CPDB Project Checkpoint 01

Devyani Gauri, James Wilkinson, Kaleem Ahmed

Data Science 339

Prof. Jennie Rogers

October 14, 2021

Questions

Q.1: Does this code compile and run without significant effort on the part of the reviewer?
Ans1: Yes, please refer to the README file.

Q.2: Quantitative Analysis: Does the code answer questions from the proposal?
Ans2: Yes our code answers the questions from the proposal:

a. What is the average (most common) use of force across the police force?

Ans: Verbal commands (62754 counts) is the most common use of force.

b. How does the average use of force compare between rookies and non-rookies? i.e What is the most common (modal) use of force for rookie officers vs for non-rookie officers? *(We adjusted for Prof. Roger's comment on the proposal)*

Ans: Amongst rookies the most common use of force was Physical Force, particularly Holding (1449 counts), while for non-rookies it was Verbal Commands (61410).

c. What is the ratio of complaints-to-TRR for rookie officers, and how does this compare to non-rookie officers? We hypothesize that rookie officers will be more likely to file TRR reports than their non-rookie counterparts which will result in officers having a lower ratio of number-of-complaints to number-of-TRR reports when they are rookies.

Ans: For rookie officers, the ratio is 173:1, while for non-rookie officers the ratio is 3:1.

d. What is the frequency of TRR reports *(update: replaced complaints)* for each type-of-force for rookie officers vs non-rookie officers? We expect the frequency

Frequency of TRRs	Rookie (<1y in force) TRR s	Non-rookie (>1y in force) TRR s
Physical Force - Holding	1449	55901
Verbal Commands	1344	61410
Member Presence	1265	58426
Physical Force - Stunning	1212	56341
Other Force	193	8831
Physical Force - Direct Mechanical	141	10703
Chemical	54	3837
Taser (Use)	54	5484
Impact Weapon	29	1760
Taser Display	13	785
Firearm	9	1014
Chemical (Authorized)	2	111

of more severe uses of force (for example gunshots) to increase as we move from observing rookie officers to more non-rookie officers

Ans: (see table)

Here, we have highlighted the different levels of force in different colors, ranging from low force (green) to high force (red), using the CPD Force Options Model as a reference (hyperlink here). In part 3 of this write up, we have extracted some trivial ratios from the results to investigate our hypothesis that non-rookie officers' TRR reports include more force than rookie officers.

Q.3: Qualitative Analysis: Does the analysis described in the write-up adequately analyze the problem we are investigating? Was it thoughtful and thorough? Does it reveal interesting open questions *(optional)*?

Ans3: Our queries revealed in an interesting set of results.

Firstly, the large difference in population sizes between rookie officers and non-rookie officers is obvious, with over two-hundred-and-fifty thousand TRR reports filed against non-rookie officers, and less than six-thousand filed against rookie officers. In order to compare TRR reports between the cohorts on a like-for-like basis, we look at the proportions of TRR reports attributed to each force type within each cohort.
For illustrative purposes, this normalization results in the following table:

Frequency of TRRs	Rookie (<1y in force) TRR s	% of TRRs	Non-rookie (>1y in force) TRR s	% of TRRs	Increase
Physical Force - Holding	1449	25.1%	55901	21.1%	-15.9%
Verbal Commands	1344	23.3%	61410	23.2%	-0.4%
Member Presence	1265	21.9%	58426	22.1%	0.6%
Physical Force - Stunning	1212	21.0%	56341	21.3%	1.3%
Other Force	193	3.3%	8831	3.3%	-0.3%
Physical Force - Direct Mechanical	141	2.4%	10703	4.0%	65.4%
Chemical	54	0.9%	3837	1.5%	54.8%
Taser (Use)	54	0.9%	5484	2.1%	121.3%
Impact Weapon	29	0.5%	1760	0.7%	32.2%
Taser Display	13	0.2%	785	0.3%	31.6%
Firearm	9	0.2%	1014	0.4%	145.5%
Chemical (Authorized)	2	0.0%	111	0.0%	20.9%

