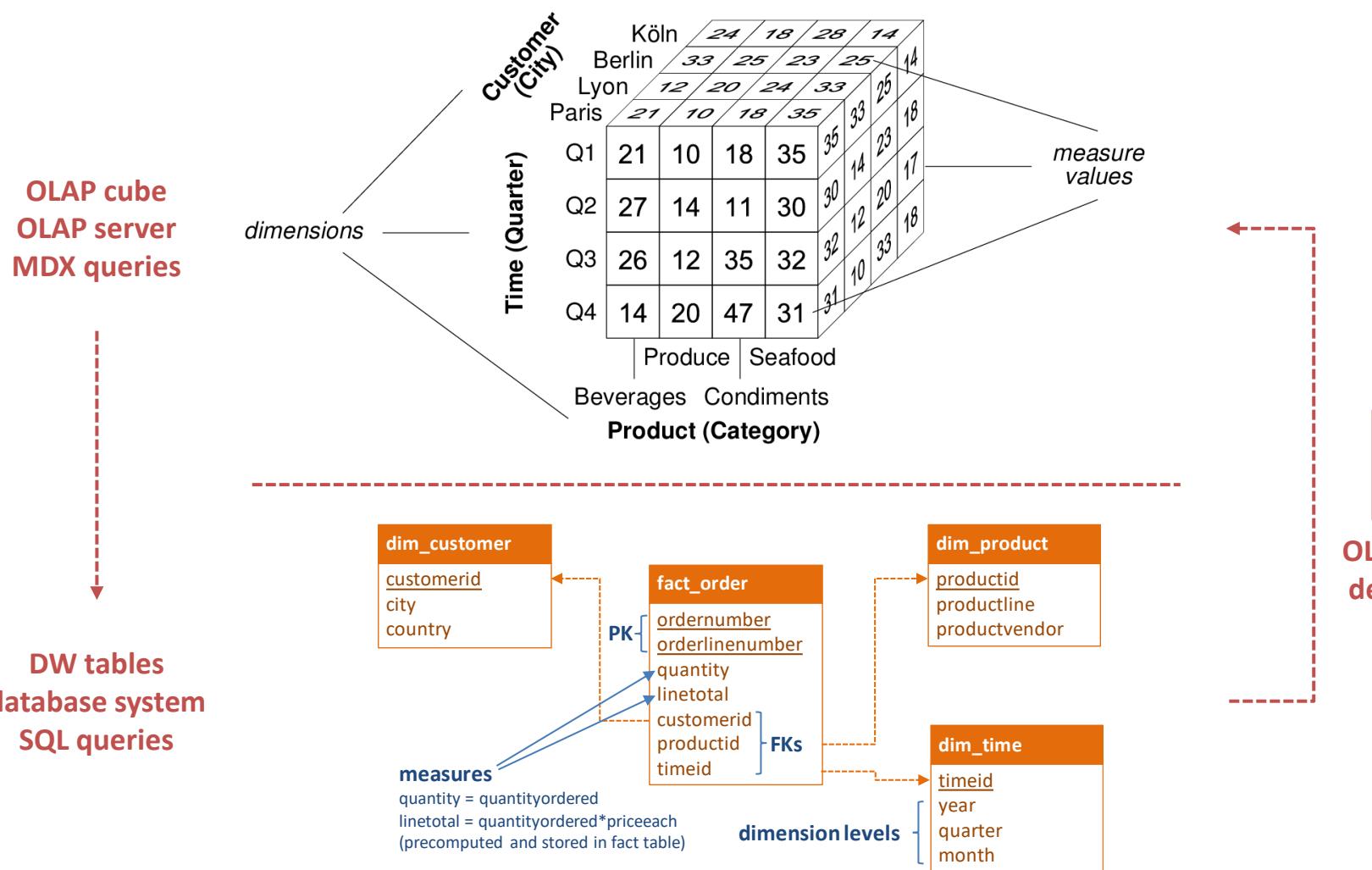


# Data Analysis and Integration

---

MDX queries

# SQL vs. MDX



# SQL vs. MDX

---

- SQL is a language to query databases
  - SQL operates over tables, columns and records
- MDX (Multi-Dimensional eXpressions) is a language to query data warehouses
  - MDX operates over cubes, dimensions and measures
  - syntax inspired in SQL (**select ... from ... where ...**)

