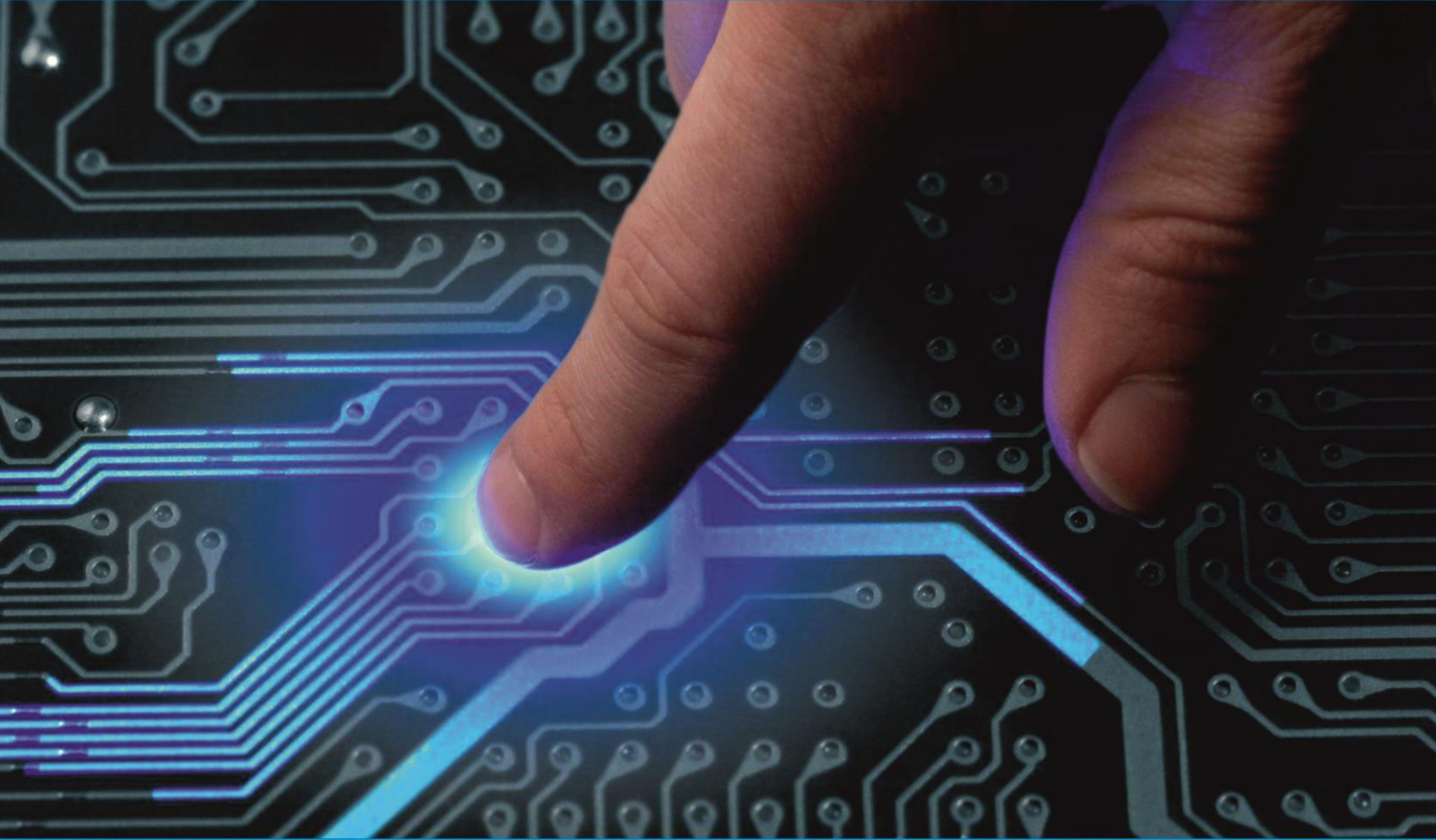




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# Stratified Sampling Method for Resident Travel and the Sampling Rate

