

Out-of-Hospital Cardiac Arrest Volunteers in NYC

How many volunteers are needed in NYC to improve survival rates from out-of-hospital cardiac arrests (OHCAs)? Generate a figure with the number of volunteers on the x axis and the expected survival rates from OHCA on the y axis. For the purposes of this case you may assume that “NYC” is restricted to those locations we used in the solutions to HW 1, and that when an OHCA arises, the probability that it came from Location i is proportional to the population in Location i . You may assume that any given volunteer is available and willing to accept an alert with probability 0.3. Use the de Maio survival function and suppose that there is a 3-minute delay from patient collapse to the time at which volunteers receive an alert. Recall that it is important to know the volunteer density (volunteers per square kilometer). You may assume that in each location the volunteer density is proportional to the population density (people per square kilometer) in that location. Thus you will need an estimate of the area of each location, which we have provided in a separate csv file on Canvas.

In addition, suppose that currently we have 5,000 volunteers in NYC and we could recruit an additional 7,000 volunteers. We want to decide the way those volunteers are located across the set of locations in NYC in the sense of the intensity of the associated Poisson point process (this helps direct recruiting efforts). What intensity (think of this as a vector, indexed by location, that integrates to $5,000 + 7,000 = 12,000$) would yield the biggest increase in survival rates? Be sure to explain how you obtained your answer and depict it graphically. (There is no need to use formal optimization methods, but at the very least you should explain how you obtained your answer and report its impact on the survival rate. Ideally you would have performed some simple mathematical modeling to gain some insight into how to allocate volunteers to locations.) You might provide a scatterplot where each point corresponds to a single location, with population density on the x axis and your suggested volunteer density on the y axis and discuss what your scatter plot shows.

If, as I think is reasonable and appropriate, your model does not explicitly consider the fact that cities are 3-dimensional (3-D) with high-rise buildings, then be sure to discuss in a paragraph or two how you might extend your model to take that into account in a tractable way. Your proposed approach need not be perfect, but it should provide a reasonable first attempt to model 3-D cities.

Provide your answer in a writeup of at most 6 pages that details any models/modeling you used at a level suitable for your classmates. Your writeup should also list any simplifying assumptions and approximations you used. Your report should be sufficient to repeat your analysis exactly. Cite any sources you use. Also, you should include an appendix with your code and a sample of its output.