CATalyst Studios Makerspace Data Analysis - Trends & Data Visualization

Final Report

Project By: Ashwini R Jannu, MS in Information Science, University of Arizona

Mentors/ Advisors: Jennifer Nichols & Hana Lipke, CATalyst Studios, University of Arizona Libraries

Instructor: Dr. Greg Chism

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1. Introduction

Makerspaces have become pivotal in fostering innovation, hands-on learning, and interdisciplinary collaboration within academic institutions. CATalyst Studios, a premier makerspace situated within the University of Arizona Libraries, embodies this trend by providing students access to an array of state-of-the-art fabrication and multimedia tools. These include 3D printers, laser cutters, vinyl cutters, sewing machines, and more, enabling students from diverse disciplines to bring their creative projects to life.

To ensure equitable access and reduce financial barriers, each student at the University of Arizona is granted a one-time $50 material credit to cover the cost of consumable materials used in the studio. This initiative supports inclusivity and encourages students to utilize the available resources without worrying about additional expenses.

However, despite the credit system being in place, there has been limited visibility into how effectively these credits are being used. Key questions remain unanswered:

- Are students fully utilizing their credit allocations?
- Which departments demonstrate higher engagement?
- Are there patterns of underutilization across semesters?
- How does usage vary across demographic groups?

Without structured insights, CATalyst Studios faces challenges in resource planning, outreach, and ensuring that the credit program meets its intended objectives. This project was initiated to address these gaps by conducting a comprehensive data analysis of student credit utilization.

Through this capstone, the goal is to extract meaningful insights from existing data, visualize usage trends, and offer actionable recommendations that can inform future strategies for CATalyst Studios.

2. Project Objectives & Research Questions

Project Objectives

The primary objective of this project is to analyze student credit utilization patterns at CATalyst Studios, with the aim of supporting data-driven decision-making for resource allocation, program improvement, and targeted outreach.

By conducting a thorough data analysis, this project seeks to:

- Provide visibility into student credit usage across semesters and departments.
- Identify patterns of full and partial credit utilization.
- Highlight disparities in credit usage among academic programs and demographic groups.

- Quantify the financial impact of the credit program on CATalyst Studios.
- Offer recommendations to enhance program awareness and efficiency.

Research Questions

To achieve these objectives, the project is guided by the following research questions:

1. **Which students or academic departments fully utilize their allocated $50 credit?**
   Understanding which departments or student groups exhaust their credit will help identify where the credit program is most impactful.
2. **Are there observable trends in underutilization across different semesters?**
   Analyzing semester-wise trends will reveal if certain timeframes see higher or lower usage, guiding future planning cycles.
3. **How does credit usage vary across academic programs, departments, and demographic groups?**
   This question addresses equity concerns by examining whether all student groups are benefiting equally from the program.
4. **What is the overall financial impact of the credit program on CATalyst Studios?**
   Assessing the total expenditure will support budgeting and resource planning.
5. **Are there departments or groups that require targeted outreach to boost credit utilization?**
   Identifying low-usage segments enables CATalyst Studios to tailor communication strategies and improve engagement.

By answering these questions, this project aims to create a comprehensive understanding of credit usage behaviors and provide actionable insights for the continuous improvement of CATalyst Studios' credit allocation program.

3. Dataset Description

The dataset used for this analysis was sourced from the central database of the University of Arizona Libraries. It consists of transaction logs that record student interactions with CATalyst Studios resources, specifically focusing on the utilization of the $50 material credit allocated to each student.

Dataset Characteristics:

- **Source:** Internal usage logs from CATalyst Studios.
- **Structure:** Primarily unstructured text data in the form of free-text comments, capturing student activities and remaining credit balances.
- **Metadata Fields:** Department affiliation, semester of usage, extracted balance amounts, and anonymized student identifiers.

- **Volume:** The dataset spans multiple academic semesters and includes entries from a wide range of departments and student groups.

Challenges with the Dataset:

- The usage details were embedded within free-text comments rather than structured fields.
- Variations in how balance information was recorded (e.g., “Remaining Balance: $25”, “Used $10”, “Leftover: $0”) necessitated a robust extraction process.
- Inconsistent or missing data entries required careful cleaning and validation.

Objective with the Data:

The primary goal was to transform this raw, unstructured data into a clean, structured format that could support meaningful analysis. This involved parsing text fields to extract numeric credit usage details and organizing the data by semester, department, and student identifiers.

4. Data Cleaning and Extraction Methodology

The raw dataset provided by CATalyst Studios consisted of transaction logs with credit usage details embedded within free-text comments. Since the dataset lacked structured fields for balances, a robust cleaning and extraction process was essential to transform the data into an analyzable format.

Step 1: Loading and Identifying Relevant Data

The primary focus was on three columns:

- **Student Identifier (anonymized)**
- **Department (Statistical Category 03)**
- **Comment field** containing credit balance information.

The challenge was that credit usage was not in a dedicated numeric column but embedded within unstructured text descriptions.

Step 2: Extracting the Remaining Balance

To isolate the remaining balance from comments, a **pattern-matching approach** was applied. The method scanned through each comment and picked up numeric values that signified remaining balances (usually found at the end of the comment).

This systematic extraction ensured consistency across diverse comment formats like:

- “Final Balance: $25”

- “Remaining: 0”
- “Used 30, Balance left 20”

Only the final numeric balance was extracted for analysis.

