TOWSON UNIVERSITY

Mark R. Ginsberg, Ph.D.
President

Office of the President
8000 York Road
Towson, MD 21252-0001

March 30, 2026

Elena Quiroz-Livanis
Acting Secretary of Higher Education
Maryland Higher Education Commission
217 E Redwood Street, Suite 2100
Baltimore, MD 21202

Dear Acting Secretary Quiroz-Livanis:

In accordance with the Code of Maryland Regulation (COMAR) 13B.02.03.06, Towson University seeks your review and approval to offer a **Bachelor of Science in Geographic Information Science**, effective fall 2026. The proposed program will be implemented using existing resources under Education Article § 11-206.1.

If you have any questions or require additional information, please contact Rhodri Evans, Assistant Provost for Assessment, Accreditation and Compliance, at rhodrievans@towson.edu or by phone at 410-704-3312.

Thank you in advance for your review.

Sincerely,

Mark R. Ginsberg, Ph.D.
President

MG/rjme

cc: Dr. Candace Caraco, Associate Vice Chancellor for Academic Affairs, USM
Dr. Melanie L. Perreault, Provost and Executive Vice President for Academic Affairs
Dr. Clare N. Muhoro, Vice Provost for Academic Affairs
Dr. Chris Chulos, Dean, College of Liberal Arts

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Cover Sheet for In-State Institutions
New Program or Substantial Modification to Existing Program

Institution Submitting Proposal	Towson University

Each action below requires a separate proposal and cover sheet.

- (●) New Academic Program
- ( ) New Area of Concentration
- ( ) New Degree Level Approval
- ( ) New Stand-Alone Certificate
- ( ) Off Campus Program
- ( ) Substantial Change to a Degree Program
- ( ) Substantial Change to an Area of Concentration
- ( ) Substantial Change to a Certificate Program
- ( ) Cooperative Degree Program
- ( ) Offer Program at Regional Higher Education Center

Payment Submitted: (●) Yes ( ) No | Payment Type: (●) R*STARS # JC164935 ( ) Check # | Payment Amount: $850 | Date Submitted: 4/1/26

Department Proposing Program	Geography and Environmental Planning
Degree Level and Degree Type	Bachelor of Science
Title of Proposed Program	Geographic Information Science
Total Number of Credits	120
Suggested Codes	HEGIS: 0799.01 CIP: 45.0702
Program Modality	(●) On-campus ( ) Distance Education (fully online) ( ) Both
Program Resources	(●) Using Existing Resources ( ) Requiring New Resources
Projected Implementation Date (must be 60 days from proposal submisison as per COMAR 13B.02.03.03)	(●) Fall ( ) Spring ( ) Summer Year: 2026
Provide Link to Most Recent Academic Catalog	URL: https://catalog.towson.edu/undergraduate/
Preferred Contact for this Proposal	Name: Rhodri Evans Title: Assistant Provost for Assessment, Accreditation & Compliance Phone: 410-704 3312 Email: rhodrievans@towson.edu
President/Chief Executive	Type Name: Mark R. Ginsberg, Ph.D. Signature: [signature] Date: 3/31/2026
	Date of Approval/Endorsement by Governing Board:

Revised 4/2025

College of Liberal Arts
Department of Geography & Environmental Planning
Proposal for Bachelor of Science in Geographic Information Science

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TOWSON UNIVERSITY

A. Centrality to Institutional Mission and Planning Priorities.

A.1 Program description and relation to TU mission

The proposed Bachelor of Science (BS) degree program prepares students in Geographic Information Science (GIS) and provides a solid background in computer science that enhances students' technological capabilities in the geospatial field. The program draws on three TU departments – Geography and Environmental Planning in the College of Liberal Arts (CLA) and Computer and Information Sciences and Mathematics in the Fisher College of Science and Mathematics (FCSM). The foundation in programming, data analytics, machine learning and other computer skills allows students to take full advantage of the spatial analytical tools available in TU's geography courses.

The proposed program aligns with TU's mission of fostering "intellectual inquiry and critical thinking" by challenging students to solve spatial problems using tools developed in the program. The program supports the "interdisciplinary" and employment goals of TU's mission by combining coursework in computer science, mathematics, and geography in preparation for "careers in high demand." Spatial problem-solving is essential for developing solutions to today's environmental and social equity challenges in addition to being a powerful tool for business, non-profits, and the state, thus addressing both the public and entrepreneurial dimensions of TU's mission. Students equipped with spatial problem-solving skills will fulfill TU's mission by crafting "solutions that enrich the culture, society, economy and environment of the state, the region and beyond."

A.2 Alignment with TU's strategic goals and priorities

The proposed program will educate students in a very in-demand academic degree that emphasizes engaged learning. The field of GIS is still rapidly growing, with applications in most professions and sectors of the economy.

The proposed program will engage the community through civic engagement such as community driven research projects for students and experiential learning in the form of internships. GIS students and faculty help businesses, non-profits, and local and state government solve spatial problems and facilitate greater efficiency and equity in delivery of services and goods.

The proposed program will foster an inclusive and collaborative community of people from all backgrounds. The study of Geographic Information Science is an attractive gateway to meaningful and productive jobs for people from all backgrounds, abilities, identities, and life experiences.

The proposed program will support students by attracting students of the highest caliber and provide an engaging campus experience not only in the classroom but also through internships, opportunities to work on the TU Geospatial Summer Camp, or field trips such as to NASA's space center and the GIS office of the Montgomery County Planning Department.

A.3 Adequate funding for first five years

The proposed new BS degree will be implemented using existing resources within the departments of Geography and Environmental Planning, Computer and Information Sciences, and Mathematics.

The program is built on existing undergraduate courses taught by current faculty who are budgeted through existing faculty lines. The current course offerings all have capacity for additional enrollment. If the program's overall enrollment grows to 30 students, the program will need to hire one new full-time faculty member and some additional specialized adjuncts to teach certain courses. Resources and expenditures anticipated for the first five years are presented in Section L**,** Tables G and H.

A.4 Institutional commitment
The proposed bachelor's degree program is aligned with the university's new research- and innovation-oriented mission and strategic plan.

The proposed program will require minimal financial commitment and no new funding allocations for administration or infrastructure (see Section L for further details). There are currently over 20 faculty from across FCSM and CLA who will contribute to this program as part of their existing instructional load (see Section I.1 and Appendix C for a detailed listing). See Section K for more details about physical facilities and infrastructure available to support the program.

