

(NEW GRADUATE INITIATIVES)

PROPOSAL PROCEDURES CHECKLIST

Academic units should adhere to the following procedures when requesting new curricular initiatives (degrees, concentrations or certificates).

- Obtain the required approval from the Office of the Provost to move the initiative forward for internal ASU governance reviews/approvals. Please see the academic strategic plan website at: <https://provost.asu.edu/curriculum-development>.**
- Submit any new courses that will be required for the new curricular program to the Curriculum ChangeMaker online course approval system for review and approval.**
 - Additional information can be found at the Provost's Office Curriculum Development website: [Courses link](#)
 - For questions regarding proposing new courses, send an email to: courses@asu.edu
- Prepare the applicable proposal template and operational appendix for the proposed initiative.**
- Obtain letters or memos of support or collaboration (if applicable).**
 - when resources (faculty or courses) from another academic unit will be utilized
 - when other academic units or degree programs may be impacted by the proposed request
 - if the program will have an online campus option support will be required from the Provost's office and ASU Online. *(Please complete the ASU Online Offering form in [Curriculum ChangeMaker](#) to begin this request.)*
- Obtain the internal reviews/approvals of the academic unit.**
 - internal faculty governance review committee(s)
 - academic unit head (e.g. Department Chair or School Director)
 - academic unit Dean or their designee (will submit approved proposal to the curriculumplanning@asu.edu email account for further ASU internal governance reviews (as applicable, University Graduate Council, CAPC and Senate)

Additional Recommendations

All new graduate programs require specific processes and procedures to maintain a successful degree program. Below are items that the Graduate College strongly recommends that academic units establish after the program is approved for implementation.

- Establish satisfactory academic progress policies, processes and guidelines** – Check within the proposing academic unit and/or college to see if there are existing academic progress policies and processes in place. If none have been established, please go to http://graduate.asu.edu/faculty_staff/policies and scroll down to the **academic progress review and remediation processes** (for faculty and staff) section to locate the reference tool and samples for establishing these procedures.
- Establish a Graduate Student Handbook for the new degree program** – Students need to know the specific requirements and milestones they must meet throughout their degree program. A Graduate Student Handbook, provided to students when they are admitted to the degree program and published on the website for the new degree, gives students this information. To be included in the handbook are the unit/college satisfactory academic progress policies, current degree program requirements (outlined in the approved proposal) and a link to the Graduate Policies and Procedures website: http://graduate.asu.edu/faculty_staff/policies.

This template is to be used only by programs that have received specific written approval from the University Provost's Office to proceed with internal proposal development and review. A separate proposal must be submitted for each individual new degree program.

DEGREE PROGRAM

College/School: College of Liberal Arts and Sciences

Note: Program ownership is coded at the College/School level first and may not be a center, department or division apart from it.

Department/Division/School: School of Mathematical and Statistical Sciences

Proposing faculty group (if applicable):

Name of proposed degree program: Master of Science (MS) in Actuarial Science

Proposed title of major: Actuarial Science

Master's degree type: MS - Master of Science

If Degree Type is "Other", provide degree type and proposed abbreviation: N/A

Is a program fee required? No, a program fee is not required.

Note: for more information about program fee requests, visit <https://provost.asu.edu/curriculum-development/changemaker/form-instructions#fees>

Is the unit willing and able to implement the program if the fee is denied? N/A

Requested effective term and year: Fall 2018

(The first semester and year for which students may begin applying to the program)

PROPOSAL CONTACT

Name: Al Boggess **Title:** Director and Professor


Phone number: 480-965-0195 **Email:** boggess@asu.edu

DEAN APPROVAL(S)

This proposal has been approved by all necessary unit and college/school levels of review, and the college/school(s) has the resources to offer this degree program. I recommend implementation of the proposed degree program.

Note: An electronic signature, an email from the dean or dean's designee, or a PDF of the signed signature page is acceptable.

College/School/Division Dean name: Kenro Kusumi

Signature:  **Date:** 4-13-2017

College/School/Division Dean name:
(if more than one college involved)

Signature: **Date:**

This proposal template should be completed in full and submitted to the University Provost's Office [mail to: curriculumplanning@asu.edu]. It must undergo all internal university review and approval steps including those at the unit, college, and university levels. A program **may not** be implemented until the Provost's Office notifies the academic unit that the program may be offered.

1. PURPOSE AND NATURE OF PROGRAM

A. Provide a brief program description

This MS program, which may be completed in 12 months, in actuarial science will build on the strength, experience, and reputation of ASU. Actuarial science involves applying mathematical and statistical concepts to the disciplines of risk management, finance, and insurance. While keeping the core technical learning outcomes in place, it will also include a new focused set of professional learning outcomes aligned with the needs of the ever evolving insurance industry. These will guide students' development of professional competencies through coursework, independent projects, and opportunities outside of the classroom, while remaining firmly based on a strong foundation of scholarly technical work in actuarial science. It will emphasize broad awareness and appreciation of current issues faced by insurance industry practitioners as well as innovative resolutions provided by actuaries. The resulting degree will be valued and respected a confirmation of both the high quality training and the integrity and relevance of the graduate.

Actuaries must pass a series of intensive professional exams to become credentialed, and this degree program prepares students for these credentialing exams. These credentialing exams are not required for the degree, but prepare students for certification and allow for membership in the Society of Actuaries (SOA) and the Casualty Actuarial Society (CAS).

Actuaries enjoy an excellent starting salary, exceptional job security with numerous opportunities for career growth. Working in areas such as health, life, property and casualty insurance, and pensions, actuaries assist in identifying, mitigating, and pricing risk for various insurance products. They also work in non-traditional areas such as banking and infrastructure. They may also work with companies to determine levels of risk in various aspects associated with reaching their developed goals.

B. Will concentrations be established under this degree program? Yes No

(Please provide additional concentration information in the curricular structure section – number 7.)

2. PROGRAM NEED

Explain why the university should offer this program (0).

There is a clear demand for a graduate degree in actuarial science in the western hemisphere. The only competitor would be in California. The University of Southern California in Santa Barbara is the only institution which offers a graduate degree in actuarial science. A small number of other schools offer concentrations in actuarial sciences, but would not be of this level. The programs that do exist are traditional programs over two years. The proposed program is more applied in nature and is designed to be able to be completed in one year.

