APM 450) will be required. See Appendix B for a course description. It will be offered by either the Department of Economics or the Department of Mathematics and Statistics. It will generally be offered during the spring and cross-listed as ECN 550 so that MBA students can take the course. This should provide enough demand to ensure that the course will have sufficient enrollment to be viable. When it is offered, it will be taught either by a part-time instructor or a full-time faculty member (whose other spring course assignment will be replaced with a part-time instructor). If there is insufficient demand to offer the course, Professors Tracy, Schmidt, and Ogunyemi are committed to teach the course as an independent study for actuarial science majors. It is not expected that this will be necessary, given the interest in this course by MBA students.

**c. Faculty qualifications**

Faculty members of the Department of Economics and Department of Mathematics and Statistics have a wide range of teaching and research interests. The Economics Department is one of the top research departments in the United States among departments that do not offer graduate programs. The Department of Mathematics and Statistics is among the most productive departments in the state of Michigan in publication of research articles per capita. It offers a Ph.D. in applied mathematics as well as M.S. degrees in applied mathematics and applied statistics and an M.A. degree in mathematics. Biographical sketches of faculty in both departments are given in Appendix C.

**d. Impact on current programs**

The Department of Mathematics and Statistics currently offers three programs that lead to a bachelors degree with majors in mathematics or statistics: a Bachelor of Science in Mathematics, a Bachelor of Arts in Mathematics, and a Bachelor of Science in Applied Statistics. The B.S. program in mathematics primarily serves those undergraduates who intend to do graduate work in mathematics and statistics, while the B.A. program serves all other students of mathematics including those in the Secondary Teacher Education Program. The B.S. program in applied statistics serves a small audience, which includes those seeking to work as statisticians in industry. All of these programs are accredited by the North Central Association of Colleges and Schools (NCA).

The Department of Economics currently offers three programs that lead to a bachelor's degree with a major in economics: a Bachelor of Science in Economics (offered through the School of Business Administration), a Bachelor of Arts in Economics (offered through the College of Arts and Sciences), and a Bachelor of Science in Business Economics (offered through the School of Business Administration). These degrees have different focuses and are designed for different students. The B.S. in Economics has a more quantitative focus than the B.A. in Economics. Both of these are regarded as non-business degrees, and neither program was evaluated in Winter 2004 by The Association to Advance Collegiate Schools of Business (AACSB) as one of Oakland University's business programs. The B.S. in Business Economics is a true business

degree, and is evaluated by the AACSB. The proposed program in Actuarial Science will also be considered a non-business degree and hence will not be evaluated by the AACSB.

With the exception of the Risk Management course (ECN 450/APM 450), all courses required for the B.S. in Actuarial Science are existing courses and are taken by students with a variety of majors. Students drawn to the actuarial science major from disciplines other than Mathematics, Statistics and in Economics will be small in number, and the additional number of students in these courses will be negligible. We expect the actuarial major to draw from the programs in Mathematics and Statistics and in Economics cited above, and as such there will be a shift in upper level classes taken by these students.

*For purposes of head count, each student majoring in the actuarial science program will count as one half of a student for the Department of Mathematics and Statistics and one half of a student for the Department of Economics. Since the actuarial major is expected to draw a small number of students from all of the majors cited above, we do not expect a major change in the head count of majors for either of the two departments.*

### **III. Program Plan**

#### **a. Admission criteria**

There are no admission criteria to take this major. However, students are required to earn a grade of 2.0 or higher in all required courses.

#### **b. Degree requirements**

The specific degree requirements are given in Table 1 below. This program allows enough room to accommodate the general education requirement as well as the current College of Arts and Sciences distribution requirement. Depending upon student choices, at least 15 free elective credits remain in the program (124 total credits – 61 or 62 required course credits – 12 cognate credits – 32 general education credits [ECN 200, MTH 154 and ECN 450 satisfy general education requirements] – 4 distribution credits [MTH 155 and ECN 201 satisfy distribution requirements already] = 18 or 19 free elective credits). A complete sample curriculum for the B.S. in Actuarial Science is provided in Appendix E.



## Table 1: B. S. in Actuarial Science

Major is jointly administered by the Department of Mathematics and Statistics and the Department of Economics. The degree is offered through the College of Arts and Sciences.

### Required Courses in Math, Economics, and Finance

<sup>§</sup> MTH 154	Calculus I	4 credits
MTH 155	Calculus II	4 credits
MTH 254	Multivariable Calculus	4 credits
MTH 275	Introduction to Linear Algebra	4 credits
STA 226	Applied Probability and Statistics	4 credits
STA 427	Introduction to Mathematical Statistics I	4 credits
1 of the following electives:		
APM 433	Numerical Methods	4 credits
APM 434	Applied Numerical Methods: Matrix Methods	4 credits
APM 255	Introduction to Differential Equations with Matrix Algebra	4 credits
STA 425	Elements of Stochastic Processes	4 credits
STA 428	Introduction to Mathematical Statistics II	4 credits
<sup>§</sup> ECN 200	Principles of Macroeconomics	4 credits
ECN 201	Principles of Microeconomics	4 credits
ECN 302	Intermediate Macroeconomics	3 credits
ECN 303	Managerial Economics (Theory of the Firm)	3 credits
QMM 241	Statistical Methods for Business II	3 credits
FIN 322	Finance I	4 credits
FIN 416	Investments	3 credits
FIN 422	Finance II	3 credits
<sup>†#</sup> ECN 450/ APM 450	Risk Management	3 credits
<sup>†</sup> ECN 405 or <sup>†</sup> STA 402	Econometrics  Applied Linear Models I	3 credits  4 credits
		61-62 credits
<b>Cognates</b>		
ACC 200	Financial Accounting	4 credits
EGR 141	Computer Problem Solving in Engineering and Computer Science	4 credits
<sup>&amp;</sup> WRT 382	Business Writing	4 credits
		12 credits

<sup>§</sup> Satisfies University General Education requirement.

<sup>&</sup> Satisfies University General Education intensive writing requirement.

<sup>†</sup> Applications will be made to the General Education Committee for ECN 405 and STA 402 to serve as the writing intensive component in the major and for ECN 450/APM 450 to serve as the capstone course in the major.

<sup>#</sup>Risk Management is a new course to be offered only in the evening during spring/summer.

- Could be team taught or taught solely by faculty in SBA or Math
- Prerequisites FIN 322 or FIN 522 and either STA 226, QMM 250, QMM 241, or QMM 510

Course Description: The course reviews interest rate theory, Poisson, exponential and probability models and then develops and uses a variety of actuarial and risk models such as contingent payment models, and frequency, severity and aggregate claims models.

Recommended Electives: COM 201 (Public Speaking) or COM 202 (Group Dynamics and Communication) and MGT 350 (Legal Environment of Business) with permission of the School of Business Administration.

### **c. Overview of the curriculum**

A complete sample curriculum for the B.S. in Actuarial Science is provided in Appendix E. A function of the Board of Advisors will be to provide input into the curriculum and any curricular changes owing to trends in the actuarial profession

The courses MTH 154 (Calculus I), MTH 155 (Calculus II), MTH 254 (Multivariable Calculus), MTH 275 (Introduction to Linear Algebra), ECN 200 (Principles of Macroeconomics), ECN 201 (Principles of Microeconomics), ECN 302 (Intermediate Macroeconomics), ECN 303 (Managerial Economics (Theory of the Firm)), and QMM 241 (Statistical Methods for Business II) form a basis for subsequent mathematics, statistics, economics, and finance courses in the program are required for all actuarial exams. Specifically, STA 226 (Applied Probability and Statistics) and STA 427 (Introduction to Mathematical Statistics I) provide the necessary background for Exam (P/1). In addition, the courses FIN 322 (Finance I) and FIN 422 (Finance II) pertain to Exam FM/2. These courses alone would justify inclusion of the proposed program in the Actuarial College Listing of Introductory Undergraduate Programs. The SOA has approved passing ECN 200 (Principles of Macroeconomics) and ECN 201 (Principles of Microeconomics) with grades of 3.0 or higher (or the single course ECN 210 with a grade of 3.0 or higher) satisfies the VEE requirement in Economics. We are in the process of applying for FIN 322 and Fin 422 to satisfy the VEE requirement in Corporate Finance and for STA 226 and QMM 241 to satisfy the VEE requirement in Applied Statistical Methods.

Depending on demand and recommendation of the Board of Advisors, OU may offer 1 credit preparation courses for Exams P/1 and FM/2 in the future. There has been discussion among other universities offering actuarial programs in creating a course in interest theory, and this will also be a consideration of the Board of Advisors.

### **d. Support of other departments**

The Department of Finance supports this program by allowing actuarial science majors to take two of their courses. A letter of support is in Appendix A. There is sufficient room in these courses to accommodate the modest number of students expected. No other direct support is required. There will be marginal increases in enrollments in general education courses.

### **e. The source of students**

We anticipate that students interested in this program will come from:

1. new students entering Oakland University without a major,
2. students attracted to the three existing degrees in economics,
3. students attracted to the existing degrees in mathematics or applied statistics,
4. students attracted to an engineering degree,
5. business students who find they have a quantitative bent.

The Department of Mathematics and Statistics and the Department of Economics administered a survey in most mathematics, statistics, and economics classes in the Fall semester of 2004 to ascertain current students' interest in a degree program in actuarial sciences. The survey form and results summarized in Tables 2 and 3 are given in Appendix F. The data reveal students' *interest* before seeing details of this demanding program. An interpretation of the survey is that there is a *commitment* on the part of existing students to a program in actuarial science. The informal survey (cited in the previous section) with the directors of the comparable programs at EMU, CMU, and UM-Flint suggests that we can expect about five students per year to pursue this program and possibly an equal number of students to take the course work in actuarial science and the first two actuarial exams but maintain the major in mathematics, statistics, or economics.

**f. Recruiting**

The proposed major will be marketed by brochures and fliers distributed to prospective and admitted OU students at the various open houses and advising functions in the SBA, Department of Economics, and Department of Mathematics and Statistics and to other universities.

**g. Expected enrollment**

The program expects an average of roughly five majors per year (or a net gain of two students per year), consistent with enrollment figures from similar in-state programs. Since most of these would otherwise major in economics or mathematics, there will be a very modest increase in overall enrollments. (See Appendix G for the revenue impact.)

**h. Academic advising**

Students will be able to get advising in the SBA's Office of Undergraduate Academic Advising or from the faculty adviser in the Department of Mathematics and Statistics.

