Harvard Extension School
HARVARD DIVISION OF CONTINUING EDUCATION

CSCI E-96
Data Mining for Business

Spring Term 2026

Full syllabus displayed to registered students only (HarvardKey login required)

****This note confirms full syllabus is now displayed****

Course Information

CRN: 26599
Section Number: 1
Format: Flexible Attendance Web Conference
Credit Status: Undergraduate, Graduate, Noncredit
Credit Hours: 4

Class Meetings: Mondays, January 26-May 16, 8:10pm-10:10pm

Course Description: This course introduces non-mathematical business professionals to data science principles widely used in today's corporations. Quantitative methods affect many of today's interactions for business leaders, students, and consumers. Emphasis is placed on practical uses and case studies utilizing data to inform business decisions rather than theoretical or complex mathematics. Case study topics include understanding customer demand, marketing, new market forecasting, revenue projections, and data mining to improve decisions. Learning goals include quantitative business application, basic programming, algorithm development, and process workflow. The course highlights methods that business leaders and data scientists have found to be the most useful. It introduces the basic concepts of R for data mining. This course is for students who want an introduction to how data science improves business outcomes.

Prerequisites: Since this course utilizes R throughout the semester students should

complete the 4-hour free online course *Introduction to R* at DataCamp.com found here: https://www.datacamp.com/courses/free-introduction-to-r.

Instructor Information & Office Hours

Edward Kwartler
Email: edwardkwartler@fas.harvard.edu

Course Goals / Learning Outcomes

If you stay engaged in the course and complete the suggested code challenges and assignments:

You will be able to think systematically about how data is used to make business decisions. This objective will be accomplished through the use of ideas from statistics, economics, and computer technology and using business-related case studies.

Students will learn how to implement a variety of popular data mining algorithms in R (a free and open-source software) to tackle business problems and identify opportunities. This course will help introduce the basics of R in data mining.

As a business leader, you will acquire the skill of applying data science concepts within business domains to improve decisions and learn how data scientists approach projects.

As a data scientist, you will acquire practical applications of data mining methods that are used in many of today's most successful organizations as well as understand what business stakeholders expect of data scientists.

Due to system issues, I cannot remove the DataCamp course above. Further that course is now pay walled! Instead, please review these three videos to help get you up to speed with the basics of R.

https://www.youtube.com/watch?v=FY8BISK5DpM&ab_channel=RProgramming101

https://www.youtube.com/watch?v=e8B9YU_M5FM&ab_channel=RProgramming101

https://www.youtube.com/watch?v=VtUVQWl0aRA&ab_channel=RProgramming101

Mode of Attendance & Participation Policy

This is a flexible attendance course, which means you can choose to: (1) attend class live over Zoom (synchronous option); or (2) watch the class recording afterward (asynchronous option). You do not need to commit to the same mode of attendance for the whole semester.

If you are attending live over Zoom:

- **Select "Zoom" in the Canvas course website to join class meetings**

Please arrive on time. You should attend Zoom meetings with a functional web-camera and microphone, prepared with materials needed, to engage thoughtfully, and with your camera on. You may turn off your camera for occasional interruptions or momentarily for privacy.

You will also need the most up-to-date Zoom client installed on your computer to join class. Please participate from a safe and appropriate environment with appropriate clothing for class. Participating while traveling or in a car is not permitted. In addition, please do not join class via mobile phone or web browser.

If you are participating asynchronously:

You are expected to watch the class recording, available in Canvas, and complete any assignments before the next live class meets.

Please be sure to review important information on **Student Policies and Conduct**.

Assignments & Grading

A course grade will be assigned based on student performance on case studies and applicable homework assignments (undergraduate).

Assignments are accepted up to 12 hours late. Any work submitted after the deadline but before 12 additional hours will be penalized 10% of the total weight of the assignment. **After 12 hours no late submissions will be accepted under ANY circumstances.** Pupils are expected to manage their own time and submit their work accordingly. Failure to

submit submissions through the University approved portal by the assignment deadline will be considered late and not accepted. **Submissions to any other location will not be accepted.**

Graduate Level Assignments

Skills Assessment: 0% (optional for grad students): Complete and turn in an R script of all tasks within the preparatory video here: https://www.youtube.com/watch?v=eR-XRSKsuR4

Case I 20%: Retail Transactions EDA

Prompt Design Assignment 5%: Generative Agent Negotiation System Prompt and Initial Prompt

Case II 25%: Banking Case Customer Propensity

Case III 50%: Vienna Coffeehouse Product Forecasting

Extra Credit: Homework II Visualization in R 1% of total grade

Undergraduate Level Assignments

Skills Assessment: 0%: Complete and turn in an R script of all tasks within the preparatory video here: https://www.youtube.com/watch?v=eR-XRSKsuR4

Case I 20%: Retail Transactions EDA

Prompt Design Assignment 5%: Generative Agent Negotiation System Prompt and Initial Prompt

Case Case II 25%: Banking Case Customer Propensity

Homework I: 10% Intro to R script - listed in class repository

Homework II: 20% Visualization in R script - listed in class repository

Homework III: 20% Obtain 2 AI/Data Ethics related articles (https://incidentdatabase.ai is a good resource). Perform the following tasks for each article.

