Business Analytics Consulting Project
(EFIMM0144) - 2024/25

University of BRISTOL
Business School

IBM Workload 1

Data-Driven Optimization in Coffee Shops: A Business Canvas Approach

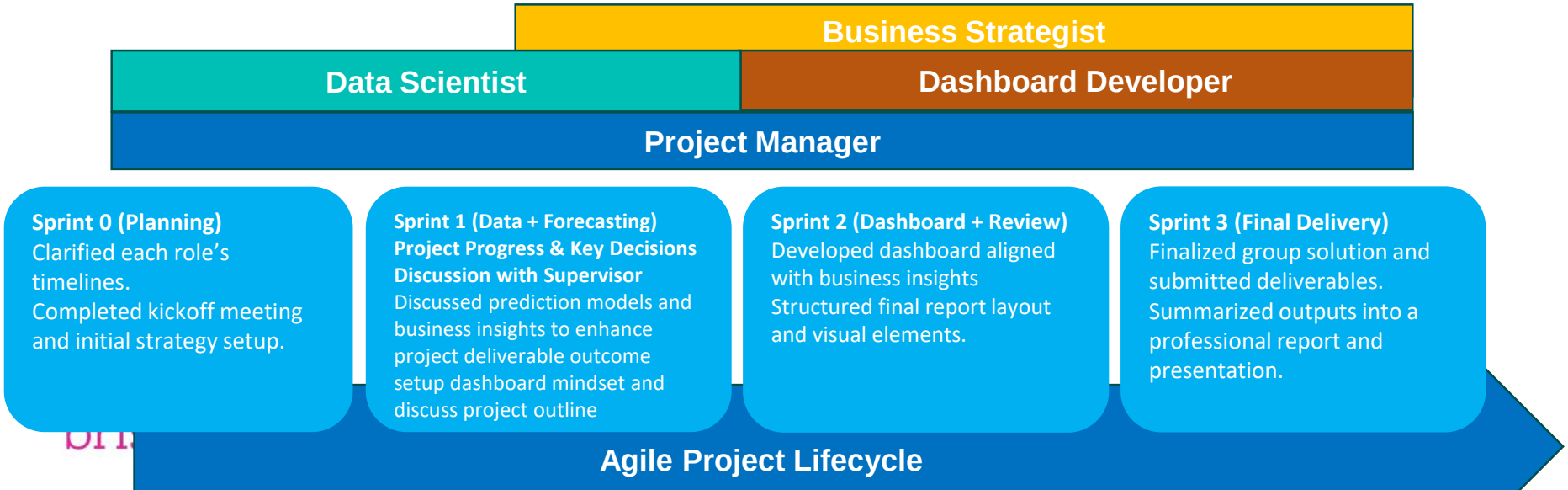
IBM Workload1 Team

Contents:

Project Overview & Agile Team Structure

Project Objectives:

- **Focus:** Optimizing coffee shop operations using data-driven methods
- **Methods:** Time-series forecasting, multi-objective optimization, business dashboards
- **Goal:** Improve staffing, forecast demand, and support evidence-based decisions
- **Framework:** Business Model Canvas (BMC) applied to coffee retail



Business Canvas Priorities & Key Challenges

Industry Context: Unique Challenges → **Business Model Canvas: 9 Key Components** → **Data-Driven Strategic Solutions**

Unpredictable customer demand

Complex workforce management

Narrow profit margins

Sensitivity to external factors
(weather, events, seasons)

Customer Segments
Value Propositions

Channels
Customer Relationships

Revenue Streams
Cost Structure
Key Activities

Key Resources
Key Partnerships

Challenge 1: Demand Forecasting

- Predictive analytics to anticipate customer flow
- Workload planning for optimal staffing

Challenge 2: Multi-Objective Optimization

Balancing:

- Service quality
- Labor efficiency
- Operational costs

Resource Optimization with Stochastic Modeling

Stochastic Simulation

$$Objective = -(\alpha \times Profit) + (\beta \times Penalty)$$

Where:

- $\alpha = 0.7, \beta = 0.3$
- Profit is calculated as:

  $$Profit = Total\ Revenue - Product\ Costs - Staff\ Costs$$

  $$Staff\ Costs = x \cdot h \cdot w$$

  With:

  $x = number\ of\ employees$

  $h = shift\ duration\ in\ hours\ (e.g., Morning = 5, Afternoon = 5, Evening = 3)$

  $w = hourly\ wage\ (e.g., \$12)$

- $Waiting\ Time\ (min) = max(0, \frac{((Demand\ per\ hour - Staff \times Service\ Rate))}{(Service\ Rate)}) \times 60$

Scenario	Time Slot	Cluster	Demand Min	Demand Max	Recommended Staff	Average Profit
Holiday	Afternoon	Low Demand	11	89	2	110.82
Holiday	Afternoon	Medium Demand	90	224	3	281.51
Holiday	Afternoon	High Demand	227	355	7	516.67
Holiday	Evening	Low Demand	14	89	2	155.25
Holiday	Evening	Medium Demand	90	225	4	279.87
Holiday	Evening	High Demand	228	232	8	400.22
Holiday	Morning	Low Demand	45	89	2	155.94
Holiday	Morning	Medium Demand	90	160	3	269.07
Normal Day	Afternoon	Low Demand	7	89	2	105.05
Normal Day	Afternoon	Medium Demand	90	217	5	297.65
Normal Day	Evening	Low Demand	8	89	2	147.82
Normal Day	Evening	Medium Demand	90	129	5	250.88
Normal Day	Morning	Low Demand	35	89	2	140.44
Normal Day	Morning	Medium Demand	90	125	2	244.21
Promotion	Afternoon	Low Demand	15	89	2	114.67
Promotion	Afternoon	Medium Demand	90	221	3	285.77
Promotion	Afternoon	High Demand	227	452	9	575.25
Promotion	Evening	Low Demand	17	89	2	159.09
Promotion	Evening	Medium Demand	90	226	4	284.03
Promotion	Evening	High Demand	229	278	9	457.65
Promotion	Morning	Low Demand	50	89	2	163.42
Promotion	Morning	Medium Demand	90	180	3	268.58

Forecasting Future Customer Numbers

Customer footfall forecasting → Using Prophet Model with logistic growth.

Prophet model → Time-series forecasting model.

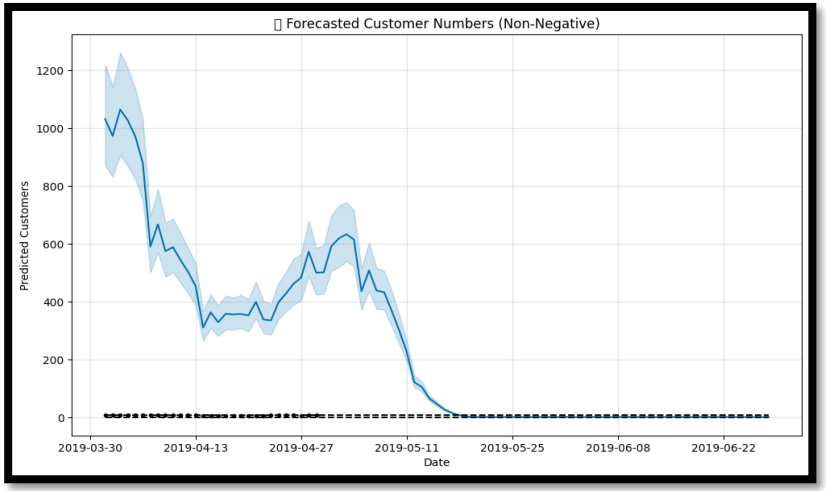
Logistic growth → Used to model customer demand realistically

