

TO: Fort Wayne Senate
FROM: Kate White, Acting Chair, Curriculum Review Subcommittee
DATE: October 20, 2016
SUBJECT: Proposals for Bachelor of Science in Actuarial Science and Bachelor of Science in Applied Statistics

Curriculum Review Subcommittee members support the proposal for a Bachelor of Science in Actuarial Science and find that the proposal requires no Senate review. We also support the proposal for a Bachelor of Science in Applied Statistics and find that it requires no Senate review.

Approving

Not Approving

Absent

S. Baddam
R. Duchovic
C. Duncan
D. Lui
S. Skekloff
J. Smith
K. White
M. Yamanda

A. Montenegro

Program Description

**Bachelor of Science in Actuarial Science
To Be Offered by the College of Arts and Sciences
Indiana University Purdue University Fort Wayne**

1. Characteristics of the Program

- a. **Campus:** Indiana University Purdue University Fort Wayne
- b. **Scope of delivery:** On-campus and online
- c. **Mode of Delivery:** Classroom/lab
- d. **Other delivery aspects:** Co-ops, Internships
- e. **Academic unit offering program:** Department of Mathematical Sciences in the College of Arts and Sciences

2. Rationale for the Program**a. Institutional Rationale (Alignment with the Institutional Mission and Strengths)**

- **Why is the institution proposing this program?**

The objective is to establish a Bachelor of Science in Actuarial Science (BSAS) at Indiana University Purdue University Fort Wayne (IPFW). According to the U.S. Bureau of Labor Statistics, the employment outlook for actuaries is much higher than the overall average, with a projected increase of 18% from 2014 to 2024. The outlook in Northeast Indiana, with its concentration of specialty insurance companies, is also favorable. Companies such as Lincoln Financial Group and Swiss Re hire approximately five to seven entry-level actuaries each year, and other local employers hire several more. It is projected that the demand for individuals prepared in actuarial science will increase in the next decade. A consistent stream of highly prepared actuarial students will help to maintain and grow the insurance and reinsurance industry in Northeast Indiana. To respond to this need, an actuarial science program offering a bachelor's degree is needed in the region to prepare students for entry into actuarial positions as well as to engage institutions of higher education in partnerships with insurance companies. Currently, no institution in Northeast Indiana offers a bachelor's degree in actuarial science.

Actuarial Science majors will be encouraged to earn a secondary major in statistics. The proposed actuarial science and applied statistics programs have been developed to provide students with a broad array of analytical skills which are desirable in today's society of intensive data analysis and modeling.

The Department of Mathematical Sciences offers a Bachelor of Science in Mathematics with an Actuarial Science option. This degree program meets the requirements of the Society of Actuaries (SOA) for inclusion on their listing of Universities and Colleges with Actuarial Programs (UCAP). The proposed program

in Actuarial Science will provide focus in alignment with professional standards. While still maintaining a strong mathematical foundation, it will feature an expansion of theories and applications of financial modeling, promoting the academic and professional growth of future actuaries. The curriculum includes coursework addressing the content for three of the SOA exams as well as meeting the requirements for the SOA Validation by Educational Experience (VEE).

- **How is it consistent with the mission of the institution?**

IPFW's mission is to provide "local access to globally recognized baccalaureate and graduate programs that drive the intellectual, social, economic, and cultural advancement of our students and our region." The vision of the institution is to be known for "respected signature programs, and graduates prepared to improve the quality of life in their communities as well as compete locally, regionally, and globally." Offering a BSAS would be consistent with both the mission and vision statements. Development of the program will foster opportunities for year-round and semester internships/co-ops for students in the local industry. It will also provide qualified graduates prepared for entry-level positions locally, regionally, and globally. A consistent stream of highly prepared actuarial students will help to maintain and grow the insurance and reinsurance industry in Northeast Indiana.

- **How does the program fit into the institution's strategic and/or academic plan?**

The first goal of the IPFW strategic plan is to "Foster Student Success" with the associated process goal to "Develop signature programs." One of the key strategies associated with this process goal is to "Identify and develop signature programs that respond to regional needs, build on faculty expertise, and uniquely distinguish IPFW from other institutions." IPFW would be unique in that no other institution in Northeast Indiana offers a BSAS.

A second strategy is to "Build and strengthen relationships with regional partners to increase research and scholarly collaborations in signature programs." IPFW has already begun building and strengthening these relationships. The Department of Mathematical Sciences has established an Actuarial Advisory Board, with members from Lincoln, Swiss Re, Medical Protective and Buck Consultants, to provide guidance on the actuarial science curriculum and better meet the needs of the local industry. As the program is developed and expanded, more scholarly collaborations are anticipated.

Another key strategy is to "Promote majors and programs with strong job placement opportunities in the region and beyond." Given the demand for graduates with a background in actuarial science, offering a BSAS would clearly meet this objective. Job placement has already been very successful with four

internships and five full-time employment hires in the last two years. The proposed degree is expected to provide students with the knowledge and skills to be more competitive in the job market.

- **How does this program build upon the strengths of the institution?**

IPFW has an established foundation for this program through the Actuarial Science option of the Bachelor of Science in Mathematics. The proposed BSAS degree would build on the curriculum currently in place. Working toward the goal of establishing a signature program in actuarial science, the Department of Mathematical Sciences has accomplished the following in the past two years: becoming the only program in Northeast Indiana with UCAP classification by the SOA; growing the enrollment in the actuarial science option by 300% (17 in 2013 and 50 in 2015); establishing a Student Actuarial Club to inform students about actuarial careers and introduce employers to the local talent; establishing an Actuarial Award co-sponsored with Swiss Re to reimburse exam costs to students successfully passing SOA exams; establishing an Actuarial Advisory Board with members from local industry; and developing new actuarial courses (Financial Mathematics, Models of Financial Economics, and a practicum to help students prepare for SOA exams).

b. State Rationale

- **How does this program address state priorities as reflected in *Reaching Higher, Achieving More*?**

The proposed BSAS program addresses several goals described in *Reaching Higher, Achieving More*. One goal is to “align the state’s higher education system to meet Indiana’s economic and workforce needs.” As will be discussed in part c. below, there is a growing need for actuaries in the state, and more specifically, in the Northeast Indiana region. The BSAS program will align strongly with this goal by graduating students who are qualified to step into actuarial positions.

The program will also meet the goal of “Producing quality college degrees and certificates that are valued by students and employers” specified in *Reaching Higher, Achieving More*. “Actuary” is consistently listed among the top five most desirable occupations. For example, the 2015 annual report by CareerCast.com ranked “Actuary” as the best job of 2015 ([see list](#)). A program preparing students for this career is valued by the local industry as well as students.

Finally, since the proposed program was developed following the Society of Actuaries’ curriculum recommendations, it aligns with the goal to “attain a standard of academic quality that ensures Indiana’s college credentials are universally recognized for their rigor and value.”

c. Evidence of Labor Market Need

i. National, State or Regional Need

• Is the program serving a national, state, or regional labor market need?

The BSAS program would serve a labor market need at the national, state and regional levels. According to the Bureau of Labor Statistics ([Bureau web site](#), July 6, 2016), the occupational outlook for actuaries is much higher than average for the next decade, with a projected change from approximately 24,600 jobs in 2014 to 29,000 in 2024 (i.e., an 18% increase). The Bureau reports that “Actuaries will be needed to develop, price, and evaluate a variety of insurance products and calculate the costs of new, emerging risks.” Graduates educated in actuarial science are needed in the insurance, pension, and financial industries.

State long-term projections for actuaries developed by Labor Market Information ([www.projectionscentral.com](#)) estimate similar employment growth over the same 10-year period for Indiana (330 to 380 or 15.2%) and the contiguous states: Michigan (410 to 510 or 24.4%), Ohio (1,010 to 1,160 or 14.9%), and Illinois (1,220 to 1,420 or 16.4%). Average annual openings in the occupation for these states are projected to be 20, 20, 50, and 60, respectively.

As mentioned previously, companies such as Lincoln Financial Group and Swiss Re hire approximately five to seven entry-level actuaries each year, and other local employers hire several more.

ii. Preparation for Graduate Programs or Other Benefits

• Does the program prepare students for Graduate Programs or provide Other Benefits to students besides preparation for entry into the labor-market?

Graduates of the BSAS will be prepared to enter a graduate program in Actuarial Science, if they desire.

Actuarial Science is an academic subject for scientific and mathematical study as well as research within the liberal arts tradition. As such, the program will enrich the educational experience of students beyond preparation for a job.

iii. Summary of Indiana DWD and/or U.S. Department of Labor Data

• Summarize the evidence of labor market demand for graduates of the program as gleaned from employment projections made by the Indiana Department of Workforce Development and/or the U.S. Department of Labor.

As mentioned in part i. above, The Bureau of Labor Statistics predicts an 18% increase in actuarial jobs (approximately 4,400) from 2014 to 2024. The employment outlook for actuaries is projected to grow much faster than the 7% average for all occupations nationally.

For those with a Bachelor's Degree, the Indiana Department of Workforce Development indicates a 25.9% job growth for actuaries nationally. The demand for actuaries with a Bachelor's degree in the Northeast region of Indiana (Economic Growth Region: EGR3) is growing at approximately three times the rate (27.6%) when compared to the state of Indiana (9.5%).

More specific details on short-term projections as well as projections across all industries can be found in Appendix 2.

iv. National, State, or Regional Studies

- **Summarize any national, state, or regional studies that address the labor market need for the program.**

Findings of the Insurance Labor Market Study conducted by the Jacobson Group and Ward Group in 2016 indicate that 66.3% of companies plan to increase staff during the next 12 months and that Technology, Claims, and underwriter roles are expected to show the greatest growth. The projection is for the creation of new jobs in the industry resulting from an increase in industry employment over the next 12 months ([see study](#)).

Findings discussed in the *Regional Intel Report* of the IPFW Community Research Institute indicate that approximately 3,600 regional openings in the next decade will be in analytical fields. This could lead to a potential supply shortage since the report also specifies that degree completions in mathematics and statistics have remained relatively flat, from 31 in 2003 to 35 in 2014. Additional studies by this same group indicate a growing demand in the Finance and Insurance sector.

Results from additional studies can be found in Appendix 3.

v. Surveys of Employers or Students and Analyses of Job Postings

- **Summarize the results of any surveys of employers or students and analyses of job postings relevant to the program.**

Job postings for a variety of sites were analyzed in July 2016 for actuaries.

- A search of CareerCast.com listed 395 job postings for actuaries in the United States. Of these postings, 2 were in Indiana, 17 were in Illinois, and 5 were in Michigan.
- A search of Monster.com listed over 1,000 jobs for actuaries. Sixty-eight jobs were in Indiana, and 547 were in one of the contiguous states: 306 in Illinois, 111 in Michigan, and 130 in Ohio.
- A search of the CareerOneStop.com Job Finder found 1,917 jobs for actuaries in the United States. Twenty-three of these jobs were in Indiana,

130 in Illinois, 47 in Michigan, and 48 in Ohio.

- A search of the Society of Actuaries Job Center website posted 131 actuarial jobs for Actuarial candidates with 1-5 SOA exams passed. Of these postings 2 were in Indiana, 15 in Illinois, 2 in Michigan, and 10 in Ohio. The Casualty Actuarial Society listed 19 jobs for candidates with a four-year degree on their www.careers.casact.org/jobs/ website. Of these postings 1 was in Indiana, 4 in Illinois, 1 in Michigan, and 0 in Ohio.

Links to the aforementioned sites as well as a list of actuary jobs posted by CareerOneStop in the states of Indiana, Illinois, Michigan, and Ohio can be found in Appendix 4.

vi. Letters of support

- **Summarize, by source, the letters received in support of the program.**

3. Cost of and Support for the Program

a. Costs

i. Faculty and Staff

- **Of the faculty and staff required to offer this program, how many are in place now and how many will need to be added?**

Mathematics and statistics courses in the current Actuarial Science option of the Bachelor of Science in Mathematics are taught by a number of faculty members in mathematical sciences. Among these is a locally respected and published Fellow of the SOA who is a fully-benefitted, half-time professional actuary-in-residence. Four faculty members (corresponding to 3.5 FTE) with Ph.D.'s in Statistics or Biostatistics teach the courses approved for Validation by Educational Experience (VEE) by the SOA. A roster of the current faculty in the Department of Mathematical Sciences can be found in Appendix 6. Courses in accounting, economics, and finance are taught by faculty in the Doermer School of Business.

It is expected that the offering of a BSAS degree will lead to an increased enrollment at IPFW and in Mathematical Sciences. Lines for 1.5 FTE tenured/tenure-track faculty members in actuarial science and/or statistics will be required to teach additional courses for the program. An additional 1.5 FTE lines will be needed for the proposed Applied Statistics degree, for a total of 3 FTE lines needed for both degrees. Faculty would be teaching courses utilized in both degrees. As the program grows, additional faculty may be required in mathematics for support courses in the long-term.

No additional staff support will be required beyond what currently exists in the Department of Mathematical Sciences.

ii. Facilities

- **Summarize any impact offering this program will have on renovations of existing facilities, requests for new capital projects (including a reference to the institution's capital plan), or leasing of new space.**

IPFW and the Department of Mathematical Sciences have made substantial investments in classroom and research facilities to support programs in mathematics and statistics. To meet curricular needs, four classrooms equipped with computing facilities for instructors and students are dedicated for use by the Department. Two of these rooms, Kettler 123 and Kettler 218, have been renovated recently to update available technology and to provide learning environments which encourage student collaboration. In addition, the Department has six dedicated classrooms in which technology is available for instructor use, but which are not equipped with laptops for student use.

The Department will need to renovate the two additional computer-equipped classrooms, Kettler 216 and Kettler 220 to update technology and to encourage student collaboration, as was done in Kettler 218. Since students in the actuarial science program take many of the same courses as in the applied statistics program, both programs are facilitated with these renovations. The renovations could be done in different years and the cost of these renovations is approximately \$150,000 for each classroom. Three to four years in the future, an additional dedicated classroom with technology for instructors and students may be required to meet the increased frequency of course offerings. Additional details are provided in Appendix 7.

One-two equipped faculty offices (including office furniture, telephones, and computers) will be needed for the additional actuarial science/statistics faculty. (Between the requests for the actuarial science and applied statistics, three faculty offices will be needed.)

iii. Other Capital Costs (e.g. Equipment) *

- **Summarize any impact offering this program will have on other capital costs, including purchase of equipment needed for the program.**

Licenses for specialized software not already provided by the university may need to be purchased to support curricular and research programs.

Depending on their areas of expertise, additional equipment may need to be purchased for supporting the research programs of new faculty members.

b. Support

i. Nature of Support (New, Existing, or Reallocated)

- **Summarize what reallocation of resources has taken place to support this program.**

The proposed BSAS program primarily uses courses currently offered in existing programs in the University. Given the anticipated enrollment increase and new course offerings, an additional 1.5 FTE full-time tenured/tenure-track actuarial science faculty lines will be required.

- **What programs, if any, have been eliminated or downsized in order to provide resources for this program?**

No programs have been eliminated to provide resources for this program. We anticipate that the proposed program will replace the Actuarial Science option of the Bachelor of Science in Mathematics.

ii. **Special Fees above Baseline Tuition**

- **Summarize any special fees above baseline tuition that are needed to support this program.**

No special fees above the baseline tuition are being proposed for this program.

4. **Similar and Related Programs**

a. **List of Programs and Degrees Conferred**

i. **Similar Programs at Other Institutions**

The following institutions in Indiana offer undergraduate degrees in actuarial science:

Public four-year institutions

- Ball State University, Muncie (B.S. in Actuarial Science)*
- Indiana University Northwest, Gary (B.S. in Actuarial Science)*
- Indiana University South Bend (B.S. in Actuarial Science)
- Indiana University Purdue University Indianapolis, Indianapolis (B.S. in Actuarial Science)*
- Purdue University, West Lafayette (B.S. in Actuarial Science)*

Private four-year institutions

- Butler University, Indianapolis (B.A. and B.S. in Actuarial Science)*
- DePauw University, Greencastle (Bachelor's in Actuarial Science)*
- Grace College, Winona Lake (B.A. and B.S. in Actuarial Science)
- St. Mary's College, Notre Dame (B.S. in Statistical and Actuarial Mathematics)*
- University of Indianapolis (Bachelor's in Actuarial Science)*
- Valparaiso University, Valparaiso (B.S. in Actuarial Science)*

*-also listed on the SOA's UCAP

No other four-year institution in Northeast Indiana offers a Bachelor of Science degree in Actuarial Science.

ii. Related Programs at the Proposing Institution

Bachelor of Science in Mathematics with an option in Actuarial Science

b. List of Similar Programs Outside Indiana

The following four-year public institutions in Michigan and Ohio offer undergraduate degrees in actuarial science:

- Central Michigan University, Mount Pleasant, MI (B.A. and B.S. in Actuarial Science)*
- Eastern Michigan University, Ypsilanti, MI (B.A. and B.S. in Actuarial Science and Economics)
- Ferris State University, Big Rapids, MI (B.S. in Actuarial Science)*
- Michigan State University, Lansing, MI (B.S. in Actuarial Science)*
- Oakland University, Rochester Hills, MI (B.S. in Actuarial Science)
- The University of Michigan, Ann Arbor, MI (Bachelor's in Actuarial Mathematics)*
- Bowling Green State University, Bowling Green, OH (B.S. in Actuarial Science)*
- The Ohio State University, Columbus, OH (B.A. and B.S. in Actuarial Science)*
- Ohio University, Athens, OH (B.S. in Actuarial Science)*

*-also listed on the SOA's UCAP

c. Articulation of Associate/Baccalaureate Programs

- **For each articulation agreement, indicate how many of the associate degree credits will transfer and apply toward the baccalaureate degree.**

As of June 2016, the Indiana Commission on Higher Education website does not list any Transfer Single Articulation Pathways in progress for actuarial science (<http://www.in.gov/che/3138.htm>).

d. Collaboration with Similar or Related Programs on Other Campuses

- **Indicate any collaborative arrangements in place to support the program.**

No plans are currently in place to collaborate with similar or related program on other campuses.

5. Quality and Other Aspects of the Program

a. Credit Hours Required/Time To Completion

- **Credit hours required for the program and how long a full-time student will need to complete the program.**

The BSAS will require 120 credit hours for students who are ready to enter Calculus in their first semester. A full-time student averaging 15 credits per semester can complete the program in eight academic semesters over four years. A sample four-year plan is provided in Appendix 10.

b. Exceeding the Standard Expectation of Credit Hours

- **If the baccalaureate degree program exceeds 120 credit hours, summarize the**

reason for exceeding the standard expectation.

The BSAS does not exceed the standard 120 credit hour limit.

c. Program Competencies or Learning Outcomes

- **List the significant competencies or learning outcomes that students completing this program are expected to master.**

Students should be able to reason mathematically.

- Students will demonstrate an understanding of the calculus: The differential and integral calculus of one and multiple variables, infinite series, the geometry of Euclidean space, and theorems of Green, Gauss, and Stokes. [MA 26300]
- Students will demonstrate an understanding of elementary linear algebra: Linear transformations, finite dimensional vector spaces, matrices, determinants, systems of linear equations. [MA 35100]
- Students will demonstrate understanding of high-level topics such as sets, logical inference, induction, recursion, counting principles, binary relations, vectors and matrices, elementary graphs, and algorithm analysis. [MA 17500]

Students should be good problem solvers.

- Students will demonstrate the ability to translate real-world or discipline-specific problems into mathematical language, and the solutions of mathematical problems into ordinary language. [STAT 51100]
- Students will demonstrate the ability to choose, apply, and adapt appropriate strategies to solve diverse problems. [STAT 51100]
- Students will be able to use computers for analysis and data management. [CS 11400]

Students should be able to understand and apply mathematical concepts to other disciplines.

- Students will understand basic applications of the calculus to the physical sciences and engineering, and be able to use appropriate techniques in various contexts. [MA 26300]
- Students will understand basic applications of linear algebra and be able to use appropriate techniques in various contexts. [MA 35100]
- Students will be able to calculate present values, future values, mortgage rates, and internal rates of return. [MA 27300]

- Students will be able to price bonds and calculate the yield of the bond. [MA 27300]
- Students will understand the financial tools and measurements used to manage risk, including duration, convexity, asset-liability matching, and interest rate swaps. [MA 27300]
- Students will be able to build binomial models for stock prices and interest rates. They will be able to use these models to price financial instruments, including call options, put options, bonds, and interest rate swaps. [MA 49000 – MFE course]

Students should have sufficient preparation in calculus, linear algebra, probability, and statistics to pass the preliminary actuarial science examinations and obtain VEE credit from the Society of Actuaries.

- Students should be able to make statistical inference by applying hypothesis tests and confidence intervals. [STAT 51700]
- Students should be able to apply calculus to solve certain probability and estimation problems. Students should be able to distinguish between different probability models and apply them in problem solving. [STAT 51600]
- Students should be able to fit a regression model, perform a diagnostic analysis, and make appropriate inferences from data. [STAT 51200]
- Students should be able to calculate interest rates, present values, future values, bond prices, and loan payments. [MA 27300]
- Students should be able to use a binomial stock price model to calculate option prices, forward prices, prepaid forward prices, futures prices, and exotic option prices. The student should be able to use the Black-Scholes model to calculate call option and put option prices. The student should understand the Greek measurements related to options and should be able to perform delta-hedging. The student should be able to use a binomial interest rate model to price bonds, interest rate derivatives, and options on bonds. [MA 49000 – MFE course]

d. Assessment

- **Summarize how the institution intends to assess students with respect to mastery of program competencies or learning outcomes.**

The Department of Mathematical Sciences has a common assessment procedure for evaluating its various programs. For each outcome, a criterion for success is

defined and courses are identified where the outcome is addressed. Assessment items are embedded on assignments, examinations, and/or projects for the identified courses and student data on these items are collected by the instructor each time the course is offered. The courses used for the assessments are offered on a regular basis since they are part of the program. The data are tabulated by an assessment committee and used longitudinally to measure progress toward achievement of the program goal. Each fall semester the results from the previous year are discussed by the department with the intention of implementing recommended changes during the following year.

Assessment of the BSAS will follow this same procedure. Outcomes will be assessed in the courses listed in part c above.

Data will be collected in designated courses each time the courses are offered. The first longitudinal review of the program will be made in the third year of the program.

e. Licensure and Certification

- **State License:**

No state licenses apply to this program.

- **National Professional Certifications (including the bodies issuing the certification):**

Graduates of the program are encouraged to pass at least three of the five preliminary SOA exams (Exams P, FM, and MFE) based on coursework offered in the curriculum.

In addition to the exams, the SOA grants Validation by Educational Experience (VEE) in three areas: Applied Statistical Methods, Economics, and Corporate Finance. A university may submit course syllabi to meet VEE requirements. Courses required in the BSAS have been approved as meeting VEE requirements in all three areas through 12/31/2018. Students who earn at least a B- in the designated courses may apply for VEE from the SOA after passing at least two SOA exams.

- **Third-Party Industry Certifications (including the bodies issuing the certification):**

No third-party industry certifications apply to this program.

f. Placement of Graduates

- **Describe the principle occupations and industries, in which the majority of graduates are expected to find employment.**

Most of the graduates of the program are expected to work in the life insurance, health insurance, or the property/casualty insurance industry. Others are expected to work in pension consulting. Some are expected to work for regulatory bodies, such as the Indiana Department of Insurance. Some are also expected to work in

the fields of investments and finance.

- **If the program is primarily a feeder for graduate programs, describe the principle kinds of graduate programs, in which the majority of graduates are expected to be admitted.**

Alumni of the program may also pursue admission into graduate programs in Actuarial Science.

g. Accreditation

- **Accrediting body from which accreditation will be sought and the timetable for achieving accreditation.**

While not an accreditation, the current degree program meets the requirements of the SOA for inclusion on their listing of Universities and Colleges with Actuarial Programs (UCAP). The Department of Mathematical Sciences will apply for inclusion of the BSAS degree on UCAP list, pending approval of the program.

- **Reason for seeking accreditation.**

The UCAP list serves as a resource for students searching for an actuarial program. Inclusion on the list assists in the recruitment of students into this major.

