A photograph of a modern high-speed train, likely a Virgin train, parked at a station platform. The train is silver and red. Several people are visible on the platform, some walking towards the train. The station has a large, complex steel and glass roof structure. A digital sign on the left shows "11:1448 OFF".

Final Assignment Data 445

Statistical Modeling

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Business Understanding

Introduction

-Virgin Rail Group continued their already successful business strategies in Virgin Air and leased the infrastructure from the United Kingdom Public Transportation for rail travel in the United Kingdom. It became one of the private companies to partially take over the rail transport in the United Kingdom, specifically the West Coast system. In this presentation we will discuss Virgin Rail's success story and present our own scenario of rail travel through Business Understanding and Data Analysis.

Case Study

❖ SAIT - Virgin Train CASE19 - VIRGIN.pdf



Six Stage Problem-solving Process

Problem Solving Process

1 – Exploring the mess

#	Question	Answer
Q1.1	What problems (or opportunities) did they face?	Virgin Rail group was presented an opportunity to lease a portion of the United Kingdom Railline – particularly the West Coast Mainline. It would be an expensive project to undertake, and the Government controlled many aspects of the lease.
Q1.2	Where was there a gap between the current situation and the desired one?	N/A
Q1.3	What were the stated and unstated goals?	The goal was to finally successfully privatize the rail service in the UK, the previous private company, Railtrack did not succeed like Virgin did. Franchises such as Virgin Rail leased trips from the British Rail Line to transport customers to specified destinations.

Problem Solving Process

2 – Searching for information

#	Question	Answer
Q2.1	What were the symptoms and causes?	Virgin Rail Lines used their previous experience in air travel to create a successful business opportunity with rail travel
Q2.2	What measures of effectiveness seemed appropriate?	One Measure of Effectiveness to create a successful business was focusing on employee training to improve customer satisfaction and improve departure/arrivals times. Many of this meant large amounts of investment.
Q2.3	What actions were available?	Employee training, Government subsidies to fill gaps specified in their agreements, and the implementation of similar tactics from previous business models with Virgin Air

Problem Solving Process

3 – Identifying a problem

#	Question	Answer
Q3.1	Which was the most important problem in this situation?	Most important problem was customer satisfaction, updating old passenger cars and the rail lines for passengers and freight cars alike.
Q3.2	Was the problem like others they had dealt with?	Virgin Rail was created from the company created by Richard Branson called Virgin. Their experience in other ventures (like Virgin Air) prepared them for what needed to be done to succeed.
Q3.3	What were the consequences of a broad versus narrow problem statement?	Railtrack did not consider themselves in the implementation of certain avenues of franchising the rail system. It could be argued that Railtrack was too narrow minded in their negotiating and did not look at the bigger picture, therefore, causing their agreements to be, in part, only positive for Virgin Rail.

Problem Solving Process

4 – Searching for solutions

#	Question	Answer
Q4.1	What decisions were open to them?	Virgin could monitor customer satisfaction, upgrade rail cars, train employees to benefit the customers and business, and marketing campaigns to increase traffic.
Q4.2	What solutions had been tried in similar situations?	Virgin excels in learning what their customers want and what will increase their repeat customers, employee retention and training. Doing these few things, they know already work for their Air business helped them succeed in the rail business.
Q4.3	How did the various candidate solutions link to the outcomes of interest?	Implementing customer surveys allowed Virgin to change what needed to be changed based on recommendations and concerns directly from their customer base and quickly since many avenues were available for customer response. They employed a few discount scenarios and perks for first class passengers, there weren't many things they could do with ticket price, since that is regulated by the Department for Transport.

Problem Solving Process

5 – Evaluating solutions

#	Question	Answer
Q5.1	How did the solution impact each of the criteria?	The solution was to increase profits and ridership. Because that was the end goal, Virgin had to focus on a few key portions of their business plan like customer satisfaction, destination and departure times, and upgrades to make rail travel more efficient.
Q5.2	What factors within their control could have improved the outcomes?	Virgin Trains out-negotiated with Rail-track which would have altered the agreement. It might not have been as positive or enticing for a company like Virgin to take on the task of major infrastructure and upgrades.
Q5.3	What factors outside their control could have altered the outcomes?	Virgin rail had no choice on infrastructure so not having that control could have changed outcomes for the worse or for the better. Ticket fares are only regulated by the Department of Transport which cuts into possible profits for Virgin Train

Problem Solving Process

6 – Implementing a solution

#	Question	Answer
Q6.1	What were the barriers to successful implementation?	Infrastructure upgrades were the biggest barriers since the need to upgrade new cars and stops was necessary as soon as possible. Keeping lines down for maintenance and upgrading costs money. Virgin had little control over the upgrades to the rail lines.
Q6.2	Where was there support and motivation, or resistance and conflict?	Government strongly supported Virgin take over because of the immediate need for upgrades Railtrack couldn't afford. Lengthy shutdowns would have cost all parties involved a lot of money since the West Coast trains transported more than 40% of freight in the UK, not to mention the passenger travel. The biggest upgrade to the West coast mainline ran long and went 3 times over budget and shut down time.
Q6.3	Were there resources available for successful implementation?	Infrastructure was already available (even if outdated), and government subsidies were given where necessary or a premium was paid for access to tracks.

5W and 1H Questions



5W 1H Analysis

1 - Who

#	Question	Answer
Q1.1	Who is involved?	British Government, British Railway Industry, Virgin Rail Group
Q1.2	Who is affected?	British Government, Virgin Rail Group, the public (customers)
Q1.3	Who will benefit?	The Government of Britain, Virgin Rail Group, the public sector
Q1.4	Who will be harmed?	N/A

5W 1H Analysis

2 - What

#	Question	Answer
Q2.1	What is your topic narrowed down in a simple phrase/sentence?	The reformation of the British Railways and the experiences learnt.
Q2.2	What does your topic involve? (i.e. What are the different parts to it?)	It involves how a successful private railway company doubled number of passengers in 12 years. It also involves the experiences and lessons learnt from franchising in an uncertain environment
Q2.3	What is it similar to / different from?	This was similar to the already existing airline company owned by Virgin group known as Virgin Air

5W 1H Analysis

3 - When

#	Question	Answer
Q3.1	When does this take place? When did this take place? When will it take place? When should this take place?	Two franchises(West Coast and Cross Country) under Virgin started in 1997 and was scheduled to end in 2012 but Cross Country agreement was terminated in early 2007.
Q3.2	Does when this takes place affect the topic?	It largely affected this topic as it was a time when the rail services suffered major setbacks and this helped to make railway services attractive to the customers while increasing the revenue to the government and rail service providers.

