Learning Management System (LMS) Analytics Dashboard

Project Summary

The LMS Analytics Dashboard is a data-driven visualization tool designed to provide educators and stakeholders with comprehensive insights into student performance, engagement, and course effectiveness. Developed using Python, Power BI, Google Sheets, Excel, and R, the dashboard transforms raw LMS data into actionable intelligence to enhance teaching strategies and learning outcomes.

Introduction

Learning Management Systems (LMS) are central to modern education, supporting content delivery, assessment, and student interaction. However, these platforms often generate vast volumes of underutilized data. This project bridges that gap by building an intuitive and interactive dashboard that visualizes LMS data effectively, enabling evidence-based academic decision-making.

Problem Statement

LMS platforms produce complex, high-volume datasets. Without analytical support, this data remains underutilized, resulting in missed opportunities to:

- Detect disengaged students early
- Assess course and teaching effectiveness
- Optimize learning resources and methods

Objective

To build a centralized analytics dashboard that facilitates:

- Monitoring student engagement and academic performance

- Evaluating instructor and content effectiveness
- Analyzing behavior trends to support strategic academic planning

Scope

In-Scope:

- Educational institutions utilizing LMS platforms
- Teachers, academic coordinators, and administrators
- Analysis based on batch-processed exported LMS data

Out-of-Scope:

- Real-time LMS data integration
- Support for LMS platforms lacking data export functionality

Target Audience

- **Educators**: To track student engagement and guide instruction
- **Administrators**: To evaluate program effectiveness and learner trends
- **Stakeholders**: To visualize institutional KPIs and learning patterns

Features

Feature Category	Description
Performance Metrics	Academic results, class distribution, absence patterns
Course Analytics	Enrollment trends, topic performance, dropout risks
Assessment Analysis	Scores, absence impact, and parent satisfaction influence
Engagement Metrics	Raised hands, resource views, announcements viewed, discussions
Custom Dashboards	Role-specific slicers and views for instructors, admins, and stakeholders

Tools & Technologies

Tool / Tech	Purpose
Python (Pandas)	Data preprocessing, KPI generation
Power BI	Final interactive dashboards
Google Sheets	Pivot analysis and collaborative filtering
MS Excel	Pre-dashboard analysis and visual summaries
R (party.ctree.plot)	Decision tree modeling and visualization

Implementation Steps

- **Dataset Used:**
  - **xAPI-Edu-Data** from Kaggle
  - 480 records, 17 attributes
  - Includes demographic, behavioral, and performance data

- **Python Preprocessing:**
  - Cleaned column names and dropped nulls
  - Encoded Class into performance_score (L = 1, M = 2, H = 3)
  - Generated CSVs for KPI analysis:
    - stage_kpi.csv, engagement_kpi.csv, absence_kpi.csv, gender_kpi.csv

- **Dashboard Visualization:**

Power BI:

- Page 1: Analytics Dashboard/Performance Overview
- Page 2: Performance by Stage

- Page 3: Engagement Metrics by Class
- Page 4: Absence Impact on Performance
- Page 5: Gender-Wise Comparison
- Slicers: GradeID, Semester, gender, Topic

Excel:

- Pivot Tables for:
    - Performance by Grade
    - Parent Satisfaction vs Performance
- Charts and slicers for quick insights

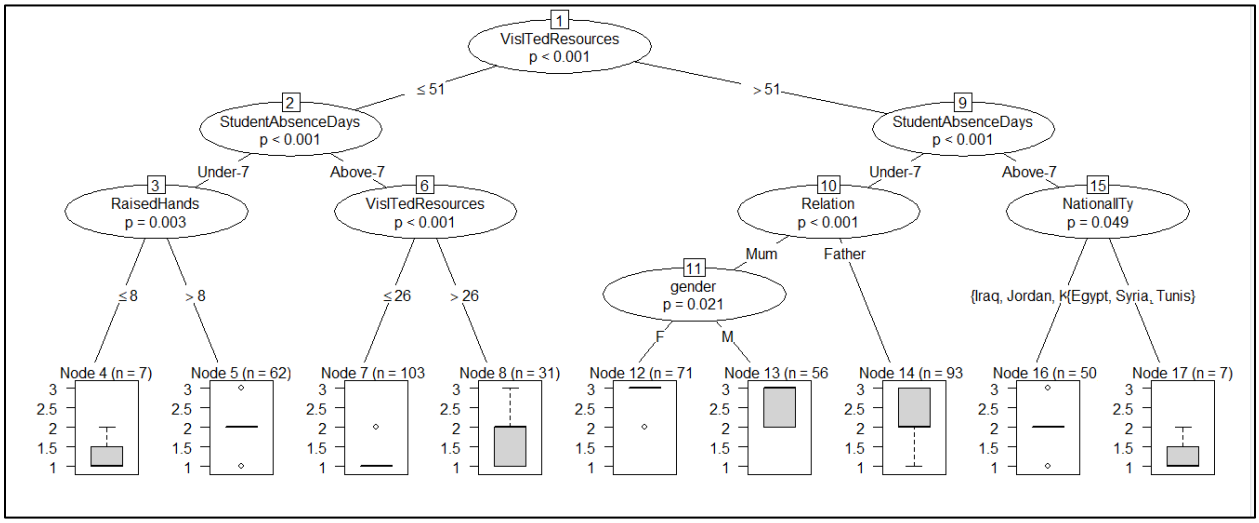
Google Sheets:

- Pivot tables and charts
- Filter views and slicers for dynamic analysis

R (Decision Tree):

- Decision tree modeled using party()
- Focused on predicting Class using behavioral features
- Output visualized using party.ctree.plot()

Decision Tree Visualization



Key Findings: Factors Influencing Performance

Positive Indicators (Associated with High Performance – Class 3)

Feature	Condition	Interpretation
VisITedResources	> 51	Student explores many learning materials strong engagement
StudentAbsenceDays	≤ 7	Low absenteeism regular attendance
RaisedHands	> 8	Actively asks questions good class participation
VisITedResources (with Absence > 7)	> 26	Compensates absence with additional learning effort

Negative Indicators (Associated with Low Performance – Class 1)

Feature	Condition	Interpretation
VisITedResources	≤ 51	Low engagement with available resources
StudentAbsenceDays	> 7	High absenteeism, poor attendance
RaisedHands	≤ 8	Lack of classroom participation
VisITedResources (with Absence > 7)	≤ 26	No effort to compensate for missed classes

Weak/Contextual Indicators

These appeared in the decision tree but are not suitable for interventions:

Feature	Condition	Reason
Relation	Mum > Father	Demographic, not changeable
Gender	Female > Male	Not ethically actionable
NationalITy	Regional differences	May reflect cultural/socioeconomic factors not actionable

