

Course Change Request

New Course Proposal

Viewing: **MATH 3622 : Mathematics of Data Science**

Also listed as: DATA 3622

Changes proposed by: camp

Original Proposal Date Monday, May 22, 2023

Proposer(s)

Completed Workflow

1. 487-MATH Curr Chair
2. 487-MATH Chair
3. 76-CSM Curr Chair
4. 76-CSM Assoc Dean
5. ASCC Chair
6. Office of the Registrar
7. Curriculum Analyst
8. PeopleSoft

Approval Path

1. 09/03/23 11:54 am
Emily Hamilton
(mhamil09):
Approved for 487-MATH Curr Chair
2. 09/06/23 11:57 am
Benjamin Richert
(brichert):
Approved for 487-MATH Chair
3. 09/06/23 2:31 pm
Elena Keeling
(ekeeling):
Approved for 76-CSM Curr Chair
4. 09/09/23 11:53 am
Camille O'Bryant
(cobryant):
Approved for 76-CSM Assoc Dean
5. 04/22/24 3:24 pm
Gregory Bohr
(gbohr): Approved for ASCC Chair
6. 04/16/25 4:11 pm
Lygia Smidt
(lsmidt): Approved for Office of the Registrar

7. 10/02/25 9:56 pm
Shayna Bailey
(sbaile03):
Approved for
Curriculum
Analyst
8. 10/03/25 1:33 am
Approved for
PeopleSoft

History

1. **Oct 3, 2025 by
Charles Camp
(camp)**

Name:	E-mail:	Phone:
Emily Hamilton	mhamil09@calpoly.edu	756 - 5557

Subject Prefix MATH Catalog Number 3622

Department Mathematics (487-MATH)

College Bailey College of Science and Mathematics

General Information

Requested Start Fall 2026
Term

Course Title
Mathematics of Data Science

Short Course Title Mathematics of Data Science
(displays in
transcripts and
the class
schedule)

Course
Description

Introduction to mathematical foundations of data science including regression, data dimension reduction, clustering, community detection, and computational topology, with a focus on advanced linear algebra tools needed to establish the mathematical foundations of methods, to show convergence, and for error minimization. 3 lectures. Prerequisite: One of the following: MATH 206, MATH 244, MATH 1151, or MATH 2341; MATH 248 or MATH 2031; and CSC 101 or CSC 1001. Crosslisted as DATA/MATH 3622.

Is the course Yes
crosslisted, or are
you adding a new
crosslisting?

Crosslisted with	DATA 3622 - Mathematics of Data Science
Is this a replacement course?	No
Will course be taught on or off campus?	On Campus
Does the course have field trips?	No

Course Requirements

Course Requisites

Type	Course	Justification
Prerequisite	MATH 1151 or MATH 2341	MATH 3622 will assume standard results from linear algebra which will be covered in MATH 1151 and also in MATH 2341.
Prerequisite	MATH 2031	Students will need experience writing mathematical proofs to be successful in MATH 3622. This will be covered in MATH 2031.
Prerequisite	CSC 1001	Students will need some programming skills to be successful in MATH 3622.

Are there non-course requirements for enrollment?

No

Units per mode of instruction:

For the definition of a unit (credit hour) and amount of work associated with it, refer to the [CSU definition](#).

For more information on modes of instruction, click [here](#).

Lecture: 3 Laboratory: 0 Activity: 0 Seminar: 0 Supervision: 0 Discussion: 0

Total Units: 3

Grading Type Regular

Is course repeatable for multiple credit?

No

Is this course to be taught with specific subtitles?

No

Purpose of the Course

This is a required course No

This is an elective course Yes

Specify name(s)
of major,
concentration,
minor, certificate,
or graduate
program:

Mathematics BS

Data Science BS (upper division elective)

Attach memos of
support from
other departments
adding the
proposed course
to their
curriculum.

