
National Rail
ANALYTICS PROJECT
Leveraging data to transform rail transportation insights
Javelin

UK NATIONAL RAIL ANALYTICS PROJECT

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UK NATIONAL RAIL
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PROJECT OVERVIEW

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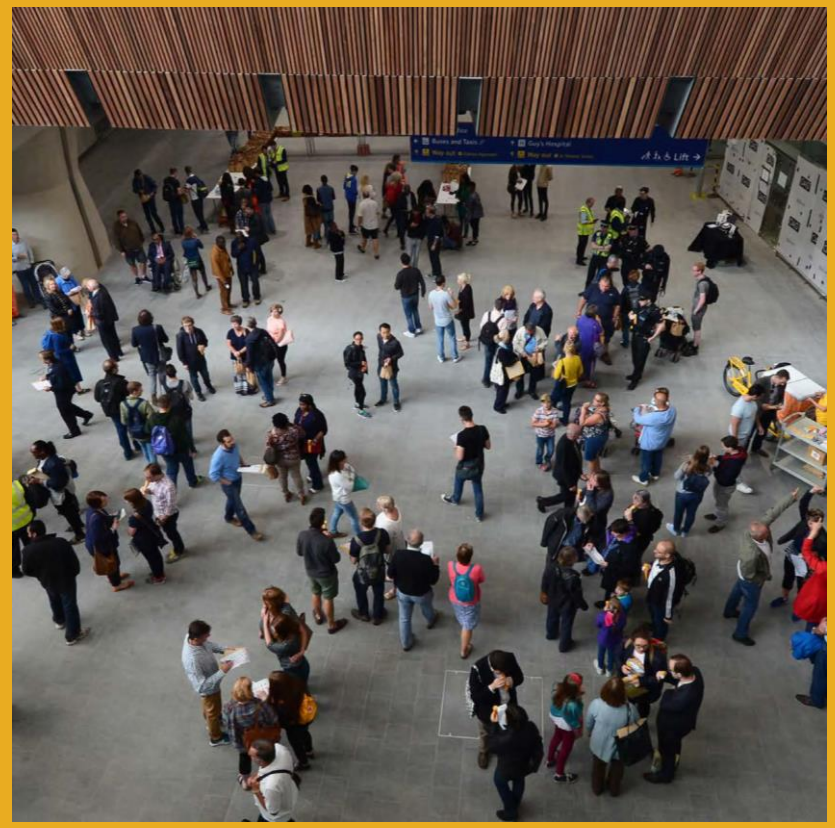

This project focuses on analyzing UK National Rail journeys to uncover patterns in passenger behavior, ticket purchasing, travel performance, and operational efficiency. Using a cleaned dataset of train ride transactions, the analysis aims to identify key trends related to ticket types, pricing, travel timings, delays, and refund requests.

The insights generated help demonstrate practical data-analysis skills, including data preparation, dashboard design, and the extraction of meaningful conclusions from real-world transport data.

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DATASET DESCRIPTION

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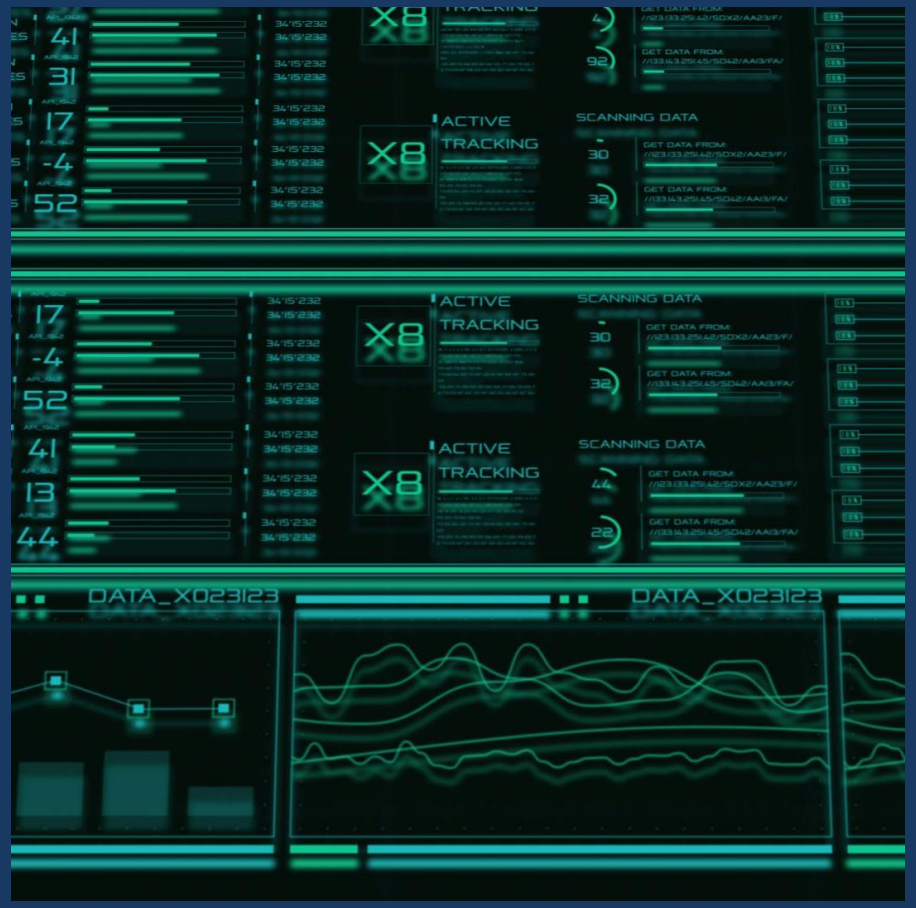

- **Size**: The dataset contains **31,653 train ride records** with a wide range of journey, ticket, passenger, and performance attributes.
- **Grain**: Each row represents **a complete train-ride transaction** for a single passenger**, including ticket purchase details and the journey's actual outcome**.
- **Purpose**: The dataset is designed to support **operational analysis**, including ticketing behavior, travel performance, delay patterns, and customer refund activity. It provides the foundation for building dashboards that reveal key insights about passenger habits and railway efficiency.

DATASET DESCRIPTION

Key Components of the Dataset

- **Transaction & Purchase Details:**
  Transaction ID, Date of Purchase, Time of Purchase, Purchase Type (Online or Station), Payment Method.
- **Passenger & Ticket Information:**
  Columns: Railcard type, Ticket Class, Ticket Type, Ticket Price.
- **Journey Information:**
  Columns: Departure Station, Arrival Destination, Date of Journey, Scheduled Departure Time, Scheduled Arrival Time.
- **Performance & Delay Metrics:**
  Columns: Actual Arrival Time, Journey Status (On Time, Delayed, Cancelled), Reason for Delay.
- **Customer Response:**
  Columns: Whether a Refund Request was submitted.

DATASET DESCRIPTION

Dataset Highlights

- Covers a broad range of ticket types and purchase behaviors.
- Includes both scheduled and actual arrival times, enabling delay analysis.
- Provides rich categorical data suitable for segmentation and performance insights.

Data Limitations

- The dataset covers only **four months** of the year, limiting the ability to analyze full-year seasonality.
- The dataset lacks a user demographics **or customer dimension table**, making it challenging to analyze segmentation by user characteristics.
- Journey records do not include **distance or route-length information**, preventing analysis linking **delay duration to journey distance**, or route complexity.

