Education vs. Earnings: An Analytical Perspective on Fields of Study and Salaries Using Python

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Abstract - This research paper presents a comprehensive data analysis of study fields, employment, and salaries, containing information on academic majors, employment rates, gender distributions, and salary metrics. The study explores the relationship between academic disciplines and employment outcomes using techniques such as data cleaning, preprocessing, exploratory data analysis (EDA), and visualization. Key metrics, including employment rates, full-time employment rates, unemployment rates, and median salaries, were computed and compared across major categories. For instance, the analysis revealed that engineering majors exhibit an 83% full-time employment rate and command the highest median salaries, while arts majors show a full-time employment rate of just 63% with significantly lower earnings. By employing visualizations like heatmaps, scatter plots, and bar plots, the study provides a detailed understanding of employment trends. These findings highlight substantial variations in employment outcomes by field of study. This analysis offers valuable insights to students, educators, and policymakers, enabling them to align educational pathways with labor market needs. The results emphasize the importance of STEM and technical fields, which offer stronger job prospects and financial rewards, compared to fields such as arts and humanities. Challenges such as missing data and multicollinearity were also addressed, ensuring the robustness of the findings.

Keywords: Employment outcomes, academic majors, salary trends.

I.Introduction

In today's increasingly complex and competitive job market, the relationship between an individual's field of study and their employment outcomes has become crucial for students, educators, and policymakers alike. Choosing an academic major is a pivotal decision that has far-reaching implications on career stability, job satisfaction, and lifetime earnings. As industries evolve, shaped by rapid technological advancements and shifting economic demands, aligning educational choices with market needs is essential for maximizing employability and financial success. Students, in particular, benefit from a nuanced understanding of how specific academic disciplines correlate with employment prospects and salary potential, enabling them to make data-informed decisions that align with their career aspirations and financial goals.

This study presents a comprehensive data analysis exploring the relationship between academic fields, employment outcomes, and salary metrics. The dataset used in this research includes diverse fields of study, with detailed data on employment rates, gender distribution, and salary metrics across multiple academic disciplines. By leveraging data cleaning, preprocessing, exploratory data analysis (EDA), and visualization techniques, this research delves into key indicators such as full-time employment rates, unemployment rates, and median salaries. Through bar plots, scatter plots, and heatmaps, the study seeks to provide a visual and statistical examination of how specific academic fields impact employment outcomes.

The findings from this analysis reveal notable disparities in employment success based on the academic major chosen. For example, majors within the arts and humanities tend to yield lower employment rates and salaries, highlighting a mismatch between these fields and current labor market demands. Conversely, disciplines such as engineering, healthcare, and business exhibit high employment rates and robust salary prospects, suggesting that technical and industry-aligned majors offer more stable career paths and financial advantages. These insights underscore the

importance of aligning educational programs with job market needs, particularly in fields where technological and industry trends drive high demand for specialized skills.

The objectives of this research are two-fold: to evaluate the economic value of different academic disciplines and to highlight trends in employment outcomes across fields of study. This paper seeks to assist students and advisors by identifying academic areas with high employment stability and competitive salary potential, thus aiding in effective educational planning and workforce readiness. Additionally, the study provides valuable insights for policymakers to guide future educational reforms that align with labor market dynamics and address gaps in high-demand sectors.

While this research provides a significant perspective on the connection between academic choices and career outcomes, it also addresses certain challenges encountered during the analysis. These include handling missing data, managing multicollinearity issues, and interpreting the impact of demographic factors such as gender. By addressing these challenges, the study presents a balanced view of the complexities involved in analyzing the interplay between education and employment.

Ultimately, this research contributes to a deeper understanding of how academic fields shape employment opportunities and economic outcomes, underscoring the need for data-driven decision-making in education and career planning. The results are anticipated to empower students, educators, and policymakers with actionable insights to align educational pathways with emerging workforce needs, fostering a generation better prepared for long-term career success.

