Predicting Mess Hall Crowd Using Machine Learning

🔹 Introduction:

The mess crowd fluctuates weekly due to various academic and environmental factors. This project analyzes historical mess data to understand trends and build a model that can accurately predict future weekly crowd sizes.

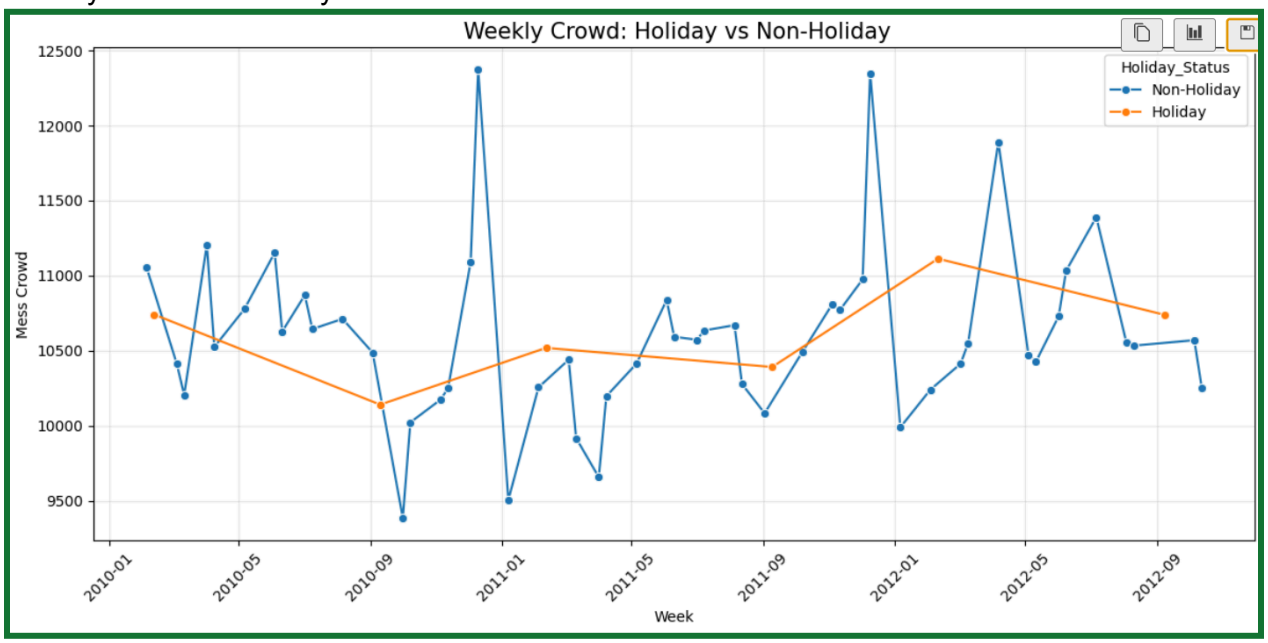
🔹 Dataset Overview:

Column Name	Description
Mess_ID	Unique identifier of mess hall
Date	Week start date
Weekly_Crowd	Total number of dinners served that week
Is_Holiday	Whether the week had a holiday (1 = Yes, 0 = No)
Temperature	Avg. temperature that week (°F)
Menu_Score	Menu quality rating
Event_Intensity_Index	Campus activity level index
Stress_Level	Academic workload index

