

Further distance

Chao XIA

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Question

For fixed area A , is the expected distance between two randomly chosen points, $E(d)$, bigger for a square or a rectangle?

Solution

For this question, we can randomly select one side of rectangle with area A and do this multiple times.

```
# Several global variable
A <- 100
a <- sqrt(A) # calcualte side of a square
distanceamount<-10000 # amount of distance between two points in a rectangle or square
amountofrectangular<-100 # amount of different rectangles in this trial

# calcualte the distance
distance<-function(c1,c2){
  m <- rbind(c1,c2)
  return(dist(m))
}

# define some vectors
r <- numeric() # distances in a rectangular
s <- numeric() # distances in a square
avr <- numeric() # different E(d)s
judge <- numeric() # judge if E(d) is bigger than D

# Calculate D
for( i in 1:distanceamount){
  s1 <- runif(2,0,a)
  s2 <- runif(2,0,a)
  s[i] <- distance(s1,s2)
}
avs <- mean(s)

# Start the trial
for( i in 1:amountofrectangular){
  for(j in 1:distanceamount){
    ra <- runif(1,0,100)
    rb <- 100/ra
    r1 <- c(runif(1,0,ra),runif(1,0,rb))
    r2 <- c(runif(1,0,ra),runif(1,0,rb))
    r[j] <- distance(r1,r2)
    s[j] <- distance(s1,s2)
  }
  avr[i] <- mean(r)
  judge[i] <- avr[i]>avs
}
```

```
}  
  
count <- sum(judge)  
p <- count/amountofrectangular  
  
cat("\nSo our p-value is: ",p)
```

```
##  
## So our p-value is:  1
```

Conclusion

The trial was repeated with 100 different rectangles.

The result is that $E(d)$ is always bigger than D with a p-value of 1.