5W 1H Analysis

4 – Where

#	Question	Answer
Q4.1	Where does this take place? (Where did it Where will it ... Where should it?)	This took place in Britain
Q4.2	Does it matter where it takes place? Is it affected by location?	Yes

5W 1H Analysis

5 - Why

#	Question	Answer
Q5.1	Why is this topic important? Why does it matter?	This topic is important as it sheds more light to how business owners can increase their success rates over time and also learn from the arising problems that they faced.
Q5.2	Why do certain things happen? (What are some causes and effects within the topic?)	Cause- The vision to be the safest, most reliable and profitable train operator in an uncertain environment Actions- sound commercial and staff management, corporate organization and prioritizing customer satisfaction Effects- Doubled number of customers over a period of 12 years, Increased PPM and overall customer satisfaction.

5W 1H Analysis

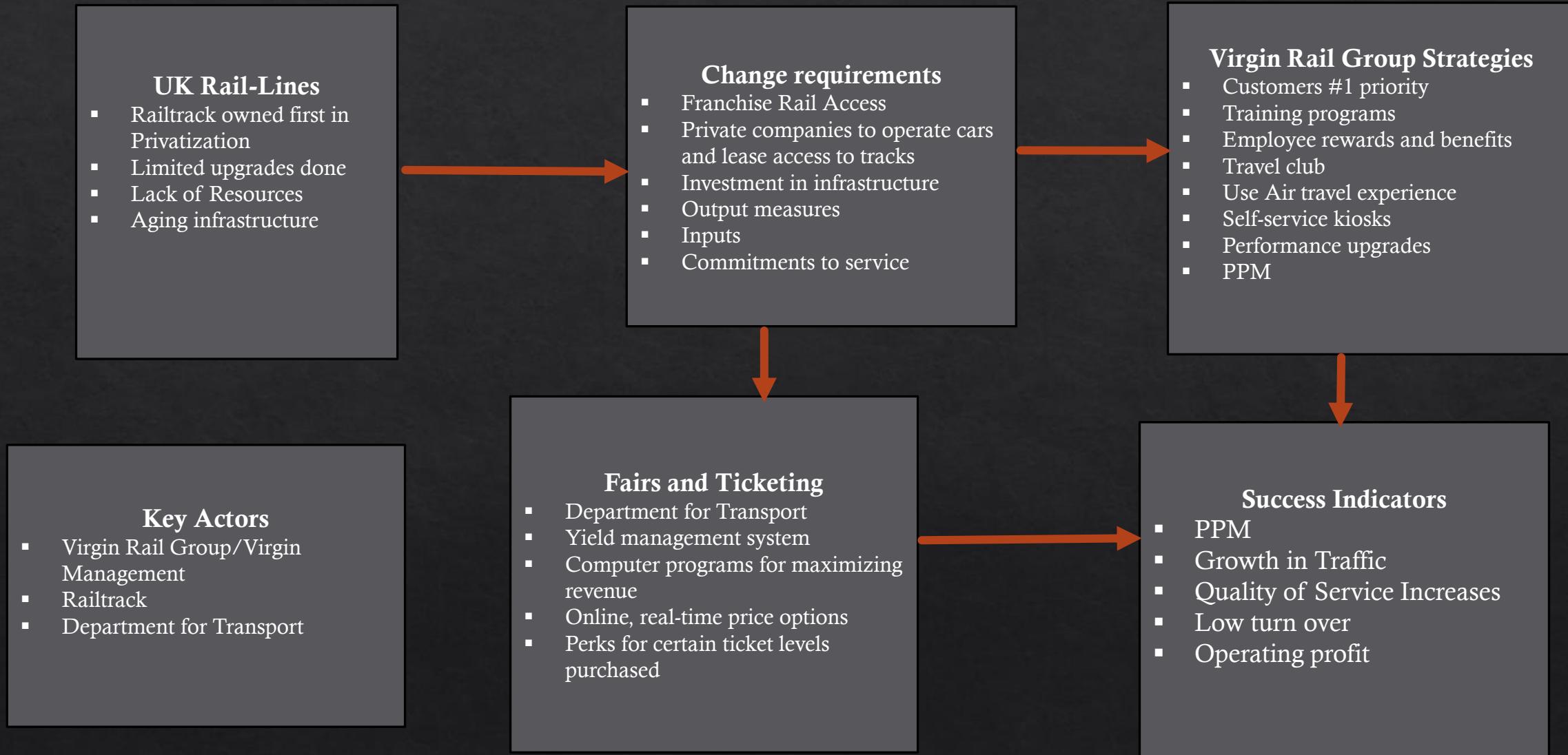
6 – How

#	Question	Answer
Q6.1	How does this topic work? How does it function? How does it do what it does?	This topic brings awareness to business owners that success can be achieved over time with well laid out strategy when implemented.
Q6.2	How did it come to be?	Need to decentralize the transport sector for effective management, the management of Virgin Rails seeing a need to be the safest, most consistent and profitable rail service operator, learning from another successful business model(Virgin Air) and also implementing practicable steps to achieve and sustain their vision.
Q6.3	How are those involved affected?	The British Government has profited from this franchise, The Virgin Rail Group (management and staff) have profited from this success and the public also enjoy better rail services.

2 – Data Understanding



Data Modeling – Conceptual Model



Data Dictionary

No	Topic	Definition
1	PPM	Public Performance Measure – timing of the trains – If the train is on time, it has a higher measure
2	Self Service	Self Service kiosks allow customers to interact directly with the company in purchasing and printing tickets individually
3	Output Measures	These are train performance and customer satisfaction – basically results from rail travel.
4	Inputs	What goes into running the train line like rail fleet, key contracts and assets
5	Department For Transport	The government entity that monitors and controls some levels of ticket pricing.
6	Yield Management	Virgin uses computer software to determine certain ticket prices to maximize revenue. It uses the pricing to balance train use between peak travel times – like giving a discount to customers who might have to stand on their journey.
7	Actual vs Capacity	Amount of people on the train vs how many people could have been on the train.
8	Customer Satisfaction	The overall satisfaction of a customer's experience
9	Railtrack	The original private owner of rail transport in the UK – formerly publicly owned.
10	Turnover	The total amount of money a business receives as a result of sales from goods and/or services
11	Franchise	Private companies who lease parts of the rail transport in the United Kingdom

Our Scenario

We built a few different tables centered around rail travel.

In the next few slides, we will answer a few business questions with our tables and our visualizations.

