Summer School – day two

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1 aha

Look at Figure 1, it shows the output of a magic function.

```r
library(TestPackage)
a <- add_2(seq(1:10))
plot(a)
```

Adding 2 to 4 we get 6.

```r
knitr::kable(head(cars),
             caption = "A table of the cars package"
             )
```

Look at the table 1.

Thanks to Xie (2016), Allaire et al. (2017), Xie (2014)

Xie knows what he (?) is doing (2014).

```r
add_3(5)
```
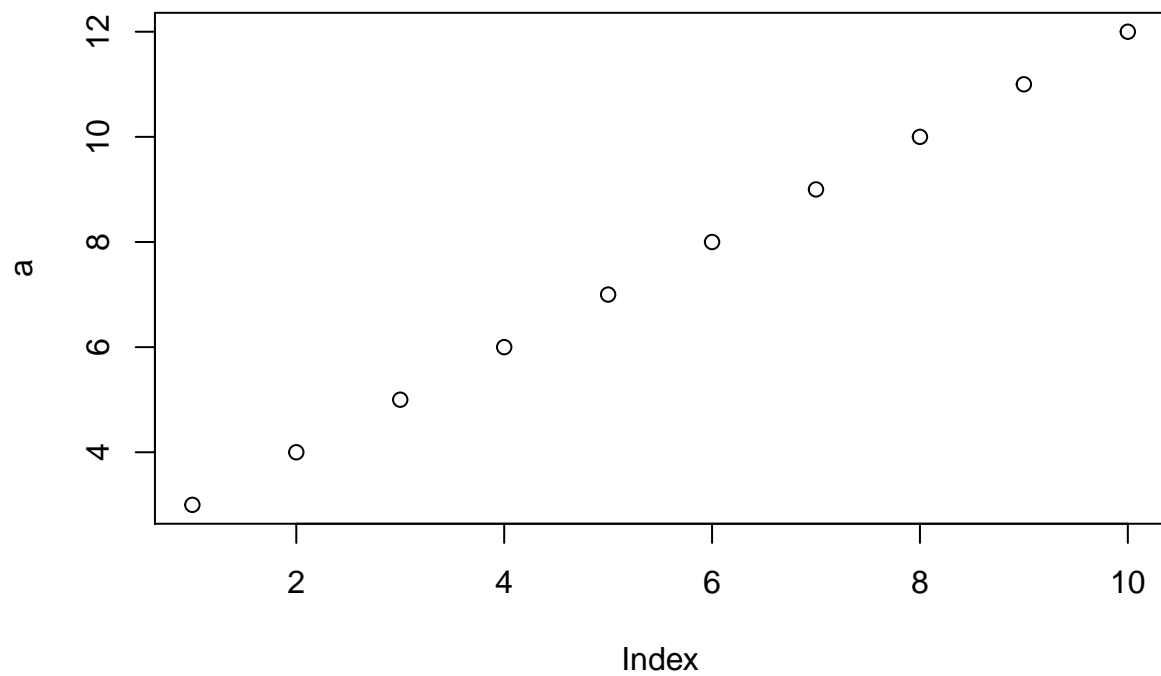
```
## [1] 8
```

Figure 1: add two

Table 1: A table of the cars package

speed	dist
4	2
4	10
7	4
7	22
8	16
9	10

2 Caching Tests

```r
library(tidyverse)
x <- rnorm(1e6) - 5e3
knitr::kable(head(x))
```

3 second column

```r
selsecond(mtcars)
```

```
##                      cyl
## Mazda RX4              6
## Mazda RX4 Wag          6
## Datsun 710             4
## Hornet 4 Drive         6
## Hornet Sportabout      8
## Valiant                6
## Duster 360             8
## Merc 240D              4
## Merc 230               4
## Merc 280               6
## Merc 280C              6
## Merc 450SE             8
## Merc 450SL             8
## Merc 450SLC            8
## Cadillac Fleetwood     8
## Lincoln Continental    8
## Chrysler Imperial      8
## Fiat 128               4
## Honda Civic            4
## Toyota Corolla         4
## Toyota Corona          4
## Dodge Challenger       8
## AMC Javelin            8
## Camaro Z28             8
## Pontiac Firebird       8
## Fiat X1-9              4
## Porsche 914-2          4
## Lotus Europa           4
## Ford Pantera L         8
## Ferrari Dino           6
## Maserati Bora          8
## Volvo 142E             4
```

