

Data Warehouse

Experiment No.: 5

**To perform various OLAP operations
such as slice, dice, drilldown, rollup, pivot
using any open source tool**

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1. **Aim:** To perform various OLAP operations such as slice, dice, drilldown, rollup, pivot using any open source tool
2. **Objectives:** to visualize and facilitate multidimensional data analysis and decision-making
3. **Course Outcomes:** Multi-dimensional views provide a clear understanding of relationships and patterns across different data dimensions, making the data more comprehensible.
4. **Hardware / Software Required:** Power BI tool to create the multi-dimensional view.
5. **Theory:** In data warehouse data modeling, a **cube** is a multi-dimensional data structure that allows for efficient querying and analysis of data across various dimensions. It organizes data into a structure that resembles a 3D cube, where each axis or dimension represents a different category of data, and the data within the cube represents metrics or facts such as sales, profit, or inventory. It represents data in the form of data cubes. Data cubes allow to model and view the data from many dimensions and perspectives. It is defined by dimensions and facts and is represented by a fact table. Facts are numerical measures and fact tables contain measures of the related dimensional tables or names of the facts. This is as represented in the below figure.

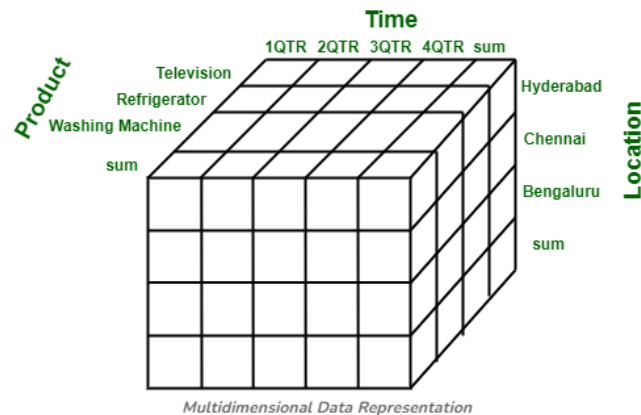


Figure: Multidimensional Data Representation

Example

Consider the following cubes illustrating temperature of certain days recorded weekly:

Temperature	64	65	68	69	70	71	72	75	80	81	83	85
Week1	1	0	1	0	1	0	0	0	0	0	1	0
Week2	0	0	0	1	0	0	1	2	0	1	0	0

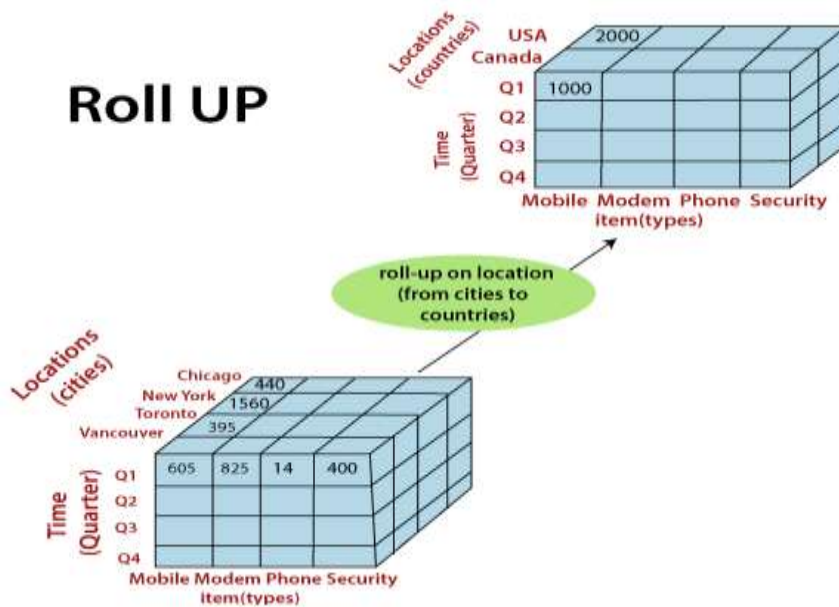
Consider that we want to set up levels (hot (80-85), mild (70-75), cool (64-69)) in temperature from the above cubes. To do this, we have to group column and add up the value according to the concept hierarchies. This operation is known as a roll-up. By doing this, we contain the following cube:

Temperature	cool	mild	hot
Week1	2	1	1
Week2	2	1	1

The roll-up operation groups the information by levels of temperature.

