SRI LANKA INSTITUE OF INFORMATION TECHNOLOGY (SLIIT)

IT3021 – DATA WAREHOUSE AND BUSINESS INTELLIGENCE

ASSIGNMENT – 02

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Table of Contents

Figures of Contents

1. Data Source

The data source used for the analysis purpose is '**CreditCardAnalysis_DW**,' which was developed in the **assignment 1**. This data warehouse was created based on a data set from a bank in Czech Republic to mine and analyze this bank data in order to extrapolate from it the type of customer who makes a good candidate for a credit card. The data set has been modified to develop a scenario that meets the requirement of the assignment. Its features allow viewing a transaction from multiple dimensions, from Accounts, Date, Permanent Order, Client, Loan, District and Disposition.

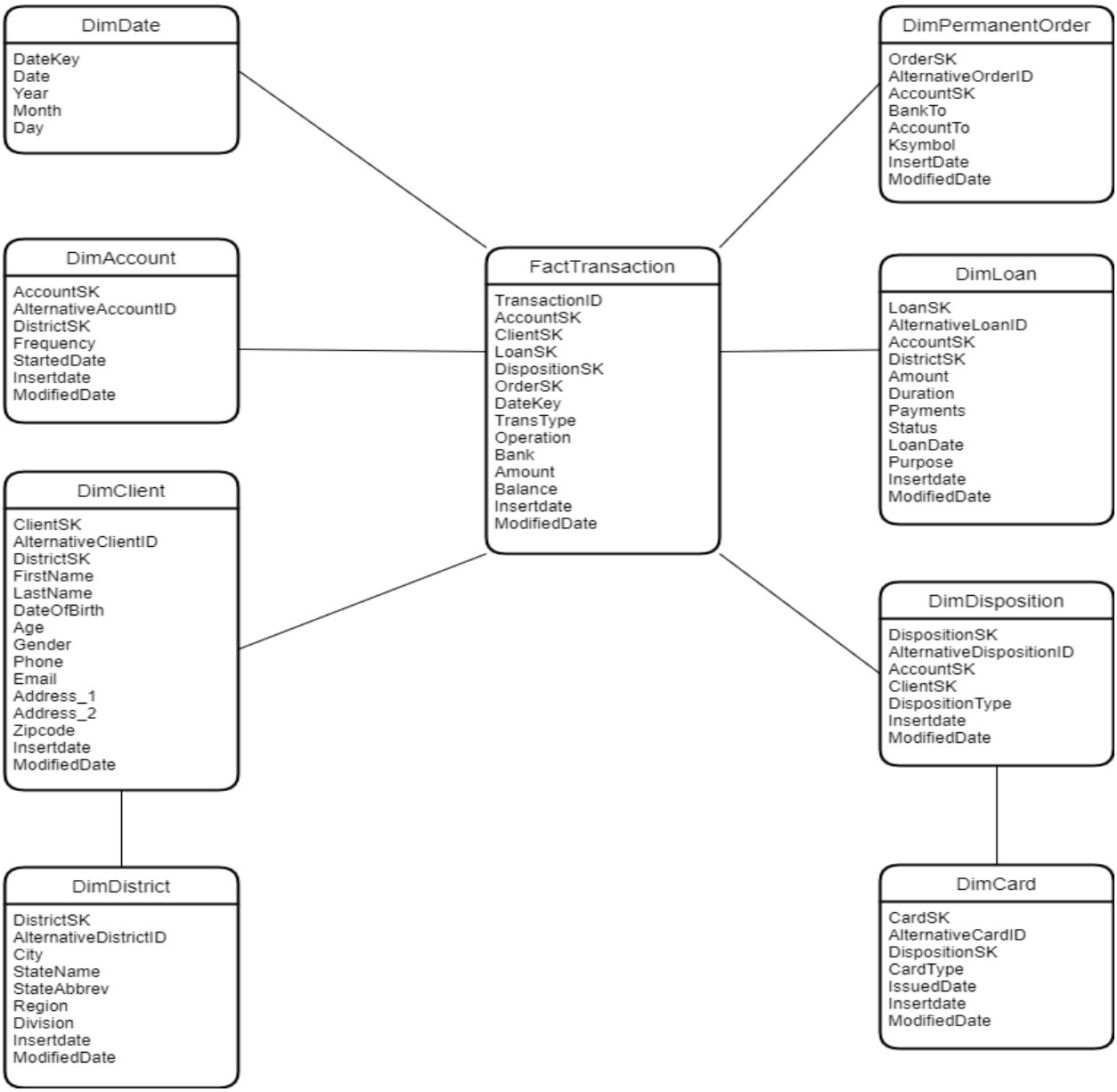


Figure 1. Snowflake Schema for Data Warehouse

The Data Warehouse design was implemented using the **Snowflake Schema**. Snowflake Schema is an extension of **Star Schema** and consists of some dimensions that are normalized. According to the schema above, there are **8 Dimensions** and **1 Fact table**.

Assumption:
Client Dimension is considered as a **Slowly Changing Dimension (SCD)**

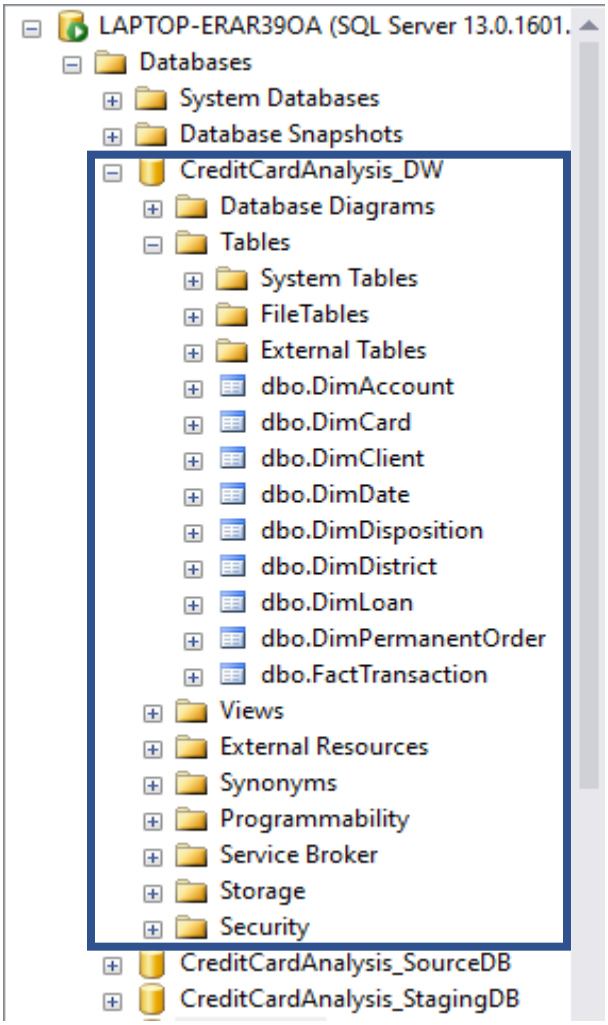


Figure 2. Data Warehouse Snapshot

Dimension Tables:

01. DimAccount
02. DimCard
03. DimClient
04. DimDate
05. DimDisposition
06. DimDistrict
07. DimPermanentOrder
08. DimLoan

Fact Table:

01. FactTransaction

2. SSAS Cube Implementation

OLAP Cube is a method for storing data in Multidimensional Forms. It will allow to analyze a multidimensional data from multiple perspectives. The advantage of using a cube is that it pre-calculates most of the queries, that is time consuming to execute over relational tables that contains joins and aggregates. The main components of the cube are:

1. **Dimensions**: Define the structure of the cube that is used for OLAP operations.
2. **Measures**: Provide aggregated numeric values of interest to the end user.

2.1. Cube Creation

- ✓ As the first step an analysis service project in the name '**CreditCardAnalysis_SSAS**' was created was the data source was configured in order to extract data to the cube.
- ✓ A data source view '**DSV_CreditCardAnalysis**' was created and all necessary table links were created.
- ✓ A cube named '**CreditCardAnalysis_Cube**' was created, by selecting the necessary measures. Then necessary attributes and hierarchies were added before the deployment of the cube.

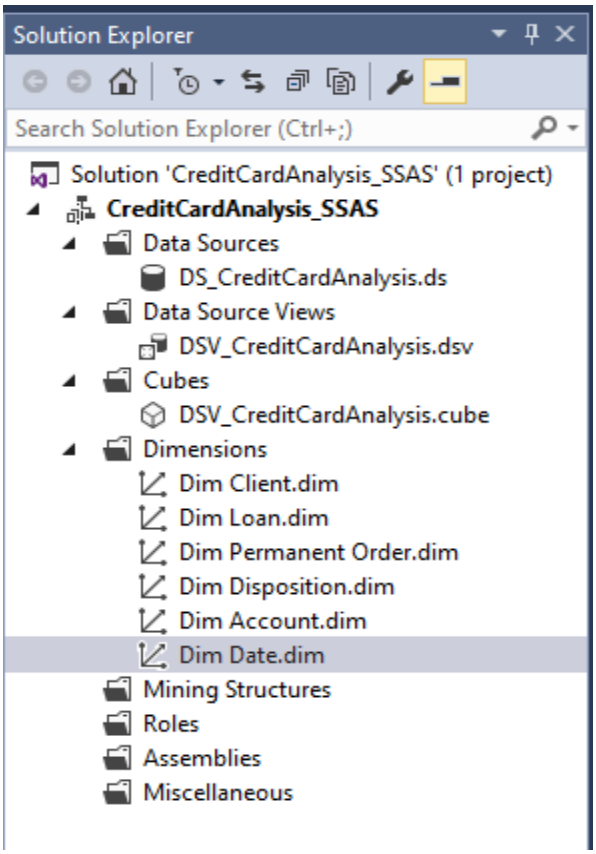


Figure 3. Cube Creation Solution Explorer

2.2. Data Source View

- It represents the cube structure, measures, and dimensions.

