Chicago Parking Tickets

Data Exploration and Revenue Development Strategies

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Project Overview

- The City of Chicago has a long history of public corruption dating back over 150 years.[1]
- Public corruption convictions are estimated to cost the Illinois state economy $550 million every year.[2]
- The full potential of municipal revenue streams must be unlocked to keep up with corruption costs.

Motivation

Data Overview/Pipeline

- Compiled by ProPublica, an investigative journalism organization, using City of Chicago records
- Data spans 1/1/96 - 5/14/18
- Every record was generated when a ticket was issued.
- 54,430,547 records. 22 features + 14 features engineered by ProPublica

  - `wc -l chicago_parking_tickets.csv`

- Features contain information about:

  - date ticket issued
  - location ticket issued
  - violation
  - vehicle information/owner zipcode
  - officer and dept
  - fine amount
  - ticket status as of 5/14/18 (paid, unpaid, dismissed etc.)

Data Overview/Pipeline

- Uncompressed csv is 19.6 GB

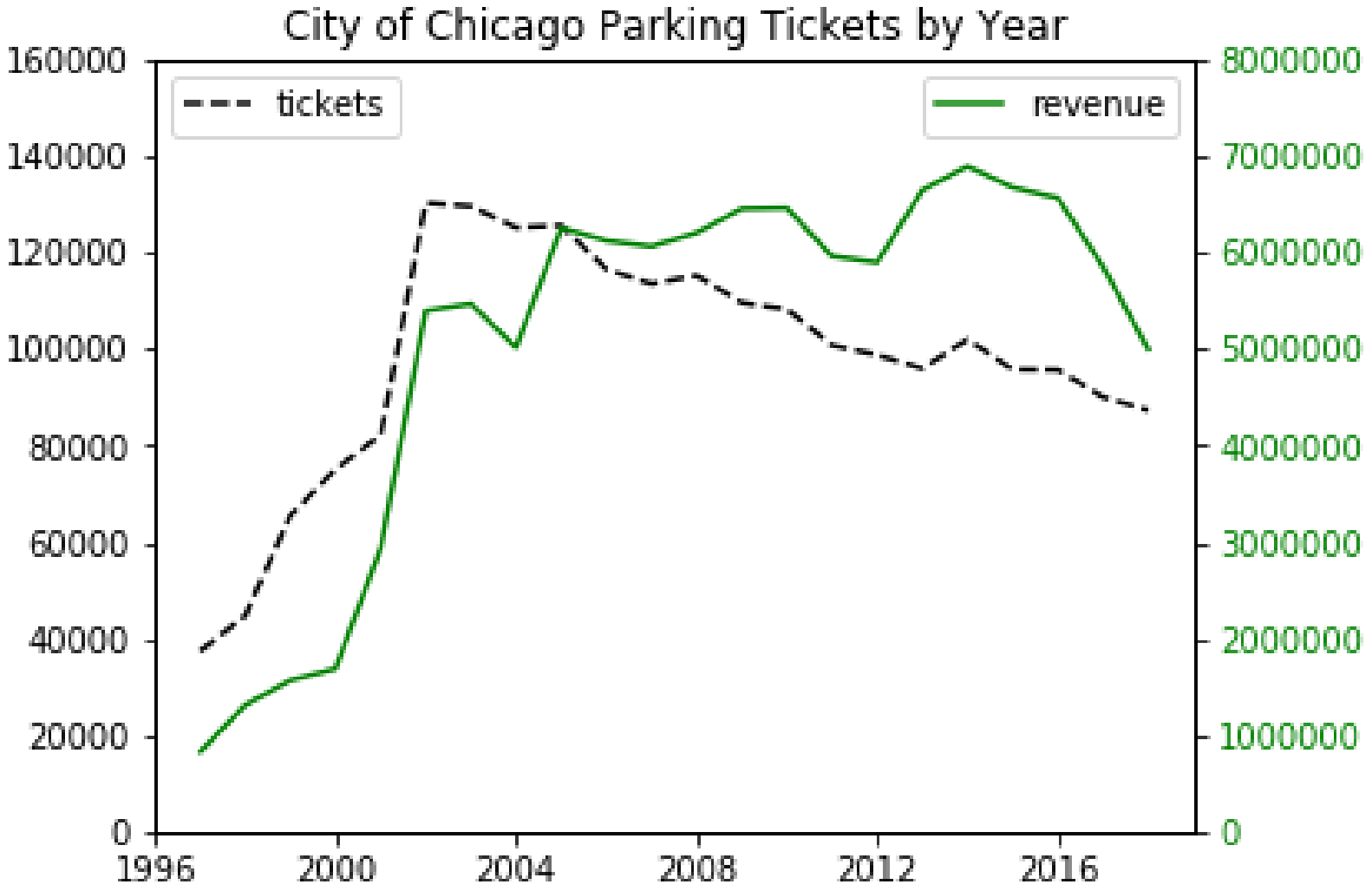
  - too large to load into memory

- Unix command line used to systematically sample every 25th record to yield 2,177,221 records (806 MB, 650 MB in memory)

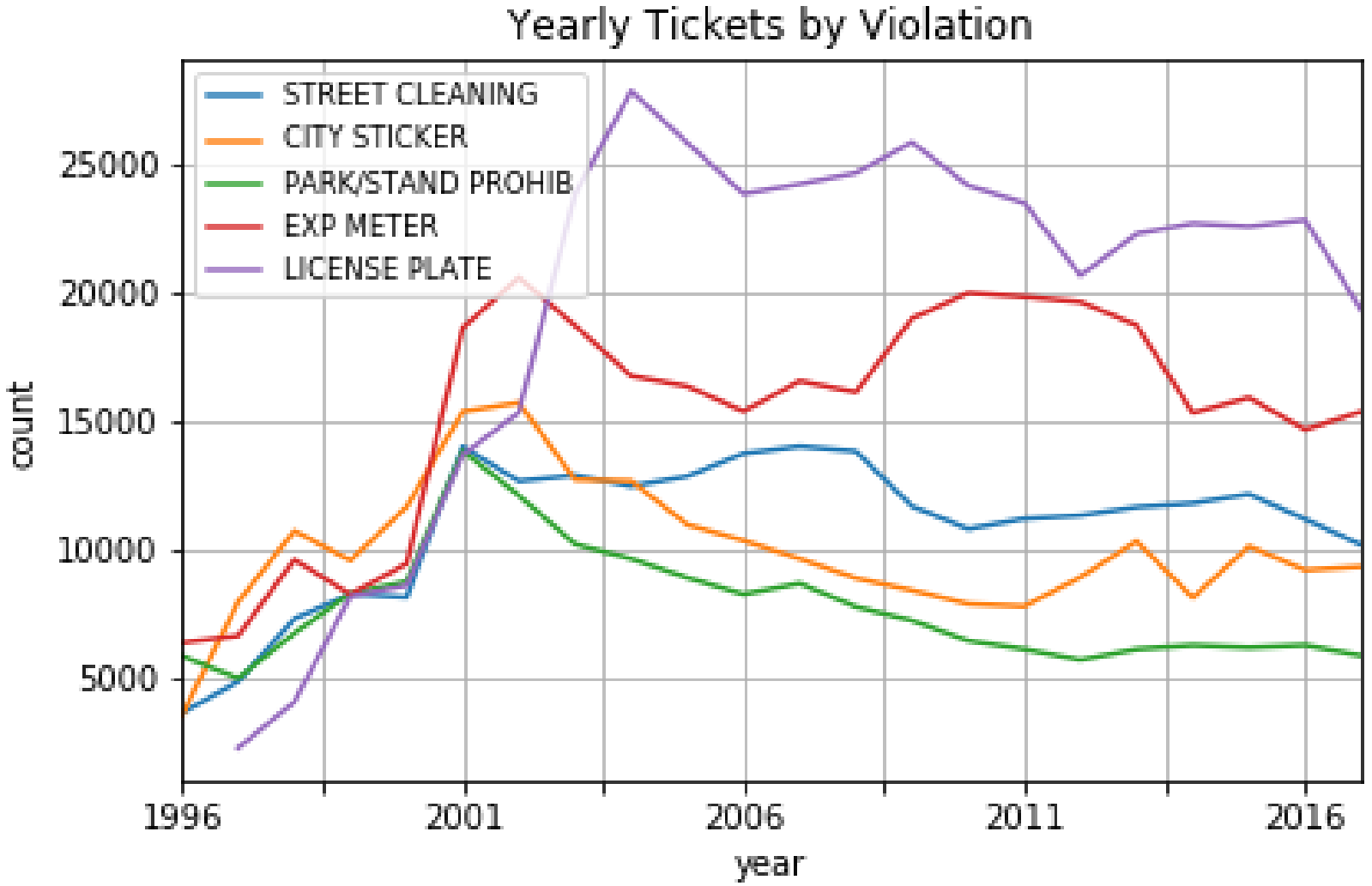
  - `awk 'NR == 1 || NR % 25 == 0' chicago_parking_tickets.csv > parking_sample.csv`

