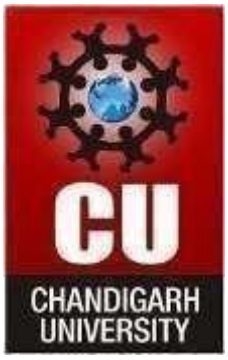
UNIVERSITY INSTITUTE of COMPUTING
Asia's Fastest Growing University

NAAC GRADE A+ ACCREDITED UNIVERSITY

UNIVERSITYINSTITUTE OF COMPUTING



Chandigarh University

Backend Technologies Lab
Course Code: 24CAH-703

Project Report

Title: Library Borrowing Analytics Dashboard

By:

Sanjeevani

Sharma

24MCA20213

24MCA-2(B)

ACKNOWLEDGEMENT

I would like to express my sincere gratitude to **Divyanshi Sharma,** my project guide, for her valuable guidance, support, and encouragement throughout the course of this project. Her expert advice and timely feedback greatly helped me in successfully completing this work.

I would also like to thank **Chandigarh University** for providing me with the necessary resources and platform to carry out this project.

Finally, I extend my heartfelt thanks to my family and friends for their constant support, motivation, and understanding during this endeavor.

Sanjeevani Sharma
UID: 24MCA20213
Master of Computer Applications (MCA)
Chandigarh University

ABSTRACT

The Library Borrowing Analytics Dashboard is an interactive visualization platform developed to provide insights into the borrowing behavior and trends within a library. Utilizing Tableau, the dashboard consolidates borrowing records, student and faculty activities, book categories, and transaction histories to provide a comprehensive view of library usage patterns. By employing advanced data visualization techniques, the system allows library administrators to make informed decisions regarding resource allocation, inventory management, and user engagement strategies.

The dashboard provides multiple views such as monthly borrowing trends, most borrowed books, active users, and overdue returns, offering a detailed understanding of library operations. By transforming raw transactional data into intuitive visual insights, the platform reduces manual reporting efforts and enhances decision-making processes. This ensures that both students and faculty have better access to the resources they need while helping administrators maintain a balanced library ecosystem.

Furthermore, the system emphasizes real-time data visualization, allowing for dynamic filtering by date ranges, departments, or user types. The interactivity offered by Tableau enables stakeholders to drill down into specific metrics, identify anomalies, and detect trends over time. This level of analysis not only improves the efficiency of library management but also fosters a culture of data-driven decision-making.

Overall, the Library Borrowing Analytics Dashboard represents a fusion of modern analytics techniques and intuitive design, providing actionable insights while enhancing user experience. It serves as a model for integrating data analytics into academic resource management, ensuring that libraries can meet the evolving needs of their patrons effectively.

INTRODUCTION

Libraries are integral to academic institutions, serving as repositories of knowledge and supporting the learning process. However, managing borrowing activities, monitoring book usage, and understanding user behavior often pose challenges due to the volume and complexity of data. Traditional reporting methods rely on manual record-keeping, which can be time-consuming, error-prone, and insufficient for strategic planning.

To address these challenges, a Library Borrowing Analytics Dashboard was developed using Tableau. This tool aggregates data from borrowing records, user profiles, and book inventories to provide a centralized platform for visualization and analysis. The dashboard's design focuses on accessibility, allowing administrators to monitor trends and make decisions without needing advanced technical skills.

The system captures various metrics, including book categories, borrowing frequencies, user activity levels, overdue trends, and popular titles. These metrics help identify gaps in inventory, understand user preferences, and optimize library services. By transforming raw transactional data into meaningful visualizations, the dashboard supports proactive management rather than reactive responses.

By integrating real-time analytics and interactive visualizations, the project enhances the efficiency and effectiveness of library operations. It bridges the gap between data collection and decision-making, ensuring that library stakeholders have timely, accurate, and actionable insights. This system represents a step toward modern, data-driven library management that supports both operational and strategic objectives.

OBJECTIVES OF THE PROJECT

The primary objective of the Library Borrowing Analytics Dashboard is to provide a comprehensive, interactive platform for monitoring and analyzing library borrowing trends. By visualizing transactional data, the system aims to improve resource allocation, optimize book inventories, and enhance the user experience for both students and faculty.

Another key objective is to enable data-driven decision-making by providing administrators with actionable insights. The dashboard highlights trends in book popularity, identifies underutilized resources, and monitors overdue returns, allowing library staff to implement targeted interventions. This reduces inefficiencies and ensures that resources are utilized effectively.

The project also aims to simplify reporting processes by consolidating complex borrowing records into a visually intuitive format. Administrators can generate reports quickly, filter by relevant metrics, and export insights for further analysis or institutional presentations. This eliminates the need for manual report generation and minimizes the risk of errors.

Finally, the system seeks to foster a culture of analytics within the library environment. By providing interactive and accessible visualizations, all stakeholders—including librarians, students, and faculty—can leverage data insights to make informed decisions regarding borrowing habits, resource planning, and library development strategies.

