DATABASE SYSTEMS

DESIGN IMPLEMENTATION AND MANAGEMENT

INTERNATIONAL EDITION

ROB · CORONEL • CROCKETT

Chapter 8
Introduction to Structured Query Language (SQL)

In this chapter, you will learn:

- The basic commands and functions of SQL

- How to use SQL for data administration (to create tables, indexes, and views)

- How to use SQL for data manipulation (to add, modify, delete, and retrieve data)

- How to use SQL to query a database to extract useful information

Introduction to SQL

- ## SQL functions fit into two broad categories:
  - ### Data definition language
    - SQL includes commands to:
      - Create database objects, such as tables, indexes, and views
      - Define access rights to those database objects
  - ### Data manipulation language
    - Includes commands to insert, update, delete, and retrieve data within database tables
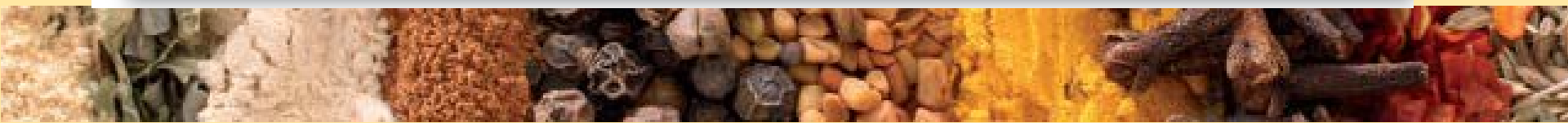
Introduction to SQL (continued)

- SQL is relatively easy to learn

- Basic command set has vocabulary of less than 100 words

- Nonprocedural language

- American National Standards Institute (ANSI) prescribes a standard SQL

- Several SQL dialects exist

Introduction to SQL (continued)

TABLE 8.1	SQL data definition commands
Command or Option	**Description**
CREATE SCHEMA AUTHORIZATION	Creates a database schema
CREATE TABLE	Creates a new table in the users database schema
NOT NULL	Ensures that a column will not have null values
UNIQUE	Ensures that a column will not have duplicate values
PRIMARY KEY	Defines a primary key for a table
FOREIGN KEY	Defines a foreign key for a table
DEFAULT	Defines a default value for a column (when no value is given)
CHECK	Constraint used to validate data in an attribute
CREATE INDEX	Creates an index for a table
CREATE VIEW	Creates a dynamic subset of rows/columns from one or more tables
ALTER TABLE	Modifies a tables definition (adds, modifies, or deletes attributes or constraints)
CREATE TABLE AS	Creates a new table based on a query in the users database schema
DROP TABLE	Permanently deletes a table (and thus its data)
DROP INDEX	Permanently deletes an index
DROP VIEW	Permanently deletes a view

DATABASE SYSTEMS: Design Implementation and Management (Rob, Coronel & Crockett 9781844807321)

Introduction to SQL (continued)

| TABLE 8.2	SQL data manipulation commands
Command or Option	**Description**
INSERT	Inserts row(s) into a table
SELECT	Selects attributes from rows in one or more tables or views
WHERE	Restricts the selection of rows based on a conditional expression
GROUP BY	Groups the selected rows based on one or more attributes
HAVING	Restricts the selection of grouped rows based on a condition
ORDER BY	Orders the selected rows based on one or more attributes
UPDATE	Modifies an attributes values in one or more tables rows
DELETE	Deletes one or more rows from a table
COMMIT	Permanently saves data changes
ROLLBACK	Restores data to their original values
Comparison operators	
=, <, >, <=, >=, <>	Used in conditional expressions
Logical operators	
AND/OR/NOT	Used in conditional expressions
Special operators	Used in conditional expressions
BETWEEN	Checks whether an attribute value is within a range
IS NULL	Checks whether an attribute value is null
LIKE	Checks whether an attribute value matches a given string pattern
IN	Checks whether an attribute value matches any value within a value list
EXISTS	Checks whether a subquery returns any rows
DISTINCT	Limits values to unique values
Aggregate functions	Used with SELECT to return mathematical summaries on columns
COUNT	Returns the number of rows with non-null values for a given column
MIN	Returns the minimum attribute value found in a given column
MAX	Returns the maximum attribute value found in a given column
SUM	Returns the sum of all values for a given column
AVG	Returns the average of all values for a given column

Data Definition Commands

- Examine simple database model and database tables that will form basis for many SQL examples

- Understand data environment

The Database Model

FIGURE 8.1 The database model
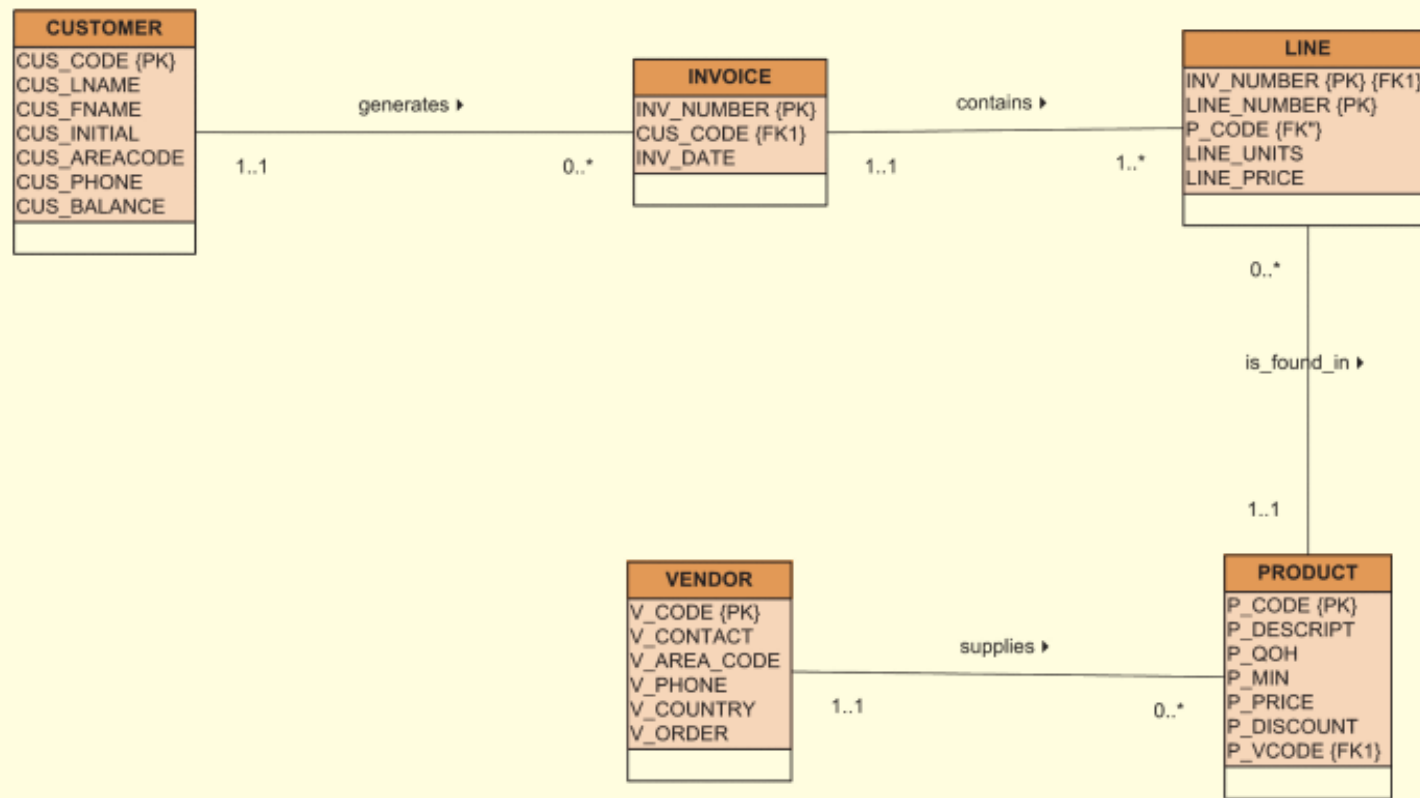
The Database Model (continued)

