An Integrated Framework for Assessing Data and Business Analytics Skills for the Job Market

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Abstract. We present a framework for integrating academic programs and students' preparation for the job market. A graduate program's curricula, especially in data and business analytics, should prepare students for landing their dream job and prepare them to excel in their desired roles and grow within the company. Our approach is to assist our students in (i) their active participation in charting a course for their career and (ii) becoming a competitive force within the market based on knowledge gained in the program. The Applied Business Analytics program at Boston University Metropolitan College has created a competitive curriculum that shapes students into leaders by assessing the marketplace's needs (a function of its environment) and preparing our students to become lifelong learners, thereby creating their competitive advantage.

The model we've created contains three key areas, (i) the academic program and the valuation of its quality through skill development, (ii) the evaluation of the job market as a subset of the macro environment, (iii) the active preparation of students in our consultation service offerings to become competitive players in the job market. We introduce the complex nature of this model by discussing the various tools offered to our students, our approach for conducting job market assessments, and the framework for creating diagnostic tools for skills assessment.

Keywords: skills development · skills assessment · student employability · industry assessment · career planning · competitive landscape analysis · knowledge competence · business analytics curriculum · job placement

1 Introduction

Two key differentiators of the Applied Business Analytics (ABA) graduate degree program are (i) the competitive landscape analysis of our graduate program, as presented during the 16th CSECS Conference on Computer Science and Education in Computer Science (CSECS) [4], and (ii) the ABA Graduates' Employability Support service, as presented during the 18th EAI International Conference on CSECS [1]. In the ABA program, we are constantly searching for ways to support our students in their journey of landing their 'dream job'. Our competitive landscape analysis program helps us ascertain

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the strength of the degree program compared to the top universities in the U.S. offering a master's degree in business analytics. Our employability support service model helps students prepare to enter the job market by creating their ePortfolio, an online web application demonstrating their skills, experience, and the application of their abilities to utilize data in solving the problems that companies face. The employability service model also helps students better understand the job market, including companies and industries hiring talents matching our students' skills. Lastly, this model allows students to prepare for their technical interviews, a key component to successfully hiring talent within analytics.

Our next focus in this series of analyses we've conducted is to ensure that we are equipping our students with the knowledge to be successful within the job market. This knowledge will land them a job aligned with their career aspirations and help them succeed to become significant contributors to the company's overall success. We now present our methodology for advancing our program at a course level that meets the demands of the job market and beyond.

2 Methodology

Our ongoing research in student employability has been a rewarding experience as students have benefitted from the critical services offered in the ABA@BU Graduates Employability Service Model [1]. Since its publication, a website has been created to store all our service materials and resources needed for students to land their dream job [2]. To continuously refine this model, we are now taking a high-level view of the integrations between the academic programs, positions to be filled in the job market, and student's ability and preparedness to demonstrate that they are the right fit for various roles within the marketplace. We present a three-step approach for curriculum improvement by adding skillsets required by selected industries. Our first step focuses on completing an industry assessment to gain a deeper understanding of the job roles and the top skills needed for an applicant to be considered and successfully chosen for the role. The second step involves an assessment of the current state of a degree program's curriculum, specifically focusing on each course within the program to understand its learning objectives and skills outcomes clearly. Here we are determining the gap between the current course curricula and the industry's requirements. The third step focuses on additional diagnostic testing upon nearing the completion of the program so that students can demonstrate the broad range of skills developed across key areas or pillars of a degree program. The following are the details of our approach:

2.1 Diagnostic Assessment of an Academic Program's Quality Through Skill Development

For an academic program to be deemed a success, constant evaluation is required. These programs must be designed in such a manner that they equip students with the skills necessary to secure roles within the industry and also to train students to become lifelong learners. From this perspective, programs must conduct thorough assessments of the needs of the industry and incorporate this information into the design, development, or

enhancements of the program's curriculum. The critical thing to mention here is that the program is on a continuous loop of valuation, enhancement, and development. We aim to assess the program's current state, one course at a time, and make improvements based on the industry's needs, as visualized in Fig. 1 below.