As such, a graduate degree in actuarial science would prepare students with already completed undergraduate degrees in mathematics, statistics, or related fields for a variety of actuarial or analytical roles by including preparation for passing multiple professional credentialing exams administered by the Society of Actuaries and the Casualty Actuarial Society. This degree will provide a perfect medium for on-going interaction with the insurance industry through continuing education programs, internships and placement of graduates in the industry.

3. IMPACT ON OTHER PROGRAMS

Attach any letters of collaboration or support from impacted programs (see checklist coversheet). Please submit as a separate document.

Attached are impact statements from the following Colleges:

W. P. Carey, Thunderbird, Fulton Engineering, New College, and the College of Integrative Arts and Sciences.

Departmental Response to WP Carey Approval

SoMSS has met with our counterparts in Finance and believe that our proposed courses will concentrate much more heavily on the mathematics that underlies the finance. Thus the proposed classes are significantly different than those offered by WPC. In particular, all the B-list classes (Appendix III) cover material that is essential to the mathematically-oriented credentialing exams for the actuarial profession as offered by the Society of Actuaries and the Casualty Actuarial Society. Positive student outcomes on these exams are essential for students to gain employment. The content of these exams vary each year and the actuarial faculty (who have taken these exams) strive to keep current on exam content. It is essential that the teaching of these courses are handled by actuarial science faculty in SoMSS.

With regard to the A-list classes (Appendix III), SoMSS would be willing to consider cross-listing one or more of the proposed ACT 57X classes with the Finance Department provided they agree to teach sections of these courses at the high level of mathematical rigor that is demanded by the actuarial profession and coordinate carefully with SoMSS. Further dialogue will be needed with the appropriate faculty members in both units before agreeing to any arrangements.

4. PROJECTED ENROLLMENT

How many new students do you anticipate enrolling in this program each year for the next five years?

Note: The Arizona Board of Regents (ABOR) requires that nine master's degrees be awarded every three years. Thus, the projected enrollment numbers must account for this ABOR requirement.

5-YEAR PROJECTED ANNUAL ENROLLMENT					
Please utilize the following tabular format	1st Year	2nd Year (Yr. 1 continuing + new entering)	3rd Year (Yr. 1 & 2 continuing + new entering)	4th Year (Yrs. 1, 2, 3 continuing + new entering)	5th Year (Yrs. 1, 2, 3, 4 continuing + new entering)
Number of Students Majoring (Headcount)	13	20	27	35	43

5. ACCREDITATION OR LICENSING REQUIREMENTS (if applicable)

Provide the names of the external agencies for accreditation, professional licensing, etc. that guide your curriculum for this program, if any. Describe any requirements for accreditation or licensing.

Completion of this degree will successfully prepare students to pass professional exams required of the Society of Actuaries (SOA) and Casualty Actuarial Society (CAS). Both the SOA and the CAS are the two governing societies for the actuarial science profession in the United States. Health and life insurance actuaries become members of the SOA while casualty and property actuaries become member of the CAS. Membership in these associations involves passing varying amounts of professional exams, course completion, and modules. Some exam topics include probability, financial mathematics, financial economics, accounting, corporate finance, predictive analytics, ratemaking and reserving, and short and long term actuarial modeling.

6. STUDENT LEARNING OUTCOMES AND ASSESMENT

- A. List the knowledge, competencies and skills** students should have attained by graduation from the proposed degree program. (Examples of program Learning Outcomes can be found at <https://uoeee.asu.edu/>. Go to the Assessment accordion dropdown and select Assessment Plan to view sample outcomes.)

Graduates of the MS in Actuarial Science will:

1. Analyze contingent cash flows with a combination of mathematical and statistical modeling techniques according to economic and financial principles as applied to real life insurance data.
2. Be well prepared for all the preliminary actuarial exams jointly administered by the Society of Actuaries (SOA) and the Casualty Actuarial Society (CAS).
3. Will be able to utilize traditional and non-traditional predictive analytics to analyze large insurance data sets.
4. Will utilize current industry-adopted statistical software (R) to analyze large insurance data.

- B. Describe the plans and methods to assess** whether students have achieved the knowledge, competencies and skills identified in the Learning Outcomes listed above. Please list measures and scales for each outcome. (You can find examples of assessment methods at <https://uoeee.asu.edu/>. Go to the Assessment accordion dropdown and select Assessment Plan to view sample measures.)

Outcome 1: Analyze contingent cash flows with a combination of mathematical and statistical modeling techniques according to economic and financial principles as applied to real life insurance data.

- 1a) 70% of students will earn a grade of B or better in their final project for ACT 593: Applied Project
- 1b) 70% of students will report that their education helped prepare them for success in their career in a post-graduation survey.

Outcome 2: Be well prepared for all the preliminary actuarial exams jointly administered by the Society of Actuaries (SOA) and the Casualty Actuarial Society (CAS).

- 2a) 70% of students will pass at least one actuarial credentialing exam.
- 2b) 30% of students will pass at least two actuarial credentialing exams.

Note: 30% completion of two credentialing exams is seen as ambitious given the timeline for degree completion.

Outcome 3: Will be able to utilize traditional and non-traditional predictive analytics to analyze large insurance data sets.

- 3a) 70% of students will get a B or higher in the final assessment project in ACT 560.
- 3b) 70% of students will get a B or higher in the final assessment project in ACT 561.

Outcome 4: Will utilize current industry-adopted statistical software (R) to analyze large insurance data.

- 4a) 70% of students will get a B or better in in their final project for ACT 593: Applied Project.
- 4b) 70% of students will report that their education helped prepare them for success in their career in a post graduation survey.

7. Curricular Structure

A. Program Rollout

In total, there are 19 proposed classes, this plan involves an initial roll-out consisting of nine of these classes (plus an internship course) in fall, 2018. As detailed in the attached Addendum (Appendix III), the list of 19 proposed courses includes two core required courses, an A-list and a B-list of electives, and a culminating experience. During our initial roll-out, SoMSS plans to offer the two required core classes plus seven electives either from the A-list (preferred) or the B-list, and the culminating experience or some combination thereof. The A-list is designed for students who have some background in actuarial science and we expect 70% of the applicants for this degree to fit this profile. By contrast, the B-list is designed for the students who have little or no background in actuarial science (but have the necessary mathematical prerequisites) and SoMSS expects 30% of the applicants to fit this profile.

