# Analysing Helipad Data

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We have some data from the KSS HEMS patients conveyed to KCH.

```
#Read the data into a dataframe, specify the NA strings to incorporate
the missing values
data <- read.csv("data/HEMSdata.csv", na.strings=c("NA","n/a", ""))

#Let's look at the table
head(data)
```

```
##   Job.ID       Date       Day  Time          Job.Type     Dispatch
## 1    176 01/07/2013    Monday 05:28               RTC    Immediate
## 2    217 06/07/2013  Saturday 19:06 Accidental injury Crew Request
## 3    224 08/07/2013    Monday 10:17 Accidental injury  Interrogate
## 4    225 08/07/2013    Monday 15:27               RTC  Interrogate
## 5    229 09/07/2013   Tuesday 11:57               RTC  Interrogate
## 6    234 10/07/2013 Wednesday 07:25               RTC  Interrogate
##                                 Location County       Grid Callsign
## 1                               tonbridge   Kent TQ 612 435     DA33
## 2            Royal Pier Road, Gravesend   Kent TQ 649 743     DA33
## 3         Wittersham Nr Tenterden, Kent   Kent TQ 903 285     DA55
## 4                           Farnborough Surrey SU 881 541      H60
## 5                         M26 Sevenoaks   Kent TQ 497 570      H60
## 6 M20 Junc 9-8, London-bound carriageway   Kent TQ 801 566     DA55
##   Vehicle Patients
Injuries
## 1   Volvo        1 Head, Thorax, Upper arm, Lower arm, Abdomen,
Upper leg
## 2   Volvo        1                                  Head, Thorax,
Abdomen
## 3   Volvo        1                                  Head, Thorax,
Abdomen
## 4  G-KSSA        1
Head
## 5  G-KSSA        1                                Head, Upper arm,
Thorax
## 6   Volvo        1                                   Lower arm,
Lower leg
##   RSI                           Interventions
## 1  No              Splintage, Packaging, Access
## 2  No              Access, Packaging, Splintage
## 3  No          Packaging, Splintage, Ultrasound
## 4 Yes                 Access, Airway, Packaging
```

```
## 5 Yes Access, Packaging, Splintage, Thoracostomy
## 6  No              Access, Packaging, Ultrasound
##
Drugs
## 1 Fentanyl, Ketamine, Paracetamol, Tranexamic Acid, Ondansetron,
Midazolam
## 2                                          Ondansetron, Ketamine,
Midazolam
## 3                                                    Morphine,
Paracetamol
## 4  Paracetamol, Fentanyl, Ketamine, Midazolam, Tranexamic Acid,
Rocuronium
## 5     Fentanyl, Ketamine, Midazolam, Morphine, Rocuronium,
Tranexamic Acid
## 6                                          Ketamine, Midazolam,
Ondansetron
##   Blood Code.Red Direct.to.CT                Hospital
Result
## 1    No       No           No King's College Hospital Patient
Conveyed
## 2    No       No           No King's College Hospital Patient
Conveyed
## 3    No       No           No King's College Hospital  Patient
Treated
## 4    No       No           No King's College Hospital Patient
Conveyed
## 5    No       No           No King's College Hospital Patient
Conveyed
## 6    No       No           No King's College Hospital Patient
Conveyed
##   Job.Done D.D.flag MR.flag Postcode D.D.outcome Team Safeguarding
## 1      Yes       NA      NA  tn110qf          NA <NA>            0
## 2      Yes       NA      NA DA12 2AZ          NA <NA>            0
## 3      Yes       NA      NA TN30 7HL          NA <NA>            0
## 4      Yes       NA      NA  gu1 6lj          NA <NA>            0
## 5      Yes       NA      NA TN13 2SA          NA <NA>            0
## 6      Yes       NA      NA  ME144PW          NA <NA>            0
```

```r
#Let's see how many cases there are
print(nrow(data))
```

```
## [1] 569
```

Notice that the coordinates are in the Ordnance Survey Grid format under the column "Grid". For us to work with this meaningfully, we need to convert this to latitude and longitude (WGS84) coordinates.