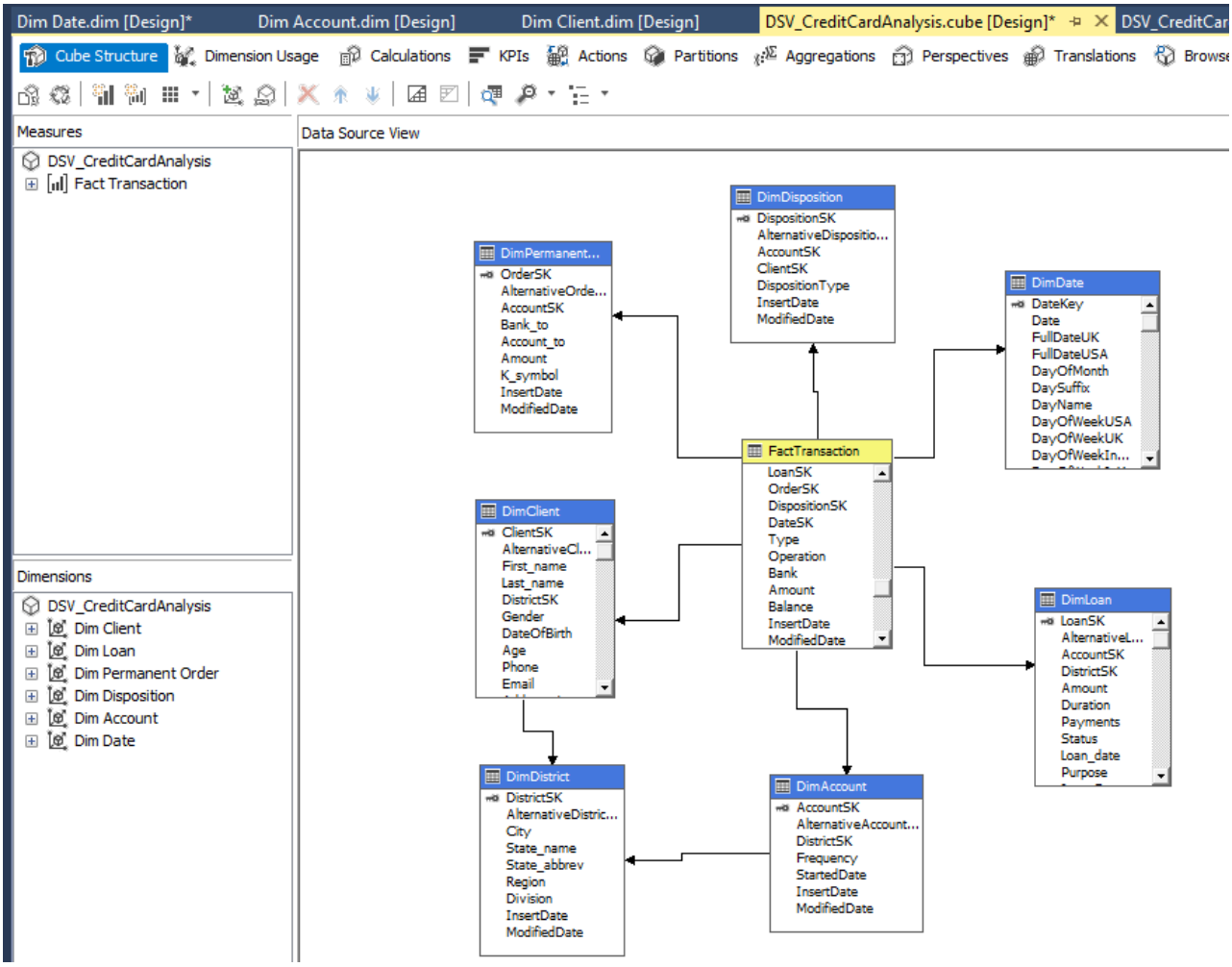


Figure 4. Cube Structure

2.3. Hierarchies

- **Hierarchies** are a useful tool in SSAS to reduce complexity between attributes and guide users into a certain drill-down behavior.

2.3.1. Location Hierarchy

- The higher level is the **Region**, which contains multiple **State**, and the States contain multiple **Cities**

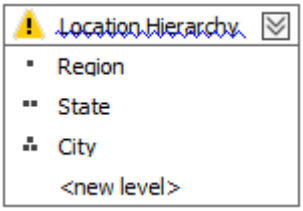


Figure 5. Location Hierarchy

2.3.2. Date Hierarchy

- The higher level is the **Year**, which then is followed by the lower levels **Quarter**, **Month**, and **Date**.

Figure 6. Date Hierarchy

2.4. KPI Values

In **SQL Server Analysis Services**(SSAS), add **Key Performance Indicators** (KPIs) can be added to our database cube in order to evaluate business performance, as reflected in the cube data. A KPI is associated with a measure group and is made up of a set of calculations. Typically, the calculations are a combination of calculated members and Multidimensional Expressions (MDX) statements.

Relevant KPI's used:

1. **KPI Amount**: Total amounts

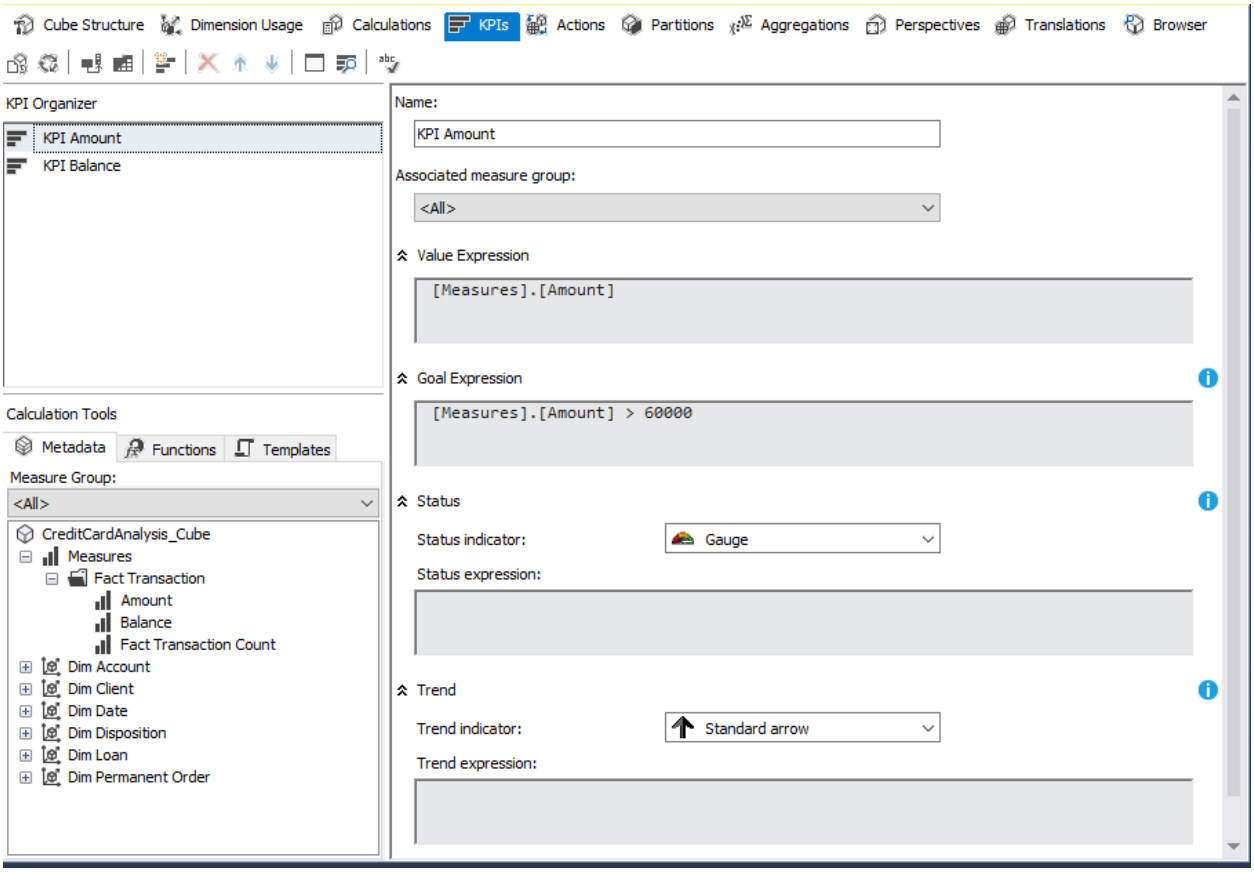


Figure 7. KPI Measure Amount

2. **KPI Balance**: Total balances

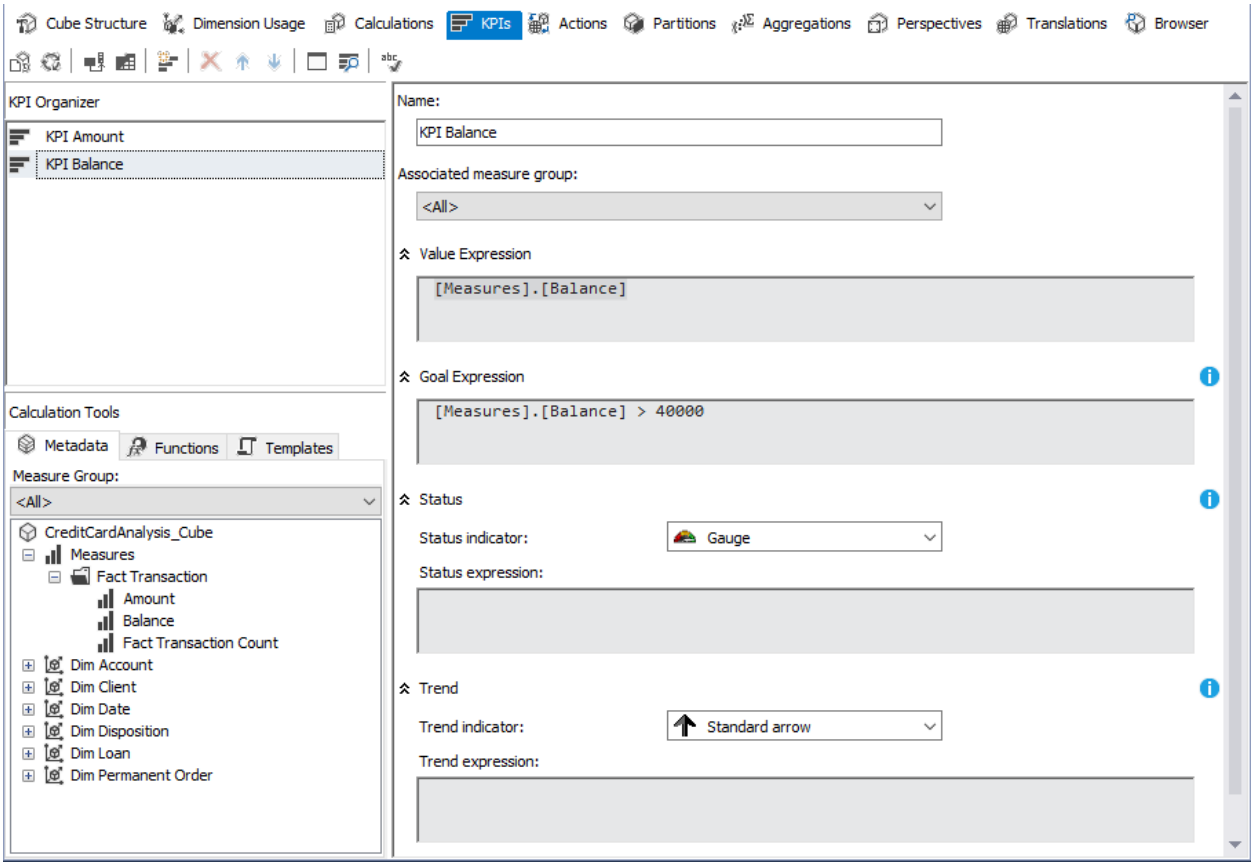


Figure 8. KPI Measure Balance

2.5. Cube Deployment

- After setting all attributes, hierarchies and KPI's, finally the cube was deployed.

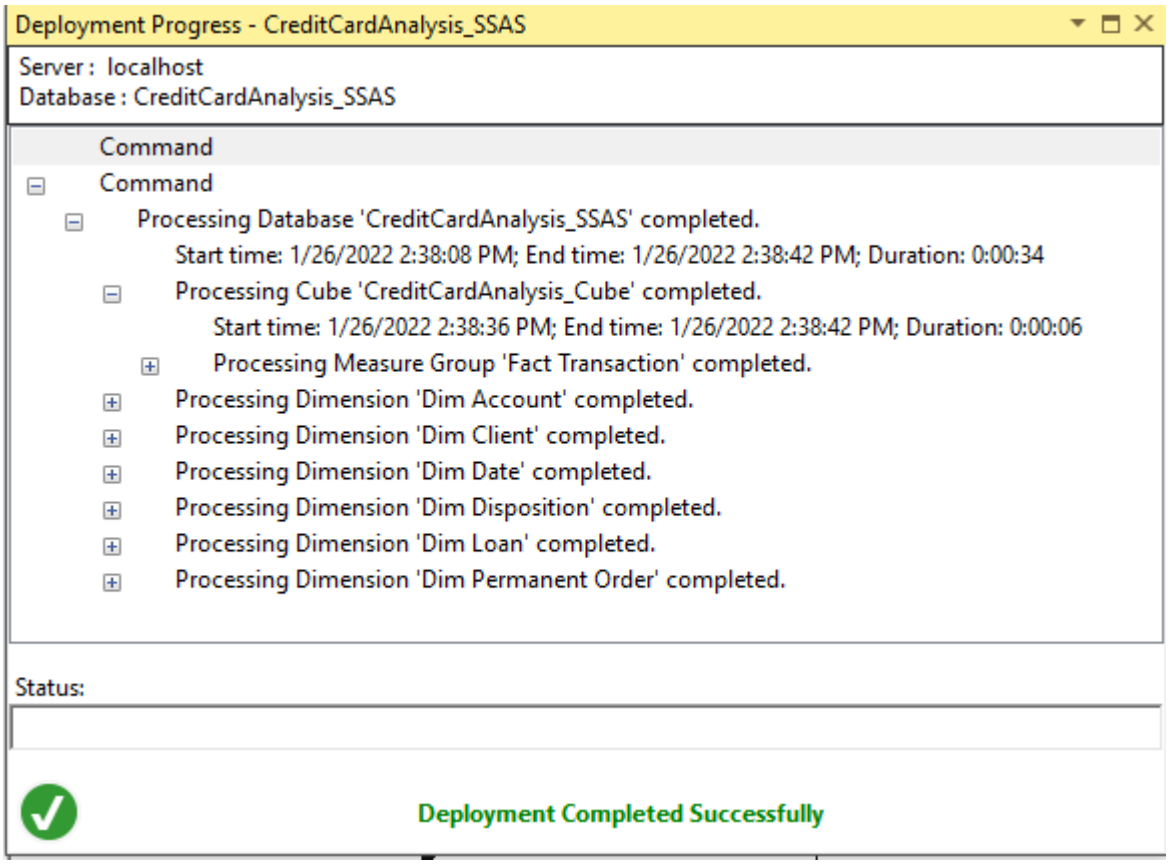


Figure 9. Cube Deployment Successfully

3. Demonstration of OLAP Operations

✓ **OLAP** operation is an important part of **Business Intelligence**, that provides powerful capabilities for data mining and trend analysis. They are capable of solving problems in both business and IT departments. OLAP helps to analyze big data amounts from different perspectives rapidly.