II.Background

Emanuel Melichar's studies for the American Economic Association [1] on economists' salaries in the 1960s identify experience, employer type, and educational attainment as significant salary determinants, with industry

roles offering the highest salary progression [2]. He finds that while advanced degrees, especially Ph.D.'s, increasingly impact earnings, the influence of experience has slightly declined, as education gains prominence in differentiating salaries among economists.

Sullivan et al. [4] and Maisel & Gaddy [8] examine how education affects career outcomes, noting that graduates from elite institutions, particularly in fields like computer science, tend to achieve higher earnings. Sullivan et al. highlight the enhanced salary potential for graduates of prestigious programs, while Maisel & Gaddy find that recent computer science doctorates enjoy high employment rates, especially in competitive industry roles. Both studies emphasize strategic educational choices as crucial for long-term career success.

In "Male-Female Pay Differentials in Professional Employment," Burton G. Malkiel and Judith A. Malkiel [5] address gender-based salary disparities within corporations, showing that factors like education, experience, and job assignments influence pay outcomes. Similarly, Dorceta Taylor [3] explores how race, gender, and field shape job and salary expectations among U.S. science and engineering students. Both studies underscore how demographic and structural influences on employment perpetuate salary disparities.

Eleanor L. Babco's [7] "Salaries of Scientists, Engineers, and Technicians: A Summary of Salary Surveys" (1987) compiles data from 1986-1987, revealing rising starting salaries in technical fields despite reduced job offers. Trends by field, gender, and employment type highlight broader economic shifts affecting demand for specific professions. Zhang and Cheng's [6] "Study of Employment Salary Forecast using KNN Algorithm" (2019) uses 2018 data to predict Java back-end salaries, achieving 88.1% accuracy. Their findings suggest a misalignment between graduates' expectations and market salaries, advocating for better alignment to improve employment outcomes.

Lastly, Gishkayeva, Aziyeva, and Abubakarov's [9] "Employment and Salary as Indicators of Social Quality of Life" (2019) examine labor relations in Russia, tracing shifts from state-controlled to market-driven systems post-1990s. They find persistent wage disparities and low labor productivity affecting quality of life and argue that wage levels play a critical role in access to essential services and public trust.

III.Methodology

This study's methodology encompasses a structured approach to examining employment outcomes across academic majors, organized into several core stages:

3.1 Data Collection: The dataset contains comprehensive information on academic majors, employment status (full-time, part-time, seasonal), unemployment rates, and median salaries. Each major is categorized under broader academic fields to facilitate aggregate comparisons.

3.2 Data Preprocessing: Extensive data cleaning and standardization were conducted to ensure data integrity. Missing values were imputed with mean or median values, and new metrics were created, including employment rates, full-time employment ratios, and unemployment rates. The dataset was also transformed and grouped by major categories to enable cross-disciplinary comparisons.

3.3 Exploratory Data Analysis (EDA): EDA was employed to identify significant trends and variations across fields of study. Descriptive statistics provided a summary of central tendencies and variability, while data visualizations like bar plots, scatter plots, and heatmaps highlighted relationships between variables and identified majors with higher or lower employment stability.

3.4 Key Metric Calculations: Key indicators, such as overall employment rate, full-time employment rate, and unemployment rate, were calculated to assess the impact of academic majors on job market outcomes. Salary percentiles were also computed to capture income potential within each field.

3.5 Visualization and Interpretation: Various visualizations, including heatmaps and bar plots, illustrated employment and salary patterns by academic major, supporting interpretation of complex data. Each visualization provided insights into how different majors correlate with employment success and earnings potential.

3.6 Conclusion and Recommendations: Based on analysis and visualization findings, recommendations were developed for students and educators. Insights into fields with higher job security and salary prospects were highlighted to assist in data-driven educational planning.

