Trabajo Fin de Máster - Datos SEVICI - Análisis inicial.

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Contents

1 Obtención y carga de datos.

1.1 Datos dinámicos

Los datos provienen de una recopilación realizada por la Universidad de Huelva, que captura los datos instantáneos ofrecidos a través de un servicio web por JCDecaux en 27 ciudades en las que opera los servicios de bicicletas compartidas.

El punto de partida ha sido un fichero comprimido que contiene para cada ciudad un conjunto de backups (mysql) en formato sql correspondiente cada uno de ellos a los datos registrados en las distintas estaciones de la ciudad en un día y que en la base de datos se corresponde cada uno con una tabla de igual nombre al fichero sql (salvo extensión).

Se ha creado un base de datos (MariaDB) con igual nombre a la original, *pfcbicis*, y se ha realizado la importación de los datos con script bash.

```
#!/bin/bash
for f in datos/Seville/*.sql; do
    echo "restaurando fichero $f"
    mysql -u usu1 pfcbicis < "$f"
done
```

Se han creado así 365 tablas correspondientes a cada uno de los días entre 2015-12-01 y 2016-11-30. Todas ellas con el mismo esquema:

```
--
-- Table structure for table `z_Seville_2015_12_01`
--

DROP TABLE IF EXISTS `z_Seville_2015_12_01`;
/*!40101 SET @saved_cs_client     = @@character_set_client */;
/*!40101 SET character_set_client = utf8 */;
CREATE TABLE `z_Seville_2015_12_01` (
  `id`                mediumint(9) NOT NULL AUTO_INCREMENT,
  `status`            varchar(50) DEFAULT NULL,
  `contract`          varchar(50) DEFAULT NULL,
  `num`               int(11) DEFAULT NULL,
  `last_update`       datetime DEFAULT NULL,
  `add_date`          datetime DEFAULT NULL,
  `stands`            int(11) DEFAULT NULL,
  `availablestands`   int(11) DEFAULT NULL,
  `availablebikes`    int(11) DEFAULT NULL,
  PRIMARY KEY (`id`),
  KEY `plantillaAjena` (`contract`,`num`)
) ENGINE=InnoDB AUTO_INCREMENT=65827 DEFAULT CHARSET=latin1;
/*!40101 SET character_set_client = @saved_cs_client */;
```

Campo:	Descripción:
id	Id registro autonumérico
status	Estado de la estación; OPEN o CLOSED
contract	Contrato, en nuestro caso; Seville
num	Número de la estación
last_update	Momento de última actualización
add_date	Fecha-Hora en fracciones de 5 minutos
stands	Número de estacionamientos operativos en la estación

Campo:	Descripción:
availablestands	Número de estacionamientos disponibles
availablebikes	Número de bicicletas operativas y disponibles

1.2 Datos estáticos

Al margen de los datos anteriormente descritos, que corresponde a los denominados datos dinámicos, en la página web del operador (https://developer.jcdecaux.com/#/opendata/vls?page=static) están disponibles los denominados datos estáticos que hacen referencia a las características de las estaciones. Esta información se ha descargado en formato csv y contiene los siguientes datos para un total de 260 estaciones:

Campo:	Descripción:
Number	Número de la estación
Name	Nombre de la estación
Address	Dirección
Latitude	Latitud (grados WGS84)
Longitude	Longitud (grados WGS84)

2 Pretratamiento.

Para facilitar los tratamientos posteriores se ha unificado la información de las 365 tablas diarias en una sola tabla (*sevidata*) y se ha creado una tabla con los datos estáticos (*seviesta*).

Para la unificación se ha creado ~~un procedimiento SQL, que por alguna razón, que por ahora desconozco, daba continuamente error en la declaración del cursor, por lo que se ha optado por una vía menos elegante con~~ un script bash que genera script sql con la secuencia de inserts.

```
DROP TABLE IF EXISTS `sevidata`;
CREATE TABLE `sevidata` LIKE `z_Seville_2015_12_01`;
```

~~ borrar

```
DROP PROCEDURE IF EXISTS unifica_data;
CREATE PROCEDURE unifica_data()
BEGIN
    DECLARE ltables CURSOR FOR SHOW TABLES LIKE 'z%';
    read_loop: LOOP
        OPEN ltables;
        FETCH ltables INTO t;
        INSERT IGNORE INTO sevidata (SELECT * FROM t);
    END LOOP;
    CLOSE list_tables;
END;
```

borrar ~~

```
#!/bin/bash
rm -rf unifica_data_insert.sql
for f in *.sql; do
    echo "procesando $f"
    name=$(echo $f | cut -f 1 -d '.')
```

```
    echo "INSERT INTO sevidata (status, contract, num, last_update, add_date,
    stands, availablestands, availablebikes) SELECT status, contract, num,
    last_update, add_date, stands, availablestands, availablebikes FROM $name;"
    >> unifica_data_insert.sql
done
```

2.1 Cambio BD a Postgresql

Los datos se han migrado finalmente a PostgreSQL que proporciona un mejor rendimiento y funcionalidad.

Se exportan a csv los datos de sevidata y se cargan en la base de datos *sevici* de PostgreSQL (9.5.5).

```
-- Database: sevici

-- DROP DATABASE sevici;

CREATE DATABASE sevici
  WITH OWNER = postgres
       ENCODING = 'UTF8'
       TABLESPACE = pg_default
       LC_COLLATE = 'es_ES.UTF-8'
       LC_CTYPE = 'es_ES.UTF-8'
       CONNECTION LIMIT = -1;

-- Table: public.sevidata

-- DROP TABLE public.sevidata;

CREATE TABLE public.sevidata
(
  id serial,
  status character varying(50),
  num integer,
  last_update timestamp without time zone,
  add_date timestamp without time zone,
  stands integer,
  availablestands integer,
  availablebikes integer,
  CONSTRAINT sevidata_pkey PRIMARY KEY (id)
)
WITH (
  OIDS=FALSE
);
ALTER TABLE public.sevidata
  OWNER TO postgres;


--- Carga datos desde CSV

\COPY sevidata(status,num,last_update,add_date,stands,availablestands, availablebikes)
FROM '/home/usu1/Documentos/Formacion/UniSE-DataScience&BigData/cont/TFM/data/sevidata.csv'
DELIMITER ';' CSV;
```

```
--- Índices

CREATE INDEX num_idx ON sevidata(num);
CREATE INDEX num_date_idx ON sevidata(num,add_date);
```

Se crea la tabla *seviesta* de datos estáticos.

```
-- Table: public.seviesta

-- DROP TABLE public.seviesta;

CREATE TABLE public.seviesta
(
  id serial,
  num integer,
  name character varying(255),
  address character varying(255),
  latitude double precision,
  longitude double precision,
  CONSTRAINT seviesta_pkey PRIMARY KEY (id)
)
WITH (
  OIDS=FALSE
);
ALTER TABLE public.seviesta
  OWNER TO postgres;


--- Carga datos
\COPY seviesta(num,name,address,latitude,longitude)
FROM '/home/usu1/Documentos/Formacion/UniSE-DataScience&BigData/cont/TFM/data/Seville.csv'
WITH DELIMITER ',' CSV HEADER;

--- Índice

CREATE UNIQUE INDEX num_unique_idx ON seviesta(num);
```

2.2 Conexión a PostgreSQL desde R.

```
library(RPostgreSQL)
```

```
## Loading required package: DBI
```

```
con = dbConnect(drv = dbDriver("PostgreSQL"),dbname='sevici',user='postgres')

summary(con)
```

```
## <PostgreSQLConnection:(7130,0)>
##   User: postgres
##   Host:
##   Dbname: sevici
##   No resultSet available
```

```
dbListConnections(dbDriver("PostgreSQL"))
```

```
## [[1]]
## <PostgreSQLConnection>
```

```
#dbListTables(con)

# dbDisconnect(con)
```

```
# Función general para facilitar respuesta rápida
# a costa de disco
#
dbQueryIf = function(qname,conn,query){
  if(!qname %in% dbListTables(conn))
    dbSendStatement(conn,
      paste0('CREATE TABLE IF NOT EXISTS ', qname, ' AS ', query))
  dbGetQuery(conn, paste0('SELECT * FROM ',qname,';'))
}
```

3 Mapa de estaciones

La geolocalización de las estaciones podrá permitir mediante análisis espacial relacionar ésta y su dinámica con otras variables geolocalizadas como pueden ser usos del suelo, servicios, variables socio-demográficas, etc.

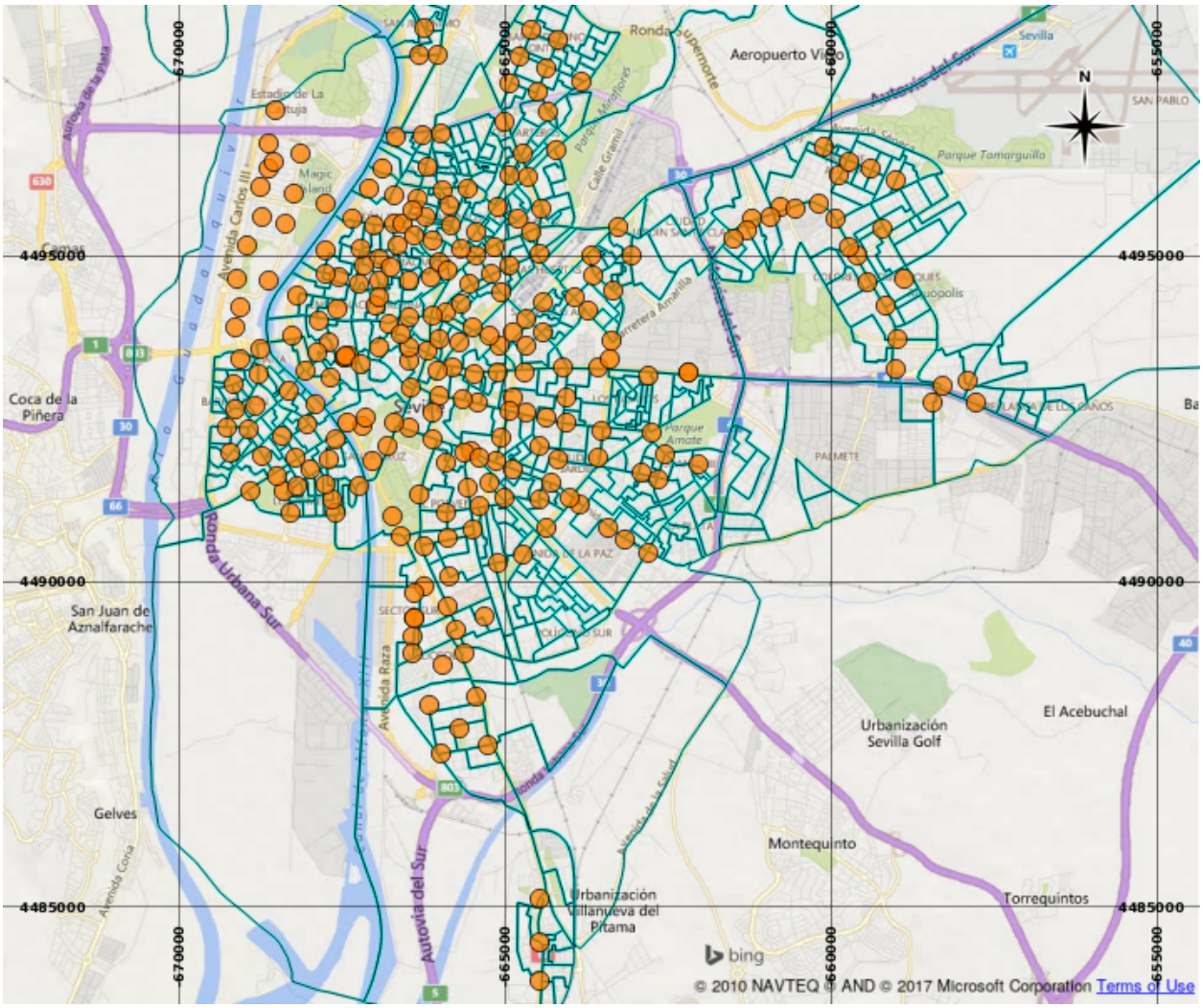

Figure 1: Mapa de Estaciones Sevici con límites de secciones censales y BingMap de fondo. Hecho con QGIS.

4 Análisis preliminar de datos

4.1 Resumen de datos por estación

```
resumen_datos_por_estacion = dbQueryIf('resumen_datos_por_estacion',con,
  'SELECT num, count(id) as N,
    min(last_update) as desde, max(last_update) as hasta,
    min(add_date) as pdesde, max(add_date) as phasta,
    min(stands) as minst, max(stands) as maxst,
    avg(stands) as avgst,
    min(availablestands) as minavst,
    max(availablestands) as maxavst,
    avg(availablestands) as avgavst,
    min(availablebikes) as minbikes,
    max(availablebikes) as maxbikes,
    avg(availablebikes) as avgbikes
    FROM sevidata group by num order by num;')
```

```
library(knitr)
library(pander)
kable(resumen_datos_por_estacion[,1:6],
             caption = 'Resumen de datos por estación')
```

Table 3: Resumen de datos por estación

num	n	desde	hasta	pdesde	phasta
1	102905	2015-11-30 23:54:18	2016-11-30 23:46:10	2015-12-01 00:00:01	2016-11-30 23:55:01
2	101649	2015-11-30 23:51:04	2016-11-30 23:54:38	2015-12-01 00:00:01	2016-11-30 23:55:01
3	101698	2015-11-30 23:58:11	2016-11-30 23:51:47	2015-12-01 00:00:01	2016-11-30 23:55:01
4	101658	2015-11-30 23:51:52	2016-11-30 23:46:54	2015-12-01 00:00:01	2016-11-30 23:55:01
5	101699	2015-11-30 23:57:02	2016-11-30 23:50:41	2015-12-01 00:00:01	2016-11-30 23:55:01
6	101658	2015-11-30 23:52:36	2016-11-30 23:48:21	2015-12-01 00:00:01	2016-11-30 23:55:01
7	101699	2015-11-30 23:58:41	2016-11-30 23:47:39	2015-12-01 00:00:01	2016-11-30 23:55:01
8	101658	2015-11-30 23:55:03	2016-11-30 23:54:28	2015-12-01 00:00:01	2016-11-30 23:55:01
9	104182	2015-11-30 23:50:43	2016-11-30 23:54:52	2015-12-01 00:00:01	2016-11-30 23:55:01
10	101622	2015-11-30 23:53:27	2016-11-30 23:52:58	2015-12-01 00:00:01	2016-11-30 23:55:01
11	102964	2015-11-30 23:50:18	2016-11-30 23:49:23	2015-12-01 00:00:01	2016-11-30 23:55:01
12	102965	2015-11-30 23:52:25	2016-11-30 23:48:49	2015-12-01 00:00:01	2016-11-30 23:55:01
13	101658	2015-11-30 23:50:42	2016-11-30 23:54:36	2015-12-01 00:00:01	2016-11-30 23:55:01
14	102965	2015-11-30 23:55:17	2016-11-30 23:53:36	2015-12-01 00:00:01	2016-11-30 23:55:01
15	101658	2015-11-30 23:56:31	2016-11-30 23:55:18	2015-12-01 00:00:01	2016-11-30 23:55:01
16	104182	2015-11-30 23:58:23	2016-11-30 23:53:51	2015-12-01 00:00:01	2016-11-30 23:55:01
17	102904	2015-11-30 23:53:11	2016-11-30 23:55:21	2015-12-01 00:00:01	2016-11-30 23:55:01
18	101699	2015-11-30 23:58:22	2016-11-30 23:53:23	2015-12-01 00:00:01	2016-11-30 23:55:01
19	101698	2015-11-30 23:51:54	2016-11-30 23:54:57	2015-12-01 00:00:01	2016-11-30 23:55:01
20	101608	2015-11-30 23:59:15	2016-11-30 23:47:34	2015-12-01 00:00:01	2016-11-30 23:55:01
21	102966	2015-11-30 23:52:37	2016-11-30 23:53:07	2015-12-01 00:00:01	2016-11-30 23:55:01
22	102963	2015-11-30 23:50:11	2016-11-30 23:45:19	2015-12-01 00:00:01	2016-11-30 23:55:01
23	101658	2015-11-30 23:53:13	2016-11-30 23:54:57	2015-12-01 00:00:01	2016-11-30 23:55:01
24	103014	2015-11-30 23:57:18	2016-11-30 23:54:24	2015-12-01 00:00:01	2016-11-30 23:55:01
25	101622	2015-11-30 23:50:29	2016-11-30 23:46:27	2015-12-01 00:00:01	2016-11-30 23:55:01
26	104182	2015-11-30 23:53:27	2016-11-30 23:47:10	2015-12-01 00:00:01	2016-11-30 23:55:01
27	102905	2015-11-30 23:59:22	2016-11-30 23:52:36	2015-12-01 00:00:01	2016-11-30 23:55:01