Our Questions:

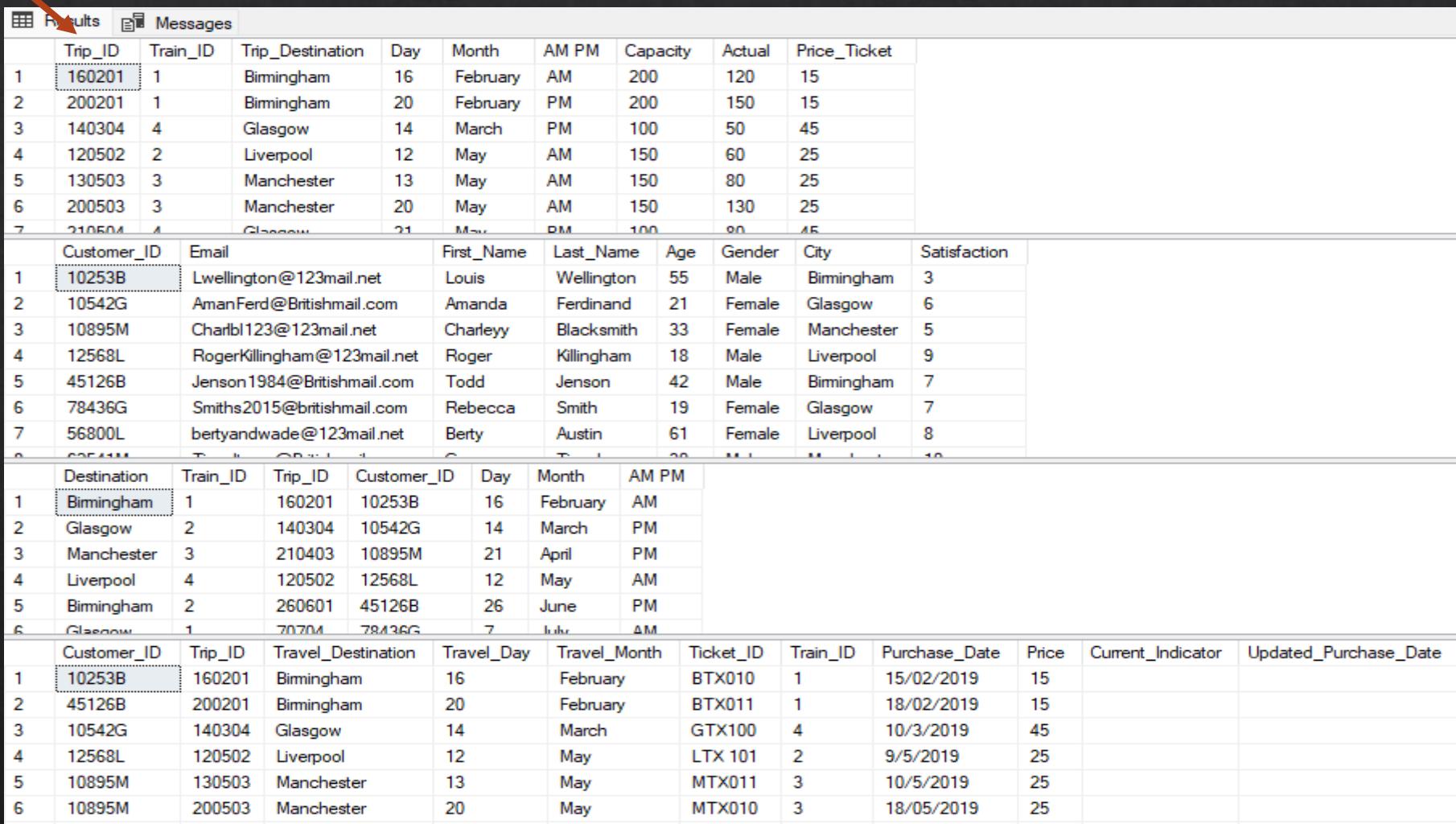
- What trains need to increase capacity? Are there any destinations that are less frequently traveled than others?
- What is the overall satisfaction level of the customer base? Are there any trends to help us make business decisions?
- How can we increase revenue from ticket sales?



Business Key = Trip_ID and Customer_ID

Unique Identifier = Trip_ID

Our Tables



The screenshot shows a SQL Server Management Studio results grid with four tables:

- Trips**: A table with columns Trip_ID, Train_ID, Trip_Destination, Day, Month, AM PM, Capacity, Actual, and Price_Ticket. The first row (Trip_ID 160201) is highlighted with a red arrow pointing to the "Results" tab.
- Customers**: A table with columns Customer_ID, Email, First_Name, Last_Name, Age, Gender, City, and Satisfaction. The first row (Customer_ID 10253B) is highlighted.
- Destinations**: A table with columns Destination, Train_ID, Trip_ID, Customer_ID, Day, Month, and AM PM. The first row (Destination Birmingham) is highlighted.
- Tickets**: A table with columns Customer_ID, Trip_ID, Travel_Destination, Travel_Day, Travel_Month, Ticket_ID, Train_ID, Purchase_Date, Price, Current_Indicator, and Updated_Purchase_Date. The first row (Customer_ID 10253B) is highlighted.