Fortunately there are others who have encountered the same problem before:

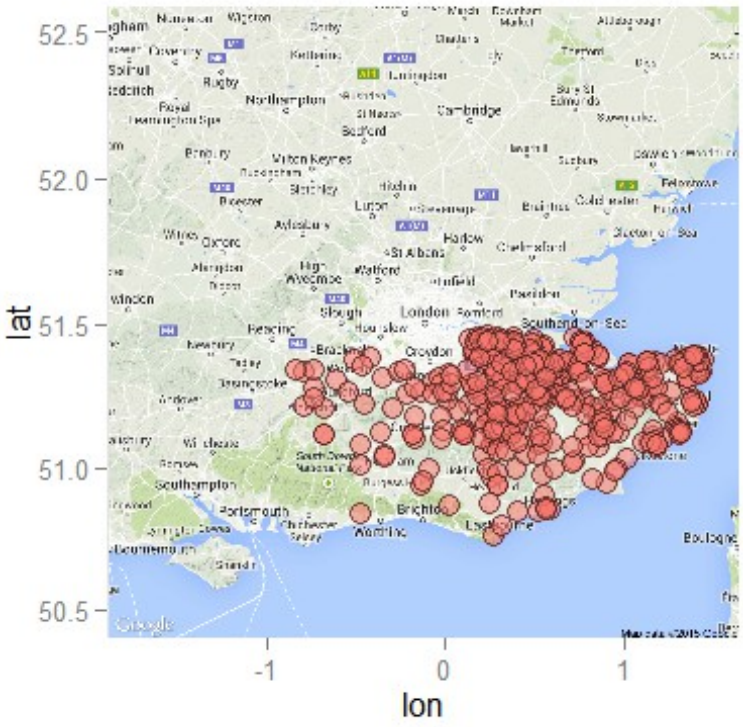
Sources:

```
* http://stackoverflow.com/questions/23017053/how-to-convert-uk-grid-reference-to-latitude-and-longitude-in-r
* https://stat.ethz.ch/pipermail/r-sig-geo/2010-November/010141.html
* http://www.hannahfry.co.uk/blog/2012/02/01/converting-british-national-grid-to-latitude-and-longitude-ii
* http://cran.r-project.org/web/packages/rnrfa/rnrfa.pdf

#Load the required packages
require(rnrfa)
require(dplyr)

#Remove the rows with missing Grid references
data <- filter(data, !is.na(Grid))

#Parse the OS Grid References into Eastings and Northings, then pipe it into WSG84 Coordinates
coordinates <- OSGParse(data$Grid) %>% OSG2LatLon()

#Add these onto the data
data <- mutate(data, lat = coordinates$Latitude, lon = coordinates$Longitude)

#Write to .csv
write.csv(data, file="data/cleaned.csv")
```

We can now start making some maps!

Let's first visualise the locations of each HEMS pickup as a quick visualisation

```
#Load the required libraries
require(ggplot2)
require(ggmap)
require(dplyr)

#Get map from Google
ukmap <- get_map(location = "London, UK", zoom = 8, scale = 4)
ggmap(ukmap) + geom_point(data = data, aes(x = data$lon, y = data$lat, fill = "red", alpha = 0.8), size = 4, shape = 21) + guides(fill=FALSE, alpha=FALSE, size=FALSE)
```

