Spatial

Derek Corcoran

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2015

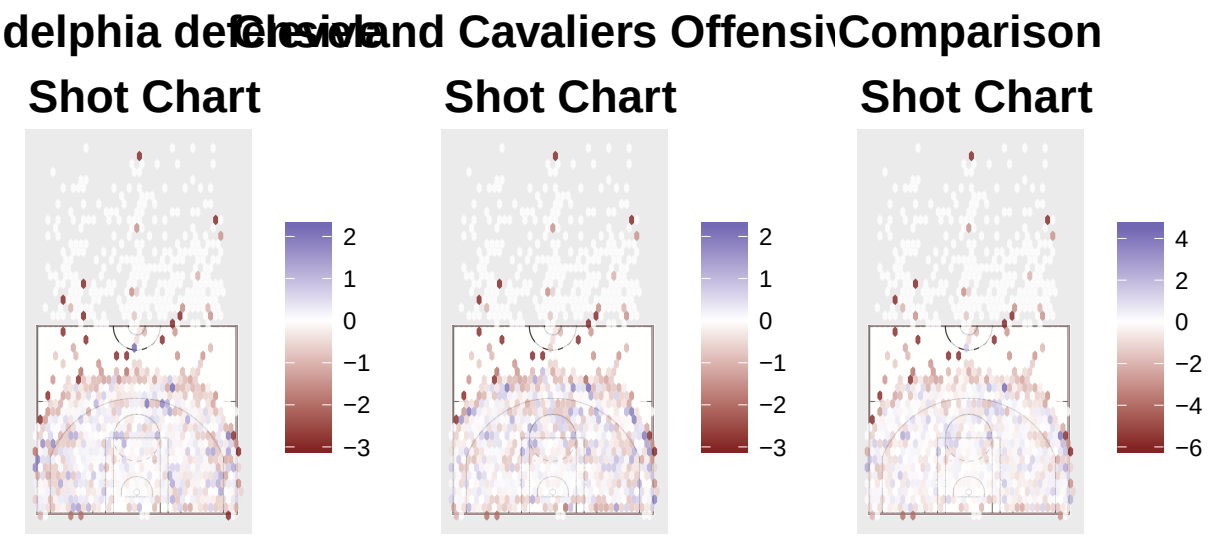
2016

2014

```
ShotComparison <- function(OffTeam, DefTown, SeasondataOff, SeasonDataDef, nbins = 40) {
  #Filter the offensive data of the Offensive Team
  Off <- filter(SeasondataOff, TEAM_NAME == OffTeam)
  #Filter the Deffensive data of the Defensive team
  deff <- SeasonDataDef[names(SeasonDataDef) == DefTown][[1]]
  #Get the maximum and minumum values for x and y
  xbnds <- range(c(SeasondataOff$LOC_X, deff$LOC_X))
  ybnds <- range(c(SeasondataOff$LOC_Y, deff$LOC_Y))
  #Make hexbin dataframes out of the teams
  makeHexData <- function(df) {
    h <- hexbin(df$LOC_X, df$LOC_Y, nbins, xbnds = xbnds, ybnds = ybnds, IDs = TRUE)
    data.frame(hcell2xy(h),
               PPS = tapply(as.numeric(as.character(df$SHOT_MADE_FLAG))*ifelse(tolower(df$SHOT_TYPE) ==
               ST = tapply(df$SHOT_MADE_FLAG, h@cID, FUN = function(z) length(z)),
               cid = h@cell)
  }
  ##Total NBA data
  Totalhex <- makeHexData(SeasondataOff)
  ##Defensive team data
  Defhex <- makeHexData(deff)
  ##Offensive team data
  Offhex <- makeHexData(Off)
  #Merge offensive and deffensive data with total data by Cell id
  DeffbyCell <- merge(Totalhex, Defhex, by = "cid", all = T)
  OffByCell <- merge(Totalhex, Offhex, by = "cid", all = T)
  ##  when calculating the difference empty cells should count as 0
  DeffbyCell$PPS.x[is.na(DeffbyCell$PPS.x)] <- 0
  DeffbyCell$PPS.y[is.na(DeffbyCell$PPS.y)] <- 0
  DeffbyCell$ST.y[is.na(DeffbyCell$ST.y)] <- 0

  OffByCell$PPS.x[is.na(OffByCell$PPS.x)] <- 0
  OffByCell$PPS.y[is.na(OffByCell$PPS.y)] <- 0
  OffByCell$ST.y[is.na(OffByCell$ST.y)] <- 0
  #  make a "difference" data.frame
  DiffDeff <- data.frame(x = ifelse(is.na(DeffbyCell$x.x), DeffbyCell$x.y, DeffbyCell$x.x),
                         y = ifelse(is.na(DeffbyCell$y.x), DeffbyCell$y.y, DeffbyCell$y.x),
                         PPS= DeffbyCell$PPS.y - DeffbyCell$PPS.x,
```

```
                      cid= DeffbyCell$cid,
                      ST = DeffbyCell$ST.y)

DiffOff <- data.frame(x = ifelse(is.na(OffByCell$x.x), OffByCell$x.y, OffByCell$x.x),
                      y = ifelse(is.na(OffByCell$y.x), OffByCell$y.y, OffByCell$y.x),
                      PPS= OffByCell$PPS.y - OffByCell$PPS.x,
                      ST = OffByCell$ST.x,
                      cid = OffByCell$cid,
                      ST = OffByCell$ST.y)
#make team comparisons
Comparison <- merge(DiffOff, DiffDeff, by = "cid", all = T)
Comparison <- Comparison[,-c(6:7)]
Comparison$Diff <- c(Comparison$PPS.x + Comparison$PPS.y)


PPSAA <- weighted.mean((Comparison$PPS.x + Comparison$PPS.y), Comparison$ST.x)

OFF <- ggplot(DiffOff)  +
  annotation_custom(court, -250, 250, -52, 418) +
  geom_hex(aes(x = x, y = y, fill = PPS),
           stat = "identity", alpha = 0.8) +
  guides(alpha = FALSE, size = FALSE) +
  coord_fixed()  +theme(line = element_blank(),
                        axis.title.x = element_blank(),
                        axis.title.y = element_blank(),
                        axis.text.x = element_blank(),
                        axis.text.y = element_blank(),
                        legend.title = element_blank(),
                        plot.title = element_text(size = 17, lineheight = 1.2, face = "bold")) + ggti
DEF <- ggplot(DiffDeff)  +
  annotation_custom(court, -250, 250, -52, 418) +
  geom_hex(aes(x = x, y = y, fill = PPS),
           stat = "identity", alpha = 0.8) +
  guides(alpha = FALSE, size = FALSE) +

  coord_fixed()  +theme(line = element_blank(),
