# http://www.ric.edu/webcommunications/images/SealWithText_Small_Black.pngUNDERGRADUATE CURRICULUM COMMITTEE (UCC)PROPOSAL FORM

## Cover page scroll over blue text to see further important [instructions](#instructions): [if not working select “COMMents on rollover” in your Word preferences under view] please read these.

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| --- | --- | --- |
| A.1. [Course or program](#Proposal) | **Math 345 Linear models for data science** |  |
|  |  |
| A.2. [Proposal type](#type) | **Course: creation**  |
| A.3. [Originator](#Originator) | **Leonardo Pinheiro** | [Home department](#home_dept) | **Mathematics and Computer Science** |
| A.4. [Context and Rationale](#Rationale)  | The applied nature of Data Science requires the creation of courses where the instructional methods used are based on a hands-on, problem-driven approach.   The fields of matrix theory and linear algebra are cornerstones of the theoretical foundations for the analysis of large-scale data and the implementation of data-driven decision making.  Traditional math majors are exposed to matrix theory and linear algebra in a stand-alone course where some applications are noted but not fully explored.  Subsequent courses require this theoretical knowledge and explore its applications.  While this is an efficient way to build gradual knowledge of the content the approach is not ideal for Data Science. This proposal aims to create a course that addresses the matrix theory and linear algebra content needs of data science. In this course students will acquire knowledge of matrix theory and linear algebra and immediately apply it to concrete, real-world problems involving data through the use of appropriate software.   Students will leave the course with a toolbox of techniques that will allow them to attack current problems in data science while at the same time having a broad understanding of the theory behind such techniques.  The current faculty in the department includes several members who are deeply involved in the research and teaching of such topics; we see no impact on faculty other than the opportunity to prepare and teach a new course. |
| A.5. [Student impact](#student_impact) | Data Science is a rapidly expanding field demanding graduates with a solid foundation in analytical skills and techniques. The creation of this course supports a robust curriculum that will prepares our students for a high-demand, high-paying career. |
| A.6. [Impact on other programs](#impact)  | **None.** |
| A.7. [Resource impact](#Resource) | [*Faculty PT & FT*](#faculty):  | **Current existing full-time faculty will be used.** |
| [*Library*:](#library) | **No additional needs are anticipated.**  |
| [*Technology*](#technology) | **We plan to use software that is already utilized on campus.** |
| [*Facilities*](#facilities): | **We expect current labs to be sufficient.**  |
| A.8. [Semester effective](#Semester_effective) | **Fall 2020** | A.9. [Rationale if sooner than next Fall](#Semester_effective) |  |
| A.10. INSTRUCTIONS FOR CATALOG COPY: This single file copy must include ALL relevant pages from the college catalog, and show how the catalog will be revised. (1) Go to the “Forms and Information” page on the UCC website. Scroll down until you see the Word files for the current catalog. (2) Download ALL catalog sections relevant for this proposal, including course descriptions and/or other affected programs. (3) Place ALL relevant catalog copy into a single file. Put page breaks between sections and **delete any catalog pages not relevant for this proposal**. (4) Using the track changes function, revise the catalog pages to demonstrate what the information should look like in next year’s catalog. (5) Check the revised catalog pages against the proposal form, especially making sure that program totals are correct if adding/deleting course credits. If new copy, indicate where it should go in the catalog. If making related proposals a single catalog copy that includes all is acceptable. Send as a separate single file along with this form. |

B. [NEW OR REVISED COURSES](#delete_if)  **DO NOT use highlight. Do not delete numbered categories, just leave blank if they do not apply. Delete this whole page if the proposal does not include a new or revised course. Always fill in b. 1 and B. 3 for context.**