- Pandas used to explore data

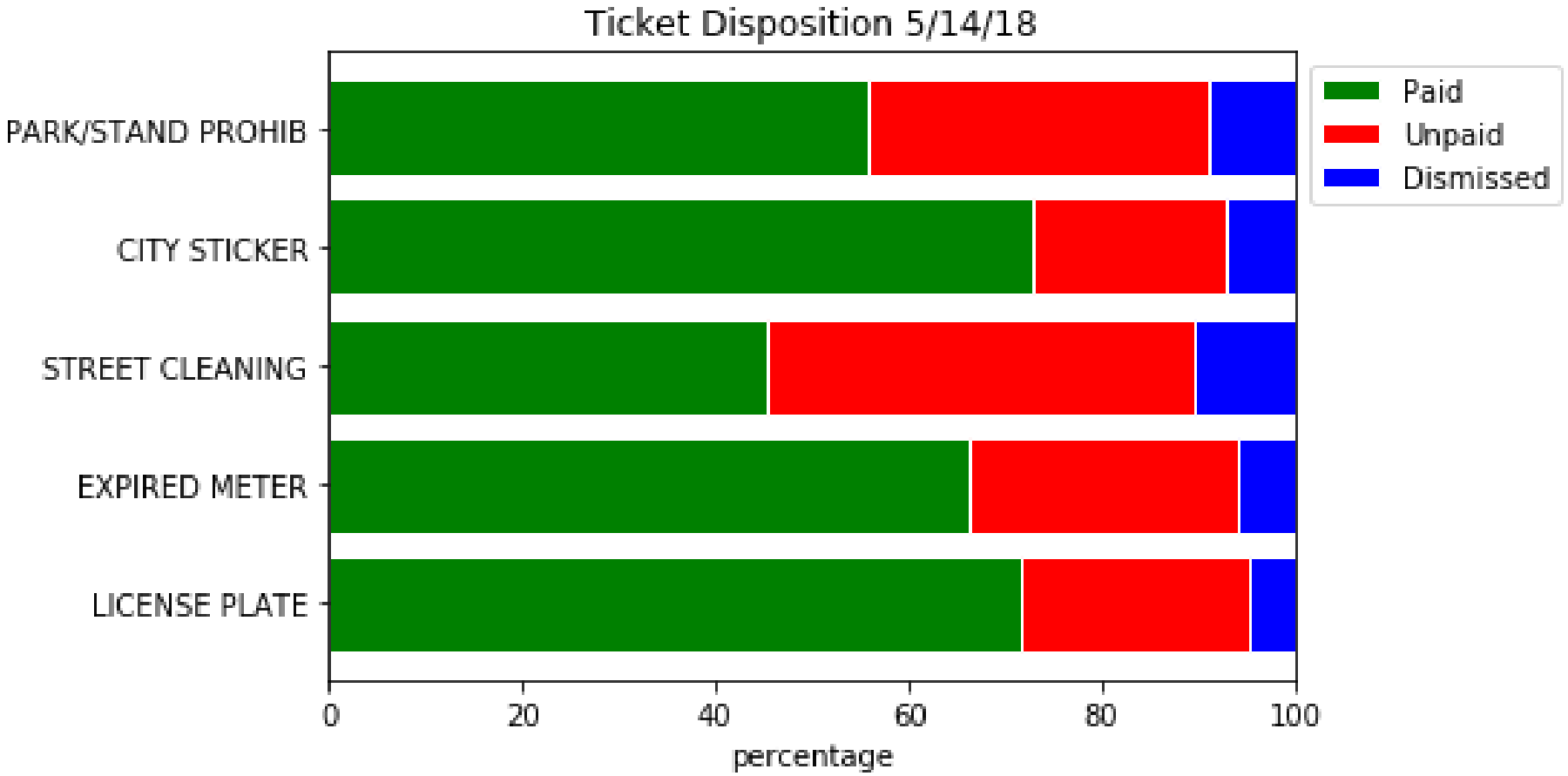
Data Exploration



Data Exploration



Data Exploration

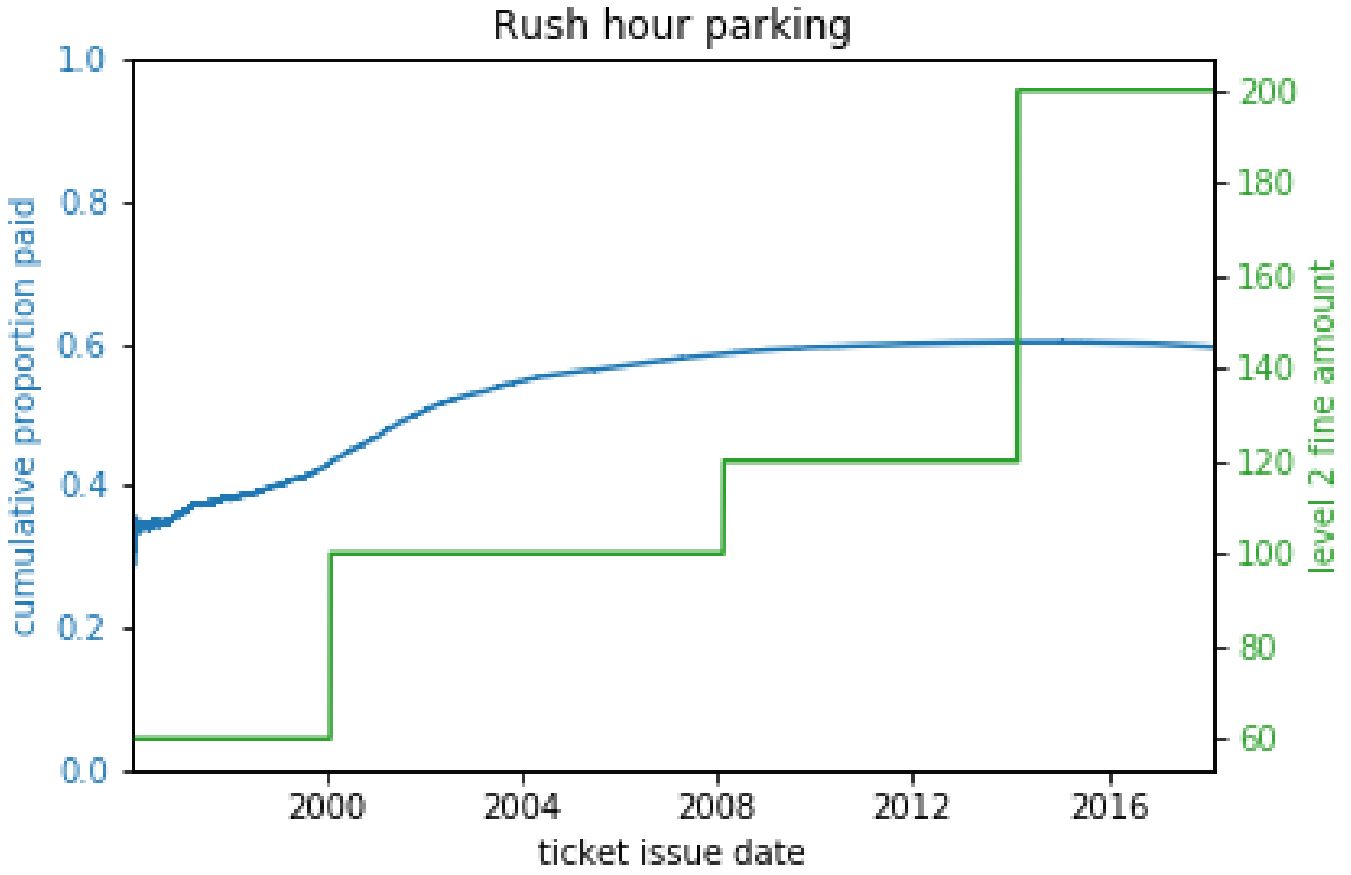


Data Exploration

Issue date	geocoded address	violation_description	license plate type	current amount due	total payments
2000-05-06 09:25:00	200 S Clark St, Chicago, IL 60604	PARKING/STANDING PROHIBITED ANYTIME	TRK	0	100
2000-05-15 17:41:00	Chicago, IL 60601	PARKING/STANDING PROHIBITED ANYTIME	PAS	50	0
2000-06-22 17:41:00	300 S Clark St, Chicago, IL 60605	WITHIN 15' OF FIRE HYDRANT	TRK	0	200
2000-08-10 15:54:00	300 S Clark St, Chicago, IL 60605	PARK OR STAND IN BUS/TAXI/CARRIAGE STAND	TRK	0	60
2000-08-21 17:15:00	300 S Clark St, Chicago, IL 60605	NO STANDING/PARKING TIME RESTRICTED	TRK	0	100

Hypothesis Testing

- Does raising ticket fine affect probability of payment?



Hypothesis Testing

- 6 month window before and after fine increase

$$H_0 : \hat{p}_{\text{after}} = \hat{p}_{\text{before}}$$

$$H_a : \hat{p}_a > \hat{p}_b$$

$$\tilde{p}_{\text{pooled}} = \frac{n_a \hat{p}_a + n_b \hat{p}_b}{n_a + n_b}$$

