04_proc_using_spatstat

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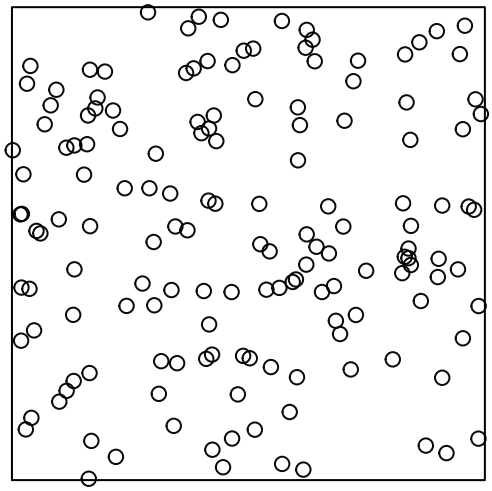
```
library(spatstat)
library(tidyverse)
library(here)
library(mvtnorm)
```

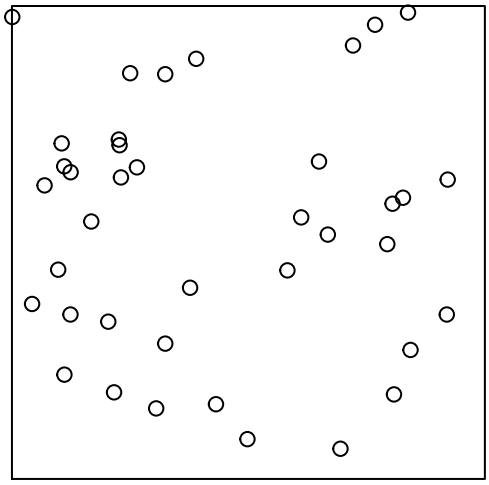
```
# Cox?
#rmvnorm(1, c(0.5, 0.5))
```

```
# Cox?
#plot(rpoispp(lambda = function(x, y) 400*x*y, win = square(1)), main = "") #plot_2D_NPP
```

```
# Cox?
#fun <- function (x, y) x*y + rbeta(1, 1/5, 1/5)*400
plot(rpoispp(lambda = rbeta(1, 1/5, 1/5)*150, win = square(1)), main = "")
```



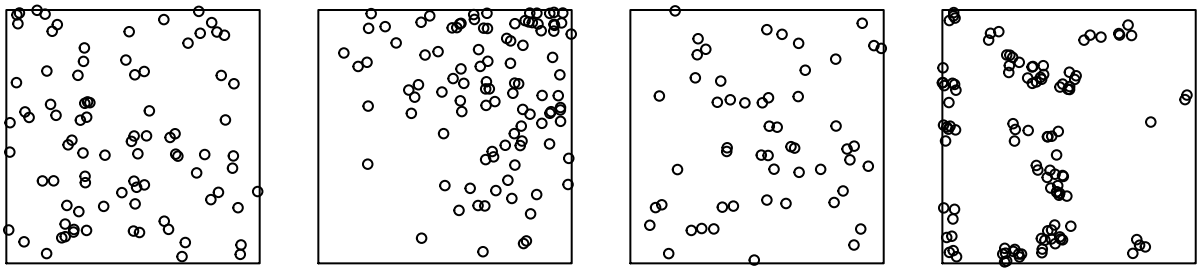
```
# Cox?
plot(rpoispp(lambda = rnorm(n = 1, 50, 0.05)), main = "") #plot_2D_Cox
```



```r
set.seed(1234)
par(mfrow=c(1, 4), mai = c(0.1, 0.1, 0.1, 0.1))

plot(rpoispp(lambda = 100, win=square(1)), main = "HPP (rate = 100)") #plot_2D_HPP
plot(rpoispp(lambda = function(x, y) 400*x*y, win = square(1)), main = "NPP (intensity = 400*x*y)") #pl
plot(rpoispp(lambda = rexp(n = 1, rate = 1/100)), main = "Cox Process") #plot_2D_Cox
plot(rMatClust(kappa = 20, r = 0.05, mu = 5), main = "Matern Process") #plot_2D_Matern
```

HPP (rate = 100) **NPP (intensity = 400*x*y)** **Cox Process** **Matern Process**