The following diagram illustrates how roll-up works.

Roll UP



Drill-Down

The drill-down operation (also called roll-down) is the reverse operation of roll-up. Drill-down is like zooming-in on the data cube. It navigates from less detailed record to more detailed data. Drill-down can be performed by either stepping down a concept hierarchy for a dimension or adding additional dimensions. Figure shows a drill-down operation performed on the dimension time by stepping down a concept hierarchy which is defined as day, month, quarter, and year. Drill-down appears by descending the time hierarchy from the level of the quarter to a more detailed level of the month. Because a drill-down adds more details to the given data, it can also be performed by adding a new dimension to a cube. For example, a drill-down on the central cubes of the figure can occur by introducing an additional dimension, such as a customer group.

Example

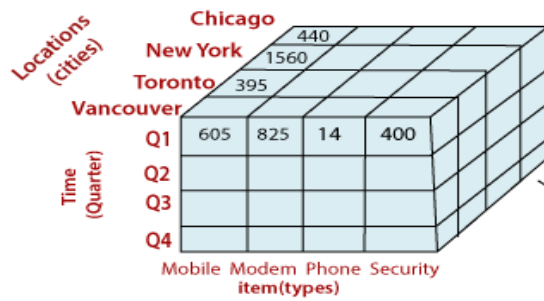
Drill-down adds more details to the given data

Temperature	cool	mild	hot
Day 1	0	0	0

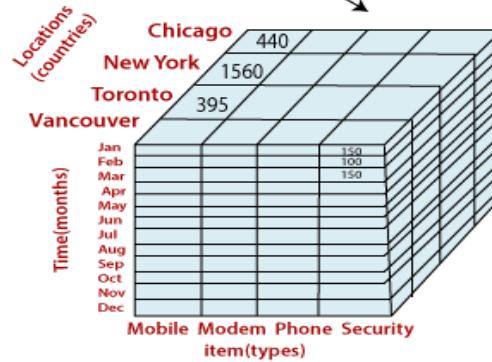
Day 2	0	0	0
Day 3	0	0	1
Day 4	0	1	0
Day 5	1	0	0
Day 6	0	0	0
Day 7	1	0	0
Day 8	0	0	0
Day 9	1	0	0
Day 10	0	1	0
Day 11	0	1	0
Day 12	0	1	0
Day 13	0	0	1
Day 14	0	0	0

The following diagram illustrates how Drill-down works.

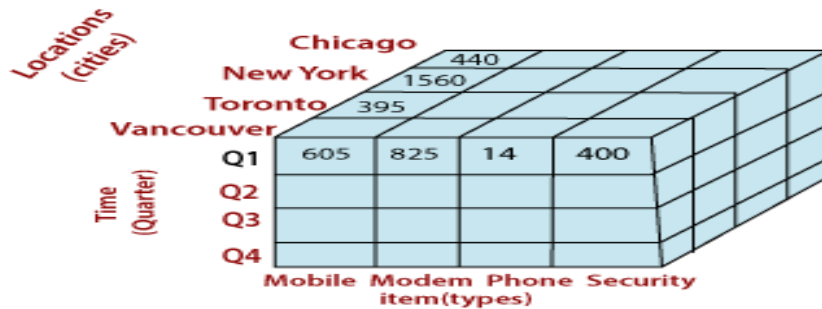
Drill Down



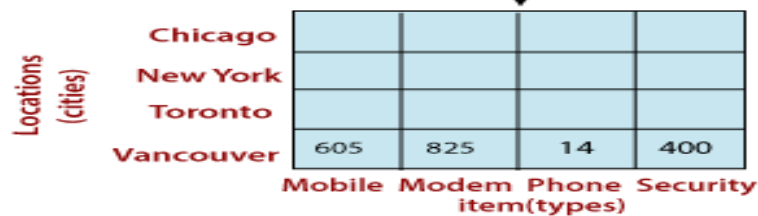
Drilldown on time(from quarters to month)