                        axis.title.x = element_blank(),
                        axis.title.y = element_blank(),
                        axis.text.x = element_blank(),
                        axis.text.y = element_blank(),
                        legend.title = element_blank(),
                        plot.title = element_text(size = 17, lineheight = 1.2, face = "bold")) + ggti

COMP <- ggplot(Comparison)  +
  annotation_custom(court, -250, 250, -52, 418) +
  geom_hex(aes(x = x.x, y = y.x, fill = Diff),
           stat = "identity", alpha = 0.8) +
  guides(alpha = FALSE, size = FALSE) +

  coord_fixed()  +theme(line = element_blank(),
                        axis.title.x = element_blank(),
                        axis.title.y = element_blank(),
                        axis.text.x = element_blank(),
```

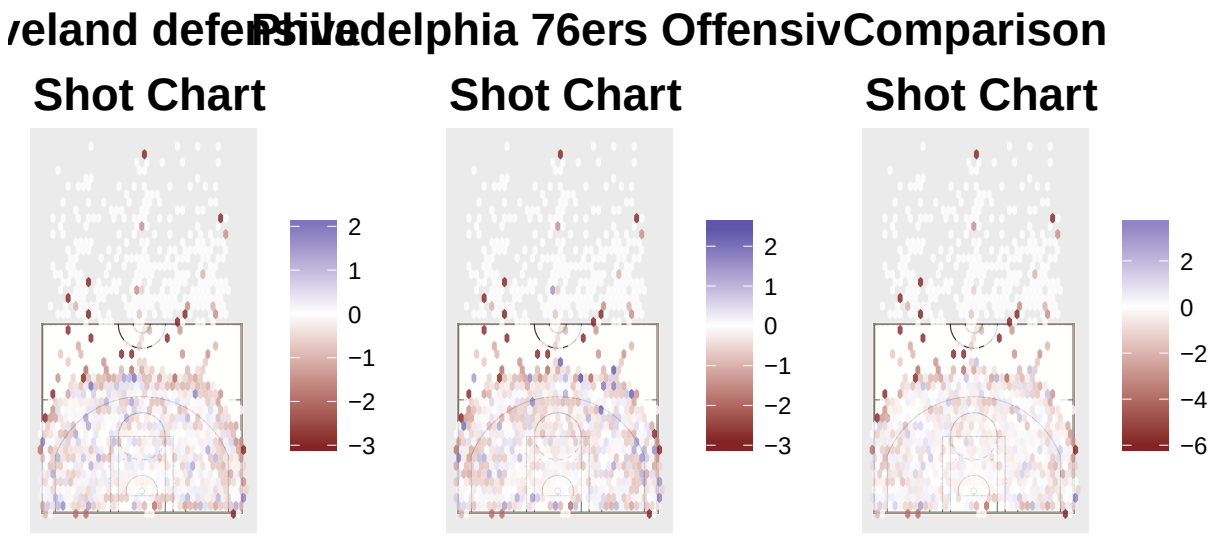
```
                          axis.text.y = element_blank(),
                          legend.title = element_blank(),
                          plot.title = element_text(size = 17, lineheight = 1.2, face = "bold")) + ggti

  grid.arrange(DEF, OFF, COMP, ncol=3)

  return(list(Off = DiffOff, deff = DiffDeff, Comparison = Comparison, Total = Totalhex, PPSAA = PPSAA))
}

Com1 <- ShotComparison(OffTeam = "Cleveland Cavaliers", DefTown = "Philadelphia", SeasondataOff = shotDa
```




```
Com1$PPSAA
```

```
## [1] 0.02043016
```

```
Com2 <- ShotComparison(OffTeam = "Philadelphia 76ers", DefTown = "Cleveland", SeasondataOff = shotDataT
```




```
Com2$PPSAA
```

```
## [1] -0.1028978
```

```
ShotComparison <- function(OffTeam, DefTown, SeasondataOff, SeasonDataDef, nbins = 30) {
  #Filter the offensive data of the Offensive Team
  Off <- filter(SeasondataOff, TEAM_NAME == OffTeam)
  #Filter the Deffensive data of the Defensive team
  deff <- SeasonDataDef[names(SeasonDataDef) == DefTown][[1]]
  #Get the maximum and minumum values for x and y
  xbnds <- range(c(SeasondataOff$LOC_X, deff$LOC_X))
  ybnds <- range(c(SeasondataOff$LOC_Y, deff$LOC_Y))
  #Make hexbin dataframes out of the teams
  makeHexData <- function(df) {
    h <- hexbin(df$LOC_X, df$LOC_Y, nbins, xbnds = xbnds, ybnds = ybnds, IDs = TRUE)
    data.frame(hcell2xy(h),
               PPS = tapply(as.numeric(as.character(df$SHOT_MADE_FLAG))*ifelse(tolower(df$SHOT_TYPE) ==
               ST = tapply(df$SHOT_MADE_FLAG, h@cID, FUN = function(z) length(z)),
               cid = h@cell)
  }
  ##Total NBA data
  Totalhex <- makeHexData(SeasondataOff)
  ##Defensive team data
  Defhex <- makeHexData(deff)
  ##Offensive team data
```

```r
Offhex <- makeHexData(Off)
#Merge offensive and deffensive data with total data by Cell id
DeffbyCell <- merge(Totalhex, Defhex, by = "cid", all = T)
OffByCell <- merge(Totalhex, Offhex, by = "cid", all = T)
##  when calculating the difference empty cells should count as 0
DeffbyCell$PPS.x[is.na(DeffbyCell$PPS.x)] <- 0
DeffbyCell$PPS.y[is.na(DeffbyCell$PPS.y)] <- 0
DeffbyCell$ST.y[is.na(DeffbyCell$ST.y)] <- 0

OffByCell$PPS.x[is.na(OffByCell$PPS.x)] <- 0
OffByCell$PPS.y[is.na(OffByCell$PPS.y)] <- 0
OffByCell$ST.y[is.na(OffByCell$ST.y)] <- 0
#  make a "difference" data.frame
DiffDeff <- data.frame(x = ifelse(is.na(DeffbyCell$x.x), DeffbyCell$x.y, DeffbyCell$x.x),
                       y = ifelse(is.na(DeffbyCell$y.x), DeffbyCell$y.y, DeffbyCell$y.x),
                       PPS= DeffbyCell$PPS.y - DeffbyCell$PPS.x,
                       cid= DeffbyCell$cid,
                       ST = DeffbyCell$ST.y)

DiffOff <- data.frame(x = ifelse(is.na(OffByCell$x.x), OffByCell$x.y, OffByCell$x.x),
                       y = ifelse(is.na(OffByCell$y.x), OffByCell$y.y, OffByCell$y.x),