num	n	desde	hasta	pdesde	phasta
28	101610	2015-11-30 23:56:37	2016-11-30 23:45:36	2015-12-01 00:00:01	2016-11-30 23:55:01
29	101673	2015-11-30 23:57:14	2016-11-30 23:46:12	2015-12-01 00:00:01	2016-11-30 23:55:01
30	101649	2015-11-30 23:53:04	2016-11-30 23:55:20	2015-12-01 00:00:01	2016-11-30 23:55:01
31	101651	2015-11-30 23:53:16	2016-11-30 23:46:07	2015-12-01 00:00:01	2016-11-30 23:55:01
32	101608	2015-11-30 23:56:44	2016-11-30 23:55:16	2015-12-01 00:00:01	2016-11-30 23:55:01
33	102968	2015-11-30 23:58:17	2016-11-30 23:47:19	2015-12-01 00:00:01	2016-11-30 23:55:01
34	101649	2015-11-30 23:55:01	2016-11-30 23:50:03	2015-12-01 00:00:01	2016-11-30 23:55:01
35	101608	2015-11-30 23:57:11	2016-11-30 23:55:10	2015-12-01 00:00:01	2016-11-30 23:55:01
36	103014	2015-11-30 23:50:14	2016-11-30 23:49:34	2015-12-01 00:00:01	2016-11-30 23:55:01
37	101649	2015-11-30 23:49:47	2016-11-30 23:48:59	2015-12-01 00:00:01	2016-11-30 23:55:01
38	102966	2015-11-30 23:57:42	2016-11-30 23:53:52	2015-12-01 00:00:01	2016-11-30 23:55:01
39	101608	2015-11-30 23:49:52	2016-11-30 23:53:51	2015-12-01 00:00:01	2016-11-30 23:55:01
40	101633	2015-11-30 23:53:58	2016-11-30 23:54:50	2015-12-01 00:00:01	2016-11-30 23:55:01
41	102965	2015-11-30 23:55:36	2016-11-30 23:53:48	2015-12-01 00:00:01	2016-11-30 23:55:01
42	101698	2015-11-30 23:51:55	2016-11-30 23:51:14	2015-12-01 00:00:01	2016-11-30 23:55:01
43	102964	2015-11-30 23:52:31	2016-11-30 23:49:36	2015-12-01 00:00:01	2016-11-30 23:55:01
44	101658	2015-11-30 23:56:30	2016-11-30 23:53:09	2015-12-01 00:00:01	2016-11-30 23:55:01
45	101699	2015-11-30 23:56:37	2016-11-30 23:53:15	2015-12-01 00:00:01	2016-11-30 23:55:01
46	102968	2015-11-30 23:52:44	2016-11-30 23:50:53	2015-12-01 00:00:01	2016-11-30 23:55:01
47	99919	2015-11-30 23:58:50	2016-11-30 23:47:49	2015-12-01 00:00:01	2016-11-30 23:55:01
48	102963	2015-11-30 23:59:22	2016-11-30 23:50:19	2015-12-01 00:00:01	2016-11-30 23:55:01
49	102904	2015-11-30 23:58:00	2016-11-30 23:55:05	2015-12-01 00:00:01	2016-11-30 23:55:01
50	101633	2015-11-30 23:55:18	2016-11-30 23:53:07	2015-12-01 00:00:01	2016-11-30 23:55:01
51	102964	2015-11-30 23:59:23	2016-11-30 23:49:07	2015-12-01 00:00:01	2016-11-30 23:55:01
52	101608	2015-11-30 23:51:40	2016-11-30 23:53:58	2015-12-01 00:00:01	2016-11-30 23:55:01
53	99919	2015-11-30 23:58:57	2016-11-30 23:46:43	2015-12-01 00:00:01	2016-11-30 23:55:01
54	99959	2015-11-30 23:51:30	2016-11-30 23:53:33	2015-12-01 00:00:01	2016-11-30 23:55:01
55	101608	2015-11-30 23:58:29	2016-11-30 23:46:56	2015-12-01 00:00:01	2016-11-30 23:55:01
56	101608	2015-11-30 23:51:57	2016-11-30 23:51:34	2015-12-01 00:00:01	2016-11-30 23:55:01
57	101610	2015-11-30 23:56:24	2016-11-30 23:54:41	2015-12-01 00:00:01	2016-11-30 23:55:01
58	102965	2015-11-30 23:53:02	2016-11-30 23:50:04	2015-12-01 00:00:01	2016-11-30 23:55:01
59	103012	2015-11-30 23:52:17	2016-11-30 23:45:20	2015-12-01 00:00:01	2016-11-30 23:55:01
60	101051	2015-11-30 23:52:04	2016-11-30 23:55:16	2015-12-01 00:00:01	2016-11-30 23:55:01
61	102965	2015-11-30 23:59:00	2016-11-30 23:53:56	2015-12-01 00:00:01	2016-11-30 23:55:01
62	102964	2015-11-30 23:55:56	2016-11-30 23:52:56	2015-12-01 00:00:01	2016-11-30 23:55:01
63	99983	2015-11-30 23:51:36	2016-11-30 23:49:47	2015-12-01 00:00:01	2016-11-30 23:55:01
64	100927	2015-11-30 23:58:59	2016-11-30 23:47:26	2015-12-01 00:00:01	2016-11-30 23:55:01
65	99919	2015-11-30 23:58:39	2016-11-30 23:53:39	2015-12-01 00:00:01	2016-11-30 23:55:01
66	102965	2015-11-30 23:57:49	2016-11-30 23:52:31	2015-12-01 00:00:01	2016-11-30 23:55:01
67	102965	2015-11-30 23:55:47	2016-11-30 23:47:56	2015-12-01 00:00:01	2016-11-30 23:55:01
68	101699	2015-11-30 23:55:52	2016-11-30 23:47:13	2015-12-01 00:00:01	2016-11-30 23:55:01
69	101699	2015-11-30 23:54:07	2016-11-30 23:54:15	2015-12-01 00:00:01	2016-11-30 23:55:01
70	101608	2015-11-30 23:50:07	2016-11-30 23:54:46	2015-12-01 00:00:01	2016-11-30 23:55:01
71	101610	2015-11-30 23:51:19	2016-11-30 23:53:59	2015-12-01 00:00:01	2016-11-30 23:55:01
72	101608	2015-11-30 23:53:57	2016-11-30 23:50:03	2015-12-01 00:00:01	2016-11-30 23:55:01
73	104182	2015-11-30 23:50:31	2016-11-30 23:47:36	2015-12-01 00:00:01	2016-11-30 23:55:01
74	99961	2015-11-30 23:54:47	2016-11-30 23:50:55	2015-12-01 00:00:01	2016-11-30 23:55:01
75	88753	2015-11-30 23:58:51	2016-11-30 23:51:38	2015-12-01 00:00:01	2016-11-30 23:55:01
76	101622	2015-11-30 23:56:52	2016-11-30 23:49:21	2015-12-01 00:00:01	2016-11-30 23:55:01
77	104182	2015-11-30 23:53:08	2016-11-30 23:50:52	2015-12-01 00:00:01	2016-11-30 23:55:01
78	101651	2015-11-30 23:50:40	2016-11-30 23:51:00	2015-12-01 00:00:01	2016-11-30 23:55:01
79	102965	2015-11-30 23:55:57	2016-11-30 23:53:37	2015-12-01 00:00:01	2016-11-30 23:55:01

num	n	desde	hasta	pdesde	phasta
80	102963	2015-11-30 23:55:02	2016-11-30 23:50:46	2015-12-01 00:00:01	2016-11-30 23:55:01
81	102920	2015-11-30 23:49:50	2016-11-30 23:54:18	2015-12-01 00:00:01	2016-11-30 23:55:01
82	104182	2015-11-30 23:50:11	2016-11-30 23:49:32	2015-12-01 00:00:01	2016-11-30 23:55:01
83	101699	2015-11-30 23:55:47	2016-11-30 23:46:28	2015-12-01 00:00:01	2016-11-30 23:55:01
84	101658	2015-11-30 23:49:49	2016-11-30 23:46:44	2015-12-01 00:00:01	2016-11-30 23:55:01
85	101622	2015-11-30 23:58:25	2016-11-30 23:54:57	2015-12-01 00:00:01	2016-11-30 23:55:01
86	101699	2015-11-30 23:55:44	2016-11-30 23:49:20	2015-12-01 00:00:01	2016-11-30 23:55:01
87	103014	2015-11-30 23:56:02	2016-11-30 23:52:42	2015-12-01 00:00:01	2016-11-30 23:55:01
88	101699	2015-11-30 23:55:46	2016-11-30 23:45:44	2015-12-01 00:00:01	2016-11-30 23:55:01
89	99943	2015-11-30 23:51:45	2016-11-30 23:47:15	2015-12-01 00:00:01	2016-11-30 23:55:01
90	102965	2015-11-30 23:59:13	2016-11-30 23:51:13	2015-12-01 00:00:01	2016-11-30 23:55:01
91	102904	2015-11-30 23:54:51	2016-11-30 23:54:34	2015-12-01 00:00:01	2016-11-30 23:55:01
92	101633	2015-11-30 23:51:54	2016-11-30 23:48:11	2015-12-01 00:00:01	2016-11-30 23:55:01
93	101651	2015-11-30 23:58:27	2016-11-30 23:53:48	2015-12-01 00:00:01	2016-11-30 23:55:01
94	101698	2015-11-30 23:49:28	2016-11-30 23:54:07	2015-12-01 00:00:01	2016-11-30 23:55:01
95	101610	2015-11-30 23:55:31	2016-11-30 23:53:41	2015-12-01 00:00:01	2016-11-30 23:55:01
96	104182	2015-11-30 23:50:05	2016-11-30 23:47:01	2015-12-01 00:00:01	2016-11-30 23:55:01
97	102963	2015-11-30 23:51:21	2016-11-30 23:49:12	2015-12-01 00:00:01	2016-11-30 23:55:01
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257	102937	2015-11-30 23:50:16	2016-11-30 23:54:31	2015-12-01 00:00:01	2016-11-30 23:55:01
258	102964	2015-11-30 23:52:17	2016-11-30 23:51:37	2015-12-01 00:00:01	2016-11-30 23:55:01
259	102963	2015-11-30 23:49:34	2016-11-30 23:49:53	2015-12-01 00:00:01	2016-11-30 23:55:01
260	101698	2015-11-30 23:58:27	2016-11-30 23:46:45	2015-12-01 00:00:01	2016-11-30 23:55:01

```
kable(resumen_datos_por_estacion[,c(1,7:15)], digits = 2,
              caption = 'Resumen de datos por estación (continuación)')
```

Table 4: Resumen de datos por estación (continuación)

num	minst	maxst	avgst	minavst	maxavst	avgavst	minbikes	maxbikes	avgbikes
1	20	20	20	0	20	11.95	0	20	7.81
2	18	18	18	0	18	14.15	0	18	3.76
3	40	40	40	0	58	32.54	0	40	6.50
4	40	40	40	0	40	29.42	0	40	10.42
5	40	40	40	0	45	26.30	0	71	13.35
6	20	20	20	0	20	15.03	0	20	4.76
7	20	20	20	0	20	15.85	0	20	4.08
8	20	20	20	0	20	16.11	0	20	3.84
9	20	20	20	0	20	13.85	0	21	5.91
10	20	20	20	0	22	12.88	0	20	6.94
11	20	20	20	0	20	14.61	0	20	5.18
12	30	30	30	0	39	24.51	0	30	5.28
13	15	15	15	0	16	9.46	0	15	5.12
14	40	40	40	0	40	26.89	0	40	12.23
15	15	15	15	0	15	9.52	0	15	5.38
16	20	20	20	0	20	10.90	0	20	8.95
17	20	20	20	0	20	9.05	0	28	10.43
18	20	20	20	0	20	15.02	0	20	4.75
19	20	20	20	0	20	15.60	0	20	3.93

num	minst	maxst	avgst	minavst	maxavst	avgavst	minbikes	maxbikes	avgbikes
20	15	15	15	0	17	11.00	0	15	3.85
21	20	20	20	0	20	12.70	0	20	7.17
22	20	20	20	0	20	11.03	0	20	8.79
23	15	15	15	0	15	11.74	0	15	3.08
24	15	15	15	0	15	10.93	0	15	3.97
25	20	20	20	0	20	11.28	0	20	8.49
26	17	17	17	0	17	9.80	0	17	7.05
27	17	17	17	0	20	9.38	0	27	7.43
28	18	18	18	0	18	7.45	0	18	10.32
29	15	15	15	0	21	8.10	0	15	6.78
30	20	20	20	0	20	15.05	0	20	4.75
31	13	13	13	0	18	7.82	0	15	5.09
32	15	15	15	0	15	9.45	0	15	5.34
33	15	15	15	0	15	10.62	0	15	4.31
34	15	15	15	0	23	9.79	0	15	5.10
35	20	20	20	0	20	10.59	0	20	9.31
36	20	20	20	0	20	15.36	0	20	4.41
37	20	20	20	0	28	12.40	0	20	7.44
38	40	40	40	3	51	34.24	0	37	5.18
39	20	20	20	0	20	12.38	0	20	7.50
40	30	30	30	0	30	13.85	0	30	15.92
41	15	15	15	0	15	8.94	0	15	5.86
42	15	15	15	0	15	12.08	0	15	2.88
43	15	15	15	0	16	9.38	0	15	5.36
44	15	15	15	0	15	8.50	0	15	6.23
45	15	15	15	0	15	8.56	0	15	6.31
46	16	16	16	0	17	10.83	0	16	5.09
47	15	15	15	0	18	10.07	0	15	4.65
48	15	15	15	0	15	10.80	0	15	4.07
49	20	20	20	0	20	12.53	0	20	7.34
50	17	17	17	0	52	9.69	0	17	7.12
51	20	20	20	0	20	12.55	0	20	7.11
52	40	40	40	0	40	32.13	0	40	7.62
53	17	17	17	0	21	9.72	0	17	7.07
54	15	15	15	0	15	9.99	0	15	4.78
55	15	15	15	0	27	10.77	0	15	3.84
56	20	20	20	0	32	15.91	0	20	3.92
57	15	15	15	0	22	10.85	0	19	3.76
58	19	19	19	0	19	12.37	0	19	6.41
59	18	18	18	0	18	9.45	0	18	8.36
60	19	19	19	0	19	8.08	0	20	10.41
61	20	20	20	0	20	6.92	0	20	12.92
62	39	39	39	0	39	18.31	0	39	20.20
63	20	20	20	0	29	8.35	0	20	11.26
64	15	15	15	0	15	11.27	0	16	3.43
65	14	14	14	0	14	11.31	0	14	2.59
66	20	20	20	0	27	13.53	0	20	6.18
67	20	20	20	0	20	15.00	0	20	4.93
68	15	15	15	0	15	10.43	0	15	4.47
69	20	20	20	0	20	12.32	0	20	7.51
70	40	40	40	0	45	30.10	0	40	9.68
71	18	18	18	0	18	10.83	0	25	6.99

