




Executive Memorandum 23-025

September 22, 2023

From: Stephen Perez, President 

Subject: Approval of the MS in Data Science and Analytics

Upon the recommendation of the Academic Senate, with the concurrence of the Provost, and with the approval of the Chancellor's Office, I approve the new Master of Science in Data Science and Analytics within the Department of Mathematics and Statistics, College of Natural Sciences. The new degree will require 34 units, will use CSU code 17035 with a paired CIP code of 30.7001, and will be effective fall 2024.

Policy Title:	EM 23-025 MS in Data Science and Analytics
Contact:	Department of Mathematics and Statistics
Supersedes:	
Revision:	
Enabling Legislation or Executive Order:	

Sylvia A. Alva, Ph.D.

Executive Vice Chancellor

CSU Office of the Chancellor

401 Golden Shore, Long Beach, CA 90802

www.calstate.edu

June 22, 2023

Dr. Gayle Hutchinson
President
California State University, Chico
400 West First Street
Chico, California 95929

Dear President Hutchinson:

Upon the recommendation of staff within the Division of Academic and Student Affairs, I am pleased to grant approval for California State University, Chico to offer the state-support Master of Science degree program in Data Science and Analytics, effective fall 2024. This program appears on the Academic Master Plan as approved by the California State University Board of Trustees, and you have provided information indicating that faculty, physical facilities and library holdings sufficient to establish and maintain this program currently exist or are expected to become available. Program approval is conditional on the continued existence of these resources.

If the program is not implemented by 2029, the university is required to submit to the Chancellor's Office an updated program proposal for review. In accordance with board policy, performance review of this degree program should be scheduled to occur within five years of program implementation. The program has been assigned the CSU degree-program code 17035, and the CIP code is 30.7001. The university is responsible for adding this degree program to the CSU Degrees Database prior to their implementation and to the Campus Academic Plan. A change in support mode or location would require Chancellor's Office review and approval.

My appreciation is extended to you and your team for continuing to develop and adapt university programs to meet the evolving needs of our students and our state. Thank you.

Sincerely,



Sylvia A. Alva, Ph.D.

Executive Vice Chancellor

Academic and Student Affairs

SAA/ci

CSU Campuses

Bakersfield
Channel Islands
Chico
Dominguez Hills
East Bay

Fresno
Fullerton
Humboldt
Long Beach
Los Angeles
Maritime Academy

Monterey Bay
Northridge
Pomona
Sacramento
San Bernardino
San Diego

San Francisco
San José
San Luis Obispo
San Marcos
Sonoma
Stanislaus

Chico State – MS in Data Science and Analytics

June 22, 2023

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- c: Stephen Perez, Interim Provost and Vice President for Academic Affairs
- Daniel Grassian, Vice Provost for Academic Programs
- Sharon Barrios, Dean of Graduate Studies

New Graduate Degree Program

Program Name: MS in Data Science and Analytics

Department Contact(s) w/phone #(s):

Nicholas Lytal (916) 849-4151

Robin Donatello (530) 898-5767

Required Signatures

The Department of Mathematics and Statistics
has reviewed and approved this new degree program

Nicholas Lytal
Chair, Department Curriculum Committee

1/31/23
Date

Kevin McGown
Department Chair

2/14/23
Date

The College of Natural Sciences
has reviewed and approved this new degree program

Jinsong Zhang
Chair, College Curriculum Committee

Mar 10, 2023
Date

David M. Hassenzahl
College Dean

Mar 14, 2023
Date

The Graduate Council has reviewed and approved this new degree program

Sharon Buppis
Dean of Graduate Studies

3/28/2023
Date

Send signature page with proposal attached to Curriculum Services at zip 128

Curriculum Review Completed

4/4/2023
Date

Ki Col Gray

**California State University
Degree Program Proposal Template
Revised April 2022**

- Approved degree programs will be subject to campus program review within five years after implementation. Program review should follow system and Board of Trustee guidelines (including engaging outside evaluators) and should not rely solely on accreditation review.
 - *Please refer to the document “Tips for Completing a Successful Program Proposal” before completing the Program Proposal Template.*
-

1. Program Type (Select all that apply)

- a. New Program (previously authorized as a projection by the BOT)
- b. Fast Track (bachelor’s or master’s only; not already on Campus Academic Plan)
- c. State-Support
- d. [Self-Support](#)
- e. Delivery Format:
 - Fully face to face
 - Hybrid
 - Fully online

2. Program Identification

- a. Campus
Chico State
- b. Full and exact degree designation and title (e.g., Master of Science in Genetic Counseling, Bachelor of Arts in History).
Master of Science in Data Science and Analytics
- c. Date the Board of Trustees approved adding this program projection to the Campus Academic Plan.
March 22, 2022
- d. Term and academic year of intended implementation (e.g., fall 2024).

Fall 2024

- e. Total number of units required for graduation. This will include all requirements (General Education and campus-specific graduation requirements), not just major requirements.

34

- f. Name of the department(s), division, or other unit of the campus that would offer the proposed degree program. Please identify the unit that will have primary responsibility.

Department of Mathematics and Statistics

- g. Name, title, and rank of the individual(s) primarily responsible for drafting the proposed degree program.

- *Nick Lytal, Assistant Professor*
- *Robin Donatello, Associate Professor*

- h. Statement from the appropriate campus administrative authority that the addition of this program supports the campus mission and will not impede the successful operation and growth of existing academic programs.

The following statement regarding the addition of this program is from Daniel Grassian, Vice Provost for Academic Affairs:

“As our mission states, Chico State considers itself to be “the comprehensive university of the North State with a global reach.” The mission also states that “through excellence of inquiry, innovation, and experiential learning, we develop students who are critical thinkers, responsible citizens, diverse leaders, and inspired stewards of environmental, social, and economic resources.”

The proposed Master’s program in Data Science and Analytics supports our campus mission in multiple ways. First, the very nature of Data Science and Analytics programs is to empower students with the tools and critical thinking skills needed in order to inquire, innovate, and become “inspired stewards of environmental, social, and economic resources.” In order to understand how to use these resources in the most effective and inclusive manner possible, we need to be able to analyze and utilize data, and this proposed program intends to teach its students precisely how to do that.

As the program proposal details, despite clear market need for professionals with a background in data science and analytics, there are very few analogous programs in the CSU system. Further, this degree would be the first of its kind in the North State and would provide a rigorous course of study leading to strong career possibilities for students in our service region (and beyond).

Also as detailed elsewhere in this proposal, this MS in Data Science and Analytics will have strong components and implications in the areas of diversity, inclusion, and equity. The program will empower students to use data in order to determine whether there is equity and inclusion in an organization or activity. More specifically, the program will include learning objectives that ensure the ethical use of data, including data security, consent, accountability, and algorithm fairness and equity. In this way, the program also relates to the university mission of helping produce “responsible citizens.” The program would also encourage and increase “critical thinking” by showing students how to uncover insight from data, build models that relate actions to consequences that lead to quality decisions and better outcomes in shorter times.

This program would not impede any other existing programs and, given its interdisciplinary nature, it could actually provide additional graduate paths for students in different fields such as nutrition, agriculture, bioinformatics, journalism, computer science, business, and political science. Further, this Master's degree could be blended with existing bachelor's programs in all of these areas (and beyond) as joint/accelerated bachelor's/master's programs.

The MS in in Data Science and Analytics at Chico State will provide students with an important, rigorous course of study that can and will lead to productive and needed careers in the North State, California, nationwide, and beyond."

- i. Any other campus approval documents that may apply (e.g., curriculum committee approvals).

Approval page with signatures is attached (page 1).

- j. Substantive Change Screening Form:

The [WASC Senior College and University Commission \(WSCUC\)](#) requires that the campus Accreditation Liaison Officer submit a Substantive Change Screening Form via the Accreditation Management portal for any proposed degree program. If it is determined that no substantive change review is required, please attach a separate document containing the email response from WSCUC.

See page 22, WSCUC Approval. No substantive change review required.

- k. Proposed Classification of Instructional Programs (CIP) and CSU Degree Program Code.

CSU Degree Program Code: 17035

CIP code: 30.7001

3. Program Overview and Rationale

- a. Provide a brief descriptive overview of the program citing its 1) purpose and strengths, 2) fit with the institutional mission or institutional learning outcomes and 3) the compelling reasons for offering the program at this time.

PURPOSE AND STRENGTHS

The purpose of this proposal is to develop a Master of Science degree program in Data Science and Analytics (MSDSA), with a track in Applied Analytics and a track in Machine Learning.