|  | Old ([for revisions only](#Revisions))ONLY include information that is being revised, otherwise leave blank.  | NewExamples are provided within some of the boxes for guidance, delete just the examples that do not apply. |
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| B.1. [Course prefix and number](#cours_title)  |  | **MATH 345** |
| B.2. Cross listing number if any |  |  |
| B.3. [Course title](#title)  |  | **Linear Models for Data Science** |
| B.4. [Course description](#description)  |  | Students will apply matrix theory to the study and implementation of linear models to problems in data science. Topics include basic matrix theory with applications to optimization, and machine learning. |
| B.5. [Prerequisite(s)](#prereqs) |  | **Math 315 or both Math 245 and Math 212** |
| B.6. [Offered](#Offered) |  | **Fall**  |
| B.7. [Contact hours](#contacthours)  |  | **4** |
| B.8. [Credit hours](#credits) |  | **4** |
| B.9. [Justify differences if any](#differences) |  |
| B.10. [Grading system](#grading)  |  | **Letter grade**  |
| B.11. [Instructional methods](#instr_methods) |  | **Laboratory | Lecture | Small group**  |
| B.12.[Categories](#required) |  | **Required for major|** |
| B.13. Is this an Honors course? |  | **NO** |
| B.14. [General Education](#ge)N.B. Connections must include at least 50% Standard Classroom instruction. |  | **NO**  |
| B.15. [How will student performance be evaluated?](#performance) |  | **Attendance | Class participation | Exams | Presentations | Papers |** **Class Work | Quizzes |Projects |**  |
| B.16 [Recommended class-size](#class_size" \o "Check appendix XVIII in the UCC Manual for Best Practices) |  | **30** |
| B.17. [Redundancy statement](#competing) |  | **No similarities.**  |
| B. 18. Other changes, if any |  |

| B.18**.** [**Course learning outcomes**](#outcomes)**: List each one in a separate row** | [**Professional Org.Standard(s)**](#standards)**, if relevant** | [**How will each outcome be measured**](#measured)**?** |
| --- | --- | --- |
| Performing basic operation with matrices |  | See B.15 |
| Implementing matrix operations using a software package. |  | See B.15 |
| Applying matrix theory to a broad range of problems in the areas of numerical linear algebra, optimization, and machine learning. |  | See B.15 |

| B.19. [**Topical outline**](#outline) |
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| 1. Introduction to Matrices 1.1 Matrix Multiplication 1.2 Row and Column Spaces |
| 2. Solving Linear Systems of Equations 2.1 Gaussian Elimination 2.2 LU Decomposition |
| 3. Special Matrices 3.1 Orthogonal Matrices 3.2 Eigenvalues and Eigenvectors 3.3 Symmetric Positive Definite Matrices 3.4 Singular Values and Singular Vectors |
| 4. Computations with Large Matrices 4.1 Numerical Linear Algebra 4.2 Least Squares |
| 5. Optimization 5.1 Convexity and Newton's Method 5.2 Linear Programming, Game Theory, and Duality |
| 6. Learning from Data 6.1 The construction of Deep Neural Networks 6.2 Convolutional Neural Networks 6.3 The World of Machine Learning |

## D. Signatures

* Changes that affect General Education in any way MUST be approved by ALL Deans and COGE Chair.
* Changes that directly impact more than one department/program MUST have the signatures of all relevant department chairs, program directors, and their relevant dean (e.g. when creating/revising a program using courses from other departments/programs). Check UCC manual 4.2 for further guidelines on whether the signatures need to be approval or acknowledgement.
* Proposals that do not have appropriate approval signatures will not be considered.
* Type in name of person signing and their position/affiliation.
* Send electronic files of this proposal and accompanying catalog copy to curriculum@ric.edu and a printed signature copy of this whole form to the current Chair of UCC. Check UCC website for due dates.

##### D.1. Approvals: required from programs/departments/deans who originate the proposal. may include multiple departments, e.g., for joint/interdisciplinary proposals.

| Name | Position/affiliation | [Signature](#_Signature" \o "Insert electronic signature, if available, in this column) | Date |
| --- | --- | --- | --- |
| Stephanie Costa | Chair of Mathematics and Computer Science |  |  |
| Earl Simson | Dean of Arts and Sciences |  |  |

##### D.2. [Acknowledgements](#acknowledge): REQUIRED from OTHER PROGRAMS/DEPARTMENTS (and their relevant deans if not already included above) that are IMPACTED BY THE PROPOSAL. SIGNATURE DOES NOT INDICATE APPROVAL, ONLY AWARENESS THAT THE PROPOSAL IS BEING SUBMITTED. CONCERNS SHOULD BE BROUGHT TO THE UCC COMMITTEE MEETING FOR DISCUSSION; all faculty are welcome to attend.

| Name | Position/affiliation | [Signature](#Signature_2) | Date |
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