num	minst	maxst	avgst	minavst	maxavst	avgavst	minbikes	maxbikes	avgbikes
72	20	20	20	0	33	15.77	0	20	4.09
73	15	15	15	0	15	9.69	0	15	5.06
74	15	15	15	0	15	10.15	0	15	4.70
75	20	20	20	0	20	8.73	0	21	10.97
76	30	30	30	0	30	12.02	0	30	17.35
77	20	20	20	0	20	11.08	0	28	8.79
78	20	20	20	0	25	11.01	0	21	8.76
79	10	10	10	0	18	6.85	0	10	3.08
80	20	20	20	0	30	14.34	0	20	5.43
81	15	15	15	0	15	10.57	0	15	4.30
82	17	17	17	0	17	12.61	0	17	4.30
83	20	20	20	0	20	14.96	0	20	4.91
84	20	20	20	0	30	14.69	0	20	5.07
85	20	20	20	0	35	11.67	0	22	7.69
86	40	40	40	0	40	33.07	0	40	6.27
87	40	40	40	0	45	17.05	0	42	22.74
88	20	20	20	0	20	15.24	0	20	4.72
89	18	18	18	0	18	9.10	0	18	8.62
90	20	20	20	0	20	11.31	0	20	8.41
91	20	20	20	0	20	11.34	0	20	8.46
92	20	20	20	0	20	8.55	0	20	11.31
93	15	15	15	0	15	4.88	0	15	10.01
94	18	18	18	0	18	7.25	0	18	10.58
95	20	20	20	0	20	16.32	0	20	3.61
96	19	19	19	0	20	8.38	0	19	9.94
97	20	20	20	0	20	9.67	0	20	10.04
98	30	30	30	0	31	16.04	0	37	13.63
99	40	40	40	9	43	37.01	0	20	2.76
100	20	20	20	0	21	12.09	0	52	7.56
101	40	40	40	0	40	28.62	0	40	11.17
102	20	20	20	0	20	14.62	0	20	5.25
103	20	20	20	0	24	16.35	0	20	3.21
104	20	20	20	0	20	15.68	0	20	4.19
105	19	19	19	0	22	7.77	0	19	10.96
106	15	15	15	0	20	10.65	0	15	4.05
107	30	30	30	0	30	21.00	0	31	6.78
108	15	15	15	0	15	9.47	0	16	5.30
109	15	15	15	0	15	9.10	0	15	5.57
110	20	20	20	0	26	13.28	0	25	6.58
111	20	20	20	0	23	7.83	0	20	11.92
112	20	20	20	0	20	6.09	0	20	13.70
113	15	15	15	0	15	4.92	0	15	9.99
114	30	30	30	0	30	10.48	0	32	19.32
115	20	20	20	0	20	6.67	0	20	13.07
116	20	20	20	0	20	10.27	0	36	9.39
117	14	14	14	0	14	5.85	0	14	7.96
118	20	20	20	0	20	9.43	0	24	10.21
119	20	20	20	0	20	12.27	0	20	7.64
120	15	15	15	0	15	8.95	0	15	5.87
121	15	15	15	0	15	8.28	0	15	6.52
122	20	20	20	0	20	13.09	0	30	6.67
123	20	20	20	0	20	13.88	0	20	6.08

num	minst	maxst	avgst	minavst	maxavst	avgavst	minbikes	maxbikes	avgbikes
124	20	20	20	0	23	12.68	0	20	6.93
125	15	15	15	0	15	9.16	0	23	5.67
126	25	25	25	0	29	14.96	0	25	9.78
127	15	15	15	0	15	4.82	0	15	10.03
128	18	18	18	0	18	3.84	0	18	14.09
129	20	20	20	0	20	10.02	0	20	9.86
130	20	20	20	0	20	5.46	0	21	13.83
131	20	20	20	0	20	10.82	0	40	8.92
132	20	20	20	0	20	9.06	0	20	10.62
133	20	20	20	0	20	5.60	0	20	14.07
134	24	24	24	0	24	6.94	0	24	16.91
135	17	17	17	0	17	6.04	0	17	10.77
136	20	20	20	0	20	4.38	0	20	14.83
137	20	20	20	0	20	9.40	0	20	10.23
138	20	20	20	0	32	11.34	0	21	8.14
139	15	15	15	0	18	8.90	0	16	5.82
140	16	16	16	0	16	7.76	0	16	7.96
141	20	20	20	0	30	9.68	0	20	10.06
142	18	18	18	0	18	4.75	0	20	13.11
143	18	18	18	0	21	6.98	0	18	10.83
144	20	20	20	0	29	10.35	0	22	9.04
145	20	20	20	0	20	12.27	0	20	7.27
146	20	20	20	0	20	10.20	0	20	9.57
147	15	15	15	0	15	8.70	0	15	6.16
148	20	20	20	0	22	11.36	0	20	8.15
149	20	20	20	0	20	12.25	0	20	7.60
150	20	20	20	0	34	13.75	0	20	6.00
151	20	20	20	0	20	12.88	0	20	6.93
152	20	20	20	0	20	9.28	0	20	8.56
153	27	27	27	0	27	14.29	0	27	12.44
154	20	20	20	0	20	9.47	0	20	10.25
155	20	20	20	0	20	11.53	0	20	8.35
156	20	20	20	0	20	12.85	0	20	6.94
157	20	20	20	0	20	11.29	0	24	8.43
158	20	20	20	0	20	10.58	0	20	9.09
159	20	20	20	0	21	9.33	0	22	10.13
160	20	20	20	0	20	12.26	0	20	7.48
161	20	20	20	0	20	10.25	0	20	9.55
162	18	18	18	0	18	9.62	0	18	8.23
163	14	14	14	0	14	9.34	0	14	4.54
164	19	19	19	0	19	14.75	0	19	4.09
165	20	20	20	0	20	14.65	0	20	5.18
166	13	13	13	0	25	9.38	0	13	3.53
167	20	20	20	0	20	9.93	0	20	9.84
168	18	18	18	0	18	9.40	0	20	8.34
169	20	20	20	0	34	10.93	0	23	8.51
170	18	18	18	0	21	14.92	0	18	2.84
171	19	19	19	0	19	5.47	0	37	12.79
172	20	20	20	0	20	9.25	0	20	10.44
173	20	20	20	0	29	9.86	0	20	9.70
174	20	20	20	0	20	9.30	0	20	10.44
175	20	20	20	0	20	10.83	0	20	9.01

num	minst	maxst	avgst	minavst	maxavst	avgavst	minbikes	maxbikes	avgbikes
176	20	20	20	0	20	14.45	0	21	5.31
177	17	17	17	0	17	10.14	0	17	6.72
178	20	20	20	0	20	10.10	0	20	9.85
179	20	20	20	0	20	9.74	0	20	10.01
180	20	20	20	0	21	9.23	0	20	10.15
181	20	20	20	0	20	12.68	0	20	6.99
182	15	15	15	0	15	6.64	0	15	8.16
183	15	15	15	0	15	9.07	0	15	5.71
184	20	20	20	0	20	10.88	0	23	8.90
185	20	20	20	0	20	12.19	0	20	7.70
186	20	20	20	0	21	10.77	0	20	9.03
187	20	20	20	0	20	12.06	0	20	7.64
188	20	20	20	0	20	10.46	0	20	9.04
189	20	20	20	0	24	14.82	0	20	5.01
190	15	15	15	0	18	11.15	0	15	3.77
191	20	20	20	0	20	8.70	0	20	10.91
192	19	19	19	0	19	8.36	0	19	10.51
193	20	20	20	0	20	4.70	0	26	15.22
194	20	20	20	0	20	8.18	0	20	11.57
195	20	20	20	0	20	9.14	0	20	10.78
196	20	20	20	0	22	11.15	0	21	8.19
197	20	20	20	0	20	11.61	0	20	8.07
198	20	20	20	0	27	9.51	0	20	10.25
199	20	20	20	0	30	11.34	0	20	8.53
200	20	20	20	0	20	8.08	0	20	11.67
201	20	20	20	0	20	9.94	0	20	9.89
202	20	20	20	0	27	10.12	0	20	9.23
203	20	20	20	0	20	11.83	0	20	7.99
204	15	15	15	0	15	9.05	0	15	5.74
205	20	20	20	0	20	8.74	0	20	10.21
206	15	15	15	0	21	6.11	0	15	8.51
207	20	20	20	0	20	3.62	0	20	15.22
208	15	15	15	0	16	5.29	0	15	9.38
209	15	15	15	0	15	4.26	0	15	10.52
210	15	15	15	0	15	5.65	0	24	9.08
211	15	15	15	0	15	6.67	0	15	8.14
212	15	15	15	0	15	2.94	0	15	11.85
213	20	20	20	0	20	14.81	0	20	5.10
214	20	20	20	0	20	15.13	0	20	4.80
215	15	15	15	0	23	9.94	0	15	4.87
216	15	15	15	0	15	6.57	0	15	8.19
217	15	15	15	0	15	9.62	0	15	5.35
218	14	14	14	0	14	7.26	0	14	6.47
219	15	15	15	0	31	8.77	0	16	5.98
220	30	30	30	0	30	14.81	0	30	15.00
221	15	15	15	0	27	8.96	0	15	5.53
222	16	16	16	0	16	7.74	0	16	8.05
223	15	15	15	0	15	7.07	0	15	7.79
224	15	15	15	0	15	7.71	0	15	7.16
225	15	15	15	0	19	7.85	0	15	6.82
226	15	15	15	0	15	8.70	0	15	6.15
227	12	12	12	0	16	5.89	0	12	6.01

num	minst	maxst	avgst	minavst	maxavst	avgavst	minbikes	maxbikes	avgbikes
228	15	15	15	0	19	8.55	0	15	5.81
229	15	15	15	0	15	7.10	0	15	7.83
230	14	14	14	0	14	10.02	0	14	3.75
231	15	15	15	0	15	3.60	0	15	11.15
232	15	15	15	0	15	6.55	0	15	8.12
233	15	15	15	0	15	5.20	0	15	9.38
234	14	14	14	0	14	8.02	0	14	5.89
235	15	15	15	0	15	7.80	0	15	7.01
236	15	15	15	0	15	10.05	0	15	4.85
237	15	15	15	0	15	10.23	0	15	4.74
238	15	15	15	0	15	7.90	0	15	6.94
239	15	15	15	0	15	11.13	0	15	3.74
240	15	15	15	0	18	4.90	0	22	9.95
241	20	20	20	0	20	9.45	0	25	10.21
242	20	20	20	0	32	8.14	0	31	11.53
243	15	15	15	0	15	8.02	0	15	6.71
244	15	15	15	0	15	5.45	0	17	9.35
245	15	15	15	0	15	6.24	0	15	8.56
246	15	15	15	0	15	3.11	0	15	11.64
247	30	30	30	0	30	18.56	0	30	11.02
248	15	15	15	0	15	4.36	0	15	10.46
249	15	15	15	0	16	5.22	0	15	9.47
250	15	15	15	0	15	5.27	0	28	9.50
251	15	15	15	0	17	10.88	0	15	3.81
252	25	25	25	0	25	16.64	0	25	8.32
253	30	30	30	0	30	22.54	0	30	7.38
254	30	30	30	0	30	13.44	0	30	16.40
255	30	30	30	2	30	22.32	0	28	7.60
256	29	29	29	19	29	27.84	0	10	0.99
257	20	20	20	11	20	18.52	0	9	1.44
258	17	17	17	0	17	6.25	0	17	10.59
259	30	30	30	0	30	21.37	0	30	8.41
260	20	20	20	0	20	10.07	0	20	9.57

Un primer vistazo al resumen anterior muestra la existencia de varias situaciones singulares o anómalas como las siguientes:

i) La estación 109 (Avenida de San Francisco Javier) tiene registros solamente durante un período de tres meses aproximadamente desde inicio.
ii) El resto de estaciones tiene registros desde fecha de inicio a fecha de fin.
iii) Los 365 días de datos deberían en teoría proporcionar para cada estación un total de 105120 registros para un frecuencia de 1/5min, sin embargo, ninguna estación alcanza dicha número total, lo que era más o menos esperable por interrupciones de registro fortuitas, etc.

a) Para todas las estaciones el número de estacionamientos operativos es constante.
b) Hay un buen número de estaciones en las que en algún momento se ha registrado un número de estacionamientos disponibles mayor que los operativos, lo cual, obviamente es un error.
c) Igualmente hay bastantes estaciones en las que en algún momento se ha registrado un número de bicicletas disponibles mayor que el número de estacionamientos operativos.

Procede, visto lo visto, una depuración que permita en primer lugar, identificar:

- posibles datos replicados,

- datos faltantes y
- registros anómalos

4.2 Datos replicados, faltantes y anómalos

4.2.1 Posibles datos replicados

En teoría la combinación (num - add_date) debe ser única, esto es, para cada estación y periodo (de 5min) debe haber un único registro.

```
if (!"sevidata_rep_num_add_date" %in% dbListTables(con))
  dbSendStatement(con,
    'CREATE TABLE IF NOT EXISTS sevidata_rep_num_add_date AS
      SELECT num, add_date, count(id) AS Rep
          FROM sevidata GROUP BY num, add_date HAVING count(id) > 1;')

if (!"sevidata_rep" %in% ls())
  sevidata_rep = dbQueryIf("sevidata_rep",con,
    'SELECT T.*, Q.Rep,
       rank() OVER (PARTITION BY T.num, T.add_date ORDER BY T.id)
      FROM sevidata_rep_num_add_date as Q, sevidata as T
      WHERE Q.num = T.num and Q.add_date = T.add_date
      ORDER BY T.num, T.add_date, T.id;')
```

El número de registros repetidos es de 6216, una muestra de ellos se recoge siguidamente.

```
kable(sevidata_rep[c(1:10,5001:5010),c(1,3,4,5,9,10)],
      caption = 'Muestra de datos replicados en sevidata')
```

Table 5: Muestra de datos replicados en sevidata

	id	num	last_update	add_date	rep	rank
1	50489648	1	2016-10-30 01:54:36	2016-10-30 02:00:01	2	1
2	50492756	1	2016-10-30 02:57:57	2016-10-30 02:00:01	2	2
3	50489907	1	2016-10-30 01:54:36	2016-10-30 02:05:01	2	1
4	50493015	1	2016-10-30 02:00:49	2016-10-30 02:05:01	2	2
5	50490166	1	2016-10-30 02:04:39	2016-10-30 02:10:01	2	1
6	50493274	1	2016-10-30 02:00:49	2016-10-30 02:10:01	2	2
7	50490425	1	2016-10-30 02:04:39	2016-10-30 02:15:01	2	1
8	50493533	1	2016-10-30 02:13:32	2016-10-30 02:15:01	2	2
9	50490684	1	2016-10-30 02:14:42	2016-10-30 02:20:01	2	1
10	50493792	1	2016-10-30 02:13:32	2016-10-30 02:20:01	2	2
5001	50490760	210	2016-10-30 02:12:57	2016-10-30 02:20:01	2	1
5002	50493868	210	2016-10-30 02:10:38	2016-10-30 02:20:01	2	2
5003	50491019	210	2016-10-30 02:23:02	2016-10-30 02:25:01	2	1
5004	50494127	210	2016-10-30 02:20:42	2016-10-30 02:25:01	2	2
5005	50491278	210	2016-10-30 02:23:02	2016-10-30 02:30:01	2	1
5006	50494386	210	2016-10-30 02:28:24	2016-10-30 02:30:01	2	2
5007	50491537	210	2016-10-30 02:33:06	2016-10-30 02:35:01	2	1
5008	50494645	210	2016-10-30 02:28:24	2016-10-30 02:35:01	2	2
5009	50491796	210	2016-10-30 02:33:06	2016-10-30 02:40:01	2	1
5010	50494904	210	2016-10-30 02:38:28	2016-10-30 02:40:01	2	2

```
sevidata_rep_by_num = dbGetQuery(con,
    'SELECT num, min(add_date) desde, max(add_date) hasta,
    min(Rep), max(Rep), count(*) as NRep
    FROM sevidata_rep_num_add_date group by num order by num;')
```

Su distribución por estación es la siguiente.

```
# pandoc.table(sevidata_rep_by_num, digits = 2, split.tables = 120,
#              caption = 'Resumen de datos replicados por estación')
kable(sevidata_rep_by_num, digits = 2,
             caption = 'Resumen de datos replicados por estación')
```