# Outline

---

- MDX Language
  - concepts
  - slicing
  - navigation
  - cross join
  - calculated members and named sets
  - relative navigation
  - filtering
  - sorting
  - top analysis

# MDX concepts

- Tuple and member

(Customer.City.Paris, Time.Quarter.Q1, Product.Category.Beverages)

Customer (City)		Köln					
		24	18	28	14		
Time (Quarter)	Berlin	33	25	23	25	14	
	Lyon	12	20	24	33	25	
	Paris	21	10	18	35	33	18
	Q1	21	10	18	35	35	17
	Q2	27	14	11	30	30	18
Product (Category)		Beverages Condiments Produce Seafood					
Beverages		21 10 18 35					
Condiments		27 14 11 30					
Produce		26 12 35 32					
Seafood		14 20 47 31					

*Dimension.Level.Member*

# MDX concepts

- Set of tuples

{ (Customer.City.Paris, Time.Quarter.Q1, Product.Category.Beverages),  
(Customer.City.Lyon, Time.Quarter.Q1, Product.Category.Beverages) }

Customer (City)		Köln				Berlin				Lyon				Paris										
		24	18	28	14	33	25	23	25	12	20	24	33	25	25	14	10	18	35	35	33	23	18	
Time (Quarter)	Q1	21	10	18	35	35	14	23	33	30	12	20	10	33	20	17	21	10	18	35	35	33	23	18
	Q2	27	14	11	30	30	12	20	18	32	10	33	10	33	20	18	14	12	11	30	32	10	33	10
	Q3	26	12	35	32	32	10	33	10	31	31	31	31	31	31	31	14	12	35	32	10	33	10	31
	Q4	14	20	47	31	31	31	31	31	31	31	31	31	31	31	31	20	18	47	31	31	31	31	31
		Beverages		Condiments		Produce		Seafood																
<b>Product (Category)</b>																								

# MDX concepts

- Other tuples

(Customer.City.Paris)

Customer (City)		Köln				Berlin				Lyon				Paris			
		24	18	28	14	33	25	23	25	12	20	24	33	21	10	18	35
Time (Quarter)	Q1	21	10	18	35	35	14	23	33	25	12	24	33	21	10	18	35
	Q2	27	14	11	30	30	12	20	33	32	10	33	35	21	10	18	35
	Q3	26	12	35	32	32	10	33	35	31	10	33	32	21	10	18	35
	Q4	14	20	47	31	31	31	31	31	31	31	31	31	31	31	31	31
		Produce	Seafood	Beverages	Condiments												
Product (Category)																	

(Customer.City.Paris,  
Product.Category.Beverages)

Customer (City)		Köln				Berlin				Lyon				Paris			
		24	18	28	14	33	25	23	25	12	20	24	33	21	10	18	35
Time (Quarter)	Q1	21	10	18	35	35	14	23	33	30	12	20	30	21	10	18	35
	Q2	27	14	11	30	30	12	20	33	32	10	33	32	21	10	18	35
	Q3	26	12	35	32	32	10	33	35	31	10	33	32	31	10	33	35
	Q4	14	20	47	31	31	31	31	31	31	31	31	31	31	31	31	31
		Produce	Seafood	Beverages	Condiments												
Product (Category)																	

# MDX concepts

(Customer.City.Paris,  
Product.Category.Members,  
Time.Quarter.Members)

Customer (City)		Köln				Berlin				Lyon				Paris			
		24	18	28	14	33	25	23	25	12	20	24	33	21	10	18	35
Time (Quarter)	Q1	21	10	18	35	35	14	23	33	25	12	24	33	21	10	18	35
	Q2	27	14	11	30	30	12	20	33	32	10	33	35	31	35	14	23
	Q3	26	12	35	32	32	10	33	35	30	12	20	33	31	30	12	20
	Q4	14	20	47	31	31	31	31	31	31	31	31	31	31	31	31	31
		Produce	Seafood	Beverages	Condiments												
Product (Category)																	

(Customer.City.Paris,  
Product.Category.Beverages,  
Time.Quarter.Members)

