

Date/time types and formats

EXPLORATORY DATA ANALYSIS IN SQL



Christina Maimone
Data Scientist

Main types

date

- YYYY-MM-DD
- example: 2018-12-30

timestamp

- YYYY-MM-DD HH:MM:SS
- example: 2018-12-30 13:10:04.3

Intervals

`interval` examples:

```
6 days 01:48:08
```

```
00:51:03
```

```
1 day 21:57:47
```

```
07:48:46
```

```
406 days 00:31:56
```

Date/time format examples

1pm on January 10, 2018

01/10/18 1:00

10/01/18 01:00:00

01/10/2018 1pm

January 10th, 2018 1pm

10 Jan 2018 1:00

01/10/18 01:00:00

01/10/18 13:00:00

ISO 8601

ISO = International Organization for Standards

YYYY-MM-DD HH:MM:SS

Example: 2018-01-05 09:35:15

UTC and timezones

UTC = Coordinated Universal Time

Timestamp with timezone:

YYYY-MM-DD HH:MM:SS+HH

Example: 2004-10-19 10:23:54+02

Date and time comparisons

Compare with `>`, `<`, `=`

```
SELECT '2018-01-01' > '2017-12-31';
```

`now()` : current timestamp

```
SELECT now() > '2017-12-31';
```

Date subtraction

```
SELECT now() - '2018-01-01';
```

```
343 days 21:26:32.710898
```

```
SELECT now() - '2015-01-01';
```

```
1439 days 21:32:22.616076
```


Date addition

```
SELECT '2010-01-01'::date + 1;
```

```
2010-01-02
```

```
SELECT '2018-12-10'::date + '1 year'::interval;
```

```
2019-12-10 00:00:00
```

```
SELECT '2018-12-10'::date + '1 year 2 days 3 minutes'::interval ;
```

```
2019-12-12 00:03:00
```

Let's practice!

EXPLORATORY DATA ANALYSIS IN SQL

Date/time components and aggregation

EXPLORATORY DATA ANALYSIS IN SQL



Christina Maimone
Data Scientist

Common date/time fields

Date/Time Functions and Operators Documentation

Fields

- century: 2019-01-01 = century 21
- decade: 2019-01-01 = decade 201
- year, month, day
- hour, minute, second
- week
- dow: day of week

Extracting fields

```
-- functions to extract datetime fields
```

```
date_part('field', timestamp)
```

```
EXTRACT(FIELD FROM timestamp)
```

```
-- now is 2019-01-08 22:15:10.647281-06
```

```
SELECT date_part('month', now()),  
       EXTRACT(MONTH FROM now());
```

```
date_part | date_part  
-----+-----  
1 | 1
```

Extract to summarize by field

Individual sales

```
SELECT *  
FROM sales  
WHERE date >= '2010-01-01'  
AND date < '2017-01-01';
```

date	amt
2010-01-05	32
2010-03-04	10
2010-07-29	7
2016-12-20	46
2015-11-01	30
2014-07-10	35
2013-09-09	15
2011-04-22	9
...	

By month

```
SELECT date_part('month', date)  
AS month,  
sum(amt)  
FROM sales  
GROUP BY month  
ORDER BY month;
```

month	sum
1	432
2	847
3	1987
4	3899
5	974
6	397
7	974
8	198
...	

<- Jan
<- Mar

Truncating dates

```
date_trunc('field', timestamp)
```

```
-- now() is 2018-12-17 21:45:15.6829-06
```

```
SELECT date_trunc('month', now());
```

```
date_trunc
```

```
-----
```

```
2018-12-01 00:00:00-06
```

Truncate to keep larger units

Individual sales

```
SELECT *  
FROM sales  
WHERE date >= '2017-06-01'  
AND date < '2019-02-01';
```

date	amt
2019-01-25 06:58:32	10
2018-03-14 18:07:03	11
2018-04-15 19:03:33	5
2018-08-10 14:30:49	28
2018-02-02 09:52:28	17
2017-08-08 08:40:35	20
2018-07-05 02:05:52	7
2018-07-28 17:49:16	16
2018-08-01 20:57:40	8
2018-03-04 08:56:04	32
...	

By month with year

```
SELECT date_trunc('month', date)  
       AS month  
       sum(amt)  
FROM sales  
GROUP BY month  
ORDER BY month;
```

month	sum
2017-06-01 00:00:00	594
2017-07-01 00:00:00	3824
2017-08-01 00:00:00	482
2017-09-01 00:00:00	1384
2017-10-01 00:00:00	3058
2017-11-01 00:00:00	259
2017-12-01 00:00:00	874
2018-01-01 00:00:00	1225
...	