6. Projected Headcount and FTE Enrollment and Degrees Conferred

- **Report headcount and FTE enrollment and degrees conferred data in a manner consistent with the Commission’s Student Information System.**

Enrollment Projections	Year 1	Year 2	Year 3	Year 4	Year 5
Full-time	45	50	55	60	65
Part-time	5	5	5	5	5
Enrollment Projections (FTE)	50	55	60	65	70
Full-time	45	50	55	60	65
Part-time	3	3	3	3	3
Degrees Conferred Projections	10	11	12	13	15

(See Appendix 12 for the enrollment history in the related mathematics program.)

- **Report a table for each campus or off-campus location at which the program will be offered.**

All BSAS courses will be offered on the IPFW campus or online.

- **If a program is offered at more than one campus or off-campus location, a summary table, which reports the total headcount and FTE enrollments and degrees conferred across all locations, should be provided.**

Not applicable.

- **Round the FTE enrollments to the nearest whole number.**

See above table.

- **If the program will take more than five years to be fully implemented and to reach steady state, report additional years of projections.**

Not applicable.

Appendix 1: Institutional Rationale Detail

IPFW Plan 2020: 2014-2020 Strategic Plan

Link to the strategic plan: <https://www.ipfw.edu/about/strategic-plan/>

MISSION

Indiana University-Purdue University Fort Wayne is a comprehensive university that provides local access to globally recognized baccalaureate and graduate programs that drive the intellectual, social, economic, and cultural advancement of our students and our region.

VISION

IPFW will be the university of choice for the citizens of northeast Indiana and beyond. It will be recognized for a transformative learning environment characterized by intensive mentoring, excellence in faculty scholarship and knowledge creation, integration of life and work experiences, and community engagement. IPFW will be known for exceptional retention, persistence, and graduation rates, respected signature programs, and graduates prepared to improve the quality of life in their communities as well as compete locally, regionally, and globally.

VALUES

IPFW values:

- Access to affordable and high-quality programs and services.
- The integrity, significance, and value of the Indiana University and Purdue University degrees.
- An environment of open intellectual inquiry, mutual respect, shared governance, and civility.
- An environment that enhances learning by recognizing the inherent worth of all individuals and celebrating differences of culture, background, and experience among all individuals and groups.
- The highest ethical standards of equity, fairness, transparency, and academic integrity.
- A multifaceted and mutually beneficial collaboration with Fort Wayne and the greater northeast Indiana region.

GOALS

Foster Student Success

A. Process Goal: Improve measurement of student learning.

1. Improve quality and fidelity of assessment processes of degree/certificate programs, General Education program, and Baccalaureate Framework with dedicated resources.
2. Use assessment data to improve student learning.

B. Process Goal: Increase student engagement.

1. Increase opportunities for engaged and experiential learning including service learning and internship programs.
2. Expand impact and profile of Honors Program.
3. Expand number of degree programs that have gateway courses.
4. Expand use of high-impact instructional and advising interventions.
5. Transform the concept of the college classroom and the delivery of education.

C. Process Goals: Increase interdisciplinary and graduate programs and internationalization of the curriculum.

1. Develop and promote interdisciplinary programs where there are sufficient university assets available and anticipated employment needs.
2. Review, prioritize, and expand international agreements.
3. Promote academic programs for international market.
4. Expand support for international students.
5. Invest in academic programs with international curricula.
6. Increase support programs for international study for domestic students.
7. Establish links between baccalaureate and post-baccalaureate programs.
8. Respond to regional demand with appropriate post-baccalaureate credentials.

D. Process Goal: Increase the diversity of the IPFW community.

1. Develop activities and experiences that promote multiculturalism as a value.
2. Embrace a definition of diversity that includes a broader array of human differences.
3. Build and strengthen relationships as well as proactive programs and services designed to encourage enrollment of students from historically under-represented groups.
4. Recruit and retain a diverse faculty and staff at all institutional levels.

E. Process Goal: Develop signature programs.

1. Identify and develop signature programs that respond to regional needs, build on faculty expertise, and uniquely distinguish IPFW from other institutions.
2. Develop activities and experiences that promote success in student achievement through programs with strong student learning outcomes, high graduation rates, and strong job placement prospects.

3. Build and strengthen relationships with regional partners to increase research and scholarly collaborations in signature programs.
4. Promote majors and programs with strong job placement opportunities in the region and beyond.

Promote the Creation, Integration, and Application of Knowledge

Process Goals:

- A. Project future regional, national, and international demand for research and collaboration.
- B. Promote mentoring relationships between faculty and students engaged in creation, integration, and application of knowledge.
- C. Promote development of opportunities for faculty and student engagement with the community for the application and integration of knowledge.

Serve as a Regional Intellectual, Cultural, and Economic Hub for Global Competitiveness

Process Goals:

- A. Expand meaningful collaborations and research opportunities with regional, national, and global partners.
- B. Provide access to outstanding intellectual programming.
- C. Produce and sponsor outstanding cultural and artistic programming.
- D. Provide non-credit enrichment experiences for the community.
- E. Provide leadership in regional economic development.
- F. Serve as an exemplar of free and open discourse.

Create a Stronger University through Improving the Support of Stakeholders and the Quality and Efficiency of the Organization

A. Process Goals: Measurement and metrics

1. Prioritize and establish a set of appropriate performance metrics for all academic and non-academic units.
2. Establish an integrated system of program reporting, review, assessment, and accreditation that is aligned to performance metrics.

B. Process Goal: Efficiency

1. Allocate resources to priorities informed by performance metrics.
2. Decentralize resource distribution and control to lowest level, mission-focused administrative units.
3. Eliminate process barriers in enrollment management that impact student achievement.
4. Identify gaps in academic and program offerings and prioritize programs for creation, expansion, merging, or cessation.
5. Continue increasing transparency in resource allocation budget formation, administration, and personnel decisions.

C. Process Goal: Philanthropic support

1. Build infrastructure to support advancement goals and functions.
2. Implement a strategy for sustainable external funding of strategic priorities.
3. Re-envision Foundation Board as fundraising leadership board.
4. Enhance volunteer engagement in support of strategic goals and fundraising.

Appendix 2: Summary of Indiana DWD and/or U.S. Department of Labor Data, Detail

The following tables were downloaded from the United States Bureau of Labor Statistics on July 7, 2016 (<http://www.bls.gov/ooh/math/actuaries.htm>). They provide employment data for actuaries as of May 2015 nationally, for Indiana and surrounding states, and for the Fort Wayne metropolitan area. While the state of Indiana is below the national average in employing actuaries, with a location quotient of 2.83, Fort Wayne has nearly a three times higher concentration for the occupation than the national average. Close to 3,000 actuaries were employed in Indiana, Illinois, Michigan, and Ohio in 2015. Graduates of the program also seek jobs in related fields, which are not included here.

Occupation: Actuaries (SOC code 152011) Period: May 2015				
Area name	Employment(1)	Employment percent relative standard error(3)	Annual mean wage(2)	Annual median wage(2)
National	19,770	3.6%	\$110,560	\$97,070

Occupation: Actuaries (SOC code 152011) Period: May 2015						
Area name	Employment (1)	Employment percent relative standard error (3)	Annual mean wage (2)	Annual median wage (2)	Employment per 1,000 jobs	Location Quotient
Indiana	260	13.3%	\$96,490	\$91,440	0.088	0.61
Illinois	1,410	15.0%	\$94,620	\$84,840	0.241	1.68
Michigan	370	24.3%	\$96,780	\$85,910	0.088	0.61
Ohio	940	24.1%	\$96,670	\$89,430	0.178	1.24

Occupation: Actuaries (SOC code 152011) Period: May 2015						
Area name	Employment (1)	Employment percent relative standard error (3)	Annual mean wage (2)	Annual median wage (2)	Employment per 1,000 jobs	Location Quotient
Fort Wayne, IN	80	35%	\$99,290	\$91,540	0.406	2.83

Footnotes:

(1) Estimates for detailed occupations do not sum to the totals because the totals include occupations not shown separately. Estimates do not include self-employed workers.

(2) Annual wages have been calculated by multiplying the hourly mean wage by 2080 hours.

(3) The relative standard error (RSE) is a measure of the reliability of a survey statistic. The smaller the relative standard error the more precise the estimate.

SOC code: Standard Occupational Classification code -- see <http://www.bls.gov/soc/home.htm>

Data extracted on July 7 2016

While the percent change in employment for 2014-2024 is projected to be 7% for all occupations in the U.S. economy, the outlook is substantially more favorable for actuarial jobs. The 2014-2024 projections of the Bureau of Labor Statistics are displayed in the following table, downloaded on July 7, 2016 from <http://www.bls.gov/ooh/math/actuaries.htm>. As can be seen, the total employment for actuaries is projected to grow 18.1%, from 24,600 jobs in 2014 to 29,000 jobs in 2024, indicating an increase of 4,400 jobs over the ten-year period. A positive percent change in employment is predicted in all industries, with the exception of actuarial jobs in the federal government. Furthermore, the percent change exceeds the national 7% rate for actuarial jobs in all industries except for hospitals, Codes 622000 and 622100. A 16.7% increase is projected for the finance and insurance industry, one of the critical sectors in the Northeast Indiana economy.

Employment by industry, occupation, and percent distribution, 2014 and projected 2024

15-2011 Actuaries

(Employment in thousands)

Industries with fewer than 50 jobs, confidential data, or poor quality data are not displayed

Industry		2014			2024			% change	Employment change
Code and Title	Employment	% of industry	% of occupation	Employment	% of industry	% of occupation			
TE1000	Total employment	24.6	0.0	100.0	29.0	0.0	100.0	18.1	4.4
TE1200	Total wage and salary employment	24.6	0.0	100.0	29.0	0.0	100.0	18.1	4.4
520000	Finance and insurance	17.5	0.3	71.5	20.5	0.3	70.6	16.7	2.9
523000	Securities, commodity contracts, and other financial investments and related activities	0.3	0.0	1.1	0.4	0.0	1.2	34.2	0.1
524000	Insurance carriers and related activities	17.2	0.7	70.1	20.1	0.8	69.2	16.5	2.8
524100	Insurance carriers	13.0	0.9	53.1	14.7	1.0	50.7	12.7	1.7
524200	Agencies, brokerages, and other insurance related activities	4.2	0.4	17.0	5.4	0.5	18.5	28.3	1.2
540000	Professional, scientific, and technical services	3.6	0.0	14.8	4.6	0.0	15.9	26.2	1.0
541000	Professional, scientific, and technical services	3.6	0.0	14.8	4.6	0.0	15.9	26.2	1.0

541900	Other professional, scientific, and technical services	0.2	0.0	1.0	0.3	0.0	1.0	24.2	0.1
550000	Management of companies and enterprises	2.1	0.1	8.7	2.6	0.1	8.9	20.7	0.4
560000	Administrative and support and waste management and remediation services	0.1	0.0	0.3	0.1	0.0	0.3	18.3	0.0
561000	Administrative and support services	0.1	0.0	0.3	0.1	0.0	0.3	18.3	0.0
620000	Healthcare and social assistance	0.1	0.0	0.5	0.1	0.0	0.5	28.3	0.0
621000	Ambulatory healthcare services	0.1	0.0	0.2	0.1	0.0	0.3	51.1	0.0
622000	Hospitals; state, local, and private	0.1	0.0	0.2	0.1	0.0	0.2	6.8	0.0
622100	General medical and surgical hospitals; state, local, and private	0.1	0.0	0.2	0.1	0.0	0.2	6.8	0.0
900000	Government	0.9	0.0	3.7	1.0	0.0	3.3	7.1	0.1
910000	Federal government	0.3	0.0	1.2	0.3	0.0	0.9	-9.6	0.0
9992-3	State and local government, excluding education and hospitals	0.6	0.0	2.4	0.7	0.0	2.4	15.6	0.1

Note: Red indicates a decline in employment from 2014 to 2024
Source: Employment Projections program, U.S. Department of Labor,
U.S. Bureau of Labor Statistics

Short-term and long-term projections for actuarial jobs were obtained from Projections Central (downloaded July 8, 2016 from the website <http://www.projectionscentral.com/>) for Indiana and surrounding states. The short-term projections from 2015-2017 for the state of Indiana indicate 20 annual openings, on average, with a projected increase in jobs of 5.4%. In the short-term, 170 average annual openings are projected for Indiana, Illinois, Michigan, and Ohio overall.

Area Name	Occupation Code	Occupation Name	Base Year	Base	Projection Year	Projection	Change	Percent Change	Average Annual Openings
Indiana	15-2011	Actuaries	2015	330	2017	350	20	5.4	20
Illinois	15-2011	Actuaries	2015	1,250	2017	1,310	60	4.5	60
Michigan	15-2011	Actuaries	2015	420	2017	450	30	7.1	30
Ohio	15-2011	Actuaries	2015	1,090	2017	1,150	60	5.5	60

Long-term projections from 2014-2024 show a 15.7% increase in actuarial jobs in Indiana compared to a 17.9% increase nationally. Similar increases are projected for Illinois, Michigan, and Ohio. In the long-term, an average of 150 annual openings is projected for Indiana, Illinois, Michigan, and Ohio overall.

Area Name	Occupation Code	Occupation Name	Base Year	Base	Projection Year	Projection	Change	Percent Change	Average Annual Openings
United States	15-2011	Actuaries	2014	24,600	2024	29,000	4,400	17.9	1,170
Indiana	15-2011	Actuaries	2014	330	2024	380	50	15.7	20
Illinois	15-2011	Actuaries	2014	1,220	2024	1,420	200	16.2	60
Michigan	15-2011	Actuaries	2014	410	2024	510	100	24.4	20
Ohio	15-2011	Actuaries	2014	1,010	2024	1,160	150	14.9	50

The following table shows the projected future demand for actuaries in the state of Indiana in 2022, provided by the Indiana Department of Workforce Development, downloaded on July 8, 2016. The projections are similar to those of the Projections Central.

Future Demand for Indiana

Code	Title	Projected Demand -2022	Avg. Annual Openings	Avg. Annual New Openings	Percent of Total Openings	Avg. Annual Replacement Openings	Percent of Total Openings	Avg. Annual Wage in (2015)	Current Demand: Online Job Ads (2-mo. avg)
152011	Actuaries	471	16	4	25.00%	12	75.00%	\$96,490	31

Source: Indiana Department of Workforce Development, Research & Analysis, Long-term Projections

The following tables were downloaded from the Indiana Department of Workforce Development on July 8, 2016. They contain the employment and job outlook for actuaries in 2022 for the United States, the state of Indiana, and EGR3, the Economic Growth Region for Northeast Indiana containing Fort Wayne. Specifically, for those individuals with a Bachelor’s Degree, the Indiana Department of Workforce Development indicates a 25.9% job growth for actuaries nationally. A favorable outlook exists for actuaries with a Bachelor’s degree in the Northeast region of Indiana. The demand for these individuals in EGR3 is growing at approximately three times the rate (27.6%) when compared to the state of Indiana (9.5%).

Side-by-Side Comparison - Actuaries in 2022

	U.S. 2022	Indiana 2022	EGR 3
Employment and Openings			
Projected Occupational Employment	30,600	471	71
Average Annual Openings	1,320	16	3
Openings to Fill by 2022	13,200	160	30
Growth Rate	25.9 %	9.3 %	24.6 %

Job Growth by Educational Requirement			
Less Than a H.S. Diploma	0.0 %	0.0 %	0.0 %
H.S. Diploma	0.0 %	0.0 %	0.0 %
Post Secondary Certificate or Some College	0.0 %	0.0 %	0.0 %
Associate Degree	0.0 %	0.0 %	0.0 %
Bachelor's Degree	25.9 %	9.5 %	27.6 %
Advanced Degrees	25.9 %	9.1 %	21.4 %
Job Distribution by Educational Requirement			
Less Than a H.S. Diploma	0.0 %	0.0 %	0.0 %
H.S. Diploma	0.0 %	0.0 %	0.0 %
Post Secondary Certificate or Some College	0.0 %	0.0 %	0.0 %

Associate Degree	0.0 %	0.0 %	0.0 %
Bachelor's Degree	51.5 %	51.6 %	52.1 %
Advanced Degrees	48.5 %	48.4 %	47.9 %

Source: Indiana Department of Workforce Development, Research & Analysis, Long-term Projections

Appendix 3: National, State, or Regional Studies, Detail

The Jacobson Group and Ward Group published a study investigating insurance industry hiring trends in the United States in February, 2016. (https://jacobsononline.com/uploadfiles/industry_labor_mkt_study_summary_q12016_final.pdf)

Findings of their Insurance Labor Market Survey in the first quarter of 2016 indicate that:

- “66.3% of companies plan to increase staff during the next 12 months driven by 68% in the Life/Health category. These are the highest percentages expected in the history of the survey.”
- “Technology, Claims, and Underwriter roles are expected to grow the greatest during the next 12 months.”
- “Technology, Actuarial, and Analytic positions are the most difficult to fill.”

The IPFW Community Research Institute has published several regional studies, including employment projections and training needs. Some relevant findings of these studies are provided below.

Labor Market Analysis in Northeast Indiana, January 2011

(<http://www.neindiana.com/docs/workforce/monster---labor-market-analysis-in-northeast-indiana.pdf?sfvrsn=6>)

- “Finance & Insurance was the largest sector across all three periods; it accounted for 15% of all National and 6% of NE Indiana job opportunities.”
- There was a 51% increase in Northeast Indiana job postings in the Finance and Insurance sector from 1,165 in the first half of 2009 to 1,764 in the first half of 2010.
- “Finance & Insurance job postings and resumes are primarily in Allen County, where 88% of job postings and 70% of candidates are located.”

Occupational Projections and Training Needs for Northeast Indiana to 2018, February 2011

<http://www.neindiana.com/docs/workforce/occupational-projections-training-needs-for-northeast-indiana-to-2018.pdf?sfvrsn=4!>

- “Other drivers of employment growth in NE Indiana include a general turnaround in US manufacturing, a reversal of the decline in the insurance cluster and continued growth in the health care and transportation clusters in Northeast Indiana.”
- “The forecast suggests that the percent of openings for workers with a college or advanced degree will increase while openings for high school graduates or workers with less than a high school diploma will drop. The forecast suggests that 30% of the training requirement will be at the Bachelor’s or higher degree level and another 7% will require a post-secondary degree or certificate.”
- “The category of Bachelor’s degree plus work experience includes many of the middle and upper management jobs in the regional economy. This is an important category in the competitiveness of the region since it represents jobs that are filled through regional or national searches in the absence of local talent. Local talent and advanced degrees in these fields are a competitive advantage while a lack of local talent is a competitive disadvantage for the region. Over half of the jobs in this category involve management occupations. Another 44 percent consists of management analysts, which is an important occupation in finance and insurance. Another one of the occupations on the list was mentioned in our insurance focus group: Actuaries.”
- The Financial Services and Insurance “Cluster has bottomed, will grow at national rates in future.”

Allen County Insight, April 2013

<https://www.ipfw.edu/dotAsset/9a5b34bd-69da-4750-98ce-45cb954dcb64.pdf>)

Allen County in 2013, the Finance and Insurance sector accounted for \$1,468,688,679 or 9.2% of the Gross Regional Product.

Indiana Business Review, Winter 2013

<http://www.ibrc.indiana.edu/ibr/2013/outlook/fortwayne.html>)

The *Fort Wayne Forecast 2014* indicated growth in Finance and Insurance employment from the first quarter of 2012 to the first quarter of 2013.

Industry	Employment		Change 2012 Q1 to 2013 Q1		2013 Q1 Average Annual Wage
	2012 Q1	2013 Q1	Number	Percent	
Finance and Insurance	8,485	8,572	87	1.0%	\$73,965

Regional Intel Report by the IPFW Community Research Institute, 2015-2016

https://ind657-my.sharepoint.com/personal/oxtobyj_ipfw_edu/Documents/USAP%20-%202015-16/Regional%20Intel%20Report.pdf

- “Approximately 17% (nearly 3,600) of regional openings over the next decade will be in analytical fields – potential connections to growth areas like Big Data, fraud prevention, market research, etc.”
- IPFW conferred 61% of all awards in the Northeast Indiana region since 2003 (268 of 441)
- Since 2003 the region’s completions in mathematics and statistics have remained flat; during this same period there has been a near doubling of completions at the state and national levels.

Region	Completions		Percent Change
	2003	2014	
Northeast Indiana Region	31	35	12.9%
State	514	991	92.8%
Nation	19,657	36,259	84.5%

Appendix 4: Surveys of Employers or Students and Analyses of Job Postings, Detail

A search of CareerCast.com listed 395 job postings for actuaries in the United States. Of these postings, 2 were in Indiana, 17 were in Illinois, and 5 were in Michigan.

Link: <http://www.careercast.com/jobs/results/keyword/actuaries>

A search of Monster.com listed over 1,000 jobs for actuaries. Sixty-eight jobs were in Indiana, and 547 were in one of the contiguous states: 306 in Illinois, 111 in Michigan, and 130 in Ohio.

Link: <http://www.monster.com/jobs/search/?q=Actuary>

A search of the Society of Actuaries Job Center website posted 131 actuarial jobs for Actuarial candidates with 1-5 SOA exams passed. Of these postings 2 were in Indiana, 15 in Illinois, 2 in Michigan, and 10 in Ohio. The Casualty Actuarial Society listed 19 jobs for candidates with a four-year degree on their www.careers.casact.org/jobs/ website. Of these postings 1 was in Indiana, 4 in Illinois, 1 in Michigan, and 0 in Ohio.

Link: <http://jobs.soa.org/jobseeker/search/results/>

A search of the CareerOneStop.com Job Finder found 1,917 jobs for actuaries in the United States. Twenty-three of these jobs were in Indiana, 130 in Illinois, 47 in Michigan, and 48 in Ohio.



CareerOneStop Job Finder

We found 23 job(s) for actuaries in Indiana.

We found 47 job(s) for actuaries in Michigan.

We found 48 job(s) for actuaries in Ohio.

We found 130 job(s) for actuaries in Illinois.

