Oregon TECH

2020-21
Program Assessment Report
Program: Data Science
Department: Applied Mathematics

*This is the first year of the data science program and therefore, there is no previous assessment activity. This report will serve as a plan and template for future year assessment activities as new courses are rolled out in the program. Not all courses will be rolled out within the first two years, so assessment plans and measures will be limited by course rollout.

Contents:

Section 1 – Program Mission and Educational Objectives

a. Program Mission:

The mission of the Bachelor of Science in Data Science program at the Oregon Institute of Technology is to prepare students for professional practice or graduate school. A graduate will be prepared with the technical skills necessary to gain actionable insights from data, the ability to effectively communicate these insights as a member of an interdisciplinary team, and the necessary foundation in ethics, mathematics, and computer science to thrive in the evolving field of data science.

Graduates are expected to be able to function as an independent data scientist at moderate sized companies or as a member of an analytics team at larger corporations. Professionally, this program will set graduates up to be life-long learners within the field of data science and data supported decision making which will allow them to gradually branch into management positions or graduate school as their career progresses.

b.) Mission Alignment:

Data science is a new and fast-growing field with roots in computer science, mathematics, statistics, geomatics and management: its applications span many other fields, including engineering, healthcare, business and various technologies. Thus a data science program aligns well with Oregon Tech's mission of providing "statewide educational opportunities for the emerging needs of Oregonians" with "innovative and rigorous applied degree programs in the areas of engineering, engineering technologies, health technologies, management, and the arts and sciences". The primary goal of a data science program should be to produce graduates who are cross trained in the foundational disciplines and who can apply these techniques to any of the fields mentioned above. This cross training spans the disciplines of management, mathematics, and engineering and will support data-driven decision making and, perhaps more importantly, to be able to design specialized solutions to data problems spanning many fields of study.

A data science program builds on Oregon Tech's signature areas of focus, including geomatics, computer science, healthcare and management. The mathematics department has a strong faculty of applied mathematicians and statisticians. Students enrolled in Oregon Tech's data science program will have the benefit of small student to faculty ratios and will be given many opportunities to learn by doing through junior and senior year projects, adding to Oregon Tech's "intimate, hands-on learning environment, focusing on application of theory to practice".

Oregon Tech's priority is to meet industry's need for skilled workers. Data science is a blossoming field with a combination of job titles and positions that these graduates could fill. Jobs range from research in science and medicine to technology jobs within companies in marketing and targeted advertising. Other jobs include self-automated learning systems (cars that drive themselves for example), governmental positions in data management and reporting. With an advanced degree, someone

trained in data science could do research in a variety of fields including statistics, business/management, survey sampling, bioinformatics, and many others.

c.) Additional Information

Outside of acting as a major with a focus on bring in new talent and students to the school, both in freshmen and transfer students, the Data science program will serve as a stop-loss program to help retain students that would have otherwise left the university when they become disenfranchised with the content of their current major programs. We expect to see, and have already seen, students from areas like Software Engineering, Business Management, and others that would have chosen to leave the school but instead have enrolled in the Data Science courses and program.

In addition, we expect to see a bilateral movement within the Data Science and Applied Mathematics majors as the goals of students future study plans may make one more appropriate than the other. For example, a student who is focused on graduate school may take advantage of the flexibility of the Applied Mathematics degree option to obtain a higher rigor of preparation in theoretical concepts while taking the Data Science courses as electives whereas students within the Applied Mathematics degree may find that they would have more choices in industry by switching to the Data Science program as they proceed through the curriculum.

Finally, students within this program will develop extensive applied data analysis and decision making skills. Our students will be able to integrate these skills with student projects throughout the university in providing support and expertise to projects in other departments such as Electrical and Renewable Energy Engineering, Environmental Sciences, Hardware, Software, and Embedded Systems Engineering, Business Management, Population Health Management, Communications, and more. This will add to the vibrancy and vitality of the university's goals in undergraduate research and external facing brand development.