Dashboard Screenshots

Power BI

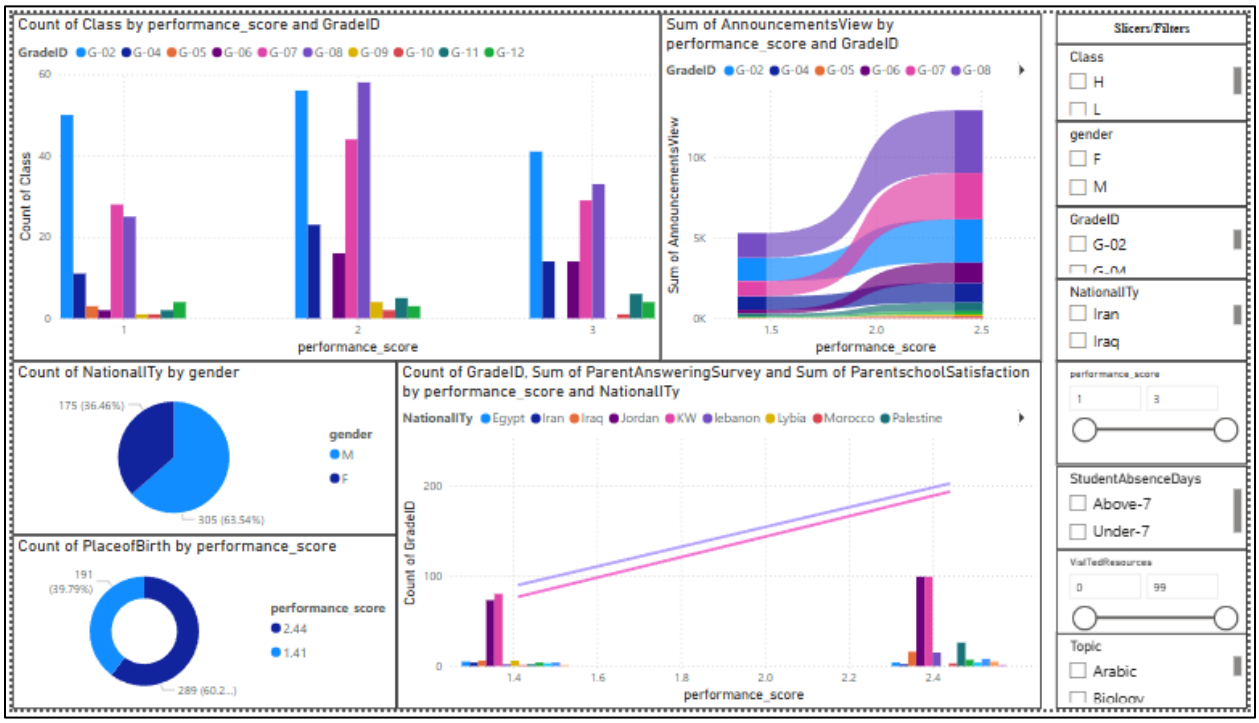


Figure: Analytics Dashboard

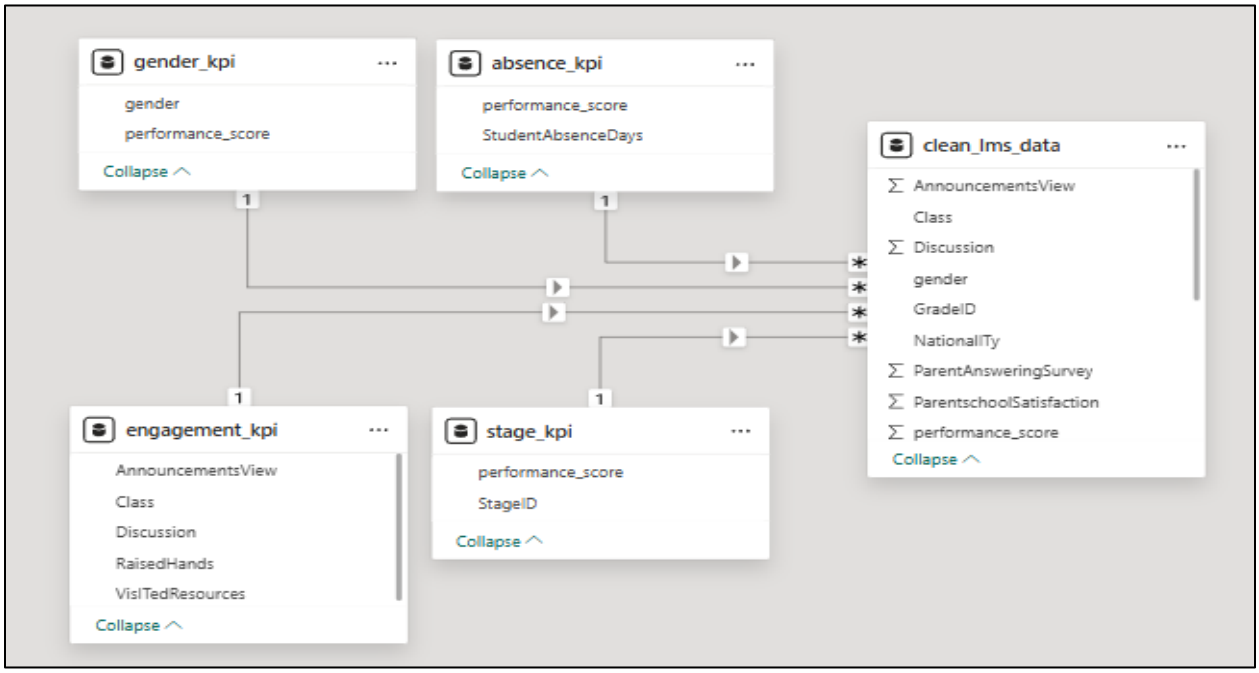


Figure: Data Relationship Structure

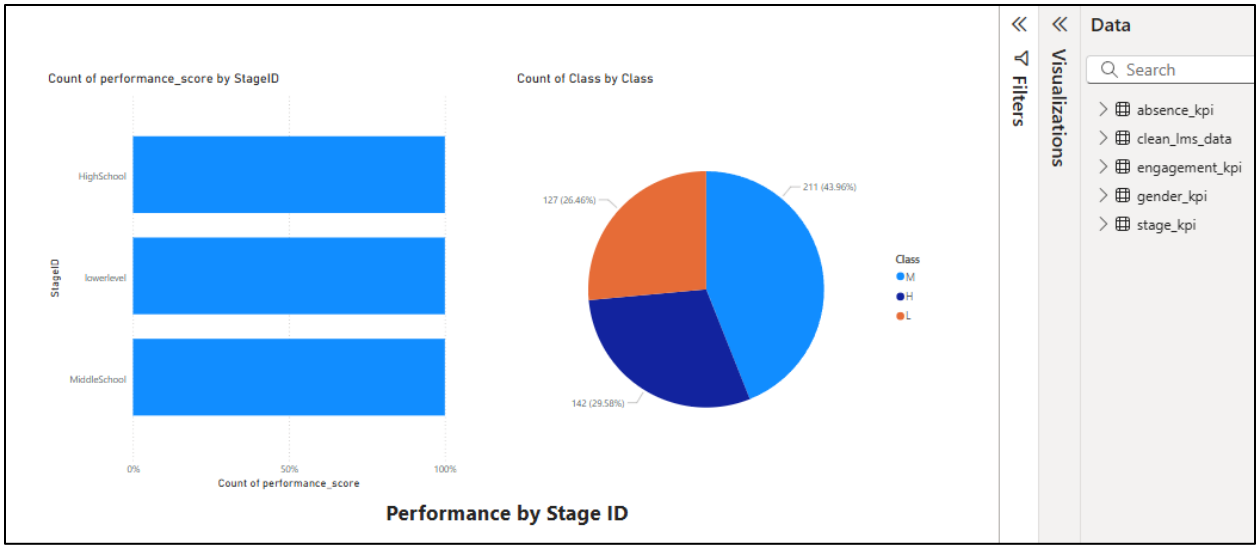