Job Title	Company	Location	Date Posted
Associate Actuary	Milliman	Indianapolis, Indiana	05/26/2016
Consulting Actuary	Milliman	Indianapolis, Indiana	05/26/2016
Actuarial Analyst- Exam	Milliman	Indianapolis, Indiana	07/01/2016
Actuarial Consultant (ASA or FSA)	Milliman	Indianapolis, Indiana	07/01/2016
Actuarial Data Analyst	Milliman	Indianapolis, Indiana	06/08/2016
Associate Actuarial Consultant	Exl Service	Indianapolis, Indiana	07/12/2016
Actuarial Analyst - Multiple Locations	UnitedHealth Group	Indianapolis, Indiana	06/13/2016
Actuarial Consultant (FSA)	Milliman	Indianapolis, Indiana	07/01/2016
Consulting Actuary (Financial Reporting Emphasis)	Milliman	Indianapolis, Indiana	06/27/2016
Consulting Actuary (Financial Reporting Emphasis)	Milliman	Indianapolis, Indiana	05/26/2016
Director, Actuarial Valuation, VUL	Lincoln Financial Group	Fort Wayne, Indiana	04/15/2016
Consultant, Actuarial Recruiting	Lincoln Financial Group	Fort Wayne, Indiana	05/28/2016
AVP, Senior Actuary Head of Valuation - Fixed, Fixed Indexed	Lincoln Financial Group	Fort Wayne, Indiana	07/08/2016
Healthcare Data Analyst	Milliman	Indianapolis, Indiana	07/01/2016

Job Title	Company	Location	Date Posted
Business Info Analyst Sr - 119821SK	Anthem, Inc	Indianapolis, Indiana	07/06/2016
Pricing Analyst - Multiple Locations	UnitedHealth Group	Indianapolis, Indiana	05/25/2016
Analyst - Healthcare Business	Rose International INC	Indianapolis, Indiana	06/29/2016
Dir Network Management- Long Term Support Services120054	Anthem, Inc	Indianapolis, Indiana	07/11/2016
Reporting Analyst	AIG	Jeffersonville, Indiana	05/27/2016
Cost of Care Director - 118866	Anthem, Inc	Indianapolis, Indiana	06/03/2016
Benefits Admin Sr. Assoc	Xerox	Fort Wayne, Indiana	06/30/2016
Benefits Admin Assoc	Xerox	Indianapolis, Indiana	06/17/2016
Tax Services Senior - PAS- Tax Technical	EY	Indianapolis, Indiana	07/08/2016
Actuary Manager	Blue Cross Blue Shield of Michigan	Detroit, Michigan	05/27/2016
Actuary Product Pricing Lead	Blue Cross Blue Shield of Michigan	Detroit, Michigan	05/24/2016
Actuarial Consultant HSS	McKinsey and Company	Detroit, Michigan	07/13/2016
Retirement/Pension Actuary - Senior Consultant	Deloitte	Detroit, Michigan	04/23/2016
Informatics Analyst I – Actuarial Analytics	Blue Cross Blue Shield of Michigan	Detroit, Michigan	06/21/2016
Informatics Analyst I - Actuarial Analytics - ACT0	Blue Cross Blue Shield (Bcbs) Of Michigan	Detroit, Michigan	06/22/2016
Director, Insurance Risk Oversight	Jackson National Life	Lansing, Michigan	06/15/2016

Job Title	Company	Location	Date Posted
	Insurance Company		
Warranty Data Analytics Manager	General Motors	Warren, Michigan	06/03/2016
Product Development Analyst	The Auto Club Group	Dearborn, Michigan	07/13/2016
Senior Analyst - Warranty Data Analytics and Reporting	General Motors	Warren, Michigan	06/03/2016
Senior Sales Information Analyst - Analytics and Reporting, Business Segment Performance	Blue Cross Blue Shield of Michigan	Detroit, Michigan	05/13/2016
Liability Claims Data Analyst	Trinity Health	Livonia, Michigan	05/26/2016
Risk Management Manager	Meijer	Grand Rapids, Michigan	07/13/2016
Business Info Analyst Sr - 119821SK	Anthem, Inc	Dearborn, Michigan	07/06/2016
Solution Manager Ingenuity	McKinsey and Company	Detroit, Michigan	07/13/2016
Commercial Property Inspections Loss Control	Verisk Insurance Solutions - Commercial Property	Lansing, Michigan	06/24/2016
Dir Network Management- Long Term Support Services120054	Anthem, Inc	Dearborn, Michigan	07/11/2016
Associate Director, Benefits and Wellness	Eastern Michigan University	Ypsilanti, Michigan	07/08/2016
Departmental Analyst 12 (Performance Based CW Analyst)	State of Michigan	Lansing, Michigan	07/14/2016
Data Scientist Ingenuity	McKinsey and Company	Detroit, Michigan	07/13/2016
Model Risk Consultant, Risk Dynamics	McKinsey and Company	Detroit, Michigan	07/13/2016
Enterprise Risk Management (ERM) Analyst	Blue Cross Blue Shield of	Detroit, Michigan	06/27/2016

Job Title	Company	Location	Date Posted
	Michigan		
Sr. Accountant Corporate Accounting and Employee	Federal Mogul Powertrain	Southfield, Michigan	06/25/2016
Trust Analyst, Detroit, MI	Comerica	Detroit, Michigan	06/17/2016
Cost of Care Director - 118866	Anthem, Inc	Dearborn, Michigan	06/03/2016
Director of Commercial Underwriting	Farmers Insurance	Caledonia, Michigan	05/25/2016
Product Development Specialist	Meridian Health Plan	Detroit, Michigan	06/22/2016
Trust Analyst, Detroit, MI	Comerica Management Co Inc.	Detroit, Michigan	06/19/2016
Trust Analyst, Detroit, MI	Comerica Management Co Inc.	Detroit, Michigan	06/19/2016
Healthcare Provider Network Contractor - Michigan	UnitedHealth Group	Southfield, Michigan	05/10/2016
Healthcare Provider Network Contractor - Michigan	UnitedHealth Group	Kalamazoo, Michigan	05/10/2016
Senior Finance Analyst - Employee Benefits and Compensation	General Motors	Detroit, Michigan	05/07/2016
Configuration Analyst	McLaren Health Plan	Flint, Michigan	04/22/2016
Claim Associate	The Auto Club Group	Grand Rapids, Michigan	07/11/2016
Claim Associate-Auto Physical Damage	The Auto Club Group	Auburn Hills, Michigan	07/11/2016
Claim Associate	The Auto Club Group	Auburn Hills, Michigan	07/11/2016
Temporary Auto Claim Associate	The Auto Club Group	Auburn Hills, Michigan	07/11/2016

Job Title	Company	Location	Date Posted
Claim Associate - Meemic Personal Injury Protection	The Auto Club Group	Auburn Hills, Michigan	07/11/2016
Hospital Contract Negotiator.	Aetna	Detroit, Michigan	05/19/2016
Senior Financial Analyst - Pharmacy	Meridian Health Plan	Detroit, Michigan	05/11/2016
Healthcare Provider Network Contract Manager - Michigan	UnitedHealth Group	Battle Creek, Michigan	04/15/2016
Healthcare Provider Network Contract Manager - Michigan	UnitedHealth Group	Kalamazoo, Michigan	04/15/2016
Healthcare Provider Network Contract Manager - Michigan	UnitedHealth Group	Grand Rapids, Michigan	04/15/2016
Healthcare Provider Network Contract Manager - Michigan	UnitedHealth Group	Portage, Michigan	04/15/2016
Healthcare Provider Network Contract Manager - Michigan	UnitedHealth Group	Southfield, Michigan	04/15/2016
Healthcare Provider Network Contract Manager - Michigan	UnitedHealth Group	Detroit, Michigan	04/15/2016
Chief Underwriting Officer - Midwest	The Hanover Insurance Group	Howell, Michigan	05/19/2016
Actuarial Analyst	Great American Insurance Co.	Cincinnati, Ohio	06/13/2016
Actuarial Analyst	Great American Insurance Co.	Cincinnati, Ohio	05/14/2016
Actuarial Consultant, NF	Nationwide	Columbus, Ohio	07/14/2016
Sr Actuary, Specialty Ins	Nationwide	Columbus, Ohio	06/21/2016

Job Title	Company	Location	Date Posted
Associate Actuary - Spec Ins	Nationwide	Columbus, Ohio	06/23/2016
Dir, Actuarial Services	Medical Mutual of Ohio	Cleveland, Ohio	06/09/2016
Director Actuarial Services Government Programs	CVS Health	Solon, Ohio	06/26/2016
Senior Actuarial Analyst I - II	Great American Insurance Co.	Cincinnati, Ohio	05/14/2016
Senior Medical Economics Consultant	Aetna	Columbus, Ohio	07/12/2016
Business Info Analyst Sr - 119821SK	Anthem, Inc	Worthington, Ohio	07/06/2016
Business Info Analyst Sr - 119821SK	Anthem, Inc	Cincinnati, Ohio	07/06/2016
Business Info Analyst Sr - 119821SK	Anthem, Inc	Valley View, Ohio	07/06/2016
Business Info Analyst Sr - 119821SK	Anthem, Inc	Mason, Ohio	07/06/2016
Dir Network Management- Long Term Support Services120054	Anthem, Inc	Mason, Ohio	07/11/2016
Dir Network Management- Long Term Support Services120054	Anthem, Inc	Valley View, Ohio	07/11/2016
Dir Network Management- Long Term Support Services120054	Anthem, Inc	Cincinnati, Ohio	07/11/2016
Dir Network Management- Long Term Support Services120054	Anthem, Inc	Worthington, Ohio	07/11/2016
Vice President, Finance	Centene Corporation	Columbus, Ohio	05/17/2016
SR Finance Director	Aetna	New Albany, Ohio	07/13/2016

Job Title	Company	Location	Date Posted
Senior Product Analyst	Great American Insurance Co.	Cincinnati, Ohio	07/01/2016
Senior Product Analyst	Great American Insurance Co.	Cincinnati, Ohio	06/25/2016
Director, Benefits Accounting	Eaton Corporation	Cleveland, Ohio	06/15/2016
Senior Production Underwriter / Production Underwriter	Great American Insurance Co.	Cincinnati, Ohio	06/03/2016
Cost of Care Director - 118866	Anthem, Inc	Cincinnati, Ohio	06/03/2016
Cost of Care Director - 118866	Anthem, Inc	Worthington, Ohio	06/03/2016
Cost of Care Director - 118866	Anthem, Inc	Valley View, Ohio	06/03/2016
Cost of Care Director - 118866	Anthem, Inc	Mason, Ohio	06/03/2016
Sr. Benefits Consultant	Battelle Memorial Institute	Columbus, Ohio	05/28/2016
Senior Accountant	AmTrust Financial Services	Cleveland, Ohio	07/08/2016
Buck Consultants - Sr. Administrative Assistant	Buck Consultants, LLC.	Cincinnati, Ohio	07/05/2016
Product Manager	First Acceptance	Columbus, Ohio	06/22/2016
Product Manager	First Acceptance	Cleveland, Ohio	06/22/2016
Vice President, Product Development	First Acceptance	Columbus, Ohio	05/22/2016
Vice President, Product Development	First Acceptance	Cleveland, Ohio	05/22/2016
Buck-Customer Svc Rep	Buck Consultants, LLC.	Maumee, Ohio	05/12/2016

Job Title	Company	Location	Date Posted
Buck-Customer Svc Rep	Buck Consultants, LLC.	Maumee, Ohio	05/12/2016
Product Manager - Personal Lines	Progressive	Mayfield Village, Ohio	04/30/2016
Specialty Operations Coord	Sedgwick Claims Management Services, Inc.	Dublin, Ohio	04/20/2016
Specialty Operations Coord	Sedgwick Claims Management Services, Inc.	Cleveland, Ohio	04/28/2016
Senior Asset/Liability Analyst	KeyBank	Cleveland, Ohio	07/01/2016
Senior Web Analyst, Digital Acquisition	Progressive	Mayfield Village, Ohio	07/09/2016
Pricing Analyst	Park Place Technologies	Mayfield Heights, Ohio	05/05/2016
Pricing Analyst	Park Place Technologies	Mayfield Heights, Ohio	05/05/2016
Buck-Senior Associate, Health	Buck Consultants, LLC.	Maumee, Ohio	05/12/2016
Network Contract Manager - East, SE or Midwest - Telecommute	UnitedHealth Group	Cleveland, Ohio	05/10/2016
Pricing Analyst	Park Place Technologies	Mayfield Heights, Ohio	05/05/2016
Pricing Analyst	Park Place Technologies	Mayfield Heights, Ohio	05/05/2016
Sr. Human Resources Analyst	Owens Corning	Toledo, Ohio	06/28/2016
Actuary	Milliman	Chicago, Illinois	05/10/2016
Actuary	Zurich NA	Schaumburg, Illinois	05/26/2016
Actuary	Centene Corporation	Chicago, Illinois	05/02/2016

Job Title	Company	Location	Date Posted
Associate Actuary	Blue Cross and Blue Shield of Illinois, Montana, N	Chicago, Illinois	06/23/2016
Associate Actuary	Blue Cross Blue Shield of Illinois	Chicago, Illinois	06/28/2016
Actuarial Project Manager / Associate Actuary	Milliman	Chicago, Illinois	05/06/2016
Consulting Actuary	Milliman	Chicago, Illinois	05/06/2016
Associate Actuary(34764)	Blue Cross Blue Shield of Illinois	Chicago, Illinois	06/29/2016
Lead Actuarial Associate	Blue Cross and Blue Shield of Illinois, Montana, N	Chicago, TX, Illinois	06/29/2016
Actuarial Analyst II	Zurich NA	Schaumburg, Illinois	05/27/2016
Senior Actuarial Analyst-Reserving	Zurich NA	Schaumburg, Illinois	05/26/2016
Lead Actuarial Associate	Blue Cross and Blue Shield of Illinois, Montana, N	Chicago, Illinois	07/06/2016
Actuarial Analyst Predictive Modeling	Zurich NA	Schaumburg, Illinois	04/25/2016
Lead Actuarial Associate(35088)	Blue Cross Blue Shield of Illinois	Chicago, Illinois	07/10/2016
Manager, Actuarial Services (commercial)	Centene Corporation	Chicago, Illinois	05/25/2016
Sr. International Actuarial Analyst	Towers Watson Delaware inc.	Chicago, Illinois	07/03/2016
Health and Benefits Actuarial Associate	Marsh & McLennan Companies	Chicago, Illinois	05/31/2016

Job Title	Company	Location	Date Posted
Lead Actuarial Associate	Blue Cross Blue Shield of Illinois	Chicago, Illinois	07/10/2016
Senior Actuarial Assistant	Centene Corporation	Chicago, Illinois	07/01/2016
Life Actuary Senior Consultant	Deloitte	Chicago, Illinois	04/23/2016
Health Actuary Manager	Deloitte	Chicago, Illinois	06/08/2016
Health Actuary Senior Consultant	Deloitte	Chicago, Illinois	04/23/2016
Vice President, Actuary & Director II	Zurich NA	Schaumburg, Illinois	05/19/2016
Senior Actuarial Analyst - Technical Services	Zurich NA	Schaumburg, Illinois	05/26/2016
Vice President, Actuary & Director II	Zurich NA	Schaumburg, Illinois	05/19/2016
Actuarial Analyst I-Technical Services	Zurich NA	Schaumburg, Illinois	07/06/2016
Consulting Actuary - Medicaid	Milliman	Chicago, Illinois	04/20/2016
Actuarial Analyst II-Technical Services	Zurich NA	Schaumburg, Illinois	05/27/2016
Multiple Life Insurance Actuary Openings	CSC	Jacksonville, Illinois	06/27/2016
AVP Reserving Actuary-Global Corporate	Zurich NA	Schaumburg, Illinois	05/26/2016
Life Product Management-Actuary-Director	Allstate	Northbrook, Illinois	06/22/2016
Property & Casualty Actuarial Senior Manager	Deloitte	Chicago, Illinois	04/23/2016
Senior Actuarial Consultant - Mercer Marketplace	Marsh & McLennan Companies	Chicago, Illinois	06/15/2016

Job Title	Company	Location	Date Posted
AVP Actuary, Business Insights for Programs and Direct Markets	Zurich NA	Schaumburg, Illinois	05/26/2016
Property & Casualty Actuarial Senior Consultant	Deloitte	Chicago, Illinois	04/23/2016
Actuarial Intern (Lincolnshire) - Fall 2016	Aon Corporation	Lincolnshire, Illinois	04/23/2016
Junior Trader Consultant (Non-Actuarial)	Milliman	Chicago, Illinois	05/20/2016
Humana One/Medicaid TQP Associate Actuary	Humana	Chicago, Illinois	06/03/2016
MAPD Divisional Actuarial Director - Northern Division	Humana	Chicago, Illinois	07/07/2016
Consultant, Human Capital, Actuarial, Rewards & Analytics - Insurance Services	Deloitte	Chicago, Illinois	05/25/2016
Health and Benefits Assistant Vice President- Actuary (Lincolnshire or Chicago, IL; Milwaukee, WI; Southfield, MI and Minneapolis/Bloomington, MN)	Aon Corporation	Lincolnshire, Illinois	06/02/2016
Advisory Services Manager - Financial Services - Insurance and Actuarial Advisory Services - Property & Casualty	EY	Chicago, Illinois	06/22/2016
Advisory Services Manager - Financial Services - Insurance and Actuarial Advisory Services - Long Term Care Manager	EY	Chicago, Illinois	06/24/2016
International Consultant	Marsh & McLennan Companies	Chicago, Illinois	07/05/2016
Product & Pricing Specialist	Nationwide	Chicago, Illinois	07/12/2016
Insurance & Claims Analyst - Risk Management - 16-0546 f/t	Northwest Community Hospital	Arlington Heights, Illinois	05/13/2016

Job Title	Company	Location	Date Posted
Pharmacist - Formulary Management	CVS Health	Northbrook, Illinois	05/06/2016
Manager, Health Outcomes & Analytics	Walgreens	Deerfield, Illinois	07/08/2016
Business Info Analyst Sr - 119821SK	Anthem, Inc	Deerfield, Illinois	07/06/2016
Business Info Analyst Sr - 119821SK	Anthem, Inc	Chicago, Illinois	07/06/2016
Business Info Analyst Sr - 119821SK	Anthem, Inc	Westchester, Illinois	07/06/2016
Retirement Provider Consulting - Senior Consultant	Deloitte	Chicago, Illinois	06/07/2016
Advanced Client Consultant(33248)	Blue Cross Blue Shield of Illinois	Chicago, Illinois	06/23/2016
Pricing Technician Analyst	Allstate	Northbrook, Illinois	06/02/2016
Benefits Analyst	Marsh & McLennan Companies	Vernon Hills, Illinois	05/25/2016
Financial Business Intelligence Technical Analyst(34004)	Blue Cross Blue Shield of Illinois	Chicago, Illinois	07/11/2016
Dir Network Management- Long Term Support Services120054	Anthem, Inc	Deerfield, Illinois	07/11/2016
Dir Network Management- Long Term Support Services120054	Anthem, Inc	Westchester, Illinois	07/11/2016
Dir Network Management- Long Term Support Services120054	Anthem, Inc	Chicago, Illinois	07/11/2016
Financial Business Intelligence Technical Analyst	Blue Cross and Blue Shield of Illinois, Montana, N	Chicago, Illinois	06/02/2016
Sr Manager Analytics & Reporting	Blue Cross and Blue Shield	Chicago, Illinois	07/01/2016

Job Title	Company	Location	Date Posted
	of Illinois, Montana, N		
Sr Director Financial Strategy and Planning(34630)	Blue Cross Blue Shield of Illinois	Chicago, Illinois	06/25/2016
Divisional Vice President Financial Operations(25144)	Blue Cross Blue Shield of Illinois	Chicago, Illinois	06/23/2016
Sr Director Financial Performance Monitor Reporting(34628)	Blue Cross Blue Shield of Illinois	Chicago, Illinois	06/25/2016
Manager, HR Due Diligence	KPMG	Chicago, Illinois	06/11/2016
Manager, HR Due Diligence	KPMG	Chicago, Illinois	06/14/2016
Contract Consultant	Allstate	Northbrook, Illinois	05/27/2016
Contract Analyst	Allstate	Northbrook, Illinois	05/26/2016
Encompass Project Manager	Allstate	Northbrook, Illinois	06/11/2016
Cost of Care Director - 118866	Anthem, Inc	Deerfield, Illinois	06/03/2016
Cost of Care Director - 118866	Anthem, Inc	Chicago, Illinois	06/03/2016
Cost of Care Director - 118866	Anthem, Inc	Westchester, Illinois	06/03/2016
Human Capital Mergers, Acquisitions, and Restructuring Senior Consultant	Deloitte	Chicago, Illinois	04/23/2016
Compensation Strategies Senior Consultant	Deloitte	Chicago, Illinois	04/27/2016
Product Management Program Manager	Allstate	Northbrook, Illinois	04/29/2016
Data Innovation Lab Practicum	Caterpillar	Champaign, Illinois	07/08/2016

Job Title	Company	Location	Date Posted
Sr Manager Analytics & Reporting	Blue Cross Blue Shield of Illinois	Chicago, Illinois	07/08/2016
Buck-Sr Consultant, Absence Management	Buck Consultants, LLC.	Chicago, Illinois	07/08/2016
Human Resources Transaction Services Director - Labor Law	PwC	Chicago, Illinois	07/07/2016
Benefits - Financial Compliance and Reporting - Manager	United Airlines	Chicago, Illinois	06/29/2016
Business Practices & Project Consultant IV	Zurich NA	Schaumburg, Illinois	07/12/2016
Healthcare Provider Network Contract Manager - Chicago, IL	UnitedHealth Group	Chicago, Illinois	06/21/2016
Specialty Sales Project Manager	Aetna	Chicago, Illinois	06/15/2016
HRO Programmer Analyst Advanced - (Lincolnshire, IL)	Aon Corporation	Illinois	07/10/2016
Healthcare Provider Network Contractor - Iowa	UnitedHealth Group	Moline, Illinois	06/02/2016
Senior Defined Contribution Consultant	Marsh & McLennan Companies	Chicago, Illinois	05/18/2016
Statistical Modeler	RELX Group	Chicago, Illinois	04/19/2016
Analyst, Application Development	Lincoln Financial Group	Rolling Meadows, Illinois	04/15/2016
Healthcare Provider Network Contract Manager - Chicago, IL	UnitedHealth Group	Chicago, Illinois	05/10/2016
Healthcare Provider Network Contract Manager - Chicago, IL	UnitedHealth Group	Chicago, Illinois	04/16/2016
Healthcare Business Transformation Workday Financials Senior Associate	PwC	Chicago, Illinois	07/07/2016

Job Title	Company	Location	Date Posted
Healthcare Business Transformation Workday Financials Manager	PwC	Chicago, Illinois	07/07/2016
Healthcare Business Transformation Taleo Lead - Senior Associate	PwC	Chicago, Illinois	07/07/2016
Pharmaceutical & Life Sciences Market Access - Director	PwC	Chicago, Illinois	07/07/2016
Healthcare Business Transformation Taleo Lead - Manager	PwC	Chicago, Illinois	07/07/2016
Workforce Management Kronos Healthcare Senior Consultant	PwC	Chicago, Illinois	07/07/2016
Procurement Specialist (670134)	Apex Systems	Northbrook, Illinois	06/28/2016
Managing Consultant	Aon Corporation	Chicago, Illinois	06/23/2016
Network Implementations Manager, Behavioral Health - Telecommute	UnitedHealth Group	Schaumburg, Illinois	06/23/2016
Senior Data Analyst(670954)	Apex Systems	Pekin, Illinois	06/21/2016
Insurance – Senior Examiner, Large Bank Supervision	Federal Reserve Bank	Chicago, Illinois	06/22/2016
Senior Data Analyst	Apex Systems, Inc.	Pekin, Illinois	06/21/2016
IT Systems Administrator II	Aon Corporation	Lincolnshire, Illinois	06/21/2016
Economics Performance Analytics Analytics - ERRM	Allstate	Northbrook, Illinois	06/14/2016
Network Implementations Manager, Behavioral Health - Telecommute	UnitedHealth Group	Schaumburg, Illinois	06/06/2016
Manager, Treasury Operations	Exelon Corporation	Chicago, Illinois	05/28/2016

Job Title	Company	Location	Date Posted
Risk Governance Leader	Aon Corporation	Lincolnshire, Illinois	05/18/2016
Systems Analyst - Health and Welfare (Lincolnshire, IL, but will consider other locations and virtual for highly qualified candidate)	Aon Corporation	Lincolnshire, Illinois	05/23/2016
Senior Corporate Accountant	Illinois Tool Works, Inc.	Glenview, Illinois	05/22/2016
Experienced Associate, Tax Technology - Data Enablement	KPMG	Chicago, Illinois	05/11/2016
Risk Manager - GROWMARK, Inc. - Bloomington, IL	GROWMARK, Inc.	Bloomington, Illinois	05/19/2016
Manager, Tax Technology -Data Enablement	KPMG	Chicago, Illinois	05/11/2016
Senior Associate, Tax Technology - Data Enablement	KPMG	Chicago, Illinois	05/11/2016
Senior Relationship Manager - Allstate Roadside	Allstate	Northbrook, Illinois	07/09/2016
Pharma & Life Sciences Aggregate Spend Transparency Senior Associate	PwC	Chicago, Illinois	07/07/2016
Buck Consultants - Senior Consultant, Health (Pharmacy Consulting) - Remote	Buck Consultants, LLC.	Chicago, Illinois	07/05/2016
Guidewire Configuration - Senior Consultant	Deloitte	Chicago, Illinois	06/25/2016
Guidewire Integration - Senior Consultant	Deloitte	Chicago, Illinois	06/25/2016
Insurance Technology Senior Manager	Deloitte	Chicago, Illinois	06/22/2016
Insurance Technology Senior Consultant	Deloitte	Chicago, Illinois	06/22/2016
Insurance Technology Manager	Deloitte	Chicago, Illinois	06/24/2016

Job Title	Company	Location	Date Posted
Health & Welfare - Lead Systems Analyst Advanced (CBA)	Aon Corporation	Lincolnshire, Illinois	06/18/2016
Insurance Technology Manager	Deloitte	Chicago, Illinois	06/18/2016
Head of Financial Institutions ~ HFP	The Hartford	Chicago, Illinois	06/13/2016
Senior Benefits Analyst (Lincolnshire OR Chicago)	Aon Corporation	Lincolnshire, Illinois	06/16/2016
Data Science Director - Operational Analytics	Allstate	Northbrook, Illinois	05/14/2016
Sourcing and Procurement Sr Consultant I - Professional Services	Allstate	Northbrook, Illinois	04/26/2016
Director, Contract Analytics	AbbVie	Lake County, Illinois	04/26/2016
Account Executive Bond/FPS	Travelers	Chicago, Illinois	05/16/2016
Advisory Services Manager - Financial Services - IT Risk & Assurance Services	EY	Chicago, Illinois	06/28/2016

Job postings here were provided by Direct Employers Association (www.us.jobs).