Table 6: Resumen de datos replicados por estación

num	desde	hasta	min	max	nrep
1	2016-10-30 02:00:01	2016-10-30 02:55:01	2	2	12
2	2016-10-30 02:00:01	2016-10-30 02:55:01	2	2	12
3	2016-10-30 02:00:01	2016-10-30 02:55:01	2	2	12
4	2016-10-30 02:00:01	2016-10-30 02:55:01	2	2	12
5	2016-10-30 02:00:01	2016-10-30 02:55:01	2	2	12
6	2016-10-30 02:00:01	2016-10-30 02:55:01	2	2	12
7	2016-10-30 02:00:01	2016-10-30 02:55:01	2	2	12
8	2016-10-30 02:00:01	2016-10-30 02:55:01	2	2	12
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14	2016-10-30 02:00:01	2016-10-30 02:55:01	2	2	12
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38	2016-10-30 02:00:01	2016-10-30 02:55:01	2	2	12
39	2016-10-30 02:00:01	2016-10-30 02:55:01	2	2	12

num	desde	hasta	min	max	nrep
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num	desde	hasta	min	max	nrep
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143	2016-10-30 02:00:01	2016-10-30 02:55:01	2	2	12
144	2016-10-30 02:00:01	2016-10-30 02:55:01	2	2	12

num	desde	hasta	min	max	nrep
145	2016-10-30 02:00:01	2016-10-30 02:55:01	2	2	12
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195	2016-10-30 02:00:01	2016-10-30 02:55:01	2	2	12
196	2016-10-30 02:00:01	2016-10-30 02:55:01	2	2	12

num	desde	hasta	min	max	nrep
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238	2016-10-30 02:00:01	2016-10-30 02:55:01	2	2	12
239	2016-10-30 02:00:01	2016-10-30 02:55:01	2	2	12
240	2016-10-30 02:00:01	2016-10-30 02:55:01	2	2	12
241	2016-10-30 02:00:01	2016-10-30 02:55:01	2	2	12
242	2016-10-30 02:00:01	2016-10-30 02:55:01	2	2	12
243	2016-10-30 02:00:01	2016-10-30 02:55:01	2	2	12
244	2016-10-30 02:00:01	2016-10-30 02:55:01	2	2	12
245	2016-10-30 02:00:01	2016-10-30 02:55:01	2	2	12
246	2016-10-30 02:00:01	2016-10-30 02:55:01	2	2	12
247	2016-10-30 02:00:01	2016-10-30 02:55:01	2	2	12
248	2016-10-30 02:00:01	2016-10-30 02:55:01	2	2	12

num	desde	hasta	min	max	nrep
249	2016-10-30 02:00:01	2016-10-30 02:55:01	2	2	12
250	2016-10-30 02:00:01	2016-10-30 02:55:01	2	2	12
251	2016-10-30 02:00:01	2016-10-30 02:55:01	2	2	12
252	2016-10-30 02:00:01	2016-10-30 02:55:01	2	2	12
253	2016-10-30 02:00:01	2016-10-30 02:55:01	2	2	12
254	2016-10-30 02:00:01	2016-10-30 02:55:01	2	2	12
255	2016-10-30 02:00:01	2016-10-30 02:55:01	2	2	12
256	2016-10-30 02:00:01	2016-10-30 02:55:01	2	2	12
257	2016-10-30 02:00:01	2016-10-30 02:55:01	2	2	12
258	2016-10-30 02:00:01	2016-10-30 02:55:01	2	2	12
259	2016-10-30 02:00:01	2016-10-30 02:55:01	2	2	12
260	2016-10-30 02:00:01	2016-10-30 02:55:01	2	2	12

Todas las estaciones, salvo la estación 109, presentan 12 datos duplicados que se concentran en un día, entre 2016-10-30 02:00:01 y 2016-10-30 02:55:01.

259 x 12 x 2 = 6216 que es el número total de réplicas.

Volviendo a los datos originales (backups) se comprueba que todos se encuentran en la tabla *z_Seville_2016_10_30*.

Para facilitar el manejo de duplicados y otras incidencias en los datos, antes en su caso de eliminación de los registros implicados, se modifica la estructura de *sevidata* añadiendo un campo indicador, *ok*, para recoger las distintas incidencias. Se crea tambien un índice *ok_idx* para acelerar filtrados.

- Sin incidencia: ok = 1.

```
dbSendStatement(con, 'ALTER TABLE sevidata
                      ADD COLUMN ok smallint DEFAULT 1;')
dbSendStatement(con, 'CREATE INDEX ok_idx ON sevidata (ok);')

dbSendStatement(con, 'UPDATE sevidata SET ok = 1;')
```

- Duplicado: ok = 2.

```
dbSendStatement(con, 'UPDATE sevidata SET ok = 2 WHERE sevidata.id IN
                      (SELECT sevidata_rep.id FROM sevidata_rep
                      WHERE sevidata_rep.rank = 2);')
```

sevici=# select count(*) from sevidata where ok = 2;

count
.....
3108
(1 fila)

4.2.2 Datos faltantes

Para identificar los posibles huecos en las series temporales de cada estación, vamos en primer lugar a obtener la secuencia temporal de 5 min de paso, para el conjunto de las estaciones, esto es, el listado ordenado de valores únicos de la columna *add_date*.

```
lista_add_date = dbQueryIf('lista_add_date', con,
                  'SELECT DISTINCT add_date
                  FROM sevidata ORDER BY add_date;')
```

El listado lo forman 104170 registros. Como ya se ha señalado anteriormente el número teórico de registros entre inicio y fin para cada estación es de 105120 (365 días x 24 horas x 12 p5min), a lo que hay que añadir 12 registros adicionales hasta las 00:55:01 del día de fin 2016-11-30 (105132), lo que supone que existen 962 huecos de 5min sin datos que afectan a la totalidad de las estaciones. El número total de huecos entre todas las estaciones será obviamente muy superior y al menos de ese tamaño para cada estación.

Para explorar los huecos de datos faltantes se construye una serie entre inicio y fin con paso de 5min y se vincula al minuto con la secuencia real de *add_date* allí donde exista.

```
lista5min_con_huecos = dbQueryIf('lista5min_con_huecos',con,
                "SELECT p5min, L.add_date
                 FROM generate_series
                    ( '2015-12-01 00:00'::timestamp
                    , '2016-11-30 00:55'::timestamp
                    , '5 min'::interval) p5min
                 LEFT JOIN lista_add_date L ON
                  date_trunc('minute', L.add_date) = p5min
                    ;")
```

```
kable(lista5min_con_huecos[c(1:5,200:210,105120:105132),],
        caption = 'Muestra de secuencia temporal completa y secuencia real con datos faltantes')
```

Table 7: Muestra de secuencia temporal completa y secuencia real con datos faltantes

	p5min	add_date
1	2015-12-01 00:00:00	2015-12-01 00:00:01
2	2015-12-01 00:05:00	2015-12-01 00:05:01
3	2015-12-01 00:10:00	2015-12-01 00:10:01
4	2015-12-01 00:15:00	2015-12-01 00:15:01
5	2015-12-01 00:20:00	2015-12-01 00:20:01
200	2015-12-01 16:35:00	NA
201	2015-12-01 16:40:00	NA
202	2015-12-01 16:45:00	NA
203	2015-12-01 16:50:00	NA
204	2015-12-01 16:55:00	NA
205	2015-12-01 17:00:00	NA
206	2015-12-01 17:05:00	NA
207	2015-12-01 17:10:00	NA
208	2015-12-01 17:15:00	NA
209	2015-12-01 17:20:00	NA
210	2015-12-01 17:25:00	NA
105120	2016-11-29 23:55:00	2016-11-29 23:55:01
105121	2016-11-30 00:00:00	2016-11-30 00:00:02
105122	2016-11-30 00:05:00	2016-11-30 00:05:01
105123	2016-11-30 00:10:00	2016-11-30 00:10:01
105124	2016-11-30 00:15:00	2016-11-30 00:15:01
105125	2016-11-30 00:20:00	2016-11-30 00:20:01
105126	2016-11-30 00:25:00	2016-11-30 00:25:01
105127	2016-11-30 00:30:00	2016-11-30 00:30:01
105128	2016-11-30 00:35:00	2016-11-30 00:35:01
105129	2016-11-30 00:40:00	2016-11-30 00:40:01
105130	2016-11-30 00:45:00	2016-11-30 00:45:01
105131	2016-11-30 00:50:00	2016-11-30 00:50:01
105132	2016-11-30 00:55:00	2016-11-30 00:55:01

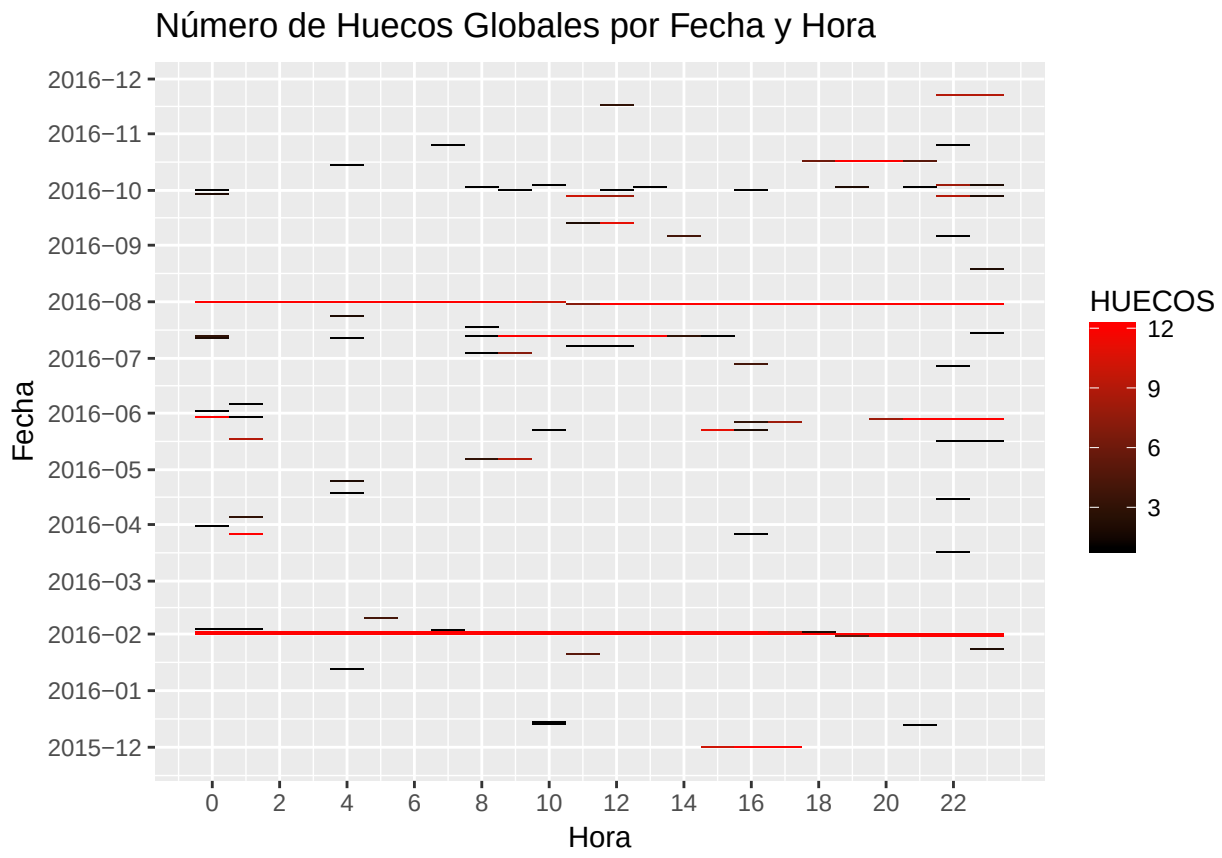
Seguidamente se presenta la distribución temporal de los huecos globales por fecha y hora, día de la semana y mes.

```
library(lubridate)
```

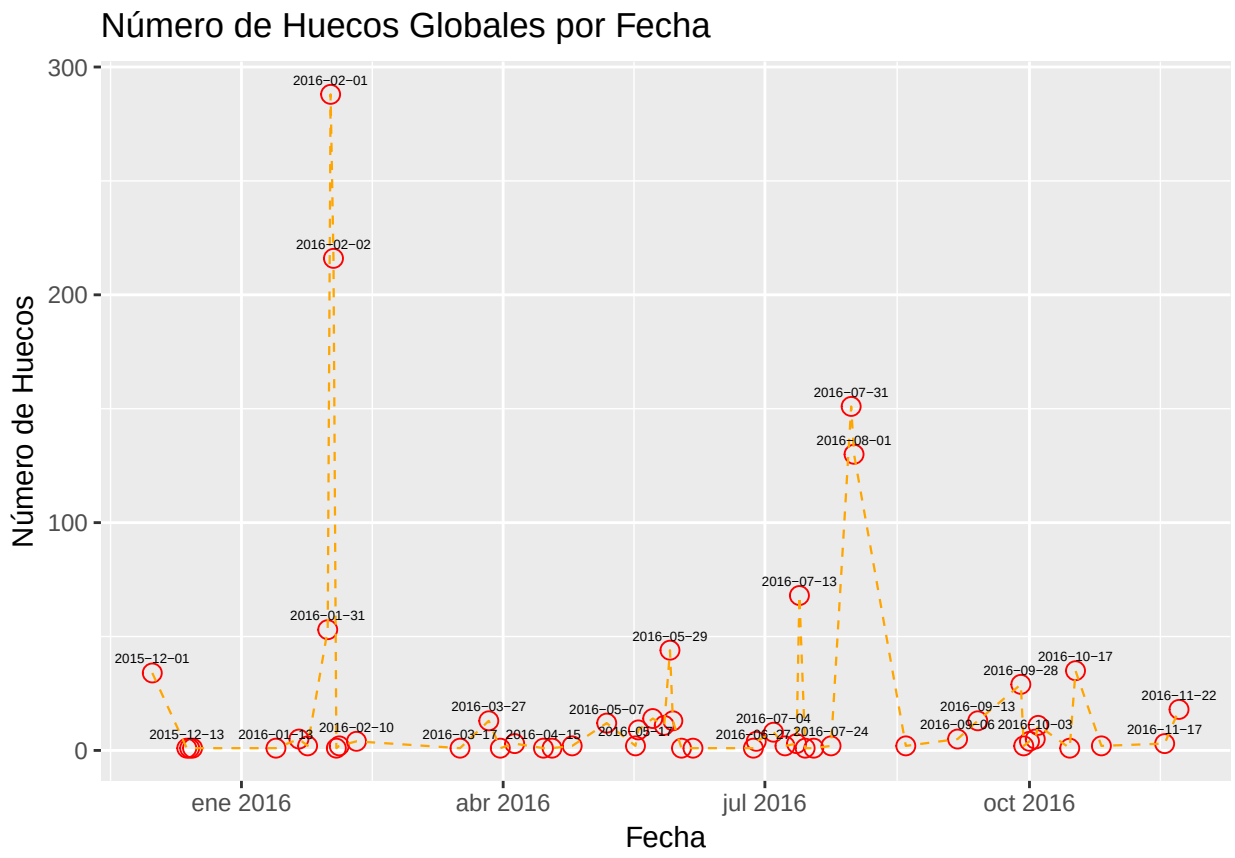
```
L5min = lista5min_con_huecos

L5min$DIA = as_date(L5min$p5min)
L5min$HORAM = hour(L5min$p5min) + minute(L5min$p5min)/60
L5min$HORA = hour(L5min$p5min)
L5min$MES = format(L5min$DIA, "%m")
L5min$DSEM = format(L5min$DIA,"%a")
L5min$DSEMN = wday(L5min$DIA)

L5min$HUECOS = is.na(L5min$add_date) * 1

L5minH = L5min[L5min$HUECOS==1,]

Huecos = aggregate(HUECOS ~ DIA + HORA, FUN = sum, data = L5minH)
HuecosDIA = aggregate(HUECOS ~ DIA, FUN = sum, data = L5minH)
HuecosHORA = aggregate(HUECOS ~ HORA, FUN = sum, data = L5minH)
HuecosMES = aggregate(HUECOS ~ MES, FUN = sum, data = L5minH)
HuecosDSEM = aggregate(HUECOS ~ DSEM + DSEMN, FUN = sum, data = L5minH)
```

```
library(ggplot2)
library(scales)
```