Step 3: Handling Missing and Incomplete Data

For entries where no numeric balance was found, it was logically assumed that the student had not used any credit. Hence, the remaining balance for such entries was set to the default full amount of **$50**.

This assumption was based on domain knowledge and verified by spot-checking a sample of records.

Step 4: Deriving the Extracted Final Balance and Computing Credit Usage

After parsing the unstructured comment field, a new column named **‘Extracted Final Balance’** was created. This field represents the remaining portion of the original $50 credit allocated to each student after material usage.

For entries without valid balance information, a default value of **$50** was assigned, signifying no credit had been used.

In subsequent analysis, the actual credit utilized by students was computed as:

Credit Used = $50 – Extracted Final Balance

Although a separate ‘Credit Used’ column was not explicitly created in the dataset, this derived metric was applied dynamically in various analyses, such as calculating averages, identifying fully utilized credits, and aggregating usage trends.

This method allowed for accurate assessment of student engagement with the CATalyst credit program without altering the original data structure.

Step 5: Data Validation & Standardization

To ensure data accuracy:

- Balances were checked to be within logical limits ($0 to $50).
- Department names were standardized for consistency in grouping.
- Duplicate entries and data inconsistencies were reviewed and corrected.

Outcome of Data Cleaning:

This meticulous process converted a messy, text-based log into a clean, structured dataset with:

- Clear values for **Remaining Balance** and **Credit Used**.

- Organized fields by **Department** and **Semester**.
- Reliable data quality ready for exploratory analysis.

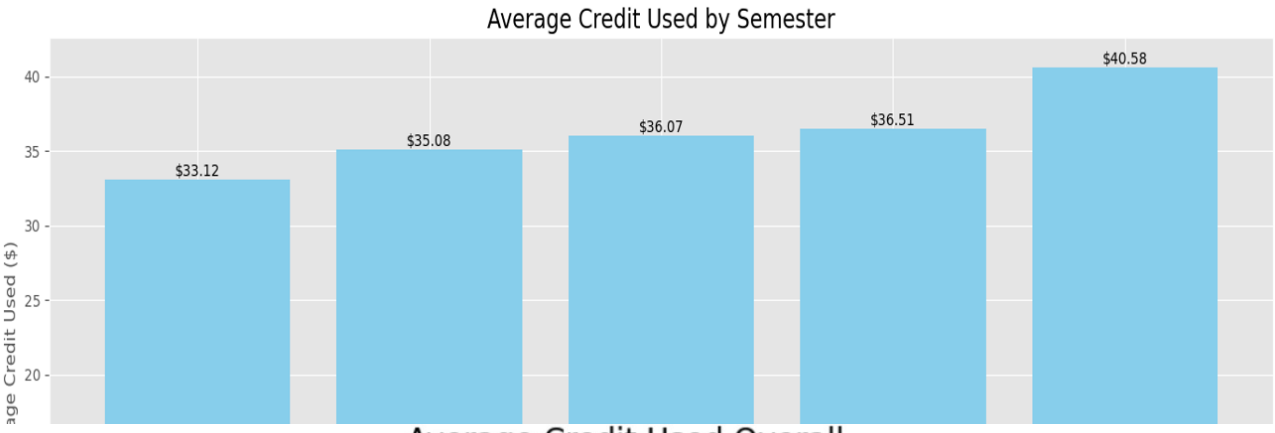
5. Exploratory Data Analysis (EDA)

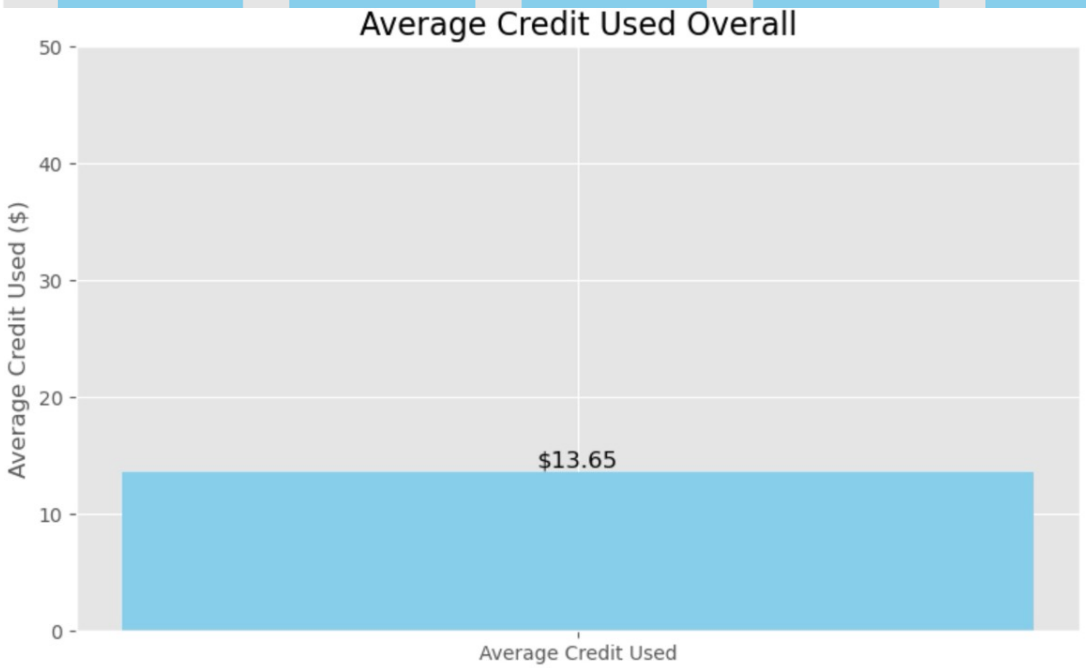
This section presents a detailed analysis of student credit usage at CATalyst Studios, supported by visualizations. The objective is to uncover patterns across semesters, departments, and demographic groups, leading to actionable insights.

