Room Utilization Analysis for Reed Mews

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SUMMARY

This report provides actionable insights into room utilization for the ground and first floors of Reed Mews. Key metrics such as average and peak utilization were calculated, and patterns and anomalies were identified. A live dashboard has been developed to visualize findings interactively, and evidence-based recommendations are provided to optimize space utilization. A scalable solution is proposed to support ongoing monitoring and future data needs.

1. OBJECTIVES

- **Analysis of Room Occupancy**:
  - Measure utilization levels (average, peak, underutilized, and overutilized).
  - Identify hourly and weekly trends.
  - Detect anomalies in room usage.
- **Recommendations:** Optimize room scheduling and utilization.
- **Scalable Solution**: Develop a flexible data model for real-time monitoring and predictive analysis.

2. METHODOLOGY

2.1 Data Preparation

- **Data Source:** Room occupancy datasets for the ground and first floors.
- **Preprocessing Steps:**
  - Removed duplicate entries.
  - Addressed missing values.
  - Converted timestamps into a standardized format and extracted hourly and weekday data.
  - Set timestamps as the index for time-series analysis.

2.2 Metrics Calculation

- **Average Utilization:** Calculated to understand overall room usage.
  - **Formula:** $Average\ Utilization = \frac{\text{Total Room Occupancy}}{Total\ Time\ Periods\ Observed} \times 100$
- **Peak Utilization:** Identified rooms with the highest demand.
  - **Formula:** $Peak\ Utilization = max\ (Room\ Occupancy\ at\ each\ time\ point)$
- **Threshold Definitions:**
  - Underutilized Rooms: Utilization below **30%**.
  - Overutilized Rooms: Utilization above **90%**.

2.3 Trends and Patterns

- **Hourly Trends:** Examined utilization patterns for different hours of the day.
- **Weekly Trends:** Analysed room usage for each day of the week.
- **Anomalies Detection:** Applied z-scores to identify irregular room usage.

2.4 Interactive Dashboard

- Developed a live dashboard using **Dash** and **Plotly** for interactive reporting.
- Key features include:
  - Filters for floor and room selection.
  - Visualizations for hourly trends, weekly trends, heatmap, and anomalies.

3. KEY FINDINGS

Ground Floor Utilization Metrics:

Room	Avg Utilization	Peak Utilization
G01 Occ St	48.45%	100%
G02 Occ St	20.83%	100%
G03 Occ St	39.44%	100%
G04 Occ St	33.51%	100%
G05 Occ St	36.56%	100%
G06 Occ St	35.56%	100%
G07 Occ St	39.01%	100%
G08 Occ St	30.40%	100%
G09 Occ St	40.50%	100%
G10 Occ St	44.77%	100%

First Floor Utilization Metrics:

Room	Avg Utilization	Peak Utilization
1.01 Occ St	33.65%	100%
1.02 Occ St	36.42%	100%
1.03 Occ St	28.11%	100%
1.04 Occ St	36.35%	100%
1.05 Occ St	33.79%	100%
Unit 11 On	42.28%	100%
Unit 12 On	29.93%	100%
Unit 13 On	41.89%	100%
Unit 14 On	32.25%	100%

Trends and Patterns:

1. **Hourly Trends:**
   - Peak usage occurs between **10 AM - 3 PM**.
   - Early morning and late evening hours show significantly lower utilization.

