

Assignment 2
IE 709: IEOR for Health Care

Vinay Chourasiya (173190011)
Karan Patel (173190012)

February 23, 2018

Answer 1:

Assumptions:

1. Uniform population density.
2. Uniform traffic condition hence identical speed of ambulance.
3. Consider only rectilinear distance.

Ans 1.a :

Solution for 1.a and 1.b is uploaded as file named '*ex1A-B.py*'.

- No. of pixels covered by each facility is as follows: Location 1 (6,4): 749
Location 2 (8,10): 689
Location 3 (18,7): 676
Location 4 (12,2): 487.
- Below picture shows no. of pixels covered by each facility:

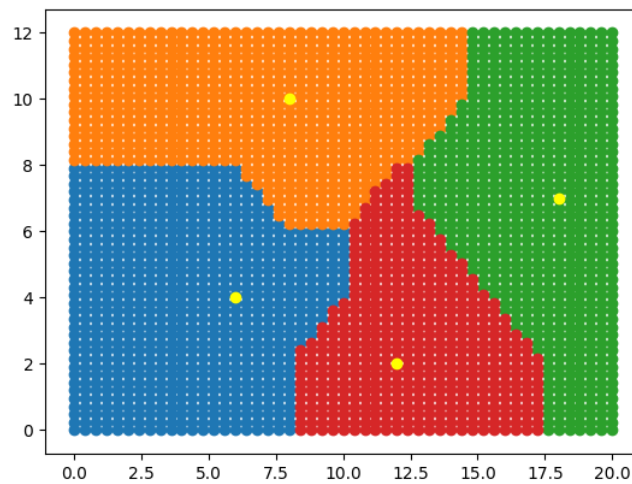


Figure 1: Map for this part:

Ans 1.b :

Extra Assumption for this part: 1. Speed of travel = 10 m/s (36 kmph). 2. Population density 10 peoples/pixel.

- Average time to service a call for the whole region is 7.042 min.
- Proportion of population served by each location is as follows:
 Location 1 (6,4): 0.2879
 Location 2 (8,10): 0.2648
 Location 3 (18,7): 0.26
 Location 4 (12,2): 0.1873

Ans 1.c :

- Code file for this part is named as '*ex1C.py*'.
- We modified location of facility 1 from (6,4) to (3,4) and remaining three locations are same as in earlier part i.e. (8,10), (18,7) and (12,2).
- As a result of above modification average time is found as 6.808 min (i.e. avg. service time is improved).
- Proportion of population served by each location is as follows:
 Location 1 (3,4): 0.2510
 Location 2 (8,10): 0.2675
 Location 3 (18,7): 0.26
 Location 4 (12,2): 0.2215
 i.e. proportion of population covered by each location is well distributed as compare to the proportion in part 1.a.

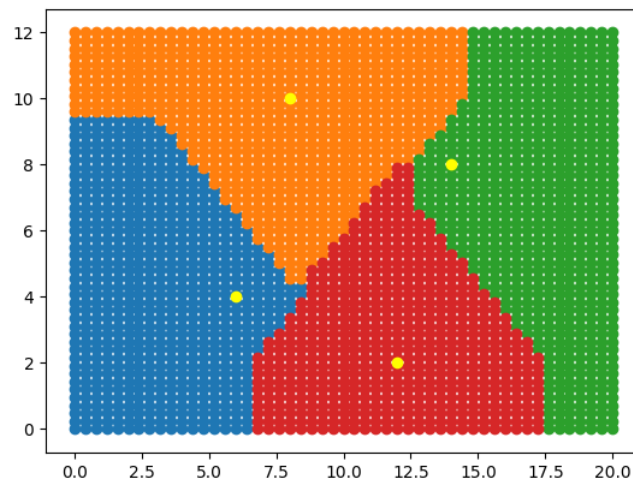


Figure 2: Modified map:

Answer 2:

Assumptions :

1. Doctor arrives exactly at 9:00 AM.
2. The time a patient sits with the practitioner is roughly gamma distributed.
3. All patients arrive at their scheduled time.

Ans 2.a :

- Code file for this part is named as '*ex2A.py*'.
- Histogram is as shown below:

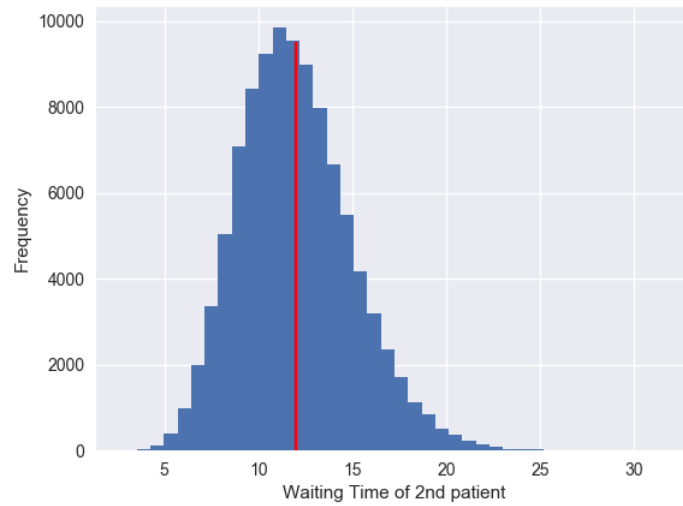


Figure 3: Histogram of waiting times :

- From above histogram we can conclude that waiting time of 2nd patient is gamma distributed with mean about 12 minutes and standard deviation 3 minutes.
- Red line in figure 3 shows mean of waiting times i.e 11.98 ($\cong 12$).

Ans 2.b :

Implementation of Bailey and Welch rule :

- Code file for this part is named as '*ex2B.py*'.

- According to Bailey and Welch rule of calling two patient at 9:00 AM and then one patient every 12 minutes.
- Average waiting time of all patients is 389.58 min.
- Average idle time of practitioner is 3.47 min.

Ans 2.c :

Implementation of Soriano's rule :

- Code file for this part is named as '*ex2C.py*'.
- According to Soriano's rule of calling two patients at 9:00 AM and then two patients every 24 minutes.
- Average waiting time of all patients is 367.727 min.
- Average idle time of practitioner is 10.44 min.

Ans 2.d :

- Since it is observed that Bailey and Welch rule dominates if we will consider only average idle time of practitioner and Soriano's rule dominates if we will consider only average waiting time of all patients. Hence **neither of two rules dominate the other** while considering patient's waiting time and practitioner's idle time simultaneously.

Ans 2.e :

- Code file for this part is named as '*ex2E.py*'.
- According to Bailey and Welch rule we will call two patient at 9:00 AM and then one patient every 12 minutes. **Instead** of this we can call one patient at 9:00 AM, second at 9:05 AM and other patient after 13 minutes and 11 minutes alternatively (i.e. 3rd at 9:18 AM, 4th patient at 9:29 AM, 5th patient at 9:42 AM, 6th patient at 9:53 AM and so on).
- Average waiting time of all patients is 285.86 min.
- Average idle time of practitioner is 6.27 min.