Section 2 – Program Description and History

a.) Program History

Development: 2015 – 2019
Approval: Summer 2019
Inception: Fall 2020

The B.S. in Data Science program began development starting during the 2015 school year with a cross department, cross college committee striving to develop a program that would train students to be employed in the growing and somewhat newly defined field of data science. This field really encompasses three different types of jobs: data engineering, data analytics, and modeling. Our goal was to develop a program that could train students in all of these fields; however, this became a challenge as a cross college program had never really been developed at Oregon Tech up to this point. After years of effort, the program was approved in Summer of 2019 and later achieved Northwest Accreditation approval during the Winter Term of 2020. The first year of our program is the 2020/2021 school year where we began with six new students and a lot of interest from students and staff.

b.) Program Locations: Klamath Falls campus only

c.) Program Enrollment (Current and forecast/goals)

Program Headcount (All Years)					
	Observed	Forecasted			
	AY 20/21	AY 21/22	AY 22/23	AY 23/24	AY 24/25
FTE Headcount	6	10	16	30	42

d.) Program Graduates

As 2020/2021 is the first year of the program, we have no current graduates.

e.) Employment Rates and Salaries

BLS data:

BLS Data for Wages and Employment				Est	30,810 Jobs
Percentile	10%	25%	50%	75%	90%
Annual Wage	52720	70090	94280	125140	158060

OIT Placement:

No Data available as there are no graduates yet.

f.) Industry Relationships

At this point, we have no specific industry relationships. We are working on this currently.

g.) Showcase Learning Experiences

No specific projects to highlight, but curriculum highlights are as follows.

Stat 395, 396, and 397 - A Junior project sequence where students attack real world problems and build their portfolio.

Stat 495, 496, and 497 – A Senior project sequence where students work with industry partners to build solutions to real-world problems in industry.

Stat 405 – A course in current methodology that looks at cutting edge research, tools, and implementation of data science techniques that involves professional webinars and presentation skills for industrial scale projects.

h.) Success Stories:

Again, no actual graduates of this program exist yet and this is the first term of the program.

i.) Program Changes:

New Faculty:

Dr. Rosanna Overholser – Applied Mathematics - 2017

We are very luck to welcome Dr. Rosanna Overholser to our program. Her hiring allowed us to fully develop this program and gave OIT the expertise to offer several advanced courses within the data science curriculum as well as stabilizing our faculty base for the program.

Dr. Douglas Peter Overholser – Applied Mathematics - 2018

We are similarly lucky to find Dr. Douglas Peter Overholser who joins us with an active background in data science competitions and regularly places highly in many of these international challenges. His versatile and rigorous background in mathematics allows a different variety of courses to be taught than we originally had the base to provide.

Dr. Cecily Heiner – Computer Systems Technology - 2019

Dr. Heiner joins us in the CST department with a background in human computer interactions and cloud computing that will be extremely beneficial to our course offerings and study instrument design coursework.

New Courses:

STAT 201 – Fall 2020

Stat 201 is the first introductory course for data science majors that introduces the profession, workflow, and standard tools and terminology for the degree. This course also serves as an introduction to Oregon Tech for freshmen and transfer students and allows the faculty member to begin mentoring the students toward building a data science portfolio and guide their curricular pathway.

STAT 211 – Spring 2021

A second course in data science, this course takes students with a base of programming experience and moves them steadily toward functioning as a data modeler. In this course we explore everything from ethics to git environments, and professional/reproducible reporting.

STAT 441 – Winter 2021

Though technically not a new course as it has been taught as a Math 407 course for several years, this is the first course in supervised machine learning algorithms for students. This course allows a rigorous introduction to mathematical background and programming for algorithms in machine learning and feature selection methods.

New Curricular Changes: None to report, though several are being considered.

Section 3 – Program Student Learning Outcomes

A.) Educational Objectives

The following educational objectives are what faculty expects graduates to be able to accomplish a few years after the commencement of their careers and stem directly from the program mission. The alumni from the program should be:

1) prepared for the professional practice of data science or acceptance into a graduate program,
2) prepared with the necessary foundation in mathematics, statistics, and computer science in order to thrive in an evolving field,
3) able to identify and incorporate ethical considerations in their work,
4) able to identify, collect and analyze data necessary for actionable insights, and
5) able to effectively communicate findings.

B.) PSLOs: Graduates of the program will be able to:

1) translate a real world question into mathematical language.
   The ability to transform a real world problem into a strategy and metric for comparison and improvement is a critical tool for any data scientist. Direct measures of this may include the identification of a loss function which is dependent of the structure of the response variable and methodology of estimation or classification. Indirect measures will include client feedback and successful job placement as this is a standard question in all interviews for this field.

2) design an efficient and cost-effective data collection strategy.
   Big data storage and retrieval is costly in terms of both storage and processing time for both upload/download and structure processing. An efficient management of data "collection" (both from a storage and retrieval) prospective is a requirement for any data science project. Direct measures of this include assessment of database design and algorithm efficiency as assessed by projects within the coursework. Indirect measures may be obtained by considering client opinions on projects and similar input.