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**ABSTRACT:** This text first dissected the relationship between average travel frequency, trip mode structure, and the characteristics of residential areas. The results showed that conducting a stratified resident travel investigation in accordance with the characteristics of residential areas will yield samples with much smaller differences and reduce the investigation sampling rate. As needs be, another sort of inhabitant travel examination technique was advanced dependent on the above thoughts. The delineated examining rate recipe and the inspecting pace of each layer have been determined in detail as per Probability Theory and Mathematical Statistical Methods. At last, for the fundamental metropolitan region of citiesin, we talked about the sensible estimations of boundaries in the recipes and got inspecting rates for movement reviews in various local locations. Hypothesis and contextual investigations outlined the operability of this strategy and its benefits contrasted with arbitrary inspecting.

**KEYWORDS:** sampling rate, degree of variation, size of error, stratified sampling

## I. INTRODUCTION

Occupant travel examination is one of the center subjects of metropolitan transportation arranging, with the primary things of request including singular fundamental data (e.g., sexual orientation, age, work class, pay, and whether one has a vehicle) and their movement attributes (travel beginning and finishing focuses, flight time, appearance time, travel reason, and excursion mode) Resident travel examination is increasingly more broadly applied; nonetheless, simultaneously, we understand that we actually need hypothetical examinations on the examination techniques for inhabitant travel. The postcard overview technique and phone request presented in cutting edge nations can barely be adjusted. The study cycle comprises of deciding the examination scope first, partitioning the field of examination into a few traffic examination zones, removing a specific number of families haphazardly from each zone as indicated by the examining rate set heretofore, giving out polls to all the relatives of the separated families that meet the conditions (i.e., can travel autonomously what's more, will be over 6 years of age) lastly accepting and figuring out the survey structures. Practically all overviews are irregular examining examinations, and the whim of the testing rate is moderately enormous, for the most part in the scope of 2–4% .

Urban population (ten thousands)	Sampling rate used in some mainland cities of China		North America recommended value (%)
	City	Sampling rate (%)	
<5	—	—	20
5–15	Taicang	4.0	12.5
15–30	Changshu	3.0	10
30–50	Yantai	4.2	6
50–100	Shantou	3.4	5
	Bengbu	4.0	
	Guiyang	4.0	
100–300	Suzhou	4.3	4-5
	Guangzhou	3.0	



>300	Nanjing	4.1	2-3
	Tianjin	1.4	
	Shanghai	3.3	

Comparison of the sampling rates of urban resident travel surveys

Numerous specialists have questioned the logical nature of such an examining rate once in a while; be that as it may, in practice, scarcely any individuals will utilize the generally high suggested estimations of Europe and America, particularly in urban areas with populaces of short of what 1,000,000. Notwithstanding, on the off chance that we can track down some trademark boundaries with huge contrasts and afterward order or separate them, at that point the examining rate will diminish correspondingly to address the high investigatory expenses. By the by, it is dire that researchers can obviously advance the testing rates for urban areas of various populace sizes to adjust logical quality and investigatory expenses. With the family visit study strategy still regularly utilized in China, this content will advance a delineated inspecting technique focused on the distinctions in the qualities of local locations with the foundation of fast urbanization in China, analyzing the choice and setting of the inspecting rate. It is normal that the outcomes can improve the current circumstance, wherein terrain zones of China need techniques for deciding the testing pace of occupant travel overviews.

## II. LITERATURE SURVEY

### I. URBAN TRANSPORTATION PLANNING: A DECISION-ORIENTED APPROACH

This reading material, confronting the real factors of contemporary transportation arranging, considers monetary severity, regular asset constraints, changing socioeconomics of metropolitan populaces, swelling, changing elements of urban communities, new accentuation on restoration and upkeep of existing framework, new vehicle alternatives, and advances in innovation. The fundamental reason is that successful metropolitan transportation arranging should be identified with the kinds of choices that will be made. It portrays in detail the significant qualities of metropolitan travel and transportation, presents an outline of dynamic in the metropolitan transportation climate and talks about the initial step of the proposed transportation arranging measure - information the executives and conclusion and furthermore look at the examination procedures that can be utilized in transportation arranging.