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KEY DIAGNOSTIC QUESTIONS

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I. Operational Performance & Reliability

- Punctuality vs. Benchmark
- Root Cause Identification
- Service Disruption Severity

II. Financial Health & Cost of Disruption

- Revenue Stream Segmentation
- Financial Leakage from Refunds
- Refund Policy Effectiveness

III. Customer Behavior & Growth Momentum

- Channel Preference
- Growth Sustainability

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TECHNICAL DEEP DIVE

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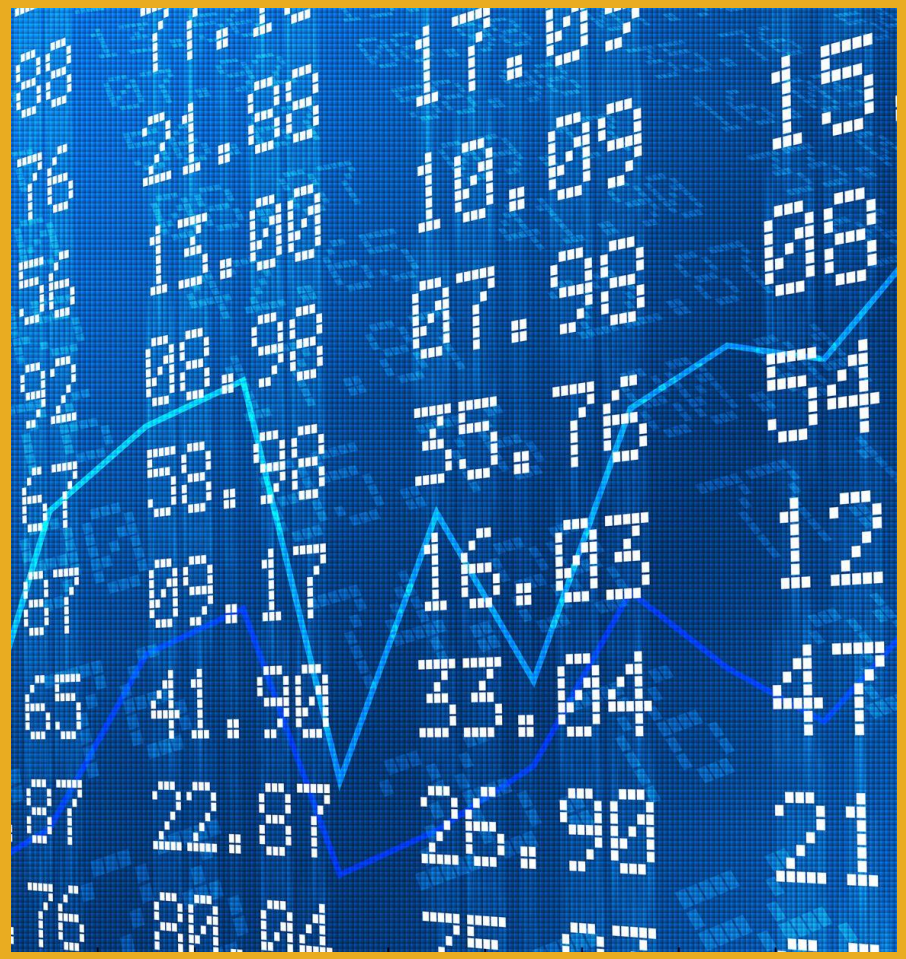


Data Cleaning & Preparation

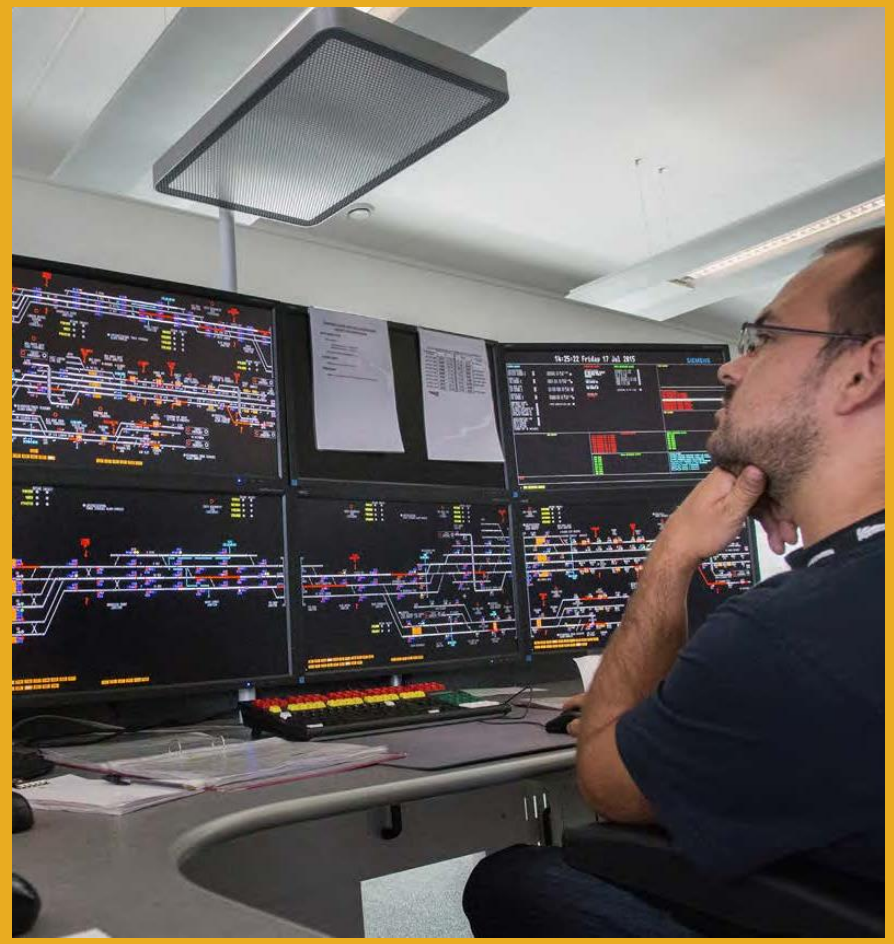
- **Source Data Ingestion:** Loaded 31,653 raw transaction records.
- **Data Type Conversion:** Ensured proper date and time formats for analysis.
- **Data Standardization:** Unified and cleaned text entries (e.g., Journey Status, Reason for Delay).
- **Handling Missing Values:** Imputed missing values in arrival times to correctly categorize journeys as Delayed or Cancelled.
- **Calculated Columns:** Created derived columns for actual ride time and delay duration.

TECHNICAL DEEP DIVE

Data Enrichment & Dimension Tables

- **Date Dimension:** Created a dedicated Date Dimension table to enable robust Time Intelligence calculations (MoM, MTD).
- **Hierarchies:** Established hierarchies for geographical and temporal analysis (e.g., Station, Date).
- **Segmentation:** Grouped and categorized Passenger attributes (e.g., Railcard holders) and Ticket details.

