

Waiting for a Bus

Chao XIA

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Question 1

Suppose we arrive at a bus-stop at some fixed time during the day (say after 10 hours). How long, on average, do we have to wait for a bus?

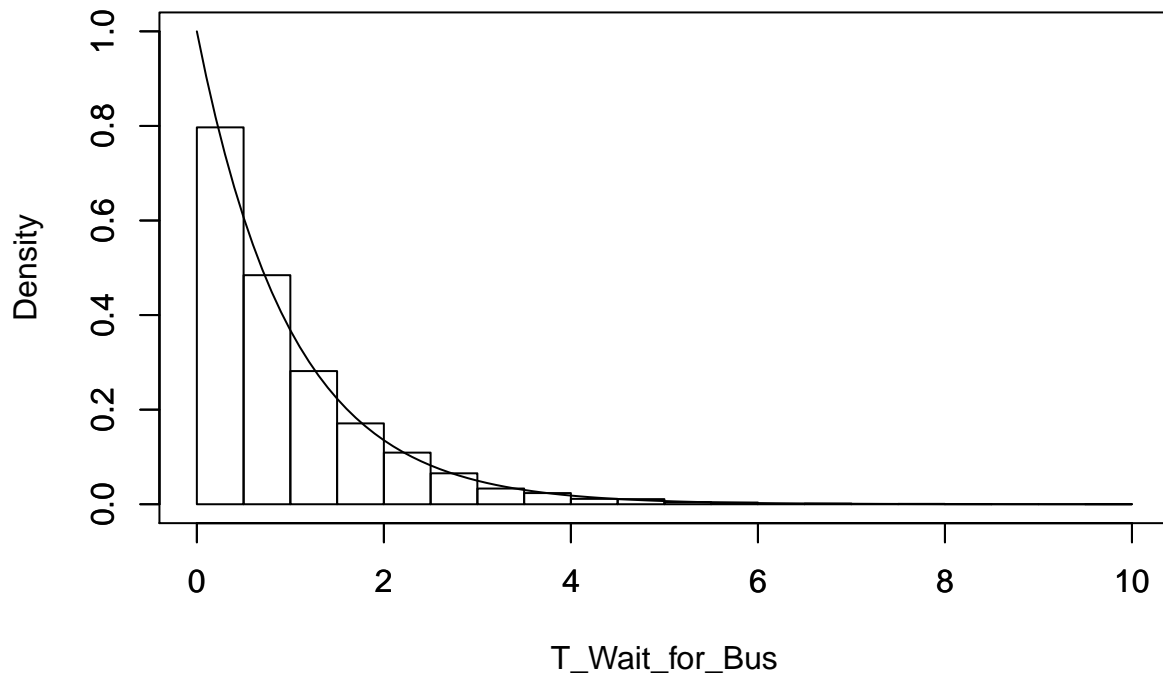
Solution

```
set.seed(2018)
T_Wait_for_Bus <- numeric()
T_Arrival <- 10
repeattimes <- 10000
for (i in 1:repeattimes){
  Time_between_bus <- numeric()
  Bus_After_Arrival <- 0
  Bus_No <- 1

  while(Bus_After_Arrival < T_Arrival){
    Time_between_bus[Bus_No] <- rexp(1)
    Bus_After_Arrival <- Bus_After_Arrival + Time_between_bus[Bus_No]
    Bus_No <- Bus_No + 1
  }
  T_Wait_for_Bus[i] <- Bus_After_Arrival - T_Arrival
}
Mean_T_Wait_for_Bus <- mean(T_Wait_for_Bus)
cat('\nOn average, we have to wait', Mean_T_Wait_for_Bus, 'hours for a bus.')
```

```
##
## On average, we have to wait 0.98445 hours for a bus.
h <- hist(T_Wait_for_Bus, breaks = 15, freq = F, ylim = 0:1)
par(new = T)
curve(dexp(x), xlab = '', ylab = '', xlim = range(h$breaks), ylim = 0:1)
```

Histogram of T_Wait_for_Bus



Extension of Question 1

What if we arrive at a random time each day?