- Use ChatGPT to summarize the article
- Critique the summarization as appropriate, inappropriate, missing relevant facts, creating or citing information from outside the article etc. in a single paragraph.
- Cite the gaps in understanding from the technology you note to provide a more nuanced understanding
- Write 1-3 paragraph(s) WITHOUT GPT with your personal reflection on the use or misuse of the technology cited in the article. In the paragraph suggest ways to mitigate or monitor to protect against the issue within the article.

Case Work Product & Expectations

Each case will have a description and specific instructions provided through the course github repository.

Each student will work on case studies individually. Each case will have the following work artifacts:

- Maximum ~10min recorded slide presentation uploaded to youtube (provide the link in your Canvas submission), embedded as a voiceover in the slides, zoom recording or shared in a similarly appropriate manner to Canvas. The presentation will outline the business problem, the insights identified, describe the data and the outcomes/recommendations satisfying the case. **The use of an AI avatar is NOT permitted. It must be your presentation and voice.**
- Slide presentation uploaded to Canvas (pptx file for example), R Script(s) supporting the creation of any visuals, models or recommendations made during the presentation.
- At least one case requires predictions be made on new data. For example, "identify the top 100 prospective customers". If mentioned in the specific case instructions, please score, identify the appropriate observations, save results in a CSV and submit that file as well.
- A Written Business Report: Submit something to represent the entirety of your presentation including the data, process, findings, and implications. Thus it's a professional report, anything less than a professionally written and organized report will be considered sub-optimal. Amazon for example doesn't use PowerPoint and instead uses "6 pagers" to make business recommendations, as such some

organizations prefer written information over presentations. The use of external and verifiable sources is expected to add context and support any component of the paper. The minimum is 2 pages maximum is 5. Double spaced and 12 point font.

Essentially all supporting material to satisfy the case including scripts, visuals, presentation slides, data tables and/or written document will need to be turned in for review.

Case Evaluation

Organization – Was the presentation well organized?

Delivery – Was the content delivered clearly and persuasively with the audience in mind?

Code Documentation – Was the data mined to support the conclusion?

Written Supplemental – Is the information clear and supported in narration and code? Did the information satisfy the case problem?

Data Mining & Modeling Process – Overall, as a complete portfolio of work, is the topic interesting, organized, researched, supported and delivered effectively? Was CRISP-DM, SEMMA, or a similar workflow followed to organize the work?

Grade Definitions

Students registered for undergraduate or graduate credit who complete the requirements of a course may earn one of the following grades:

A Earned by work whose superior quality indicates a full mastery of the subject—and in the case of A, work of extraordinary distinction. There is no grade of A+.

B+, B Earned by work that indicates a strong comprehension of the course material, a good command of the skills needed to work with the course materials, and the student's full engagement with the course requirements and activities.

C+, C Earned by work that indicates an adequate and satisfactory comprehension of the course material and the skills needed to work with the course materials, and that indicates that the student has met the basic requirements for completing assigned work and participating in class activities.

D+, D Earned by work that is unsatisfactory but that indicates some minimal command of the course materials and some minimal participation in class activities that is worthy of course credit.

E Earned by work that is unsatisfactory and unworthy of course credit. This grade may also be assigned to students who do not submit required work in courses from which they have not officially withdrawn by the withdrawal deadline. Zero or E grades are assigned to students for missing work. These grades are included in the calculation of the final grade.

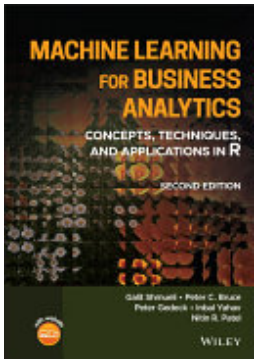
It is the belief of the instructor that minus grades constitute a false precision in many academic courses and further penalize frequent "A-" students since there is no way to obtain an "A+" to rebalance a GPA. To the student's benefit, one can still earn a "plus" on their final grade according to the scale above.

See Grades & Grading System for additional information.

Graduate Credit Requirements

See "Assignments & Grading," above.