IV.Results

4.1 Bar Graphs

4.1.1 Total Employed vs Major

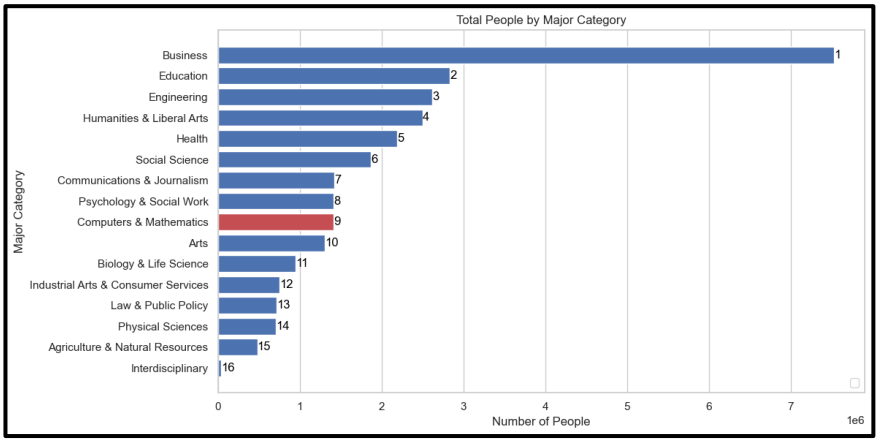

Figure 1: Total Employed vs Major

The figure 1 shows the total number of individuals employed across different major categories. Business leads with the highest number of employed individuals, followed by Education, Engineering, and Humanities

& Liberal Arts. Computers & Mathematics ranks ninth, while fields such as Arts, Biology & Life Sciences, and Agriculture & Natural Resources appear lower on the employment scale.

This distribution underscores the influence of academic choices on employment outcomes, with Business and Engineering graduates enjoying strong demand due to their broad applicability and technical expertise. Lower-ranked majors often align with more specialized industries, where graduates may pursue non-traditional career paths, resulting in fewer full-time employment opportunities.

4.1.2 Full-time Employment by Major Category

The figure 2 titled "Full-time Employment by Major Category" ranks various academic fields by the number of full-time employees. Business leads significantly, with close to 6 million employed, followed by Engineering with over 2 million, reflecting strong demand in these areas.

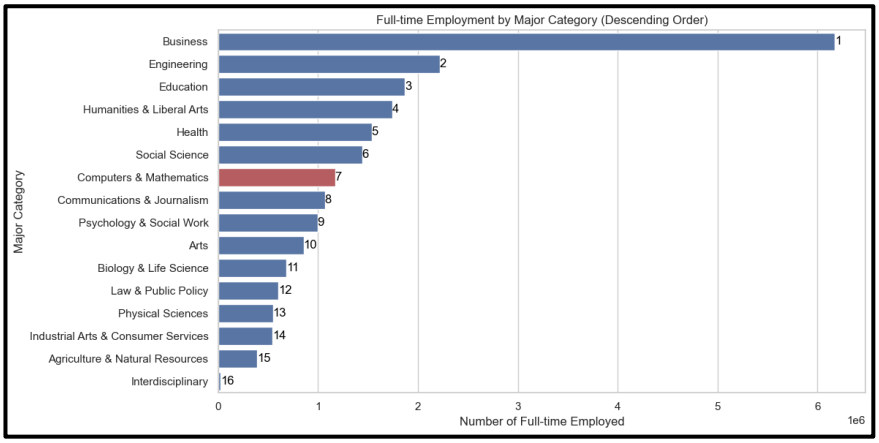

Figure 2: Full-time Employment by Major Category

Education, Humanities & Liberal Arts, and Health occupy mid-range positions, each having over 1.5 million employees. Computers &

Mathematics and Social Science also feature prominently, showing relevance in the job market.

Fields such as Industrial Arts, Agriculture, and Interdisciplinary show fewer employees, indicating more specialized demand. Overall, the data highlights the dominance of business-related and technical fields in full-time employment.

4.1.3 Seasonal Employment by Major Category

The figure 3 "Seasonal Employment by Major Category" highlights the distribution of seasonal employment across various academic fields. Business tops the list with the highest number of seasonal employees, followed by Education and Humanities & Liberal Arts. In contrast, fields like Interdisciplinary Studies and Agriculture & Natural Resources show minimal seasonal employment.