                       PPS= OffByCell$PPS.y - OffByCell$PPS.x,
                       ST = OffByCell$ST.x,
                       cid = OffByCell$cid,
                       ST = OffByCell$ST.y)
#make team comparisons
Comparison <- merge(DiffOff, DiffDeff, by = "cid", all = T)
Comparison <- Comparison[,-c(6:7)]
Comparison$Diff <- c(Comparison$PPS.x + Comparison$PPS.y)


PPSAA <- weighted.mean((Comparison$PPS.x + Comparison$PPS.y), Comparison$ST.x)
print(PPSAA)
# OFF <- ggplot(DiffOff)  +
#   annotation_custom(court, -250, 250, -52, 418) +
#   geom_hex(aes(x = x, y = y, fill = PPS),
#            stat = "identity", alpha = 0.8) +
#   guides(alpha = FALSE, size = FALSE) +
#   coord_fixed()  +theme(line = element_blank(),
#                         axis.title.x = element_blank(),
#                         axis.title.y = element_blank(),
#                         axis.text.x = element_blank(),
#                         axis.text.y = element_blank(),
#                         legend.title = element_blank(),
#                         plot.title = element_text(size = 17, lineheight = 1.2, face = "bold")) + gg
# DEF <- ggplot(DiffDeff)  +
#   annotation_custom(court, -250, 250, -52, 418) +
#   geom_hex(aes(x = x, y = y, fill = PPS),
#            stat = "identity", alpha = 0.8) +
#   guides(alpha = FALSE, size = FALSE) +
#
#   coord_fixed()  +theme(line = element_blank(),
#                         axis.title.x = element_blank(),
```

```
  #                         axis.title.y = element_blank(),
  #                         axis.text.x = element_blank(),
  #                         axis.text.y = element_blank(),
  #                         legend.title = element_blank(),
  #                         plot.title = element_text(size = 17, lineheight = 1.2, face = "bold")) + gg
  #
  # COMP <- ggplot(Comparison)  +
  #   annotation_custom(court, -250, 250, -52, 418) +
  #   geom_hex(aes(x = x.x, y = y.x, fill = Diff),
  #            stat = "identity", alpha = 0.8) +
  #   guides(alpha = FALSE, size = FALSE) +
  #
  #   coord_fixed()  +theme(line = element_blank(),
  #                         axis.title.x = element_blank(),
  #                         axis.title.y = element_blank(),
  #                         axis.text.x = element_blank(),
  #                         axis.text.y = element_blank(),
  #                         legend.title = element_blank(),
  #                         plot.title = element_text(size = 17, lineheight = 1.2, face = "bold")) + gg
  #
  # grid.arrange(DEF, OFF, COMP, ncol=3)

  return(PPSAA)
}


Offensive_teams <- as.character(unique(shotDataTotal2016$TEAM_NAME))

defenseve_names <- names(shotDatafDef2016)
df2016 <- data.frame(matrix(ncol = 30, nrow = 30))
colnames(df2016) <- as.character(unique(shotDataTotal2016$TEAM_NAME))
rownames(df2016) <- names(shotDatafDef2016)

system.time(for (i in 1:length(Offensive_teams)) {
  Offensive_team <- Offensive_teams[i]
  for (j in 1:length(defenseve_names)){
    df2016[j,i] <- ShotComparison(OffTeam = Offensive_team, DefTown =                    defenseve_
  }
})
```

```
## [1] -0.1155454
## [1] -0.08707377
## [1] -0.0830189
## [1] -0.01384599
## [1] -0.08412699
## [1] -0.05694221
## [1] -0.03634887
## [1] -0.09020081
## [1] -0.04160005
## [1] -0.0870888
## [1] -0.03884313
## [1] -0.08610983
## [1] -0.08418332
```

```
