**Purdue Northwest Curriculum Document Coversheet**

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| **Document No:**(According to [Instruction](http://faculty.pnw.edu/blog/curriculum-document-approval-procedures/)s[[1]](#footnote-1)) | CES 18-10 NEW PROG STAT | **Approval by Faculty Senate:** (Leave Blank) | 3/8/2019 |
| **Proposed Effective Date**  | Fall 2019 | **Date Reviewed by Senate Curriculum****Committee:** (Leave blank) | 2/22/2019 |
| **Submitting Department:**(Name of both Dept & College/School ) | MSCS/CES | **Name(s) of Library Staff Consulted:** (NA if not required) | N/A |
| **Date Reviewed by Department**  | 11/16/18 |  |  |
| **Submission Date:**(Date sent to College/School Curr Comm after Dept Review) | 11/20/18 | **Will New Library****Resources Used?** | [ ]  **Yes**[x]  **No** Double-click to check Yes / No. |
| **Date Reviewed by College/School Curriculum Committee**  | 12/14/18 | **Form 40 Needed?**(Double-click one box.)Registrar will complete Form 40 **after** Senate approval of document. | [x]  **Yes** New courses or any course change, check **YES**[ ]  **No** For **all other** curriculum matters, check **NO**. |
| **Contact Person(s):**(Name & Title) | Dr. Jonathan Kuhn, Associate Professor of Statistics; Dr. Catherine Murphy, Head, MSCS |  |  |

Unless marked “Leave blank” all parts of this form must be filled in **before** sending to Secretary of the Faculty Senate.

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| **Task (check all that apply and fill out sections appropriate for each change).** [x]  Program/Concentration Change or New Program/Concentration Proposal: Complete Section I, III, & IV[ ]  Minor Change or New Minor Proposal: Complete Section I (delete sections III & IV)[ ]  Certificate Change or New Certificate Proposal: Complete Section I (delete sections III & IV)[ ]  Course Change or New Course Proposal: Complete Section II (delete sections III & IV) |
| **Program name**.Bachelor of Science in Applied Statistics |
| **Degree name(s).** (If applicable.)Bachelor of Science in Applied Statistics |

## Section I: This section is for changes in programs, minors and certificates

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| **List the major changes in each program of study, minor or certificate.** This is a new undergraduate program at PNW requiring 6 new courses:* STAT 43100 Design of Experiments,
* STAT 34600 Probability and Statistics II,
* STAT 46600 Time Series,
* STAT 46700 Topics in Data Science,
* STAT 46800 Applied Multivariate Analysis
* STAT 46900 Senior Seminar in Statistics.

