How to improve our on-campus parking system?

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A.

The city of Pittsburgh has recently increased the rates at the parking meters on Frew and Tech Streets. They have also increased the hours at which the meters must be paid: until 10pm on all days except Sunday. However, this has created a lot of problems for the users of these spaces – the students, staff, and faculty at CMU. We want to implement a survey in order to understand what the effect of this policy on the community at CMU. It is possible that there are better, more efficient ways for the parking on Frew and Tech Streets to be handled, either by CMU or by the city of Pittsburgh. For instance, if nobody parks behind on these streets any longer, the city loses revenue instead of gaining revenue as expected.

B.

The basic question we wish to analyze is how satisfied are members of the CMU community with the current parking conditions on Frew Street, and what kinds of alternatives would they find more satisfactory. We will ask questions such as, (we can also use anchoring vignettes!) how much inconvenience does it cause you that the only method of payment at the meters is quarters? We will also ask how much more convenient various alternatives would be, such as offering a day pass for parking at a meter, or lowering the price at the meters.

C.

A good bit of research, from parking rates and meter use to consumer perceptions of parking, has been done. The research on this topic is presented below:

(1)

Financial Analysis of Parking Assets of the Public Parking Authority of Pittsburgh-
http://www.city.pittsburgh.pa.us/council/assets/parkingassets/meterstudy.pdf

This contains a range of details about parking in Pittsburgh, including comparisons of its meter costs with other US cities, graphs of peak times that meters are used, and historical revenues due to parking. It could be used to suggest price ranges that may seem fair to our sample, and to compare the use of meters now with previous meter use.

(By Silvia Manolache)

(2)

Parking Research
http://www.city.pittsburgh.pa.us/council/assets/parkingassets/Final_Report_Sept_22.p df

Finance Scholars Group

September 24th 2010

This is a report regarding monetizing Pittsburgh's parking assets completed by a professional finance consulting firm. It describes a number of different ways to increase revenues from parking. This is a relevant document as it describes a number of different methods that are currently being used in Pittsburgh, as well as methods which could be implemented but are not that may potentially make the parking system more efficient (By Nicholas Thieme)

(3)

On-Street Parking Meter Behavior

http://141.213.232.243/bitstream/2027.42/64/2/74189.0001.001.pdf

The study included both an analysis of historical data and a survey of selected on-street parking meter sites in Ann Arbor area, and the objective of the study is to examine the questions of parking behavior, trying to understand the violation conditions and law enforcement results. The studies found that 1/3 of parking vehicles violate meter regulation while only 5.9 % was issued a citation.

(By Yijia Zhou)

(4)

University Parking Survey

http://facweb.knowlton.ohio-state.edu/jevanscowley/crp852/survey.pdf

In this survey, the University District randomly asked residents their household's parking habits, work and commute characteristics, parking problems and improvements they would like to see so that they could determine the current parking situation and improve it in the future. They found that the most frequent improvements noted are: improved safety, more parking lots, more parking spaces and improved transit.

(By Shu Wang)

D.

For our study, the sampling frame is people whose e-mail address can be found in the c-book or on the CMU website directory. (We may have a problem using the directory because of its disclaimer not to use the directory for solicitation of information)

E.

The target population is going to be students and faculty members of CMU. As we mentioned above, since our sampling frame is the c-book, which contains students, faculties and staffs' email addresses, we shouldn't worry too much about the coverage error. But still, there might be people whose email address cannot be found in the c-book for some reasons; in this way undercoverage will occur. Also since we are going to use a number generator to randomly select the page and item numbers from c-book, we may accidentally get the same person, thus duplication will occur. In order to reduce this error, we can either keep track of the people we already surveyed or first ask them if they have filled out our survey before. If they did, they can just ignore it.

F

We have chosen to use email as our mode of reaching our sample because first of all, our c-book contains email addresses for almost every student, faculty and staff, so it's very doable and won't cause serious coverage error. Secondly, Email is the only way we can reach a fair number of dissatisfied and satisfied people without risking bias, which is why it is our first choice. Also, since we can use python to generate random page and item numbers, it's very easy to randomly select people from the c-book.

