Using New IT for Area Sampling in a Metropolitan Household survey

Young-Je Woo

Sun-Woong Kim

So-Hyung Park

Sang-Eun Lee

Boyoon- Choi

Dongguk University
Survey & Health Policy Research Center(SHPRC)

OUTLINE

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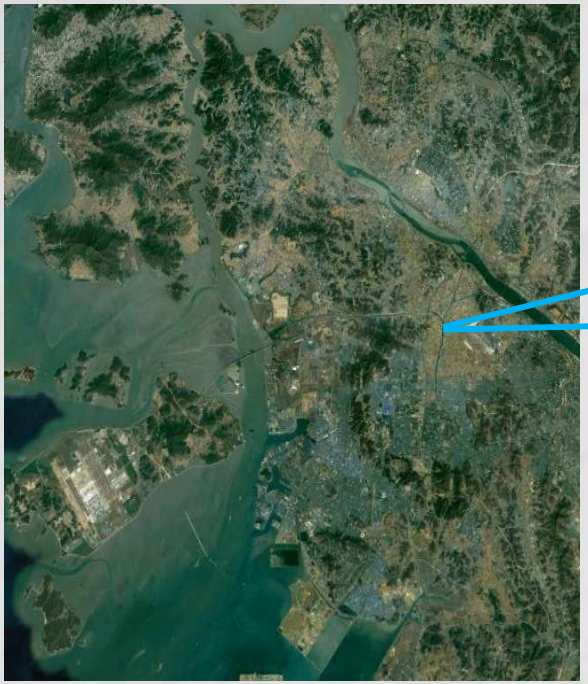
Using New IT for Area Sampling?

- Developed from Survey & Health Policy Research Center(SHPRC) in the 2011 based on the theory of sample design(2012 JSM, San diego)
- Using Information Technology(IT) such as….. enables researchers to conduct Area Sampling more efficient with respect to its own weakness(time, effort and cost)

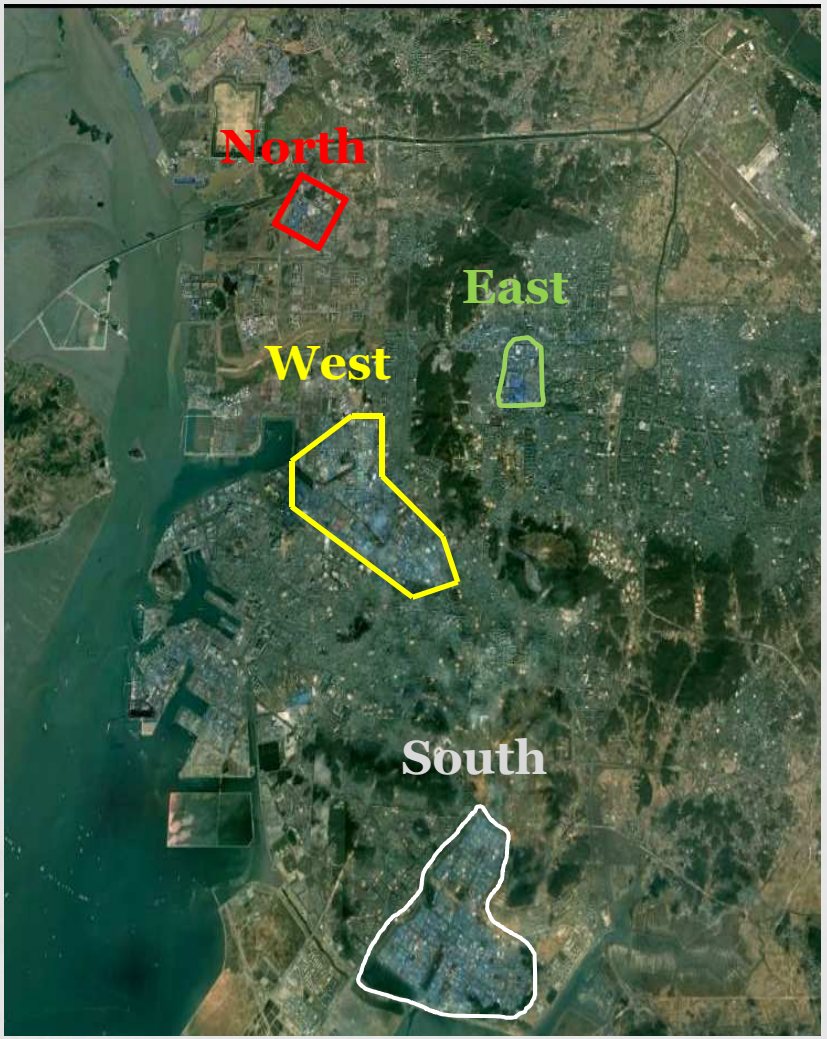
Description of the Metropolitan Household Survey