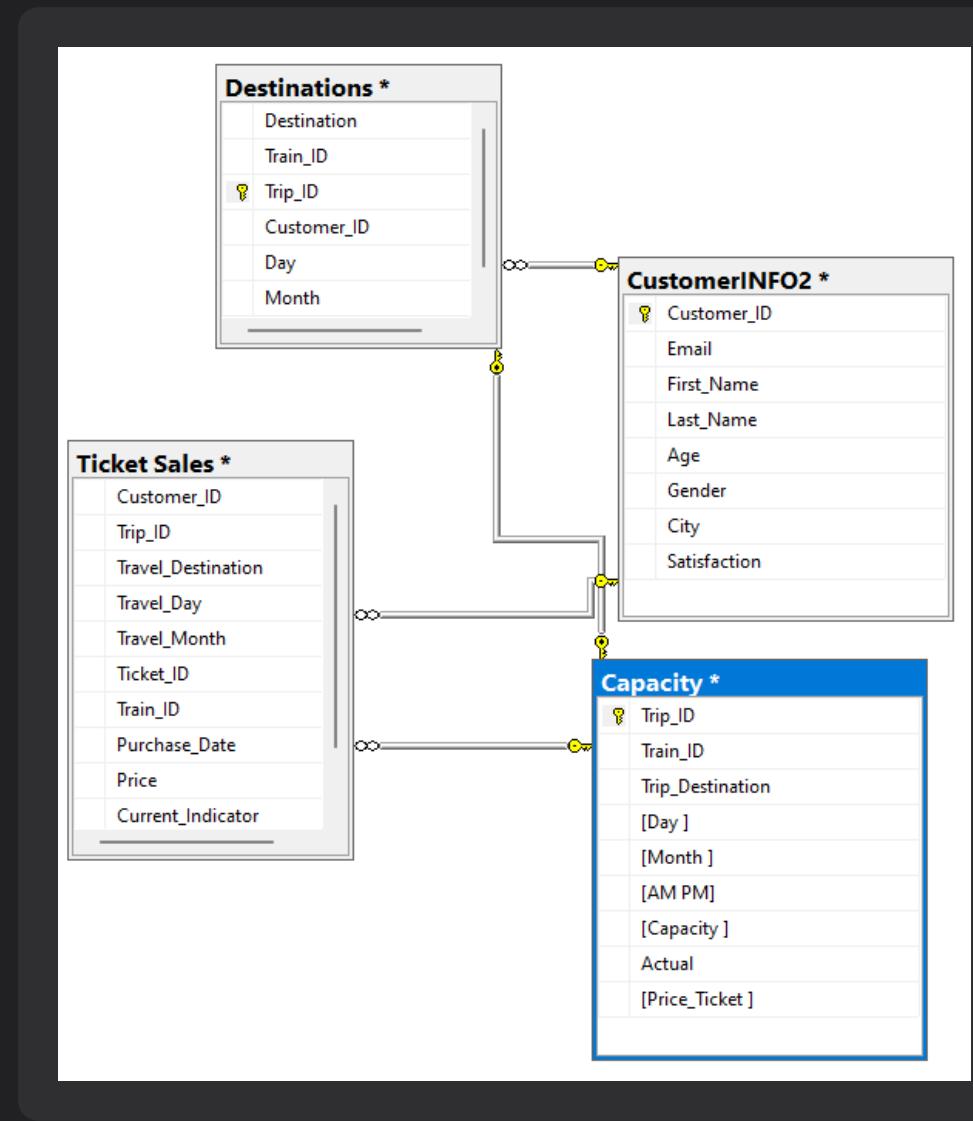
	Trip_ID	Train_ID	Trip_Destination	Day	Month	AM PM	Capacity	Actual	Price_Ticket
1	160201	1	Birmingham	16	February	AM	200	120	15
2	200201	1	Birmingham	20	February	PM	200	150	15
3	140304	4	Glasgow	14	March	PM	100	50	45
4	120502	2	Liverpool	12	May	AM	150	60	25
5	130503	3	Manchester	13	May	AM	150	80	25
6	200503	3	Manchester	20	May	AM	150	130	25
7	210504	4	Glasgow	21	May	PM	100	on	45

	Customer_ID	Email	First_Name	Last_Name	Age	Gender	City	Satisfaction
1	10253B	Lwellington@123mail.net	Louis	Wellington	55	Male	Birmingham	3
2	10542G	AmanFerd@Britishmail.com	Amanda	Ferdinand	21	Female	Glasgow	6
3	10895M	Charlbl123@123mail.net	Charleyy	Blacksmith	33	Female	Manchester	5
4	12568L	RogerKillingham@123mail.net	Roger	Killingham	18	Male	Liverpool	9
5	45126B	Jenson1984@Britishmail.com	Todd	Jenson	42	Male	Birmingham	7
6	78436G	Smiths2015@britishmail.com	Rebecca	Smith	19	Female	Glasgow	7
7	56800L	bertyandwade@123mail.net	Berty	Austin	61	Female	Liverpool	8
8	60541M	TonyT@123mail.net	Tony	Taylor	30	Male	Milan	10

	Destination	Train_ID	Trip_ID	Customer_ID	Day	Month	AM PM
1	Birmingham	1	160201	10253B	16	February	AM
2	Glasgow	2	140304	10542G	14	March	PM
3	Manchester	3	210403	10895M	21	April	PM
4	Liverpool	4	120502	12568L	12	May	AM
5	Birmingham	2	260601	45126B	26	June	PM
6	Glasgow	1	20704	78436G	7	July	AM

	Customer_ID	Trip_ID	Travel_Destination	Travel_Day	Travel_Month	Ticket_ID	Train_ID	Purchase_Date	Price	Current_Indicator	Updated_Purchase_Date
1	10253B	160201	Birmingham	16	February	BTX010	1	15/02/2019	15		
2	45126B	200201	Birmingham	20	February	BTX011	1	18/02/2019	15		
3	10542G	140304	Glasgow	14	March	GTX100	4	10/3/2019	45		
4	12568L	120502	Liverpool	12	May	LTX101	2	9/5/2019	25		
5	10895M	130503	Manchester	13	May	MTX011	3	10/5/2019	25		
6	10895M	200503	Manchester	20	May	MTX010	3	18/05/2019	25		