[memo-new-course MATH 3622 \(CSSE\) .pdf](#)

[memo-new-course MATH 3622 \(STAT-DATA\) .pdf](#)

This course is
used in the
following
credential
program(s):
N/A

Briefly explain the
need for this
course:

MATH 3622 will cover the mathematical foundations of data science. Data science is an important emerging field, and there are currently no other classes at Cal Poly that cover the mathematics of data science. This course has been offered a few times as MATH 476, Advanced Topics in Applied Mathematics. There was a great deal of interest and the class was fully enrolled. We anticipate that students from several departments, such as Mathematics, Computer Science, and Statistics, will be interested in the class. MATH 3622 will be an approved elective in the BS in Mathematics under semester conversion, and it will be an approved elective for the BS in Data Science, if that program is approved.

The prerequisites for MATH 3622 are fulfilled by either required or elective support courses within the BS in STAT, the BS in CSC, and the current minor in DATA; so, we expect they will be fulfilled by required or elective support courses in the BS in Data Science as well, if that program is approved.

GE, USCP, GWR or SUSCAT Courses

Is this a General Education Course? No

Is this a United States Cultural Pluralism Course? No

Is this a Graduation Writing Requirement Course? No

Is this course being proposed for inclusion in the No

Sustainability Catalog (SUSCAT)?

Course Delivery and Resources

Estimated number of students in one section of this course:

Lecture/Seminar: 35

Lab/Activity:

Estimated number of Lecture/Seminar sections to be offered:

Fall:

Spring: 1

Summer:

Total: 1

What is the primary modality in which the course is intended to be taught:
Face-to-Face, Traditional (FT)

Indicate other modalities in which the course is intended to be taught:

Please answer the following questions about direct instruction and out-of-class work for EACH of the modalities selected above (or its equivalent for online). For each modality listed above please include the hours estimate on a weekly basis. For example FT: x hours, FO: y hours, etc.

Hours of face-to-face or synchronous instruction (may include instruction through web-conferencing software such as Zoom, Skype, Microsoft Teams, or its equivalent):

3

Briefly describe planned methods of direct instruction face-to-face or synchronous (e.g., lecture, discussion, small group problem-solving, videos, demonstrations, etc.):

Lecture, small group problem-solving

Hours of direct instruction online (asynchronous):

0

Briefly describe planned methods of direct instruction online (e.g., text-based learning modules, screencast lectures, lecture transcripts, recorded podcasts, assigned videos, faculty-mediated discussions, quizzes/exams, etc.):

NA

Hours of out-of-class work or its equivalent:

6

Briefly describe planned methods for engaging students in out-of-class work or its equivalent for online (e.g., assigned reading, homework problems, non-faculty mediated discussion board

posts, individual/group projects, papers, service-learning, etc.):

Assigned reading, homework problems, individual/group projects

Enrollment capacity by modality. (Faculty may not be required to teach more students in an online modality than they would be assigned to teach in a face-to-face modality.)

All sections will be face to face with an enrollment capacity of 35 students per section.

Indicate the names of faculty members who will initially teach the course, and if one (or more) of the online modalities (FO, RO, LO & HY) are being proposed, please briefly provide their prior online experience and/or training:

Joyce Lin, Elena Dimitrova

Does this course require new equipment? No

Does this course require new supplies? No

Indicate type of teaching environment needed: Lecture

Will staff resources be required to support the course? No

Does this course require new computer facilities and/or software? No

Program Learning Objectives

Select a program to display program learning objectives supported by this course.

(MATH-BS) BS Mathematics

- PLO 1:** Understand the nature of mathematical proof and be able to write clear and concise proofs.
- PLO 2:** Develop the ability to read, understand, and use basic definitions in linear and abstract algebra and real analysis, and be able to prove simple consequences of these definitions.
- PLO 3:** Be able to use standard mathematical techniques to solve elementary problems.
- PLO 4:** Be able to communicate effectively in oral and written form.
- PLO 5:** Be able to write simple computer programs to perform mathematical computations.
- PLO 6:** Gain experience exploring open-ended problems, learn to make conjectures, and gather evidence to support or refute these conjectures.
- PLO 7:** Develop the ability to read and to learn mathematics independently.
- PLO 8:** Learn about applications of mathematics in other fields and gain experience in mathematical modeling.
- PLO 9:** Foster global citizenship by developing critical thinking skills.