## IV. Needs and Costs of the Program

### a. New resources needed for the program

No additional faculty/ staff positions are required. One half of a graduate assistantship is requested to be shared by the Department of Mathematics and Statistics and the Department of Economics. One part-time instructor will be needed to teach ECN 450/APM 450 or to replace a full-time faculty member's spring/summer teaching assignment. The program will entail minimal spending on marketing and advertisement, and advising brochures:

- Marketing & advertisement (\$500 initial cost, \$200 in subsequent years).
- Reprinting Advising Forms (\$200 initial cost).

### b. Source of new resources

Additional tuition will provide for the few new resources required for the proposed program. See Appendix G.

### c. Budget and revenue from program

See Appendix G for the budget forecast.

### d. Library holdings

Actuarial Science Journals Accessible for OU:

See Appendix A.

Journals Not Currently Available (including titles available only via Business Source Premier):

*Annals of Applied Probability*  
*ASTIN Bulletin (International Actuarial Association)*  
*British Actuarial Journal*  
*International Statistical Review*  
*Journal of Applied Probability*  
*Journal of Pension Economics and Finance*  
*Journal of Statistics and Applications*

Titles for which our best access is Business Source Premier :

International Journal of Theoretical & Applied Finance  
*Journal of Financial Service Professionals*  
*Scandinavian Actuarial Journal (Taylor & Francis)*

All texts listed below will be contributed to Kresge Library by faculty in the Department of Economics and the Department of Mathematics and Statistics.

**Textbooks for appropriate background and for Exam P/1:**

Calculus:

- |  |               |
|--|---------------|
| 1. <i>Calculus, Late Transcendentals Combined Version</i> , 8 <sup>th</sup> Ed., 2005,<br>by H. Anton, I. Bivens, & S. Davis (Wiley) | Not available |
| 2. <i>Calculus: Concepts and Contexts</i> , 3 <sup>rd</sup> Ed., 2005, by A. J. Stewart<br>(Brooks/Cole)                             | Available     |

Probability:

- |  |               |
|--|---------------|
| 1. <i>Probability: The Science of Uncertainty with Applications to Investments, Insurance, and Engineering</i> , by M. A. Bean (Brooks/Cole) | Not available |
| 2. <i>A First Course in Probability</i> , 8 <sup>th</sup> Ed., 2008 by S. M. Ross<br>(Prentice Hall)   | Available     |

**Textbooks for background and Exam FM/2:**

Economics:

- |   |               |
|---|---------------|
| 1. <i>Price Theory and Applications</i> , 7 <sup>th</sup> Ed., 2008,<br>by S.E. Landsburg (Southwestern College Pub.) | Not available |
| 2. <i>Macroeconomics</i> , Society of Actuaries Study Note  | Not available |

Interest Theory and Finance:

- |  |           |
|--|-----------|
| 1. <i>Theory of Interest</i> , 3 <sup>rd</sup> Ed., 2008, by S. Kellison (Irwin)   | Available |
| 2. <i>Principles of Corporate Finance</i> , 8 <sup>th</sup> Ed., 2004,<br>by R. A. Brealey and S. C. Myers (McGraw Hill) | Available |

Note: These texts are recommended by SOA.

**Software (based on job advertisements):**

- |                     |           |
|---------------------|-----------|
| 1. SAS              | Available |
| 2. Microsoft Access | Available |
| 3. Visual Basic     | Available |
| 4. Excel            | Available |

**d. Classroom, laboratory, and/or studio space**

No additional space is required.

**e. Equipment and software**

Although there is a need for advanced statistical software, the School of Business Administration already purchases a yearly site license for SAS and SPSS, and the Department of Mathematics and Statistics purchases a yearly site license for Minitab and SAS. Therefore, no additional equipment or software will be required

## **V. Implementation**

If approved in a timely fashion, the program can be implemented for Fall 2009.

## **VI. Assessment and Accreditation**

The Actuarial program at Oakland University has four learning goals that will be assessed to evaluate and improve student learning. The four learning goals are: Critical Thinking, Communication Skills (both written and oral), Information Technology Skills, and Knowledge within the Disciplines. Each learning goal has between 5 and 8 learning objectives that will be measured. With the exception of the last two learning objectives in the Knowledge within the Discipline learning goal (Understands Financial Mathematics and Understands Probability) these learning goals and learning objectives will be measured and analyzed in the capstone Risk Management course. The other two learning objectives will be measured by the student's performance on the first two actuarial exams. The expectation is that for each learning objective, 60% of the students should earn a score of 2 or 3. In addition, for each learning goal, 75% of the students should receive a score of 2 or 3 on all of its learning objectives. Failing to meet this standard will suggest potential curricular or instructional deficiencies that will need to be addressed within the program.

The first three learning goals will be assessed using student projects in the Risk Management class. The first three learning outcomes of the Knowledge within the Disciplines learning goal will be assessed in a required exam that student will know is administered the first day of the Risk Management class and counts 10% of their course grade. Although many of these topics will be reviewed during the Risk Management class, students are expected to know the material at a sufficient level at the beginning of the course. As is always the case, these assessment tools

are being used to assess the program not the instructors.

Rubrics for each of these learning goals and objectives is in Appendix I.

The SOA and the CAS do not presently accredit programs in actuarial science. Currently, the SOA maintains two undergraduate program listings—one of introductory programs which cover all topics on the first CAS/SOA exams and includes introductory mathematics of finance and micro/macro economics courses, and one of advanced programs that cover all topics on the first two CAS/SOA exams plus 12 semester hours toward the third and fourth exams. As of August 2008, the SOA has established an initiative that includes the establishment of an accreditation process. Upon approval of the proposed program, the Department of Mathematics and Statistics and the Department of Economics will apply for entry on the list of elementary programs. The proposed program includes sufficient coursework to justify inclusion on the list of advanced programs and, when the program establishes a track record, the Department Mathematics and Statistics and the Department of Economics plan to apply for inclusion on this list. If the SOA and CAS establish an accreditation system, we will seek accreditation.

All programs in the College of Arts and Sciences are reviewed by the North Central Accreditation Association every ten years, and this program will also be studied by NCA.

## VII. Expected Career Options for Graduates

The following excerpt is taken from the 2008-2009 *Occupational Outlook Handbook* of the Bureau of Labor Statistics, U.S. Department of Labor:

Opportunities for actuaries should be good, particularly for those who have passed at least one or two of the initial exams. In addition, a small number of jobs will open up each year to replace actuaries who leave the occupation to retire or transfer to new jobs. Candidates with additional knowledge or experience, such as computer programming skills, will be particularly attractive to employers. Most jobs in this occupation are located in urban areas, but opportunities vary by geographic location.

Steady demand by the insurance industry should ensure that actuarial jobs in this key industry will remain stable during the projection period. Although relatively few new jobs will be created, actuaries will continue to be needed to develop, price, and evaluate a variety of insurance products and calculate the costs of new risks. The demand for actuaries in life insurance has been growing rapidly as a result of the rise in popularity of annuities, a financial product offered primarily by life insurance companies. In addition, the risk of terrorism and natural disasters has created a large demand for actuaries in property insurance.

Some new employment opportunities for actuaries should also become available in the health-care field as health-care issues and Medicare reform continue to receive

attention. Increased regulation of managed health-care companies and the desire to contain health-care costs will continue to provide job opportunities for actuaries, who will also be needed to evaluate the risks associated with new medical issues, such as genetic testing and the impact of new diseases. Others in this field are involved in drafting health-care legislation.

A significant proportion of new actuaries will find employment with consulting firms. Companies that may not find it cost effective to employ their own actuaries are increasingly hiring consulting actuaries to analyze various risks. Other areas with notable growth prospects are information services and accounting services. Also, because actuarial skills are increasingly seen as useful to other industries that deal with risk, such as the airline and the banking industries, additional job openings may be created in these industries.

Thus the career outlook is quite good for those who succeed in this demanding proposed program.



## **VIII. Appendices**

### **Appendix A**

#### **Letters of Support**

February 9, 2009

To Whom it May Concern

From Mohinder Parkash, Chair  
Department of Accounting and Finance

RE: Actuarial Science program

The Department of Accounting and Finance supports the new program in actuarial sciences. The enrollment demands in ACC 200, FIN 322 and FIN 422 can be met given the modest enrollment projections of about five students per year. Given that some of these students may have taken some of these courses as part of an SBA curriculum, these enrollment projections will not require any additional faculty resources.

Finally, given the strong mathematical skills required in this new program, we don't anticipate very many of our Finance or Accounting majors being attracted to this program. However, if some of our students do decide that this would be better preparation for their career, we would strongly support their decision to major in actuarial sciences.

Signed copy on file in SBA Dean's office



Kresge Library  
Rochester, Michigan

*A teaching library with an outstanding student-centered  
information literacy program*

## MEMORANDUM

**TO:** Theophilus Ogunyemi, Department of Mathematics and Statistics

**FROM:** Shawn Lombardo, Coordinator of Collection Development, Kresge Library  
Millie Merz, Associate Professor, Kresge Library

**SUBJECT:** Library Collection Evaluation for proposed B.S. in Actuarial Science

**DATE:** February 19, 2007; updated February 2, 2009; updated March 5, 2009

In preparing this collection evaluation, we examined the proposal for the undergraduate major in Actuarial Science. In addition, Millie Merz met with Professor Ogunyemi in January 2007 concerning library needs for the program and evaluated the library holdings of other universities with similar programs, referred to Web sites of actuarial organizations (e.g., Society of Actuaries), reviewed library guides on the topic (e.g., Penn State, the University of Wisconsin in Madison), and performed sample searches in journal databases devoted to business, economics and mathematics.

### Reference/Journal Databases

The library's reference collection contains basic business, economics, mathematics and statistics dictionaries and encyclopedias. However, the library's greatest need for this particular program would be to acquire the three-volume *Encyclopedia of Actuarial Science* (New York: Wiley, 2004). In order to enhance access to this resource, we recommend subscribing to the online version of the title. The encyclopedia contains hundreds of lengthy entries, written by experts in the field (<http://www.wiley.co.uk/eoas/contents.html>); each entry also includes a lengthy bibliography for further research.

The library maintains subscriptions to a number of bibliographic databases supportive of the actuarial science discipline that cover topics such as insurance, risk management, employee benefits, etc. These databases include *MathSciNet* (the online equivalent of *Mathematical Reviews*); *EconLit* (from the American Economic Association) and *ABI/Inform* and *Business Source Premier* – two business databases that provide full-text access to many journals in the field. *ABI/Inform* and *Business Source Premier* each provide access to unique titles, although the past volume holdings in *Business Source Premier* generally are more extensive.

It is important to note that the library began a subscription to *Business Source Premier* in 2006 with funds provided by the School of Business Administration. For FY07 and FY08, funds were provided by the Provost with the understanding that SBA would fund the resource in FY09 and future years. Without this funding, the library must cancel its subscription to *Business Source Premier*; unfortunately, this program, as well as other SBA programs, will be severely affected.