FIGURE 8.2   The VENDOR and PRODUCT tables

Database name: Ch8_SaleCo

Table name: VENDOR

V_CODE	V_NAME	V_CONTACT	V_AREACODE	V_PHONE	V_Country	V_ORDER
21225	Bryson, Inc.	Smithson	0181	223-3234	UK	Y
21226	SuperLoo, Inc.	Flushing	0113	215-8995	SA	N
21231	D&E Supply	Singh	0181	228-3245	UK	Y
21344	Gomez Bros.	Ortega	0181	889-2546	UK	N
22567	Dome Supply	Smith	7253	678-1419	FR	N
23119	Randsets Ltd.	Anderson	7253	678-3998	FR	Y
24004	Brackman Bros.	Browning	0181	228-1410	UK	N
24288	ORDVA, Inc.	Hakford	0181	898-1234	UK	Y
25443	B&K, Inc.	Smith	0113	227-0093	SA	N
25501	Damal Supplies	Smythe	0181	890-3529	UK	N
25595	Rubicon Systems	Orton	0113	456-0092	SA	Y

Table name: PRODUCT

P_CODE	P_DESCRIPT	P_INDATE	P_QOH	P_MIN	P_PRICE	P_DISCOUNT	V_CODE
11QER/31	Power painter, 15 psi., 3-nozzle	03-Nov-06	8	5	109.99	0.00	25595
13-Q2/P2	18cm pwr. saw blade	13-Dec-06	32	15	14.99	0.05	21344
14-Q1/L3	22cm pwr. saw blade	13-Nov-06	18	12	17.49	0.00	21344
1546-QQ2	Hrd. cloth, 0.6cm, 2x50	15-Jan-07	15	8	39.95	0.00	23119
1558-QW1	Hrd. cloth, 1.25cm, 3x50	15-Jan-07	23	5	43.99	0.00	23119
2232/QTY	B&D jigsaw, 30cm blade	30-Dec-06	8	5	109.92	0.05	24288
2232/QWE	B&D jigsaw, 20cm blade	24-Dec-06	6	5	99.87	0.05	24288
2238/QPD	B&D cordless drill, 1.25cm	20-Jan-07	12	5	38.95	0.05	25595
23109-HB	Claw hammer	20-Jan-07	23	10	9.95	0.10	21225
23114-AA	Sledge hammer, 7kg	02-Jan-07	8	5	14.40	0.05	
54778-2T	Rat-tail file, 0.5cm fine	15-Dec-06	43	20	4.99	0.00	21344
89-WRE-Q	Hicut chain saw, 40cm	07-Feb-07	11	5	256.99	0.05	24288
PVC23DRT	PVC pipe, 9cm, 2.5m	20-Feb-07	188	75	5.87	0.00	
SM-18277	3cm metal screw, 25	01-Mar-07	172	75	6.99	0.00	21225
SW-23116	6cm wd. screw, 50	24-Feb-07	237	100	8.45	0.00	21231
WR3/TT3	Steel matting, 10cm × 20cm × 0.5cm ×1.25cm mesh	17-Jan-07	18	5	119.95	0.10	25595

Creating the Database

- Following two tasks must be completed:
  - Create database structure
  - Create tables that will hold end-user data

- First task:
  - RDBMS creates physical files that will hold database
  - Tends to differ substantially from one RDBMS to another

The Database Schema

- Authentication
  - Process through which DBMS verifies that only registered users are able to access database
  - Log on to RDBMS using user ID and password created by database administrator

- Schema
  - Group of database objects—such as tables and indexes—that are related to each other

Data Types

- Data type selection is usually dictated by nature of data and by intended use

- Pay close attention to expected use of attributes for sorting and data retrieval purposes

COURSE TECHNOLOGY
CENGAGE Learning™

Data Types (continued)

TABLE 8.4	Some common SQL data types	
Data Type	**Format**	**Comments**
Numeric	NUMBER(L,D) INTEGER SMALLINT DECIMAL(L,D)	The declaration NUMBER(7,2) indicates numbers that will be stored with two decimal places and may be up to six digits long, including the sign and the decimal place. Examples: 12.32, -134.99.
		May be abbreviated as INT. Integers are (whole) counting numbers, so they cannot be used if you want to store numbers that require decimal places.
		Like INTEGER, but limited to integer values up to six digits. If your integer values are relatively small, use SMALLINT instead of INT. Like the NUMBER specification, but the storage length is a *minimum* specification. That is, greater lengths are acceptable, but smaller ones are not. DECIMAL(9,2), DECIMAL(9) and DECIMAL are all acceptable.
Character	CHAR(L) VARCHAR(L) or VARCHAR2(L)	Fixed-length character data for up to 255 characters. If you store strings that are not as long as the CHAR parameter value, the remaining spaces are left unused. Therefore, if you specify CHAR(25), strings such as Smith and Katzenjammer are each stored as 25 characters. However, an area code is always three digits long, so CHAR(3) would be appropriate if you wanted to store such codes.
		Variable-length character data. The designation VARCHAR2(25) will let you store characters up to 25 characters long. However, VARCHAR will not leave unused spaces. Oracle users may use VARCHAR2 as well as VARCHAR.
Date	DATE	Stores dates in the Julian date format.

Creating Table Structures

- Use one line per column (attribute) definition

- Use spaces to line up attribute characteristics and constraints

- Table and attribute names are capitalized

- NOT NULL specification

- UNIQUE specification

Creating Table Structures (continued)

- Primary key attributes contain both a NOT NULL and a UNIQUE specification

- RDBMS will automatically enforce referential integrity for foreign keys

- Command sequence ends with semicolon

SQL Constraints

- ## NOT NULL constraint
  - Ensures that column does not accept nulls

- ## UNIQUE constraint
  - Ensures that all values in column are unique

- ## DEFAULT constraint
  - Assigns value to attribute when a new row is added to table

- ## CHECK constraint
  - Validates data when attribute value is entered

SQL Indexes

- When primary key is declared, DBMS automatically creates unique index

- Often need additional indexes

- Using CREATE INDEX command, SQL indexes can be created on basis of any selected attribute

- Composite index
  - Index based on two or more attributes
  - Often used to prevent data duplication

SQL Indexes (continued)

TABLE 8.5	A duplicated test record			
EMP_NUM	**TEST_NUM**	**TEST_CODE**	**TEST_DATE**	**TEST_SCORE**
110	1	WEA	15-May-2006	93
110	2	WEA	12-May-2006	87
111	1	HAZ	14-Dec-2006	91
111	2	WEA	18-Feb-2007	95
111	3	WEA	18-Feb-2007	95
112	1	CHEM	17-Aug-2006	91

COURSE TECHNOLOGY
CENGAGE Learning™

Data Manipulation Commands

- Adding table rows

- Saving table changes

- Listing table rows

- Updating table rows

- Restoring table contents

- Deleting table rows

- Inserting table rows with a select subquery

Adding Table Rows

- INSERT
  - Used to enter data into table
  - Syntax:
    - INSERT INTO *columnname*
      VALUES (*value1, value2, … , valuen*);

Adding Table Rows (continued)

- When entering values, notice that:
  - Row contents are entered between parentheses
  - Character and date values are entered between apostrophes
  - Numerical entries are not enclosed in apostrophes
  - Attribute entries are separated by commas
  - A value is required for each column

- Use NULL for unknown values

Saving Table Changes

- Changes made to table contents are not physically saved on disk until, one of the following occurs:
  - Database is closed
  - Program is closed
  - COMMIT command is used

- Syntax:
  - COMMIT [WORK];

- Will permanently save any changes made to any table in the database

Listing Table Rows

- SELECT
  - Used to list contents of table
  - Syntax:
    - SELECT *columnlist*
      FROM *tablename*;

- *Columnlist* represents one or more attributes, separated by commas

- Asterisk can be used as wildcard character to list all attributes

Listing Table Rows (continued)