TECHNICAL DEEP DIVE



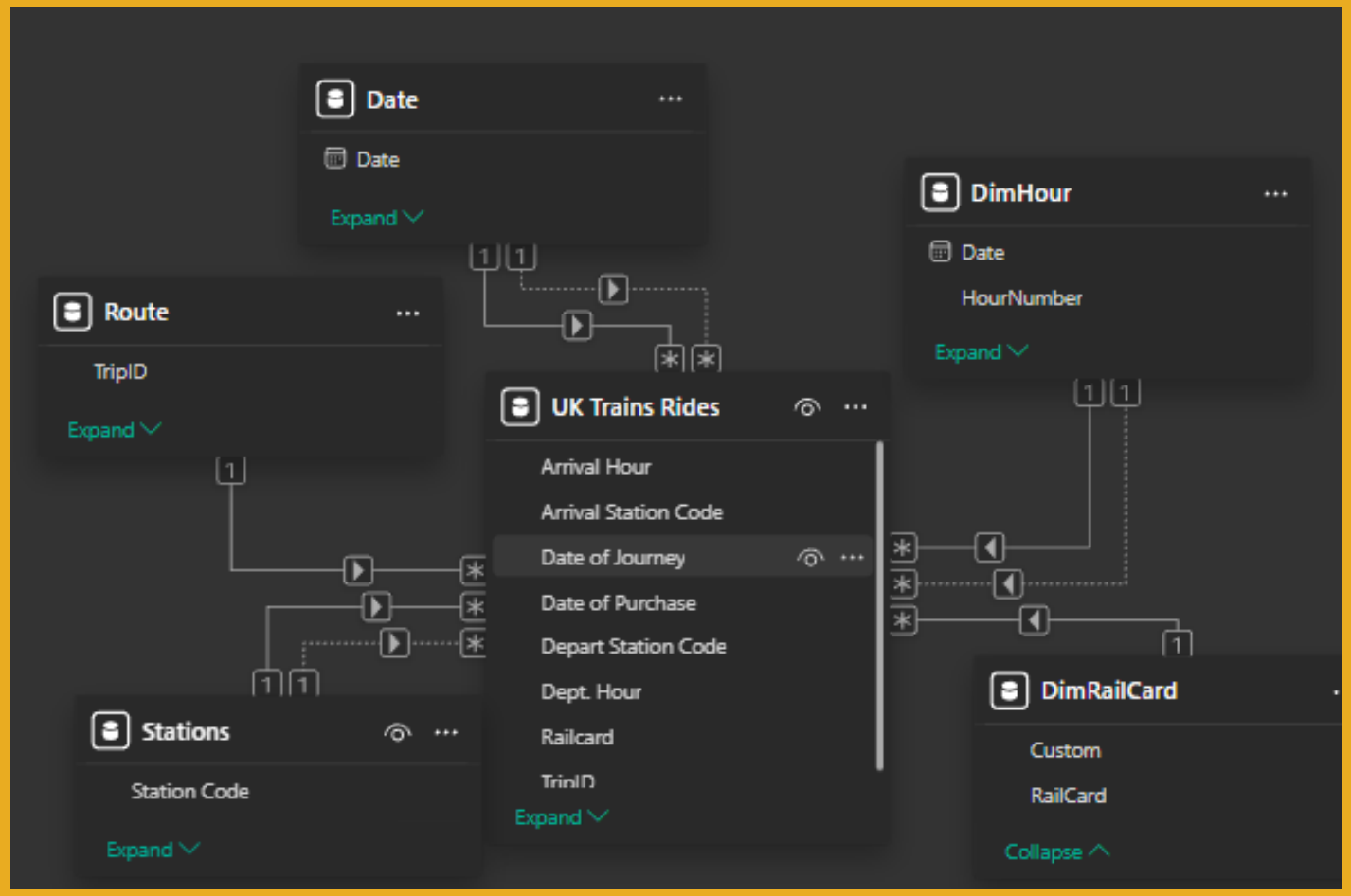
Exploratory Data Analysis (EDA)

- **Total Rides: 31,653** total transactions.
- **Total Revenue: £742K** generated.
- **Performance Baseline: 86.82%** of rides were On Time.
- **Disruption Volumes: 7.24%** Delayed rides and **5.94%** Cancelled rides.
- **Financial Leakage: £39K** paid in refunds, with an Incident Refund Rate of **26.80%**.
- **Growth Trajectory:** Strong Month-over-Month Growth of **33.89%**.

TECHNICAL DEEP DIVE

Data Modeling

- **Model Architecture:** Implemented a **Star Schema** to optimize performance and query speed in Power BI.
- **Fact Table:** Central UK Trains Rides table containing all transactional data.
- **Dimension Tables:** Linked Date and Stations dimensions.
- **Relationships:** Established robust One-to-Many relationships to ensure accurate measure calculations across filters.



TECHNICAL DEEP DIVE

DAX Measures Overview

- **Operational Measures:** Calculated core metrics like PPM%, Delay Time Averages, and Service Failure Rates.
- **Financial Measures:** Defined revenue totals, Average Ticket Price, and the financial impact of Refunds.
- **Time Intelligence:** Utilized DAX functions (DATEADD, TOTALMTD) for Month-over-Month growth and trend analysis.
- **Segmentation Measures:** Quantified passenger groups (Railcard holders vs. Non-Railcard holders).