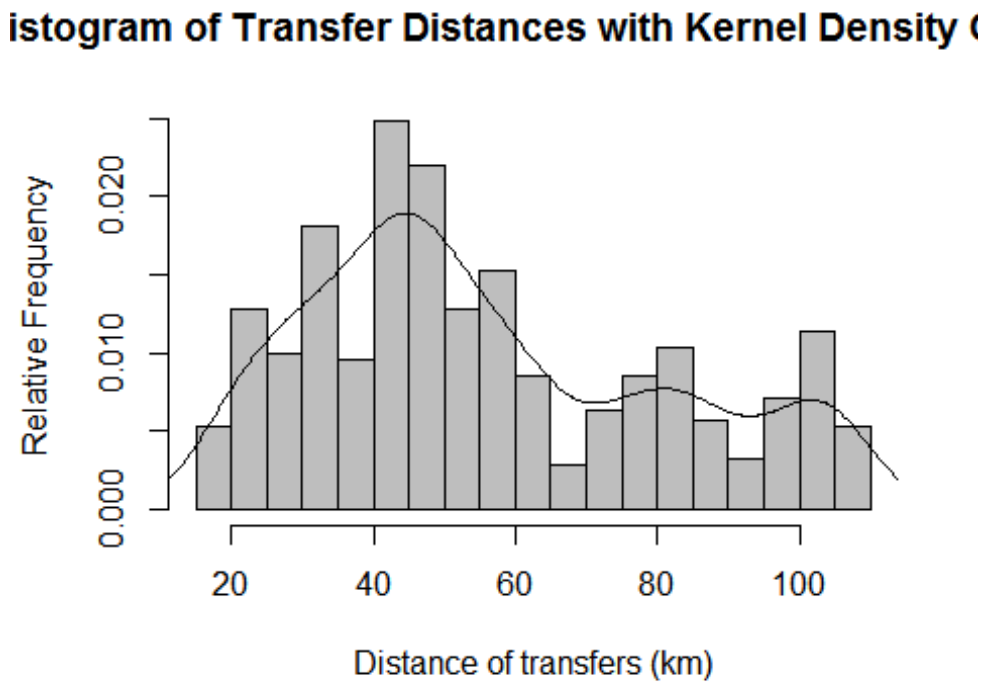



```
#We can separate the cases by the county where they come from, let's
see the counties where they come from
county <- count(data, County)
county
```

```
## Source: local data frame [7 x 2]
##
##           County   n
## 1    East Sussex  21
## 2 Greater London   1
## 3      Hampshire   1
## 4           Kent 490
## 5         Surrey  33
## 6    West Sussex  12
## 7             NA   5
```

```
#Let's write this into a .csv file for QGIS to use
write.csv(county, "data/county.csv")

#Let's measure the distances between all the HEMS pickup sites and KCH
#We need the coordinates for KCH
KCH <- geocode("King's College Hospital, Denmark Hill, London")

#Let's load the required library to calculate distances
require(geosphere)

#We apply the VincentyEllipsoid method of calculating straight-line
```

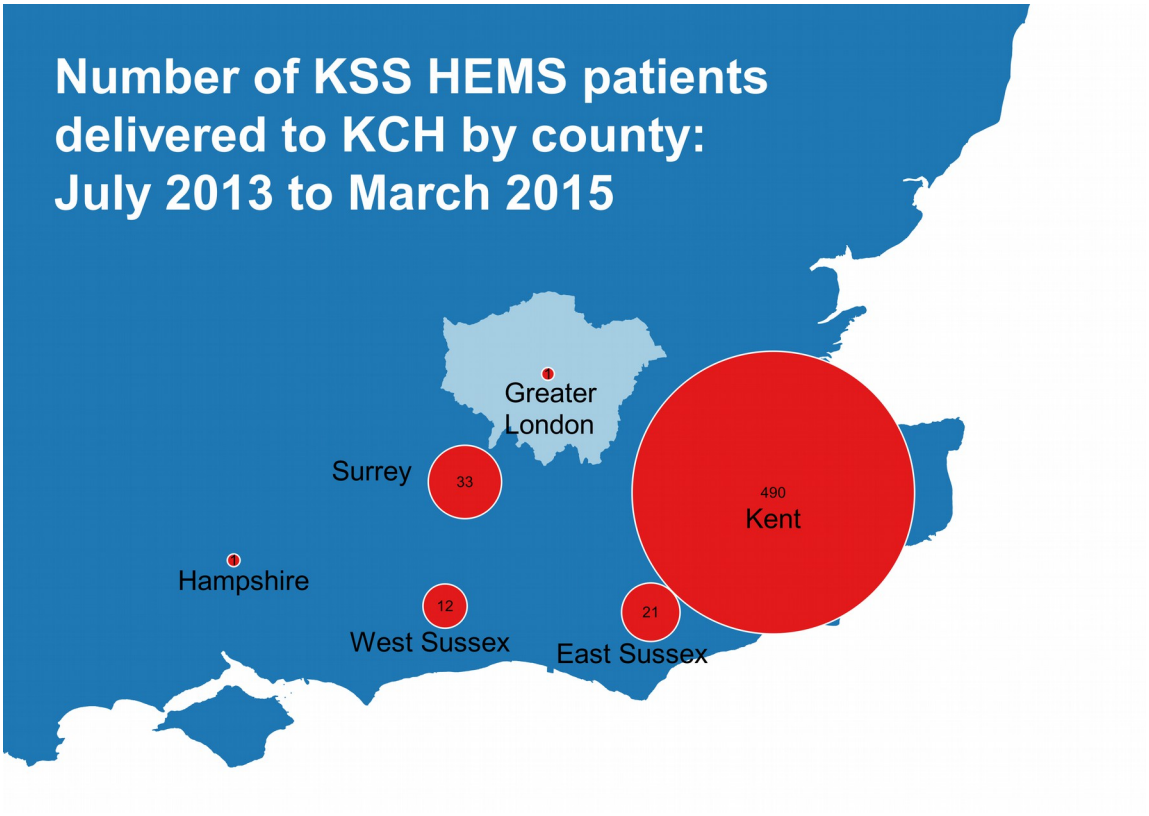
```
distance, and
coordinates <- data.frame("lon" = coordinates$Longitude, "lat" =
coordinates$Latitude)
KCH <- data.frame("lon" = KCH$lon, "lat" = KCH$lat)
coordinates$distance <- distVincentyEllipsoid(p1 = coordinates, p2 =
KCH) #This calculates distances in meters

#Lets add this distance to the master data frame, but convert it to
kilometers first
data <- mutate(data, distance = coordinates$distance/1000)

summary(data$distance)

##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   16.02   37.90   49.11   56.03   75.51  107.80

#Plot a histogram of the distances
hist(data$distance, breaks = 25, prob=TRUE, col="grey", xlab =
"Distance of transfers (km)", ylab = "Relative Frequency", main =
"Histogram of Transfer Distances with Kernel Density Curve")

#Overlay the kernel density plot of the distances
lines(density(data$distance))
```

