95851-A1

Course Syllabus: Making Products Count - Data Science for Product Managers (DSPM) – 94-851/451

- Fall 2024, Mini 1
- Lectures T/TH 9:30 – 10:50 AM Hamburg Hall (HBH) – 2008
- Recitation F 11:00 – 12:20 PM Hamburg Hall (HBH) – 1005
- Professor: Ari Lightman, **aligh@andrew.cmu.edu (mailto:aligh@andrew.cmu.edu)**
- Teaching Assistants
  - Shreya Tallam, **stallam@andrew.cmu.edu (mailto:stallam@andrew.cmu.edu)**
    Office Hours: Monday and Wednesday 12:00pm - 1:00pm, **Zoom Link** ⤵
    (https://cmu.zoom.us/j/5322123530)
  - Atharva Kulkarni, **askulka2@andrew.cmu.edu (mailto:askulka2@andrew.cmu.edu)**

Course Rationale:

The idea of Product Management dates back to P&G in the mid-1920s. There was a need for professionals to work across different departments (marketing, engineering, operations) to ensure the right products get to the right set of customers. In addition, these products would have features and functions in demand by consumers and moreover match the capabilities and competencies of the organization producing them. Also, they would need to ensure adequate supply and distribution channels for the product commensurate with market demand. Today, Product Manager need a variety of skillsets and acumen to ensure products can get adequately developed, deployed, utilized and eventually disposed of safely and environmentally. Increasingly, a greater level of digital components and functions are added into physical products while higher level computation (AI) are added into software for both business and consumer use. As more digitization occurs, new challenges are emerging that today's product managers need to address namely: privacy, security, ethical use, IP issues, and adoption patterns.

Historically, Product Managers relied on what information they could gather from observation, focus groups and other manually intensive

ways of collecting information. As products became increasingly complex and the market space became increasingly fragmented, mis alignment with everything from product direction to customer value led to product failures. Today, there is a seeming less endless supply of multi-modal data that

product managers can use to inform their decisions and optimize their processes creating additional value for their organization and their consumers. How and why, they use this data to inform their decisions is a central theme of this course.

Course Summary:

This course is not a theoretical data science class. It is a course designed to understand the use and application of data science processes and techniques for effective product management. Recent developments in data science, combining the increasing availability of data from internal and external sources with new algorithms that exploit that data at scale, offer new possibilities bringing quantitative assessment, efficiency, targeting and resiliency to product management decisions.

This course is for students interested in an introduction to the application of data science to product management. It is also geared for student who have an interest in the function of product management and current issues and resolutions associated with modern day product management. We will be using real world issues (semi- experiential learning) facing product managers and you will be responsible for understanding, assessing and developing recommendations using data analysis. It is expected that students in the class will have some basic background in statistics and programming. Python (similarly to excel) will be used as a platform in the class to conduct data analysis. However, please note this is not a Python class. There are several classes at Heinz and across CMU if you wish to advance Python skills.

- Students may wish to review the fundamentals of statistics and probability in the free online learning class at https://oli.cmu.edu/courses/probability-statistics-open-free/.

- Students who are unfamiliar with or would like refresh their Python skills will get access to online tutorials in **DataCamp** ⤴ **(https://app.datacamp.com/groups/data-science-for-product-management/dashboard)** to build up their Python skills.

Course Outcomes:

The main objectives of this class are to provide students:

- Understanding of the role of product management and key decision points within the product life cycles as well as their effect
- Work through issues facing product managers to understand impact of using data techniques to increase targeting, specificity and value outcomes
- Select and apply a broad set of metrics, modeling and visualizations to guide product management decisions
- Plan and execute a product management plan to inform product management decision demonstrating an understanding and application of objectives #1 - 3

Instructor: Ari Lightman (MBA, MEng, BSc)

I have had the pleasure of being on the faculty of the Heinz College since 2011. I teach a variety of classes that incorporate simulated and experiential learning at the intersection of digitization, human behavior and data driven decision making including digital transformation, applied strategic marketing and Measuring Social. The latter is an experiential learning class where students work with sponsors (well- known brands) on how to gather, interpret and drive decisions using unstructured social data. I have an affiliation with CS as an advisor and PI for the Center for Machine Learning and Health (CMLH) and the Institute for Patient Safety Research (IPSR). I also work with both Heinz and Tepper directing and teaching within several executive education programs. Prior to CMU, I was a management consultant at one of the big 4 consulting firms and a member of 4 different startups where I held

titles of business development, sales, and product management. In relation to this class, I held the role of product manager for three different organizations: a robotics startup, a telecom integration SW provider and a web- based SW provider for higher ed.

