**Howdy Group Sales Intelligence System**

**Overview**
As a Business Analytics & Compliance Executive at Howdy Group, I developed this project to build an intelligent, data-driven system for sales prediction, outlet performance analysis, and strategic decision support across our restaurant brands. The system integrates Power BI dashboards with Python-based machine learning models to generate dynamic insights, simulate various business scenarios, and guide decisions on staffing, promotions, and operational efficiency. This initiative played a key role in enhancing data governance, business agility, and decision-making confidence across the group's diverse outlets.

**1. Starting Point**
We began with a comprehensive dataset containing sales data, operational metrics (e.g., staff, compliance, weather), outlet identifiers, and promotional types for multiple Howdy Group brands: Howdy (F7, Giga Mall, Centaurus), Rare, The Lost Tribe, and GreenBae.

Initially, we performed linear regression across all outlet data collectively. However, the low model interpretability and insight generalization prompted us to pivot toward a **segmented approach by brand**.

**2. Segmented Regression Models by Brand**
We trained individual linear regression models for each outlet. This allowed us to extract outlet-specific $R^2$ and RMSE values, revealing that **Howdy F7 Branch** underperformed relative to others ($R^2$ ~94.8% vs ~98% elsewhere). This discovery justified further ML exploration for Howdy F7.

**3. Simulation Use Case: Howdy F7 Branch**
We isolated the Howdy F7 dataset and trained a **Random Forest Regressor**. This model outperformed the linear model and gave us high-fidelity predictions with better handling of nonlinear relationships.

- **$R^2$: ~99.28%**
- **RMSE: ~13.8K**

**4. SHAP-Based Explainability**
To interpret the Random Forest, we applied SHAP (SHapley Additive exPlanations). Key drivers included:

- Conversion Rate
- Foot Traffic
- Compliance
- Order Value
- Staff Count

This analysis enhanced transparency in identifying controllable sales levers.

**5. Simulation Scenario Grid (4,000+ Cases)**
We created a grid of over **4,000 business scenarios** simulating varied combinations of:

- Rain (True/False)
- Promo Types (Combo, None, Debit 40%)
- Foot Traffic levels
- Staff counts
- Conversion Rates

This scenario matrix powered the **Recommendation Engine**, surfacing actionable strategies.

**6. Recommendation Engine**
Each simulated case generated predicted sales, a risk flag, and a recommendation.

- *Switch Promo: Combo Underperforming*
- *Use Debit 40% Promo in Rain*
- *Reduce Staff: Inefficient Load*

We defined thresholds (e.g., sales < Rs 115K with 4+ staff = inefficient), simulating real-world business risk logic.

**7. Time-Based Feature Engineering & Time-Aware Modeling**
We introduced **time-based features** like Month and Day Type (Weekday/Weekend), enriching context for model learning. These were incorporated into both regression and simulation phases.

**8. Dashboard in Power BI**
We built a 2-page dashboard with:

- Page 1: Segmented Model Overview ($R^2$ by outlet, actual vs predicted sales, conversion trends, compliance)
- Page 2: ML-enhanced diagnostic for Howdy F7 (promo-level simulations, SHAP insights, recommendations, scenario conditions)
- Supporting filters: promo selector, rain toggle, foot traffic slider
- Simulation Log Table (Batch-wise, scrollable)

**9. Deliverables**

- Python Script (Regression, SHAP, Simulation Engine)
- Excel exports (Actual vs Predicted, SHAP, 4,000+ Scenario Results)
- Power BI Dashboard (Business Narrative)

**Conclusion**
This project represents an end-to-end intelligent decision support system developed during my role as a Business Analytics & Compliance Executive at Howdy Group. It blends

linear modeling, machine learning, simulation logic, model explainability, and interactive data visualization to support high-impact business decisions across multiple restaurant brands. The methodology emphasizes technical rigor, interpretability, and actionable insights tailored for real-world stakeholders.

**Business Impact & Accomplishments:**

- Helped Howdy F7 identify suboptimal promotional strategies and reduce inefficient staff allocations
- Demonstrated revenue uplift potentials under targeted weather-promotion-staffing configurations
- Enabled dynamic monitoring of outlet KPIs via Power BI
- Provided replicable logic for brand-specific prediction and strategy testing
- Contributed toward building a scalable data-driven decision system across the group.