## [1] -0.05034676
## [1] -0.01471371
## [1] -0.08905573
## [1] -0.04785826
## [1] -0.08751748
## [1] -0.03115664
## [1] -0.02559498
## [1] -0.05279838
## [1] -0.009853816
## [1] -0.1022051
## [1] -0.1088658
## [1] -0.07024175
## [1] -0.07485516
## [1] -0.05301926
## [1] -0.03974702
## [1] -0.07151634
## [1] -0.08415645
## [1] -0.06973204
## [1] -0.04126043
## [1] -0.03720556
## [1] 0.03196734
## [1] -0.03831365
## [1] -0.01112888
## [1] 0.009464468
## [1] -0.04438748
## [1] 0.004213292
## [1] -0.04127546
## [1] 0.006970204
## [1] -0.04029649
## [1] -0.03836998
## [1] -0.004533422
## [1] 0.03109963
## [1] -0.04324239
## [1] -0.002044926
## [1] -0.04170414
## [1] 0.0146567
## [1] 0.02021836
## [1] -0.006985046
## [1] 0.03595952
## [1] -0.05639175
## [1] -0.06305243
## [1] -0.02442842
## [1] -0.02904183
## [1] -0.007205921
## [1] 0.006066315
## [1] -0.02570301
## [1] -0.03834312
## [1] -0.07673236
## [1] -0.04826075
## [1] -0.04420588
## [1] 0.02496703
## [1] -0.04531397
## [1] -0.01812919
## [1] 0.002464152
```

```
## [1] -0.05138779
## [1] -0.002787025
## [1] -0.04827578
## [1] -3.01121e-05
## [1] -0.04729681
## [1] -0.0453703
## [1] -0.01153374
## [1] 0.02409931
## [1] -0.05024271
## [1] -0.009045242
## [1] -0.04870446
## [1] 0.007656383
## [1] 0.01321804
## [1] -0.01398536
## [1] 0.0289592
## [1] -0.06339207
## [1] -0.07005274
## [1] -0.03142873
## [1] -0.03604214
## [1] -0.01420624
## [1] -0.000934001
## [1] -0.03270332
## [1] -0.04534343
## [1] -0.04250202
## [1] -0.01403041
## [1] -0.009975545
## [1] 0.05919736
## [1] -0.01108364
## [1] 0.01610114
## [1] 0.03669449
## [1] -0.01715746
## [1] 0.03144331
## [1] -0.01404544
## [1] 0.03420022
## [1] -0.01306647
## [1] -0.01113996
## [1] 0.0226966
## [1] 0.05832964
## [1] -0.01601238
## [1] 0.02518509
## [1] -0.01447412
## [1] 0.04188672
## [1] 0.04744837
## [1] 0.02024497
## [1] 0.06318954
## [1] -0.02916174
## [1] -0.03582241
## [1] 0.002801601
## [1] -0.001811809
## [1] 0.0200241
## [1] 0.03329633
## [1] 0.00152701
## [1] -0.0111131
## [1] -0.08122795
```

```
## [1] -0.05275633
## [1] -0.04870147
## [1] 0.02047144
## [1] -0.04980956
## [1] -0.02262478
## [1] -0.002031436
## [1] -0.05588338
## [1] -0.007282612
## [1] -0.05277136
## [1] -0.0045257
## [1] -0.05179239
## [1] -0.04986589
## [1] -0.01602933
## [1] 0.01960372
## [1] -0.0547383
## [1] -0.01354083
## [1] -0.05320005
## [1] 0.003160796
## [1] 0.008722454
## [1] -0.01848095
## [1] 0.02446362
## [1] -0.06788766
## [1] -0.07454833
## [1] -0.03592432
## [1] -0.04053773
## [1] -0.01870182
## [1] -0.005429589
## [1] -0.03719891
## [1] -0.04983902
## [1] 0.00994497
## [1] 0.03841658
## [1] 0.04247145
## [1] 0.1116444
## [1] 0.04136336
## [1] 0.06854813
## [1] 0.08914148
## [1] 0.03528954
## [1] 0.0838903
## [1] 0.03840155
## [1] 0.08664722
## [1] 0.03938052
## [1] 0.04130703
## [1] 0.07514359
## [1] 0.1107766
## [1] 0.03643462
## [1] 0.07763209
## [1] 0.03797287
## [1] 0.09433371
## [1] 0.09989537
## [1] 0.07269197
## [1] 0.1156365
## [1] 0.02328526
## [1] 0.01662459
## [1] 0.0552486
```

```
## [1] 0.05063519
## [1] 0.07247109
## [1] 0.08574333
## [1] 0.053974
## [1] 0.04133389
## [1] -0.05452651
## [1] -0.0260549
## [1] -0.02200003
## [1] 0.04717287
## [1] -0.02310812
## [1] 0.004076654
## [1] 0.02467
## [1] -0.02918194
## [1] 0.01941882
## [1] -0.02606993
## [1] 0.02217574
## [1] -0.02509096
## [1] -0.02316445
## [1] 0.01067211
## [1] 0.04630516
## [1] -0.02803686
## [1] 0.01316061
## [1] -0.02649861
## [1] 0.02986223
## [1] 0.03542389
## [1] 0.008220486
## [1] 0.05116505
## [1] -0.04118622
## [1] -0.04784689
## [1] -0.009222886
## [1] -0.01383629
## [1] 0.00799961
## [1] 0.02127185
## [1] -0.01049748
## [1] -0.02313759
## [1] -0.04901355
## [1] -0.02054194
## [1] -0.01648707
## [1] 0.05268583
## [1] -0.01759517
## [1] 0.009589611
## [1] 0.03018296
## [1] -0.02366899
## [1] 0.02493178
## [1] -0.02055697
## [1] 0.02768869
## [1] -0.019578
## [1] -0.01765149
## [1] 0.01618507
## [1] 0.05181811
## [1] -0.0225239
## [1] 0.01867356
## [1] -0.02098565
## [1] 0.03537519
```