TU's Office of Technology Services will provide support for general computing needs. More specialized technical support will come directly from the relevant colleges involved in the program, which have dedicated staff for computer technology needs, classroom support, and website development. This program will benefit from the computer labs in FCSM and access to several software packages and utilities available through institutional, college, and departmental licenses: ArcGIS Pro, Minitab, Erdas, Capstone, DataStudio, Tracker, LabVIEW, MultiSim, Mathematica, Origin, SigmaPlot, MatLab, OSLO EDU, Adobe Illustrator, and Acrobat Creative Cloud.

TU is committed to student success. Students in the program will receive academic advising from Department of Geography and Environmental Planning faculty who will assist them in designing degree completion plans, completing the degree requirements, choosing elective courses, and finding and applying for internship opportunities. The Geographic Information Science major requirements are designed to be completed in the standard four-year duration of an undergraduate degree. Required courses and a typical four-year plan of study are outlined in Appendices A and B.

B. Critical and Compelling Regional or Statewide Need as Identified in the State Plan.
B.1 Demonstrated demand and need
Geographic Information Science is increasingly in demand across many industries and sectors in today's workforce. GIS includes GIS software, remote sensing, global positioning systems (GPS), and other tools used to collect, analyze, and visualize spatial data.

GIS is essential today in designing infrastructure, managing urban growth, and implementing sustainable practices in smart cities. These technologies help monitor climate change, manage natural resources, and track deforestation, biodiversity, and pollution. Precision agriculture uses

GIS to optimize crop yields, monitor soil health, and manage irrigation. GIS also supports route optimization, fleet management, and infrastructure planning.

Within the field of GIS, geospatial data is critical for predicting, monitoring, and responding to natural disasters such as hurricanes, wildfires, and floods. It helps emergency teams plan evacuation routes and allocate resources effectively. Companies use geospatial analytics to understand market trends, identify target demographics, and optimize store locations. Geospatial data is also used for logistics and supply chain optimization.

During the COVID-19 pandemic, GIS was widely used to track the spread of the virus, map hotspots, and manage healthcare resources. Public health agencies continue to use GIS for disease mapping and resource allocation. Governments and defense agencies rely on geospatial intelligence for surveillance, border security, and strategic planning.

B.2 Consistency with the Maryland State Plan for Postsecondary Education
The proposed BS in Geographic Information Science aligns with the Maryland State Plan for Postsecondary Education in several ways. The program aligns with both Priority 5 (maintaining a commitment to high-quality post-secondary education in Maryland) and Priority 7 (enhancing post-secondary education as a platform for ongoing lifelong learning) within the Student Success goal. GIS encompasses emerging technologies that are constantly changing and evolving, therefore requiring institutions to adapt to the latest developments in the field to ensure that their program offerings remain relevant for students wishing to pursue careers in this field. The proposed program will keep Maryland students on the cusp of the GIS technological wave.

The fact that GIS is still an emerging field also supports Priority 8 within the Innovation goal, promoting a culture of risk-taking, in that the field is rapidly evolving as software and hardware develops and new applications are found. A high percentage of graduates in GIS tend to become entrepreneurs founding their own businesses because the technology is in such high demand.

C. Quantifiable and Reliable Evidence and Documentation of Market Supply and Demand in the Region and State.

C.1 Employment opportunities
As described in B.1, GIS technicians are found in a wide variety of industries and sectors including planning, defense, business analytics, transportation and logistics, emergency management, environmental management, and public health, as well as academia. GIS graduates are even sought in fields seemingly far from geography such as forensics and archeology.

Because of the unique interdisciplinary nature of the program with its heavy computer science component, graduates holding a BS degree will be extremely well-positioned to begin careers in high-level technology positions.

C.2 Market demand

The GIS career is a high demand, fast growing occupational skill set. O*net Online predicts a "Bright Outlook" for Geographic Information Systems Technicians And Technologists in Maryland with a 19% job growth over the 2022-2032 decade (https://www.onetonline.org/link/localtrends/15-1299.02?st=MD). The same source uses the US Bureau of Labor Statistics to predict that nationally Geographic Information Systems Technicians And Technologists will see an 11% growth in opportunities between 2023 and 2033, which is categorized as "much faster than average."

However, this specific occupational category represents only a subset of the careers available because labor force statistics have not kept up with the rapidly evolving field of GIS, which encompasses a range of skills that involve the generation, manipulation, analysis, and presentation of georeferenced data. Some of these skills are in the labor category of cartography and photogrammetry, while others fall under database management and computer sciences. Suffice it to say that the collection, creation, processing, analysis, and presentation of georeferenced data is a high-demand field, evidenced by the fact that the Maryland Department of Labor's Growth Occupational Tool website prominently displays an interactive map using the very same GIS and data analysis technology that the proposed major will train graduates to use.

The market for geospatial products is expected to growth significantly as well. The market for mobile mapping is expected to grow at an annual rate of 16% between 2019 and 2033, an extraordinary rate of growth by any measure (https://www.archivemarketresearch.com/reports/mobile-mapping-market-5010).

C.3 Expected vacancies over the next five years

In Maryland, there are projected to 1,960 job openings annually for GIS technicians and technologists between 2022 and 2032, with the total number of positions increasing from 18,120 to 20,560 over this decade. Nationally, job growth is "much faster than average" with 34,800 projected annual job openings between 2023 and 2033, with the total number of positions exceeding half a million (522,000) by 2033.

C.4 Projected supply of prospective graduates

The proposed BS program is expected to draw students with backgrounds primarily in computer science and GIS. Tables A (enrollments) and B (degrees/certificates awarded) show the potential pipeline of students who might be recruited into the program from community colleges. As is evident from these tables, which only provide a sampling of potential routes into the program, there are thousands of students in a pipeline that is increasing in size who might be interested and qualified and interested in pursuing a bachelor's degree in Geographic Information Science.