Time to practice extracting and aggregating dates

EXPLORATORY DATA ANALYSIS IN SQL

Aggregating with date/time series

EXPLORATORY DATA ANALYSIS IN SQL

SQL

Christina Maimone

Data Scientist

Generate series

```
SELECT generate_series(from, to, interval);
```

```
SELECT generate_series('2018-01-01',  
                        '2018-01-15',  
                        '2 days'::interval);
```

```
generate_series  
-----  
2018-01-01 00:00:00  
2018-01-03 00:00:00  
2018-01-05 00:00:00  
2018-01-07 00:00:00  
2018-01-09 00:00:00  
2018-01-11 00:00:00  
2018-01-13 00:00:00  
2018-01-15 00:00:00  
(8 rows)
```

Generate series

```
SELECT generate_series('2018-01-01',  
                      '2018-01-02',  
                      '5 hours'::interval);
```

```
generate_series  
-----  
2018-01-01 00:00:00  
2018-01-01 05:00:00  
2018-01-01 10:00:00  
2018-01-01 15:00:00  
2018-01-01 20:00:00  
(5 rows)
```

Generate series from the beginning

```
SELECT generate_series('2018-01-31',  
                        '2018-12-31',  
                        '1 month'::interval);
```

```
generate_series  
-----  
2018-01-31 00:00:00  
2018-02-28 00:00:00  
2018-03-28 00:00:00  
2018-04-28 00:00:00  
2018-05-28 00:00:00  
2018-06-28 00:00:00  
2018-07-28 00:00:00  
2018-08-28 00:00:00  
2018-09-28 00:00:00  
2018-10-28 00:00:00  
2018-11-28 00:00:00  
2018-12-28 00:00:00  
(12 rows)
```

Generate series from the beginning

```
-- Subtract 1 day to get end of month
SELECT generate_series('2018-02-01', -- start 1 month late
                      '2019-01-01',
                      '1 month'::interval) - '1 day'::interval;
```

```
generate_series
-----
2018-01-31 00:00:00
2018-02-28 00:00:00
2018-03-31 00:00:00
2018-04-30 00:00:00
2018-05-31 00:00:00
2018-06-30 00:00:00
2018-07-31 00:00:00
2018-08-31 00:00:00
2018-09-30 00:00:00
2018-10-31 00:00:00
2018-11-30 00:00:00
2018-12-31 00:00:00
(12 rows)
```

Normal aggregation

```
SELECT * FROM sales;
```

date	amount
2018-04-23 09:13:14	12
2018-04-23 13:57:53	41
2018-04-23 12:05:44	23
2018-04-23 09:07:33	31
2018-04-23 10:31:40	5
2018-04-23 09:35:16	18
2018-04-23 12:17:43	19
2018-04-23 12:57:49	32
2018-04-23 10:12:35	13
2018-04-23 13:21:30	6

(10 rows)

```
SELECT date_trunc('hour', date)
       AS hour,
       count(*)
FROM sales
GROUP BY hour
ORDER BY hour;
```

hour	count
2018-04-23 09:00:00	3
2018-04-23 10:00:00	2
2018-04-23 12:00:00	3
2018-04-23 13:00:00	2

(4 rows)

Aggregation with series

```
-- Create the series as a table called hour_series
WITH hour_series AS (
    SELECT generate_series('2018-04-23 09:00:00',           -- 9am
                          '2018-04-23 14:00:00',           -- 2pm
                          '1 hour'::interval) AS hours)
-- Hours from series, count date (NOT *) to count non-NULL
SELECT hours, count(date)

-- Join series to sales data
FROM hour_series
    LEFT JOIN sales
        ON hours=date_trunc('hour', date)

GROUP BY hours
ORDER BY hours;
```


Aggregation with series: result

hours	count
2018-04-23 09:00:00-05	3
2018-04-23 10:00:00-05	2
2018-04-23 11:00:00-05	0
2018-04-23 12:00:00-05	3
2018-04-23 13:00:00-05	2
2018-04-23 14:00:00-05	0

(6 rows)

Aggregation with bins

```
-- Create bins
WITH bins AS (
    SELECT generate_series('2018-04-23 09:00:00',
                           '2018-04-23 15:00:00',
                           '3 hours'::interval) AS lower,
           generate_series('2018-04-23 12:00:00',
                           '2018-04-23 18:00:00',
                           '3 hours'::interval) AS upper)

-- Count values in each bin
SELECT lower, upper, count(date)

-- left join keeps all bins
FROM bins
    LEFT JOIN sales
        ON date >= lower
        AND date < upper

-- Group by bin bounds to create the groups
GROUP BY lower, upper
ORDER BY lower;
```

Bin result

lower			upper			count
-----		+	-----		+	-----
2018-04-23	09:00:00		2018-04-23	12:00:00		5
2018-04-23	12:00:00		2018-04-23	15:00:00		5
2018-04-23	15:00:00		2018-04-23	18:00:00		0
(3 rows)						

Practice generating series!

