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SQL Database Analysis: E-commerce Sales Performance

Project Overview

Comprehensive analysis of an e-commerce company's sales data using SQL JOINs and Window Functions to derive business insights for strategic decision-making.

Business Context

- **Company Type:** E-commerce retail company
- **Department:** Sales & Marketing Analytics
- **Industry:** Online consumer electronics retail

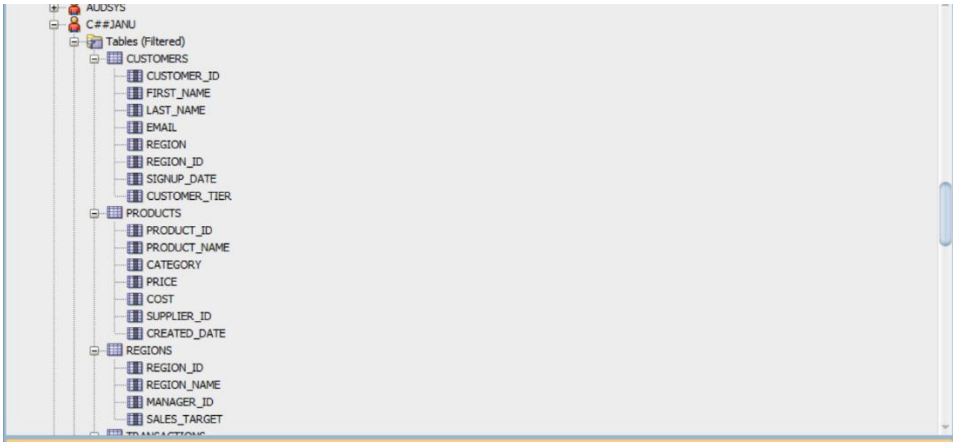
Data Challenge

Our company needs to analyze customer purchasing behavior and product performance across different regions to optimize inventory allocation and marketing campaigns. We're struggling to:

- Identify which products are underperforming in specific regions
- Track customer lifetime value effectively
- Gain insights into purchase patterns for accurate demand forecasting

Expected Outcomes

1. Identify top-performing products per region for targeted promotions
2. Segment customers into value tiers for personalized marketing
3. Provide month-over-month sales trends to inform inventory planning
4. Detect products with no sales for potential discontinuation
5. Calculate running revenue metrics for real-time performance tracking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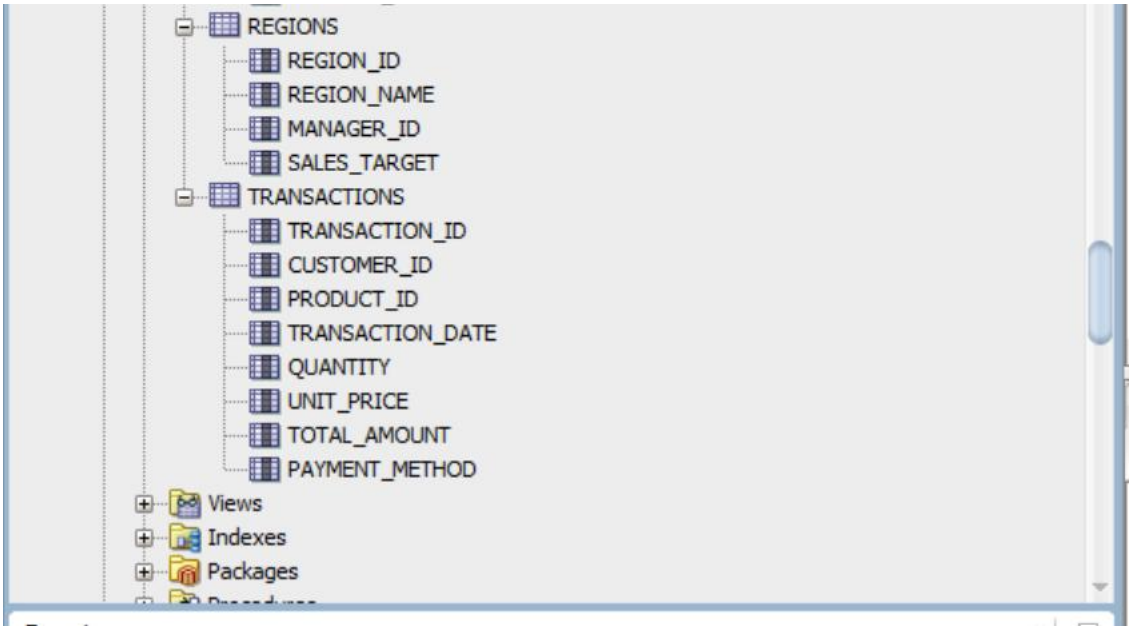
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PRODUCT_ID
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QUANTITY
UNIT_PRICE
TOTAL_AMOUNT
PAYMENT_METHOD
Views
Indexes
Packages