The new applied statistics degree will only require 6 new statistics courses as the remaining mathematics and statistics courses are already taught as service or required courses. The new degree builds on the statistics minor and compliments the mathematics and computer science degrees. As the program is implemented we anticipate that the 6 new courses required for this program will each be offered once a year.  |
| **Impact on Students.** (State “N/A” if proposal will not greatly affect students.)* Students would have the opportunity to take a new undergraduate program in applied statistics at PNW.
* The PNW region: PNW would fill a need for an undergraduate statistics degree program in the northwest Indiana and Chicagoland area: none of the comparable colleges of PNW size, including Purdue University Fort Wayne (PFW), Ferris State, Southern Indiana, Southern Illinois Edwardsville and Western Illinois, have an undergraduate statistics program. However, three (PFW, Southern Illinois Edwardsville and Western Illinois) have a mathematics program with an option or specialization in statistics. One institution, Southern Indiana has a statistics minor only and one, Ferris State, has no program related to statistics.
* Online, state, elsewhere of relevance: The only college giving an online undergraduate statistics program is the American Public University System, an online for-profit institution. Although some of the undergraduate statistics courses will be given online or in hybrid form, all courses will be offered in the classroom. According to US News, University of Chicago, University of Michigan and Purdue West Lafayette are all very strong top nationally ranked statistics departments, 6th, 12th and 27th, respectively, with undergraduate and graduate degree programs; however, these are research universities not catering to the type of student PNW attracts.
* General rationale: No new faculty position will be required for this degree as there are five statisticians at PNW who are highly motivated and fully capable of teaching and supporting an undergraduate program in statistics. PNW students have demonstrated strong support for this program both with positive surveys and by filling to capacity and beyond three statistics courses in the current statistics minor. Full- and part-time students would be served from the geographic region surrounding Purdue University Northwest campuses in both Hammond and Westville, Indiana. Students completing this degree will be qualified for a wide variety of important positions including Analytical Statistician, Applied Statistician, Biometrician, Biostatistician, Environmental Statistician, Mathematical Statistician, Research Biostatistician, Sampling Expert, Statistical Analyst, Statistical Reporting Analyst, Statistician, Survey Statistician and Time Study Statistician.
* Alignment with university/college/department mission and goals: The new statistics degree program builds upon PNW's statistics minor and successful baccalaureate degrees in mathematics and computer science. The program will share many of the same courses. This program is aimed at students who wish to develop a career in statistics or related disciplines. We value and therefore encourage our students to be active, motivated, and both autonomous and team learners who have a critical and reflective approach to statistics. The program also includes sufficient course material to prepare students to be competent in contemporary topics including data analytics and data science. Understanding of statistical methods, of teamwork and communication of results, of experiential learning, are key elements in the program’s design. As a result of this approach to learning, the program in particular uses teaching, learning and assessment approaches such as statistical analysis, case studies and project work.
* The three courses in the statistics minor (which would be included as part of the statistics major) introduced just a little over two years ago, in fall 2015, have all attracted at least 20 students and one of these courses, the probability and statistics course, in particular, drew 110 students in spring 2018 semester and 100 so far for the coming spring 2019 semester. As of spring 2018, 10 students had enrolled in the minor and 6 had completed it and so far another 8 have enrolled in the capstone course of this minor for spring 2019.
* Evidence of labor market need/demand: According to the United States Bureau of Labor Statistics, statisticians had a median salary of $80,110 per year compared to the median salary of $36,200 for all jobs. The statistician occupation is expected to be the third fastest-growing occupation in the nation between 2014 and 2024; furthermore, the statistician occupation is expected to rank as the 39th, 17th and 4th fastest-growing occupation in Indiana, Illinois and Michigan, respectively, between 2012 and 2022. Statisticians are hired by a wide variety of industries and do not depend on any one particular industry. Having said this, about 5.0% of all available statisticians (1,500 of 30,000) in the U.S.A. in 2014 were hired by direct health and medical insurance carriers, an important industry in northwest Indiana, and this is expected to grow to about 2,400 individuals in 2024, an increase of 58.8%. Also, about 6.9% of all available statisticians (2,100 of 30,000) in the U.S.A. were hired by management, scientific and technical consulting services and this is expected to grow to about 3,300 individuals, an increase of 26.5%. For the nation as a whole, the 30,000 statisticians hired in 2014 is expected to grow 33.8% to about 40,100. See http://www.careeronestop.org/
* Graduate education preparation or other benefits: This undergraduate program at PNW would prepare graduates for Masters Level or Doctorates level programs at any university in the world.
 |
| **Impact on University Resources.** (State “N/A” if proposal will not require new resources, faculty or funds.)The five statistics faculty members in the MSCS department, who typically teach approximately 15 statistics courses/sections per semester, as well as approximately 5 mathematics courses as part of their course load. The fall 2018 semester load is provided as an example. The number of sections of STAT and MATH courses taught by faculty members, G. Aryal (GA), H. Fernando (HF), G. Hystad (GH), J. Kuhn (JK) and S. Karunaratne (SK), and limited term lecturers (LTLs) is given in the table below. In fall 2018, the five faculty members teach all 15 STAT course sections except one taught by an LTL and, in addition, teach 4 MATH course sections.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Ins. | STAT 113/13000 | STAT 30100 | STAT 31000 | STAT 33001 | STAT 34500 | STAT40001 | STAT 43000 | MATH | Total |
| GA | 2 | 1 |  |  |  | 1 |  |  | 4 |
| HF | 1 |  | 1 | 1 |  |  |  | 1 | 4 |
| GH | 1 | 1 |  | 1 |  |  |  |  | 3 |
| JK |  | 3 |  |  | 1 |  |  |  | 4 |
| SK |  |  |  |  |  |  |  | 3 | 3 |
| LTLs | 1 |  |  |  |  |  |  |  | 1 |
| Total | 5 | 6 |  | 2 | 1 | 1 | 0 | 4 | 19 |

Initially the six new courses, **black-bolded**, will be offered once every two years and, then every year from fall 2021 onwards. The anticipated statistics (STAT) course offerings, with number of course sections taught in parentheses, are given in the table below. Only STAT 34600 would be immediately offered once a year from fall 2019 onwards. In addition, current courses STAT 345, STAT 40001 and STAT 43000 would all be taught more frequently, up from once a year to once a semester, beginning spring 2021. The number of statistics course sections taught per semester increases by around 4, from 15-17 sections in fall 2018 – spring 2019 to around 20 sections in fall 2023 – spring 2024.