This information was retrieved on 7/14/2016 R 3:51 PM from Job Finder at CareerOneStop (www.careeronestop.org), sponsored by the U.S. Department of Labor, Employment, and Training Administration.

<http://www.careeronestop.org/toolkit/jobs/find-jobs.aspx>

Appendix 5: Letters of Support, Detail

Appendix 6: Faculty and Staff, Detail

Last name	First name	Academic Title	CIP code	Diploma Information	Area of Specialization
Akkari	Safwan	Associate Professor of Mathematical Sciences	27.01	Ph.D., Louisiana State University, 1988	Matroid theory, graph theory
Alexander	Deana	Continuing Lecturer in Mathematical Sciences	27.01	M.S., Purdue University, 2006	Online teaching, applied mathematics
Anderson	Jeffrey	Professor of Mathematics	27.01	Ph.D., Iowa State University, 1989	Partial differential equations, applied mathematics
Beineke	Lowell	Jack W. Schrey Professor of Mathematical Sciences	27.01	Ph.D., University of Michigan, 1965	Graph theory, combinatorics
Berry	Sandra	Associate Professor of Mathematics Education	27.01	Ph.D., Purdue University, 2007	Mathematics education
Chauhan	Chand	Associate Professor of Mathematics	27.01	Ph.D., The Ohio State University, 1983	Applied statistics, design of experiments
Coffman***	Adam	Professor of Mathematics	27.01	Ph.D., University of Chicago, 1997	Geometry, complex analysis, topology
Coroian	I. Dan	Associate Professor of Mathematics	27.01	Ph.D., University of Iowa, 1997	Numerical analysis, applied mathematics, mathematical modeling
Deng	Yihao	Associate Professor of Statistics	27.05	Ph.D., Old Dominion University, 2006	Regression analysis, generalized linear models, time series analysis
Dragnev*	Peter	Professor of Mathematics	27.01	Ph.D., University of South Florida, 1997	Analysis, potential theory, approximation theory
Francis	Joe	Professional Actuary in Residence/ Continuing Lecturer in Mathematical Sciences	27.01	B.S., DePauw University, 1987	Actuarial science

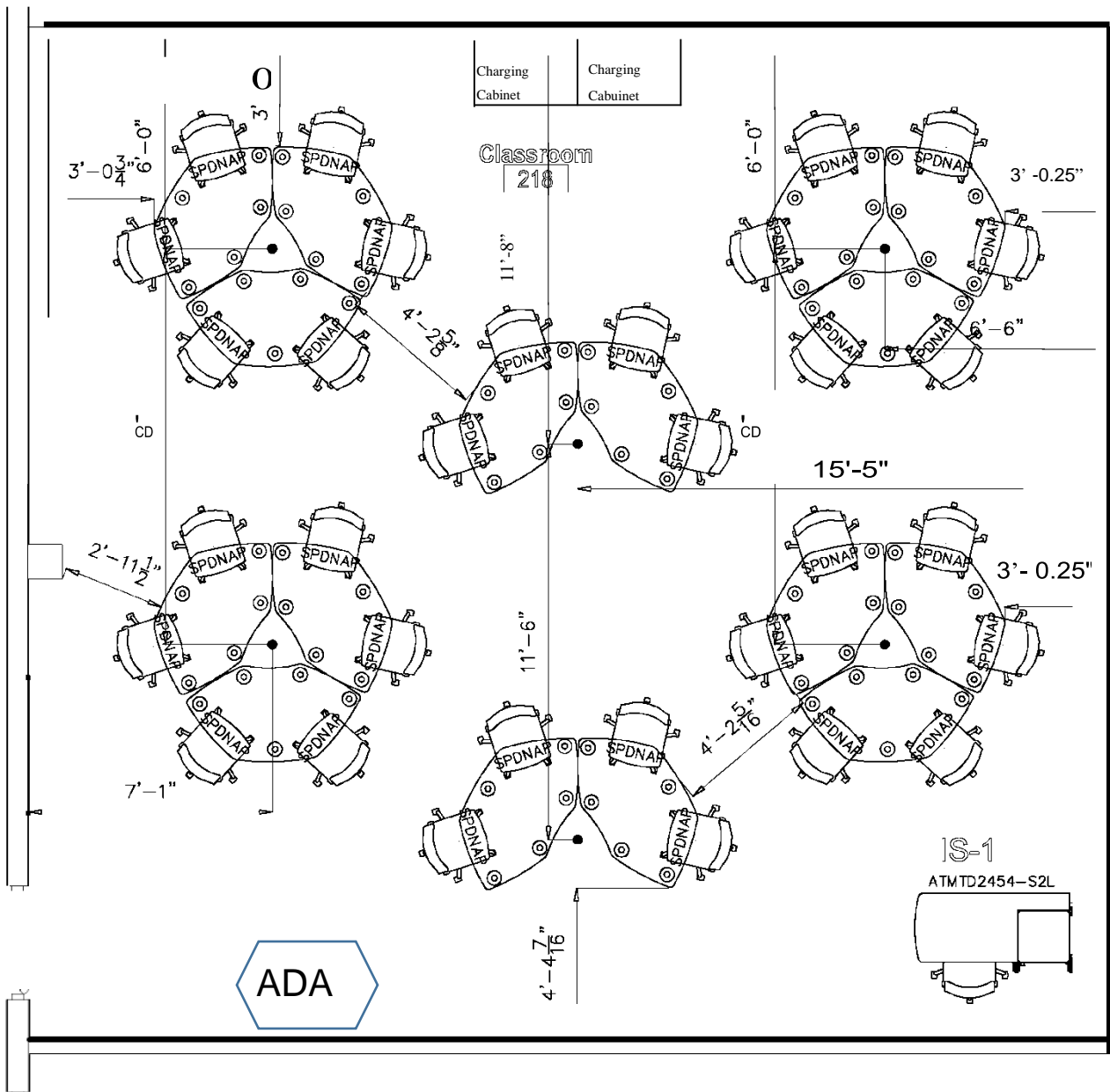
Last name	First name	Academic Title	CIP code	Diploma Information	Area of Specialization
Hersberger**	James	Professor of Mathematics	27.01	Ph.D., Purdue University, 1983	Problem solving, mathematical giftedness, school mathematics curriculum
LaMaster	John	Senior Instructor in Mathematics	27.01	M.S., Purdue University, 1992	Teaching with technology, math anxiety reduction, school mathematics curriculum
Legg	Alan	Visiting Assistant Professor of Mathematics	27.01	Ph.D., Purdue 2016	Complex Analysis
Lipman	Marc	Professor of Mathematical Sciences	27.01	Ph.D., Dartmouth College, 1976	Graph theory, discrete mathematics
Mau	Sue	Associate Professor of Math Education	27.01	Ph.D., Indiana University, 1992	Teachers' and students' mathematical understanding, teachers' professional growth
Osowski	John	Continuing Lecturer in Mathematics	27.01	M.A.S., The Ohio State Univ., 1985	Teaching of statistics, applied statistics
Pan	Yifei	Professor of Mathematical Sciences	27.01	Ph.D., University of Michigan, 1990	Complex analysis, partial differential equations, complex analytic dynamics
Townsend	Douglas	Professor of Mathematical Sciences	27.0101	Ph.D., University of Illinois, Ph.D., 1976	Approximation theory, applied statistics
Vandell	Robert	Associate Professor of Mathematics	27.01	Ph.D., Western Michigan University, 1996	Graph theory, graph connectivity, secondary math education
Vanderlaan	Cynthia	Continuing Lecturer in Mathematics	27.01	M.S., Indiana University, 1999	Precalculus curriculum development, teaching with technology
Wagner	Linda	Continuing Lecturer in Mathematics	27.01	M.S., Univ. of Illinois - Urbana/Champaign, 1978	Mathematics education, precalculus curriculum
Weakley	W. Douglas	Professor of Mathematics	27.01	Ph.D., Northwestern University, 1980	Graph theory, algebra covering codes, combinatorics
Weakley	Cecilia	Assistant Professor of Mathematics	27.01	Ph.D., University of North Carolina, 1978	Real analysis, topology

Last name	First name	Academic Title	CIP code	Diploma Information	Area of Specialization
Yorgov	Daniel	Visiting Assistant Professor in Applied Statistics	27.01	Ph.D., University of Colorado, 2016	Statistical genetics, high performance computing
Zhang	Yuan	Associate Professor of Mathematics	27.01	Ph.D., Rutgers University, 2009	Several complex variables, CR geometry, partial differential equations
Zook	Dianna	Instructor in Mathematics	27.01	M.A., Kent State University, 1979	Calculus and precalculus curriculum development, technology
Zubovic	Yvonne	Associate Professor of Mathematical Sciences	27.01	Ph.D., The Ohio State University, 1988	Biostatistics, survival analysis, applied statistics

*** Chair of Department; ** Associate Chair of Department; *** Acting Chair of Department (July 1, 2016 – December 31, 2016)**

Appendix 7: Facilities, Detail

During the summer of 2016, the classrooms Kettler 123 and Kettler 218 were under renovation. The renovation included upgrades to the available technology as well as reconfigurations of the layout to allow for students to collaborate in teams (see figure below). The estimated cost of these renovations is \$150,000 each, for a total of \$300,000.



Similar upgrades are required for Kettler 216 and Kettler 220 at an estimated cost of \$150,000 apiece.

Appendix 8: Other Capital Costs, Detail

Salaries and Wages	Recurring	\$112,500 (for 1.5 FTE)
Supplies and Expenses	Recurring	\$5,000
Other		\$5,000
		<ul style="list-style-type: none">• e.g., office furniture, computer, software
Professional Development		\$7,500 (1.5 @ \$5,000)

Appendix 9: Articulation of Associate/Baccalaureate Programs, Detail

As of June 2016, the Indiana Commission on Higher Education website does not list any Transfer Single Articulation Pathways in progress for actuarial science.

Link: <http://www.in.gov/che/3138.htm>

Appendix 10: Credit hours Required/Time to Completion, Detail

Curriculum and Requirements

Admission Requirements

For a beginner regular admit, the admission requirements are:

- (1) High School G.P.A. of 2.5 or higher;
- (2) One of the following SAT/ACT Score requirements:
 - SAT Score (new scale) of 840 or above and Math SAT Score (new) of 420 or above;
 - SAT Score (old scale) of 1120 or above and Math SAT Score (old) of 380 or above;
 - ACT Score of 16 or above overall and ACT Score of 15 or higher in Math.

Curriculum Requirements

The Bachelor of Science in Actuarial Sciences consists of 120 credit hours distributed according to the following:

Basic Mathematics Core (18 credits – must earn C- or higher in all courses)

MA 16500 Analytic Geometry and Calculus I	(4 credits)
MA 16600 Analytic Geometry and Calculus II	(4 credits)
MA 26300 Multivariate and Vector Calculus or MA 26100 Multivariate Calculus	(4 credits)
MA 35100 Elementary Linear Algebra	(3 credits)
MA 36300 Differential Equations	(3 credits)

Validation by Educational Experience (VEE) (18 credits)

Applied Statistical Methods (take both, must earn grade B- or higher in each course)	
STAT 51200 Applied Regression Analysis	(3 credits)
STAT 52000 Time Series and Applications	(3 credits)

Economics (take both, must earn grade B- or higher in each course)

ECON E201 Introduction to Microeconomics	(3 credits)
ECON E202 Introduction to Macroeconomics	(3 credits)

Corporate Finance (take both, must earn grade B- or higher in one course and C- or higher in the other)

BUS F301 Financial Management	(3 credits)
BUS F303 ¹ Intermediate Investments	(3 credits)

Additional Required Courses (25 credits - must earn C- or higher in all courses)

¹ Students double majoring in Business may choose BUS F305 instead of BUS F303.

CS 11400 Introduction to Visual Basic	(3 credits)
MA 27300 ² Financial Mathematics	(3 credits)
MA 49000-02 ³ Models for Financial Economics	(4 credits)
STAT 51100 Statistical Methods	(3 credits)
STAT 51600 ⁴ Basic Probability and Applications	(3 credits)
STAT 51700 Statistical Inference	(3 credits)
BUS A201 Principles of Financial Accounting	(3 credits)
BUS A202 Principles of Managerial Accounting	(3 credits)

General Education Requirements (see Bulletin or myBLUEprint for courses) (33 credits---
Must earn C- or higher in all courses)

GA1 Category A1 (3 credits)	Written Communication
GA2 Category A2 (3 credits)	Speaking and Listening
GA3 Category A3 (3 credits)	Quantitative Reasoning (MA 16500 can be used)
GB4 Category B4 (3 credits)	Scientific Ways of Knowing
GB5 Category B5 (3 credits)	Social & Behavioral Ways of Knowing
GB6 Category B6 (3 credits)	Humanistic and Artistic Ways of Knowing
GB7/71 Category B7 or B71 (3 credits)	Interdisciplinary or Creative Ways of Knowing (foreign language courses 111 and 112)

Additional Credits - Category A or B (9 credits) - (foreign language courses 111/112, ENG W233, 2nd Science)

GCAP Category C8 – Capstone Experience (Upper level Actuarial Science Course / Internship Experience)

COAS BS Liberal Arts Requirements (approximately 14 credits – must earn C- or higher in all courses)

Second Semester Writing (3 credits) (ENG W140 or ENG W223)

Speaking Requirement (3 credits) (COM 11400)

Language Sequence (8 credits) (credit/placement required for 2 semesters of foreign language, one course at second semester level required)

Summer Internships It is recommended that all students participate in a summer internship. These are offered on a competitive basis and are **not** guaranteed. Good internships tend to pay well and provide valuable experience that future employers look for in a good job candidate. Completion of at least one actuarial exam is helpful in acquiring a summer internship.

Minor/Electives (to reach 120 credits).

² Provides background for SOA Exam FM.

³ Provides background for SOA Exam MFE.

⁴ Provides background for SOA Exam P.

Sample Curriculum: Bachelor of Science in Actuarial Science

Taking a typical load of 15 credit hours per semester, a calculus-ready student is able to complete the requirements in four years. A sample plan for the fall and spring semesters of each of the four years is provided below.

1 st Year Fall Semester				1 st Year Spring Semester			
Course No.	Course Title	Pre-Reqs	Crs.	Course No.	Course Title	Pre-Reqs	Crs.
MA 165000 (GA3)	Analytic Geometry & Calculus I	MA 15900 or MA 15400 (C- or above); or placement	4	MA 16600	Analytic Geometry & Calculus II	MA 16500 (C- or above)	4
ENG W131 or (GA1)	Reading, Writing, & Inquiry I	Self-Place or ENG W129 (C- or above)	3	COM 11400 <u>or</u> HIST H125 (GA2/A&S)	Fundamentals of Speech <u>or</u> Great Debates		3
GB4 (See GB4 and department options)	Gen Ed Science/Lab (Approved course)	*See lab requirement	4	Science/with Lab (See GB4 options)	Approved Science/Lab	*See lab requirement	4
FL 1 st semester (See GB7 options)	Foreign Language 1		4	FL 2nd (See GB7 options)	Foreign Language 2	FL 1/ placement	4
Total Semester Credit Hours			15	Total Semester Credit Hours			15

2nd Year Fall Semester				2nd Year Spring Semester			
Course No.	Course Title	Pre-Reqs	Crs.	Course No.	Course Title	Pre-Reqs	Crs.
MA 26300 or MA 26100	Multivariate & Vector Calculus <u>or</u> Multivariate Calculus	MA 16600 (C- or above)	4	MA 35100	Elementary Linear Algebra	2 sem calc (C- or above grades)	3
MA 27300	Financial Mathematics	MA 16600 (C- or above)	3	CS 11400	Introduction to Visual Basic	MA 15300	3
BUS A201	Principles of Financial Accounting	Sophomore or permission	3	STAT 51100	Statistical Methods	2 sem calc (C- or above grades)	3
ECON E201	Intro to Microeconomic	Sophomore; MA 153 or beyond	3	ECON E202	Intro to Macroeconomic	ECON E201	3
ENG W233 (Gen Ed A/B)	Intermediate Expository Writing	ENG W131 (C- or above)	3	BUS A202	Intro to Managerial Accounting	BUS A201	3
				MA 49000-04	Financial Mathematics Practicum		1
Total Semester Credit Hours			16	Total Semester Credit Hours			16

3rd Year Fall Semester				3rd Year Spring Semester			
Course No.	Course Title	Pre-Reqs	Crs.	Course No.	Course Title	Pre-Reqs	Crs.
MA 36300	Differential Equations	MA 26100 or 26300; MA 35100 (C- or above for all)	3	MA 49000-02	Models for Financial Economics	√	4
BUS F301	Financial Management	√	3	STAT 51700	Statistical Inference	STAT 51600 (C- or above)	3
GB5	Gen Ed Social/Behavior		3	BUS F305 (Recommended)	Intermediate Corporate Finance	√	3

STAT 51600	Basic Probability and Applications	MA 26100 or MA 26300 (C- or above)	3	GB7/71 (if needed) or Elective	Gen Ed Creative or Interdisciplinary <u>or</u> Free Elective		3
Elective or Gen Ed A or B	Free elective course or Gen Ed A or B (if needed)		3	GB6	Gen Ed Hum/Artistic		3
Total Semester Credit Hours			15	Total Semester Credit Hours			16

4th Year Fall Semester				4th Year Spring Semester			
Course No.	Course Title	Pre-Reqs	Crs.	Course No.	Course Title	Pre-Reqs	Crs.
BUS F303 (Recommended)	Intermediate Finance	BUS F301	3	STAT 52000	Time Series and Applications	STAT 512 or permission	3
STAT 51200	Applied Regression Analysis	STAT 511, 517, or 528 (C- or above)	3	BUS F420 (Recommended)	Equity & Fixed Income Investments	BUS F303 or BUS F305	3
GCAP (C8)	Gen Ed Capstone	√	3	Elective or Gen Ed A or B	Free elective course <u>or</u> Gen Ed A or B (if needed)		3
Elective or Gen Ed A or B	Free elective course <u>or</u> Gen Ed A or B (if needed)		3	Elective or Gen Ed A or B	Free elective course <u>or</u> Gen Ed A or B (if needed)		3
Elective or Gen Ed A or B	Free elective course <u>or</u> Gen Ed A or B (if needed)		3				
Total Semester Credit Hours			15	Total Semester Credit Hours			12

√ = See IPFW Bulletin or myBLUEprint for additional course prerequisites

120 credits required for Bachelor of Science degree

2.0 GPA required for Bachelor of Science degree/major

Existing courses in the proposed curriculum

Course descriptions for the 2016-2017 can be found at <http://bulletin.ipfw.edu/index.php>.

MA 16500	Analytic Geometry and Calculus I
MA 16600	Analytic Geometry and Calculus II
MA 26300	Multivariate & Vector Calculus
MA 26100	Multivariate Calculus
MA 27300	Financial Mathematics
MA 35100	Elementary Linear Algebra
MA 36300	Differential Equations
MA 49000-02	Models for Financial Economics (syllabus provided below)
MA 49000-04	Financial Mathematics Practicum (information sheet provided below)
CS 11400	Introduction to Visual Basic
STAT 51100	Statistical Methods
STAT 51600	Basic Probability and Applications
STAT 51700	Statistical Inference
STAT 51200	Applied Regression Analysis
STAT 52000	Time Series and Applications
ENG W131	Reading, Writing, and Inquiry I
ENG W233	Intermediate Expository Writing
COM 11400	Fundamentals of Speech Communication
HIST H125	Great Debates
BUS A201	Principles of Financial Accounting
BUS A202	Principles of Managerial Accounting
ECON E201	Introduction to Microeconomics
ECON E202	Introduction to Macroeconomics
BUS F301	Financial Management
BUS F303	Intermediate Investments
BUS F305	Intermediate Corporate Finance
BUS F420	Equity and Fixed Income Investments

In addition, courses meeting General Education Requirements GA1 – GA3 and GB4 – GB7 already exist (see [General Education Courses](#) for a complete list).

Courses to be added

The following courses have been offered as special topics courses under the variable title course number MA 49000. These courses will be added to the bulletin with appropriate course numbers. A syllabus/information sheet for each course is provided below.

MA 49000-02	Models for Financial Economics
MA 49000-04	Financial Mathematics Practicum

Models for Financial Economics – MA 49000-02 Syllabus - Spring 2016

Description: This 4 credit, online course in actuarial science and finance:

- covers stock price models, the valuation of derivative securities, Monte Carlo simulation, and interest rate models; and
- covers the Society of Actuaries' learning objectives/outcomes for SOA Exam MFE (CAS Exam 3F).

Objectives: Students will understand how no-arbitrage models can be used to price financial instruments. Students will learn how to derive the Black-Scholes Formula, which is used to price European call and put options. Students will understand the following:

- A discrete binomial model for stock prices, when properly set up, becomes a model with normally distributed, continuously compounded returns as the time periods become small.
- A stock price model with normally distributed, continuously compounded returns has log-normally distributed prices, and those prices follow geometric Brownian motion.

Instructor: Joe Francis, FSA, CFA

KT 287, (260) 481-6230 or (260) 255-6331, franjp01@ipfw.edu

Office Hours: T 2:30 – 4:00 pm, W 1:30 – 3:30 pm, and by appointment

Kettler G21 (Tutoring Center): T 2:00 – 2:30

Prerequisites: MA 273, BUSF 301, STAT 516

Textbooks:

- *Actuarial Models, Financial Economics Segment*, by Joe Francis and Chris Ruckman, ©ActuarialBrew.com.
- *Actuarial Models: Questions for the Financial Economics Segment*, by Joe Francis and Chris Ruckman, ©ActuarialBrew.com.

Topics:

Stock Price Models

Put-Call Parity

Replication of Derivatives

Comparing Options

Binomial Stock Price Trees

General, forward tree, Cox-Ross-Rubinstein, and Jarrow-Rudd

Risk-Neutral Valuation

Realistic Valuation

- Greek Measures and Elasticity
- Lognormally Distributed Prices
 - Prediction Intervals
- The Black-Scholes Formula for European Calls and Puts
 - General form, Options on dividend-paying stocks, Options on Futures
- Delta-Hedging
- Exotic Options
 - Asian, Barrier, Compound, Gap, Exchange, Chooser, Forward Start,
- Digital
 - Volatility
 - Monte Carlo Simulation
 - Sharpe Ratio and the Market Price of Risk
 - The Black-Scholes Equation
- Brownian Motion
 - Standard, Arithmetic, Ornstein-Uhlenbeck, and Geometric
 - Multiplication Rules
 - Itô's Lemma
- Interest Rate Models
 - The Black Model for Options on Bonds
 - Binomial Short-Rate Models
 - General and Black-Derman-Toy
 - Continuous-Time Models
 - General, Vasicek, and Cox-Ingersoll-Ross
 - Sharpe Ratio

Grading:

2 Exams	40%	
Quizzes/Graded homework	35%	Expect frequent quizzes.
<u>Final Exam</u>	<u>25%</u>	
Total	100%	

Scale: A - 90% or above
 B - 80% or above
 C - 70% or above
 D - 60% or above

To reschedule a test or quiz, you must provide an acceptable excuse at least 24 hours before the test or quiz. In the event of a demonstrable emergency, exceptions to the 24 hour notice policy may be permitted, provided that the emergency is reported and explained within 24 hours after the test or quiz.

Proctored Exams

This online course requires that your tests be proctored.* If you live near IPFW, you will be taking your proctored exams in Testing Services, located in Kettler Hall, room 232 on the IPFW campus. Call ahead to schedule a testing appointment 260-481-6600.

If you live out of the IPFW area, contact Tanner Clarke at 260-481-6111 or e-mail clarte02@ipfw.edu or online@ipfw.edu with your name, course(s), and the name of a local college/university or public library, and the contact person's name and phone number. Some proctor sites may charge you a fee. If you need assistance finding a testing site call or email Tanner.