✓ **MDX** query can be used to connect to the excel workbooks to get data to the semantic layer for respective demonstrations. This method needs to build up MDX query through SSAS project by browsing data. The same can be done using 'data' tab in excel. This will enable the connection with the whole set of facts and dimension tables. For the assignment purpose, the second approach of connecting to the entire data set was used.

- Five analytical operations can be performed using OLAP:
    1. Roll-up
    2. Drill-down
    3. Slice
    4. Dice
    5. Pivot

3.1. Roll-up

- **Roll-up** is also known as 'consolidation' and 'aggregation,' which can be performed in two ways:
    1. Reducing dimensions
    2. Climbing up a dimension hierarchy

3.2. Drill-down

- **Drill-down** is the opposite of roll-up. It means to step down a hierarchy, which will enable navigation through details of a dimension. This operation fragments data into smaller parts. It can be done via:
    1. Moving down a hierarchy
    2. Increasing the dimension.

Report 1:

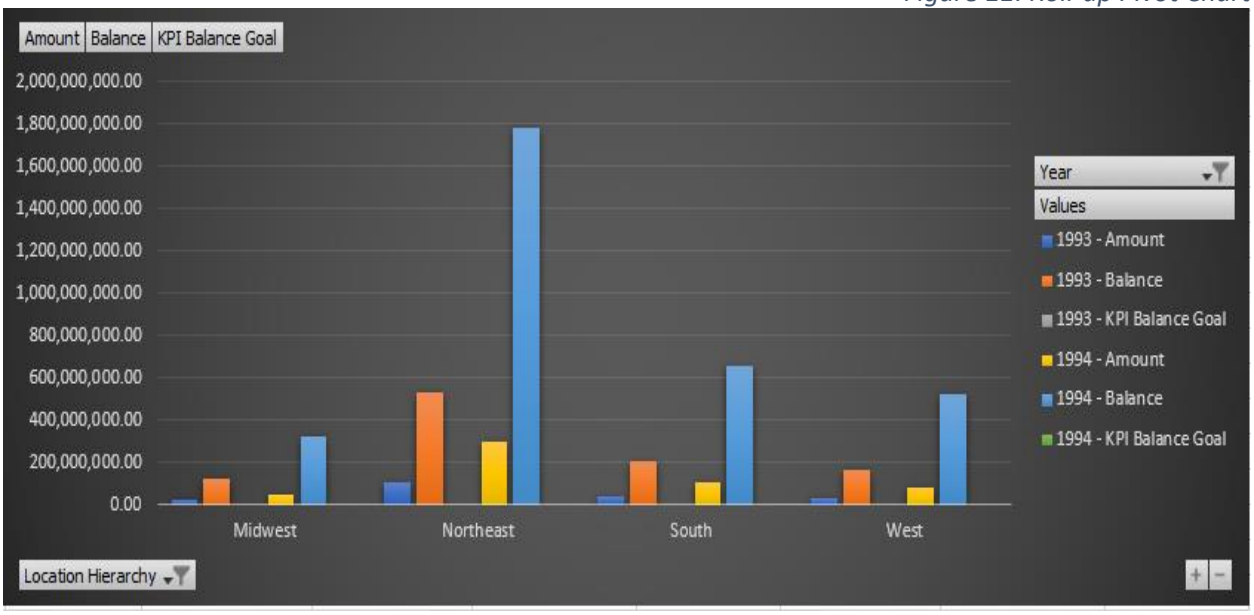
✓ **Total loan Amounts** and **Balances** based on **Roll-ups** and **Drill-down** of **Region** and **State**. The report displays the **Total Loan Amount**, **Total Account Balances**, and the achievement of the **KPI goal** for each **Year**, based on the **Roll-ups** and **Drill-downs** of **Regions**, **State** and **Cities**.

Roll-Up (States rolled-up to Regions)

Figure 10. Roll-up Pivot Table

	Years								
	1993			1994			Total Amount	Total Balance	Total KPI Balance Goal
Regions	Amount	Balance	KPI Balance Goal	Amount	Balance	KPI Balance Goal			
⊞Midwest	24,581,891.00	118,576,298.00	TRUE	51,102,626.00	320,581,016.00	TRUE	75,684,517.00	439,157,314.00	TRUE
⊞Northeast	105,657,661.00	534,156,735.00	TRUE	296,526,287.00	1,780,365,104.00	TRUE	402,183,948.00	2,314,521,839.00	TRUE
⊞South	40,481,900.00	203,079,942.00	TRUE	106,696,317.00	653,396,403.00	TRUE	147,178,217.00	856,476,345.00	TRUE
⊞West	33,582,639.00	167,063,383.00	TRUE	84,450,366.00	524,273,485.00	TRUE	118,033,005.00	691,336,868.00	TRUE
Grand Total	204,304,091.00	1,022,876,358.00	TRUE	538,775,596.00	3,278,616,008.00	TRUE	743,079,687.00	4,301,492,366.00	TRUE

Figure 11. Roll-up Pivot Chart



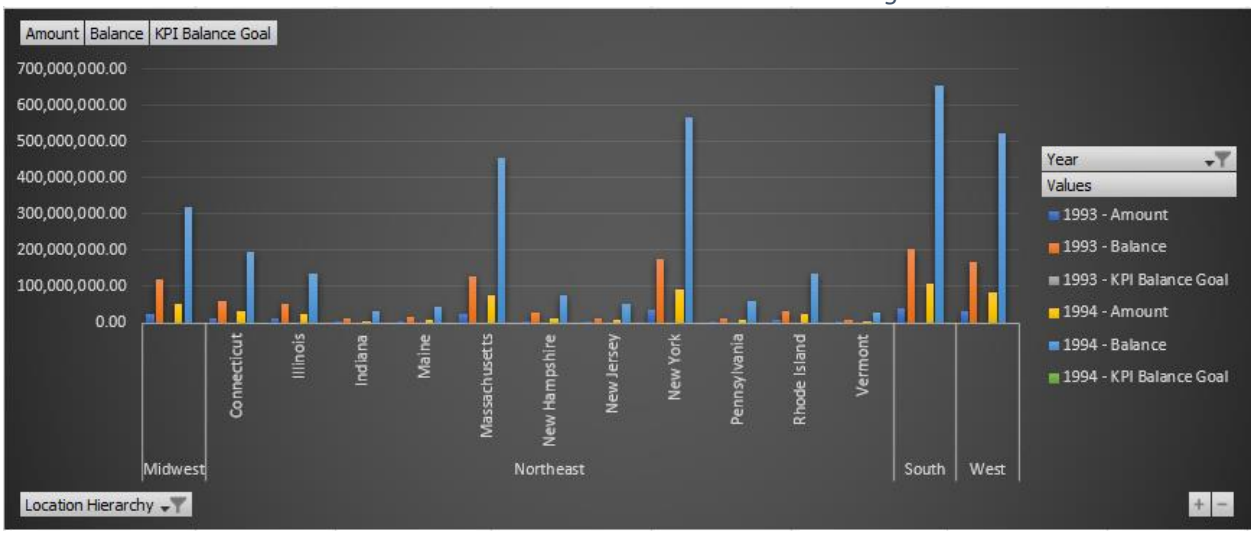
- The **Pivot table** and the **Pivot chart** show the **Total Loan Amounts** and the **Balances** for all the rolled-up **Regions**, according to each **Year**.

Drill-down(Regions have been drilled down to States)

Figure 12. Drill-down Pivot table

	Years								
	1993			1994			Total Amount	Total Balance	Total KPI Balance Goal
Regions	Amount	Balance	KPI Balance Goal	Amount	Balance	KPI Balance Goal			
⊞Midwest	24,581,891.00	118,576,298.00	TRUE	51,102,626.00	320,581,016.00	TRUE	75,684,517.00	439,157,314.00	TRUE
⊟Northeast									
⊞Connecticut	11,938,207.00	59,352,429.00	TRUE	30,964,216.00	196,540,777.00	TRUE	42,902,423.00	255,893,206.00	TRUE
⊞Illinois	10,781,933.00	52,241,543.00	TRUE	24,308,932.00	137,020,403.00	TRUE	35,090,865.00	189,261,946.00	TRUE
⊞Indiana	2,661,029.00	12,454,097.00	TRUE	5,942,221.00	33,584,315.00	TRUE	8,603,250.00	46,038,412.00	TRUE
⊞Maine	3,314,178.00	14,756,464.00	TRUE	7,369,360.00	42,690,393.00	TRUE	10,683,538.00	57,446,857.00	TRUE
⊞Massachusetts	24,682,716.00	129,346,650.00	TRUE	76,038,822.00	455,854,425.00	TRUE	100,721,538.00	585,201,075.00	TRUE
⊞New Hampshire	4,789,835.00	26,288,423.00	TRUE	12,575,488.00	76,609,810.00	TRUE	17,365,323.00	102,898,233.00	TRUE
⊞New Jersey	2,128,282.00	10,174,750.00	TRUE	9,741,824.00	50,232,683.00	TRUE	11,870,106.00	60,407,433.00	TRUE
⊞New York	34,864,710.00	175,990,356.00	TRUE	92,504,207.00	565,314,715.00	TRUE	127,368,917.00	741,305,071.00	TRUE
⊞Pennsylvania	1,779,093.00	12,223,435.00	TRUE	9,318,317.00	61,073,421.00	TRUE	11,097,410.00	73,296,856.00	TRUE
⊞Rhode Island	6,365,680.00	31,768,942.00	TRUE	22,890,022.00	133,808,876.00	TRUE	29,255,702.00	165,577,818.00	TRUE
⊞Vermont	2,351,998.00	9,559,646.00	TRUE	4,872,878.00	27,635,286.00	TRUE	7,224,876.00	37,194,932.00	TRUE
⊞South	40,481,900.00	203,079,942.00	TRUE	106,696,317.00	653,396,403.00	TRUE	147,178,217.00	856,476,345.00	TRUE
⊞West	33,582,639.00	167,063,383.00	TRUE	84,450,366.00	524,273,485.00	TRUE	118,033,005.00	691,336,868.00	TRUE
Grand Total	204,304,091.00	1,022,876,358.00	TRUE	538,775,596.00	3,278,616,008.00	TRUE	743,079,687.00	4,301,492,366.00	TRUE

Figure 13. Drill-down Pivot Chart



- The **Pivot table** and **Pivot chart** represent the **Total Loan Amounts** and **Balances** for the **drilled downed** States of the Region '**Northeast**,' for each year.

