Reporting Aggregated Data Using the Group Functions

Objectives

After completing this lesson, you should be able to do the following:

- Identify the available group functions
- Describe the use of group functions
- Group data by using the `GROUP BY` clause
- Include or exclude grouped rows by using the `HAVING` clause

Lesson Agenda

- Group functions:
  - Types and syntax
  - Use `AVG`, `SUM`, `MIN`, `MAX`, `COUNT`
  - Use `DISTINCT` keyword within group functions
  - `NULL` values in a group function
- Grouping rows:
  - `GROUP BY` clause
  - `HAVING` clause
- Nesting group functions

What Are Group Functions?

Group functions operate on sets of rows to give one result per group.

EMPLOYEES

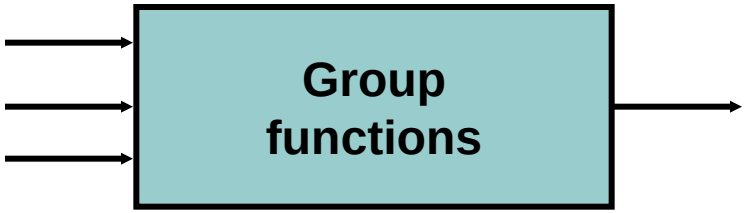
	DEPARTMENT_ID	SALARY
1	90	24000
2	90	17000
3	90	17000
4	60	9000
5	60	6000
6	60	4200
7	50	5800
8	50	3500
9	50	3100
10	50	2600
...		
18	20	6000
19	110	12000
20	110	8300

Maximum salary in EMPLOYEES table

MAX(SALARY)
24000

Types of Group Functions

- AVG
- COUNT
- MAX
- MIN
- STDDEV
- SUM
- VARIANCE



Group Functions: Syntax

```
SELECT      group_function(column), ...
FROM        table
[WHERE      condition]
[ORDER BY   column];
```

Using the AVG and SUM Functions

You can use AVG, MAX, MIN and SUM for numeric data.

```
SELECT  AVG(salary), MAX(salary),
        MIN(salary), SUM(salary)
FROM    employees
WHERE   job_id LIKE '%REP%';
```

	AVG(SALARY)	MAX(SALARY)	MIN(SALARY)	SUM(SALARY)
1	8150	11000	6000	32600

Using the MIN and MAX Functions

You can use MIN and MAX for numeric, character, and date data types.

```
SELECT MIN(hire_date), MAX(hire_date)
FROM       employees;
```

	MIN(HIRE_DATE)	MAX(HIRE_DATE)
1	17-JUN-87	29-JAN-00

Using the COUNT Function

`COUNT(*)` returns the number of rows (records) in a table:

1

```
SELECT COUNT(*)
FROM   employees
WHERE  department_id = 50;
```

	COUNT(*)
1	5

`COUNT(expr)` returns the number of rows with non-null values for *expr*:

2

```
SELECT COUNT(commission_pct)
FROM   employees
WHERE  department_id = 80;
```

	COUNT(COMMISSION_PCT)
1	3

Using the DISTINCT Keyword

- COUNT(DISTINCT *expr*) returns the number of distinct non-null values of *expr*.
- To display the number of distinct department values in the EMPLOYEES table:

```
SELECT COUNT(DISTINCT department_id)
FROM   employees;
```

	COUNT(DISTINCTDEPARTMENT_ID)
1	7

Group Functions and Null Values

Group functions ignore null values in the column:

1

```
SELECT AVG(commission_pct)
FROM   employees;
```

	AVG(COMMISSION_PCT)
1	0.2125

The NVL function forces group functions to include null values:

2

```
SELECT AVG(NVL(commission_pct, 0))
FROM   employees;
```

	AVG(NVL(COMMISSION_PCT,0))
1	0.0425

W3C SQL Tutorial

https://www.w3schools.com/sql/

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  - `GROUP BY` clause
  - `HAVING` clause
- Nesting group functions

Creating Groups of Data

EMPLOYEES

	DEPARTMENT_ID	SALARY	
1	10	4400	4400
2	20	13000	9500
3	20	6000	
4	50	5800	
5	50	2500	
6	50	2600	3500
7	50	3100	
8	50	3500	
9	60	4200	6400
10	60	6000	
11	60	9000	
12	80	11000	10033
13	80	10500	
14	80	8600	
...			
19	110	12000	
20	(null)	7000	

Average salary in EMPLOYEES table for each department

	DEPARTMENT_ID	AVG(SALARY)
1	10	4400
2	20	9500
3	50	3500
4	60	6400
5	80	10033.333333333333...
6	90	19333.333333333333...
7	110	10150
8	(null)	7000

Creating Groups of Data: GROUP BY Clause Syntax

```
SELECT     column, group_function(column)
FROM       table
[WHERE     condition]
[GROUP BY  group_by_expression]
[ORDER BY  column];
```

You can divide rows in a table into smaller groups by using the GROUP BY clause.