The emerging Data Science/Analytics field is described by the National Academies of Sciences, Engineering, and Medicine (NASEM) as the application of data collection, storage, integration, analysis, statistical inference, communication, and ethical principles. (NASEM, 2018)

Thus, Data Science is a multi-disciplinary field that uses scientific methods, processes, algorithms and systems to extract knowledge and insights from structured and unstructured data. Being able to collect, prepare, and analyze data to inform high level decisions is critical in our current global society, both for social and scientific benefit. Companies are increasingly putting data at the center stage in their strategic priorities, including Chico State.

Both areas of Data Science and Data Analytics help to uncover insight from data, build models that relate actions to consequences that can lead to quality decisions and better outcomes in shorter times. Students studying in this field integrate multidisciplinary knowledge to engage in practical data analytics projects, from analyzing requirements to managing data, building models, presenting results, and assessing societal impacts of recommendations generated using data.

Students will have two tracks to choose from. The Applied Analytics can be thought of as a “breadth” or “applied track”, where the focus is for students to collaborate closely with researchers or companies in a domain specific field. Students in this track could be employed in positions where they are the “data person” on a team.

A second track in Machine Learning will be offered for students who want to further explore the mathematical and computational underpinnings of the statistical, machine learning and artificial intelligence models being used, including the computational infrastructure that supports big data analysis and cloud computing.

Leveraging their more technical backgrounds students in this track will learn how to develop, implement, and integrate algorithmic solutions using massive amounts of data based on artificial intelligence, machine learning, or statistical analysis methods.

By offering a MS in data science and analytics with both an applied “breadth” track and a more targeted “depth” track with a strong overlap in core concepts and classes, we will be able to recruit from a broad range of majors and domain interests such as nutrition, agriculture, bioinformatics, journalism, political science and even the digital humanities. Students with backgrounds in technical areas such as mathematics, statistics, or computer science, the machine learning track will provide deeper and more technical training that would prepare them for high paying jobs in tech.

PROGRAM’S FIT WITH THE CAMPUS MISSION AND STRATEGIC PLAN

Mission: Chico State is the comprehensive university of the North State with a global reach.

Through excellence of inquiry, innovation, and experiential learning, we develop students who are critical thinkers, responsible citizens, diverse leaders, and inspired stewards of environmental, social, and economic resources. Data science programs are few and far between within the CSU system despite the need and number of careers available at the local, state, national and international levels. This competitive and practical skill-based degree will become the first in the North State and will help ensure continued enrollment long term.

Similar to the campus mission and strategic priorities, this data science degree will honor equity and inclusion. Data are a form of power and can be used to advance others in an ethical and inequitable manner. This proposed program will include learning objectives that ensure the ethical use of data, including data security, consent, accountability, and algorithm fairness and equity. In the program, students will address real-world examples using data through interdisciplinary experiences. Several grant-funded efforts are already working to create an

applied data science internship. These internship outcomes were proposed to create equitable and accessible experiential learning in the data science and analytics space. Furthermore, this multidisciplinary degree will develop students' abilities to think in terms of systems and interrelationships within complex organizations.

- b. Provide the proposed catalog description. The description should include:
- i. a narrative description of the program
 - ii. admission requirements
 - iii. a list of all required courses for graduation including electives, specifying course numbers, course titles, prerequisites or co-requisites (ensuring there are no “hidden prerequisites” that would drive the total units required to graduate beyond the total reported in 2e above), course unit requirements, and any units associated with demonstration of proficiency beyond what is included in university admission criteria.
 - iv. total units required to complete the degree
 - v. if a master's degree, catalog copy describing the culminating experience requirement(s)

See page 23, Catalog Description.

4. Curriculum – (These requirements conform to the WSCUC 2013 Handbook of Accreditation)

a. These program proposal elements are required:

- Institutional learning outcomes (ILOs)
- Program learning outcomes (PLOs)
- Student learning outcomes (SLOs)

Describe outcomes for the 1) institution, 2) program and for 3) student learning. Institutional learning outcomes (ILOs) typically highlight the general knowledge, skills, and dispositions all students are expected to have upon graduating from an institution of higher learning. Program learning outcomes (PLOs) highlight the knowledge, skills, and dispositions students are expected to know as graduates from a specific program. PLOs are more narrowly focused than ILOs. Student learning outcomes (SLOs) clearly convey the specific and measurable knowledge, skills, and/or behaviors expected and guide the type of assessments to be used to determine if the desired the level of learning has been achieved. (WASC 2013 CFR: 1.1, 1.2, 2.3)

The following learning objectives satisfy both [CAC and ANSAC accreditation](#) requirements currently being proposed for data science and analytics degree programs. Once these accreditation bodies are formalized we plan to pursue external accreditation.

Institutional Learning Outcomes (ILOs)

There are no graduate level Institutional learning outcomes at Chico State.

Program Learning Outcomes (PLOs)

1. *Subject Matter Knowledge*: Candidates demonstrate solid knowledge in subject matter with the ability and commitment to keeping current with the field.
2. *Professional Practice*: Candidates demonstrate solid ability to use appropriate tools with the ability and commitment to keep current with new tools and technologies.
3. *Collaboration*: Candidates actively engage in collaborative work within and across teams, demonstrating effective communication as subject/tool based experts on that team.
4. *Ethics, Privacy and Security*: Candidates promote practices that support the ethical uses of data and algorithms and implement appropriate measures to ensure data privacy and security.

Student Learning Outcomes (SLOs)

1. *An understanding of the fundamental lifecycle of data. (PLO 1)*
2. *Effectively communicate results and recommendations using appropriate data products. (PLO 2, 3)*
3. *Analyze critically and recognize professional responsibility to ensure data privacy, security, governance, and algorithmic fairness. (PLO 2, 4)*
4. *Demonstrate professionalism and a commitment to lifelong learning. (PLO 1, 2, 3)*
5. *Proficiency in the fundamental core areas of Statistics, Mathematics, and Computing. (PLO 1, 2)*
6. *Demonstrate functional understanding of data applications in a topic domain. (PLO 1) (AA track)*
7. *Apply theory, techniques, and tools to devise and implement appropriate solutions in a relevant domain. (PLO 2, 3, 4) (AA track)*
8. *Design and implement solutions using big data based on artificial-intelligence, machine-learning, or statistical-analysis methods. (PLO 1, 3, 4) (ML track)*
9. *Apply software development methodologies to create efficient, well-structured applications that other programmers can easily understand. (PLO 2, 3, 4) (ML track)*
10. *Design, implement, test, and debug extensible and modular programs. (PLO 2, 3, 4) (ML track)*

b. These program proposal elements are required:

- Comprehensive Assessment Plan addressing all assessment elements

Key to program planning is creating a comprehensive assessment plan addressing multiple elements, including a strategy and tool to assess each student learning outcome. SLOs operationalize the PLOs and serve as the basis for assessing student learning in the major. Constructing an assessment matrix, showing the relationship between all assessment elements, is an efficient and clear method of displaying all assessment plan components.

Since many of the courses included in this degree do not currently exist, we list below a draft of an assessment plan that can be put into place, with revisions and clearly identified assessment tools, once the classes exist. Details on the specific assessment tool used to measure outcome success, and how data and findings will be

quantitatively or qualitatively reported (h) will be developed once the courses are offered.

The designated personnel to collect, analyze and interpret student learning outcome data (i) will be a collaboration between the department assessment committee and the graduate program advisor. This team will also determine the appropriate dissemination schedule (j), with a minimum of annual reports for SLO's that are assessed that year. Based on findings, faculty will revisit credential or graduate courses to ensure all SLOs are being addressed (k).

<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>	<i>g</i>
PLOs	SLOs	Course where each SLO is assessed	Assessment activity/ assignment used to measure each SLO	Assessment tool used to measure outcome success	Assessment schedule – how often SLOs will be assessed
1	1	MATH 456	Final exam	Final exam	Middle of program
2,3	2	ERTH 600	Literature review paper	Paper rubric	Early in program
2,4	3	MATH 485	Final exam	Final exam	Middle of program
1,2,3	4	MATH/CSCI 500	Student generated topic presentation	Presentation rubric	Early-middle in program
1,2	5	MATH/CSCI 699P	Culminating project report and presentation	Rubric similar to the BIOL example page 34.	End of Program
1	6	MATH/CSCI 697P	Project proposal	Rubric similar to the BIOL example page 34.	Annually
2,3,4	7	MATH 589	Consulting summary/report	Consulting summary/report	Middle of program
1,3,4	8	MATH 644	Final project	Final exam or project	Middle of program
2,3,4	9	MATH 611	Final exam or project	Final exam or project	Middle-end of program
2,3,4	10	MATH 644	Final project	Final exam or project	Middle-end of program

- Matrix showing where student learning outcomes are introduced (I), developed (D), and mastered (M)

Creating a curriculum map matrix, identifying the student learning outcomes, the courses where they are found, and where content is “introduced,” “developed,” and “mastered” ensures that all student learning outcomes are directly related to overall program goals and represented across the curriculum at the appropriate times. Assessment of outcomes is expected to be carried out systematically according to an established schedule, generally every five years.