### II. Land use–transport interaction modeling: A review of the literature and future research directions

Expansions in per capita vehicle utilization and related emanations have brought forth an expanded assessment of the manners by which our networks and districts are creating. Related with expanded vehicle utilization are diminished degrees of strolling and trekking, two legitimate types of active work. The Surgeon General's 1996 report, Physical Activity and Health, features the expanding level of actual latency as a developing reason for mortality. The expenses and advantages of differentiating land advancement and transportation venture rehearses have been the subject of impressive discussion in the writing. Discoveries have been invalidated dependent on methodological grounds and mistaken translation of information. A few of these examinations, their methodological methodologies, and their evaluations are broke down. While most concur that the assembled climate impacts travel, impressive conflict exists over the probably effects of expanded thickness, blend, and road network on air quality, and on transportation framework execution and family movement designs.

### III. Spatial statistics for urban analysis: A review of techniques with examples

Customarily, metropolitan examination has rushed to receive and profit by improvements in innovation (e.g., microcomputer, GIS) and methods (e.g., insights, numerical programming). This has not been the situation, notwithstanding, with fresher strategies for spatial examination — specifically, spatial insights. As of late has the present circumstance began to change. This paper reports the conversion of spatial measurements and metropolitan investigation by first auditing improvements in quite a while, and afterward introducing instances of late applications in metropolitan examination. The advancements assessed fall under the rubric of worldwide and nearby types of spatial investigation, and cover three significant specialized issues: spatial affiliation, spatial heterogeneity and the modifiable areal unit issue. The models feature the pertinence and convenience of the methods audited for metropolitan transportation and land-use applications. The paper finishes up with guesses concerning future improvements at the convergence of spatial measurements and metropolitan examination.