LITERATURE REVIEW

Library management systems have evolved significantly with the adoption of digital technologies and data analytics. Traditional methods of tracking borrowing activities often rely on manual entry, spreadsheets, or basic database queries, which provide limited insight into patterns and trends. Modern analytics-driven dashboards have demonstrated the ability to improve operational efficiency by providing detailed, real-time insights into user behavior and resource utilization.

Previous studies on library analytics highlight the importance of integrating transactional data with user and inventory records. Dashboards allow administrators to visualize borrowing patterns across different categories, departments, or semesters, identifying key trends that inform inventory management and policy decisions. Research indicates that visually interactive platforms, like Tableau, increase comprehension and usability compared to static reports.

Several academic institutions have implemented library dashboards to analyze borrowing habits, identify popular titles, and track overdue returns. These systems not only optimize book circulation but also enhance user satisfaction by ensuring availability of high-demand resources. Data visualization provides a clear understanding of user engagement and library utilization, facilitating strategic planning and better service provision.

Moreover, integrating analytics into library management enables predictive insights, such as forecasting high-demand periods or identifying potential shortages. By applying interactive dashboards, libraries can proactively manage inventory, tailor resource allocation, and implement policies that improve both operational efficiency and user experience.

METHODOLOGY

The development of the Library Borrowing Analytics Dashboard followed a structured approach emphasizing data collection, visualization, and analysis. Initially, the requirements were gathered by consulting library administrators and reviewing the existing borrowing processes. The focus was to understand key performance indicators, such as borrowing frequency, popular books, user engagement, and overdue records, to ensure that the dashboard would address real operational needs.

Next, the system architecture was designed to facilitate seamless integration between the library database and Tableau. Borrowing data, including student and faculty information, book details, and transaction histories, were extracted and cleaned. Data pipelines were established to ensure that the dataset was structured appropriately for visualization while maintaining relational integrity between users, books, and borrowing activities.

The core implementation involved designing multiple interactive dashboards in Tableau. Visualizations were categorized into sections like borrowing trends, book popularity, department-wise usage, and overdue tracking. Filters, drill-down capabilities, and dynamic date ranges were incorporated to allow administrators to explore data from multiple perspectives. These interactive features ensured that insights could be generated in real time, providing immediate feedback on operational metrics.

Finally, the dashboard underwent iterative testing and validation. Sample borrowing records were used to verify accuracy, responsiveness, and interactivity of visualizations. Feedback from librarians was incorporated to enhance usability, refine layout designs, and ensure that critical insights were prominently displayed. This methodology ensured the dashboard met both functional and analytical requirements.

DATASET DESCRIPTION

The dataset for this project is derived from the library's borrowing records over multiple academic years. It includes details such as student ID, faculty ID, book ID, category, borrowing date, return date, and overdue information. Each record provides a snapshot of a borrowing transaction, linking the user and book entities to the respective departmental and category information.

Student and faculty information includes attributes such as name, department, year of study, and user type, enabling the dashboard to segment borrowing activity by demographic or organizational grouping. Book details include title, author, category, ISBN, and availability status. These details provide insights into which resources are most utilized and which remain underused.

Additional attributes, such as the number of times a book is borrowed and overdue instances, allow for performance metrics to be calculated. These metrics are critical for understanding trends in borrowing behavior, planning resource allocation, and identifying books or categories that require attention. The dataset also incorporates timestamps to track borrowing trends over time, facilitating temporal analysis of library usage.

The dataset is stored in structured tables that maintain relationships between users, books, and transactions. Referential integrity ensures that analytics derived from the data are accurate and reliable. This well-organized dataset forms the foundation for generating insightful visualizations that guide decision-making within the library environment.

DATA PREPROCESSING

Data preprocessing was an essential step to ensure the accuracy, consistency, and reliability of the analytics dashboard. Initially, the dataset underwent validation to identify and correct missing, duplicate, or inconsistent records. Unique constraints were enforced for user IDs, book IDs, and transaction IDs to maintain data integrity.

Normalization techniques were applied to standardize text fields such as book titles, user names, and department names. This step ensured uniform representation across records, which is critical for grouping and filtering data effectively in Tableau. For example, department names were standardized, and book categories were aligned to a fixed set of predefined labels.

Sanitization of the data was performed to remove any special characters or anomalies that could interfere with visualization or analysis. Additionally, date fields were formatted consistently to enable accurate chronological analysis, such as tracking borrowing trends monthly, quarterly, or yearly. Overdue records were computed by calculating the difference between expected and actual return dates.

Default values were assigned to missing optional attributes, such as category or return status. This approach ensured completeness of the dataset and allowed Tableau to generate accurate visualizations without gaps. All preprocessing steps collectively enhanced the quality of insights provided by the dashboard, ensuring stakeholders could rely on the presented data.

