5

# Aggregating Data Using Group Functions

ORACLE



| Schedule: | Timing | Topic |
|---|---|---|
| | 35 minutes | Lecture |
| | 40 minutes | Practice |
| | 75 minutes | Total |

# 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 using the `GROUP BY` clause**
- **Include or exclude grouped rows by using the `HAVING` clause**




**Lesson Aim**

This lesson further addresses functions. It focuses on obtaining summary information, such as averages, for groups of rows. It discusses how to group rows in a table into smaller sets and how to specify search criteria for groups of rows.

# What Are Group Functions?

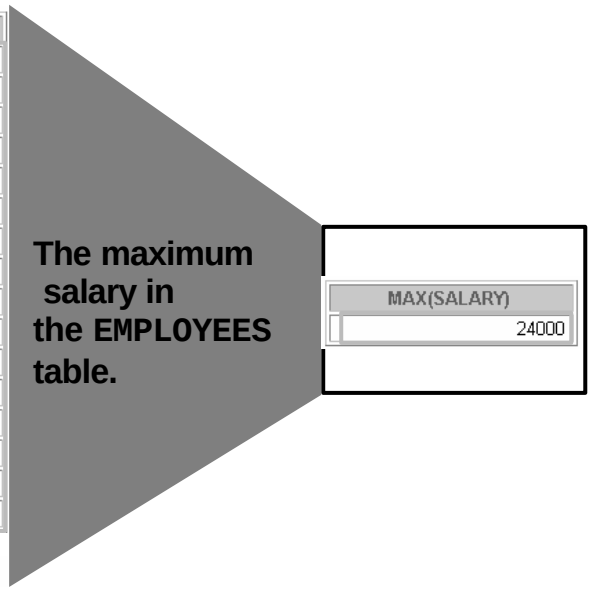
**Group functions operate on sets of rows to give one result per group.**

**EMPLOYEES**

| DEPARTMENT_ID | SALARY |
|---|---|
| 90 | 24000 |
| 90 | 17000 |
| 90 | 17000 |
| 60 | 9000 |
| 60 | 6000 |
| 60 | 4200 |
| 50 | 5800 |
| 50 | 3500 |
| 50 | 3100 |
| 50 | 2600 |
| 50 | 2500 |
| 80 | 10500 |
| 80 | 11000 |
| 80 | 8600 |
| | 7000 |
| 10 | 4400 |

...

20 rows selected.




ORACLE





### Group Functions

Unlike single-row functions, group functions operate on sets of rows to give one result per group. These sets may be the whole table or the table split into groups.

# Types of Group Functions

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

ORACLE




### Group Functions (continued)

Each of the functions accepts an argument. The following table identifies the options that you can use in the syntax:

| Function | Description |
|---|---|
| AVG([DISTINCT\|ALL]*n*) | Average value of *n*, ignoring null values |
| COUNT({*\|[DISTINCT\|ALL]*expr*}) | Number of rows, where *expr* evaluates to something other than null (count all selected rows using *, including duplicates and rows with nulls) |
| MAX([DISTINCT\|ALL]*expr*) | Maximum value of *expr*, ignoring null values |
| MIN([DISTINCT\|ALL]*expr*) | Minimum value of *expr*, ignoring null values |
| STDDEV([DISTINCT\|ALL]*x*) | Standard deviation of *n*, ignoring null values |
| SUM([DISTINCT\|ALL]*n*) | Sum values of *n*, ignoring null values |
| VARIANCE([DISTINCT\|ALL]*x*) | Variance of *n*, ignoring null values |

# Group Functions Syntax

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

ORACLE




### Guidelines for Using Group Functions

- DISTINCT makes the function consider only nonduplicate values; ALL makes it consider every value including duplicates. The default is ALL and therefore does not need to be specified.
- The data types for the functions with an expr argument may be CHAR, VARCHAR2, NUMBER, or DATE.
- All group functions ignore null values. To substitute a value for null values, use the NVL, NVL2, or COALESCE functions.
- The Oracle server implicitly sorts the result set in ascending order when using a GROUP BY clause. To override this default ordering, DESC can be used in an ORDER BY clause.

### Instructor Note

Stress the use of DISTINCT and group functions ignoring null values. ALL is the default and is very rarely specified.

