Data Warehouse Service
8.1.3
Performance White Paper

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Contents

1 Overview

This performance test was performed based on the TPC-H and TPC-DS standard test sets.

TPC-H

TPC-H is developed and released by the Transaction Processing Performance Council to evaluate the analysis and query capabilities of databases. TPC-H queries include eight data tables and 22 complex SQL queries. Most queries include multiple joins, subqueries, and GROUP BY statements.

TPC-DS

TPC-DS is a decision support benchmark that was developed and released by the Transaction Processing Performance Council. It is used to measure the analysis performance of big data products. The TPC-DS query contains 24 tables and 99 query test statements.

2 Test Result

2.1 TPC-H Single Query Test

Test Environment

Table 2-1 Test environment

Product	Flavor	CPU	Memory	Storage	Version
GaussDB(DWS)	8xlarge	32U	256G	Cloud SSD	8.1.3

Test Result

The following is the TPC-H performance test result. (scale=1000, time unit=s)

Table 2-2 TPC-H 1000X test result

ID	TPC-H Query	Test Result (s)
1	Q1	22.15
2	Q2	2.65
3	Q3	28.29
4	Q4	49.07
5	Q5	44.45
6	Q6	1.24
7	Q7	33.26
8	Q8	32.10

ID	TPC-H Query	Test Result (s)
9	Q9	112.67
10	Q10	20.63
11	Q11	6.49
12	Q12	13.73
13	Q13	20.61
14	Q14	3.10
15	Q15	3.45
16	Q16	7.77
17	Q17	16.97
18	Q18	81.23
19	Q19	16.74
20	Q20	16.99
21	Q21	53.11
22	Q22	10.20
23	Total duration (s)	596.90

2.2 TPC-DS Single Query Test

Test Environment

Table 2-3 Test environment

Product	Flavor	CPU	Memory	Storage	Version
GaussDB(DWS)	8xlarge	32U	256G	Cloud SSD	8.1.3

Test Result

The following is the TPC-DS performance test result. (scale=1000, time unit=s)

Table 2-4 TPC-DS 1000X test result

ID	TPC-DS Query	Test Result (s)
1	Q1	1.46
2	Q2	9.33
3	Q3	2.40
4	Q4	142.24
5	Q5	6.36
6	Q6	0.82
7	Q7	3.20
8	Q8	1.02
9	Q9	10.92
10	Q10	1.68
11	Q11	78.92
12	Q12	0.53
13	Q13	3.95
14	Q14	113.09
15	Q15	2.99
16	Q16	8.08
17	Q17	6.94
18	Q18	3.58
19	Q19	1.20
20	Q20	0.51
21	Q21	0.51
22	Q22	11.37
23	Q23	188.13
24	Q24	14.51
25	Q25	6.90
26	Q26	1.30
27	Q27	3.42
28	Q28	18.44
29	Q29	5.27

ID	TPC-DS Query	Test Result (s)
30	Q30	1.09
31	Q31	7.13
32	Q32	2.21
33	Q33	2.35
34	Q34	4.00
35	Q35	3.60
36	Q36	10.27
37	Q37	0.56
38	Q38	52.97
39	Q39	7.00
40	Q40	1.29
41	Q41	0.08
42	Q42	0.66
43	Q43	2.99
44	Q44	3.05
45	Q45	1.38
46	Q46	5.86
47	Q47	10.98
48	Q48	2.32
49	Q49	3.54
50	Q50	10.30
51	Q51	13.90
52	Q52	0.63
53	Q53	1.68
54	Q54	6.27
55	Q55	0.57
56	Q56	1.60
57	Q57	4.76
58	Q58	1.89

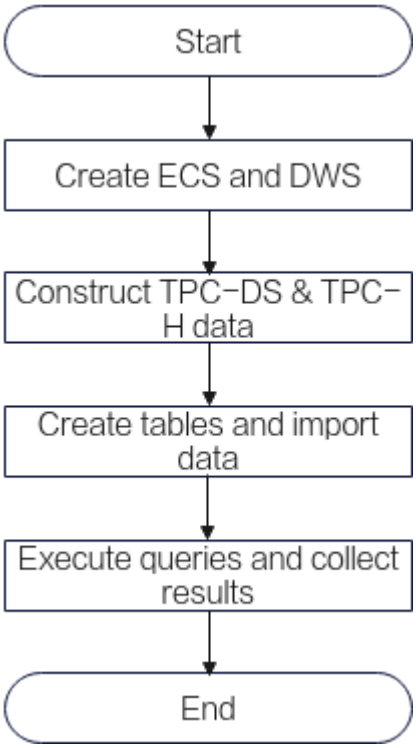
ID	TPC-DS Query	Test Result (s)
59	Q59	20.85
60	Q60	3.21
61	Q61	1.89
62	Q62	1.83
63	Q63	2.10
64	Q64	35.18
65	Q65	14.18
66	Q66	2.71
67	Q67	231.01
68	Q68	5.41
69	Q69	1.48
70	Q70	10.46
71	Q71	5.34
72	Q72	7.81
73	Q73	2.19
74	Q74	49.95
75	Q75	19.64
76	Q76	6.32
77	Q77	2.55
78	Q78	136.59
79	Q79	8.08
80	Q80	4.90
81	Q81	1.77
82	Q82	1.32
83	Q83	0.46
84	Q84	0.52
85	Q85	3.43
86	Q86	5.01
87	Q87	53.19

ID	TPC-DS Query	Test Result (s)
88	Q88	8.94
89	Q89	2.23
90	Q90	0.77
91	Q91	0.42
92	Q92	1.06
93	Q93	13.28
94	Q94	4.90
95	Q95	41.46
96	Q96	2.16
97	Q97	12.01
98	Q98	2.04
99	Q99	3.35
100	Total duration (s)	1545.93

3 Test Methods

3.1 General Process

Figure 3-1 Development process



3.2 Creating an ECS and GaussDB(DWS) Data Warehouse

3.2.1 Creating an ECS Server

Create an ECS by referring to the **Elastic Cloud Server User Guide**. The following table lists the created flavors.

NOTE

TPC-DS and TPC-H data sets occupy large space. For example, TPC-DS 1000X and TPC-H 1000X occupy 930 GB and 1100 GB, respectively. Therefore, select a suitable data disk when creating an ECS. Fore example:

- Performing TPC-DS or TPC-H test: 2 ultra-high I/O 600 GB data disks
- Performing TPC-DS and TPC-H tests: 2 ultra-high I/O 1200 GB data disks

Table 3-1 ECS specifications

Billing mode	Pay-per-use
Region	CN-Hong Kong
AZ	AZ1
CPU architecture	Kunpeng
Flavor	Kunpeng General Computing-Plus | kc1.8xlarge.2 32vCPUs|64 GiB
Image	EulerOS: 2.8 64bit with ARM (40 GB)
Data disk	The system disk uses general-purpose SSD 40 GB. Data disks should be: • 2 ultra-high I/O 600 GB data disks when TPC-DS or TPC-H test is performed. • 2 ultra-high I/O 1200 GB data disks when both TPC-DS and TPC-H tests are performed.

3.2.2 Creating a DWS Data Warehouse

Create a GaussDB(DWS) data warehouse by following the instructions provided in " **Creating a Cluster** " in the *Data Warehouse Service (DWS) User Guide*. **After the cluster is created, record the private IP address of the cluster.**

NOTICE

To ensure network connectivity between ECS and DWS, the created data warehouse and ECS must be in the same region, VPC, and subnet.

Table 3-2 DWS specifications

Region	CN-Hong Kong

AZ	AZ1
Cluster type	Cloud
Node flavor	8xlarge | 32 vCPUs | 256GB
Available Storage	500 GB
Nodes	3

3.3 Constructing Data for TPC-H and TPC-CDS Tests

3.3.1 Preparing Tools for the Data Construction

Step 1 Remotely log in to the ECS.

Step 2 Run the following command to install git:

yum install git

Step 3 Run the following commands to install gcc:

yum install gcc

----End

3.3.2 TPC-H Data Construction

Step 1 Obtain TPC-H tools from the **Official website**.

Step 2 Log in to the ECS and run the following command to create a directory for storing the TPC-H tools:

```
mkdir -p /data1/script/tpch-kit/tpch1000X
mkdir -p /data2/script/tpch-kit/tpch1000X
```

Step 3 Use SFTP to upload the obtained TPC-H tools to the **/data1/script/tpch-kit** directory of the ECS and run the following command to decompress the tools:

```
cd /data1/script/tpch-kit && unzip tpch_v3.0.0.zip
```

Step 4 Run the following command to compile and generate the data construction tool dbgen:

NOTICE

Before compilation, modify the **makefile.suite** and **tpcd.h** files in the dbgen directory.

1. Modifying makefile.suite

```
#Change the parameters of makefile.suite as follows (line 103 to line 111):

CC      = gcc
# Current values for DATABASE are: INFORMIX, DB2, TDAT (Teradata)
#                                  SQLSERVER, SYBASE, ORACLE, VECTORWISE
# Current values for MACHINE are:  ATT, DOS, HP, IBM, ICL, MVS,
#                                  SGI, SUN, U2200, VMS, LINUX, WIN32
# Current values for WORKLOAD are:  TPCH

DATABASE = POSTGRESQL # The specified parameter of the program does not contain postgresql.
Modify tpcd.h to add the POSTGRESQL script.
MACHINE = LINUX
WORKLOAD = TPCH
```

2. Modifying **tpcd.h**

```
//Add the following statements to the tpcd.h file:
#ifdef POSTGRESQL
#define GEN_QUERY_PLAN  "EXPLAIN"
#define START_TRAN      "BEGIN TRANSACTION"
#define END_TRAN        "COMMIT;"
#define SET_OUTPUT      ""
#define SET_ROWCOUNT    "LIMIT %d\n"
#define SET_DBASE       ""
#endif /* POSTGRESQL */
```

```
cd TPC-H_Tools_v3.0.0/dbgen && make
```

Step 5 Log in to the ECS and run the following commands to generate data for the TPC-H 1000X test. In this example, TPC-H 1000X data is generated on two data disks synchronously.

NOTICE

The total size of TPC-H 1000X data file is about 1100 GB. Make sure that the ECS disk space is sufficient.

1. Go to the **/data1/script/tpch-kit/TPC-H_Tools_v3.0.0/dbgen** directory and run the following command:

```
for c in {1..5};do (./dbgen -s 1000 -C 10 -S ${c} –f > /dev/null 2>&1 &);done
```

2. Copy the **dbgen** script.

```
cp -r  /data1/script/tpch-kit/TPC-H_Tools_v3.0.0/dbgen  /data2/script/tpch-kit/TPC-H_Tools_v3.0.0/dbgen
```

   Go to the **/data2/script/tpch-kit/TPC-H_Tools_v3.0.0/dbgen** directory and run the following command:

```
for c in {6..10};do (./dbgen -s 1000 -C 10-S ${c} –f > /dev/null 2>&1 &);done
```

   Where,

   - **-s** specifies the data scale. In this example, the value is 1000.
   - **-C** specifies the number of chunks. In this example, the value is 10.
   - **-S** specifies the sequence number of the current chunk. You do not need to change the value.

Step 6 Run the following commands to check the data file generation progress: You can also run the **ps ux|grep dsdgen** command to check whether the file generation process stops.

```
du -sh /data1/script/tpch-kit/TPC-H_Tools_v3.0.0/dbgen/*.tbl*
du -sh /data2/script/tpch-kit/TPC-H_Tools_v3.0.0/dbgen/*.tbl*
```

Step 7 Copy data to a specified directory.

```
mv /data1/script/tpch-kit/TPC-H_Tools_v3.0.0/dbgen/*.tbl* /data1/script/tpch-kit/tpch1000X
mv /data2/script/tpch-kit/TPC-H_Tools_v3.0.0/dbgen/*.tbl* /data2/script/tpch-kit/tpch1000X
```

----End

3.3.3 TPC-DS Data Construction

Step 1 Log in to the ECS and run the following command to create a directory for storing the TPC-DS tool:

```
mkdir -p /data1/script/tpcds-kit/tpcds1000X
mkdir -p /data2/script/tpcds-kit/tpcds1000X
```

Step 2 Obtain the latest TPC-DS data construction tool **dsdgen** from the **Official website** and use SFTP to upload the tool to the **/data1/script/tpcds-kit** directory on the ECS.

Step 3 Run the following commands to decompress the TPC-DS package and compile the package to generate the data construction tool **dsdgen**:

- Replace *tpcds_3.2.0.zip* with the actual software package name.
- Replace *DSGen-software-code-3.2.0rc1* with the actual name of the decompressed folder.

```
cd /data1/script/tpcds-kit && unzip tpcds_3.2.0.zip
cd DSGen-software-code-3.2.0rc1/tools && make
```

Step 4 Go to the **/data1/script/tpcds-kit/DSGen-software-code-3.2.0rc1/tools** directory and run the following commands to generate data:

NOTE

- Because of the large size of the TPC-DS data, the size of a single table is also large. Therefore, data is generated in shards.
- The total size of TPC-DS 1000X data file is about 930 GB. Make sure that the ECS disk space is sufficient.
- Because the generated data is large, it takes a long time to import data if only one GDS is started. You are advised to generate data on two data disks evenly. In the following example, shards 1 to 5 are stored in **/data1/script/tpcds-kit/tpcds1000X**, and shards 6 to 10 are stored in **/data2/script/tpcds-kit/tpcds1000X**.

```
for c in {1..5};do (./dsdgen -scale 1000 -dir /data1/script/tpcds-kit/tpcds1000X -TERMINATE N -parallel
10 -child ${c} -force Y > /dev/null 2>&1 &);done
for c in {6..10};do (./dsdgen -scale 1000 -dir /data2/script/tpcds-kit/tpcds1000X -TERMINATE N -parallel
10 -child ${c} -force Y > /dev/null 2>&1 &);done
```

Where,

- **-scale** specifies the data scale. In this example, the value is 1000.
- **-dir** specifies the directories where the generated data files are stored. In this example, the directories are **/data1/script/tpcds-kit/tpcds1000X** and **/data2/script/tpcds-kit/tpcds1000X**.
- **-TERMINATE** indicates whether a separator is required at the end of each record.

- **-parallel** specifies the number of shards. In this example, the value is 10.
- **-child** specifies a shard sequence. It does not need to be changed.

Step 5 Run the following commands to check the data file generation progress: You can also run the **ps ux|grep dsdgen** command to check whether the file generation process stops.

```
du -sh /data1/script/tpcds-kit/tpcds1000X/*.dat
du -sh /data2/script/tpcds-kit/tpcds1000X/*.dat
```

----End

3.4 Table Creation and Data Import

3.4.1 Importing Data Using GDS

3.4.1.1 Installing and Starting GDS

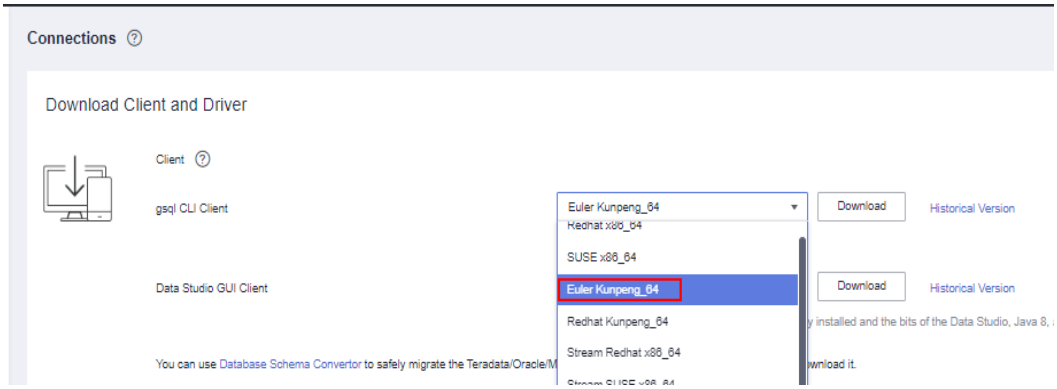
Installing and Starting GDS

Step 1 Log in to the GaussDB(DWS) console.

Step 2 In the navigation tree on the left, click **Connections**.

Step 3 Select the GaussDB(DWS) client from the Client drop-down list.

Select a version based on the cluster version and the OS where the client is installed.



Step 4 Click **Download**.

Step 5 Upload the GDS tool package to the **/opt** directory on the ECS. In this example, the tool package of Euler Kunpeng is uploaded.

Step 6 Go to the directory and decompress the package.

```
cd /opt/
unzip dws_client_8.1.x_euler_kunpeng_x64.zip
```

Step 7 Create a user (**gds_user**) and the user group (**gdsgrp**) to which the user belongs. This user is used to start GDS and must have the permission for reading the source data file directory.


```
groupadd gdsgrp
useradd -g gdsgrp gds_user
```

Step 8 Change the owner of the GDS package and source data file directory to **gds_user** and change the user group to **gdsgrp**.

```
chown -R gds_user:gdsgrp /opt/
chown -R gds_user:gdsgrp /data1
chown -R gds_user:gdsgrp /data2
```

Step 9 Switch to user **gds_user**.

```
su - gds_user
```

Step 10 Execute the script on which the environment depends (applicable only to version 8.1.x).

```
cd /opt/gds/bin
source gds_env
```

Step 11 Start GDS.

```
/opt/gds/bin/gds -d /data1/script/tpch-kit/tpch1000X -p 192.168.0.90:5000 -H 192.168.0.0/24 -l /opt/gds/gds01_log.txt -D #Used in the TPC-H test.
/opt/gds/bin/gds -d /data2/script/tpch-kit/tpch1000X -p 192.168.0.90:5001 -H 192.168.0.0/24 -l /opt/gds/gds02_log.txt -D #Used in the TPC-H test.
/opt/gds/bin/gds -d /data1/script/tpcds-kit/tpcds1000X/ -p 192.168.0.90:5002 -H 192.168.0.0/24 -l /opt/gds/gds03_log.txt -D #Used in the TPC-DS test.
/opt/gds/bin/gds -d /data2/script/tpcds-kit/tpcds1000X/ -p 192.168.0.90:5003 -H 192.168.0.0/24 -l /opt/gds/gds04_log.txt -D  #Used in the TPC-DS test.
```

NOTICE

- Replace the italic part in the command with the actual values. If data shards are stored in multiple data disk directories, start same number of GDSs as the directories.
- If TPC-H and TPC-DS data is tested at the same time, you need to start the preceding four GDSs. If only TPC-DS or TPC-H data is tested, start the corresponding GDS.

- **-d** *dir*: directory for storing data files that contain data to be imported.
- **-p** *ip:port*: listening IP address and port for GDS. Replace the IP address with the private network IP address of ECS to ensure that DWS can communicate with GDS through this IP address. The port numbers are 5000 and 5001 for TPC-H and 5002 and 5003 for TPC-DS.
- **-H** *address_string*: servers that are allowed to connect to and use GDS. The value must be in CIDR format. Set this parameter to the internal network segment of the data warehouse cluster, for example, *192.168.0.0/24*. The ECS where GDS is located and data warehouse are in the same VPC and can communicate with each other through the internal network.
- **-l** *log_file*: GDS log directory and log file name.
- **-D**: GDS in daemon mode. This command can be used only in the Linux operating system.

----End

3.4.1.2 Using gsql to Connect to DWS

Connecting to DWS Cluster Using gsql

Step 1 Go to the **/opt** directory of the ECS and run the environment variables.

```
cd /opt
source gsql_env.sh
```

Step 2 Run the following command to connect to the GaussDB(DWS) database. Obtain the GaussDB(DWS) private network IP address and the password of user **dbadmin** from **Creating a DWS Data Warehouse**.

```
gsql -d gaussdb -h GaussDB(DWS)_private_network_IP_address -U dbadmin -p 8000 -r -W Password_of_user_dbadmin ;
```

----End

3.4.1.3 Creating a GDS Foreign Table and Importing TPC-H Data

This section describes how to import TPC-H 1000X data using a GDS foreign table. **Table 3-3** lists the number of table rows in the TPC-H sets.

NOTICE

For TPC-DS, skip this section.