```
## [1] 0.04093685
## [1] 0.01373344
## [1] 0.05667801
## [1] -0.03567327
## [1] -0.04233394
## [1] -0.003709929
## [1] -0.008323338
## [1] 0.01351257
## [1] 0.0267848
## [1] -0.004984519
## [1] -0.01762463
## [1] -0.1231036
## [1] -0.09463202
## [1] -0.09057715
## [1] -0.02140425
## [1] -0.09168524
## [1] -0.06450047
## [1] -0.04390712
## [1] -0.09775906
## [1] -0.0491583
## [1] -0.09464705
## [1] -0.04640138
## [1] -0.09366808
## [1] -0.09174157
## [1] -0.05790501
## [1] -0.02227196
## [1] -0.09661398
## [1] -0.05541651
## [1] -0.09507573
## [1] -0.03871489
## [1] -0.03315323
## [1] -0.06035663
## [1] -0.01741207
## [1] -0.1097633
## [1] -0.116424
## [1] -0.07780001
## [1] -0.08241342
## [1] -0.06057751
## [1] -0.04730527
## [1] -0.0790746
## [1] -0.09171471
## [1] -0.1081082
## [1] -0.07963662
## [1] -0.07558175
## [1] -0.006408848
## [1] -0.07668984
## [1] -0.04950507
## [1] -0.02891172
## [1] -0.08276367
## [1] -0.0341629
## [1] -0.07965165
## [1] -0.03140599
## [1] -0.07867268
## [1] -0.07674617
```

```
## [1] -0.04290961
## [1] -0.007276566
## [1] -0.08161858
## [1] -0.04042112
## [1] -0.08008033
## [1] -0.02371949
## [1] -0.01815783
## [1] -0.04536124
## [1] -0.002416671
## [1] -0.09476795
## [1] -0.1014286
## [1] -0.06280461
## [1] -0.06741802
## [1] -0.04558211
## [1] -0.03230988
## [1] -0.0640792
## [1] -0.07671931
## [1] -0.05540715
## [1] -0.02693554
## [1] -0.02288067
## [1] 0.04629223
## [1] -0.02398876
## [1] 0.003196014
## [1] 0.02378936
## [1] -0.03006258
## [1] 0.01853818
## [1] -0.02695057
## [1] 0.0212951
## [1] -0.0259716
## [1] -0.02404509
## [1] 0.009791469
## [1] 0.04542452
## [1] -0.0289175
## [1] 0.01227997
## [1] -0.02737925
## [1] 0.02898159
## [1] 0.03454325
## [1] 0.007339846
## [1] 0.05028441
## [1] -0.04206686
## [1] -0.04872753
## [1] -0.01010353
## [1] -0.01471693
## [1] 0.00711897
## [1] 0.02039121
## [1] -0.01137812
## [1] -0.02401823
## [1] -0.0588809
## [1] -0.03040928
## [1] -0.02635442
## [1] 0.04281849
## [1] -0.02746251
## [1] -0.0002777308
## [1] 0.02031561
```

```
## [1] -0.03353633
## [1] 0.01506444
## [1] -0.03042431
## [1] 0.01782135
## [1] -0.02944534
## [1] -0.02751884
## [1] 0.006317724
## [1] 0.04195077
## [1] -0.03239125
## [1] 0.008806221
## [1] -0.03085299
## [1] 0.02550785
## [1] 0.0310695
## [1] 0.003866101
## [1] 0.04681067
## [1] -0.04554061
## [1] -0.05220128
## [1] -0.01357727
## [1] -0.01819068
## [1] 0.003645226
## [1] 0.01691746
## [1] -0.01485186
## [1] -0.02749197
## [1] -0.05359022
## [1] -0.02511861
## [1] -0.02106374
## [1] 0.04810917
## [1] -0.02217183
## [1] 0.005012946
## [1] 0.02560629
## [1] -0.02824565
## [1] 0.02035511
## [1] -0.02513364
## [1] 0.02311203
## [1] -0.02415467
## [1] -0.02222816
## [1] 0.0116084
## [1] 0.04724145
## [1] -0.02710057
## [1] 0.0140969
## [1] -0.02556232
## [1] 0.03079852
## [1] 0.03636018
## [1] 0.009156777
## [1] 0.05210134
## [1] -0.04024993
## [1] -0.0469106
## [1] -0.008286594
## [1] -0.0129
## [1] 0.008935902
## [1] 0.02220814
## [1] -0.009561184
## [1] -0.02220129
## [1] -0.07100078
```

```
