Optimizing Course Enrollment, Capacity, and Learning Paths at Indiana University: A Visual Analytics Dashboard

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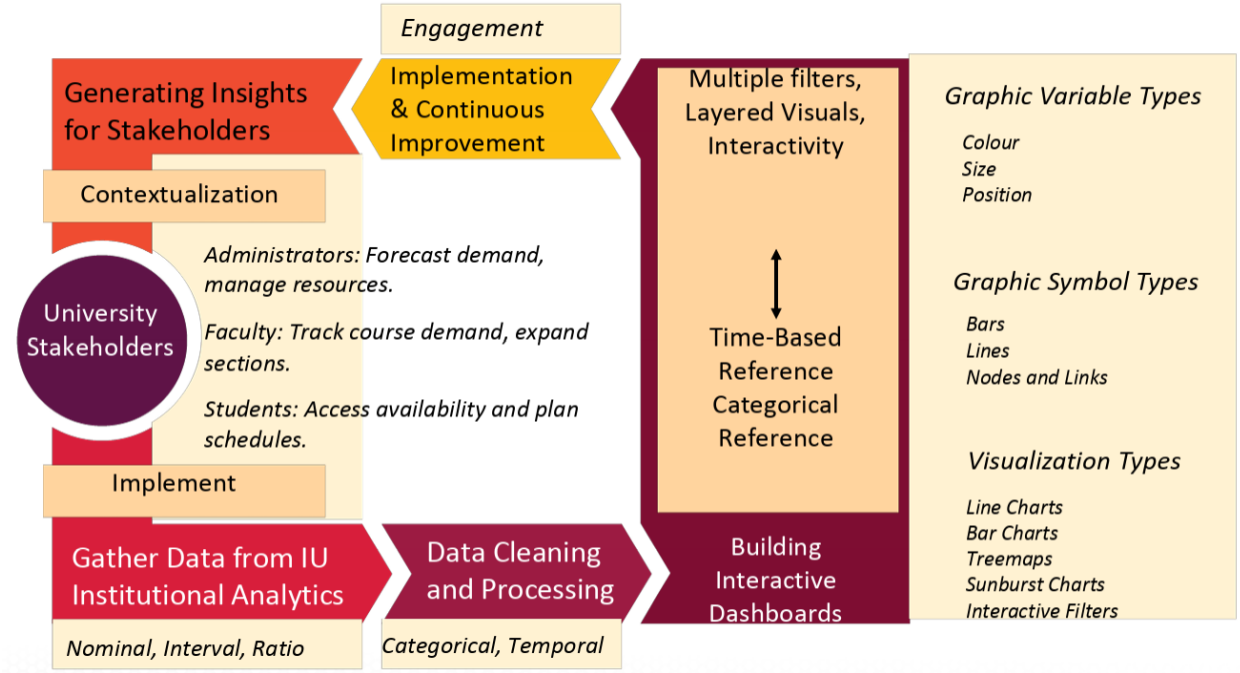

Fig. 1. The visual abstract summarizes the project, showcasing the problem, data sources, methodology, and key visualizations.

1. INTRODUCTION AND PRIOR WORK

Efficient course enrollment management is essential for universities to ensure students can register for required courses while optimizing faculty and classroom resources. Without proper planning, issues like overfilled classes and scheduling conflicts can arise. Data visualization and analytics help track enrollment trends, predict demand, and improve decision-making.

Indiana University's current analytics dashboard provides class capacity and enrollment data but lacks interactive features for trend analysis and predictions. This project enhances the system by developing an interactive Power BI dashboard that allows users to analyze enrollment trends, course capacity, and demand across campuses. It includes filters and visual tools to improve data exploration.

By offering these advanced visualization capabilities, the project helps administrators, faculty, and students make informed decisions about course planning and resource allocation.

1.1 Stakeholder Groups

This project is designed for university administrators, faculty members, and students. Administrators need accurate data to manage course availability, faculty assignments, and classroom space efficiently. Faculty members use enrollment trends to adjust course offerings and teaching methods. Students, both current and prospective, rely on enrollment data to plan their courses and make informed academic decisions.

1.2 Stakeholder Needs

Administrators need tools to analyze enrollment trends, predict course demand, and allocate resources effectively. Faculty members require insights into enrollment patterns to plan their courses and manage class capacities. Students need a simple and interactive dashboard to check course availability and understand study options to make better academic choices.