Course Resources:

There will be no required texts to purchase for this course, but two references are recommended, both of which are available online for free through the library.

- Grus, Data Science from Scratch: First Principles with Python, 2019 (Second edition), O'Reilly (see CMU Library)
- Transformed: Moving to the Product Operating Model Wiley 2024 (see CMU Library)
- Online articles as listed in the course outline below will supplement these texts.

Materials for the class, online discussions and submission of materials will take place through our Canvas Site. There is also a Piazza add on linked to the Canvas site. To enroll, please use the link. Rather than emailing questions, students are encouraged to post on Piazza.

Course Grading:

Grading for the course will be as follows: 5%   - Initial Python proficiency exercise

60% - 3 HW assignments, 3 total at 20% (Individual) 20% - Final Project (Team Based)

10% - Class attendance and Engagement

5%   - Mid-Point quiz

HW are due at midnight (EST). Late assignments (without a written excuse for medical of family emergencies) will be penalized at the rate of 10% of the assignment's grade per day late. In-person attendance is required for credit for class participation; limited exceptions will be made for medical reasons. One absence (with advance notice) is permitted, with further absences causing a proportional deduction in the class participation grade.

Note: There is no final exam for this class.

The code and results for homework assignments should be submitted in the form using Jupyter notebooks that we can run while grading. Use the file name convention DSPM_HW<HW #>_ <AndrewID>.ipynb, e.g.

DSPM_HW2_lightman.ipynb. Within the Python code, file references should assume that the data file is in the same directory as the notebook (no hard-coded references to your personal directory structure), and keep the data file names as described in the assignment. You do not need to submit the data file. You may also submit a .pdf or word document writeup (recommended) to accompany the notebook.

Please include comments in your Jupyter notebooks to show what you've done. You need not do it for every cell, just where necessary. For those new to Jupyter, you could just use '#' to comment in the cells. You may use Markdown (go to Code drop down-->Markdown) to write your answers for reasoning-based questions (no need for hashtags here). You could even make use of HTML tags like <h1>,<h2>... for headers(size in decreasing order) and <br> for a new line.

Grading will be on a straight scale (no rounding up) as follows:

A+	98.0-100%	B+	88.0-89.9%	C+	78.0-79.9%
A	92.0-97.9%	B	82.0-87.9%	C	72.0-77.9%
A-	90.0-91.9%	B-	80.0-81.9%	C-	70.0-71.9%

Everyone taking the class should expect to register for a letter grade. Auditing the class or taking the class Pass/Fail are intended for extremely rare circumstances and only with consent of the instructor.

Course Outline:

This course is planned around fourteen classes that will be taught in-person in Hamburg Hall 2008. Guest lecturer and alumni panel will complement the learning from the course. Starting in week 3,

time will be allocated for teams to work on a critical thinking exercise focused on disruption in the product management space. There will also be recitations on Friday in Hamburg Hall 1005.

Class and recitation in in person attendance is not mandatory, however it is highly encouraged as Python material will be presented and team exercises will be provided.

Week 1: (Lecture 8/27 & 29; Recitation 8/30): Introductions and the role of Product Management (PM)

- Topics
  - Introductions
  - Structure of the class
  - Role of the PM
  - Fundamentals of PM
  - Frameworks – Industry, Product, Positioning, PM specific
  - Business Model Canvas
  - Friday recitation: Python review
- Readings
  - **The Fundamentals of Modern Product** ⤷ **(https://www.pendo.io/resources/the-fundamentals-of-modern-product-management/)** Management - Pendo
  - Transformed: Moving to the Product Operating Model Wiley 2024 – Chapter 10, Product Managers (see CMU Library)
- Assignments Out
  - Python proficiency exercise
  - HW1