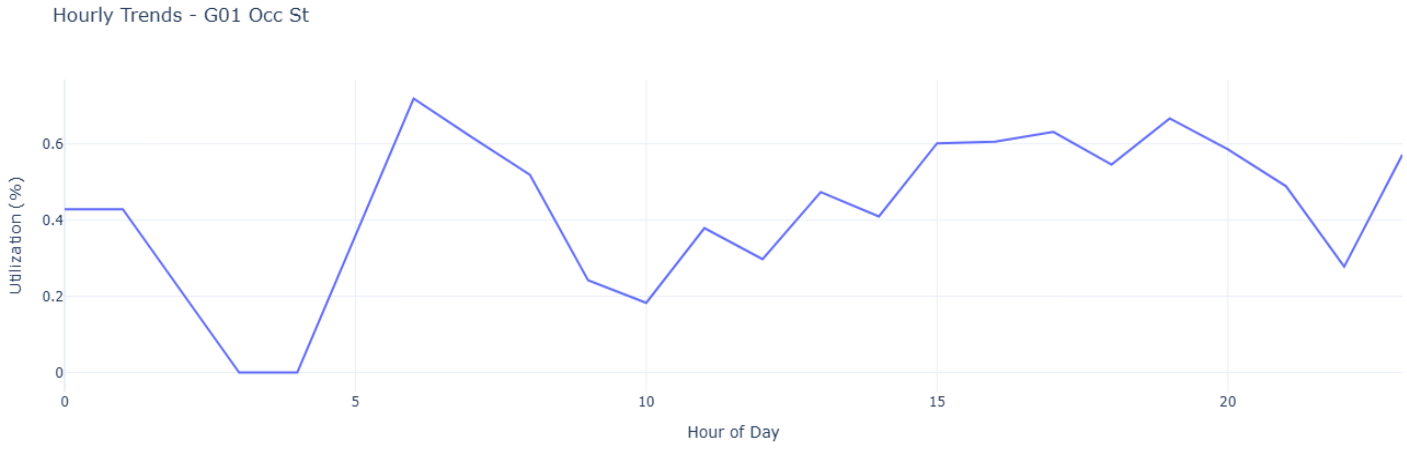

Figure: Hourly Utilization Trends for Room G01 Occ St

2. **Weekly Trends:**
    - Monday and Wednesday exhibit higher usage compared to other weekdays.
    - Fridays show the least room usage, suggesting underutilization opportunities.

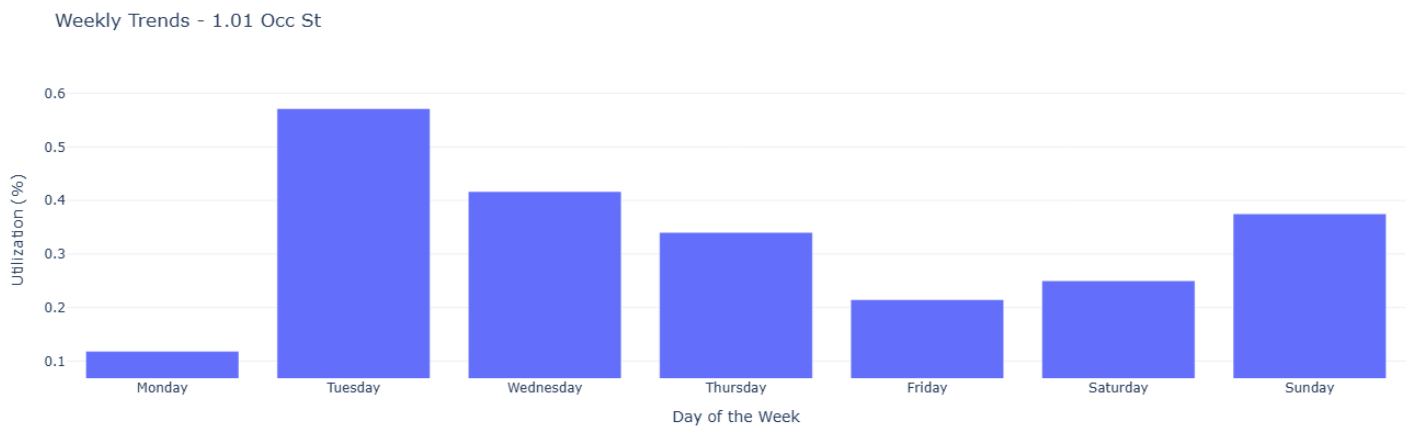

Figure: Weekly Utilization Trends for Room 1.01 Occ St

3. **Anomalies:**
    - High z-scores (above 2.0) represent unusual spikes in room usage, likely caused by one-off events or errors in scheduling.