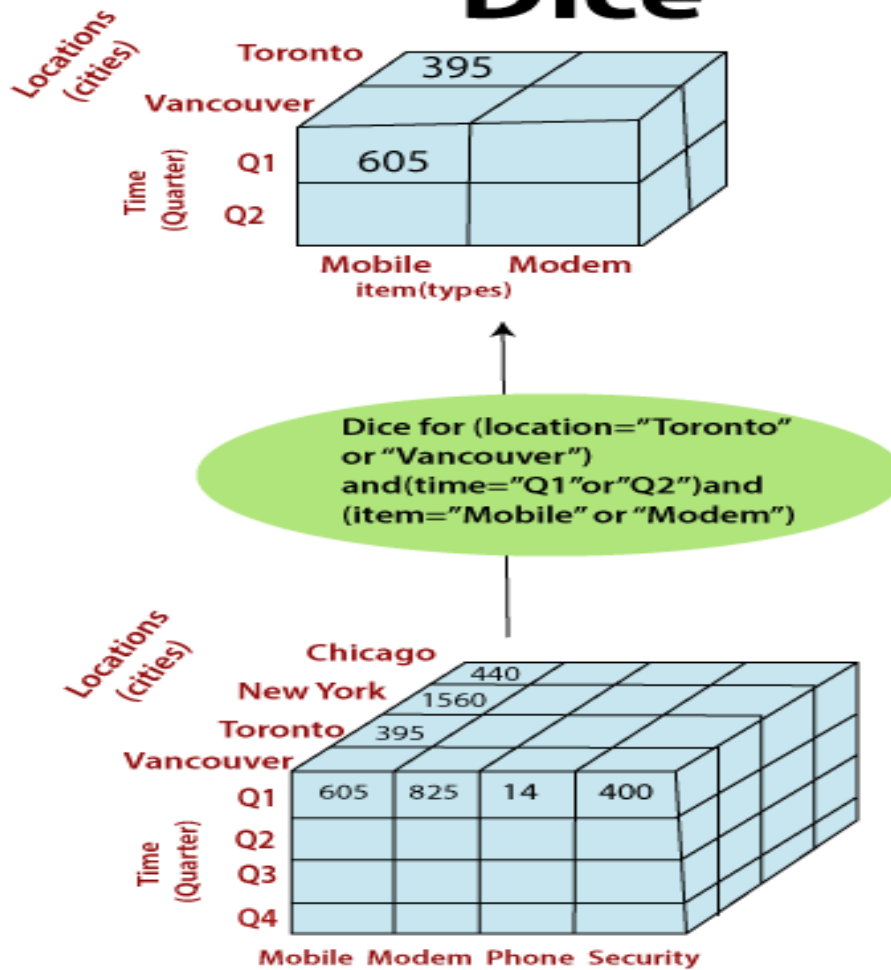
Slice



slice for time = "Q1"



Dice




6. Algorithm / Design / Procedure / Flowchart / Analysis:

First Step

Creating a Table

Click on the table visual to add it on your canvas. Once added, drag any field you want to visualize in the columns box.



