

Graduate Intent to Plan--Major or Degree

NOTE: This "Intent to Plan" form must be submitted and go through the approval process BEFORE you submit the form titled, "Request for Graduate Addition, Deletion or Change of a Major or Degree." For detailed information on new programs please see: <http://wvhepcdoc.wvnet.edu/resources/133-11.pdf>.

1. Prepare one paper copy with all signatures and supporting material and forward to the Graduate Council Chair.
2. E-mail one PDF copy without signatures to the Graduate Council Chair. If attachments are included, please merge into a single file.
3. **The Graduate Council cannot process this application until it has received both the PDF copy and the signed hard copy.**

College: CITEDept/Division: Computer ScienceContact Person: Wook-Sung YooPhone: x5452New Degree Program Data Analytics

Effective Term/Year

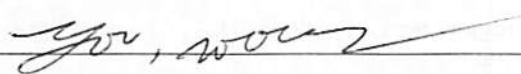
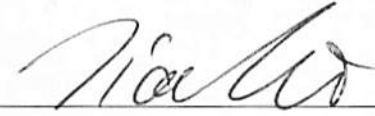
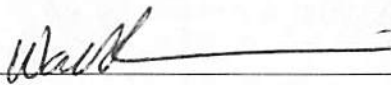
Fall 20

Spring 20

Summer 20

Information on the following pages must be completed before signatures are obtained.

Signatures: if disapproved at any level, do not sign. Return to previous signer with recommendation attached.

Dept. Chair/Division Head <u></u>	Date <u>March 18, '19</u>
College Curriculum Chair <u></u>	Date <u>3/20/19</u>
College Dean <u></u>	Date <u>04/01/2019</u>
Graduate Council Chair _____	Date _____
Provost/VP Academic Affairs _____	Date _____
Presidential Approval _____	Date _____
Board of Governors Approval _____	Date _____

Graduate Intent to Plan--Major or Degree-Page 2

Please provide a rationale for new degree program: (May attach separate page if needed)

With exponentially increasing amounts of data accumulating in real-time, every business and entrepreneur in today's society needs data analytics to have the ability to turn data into a competitive advantage to augment their competitive position relative to others in the field.

As a result, Data Analysts are among the most sought-after positions in America. With 163 zettabytes of data to be created by 2025 (10 times the amount of data in the digital universe in 2016), employers will have an extensive need for data experts who can manage and analyze the vast amount of information they collect. IBM predicts that by 2020, the number of jobs for all U.S. data professionals will increase by 364,000 openings to 2,720,000 jobs. This data boom is challenging businesses in every industry to hire professionals with a master's degree in data analytics who are skilled at data management and governance. Nearly 40% of advanced data and business analytic positions require a master's degree or Ph.D. according to a research study performed by IBM.

- Top 5 jobs by Google Careers are related to data analytics.

- According to the U.S Bureau of Labor and Statistics, the average wage of the U.S data scientists in 2016 is \$130,000.

- McKinsey & Co. estimates that big data analytics revenue will be \$325 billion by 2020.

Data scientist has been named the best job in America for three years running, according to Glassdoor's 2018 Rankings, with a median base salary of \$110,000. Common data analytics jobs are Chief Executive Officer, Chief Data Officer, Director of IT, Human Resources Manager, Financial Manager and Marketing Manager.

Data analyst skills and competencies have different forms of analytics that will add value to a business. However, the elite data analyst must master five essential skills: programming, quantitative skills, technologies, domain knowledge, and critical thinking. A data analyst should know how to code and have mathematical knowledge to include probability and statistics in order to conduct numerical and statistical analysis. The curriculum of the proposed M.S. in Data Analytics program provides courses to build the skills necessary to become an elite data analyst to analyze, discover, and innovate in a data-rich world.



1. ADDITIONAL RESOURCE REQUIREMENTS: If your new program requires additional faculty, equipment or specialized materials, attach an estimate of the time and money required to secure these items.

NOTE: Approval of this form does not imply approval for additional resources. Enter NONE if not applicable.

2. NON-DUPLICATION: If a question of possible duplication occurs, attach a copy of the correspondence sent to the appropriate department(s) describing the request and any response received from them. Enter NONE if not applicable.

None

For catalog changes as a result of the above actions, please fill in the following pages.

5. New Catalog Description

Insert a 'clean' copy of your proposed description, i.e., no strikeouts or highlighting included. This should be what you are proposing for the new description. (May attach separate page if needed)

See attachment

Graduate Intent to Plan--Major or Degree-Page 4

Please insert in the text box below your summary information for the Graduate Council agenda. Please enter the information exactly in this way (including headings):

Department:

New Major or Degree:

Credit Hours:

Rationale:

Department: Weisberg Division of Computer Science

New Major or Degree: Masters of Science in Data Analytics

Credit Hours: 30 Credit Hours

Type of Change: Addition

Rationale: With exponentially increasing amounts of data accumulating in real-time, every business and entrepreneur in today's society needs data analytics to have the ability to turn data into a competitive advantage to augment their competitive position relative to others in the field.


