# **LEVEL II MEMORANDUM**

DATE: December 12, 2016

**TO:** Chief Academic Officers, Montana University System

**FROM:** John Cech, Deputy Commissioner for Academic and Student Affairs

**RE:** Level II Proposals

The campuses of the Montana University System have proposed new academic programs or changes under the Level II approval process authorized by the Montana Board of Regents. The Level II proposals are being sent to you for your review and approval. If you have concerns about a particular proposal, you must share those concerns with your colleagues at that institution and try to come to some understanding prior to the Chief Academic Officer's conference call on January 4. If you cannot resolve your concerns, raise them at the Chief Academic Officer's conference call. Issues not resolved at that meeting should be submitted in writing to OCHE by noon on Friday, January 6. If no concerns are received, OCHE will assume that the proposals have your approval.

### **Level II Items**

# **University of Montana:**

Request for authorization to establish a M.S. in Data Science
 Item 174-1001-R0117 | Academic Proposal Request Form | Curriculum Proposal Form | Intent to Plan Form

#### ITEM 174-1001-R0117

#### Request for authorization to establish a M.S. in Data Science, University of Montana-Missoula

#### **THAT**

The Board of Regents of Higher Education authorizes the University of Montana-Missoula to establish a master of science in Data Science.

#### **EXPLANATION**

We propose to augment our existing program in Data Analytics by creating a M.S. degree in Data Science, housed in the Department of Mathematical Sciences. The Department of Mathematical Sciences has developed an innovative, industry-centered program to train students in data science. Our focus, which is significantly different from other universities that have also begun data science programs, is on teaching data analytics and theory for real big data problems. Our program goes beyond mathematics/statistics and has an emphasis on integrating computer programming and domain-specific topics (e.g., healthcare analytics). Our goal is to produce graduates that have faced the challenges of big data with real problems and are ready to be productive employees.

#### **ATTACHMENTS**

Academic Request Form Curriculum Proposal Form

# **ACADEMIC PROPOSAL REQUEST FORM**

ITEM	174-1001-R0117	Submission Month or Meeting: January 12-13, 2017  CIP Code: 27.9999	
Institution:	University of Montana-Missoula		
Program/Center/Institute Title:	Data Science M.S.		
Includes (please specify below):	Online Offering Options		
listed in parentheses following	ing the type of request. For more	an Item Template and any additional materials, including those information pertaining to the types of requests listed below, how to p://mus.edu/che/arsa/preparingacademicproposals.asp.	
A. Level I:			
Campus Approvals			
1a. Placing a p	ostsecondary educational progra	m into moratorium (Program Termination and Moratorium Form)	
1b. Withdrawi	ng a postsecondary educational p	program from moratorium	
2. Establishing	, re-titling, terminating or revising	g a campus certificate of 29 credits or less	
3. Establishing	a B.A.S./A.A./A.S. area of study		
4. Offering an	existing postsecondary education	nal program via distance or online delivery	
OCHE Approvals			
5. Re-titling an	existing postsecondary educatio	nal program	
6. Terminating	an existing postsecondary educa	tional program (Program Termination and Moratorium Form)	
7. Consolidatin	g existing postsecondary educati	ional programs ( <u>Curriculum Proposal Form</u> )	
8. Establishing	a new minor where there is a ma	ajor or an option in a major (Curriculum Proposal Form)	
9. Revising a p	ostsecondary educational progra	m ( <u>Curriculum Proposal Form)</u>	
10. Establishin	g a temporary C.A.S. or A.A.S. de	gree program Approval limited to 2 years	

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# **Montana Board of Regents**

**ACADEMIC PROPOSAL REQUEST FORM** 

<u>B.</u>	Level II:
X	1. Establishing a new postsecondary educational program (Curriculum Proposal and Completed Intent to Plan Form
	2. Exceeding the 120 credit maximum for baccalaureate degrees Exception to policy 301.11
	3. Forming, eliminating or consolidating an academic, administrative, or research unit (Curriculum or Center/Institute Proposal and Completed Intent to Plan Form, except when eliminating or consolidating)
	4. Re-titling an academic, administrative, or research unit