3.3. Slice

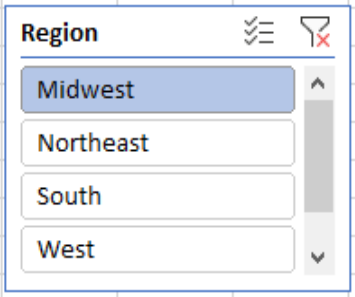
- **Slice** create a rectangular subset of the cube, by selecting a single value for one of its dimensions. A slice function is much like a report or a query that it returns data based on a request for what to see.

Report:

- ✓ **Total Loan Amounts, Balances, Number of Transactions** and the **KPI goals** based on **Regions** and the **Banks**. The report represents the **Total Loan Amounts, Balances**, **Number of Transactions**, and the achievement of the **KPI goals** based on a selected **Region** and the **Banks** belonging to the **Region**.

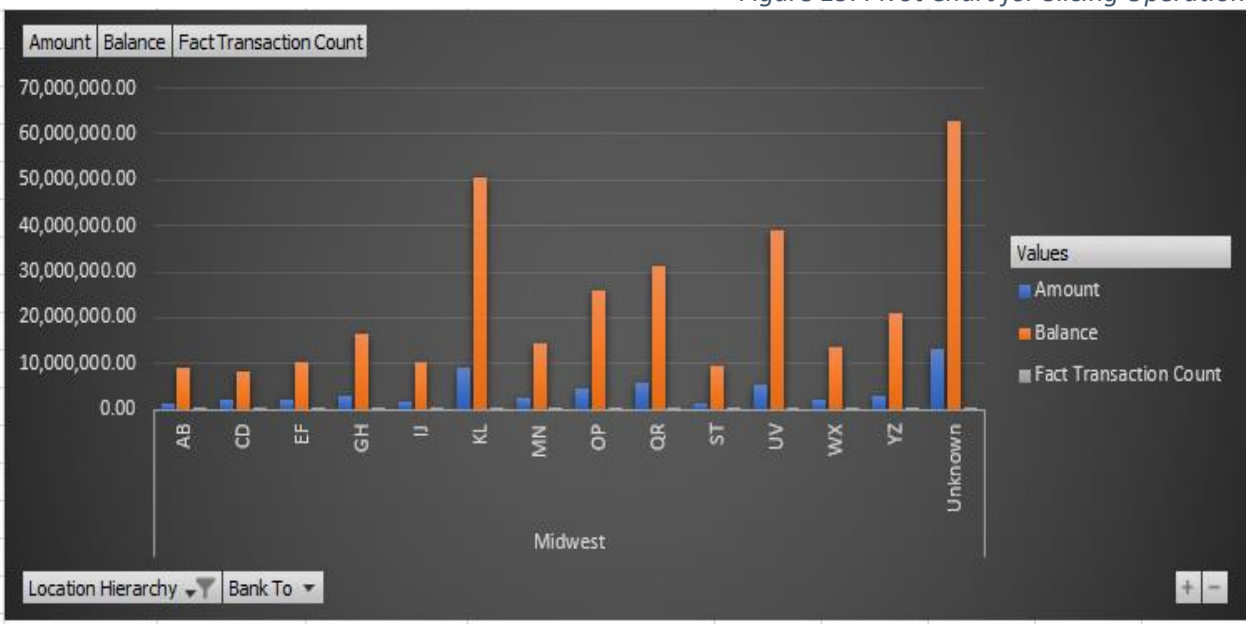
Figure 14. Pivot Table and Slicer

Row Labels	Amount	Balance	Fact Transaction Count
⊞ **Midwest**			
AB	1,311,488.00	9,105,016.00	254
CD	2,021,296.00	8,220,776.00	212
EF	1,939,737.00	10,342,169.00	325
GH	2,758,715.00	16,628,196.00	494
IJ	1,493,993.00	10,315,339.00	321
KL	8,907,214.00	50,689,282.00	1,358
MN	2,581,251.00	14,218,196.00	472
OP	4,709,527.00	25,804,172.00	650
QR	5,750,939.00	31,397,368.00	783
ST	1,079,450.00	9,659,781.00	371
UV	5,519,441.00	38,873,301.00	996
WX	2,065,907.00	13,658,805.00	503
YZ	3,098,805.00	20,923,793.00	653
Unknown	13,020,351.00	62,812,568.00	1,474
Grand Total	56,258,114.00	322,648,762.00	8,866



- ❖ The **Pivot table** displays **Bank** wise **Total Loan Amounts**, **Balances**, and the **Number of Transactions**, based on the **slicing** of Region **'Midwest'**

Figure 15. Pivot Chart for Slicing Operation



- The **Pivot chart** displays the **Bank** wise **Total Loan Amounts, Balances**, and the **Number of Transactions,** based on the **slicing** of Region '**Midwest'**

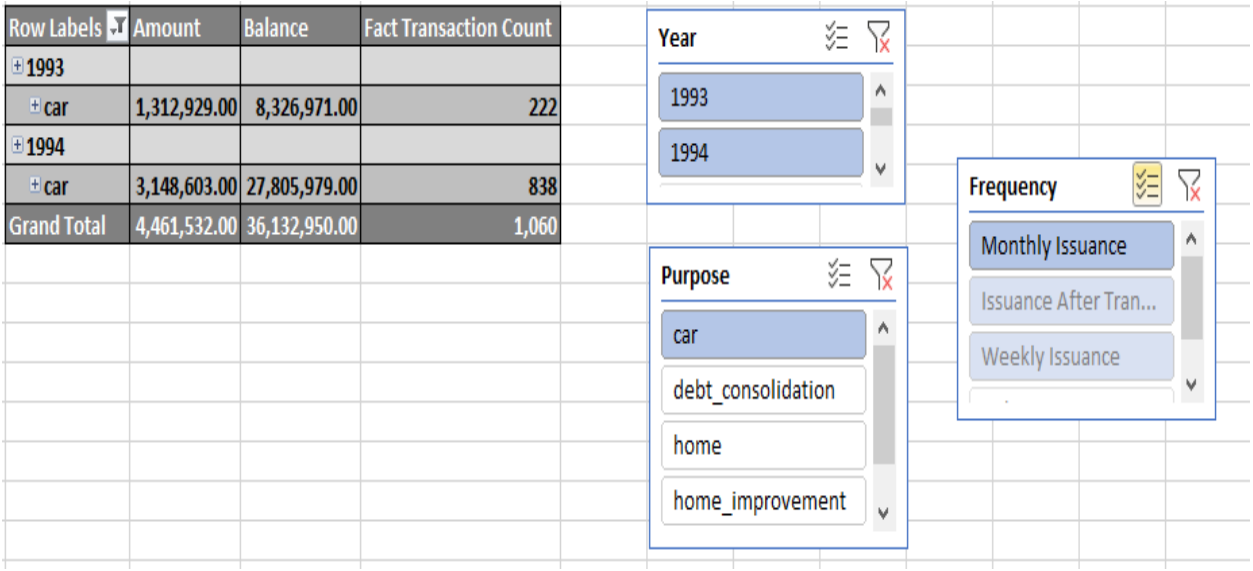
3.4. Dice

- **Dice** operation selects two or more dimensions from a cube, and results in a sub cube by selecting specific values on those selected dimensions. Dicing on the other hand, is more of a zoom feature that selects a subset over all the dimensions, but for specific values of the dimension.

Report:

- ✓ **Total Loan Amount**, **Balances** and **Number of Transactions** based on **Loan Purpose, Year,** and **Frequency of the Loan**. The report represents the **Total Loan Amounts, Balances, and Number of Transactions**, that could be gathered for a **selected Year, selected Purpose of the Loan, and a selected Frequency of Loans.**

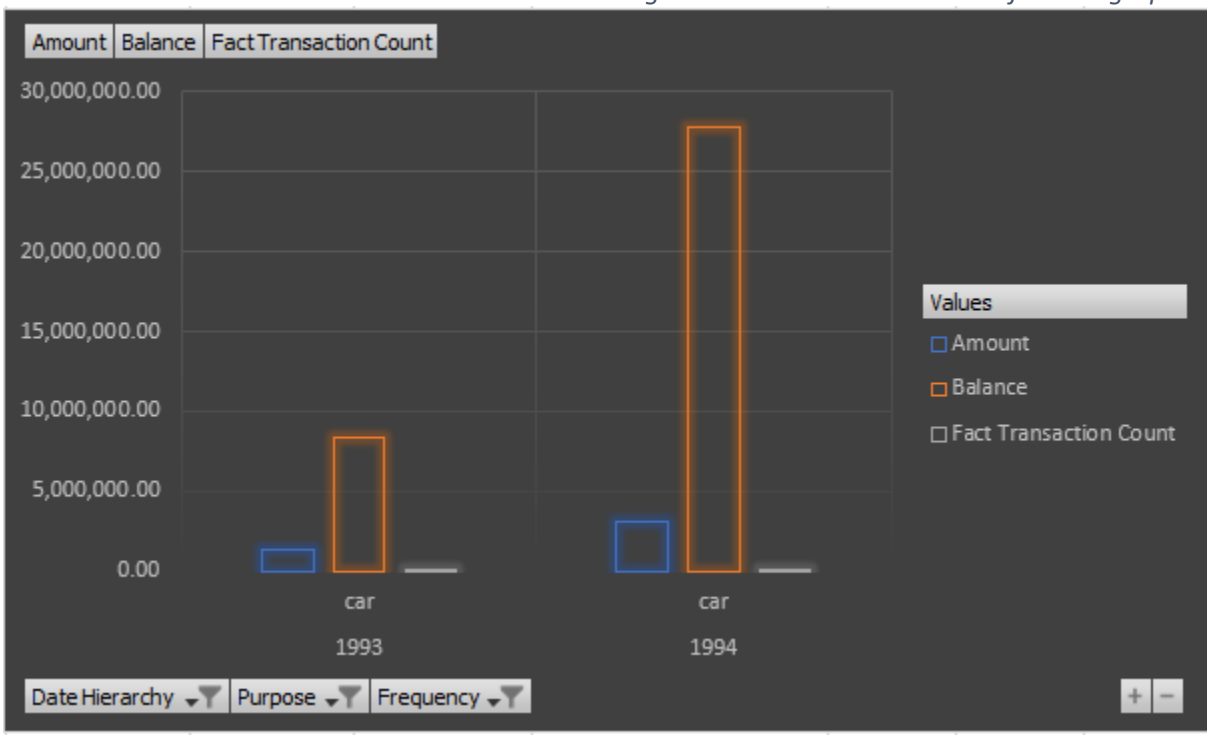
Figure 16. Pivot Table and Slicers for Dicing Operation



Row Labels	Amount	Balance	Fact Transaction Count
1993			
car	1,312,929.00	8,326,971.00	222
1994			
car	3,148,603.00	27,805,979.00	838
Grand Total	4,461,532.00	36,132,950.00	1,060

- ❖ The **Pivot table** represents **the Total Loan Amounts, Balances, the Number of Transactions** for the selected years '**1993** and **1994'**, selected **Loan Purpose** '**car'** and the **Frequency 'Monthly Insurance'**

Figure 17. Pivot Chart and Slicer for Dicing Operation



- The **Pivot chart** represents the **Total Loan Amounts**, **Balances**, the **Number of Transactions** for the selected Years '**1993** and **1994'**, selected Loan Purpose '**car'** and the Frequency '**Monthly Issuance**.'

3.5. Pivot

- **Pivot** operation provides a new perspective to the cube by rotating the data axes of the cube. It may contain swapping the rows and columns or moving one of the Row dimensions into the column dimensions.