5.1 Average Credit Used by Semester

Observation:

- The bar chart shows that **Fall 2024** had the **highest average credit usage** per student.
- Other semesters like Spring 2024 and earlier terms displayed moderate but consistent usage levels.
- The overall average credit used per student was **$13.65**.





Interpretation:

- The peak in Fall 2024 suggests heightened activity, possibly due to capstone projects, design-based courses, or effective promotions.
- This could also reflect academic cycles where certain semesters inherently demand more material usage.

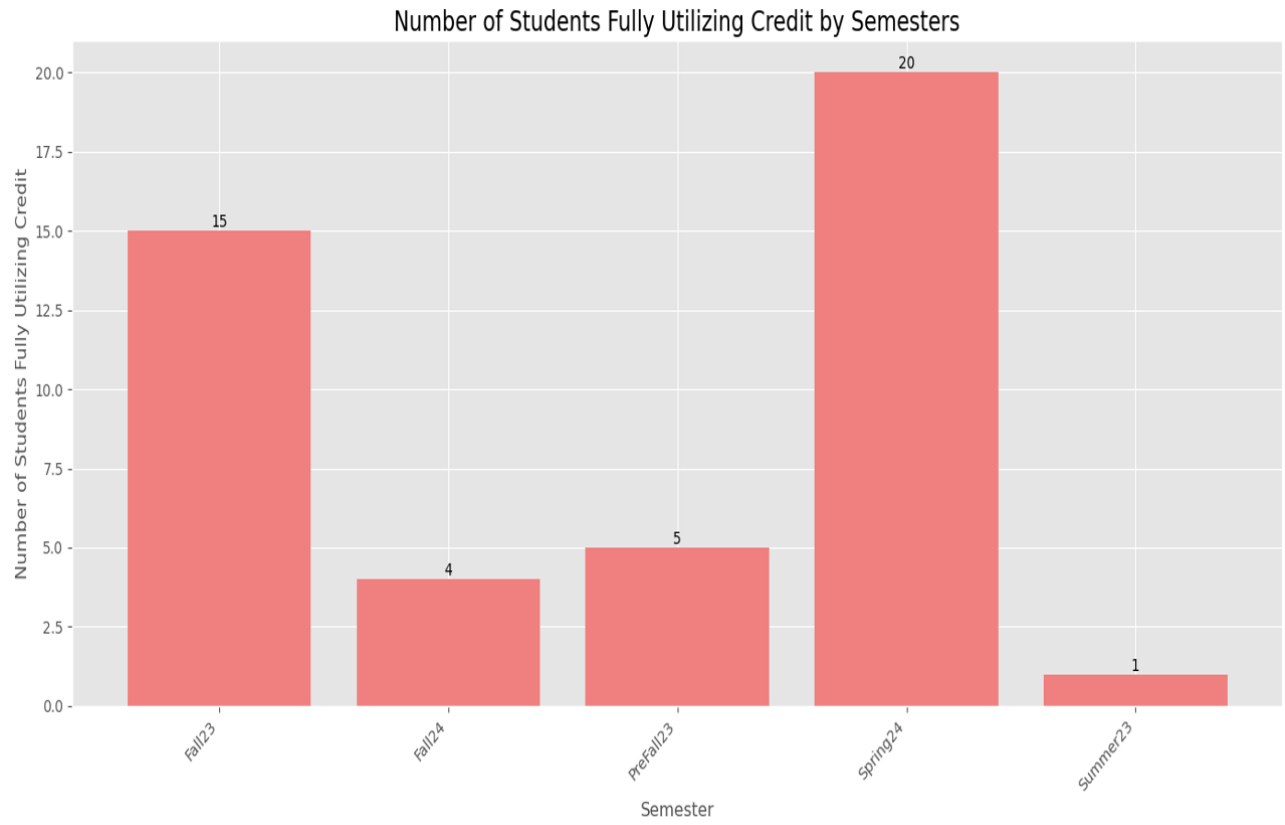
Conclusion:

- CATalyst Studios should anticipate higher demand in Fall semesters and plan resource allocation accordingly.
- Analyzing what worked in Fall 2024 (events, faculty involvement) can help replicate success in other semesters.

5.2 Fully Utilized Credit by Semester

Observation:

- **Spring 2024** had the **highest number of students fully utilizing their $50 credit**.
- Other semesters had fewer students reaching full utilization.



Interpretation:

- Spring 2024's efficiency indicates improved student awareness or curriculum integration.
- It may also reflect increased maker-centric courses during this term.