	SLO 1	SLO 2	SLO 3	SLO 4	SLO 5	SLO 6	SLO 7	SLO 8	SLO 9	SLO 10
MATH 615	I				I		I			
MATH/CSCI 608	I		I			I	I			
CSCI 605					I			I	I	I
ERTH 600		I								
MATH 456	D				D					
MATH/CSCI 485	D		D	I	D			D		
MATH/CSCI 500		I, D	I	D, M						
MATH 650					I			I		
MATH 589	M	I, D				I	D			
CSCI 611					M			D	M	
CSCI 644								D	D	D
Domain Elective		I				D	D			
MATH/CSCI 697/699P	M	M	M		M	M	M	M	M	M

c. Indicate total number of units required for graduation.

Reference item 2e: 34 units

d. Include a justification for any baccalaureate program that requires more than 120-semester units or 180-quarter units. Programs proposed at more than 120 semester units will have to provide either a Title 5 justification for the higher units or a campus-approved request for an exception to the Title 5 unit limit for this kind of baccalaureate program.

Not Applicable

e. If any formal options, emphases or concentrations are planned under the proposed major, identify and list the required courses. Optional: You may propose a CSU degree program code and CIP code for each concentration that you would like to report separately from the major program.

Core Required Coursework (25 Units)

Course	Title	Units
ERTH 600	Graduate Seminar I	1
MATH/CSCI 500	Data Science Seminar (one unit course taken twice)	2
MATH 456	Applied Statistics II	3
CSCI 605	Data Structures and Algorithms for Data Science	3
MATH/CSCI 608	Data Science for Graduate Studies	3
MATH 615	Data Analysis for Graduate Research	3
MATH/CSCI 485	Advanced Topics in Data Science	3
MATH 650	Probability and Statistics	3
MATH/CSCI 697	Masters Project Preparation	1
MATH/CSCI 699P	Masters Project	3

The Applied Analytics Track (9 units)

Course	Title	Units
MATH 589	Statistics and Data Science Consulting	3
	2 Domain Electives (600 level)	6

The Machine Learning Track (9 units)

Course	Title	Units
CSCI 644	DevOps Engineering	3
CSCI 611	Applied Machine Learning	3
	1 Computer Science Elective (500/600 level)	3

- f. List any new courses that are: (1) needed to initiate the program or (2) needed during the first two years after implementation. Include proposed catalog descriptions for new courses.

All course descriptions for new courses can be found in Catalog Description

(1) needed to initiate the program

- CSCI 130: Introduction to Python
- MATH/CSCI 500: Graduate Seminar
- CSCI 605: Data Structures and Algorithms for Data Science
- MATH/CSCI 608: Data Science for Graduate Studies
-

(2) needed during the first two years after implementation.

- MATH 589: Statistics and Data Science Consulting
- CSCI 644: DevOps Engineering

- g. Attach a proposed course-offering plan for the first three years of program implementation, indicating likely faculty teaching assignments. (WASC 2013 CFR: 2.2b)

Course	Units	F24	S25	F25	S26	F26	S27
ERTH 600	1	ERTH		ERTH		ERTH	
MATH 456	3		NL		NL		NL
MATH 589	2			RAD	JG	RAD	JG
MATH 615	3	RAD		JG		RAD	
MATH 650	3			ER		ER	
CSCI 605	3	CS		CS		CS	
CSCI 611	3			CT	CS	CS	CT
CSCI 644	3				CS		CS
MATH/CSCI 500	1		RAD		RAD		JG
MATH/CSCI 485	3		JG		CT		KG
MATH/CSCI 608	3	CT		KG		CT	
MATH/CSCI 697	1			RAD		CS	
MATH/CSCI 699P	3				RAD		CS
ER: Edward Roualdes (MATH)		JG: Jane Guo (MATH)					
KG: Kathy Gray (MATH)							
RAD: Robin Donatello (MATH)		CT: Carter Tillquist (CSCI)					
NL: Nick Lytal (MATH)		CS: Other CSCI Faculty e.g. (Abbas Attarwala, Kun Tian)					
ERTH: Faculty from Environmental and Earth Science (e.g. Kristen Kaczynski)							

- h. For master's degree proposals, include evidence that program requirements conform to the minimum requirements for the culminating experience, as specified in Section 40510 of Title 5 of the California Code of Regulations.

Title V, section 40510 requires that the graduate culminating activity be a thesis, project, or exam; this program requires a project and conforms with the requirements of Title V.

- i. For graduate degree proposals, cite the corresponding bachelor's program and specify whether it is (a) subject to accreditation and (b) currently accredited. (WASC 2013 CFR: 2.2b)

No current accreditation exists for undergraduate programs in Data Science. The Computing Accreditation Commission (CAC) and Computing Area Delegation (CAD) of ABET approved criteria for accrediting undergraduate data science programs under CAC in summer 2021 [\[link\]](#).

- j. For graduate degree programs, specify admission criteria, including any prerequisite coursework. (WASC 2013 CFR: 2.2b)

Students can be admitted in either classified or conditionally classified standing.

Prerequisites for Admission to Conditionally Classified Status

1. *Meet all of the Graduate Studies requirements as specified in [Graduate and Postbaccalaureate Admission Requirements](#) in the University Catalog.*
2. *Submission of all attachments required by the application.*
3. *Approval by the Department of Mathematics and Statistics, and the Office of Graduate Studies.*
4. *Completion of background preparation in the following areas. Equivalent courses at Chico State courses are listed.*
 - a. *Introductory Statistics (MATH 105)*
 - b. *Calculus I (MATH 109 or MATH 120)*

Proficiency in the above areas is most often demonstrated through completion of prerequisite coursework with a C or better within the prior five years. A waiver of prerequisites may be available, subject to approval by the Graduate Coordinator.

Prerequisites for Admission to Classified Status

In addition to the above minimum requirements for admission, students who have the following additional background knowledges will be at an advantage both as to selection for admission to the program and optimal progress toward the degree if admitted.

1. *Calculus II (MATH 121)*
2. *Upper division Applied Statistics (MATH 315)*
3. *Introductory level in both Python (CSCI 130) and R (Math 130)*

Prerequisite courses taken for the purpose of advancement to classified status will not be used towards the MS degree.

- k. For graduate degree programs, specify criteria for student continuation in the program.

Students must maintain continuous enrollment and good academic standing as specified in the [Graduate Education Policies](#).

Declaring a Track

Students are expected to declare their intended track (AA or ML) with the Graduate Coordinator by the end of their second semester. The same policies guiding the MSDSA degree apply to both tracks. Students must hold classified graduate standing before declaring their intent.

To declare their intent for the ML track students must have completed additional background preparation coursework at a C or better:

- 1. Multivariable Calculus (MATH 220)*
- 2. Linear Algebra (MATH 235)*
- 3. Advanced Object-oriented programming (CSCI 211)*

Advancement to Candidacy

To advance to candidacy students must have completed the following:

- 1. Completion of the Graduate Requirement in Writing Proficiency (ERTH 600 and CSCI/MATH 500).*
 - 2. Have completed 18 units from the graduate core courses (first year courses)*
 - 3. Have a declared track*
 - 4. Establishment of a Graduate Advisory Committee.*
 - 5. Submission of an Approved Program Plan for both coursework and culminating activity developed in consultation with the Graduate Coordinator.*
-
- 1. For undergraduate programs, specify planned provisions for articulation of the proposed major with community college programs.*

Not Applicable

- m. Roadmaps. Provide an appropriate year major roadmap for master's degree programs that outlines the suggested coursework students should complete each semester.*

To account for both full-time and part-time graduate students, we offer both a two-year and a three-year plan for completing either track of the MSDSA degree.