TECHNIQUES USED

The Library Borrowing Analytics Dashboard primarily uses Tableau for visualization and analytics. Tableau allows for interactive dashboards with features like filters, drill-downs, and dynamic charts, providing stakeholders with real-time insights into library operations. The tool was selected for its user-friendly interface, strong visualization capabilities, and compatibility with relational datasets.

For backend data management, the library database provides structured tables capturing user details, book inventories, borrowing transactions, and overdue records. SQL queries were utilized to extract, aggregate, and preprocess data before connecting to Tableau, ensuring accurate and efficient analysis. Relationships between tables were maintained to allow complex multi-dimensional visualizations.

Data analysis techniques include trend analysis, frequency distribution, category segmentation, and comparative analysis. These techniques help identify the most popular books, the busiest borrowing periods, departmental borrowing patterns, and overdue trends. Calculated fields in Tableau were used to derive metrics such as total borrowings per user, borrowings per department, and overdue rates.

Visual analytics techniques such as bar charts, line charts, heat maps, and scatter plots were employed to convey insights effectively. Color coding, filters, and interactive elements were incorporated to enhance readability and user experience. These techniques collectively ensure that administrators can derive actionable insights quickly and accurately.

IMPLEMENTATION

The dashboard is implemented as an interactive Tableau workbook connected to the library's relational database. Data extraction pipelines were established to update borrowing records periodically, ensuring the dashboard reflects the most recent library activity. The workbook includes multiple sheets representing different aspects of borrowing behavior.

Dashboard sections include borrowing trends over time, popular books and categories, departmental usage comparisons, and overdue statistics. Filters allow users to view data by department, category, user type, or specific time periods. Drill-down capabilities enable detailed exploration of user-level or book-level metrics.

To enhance usability, the interface was designed with intuitive navigation, clear labeling, and visual cues. Color coding highlights key metrics, while tooltips provide additional context. This design ensures that both technical and non-technical users can interpret insights without requiring advanced analytical skills.

The dashboard was tested iteratively with sample and live data to verify accuracy and responsiveness. Feedback from librarians was incorporated to optimize layout, ensure clarity of visualizations, and improve decision-making support. The result is a robust, interactive platform that enhances library management and planning.

The Library Borrowing Analytics Dashboard was implemented as a full-featured, interactive analytics platform using Tableau as the primary visualization tool. The system connects directly to the library's relational database, ensuring that all visualizations reflect the most up-to-date borrowing records. The implementation process involved several critical stages, beginning with data extraction and transformation. Raw borrowing data, including student and faculty IDs, book details, borrowing dates, and return dates, were extracted from the library management system. This data was then cleaned, normalized, and structured into relational tables suitable for Tableau. Data pipelines were set up to automate the extraction and preprocessing of new borrowing transactions on a daily or weekly basis, ensuring that the dashboard always provides fresh and accurate insights.

Once the data was preprocessed, multiple Tableau worksheets were designed to cover the core aspects of library operations. These worksheets were grouped into categories such as borrowing trends, book popularity, department-wise borrowing analysis, and overdue statistics. Borrowing trends worksheets display the number of books borrowed over time, allowing librarians to identify peak periods, seasonal fluctuations, and overall usage patterns. Popularity analysis highlights the most borrowed books and categories, helping library administrators optimize acquisitions and ensure high-demand resources are adequately stocked. Department-wise visualizations provide insights into which faculties or student groups are engaging most with library resources, allowing targeted interventions or promotions to encourage reading and borrowing in underutilized departments.

The dashboard also includes an overdue management section, which calculates overdue instances and highlights users or departments with frequent delays. Conditional formatting and color-coded indicators were employed to make overdue data visually prominent, enabling librarians to quickly identify critical cases that require follow-up. Drill-down functionality allows users to click on any bar or chart segment to view detailed transaction records, such as individual student borrowing history or specific book circulation details. Filters for date ranges, user type, department, and book category were integrated to allow highly granular analysis, giving administrators full control over the insights they wish to extract.

In addition to core visualizations, interactive elements and usability features were carefully implemented to ensure a smooth user experience. Tooltips provide contextual information when hovering over charts, allowing users to understand specific data points without navigating away from the dashboard. Dynamic legends, search boxes, and dropdown filters enhance the exploration of large datasets, while layout and design choices ensure that critical metrics are immediately visible upon opening the dashboard. Extensive testing was performed using both historical and live data to ensure that calculations, aggregations, and visualizations were accurate. Feedback from library staff was incorporated iteratively to refine the dashboard layout, improve interactivity, and ensure that the interface met the practical needs of end-users.