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DASHBOARD WALKTHROUGH

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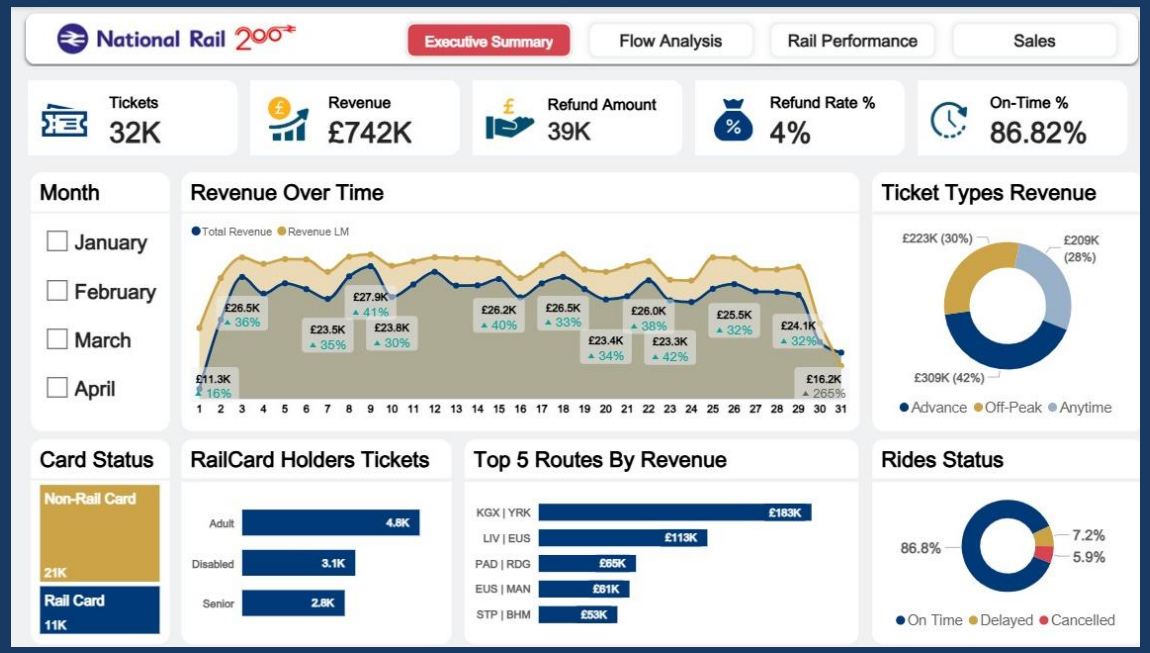
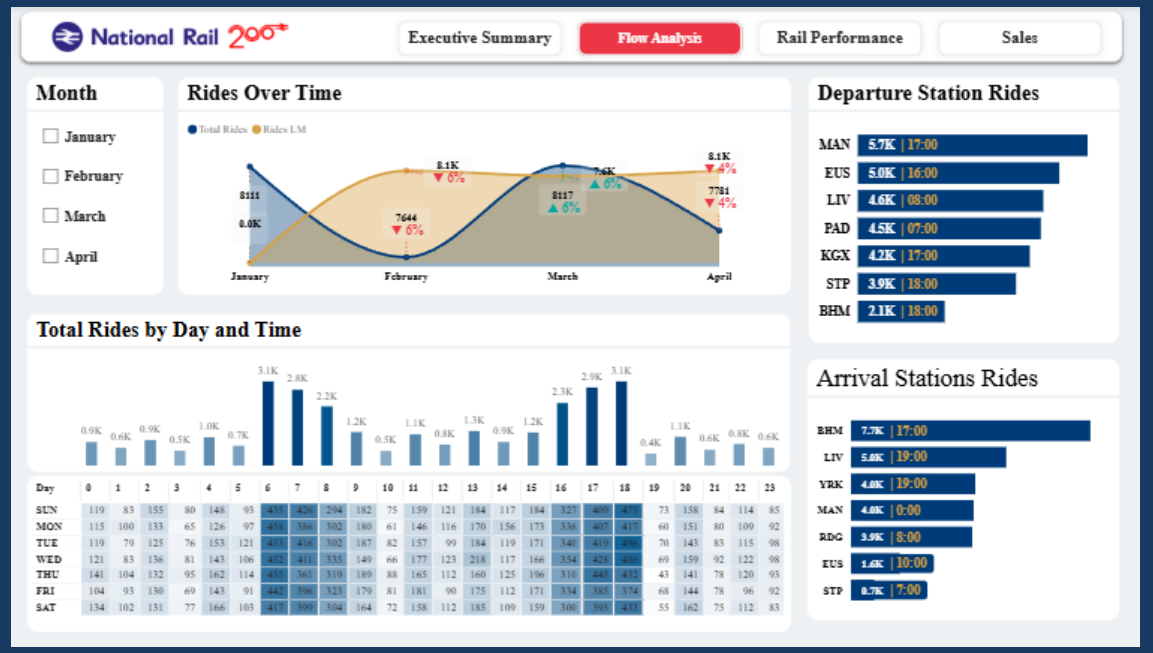
Landing Page