# Using the AVG and SUM Functions

**You can use AVG 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) |
|---|---|---|---|
| 8150 | 11000 | 6000 | 32600 |

ORACLE




### Group Functions

You can use AVG, SUM, MIN, and MAX functions against columns that can store numeric data. The example on the slide displays the average, highest, lowest, and sum of monthly salaries for all sales representatives.

# Using the MIN and MAX Functions

**You can use MIN and MAX for any data type.**

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

| MIN(HIRE_ | MAX(HIRE_ |
|---|---|
| 17-JUN-87 | 29-JAN-00 |

ORACLE




### Group Functions (continued)

You can use the MAX and MIN functions for any data type. The slide example displays the most junior and most senior employee.

The following example displays the employee last name that is first and the employee last name that is the last in an alphabetized list of all employees.

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

| MIN(LAST_NAME) | MAX(LAST_NAME) |
|---|---|
| Abel | Zlotkey |

**Note:** AVG, SUM, VARIANCE, and STDDEV functions can be used only with numeric data types.

# Using the COUNT Function

**COUNT(*) returns the number of rows in a table.**

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

| COUNT(*) |
|---|
| 5 |

ORACLE




### The COUNT Function

The COUNT function has three formats:

- COUNT(*)
- COUNT(*expr*)
- COUNT(DISTINCT *expr*)

COUNT(*) returns the number of rows in a table that satisfy the criteria of the SELECT statement, including duplicate rows and rows containing null values in any of the columns. If a WHERE clause is included in the SELECT statement, COUNT(*) returns the number of rows that satisfies the condition in the WHERE clause.

In contrast, COUNT(*expr*) returns the number of non-null values in the column identified by *expr*.

COUNT(DISTINCT *expr*) returns the number of unique, non-null values in the column identified by *expr*.

The slide example displays the number of employees in department 50.

### Instructor Note

Demo: 5_count1.sql, 5_count2.sql

Purpose: To illustrate using the COUNT(*) and COUNT(*expr*) functions

# Using the COUNT Function

- **COUNT(*expr*) returns the number of rows with non-null values for the *expr*.**
- **Display the number of department values in the EMPLOYEES table, excluding the null values.**

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

| COUNT(COMMISSION_PCT) |
|---|
| 3 |

ORACLE




### The COUNT Function (continued)

The slide example displays the number of employees in department 80 who can earn a commission.

**Example**

Display the number of department values in the EMPLOYEES table.

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

| COUNT(DEPARTMENT_ID) |
|---|
| 19 |

# Using the DISTINCT Keyword

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

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

| COUNT(DISTINCTDEPARTMENT_ID) |
|---|
| 7 |




### The DISTINCT Keyword

Use the DISTINCT keyword to suppress the counting of any duplicate values within a column.

The example on the slide displays the number of distinct department values in the EMPLOYEES table.

# Group Functions and Null Values

## Group functions ignore null values in the column.

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

| AVG(COMMISSION_PCT) |
| --- |
| .2125 |

ORACLE




### Group Functions and Null Values

All group functions ignore null values in the column. In the slide example, the average is calculated based *only* on the rows in the table where a valid value is stored in the `COMMISSION_PCT` column. The average is calculated as the total commission paid to all employees divided by the number of employees receiving a commission (four).

# Using the NVL Function with Group Functions

**The NVL function forces group functions to include null values.**

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

| AVG(NVL(COMMISSION_PCT,0)) |
|---|
| .0425 |

ORACLE




### Group Functions and Null Values (continued)

The NVL function forces group functions to include null values. In the slide example, the average is calculated based on *all* rows in the table, regardless of whether null values are stored in the COMMISSION_PCT column. The average is calculated as the total commission paid to all employees divided by the total number of employees in the company (20).

# Creating Groups of Data

**EMPLOYEES**

| DEPARTMENT_ID | SALARY |
|---|---|
| 10 | 4400 |
| 20 | 13000 |
| 20 | 6000 |
| 50 | 5800 |
| 50 | 3500 |
| 50 | 3100 |
| 50 | 2500 |
| 50 | 2600 |
| 60 | 9000 |
| 60 | 6000 |
| 60 | 4200 |
| 80 | 10500 |
| 80 | 8600 |
| 80 | 11000 |
| 90 | 24000 |
| 90 | 17000 |

...