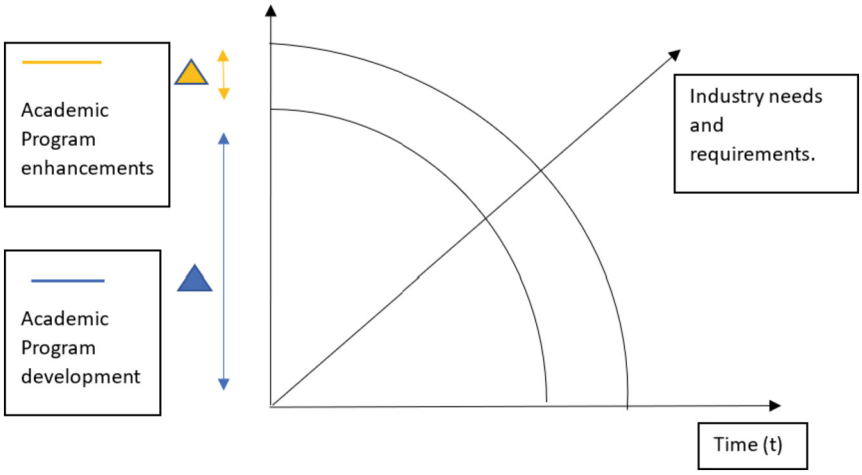


Fig. 1. Diagram representing the enhancements of academic programs based on the increasing needs of the industry as a function of time.

By applying tools like the ABA@BU Competitive analysis framework [4], we can quantitatively assess the program's strength based on key differentiating factors like program rankings, delivery format, tuition, and total credits. In addition to this approach, we would like to propose a diagnostic assessment tool to determine the fit between the academic program's offerings and the needs of the Industry. It requires a thorough review and valuation of the skills offered through individual courses and the skills to be gained through the completion of industry-relevant certifications. For each class, it is essential to determine the skills offered and difficulty level ranging from beginner to advanced. In addition, it is crucial to identify industry-relevant certifications and skills gained through completing these certifications that can complement the student's learning. Through the combination of the skills earned in the degree program and the skills offered through the completion of the relevant industry certifications, students will now have a competitive advantage within the job market as their skills demonstrate that they can meet job performance standards and also the ability to grow within the role and take on additional challenges which then leads to a rewarding career. To further explore this approach, we will discuss the development of the academic program to offer skills at the beginner's, intermediate and advanced levels and skills obtained through industry certifications. Figure 2 represents our approach to skill development by segmenting our audience into various groups and designing content that will meet or surpass each group's needs, ensuring that they are a successful fit for specific roles within the job market.

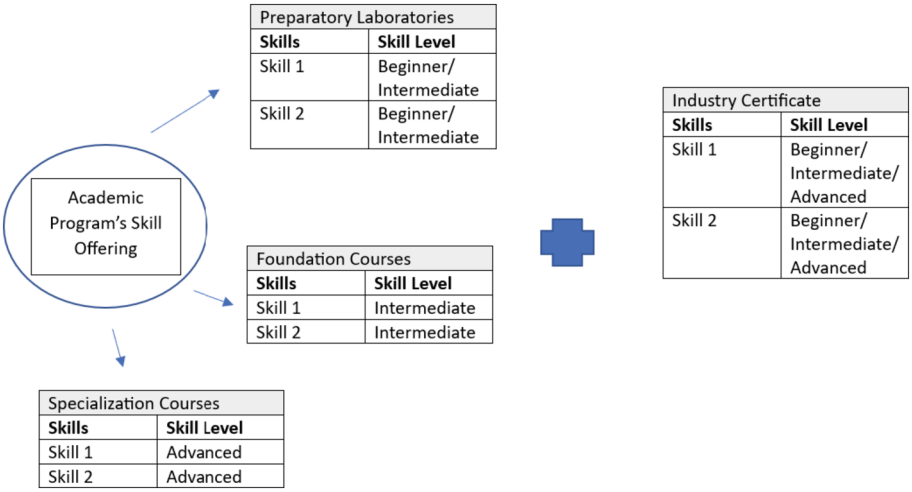


Fig. 2. The ABA Academic Program's Approach to skill development.