4 Packrat test

```r
library(binford)
data(LRB)
knitr::kable(head(LRB))
```

X	seq339	groupno	name	year	ethref
Punan	1	1	Punan_(Borneo)	1970	Kedit 1982 Harrison 1949 Avadhani 1975
Batek	2	2	Batek_Phillipines	1968	Eder 1987 Cadelina 1982
Kubu	3	3	Kubu-(Ridan)	1900	NA
Shompen	4	4	Shompen	1989	Rivzi 1990
Onge	5	5	Onge	1952	Heine-Geldern Hoehn-Gerlachstein 1958 Sen 1962 Cooper
Jarwa	6	6	Jarwa	1906	Temple 1903 Radcliffe-Brown 1948

```
harran <- read.table("../data/Sites_HarranPlain.csv", sep = ",", header=TRUE)
str(harran)
```

```
## 'data.frame':    344 obs. of  5 variables:
##  $ X.1            : int  1 2 3 4 5 6 7 8 9 10 ...
##  $ Name           : Factor w/ 166 levels "Ahmet Aslan Tar. (FALSCH)",..: 9 40 40 62 62 62 62 64 6
##  $ X              : num  38.8 38.9 38.9 38.9 38.9 ...
##  $ Y              : num  37.6 37.7 37.7 37.2 37.2 ...
##  $ Mentioned_Epoch: Factor w/ 179 levels "","-","Aceramic Neolithic ",..: 175 150 139 162 108 151
```

```
library(sp)
coordinates(harran) <- ~X+Y
proj4string(harran) <- CRS("+init=epsg:4326")
str(harran)
```

```
## Formal class 'SpatialPointsDataFrame' [package "sp"] with 5 slots
##   ..@ data       :'data.frame':  344 obs. of  3 variables:
##   .. ..$ X.1            : int [1:344] 1 2 3 4 5 6 7 8 9 10 ...
##   .. ..$ Name           : Factor w/ 166 levels "Ahmet Aslan Tar. (FALSCH)",..: 9 40 40 62 62 62 6
##   .. ..$ Mentioned_Epoch: Factor w/ 179 levels "","-","Aceramic Neolithic ",..: 175 150 139 162 1
##   ..@ coords.nrs : int [1:2] 3 4
##   ..@ coords     : num [1:344, 1:2] 38.8 38.9 38.9 38.9 38.9 ...
##   .. ..- attr(*, "dimnames")=List of 2
##   .. .. ..$ : chr [1:344] "1" "2" "3" "4" ...
##   .. .. ..$ : chr [1:2] "X" "Y"
##   ..@ bbox       : num [1:2, 1:2] 38.8 36.7 39.2 38.8
##   .. ..- attr(*, "dimnames")=List of 2
##   .. .. ..$ : chr [1:2] "X" "Y"
##   .. .. ..$ : chr [1:2] "min" "max"
##   ..@ proj4string:Formal class 'CRS' [package "sp"] with 1 slot
##   .. .. ..@ projargs: chr "+init=epsg:4326 +proj=longlat +datum=WGS84 +no_defs +ellps=WGS84 +towg
```

```
library(raster)
##srtm <- getData("SRTM", lon=38, lat=37)
srtm <- raster("srtm_44_05.tif")
plot(srtm)
points(harran)
srtm <- crop(srtm, extent(harran)+1)
plot(srtm)
srtm <- projectRaster(srtm, crs = CRS("+init=epsg:32637"))
srtm2 <- aggregate(srtm, fact = 2)
writeRaster(srtm2, "data/dem.tif", overwrite = TRUE)
```

4.1   create point pattern object

```
harran <- spTransform(harran, CRSobj = CRS("+init=epsg:32637"))
library(spatstat)
```

```
## Loading required package: nlme
```

```
## Loading required package: rpart
```

```
## 
## spatstat 1.51-0        (nickname: 'Poetic Licence')
## For an introduction to spatstat, type 'beginner'

## 
## Note: spatstat version 1.51-0 is out of date by more than 11 weeks; a newer version should be ava
```

```r
harran_ppp <- ppp(x = harran@coords[,1],
              y = harran@coords[,2],
              window = owin(xrange = harran@bbox[1,],
                            yrange = c(min(harran@coords[,2]), min(harran@coords[,2]+52000)))))
```

```
## Warning: 65 points were rejected as lying outside the specified window
```

```
## Warning: data contain duplicated points
```

```r
plot(harran)
```
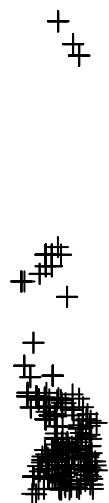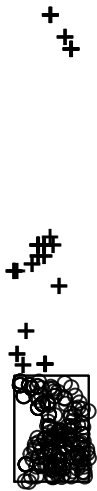