Week 2 (Lecture 9/3 and 5, Recitation 9/6): Metrics and Data for PM

- Topics
  - Understanding and Assessing data sources
  - Metrics, Assessments, Analysis
  - Consumer Behavior
  - Customer lifetime value (CLV)
  - Friday recitation: Customer lifetime value
- Readings

- Grus, Chapter 10, "Working with Data"
- Qualtrics, **The Customer Behavior Analysis Guide** ↪ **(https://www.qualtrics.com/en-au/experience-management/customer/customer-behaviour-analysis/)**
- Assignment
  - Python proficiency exercise (9/5)

Week 3 (Lectures 9/10 & 12; Recitation 9/13): Customer Segmentation and Product Feature Selection

- Topics
  - Customer segmentation
  - Supervised and Unsupervised learning
  - Selecting the right features and functions – QFD
  - Friday recitation: Machine learning for market segmentation
- Readings
  - Lifecycle of Machine Learning Models – Oracle (on canvas)
  - L A. Alzahran , "Customer Segmentation: Unsupervised Machine Learning Algorithms In Python", Jul 14, 2021,

- Assignment
  - HW 1 (due 9/12)

Week 4 (Lectures 9/17 and 19; Recitation 9/20): Analyzing Customer Feedback

- Topics
  - Social media listening
  - Natural language processing (NLP)
  - Surveys, Focus Groups, Ethnographic Research
  - Large language models
  - Friday recitation: Large language models for customer feedback

- Guest Lecture – Anupam Singh, Founder, President, 113 Industries

- Readings:
    - Lee and S. Trott, "A jargon-free explanation of how AI large language models work," July 31, 2023,
    - Grus, Data Science from Scratch, 23, "Natural Language Processing," (pp. 279-293)

Week 5 (Lectures 9/24 and 26, Recitation 9/27): Demand Forecasting; Web Analytics and A/B Testing

- Topics
    - Quiz (9/24)
    - Demand forecasting
    - Clickstream analytics
    - A/B testing
    - Friday recitation: Clickstream analytics

- Readings
    - Schur, "Demand forecast with different data science approaches", March 15, 2021
    - WVO's **A/B Testing Guide** ⊟ **(https://vwo.com/ab-testing/)**
    - Hostfully, **An In-Depth Guide to Airbnb Smart Pricing [+ Alternatives]** ⊟ **(https://www.hostfully.com/blog/airbnb-smart-pricing-and-alternatives/)**
    - Mitra, Soumyadeb, **Clickstream Data Mining Techniques: An Introduction** ⊟ **(https://www.rudderstack.com/blog/data-mining-for-clickstream-analytics/)**

- Assignment
    - HW2 due (9/26)

Week 6 (Lectures 10/1 & 10/3, Recitation 10/4): Pricing & Managing Data Science Products

- Topics
    - Price elasticity and optimization
    - Managing AI / data science products

- Alumni Panel – Path to PM, Skills, AI

- Readings
  - Cagan and Nika, **AI Product Management** ⬈ **(https://www.svpg.com/ai-product-management/)**
    , April 2024 (I would recommend bookmarking SPVG even signing up for their newsletter).

- Assignment
  - HW3 due (10/3)

Week 7 (10/8 and 10, no recitation): Final Presentations

- Topics
  - Final project presentations
- Assignment
  - Final project reports due (10/18)

Academic Integrity

Students are expected to strictly follow Carnegie Mellon University rules of academic integrity in this course. This means that unless otherwise specified, homework is to be the work of the individual student using only permitted material and without any cooperation of other students or third parties. It also means that usage of work by others is only permitted in the form of quotations and any such quotation must be distinctively marked to enable identification of the student's own work and own ideas. All external sources used must be properly cited, including author name(s), publication title, year of publication, and a complete reference needed for retrieval. The same work may not be submitted for credit in multiple courses. Violations will be penalized as mandated by CMU policies. Please reach out to us for any issues associated with citation and

In general, GenAI tools are allowable for content ideation but not generation. The use of generative AI must be appropriately acknowledged and cited. For instance, if you generated the whole document through ChatGPT and edited it for accuracy, your submitted work would need to include a note such as "I generated this work through Chat GPT and edited the content for accuracy." Paraphrasing or quoting smaller samples of AI generated content must be appropriately acknowledged and cited, following the guidelines established by the APA Style Guide. It is each student's responsibility to assess the validity and applicability of any AI output that is submitted. You may not earn full credit if inaccurate or invalid information is found in your work.