Database Diagram



SCD – SSIS 4 to 8 changes

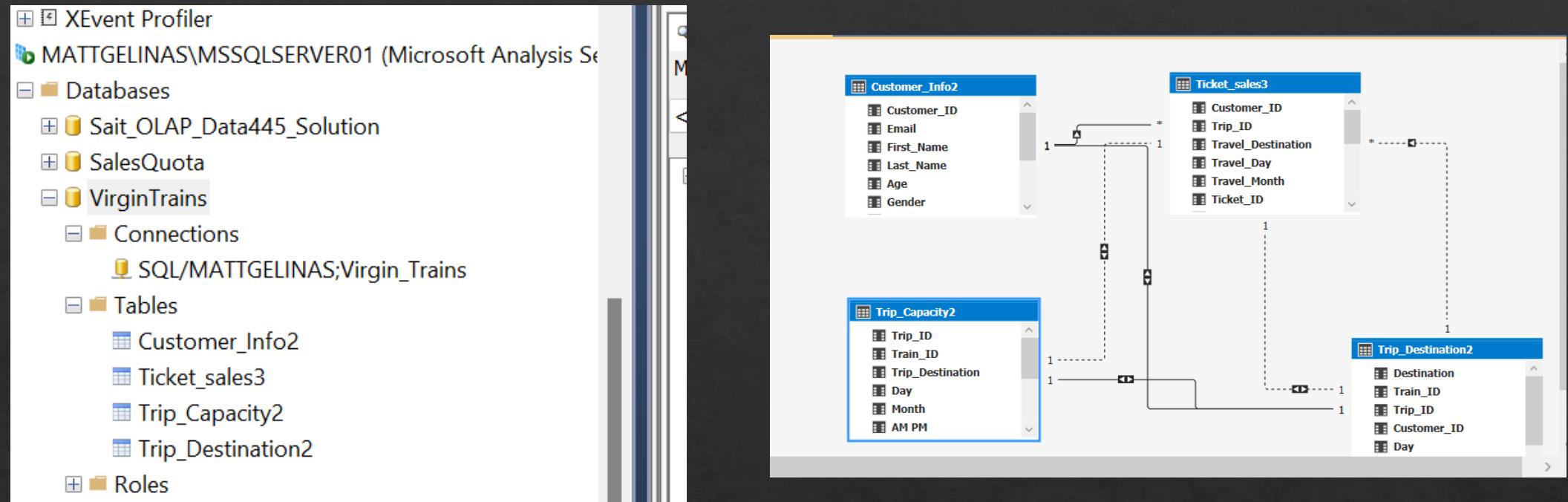
	Customer_ID	Trip_ID	Travel_Destination	Travel_Day	Travel_Month	Ticket_ID	Train_ID	Purchase_Date	Price	Current_Indicator	Updated_Purchase_Date
1	10253B	160201	Birmingham	16	February	BTX010	1	15/02/2019	15	0	..
2	45126B	200201	Birmingham	20	February	BTX011	1	18/02/2019	15	0	..
3	10542G	140304	Glasgow	14	March	GTX100	4	10/3/2019	45	0	..
4	12568L	120502	Liverpool	12	May	LTX 101	2	9/5/2019	25	0	..
5	10895M	130503	Manchester	13	May	MTX011	3	10/5/2019	25	0	..
6	10895M	200503	Manchester	20	May	MTX010	3	18/05/2019	25	0	..
7	32685G	210504	Glasgow	21	May	GTX150	4	19/05/2019	45	0	..
8	45126B	260601	Birmingham	26	June	BTX013	1	20/06/2019	15	0	..
9	97841B	280601	Birmingham	28	June	BTX015	1	25/06/2019	15	0	..
10	62541M	10703	Manchester	1	July	MTX018	3	26/06/2019	25	0	..
11	78436G	70704	Glasgow	7	July	GTX105	4	1/7/2019	45	0	..
12	62541M	150703	Manchester	15	July	MTX012	3	10/7/2019	25	0	..
13	56800L	280802	Liverpool	28	August	LTX 102	2	25/08/2019	25	0	..
14	0					0	0	0	0	0	..
15	62541M	150703	Manchester	15	July	MTX541	3	10/07/2019	15	0	NULL
16	62541M	150703	Manchester	15	July	MTX541	3	10/07/2019	15	1	NULL
17	78436G	707701	Birmingham	8	July	BTX436	1	02/07/2019	10	0	NULL
18	78436G	808080	Manchester	8	July	MTX784	3	01/07/2019	15	1	NULL
19	10542G	245013	Glasgow	15	March	GTX054	4	14/03/2019	40	0	NULL
20	10542G	560700	Glasgow	20	March	GTX5102	4	19/03/2019	40	1	NULL
21	45126B	560700	Liverpool	22	March	LTX5607	2	19/03/2019	20	0	NULL
22	45126B	445401	Liverpool	24	March	LTX4451	2	21/03/2019	15	1	NULL

Query executed successfully.

	Customer_ID	Trip_ID	Travel_Destination	Travel_Day	Travel_Month	Ticket_ID	Train_ID	Purchase_Date	Price	Current_Indicator	DateUpdate
1	45126B	445401	Liverpool	24	March	LTX4451	2	21/03/2019	15	1	NULL

	Customer_ID	Trip_ID	Travel_Destination	Travel_Day	Travel_Month	Ticket_ID	Train_ID	Purchase_Date	Price	Current_Indicator	Updated_Purchase_Date
11	78436G	70704	Glasgow	7	July	GTX105	4	1/7/2019	45	0	..
12	62541M	150703	Manchester	15	July	MTX012	3	10/7/2019	25	0	..
13	56800L	280802	Liverpool	28	August	LTX 102	2	25/08/2019	25	0	..
14	0					0	0	0	0	0	..
15	62541M	150703	Manchester	15	July	MTX541	3	10/07/2019	15	0	NULL
16	62541M	150703	Manchester	15	July	MTX541	3	10/07/2019	15	1	NULL
17	78436G	707701	Birmingham	8	July	BTX436	1	02/07/2019	10	0	NULL
18	78436G	808080	Manchester	8	July	MTX784	3	01/07/2019	15	1	NULL
19	10542G	245013	Glasgow	15	March	GTX054	4	14/03/2019	40	0	NULL
20	10542G	560700	Glasgow	20	March	GTX5102	4	19/03/2019	40	1	NULL
21	45126B	560700	Liverpool	22	March	LTX5607	2	19/03/2019	20	0	NULL
22	45126B	445401	Liverpool	24	March	LTX4451	2	21/03/2019	15	1	NULL

Query executed successfully.



Cube

Measures

Model [Browse] SQLQuery14.sql - MA...in_Trains (sa (51))*

Language: Default

Edit as Text Import... MDX

Model Metadata Search Model Measure Group: <All>

Measures

- Customer_Info2
 - Average of Age
 - Average of Satisfaction
- Ticket_sales3
 - Count of Train_ID
 - Maximum of Price
 - Minimum of Price
- Trip_Capacity2
 - Sum of Actual
 - Sum of Capacity

KDTc

Calculated Members

Dimension	Hierarchy	Operator
<Select dimension>		

Drag levels or measure

The screenshot shows the SSMS Model Browser interface. The left pane displays the hierarchy of measures, grouped by measure group. The right pane provides a visual editor for creating calculated members, with fields for Dimension, Hierarchy, and Operator.

Row Labels		Average of Satisfaction
Female		5.6
Male		7.4
Grand Total		6.5

A	B	C
Row Labels	Sum of Actual	Sum of Capacity
Birmingham		
February	270	400
June	245	400
Glasgow		
July	20	100
March	50	100
May	80	100
Liverpool		
August	120	150
May	60	150
Manchester		
July	150	300
May	210	300
Grand Total	1205	2000

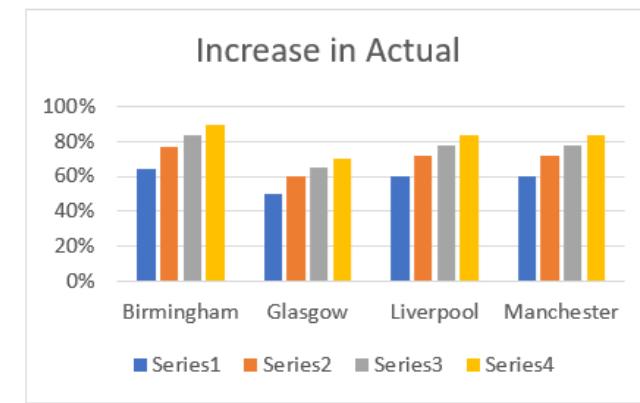
Row Labels		Average of Satisfaction	Average of Age
AM		6.75	38.25
PM		6.5	31.5
		6.25	34
Grand Total		6.5	35.2