Two-Year Plan

COMMON CORE			
Fall 1	10	Spring 1	8
<u>ERTH 600 Graduate Seminar I</u>	<u>1</u>	<u>MATH/CSCI 485 Advanced Topics in Data Science</u>	<u>3</u>
<u>MATH/CSCI 608 Data Science for Graduate Studies</u>	<u>3</u>	<u>MATH 456 Applied Statistics II</u>	<u>3</u>
<u>MATH 615 Data Analysis for Graduate Research</u>	<u>3</u>	<u>MATH 500 Data Science Seminar</u>	<u>1</u>
<u>CSCI 605 Data Structures and Algorithms for Data Science</u>	<u>3</u>	<u>MATH/CSCI 699P Master's Project</u>	<u>1</u>
APPLIED ANALYTICS			
Fall 2	9	Spring 2	7
<u>MATH 650 Probability and Statistics</u>	<u>3</u>	<u>MATH/CSCI 500 Data Science Seminar</u>	<u>1</u>
<u>MATH 589 Statistics and Data Science Consulting</u>	<u>3</u>	<u>MATH/CSCI 699P Master's Project</u>	<u>3</u>
<u>Domain Elective 600 level</u>	<u>3</u>	<u>Domain Elective 600 level</u>	<u>3</u>
MACHINE LEARNING			
Fall 2	9	Spring 2	7
<u>MATH 650 Probability and Statistics</u>	<u>3</u>	<u>MATH 500 Data Science Seminar</u>	<u>1</u>
<u>CSCI 644 DevOps Engineering</u>	<u>3</u>	<u>MATH/CSCI 699P Master's Project</u>	<u>3</u>
<u>Computer Science Elective 500/600 level</u>	<u>3</u>	<u>CSCI 611 Applied Machine Learning</u>	<u>3</u>

APPLIED ANALYTICS			
Fall 1	6	Spring 1	6
MATH/CSCI 608 Data Science for Graduate Studies	3	MATH/CSCI 485 Advanced Topics in Data Science	3
MATH 615 Data Analysis for Graduate Research	3	MATH 456 Applied Statistics II	3
Fall 2	7	Spring 2	5
CSCI 605 Data Structures and Algorithms for Data Science	3	MATH 500 Data Science Seminar	1
MATH 650 Probability and Statistics	3	MATH/CSCI 699P Master's Project	1
ERTH 600 Graduate Seminar I	1	Domain Elective 600 level	3
Fall 3	6	Spring 3	4
MATH 589 Statistics and Data Science Consulting	3	MATH 500 Data Science Seminar	1
Domain Elective 600 level	3	MATH/CSCI 699P Master's Project	3

MACHINE LEARNING			
Fall 1	6	Spring 1	6
MATH/CSCI 608 Data Science for Graduate Studies	3	MATH/CSCI 485 Advanced Topics in Data Science	3
MATH 615 Data Analysis for Graduate Research	3	MATH 456 Applied Statistics II	3
Fall 2	7	Spring 2	5
CSCI 605 Data Structures and Algorithms for Data Science	3	CSCI 611 Applied Machine Learning	3
MATH 650 Probability and Statistics	3	MATH 500 Data Science Seminar	1
ERTH 600 Graduate Seminar I	1	MATH/CSCI 699P Master's Project	1
Fall 3	6	Spring 3	4
CSCI 644 DevOps Engineering	3	MATH 500 Data Science Seminar	1
Computer Science Elective 500/600 level	3	MATH/CSCI 699P Master's Project	3

- n. Describe how accreditation requirements will be met, if applicable, and anticipated date of accreditation request (including the WASC Substantive Change process).

No current accreditation programs exist for Masters programs in Data Science. The Computing Accreditation Commission (CAC) and Computing Area Delegation (CAD) of ABET approved criteria for accrediting undergraduate data science programs under CAC in summer 2021 [[link](#)].

5. Societal and Public Need for the Proposed Degree Program

- a. List other California State University campuses currently offering or projecting the proposed degree program; list neighboring institutions, public and private, currently offering the proposed degree program.

*[CSU San Jose](#) - MS in Data Science, MS in Data Analytics; Offered by Dept of Statistics.
[CSU Fullerton](#) - MS in Information Technology; tracks for Data Science and IT Management
[CSU Sacramento](#) - MS in Business Analytics; Offered by College of Business*

[CSU Pomona](#) - MS in Business Analytics; Offered by College of Professional and Global Education

[CSU San Francisco](#) – MS in Statistical Data Science; Offered by College of Science and Engineering

[CSU San Diego](#) - MS in Big Data Analytics; Offered by College of Arts & Letters

[CSU East Bay](#) – MS in Business Analytics; Offered by College of Business & Economics

[UC Riverside](#) - MS in Engineering, Data Science specialization; Offered online by College of Engineering

[UC San Diego](#) - MS in Data Science; Offered online by School of Engineering

[UC Berkeley](#) - MS in Information and Data Science; Offered online

b. Describe differences between the proposed program and programs listed in Section 5a above.

There are three fundamental or traditional domains that equally contribute to the field of Data Science & Analytics: Statistics & Mathematics, Computer Science, and a Domain understanding. This third field could be considered an “application” field. The field of Data Science & Analytics is relatively new as an academic discipline, and so degree programs are often tailored to the school or college that is offering the program. For example, a Business school will offer a degree in Data Analytics, or Business Analytics with learning objectives about how to collect, process, model, and communicate business decisions. Whereas a Computer Science or Mathematics department that has an existing theoretical graduate program may offer a Big Data or Data Science degree that would focus on the underlying data engineering aspects (how to collect, organize and process massive data sets), or the mathematical efficiencies (how to use new computational tools to improve statistical techniques to model more challenging problems).



Out of the 23 CSU campuses, only CSU, San Jose offers face-to-face state supported MS degrees in Data Science and a MS in Data Analytics. Five CSU campuses have MS degrees in Business Analytics, however the focus on business and use of business software is narrower in scope for careers in data science. Currently, CSU Cal Poly is building an

undergrad Data Science program and CSU Sacramento is building a Statistics program, but no other such programs exist in the north state, making the proposed program the first of its kind in the region. The proposed MSDSA will support bachelor's-prepared graduates from all disciplines who collect or have access to their area-specified data but do not have the education or skills to manage, clean, or visualize the data in real time for reporting and/or dissemination. Data science education requires a great deal on hands-on support and guidance from instructors and insight into the practical application. Currently, undergraduate students from multiple disciplines are interning in data science with the limited support of faculty. In order to support this broader campus need, the proposed program will include a student internship training lab for sustained peer to peer mentorship between the graduate and undergraduate students. This mentorship of undergraduate students and use of data in this internship will provide additional communication skills needed in careers with data science teams.

- c. List other curricula currently offered by the campus that are closely related to the proposed program.

The closest related program would be the Undergraduate Certificate in Data Science. There are no closely related graduate programs, however there are a few courses in MATH, CSCI and BSIS that are directly related to this program. These relevant courses are either listed as either required or elective courses for this program.

- d. Describe community participation, if any, in the planning process. This may include prospective employers of graduates.

During summer 2021, Dr. Donatello participated in a Faculty Fellow program at Microsoft, shadowing and learning from their Bing Ads Data Science team. One of the key takeaways from this experience was an understanding of the tools, knowledges and experiences they are looking for in new graduates. Additionally, ongoing conversations with the Butte County Local Food Network and tech supporter Chico Start may provide student project collaborations.

- e. Provide applicable workforce demand projections and other relevant data.

Emsi data (a hybrid dataset derived from official government sources such as the US Census Bureau, Bureau of Economic Analysis, and Bureau of Labor Statistics) reveal 1,158,178 jobs in California in occupations requiring data analysis and data science skills including Database Administrators and Architects, Statisticians, Financial and Investment Analysts, Accountants and Auditors, General and Operations Managers, Computer Systems Analysts, Market Research Analysts, and Project Management Specialists.

A total of 905,994 unique jobs were posted for these occupations between January 2020 and August 2021 in a four state area that includes California, Arizona, Nevada, and Washington. Those jobs were posted by 47,832 employers, such as Oracle, Amazon, Robert Half International, Anthem, Deloitte LLP., and Microsoft.

BLS data indicate above average growth in occupations that require data analysis and data science knowledge and skills between now and 2030.

Operations Research: 25%

Market Research Analysts: 22%

Management Analysts: 14%

Database Administrators and Architects: 8%

Note: Data Sources for Demonstrating Evidence of Need

[US Department of Labor, Bureau of Labor Statistics](#)

[California Labor Market Information](#)

6. Student Demand

- a. Provide compelling evidence of student interest in enrolling in the proposed program. Types of evidence vary and may include national, statewide, and professional employment forecasts and surveys; petitions; lists of related associate degree programs at feeder community colleges; reports from community college transfer centers; and enrollments from feeder baccalaureate programs.