20 rows selected.

4400

9500

3500

6400

10033

**The average salary in EMPLOYEES table for each department.**

| DEPARTMENT_ID | AVG(SALARY) |
|---|---|
| 10 | 4400 |
| 20 | 9500 |
| 50 | 3500 |
| 60 | 6400 |
| 80 | 10033.3333 |
| 90 | 19333.3333 |
| 110 | 10150 |
| | 7000 |

ORACLE




## Groups of Data

Until now, all group functions have treated the table as one large group of information. At times, you need to divide the table of information into smaller groups. This can be done by using the GROUP BY clause.

# Creating Groups of Data: The GROUP BY Clause Syntax

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

**Divide rows in a table into smaller groups by using the GROUP BY clause.**




### The GROUP BY Clause

You can use the GROUP BY clause to divide the rows in a table into groups. You can then use the group functions to return summary information for each group.

In the syntax:

| | |
|---|---|
| *group_by_expression* | specifies columns whose values determine the basis for grouping rows |

### Guidelines

- If you include a group function in a SELECT clause, you cannot select individual results as well, *unless* the individual column appears in the GROUP BY clause. You receive an error message if you fail to include the column list in the GROUP BY clause.
- Using a WHERE clause, you can exclude rows before dividing them into groups.
- You must include the *columns* in the GROUP BY clause.
- You cannot use a column alias in the GROUP BY clause.
- By default, rows are sorted by ascending order of the columns included in the GROUP BY list. You can override this by using the ORDER 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) |
|---|---|
| 10 | 4400 |
| 20 | 9500 |
| 50 | 3500 |
| 60 | 6400 |
| 80 | 10033.3333 |
| 90 | 19333.3333 |
| 110 | 10150 |
| | 7000 |

ORACLE




### The GROUP BY Clause (continued)

When using the GROUP BY clause, make sure that all columns in the SELECT list that are not group functions are included in the GROUP BY clause. The example on the slide displays the department number and the average salary for each department. Here is how this SELECT statement, containing a GROUP BY clause, is evaluated:

- The SELECT clause specifies the columns to be retrieved:
  - Department number column in the EMPLOYEES table
  - The average of all the salaries in the group you specified in the GROUP BY clause
- The FROM clause specifies the tables that the database must access: the EMPLOYEES table.
- The WHERE clause specifies the rows to be retrieved. Since there is no WHERE clause, all rows are retrieved by default.
- The GROUP BY clause specifies how the rows should be grouped. The rows are being grouped by department number, so the AVG function that is being applied to the salary column will calculate the *average salary for each department.*

### Instructor Note

Group results are sorted implicitly, on the grouping column. You can use ORDER BY to specify a different sort order, remembering to use only group functions, or the grouping column.

# 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) |
|---|
| 4400 |
| 9500 |
| 3500 |
| 6400 |
| 10033.3333 |
| 19333.3333 |
| 10150 |
| 7000 |

ORACLE




### The GROUP BY Clause (continued)

The GROUP BY column does not have to be in the SELECT clause. For example, the SELECT statement on the slide displays the average salaries for each department without displaying the respective department numbers. Without the department numbers, however, the results do not look meaningful.

You can use the group function in the ORDER BY clause.

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

| DEPARTMENT_ID | AVG(SALARY) |
|---|---|
| 50 | 3500 |
| 10 | 4400 |
| 60 | 6400 |
| ... | |
| 90 | 19333.3333 |

8 rows selected.

Demonstrate the query with and without the DEPARTMENT_ID column in the SELECT statement.

# Grouping by More Than One Column

**EMPLOYEES**

| DEPARTMENT_ID | JOB_ID | SALARY |
|---|---|---|
| 90 | AD_PRES | 24000 |
| 90 | AD_VP | 17000 |
| 90 | AD_VP | 17000 |
| 60 | IT_PROG | 9000 |
| 60 | IT_PROG | 6000 |
| 60 | IT_PROG | 4200 |
| 50 | ST_MAN | 5800 |
| 50 | ST_CLERK | 3500 |
| 50 | ST_CLERK | 3100 |
| 50 | ST_CLERK | 2600 |
| 50 | ST_CLERK | 2500 |
| 80 | SA_MAN | 10500 |
| 80 | SA_REP | 11000 |
| 80 | SA_REP | 8600 |
| ... | | |
| 20 | MK_REP | 6000 |
| 110 | AC_MGR | 12000 |
| 110 | AC_ACCOUNT | 8300 |

20 rows selected.