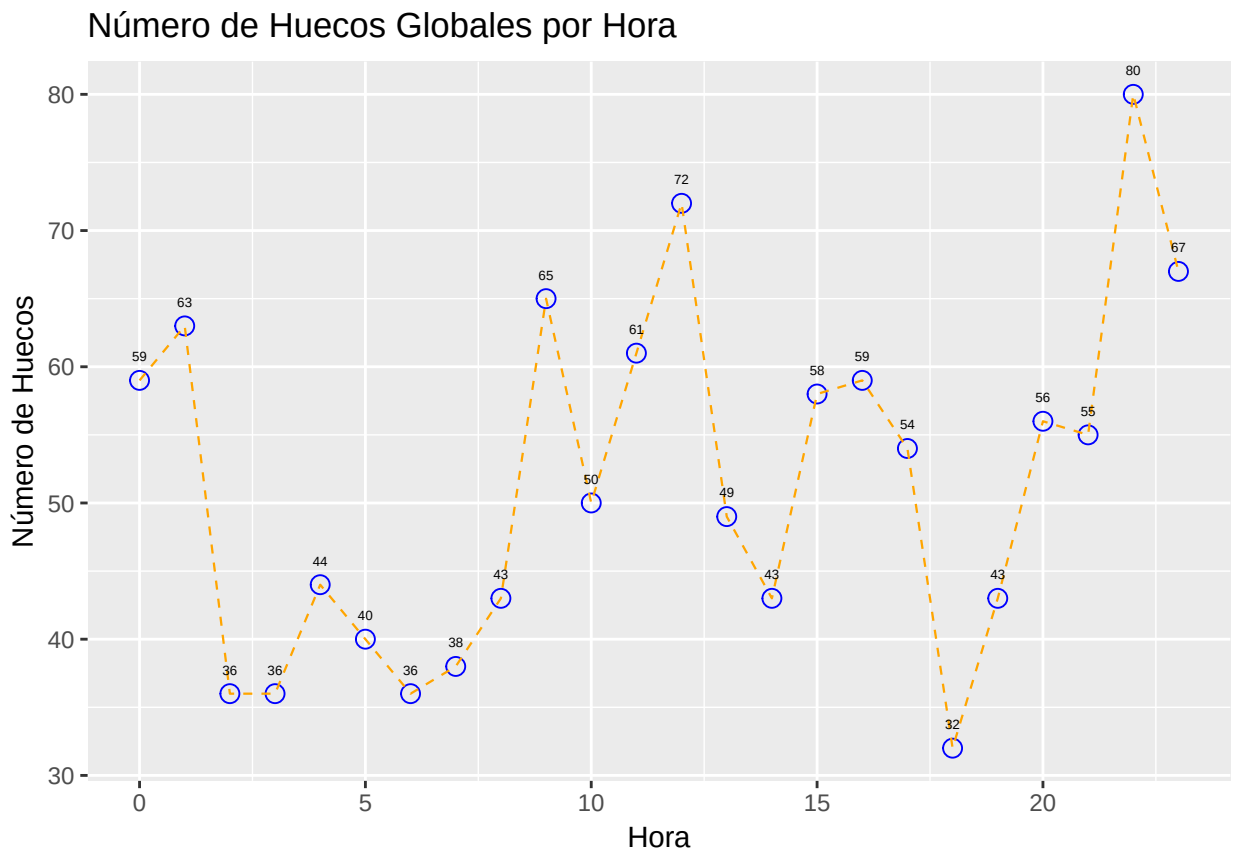
```
ggplot(Huecos, aes(x=HORA,y=DIA))+
  geom_tile(aes(fill=HUECOS))+
  scale_fill_gradientn(colors = c('black','red'))+
  labs(x="Hora", y="Fecha",
       title="Número de Huecos Globales por Fecha y Hora")+
  scale_y_date(date_breaks = "1 month", labels = date_format("%Y-%m"))+
  scale_x_continuous(breaks = c(0,2,4,6,8,10,12,14,16,18,20,22))
```



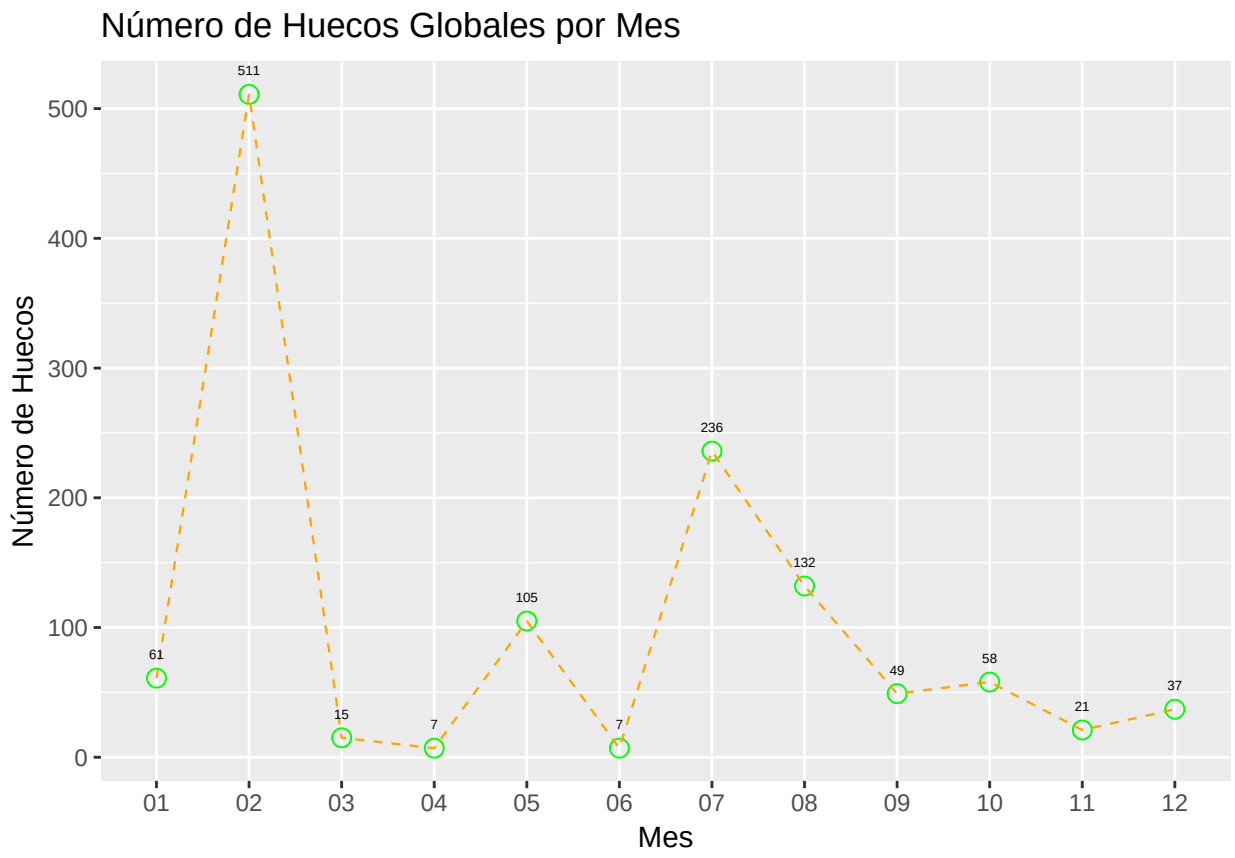

```
ggplot(HuecosDIA[HuecosDIA$HUECOS>0,], aes(DIA,HUECOS,label=DIA))+
  geom_point(shape = 21, colour = "red", size = 3, stroke = 0.5)+
  geom_line(colour = "orange",linetype = 2, size=0.4)+
  geom_text(check_overlap = TRUE, angle=0, size=1.8, vjust=-1)+
  labs(x="Fecha", y="Número de Huecos",
       title="Número de Huecos Globales por Fecha")
```



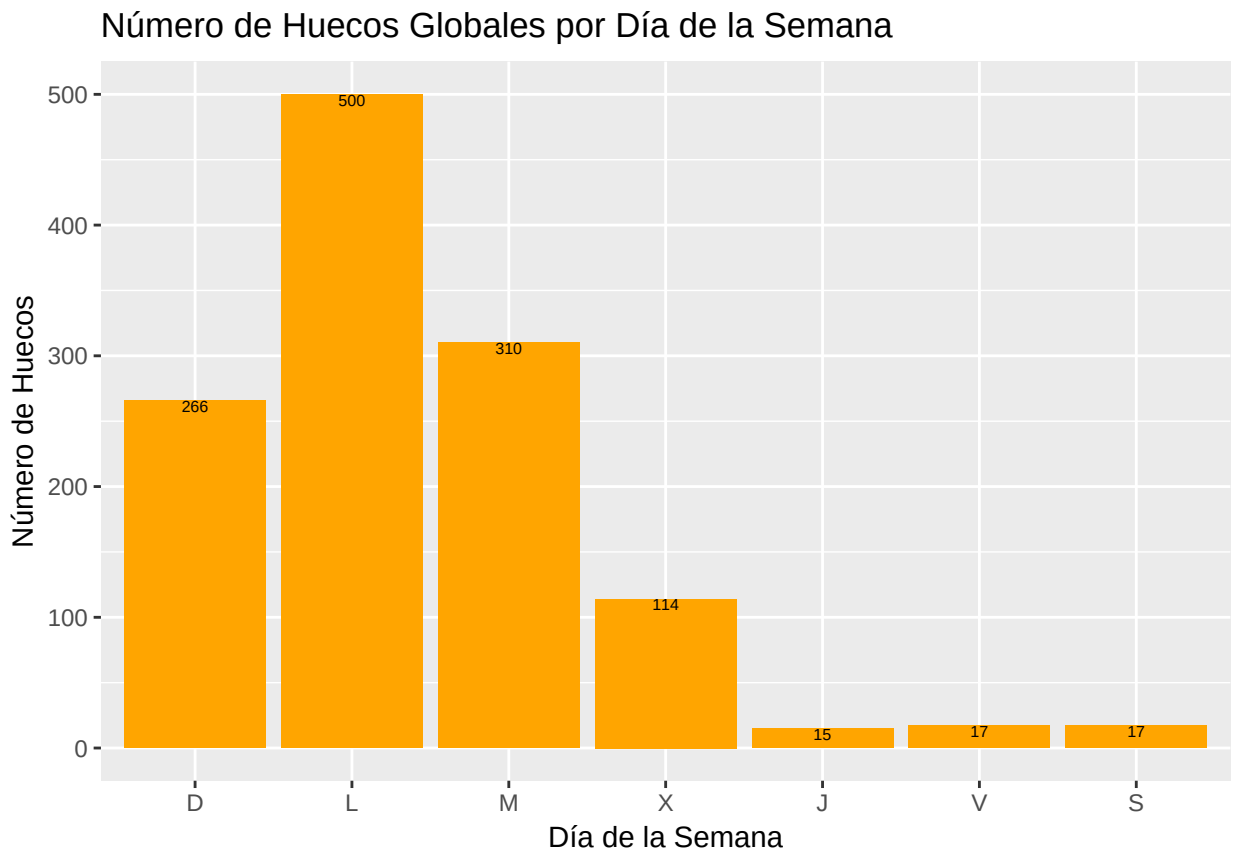

```
ggplot(HuecosHORA[HuecosHORA$HUECOS>0,], aes(HORA,HUECOS,label=HUECOS))+
  geom_point(shape = 21, colour = "blue", size = 3, stroke = 0.5)+
  geom_line(colour = "orange",linetype = 2, size=0.4)+
  geom_text(check_overlap = TRUE, angle=0, size=1.8, vjust=-2)+
  labs(x="Hora", y="Número de Huecos",
       title="Número de Huecos Globales por Hora")
```




```
ggplot(HuecosMES[HuecosMES$HUECOS>0,], aes(MES,HUECOS,group = 1,label=HUECOS))+
  geom_point(shape = 21, colour = "green", size = 3, stroke = 0.5)+
  geom_line(colour = "orange",linetype = 2, size=0.4)+
  geom_text(check_overlap = TRUE, angle=0, size=1.8, vjust=-2)+
  labs(x="Mes", y="Número de Huecos",
       title="Número de Huecos Globales por Mes")
```




```
ggplot(HuecosDSEM[HuecosDSEM$HUECOS>0,],
       aes(factor(DSEMN,labels = c('D','L','M','X','J','V','S')),
           HUECOS,group = 1,label=HUECOS))+
  geom_col(fill = 'orange')+
  geom_text(check_overlap = TRUE, angle=0, size=2, vjust=1)+
  labs(x="Día de la Semana", y="Número de Huecos",
       title="Número de Huecos Globales por Día de la Semana")
```




```
kable(HuecosDIA, digits = 2,
            caption = "Número de Huecos Globales por Fecha")
```

Table 8: Número de Huecos Globales por Fecha

DIA	HUECOS
2015-12-01	34
2015-12-13	1
2015-12-14	1
2015-12-15	1
2016-01-13	1
2016-01-21	5
2016-01-24	2
2016-01-31	53
2016-02-01	288
2016-02-02	216
2016-02-03	1
2016-02-04	2
2016-02-10	4
2016-03-17	1
2016-03-27	13
2016-03-31	1
2016-04-05	3
2016-04-15	1
2016-04-18	1
2016-04-25	2

DIA	HUECOS
2016-05-07	12
2016-05-17	2
2016-05-18	9
2016-05-23	14
2016-05-27	11
2016-05-29	44
2016-05-30	13
2016-06-02	1
2016-06-06	1
2016-06-27	1
2016-06-28	4
2016-07-04	8
2016-07-08	2
2016-07-12	3
2016-07-13	68
2016-07-15	1
2016-07-18	1
2016-07-24	2
2016-07-31	151
2016-08-01	130
2016-08-19	2
2016-09-06	5
2016-09-13	13
2016-09-28	29
2016-09-29	2
2016-10-01	4
2016-10-03	5
2016-10-04	11
2016-10-15	1
2016-10-17	35
2016-10-26	2
2016-11-17	3
2016-11-22	18

Para almacenar la información en forma de series temporales correspondientes a cada estación y variable (s: availablestands, b:availablebikes) creamos la tabla *sevicip5m* a partir de la anteriormente creada, *lista5min_con_huecos*

```
CREATE TABLE sevicip5m
(
  p5min timestamp,
  hueco boolean,
  CONSTRAINT sevicip5m_pkey PRIMARY KEY (p5min)
)
WITH (
  OIDS=FALSE
);
ALTER TABLE sevicip5m
  OWNER TO postgres;

INSERT INTO sevicip5m (p5min, hueco)
SELECT p5min, isfinite(add_date) FROM Lista5min_con_huecos order by p5min;
```

se añaden las columnas correspondientes a cada estación-variable

```
for (num in 1:260){
  for (var in c('s','b')){
    addCol = paste0('ALTER TABLE sevicip5m ADD COLUMN ',
                    var,num,' smallint;')
    dbSendStatement(con, addCol)
  }
}
```

se incorporan los datos de *sevidata* a la tabla *sevicip5m*

```
#
# Ojo, este script ha tardado más de 12h
#

for (num in 1:260)
{
addColDataS = paste0("UPDATE sevicip5m as T SET s", num, " =
          D.availablestands FROM (select add_date, availablestands from
          sevidata where ok = 1 and num = ", num,") AS D WHERE
          date_trunc('minute', D.add_date) = T.p5min;")

addColDataB = paste0("UPDATE sevicip5m as T SET b", num,
          " = D.availablebikes FROM (select add_date,
          availablebikes from sevidata where ok = 1 and num = ", num,") AS D
          WHERE date_trunc('minute', D.add_date) = T.p5min;")

dbSendStatement(con, addColDataS)
dbSendStatement(con, addColDataB)

print(num)
#print(addColDataS)
#print(addColDataB)
}
```

exportamos el resultado a csv

```
\COPY (select * from sevicip5m order by p5min) TO
'/home/usu1/Documentos/Formacion/UniSE-DataScience&BigData/cont/TFM/data/sevicip5min.csv'
WITH CSV HEADER DELIMITER ';';
```

leemos desde fichero y presentamos una muestra de su contenido

```
if (!"sevicip5m" %in% ls()){
  sevicip5m = read.csv('sevicip5min.csv',sep = ';')}
sevicip5m[1:20,1:15]
```

```
##                 p5min hueco s1 b1 s2 b2 s3 b3 s4 b4 s5 b5 s6 b6 s7
## 1  2015-12-01 00:00:00     t 19  1 17  1 38  0 39  0 33  1 20  0 20
## 2  2015-12-01 00:05:00     t 19  1 17  1 38  0 39  0 33  1 20  0 20
## 3  2015-12-01 00:10:00     t 19  1 17  1 38  0 39  0 33  1 20  0 20
## 4  2015-12-01 00:15:00     t 19  1 17  1 38  0 39  0 33  1 20  0 20
## 5  2015-12-01 00:20:00     t 19  1 17  1 38  0 39  0 33  1 20  0 20
## 6  2015-12-01 00:25:00     t 19  1 17  1 38  0 39  0 33  1 20  0 20
```

```
## 7  2015-12-01 00:30:00     t 19  1 17  1 38  0 39  0 33  1 20  0 20
## 8  2015-12-01 00:35:00     t 19  1 17  1 38  0 39  0 33  1 20  0 20
## 9  2015-12-01 00:40:00     t 19  1 17  1 38  0 39  0 33  1 20  0 20
## 10 2015-12-01 00:45:00     t 19  1 16  2 38  0 39  0 33  1 20  0 20
## 11 2015-12-01 00:50:00     t 19  1 16  2 38  0 39  0 33  1 20  0 20
## 12 2015-12-01 00:55:00     t 19  1 16  2 38  0 39  0 33  1 20  0 20
## 13 2015-12-01 01:00:00     t 19  1 16  2 38  0 39  0 33  1 20  0 20
## 14 2015-12-01 01:05:00     t 19  1 16  2 38  0 39  0 33  1 20  0 20
## 15 2015-12-01 01:10:00     t 19  1 16  2 38  0 39  0 33  1 20  0 20
## 16 2015-12-01 01:15:00     t 19  1 16  2 38  0 39  0 33  1 20  0 20
## 17 2015-12-01 01:20:00     t 19  1 16  2 38  0 39  0 33  1 20  0 20
## 18 2015-12-01 01:25:00     t 19  1 16  2 38  0 39  0 33  1 20  0 20
## 19 2015-12-01 01:30:00     t 19  1 16  2 38  0 39  0 33  1 20  0 20
## 20 2015-12-01 01:35:00     t 19  1 16  2 38  0 39  0 33  1 20  0 20
```

El tamaño del fichero csv 'sevicip5min.csv' en disco es de 128,7 Mb y su lectura y procesamiento desde R es relativamente rápido.

