A. Summary

**Actuarial science** is the discipline that applies mathematical and statistical methods to assess risk in the insurance and finance industries. Actuarial science includes a number of interrelating subjects, including probability and statistics, finance, and economics. Historically, actuarial science used deterministic models in the construction of tables and premiums. The science has gone through revolutionary changes during the last 30 years due to the proliferation of high speed computers and the synergy of stochastic actuarial models with modern financial theory.

Actuaries are professionals who are qualified in this field through education and experience. The core function of an actuary's job is to assess and quantify financial/economic risk. As the financial crisis spreads over the world, the demand for professionals who manage the financial/economic risk is more and more desirable. In the United States, Canada, the United Kingdom, and several other countries, actuaries must demonstrate their qualifications by passing a series of professional examinations.

Many universities have undergraduate and graduate degree programs in actuarial science. In 2002, a Wall Street Journal survey on the best jobs in the United States listed "actuary" as the second best job. As it is increasingly viewed as a desirable career by students in the mathematical sciences, the high starting salaries, which reflect the rigorous and lengthy training demanded of the prospective actuary, are part of the reason for this interest. This training requires one to pass a series of established (society) exams, leading to the two major milestones of: **Associateship** (at least 5 exams), and **Fellowship** (several more exams). For life, health, and pension actuaries, exams are given by the Society of Actuaries (SOA). For property and casualty actuaries, the exams are administered by the Casualty Actuarial Society (CAS).

The department of Mathematics, Computer Science, and Software Engineering has noticed the need in the job market. A course MTH3050, Mathematics of Finance was developed by Kathy Zhong many years ago to help students in the actuarial track. This course was refined and promoted throughout the university last year. However, due to low enrollment, it did not run. The low enrollment could be caused by the unfamiliarity of the nature and content of the course. Since some corporations expressed interest to recruit our students who want to pursue a career in this direction, we realized that it is necessary to establish a minor in Actuarial Science. This will provide students the opportunity to obtain formal training and receive guidance in preparing for a career in Actuarial Science.
B. DESCRIPTION OF THE MINOR:

1. CATALOG DESCRIPTION:

Actuarial Science stands at the intersection of risk management and financial management. Actuaries use their knowledge of mathematics and probability theory to define, analyze and solve complex business, financial and social problems. Actuaries evaluate individual and corporate risks, and design financially sound insurance and investment plans. An actuary minor offers a blend of courses in statistics, business and economics. Graduates with actuarial education are expected to be in great demand by the insurance and banking industry.

2. MINOR REQUIREMENTS

The Minor in Actuarial Science consists of six courses (a total of 18 credit hours) in the areas of mathematical statistics, finance of mathematics, economy and business management. The required courses are given below in Table 1.

Students can select either of the two business courses to satisfy their business requirement. In addition, students are required to take at least one recitation session depending on the SOA exam they register for. The selection of these courses is based on the initial needs and requirement from employers.

All courses are taken from the current offerings of the Department of Mathematics, Computer Science, and Software Engineering, the College of Liberal Arts and Education, and the College of Business. Qualified faculty members will teach the sections which include exam preparation recitations.

Table 1: Required Courses and Credits for Actuarial Minor

<table>
<thead>
<tr>
<th>Prefix</th>
<th>Num</th>
<th>Title</th>
<th>Credits</th>
<th>Prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>1*</td>
<td>MTH</td>
<td>3050 Mathematics of Finance</td>
<td>3</td>
<td>MTH1120 or MTH1420</td>
</tr>
<tr>
<td>2**</td>
<td>MTH</td>
<td>4270 Applied Probability and Statistics</td>
<td>3</td>
<td>MTH1120 or MTH1420</td>
</tr>
<tr>
<td>3</td>
<td>MTH</td>
<td>4590 Mathematical Model Building</td>
<td>3</td>
<td>MTH1120 or MTH1420</td>
</tr>
<tr>
<td>4</td>
<td>BUS</td>
<td>3130 Financial Management</td>
<td>3</td>
<td>ACCT2010 or ECN2950; MTH2140 or MTH4270</td>
</tr>
<tr>
<td></td>
<td>BUS</td>
<td>3150 Quantitative method for decision-making</td>
<td>3</td>
<td>MTH2140 or MTH4270; MTH1120 or MTH1420</td>
</tr>
<tr>
<td>5</td>
<td>ECN</td>
<td>2950 Microeconomic Principles</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>ECN</td>
<td>2960 Macroeconomic Principles</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