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

| DEPARTMENT_ID | JOB_ID | SUM(SALARY) |
|---|---|---|
| 10 | AD_ASST | 4400 |
| 20 | MK_MAN | 13000 |
| 20 | MK_REP | 6000 |
| 50 | ST_CLERK | 11700 |
| 50 | ST_MAN | 5800 |
| 60 | IT_PROG | 19200 |
| 80 | SA_MAN | 10500 |
| 80 | SA_REP | 19600 |
| 90 | AD_PRES | 24000 |
| 90 | AD_VP | 34000 |
| 110 | AC_ACCOUNT | 8300 |
| 110 | AC_MGR | 12000 |
| | SA_REP | 7000 |

13 rows selected.

ORACLE




### Groups within Groups

Sometimes you need to see results for groups within groups. The slide shows a report that displays the total salary being paid to each job title, within each department.

The `EMPLOYEES` table is grouped first by department number and, within that grouping, by job title. For example, the four stock clerks in department 50 are grouped together and a single result (total salary) is produced for all stock clerks within the group.

### Instructor Note

Demo: `5_order1.sql`, `5_order2.sql`

Purpose: To illustrate ordering columns that are grouped by `DEPARTMENT_ID` first and ordering columns that are grouped by `JOB_ID` first.

# Using the GROUP BY Clause on Multiple Columns

```
SELECT   department_id dept_id, job_id, SUM(salary)
FROM     employees
GROUP BY department_id, job_id ;
```

| DEPT_ID | JOB_ID | SUM(SALARY) |
|---|---|---|
| 10 | AD_ASST | 4400 |
| 20 | MK_MAN | 13000 |
| 20 | MK_REP | 6000 |
| 50 | ST_CLERK | 11700 |
| 50 | ST_MAN | 5800 |
| 60 | IT_PROG | 19200 |
| 80 | SA_MAN | 10500 |
| 80 | SA_REP | 19600 |
| 90 | AD_PRES | 24000 |
| 90 | AD_VP | 34000 |
| 110 | AC_ACCOUNT | 8300 |
| 110 | AC_MGR | 12000 |
| | SA_REP | 7000 |

13 rows selected.

ORACLE




### Groups within Groups (continued)

You can return summary results for groups and subgroups by listing more than one GROUP BY column. You can determine the default sort order of the results by the order of the columns in the GROUP BY clause. Here is how the SELECT statement on the slide, containing a GROUP BY clause, is evaluated:

- The SELECT clause specifies the column to be retrieved:
  - Department number in the EMPLOYEES table
  - Job ID in the EMPLOYEES table
  - The sum of all the salaries in the group that you specified in the GROUP BY clause
- The FROM clause specifies the tables that the database must access: the EMPLOYEES table.
- The GROUP BY clause specifies how you must group the rows:
  - First, the rows are grouped by department number.
  - Second, within the department number groups, the rows are grouped by job ID.

So the SUM function is being applied to the salary column for all job IDs within each department number group.

# 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;
```

```
SELECT department_id, COUNT(last_name)
       *
ERROR at line 1:
ORA-00937: not a single-group group function
```

**Column missing in the GROUP BY clause**

ORACLE




### Illegal Queries Using Group Functions

Whenever you use a mixture of individual items (DEPARTMENT_ID) and group functions (COUNT) in the same SELECT statement, you must include a GROUP BY clause that specifies the individual items (in this case, DEPARTMENT_ID). If the GROUP BY clause is missing, then the error message "not a single-group group function" appears and an asterisk (*) points to the offending column. You can correct the error on the slide by adding the GROUP BY clause.

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

| DEPARTMENT_ID | COUNT(LAST_NAME) |
|---|---|
| 10 | 1 |
| 20 | 2 |
| ... | |
| | 1 |

8 rows selected.

GROUP BY clause.

### Instructor Note

Demo: 5_error.sql

Purpose: To illustrate executing a SELECT statement with no GROUP BY clause

# 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;
```

```
WHERE  AVG(salary) > 8000
       *
ERROR at line 3:
ORA-00934: group function is not allowed here
```

**Cannot use the WHERE clause to restrict groups**




### Illegal Queries Using Group Functions (continued)

The WHERE clause cannot be used to restrict groups. The SELECT statement on the slide results in an error because it uses the WHERE clause to restrict the display of average salaries of those departments that have an average salary greater than $8,000.