Table A: Enrollment in Potential Feeder Programs

Institution	Degree Level	Program Name	2019	2020	2021	2022	2023
Allegany College of Maryland	Associates	COMPUTER SCIENCE TRANSFER	17	15	17	17	16
Allegany College of Maryland	Associates	COMPUTER TECHNOLOGY	75	51	60	69	75
Anne Arundel Community College	Lower Division Certificate	COMPUTER INFORMATION SYSTEMS	17	16	14	17	10
Anne Arundel Community College	Associates	COMPUTER SCIENCE TRANSFER	327	343	291	386	395
Anne Arundel Community College	Associates	COMPUTER SCIENCE, DATABASE MANAGEMENT SYSTEMS	72	87	83	77	67
Baltimore City Community College	Associates	COMPUTER INFORMATION SYSTEMS	177	145	114	97	97
Cecil Community College	Associates	COMPUTER SCIENCE - PROGRAMMING	8	12	11	16	24
Cecil Community College	Associates	GEOSCIENCES	1	1	3	3	1
Chesapeake College	Associates	COMPUTER INFORMATION SYSTEMS	40	28	1	0	0
Chesapeake College	Associates	COMPUTER SCIENCE TECHNOLOGY	0	0	49	67	61
College of Southern Maryland	Associates	COMPUTER SCIENCE	189	187	182	206	214
College of Southern Maryland	Associates	COMPUTER SCIENCE	0	0	9	12	20
College of Southern Maryland	Associates	INFORMATION SYSTEMS	24	21	25	36	25
College of Southern Maryland	Lower Division Certificate	INFORMATION SYSTEMS	0	0	2	0	1
Community College of Baltimore County	Lower Division Certificate	ADVANCED GEOSPATIAL APPLICATIONS	24	14	10	7	2
Community College of Baltimore County	Associates	COMPUTER SCIENCE	412	441	379	460	463
Community College of Baltimore County	Associates	INFORMATION TECHNOLOGY	290	277	249	273	314
Frederick Community College	Lower Division Certificate	COMPUTER SCIENCE STUDIES CERTIFICATE	5	3	1	0	3
Frederick Community College	Associates	COMPUTER SCIENCE TRANSFER	136	142	139	186	218
Frederick Community College	Associates	INFORMATION TECHNOLOGY	5	5	4	2	0
Garrett College	Associates	COMPUTER SCIENCE	10	17	16	9	17
Hagerstown Community College	Associates	COMPUTER SCIENCE	53	55	62	56	77
Hagerstown Community College	Associates	INFORMATION SYSTEMS TECHNOLOGY	56	49	51	60	73
Harford Community College	Associates	COMPUTER INFORMATION SYSTEMS	112	96	71	88	88

Institution	Degree Level	Program Name	2019	2020	2021	2022	2023
Harford Community College	Lower Division Certificate	COMPUTER INFORMATION SYSTEMS	10	5	10	9	6
Harford Community College	Associates	COMPUTER SCIENCE TRANSFER	110	94	94	111	110
Harford Community College	Associates	GEOSPATIAL TECHNOLOGY	0	3	8	8	9
Howard Community College	Associates	COMPUTER SCIENCE TRANSFER	176	257	277	342	319
Howard Community College	Associates	INFORMATION TECHNOLOGY	335	329	370	339	395
Montgomery College	Lower Division Certificate	CARTOGRAPHY & GEOGRAPHIC INFORMATION SYSTEMS	4	12	7	7	7
Montgomery College	Associates	COMPUTER SCIENCE AND TECHNOLOGIES	1167	1165	1099	1286	1443
Montgomery College	Lower Division Certificate	INFORMATION TECHNOLOGY	12	17	14	10	9
Prince George's Community College	Associates	COMPUTER INFORMATION SYSTEMS	324	326	320	262	218
Prince George's Community College	Associates	COMPUTER SCIENCE	394	360	374	367	416
Prince George's Community College	Associates	INFORMATION TECHNOLOGY	0	0	13	115	205
Wor-Wic Community College	Associates	COMPUTER STUDIES TRANSFER	67	54	68	64	63
Wor-Wic Community College	Associates	COMPUTER TECHNOLOGY	43	38	37	30	27
		Total Enrollments	**4,692**	**4,665**	**4,534**	**5,094**	**5,488**

Source: MHEC Report - Trends in Fall Enrollment by Program 2013-2023

Table B: Associate Degrees and Lower-Division Certificates Awarded in Potential Feeder Programs

Institution	Degree Level	Program Name	2020	2021	2022	2023	2024
Allegany College of Maryland	Associates	COMPUTER SCIENCE TRANSFER	3	0	2	1	2
Allegany College of Maryland	Associates	COMPUTER TECHNOLOGY	18	29	20	24	29
Anne Arundel Community College	Lower Division Certificate	COMPUTER INFORMATION SYSTEMS	12	10	12	9	3
Anne Arundel Community College	Associates	COMPUTER SCIENCE TRANSFER	29	39	43	44	40
Anne Arundel Community College	Associates	COMPUTER SCIENCE, DATABASE MANAGEMENT SYSTEMS	13	23	17	20	11
Baltimore City Community College	Associates	COMPUTER INFORMATION SYSTEMS	37	28	32	25	28
Cecil Community College	Associates	COMPUTER SCIENCE - PROGRAMMING	0	4	3	4	3
Cecil Community College	Associates	GEOSCIENCES	0	0	0	0	1

Institution	Degree Level	Program Name	2020	2021	2022	2023	2024
Chesapeake College	Associates	COMPUTER INFORMATION SYSTEMS	4	1	0	0	0
Chesapeake College	Associates	INFORMATION TECHNOLOGY	0	0	0	0	2
College of Southern Maryland	Associates	COMPUTER SCIENCE	18	19	33	24	26
College of Southern Maryland	Associates	COMPUTER SCIENCE	0	0	0	0	2
College of Southern Maryland	Associates	INFORMATION SYSTEMS	1	2	5	5	3
College of Southern Maryland	Lower Division Certificate	INFORMATION SYSTEMS	0	1	3	1	1
Community College of Baltimore County	Lower Division Certificate	ADVANCED GEOSPATIAL APPLICATIONS	5	7	8	5	0
Community College of Baltimore County	Associates	COMPUTER SCIENCE	51	44	40	44	70
Community College of Baltimore County	Associates	INFORMATION TECHNOLOGY	53	36	41	38	48
Frederick Community College	Lower Division Certificate	COMPUTER SCIENCE STUDIES CERTIFICATE	1	0	1	3	3
Frederick Community College	Associates	COMPUTER SCIENCE TRANSFER	9	20	20	30	33
Frederick Community College	Associates	INFORMATION TECHNOLOGY	4	3	2	0	0
Garrett College	Associates	COMPUTER SCIENCE	1	4	5	5	4
Hagerstown Community College	Associates	COMPUTER SCIENCE	14	7	12	10	10
Hagerstown Community College	Associates	INFORMATION SYSTEMS TECHNOLOGY	16	10	7	12	11
Harford Community College	Associates	COMPUTER INFORMATION SYSTEMS	32	20	24	18	19
Harford Community College	Lower Division Certificate	COMPUTER INFORMATION SYSTEMS	2	1	0	1	5
Harford Community College	Associates	COMPUTER SCIENCE TRANSFER	19	15	12	13	20
Harford Community College	Associates	GEOSPATIAL TECHNOLOGY	0	0	0	0	5
Howard Community College	Associates	COMPUTER SCIENCE TRANSFER	28	39	21	29	36
Howard Community College	Associates	INFORMATION TECHNOLOGY	74	54	63	60	49
Montgomery College	Lower Division Certificate	CARTOGRAPHY & GEOGRAPHIC INFO SYS CERTIF	9	4	4	4	4
Montgomery College	Associates	COMPUTER SCIENCE AND TECHNOLOGIES	195	271	246	257	291
Montgomery College	Lower Division Certificate	INFORMATION TECHNOLOGY	3	4	6	3	3
Prince George's Community College	Associates	COMPUTER INFORMATION SYSTEMS	70	72	61	76	69