3) apply ethical standards necessary in data collection, analysis, and storage.
   Ethics of practice are considered in all stages of the data science workflow from data collection and storage to presentation. Direct measures of ethical standards will include specific scenario based questions and student responses to exam and assignment questions. Employer specific questionnaires and client feedback would be necessary in order to assess ethical practice.

4) construct a reproducible workflow with project documentation.
   Reproducible workflow and documentation allows for others to read a data scientists work and verify assumptions and methodology. It is part of ethics and professionalism. Direct assessment of this can be observed through project documentation.

5) design, create, and manage data storage framework.
   Database and flat file storage of data keeps a workflow consistent, cost effective and reproducible. Measurement of a student's understanding and ability can be directly measured from student project and course grades.

6) clean, impute, and structure features for modeling data.
   Direct measures of a student's ability to clean, impute, and structure data can be taken from class assignments and

7) produce sophisticated visualizations and quantitative summaries of data.
8) identify and quantify correlations and causal relations within a dataset.
9) optimize and validate predictive analytics.
10) effectively synthesize and communicate findings in written and oral reports.
11) work effectively as a member of diverse teams.

C.) Origin and External Validation:

The design of our current PSLO's came from a web scrape of hundreds of industry jobs of data science. These job postings were analyzed to see what skills and talents employers find necessary for their new employees. Furthermore, the National Academy of Sciences Report "Data Science for Undergraduate: Opportunities and Options" was reviewed and employed in order to identify these core skills. These external sources are going to be updated regularly as methodology and tools are introduced. Program student learning outcomes have not yet been reviewed by the program's industry advisory board.

Changes to these program student learning outcomes were made to include verbs used within Bloom's taxonomy which changed the style but not the substance of the student learning objectives.

Section 4 – Curriculum Map

NWCCU's standards for accreditation requires that programs must demonstrate "an appropriate breadth, depth, sequencing, and synthesis of learning" of student learning outcomes. (1.C.2)

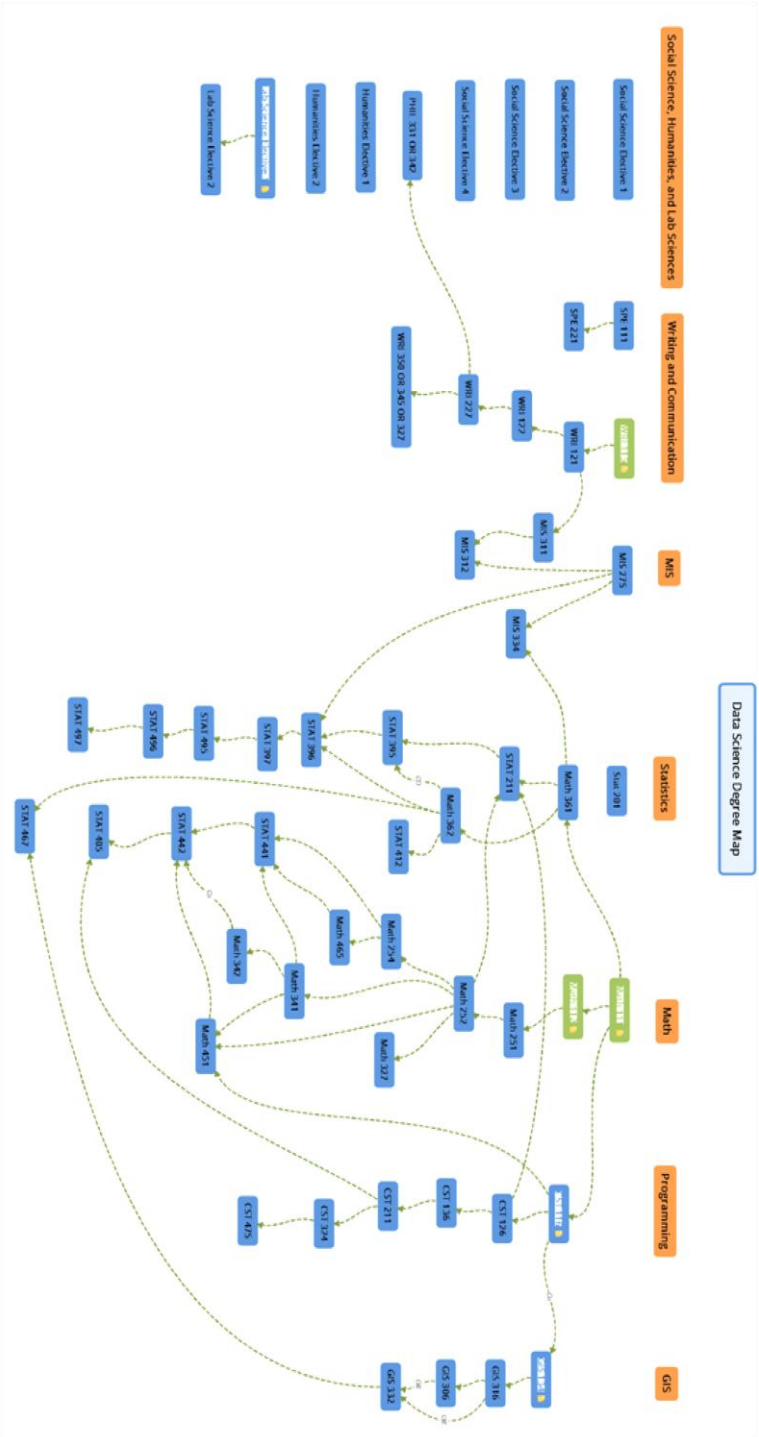
A.) Curriculum Map:

		Outcome											ESLO					
Semester	**Course**	1	2	3	4	5	6	7	8	9	10	11	Com	Team	Ethics	IA	QL	DivP
Freshmen	Social Science Elective																	F
Fall	STAT 201				F	F	F		F				F					
	WRI 121										F		F					
	Humanities Elective																	F
Freshmen	Social Science Elective																	
Winter	CST 116																	
	GIS 134							F										
	WRI 122										F		F					
	Humanities Elective																	F
Freshmen	MATH 251	F																
Spring	Social Science Elective																	
	CST 126																	
	SPE 111										F		F					
Sophomore	MATH 252	F																
Fall	Lab Science Elective										F					F		
	CST 136																	
	WRI 227										F		P					
Sophomore	MATH 254																	
Winter	MATH 361	F	F	F				F	F						F		F	
	Lab Science Elective										F					F		
	MIS 275			F		F												
Sophomore	STAT 211	P		F	F		F	F	F			F	P		F			

Spring	Social Science Elective																	
	SPE 221										P	F		F				
	CST 211				F	F												
Junior	STAT 395		P		P			P	F			P	P	P				
Fall	MATH 465	P																
	MATH 362	P						P	F	F	F						P	
	MATH 341																	
Junior	MATH 451																	
Winter	STAT 396	P	P		P				P			P	P	P				
	GIS 316																	
	STAT 441	P			P		P	P	P	F	P					P		
Junior	MATH 342																	
Spring	STAT 412	P						P	P		P						P	
	STAT 442	P			P		P		P	P	P							
	STAT 397	P			P	P	P	P	P		P	P	P	P		P		P
	MIS 311			P		P					P							
Senior	MIS 312					P												
Fall	CST 324					P												
	STAT 495	C			C		C	C	P	P		C	C				C	
	GIS 306								P									
Senior	MATH 327																	
Winter	GIS 332								C									
	STAT 496	C			C		C	C	C	C		C	C				C	
	PHIL 331			P											P			
	or																	
	PHIL 342														P			
	MIS 334					P					C							
Senior	STAT 405	C	C		C		C		C	C	C	C	C			C		
Spring	STAT 497	C	C	C	C	C	C	C	C	C	C	C	C	C	C		C	
	STAT 467	C				C		C	C	C						C		C
	WRI 350				C						C		C					
	or																	
	WRI 345				C						C		C					
	or																	
	WRI 327				C						C		C					
	CST 475		C	C		C												

Key: F = Foundation, P = Practicing, C = Capstone

B.) Prerequisite Structure Map:



C.) Course descriptions and outcome scaffolding

TBD. Course outcome documentation is being developed concurrently with course delivery. Only 2 new courses are yet to be created this year, so documentation of those courses is currently under development. Documentation of the other courses is being retrieved from departments represented in the program later this term and entering winter term. A complete course documentation will be posted to the Data Science webpage in due course.

Section 5 – Assessment Cycle

Data Science B.S. Cycle for PSLOs and ESLO's			
Outcome	2020/2021	2021/2022	2022/2023
PSLO 1	Plan	Assess	Act
PSLO 2	Plan	Assess	Act
PSLO 3	Plan	Assess	Act
PSLO 4	Plan	Assess	Act
PSLO 5		Plan	Assess
PSLO 6		Plan	Assess
PSLO 7		Plan	Assess
PSLO 8		Plan	Assess
PSLO 9			Plan
PSLO 10			Plan
PSLO 11			Plan
ESLO: Communication	Plan	Assess	Act
ESLO: Teamwork	Plan	Assess	Act
ESLO: Ethical Reasoning	Plan	Assess	Act
ESLO: Inquiry & Analysis	Assess	Act	Plan
ESLO: Quantitative Lit	Assess	Act	Plan
ESLO: Diverse Perspectives	Act	Plan	Assess

Each PSLO should be assessed with 2 direct measures and 1 indirect measure (the indirect measure is often the Student Exit Survey, which asks graduating students about each PSLO each year).