B. Curriculum Listing

Required Core Courses for the Degree			
Prefix and Number	Course Title	New Course?	Credit Hours
ACT 560	Advanced Data Analytics in Insurance I	Yes	3
ACT 561	Advanced Data Analytics in Insurance II	Yes	3
<i>Section sub-total:</i>			6
Elective or Research Courses			
<i>(Students select 7 courses from the list below. Other courses may be used with approval of the academic unit. Only 6 credit hours of 400 level coursework will be allowed on the plan of study per Graduate College policy.)</i>			
Prefix and Number	Course Title	New Course?	Credit Hours
ACT 505	Advanced Models for Enterprise Risk Management	Yes	3
ACT 510	Mathematics of Finance	Yes	3
ACT 515	Probability for Risk Management	Yes	3
ACT 520	Intro to Rate Making and Reserving	Yes	3
ACT 530	Mathematics for Financial Derivatives	Yes	3
ACT 535	Statistics for Risk Modeling	Yes	3
ACT 540	Long Term Actuarial Mathematics I	Yes	3
ACT 541	Long Term Actuarial Mathematics II	Yes	3
ACT 550	Actuarial Models and Modeling I	Yes	3
ACT 551	Actuarial Models and Modeling II	Yes	3
ACT 570	Stochastic Calculus for Finance	Yes	3
ACT 571	Advanced Mathematics and Financial Derivatives	Yes	3
ACT 575	Portfolio Theory and Risk Management	Yes	3
ACT 580	Regulation and Financial Reporting	Yes	3
ACT 584	Internship	Yes	3
ACT 585	Advanced Mortality Modeling and Management of Longevity Risk	Yes	3
ACT 415	Probability for Risk Management	No	3
ACT 430	Mathematics of Financial Derivatives	No	3
ACT 440	Long Term Actuarial Mathematics I	No	3
ACT 441	Long Term Actuarial Mathematics II	No	3
ACT 450	Actuarial Models and Modeling I	No	3
ACT 451	Actuarial Models and Modeling II	No	3
ACT 435	Actuarial Business Forecasting	No	3
ACT 420	Intro to Rate Making and Reserving	No	3

STP 421	Probability	No	3
STP 427	Mathematical Statistics	No	3
<i>Section sub-total:</i>			21
Culminating Experience(s) <i>E.g. – Capstone course, portfolio, written comprehensive exam, applied project, thesis (must be 6 credit hours with oral defense)</i>			Credit Hours
ACT 593: Applied Project			3
<i>Section sub-total:</i>			3
Total required credit hours			30

1. List all required core courses and total credit hours for the core (required courses other than internships, thesis, dissertation, capstone course, etc.).
2. Omnibus numbered courses cannot be used as core courses.
3. Permanent numbers must be requested by submitting a course proposal to Curriculum ChangeMaker for approval. Courses that are new, but do not yet have a new number can be designated with the prefix, level of the course and X's (e.g. ENG 5XX or ENG 6XX).
 - a. **Will concentrations be established under this degree program?** Yes No

8. COURSES

A. Course Prefix(es): Provide the following information for the proposed graduate program.

- i. Will a new course prefix(es) be required for this degree program?
Yes No
- ii. If yes, complete the [Course Prefixes / Subjects Form](#) for each new prefix and submit it as part of this proposal submission.

B. New Courses Required for Proposed Degree Program: Provide course prefix, number, title, credit hours and description for any new courses required for this degree program.

COURSE

ACT 505: Advanced Models for Enterprise Risk Management (3)

Course description: This course provides an introduction to actuarial modeling methods that are used in enterprise risk management. These methods are useful for the quantification of many types of risks faced by businesses and other organizations. Furthermore, these methods look at the correlation between risks that can create unexpectedly large exposures. Students will build risk models for an actual enterprise.

ACT 510: Mathematics of Finance (3)

Course description: Provides an understanding of the fundamental concepts of financial mathematics, and how those concepts are applied in calculating present and accumulated values for various streams of cash flows as a basis for future use in: reserving, valuation, pricing, asset/liability management, investment income, capital budgeting, and valuing contingent cash flows. Topics include: mathematics of compound interest, including annuities certain, amortization schedules, yields curves, sinking funds and bonds. Gives an introduction to financial instruments, including derivatives, and the concept of no-arbitrage as it relates to financial mathematics.

ACT 515: Probability for Risk Management (3)

Course description: The purpose of this course is to develop knowledge of the fundamental probability tools for quantitatively assessing risk. Topics include: introduction to probability concepts, including definition of

probability, independence, conditional probability, random variables, specific discrete and continuous probability distributions, multivariate random variables, moments and moment generating functions, functions of random variables, sampling distributions, and central limit theorem. The application of these tools to problems encountered in actuarial science is emphasized.

ACT 520: Intro to Rate Making and Reserving (3)

Course description: This course provides an introduction to property & casualty ratemaking and reserving techniques, from an actuarial perspective. Ratemaking and loss reserving are the two fundamental functions performed by actuaries, and are necessary for satisfying an organization's strategic, operational, and regulatory goals and requirements.

ACT 530: Mathematics of Financial Derivatives (3)

Course description: The purpose of this course is to develop knowledge of the theoretical basis of certain actuarial models and the application of those models to insurance and other financial risks. Topics include: option pricing, Black-Scholes formula, delta hedging, exotic options, Brownian motion, interest rate models and simulations.

ACT 535: Statistics for Risk Modeling (3)

Course description: This course introduces statistical techniques in business forecasting such as: simple linear regression, multiple linear regression, hypothesis testing and confidence intervals in linear regression models, testing of models, data analysis and appropriateness of models, linear time series models, moving average, regression based and/or ARIMA models, estimation, data analysis and forecasting with time series models, forecast errors and confidence intervals. Analysis of various types of real data using R will be emphasized.

ACT 540: Long Term Actuarial Mathematics I (3)

Course description: This course develops an understanding of the key features of long-term insurance coverages (life, health, and general), annuities, and retirement benefits (pensions, retiree health care, etc.). Students will accumulate knowledge of the theoretical basis of actuarial models and the application of those models to long-term insurance and other financial risks. Topics include: life tables, present value determination for life insurances and annuities and premium calculations.

ACT 541: Long Term Actuarial Mathematics II (3)

Course description: This course focuses on reserving for insurances and annuities for long-term actuarial models including multiple lives and/or multiple decrement models. Furthermore, this course will expose students to different reserving types as well as interpretation of common profit measures. Other topics covered include applications of the long-term models to pension plans and retirement benefits.