## [1] -0.04252917
## [1] -0.0384743
## [1] 0.0306986
## [1] -0.03958239
## [1] -0.01239762
## [1] 0.00819573
## [1] -0.04565621
## [1] 0.002944553
## [1] -0.0425442
## [1] 0.005701466
## [1] -0.04156523
## [1] -0.03963872
## [1] -0.00580216
## [1] 0.02983089
## [1] -0.04451113
## [1] -0.003313664
## [1] -0.04297288
## [1] 0.01338796
## [1] 0.01894962
## [1] -0.008253784
## [1] 0.03469078
## [1] -0.05766049
## [1] -0.06432116
## [1] -0.02569715
## [1] -0.03031056
## [1] -0.008474659
## [1] 0.004797577
## [1] -0.02697175
## [1] -0.03961186
## [1] -0.03728477
## [1] -0.008813157
## [1] -0.004758289
## [1] 0.06441462
## [1] -0.00586638
## [1] 0.0213184
## [1] 0.04191174
## [1] -0.0119402
## [1] 0.03666057
## [1] -0.008828187
## [1] 0.03941748
## [1] -0.007849216
## [1] -0.005922708
## [1] 0.02791385
## [1] 0.0635469
## [1] -0.01079512
## [1] 0.03040235
## [1] -0.009256868
## [1] 0.04710397
## [1] 0.05266563
## [1] 0.02546223
## [1] 0.06840679
## [1] -0.02394448
## [1] -0.03060515
## [1] 0.008018857
```

```
## [1] 0.003405447
## [1] 0.02524135
## [1] 0.03851359
## [1] 0.006744266
## [1] -0.005895844
## [1] -0.05518649
## [1] -0.02671488
## [1] -0.02266001
## [1] 0.0465129
## [1] -0.0237681
## [1] 0.003416678
## [1] 0.02401002
## [1] -0.02984192
## [1] 0.01875885
## [1] -0.0267299
## [1] 0.02151576
## [1] -0.02575093
## [1] -0.02382443
## [1] 0.01001213
## [1] 0.04564518
## [1] -0.02869684
## [1] 0.01250063
## [1] -0.02715859
## [1] 0.02920226
## [1] 0.03476391
## [1] 0.00756051
## [1] 0.05050508
## [1] -0.0418462
## [1] -0.04850687
## [1] -0.009882861
## [1] -0.01449627
## [1] 0.007339635
## [1] 0.02061187
## [1] -0.01115745
## [1] -0.02379756
## [1] -0.07837181
## [1] -0.0499002
## [1] -0.04584533
## [1] 0.02332758
## [1] -0.04695342
## [1] -0.01976864
## [1] 0.0008247026
## [1] -0.05302724
## [1] -0.004426474
## [1] -0.04991523
## [1] -0.001669561
## [1] -0.04893625
## [1] -0.04700975
## [1] -0.01317319
## [1] 0.02245986
## [1] -0.05188216
## [1] -0.01068469
## [1] -0.05034391
## [1] 0.006016934
```

```
## [1] 0.01157859
## [1] -0.01562481
## [1] 0.02731976
## [1] -0.06503152
## [1] -0.07169219
## [1] -0.03306818
## [1] -0.03768159
## [1] -0.01584569
## [1] -0.00257345
## [1] -0.03434277
## [1] -0.04698288
## [1] -0.1000877
## [1] -0.07161604
## [1] -0.06756117
## [1] 0.001611732
## [1] -0.06866926
## [1] -0.04148449
## [1] -0.02089114
## [1] -0.07474309
## [1] -0.02614232
## [1] -0.07163107
## [1] -0.02338541
## [1] -0.0706521
## [1] -0.06872559
## [1] -0.03488903
## [1] 0.0007440143
## [1] -0.073598
## [1] -0.03240054
## [1] -0.07205975
## [1] -0.01569891
## [1] -0.01013725
## [1] -0.03734066
## [1] 0.00560391
## [1] -0.08674736
## [1] -0.09340804
## [1] -0.05478403
## [1] -0.05939744
## [1] -0.03756153
## [1] -0.0242893
## [1] -0.05605862
## [1] -0.06869873
## [1] -0.106116
## [1] -0.07764443
## [1] -0.07358956
## [1] -0.004416656
## [1] -0.07469765
## [1] -0.04751288
## [1] -0.02691953
## [1] -0.08077147
## [1] -0.03217071
## [1] -0.07765946
## [1] -0.02941379
## [1] -0.07668049
## [1] -0.07475398
```

```
## [1] -0.04091742
## [1] -0.005284374
## [1] -0.07962639
## [1] -0.03842892
## [1] -0.07808814
## [1] -0.0217273
## [1] -0.01616564
## [1] -0.04336904
## [1] -0.0004244782
## [1] -0.09277575
## [1] -0.09943642
## [1] -0.06081242
## [1] -0.06542582
## [1] -0.04358992
## [1] -0.03031768
## [1] -0.06208701
## [1] -0.07472712
## [1] -0.07554851
## [1] -0.0470769
## [1] -0.04302203
## [1] 0.02615087
## [1] -0.04413013
## [1] -0.01694535
## [1] 0.003647996
## [1] -0.05020395
## [1] -0.001603181
## [1] -0.04709193
## [1] 0.001153732
## [1] -0.04611296
## [1] -0.04418645
## [1] -0.01034989
## [1] 0.02528315
## [1] -0.04905886
## [1] -0.007861398
## [1] -0.04752061
## [1] 0.008840227
## [1] 0.01440189
## [1] -0.01280152
## [1] 0.03014305
## [1] -0.06220823
## [1] -0.0688689
## [1] -0.03024489
## [1] -0.0348583
## [1] -0.01302239
## [1] 0.0002498431
## [1] -0.03151948
## [1] -0.04415959
## [1] -0.08805472
## [1] -0.0595831
## [1] -0.05552824
## [1] 0.01364467
## [1] -0.05663633
## [1] -0.02945155
## [1] -0.008858206
```