FIGURE 8.3 The contents of the PRODUCT table

P_CODE	P_DESCRIPT	P_INDATE	P_QOH	P_MIN	P_PRICE	P_DISCOUNT	V_CODE
11QER/31	Power painter, 15 psi., 3-nozzle	03-Nov-06	8	5	109.99	0.00	25595
13-Q2/P2	7.25-cm pwr. saw blade	13-Dec-06	32	15	14.99	0.05	21344
14-Q1/L3	9.00-cm pwr. saw blade	13-Nov-06	18	12	17.49	0.00	21344
1546-QQ2	Hrd. cloth, 1/4-cm, 2x50	15-Jan-07	15	8	39.95	0.00	23119
1558-QW1	Hrd. cloth, 1/2-cm, 3x50	15-Jan-07	23	5	43.99	0.00	23119
2232/QTY	B&D jigsaw, 12-cm blade	30-Dec-06	8	5	109.92	0.05	24288
2232/QWE	B&D jigsaw, 8-cm blade	24-Dec-06	6	5	99.87	0.05	24288
2238/QPD	B&D cordless drill, 1/2-cm	20-Jan-07	12	5	38.95	0.05	25595
23109-HB	Claw hammer	20-Jan-07	23	10	9.95	0.10	21225
23114-AA	Sledge hammer, 12 kg	02-Jan-07	8	5	14.40	0.05	
54778-2T	Rat-tail file, 1/8-cm fine	15-Dec-06	43	20	4.99	0.00	21344
89-WRE-Q	Hicut chain saw, 16 cm	07-Feb-07	11	5	256.99	0.05	24288
PVC23DRT	PVC pipe, 3.5-cm, 8-m	20-Feb-07	188	75	5.87	0.00	
SM-18277	1.25-cm metal screw, 25	01-Mar-07	172	75	6.99	0.00	21225
SW-23116	2.5-cm wd. screw, 50	24-Feb-07	237	100	8.45	0.00	21231
WR3/TT3	Steel matting, 4m × 8m × 1/6m, .5m mesh	17-Jan-07	18	5	119.95	0.10	25595

Updating Table Rows

- UPDATE
  - Modify data in a table
  - Syntax:
    - UPDATE *tablename*
      SET *columnname* = *expression* [, *columname* = *expression*]
      [WHERE *conditionlist*];

- If more than one attribute is to be updated in row, separate corrections with commas

COURSE TECHNOLOGY
CENGAGE Learning™

Restoring Table Contents

- ROLLBACK
    - Used to restore database to its previous condition
    - Only applicable if COMMIT command has not been used to permanently store changes in database

- Syntax:
    - ROLLBACK;

- COMMIT and ROLLBACK only work with data manipulation commands that are used to add, modify, or delete table rows

Deleting Table Rows

- ## DELETE
  - Deletes a table row
  - Syntax:
    - DELETE FROM *tablename*
      [WHERE *conditionlist*];

- ## WHERE condition is optional

- ## If WHERE condition is not specified, all rows from specified table will be deleted

Inserting Table Rows with a Select Subquery

- **INSERT**
  - Inserts multiple rows from another table (source)
  - Uses SELECT subquery
    - Query that is embedded (or nested) inside another query
    - Executed first
  - Syntax:
    - INSERT INTO *tablename* SELECT *columnlist* FROM *tablename*;

Selecting Rows with Conditional Restrictions

- Select partial table contents by placing restrictions on rows to be included in output
  - Add conditional restrictions to SELECT statement, using WHERE clause

- Syntax:
  - SELECT *columnlist*
    FROM *tablelist*
    [WHERE *conditionlist*] ;

COURSE TECHNOLOGY
CENGAGE Learning™

Selecting Rows with Conditional Restrictions (continued)

FIGURE 8.4 Selected PRODUCT table attributes for vendor code 21344

P_DESCRIPT	P_PRICE	V_CODE
7.25cm pwr. saw blade	14.99	21344
9.00cm pwr. saw blade	17.49	21344
Rat-tail file, 1/8-in. fine	4.99	21344

Selecting Rows with Conditional Restrictions (continued)
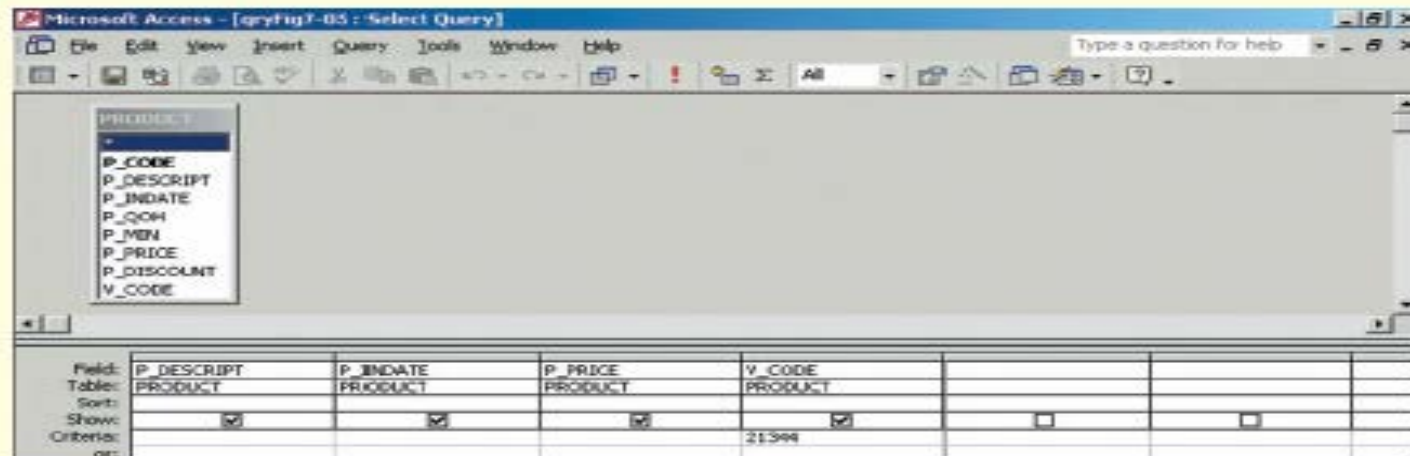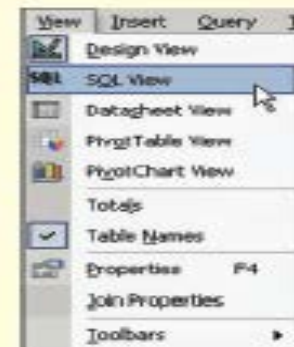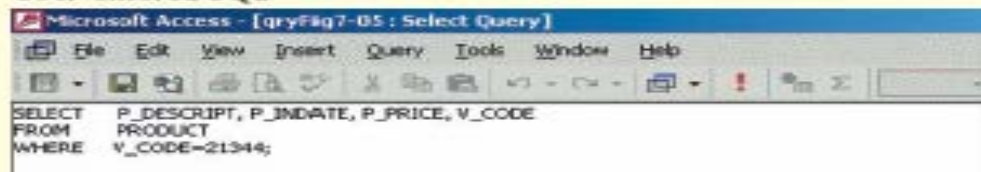
Selecting Rows with
Conditional Restrictions (continued)

TABLE 8.6	Comparison operators
Symbol	**Meaning**
=	Equal to
<	Less than
<=	Less than or equal to
>	Greater than
>=	Greater than or equal to
<> or !=	Not equal to

Selecting Rows with Conditional Restrictions (continued)

| FIGURE 8.6 | Selected PRODUCT table attributes for vendor codes other than 21344 |

P_DESCRIPT	P_INDATE	P_PRICE	V_CODE
Power painter, 15 psi., 3-nozzle	03-Nov-06	109.99	25595
Hrd. cloth, 1/4cm, 2x50	15-Jan-07	39.95	23119
Hrd. cloth, 1/2cm, 3x50	15-Jan-07	43.99	23119
B&D jigsaw, 12cm blade	30-Dec-06	109.92	24288
B&D jigsaw, 3cm blade	24-Dec-06	99.87	24288
B&D cordless drill, 1/2cm	20-Jan-07	38.95	25595
Claw hammer	20-Jan-07	9.95	21225
Hicut chain saw, 16cm	07-Feb-07	256.99	24288
1.25cm metal screw, 25	01-Mar-07	6.99	21225
2.5cm wd. screw, 50	24-Feb-07	8.45	21231
Steel matting, 4 × 8 × 1/6 × 5cm mesh	17-Jan-07	119.95	25595