# **Specify Request:**

We propose to augment our existing program in Data Analytics by creating a M.S. degree in Data Science, housed in the Department of Mathematical Sciences. The Department of Mathematical Sciences has developed an innovative, industry-centered program to train students in data science. Our focus, which is significantly different from other universities that have also begun data science programs, is on teaching data analytics and theory for real big data problems. Our program goes beyond mathematics/statistics and has an emphasis on integrating computer programming and domain-specific topics (e.g., healthcare analytics). Our goal is to produce graduates that have faced the challenges of big data with real problems and are ready to be productive employees.

**CURRICULUM PROPOSAL FORM** 

#### 1. Overview

A. Provide a one paragraph description of the proposed program. Be specific about what degree, major, minor or option is sought.

We propose to augment our existing program in Data Analytics by creating a Master of Science degree in data science, housed in the department of Mathematical Sciences. The Department of Mathematical Sciences has developed an innovative, industry-centered program to train students in data science. Our focus, which is significantly different from other universities that also have begun data science programs, is on teaching data analytics and theory for real big data problems. Our program goes beyond mathematics/statistics and has an emphasis on integrating computer programming and domain-specific topics (e.g., healthcare analytics). Our goal is to produce graduates that have faced the challenges of big data with real problems and are ready to be productive employees.

# 2. Institutional and System Fit

A. What is the connection between the proposed program and existing programs at the institution?

Our proposed program has connections with several existing programs. The new program is allied with the existing M.A. in Mathematics but principally with the statistics specialization within the Department of Mathematical Sciences. In fact, statistical science overlaps with data science with respect to the objective of extracting information from data. But the problems and goals of data science are usually beyond the scope of statistics. In these situations the statistical aspects of the problem pale in comparison with the importance of algorithmic and computational considerations. Data science focuses on the algorithmic and computational demands. Both programming techniques and statistical methods are necessary and ubiquitous in data science. But data science is not statistics and one cannot teach data science as if it were.

The proposed program has connections to the Masters of Business Analytics offered by the School of Business Administration. Their program integrates content from marketing and management information systems. Their core curriculum spans business intelligence, big data analysis, business statistics, statistical computing, and data mining and management. As such, the emphasis is distinctly different and is aimed at the application of data science to business. Our program focuses on the fundamental principles and data analytic methods. The goal is to train data scientists that are capable of working in much larger domain than business analytics, and include areas such as biology (genomics), physics, linguistics, cyber security, and healthcare.

The School of Business manages the University of Montana's Big Data Certificate program. The certificate is awarded to any student that completes four courses in data science, one of which must be BMIS 326-Introduction to Data Analytics. The remaining three courses are selected from courses offered in Mathematics, Computer Science, and Business Management and Information Science. Both our proposed program and the Masters of Business Analytics go well beyond the Certificate and in no sense can be thought of as redundant.

B. Will approval of the proposed program require changes to any existing programs at the institution? If so, please describe.

No.

C. Describe what differentiates this program from other, closely related programs at the institution (if appropriate).

#### **CURRICULUM PROPOSAL FORM**

The School of Business Administration offers a Business Analytics MS degree, which was developed synchronously with this program. We have shared classes with them during that development phase, and have BMIS classes in our list of electives. They have only one general statistics methods (Stat 451) class in their requirements, and are not focused on the mathematical and statistical algorithms of data analytics, but rather on business applications and the appropriate use of software. We are both part of the Data Analytics Initiative on campus, and as such work together on planning of events for the Initiative, working with local businesses, etc. The Data Science Master's program, housed in Mathematical Sciences, will raise the overall profile of data analytics on campus.

Computer Science is also involved in the Data Science Initiative and is our close Humanities & Sciences partner in this endeavor. We have constructed our curriculum with their input early on in the process. We anticipate some students will want a more Computer Science oriented degree, which they will be able to do thanks to the help of the faculty in Computer Science. Again, we see ourselves as cooperative partners in bringing data analytics to the College of Humanities and Sciences, and will continue to work closely with Computer Science to give our students the best training opportunities possible.