2. DATA ACQUISITION

This project uses data from Indiana University's Institutional Analytics reports to analyze enrollment trends, capacity utilization, and instructional modes. The dataset was initially large, with redundant columns and separate records for each term. To improve usability, all terms were merged into a single document, unnecessary columns were removed, and data formatting was standardized. These steps ensured accuracy, consistency, and suitability for visualization.

2.1 Data Sources

The dataset was sourced from Indiana University's Institutional Analytics System, which provides enrollment, course capacity, and instructional mode reports. Since the data was stored separately for each term, it was consolidated into a single file for easier trend analysis. Standardization and cleaning processes included merging records, eliminating redundancies, and addressing missing values. The final dataset is available on **GitHub** for transparency and reproducibility. https://github.com/satyapriyankaponduru/My-Visualization-Project/blob/main/Data%20Set.xlsx

2.2 Data Description, Quality and Coverage

The dataset includes academic terms, course names, departments, session types, instructional modes, enrollment counts, course capacities, and waitlist numbers. Each entry represents a unique course offering in a specific term. Data quality was ensured by removing inconsistencies and duplicates while retaining essential variables. The dataset is structured for seamless integration with Power BI, allowing stakeholders to explore enrollment patterns and make informed decisions.

3. DATA ANALYSIS

The analysis examined enrollment trends, course capacity utilization, and student demand at Indiana University using Excel for data cleaning and Power BI for visualization. Fall and Spring enrollments have steadily increased, while Summer enrollments fluctuate, indicating seasonal demand shifts. Certain courses consistently reach full capacity, requiring additional sections or resource reallocation, while others remain under enrolled. Computer Science and Public Health have the highest enrollments, and online and hybrid learning modes continue to grow.

By leveraging Excel and Power BI, this project provides an interactive and data-driven approach to course planning, helping administrators and faculty optimize resources, improve scheduling, and enhance student access to required courses.

4. VISUALIZATIONS

This section presents Power BI visualizations used to analyze enrollment trends, course demand, and class capacity at Indiana University through two types of analysis: temporal and categorical. Temporal analysis tracks enrollment trends over time, while categorical analysis examines course demand across departments and instructional modes.

Link for the dashboards: https://indiana-my.sharepoint.com/:u:/g/personal/sponduru_iu_edu/EVctbRwgDwpElnLqDKdYBEMBW0M_3troRFkr12E2l4q41Q?e=5DyefA

4.1 Temporal Visualization

Tracking enrollment trends over time helps universities plan course availability and manage resources effectively. By analyzing how many students enroll in different academic terms each year, administrators can adjust course offerings, and students can plan their schedules better.

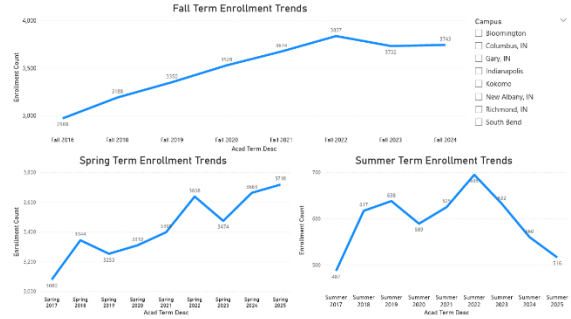

Figure 2: Enrollment trends across terms, showing growth in Fall and Spring and a decline in Summer.

Figure 2 shows a line chart representing enrollment trends for Fall, Spring, and Summer terms over the years. The data indicates a steady increase in Fall and Spring enrollments, while Summer enrollments have declined. This information helps administrators allocate resources efficiently and ensures that students have access to required courses. For students, understanding these trends allows them to plan their course schedules accordingly, especially if they want to take advantage of less crowded summer courses.

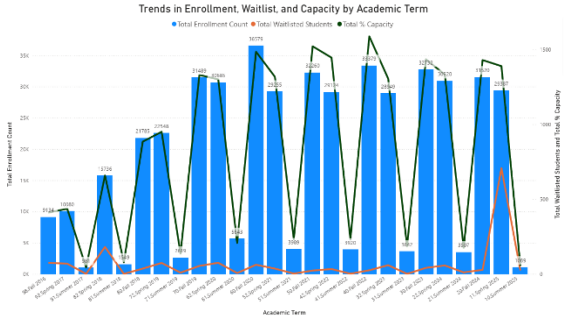

Figure 3: Enrollment and waitlist data per term, highlighting demand fluctuations.