ANALYTICAL REVIEW



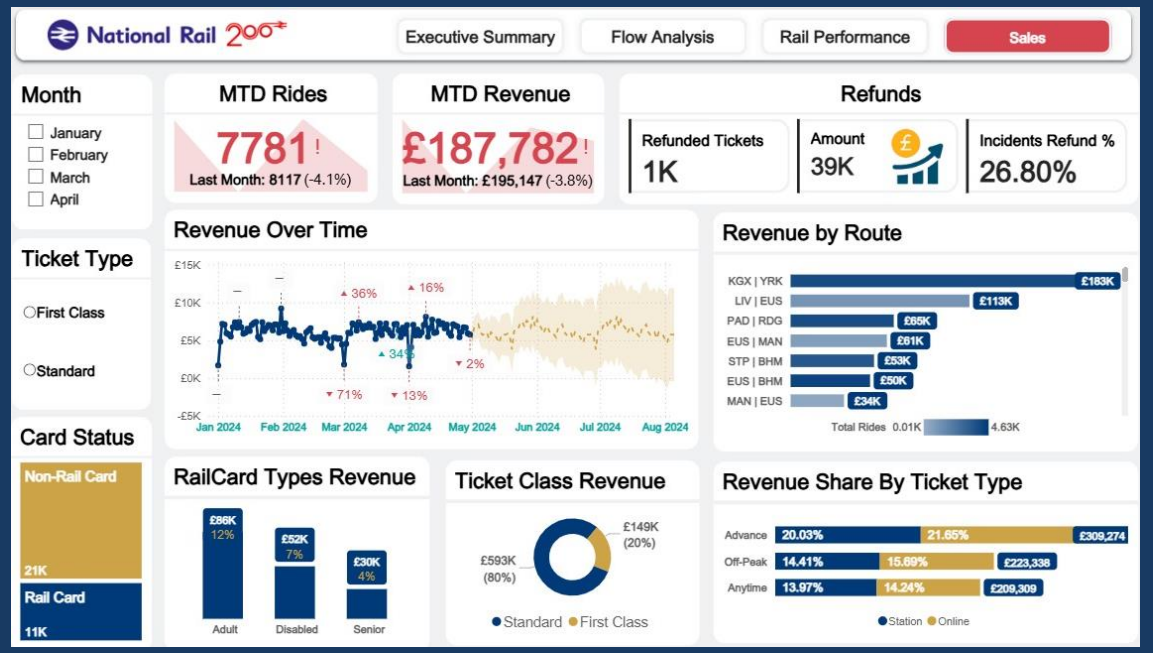
Executive Summery



Flow Analysis

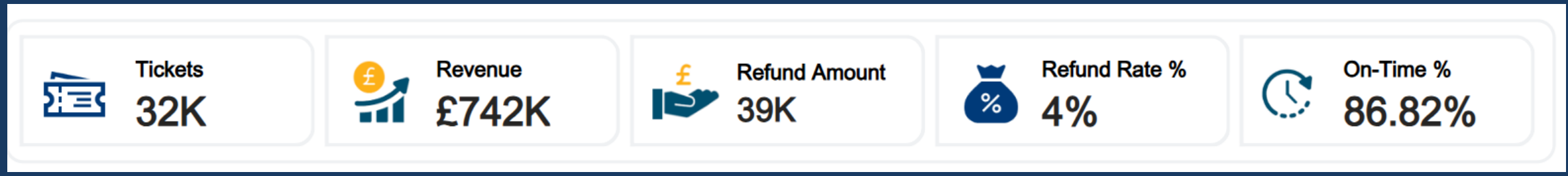
ANALYTICAL REVIEW

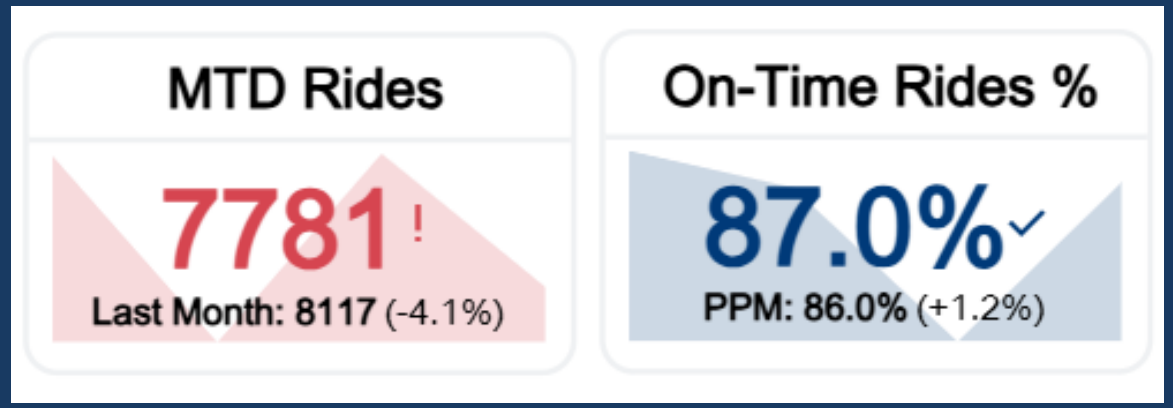
Rail Performance



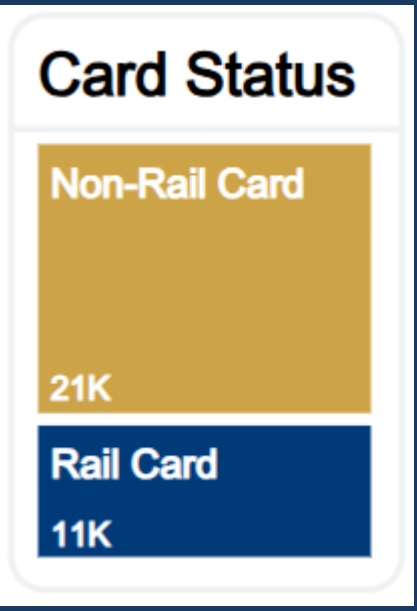
Sales Analysis

ANALYTICAL REVIEW



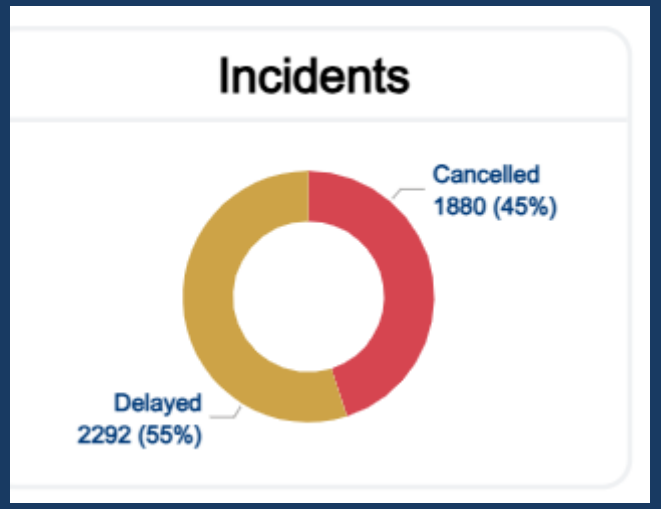