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Fall 2018 | Spring 2019 | Fall 2019 | Spring 2020 | Fall 2020 | Spring 2021 | Fall 2021 | Spring 2022 | Fall 2022 | Spring 2023 | Fall 2023 | Spring 2024 |
| 13000 (5)30100 (5)31000 (1)33001 (2)34500 (1)40001 (1) | 13000 (5)30100 (5)31000 (1)33001 (2)34500 (3)43000 (1) | 13000 (5)30100 (5)31000 (1)33001 (2)34500 (1)40001 (1)**34600 (1)****43100 (1)** | 13000 (5)30100 (5)31000 (1)33001 (2)34500 (3)**46600 (1)**43000 (1)**46700 (1)** | 13000 (5)30100 (5)31000 (1)33001 (2)34500 (1)40001 (1)**34600 (1)****46800 (1)** | 13000 (5)30100 (5)31000 (1)33001 (2)34500 (3)40001 (1)43000 (1)**46700 (1)****46900 (1)** | 13000 (5)30100 (5)31000 (1)33001 (2)34500 (1)40001 (1)**46800 (1)**43000 (1)**34600 (1)****43100 (1)** | 13000 (5)30100 (5)31000 (1)33001 (2)34500 (3)40001 (1)**46600 (1)**43000 (1)**46700 (1)****46900 (1)** | 13000 (5)30100 (5)31000 (1)33001 (2)34500 (2)40001 (1)**46800 (1)**43000 (1)**34600 (1)****43100 (1)** | 13000 (5)30100 (5)31000 (1)33001 (2)34500 (2)40001 (1)**46600 (1)**43000 (1)**46700 (1)****46900 (1)** | 13000 (5)30100 (5)31000 (1)33001 (2)34500 (2)40001 (1)**46800 (1)**43000 (1)**34600 (1)****43100 (1)** | 13000 (5)30100 (5)31000 (1)33001 (2)34500 (2)40001 (1)**46600 (1)**43000 (1)**46700 (1)****46900 (1)** |
| 15 sections | 17 sections | 17 sections | 19 sections | 17 sections | 20 sections | 19 sections | 21 sections | 20 sections | 20 sections | 20 sections | 20 sections |

The mathematics courses taught by the statistics faculty are those which can be taught by limited term lecturers; therefore, there is no need for new mathematics faculty members with this major. Once the statistics major is fully operational, statistics faculty would devote most of their time to teaching statistics courses. The anticipated statistics/mathematics courses teaching distributions for the statistics faculty members (GA, HF, GH, JK and SK) and LTLs over the next few years in given in the table below. Beginning fall 2020, an increase from one to two LTLs teaching a total of 3 sections per semester, is required per semester. The increase in students would have to be fairly substantial for a course in the program, above 30-50 students per course, to require more than one section/class per course. We anticipate total of 3 or more LTLs, each teaching at most 2 sections, will be required.

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Ins.** | **Fall 2018** | **Spring 2019** | **Fall 2019** | **Spring 2020** | **Fall 2020** | **Spring 2021** | **Fall 2021** | **Spring 2022** | **Fall 2022** | **Spring 2023** | **Fall 2023** | **Spring 2024** |
| GA | 4/0 | 4/0 | 4/0 | 4/0 | 4/0 | 4/0 | 4/0 | 4/0 | 4/0 | 4/0 | 4/0 | 4/0 |
| HF | 3/1 | 3/1 | 3/1 | 4/0 | 4/0 | 4/0 | 3/1 | 4/0 | 3/1 | 3/1 | 3/1 | 3/1 |
| GH | 3/0 | 3/0 | 3/0 | 3/0 | 3/0 | 3/0 | 4/0 | 4/0 | 4/0 | 4/0 | 4/0 | 4/0 |
| JK | 4/0 | 4/0 | 4/0 | 4/0 | 4/0 | 4/0 | 4/0 | 4/0 | 4/0 | 4/0 | 4/0 | 4/0 |
| SK | 0/3 | 2/1 | 1/2 | 2/1 | 1/2 | 2/1 | 1/2 | 2/1 | 2/1 | 2/1 | 2/1 | 2/1 |
| LTLs | 1/0 | 1/0 | 2/0 | 2/0 | 3/0 | 3/0 | 3/0 | 3/0 | 3/0 | 3/0 | 3/0 | 3/0 |
| Total | 15/4 | 17/3 | 17/3 | 19/1 | 17/2 | 20/1 | 19/3 | 21/1 | 20/2 | 20/2 | 20/2 | 20/2 |

 |
| **Impact on other Academic Units.** (State “N/A” if proposal will not affect other units.)(Include name of person in affected area discussed with)Statistics is ubiquitous in many different subject areas, including but not restricted to mathematics, computer science, biology, psychology, business. The flexibility of this program, due to the large number of electives, allows a student to take a minor or even a major in many of these other subjects. Therefore, the addition of this degree will increase the number of credit hours in non-statistics courses. The required Computer Science courses will increase the number of students in CS 12300, 12400, and 27500 which will increase the teaching load of the computer science faculty which could lead to increasing the numbers of sections of these courses. |