Report:

- ✓ **Loan Amounts, Balances** and **Number of Transactions** based on **Loan Purpose**

Figure 18. Pivot Table

Purpose	Amount	Balance	Fact Transactior
car	4,461,532.00	36,132,950.00	1,060
debt_consolidation	16,473,095.00	87,082,546.00	2,097
home	133,998,582.00	641,321,256.00	14,558
home_improvement	13,433,891.00	69,733,356.00	1,658
Unknown	574,712,587.00	3,467,222,258.00	100,460
Grand Total	**743,079,687.00**	**4,301,492,366.00**	**119,833**

❖ The report with **Loan Purpose** as the rows and the **Total Loan Amounts, Balances, and the Number of Transaction** as columns.

Figure 19. Change the Angle of the Pivot Table

	Purpose					
Values	car	debt_consolidation	home	home_improvement	Unknown	Grand Total
Amount	4,461,532.00	16,473,095.00	133,998,582.00	13,433,891.00	574,712,587.00	743,079,687.00
Balance	36,132,950.00	87,082,546.00	641,321,256.00	69,733,356.00	3,467,222,258.00	4,301,492,366.00
Fact Transaction Count	1,060	2,097	14,558	1,658	100,460	119,833

❖ The report has now **changed** the perspective, as **the Total Loan Amounts, Balances and the Number of Transactions** is transposed to rows and the **Loan Purpose** to columns.

4. SSRS Reports

SQL Server Reporting Services (SSRS) is a reporting software that allows you to produce formatted reports with tables in the form of data, graph, images, and charts. These reports are hosted on a server that can be executed any time using parameters defined by the users. SSRS reports can be developed using tools like report builder and deployed in SSRS Web portal for viewing.

Report Builder:

- ✓ It is a standalone application for creating paginated reports. Once designed the report can be deployed to the report server and displayed on the SSRS web portal.

SSRS Web Portal:

- ✓ The SQL Server Report Service Web Portal is a web-based experience. In this portal users can view reports, KPIs and navigate through the elements in the report server instance. User can also use the web portal to administer a single report server instance.

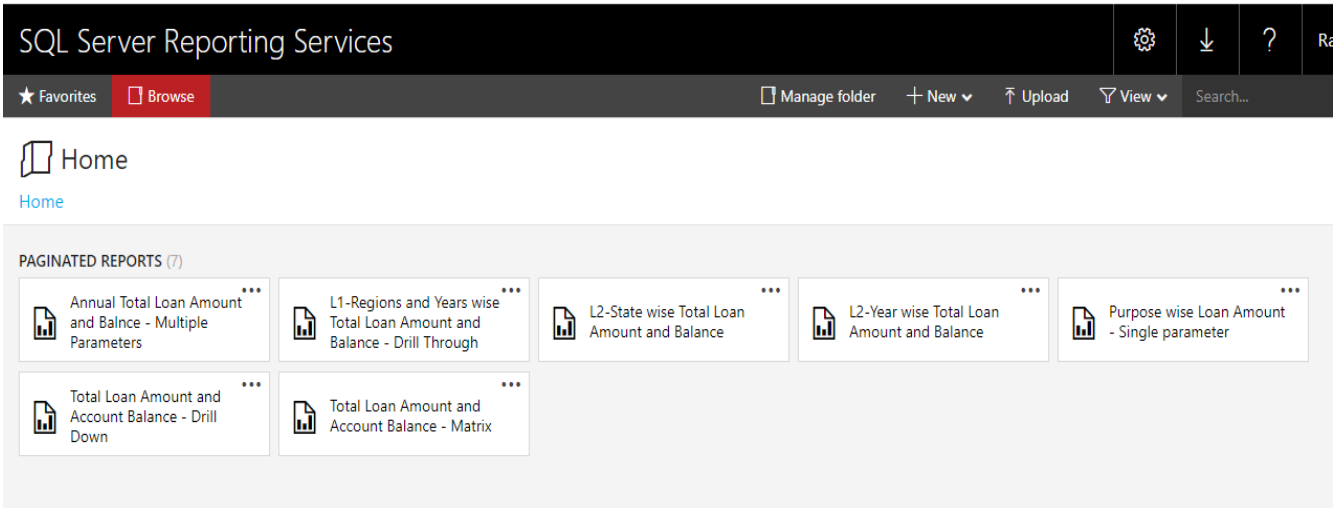


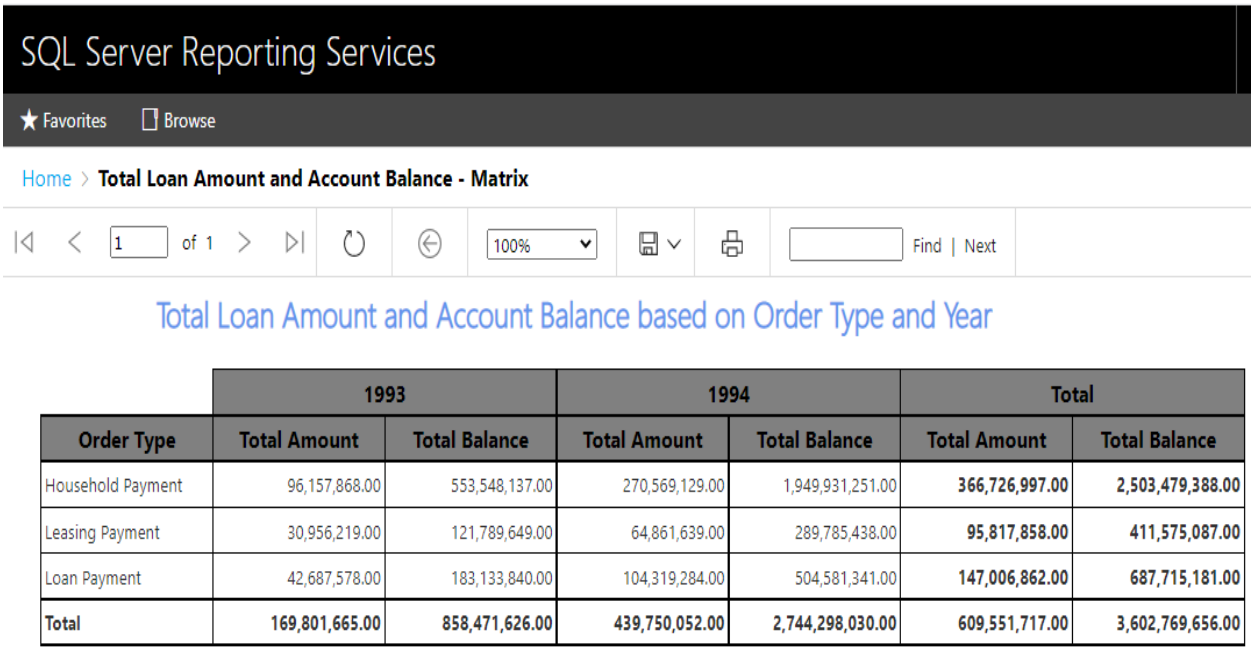
Figure 20. SSRS Web Portal Home Page

4.1. Report with Matrix

- In SSRS, Matrix is very similar to a table, but it is configured to show data grouped by columns and rows, with aggregate data at the intersection.

Report:

- ✓ **Total Loan Amount and Account balances**. The report contains the data of **Total Loan Amounts and Balances for each Order Type for each Year**.



Total Loan Amount and Account Balance based on Order Type and Year

	1993		1994		Total	
Order Type	Total Amount	Total Balance	Total Amount	Total Balance	Total Amount	Total Balance
Household Payment	96,157,868.00	553,548,137.00	270,569,129.00	1,949,931,251.00	**366,726,997.00**	**2,503,479,388.00**
Leasing Payment	30,956,219.00	121,789,649.00	64,861,639.00	289,785,438.00	**95,817,858.00**	**411,575,087.00**
Loan Payment	42,687,578.00	183,133,840.00	104,319,284.00	504,581,341.00	**147,006,862.00**	**687,715,181.00**
Total	**169,801,665.00**	**858,471,626.00**	**439,750,052.00**	**2,744,298,030.00**	**609,551,717.00**	**3,602,769,656.00**

Figure 21. SSRS Matrix Report

SQL Query:

```
select dd.Year, po.OrderType, sum(ft.Amount) as 'Total Amount',
sum(ft.Balance) as 'Total Balance'
from FactTransaction ft
inner join DimDate dd
      on ft.DateSK = dd.DateKey
inner join DimPermanentOrder po
      on ft.OrderSK = po.OrderSK

group by dd.Year, po.OrderType
```

4.2. Report With Single Parameter

- In SSRS, allows Parameter us to pass input value to the report. Also, it offers 'Select All' option that helps to select all parameter values.

Report:

✓ **Loan Purpose** wise **Total Loan Amount**.

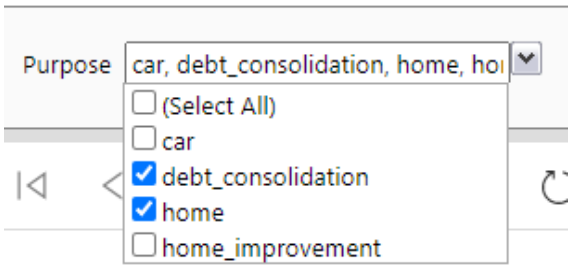
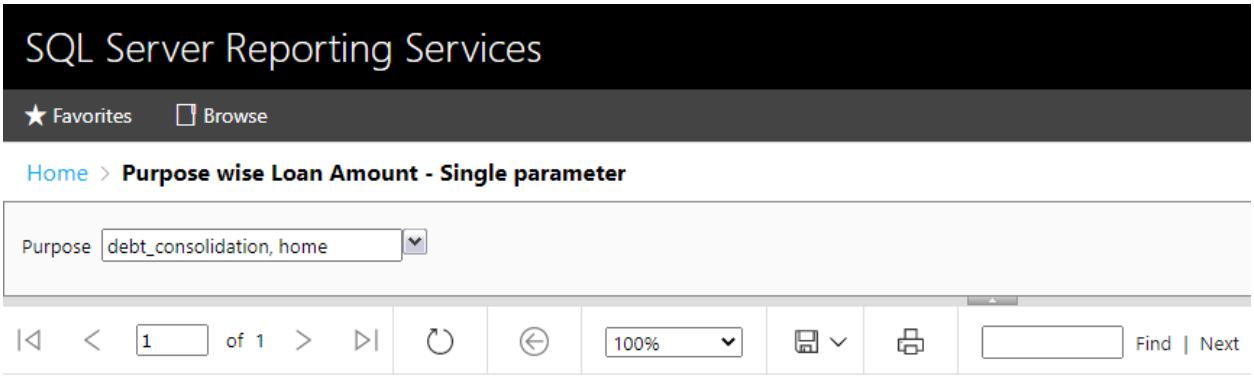


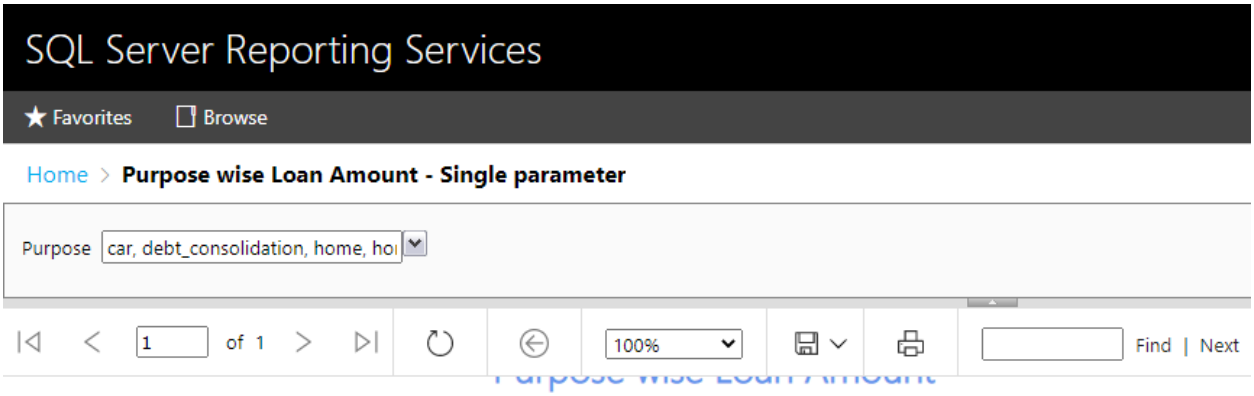
Figure 22. Selection of Loan Purpose



Purpose wise Loan Amount

Purpose	Frequency	1993	1994	Total
⊟debt_consolidation	Issuance After Transaction	426,315.00	354,595.00	**780,910.00**
	Monthly Issuance	4,696,469.00	7,785,188.00	**12,481,657.00**
	Weekly Issuance	698,386.00	2,512,142.00	**3,210,528.00**
	Total	5,821,170.00	10,651,925.00	16,473,095.00
⊟home	Issuance After Transaction	1,621,924.00	7,408,310.00	**9,030,234.00**
	Monthly Issuance	26,691,042.00	74,069,437.00	**100,760,479.00**
	Weekly Issuance	7,211,057.00	16,996,812.00	**24,207,869.00**
	Total	35,524,023.00	98,474,559.00	133,998,582.00
Total		**41,345,193.00**	**109,126,484.00**	**150,471,677.00**