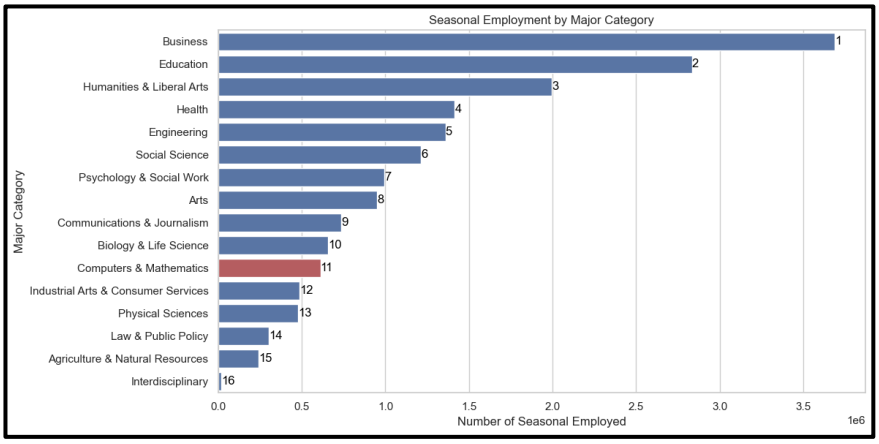

Figure 3: Seasonal Employment by Major Category

Computers & Mathematics ranks lower than expected at 11th, indicating fewer seasonal roles compared to long-term job stability. The analysis underscores the variance in seasonal job availability across

disciplines, suggesting that some fields, particularly Business and Education, offer more flexible, short-term job opportunities.

4.1.4 Unemployment by Major Category

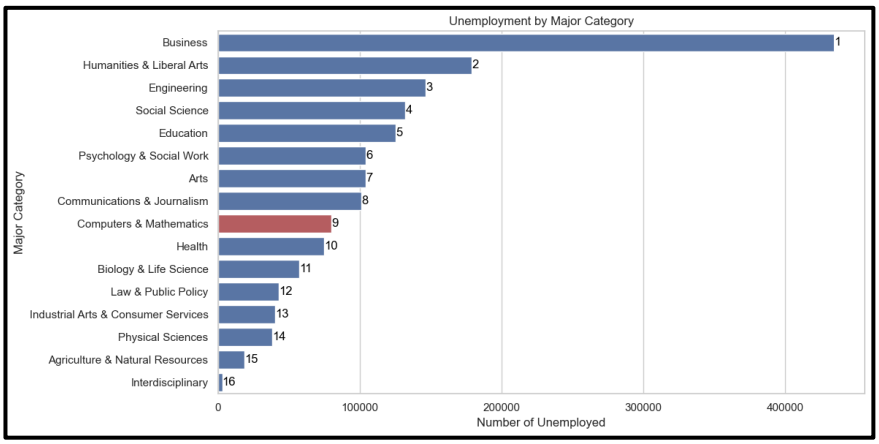

Figure 4: Unemployment by Major Category

The figure 4 shows unemployment rates across various academic majors, with Business majors experiencing the highest unemployment, likely due to field saturation. Humanities & Liberal Arts and Engineering also have high unemployment, despite their skill advantages.

Computers & Mathematics fare better, indicating higher demand for tech skills, unlike the arts, social sciences, and education, which see greater unemployment. Fields like Agriculture and Interdisciplinary Studies show the lowest unemployment, suggesting niche markets with fewer graduates. This trend implies that broader fields face more competition, while specialized majors offer stronger employment prospects.