#### D. How does the proposed program serve to advance the strategic goals of the institution?

Data Science was named one the five areas targeted for growth in by President Engstrom (Remarks for the Campus Budget Forum, November 17, 2015). The Department of Mathematical Sciences has played a pivotal role in the development of the undergraduate certificate in Big Data Analytics, which is housed in Business Management Information Systems and Mathematical Sciences. We propose to build on this curriculum to create a Master of Science degree in Data Science. The School of Business Administration has launched a Master's in Business Analytics focused on data analytics, which is geared toward Marketing and Management, with a minimal Mathematics and Statistics curriculum base. A Master of Science in Data Science, administered through Mathematical Sciences, would emphasize algorithms, data analytics (methods) and the theory supporting the algorithms and methods. The content of the coursework and expectation of the students would be much different than the Masters in Business Analytics. In collaboration with computer science, the necessary programming skills will also be developed. Projects based courses and dedicated internships would prepare these student to "hit the ground running" once on the job.

E. Describe the relationship between the proposed program and any similar programs within the Montana University System. In cases of substantial duplication, explain the need for the proposed program at an additional institution. Describe any efforts that were made to collaborate with these similar programs; and if no efforts were made, explain why. If articulation or transfer agreements have been developed for the substantially duplicated programs, please include the agreement(s) as part of the documentation.

At the time that this proposal was drafted, no programs exist like it in the MUS. We have seen curriculum proposals from Montana Tech around an undergraduate degree in Data Science, and we are reaching out to Chip Todd in Statistics to see how their program could dovetail into ours, and where we might be able to share resources. MSU-Bozeman Math/Stat and CSCI teach classes that support a data science program, but as of now have no actual program on the books. We do support the development of such a program there, however, as there is plenty of work to do in this area, in Missoula and in Bozeman.

#### 3. Program Details

A. Provide a detailed description of the proposed curriculum. Where possible, present the information in the form intended to appear in the catalog or other publications. NOTE: In the case of two-year degree programs and certificates of applied science, the curriculum should include enough detail to determine if the

#### **CURRICULUM PROPOSAL FORM**

characteristics set out in Regents' Policy 301.12 have been met.

**Non-thesis Option**: 36 credits, including up to 10 research credits. Of the course credits, at least half must be at the 500 level or above. The student and the student's advisor design a program of study for each student. The program of study must include the following:

- **Depth requirement in Data Science**: M561 (Practical Big Data Analysis, co-convened), M562 (Theoretical Data Analytic, co-convened), M567 (Data Analytics Projects, co-convened), M540 (Numerical Linear Algebra, co-convened), one 3 credit CSCI course from list below.
- 2 credits of Applied Math/Stat seminar
- 1 credit Colloquium

The remaining course credits in Stats and CSCI are chosen from the following list.

- Stats: S421, S422, S542, S543, S545
- CSCI: CSCI 444 (Data Visualization), CSCI 547 (Machine Learning), CSCI 548 (Pattern Recognition), CSCI 564 (Applications of Mining Big Data), CSCI 580 (Applied Parallel Computing Techniques)
- Electives from Math Sci., CSCI and Business Analytics: BMIS 465 (real time data analytics) and BMKT 440 (marketing analytics), may also be taken. These courses must be approved by the advisor. A maximum of 6 credits of electives only.

After the first year students will take a comprehensive exam on material from M561 and M540. It would be structured like a stat exam in two parts, written and computational.

A minimum of 2 research credits is required. A final presentation on a research project must be given the Applied/Stat seminar.

C. Describe the planned implementation of the proposed program, including estimates of numbers of students at each stage.

We have 4-6 faculty interested in advising Data Science MS students, so we anticipate our maximum load would be 8 students in the program at any one time. One or two would be supported by departmental TAs, the others would be self-supporting with possibly small scholarships from our business partners.

For the current 2016-17 academic year we have two Math Masters students interested in the degree, and taking classes so that they could complete the degree in May 2018, if it is offered. We will carry out recruitment to bring in two more students in Fall 2017 to begin the program.