Figure 23. SSRS Single Parameter Report



Purpose	Frequency	1993	1994	Total
⊟car	Monthly Issuance	1,312,929.00	3,148,603.00	**4,461,532.00**
	Total	1,312,929.00	3,148,603.00	4,461,532.00
⊞debt_consolidation	Total	5,821,170.00	10,651,925.00	16,473,095.00
⊞home	Total	35,524,023.00	98,474,559.00	133,998,582.00
⊟home_improvement	Monthly Issuance	4,645,802.00	8,069,162.00	**12,714,964.00**
	Weekly Issuance	21,517.00	697,410.00	**718,927.00**
	Total	4,667,319.00	8,766,572.00	13,433,891.00
Total		**47,325,441.00**	**121,041,659.00**	**168,367,100.00**

Figure 24. SSRS Single Parameter Report with Select All

SQL Query:

```
select ac.Frequency, dd.Year, ln.Purpose, sum(ft.Amount) as ' Total Amount'
from FactTransaction ft
inner join DimAccount ac
       on ft.AccounSK = ac.AccountSK
inner join DimLoan ln
       on ft.LoanSK = ln.LoanSK
inner join DimDate dd
       on ft.DateSK = dd.DateKey

where ln.Purpose in (@Purpose)
group by ac.Frequency, dd.Year, ln.Purpose


-- Getting Loan Purpose --
select distinct(Purpose)
from DimLoan
```

4.3. Report with Multiple Parameters

- In SSRS, Multiparameter-values allows us to pass either one or more input parameter values to the report. Also, it offers a "Select All" option that helps to select all parameter values.

Report:

- ✓ **Region and State wise Total Amount and Balances**. The report allows to select the Region and State through a drop down. When the Regions are selected, the States belonging to the particular Region will be filtered and allowed for selection. On selection of view report, the report displays the Total Loan Amounts and the Total Balances for each Year, grouped according to type of Order, and the selected Region and States accepted as parameters.

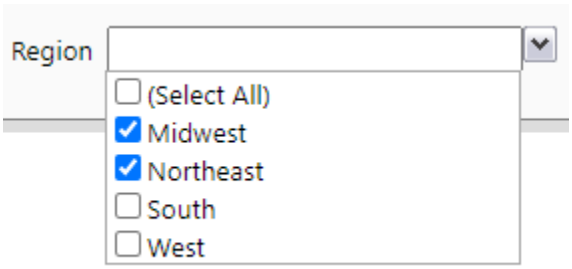


Figure 25. Region Selection

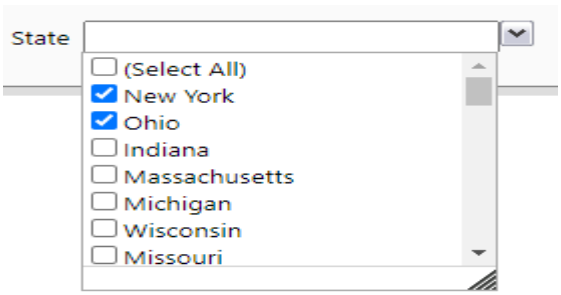
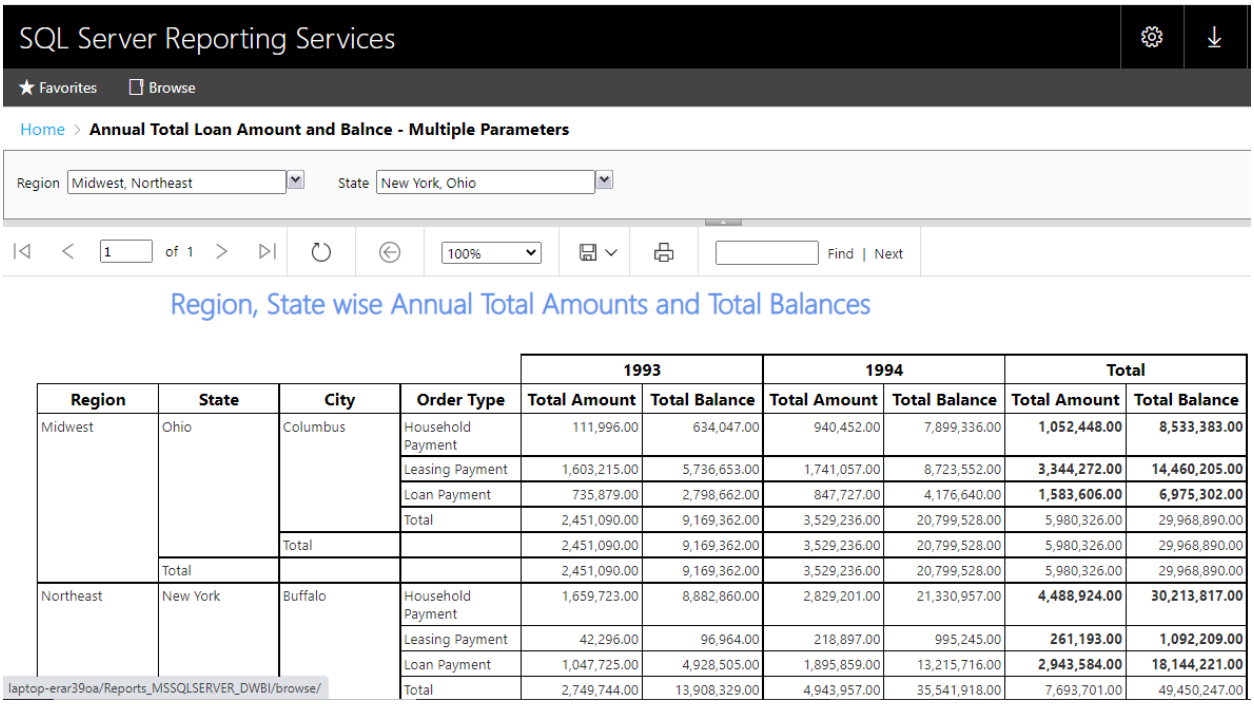
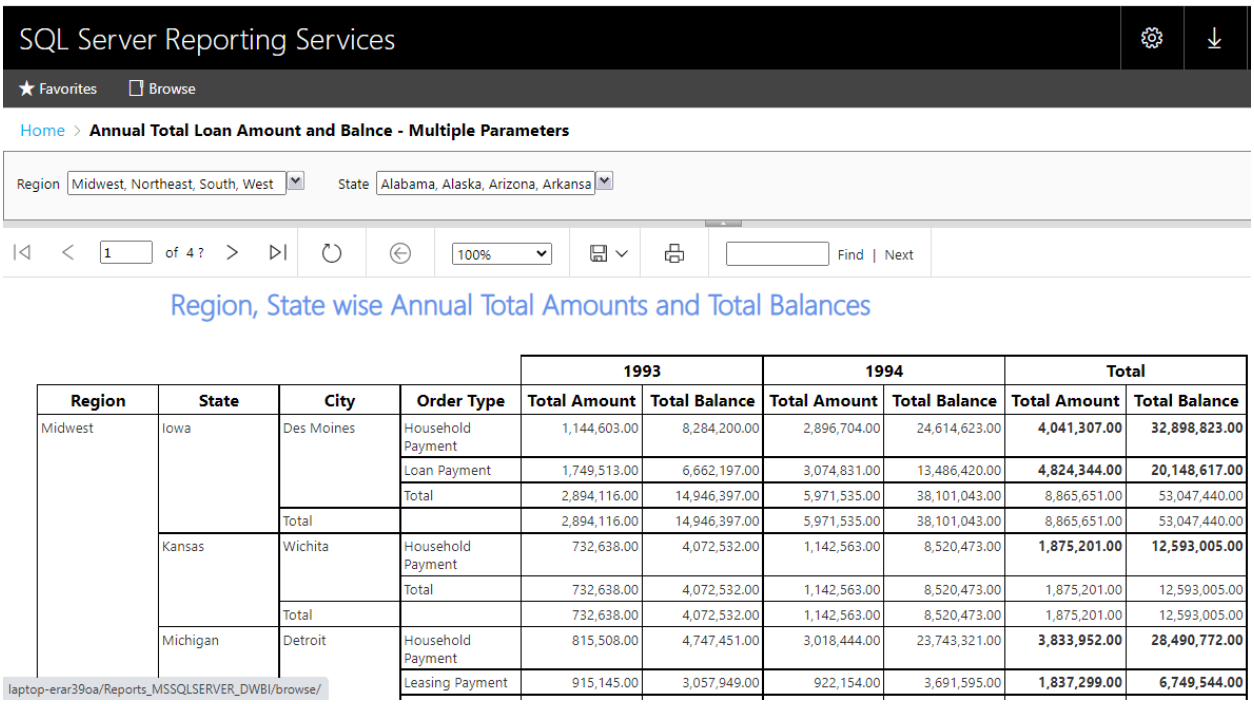


Figure 26. State Selection



				1993		1994		Total	
Region	State	City	Order Type	Total Amount	Total Balance	Total Amount	Total Balance	Total Amount	Total Balance
Midwest	Ohio	Columbus	Household Payment	111,996.00	634,047.00	940,452.00	7,899,336.00	**1,052,448.00**	**8,533,383.00**
			Leasing Payment	1,603,215.00	5,736,653.00	1,741,057.00	8,723,552.00	**3,344,272.00**	**14,460,205.00**
			Loan Payment	735,879.00	2,798,662.00	847,727.00	4,176,640.00	**1,583,606.00**	**6,975,302.00**
			Total	2,451,090.00	9,169,362.00	3,529,236.00	20,799,528.00	5,980,326.00	29,968,890.00
		Total		2,451,090.00	9,169,362.00	3,529,236.00	20,799,528.00	5,980,326.00	29,968,890.00
	Total			2,451,090.00	9,169,362.00	3,529,236.00	20,799,528.00	5,980,326.00	29,968,890.00
Northeast	New York	Buffalo	Household Payment	1,659,723.00	8,882,860.00	2,829,201.00	21,330,957.00	**4,488,924.00**	**30,213,817.00**
			Leasing Payment	42,296.00	96,964.00	218,897.00	995,245.00	**261,193.00**	**1,092,209.00**
			Loan Payment	1,047,725.00	4,928,505.00	1,895,859.00	13,215,716.00	**2,943,584.00**	**18,144,221.00**
			Total	2,749,744.00	13,908,329.00	4,943,957.00	35,541,918.00	7,693,701.00	49,450,247.00