4.1.5 Unemployment Rate vs. Major Category

The figure 5 highlights unemployment rates across various academic majors, showing that Interdisciplinary majors face the highest unemployment, followed by Arts, Communications & Journalism, and Psychology & Social Work. Conversely, Health, Education, and Agriculture & Natural Resources majors show the lowest rates, suggesting greater job stability in these fields. Computers & Mathematics sit in the middle at 4.5%, reflecting a relatively stable outlook despite tech's rapid evolution. Business, Health, and Education not only have lower unemployment but also attract more job openings, while higher rates in certain majors often point to niche or competitive markets. This underscores that technical and vocational majors tend to offer more stable career paths.

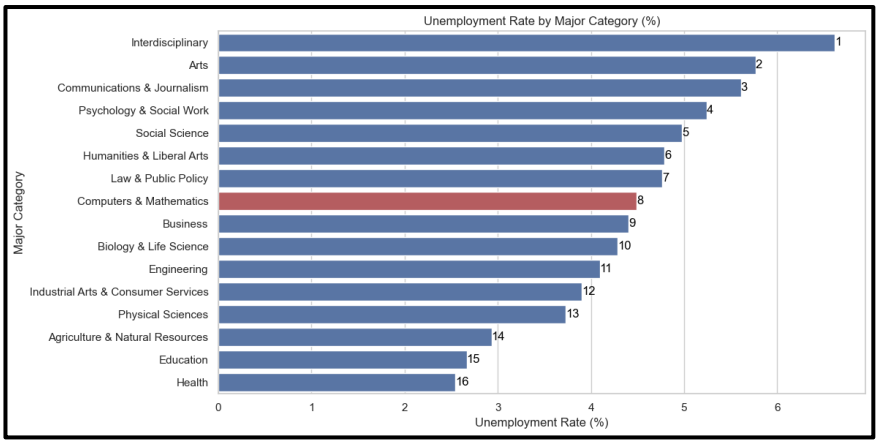

Figure 5: Unemployment Rate vs. Major Category

4.1.6 Median Salary vs. Major Category

The figure 6 shows that Engineering, Computers & Mathematics, and Business majors earn the highest median salaries, reflecting the strong market demand for technical and managerial skills. Physical Sciences and Agriculture & Natural Resources also offer competitive wages, though not as high as these top fields. In contrast, Humanities & Liberal Arts, Arts, Psychology & Social Work, and Education rank lower, with Education

earning the lowest median salary. The salary gap highlights the financial advantage of technical fields, where specialized skills align with industry demand. This data suggests that while lower-salary majors may offer fulfilling careers, they often come with non-financial rewards.

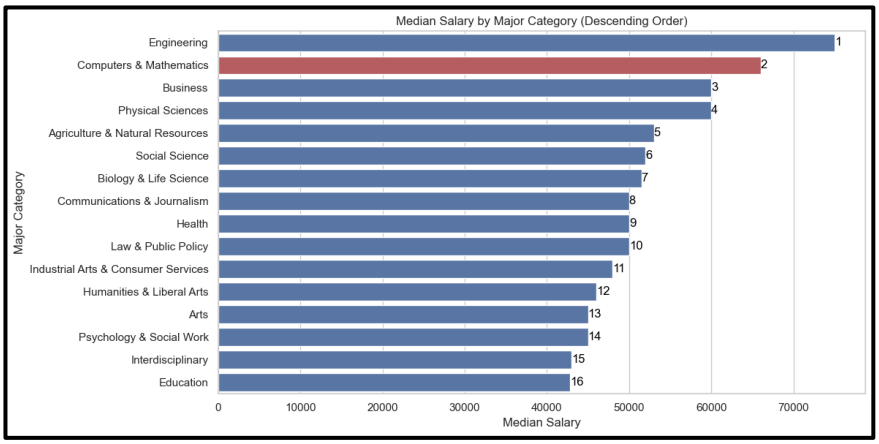

Figure 6: Median Salary vs. Major Category

4.2 Heat Maps

4.2.1 Employment Rate Cross-Comparison Between Major Categories

The figure 7 highlights employment rates by academic major, with Computers & Mathematics leading at 80%, followed by Communications & Journalism and Business at 79%, reflecting strong demand in technology, media, and business sectors. Education ranks lowest at 63%, suggesting job market challenges, possibly due to regional teacher shortages or demand fluctuations. Social Science, Psychology & Social Work, and Humanities & Liberal Arts also show lower employment rates (around 68%-69%), likely reflecting fewer positions in these specialized fields. Majors like Engineering, Health, and Agriculture & Natural Resources have moderate employment rates (72%-76%), indicating steady demand. Overall, technical

fields tend to offer higher employment rates, while niche or public sector majors may face more variability.