Beginner-Level Skill Offerings Through Preparatory Labs. The ABA academic program is designed to meet the needs of students at various stages within their careers and to provide them with an opportunity to complete the program with an advanced level of command of the industry-required skills. There is a unique challenge posed to us as we received interest in the program from five categories of individuals:

- With less than two years of working experience
- With 2–5 years of working experience
- With more than five years of work experience
- With no experience who just graduated with a bachelor's degree
- Individuals who are switching careers

We have aimed to design and develop a program to meet the needs of these varying groups keeping in mind the rapid advancement of the Industry as a result of the advancements made in the technological landscape, thereby increasing the complexities of problems within the Industry and the need for capable individuals to solve these challenges. The program starts by introducing all students to what we call preparatory laboratories. These laboratories are designed to provide foundational knowledge to develop missing skills in the programming languages R, Python, SQL, and software applications such as Microsoft Excel, Microsoft Power B.I., and more. For the groups of persons with more than two years of working experience, these laboratories serve as a refresher to help prepare these students for the next stage, obtaining intermediate-level skill development through our program's foundational courses.

Intermediate-Level Skill Offerings Through Foundation Courses. Once students have completed the preparatory labs, the next stage of skill development, the intermediate level, can be obtained through the completion of several of our foundation courses. Students will learn in-depth knowledge and applications of the statistical language, R, with applications to real-world datasets.

Advanced Level Skill Offerings Through Specialization Courses. The specialization and elective courses provide students with advanced knowledge in R, Python, SQL, and various visualization tools, for example, Microsoft Power B.I., Tableau, and Google Data Studio (Looker).

These three levels of the program's courses provide students with the skills needed to be successful in the job market. As the business analytics field is highly competitive, the program aims to provide students with a competitive edge by completing in-demand course certifications. The certifications allow students to learn and test their skill levels and demonstrate to potential employers that they can solve challenging problems.

Increasing Student Competitiveness in the Industry Through the Completion of Industry-Relevant Certifications. Our goal is to enable our students to become competitive applicants within the Industry by completing industry-relevant certifications. Potential employers widely accept these certifications as evidence that the applicant is dedicated to the field and has the aptitude for learning and contributing to the organization's success and, in turn, personal growth.

2.2 Job Market Assessment

The job market assessment aims to determine the critical skills needed for a job seeker to succeed in the field of analytics. It is essential for academic programs to stay abreast of the changing needs of the Industry and to incorporate in their program's curricula the skills needed to become successful within the selected field. There are several ways in which programs can obtain this information. One is collecting data from various job sites, compiled through manual or automated efforts like web scraping. Our approach is to gain support from companies like Lightcast [5], which delivers job market data with the option for clients to design and develop their reports to understand the job market's needs thoroughly. Figure 3 displays our approach to assessing the job market.

The first step seeks to identify the occupational category under which the particular course's skills generally fall and is part of the Standard Occupational Classification (SOC) Code system, which the U.S. Bureau of Labor Statistics uses to group workers into various categories [3]. To determine key employment statistics, we are focusing on the following areas: (i) the total unique job postings, (ii) the total number of employers in search of talent, (iii) the median salary, (iv) a summary of the popular job titles for that category determined by the number of postings per job title, (v) a summary of the top cities with job postings for that category or group and, (vi) a summary of the top industries. This valuation gives us a high-level view of the demand for talent for each occupational category. The second stage requires a deep dive into this data to understand the demand and supply of the necessary top skills for the overall occupational category and top job titles, see Fig. 4.

We identify the top software, specialized skills, and top qualifications in demand for the occupational category. For each of the three elements in the skills identification chart, we conduct an additional evaluation to determine the supply/ demand ratio by identifying the percentage of job postings that required a specific skill, the rate of job applicants that possessed the talent, and the computation of the supply/ demand ratio.