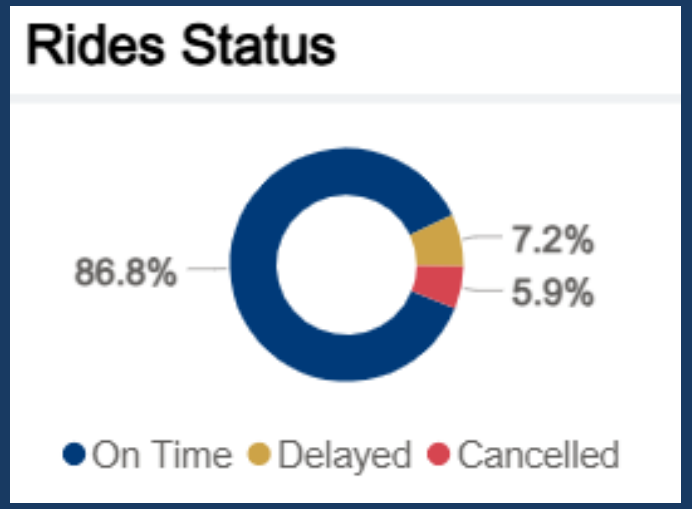
KPIs and Cards



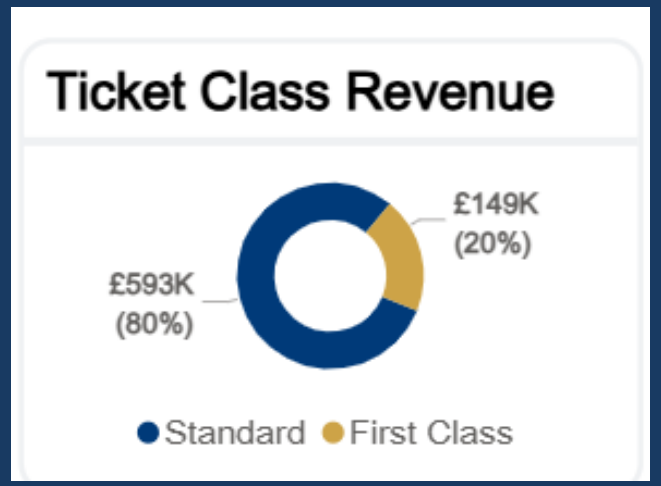
Tree Map Chart

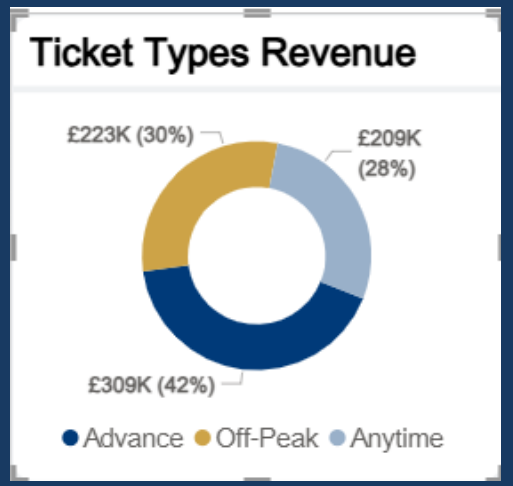
ANALYTICAL REVIEW





Pie Charts





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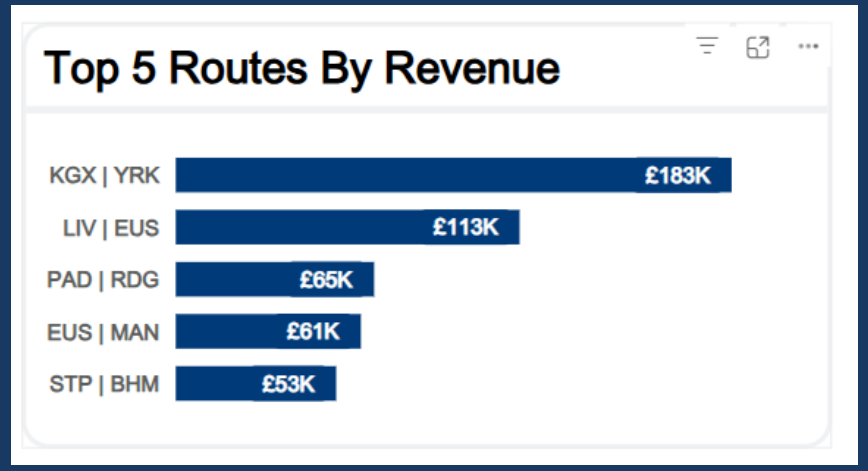
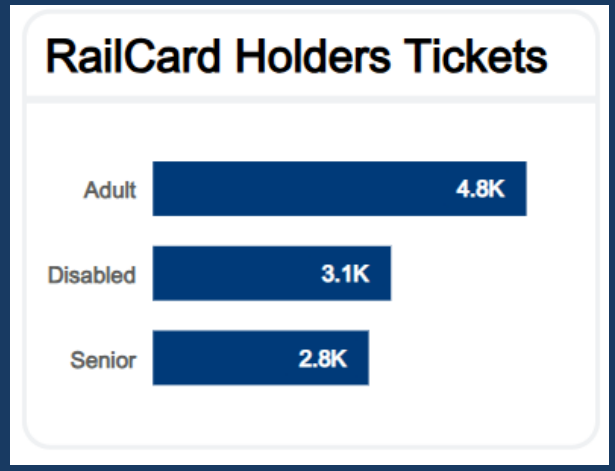