Institution	Degree Level	Program Name	2020	2021	2022	2023	2024
Prince George's Community College	Associates	COMPUTER SCIENCE	17	22	25	32	30
Prince George's Community College	Associates	INFORMATION TECHNOLOGY	0	0	0	10	25
Wor-Wic Community College	Associates	COMPUTER STUDIES TRANSFER	9	3	12	2	12
Wor-Wic Community College	Associates	COMPUTER TECHNOLOGY	13	6	5	9	5
		Total Enrollments	**4,692**	**4,665**	**4,534**	**5,094**	**5,488**

Source: MHEC Report - Trends in Degrees and Certificates by Program 2015-2024

D. Reasonableness of Program Duplication.

D.1 Program duplication

There are currently no undergraduate programs offered in Maryland leading to the award of bachelor's degree in Geographic Information Science – TU's proposed program will be the first of its kind in the state. There are two programs in Maryland that include tracks with a GIS/geospatial data science focus – Salisbury University's Geographic Information Science track within the Geography major and the University of Maryland, College Park's Geospatial Data Science track within the Geographical Sciences major – but neither of these offerings rises to the level of a formal area of concentration, let alone a full degree, and thus do not provide the breadth and depth of study in Geographic Information Science that TU's program will provide.

D.2 Justification for the proposed program

TU's proposed BS in Geographic Information Science will be the only program in Maryland in which students are required to complete extensive coursework in computer science, information technology, and mathematics along with the geospatial courses, which are all fields of knowledge that a GIS technician is expected to possess in order to succeed in this career.

E. Relevance to High-demand Programs at Historically Black Institutions (HBIs).

While most HBIs offer a GIS course, and Coppin State University has a bachelor's degree in geography, none of Maryland's four HBIs offers an undergraduate major that is comparable to TU's proposed degree.

F. Relevance to the identity of Historically Black Institutions (HBIs).

Given the specialized nature of the proposed program, TU does not anticipate that its implementation will impact the uniqueness and institutional identities and missions of Maryland's HBIs.

G. Adequacy of Curriculum Design, Program Modality, and Related Learning Outcomes.

G.1 Program development and faculty oversight

The program was established through consultation principally in the departments of Geography and Environmental Planning and Computer and Information Sciences. Faculty in Geography and Environmental Planning specializing in GIS, the chairs of both departments, and faculty in

Computer and Information Sciences teaching the required courses in the program collectively refined the goals and course composition of the major. The Department of Geography and Environmental Planning within CLA will administer, maintain, and assess the efficacy of the program.

G.2 Educational objectives and learning outcomes

The overarching educational objective of the program is to create technically competent GIS technicians possessing the skills necessary for advanced GIS analysis and for supporting applications of GIS in a wide variety of private and public sector settings. The program learning outcomes (PLOs) are as follows (with the alignment to TU's institutional student learning outcomes [ISLOs] indicated):

1. **Spatial Data Analysis** *(Critical Analysis and Reasoning)*: Students will be able to perform comprehensive analyses of geospatial data using professional geospatial software, spatial analysis techniques, and statistical methods.
2. **Data Mining and Management** *(Information Literacy and Technological Competency):* Students will apply information systems and data science techniques, such as programming, data mining, big data processing, database management, algorithm development, workflow automation, and web development, to effectively manage, analyze, and visualize geospatial data and to address complex geospatial challenges in diverse industries.
3. **Data Visualization** *(Effective Communication)*: Students will be able to visualize and communicate geospatial data and results using various formats, such as maps, web mapping applications, story maps, charts, and professional presentations.
4. **Problem-Solving Skills** *(Working in Multifaceted Work Environments)*: Students will be able to integrate geospatial data with other types of data to address socio-economic, environmental, planning, and other real-world challenges, supporting decision-making processes.

G.3 Assessment and documentation of student learning outcomes

Table C.1 indicates the courses in which the program learning outcomes will be assessed and the measures used, while Table C.2 shows the alignment of these PLOs with TU's ISLOs. Data on student achievement will be reported each year using TU's institutional assessment data collection tool.

Table C.1: Program Learning Outcomes Assessment

	Program Learning Outcomes (PLOs):	**Direct and Indirect Measures**	
PLO 1	Spatial Data Analysis	Measure 1a:	Final Project in GEOG 465 or 414
		Measure 1b:	Survey of students

	Program Learning Outcomes (PLOs):	Direct and Indirect Measures	
PLO 2	Data Mining and Management	Measure 2a:	Project in GEOG 416
		Measure 2b:	Survey of students
PLO 3	Data Visualization	Measure 3a:	Normalized Difference Vegetation Project and Heat Island Analysis GEOG 321
		Measure 3b:	Survey of Students
PLO 4	Problem-Solving Skills	Measure 4a:	Pattern analysis lab in GEOG 465 or GEOG 414
		Measure 4b:	Survey of Students

Table C.2: PLO Alignment to TU ISLOs

ISLO / PLO	Information Literacy & Technological Competency	Effective Communication	Critical Analysis & Reasoning	Specialized Knowledge in Defined Fields	Working in Multifaceted Work Environments
Spatial Data Analysis	X		X	X	
Data Mining & Management	X			X	
Data Visualization	X	X		X	
Problem-Solving Skills	X		X	X	X

G.4 Program requirements

The BS in Geographic Information Science includes required courses in geography, computer science, computer information science, and mathematics. Table D summarizes the program requirements. (See Appendices A and B for the course descriptions for required courses in the major and a sample four-year program completion plan.)