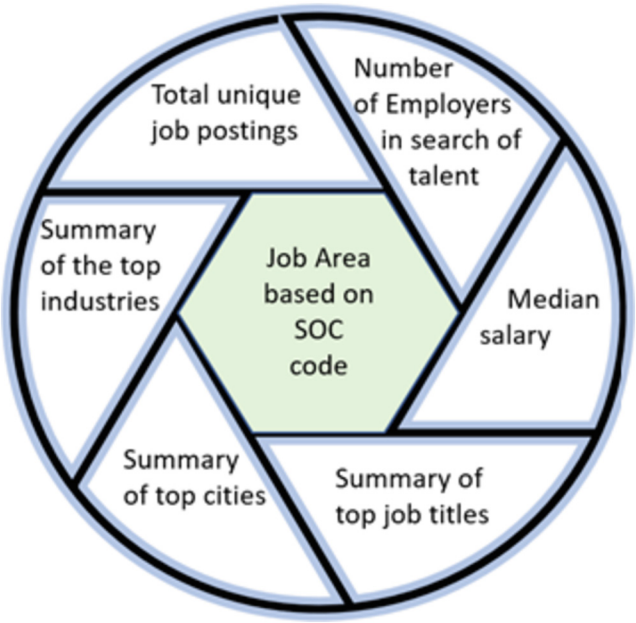


Fig. 3. The ABA Academic Program's Approach to the Assessment of the Job Market.

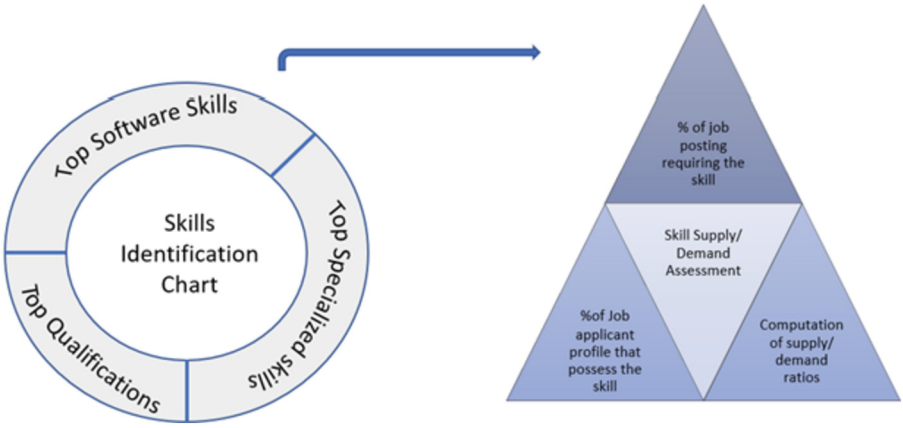


Fig. 4. The ABA Academic Program's skill identification and skill supply/ demand assessment approach.

These results will provide an idea of what is needed within the market and whether this demand is covered.

2.3 Determination of the Presence of In-Demand Skills Within the Course Curriculum at a Beginner, Intermediate, or Advanced Level

The next step would be to perform a gap analysis to address whether the required skills in the skills identification chart exist within the course curriculum, and if it exists within the curriculum, at what level it exists: beginners, intermediate, or advanced. It concludes by altering the learning objectives within the course curriculum to include the newly required skill.

2.4 Students' Preparation to Enter the Workforce

Throughout the degree program, we've prepared students to gain skills in the field of business analytics at beginner, intermediate, and advanced levels. Before completing the program, students should test their knowledge through participation in our Employability Services, Service 3 – preparation for Technical Interview Simulations. Our faculty designed and developed this diagnostic approach to test students' technical competency based on the top skills needed in business analytics: SQL, R, Python, and Microsoft Excel ([2] section Instructions for the ABA Program's Technical Interviews). In collaboration with our technical services team, we created the technical infrastructure to support this simulation environment through the Blackboard Learning Management System, where we can store a test bank of questions across the significant analytics programming languages, including software applications like Microsoft Excel and the accompanying datasets that students are required to utilize for solving the questions or business problems presented.

Students are required to register for these sessions. Upon successful registration, students will receive instructions on how to proceed with their technical interviews. On the day of the technical interview, students choose one offered by the system topic. A question from our test bank is then displayed randomly to the student, upon which the student has forty-five minutes to solve the problem. Students will then have 15 min to complete a presentation deck demonstrating their approach to solving the problem and the results obtained. They present in front of a panel of faculty members who will ask probing questions and provide feedback for improvement.

3 Applications of the Methodology

The presented methodology demonstrated our approach to enhancing a program's curriculum and its relations to preparing students for the job market. We will illustrate this approach by applying this methodology to one of the program's specialization courses, Web Analytics for Business.