 ***Document No:***

## Section III: PLAN OF STUDY REVISION

### Degree Name: Bachelor of Science in Applied Statistics

### Degree Requirements

### PNW General Education Core

| **Core Categories** | **Credits** | **Courses:** Enter “Select from list” or designate course(s) from list |
| --- | --- | --- |
| English Composition  | 6 | ENGL 10400 (or ENGL 10000) and ENGL 10500 |
| Speech Communication | 3 | COM 11400  |
| Quantitative Reasoning  | 5 | MA 16300 |
| Natural Sciences  | 3-4 | Any General Education Science course. |
| Technology | 3 | CS 12300 |
| Humanities | 3 | Any General Education Humanities course. |
| Social Sciences | 3 | Any General Education Social Sciences course. |
| Additional credits |  |  |
| General Ed Elective | 3 | Any General Education Elective |
| First-Year Experience (FYE) | 1 | MA 10000 |
| **Total** (minimum)  | 30-31 |  |

### Other Required Courses

MA 16400 Integrated Calculus and Analytic Geometry II 5 credits

MA 26100 Multivariate Calculus 4 credits

MA 26500 Linear Algebra 3 credits

CS 12400 Programming I: Java 3 credits

CS 27500 Data Structures 3 credits

Science Electives, see note 4 6-8 credits

Selective Area Electives 18 credits

Electives 16 credits

Total Other Required Courses 58-60 credits

### Core: Required Courses

STAT 30100 Elementary Statistical Methods (or STAT 33001 Biostatistics) 3 credits

STAT 34500 Statistics 3 credits

STAT 34600 Probability and Statistics II 3 credits

STAT 40001 Statistical Computing 3 credits

STAT 43000 Applied Statistics 3 credits

STAT 43100 Design of Experiments 3 credits

STAT 46600 Time Series 3 credits

STAT 46700 Topics in Data Science 3 credits

STAT 46800 Applied Multivariate Analysis 3 credits

STAT 46900 Senior Seminar in Statistics 3 credits

Total Core 30 credits

**Total credits required for baccalaureate degree: 120**

## Section IV continued: For all Program Changes;

## Proposed Semester by Semester

Semester One **Total Credits** = 15-16

| **Program Requirements : Designate Program Requirement** | **Subject Code/Course Number** | **(GenEd)****Yes=X** | **Credits****Number** | **Min Grade** | **Prerequisites** |
| --- | --- | --- | --- | --- | --- |
| First Year Experience Introduction to Mathematical Sciences | MA 10000 | X | 1 | P |  |
| Integrated Calculus and Analytic Geometry I (m) | MA 16300 | X | 5 | C | MA 15400, or MA 15900 |
| English Composition I | ENGL 10400 | X | 3 |  | See note 1 |
| Programming I: Java | CS 12300 | X | 3 | C- |  |
| Natural Sciences | Any General Education Natural Science course with lab | X | 3-4 |  |  |

Semester Two **Total Credits** = 17

| **Program Requirements : Designate Program Requirement** | **Subject Code/Course Number** | **(GenEd)****Yes=X** | **Credits****Number** | **Min Grade** | **Prerequisites** |
| --- | --- | --- | --- | --- | --- |
| Integrated Calculus and Analytic Geometry II | MA 16400 |  | 5 | C | MA 16300 |
| Elementary Statistical Methods (m) | STAT 30100 | X | 3 | C | MA 14700, MA 15200, MA 15300  |
| English Composition II | ENGL 10500 | X | 3 |  | ENGL 10000 “B” minimum orENGL 10400 “C” minimum |
| Programming II: C++ | CS 12400 |  | 3 | C- | CS 12300 |
| Social Sciences | Any General Education Social Science course | X | 3 |  |  |

Semester Three **Total Credits** = 15

| **Program Requirements : Designate Program Requirement** | **Subject Code/Course Number** | **(GenEd)****Yes=X** | **Credits****Number** | **Min Grade** | **Prerequisites** |
| --- | --- | --- | --- | --- | --- |
| Linear Algebra | MA 26500 |  | 3 | C | MA 16400  |
| Statistical Computing | STAT 40001 |  | 3 | C | STAT 30100 |
| Probability and Statistics | STAT 34500 |  | 3 | C | MA 16400 |
| Fundamentals of Speech | COM 11400 | X | 3 |  |  |
| Data Structures | CS 27500 |  | 3 | C- | CS 12400 or ECE 25100 |