Customer (City)		Köln				Berlin				Lyon				Paris			
		24	18	28	14	33	25	23	25	12	20	24	33	21	10	18	35
Time (Quarter)	Q1	21	10	18	35	35	14	23	33	35	14	23	33	21	10	18	35
	Q2	27	14	11	30	30	12	20	33	32	10	33	35	31	30	12	20
	Q3	26	12	35	32	32	10	33	35	30	12	20	33	31	32	10	33
	Q4	14	20	47	31	31	31	31	31	31	31	31	31	31	31	31	31
		Produce	Seafood	Beverages	Condiments												
Product (Category)																	

# MDX concepts

(Customer.City.Paris,  
Product.Category.Beverages,  
Time.Quarter.Q1)

		Customer (City)							
		Köln	Berlin	24	18	28	14		
		Paris	Lyon	33	25	23	25	14	
Q1		21	10	18	35	35	33	23	18
Q2		27	14	11	30	30	14	20	17
Q3		26	12	35	32	32	12	33	18
Q4		14	20	47	31	31	10	33	17
				Produce	Seafood				
				Beverages	Condiments				
Product (Category)									

(Customer.Country.France,  
Product.Category.Beverages,  
Time.Quarter.Q1)

		Customer (Country)							
		Germany	France	57	43	51	39		
		Q1	33	30	42	68	68	41	
Q2		39	26	41	44	44	37		
Q3		30	22	46	44	44	51		
Q4		25	29	49	41	41			
				Produce	Seafood				
				Beverages	Condiments				
Product (Category)									

# MDX concepts

- Specifying measures

Customer (City)		Köln				Berlin				Lyon				Paris					
		24	18	28	14	33	25	23	25	12	20	24	33	25	14	21	10	18	35
Time (Quarter)	Q1	21	10	18	35	35	33	23	14	12	20	30	10	33	17	27	14	11	30
	Q2	27	14	11	30	30	12	20	14	10	32	32	10	33	18	26	12	35	32
	Q3	26	12	35	32	32	10	33	12	20	31	31	10	33	18	14	20	47	31
	Q4	14	20	47	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31
Beverages Condiments				Produce Seafood				Product (Category)											

(Customer.City.Paris,  
Product.Category.Beverages,  
Time.Quarter.Q1,  
Measures.SalesAmount)

# MDX queries

- Typical MDX query

```
SELECT < axis specification >
FROM   < cube >
[ WHERE < slicer specification > ]
```

- select members to be displayed on each axis
  - AXIS(0) ↔ COLUMNS
  - AXIS(1) ↔ ROWS
  - AXIS(2) ↔ PAGES
  - AXIS(3) ↔ SECTIONS
  - AXIS(4) ↔ CHAPTERS

} **most used**

# MDX queries

- Show all measures by country

```
SELECT [Measures].Members ON COLUMNS,  
       [Customer].[Country].Members ON ROWS  
FROM [Orders]
```

- use [ ] for names with spaces, numbers, and MDX keywords

Country	Sales	Quantity
Australia	\$ 630,638.00	6,246
Austria	\$ 202,089.00	1,974
Belgium	\$ 108,485.00	1,074
Canada	\$ 224,085.00	2,293
Denmark	\$ 245,582.00	2,197

# MDX queries

- Show all measures by country

```
SELECT [Measures].Members ON COLUMNS,  
       NON EMPTY [Customer].[Country].Members ON ROWS  
FROM [Orders]
```

- use NON EMPTY to hide countries without sales

Country	Sales	Quantity
Australia	\$ 630,638.00	6,246
Austria	\$ 202,089.00	1,974
Belgium	\$ 108,485.00	1,074
Canada	\$ 224,085.00	2,293
Denmark	\$ 245,582.00	2,197

# Slicing

- Show all measures by year

```
SELECT Measures.Members ON COLUMNS,  
       Time.Year.Members ON ROWS  
FROM Orders
```

Year	Sales	Quantity
2003	\$ 4,312,435.00	38,529
2004	\$ 4,987,780.00	49,417
2005	\$ 1,980,850.00	19,475

# Slicing

- Show all measures by year for customers in Italy

```
SELECT Measures.Members ON COLUMNS,  
       Time.Year.Members ON ROWS  
  FROM Orders  
 WHERE Customer.Country.Italy
```

Year	Sales	Quantity
2003	\$ 162,640.00	1,696
2004	\$ 199,504.00	1,889
2005	\$ 41,552.00	460