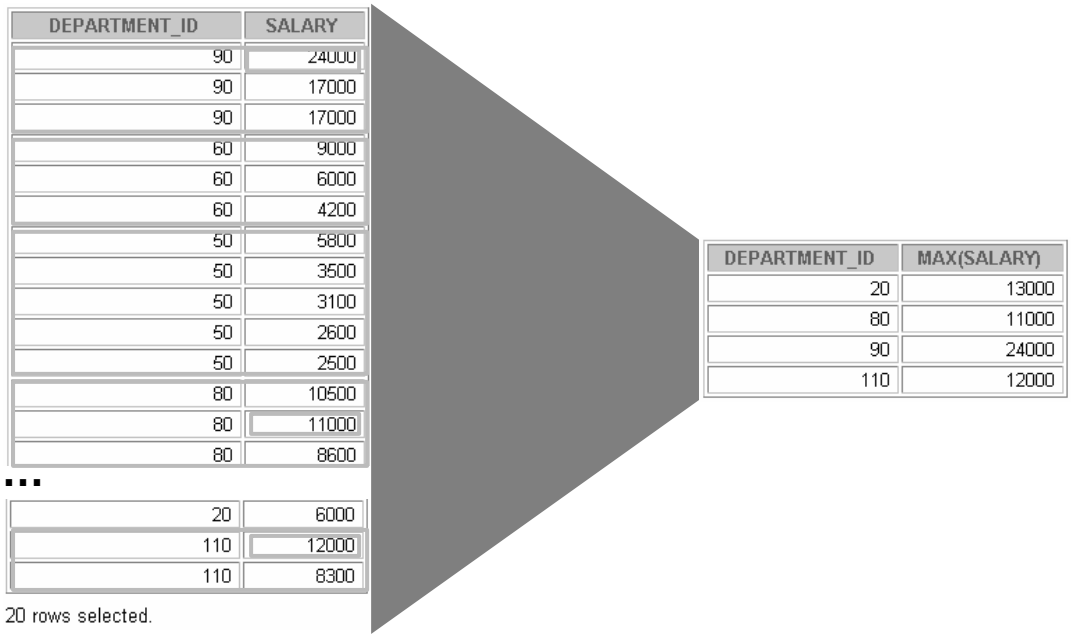
You can correct the slide error by using the HAVING clause to restrict groups.

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

| DEPARTMENT_ID | AVG(SALARY) |
|---|---|
| 20 | 9500 |
| 80 | 10033.3333 |
| 90 | 19333.3333 |
| 110 | 10150 |

# Excluding Group Results

**EMPLOYEES**



| DEPARTMENT_ID | SALARY |
|---|---|
| 90 | 24000 |
| 90 | 17000 |
| 90 | 17000 |
| 60 | 9000 |
| 60 | 6000 |
| 60 | 4200 |
| 50 | 5800 |
| 50 | 3500 |
| 50 | 3100 |
| 50 | 2600 |
| 50 | 2500 |
| 80 | 10500 |
| 80 | 11000 |
| 80 | 8600 |
| ... | |
| 20 | 6000 |
| 110 | 12000 |
| 110 | 8300 |

20 rows selected.

| DEPARTMENT_ID | MAX(SALARY) |
|---|---|
| 20 | 13000 |
| 80 | 11000 |
| 90 | 24000 |
| 110 | 12000 |




## Restricting Group Results

In the same way that you use the `WHERE` clause to restrict the rows that you select, you use the `HAVING` clause to restrict groups. To find the maximum salary of each department, but show only the departments that have a maximum salary of more than $10,000, you need to do the following:

1. Find the average salary for each department by grouping by department number.
2. Restrict the groups to those departments with a maximum salary greater than $10,000.

