Reporting Aggregated Data Using the Group Functions

5

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

Objectives

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.

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

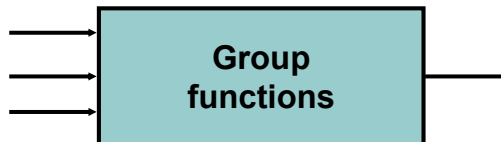**Maximum salary in EMPLOYEES table**

MAX(SALARY)
24000

What Are Group Functions?

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

Types of Group Functions

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

Group functions

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Types of Group Functions

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

Group Functions: Syntax

The group function is placed after the `SELECT` keyword. You may have multiple group functions separated by commas.

Guidelines for using the 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.

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)
1	8150	11000	6000	32600

Using the AVG and SUM Functions

You can use the AVG, SUM, MIN, and MAX functions against the columns that can store numeric data. The example in 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 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

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Using the MIN and MAX Functions

You can use the MAX and MIN functions for numeric, character, and date data types. The example in the slide displays the most junior and most senior employees.

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

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

	MIN(LAST_NAME)	MAX(LAST_NAME)
1	Abel	Zlotkey

Note: The AVG, SUM, VARIANCE, and STDDEV functions can be used only with numeric data types. MAX and MIN cannot be used with LOB or LONG data types.

Using the COUNT Function

COUNT(*) returns the number of rows 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 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 satisfy the condition in the WHERE clause.

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

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

Examples:

1. The example in the slide displays the number of employees in department 50.
2. The example in the slide displays the number of employees in department 80 who can earn a commission.

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

Using the DISTINCT Keyword

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

The example in the slide displays the number of distinct department values that are 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)
1	0.2125

The `NVL` function forces group functions to include null values:


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

	AVG(NVL(COMMISSION_PCT,0))
1	0.0425

Group Functions and Null Values

All group functions ignore null values in the column.

However, the `NVL` function forces group functions to include null values.

Examples:
1. The average is calculated based on *only* those rows in the table in which a valid value is stored in the `COMMISSION_PCT` column. The average is calculated as the total commission that is paid to all employees divided by the number of employees receiving a commission (four).
2. 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 that is paid to all employees divided by the total number of employees in the company (20).

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

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

Until this point in our discussion, all group functions have treated the table as one large group of information. At times, however, 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:
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.

Creating Groups of Data: GROUP BY Clause Syntax

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.

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

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 in 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, as follows:
  - Department number column in the EMPLOYEES table
  - The average of all 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 WHERE clause specifies the rows to be retrieved. Because 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 grouped by department number, so the AVG function that is applied to the salary column calculates the average salary for each department.

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	19333.3333333333333333333...
3	9500
4	10150
5	3500
6	10033.3333333333333333333...
7	6400
8	4400

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Using the GROUP BY Clause (continued)

The GROUP BY column does not have to be in the SELECT clause. For example, the SELECT statement in 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 also 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)
1	50	3500
2	10	4400
3	60	6400

...

	DEPARTMENT_ID	AVG(SALARY)
7	110	10150
8	90	19333.33333333333333333333333333333333

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Grouping by More than One Column

EMPLOYEES

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

	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 |

	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

Grouping by More than One Column

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

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

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
ORDER BY department_id;
```

	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

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. In the example in the slide, the SELECT statement containing a GROUP BY clause is evaluated as follows:

- 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 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 the department number.
    - Second, the rows are grouped by job ID in the department number groups.

So the SUM function is applied to the salary column for all job IDs in 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;
```

ORA-00937: not a single-group group function
00937. 00000 - "not a single-group group function"

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;
```

ORA-00979: not a GROUP BY expression
00979. 00000 - "not a GROUP BY expression"

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

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 in the first example in the slide by adding the GROUP BY clause:

```
SELECT    department_id, count(last_name)
FROM      employees
GROUP BY department_id;
```
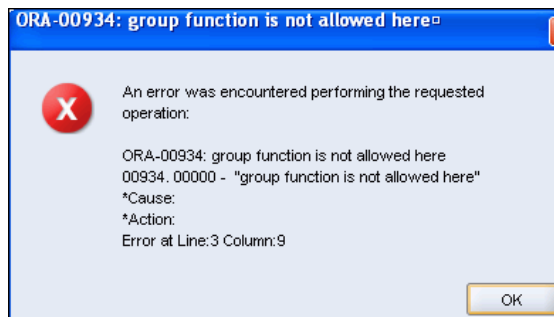
Any column or expression in the SELECT list that is not an aggregate function must be in the GROUP BY clause. In the second example in the slide, job_id is neither in the GROUP BY clause nor is it being used by a group function, so there is a "not a GROUP BY expression" error. You can correct the error in the second slide example by adding job_id in the GROUP BY clause.

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

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;
```

ORA-00934: group function is not allowed here

An error was encountered performing the requested operation:

ORA-00934: group function is not allowed here
00934. 00000 - "group function is not allowed here"
*Cause:
*Action:
Error at Line:3 Column:9

OK

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 in the example in the slide results in an error because it uses the `WHERE` clause to restrict the display of the average salaries of those departments that have an average salary greater than $8,000.