### **Journals**

The library's access to the actuarial science journal literature is quite good; Appendix A provides a selective list of some of these titles. Most of these publications are accessible through the library's various journal packages or as a part of *ABI/Inform* and *Business Source Premier*. For example, two particularly important titles (*Journal of Mathematical Economics* and *Insurance: Mathematics and Economics*) are included in the Elsevier ScienceDirect *Freedom Collection*. Subscriptions to these two titles on an individual basis would cost more than \$3,000. In addition, the library recently gained access to the *Journal of Pension Economics and Finance* through its subscription to the Cambridge University Press journal package and the *International Statistical Review* through the Wiley-Blackwell journal package. Because faculty and students in the program will rely heavily on these and other journal packages for access to the professional literature, and because the library struggles each year to maintain subscriptions to these resources, funding to support these current subscriptions is built into the library budget for the program. There are a few other important titles which the library should acquire; these are listed in Appendix B.

### **Books**

The library has few monographs specific to actuarial science and therefore funding for monographs is included in the proposed library budget to build a modest collection in this area. Most books in this field are rather expensive (more than \$50 per title), but only a few titles are published each year.

### **Conclusion**

As a result of the library's subscription to several journal packages and to databases that include access to online journal articles, the library's holdings to support the proposed program are good. However, the library still has needs (some journals, books, and the encyclopedia) to bring our holdings to an acceptable level. Finally, if the library is unable to maintain subscriptions to our existing resources, most notably *Business Source Premier*, student- and faculty-researchers in this program will be dramatically and negatively impacted.

C: Julie Voelck, Dean of the Library  
Ronald Sudol, Dean of the College of Arts and Sciences  
Mohan Tanniru, Dean of the School of Business Administration  
Dan Ring, Library Liaison to Mathematics and Statistics  
Kristine Condic, Library representative to the University Senate

**Appendix A**  
**Actuarial Science Journals Accessible for OU**

Journal Title	Database Access
Applied Economics	AcademicOneFile, Business Source Premier
Benefits Quarterly	ABI/Inform, Business Source Premier
Best's Review	ABI/Inform, Business Source Premier
Business Insurance	ABI/Inform, Business Source Premier
Demography	Project Muse
Econometrica	online subscription
Geneva Papers on Risk and Insurance	Academic OneFile until 1 year ago
Geneva Risk and Insurance Review	SpringerLink
Insurance & Technology	ABI/Inform
Insurance: Mathematics, and Economics	ScienceDirect Freedom Collection
International Journal of Theoretical & Applied Finance	Business Source Premier until 1 year ago
International Statistical Review	Wiley-Blackwell
Journal of Applied Statistics	print plus online subscription
Journal of Banking & Finance	ScienceDirect Freedom
Journal of Business, Finance, & Accounting	Wiley-Blackwell
Journal of Economic Theory	ScienceDirect Freedom
Journal of Economics and Finance	ABI/Inform, Business Source Premier
Journal of Finance	Wiley-Blackwell
Journal of Financial Economics	Oxford Journals Online
Journal of Financial Planning	ABI/Inform, Business Source Premier
Journal of Financial Service Professionals	Business Source Premier
Journal of Financial Services Research	SpringerLink
Journal of Insurance Issues	ABI/Inform
Journal of Insurance Regulation	ABI/Inform, Business Source Premier
Journal of Labor Economics	print plus online subscription
Journal of Mathematical Economics	ScienceDirect Freedom Collection
Journal of Money, Credit, and Banking	Project Muse
Journal of Pension Economics and Finance	Cambridge UP
Journal of Risk and Insurance	Wiley-Blackwell
Journal of Risk and Uncertainty	SpringerLink
Journal of the American Statistical Association	print plus online subscription
Mathematical Finance	Wiley-Blackwell
National Underwriter (all 3)	various aggregators
North American Actuarial Journal	ABI/Inform
Pensions and Investments	ABI/Inform, Business Source Premier
Risk Management	ABI/Inform
Risk Management and Insurance Review	Wiley-Blackwell
Scandinavian Actuarial Journal	Business Source Premier until 1 year ago

**Appendix B  
Journals Subscriptions to be Added to Support Proposed BS in Actuarial Science**

Title	Format	Price
ASTIN Bulletin (International Actuarial Association)	print + online	\$150
British Actuarial Journal	print + online	\$180
Journal of Applied Probability	print + online	\$384
		\$714

**Appendix C  
Library Materials Budget**

	Year 1	Year 2	Year 3	Year 4	Year 5
Journal subscriptions <sup>1</sup>	\$ 715	\$ 787	\$ 865	\$ 952	\$ 1,047
Books <sup>2</sup>	\$ -	\$ 200	\$ 210	\$ 221	\$ 232
Encyclopedia of Actuarial Sciences (online) <sup>2</sup>	\$ 350	\$ -	\$ -	\$ -	\$ 425
Support for current e-journal packages <sup>1</sup>	\$ 500	\$ 550	\$ 605	\$ 666	\$ 732
<b>Total</b>	<b>\$ 1,565</b>	<b>\$ 1,537</b>	<b>\$ 1,680</b>	<b>\$ 1,838</b>	<b>\$ 2,436</b>
<sup>1</sup> Presumes 10% annual inflationary increase					
<sup>2</sup> Presumes 5% annual inflationary increase					

## **Appendix B**

### **Course Descriptions**

One new course will be required, ECN 450/APM 450, Risk Management. It will generally be offered in the spring. To ensure sufficient enrollment it will be cross-listed with ECN 550, which can be taken by MBA students. This course will be taught by a part-time instructor or by a full-time faculty whose other spring/summer assignment will be taught by a part-time instructor. If there is insufficient enrollment, Professors Tracy, Schmidt, and Ogunyemi are committed to offering the course as an independent study for actuarial science students. Part time faculty already teach a similar course in Continuing Education.

#### **ECN 450/APM 450 Risk Management (4)**

The course reviews interest rate theory, Poisson, exponential and probability models and then develops and uses a variety of actuarial and risk models such as contingent payment models, and frequency, severity and aggregate claims models.

Prerequisite: FIN 322 or FIN 522 and either STA 226, QMM 250, QMM 240, or QMM 510.

## APPENDIX C

### Biographical Sketches of Selected Faculty of the Department of Economics and the Department of Mathematics and Statistics

#### Department of Economics

**ADDINGTON COPPIN**, Professor of Economics and Chairman of the Economics Department. Prior to joining the faculty at Oakland University in 1989, he taught at the University of West Indies and worked as a senior economist at the Central Bank of Barbados. His primary teaching and research interests are in the areas of International Economics, International Economic Development, International Business, and Labor Economics. He is the author of over two dozen articles on socio-economic issues related to the Caribbean region. Among the journals where his research appears are *The Journal of Development Studies*, *The Journal of Developing Areas*, *Social and Economic Studies*, *The Journal of Economic Development*, *The Review of Black Political Economy*, *The North American Review of Economics and Finance*, and *Economic Review*.

#### Education:

University of West Indies (B.Sc. in Economics and Mathematics)  
University of Illinois at Urbana-Champaign (Ph.D. in Economics)

#### Specialties:

- International Business and Economics

**FUAD HASANOV** Assistant Professor of Economics. His areas of interest include Applied Econometrics, Financial Economics, Monetary Economics and Public Finance. He has served as a Teaching Assistant at the University of Texas at Austin since 1999 assisting with upper-division undergraduate courses in Financial Economics, Monetary Economics, Money and Banking, Intermediate Macroeconomics and Intermediate

Microeconomics. In addition, he served as a Research Assistant in the summer of 1999 and 2000, researching, compiling and analyzing data and literature on interest rates and returns on financial and real assets. He was a Principal Partner in a telecommunications/internet venture in the Caspian Region from 1998-2000, where he planned and evaluated communications opportunities and met with US Ambassadors and Bank Representatives for the region. From 2007 – 2009 he was on leave from Oakland University and worked at the International Monetary Fund.

#### Education:

University of Texas at Austin (B.A., M.S., and Ph.D. in Economics)

#### Specialties:

- Applied Econometrics
- Financial Economics
- Monetary Economics
- Public Finance

**SHERMAN T. FOLLAND**, Professor of Economics, specializes in health economics and related microeconomic topics. Within this field, he has studied hospital economic behavior, comparative hospital efficiency, physician advertising, nuclear power plant externalities, economic models of non-profit organizations, and methodological issues of applications of frontier analysis to hospitals. During a Fulbright year, in 1993/1994, in Freiburg, Germany he studied small areas of East Bloc countries and several hundred hospital districts under Communism. He has published numerous articles in academic journals including *Journal of Health Economics*, *Inquiry*, *Medical Care*, *Southern Economic Journal*, *Applied Economics*, *Journal of Advertising*, and *Medical Care Research and Review*. He and co-authors Allen Goodman and Miron Stano, are contracted

with Prentice Hall to bring out the 3rd Edition of their textbook, The Economics of Health and Health Care in late 1999.

**Education:**

The University of Iowa, Iowa City (M.A., Ph.D., Economics)  
Concordia College, Moorhead, Minnesota (B.A., Political Science/History)

**Specialties:**

- Hospital Economic Behavior
- Physician Advertising
- Nuclear Power Plant Externalities
- Non-Profit Economics

**ODED IZRAELI**, Professor of Economics, has published numerous scholarly articles in journals such as: *Journal of Urban Economics*, *Journal of Regional Science*, *Urban Studies*, *Regional Studies*, *Journal of Environmental Economics and Management*, *Economic Development and Cultural Change*, *Transport Economic and Policy*, *Logistics and Transportation Review*, and the *Annals of Regional Science*. His areas of interest are urban and regional economics, state and local public finance, environmental economics and labor economics. His current research interests include work on interstate differences in state and local revenues, trade-off between environment quality and jobs, interstate equity implications of the 1986 tax reform, the effect of state governor party affiliation on state economic performance, convergence in state per capita income and the comparison of the impact of the environment on earnings and housing values overtime. Some of these research projects have already been published in journals such as *Growth and Change* and *Environmental, Planning A*, and *Public Finance Review*.

**Education:**

University of Chicago (M.A., Ph.D. in Economics)  
Hebrew University (B.A. in Economics and Statistics)

**Specialties:**

- Urban and Regional Economics
- State and Local Public Finance
- Environmental Economics

- Labor Economics

**NIVEDITA MUKHERJI**, Associate Professor of Economics, specializes in macroeconomic and monetary economic theories. Her research interests include issues related to optimal monetary policies under uncertainty, effects of monetary policies on investment, financial intermediation, asymmetric information and monetary policy, complex dynamics, economic growth and finite versus infinite horizon optimization. She has published and has articles forthcoming in journals such as: *The International Economic Review*, *Journal of Macroeconomics*, *Annals of Regional Science*, *Quarterly Review of Economics and Finance*, *Journal of Economics, Business, Atlantic Economic Journal* and *The Journal of Development Economics*. She has also presented her research in several national conferences.