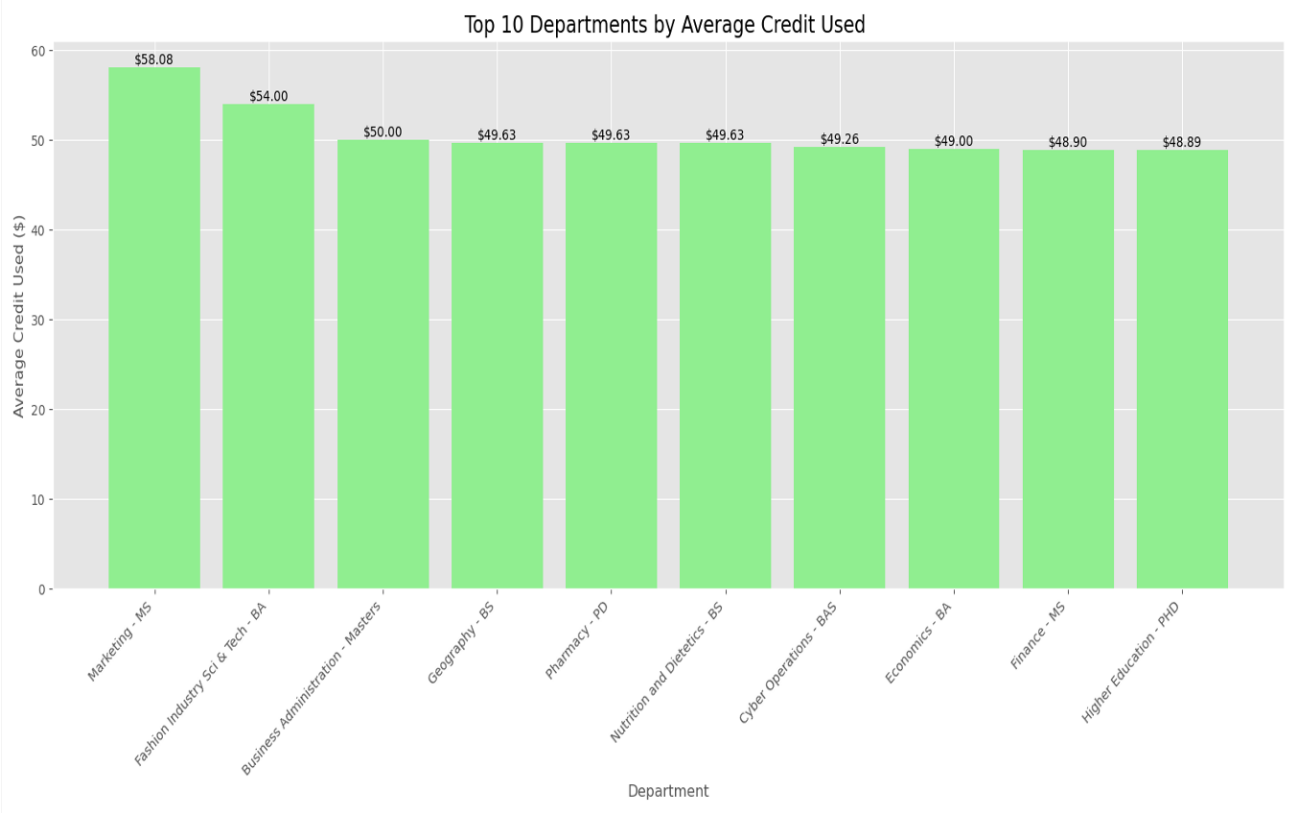
Conclusion:

- CATalyst Studios should investigate successful strategies from Spring 2024 and standardize them for future semesters.
- Regular tracking of full utilization metrics is crucial for measuring program effectiveness.

5.3 Top 10 Departments by Average Credit Used

Observation:

- **Marketing MS** department exhibited the **highest average credit usage** among all programs.
- Other departments showed relatively balanced but lower average usage.



Interpretation:

- Marketing students possibly engaged in projects requiring prototyping, media production, or promotional material creation.
- Departments with practical, hands-on curricula are naturally higher consumers of makerspace resources.

