Increasing Violations Capture Rates by Improving Parking Control Routing and Scheduling

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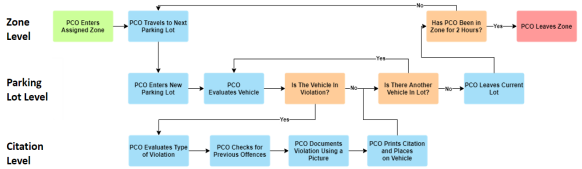
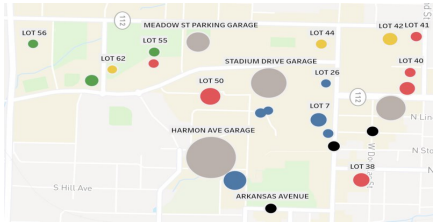
University of Arkansas Transit and Parking Patrol Process

We partnered with the University of Arkansas Transit and Parking Department (UATP) to help improve their Parking Control sector. Parking Control employs parking control officers (PCOs) who are in charge of patrolling the university's parking lots and garages in order to identify and issue citations to any parking violations. To patrol campus, PCOs are assigned to one of six patrol zones for each two-hour period of their shift. In their assigned zone, PCOs walk through each parking lot looking for any vehicles in violation of campus parking regulations. UATP is concerned that a number of parking violations are being missed by Parking Control and asked us to make recommendations for improving the effectiveness of the Parking Control process.



When and Where Citations are Being Recorded

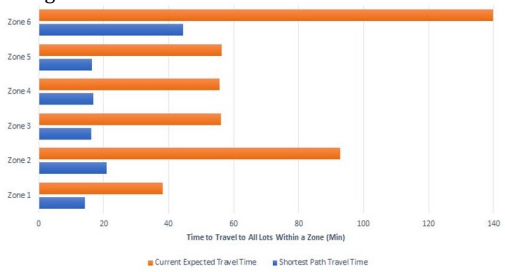
By reviewing 12-months' worth of historical citation records, we were able to determine that 80% of the 34,000 citations occurred in 25 of the 115 parking lots. We also determined that average citation rates drop between 2:00-3:00PM, which lines up with the 2:30PM shift change.



PCO Travel Between Parking Lots and Optimizing Patrol Routes

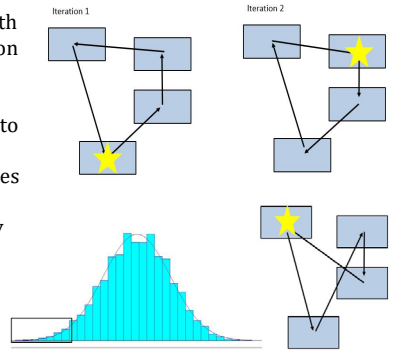
UATP does not keep any information on PCO travel; therefore, we estimated the time spent traveling for each zone. We first used Google Earth to measure the distance between each set of lots within a zone. PCOs currently have no restrictions regarding in what order to visit lots, so we used Monte Carlo simulation to estimate the distance required for 1 million random routes through each zone. We then converted the estimated distances into walking times.

Finally, we identified the shortest path through each zone using the nearest-neighbor heuristic. We found that PCO travel time within a zone could potentially decrease by 24-95 minutes.



