



# MSc in Analytics: Summer 2020

## Course Syllabus

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### **RESEARCH DESIGN FOR BUSINESS APPLICATIONS**

MSCA 31001

Anil Chaturvedi

[anilchaturvedi@uchicago.edu](mailto:anilchaturvedi@uchicago.edu)

## **COURSE DESCRIPTION**

In addition to theory and experimentation, big data analytics has now emerged as an alternative way to discover new knowledge. This course covers the analytics research process from the translation of business problems into questions that can be addressed by using analytics, development of data sources to address each key researchable issue, to the initial translation of research results back to business implications. By completing the course, students will be able to: frame a business problem, map alternative solutions, and communicate the plan back to a non-technical manager; identify potential sources or relevant data, explain the pros and cons of the selected methodology to the analytical team as well as non-analysts; understand analytical principles that can be applied to design data-gathering experiments. Students will develop a research/analytical proposal to produce knowledge from data to address a real business problem/opportunity in incremental steps throughout the course.

## **Textbooks (RECOMMENDED):**

**Sreejesh, S., Mohapatra, S., and Anusree, R.R. (2014). Business Research Methods: An Applied Orientation. Springer: Switzerland (Library Course Reserve).**

Sue Greener. *Business Research Methods*. Free online book at <http://www.ftvs.cuni.cz/hendl/metodologie/introduction-to-research-methods.pdf>.

Ghauri, P. and Grønhaug, K. (2010). *Research Methods in Business Studies*. 4<sup>th</sup> Edition. Pearson: England.

Provost, F. and Fawcett, T (2013). *Data Science for Business: What You Need to Know about Data Mining and Data-analytic Thinking*. O'Reilly Media Inc.: Sebastopol CA.

Neuman, W. Lawrence (2011). *Social Research Methods: Qualitative and Quantitative Approaches*. Allyn & Bacon: Boston. (Library Course Reserve)

Journal Articles on Library Course Reserve at Canvas site.

## LEARNING OBJECTIVES

After completing this course, students should be able to:

- Describe a business opportunity/problem that can be addressed using Data Science methods
- Formulate and articulate the purpose (goals) of the analysis
- Identify the data requirements and available data
- Design studies to collect valid and reliable data (Optional)
- Develop the analytical plan that describes the Data Science methodology the Group will use to generate the solution to the business problem/opportunity.
- Write a business analysis proposal
- Communicate the planned research/analytical process to technical and non-technical audiences

## EVALUATION:

Your course grade will be calculated as follows:

- 15% Class Participation and Engagement in Class
- 15% Quizzes
- 45% Capstone Proposal presentations
- 25% Final project proposal

## GRADING SCALE

A = 94%–100%  
 A- = 90%–94%  
 B+ = 87%–90%  
 B = 84%–87%  
 B- = 80%–84%  
 C+ = 77%–80%  
 C = 74%–77%  
 C- = 70%–74%  
 F = 0%–70%

## ATTENDANCE

This course will meet once a week. All course goals, session learning objectives, and assessments are supported through in class lecture, activities, and discussions. Your attendance is thus required and paramount to your success in this class. **You are allowed to miss at most one session, provided that you make arrangements with the instructor in advance.** Being Late by more than 15 minutes will be considered an absence. Traffic delays are not considered acceptable reasons for being late to class.

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## FINAL CAPSTONE PROJECT PROPOSAL

Final Capstone project proposals should be at most 10 pages (excluding appendices) – intended to generate knowledge to address a real business problem or opportunity. Note that, if the purpose of the project is to

develop an algorithm to optimize a certain process, the algorithm is the knowledge the research process will produce.

The research proposal will be written by groups of at most three students. There will be peer evaluation of team members at the end of the quarter and the grades of free riding members will be discounted by at least 20%. Teams are responsible for both, identifying or selecting a company with a business problem/opportunity and the resources needed to carry out the research process.

You will write the proposal throughout the course in several steps. The final project proposal will put together all the sections you wrote from earlier sessions. **Therefore, it is important that you envision a solution early on to plan your proposal in a way that all sections are designed to produce that solution.** The goal of the project is to develop a coherent, concise, and realistic research proposal that, if carried out, will produce the desired knowledge. It is important that your decisions at each stage are substantiated on the basis of business context or requirements provided by the client and/or resources that are available in your readings, presented in the earlier courses you have completed in the program, or identified through literature review. Put your detailed information (e.g., description of the dataset(s)) in an appendix and submit together with the written report.

In addition to a brief executive summary of the entire proposal at the beginning, the written proposal must have the sections listed below. It is important that you write each section in a way that information reader needs to understand the issues is provided either in that or the earlier sections. Also, assume that reader is not knowledgeable on the problem, the company, and the industry.

- Problem/Opportunity Statement: Description of the business problem/opportunity. This section should also include a brief description of the current practice and business context, significance of the problem, causes of the problem, and a desired solution
- Analysis Goals: Describes the knowledge your analysis aims to produce. You should state the objectives of the analysis in this section
- Data Requirements and Identification and Definition of Variables
- Analytical Plan describing the appropriate methodologies that will be used to accomplish the analytical goals
- Expected Findings and Project Completion Plan
- References: List of sources you have consulted and that are relevant for your project.