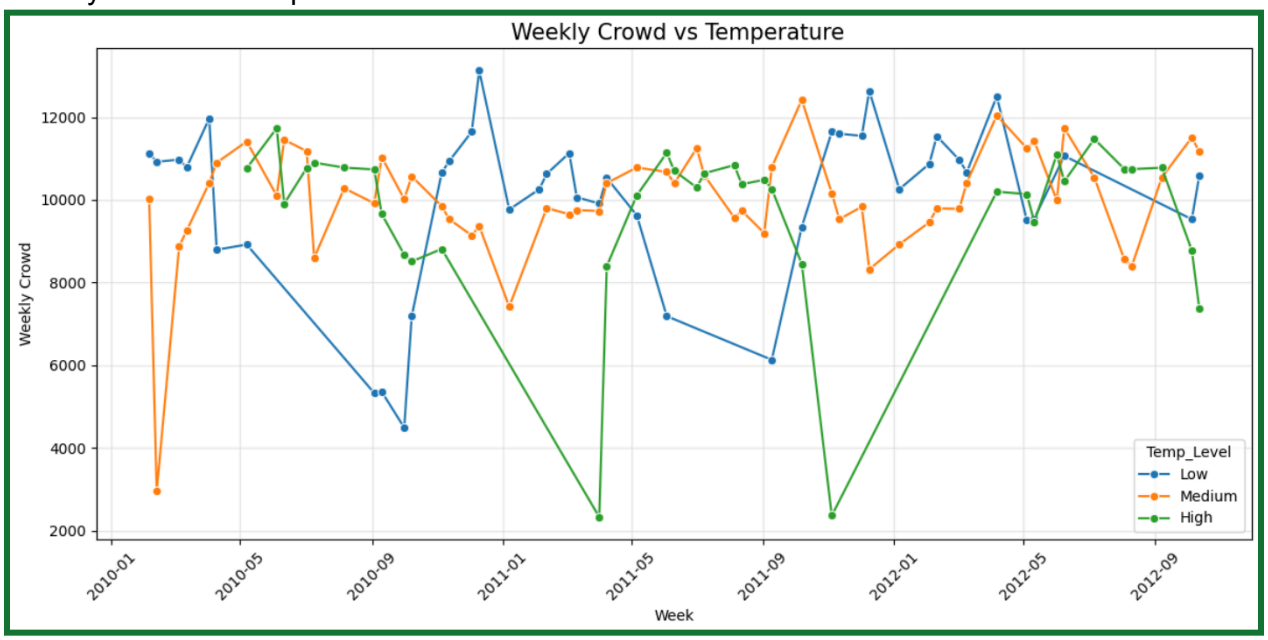
🔹 Exploratory Data Analysis (EDA):

You created **6 key graphs**:

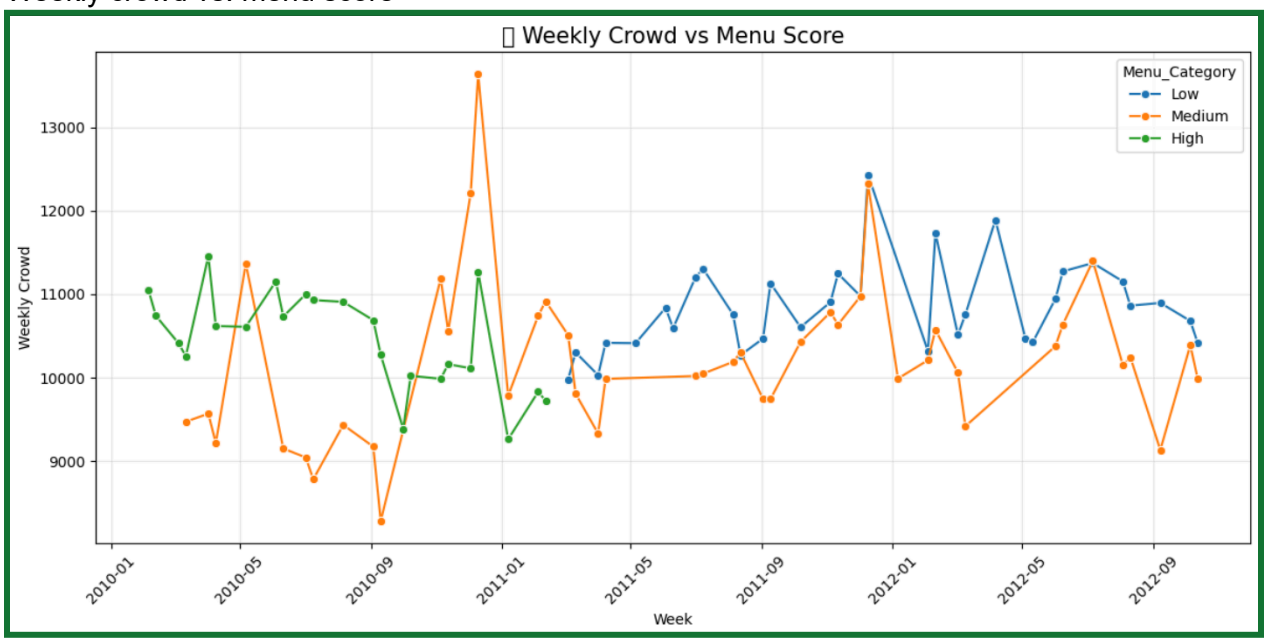
1. Weekly crowd vs. holidays



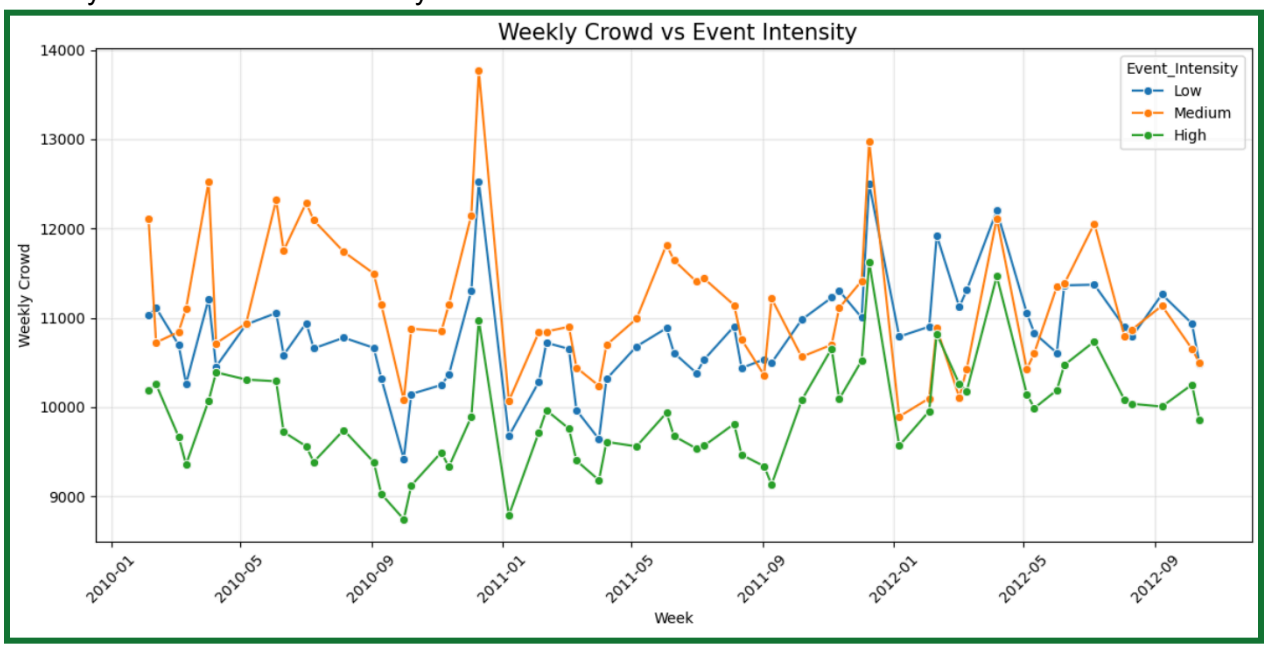
2. Weekly crowd vs. temperature



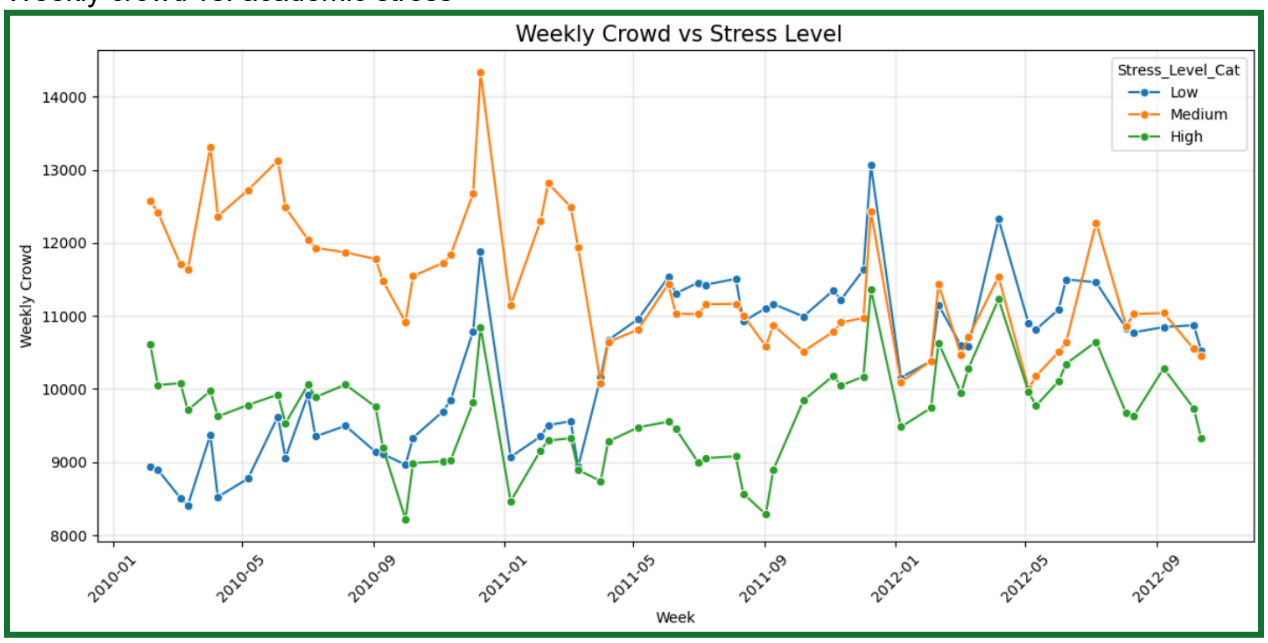
3. Weekly crowd vs. menu score



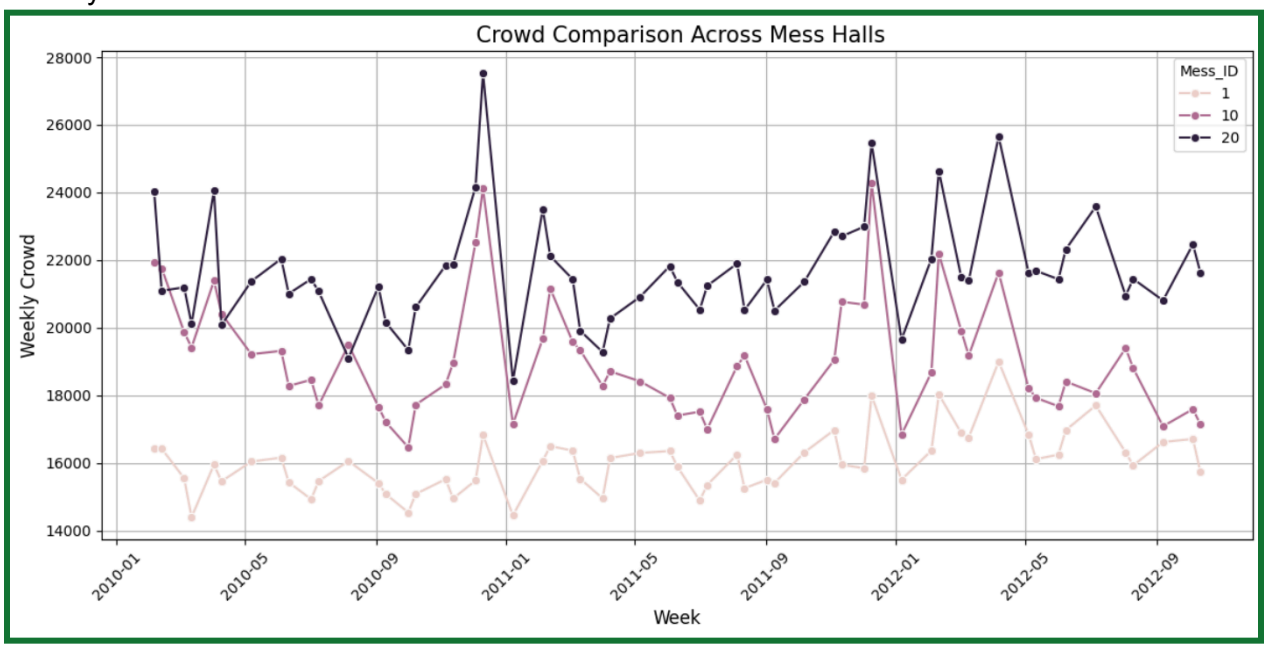
4. Weekly crowd vs. event intensity



5. Weekly crowd vs. academic stress



6. Weekly crowd vs. Mess ID



These graphs helped identify patterns:

- Holidays reduce crowd.
- Higher menu score correlates with higher turnout.

- Higher stress levels slightly lower turnout.
- Different mess halls have different baseline usage.

🔹 Model Used:

- **Random Forest Regressor**
- Features: `Mess_ID`, `Is_Holiday`, `Temperature`, `Menu_Score`, `Event_Intensity_Index`, `Stress_Level`, `Month`, `Year`

Results:

- **Mean Squared Error:** `1,025,268`
- **R² Score:** `0.9685`

🔹 Feature Importance:

Top contributors to prediction:

1. Menu_Score
2. Mess_ID
3. Month