# Slicing

- Show all measures by year for customers in Italy who bought Classic Cars

```
SELECT Measures.Members ON COLUMNS,  
       Time.Year.Members ON ROWS  
FROM Orders  
WHERE (Customer.Country.Italy,  
       Product.[Product Line].[Classic Cars])
```

Year	Sales	Quantity
2003	\$ 43,248.00	304
2004	\$ 89,937.00	678

# Slicing

- Show all measures by year for customers in Italy or France who bought Classic Cars

```
SELECT Measures.Members ON COLUMNS,  
       Time.Year.Members ON ROWS  
FROM Orders  
WHERE {(Customer.Country.Italy,  
        Product.[Product Line].[Classic Cars]),  
(Customer.Country.France,  
        Product.[Product Line].[Classic Cars])}
```

Year	Sales	Quantity
2003	\$ 184,463.00	1,514
2004	\$ 274,296.00	2,382
2005	\$ 63,314.00	626

# Slicing

- Show sales by country and year

```
SELECT Time.Year.Members ON COLUMNS,  
Customer.Country.Members ON ROWS  
FROM Orders  
WHERE Measures.Sales
```

Country	2003	2004	2005
Australia	\$ 253,125.00	\$ 232,267.00	\$ 145,246.00
Austria	\$ 82,131.00	\$ 51,703.00	\$ 68,255.00
Belgium	\$ 3,341.00	\$ 80,093.00	\$ 25,051.00
Canada	\$ 54,584.00	\$ 135,791.00	\$ 33,710.00
Denmark	\$ 99,205.00	\$ 120,403.00	\$ 25,974.00

# Slicing

- Show sales by country and year for Classic Cars

```
SELECT Time.Year.Members ON COLUMNS,  
       Customer.Country.Members ON ROWS  
  FROM Orders  
 WHERE (Measures.Sales,  
        Product.[Product Line].[Classic Cars])
```

Country	2003	2004	2005
Australia	\$ 85,355.00	\$ 76,198.00	\$ 31,460.00
Austria	\$ 26,647.00	\$ 15,333.00	\$ 59,480.00
Belgium	-	\$ 3,510.00	\$ 16,631.00
Canada	\$ 28,896.00	\$ 20,600.00	\$ 12,138.00
Denmark	\$ 60,756.00	\$ 70,338.00	\$ 25,974.00

# Slicing

---

- Limitations
  - if a dimension appears in an axis (SELECT), it cannot be used in a slicer (WHERE)
  - if a dimension appears in a slicer (WHERE), it cannot be used in an axis (SELECT)

# Navigation: children

- Use of CHILDREN member

```
SELECT Time.[2003].Children ON COLUMNS,  
       Customer.Country.Members ON ROWS  
FROM Orders  
WHERE Measures.Sales
```

Country	Q1	Q2	Q3	Q4
Australia	-	\$ 60,109.00	\$ 86,214.00	\$ 106,802.00
Austria	-	\$ 38,688.00	-	\$ 43,443.00
Belgium	-	\$ 1,701.00	\$ 1,640.00	-
Canada	-	-	-	\$ 54,584.00
Denmark	\$ 58,894.00	-	-	\$ 40,311.00

# Navigation: children

- Sales by quarter of 2003 in France and Italy

```
SELECT Time.[2003].Children ON COLUMNS,  
      {Customer.Country.France,  
       Customer.Country.Italy} ON ROWS  
FROM Orders  
WHERE Measures.Sales
```

Country	Q1	Q2	Q3	Q4
France	-	\$ 126,264.00	\$ 58,101.00	\$ 128,548.00
Italy	\$ 56,203.00	-	-	\$ 106,437.00

# Navigation

---

- If there is no ambiguity, all of these work

`Customer.[Customer Hierarchy].Country.France`

`Customer.Country.France`

`Customer.France`

– fully qualified form is *Dimension.Hierarchy.Level.Member*

# Navigation: children

- Sales by quarter of 2003 in German and Italian cities

```
SELECT Time.[2003].Children ON COLUMNS,  
      {Customer.Country.Germany.Children,  
       Customer.Country.Italy.Children} ON ROWS  
FROM Orders  
WHERE Measures.Sales
```