Our evidence of student interest comes from three main places: 1) a market assessment by Everspring, 2) conversations with international recruiters, and 3) national trends in new Data Science Masters programs being developed.

- 1) *In 2021 PCE contracted Everspring to conduct a market assessment for potential new masters programs for Chico State to consider. Excerpts from the report are shown below.*

“Further developing its graduate business portfolio with an online Master’s degree in Finance/Financial Mathematics, Digital Marketing, or Data Science/Analytics will attract a larger pool of applicants for Chico and solidify its standing as a forward-thinking institution. As such, these two roles are expected to grow at a 19 and 14 percent rate, respectively, with above-market compensation (Mean Salaries in 2019 of \$147,530 and \$95,560, respectively).

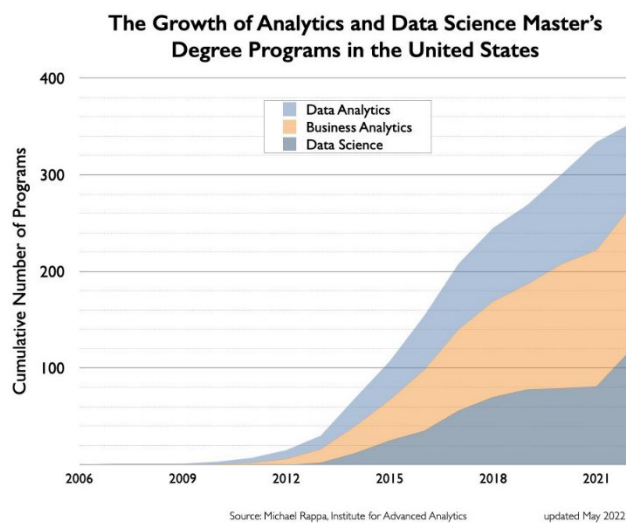
Our analysis of the Education and Labor market data available demonstrates that current and projected demand for healthcare, analytics, and “digital” technology occupations in the workplace is driving growth in Master’s degree completions in related disciplines. Recent job market data suggest that many of these education and labor trends will further be accelerated by the effects of the pandemic. In general, growth in emerging health, technology and analytical disciplines—including Nursing, Healthcare Informatics, Computer Science, and Data/Information Science—is outpacing growth in traditional disciplines such as Social Sciences and Education. Chico’s opportunity will be to align its portfolio and brand with key market growth drivers while continuing to maintain and grow its share in traditional areas of strength. The following summary table charts Chico’s online graduate portfolio by national completion volume, educational growth, and occupational demand. Programs are sorted by our recommended order of prioritization.”

Figure 36 Program Prioritization and Opportunity Set, Master's Level

Tier	Discipline	Chico 2019 Completions	Additional Completions at 75 th tile	Additional Completions at 90 th tile	Everspring enrollment for market-responsive program
Target	Speech-Language Pathology	23	17	26	75-150
	Social Work	37	92	203	200-400
	Computer Science	1	47	139	100-200
	Information/Data Science	N/A	66	146	75-150
	Nurse Practitioner	N/A	53	138	75-150
	Healthcare Management/Informatics	N/A	22	35	50-100
	Financial Mathematics	N/A	79	124	50-100
	Public Health	N/A	54	101	100-200
	Digital Marketing	N/A	30	53	50-100
Estimated Additional Completions at the Next Percentile Compared to Chico			450-475	950-975	Est. Add'l Enrollment: ~700-1,500

2) While the report above from Everspring was for an online degree program, informal conversations with student recruiters in India and both our International Admissions and Outreach office, and the Chair of the Computer Science have expressed that there is strong interest from international audience for an in-person Data Science degree program.

3) The following chart from the Institute for Advanced Analytics, North Carolina State University, shows the cumulative growth of Data Science degree programs. It suggests a fairly constant rate of growth over the past decade, with the number expected to continue to rise in the future given the aforementioned market assessment for positions employing graduates of such programs.



- b. Identify how issues of diversity and access to the university were considered when planning this program. Describe what steps the program will take to ensure all prospective candidates have equitable access to the program. This description may include recruitment strategies and any other techniques to ensure a diverse and qualified candidate pool.

In addition to recruiting internationally, this program would draw on existing programs which have been recruiting and supporting students by providing access for all students from diverse backgrounds.

- c. For master’s degree proposals, cite the number of declared undergraduate majors and the degree production over the preceding three years for the corresponding baccalaureate program, if there is one.

There is no current undergraduate degree in Data Science at Chico State. However, 16 students have completed the UG certificate in DS since its inception in 2019.

- d. Describe professional uses of the proposed degree program.

Students with this degree can work in a wide variety of fields and industries including tech, medicine, bioinformatics, cybersecurity, sports, market, risk analysis, business, math and statistics, artificial intelligence, non-profit, profit and other governmental agencies that use data to make decisions.

- e. Specify the expected number of majors in the initial year, and three years and five years thereafter. Specify the expected number of graduates in the initial year, and three years and five years thereafter.

The table below lists initial student projections:

	At Initiation	After 3 Years	After 5 Years
Number of Majors (Annual)	20	40	42
Number of Graduates (Cumulative)	-	40	86

At launch, we estimate enrollment and admission of 20 students. Future year projections are based on a two-year completion cycle and an average attrition rate of 5%, and a 10% growth rate by year three. The number 20 is a conservative projection based on the anticipated demand for similar online programs based on the Everspring report.

Note: Sections 7 and 8 should be prepared in consultation with the campus administrators responsible for faculty staffing and instructional facilities allocation and planning. A statement from the responsible administrator(s) should be attached to the proposal assuring that such consultation has taken place.

7. Existing Support Resources for the Proposed Degree Program

- a. List faculty who would teach in the program, indicating rank, appointment status, highest degree earned, date and field of highest degree, professional experience, and affiliations with other campus programs. **Note:** For all proposed graduate degree programs, there must be a minimum of five full-time faculty members with the appropriate terminal degree. (Coded Memo EP&R 85-20)

Faculty involved in the development and implementation of the MSDSA will consist of TT faculty from both the departments of Mathematics & Statistics, and Computer Science.

- *Robin Donatello, DrPH 2013 Biostatistics, Associate Professor of Statistics.*
- *Nick Lytal, PhD 2020 Statistical Informatics, Assistant Professor of Statistics*
- *Edward Roualdes, PhD 2015 Statistics, Associate of Statistics.*
- *Kathy Gray, PhD 2007, Professor of Statistics.*

- *Jing (Jane) Guo, PhD 2015, Assistant Professor of Statistics*
- *Kevin Buffardi, Associate Professor of Computer Science*
- *Richard (Carter) Tillquist, Assistant Professor of Computer Science*
- *Abbas Attarwala, PhD Management Science, Assistant Professor of Computer Science*
- *Kun Tian, PhD, Associate Professor of Computer Science*
- *Bryan Dixon, PhD, Associate Professor of Computer Science*

- b. Describe facilities that would be used in support of the proposed program.

Hybrid online courses will require the use of classrooms with available recording and smart video camera technology, which already exist in HOLT Hall and other available buildings.

- c. Provide evidence that the institution offers adequate access to both electronic and physical library and learning resources.

See page 36 for statement from librarian confirming that our institution offers adequate access.

- d. Describe available academic technology, equipment, and other specialized materials.

Students will require their own laptop computers for most if not all classes, and those without a personal device may borrow them through Meriam Library's Technology Lending programs. Students will be able to also use the High-Performance Computers in the library, and our upcoming Mathematics & Statistics Research space.

8. Additional Support Resources Required

***Note:** If additional support resources will be needed to implement and maintain the program, a statement by the responsible administrator(s) should be attached to the proposal assuring that such resources will be provided.*

- a. Describe additional faculty or staff support positions needed to implement the proposed program.

The College of Natural Sciences has agreed to provide support consistent with that offered to other graduate programs in the College. The College of Engineering, Computer Science and Construction Management has agreed to 'hold harmless' courses that may have lower than desired enrollment for two years, to allow for reasonable program initiation. To reflect the fact that Data Science is more than the separate efforts of Computer Science and Statistics, we believe this program will need a specialized new faculty hire. Strategically searching for someone with expertise in building Data Science and Big Data curriculum for a broad audience can ensure the successful launch and growth of this program. We request that a tenure-track hire for this program be considered as part of the normal campus process. Additionally, depending on enrollment in other programs, the Computer Science Department may need funds to support additional instructors to meet the teaching obligations of the Master's of Data Science.