Number of Rows in TPC-H Tables

Table 3-3 TPC-H table rows

No.	Table Name	Number of Rows
1	region	5
2	nation	25
3	supplier	10,000,000
4	customer	150,000,000
5	part	200,000,000
6	partsupp	800,000,000
7	orders	1,500,000,000
8	lineitem	5,999,989,709

Procedure

Step 1 Run the following commands to create the eight target tables:


```
DROP TABLE IF EXISTS region;
CREATE TABLE region
(
    R_REGIONKEY  INT NOT NULL,
    R_NAME       CHAR(25) NOT NULL,
    R_COMMENT    VARCHAR(152)
)
with (orientation = column)
distribute by replication;

DROP TABLE IF EXISTS nation;
CREATE TABLE nation
(
    N_NATIONKEY  INT NOT NULL,
    N_NAME       CHAR(25) NOT NULL,
    N_REGIONKEY  INT NOT NULL,
    N_COMMENT    VARCHAR(152)
)
with (orientation = column)
distribute by replication;

DROP TABLE IF EXISTS supplier;
CREATE TABLE supplier
(
    S_SUPPKEY     INT NOT NULL,
    S_NAME        CHAR(25) NOT NULL,
    S_ADDRESS     VARCHAR(40) NOT NULL,
    S_NATIONKEY   INT NOT NULL,
    S_PHONE       CHAR(15) NOT NULL,
    S_ACCTBAL     DECIMAL(15,2) NOT NULL,
    S_COMMENT     VARCHAR(101) NOT NULL
)
with (orientation = column)
distribute by hash(S_SUPPKEY);

DROP TABLE IF EXISTS customer;
CREATE TABLE customer
(
    C_CUSTKEY     INT NOT NULL,
    C_NAME        VARCHAR(25) NOT NULL,
    C_ADDRESS     VARCHAR(40) NOT NULL,
    C_NATIONKEY   INT NOT NULL,
    C_PHONE       CHAR(15) NOT NULL,
    C_ACCTBAL     DECIMAL(15,2)   NOT NULL,
    C_MKTSEGMENT  CHAR(10) NOT NULL,
    C_COMMENT     VARCHAR(117) NOT NULL
)
with (orientation = column)
distribute by hash(C_CUSTKEY);

DROP TABLE IF EXISTS part;
CREATE TABLE part
(
    P_PARTKEY     INT NOT NULL,
    P_NAME        VARCHAR(55) NOT NULL,
    P_MFGR        CHAR(25) NOT NULL,
    P_BRAND       CHAR(10) NOT NULL,
    P_TYPE        VARCHAR(25) NOT NULL,
    P_SIZE        INT NOT NULL,
    P_CONTAINER   CHAR(10) NOT NULL,
    P_RETAILPRICE DECIMAL(15,2) NOT NULL,
    P_COMMENT     VARCHAR(23) NOT NULL
)
with (orientation = column)
distribute by hash(P_PARTKEY);

DROP TABLE IF EXISTS partsupp;
CREATE TABLE partsupp
(
```



```
    PS_PARTKEY     INT NOT NULL,
    PS_SUPPKEY     INT NOT NULL,
    PS_AVAILQTY    INT NOT NULL,
    PS_SUPPLYCOST  DECIMAL(15,2)  NOT NULL,
    PS_COMMENT     VARCHAR(199) NOT NULL
)
with (orientation = column)
distribute by hash(PS_PARTKEY);

DROP TABLE IF EXISTS orders;
CREATE TABLE orders
(
    O_ORDERKEY       BIGINT NOT NULL,
    O_CUSTKEY        INT NOT NULL,
    O_ORDERSTATUS    CHAR(1) NOT NULL,
    O_TOTALPRICE     DECIMAL(15,2) NOT NULL,
    O_ORDERDATE      DATE NOT NULL,
    O_ORDERPRIORITY  CHAR(15) NOT NULL,
    O_CLERK          CHAR(15) NOT NULL,
    O_SHIPPRIORITY   INT NOT NULL,
    O_COMMENT        VARCHAR(79) NOT NULL
)
with (orientation = column)
distribute by hash(O_ORDERKEY)
PARTITION BY RANGE(O_ORDERDATE)
(
    PARTITION O_ORDERDATE_1 VALUES LESS THAN('1993-01-01 00:00:00'),
    PARTITION O_ORDERDATE_2 VALUES LESS THAN('1994-01-01 00:00:00'),
    PARTITION O_ORDERDATE_3 VALUES LESS THAN('1995-01-01 00:00:00'),
    PARTITION O_ORDERDATE_4 VALUES LESS THAN('1996-01-01 00:00:00'),
    PARTITION O_ORDERDATE_5 VALUES LESS THAN('1997-01-01 00:00:00'),
    PARTITION O_ORDERDATE_6 VALUES LESS THAN('1998-01-01 00:00:00'),
    PARTITION O_ORDERDATE_7 VALUES LESS THAN('1999-01-01 00:00:00')
);

DROP TABLE IF EXISTS lineitem;
CREATE TABLE lineitem
(
    L_ORDERKEY    BIGINT NOT NULL,
    L_PARTKEY     INT NOT NULL,
    L_SUPPKEY     INT NOT NULL,
    L_LINENUMBER  INT NOT NULL,
    L_QUANTITY    DECIMAL(15,2) NOT NULL,
    L_EXTENDEDPRICE  DECIMAL(15,2) NOT NULL,
    L_DISCOUNT    DECIMAL(15,2) NOT NULL,
    L_TAX         DECIMAL(15,2) NOT NULL,
    L_RETURNFLAG  CHAR(1) NOT NULL,
    L_LINESTATUS  CHAR(1) NOT NULL,
    L_SHIPDATE    DATE NOT NULL,
    L_COMMITDATE  DATE NOT NULL,
    L_RECEIPTDATE DATE NOT NULL,
    L_SHIPINSTRUCT CHAR(25) NOT NULL,
    L_SHIPMODE     CHAR(10) NOT NULL,
    L_COMMENT      VARCHAR(44) NOT NULL
)
with (orientation = column)
distribute by hash(L_ORDERKEY)
PARTITION BY RANGE(L_SHIPDATE)
(
    PARTITION L_SHIPDATE_1 VALUES LESS THAN('1993-01-01 00:00:00'),
    PARTITION L_SHIPDATE_2 VALUES LESS THAN('1994-01-01 00:00:00'),
    PARTITION L_SHIPDATE_3 VALUES LESS THAN('1995-01-01 00:00:00'),
    PARTITION L_SHIPDATE_4 VALUES LESS THAN('1996-01-01 00:00:00'),
    PARTITION L_SHIPDATE_5 VALUES LESS THAN('1997-01-01 00:00:00'),
    PARTITION L_SHIPDATE_6 VALUES LESS THAN('1998-01-01 00:00:00'),
    PARTITION L_SHIPDATE_7 VALUES LESS THAN('1999-01-01 00:00:00')
);
```

Step 2 Run the following commands to create GDS foreign tables (eight tables):

NOTICE

Replace the IP addresses and port numbers in **gsfs:// 192.168.0.90:500x /xxx | gsfs:// 192.168.0.90:500x /xxx** with the corresponding GDS listening IP addresses and port numbers provided in **Installing and Starting GDS**. Use vertical bars (|) to distinguish IP_Port groups. If multiple GDS servers are configured, add the listening IP addresses and ports of all GDS servers to the foreign table.

```
DROP FOREIGN TABLE IF EXISTS region_load;
CREATE FOREIGN TABLE region_load
(
    R_REGIONKEY  INT,
    R_NAME       CHAR(25),
    R_COMMENT    VARCHAR(152)
)
SERVER gsmpp_server
OPTIONS(location 'gsfs://192.168.0.90:5000/region*.tbl | gsfs://192.168.0.90:5001/region*.tbl',
format 'text',
delimiter '|',
encoding 'utf8',
mode 'Normal'
);

DROP FOREIGN TABLE IF EXISTS nation_load;
CREATE FOREIGN TABLE nation_load
(
    N_NATIONKEY  INT,
    N_NAME       CHAR(25),
    N_REGIONKEY  INT,
    N_COMMENT    VARCHAR(152)
)
SERVER gsmpp_server
OPTIONS(location 'gsfs://192.168.0.90:5000/nation*.tbl* | gsfs://192.168.0.90:5001/nation*.tbl*',
format 'text',
delimiter '|',
encoding 'utf8',
mode 'Normal'
);

DROP FOREIGN TABLE IF EXISTS supplier_load;
CREATE FOREIGN TABLE supplier_load
(
    S_SUPPKEY     INT,
    S_NAME        CHAR(25),
    S_ADDRESS     VARCHAR(40),
    S_NATIONKEY   INT,
    S_PHONE       CHAR(15),
    S_ACCTBAL     DECIMAL(15,2),
    S_COMMENT     VARCHAR(101)
)
SERVER gsmpp_server
OPTIONS(location 'gsfs://192.168.0.90:5000/supplier*.tbl* | gsfs://192.168.0.90:5001/supplier*.tbl*',
format 'text',
delimiter '|',
encoding 'utf8',
mode 'Normal'
);

DROP FOREIGN TABLE IF EXISTS customer_load;
CREATE FOREIGN TABLE customer_load
(
    C_CUSTKEY     INT,
    C_NAME        VARCHAR(25),
    C_ADDRESS     VARCHAR(40),
    C_NATIONKEY   INT,
    C_PHONE       CHAR(15),
```



```
    C_ACCTBAL     DECIMAL(15,2),
    C_MKTSEGMENT  CHAR(10),
    C_COMMENT     VARCHAR(117)
)
SERVER gsmpp_server
OPTIONS(location 'gsfs://192.168.0.90:5000/customer*.tbl* | gsfs://192.168.0.90:5001/customer*.tbl*',
format 'text',
delimiter '|',
encoding 'utf8',
mode 'Normal'
);

DROP FOREIGN TABLE IF EXISTS part_load;
CREATE FOREIGN TABLE part_load
(
    P_PARTKEY     INT,
    P_NAME        VARCHAR(55),
    P_MFGR        CHAR(25),
    P_BRAND       CHAR(10),
    P_TYPE        VARCHAR(25),
    P_SIZE        INT,
    P_CONTAINER   CHAR(10),
    P_RETAILPRICE DECIMAL(15,2),
    P_COMMENT     VARCHAR(23)
)
SERVER gsmpp_server
OPTIONS(location 'gsfs://192.168.0.90:5000/part*.tbl* | gsfs://192.168.0.90:5001/part*.tbl*',
format 'text',
delimiter '|',
encoding 'utf8',
mode 'Normal'
);

DROP FOREIGN TABLE IF EXISTS partsupp_load;
CREATE FOREIGN TABLE partsupp_load
(
    PS_PARTKEY     INT,
    PS_SUPPKEY     INT,
    PS_AVAILQTY    INT,
    PS_SUPPLYCOST  DECIMAL(15,2),
    PS_COMMENT     VARCHAR(199)
)
SERVER gsmpp_server
OPTIONS(location 'gsfs://192.168.0.90:5000/partsupp*.tbl* | gsfs://192.168.0.90:5001/partsupp*.tbl*',
format 'text',
delimiter '|',
encoding 'utf8',
mode 'Normal'
);


DROP FOREIGN TABLE IF EXISTS orders_load;
CREATE FOREIGN TABLE orders_load
(
    O_ORDERKEY       BIGINT,
    O_CUSTKEY        INT,
    O_ORDERSTATUS    CHAR(1),
    O_TOTALPRICE     DECIMAL(15,2),
    O_ORDERDATE      DATE,
    O_ORDERPRIORITY  CHAR(15),
    O_CLERK          CHAR(15),
    O_SHIPPRIORITY   INT,
    O_COMMENT        VARCHAR(79)
)
SERVER gsmpp_server
OPTIONS(location 'gsfs://192.168.0.90:5000/orders*.tbl* | gsfs://192.168.0.90:5001/orders*.tbl*',
format 'text',
delimiter '|',
encoding 'utf8',
```



```
mode 'Normal'
);

DROP FOREIGN TABLE IF EXISTS lineitem_load;
CREATE FOREIGN TABLE lineitem_load
(
    L_ORDERKEY    BIGINT,
    L_PARTKEY     INT,
    L_SUPPKEY     INT,
    L_LINENUMBER  INT,
    L_QUANTITY    DECIMAL(15,2),
    L_EXTENDEDPRICE  DECIMAL(15,2),
    L_DISCOUNT    DECIMAL(15,2),
    L_TAX         DECIMAL(15,2),
    L_RETURNFLAG  CHAR(1),
    L_LINESTATUS  CHAR(1),
    L_SHIPDATE    DATE,
    L_COMMITDATE  DATE,
    L_RECEIPTDATE DATE,
    L_SHIPINSTRUCT CHAR(25),
    L_SHIPMODE     CHAR(10),
    L_COMMENT      VARCHAR(44)
)
SERVER gsmpp_server
OPTIONS(location 'gsfs://192.168.0.90:5000/lineitem*.tbl* | gsfs://192.168.0.90:5001/lineitem*.tbl*',
format 'text',
delimiter '|',
encoding 'utf8',
mode 'Normal'
);
```

Step 3 Run the following command to import data:

```
INSERT INTO region SELECT * FROM region_load;
INSERT INTO nation SELECT * FROM nation_load;
INSERT INTO supplier SELECT * FROM supplier_load;
INSERT INTO customer SELECT * FROM customer_load;
INSERT INTO part SELECT * FROM part_load;
INSERT INTO partsupp SELECT * FROM partsupp_load;
INSERT INTO orders SELECT * FROM orders_load;
INSERT INTO lineitem SELECT * FROM lineitem_load;
```

----End

3.4.1.4 Creating a GDS Foreign Table and Importing TPC-DS Data

This section describes how to import TPC-DS 1000X data using a GDS foreign table. **Table 3-4** lists the number of table rows in the TPC-DS sets.

NOTICE

For TPC-H, skip this section.

Number of Rows in TPC-DS Tables

Table 3-4 TPC-DS table rows

No.	Table Name	Number of Rows
1	customer_address	6,000,000

No.	Table Name	Number of Rows
2	customer_demographics	1,920,800
3	date_dim	73,049
4	warehouse	20
5	ship_mode	20
6	time_dim	86,400
7	reason	65
8	income_band	20
9	item	300,000
10	store	1,002
11	call_center	42
12	customer	12,000,000
13	web_site	54
14	household_demographics	7,200
15	web_page	3,000
16	promotion	1,500
17	catalog_page	30,000
18	inventory	783,000,000
19	catalog_returns	143,996,756
20	web_returns	71,997,522
21	store_returns	287,999,764
22	web_sales	720,000,376
23	catalog_sales	1,439,980,416
24	store_sales	2,879,987,999