During the tests, only calculators approved by the Society of Actuaries will be permitted. I recommend the TI-30XS MultiView (which costs around \$20). Other approved calculators are listed here: <https://www.soa.org/Education/Exam-Req/Exam-Day-Info/edu-id-calculators.aspx>

A **proctored exam is an exam that is administered by an individual who supervises the student while they are taking the exam. The proctor's function is to ensure the integrity and security of the exam in a secure environment.*

Disabilities Statement:

If you have a disability and need assistance, special arrangements can be made to accommodate most needs. Contact the Director of Services for Students with Disabilities (Walb Union, Room 113, phone number (260) 481-6658, web site: www.ipfw.edu/ssd) as soon as possible to work out the details. Once the Director has provided you with a letter attesting to your needs for modification, bring the letter to me.

Financial Math Practicum – MA 49000-04 Information Sheet - Spring 2016

Description: This 1 credit course is a preparation course for the Actuarial Exam FM. Class time will be spent working problems. Students will be expected to work on problems outside of class time as well as during class time, and students should come to class prepared to explain how they have solved the assigned problems.

Objective: Students will become proficient in the Financial Mathematics concepts and techniques that are tested by the Society of Actuaries.

Grading: This class will be offered on a Pass/Fail basis. Attendance and participation will be important to receive a passing grade.

Co-requisite: MA 166 (may be waived with permission of instructor)

Course Materials: ASM Manual (11th edition preferred, but 9th edition or later accepted). See <http://www.studymanuals.com/Product/Show/453062368>

Instructor: Joe Francis, FSA, CFA
KT 287, 481-6230, franjp01@ipfw.edu

Class Times: Class will meet weekly from January 13 through February 17, for a total of 6 classes. Class will meet on Wednesdays from 3:30 – 5:30 pm.

Class Location: Kettler 218.

Disabilities Statement:

If you have a disability and need assistance, special arrangements can be made to accommodate most needs. Contact the Director of Services for Students with Disabilities (Walb Union, Room 113, phone number (260) 481-6658, web site: www.ipfw.edu/ssd) as soon as possible to work out the details. Once the Director has provided you with a letter attesting to your needs for modification, bring the letter to me.

Appendix 11: Exceeding the Standard Expectation of Credit Hours, Detail

The proposed Bachelor of Science in Actuarial Science does not exceed the standard 120 credit hour limit.

Appendix 12: Enrollment Trends

The numbers of majors in the Bachelor of Science in Mathematics program for the Actuarial Science option for the fall semesters from 1999 to 2015 are provided below.

Mathematical Sciences - Historical Enrollment Trends

Program	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Math BS-Actuarial Sci.	10	8	12	16	16	16	17	10	7	14	24	21	19	21	26	31	49



Liaison Librarian Memo

Date: 7/27/16
From: David Dunham
To: Yvonne Zubovic
Re: Library Resources for Actuarial Science Program

Describe availability of library resources to support proposed new program:

I have conducted a thorough investigation of the resources currently held by the Helmke Library relating to Actuarial Science. A search in IUCAT, our online catalog, for books and e-books published in the last 10 years on the subject of "actuarial science" shows our current collection to be relatively minimal. However, I have obtained a recent list of recommended texts from the Society of Actuaries and checked it against the Helmke Library holdings. This should serve as a helpful springboard for beginning to build an adequate Actuarial Science collection.

Comments:

Additional one-time purchases may also be made via a Helmke Library Special Needs Grant (<http://library.ipfw.edu/about/policies/special-needs-grants.html>). Priority in collection development will be given to test preparation materials for actuarial credentialing and exams. I thus believe that, through a focused collection development initiative in collaboration with the Department of Mathematical Sciences, the resources provided by and accessible to the Helmke Library can be brought up to the appropriate level to support this program within a reasonable time frame.

8/9/16

Liaison Librarian Signature

Date

Program Description

**Bachelor of Science in Applied Statistics
To Be Offered by the College of Arts and Sciences
Indiana University Purdue University Fort Wayne**

1. Characteristics of the Program

- a. **Campus:** Indiana University Purdue University Fort Wayne
- b. **Type of delivery:** On-campus only
- c. **Mode of Delivery:** Classroom/lab
- d. **Other delivery aspects:** Co-ops, Internships
- e. **Academic unit offering program:** Department of Mathematical Sciences in the College of Arts and Sciences

2. Rationale for the Program**a. Institutional Rationale (Alignment with the Institutional Mission and Strengths)**

- **Why is the institution proposing this program?**

The objective is to establish a Bachelor of Science in Applied Statistics (BSS) at Indiana University Purdue University Fort Wayne (IPFW). According to the Bureau of Labor Statistics ([Bureau web site](#), June 22, 2016), careers in statistics rank 9th on the list of the national fastest growing occupations, with a projected change from approximately 30,000 jobs in 2014 to 40,000 in 2024 (i.e., a 34% increase). Graduates educated in statistical methodology and data analysis are needed in the health industry, education, government, business and industry, and the sciences.

For the Northeast Indiana region, the IPFW Community Research Institute *Regional Intel Report* forecasts that “Approximately 17% (nearly 3,600) of regional openings over the next decade will be in analytical fields, with potential connections to growth areas like Big Data, fraud prevention, market research, etc.” A common thread for these analytical fields is the need for a strong quantitative background and data analysis skills, which a program in statistics provides.

A consideration of degrees conferred in Mathematics and Statistics indicates that Northeast Indiana is lagging behind the rest of the state in terms of degree completions in these fields of study. The region’s degree completions in Mathematics and Statistics have remained relatively flat since 2003 while there has been a near doubling of completions at the state and national levels; Region: 31 vs. 35 (13% increase from 2003 to 2014); State: 514 vs. 991 (93% increase); Nation: 19,657 vs. 36,259 (85% increase). Note that IPFW conferred 61% of all the awards in Mathematics and Statistics in the region since 2003 (268 of 441).

Actuarial science majors will be encouraged to earn a secondary major in statistics. The proposed applied statistics and actuarial science curricula have been developed to provide students with a broader array of analytical skills which are desirable in today's society of intensive data analysis and modeling.

The Department of Mathematical Sciences at IPFW currently offers a Bachelor of Science in Mathematics with a Statistics option which includes a core set of courses that are foundational in mathematics, as well as a set of courses introducing students to probability and to statistical methods primarily in the areas of experimental design and regression analysis. The proposed program in Applied Statistics, while maintaining a strong mathematical foundation, places emphasis on statistical methodology, providing breadth and depth that is crucial for students wishing to pursue a career path involving data analysis and statistical modeling. Students in this program will acquire knowledge, skills, and experience in topics such as statistical modeling, a variety of statistical methodologies, and data analysis.

- **How is it consistent with the mission of the institution?**

IPFW's mission is to provide "local access to globally recognized baccalaureate and graduate programs that drive the intellectual, social, economic, and cultural advancement of our students and our region." The vision of the institution is to be known for "respected signature programs, and graduates prepared to improve the quality of life in their communities as well as compete locally, regionally, and globally." Offering a BSS would be consistent with both the mission and vision statements. The demand for people with analytical talent is expected to grow in the next decade, establishing a need for this program to support the industry in the region. This program would provide graduates with data analysis and modeling skills to meet this demand.

- **How does the program fit into the institution's strategic and/or academic plan?**

The first goal of the IPFW strategic plan is to "Foster Student Success" with the associated process goal to "Develop signature programs." One of the key strategies associated with this process goal is to "Identify and develop signature programs that respond to regional needs, build on faculty expertise, and uniquely distinguish IPFW from other institutions." The Bachelor of Science in Applied Statistics program could be a signature program to address the need for graduates with analytical skills. No other four-year institution in Northeast Indiana offers such a degree.

A second strategy is to "Build and strengthen relationships with regional partners to increase research and scholarly collaborations in signature programs." Since January 2015, IPFW's Center for Applied Math and Statistics has undertaken

several projects with clients external to the university demonstrating the need for analytical assistance, as well as the expertise for providing it. Development of the proposed program would enhance the scholarly resources available for collaborations involving data analysis and modeling.

Another key strategy is to “Promote majors and programs with strong job placement opportunities in the region and beyond.” Given the demand for graduates with a background in applied statistics, described in more detail in part c. below, offering a BSS would meet this objective.

- **How does this program build upon the strengths of the institution?**

Over the past few decades, IPFW has established a foundation for an applied statistics program through the Statistics option of the Bachelor of Science in Mathematics as well as the Graduate Certificate in Applied Statistics. The undergraduate program is gaining in popularity with an increase from 2 majors in 2010 to 7 in 2015. The proposed BSS degree would build on the curriculum already in place for this program. Currently there are four faculty members, representing 3.5 FTE, with a Ph.D. in Statistics or Biostatistics. There are two additional faculty members with a Master’s degree in Statistics, one of whom also worked in industry as an applied statistician. Thus the necessary faculty expertise to offer the required coursework exists within the Department. In addition, since January 2015 the Center for Applied Math and Statistics has undertaken two Technical Assistance Agreements, four Technical Assistance Projects, and two Research Projects with clients external to the university. These activities demonstrate the need, as well as the expertise available, for providing this mathematical and statistical assistance in the region.

b. State Rationale

- **How does this program address state priorities as reflected in *Reaching Higher, Achieving More*?**

The proposed BSS program addresses several goals described in *Reaching Higher, Achieving More*. One goal is to “align the state’s higher education system to meet Indiana’s economic and workforce needs.” As will be discussed in part c. below, there is a growing need for statisticians in the state, and more specifically, in the Northeast Indiana region. The BSS program will align strongly with this goal by graduating students with analytical skills.

“I keep saying that the sexy job in the next 10 years will be statistician,” said Hal Varian, chief economist at Google. “And I’m not kidding.” (New York Times, August 5, 2009, [see article](#)). The annual report by CareerCast.com ranked Statistician as the 4th best job of 2015 and 2nd best job in 2016. This demonstrates the desirability of the career by employees and employers alike.

The program will meet the goal of “Producing quality college degrees and certificates that are valued by students and employers” specified in *Reaching Higher, Achieving More*.

Reaching Higher, Achieving More also identifies the need to “emphasize high quality instruction.” The program will address this goal since the curriculum will be taught by faculty members committed to teaching, many of whom have won local and state teaching awards.

Finally, since the proposed program was developed following the American Statistical Association’s Curriculum Guidelines for Undergraduate Programs in Statistical Science, it aligns with the goal to “attain a standard of academic quality that ensures Indiana’s college credentials are universally recognized for their rigor and value.”

c. Evidence of Labor Market Need

i. National, State or Regional Need

• Is the program serving a national, state, or regional labor market need?

According to the Bureau of Labor Statistics ([Bureau web site](#), June 22, 2016), careers in statistics rank 9th on the list of the national fastest growing occupations, with a projected change from approximately 30,000 jobs in 2014 to 40,000 in 2024 (i.e., a 34% increase). Graduates educated in statistical methodology and data analysis are needed in the health industry (e.g., clinical trials, genetics, public health, medical device industry and the pharmaceutical industry), education, government (e.g., the Bureau of Justice Statistics, Census, and Forestry), business and industry (such as finance, insurance, research and development, defense industry, manufacturing, marketing, and quality improvement), and the sciences (including agriculture, chemistry, and engineering fields).

The Northeast Indiana Regional Partnership identifies business development strategies for several target industries (e.g., Medical Devices and Technology, Specialty Insurance, and Vehicles) that include data analytics, modeling, and product research and development (*Target Industries 2.0: Post-Recession Review and Business Development Strategies*, <http://www.neindiana.com/target-industries>.) Statisticians play a critical role in implementing these strategies.

Similarly, the IPFW Community Research Institute Regional Intel Report forecasts that “Approximately 17% (nearly 3,600) of regional openings over the next decade will be in analytical fields, with potential connections to growth areas like Big Data, fraud prevention, market research, etc.” A common thread for these analytical fields is the need for a data analysis and modeling skills, which a program in statistics provides.

As mentioned previously, a consideration of degrees conferred indicates that the Northeast Indiana region is lagging behind the rest of the state in degree completions in Mathematics and Statistics. The region's degree completions in these fields have remained relatively flat since 2003 while there has been a near doubling of completions at the state and national levels; Region: 31 vs. 35 (13% increase from 2003 to 2014); State: 514 vs. 991 (93% increase); Nation: 19,657 vs. 36,259 (85% increase). Note that IPFW conferred 61% of all the awards in the region since 2003 (268 of 441).

ii. Preparation for Graduate Programs or Other Benefits

- **Does the program prepare students for Graduate Programs or provide Other Benefits to students besides preparation for entry into the labor-market?**

The proposed BSS program will prepare students for graduate study, including Master of Science degrees in Theoretical Statistics and in Applied Statistics.

Statistics is an academic subject for scientific study and research within the liberal arts tradition. As such, the program will enrich the educational experience of students beyond job preparation.

iii. Summary of Indiana DWD and/or U.S. Department of Labor Data

- **Summarize the evidence of labor market demand for graduates of the program as gleaned from employment projections made by the Indiana Department of Workforce Development and/or the U.S. Department of Labor.**

As mentioned in i. above, the Bureau of Labor Statistics projects a 34% increase in jobs (approximately 10,000) in statistics nationally from 2014 to 2024. The employment outlook for statisticians is substantially more favorable than the national growth of 7% for all occupations.

For individuals with a Bachelor's degree, the Indiana Department of Workforce Development estimates a 26.4% job growth for statisticians nationally for 2022. The demand for statisticians with a Bachelor's degree in the Northeast Indiana Economic Growth Region #3 (EGR3) is growing at over three times the rate (33.3%) when compared to the state as a whole (10.8%).

More specific details on short-term projections and projections across all industries can be found in Appendix 2.

iv. National, State, or Regional Studies

- **Summarize any national, state, or regional studies that address the labor market need for the program.**

As society becomes increasingly data-rich and data-dependent, the demand for professionals with expertise in statistical methods continues to grow. According

to the June 2011 report by the McKinsey Global Institute, the supply of people with deep analytical talent, i.e., expertise in statistics and machine learning, is projected to be 300,000 by 2018. The demand for such individuals is expected to fall between 440,000 and 490,000 jobs, creating a situation in which the demand could exceed the supply by 140,000 to 190,000 positions ([see study](#)).

The IPFW Community Research Institute *Regional Intel Report* predicts that nearly 3,600 of regional openings over the next decade will be in analytical fields.

Results from additional studies can be found in Appendix 3.

v. Surveys of Employers or Students and Analyses of Job Postings

• Summarize the results of any surveys of employers or students and analyses of job postings relevant to the program.

Job postings for a variety of sites were analyzed in July 2016 for statisticians and related occupations.

- A search of CareerCast.com listed 2,194 job postings for statisticians. Of these postings, 26 were in Indiana and 157 were in one of the contiguous states: Illinois 63, Michigan 41, and Ohio 53.
- A search of Monster.com listed 609 jobs for statisticians. Twenty-two jobs were in Indiana, and 40 were in one of the contiguous states: 23 in Illinois, 10 in Michigan, and 7 in Ohio.
- A search of the CareerOneStop.com Job Finder found 407 jobs for statisticians in the United States. Nine of these jobs were in Indiana, 19 in Illinois, 6 in Michigan, and 7 in Ohio. A search for job postings for biostatisticians found 22 U.S. jobs, of which 3 were in Indiana, 11 in Illinois, 6 in Michigan, and 2 in Ohio. A search for job postings for clinical data managers found 36,923 U.S. jobs, of which 380 were in Indiana, 1,072 in Illinois, 1,395 in Michigan, and 826 in Ohio.
- A search of www.usajobs.gov yielded 391 government job postings in statistics, of which 7 were in Indiana. Seventeen of these listings were in Illinois, 16 in Ohio, and 7 in Michigan.
- A search of ASA JobWeb, the job listings website for the American Statistical Association, listed 49 positions, 10 of which required a Bachelor's degree as the highest attained educational level.

Links to the aforementioned sites as well as a list of statistics and biostatistics job postings by CareerOneStop in the states of Indiana, Illinois, Michigan, and

Ohio can be found in Appendix 4.

vi. **Letters of support**

- **Summarize, by source, the letters received in support of the program.**

3. **Cost of and Support for the Program**

a. **Costs**

i. **Faculty and Staff**

- **Of the faculty and staff required to offer this program, how many are in place now and how many will need to be added?**

The current Statistics option of the Bachelor of Science in Mathematics is taught by a number of faculty members in mathematical sciences. A roster of the current faculty can be found in Appendix 6. Note that there are four faculty members, representing 3.5 FTE, with a Ph.D. in Statistics or Biostatistics and two additional faculty members with a Master's degree in Statistics or Applied Statistics, one of whom also worked in industry as an applied statistician.

It is expected that the offering of a BSS degree will lead to an increased enrollment at IPFW and in Mathematical Sciences. Lines for 1.5 FTE tenured/tenure-track faculty members in statistics will be required to teach additional courses for the program. An additional 1.5 FTE lines will be needed for the proposed Actuarial Science degree, for a total of 3 FTE lines needed for both degrees. Faculty would be teaching courses utilized in both degrees. As both programs grow, additional faculty may be required in mathematics for support courses.

No additional staff support will be required beyond what currently exists in the Department of Mathematical Sciences.

ii. **Facilities**

- **Summarize any impact offering this program will have on renovations of existing facilities, requests for new capital projects, or leasing of new space.**

IPFW and the Department of Mathematical Sciences have made substantial investments in classroom and research facilities to support programs in the mathematical sciences. To meet curricular needs, four classrooms equipped with computing facilities for instructors and students are dedicated for use by the Department. Two of these rooms, Kettler 123 and Kettler 218, have been renovated recently to update available technology and to provide learning environments which encourage student collaboration. Details on costs of these renovations are provided in Appendix 7. In addition, the Department has six dedicated classrooms in which technology is available for instructor use, but which are not equipped with laptops for student use.

Given the hands-on applications required in the program, the Department will need to renovate the two additional computer-equipped classrooms, Kettler 216 and Kettler 220 to update technology and to encourage student collaboration, as was done in Kettler 218. The renovations could be done in different years and the cost of these renovations is approximately \$150,000 for each classroom. Since students in the actuarial science program take many of these same courses, both programs are facilitated with these renovations. Three to four years in the future, an additional dedicated classroom with technology for instructors and students may be required to meet the increased course offerings in statistics described in the proposal. Additional details are provided in Appendix 7.

One-two equipped faculty offices (including office furniture, telephones, and computers) will be needed for the additional statistics faculty. (Between the requests for the applied statistics and actuarial science, three faculty offices will be needed.)

iii. Other Capital Costs (e.g. Equipment) *

- **Summarize any impact offering this program will have on other capital costs, including purchase of equipment needed for the program.**

Licenses for specialized software not already provided by the university may need to be purchased to support curricular and research programs.

Depending on their areas of expertise, additional equipment may need to be purchased for supporting the research programs of new faculty members.

b. Support

i. Nature of Support (New, Existing, or Reallocated)

- **Summarize what reallocation of resources has taken place to support this program.**

The proposed Applied Statistics degree program uses many courses currently taught in existing programs within the University. To meet the growing need for additional course offerings in statistics, the Department of Mathematical Sciences hired a faculty member with a Ph.D. in statistics to begin in August 2016. The anticipated increase in enrollments and new course offerings will require an additional 1.5 FTE full-time tenured/tenure-track statistics faculty lines.

- **What programs, if any, have been eliminated or downsized in order to provide resources for this program?**

No programs have been eliminated to provide resources for this program. We anticipate that the proposed program will replace the Statistics option of the Bachelor of Science in Mathematics.

ii. Special Fees above Baseline Tuition

No special fees above the baseline tuition are required for this program.

4. Similar and Related Programs

a. List of Programs and Degrees Conferred

i. Similar Programs at Other Institutions

- **Campuses offering programs that are similar:**

The following institutions in Indiana offer undergraduate degrees in statistics:

Public four-year institutions

- Indiana University, Bloomington (B.S. in Statistics as of 2015-2016)
- Purdue University, West Lafayette (B.S. in Statistics with options in either applied statistics or mathematical statistics)

Private four-year institutions

- Saint Mary's College, Notre Dame (B.S. with a major in Statistics and Actuarial Mathematics)
- University of Evansville, Evansville (B.S. in Statistics and Data Science, to begin Fall 2016)
- Valparaiso University, Valparaiso (B.A. in Statistics)

No other four-year institution in Northeast Indiana offers a Bachelor of Science degree in Applied Statistics.

ii. Related Programs at the Proposing Institution

Bachelor of Science in Mathematics with an option in Statistics

b. List of Similar Programs Outside Indiana

- **If relevant, institutions outside of Indiana offering programs that are similar:**

The following four-year public institutions in Michigan and Ohio offer undergraduate degrees in statistics:

- Central Michigan University, Mount Pleasant, MI (B.A. and B.S. in Statistics)
- Grand Valley State University, Grand Rapids, MI (B.A. and B.S. in Statistics)
- Michigan State University, Lansing, MI (B.A. and B.S. in Statistics)
- Michigan Technological University, Houghton, MI (B.S. in Statistics)
- Oakland University, Rochester Hills, MI (B.S. in Applied Statistics)
- The University of Michigan, Ann Arbor, MI (B.S. in Statistics)
- The University of Michigan, Dearborn, MI (B.A. and B.S. in Applied Statistics)
- Western Michigan University, Kalamazoo, MI (B.S. in Statistics)
- University of Akron, Akron, OH (B.A. and B.S. in Statistics)
- Bowling Green State University, Bowling Green, OH (B.A. and B.S. in Statistics)
- Miami University, Oxford, OH (B.S. in Statistics)
- Ohio University, Athens, OH (B.S. in Mathematical Statistics)
- Wright State University, Dayton, OH (B.S. in Statistics)

c. Articulation of Associate/Baccalaureate Programs

- **For each articulation agreement, indicate how many of the associate degree credits will transfer and apply toward the baccalaureate degree.**

As of June 2016, the Indiana Commission on Higher Education website does not list any Transfer Single Articulation Pathways in progress for statistics or applied statistics (<http://www.in.gov/che/3138.htm>).

d. Collaboration with Similar or Related Programs on Other Campuses

- **Indicate any collaborative arrangements in place to support the program.**

No plans are currently in place to collaborate with similar or related program on other campuses.

5. Quality and Other Aspects of the Program

a. Credit Hours Required/Time To Completion

- **Credit hours required for the program and how long a full-time student will need to complete the program.**

The BSS will require 120 credit hours for students who are ready to enter Calculus in their first semester. A full-time student averaging 15 credits per semester can complete the program in eight academic semesters over four years. A sample four-year plan is provided in Appendix 10.

b. Exceeding the Standard Expectation of Credit Hours

- **If the baccalaureate degree program exceeds 120 credit hours, summarize the reason for exceeding the standard expectation.**

The BSS does not exceed the standard 120 credit hour limit.

c. Program Competencies or Learning Outcomes

- **List the significant competencies or learning outcomes that students completing this program are expected to master.**

Students should be able to demonstrate knowledge of basic mathematical skills needed for a deep understanding of statistics.

- Students will demonstrate an understanding of differential and integral calculus of one and multiple variables and the application of calculus concepts in probability and statistics. [MA 26300/26100]
- Students will demonstrate an understanding of elementary linear algebra and matrices and the application of linear algebra concepts in theoretical and applied statistics. [MA 35100]

Students should be able to demonstrate understanding of the fundamentals concepts of probability and statistics and to apply these concepts appropriately.

- Students will demonstrate theoretical understanding of probability and various inferential procedures, their applications, and the scope of the conclusions. [STAT 51600, 51700]
- Students will demonstrate the understanding of the principles of statistical designs and be able to design, analyze and interpret simple experiments/surveys. [STAT 51400]
- Students will be able to build, assess, apply, and understand the theory of the statistical models. [STAT 51200]
- Students will demonstrate the ability to choose, apply, and adapt appropriate strategies to analyze data. [STAT 51100, STAT 49000]

Students should be able to communicate individually as well as a team, (both written and oral) statistical results and inference in basic language to non-statistical audience.