Selecting Rows with Conditional Restrictions (continued)

FIGURE 8.7 Selected PRODUCT table attributes with a P_PRICE restriction

P_DESCRIPT	P_QOH	P_MIN	P_PRICE
Claw hammer	23	10	9.95
Rat-tail file, 1/8-cm fine	43	20	4.99
PVC pipe, 3.5-cm, 8-m	188	75	5.87
1.25-cm metal screw, 25	172	75	6.99
2.5-cm wd. screw, 50	237	100	8.45

Selecting Rows with Conditional Restrictions (continued)

FIGURE 8.8 Selected PRODUCT table attributes; the ASCII code effect

P_CODE	P_DESCRIPT	P_QOH	P_MIN	P_PRICE
11QER/31	Power painter, 15 psi., 3-nozzle	8	5	109.99
13-Q2/P2	7.25cm pwr. saw blade	32	15	14.99
14-Q1/L3	9.00cm pwr. saw blade	18	12	17.49
1546-QQ2	Hrd. cloth, 1/4cm, 2x50	15	8	39.95

Selecting Rows with
Conditional Restrictions (continued)

FIGURE 8.9 Selected PRODUCT table attributes: date restriction

P_DESCRIPT	P_QOH	P_MIN	P_PRICE	P_INDATE
B&D cordless drill, 1.25cm	12	5	38.95	20-Jan-07
Claw hammer	23	10	9.95	20-Jan-07
Hicut chain saw, 40cm	11	5	256.99	07-Feb-07
PVC pipe, 9cm, 2.5m	188	75	5.87	20-Feb-07
3cm metal screw, 25	172	75	6.99	01-Mar-07
6cm wd. screw, 50	237	100	8.45	24-Feb-07

Selecting Rows with
Conditional Restrictions (continued)

FIGURE 8.10 SELECT statement with a computed Column in ACCESS

P_DESCRIPT	P_QOH	P_PRICE	Expr1
Power painter, 15 psi., 3-nozzle	8	109.99	879.92
7.25-cm. pwr. saw blade	32	14.99	479.68
9.00-cm. pwr. saw blade	18	17.49	314.82
Hrd. cloth, 1/4-cm., 2x50	15	39.95	599.25
Hrd. cloth, 1/2-cm., 3x50	23	43.99	1011.77
B&D jigsaw, 12-cm. blade	8	109.92	879.36
B&D jigsaw, 8-cm. blade	6	99.87	599.22
B&D cordless drill, 1/2-cm.	12	38.95	467.40
Claw hammer	23	9.95	228.85
Sledge hammer, 6kg.	8	14.40	115.20
Rat-tail file, 1/8-cm. fine	43	4.99	214.57
Hicut chain saw, 16 cm.	11	256.99	2826.89
PVC pipe, 3.5-cm., 4m	188	5.87	1103.56
1.25-cm. metal screw, 25	172	6.99	1202.28
2.5-cm. wd. screw, 50	237	8.45	2002.85
Steel matting, 4x8x1/6, .5m mesh	18	119.95	2159.10
	0	0.00	

Selecting Rows with
Conditional Restrictions (continued)

FIGURE 8.11 SELECT statement with a computed column and an alias

P_DESCRIPT	P_QOH	P_PRICE	TOTVALUE
Power painter, 15 psi., 3-nozzle	8	109.99	879.92
7.25cm pwr. saw blade	32	14.99	479.68
9.00cm pwr. saw blade	18	17.49	314.82
Hrd. cloth, 1/4cm, 2x50	15	39.95	599.25
Hrd. cloth, 1/2cm, 3x50	23	43.99	1011.77
B&D jigsaw, 12cm blade	8	109.92	879.36
B&D jigsaw, 8cm blade	6	99.87	599.22
B&D cordless drill, 1/2cm	12	38.95	467.40
Claw hammer	23	9.95	228.85
Sledge hammer, 12 kg	8	14.40	115.20
Rat-tail file, 1/8cm fine	43	4.99	214.57
Hicut chain saw, 16 cm	11	256.99	2826.89
PVC pipe, 3.5cm, 8m	188	5.87	1103.56
1.25cm metal screw, 25	172	6.99	1202.28
2.5cm wd. screw, 50	237	8.45	2002.65
Steel matting, 4 × 8 × 1/6cm, .5cm mesh	18	119.95	2159.10

Arithmetic Operators:
The Rule of Precedence

- Perform operations within parentheses

- Perform power operations

- Perform multiplications and divisions

- Perform additions and subtractions

COURSE TECHNOLOGY
CENGAGE Learning™

Arithmetic Operators:
The Rule of Precedence (continued)

TABLE 8.7	The arithmetic operators
Arithmetic Operator	**Description**
+	Add
-	Subtract
*	Multiply
/	Divide
^	Raise to the power of (some applications use ** instead of ^.)

COURSE TECHNOLOGY
CENGAGE Learning

Logical Operators:
AND, OR, and NOT

FIGURE 8.12 Select PRODUCT table attributes: logical OR

P_DESCRIPT	P_INDATE	P_PRICE	V_CODE
18cm pwr. saw blade	13-Dec-06	14.99	21344
22cm pwr. saw blade	13-Nov-06	17.49	21344
B&D jigsaw, 30cm blade	30-Dec-06	109.92	24288
B&D jigsaw, 20cm blade	24-Dec-06	99.87	24288
Rat-tail file, 0.3cm fine	15-Dec-06	4.99	21344
Hicut chain saw, 40cm	07-Feb-07	256.99	24288

Logical Operators: AND, OR, and NOT (continued)

FIGURE 8.13 Select PRODUCT table attributes: logical AND

P_DESCRIPT	P_INDATE	P_PRICE	V_CODE
B&D cordless drill, 1.25cm	20-Jan-07	38.95	25595
Claw hammer	20-Jan-07	9.95	21225
PVC pipe, 9cm, 2.5m	20-Feb-07	5.87	
3cm metal screw, 25	01-Mar-07	6.99	21225
6cm wd. screw, 50	24-Feb-07	8.45	21231

Logical Operators:
AND, OR, and NOT (continued)

FIGURE 8.14 Select PRODUCT table attributes: logical AND and OR

P_DESCRIPT	P_INDATE	P_PRICE	V_CODE
B&D jigsaw, 30cm blade	30-Dec-06	109.92	24288
B&D jigsaw, 20cm blade	24-Dec-06	99.87	24288
B&D cordless drill, 1.25cm	20-Jan-07	38.95	25595
Claw hammer	20-Jan-07	9.95	21225
Hicut chain saw, 40cm	07-Feb-07	256.99	24288
PVC pipe, 9cm, 2.5m	20-Feb-07	5.87	
3cm metal screw, 25	01-Mar-07	6.99	21225
6cm wd. screw, 50	24-Feb-07	8.45	21231

Special Operators

- BETWEEN
  - Used to check whether attribute value is within a range

- IS NULL
  - Used to check whether attribute value is null

- LIKE
  - Used to check whether attribute value matches given string pattern

COURSE TECHNOLOGY
CENGAGE Learning™

Special Operators (continued)

- IN
  - Used to check whether attribute value matches any value within a value list

- EXISTS
  - Used to check if subquery returns any rows

COURSE TECHNOLOGY
CENGAGE Learning™

Advanced Data Definition Commands

- All changes in table structure are made by using ALTER command
  - Followed by keyword that produces specific change
  - Following three options are available:
    - ADD
    - MODIFY
    - DROP

Changing a Column's Data Type

- ALTER can be used to change data type

- Some RDBMSs (such as Oracle) do not permit changes to data types unless column to be changed is empty

Changing a Column's Data Characteristics

- Use ALTER to change data characteristics

- If column to be changed already contains data, changes in column's characteristics are permitted if those changes do not alter the data type