As a result, Data Analysts are among the most sought-after positions in America. With 163 zettabytes of data to be created by 2025 (10 times the amount of data in the digital universe in 2016), employers will have an extensive need for data experts who can manage and analyze the vast amount of information they collect. IBM predicts that by 2020, the number of jobs for all U.S. data professionals will increase by 364,000 openings to 2,720,000 jobs. This data boom is challenging businesses in every industry to hire professionals with a master's degree in data analytics who are skilled at data management and governance. Nearly 40% of advanced data and business analytic positions require a master's degree or Ph.D. according to a research study performed by IBM.

- Top 5 jobs by Google Careers are related to data analytics.

- According to the U.S Bureau of Labor and Statistics, the average wage of the U.S data scientists in 2016 is \$130,000.

- McKinsey & Co. estimates that big data analytics revenue will be \$325 billion by 2020.

Data scientist has been named the best job in America for three years running, according to Glassdoor's 2018 Rankings, with a median base salary of \$110,000. Common data analytics jobs are Chief Executive Officer, Chief Data Officer, Director of IT, Human Resources Manager, Financial Manager and Marketing Manager.

Data analyst skills and competencies have different forms of analytics that will add value to a business. However, the elite data analyst must master five essential skills: programming, quantitative skills, technologies, domain knowledge, and critical thinking. A data analyst should know how to code and have mathematical knowledge to include probability and statistics in order to conduct numerical and statistical analysis. The curriculum of the proposed M.S. in Data Analytics program provides courses to build the skills necessary to become an elite data analyst to analyze, discover, and innovate in a data-rich world. 

DATA ANALYTICS, M.S.

Program Description

The Master of Science in Data Analytics provides students with technical expertise in computational modeling, data collection and integration, data storage and retrieval, data processing, modeling and analytics, and visualization. Students graduating from this program will be able to handle large data sets (big data), write software to work with these large data sets, and apply the statistical skills to model and analyze sub-data sets of interest. The job opportunities in this field are rapidly growing.

Admission Requirements

Minimum requirements for admission is a four-year bachelor's degree with GPA of 2.75 or higher out of 4.0 in Computer Science, or any related areas listed below.

- Data Science/Data Analytics
- Information Systems/Information Technology
- Computer Information Technology
- Mathematics/Statistics
- Computer Engineering
- Electrical Engineering
- Software Engineering

Whether a student meets the above requirements will be determined by the division chair or designee based on the information provided in the admission application and transcripts. Applicants with a bachelor's degree in a major not listed above may be admitted to the program with a provision of successful completion of the following three bridge courses with a grade of B or above in the first two semesters of the program:

- Data Structure and Algorithms (CS 210)
- Data Engineering (CS 410)
- Applied Probability and Statistics (STA 345)

Foreign nationals must provide proof of English proficiency with a minimum score of 6.5 in IELTS or 80 on TOEFL IBT (or 550 paper based) and must have met all other admission criteria prior to registering for the first semester of courses. Applicants should follow the admissions process as stated in the graduate catalog or on the graduate admissions web site.

Degree Requirements

The MSDA degree requires 30 credit hours (CR) of graduate work. The 30 CR is comprised of the following components:

- Required Core courses (15 CR)
 CS 511 Advanced Programming
 CS 515 Data Mining
 CS 630 Machine Learning
 CS 660 Big Data Systems
 CS 670 Visual Analytics
- Domain Emphasis (9 CR)
 Domain Emphasis gives students a grounded understanding of a particular domain and a student should take 9 credits of courses in her/his domain area.
 - **Mathematic Modeling**
 This domain emphasis gives students the opportunity to explore mathematical techniques essential to mathematical modeling.
 - **Computing**
 This domain emphasis tackles computing areas including high performance computing, cloud computing, IoT, Artificial Intelligence, Cybersecurity, bioinformatics, etc.
 - **Information Systems**
 This domain emphasizes the use of information technology and their expected utility of their information systems.
 - **Healthcare**
 This domain emphasis focuses on analysis of data collected from healthcare areas, including claims and cost data, pharmaceutical and R&D data, clinical data, and patient behavior and sentiment data.

A Domain Emphasis is comprised of three courses chosen from the list below:

Mathematical Modeling	Computing	Information Systems	Healthcare
STA 513	CS 504	IS 545	IS 535
STA 520	CS 539	IS 623	IS 545
STA 525	CS 540	IS 624	HP 605
STA 564	CS 550	IS 645	HP 615
STA 570	CS 559	IS 665	HP 630
STA 660	CS 620		HP 650
STA 661	CS 625		
STA 662	CS 630		
STA 663	CS 645		

- Electives (6 CR) or Thesis Option (6 CR)
 Student may choose a thesis option or take any two additional courses from the list of courses in the Domain Emphasis. The thesis option (Thesis I and II) offers students an opportunity for serious investigation into an area of interest. Students must summarize their thesis work in the form of a formal written document and deliver an oral presentation. Thesis work is typically conducted over two semesters. The thesis option can be taken after

the completion of 12 credit hours. The 6 CR of the thesis option cannot be combined in a semester. In the event that a student in the thesis option wishes to switch to the other option, the course taken in the thesis option will not count toward fulfilling the graduation requirement.