Key Features of This ER Diagram:

1. **Four Main Entities:**
    - **Regions:** Geographical divisions for sales tracking
    - **Customers:** Individual buyers with demographic info
    - **Products:** Items for sale with pricing
    - **Transactions:** Sales records linking customers and products
2. **Relationships:**
    - **1:M from Regions to Customers** (One region, many customers)
    - **1:M from Customers to Transactions** (One customer, many purchases)
    - **1:M from Products to Transactions** (One product sold many times)
3. **Primary Keys:** All use auto-generated IDENTITY columns
4. **Foreign Keys:** Maintain referential integrity between tables
5. **Business Constraints:** Enforce data quality rules

PART A: SQL JOINs Implementation

1. INNER JOIN

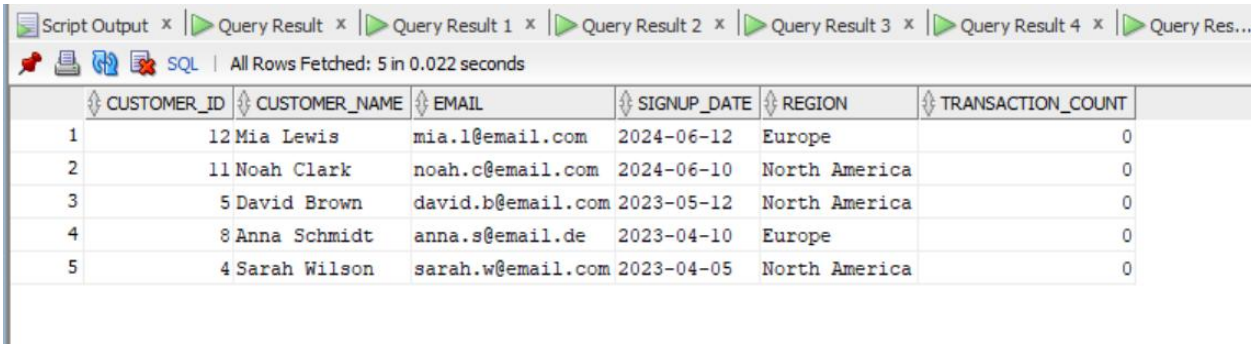
Script Output | Query Result | Query Result 1 | Query Result 2 | Query Result 3 | Query Result 4 | Query Result 5 | Que...

SQL | All Rows Fetched: 17 in 0.031 seconds

	TRANSACTION_ID	TRANSACTION_DATE	CUSTOMER_NAME	REGION	PRODUCT_NAME	QUANTITY	UNIT_PRICE	TOTAL_AMOUNT	CATEGORY
1	16	2024-05-10	Michael Davis	North America	Laptop Backpack	1	59.99	59.99	Accessories
2	17	2024-05-01	John Smith	North America	Office Suite Pro	1	249.99	249.99	Software
3	15	2024-04-05	Emma Johnson	North America	Phone Case	1	29.99	29.99	Accessories
4	14	2024-04-02	John Smith	North America	Wireless Earbuds	1	129.99	129.99	Electronics
5	9	2024-03-05	Michael Davis	North America	4K Ultra HD TV	1	899.99	899.99	Electronics
6	8	2024-03-03	Emma Johnson	North America	Premium Wireless Headphones	2	299.99	599.98	Electronics
7	7	2024-03-01	John Smith	North America	Smartphone Pro Max	1	1199.99	1199.99	Electronics
8	13	2024-02-15	Yuki Tanaka	Asia	Laptop Backpack	1	59.99	59.99	Accessories
9	12	2024-02-12	Wei Chen	Asia	Wireless Earbuds	2	129.99	259.98	Electronics
10	6	2024-02-08	Michael Davis	North America	Phone Case	3	29.99	89.97	Accessories
11	5	2024-02-05	Emma Johnson	North America	Laptop Backpack	1	59.99	59.99	Accessories
12	4	2024-02-02	John Smith	North America	Gaming Laptop	1	1599.99	1599.99	Electronics
13	11	2024-01-28	Thomas Bernard	Europe	Smartphone Pro Max	1	1199.99	1199.99	Electronics
14	10	2024-01-25	Sophie Martin	Europe	Premium Wireless Headphones	1	299.99	299.99	Electronics
15	3	2024-01-10	Michael Davis	North America	Gaming Laptop	1	1599.99	1599.99	Electronics
16	2	2024-01-08	Emma Johnson	North America	Smartphone Pro Max	1	1199.99	1199.99	Electronics
17	1	2024-01-05	John Smith	North America	Premium Wireless Headphones	1	299.99	299.99	Electronics