- IV. Manual of traffic engineering studies  
Substance incorporates: inventories for traffic examines , Traffic volumes , Traffic mishap considers , traffic clashes and Spot speeds, Travel times and deferrals , Intersection delays. Root objective reviews , Parking contemplates , Public transportation use , Public transportation speed and postponements , Street lighting and Observance of control gadgets.
- V. Characterizing street hierarchies through network analysis and large-scale taxi traffic flow: a case study of Wuhan, China  
Progressive system is a significant property of a road organization, which recommends that solitary few roads are unmistakable. A past exact investigation of an European city has recognized four degrees of scale in a road organization, specifically the top 1%, top 20%, base 80%, and base 20%. This paper researches such road chains of importance in an enormous Asian city, Wuhan, with a confounded organization of roads. In view of organization examination, we find that road chains of importance for this situation study are marginally unique so the fourth scale is changed from the underlying 20 to 25%. The recognized road chains of importance are additionally contrasted with the power of huge scope traffic streams at various time scales. We find that disseminations of both day by day and hourly traffic adjust well to the road pecking orders. All the more explicitly, the 20% of top roads oblige about 98% of traffic stream, and the 1% of top roads represent over 60% of traffic stream. Additionally, this finding demonstrates that the current road organization of Wuhan should be improved on the grounds that the top 20% of roads are fairly overburdened prompting gridlock. Our examination not just gives new quantitative proof concerning the rise of road chains of command yet in addition features the conceivable gridlock.
- VI. Resident trip survey based on residential area stratification  
The connections between the normal excursion times just as the outing mode structure, as the principle aftereffects of the inhabitant trip survey (RTS), with the local location attributes were dissected in detail. It turned out that there are some comparing relationships between them, and the examples would be exceptionally delegate if the RTS was performed by the definition of neighborhood characteristics. A new RTS approach was proposed and its examining strategy was concentrated in detail. The recipes to decide the aggregate and separated inspecting rates were given. Taking the old metropolitan zone of Kunshan city, Jiangsu province, China, as an example, the assessment of the boundaries in the given equations was discussed. The testing paces of the RTS relating 3 kinds of occupant region were obtained, demonstrating the predominance in operability of the delineated testing over the conventional irregular testing.
- VII. Travel demand and the 3Ds: Density, diversity, and design  
The exploration finds that thickness, land-use variety, and walker situated plans by and large decrease trip rates and empower non-auto travel in genuinely huge manners, however their persuasions have all the earmarks of being genuinely minimal. Flexibilities among factors and factors that catch the 3Ds and different proportions of movement request are by and large in the 0.06 to 0.18 territory, communicated in outright terms.
- VIII. Introduction to statistical analysis.  
This reading material for a fundamental measurements course accepts, arithmetic to just logarithmic expansion, deduction, and duplication. Text conversation, models, and issues use material from a wide assortment of subject fields including brain science. Points covered incorporate appropriations, tests, populaces, factual deduction, trial of speculations, investigation of difference and co-fluctuation, relapse and relationship, nonparametric insights, consecutive examination, and so forth.
- IX. Solving Large-Scale Zero-One Linear Programming Problems  
In this paper we report on the answer for optimality of 10 huge scope zero-one direct programming issues. All difficult information come from genuine modern applications and are described by scanty limitation networks with normal information. About portion of the example issues have no evident unique construction; the rest of primary attributes that our computational methods don't abuse straightforwardly. By the present guidelines, our approach created amazing computational outcomes, especially on scanty issues having no evident uncommon construction.
- X. A lift-and-project cutting plane algorithm for mixed 0–1 programs  
We propose a cutting plane calculation for blended 0–1 projects dependent on a group of polyhedra which fortify the standard LP unwinding. We tell the best way to produce a feature of a polyhedron in this family which is

generally disregarded by the current partial point. This slice is found through the arrangement of a direct program that has about double the size of the standard LP unwinding. A lifting step is utilized to lessen the size of the LP's expected to create the cuts. An extra fortifying advance recommended by Balas and Jeroslow is then applied. We report our computational involvement in a primer form of the calculation. This methodology is identified with crafted by Balas on disjunctive programming, the network cone relaxations of Lovász and Schrijver and the chain of command of relaxations of Sherali and Adams.

### Stratified Method

- Proposal of Stratified Sampling Method

The examination of this content spotlights on defining dependent on the qualities of neighborhoods thus underneath centers around the connection between the attributes of local locations and occupant travel qualities.

Inhabitant travel examinations incorporate numerous things, yet the main information required in transportation arranging ought to be the normal recurrence of outings per capita (on the off chance that all individuals from a family are researched, it ought to be the normal recurrence of excursions per family), trip mode construction, and occupant travel OD grid. On the off chance that we execute examining reviews with a similar extent for the entire area, at that point the throughout the day OD framework ought to be the OD lattice, which is gotten from the examination, partitioned by the testing rate. On the off chance that we execute examining overviews with various extents comparing to various traffic examination zones, the entire day OD lattice ought to be the incorporated information of all zones through the OD travel information studied for each zone isolated by the relating inspecting rate; hence, we can likewise acquire the total OD grid. In this manner, the total OD lattice has nothing to do with whether we utilize a similar testing rate; maybe the strategy for utilizing a similar examining rate in the entire area in the past is excessively "unbending." Thus, is the inspecting rate meeting the precision conditions chosen by the provincial qualities of each zone practicable? Then, we will additionally investigate the two significant arrangements of pointers of the recurrence of outings per capita (or family) and outing mode structure.