Adding a Column

- ## Use ALTER to add column
  - Do not include the NOT NULL clause for new column

Dropping a Column
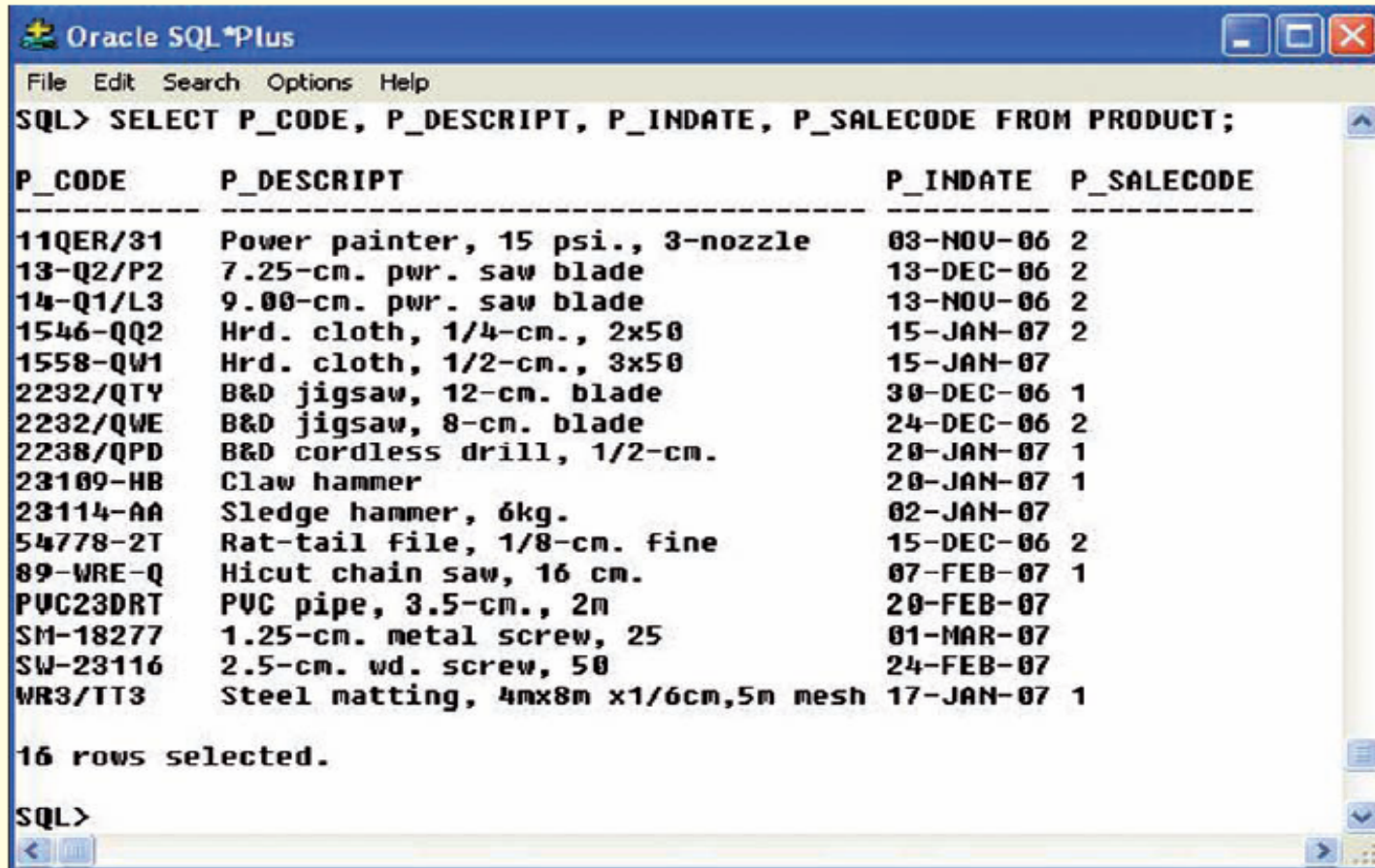
- ## Use ALTER to drop column
  - Some RDBMSs impose restrictions on the deletion of an attribute

Advanced Data Updates

FIGURE 8.15   The cumulative effect of multiple updates in the PRODUCT table (ORACLE)

Copying Parts of Tables

- SQL permits copying contents of selected table columns so that the data need not be reentered manually into newly created table(s)

- First create the PART table structure

- Next add rows to new PART table using PRODUCT table rows

Copying Parts of Tables (continued)

FIGURE 8.16   PART table attributes copied from the PRODUCT table

PART_CODE	PART_DESCRIPT	PART_PRICE	V_CODE
11QER/31	Power painter, 15 psi., 3-nozzle	109.99	25595
13-Q2/P2	7.25cm pwr. saw blade	14.99	21344
14-Q1/L3	9.00cm pwr. saw blade	17.49	21344
1546-QQ2	Hrd. cloth, 1/4cm, 2x50	39.95	23119
1558-QW1	Hrd. cloth, 1/2cm, 3x50	43.99	23119
2232/QTY	B&D jigsaw, 12cm blade	109.92	24288
2232/QWE	B&D jigsaw, 8cm blade	99.87	24288
2238/QPD	B&D cordless drill, 1/2cm	38.95	25595
23109-HB	Claw hammer	9.95	21225
23114-AA	Sledge hammer, 12kg	14.4	
54778-2T	Rat-tail file, 1/8cm fine	4.99	21344
89-WRE-Q	Hicut chain saw, 16cm	256.99	24288
PVC23DRT	PVC pipe, 3.5cm, 8m	5.87	
SM-18277	1.25cm metal screw, 25	6.99	21225
SW-23116	2.5cm wd. screw, 50	8.45	21231
WR3/TT3	Steel matting, 4 × 8 × 1/6m, .5m mesh	119.95	25595

Adding Primary and Foreign Key Designations

- When table is copied, integrity rules do not copy, so primary and foreign keys need to be manually defined on new table

- User ALTER TABLE command
  - Syntax:
    - ALTER TABLE *tablename* ADD PRIMARY KEY(*fieldname*);
    - For foreign key, use FOREIGN KEY in place of PRIMARY KEY

Deleting a Table from the Database

- ## DROP
  - Deletes table from database
  - Syntax:
    - DROP TABLE *tablename*;

Advanced Select Queries

- SQL provides useful functions that can:
  - Count
  - Find minimum and maximum values
  - Calculate averages

- SQL allows user to limit queries to only those entries having no duplicates or entries whose duplicates may be grouped

Ordering a Listing

FIGURE 8.17 Selected PRODUCT table attributes: ordered by (ascending) P_PRICE

P_CODE	P_DESCRIPT	P_INDATE	P_PRICE
54778-2T	Rat-tail file, 0.5cm fine	15-Dec-06	4.99
PVC23DRT	PVC pipe, 9cm, 2.5m	20-Feb-07	5.87
SM-18277	3cm metal screw, 25	01-Mar-07	6.99
SW-23116	6cm wd. screw, 50	24-Feb-07	8.45
23109-HB	Claw hammer	20-Jan-07	9.95
23114-AA	Sledge hammer, 7kg	02-Jan-07	14.40
13-Q2/P2	7.25cm pwr. saw blade	13-Dec-06	14.99
14-Q1/L3	9.00cm pwr. saw blade	13-Nov-06	17.49
2238/QPD	B&D cordless drill, 1/2cm	20-Jan-07	38.95
1546-QQ2	Hrd. cloth, 1/4cm, 2x50	15-Jan-07	39.95
1558-QW1	Hrd. cloth, 1/2cm, 3x50	15-Jan-07	43.99
2232/QWE	B&D jigsaw, 8cm blade	24-Dec-06	99.87
2232/QTY	B&D jigsaw, 12cm blade	30-Dec-06	109.92
11QER/31	Power painter, 15 psi., 3-nozzle	03-Nov-06	109.99
WR3/TT3	Steel matting, 4 × 8 × 1/6m, .5m mesh	17-Jan-07	119.95
89-WRE-Q	Hicut chain saw, 16cm	07-Feb-07	256.99

Ordering a Listing (continued)