Course Learning Objectives and Assessment Methods

Complete the Course Learning Objectives and Assessment Methods if proposing a new course, proposing a new modality for an existing course, changing the mode of an existing course, OR reducing the contact hours of an existing course.

List the learning objectives for this course (e.g. what should students know or be able to do after taking this course), the assessment method that will be used to collect direct evidence of student achievement of each learning objective, and map the program learning objective(s) to each of the CLOs. Consult the Associate Dean in your college about assessment resources.

Include assessment methods designed to measure attainment of course learning objectives by the other modalities chosen above.

If the course is being proposed for General Education, indicate the GE educational objectives and criteria supported by the course (e.g. GE C3 EO 1, 2, 3, 6 and CR 2, 5). If the course is being proposed for U.S. Cultural Pluralism, indicate the USCP criteria and educational objectives supported in the Program Learning Objective field.

Course Learning Objectives and Assessment Methods

	Course Learning Objective	Modality Assessment Method(s)	Program Learning Objective(s)
1	Prove theorems that guarantee convergence of popular algorithms in data science	Homework and exams	PLO1, PLO2, PLO4
2	Use linear algebra and calculus to state the mathematical formulation of common methods in data science	Homework and exams	PLO2, PLO3, PLO4
3	Solve linear and nonlinear systems of eigenproblems	Homework and exams	PLO3, PLO5
4	Perform stability and complexity analysis of various data science algorithms	Homework and exams	PLO4, PLO5, PLO6
5	Apply algorithms for community detection on interaction graphs	Homework and exams	PLO5, PLO6

	Course Learning Objective	Modality Assessment Method(s)	Program Learning Objective(s)
6	Analyze point clouds of data using methods from topological data analysis and interpret the results	Homework and exams	PLO4, PLO5, PLO6, PLO8
7	Apply mathematics of data science to data sets to solve real-life problems.	Homework and exams	PLO5, PLO6, PLO7, PLO8

Please include a list of measures that will be employed to ensure academic integrity in the assessment of students' attainment of the CLOs:

Students will be expected to follow the campus wide policy on academic integrity and will be informed of student and faculty responsibilities related to academic integrity. A statement about academic integrity and expectations about student rights and responsibilities will be posted in the syllabus.

All exams will be in-person and proctored by faculty.

Expanded Course Content

List textbooks, materials, and/or other resources for the course.

Textbooks, materials, and/or other resources

Pattern Recognition and Machine Learning by Christopher M. Bishop

Optimization Algorithms for Data Analysis by Stephen Wright

Numerical Algorithms by Solomon

Topological Data Analysis with Applications by Gunnar Carlsson and Mikael Vejdemo-Johansson

Provide a detailed outline of the content for this course:

Week	Readings	Topics of Discussion	Labs, Activities, Assignments
1	Solomon 4.1, 5.4	What is Data Science? Regression: least squares, Gram-Schmidt, QR factorization	Activities: In-class exercises Assessments: homework
2	Solomon 6.3, 6.4	Regression: cross-validation, bootstrapping	Activities: In-class exercises Assessments: homework