$$Z_{\text{test}} = \frac{\hat{p}_a - \hat{p}_b}{\sqrt{\tilde{p}(1-\tilde{p})\left(\frac{1}{n_a} + \frac{1}{n_b}\right)}}$$

$$\text{p-value} : 1 - \Phi^* \left(Z_{\text{test}}\right)$$

$$^*\Phi = \text{norm.cdf}()$$

Hypothesis Testing

- Rush hour parking level 1 fine increased
  - $30 > $50 (+67%) on 02/02/00 (p-val: 0.336)
  - $50 > $60 (+20%) on 02/19/08 (p-val: 0.345)
  - $60 > $100 (+67%) on 02/23/14 (p-val: 0.964)
- Conclusion: There is not enough evidence to reject the null hypothesis that raising ticket fines decreases payment probability.

Hypothesis Testing

- Rush hour parking level 2 fine increased
  - $60 > $100 (+67%) on 02/02/00 (p-val: 0.997)
  - $100 > $120 (+20%) on 02/19/08 (p-val: 0.588)
  - $120 > $200 (+67%) on 02/23/14 (**p-val: 0.007**)
- No fine increase
  - 02/02/99 (0.782), 02/02/01 (0.630)
  - 02/19/07 (0.819), 02/19/09 (0.799)
  - 02/23/13 (0.050), 02/23/15 (0.364)

Hypothesis Testing

- Conclusion: After Bonferroni correction for multiple testing, there is not enough evidence to reject the null hypothesis that raising ticket fines reduces the probability of payment.
- Even disregarding the Bonferroni correction, which is a very strong correction when performing a large number of tests, the weight of the evidence from multiple hypothesis tests is that increasing ticket fines doesn’t seem to decrease the probability of payment.

Conclusion

Future Directions

- Generate a data set of change in payment probabilities and change in fine amount (e.g. (0.65 – 0.70, $200 - $100) => (-0.05, 200)

  (1 - 0.65/0.70, $200/$100) => (0.07, 2)
- Investigate the correlation between change in payment probability and change in price.
- Investigate other violations.
- Investigate revenue amounts rather than probability of payment.

References

- 1. Simpson, D., Gradel, T.J., Rossi, M.R, & Taylor, K. Continuing Corruption in Illinois: Anti-Corruption Report #10. (2018) https://pols.uic.edu/wp-content/uploads/sites/273/2018/10/cpl_continuingcorruptioinillinois.pdf
- 2. Johnson, N.D., LaFountain, C.L. & Yamarik, S. Corruption is bad for growth (even in the United States). Public Choice 147, 377–393 (2011) doi:10.1007/s11127-010-9634-5