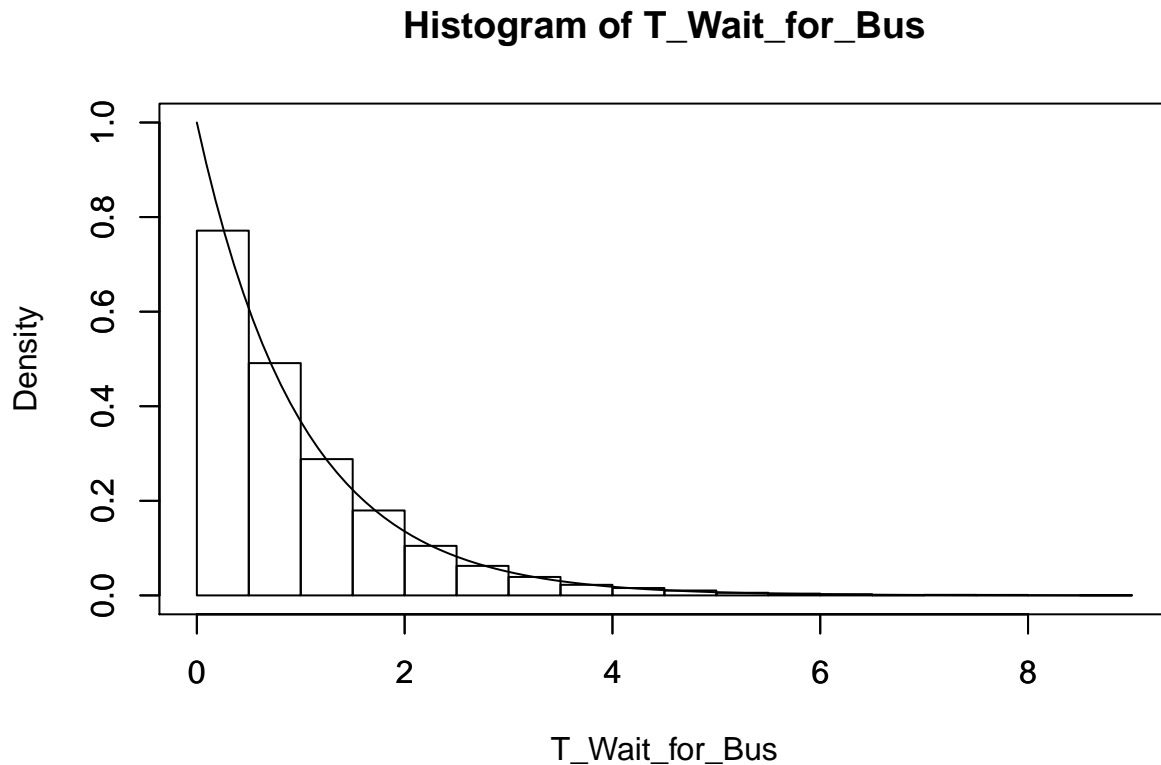
Solution

```
set.seed(2018)
T_Wait_for_Bus <- numeric()
repeattimes <- 10000
for (i in 1: repeattimes){
  Time_between_bus <- numeric()
  T_Arrival <- runif(1,max = 24)
  Bus_After_Arrival <- 0
  Bus_No <- 1

  while(Bus_After_Arrival < T_Arrival){
    Time_between_bus[Bus_No] <- rexp(1)
    Bus_After_Arrival <- Bus_After_Arrival + Time_between_bus[Bus_No]
    Bus_No <- Bus_No + 1
  }
  T_Wait_for_Bus[i] <- Bus_After_Arrival - T_Arrival
}
Mean_T_Wait_for_Bus <- mean(T_Wait_for_Bus)
cat('\nOn average, we have to wait', Mean_T_Wait_for_Bus, 'hours for a bus.')
```

```
##
```

```
## On average, we have to wait 1.011126 hours for a bus.
h <- hist(T_Wait_for_Bus, breaks = 15, freq = F, ylim = 0:1)
par(new = T)
curve(dexp(x), xlab = '', ylab = '', xlim = range(h$breaks), ylim = 0:1)
```



Question 2

If we get off one bus and wait for the next one to arrive on the same route, how long, on average, do we have to wait?

```
Time_between_bus <- rexp(repeattimes,1)
T_Wait_for_Bus_After_We_Get_Off <- mean(Time_between_bus)
cat('\nIf we get off one bus and wait for the next one to arrive
on the same route, on average, we have to wait',T_Wait_for_Bus_After_We_Get_Off, 'hours.')
```

```
##
## If we get off one bus and wait for the next one to arrive
## on the same route, on average, we have to wait 0.9870515 hours.
```