ACT 550: Actuarial Models and Modeling I (3)

Course description: This course provides detailed understand of the steps involved in the modeling process and how to carry out these steps in solving business problems. Students will analyze data from an application in a business context, determine a suitable model including parameter values and provide measures of confidence for decision making based on the model. Estimation of parameters for the severity, frequency, and aggregate models and their modifications will be covered.

ACT 551: Actuarial Models and Modeling II (3)

Course description: This course provides detailed understand of the steps involved in the modeling process and how to carry out these steps in solving business problems The student should be able to: analyze data from an application in a business context, determine a suitable model including parameter values, and provide measures of confidence for decision making based upon the model. Topics include: credibility, insurance and reinsurance coverages, pricing and reserving for short-term insurance coverages.

ACT 560: Advanced Data Analytics in Insurance I (3)

Course description: This course provides an introduction to advanced applications of predictive modeling methods for solving actuarial problems. Methods that use the general and generalized linear models are becoming more important in the insurance industry for both traditional actuarial pricing and reserving problems and for marketing and operational problems. This course will prepare students to understand these problems and to gain some experience in analyzing them through projects involving real data. Topics include: linear models, regression with categorical dependent variables, regression with count dependent variables, generalized linear models, frequency and severity models, and others.

ACT 561: Advanced Data Analytics in Insurance II (3)

Course description: This course will expose students to a wide variety of advanced analytics techniques applicable to data types that are routinely found within the insurance industry. Application of data science is rapidly growing in insurance industry and this course will create a long-term knowledge base for students to remain empowered, and in time, master and use more sophisticated emerging techniques. Topics covered include generalized additive models, discriminant analysis, classification and regression trees, bagging, random forests, boosting, Mixture Model-Based Approaches, Spatial models, and others.

ACT 570: Stochastic Calculus for Finance (3)

Course description: This course introduces students to stochastic calculus as foundation for advanced mathematics of financial derivatives. Topics covered include: stochastic calculus, martingales and arbitrage, Black-Scholes equation and pricing derivative securities, and fundamental theorems of asset pricing.

ACT 571: Advanced Mathematics of Financial Derivatives (3)

Course description: This course enables students to apply stochastics calculus to advanced topics in mathematics of financial derivatives. Topics covered include: term structure models, pricing derivative securities, fundamental theorems of asset pricing, models of equity and fixed income markets, and exotic options.

ACT 575: Portfolio Theory and Risk Management (3)

Course description: This course provides an overview of measurement and management of risk and enables students to master the methods and concepts of portfolio theory. Those models and concepts include risk aversion, utility functions as a representation of preferences, efficient frontiers, Markowitz Portfolio theory, the Capital Asset Pricing model, Security Market Line, Value at Risk, and Expected Shortfall, as well as concepts of coherent risk measures.

ACT 580: Regulation and Financial Reporting (3)

Course description: This course provides an overview of insurance regulation with regards to property and casualty coverages, ratemaking, pricing, and solvency, and U.S. tort law as it affects the property and casualty business. Furthermore, this course identifies major U.S. insurance programs administered by government

agencies and insurance industry organizations such as: automobile plans, crop insurance, flood insurance, government backstops, guaranty funds, residential markets (auto, workers comp, property), workers compensation (including interaction with Medicare). While addressing financial reporting, solvency, and taxation issues students will be able evaluate the financial health of an insurance entity by completing specific schedules and exhibits.

ACT 584: Internship (3)

Course description: Structured practical experience following a contract or plan, supervised by faculty and practitioners

ACT 585: Advanced Mortality Modeling and Management of Longevity Risk (3)

Course description: This course will expose students to a wide variety of advanced models for forecasting human mortality. The relevant repositories of mortality data will be explained in the context of application of most used advanced mortality forecasting models. Both discrete time as well as continuous time stochastic mortality models will be presented. Students will also learn about approaches for managing longevity risk via natural hedging, reinsurance, and mortality linked derivatives as well as be exposed to pricing of basic insurance products in the context of advanced mortality models.

ACT 593: Applied Project (3)

Course description: Preparation of a supervised applied project that is a graduation requirement in some professional majors.

E. FACULTY, STAFF, AND RESOURCE REQUIREMENTS

A. Faculty

i. **Current Faculty** – Complete the table below for all current faculty members who will teach in the program.

Name	Rank	Highest Degree	Area of Specialization/Expertise	Estimated Level of Involvement
Jelena Milovanovic	Professor of Practice	PHD	Actuarial Science	Coordinator of Program
John Zicarelli	Professor of Practice	PHD	Actuarial Science	Faculty
Petar Jevtic	Assistant Professor	PHD	Mathematical Finance	Faculty
May Boggess	Associate Professor	PHD	Actuarial Science	Faculty
Matt Hassett	Faculty Associate	PHD	Actuarial Science	Faculty (Part Time)
Ye Zhang	Lecturer	PHD	Actuarial Science	Faculty (Part Time)

ii. **New Faculty** - Describe the new faculty hiring needed during the next three years to sustain the program. List the anticipated hiring schedule and financial sources for supporting the addition of these faculty members.

To functionally operate, the program needs to hire one Professor of Practice and at least one Assistant/Full Professor. The School of Mathematical & Statistical Sciences Director, Al Boggess, has expressed his support these hiring initiatives. These hires will require and are contingent on central funding from CLAS/Provost.

Full implementation of the A-list curriculum (Appendix III) will require an additional two faculty lines – a professor of practice and an assistant professor. The bulk of the development and teaching of these classes will be borne by the professors of practice in the actuarial program – two already on board together with the requested third position. The courses in the B-list (Appendix III) all have undergraduate counterparts (mostly at the 400-level) and thus are mostly developed now and easy to staff with the five faculty members currently in the department. In fact, some master's level students needing these classes may opt to enroll in the undergraduate versions and count up to 6 credit hours of these classes towards their MS degree. Once SoMSS hires the requested two faculty positions, the department will be able to staff both A and B list classes (and offer a few key classes both fall and spring).

- iii. **Administration of the program** - Explain how the program will be administered for the purposes of admissions, advising, course offerings, etc. Discuss the available staff support.

The School of Mathematical and Statistical Sciences is currently hiring a Program Coordinator to assist with program administration. This role, along with the Program Coordinator, Sr. will assist the program director in admissions, advising, and course offerings.

