Criminologist builds computer model for more efficient police patrols

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Dr. Andrew Wheeler, assistant professor of criminology at UT Dallas, teaches students, including criminology senior Alexis Cox, about law enforcement. Wheeler recently completed an analysis of patrol areas for the Carrollton Police Department. Credit: University of Texas at Dallas

Redrawing patrol beats could result in 20 percent less travel for police officers in Carrollton, Texas, according to research from The University of Texas at Dallas.

Dr. Andrew Wheeler, assistant professor of criminology in the School of Economic, Political and Policy Sciences, has completed an analysis that shows the police department how it could improve by optimizing patrol areas.

"I was contacted by the Carrollton Police Department in 2018," Wheeler said. "They asked me to analyze their beat system and find inefficiencies."

The results are detailed in a paper titled "Creating optimal patrol areas using the P-median model," published recently in *Policing: An International Journal*.

Wheeler found that some patrol areas had lots of calls, and some had fewer. Wheeler introduced a computer model of how to create efficient patrol areas in a relatively simple way.

"If they redo the beats as I suggested, it would reduce their amount of travel 20 percent and make the call loads more equal," he said.

Optimizing patrol areas is a typical task for police departments, especially in growing cities, although many departments create patrol beats in an ad hoc fashion.

"Automatic routing gives officers turn-by-turn directions to calls," said Andrew Horn, director of information technology for the Carrollton Police Department. "It's been around for some time, but until we had Dr. Wheeler's research, we had no practical way to change our organization to take full advantage of that technology."

There are several advantages to optimizing patrol beats, said Wheeler, who is working on a similar project with the Mesquite Police Department and researchers from the University of California, Irvine.

"In addition to improved response time to calls, there are savings in fuel and vehicle maintenance," he said. "Officers who spend less time driving to calls and more time proactively policing could become more familiar with the people and places in that area. A greater familiarity with their beats could better facilitate community policing."

The computer program takes several factors into consideration, including natural barriers and man-made boundaries such as on-ramps and frontage roads. The algorithm also constrains the solution to return areas with equal call loads, Wheeler said.

"When call loads are unequal, officers will more often be dispatched to calls within other patrol areas, which can cascade into inefficient call times

throughout the system," he said.

Provided by University of Texas at Dallas

Patrolling Hot Spots

Wheeler suggests patrol areas be more compact, particularly in areas with high crime density. It is possible for the algorithm to assign small hot spots in an officer's own patrol area, if the call load is sufficient enough to warrant it.

"We can configure the program so that officers assigned to patrol areas with hot spots won't have as much real estate to cover, compared to officers covering areas with less crime; thus, they should have an equal amount of time to pursue proactive activities as do officers assigned to non-high crime locations," Wheeler said.

There are limitations, however.

"One limitation of the linear programming model is that it assumes travel will be coming from one place, which is unrealistic and does not take into account how patrol officers will randomly move about and beyond their assigned patrol area," Wheeler said.

Another limitation of the program is that it doesn't consider the need to provide backup to officers.

"It will often be the case that departments will have to conduct manual adjustments to account for factors that cannot be encoded in the model," Wheeler said.

That's fine with the Carrollton Police Department.

"Dr. Wheeler's research partners perfectly with the expertise and experience our staff has built over the years by working with our community," Horn said. "While no algorithm can perfectly account for every situation, Dr. Wheeler's work allows us to ground our decisions in hard science and use those years of knowledge to smooth out the edges."

More information: Andrew Palmer Wheeler. Creating optimal patrol areas using the P-median model, *Policing: An International Journal* (2018). DOI: 10.1108/PIJPSM-02-2018-0027

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