

# Probability hackathon BM2033

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# Placement of vans

- In the first step, we have our random variables to be  $X$ ,  $Y$  at different snapshots of time.
- At a particular time, we plot a 3D histogram of  $X$  and  $Y$  with  $Z$ -axis being frequency.
- We now get 3D histograms for different times which shows that the distribution of people changes with time. From frequency of 3D histograms, we get joint pdf of  $X$  and  $Y$ .
- The joint pdf of  $X$  and  $Y$  is a multimodal Gaussian, that is, it is a combination of different Gaussians.
- As the density functions of coordinates change with time, the advertising van needs to move(it is dynamic) to maximize footfall.

# Placement of vans(contd.)

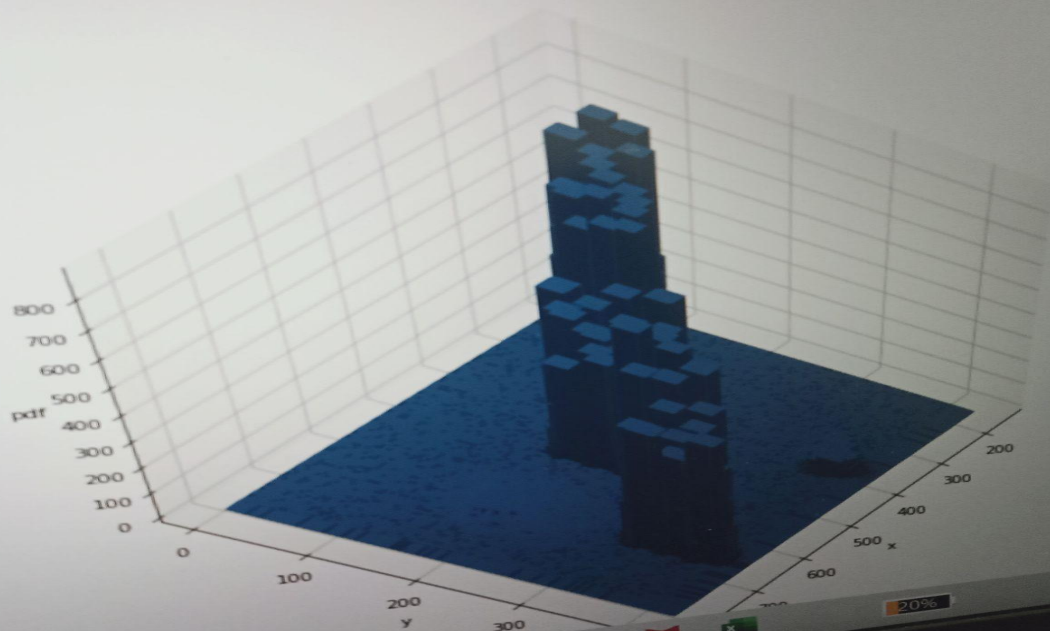
- We need to place the advertising van such that it is visible to maximum number of people.
- Hence, we can place the van at a point where the density of finding people is the highest if the point is at road.
- Let  $(u, v)$  be coordinates of a point not on road having the highest density. We place the van at the coordinate  $E[|x-u||u]$ .
- If  $E[|x-u||u] > 5 \cdot \sigma$  of Gaussian with mean at  $u$ , we move to the point having the next highest frequency and repeat the above 2 steps (Let  $\sigma^2$  be the variance of Gaussian with mean at  $u$ ).
- We can place the pharmacy van near the hospital as people visiting the hospital would buy them. The pharmacy van is static and need not move.
- We can make the orthopaedic/paediatric van follow the advertising van except the hospital.

# Movement of vans

- After placing the advertising van at some coordinate, we decide its movement.
- As the density functions at a particular coordinate change with time, we observe the number of times the van passes a particular coordinate.
- Since we are dealing with atomic events, we can model the movement of the advertising van based on a Poisson process.
- We can calculate the number of times the van crossed a particular time in times: 1,2,3,4,5,..
- We can count the number of people at distances  $v*t$  from the point of consideration and get  $N_1, N_2, N_3, \dots$  where  $N_t$  is poisson random process at time  $t$  as  $v$  is speed of van.
- As we have  $N_1, N_2, N_3, N_4, \dots$  we can estimate the lambda parameter or rate of arrival of poisson using maximum likelihood expectation ( $N_1, N_2 - N_1, N_3 - N_2$  are independent so  $\lambda = [N_1 + (N_2 - N_1) + \dots (N_n - N_{n-1})] / n = N_n / n$ ).
- Greater value of lambda depicts greater probability of finding a particular number of people.

# Back-up slide-1

Histogram plot



AI DUAL CAMERA  
Shot by Pranavi

GB available



22°C

Humid



20%

LEGION