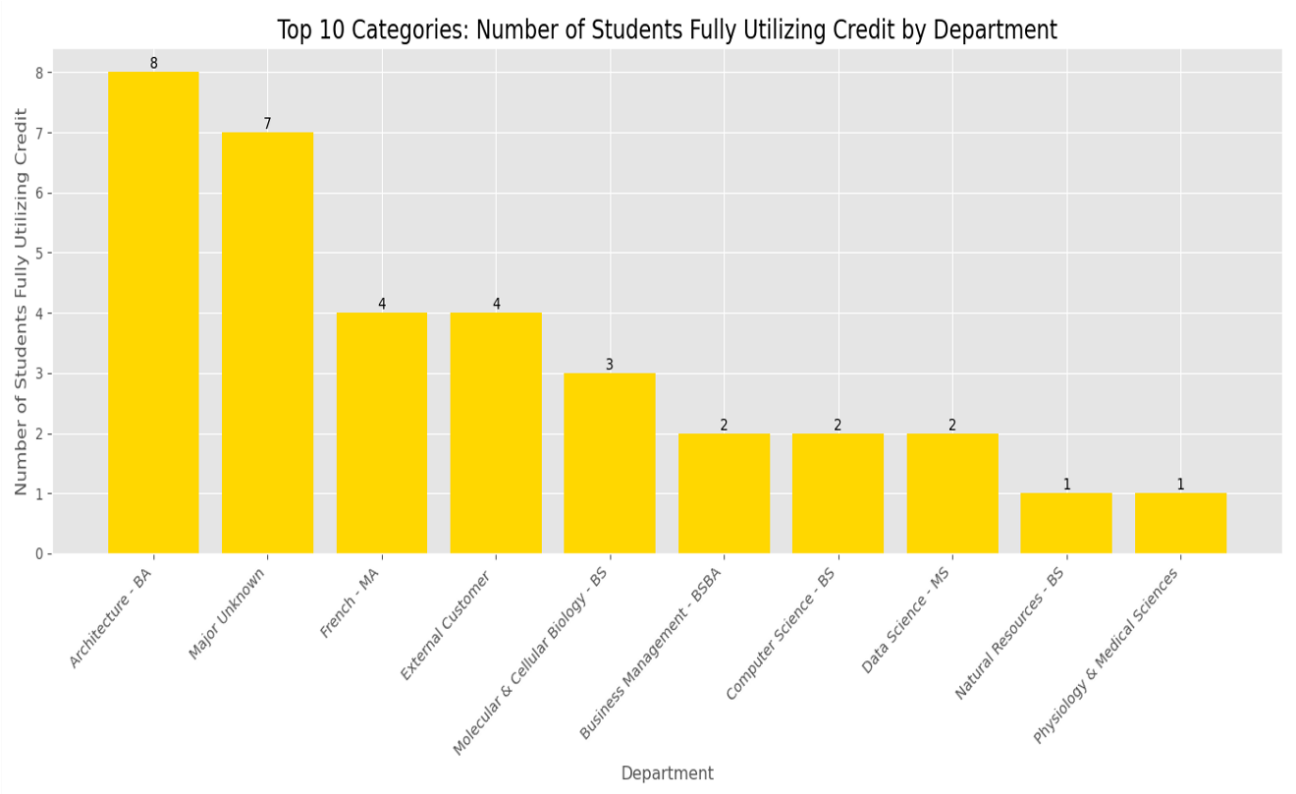
Conclusion:

- Departments like Marketing MS are key stakeholders in the credit program and should be prioritized for resource planning.
- Low-usage departments could benefit from targeted outreach to enhance participation.

5.4 Top 10 Departments by Fully Utilized Credit

Observation:

- **Architecture – BA** led with the **most students fully utilizing their credit**.
- Other design and fabrication-heavy departments followed closely.



Interpretation:

- Architecture students frequently work on models and prototypes, driving up material usage.
- This validates the high engagement of design-centric programs with CATalyst Studios resources.

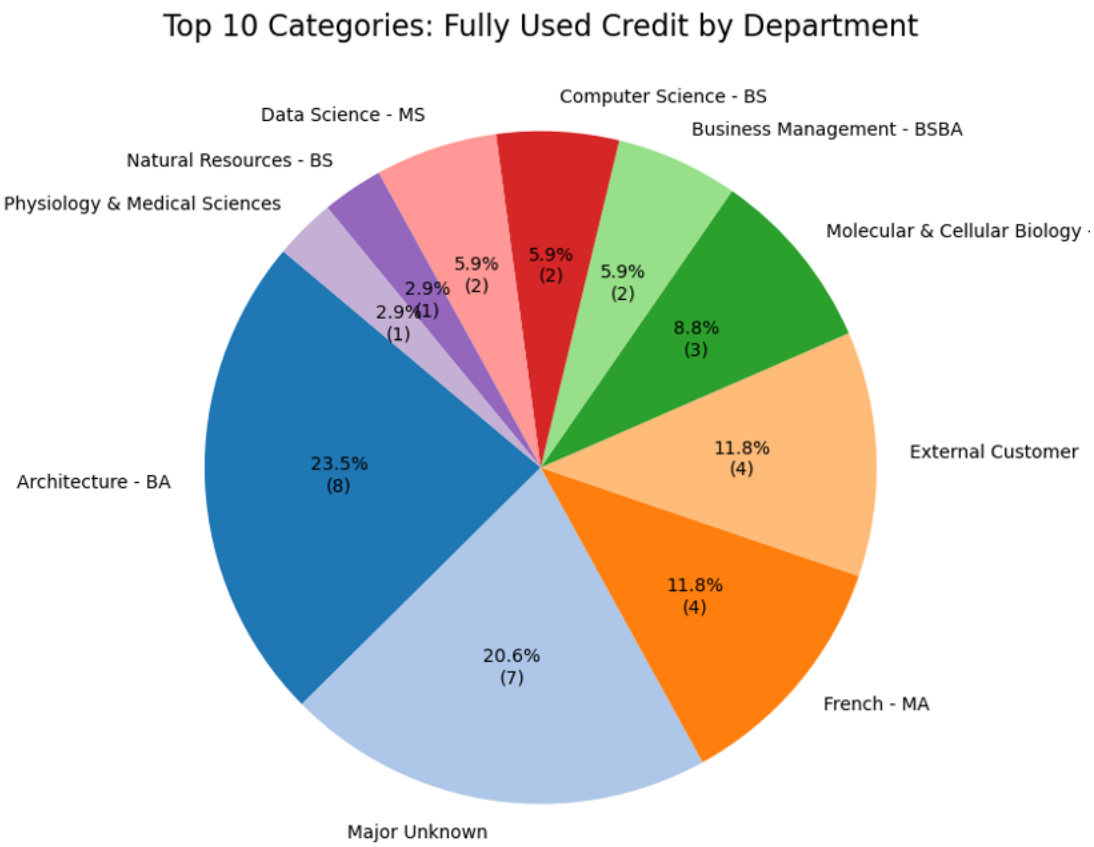
Conclusion:

- Departments with high full utilization should be considered for additional support, possibly flexible credit limits.
- CATalyst should continue fostering strong ties with these departments to maintain and enhance usage levels.