FIGURE 8.18	Selected PRODUCT table attributes: ordered by (ascending) P_PRICE

EMP_LNAME	EMP_FNAME	EMP_INITIAL	EMP_AREACODE	EMP_PHONE
Brandon	Marie	G	7325	882-0845
Diante	Jorge	D	0181	890-4567
Genkazi	Leighla	W	7235	569-0093
Johnson	Edward	E	0181	898-4387
Jones	Anne	M	0181	898-3456
Kolmycz	George	D	0181	324-5456
Lange	John	P	7325	504-4430
Lewis	Rhonda	G	0181	324-4472
Saranda	Hermine	R	0181	324-5505
Smith	George	A	0181	890-2984
Smith	George	K	7235	504-3339
Smith	Jeanine	K	0181	324-7883
Smythe	Melanie	P	0181	324-9006
Vandam	Rhett		7325	675-8993
Washington	Rupert	E	0181	890-4925
Wiesenbach	Paul	R	0181	897-4358
Williams	Robert	D	0181	890-3220

Ordering a Listing (continued)

FIGURE 8.19   A query based on multiple restrictions

P_DESCRIPT	V_CODE	P_INDATE	P_PRICE
Sledge hammer, 12kg		02-Jan-07	14.40
Claw hammer	21225	20-Jan-07	9.95
9.00cm pwr. saw blade	21344	13-Nov-06	17.49
7.25cm pwr. saw blade	21344	13-Dec-06	14.99
Rat-tail file, 1/8cm fine	21344	15-Dec-06	4.99
Hrd. cloth, 1/2cm, 3x50	23119	15-Jan-07	43.99
Hrd. cloth, 1/4cm, 2x50	23119	15-Jan-07	39.95
B&D cordless drill, 1/2cm	25595	20-Jan-07	38.95

Listing Unique Values

FIGURE 8.20   A listing of distinct (different) V_CODE values in the PRODUCT table

V_CODE
21225
21231
21344
23119
24288
25595

Aggregate Functions
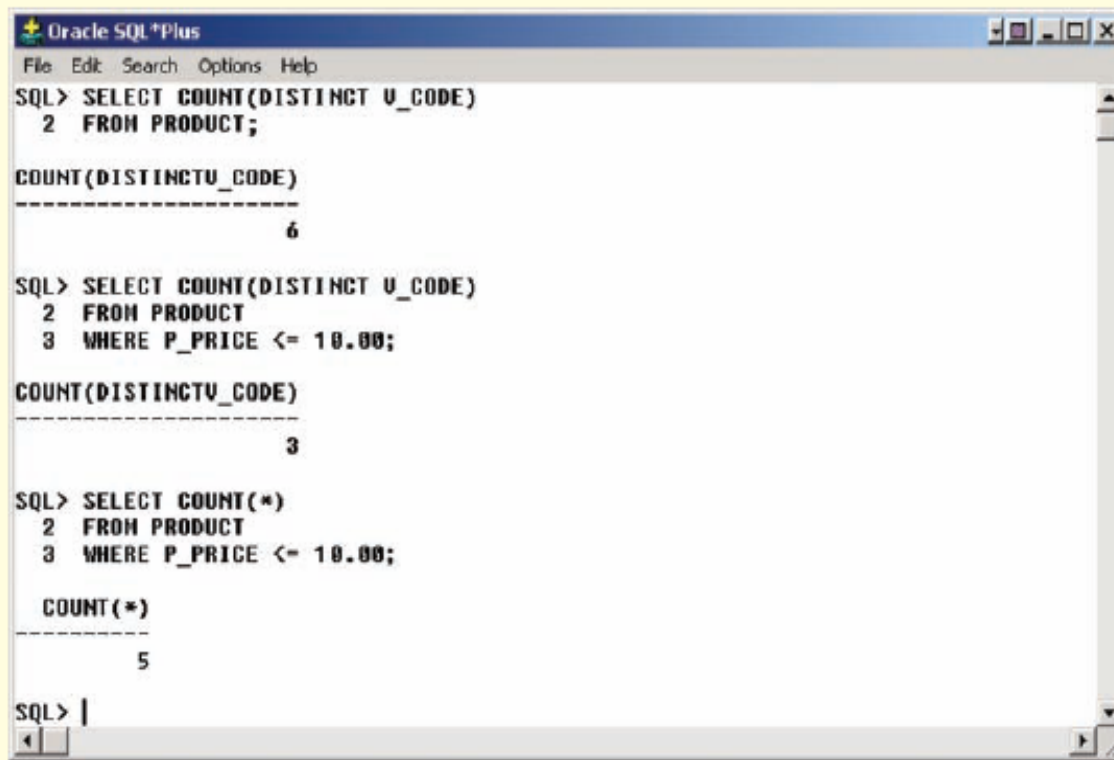
TABLE 8.8	Some basic SQL aggregate functions
Function	**Output**
COUNT	The number of rows containing non-null values
MIN	The minimum attribute value encountered in a given column
MAX	The maximum attribute value encountered in a given column
SUM	The sum of all values for a given column
AVG	The arithmetic mean (average) for a specified column

Aggregate Functions (continued)

FIGURE 8.21 COUNT function output examples

Aggregate Functions (continued)

FIGURE 8.22   MIN and MAX function output examples

```
Oracle SQL*Plus
File  Edit  Search  Options  Help
SQL> SELECT MAX(P_PRICE) FROM PRODUCT;

MAX(P_PRICE)
------------
      256.99

SQL> SELECT MIN(P_PRICE) FROM PRODUCT;

MIN(P_PRICE)
------------
        4.99

SQL> SELECT P_CODE, P_DESCRIPT, P_PRICE
  2  FROM    PRODUCT
  3  WHERE   P_PRICE = (SELECT MAX(P_PRICE) FROM PRODUCT);

P_CODE      P_DESCRIPT                                 P_PRICE
----------  -------------------------------------  -----------
89-WRE-Q    Hicut chain saw, 16 cm.                     256.99

SQL>
```
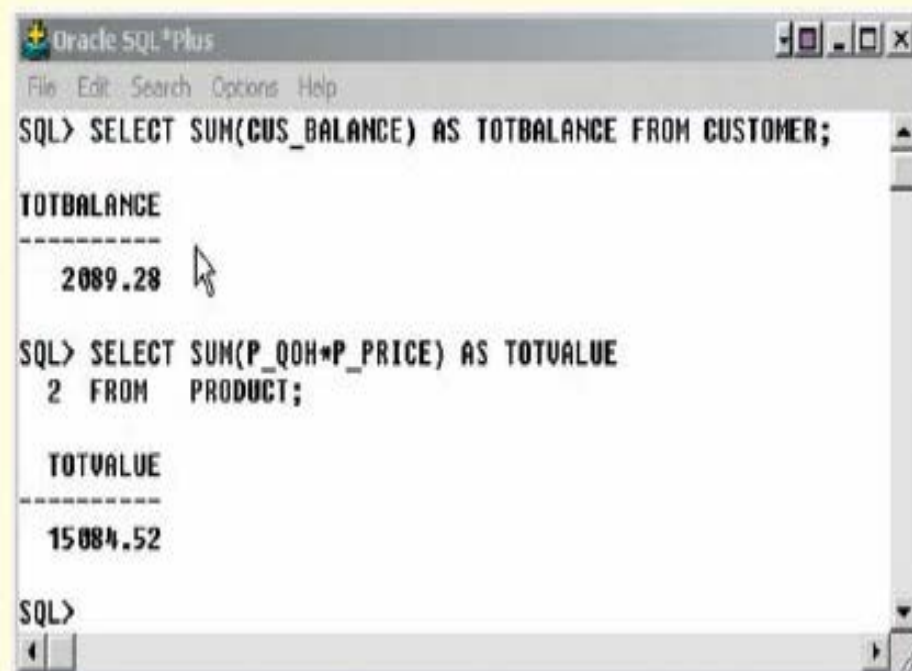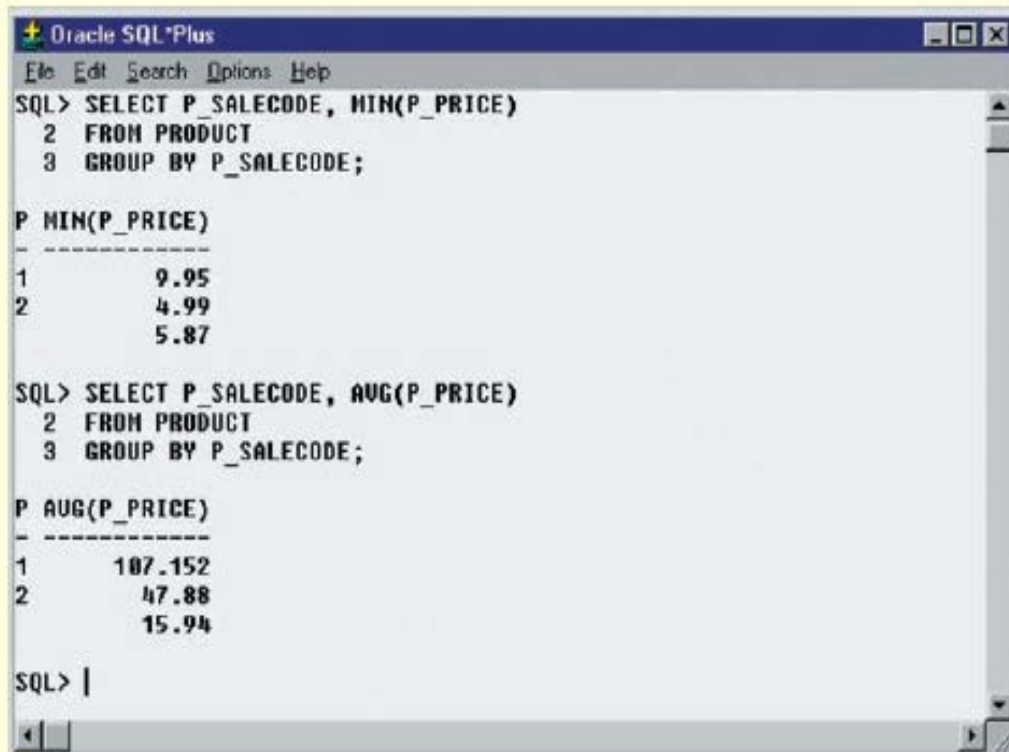
Aggregate Functions (continued)