**Education:**

Calcutta University (B.Sc.)  
Virginia Tech (M.A., Ph.D.)

**Specialties:**

- Monetary Policy
- Financial Intermediation
- Monetary Policy under Uncertainty
- Asymmetric Information and Macroeconomic Policies
- Economic Growth

**KEVIN J. MURPHY**, Professor of Economics, specializes in the areas of labor economics and econometrics. His current research interests include labor contracting, payroll tax incidence, the effect of industrial diversity on state economies and economic convergence in the United States. His scholarly work has appeared in journals such as: *Southern Economic Journal*, *Economic Inquiry*, *Review of Economics and Statistics*, *Industrial and Labor Relations Review*, *Journal of Regional Science*, and the *Journal of Macroeconomics*. He consults locally on Act 312 Arbitrations and has conducted econometric analyses for private sector firms. His research has been supported by the U.S. Department of Labor and he held a Fulbright



Fellowship to the National University of Ireland

**Education:**

Michigan State University (B.A., M.A., and Ph.D. in Economics)

**Specialties:**

- Labor Economics
- Econometrics

**RAM ORZACH**, Assistant Professor of Economics, specializes in the area of asymmetric information and its influence on decision making. When private information is held by a decision maker and he has to choose an action that the market observes and responds to, it is considered a signaling game. He works on signaling games concerning advertising and entrepreneurship. When the private information is held by more than one decision maker, it is considered a multi-sender game. He works on a model in which incumbent firms are facing competition from potential entrants. Models in which the decision makers hold different information are called differential information. He uses these methods to understand the behavior of buyers and sellers in auctions. Recent work introduces these methods to Law and Economics. His work is published in the *RAND Journal of Economics, Games & Economic Behavior, International Economic Review, Journal of Mathematical Economics, and the International Journal of Game Theory.*

**Education:**

Tel-Aviv University (BSc, MSc, Ph.D. Operations Research)

**Specialties:**

- Models of Incomplete Information
- Signaling Games
- Auctions
- Law & Economics

**ANANDI P. SAHU**, Professor of Economics, has concentrated his research efforts in three fields: macroeconomics, monetary theory and finance. Dr. Sahu has published numerous articles in scholarly and professional outlets. His journal publications include articles in *Southern*

*Economic Journal, Financial Services Review, Quarterly Journal of Business and Economics, Review of Business and Economic Research, Eastern Economic Journal, Journal of Economics and Finance, Journal of Applied Business Research and Public Finance Quarterly.* He is also co-editor of two books on public policy -- The Economic Legacy of Reagan Years: Euphoria or Chaos? (Praeger Publishers, 1991) and Defense Spending and Economic Growth (Westview Press, 1993).

**Education:**

Washington University - St. Louis (A.M. and Ph.D. in Economics)

Delhi School of Economics (M.A. in Economics)

**Specialties:**

- Fiscal and Monetary Policies
- Financial Markets
- Financial Institutions
- Investments & Portfolio Management
- Privatization in Government

**JONATHAN SILBERMAN**, Professor of Economics, comes to Oakland University from Arizona State University West campus where he was dean of the School of Management from 1992 to 2000 and Professor of Economics from 2000 to 2005. He has served as an advisor and consultant to the cities of Virginia Beach, Norfolk, and Richmond, as well as to the U.S. Army Corps of Engineers, Virginia Port Authority, Colonial Williamsburg, the Greater Baltimore Committee, the (Virginia) Governor's Economic Advisory Council, Baltimore's Regional Economic Development Committee, and The Future of Hampton Roads. He served on the Board of the Peoria Economic Development Group as its Chair and the Surprise Economic Development Group, both located in metropolitan Phoenix. Dr. Silberman designed a computer database and leading economic index for Baltimore, which was featured each week in a special section of the Baltimore Sun. He was the project director of the 1992 International Scorecard for Maryland and past editor of Tidewater Economic Report.

**Education:**

Florida State University, Ph.D.

**Specialties:**

- Public Policy
- Regional Economic Development

**MIRON STANO**, Professor of Economics and Management, specializes in health economics and the financing of health care. He conducts research in managed care, the professional services markets, outcomes analysis, and cost evaluation. His research has been supported by the Health Care Financing Administration, the Health Resources Services Administration, and the Michigan Health Care Education and Research Foundation. In 1981, his article "Individual Health Accounts: An Alternative Health Care Financing Approach," (Health Care Financing Review) introduced the concept of medical savings accounts. Other publications include, *The Economics of Health and Health Care*, 5th edition (Prentice-Hall, 2007) and many articles in journals such as the *Journal of Health Economics*, *Medical Care*, *Health Services Research*, *Breast Cancer Research and Treatment*, *Inquiry*, *Southern Economic Journal*, *Bell Journal of Economics*, *Journal of Human Resources*, *Public Finance Review*, *Health Policy*, *American Journal of Managed Care*, and the *Journal of Health Policy, Politics and Law*. Dr. Stano has served as Associate Editor of the *American Journal of Managed Care* and as a research consultant to various organizations including Blue Cross-Blue Shield of Michigan, Wayne State University's School of Medicine and the U.S. General Accounting Office. He has also served as an expert witness in antitrust cases involving the health care professions.

**Education:**

Cornell University (M.A. and Ph.D.)  
McGill University (B. Commerce)

**Specialties:**

- Managed Care
- Health System Reform
- Health Care Evaluation/Cost Effectiveness
- Professional Services Markets

**KASAUNDR TOMLIN**, Associate Professor of Economics, specializes in international economics, industrial organization, and applied microeconomics. Her current research interests include foreign direct investment, exchange rates, and the effectiveness of antidumping policies in the United States. Her scholarly work has been published in the *International Journal of Industrial Organization*, *Southern Economic Journal*, and the *National Bureau of Economic Research Working Paper Series*. Her research has been supported by the *National Science Foundation*. Her teaching interests are in international trade, managerial economics, and introductory microeconomics.

**Education:**

University of Oregon, Ph.D.  
Eastern Michigan University, (M.A. and B.A.)

**Specialties:**

- International Economics
- Trade Policy-Multinational Firms
- Industrial Organization

**RONALD L. TRACY**, Associate Professor of Economics. He came to Oakland University from a faculty position at Southern Illinois University. He was Chair of the Department of Economics from 1985 until 1993. He has been the Associate Dean of the School of Business Administration since 2006. His research interests include econometric methodology, time series analysis and applied economics. He has published in the area of statistical theory, demography and macroeconomics. His publications have appeared in such journals as the *Journal of Macroeconomics*, *Southern Economic Journal*, and the *Journal of Economic Development*. In addition, he has recently co-edited a book entitled *The Economic Legacy of the Reagan Years: Euphoria or Chaos?* His research has been supported by Oakland University Research Fellowships and other university grants. His research is currently being supported by a National Science Foundation grant to study how computers can be used to teach business statistics effectively.

**Education:**

Michigan State University (B.A. in

Mathematics, M.S. and Ph.D. in Economics)

**Specialties:**

- Econometric Methodology
- Time Series Analysis
- Applied Economics

**Xie Zhu**, Assistant Professor of Economics, specializes in environmental economics and public economics. Her current researches include how the type of externality, the timing of international income transfers and costly enforcement affect Pareto efficient arrangements of international carbon dioxide emissions trading; the pollution haven hypothesis; and economics of law enforcement and corruption.

**Education:**

University of International Business and Economics (B.A., M.A.)  
Tulane University (M.A., Ph.D., Economics)

**Specialties:**

- Environmental Economics
- Public Economics
- International Economics

**Department of Mathematics and Statistics**

**KEVIN T. ANDREWS** (Ph.D. University of Illinois—Professor) specializes in applied analysis, functional analysis, and operator theory. His research has been published in a number of journals devoted to pure and applied mathematics including the *Transactions of the American Mathematical Society*, the *Journal of Mathematical Analysis and Applications*, the *SIAM Journal on Applied Mathematics* and the *Journal of Applied Mathematics and Optimization*.

**EDDIE CHENG** (Ph.D. University of Waterloo—Professor) specializes in combinatorial optimization, integer and linear programming, and network analysis. His research works have been published in journals such as *Networks*, *Mathematical Programming*,

*Operations Research Letters*, *Information Processing Letters*, *Ars Combinatoria*, *Discrete Applied Mathematics*, *SIAM Journal on Discrete Mathematics*, *International Journal of Foundations of Computer Science*, *Information Sciences*, and *Mathematical and Computer Modelling*. He is on the editorial board of *Networks* and *The Open Operational Research Journal*. He is currently a member of examination committee of the Michigan Mathematics Prize competition (MMPC), a post he held previously from 2001 to 2005; he was the director of MMPC from 2005 to 2008. He is currently the Director of Oakland University Summer Mathematics Institute. He has taught several courses in discrete mathematics and operations research. He is the recipient of the 2007 Mathematical Association of America (Michigan Section) Distinguished Teaching Award.

**BARUCH CAHLON** (Ph.D. Tel-Aviv University—Professor) specializes in numerical analysis, integral equations, and delay differential equations. His research work has been published in several journals including the *Journal of Mathematical Analysis and Applications*, the *Journal of Computational and Applied Mathematics*, and the *Journal of Differential Equations*. He is a recipient of the 1997 Research Award of the Internal Security of Israel and has received grants from the United States-Israel Binational Science Foundation for work with Samuel Rakover on a face recognition model.

**JERROLD GROSSMAN** (Ph.D. Massachusetts Institute of Technology—Professor) specializes in graph theory and combinatorics with interests in algebraic topology, statistics, theoretical computer science, and number theory. He has published in the *Proceedings of the American Mathematical Society*, *Transactions of the American Mathematical Society*, *Discrete Mathematics*, *Journal of Combinatorial Theory* among others. He is the author of the text *Discrete Mathematics: An Introduction to Concepts, Methods and Applications*. He received the Oakland University Teaching Excellence Award in 1992 and the Award for Distinguished

College or University Teaching of Mathematics of the Michigan Section of the Mathematics Association of America in 1994. He also received state and national service awards from the MAA in 2005 and 2007.

**BO-NAN JIANG** (Ph.D. The University of Texas at Austin—Associate Professor) specializes in Scientific Computing with interests in least squares finite elements with applications to fluid dynamics, solid mechanics, and electromagnetics. He authored a book "The Least-Squares Finite Element Method" published by Springer. His papers have appeared in the *International Journal for Numerical Methods in Engineering*, *Computer Methods in Applied Mechanics and Engineering*, and other journals.