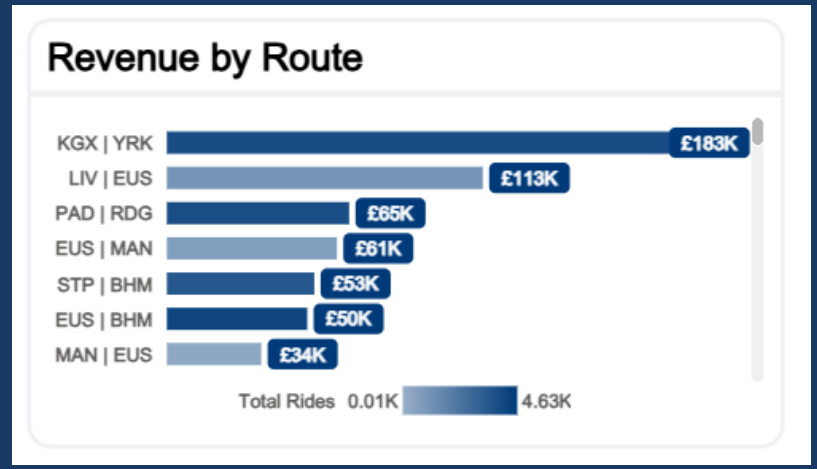
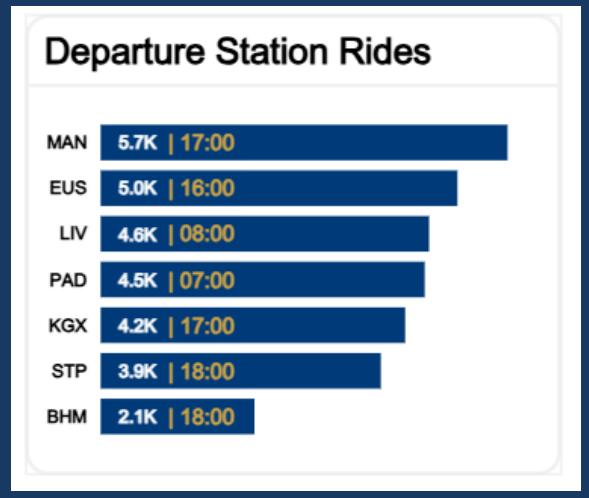
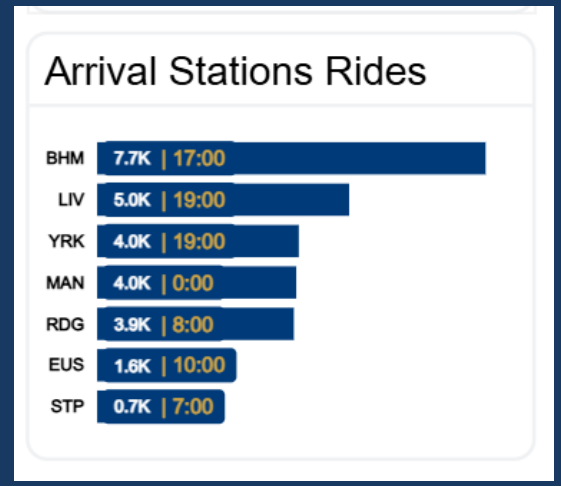






Bar Charts





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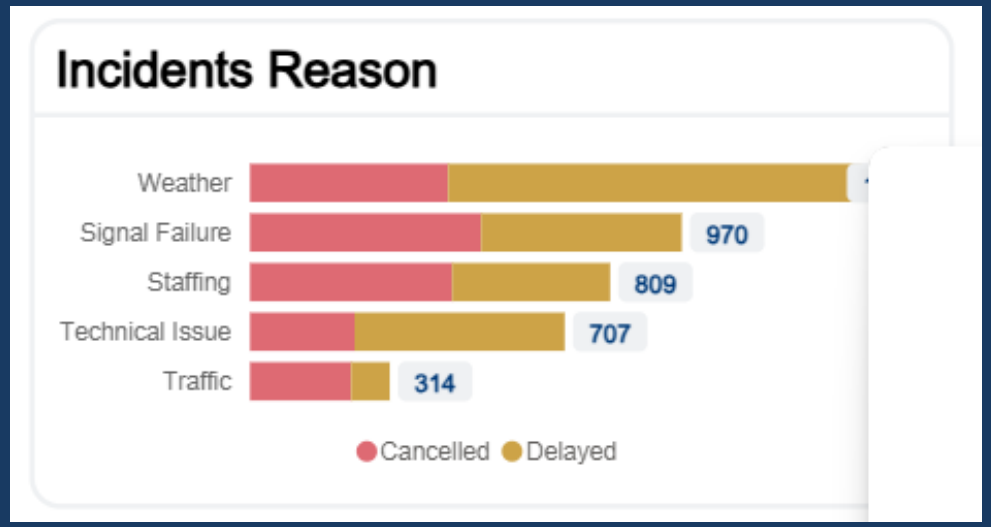
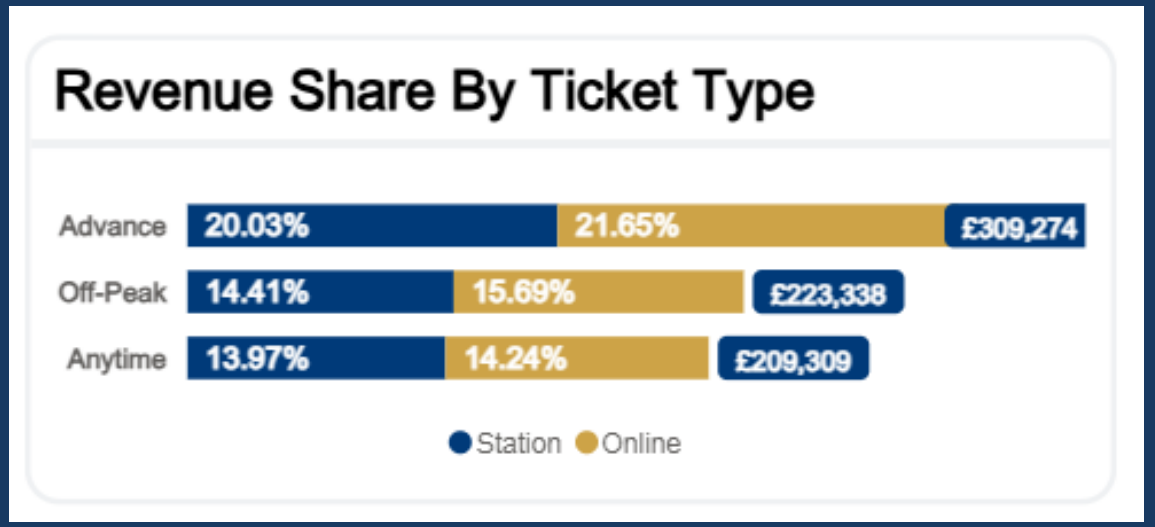
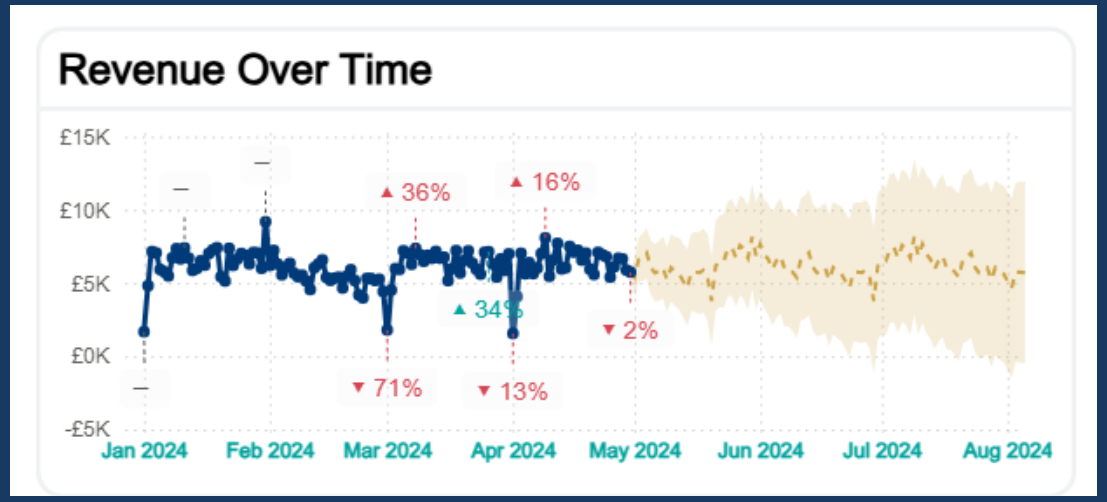
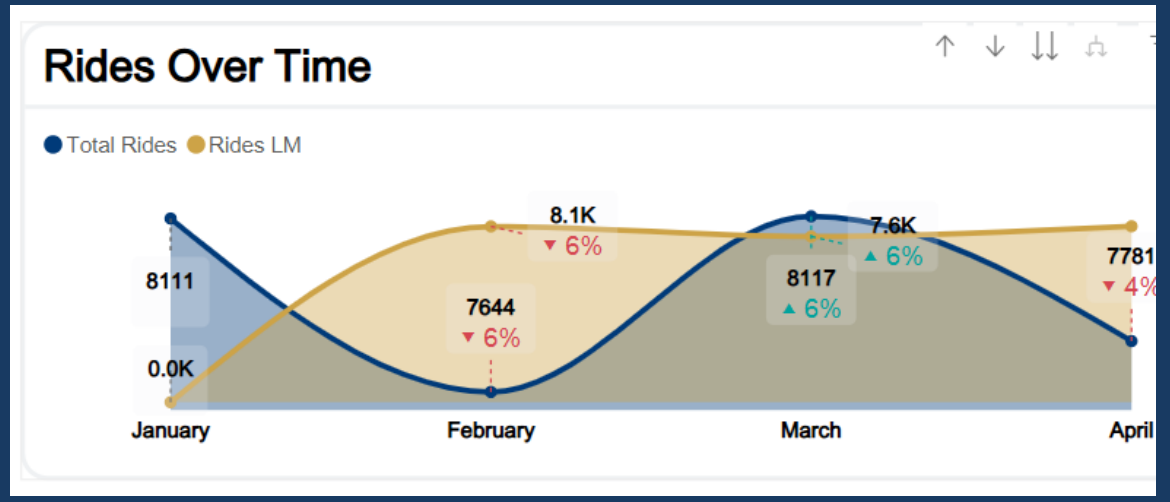