- b. Describe the amount of additional lecture and/or laboratory space required to initiate and to sustain the program over the next five years. Indicate any additional special facilities that will be required. If the space is under construction, what is the projected occupancy date? If the space is planned, indicate campus-wide priority of the facility, capital outlay program priority, and projected date of occupancy. Major capital outlay construction projects are those projects whose total cost is \$610,000 or more (as adjusted pursuant to Cal. Pub. Cont. Code 10705(a); 10105 and 10108).

Existing facilities and lecture spaces are already in place to support the program, and no additional special facilities are required to initiate the program. This program would require 3-4 normal smart classrooms each semester as part of regular classroom programming.

- c. Include a report written in consultation with the campus librarian which indicates any necessary library resources not available through the CSU library system. Indicate the commitment of the campus to purchase these additional resources.

Necessary resources to run this program currently exist on campus. No additional resources needed.

- d. Indicate additional academic technology, equipment, or specialized materials that will be (1) needed to implement the program, and (2) needed during the first two years after initiation. Indicate the source of funds and priority to secure these resource needs.

No additional academic technology, equipment, or specialized materials are needed to implement the program.

FW: Substantive Change Screening Determination: No further review of program needed

Daniel S Grassian <dsgrassian@csuchico.edu>

Wed 1/18/2023 11:58 AM

To: Robin Donatello <rdonatello@csuchico.edu>; Nicholas Lytal <nlytal@csuchico.edu>

Hi Robin and Nick,

Well, this is incredibly unusual, but within minutes after I submitted the relevant information to WSCUC for the MS, they approved us going forward to go forward without any further review (see below). It usually takes at least a week (more like two or three) to hear back from them. Perhaps they have a lighter work load in mid-January? In any case, good news!

If you could use anything else, please let me know.

Sincerely,
Daniel

From: John Hausaman <jhausaman@wscuc.org>

Sent: Wednesday, January 18, 2023 9:50 AM

To: Daniel S Grassian <dsgrassian@csuchico.edu>

Subject: Substantive Change Screening Determination: No further review of program needed



Dear ALO:

Thank you for submitting the Substantive Change Screening form. Following a review of the information submitted, it has been determined that no substantive change review will be necessary for the proposed program.

Program Implementation Notification Required

You are required to confirm implementation of the program in order for the program or location to be listed on the WSCUC website for purposes of financial aid eligibility verification by the U.S. Department of Education.

Login to the [Accreditation Management Portal](#) and the Masters of Science in Data Science and Analytics as Active within 30 days of implementation. Failure to report implementation may result in the suspension of financial aid eligibility for enrolled students.

CONFIDENTIAL COMMUNICATIONS: This email and any files transmitted with it are intended only for the person or entity to which it is addressed and may contain confidential and/or privileged material. Any review, retransmission, dissemination or other use of, or taking any action in reliance upon this information by persons or entities other than the intended recipient is strictly prohibited. If you received this message in error, please contact the sender at the WASC Senior College and University Commission immediately and

Catalog Description for the Masters of Science in Data Science and Analytics

Total Units Required: 34

Overview:

The Masters in Data Science and Analytics (MSDSA) is a joint effort between the Department of Mathematics and Statistics and the Department of Computer Science to create a blended curriculum providing a relevant and applicable treatment to the evolving and complex field of Data Science.

The MSDSA is open to students with a Bachelor's degree that have a strong interest in pursuing a programming approach to solving problems using data. We believe that Data Science is useful for everyone, and anyone can learn the mathematics, statistical, and programming skills needed to tell a compelling story with data, whether that be for business operations, public policy, or environmental research. Students lacking preparation in one or more areas can take the required prerequisite courses after being admitted.

With tracks in Applied Analytics and Machine Learning, graduates will be able to seek a variety of data-centric careers such as data analyst, data or research manager, data scientist, machine learning engineer, or quantitative research analyst in an application field of their choosing.

Admission Requirements

To be admitted to the Masters of Data Science and Analytics (MSDSA), students must hold an acceptable baccalaureate from an accredited institution, or an equivalent approved by the Office of Graduate Studies. Bachelor's degrees from Statistics, Computer Science, or any heavy data analytic field are recommended.

Students can be admitted in either classified or conditionally classified standing.

Prerequisites for Admission to Conditionally Classified Status

1. Meet all of the Graduate Studies requirements as specified in [Graduate and Postbaccalaureate Admission Requirements](#) in the University Catalog.
2. Submission of all attachments required by the application.
3. Approval by the Department of Mathematics and Statistics, and the Office of Graduate Studies.
4. Completion of background preparation in the following areas. Equivalent courses at Chico State courses are listed.
 - a. Introductory Statistics (MATH 105)
 - b. Introductory Computer Science (CSCI 101)
 - c. Calculus I (MATH 109 or MATH 120)

Proficiency in the above areas is most often demonstrated through completion of prerequisite coursework with a C or better within the prior five years. A waiver of prerequisites may be available, subject to approval by the Graduate Coordinator.

Prerequisites for Admission to Classified Status

In addition to the above minimum requirements for admission, students who have the following additional background knowledges (at a C or better) will be at an advantage both as to selection for admission to the program and optimal progress toward the degree if admitted.

1. Calculus II (MATH 121)
2. Upper division Applied Statistics (MATH 315)
3. Introductory level in both Python (CSCI 130) and R (Math 130)

Prerequisite courses taken for the purpose of advancement to classified status will not be used towards the MS degree.

The Admissions Committee seeks motivated and mature candidates who demonstrate strong leadership skills and academic performance. In particular, the Committee reviews the following:

- a. Motivation to pursue graduate study in data science or analytics, as well as personal qualities essential to academic and professional success, including interpersonal skills, leadership, and both verbal and visual communication skills.
- b. Collegiate-level scholastic achievements, including relevant undergraduate and graduate record with respect to course content and grades.

Program Requirements for the MS in Data Science and Analytics

Completion of all requirements as established by the departmental graduate committee, the Graduate Advisory Committee, and Graduate Studies, to include:

1. Completion of an approved program consisting of at least 34 units of work as follows:
 1. At least 18 of the units required for the degree in 600-level courses.
 2. Completion of the graduate core courses for the MSDSA (25 units)
 3. Completion of required courses in either the Track in Machine Learning or the Track in Data Analytics. (9 units)
 4. At the discretion of the academic program, a maximum of 30 percent of the units counted toward the degree requirements may be special session credit earned in non-matriculated status combined with all transfer coursework. This applies to special session credit earned through Open University, or in courses offered for academic credit through Regional and Continuing Education. (Correspondence courses and UC Extension coursework are not acceptable for transfer).
 5. Not more than 9 units taken before admission to classified status.
2. Culminating Activity: Completion and final approval of an independent data science project resulting in an acceptable product as specified by the student's Graduate Advisory Committee. This includes the following items:
 1. A formal written description of the project must be submitted to Graduate Studies for approval and accession to the library.
 2. Presentation of a seminar based on the student's master's project. This seminar will usually be given during the semester in which the student plans to complete the degree requirements.
3. Approval by the departmental graduate committee and the Graduate Council on behalf of the faculty of the University.

Timeline Summary

Students admitted into the program who meet all prerequisites coursework can expect to complete this program in 4 semesters of full-time enrollment.

- Fall 1: 10 units of coursework, identify a graduate committee chair and brainstorm project ideas.
- Spring 1: 7 units of coursework, declare a Track, have an approved project plan, finalize graduate advisory committee and advance to candidacy
- Fall 2: 10 units of coursework including MATH/CSCI 697 Masters Project Preparation, proposal presentation to committee.
- Spring 2: 7 units of coursework including MATH/CSCI 699P Masters Project, Final defense, apply for graduation

Core Required Coursework (25 Units)

Course	Title	Units
ERTH 600	Graduate Seminar I	1
MATH/CSCI 500	Data Science Seminar	2
MATH 615	Data Analysis for Graduate Research	3
MATH 456	Applied Statistics II	3
CSCI 605	Data Structures and Algorithms for Data Science	3
MATH/CSCI 608	Data Science for Graduate Studies	3
MATH/CSCI 485	Advanced Topics in Data Science	3
MATH 650	Probability and Statistics	3
MATH/CSCI 697	Masters Project Preparation	1
MATH/CSCI 699P	Masters Project	3

All MSDSA students must enroll in MATH/CSCI 500 each spring term but are encouraged to enroll in this course continuously.

Forming a Graduate Advisory Committee

Details on forming this committee are specified in [A Guide to Graduate Studies: Policies, Procedures, & Format](#). For MSDSA graduate students, the committee chair can be selected from any program with the expectation that the chair has expertise in at least one of the main areas of study pursued.