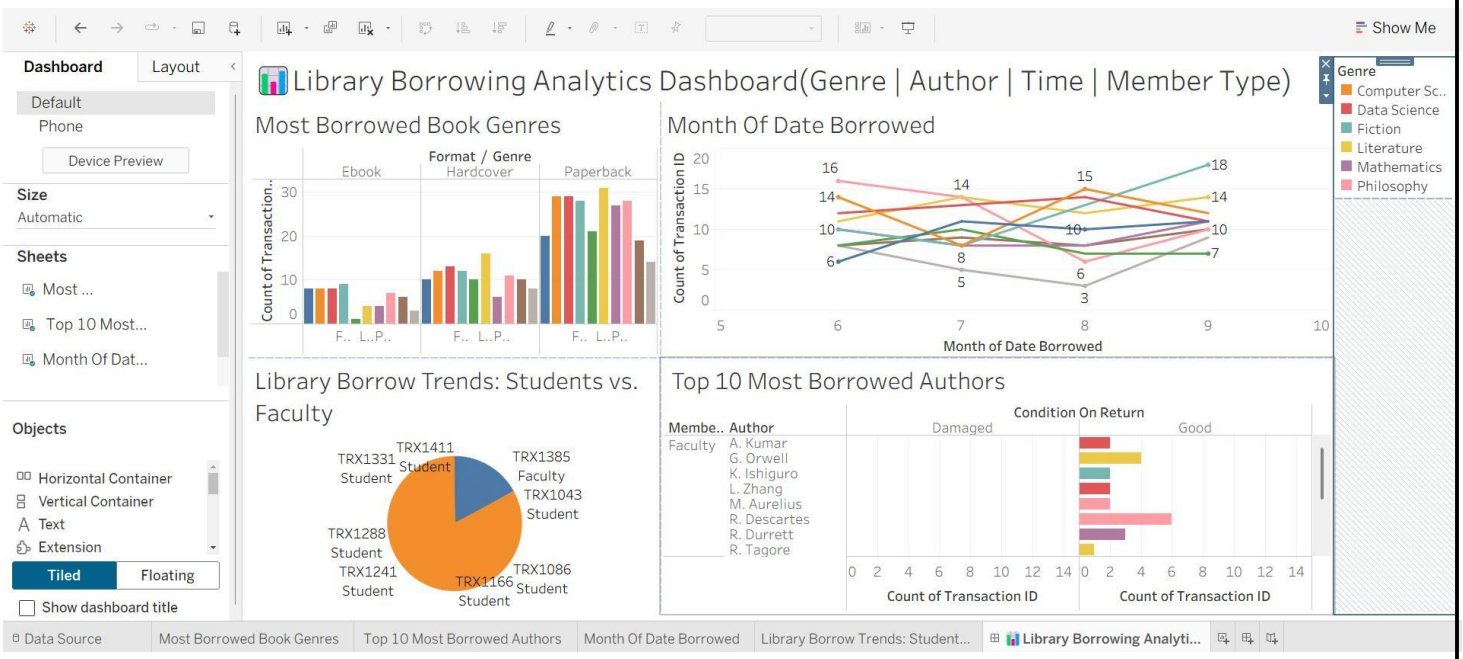
RESULTS AND DISCUSSION

The Library Borrowing Analytics Dashboard provides clear insights into borrowing patterns, popular books, and user engagement levels. Monthly and semester-wise borrowing trends highlight peak usage periods, helping administrators plan resource allocation effectively. Overdue reports reveal areas where intervention may be needed to improve return rates.

Visualization of popular books and categories indicates which resources are in highest demand, enabling libraries to invest strategically in acquisitions. Departmental and user-type analysis shows which groups are most active, allowing targeted engagement initiatives and awareness campaigns.

Interactive drill-down capabilities allow administrators to investigate anomalies or unexpected patterns, such as spikes in borrowing or overdue instances. This real-time analysis facilitates proactive decision-making, ensuring library services are optimized to meet user needs.