4. Event_Intensity_Index

Final Insights

- **Mess crowd levels change week to week** due to factors like holidays, menu quality, and academic pressure.

- **Holidays significantly reduce mess crowd**. Students tend to go home or skip meals during such weeks.

- **Better menu scores increase the crowd**. Popular or higher-rated food attracts more students to dine.

- **Higher academic stress slightly lowers the crowd**, as students may skip meals or study late.

- **Temperature has a minor impact** on crowd levels, likely due to seasonal behavior.

- **Month and year are important** for predicting crowds — vacation months and exam periods show clear patterns.

- **Each mess hall has its own usage pattern** — some messes consistently serve more students than others.

- The Random Forest model achieved **$R^2 = 0.9685$**, meaning it can **predict the crowd very accurately**.

Recommendations for Mess/Admin Team

Based on your model's performance and feature importance:

1. **Plan staffing and food quantity dynamically** based on upcoming:
    - **Holiday weeks**
    - **Menu score**
    - **Academic stress**
2. **Avoid heavy/expensive menus** during weeks with **low predicted turnout** (e.g., holidays, exam stress).
3. **Use month-wise patterns**:
    - If your feature importance chart shows `Month` is significant, use that to **anticipate semester break or peak crowd weeks**.

How Admins Can Use Model

- Use the model to **forecast the mess crowd** weekly and prepare accordingly.
- Avoid fancy or expensive menus during **low-turnout weeks** (like holidays or exams).
- Use **predictions to manage staff and food quantity**, avoiding waste or shortage.
- Plan **special menus or promotions** during high-crowd weeks for better experience.

🔹 Technologies Used:

- Python (Pandas, Seaborn, scikit-learn,Numpy)
- Jupyter Notebook
- Matplotlib