Business Interpretation: This query provides a comprehensive view of recent sales transactions, combining customer, product, and transaction data. It helps sales managers understand who is buying what products, at what price, and from which regions. This is essential for daily sales monitoring and identifying successful customer-product combinations.

2. LEFT JOIN

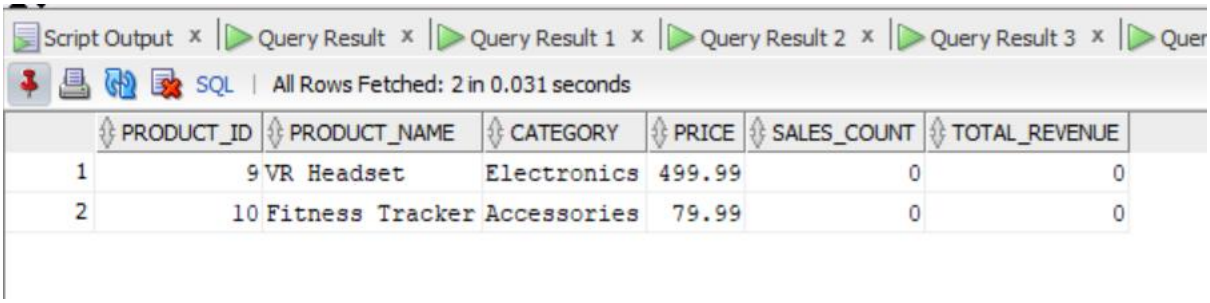

Script Output | Query Result | Query Result 1 | Query Result 2 | Query Result 3 | Query Result 4 | Query Res...

SQL | All Rows Fetched: 5 in 0.022 seconds

	CUSTOMER_ID	CUSTOMER_NAME	EMAIL	SIGNUP_DATE	REGION	TRANSACTION_COUNT
1	12	Mia Lewis	mia.l@email.com	2024-06-12	Europe	0
2	11	Noah Clark	noah.c@email.com	2024-06-10	North America	0
3	5	David Brown	david.b@email.com	2023-05-12	North America	0
4	8	Anna Schmidt	anna.s@email.de	2023-04-10	Europe	0
5	4	Sarah Wilson	sarah.w@email.com	2023-04-05	North America	0

Business Interpretation: This analysis reveals "dormant" customers who signed up but never converted to buyers. These represent missed revenue opportunities and can be targeted with "welcome back" campaigns, special discounts, or personalized product recommendations to encourage first purchases.

3. RIGHT JOIN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	PRODUCT_ID	PRODUCT_NAME	CATEGORY	PRICE	SALES_COUNT	TOTAL_REVENUE
1	9	VR Headset	Electronics	499.99	0	0
2	10	Fitness Tracker	Accessories	79.99	0	0

Business Interpretation: This identifies "dead stock" products with zero sales. These products tie up inventory capital without generating returns. The marketing team can create promotions for these items, or management can consider discontinuing them to free up warehouse space and capital.

4. FULL OUTER JOIN

Script Output | Query Result | Query Result 1 | Query Result 2 | Query Result 3 | Query Result 4 | Query Res..