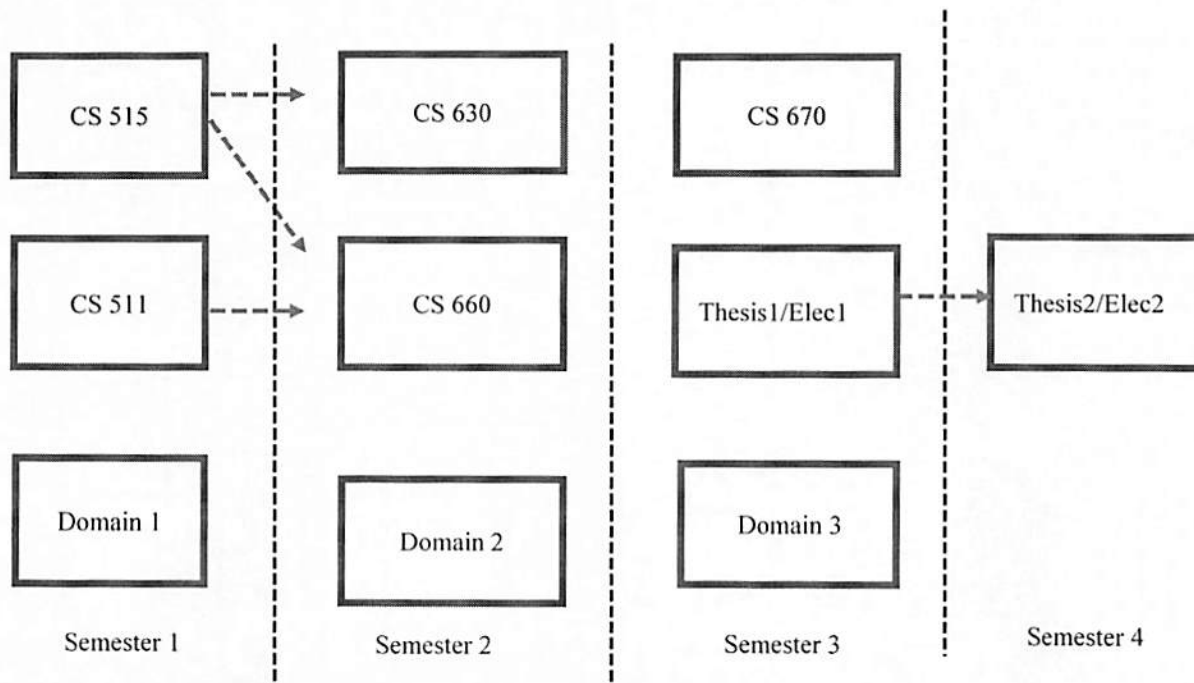
Plan of Study

Below is a typical two-year study plan for full-time (9 credit hours a semester) students:

Year	Term	Course	Hr	Pre-requisite
1	FA	CS 511 Advanced Programming	3	None
		CS 515 Data Mining	3	None
		Domain Emphasis course 1	3	
	SP	CS 630 Machine Learning	3	CS 515
		CS 660 Big Data Systems	3	CS 511, CS515
		Domain Emphasis course 2	3	
2	FA	CS 670 Visual Analytics	3	
		Domain Emphasis course 3	3	
		Thesis 1 or Elective Course 1	3	
	SP	Thesis 2 or Elective Course 2	3	

Note: All required core courses will be offered every semester. However, some elective courses may only be offered one semester a year. Students should work closely with advisors in developing a study plan.

Some courses may have a pre-requisite as indicated with ----->





MARSHALL UNIVERSITY

**College of Information Technology and Engineering
Weisberg Division of Computer Science**

March 18, 2019

Master of Science in Data Analytics

Effective Date: Spring 2020

Contact Person:

Dr. Wael Zatar, Dean

College of Information Technology and Engineering
and

Dr. Wook Sung Yoo, Chair

Weisberg Division of Computer Science

Summary Statement

The Weisberg Division of Computer Science in the College of Information Technology and Engineering (CITE) proposes the establishment of the Master of Science (M.S.) in Data Analytics degree program at Marshall University.

Data analytics is the process of examining data sets in order to draw conclusions about the information they contain, increasingly with the aid of specialized systems and software. Data analysts extract meaningful insight from various data sources using techniques such as data mining, machine learning, and other data sources to forecast the future. This information can then be used to optimize the processes to increase the overall efficiency of a business or system.

The proposed M.S. in Data Analytics provides students with technical expertise in computational modeling, data collection and integration, data storage and retrieval, data processing, modeling and analytics, and visualization. Data analysts are among the most sought-after positions in America. Although data analyst jobs are often multidisciplinary, in industry today, there is a need to hire data analysts who are skilled at data management and governance. Nearly 40% of advanced data and business analyst positions require a master's degree or Ph.D. The Weisberg Division of Computer Science in the College of Information Technology and Engineering currently offers the required core data analytics courses, and various domain emphases will be provided using existing courses in different programs at Marshall University. We believe the proposed degree program will not only create exciting and productive new pathways for research and development, but will increase educational opportunities and inter-departmental collaborations across the campus.

The proposed program does not anticipate any need of additional faculty lines, major funding, or other resources to establish the program. The program will become viable from its first year and will grow each year. The College of Information Technology and Engineering aims at enrolling 70 students and graduating 28 students with a M.S. in Data Analytics in the fifth year of the program. The projected net revenue in the fifth year is estimated at \$955,528. The program will generate close to \$3.2 million in new revenue during its first five years.

