EXERCISE-8

Aggregating Data Using Group Functions

Objectives

After the completion of this exercise, the students be will 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

What Are Group Functions?

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

Types of Group Functions

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

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*];

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.

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%';
```

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;
```

You can use the MAX and MIN functions for numeric, character, and date data types. example 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 alphabetized list of all employees:

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

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:

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

COUNT(*expr*) returns the number of rows with nonnull values for the *expr*:

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

Using the DISTINCT Keyword

• COUNT(DISTINCT expr) returns the number of distinct non-null values of the *expr*.

• To display the number of distinct department values in the EMPLOYEES table:

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

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

Group Functions and Null Values

Group functions ignore null values in the column:

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

The NVL function forces group functions to include null values:

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

Creating Groups of Data

To divide the table of information into smaller groups. This can be done by using the GROUP BY clause.

GROUP BY Clause Syntax

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

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 ;
```

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

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

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);

Grouping by More Than One Column

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

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;

You can correct the error by adding the GROUP BY clause:

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

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;
You can correct the error in the example by using the HAVING clause to restrict groups:

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

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.

Using the HAVING Clause

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

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

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

Example 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.

```
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);
```

Nesting Group Functions

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

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

Summary
In this exercise, students should have learned how to:
- Use the group functions COUNT, MAX, MIN, 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*];

Find the Solution for the following:

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 **TRUE**

2. Group functions include nulls in calculations.
True/False **FALSE**

3. The WHERE clause restricts rows prior to inclusion in a group calculation.
True/False **TRUE**

The HR department needs the following reports:
4. Find 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

```
SELECT
  ROUND(MAX(salary)) AS Maximum,
  ROUND(MIN(salary)) AS Minimum,
  ROUND(SUM(salary)) AS Sum,
  ROUND(AVG(salary)) AS Average
FROM MY_EMPLOYEE;
```

Download Execution time: 0.109 seconds

	MAXIMUM	MINIMUM	SUM	AVERAGE
1	71000	45401	280202	56040

5. Modify the above query to display the minimum, maximum, sum, and average salary for each job type.

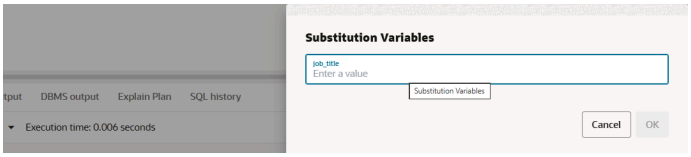
```
SELECT
    job_id,
    ROUND(MIN(salary)) AS Minimum,
    ROUND(MAX(salary)) AS Maximum,
    ROUND(SUM(salary)) AS Sum,
    ROUND(AVG(salary)) AS Average
FROM employees
GROUP BY job_id;
```

Download Execution time: 0.009 seconds

	JOB_ID	MINIMUM	MAXIMUM	SUM	AVERAGE
1	AD_PRES	12000	12000	12000	12000
2	IT_PROG	8000	8000	8000	8000
3	HR_REP	6000	6000	6000	6000
4	SA_REP	5500	5500	5500	5500

6.Write a query to display the number of people with the same job. Generalize the query so that the user in the HR department is prompted for a job title.

```
SELECT
    job_id,
    COUNT(*) AS Number_of_People
FROM employees
WHERE job_id = '&job_title'
GROUP BY job_id;
```



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.*

```
SELECT
    COUNT(DISTINCT manager_id)
    AS "Number of Managers"
FROM employees
WHERE manager_id IS NOT NULL;
```

Download Execution time: 0.004 seconds

	NUMBER OF MANAGERS
1	2

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

```
SELECT
    MAX(salary) - MIN(salary)
    AS Difference
FROM employees;
```

Download Execution time: 0.115 seconds

	DIFFERENCE
1	6500

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.

```
SELECT
    manager_id,
    MIN(salary) AS Lowest_Salary
FROM employees
WHERE manager_id IS NOT NULL
GROUP BY manager_id
HAVING MIN(salary) > 6000
ORDER BY Lowest_Salary DESC;
```

Download Execution time: 0.115 seconds

	DIFFERENCE
1	6500

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.

```
SELECT
    COUNT(*) AS Total_Employees,
    SUM(CASE WHEN EXTRACT(YEAR FROM hire_date) = 1995 THEN 1 ELSE 0 END) AS Hired_1995,
    SUM(CASE WHEN EXTRACT(YEAR FROM hire_date) = 1996 THEN 1 ELSE 0 END) AS Hired_1996,
    SUM(CASE WHEN EXTRACT(YEAR FROM hire_date) = 1997 THEN 1 ELSE 0 END) AS Hired_1997,
    SUM(CASE WHEN EXTRACT(YEAR FROM hire_date) = 1998 THEN 1 ELSE 0 END) AS Hired_1998
FROM employees;
```

Download ▾ Execution time: 0.008 seconds

	TOTAL_EMPLOYEES	HIRED_1995	HIRED_1996	HIRED_1997	HIRED_1998
1	4	0	0	0	0

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.

```
SELECT
    job_id AS Job,
    SUM(CASE WHEN department_id = 20 THEN salary ELSE 0 END) AS Dept_20,
    SUM(CASE WHEN department_id = 50 THEN salary ELSE 0 END) AS Dept_50,
    SUM(CASE WHEN department_id = 80 THEN salary ELSE 0 END) AS Dept_80,
    SUM(CASE WHEN department_id = 90 THEN salary ELSE 0 END) AS Dept_90,
    SUM(salary) AS Total_Salary
FROM employees
WHERE department_id IN (20, 50, 80, 90)
GROUP BY job_id;
```

Download ▾ Execution time: 0.012 seconds

	JOB	DEPT_20	DEPT_50	DEPT_80	DEPT_90	TOTAL_SALARY
1	AD_PRES	0	0	0	12000	12000
2	SA_REP	0	5500	0	0	5500

12.Write a query to display each department's name, location, number of employees, and the average salary for all the employees in that department. Label the column name-Location, Number of people, and salary respectively. Round the average salary to two decimal places.

```
SELECT
  d.dept_name AS Name,
  d.location_id AS Location,
  COUNT(e.employee_id) AS "Number of People",
  ROUND(AVG(e.salary), 2) AS Salary
FROM department d
LEFT JOIN employees e ON d.dept_id = e.department_id
GROUP BY d.dept_name, d.location_id
ORDER BY d.dept_name;
```

Download ▾ Execution time: 0.013 seconds

	NAME	LOCATION	NUMBER OF PEOPLE	SALARY
1	Administration	1700	0	*(null)*
2	Human Resources	2400	1	6000
3	Marketing	1800	0	*(null)*
4	Purchasing	1700	0	*(null)*

Evaluation Procedure	Marks awarded
Query(5)	
Execution (5)	
Viva(5)	
Total (15)	
Faculty Signature	