**RAVINDRA KHATTREE** (Ph.D. University of Pittsburgh—Professor) has expertise in several areas of statistics. He has published articles in biostatistics, statistical inference, experimental designs, multivariate analysis and industrial statistics as well as in other interdisciplinary areas. His publications appear in numerous journals including the *Biometrika*, *Journal of Multivariate Analysis*, *Journal of Applied Statistics*, the *Journal of Statistical Planning and Inference*, *Statistics*, the *American Statistician*, *Communications in Statistics*, *Sankhya*, the *Journal of Pharmaceutical Statistics*, the *Proceedings of Academy Marketing Studies*, and the *Journal of Applied Toxicology*. He is the coauthor of three texts and has co-edited two volumes, one each in *Industrial Statistics* and *Biomedical Statistics*. His honors include being named Fellow of the American Statistical Association, being elected as a Member of the International Statistical Institute, receiving the Young Statistician Award of the International Indian Statistical Association and Oakland University Research excellence Award. He is the chief editor of the *Journal of Statistics and Applications*, the editor of the electronic journal *InterStat*, the *Journal of Statistical Theory and Applications* and an Ex-associate editor of *Communications in Statistics*. Prof. Khattree is a participating investigator at the Center for Biomedical Research.

**SERGE KRUK** (Ph.D. University of Waterloo—Associate Professor) specializes in optimization. His research works have been published in several journals such as the *Congressus Numerantium*, *Journal of Applied Mathematics*, *Journal of Optimization Theory and Applications*, *Mathematical and Computer Modelling*, *Optimization Software and Methods*, and *Advances in Nonlinear Programming*. He has taught several courses in linear algebra, operations research, numerical methods, theory of computation, and optimization. Before joining Oakland University, he worked in several places as a software designer. He is a member of the Association for Computing Machinery, Institute for Operations Research and the Management Sciences (INFORMS), American Mathematical Society, Mathematical Association of America, and Society for Industrial and Applied Mathematics (SIAM).

**ROBERT KUSHLER** (Ph.D. University of Michigan—Associate Professor) has expertise in statistical modeling, industrial statistics, and statistical computing. His research and consulting work has appeared in professional journals such as *Statistics in Medicine*, *Journal of Quality Technology*, *Journal of Microscopy*, and *Neuroendocrinology*. He has taught several courses in applied statistics and he has a wide range of statistical consulting. He coordinated the joint Ford/OU Cooperative program for graduate students in applied statistics for many years.

**LASZLO LIPTAK** (Ph.D. Yale University—Assistant Professor) specializes in combinatorics and discrete optimization. His research works have been published in several journals such as *Discrete Applied Mathematics*, *Discrete Mathematics*, *Information Processing Letters*, *Mathematical Programming*, *Operations Research Letters*, and *Combinatorica*. He has taught several courses in discrete mathematics, calculus, and business calculus.

**THEOPHILUS OGUNYEMI** (Ph.D. Kansas State—Associate Professor) has over twenty five years of teaching mathematics and statistics at

the university level including teaching experience in Nigeria. His research interests are in the areas of statistical inference, design of experiments, stochastic processes, and time series analysis. Among the journals where his research works appear are *Journal of Statistical Planning and Inference*, *IEEE Transactions on Reliability*, *Journal of Applied Statistical Inference*, and *Communication in Statistics*. He completed some actuarial exams many years ago. He has future interests in pedagogical and research aspects of actuarial studies. He initiated the problem solving workshops in lower division and remedial courses in mathematics. Similar problem solving workshops can be conducted in preparing students in the proposed actuarial degree program for professional exams.

**SUBBAIAH PERLA** (Ph.D. University of Rochester—Professor) has expertise in multivariate statistical methods, quality control, and reliability. He has published his works in several professional journals including *Biometrika*, *Journal of Multivariate Analysis*, *Sankhya*, *Metrika*, *Journal of the American Statistical Association*, *Communications in Statistics*, *Statistica Neerlandica*, *Journal of Applied Statistics*, *Journal of Ultrasound in Medicine*, and *Pediatric Radiology*. His research work has been cited in several books. He has taught several courses in undergraduate and graduate statistics spanning across a broad spectrum, calculus and linear algebra in mathematics.

**XIANGGUI QU** (Ph.D. University of Michigan—Assistant Professor) has research interests in the areas of experimental designs, computer experiments, nonparametric statistics, and statistical applications. His research work has been published in professional journals such as *Journal of Statistical Planning and Inference*, *International Journal of Pharmaceutics*, *Journal of Pharmaceutical Sciences*, and *Journal of Molecular Structure*. He has taught several courses in statistics at the undergraduate and graduate levels. He has considerable statistical consulting experience in pharmaceutical industry.

**DARRELL SCHMIDT** (Ph.D. Montana State—

Professor) has expertise in delay differential equations, approximation theory, and numerical analysis. He has published numerous scholarly articles in journals in these areas such as *Journal of Computational and Applied Mathematics*, *Linear Algebra and Its Applications*, *Journal of Approximation Theory*, *European Journal of Applied Mathematics*, *SIAM Journal of Numerical Analysis*, *Mathematics of Computation*, *Journal of Integral Equations*, *Acta Mathematica Hungarica*, *IMA Journal of Numerical Analysis*, and others. He is a recipient of Oakland University's Teaching Excellence Award in 1999.

**IRWIN E. SCHOCHETMAN** (Ph.D. University of Maryland—Professor) specializes in operations research, functional analysis, and applied mathematics. He has concentrated his research efforts in the areas of mathematical optimization, infinite mathematical programming and infinite horizon optimization. He has published numerous articles in journals such as *Advances in Mathematics*, *International Journal of Mathematics and Mathematical Sciences*, *Mathematics of Operations Research*, *Mathematical and Computational Model*, *Mathematical Programming*, *Journal of Computational and Applied Mathematics*, *Journal of Mathematics and Computation in Simulation*, *Applied Mathematics Letter*, *Linear Algebra and Its Applications*, *Annals of Operations Research* and *Journal of Optimization Theory and Application*. He has presented his research in several national conferences.

**TANUSH SHASKA** (Ph.D. University of Florida—Assistant Professor) has research interests in computational algebraic geometry, interactions between group theory and algebraic geometry, moduli spaces of curves, cryptography, and algebraic coding theory. His research works have been published in several professional journals such as *Contemporary Mathematics*, *Journal of Computational Mathematics*, *Journal of Algebra Applications*, *Lecture Notes in Computing*, *Developments in Mathematics*, *Journal of Symbolic Computation*, and *Applicable Algebra in Engineering, Communication and Computing*.

His works were supported by grants from sources such as NSA, Outreach Programs, NSF-Epscor, German Academy of Sciences, and Institute of Advanced Studies, Princeton. He is a member of the International Scientific Board of Applications of Computer Algebra and an editor of the Journal of Computational Aspects of Algebraic Curves.

**PETER SHI** (Ph.D. University of Delaware—Associate Professor) specializes in partial differential equations, numerical analysis and computation, and mathematical modeling in engineering and biology. He has published numerous articles in journals such as *Complex Variables*, *Mathematical Methods in Applied Science*, *Nonlinear Analysis*, *Numerische Mathematik*, *European Journal of Applied Mathematics*, *Computational Mathematics with Applications*, *Journal of Partial Differential Equations*, *Journal of Mathematical Analysis*, *Journal of Elasticity*, *Journal of Differential Equations*, *Computational Mathematics*, and several others. He has several years of teaching in his areas of research interests and in lower division courses. He is proficient in Fortran, C, PHP, Perl, Java Script. He developed a comprehensive 2-dimensional finite element software package and a private web based financial software package called Market Dagger.

**MEIR SHILLOR** (Ph.D. Hebrew University of Jerusalem—Professor) has expertise and research interests in mathematical modeling, PDEs, variational inequalities and contact problems, and mathematical modeling and analysis of industrial problems. His published works (over a hundred) have appeared in various professional journals such as *Mathematical Computation and Modeling*, *Applicable Analysis*, *European Journal of Applied Mathematics*, *SIAM Journal of Mathematical*

*Analysis*, *Journal of Mathematical Analysis and Applications*, *Mathematics of Computer Modeling*, *International Journal of Solid Structures*, *International Journal of Engineering Science*, *Lubrication Engineering*, *Journal of Engineering Mathematics*, *Electronic Journal of Differential Equations*, *Quarterly Applied Mathematics*, and *Nonlinear Analysis*. His research activities were supported by NSF and GM Power Train. He is the recipient of the Oakland University Research Excellence Award in 2002, and is a member of more than twenty doctoral committees in the School of Engineering and Computer Science at OU. He has co-authored two books, and taught many courses in applied mathematics.

**ANNA SPAGNUOLO** (Ph.D. Purdue University—Associate Professor) conducts research in modeling of physical phenomena, particularly fluid flow in porous media and disease processes, and numerical methods for approximating their solutions. She has published several articles in journals such as *Computational and Applied Mathematics*, *Journal of the Korean Mathematical Society*, *Contemporary Mathematics*, *SIAM Journal on Numerical Analysis*, and *Journal of Numerical Mathematics*. She participates in the department's calculus reforms and has advised and supervised several students on industrial problems involving springs and suspension systems, NASA Reduced Gravity Student Flight Opportunities, and on projects involving mathematics and computer science and on projects involving mathematics and computer science, such as an NSF-funded project on the speedup of numerical algorithms.

## APPENDIX D

### Degree Requirements for Majors in Actuarial Sciences or Mathematics Programs with an Actuarial Option at Other Michigan Public Universities

#### Eastern Michigan University

EMU offers a bachelors degree with an Actuarial Science and Economics major. This is a joint program with the Departments of Mathematics and Economics. The major consists of

One computing course (FORTRAN Programming, Computer Science I, or Computer Programming with Numerical Methods) (3)

Principles of Economics I (3)

Principles of Economics II (3)

Calculus I and II, Multivariable Calculus (4 each)

Elementary Linear Algebra (3)

Probability and Statistics I (4)

Problems in Actuarial Studies I (2)

Probability and Statistics II (3)

Problems in Actuarial Studies II (2)

Principles of Macroeconomics (3)

Intermediate Macroeconomic Analysis (3)

Intermediate Microeconomic Analysis (3)

Labor Economics (3)

Money and Banking (3)

Introduction to Econometrics (3)

6 hours of electives at the 300 level and above in mathematics or the economics courses Money and Banking, Economic Fluctuations and Forecasting, Cost-benefit analysis.