Procedure

Step 1 Run the following SQL statements to create target tables (24 tables in total).

```
CREATE TABLE customer_address
(
    ca_address_sk             bigint               not null ,
    ca_address_id             char(16)               not null,
    ca_street_number          char(10)                       ,
    ca_street_name            varchar(60)                    ,
    ca_street_type            char(15)                      ,
    ca_suite_number           char(10)                       ,
```



```
    ca_city                 varchar(60)               ,
    ca_county               varchar(30)               ,
    ca_state                char(2)                   ,
    ca_zip                  char(10)                  ,
    ca_country              varchar(20)               ,
    ca_gmt_offset           decimal(5,2)              ,
    ca_location_type        char(20)
)
 with (orientation = column)
distribute by hash (ca_address_sk);


CREATE TABLE customer_demographics
(
    cd_demo_sk              bigint              not null ,
    cd_gender               char(1)                   ,
    cd_marital_status       char(1)                   ,
    cd_education_status     char(20)                  ,
    cd_purchase_estimate    bigint                    ,
    cd_credit_rating        char(10)                  ,
    cd_dep_count            bigint                    ,
    cd_dep_employed_count   bigint                    ,
    cd_dep_college_count    bigint
)
 with (orientation = column)
distribute by hash (cd_demo_sk);


CREATE TABLE date_dim
(
    d_date_sk               bigint              not null,
    d_date_id               char(16)            not null,
    d_date                  date                      ,
    d_month_seq             bigint                    ,
    d_week_seq              bigint                    ,
    d_quarter_seq           bigint                    ,
    d_year                  bigint                    ,
    d_dow                   bigint                    ,
    d_moy                   bigint                    ,
    d_dom                   bigint                    ,
    d_qoy                   bigint                    ,
    d_fy_year               bigint                    ,
    d_fy_quarter_seq        bigint                    ,
    d_fy_week_seq           bigint                    ,
    d_day_name              char(9)                   ,
    d_quarter_name          char(6)                   ,
    d_holiday               char(1)                   ,
    d_weekend               char(1)                   ,
    d_following_holiday     char(1)                   ,
    d_first_dom             bigint                    ,
    d_last_dom              bigint                    ,
    d_same_day_ly           bigint                    ,
    d_same_day_lq           bigint                    ,
    d_current_day           char(1)                   ,
    d_current_week          char(1)                   ,
    d_current_month         char(1)                   ,
    d_current_quarter       char(1)                   ,
    d_current_year          char(1)
)
 with (orientation = column)
 DISTRIBUTE by replication;


CREATE TABLE warehouse
(
    w_warehouse_sk          bigint              not null,
    w_warehouse_id          char(16)            not null,
    w_warehouse_name        varchar(20)               ,
    w_warehouse_sq_ft       bigint                    ,
```



```
    w_street_number           char(10)                  ,
    w_street_name             varchar(60)               ,
    w_street_type             char(15)                  ,
    w_suite_number            char(10)                  ,
    w_city                    varchar(60)               ,
    w_county                  varchar(30)               ,
    w_state                   char(2)                   ,
    w_zip                     char(10)                  ,
    w_country                 varchar(20)               ,
    w_gmt_offset              decimal(5,2)
)
 with (orientation = column)
distribute by replication;


CREATE TABLE ship_mode
(
    sm_ship_mode_sk           bigint               not null,
    sm_ship_mode_id           char(16)             not null,
    sm_type                   char(30)                  ,
    sm_code                   char(10)                  ,
    sm_carrier                char(20)                  ,
    sm_contract               char(20)
)
 with (orientation = column)
distribute by replication;


CREATE TABLE time_dim
(
    t_time_sk                 bigint               not null,
    t_time_id                 char(16)             not null,
    t_time                    bigint                    ,
    t_hour                    bigint                    ,
    t_minute                  bigint                    ,
    t_second                  bigint                    ,
    t_am_pm                   char(2)                   ,
    t_shift                   char(20)                  ,
    t_sub_shift               char(20)                  ,
    t_meal_time               char(20)
)
 with (orientation = column)
distribute by hash (t_time_sk);


CREATE TABLE reason
(
    r_reason_sk               bigint               not null,
    r_reason_id               char(16)             not null,
    r_reason_desc             char(100)
)
 with (orientation = column)
distribute by replication;


CREATE TABLE income_band
(
    ib_income_band_sk         bigint               not null,
    ib_lower_bound            bigint                    ,
    ib_upper_bound            bigint
)
 with (orientation = column)
distribute by replication;

CREATE TABLE item
(
    i_item_sk                 bigint               not null,
    i_item_id                 char(16)             not null,
    i_rec_start_date          date                      ,
```



```
    i_rec_end_date            date                    ,
    i_item_desc               varchar(200)              ,
    i_current_price           decimal(7,2)              ,
    i_wholesale_cost          decimal(7,2)                ,
    i_brand_id                bigint                  ,
    i_brand                   char(50)                  ,
    i_class_id                bigint                  ,
    i_class                   char(50)                  ,
    i_category_id             bigint                    ,
    i_category                char(50)                  ,
    i_manufact_id             bigint                    ,
    i_manufact                char(50)                  ,
    i_size                    char(20)                  ,
    i_formulation             char(20)                  ,
    i_color                   char(20)                  ,
    i_units                   char(10)                  ,
    i_container               char(10)                  ,
    i_manager_id              bigint                    ,
    i_product_name            char(50)
)
 with (orientation = column)
distribute by hash (i_item_sk);


CREATE TABLE store
(
    s_store_sk                bigint                not null,
    s_store_id                char(16)              not null,
    s_rec_start_date          date                    ,
    s_rec_end_date            date                    ,
    s_closed_date_sk          bigint                  ,
    s_store_name              varchar(50)               ,
    s_number_employees        bigint                    ,
    s_floor_space             bigint                  ,
    s_hours                   char(20)                  ,
    s_manager                 varchar(40)               ,
    s_market_id               bigint                  ,
    s_geography_class         varchar(100)              ,
    s_market_desc             varchar(100)              ,
    s_market_manager          varchar(40)               ,
    s_division_id             bigint                  ,
    s_division_name           varchar(50)               ,
    s_company_id              bigint                  ,
    s_company_name            varchar(50)               ,
    s_street_number           varchar(10)               ,
    s_street_name             varchar(60)               ,
    s_street_type             char(15)                  ,
    s_suite_number            char(10)                  ,
    s_city                    varchar(60)               ,
    s_county                  varchar(30)               ,
    s_state                   char(2)                   ,
    s_zip                     char(10)                  ,
    s_country                 varchar(20)               ,
    s_gmt_offset              decimal(5,2)              ,
    s_tax_precentage          decimal(5,2)
)
 with (orientation = column)
distribute by replication;

CREATE TABLE call_center
(
    cc_call_center_sk         bigint                not null,
    cc_call_center_id         char(16)              not null,
    cc_rec_start_date         date                    ,
    cc_rec_end_date           date                    ,
    cc_closed_date_sk         bigint                  ,
    cc_open_date_sk           bigint                  ,
    cc_name                   varchar(50)               ,
    cc_class                  varchar(50)               ,
```



```
    cc_employees              bigint                    ,
    cc_sq_ft                  bigint                    ,
    cc_hours                  char(20)                  ,
    cc_manager                varchar(40)               ,
    cc_mkt_id                 bigint                    ,
    cc_mkt_class              char(50)                  ,
    cc_mkt_desc               varchar(100)              ,
    cc_market_manager         varchar(40)               ,
    cc_division               bigint                    ,
    cc_division_name          varchar(50)               ,
    cc_company                bigint                    ,
    cc_company_name           char(50)                  ,
    cc_street_number          char(10)                  ,
    cc_street_name            varchar(60)               ,
    cc_street_type            char(15)                  ,
    cc_suite_number           char(10)                  ,
    cc_city                   varchar(60)               ,
    cc_county                 varchar(30)               ,
    cc_state                  char(2)                   ,
    cc_zip                    char(10)                  ,
    cc_country                varchar(20)               ,
    cc_gmt_offset             decimal(5,2)              ,
    cc_tax_percentage         decimal(5,2)
)
 with (orientation = column)
distribute by replication;

drop table if exists customer;
CREATE TABLE customer
(
    c_customer_sk             bigint            not null,
    c_customer_id             char(16)          not null,
    c_current_cdemo_sk        bigint                    ,
    c_current_hdemo_sk        bigint                    ,
    c_current_addr_sk         bigint                    ,
    c_first_shipto_date_sk    bigint                    ,
    c_first_sales_date_sk     bigint                    ,
    c_salutation              char(10)                  ,
    c_first_name              char(20)                  ,
    c_last_name               char(30)                  ,
    c_preferred_cust_flag     char(1)                   ,
    c_birth_day               bigint                    ,
    c_birth_month             bigint                    ,
    c_birth_year              bigint                    ,
    c_birth_country           varchar(20)               ,
    c_login                   char(13)                  ,
    c_email_address           char(50)                  ,
    c_last_review_date_sk     char(10)
)
 with (orientation = column)
distribute by hash (c_customer_sk);


CREATE TABLE web_site
(
    web_site_sk               bigint            not null,
    web_site_id               char(16)          not null,
    web_rec_start_date        date                      ,
    web_rec_end_date          date                      ,
    web_name                  varchar(50)               ,
    web_open_date_sk          bigint                    ,
    web_close_date_sk         bigint                    ,
    web_class                 varchar(50)               ,
    web_manager               varchar(40)               ,
    web_mkt_id                bigint                    ,
    web_mkt_class             varchar(50)               ,
    web_mkt_desc              varchar(100)              ,
    web_market_manager        varchar(40)               ,
    web_company_id            bigint                    ,
```



```
    web_company_name          char(50)                ,
    web_street_number         char(10)                ,
    web_street_name           varchar(60)             ,
    web_street_type           char(15)                ,
    web_suite_number          char(10)                ,
    web_city                  varchar(60)             ,
    web_county                varchar(30)             ,
    web_state                 char(2)                 ,
    web_zip                   char(10)                ,
    web_country               varchar(20)             ,
    web_gmt_offset            decimal(5,2)            ,
    web_tax_percentage        decimal(5,2)
)
 with (orientation = column)
distribute by replication;

CREATE TABLE household_demographics
(
    hd_demo_sk                bigint                not null,
    hd_income_band_sk         bigint                ,
    hd_buy_potential          char(15)              ,
    hd_dep_count              bigint                ,
    hd_vehicle_count          bigint
)
 with (orientation = column)
distribute by hash (hd_demo_sk);


CREATE TABLE web_page
(
    wp_web_page_sk            bigint                not null,
    wp_web_page_id            char(16)              not null,
    wp_rec_start_date         date                  ,
    wp_rec_end_date           date                  ,
    wp_creation_date_sk       bigint                ,
    wp_access_date_sk         bigint                ,
    wp_autogen_flag           char(1)               ,
    wp_customer_sk            bigint                ,
    wp_url                    varchar(100)          ,
    wp_type                   char(50)              ,
    wp_char_count             bigint                ,
    wp_link_count             bigint                ,
    wp_image_count            bigint                ,
    wp_max_ad_count           bigint
)
 with (orientation = column)
distribute by replication;


CREATE TABLE promotion
(
    p_promo_sk                bigint                not null,
    p_promo_id                char(16)              not null,
    p_start_date_sk           bigint                ,
    p_end_date_sk             bigint                ,
    p_item_sk                 bigint                ,
    p_cost                    decimal(15,2)         ,
    p_response_target         bigint                ,
    p_promo_name              char(50)              ,
    p_channel_dmail           char(1)               ,
    p_channel_email           char(1)               ,
    p_channel_catalog         char(1)               ,
    p_channel_tv              char(1)               ,
    p_channel_radio           char(1)               ,
    p_channel_press           char(1)               ,
    p_channel_event           char(1)               ,
    p_channel_demo            char(1)               ,
    p_channel_details         varchar(100)          ,
    p_purpose                 char(15)              ,
```



```
    p_discount_active         char(1)
)
 with (orientation = column)
DISTRIBUTE BY HASH(p_promo_sk);


CREATE TABLE catalog_page
(
    cp_catalog_page_sk        bigint               not null,
    cp_catalog_page_id        char(16)             not null,
    cp_start_date_sk          bigint                       ,
    cp_end_date_sk            bigint                       ,
    cp_department             varchar(50)                  ,
    cp_catalog_number         bigint                       ,
    cp_catalog_page_number    bigint                       ,
    cp_description            varchar(100)                 ,
    cp_type                   varchar(100)
)
 with (orientation = column)
distribute by hash (cp_catalog_page_sk);

CREATE TABLE inventory
(
    inv_date_sk               bigint               not null,
    inv_item_sk               bigint               not null,
    inv_warehouse_sk          bigint               not null,
    inv_quantity_on_hand      integer
)
 with (orientation = column)
distribute by hash (inv_date_sk)
partition by range(inv_date_sk)
(
    partition p1 values less than(2451179),
    partition p2 values less than(2451544),
    partition p3 values less than(2451910),
    partition p4 values less than(2452275),
    partition p5 values less than(2452640),
    partition p6 values less than(2453005),
    partition p7 values less than(maxvalue)
)
;

CREATE TABLE catalog_returns
(
    cr_returned_date_sk       bigint                       ,
    cr_returned_time_sk       bigint                       ,
    cr_item_sk                bigint               not null,
    cr_refunded_customer_sk   bigint                       ,
    cr_refunded_cdemo_sk      bigint                       ,
    cr_refunded_hdemo_sk      bigint                       ,
    cr_refunded_addr_sk       bigint                       ,
    cr_returning_customer_sk  bigint                       ,
    cr_returning_cdemo_sk     bigint                       ,
    cr_returning_hdemo_sk     bigint                       ,
    cr_returning_addr_sk      bigint                       ,
    cr_call_center_sk         bigint                       ,
    cr_catalog_page_sk        bigint                       ,
    cr_ship_mode_sk           bigint                       ,
    cr_warehouse_sk           bigint                       ,
    cr_reason_sk              bigint                       ,
    cr_order_number           bigint               not null,
    cr_return_quantity        bigint                       ,
    cr_return_amount          decimal(7,2)                 ,
    cr_return_tax             decimal(7,2)                 ,
    cr_return_amt_inc_tax     decimal(7,2)                 ,
    cr_fee                    decimal(7,2)                 ,
    cr_return_ship_cost       decimal(7,2)                 ,
    cr_refunded_cash          decimal(7,2)                 ,
    cr_reversed_charge        decimal(7,2)                 ,
```



```
    cr_store_credit           decimal(7,2)               ,
    cr_net_loss               decimal(7,2)
)
with (orientation = column)
distribute by hash (cr_item_sk)
partition by range(cr_returned_date_sk)
(
    partition p1 values less than(2450815),
    partition p2 values less than(2451179),
    partition p3 values less than(2451544),
    partition p4 values less than(2451910),
    partition p5 values less than(2452275),
    partition p6 values less than(2452640),
    partition p7 values less than(2453005),
    partition p8 values less than(maxvalue)
)
;


CREATE TABLE web_returns
(
    wr_returned_date_sk       bigint                    ,
    wr_returned_time_sk       bigint                    ,
    wr_item_sk                bigint              not null,
    wr_refunded_customer_sk   bigint                    ,
    wr_refunded_cdemo_sk      bigint                    ,
    wr_refunded_hdemo_sk      bigint                    ,
    wr_refunded_addr_sk       bigint                    ,
    wr_returning_customer_sk  bigint                    ,
    wr_returning_cdemo_sk     bigint                    ,
    wr_returning_hdemo_sk     bigint                    ,
    wr_returning_addr_sk      bigint                    ,
    wr_web_page_sk            bigint                    ,
    wr_reason_sk              bigint                    ,
    wr_order_number           bigint              not null,
    wr_return_quantity        bigint                    ,
    wr_return_amt             decimal(7,2)              ,
    wr_return_tax             decimal(7,2)              ,
    wr_return_amt_inc_tax     decimal(7,2)              ,
    wr_fee                    decimal(7,2)              ,
    wr_return_ship_cost       decimal(7,2)              ,
    wr_refunded_cash          decimal(7,2)              ,
    wr_reversed_charge        decimal(7,2)              ,
    wr_account_credit         decimal(7,2)              ,
    wr_net_loss               decimal(7,2)
)
 with (orientation = column)
distribute by hash (wr_item_sk)
partition by range(wr_returned_date_sk)
(
    partition p1 values less than(2450815),
    partition p2 values less than(2451179),
    partition p3 values less than(2451544),
    partition p4 values less than(2451910),
    partition p5 values less than(2452275),
    partition p6 values less than(2452640),
    partition p7 values less than(2453005),
    partition p8 values less than(maxvalue)
)
;

CREATE TABLE store_returns
(
    sr_returned_date_sk       bigint                    ,
    sr_return_time_sk         bigint                    ,
    sr_item_sk                bigint              not null,
    sr_customer_sk            bigint                    ,
    sr_cdemo_sk               bigint                    ,
    sr_hdemo_sk               bigint                    ,
```



```
    sr_addr_sk                bigint                    ,
    sr_store_sk               bigint                    ,
    sr_reason_sk              bigint                    ,
    sr_ticket_number          bigint                not null,
    sr_return_quantity        bigint                    ,
    sr_return_amt             decimal(7,2)              ,
    sr_return_tax             decimal(7,2)              ,
    sr_return_amt_inc_tax     decimal(7,2)              ,
    sr_fee                    decimal(7,2)              ,
    sr_return_ship_cost       decimal(7,2)              ,
    sr_refunded_cash          decimal(7,2)              ,
    sr_reversed_charge        decimal(7,2)              ,
    sr_store_credit           decimal(7,2)              ,
    sr_net_loss               decimal(7,2)
)
 with (orientation = column)
distribute by hash (sr_item_sk)
partition by range(sr_returned_date_sk)
(
    partition p1 values less than (2451179) ,
    partition p2 values less than (2451544) ,
    partition p3 values less than (2451910) ,
    partition p4 values less than (2452275) ,
    partition p5 values less than (2452640) ,
    partition p6 values less than (2453005) ,
    partition p7 values less than (maxvalue)
)
;


CREATE TABLE web_sales
(
    ws_sold_date_sk           bigint                    ,
    ws_sold_time_sk           bigint                    ,
    ws_ship_date_sk           bigint                    ,
    ws_item_sk                bigint                not null,
    ws_bill_customer_sk       bigint                    ,
    ws_bill_cdemo_sk          bigint                    ,
    ws_bill_hdemo_sk          bigint                    ,
    ws_bill_addr_sk           bigint                    ,
    ws_ship_customer_sk       bigint                    ,
    ws_ship_cdemo_sk          bigint                    ,
    ws_ship_hdemo_sk          bigint                    ,
    ws_ship_addr_sk           bigint                    ,
    ws_web_page_sk            bigint                    ,
    ws_web_site_sk            bigint                    ,
    ws_ship_mode_sk           bigint                    ,
    ws_warehouse_sk           bigint                    ,
    ws_promo_sk               bigint                    ,
    ws_order_number           bigint                not null,
    ws_quantity               bigint                    ,
    ws_wholesale_cost         decimal(7,2)              ,
    ws_list_price             decimal(7,2)              ,
    ws_sales_price            decimal(7,2)              ,
    ws_ext_discount_amt       decimal(7,2)              ,
    ws_ext_sales_price        decimal(7,2)              ,
    ws_ext_wholesale_cost     decimal(7,2)              ,
    ws_ext_list_price         decimal(7,2)              ,
    ws_ext_tax                decimal(7,2)              ,
    ws_coupon_amt             decimal(7,2)              ,
    ws_ext_ship_cost          decimal(7,2)              ,
    ws_net_paid               decimal(7,2)              ,
    ws_net_paid_inc_tax       decimal(7,2)              ,
    ws_net_paid_inc_ship      decimal(7,2)              ,
    ws_net_paid_inc_ship_tax  decimal(7,2)              ,
    ws_net_profit             decimal(7,2)
)
 with (orientation = column)
distribute by hash (ws_item_sk)
```



```
partition by range(ws_sold_date_sk)
(
    partition p1 values less than(2451179),
    partition p2 values less than(2451544),
    partition p3 values less than(2451910),
    partition p4 values less than(2452275),
    partition p5 values less than(2452640),
    partition p6 values less than(2453005),
    partition p7 values less than(maxvalue)
)
;

CREATE TABLE catalog_sales
(
    cs_sold_date_sk           bigint                    ,
    cs_sold_time_sk           bigint                    ,
    cs_ship_date_sk           bigint                    ,
    cs_bill_customer_sk       bigint                    ,
    cs_bill_cdemo_sk          bigint                    ,
    cs_bill_hdemo_sk          bigint                    ,
    cs_bill_addr_sk           bigint                    ,
    cs_ship_customer_sk       bigint                    ,
    cs_ship_cdemo_sk          bigint                    ,
    cs_ship_hdemo_sk          bigint                    ,
    cs_ship_addr_sk           bigint                    ,
    cs_call_center_sk         bigint                    ,
    cs_catalog_page_sk        bigint                    ,
    cs_ship_mode_sk           bigint                    ,
    cs_warehouse_sk           bigint                    ,
    cs_item_sk                bigint              not null,
    cs_promo_sk               bigint                    ,
    cs_order_number           bigint              not null,
    cs_quantity               bigint                    ,
    cs_wholesale_cost         decimal(7,2)              ,
    cs_list_price             decimal(7,2)              ,
    cs_sales_price            decimal(7,2)              ,
    cs_ext_discount_amt       decimal(7,2)              ,
    cs_ext_sales_price        decimal(7,2)              ,
    cs_ext_wholesale_cost     decimal(7,2)              ,
    cs_ext_list_price         decimal(7,2)              ,
    cs_ext_tax                decimal(7,2)              ,
    cs_coupon_amt             decimal(7,2)              ,
    cs_ext_ship_cost          decimal(7,2)              ,
    cs_net_paid               decimal(7,2)              ,
    cs_net_paid_inc_tax       decimal(7,2)              ,
    cs_net_paid_inc_ship      decimal(7,2)              ,
    cs_net_paid_inc_ship_tax  decimal(7,2)              ,
    cs_net_profit             decimal(7,2)
)
 with (orientation = column)
distribute by hash (cs_item_sk)
partition by range(cs_sold_date_sk)
(
    partition p1 values less than(2451179),
    partition p2 values less than(2451544),
    partition p3 values less than(2451910),
    partition p4 values less than(2452275),
    partition p5 values less than(2452640),
    partition p6 values less than(2453005),
    partition p7 values less than(maxvalue)
)
;

CREATE TABLE store_sales
(
    ss_sold_date_sk           bigint                    ,
    ss_sold_time_sk           bigint                    ,
    ss_item_sk                bigint              not null,
    ss_customer_sk            bigint                    ,
```

```
    ss_cdemo_sk               bigint                    ,
    ss_hdemo_sk               bigint                    ,
    ss_addr_sk                bigint                    ,
    ss_store_sk               bigint                    ,
    ss_promo_sk               bigint                    ,
    ss_ticket_number          bigint                not null,
    ss_quantity               bigint                    ,
    ss_wholesale_cost         decimal(7,2)              ,
    ss_list_price             decimal(7,2)              ,
    ss_sales_price            decimal(7,2)              ,
    ss_ext_discount_amt       decimal(7,2)              ,
    ss_ext_sales_price        decimal(7,2)              ,
    ss_ext_wholesale_cost     decimal(7,2)              ,
    ss_ext_list_price         decimal(7,2)              ,
    ss_ext_tax                decimal(7,2)              ,
    ss_coupon_amt             decimal(7,2)              ,
    ss_net_paid               decimal(7,2)              ,
    ss_net_paid_inc_tax       decimal(7,2)              ,
    ss_net_profit             decimal(7,2)
)
 with (orientation = column)
distribute by hash (ss_item_sk)
partition by range(ss_sold_date_sk)
(
    partition p1 values less than(2451179),
    partition p2 values less than(2451544),
    partition p3 values less than(2451910),
    partition p4 values less than(2452275),
    partition p5 values less than(2452640),
    partition p6 values less than(2453005),
    partition p7 values less than(maxvalue)
)
;
```

Step 2 Run the following SQL statements to create GDS foreign tables (24 tables in total).