# Excluding Group Results: The HAVING Clause

**Use the HAVING clause to restrict groups:**

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];
```

ORACLE




### The HAVING Clause

You use the HAVING clause to specify which groups are to be displayed, and thus, you further restrict the groups on the basis of aggregate information.

In the syntax:

| | |
|---|---|
| *group_condition* | restricts the groups of rows returned to those groups for which the specified condition is true |

The Oracle server performs the following steps when you use the HAVING clause:

1. Rows are grouped.
2. The group function is applied to the group.
3. The groups that match the criteria in the HAVING clause are displayed.

The HAVING clause can precede the GROUP BY clause, but it is recommended that you place the GROUP BY clause first because that is more logical. Groups are formed and group functions are calculated before the HAVING clause is applied to the groups in the SELECT list.

### Instructor Note

The Oracle server evaluates the clauses in the following order:

- If the statement contains a WHERE clause, the server establishes the candidate rows.
- The server identifies the groups specified in the GROUP BY clause.
- The HAVING clause further restricts result groups that do not meet the group criteria in the HAVING clause.

# Using the HAVING Clause

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

| DEPARTMENT_ID | MAX(SALARY) |
|---|---|
| 20 | 13000 |
| 80 | 11000 |
| 90 | 24000 |
| 110 | 12000 |

ORACLE




### The HAVING Clause (continued)

The slide example displays department numbers and maximum salaries for those departments whose maximum salary is greater than $10,000.

You can use the GROUP BY clause without using a group function in the SELECT list.

If you restrict rows based on the result of a group function, you must have a GROUP BY clause as well as the HAVING clause.

The following example displays the department numbers and average salaries for those departments whose maximum salary is greater than $10,000:

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

| DEPARTMENT_ID | AVG(SALARY) |
|---|---|
| 20 | 9500 |
| 80 | 10033.3333 |
| 90 | 19333.3333 |
| 110 | 10150 |

# 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 |
|---|---|
| IT_PROG | 19200 |
| AD_PRES | 24000 |
| AD_VP | 34000 |

ORACLE




### The HAVING Clause (continued)

The slide example displays the job ID and total monthly salary for each job with a total payroll exceeding $13,000. The example excludes sales representatives and sorts the list by the total monthly salary.

### Instructor Note

Demo: `5_job1.sql`, `5_job2.sql`

Purpose: To illustrate using a `WHERE` clause to restrict rows by `JOB_ID` and using a `HAVING` clause to restrict groups by `SUM(SALARY)`.

# Nesting Group Functions

## Display the maximum average salary.

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

| MAX(AVG(SALARY)) |
|---|
| 19333.3333 |




### Nesting Group Functions

Group functions can be nested to a depth of two. The slide example displays the maximum average salary.

# Summary

**In this lesson, you should have learned how to:**

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

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

ORACLE




### Summary

Seven group functions are available in SQL:

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

You can create subgroups by using the GROUP BY clause. Groups can be excluded using the HAVING clause.

Place the HAVING and GROUP BY clauses after the WHERE clause in a statement. Place the ORDER BY clause last.

The Oracle server evaluates the clauses in the following order:

1. If the statement contains a WHERE clause, the server establishes the candidate rows.
2. The server identifies the groups specified in the GROUP BY clause.
3. The HAVING clause further restricts result groups that do not meet the group criteria in the HAVING clause.

# 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**
- **Excluding groups by using the `HAVING` clause**

ORACLE




### Practice 5 Overview

At the end of this practice, you should be familiar with using group functions and selecting groups of data.