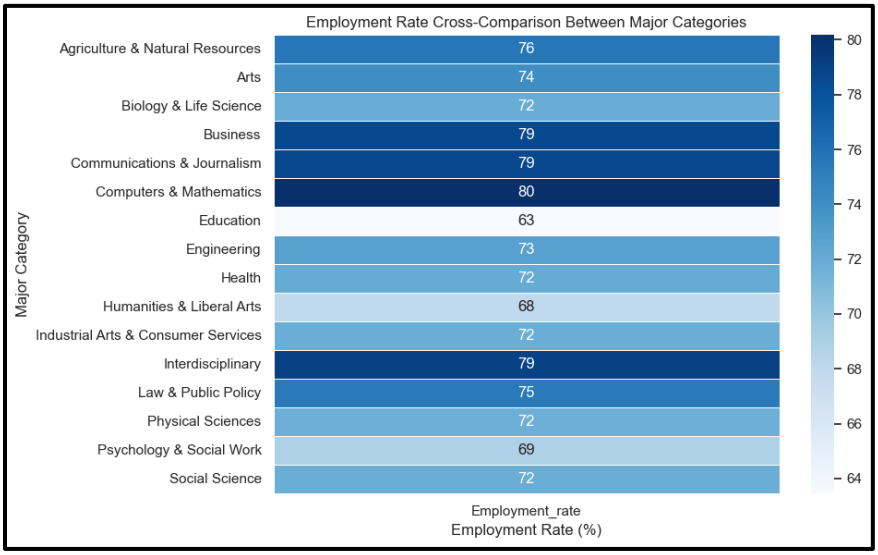

Figure 7: Employment Rate Cross-Comparison Between Major Categories

4.2.2 Full-Time Employment Rate by Major Categories

The figure 8 compares full-time employment rates across academic fields, showing significant variations based on majors. Engineering leads with an 83% full-time employment rate, followed by Business, Computers & Mathematics, and Agriculture & Natural Resources, each exceeding 81%, indicating strong job stability in technical and vocational fields. Arts has the lowest full-time employment rate at 63%, underscoring challenges in creative fields, while Education, Health, and Humanities & Liberal Arts hover around 67-68%, reflecting moderate job stability. Fields like Communications & Journalism (75%) and Social Sciences (76%) offer balanced opportunities but often require specialization. Overall, STEM-B fields tend to secure higher full-time employment, contrasting with more

niche fields like Arts and Humanities, which face competitive job markets and lower full-time employment prospects.