NOTICE

Replace the IP addresses and port numbers in **gsfs:// 192.168.0.90:500x /xxx | gsfs:// 192.168.0.90:500x /xxx** with the corresponding GDS listening IP addresses and port numbers provided in **Installing and Starting GDS**. Use vertical bars (|) to distinguish IP_Port groups. If multiple GDS servers are configured, add the listening IP addresses and ports of all GDS servers to the foreign table.

```
DROP FOREIGN TABLE IF EXISTS customer_address_ext;
CREATE FOREIGN TABLE customer_address_ext
(
    ca_address_sk             bigint                    ,
    ca_address_id             char(16)                  ,
    ca_street_number          char(10)                  ,
    ca_street_name            varchar(60)               ,
    ca_street_type            char(15)                  ,
    ca_suite_number           char(10)                  ,
    ca_city                   varchar(60)               ,
    ca_county                 varchar(30)               ,
    ca_state                  char(2)                   ,
    ca_zip                    char(10)                  ,
    ca_country                varchar(20)               ,
    ca_gmt_offset             decimal(5,2)              ,
    ca_location_type          char(20)
)
SERVER gsmpp_server
OPTIONS(location 'gsfs://192.168.0.90:5002/customer_address*.dat | gsfs://192.168.0.90:5003/
customer_address*.dat',
```



```
FORMAT 'TEXT' ,
DELIMITER '|',
encoding 'utf8',
mode 'Normal'
)
with  customer_address_err
;

DROP FOREIGN TABLE IF EXISTS customer_demographics_ext;
CREATE FOREIGN TABLE customer_demographics_ext
(
    cd_demo_sk                bigint                        ,
    cd_gender                 char(1)                       ,
    cd_marital_status         char(1)                         ,
    cd_education_status       char(20)                          ,
    cd_purchase_estimate      bigint                          ,
    cd_credit_rating          char(10)                        ,
    cd_dep_count              bigint                        ,
    cd_dep_employed_count     bigint                              ,
    cd_dep_college_count      bigint
)
SERVER gsmpp_server
OPTIONS(location 'gsfs://192.168.0.90:5002/cuatomer_demographics*.dat | gsfs://192.168.0.90:5003/
cuatomer_demographics*.dat',
FORMAT 'TEXT' ,
DELIMITER '|',
encoding 'utf8',
mode 'Normal'
)
with  customer_demographics_err
;

DROP FOREIGN TABLE IF EXISTS date_dim_ext;
CREATE FOREIGN TABLE date_dim_ext
(
    d_date_sk                 bigint                      ,
    d_date_id                 char(16)                      ,
    d_date                    date                        ,
    d_month_seq                 bigint                      ,
    d_week_seq                bigint                        ,
    d_quarter_seq             bigint                        ,
    d_year                    bigint                      ,
    d_dow                     bigint                      ,
    d_moy                     bigint                      ,
    d_dom                     bigint                      ,
    d_qoy                     bigint                      ,
    d_fy_year                 bigint                      ,
    d_fy_quarter_seq            bigint                      ,
    d_fy_week_seq             bigint                        ,
    d_day_name                char(9)                         ,
    d_quarter_name              char(6)                       ,
    d_holiday                 char(1)                     ,
    d_weekend                 char(1)                       ,
    d_following_holiday         char(1)                       ,
    d_first_dom               bigint                      ,
    d_last_dom                bigint                      ,
    d_same_day_ly               bigint                      ,
    d_same_day_lq               bigint                      ,
    d_current_day             char(1)                       ,
    d_current_week              char(1)                       ,
    d_current_month             char(1)                       ,
    d_current_quarter         char(1)                       ,
    d_current_year            char(1)
)
SERVER gsmpp_server
OPTIONS(location 'gsfs://192.168.0.90:5002/date_dim*.dat | gsfs://192.168.0.90:5003/date_dim*.dat',
FORMAT 'TEXT' ,
DELIMITER '|',
encoding 'utf8',
```



```
mode 'Normal'
)
with  date_dim_err
;

DROP FOREIGN TABLE IF EXISTS warehouse_ext;
CREATE FOREIGN TABLE warehouse_ext
(
    w_warehouse_sk            bigint                    ,
    w_warehouse_id            char(16)                  ,
    w_warehouse_name            varchar(20)             ,
    w_warehouse_sq_ft         bigint                    ,
    w_street_number           char(10)                  ,
    w_street_name             varchar(60)               ,
    w_street_type             char(15)                  ,
    w_suite_number            char(10)                  ,
    w_city                    varchar(60)               ,
    w_county                  varchar(30)               ,
    w_state                   char(2)                   ,
    w_zip                     char(10)                  ,
    w_country                 varchar(20)               ,
    w_gmt_offset              decimal(5,2)
)
SERVER gsmpp_server
OPTIONS(location 'gsfs://192.168.0.90:5002/warehouse*.dat | gsfs://192.168.0.90:5003/warehouse*.dat',
FORMAT 'TEXT' ,
DELIMITER '|',
encoding 'utf8',
mode 'Normal'
)
with  warehouse_err
;

DROP FOREIGN TABLE IF EXISTS ship_mode_ext;
CREATE FOREIGN TABLE ship_mode_ext
(
sm_ship_mode_sk           bigint                    ,
sm_ship_mode_id           char(16)                  ,
sm_type                   char(30)                  ,
sm_code                   char(10)                  ,
sm_carrier                char(20)                  ,
sm_contract               char(20)
)
SERVER gsmpp_server
OPTIONS(location 'gsfs://192.168.0.90:5002/ship_mode*.dat | gsfs://192.168.0.90:5003/ship_mode*.dat',
FORMAT 'TEXT' ,
DELIMITER '|',
encoding 'utf8',
mode 'Normal'
)
with  ship_mode_err
;

DROP FOREIGN TABLE IF EXISTS time_dim_ext;
CREATE FOREIGN TABLE time_dim_ext
(
t_time_sk                 bigint                    ,
t_time_id                 char(16)                  ,
t_time                    bigint                    ,
t_hour                    bigint                    ,
t_minute                  bigint                    ,
t_second                  bigint                    ,
t_am_pm                   char(2)                   ,
t_shift                   char(20)                  ,
t_sub_shift               char(20)                  ,
t_meal_time               char(20)
)
SERVER gsmpp_server
OPTIONS(location 'gsfs://192.168.0.90:5002/time_dim*.dat | gsfs://192.168.0.90:5003/time_dim*.dat',
```

```
FORMAT 'TEXT' ,
DELIMITER '|',
encoding 'utf8',
mode 'Normal'
)
with  time_dim_err
;

DROP FOREIGN TABLE IF EXISTS reason_ext;
CREATE FOREIGN TABLE reason_ext
(
r_reason_sk               bigint               ,
r_reason_id               char(16)             ,
r_reason_desc             char(100)
)
SERVER gsmpp_server
OPTIONS(location 'gsfs://192.168.0.90:5002/reason*.dat | gsfs://192.168.0.90:5003/reason*.dat',
FORMAT 'TEXT' ,
DELIMITER '|',
encoding 'utf8',
mode 'Normal'
)
with reason_err
;

DROP FOREIGN TABLE IF EXISTS income_band_ext;
CREATE FOREIGN TABLE income_band_ext
(
ib_income_band_sk         bigint               ,
ib_lower_bound            bigint               ,
ib_upper_bound            bigint
)
SERVER gsmpp_server
OPTIONS(location 'gsfs://192.168.0.90:5002/income_band*.dat | gsfs://192.168.0.90:5003/
income_band*.dat',
FORMAT 'TEXT' ,
DELIMITER '|',
encoding 'utf8',
mode 'Normal'
)
with  income_band_err
;

DROP FOREIGN TABLE IF EXISTS item_ext;
CREATE FOREIGN TABLE item_ext
(
    i_item_sk                 bigint                    ,
    i_item_id                 char(16)                  ,
    i_rec_start_date          date                      ,
    i_rec_end_date            date                      ,
    i_item_desc               varchar(200)              ,
    i_current_price           decimal(7,2)              ,
    i_wholesale_cost          decimal(7,2)              ,
    i_brand_id                bigint                    ,
    i_brand                   char(50)                  ,
    i_class_id                bigint                    ,
    i_class                   char(50)                  ,
    i_category_id             bigint                    ,
    i_category                char(50)                  ,
    i_manufact_id             bigint                    ,
    i_manufact                char(50)                  ,
    i_size                    char(20)                  ,
    i_formulation             char(20)                  ,
    i_color                   char(20)                  ,
    i_units                   char(10)                  ,
    i_container               char(10)                  ,
    i_manager_id              bigint                    ,
    i_product_name            char(50)
)
```

```
SERVER gsmpp_server
OPTIONS(location 'gsfs://192.168.0.90:5002/item*.dat | gsfs://192.168.0.90:5003/item*.dat',
FORMAT 'TEXT' ,
DELIMITER '|',
encoding 'utf8',
mode 'Normal'
)
with  item_err
;

DROP FOREIGN TABLE IF EXISTS store_ext;
CREATE FOREIGN TABLE store_ext
(
    s_store_sk               bigint               ,
    s_store_id               char(16)             ,
    s_rec_start_date         date                 ,
    s_rec_end_date           date                 ,
    s_closed_date_sk         bigint               ,
    s_store_name             varchar(50)          ,
    s_number_employees       bigint               ,
    s_floor_space            bigint               ,
    s_hours                  char(20)             ,
    s_manager                varchar(40)          ,
    s_market_id              bigint               ,
    s_geography_class        varchar(100)         ,
    s_market_desc            varchar(100)         ,
    s_market_manager         varchar(40)          ,
    s_division_id            bigint               ,
    s_division_name          varchar(50)          ,
    s_company_id             bigint               ,
    s_company_name           varchar(50)          ,
    s_street_number          varchar(10)          ,
    s_street_name            varchar(60)          ,
    s_street_type            char(15)             ,
    s_suite_number           char(10)             ,
    s_city                   varchar(60)          ,
    s_county                 varchar(30)          ,
    s_state                  char(2)              ,
    s_zip                    char(10)             ,
    s_country                varchar(20)          ,
    s_gmt_offset             decimal(5,2)         ,
    s_tax_precentage         decimal(5,2)
)
SERVER gsmpp_server
OPTIONS(location 'gsfs://192.168.0.90:5002/store*.dat | gsfs://192.168.0.90:5003/store*.dat',
FORMAT 'TEXT' ,
DELIMITER '|',
encoding 'utf8',
mode 'Normal'
)
with store_err
;

DROP FOREIGN TABLE IF EXISTS call_center_ext;
CREATE FOREIGN TABLE call_center_ext
(
    cc_call_center_sk        bigint              ,
    cc_call_center_id        char(16)            ,
    cc_rec_start_date        date                ,
    cc_rec_end_date          date                ,
    cc_closed_date_sk        bigint              ,
    cc_open_date_sk          bigint              ,
    cc_name                  varchar(50)         ,
    cc_class                 varchar(50)         ,
    cc_employees             bigint              ,
    cc_sq_ft                 bigint              ,
    cc_hours                 char(20)            ,
    cc_manager               varchar(40)         ,
    cc_mkt_id                bigint              ,
```



```
    cc_mkt_class              char(50)                ,
    cc_mkt_desc               varchar(100)              ,
    cc_market_manager         varchar(40)                 ,
    cc_division               bigint                    ,
    cc_division_name          varchar(50)                ,
    cc_company                bigint                   ,
    cc_company_name           char(50)                    ,
    cc_street_number          char(10)                  ,
    cc_street_name            varchar(60)               ,
    cc_street_type            char(15)                 ,
    cc_suite_number           char(10)                  ,
    cc_city                   varchar(60)              ,
    cc_county                 varchar(30)               ,
    cc_state                  char(2)                  ,
    cc_zip                    char(10)                 ,
    cc_country                varchar(20)                ,
    cc_gmt_offset             decimal(5,2)               ,
    cc_tax_percentage         decimal(5,2)
)
SERVER gsmpp_server
OPTIONS(location 'gsfs://192.168.0.90:5002/call_center*.dat | gsfs://192.168.0.90:5003/call_center*.dat',
FORMAT 'TEXT' ,
DELIMITER '|',
encoding 'utf8',
mode 'Normal'
)
with call_center_err
;

DROP FOREIGN TABLE IF EXISTS customer_ext;
CREATE FOREIGN TABLE customer_ext
(
    c_customer_sk             bigint               ,
    c_customer_id             char(16)               ,
    c_current_cdemo_sk        bigint                   ,
    c_current_hdemo_sk        bigint                    ,
    c_current_addr_sk         bigint                  ,
    c_first_shipto_date_sk    bigint                   ,
    c_first_sales_date_sk     bigint                  ,
    c_salutation              char(10)                 ,
    c_first_name              char(20)                  ,
    c_last_name               char(30)                  ,
    c_preferred_cust_flag     char(1)                    ,
    c_birth_day               bigint                  ,
    c_birth_month             bigint                   ,
    c_birth_year              bigint                  ,
    c_birth_country           varchar(20)                ,
    c_login                   char(13)                  ,
    c_email_address           char(50)                   ,
    c_last_review_date_sk     char(10)
)
SERVER gsmpp_server
OPTIONS(location 'gsfs://192.168.0.90:5002/customer*.dat | gsfs://192.168.0.90:5003/customer*.dat',
FORMAT 'TEXT' ,
DELIMITER '|',
encoding 'GBK',
mode 'Normal'
)
with  customer_err
;

DROP FOREIGN TABLE IF EXISTS web_site_ext;
CREATE FOREIGN TABLE web_site_ext
(
    web_site_sk               bigint               ,
    web_site_id               char(16)               ,
    web_rec_start_date        date                     ,
    web_rec_end_date          date                      ,
    web_name                  varchar(50)               ,
```

```
    web_open_date_sk          bigint                    ,
    web_close_date_sk         bigint                    ,
    web_class                 varchar(50)               ,
    web_manager               varchar(40)               ,
    web_mkt_id                bigint                    ,
    web_mkt_class             varchar(50)               ,
    web_mkt_desc              varchar(100)              ,
    web_market_manager        varchar(40)               ,
    web_company_id            bigint                    ,
    web_company_name          char(50)                  ,
    web_street_number         char(10)                  ,
    web_street_name           varchar(60)               ,
    web_street_type           char(15)                  ,
    web_suite_number          char(10)                  ,
    web_city                  varchar(60)               ,
    web_county                varchar(30)               ,
    web_state                 char(2)                   ,
    web_zip                   char(10)                  ,
    web_country               varchar(20)               ,
    web_gmt_offset            decimal(5,2)              ,
    web_tax_percentage        decimal(5,2)
)
SERVER gsmpp_server
OPTIONS(location 'gsfs://192.168.0.90:5002/web_site*.dat | gsfs://192.168.0.90:5003/web_site*.dat',
FORMAT 'TEXT' ,
DELIMITER '|',
encoding 'utf8',
mode 'Normal'
)
with  web_site_err
;

DROP FOREIGN TABLE IF EXISTS store_returns_ext;
CREATE FOREIGN TABLE store_returns_ext
(
    sr_returned_date_sk       bigint                    ,
    sr_return_time_sk         bigint                    ,
    sr_item_sk                bigint                    ,
    sr_customer_sk            bigint                    ,
    sr_cdemo_sk               bigint                    ,
    sr_hdemo_sk               bigint                    ,
    sr_addr_sk                bigint                    ,
    sr_store_sk               bigint                    ,
    sr_reason_sk              bigint                    ,
    sr_ticket_number          bigint                    ,
    sr_return_quantity        bigint                    ,
    sr_return_amt             decimal(7,2)              ,
    sr_return_tax             decimal(7,2)              ,
    sr_return_amt_inc_tax     decimal(7,2)              ,
    sr_fee                    decimal(7,2)              ,
    sr_return_ship_cost       decimal(7,2)              ,
    sr_refunded_cash          decimal(7,2)              ,
    sr_reversed_charge        decimal(7,2)              ,
    sr_store_credit           decimal(7,2)              ,
    sr_net_loss               decimal(7,2)
)
SERVER gsmpp_server
OPTIONS(location 'gsfs://192.168.0.90:5002/store_returns*.dat | gsfs://192.168.0.90:5003/store_returns*.dat',
FORMAT 'TEXT' ,
DELIMITER '|',
encoding 'utf8',
mode 'Normal'
)
with store_returns_err
;

DROP FOREIGN TABLE IF EXISTS household_demographics_ext;
CREATE FOREIGN TABLE household_demographics_ext
(
```



```
    hd_demo_sk               bigint               ,
    hd_income_band_sk        bigint               ,
    hd_buy_potential         char(15)             ,
    hd_dep_count             bigint               ,
    hd_vehicle_count         bigint
)
SERVER gsmpp_server
OPTIONS(location 'gsfs://192.168.0.90:5002/household_demographics*.dat | gsfs://192.168.0.90:5003/
household_demographics*.dat',
FORMAT 'TEXT' ,
DELIMITER '|',
encoding 'utf8',
mode 'Normal'
)
with  household_demographics_err
;

DROP FOREIGN TABLE IF EXISTS web_page_ext;
CREATE FOREIGN TABLE web_page_ext
(
    wp_web_page_sk           bigint              ,
    wp_web_page_id           char(16)            ,
    wp_rec_start_date        date                ,
    wp_rec_end_date          date                ,
    wp_creation_date_sk      bigint              ,
    wp_access_date_sk        bigint              ,
    wp_autogen_flag          char(1)             ,
    wp_customer_sk           bigint              ,
    wp_url                   varchar(100)        ,
    wp_type                  char(50)            ,
    wp_char_count            bigint              ,
    wp_link_count            bigint              ,
    wp_image_count           bigint              ,
    wp_max_ad_count          bigint
)
SERVER gsmpp_server
OPTIONS(location 'gsfs://192.168.0.90:5002/web_page*.dat | gsfs://192.168.0.90:5003/web_page*.dat',
FORMAT 'TEXT' ,
DELIMITER '|',
encoding 'utf8',
mode 'Normal'
)
with web_page_err
;

DROP FOREIGN TABLE IF EXISTS promotion_ext;
CREATE FOREIGN TABLE promotion_ext
(
    p_promo_sk               bigint              ,
    p_promo_id               char(16)            ,
    p_start_date_sk          bigint              ,
    p_end_date_sk            bigint              ,
    p_item_sk                bigint              ,
    p_cost                   decimal(15,2)       ,
    p_response_target        bigint              ,
    p_promo_name             char(50)            ,
    p_channel_dmail          char(1)             ,
    p_channel_email          char(1)             ,
    p_channel_catalog        char(1)             ,
    p_channel_tv             char(1)             ,
    p_channel_radio          char(1)             ,
    p_channel_press          char(1)             ,
    p_channel_event          char(1)             ,
    p_channel_demo           char(1)             ,
    p_channel_details        varchar(100)        ,
    p_purpose                char(15)            ,
    p_discount_active        char(1)
)
SERVER gsmpp_server
```



```
OPTIONS(location 'gsfs://192.168.0.90:5002/promotion*.dat | gsfs://192.168.0.90:5003/promotion*.dat',
FORMAT 'TEXT' ,
DELIMITER '|',
encoding 'utf8',
mode 'Normal'
)
with promotion_err
;

DROP FOREIGN TABLE IF EXISTS catalog_page_ext;
CREATE FOREIGN TABLE catalog_page_ext
(
    cp_catalog_page_sk        bigint              ,
    cp_catalog_page_id        char(16)            ,
    cp_start_date_sk          bigint              ,
    cp_end_date_sk            bigint              ,
    cp_department             varchar(50)         ,
    cp_catalog_number         bigint              ,
    cp_catalog_page_number    bigint              ,
    cp_description            varchar(100)        ,
    cp_type                   varchar(100)
)
SERVER gsmpp_server
OPTIONS(location 'gsfs://192.168.0.90:5002/catalog_page*.dat | gsfs://192.168.0.90:5003/
catalog_page*.dat',
FORMAT 'TEXT' ,
DELIMITER '|',
encoding 'utf8',
mode 'Normal'
)
with  catalog_page_err
;

DROP FOREIGN TABLE IF EXISTS inventory_ext;
CREATE FOREIGN TABLE inventory_ext
(
    inv_date_sk               bigint              ,
    inv_item_sk               bigint              ,
    inv_warehouse_sk          bigint              ,
    inv_quantity_on_hand      integer
)
SERVER gsmpp_server
OPTIONS(location 'gsfs://192.168.0.90:5002/inventory*.dat | gsfs://192.168.0.90:5003/inventory*.dat',
FORMAT 'TEXT' ,
DELIMITER '|',
encoding 'utf8',
mode 'Normal'
)
with inventory_err
;

DROP FOREIGN TABLE IF EXISTS catalog_returns_ext;
CREATE FOREIGN TABLE catalog_returns_ext
(
    cr_returned_date_sk       bigint              ,
    cr_returned_time_sk       bigint              ,
    cr_item_sk                bigint              ,
    cr_refunded_customer_sk   bigint              ,
    cr_refunded_cdemo_sk      bigint              ,
    cr_refunded_hdemo_sk      bigint              ,
    cr_refunded_addr_sk       bigint              ,
    cr_returning_customer_sk  bigint              ,
    cr_returning_cdemo_sk     bigint              ,
    cr_returning_hdemo_sk     bigint              ,
    cr_returning_addr_sk      bigint              ,
    cr_call_center_sk         bigint              ,
    cr_catalog_page_sk        bigint              ,
    cr_ship_mode_sk           bigint              ,
    cr_warehouse_sk           bigint              ,
```



```
    cr_reason_sk              bigint                    ,
    cr_order_number           bigint                    ,
    cr_return_quantity        bigint                    ,
    cr_return_amount          decimal(7,2)              ,
    cr_return_tax             decimal(7,2)              ,
    cr_return_amt_inc_tax     decimal(7,2)              ,
    cr_fee                    decimal(7,2)              ,
    cr_return_ship_cost       decimal(7,2)              ,
    cr_refunded_cash          decimal(7,2)              ,
    cr_reversed_charge        decimal(7,2)              ,
    cr_store_credit           decimal(7,2)              ,
    cr_net_loss               decimal(7,2)
)
SERVER gsmpp_server
OPTIONS(location 'gsfs://192.168.0.90:5002/catalog_returns*.dat | gsfs://192.168.0.90:5003/
catalog_returns*.dat',
FORMAT 'TEXT' ,
DELIMITER '|',
encoding 'utf8',
mode 'Normal'
)
with catalog_returns_err
;

DROP FOREIGN TABLE IF EXISTS web_returns_ext;
CREATE FOREIGN TABLE web_returns_ext
(
    wr_returned_date_sk       bigint                    ,
    wr_returned_time_sk       bigint                    ,
    wr_item_sk                bigint                    ,
    wr_refunded_customer_sk   bigint                    ,
    wr_refunded_cdemo_sk      bigint                    ,
    wr_refunded_hdemo_sk      bigint                    ,
    wr_refunded_addr_sk       bigint                    ,
    wr_returning_customer_sk  bigint                    ,
    wr_returning_cdemo_sk     bigint                    ,
    wr_returning_hdemo_sk     bigint                    ,
    wr_returning_addr_sk      bigint                    ,
    wr_web_page_sk            bigint                    ,
    wr_reason_sk              bigint                    ,
    wr_order_number           bigint                    ,
    wr_return_quantity        bigint                    ,
    wr_return_amt             decimal(7,2)              ,
    wr_return_tax             decimal(7,2)              ,
    wr_return_amt_inc_tax     decimal(7,2)              ,
    wr_fee                    decimal(7,2)              ,
    wr_return_ship_cost       decimal(7,2)              ,
    wr_refunded_cash          decimal(7,2)              ,
    wr_reversed_charge        decimal(7,2)              ,
    wr_account_credit         decimal(7,2)              ,
    wr_net_loss               decimal(7,2)
)
SERVER gsmpp_server
OPTIONS(location 'gsfs://192.168.0.90:5002/web_returns*.dat | gsfs://192.168.0.90:5003/web_returns*.dat',
FORMAT 'TEXT' ,
DELIMITER '|',
encoding 'utf8',
mode 'Normal'
)
with web_returns_err
;

DROP FOREIGN TABLE IF EXISTS web_sales_ext;
CREATE FOREIGN TABLE web_sales_ext
(
    ws_sold_date_sk           bigint                    ,
    ws_sold_time_sk           bigint                    ,
    ws_ship_date_sk           bigint                    ,
    ws_item_sk                bigint                    ,
```



```
    ws_bill_customer_sk       bigint                  ,
    ws_bill_cdemo_sk          bigint                  ,
    ws_bill_hdemo_sk          bigint                  ,
    ws_bill_addr_sk           bigint                  ,
    ws_ship_customer_sk       bigint                  ,
    ws_ship_cdemo_sk          bigint                  ,
    ws_ship_hdemo_sk          bigint                  ,
    ws_ship_addr_sk           bigint                  ,
    ws_web_page_sk            bigint                  ,
    ws_web_site_sk            bigint                  ,
    ws_ship_mode_sk           bigint                  ,
    ws_warehouse_sk           bigint                  ,
    ws_promo_sk               bigint                  ,
    ws_order_number           bigint                  ,
    ws_quantity               bigint                  ,
    ws_wholesale_cost         decimal(7,2)            ,
    ws_list_price             decimal(7,2)            ,
    ws_sales_price            decimal(7,2)            ,
    ws_ext_discount_amt       decimal(7,2)            ,
    ws_ext_sales_price        decimal(7,2)            ,
    ws_ext_wholesale_cost     decimal(7,2)            ,
    ws_ext_list_price         decimal(7,2)            ,
    ws_ext_tax                decimal(7,2)            ,
    ws_coupon_amt             decimal(7,2)            ,
    ws_ext_ship_cost          decimal(7,2)            ,
    ws_net_paid               decimal(7,2)            ,
    ws_net_paid_inc_tax       decimal(7,2)            ,
    ws_net_paid_inc_ship      decimal(7,2)            ,
    ws_net_paid_inc_ship_tax  decimal(7,2)            ,
    ws_net_profit             decimal(7,2)
)
SERVER gsmpp_server
OPTIONS(location 'gsfs://192.168.0.90:5002/web_sales*.dat | gsfs://192.168.0.90:5003/web_sales*.dat',
FORMAT 'TEXT' ,
DELIMITER '|',
encoding 'utf8',
mode 'Normal'
)
with web_sales_err
;

DROP FOREIGN TABLE IF EXISTS catalog_sales_ext;
CREATE FOREIGN TABLE catalog_sales_ext
(
    cs_sold_date_sk           bigint                  ,
    cs_sold_time_sk           bigint                  ,
    cs_ship_date_sk           bigint                  ,
    cs_bill_customer_sk       bigint                  ,
    cs_bill_cdemo_sk          bigint                  ,
    cs_bill_hdemo_sk          bigint                  ,
    cs_bill_addr_sk           bigint                  ,
    cs_ship_customer_sk       bigint                  ,
    cs_ship_cdemo_sk          bigint                  ,
    cs_ship_hdemo_sk          bigint                  ,
    cs_ship_addr_sk           bigint                  ,
    cs_call_center_sk         bigint                  ,
    cs_catalog_page_sk        bigint                  ,
    cs_ship_mode_sk           bigint                  ,
    cs_warehouse_sk           bigint                  ,
    cs_item_sk                bigint                  ,
    cs_promo_sk               bigint                  ,
    cs_order_number           bigint                  ,
    cs_quantity               bigint                  ,
    cs_wholesale_cost         decimal(7,2)            ,
    cs_list_price             decimal(7,2)            ,
    cs_sales_price            decimal(7,2)            ,
    cs_ext_discount_amt       decimal(7,2)            ,
    cs_ext_sales_price        decimal(7,2)            ,
    cs_ext_wholesale_cost     decimal(7,2)            ,
```

```
    cs_ext_list_price         decimal(7,2)                ,
    cs_ext_tax                decimal(7,2)                ,
    cs_coupon_amt             decimal(7,2)                ,
    cs_ext_ship_cost          decimal(7,2)                ,
    cs_net_paid               decimal(7,2)                ,
    cs_net_paid_inc_tax       decimal(7,2)                ,
    cs_net_paid_inc_ship      decimal(7,2)                ,
    cs_net_paid_inc_ship_tax  decimal(7,2)                ,
    cs_net_profit             decimal(7,2)
)
SERVER gsmpp_server
OPTIONS(location 'gsfs://192.168.0.90:5002/catalog_sales*.dat | gsfs://192.168.0.90:5003/
catalog_sales*.dat',
FORMAT 'TEXT' ,
DELIMITER '|',
encoding 'utf8',
mode 'Normal'
)
with  catalog_sales_err
;

DROP FOREIGN TABLE IF EXISTS store_sales_ext;
CREATE FOREIGN TABLE store_sales_ext
(
    ss_sold_date_sk           bigint                    ,
    ss_sold_time_sk           bigint                    ,
    ss_item_sk                bigint                    ,
    ss_customer_sk            bigint                    ,
    ss_cdemo_sk               bigint                    ,
    ss_hdemo_sk               bigint                    ,
    ss_addr_sk                bigint                    ,
    ss_store_sk               bigint                    ,
    ss_promo_sk               bigint                    ,
    ss_ticket_number          bigint                    ,
    ss_quantity               bigint                    ,
    ss_wholesale_cost         decimal(7,2)              ,
    ss_list_price             decimal(7,2)              ,
    ss_sales_price            decimal(7,2)              ,
    ss_ext_discount_amt       decimal(7,2)              ,
    ss_ext_sales_price        decimal(7,2)              ,
    ss_ext_wholesale_cost     decimal(7,2)              ,
    ss_ext_list_price         decimal(7,2)              ,
    ss_ext_tax                decimal(7,2)              ,
    ss_coupon_amt             decimal(7,2)              ,
    ss_net_paid               decimal(7,2)              ,
    ss_net_paid_inc_tax       decimal(7,2)              ,
    ss_net_profit             decimal(7,2)
)
SERVER gsmpp_server
OPTIONS(location 'gsfs://192.168.0.90:5002/store_sales*.dat | gsfs://192.168.0.90:5003/store_sales*.dat',
FORMAT 'TEXT' ,
DELIMITER '|',
encoding 'utf8',
mode 'Normal'
)
with store_sales_err
;
```