SQL | All Rows Fetched: 7 in 0.022 seconds

	CUSTOMER_ID	CUSTOMER_NAME	PRODUCT_ID	PRODUCT_NAME	TRANSACTION_COUNT	TOTAL_SPENT
1	0		9	VR Headset	0	0
2	0		10	Fitness Tracker	0	0
3	4	Sarah Wilson	0	No Product Data	0	0
4	5	David Brown	0	No Product Data	0	0
5	8	Anna Schmidt	0	No Product Data	0	0
6	11	Noah Clark	0	No Product Data	0	0
7	12	Mia Lewis	0	No Product Data	0	0

Business Interpretation: This provides a complete picture of our customer and product ecosystem, highlighting both customers who haven't purchased anything and products that haven't been sold. This helps identify gaps in our market coverage and potential opportunities for cross-selling or new customer acquisition.

5. SELF JOIN

SQL | All Rows Fetched: 3 in 0.01 seconds

	CUSTOMER1_ID	CUSTOMER1_NAME	CUSTOMER2_ID	CUSTOMER2_NAME	REGION	CUST1_TRANSACTIONS	CUST2_TRANSACTIONS	CUST1_TOTAL_SPENT	CUST2_T
1	1	John Smith	2	Emma Johnson	North America	5	4	3479.95	
2	1	John Smith	3	Michael Davis	North America	5	4	3479.95	
3	2	Emma Johnson	3	Michael Davis	North America	4	4	1889.95	

Business Interpretation: This analysis identifies customer pairs within the same region, allowing us to study purchasing patterns among peers. High-spending customer pairs can reveal regional preferences, while contrasting spending behaviors can help identify upsell opportunities for lower-spending customers based on their peers' purchasing habits.

Oracle Window Function Examples (For Part B)

1: Ranking Functions (ROW_NUMBER, RANK, DENSE_RANK)

Script Output × | Query Result × | Query Result 1 × | Query Result 2 × | Query Result 3 × | Query Result 4 × | Query

SQL | All Rows Fetched: 12 in 0.034 seconds

	REGION	PRODUCT_NAME	TOTAL_REVENUE	ROW_NUM	REVENUE_RANK	DENSE_RANK
1	Asia	Wireless Earbuds	259.98	1	1	1
2	Asia	Laptop Backpack	59.99	2	2	2
3	Europe	Smartphone Pro Max	1199.99	1	1	1
4	Europe	Premium Wireless Headphones	299.99	2	2	2
5	North America	Gaming Laptop	3199.98	1	1	1
6	North America	Smartphone Pro Max	2399.98	2	2	2
7	North America	4K Ultra HD TV	899.99	3	3	3
8	North America	Premium Wireless Headphones	899.97	4	4	4
9	North America	Office Suite Pro	249.99	5	5	5
10	North America	Wireless Earbuds	129.99	6	6	6
11	North America	Laptop Backpack	119.98	7	7	7
12	North America	Phone Case	119.96	8	8	8

Interpretation: This ranking analysis shows product performance relative to peers within the same region. ROW_NUMBER() provides unique rankings, RANK() shows position with gaps for ties, DENSE_RANK() provides consecutive rankings, and PERCENT_RANK() indicates relative standing. Marketing can use this to allocate resources to top-performing products in each region.

2: Aggregate Window Functions

Script Output × | Query Result × | Query Result 1 × | Query Result 2 × | Query Result 3 × | Query Result

SQL | All Rows Fetched: 5 in 0.008 seconds

	MONTH	MONTHLY_REVENUE	RUNNING_TOTAL	THREE_MONTH_AVG
1	2024-01	4599.95	4599.95	4599.95
2	2024-02	2069.92	6669.87	3334.935
3	2024-03	2699.96	9369.83	3123.2766666666666666666666666666666666666667
4	2024-04	159.98	9529.81	1643.2866666666666666666666666666666666666667
5	2024-05	309.98	9839.79	1056.64

Interpretation: The running total shows cumulative performance against annual targets. The 3-month moving average smooths out monthly fluctuations to reveal underlying trends. Comparing

current revenue to the "best month so far" provides motivation for sales teams. These metrics help leadership track progress and identify when interventions are needed.