3.1 Market Assessment for the Field of Web Analytics

Based on reports generated from Lightcast for the period January 2020 to April 2022, related to SOC code 13–1161, Market Research Analyst and Marketing Specialists, there were over 527,357 unique job postings within the U.S. a resounding 36% of all

job postings within the U.S. over 107,746 employers were competing for talent within this field (appendix 2, industry statistics). Massachusetts ranked 7th within the U.S. with 17,388 job posts, with California ranking at 1 with 88,263 job posts (appendix 3, state statistics).

Based on the job postings, a few of the relevant job titles we've seen are Marketing Analysts, Digital Marketing Consultants, Social Media Specialists, Search Engine Optimization Specialists, Marketing Coordinators, Digital Marketing Consultants, Web Marketing Managers, Business Intelligence Analysts and more (appendix 4, top job titles).

From the job postings, the top software skills required were Microsoft Excel, Microsoft Office, Microsoft PowerPoint, and Google Analytics (appendix 5, top software skills). More than 60,756 job postings require the following skills: Google Analytics, Microsoft PowerPoint, Microsoft Office, and Microsoft Excel (appendix 6, a dashboard summarizing the critical data).

For the role of Marketing Analyst, there's a slight difference in the required skills; for example, we now see the inclusion of SQL, Dashboard, and Business Intelligence Software like Tableau and Python (appendix 7, job posts and top software skills required for Marketing Analysts). Based on this assessment, the skills in demand in the industry are Microsoft Excel, Microsoft Office, Microsoft PowerPoint, Google Analytics, SQL, Dashboard, and Business Intelligence Software like Tableau and Python (Fig. 5).

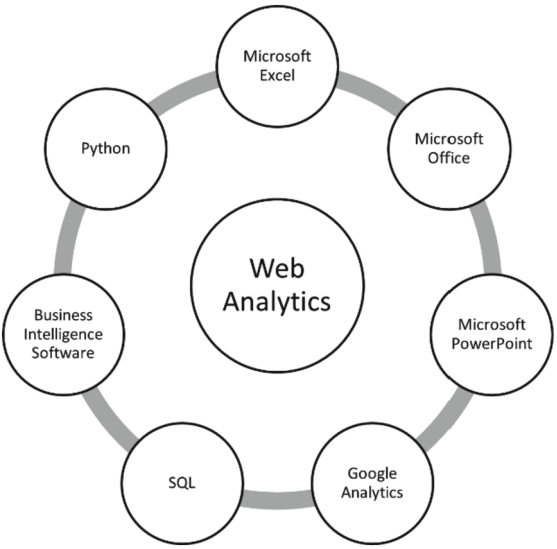


Fig. 5. Skills needed for a successful career in Web Analytics.

3.2 Incorporating Industry Skills into Curriculum Design and Enhancement for Specialization Course Web Analytics for Business

Incorporation of Industry Skills into the Curriculum. Having this knowledge of the skills that are in – demand within the market, for our students to be competitive and receive top positions, we incorporated these skills into the design enhancement of the curriculum. At the preparatory lab level, students are required to complete AD100, which covers the skill areas of Microsoft Excel and Microsoft Office. PY100 prepares students for basic or beginner knowledge in Python, covering the concepts needed to familiarize them with the programming language and its components. Our program's foundation course equips students with the knowledge of presenting findings of the analysis performed and utilizing tools like Microsoft PowerPoint. It also exposes students to using visualization software like Microsoft Power B.I. The program covers several learning objectives described below at the specialization course level, Web Analytics (See Table 1). For the first learning objective, exposure to data collection principles and techniques, students are given hands-on experience in collecting external data. These data do not exist within the company through practices like web scraping, a valuable skill needed in developing competitive intelligence reports. Students are then exposed to knowledge of advanced techniques like Text Mining and Sentiment Analysis to uncover patterns and more profound meaning within the data collected. In internal data collection, students are exposed to understanding customer behavior on a website and introduced to tools like Google Analytics, one of the job market's most sought-after tools in the field of Digital Marketing, Market Research Analysts, and Marketing Analysts. The second learning objective focuses on Data Storage, Analysis, and Visualization. Students gain hands-on experience designing and developing relational database management systems to store structured data collected from various sources.