Course Materials



Machine Learning for Business Analytics
ISBN: 9781119835172
Authors: Galit Shmueli, Peter C. Bruce, Peter Gedeck, Inbal Yahav, Nitin R. Patel
MACHINE LEARNING FOR BUSINESS ANALYTICS Machine learning —also known as data mining or data analytics— is a fundamental part of data science. It is used by organizations in a wide variety of arenas to turn raw data into actionable information. Machine Learning for Business Analytics: Concepts, Techniques, and Applications in R provides a comprehensive introduction and an overview of this methodology. This best-selling textbook covers both statistical and machine learning algorithms for prediction, classification, visualization, dimension

reduction, rule mining, recommendations, clustering, text mining, experimentation, and network analytics. Along with hands-on exercises and real-life case studies, it also discusses managerial and ethical issues for responsible use of machine learning techniques. This is the second R edition of Machine Learning for Business Analytics. This edition also includes: A new co-author, Peter Gedeck, who brings over 20 years of experience in machine learning using R An expanded chapter focused on discussion of deep learning techniques A new chapter on experimental feedback techniques including A/B testing, uplift modeling, and reinforcement learning A new chapter on responsible data science Updates and new material based on feedback from instructors teaching MBA, Masters in Business Analytics and related programs, undergraduate, diploma and executive courses, and from their students A full chapter devoted to relevant case studies with more than a dozen cases demonstrating applications for the machine learning techniques End-of-chapter exercises that help readers gauge and expand their comprehension and competency of the material presented A companion website with more than two dozen data sets, and instructor materials including exercise solutions, slides, and case solutions This textbook is an ideal resource for upper-level undergraduate and graduate level courses in data science, predictive analytics, and business analytics. It is also an excellent reference for analysts, researchers, and data science practitioners working with quantitative data in management, finance, marketing, operations management, information systems, computer science, and information technology.
Publisher: John Wiley & Sons
Publication Date: 2023-03-08
Edition: 2nd
The book is optional.

This textbook has some overlap with lessons and should be purchased by students wishing to expand beyond lessons to add additional fluency and technical knowledge.

Community Charter

By enrolling in courses offered by the Harvard University Division of Continuing Education (DCE), individuals agree to abide by our community standards to promote a culture of trust, cooperation, mutual understanding, and learning.

Members of the DCE community, including students, faculty, and staff, are expected to treat each other with dignity and communicate respectfully and appropriately across all channels. When using social media or other forms of communication designed to reach members of the public, no one should repeat an oral or written statement made in class in a way that would identify the person who made the statement.

Our commitment to academic integrity and excellence includes holding ourselves accountable for our actions. Violations of these community standards may result in disciplinary actions. DCE adheres to all University-wide policies that address discrimination, bullying, and harassment. Resources including the Office for Community Support, Non-Discrimination, Rights and Responsibilities (CSNDR) and the Harvard Ombuds Office are available to assist community members with concerns.

Academic Integrity Policy

You are responsible for understanding Harvard Extension School policies on Academic Integrity and how to use sources responsibly. Violations of academic integrity are taken very seriously. Visit Using Sources Effectively and Responsibly and the Harvard Guide to Using Sources to review important information on academic citation rules.

AI Technologies Policy

This course encourages students to explore the use of generative artificial intelligence (GAI) tools such as ChatGPT for all assignments and assessments. **Any such use must be appropriately acknowledged and cited**. It is each student's responsibility to assess the validity and applicability of any GAI output that is submitted; you bear the final responsibility. Violations of this policy will be considered academic misconduct. We draw your attention to the fact that different classes at Harvard could implement different AI policies, and it is the student's responsibility to conform to expectations for each course.

Writing Code

While it may be common practice in non-academic settings to adapt code examples found online or in texts, this is not the case in academia. In particular, you should never copy code produced as coursework by other students, whether in the current term or a previous term; nor may you provide work for other students to use. Copying code from another student or any other source is a form of academic dishonesty, as is deriving a program substantially from the work of another.

Writing code is similar to academic writing in that when you use or adapt code developed by someone else as part of your assigned coursework, you must cite your source. Paraphrasing without proper citation is just as dishonest with programming as it is with prose. A program can be considered plagiarized even though no single line is identical to any line of the source.

Turnitin

At the instructor's discretion, this course may use Turnitin, a text-matching software that assists with plagiarism detection. By enrolling in this course, you consent to the submission of your assignments to Turnitin. Turnitin integrates with Canvas and does not require students to take additional steps to submit assignments. More information about Turnitin is available on the Extension School Academic Integrity webpage.

Accessibility Services Policy

The Division of Continuing Education (DCE) is committed to providing an accessible academic community. The Accessibility Services Office (ASO) is responsible for providing accommodations to students with disabilities. Students must request accommodations or adjustments through the ASO. Instructors cannot grant accommodation requests without prior ASO approval. It is imperative to be in touch with the ASO as soon as possible to avoid delays in the provision of accommodation.