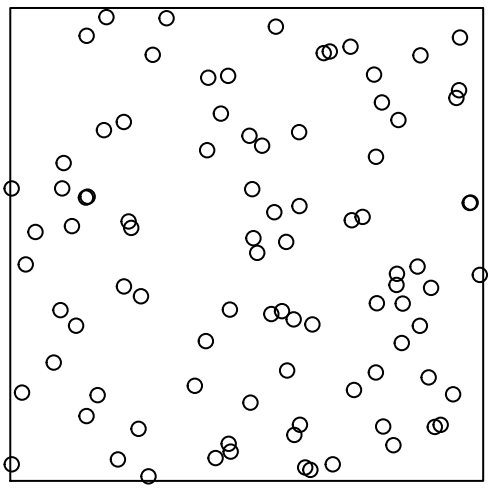


```r
#HPP (rate = 100)
#NPP (intensity = 400*x*y)
#Cox Process
#Matern Process
#Cox (intensity = exp(n = 1, rate = 1/100))
#Matern (kappa = 20, r = 0.05, mu = 5)
```

```r
# Check to see how to use the function
?rpoispp
# Check to see how this is written
#View(rpoispp)
```

```r
# Plot a homogeneous Poisson process
# p.1334 of https://mran.microsoft.com/snapshot/2016-04-25/web/packages/spatstat/spatstat.pdf
# https://spatstat.org/SSAI2017/solutions/solution04.html

par(mfrow=c(1, 1))
plot_2D_HPP <- plot(rpoispp(lambda = 100, win=square(1)), main = "HPP (rate = 100)")
```




```r
plot_2D_HPP
```

```
## Symbol map with no parameters
```

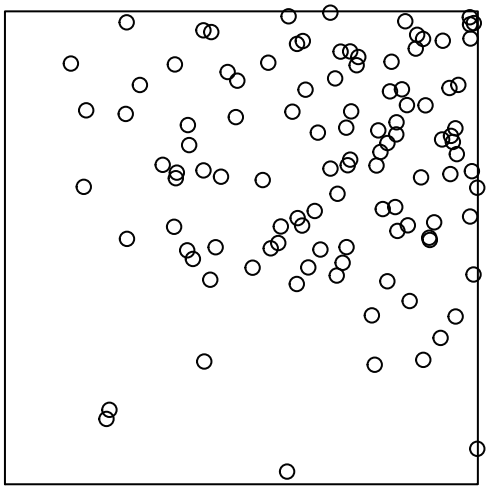
```r
#plot(rpoispp(lambda = 50, win=square(1)),main = "HPP (rate = 50)")
#plot(rpoispp(lambda = 10, win=square(1)),main = "HPP (rate = 10)")
```

```r
# Plot a nonhomogeneous Poisson process
# p.33 of https://spatstat.org/resources/spatstatJSSpaper.pdf

#lmbda_function <- function(x, y) 400*x
#so that they have the same expected # of events but why ???

par(mfrow=c(1, 1))
plot_2D_NPP <- plot(rpoispp(lambda = function(x, y) 400*x*y, win=square(1)), main = "NPP (intensity = 4
```

NPP (intensity = 400*x*y)



```
plot_2D_NPP
```

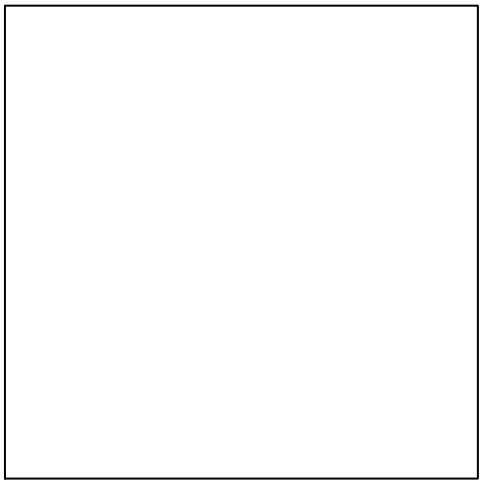
```
## Symbol map with constant values
## cols: #000000FD
```

```
#plot(rpoispp(lambda = function(x, y) 50*x, win=square(1)), main = "NPP (intensity = 50*x)")
#plot(rpoispp(lambda = function(x, y) 10*x, win=square(1)), main = "NPP (intensity = 10*x)")
```

```
# Plot a Cox process
# p.80 of https://darrylmcleod.com/wp-content/uploads/2016/06/Analysing-spatial-point-patterns-in-R.pdf

lmbda <- rexp(n = 1, rate = 1/100)
X <- rpoispp(lmbda)
plot(X, main = "Cox (intensity = exp(n = 1, rate = 1/100))")
```