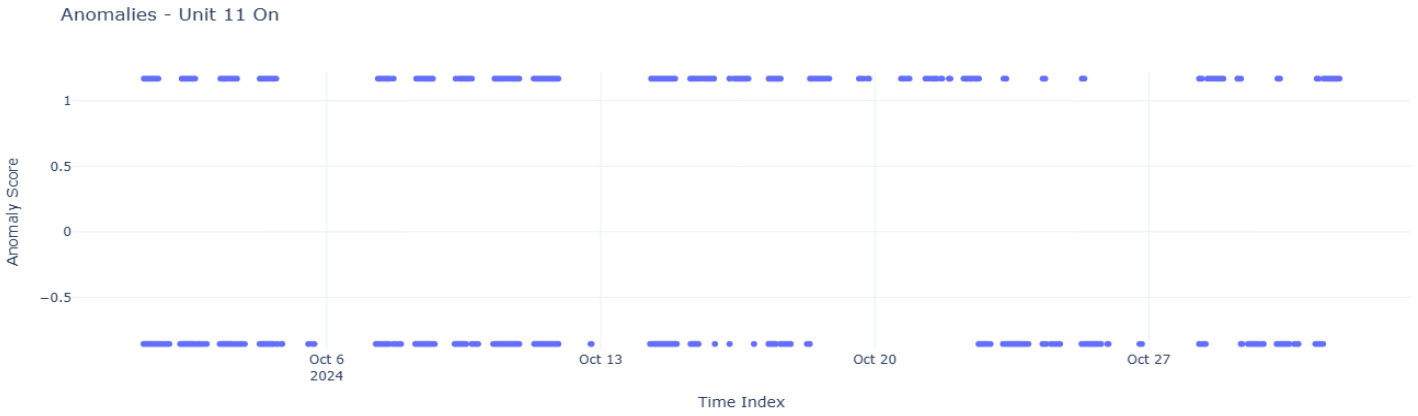

Figure: Anomaly Detection for Unit 11 On

4. EVIDENCE-BASED RECOMMENDATIONS

1. **Redistribute Activities to Underutilized Rooms**:

    - Ground Floor: Increase usage of **G02 Occ St** by assigning flexible activities.
    - First Floor: Utilize rooms such as **1.03 Occ St** and **Unit 12 On** for additional activities.

2. **Optimize Peak Hour Usage**:

    - Shift activities from **10 AM to 3 PM** to less utilized times (early mornings and evenings).

3. **Investigate Anomalies**:

    - Address unusual spikes or irregularities caused by scheduling errors or unexpected events.

4. **Implement a Smart Booking System**:

    - Introduce dynamic scheduling that adjusts room assignments based on predicted usage trends.

5. SCALABLE SOLUTION PROPOSAL

Data Model Design:

Table Name	Fields	Purpose
`Rooms`	Room ID, Floor, Capacity	Stores details about each room.
`Occupancy`	Room ID, Timestamp, Occupancy Count	Tracks live and historical room utilization.
`Anomalies`	Room ID, Timestamp, Anomaly Score	Captures irregular usage patterns.

Proposed Features:

1. **Real-Time Monitoring:**
   - Use IoT sensors to continuously collect live occupancy data.
2. **Historical Data Storage:**
   - Maintain data for trend analysis and future forecasting.
3. **Predictive Insights:**
   - Enable machine learning models to predict future utilization trends.

Implementation Workflow:

1. **IoT Sensors:** Track real-time occupancy data.
2. **Data Pipeline:** Use platforms like AWS or Azure to process and store data.
3. **Visualization:** Extend the current dashboard to incorporate predictive insights.

6. TECHNICAL JUSTIFICATION FOR TOOLS

This project was implemented entirely in Python, leveraging its ecosystem of powerful libraries for data analysis, visualization, and scalability. Below is a concise justification for the tools used and recommendations for future improvements:

Why Python?

- **Comprehensive and Unified Workflow:** Python handles data manipulation, analysis, and visualization in one ecosystem, streamlining the entire process.
- **Efficiency and Automation:** Its libraries (e.g., Pandas, NumPy) allow efficient data handling and automated preprocessing tasks.
- **Scalability:** Python integrates seamlessly with cloud platforms for handling larger datasets and real-time data pipelines.
- **Cost-Effectiveness:** Open-source tools eliminate licensing costs, making it ideal for budget-conscious teams.

Tools Used

1. **Dash and Plotly:**
   - **Reason:** Enables the creation of interactive, visually engaging dashboards.
   - **Stakeholder Benefit:** Non-technical users can easily interact with data, explore trends, and generate insights intuitively.
2. **Pandas and NumPy:**
   - **Reason:** Efficient for data preprocessing, aggregation, and time-series analysis.
   - **Stakeholder Benefit:** Clean and organized data ensures accurate analysis and actionable insights.
3. **Seaborn and Matplotlib:**
   - **Reason:** Provides detailed visualizations during exploratory data analysis.
   - **Stakeholder Benefit:** Visual aids to support evidence-based recommendations.
4. **Cloud Platforms (Recommended for Future):**
   - **Reason:** AWS/Azure can handle real-time data ingestion, storage, and advanced analytics.
   - **Stakeholder Benefit:** Enables long-term scalability, real-time monitoring, and predictive capabilities.

Future Recommendations

1. **Real-Time Monitoring:** Incorporate IoT sensors and cloud pipelines for live occupancy data.
2. **Predictive Analytics:** Use machine learning to forecast room utilization trends for proactive planning.
3. **Cloud-Hosted Dashboard:** Host the dashboard on platforms like AWS or Azure for easy stakeholder access.

This Python-based approach ensures a streamlined, scalable, and cost-effective solution tailored to stakeholder needs while providing room for future growth.