1. Program Description

Data analysis is a process of inspecting, cleansing, transforming, and modeling data with the goal of discovering useful information, informing conclusions, and supporting decision-making with the aid of specialized systems and software. Data analysts extract meaningful insight from various data sources using techniques such as data mining, machine learning, and many other data sources to forecast the future. This information can then be used to optimize the processes to increase the overall efficiency of a business, reduce business costs by identifying more efficient ways of doing business, and make more informed business decisions, leading to better products and services.

The proposed M.S. in Data Analytics degree program provides students with technical expertise in computational modeling, data collection and integration, data storage and retrieval, data processing, modeling and analytics, and visualization. Students graduating with a M.S. degree in Data Analytics will have the ability to handle large data sets, write software to work with large data sets, and apply statistical skills to model and analyze sub-data sets of interest. The Data Analytics degree program offers a holistic approach to data analytics education and takes advantage of the strong related programs in the Weisberg Division of Computer Science (Computer Science, Information Systems, and Cybersecurity), as well as other programs at Marshall University. The Data Analytics degree program prepares graduates to succeed in professional careers in a rapidly growing data analytics field, thus leading to technological changes in the industry and research fields both locally and nationally. The following sections provide additional details of the proposed M.S. in the Data Analytics degree program.

1.1 Program Mission

Marshall University provides innovative undergraduate and graduate education programs that contribute to the development of the individual and their role in society. An important goal of the M.S. in Data Analytics (MSDA) is to equip students with a strong foundation in the theory and practice of data analytics. This foundation builds on Marshall's mission, where it is stated "to actively facilitate learning through the preservation, discovery, synthesis, and dissemination of knowledge". The proposed program will cover the fundamental concepts of data analytics and provide opportunities to apply the technical knowledge and skills to produce viable solutions for industry and research fields. Graduates from the M.S. in Data Analytics program will achieve competency in the following four Program Educational Objectives (PEO): *After graduation, students will be able to:*

PEO 1: be employed in Data Analytics or related areas

PEO 2: be engaged in life-long learning and professional development through self-study, continuing education or graduate and professional studies

PEO 3: become effective communicators, collaborators and innovators

PEO 4: practice professional ethics with social responsibility addressing social, technical and business challenges

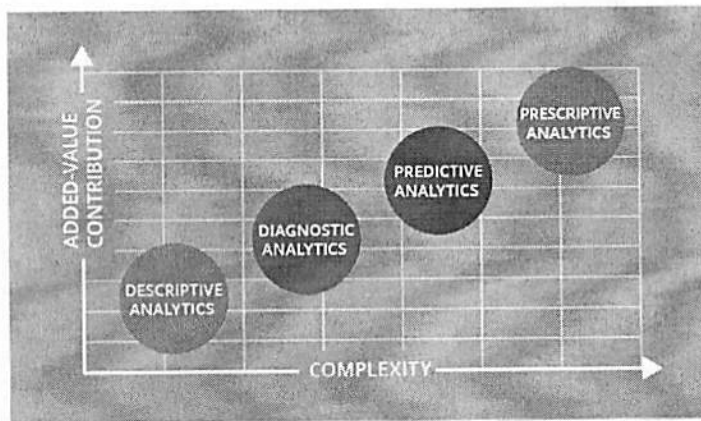
The M.S. in Data Analytics degree program will strive to ensure that its graduates are placed in data analytics jobs or closely related fields within the professional practice. The graduates are trained to contribute to the evolving technology at their workplace, identify opportunities for breakthrough research, and assume reasonable responsibilities in the decision-making process.

The M.S. in Data Analytics program aligns well with the mission of the College of Information Technology and Engineering (CITE):

- CITE will be a recognized leader in practice-oriented teaching and applied research.
- CITE is committed to serve the lifelong educational needs of students, new graduates, working professionals, and employees.
- CITE builds on combined traditions of student-focused education, entrepreneurship, and funded research and service emphasis.
- CITE provides education when and where needed, incorporating technology-enhanced methods, by full-time, dedicated faculty complemented by expert adjunct faculty from industry and government.

1.2 Program Features

With exponentially increasing amounts of data accumulating in real-time, every business and entrepreneur in today's society needs data analytics to have the ability to turn data into a competitive advantage to augment their competitive position relative to others in the field. Data analytics is broken down into four basic types:



- *Descriptive analytics* describes what has happened over a period of time.
- *Diagnostic analytics* focuses more on why something happened.
- *Predictive analytics* moves to what is likely going to happen in the future.
- *Prescriptive analytics* moves into the territory of suggesting actions.

Data analyst skills and competencies have different forms of analytics that will add value to a business. However, the elite data analyst must master five essential skills: programming, quantitative skills, technologies, domain knowledge, and critical thinking. A data analyst should know how to code and have mathematical knowledge to include probability and statistics in order to conduct numerical and statistical analysis. They should also be familiar with a wide range of technologies to include analytical tools, platforms, hardware, and software. Analysis of data would be useless if it cannot be applied to a business setting. All data analysts need to have a strong understanding of the business and domain knowledge they operate in, which enables data analysts to have insight and communicate effectively with different stakeholders. Data analysts need to be critical thinkers with creativity, to be able to apply objective analysis of facts on a given topic or problem before formulating opinions or rendering judgments.

The curriculum of the proposed M.S. in Data Analytics program provides courses to build the skills necessary to become an elite data analyst to analyze, discover, and innovate in a data-rich world. A total of 30 credit hours are required for graduation:

(1) **15 credits core courses** provide opportunities for students to build fundamental skills and knowledge of Data Analytics such as programming skills, quantitative skills, technologies, and critical thinking.