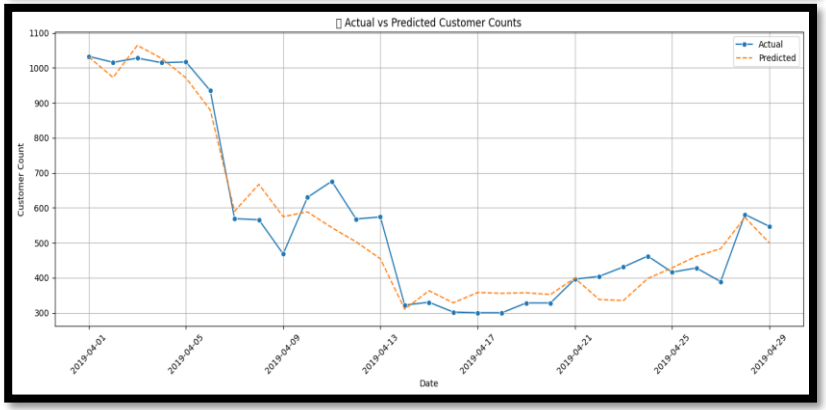
Why Prophet model? → Handles missing data, seasonality, external factors

Model performance →

✅ Model Evaluation Metrics:
📉 MAE: 49.85
📉 MSE: 3738.61
📉 RMSE: 61.14
📊 MAPE: 10.25%
📈 R² Score: 0.9397