El número de huecos para cada estación es el siguiente:

```
library(dplyr)
library(tidyr)
library(dtplyr)
```

```
na_count <-sapply(select(sevicip5m,starts_with('s')),
                  function(y) sum(length(which(is.na(y)))))
na_df = data.frame(na_count)
na_df = data.frame('num' = as.integer(substr(rownames(na_df),2,10)),na_df)

# Listamos
multi_na_df = bind_cols(na_df[1:65,],na_df[66:130,])
multi_na_df = bind_cols(multi_na_df, na_df[131:195,])
multi_na_df = bind_cols(multi_na_df, na_df[196:260,])
#multi_na_df
```

```
kable(multi_na_df, digits = 2,
             caption = "Resumen de Huecos por Estación")
```

Table 9: Resumen de Huecos por Estación

num	na_count	num	na_count	num	na_count	num	na_count
1	2516	66	2456	131	3813	196	2457
2	3772	67	2456	132	2409	197	3772
3	3723	68	3722	133	2458	198	3722
4	3763	69	3722	134	3813	199	3723
5	3722	70	3813	135	3813	200	2453
6	3763	71	3811	136	3763	201	3772
7	3722	72	3813	137	3722	202	2409
8	3763	73	1239	138	3723	203	2456
9	1239	74	5460	139	3772	204	3770
10	3799	75	16668	140	2517	205	3722
11	2457	76	3799	141	2515	206	2456
12	2456	77	1239	142	2457	207	2456
13	3763	78	3770	143	2453	208	2456
14	2456	79	2456	144	3799	209	1239
15	3763	80	2458	145	3770	210	3772

num	na_count	num	na_count	num	na_count	num	na_count
16	1239	81	2501	146	3799	211	2409
17	2517	82	1239	147	3723	212	3722
18	3722	83	3722	148	2409	213	3799
19	3723	84	3763	149	4024	214	2501
20	3813	85	3799	150	3770	215	3799
21	2455	86	3722	151	3788	216	2457
22	2458	87	2407	152	3723	217	2516
23	3763	88	3722	153	2517	218	4510
24	2407	89	5478	154	2407	219	3722
25	3799	90	2456	155	3788	220	2407
26	1239	91	2517	156	3749	221	1239
27	2516	92	3788	157	3813	222	3722
28	3811	93	3770	158	3770	223	3799
29	3748	94	3723	159	3813	224	2457
30	3772	95	3811	160	2515	225	3811
31	3770	96	1239	161	3749	226	1239
32	3813	97	2458	162	3813	227	2456
33	2453	98	3723	163	3772	228	17511
34	3772	99	3722	164	3763	229	3788
35	3813	100	2409	165	2458	230	3811
36	2407	101	2409	166	3763	231	3811
37	3772	102	2456	167	2456	232	2456
38	2455	103	1239	168	2456	233	3772
39	3813	104	3763	169	2408	234	2501
40	3788	105	3799	170	3763	235	2501
41	2456	106	2458	171	2409	236	3772
42	3723	107	3772	172	3748	237	2457
43	2457	108	3811	173	2409	238	3812
44	3763	109	81533	174	3813	239	3748
45	3722	110	2517	175	3772	240	3763
46	2453	111	3788	176	3722	241	2456
47	5502	112	3813	177	3722	242	2515
48	2458	113	3723	178	3811	243	7731
49	2517	114	3799	179	3763	244	2515
50	3788	115	2517	180	3813	245	3770
51	2457	116	3788	181	3772	246	2409
52	3813	117	2457	182	3748	247	2515
53	5502	118	2456	183	3812	248	2458
54	5462	119	2453	184	2458	249	2454
55	3813	120	3772	185	3748	250	2458
56	3813	121	3799	186	2409	251	2457
57	3811	122	2409	187	2458	252	3788
58	2456	123	2457	188	2455	253	2456
59	2409	124	3788	189	3788	254	3723
60	4370	125	2409	190	2515	255	2453
61	2456	126	1239	191	2517	256	1239
62	2457	127	3811	192	2409	257	2484
63	5438	128	1239	193	3722	258	2457
64	4494	129	3813	194	2409	259	2458
65	5502	130	3770	195	2408	260	3723

```r
# Resumen
summary(na_df$na_count)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##    1239    2456    3722    3601    3788   81530
```

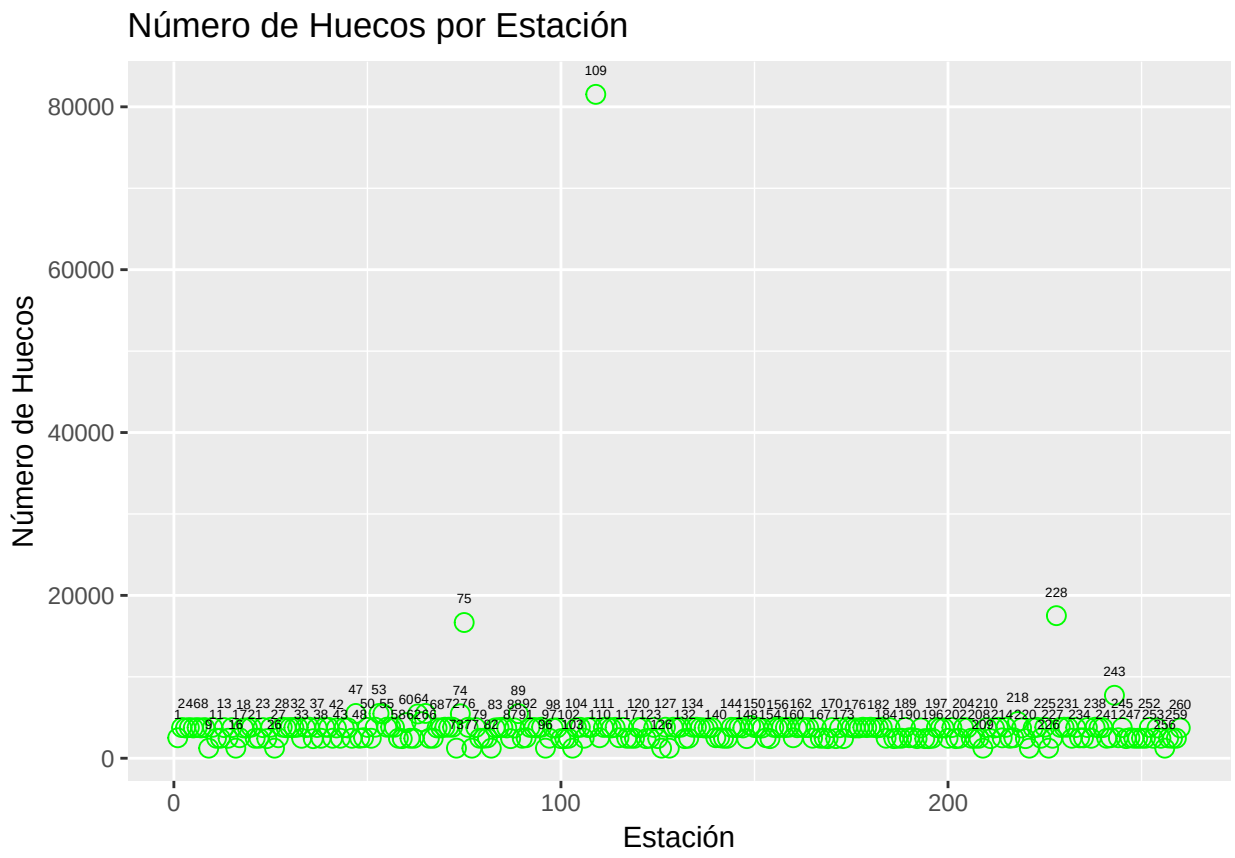
```r
resumen_huecos = data.frame(
  'Variable'= c(
    'Número de huecos','Número de huecos en estación 109',
    'Número de huecos sin estación 109', 'Número de p5min con huecos globales',
    'Número de huecos globales (sin e109)', 'Número de huecos específicos (sin e109)'
  ),'Valor'= c(
    sum(na_count), na_count[109],
    sum(na_count)-na_count[109], eval(105132 - nrow(lista_add_date)),
    eval((105132 - nrow(lista_add_date))*259),
    sum(na_count)-na_count[109]-eval((105132 - nrow(lista_add_date))*259)
  )
)
```

```r
kable(resumen_huecos, digits = 2,
             caption = "Resumen de Huecos")
```

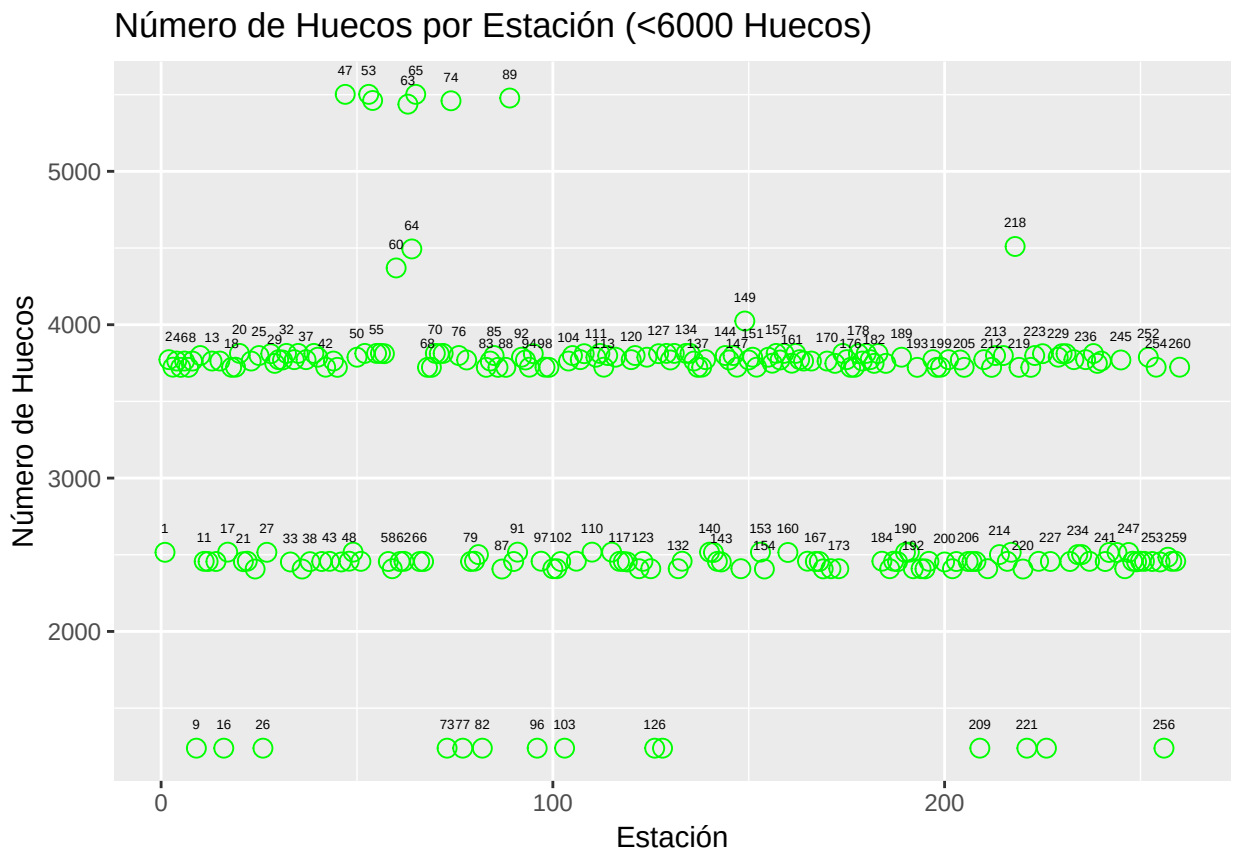
Table 10: Resumen de Huecos

Variable	Valor
Número de huecos	936353
Número de huecos en estación 109	81533
Número de huecos sin estación 109	854820
Número de p5min con huecos globales	962
Número de huecos globales (sin e109)	249158
Número de huecos específicos (sin e109)	605662

```r
ggplot(na_df, aes(num,na_count,label=num))+
  geom_point(shape = 21, colour = "green", size = 3, stroke = 0.5)+
  geom_text(check_overlap = TRUE, angle=0, size=1.8, vjust=-2)+
  labs(x="Estación", y="Número de Huecos",
       title="Número de Huecos por Estación")
```




```
ggplot(na_df[na_df$na_count<6000,], aes(num,na_count,label=num))+
  geom_point(shape = 21, colour = "green", size = 3, stroke = 0.5)+
  geom_text(check_overlap = TRUE, angle=0, size=1.8, vjust=-2)+
  labs(x="Estación", y="Número de Huecos",
       title="Número de Huecos por Estación (<6000 Huecos)")
```



El número total de huecos en el conjunto de datos es 936353 de los cuales 81533 corresponden a la estación 109 que como ya se señaló sólo estuvo en funcionamiento durante aproximadamente los tres primeros meses de estudio. Excluyendo la estación 109 se tendrán 854820 huecos.

Recordar que el número de periodos de 5min que afectan a la totalidad de estaciones es de 962, lo que supone un total de 962 x 259 = 249158 huecos globales, excluida la estación 109, y por tanto, el número de huecos en los que existe al menos una estación con datos es de 605662.

Más adelante se juzgará el alcance, necesidad y forma de imputación de los datos faltantes.

4.2.3 Datos anómalos.

Entre los datos anómalos se consideran las siguientes situaciones:

a) Número de estacionamientos disponibles mayor que operativos
b) Número de bicicletas disponibles mayor que estacionamientos operativos
c) Suma de estacionamientos disponibles y bicicletas disponibles mayor que el número de estacionamientos operativos.
d) Suma de estacionamientos disponibles y bicicletas disponibles menor que el número de estacionamientos operativos.