- B. **Resource requirements needed to launch and sustain the program:** Describe any new resources required for this program's success such as new staff, new facilities, new library resources, new technology resources, etc.

The School of Mathematical & Statistical Sciences is supporting the hiring initiatives needed to support the program.

**APPENDIX I
OPERATIONAL INFORMATION FOR GRADUATE PROGRAMS**

(This information is used to populate the [Graduate Programs Search](#)/catalog website.)

1. **Proposed title of major:** Actuarial Science

2. **Provide a brief program description** (catalog type (i.e. will appear in Degree Search) – no more than 150 words):

The MS program in actuarial science will build on the strength, experience, and reputation of ASU. While keeping the core technical learning outcomes in place, it will also include a new focused set of professional learning outcomes aligned with the needs of the ever evolving insurance industry. These will guide students' development of professional competencies through coursework, independent projects, and opportunities outside of the classroom, while remaining firmly based on a strong foundation of scholarly technical work in actuarial science. It will emphasize broad awareness and appreciation of current issues faced by insurance industry practitioners as well as innovative resolutions provided by actuaries. The resulting degree will be valued and respected due to the high quality training and the integrity and relevance of the graduate.

Actuaries must pass a series of intensive professional exams to become credentialed, and this degree program prepares students for these credentialing exams.

3. **Campus(es) where program will be offered:**

ASU Online curriculum consists of courses that have no face-to-face content. iCourses are online courses for students in on-campus programs. iCourses may be included in a program, but may not comprise the entirety of a program. On-campus programs must have some face-to-face content.

Note: Office of the Provost approval is needed for ASU Online campus options.

ASU Online only (all courses online and managed by ASU Online)

All other campus or location options (please select all that apply):

Downtown Phoenix Polytechnic Tempe West Other: _____

Both on-campus and ASU Online* - (check applicable campus(es) from options listed above)

**Note: Once students elect a campus or Online option, students will not be able to move back and forth between the on-campus and the ASU Online options. Approval from the Office of the University Provost and Philip Regier (Executive Vice Provost and Dean) is required to offer programs through ASU Online. Please complete the ASU Online Offering form in [Curriculum ChangeMaker](#) to begin this request.*

4. **Admission Requirements:**

An applicant must fulfill the requirements of both the Graduate College and the College of Liberal Arts and Sciences.

An applicant must have the minimum of a bachelor's degree (or equivalent) or master's degree from a regionally accredited college or university in a related field such as mathematics, statistics, business, economics, and predictive analytics.

A minimum of a 3.00 cumulative GPA (scale is 4.00 = "A") in the last 60 hours of a student's first bachelor's degree program is required. A minimum of a 3.00 cumulative GPA (scale is 4.00 = "A") in an applicable master's degree program is required.

Applicants are required to submit:

1. graduate admission application and application fee
2. official transcripts
3. letter of intent/written statement

4. GRE scores
5. two letters of recommendation
6. proof of English proficiency
7. professional resume

Additional Application Information

Applicants whose native language is not English (regardless of current residency) must provide proof of English proficiency.

Applicants should have completed, with a B or better, the following courses (equivalents at ASU are given in parenthesis).

- Upper division in Probability (ACT 415 or STP 421)
- Mathematical Statistics (STP 427)
- Statistics (STP 420)
- Applied linear regression (STP 429 or ACT 435).
- Risk Management (ACT 301)
- Accounting (ACC 231 and ACC 241)

5. Application Review Terms (if applicable session):

Indicate the first term and year in which applications will be opened for admission. Applications will be accepted on a rolling basis after that time.

Note: It is the academic unit's responsibility to display program deadline dates on their website.

Terms	Years	University Late Fee Deadline
<input checked="" type="checkbox"/> Fall (regular) <input type="checkbox"/> Session B	(year): 2018 (year):	July 1st October 1st
<input type="checkbox"/> Spring (regular) <input type="checkbox"/> Session B	(year): (year):	December 1st February 8th
<input type="checkbox"/> Summer (regular) <input type="checkbox"/> Summer B	(year): (year):	May 14th May 14th
<p><i>Note: Session B is only available for approved online programs.</i></p>		

Program admission deadlines website address: <https://math.asu.edu/admission/graduate-admission>

6. Curricular Requirements:

Curricular Structure Breakdown for the Academic Catalog:

(To be completed by Graduate College)

Required Core (6 credit hours)

- ACT 560 Advanced Data Analytics in Insurance I (3)
- ACT 561 Advanced Data analytics in Insurance (3)

Electives or Research (21 credit hours)

Culminating Experience (3 credit hours)

ACT 593 Applied Project (3)

Additional Curriculum Information

For electives and research, students select seven courses from an approved list. Please see the academic unit for the approved course list. Other courses may be used with approval of the academic unit.

Only 6 credit hours of 400 level coursework will be allowed on the plan of study per Graduate College policy.

7. Comprehensive Exams:

Master's Comprehensive Exam (when applicable), please select from the appropriate option.

N/A

8. Allow 400-level courses: **Yes** **No**

Note: No more than 6 credit hours of 400-level coursework may be included on a graduate student plan of study.

9. Committee:

Required number of thesis committee members (must be at least 3 including chair or co-chairs): N/A

Required number of non-thesis option committee members (must be a minimum of one): Two

10. Keywords: List all keywords that could be used to search for this program. Keywords should be specific to the proposed program – limit 10 keywords.

Actuary, Actuarial Science, Financial Engineering, Business Forecasting, Predictive Analytics

11. Area(s) of Interest

A. Select one (1) primary area of interest from the list below that applies to this program.

- | | |
|--|---|
| <input type="checkbox"/> Architecture & Construction | <input type="checkbox"/> Interdisciplinary Studies |
| <input type="checkbox"/> Arts | <input type="checkbox"/> Law & Justice |
| <input type="checkbox"/> Business | <input checked="" type="checkbox"/> Mathematics |
| <input type="checkbox"/> Communication & Media | <input type="checkbox"/> Psychology |
| <input type="checkbox"/> Education & Teaching | <input type="checkbox"/> STEM |
| <input type="checkbox"/> Engineering & Technology | <input type="checkbox"/> Science |
| <input type="checkbox"/> Entrepreneurship | <input type="checkbox"/> Social and Behavioral Sciences |
| <input type="checkbox"/> Health & Wellness | <input type="checkbox"/> Sustainability |
| <input type="checkbox"/> Humanities | |