- Students will demonstrate the ability to translate real-world or discipline-specific problems into mathematical language, and the solutions of statistical problems into ordinary language. [STAT 51100]
- Students will demonstrate proficiency in writing detailed and concise report by constructing effective visual displays, explaining statistical ideas, methods, and results. [STAT 49000]
- Students will demonstrate knowledge of statistical soft wares and other technological tools to enhance data exploration and statistical report. [CS 11400/16000, STAT 51200, STAT 52000]
- Students will demonstrate proficiency in applying statistical methods in a variety of disciplines. [STAT 49000].

d. Assessment

- **Summarize how the institution intends to assess students with respect to mastery of program competencies or learning outcomes.**

The Department of Mathematical Sciences has a common assessment procedure for evaluating its various programs. For each outcome, a criterion for success is defined and courses are identified where the outcome is addressed. Assessment items are embedded on assignments, examinations, and/or projects for the identified courses and student data on these items are collected by the instructor each time the course is offered. The courses used for the assessments are offered on a regular basis since they are part of the program. The data are tabulated by an assessment committee and used longitudinally to measure progress toward achievement of the program goal. Each fall semester the results from the previous

year are discussed by the department with the intention of implementing recommended changes during the following year.

Assessment of the BSS will follow this same procedure. Courses indicated in brackets in part c. will be used to assess the associated outcomes.

Data will be collected in designated courses each time the course is offered. The first longitudinal review of the program will be made in the third year of the program.

e. Licensure and Certification

- **State License:**

No state licenses apply to this program.

- **National Professional Certifications (including the bodies issuing the certification):**

No professional certifications apply to this program.

- **Third-Party Industry Certifications (including the bodies issuing the certification):**

No third-party industry certifications apply to this program.

f. Placement of Graduates

- **Describe the principle occupations and industries, in which the majority of graduates are expected to find employment.**

Most of the graduates of the program are expected to work in the health industry (e.g., clinical trials, genetics, public health, and the pharmaceutical industry), education, government (e.g., the Bureau of Justice Statistics, Census, and Forestry), business and industry (such as finance, insurance, research and development, manufacturing, marketing, and quality improvement), and the sciences (including agriculture, chemistry, and engineering fields).

- **If the program is primarily a feeder for graduate programs, describe the principle kinds of graduate programs, in which the majority of graduates are expected to be admitted.**

Alumni of the program may also pursue admission into graduate programs in Theoretical Statistics, Applied Statistics, and Data Science.

g. Accreditation

- **Accrediting body from which accreditation will be sought and the timetable for achieving accreditation.**

None

- **Reason for seeking accreditation.**

None

6. Projected Headcount and FTE Enrollment and Degrees Conferred

- Report headcount and FTE enrollment and degrees conferred data in a manner consistent with the Commission’s Student Information System.

Enrollment Projections	Year 1	Year 2	Year 3	Year 4	Year 5
Full-time	10	12	14	17	20
Part-time	5	5	5	6	7
Enrollment Projections (FTE)	15	17	19	23	27
Full-time	10	12	14	17	20
Part-time	3	3	3	3	4
Degrees Conferred Projections	2	4	6	7	8

(See Appendix 12 for the enrollment history in the related mathematics program.)

- Report a table for each campus or off-campus location at which the program will be offered.
All BSS courses will be offered on the IPFW campus.
- If a program is offered at more than one campus or off-campus location, a summary table, which reports the total headcount and FTE enrollments and degrees conferred across all locations, should be provided.
Not applicable.
- Report the FTE enrollments to the nearest whole number.
See above table.
- If the program will take more than five years to be fully implemented and to reach steady state, report additional years of projections.
Not applicable.

Appendix 1: Institutional Rationale Detail

IPFW Plan 2020: 2014-2020 Strategic Plan

Link to the strategic plan: <https://www.ipfw.edu/about/strategic-plan/>

MISSION

Indiana University-Purdue University Fort Wayne is a comprehensive university that provides local access to globally recognized baccalaureate and graduate programs that drive the intellectual, social, economic, and cultural advancement of our students and our region.

VISION

IPFW will be the university of choice for the citizens of northeast Indiana and beyond. It will be recognized for a transformative learning environment characterized by intensive mentoring, excellence in faculty scholarship and knowledge creation, integration of life and work experiences, and community engagement. IPFW will be known for exceptional retention, persistence, and graduation rates, respected signature programs, and graduates prepared to improve the quality of life in their communities as well as compete locally, regionally, and globally.

VALUES

IPFW values:

- Access to affordable and high-quality programs and services.
- The integrity, significance, and value of the Indiana University and Purdue University degrees.
- An environment of open intellectual inquiry, mutual respect, shared governance, and civility.
- An environment that enhances learning by recognizing the inherent worth of all individuals and celebrating differences of culture, background, and experience among all individuals and groups.
- The highest ethical standards of equity, fairness, transparency, and academic integrity.
- A multifaceted and mutually beneficial collaboration with Fort Wayne and the greater northeast Indiana region.

GOALS

Foster Student Success

A. Process Goal: Improve measurement of student learning.

1. Improve quality and fidelity of assessment processes of degree/certificate programs, General Education program, and Baccalaureate Framework with dedicated resources.
2. Use assessment data to improve student learning.

B. Process Goal: Increase student engagement.

1. Increase opportunities for engaged and experiential learning including service learning and internship programs.
2. Expand impact and profile of Honors Program.
3. Expand number of degree programs that have gateway courses.
4. Expand use of high-impact instructional and advising interventions.
5. Transform the concept of the college classroom and the delivery of education.

C. Process Goals: Increase interdisciplinary and graduate programs and internationalization of the curriculum.

1. Develop and promote interdisciplinary programs where there are sufficient university assets available and anticipated employment needs.
2. Review, prioritize, and expand international agreements.
3. Promote academic programs for international market.
4. Expand support for international students.
5. Invest in academic programs with international curricula.
6. Increase support programs for international study for domestic students.
7. Establish links between baccalaureate and post-baccalaureate programs.
8. Respond to regional demand with appropriate post-baccalaureate credentials.

D. Process Goal: Increase the diversity of the IPFW community.

1. Develop activities and experiences that promote multiculturalism as a value.
2. Embrace a definition of diversity that includes a broader array of human differences.
3. Build and strengthen relationships as well as proactive programs and services designed to encourage enrollment of students from historically under-represented groups.
4. Recruit and retain a diverse faculty and staff at all institutional levels.

E. Process Goal: Develop signature programs.

1. Identify and develop signature programs that respond to regional needs, build on faculty expertise, and uniquely distinguish IPFW from other institutions.
2. Develop activities and experiences that promote success in student achievement through programs with strong student learning outcomes, high graduation rates, and strong job placement prospects.

3. Build and strengthen relationships with regional partners to increase research and scholarly collaborations in signature programs.
4. Promote majors and programs with strong job placement opportunities in the region and beyond.

Promote the Creation, Integration, and Application of Knowledge

Process Goals:

- A. Project future regional, national, and international demand for research and collaboration.
- B. Promote mentoring relationships between faculty and students engaged in creation, integration, and application of knowledge.
- C. Promote development of opportunities for faculty and student engagement with the community for the application and integration of knowledge.

Serve as a Regional Intellectual, Cultural, and Economic Hub for Global Competitiveness

Process Goals:

- A. Expand meaningful collaborations and research opportunities with regional, national, and global partners.
- B. Provide access to outstanding intellectual programming.
- C. Produce and sponsor outstanding cultural and artistic programming.
- D. Provide non-credit enrichment experiences for the community.
- E. Provide leadership in regional economic development.
- F. Serve as an exemplar of free and open discourse.

Create a Stronger University through Improving the Support of Stakeholders and the Quality and Efficiency of the Organization

A. Process Goals: Measurement and metrics

1. Prioritize and establish a set of appropriate performance metrics for all academic and non-academic units.
2. Establish an integrated system of program reporting, review, assessment, and accreditation that is aligned to performance metrics.

B. Process Goal: Efficiency

1. Allocate resources to priorities informed by performance metrics.
2. Decentralize resource distribution and control to lowest level, mission-focused administrative units.
3. Eliminate process barriers in enrollment management that impact student achievement.
4. Identify gaps in academic and program offerings and prioritize programs for creation, expansion, merging, or cessation.
5. Continue increasing transparency in resource allocation budget formation, administration, and personnel decisions.

C. Process Goal: Philanthropic support

1. Build infrastructure to support advancement goals and functions.
2. Implement a strategy for sustainable external funding of strategic priorities.
3. Re-envision Foundation Board as fundraising leadership board.
4. Enhance volunteer engagement in support of strategic goals and fundraising.

Appendix 2: Summary of Indiana DWD and/or U.S. Department of Labor Data, Detail

The following tables were downloaded from the United States Bureau of Labor Statistics on July 7, 2016 (<http://www.bls.gov/ooh/math/statisticians.htm>). They provide employment data for statisticians as of May 2015 nationally, for Indiana and surrounding states, and for metropolitan area in these same states. Approximately 2,650 statisticians were employed in Indiana, Illinois, Michigan, and Ohio in May 2015. The location quotient for Indiana indicates a slightly lower than average concentration of statisticians compared to the nation as a whole. Although the listed states have location quotients below 1.0, several metropolitan areas within these states, e.g., Indianapolis-Carmel-Anderson, have location quotients of 1.5 or higher. Note that data for the Fort Wayne metropolitan area was not available.

Occupation: Statisticians (SOC code 152041)				
Period: May 2015				
Area name	Employment (1)	Employment percent relative standard error (3)	Annual mean wage (2)	Annual median wage (2)
National	29,870	1.9	84,440	80,110

Area name	Employment (1)	Employment percent relative standard error (3)	Annual mean wage (2)	Annual median wage (2)	Employment per 1,000 jobs	Location Quotient
Indiana	600	23.6	61,310	52,880	0.202	0.93
Illinois	830	9.7	81,910	76,930	0.142	0.66
Michigan	500	12.9	85,220	84,560	0.120	0.55
Ohio	720	11.8	86,470	79,690	0.136	0.63

Area name	Employment (1)	Employment percent relative standard error (3)	Annual mean wage (2)	Annual median wage (2)	Employment per 1,000 jobs	Location Quotient
Chicago-Naperville-Arlington Heights, IL Metropolitan Division	550	12.9	78,430	73,590	0.153	0.71
Chicago-Naperville-Elgin IL-IN-WI	680	11.2	81,500	76,160	0.151	0.7

Area name	Employment (1)	Employment percent relative standard error (3)	Annual mean wage (2)	Annual median wage (2)	Employment per 1,000 jobs	Location Quotient
Lake County- Kenosha County IL- WI Metropolitan Division	120	22.5	97,470	95,540	0.303	1.4
Indianapolis- Carmel-Anderson IN	390	35.5	54,040	47,840	0.39	1.8
Southern Indiana nonmetropolitan area	30	39.7	67,720	53,740	0.17	0.78
Louisville/Jefferson County KY-IN	130	1.4	80,310	79,560	0.208	0.96
Ann Arbor MI	130	23.5	88,670	83,890	0.62	2.86
Detroit-Dearborn- Livonia MI Metropolitan Division	60	13.7	69,460	60,310	0.081	0.37
Detroit-Warren- Dearborn MI	140	16.5	77,460	81,010	0.072	0.33
Kalamazoo-Portage MI	60	30.8	104,830	101,820	0.451	2.08
Lansing-East Lansing MI	70	3.1	71,410	71,550	0.336	1.55
Warren-Troy- Farmington Hills MI Metropolitan Division	80	26.9	83,430	84,940	0.067	0.31
Akron OH	100	36.6	102,630	65,080	0.308	1.42
Cincinnati OH-KY-IN	260	24.3	82,330	82,880	0.251	1.16
Cleveland-Elyria OH	90	35.6	81,640	78,580	0.09	0.42
Columbus OH	200	13.5	90,920	85,290	0.194	0.9

Area name	Employment (1)	Employment percent relative standard error (3)	Annual mean wage (2)	Annual median wage (2)	Employment per 1,000 jobs	Location Quotient
Dayton OH	30	31.8	78,250	82,060	0.083	0.38

Footnotes:

(1) Estimates for detailed occupations do not sum to the totals because the totals include occupations not shown separately. Estimates do not include self-employed workers.

(2) Annual wages have been calculated by multiplying the hourly mean wage by 2080 hours.

(3) The relative standard error (RSE) is a measure of the reliability of a survey statistic. The smaller the relative standard error the more precise the estimate.

SOC code: Standard Occupational Classification code -- see <http://www.bls.gov/soc/home.htm>

Data extracted on July 7 2016

While the percent change in employment for 2014-2024 is projected to be 7% for all occupations in the U.S. economy, the outlook is substantially more favorable for statisticians. The 2014-2024 projections of the Bureau of Labor Statistics are displayed in the following table, downloaded on July 7, 2016 from <http://www.bls.gov/ooh/math/statisticians.htm>. As can be seen, the employment for statisticians is projected to grow 33.8%, from 30,000 jobs in 2014 to 40,100 jobs in 2024, indicating an increase of 10,100 jobs over the ten-year period. An increase in percent employment above the national average of 7% in all occupations is predicted in all industries, with the exception of Code 511100: Newspaper, periodical, book, and directory publishers.

Employment by industry, occupation, and percent distribution, 2014 and projected 2024 15-2041 Statisticians

(Employment in thousands)

Industries with fewer than 50 jobs, confidential data, or poor quality data are not displayed

Industry		2014			2024			% change	Employment change
Code	Title	Employment	% of industry	% of occupation	Employment	% of industry	% of occupation		
TE1000	Total employment	30.0	0.0	100.0	40.1	0.0	100.0	33.8	10.1
TE1100	Total self-employed workers	0.9	0.0	3.1	1.0	0.0	2.6	10.9	0.1
TE1200	Total wage and salary employment	29.0	0.0	96.9	39.1	0.0	97.4	34.6	10.0
220000	Utilities	0.1	0.0	0.2	0.1	0.0	0.2	11.9	0.0
221000	Utilities	0.1	0.0	0.2	0.1	0.0	0.2	11.9	0.0
31-330	Manufacturing	1.0	0.0	3.3	1.2	0.0	3.0	22.3	0.2
325000	Chemical manufacturing	0.7	0.1	2.4	0.9	0.1	2.2	24.2	0.2
334000	Computer and electronic product manufacturing	0.1	0.0	0.4	0.1	0.0	0.3	10.9	0.0
339000	Miscellaneous manufacturing	0.1	0.0	0.3	0.1	0.0	0.2	25.1	0.0
420000	Wholesale trade	0.3	0.0	0.8	0.3	0.0	0.8	25.2	0.1
424000	Merchant wholesalers, nondurable goods	0.1	0.0	0.5	0.2	0.0	0.4	13.8	0.0
44-450	Retail trade	0.1	0.0	0.2	0.1	0.0	0.2	82.4	0.0
4445R0	Retail trade, except motor vehicle and parts dealers, food and beverage stores, and general merchandise stores	0.1	0.0	0.2	0.1	0.0	0.2	82.4	0.0
510000	Information	1.4	0.0	4.5	1.8	0.1	4.6	36.6	0.5
511000	Publishing industries (except Internet)	0.3	0.0	1.1	0.4	0.1	1.1	34.5	0.1

511100	Newspaper, periodical, book, and directory publishers	0.1	0.0	0.5	0.1	0.0	0.4	3.8	0.0
520000	Finance and insurance	3.8	0.1	12.7	5.5	0.1	13.8	45.2	1.7
521-20	Monetary authorities, credit intermediation, and related activities	0.5	0.0	1.7	0.7	0.0	1.7	30.6	0.2
522000	Credit intermediation and related activities	0.3	0.0	0.9	0.4	0.0	0.9	32.3	0.1
522200	Nondepository credit intermediation	0.2	0.0	0.5	0.2	0.0	0.5	21.0	0.0
524000	Insurance carriers and related activities	2.8	0.1	9.4	4.1	0.2	10.2	43.9	1.2
524100	Insurance carriers	2.3	0.2	7.8	3.3	0.2	8.3	42.7	1.0
524200	Agencies, brokerages, and other insurance related activities	0.5	0.0	1.7	0.7	0.1	1.9	49.2	0.2
540000	Professional, scientific, and technical services	8.2	0.1	27.3	11.7	0.1	29.0	42.4	3.5
541000	Professional, scientific, and technical services	8.2	0.1	27.3	11.7	0.1	29.0	42.4	3.5
541300	Architectural, engineering, and related services	0.3	0.0	0.9	0.4	0.0	0.9	35.9	0.1
541700	Scientific research and development services	4.1	0.6	13.7	5.4	0.8	13.3	30.0	1.2
541900	Other professional, scientific, and technical services	0.5	0.1	1.8	0.9	0.1	2.1	55.2	0.3
550000	Management of companies and enterprises	1.3	0.1	4.2	1.6	0.1	4.1	31.2	0.4
560000	Administrative and support and waste management and remediation services	0.4	0.0	1.3	0.5	0.0	1.3	41.9	0.2
561000	Administrative and support services	0.4	0.0	1.3	0.5	0.0	1.3	41.9	0.2
561300	Employment services	0.2	0.0	0.6	0.3	0.0	0.7	43.0	0.1
610000	Educational services; state, local, and private	3.1	0.0	10.2	4.2	0.0	10.4	36.8	1.1
611000	Educational services; state, local, and private	3.1	0.0	10.2	4.2	0.0	10.4	36.8	1.1
611100	Elementary and secondary schools; state, local, and private	0.1	0.0	0.3	0.1	0.0	0.3	32.4	0.0
6112-3	Junior colleges, colleges, universities, and professional schools; state, local, and private	2.7	0.1	9.1	3.7	0.1	9.3	36.3	1.0
611200	Junior colleges; state, local, and private	0.1	0.0	0.3	0.1	0.0	0.3	41.2	0.0
611300	Colleges, universities, and professional schools; state, local, and private	2.7	0.1	8.8	3.6	0.1	9.0	36.2	1.0
6114-7	Other educational services; state, local, and private	0.2	0.0	0.7	0.3	0.0	0.8	44.7	0.1
611700	Educational support services; state, local, and private	0.2	0.1	0.7	0.3	0.2	0.8	50.8	0.1
620000	Healthcare and social assistance	1.9	0.0	6.4	2.8	0.0	6.9	45.3	0.9
621000	Ambulatory healthcare services	0.5	0.0	1.7	0.9	0.0	2.2	73.6	0.4
621400	Outpatient care centers	0.2	0.0	0.7	0.4	0.0	1.0	81.2	0.2
622000	Hospitals; state, local, and private	1.3	0.0	4.4	1.8	0.0	4.5	35.0	0.5

622100	General medical and surgical hospitals; state, local, and private	1.1	0.0	3.6	1.5	0.0	3.6	33.7	0.4
624000	Social assistance	0.1	0.0	0.2	0.1	0.0	0.2	27.8	0.0
810000	Other services (except public administration)	0.6	0.0	1.9	0.8	0.0	1.9	29.1	0.2
813000	Religious, grantmaking, civic, professional, and similar organizations	0.4	0.0	1.2	0.5	0.0	1.2	29.8	0.1
8132-3	Grantmaking and giving services and social advocacy organizations	0.1	0.0	0.3	0.1	0.0	0.3	35.4	0.0
8134-9	Civic, social, professional, and similar organizations	0.3	0.0	0.9	0.3	0.0	0.8	27.9	0.1
813900	Business, professional, labor, political, and similar organizations	0.3	0.1	0.9	0.3	0.1	0.8	27.9	0.1
900000	Government	7.1	0.1	23.5	8.3	0.1	20.8	18.0	1.3
910000	Federal government	4.6	0.2	15.3	5.2	0.2	12.9	12.7	0.6
9992-3	State and local government, excluding education and hospitals	2.5	0.0	8.2	3.1	0.0	7.8	28.1	0.7

Note: Red indicates a decline in employment between 2014 and 2024

Source: Employment Projections program, U.S. Department of Labor, U.S. Bureau of Labor Statistics

Short-term and long-term projections for jobs for statisticians were obtained from Projections Central (downloaded July 8, 2016 from the website <http://www.projectionscentral.com/>) for Indiana and surrounding states. The short-term projections from 2015-2017 for the state of Indiana indicate 30 annual openings, on average, with a projected increase in jobs of 8.5%. In the short-term, 110 average annual openings in statistics are estimated for Illinois, Michigan, and Ohio.

Area Name	Occupation Code	Occupation Name	Base Year	Base	Projection Year	Projection	Change	Percent Change	Average Annual Openings
Indiana	15-2041	Statisticians	2015	580	2017	630	50	8.5	30
Illinois	15-2041	Statisticians	2015	580	2017	630	50	7.6	30
Michigan	15-2041	Statisticians	2015	580	2017	630	50	8.6	40
Ohio	15-2041	Statisticians	2015	740	2017	770	30	4.1	40

Long-term projections from 2014-2024 show a 33.7% increase nationally, and a 39.4% increase in jobs for statisticians in Indiana. Similar increases are projected for Michigan and Ohio. In the long-term, an average of 120 openings annually is projected for Indiana, Illinois, Michigan, and Ohio overall.

Area Name	Occupation Code	Occupation Name	Base Year	Base	Projection Year	Projection	Change	Percent Change	Average Annual Openings
United States	15-2041	Statisticians	2014	30000	2024	40100	10100	33.7	1540
Indiana	15-2041	Statisticians	2014	570	2024	800	230	39.4	30
Illinois	15-2041	Statisticians	2014	560	2024	660	100	18.2	20
Michigan	15-2041	Statisticians	2014	560	2024	790	230	41.1	30
Ohio	15-2041	Statisticians	2014	880	2024	1160	280	31.8	40

The following table shows the projected future demand for statisticians in the state of Indiana in 2022, provided by the Indiana Department of Workforce Development, downloaded on July 8, 2016. A demand of 639 jobs for statisticians in Indiana is projected by 2022, with 24 average annual openings.

Future Demand for Indiana

Code	Title	Projected Demand -2022	Avg. Annual Openings	Avg. Annual New Openings	Percent of Total Openings	Avg. Annual Replacement Openings	Percent of Total Openings	Avg. Annual Wage in (2015)	Current Demand: Online Job Ads (2-mo. avg)
152041	Statisticians	639	24	6	25.00%	18	75.00%	\$61,310	39

Source: Indiana Department of Workforce Development, Research & Analysis, Long-term Projections

The following tables were downloaded from the Indiana Department of Workforce Development on July 8, 2016. They contain the employment and job outlook for statisticians in 2022 for the United States, the state of Indiana, and EGR 3, the Economic Growth Region for Northeast Indiana containing Fort Wayne. Specifically, for those individuals with a Bachelor's degree, the Indiana Department of Workforce Development shows a 26.4% job growth for statisticians nationally. A more favorable outlook exists for statisticians with a Bachelor's degree in Northeast Indiana. The demand for these individuals in EGR 3 is growing at more than three times the rate (33.3%) when compared to the state of Indiana (10.5%).

Side-by-Side Comparison - Statisticians in 2022

	U.S. 2022	Indiana 2022	EGR 3
Employment and Openings			
Projected Occupational Employment	34,900	639	57
Average Annual Openings	1,610	24	3
Openings to Fill by 2022	16,100	240	30
Growth Rate	26.4 %	10.6 %	35.7 %
Job Growth by Educational Requirement			
Less Than a H.S. Diploma	0.0 %	0.0 %	0.0 %
H.S. Diploma	0.0 %	0.0 %	0.0 %
Post Secondary Certificate or Some College	0.0 %	0.0 %	0.0 %
Associate Degree	0.0 %	0.0 %	0.0 %
Bachelor's Degree	26.4 %	10.5 %	33.3 %
Advanced Degrees	26.4 %	10.8 %	33.3 %
Job Distribution by Educational Requirement			
Less Than a H.S. Diploma	0.0 %	0.0 %	0.0 %
H.S. Diploma	0.0 %	0.0 %	0.0 %
Post Secondary Certificate or Some College	0.0 %	0.0 %	0.0 %

Associate Degree	0.0 %	0.0 %	0.0 %
Bachelor's Degree	28.0 %	28.0 %	28.1 %
Advanced Degrees	72.0 %	72.1 %	70.2 %

Source: Indiana Department of Workforce Development, Research & Analysis, Long-term Projections

Appendix 3: National, State, or Regional Studies, Detail

<http://www.ipfw.edu/microsites/usap/employment-outlook/index.html>.

The McKinsey Global Institute published a study in May 2011 analyzing the supply and demand of data analytical talent and the implications of the availability and use of big data.