Choosing a Track

Students are expected to declare their intended track with the Graduate Coordinator by the end of their second semester. The same policies guiding the MSDSA degree apply to both tracks. Students must hold classified graduate standing before declaring their intent. Electives chosen to fulfil program requirements must be approved by the graduate committee.

Machine Learning Track (9 units)

Students who declare the Machine Learning track must have additional background preparation (at a C or better) in the following areas. Equivalent courses at Chico State courses are listed.

1. Multivariable calculus (Math 220)
2. Linear algebra (Math 235)
3. Object-oriented programming (CSCI 211)

Students in the Machine Learning track must complete an additional 9 units from the following courses.

Course	Title	Units
CSCI 644	DevOps Engineering	3
CSCI 611	Applied Machine Learning	3
	Computer Science Elective (500/600 level)	3

Applied Analytics Track (9 units)

Students who do not declare the Machine Learning track are placed in the Applied Analytics track and must complete an additional 9 units from the following courses.

Course	Title	Units
MATH 589	Statistics and Data Science Consulting	2
	2 Domain Electives (600 level)	6

Culminating Activity

The candidate shall complete a Data Science project based on original ideas developed by the student and agreed to by the student's graduate advisory committee.

1. Approval of project: The project proposal by the graduate advisory committee before the student begins the research.
2. Registration in MATH/CSCI 697
3. Project proposal: The proposal includes a literature review, a statement of the problem and purpose or hypothesis of the research, research design, and methods to be used. The proposal is a formal document that must have appropriate attention given to matters of format, documentation, and quality of writing.
4. Registration in MATH/CSCI 699P and MATH 500
5. Project paper. This is a continuation of the approved project proposal that includes details on methods, findings, and recommendations.
6. Project Presentation. Students will present their project as part of MATH 500.
7. Oral defense: The candidate's graduate advisory committee shall conduct an oral defense of the project.

Graduate Grading Requirements

All courses in the major (with the exceptions of Independent Study - 697, Master's Project - 699P) must be taken for a letter grade, except those courses specified by the department as ABC/No Credit (400/500-level courses), AB/No Credit (600-level courses), or Credit/No Credit grading only. A maximum of 10 units combined of ABC/No Credit, AB/No Credit, and Credit/No Credit grades may be used on the approved program (including 697, 699P, 699T and courses outside the major). While grading standards are determined by individual programs and instructors, it is also the policy of the University that unsatisfactory grades may be given when work fails to reflect achievement of the high standards, including high writing standards, expected of students pursuing graduate study.

Students must maintain a minimum 3.0 grade point average in each of the following three categories: all coursework taken at any accredited institution subsequent to admission to the master's program; all coursework taken at California State University, Chico subsequent to admission to the program; and all courses on the approved master's degree program.

Students whose grade point average falls below 3.0 will be put on academic probation and after one additional semester without improvement may be disqualified from the program.

Advancement to Candidacy

Advancement to candidacy is an acknowledgement of a student's potential to successfully complete the specific degree requirements. To advance to candidacy students must have completed the following:

1. Completion of the Graduate Requirement in Writing Proficiency (ERTH 600 & CSCI/MATH 500)
2. Have completed 18 units from the graduate core courses (first year courses)
3. Have a declared track
4. Establishment of a Graduate Advisory Committee
5. Submission of an Approved Program Plan for both coursework and culminating activity developed in consultation with the Graduate Coordinator

Graduation Requirements:

Continuous enrollment is required. At the discretion of the academic program, a maximum of 30 percent of the units counted toward the degree requirements may be special session credit earned in non-matriculated status combined with all transfer coursework. This applies to special session credit earned through Open University, or in courses offered for academic credit through Regional and Continuing Education.

Graduate Time Limit

All requirements for the degree are to be completed within five years of the end of the semester of enrollment in the oldest course applied toward the degree. See [Master's Degree Requirements](#) for complete details on general degree requirements.

Due to the rapid changes in the field of Data Science, the Department of Mathematics and Statistics requires all candidates to complete the program within five years, including projects. No course validation will be allowed, and no program extensions will be granted.

Graduate Requirement in Writing Proficiency

All students must demonstrate competency in writing skills as a requirement for graduation. MSDSA students will demonstrate their writing competence in the English language by successfully passing (B- or higher) both ERTH 600 and CSCI/MATH 500.

Catalog Descriptions (for new or modified courses)

MATH 130 Introduction to R 1 Unit

Typically Offered: Fall, Spring, and Summer

This accelerated short-course is designed as a primer to get the complete novice up and running with the basic knowledge of how to use the statistical programming language R. Target audience is anyone who wants to become the boss of their own data and conduct their own analysis. We cover how to get data into R, how to manipulate it into analyzable format, and how to create basic plots. Emphasis is placed on reproducibility and literate programming. The course culminates with a data exploration project. This course requires the use of a laptop computer and appropriate software.

Grade Basis: Credit/No Credit

Repeatability: You may take this course for a maximum of 1 unit

Course Attributes: Lower Division; Laptop required

CSCI 130 Introduction to Python 1 Unit

Typically Offered: Fall, Spring, and Summer

This accelerated short-course is designed as a primer to get the complete novice up and running with the basic knowledge of how to use the statistical programming language Python. Target audience is anyone who wants to become the boss of their own data and conduct their own analysis. We cover how to get data into Python, how to manipulate it into analyzable format, and how to create basic plots. Emphasis is placed on reproducibility and literate programming. The course culminates with a data exploration project. This course requires the use of a laptop computer and appropriate software.

Grade Basis: Credit/No Credit

Repeatability: You may take this course for a maximum of 1 unit

Course Attributes: Lower Division; Laptop required

MATH 456 Applied Statistical Methods II 3 Units

Prerequisite: MATH 314 and MATH 385, or MATH 315, or MATH 615

Typically Offered: Spring only

Advanced topics in applied statistics including multiple and logistic regression, multivariate methods, multi-level modeling, repeated measures, and others as appropriate. The statistical programming language R is used. Appropriate for all majors working with data. 3 hours discussion. (005570)

Grade Basis: Graded

Repeatability: You may take this course for a maximum of 3 units

Course Attributes: Upper Division

MATH 485 Advanced Topics in Data Science 3 Units

Prerequisite: MATH/CSCI 385 or MATH/CSCI 608; MATH 235 and MATH 456 strongly recommended (may be taken concurrently).

Typically Offered: Spring only

Introduction to predictive modeling, and machine learning techniques. Linear algebra fundamentals as they relate to dimension reduction. Relational databases and SQL. Project collaboration using version control. Ethics of predictive analytics and privacy with open data. 3 hours discussion. (021890)

Cross listing(s): None

Grade Basis: Graded

Repeatability: You may take this course for a maximum of 3 units

Course Attributes: Upper Division

MATH/CSCI 500 Data Science Seminar 1 Unit

Typically Offered: Spring only

Prerequisite:

Appropriate for senior and graduate students in relevant majors. This seminar explores current and relevant applications and implementations of data science and analytical methods and tools in the field. Seminars will include external and student-led presentations and hands on tutorials. Emphasis placed on students sharing and getting feedback on an approved capstone or masters project.

1 hour seminar.

Grade Basis: ABC/No Credit

Repeatability: You may take this course for a maximum of 4 units

Course Attributes: Upper Division

MATH 589 Statistics and Data Science Consulting

3 Units

Prerequisite:

Typically Offered: Fall and Spring

Development of experience and expertise in collaborating with students, faculty and researchers from across campus. Students meet with clients, work to understand their problem, and provide advice and or assistance. Topics include how to ask questions and provide help, project management, modeling strategies. When available students may be placed in intern or externship projects.

Grade Basis: Graduate Graded

Repeatability: You may take this course for a maximum of 9 units

Course Attributes: Upper Division

CSCI 605 Data Structures and Algorithms for Data Science 3 Units

Prerequisite: Admission to the master's program in data science or instructor permission.

Typically Offered: Fall only

This course focuses on object-oriented methodologies in designing and implementing a variety of data structures and algorithms. Coverage includes recursion, trees, search structures, hashing, heaps, sorting algorithms, and graph algorithms. Particular attention will be given to studying the relative merits of these data structures under different conditions both mathematically and

through empirical measurement. This course is not an approved elective for students in the Masters in Computer Science. 3 hours lecture.

Grade Basis: Graduate Graded

Repeatability: You may take this course for a maximum of 3 units

MATH/CSCI 608 Data Science for Graduate Studies 3 Units

Prerequisite: Basic programming knowledge (E.g. MATH 130), admission to the master's program in Data Science, or instructor permission.