Step 3 Run the following SQL statement to import data.

```
INSERT INTO   customer_address  SELECT * FROM  customer_address_ext;
INSERT INTO   customer_demographics SELECT * FROM  customer_demographics_ext;
INSERT INTO   date_dim SELECT * FROM  date_dim_ext;
INSERT INTO   warehouse SELECT * FROM  warehouse_ext;
INSERT INTO   ship_mode SELECT * FROM  ship_mode_ext;
INSERT INTO   time_dim SELECT * FROM  time_dim_ext;
INSERT INTO   reason SELECT * FROM  reason_ext;
INSERT INTO   income_band SELECT * FROM  income_band_ext;
INSERT INTO   item SELECT * FROM  item_ext;
INSERT INTO   store SELECT * FROM  store_ext;
```



```
INSERT INTO   call_center SELECT * FROM  call_center_ext;
INSERT INTO   customer SELECT * FROM  customer_ext;
INSERT INTO   web_site SELECT * FROM  web_site_ext;
INSERT INTO   household_demographics SELECT * FROM  household_demographics_ext;
INSERT INTO   web_page SELECT * FROM  web_page_ext;
INSERT INTO   promotion SELECT * FROM  promotion_ext;
INSERT INTO   catalog_page SELECT * FROM  catalog_page_ext;
INSERT INTO   inventory SELECT * FROM  inventory_ext;
INSERT INTO   catalog_returns SELECT * FROM  catalog_returns_ext;
INSERT INTO   web_returns SELECT * FROM  web_returns_ext;
INSERT INTO   store_returns SELECT * FROM  store_returns_ext;
INSERT INTO   web_sales SELECT * FROM  web_sales_ext;
INSERT INTO   catalog_sales SELECT * FROM  catalog_sales_ext;
INSERT INTO   store_sales SELECT * FROM  store_sales_ext;
```

----End

3.5 Performing Queries and Collecting Results

3.5.1 Using Shell Scripts to Automatically Execute Queries and Collect Results

Step 1 Log in to the ECS, go to the **/opt** directory, and run the **vim** commands to generate two script files **query.conf** and **run_query.sh**. The script content is as follows. After editing, press **:wq!** to save the scripts.

run_query.sh script:

```
#!/bin/bash
script_path=$(cd `dirname $0`;pwd)
query_mode=$1
query_path=$2
query_object=$3
query_log=${script_path}/query_log_`date +%y%m%d_%H%M%S`
source ${script_path}/query.conf

function usage()
{
    echo "[NOTICE]: This script is used to run queries and collect cost time, according to sepcified path and
query file name."
    echo "          You can run the script as below:"
    echo -e ""
    echo "          1. config the query.conf file."
    echo "          2. run the script in batch mode. "
    echo "          eg. sh run_query.sh batch [query file's absolute path]"
    echo -e ""
    echo "          3. run the script in single mode."
    echo "          eg. sh run_query.sh single [query file's absolute path] [specified query file name]"
}

function log_file_init()
{
    mkdir -p ${query_log}/explain_log
    mkdir -p ${query_log}/pre_warm_log
    mkdir -p ${query_log}/query_test_log
    touch ${query_log}/query_result.csv
    echo "query name,cost time1,cost time2,cost time3,average cost" > ${query_log}/query_result.csv
}

function single_query()
{
    echo "[INFO]: Single mode query is to start."
    echo "*****${query_object} begin*****"
    collect_plan
```



```
    pre_warm
    query_test
    echo "*****${query_object} end*****"
    echo "[INFO]: Single mode query is finished."
    echo "[NOTICE]: Get more details by query_result.csv and other logs in ${query_log}."
}

function batch_query()
{
    echo "[INFO]: Batch mode query is to start."
    for query_object in `ls ${query_path}`
    do
        echo "*****${query_object} begin*****"
        collect_plan
        pre_warm
        query_test
        echo "*****${query_object} end*****"
    done
    echo "[INFO]: Batch mode query is finished."
    echo "[NOTICE]: Get more details by query_result.csv and other logs in ${query_log}."
}

function collect_plan()
{
    echo "[STEP1]: Starting to collect plan."
    echo "explain performance" > ${query_log}/explain_log/${query_object}.tmp
    cat ${query_path}/${query_object} >> ${query_log}/explain_log/${query_object}.tmp
    gsql -h ${cluster_ip} -d ${db_name} -p ${db_port} -U ${db_user} -W "${user_pad}" -f ${query_log}/
explain_log/${query_object}.tmp > ${query_log}/explain_log/${query_object}.explain 2>&1
    echo "[STEP1]: Finished."
}

function pre_warm()
{
    echo "[STEP2]: Starting to pre-warm."
    for i in {1..2}
    do
        gsql -h ${cluster_ip} -d ${db_name} -p ${db_port} -U ${db_user} -W "${user_pad}" -f ${query_path}/$
{query_object} > ${query_log}/pre_warm_log/${query_object}.pre${i} 2>&1
    done
    echo "[STEP2]: Finished."
}

function query_test()
{
    time1=""
    time2=""
    time3=""
    echo "[STEP3]: Starting to do real test."
    for i in {1..3}
    do
        gsql -h ${cluster_ip} -d ${db_name} -p ${db_port} -U ${db_user} -W "${user_pad}" -f ${query_path}/$
{query_object} > ${query_log}/query_test_log/${query_object}.real${i} 2>&1
        let "`eval echo "time"${i}`=`cat ${query_log}/query_test_log/${query_object}.real${i}|grep "total time:"|
awk {'print$3'}`"
    done
    time_ave=`echo "scale=2;(${time1}+${time2}+${time3})/3"|bc -l`
    echo "${query_object},${time1},${time2},${time3},${time_ave}" >> ${query_log}/query_result.csv
    echo "[step3]: Finished. The average time:${time_ave} ms."
}
case ${query_mode} in
    single)log_file_init;single_query;;
    batch)log_file_init;batch_query;;
    *)usage;;
esac
```

query.conf is the cluster information configuration file, which contains the following variables:

```
cluster_ip=127.0.0.1: private network IP address of the primary Coordinator node in the cluster
db_name=tpcds_test: database name
db_port=6000: database port number
db_user=tpcds_user: database user
user_pwd=123456: database user password
```

Step 2 After adding the cluster information to the **query.conf** script, run the **source gsql_env** variable and then run the **sh run_query.sh** command to execute queries and collect results.

Example: **sh run_query.sh** *batch query1000x/*

Parameter 1: Select **batch** for batch execution and **single** for single query execution.

Parameter 2: absolute path for storing TPC-DS 1000X or TPC-H 1000X queries.

Parameter 3: If parameter 1 is set to **batch**, ignore this parameter. If parameter 1 is set to **single**, set this parameter to the name of the query to be executed, for example, Q1.

NOTICE

1. To use the gsql client, run the **source gsql_env** command after each connection. Before running the query script, ensure that gsql is executable.
2. By default, each query is executed for six times. The execution plan is collected at the first time, warm-up is performed at the second and third times, and formal execution are performed at the fourth to sixth times. The final result is the average value of the three formal execution results.
3. After the query script is executed, a directory named **query_log_yymmdd_hhmmss** is generated immediately.
   - The **exlain_log** subdirectory stores query plans.
   - The **pre_warm** subdirectory stores the warm-up execution result.
   - The **query_test** subdirectory stores formal query execution results.
   - The **query_result.csv** file summarizes the execution results of all queries and stores them in CSV format.

----End

4 Appendixes

4.1 TPC-H Test Sets

You can use **Using Commands to Generate TPC-H Test Sets** to generate TPC-H test sets or directly use **Using Scripts to Generate TPC-H Test Sets** to generate TPC-H test sets. We provide all TPC-H **Test Sets** for your reference.

Using Commands to Generate TPC-H Test Sets

The SQL statements of the 22 standard TPC-H queries can be generated as follows:

Step 1 Log in to the ECS and run the following commands:

```
cd /data1/script/tpch-kit/TPC-H_Tools_v3.0.0/dbgen
cp qgen queries
cp dists.dss queries
for i in {1..22}
do
    ./qgen -s 1000 -d $i > Q$i
done
```

Step 2 The generated query cannot be directly used and needs to be modified as follows:

```
If the statement contains LIMIT -1, delete LIMIT -1.
Q15: Change CREATE VIEW statements to WITH statements and remove DROP VIEW statements.
```

----End

Using Scripts to Generate TPC-H Test Sets

You are advised to use the following script to generate TPC-H queries for GaussDB(DWS):

```
# -*- coding: utf-8 -*-
import os
import sys
import re


def genseq(qgenfile, scale, query_dir):
    flags = os.O_WRONLY | os.O_CREAT | os.O_EXCL
    modes = stat.S_IWUSR | stat.S_IRUSR
    if not os.path.exists(query_dir):
```



```
    os.mkdir(query_dir)

  for i in range(1, 23):
    cmd = qgenfile + ' -s ' + str(scale) + ' -d ' + str(i) + ' > ' + query_dir + '/Q' + str(i)
    os.system(cmd)

  os.chdir(query_dir)
  for i in range(1, 23):
    with open("Q" + str(i), 'r') as fr:
      qlist = list(fr)
    for j in range(len(qlist)):
      if i == 15:
        if 'create view' in qlist[j]:
          qlist[j] = qlist[j].replace('create view', 'with')
        elif 'l_suppkey;' in qlist[j]:
          qlist[j] = qlist[j].replace(';\n', ')')
        elif 'drop view' in qlist[j] or 'LIMIT -1' in qlist[j]:
          qlist[j] = ''
        continue
      if 'LIMIT -1' in qlist[j]:
        qlist[j] = ''
      elif 'LIMIT -1' not in qlist[j] and 'LIMIT' in qlist[j]:
        qlist[j - 1] = qlist[j - 1].replace(';', '')
        qlist[j] = qlist[j].replace('LIMIT', 'limit').replace('\n', ';\n')
    with os.fdopen(os.open("Q" + str(i), flags, modes), 'w') as fw:
      for z in range(len(qlist)):
        fw.write(qlist[z])
  print("TPCH Q1~Q22 query store at " + query_dir)


if __name__ == '__main__':
  if len(sys.argv) != 4:
print('Wrong number of parameters! ')
print('Usage: python3 gen_tpch_thpseq.py qgen_file_path scale query_dir')
    print("""Parameter:
qgen_file_path: tpch qgen file path
scale: data scale corresponding to the generated query, in GB.
query_dir: path for storing the generated file""")
    print("Notice: Make sure the qgen and dists.dss files are in the queries directory of the tpch tool ")
    print("""Example:
      python3 gen_tpch_thpseq.py ./qgen 1000 tpch_query1000x""")
    sys.exit(1)

  qgen_file_path = sys.argv[1]
  scale = sys.argv[2]
  query_dir = sys.argv[3]
  try:
    if not re.match(r'^\.?\/(\w+\/?)+$', qgen_file_path):
      print("error param qgenfilepath:", qgen_file_path)
    if not re.match(r'\d+', scale):
      print('error param scale:', scale)
    if not re.match(r'^\/?(\w+\/?)+$', query_dir):
      print('error param query_dir:', query_dir)
  except Exception as ex:
    print('exception: invalid param!')


  if not os.path.isfile(qgen_file_path):
    print('The file %s is not exist!' % qgen_file_path)
    sys.exit(1)

  genseq(qgen_file_path, int(scale), query_dir)
```

Save the script as **gen_tpch_thpseq.py** and save it in the **queries** directory. Run the **python3 gen_tpch_thpseq.py ./qgen 1000 tpch1000x_query** command. In the command, **1000** indicates the data scale, and **tpch1000x_query** indicates the location where 22 SQL statements are saved.

Test Sets

The following 22 query SQL statements are executed in the performance test sets.