We can see TRR complaints involving non-rookie officers are 146% (2.46x) more likely to involve a firearm compared to rookie officers. Use of a taser is similarly 121% (2.21x) more likely to appear in a non-rookie officer's TRR report. In fact, every category using high levels of force (highlighted red in the table) show a significant increase amongst non-rookie officers, with the only use-of-force with rookie officers showing a higher proportion of complaints is with "Physical Force - Holding". This is a strong indication that our hypothesis ("We expect the frequency of more severe uses of force to increase as we move from observing rookie officers to more non-rookie officers") is correct. We believe that this this effect could come from two underlying drivers: firstly, that as officers gain experience, they become less disciplined; secondly, that as a result of their elevated experience, the non-rookie officers are assigned to areas that involve more force. In order to advance this analysis, we must investigate the presence of these two mechanisms. A follow-up question would be: "are non-rookie officers are more commonly assigned to areas that more involve more frequent uses of force?". Answering this question would shed light on the second mechanism, and whether discipline involving firearms decreases as officers advance in their career.

Our first analysis is useful in that it demonstrates that TRR reports are significantly more frequent for a low-level force across the CDPD. While this is intuitive, it does confirm a significant insight: that police officers are frequently reporting even minor occurrences of perceived misconduct. This result also has relevance to our second analysis.

Our second analysis shows that rookie officers are reported most frequently for using "Physical Force - Handling". While the non-rookie officers are reported most commonly due to "Verbal Commands". The larger non-rookie officer population means that overall, the force is most commonly reported for "Verbal Commands" across the whole CDPD as we revealed in the first analysis. Using the more granular data from the forth analysis, we can see that rookie officers receive about 9% more TRR reports for "Physical Force - Holding" than for "Verbal Commands", while non-rookie officers receive about 9% less. This is a significant revelation, and could indicate that rookie officers lack experience when employing force to physically restrain a subject, and are thus more likely to be reported for misconduct in these instances. To confirm the significance of this result, it would be fruitful to investigate the how the proportion of "Physical Force - Holding" changes by "years spent in force" across the CDPD. With this more detailed analysis, we would be able to determine whether proportions of TRR complaints involving "Physical Force - Holding" decreases as part of a clear trend as an officer gains experience, or whether our current result is an artifact dependent on our arbitrary distinction of "rookie" (sub-1-year in the CDPD) and "non-rookie" (post-1-year in the CDPD).

Finally, we look at the results to our third analysis. We believed that non-rookie officers could be less likely (perhaps through decreased discipline) to file TRR reports against one another, meaning that TRR report frequencies would become biased against rookie officers. This effect could need normalizing, which could be achieved by using the frequency of complaints for rookie and non-rookie officers as an independent baseline. However, the preliminary results appear to be somewhat erroneous (with the ratio being a factor of 60x in favor of Rookies receiving less complaints), and we believe this could invalidate our proposed method of normalization, and could need data

cleaning to rectify. To follow this up, we should investigate whether the number of TRR complaints shows a significant trend if plotted against “time spent in force” across the CDPD. It is possible that no significant trend is seen, which could indicate that no normalization is needed in in this respect. As noticed in our forth analysis, normalizing cohorts for their population sizes could be an appropriate normalization.

Our Relational Analytics results have revealed two significant insights into officers’ “learned” behavior. Firstly, that non-rookie officers are reported for using levels of high-force far more frequently than their rookie counterparts. This could be symptomatic of officer discipline concerning use-of-force decreasing over time. Secondly, that officers judgement and execution of forceful restraint (“Physical Force - Holding”) improves as they gain experience. Both of these insights have opened up new questions which could further our investigation, and solidify these conclusions. We should investigate whether non-rookie officers are assigned more to areas that are prone to high-level uses of force; and we should also investigate whether the proportion of TRR reports involving “Physical Force - Holding” decreases as part of a clear trend as officers progress in their career, using a more granular analysis involving “time spent in force” as opposed to the arbitrary classification of “rookie” and “non-rookie” officers.