City	Q1	Q2	Q3	Q4
Frankfurt	\$ 11,424.00	-	-	\$ 27,251.00
Köln	-	-	-	\$ 31,364.00
Bergamo	\$ 56,203.00	-	-	\$ 40,078.00
Milan	-	-	-	\$ 21,711.00
Reggio Emilia	-	-	-	\$ 44,648.00

# Navigation: drilldownlevel

- Sales by quarter of 2003 in German and Italian cities, with country too

```
SELECT Time.[2003].Children ON COLUMNS,  
      {DRILLDOWNLEVEL(Customer.Country.Germany),  
       DRILLDOWNLEVEL(Customer.Country.Italy)} ON ROWS  
FROM Orders  
WHERE Measures.Sales
```

Country	City	Q1	Q2	Q3	Q4
Germany		\$ 11,424.00	-	-	\$ 58,615.00
	Frankfurt	\$ 11,424.00	-	-	\$ 27,251.00
	Köln	-	-	-	\$ 31,364.00
Italy		\$ 56,203.00	-	-	\$ 106,437.00
	Bergamo	\$ 56,203.00	-	-	\$ 40,078.00

# Navigation: descendants

- Use of DESCENDANTS at a specific level

```
SELECT Time.[2003].Children ON COLUMNS,  
       DESCENDANTS(Customer.Italy, Customer.City) ON ROWS  
FROM Orders  
WHERE Measures.Sales
```

City	Q1	Q2	Q3	Q4
Bergamo	\$ 56,203.00	-	-	\$ 40,078.00
Milan	-	-	-	\$ 21,711.00
Reggio Emilia	-	-	-	\$ 44,648.00

# Navigation: descendants

- Third argument specifies which level to include in the results

```
SELECT Time.[2003].Children ON COLUMNS,  
       DESCENDANTS(Customer.Italy,  
                  Customer.City,  
                  SELF) ON ROWS  
  
FROM Orders  
  
WHERE Measures.Sales
```

City	Q1	Q2	Q3	Q4
Bergamo	\$ 56,203.00	-	-	\$ 40,078.00
Milan	-	-	-	\$ 21,711.00
Reggio Emilia	-	-	-	\$ 44,648.00

# Navigation: descendants

- Third argument specifies which level to include in the results

```
SELECT Time.[2003].Children ON COLUMNS,  
      DESCENDANTS(Customer.Italy,  
                  Customer.City,  
                  BEFORE) ON ROWS  
FROM Orders  
WHERE Measures.Sales
```

Country	Q1	Q2	Q3	Q4
Italy	\$ 56,203.00	-	-	\$ 106,437.00

# Navigation: descendants

- Third argument specifies which level to include in the results

```
SELECT Time.[2003].Children ON COLUMNS,  
DESCENDANTS(Customer.Italy,  
Customer.City,  
SELF_AND_BEFORE) ON ROWS  
FROM Orders  
WHERE Measures.Sales
```

Country	City	Q1	Q2	Q3	Q4
Italy		\$ 56,203.00	-	-	\$ 106,437.00
	Bergamo	\$ 56,203.00	-	-	\$ 40,078.00
	Milan	-	-	-	\$ 21,711.00
	Reggio Emilia	-	-	-	\$ 44,648.00

# Navigation: descendants

- Third argument specifies which level to include in the results

```
SELECT Time.[2003].Children ON COLUMNS,  
DESCENDANTS(Customer.Italy,  
Customer.City,  
AFTER) ON ROWS  
FROM Orders  
WHERE Measures.Sales
```

Customer Name	Q1	Q2	Q3	Q4
Rovelli Gifts	\$ 56,203.00	-	-	\$ 40,078.00
Frau da Collezione		-	-	\$ 21,711.00
L'ordine Souveniers	-	-	-	\$ 44,648.00

# Navigation: descendants

- Third argument specifies which level to include in the results

```
SELECT Time.[2003].Children ON COLUMNS,  
      DESCENDANTS(Customer.Italy,  
                  Customer.City,  
                  SELF_AND_AFTER) ON ROWS  
FROM Orders  
WHERE Measures.Sales
```

City	Customer Name	Q1	Q2	Q3	Q4
Bergamo		\$ 56,203.00	-	-	\$ 40,078.00
	Rovelli Gifts	\$ 56,203.00	-	-	\$ 40,078.00
Milan		-	-	-	\$ 21,711.00
	Frau da Collezione	-	-	-	\$ 21,711.00