(<http://www.mckinsey.com/business-functions/business-technology/our-insights/big-data-the-next-frontier-for-innovation>)

Their study argues for the need for individuals who can analyze and manage data:

- “Data have swept into every industry and business function and are now an important factor of production, alongside labor and capital.”
- “Leading companies are using data collection and analysis to conduct controlled experiments to make better management decisions; others are using data for basic low-frequency forecasting to high-frequency nowcasting to adjust their business levers just in time.”
- “...sophisticated analytics can substantially improve decision-making. Finally, big data can be used to improve the development of the next generation of products and services.”

Their findings indicate a disparity between the supply and demand of individuals with deep analytical skills:

- “There will be a shortage of talent necessary for organizations to take advantage of big data. By 2018, the United States alone could face a shortage of 140,000 to 190,000 people with deep analytical skills as well as 1.5 million managers and analysts with the know-how to use the analysis of big data to make effective decisions.”

The IPFW Community Research Institute has published several regional studies, including employment projections and training needs. Some relevant findings of these studies are provided below.

Regional Intel Report by the IPFW Community Research Institute, 2015-2016

(https://ind657-my.sharepoint.com/personal/oxtobyj_ipfw_edu/Documents/USAP%20-%202015-16/Regional%20Intel%20Report.pdf)

- “Approximately 17% (nearly 3,600) of regional openings over the next decade will be in analytical fields – potential connections to growth areas like Big Data, fraud prevention, market research, etc.”
- IPFW conferred 61% of all awards in the Northeast Indiana region since 2003 (268 of 441)

- Since 2003 the region’s completions in mathematics and statistics have remained flat; during this same period there has been a near doubling of completions at the state and national levels.

Region	Completions		Percent Change
	2003	2014	
Northeast Indiana Region	31	35	12.9%
State	514	991	92.8%
Nation	19,657	36,259	84.5%

Occupational Projections and Training Needs for Northeast Indiana to 2018, February 2011
<http://www.neindiana.com/docs/workforce/occupational-projections-training-needs-for-northeast-indiana-to-2018.pdf?sfvrsn=41>)

- “The forecast suggests that the percent of openings for workers with a college or advanced degree will increase while openings for high school graduates or workers with less than a high school diploma will drop. The forecast suggests that 30% of the training requirement will be at the Bachelor’s or higher degree level and another 7% will require a post-secondary degree or certificate.”
- “The category of Bachelor’s degree plus work experience includes many of the middle and upper management jobs in the regional economy. This is an important category in the competitiveness of the region since it represents jobs that are filled through regional or national searches in the absence of local talent. Local talent and advanced degrees in these fields are a competitive advantage while a lack of local talent is a competitive disadvantage for the region.”

Appendix 4: Surveys of Employers or Students and Analyses of Job Postings, Detail

A search of CareerCast.com listed 2,194 job postings for statisticians. Of these postings, 26 were in Indiana and 157 were in one of the contiguous states: Illinois 63, Michigan 41, and Ohio 53. One hundred seventeen of the postings were within a 150 mile radius of Fort Wayne. Career Cast indicates that four of the top ten ranked professions for 2016 are math-intensive: #1 Data Scientist, #2 Statistician, #6 Mathematician, and #10 Actuary.

Link: <http://www.careerCast.com/jobs/results/keyword/statistician>

A search of Monster.com listed 609 jobs for statisticians. Twenty-two jobs were in Indiana, and 40 were in one of the contiguous states: 23 in Illinois, 10 in Michigan, and 7 in Ohio.

Link: <http://www.monster.com/jobs/search/?q=Statistician>

A search of USA Jobs, an official website of the United States Government yielded 391 government job postings in statistics, of which 7 were in Indiana. Seventeen of these listings were in Illinois, 16 in Ohio, and 7 in Michigan.

Link:

<https://www.usajobs.gov/Search/?Keyword=Statistician&Location=&homeRadPublic=public&search=Search&AutoCompleteSelected=False&CanSeekStatusJobs=False>

A search of ASA JobWeb, the job listings website for the American Statistical Association, listed 49 positions, 10 of which required a Bachelor's degree as the highest attained educational level.

Link: <http://jobs.amstat.org/jobs/>

A search of the CareerOneStop.com Job Finder found 407 jobs for statisticians in the United States. Nine of these jobs were in Indiana, 19 in Illinois, 6 in Michigan, and 7 in Ohio. A search for job postings for biostatisticians found 22 U.S. jobs, of which 3 were in Indiana, 11 in Illinois, 6 in Michigan, and 2 in Ohio. A search for job postings for clinical data managers found 36,923 U.S. jobs, of which 380 were in Indiana, 1,072 in Illinois, 1,395 in Michigan, and 826 in Ohio.

Link: <http://www.careeronestop.org/toolkit/jobs/find-jobs.aspx?keyword=15-2041.00&location=US&occtitle=Statisticians&source=DEA>

CareerOneStop Job Finder

Jobs for Statisticians in Indiana, Michigan, Ohio and Illinois.

Job Title	Company	Location	Date Posted
Statistical Fellow	Covance	Indianapolis, Indiana	07/08/2016
Statistical Fellow	Covance	Greenfield, Indiana	07/08/2016
Statistician-Comput Bus Analytics-FDE	Lilly	Indianapolis, Indiana	07/01/2016
Travel Demand Modeler	Resource Systems Group	Evansville, Indiana	06/29/2016
Research Scientist-Clinical Project Statistician-FDE	Lilly	Indianapolis, Indiana	06/28/2016
Statistician	Cook Medical	West Lafayette, Indiana	06/14/2016
Research Scientist-Clinical Project Statistician	Lilly	Indianapolis, Indiana	06/08/2016
Statistician-Clinical Programmer	Lilly	Indianapolis, Indiana	05/20/2016
Industrial Statistician	Lilly	Indianapolis, Indiana	05/19/2016
Analyst Biostatistics	McKinsey and Company	Detroit, Michigan	07/13/2016
Associate Machine Learning	McKinsey and Company	Detroit, Michigan	07/13/2016
UBC Principal Statistician	Express Scripts	Ann Arbor, Michigan	07/08/2016
Data Miner Sr	Truven Health Analytics	Ann Arbor, Michigan	06/29/2016
Statistician Senior	University of Michigan	Ann Arbor, Michigan	06/21/2016
Biostatistician	Spectrum Health	Grand Rapids, Michigan	06/03/2016
Predictive Modeler	CyberCoders	Akron, Ohio	07/07/2016
Research Statistician	Battelle Memorial Institute	Columbus, Ohio	07/06/2016
Data Analyst - Statistician	Total Quality Logistics	Cincinnati, Ohio	06/18/2016
R&D Statistical Analyst	Progressive	Mayfield Village, Ohio	06/14/2016
Senior Research Biostatistician	Battelle Memorial Institute	Columbus, Ohio	05/20/2016
Biostatistician	Cleveland Clinic	Cleveland, Ohio	04/21/2016
Sr. Statistical Modeler	JPMorgan Chase	Columbus, Ohio	04/20/2016
Principal Statistician, Biosimilar Pharmaceutical Sciences	Pfizer	Lake Forest, Illinois	07/12/2016

Job Title	Company	Location	Date Posted
Staff VP Advanced Analytics - 119019	Anthem, Inc	Chicago, Illinois	07/10/2016
Statistical Fellow	Covance	Chicago, Illinois	07/08/2016
Principal Statistician	General Dynamics Information Technology	Chicago, Illinois	07/07/2016
Biostatistician III	Covance	Chicago, Illinois	07/06/2016
Biostatistician	CSL Behring	Kankakee, Illinois	07/05/2016
Staff VP Advanced Analytics	Anthem, Inc.	Chicago, Illinois	07/02/2016
Senior Statistician	University of Chicago	Chicago, Illinois	07/01/2016
Sr Statistical Modeler	RELX Group	Chicago, Illinois	07/01/2016
Sr Statistical Modeler	RELX Group	Chicago, Illinois	06/30/2016
Travel Demand Modeler	RSG	Chicago, Illinois	06/26/2016
Statistician	Abbott	Lake Forest, Illinois	06/23/2016
Statistician	CBRE	Chicago, Illinois	06/22/2016
Statistician	St. Anthony's Health Center	Peoria, Illinois	05/29/2016
Senior Research Statistician	AbbVie	Lake County, Illinois	05/26/2016
Biostatistician II	Covance	Chicago, Illinois	05/26/2016
Statistician	NORC	Chicago, Illinois	05/19/2016
Statistician	Rose International INC	Abbott Park, Illinois	05/13/2016
Statistical Modeler	RELX Group	Chicago, Illinois	04/19/2016

Job postings here were provided by Direct Employers Association (www.us.jobs).

<http://www.careeronestop.org/credentials/toolkit/find-jobs.aspx>

This information was retrieved on 7/13/2016 at 4:25 PM from Job Finder at CareerOneStop (www.careeronestop.org), sponsored by the U.S. Department of Labor, Employment, and Training Administration.

CareerOneStop Job Finder

Jobs for Biostatisticians in Indiana, Michigan, Ohio and Illinois.

Job Title	Company	Location	Date Posted
Biostatistician / St Vincent Indpls Acute / FT Days	Ascension Health	Indianapolis, Indiana	06/28/2016
Statistical Fellow	Covance	Indianapolis, Indiana	07/08/2016
Statistical Fellow	Covance	Greenfield, Indiana	07/08/2016
Biostatistician	Spectrum Health	Grand Rapids, Michigan	06/03/2016
Biostatistician SR. - Meijer Heart & Vascular Institute Cardiovascular Research Team	Spectrum Health	Grand Rapids, Michigan	06/22/2016
Administrative Assistant Assoc	University of Michigan	Ann Arbor, Michigan	06/23/2016
Project Manager	Arbor Research Collaborative For Health	Ann Arbor, Michigan	06/22/2016
Information Services Project Manager	Arbor Research Collaborative For Health	Ann Arbor, Michigan	06/17/2016
Research Area Specialist Inter	University of Michigan	Ann Arbor, Michigan	06/17/2016
Biostatistician	Cleveland Clinic	Cleveland, Ohio	04/21/2016
Senior Research Biostatistician	Battelle Memorial Institute	Columbus, Ohio	05/20/2016
Biostatistician	CSL Behring	Kankakee, Illinois	07/05/2016
Biostatistician II	Covance	Chicago, Illinois	05/26/2016
Sr. Biostatistician	University of Chicago	Chicago, Illinois	06/15/2016
Biostatistician III	Covance	Chicago, Illinois	07/06/2016
Programmer I	Covance	Chicago, Illinois	05/07/2016
Statistical Analyst	Northwestern University	Chicago, Illinois	06/25/2016
Clinical Research Analyst - Chicago, IL	UnitedHealth Group	Chicago, Illinois	06/16/2016

Job Title	Company	Location	Date Posted
Statistical Fellow	Covance	Chicago, Illinois	07/08/2016
Senior Bioinformatician	University of Chicago	Chicago, Illinois	04/27/2016
Health Economics & Clinical Outcomes Research (HECOR) Director (Oncology)	Astellas Pharma	Northbrook, Illinois	06/02/2016
Associate Director, RWI Statistical Methodologist	Astellas Pharma	Northbrook, Illinois	05/04/2016

This information was retrieved on 7/13/2016 at 5:23 PM from Job Finder at CareerOneStop (www.careeronestop.org), sponsored by the U.S. Department of Labor, Employment, and Training Administration.

Job postings here were provided by Direct Employers Association (www.us.jobs).

<http://www.careeronestop.org/credentials/toolkit/find-jobs.aspx>

Appendix 5: Letters of Support, Detail

Appendix 6: Faculty and Staff, Detail

Last name	First name	Academic Title	CIP code	Diploma Information	Area of Specialization
Akkari	Safwan	Associate Professor of Mathematical Sciences	27.01	Ph.D., Louisiana State University, 1988	Matroid theory, graph theory
Alexander	Deana	Continuing Lecturer in Mathematical Sciences	27.01	M.S., Purdue University, 2006	Online teaching, applied mathematics
Anderson	Jeffrey	Professor of Mathematics	27.01	Ph.D., Iowa State University, 1989	Partial differential equations, applied mathematics
Beineke	Lowell	Jack W. Schrey Professor of Mathematical Sciences	27.01	Ph.D., University of Michigan, 1965	Graph theory, combinatorics
Berry	Sandra	Associate Professor of Mathematics Education	27.01	Ph.D., Purdue University, 2007	Mathematics education
Chauhan	Chand	Associate Professor of Mathematics	27.01	Ph.D., The Ohio State University, 1983	Applied statistics, design of experiments
Coffman***	Adam	Professor of Mathematics	27.01	Ph.D., University of Chicago, 1997	Geometry, complex analysis, topology
Coroian	I. Dan	Associate Professor of Mathematics	27.01	Ph.D., University of Iowa, 1997	Numerical analysis, applied mathematics, mathematical modeling
Deng	Yihao	Associate Professor of Statistics	27.05	Ph.D., Old Dominion University, 2006	Regression analysis, generalized linear models, time series analysis
Dragnev*	Peter	Professor of Mathematics	27.01	Ph.D., University of South Florida, 1997	Analysis, potential theory, approximation theory
Francis	Joe	Professional Actuary in Residence/ Continuing Lecturer in Mathematical Sciences	27.01	B.S., DePauw University, 1987	Actuarial science

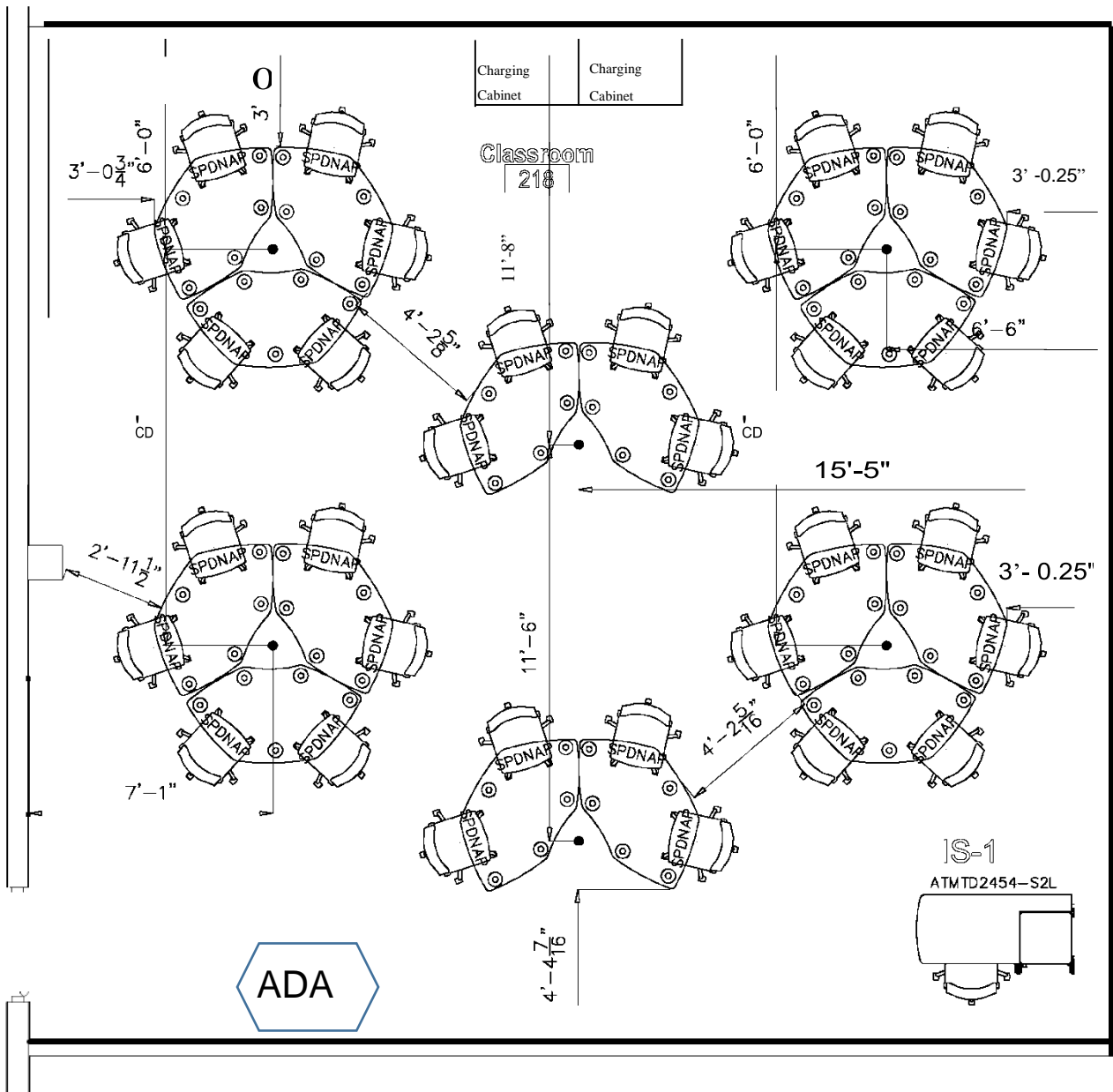
Last name	First name	Academic Title	CIP code	Diploma Information	Area of Specialization
Hersberger**	James	Professor of Mathematics	27.01	Ph.D., Purdue University, 1983	Problem solving, mathematical giftedness, school mathematics curriculum
LaMaster	John	Senior Instructor in Mathematics	27.01	M.S., Purdue University, 1992	Teaching with technology, math anxiety reduction, school mathematics curriculum
Legg	Alan	Visiting Assistant Professor of Mathematics	27.01	Ph.D., Purdue 2016	Complex Analysis
Lipman	Marc	Professor of Mathematical Sciences	27.01	Ph.D., Dartmouth College, 1976	Graph theory, discrete mathematics
Mau	Sue	Associate Professor of Math Education	27.01	Ph.D., Indiana University, 1992	Teachers' and students' mathematical understanding, teachers' professional growth
Osowski	John	Continuing Lecturer in Mathematics	27.01	M.A.S., The Ohio State Univ., 1985	Teaching of statistics, applied statistics
Pan	Yifei	Professor of Mathematical Sciences	27.01	Ph.D., University of Michigan, 1990	Complex analysis, partial differential equations, complex analytic dynamics
Townsend	Douglas	Professor of Mathematical Sciences	27.0101	Ph.D., University of Illinois, Ph.D., 1976	Approximation theory, applied statistics
Vandell	Robert	Associate Professor of Mathematics	27.01	Ph.D., Western Michigan University, 1996	Graph theory, graph connectivity, secondary math education
Vanderlaan	Cynthia	Continuing Lecturer in Mathematics	27.01	M.S., Indiana University, 1999	Precalculus curriculum development, teaching with technology
Wagner	Linda	Continuing Lecturer in Mathematics	27.01	M.S., Univ. of Illinois - Urbana/Champaign, 1978	Mathematics education, precalculus curriculum
Weakley	W. Douglas	Professor of Mathematics	27.01	Ph.D., Northwestern University, 1980	Graph theory, algebra covering codes, combinatorics
Weakley	Cecilia	Assistant Professor of Mathematics	27.01	Ph.D., University of North Carolina, 1978	Real analysis, topology

Last name	First name	Academic Title	CIP code	Diploma Information	Area of Specialization
Yorgov	Daniel	Visiting Assistant Professor in Applied Statistics	27.01	Ph.D., University of Colorado, 2016	Statistical genetics, high performance computing
Zhang	Yuan	Associate Professor of Mathematics	27.01	Ph.D., Rutgers University, 2009	Several complex variables, CR geometry, partial differential equations
Zook	Dianna	Instructor in Mathematics	27.01	M.A., Kent State University, 1979	Calculus and precalculus curriculum development, technology
Zubovic	Yvonne	Associate Professor of Mathematical Sciences	27.01	Ph.D., The Ohio State University, 1988	Biostatistics, survival analysis, applied statistics

*** Chair of Department; ** Associate Chair of Department; *** Acting Chair of Department (July 1, 2016 – December 31, 2016)**

Appendix 7: Facilities, Detail

During the summer of 2016, the classrooms Kettler 123 and Kettler 218 were under renovation. The renovation included upgrades to the available technology as well as reconfigurations of the layout to allow for students to collaborate in teams (see figure below). The estimated cost of these renovations is \$150,000 each, for a total of \$300,000.



Similar upgrades are required for Kettler 216 and Kettler 220 at an estimated cost of \$150,000 apiece.

Appendix 8: Other Capital Costs, Detail

Salaries and Wages	Recurring	\$112,500 (for 1.5 FTE)
Supplies and Expenses	Recurring	\$5,000
Other		\$5,000
		<ul style="list-style-type: none">• e.g., office furniture, computer, software
Professional Development		\$7,500 (1.5 @ \$5,000)

Appendix 9: Articulation of Associate/Baccalaureate Programs, Detail

As of June 2016, the Indiana Commission on Higher Education website does not list any Transfer Single Articulation Pathways in progress for applied statistics.

Link: <http://www.in.gov/che/3138.htm>

Appendix 10: Credit hours Required/Time to Completion, Detail

Curriculum and Requirements

Admission Requirements

For a beginning regular admit, the admission requirements are:

- (1) High School G.P.A. of 2.5 or higher;
- (2) One of the following SAT/ACT Score requirements:
 - SAT Score (new scale) of 840 or above and Math SAT Score (new) of 420 or above;
 - SAT Score (old scale) of 1120 or above and Math SAT Score (old) of 380 or above;
 - ACT Score of 16 or above overall and ACT Score of 15 or higher in Math.

Curriculum Requirements

The Bachelor of Science in Applied Statistics consists of 120 credit hours distributed according to the following:

<u>Basic Mathematics and Computing Core</u>		<u>(18-19 credits)</u>
MA 16500	Analytic Geometry and Calculus I	(4 credits)
MA 16600	Analytic Geometry and Calculus II	(4 credits)
Choice of:		
MA 26300	Multivariate & Vector Calculus	(4 credits)
MA 26100	Multivariate Calculus	
MA 35100	Elementary Linear Algebra	(3 credits)
Choice of:		
CS 11400	Introduction to Visual Basic	(3-4 credits)
CS 16000	Introduction to Computer Science I	
<u>Basic Statistics Core</u>		<u>(15 credits)</u>
STAT 51100	Statistical Methods	(3 credits)
STAT 51600	Basic Probability and Applications	(3 credits)
STAT 51700	Statistical Inference	(3 credits)
STAT 51200	Applied Regression Analysis	(3 credits)
STAT 51400	Design of Experiments	(3 credits)
<u>Statistics Electives</u>		<u>(9 credits)</u>
Select 3 courses from:		
STAT 42100	Modern Statistical Modeling Using R and SAS	(3 credits)

STAT 43200	Introduction to Stochastic Processes	(3 credits)
STAT 43300	Introduction to Nonparametric Statistics	(3 credits)
STAT 51300	Statistical Quality Control	(3 credits)
STAT 52000	Time Series and Applications	(3 credits)

Capstone (3 credits)

STAT 49000	Data Analysis	(3 credits)
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-Students should complete a data analysis project. In addition to emphasizing the application of statistical methods, the course should provide students ample opportunity to collaborate as part of a team and to communicate their findings through written reports and oral presentation.

General Education Requirements (33 credits)

- GA1 Written Communication
- GA2 Speaking and Listening
- GA3 Quantitative Reasoning (MA 16500 can be used)
- GB4 Scientific Ways of Knowing
- GB5 Social and Behavioral Ways of Knowing
- GB6 Humanistic and Artistic Ways of knowing
- GB7 Interdisciplinary or Creative Ways of Knowing (for example, foreign language courses 112)

Additional Credits from Category A or B (for example, foreign language courses, ENG W233, 2nd science course) to meet the 30 credit hour requirement for GA1-GA3, GB4-GB7.

GCAP Capstone Experience (STAT 49000 Data Analysis)

COAS B.S. Liberal Arts Requirements (14 credits)

Second Semester Writing	ENG W140 or ENG W233	(3 credits)
Speaking Requirement	COM 11400	(3 credits)
Foreign Language Requirement	(2 nd semester of a foreign language)	(8 credits)

Departmental Science Requirements (11 credits)

3 Approved Science Courses, two of which include a lab (see Mathematical Sciences Department approved list)

Minor/Additional Electives to Reach 120 credits needed for graduation

Sample Curriculum: Bachelor of Science in Statistics

Taking a typical load of 15 credit hours per semester, a calculus-ready student is able to complete the requirements in four years. A sample plan for the fall and spring semesters of each of the four years is provided below.