G

Satisfaction score (outcome variable, range from 1 to 10)

Several indicator variables are:

Hours (On average how many hours per week do you park in the certain area?) Availability (What percent of the time can you find a parking spot easily?) Quarters (Do you always carry enough quarters to pay?)

Tickets (How often do you get tickets?)

Length (On average how long do you park there at a time?)

Satisfaction with various methods of fixing the parking situation, such as allowing meters to take credit cards, lowering the price, allowing purchase of a daily parking pass, etc.

H

We have decided to choose this parking project because it seems more interesting to us and also very doable. Moreover, there certainly exist some problems in our current on-campus parking system and we would like to contribute some findings and even improve the system.

I.

IRB form

J.

For the survey, the only things we want to find out are people's satisfaction towards our current on-campus parking system and their parking habits, as well as their suggestions, so they are really not private. But our survey will be anonymous. We might have to write down the e-mail addresses of the people we sent out a survey, but they are just for recording purposes in case we send out survey to the same people.

K.

Because we have the campus directory (C-Book) for both faculty (including administrative staffs) and students at Carnegie Mellon University, we can access all data of individual units in the target population. To better understand our target population, we have decided to implement stratified SRS without replacement because we need to make a separate inference for each stratum as they might have different preferences and experiences regarding the parking choice. Two strata in our project are CMU faculty (including staffs) and CMU students (both undergraduate and graduate).

We will use the same sampling scheme for each stratum, and we need to generate 202 pairs of numbers to determine the name of the individual in each stratum. For each pair of the numbers, it consists of two parts: first, page number; second, the item number. We would run 202 times for these two numbers, and every time, we would randomly generate a pair of the page number and the item number. For the page number, we would use it to determine which page of the C-Book would be used, and the item number would determine which person in the chosen page would be the sample. For example, if we have the pair number generated as (100, 20), we would open the C-Book for Page 100 and select the 20^{th} person of the chosen page as one of our sample.

The reason we chose this stratified SRS without replacement is that we need to make a separate inference for students and faculty members, and running 202 times for the pair numbers would be appropriate given our sample size through MOE calculation. Using C-Book helps minimize coverage errors while using stratified SRS without replacement through random selection allows us to have a better understanding about the parking system.

L.

Final Survey Questions:

1. Please select which of the following best describes you:
    a. Freshman
    b. Sophomore
    c. Junior
    d. Senior
    e. Graduate student
    f. Staff/faculty member

2. Please select your gender:
    a. Male
    b. Female

3. In what college do you belong to? (Only apply to undergraduate students)
    a. HSS
    b. MCS
    c. CIT
    d. CFA
    e. Tepper
    f. SCS
    g. Heinz

4. Do you own a car that you use (either regularly or occasionally) to commute to and from CMU?
    a. Yes
    b. No

5. Do you use a friend's or family member's car to commute to and from CMU (either regularly or occasionally)?
    a. Yes
    b. No

For the following questions, please think about how often in the LAST SEMESTER(starting January), you have parked at the METERED parking spots on Tech Streets, Frew Street, or surrounding Schenley Park.

6. How many times in an average week in the past semester have you parked at a metered spot on Tech Street, Frew Street, or surrounding Schenley Park? If you leave campus and return on the same day please count each distinct number of times you have parked.

   Please fill in the blank with your answer: _____times in a regular week

7. How fair do you think the rates for the metered spots mentioned above are? The rate is $1 for 30 minutes ($2 per hour)?
   a. Very fair
   b. Moderately fair
   c. Neither fair nor unfair
   d. Slightly unfair
   e. Very unfair
   f. No opinion

8. How many times have you gotten a ticket in this semester (insert dates appropriate for start of survey) because you have parked at a metered spot on Tech Street, Frew Street, or surrounding Schenley Park and the meter has run out or you have failed to pay?
   Please fill in the blank with your answer? _____times.

9. How many times have you parked at the above mentioned meters that you wanted to pay, but have not been able to pay in full or at all because you did not have enough quarters?
   Please fill in the blank with your answer? _____times.