# Navigation: descendants

- Third argument specifies which level to include in the results

```
SELECT Time.[2003].Children ON COLUMNS,  
      DESCENDANTS(Customer.Italy,  
                  Customer.City,  
                  BEFORE_AFTER) ON ROWS  
FROM Orders  
WHERE Measures.Sales
```

Country	Customer Name	Q1	Q2	Q3	Q4
Italy	Rovelli Gifts	\$ 56,203.00	-	-	\$ 106,437.00
	Frau da Collezione	\$ 56,203.00	-	-	\$ 40,078.00
	L'ordine Souveniers	-	-	-	\$ 21,711.00
		-	-	-	\$ 44,648.00

# Navigation: descendants

- Third argument specifies which level to include in the results

```
SELECT Time.[2003].Children ON COLUMNS,  
DESCENDANTS(Customer.Italy,  
Customer.City,  
SELF_BEFORE_AFTER) ON ROWS  
FROM Orders  
WHERE Measures.Sales
```

Country	City	Customer Name	Q1	Q2	Q3	Q4
Italy			\$ 56,203.00	-	-	\$ 106,437.00
	Bergamo		\$ 56,203.00	-	-	\$ 40,078.00
		Rovelli Gifts	\$ 56,203.00	-	-	\$ 40,078.00
	Milan		-	-	-	\$ 21,711.00
		Frau da Collezione	-	-	-	\$ 21,711.00

# Navigation: descendants

- DESCENDANTS returns a set that includes all the descendants of a member and the member itself

```
SELECT Time.[2003].Children ON COLUMNS,  
       DESCENDANTS(Customer.City.Milan) ON ROWS  
FROM Orders  
WHERE Measures.Sales
```

(All)	Country	City	Q1	Q2	Q3	Q4
All Customers	Italy	Milan	-	-	-	\$ 21,711.00
			\$ 56,203.00	-	-	\$ 106,437.00
			\$ 1,080,270.00	\$ 564,875.00	\$ 687,296.00	\$ 1,979,994.00

# Navigation: ancestor

- Use of ANCESTOR at a specific level

```
SELECT Time.[2003].Children ON COLUMNS,  
       ANCESTOR(Customer.City.Milan,  
                  Customer.Country) ON ROWS  
FROM Orders  
WHERE Measures.Sales
```

Country	Q1	Q2	Q3	Q4
Italy	\$ 56,203.00	-	-	\$ 106,437.00

# Cross join

- Multiple dimensions on ROWS or COLUMNS

```
SELECT Product.[Product Line].Members ON COLUMNS,  
      CROSSJOIN(Customer.Country.Members,  
                Time.Year.Members) ON ROWS  
FROM Orders  
WHERE Measures.Sales
```

Country	Year	Classic Cars	Motorcycles	Planes	Ships
Australia	2003	\$ 85,355.00	\$ 42,337.00	\$ 22,316.00	-
	2004	\$ 76,198.00	\$ 33,077.00	\$ 41,416.00	\$ 1,080.00
	2005	\$ 31,460.00	\$ 14,478.00	\$ 11,086.00	\$ 3,072.00
Austria	2003	\$ 26,647.00	-	\$ 14,221.00	\$ 9,028.00
	2004	\$ 15,333.00	\$ 26,060.00	\$ 3,638.00	-

# Cross join

- Multiple dimensions on ROWS or COLUMNS

```
SELECT Product.[Product Line].Members ON COLUMNS,  
      Customer.Country.Members * Time.Year.Members ON ROWS  
FROM Orders  
WHERE Measures.Sales
```

Country	Year	Classic Cars	Motorcycles	Planes	Ships
Australia	2003	\$ 85,355.00	\$ 42,337.00	\$ 22,316.00	-
	2004	\$ 76,198.00	\$ 33,077.00	\$ 41,416.00	\$ 1,080.00
	2005	\$ 31,460.00	\$ 14,478.00	\$ 11,086.00	\$ 3,072.00
Austria	2003	\$ 26,647.00	-	\$ 14,221.00	\$ 9,028.00
	2004	\$ 15,333.00	\$ 26,060.00	\$ 3,638.00	-