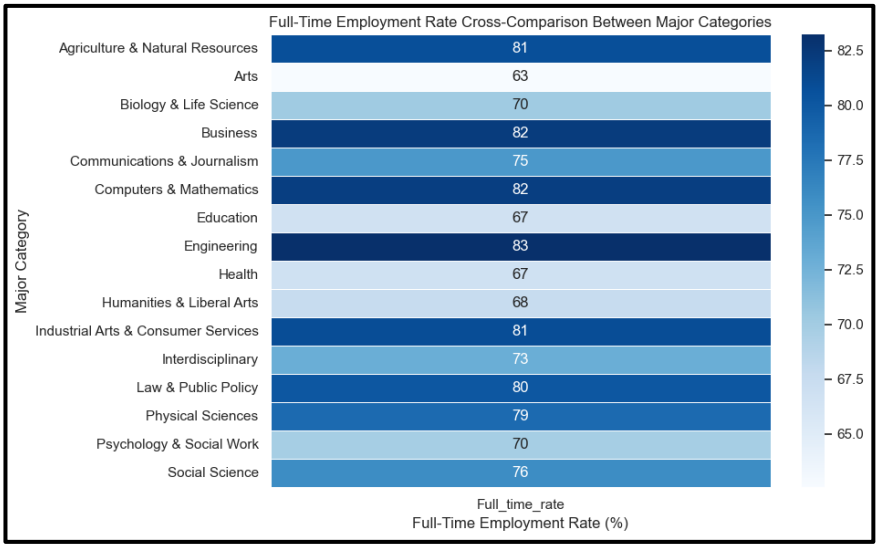

Figure 8: Full-Time Employment Rate by Major Categories

4.3 Scatter Plot

4.3.1 Comparison between Number of Majors and Average Unemployment Rate by Major Category

The figure 9 illustrates the relationship between the number of academic majors and their average unemployment rates across various categories. Engineering, with nearly 30 majors, boasts the lowest unemployment rate below 3%, highlighting strong demand for technical graduates. Business, with around 20 majors, follows closely at approximately 4%, reflecting its competitive nature and broad applicability.

In contrast, the Arts category, despite fewer majors, experiences high unemployment rates exceeding 7%, indicating significant challenges for creative graduates, while Interdisciplinary studies also struggle with over

6% unemployment. Fields like Health, Education, and Agriculture & Natural Resources, which offer moderate major numbers, maintain lower unemployment rates around 3-4%, suggesting stable demand. Overall, this analysis emphasizes that selecting a major with a technical or vocational focus, such as Engineering or Business, is likely to lead to better employment outcomes compared to creative or interdisciplinary fields.

Category	Major Counts
Engineering	29
Education	16
Humanities & Liberal Arts	15
Biology & Life Science	14
Business	13
Health	12
Computers & Mathematics	11
Agriculture & Natural Resources	10
Physical Sciences	10
Psychology & Social Work	9
Social Science	9
Arts	8
Industrial Arts & Consumer Services	7
Law & Public Policy	5
Communications & Journalism	4
Interdisciplinary	1

Table 1: Major Category and Major Counts

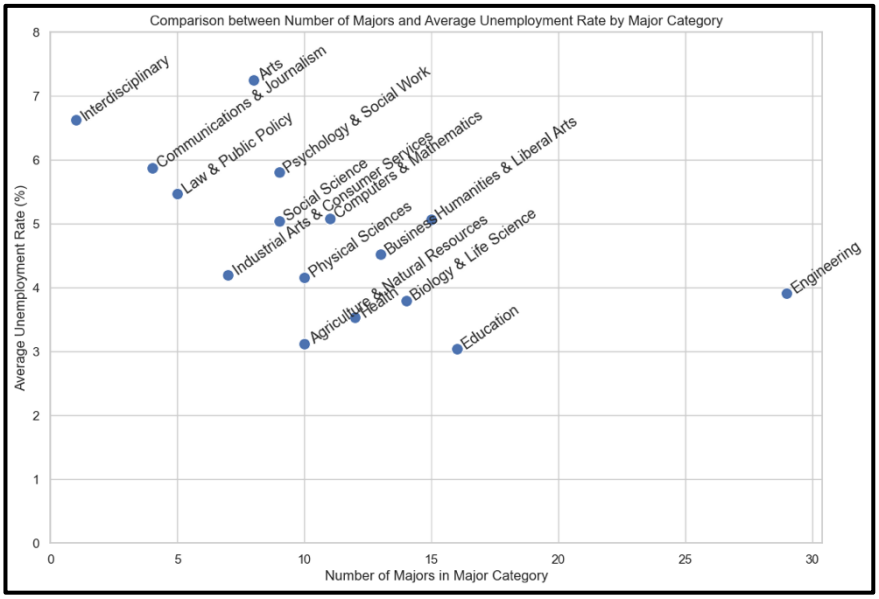

Figure 9: Number of Majors and Unemployment Rate

4.4 Pie Chart

4.4.1 Distribution Analysis by Major Categories

The pie chart (figure 10) depicts the distribution of individuals across various academic disciplines, highlighting significant disparities in educational focus. Business is the largest field, accounting for 24.7% of the total population, followed by Psychology & Social Work (11.8%) and Social Science (9.0%), indicating a strong preference for business education likely driven by market demand. STEM fields collectively represent a smaller portion, with Engineering at 6.7%, Computers & Mathematics at 4.5%, and Biology & Life Science at 2.6%, raising concerns about workforce development in these high-employability areas. Humanities-related disciplines, such as Arts (9.4%) and Humanities & Liberal Arts (4.5%),