Figure 27. SSRS Multiple Parameter Report



				1993		1994		Total	
Region	State	City	Order Type	Total Amount	Total Balance	Total Amount	Total Balance	Total Amount	Total Balance
Midwest	Iowa	Des Moines	Household Payment	1,144,603.00	8,284,200.00	2,896,704.00	24,614,623.00	**4,041,307.00**	**32,898,823.00**
			Loan Payment	1,749,513.00	6,662,197.00	3,074,831.00	13,486,420.00	**4,824,344.00**	**20,148,617.00**
			Total	2,894,116.00	14,946,397.00	5,971,535.00	38,101,043.00	8,865,651.00	53,047,440.00
		Total		2,894,116.00	14,946,397.00	5,971,535.00	38,101,043.00	8,865,651.00	53,047,440.00
	Kansas	Wichita	Household Payment	732,638.00	4,072,532.00	1,142,563.00	8,520,473.00	**1,875,201.00**	**12,593,005.00**
			Total	732,638.00	4,072,532.00	1,142,563.00	8,520,473.00	1,875,201.00	12,593,005.00
		Total		732,638.00	4,072,532.00	1,142,563.00	8,520,473.00	1,875,201.00	12,593,005.00
	Michigan	Detroit	Household Payment	815,508.00	4,747,451.00	3,018,444.00	23,743,321.00	**3,833,952.00**	**28,490,772.00**
			Leasing Payment	915,145.00	3,057,949.00	922,154.00	3,691,595.00	**1,837,299.00**	**6,749,544.00**

laptop-erar39oa/Reports_MSSQLSERVER_DWBI/browse/

Figure 28. SSRS Multiple Parameter All Selected Report

SQL Query:

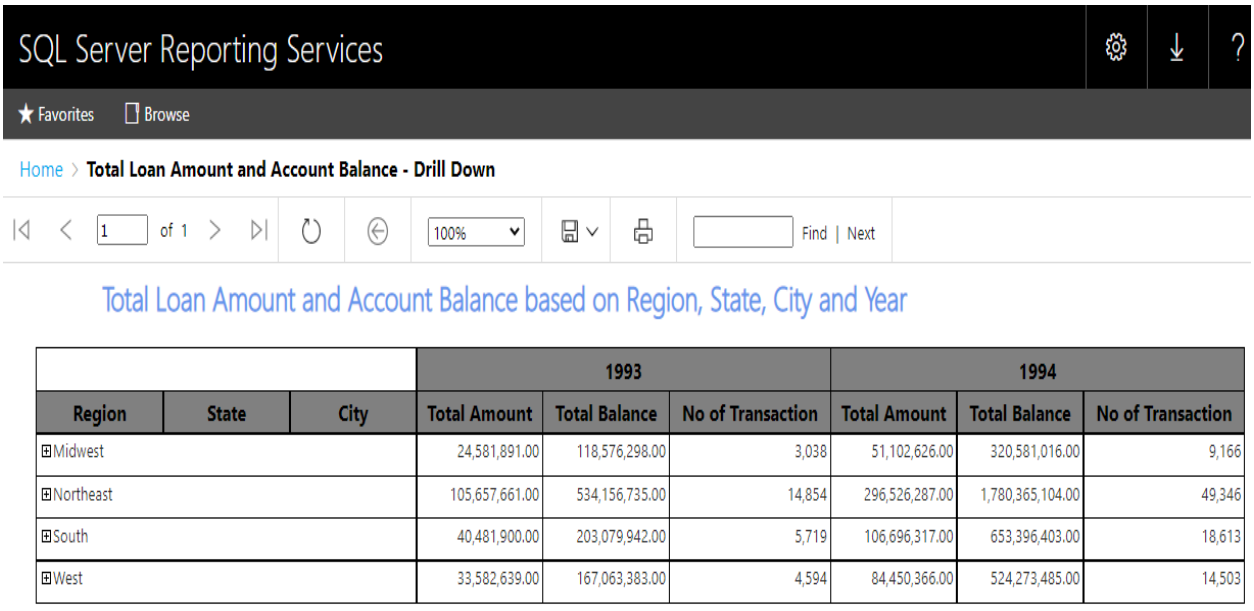
```
select dt.Region, dt.State, dt.City, dd.Year, po.OrderType, sum(ft.Amount) as ' Total
Amount',
sum(ft.Balance) as ' Total Balance'
from FactTransaction ft
inner join DimClient cl
       on ft.ClientSK = cl.ClientSK
inner join DimDistrict dt
       on cl.DistrictSK = dt.DistrictSK
inner join DimDate dd
       on ft.DateSK = dd.DateKey
inner join DimPermanentOrder po
       on ft.OrderSK = po.OrderSK
where dt.State in (@State)
group by dt.Region, dt.State, dt.City, dd.Year, po.OrderType

-- Getting State --
select dt.Region, dt.State, ac.DistrictSK, ac.AccountSK, ft.AccounSK
from DimDistrict dt
inner join DimAccount ac
       on dt.DistrictSK = ac.DistrictSK
inner join FactTransaction ft
       on ac.AccountSK = ft.AccounSK
where dt.Region in (@Region)

-- Region List --
select distinct(Region)
from DimDistrict

-- State List --
select distinct(State)
from DimDistrict
where Region in (@Region)
```

4.4. Drill-Down Report

- In SSRS reports, Drill-down allows expand or collapse a section of a report to show or hide detail data. We can expand the data using the plus button and collapse data using the minus button.

Report:

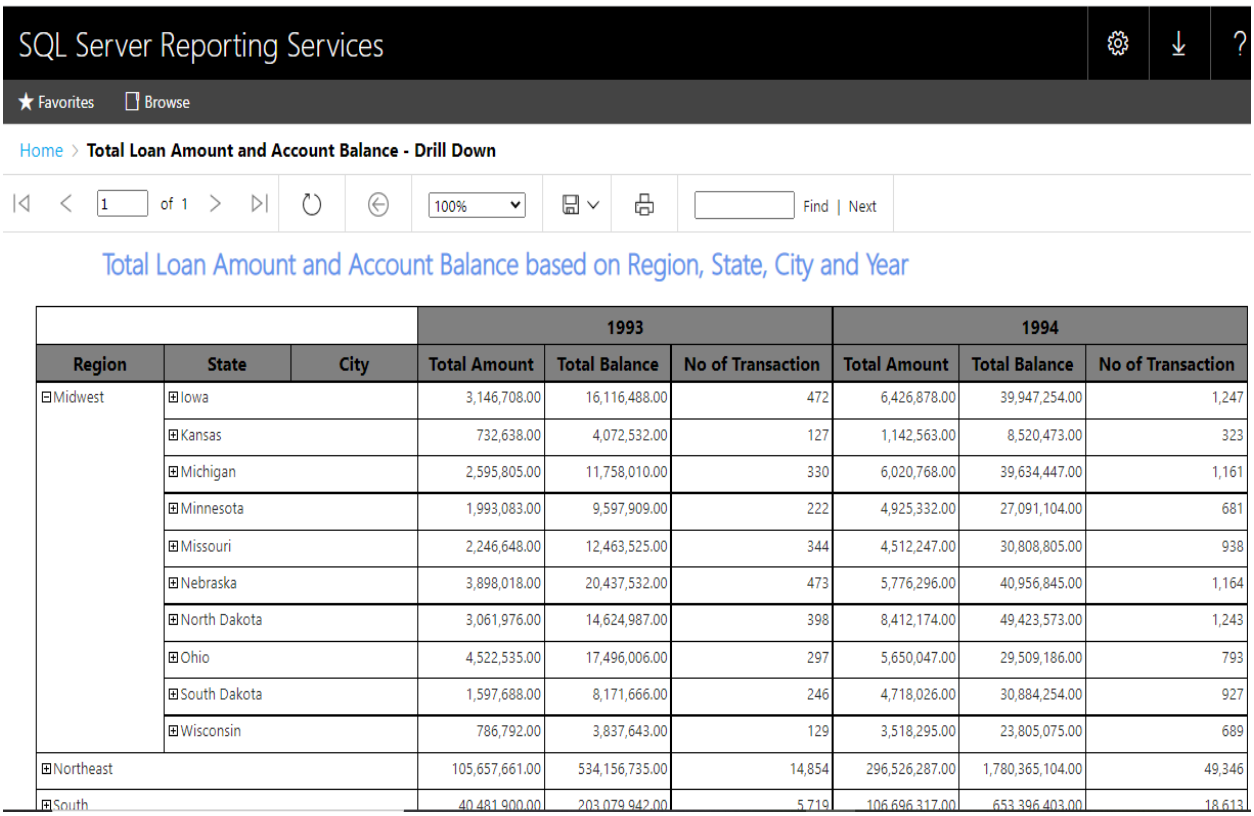
- ✓ **Drill down through Region, States, and Cities**. The feature allows a user to view Total Loan Amounts and Total Balances for each Year based on Region, State, and Cities. Initially the Totals for a Region will be displayed, which must then be expanded to view the same for a State and a City.



Total Loan Amount and Account Balance based on Region, State, City and Year

			1993			1994		
Region	State	City	Total Amount	Total Balance	No of Transaction	Total Amount	Total Balance	No of Transaction
⊞Midwest			24,581,891.00	118,576,298.00	3,038	51,102,626.00	320,581,016.00	9,166
⊞Northeast			105,657,661.00	534,156,735.00	14,854	296,526,287.00	1,780,365,104.00	49,346
⊞South			40,481,900.00	203,079,942.00	5,719	106,696,317.00	653,396,403.00	18,613
⊞West			33,582,639.00	167,063,383.00	4,594	84,450,366.00	524,273,485.00	14,503

Figure 29. SSRS Report before Drill-down



			1993			1994		
Region	State	City	Total Amount	Total Balance	No of Transaction	Total Amount	Total Balance	No of Transaction
⊟Midwest	⊞Iowa		3,146,708.00	16,116,488.00	472	6,426,878.00	39,947,254.00	1,247
	⊞Kansas		732,638.00	4,072,532.00	127	1,142,563.00	8,520,473.00	323
	⊞Michigan		2,595,805.00	11,758,010.00	330	6,020,768.00	39,634,447.00	1,161
	⊞Minnesota		1,993,083.00	9,597,909.00	222	4,925,332.00	27,091,104.00	681
	⊞Missouri		2,246,648.00	12,463,525.00	344	4,512,247.00	30,808,805.00	938
	⊞Nebraska		3,898,018.00	20,437,532.00	473	5,776,296.00	40,956,845.00	1,164
	⊞North Dakota		3,061,976.00	14,624,987.00	398	8,412,174.00	49,423,573.00	1,243
	⊞Ohio		4,522,535.00	17,496,006.00	297	5,650,047.00	29,509,186.00	793
	⊞South Dakota		1,597,688.00	8,171,666.00	246	4,718,026.00	30,884,254.00	927
	⊞Wisconsin		786,792.00	3,837,643.00	129	3,518,295.00	23,805,075.00	689
⊞Northeast			105,657,661.00	534,156,735.00	14,854	296,526,287.00	1,780,365,104.00	49,346
⊞South			40,481,900.00	203,079,942.00	5,719	106,696,317.00	653,396,403.00	18,613

Figure 30. SSRS Report After Drilled down

SQL Query:

```
select dt.Region, dt.State, dt.City, dd.Year, sum(ft.Amount) as ' Total
Amount', sum(ft.Balance) as ' Total Balance', count(ft.TransactionID) as 'No
of Transaction'
from FactTransaction ft
inner join DimClient cl
       on ft.ClientSK = cl.ClientSK
inner join DimDistrict dt
       on cl.DistrictSK = dt.DistrictSK
inner join DimDate dd
       on ft.DateSK = dd.DateKey

group by dt.Region, dt.State, dt.City, dd.Year
```

4.5. Drill-Through Report

- In SSRS, a drill through allows a user click on a link or an area in a chart with summarized data, which then opens a separate, related report to show detailed data. Drill through reports commonly contain details about an item that is contained in an original summary report. The data in the drill through report is not retrieved until the user clicks the link in the main report.

Report:

- ✓ **Level 1** – Year and Region wise Loan Amounts and Balances L1
- ✓ **Level 2** – State wise Total Amounts and Balances report 2 & Year wise drill through.

This report displays two column charts. 1st chart represents the data of Total Loan Amounts and Total Balances for each **Region**. 2nd chart represents the Total Loan Amounts and Total Balances for each **Year**.