FIGURE 8.23 The total value of all items in the PRODUCT table
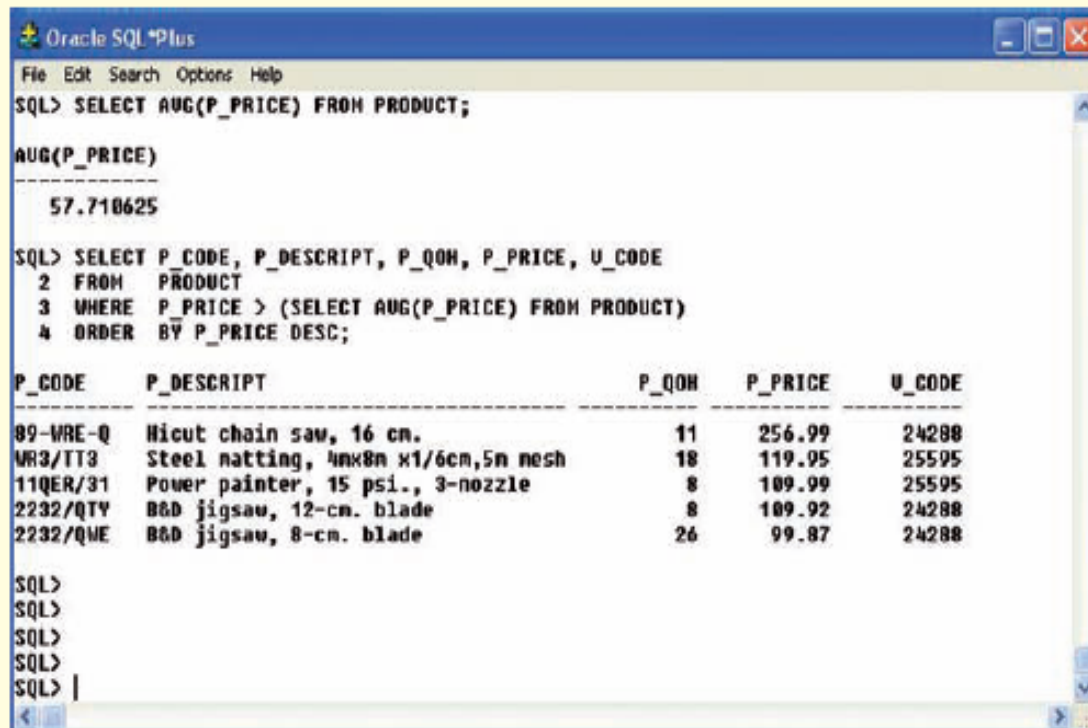
Aggregate Functions (continued)

FIGURE 8.24   AVG function output examples

Grouping Data

FIGURE 8.25 GROUP BY clause output examples

Grouping Data (continued)

FIGURE 8.26   Incorrect and correct use of the GROUP BY clause

```
Oracle SQL*Plus                                              _ □ ×
File  Edit  Search  Options  Help
SQL> SELECT U_CODE, P_CODE, P_DESCRIPT, P_PRICE
  2   FROM PRODUCT
  3   GROUP BY U_CODE;
SELECT U_CODE, P_CODE, P_DESCRIPT, P_PRICE
                *
ERROR at line 1:
ORA-00979: not a GROUP BY expression


SQL> SELECT U_CODE, COUNT(DISTINCT (P_CODE))
  2   FROM PRODUCT
  3   GROUP BY U_CODE;

   U_CODE COUNT(DISTINCT(P_CODE))
---------- -----------------------
    21225                        2
    21231                        1
    21344                        3
    23119                        2
    24288                        3
    25595                        3
                                 2

7 rows selected.

SQL> |
```

Grouping Data (continued)

FIGURE 8.27 An application of the HAVING clause

Virtual Tables: Creating a View

- View is virtual table based on SELECT query
  - Can contain columns, computed columns, aliases, and aggregate functions from one or more tables

- Base tables are tables on which view is based

- Create view by using CREATE VIEW command

Virtual Tables: Creating a View (continued)

FIGURE 8.28   Creating a virtual table with the CREATE VIEW command

```
Oracle SQL *Plus
File  Edit  Search  Options  Help
SQL> CREATE VIEW PRICEGT50 AS
  2       SELECT P_DESCRIPT, P_QOH, P_PRICE
  3       FROM PRODUCT
  4       WHERE P_PRICE > 50.00;

View created.

SQL> SELECT * FROM PRICEGT50;

P_DESCRIPT                                P_QOH    P_PRICE
---------------------------------------- ----------- ----------
Power painter, 15 psi., 3-nozzle           29       109.99
B&D jigsaw, 12-cm. blade                    8       109.92
B&D jigsaw, 8-cm. blade                     6        99.87
Hicut chain saw, 16 cm.                    11       256.99
Steel matting, 4x8x1/6cm, .5m mesh         18       119.95

SQL>
```

Joining Database Tables

- Ability to combine (join) tables on common attributes is most important distinction between relational database and other databases

- Join is performed when data are retrieved from more than one table at a time

- Join is generally composed of an equality comparison between foreign key and primary key of related tables

Joining Database Tables (continued)

TABLE 8.9	Creating links through foreign keys	
Table	**Attributes to be shown**	**Linking attribute**
PRODUCT	P_DESCRIPT, P_PRICE	V_CODE
VENDOR	V_COMPANY, V_PHONE	V_CODE

Joining Database Tables (continued)