#### Central Michigan University

CMU offers a B.S. or B.A. with an Actuarial Science major. This is an interdisciplinary program administered through the Department of Mathematics. The major consists of

Calculus I, II, and III (4 each)

Linear Algebra and Matrix Theory (3)

Introduction to Analysis (3)

Introduction to Analysis (3)

Mathematical Foundations of Actuarial Science (3)

Statistical Programming for Data Management and Analysis (3)

Mathematical Statistics I (3)

Mathematical Statistics II (3)  
Concepts of Financial Accounting (3)  
Concepts of Managerial Accounting (3)  
Legal Environment for Business (3)  
FORTRAN Programming (2)  
Principles of Macroeconomics (3)  
Principles of Microeconomics (3)  
Insurance Planning (3)  
Managerial Finance (3)  
Economic Forecasting (3)  
Time Series Forecasting (3)  
One elective from Business Communication, Intermediate Microeconomic Theory (3),  
Intermediate Microeconomic Theory (3), Intermediate Financial Management (3),  
Advanced Calculus I (3)

### **University of Michigan-Flint**

UM-Flint offers a B.S. in Mathematics with a Concentration in Actuarial Mathematics.  
Requirements are

Calculus I, Calculus II, Multivariable Calculus (4 each)  
Mathematical Proofs and Structures (3)  
Elementary Linear Algebra (3)  
Probability (3)  
Introduction to Numerical Analysis (3)  
Mathematical Statistics (3)  
Methods of Operations Research (3)  
Theory of Interest (3)  
Actuarial Exam Preparation Seminar (1)  
Senior Seminar in Mathematics (3)  
two mathematics electives at the 300 level or above

Principles of Financial Accounting (3)  
Principles of Managerial Accounting (3)  
Financial Management (3)

Problem Solving and Programming I (4)

Principles of Economics (Macroeconomics) (3)  
Principles of Economics (Microeconomics) (3)  
Intermediate Microeconomic Theory (3)  
Intermediate Macroeconomic Theory (3)

Recommended: Investments, Financial Engineering,  
knowledge of Excel, a minor on Computer Science



or Business (Finance)

### **University of Michigan-Ann Arbor**

UM-Ann Arbor offers a B.S. in Actuarial Mathematics. The requirements are

Prerequisite for the concentration:

One combination of courses that constitutes Multivariable Calculus and Linear Algebra

Two introductory courses in Economics

A knowledge of a higher level computer programming language (e.g., FORTRAN, C, or C++ )

Four basic courses—one from each of the following groups:

Differential Equations: One course which constitutes an introduction to differential equations

Probability: Introduction to Probability

Finance: Mathematics of Finance

Statistics: Introduction to Theoretical Statistics

Special actuarial financial mathematics courses:

These must include three courses in actuarial mathematics—Compound Interest and Life Insurance, Life Contingencies I, and at least one of Life Contingencies II or Actuarial Theory of Pensions and Social Security—and four courses in financial mathematics—Numerical Methods with Financial applications (or Numerical Methods), Probability theory, Discrete State Stochastic Processes, and Financial Economics.

Two additional intermediate or advanced courses related to Actuarial or Financial Mathematics selected with the approval of the actuarial and financial mathematics advisor. Some, but not all, of the courses numbered 300 and above offered by Accounting, Computer Science, Economics, Finance, Industrial and Operations Engineering, and Statistics are appropriate here.

### **Michigan Technological University**

MTU offers a B.S. in Mathematics with an Actuarial Science Concentration. Requirements are

Major Requirements

Calculus with Technology I and II, Multivariable Calculus with Technology (4 each)

Introduction to Linear Algebra (3)

Introduction to Statistical Analysis (3)

Introduction to Combinatorics (3)

Introduction to Abstract Algebra (3)

Introduction to Real Analysis (3)  
Mathematical Modeling with Differential Equations (4)  
A laboratory science course, a computer science programming course, and a course in science, engineering or computer science

Concentration Requirements

Accounting I, Accounting II (3 each)  
Business Law I (3)  
Principles of Finance (3)  
Investment Analysis (3)  
Probability (3)  
Introduction to Actuarial Mathematics (3)  
Regression Analysis (3)  
Life Contingencies (3)  
Loss Distribution/Credibility Theory (3)

**Lake Superior State University**

LSSU offers a B.S. in Mathematics–Actuarial and Business Applications. Requirements are

Calculus I, II, and III (4 each)  
Fundamental Concepts of Mathematics (3)  
Discrete Mathematics and Problem Solving (3)  
Linear Algebra (3)  
Probability and Mathematical Statistics (4)  
Applied Statistics (3)  
Differential Equations (3)  
Abstract Algebra I (3)  
Graph Theory (3)  
Mathematical Modeling (3)  
Advanced Calculus (3)  
Research Topics in Mathematics (3)

Any two of Survey of Computer Science (3), Introduction to Computer Programming (3), or Principles of Programming (3)

Principles of Macroeconomics (3)  
Managerial Finance (4)

A minor in Accounting or Finance

**Ferris State University**

FSU offers a B.S. in Applied Mathematics/Actuarial Science Concentration. Major requirements

are

Analytical Geometry & Calculus I and II (5 each)

Analytical Geometry & Calculus III (3)

Statistics for the Life Sciences (3)

Linear Algebra (3)

Object Oriented Programming (4) or Scientific Programming with FORTRAN (3)

Linear Models in Statistics (3)

Probability (3)

Numerical Analysis (3)

Mathematical Statistics 1, Mathematical Statistics 2 (3 each)

Principles of Risk Macroeconomics (3)

### **Wayne State University**

WSU offers a bachelors degree in mathematics with a concentration in Actuarial Science. The requirements are

Calculus I, II, and III (4 each)

Elementary Linear Algebra (3)

Advanced Calculus (4)

Numerical Methods I (3)

Algebra I (with writing intensive designation) (4)

Introduction to Probability Theory (4)

The Theory of Interest (3)

Introduction to Stochastic Processes (3)

Introduction to Mathematical Statistics (4)

Introduction to Analysis I (4) (required for the B.S. but not the B.A. degree)

Elementary Differential Equations (3) or one additional mathematics course numbered above 500, excluding certain courses, or one computer science course numbered above 510.

## APPENDIX E

### Sample Curriculum

<u>Semester 1</u>		<u>Credits</u>	<u>Semester 2</u>		<u>Credits</u>
MTH 141	Pre Calculus	4	WRT 160	Composition II	4
WRT 150	Composition I	4	MTH 154	Calculus I	4
Literature area general education		4	Foreign Language and Culture area gen ed		4
Western Civilization area general education		<u>4</u>	Global perspective area general education		<u>4</u>
		<b>16</b>			<b>16</b>
<u>Semester 3</u>			<u>Semester 4</u>		
ACC 200	Intro. Fin. Accounting	4	ECN 201	Prin. of Microeconomics	4
MTH 155	Calculus II	4	MTH 254	Calculus III	4
EGR 141	Programming	4	STA 226	Statistics	4
ECN 200	Prin. of Macroeconomics	<u>4</u>	Arts area of general education		<u>4</u>
		<b>16</b>			<b>16</b>
<u>Semester 5</u>			<u>Semester 6</u>		
FIN 322	Managerial Finance	4	FIN 422	Finance 2	3
QMM 241	Stat Meth for Bus II	3	WTR 382	Business Writing	4
MTH 275	Linear Algebra	4	ECN 303	Managerial Economics	3
ECN 302	Intermediate Macro	<u>3</u>	Natural Science area of general education		<u>4</u>
		<b>14</b>			<b>14</b>
FM/2 exam during the junior year					
<b>Spring Session</b>					
ECN450/APM 450 Risk Management					
					<u>3</u>
					<b>3</b>
<u>Semester 7</u>			<u>Semester 8</u>		
STA 427	Math Stat I	4	STA 428	Math Stat II	4
FIN 416	Investments	3	Free elective		3
ECN 405	Econometrics	3/4	Free elective		4
or STA 402	Applied Linear Models I		Free Elective		<u>4</u>
Free elective		<u>4/3</u>			<b>15</b>
		<b>14</b>			
P/I exam during the senior year					

**Total Credits = 124**

Recommended Electives: COM 201 (Public Speaking) or COM 202 (Group Dynamics and Communication) and MGT 350 (Legal Environment of Business) with permission of the School of Business Administration.

## APPENDIX F

### A SHORT SURVEY ON A PROPOSED PROGRAM IN ACTUARIAL SCIENCE

- Proposed major in actuarial science
  - ✓ Earn B.S. in Actuarial Science
  - ✓ Automatically earn minors in both Mathematics and Economics
  - ✓ Major for student with good mathematical skills who wants to apply them in a business environment
  - ✓ High paying entry jobs in the insurance, consulting, and financial services industries
  - ✓ Good preparation for graduate study in actuarial science, mathematics, statistics, economics, business, finance, or law
- To be certified as an actuary, student takes exams offered by the Society of Actuaries
  - ✓ During junior year student takes the first exam, covering calculus and probability
    - Passing exam qualifies student to get a summer internship after junior year
  - ✓ During senior year student takes second exam, covering economics and finance
    - Passing exam qualifies student to get an actuarial job upon graduation
  - ✓ If exam 1 or 2 is not passed, student gets job as actuarial trainee until exams are passed
  - ✓ Coursework in senior year covers some of the topics in exams 3 and 4
  - ✓ After the first two exams, student decides on focus and level of certification
    - Highest level of certification is Fellow of the Society of Actuaries
- An example of the program is shown below:

<u>Freshman</u>	<u>Sophomore</u>	<u>Junior</u>	<u>Senior</u>
MTH 141(Precalculus)	*MTH 155 (Calculus 2)	MTH 256 (Linear Algebra)	STA 427 (Math Stat 1)
RHT 150 (Composition 1)	*ECN 200 (Macroecon)	ECN 303 (Managerial Econ)	ECN 405 (Econometrics)
*General Education	ACC 200 (Financial Acct)	*ECN 302 (Inter Marcoecon)	*Elective
*General Education	CSE 141(Programming)	FIN 322 (Finance 1)	*Elective
*MTH 154 (Calculus 1)	MTH 254 (Calculus 3)	*General Education	STA 428 (Math Stat 2)
RHT 160 (Composition 2)	ECN 201(Microecon)	ECN 304 (Consumer Econ)	Elective
*General Education	STA 226 (Statistics)	FIN 422 (Finance 2)	Elective
*General Education	*General Education	Elective	Elective
		QMM 470 (Risk Management)	

\* General Education/Distribution Classes

1. What is your academic level? (1) Freshman (2) Sophomore (3) Junior (4) Senior
2. Do you have a current major? (1) Yes (2) No  
If yes, what is it? \_\_\_\_\_  
If no, what is your future plan? \_\_\_\_\_
3. How many credits of math/stat and econ/business courses have you taken prior to this semester?  
Math/Stat \_\_\_\_\_ Econ/Business \_\_\_\_\_
4. Prior to this survey, how much did you know about the actuarial profession?  
(1) A great deal (2) Some (3) Very little (4) Nothing
5. Would such a program interest you or would it have interested you had it been available when you enrolled at Oakland University? (1) Yes (2) No (3) Maybe
6. Would you consider majoring in actuarial science?  
(1) Yes (2) Maybe (3) No, I am not interested (4) No, I am too far into my program
7. In what class are you taking this survey? Course Number \_\_\_\_\_  
Instructor's Name \_\_\_\_\_

Thank you for completing the survey.