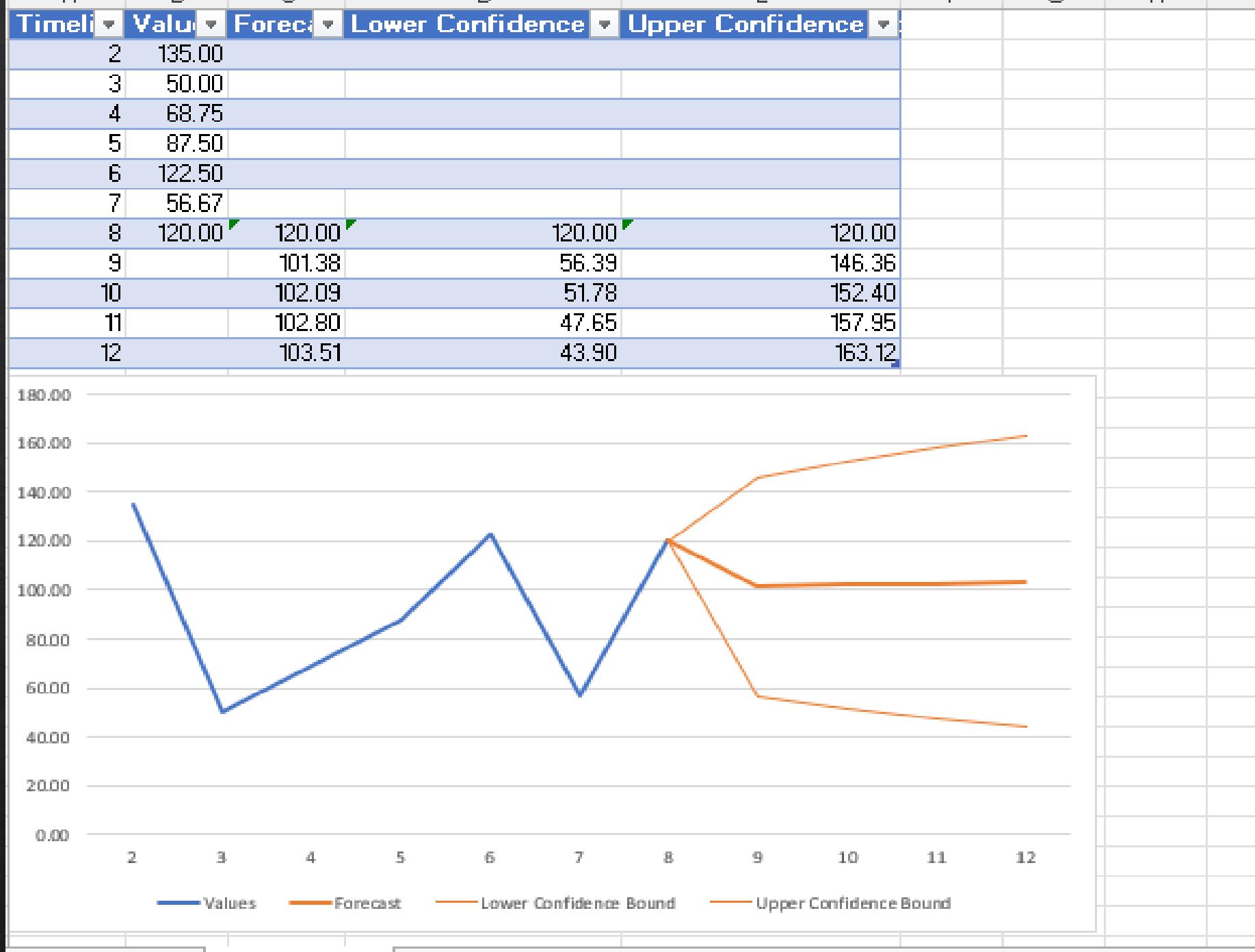
Row Labels		Average of Age	Average of Satisfaction
Amanda		21	6
Berty		61	8
Charleyy		33	5
Edna		48	2
Greg		30	10
Jonathan		25	8
Louis		55	3
Rebecca		19	7
Roger		18	9
Todd		42	7
Grand Total		35.2	6.5

	Original	Increase20	Increase30	Increase40
Changing Cells:				
BirminghamActual	515	618	669.5	721
GlasgowActual	150	180	195	210
LiverpoolActual	180	216	234	252
ManchesterActual	360	432	468	504
BirminghamCapacity	800	800	800	800
GlasgowCapacity	300	300	300	300
LiverpoolCapacity	300	300	300	300
ManchesterCapacity	600	600	600	600
Increase1	1	1	1	1
Increase2	1.2	1.2	1.2	1.2
Increase3	1.3	1.3	1.3	1.3
Increase4	1.4	1.4	1.4	1.4

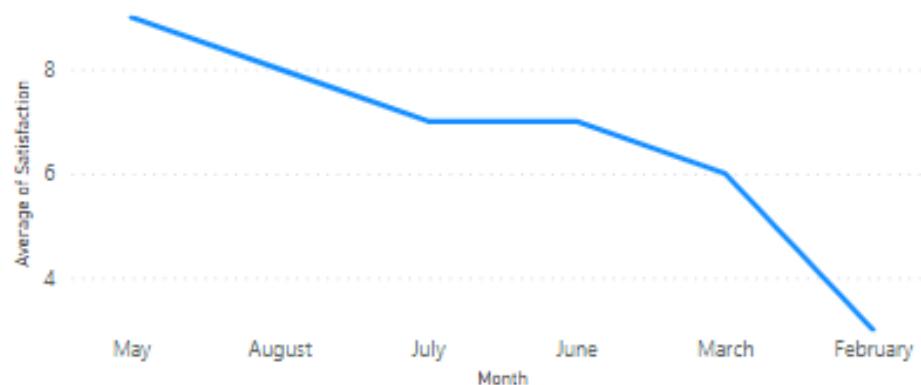
Notes: Current Values column represents values of changing cells at time Scenario Summary Report was created. Changing cells for each scenario are highlighted in gray.