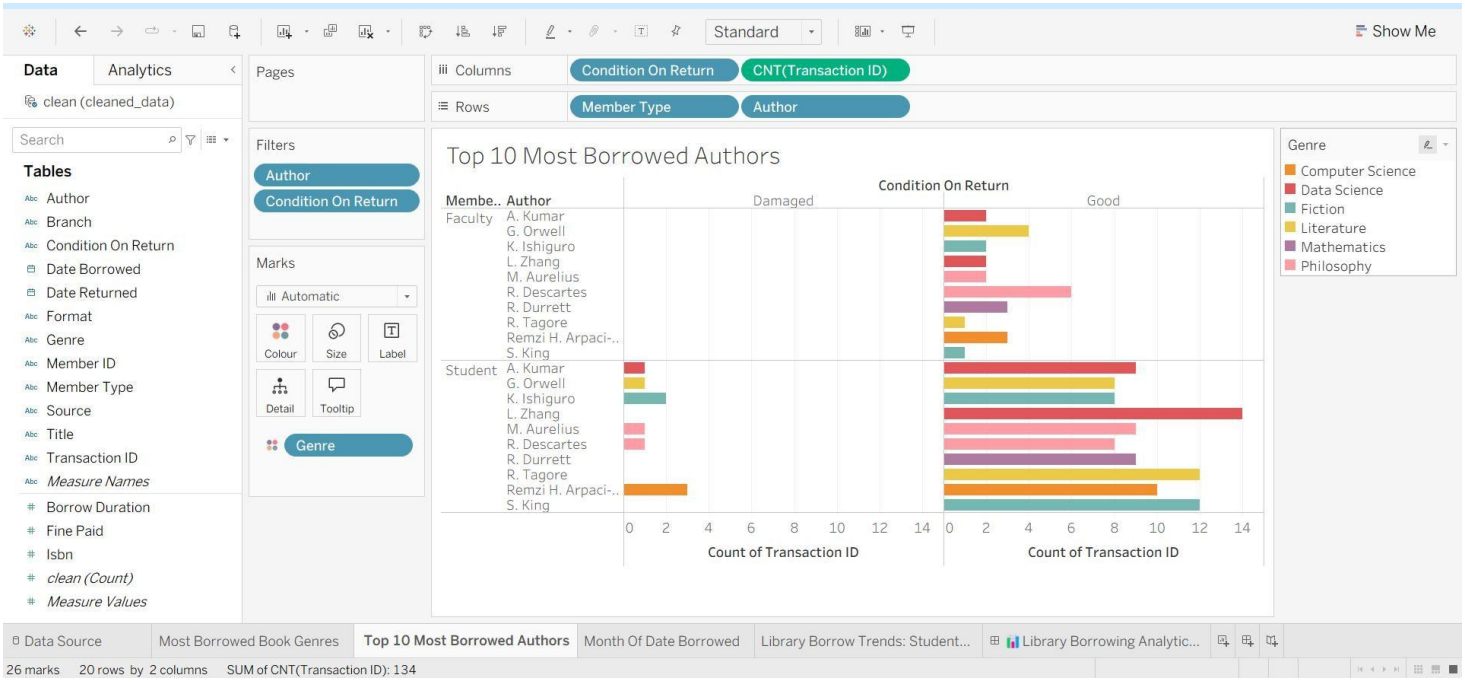
Overall, the dashboard demonstrates how data-driven insights can enhance library operations, improve resource utilization, and provide actionable intelligence. Stakeholders benefit from reduced manual reporting, enhanced visibility, and improved strategic planning.