4.1.1 challenge: delete duplicated points

```r
anyDuplicated(harran_ppp)
```

```
## [1] 2
```

```r
harran <- unique(harran_ppp)
plot(harran_ppp)
```

```
## Warning: Interpretation of arguments maxsize and markscale has changed (in
## spatstat version 1.37-0 and later). Size of a circle is now measured by its
## diameter.
```

```
## Warning in plot.ppp(harran_ppp): 65 illegal points also plotted
```
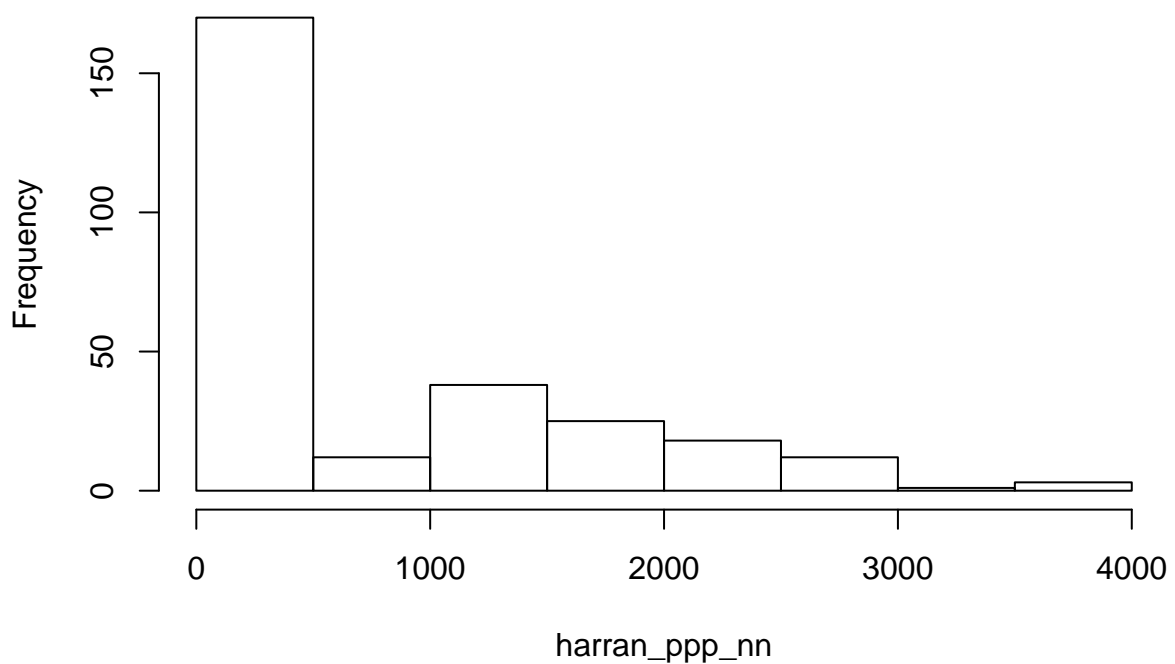
harran_ppp


```
harran_ppp_nn <- nndist(harran_ppp)
str(harran_ppp_nn)
```

```
##  num [1:279] 0 0 0 0 0 0 0 0 0 0 ...
```
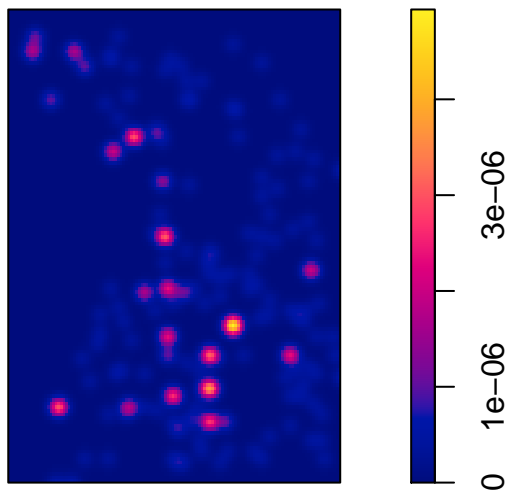
```
hist(harran_ppp_nn)
```