City	Original	Increase20	Increase30	Increase40
Birmingham	64%	77%	84%	90%
Glasgow	50%	60%	65%	70%
Liverpool	60%	72%	78%	84%
Manchester	60%	72%	78%	84%
Totals	59%	70%	76%	82%

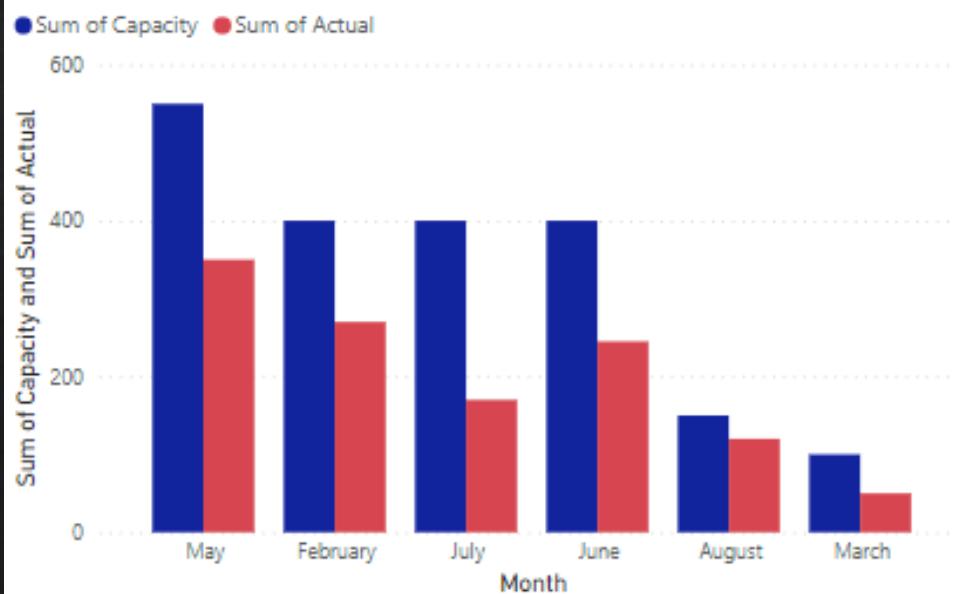




Average of Satisfaction by Month



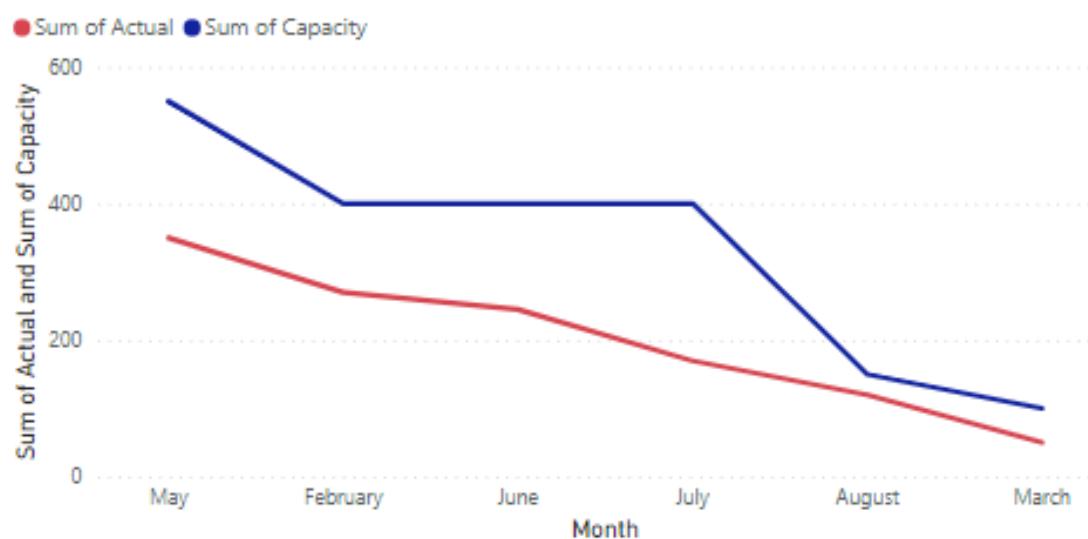
Sum of Capacity and Sum of Actual by Month



Sum of Actual and Sum of Capacity by Trip_Destination



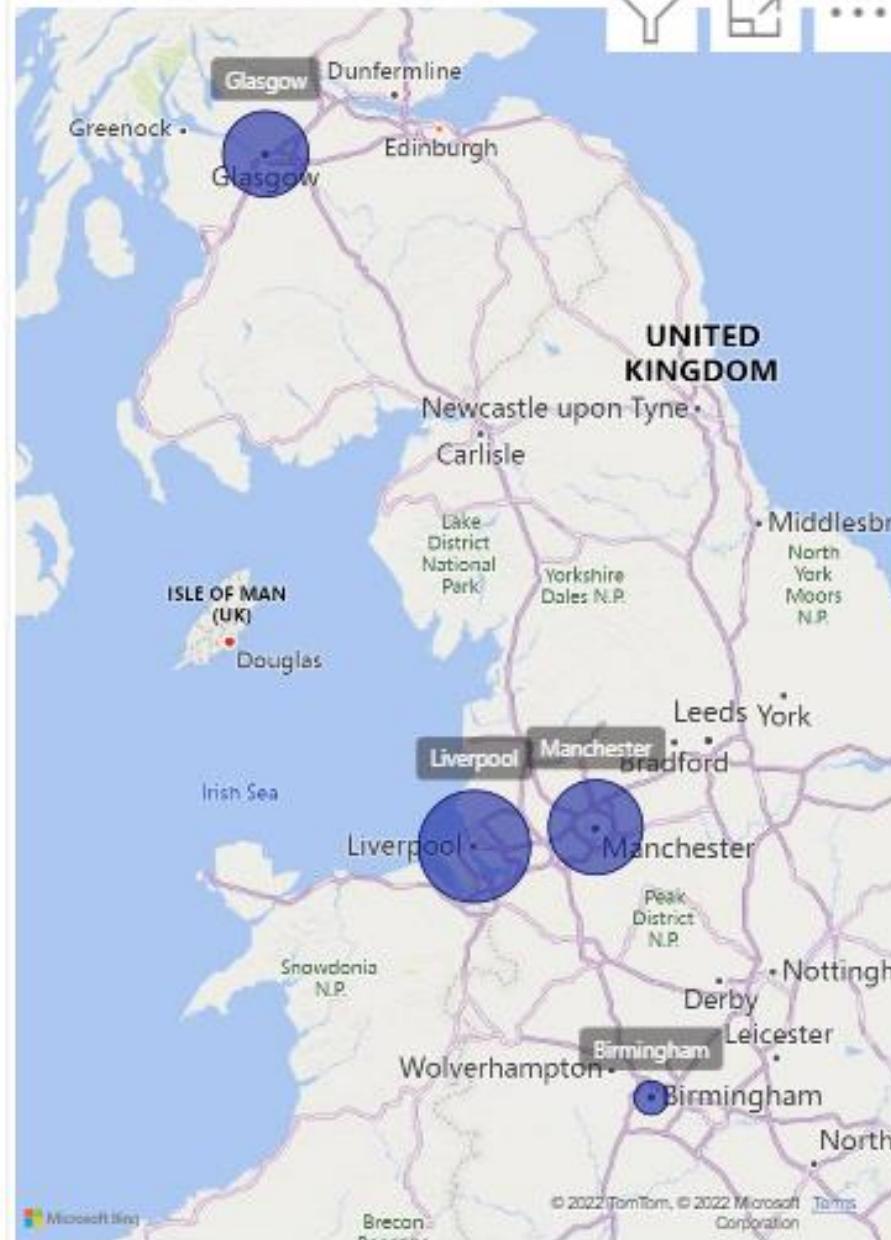
Sum of Actual and Sum of Capacity by Month