remain popular, while Agriculture & Natural Resources (7.4%) and Health (1.6%) have modest representation despite their societal importance. This distribution suggests a potential misalignment between educational choices and market needs, highlighting the importance of workforce planning and educational policy to address skills gaps in critical sectors.

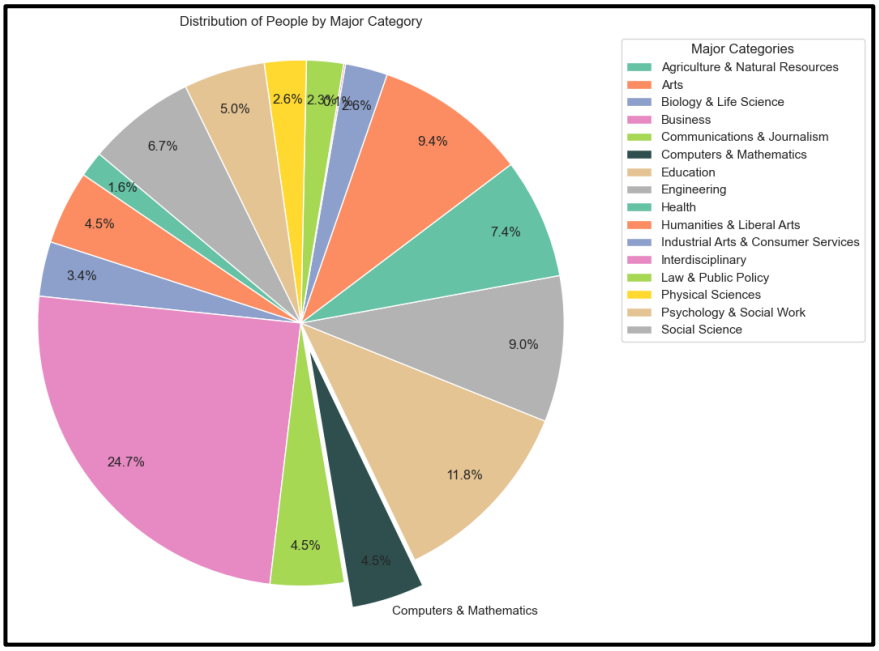

Figure 10: Distribution Analysis by Major Categories

V.Conclusion

In conclusion, the findings of this study provide a comprehensive view of the relationship between academic disciplines, employment outcomes, and salaries. STEM and business majors emerge as clear leaders in employment stability and financial returns, reflecting the high market demand for specialized technical and managerial skills. Fields like engineering, computers, and mathematics command the highest median

salaries and exhibit robust employment rates, positioning them as attractive choices for students prioritizing career stability and growth. Conversely, the arts, humanities, and interdisciplinary studies face more significant challenges, with lower employment rates and median earnings highlighting the competitive nature of these fields.

This analysis underscores the importance of aligning academic programs with labor market demands. For students, it emphasizes making informed decisions based on their career aspirations and the economic viability of their chosen field. For educators and policymakers, the insights offer guidance for tailoring curricula and resource allocation to meet industry needs and close skill gaps in critical sectors like technology and healthcare. Addressing challenges like missing data and demographic disparities remains essential for refining future analyses and ensuring a fair representation of all fields.

Ultimately, the study advocates for a data-driven approach to educational planning, enabling students to achieve meaningful careers and policymakers to foster a workforce that aligns with evolving economic priorities.

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