10. What time of day (on every day but Sunday) would you consider to be the most fair to START requiring payment at the meters mentioned above? (be sure to mention AM or PM, and note 12 pm is noon)
    Please fill in the blank with your answer? _____

11. What time of day (on every day but Sunday) would you consider to be the most fair to STOP requiring payment at the meters mentioned above? (be sure to mention AM or PM, and note 12 pm is noon)
    Please fill in the blank with your answer? _____

12. Which of the following rates would you consider to be the most fair for parking at the mentioned meters?
    a. less than $.5 per hour

b. $.5 per hour
c. $1 per hour
d. $1.5 per hour
e. $2 per hour
f. $2.5 per hour
g. $3 per hour
h. $3.5 per hour
i. More than $3.5 per hour

13. For how long do you normally park at the metered spots at any given time?
    a. Less than 1 hour
    b. About 1 hour
    c. Between 1 and 2 hours
    d. About 2 hours
    e. Between 2 and 3 hours
    f. About 3 hours
    g. Between 3 and 4 hours
    h. About 4 hours
    i. More than 4 hours

14. How many times in a given week do you park at the metered spots in the following time slots?
    a. Before noon _____times
    b. 12pm-7pm _____times
    c. After 7pm _____times

15. How much more or less satisfied would you be if the following scenario happened?

(Check one box in each column)

	You are allowed to pay with multiple kinds of coins (quarter, dimes, nickels)	You are allowed to pay with credit and debit cards at the meters
Much less satisfied		
Less satisfied		
The same		
More satisfied		
Much more satisfied		

16. How crowded do you perceive the metered parking spots above mentioned to be during the following hours?

(Check one box in each column)

	Before noon	12pm-7pm	After 7pm
Almost no cars (close to 0% of the spaces are taken)			
Fewer than 25%			
About 25%-50%			
About 50%-75%			
About 75%-100%			
Pretty much 100%			
I don’t know			

17. How much more or less often you would park at the metered spots if the follow scenario happened? (Check one box in each column)

	You are allowed to pay with multiple kinds of coins (quarter, dimes, nickels)	You are allowed to pay with credit or debit cards
Much less often		
Slightly less often		
The same amount		
Slightly more often		
Much more often		

M.

We have chosen to calculate the Margin of Error (hereafter known as MOE) for questions 2 and 3 in our survey, "Do you own a car which you use (either regularly or occasionally) to commute to and from CMU?" and " Do you use a friend's or family member's car to commute to and from CMU (either regularly or occasionally)?", however, as both questions (for now) can be assumed to have the same Standard Error, one MOE calculation with suffice for both questions. The logic behind choosing these questions is simple. As we intend to determine satisfaction with on campus parking, it is vital for us to be able to accurately estimate the number of people who drive to campus and are thus involved with our topic of interest. As such, we believe that out of all of the constructs in our survey, the number of members in CMU community who drive to campus should be the construct which is considered most heavily when calculating our sample size.

Using $\frac{n_0 N}{n_0 + N}$ where $n_0 = \left(\frac{\frac{z_a}{2}\sigma_X}{\text{ME}} \right)^2$, we were able to determine three viable Margin of Error's with the consideration of a reasonable sample size. Additionally, we assumed N=13,323, the number of total students and faculty at Carnegie Mellon University.

The first was a MOE of .05. This is assuming an SD of .5 (a reasonable assumption as the question is a yes or no question). The accompanying Sample size would be 388 people. The calculation was as follows:

$$\left(\frac{2(.5)}{.05} \right)^2 = 400, \quad \frac{400(13{,}323)}{13{,}723} = 388$$

The second was a MOE of .06. The accompanying Sample size would be 273 people. The calculation was as follows:

$$\left(\frac{2(.5)}{.06}\right)^2 = 277, \quad \frac{277(13{,}323)}{13{,}600} = 272$$

The third was a MOE of .07. The accompanying Sample size would be 202 people. The calculation was as follows: $\left(\frac{2(.5)}{.07}\right)^2 = 204, \quad \frac{204(13{,}323)}{13{,}527} = 202$

None of the calculation were even, but in the interest of preserving statistical strength, any number with a non-zero decimal point was rounded up to the nearest integer.

The benefit of calculating three sample sizes is that while the .05 MOE is preferable it will be difficult to attain a sample size of 388 people, and we are willing to trade some width for attainability. We are not willing to go below a MOE of .07 as we believe that 202 should certainly be attainable, and to compromise any more MOE would be detrimental to the statistical strength of our findings.