Figure: Performance overview by StageID

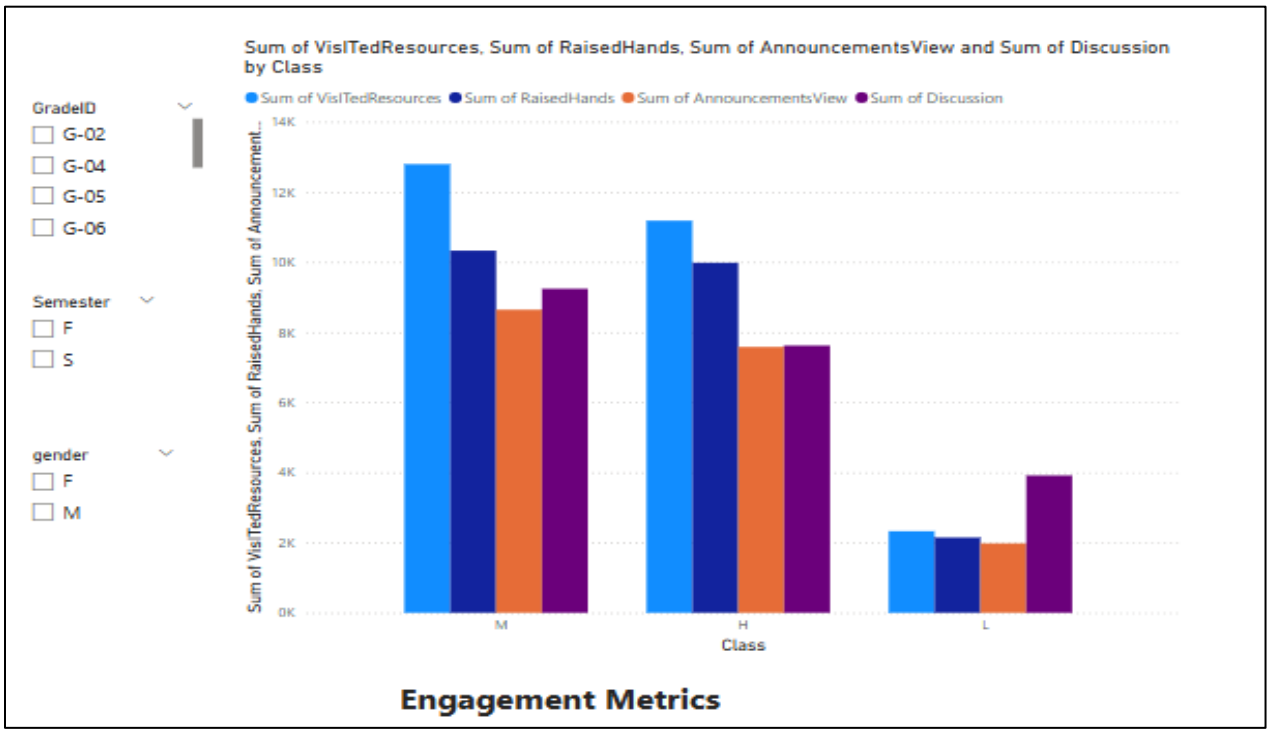


Figure: Engagement Metrics using multiple parameters

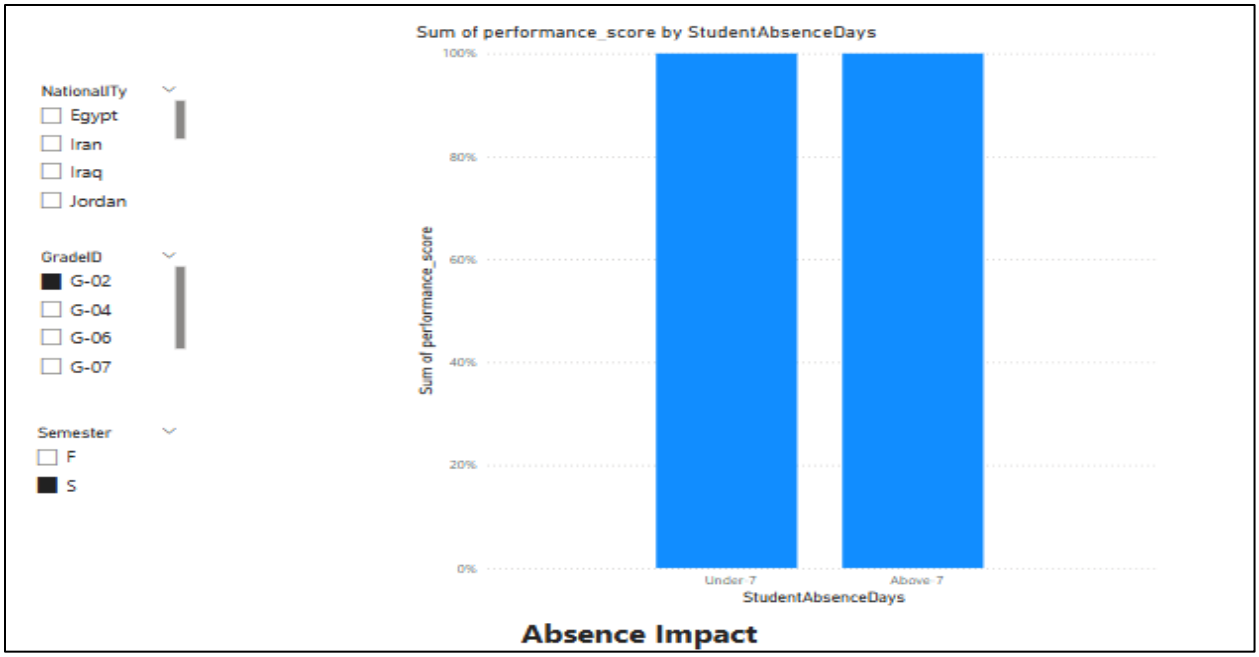


Figure: Impact of Absence on Performance Score

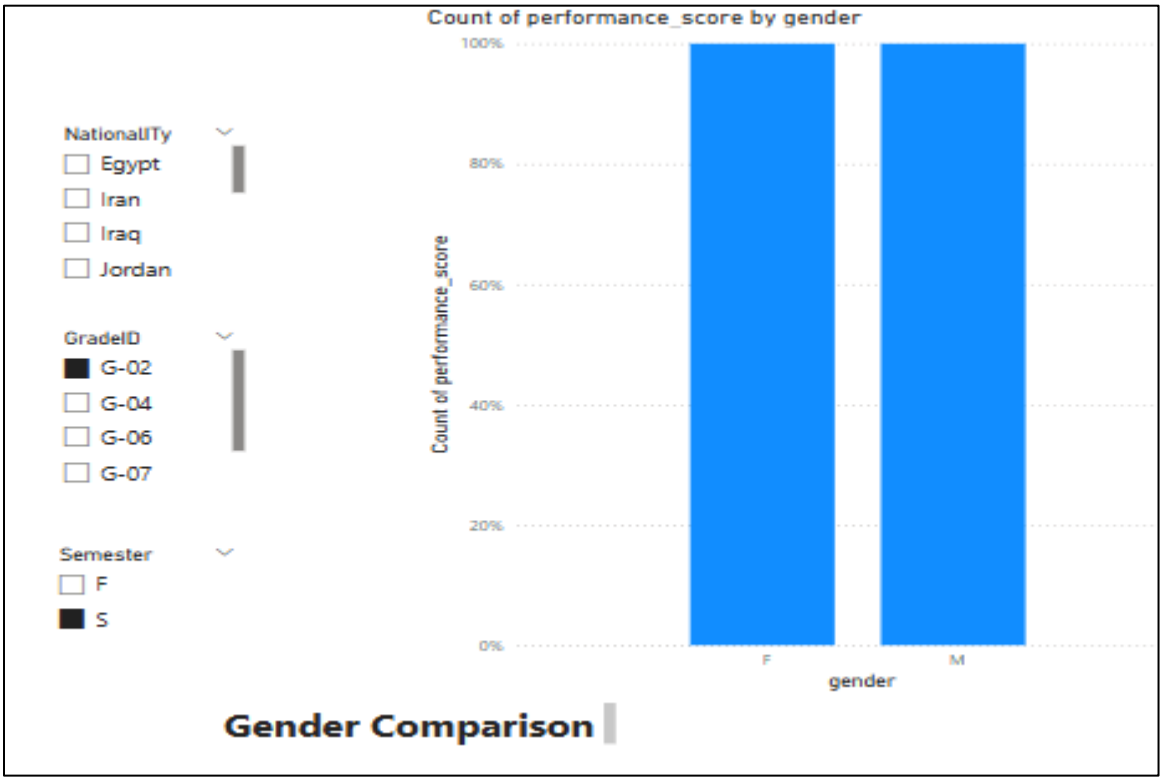