Table D: Program Curriculum

Course Number	Course Title	Credit Weighting
Required courses in Geography		
GEOG 101*	Physical Geography	3

Course Number	Course Title	Credit Weighting
GEOG 221	Introduction to Geospatial Technology	3
GEOG 321	Introduction to Remote Sensing and Photogrammetry	3
GEOG 322	Introduction to Geographic Information Science	4
GEOG 323	Cartography and Graphics	3
GEOG 414 or	GIS Applications	3
GEOG 465	Advanced Techniques in GIS	
GEOG 416	Advanced Remote Sensing	3
	Total GEOG required	***22***
Required courses in Computer Science and Computer Information Science		
COSC 236	Introduction to Computer Science	4
CIS 211	Fundamentals of Information Systems & Technology	3
CIS 328	Introduction to Data Analytics	3
	Total COSC and CIS required	***10***
Required courses in Mathematics*		
MATH 231	Basic Statistics	3
MATH 211 or	Calculus for Applications	3/4
MATH 273	Calculus I	
	Total MATH required	**6/7**
Upper-level electives in GEOG		**9**
Upper-level electives in COSC and CIS and MATH		**6**
Total Credits in Major		**53/4**
Additional core curriculum/electives credits required to complete degree		**66/67**
Total Credits for BS Degree		**120**

**Satisfies TU Core Curriculum requirement*

G.5 General education requirements

TU's Core Curriculum, comprising fourteen categories within four themes (43-46 credits in total), satisfies the general education requirements mandated by the State of Maryland (COMAR 13B.06.01.03) and educational effectiveness standards held by the university's accrediting body, the Middle States Commission on Higher Education. To fulfill Towson University's Core Curriculum requirements, students must complete one course from each of the following categories (1-14).

Table E: TU Core Curriculum Requirements

Core Category	Credits
Fundamentals	
(1) Towson Seminar (*Must be completed with a minimum C grade; course not required for transfer students*)	3
(2) English Composition (*Must be completed with a minimum C grade*)	3
(3) Mathematics	3-4
(4) Creativity & Creative Development*	3

Core Category	Credits
Ways of Knowing	
(5) Arts and Humanities*	3
(6) Social & Behavioral Sciences	3
(7) & (8) Biological & Physical Sciences	7-8
Writing in a Chosen Field	
(9) Advanced Writing Seminar (*Must be completed with a minimum C grade*)	3-4
Perspectives	
(10) Metropolitan Perspectives	3
(11) The United States as a Nation	3
(12) Global Perspectives	3
(13) Diversity & Difference	3
(14) Ethical Issues & Perspectives	3
Total Credits	**43-46**

**Courses fulfilling Core 4 and Core 5 requirements must be from different subjects.*

GEOG 101 satisfies Core 8 and one of MATH 211, MATH 231, or MATH 273 satisfies Core 3 in the TU core curriculum while also fulfilling the major requirement. For the geography electives, students may choose from a Core 10 or Core 12 course . Students will need to take an additional 12 core courses to meet TU's core curriculum requirements.

All other TU Core Curriculum requirements will be fulfilled through additional credits as described in Table D and in Appendix B. The proposed major allows students to fulfil major and TU Core Curriculum requirements in 120 total credits.

G.6 Specialized accreditation requirements
Not applicable

G.7 Outside contracts
Not applicable

G.8 Program assurances
Curriculum, course, and degree requirements are updated and published annually in TU's academic catalog. The Department of Geography and Environmental Planning's website will post detailed information about degree requirements as well as information that will help students be successful in the program, such as advising resources, scholarship, and internship opportunities. TU's website offers extensive information about student support services, financial aid, and tuition costs each year.

All TU undergraduate students are required to meet with an academic advisor each semester. In the first meeting with an advisee after the student reaches 45 credits, the academic advisor develops a Four-Year Degree Completion Plan for the student, according to the academic requirements for the major and the expected schedule of course offerings. During subsequent

advising meetings, the advisor reviews the student's progress towards their degree and helps the student plan courses for the next semester. The advisor may help the student modify the degree completion plan, if necessary. Advisors and students will also discuss the students' plans for employment or postgraduate education. Academic advisors often provide information about internships and other opportunities to help students achieve those goals.

Students in the GIS program will be expected to develop technical competencies throughout the duration of the program, but there are no specific requirements to enter the program other than admission to TU. Students will have access to the same academic support that all TU students have, such as tutoring, coaching, and workshops available through the TU Tutoring and Learning Center.

GIS students will pay regular TU undergraduate tuition and fees and will have the same opportunities for scholarships and research experiences as students in the existing Geography undergraduate major, including the Drew Dedrick Scholarship, the Morgan GIS Endowment, the Fred and Joan Ward Scholarship, the Barnes Paper Award, and the Mitchell Scholarship.

G.9 Assurances of advertising, recruiting, and admissions materials
TU regularly reviews its advertising, recruiting, and admissions materials to ensure that they clearly and accurately represent programs and services available, and that there is consistency across different modes of communication such as the TU website, the academic catalog, and other print and online promotional materials.

H. Adequacy of Articulation.
TU has signed an articulation agreement with Harford Community College to facilitate transfer into the program (see Appendix C).

I. Adequacy of Faculty Resources.
I.1 Quality of program faculty
The proposed program relies upon well-qualified full-time core faculty (see Table F) in the departments of Geography and Environmental Planning, Mathematics, and Computer and Information Sciences as well as adjuncts who meet minimum qualifications and who are vetted and supervised by full-time faculty. Adjuncts typically teach introductory courses that are in high demand by students looking to satisfy general education requirements such as GEOG 101, MATH 211, and MATH 231. The demand for these courses is such that only the addition of contingent adjunct instructors can satisfy student demand.

All courses in the program are existing courses and can be delivered using existing faculty lines. If the program's overall enrollment grows to 30 students, the program will need to hire one new full-time faculty member to teach GIS coursework.

Table F: Faculty Resources

Faculty Name	Status (Full-Time, Part-Time, Adjunct)	Highest Degree Earned/ Field of Study/Institution/ Degree Award Date	Title/Rank	Proposed Courses Faculty Will Teach (Course Number)
Dr. Paporn Thebpanya	Full-Time	Ph.D., Geography, University of Georgia, 2003	Professor	GEOG 101 GEOG 322 GEOG 323 GEOG 465
Dr. Shou Lu	Full-Time	Ph.D., Geographic Information Systems and Land Use Planning, Clemson University, 2001	Professor	GEOG 101 GEOG 414
Dr. Carter Wang	Full-Time	Ph.D., Geography, Arizona State University, 2018	Assistant Professor	GEOG 101 GEOG 221 GEOG 321 GEOG 416
Dr. Nadim Alkharouf	Full-Time	Ph.D., Computation Sciences and Informatics, George Mason University, 2004	Professor	COSC 236
Dr. Weixian Liao	Full-Time	Ph.D., Computer Engineering, Case Western Reserve University, 2018	Associate Professor	COSC 236
Dr. Nam Phoung Nguyen	Full-Time	Ph.D., Computer Science, University of Florida, 2013	Professor	COSC 236
Dr. Bassam Zahran	Full-Time	D.Sc., Information Technology, Towson University, 2019	Clinical Assistant Professor	COSC 236
Mr. Hashi Orabi	Full-Time	M.S., Computer Science, New Mexico Institute of Mining and Technology	Lecturer	CIS 211
Dr. Jinjuan Feng	Full-Time	Ph.D., Information Systems, University of Maryland, Baltimore County	Professor	CIS 328
Kari Schumm	Full-Time	M.S., Operations Research, The University of North Carolina at Chapel Hill, 2018	Lecturer	MATH 231
Dr. Felice Shore	Full-Time	Ph.D., Mathematics Education, University of Maryland, College Park, 2003	Professor	MATH 231
Dr. Christopher Robert Cornwell	Full-Time	Ph.D., Mathematics, Michigan State University, 2016	Associate Professor	MATH 273 MATH 211
Dr. Yunwei Cui	Full Time	Ph.D., Statistics, Clemson University, 2009	Professor	MATH 273 MATH 211
Dr. Vefa Goksel	Full-Time	Ph.D., Mathematics, University of Wisconsin-Madison, 2020	Assistant Professor	MATH 273 MATH 211
Dr. Vincent Guingona	Full-Time	Ph.D., Mathematics, University of Maryland, College Park, 2011	Associate Professor	MATH 273 MATH 211
Dr. Ge Han	Full-Time	Ph.D., Mathematics, University of Pittsburgh, 2003	Associate Professor	MATH 273 MATH 211
Dr. Angel Kumchev	Full-Time	Ph.D., Mathematics, University of South Carolina, 2001	Professor	MATH 273 MATH 211