SQL1

```
select
    l_returnflag,
    l_linestatus,
    sum(l_quantity) as sum_qty,
    sum(l_extendedprice) as sum_base_price,
    sum(l_extendedprice * (1 - l_discount)) as sum_disc_price,
    sum(l_extendedprice * (1 - l_discount) * (1 + l_tax)) as sum_charge,
    avg(l_quantity) as avg_qty,
    avg(l_extendedprice) as avg_price,
    avg(l_discount) as avg_disc,
    count(*) as count_order
from
    lineitem
where
    l_shipdate <= date '1998-12-01' - interval '90' day (3)
group by
    l_returnflag,
    l_linestatus
order by
    l_returnflag,
    l_linestatus;
```

SQL2

```
select
    s_acctbal,
    s_name,
    n_name,
    p_partkey,
    p_mfgr,
    s_address,
    s_phone,
    s_comment
from
    part,
    supplier,
    partsupp,
    nation,
    region
where
    p_partkey = ps_partkey
    and s_suppkey = ps_suppkey
    and p_size = 15
    and p_type like '%BRASS'
    and s_nationkey = n_nationkey
    and n_regionkey = r_regionkey
    and r_name = 'EUROPE'
    and ps_supplycost = (
        select
            min(ps_supplycost)
        from
            partsupp,
            supplier,
            nation,
            region
        where
            p_partkey = ps_partkey
            and s_suppkey = ps_suppkey
            and s_nationkey = n_nationkey
            and n_regionkey = r_regionkey
            and r_name = 'EUROPE'
    )
```



```
order by
    s_acctbal desc,
    n_name,
    s_name,
    p_partkey
    limit 100;
```

SQL3

```
select
    l_orderkey,
    sum(l_extendedprice * (1 - l_discount)) as revenue,
    o_orderdate,
    o_shippriority
from
    customer,
    orders,
    lineitem
where
    c_mktsegment = 'BUILDING'
    and c_custkey = o_custkey
    and l_orderkey = o_orderkey
    and o_orderdate < date '1995-03-15'
    and l_shipdate > date '1995-03-15'
group by
    l_orderkey,
    o_orderdate,
    o_shippriority
order by
    revenue desc,
    o_orderdate
    limit 10;
```

SQL4

```
select
    o_orderpriority,
    count(*) as order_count
from
    orders
where
    o_orderdate >= date '1993-07-01'
    and o_orderdate < date '1993-07-01' + interval '3' month
    and exists (
        select
            *
        from
            lineitem
        where
            l_orderkey = o_orderkey
            and l_commitdate < l_receiptdate
    )
group by
    o_orderpriority
order by
    o_orderpriority;
```

SQL5

```
select
    n_name,
    sum(l_extendedprice * (1 - l_discount)) as revenue
from
    customer,
    orders,
    lineitem,
    supplier,
```



```
    nation,
    region
where
    c_custkey = o_custkey
    and l_orderkey = o_orderkey
    and l_suppkey = s_suppkey
    and c_nationkey = s_nationkey
    and s_nationkey = n_nationkey
    and n_regionkey = r_regionkey
    and r_name = 'ASIA'
    and o_orderdate >= date '1994-01-01'
    and o_orderdate < date '1994-01-01' + interval '1' year
group by
    n_name
order by
    revenue desc;
```

SQL6

```
select
    sum(l_extendedprice * l_discount) as revenue
from
    lineitem
where
    l_shipdate >= date '1994-01-01'
    and l_shipdate < date '1994-01-01' + interval '1' year
    and l_discount between .06 - 0.01 and .06 + 0.01
    and l_quantity < 24;
```

SQL7

```
select
    supp_nation,
    cust_nation,
    l_year,
    sum(volume) as revenue
from
    (
        select
            n1.n_name as supp_nation,
            n2.n_name as cust_nation,
            extract(year from l_shipdate) as l_year,
            l_extendedprice * (1 - l_discount) as volume
        from
            supplier,
            lineitem,
            orders,
            customer,
            nation n1,
            nation n2
        where
            s_suppkey = l_suppkey
            and o_orderkey = l_orderkey
            and c_custkey = o_custkey
            and s_nationkey = n1.n_nationkey
            and c_nationkey = n2.n_nationkey
            and (
                (n1.n_name = 'FRANCE' and n2.n_name = 'GERMANY')
                or (n1.n_name = 'GERMANY' and n2.n_name = 'FRANCE')
            )
            and l_shipdate between date '1995-01-01' and date '1996-12-31'
    ) as shipping
group by
    supp_nation,
    cust_nation,
    l_year
order by
    supp_nation,
```



```
    cust_nation,
    l_year;
```

SQL8

```
select
    o_year,
    sum(case
        when nation = 'BRAZIL' then volume
        else 0
    end) / sum(volume) as mkt_share
from
    (
        select
            extract(year from o_orderdate) as o_year,
            l_extendedprice * (1 - l_discount) as volume,
            n2.n_name as nation
        from
            part,
            supplier,
            lineitem,
            orders,
            customer,
            nation n1,
            nation n2,
            region
        where
            p_partkey = l_partkey
            and s_suppkey = l_suppkey
            and l_orderkey = o_orderkey
            and o_custkey = c_custkey
            and c_nationkey = n1.n_nationkey
            and n1.n_regionkey = r_regionkey
            and r_name = 'AMERICA'
            and s_nationkey = n2.n_nationkey
            and o_orderdate between date '1995-01-01' and date '1996-12-31'
            and p_type = 'ECONOMY ANODIZED STEEL'
    ) as all_nations
group by
    o_year
order by
    o_year;
```

SQL9

```
select
    nation,
    o_year,
    sum(amount) as sum_profit
from
    (
        select
            n_name as nation,
            extract(year from o_orderdate) as o_year,
            l_extendedprice * (1 - l_discount) - ps_supplycost * l_quantity as amount
        from
            part,
            supplier,
            lineitem,
            partsupp,
            orders,
            nation
        where
            s_suppkey = l_suppkey
            and ps_suppkey = l_suppkey
            and ps_partkey = l_partkey
            and p_partkey = l_partkey
            and o_orderkey = l_orderkey
            and s_nationkey = n_nationkey
```



```
        and p_name like '%green%'
    ) as profit
group by
    nation,
    o_year
order by
    nation,
    o_year desc;
```

SQL10

```
select
    c_custkey,
    c_name,
    sum(l_extendedprice * (1 - l_discount)) as revenue,
    c_acctbal,
    n_name,
    c_address,
    c_phone,
    c_comment
from
    customer,
    orders,
    lineitem,
    nation
where
    c_custkey = o_custkey
    and l_orderkey = o_orderkey
    and o_orderdate >= date '1993-10-01'
    and o_orderdate < date '1993-10-01' + interval '3' month
    and l_returnflag = 'R'
    and c_nationkey = n_nationkey
group by
    c_custkey,
    c_name,
    c_acctbal,
    c_phone,
    n_name,
    c_address,
    c_comment
order by
    revenue desc
    limit 20;
```

SQL11

```
select
    ps_partkey,
    sum(ps_supplycost * ps_availqty) as value
from
    partsupp,
    supplier,
    nation
where
    ps_suppkey = s_suppkey
    and s_nationkey = n_nationkey
    and n_name = 'GERMANY'
group by
    ps_partkey having
        sum(ps_supplycost * ps_availqty) > (
            select
                sum(ps_supplycost * ps_availqty) * 0.0000001000
            from
                partsupp,
                supplier,
                nation
            where
                ps_suppkey = s_suppkey
                and s_nationkey = n_nationkey
```



```
            and n_name = 'GERMANY'
    )
order by
    value desc;
```

SQL12

```
select
    l_shipmode,
    sum(case
        when o_orderpriority = '1-URGENT'
            or o_orderpriority = '2-HIGH'
            then 1
        else 0
    end) as high_line_count,
    sum(case
        when o_orderpriority <> '1-URGENT'
            and o_orderpriority <> '2-HIGH'
            then 1
        else 0
    end) as low_line_count
from
    orders,
    lineitem
where
    o_orderkey = l_orderkey
    and l_shipmode in ('MAIL', 'SHIP')
    and l_commitdate < l_receiptdate
    and l_shipdate < l_commitdate
    and l_receiptdate >= date '1994-01-01'
    and l_receiptdate < date '1994-01-01' + interval '1' year
group by
    l_shipmode
order by
    l_shipmode;
```

SQL13

```
select
    c_count,
    count(*) as custdist
from
    (
        select
            c_custkey,
            count(o_orderkey)
        from
            customer left outer join orders on
                c_custkey = o_custkey
                and o_comment not like '%special%requests%'
        group by
            c_custkey
    ) as c_orders (c_custkey, c_count)
group by
    c_count
order by
    custdist desc,
    c_count desc;
```

SQL14

```
select
    100.00 * sum(case
        when p_type like 'PROMO%'
            then l_extendedprice * (1 - l_discount)
        else 0
    end) / sum(l_extendedprice * (1 - l_discount)) as promo_revenue
from
```



```
    lineitem,
    part
where
    l_partkey = p_partkey
    and l_shipdate >= date '1995-09-01'
    and l_shipdate < date '1995-09-01' + interval '1' month;
```

SQL15

```
with revenue (supplier_no, total_revenue) as --change view to cte
(
    select
        l_suppkey,
        sum(l_extendedprice * (1 - l_discount))
    from
        lineitem
    where
        l_shipdate >= date '1996-01-01'
        and l_shipdate < date '1996-01-01' + interval '3 month'
    group by
        l_suppkey
)
select
    s_suppkey,
    s_name,
    s_address,
    s_phone,
    total_revenue
from
    supplier,
    revenue
where
    s_suppkey = supplier_no
    and total_revenue = (
        select
            max(total_revenue)
        from
            revenue
    )
order by
    s_suppkey;
```

SQL16

```
select
    p_brand,
    p_type,
    p_size,
    count(distinct ps_suppkey) as supplier_cnt
from
    partsupp,
    part
where
    p_partkey = ps_partkey
    and p_brand <> 'Brand#45'
    and p_type not like 'MEDIUM POLISHED%'
    and p_size in (49, 14, 23, 45, 19, 3, 36, 9)
    and ps_suppkey not in (
        select
            s_suppkey
        from
            supplier
        where
            s_comment like '%Customer%Complaints%'
    )
group by
    p_brand,
    p_type,
    p_size
```



```
order by
    supplier_cnt desc,
    p_brand,
    p_type,
    p_size;
```

SQL17

```
select
    sum(l_extendedprice) / 7.0 as avg_yearly
from
    lineitem,
    part
where
    p_partkey = l_partkey
    and p_brand = 'Brand#23'
    and p_container = 'MED BOX'
    and l_quantity < (
        select
            0.2 * avg(l_quantity)
        from
            lineitem
        where
            l_partkey = p_partkey
    );
```

SQL18

```
select
    c_name,
    c_custkey,
    o_orderkey,
    o_orderdate,
    o_totalprice,
    sum(l_quantity)
from
    customer,
    orders,
    lineitem
where
    o_orderkey in (
        select
            l_orderkey
        from
            lineitem
        group by
            l_orderkey having
                sum(l_quantity) > 300
    )
    and c_custkey = o_custkey
    and o_orderkey = l_orderkey
group by
    c_name,
    c_custkey,
    o_orderkey,
    o_orderdate,
    o_totalprice
order by
    o_totalprice desc,
    o_orderdate
    limit 100;
```

SQL19

```
select
    sum(l_extendedprice* (1 - l_discount)) as revenue
from
    lineitem,
```



```
    part
where
    (
        p_partkey = l_partkey
        and p_brand = 'Brand#12'
        and p_container in ('SM CASE', 'SM BOX', 'SM PACK', 'SM PKG')
        and l_quantity >= 1 and l_quantity <= 1 + 10
        and p_size between 1 and 5
        and l_shipmode in ('AIR', 'AIR REG')
        and l_shipinstruct = 'DELIVER IN PERSON'
    )
    or
    (
        p_partkey = l_partkey
        and p_brand = 'Brand#23'
        and p_container in ('MED BAG', 'MED BOX', 'MED PKG', 'MED PACK')
        and l_quantity >= 10 and l_quantity <= 10 + 10
        and p_size between 1 and 10
        and l_shipmode in ('AIR', 'AIR REG')
        and l_shipinstruct = 'DELIVER IN PERSON'
    )
    or
    (
        p_partkey = l_partkey
        and p_brand = 'Brand#34'
        and p_container in ('LG CASE', 'LG BOX', 'LG PACK', 'LG PKG')
        and l_quantity >= 20 and l_quantity <= 20 + 10
        and p_size between 1 and 15
        and l_shipmode in ('AIR', 'AIR REG')
        and l_shipinstruct = 'DELIVER IN PERSON'
    );
```

SQL20

```
select
    s_name,
    s_address
from
    supplier,
    nation
where
    s_suppkey in (
        select
            ps_suppkey
        from
            partsupp
        where
            ps_partkey in (
                select
                    p_partkey
                from
                    part
                where
                    p_name like 'forest%'
            )
            and ps_availqty > (
                select
                    0.5 * sum(l_quantity)
                from
                    lineitem
                where
                    l_partkey = ps_partkey
                    and l_suppkey = ps_suppkey
                    and l_shipdate >= date '1994-01-01'
                    and l_shipdate < date '1994-01-01' + interval '1' year
            )
    )
    and s_nationkey = n_nationkey
    and n_name = 'CANADA'
```



```
order by
    s_name;
```

SQL21

```
select
    s_name,
    count(*) as numwait
from
    supplier,
    lineitem l1,
    orders,
    nation
where
    s_suppkey = l1.l_suppkey
    and o_orderkey = l1.l_orderkey
    and o_orderstatus = 'F'
    and l1.l_receiptdate > l1.l_commitdate
    and exists (
        select
            *
        from
            lineitem l2
        where
            l2.l_orderkey = l1.l_orderkey
            and l2.l_suppkey <> l1.l_suppkey
    )
    and not exists (
        select
            *
        from
            lineitem l3
        where
            l3.l_orderkey = l1.l_orderkey
            and l3.l_suppkey <> l1.l_suppkey
            and l3.l_receiptdate > l3.l_commitdate
    )
    and s_nationkey = n_nationkey
    and n_name = 'SAUDI ARABIA'
group by
    s_name
order by
    numwait desc,
    s_name
    limit 100;
```

SQL22

```
select
    cntrycode,
    count(*) as numcust,
    sum(c_acctbal) as totacctbal
from
    (
        select
            substring(c_phone from 1 for 2) as cntrycode,
            c_acctbal
        from
            customer
        where
            substring(c_phone from 1 for 2) in
                ('13', '31', '23', '29', '30', '18', '17')
            and c_acctbal > (
                select
                    avg(c_acctbal)
                from
                    customer
                where
                    c_acctbal > 0.00
```



```
                and substring(c_phone from 1 for 2) in
                    ('13', '31', '23', '29', '30', '18', '17')
            )
            and not exists (
                select
                    *
                from
                    orders
                where
                    o_custkey = c_custkey
            )
    ) as custsale
group by
    cntrycode
order by
    cntrycode;
```

4.2 TPC-DS Test Sets

You can use **Using Commands to Generate TPC-DS Test Sets** to generate TPC-DS test sets or directly use **Using Scripts to Generate TPC-DS Test Sets** to generate TPC-DS test sets. We provide the preceding 20 TPC-DS **Test Sets** for your reference.

Using Commands to Generate TPC-DS Test Sets

The SQL statements of the 99 TPC-DS SQL standard queries can be generated as follows:

Step 1 Preparations Modify the following files in the **query_templates** directory before generating TPC-DS query statements:

1. Log in to the ECS and go to the **/data1/script/tpcds-kit/DSGen-software-code-3.2.0rc1/query_templates** directory.
   ```
   cd /data1/script/tpcds-kit/DSGen-software-code-3.2.0rc1/query_templates
   ```
2. Create a file **hwdws.tpl**.
   ```
   define __LIMITA = "";
   define __LIMITB = "";
   define __LIMITC = "limit %d";
   define _BEGIN = "-- begin query " + [_QUERY] + " in stream " + [_STREAM] + " using template " + [_TEMPLATE];
   define _END = "-- end query " + [_QUERY] + " in stream " + [_STREAM] + " using template " + [_TEMPLATE];
   ```
3. The syntax of the SQL statement generation template in the TPC-DS tool is incorrect. You need to change **', coalesce(returns, 0) returns'** in line 135 to **', coalesce(returns, 0) as returns** in **query77.tpl**.

Step 2 Run the following command to generate query statements:

```
./dsqgen  -input ../query_templates/templates.lst -directory ../query_templates/ -scale 1000 -dialect hwdws
```

After the command is executed, the **query_0.sql** file is generated, which contains 99 standard SQL statements. You need to manually split the file into 99 files.

Step 3 DWS does not support the following date function syntax in the generated standard queries. You need to manually modify the syntax.

```
Q5:  and (cast('2001-08-19' as date) +  14 days)
to
and (cast('2001-08-19' as date) +  14)
```



```
Q12:and (cast('1999-02-28' as date) + 30 days)
to
and (cast('1999-02-28' as date) + 30)

Q16:(cast('1999-4-01' as date) + 60 days)
to
(cast('1999-4-01' as date) + 60)

Q20:and (cast('1998-05-05' as date) + 30 days)
to
and (cast('1998-05-05' as date) + 30)

Q21:and d_date between (cast ('2000-05-19' as date) - 30 days)
to
and d_date between (cast ('2000-05-19' as date) - 30)

and (cast ('2000-05-19' as date) + 30 days)
to
and (cast ('2000-05-19' as date) + 30)

Q32:(cast('1999-02-22' as date) + 90 days)
to
(cast('1999-02-22' as date) + 90)

Q37:and d_date between cast('1998-04-29' as date) and (cast('1998-04-29' as date) +  60 days)
to
and d_date between cast('1998-04-29' as date) and (cast('1998-04-29' as date) +  60)

Q40:and d_date between (cast ('2002-05-10' as date) - 30 days)
to
and d_date between (cast ('2002-05-10' as date) - 30)

and (cast ('2002-05-10' as date) + 30 days)
to
and (cast ('2002-05-10' as date) + 30)

Q77:and (cast('1999-08-29' as date) +  30 days)
to
and (cast('1999-08-29' as date) +  30)

Q80:and (cast('2002-08-04' as date) +  30 days)
to
and (cast('2002-08-04' as date) +  30)

Q82:and d_date between cast('1998-01-18' as date) and (cast('1998-01-18' as date) +  60 days)
to
and d_date between cast('1998-01-18' as date) and (cast('1998-01-18' as date) +  60)

Q92:(cast('2001-01-26' as date) + 90 days)
to
(cast('2001-01-26' as date) + 90)

Q94:(cast('1999-5-01' as date) + 60 days)
to
(cast('1999-5-01' as date) + 60)

Q95:(cast('1999-4-01' as date) + 60 days)
to
(cast('1999-4-01' as date) + 60)

Q98:and (cast('2002-04-01' as date) + 30 days)
to
and (cast('2002-04-01' as date) + 30)
```

----End

Using Scripts to Generate TPC-DS Test Sets

You are advised to use the following script to directly generate SQL statements for GaussDB(DWS):

```
# -*- coding: utf-8 -*-
import os
import sys
import re


def gen_thp_seq(dsqgen_file, scale, query_dir):
    flags = os.O_WRONLY | os.O_CREAT | os.O_EXCL
    modes = stat.S_IWUSR | stat.S_IRUSR
    if not os.path.exists(query_dir):
        os.mkdir(query_dir)

    cmd = dsqgen_file + ' -input ../query_templates/templates.lst -directory ../query_templates/ -scale ' +
str(scale) + ' -dialect hwdws'
    os.system(cmd)
    with open('query_0.sql', 'r') as f1:
        line = f1.readline()
        queryname = ''
        while line:
            if '-- begin' in line.strip():
                #line:'-- begin query 1 in stream 0 using template query96.tpl\n'
                queryname = line.split(' ')[-1][5:-5]
                fquery = os.fdopen(os.open(query_dir + '/Q' + queryname, flags, modes), 'w+')
                line = f1.readline()
                continue

            if not queryname or line == '\n':
                line = f1.readline()
                continue

            if '-- end' in line.strip():
                fquery.close()
                line = f1.readline()
                continue

            if 'days)' in line:
                line = line.replace('days', '')
            fquery.write(line)
            line = f1.readline()

    print("TPCDS Q1~Q99 query store at " + query_dir)
    os.system('rm -rf query_0.sql')



if __name__ == '__main__':
    if len(sys.argv) != 4:
print('Wrong number of parameters! ')
print('Usage: python3 gen_tpcds_thpseq.py dsqgen_file_path scale query_dir')
        print("""Parameter:
qgen_file_path: tpcds dsqgen file path
scale: data scale corresponding to the generated query.
query_dir: path for storing the generated file""")
        print("""Example:
            python3 gen_tpcds_thpseq.py ./dsqgen 1000 tpcds_query1000x""")
        sys.exit(1)

    dsqgen_file_path = sys.argv[1]
    scale = sys.argv[2]
    query_dir = sys.argv[3]
    try:
        if not re.match(r'^\.?\/(\w+\/?)+$', dsqgen_file_path):
            print("error param qgenfilepath:", dsqgen_file_path)
        if not re.match(r'\d+', scale):
```



```
            print('error param scale:', scale)
        if not re.match(r'^\/?(\w+\/?)+$', query_dir):
            print('error param query_dir:', query_dir)
    except Exception as ex:
        print('exception: invalid param!')

    if not os.path.isfile(dsqgen_file_path):
        print('The file %s is not exist!' % dsqgen_file_path)
        sys.exit(1)

    gen_thp_seq(dsqgen_file_path, int(scale), query_dir)
```

Save the preceding script in **gen_tpcds_thpseq.py**. Run the **python3 gen_tpcds_thpseq.py ./dsqgen 1000 tpcds_query1000x** command to obtain 99 SQL statements. 1000 indicates the data scale, **tpcds_query1000x** indicates the location where the generated SQL statements are stored.

Test Sets

The TPC-DS test set contains 99 SQL queries. This section describes only the first 20 SQL queries. Use the preceding method to generate other files.