Figure: Performance Score by Gender

Excel – Pivot Table Analysis

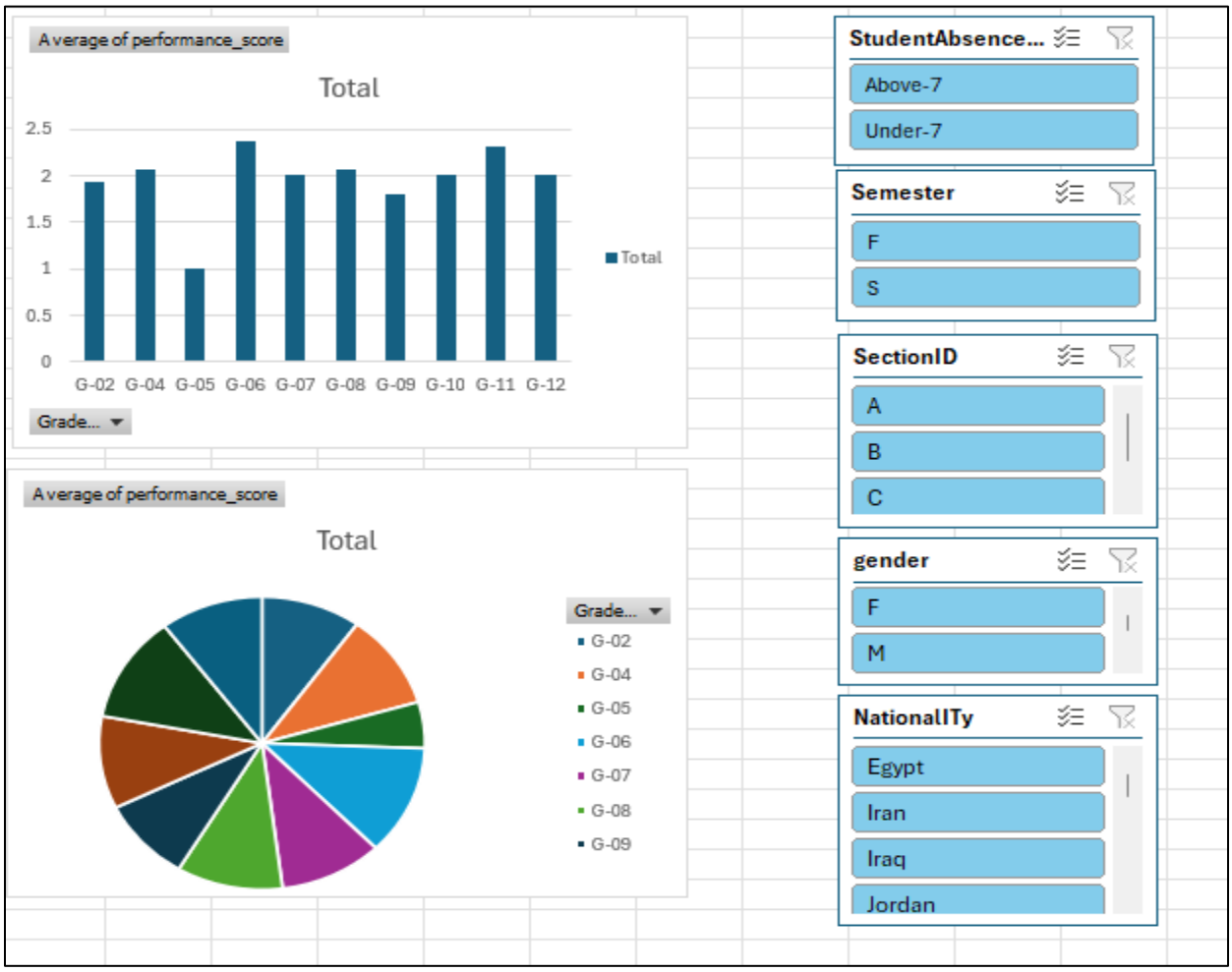


Figure: Pivot Table-1

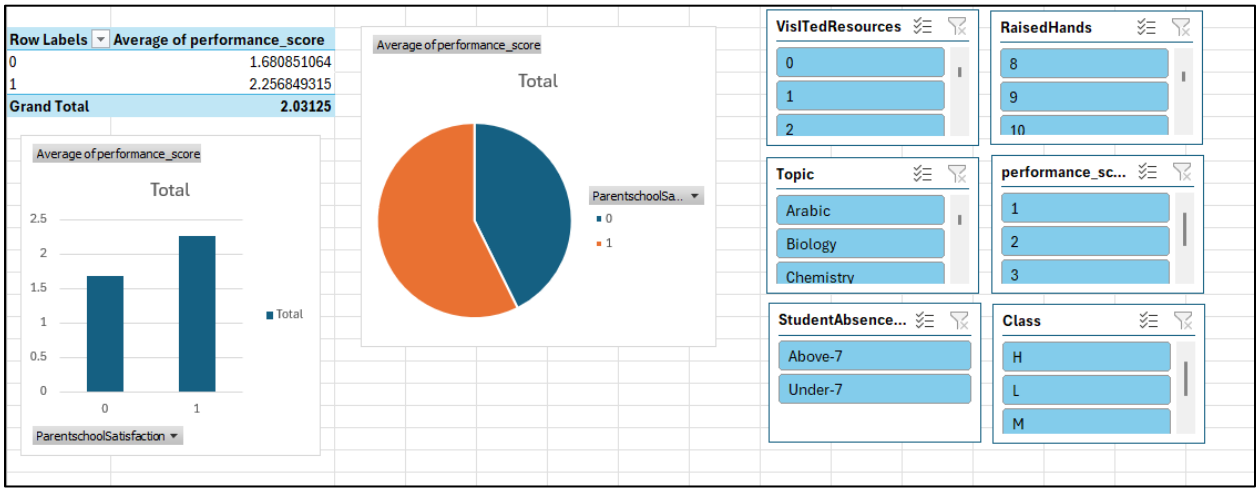


Figure: Pivot Table-2

Google Sheets – Chart and Filter View

Access link: [Google Sheets Click Here](https://docs.google.com/spreadsheets/d/1T_8Grrmlc0f5yjvoloNguFrWWu8_rBUAluiV_2FT-rs/edit?gid=698468894)

(https://docs.google.com/spreadsheets/d/1T_8Grrmlc0f5yjvoloNguFrWWu8_rBUAluiV_2FT-rs/edit?gid=698468894)