- For the academic year 2017-2018 there will thus be two new students and two second year students. We will recruit for three more new students in Fall 2018.
- For the academic year 2018-2019 there will be two second year and three new students. Two students will graduate in May 2019. We will recruit for four more new students in Fall 2019
- For the academic year 2019-2020 there will be three second year and four new students. Three students will graduate in May 2020. We will recruit for four more students in Fall 2020.
- For the academic year 2020-2021 there will be four second year and four new students. This is our maximum class size.

#### 4. Need

#### **CURRICULUM PROPOSAL FORM**

Big Data is a catch phrase of our times. But, is it just a fad? We quote from a presentation at UM by Peter Coffee, VP for Strategic Research of Sales Force, a leader in cloud-computing and customer relationship management software:

'Is "Big Data" a Thing? Oh, Yeah. <u>Health Care</u> "We estimate that the value from data in the sector could be more than \$300 billion every year...reducing US expenditures by about 8%". <u>Profit Sector</u> "A retailer has the potential to increase its operating margin by more than 60%." <u>Public Sector</u> "In the developed economies of Europe, we estimate that government could save more than \$149 billion in operational efficiency improvements alone —not including reduction of fraud, error, and tax gaps." (McKinsey Global Institute, May 2011)'

Also stated in Coffee's presentation: "It's not enough to answer questions faster: Data and algorithms must *suggest* them." Our specialized courses in data analytics build on core courses in statistics and computer science to gives students the techniques they will need to create, use and interpret the algorithms of data analytics.

Businesses are asking for graduates with these skills. A recent MIT Sloan Management Review survey (<a href="http://www.forbes.com/sites/louiscolumbus/2015/11/16/where-big-data-jobs-will-be-in-2016/#31abd2a6f7f1">http://www.forbes.com/sites/louiscolumbus/2015/11/16/where-big-data-jobs-will-be-in-2016/#31abd2a6f7f1</a>) reported that 43% of companies view lack of appropriate analytical skills as a key challenge connected to Internships. <a href="https://www.forbes.com/sites/louiscolumbus/2015/11/16/where-big-data-jobs-will-be-in-2016/#31abd2a6f7f1">https://www.forbes.com/sites/louiscolumbus/2015/11/16/where-big-data-jobs-will-be-in-2016/#31abd2a6f7f1</a>) reported that 43% of companies view lack of appropriate analytical skills as a key challenge connected to Internships. <a href="https://www.forbes.com/sites/louiscolumbus/2015/11/16/where-big-data-jobs-will-be-in-2016/#31abd2a6f7f1">https://www.forbes.com/sites/louiscolumbus/2015/11/16/where-big-data-jobs-will-be-in-2016/#31abd2a6f7f1</a>) reported that 43% of companies view lack of appropriate analytical skills as a key challenge connected to Internships. <a href="https://www.forbes.com/sites/louiscolumbus/2015/11/16/where-big-data-jobs-will-be-in-2016/#31abd2a6f7f1">https://www.forbes.com/sites/louiscolumbus/2015/11/16/where-big-data-jobs-will-be-in-2016/#31abd2a6f7f1</a>) reported that 43% of companies view lack of appropriate analytical skills as a key challenge connected to Internships. <a href="https://www.forbes.com/sites/louiscolumbus/2015/11/16/where-big-data-jobs-will-be-in-2016/#31abd2a6f7f1">https://www.forbes.com/sites/louiscolumbus/2015/11/16/where-big-data-jobs-will-be-in-2016/#31abd2a6f7f1</a>) reported that 43% of companies view lack of appropriate analytical skills as a key challenge connected to Internships. <a href="https://www.forbes.com/sites/louiscolumbus/2015/#16/where-big-data-jobs-will-be-in-2016/#31abd2a6f7f1">https://www.forbes.com/sites/louiscolumbus/2015/#16/where-big-data-jobs-will-be-in-2016/#31abd2a6f7f1</a>) reported that 43% o

#### B. How will students and any other affected constituencies be served by the proposed program?

The University of Montana has offered Data Analytics courses in Mathematics and Business since 2012. The demand for data scientists is expanding explosively, and in response, the University of Montana has developed a curriculum with specialized courses in data science and significant experience in teaching data science. We are proposing to build the program, increase the number of trained graduates, strengthen our relationships with local and regional businesses, and support technology-based and technology-dependent Montana businesses.