5.5 Fully Used Credit Share by Department

Observation:

- The pie chart shows **Architecture – BA** accounting for the **largest share of fully used credits**.
- Other departments contributed smaller but significant shares.



Interpretation:

- Concentration of fully used credits in a few departments reflects how resource needs align with specific academic requirements.
- While some programs inherently require more materials, others may need awareness to increase participation.

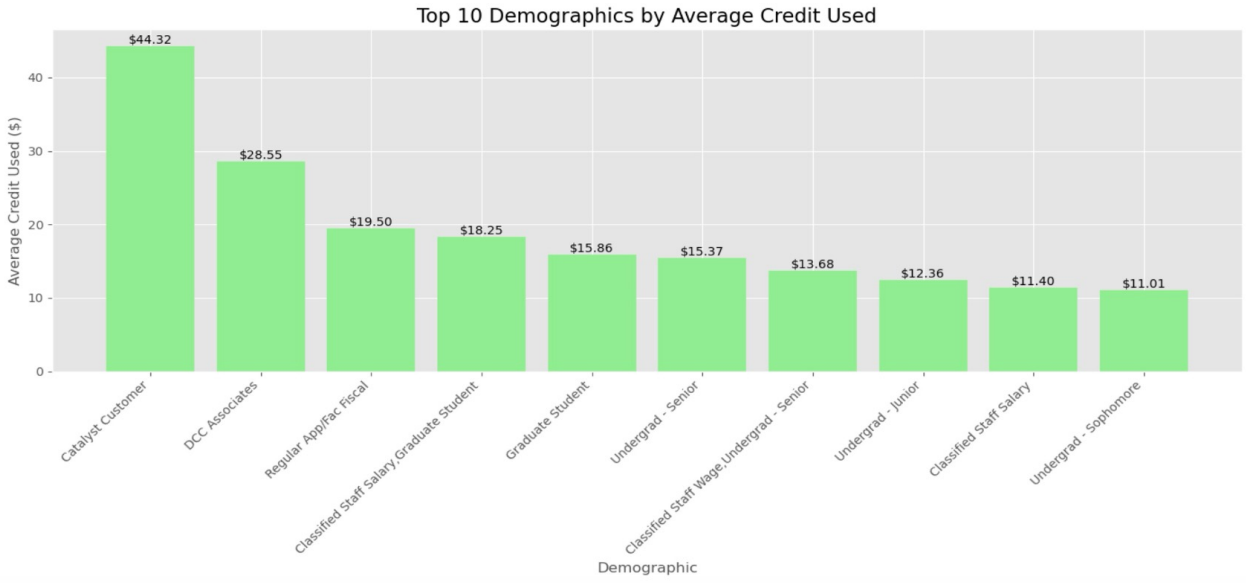
Conclusion:

- Resource allocation strategies should consider these usage concentrations.
- CATalyst should explore whether low-share departments face barriers to credit usage.

5.6 Demographic Insights

Observation:

- The analysis revealed differences in credit usage across demographic groups.
- Some groups had higher average usage and full utilization rates, while others lagged behind.



Interpretation:

- Variations may stem from differences in awareness, program requirements, or access barriers.
- Underrepresented groups might not be fully leveraging the credit program's benefits.

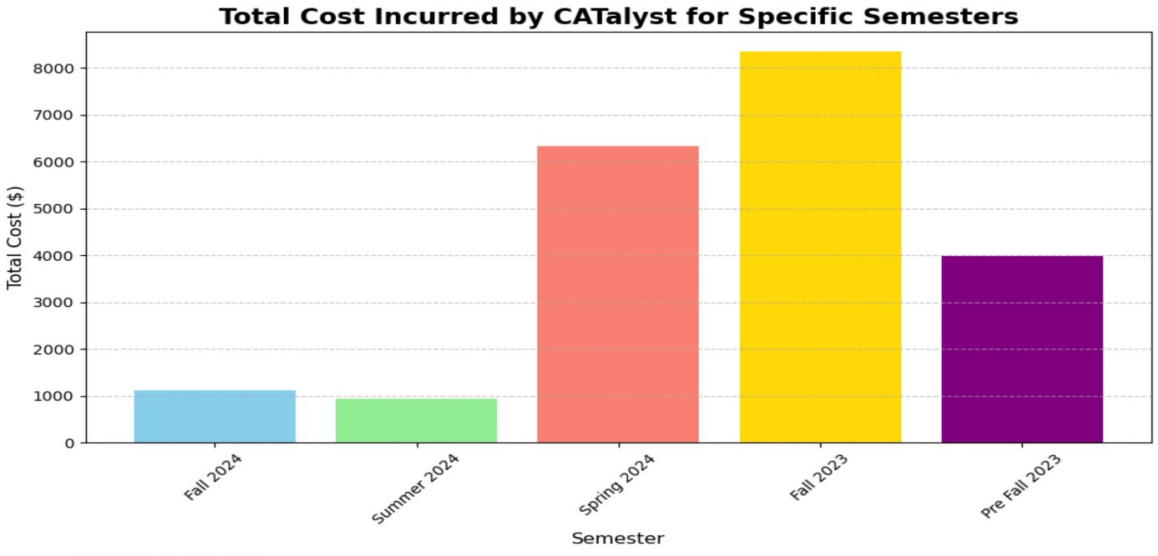
Conclusion:

- CATalyst should develop inclusive outreach strategies to ensure equitable participation.
- Focused engagement with low-usage demographics can improve overall program impact.

5.7 Total Cost Incurred by CATalyst

Observation:

- The cumulative cost visualization indicates a significant financial outlay by CATalyst Studios due to credit utilization.
- Departments with high engagement accounted for the majority of this cost.



	Semester	Total Cost
0	Fall 2024	1111.690
1	Summer 2024	937.810
2	Spring 2024	6325.794
3	Fall 2023	8349.280
4	Pre Fall 2023	3979.780

Interpretation:

- Increased usage reflects program success but necessitates careful financial planning.
- Historical cost patterns are vital for forecasting future budget needs.

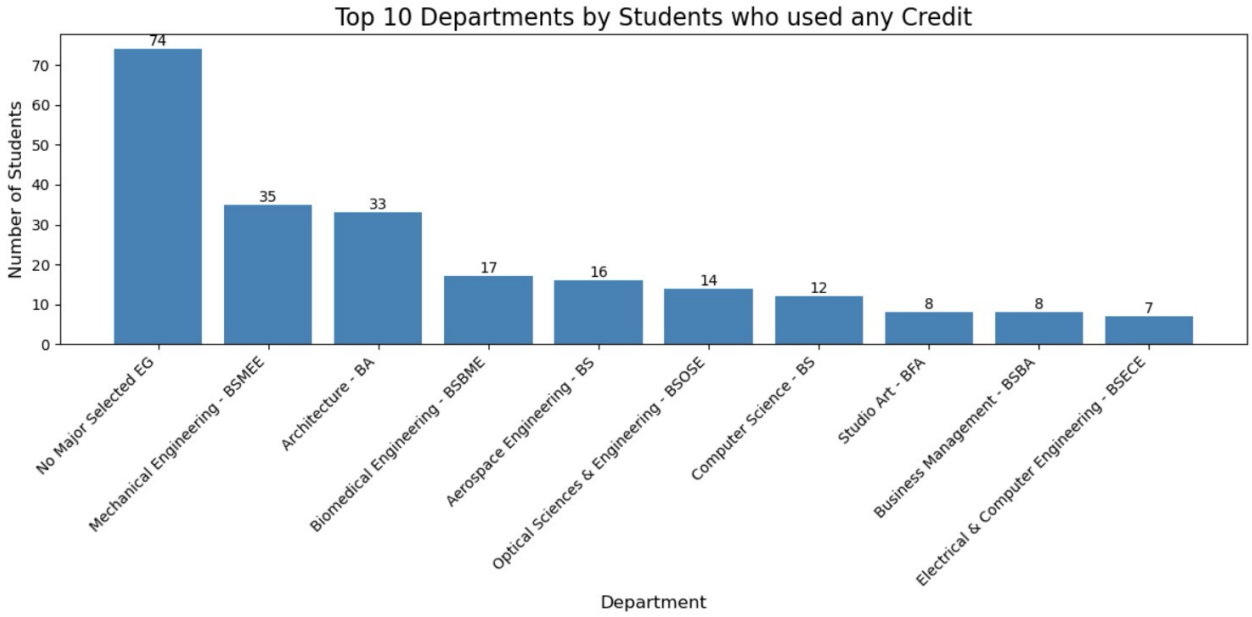
Conclusion:

- Sustainable budgeting strategies should be informed by usage trends.
- High-usage departments may warrant separate cost-sharing models or dedicated funding.

5.8 Top 10 Departments by Students Who Used Any Credit

Observation:

- This analysis showed which departments had the **largest number of students using any portion of their credit**.
- High participation was observed in a few key departments, while others had lower engagement.



Interpretation:

- Departments with broad participation reflect successful program visibility.
- Low-participation departments present opportunities for increased outreach and engagement.

Conclusion:

- Regularly monitoring department-level participation will help CATalyst identify growth areas.
- Initiatives to raise awareness in under-engaged departments can enhance overall program effectiveness.

Overall Summary of EDA:

- Usage patterns correlate with project-heavy programs and academic cycles.
- High-engagement departments like Architecture – BA and Marketing MS are consistent drivers of credit usage.
- Disparities across demographics and departments suggest areas for targeted improvement.
- Financial implications of credit usage require proactive planning.
- Data-driven insights from this analysis provide a strong foundation for optimizing the credit program.

6. Total Cost Analysis

Understanding the **total financial impact** of the CATalyst credit program is critical for ensuring its sustainability. This section evaluates the cumulative cost incurred by CATalyst Studios as a result of student credit usage across semesters and departments.