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
1	gender	NationalITy	PlaceofBirth	StageID	GradeID	SectionID	Topic	Semester	Relation	RaisedHand	VisITedResc	Announcem	Discussion	ParentAnsw	Parentschoo	StudentAbs	Class	performance
2	M	KW	KuwaIT	lowerlevel	G-02	A	IT	F	Father	8	25	1	70	0	0	Above-7	L	1
3	M	KW	KuwaIT	lowerlevel	G-02	B	IT	F	Father	7	5	2	80	1	1	Above-7	L	1
4	M	KW	KuwaIT	lowerlevel	G-02	B	IT	F	Father	1	0	1	12	0	0	Above-7	L	1
5	M	KW	KuwaIT	lowerlevel	G-02	B	IT	F	Father	19	70	3	50	0	0	Under-7	L	1
6	F	KW	KuwaIT	lowerlevel	G-02	B	IT	F	Father	3	12	4	33	0	0	Under-7	L	1
7	M	KW	KuwaIT	lowerlevel	G-02	B	IT	F	Father	5	20	1	50	1	1	Above-7	L	1
8	M	KW	KuwaIT	lowerlevel	G-02	B	IT	F	Father	4	8	10	60	1	1	Above-7	L	1
9	F	KW	KuwaIT	lowerlevel	G-02	B	IT	F	Father	80	44	35	10	0	1	Above-7	L	1
10	F	KW	KuwaIT	lowerlevel	G-02	B	IT	F	Father	2	6	2	8	0	0	Above-7	L	1
11	M	KW	KuwaIT	lowerlevel	G-02	B	IT	F	Father	1	7	6	10	0	0	Above-7	L	1
12	F	KW	KuwaIT	lowerlevel	G-02	B	IT	F	Father	0	0	5	80	1	1	Above-7	L	1
13	M	KW	KuwaIT	lowerlevel	G-02	B	IT	F	Father	2	5	3	50	0	0	Above-7	L	1
14	M	KW	KuwaIT	lowerlevel	G-02	B	IT	F	Father	25	27	0	69	0	0	Above-7	L	1
15	M	KW	KuwaIT	lowerlevel	G-02	B	IT	F	Father	11	2	0	50	0	0	Above-7	L	1
16	M	KW	KuwaIT	lowerlevel	G-02	B	IT	F	Father	0	8	11	70	1	1	Above-7	L	1
17	M	KW	KuwaIT	lowerlevel	G-02	C	IT	F	Mum	0	4	8	30	0	0	Above-7	L	1
18	M	KW	KuwaIT	lowerlevel	G-02	C	IT	F	Father	0	6	4	15	1	0	Under-7	L	1
19	M	KW	KuwaIT	lowerlevel	G-02	B	IT	F	Father	12	30	0	17	0	1	Above-7	L	1
20	M	KW	KuwaIT	lowerlevel	G-02	B	IT	F	Father	55	33	6	9	0	0	Above-7	L	1
21	M	KW	KuwaIT	lowerlevel	G-02	C	IT	F	Father	12	10	20	16	0	0	Under-7	L	1
22	M	KW	KuwaIT	lowerlevel	G-02	B	IT	F	Father	70	90	2	2	1	1	Under-7	L	1
23	F	KW	KuwaIT	lowerlevel	G-02	C	IT	F	Father	7	9	5	30	0	0	Above-7	L	1
24	M	KW	KuwaIT	lowerlevel	G-02	C	IT	S	Father	0	3	10	3	0	0	Above-7	L	1
25	M	KW	KuwaIT	lowerlevel	G-02	A	IT	S	Father	12	60	0	70	1	1	Above-7	L	1
26	M	Iran	Iran	lowerlevel	G-02	B	French	S	Mum	20	22	53	13	0	1	Above-7	L	1
27	M	Syria	Syria	lowerlevel	G-02	B	French	S	Mum	20	52	23	33	1	1	Above-7	L	1
28	M	Iran	Iran	lowerlevel	G-02	B	French	S	Father	10	2	13	53	0	0	Above-7	L	1
29	M	Jordan	Jordan	lowerlevel	G-02	B	French	S	Father	50	62	13	33	0	0	Above-7	L	1
30	M	Jordan	Jordan	lowerlevel	G-02	A	French	F	Father	10	15	10	21	0	0	Above-7	L	1
31	M	Jordan	Jordan	lowerlevel	G-02	A	French	S	Father	30	10	20	5	0	0	Above-7	L	1
32	M	Jordan	Jordan	lowerlevel	G-02	A	French	F	Father	10	15	10	21	0	0	Above-7	L	1
33	M	Jordan	Jordan	lowerlevel	G-02	A	French	S	Father	30	10	20	5	0	0	Above-7	L	1
34	M	Jordan	Jordan	lowerlevel	G-02	A	French	F	Father	40	7	50	41	0	1	Above-7	L	1
35	M	Jordan	Jordan	lowerlevel	G-02	A	French	S	Father	35	2	29	33	0	1	Above-7	L	1
36	M	Lybia	Lybia	lowerlevel	G-02	A	French	F	Mum	10	8	9	3	0	1	Above-7	L	1

Figure: Filtered Data

A	B	C	D	E	F	G
gender	SUM of RaisedHands	SUM of VisITedResources	AVERAGE of AnnouncementsView	COUNT of Discussion	SUM of ParentAnsweringSurvey	AVERAGE of ParentschoolSatisfaction
F	9251	11200	39.74857143	175	101	0.6685714286
M	13201	15103	36.86885246	305	169	0.5737704918
Grand Total	**22452**	**26303**	**37.91875**	**480**	**270**	**0.6083333333**