During this year, we will be planning activities for assessment in PSLO's 1 through 4 for next year.
More specific class identification and direct/indirect measures as well as instruments and scoring rubrics will be forthcoming on next year's report.

Section 6 – Assessment Activity

In this section, address the following for each assessment activity conducted during the academic year covered by the report. This section may be integrated with Section 7 (Action Plans) and 8 (Re-assessment) as appropriate:

PSLO's:

As no activities other than planning assessments for next year have yet occurred or are planned for this year for PSLO's (due to this being the first year of the program) we will be planning our assessments for PLSO's 1-4 for the next academic year during this Winter and Spring quarters.

ESLO's:

Activities for ESLO's will be carried out as follows:

- **Activity**: Quantitative Literacy and Inquiry and Analysis should be carried out this year. Acting on the Diverse Perspectives, Cultural Sensitivity, and Global Awareness is also required.

  Quantitative literacy will require that our program analyze foundation level knowledge. The QL plan is for all students in Math 361 and 243 to be given an assignment during winter term that will assess their knowledge in quantitative literacy. Our students will be assessed in Math 361, but outside of providing the assessment, there is no specific activity on the part of the teacher that is required.

  Inquiry and analysis asks us to give assignments that were previously given and make a determination of grade and changes from previous years. As the program did not exist, we will not have comparison data so this will be our baseline. As of yet, we have no information on how to implement this.

  The plan to act on Diverse Perspectives, Cultural Sensitivity, and Global Awareness requires our program to close the loop based on results from the 2016/17 year. As this report does not exist (since the program did not exist) there is no way for our program to implement improvement methods for this.

- **Rubric**: How is the activity to be scored/evaluated? Unknown

- **Sample**: For QL it is all students in Math 361. We have no idea for the other two.

- **Reliability**: QL will be scored by all faculty, but we have no baseline data to draw from yet. IA will be scored according to the faculty teaching the courses; however, more information needs to be provided to do this.

- **Performance Target**: Unknown yet as we have no baseline.

- **Performance Level**: This would apply to last year, we do not have this yet.

- **History of Results**: Cannot assess on first year of program.

- **Faculty Discussion:** Faculty will discuss planning for next year and implementing IA and QL during the end of fall and beginning of winter term as more information becomes available.

- **Interpretation**: Unknown yet as this will be our first cycle of assessment.

Section 7 – Data-driven Action Plans: Changes Resulting from Assessment

Every program should, based on assessment data, identify at least one area to focus on for improvement stemming from assessment results. Performance is below target threshold should also trigger action.

Again, we have no results for this section yet, as this is the first year of the program.

In this section, address the following for each improvement activity sparked by assessment data:

- **Action Driver:** No assessments have been conducted yet in this new program. As such, there are no plans for improvement.

- **Action Specifics:** No assessments have been conducted yet in this new program. As such, there are no plans for improvement.

- **Accountability:** No assessments have been conducted yet in this new program. As such, there are no plans for improvement.

- **Planning and Budgeting:** No assessments have been conducted yet in this new program. As such, there are no plans for improvement.

- **Improvements in Assessment Process:** No assessments have been conducted yet in this new program. As such, there are no plans for improvement.

- **Reassessment:** The cycle, as stated in section 5 dictates the re-assessment goals. This will happen sooner if more specific action is needed due to large deficiencies or particular changes within the program.

Section 8 – Closing the Loop: Evidence of Improvement in Student Learning.

NWCCU's standards for accreditation require that institutions provide evidence of "continuous improvement of student learning." (1.C.7.)

Again, we have no results for this section yet, as this is the first year of the program.

If this is an outcome being assessed following improvement activity, did you have past results from this outcome? If this is a specifically scheduled "closing the loop" assessment, how do this year's results compare with the results that prompted improvements?

Did you have past action plans? Can you say that data supports that those plans resulted in improvements?

Look backwards: Discuss the last time that outcome was assessed.

- Were changes recommended?
- Were those changes implemented?
- If so, was improvement seen?