Faculty Name	Status (Full-Time, Part-Time, Adjunct)	Highest Degree Earned/ Field of Study/Institution/ Degree Award Date	Title/Rank	Proposed Courses Faculty Will Teach (Course Number)
Dr. Nathan McNew	Full-Time	Ph.D., Mathematics, Dartmouth College, 2015	Associate Professor	MATH 273 MATH 211
Dr. Herve Nganguia	Full-Time	Ph.D., Mathematical Sciences, New Jersey Institute of Technology, 2014	Associate Professor	MATH 273 MATH 211
Dr. Miriam Parnes	Full-Time	Ph.D., Mathematics, Wesleyan University, 2019	Lecturer	MATH 273 MATH 211
Dr. Rajeev Walia	Full-Time	Ph.D., Mathematics, Michigan State University, 2007	Lecturer	MATH 273 MATH 211
Dr. Moustapha Pemy	Full-Time	Ph.D., Mathematics, University of Georgia, 2005	Professor	MATH 273 MATH 211
Dr. Na Zhang	Full-Time	Ph.D., Mathematics, University of Cincinnati, 2019	Assistant Professor	MATH 273 MATH 211

I.2 Ongoing pedagogy training for faculty

The Faculty Academic Center of Excellence at Towson (FACET) is the faculty development center for Towson University. FACET's mission is to support an inclusive and collaborative faculty community and foster a culture of excellence in scholarship and teaching. FACET supports all campus faculty in their scholarship and teaching through a combination of programs, workshops, resources, funding, and communities of practice such as: Student Engagement, Emerging Technologies, Open Educational Resources, and High Impact Educational Practices. In collaboration with the TU Office of Technology Services, FACET also recommends, reviews, and provides programs to support advancement of faculty skills with Blackboard, TU's learning management system. FACET provides one-on-one or small group, virtual or face-to-face meetings with an instructional design team, who also perform course reviews. Faculty may attend open meetings as well as request consultation from FACET staff.

In addition, faculty are mentored by peers. All faculty are required to undergo periodic peer review which allows fellow faculty to mentor fellow faculty at all levels to improve pedagogy and make adjustments to changing student and curricular needs.

J. Adequacy of Library Resources

Resources available through TU's Cook Library are sufficient to meet the needs of students and faculty in the proposed program. The library houses an extensive collection of materials, including more than 500,000 print and electronic volumes. In addition to a dedicated subject librarian, team of research librarians, and subject-specific research guides, the library provides access to 19 physics and astronomy subject-specific databases, such as Nature Portfolio, Scopus, ScienceDirect, JoVE Science Education Unlimited, JSTOR, and SpringerLink. Cook Library also houses computer workstations with specialty software for data analysis, data visualization and mapping.

In addition to Cook Library, faculty and students have access to materials through reciprocal agreements at nearby Baltimore institutions and across USM-affiliated institutions. Materials from

other libraries across the country can be requested for loan through standard interlibrary loan (ILL) services. As part of this service, faculty and students have access to RAPID ILL, a service customary at high research activity institutions. The current turnaround time for article requests is typically less than 48 hours.

K. Adequacy of Physical Facilities, Infrastructure and Instructional Equipment

K.1 Assurance of physical facilities

TU's existing physical facilities, infrastructure, and instructional equipment are sufficient to support the needs of the proposed program. The departments of Mathematics and Computer and Information Sciences are housed in a recently renovated building on the main TU campus dedicated entirely to the two disciplines. Additionally, TU opened the 320,000 square foot Science Complex building in 2021 that includes 50 new teaching laboratories and 30 research laboratory facilities with state-of-the-art instrumentation. The Department of Geography and Environmental Planning is housed in the College of Liberal Arts located in a facility completed in 2010 that includes nine computer labs with over 250 seats for students and an extensive array of software. Software needed for student work is included also in the large computer facility on the main floor of the Cook Library.

K.2 Assurance of distance education

The proposed program is designed to be delivered in-person via traditional modes of face-to-face instruction. If distance learning resources are required, whether in an individual course or at a broader scale, TU is well positioned to provide adequate support. FACET offers training and certification programs for online and hybrid/blended instruction, Universal Design for Learning (UDL), and effective pedagogical approaches for enriching distance learning, including the Quality Matters Rubric. Students and faculty can enroll in training modules that provide instruction in university-sponsored distance learning technologies, including Blackboard, WebEx, Zoom, and Panopto. Technology support is available online, as well as via email, text, phone and on a walk-in basis at Student Computing Services and the Office of Technology Services.

L. Adequacy of Financial Resources

The proposed GIS program will be implemented using existing resources from CLA and FCSM. All courses in the program are pre-existing. TU does not anticipate that additional faculty expenditures will be necessary for the first four years of the program. If the program's overall enrollment grows to 30 students, the program will need to hire one new full-time faculty member to teach the geospatial courses.