```
## [1] -0.06271015
## [1] -0.01410938
## [1] -0.05959813
## [1] -0.01135247
## [1] -0.05861916
## [1] -0.05669266
## [1] -0.0228561
## [1] 0.01277695
## [1] -0.06156507
## [1] -0.0203676
## [1] -0.06002682
## [1] -0.003665975
## [1] 0.001895683
## [1] -0.02530772
## [1] 0.01763685
## [1] -0.07471443
## [1] -0.0813751
## [1] -0.04275109
## [1] -0.0473645
## [1] -0.0255286
## [1] -0.01225636
## [1] -0.04402568
## [1] -0.05666579
## [1] -0.04797187
## [1] -0.01950026
## [1] -0.01544539
## [1] 0.05372752
## [1] -0.01655348
## [1] 0.0106313
## [1] 0.03122464
## [1] -0.0226273
## [1] 0.02597347
## [1] -0.01951529
## [1] 0.02873038
## [1] -0.01853631
## [1] -0.01660981
## [1] 0.01722675
## [1] 0.0528598
## [1] -0.02148222
## [1] 0.01971525
## [1] -0.01994397
## [1] 0.03641687
## [1] 0.04197853
## [1] 0.01477513
## [1] 0.0577197
## [1] -0.03463158
## [1] -0.04129225
## [1] -0.002668242
## [1] -0.007281652
## [1] 0.01455425
## [1] 0.02782649
## [1] -0.003942833
## [1] -0.01658294
## [1] 0.01577549
```

```
## [1] 0.0442471
## [1] 0.04830197
## [1] 0.1174749
## [1] 0.04719388
## [1] 0.07437866
## [1] 0.094972
## [1] 0.04112006
## [1] 0.08972083
## [1] 0.04423207
## [1] 0.09247774
## [1] 0.04521104
## [1] 0.04713755
## [1] 0.08097411
## [1] 0.1166072
## [1] 0.04226514
## [1] 0.08346261
## [1] 0.04380339
## [1] 0.1001642
## [1] 0.1057259
## [1] 0.07852249
## [1] 0.1214671
## [1] 0.02911578
## [1] 0.02245511
## [1] 0.06107912
## [1] 0.05646571
## [1] 0.07830161
## [1] 0.09157385
## [1] 0.05980453
## [1] 0.04716442
## [1] -0.05183947
## [1] -0.02336785
## [1] -0.01931299
## [1] 0.04985992
## [1] -0.02042108
## [1] 0.006763699
## [1] 0.02735704
## [1] -0.0264949
## [1] 0.02210587
## [1] -0.02338288
## [1] 0.02486278
## [1] -0.02240391
## [1] -0.02047741
## [1] 0.01335915
## [1] 0.0489922
## [1] -0.02534982
## [1] 0.01584765
## [1] -0.02381156
## [1] 0.03254928
## [1] 0.03811093
## [1] 0.01090753
## [1] 0.0538521
## [1] -0.03849918
## [1] -0.04515985
## [1] -0.00653584
```

```
## [1] -0.01114925
## [1] 0.01068666
## [1] 0.02395889
## [1] -0.007810431
## [1] -0.02045054
## [1] -0.1016691
## [1] -0.07319752
## [1] -0.06914265
## [1] 3.025283e-05
## [1] -0.07025074
## [1] -0.04306597
## [1] -0.02247262
## [1] -0.07632457
## [1] -0.0277238
## [1] -0.07321255
## [1] -0.02496689
## [1] -0.07223358
## [1] -0.07030707
## [1] -0.03647051
## [1] -0.0008374651
## [1] -0.07517948
## [1] -0.03398202
## [1] -0.07364123
## [1] -0.01728039
## [1] -0.01171873
## [1] -0.03892214
## [1] 0.00402243
## [1] -0.08832884
## [1] -0.09498952
## [1] -0.05636551
## [1] -0.06097892
## [1] -0.03914301
## [1] -0.02587078
## [1] -0.0576401
## [1] -0.07028021
## [1] -0.064248
## [1] -0.03577639
## [1] -0.03172153
## [1] 0.03745138
## [1] -0.03282962
## [1] -0.00564484
## [1] 0.01494851
## [1] -0.03890344
## [1] 0.009697329
## [1] -0.03579142
## [1] 0.01245424
## [1] -0.03481245
## [1] -0.03288594
## [1] 0.0009506148
## [1] 0.03658366
## [1] -0.03775836
## [1] 0.003439111
## [1] -0.0362201
## [1] 0.02014074
```

```