# C. What is the anticipated demand for the program? How was this determined?

The anticipated demand is expected to be 5 to 10 students in the program each year for the first 3 to 5 years and increasing thereafter to perhaps 20 per year in 10 years. These numbers were determined in light of recent graduate students that have been admitted for Autumn 2016 expressly to study data science within the Statistics program. Furthermore, enrollment in our core data science classes, M 461 (Practical Big Data Analytics) and M 462 (Theoretical Basics of Big Data Analytics and Real Time Computation Algorithms) in the current and past semesters exceeds 15 students. We expect that at least one third of these students would seriously consider pursuing a degree in Data Science if it were offered.

The second source of data supporting our projections are the MIT Sloan Management Review (<a href="http://sloanreview.mit.edu/projects/analytics-talent-dividend/">http://sloanreview.mit.edu/projects/analytics-talent-dividend/</a>) and the Burtch Works Study (<a href="http://www.burtchworks.com/big-data-analyst-salary/big-data-career-tips/the-burtch-works-study/">http://www.burtchworks.com/big-data-analyst-salary/big-data-career-tips/the-burtch-works-study/</a>). Some finding from these studies: 43% of the surveyed companies report their lack of appropriate (data) analytical skills as a key challenge. 63% of the companies provide in-house data analytic training to meet their needs. The

#### **CURRICULUM PROPOSAL FORM**

median salary for data scientists at the junior level was \$91,000 and those managing a team of ten or more data scientists earned more than \$250,000. We conclude that students are strongly motivated to pursue "the sexiest job of the 21st Century," according to the Harvard Business Review (2012). While other areas will rise in prominence and interest as time passes, data science is not a fad. As long as technology is integral to society, there will be opportunity and demand for data science and data scientists.

# 5. Process Leading to Submission

A. Describe the process of developing and approving the proposed program. Indicate, where appropriate, involvement by faculty, students, community members, potential employers, accrediting agencies, etc.

Our program in Data Analytics has been developing over the past 5 years. The Big Data Task Force (led by Nancy Hinman, then Interim Associate Provost) started the process by requesting a list of courses we already offered, and ones that could be developed, that would serve students wishing to practice data analytics as a career, or part of a career. Courses have been created with Business that address the overlap between the private sector and working mathematicians and statisticians. Key to these are the classes that merge learning statistical techniques with training in the necessary software for handling large amounts of data (more notably Hadoop), taught by Brian Steele. Leonid Kalachev worked tirelessly to develop partnerships with local high tech companies. The consulting core has worked on Data Science projects for these companies since 2011. The creation of our Master's program has proceeded as a direct offshoot of all these efforts. Our collaboration with the local companies and the Business school has given it continued momentum, along with the tacit support of the Provost's office.

In 2013 a certificate program was created in which undergraduates in Math and Business could take specialized courses to receive the certificate. In 2015, Business proposed their MS in Business Analytics, which was approved in Spring 2016. As mentioned previously, this MS is distinct from what we are proposing here, though students will share the classes in Business and in Math where appropriate. In 2015 Emily Stone was encouraged by Jenn Ewing and Lee Tangedahl to begin discussions with the Stat and Applied Math groups to create a Masters in Data Science housed in the Department of Mathematical Sciences. The matter was on the agenda of a departmental retreat in January 2016, where it received the green light from the faculty for further discussions and development. The Stat and Applied Math groups worked on the degree proposal in Spring 2016. A template was presented to the grad committee, where it was discussed and reworked. Faculty meetings were held to further refine the proposal. The faculty approved the Intent to Plan form, which was submitted to the Provost in May 2016. We received approval from the Provost's office and started work on the Curriculum Proposal form in Summer 2016.