SQL1

```
with customer_total_return as
(select sr_customer_sk as ctr_customer_sk
,sr_store_sk as ctr_store_sk
,sum(SR_RETURN_AMT_INC_TAX) as ctr_total_return
from store_returns
,date_dim
where sr_returned_date_sk = d_date_sk
and d_year =2001
group by sr_customer_sk
,sr_store_sk)
 select  c_customer_id
from customer_total_return ctr1
,store
,customer
where ctr1.ctr_total_return > (select avg(ctr_total_return)*1.2
from customer_total_return ctr2
where ctr1.ctr_store_sk = ctr2.ctr_store_sk)
and s_store_sk = ctr1.ctr_store_sk
and s_state = 'PA'
and ctr1.ctr_customer_sk = c_customer_sk
order by c_customer_id
limit 100;
```

SQL2

```
with wscs as
 (select sold_date_sk
        ,sales_price
  from (select ws_sold_date_sk sold_date_sk
              ,ws_ext_sales_price sales_price
        from web_sales
        union all
        select cs_sold_date_sk sold_date_sk
              ,cs_ext_sales_price sales_price
        from catalog_sales)),
 wswscs as
 (select d_week_seq,
        sum(case when (d_day_name='Sunday') then sales_price else null end) sun_sales,
        sum(case when (d_day_name='Monday') then sales_price else null end) mon_sales,
        sum(case when (d_day_name='Tuesday') then sales_price else  null end) tue_sales,
        sum(case when (d_day_name='Wednesday') then sales_price else null end) wed_sales,
```



```
       sum(case when (d_day_name='Thursday') then sales_price else null end) thu_sales,
       sum(case when (d_day_name='Friday') then sales_price else null end) fri_sales,
       sum(case when (d_day_name='Saturday') then sales_price else null end) sat_sales
from wscs
   ,date_dim
where d_date_sk = sold_date_sk
group by d_week_seq)
select d_week_seq1
      ,round(sun_sales1/sun_sales2,2)
      ,round(mon_sales1/mon_sales2,2)
      ,round(tue_sales1/tue_sales2,2)
      ,round(wed_sales1/wed_sales2,2)
      ,round(thu_sales1/thu_sales2,2)
      ,round(fri_sales1/fri_sales2,2)
      ,round(sat_sales1/sat_sales2,2)
from
(select wswscs.d_week_seq d_week_seq1
       ,sun_sales sun_sales1
       ,mon_sales mon_sales1
       ,tue_sales tue_sales1
       ,wed_sales wed_sales1
       ,thu_sales thu_sales1
       ,fri_sales fri_sales1
       ,sat_sales sat_sales1
 from wswscs,date_dim
 where date_dim.d_week_seq = wswscs.d_week_seq and
       d_year = 1999) y,
(select wswscs.d_week_seq d_week_seq2
       ,sun_sales sun_sales2
       ,mon_sales mon_sales2
       ,tue_sales tue_sales2
       ,wed_sales wed_sales2
       ,thu_sales thu_sales2
       ,fri_sales fri_sales2
       ,sat_sales sat_sales2
 from wswscs
     ,date_dim
 where date_dim.d_week_seq = wswscs.d_week_seq and
       d_year = 1999+1) z
where d_week_seq1=d_week_seq2-53
order by d_week_seq1;
```

SQL3

```
select  dt.d_year
       ,item.i_brand_id brand_id
       ,item.i_brand brand
       ,sum(ss_ext_sales_price) sum_agg
 from  date_dim dt
      ,store_sales
      ,item
 where dt.d_date_sk = store_sales.ss_sold_date_sk
   and store_sales.ss_item_sk = item.i_item_sk
   and item.i_manufact_id = 125
   and dt.d_moy=11
 group by dt.d_year
      ,item.i_brand
      ,item.i_brand_id
 order by dt.d_year
         ,sum_agg desc
         ,brand_id
 limit 100;
```

SQL4

```
with year_total as (
 select c_customer_id customer_id
       ,c_first_name customer_first_name
       ,c_last_name customer_last_name
```



```
       ,c_preferred_cust_flag customer_preferred_cust_flag
       ,c_birth_country customer_birth_country
       ,c_login customer_login
       ,c_email_address customer_email_address
       ,d_year dyear
       ,sum(((ss_ext_list_price-ss_ext_wholesale_cost-ss_ext_discount_amt)+ss_ext_sales_price)/2) year_total
       ,'s' sale_type
 from customer
     ,store_sales
     ,date_dim
 where c_customer_sk = ss_customer_sk
   and ss_sold_date_sk = d_date_sk
 group by c_customer_id
         ,c_first_name
         ,c_last_name
         ,c_preferred_cust_flag
         ,c_birth_country
         ,c_login
         ,c_email_address
         ,d_year
 union all
 select c_customer_id customer_id
       ,c_first_name customer_first_name
       ,c_last_name customer_last_name
       ,c_preferred_cust_flag customer_preferred_cust_flag
       ,c_birth_country customer_birth_country
       ,c_login customer_login
       ,c_email_address customer_email_address
       ,d_year dyear
       ,sum((((cs_ext_list_price-cs_ext_wholesale_cost-cs_ext_discount_amt)+cs_ext_sales_price)/2) ) year_total
       ,'c' sale_type
 from customer
     ,catalog_sales
     ,date_dim
 where c_customer_sk = cs_bill_customer_sk
   and cs_sold_date_sk = d_date_sk
 group by c_customer_id
         ,c_first_name
         ,c_last_name
         ,c_preferred_cust_flag
         ,c_birth_country
         ,c_login
         ,c_email_address
         ,d_year
union all
 select c_customer_id customer_id
       ,c_first_name customer_first_name
       ,c_last_name customer_last_name
       ,c_preferred_cust_flag customer_preferred_cust_flag
       ,c_birth_country customer_birth_country
       ,c_login customer_login
       ,c_email_address customer_email_address
       ,d_year dyear
       ,sum((((ws_ext_list_price-ws_ext_wholesale_cost-ws_ext_discount_amt)+ws_ext_sales_price)/2) )
year_total
       ,'w' sale_type
 from customer
     ,web_sales
     ,date_dim
 where c_customer_sk = ws_bill_customer_sk
   and ws_sold_date_sk = d_date_sk
 group by c_customer_id
         ,c_first_name
         ,c_last_name
         ,c_preferred_cust_flag
         ,c_birth_country
         ,c_login
         ,c_email_address
         ,d_year
```



```
        )
 select
                 t_s_secyear.customer_id
                ,t_s_secyear.customer_first_name
                ,t_s_secyear.customer_last_name
                ,t_s_secyear.customer_preferred_cust_flag
 from year_total t_s_firstyear
    ,year_total t_s_secyear
    ,year_total t_c_firstyear
    ,year_total t_c_secyear
    ,year_total t_w_firstyear
    ,year_total t_w_secyear
 where t_s_secyear.customer_id = t_s_firstyear.customer_id
   and t_s_firstyear.customer_id = t_c_secyear.customer_id
   and t_s_firstyear.customer_id = t_c_firstyear.customer_id
   and t_s_firstyear.customer_id = t_w_firstyear.customer_id
   and t_s_firstyear.customer_id = t_w_secyear.customer_id
   and t_s_firstyear.sale_type = 's'
   and t_c_firstyear.sale_type = 'c'
   and t_w_firstyear.sale_type = 'w'
   and t_s_secyear.sale_type = 's'
   and t_c_secyear.sale_type = 'c'
   and t_w_secyear.sale_type = 'w'
   and t_s_firstyear.dyear =  2000
   and t_s_secyear.dyear = 2000+1
   and t_c_firstyear.dyear =  2000
   and t_c_secyear.dyear =  2000+1
   and t_w_firstyear.dyear = 2000
   and t_w_secyear.dyear = 2000+1
   and t_s_firstyear.year_total > 0
   and t_c_firstyear.year_total > 0
   and t_w_firstyear.year_total > 0
   and case when t_c_firstyear.year_total > 0 then t_c_secyear.year_total / t_c_firstyear.year_total else null
end
           > case when t_s_firstyear.year_total > 0 then t_s_secyear.year_total / t_s_firstyear.year_total else null
end
   and case when t_c_firstyear.year_total > 0 then t_c_secyear.year_total / t_c_firstyear.year_total else null
end
           > case when t_w_firstyear.year_total > 0 then t_w_secyear.year_total / t_w_firstyear.year_total else
null end
 order by t_s_secyear.customer_id
         ,t_s_secyear.customer_first_name
         ,t_s_secyear.customer_last_name
         ,t_s_secyear.customer_preferred_cust_flag
limit 100;
```

SQL5

```
with ssr as
 (select s_store_id,
        sum(sales_price) as sales,
        sum(profit) as profit,
        sum(return_amt) as returns,
        sum(net_loss) as profit_loss
 from
  ( select  ss_store_sk as store_sk,
            ss_sold_date_sk  as date_sk,
            ss_ext_sales_price as sales_price,
            ss_net_profit as profit,
            cast(0 as decimal(7,2)) as return_amt,
            cast(0 as decimal(7,2)) as net_loss
    from store_sales
    union all
    select sr_store_sk as store_sk,
           sr_returned_date_sk as date_sk,
           cast(0 as decimal(7,2)) as sales_price,
           cast(0 as decimal(7,2)) as profit,
           sr_return_amt as return_amt,
           sr_net_loss as net_loss
```



```
   from store_returns
  ) salesreturns,
    date_dim,
    store
where date_sk = d_date_sk
      and d_date between cast('2002-08-05' as date)
                 and (cast('2002-08-05' as date) +  14 )
      and store_sk = s_store_sk
group by s_store_id)
,
csr as
(select cp_catalog_page_id,
       sum(sales_price) as sales,
       sum(profit) as profit,
       sum(return_amt) as returns,
       sum(net_loss) as profit_loss
from
 ( select  cs_catalog_page_sk as page_sk,
           cs_sold_date_sk  as date_sk,
           cs_ext_sales_price as sales_price,
           cs_net_profit as profit,
           cast(0 as decimal(7,2)) as return_amt,
           cast(0 as decimal(7,2)) as net_loss
   from catalog_sales
   union all
   select cr_catalog_page_sk as page_sk,
          cr_returned_date_sk as date_sk,
          cast(0 as decimal(7,2)) as sales_price,
          cast(0 as decimal(7,2)) as profit,
          cr_return_amount as return_amt,
          cr_net_loss as net_loss
   from catalog_returns
  ) salesreturns,
    date_dim,
    catalog_page
where date_sk = d_date_sk
      and d_date between cast('2002-08-05' as date)
                 and (cast('2002-08-05' as date) +  14 )
      and page_sk = cp_catalog_page_sk
group by cp_catalog_page_id)
,
wsr as
(select web_site_id,
       sum(sales_price) as sales,
       sum(profit) as profit,
       sum(return_amt) as returns,
       sum(net_loss) as profit_loss
from
 ( select  ws_web_site_sk as wsr_web_site_sk,
           ws_sold_date_sk  as date_sk,
           ws_ext_sales_price as sales_price,
           ws_net_profit as profit,
           cast(0 as decimal(7,2)) as return_amt,
           cast(0 as decimal(7,2)) as net_loss
   from web_sales
   union all
   select ws_web_site_sk as wsr_web_site_sk,
          wr_returned_date_sk as date_sk,
          cast(0 as decimal(7,2)) as sales_price,
          cast(0 as decimal(7,2)) as profit,
          wr_return_amt as return_amt,
          wr_net_loss as net_loss
   from web_returns left outer join web_sales on
        ( wr_item_sk = ws_item_sk
          and wr_order_number = ws_order_number)
  ) salesreturns,
    date_dim,
    web_site
where date_sk = d_date_sk
```



```
      and d_date between cast('2002-08-05' as date)
                 and (cast('2002-08-05' as date) +  14 )
      and wsr_web_site_sk = web_site_sk
group by web_site_id)
 select  channel
       , id
       , sum(sales) as sales
       , sum(returns) as returns
       , sum(profit) as profit
from
(select 'store channel' as channel
       , 'store' || s_store_id as id
       , sales
       , returns
       , (profit - profit_loss) as profit
from   ssr
union all
select 'catalog channel' as channel
       , 'catalog_page' || cp_catalog_page_id as id
       , sales
       , returns
       , (profit - profit_loss) as profit
from  csr
union all
select 'web channel' as channel
       , 'web_site' || web_site_id as id
       , sales
       , returns
       , (profit - profit_loss) as profit
from   wsr
) x
group by rollup (channel, id)
order by channel
        ,id
limit 100;
```

SQL6

```
select  a.ca_state state, count(*) cnt
 from customer_address a
    ,customer c
    ,store_sales s
    ,date_dim d
    ,item i
 where       a.ca_address_sk = c.c_current_addr_sk
   and c.c_customer_sk = s.ss_customer_sk
   and s.ss_sold_date_sk = d.d_date_sk
   and s.ss_item_sk = i.i_item_sk
   and d.d_month_seq =
        (select distinct (d_month_seq)
         from date_dim
             where d_year = 1998
           and d_moy = 7 )
   and i.i_current_price > 1.2 *
            (select avg(j.i_current_price)
        from item j
        where j.i_category = i.i_category)
 group by a.ca_state
 having count(*) >= 10
 order by cnt, a.ca_state
 limit 100;
```

SQL7

```
select  i_item_id,
       avg(ss_quantity) agg1,
       avg(ss_list_price) agg2,
       avg(ss_coupon_amt) agg3,
```



```
       avg(ss_sales_price) agg4
from store_sales, customer_demographics, date_dim, item, promotion
where ss_sold_date_sk = d_date_sk and
      ss_item_sk = i_item_sk and
      ss_cdemo_sk = cd_demo_sk and
      ss_promo_sk = p_promo_sk and
      cd_gender = 'M' and
      cd_marital_status = 'U' and
      cd_education_status = 'College' and
      (p_channel_email = 'N' or p_channel_event = 'N') and
      d_year = 1999
group by i_item_id
order by i_item_id
limit 100;
```

SQL8

```
select  s_store_name
     ,sum(ss_net_profit)
 from store_sales
    ,date_dim
    ,store,
    (select ca_zip
    from (
     SELECT substr(ca_zip,1,5) ca_zip
     FROM customer_address
     WHERE substr(ca_zip,1,5) IN (
                        '74804','87276','13428','49436','56281','79805',
                        '46826','68570','20368','28846','41886',
                        '68164','68097','16113','18727','96789',
                        '63317','57937','19554','69911','83554',
                        '84246','61336','46999','25229','15960',
                        '61657','28058','64558','39712','74928',
                        '34018','87826','69733','26479','73630',
                        '88683','61704','81441','42706','54175',
                        '45152','49049','30850','63980','40484',
                        '71665','63755','23769','79855','24308',
                        '28241','16343','25663','85999','46359',
                        '93691','34706','99973','74947','60316',
                        '58637','48063','81363','19268','66228',
                        '78136','16368','99907','58139','17043',
                        '89764','14834','25152','70158','76080',
                        '81251','83972','48635','54671','35602',
                        '10788','57325','46354','92707','41103',
                        '89761','31840','69225','76139','18826',
                        '12556','51692','20579','50965','32136',
                        '71357','16309','82922','59273','40999',
                        '73273','93217','65679','12653','16978',
                        '27319','41973','65580','56237','17799',
                        '53192','63632','37089','65994','58048',
                        '14388','58085','80614','40042','79194',
                        '42268','61913','97332','37349','72146',
                        '52681','18176','39332','89283','69023',
                        '84175','11520','33483','60169','93562',
                        '10097','14536','70276','64042','22822',
                        '87229','51528','70269','44519','48044',
                        '78170','81440','60315','14543','30719',
                        '13240','62325','35517','51529','98085',
                        '79007','16582','95187','15625','88780',
                        '38656','74607','75117','62819','31929',
                        '27665','88890','98611','53527','48652',
                        '10324','62273','17726','36232','38526',
                        '50705','61179','30363','54408','58631',
                        '23622','50319','33299','78829','91267',
                        '25571','60347','44750','62797','10713',
                        '46494','91163','20973','42007','54724',
                        '89203','12561','71116','60404','70589',
                        '66744','46074','69138','34737','25092',
                        '59246','74778','40140','89476','71030',
```



```
                    '89861','93207','44996','34850','48752',
                    '79574','29570','76507','79728','43195',
                    '47596','46415','42514','68144','14169',
                    '17041','75747','33630','19378','32618',
                    '78704','75807','76800','80916','87272',
                    '37109','21714','14867','83806','33895',
                    '80637','20658','75224','92772','55791',
                    '58603','31681','38788','91922','42465',
                    '74371','72854','75746','80383','75909',
                    '37151','82077','80604','66771','46075',
                    '58723','15380','83174','53615','50347',
                    '98340','68957','63361','18705','47629',
                    '76013','68572','50588','31168','41563',
                    '38936','88746','19052','75648','46403',
                    '24332','54711','28218','80432','53870',
                    '25049','32562','94211','99803','49133',
                    '21202','50005','17953','14324','85525',
                    '51984','37304','69870','64321','66962',
                    '66453','40619','91199','54400','28804',
                    '65544','27059','31143','20303','52429',
                    '24476','91458','52514','55145','99015',
                    '51657','10001','96434','38325','39628',
                    '83338','62381','67697','61542','86076',
                    '89833','32657','56881','93983','85031',
                    '57530','56318','46934','34740','79458',
                    '88443','15861','56034','24808','32336',
                    '34312','96450','12923','91876','53509',
                    '30241','35816','52377','23946','23644',
                    '16413','35796','59100','21689','49199',
                    '40062','82510','14072','78823','49158',
                    '99933','75399','11365','44799','77549',
                    '19569','39186','78909','68143','70468',
                    '14944','33047','98329','42262','68647',
                    '65754','27357','56372','18073','12363',
                    '64467','26221','32914','70431','42436',
                    '55316','33335','27701','44687','22360',
                    '76124','44007','59525','51574','71555',
                    '43130','64199','19616','94285')
    intersect
     select ca_zip
     from (SELECT substr(ca_zip,1,5) ca_zip,count(*) cnt
           FROM customer_address, customer
           WHERE ca_address_sk = c_current_addr_sk and
                 c_preferred_cust_flag='Y'
           group by ca_zip
           having count(*) > 10)A1)A2) V1
where ss_store_sk = s_store_sk
 and ss_sold_date_sk = d_date_sk
 and d_qoy = 1 and d_year = 1999
 and (substr(s_zip,1,2) = substr(V1.ca_zip,1,2))
group by s_store_name
order by s_store_name
limit 100;
```

SQL9

```
select case when (select count(*)
                  from store_sales
                  where ss_quantity between 1 and 20) > 40845849
            then (select avg(ss_ext_tax)
                  from store_sales
                  where ss_quantity between 1 and 20)
            else (select avg(ss_net_paid)
                  from store_sales
                  where ss_quantity between 1 and 20) end bucket1 ,
       case when (select count(*)
                  from store_sales
                  where ss_quantity between 21 and 40) > 5712087
            then (select avg(ss_ext_tax)
```



```
                from store_sales
                where ss_quantity between 21 and 40)
            else (select avg(ss_net_paid)
                from store_sales
                where ss_quantity between 21 and 40) end bucket2,
        case when (select count(*)
                from store_sales
                where ss_quantity between 41 and 60) > 30393328
            then (select avg(ss_ext_tax)
                from store_sales
                where ss_quantity between 41 and 60)
            else (select avg(ss_net_paid)
                from store_sales
                where ss_quantity between 41 and 60) end bucket3,
        case when (select count(*)
                from store_sales
                where ss_quantity between 61 and 80) > 46385791
            then (select avg(ss_ext_tax)
                from store_sales
                where ss_quantity between 61 and 80)
            else (select avg(ss_net_paid)
                from store_sales
                where ss_quantity between 61 and 80) end bucket4,
        case when (select count(*)
                from store_sales
                where ss_quantity between 81 and 100) > 29981928
            then (select avg(ss_ext_tax)
                from store_sales
                where ss_quantity between 81 and 100)
            else (select avg(ss_net_paid)
                from store_sales
                where ss_quantity between 81 and 100) end bucket5
from reason
where r_reason_sk = 1
;
```

SQL10

```
select
  cd_gender,
  cd_marital_status,
  cd_education_status,
  count(*) cnt1,
  cd_purchase_estimate,
  count(*) cnt2,
  cd_credit_rating,
  count(*) cnt3,
  cd_dep_count,
  count(*) cnt4,
  cd_dep_employed_count,
  count(*) cnt5,
  cd_dep_college_count,
  count(*) cnt6
 from
  customer c,customer_address ca,customer_demographics
 where
  c.c_current_addr_sk = ca.ca_address_sk and
  ca_county in ('Clark County','Richardson County','Tom Green County','Sullivan County','Cass County') and
  cd_demo_sk = c.c_current_cdemo_sk and
  exists (select *
          from store_sales,date_dim
          where c.c_customer_sk = ss_customer_sk and
                ss_sold_date_sk = d_date_sk and
                d_year = 2000 and
                d_moy between 1 and 1+3) and
   (exists (select *
            from web_sales,date_dim
            where c.c_customer_sk = ws_bill_customer_sk and
                  ws_sold_date_sk = d_date_sk and
```



```
                d_year = 2000 and
                d_moy between 1 ANd 1+3) or
   exists (select *
          from catalog_sales,date_dim
          where c.c_customer_sk = cs_ship_customer_sk and
                cs_sold_date_sk = d_date_sk and
                d_year = 2000 and
                d_moy between 1 and 1+3))
 group by cd_gender,
          cd_marital_status,
          cd_education_status,
          cd_purchase_estimate,
          cd_credit_rating,
          cd_dep_count,
          cd_dep_employed_count,
          cd_dep_college_count
 order by cd_gender,
          cd_marital_status,
          cd_education_status,
          cd_purchase_estimate,
          cd_credit_rating,
          cd_dep_count,
          cd_dep_employed_count,
          cd_dep_college_count
limit 100;
```