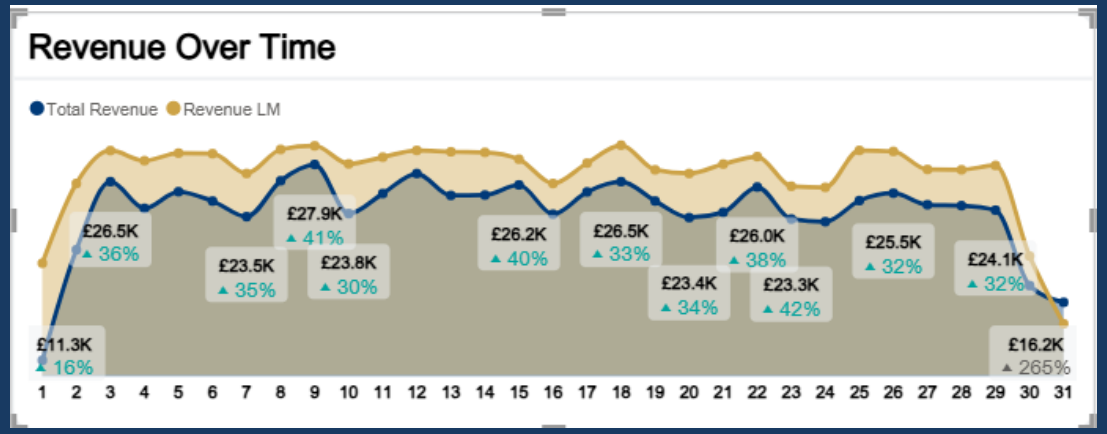
Stacked Bar Charts

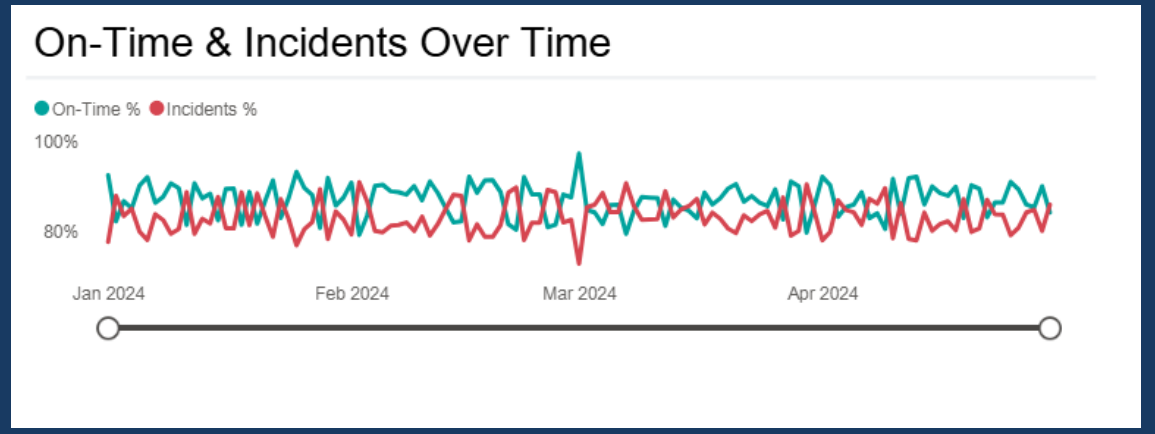
ANALYTICAL REVIEW





Line Charts





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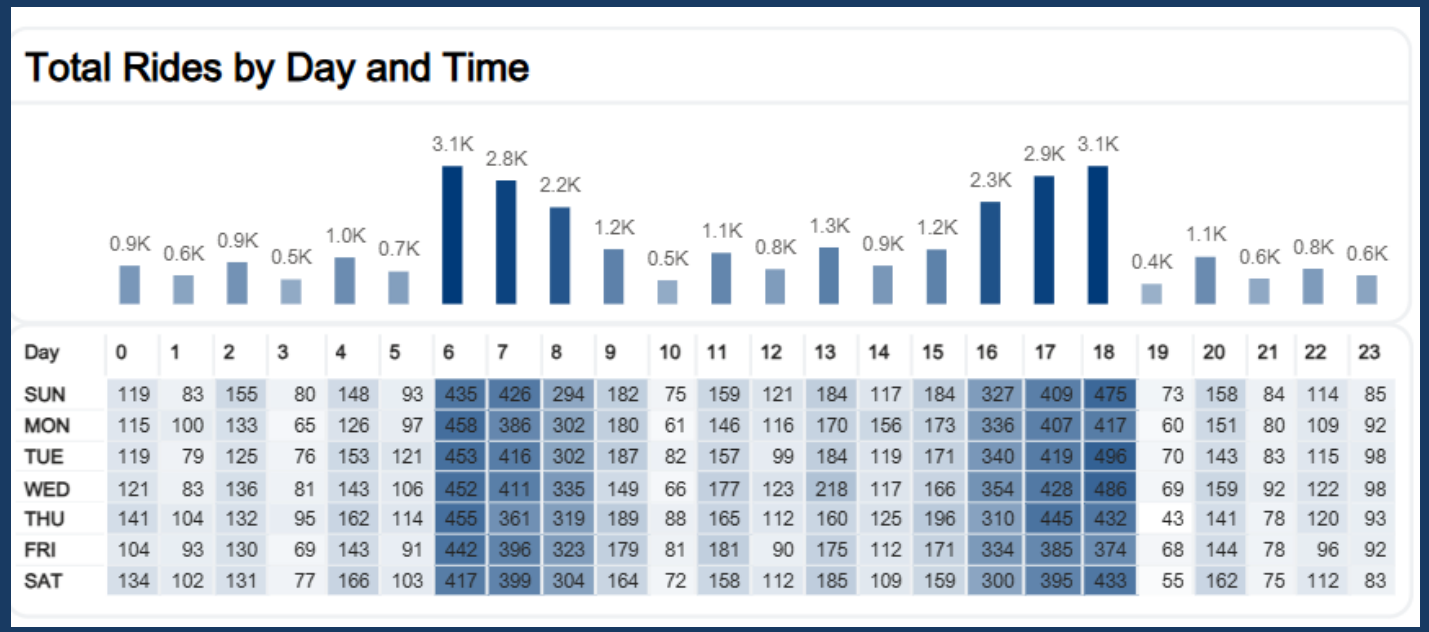
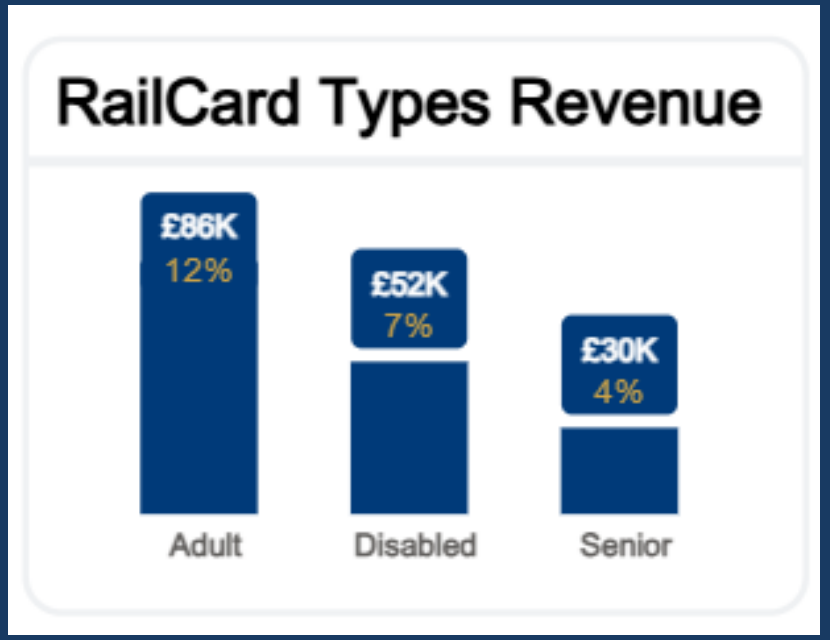


Day	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
SUN	119	83	155	80	148	93	435	426	294	182	75	159	121	184	117	184	327	409	475	73	158	84	114	85
MON	115	100	133	65	126	97	458	386	302	180	61	146	116	170	156	173	336	407	417	60	151	80	109	92
TUE	119	79	125	76	153	121	453	416	302	187	82	157	99	184	119	171	340	419	496	70	143	83	115	98
WED	121	83	136	81	143	106	452	411	335	149	66	177	123	218	117	166	354	428	486	69	159	92	122	98
THU	141	104	132	95	162	114	455	361	319	189	88	165	112	160	125	196	310	445	432	43	141	78	120	93
FRI	104	93	130	69	143	91	442	396	323	179	81	181	90	175	112	171	334	385	374	68	144	78	96	92
SAT	134	102	131	77	166	103	417	399	304	164	72	158	112	185	109	159	300	395	433	55	162	75	112	83

Combined Matrix and Column Charts



Column Chart with KPI Indicator

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KEY INSIGHTS & FINDINGS

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- **Cancellation Crisis:** The 5.94% cancellation rate **exceeds the 5.0% threshold** for severe disruption, highlighting critical service instability despite meeting the general PPM target.
- **Infrastructure Failure Dominance: Signal Failure** is confirmed as the single largest root cause of delays, underscoring systemic reliability issues in the railway infrastructure.
- **Direct Cost of Disruption: £39K** in refunds and a high **26.80%** Incident Refund Rate quantify the direct financial penalty of operational failures, proving that poor performance is expensive.
- **Growth Vulnerability:** The impressive **33.89% MoM Growth** is at risk unless immediate action is taken to stabilize service reliability and convert new passengers into loyal customers.

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CONCLUSIONS

CONCLUSIONS

- **Performance Gap:** The network is **punctual (86.82% PPM compliant)** but severely **unreliable (high cancellation rate)**.
- **Financial Impact:** Unstable operational performance is directly translating into quantifiable financial losses through high refund rates.
- **Focus Area:** The immediate priority must shift from simply tracking on-time performance to aggressively mitigating the **root causes** of delays and cancellations.

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RECOMMENDATIONS / ACTIONS

RECOMMENDATIONS / ACTIONS

- **Prioritize Signal Investment:** Allocate urgent capital expenditure to upgrade and maintain signalling infrastructure to directly address the primary cause of delays.
- **Operational Review of Cancellations:** Launch an immediate process review to identify and eliminate the systemic issues driving the high 5.94% cancellation rate.
- **Proactive Refund Mitigation:** Implement strategies to reduce average delay times, thereby minimizing the volume of refund-eligible disruptions and capping financial leakage.

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FORECASTS
(SUGGESTED FUTURE PROJECTIONS)

FORECASTS

- **Revenue Projection:** Forecast future revenue growth based on scenario analysis (e.g., impact of reducing cancellation rates by 1.0%).
- **Service Level Projection:** Project the expected reduction in delay minutes if Signal Failure is mitigated by X%.
- **Financial Impact Forecasting:** Model the potential savings in refund expenditure over the next fiscal period by improving punctuality.

Q & A