* includes additional recitation section for SOA Exam FM/1
** includes additional recitation section for SOA Exam P/1
COURSE DESCRIPTIONS

MTH3050 Mathematics of Finance, 3 credits.
Prerequisite: MTH1120 or MTH 1420.
Measurement of interest; nominal and effective interest; force of interest; present value factor; annuities; amortization schedules and sinking funds; reinvestment rates; bonds and other securities.

Recitation for SOA Exam FM/2. Taken with MTH 3050.
This course will focus on the preparation for Actuarial Exam FM/2, Financial Mathematics, which one of the first few exams toward the associateship of the Society of Actuarial (SOA) or the Casualty Actuarial Society (CAS). Students will practice on past exam problems arranged according to the progress of the course MTH3050.

MTH4270 Applied Probability and Statistics, 3 credits.
Prerequisite: MTH 1420.
Introductory probability theory; elements of sampling and descriptive statistics; sampling distributions; estimations and hypothesis testing; regression and correlation analysis; computer laboratory using a statistical software package.

Recitation for SOA Exam P/1. Taken with MTH4270.
This course will focus on the preparation for Actuarial Exam P/1, Probability, which one of the first few exams toward the associateship of the Society of Actuarial (SOA) or the Casualty Actuarial Society (CAS). Students will practice on past exam problems arranged according to the progress of the course MTH4270.

MTH4590 Principles of Model Building, 3 credits. Prerequisite: MTH1420.
Introduction to the ideas of a mathematical model and model building, linear programming models, game-theoretic models, regression analysis models. Applications in business, ecology, psychology, sociology, and political science.

BUS3130 Financial Management, 3 credits. Prerequisites: MTH2140, ACCT2010, ECN2950
An introduction to the concepts and techniques employed to manage the financial resources of the firm. Major topics include: working capital management, capital expenditure analysis, valuation of the firm, dividend policy and sources of capital.

Bus3150 Quantitative Methods for Decision-Making, 3 credits. Prerequisite: MTH2140, MTH1120
Concepts, techniques and applications of quantitative methods for decision making are introduced. Topics include: forecasting, regression analysis, analysis of variance, statistical decision theory, utility theory, linear programming and waiting lines. The course incorporates computer software packages.
ECN 2950 Microeconomic Principles, 3 credits.
Study of the scope and method of economics. The course focuses on: the allocation of resources and economic efficiency in production, demand and supply in consumption, pricing system, competition and monopoly, the pricing of factor services, and the distribution of income.

ECN 2960 Macroeconomic Principles, 3 credits
Study of the scope and method of economics. Course topics include: measures and determinants of the level of aggregate income and demand, inflation, employment, economic development; monetary institutions and money supply, monetary policy; taxes, government borrowing; expenditures, fiscal policy, international trade and alternative systems of economic organization.

3. IMPACT OR EFFECT ON THE RELATED DEPARTMENT

The addition of the minor will enrich the programs of the department of Mathematics and Computer Science. It provides more options for students which in turn will attract more students to the university.

C. MISSION

The Mathematics and Computer Science Department stresses the importance of social responsibility, community service, spiritual and ethical commitment, as well as academic excellence in the courses and programs offered. Especially, ethical issues of the mission will be emphasized throughout the courses so that the students realize their role in the future work places since these students will be managing risks. Faculty members model the mission of the University through their approachability, their availability, and the supportive atmosphere they create both inside and outside of class. This care will be a central feature of the mathematics minor as well as the major.

D. MINOR OBJECTIVES AND OUTCOMES

1. MINOR OBJECTIVE

- Introduce basic knowledge of probability and statistics, mathematical finance.
- Provide the knowledge of economy in the micro and macro aspects
- Prepare students to take at least one actuarial exam.
- Prepare students for further studies or employment in the actuarial field
- Enable students to gain practical experience in actuarial science through internships, independent projects, or research.
2. MINOR OUTCOMES

Upon completion of the Actuarial Science Minor, students will be able to:

- demonstrate a basic understanding of probability and statistics by their ability to solve a variety of exam problems.
- correctly solve a variety of actuarial science problems using both basic and advanced mathematical techniques.