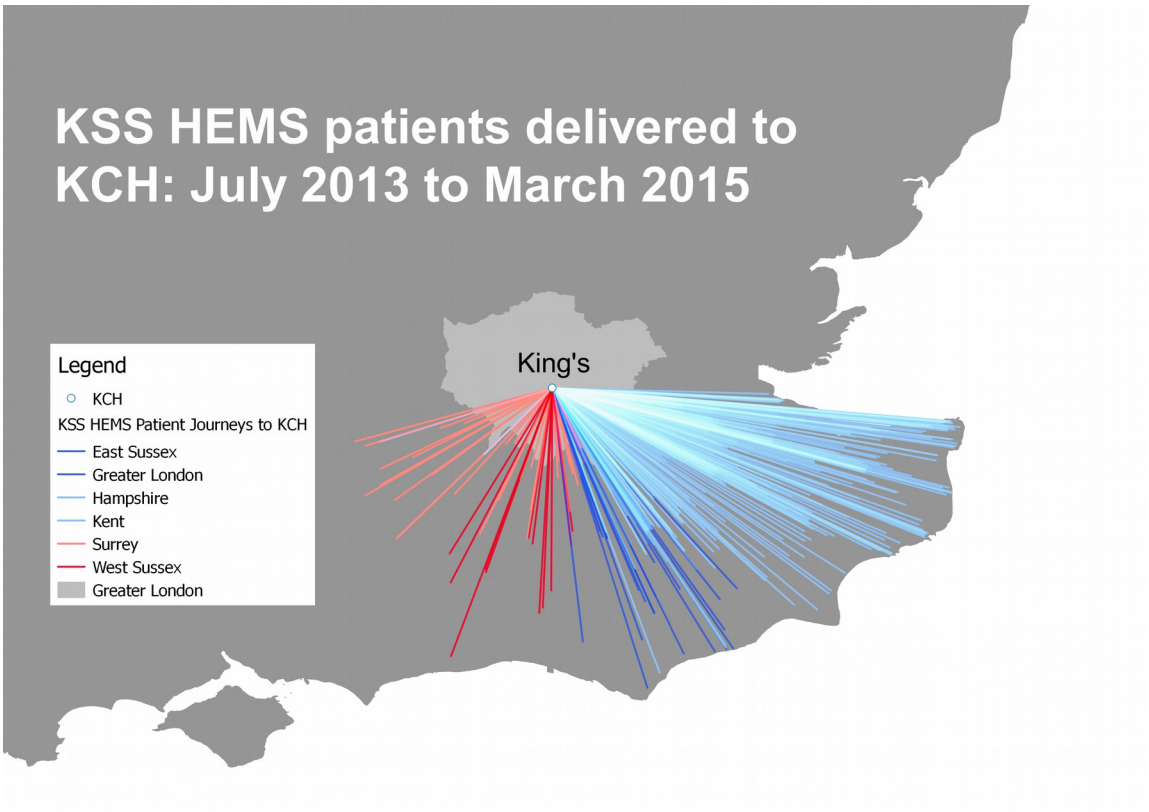



We will create a new field for drawing lines between the Head and Tail sites on QGIS in a Well-Known-Text (WKT) LINESTRING format

```
#Text formatting for WKT LINESTRING
data$wkt <- paste0("LINESTRING(", data$lon, " ", data$lat, ",",
KCH$lon, " ", KCH$lat, ")")

#Save the dataframe as a .csv
write.csv(data, file = "data/cleaned.csv")
write.csv(KCH, "data/KCH.csv")
```

We can now see the QGIS mapping results below:



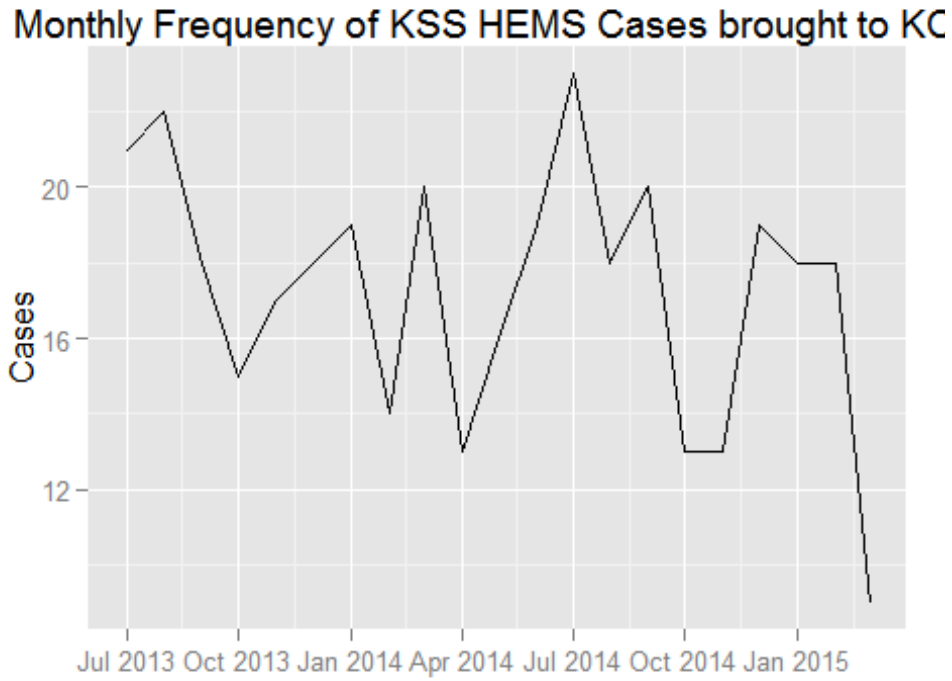



We want to see whether there is a temporal relationship with HEMS cases, and whether there St George's building their Helipad has had any effect on KCH's workload.