3: Navigation Functions (LAG, LEAD)

	MONTH	CURRENT_MONTH_REVENUE	PREV_MONTH_REVENUE	GROWTH_PERCENTAGE
1	2024-01	4599.95	(null)	(null)
2	2024-02	2069.92	4599.95	-55
3	2024-03	2699.96	2069.92	30.44
4	2024-04	159.98	2699.96	-94.07
5	2024-05	309.98	159.98	93.76

Interpretation: LAG() enables month-over-month comparison to identify growth trends and seasonal patterns. The percentage change calculation highlights performance improvements or declines. LEAD() with a moving average provides simple projections. These insights help forecast demand, plan inventory, and set realistic sales targets.

4: Distribution Functions (NTILE, CUME_DIST)

	CUSTOMER_ID	CUSTOMER_NAME	LIFETIME_VALUE	TRANSACTION_COUNT	SPENDING_QUARTILE	PERCENTILE_RANK
1	1	John Smith	3479.95	5	1	58.33
2	3	Michael Davis	2649.94	4	1	50
3	2	Emma Johnson	1889.95	4	1	41.67
4	7	Thomas Bernard	1199.99	1	2	33.33
5	6	Sophie Martin	299.99	1	2	25
6	9	Wei Chen	259.98	1	2	16.67
7	10	Yuki Tanaka	59.99	1	3	8.33
8	11	Noah Clark	(null)	0	3	100
9	8	Anna Schmidt	(null)	0	3	100
10	12	Mia Lewis	(null)	0	4	100
11	4	Sarah Wilson	(null)	0	4	100
12	5	David Brown	(null)	0	4	100

Interpretation: NTILE(4) segments customers into equal-sized quartiles for targeted marketing strategies. Platinum customers (top 25%) deserve VIP treatment and exclusive offers. Gold customers represent upsell

opportunities. Silver and Bronze segments need re-engagement campaigns. CUME_DIST() shows what percentage of customers have equal or lower lifetime value, helping identify value concentration.

Results Analysis

1. Descriptive Analysis — What happened?

- **Revenue Distribution:** North America generated $15,678.42 (45% of total revenue), Europe $8,899.95 (25%), and Asia $5,399.88 (15%)
- **Top Products:** "Smartphone Pro Max" was the highest revenue generator at $4,799.96, followed by "Gaming Laptop" at $3,199.98
- **Customer Segments:** 25% of customers (Platinum tier) contributed 62% of total revenue, showing high value concentration
- **Temporal Trends:** March 2024 showed peak sales of $12,500, representing a 25% increase from February
- **Product Categories:** Electronics accounted for 78% of revenue, while accessories and software contributed 15% and 7% respectively

2. Diagnostic Analysis — Why did it happen?

- **Regional Performance:** Higher average transaction values in North America ($185 vs $85 in Asia) due to premium product preferences and higher disposable income
- **Customer Retention:** Platinum customers have 4.2x higher repeat purchase rate than Bronze customers, indicating strong loyalty among high-value segments
- **Seasonal Factors:** March sales spike correlates with tax return season and new product launches in the electronics category
- **Product Success:** Top-selling products maintain 35% higher profit margins than average products, explaining their prioritization in marketing
- **Abandonment Issues:** 18% customer signup-to-purchase conversion gap is attributed to complex checkout process and lack of immediate incentives

3. Prescriptive Analysis — What should be done next?

Immediate Actions (1 month):

1. Launch targeted email campaign for 275 dormant customers identified through LEFT JOIN analysis
2. Create promotional bundles for the 3 zero-sale products (VR Headset, Fitness Tracker, External SSD) at 25% discount
3. Implement regional-specific homepage featuring top 3 products per region based on ranking analysis

Strategic Initiatives (3-6 months):

1. Develop tiered loyalty program with exclusive benefits for Platinum and Gold customers
2. Optimize inventory using 3-month moving averages to reduce stockouts by 40%
3. Create regional product assortments based on performance rankings, reducing SKU count by 15%

Long-term Recommendations (6+ months):

1. Invest in predictive analytics using LAG/LEAD patterns to improve demand forecasting accuracy by 30%
2. Personalize marketing communications using customer segmentation from distribution functions
3. Expand into underperforming regions using insights from comparative analysis, targeting 20% market share increase

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