Table G: Programmatic Resources

Resources Categories	Year 1	Year 2	Year 3	Year 4	Year 5
1. Reallocated Funds	**$0**	**$0**	**$0**	**$0**	**$0**
2. Tuition/Fee Revenue[1]	**$58,640**	**$120,800**	**$223,956**	**$333,190**	**$396,000**
Number of Full-time Students	5	10	18	26	30
Annual Tuition Rate[2]	$11,728	$12,080	$12,442	$12,815	$13,200
Subtotal Tuition	$58,640	$120,800	$223,956	$333,190	$396,000
Annual Fees	$0	$0	$0	$0	$0
Subtotal Fees	$0	$0	$0	$0	$0
Total Full-time Revenue of New Students	$58,640	$120,800	$223,956	$333,190	$396,000
Number of Part-Time Students	0	0	0	0	0
Credit Hour Tuition Rate	$0	$0	$0	$0	$0
Annual Fees Per Credit Hour	$0	$0	$0	$0	$0
Annual Credit Hours Per Student	0	0	0	0	0
Subtotal Tuition	$0	$0	$0	$0	$0
Subtotal Fees	$0	$0	$0	$0	$0
Total Part-Time Revenue of New Students	$0	$0	$0	$0	$0
3. Grants, Contracts & Other External Sources	**$0**	**$0**	**$0**	**$0**	**$0**
4. Other Sources	**$0**	**$0**	**$0**	**$0**	**$0**
TOTAL (Add 1-4)	**$58,640**	**$120,800**	**$223,956**	**$333,190**	**$396,000**

[1] *Student enrollments are calculated at 100% in-state. It is anticipated that all students will enroll on a full-time basis.*

[2] *Tuition and fees increase by 3% annually.*

Table H: Programmatic Expenditures

Expenditure Categories	Year 1	Year 2	Year 3	Year 4	Year 5
1. Total Faculty Expenses (b + c below)	**$0**	**$0**	**$0**	**$0**	**$99,750**
a. #FTE	0	0	0	0	1.0
b. Total Salary	$0	$0	$0	$0	$75,000
c. Total Benefits (x 33%)	$0	$0	$0	$0	$24,750
2. Total Administrative Staff Expenses (b + c below)	**$0**	**$0**	**$0**	**$0**	**$0**
a. #FTE	0	0	0	0	0
b. Total Salary	$0	$0	$0	$0	$0
c. Total Benefits	$0	$0	$0	$0	$0
3. Total Support Staff Expenses (adjunct) (b + c below)	**$0**	**$0**	**$0**	**$0**	**$13,500**
a. #FTE	0	0	0	0	0.2
b. Total Salary	$0	$0	$0	$0	$13,500
c. Total Benefits	$0	$0	$0	$0	$0
4. Equipment	**$0**	**$0**	**$0**	**$0**	**$0**
5. Library	**$0**	**$0**	**$0**	**$0**	**$0**
6. New or Renovated Space	**$0**	**$0**	**$0**	**$0**	**$0**
7. Other Expenses	**$1,000**	**$1,000**	**$1,000**	**$1,000**	**$1,000**
TOTAL (Add 1-7)	**$1,000**	**$1,000**	**$1,000**	**$1,000**	**$113,350**

Faculty (#FTE, Salary, and Benefits)
Only when enrollment reaches 30 students does the program anticipate the need for additional faculty in the form of one full-time faculty member. Faculty salary was estimated at current assistant professor starting salary.

Administrative Staff (# FTE, Salary, and Benefits)
The Department of Geography and Environmental Planning has sufficient administrative staff to run the proposed program through its initial launch. No additional administrative staff will be needed.

Support Staff (# FTE, Salary, and Benefits)
Only when enrollment reaches 30 students does the program anticipate the need for additional adjunct faculty to teach three courses. Adjunct faculty were calculated at current rates. No additional support staff will be needed in the initial phases of the program.

Equipment
The GIS program will use the Department of Geography and Environmental Planning's existing computer lab space in the College of Liberal Arts building for teaching. Students have access to most of the labs in the CLA building as well as in Cook Library.

Library
No additional library expenses are necessary.

New and/or Renovated Spaces
The program will use existing spaces.

Other Expenses
The new program will require some modest marketing resources to attract prospective, new, and transferring TU students into the program, as well as to advertise the new opportunity to current TU students. The types of marketing activities the program anticipates undertaking include website development, email and social media marketing, flyers, and giveaway items for TU Open House/TU4U events, and visits to Maryland's community colleges. TU has budgeted approximately $1,000 per year for these efforts.

M. Adequacy of Provisions for Evaluation of Program

M.1 Evaluation of the program
The proposed program will be built using existing courses. Nevertheless, future course development will follow the regular Towson University procedures for approval, first at the program and department level, through the FCSM or CLA curriculum committees, and finally the University Curriculum Committee.

The course approval process evaluates new courses for appropriate rigor, effective assessment and grading, and adherence of the course syllabus to best practices. Evaluation at the program level ensures course content accuracy and program alignment, while the college and university level reviews facilitate the production of quality course proposals.

Existing courses are evaluated through regular review by program faculty and by student evaluations. Faculty regularly review courses to determine if the course meets overall program objectives. Additionally, instructors are observed by peers on a routine basis, with more frequent observations if faculty are new to a course or the university. If a course review indicates concerns or problems with a course, faculty develop strategies for addressing problems. Student course evaluation takes place at the end of every semester. Using a tool developed by TU faculty that allows for quantitative and qualitative feedback, students give feedback on instructors (e.g., ability to communicate clearly; quality of student-instructor interaction; preparedness) and suggest improvements for a course.

Evaluation of faculty follows policies and procedures established by TU's policies for faculty annual merit review and for faculty reappointment, tenure, and promotion. These evaluations occur at

the department, college, and university level. The main areas of evaluation include teaching, scholarship, and service. Tools used as part of the annual evaluation process include review of the individual's portfolio that includes, but is not limited to, the following:

- Evidence of scholarship (e.g., articles in scholarly journals; presentations at scholarly meetings).
- Service work.
- A synopsis of teaching related activities (e.g., courses taught; new instructional procedures; interdisciplinary, diversity, international, and technology-related projects).
- Review of course syllabi.
- Peer teaching observation reports.
- Quantitative and qualitative student evaluation of instruction.

Section G.3 outlines the program assessment measures and shows their alignment with specific student learning outcomes. On an annual basis, specific learning outcomes are identified for assessment purposes. The program director, with the support of TU's Office of Assessment, will oversee the processes involved in the assessment of student learning outcomes, including collection and analysis of data, and creation of action plans, as necessary.

M.2 Evaluation of program effectiveness
The assessment of this program will be guided by TU's Office of Assessment, following established TU policies and procedures, including review of the program's assessment plan to ensure that learning outcomes remain appropriate, and that students are meeting expectations.

The program will work with TU entities such as the Office of the Provost, Enrollment Services, and Student Services to review data on a regular basis and improve the program when needed. Effectiveness will be assessed by student retention, progress toward degree completion, career outcomes for graduates, student and faculty satisfaction, cost-effectiveness, and other key performance indicators.