B. Select one (1) secondary area of interest from the list below that applies to this program.

- | | |
|--|---|
| <input type="checkbox"/> Architecture & Construction | <input type="checkbox"/> Interdisciplinary Studies |
| <input type="checkbox"/> Arts | <input type="checkbox"/> Law & Justice |
| <input checked="" type="checkbox"/> Business | <input type="checkbox"/> Mathematics |
| <input type="checkbox"/> Communications & Media | <input type="checkbox"/> Psychology |
| <input type="checkbox"/> Education & Teaching | <input type="checkbox"/> STEM |
| <input type="checkbox"/> Engineering & Technology | <input type="checkbox"/> Science |
| <input type="checkbox"/> Entrepreneurship | <input type="checkbox"/> Social and Behavioral Sciences |
| <input type="checkbox"/> Health & Wellness | <input type="checkbox"/> Sustainability |
| <input type="checkbox"/> Humanities | |

12. Contact and Support Information:

Office Location (Building Code & Room):	WXLR 216
--	----------

Campus Telephone Number: (may not be an individual's number)	480-965-3951
Program Email Address: (may not be an individual's email)	grad.math@asu.edu
Program Website Address: (if one is not yet created, use unit website until one can be established)	https://math.asu.edu/admission/graduate-admission
Program Director (Name):	Al Boggess
Program Director (ASURITE):	abogges1
Program Support Staff (Name):	Jennifer May
Program Support Staff (ASURITE):	jamay
Admissions Contact (Name):	Jennifer May
Admissions Contact (ASURITE):	jamay

13. **Application and iPOS Recommendations:** List the Faculty and Staff who will input admission/POS recommendations to Gportal **and** indicate their approval for Admissions and/or POS:

NAME	ASURITE	ADMSN	POS
Jennifer May	jamay	Yes	Yes

APPENDIX II

Letters of Support

College of Liberal Arts and Science – Official Submission

From: Paul LePore [<mailto:Paul.Lepore@asu.edu>]
Sent: Thursday, April 27, 2017 2:39 PM
To: curriculumplanning@asu.edu
Cc: Jenny Smith; P.F. Lengel; Paul LePore
Subject: Proposal to Establish a New Master's Degree in Actuarial Science

Please accept the attached proposal to establish a new master's degree in Actuarial Science.

Thank you,
PL

PAUL C. LEPORE, Ph.D.
Associate Dean
College of Liberal Arts and Sciences
Foundation Building, Suite 110
Arizona State University | P.O. Box 876605 | Tempe, Arizona 85287-6605
480.965.6506 | Fax: 480.965.2110 | e-mail: paul.lepore@asu.edu

ASU College of Liberal Arts and Sciences — *Transforming learning, discovery and lives*

School of Mathematical and Statistical Sciences – Support



March 16, 2017

Support Letter for Proposed Master of Science in Actuarial Science

With this memorandum, I give my strong support for the proposed Master of Science in Actuarial Science degree. This degree program would complement our current B.S. degree in actuarial science which started just over two years ago and which has already enrolled over 100 majors. Actuarial degree programs are in short supply in the western half of the nation (and there are none others in Arizona outside of ASU). Therefore, this proposed M.S. degree in actuarial science fills an important niche.

The demand for graduates who are trained in actuarial science and the related fields of insurance and management risk is at an all-time high. The insurance industry is facing a large wave of retirements in their actuarial science employment ranks. Phoenix is home to many industries who employ actuaries and those trained in risk management. This trend will continue as additional companies (such as State Farm and Allstate) move to the Phoenix valley.

This proposed degree has the support of our graduate program committee and our School's Associate Director of Graduate Programs. As per our School's bylaws, this committee is charged with reviewing new graduate degree programs and obtaining input from our faculty.

Please let me know if any further information is needed to assess and evaluate this proposed degree program.

Sincerely,

A handwritten signature in black ink that reads "Al Boggess".

Al Boggess, Director

COLLEGE OF LIBERAL ARTS AND SCIENCES
Al Boggess, Director, School of Mathematical and Statistical Sciences
PO BOX 871804 TEMPE, AZ 85287-1804
(480) 965-3951 FAX: (480) 965-8119
<http://math.asu.edu>

College of Integrative Sciences and Arts – Impact Statement

From: **Duane Roen** <Duane.Roen@asu.edu>
Date: Wed, Jul 12, 2017 at 12:27 PM
Subject: RE: request for impact statement
To: Casey Self <Casey.Self@asu.edu>, Albert Boggess <boggess@asu.edu>
Cc: Ferran Garcia-Pichel <ferran@asu.edu>

Al,

The College of Integrative Sciences and Arts is happy to support your proposal for an MS degree in actuarial science. It sounds exciting!

Please let me know if we can do anything else to help.

Best,

Duane

Duane Roen

Vice Provost, Polytechnic campus

Dean, College of Integrative Sciences and Arts

Dean, University College

Arizona State University

College of Integrative Sciences and Arts | cisa.asu.edu

**Fulton Schools of Engineering
School of Mathematical and Statistical Sciences – Impact Statement**

From: Patrick Phelan (Professor)
Sent: Monday, July 24, 2017 1:00 PM
To: Melanie Smock <Melanie.Smock@asu.edu>
Cc: Sergio Quiros <Sergio.Quiros@asu.edu>; Jeremy Helm <JEREMY.HELM@asu.edu>
Subject: RE: SoMSS impact statement?

Melanie:

Thanks for the reminder!

The Fulton Schools of Engineering do not foresee any negative impacts caused by the establishment of the MS in Actuarial Science program.

Pat Phelan

Patrick Phelan
Arizona State University
Professor, [Mechanical & Aerospace Engineering &
Professional Science Master's in Solar Energy Engineering & Commercialization](#)
Assistant Dean of Graduate Programs, [Ira A. Fulton Schools of Engineering](#)
Assistant Director, [ASU Industrial Assessment Center](#)
Senior Sustainability Scientist, [Global Institute of Sustainability](#)
Honors Faculty, [Barrett, The Honors College](#)

Mailing Address:
School for Engineering of Matter, Transport & Energy
501 E Tyler Mall ECG303
Tempe, AZ 85287-6106
Tel: (480)965-1625
Fax: (480)727-9321

New College of Interdisciplinary Arts and Sciences
School of Mathematical and Natural Sciences – Impact Statement

From: Lara Ferry <Lara.Ferry@asu.edu>
Date: Mon, Jul 17, 2017 at 7:51 AM
Subject: Re: request for impact statement
To: Al Boggess <abogges1@asu.edu>
Cc: Albert Boggess <bogges@asu.edu>, Tosha Ruggles <tosha.ruggles@asu.edu>, Patricia Friedrich <Patricia.Friedrich@asu.edu>

Hello Al,

I don't see any issues for us here. Thanks for reaching out.