The Data Science Initiative has had, and will continue to have, a direct impact on the economic development of Missoula and Montana. Many tech companies are locating here with an expectation that we can provide a workforce with very specialized skills. Companies that have already hired UM students include Washington Corp., ATG, CGS, LMG, Terra Echos, Upstream Research, GCS, TeraDact Solutions and Data Smart. We are involved in ongoing conversations with the UM/Private Sector Data Science Group about the design of the program. The companies in this group also include Unoceros (in Seattle), who will be hiring 5 FTE in the next six months, Consumer Direct, a self-directed care management company in Missoula, and Dolce Software, a local pre-packaged software start up. (Information provided by Jennifer Ewan, Vice President, Missoula Economic Partnership).

#### 6. Resources

A. Will additional faculty resources be required to implement this program? If yes, please describe the need and indicate the plan for meeting this need.

#### **CURRICULUM PROPOSAL FORM**

- No. We were able to hire a Statistician (in an Assistant professor position) this past academic year who will contribute to the program. As part of a spousal accommodation for another hire, we will be adding a second computational math professor in FY 2017, albeit with temporary status.
- B. Are other, additional resources required to ensure the success of the proposed program? If yes, please describe the need and indicate the plan for meeting this need.

While the program remains small (in the first 2 years) we anticipate we will be able to meet the computing needs of the students within the department with the assistance of college IT people. A more long term (but flexible) solution to large scale computing needs will be developed during those years, in collaboration with other units in the College. Funding sources for this endeavor will also be sought, through governmental agencies and with the help of the Foundation and the Missoula Economic Partnership.

We will also develop a suite of small scholarships funded by interested high tech companies to help self-funded students defray the cost of the degree. These can be one-time gifts, solicited by the Foundation that will allow companies to contribute to the program without making a long time or large commitment. For start-ups this is especially important. We also anticipate placing students in summer internships, or on projects in the Core, for which they will receive a stipend. Many of our recent graduates have had this experience, and so far two are employed full-time by the companies.

#### 7. Assessment

#### A. How will the success of the program be measured?

We will maintain a database of students that will allow us to document the number of degrees issued, the time to graduation, the size of the applicant pool, internships and projects done by the students, and job placement data. In addition we will be keeping track of the outside support students receive individually, and for the program itself. We plan to involve former students as much as possible in the program after they graduate, as advisors on methods and courses, as mentors for current students, and as contacts within the industry. Data Analytic techniques are evolving very quickly, and keeping in contact with former students will help us stay abreast of the new issues and methods.



# Date Page 1 of 3

# Montana University System

INTENT TO PLAN FORM

Program/Center/Institute Title:	Master of Science in Data Science	o de la compania del compania del compania de la compania del compania de la compania del compania de la compania de la compania de la compania de la compania del compania	
Campus, School/Department:	UM Mountain, Mathematical Sciences	Expected Submission Date:	10/1/201 6
Contact Name/Info:	Emily Stone, Chair, x5365, stone@mso.umt.edu		

To increase communication, collaboration, and problem solving opportunities throughout the MUS in the program/center/institute development process, please complete this form not more than 18 months in advance of the anticipated date of submission of the proposed program/center/institute to the Board of Regents for approval. The completed form should not be more than 2-3 pages. For more information regarding the Intent to Plan process, please visit http://mus.edu/che/arsa/preparingacademicproposals.asp.

# 1) Provide a description of the program/center/institute.

The Department of Mathematical Sciences has developed an innovative, industry-centered program to train students in data science. Our focus, which is significantly different from other Universities that also have begun data science programs, is on teaching data analytics and theory for real big data problems. Our program goes beyond mathematics/statistics and has a heavy emphasis on integrating computer science and domain-specific topics (e.g., healthcare analytics). Our goal is to produce graduates that have faced the challenges of big data with real problems and are ready to be productive employees. We propose to augment the existing program and certificate in data analytics by creating a Master's degree program in data science, housed in the department of Mathematical Sciences.

 Describe the need for the program/center/institute. Specifically, how the program/center/institute meets current student and workforce demands. (Please cite sources).