However, you can correct the error in the example by using the `HAVING` clause to restrict groups:

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

	DEPARTMENT_ID	AVG(SALARY)
1	90	19333.333333333333333...
2	20	9500
3	110	10150
4	80	10033.333333333333333...

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

You use the HAVING clause to restrict groups in the same way that you use the WHERE clause to restrict the rows that you select. To find the maximum salary in each of the departments that have a maximum salary greater 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.

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];
```

Restricting Group Results with the HAVING Clause

You use the HAVING clause to specify the groups that are to be displayed, thus further restricting 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 it is more logical. Groups are formed and group functions are calculated before the HAVING clause is applied to the groups in the SELECT list.

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

The example in the slide displays the department numbers and maximum salaries for those departments with a maximum salary 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 with a maximum salary greater than $10,000:

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

	DEPARTMENT_ID	AVG(SALARY)
1	90	19333.333333333333333...
2	20	9500
3	110	10150
4	80	10033.333333333333333...

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

Using the HAVING Clause (continued)

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

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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**

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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	19333.33333333333333333333333333333333

Nesting Group Functions

Group functions can be nested to a depth of two functions. The example in the slide calculates the average salary for each `department_id` and then displays the maximum average salary.

Note that `GROUP BY` clause is mandatory when nesting group functions.

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];
```

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Summary

There are several group functions available in SQL, such as:
   AVG, COUNT, MAX, MIN, SUM, STDDEV, and VARIANCE

You can create subgroups by using the GROUP BY clause. Further, groups can be restricted using the HAVING clause.

Place the HAVING and GROUP BY clauses after the WHERE clause in a statement. The order of the GROUP BY and HAVING clauses following the WHERE clause is not important. Place the ORDER BY clause at the end.

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 that are 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.

Note: For a complete list of the group functions, see *Oracle Database SQL Language Reference 11g, Release 1 (11.1)*.

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

Practice 5: Overview

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

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 before inclusion in a group calculation.
   True/False

The HR department needs the following reports:

4. Find the highest, lowest, sum, and average salary of all employees. Label the columns as Maximum, Minimum, Sum, and Average, respectively. Round your results to the nearest whole number. Save your SQL statement as lab_05_04.sql. Run the query.

	Maximum	Minimum	Sum	Average
1	24000	2500	175500	8775

5. Modify the query in lab_05_04.sql to display the minimum, maximum, sum, and average salary for each job type. Resave lab_05_04.sql as lab_05_05.sql. Run the statement in lab_05_05.sql.

	JOB_ID	Maximum	Minimum	Sum	Average
1	IT_PROG	9000	4200	19200	6400
2	AC_MGR	12000	12000	12000	12000
3	AC_ACCOUNT	8300	8300	8300	8300
4	ST_MAN	5800	5800	5800	5800
5	AD_ASST	4400	4400	4400	4400
6	AD_VP	17000	17000	34000	17000
7	SA_MAN	10500	10500	10500	10500
8	MK_MAN	13000	13000	13000	13000
9	AD_PRES	24000	24000	24000	24000
10	SA_REP	11000	7000	26600	8867
11	MK_REP	6000	6000	6000	6000
12	ST_CLERK	3500	2500	11700	2925

Practice 5 (continued)

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

	JOB_ID	COUNT(*)
1	AC_ACCOUNT	1
2	AC_MGR	1
3	AD_ASST	1
4	AD_PRES	1
5	AD_VP	2
6	IT_PROG	3
7	MK_MAN	1
8	MK_REP	1
9	SA_MAN	1
10	SA_REP	3
11	ST_CLERK	4
12	ST_MAN	1

Generalize the query so that the user in the HR department is prompted for a job title. Save the script to a file named `lab_05_06.sql`. Run the query. Enter `IT_PROG` when prompted.

	JOB_ID	COUNT(*)
1	IT_PROG	3

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

	Number of Managers
1	8

8. Find the difference between the highest and lowest salaries. Label the column `DIFFERENCE`.

	DIFFERENCE
1	21500

Practice 5 (continued)

If you have time, complete the following exercises:

9. Create a report to 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)
1	102	9000
2	205	8300
3	149	7000

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

10. Create a query to 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
1	20	1	2	2	3

11. Create a matrix query to display the job, the salary for that job based on department number, and the total salary for that job, for departments 20, 50, 80, and 90, giving each column an appropriate heading.

	Job	Dept 20	Dept 50	Dept 80	Dept 90	Total
1	IT_PROG	(null)	(null)	(null)	(null)	19200
2	AC_MGR	(null)	(null)	(null)	(null)	12000
3	AC_ACCOUNT	(null)	(null)	(null)	(null)	8300
4	ST_MAN	(null)	5800	(null)	(null)	5800
5	AD_ASST	(null)	(null)	(null)	(null)	4400
6	AD_VP	(null)	(null)	(null)	34000	34000
7	SA_MAN	(null)	(null)	10500	(null)	10500
8	MK_MAN	13000	(null)	(null)	(null)	13000
9	AD_PRES	(null)	(null)	(null)	24000	24000
10	SA_REP	(null)	(null)	19600	(null)	26600
11	MK_REP	6000	(null)	(null)	(null)	6000
12	ST_CLERK	(null)	11700	(null)	(null)	11700