(2) **9 credits domain emphasis** will give students a grounded understanding of a particular domain. Any type of information can be subjected to data analytics techniques to get insight including the areas of healthcare, business, science, retail, engineering, humanity, and education. At this time, the proposed program includes four domain emphases which have been discussed and approved by the programs involved: statistical modeling (mathematics department), computing (computer science program), Information systems (information systems program), and healthcare (health

informatics program). The initial course offerings in each domain are listed in the catalog below but domain knowledge courses can be updated at any time under the discretion of individual department. The number of domain emphasis is expected to be increased as the program matures. Future domains to be included could be the business domain for the College of Business and computational biology domain for Bioinformatics program. Business domain was not included in this proposal due to the accreditation constraints of College of Business and computational biology domain is currently under the discussion of curriculum revision. The proposed program is open to those and other domains to be added in near future once they are ready. Initial four domain emphases and their course offerings are listed below:

- **Statistical Modeling**

This domain emphasis gives students the opportunity to explore statistical techniques essential to statistical modeling.

- **Computing**

This domain emphasis tackles computing areas including high performance computing, cloud computing, IoT, Artificial Intelligence, Cybersecurity, bioinformatics, etc.

- **Information Systems**

This domain emphasizes the use of information technology and the expected utility of information systems.

- **Healthcare**

This domain emphasis focuses on analysis of data collected from healthcare areas, including claims and cost data, pharmaceutical and R&D data, clinical data, and patient behavior and sentiment data.

(3) 6 credits of electives or thesis option will provide opportunities for students to build research opportunities or areas of additional expertise.

The M.S. in Data Analytics will promote collaboration with industries, government agencies, and educational institutions by:

- developing partnerships and alliances with external corporate and industry organizations for pursuing joint educational and research opportunities in data analytics
- pursuing research and grant opportunities in data analytics related areas
- coordinating availability of data analytics coursework to assist not only West Virginia, but the rest of the nation to meet the demand for data analytics professionals

- providing outreach opportunities to interested parties and organizations

We expect the M.S. in Data Analytics will make Marshall University a recognized leader in education, research and practice in data analytics fields. The program will attract traditional and non-traditional students from West Virginia, the Tri-State region and the surrounding states. The delivery of the M.S. in Data Analytics will be following classical instructional mechanisms at this time; however, the program can include online/hybrid courses and may be extended to an online degree program. The catalog description of the proposed M.S. in Data Analytics is as follows.

DATA ANALYTICS, M.S.

Program Description

The Master of Science in Data Analytics provides students with technical expertise in computational modeling, data collection and integration, data storage and retrieval, data processing, modeling and analytics, and visualization. Students graduating from this program will be able to handle large data sets (big data), write software to work with these large data sets, and apply the statistical skills to model and analyze sub-data sets of interest. The job opportunities in this field are rapidly growing.

Admission Requirements

Minimum requirements for admission is a four-year bachelor's degree with GPA of 2.75 or higher out of 4.0 in Computer Science, or any related areas listed below.

- Data Science/Data Analytics
- Information Systems/Information Technology
- Computer Information Technology
- Mathematics/Statistics
- Computer Engineering
- Electrical Engineering
- Software Engineering

Whether a student meets the above requirements will be determined by the division chair or designee based on the information provided in the admission application and transcripts. Applicants with a bachelor's degree in a major not listed above may be admitted to the program with a provision of successful completion of the following three bridge courses with a grade of B or above in the first two semesters of the program:

- Data Structure and Algorithms (CS 210)
- Data Engineering (CS 410)
- Applied Probability and Statistics (STA 345)

Foreign nationals must provide proof of English proficiency with a minimum score of 6.5 in IELTS or 80 on TOEFL IBT (or 550 paper based) and must have met all other admission criteria prior to registering for the first semester of courses. Applicants should follow the admissions process as stated in the graduate catalog or on the graduate admissions web site.

Degree Requirements

The MSDA degree requires 30 credit hours (CR) of graduate work. The 30 CR is comprised of the following components:

- Required Core courses (15 CR)

CS 511 Advanced Programming

CS 515 Data Mining

CS 630 Machine Learning

CS 660 Big Data Systems

CS 670 Visual Analytics

- Domain Emphasis (9 CR)

Domain Emphasis gives students a grounded understanding of a particular domain and a student should take 9 credits of courses in her/his domain area.

- Statistical Modeling

This domain emphasis gives students the opportunity to explore statistical techniques essential to statistical modeling.

- Computing

This domain emphasis tackles computing areas including high performance computing, cloud computing, IoT, Artificial Intelligence, Cybersecurity, bioinformatics, etc.

- Information Systems

This domain emphasizes the use of information technology and their expected utility of their information systems.

- Healthcare

This domain emphasis focuses on analysis of data collected from healthcare areas, including claims and cost data, pharmaceutical and R&D data, clinical data, and patient behavior and sentiment data.