Typically Offered: Fall only

Introduction to the foundational practices of data science emphasizing reproducibility and ethical practices at all stages of the data science lifecycle. Topics include version control, data wrangling, scientific thinking, web scraping, intermediate data wrangling, data visualization introduction to prediction, modeling, classification, and text analysis. 3 hours discussion.

Grade Basis: Graduate Graded

Repeatability: You may take this course for a maximum of 3 units

Course Attributes: Upper Division

MATH 615 Data Analysis for Graduate Research 3 Units

Prerequisite: MATH 105, MATH 305, MATH 315, or MATH 350 (only one is required). Basic programming experience with one of R, Python, Stata or SPSS recommended.

Typically Offered: Fall only

Introduction to common procedures used to clean and analyze data. Single and two-sample inference, analysis of variance and co-variance, multiple regression, logistic regression, nonparametric procedures, and categorical data analysis. Examples will be drawn from a variety of disciplines. Statistical computing languages will be used with an emphasis on conducting reproducible research. Appropriate for all majors doing research with data. 3 hours discussion. (005597)

Grade Basis: Graduate Graded

Repeatability: You may take this course for a maximum of 3 units

Course Attributes: Upper Division

MATH 650. Probability and Statistics 3 Units

Prerequisite: MATH 615 or instructor permission. MATH 435 recommended

Simulation, probability theory and distributions, sampling distributions, point and interval estimation. Maximum likelihood, testing hypotheses, likelihood ratio tests. Bayes' methods and multivariate regression theory. The statistical programming language R is used.

Typically Offered: Spring only

Grade Basis: Graduate Graded

Repeatability: You may take this course for a maximum of 3 units

Course Attributes: Graduate Division

CSCI 644 DevOps Engineering

3 Units

Prerequisite: CSCI 311, or CSCI 605 and MATH/CSCI 485; and classified graduate status

Typically Offered: Spring only

The course introduces students to distributed system administration skills, setting up distributed computation environments, cloud virtualization technologies, and setting up mobile, web, machine learning, artificial intelligence, and data science pipelines.

Grade Basis: Graduate Graded

Repeatability: You may take this course for a maximum of 3 units

Masters Thesis Checklist:

Rate each of the following categories according to the following criteria:

1 – poor to fair

3 – good to very good

2 – fair to good

4 – very good to excellent

Scientific Content:

___ Introduction _____

___ Goals and Objectives or hypotheses clearly stated _____

___ Background _____

___ Thorough review of the existing relevant current and historic literature _____

___ Methods _____

___ Results _____

___ Discussion _____

___ Goals and Objectives or hypotheses addressed _____

___ Scientific Merit and Significance _____

___ Limitations _____

Communication

___ Organization _____

___ Clarity _____

___ Logic _____

___ Flow _____

___ Style _____

Masters Defense Checklist

Graduation year _____

Student research area: (circle one) Ecology, Cell/molec, Microbiology, Botany

Rate each of the following categories according to the following criteria:

1 – poor to fair

3 – good to very good

2 – fair to good

4 – very good to excellent

_____ Exhibits thorough knowledge of specific research system

_____ Exhibits knowledge of literature both for research system and in the broader context

_____ Understands how their research fits into the larger picture

_____ Understands limitations of their research, how it might be improved and next steps in furthering the research in their area

_____ Exhibits knowledge of experimental design that is appropriate for their specific subject

_____ Exhibits knowledge of statistical procedures that is appropriate for their specific subject

_____ Exhibits the ability to reason

_____ Student is articulate and can present themselves well

Other Comments:

Please submit this form to the Graduate Coordinator at the completion of the defense.

Meriam Library
California State University, Chico

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MEMORANDUM

To: Dr. Nicholas Lytal

From: Marc Langston

Date: January 24, 2023

Subject: Library materials support for proposed MS in Data Science and Analytics

Library materials appropriate for the proposed MS in Data Science and Analytics are generally classified under the Library of Congress classification areas Q Science (General), and QA Mathematics, and more specifically to those sections covering machine learning, cloud computing, data mining, probabilities, and analysis. The Library examined its print holdings covered in these classification areas, as well as online materials assigned subject headings in data processing, big data, and mathematical analysis – statistical methods.

Library materials currently held by the library in these classification and subject areas are listed below:

Print Books: 4,063 titles

Print journals: 30 titles

E-books: 9,425 titles

E-journals: 839 titles

Databases: Math SciNet, Science Direct, Wiley Online Library, Compendex, and IEEE Xplore

In addition to resources currently held in the Library, the Mathematics and Statistics Department is allotted an annual book budget to purchase new library materials. Selection of these new materials is overseen by the Library's Mathematics and Statistics Librarian, who also makes available information literacy instruction for all math and statistics classes.

The Meriam Library currently provides adequate access to both electronic and physical library and learning resources that would support an MS in Data Science and Analytics.

February 20, 2023

Dear Colleagues,

The MS in Data Science and Analytics has stated that they technically need support for only three courses: one taught fully remote, one taught via ChicoFlex, and one other course to be defined in the future that might be taught in some other mode than in-person. I do not expect three courses to need a lot of extra resources from TLP so I approve of the proposal.

As the Academic Technology Officer who oversees TLP and the affiliated staff, from a broader view the university needs to consider the workload on TLP. TLP has been providing faculty with technology support for remote instruction both before and during COVID, at which time the unit's workload significantly increased, not only due to the proliferation of online and hybrid courses, but also because we piloted new modes of instruction: ChicoFlex and Hyflex. TLP assisted the College of Business in launching their Online MBA in fall 2020. And in fall 2022, TLP assisted the OBSBA program in launching their online program. In Spring 2023, we are assisting Multicultural and Gender studies launching their state-supported online program in fall 2023. And in fall 2024, we will be launching a state-supported online Humanities program. While TLP received some additional resources for the self-support business programs, there is no similar support mechanism in place for state-supported online or hybrid programs.

If an online or hybrid program plans to use Hyflex or ChicoFlex modes of instruction, Hyflex/ChicoFlex training is recommended in addition to Quality Learning and Teaching (QLT) training. TLP works closely with Faculty Development to provide the QLT series of workshops to define quality online teaching and learning, as well as to determine how to assess it and make desired improvements. In commitment to quality, we offer multiples services and resources to faculty regarding instructional quality, course design, Universal Design for Learning, Accessibility, Academic Integrity according to [EM 21-029](#) Policy for the Use of Digital Technologies in Teaching and Learning.

Adding to the workload above, TLP is currently working on the large project of migrating faculty from Blackboard to Canvas. TLP is assisting faculty in migrating the content of their courses from Blackboard to Canvas and training faculty to use the new system. This Canvas Migration project is in its height here in spring 2023 and will continue until Fall 2023 when all faculty are teaching with Canvas.

Overall, the campus needs a more strategic approach of what it takes to launch successful, quality online degree programs, particularly state-side programs, and the labor resources it takes to support the faculty and program coordinators in launching those programs online or hybrid.

Kathy Fernandes
Academic Technology Officer

MEMORANDUM

From: David M. Hassenzahl, Dean
To: Robin Donatello, Department of Mathematics and Statistics
Nick Lytal, Department of Mathematics and Statistics
CC: Catherine Wiggins, ASC, College of Natural Sciences
Date: March 2, 2023

Re: College support for Master of Science in Data Science and Analytics

This memorandum confirms that the College of Natural Sciences will provide the same sort and amount of support to administer the new Master of Science in Data Science and Analytics that we do for other master degrees in the college. This may include, as needed, faculty release time for a program director, office administrative support, student support, and material resources such as hardware and software.

From: Terence Lau <tjlau@csuchico.edu>

Sent: Wednesday, February 22, 2023 12:00 PM

To: Sharon A Barrios <SBarrios@csuchico.edu>; David M Hassenzahl <dhassenzahl@csuchico.edu>;
David G Alexander <dgalexander@csuchico.edu>

Cc: Daniel S Grassian <dsgrossian@csuchico.edu>; Robin Donatello <rdonatello@csuchico.edu>; Jennifer
L Gruber <jlgruber@csuchico.edu>; Nicholas Lytal <nlytal@csuchico.edu>; Kevin J McGown
<kmcgown@csuchico.edu>

Subject: Re: Updated timeline for the MSDSA proposal

Sharon-- I have committed to Computer Science that the College will "hold harmless" the department for low enrolled classes in support of the MS DA program for at least two years after the program launches. I understand new programs need a runway to prove themselves. This applies to the three courses that Computer Science is developing for the program.

With this commitment, the Department reaffirms it is ready to support the MS DA program and will develop the courses as previously agreed.

Terence