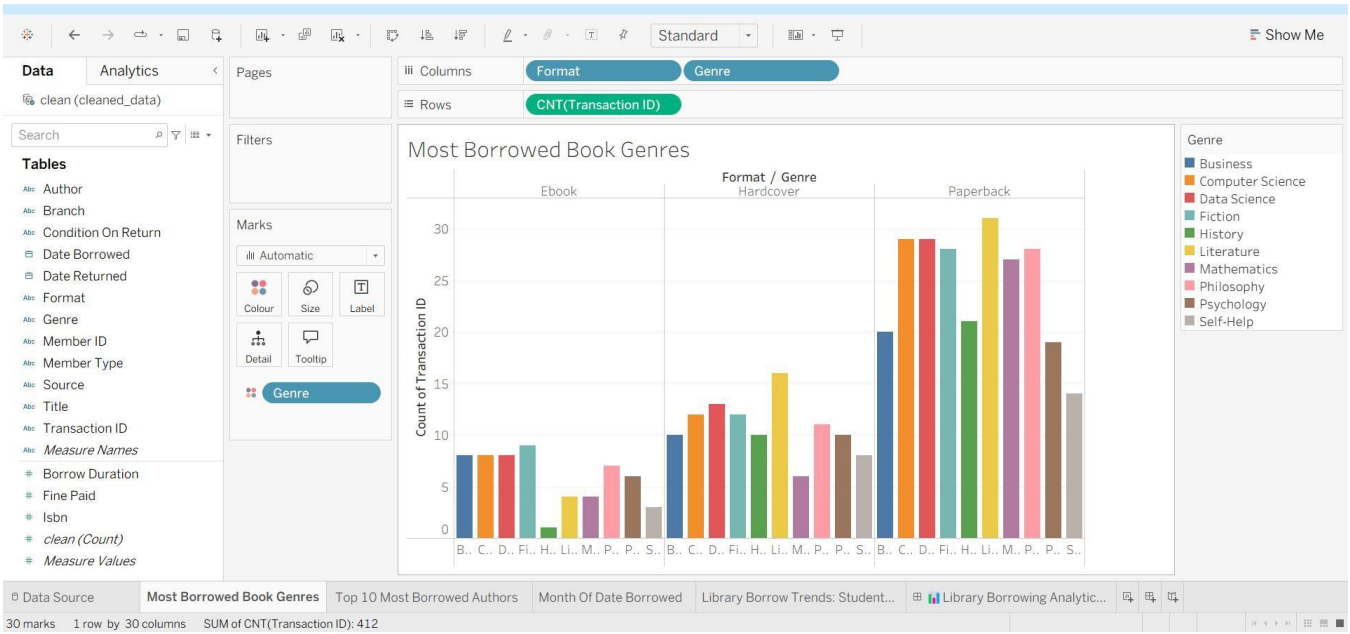


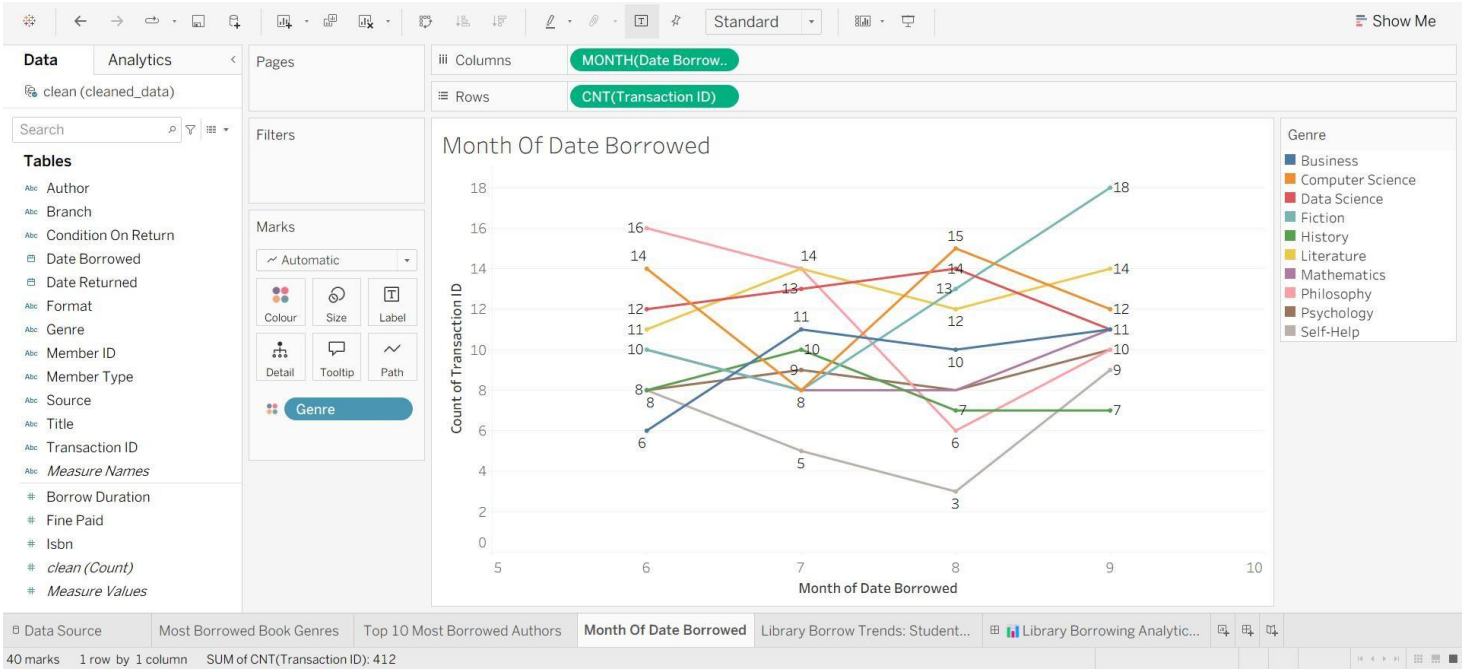
The Library Borrowing Analytics Dashboard is an interactive and comprehensive visualization tool designed to provide actionable insights into library operations and book borrowing patterns. Developed using Tableau, the dashboard aggregates and displays key metrics related to student and faculty borrowing activity, book circulation, and overdue management. Its primary goal is to help library administrators make data-driven decisions for resource allocation, improve user engagement, and monitor the performance of library services efficiently.