Question 3

How long on average was the time between the arrival of the bus we caught and the one before it.

```
set.seed(2018)
Time_between_busC_and_busP <- numeric()
T_Arrival <- 10
repeattimes <- 10000
for (i in 1: repeattimes){
```

```

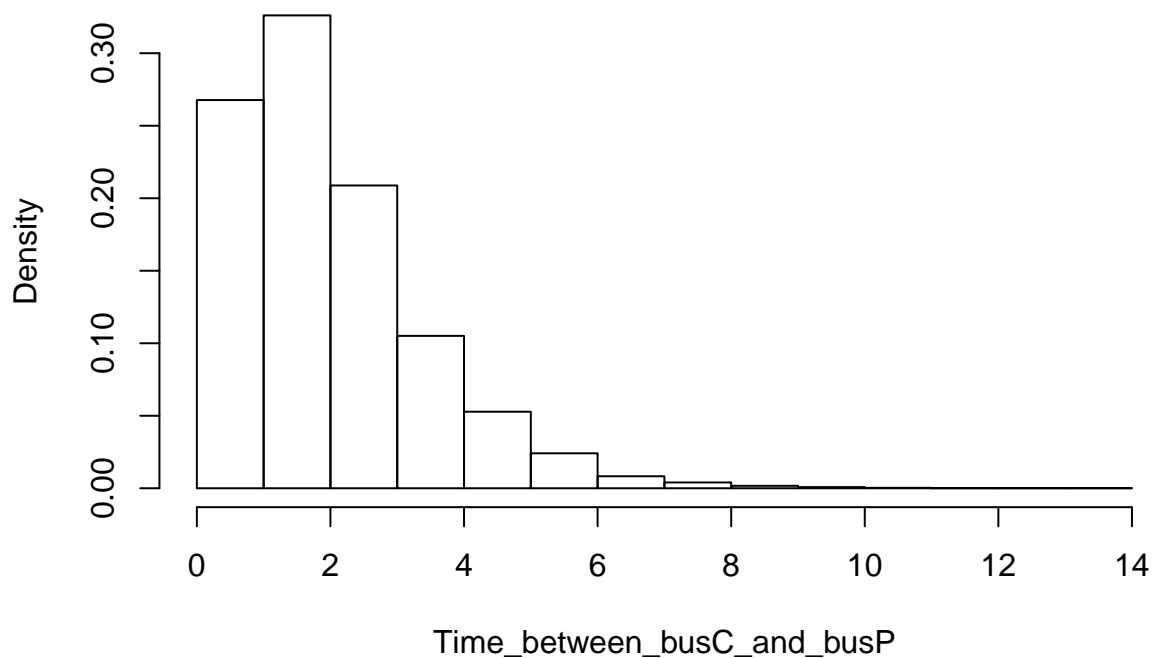
Time_between_bus <- numeric()
Bus_After_Arrival <- 0
Bus_No <- 1

while(Bus_After_Arrival < T_Arrival){
  Time_between_bus[Bus_No] <- rexp(1)
  Bus_After_Arrival <- Bus_After_Arrival + Time_between_bus[Bus_No]
  Bus_No <- Bus_No + 1
}
Time_between_busC_and_busP[i] <- Time_between_bus[Bus_No-1]
}
Mean_Time_between_busC_and_busP <- mean(Time_between_busC_and_busP)
cat('\nOn average, the time between the arrival of the bus we caught and the one before it is', Mean_Ti

##
## On average, the time between the arrival of the bus we caught and the one before it is 1.992676 hours
h <- hist(Time_between_busC_and_busP, breaks = 15, freq = F)

```

Histogram of Time_between_busC_and_busP



Question 4

What is the expected time between any two buses?

```

Time_between_bus <- rexp(repeattimes,1)
T_Wait_for_Bus_After_We_Get_Off <- mean(Time_between_bus)
cat('\nThe expected time between any two buses',T_Wait_for_Bus_After_We_Get_Off, 'hours.')

```

##

The expected time between any two buses 0.9980021 hours.

Actually, I think Question 2 and 4 are the same question.