Lara

Lara Ferry, PhD
Director and Professor, School of Mathematical & Natural Sciences
Honors Faculty, Barrett The Honors College
Sr. Sustainability Scholar, Julie Ann Wrigley Global Institute of Sustainability

Arizona State University
Mailing Address (letters): PO Box 37100, MC 2352 • Phoenix, AZ 85069-7100
Shipping Address (packages): 4701 W. Thunderbird Rd • Glendale, AZ 85306-4908
Office: CLCC 290 • [\(602\) 543-2817](tel:6025432817)
Research Website: <http://morphology.asu.edu>

On Jul 15, 2017, at 6:35 AM, Patrick Bixby <Patrick.Bixby@asu.edu> wrote:

Dear Prof. Boggess,
As of July 1st, I am no longer serving as Director of Graduate Studies for the New College; so I'm Ccing the Director of our School of Mathematics and Natural Sciences, Prof. Lara Ferry, who should be able to provide an impact statement. I wish you the best of luck with your new degree.

Le gach dea-ghuí,

Patrick

Patrick W. Bixby, Ph.D.

Associate Professor of English – School of Humanities, Arts & Cultural Studies

Thunderbird School of Global Management – Impact Statement

July 12, 2017

To: Al Boggess, Director of the School of Mathematical and Statistical Sciences.

From: James V. Scott, Executive Director, Academic Operations

Subject: Impact Statement for MS in Actuarial Science

Thunderbird School of Global Management has reviewed the proposal from School of Mathematical and Statistical Sciences for the MS in Actuarial Science and supports this proposal. As this program is designed specifically for students in mathematical and statistical sciences and devoted to preparing students for exams in these fields of employment, there is no negative impact on our degrees.

If you have any questions, please let us know. Best wishes on this program.

W. P. Carey School of Business – Impact Statement

From: Albert Boggess <boggess@asu.edu>
Sent: Wednesday, July 19, 2017 9:40 AM
To: Kay Faris
Cc: Thomas Bates; Jelena Milovanovic; Joseph Davis (Mathematics); Melanie Smock
Subject: Re: FW: impact statement for ACT MS degree proposal

Follow Up Flag: Follow up
Flag Status: Flagged

Kay - Thank you very much for this statement and I look forward to seeing the syllabi of the overlap courses.

Al

On Wed, Jul 19, 2017 at 9:33 AM, Kay Faris <KAY.FARIS@asu.edu> wrote:

Hi Al,

Thank you for consulting with us on your proposed new degree. As we discussed on the phone, W. P. Carey is supportive of this degree and believes it will provide real value to students.

We do believe, however, that we teach the content from several of your courses in the program related to finance, portfolio and derivatives and we would like to discuss this component further. In fact, our department would consider several of your courses as equivalents to our courses—thereby indicating significant overlap. It may be possible that we could provide and teach some of these courses for your program. I am sending you several of our syllabi for these courses for further discussion.

Again, we are supportive of the degree, but we need to discuss some of the finance course work further.

Please let me know if you have additional questions at this point.

Thanks,

Kay

Kay A. Faris

Senior Associate Dean, Academic Programs

W. P. Carey School of Business

Arizona State University

Tempe, AZ 85287-3406

From: Albert Boggess [mailto:boggess@asu.edu]
Sent: Wednesday, July 12, 2017 11:55 AM
To: Kay Faris <KAY.FARIS@asu.edu>
Subject: impact statement for ACT MS degree proposal

Dear Kay,

Our School is submitting a proposal for a new MS degree in actuarial science (see attached proposal) and I would like to request a short statement from you on the impact on your unit. The degree will focus on the mathematical and statistical concepts to the disciplines of risk management, finance, and insurance. Actuaries must pass a series of intensive professional exams to become credentialed. While passing these credentialing exams is not required for the degree, a significant part of the curriculum for this proposed degree is devoted to preparing students for these exams. This proposed degree is a natural next step after our creation (3 years ago) of an undergraduate degree in actuarial science (although entry into the MS degree does not require a BS degree in actuarial science as a prerequisite).

The proposed degree program does not require any coursework from your unit, but it may impact your unit, hopefully in a positive way. Can you please send me a short statement regarding the impact on your unit with (hopefully) a sentence of support for our proposed degree program? I would need this statement one week from today (July 19, 2017).

Thank you for your consideration.

Al Boggess, Director (SoMSS)

School of Mathematical and Statistical Sciences – Responses to W. P. Carey Statement

From: Jelena Milovanovic <jmz@asu.edu>
Sent: Monday, July 24, 2017 11:16 AM
To: Albert Boggess
Cc: Joseph Davis (Mathematics)
Subject: Evaluating graduate level FIN courses

Al,

I have reached out to our faculty about commenting on the FIN courses equivalent to our ACT 571 and ACT 575 and after evaluating the 5 FIN courses here are the comments of why these are not equivalent to any of our ACT classes:

- ACT 571 requires a prerequisite of stochastic calculus and as such does not map to any of the FIN courses provided.
- Fin 525: It appears that mathematical underpinnings of modern portfolio theory in FIN 525 are not covered in depth and spirit of ACT 575. Though for sure useful as an overview course geared for practitioners it is not a full equivalent of FIN 525.
- Fin 540: This course only partially touches on content relevant for us. However, the pricing theory introduced is elementary. Unfortunately, this course cannot be mapped in any of ours.
- Fin 530: Thought clearly good introductory undergraduate course, unfortunately this course fundamentally falls short of graduate level material covered in ACT 571.
- Fin 580: This course unfortunately has no adequate graduate level coverage of mathematical underpinning of modern portfolio theory and risk management.
- Fin 494/59: Has small overlap with ACT 575 but it appears it is geared much more for practitioners without more detailed mathematical coverage of the topic.

Question: Is there pressure to map an ACT course to a FIN course? If so, the closest one is FIN 525 for ACT 575. Having said this, it would be such a far reach and we would honestly prefer such did not occur.