# Calculated members

- Define new member or measure inside the query

```
WITH MEMBER Measures.SalesPerUnit AS  
      (Measures.Sales / Measures.Quantity)  
SELECT Measures.SalesPerUnit ON COLUMNS,  
      Customer.Country.Members ON ROWS  
FROM Orders
```

Country	SalesPerUnit
Australia	\$ 100.97
Austria	\$ 102.38
Belgium	\$ 101.01
Canada	\$ 97.73
Denmark	\$ 111.78

# Calculated members

- Define new member or measure inside the query

```
WITH MEMBER Measures.SalesPerUnit AS  
    (Measures.Sales / Measures.Quantity)  
SELECT Measures.AllMembers ON COLUMNS,  
      Customer.Country.Members ON ROWS  
FROM Orders
```

Country	Sales	Quantity	SalesPerUnit
Australia	\$ 630,638.00	6,246	\$ 100.97
Austria	\$ 202,089.00	1,974	\$ 102.38
Belgium	\$ 108,485.00	1,074	\$ 101.01
Canada	\$ 224,085.00	2,293	\$ 97.73
Denmark	\$ 245,582.00	2,197	\$ 111.78

# Calculated members

- Define new member or measure inside the query

```
WITH MEMBER Product.Cars AS  
    Product.[Product Line].[Classic Cars]  
    + Product.[Product Line].[Vintage Cars]  
SELECT Time.Year.Members ON COLUMNS,  
    Product.Cars ON ROWS  
FROM Orders  
WHERE Measures.Sales
```

(All)	2003	2004	2005
Cars	\$ 2,829,087.00	\$ 2,835,612.00	\$ 1,127,404.00

# Named sets

- Define an alias for a set of members

```
WITH SET [Nordic Countries] AS
    {Customer.Country.Denmark, Customer.Country.Finland,
     Customer.Country.Norway, Customer.Country.Sweden}
SELECT Time.Year.Members ON COLUMNS,
      [Nordic Countries] ON ROWS
FROM Orders
WHERE Measures.Sales
```

Country	2003	2004	2005
Denmark	\$ 99,205.00	\$ 120,403.00	\$ 25,974.00
Finland	\$ 111,076.00	\$ 91,568.00	\$ 126,828.00
Norway	\$ 196,355.00	\$ 110,977.00	-
Sweden	\$ 58,485.00	\$ 120,006.00	\$ 31,569.00

# Named sets

- Define an alias for a set of members

```
WITH SET TopCountries AS  
    TOPCOUNT(Customer.Country.Members, 3, Measures.Sales)  
SELECT Measures.Members ON COLUMNS,  
      TopCountries ON ROWS  
FROM Orders
```

Country	Sales	Quantity
USA	\$ 4,263,627.00	37,749
Spain	\$ 1,215,356.00	12,429
France	\$ 1,111,022.00	11,090

# Relative navigation

- Define new measure based on relative navigation

```
WITH MEMBER Measures.PercentSales AS  
    (Measures.Sales, Customer.Country.CurrentMember)  
    / (Measures.Sales, Customer.Country.CurrentMember.Parent),  
    FORMAT_STRING = '#0.00'%  
SELECT {Measures.Sales, Measures.PercentSales} ON COLUMNS,  
Customer.Country.Members ON ROWS  
FROM Orders
```

Country	Sales	PercentSales
Australia	\$ 630,638.00	5.59%
Austria	\$ 202,089.00	1.79%
Belgium	\$ 108,485.00	0.96%
Canada	\$ 224,085.00	1.99%

# Relative navigation

- Define new measure based on relative navigation

```
WITH MEMBER Measures.[Previous Month] AS  
      Time.Month.CurrentMember.PrevMember  
MEMBER Measures.[Sales Growth] AS  
      Measures.Sales - Measures.[Previous Month]  
SELECT {Measures.Sales,  
        Measures.[Previous Month],  
        Measures.[Sales Growth]} ON COLUMNS,  
DESCENDANTS(Time.Year.[2004], Time.Month) ON ROWS  
FROM Orders
```

Month	Sales	Previous Month	Sales Growth
Jan	\$ 316,662.00	303,464	\$ 13,198.00
Feb	\$ 318,663.00	316,662	\$ 2,001.00
Mar	\$ 242,222.00	318,663	-\$ 76,441.00