- Purpose: To investigate health problems among residents from communities surrounding industrial complexes in Incheon, South Korea
- Target Population: Residents in Incheon
- Survey Population: Residents living near the industrial complexes in Incheon
- Survey mode: CAPI(Computer Assisted Personal Interviewing)
- Sampling method: Four-stage area sampling
- Sample size: 900 households

Geographical Location of Industrial Complexes in Incheon

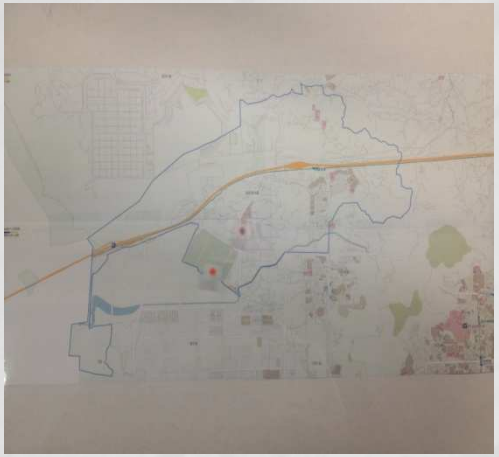


Incheon



Target population

- The population distribution of communities surrounding industrial complexes
  - Population size: 573,796(2010 Census)
  - Number of households: 199,328(2010 Census)
  - Four Industrial Complexes located



North Industrial Complex

East and West Industrial Complexes

South Industrial Complex

Summary of Survey Area

Area	Industrial complex	층1*	층2*	합계
		해당지역 (인구수 / 가구수)	**해당지역** (인구수 / 가구수)	(인구수 / 가구수)
1	East	**갈산1동** (17,728 / 6,265) **작전2동** (28,312 / 10,314) **부평1동** (34,327 / 12,512) **산곡4동** (20,174 / 6,391) **청천2동** (37,151 / 12,480)	**갈산2동** (22,983 / 7,964) **산곡2동** (32,328 / 9,656) **효성2동** (34,322 / 11,002) **청천1동** (15,583 / 6,306)	(242,908 / 82,890)
2	West	**가좌3동** (20,276 / 7,115) **도화 2·3동** (20,686 / 7,821) **가좌1동** (13,295 / 4,999) **가좌2동** (22,885 / 7,156) **십정1동** (20,952 / 7,721) **송림4동** (5,378 / 1,873)	**주안5동** (23,142 / 8,654) **송림6동** (7,601 / 2,662) **송현3동** (4,735 / 1,923) **가좌4동** (12,054 / 4,474) **간석4동** (29,548 / 10,833)	(180,552 / 65,231)

Summary of Survey Area(Cont.)

3	North	**검암경서동**** (5,841 / 1,750)			(5,841 / 1,750)
4	South	**논현고잔동**** (33,546 / 11,346) **동춘3동** (19,748 / 5,577) **남촌도림동** (23,827 / 8,073) **선학동** (21,685 / 8,590)	**동춘2동** (21,793 / 6,743) **연수2동** (23,896 / 9,128)		(144,495 / 49,457)

How to Conduct Area Sampling Using New IT

▶ Selection Procedure of Area Sampling

	First stage	*Second stage*	*Third stage*	*Fourth stage*
Sampling Unit	City	Enumeration district	Chunk	Segment
	Primary selection of city	Select EDs from sel ected cities	Select 2 chunks from each selected ED	Select a segment from selected chunk
f_h	$\frac{2\,Mos_{h\alpha}}{\sum_{\alpha} Mos_{h\alpha}}$	$\frac{d_{h\alpha} Mos_{h\alpha\beta}}{\sum_{\beta} Mos_{h\alpha\beta}}$	$\frac{2 Mos_{h\alpha\beta\gamma}}{\sum_{\gamma} Mos_{h\alpha\beta\gamma}}$	$\frac{Mos_{h\alpha\beta\gamma\delta}}{\sum_{\delta} Mos_{h\alpha\beta\gamma\delta}}$

Chunk: a set of 24 HU's
Segment: a set of 4 HU‘s

How to Conduct Area Sampling Using New IT(Cont.)