7. CONCLUSION

This analysis provides a comprehensive understanding of room utilization at Reed Mews, offering actionable insights to optimize space usage. By implementing the proposed recommendations and scalable solution, the Estates Capital Planning team can improve decision-making, resource allocation, and long-term efficiency.

Key Outcomes:

1. Clear identification of under- and overutilized rooms.
2. Evidence-based recommendations for room scheduling and optimization.
3. A robust and scalable monitoring solution for real-time and future analysis.

This report equips stakeholders with the tools and insights to enhance operational efficiency and ensure effective space utilization for Reed Mews.

ATTACHEMENTS

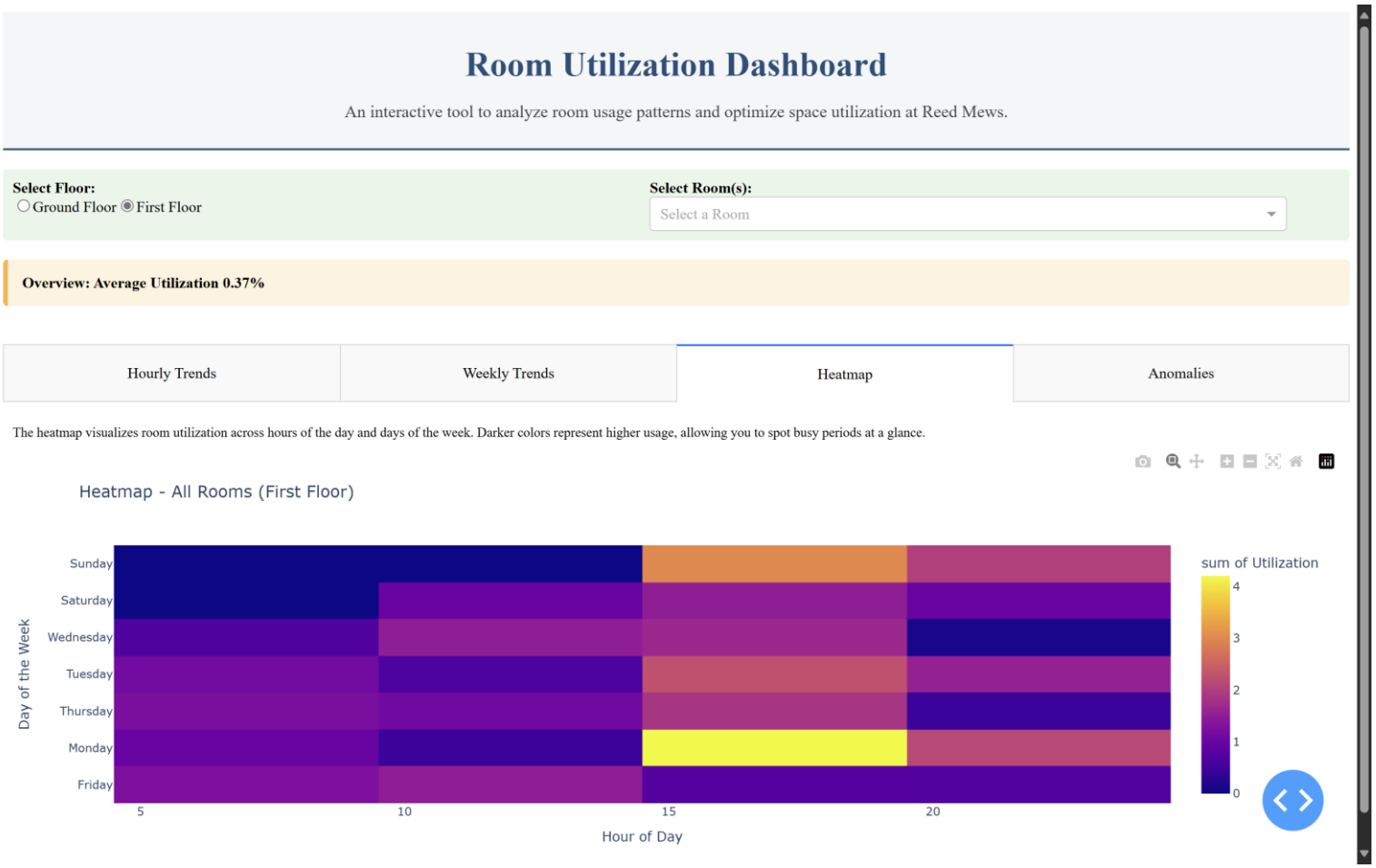

Figure: Room Utilization Dashboard Overview