1 st Year Fall Semester				1 st Year Spring Semester			
Course No.	Course Title	Pre-Reqs	Crs.	Course No.	Course Title	Pre-Reqs	Crs.
MA 165000 (GA3)	Analytic Geometry & Calculus I	MA 15900 or MA 15400 (C- or above); or placement	4	MA 16600	Analytic Geometry & Calculus II	MA 16500 (C- or above)	4
ENG W131 (GA1)	Reading, Writing, & Inquiry	Self-Place or ENG W129 (C- or above)	3	GB5	Gen Ed Social/Behavior		3
GB4 (see Math. Dept. options)	Gen Ed Science/Lab (Approved course)	*See lab requirement	4	Science/with Lab (see GB4 and Math. Dept. options)	Approved Science/Lab	*See lab requirement	4
FL 1 st semester (see GB7 or Gen Ed A/B options)	Foreign Language 1		4	FL 2nd (GB7 or Gen Ed A/B options)	Foreign Language 2	FL 1/ placement	4
Total Semester Credit Hours			15	Total Semester Credit Hours			15

2 nd Year Fall Semester				2 nd Year Spring Semester			
Course No.	Course Title	Pre-Reqs	Crs.	Course No.	Course Title	Pre-Reqs	Crs.
MA 26300 or MA 261	Multivariate & Vector Calculus <u>or</u> Multivariate Calculus	MA 16600 (C- or above)	4	MA 35100	Elem Linear Algebra	2 sem calc (C- or above grades)	3
Science (no lab) (see GB4 options and Math. Dept. options)	Approved Science		3	STAT 51100	Statistical Methods	2 sem calc (C- or above grades)	3
COM 11400 (GA2/A&S)	Fundamentals of Speech Communication		3	ENG W233 (Gen Ed A/B)	Intermediate Expository Writing	ENG W131 (C- or above)	3
GB7 (if needed)	Gen Ed Creative or Interdisciplinary		3	CS 11400 or CS 16000	Introduction to Visual Basic <u>or</u> Introduction to Computer Science I	√	3-4
GB6	Gen Ed Humanistic and Artistic		3	Elective	Free Elective		3
Total Semester Credit Hours			16	Total Semester Credit Hours			15-16

3 rd Year Fall Semester				3 rd Year Spring Semester			
Course No.	Course Title	Pre-Reqs	Crs.	Course No.	Course Title	Pre-Reqs	Crs.
STAT 51200	Applied Regression Analysis	STAT 511, 517, or 528 (C- or above grades)	3	STAT 51400	Design of Experiments	STAT 51200 (C- or above)	3
STAT 51600	Basic Probability and Applications	MA 261 or MA 263 (C- or above)	3	STAT 51700	Statistical Inference	STAT 51600 (C- or above)	3
Elective or Gen Ed A or B	Free elective course <u>or</u> Gen Ed A or B (if needed)		3	Elective or Gen Ed A or B	Free elective course <u>or</u> Gen Ed A or B (if needed)		3
Elective	Free elective		3	Elective	Free elective		3

Elective	Free elective		3	Elective	Free elective		3
Total Semester Credit Hours			15	Total Semester Credit Hours			15

4th Year Fall Semester				4th Year Spring Semester			
Course No.	Course Title	Pre-Reqs	Crs.	Course No.	Course Title	Pre-Reqs	Crs.
Statistics Elective:	Approved Statistics elective	√	3	Statistics Elective	Approved Statistics elective	√	3
Statistics Elective or Free Elective:	Approved Statistics elective <u>or</u> Free elective course	√	3	Statistics Elective or Free Elective	Approved Statistics elective (if needed) <u>or</u> Free elective course	√	3
Elective or Gen Ed A or B	Free elective course <u>or</u> Gen Ed A or B (if needed)		3	STAT 49000 (GCAP C8)	Data Analysis	STAT 511 (C- or above)	3
Elective or Gen Ed A or B	Free elective course <u>or</u> Gen Ed A or B (if needed)		3	MA 49000 or Elective	VT-Topics in Mathematics for Undergraduates <u>or</u> Free Elective		1-2
Elective	Free elective course		3	Elective	Free elective course		3
Total Semester Credit Hours			15	Total Semester Credit Hours			13-14

√ = See IPFW Bulletin or myBLUEprint for additional course prerequisites

Approved Statistics Electives: STAT 42100, STAT 43200, STAT 43300, STAT 51300, or STAT 52000

120 credits required for Bachelor of Science degree

2.0 GPA required for Bachelor of Science degree/major

Existing courses in the proposed curriculum

Course descriptions for the 2016-2017 can be found at <http://bulletin.ipfw.edu/index.php>.

MA 16500	Analytic Geometry and Calculus I
MA 16600	Analytic Geometry and Calculus II
MA 26300	Multivariate & Vector Calculus
MA 26100	Multivariate Calculus
MA 35100	Elementary Linear Algebra
CS 11400	Introduction to Visual Basic
CS 16000	Introduction to Computer Science I
STAT 51100	Statistical Methods
STAT 51600	Basic Probability and Applications
STAT 51700	Statistical Inference
STAT 51200	Applied Regression Analysis
STAT 51400	Design of Experiments
STAT 52000	Time Series and Applications
ENG W140	Elementary Composition Honors
ENG W233	Intermediate Expository Writing
COM 11400	Fundamentals of Speech Communication

In addition, courses meeting General Education Requirements GA1 – GA3 and GB4 – GB7 already exist (see [General Education Courses](#) for a complete list).

Courses to be added

Several new courses will be added to the curriculum. An asterisk * indicates the course is in the bulletin for either the West Lafayette or Indianapolis campus of Purdue. Syllabi for these courses are in the pages that follow.

STAT 49000	Data Analysis
STAT 42100*	Modern Statistical Modeling Using R and SAS
STAT 43200*	Introduction to Stochastic Processes
STAT 43300*	Introduction to Nonparametric Statistics
STAT 51300*	Statistical Quality Control

STAT 42100 Modern Statistical Modeling Using R and SAS

COURSE DESCRIPTION: An introductory course on statistical computation. The primary goals of this course are (i) to introduce popular statistical software SAS and R and to develop basic data analysis skills, and (ii) to introduce basic statistical computation methods used in applications.

CREDIT HOURS: 3 credits

PREREQUISITE: STAT 517 Statistical Inference.

TEXT: *Statistical Computing with R* by Maria Rizzo, Chapman and Hall, 1st Edition, 2007.

COURSE OBJECTIVES:

This course provides a broad overview of computational methods in various statistical analyses.

Upon completion of this course, students will be able to

- Understand and apply the theory underlying various statistical computing approaches.
- Implement statistical computing approaches in the R and SAS environments.
- Apply statistical computing methods to efficiently execute statistical analyses in a wide range of situations.

TOPICS:

Tentatively, you will explore the following topics throughout the semester. The pace and content covered will be adjusted according to the interest and needs of the class, at the discretion of the instructor.

Introduction to R	Chapter 1	1 week
Review of Probability and Statistics Basics	Chapter 2	1 week
Generating Random Variables	Chapter 3	2 weeks
Visualization of Multivariate Data	Chapter 4	1 week
Basics of Monte Carlo	Chapter 5	2 weeks
Inference using Monte Carlo Methods	Chapter 6	2 weeks
Bootstrap and Jackknife	Chapter 7	2 weeks
Permutation Tests	Chapter 8	1 week
Probability Density Estimation	Chapter 10	1 week
Optimization	Chapter 11	2 weeks

HOMEWORK:

Regular homework assignments are planned for the course, worth 250 total points. The homework assignments will be a combination of theoretical derivations and applications to real data sets. Due dates will be provided for each assignment. Late assignments will be accepted but may be assessed a penalty of up to 10% per calendar day that the assignment is late.

TESTS:

You will take one midterm test (**100 points**) and a comprehensive final exam (**150 points**) to assess your understanding of the course content. These tests will cover the material presented in class, assigned reading, and homework problems.

GRADING: Midterm (100 pts.) + Homework (250 pts.) + Final Exam (150 pts.) = Total (500 pts.)

Grading Scale:	A	450 - 500 pts.
	B	400 - 449
	C	350 - 399
	D	300 - 349
	F	below 300

COURSE POLICIES:

You are expected to follow the information in the current IPFW Student Handbook and Planner. In particular, be familiar with the *IPFW Code of Student Rights, Responsibilities, and Conduct* found at <http://bulletin.ipfw.edu/content.php?catoid=38&navoid=1019#Disciplinary>.

Academic Integrity: Academic integrity is the pursuit of scholarly activity free from fraud and deception and is an educational objective of this institution. Policies regarding academic integrity as described in the *IPFW Code of Student Rights, Responsibilities, and Conduct* apply to this course. Academic dishonesty includes, but is not limited to, cheating, plagiarizing, fabricating of information or citations, facilitating acts of academic dishonesty by others, having unauthorized possession of homework solutions or examinations, submitting work of another person, and tampering with the academic work of other students.

Attendance: Class attendance and participation is essential for success. It is your responsibility to clarify missed work with classmates or with me prior to the next class.

Missed tests: To be eligible for a make-up test, students who cannot take a test must contact me **within 24 hours after the test is given** with a valid excuse. I judge the validity of the excuse in determining whether a make-up will be given. Individual arrangements will be made for a make-up test for those who are eligible.

Civility: I am committed to creating a climate for learning characterized by respect for one another and the contributions each person makes to class. I ask that you make a similar commitment.

ADDITIONAL RESOURCES:

Students with Disabilities. If you have a disability and need assistance, special arrangements can be made to accommodate most needs. Contact the Director of Services for Students with Disabilities (Walb Union, Room 113, telephone number (260) 481-6658), as soon as possible to work out the details. The SSD office will provide you with a Disability Accommodation Verification Card attesting to your needs for modification that you need to bring to me. For more information, please visit the web site for <http://www.ipfw.edu/disabilities/>.

Center for Academic Support and Advancement (CASA): Tutoring Center. Tutoring for a variety of courses is available at the Tutoring Center in Kettler G19 or in the Math Assistance Learning Lab (MALL) in Kettler G38. For more information see the websites <http://www.ipfw.edu/offices/casa/> and <http://www.ipfw.edu/departments/coas/depts/math/mall/> .

Information Technology Services Help Desk. If you have questions concerning the use of computers at IPFW, hardware and software support, or student email accounts, please contact the Help Desk in KT 206, telephone (260) 481-6030 or visit the website <http://www.ipfw.edu/its/> .

STAT 43200 Introduction to Stochastic Process and Probability Modeling

COURSE DESCRIPTION: The course builds on elementary probability theory and introduces stochastic processes applied to the study of phenomena in fields such as engineering, computer science, management science, the life, physical and social sciences, and operations research. The approach is heuristic and non-rigorous. It develops students' intuitive feel for the subject and enables them to think probabilistically. Computation is emphasized and requires use of software such as Excel, MINITAB, and R.

CREDIT HOURS: 3 credits

PREREQUISITE: STAT 516 Basic Probability and Applications with C- or higher.

TEXT: *Introduction to Probability Models* by Sheldon Ross, Academic Press, 11th Edition, 2014.

COURSE OBJECTIVES:

Below are learning objectives organized by course topic. For each item listed, expect to gain experience working with, computing, and interpreting said item.

1. It is assumed that you have familiarity with the concept of probability and many common probabilistic models. Therefore, only a brief overview will be given to refresh the following concepts: discrete and continuous probability distributions; compute and interpret expected values and variances; joint distributions.
2. While you are expected to have some familiarity with conditional probability, a longer overview will be presented due to the importance it plays in later chapters. In particular, students will gain an understanding of what conditional probability and expected value mean, and how to work with and compute conditional probabilities and expectations.
3. You will be introduced to Markov chains, starting with discrete space and time models. You will learn about the transition probability matrix and Chapman---Kolmogorov equations. You will also learn to compute multi-step probabilities, and limiting and stationary behavior of Markov chains.
4. You will expand on the previous chapter by learning about a continuous---time/discrete space Markov chain called the Poisson point process. You will learn about the connection between the Poisson process and exponential waiting times, and explore generalizations of the Poisson process.
5. You will then examine a more general framework for continuous time stochastic processes. You will consider different examples, define the transition probability function, the generalization of the Chapman---Kolmogorov equations, and limiting

and stationary behavior.

6. The course concludes with a discussion of continuous time and continuous state stochastic processes, and, in particular, Brownian motion. You will define Brownian motion, discuss its construction, and its various properties. As time permits, you will learn about variations of Brownian motion, followed by a very basic introduction to stochastic integration, Gaussian processes, and harmonic analysis of stationary processes

TOPICS:

To model a process using stochastic models you will need to understand some basic concepts such as variability, uncertainty, probability, randomness, and independence. These ideas are the basis for the probability and statistical methodology that comprise the content of the course. Tentatively, we will explore the following topics throughout the semester. The pace and content covered will be adjusted according to the interest and needs of the class, at the discretion of the instructor.

1. Probability Models	Chapter 1	1 week
2. Random Variables	Chapter 2	1 week
3. Conditional Probability	Chapter 3	2 weeks
4. Discrete Time/State Markov Chains	Chapter 4	3 weeks
5. The Poisson Process	Chapter 5	2 weeks
6. Continuous Time Markov Chains	Chapter 6	3 weeks
7. Brownian Motion	Chapter 10	3 weeks

HOMEWORK:

Five homework assignments are planned for the course, each worth 30 points. The homework assignments will be a combination of theoretical derivations and applications to real data sets. Due dates will be provided for each assignment. Late assignments will be accepted but may be assessed a penalty of up to 10% per calendar day that the assignment is late.

TESTS:

You will take two tests (**100 points each**) and a comprehensive final exam (**150 points**) to assess your understanding of the course content. These tests will cover the material presented in class, assigned reading, and homework problems. The tests will consist of a combination of computational problems (evaluating “how to” perform the methods) and short-answer questions (assessing the interpretation and understanding of these methods).

GRADING: Tests (200 pts.) + Homework (150 pts.) + Final Exam (150 pts.) = Total (500 pts.)

Grading Scale:	A	450 - 500 pts.
	B	400 - 449
	C	350 - 399

D 300 - 349
F below 300

COURSE POLICIES:

You are expected to follow the information in the current IPFW Student Handbook and Planner. In particular, be familiar with the *IPFW Code of Student Rights, Responsibilities, and Conduct* found at <http://bulletin.ipfw.edu/content.php?catoid=38&navoid=1019#Disciplinary>.

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Attendance: Class attendance and participation is essential for success. It is your responsibility to clarify missed work with classmates or with me prior to the next class.

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ADDITIONAL RESOURCES:

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STAT 43300 Introduction to Nonparametric Statistics

COURSE DESCRIPTION: The course acquaints students with rank-based, permutation-based and resampling-based methods of statistical analysis used in widely applicable settings where the data do not follow parametric models. It extends techniques taught in STAT 51100, where the normal theory is assumed, to situations where the normal theory does not hold. It includes computer projects which use statistical software such as R and SAS.

CREDIT HOURS: 3 credits

PREREQUISITE: STAT 517 Statistical Inference.

TEXT: *Introduction to Modern Nonparametric Statistics* by James Higgins, Duxbury Press, 1st Edition, 2004.

COURSE OBJECTIVES:

This course provides a broad overview of nonparametric statistics. The goal is for you to be introduced to the wide range of interesting nonparametric ideas in statistics, including ideas that are theoretical, computational and methodological. Theory will be introduced when it is relevant, but the emphasis will be on applications.

Upon completion of this course, students will be able to

- Ascertain whether the assumptions for parametric and nonparametric statistical tests are reasonably met for a set of data.
- Identify which nonparametric method to apply for a given setting.
- Understand, implement, and interpret various nonparametric procedures.
- Use statistical software to analyze data using nonparametric methods.

TOPICS:

Tentatively, you will explore the following topics throughout the semester. The pace and content covered will be adjusted according to the interest and needs of the class, at the discretion of the instructor.

Introduction		
One Sample Tests	Chapter 1	2 weeks
Two Sample Tests	Chapter 2	2 weeks
Tests for Variances	Chapter 2	1 week
One-Way Layout (k-sample)	Chapter 3	2 weeks
Paired Comparisons and Block Designs	Chapter 4	1 week
Two-Way Layout	Chapter 4	2 weeks
Repeated Measures	Chapter 9	1 week

Trends and Correlation	Chapter 5	2 weeks
Bootstrapping	Chapter 8	1 week
Robust Model Fitting	Chapter 10	1 week

HOMEWORK:

Five homework assignments are planned for the course, each worth 30 points. The homework assignments will be a combination of theoretical derivations and applications to real data sets. Due dates will be provided for each assignment. Late assignments will be accepted but may be assessed a penalty of up to 10% per calendar day that the assignment is late.

TESTS:

You will take two tests (**100 points each**) and a comprehensive final exam (**150 points**) to assess your understanding of the course content. These tests will cover the material presented in class, assigned reading, and homework problems. The tests will consist of a combination of computational problems (evaluating “how to” perform the methods) and short-answer questions (assessing the interpretation and understanding of these methods).

GRADING: Tests (200 pts.) + Homework (150 pts.) + Final Exam (150 pts.) = Total (500 pts.)

Grading Scale:	A	450 - 500 pts.
	B	400 - 449
	C	350 - 399
	D	300 - 349
	F	below 300

COURSE POLICIES:

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STAT 49000 Data Analysis

COURSE DESCRIPTION: Students will learn a systematic approach to statistical consulting, how to communicate with nonmathematical audiences, and develop the ability to apply appropriate statistical techniques to answer research questions. Students will complete a data analysis project.

CREDIT HOURS: 3 credits

PREREQUISITE: STAT 511 Statistical Methods

TEXTS: *The Statistical Sleuth: A Course in Methods of data Analysis*, by Fred Ramsey and Daniel Schafer, Brooks Cole, 3rd Edition, 2012.
Statistical Consulting by Javier Cabrera and Andrew McDougall, Springer, 2002.

COURSE OBJECTIVES:

Students who have taken various courses in statistical methodology are familiar with a variety of procedures, including chi-square tests, t-tests, regression, ANOVA, nonparametric tests and some multivariate techniques. However, the statistical consulting experience goes beyond conducting the data analysis. The course has four components: professional practice, data analysis, communication, and technical tools. Professional practice deals with for example: ethics in statistical consulting, working with clients, defining problems, and interpersonal skills. Data analysis involves applying the appropriate statistical methodology to address the problem and research questions. Communication deals with effective writing, oral presentation, the presentation of data via tables and graphs, and publication. Technical tools include some techniques, but mostly thinking about and learning about new ideas, approaches, and techniques.

The course objectives include providing the students with an opportunity to gain experience in:

- statistical consulting,
- manipulating data using statistical software,
- applying the appropriate statistical technique for a given situation,
- correctly interpreting the results, and
- communicating the findings in clear, non-mathematical terms.

TOPICS:

The course is built around case studies for various types of statistical analyses. Tentative course topics may include:

About Consulting

- Communication
- Asking Questions
- Managing a Session
- Dealing with Difficult Clients
- Consulting from Start to Finish

Technical Aspects of Consulting

- Designed Experiments and Sampling
- Observational Studies
- Survey Studies
- Mixed Models with SAS Proc Mixed
- Categorical Data Analysis
- Power Analysis
- Nonparametric Statistics
- Missing data
- Sampling

HOMEWORK:

Regular homework assignments are planned for the course, worth 300 total points. The homework assignments will involve analyzing case studies and reporting on the results. Due dates will be provided for each assignment. Late assignments will be accepted but may be assessed a penalty of up to 10% per calendar day that the assignment is late.

PROJECT:

Students will pick a topic that is scientifically interesting and statistically challenging, write a proposal for the topic to get approved, write a capstone report, review peers' reports, and present the project to the rest of the class. The format of the capstone report usually depends on the nature of the project. If the project is more like a consulting project, then the report should read like a consulting report. If the project is more like independent research, the report should read like a research paper. The capstone report will undergo a peer-review process where each student will read two other reports and provide comments. The capstone report and presentation are each worth 100 points.

GRADING:

Homework (300 pts.) + Project Report (100 pts.) + Presentation (100 pts.) = Total (500 pts.)

Grading Scale:	A	450 - 500 pts.
	B	400 - 449
	C	350 - 399
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STAT 51300 Statistical Quality Control

COURSE DESCRIPTION: Techniques of modern Quality Control and Management. Topics include Statistical and graphical data summaries, basic tools (pareto charts, fishbone diagrams, flowcharts), Control Charts for Measurement and Attribute data, proper use of Control Charts, Capability Studies, Continuous Improvement, ISO 9000:2008 Requirements, Six Sigma and Taguchi Methodology

CREDIT HOURS: 3 credits

PREREQUISITE: One semester of post-calculus statistics such as IE 230, MGMT 305, or STAT 511.

TEXT: *Introduction to statistical quality control*, 7th edition, Montgomery, D.C. Wiley 2013

COURSE OBJECTIVES:

Upon completion of this course, students will be able to acquire fluency in the language and techniques of modern quality control and its applications in the areas of manufacturing, health care, service industry, etc.

- Conceptually understand the utility of statistics for quality control.
- Apply control charts to solve real-life quality control problems.
- Utilize statistical software to perform statistical computation, visualization, control chart construction.

TOPICS:

Tentatively, you will explore the following topics throughout the semester. The pace and content covered will be adjusted according to the interest and needs of the class, at the discretion of the instructor.

Introduction to Quality Control Process	Chapter 1, 2	1 week
Review of Probability and Statistics Basics	Chapter 3, 4	1 week
Control Charts for Variables	Chapter 5, 6	2 weeks
Control Charts for Attributes	Chapter 7	2 weeks
Capability Analysis	Chapter 8	2 weeks
CUSUM Charts	Chapter 9	1 week
Weighted Moving Average Charts	Chapter 9	1 week
Univariate Monitoring and Control	Chapter 10	1 week
Multivariate Monitoring and Control	Chapter 11	1 week
Acceptance Sampling Techniques	Chapter 15	2 weeks
Discussion about ISO Requirements		1 week

HOMEWORK:

Regular homework assignments are planned for the course, worth 250 total points. The homework assignments will be a combination of theoretical derivations and applications to real data sets. Due dates will be provided for each assignment. Late assignments will be accepted but may be assessed a penalty of up to 10% per calendar day that the assignment is late.

TESTS:

You will take one midterm test (**100 points**) and a comprehensive final exam (**150 points**) to assess your understanding of the course content. These tests will cover the material presented in class, assigned reading, and homework problems.

GRADING: Midterm (100 pts.) + Homework (250 pts.) + Final Exam (150 pts.) = Total (500 pts.)

Grading Scale:	A	450 - 500 pts.
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Appendix 11: Exceeding the Standard Expectation of Credit Hours, Detail

The proposed Bachelor of Science in Applied Statistics does not exceed the standard 120 credit hour limit.

Appendix 12: Enrollment Trends

The numbers of majors in the Bachelor of Science in Mathematics program for the Statistics and Actuarial Science options for the fall semesters from 1999 to 2015 are provided below. Note that students in the actuarial program will be encouraged to earn a statistics degree as a secondary major.

Mathematical Sciences - Historical Enrollment Trends

Program	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Math BS-Statistics	1	2	1	1	1	1	1	0	5	6	3	2	3	3	6	8	7
Math BS-Actuarial Sci.	10	8	12	16	16	16	17	10	7	14	24	21	19	21	26	31	49



Liaison Librarian Memo

Date: 7/27/16
From: David Dunham
To: Yvonne Zubovic
Re: Library Resources for Applied Statistics Program

Describe availability of library resources to support proposed new program:

Through our various online databases, such as MathSciNet and Scopus, we currently have access to at least 514 journals within the category of "Physical Sciences & Mathematics: Mathematics: Mathematical Statistics." A search in IUCAT, our online catalog, for books and e-books published in the last 10 years on the subject of "statistics" currently brings up 3,656 results. I thus believe that the resources provided by and accessible to the Helmke Library are more than adequate for supporting a new degree program.

Comments:

Books and journal articles to which the Helmke Library does not currently have direct access may be easily requested by students and faculty from other universities via our Document Delivery Service (DDS). In addition, every department has a yearly allocation for the purchase of new library materials, so new resources may be purchased as needed.

Liaison Librarian Signature

8/9/16

Date