SQL11

```
with year_total as (
 select c_customer_id customer_id
       ,c_first_name customer_first_name
       ,c_last_name customer_last_name
       ,c_preferred_cust_flag customer_preferred_cust_flag
       ,c_birth_country customer_birth_country
       ,c_login customer_login
       ,c_email_address customer_email_address
       ,d_year dyear
       ,sum(ss_ext_list_price-ss_ext_discount_amt) year_total
       ,'s' sale_type
 from customer
     ,store_sales
     ,date_dim
 where c_customer_sk = ss_customer_sk
   and ss_sold_date_sk = d_date_sk
 group by c_customer_id
         ,c_first_name
         ,c_last_name
         ,c_preferred_cust_flag
         ,c_birth_country
         ,c_login
         ,c_email_address
         ,d_year
 union all
 select c_customer_id customer_id
       ,c_first_name customer_first_name
       ,c_last_name customer_last_name
       ,c_preferred_cust_flag customer_preferred_cust_flag
       ,c_birth_country customer_birth_country
       ,c_login customer_login
       ,c_email_address customer_email_address
       ,d_year dyear
       ,sum(ws_ext_list_price-ws_ext_discount_amt) year_total
       ,'w' sale_type
 from customer
     ,web_sales
     ,date_dim
 where c_customer_sk = ws_bill_customer_sk
   and ws_sold_date_sk = d_date_sk
 group by c_customer_id
```



```
        ,c_first_name
        ,c_last_name
        ,c_preferred_cust_flag
        ,c_birth_country
        ,c_login
        ,c_email_address
        ,d_year
        )
 select
                 t_s_secyear.customer_id
                ,t_s_secyear.customer_first_name
                ,t_s_secyear.customer_last_name
                ,t_s_secyear.customer_birth_country
 from year_total t_s_firstyear
    ,year_total t_s_secyear
    ,year_total t_w_firstyear
    ,year_total t_w_secyear
 where t_s_secyear.customer_id = t_s_firstyear.customer_id
        and t_s_firstyear.customer_id = t_w_secyear.customer_id
        and t_s_firstyear.customer_id = t_w_firstyear.customer_id
        and t_s_firstyear.sale_type = 's'
        and t_w_firstyear.sale_type = 'w'
        and t_s_secyear.sale_type = 's'
        and t_w_secyear.sale_type = 'w'
        and t_s_firstyear.dyear = 2001
        and t_s_secyear.dyear = 2001+1
        and t_w_firstyear.dyear = 2001
        and t_w_secyear.dyear = 2001+1
        and t_s_firstyear.year_total > 0
        and t_w_firstyear.year_total > 0
        and case when t_w_firstyear.year_total > 0 then t_w_secyear.year_total / t_w_firstyear.year_total else
0.0 end
            > case when t_s_firstyear.year_total > 0 then t_s_secyear.year_total / t_s_firstyear.year_total else
0.0 end
 order by t_s_secyear.customer_id
        ,t_s_secyear.customer_first_name
        ,t_s_secyear.customer_last_name
        ,t_s_secyear.customer_birth_country
limit 100;
```

SQL12

```
select  i_item_id
      ,i_item_desc
      ,i_category
      ,i_class
      ,i_current_price
      ,sum(ws_ext_sales_price) as itemrevenue
      ,sum(ws_ext_sales_price)*100/sum(sum(ws_ext_sales_price)) over
          (partition by i_class) as revenueratio
from
    web_sales
    ,item
    ,date_dim
where
    ws_item_sk = i_item_sk
    and i_category in ('Music', 'Shoes', 'Children')
    and ws_sold_date_sk = d_date_sk
    and d_date between cast('2000-05-14' as date)
                and (cast('2000-05-14' as date) + 30 )
group by
    i_item_id
        ,i_item_desc
        ,i_category
        ,i_class
        ,i_current_price
order by
    i_category
        ,i_class
```



```
       ,i_item_id
       ,i_item_desc
       ,revenueratio
limit 100;
```

SQL13

```
select avg(ss_quantity)
       ,avg(ss_ext_sales_price)
       ,avg(ss_ext_wholesale_cost)
       ,sum(ss_ext_wholesale_cost)
 from store_sales
     ,store
     ,customer_demographics
     ,household_demographics
     ,customer_address
     ,date_dim
 where s_store_sk = ss_store_sk
 and  ss_sold_date_sk = d_date_sk and d_year = 2001
 and((ss_hdemo_sk=hd_demo_sk
  and cd_demo_sk = ss_cdemo_sk
  and cd_marital_status = 'U'
  and cd_education_status = '4 yr Degree'
  and ss_sales_price between 100.00 and 150.00
  and hd_dep_count = 3
     )or
     (ss_hdemo_sk=hd_demo_sk
  and cd_demo_sk = ss_cdemo_sk
  and cd_marital_status = 'D'
  and cd_education_status = '2 yr Degree'
  and ss_sales_price between 50.00 and 100.00
  and hd_dep_count = 1
     ) or
     (ss_hdemo_sk=hd_demo_sk
  and cd_demo_sk = ss_cdemo_sk
  and cd_marital_status = 'S'
  and cd_education_status = 'Advanced Degree'
  and ss_sales_price between 150.00 and 200.00
  and hd_dep_count = 1
     ))
 and((ss_addr_sk = ca_address_sk
  and ca_country = 'United States'
  and ca_state in ('IL', 'WI', 'TN')
  and ss_net_profit between 100 and 200
     ) or
     (ss_addr_sk = ca_address_sk
  and ca_country = 'United States'
  and ca_state in ('MO', 'OK', 'WA')
  and ss_net_profit between 150 and 300
     ) or
     (ss_addr_sk = ca_address_sk
  and ca_country = 'United States'
  and ca_state in ('NE', 'VA', 'GA')
  and ss_net_profit between 50 and 250
     ))
;
```

SQL14

```
with  cross_items as
 (select i_item_sk ss_item_sk
 from item,
 (select iss.i_brand_id brand_id
     ,iss.i_class_id class_id
     ,iss.i_category_id category_id
 from store_sales
     ,item iss
     ,date_dim d1
 where ss_item_sk = iss.i_item_sk
```



```
  and ss_sold_date_sk = d1.d_date_sk
  and d1.d_year between 2000 AND 2000 + 2
intersect
select ics.i_brand_id
    ,ics.i_class_id
    ,ics.i_category_id
from catalog_sales
    ,item ics
    ,date_dim d2
where cs_item_sk = ics.i_item_sk
  and cs_sold_date_sk = d2.d_date_sk
  and d2.d_year between 2000 AND 2000 + 2
intersect
select iws.i_brand_id
    ,iws.i_class_id
    ,iws.i_category_id
from web_sales
    ,item iws
    ,date_dim d3
where ws_item_sk = iws.i_item_sk
  and ws_sold_date_sk = d3.d_date_sk
  and d3.d_year between 2000 AND 2000 + 2)
where i_brand_id = brand_id
     and i_class_id = class_id
     and i_category_id = category_id
),
avg_sales as
(select avg(quantity*list_price) average_sales
 from (select ss_quantity quantity
            ,ss_list_price list_price
      from store_sales
          ,date_dim
      where ss_sold_date_sk = d_date_sk
        and d_year between 2000 and 2000 + 2
      union all
      select cs_quantity quantity
           ,cs_list_price list_price
      from catalog_sales
          ,date_dim
      where cs_sold_date_sk = d_date_sk
        and d_year between 2000 and 2000 + 2
      union all
      select ws_quantity quantity
           ,ws_list_price list_price
      from web_sales
          ,date_dim
      where ws_sold_date_sk = d_date_sk
        and d_year between 2000 and 2000 + 2) x)
 select  channel, i_brand_id,i_class_id,i_category_id,sum(sales), sum(number_sales)
from(
      select 'store' channel, i_brand_id,i_class_id
           ,i_category_id,sum(ss_quantity*ss_list_price) sales
           , count(*) number_sales
      from store_sales
          ,item
          ,date_dim
      where ss_item_sk in (select ss_item_sk from cross_items)
        and ss_item_sk = i_item_sk
        and ss_sold_date_sk = d_date_sk
        and d_year = 2000+2
        and d_moy = 11
      group by i_brand_id,i_class_id,i_category_id
      having sum(ss_quantity*ss_list_price) > (select average_sales from avg_sales)
      union all
      select 'catalog' channel, i_brand_id,i_class_id,i_category_id, sum(cs_quantity*cs_list_price) sales,
count(*) number_sales
      from catalog_sales
          ,item
          ,date_dim
```



```
      where cs_item_sk in (select ss_item_sk from cross_items)
        and cs_item_sk = i_item_sk
        and cs_sold_date_sk = d_date_sk
        and d_year = 2000+2
        and d_moy = 11
      group by i_brand_id,i_class_id,i_category_id
      having sum(cs_quantity*cs_list_price) > (select average_sales from avg_sales)
      union all
      select 'web' channel, i_brand_id,i_class_id,i_category_id, sum(ws_quantity*ws_list_price) sales , count(*)
number_sales
      from web_sales
          ,item
          ,date_dim
      where ws_item_sk in (select ss_item_sk from cross_items)
        and ws_item_sk = i_item_sk
        and ws_sold_date_sk = d_date_sk
        and d_year = 2000+2
        and d_moy = 11
      group by i_brand_id,i_class_id,i_category_id
      having sum(ws_quantity*ws_list_price) > (select average_sales from avg_sales)
) y
group by rollup (channel, i_brand_id,i_class_id,i_category_id)
order by channel,i_brand_id,i_class_id,i_category_id
limit 100;
with  cross_items as
(select i_item_sk ss_item_sk
from item,
(select iss.i_brand_id brand_id
    ,iss.i_class_id class_id
    ,iss.i_category_id category_id
from store_sales
    ,item iss
    ,date_dim d1
where ss_item_sk = iss.i_item_sk
  and ss_sold_date_sk = d1.d_date_sk
  and d1.d_year between 2000 AND 2000 + 2
intersect
select ics.i_brand_id
    ,ics.i_class_id
    ,ics.i_category_id
from catalog_sales
    ,item ics
    ,date_dim d2
where cs_item_sk = ics.i_item_sk
  and cs_sold_date_sk = d2.d_date_sk
  and d2.d_year between 2000 AND 2000 + 2
intersect
select iws.i_brand_id
    ,iws.i_class_id
    ,iws.i_category_id
from web_sales
    ,item iws
    ,date_dim d3
where ws_item_sk = iws.i_item_sk
  and ws_sold_date_sk = d3.d_date_sk
  and d3.d_year between 2000 AND 2000 + 2) x
where i_brand_id = brand_id
     and i_class_id = class_id
     and i_category_id = category_id
),
avg_sales as
(select avg(quantity*list_price) average_sales
 from (select ss_quantity quantity
           ,ss_list_price list_price
      from store_sales
          ,date_dim
      where ss_sold_date_sk = d_date_sk
        and d_year between 2000 and 2000 + 2
      union all
```



```
      select cs_quantity quantity
           ,cs_list_price list_price
      from catalog_sales
          ,date_dim
      where cs_sold_date_sk = d_date_sk
        and d_year between 2000 and 2000 + 2
      union all
      select ws_quantity quantity
           ,ws_list_price list_price
      from web_sales
          ,date_dim
      where ws_sold_date_sk = d_date_sk
        and d_year between 2000 and 2000 + 2) x)
 select  this_year.channel ty_channel
                          ,this_year.i_brand_id ty_brand
                          ,this_year.i_class_id ty_class
                          ,this_year.i_category_id ty_category
                          ,this_year.sales ty_sales
                          ,this_year.number_sales ty_number_sales
                          ,last_year.channel ly_channel
                          ,last_year.i_brand_id ly_brand
                          ,last_year.i_class_id ly_class
                          ,last_year.i_category_id ly_category
                          ,last_year.sales ly_sales
                          ,last_year.number_sales ly_number_sales
from
(select 'store' channel, i_brand_id,i_class_id,i_category_id
       ,sum(ss_quantity*ss_list_price) sales, count(*) number_sales
from store_sales
    ,item
    ,date_dim
where ss_item_sk in (select ss_item_sk from cross_items)
  and ss_item_sk = i_item_sk
  and ss_sold_date_sk = d_date_sk
  and d_week_seq = (select d_week_seq
                    from date_dim
                    where d_year = 2000 + 1
                      and d_moy = 12
                      and d_dom = 17)
group by i_brand_id,i_class_id,i_category_id
having sum(ss_quantity*ss_list_price) > (select average_sales from avg_sales)) this_year,
(select 'store' channel, i_brand_id,i_class_id
       ,i_category_id, sum(ss_quantity*ss_list_price) sales, count(*) number_sales
from store_sales
    ,item
    ,date_dim
where ss_item_sk in (select ss_item_sk from cross_items)
  and ss_item_sk = i_item_sk
  and ss_sold_date_sk = d_date_sk
  and d_week_seq = (select d_week_seq
                    from date_dim
                    where d_year = 2000
                      and d_moy = 12
                      and d_dom = 17)
group by i_brand_id,i_class_id,i_category_id
having sum(ss_quantity*ss_list_price) > (select average_sales from avg_sales)) last_year
where this_year.i_brand_id= last_year.i_brand_id
  and this_year.i_class_id = last_year.i_class_id
  and this_year.i_category_id = last_year.i_category_id
order by this_year.channel, this_year.i_brand_id, this_year.i_class_id, this_year.i_category_id
limit 100;
```

SQL15

```
select  ca_zip
       ,sum(cs_sales_price)
 from catalog_sales
    ,customer
    ,customer_address
```



```
    ,date_dim
 where cs_bill_customer_sk = c_customer_sk
   and c_current_addr_sk = ca_address_sk
   and ( substr(ca_zip,1,5) in ('85669', '86197','88274','83405','86475',
                                '85392', '85460', '80348', '81792')
         or ca_state in ('CA','WA','GA')
         or cs_sales_price > 500)
   and cs_sold_date_sk = d_date_sk
   and d_qoy = 2 and d_year = 1999
 group by ca_zip
 order by ca_zip
 limit 100;
```

SQL16

```
select
   count(distinct cs_order_number) as "order count"
  ,sum(cs_ext_ship_cost) as "total shipping cost"
  ,sum(cs_net_profit) as "total net profit"
from
   catalog_sales cs1
  ,date_dim
  ,customer_address
  ,call_center
where
    d_date between '1999-2-01' and
           (cast('1999-2-01' as date) + 60 )
and cs1.cs_ship_date_sk = d_date_sk
and cs1.cs_ship_addr_sk = ca_address_sk
and ca_state = 'TX'
and cs1.cs_call_center_sk = cc_call_center_sk
and cc_county in ('Barrow County','Luce County','Mobile County','Richland County',
                  'Wadena County'
)
and exists (select *
            from catalog_sales cs2
            where cs1.cs_order_number = cs2.cs_order_number
              and cs1.cs_warehouse_sk <> cs2.cs_warehouse_sk)
and not exists(select *
               from catalog_returns cr1
               where cs1.cs_order_number = cr1.cr_order_number)
order by count(distinct cs_order_number)
limit 100;
```

SQL17

```
select  i_item_id
       ,i_item_desc
       ,s_state
       ,count(ss_quantity) as store_sales_quantitycount
       ,avg(ss_quantity) as store_sales_quantityave
       ,stddev_samp(ss_quantity) as store_sales_quantitystdev
       ,stddev_samp(ss_quantity)/avg(ss_quantity) as store_sales_quantitycov
       ,count(sr_return_quantity) as store_returns_quantitycount
       ,avg(sr_return_quantity) as store_returns_quantityave
       ,stddev_samp(sr_return_quantity) as store_returns_quantitystdev
       ,stddev_samp(sr_return_quantity)/avg(sr_return_quantity) as store_returns_quantitycov
       ,count(cs_quantity) as catalog_sales_quantitycount ,avg(cs_quantity) as catalog_sales_quantityave
       ,stddev_samp(cs_quantity) as catalog_sales_quantitystdev
       ,stddev_samp(cs_quantity)/avg(cs_quantity) as catalog_sales_quantitycov
 from store_sales
     ,store_returns
     ,catalog_sales
     ,date_dim d1
     ,date_dim d2
     ,date_dim d3
     ,store
     ,item
 where d1.d_quarter_name = '2000Q1'
```



```
  and d1.d_date_sk = ss_sold_date_sk
  and i_item_sk = ss_item_sk
  and s_store_sk = ss_store_sk
  and ss_customer_sk = sr_customer_sk
  and ss_item_sk = sr_item_sk
  and ss_ticket_number = sr_ticket_number
  and sr_returned_date_sk = d2.d_date_sk
  and d2.d_quarter_name in ('2000Q1','2000Q2','2000Q3')
  and sr_customer_sk = cs_bill_customer_sk
  and sr_item_sk = cs_item_sk
  and cs_sold_date_sk = d3.d_date_sk
  and d3.d_quarter_name in ('2000Q1','2000Q2','2000Q3')
group by i_item_id
        ,i_item_desc
        ,s_state
order by i_item_id
        ,i_item_desc
        ,s_state
limit 100;
```

SQL18

```
select  i_item_id,
        ca_country,
        ca_state,
        ca_county,
        avg( cast(cs_quantity as decimal(12,2))) agg1,
        avg( cast(cs_list_price as decimal(12,2))) agg2,
        avg( cast(cs_coupon_amt as decimal(12,2))) agg3,
        avg( cast(cs_sales_price as decimal(12,2))) agg4,
        avg( cast(cs_net_profit as decimal(12,2))) agg5,
        avg( cast(c_birth_year as decimal(12,2))) agg6,
        avg( cast(cd1.cd_dep_count as decimal(12,2))) agg7
 from catalog_sales, customer_demographics cd1,
     customer_demographics cd2, customer, customer_address, date_dim, item
 where cs_sold_date_sk = d_date_sk and
       cs_item_sk = i_item_sk and
       cs_bill_cdemo_sk = cd1.cd_demo_sk and
       cs_bill_customer_sk = c_customer_sk and
       cd1.cd_gender = 'M' and
       cd1.cd_education_status = 'Primary' and
       c_current_cdemo_sk = cd2.cd_demo_sk and
       c_current_addr_sk = ca_address_sk and
       c_birth_month in (10,1,8,7,3,5) and
       d_year = 1998 and
       ca_state in ('NE','OK','NC'
                   ,'CO','ID','AR','MO')
 group by rollup (i_item_id, ca_country, ca_state, ca_county)
 order by ca_country,
        ca_state,
        ca_county,
    i_item_id
 limit 100;
```

SQL19

```
select  i_brand_id brand_id, i_brand brand, i_manufact_id, i_manufact,
    sum(ss_ext_sales_price) ext_price
 from date_dim, store_sales, item,customer,customer_address,store
 where d_date_sk = ss_sold_date_sk
   and ss_item_sk = i_item_sk
   and i_manager_id=62
   and d_moy=11
   and d_year=2000
   and ss_customer_sk = c_customer_sk
   and c_current_addr_sk = ca_address_sk
   and substr(ca_zip,1,5) <> substr(s_zip,1,5)
   and ss_store_sk = s_store_sk
 group by i_brand
```



```
      ,i_brand_id
      ,i_manufact_id
      ,i_manufact
 order by ext_price desc
         ,i_brand
         ,i_brand_id
         ,i_manufact_id
         ,i_manufact
limit 100 ;
```

SQL20

```
select  i_item_id
       ,i_item_desc
       ,i_category
       ,i_class
       ,i_current_price
       ,sum(cs_ext_sales_price) as itemrevenue
       ,sum(cs_ext_sales_price)*100/sum(sum(cs_ext_sales_price)) over
           (partition by i_class) as revenueratio
 from    catalog_sales
     ,item
     ,date_dim
 where cs_item_sk = i_item_sk
   and i_category in ('Sports', 'Shoes', 'Women')
   and cs_sold_date_sk = d_date_sk
 and d_date between cast('2001-03-21' as date)
                and (cast('2001-03-21' as date) + 30)
 group by i_item_id
         ,i_item_desc
         ,i_category
         ,i_class
         ,i_current_price
 order by i_category
         ,i_class
         ,i_item_id
         ,i_item_desc
         ,revenueratio
limit 100;
```

