# 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.

**N.B. DO NOT USE HIGHLIGHT, where choices are given within categories, please DELETE those THAT DO NOT APPLY TO YOUR PROPOSAL. Do not delete numbered categories.**

**ALL numbers in section (A) to be completed, including the impact ones (#5-7), put “none” if that is the case.**

|  |  |  |
| --- | --- | --- |
| A.1. [Course or program](#Proposal) | **MATH 445: Advanced statistical methods** |  |
| [Replacing](#Ifapplicable)  |  |
| A.2. [Proposal type](#type) | **Course: revision** |
| A.3. [Originator](#Originator) | **Walter Gall** | [Home department](#home_dept) | **Mathematics and Computer Science** |
| A.4. [Context and Rationale](#Rationale)  | **New topics added into this course are consistent with an Advanced Statistical Methods course, but were missing from the current format of the course. These new topics must be included based upon the Curriculum Guidelines for Undergraduate Programs in Data Science1. The description and prerequisites are also being updated to reflect these changes.****The increased credit hour comes from the addition of the following topics: statistical learning, tree-based methods, support vector machines, and unsupervised learning. These topics fall into the category of computational statistics and machine learning.****Due to the change in topics covered, the material in Math 445 no longer has significant overlap with the material in Management 249, so we have removed the statement “students cannot receive credit for both MATH 445 and MGT 249” from the course description.** **The class will be capped at 24 students since a substantial amount of time will be spent in campus computer labs.**1. De Veaux, R. Agarwal, M., Averett, M., Baumer, B., Bray, A., Bressoud, T., …, Ye, P., 2016, ‘Curriculum Guidelines for Undergraduate Programs in Data Science’, Retrieved October 4, 2019 (<https://www.amstat.org/asa/files/pdfs/EDU-DataScienceGuidelines.pdf>).
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| A.5. [Student impact](#student_impact) | **The demand for data analysts, trained in machine or statistical learning,****is at an all-time high. It has been reported that the highest starting salaries****(in excess of 100K) for college graduates in 2019 was for data science majors.****Beside data science, any student with the prerequisites****should be able to complete this course and greatly extend their employment opportunities.** |
| A.6. [Impact on other programs](#impact)  | **This course is a required elective in both Math and Computer Science majors, but since there are other 4 credit options it will not affect either one’s total credit.** |
| A.7. [Resource impact](#Resource) | [*Faculty PT & FT*](#faculty):  | **None.** |
| [*Library*:](#library) | **None.** |
| [*Technology*](#technology) | **None, existing and open source software packages will be utilized.** |
| [*Facilities*](#facilities): | **None, existing computer labs will be utilized.** |
| 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. |
| --- | --- | --- |
| B.1. [Course prefix and number](#cours_title)  |  | **Math 445** |
| B.2. Cross listing number if any |  |  |
| B.3. [Course title](#title)  |  | **Advanced Statistical Methods** |
| B.4. [Course description](#description)  | **Using computer packages, study is made of advanced statistical topics, such as design of experiments, analysis of variance, and multiple regression. Students cannot receive credit for both**[**MATH 445**](http://ric.smartcatalogiq.com/2019-2020/Catalog/Courses/MATH-Mathematics/400/MATH-445)**and**[**MGT 249**](http://ric.smartcatalogiq.com/2019-2020/Catalog/Courses/MGT-Management/200/MGT-249)**.** | **Students will be introduced to methods that are necessary to analyze large data sets commonly encountered in data science and statistics.**  |
| B.5. [Prerequisite(s)](#prereqs) | **Math 212 and either Math 240 or Math 248 or Math 441.** | **MATH 240, and either MATH 345; MATH 315; or completion or concurrent enrollment in CSCI 423.**  |
| B.6. [Offered](#Offered) |  | **Spring**  |
| B.7. [Contact hours](#contacthours)  | **3** | **4** |
| B.8. [Credit hours](#credits) | **3** | **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) | **Restricted elective for major in B. A. in Mathematics; elective for B.S. in Computer Science.** | **Restricted elective for major in B. A. in Mathematics; elective for B.S. in Computer Science.** |
| 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 | Presentations | Papers |** **Class Work | Projects |** |
| B.16 [Recommended class-size](#class_size" \o "Check appendix XVIII in the UCC Manual for Best Practices) |  | **24**  |
| B.17. [Redundancy statement](#competing) |  | **None** |
| 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)**?** |
| --- | --- | --- |
| Students will acquire a background in the content and methodology of advanced statistics  |  | See B. 15 |
| Students will understand and use concepts and techniques in data collection, analysis, modeling, and statistical inference.  |  | See B. 15 |
| Students will use a high-level language to explore, visualize, and form hypotheses about data. |  | See B. 15 |
| Students will conduct data-based investigations and effectively communicate their findings.  |  | See B. 15 |
| Students will communicate data-based findings visually, orally, and in writing. |  | See B. 15 |

| B.19. [**Topical outline**](#outline)**: DO NOT INSERT WHOLE SYLLABUS, JUST A TWO-TIER TOPIC OUTLINE. Proposals that ignore this request will be returned for revision.** |
| --- |
| 1. Review and Introduction to Statistical Software R

 a) Introduce statistical software R to be used by way of exploratory data analysis of data from case studies2) Hypothesis Testing a) Two-sample permutation tests.  b) Permutation tests for independence of two variables3) Sampling Distributions a) Simulating sampling distributions and the Central Limit Theorem4) Bootstrap Methods a) Bootstrap distributions and sampling distributions b) Bootstrap percentile confidence intervals c) Two sample bootstrap d) Other statistics, bias, Monte Carlo sampling. 5) Maximum Likelihood Estimates a) Properties of estimators b) Mean square error6) Statistical Learning a) Supervised versus unsupervised learning b) Regression versus classification problems c) Quality of fit d) Bias-variance trade-off7) Multiple Linear Regression a) Qualitative predictors b) extensions of the linear model c) Comparisons with K-nearest neighbors8) Classification a) Logistic regression b) linear discriminant analysis9) Resampling Methods a) Cross-Validation, Subset selection10) Tree-Based Methods a) Decision trees, trees versus linear models11) Introduction to Support Vector Machines a) Maximal margin classifier b) kernels c) non-linear decision boundaries12) Unsupervised Learning a) K-means clustering b) Hierarchical clustering |

## 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 |
| --- | --- | --- | --- |
| Jeff Mello | Dean School of Business |  |  |
| Connie Milbourne | Chair Management and Marketing Department |  |  |