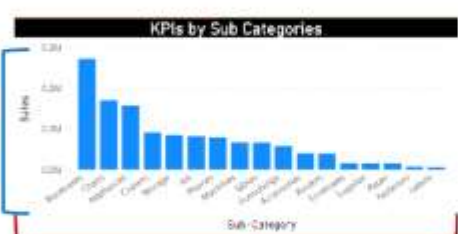
The screenshot shows a table visual on the left with columns: Customer Name, Sales, Cost, Profit. A red arrow points from the table visual to the columns box on the right. The columns box contains the following fields:

- Columns
- Customer Name
- Sales
- Cost
- Profit

Second Step

Creating a Column Chart – X-axis & Y-axis


Sales is your Y-axis. Adding numerical metric as Y-axis helps the user understand the extent of it by the column height.



The chart shows a bar chart with the Y-axis labeled 'Sales' and the X-axis labeled 'Sub-Category'. The bars represent the sales for each sub-category.

Sub-Category is your X-axis. Add the text based field that you want to see in the X-axis. As we are using a column chart, numerical metrics like sales, profit etc will become Y-axis as we want the column HEIGHT to show the extent of that metric.

Add fields in X & Y Axis as shown below.



The configuration panel shows the following fields:

- X-axis: Sub-Category
- Y-axis: Sales
- Legend: Add data fields here
- Small multiples: Add data fields here
- Tooltips: Profit


Third Step

Creating a Column Chart – Legend

Legend further divides your visual into different colors by adding a second level of breakdown.


Adding Region to legend breaks all our subcategories from 1 column for each subcategory to 3 columns for each sub-category, all having different colors.

For ex – 1 Column of bookcases becomes 3 columns of Bookcases from Central, Bookcases from North & Bookcases from South.



The chart shows a grouped bar chart with the Y-axis labeled 'Sales' and the X-axis labeled 'Sub-Category'. The legend indicates three regions: Central (blue), North (red), and South (green).

Add fields in Legend as shown below.



The configuration panel shows the following fields:

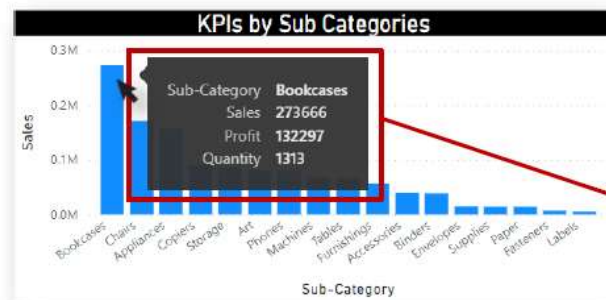
- X-axis: Sub-Category
- Y-axis: Sales
- Legend: Region
- Small multiples: Add data fields here
- Tooltips: Profit

Fourth Step

Creating a Column Chart – Tooltips

Any metric (numerical field) that you add in Tooltips will be visible to you when you hover over different elements of the visual.

For ex – After adding Profit to tooltips, whenever user hovers over ANY column of the column chart, they will see profit of that subcategory along with the Sales amount as well. Profit amount will only be visible as a value in the hover box and not as an additional column in the chart.



Add fields in Tooltips as shown below.

The configuration pane shows the following settings:

- X-axis: Sub-Category
- Y-axis: Sales
- Legend: Add data fields here
- Small multiples: Add data fields here
- Tooltips: Profit

7. Results/Output Analysis:

The sample table of drill down and drill up operations using Power BI for representing 3D data is performed.

8. **Conclusions:** By analyzing this 3D data at various legends, users can easily identify trends, correlations, and key performance indicators, turning raw data into actionable insights for business strategy and operations by drilling down the data.

9. **Viva Questions:** A list of potential questions related to the OLAP operations can be expected.

10. References:

1. Kimball Group: Kimball Group's Website offers articles and resources on dimensional modeling and data warehousing.
2. "The Data Warehouse Toolkit: The Definitive Guide to Dimensional Modeling" by Ralph Kimball and Margy Ross
3. Building the Data Warehouse" by William H. Inmon
4. <https://www.javatpoint.com/olap-operations>