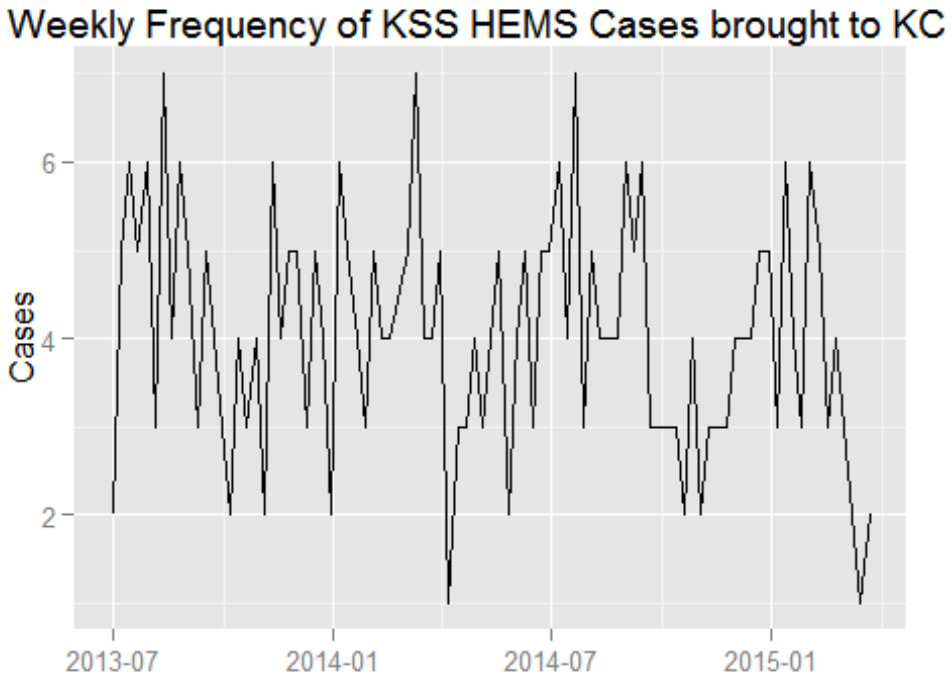
```
#Load the required libraries
require(lubridate)
require(dplyr)

#We use the Lubridate package to manipulate the dates and time strings
into POSIXct format so we can perform stats on them
timestamp <- paste(data$Date, " ", data$Time)

data$Date <- dmy(data$Date)
data$Day <- wday(data$Date, label = TRUE)

#Let's see if there is a difference between the cases depending of
which day of the week they arrive
count(data, Day)
```

```
## Source: local data frame [7 x 2]
##
##     Day  n
## 1   Sun 90
## 2   Mon 69
## 3  Tues 72
## 4   Wed 78
```

```
## 5 Thurs 90
## 6   Fri 89
## 7   Sat 75

#Let's select the cases 6 months before St George's Helipad was
constructed and 6 months after
data_before <- data %>% filter(Date >= dmy("01/10/2013") & Date <
dmy("01/04/2014"))
data_after <- data %>% filter(Date >= dmy("01/04/2014") & Date <
dmy("01/10/2014"))

count(data_before, County)

## Source: local data frame [6 x 2]
##
##           County   n
## 1    East Sussex   3
## 2 Greater London   1
## 3           Kent 132
## 4         Surrey  12
## 5    West Sussex   5
## 6             NA   5

count(data_after, County)

## Source: local data frame [4 x 2]
##
##        County   n
## 1 East Sussex  10
## 2        Kent 150
## 3      Surrey   4
## 4 West Sussex   3

#Let's draw a time series of the cases, by monthly frequency
case_count <- count(data, Date)
case_count$Month <- as.Date(cut(case_count$Date, breaks = "month"))
monthly_count <- count(case_count, Month)

#Load ggplot2 to graph
require(ggplot2)

#Plot
ggplot(monthly_count, aes(Month, n)) +
    geom_line() +
    xlab("") +
    ylab("Cases") +
    ggtitle("Monthly Frequency of KSS HEMS Cases brought to KCH")
```




```r
#Let's now draw a time series of the cases, by weekly frequency this
time
case_count$Week <- as.Date(cut(case_count$Date, breaks = "week"))
weekly_count <- count(case_count, Week)

#Plot
ggplot(weekly_count, aes(Week, n)) +
    geom_line() +
    xlab("") +
    ylab("Cases") +
    ggtitle("Weekly Frequency of KSS HEMS Cases brought to KCH")
```


Weekly Frequency of KSS HEMS Cases brought to KC
Cases
6
4
2
2013-07
2014-01
2014-07
2015-01