A Domain Emphasis is comprised of three courses chosen from the list below:

Statistical Modeling	Computing	Information Systems	Healthcare
STA 513	CS 504	IS 545	IS 535
STA 520	CS 539	IS 623	IS 545
STA 525	CS 540	IS 624	HP 605
STA 564	CS 550	IS 645	HP 615
STA 570	CS 559	IS 665	HP 630
STA 660	CS 620		HP 650
STA 661	CS 625		
STA 662	CS 630		
STA 663	CS 645		

- Electives (6 CR) or Thesis Option (6 CR)

Student may choose a thesis option or take any two additional courses from the list of courses in the Domain Emphasis. The thesis option (Thesis I and II) offers students an opportunity for serious investigation into an area of interest. Students must summarize their thesis work in the form of a formal written document and deliver an oral presentation. Thesis work is typically conducted over two semesters. The thesis option can be taken after the completion of 12 credit hours. The 6 CR of the thesis option cannot be combined in a semester. In the event that a student in the thesis option wishes to switch to the other option, the course taken in the thesis option will not count toward fulfilling the graduation requirement.

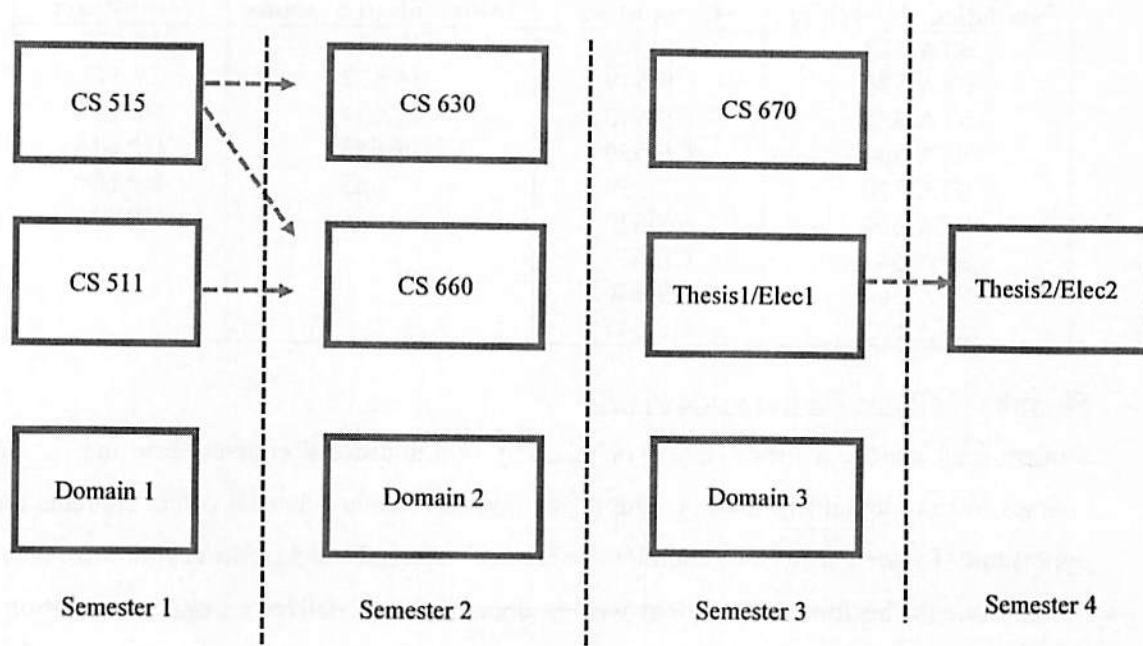
Plan of Study

Below is a typical two-year study plan for full-time (9 credit hours a semester) students:

Year	Term	Course	Hr	Pre-requisite
1	FA	CS 511 Advanced Programming	3	None
		CS 515 Data Mining	3	None
		Domain Emphasis course 1	3	
	SP	CS 630 Machine Learning	3	CS 515
		CS 660 Big Data Systems	3	CS 511, CS515
		Domain Emphasis course 2	3	
2	FA	CS 670 Visual Analytics	3	
		Domain Emphasis course 3	3	
		Thesis 1 or Elective Course 1	3	
	SP	Thesis 2 or Elective Course 2	3	

Note: All required core courses will be offered every semester. However, some elective courses may only be offered one semester a year. Students should work closely with advisors in developing a study plan.

Some courses may have a pre-requisite as indicated with ----->



2. Program Needs and Justification

2.1 Existing Program

2.1.1 Data Analytics Degree Programs in West Virginia

Shepherd University provides a B.S. in Data Analytics Comprehensive degree program. An online M.S. degree program in Business Data Analytics is offered at West Virginia University.

Table 1: Data Analytics or Related Degree Programs in the State of West Virginia

Institution	Degree	Public	Distance from MU
Shepherd University	B.S. in Data Analytics Comprehensive	Yes	353 miles
West Virginia University	Online M.S. in Business Data Analytics	Yes	207 miles

2.1.2 Data Analytics Degree Programs in the Surrounding States

A few educational institutions within the surrounding 300 miles offers data analytics related degrees or certificates as shown in table 2.

Table 2: Data Analytics or Related Programs in Surrounding Area

Institution	Degree	Public	Distance from MU
Case Western University	B.S. Degree in Data Science	No	278 Miles
Miami University of Ohio	Minor in Data Analytics	Yes	188 Miles
Northern Kentucky University	B.S. Degree in Data Science	Yes	144 Miles
The Ohio State University	B.S. Degree in Data Analytics	Yes	150 Miles
Virginia Tech	B.S. Degree in Computational Modeling and Data Analytics	Yes	188 Miles

At a national level, there is a growing list of undergraduate and graduate programs in data analytics and related areas.