EXPLORATORY DATA ANALYSIS IN SQL

Time between events

EXPLORATORY DATA ANALYSIS IN SQL



Christina Maimone
Data Scientist

The problem

```
SELECT *  
  FROM sales  
 ORDER BY date;
```

date	amount
2018-04-23 09:07:33	31
2018-04-23 09:13:14	12
2018-04-23 09:35:16	18
2018-04-23 10:12:35	13
2018-04-23 10:31:40	5
2018-04-23 12:05:44	23
2018-04-23 12:17:43	19
2018-04-23 12:57:49	32
2018-04-23 13:21:30	6
2018-04-23 13:57:53	41

(10 rows)

Lead and lag

```
SELECT date,  
       lag(date) OVER (ORDER BY date),  
       lead(date) OVER (ORDER BY date)  
FROM sales;
```

date		lag		lead
2018-04-23 09:07:33				2018-04-23 09:13:14
2018-04-23 09:13:14		2018-04-23 09:07:33		2018-04-23 09:35:16
2018-04-23 09:35:16		2018-04-23 09:13:14		2018-04-23 10:12:35
2018-04-23 10:12:35		2018-04-23 09:35:16		2018-04-23 10:31:40
2018-04-23 10:31:40		2018-04-23 10:12:35		2018-04-23 12:05:44
2018-04-23 12:05:44		2018-04-23 10:31:40		2018-04-23 12:17:43
2018-04-23 12:17:43		2018-04-23 12:05:44		2018-04-23 12:57:49
2018-04-23 12:57:49		2018-04-23 12:17:43		2018-04-23 13:21:30
2018-04-23 13:21:30		2018-04-23 12:57:49		2018-04-23 13:57:53
2018-04-23 13:57:53		2018-04-23 13:21:30		

(10 rows)

Lead and lag

```
SELECT date,  
       lag(date) OVER (ORDER BY date),  
       lead(date) OVER (ORDER BY date)  
FROM sales;
```


Time between events

```
SELECT date,  
       date - lag(date) OVER (ORDER BY date) AS gap  
FROM sales;
```

date	gap
2018-04-23 09:07:33	
2018-04-23 09:13:14	00:05:41
2018-04-23 09:35:16	00:22:02
2018-04-23 10:12:35	00:37:19
2018-04-23 10:31:40	00:19:05
2018-04-23 12:05:44	01:34:04
2018-04-23 12:17:43	00:11:59
2018-04-23 12:57:49	00:40:06
2018-04-23 13:21:30	00:23:41
2018-04-23 13:57:53	00:36:23

(10 rows)

Average time between events

```
SELECT avg(gap)
  FROM (SELECT date - lag(date) OVER (ORDER BY date) AS gap
        FROM sales) AS gaps;
```

```
      avg
-----
00:32:15.555556
(1 row)
```

Change in a time series

```
SELECT date,  
       amount,  
       lag(amount) OVER (ORDER BY date),  
       amount - lag(amount) OVER (ORDER BY date) AS change  
FROM sales;
```

date	amount	lag	change
2018-04-23 09:07:33	31		
2018-04-23 09:13:14	12	31	-19
2018-04-23 09:35:16	18	12	6
2018-04-23 10:12:35	13	18	-5
2018-04-23 10:31:40	5	13	-8
2018-04-23 12:05:44	23	5	18
2018-04-23 12:17:43	19	23	-4
2018-04-23 12:57:49	32	19	13
2018-04-23 13:21:30	6	32	-26
2018-04-23 13:57:53	41	6	35

(10 rows)

On to the exercises!

EXPLORATORY DATA ANALYSIS IN SQL

Wrap-up

EXPLORATORY DATA ANALYSIS IN SQL



Christina Maimone

Data Scientist

Download the data

Links on the course landing page!

Parting tips

- Spend time exploring your data
- Use the [PostgreSQL documentation](#)
- Be curious
- Check data distributions first

Start exploring!

EXPLORATORY DATA ANALYSIS IN SQL