3. MINOR ASSESSMENT

Assessment of the Actuarial Science minor employs a combination of assessment procedures used by the department of mathematics and computer science, and mirrors what is being done in the other programs offering actuarial minor:

- Students are required to take at least one actuarial exam (Exam P/1 or FM/2). However, passing of the exams is not required to obtain the minor. The best timing will be within 3 months of finishing MTH3050 or MTH4270. Exam P/1 is offered 6 times a year and Exam FM/2 is offered 3 times a year. Both exams are administrated jointly by SOA and CAS. The minor advisor, usually a faculty member of the Department of Mathematics, Computer Science, and Software Engineering, is responsible to verify that the requirement is fulfilled.
- The advising worksheet in the appendix is used as a tool to track the progress of a student in the Actuarial minor. The data collected can be used to assess the program.
- In addition to the advising sheet, a data base can be set up to keep track of the information of students’ first employment after graduation. Such data can be analyzed and used to assess the minor.

4. RESTRICTIONS

1. Students must have at completion a cumulative 2.0 grade point average in all minor courses in order for the minor to be posted on the official transcript at the time of graduation.
2. At least 12 credits (or 4 courses) of the courses required for the minor must be taken at UDM unless the courses are taken as part of a consortium agreement.
3. The minor is most beneficial for students from Mathematics, Computer Science, Engineering, Economy, and Business. However, any student fulfilling the prerequisites of the Minor’s courses may enroll in the Minor in Actuarial Science with the approval of the Department.
E. JUSTIFICATION

1. REQUIRED RESOURCES

As all the courses needed for the minor are currently included in the course offering of the departments in different colleges, no new course needs to be developed. The recitations will be included in separate sections of MTH3050 and MTH4270; these sections may be cross-listed with “normal” sections of the courses.

No additional facilities or equipment are required in order to provide this minor. In addition, no faculty is needed to be hired exclusively for this minor. It is not believed the creation of a minor will place any resource strain on any department.

2. FACULTY ADVISOR

The faculty advisors for this minor will be faculty from the Department of Mathematics and Computer Science. They will:

- Inform and advise students about the minor
- Monitor the implementation of the minor and recommend future improvements
- Create the Minor Advising Worksheet and ensure its presence in students’ files
- Confirm the completion of the minor including taking at least one actuarial exam
- Participate in promoting the minor inside and outside the University
- Contact potential employers with internship opportunities
- Inform students and advise students to take advantage of the internship

3. CHANGES TO THE MINOR

Any future modifications to the minor are subject to the same review procedure as other minors offered by the Department, which are overseen by the Mathematics Curriculum Committee and the administration of the E&S college.

Appendix: Minor Advising Worksheet

The Advising sheet below will be used by the Department of Mathematics to track student’s progress.
Name of Student ______________________________________________________
Student ID____________________________ Major__________________________
Telephone_____________________________ E-Mail_________________________

Courses Completed for the minor:

<table>
<thead>
<tr>
<th>#</th>
<th>Prefix</th>
<th>Number</th>
<th>Title</th>
<th>Credits</th>
<th>Grade</th>
<th>Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>MTH</td>
<td>3050</td>
<td>Mathematics of Finance with recitation</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>MTH</td>
<td>4270</td>
<td>Applied Probability and Statistics with recitation</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>MTH</td>
<td>4590</td>
<td>Mathematical Model Building</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>BUS</td>
<td>3130 or 3150</td>
<td>Financial Management or Quantitative Methods for Decision-Making</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>ECN</td>
<td>2950</td>
<td>Microeconomic Principles</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>ECN</td>
<td>2960</td>
<td>Macroeconomic Principles</td>
<td>3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Actuarial Exam (FM/1)
Actuarial Exam (P/1)

GPA for the Minor________________________
Total Credits for Major________________________
Total Credits_______________________________

(Signature of Minor Advisor) ________________________________ (Date) ____________________________