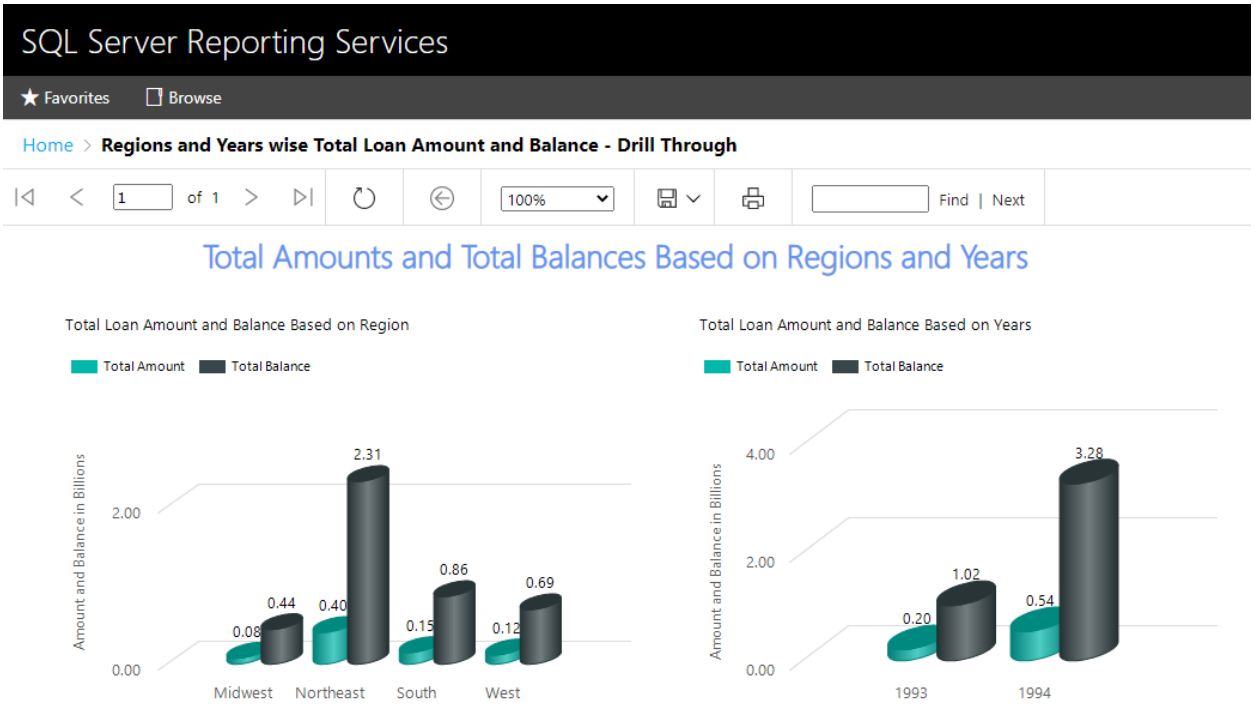


Figure 31. Level – 1 SSRS Report for Drill Through

- When the user clicks on a bar in the report contain Regions, it will display a detailed report that provides the same information based on each State belonging to the Region. The below diagram shows details when the state '**South'** is clicked.

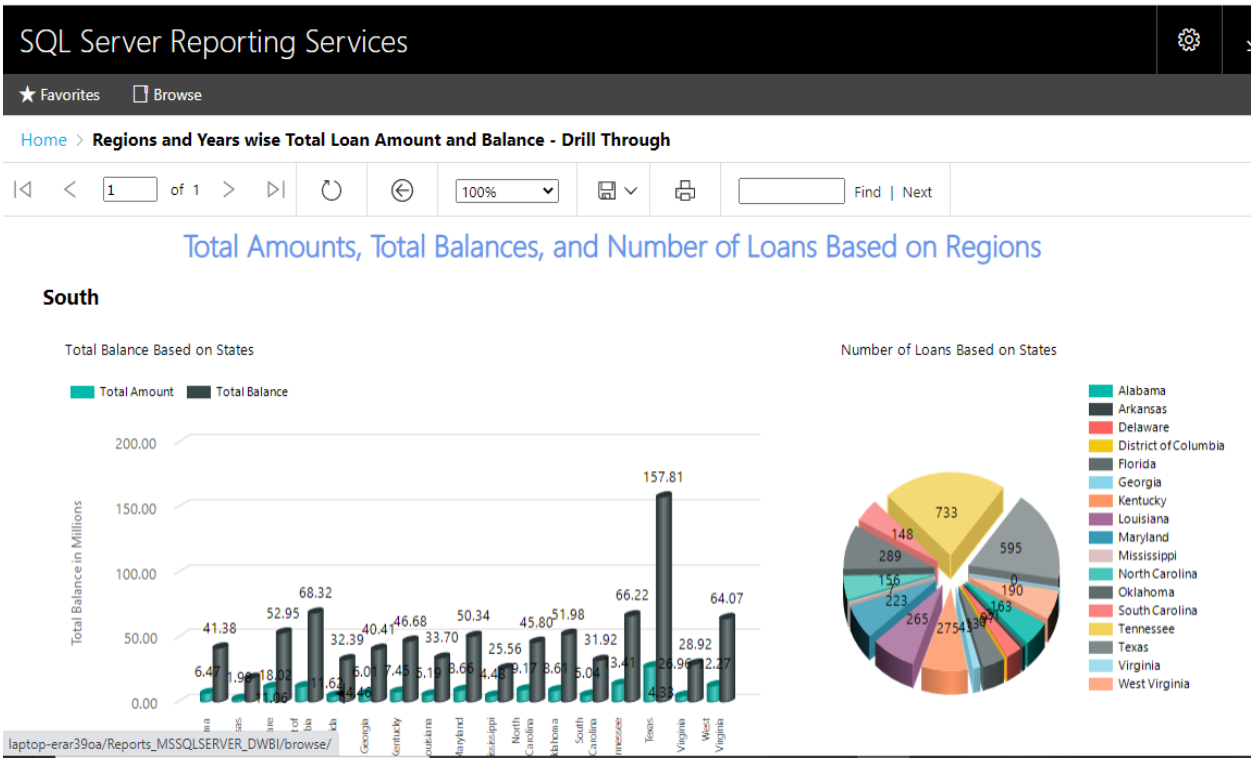


Figure 32. South Region Drilled Through

- When the user clicks on a bar in the report containing Years, it will display a detailed report that provides the Total Loan Amount and Balance Based on Loan Purpose and Total Loan Amount and Balance Based on Quarter in that particular year. The below diagram shows details when the year '**1993'** is clicked.

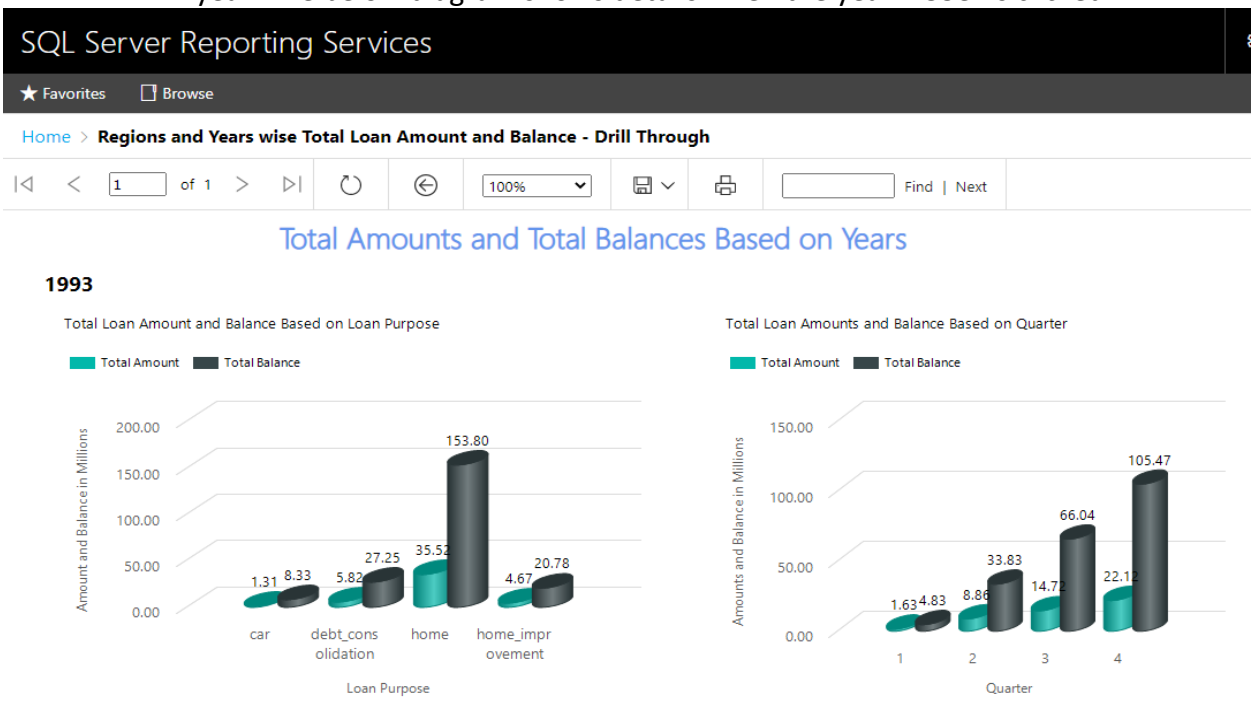


Figure 33. Year 1993 Drilled Through

SQL Query:

```
select dt.Region, dt.State, dt.City, dd.Year, sum(ft.Amount) as ' Total
Amount',
sum(ft.Balance) as ' Total Balance'
from FactTransaction ft
inner join DimClient cl
       on ft.ClientSK = cl.ClientSK
inner join DimDistrict dt
       on cl.DistrictSK = dt.DistrictSK
inner join DimDate dd
       on ft.DateSK = dd.DateKey

group by dt.Region, dt.State, dt.City, dd.Year

-- State wise Report --
select dt.State, sum(ft.Amount) as ' Total Amount', sum(ft.Balance) as ' Total
Balance',
count(ft.LoanSK) as 'No of Loans'
from FactTransaction ft
inner join DimClient cl
       on ft.ClientSK = cl.ClientSK
inner join DimDistrict dt
       on cl.DistrictSK = dt.DistrictSK
where dt.Region in (@Regions)
group by  dt.State

-- Year wise Report --
select dd.Quarter, ln.Purpose, sum(ft.Amount) as ' Total Amount',
sum(ft.Balance) as ' Total Balance'
from FactTransaction ft
inner join DimLoan ln
       on ft.LoanSK = ln.LoanSK
inner join DimDate dd
       on ft.DateSK = dd.DateKey

where dd.Year = (@Years)
group by  dd.Quarter, ln.Purpose
```

5. References

[1] https://www.sqlshack.com/analysis-services-ssas-multidimensional-design-tips-relationshierarchies/#:~:text=sample%20OLAP%20cube.,Hierarchies,a%20certain%20drill%2Ddown%2 0behavior

[2] https://www.red-gate.com/simple-talk/databases/sql-server/bi-sql-server/adding-a-kpi-to-ansql-server-analysis-servicescube/#:~:text=In%20SQL%20Server%20Analysis%20Services,of%20a%20set%20of%20calcul ations.

[3] https://www.guru99.com/online-analytical-processing.html

[4]https://www.google.com/search?q=SSRS&oq=SSRS&aqs=chrome..69i57j0i271l3j69i61j69i65j6 9i60l2.697j0j7&sourceid=chrome&ie=UTF-8

[5] "SSRS - How to build Drill-Through Report in SSRS," https://www.youtube.com/watch?v=sPl-Zp0X5Pk&feature=youtu.be

[6] Working with Multi-Valued Parameters in SSRS, https://www.interfacett.com/blogs/usingparameters-with-multiple-values-in-sql-server-reporting-services/