From the above examination, it isn't hard to see that the normal recurrence of excursions and the outing mode constructions of these three sorts of local locations (i.e., recently created regions in the city, multi-facet abiding houses fabricated a specific timeframe back, and neighborhoods in Old Town) are entirely unexpected; subsequently, it is exceptionally proper to make sensible divisions as indicated by their disparities and utilize the separated testing strategy to do occupant travel examinations. This content proposes a local location defined based testing examination technique for occupant travel. Since we actually utilize arbitrary testing to choose the respondents of each layer after grouping, in the accompanying sections, the possible fluctuation of irregular examining for each layer and different boundaries are contemplated in the investigation of the delineated examination inspecting rate.

- Main Factors Affecting Size of the Sampling Rate

The example size is primarily settled by the accompanying :the level of variety of the study objects; prerequisites and the admissible size of mistake, that is, precision necessities; the necessary certainty coefficient, which, as a rule, is taken as 95%; the populace; and the testing technique. The more perplexing the contemplated question is and the bigger the level of variety is, the bigger the example size should be. The higher the necessary exactness is, the bigger the example size ought to be. The bigger the populace is, the bigger the comparing test size ought to be, however the relationship isn't direct. Simultaneously, the inspecting strategy likewise decides the example size. Normally utilized techniques incorporate irregular examining and separated testing. The idea of the previous is self-evident. Purported separated testing implies partitioning the parent populace into a few sorts or layers and afterward examining haphazardly from each layer, not inspecting arbitrarily straightforwardly from the parent populace. The upside of this strategy is it limits the contrast between various sorts of people through arrangement, which is helpful for separating agent tests and diminishing the example size. In this way, contrasted and irregular examining, delineated inspecting has generally wonderful benefits, however the precondition is the means by which to order.

### Study on the Stratified Survey Sampling Rate

- Study on the Sample Variance of Each Layer

To utilize the Mathematical Measurement Method to examine the inspecting rate, we ought to present an arbitrary variable; here, we utilize a moderately basic what's more, natural variable, day by day normal recurrence of outings, as the arbitrary variable. We utilize capital letter  $M$  and  $m$  to, separately, represent the parent populace and



the example.  $M = (1/N) \sum_{i=1}^N M_i$  represents the populace mean, and  $m = (1/n) \sum_{i=1}^n m_i$  represents the example mean. For arbitrary examining, when there is no populace data can be utilized, we can take  $m$  as the gauge of  $\square$ . To acquire the fluctuation equation of  $\square$ , we ought to present the following two lemmas :

- Lemma 1. If one extracts a simple random sample with a sample size of  $n$  from a population with size  $N$ , then the sampled probability of each specific cell in the population is  $n/N$  and the probability of two cells being sampled is  $n(n-1)/(N(N-1))$ .
- Lemma 2. If one extracts a simple random sample with a sample size of  $n$  from a population with size  $N$ , then one can introduce a random variable  $\square_i$  for each unit  $\square_i$  in the population as follows:  $\square_i = \{1, \text{ if } \square_i \text{ is taken into the sample } 0, \text{ if } \square_i \text{ is not taken into the sample, } \square_i = 1, 2, \dots$

Obviously, each  $\square_i$  obeys a two-point Distribution (or Bernoulli Distribution) according to Lemma 1,  $E(a_i) = n/N$  and  $E(a_i a_j) = n(n-1)/(N(N-1)) (i \neq j)$ ; thus,  $V(a_i) = n^2(n-1)/N^2(N-1)$  and  $\text{cov}(a_i, a_j) = E(a_i a_j) - E(a_i)E(a_j) = -n(N-n)/N^2(N-1)$ .

With the above two lemmas, we can prove that, for random sampling, the variance of  $\square$  is as follows:

$$V(\bar{m}) = \frac{S^2}{n} \left(1 - \frac{n}{N}\right)$$

where  $S^2$  is the population variance of  $\square$ , which can be replaced by the sample variance  $s^2$  during

calculation:  $S^2 = \frac{1}{(N-1)} \sum_{i=1}^N (M_i - \bar{M})^2$ .