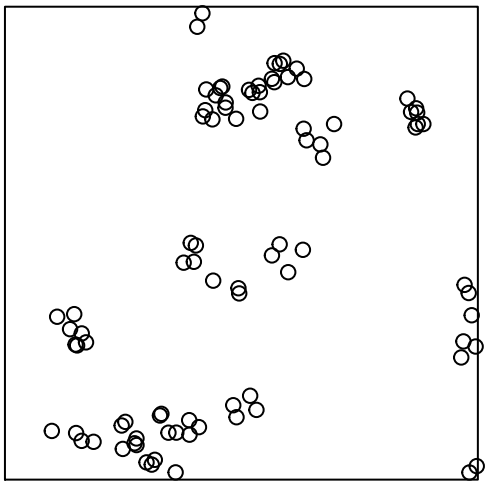
Cox (intensity = exp(n = 1, rate = 1/100))



```
?rMatClust
#kappa = intensity
#scale = radius of the clusters
#mu = mean # of points per cluster
```

```
plot_2D_Matern <- plot(rMatClust(kappa = 20, r = 0.05, mu = 5), main = "Matern (kappa = 20, r = 0.05, mu
```

Matern (kappa = 20, r = 0.05, mu = 5)



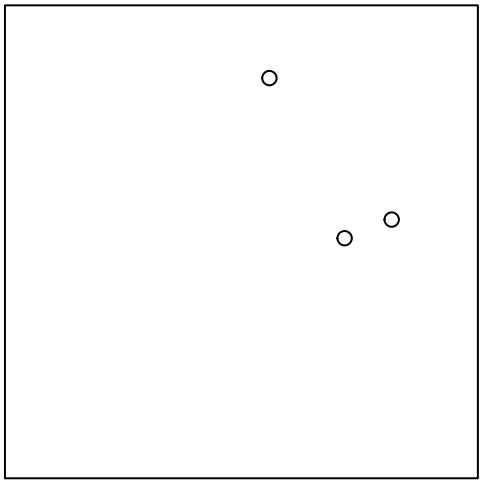
```
plot_2D_Matern
```

```
## Symbol map with no parameters
```

```
?rMaternII
# kappa = intensity
# r = inhibition distance
```

```
# Plot a Matern I process #Inhibition
par(mfrow=c(1, 1))
plot(rMaternI(kappa = 100, r = 0.1), main = "Matern I (kappa = 100, r = 0.05)")
```