FIGURE 8.29 The results of a join

P_DESCRIPT	P_PRICE	V_NAME	V_CONTACT	V_AREACODE	V_PHONE
Claw hammer	9.95	Bryson, Inc.	Smithson	0181	223-3234
1.25cm metal screw, 25	6.99	Bryson, Inc.	Smithson	0181	223-3234
2.5cm wd. screw, 50	8.45	D&E Supply	Singh	0181	228-3245
7.25cm pwr. saw blade	14.99	Gomez Bros.	Ortega	0181	889-2546
9.00cm pwr. saw blade	17.49	Gomez Bros.	Ortega	0181	889-2546
Rat-tail file, 1/8cm fine	4.99	Gomez Bros.	Ortega	0181	889-2546
Hrd. cloth, 1/4cm, 2x50	39.95	Randsets Ltd.	Anderson	7253	678-3998
Hrd. cloth, 1/2cm, 3x50	43.99	Randsets Ltd.	Anderson	7253	678-3998
B&D jigsaw, 12cm blade	109.92	ORDVA, Inc.	Hakford	0181	898-1234
B&D jigsaw, 8cm blade	99.87	ORDVA, Inc.	Hakford	0181	898-1234
Hicut chain saw, 16cm	256.99	ORDVA, Inc.	Hakford	0181	898-1234
Power painter, 15 psi., 3-nozzle	109.99	Rubicon Systems	Orton	0113	456-0092
B&D cordless drill, 1/2cm	38.95	Rubicon Systems	Orton	0113	456-0092
Steel matting, 4 × 8 × 1/6m, .5m mesh	119.95	Rubicon Systems	Orton	0113	456-0092

Joining Database Tables (continued)

FIGURE 8.30 An ordered and limited listing after a join

P_DESCRIPT	P_PRICE	V_NAME	V_CONTACT	V_AREACODE	V_PHONE
1.25cm metal screw, 25	6.99	Bryson, Inc.	Smithson	0181	223-3234
2.5cm wd. screw, 50	8.45	D&E Supply	Singh	0181	228-3245
Claw hammer	9.95	Bryson, Inc.	Smithson	0181	223-3234
B&D cordless drill, 1/2cm	38.95	Rubicon Systems	Orton	0113	456-0092
Steel matting, 4 × 8 × 1/6m, .5m mesh	119.95	Rubicon Systems	Orton	0113	456-0092
Hicut chain saw, 16cm	256.99	ORDVA, Inc.	Hakford	0181	898-1234

COURSE TECHNOLOGY
CENGAGE Learning™

Joining Tables with an Alias

- Alias can be used to identify source table

- Any legal table name can be used as alias

- Add alias after table name in FROM clause
    - FROM *tablename alias*

Recursive Joins

FIGURE 8.31 The contents of the EMP table

EMP_NUM	EMP_TITLE	EMP_LNAME	EMP_FNAME	EMP_INITIAL	EMP_DOB	EMP_HIRE_DATE	EMP_AREACODE	EMP_PHONE	EMP_MGR
100	Mr.	Kolmycz	George	D	15-Jun-42	15-Mar-85	0181	324-5456	
101	Ms.	Lewis	Rhonda	G	19-Mar-65	25-Apr-86	0181	324-4472	100
102	Mr.	Vandam	Rhett		14-Nov-58	20-Dec-90	7253	675-8993	100
103	Ms.	Jones	Anne	M	16-Oct-74	28-Aug-94	0181	898-3456	100
104	Mr.	Lange	John	P	08-Nov-71	20-Oct-94	7253	504-4430	105
105	Mr.	Williams	Robert	D	14-Mar-75	08-Nov-98	0181	890-3220	
106	Mrs.	Smith	Jeanine	K	12-Feb-68	05-Jan-89	0181	324-7883	105
107	Mr.	Diante	Jorge	D	21-Aug-74	02-Jul-94	0181	890-4567	105
108	Mr.	Wiesenbach	Paul	R	14-Feb-66	18-Nov-92	0181	897-4358	
109	Mr.	Smith	George	K	18-Jun-61	14-Apr-89	7253	504-3339	108
110	Mrs.	Genkazi	Leighla	W	19-May-70	01-Dec-90	7253	569-0093	108
111	Mr.	Washington	Rupert	E	03-Jan-66	21-Jun-93	0181	890-4925	105
112	Mr.	Johnson	Edward	E	14-May-61	01-Dec-83	0181	898-4387	100
113	Ms.	Smythe	Melanie	P	15-Sep-70	11-May-99	0181	324-9006	105
114	Ms.	Brandon	Marie	G	02-Nov-56	15-Nov-79	7253	882-0845	108
115	Mrs.	Saranda	Hermine	R	25-Jul-72	23-Apr-93	0181	324-5505	105
116	Mr.	Smith	George	A	08-Nov-65	10-Dec-88	0181	890-2984	108

Recursive Joins (continued)

FIGURE 8.32 Using an alias to join a table to itself

EMP_MGR	M.EMP_LNAME	EMP_NUM	E.EMP_LNAME
100	Kolmycz	112	Johnson
100	Kolmycz	103	Jones
100	Kolmycz	102	Vandam
100	Kolmycz	101	Lewis
105	Williams	115	Saranda
105	Williams	113	Smythe
105	Williams	111	Washington
105	Williams	107	Diante
105	Williams	106	Smith
105	Williams	104	Lange
108	Wiesenbach	116	Smith
108	Wiesenbach	114	Brandon
108	Wiesenbach	110	Genkazi
108	Wiesenbach	109	Smith

Outer Joins

FIGURE 8.33 The left outer join results

P_CODE	V_CODE	V_NAME
23109-HB	21225	Bryson, Inc.
SM-18277	21225	Bryson, Inc.
	21226	SuperLoo, Inc.
SW-23116	21231	D&E Supply
13-Q2/P2	21344	Gomez Bros.
14-Q1/L3	21344	Gomez Bros.
54778-2T	21344	Gomez Bros.
	22567	Dome Supply
1546-QQ2	23119	Randsets Ltd.
1558-QW1	23119	Randsets Ltd.
	24004	Brackman Bros.
2232/QTY	24288	ORDVA, Inc.
2232/QWE	24288	ORDVA, Inc.
89-WRE-Q	24288	ORDVA, Inc.
	25443	B&K, Inc.
	25501	Damal Supplies
11QER/31	25595	Rubicon Systems
2238/QPD	25595	Rubicon Systems
WR3/TT3	25595	Rubicon Systems

Outer Joins (continued)

FIGURE 8.34 The right outer join results

P_CODE	V_CODE	V_NAME
23114-AA		
PVC23DRT		
23109-HB	21225	Bryson, Inc.
SM-18277	21225	Bryson, Inc.
SW-23116	21231	D&E Supply
13-Q2/P2	21344	Gomez Bros.
14-Q1/L3	21344	Gomez Bros.
54778-2T	21344	Gomez Bros.
1546-QQ2	23119	Randsets Ltd.
1558-QW1	23119	Randsets Ltd.
2232/QTY	24288	ORDVA, Inc.
2232/QWE	24288	ORDVA, Inc.
89-WRE-Q	24288	ORDVA, Inc.
11QER/31	25595	Rubicon Systems
2238/QPD	25595	Rubicon Systems
WR3/TT3	25595	Rubicon Systems

Summary

- SQL commands can be divided into two overall categories:
    - Data definition language commands
    - Data manipulation language commands

- The ANSI standard data types are supported by all RDBMS vendors in different ways

- Basic data definition commands allow you to create tables, indexes, and views

Summary (continued)

- DML commands allow you to add, modify, and delete rows from tables

- The basic DML commands are SELECT, INSERT, UPDATE, DELETE, COMMIT, and ROLLBACK

- INSERT command is used to add new rows to tables

- SELECT statement is main data retrieval command in SQL

Summary (continued)

- Many SQL constraints can be used with columns

- The column list represents one or more column names separated by commas

- WHERE clause can be used with SELECT, UPDATE, and DELETE statements to restrict rows affected by the DDL command

Summary (continued)

- ## Aggregate functions
  - Special functions that perform arithmetic computations over a set of rows

- ## ORDER BY clause
  - Used to sort output of SELECT statement
  - Can sort by one or more columns and use either an ascending or descending order

- ## Join output of multiple tables with SELECT statement

Summary (continued)

- Natural join uses join condition to match only rows with equal values in specified columns

- Right outer join and left outer join used to select rows that have no matching values in other related table