The courses included in the student survey on the proposed program in actuarial science are: ECN 150 (Economics in Today's World), ECN 200 (Principles of Macroeconomics), ECN 201 (Principles of Microeconomics), ECN 210 (Principles of Economics), ECN 302 (Intermediate Macroeconomics), ECN 303 (Managerial Economics), ECN 385 (Economics of Industries), ECN 405 (Econometrics); MTH 121 (Linear Programming, Elementary Functions), MTH 122 (Calculus for the Social Sciences), MTH 141 (Precalculus), MTH 154 (Calculus I), MTH 155 (Calculus II), MTH 254 (Multivariable Calculus), MTH 256 (Introduction to Linear Algebra), APM 257 (Introduction to Differential Equations), MTH 302 (Introduction to Advanced Mathematical Thinking), MTH 351 (Advanced Calculus I), MTH 361 (Geometric Structures), and STA 226 (Applied Probability and Statistics).

		Yes	Maybe	No	Total
Freshman	Business	7% (5)	5% (21)	2% (8)	4% (34)
	Economics	0	0	0	0
	Engineering	0	9% (36)	5% (18)	6% (54)
	Mathematics	0	0% (2)	0% (1)	0% (3)
	Science and others	0	4% (16)	5% (19)	4% (35)
	Undecided	6% (4)	10% (39)	5% (18)	7% (61)
	<b>Total</b>	<b>12% (9)</b>	<b>28% (114)</b>	<b>17% (64)</b>	<b>22% (187)</b>
Sophomore	Business	14% (10)	13% (53)	15% (56)	14% (119)
	Economics	0	1% (5)	0% (1)	1% (6)
	Engineering	7% (5)	7% (30)	7% (28)	7% (63)
	Mathematics	1% (1)	2% (9)	0% (2)	1% (12)
	Science and others	3% (2)	2% (7)	5% (19)	3% (28)
	Undecided	14% (10)	12% (47)	5% (18)	9% (75)
	<b>Total</b>	<b>39% (28)</b>	<b>38% (151)</b>	<b>33% (124)</b>	<b>35% (303)</b>
Junior	Business	13% (9)	12% (48)	16% (62)	14% (119)
	Economics	4% (3)	1% (3)	1% (5)	1% (11)
	Engineering	10% (7)	6% (25)	8% (32)	7% (64)
	Mathematics	7% (5)	2% (8)	1% (4)	2% (17)
	Science and others	3% (2)	1% (3)	4% (17)	3% (22)
	Undecided	1% (1)	5% (20)	3% (13)	4% (34)
	<b>Total</b>	<b>38% (27)</b>	<b>27% (107)</b>	<b>35% (133)</b>	<b>31% (267)</b>
Senior	Business	3% (2)	3% (11)	6% (24)	4% (37)
	Economics	4% (3)	1% (3)	1% (6)	1% (12)
	Engineering	1% (1)	0% (2)	2% (9)	1% (12)
	Mathematics	1% (1)	1% (6)	2% (9)	2% (16)
	Science and others	1% (1)	1% (3)	3% (11)	2% (15)
	Undecided	0	1% (4)	0% (1)	1% (5)
	<b>Total</b>	<b>11% (8)</b>	<b>7% (29)</b>	<b>16% (60)</b>	<b>11% (97)</b>
<b>Total</b>		<b>72</b>	<b>401</b>	<b>381</b>	<b>854</b>

All percentages are rounded to the nearest percent.

The percentages of "Yes" are roughly uniform across the academic levels.

Freshman	Sophomore	Junior	Senior	Overall
5% (9/187)	9% (28/303)	10% (27/267)	8% (8/97)	8% (72/854)

These percentages, as potential indicators for level of enrollment in the future, are consistent with the levels of enrollments in other universities offering a similar program according to the data we collected from those places. While the high numbers under "Maybe" across all academic levels and high numbers of "Undecided" at freshman and sophomore levels seem to be encouraging indicators for potential recruitment into the proposed program in the future, it should be made clear that this is not a program that easily attracts a large number of potential recruits. The overall percentage of "Yes" given above would be considered to be a good approximation with regard to the future pool of potential recruits into the program.

**Table 3: Would the actuarial program interest you or would it have interested you had it been available when you enrolled at Oakland University?**

		Yes	Maybe	No	Total
Freshman	Business	4% (10)	4% (24)	0	4% (34)
	Economics	0	0	0	0
	Engineering	3% (9)	7% (43)	22% (2)	6% (54)
	Mathematics	0% (1)	0% (2)	0	0% (3)
	Science and others	2% (6)	5% (29)	0	4% (35)
	Undecided	6% (15)	8% (44)	22% (2)	7% (61)
	<b>Total</b>	<b>15% (41)</b>	<b>25% (142)</b>	<b>44% (4)</b>	<b>21% (187)</b>
Sophomore	Business	15% (39)	14% (80)	0	14% (119)
	Economics	1% (2)	1% (4)	0	0% (6)
	Engineering	6% (17)	6% (45)	11% (1)	7% (63)
	Mathematics	1% (3)	2% (9)	0	1% (12)
	Science and others	2% (5)	4% (22)	11% (1)	3% (28)
	Undecided	9% (23)	9% (52)	0	9% (75)
	<b>Total</b>	<b>33% (89)</b>	<b>37% (212)</b>	<b>22% (2)</b>	<b>34% (303)</b>
Junior	Business	14% (38)	14% (80)	11% (1)	14% (119)
	Economics	2% (5)	1% (6)	0	1% (11)
	Engineering	8% (21)	7% (42)	11% (1)	7% (64)
	Mathematics	5% (13)	1% (4)	0	2% (17)
	Science and others	2% (4)	3% (18)	0	3% (22)
	Undecided	5% (14)	3% (20)	0	4% (34)
	<b>Total</b>	<b>36% (95)</b>	<b>29% (170)</b>	<b>22% (2)</b>	<b>31% (267)</b>
Senior	Business	6% (17)	3% (19)	11% (1)	4% (37)
	Economics	3% (7)	1% (5)	0	1% (12)
	Engineering	2% (4)	8% (15)	0	1% (12)
	Mathematics	2% (4)	2% (12)	0	2% (16)
	Science and others	3% (8)	1% (7)	0	2% (15)
	Undecided	0% (1)	1% (4)	0	0% (5)
	<b>Total</b>	<b>15% (41)</b>	<b>9% (55)</b>	<b>11% (1)</b>	<b>11% (97)</b>
<b>Total</b>		<b>198</b>	<b>516</b>	<b>140</b>	<b>854</b>

All percentages are rounded to the nearest percent.

As expected, the percentages of “Yes” in this table seem to be on the high side; which is not unexpected considering the nature of the question being asked.

Note: The analysis above is based on the students who indicated a program interest as asked in Question 4 of the survey. Though not displayed here, the separate table showing the distribution of students not interested in the program shows that most of the students not having interest in the program are mostly sophomores and juniors taking classes in economics and freshmen to juniors taking mathematics classes.



## APPENDIX G

### Budget Forecast

	Year I 2009-10	Year II 2010-11	Year III 2011-12	Year IV 2012-13	Year V 2013-2014
<b>Revenue Variables:</b>					
Enrollments/Students <sup>1</sup>	2	4	6	8	8
Total Credit Hours <sup>2</sup>	60	120	180	240	240
Tuition Rate/Per Credit Hour <sup>3</sup>	\$293.25	\$307.91	\$323.31	\$339.47	\$356.45
<b>Revenue:</b>					
Tuition	\$17,595.00	\$36,949.20	\$58,195.80	\$81,475.20	\$85,548.00
<b>Total Revenue</b>	<b>\$17,595.00</b>	<b>\$36,949.20</b>	<b>\$58,195.80</b>	<b>\$81,475.20</b>	<b>\$85,548.00</b>
<b>Expenses:</b>					
Faculty replacement costs	-	-	-	-	-
Lecturers (SBA)	-	-	\$3,500.00	\$3,550.00	\$3,600.00
Fringes (SBA) (8% of wages)	-	-	\$280.00	\$284.00	\$288.00
Administrator	-	-	-	-	-
Student Labor	-	-	-	-	-
Grad. Assist. (half time) (Math/SBA) <sup>4</sup>	\$2,566.00	\$2,642.00	\$2,722.00	\$2,804.00	\$2,888.00
Fringe benefits	-	-	-	-	-
<b>Total expenses</b>	<b>\$2,566.00</b>	<b>\$2,642.00</b>	<b>\$6,502.00</b>	<b>\$6,638.00</b>	<b>\$6,776.00</b>
<b>Operating Expenses</b>					
Supplies and Services (Math)	\$900.00	\$200.00	\$200.00	\$200.00	\$200.00
Supplies and Services (SBA)	\$200.00	\$100.00	\$100.00	\$100.00	\$100.00
Tuition <sup>4</sup> (half time GA) (Math/SBA)	\$4,464.00	\$4,688.00	\$4,922.00	\$5,168.00	\$5,426.00
Travel (Math/SBA) <sup>4,5</sup>	\$2,400.00	\$2,500.00	\$2,600.00	\$2,700.00	\$2,800.00
Telephone	-	-	-	-	-
Equipment	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Library <sup>6</sup>	\$ 1,565.00	\$ 1,704.00	\$ 1,856.00	\$ 2,022.00	\$ 2,204.00
<b>Total Operating Expenses</b>	<b>\$9,529.00</b>	<b>\$9,192.00</b>	<b>\$9,678.00</b>	<b>\$10,190.00</b>	<b>\$10,730.00</b>
<b>Total Expenses</b>	<b>\$12,095.00</b>	<b>\$11,834.00</b>	<b>\$16,180.00</b>	<b>\$16,828.00</b>	<b>\$17,506.00</b>
Net Income/Loss	\$5,500.00	\$25,115.20	\$42,015.80	\$64,647.20	\$68,042.00
Total Available for Distribution	\$5,500.00	\$25,115.20	\$42,015.80	\$64,647.20	\$68,042.00
Net Income Percentage	31%	68%	72%	79%	80%

<sup>1</sup>Enrollment projections are based on 2 net new students (out of 5) per year with four years to complete the degree. These headcounts are divided equally between The Department of Mathematics and Statistics and the Department of Economics.