Using the GROUP BY Clause

All columns in the SELECT list that are not in group functions must be in the GROUP BY clause.

```
SELECT    department_id, AVG(salary)
FROM      employees
GROUP BY department_id ;
```

	DEPARTMENT_ID	AVG(SALARY)
1	(null)	7000
2	90	19333.33333333333...
3	20	9500
4	110	10150
5	50	3500
6	80	10033.33333333333...
7	60	6400
8	10	4400

Using the GROUP BY Clause

The GROUP BY column does not have to be in the SELECT list.

```
SELECT   AVG(salary)
FROM     employees
GROUP BY department_id ;
```

	AVG(SALARY)
1	7000
2	19333.333333333333333333...
3	9500
4	10150
5	3500
6	10033.333333333333333333...
7	6400
8	4400

Grouping by More than One Column

EMPLOYEES

	DEPARTMENT_ID	JOB_ID	SALARY
1	10	AD_ASST	4400
2	20	MK_MAN	13000
3	20	MK_REP	6000
4	50	ST_MAN	5800
5	50	ST_CLERK	2500
6	50	ST_CLERK	2600
7	50	ST_CLERK	3100
8	50	ST_CLERK	3500
9	60	IT_PROG	4200
10	60	IT_PROG	6000
11	60	IT_PROG	9000
12	80	SA_REP	11000
13	80	SA_MAN	10500
14	80	SA_REP	8600
...			
19	110	AC_MGR	12000
20	(null)	SA_REP	7000

Add the salaries in the EMPLOYEES table for each job, grouped by department.

	DEPARTMENT_ID	JOB_ID	SUM(SALARY)
1	10	AD_ASST	4400
2	20	MK_MAN	13000
3	20	MK_REP	6000
4	50	ST_CLERK	11700
5	50	ST_MAN	5800
6	60	IT_PROG	19200
7	80	SA_MAN	10500
8	80	SA_REP	19600
9	90	AD_PRES	24000
10	90	AD_VP	34000
11	110	AC_ACCOUNT	8300
12	110	AC_MGR	12000
13	(null)	SA_REP	7000

Using the GROUP BY Clause on Multiple Columns

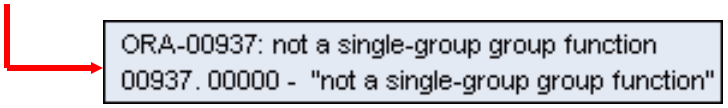
```
SELECT   department_id, job_id, SUM(salary)
FROM     employees
WHERE     department_id > 40
GROUP BY department_id, job_id
ORDER BY department_id;
```

	DEPARTMENT_ID	JOB_ID	SUM(SALARY)
1	50	ST_CLERK	11700
2	50	ST_MAN	5800
3	60	IT_PROG	19200
4	80	SA_MAN	10500
5	80	SA_REP	19600
6	90	AD_PRES	24000
7	90	AD_VP	34000
8	110	AC_ACCOUNT	8300
9	110	AC_MGR	12000

Illegal Queries Using Group Functions

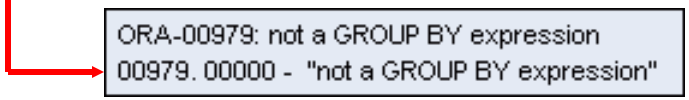
Any column or expression in the `SELECT` list that is not an aggregate function must be in the `GROUP BY` clause:

```
SELECT department_id, COUNT(last_name)
FROM   employees;
```



A `GROUP BY` clause must be added to count the last names for each `department_id`.

```
SELECT department_id, job_id, COUNT(last_name)
FROM   employees
GROUP BY department_id;
```