Students then utilize Structures Query Language (SQL) to create and query the database and extract data to create visualizations using Python or R. The third learning objective focuses on data analysis for the performance of communication channels like email marketing, Social Media Analytics, and Mobile Analytics. Students are introduced to marketing campaigns like MailChimp, Constant Contact to distribute and monitor the performance of marketing campaigns. Google Analytics for Firebase is also introduced as an opportunity to track the performance of mobile applications to determine revenue earned through the application, number of downloads, number of uninstalls and number of application crashes, to name a few. The final Learning Objective looks at the Applications of topics in Web Analytics. This area focuses allowing students to gain the experience of designing websites while providing consideration for the analysis of web traffic data. This means that students are designing these websites intending to collect and measurement of customer behavior data. Students are then exposed to the strategies used to generate traffic to their websites, and they begin measuring customer data. Visualization tools like Google Data Studio are then used to create visualizations demonstrating various key performance indicators for the business. Students are then introduced to conducting experiments, more specifically A/B testing, informing the changes to be made on their websites. The idea here is that before an actual change is made, let's run a test to determine customer's acceptance of this change before we finalize the change on a website.

Table 1. Web Analytics learning objectives and skills offered.

Learning Objectives	Sub Areas	Software Skills	Specialized Skills
Data Collection	External Data Collection - Web Scraping	Python	Text Mining, Sentiment Analysis
	Internal Data Collection - Customer Behavior Data	Google Analytics	Google Analytics
Data Storage, Analysis and Visualization	Relational Database Design & Development	SQL	Database design
	Database Queries	SQL	
	Query result extraction & visualization	SQL, Python	
Marketing Communication Analytics	Email Marketing— Campaign Design & Execution & Analysis	Google Analytics, MailChimp, Constant Contact	Email Marketing
	Social Media Analytics		Social Media Analytics
	Mobile Application Analytics	Google Analytics for Firebase	
Applications of topics in Web Analytics	Web Design & Development	Blogger, Google Sites, Wix, Squarespace	Web Design & Development
	Web Traffic Analysis	Google Analytics	Google Analytics
	Dashboard Design & Development	Google Data Studio	Google Data Studio
	Web Experimentation	Google Optimize	A/9 Testing
	Presentation of Findings and recommendations	Microsoft Power Point	

Increasing Student Competitiveness in the Industry Through Completing Industry-Relevant Certifications for Top Required Skill, Google Analytics. As part of the Web Analytics course requirements, students must complete several courses from the Google Analytics Academy platform. The first certification is the Google Analytics for Beginners certification, which covers several introductory topics on becoming familiarized with the Google Analytics interface, including creating an account, exploring the interface and the various reports established to understand user behavior, and more. The second

required certification, Advanced Google Analytics, exposes students to advanced topics like creating custom metrics, reports, dimensions, and more. As these courses are based on the Google Analytics Universal Analytics property, which will be retired by Google on June 30th, students will be asked to complete the Google Analytics Certification, which will test their skills in setting up a Google Analytics 4 property identification for websites and using the new interface to gain insights into user behavior.

4 Conclusion and What's Next

The next step in this assessment is to develop a dashboard displaying the data for all the critical areas of our proposed framework, especially for the job market assessment. Here we would like the dashboard to show the occupational category related to a specific course, the top statistics on the job market, and a deep dive into the skills by completing the skill identification chart and computing the skill/ demand ratios, and also refining the course curriculum to match the latest trend in the data.

So far, we've completed the skills assessment on a high level. Our next step is to repeat the process by focusing on the skill identification chart for the top job titles in the SOC 13-1161 Marketing Research Analysts and Marketing Specialists occupational job category.

Appendix 1: Instructions for the ABA Program's Technical Interviews

Session #1: Testing your technical skills in Python & SQL for Business Analytics Applications.

Availability: Item is available, but some students or groups may not have access.
Enabled: Adaptive Release: Statistics Tracking

Welcome to the Technical Interviews on testing your knowledge in Python and SQL

We are pleased to have you join us and wish you a successful learning experience upon the completion of this interview. During this interview, you will be provided with questions to be solved using either SQL or Python. The aim of this event is to provide you with an opportunity to apply the skills and techniques learned in your ABA program to solve problems in a time sensitive, interview-style environment.