To prove, we introduce random variable  $\square_i$  (the meaning is idem). Thus,

$$\begin{aligned} V(\bar{m}) &= V\left[\frac{1}{n} \sum_{i=1}^N a_i M_i\right] = \frac{1}{n^2} \left[ \sum_{i=1}^N M_i^2 V(a_i) + 2 \sum_{i < j}^N \text{cov}(a_i, a_j) \right] \\ &= \frac{N-n}{nN^2} \left[ \frac{N}{N-1} \sum_{i=1}^N M_i^2 - \frac{1}{N-1} \left( \sum_{i=1}^N M_i^2 \right) \right] \\ &= \frac{N-n}{nN(N-1)} \sum_{i=1}^N (M_i - \bar{M})^2 = \frac{S^2}{n} \left(1 - \frac{n}{N}\right) \end{aligned}$$

- Study on Stratified Survey Sampling Rate

We continue to take the daily average frequency of trips as the random variable. According to formula, we can obtain the following variance estimator formula of population mean

$$V(\bar{y}_{st}) = V\left(\sum_{h=1}^L W_h \bar{y}_h\right) = \sum_{h=1}^L W_h^2 \frac{S_h^2}{n_h} (1 - f_h)$$

where  $V(\bar{y}_{st})$  is the variance estimator of the population mean  $\bar{y}$  (st stands for stratified);

$$W_h : \text{ is the layer weight } \left( = \frac{N_h}{N} \right);$$

$$f_h \text{ is the sampling rate of layer } h \left( = \frac{n_h}{N_h} \right).$$

the distribution of its sample mean tends to be a normal distribution as  $n$  increases, as long as its standard deviation is limited; thus,

$$\square(\square) = (\square / \square \square)^2$$

We rewrite formula  $\square \square \square(\square \square \square) = \left(\frac{\square}{\square \square}\right)^2$ , and we can obtain the following formula by combining formulas

$$\sum_{i=1}^2 W_h^2 \frac{S_h^2}{n_h} (1 - f_h) = \left(\frac{d}{u_\alpha}\right)^2.$$

We normally use Neyman Allocation (or Optimum Allocation) to solidly decide the populace inspecting rate and separated inspecting rate. The inhabitant travel examination expense follows the accompanying equation :

$$C = C_0 + \sum_{h=1} c_h n_h$$

where  $\bar{c}_h$  is the average investigation fee of each sample unit of layer  $h$  and  $c_0$  is the fixed fee. Then, we can obtain the Optimum Allocation of each sample size as follows:

$$\frac{n_h}{n} = \frac{W_h S_h / \sqrt{c_h}}{\sum_{h=1}^L W_h S_h / \sqrt{c_h}}$$

$$\frac{n_h}{n} = \frac{W_h S_h}{\sum_{h=1}^L W_h S_h}$$

$$f_h = f \frac{S_h}{\sum_{h=1}^L W_h S_h}$$

$$f = \frac{\left(\sum_{h=1}^L W_h S_h\right)^2}{\sum_{h=1}^L W_h S_h^2 + N(d/u_\alpha)^2}$$

If the  $W_h$  and  $S_h^2$  of each layer are known, the population sampling rate can be found according to formula under a certain accuracy (i.e.,  $d, u_\alpha$ ); thus, the sampling rate of each layer can be found according to formula .

### Example

We will show the operability of the examination technique with the case of the principle metropolitan zone of Kunshan City, Jiangsu Province, China. The primary metropolitan region is the focal point of Kunshan City and the city's business administration focus, which serve the significant elements of schooling, wellbeing, culture, account, organization, etc. The complete region is around 6.1 square kilometers, with a populace of roughly 134 thousand. We will discover the populace examining rate and separated inspecting rate as indicated by the occupant travel examination technique, which depends on delineating the local location.

- Determining the Sampling Rate

As per  $d, u_\alpha, W_h$ , and  $S_h^2$  are the critical boundaries for the estimation of the populace inspecting rate and separated examining rate. These boundaries will be examined individually in the accompanying sections.