2.2 Program Planning & Development

The Weisberg Division of Computer Science currently houses five programs (B.S. in Computer Science, B.S. in Computer and Information Security, M.S. in Computer Science, M.S. in Information Systems, and M.S. in Cybersecurity) and offers various data analytics related courses. The division has also been offering several CS courses (ex. CS 505 Computing for Bioinformatics, CS 510 Database Systems, CS 540 Digital Image Processing, CS 630 Machine Learning, CS 640 Advanced Topics in Bioinformatics) for Graduate Certificate in Bioinformatics and Information Systems courses (IS 623 Database Management, IS 665 Health Informatics Application, IS 535 Applied Healthcare Databases/Tools, IS 545 Healthcare Data Analysis & Visualization) for the Health Informatics program of the College of Health Professions (COHP).

2.2.1 Clientele and Need

Data analysts are among the most sought-after positions in America. With 163 zettabytes of data to be created by 2025 (10 times the amount of data in the digital universe in 2016), employers will have an extensive need for data experts who can manage and analyze the vast amount of information they collect. IBM predicts that by 2020, the number of jobs for all U.S. data

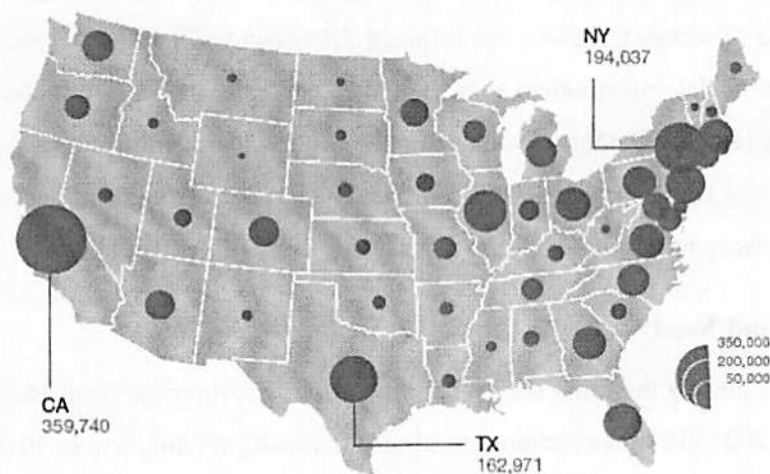
professionals will increase by 364,000 openings to 2,720,000 jobs. This data boom is challenging businesses in every industry to hire professionals with a master's degree in data analytics who are skilled at data management and governance. Nearly 40% of advanced data and business analytic positions require a master's degree or Ph.D. according to a research study performed by IBM.

- Top 5 jobs by Google Careers are related to data analytics.
- According to the U.S Bureau of Labor and Statistics, the average wage of the U.S data scientists in 2016 is \$130,000.
- McKinsey & Co. estimates that big data analytics revenue will be \$325 billion by 2020.

2.2.2 Employment Opportunities

Data scientist has been named the best job in America for three years running, according to Glassdoor's 2018 Rankings, with a median base salary of \$110,000. The proposed M.S.

in Data Analytics degree program is very timely for West Virginia, the nation, and the world. Common data analytics jobs are Chief Executive Officer, Chief Data Officer, Director of IT, Human Resources Manager, Financial Manager and Marketing Manager. On October 1, 2018 a search on indeed.com for data analytics careers in West Virginia showed statistics for 231 different positions (<https://www.indeed.com/jobs?q=data+analyst&l=WV>) in various industries including government, health industries, IT, bank, engineering, education, etc. Figures in the USA map below shows the number of jobs in states in the US. Although the job of data analysis in WV is still under the growth, WV is located in the middle of very hot states of data analytics job market.



Source: PwC analysis based on Burning Glass Technologies data, January 2017.

2.2.3 Program Impact

The M.S. in Data Analytics will strengthen existing programs at Marshall University. Closely-related programs will greatly benefit from the addition of the M.S. in Data Analytics, as this new program will offer the students additional electives that can enrich their academic experience. Existing Marshall University undergraduate and graduate degree and certificate programs in Computer Science, Information System, Technology Management, Electrical and Computer Engineering, Management Information Systems, Health Informatics, and Bioinformatics will have the option of enhancing their offerings by incorporating data analytics courses. Students in the M.S. in Data Analytics may choose to get another major in any of the closely-related fields or may add a minor in one of these fields. The proposed program opens the door for graduates within non-CS undergraduate majors, and any graduates from other programs can pursue a master's degree in the M.S. in Data Analytics program after successful completion of the three bridge courses. As a result, the M.S. in Data Analytics will create exciting and productive new paths, which will eventually promote interdisciplinary education and research. The students in the M.S. in Data Analytics will have many opportunities to learn and implement advanced technologies in addition to participation in undergraduate and graduate research. Collaborative cutting-edge research in data analytics will be conducted in partnership with other universities and research institutions.

2.4 Cooperative Arrangements

The Weisberg Division of Computer Science has strong partnerships with several industry partners and state government agencies. The proposed Data Analytics program has the strongest support of the local, state and Tri-State industries and employers. The advisory board members of the Weisberg Division of Computer Science have been very excited about this much-needed degree program and are in supportive providing suitable employment opportunities for the students and graduates of this proposed degree program. In addition, the advisory board members have committed to facilitating the pursuit of less formal relationships earlier in the students' curriculum through field experiences, internships, and co-ops beginning in their sophomore year.