Matern I (kappa = 100, r = 0.05)



```
#plot(rMaternI(kappa = 50, r = 0.05), main = "Matern I (kappa = 50, r = 0.05)")
#plot(rMaternI(kappa = 10, r = 0.05), main = "Matern I (kappa = 10, r = 0.05)")
points <- rMaternI(kappa = 100, r = 0.07)
length(points)
```

```
## [1] 5
```

```
pairdist(points)
```

```
##            [,1]      [,2]      [,3]       [,4]      [,5]       [,6]
##  [1,] 0.0000000 0.8906470 0.2660167 0.78626944 0.6466642 0.51814054
##  [2,] 0.8906470 0.0000000 0.7374478 0.54910611 0.2516281 0.37816964
##  [3,] 0.2660167 0.7374478 0.0000000 0.80811073 0.5270507 0.36652277
##  [4,] 0.7862694 0.5491061 0.8081107 0.00000000 0.4276549 0.53998052
##  [5,] 0.6466642 0.2516281 0.5270507 0.42765489 0.0000000 0.16433413
##  [6,] 0.5181405 0.3781696 0.3665228 0.53998052 0.1643341 0.00000000
##  [7,] 0.7911280 0.4773255 0.7886543 0.07295554 0.3710141 0.49647461
##  [8,] 0.3453091 0.6608089 0.4240233 0.44124535 0.4124769 0.36593672
##  [9,] 0.7240486 0.8962979 0.8669930 0.38199178 0.7076334 0.74896827
## [10,] 0.7570071 0.6996875 0.8321377 0.16212420 0.5444903 0.62527049
## [11,] 0.8980516 0.7781350 0.9759728 0.23322741 0.6568224 0.75439304
## [12,] 0.4109388 0.4798020 0.3073241 0.51850595 0.2381271 0.11893644
## [13,] 0.5950723 0.3267160 0.4128381 0.59406926 0.1763221 0.09342385
## [14,] 0.2078319 0.6842057 0.2188073 0.61932506 0.4388951 0.31697627
## [15,] 0.6932259 0.4204705 0.6743479 0.16143660 0.2673877 0.38130047
## [16,] 0.1484294 0.7811129 0.1211176 0.76585167 0.5491465 0.40299231
## [17,] 0.9445826 0.1035288 0.8128040 0.50156827 0.2981567 0.44711773
## [18,] 0.3715585 0.5862813 0.1521936 0.71358439 0.3859251 0.22199002
## [19,] 0.5876155 0.8993672 0.7538249 0.44495859 0.6829552 0.69156081
## [20,] 0.6372185 0.3321799 0.5723225 0.29996690 0.1316404 0.24857278
## [21,] 0.5070585 0.8695374 0.6756492 0.45791937 0.6419371 0.63466680
##             [,7]      [,8]      [,9]     [,10]     [,11]     [,12]
##  [1,] 0.79112799 0.3453091 0.7240486 0.7570071 0.8980516 0.4109388
```

```
##  [2,] 0.47732548 0.6608089 0.8962979 0.6996875 0.7781350 0.4798020
##  [3,] 0.78865426 0.4240233 0.8669930 0.8321377 0.9759728 0.3073241
##  [4,] 0.07295554 0.4412454 0.3819918 0.1621242 0.2332274 0.5185060
##  [5,] 0.37101407 0.4124769 0.7076334 0.5444903 0.6568224 0.2381271
##  [6,] 0.49647461 0.3659367 0.7489683 0.6252705 0.7543930 0.1189364
##  [7,] 0.00000000 0.4504069 0.4503145 0.2333350 0.3018932 0.4896116
##  [8,] 0.45040694 0.0000000 0.4457236 0.4214604 0.5653681 0.2564665
##  [9,] 0.45031455 0.4457236 0.0000000 0.2221166 0.2724052 0.6688534
## [10,] 0.23333499 0.4214604 0.2221166 0.0000000 0.1443304 0.5744931
## [11,] 0.30189318 0.5653681 0.2724052 0.1443304 0.0000000 0.7124714
## [12,] 0.48961157 0.2564665 0.6688534 0.5744931 0.7124714 0.0000000
## [13,] 0.54253052 0.4591508 0.8315901 0.6945394 0.8172078 0.2106300
## [14,] 0.61215798 0.2067950 0.6481863 0.6233134 0.7676437 0.2046444
## [15,] 0.11702806 0.3626305 0.4760594 0.2851119 0.3895690 0.3731443
## [16,] 0.75698036 0.3474519 0.7772708 0.7677450 0.9119846 0.3121973
## [17,] 0.42861550 0.6851258 0.8677605 0.6597008 0.7219840 0.5360060
## [18,] 0.68357881 0.3948575 0.8360620 0.7636234 0.9038505 0.1950815
## [19,] 0.50220770 0.3486713 0.1484199 0.3076127 0.4005681 0.5957192
## [20,] 0.24954192 0.3464133 0.5819075 0.4129206 0.5264271 0.2650015
## [21,] 0.50677297 0.2797935 0.2220986 0.3407334 0.4523919 0.5329599
##           [,13]     [,14]     [,15]     [,16]     [,17]     [,18]
##  [1,] 0.59507229 0.2078319 0.6932259 0.1484294 0.9445826 0.3715585
##  [2,] 0.32671599 0.6842057 0.4204705 0.7811129 0.1035288 0.5862813
##  [3,] 0.41283815 0.2188073 0.6743479 0.1211176 0.8128040 0.1521936
##  [4,] 0.59406926 0.6193251 0.1614366 0.7658517 0.5015683 0.7135844
##  [5,] 0.17632205 0.4388951 0.2673877 0.5491465 0.2981567 0.3859251
##  [6,] 0.09342385 0.3169763 0.3813005 0.4029923 0.4471177 0.2219900
##  [7,] 0.54253052 0.6121580 0.1170281 0.7569804 0.4286155 0.6835788
##  [8,] 0.45915083 0.2067950 0.3626305 0.3474519 0.6851258 0.3948575
##  [9,] 0.83159007 0.6481863 0.4760594 0.7772708 0.8677605 0.8360620
## [10,] 0.69453935 0.6233134 0.2851119 0.7677450 0.6597008 0.7636234
## [11,] 0.81720779 0.7676437 0.3895690 0.9119846 0.7219840 0.9038505
## [12,] 0.21063001 0.2046444 0.3731443 0.3121973 0.5360060 0.1950815
## [13,] 0.00000000 0.4006108 0.4326796 0.4694369 0.4103950 0.2608046
## [14,] 0.40061080 0.0000000 0.5056616 0.1467640 0.7367540 0.2281147
## [15,] 0.43267955 0.5056616 0.0000000 0.6483377 0.3960907 0.5667235
## [16,] 0.46943692 0.1467640 0.6483377 0.0000000 0.8454178 0.2282142
## [17,] 0.41039501 0.7367540 0.3960907 0.8454178 0.0000000 0.6641613
## [18,] 0.26080461 0.2281147 0.5667235 0.2282142 0.6641613 0.0000000
## [19,] 0.78070287 0.5371106 0.4928541 0.6550854 0.8877567 0.7429663
## [20,] 0.29431117 0.4345981 0.1385360 0.5665150 0.3406713 0.4497649
## [21,] 0.72581244 0.4602401 0.4786007 0.5752103 0.8669220 0.6709299
##           [,19]     [,20]     [,21]
##  [1,] 0.5876155 0.6372185 0.5070585
##  [2,] 0.8993672 0.3321799 0.8695374
##  [3,] 0.7538249 0.5723225 0.6756492
##  [4,] 0.4449586 0.2999669 0.4579194
##  [5,] 0.6829552 0.1316404 0.6419371
##  [6,] 0.6915608 0.2485728 0.6346668
##  [7,] 0.5022077 0.2495419 0.5067730
##  [8,] 0.3486713 0.3464133 0.2797935
##  [9,] 0.1484199 0.5819075 0.2220986
## [10,] 0.3076127 0.4129206 0.3407334
## [11,] 0.4005681 0.5264271 0.4523919
```