▶ Selection Probability

$$f = \frac{n}{N}$$

$$f_h = \frac{2\,Mos_{h\alpha}}{\sum_{\alpha} Mos_{h\alpha}} \times \frac{d_{h\alpha}\,Mos_{h\alpha\beta}}{\sum_{\beta} Mos_{h\alpha\beta}} \times \frac{2\,Mos_{h\alpha\beta\gamma}}{\sum_{\gamma} Mos_{h\alpha\beta\gamma}} \times \frac{Mos_{h\alpha\beta\gamma\delta}}{\sum_{\delta} Mos_{h\alpha\beta\gamma\delta}}$$

$$= \frac{2\,Mos_{h\alpha}}{\sum_{\alpha} Mos_{h\alpha}} \times \frac{(d_{h\alpha} \times Mos^{*}_{h\alpha\beta} \times 24)}{Mos_{h\alpha}} \times \frac{2}{Mos^{*}_{h\alpha\beta}} \times \frac{4}{24}$$

$$= \frac{2\,Mos_{h\alpha}}{\sum_{\alpha} Mos_{h\alpha}} \times \frac{(d_{h\alpha} \times 24)}{Mos_{h\alpha}} \times 2 \times \frac{1}{6}$$

$$= f$$

First Stage: Primary Selection of City

- Using πPS sampling select 2 cities from each stratum

Area	Industrial Complex	Stratum1	Stratum2
		City (# of population/# of household)	City (# of population/# of household)
1	East	Gal-san1 (17,728/6,265) Jak-jun2(28,312/10,314)	Hyo-sung2 (34,322/11,002) Chung-chun1 (15,583/6,306)
2	West	Ga-ja3 (20,276/7,115) Do-hwa 2·3 (20,686/7,821)	Ga-ja4 (12,054/4,474) Gan-suk4 (29,548/10,833)
3	Nort	Kyung-seo(5,841/1,750)	
4	South	Go-jan(33,546/11,346) Dong-chun3 (19,748/5,577)	Dong-chun2(21,793/6,743) Yun-su2(23,896/9,128)

▶ Equal Probability Selection for each stratum

$$d_{h\alpha} = \left(\frac{2Mos_{h\alpha}}{\sum_{\alpha} Mos_{h\alpha}} \right)^{-1} \times \left(\frac{24}{Mos_{h\alpha}} \right)^{-1} \times 3f$$

City	# of Enumeration District	# of chunk	# of Household	Total Households
Gal-san1	6	2	4	48
Jak-jun2	6	2	4	48
Ga-ja3	14	2	4	112
Do-hwa 2·3	14	2	4	112
Kyung-seo	2	2	4	16
Go-jan	12	2	4	96
Dong-chun3	12	2	4	96
Chung-chun1	6	2	4	48
Hyo-sung2	7	2	4	56
Ga-ja4	11	2	4	88
Gan-suk4	11	2	4	88
Dong-chun2	6	2	4	48
Yun-su2	6	2	4	48

Second Stage: Select Enumeration districts

- **πPS sampling**
  - Statistic Korea provides the data of the city divided into ED
  - Make the list of the number of dwellings for all ED from selected Dong

The list of sampled ED

Gal-san1		Jak-jun2		Jak-jun2	
ED	# of dwellings	ED	# of dwellings	ED	# of dwellings
1	483	3	337	2	276
2	345	11	248	5	218
4	270	13	240	11	187
5	216	17	211	17	139
6	198	26	142	18	135

Third Stage: Select Chunks

- **Making up the Chunk**
  - Divide each block into ‘chunks’ with approximately 24 occupied housing units
  - $\dfrac{\text{The number of HU's}}{24} = \text{the number of chunks}$
  - $\dfrac{\text{The number of buildings}}{\text{The number of chunks}} = \text{The number of buildings per chunk}$

Fourth Stage: Select Segment

- **Selecting segment**
  - Select one chunk at random from each selected block
  - Listing all dwelling units on selected chunk
  - Divide chunks into compact segments of size 4 occupied HU's each
  - Select one compact segment from each chunk

Survey Results

▶ Population and Sample Distribution

▪Gender

Gender	Population	Sample
Male	50.1%	48.0%
Female	49.9%	52.0%
total	100%	100%

▪Age

Age	Population	Sample
Under 12	18.0%	15.6%
20~64	73.5%	68.8%
Over 65	8.5%	15.6%
Total	100.0	100.0

Concluding Remarks

- Area sampling using New IT can be an alternative for saving time and effort
- It is possible to select sample in equal probability, even though there is no proper sampling frame for household.
- This approach would be applicable to national surveys

Thank you