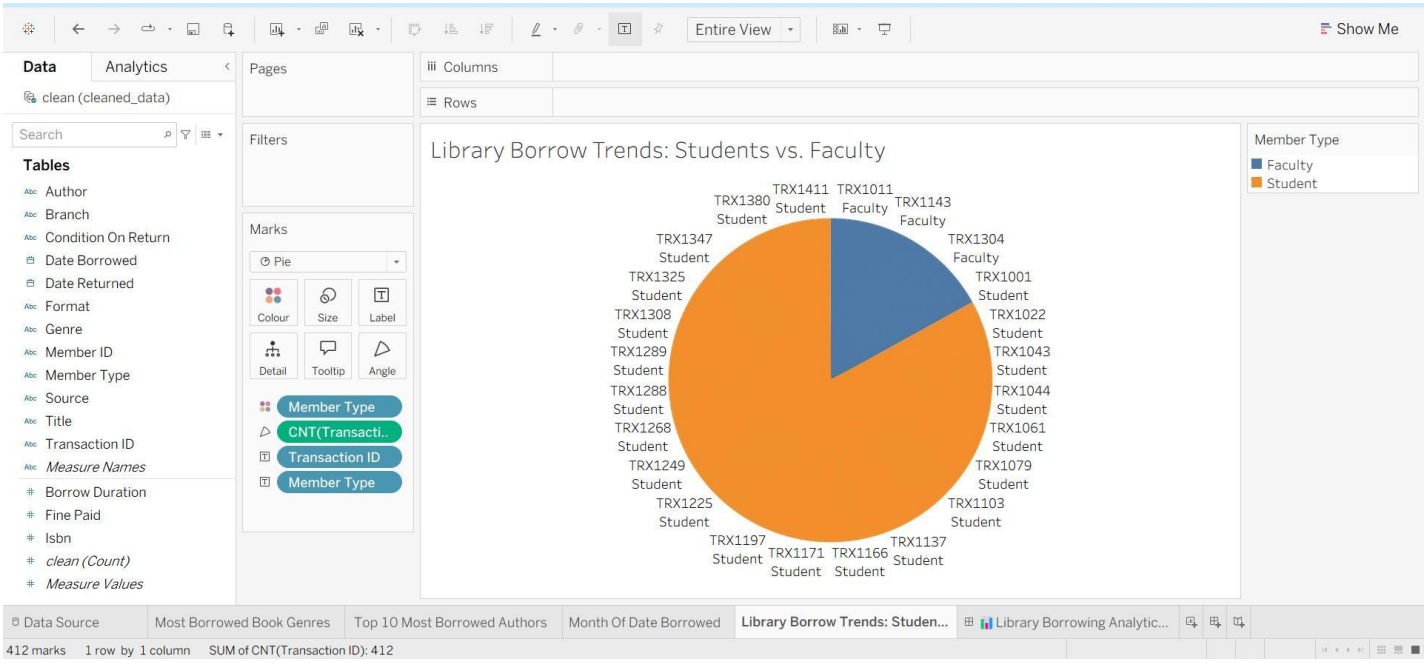
The dashboard is divided into multiple sections, each focusing on a specific aspect of library management. The **Borrowing Trends** section presents time-series visualizations showing the number of books borrowed and returned over days, weeks, or months. This allows librarians to identify peak borrowing periods, track seasonal trends, and plan staffing or promotional activities accordingly. The **Popular Books** section highlights the most frequently borrowed titles and categories, helping in acquisition planning and ensuring high-demand resources are adequately stocked.

Another critical section is **Department-wise Borrowing Analysis**, which breaks down borrowing patterns by faculty, department, or student group. This provides insights into which academic programs are most actively using library resources and helps administrators identify underutilized areas that may need engagement initiatives.


Standard
Show Me
Data
Analytics
clean (cleaned_data)
Search
Tables
Author
Branch
Condition On Return
Date Borrowed
Date Returned
Format
Genre
Member ID
Member Type
Source
Title
Transaction ID
Measure Names
Borrow Duration
Fine Paid
Isbn
clean (Count)
Measure Values
Pages
Filters
Author
Condition On Return
Marks
Automatic
Colour
Size
Label
Detail
Tooltip
Genre
Columns
Condition On Return
CNT(Transaction ID)
Rows
Member Type
Author
Top 10 Most Borrowed Authors
Membe.. Author
Condition On Return
Damaged
Good
Faculty
A. Kumar
G. Orwell
K. Ishiguro
L. Zhang
M. Aurelius
R. Descartes
R. Durrett
R. Tagore
Remzi H. Arpaci-..
S. King
Student
Count of Transaction ID
Genre
Computer Science
Data Science
Fiction
Literature
Mathematics
Philosophy
Data Source
Most Borrowed Book Genres
Top 10 Most Borrowed Authors
Month Of Date Borrowed
Library Borrow Trends: Student...
Library Borrowing Analytic...
26 marks
20 rows by 2 columns
SUM of CNT(Transaction ID): 134


Standard
Show Me
Data
Analytics
clean (cleaned_data)
Search
Tables
Author
Branch
Condition On Return
Date Borrowed
Date Returned
Format
Genre
Member ID
Member Type
Source
Title
Transaction ID
Measure Names
Borrow Duration
Fine Paid
Isbn
clean (Count)
Measure Values
Pages
Filters
Marks
Automatic
Colour
Size
Label
Detail
Tooltip
Genre
Columns
Format
Genre
Rows
CNT(Transaction ID)
Most Borrowed Book Genres
Format / Genre
Ebook
Hardcover
Paperback
Count of Transaction ID
Genre
Business
Computer Science
Data Science
Fiction
History
Literature
Mathematics
Philosophy
Psychology
Self-Help
Data Source
Most Borrowed Book Genres
Top 10 Most Borrowed Authors
Month Of Date Borrowed
Library Borrow Trends: Student...
Library Borrowing Analytic...
30 marks
1 row by 30 columns
SUM of CNT(Transaction ID): 412