Best,

Jelena Milovanovic, ACIA, AIAA, Ph.D.

Professor of Practice
Actuarial Science Coordinator | Faculty Advisor for the Gamma Iota Sigma Kappa Chapter @ ASU | Honors Faculty
School of Mathematical and Statistical Sciences | math.asu.edu
College of Liberal Arts and Sciences
Arizona State University
Direct: 480-965-0064 | e-mail: Jelena.Milovanovic@asu.edu

From: [Ferran Garcia-Pichel](#)
To: [Tamara Underiner](#)
Cc: [Amy Hillman \(DEAN\)](#)
Subject: actuarial MS
Date: Thursday, October 26, 2017 2:40:59 PM

Hi Tamara,

There were originally some differences of opinion between faculty in CLAS and WPCarey with respect to some of the courses proposed in the Actuarial MS that I think is on your desk by now. Dean Hillman and I discussed this, and agreed that they can be regarded as Math Courses with Finance content, so the proposal should be OK as is.

Thanks

FERRAN GARCIA-PICHEL, PH.D.
DEAN OF NATURAL SCIENCES, COLLEGE OF LIBERAL ARTS AND SCIENCES, &
PROFESSOR, SCHOOL OF LIFE SCIENCES
ARIZONA STATE UNIVERSITY
ASSISTANT: MICHELLE.WATSON@ASU.EDU 480 9658065

LAB: garcia-pichel.lab.asu.edu

School of Mathematical and Statistical Sciences – Ira A. Fulton Update to Updated Proposal

From: Patrick Phelan (Professor)
Sent: Saturday, October 7, 2017 1:58 PM
To: Albert Boggess <boggess@asu.edu>
Cc: Joseph Davis (Mathematics) <Joseph.W.Davis@asu.edu>; Jelena Milovanovic <jmz@asu.edu>
Subject: RE: Updated Actuary MS Degree Proposal

Al:

Thanks for sending the updated version. We are now once again in support of your proposed program.

Pat Phelan

Patrick Phelan

Arizona State University

Professor, [Mechanical & Aerospace Engineering &](#)

[Professional Science Master's in Solar Energy Engineering & Commercialization](#)

Assistant Dean of Graduate Programs, [Ira A. Fulton Schools of Engineering](#)

Assistant Director, [ASU Industrial Assessment Center](#)

Senior Sustainability Scientist, [Global Institute of Sustainability](#)

Honors Faculty, [Barrett, The Honors College](#)

APPENDIX III

Details on Profile A and B Classes and the Roll-Out Plan

Currently, all of the graduate programs in Actuarial Sciences at the master's level offered nationwide cater exclusively for **ONLY ONE** of the following student profiles:

- **Profile A:** Students who have earned an undergraduate degree in actuarial science or have a major/minor/concentration in actuarial science. Approximately **70%** of the applicants.

OR

- **Profile B:** Students who have completed an undergraduate degree in a related field but have no past experience in taking course work in actuarial science. Approximately **30%** of the applicants.

The proposed master's degree in actuarial science at ASU would become the first of its kind, when fully implemented, by catering simultaneously to **BOTH** student populations. In order to realize its vision an addition of only two faculty lines will be necessary: assistant professor and professor of practice. The initial rollout will focus on developing the pathway for Profile A as this pathway will be extremely attractive to ASU's very own actuarial science undergraduates. Once this pathway is established with minimal development efforts, the second pathway for Profile B will be rolled out. Full implementation of these two pathways will require two additional faculty members (assistant professor and professor of practice) as stated in the MS degree program proposal.

A sample of ASU's actuarial science masters program unique design is outlined below. Note that this does not exhaust the electives list, but provides an idea of how a student from each pathway could achieve graduation.

PROFILE A	PROFILE B
Required Courses	
ACT 560: Advanced data analytics in insurance I (3) ACT 561: Advanced data analytics in insurance II (3) Culminating Experience ACT 593: Applied project (taken in the last semester) (3)	
Electives	
6 credit hours from an approved list of 400 level courses can also be used as electives	
ACT 505: Advanced Models for Enterprise Risk Management (3) ACT 570: Stochastic Calculus for Finance (3) ACT 571: Advanced Mathematics and Financial Derivatives(3) ACT 575: Portfolio Theory and Risk Management (3) ACT 580: Regulation and Financial Reporting (3) ACT 585: Advanced Mortality Modeling and Management of Longevity Risk (3) ACT 584: Internship (3) Total Units: 30	ACT 510: Mathematics of Finance(3) ACT 515: Probability for Risk Management (3) ACT 520: Intro to Rate Making and Reserving (3) ACT 530: Mathematics for Financial Derivatives (3) ACT 540: Long Term Actuarial Mathematics I (3) ACT 550: Actuarial Models and Modeling I (3) ACT 584: Internship (3) Total Units: 30

PROFILE A - Approximately 70% of applicants would fit this profile

Students who have earned an undergraduate degree in actuarial science or major/minor/concentration are interested in differentiating themselves from their actuarial science peers by expanding their predictive analytics tool kit as well as exposure to higher level *fellowship* exams offered by the Society of Actuaries (SOA) and Casualty Actuarial Society (CAS). Such exams are captured in the proposed ACT 505, 570, 571, 575, 580, and 585. The initial focus for the rollout of the program is to establish this pathway for fall 2018.

In order to cover the proposed courses two additional faculty lines are needed: assistant professor and professor of practice. The assistant professor would develop two courses and the professor of practice would develop the remaining courses as their teaching expectation is 3-3 with no research component.

PROFILE B - Approximately 30% of applicants would fit this profile

Students who have completed an undergraduate degree in a related field but have no past experience in taking course work in actuarial science are interested in maximizing their exposure to preliminary *associateship* exams offered by the Society of Actuaries (SOA) and Casualty Actuarial Society (CAS). In addition to the Core courses and the Culminating Experience, the seven elective courses would come from a maximum of 6 credit hours of 400 level courses from an approved list and the proposed 500 level actuarial courses: ACT 510, 515, 520, 530, 535, 540, 541, 550, 551, and 584. These classes all have undergraduate counterparts (mostly 400-level). Thus, minimal development would be required for these 500-level courses. Since the number of masters level students needing these courses will be small, staffing needs will be met by pairing the undergraduate level course with the graduate course (e.g. ACT 435 and 535) with extra expectations for the graduate students. Thus minimal extra staffing will be needed for these 500-level classes.