Make sure that your writing is clear and free of grammatical and spelling mistakes and that you use APA format for citations (5 points).

## ASSIGNMENTS

There are two assignments. Assignments add up to 30 points. Submit the assignments on or before the due date on Canvas site for the course. Each assignment has sections relevant for the final project proposal. Sections in the assignments will be graded separately from the final project proposal.

Please type your assignments using R-Markdown or Jupyter Notebooks.

## LATE WORK

All assignments must be submitted to the Canvas site for the course on the due date before 11:59 pm. If you turn in an assignment late, 10% credit will be deducted from the total score for each day after the deadline. Assignments turned in more than one week late will not receive credit. In the case of unexpected events, you must contact the instructor before the assignment due date in order to receive a grace period. Students can only receive up to two grace periods in the course.

## **REQUESTING REASONABLE ACCOMODATIONS**

If you are interested in requesting disability accommodations, you may want to begin by reading through the information published on this website <https://disabilities.uchicago.edu/>. Also, please do communicate your requests as soon as possible to Gregory Moorehead, director of disability services, at 773.702.7776 or [gmoorehead@uchicago.edu](mailto:gmoorehead@uchicago.edu).

## **ACADEMIC HONESTY & PLAGIARISM**

It is contrary to justice, academic integrity, and to the spirit of intellectual inquiry to submit another's statements or ideas of work as one's own. To do so is plagiarism or cheating, offenses punishable under the University's disciplinary system. Because these offenses undercut the distinctive moral and intellectual character of the University, we take them very seriously.

Proper acknowledgment of another's ideas, whether by direct quotation or paraphrase, is expected. In particular, if any written or electronic source is consulted and material is used from that source, directly or indirectly, the source should be identified by author, title, and page number, or by website and date accessed. Any doubts about what constitutes "use" should be addressed to the instructor.

## **COURSE SCHEDULE**

**Important Note:** Changes may occur to the syllabus at the instructor's discretion. When changes are made, students will be notified via email and in-class announcement.

### **SESSION 1**

Part 1: Overview of capstone  
Introduction to the course  
Part 2: Business Problem/Opportunity statement  
Reading: Sreejesh Chapters 1- 2.

### **SESSION 2**

Part 1: Research Purpose or Goal of Analysis:  
Part 2: Research Purpose or Goal of Analysis  
Part 3: Goal of Analysis – Case Studies – Utilities, Supply Chain, Finance, Marketing  
Reading: Provost, Chapter 2. Sreejesh, Chapter 3.

### **SESSION 3:**

Part 1: Student Initial Proposal Presentations of Intro, Business Problem/Opportunity and Goals of Analysis  
Part 2: Literature review before selecting research methodology

Part 3: Selection of Research Methodology

Part 4: Case Studies – Financial SBB, Marketing, Supply Chain Risk

Reading: Sreejesh, Chapter 12. Neuman, Chapter 5; Bollen et al. - Twitter mood predicts the stock market.

#### **SESSION 4**

Part 1: Primary data collection techniques. Experimental design

Part 2: Survey design. Sampling, Population, Sample, Sample size

Part 3: Case Studies – Finance, Marketing, Business Risk

Reading: 7. Neuman, Chapter 9. Gideon chapters 4(optional), 5, 6(optional)

#### **SESSION 5**

Part 1: Student Intermediate Proposal Presentations: Literature Review, Data, Sampling, and Methodology

Part 2: Quantitative research methodologies: Case studies in Designing Experiments – Treatment and Control

Part 3: Assessing data requirements, identification and definition of variables

Part 4: Case studies in Development of metrics, measures, scales

Reading: Sreejesh, Chapter 4-5. Peter, P.J. - Construct Validity: A Review of Basic Issues and Marketing Practices.

#### **SESSION 6**

Part 1: Quantitative research methodologies, Designing Smart Experiments

Part 2: Working with secondary data sources

Reading: Ghauri, Chapter 7, Sreejesh Chapter 6.

#### **SESSION 7**

Part 1: Quantitative methodologies: ANOVA, ANCOVA, and Propensity Score Analysis

Part 2: Quantitative methodologies for analyzing data that has measurement error

Reading: Gideon chapters 4(optional), 5, 6(optional), 7. Neuman, Chapter 9.

#### **SESSION 8**

Part 1: Overview of Quantitative Methodologies and modeling

Part 2: Model evaluation and validation, Bias, Variance, Relationship to Model Validation

Reading: Ghauri, Chapter 12

#### **SESSION 9**

Part 1: Interpretation and communication of research and analysis findings

Part 2: Class discussion on the projects

Reading: Provost, Chapter 5 and 7 and Sreejesh Chapter 12

#### **SESSION 10**

Team presentations of the Final Proposals by each team.

Final Capstone Project Proposal due by Sunday of the week.