Observation:

- The total cost visualization shows a **significant cumulative expenditure** on student credit usage.
- **Fall 2024 and Spring 2024** were identified as periods contributing the most to overall costs.
- Departments with high engagement, such as **Architecture – BA** and **Marketing MS**, accounted for a large portion of the expenses.
- While some departments had high per-student usage, others impacted the cost more due to the sheer number of participating students.

Interpretation:

- The alignment between high credit utilization and increased costs is a positive indicator of program engagement but also poses challenges for budget management.
- Seasonal trends in usage directly influence cost surges, especially during project-heavy semesters.
- Certain departments consistently contribute to higher costs, which reflects their genuine need for makerspace resources, not necessarily inefficiency.

Conclusion:

- **Budget forecasting** should be based on historical usage patterns, particularly considering peak semesters.
- Departments with high but justified usage should be prioritized in funding models.

- For long-term sustainability, CATalyst Studios should explore additional funding avenues or partnerships to support high-demand periods.
- Regular cost analysis is essential to balance engagement goals with available financial resources.

7. Key Recommendations

Based on the detailed Exploratory Data Analysis and cost evaluations, the following strategic recommendations are proposed for CATalyst Studios to optimize the credit utilization program:

7.1 Improve Outreach to Low-Engagement Departments

- Conduct **awareness sessions** at the beginning of each semester.
- Collaborate with faculty in low-usage departments to integrate makerspace resources into their coursework.
- Provide **easy-to-understand guides** on how to use the credit and its benefits.

7.2 Target Underutilized Demographics

- Identify student groups with consistently low credit utilization.
- Develop **inclusive communication strategies** tailored to these groups.
- Address potential barriers such as lack of awareness, relevance, or accessibility.

7.3 Maintain and Support High-Usage Departments

- Engage proactively with high-usage departments like **Architecture – BA** and **Marketing MS**.
- Explore **customized support programs** for these departments, such as material replenishment schedules or priority access slots.
- Consider **flexible credit extensions** or additional credits for departments with intensive material needs.

7.4 Optimize Financial Planning

- Utilize historical cost data to **forecast future expenses** accurately.
- Align budget allocations with projected high-demand periods, especially Fall and Spring semesters.
- Explore **external sponsorships or grants** to support program growth without compromising quality.

7.5 Continuous Monitoring and Feedback Loops

- Establish a system for **semester-wise tracking** of credit usage and cost metrics.
- Gather **student feedback** to identify unmet needs and improve user experience.
- Share usage insights with department heads to foster collaborative engagement.

7.6 Simplify Credit Tracking for Students

- Implement tools or notifications that allow students to **easily track their remaining credit balance**.
- Promote transparency to encourage mindful and efficient usage.

Conclusion of Recommendations:

The proposed recommendations are designed to enhance program effectiveness, promote equitable access, and ensure financial sustainability. By focusing on both high-engagement and underrepresented groups, CATalyst Studios can optimize resource allocation and maintain its role as a central hub for innovation and creativity.

8. Conclusion

The CATalyst Studios credit utilization analysis was undertaken to address a critical gap in understanding how students engage with the makerspace's $50 credit allocation program. Through a structured approach involving data extraction, cleaning, and in-depth exploratory analysis, this project provided valuable insights into usage patterns, department-level engagement, demographic trends, and financial impacts.

Key Takeaways:

- **Fall 2024 emerged as the semester with the highest average credit usage**, indicating a significant level of student engagement aligned with project-heavy academic schedules.
- **Spring 2024 recorded the highest number of students fully utilizing their credit**, reflecting the success of targeted outreach or curricular integration during that term.
- Departments such as **Marketing MS and Architecture – BA** consistently exhibited high levels of credit usage, highlighting their alignment with CATalyst Studios' resources.
- **Demographic analysis revealed disparities** in engagement, suggesting that some student groups may lack awareness or face barriers in accessing makerspace services.
- The **total financial impact on CATalyst Studios was substantial**, driven by peak semesters and high-usage departments, underscoring the need for strategic budgeting and resource planning.

Impact of the Study:

- The analysis provided CATalyst Studios with a **data-driven understanding of usage behaviors**, enabling informed decision-making.
- Identified patterns can guide future initiatives to enhance equitable access, improve program visibility, and ensure efficient resource allocation.
- By quantifying total costs, the study aids in **sustainable financial planning**, balancing engagement goals with budget constraints.

Strategic Implications:

- The findings support the development of **targeted outreach strategies** for underutilizing departments and demographics.
- Proactive engagement with high-usage departments will help maintain strong participation while managing resources effectively.
- Continuous monitoring of usage and cost trends will ensure that the credit program remains relevant, impactful, and financially viable.

Future Outlook:

- Moving forward, CATalyst Studios can leverage this foundational analysis to implement ongoing tracking mechanisms.
- Establishing feedback loops with students and faculty will ensure that evolving needs are addressed.
- Exploring partnerships or external funding can provide additional support for the program's growth.

Final Thought:

The CATalyst Studios credit program represents more than just financial support—it is an enabler of student innovation, creativity, and interdisciplinary learning. This analysis ensures that the program's benefits are maximized, equitably distributed, and aligned with both academic and operational goals.

By fostering a culture of data-informed decision-making, CATalyst Studios can continue to be a pivotal resource for the University of Arizona's students, nurturing the next generation of makers, innovators, and problem-solvers.