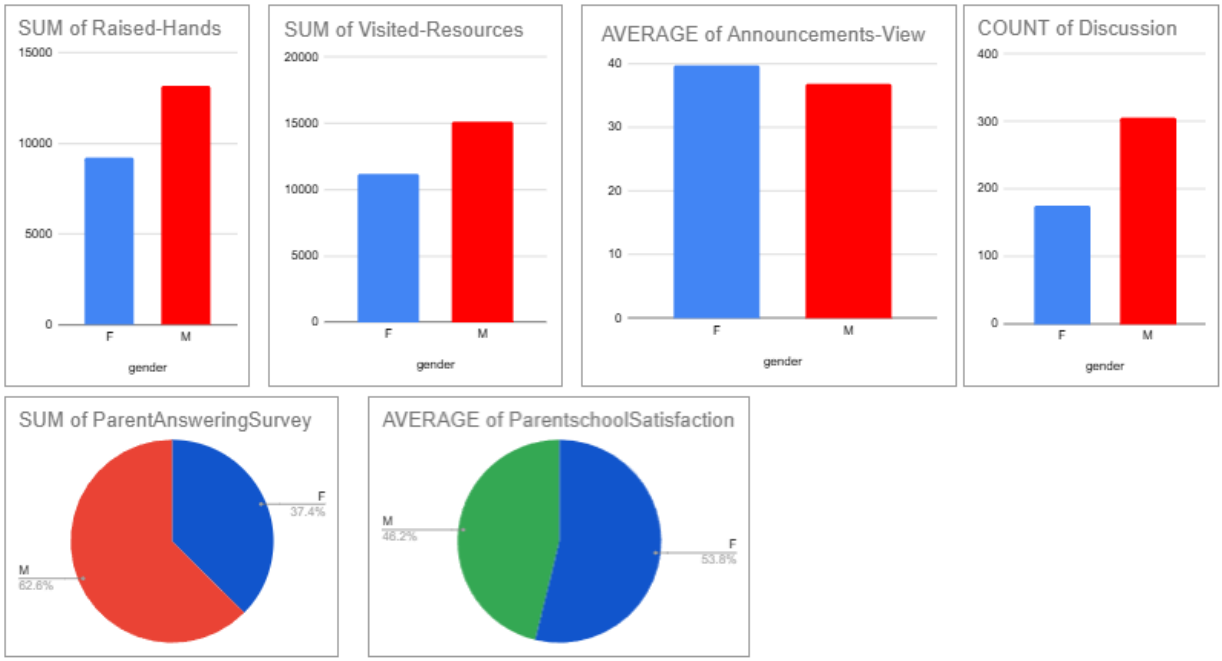
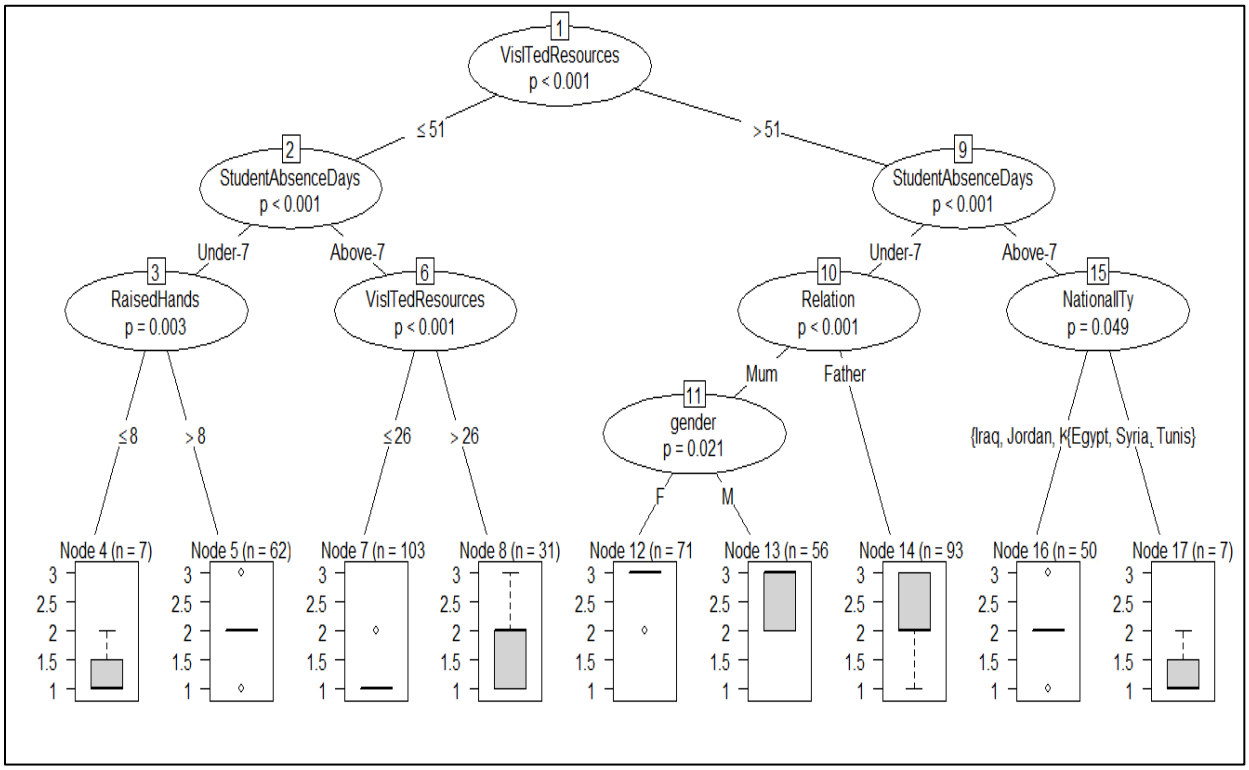


Figure: Data Exploration Dashboard

R – Decision Tree Output

```
> library("party")
> data<-read.csv("C:/Users/ashra/OneDrive/Desktop/clean_lms_data.csv")
> data[] <- lapply(data, function(x) if(is.character(x)) as.factor(x) else x)
> tree<-ctree(performance_score ~ .,data=data)
> plot(tree)
```



Challenges

- Manual CSV exports from LMS platforms
- Inconsistent label formatting and missing standardizations
- No real-time auto-refresh pipeline

Assumptions

- Dataset structure remains stable across exports
- Users have basic skills in Excel or BI tools
- Class labels (L, M, H) are valid reflections of academic performance

Results & Impact

Impact Area	Result / Insight
Performance Trend	Preparatory stage students showed the highest average scores
Absenteeism Detection	High absenteeism linked to lower performance
Engagement vs Performance	Raised hands and resource use positively correlated with success
Early Intervention	Identification of low performers using clear engagement indicators
Curriculum Feedback	Inactive or ineffective modules highlighted for redesign

Future Enhancements

- LMS API-based real-time data syncing
- Dropout prediction using machine learning
- Alert system for low engagement or declining performance
- Multi-platform support (Moodle, Canvas, Google Classroom)

Conclusion

The LMS Analytics Dashboard provides a scalable, data-driven approach to improving academic outcomes. By leveraging multiple tools to preprocess, analyze, and visualize LMS data, we've empowered educators to act on real insights not assumptions. This system identifies at-risk students, guides curriculum improvement, and enhances decision-making across academic roles.