DCE takes student privacy seriously. Any medical documentation should be provided directly to the ASO if a substantial accommodation is required. If you miss class due to a short-term illness, notify your instructor and/or TA but do not include a doctor's note. Course staff will not request, accept, or review doctor's notes or other medical documentation. For more information, email accessibility@extension.harvard.edu.

Publishing or Distributing Course Materials Policy

Students may not post, publish, sell, or otherwise distribute course materials without the written permission of the course instructor. Such materials include, but are not limited to, the following: lecture notes, lecture slides, video, or audio recordings, assignments, problem sets, examinations, other students' work, and answer keys. Students who sell, post, publish, or distribute course materials without written permission, whether for the purposes of soliciting answers or otherwise, may be subject to disciplinary action, up to and including requirement to withdraw. Further, students may not make video or audio recordings of class sessions for their own use without written permission of the instructor.

Canvas Access After End of Term

You may access your Canvas course website for approximately **six months** after the term ends. At that time, course websites are removed from your Canvas account, and you can no longer view or access course materials. **You are encouraged to download coursework and materials you wish to keep before your access expires.**

Syllabi of DCE courses you completed remain available through the Simple Syllabus library (HarvardKey login required).

Class Meeting Schedule

Class lessons may be adjusted to accommodate cohort learning rate.

January 26: Class 1 Introduction to R & software set up

We will set up our development environment on your local laptops & explain how each of the software components are used. The class will execute some basic code examples.

February 2: Class 2 Introduction to Data Mining & Basic Exploratory Data Analysis (EDA)

We introduce more coding concepts including data types & functions. Then we start to get summary statistics and build visualizations based on data.

February 9: Class 3 Visualizations Practice & More EDA

The class will join data sets, and build more robust and interesting visualizations as part of more sophisticated EDA.

February 16: NO CLASS (University holiday)

February 23: Class 4 LLM Prompting & Data Mining Workflow

In this lesson, the class will learn how GPT models work. We will discuss best practices for prompting, and how this technology can be useful. Our objective is to set the class up with an understanding of how this technology can support their work the rest of the semester

March 2: Class 5 Regression & Logistic Regression

The class will learn the basics of linear regression and how this traditional model can still be useful for solving business problems. The class will follow code and execute the steps of a model fit including future predictions after cleaning up realistic business data.

March 9: Class 6 Decision Trees & Random Forest

Students will conceptually learn how a decision tree and random forest learn patterns within a data set. The class will build and evaluate real machine learning or "AI" models in a business context using all the code, data cleaning, EDA and machine learning methods learned to date.

March 16: *Spring Break* - NO CLASS

March 23: Class 7 Time Series

The class will learn about a new data class called time series which is useful in demand forecasting. Code and explanations are given for predicting quarterly revenue and other time series so students learn the basics of this robust field and how to identify when data has a temporal element.

March 30: Class 8 Working with Application Programming Interface

The class starts with a discussion of APIs, showing how an R session can interact with LLMs and other services programmatically. Time permitting we will create single page applications with LLMs coding the front-end.

April 6: Class 9 Equities

Students will use an API to obtain stock trading data and learn basic methods of algorithmic trading. The goal is not to make day-traders of the participants but to showcase how markets are highly efficient and technically supported despite retail investors being naive to technical trading rules and methods.

April 13: Class 10 Credit Modeling & Non-traditional Market Investing

The class covers building models to predict individual investment outcomes then selecting optimal investments based on the relationship between risk & reward. Next, a simple simulation is constructed to mimic a non-traditional investment market investing in collectible trading cards so an investor can understand the outcomes before risking capital.

April 20: Class 11 Text Mining & Natural Language Processing 1

As a new data type for the class, we explore how to extract insights and frequent phrases from text. As a basic primer on natural language processing we discuss and demonstrate code for "bag of words" methods.

April 27: Class 12 Text Mining & Natural Language Processing 2

We expand on the previous NLP lesson to include sentiment analysis & time permitting unsupervised methods to identify topics, and document classes a mixture of tools such as spherical K-Means, LDA topic modeling or API LLM evaluation.

May 4: Class 13 AI Industry Dynamics

The AI industry is unlike most we've experienced both professionally and as consumers. This presentation will explain the underlying structure, the major companies and resulting impacts of this growing, and some would say over-hyped industry.

May 11: Technology Ethics (final class)

Technology ethics, and how to think about the responsible use of technology are paramount in this AI driven world. As practitioners and consumers are affected by AI, it is important to have a grasp of the technology, its limitations and how to ethically apply these technologies. This lesson covers some basic tenets of responsible AI and students

will purposefully build a sexist resume tool then apply methods to identify this unjust (and illegal) model behavior.