Semester Four **Total Credits** = 16-17

| **Program Requirements : Designate Program Requirement** | **Subject Code/Course Number** | **(GenEd)****Yes=X** | **Credits****Number** | **Min Grade** | **Prerequisites** |
| --- | --- | --- | --- | --- | --- |
| Multivariate Calculus  | MA 26100 |  | 4 | C | MA 16400  |
| Applied Statistics | STAT 43000 |  | 3 | C | STAT 34500 and STAT 40001 |
| Humanities | Any General Education humanities course | X | 3 |  |  |
| Selective Area Elective | See note 2. |  | 3 |  |  |
| Science Elective | Any Science course, see note 4. |  | 3-4 |  |  |

Semester Five **Total Credits** = 15-16

| **Program Requirements : Designate Program Requirement** | **Subject Code/Course Number** | **(GenEd)****Yes=X** | **Credits****Number** | **Min Grade** | **Prerequisites** |
| --- | --- | --- | --- | --- | --- |
| Probability and Statistics II (m) | STAT 34600 |  | 3 | C | STAT 34500 and MA 26100 |
| Design of Experiments | STAT 43100 |  | 3 | C | STAT 43000 |
| Selective Area Elective  | See note 2 |  | 3 |  |  |
| General Education Elective | Any General Education elective |  | 3 |  |  |
| Science Elective | Any Science course, see note 4. |  | 3-4 |  |  |

Semester Six **Total Credits** = 15

| **Program Requirements : Designate Program Requirement** | **Subject Code/Course Number** | **(GenEd)****Yes=X** | **Credits****Number** | **Min Grade** | **Prerequisites** |
| --- | --- | --- | --- | --- | --- |
| Time Series  | STAT 46600 |  | 3 | C | STAT 34600, STAT 43100 |
| Topics in Data Science | STAT 46700 |  | 3 | C | STAT 34600, STAT 43100 |
| Selective Area Elective  | See note 2 |  | 3 |  |  |
| Free Elective | See note 3 |  | 3 |  |  |
| Free Elective | See note 3 |  | 3 |  |  |

Semester Seven **Total Credits** = 15

| **Program Requirements : Designate Program Requirement** | **Subject Code/Course Number** | **(GenEd)****Yes=X** | **Credits****Number** | **Min Grade** | **Prerequisites** |
| --- | --- | --- | --- | --- | --- |
| Applied Multivariate Analysis  | STAT 46800 |  | 3 | C | STAT 34600, STAT 43100 |
| Selective Area Elective | See note 2 |  | 3 |  |  |
| Selective Area Elective  | See note 2 |  | 3 |  |  |
| Free Elective | See note 3 |  | 3 |  |  |
| Free Elective | See note 3 |  | 3 |  |  |

Semester Eight **Total Credits** = 9-as needed

| **Program Requirements : Designate Program Requirement** | **Subject Code/Course Number** | **(GenEd)****Yes=X** | **Credits****Number** | **Min Grade** | **Prerequisites** |
| --- | --- | --- | --- | --- | --- |
| Senior Seminar in Statistics  | STAT 46900 |  | 3 | C | STAT 46600, STAT 46700 and STAT 46800 |
| Free Elective | See note 3 |  | 3 |  |  |
| Free Elective | See note 3 |  | 3 |  |  |
| Free Elective | See note 3 |  | If needed |  |  |

Note 1: Students who take ENGL 10800 instead of ENGL 10400 must complete a General Education requirement with a writing intensive English course.

Note 2: Selected Area Elective - Statistics majors must consult with an academic advisor to choose an 18 credit hour Selected Area (which may be a Minor). At least 3 courses in the Selected Area must be beyond the introductory level (20000 level or above).

Note 3: Elective course which fulfills 120 credit total.

Note 4: Science Elective - Statistics majors must consult with an academic advisor to choose 6-8 credit hours in science including but not restricted to astronomy, geoscience, functional biology, cellular biology, chemistry and physics.

Note 5: No course below MA 16300 counts as graduation credit but does count towards GPA.

**Milestone Courses, noted by (m) next to the subject code / course number, have been identified as being critical to your success in this field of study.** Failure to master the subject matter in milestone courses may impact your ability to progress in your degree program. In many cases this means achieving higher grades than just the minimum that may be noted in this plan of study. Review your program requirements with your academic advisor to stay on track for graduation.

1. <http://faculty.pnw.edu/blog/curriculum-document-approval-procedures/> [↑](#footnote-ref-1)