Deviations from the guidelines above will be considered violations of CMUs academic integrity policy. Note that expectations for "plagiarism, cheating, and acceptable assistance" on student work may vary across your courses and instructors. Please email me if you have questions regarding what is permissible.

Some thoughts on Diversity

To be successful in today's work environment, it is critical to work productively and effectively with people from all backgrounds, perspectives and capabilities. It is my intent to model that environment in the class and that students from all diverse backgrounds and perspectives be well served by this course. In addition, student learning needs be addressed both in and out of class and the diversity that students bring to this class should be viewed as a resource, strength and benefit. It is my intent to present materials and activities that are respectful of diversity: gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture. Your suggestions are encouraged and appreciated. Please let me know ways to improve the effectiveness of the course for you personally or for other students or student groups.

Academic Integrity

Students are expected to strictly follow Carnegie Mellon University rules of academic integrity in this course. This means in particular that unless otherwise specified, homework are to be the work of the individual student using only permitted material and without any cooperation of other students or third parties. It also means that usage of work by others is only permitted in the form of quotations and any such quotation must be distinctively marked to enable identification of the student's own work and own ideas. All external sources used must be properly cited, including author name(s), publication title, year of publication, and a complete reference needed for retrieval. The same work may not be submitted for credit in multiple courses. Violations will be penalized to the full extent mandated by the CMU policies. There will be no exceptions.

HW#3 will encourage the use of generative artificial intelligence (AI) tools, such as ChatGPT. When AI use is permissible, it will be clearly stated in the assignment prompt posted in Canvas. For HW#1 and #2, use of generative AI is disallowed. For the final project, use of generative AI is permitted, but the use of generative AI must be appropriately acknowledged and cited. For instance, if you generated the whole

document through ChatGPT and edited it for accuracy, your submitted work would need to include a note such as "I generated this work through Chat GPT and edited the content for accuracy." Paraphrasing or quoting smaller samples of AI generated content must be appropriately acknowledged and cited, following the guidelines established by the APA Style Guide. It is each student's responsibility to assess the validity and applicability of any AI output that is submitted. You may not earn full credit if inaccurate on invalid information is found in your work.

Deviations from the guidelines above will be considered violations of

CMU's academic integrity policy. Note that expectations for "plagiarism, cheating, and acceptable assistance" on student work may vary across your courses and instructors. Please email me if you have questions regarding what is permissible and not for a particular course or assignment.

Class Diversity

It is my intent that students from all diverse backgrounds and perspectives be well served by this course, that students' learning needs be addressed both in and out of class, and that the diversity that students bring to this class be viewed as a resource, strength and benefit. It is my intent to present materials and activities that are respectful of diversity: gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture. Your suggestions are encouraged and appreciated. Please let me know ways to improve the effectiveness of the course for you personally or for other students or student groups.

Disability Accommodations

If you have a disability and have an accommodations letter from the Disability Resources office, I encourage you to discuss your accommodations and needs with me as early in the semester as possible. I will work with you to ensure that accommodations are provided as

appropriate. If you suspect that you may have a disability and would benefit from accommodations but are not yet registered with the Office of Disability Resources, I encourage you to contact them at **access@andrew.cmu.edu. (mailto:access@andrew.cmu.edu)**

A quick note on Mental Health

Higher education and especially CMU can be a stressful environment. As a student, you may experience a range of challenges that can interfere with learning, such as strained relationships, increased anxiety, substance use, feeling down, difficulty concentrating and/or lack of motivation. These mental health concerns or stressful events may diminish your academic performance and/or reduce your ability to participate in daily activities. CMU services are available, and treatment does work (I can testify to this…) Support is always available (24/7) from Counseling and Psychological Services: 412-268-2922.