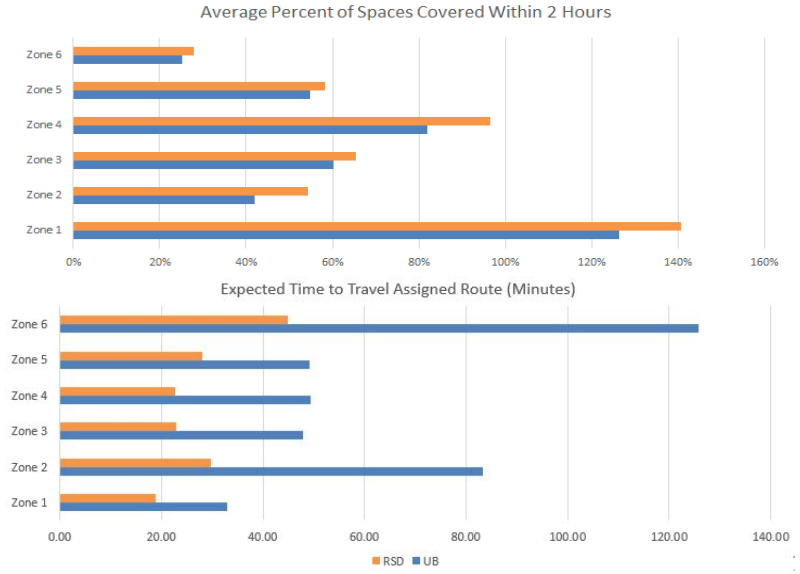
Alternative Patrol Routing Policies

We identified three objectives associated with an improved routing policy: increase violation capture rate, reduce patrol travel time, and randomize patrol routes. We used these objectives to create an additive value model to compare two alterative routing polices. The first policy (RSD) generates zone patrol routes that followed the shortest paths from a randomly selected starting lot and randomly selected direction. Our second policy (UB) randomly chooses zone routes found to be within the 10th percentile of travel time as determined by our Monte Carlo simulation.



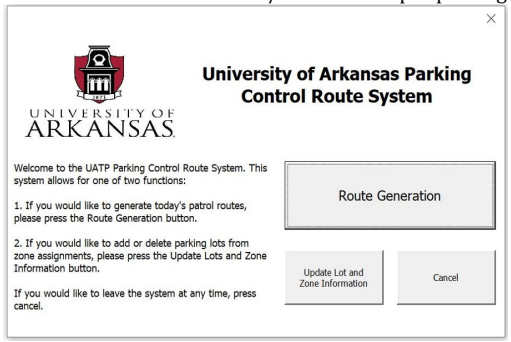
Comparing Alternative Routing Policies

To compare the two policies ability to increase violation capture rate, we simulated 32 routes for each zone and compared the percentage of total parking spaces each route could cover within two hours; RSD was able to cover 8.8% more spaces on average. For travel time, we found RSD reduced travel time between 14-81 minutes more than UB. UB is more effective for randomness, as the total number of UB routes for a zone can be as much as 27!, as compared to 22-54 routes for RSD. However, both increased citations and travel time have more importance to UATP, thus we recommend RSD.



Implementing The Recommended Routing Policy

To facilitate the implementation of the new RSD policy, we developed a Microsoft Excel-based routing tool. The tool allows UATP to select the zone(s) to route and to remove any lots that they do not want patrolled that day. The tool allows for permanent addition and removal of lots to/from the campus parking system.



Zone 1	Zone 3	Zone 4
26	MSPG	49A
29	59	49
27	45	24A
28	67	24
37	73A	61
40	73	17
40A	72	50
41	76	50B
42	44	6
43	74C	5
1	74B	4
	74A	25
	74	SDPG
	74D	22
		11
		48
		58
		48A

Cost-Benefit Analysis for Shift Change Alternatives

Using the citation data from 2019 to 2020, we were able to estimate that UATP is losing $80,000 in annual revenue during the 2:30PM shift change. We suggested three potential solutions and found that either creating a 30-minute shift overlap or new mid-day shift are viable options. We also included a cost-benefit analysis of the three solutions in order to determine which would add the most revenue.

	(1) 30-Minute Shift Overlap: Moving Night Shift Earlier	(2) 30-Minute Shift Overlap: Extend Night Shift by One Hour	(3) Creation of a Mid-day Shift Using Three Part Time PCOs	Alternative 1 vs 2	Alternative 1 vs 3
Annual Added Revenue	$87, 823.67	$88,102.67	$131,759.97	$279.00	$43,936.30
Annual Added Cost	$667.37	$15,123.72	$44,603.67	$14,456.35	$43,936.30
Ratio	131.60			0.02	1.00