The following are the rules for partaking in this event:

1. The first step is to register for a Technical Interview. On the left-hand menu bar, select the ***Technical Interview: Sessions Registration*** link.
2. On the day of your Technical Interview, go to the **MET Applied Business Analytics Programs** blackboard site and on the left-hand menu bar, select ***Technical Interview: Sessions***
3. Promptly at 2:00 pm ET, you will be provided with a list of topics to choose from and these topics will be displayed below. Examples of topics can include (but not limited to) Regression Analysis, Sentiment Analysis, Clustering and much more. Please select **ONE** topic.
4. A question and dataset will then be provided, and you have a total of 45 minutes to complete this exercise.
5. At 2:45 pm, you'll have 15 minutes to complete a presentation deck to demonstrate your findings. Submit your presentation deck at the end of the 15-minute timer.
6. You cannot submit anything after 3:00 pm. At 3:00 pm, you will be invited by the moderators to present the ***solutions you submitted*** and the interpretation of the results within 5 minutes. You will have another 10 minutes for Q&A.
7. At 3:00 pm – 5:00 pm ET, you will have your live presentations. You will present your findings to a panel of professors, and they will provide you with feedback on your performance and also recommendations for improvement. For the presentation of your findings, please go to the ***Zoom Employability Consultations*** room in the MET Applied Business Analytics Programs blackboard site.

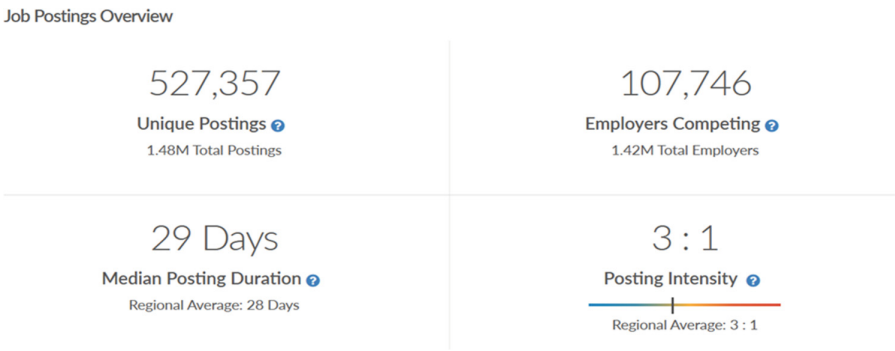
Session #1: Technical Interview Date

The Technical Interviews for session 1, Python and SQL is offered on Friday 10th February 2023, 2:00 pm – 5:00 pm ET.

Tools Needed for Session #1 Topics

1) For all Python questions, please use Jupyter Notebook to write all your codes and run all outputs.
2) You can download Anaconda from the link below, and after installation, you can use the embedded Jupyter notebook. https://www.anaconda.com/
3) However, if you are using Win 11 system (which is known as very incompatible with many software), you can use the online version of Jupyter Notebook from the link here: https://jupyter.org/try-jupyter/retro/notebooks/?path=notebooks/intro.ipynb
4) All submissions for Python questions should be a Jupyter Notebook file (.ipynb file), or a pdf file printed out from the notebook. Please include all your codes and outputs in your submissions.
5) For all SQL questions, all you need to do is to write the queries and explain your logic during the presentation. You can submit a text file, or a word file, as long as it can be opened and reviewed by all operating systems.

Appendix 2: Job Posting Data for Marketing Research Analyst and Marketing Analyst



Appendix 3: Job Posting by State

State Name	Unique Postings from Jan 2020 - Apr 2022
California	88,263
Texas	47,079
New York	38,523
Florida	35,751
Illinois	24,658
Georgia	17,453
Massachusetts	17,388
North Carolina	16,740
Colorado	16,186
Ohio	15,947