Figure 3 combines a bar chart and two-line graphs. The bars indicate the total number of students enrolled, while orange line graph highlights the number of students on waitlists and green indicates total enrollment capacity. This helps administrators see if high enrollments lead to long waitlists, indicating the need for more course sections. Faculty members can adjust their offerings, and students can anticipate potential challenges in course registration.

4.2 Categorical Visualization

Categorical analysis provides insights into student enrollment patterns across different departments and course types. It helps identify trends in course preferences, guiding administrators and faculty in resource allocation and curriculum planning.

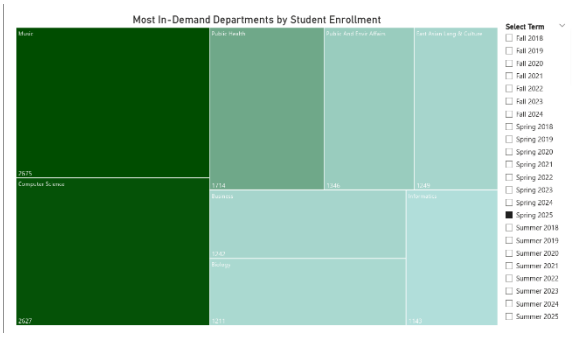

Figure 4 shows student enrollment across departments, highlighting the most in-demand fields.

Figure 4 represents a treemap that categorizes student enrollment based on academic departments. The size of each section indicates the relative number of students enrolled in that department. For example, departments such as Music and Computer Science show higher enrollment numbers compared to others. This visualization helps administrators assess demand trends and allocate resources accordingly. Additionally, the ability to filter by academic term allows

stakeholders to analyze how enrollment patterns have changed over time, identifying growth trends in specific disciplines.

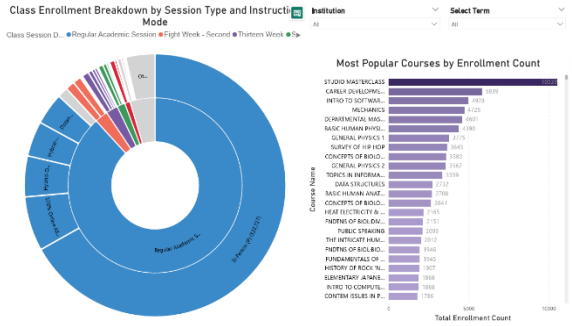

Figure 5 represents enrollment patterns by session type and instructional mode, revealing student preferences.

Figure 5 presents a sunburst chart and a bar chart that analyzes enrollment based on session type and instructional mode. The sunburst chart breaks down course enrollments into categories such as in-person, hybrid, and online formats, giving insights into students learning preferences. The bar chart ranks courses by enrollment count, helping faculty and administrators identify the most popular courses. The inclusion of filtering options by academic term and campus allows for a more granular exploration of enrollment trends, ensuring that stakeholders can tailor their analysis based on specific needs.

5. USAGE AND CRITIQUE OF AI TOOLS

AI tools were helpful in selecting some right visualization techniques, improving data representation, and making the dashboard more interactive. They suggested combined line and bar charts for enrollment trends and treemaps and horizontal bar chart for analyzing popular courses. AI also recommended color schemes and interactive features like filters and tooltips to improve readability and usability.

However, some AI suggestions were not useful. It suggested word clouds for course names and Sankey diagrams for course-professor mapping, which did not fit the dataset. AI also initially suggested showing every department separately in the treemap, but grouping smaller ones under “Other” made the visualization clearer. Some AI-generated color schemes also needed adjustments for better accessibility.

Overall, AI helped speed up the design process and provided useful ideas, but manual modifications were needed to ensure that the visualizations were meaningful and easy to understand for university administrators, faculty, and students.

6. INTERPRETATION OF RESULTS

The analysis of Indiana University’s enrollment data showed that Fall and Spring enrollments are increasing, while Summer enrollments are declining, suggesting students are not really showing interest in summer courses. The waitlist analysis revealed that certain high-demand courses, especially in Computer Science and Public Health, consistently reach full capacity, indicating the need for more sections or larger class sizes.

The sunburst and bar chart analysis highlighted a shift toward online and hybrid learning, suggesting that expanding flexible course options would benefit students. Enrollment patterns also varied across campuses, emphasizing the need for better resource allocation based on demand.

The interactive Power BI dashboard helps stakeholders analyze trends, predict course demand, and make informed academic decisions. Future studies can explore faculty availability and scheduling impact on enrollment trends to further optimize course planning.

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