Big Data is a catch phrase of our times. But is it just a fad? We quote from a presentation at UM by Peter Coffee, VP for Strategic Research of Sales Force, a leader in cloud-computing and customer relationship management software: 'Is "Big Data" a Thing? Oh, Yeah. Health Care "We estimate that the value from data in the sector could be more than \$300 billion every year...reducing US expenditures by about 8%". Profit Sector "A retailer has the potential to increase its operating margin by more than 60%." Public Sector "In the developed economies of Europe, we estimate that government could save more than \$149 billion in operational efficiency improvements alone —not including reduction of fraud, error, and tax gaps." (McKinsey Global Institute, May 2011)' Also stated in Coffee's presentation: "It's not enough to answer questions faster: Data and algorithms must suggest them." Our specialized courses in data analytics build on core courses in statistics and computer science to gives students the techniques they will need to create, use and interpret the algorithms of data analytics.

Businesses are asking for graduates with these skills. A recent MIT Sloan Management Review survey (http://www.forbes.com/sites/gilpress/2015/04/30) reported that 43% of companies view lack of appropriate analytical skills as a key challenge connected to Internships. **Furthermore**, "There will be a shortage of talent necessary for organizations to take advantage of big data. By 2018, the United States alone could face a shortage

# Montana University System

INTENT TO PLAN FORM

of 140,000 to 190,000 people with deep analytical skills as well as 1.5 million managers and analysts with the know-how to use the analysis of big data to make effective decisions." (McKinsey Global Institute) Our program will produce the people with these ``deep analytical skills".

Locally the data science initiative has had, and will continue to have, a direct impact on the economic development of Missoula and Montana. Many tech companies are locating here with an expectation that we can provide a workforce with very specialized skills. Companies that have already hired UM students include Washington Corp., ATG, CGS, LMG, Terra Echos, TeraDact Solutions and Data Smart (citation from UM data science webpage). We are involved in ongoing conversations with the UM/Private Sector Data Science Group about the design of the program. The companies in this group also include Unoceros (in Seattle), who will be hiring 5 FTE in the next 6 months, Consumer Direct, a self-directed care management company in Missoula, and Dolce Software, a local pre-packaged software start up. (Information provided by Jennifer Ewan, Vice President, Missoula Economic Partnership).

3) Describe how the program/center/institute fits with the institutional mission, strategic plan, and existing institutional program array.

Data Science is one the five areas targeted for growth in the President's strategic plan, see Remarks for the Campus Budget Forum, dated November 17, 2015. The Dept. of Mathematical Sciences has played a pivotal role in the development of the undergraduate certificate in Big Data Analytics, which is housed in Business Management Information Systems and Mathematical Sciences. We propose to build on this curriculum to create a Master of Science degree in Data Science. The Business school has launched a Masters in Marketing Science focused on data analytics, which is geared toward Marketing and Management, with a minimal Mathematics and Statistics curriculum base. A Master of Science in Data Science, administered through Mathematical Sciences, would emphasize algorithms, data analytics (methods) and the theory supporting the algorithms and methods. The content of the coursework and expectation of the students would be much different than the Masters in Marketing Science. In collaboration with computer science, the necessary programming skills will also be developed. Projects based courses and dedicated internships would prepare these student to "hit the ground running" once on the job.

4) How does the proposed program/center/institute fit within the MUS system?

The University of Montana has offered Data Analytics courses in Mathematics and Business since 2012. Though the demand for data scientists is expanding explosively, the University of Montana is the only MUS institution with a developed curriculum and experience in teaching data science. We are proposing to build the program, increase the number of trained graduates, strengthen our relationships with local and regional businesses, and support technology-based and technology-dependent Montana businesses.

Signature/Date

College/School Dean:

**Chief Academic Officer:** 

01/2017 Submission for Action

6/4/16

Level II Memorandum

# **Montana University System**

INTENT TO PLAN FORM

6/4/16 6/26/11

**Chief Executive Officer:** 

Flagship Provost\*:

Flagship President\*:

\*Not applicable to the Community Colleges.

Date of Final Review: September 15, 2016

When submitting the proposal to the BOR, include this signed form with the Level II request.