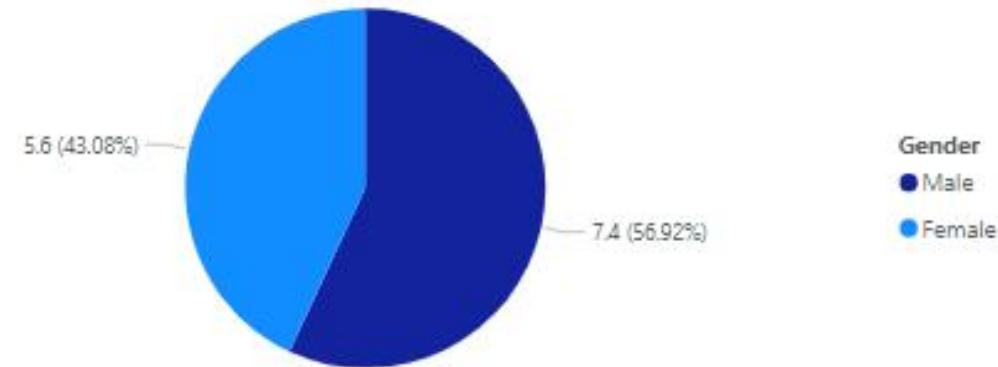
Actual/Capacity by City



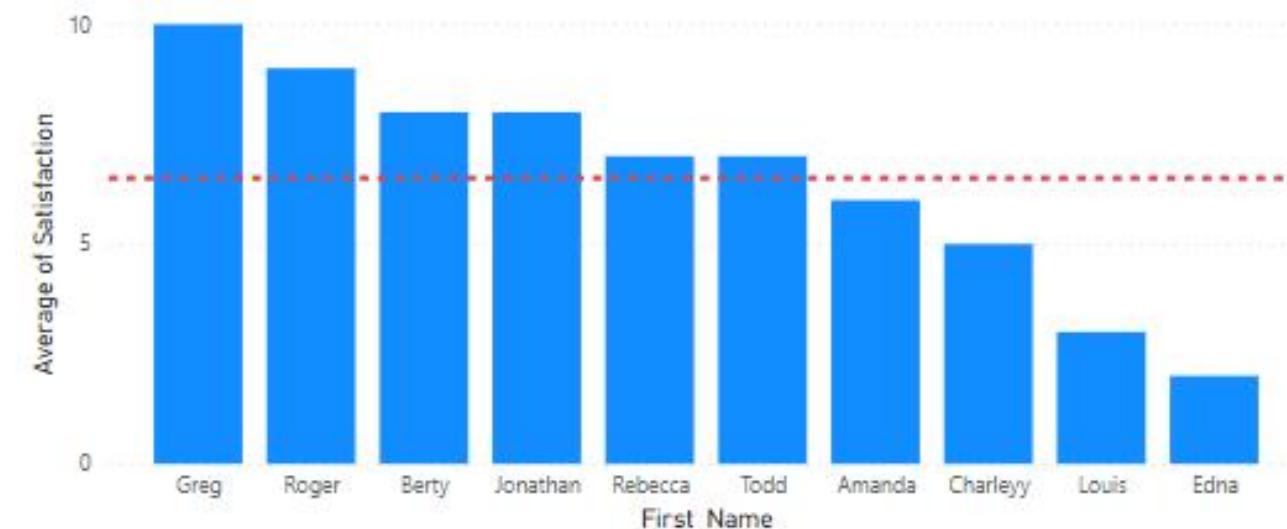
Average of Satisfaction by City



Average of Satisfaction by Gender



Average of Satisfaction by First_Name



Question 1

What trains are in need of an increase in capacity? Are there any destinations that are less frequent than others?

All trains are averaging about 59% capacity. With the lowest being the rail to Glasgow. This is also the most expensive ticket at \$45 but also has the longest rail time. Virgin Trains should potentially look at cutting back on the ticket price to attract more people to ride the train. With the overall actual capacity of the trains being relatively low a marketing campaign or promotion should be put in place to help attract attention and potentially boost revenues.

Question 2

What is the overall satisfaction level of the customer base? Are there any trends to help us make business decisions?

Overall customer satisfaction is currently at 6.5 out of 10. Which is sitting above average but still has room to improve. When breaking down the number it looks like males are overall more satisfied with the service being their average score is 7.4 out of 10. While on the other side women's overall satisfaction 5.6 out of 10. Virgin needs to do more digging to find the reason women are less satisfied than men. Virgin will need to improve this issue with women to improve the average rating.

We can also see from the city's the customers live and their average satisfaction rating. It looks like the customers living in Liverpool are the highest satisfied customer base. While Birmingham is significantly lower with an overall satisfaction level of 4. This is the train with the largest capacity, Virgin needs to dial in on this specific area to find the issue then improve it moving forward, allowing for more revenue growth.

Question 3

*How can we
increase revenue
from ticket sales?*

At this time increasing revenues will be difficult as due to the current actual capacity compared to overall capacity, which is significantly low. This makes increasing ticket price out of the question. Virgin needs to look at different marketing campaigns or deals to help entice more customers to use their service. They will also have to get to the bottom of their low customer satisfaction levels specifically with women and people from Birmingham.

A Virgin Pendolino train, featuring a red, white, and yellow livery, is shown from a low angle, moving along a curved railway track through a lush green landscape. The train's distinctive red front and silver body are clearly visible. In the background, there are rolling hills, a small town, and wind turbines on a hillside.

The End

Thank you