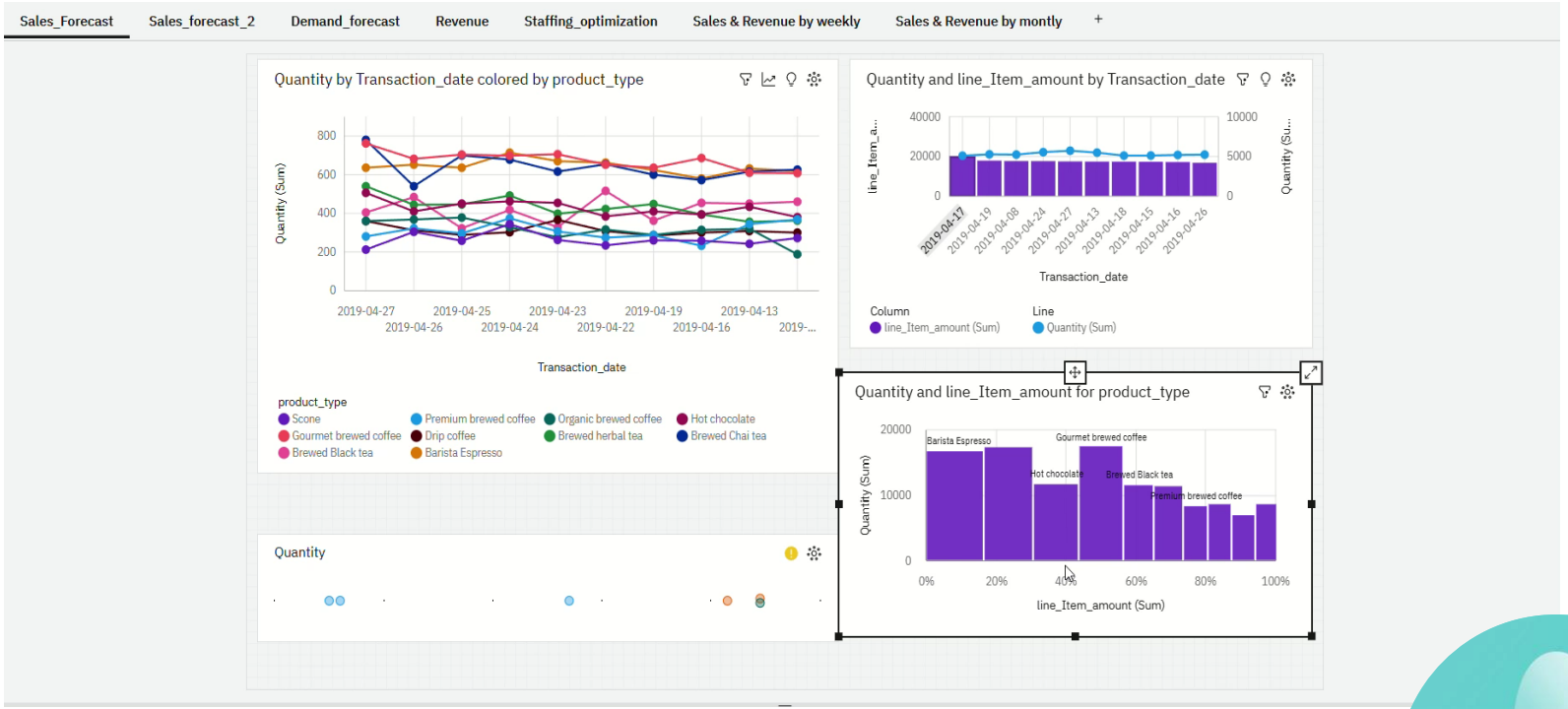
Results





bristol.ac.uk

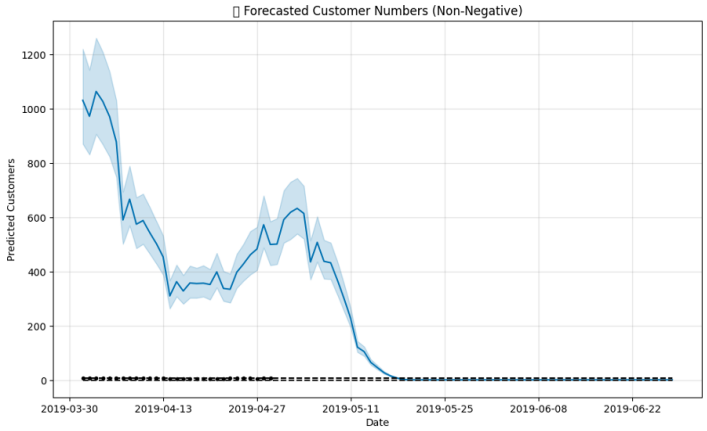
Real-Time Insights via IBM Watson Dashboard



Business Impact: Provides real-time insights for optimizing workload planning. Helps IBM enhance efficiency and decision-making.

Limitation: Unable to export IBM Cognos Analytics dashboard as an HTML output due to trial version restrictions.

Business Insights & Final Takeaways



Scenario	Time Slot	Cluster	Demand Min	Demand Max	Recommended Staff	Average Profi
Holiday	Afternoon	Low Demand	11	89	2	110.82
Holiday	Afternoon	Medium Demand	90	224	3	281.51
Holiday	Afternoon	High Demand	227	355	7	516.67
Holiday	Evening	Low Demand	14	89	2	155.25
Holiday	Evening	Medium Demand	90	225	4	279.87
Holiday	Evening	High Demand	228	232	8	400.22
Holiday	Morning	Low Demand	45	89	2	155.94
Holiday	Morning	Medium Demand	90	160	3	269.07
Normal Day	Afternoon	Low Demand	7	89	2	105.05
Normal Day	Afternoon	Medium Demand	90	217	5	297.65
Normal Day	Evening	Low Demand	8	89	2	147.82
Normal Day	Evening	Medium Demand	90	129	5	250.88
Normal Day	Morning	Low Demand	35	89	2	140.44
Normal Day	Morning	Medium Demand	90	125	2	244.21
Promotion	Afternoon	Low Demand	15	89	2	114.67
Promotion	Afternoon	Medium Demand	90	221	3	285.77

- Digital sales channels
- Personalized promotions

- Dynamic staffing
- High-demand periods

Limitations:

- Limited timeframe
- External variables

Future Direction

- Multiple stores and seasons
- Dynamic dashboard updates

University of BRISTOL

Thank You!