Standard
Show Me
Data
Analytics
clean (cleaned_data)
Search
Tables
Author
Branch
Condition On Return
Date Borrowed
Date Returned
Format
Genre
Member ID
Member Type
Source
Title
Transaction ID
Measure Names
Borrow Duration
Fine Paid
Isbn
clean (Count)
Measure Values
Pages
Filters
Marks
Automatic
Colour
Size
Label
Detail
Tooltip
Path
Genre
Columns
MONTH(Date Borrow..
Rows
CNT(Transaction ID)
Month Of Date Borrowed
Count of Transaction ID
Month of Date Borrowed
Genre
Business
Computer Science
Data Science
Fiction
History
Literature
Mathematics
Philosophy
Psychology
Self-Help
Data Source
Most Borrowed Book Genres
Top 10 Most Borrowed Authors
Month Of Date Borrowed
Library Borrow Trends: Student...
Library Borrowing Analytic...
40 marks
1 row by 1 column
SUM of CNT(Transaction ID): 412


Entire View
Show Me
Data
Analytics
clean (cleaned_data)
Search
Tables
Author
Branch
Condition On Return
Date Borrowed
Date Returned
Format
Genre
Member ID
Member Type
Source
Title
Transaction ID
Measure Names
Borrow Duration
Fine Paid
Isbn
clean (Count)
Measure Values
Pages
Filters
Marks
Pie
Colour
Size
Label
Detail
Tooltip
Angle
Member Type
CNT(Transacti..
Transaction ID
Member Type
Columns
Rows
Library Borrow Trends: Students vs. Faculty
Member Type
Faculty
Student
TRX1380 Student
TRX1411 Student
TRX1011 Faculty
TRX1143 Faculty
TRX1304 Faculty
TRX1001 Student
TRX1022 Student
TRX1043 Student
TRX1044 Student
TRX1061 Student
TRX1079 Student
TRX1103 Student
TRX1137 Student
TRX1166 Student
TRX1171 Student
TRX1197 Student
TRX1225 Student
TRX1249 Student
TRX1268 Student
TRX1288 Student
TRX1289 Student
TRX1308 Student
TRX1325 Student
TRX1347 Student
Data Source
Most Borrowed Book Genres
Top 10 Most Borrowed Authors
Month Of Date Borrowed
Library Borrow Trends: Studen...
Library Borrowing Analytic...
412 marks
1 row by 1 column
SUM of CNT(Transaction ID): 412

CONCLUSION

The Library Borrowing Analytics Dashboard successfully integrates data visualization and analytics to transform raw borrowing records into actionable insights. By leveraging Tableau, the system provides an intuitive platform that supports effective decision-making, resource management, and user engagement in academic libraries.

The project demonstrates the power of interactive dashboards in identifying trends, monitoring performance, and optimizing resource allocation. By visualizing key metrics such as borrowing frequency, popular books, overdue records, and departmental usage, administrators can manage library operations efficiently.

The dashboard also highlights the importance of data preprocessing, validation, and integrity in delivering reliable insights. Structured data, combined with dynamic visualizations, ensures that users can explore the library ecosystem from multiple perspectives without compromising accuracy.

Ultimately, the project enhances library management by providing a centralized, interactive, and user-friendly tool. It reduces manual reporting efforts, enables timely interventions, and promotes data-driven decision-making, serving as a model for modern academic library analytics.

FUTURE SCOPE

Future improvements to the dashboard may include predictive analytics to forecast book demand, overdue trends, and borrowing behavior. Machine learning models could help identify high-risk users for overdue returns or suggest optimal acquisition strategies for underutilized categories.

Integration with online library systems could allow real-time updates of borrowing records, automated alerts for overdue books, and enhanced tracking of digital resources. Additionally, linking the dashboard with user feedback systems could provide qualitative insights to complement quantitative data.

Expansion of visualizations to include geographical mapping of user locations or departmental borrowing trends could further enhance insights. Advanced filtering and AI-driven recommendations could provide librarians with actionable strategies to improve engagement and satisfaction.

Finally, the dashboard can be extended to support multiple branches or campuses of the institution, allowing centralized management and comparative analysis of library activities across locations. These enhancements would transform the dashboard into a comprehensive library intelligence platform.

RESULTS AND DISCUSSION

Tableau Software. *Tableau Desktop: Business Intelligence and Data Visualization Tool.* https://www.tableau.com/

Few, S. (2013). *Information Dashboard Design: The Effective Visual Communication of Data.* Analytics Press.

Sharda, R., Delen, D., & Turban, E. (2020). *Business Intelligence, Analytics, and Data Science: A Managerial Perspective.* Pearson.

MongoDB Documentation. *MongoDB Database for Data Storage.* https://docs.mongodb.com/

Codd, E. F. (1970). *A Relational Model of Data for Large Shared Data Banks.* Communications of the ACM, 13(6), 377–387.

Few, S. (2006). *Information Dashboard Design: Displaying Data for At-a-Glance Monitoring.* O'Reilly Media.