## [1] 0.02570239
## [1] -0.001501009
## [1] 0.04144356
## [1] -0.05090772
## [1] -0.05756839
## [1] -0.01894438
## [1] -0.02355779
## [1] -0.001721884
## [1] 0.01155035
## [1] -0.02021897
## [1] -0.03285908
## [1] -0.00331059
## [1] 0.02516102
## [1] 0.02921589
## [1] 0.09838879
## [1] 0.0281078
## [1] 0.05529257
## [1] 0.07588592
## [1] 0.02203398
## [1] 0.07063474
## [1] 0.02514599
## [1] 0.07339166
## [1] 0.02612496
## [1] 0.02805147
## [1] 0.06188803
## [1] 0.09752108
## [1] 0.02317906
## [1] 0.06437653
## [1] 0.02471731
## [1] 0.08107815
## [1] 0.08663981
## [1] 0.05943641
## [1] 0.102381
## [1] 0.0100297
## [1] 0.003369026
## [1] 0.04199304
## [1] 0.03737963
## [1] 0.05921553
## [1] 0.07248777
## [1] 0.04071844
## [1] 0.02807833
## [1] -0.0435826
## [1] -0.01511099
## [1] -0.01105612
## [1] 0.05811678
## [1] -0.01216421
## [1] 0.01502056
## [1] 0.03561391
## [1] -0.01823804
## [1] 0.03036273
## [1] -0.01512602
## [1] 0.03311964
## [1] -0.01414705
## [1] -0.01222054
```

```
## [1] 0.02161602
## [1] 0.05724906
## [1] -0.01709295
## [1] 0.02410451
## [1] -0.0155547
## [1] 0.04080614
## [1] 0.0463678
## [1] 0.01916439
## [1] 0.06210896
## [1] -0.03024231
## [1] -0.03690299
## [1] 0.001721022
## [1] -0.002892387
## [1] 0.01894352
## [1] 0.03221575
## [1] 0.0004464316
## [1] -0.01219368
## [1] -0.1369599
## [1] -0.1084883
## [1] -0.1044334
## [1] -0.03526052
## [1] -0.1055415
## [1] -0.07835674
## [1] -0.0577634
## [1] -0.1116153
## [1] -0.06301457
## [1] -0.1085033
## [1] -0.06025766
## [1] -0.1075244
## [1] -0.1055978
## [1] -0.07176129
## [1] -0.03612824
## [1] -0.1104703
## [1] -0.06927279
## [1] -0.108932
## [1] -0.05257117
## [1] -0.04700951
## [1] -0.07421291
## [1] -0.03126835
## [1] -0.1236196
## [1] -0.1302803
## [1] -0.09165628
## [1] -0.09626969
## [1] -0.07443379
## [1] -0.06116155
## [1] -0.09293087
## [1] -0.105571
## [1] -0.06820139
## [1] -0.03972978
## [1] -0.03567491
## [1] 0.03349799
## [1] -0.03678301
## [1] -0.00959823
## [1] 0.01099512
```

```
## [1] -0.04285683
## [1] 0.005743939
## [1] -0.03974481
## [1] 0.008500851
## [1] -0.03876584
## [1] -0.03683933
## [1] -0.003002775
## [1] 0.03263027
## [1] -0.04171175
## [1] -0.0005142785
## [1] -0.04017349
## [1] 0.01618735
## [1] 0.021749
## [1] -0.005454398
## [1] 0.03749017
## [1] -0.05486111
## [1] -0.06152178
## [1] -0.02289777
## [1] -0.02751118
## [1] -0.005675274
## [1] 0.007596962
## [1] -0.02417236
## [1] -0.03681247
```

```
##    user  system elapsed
##  207.74    4.38  213.44
```

```
write.csv(df2016, "datos2016.csv")
colMeans(df2016, na.rm = TRUE)
```

```
##        Detroit Pistons          Atlanta Hawks          Chicago Bulls
##          -0.0639476883          -0.0181343515          -0.0251346676
##    Cleveland Cavaliers   New Orleans Pelicans  Golden State Warriors
##           0.0090956659          -0.0296302552           0.0615426604
##          Orlando Magic     Washington Wizards     Philadelphia 76ers
##          -0.0029288203           0.0025841366          -0.0715059404
##         Boston Celtics          Brooklyn Nets              Utah Jazz
##          -0.0565105429          -0.0038094603          -0.0072832049
##             Miami Heat      Charlotte Hornets        Toronto Raptors
##          -0.0019925284          -0.0194030897           0.0143129220
##         Indiana Pacers        Houston Rockets         Denver Nuggets
##          -0.0035887957          -0.0267741169          -0.0484899622
##      Memphis Grizzlies        New York Knicks        Milwaukee Bucks
##          -0.0545183503          -0.0239508236          -0.0364570256
##  Oklahoma City Thunder      San Antonio Spurs       Dallas Mavericks
##           0.0036258230           0.0673731824          -0.0002417748
##           Phoenix Suns Portland Trail Blazers   Los Angeles Clippers
##          -0.0500714416          -0.0126503144           0.0482871003
##       Sacramento Kings     Los Angeles Lakers Minnesota Timberwolves
##           0.0080150877          -0.0853622177          -0.0166037041
```

```r
min(df2016)
```

```
## [1] -0.1369599
```