Week	Readings	Topics of Discussion	Labs, Activities, Assignments
3	Solomon 7.1, Instructor's Notes	Principal component analysis: spectral theorem, singular value decomposition	Activities: In-class exercises Assessments: homework
4	Solomon 7.2, Instructor's Notes	Principal component analysis: power iteration method, Rayleigh Quotient, PCA in higher dimensions	Activities: In-class exercises Assessments: homework
5	Bishop 9.1, Instructor's Notes	Clustering: k-means, optimization	Activities: In-class exercises Assessments: homework, exam
6	Instructor's Notes	Clustering: convergence	Activities: In-class exercises Assessments: homework
7	Instructor's Notes	Linear and nonlinear classifiers	Activities: In-class exercises Assessments: homework
8	Wright 2.9, Instructor's Notes	Support vector machines	Activities: In-class exercises Assessments: homework
9	Instructor's Notes	Community detection: Stochastic block models, null model	Activities: In-class exercises Assessments: homework
10	Instructor's Notes	Community detection: modularity, Louvain algorithm, cluster coefficient	Activities: In-class exercises Assessments: homework, exam
11	Carlsson 4.1-4.3	Simplicial complexes and simplicial homology	Activities: In-class exercises Assessments: homework
12	Carlsson 4.4-4.9	Filtered simplicial complexes and persistent homology	Activities: In-class exercises Assessments: homework
13	Carlsson 5.1-5.2	Feature maps and persistence landscapes	Activities: In-class exercises Assessments: homework
14	Carlsson 6.1-6.4	Topological data analysis	Activities: In-class exercises Assessments: homework
15	None	Final Presentations	Activities: Final presentations Assessments: homework, final presentations
16	None	None	Final Exam

Final Assessment

Final assessments for 1-unit courses, labs, and activities occur during the regularly designated meeting time in the last week of instruction. Final assessments for all lecture and seminar courses (other than 1-unit courses) occur during the scheduled final assessment period ('finals week').

What will be the

method for final
assessment for
this course?

Cumulative Final Exam

Will the final assessment occur during the designated time period? Yes

Consultation

List all courses that already cover any significant part of the planned content/learning objectives of this course either within the department or from other departments. Explain why duplication of subject matter is necessary. Please talk with any other department with which there will be significant duplication.

Courses with possible duplication of content DATA 4610 - Fundamentals of Machine Learning

Please explain the duplication in subject matter and why it is necessary:

There is some overlap in content between MATH 3622 and DATA 4610. MATH 3622 will be more theoretical, with a focus on convergence and proofs. DATA 4610 will focus more on algorithms.

Use the [memo template](#) for consultation with other departments offering any of the above listed courses. Attach signed memos to the proposal.

[memo-new-course MATH 3622 \(CSSE\) .pdf](#)

[memo-new-course MATH 3622 \(STAT-DATA\) .pdf](#)

Instructional Materials and Information Technology Accessibility

"It is the policy of the CSU to make information technology resources and services accessible to all CSU students, faculty, staff and the general public regardless of disability." (EO 1111)

The [CSU Accessible Technology Initiative](#) requires that new course content, including instructional materials and websites, be designed and authored to be accessible to all students.

Please review the [Accessible Instructional Materials Checklist for Cal Poly Faculty](#) and related links to understand what this means as you develop your course content.

Take advantage of the [Center of Teaching, Learning and Technology](#) support tutorials, workshops and other services the [CSU Professional Development for Accessible Technology](#) resources.

I have reviewed the information and understand what is expected.

If you still have questions or need any assistance, email the [Information and Communication Technology \(ICT\)](#)

[Campus Compliance Officer](#) or telephone 805-756-5538.

Supporting
Documents

[MATH Department Response.pdf](#)

Reviewer
Comments

Bree Chaffin (ehugins) (01/12/24 3:29 pm): Updated the course description to meet the Office of the Registrar catalog conventions.

Bree Chaffin (ehugins) (04/11/24 10:23 am): Updated prerequisite from "and introductory college-level programming class" to "and CSC 1001", per the attached communication with the department.

Daniel Parsons (daparson) (04/18/24 3:13 pm): Friendly edits made to CLOs by ASCC.

Bree Chaffin (ehugins) (10/02/24 4:05 pm): Updated the course description to meet the Office of the Registrar catalog conventions and added equivalent quarter requisites to allow pathway for quarter students to register.

Key: 9827