Histogram of harran_ppp_nn

4.2   challenge create kernel density estimation

```
harran_kde <- density.ppp(x = harran_ppp, sigma = mean(harran_ppp_nn))
plot(harran_kde)
```

harran_kde

## 4.3 raster

```r
library(raster)
```

```
##
## Attaching package: 'raster'
```

```
## The following objects are masked from 'package:spatstat':
##
##      area, rotate, shift
```

```
## The following object is masked from 'package:nlme':
##
##      getData
```

```r
dem <- raster("../data/dem.tif")

im_dem <- as.im(as.image.SpatialGridDataFrame(as(dem, "SpatialGridDataFrame")))

harran_rhohat <- rhohat(object = harran_ppp,
                        covariate = im_dem,
                        bw = 200
                        )
plot(harran_rhohat)
```

harran_rhohat
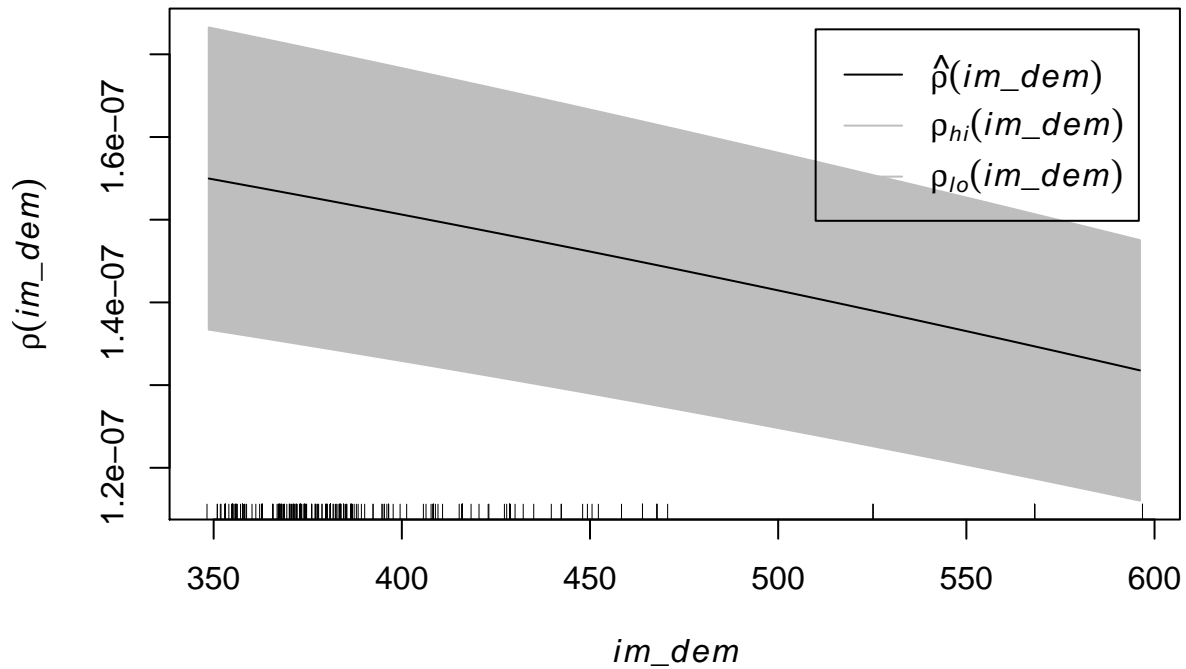

```r
str(harran_rhohat)
```

```
## Classes 'rhohat', 'fv' and 'data.frame':  512 obs. of  5 variables:
##  $ im_dem: num  347 348 349 350 350 ...
##  $ rho   : num  1.55e-07 1.55e-07 1.55e-07 1.55e-07 1.55e-07 ...
##  $ var   : num  8.70e-17 8.69e-17 8.68e-17 8.68e-17 8.67e-17 ...
##  $ hi    : num  1.73e-07 1.73e-07 1.73e-07 1.73e-07 1.73e-07 ...
##  $ lo    : num  1.37e-07 1.37e-07 1.37e-07 1.37e-07 1.37e-07 ...
##  - attr(*, "argu")= chr "im_dem"
##  - attr(*, "valu")= chr "rho"
##  - attr(*, "ylab")= language rho(im_dem)
##  - attr(*, "yexp")= language rho(im_dem)
##  - attr(*, "fmla")= chr ".~im_dem"
##  - attr(*, "alim")= num  348 597
##  - attr(*, "labl")= chr  "im_dem" "hat(%s)(im_dem)" "bold(Var)~hat(%s)(im_dem)" "%s[hi](im_dem)"
##  - attr(*, "desc")= chr  "covariate im_dem" "Estimated intensity" "Variance of estimator" "Upper
##  - attr(*, "units")=List of 3
##   ..$ singular  : chr "unit"
##   ..$ plural    : chr "units"
##   ..$ multiplier: num 1
##   ..- attr(*, "class")= chr "units"
##  - attr(*, "fname")= chr "rho"
##  - attr(*, "dotnames")= chr  "rho" "hi" "lo"
##  - attr(*, "stuff")=List of 11
##   ..$ modelcall : NULL
##   ..$ callstring: chr "rhohat.ppp(object = harran_ppp, covariate = im_dem, bw = 200)"
##   ..$ sigma     : num 200
##   ..$ covname   : chr "im_dem"
##   ..$ ZX        : num  464 464 371 371 371 ...
##   ..$ lambda    : num  1.47e-07 1.47e-07 1.47e-07 1.47e-07 1.47e-07 ...
##   ..$ method    : chr "ratio"
##   ..$ smoother  : chr "kernel"
##   ..$ reference : chr "Lebesgue"
##   ..$ horvitz   : logi FALSE
```

```
##   ..$ Zimage    :List of 10
##   .. ..$ v     : num [1:1842, 1:871] NA NA NA NA NA NA NA NA NA NA ...
##   .. ..$ dim   : int  1842 871
##   .. ..$ xrange: num  432102 559965
##   .. ..$ yrange: num  4006377 4347147
##   .. ..$ xstep : num 147
##   .. ..$ ystep : num 185
##   .. ..$ xcol  : num  432176 432323 432469 432616 432763 ...
##   .. ..$ yrow  : num  4006469 4006654 4006839 4007024 4007209 ...
##   .. ..$ type  : chr "real"
##   .. ..$ units :List of 3
##   .. .. ..$ singular  : chr "unit"
##   .. .. ..$ plural    : chr "units"
##   .. .. ..$ multiplier: num 1
##   .. .. ..- attr(*, "class")= chr "units"
##   .. ..- attr(*, "class")= chr "im"
```

```
rho_dem <- predict(harran_rhohat)
plot(rho_dem)
```