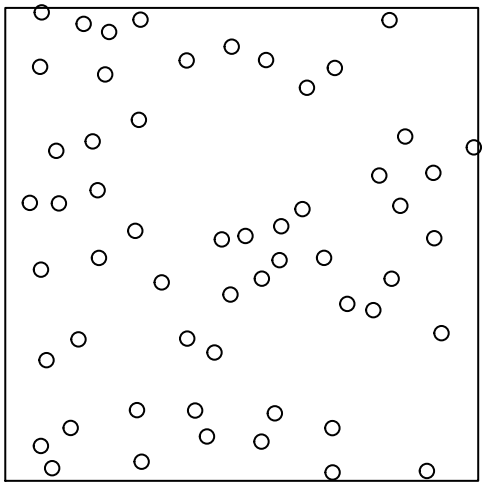
```
## [12,] 0.5957192 0.2650015 0.5329599
## [13,] 0.7807029 0.2943112 0.7258124
## [14,] 0.5371106 0.4345981 0.4602401
## [15,] 0.4928541 0.1385360 0.4786007
## [16,] 0.6550854 0.5665150 0.5752103
## [17,] 0.8877567 0.3406713 0.8669220
## [18,] 0.7429663 0.4497649 0.6709299
## [19,] 0.0000000 0.5696563 0.0807982
## [20,] 0.5696563 0.0000000 0.5373964
## [21,] 0.0807982 0.5373964 0.0000000
```

```
min(pairdist(points)[upper.tri(pairdist(points))])
```

```
## [1] 0.07295554
```

```
# Plot a Matern II process
par(mfrow=c(1, 1))
plot(rMaternII(kappa = 100, r = 0.05), main = "Matern II (kappa = 100, r = 0.05)")
```

Matern II (kappa = 100, r = 0.05)



```
#plot(rMaternII(kappa = 50, r = 0.05), main = "Matern II (kappa = 50, r = 0.05)")
#plot(rMaternII(kappa = 10, r = 0.05), main = "Matern II (kappa = 10, r = 0.05)")
```

```
# # Save out results
# write_rds(plot_2D_HPP, here("results", "plot_2D_HPP.jpeg"))
```

```
# # Error checking
# plot_2D_HPP <- readRDS(here("results", "plot_2D_HPP.jpeg"))
# plot_2D_HPP
```