### **IN-CLASS PRESENTATIONS**

#### **Initial Presentation Week 3:**

1. Client Introduction/Background
2. Business Problem/Opportunity Statement

3. Analysis Goals or Research Purpose
4. **Due Sunday at 11:59 PM week of Session 3**

**Intermediate Presentation Week 5:**

1. Client Introduction/Background (Revised)
2. Business Problem/Opportunity Statement (Revised)
3. Analysis Goals or Research Purpose (Revised)
4. Sampling, Data collection (including any experimental design, if needed)
5. Data requirements and identification and definition of variables
6. Quantitative Methodology
7. **Due Sunday at 11:59 PM week of Session 5**

**Final Presentation Week 10:**

1. Client Introduction/Background (Revised)
2. Business Problem/Opportunity Statement (Revised)
3. Analysis Goals or Research Purpose (Revised)
4. Sampling, Data collection (including any experimental design, if needed) (Revised)
5. Data requirements and identification and definition of variables (Revised)
6. Quantitative methodology – Analytical plan including models and methods (Revised)
7. Methodology for Model evaluation and validation
8. Expected Findings
9. Project completion plan
- **Due Sunday at 11:59 PM week of Session 10**

**WRITTEN PROPSAL**

**Written Proposal:**

- Client Introduction/Background
- Business Problem/Opportunity Statement
- Analysis Goals or Research Purpose
- Sampling, Data collection (including any experimental design, if needed)
- Data requirements and identification and definition of variables
- Quantitative methodology – Analytical plan including models and methods
- Methodology for Model evaluation and validation
- Expected Findings
- Project completion plan
- **Due Sunday at 11:59 PM week of Session 10**

**Mega Capstone Projects: The process (May not be applicable to some sections or some students)**

*Some groups may work to develop a Capstone project proposal that addresses a sub-problem related to a larger business issue or opportunity (Mega Project) sponsored by our Business Partner. The mega project is a larger-scale project that presents multi-dimensional challenges and opportunities in application of data science and advanced analytical methodologies. It is called a Mega Project since the business problem/opportunity it represents is so*



*broad in scope and complex in nature, that solutions are accomplished by combining the solutions from its smaller sub-pieces. The mega project, when solved completely with the combined efforts of the individual Capstone teams working both independently (on their respective sub-problems) and collaboratively (in combining their results into a final overall solution for the client), will have significant business impact to the client.*

*The MScA team that consists of the program director and a faculty member who will serve as advisor for the teams, have already worked with the client to finalize the Problem definition. The MScA team has also divided the Mega Problem into several smaller problems (micro-problems) that could be addressed independently. Each Capstone team in this course will select a micro-problem to work on, with the guidance of the faculty advisor and the Instructor of the Research Design course.*

*In addition to the learning objectives listed above, the Mega Project aims to achieve the following learning objectives.*

- *Ability to collaborate with others to create a collective analytics solution*
- *Document the analytics process and related code and make sure that research findings are reproducible.*

*Each Capstone team will complete the Mega Project using the following Capstone process.*

**Step 1 (first quarter) Proposal Development (Research Design for Business Application course):** *Each team will develop a proposal with a detailed description of the solution for the selected micro-problem as part of the Research Design course. The proposals also include data requirements and the methodology that would support the solution, as well as a project completion plan. Faculty advisor and the instructors of the course assure that proposed methodologies across teams are compatible with each other to be part of the solution for the Mega Problem when combined.*

*Each Capstone team will produce a research proposal (at most 10 pages, with Appendices and references) The research proposal will be written by groups of at most three students. There will be peer evaluation of team members at the end of the quarter and the grades of free riding members will be discounted by at least 20%.*

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**Step 2 (second quarter) Preparing the Data for Analytics:** *Teams create the smallest number of data marts as possible to support the data requirements of all teams with the guidance of the faculty advisor. For instance, one data mart might be a cross-sectional data set where all variables are aggregated over a given time period (e.g., year) by each unit (e.g., customer), whereas another data mart might be in the form of time series of selected variables that might be aggregated by smaller units (e.g., month) per unit or segments of units. This is a collaborative process across teams where the data are cleaned, as well as missing values and outliers are handled as necessary. Deliverable at this step is a presentation of results aiming to understand the insights as revealed by the data.*

**Step 3 (second quarter) Modeling:** *Teams implement the proposed methodology with the guidance of the faculty advisor. Faculty advisor makes sure that the solutions developed by different teams are revised as necessary while remaining compatible with each other. Teams will present their results and submit a Capstone Implementation Report at the end of the quarter. The approved implementation reports will be shared with client.*

**Step 4 (third quarter) Capstone Writing:** *Each team writes a report summarizing their solution in a way that the solution becomes part of a larger report. At the end, teams work collaboratively to integrate their solutions towards the ultimate solution for the Mega Problem to produce one report and one presentation. The final capstone report, presentation, and code will be shared with the client.*

*The client will be invited to participate in discussions following the presentations of results obtained at the middle of quarter aiming to evaluate effectiveness of the solution, and to participate in the final Capstone Showcase at the end of the quarter.*