<sup>2</sup>Credit hours are based on each student taking 30 credits (8 courses since many SBA courses are 3 credits) per academic year.

<sup>3</sup>Tuition rate is based on undergraduate upper division AY 2008-09, 0% increase in 2009-10, and 5% per year thereafter

<sup>4</sup>Split evenly between Math and SBA, incremented 3% per year.

<sup>5</sup>Faculty travel to other Actuarial programs, or conferences, and student travel to present papers at meetings such as Michigan Academy of Sciences

<sup>6</sup>See the library proposal below.

Since the Encyclopedia of Actuarial Sciences is updated every four years, there is a periodic spike in the library budget. To remedy this situation, we propose a consistent book/encyclopedia budget for each year and that this be devoted entirely to the Encyclopedia of Actuarial Sciences every fourth year. Appendix C, Library Materials Budget, appearing in Appendix A of this document, is revised as follows.

### Library Materials Budget

	Year 1	Year 2	Year 3	Year 4	Year 5
Journal subscriptions <sup>1</sup>	\$ 715	\$ 787	\$ 865	\$ 952	\$ 1,047
Books <sup>2</sup>	\$ -	\$ 367	\$ 386	\$ 405	\$ -
Encyclopedia of Actuarial Sciences (online) <sup>2</sup>	\$ 350	\$ -	\$ -	\$ -	\$ 425
Support for current e-journal packages <sup>1</sup>	\$ 500	\$ 550	\$ 605	\$ 666	\$ 732
<b>Total</b>	<b>\$ 1,565</b>	<b>\$ 1,704</b>	<b>\$ 1,856</b>	<b>\$ 2,022</b>	<b>\$ 2,630</b>

<sup>1</sup>Presumes 10% annual inflationary increase

<sup>2</sup>Presumes 5% annual inflationary increase

## Appendix H

### Description of the Actuarial Profession

The following is excerpted from the *Occupational Outlook Handbook* of the Bureau of Labor Statistics, U.S. Department of Labor:

Actuaries determine future risk, make price decisions, and formulate investment strategies. Some actuaries also design insurance, financial, and pension plans. Most actuaries specialize in life and health or property and casualty insurance; others work primarily in finance or employee benefits. Some use a broad knowledge of business and mathematics in investment, risk classification, or pension planning.

Regardless of specialty, actuaries assemble and analyze data to estimate probabilities of an event taking place, such as death, sickness, injury, disability, or property loss. They also address financial questions, including those involving the level of pension contributions required to produce a certain retirement income level or how a company should invest resources to maximize return on investment in light of potential risk. Moreover, actuaries may help determine company policy and sometimes explain complex technical matters to company executives, government officials, shareholders, policyholders, or the public in general. Also help companies develop plans to enter new lines of business or new geographic markets with existing lines of business by forecasting demand in competitive settings.

Most actuaries are employed in the insurance industry, in which they estimate the amount a company will pay in claims. For example, property/casualty actuaries calculate the expected amount of claims resulting from automobile accidents, which vary depending on the insured person's age, sex, driving history, and other factors. Actuaries ensure that the price, or premium, charged for such insurance will enable the company to cover claims and other expenses. This premium must be profitable and yet competitive with other insurance companies.

Actuaries employed in other industries perform several different functions. The small but growing group of actuaries in the financial services industry, for example, manages credit and helps price corporate security offerings. Actuaries increasingly help financial institutions manage the substantial risks associated with annuities and asset management services. Actuaries employed as pension actuaries enrolled under the provisions of the Employee Retirement Income Security Act of 1974 evaluate pension plans covered by that act and report on their financial soundness to plan members, sponsors, and federal regulators. Actuaries working in government help manage social programs such as Social

and personal injury liability. The examinations administered by the SOA are jointly sponsored by the American Academy of Actuaries (AAA), the Conference of Consulting Actuaries (CCA), the CIA, and the SOA. The CAS jointly sponsors and administers Courses 1–4 (the Preliminary Actuarial Exams) with the SOA. These first examinations cover the foundations of actuarial science, interest theory, economics, finance, and actuarial models and modeling.

According to the SOA and CAS information brochures, many prospective actuaries with concentration mostly in mathematics and business begin taking exams while in college with the aid of self-study courses jointly offered by the CAS and SOA. While applicants for beginning actuarial jobs usually have a bachelor's degree in mathematics, actuarial science, statistics, or a business-related discipline such as economics, finance, or accounting, some companies hire applicants without specifying a major, provided that the applicant has a working knowledge of mathematics and has demonstrated this ability by passing one or more actuarial exams required for professional designation. It is also mentioned that those who pass one or more exams have better opportunities for employment at higher starting salaries than those who do not. In light of their advice to prospective actuaries to complete the entire series of examinations as soon as possible, advancing to the associate level, and then to the fellowship level, our program, requiring students to take the first exam in calculus and probability during their junior year and the second exam in economics, finance, and investments during their senior year, seems to be in the right direction.

## Appendix I

### RUBRICS FOR STUDENT ASSESSMENT OF THE ACTUARIAL PROGRAM

#### Learning Goal: Critical Thinking

#### Critical Thinking Rubric

Learning Objectives  Scores	Does Not Meet Expectations  1	Meets Expectations  2	Exceeds Expectations  3
Identify assumptions and/or context.	None or only minor ones identified.	Most important ones identified.	Most or all major ones and some minor ones identified.
Identify relevant and irrelevant information.	None or only some minor relevant information identified. Failed to identify irrelevant information.	Most important ones identified.	Most or all major ones and some minor ones identified.
Identify different questions or approaches.	Unable to identify or only some identified with weak descriptions.	Most important ones identified and described.	Most or all major and minor ones identified with descriptions.
Derive or describe solution.	Incorrect or partially correct solutions.	Correct analysis. Adequate knowledge and competence demonstrated.	Correct analysis. Superior or mastery of knowledge and competence demonstrated.
Conclusions.	Incorrect conclusion reached or conclusions not well supported by analysis.	Conclusions logically follow from analysis and major ones identified.	Conclusions logically follow from analysis and most or all are identified.

## Learning Goal: Communications Skills

### Written Communications Skills Rubric

<b>Learning Objectives Scores</b>	<b>Does Not Meet Expectations 1</b>	<b>Meets Expectations 2</b>	<b>Exceeds Expectations 3</b>
Be able to articulate main concepts in writing.	Main points have not been communicated.	Main points have been communicated.	Everything in the written document is related to the main concepts in a clear way.
Be able to write logically.	Unable to follow the argument.	Possible to follow argument.	Easy to follow argument.
Be able to write clearly and concisely.	Unable to write clearly and concisely.	Able to get the sense of the author's meaning.	Clear and easy to understand.
Be able to write using correct grammar and spelling.	Many grammatical and/or spelling mistakes.	Very few grammatical and/or spelling mistakes.	No grammatical and no spelling mistakes.

### Oral Communications Skills Rubric

<b>Learning Objectives Scores</b>	<b>Does Not Meet Expectations 1</b>	<b>Meets Expectations 2</b>	<b>Exceeds Expectations 3</b>
Be able to articulate main concepts orally.	Main points have not been communicated.	Main points have been communicated.	Everything in the oral presentation is related to the main concepts in a clear way.
Be able to speak coherently.	Unable to follow the argument.	Possible to follow the argument.	Easy to follow the argument.
Be able to keep audience's attention.	Unable to capture audience's attention at all.	Catches audience's attention, but loses it at times.	Catches and keeps audience's attention.
Be able to use time effectively.	Wastes most of the time.	Uses time somewhat effectively.	Uses time effectively.

## Learning Goal: Information Technology Skills

### Information Technology Skills Rubric

Learning Objectives Scores	Does Not Meet Expectations 1	Meets Expectations 2	Exceeds Expectations 3
Create a professional document using a word processor.	Unable to create complex documents containing elements such as headers and footers containing fields, table of contents, end notes, tables, embedded objects from other software applications.	Able to create complex documents containing elements such as headers and footers containing fields, table of contents, end notes, tables, embedded objects from other software applications.	Able to use various features to facilitate document sharing, use of comments and other markup elements, and document metadata.
Conduct research using the Internet.	Unable to gather relevant information.	Able to find relevant information.	Able to find information of highest relevancy.
Create an effective presentation using a presentation package.	Unable to create an effective presentation.	Able to create an effective presentation with propose use of layout, format, animation, and graphics and images.	Able to create an effective presentation with advanced features such as embedding objects from other applications.
Collect and analyze data using a spreadsheet.	Unable to use common statistical, financial, logical, date/time, text and lookup functions to address common business spreadsheet development needs.	Able to use common statistical, financial, logical, date/time, text and lookup functions to address common business spreadsheet development needs.	Able to manipulate data using import/export, sort, filter, pivot tables, web queries, integration with Access, spreadsheet modeling.
Use a database software.	Unable to do basic relational database design including fields, tables, keys, and relationships.	Able to create queries involving record selection, calculated fields, sort, aggregation (sum, average, etc.), crosstabs, and action queries (delete, append, update).	Able to create basic forms and reports creation and basic database application development using macros.

## Learning Goal: Knowledge Within Disciplines

### Knowledge Within Disciplines Rubric

<b>Learning Objectives Scores</b>	<b>Does Not Meet Expectations 1</b>	<b>Meets Expectations 2</b>	<b>Exceeds Expectations 3</b>
Understands Economics (assessment of VEE requirement).	Does not have a grasp of many of the required economic principles.	Can apply most of the required economic principles.	Can apply all of the required economic principles and has a deeper understanding of many.
Understands Applied Statistics (assessment of VEE requirement).	Does not have a grasp of many applied statistical concepts that are required.	Is able to apply most of the applied statistical concepts that are required.	Is able to apply all of the applied statistical concepts that are required and has a deeper understanding of many.
Understands Corporate Finance (assessment of VEE requirement).	Does not have a grasp of many of the required corporate finance concepts.	Can apply most of the required corporate finance concepts.	Can apply all of the required corporate finance concepts and has a deeper understanding of many.
Understands Financial Mathematics.	Not able to pass the Financial Mathematics Actuarial exam in two attempts.	Passed the Financial Mathematics Actuarial exam in second attempt.	Passed the Financial Mathematics Actuarial exam on first attempt.
Understands Probability.	Not able to pass the Probability Actuarial exam in two attempts.	Passed the Probability Actuarial exam in second attempt.	Passed the Probability Actuarial exam on first attempt.