Se codifican dichas situaciones en la tabla *sevidata* en el campo *ok* con los siguientes valores:

a) –> ok = 3 b) –> ok = 4 c) –> ok = 5 d) –> ok = 6

```
# Ojo con el orden de los UPDATE

dbSendStatement(con, 'UPDATE sevidata SET ok = 5
```

```
                      WHERE stands < availablestands + availablebikes;')

dbSendStatement(con, 'UPDATE sevidata SET ok = 6
                      WHERE stands > availablestands + availablebikes;')

dbSendStatement(con, 'UPDATE sevidata SET ok = 3
                      WHERE stands < availablestands;')

dbSendStatement(con, 'UPDATE sevidata SET ok = 4
                      WHERE stands < availablebikes;')
```

```
if (!"resumen_datos_anomalos_por_estacion" %in% ls()){
 resumen_datos_anomalos_por_estacion =
  dbQueryIf('resumen_datos_anomalos_por_estacion',con,
  'SELECT num, ok, count(id) as N
    FROM sevidata group by num, ok order by num, ok;')
}
```

Se muestra seguidamente el resumen incidencias realtivas a datos duplicados y anómalos identificados

Valor ok	Descripcion
ok_1	Sin incidencia aparente
ok_2	Dato duplicado
ok_3	Estacionamientos disponibles > Est. operativos
ok_4	Bicicletas disponibles > Est. operativos
ok_5	Estacionamientos + Bicicletas disponibles > Est. operativos
ok_6	Estacionamientos + Bicicletas disponibles < Est. operativos

```
resumen_tabla_ok = spread(resumen_datos_anomalos_por_estacion, ok, n, sep = '_', fill = 0)
resumen_tabla_ok = mutate(resumen_tabla_ok,
                          TotOK_2_6 = ok_2+ok_3+ok_4+ok_5+ok_6,
                          Total = ok_1 + TotOK_2_6
                          )

resumen_tabla_ok_suma = summarise_each(resumen_tabla_ok,funs(sum))
```

```
kable(resumen_tabla_ok,
      caption = "Resumen de datos anómalos por estación")
```

Table 12: Resumen de datos anómalos por estación

num	ok_1	ok_2	ok_3	ok_4	ok_5	ok_6	TotOK_2_6	Total
1	90265	12	0	0	2	12626	12640	102905
2	93543	12	0	0	2	8092	8106	101649
3	77052	12	83	0	713	23838	24646	101698
4	88095	12	0	0	0	13551	13563	101658
5	80852	12	2	2	0	20831	20847	101699
6	85307	12	0	0	0	16339	16351	101658
7	95864	12	0	0	0	5823	5835	101699
8	96181	12	0	0	0	5465	5477	101658
9	87946	12	0	1	2	16221	16236	104182
10	84659	12	2	0	3	16946	16963	101622
11	86967	12	0	0	0	15985	15997	102964

num	ok_1	ok_2	ok_3	ok_4	ok_5	ok_6	TotOK_2_6	Total
12	84754	0	6	0	4	18201	18211	102965
13	86148	12	2	0	0	15496	15510	101658
14	83507	0	0	0	6	19452	19458	102965
15	92028	12	0	0	0	9618	9630	101658
16	92253	12	0	0	0	11917	11929	104182
17	72410	12	0	1	0	30481	30494	102904
18	85954	12	0	0	0	15733	15745	101699
19	86829	12	0	0	2	14855	14869	101698
20	89697	12	5	0	0	11894	11911	101608
21	91448	12	0	0	4	11502	11518	102966
22	87091	12	0	0	10	15850	15872	102963
23	87981	12	0	0	7	13658	13677	101658
24	94037	12	0	0	0	8965	8977	103014
25	85679	12	0	0	2	15929	15943	101622
26	90922	12	0	0	0	13248	13260	104182
27	90141	12	2	3	3	12744	12764	102905
28	80941	12	0	0	0	20657	20669	101610
29	92109	12	2	0	0	9550	9564	101673
30	87194	12	0	0	5	14438	14455	101649
31	93306	12	7	2	0	8324	8345	101651
32	82732	12	0	0	3	18861	18876	101608
33	95815	12	0	0	0	7141	7153	102968
34	91147	12	8	0	4	10478	10502	101649
35	92823	12	0	0	17	8756	8785	101608
36	86329	0	0	0	4	16681	16685	103014
37	89121	0	2	0	0	12526	12528	101649
38	69701	12	25	0	135	33093	33265	102966
39	91296	0	0	0	0	10312	10312	101608
40	87165	12	0	0	0	14456	14468	101633
41	90092	12	0	0	85	12776	12873	102965
42	98477	12	0	0	0	3209	3221	101698
43	80295	12	3	0	0	22654	22669	102964
44	82397	12	0	0	0	19249	19261	101658
45	90722	12	0	0	0	10965	10977	101699
46	94878	12	2	0	0	8076	8090	102968
47	77410	0	3	0	4	22502	22509	99919
48	90879	12	0	0	2	12070	12084	102963
49	91078	12	0	0	3	11811	11826	102904
50	88035	0	200	0	149	13249	13598	101633
51	84283	12	0	0	0	18669	18681	102964
52	80237	0	0	0	2	21369	21371	101608
53	86070	12	2	0	0	13835	13849	99919
54	83142	12	0	0	3	16802	16817	99959
55	67799	0	4	0	0	33805	33809	101608
56	87714	12	7	0	5	13870	13894	101608
57	83515	12	2	7	0	18074	18095	101610
58	83648	12	0	0	0	19305	19317	102965
59	85963	12	0	0	0	17037	17049	103012
60	78602	12	0	3	2	22432	22449	101051
61	89455	12	0	0	0	13498	13510	102965
62	67639	0	0	0	0	35325	35325	102964
63	84391	12	2	0	11	15567	15592	99983

num	ok_1	ok_2	ok_3	ok_4	ok_5	ok_6	TotOK_2_6	Total
64	83806	12	0	27	39	17043	17121	100927
65	90128	12	0	0	0	9779	9791	99919
66	85764	12	2	0	0	17187	17201	102965
67	95417	12	0	0	0	7536	7548	102965
68	94314	12	0	0	3	7370	7385	101699
69	87713	12	0	0	0	13974	13986	101699
70	82836	0	4	0	0	18768	18772	101608
71	84087	12	0	128	218	17165	17523	101610
72	90962	12	10	0	0	10624	10646	101608
73	83270	0	0	0	0	20912	20912	104182
74	88056	12	0	0	0	11893	11905	99961
75	80306	12	0	13	5	8417	8447	88753
76	67767	12	0	0	5	33838	33855	101622
77	92516	12	0	2	0	11652	11666	104182
78	87605	12	5	1	13	14015	14046	101651
79	96041	12	5	0	0	6907	6924	102965
80	81072	12	4	0	5	21870	21891	102963
81	92011	12	0	0	0	10897	10909	102920
82	95621	12	0	0	0	8549	8561	104182
83	89033	12	0	0	5	12649	12666	101699
84	86244	12	4	0	3	15395	15414	101658
85	64010	0	14	10	117	37471	37612	101622
86	75261	0	0	0	0	26438	26438	101699
87	84396	12	4	34	147	18421	18618	103014
88	98068	12	0	0	0	3619	3631	101699
89	77358	12	0	0	3	22570	22585	99943
90	84300	12	0	0	0	18653	18665	102965
91	92884	12	0	0	0	10008	10020	102904
92	91008	12	0	0	0	10613	10625	101633
93	91988	12	0	0	0	9651	9663	101651
94	85359	12	0	0	0	16327	16339	101698
95	94202	12	0	0	0	7396	7408	101610
96	76604	0	2	0	0	27576	27578	104182
97	78948	12	0	0	0	24003	24015	102963
98	77846	12	3	3	12	23822	23852	101698
99	97097	12	3	0	1	4586	4602	101699
100	78109	0	2	154	566	24181	24903	103012
101	85134	12	0	0	0	17866	17878	103012
102	92018	12	0	0	11	10924	10947	102965
103	72121	12	5	0	0	32044	32061	104182
104	91417	12	0	0	0	10229	10241	101658
105	87823	0	2	0	0	13797	13799	101622
106	79396	12	2	0	0	23553	23567	102963
107	78006	12	0	1	12	23618	23643	101649
108	81851	12	0	2	0	19745	19759	101610
109	17974	0	0	0	0	5625	5625	23599
110	78512	12	173	234	1562	22411	24392	102904
111	83946	12	4	0	0	17671	17687	101633
112	90578	12	0	0	0	11018	11030	101608
113	91829	12	0	0	0	9857	9869	101698
114	85534	12	0	9	18	16049	16088	101622
115	84494	0	0	0	0	18410	18410	102904

num	ok_1	ok_2	ok_3	ok_4	ok_5	ok_6	TotOK_2_6	Total
116	78796	12	0	2	3	22820	22837	101633
117	90124	12	0	0	0	12828	12840	102964
118	77484	12	0	13	26	25430	25481	102965
119	95744	12	0	0	0	7212	7224	102968
120	84915	12	0	0	2	16720	16734	101649
121	86471	0	0	0	0	15151	15151	101622
122	85082	12	0	2	0	17916	17930	103012
123	99045	12	0	0	0	3907	3919	102964
124	77779	0	54	0	11	23789	23854	101633
125	89701	12	0	3	3	13293	13311	103012
126	82220	6	5	0	1	21950	21962	104182
127	88047	12	0	0	0	13551	13563	101610
128	98129	12	0	0	0	6041	6053	104182
129	91543	12	0	0	0	10053	10065	101608
130	77191	0	0	8	32	24420	24460	101651
131	79214	12	0	7	5	22370	22394	101608
132	81977	12	0	0	0	21023	21035	103012
133	83676	12	0	0	2	19273	19287	102963
134	88197	12	0	0	3	13396	13411	101608
135	84859	12	0	0	0	16737	16749	101608
136	84870	12	0	0	5	16771	16788	101658
137	75209	12	0	0	0	26478	26490	101699
138	71008	0	147	5	124	30414	30690	101698
139	77944	0	4	1	4	23696	23705	101649
140	83909	12	0	0	0	18983	18995	102904
141	87757	12	3	0	0	15134	15149	102906
142	91380	0	0	4	0	11580	11584	102964
143	92856	12	4	0	0	10096	10112	102968
144	73198	0	2	3	537	27882	28424	101622
145	81251	12	0	0	4	20384	20400	101651
146	86736	12	0	0	0	14874	14886	101622
147	90612	12	0	0	2	11072	11086	101698
148	84297	12	4	0	31	18668	18715	103012
149	88922	12	0	0	0	12463	12475	101397
150	82533	0	10	0	7	19101	19118	101651
151	91745	12	0	0	0	9876	9888	101633
152	55741	0	0	0	28	45929	45957	101698
153	85794	12	0	0	37	17061	17110	102904
154	81203	12	0	0	0	21799	21811	103014
155	92508	12	0	0	0	9113	9125	101633
156	86908	12	0	0	0	14752	14764	101672
157	85458	12	0	3	0	16135	16150	101608
158	80327	12	0	0	1	21311	21324	101651
159	70262	0	4	27	198	31117	31346	101608
160	86673	12	0	0	0	16221	16233	102906
161	84839	12	0	0	0	16821	16833	101672
162	89310	12	0	0	0	12286	12298	101608
163	89832	12	0	0	0	11805	11817	101649
164	90345	12	0	0	0	11301	11313	101658
165	91229	12	0	0	0	11722	11734	102963
166	93094	12	4	0	2	8546	8564	101658
167	85270	12	0	0	2	17681	17695	102965

num	ok_1	ok_2	ok_3	ok_4	ok_5	ok_6	TotOK_2_6	Total
168	83044	12	0	31	51	19827	19921	102965
169	63362	12	13	21	156	39449	39651	103013
170	84084	12	3	0	19	17540	17574	101658
171	60989	12	0	2	2	42007	42023	103012
172	77510	12	0	0	1	24150	24163	101673
173	70476	0	5	0	3	32528	32536	103012
174	79498	12	0	0	0	22098	22110	101608
175	87638	0	0	0	2	14009	14011	101649
176	86224	12	0	2	73	15388	15475	101699
177	89561	12	0	0	0	12126	12138	101699
178	97729	12	0	0	0	3869	3881	101610
179	79365	0	0	0	0	22293	22293	101658
180	65802	12	4	0	34	35756	35806	101608
181	75366	12	0	0	3	26268	26283	101649
182	86966	12	0	0	0	14695	14707	101673
183	83818	12	0	0	3	17776	17791	101609
184	86072	12	0	4	28	16847	16891	102963
185	90950	12	0	0	0	10711	10723	101673
186	83725	12	4	0	70	19201	19287	103012
187	80362	0	0	0	4	22597	22601	102963
188	78373	12	0	0	3	24578	24593	102966
189	84728	12	2	0	0	16891	16905	101633
190	94796	12	2	0	0	8096	8110	102906
191	85251	0	0	0	3	17650	17653	102904
192	90305	12	0	0	0	12695	12707	103012
193	94411	12	0	2	0	7274	7288	101699
194	80600	12	0	0	0	22400	22412	103012
195	95687	12	0	0	4	7310	7326	103013
196	80822	3	2	2	11	22124	22142	102964
197	80225	12	0	0	0	21412	21424	101649
198	83915	12	4	0	4	17764	17784	101699
199	90799	12	1	0	3	10883	10899	101698
200	84329	12	0	0	0	18627	18639	102968
201	88375	12	0	0	0	13262	13274	101649
202	65022	12	2	0	12	37964	37990	103012
203	89082	0	0	0	2	13881	13883	102965
204	84179	12	0	0	0	17460	17472	101651
205	37650	0	0	0	3	64046	64049	101699
206	72849	12	1	0	3	30100	30116	102965
207	70771	0	0	0	5	32189	32194	102965
208	84668	12	2	0	7	18276	18297	102965
209	87838	12	0	0	0	16332	16344	104182
210	84485	12	0	1	3	17148	17164	101649
211	92556	12	0	0	0	10444	10456	103012
212	84602	12	0	0	1	17084	17097	101699
213	94998	12	0	0	0	6612	6624	101622
214	96082	12	0	0	0	6826	6838	102920
215	86903	12	2	0	0	14705	14719	101622
216	82725	0	0	0	9	20230	20239	102964
217	99819	12	0	0	0	3074	3086	102905
218	88389	12	0	0	2	12508	12522	100911
219	88913	12	5	2	28	12739	12786	101699