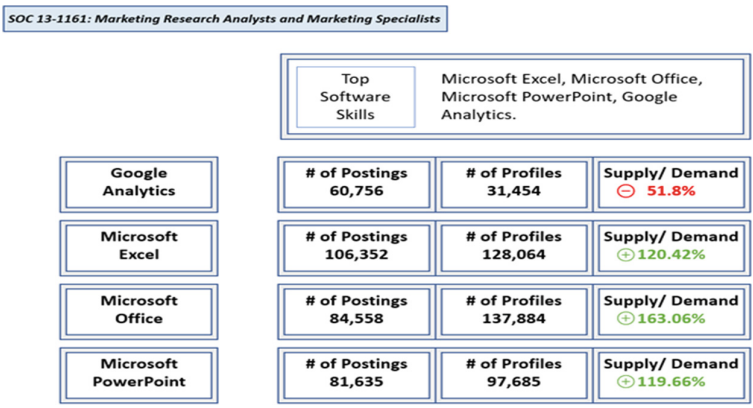
Appendix 4: Job Titles

Job Title	Total/Unique (Jan 2020 - Apr 2022)	Posting Intensity	Median Posting Duration
Marketing Coordinators	98,333 / 37,068	3 : 1	30 days
Marketing Specialists	60,660 / 23,565	3 : 1	28 days
Marketing Assistants	52,910 / 17,268	3 : 1	29 days
Digital Marketing Specialists	44,374 / 16,741	3 : 1	27 days
Social Media Managers	43,676 / 14,107	3 : 1	31 days
Marketing Associates	32,302 / 11,175	3 : 1	30 days
Social Media Specialists	33,612 / 9,686	3 : 1	27 days
Social Media Coordinators	24,379 / 7,754	3 : 1	28 days
Marketing Analysts	17,439 / 7,151	2 : 1	26 days
Email Marketing Specialists	34,467 / 5,721	6 : 1	28 days

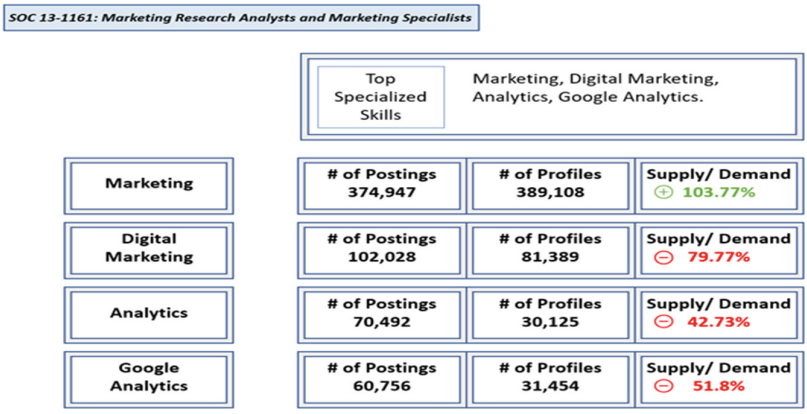
Appendix 5: Top Software Skills

Skills	Postings	% of Total Postings	Profiles	% of Total Profiles
Microsoft Excel	106,351	20%	128,064	17%
Microsoft Office	84,558	16%	137,844	18%
Microsoft PowerPoint	81,635	15%	97,685	13%
Google Analytics	60,756	12%	31,454	4%
Instagram	54,500	10%	19,315	3%
Adobe Photoshop	43,397	8%	40,906	5%
Salesforce	40,644	8%	23,955	3%
Microsoft Outlook	35,664	7%	19,864	3%
HyperText Markup Language (HTML)	35,418	7%	20,720	3%
Adobe Creative Suite	30,112	6%	18,584	2%

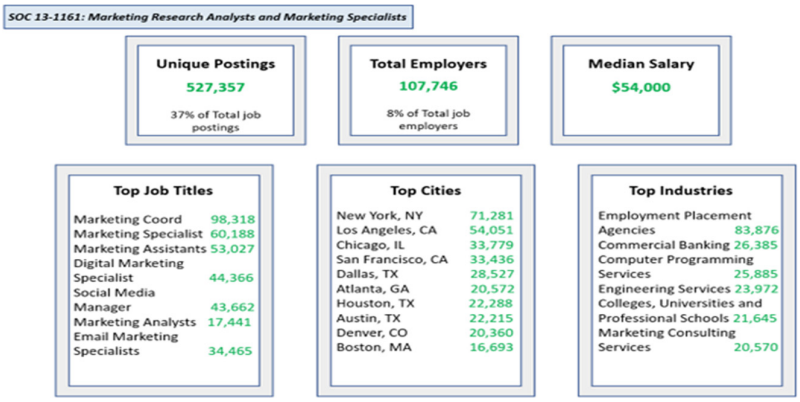
Appendix 6: Dashboard Displaying Top Software Skills



Appendix 7: Dashboard Displaying Top Specialized Skills



Appendix 8: Industry Analysis Dashboard



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