The connection between the passable total blunder and the overall mistake is  $d = Ex$ , where represents the example mean of the control records. For various control files, the inspecting rate is typically unique. For the every day normal recurrence record of outings chose over, the overall mistake is by and large under 1%. The day by day normal recurrence of excursions is typically somewhere in the range of 2.4 and 2.8; so can be from 0.024 to 0.028. is the respective quantile of the standard ordinary dissemination, which has something to do with the certainty coefficient. The certainty coefficient is generally 95%; subsequently, can be 1.96. In light of the measurement populace of every local area, we can acquire the populace layer weight for each neighborhood, in particular,  $w_1 = 0.22, w_2 = 0.68$ , and  $w_3 = 0.10$ .

Utilizing equation , we get the populace testing rate  $f = 5.30\%$ . As per recipe , the examination testing paces of occupant travel for the three sorts of neighborhoods are 4.41%, 5.66%, and 4.80%, separately.

### III. FUTURE SCOPE & DISCUSSION

For the single-stage bunch examining, the areas were defined by either complete number of structures per segment, or by absolute people per segment. As another option, Bo could split into equivalent squares utilizing a network. There is a sensibly very much characterized focus of data set , simply are there are sensibly all around characterized high-populace thickness focuses that could be outwardly distinguished from aeronautical photos of most urban communities. Plainly if a network was overlaid on a guide of , the cells farther from thick populace zones would have less private designs and a lower populace thickness. In the event that a Neyman delineation calculation were to be applied, we would guess that cells would be allocated to layers as a harsh capacity of their separation from the focal point of the

city. It is fascinating to think about the productivity of this convention for delineation with our current outcomes for single-stage group testing, searching for conceivable improvement. Right now, we don't have adequate information to test this speculation. The capacity to rapidly appraise the absolute populace size with sensible accuracy in asset restricted conditions can be of high incentive for demography, the study of disease transmission, and wellbeing and social administrations research. The two methodologies investigated here are both of possible worth in accomplishing these objectives. Albeit the ideal separation by private inhabitation is exceptionally productive, a solitary stage bunch inspecting convention requires negligible information ahead of time, while limiting the quantity of segments that should be overviewed.

#### IV. CONCLUSION

Looking at the testing pace of the fundamental metropolitan zone of Kunshan City with Table 1, we find that examination responsibility is significantly diminished in the strategy proposed in this content contrasted and the prerequisites of North America on inspecting rate. In any case, we can see that specific urban areas in terrain China were to some degree imprudent when they decided the examination testing rate. For example, For Taicang City, which is of a comparable size, even with arbitrary inspecting, its examining rate is more modest than the separated testing pace of Kunshan City determined in this content. The principle benefits of delineated inspecting are that boundary assessment of each layer can be gotten; the example for separated examining is more agent than that for arbitrary testing, in this way improving the exactness of the boundary assessment; and it incredibly decreases the examination test size contrasted and irregular inspecting. Both irregular examining and separated inspecting require a specific responsibility of preinvestigation already to get the difference and to additionally decide the testing rate.

The occupant travel study is the most fundamental and most significant examination in metropolitan transportation arranging. The primary point is to get singular travel attributes to comprehend the laws of movement action. Inhabitant travel reviews require a lot of labor, actual assets, and monetary assets. The examination cost per capita in territory China is roughly from RMB 60 to 80 Yuan. It is a lot higher in the 14 urban areas in America, including Los Angeles, San Francisco, and Chicago, where it costs up to 90 US dollars for each capita. Finishing the examination at the very least responsibility and cost under the precondition of fulfilling project precision is the longing of each individual accountable for movement studies and arranging projects. In view of contrasts in the attributes of local locations, this content advances the solid thought of defined examining and gives techniques for computation to the populace testing rate and separated inspecting rate. This content depends on successful hypothesis and strategies for occupant travel examination and makes a more logical examination testing rate.

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