TO ANALYZE CLINIC OPERATIONS DATA AND REDUCE AVERAGE PATIENT WAIT TIME ACROSS HIGH-TRAFFIC DEPARTMENTS USING MINITAB

1. Background

NHS outpatient services in the UK are under pressure due to rising demand and staff shortages. The client reported extended wait times across general practice, dermatology, and orthopaedics. The goal was to identify operational inefficiencies using statistical methods in Minitab and generate actionable recommendations for time reduction, especially during peak appointment hours.

2. Data Used

Period Covered:

6 months of data (January–June 2023)

Dataset Composition:

Variable	Type	Description
Appointment_Day	Categorical	Day of the week
Appointment_Time	Continuous	Time in 24h format (converted to hour slots)
Clinic_Type	Categorical	Department name (e.g., GP, Ortho, Derm)
Scheduled_Time	Continuous	Official appointment time
Actual_Seen_Time	Continuous	Time patient was actually seen
Delay_Minutes	Continuous	Difference between scheduled and actual seen time
Doctor_ID	Categorical	Unique identifier for the attending doctor

Data was anonymized before analysis to comply with NHS information governance standards.

3. Analysis Approach

Software Used:

Minitab 21

Key Steps Performed:

1. **Data Cleaning & Time Transformation**
    - Converted time fields to continuous variables using decimal hours
    - Removed 3% of records with data entry errors or outliers
2. **Descriptive Statistics & Visualization**
    - Used *Stat > Basic Statistics > Display Descriptive Stats*
    - Boxplots created by department and day of week
3. **ANOVA Testing**
    - *Stat > ANOVA > One-Way ANOVA* to assess variation in delay across departments
    - Post-hoc Tukey analysis to identify which departments showed statistically significant delay differences
4. **Regression Modeling**
    - *Stat > Regression > Fit Regression Model*
    - Delay_Minutes regressed on Appointment_Time, Clinic_Type, and Doctor_ID (coded as dummies)
    - VIFs computed to check multicollinearity
5. **Control Charts (Optional Check)**
    - *Stat > Control Charts > I-MR Chart* created for ongoing monitoring of individual doctor performance over weeks

4. Key Findings

Variable	Significance (p-value)	Interpretation
Appointment_Time	0.001	Later appointments had higher delays
Clinic_Type	<0.001	Orthopaedics had the longest wait times
Doctor_ID (pooled)	0.034	Specific providers showed consistently high delays

- **Overall R^2 of regression model**: 0.67
- **Average baseline delay before intervention**: 18.5 minutes
- **Identified optimal time slots (lowest delays)**: 8:30–10:30 AM

5. Visual Outputs (Created in Minitab)

- **Boxplot**: Delay by Clinic Type
- **Scatterplot**: Delay vs. Appointment Time (colored by department)
- **Regression Coefficient Table**
- **Tukey Grouping Plot**: ANOVA group differences across departments
- **Xbar Chart**: Doctor-specific weekly delay variation

6. Results & Implementation

- A **targeted schedule reshuffle** was implemented based on low-delay time slots
- **One GP clinic's morning appointments were increased by 20%**
- Staff training was introduced for three clinicians identified with delay outliers
- **After three months**, average wait time **reduced by 17% (to 15.4 minutes)**

7. Recommendations Provided

- Implement ongoing Minitab-based control chart monitoring for real-time wait tracking
- Use queue modeling to simulate impact of further schedule changes
- Prioritize first appointments of each session for chronic care patients
- Align break schedules with lowest-demand periods based on historical patterns

8. Future Scope

- Apply time series forecasting in Minitab for seasonal load prediction
- Automate real-time data feeds from EMR to integrate with Minitab dashboards
- Extend project to cover inpatient discharges and lab turnaround times

9. Relevance to Stakeholders

NHS Operational Leaders

- Supports data-backed schedule redesign
- Reduces patient dissatisfaction and doctor burnout

Academic Use

- Strong teaching case for health systems engineering courses
- Demonstrates statistical thinking in public healthcare optimization