2.5 Alternatives to Program Development

The proposed M.S. in Data Analytics degree program at Marshall University will be the first established non-online M.S. in Data Analytics in the state of West Virginia. The needs of the

stakeholders and the huge regional, national and international shortage of qualified graduates and experts in this specialized field shaped the process of identifying the program curriculum, learning objectives and learning outcomes, and deciding on the curriculum. There are no alternatives to the proposed degree program at Marshall University.

3. Program Implementation Projected Resource Requirements.

The proposed program does not require additional resources and can be sustainable by leveraging already existing resources available at the Weisberg Division of Computer Science. The proposed program will provide multiple benefits at almost no cost upon its initiation.

3.1 Program Administration:

The Weisberg Division of Computer Science of the College of Information Technology and Engineering will house the M.S. in Data Analytics degree program. The Chair of the Weisberg Division of Computer Science will supervise and manage the program with oversight by the Dean of the College of Information Technology and Engineering. The college does not project changes in the administration of the division with the addition of this new degree program.

3.2 Program Projections:

Based upon the number of student inquiries and interest of the proposed degree, it is conservatively estimated that the M.S. in Data Analytics program will have 20 full-time equivalent students in its first year, with an additional 20% annual growth and approximately 20% withdrawal (transferring out) from the program in the next 5 subsequent years as shown in Table 3. The anticipated program graduation rate should reach at least 28 full-time equivalent students in 5th year.

Table 3: Student Enrollment Projection

Academic Year		2019-20	2020-21	2021-22	2022-23	2023-24
2019-2020	First Year Students	20				
	Second Year Students	0				
2020-2021	First Year Students		24			
	Second Year Students		16			
2021-2022	First Year Students			29		
	Second Year Students			19		
2022-2023	First Year Students				35	
	Second Year Students				23	
2023-2024	First Year Students					42
	Second Year Students					28
Estimated Total Student Enrollment		20	40	48	58	70

3.3 Faculty Instructional Requirements:

The College of Information Technology and Engineering has the administrative system and necessary faculty to support the proposed M.S. in Data Analytics degree program. The faculty in the Weisberg Division of Computer Science possess the technical expertise to support the program with excellent research and publication records.

Five required core courses for the M.S. in Data Analytics have been offered in the M.S. in Computer Science (MSCS) program since the start of the MSCS program as below:

Table 4. New Data Analytics Courses and Faculty Assignment

New Data Analytics Courses	Term	Faculty
CS 511 Advanced Programming	FA/SP	Dr. Cong Pu
CS 515 Data Mining	FA	Dr. Wook-Sung Yoo
CS 630 Machine Learning	SP	Dr. Paulus Wahjudi
CS 660 Big Data Systems	FA/SP	Dr. Haroon Malik
CS 670 Visual Analytics	SP	Dr. Husnu Narman

If the program is successful in recruiting a large number of students in the future, additional faculty and adjuncts will be needed.

3.4 Library Resources and Instructional Materials:

Marshall University Libraries have the majority of the resources needed to support the proposed degree program. The Computer Science programs in CITE share the library resources; however, a few additional library collections may need to be added over time to support the Data Analytics program.

3.5 Support Service Requirements:

No special support will be needed unless the program acquires a critical mass (probably after 3 years from the starting of the program).

3.6 Facilities Requirements:

Marshall University Computing Services currently supports all computing needs of the users on campus. The College of Information Technology and Engineering has fully equipped state-of-the-art computer labs and classrooms within the Arthur Weisberg Family Applied Engineering Complex (WAEC) to support the various programs of the Weisberg Division of Computer Science. The Weisberg Division of Computer Science houses a Cybersecurity lab, Computer Science

Project lab, and Computer Graphics lab. These spaces are shared amongst the existing programs in the division and will support the addition of other programs in the division, including the proposed M.S. in Data Analytics degree program. The Data Analytics program will have access to the available computer workstations and Wi-Fi in the WAEC. As the program continues to grow, a Data Analytics specialized lab/classroom will be considered through the conversion of one of the existing spaces of the division.

3.7. Operating Resource Requirements:

Since the Data Analytics program will be a part of the Weisberg Division of Computer Science, it will share the operating resources with the other programs offered by the division. Table 5 shows the estimated revenue generated by the proposed program during its first five years, as shown based on the number of students in the program summarized in Table 3.

Table 5. Revenue Generated by the Proposed Program in 5 years

	Tuition & Fees	1st Year		2nd Year		3rd Year		4th Year		5th Year	
		Yearly	FTE	Revenue	FTE	Revenue	FTE	Revenue	FTE	Revenue	FTE
Resident of WV (50%)	\$9,188	10	\$91,880	20	\$183,760	24	\$220,512	29	\$266,452	35	\$321,580
Metro resident (20%)	\$16,040	6	\$96,240	12	\$192,480	14	\$224,560	17	\$272,680	21	\$336,840
Out of State (30%)	\$21,222	4	\$84,888	8	\$169,776	10	\$212,220	12	\$254,664	14	\$297,108
Total		20	\$273,008	40	\$546,016	48	\$657,292	58	\$793,796	70	\$955,528