Additionally, TU will conduct a comprehensive evaluation of the program every seven years as part of the USM-mandated Periodic Review of Academic Programs process. The purpose of the review is to promote continuous program improvement and ensure that the needs of students are being met. Each program will prepare a self-study, engage an external reviewer to evaluate the program and identify strengths and areas for improvement, and submit a final report to the USM Board of Regents for review and approval.

N. Consistency with the State's Minority Student Achievement

With approximately 60% of students identifying as non-white,[1] TU is nearly as diverse as the state of Maryland. It is one of only a few universities in the country to have no achievement gap, meaning that underrepresented student groups achieve the same or better academic success as

[1] https://www.towson.edu/ir/documents/fall2025_factsheet_final.pdf

the entire student population. TU strives to foster a learning community that reflects the population of our campus, region, and state, and recognizes that our success is dependent on cultivating diverse perspectives and approaches.

O. Relationship to Low Productivity Programs Identified by the Commission.
Not applicable.

P. Adequacy of Distance Education Programs
Not applicable. The program will be delivered in-person on the main TU campus.

TOWSON UNIVERSITY

Appendix A: Course Descriptions
Required Courses in the BS in Geographic Information Science

GEOG 101 PHYSICAL GEOGRAPHY (3)
Introductory spatial analysis of fundamental terrestrial natural phenomena, including their impact on humanity. Emphasis on Earth planetary motions, weather and climate, landforms, soils and vegetation. (Fulfills Core 8: Biological & Physical Sciences)

GEOG 221 INTRODUCTION TO GEOSPATIAL TECHNOLOGY (3)
Introduction to most effective ways to record and communicate spatial information. Emphasizes geotechniques including digital cartography, remote sensing, GIS and GPS. Includes georeference systems, cartographic representation, and basic skills needed to use and understand geospatial data.

GEOG 321 INTRODUCTION TO REMOTE SENSING AND PHOTOGRAMMETRY (3)
Fundamentals and the development of remote sensing, the nature of the electromagnetic radiation and its interaction with the atmosphere and surface objects, photographic systems, aerial photography, and photogrammetry basics. Prerequisites: GEOG 101 and GEOG 221.

GEOG 322 INTRODUCTION TO GEOGRAPHIC INFORMATION SCIENCE (4)
Study and use of selected computer hardware and software for the storage, retrieval, manipulation, analysis, and display of geographic data. Emphasis on practical applications of geographic information systems (GIS). Prerequisite: GEOG 221 or consent of instructor.

GEOG 323 CARTOGRAPHY AND GRAPHICS I (3)
Study in design, construction, and effective application of maps and charts for analysis and publications; practical exercises in the use of cartographic tools, materials, and techniques. Prerequisite: GEOG 322 or consent of instructor.

GEOG 414 GIS APPLICATIONS (3)
Vector-based GIS software for solving real world problems. Prerequisite: GEOG 322 or consent of instructor.

GEOG 416 ADVANCED REMOTE SENSING: DIGITAL IMAGE PROCESSING AND ANALYSIS (3)
Remote sensing platforms and sensors, remotely sensed data collection, field measurements, and the processing and analysis of various types of remotely sensed digital imagery. Prerequisite: GEOG 321.

GEOG 465 ADVANCED TECHNIQUES IN GIS (3)
Project-based learning within the spatial framework of GIS. Emphasis on advanced GIS techniques for spatial analysis and on quantifying geographic patterns and relationships. Prerequisite: GEOG 322.

COSC 236 INTRODUCTION TO COMPUTER SCIENCE I (4)
Introduction to structured problem-solving, algorithm development and computer programming. Three lecture hours and two laboratory hours. Prerequisites: COSC 175 and at least one of [MATH 115, MATH 117, MATH 119, MATH 211, (MATH 231 or ECON 205), MATH 273, MATH 274, MATH 275, or a qualifying score on the Math Placement Exam].

CIS 211 FUNDAMENTALS OF INFORMATION SYSTEMS & TECHNOLOGY (3)
An introduction to information systems and technology in today's organizations. Topics include hardware, software and communications fundamentals, systems development, information management, work force considerations, and related societal, legal, and ethical issues. Prerequisite: COSC 111 (may be taken concurrently).

CIS 328 INTRODUCTION TO DATA ANALYTICS (3)
Designed as an entry-level course of a three-course sequence that prepares students to pursue a career related to data analytics. The course provides an overview of the lifecycle of data analysis, the introduction and practical application of commonly used parametric and non-parametric statistical tests as well as predictive data modeling. The datasets and analysis cases will cover a variety of domains including IT, healthcare, education, manufacture, natural science. Students will learn how to apply the statistical tests and modeling techniques to solve practical problems through widely adopted statistical and programming tools such as SPSS, R, and Python. This course has been offered as a special topic; students who have earned credit for this course as a special topic will not receive additional credit for CIS 328. Prerequisites: CIS 211; MATH 231 or MATH 330 or ECON 205, or consent of instructor.

MATH 211 CALCULUS FOR APPLICATIONS (3)
Intended primarily for students in biology, business, economics, psychology and the social sciences. Elements of differential and integral calculus from an intuitive standpoint with emphasis on the use of calculus in the above fields. Exponential and logarithmic functions, partial derivatives included. Not open to mathematics majors or minors. Prerequisite: qualifying score on the Math Placement Test or MATH 115 (recommended) or MATH 119. (Fulfills Core 3: Mathematics)[2]

MATH 231 BASIC STATISTICS (3)
A non-calculus based introduction to statistics with emphasis on applications. Topics include categorical and quantitative data collection through sampling and experimental design, data description and displays, confidence intervals and hypothesis tests for one- and two-samples, and matched-pairs design; normal and t-distributions; correlation and simple linear regression. Emphasis on interpretations of results throughout. Substantial use of a computer package as a learning and computational tool. Students who have successfully completed the honors version of this course (MATH 233) will not receive additional credit for this course. Prerequisite: qualifying score on Math Placement exam or MATH 100 (recommended) or MATH 102 or higher. (Fulfills Core 3: Mathematics)[2]

[2] Students may only apply one of MATH 211, MATH 231, and MATH 273 to fulfill the Core 3 Mathematics requirement.

MATH 273 CALCULUS I (4)
Functions, limits, and continuity; differentiation of algebraic and trigonometric functions; mean value theorem; differentials; introduction to integration; applications. Four lecture hours and one laboratory hour per week. Students who have successfully completed the honors version of this course (MATH 283) will not receive additional credit for this course. Prerequisite: qualifying score on Math Placement exam or MATH 117 or MATH 119. (Fulfills Core 3: Mathematics)[2]