# Relative navigation

- Define new measure based on relative navigation

```
WITH MEMBER Measures.[Previous Year] AS  
    PARALLELPERIOD(Time.Month, 12)  
MEMBER Measures.[Sales Growth] AS  
    Measures.Sales - Measures.[Previous Year]  
SELECT {Measures.Sales,  
        Measures.[Previous Year],  
        Measures.[Sales Growth]} ON COLUMNS,  
DESCENDANTS(Time.Year.[2004], Time.Month) ON ROWS  
FROM Orders
```

Month	Sales	Previous Year	Sales Growth
Jan	\$ 316,662.00	764,883	-\$ 448,221.00
Feb	\$ 318,663.00	140,920	\$ 177,743.00
Mar	\$ 242,222.00	174,467	\$ 67,755.00

# Filtering

- Filter members based on condition

```
SELECT Measures.Members ON COLUMNS,  
       FILTER(Customer.Country.Members,  
              Measures.Sales > 1000000) ON ROWS  
FROM Orders
```

Country	Sales	Quantity
France	\$ 1,111,022.00	11,090
Spain	\$ 1,215,356.00	12,429
USA	\$ 4,263,627.00	37,749

# Filtering

- Filter members based on condition

```
SELECT Time.Year.Members ON COLUMNS,  
      FILTER(Customer.Country.Members,  
             (Measures.Sales, Time.[2004]) > 250000) ON ROWS  
FROM Orders  
WHERE Measures.Sales
```

Country	2003	2004	2005
France	\$ 312,913.00	\$ 555,193.00	\$ 242,916.00
New Zealand	\$ 90,055.00	\$ 256,376.00	\$ 189,185.00
Spain	\$ 405,336.00	\$ 483,344.00	\$ 326,676.00
UK	\$ 180,317.00	\$ 257,648.00	\$ 40,755.00
USA	\$ 1,940,324.00	\$ 1,685,741.00	\$ 637,562.00

# Sorting

- Sales and quantity by country

```
SELECT Measures.Members ON COLUMNS,  
       Customer.Country.Members ON ROWS  
FROM Orders
```

Country	Sales	Quantity
Australia	\$ 630,638.00	6,246
Austria	\$ 202,089.00	1,974
Belgium	\$ 108,485.00	1,074
Canada	\$ 224,085.00	2,293
Denmark	\$ 245,582.00	2,197
Finland	\$ 329,472.00	3,192

# Sorting

- Sales and quantity by country sorted by sales

```
SELECT Measures.Members ON COLUMNS,  
       ORDER(Customer.Country.Members,  
             Measures.Sales, DESC) ON ROWS  
FROM Orders
```

Country	Sales	Quantity
USA	\$ 4,263,627.00	37,749
Spain	\$ 1,215,356.00	12,429
France	\$ 1,111,022.00	11,090
Australia	\$ 630,638.00	6,246
New Zealand	\$ 535,616.00	5,396
UK	\$ 478,720.00	5,013

# Top analysis

- Top 3 countries by sales

```
SELECT Measures.Members ON COLUMNS,  
       HEAD(ORDER(Customer.Country.Members,  
                  Measures.Sales, DESC), 3) ON ROWS  
FROM Orders
```

Country	Sales	Quantity
USA	\$ 4,263,627.00	37,749
Spain	\$ 1,215,356.00	12,429
France	\$ 1,111,022.00	11,090

# Top analysis

- Top 3 countries by sales (another approach)

```
SELECT Measures.Members ON COLUMNS,  
       TOPCOUNT(Customer.Country.Members, 3,  
               Measures.Sales) ON ROWS  
FROM Orders
```

Country	Sales	Quantity
USA	\$ 4,263,627.00	37,749
Spain	\$ 1,215,356.00	12,429
France	\$ 1,111,022.00	11,090

# Top analysis

- Top 50% countries by sales

```
SELECT Measures.Members ON COLUMNS,  
TOPPERCENT(Customer.Country.Members, 50,  
Measures.Sales) ON ROWS  
FROM Orders
```

Country	Sales	Quantity
USA	\$ 4,263,627.00	37,749
Spain	\$ 1,215,356.00	12,429
France	\$ 1,111,022.00	11,090