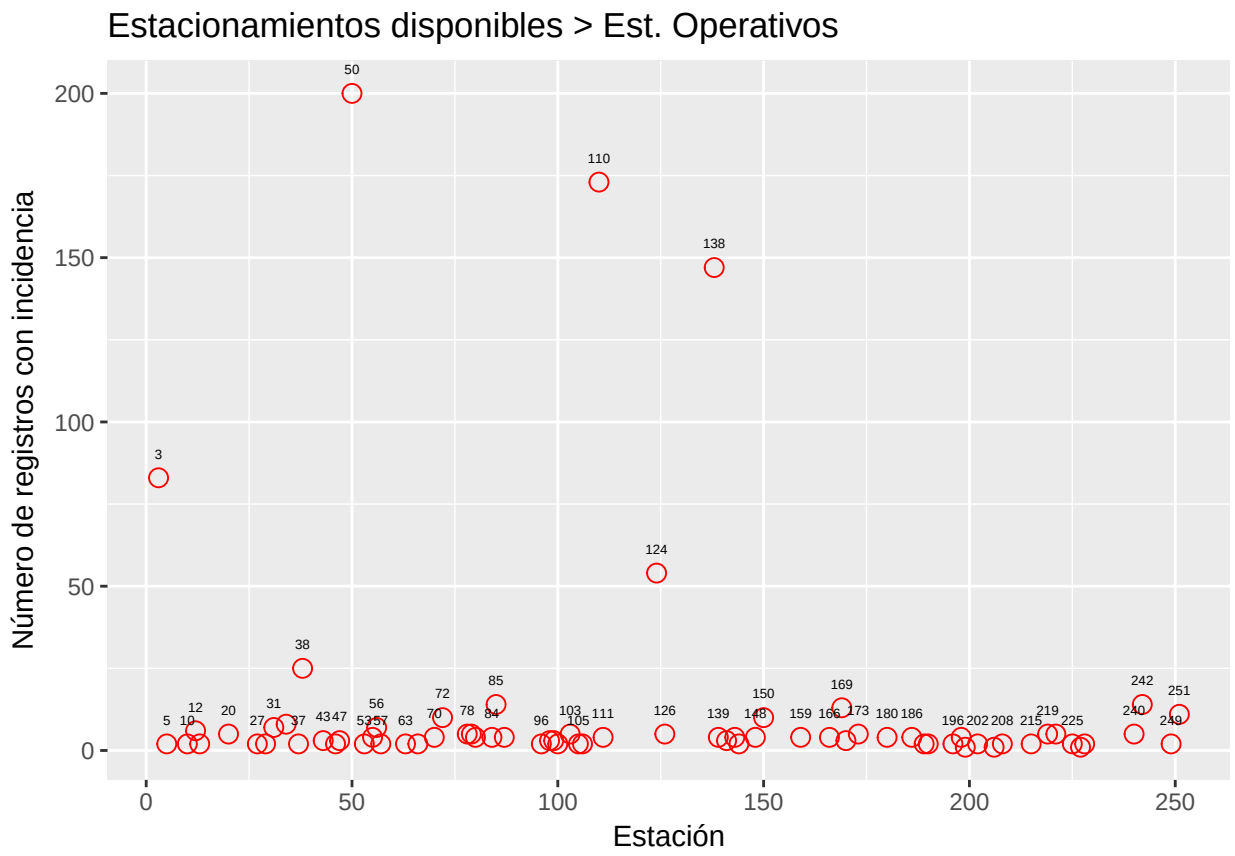
num	ok_1	ok_2	ok_3	ok_4	ok_5	ok_6	TotOK_2_6	Total
220	86895	12	0	0	3	16104	16119	103014
221	69275	12	5	0	15	34875	34907	104182
222	86158	12	0	0	0	15529	15541	101699
223	89289	0	0	0	0	12333	12333	101622
224	90906	12	0	0	0	12046	12058	102964
225	78174	0	2	0	7	23427	23436	101610
226	92865	12	0	0	0	11305	11317	104182
227	94661	12	1	0	0	8291	8304	102965
228	69139	12	2	0	50	18707	18771	87910
229	94909	12	0	0	0	6712	6724	101633
230	82744	12	0	0	0	18854	18866	101610
231	78007	0	0	0	0	23603	23603	101610
232	74420	12	0	0	0	28533	28545	102965
233	67594	0	0	0	0	34055	34055	101649
234	93290	0	0	0	0	9630	9630	102920
235	86273	12	0	0	0	16635	16647	102920
236	93197	12	0	0	0	8440	8452	101649
237	100059	12	0	0	0	2893	2905	102964
238	89318	12	0	0	0	12279	12291	101609
239	88300	12	0	0	0	13361	13373	101673
240	91121	12	5	1	0	10519	10537	101658
241	86996	12	0	4	0	15953	15969	102965
242	90687	9	14	172	42	11982	12219	102906
243	78030	12	0	0	0	19648	19660	97690
244	87804	12	0	2	0	15088	15102	102906
245	87324	12	0	0	0	14315	14327	101651
246	83061	12	0	0	0	19939	19951	103012
247	71889	0	0	0	15	31002	31017	102906
248	87979	12	0	0	2	14970	14984	102963
249	82734	12	2	0	4	20215	20233	102967
250	84559	0	0	4	2	18398	18404	102963
251	75662	0	11	0	13	27278	27302	102964
252	97811	12	0	0	0	3810	3822	101633
253	96102	12	0	0	0	6851	6863	102965
254	88221	12	0	0	0	13465	13477	101698
255	94118	12	0	0	0	8838	8850	102968
256	88255	12	0	0	0	15915	15927	104182
257	99419	12	0	0	0	3506	3518	102937
258	88069	12	0	0	8	14875	14895	102964
259	86155	12	0	0	0	16796	16808	102963
260	76877	0	0	0	6	24815	24821	101698

```
kable(resumen_tabla_ok_suma[,-1],
      caption = "Resumen de datos anómalos global")
```

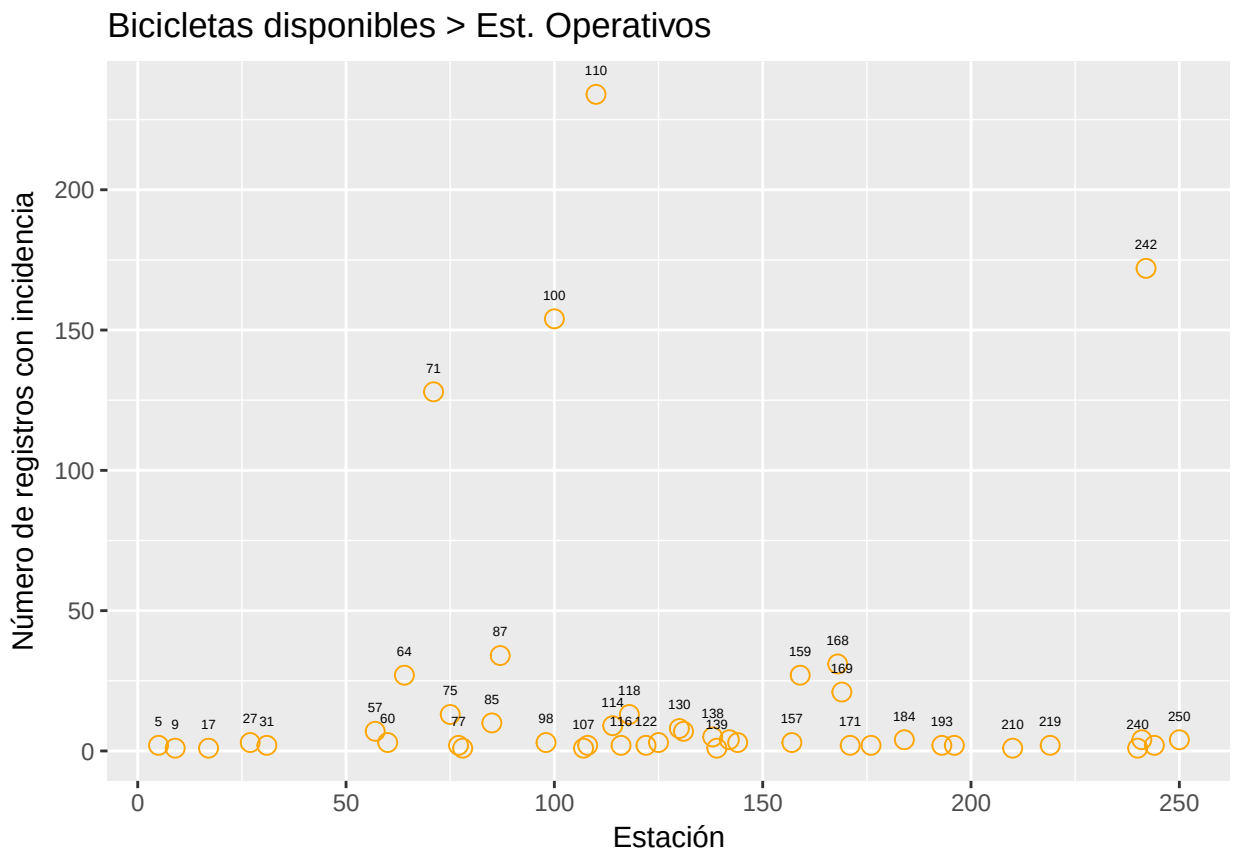
Table 13: Resumen de datos anómalos global

ok_1	ok_2	ok_3	ok_4	ok_5	ok_6	TotOK_2_6	Total
22094898	2538	954	965	5728	4367735	4377920	26472818

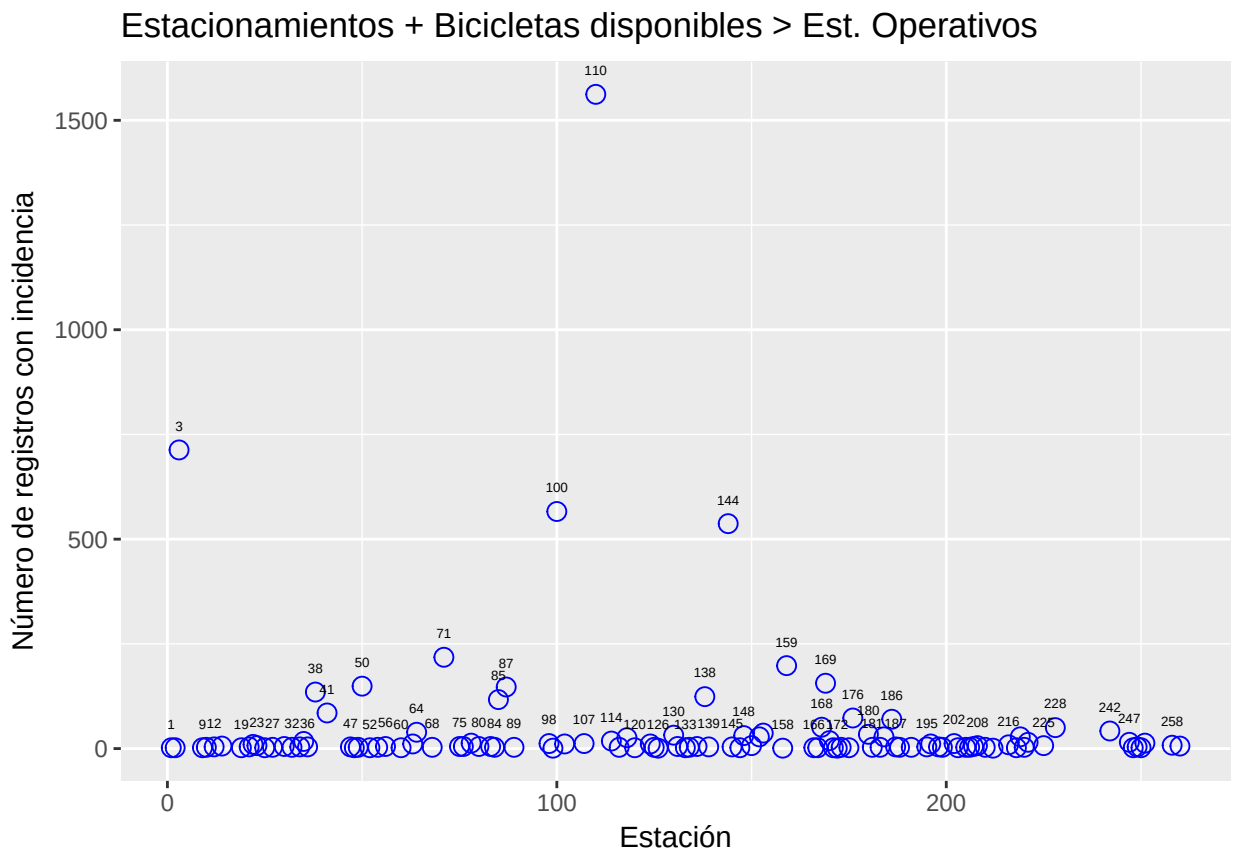
```
ggplot(resumen_tabla_ok[resumen_tabla_ok$ok_3 > 0,], aes(num, ok_3, label=num))+
  geom_point(shape = 21, colour = "red", size = 3, stroke = 0.5)+
  geom_text(check_overlap = TRUE, angle=0, size=1.8, vjust=-2)+
  labs(x="Estación", y="Número de registros con incidencia",
       title="Estacionamientos disponibles > Est. Operativos")
```



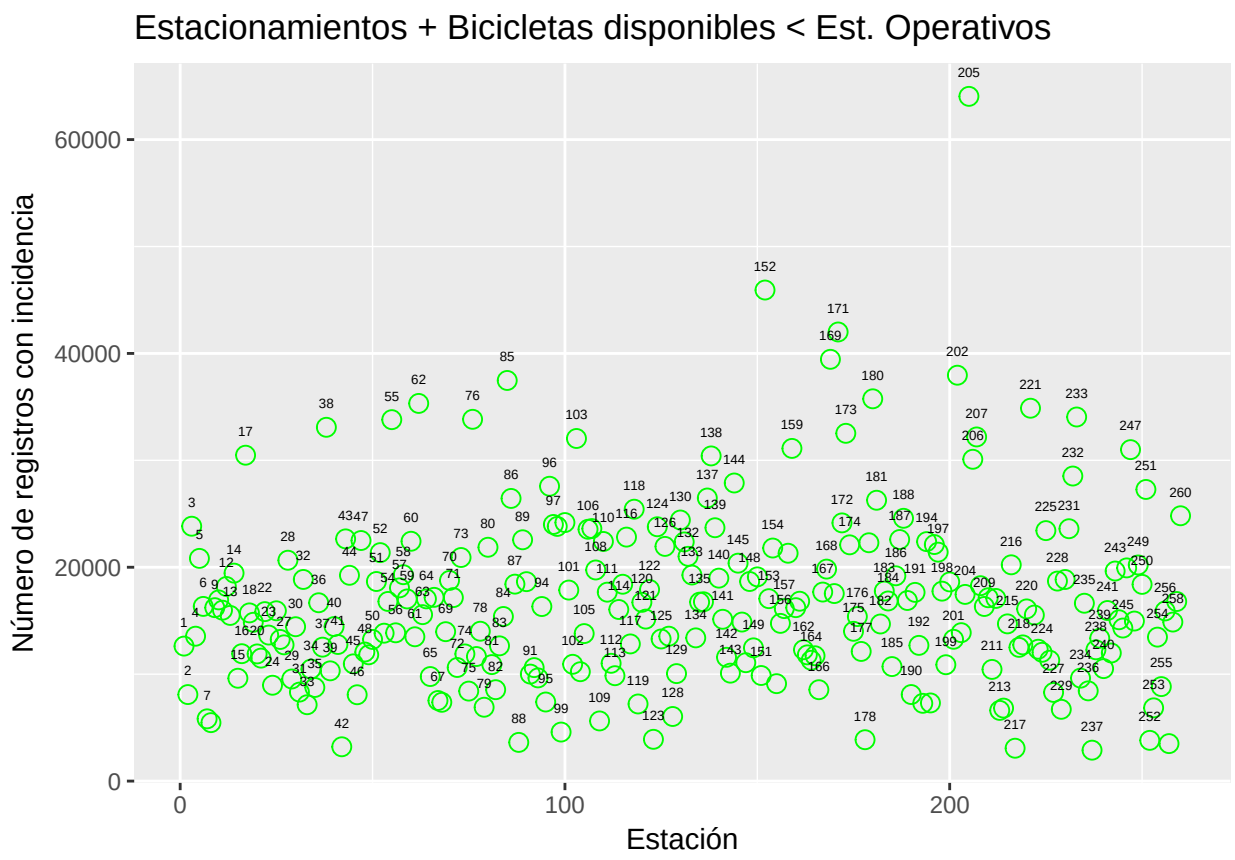

```
ggplot(resumen_tabla_ok[resumen_tabla_ok$ok_4 > 0,], aes(num, ok_4, label=num))+
  geom_point(shape = 21, colour = "orange", size = 3, stroke = 0.5)+
  geom_text(check_overlap = TRUE, angle=0, size=1.8, vjust=-2)+
  labs(x="Estación", y="Número de registros con incidencia",
       title="Bicicletas disponibles > Est. Operativos")
```




```r
ggplot(resumen_tabla_ok[resumen_tabla_ok$ok_5 > 0,], aes(num, ok_5, label=num))+
  geom_point(shape = 21, colour = "blue", size = 3, stroke = 0.5)+
  geom_text(check_overlap = TRUE, angle=0, size=1.8, vjust=-2)+
  labs(x="Estación", y="Número de registros con incidencia",
       title="Estacionamientos + Bicicletas disponibles > Est. Operativos")
```




```
ggplot(resumen_tabla_ok[resumen_tabla_ok$ok_6 > 0,], aes(num, ok_6, label=num))+
  geom_point(shape = 21, colour = "green", size = 3, stroke = 0.5)+
  geom_text(check_overlap = TRUE, angle=0, size=1.8, vjust=-2)+
  labs(x="Estación", y="Número de registros con incidencia",
       title="Estacionamientos + Bicicletas disponibles < Est. Operativos")
```




```
# dbDisconnect(con)
```