### Paper-Based Questions

For questions 1-3, circle either True or False.

**Note:** Column aliases are used for the queries.

### Instructor Note

Hint for Question #7: Advise the students to think about the `MANAGER_ID` column in `EMPLOYEES` when determining the number of managers, rather than the `JOB_ID` column.

## Practice 5

Determine the validity of the following three statements. Circle either True or False.

1. Group functions work across many rows to produce one result per group.
   True/False
2. Group functions include nulls in calculations.
   True/False
3. The `WHERE` clause restricts rows prior to inclusion in a group calculation.
   True/False
4. Display the highest, lowest, sum, and average salary of all employees. Label the columns `Maximum`, `Minimum`, `Sum`, and `Average`, respectively. Round your results to the nearest whole number. Place your SQL statement in a text file named `lab5_4.sql`.

| Maximum | Minimum | Sum | Average |
|---|---|---|---|
| 24000 | 2500 | 175500 | 8775 |

5. Modify the query in `lab5_4.sql` to display the minimum, maximum, sum, and average salary for each job type. Resave `lab5_4.sql` to `lab5_5.sql`. Run the statement in `lab5_5.sql`.

| JOB_ID | Maximum | Minimum | Sum | Average |
|---|---|---|---|---|
| AC_ACCOUNT | 8300 | 8300 | 8300 | 8300 |
| AC_MGR | 12000 | 12000 | 12000 | 12000 |
| AD_ASST | 4400 | 4400 | 4400 | 4400 |
| AD_PRES | 24000 | 24000 | 24000 | 24000 |
| AD_VP | 17000 | 17000 | 34000 | 17000 |
| IT_PROG | 9000 | 4200 | 19200 | 6400 |
| MK_MAN | 13000 | 13000 | 13000 | 13000 |
| MK_REP | 6000 | 6000 | 6000 | 6000 |
| SA_MAN | 10500 | 10500 | 10500 | 10500 |
| SA_REP | 11000 | 7000 | 26600 | 8867 |
| ST_CLERK | 3500 | 2500 | 11700 | 2925 |
| ST_MAN | 5800 | 5800 | 5800 | 5800 |

12 rows selected.

**Practice 5 (continued)**

6. Write a query to display the number of people with the same job.

| JOB_ID | COUNT(*) |
|---|---|
| AC_ACCOUNT | 1 |
| AC_MGR | 1 |
| AD_ASST | 1 |
| AD_PRES | 1 |
| AD_VP | 2 |
| IT_PROG | 3 |
| MK_MAN | 1 |
| MK_REP | 1 |
| SA_MAN | 1 |
| SA_REP | 3 |
| ST_CLERK | 4 |
| ST_MAN | 1 |

12 rows selected.

7. Determine the number of managers without listing them. Label the column `Number of Managers`. *Hint: Use the* ***`MANAGER_ID`*** *column to determine the number of managers.*

| Number of Managers |
|---|
| 8 |

8

column DIFFERENCE.

| DIFFERENCE |
|---|
| 21500 |

If y

9. Display the manager number and the salary of the lowest paid employee for that manager. Exclude anyone whose manager is not known. Exclude any groups where the minimum salary is $6,000 or less. Sort the output in descending order of salary.

| MANAGER_ID | MIN(SALARY) |
|---|---|
| 102 | 9000 |
| 205 | 8300 |
| 149 | 7000 |

**Practice 5 (continued)**

10. Write a query to display each department's name, location, number of employees, and the average salary for all employees in that department. Label the columns `Name`, `Location`, `Number of People`, and `Salary`, respectively. Round the average salary to two decimal places.

| Name | Location | Number of People | Salary |
|---|---|---|---|
| Accounting | 1700 | 2 | 10150 |
| Administration | 1700 | 1 | 4400 |
| Executive | 1700 | 3 | 19333.33 |
| IT | 1400 | 3 | 6400 |
| Marketing | 1800 | 2 | 9500 |
| Sales | 2500 | 3 | 10033.33 |
| Shipping | 1500 | 5 | 3500 |

7 rows selected.

If you want an extra challenge, complete the following exercises:

11. Create a query that will display the total number of employees and, of that total, the number of employees hired in 1995, 1996, 1997, and 1998. Create appropriate column headings.

| TOTAL | 1995 | 1996 | 1997 | 1998 |
|---|---|---|---|---|
| 20 | 1 | 2 | 2 | 3 |

12. , appropriate heading.

| Job | Dept 20 | Dept 50 | Dept 80 | Dept 90 | Total |
|---|---|---|---|---|---|
| AC_ACCOUNT | | | | | 8300 |
| AC_MGR | | | | | 12000 |
| AD_ASST | | | | | 4400 |
| AD_PRES | | | | 24000 | 24000 |
| AD_VP | | | | 34000 | 34000 |
| IT_PROG | | | | | 19200 |
| MK_MAN | 13000 | | | | 13000 |
| MK_REP | 6000 | | | | 6000 |
| SA_MAN | | | 10500 | | 10500 |
| SA_REP | | | 19600 | | 26600 |
| ST_CLERK | | 11700 | | | 11700 |
| ST_MAN | | 5800 | | | 5800 |

12 rows selected.