rho_dem
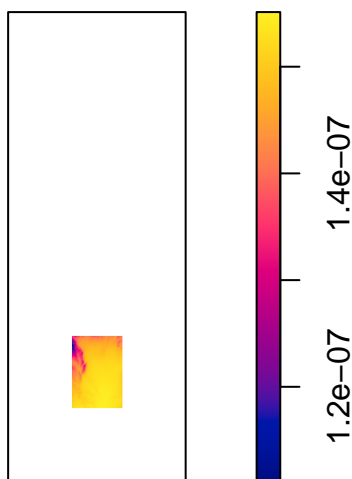

```
diff_rho <- harran_kde - rho_dem
```

```
## Warning: the images 'e1' and 'e2' were not compatible
```

create random points with rpoispp function that have the same intensity like our point pattern.

```
set.seed(123)
harran_poispp2 <- rpoispp(lambda = harran_ppp$n/area.owin(harran_ppp$window), win = harran_ppp$windo
set.seed(123)
harran_poispp3 <- rpoispp(intensity(harran_ppp), win=Window(harran_ppp))
set.seed(123)
harran_poispp4 <- rpoispp(ex = harran_ppp)

plot(harran_ppp)
```

```
## Warning in plot.ppp(harran_ppp): 65 illegal points also plotted
```

```
points(harran_poispp2, col = "red")
points(harran_poispp3, col = "blue")
points(harran_poispp4, col = "green")
```

harran_ppp
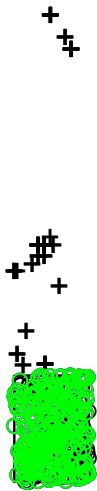
4.4 Second order effects

References

Allaire, JJ, Joe Cheng, Yihui Xie, Jonathan McPherson, Winston Chang, Jeff Allen, Hadley Wickham, Aron Atkins, Rob Hyndman, and Ruben Arslan. 2017. *Rmarkdown: Dynamic Documents for R.* https://CRAN.R-project.org/package=rmarkdown.

Xie, Yihui. 2014. "Knitr: A Comprehensive Tool for Reproducible Research in R." In *Implementing Reproducible Computational Research*, edited by Victoria Stodden, Friedrich Leisch, and Roger D. Peng. Chapman; Hall/CRC. http://www.crcpress.com/product/isbn/9781466561595.

———. 2016. *Bookdown: Authoring Books and Technical Documents with R Markdown.* Boca Raton, Florida: Chapman; Hall/CRC. https://github.com/rstudio/bookdown.