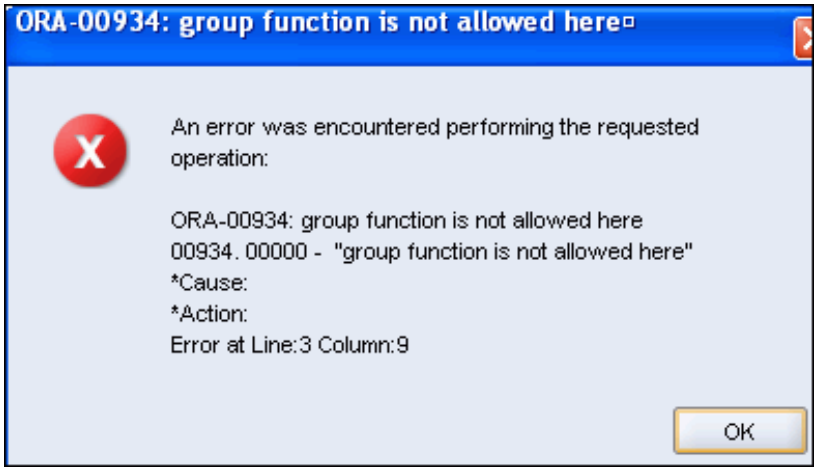


Either add `job_id` in the `GROUP BY` or remove the `job_id` column from the `SELECT` list.

Illegal Queries Using Group Functions

- You cannot use the `WHERE` clause to restrict groups.
- You use the `HAVING` clause to restrict groups.
- You cannot use group functions in the `WHERE` clause.

```
SELECT   department_id, AVG(salary)
FROM     employees
WHERE    AVG(salary) > 8000
GROUP BY department_id;
```



Cannot use the `WHERE` clause to restrict groups

Restricting Group Results

EMPLOYEES

	DEPARTMENT_ID	SALARY
1	10	4400
2	20	13000
3	20	6000
4	50	5800
5	50	2500
6	50	2600
7	50	3100
8	50	3500
9	60	4200
10	60	6000
11	60	9000
12	80	11000
13	80	10500
14	80	8600

...

18	110	8300
19	110	12000
20	(null)	7000

The maximum salary per department when it is greater than $10,000

	DEPARTMENT_ID	MAX(SALARY)
1	20	13000
2	80	11000
3	90	24000
4	110	12000

Restricting Group Results with the HAVING Clause

When you use the HAVING clause, the Oracle server restricts groups as follows:

1. Rows are grouped.
2. The group function is applied.
3. Groups matching the HAVING clause are displayed.

```
SELECT     column, group_function
FROM       table
[WHERE     condition]
[GROUP BY  group_by_expression]
[HAVING    group_condition]
[ORDER BY  column];
```

Using the HAVING Clause

```
SELECT    department_id, MAX(salary)
FROM      employees
GROUP BY  department_id
HAVING    MAX(salary)>10000 ;
```

	DEPARTMENT_ID	MAX(SALARY)
1	90	24000
2	20	13000
3	110	12000
4	80	11000

Using the HAVING Clause

```
SELECT   job_id, SUM(salary) PAYROLL
FROM     employees
WHERE    job_id NOT LIKE '%REP%'
GROUP BY job_id
HAVING   SUM(salary) > 13000
ORDER BY SUM(salary);
```

	JOB_ID	PAYROLL
1	IT_PROG	19200
2	AD_PRES	24000
3	AD_VP	34000

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Nesting Group Functions

Display the maximum average salary:

```
SELECT   MAX(AVG(salary))
FROM     employees
GROUP BY department_id;
```

	MAX(AVG(SALARY))
1	19333.333333333333333333333333333333333333

Quiz

Identify the guidelines for group functions and the `GROUP BY` clause.

1. You cannot use a column alias in the `GROUP BY` clause.
2. The `GROUP BY` column must be in the `SELECT` clause.
3. By using a `WHERE` clause, you can exclude rows before dividing them into groups.
4. The `GROUP BY` clause groups rows and ensures order of the result set.
5. If you include a group function in a `SELECT` clause, you cannot select individual results as well.

Summary

In this lesson, you should have learned how to:

- Use the group functions `COUNT`, `MAX`, `MIN`, `SUM`, and `AVG`
- Write queries that use the `GROUP BY` clause
- Write queries that use the `HAVING` clause

```
SELECT     column, group_function
FROM       table
[WHERE     condition]
[GROUP BY  group_by_expression]
[HAVING    group_condition]
[ORDER BY  column];
```

Practice 5: Overview

This practice covers the following topics:

- Writing queries that use the group functions
- Grouping by rows to achieve more than one result
- Restricting groups by using the `HAVING` clause

W3C SQL Tutorial for Group By and Having

https://www.w3schools.com/sql/sql_groupby.asp

https://www.w3schools.com/sql/sql_having.asp