Notes on the analysis process

①～② Create base data for analysis program
① Preparation for creating data for "candidate location points", "distance between candidate location points", and "demand volume at demand points" required for optimal placement analysis
・Process and integrate [original data] (population, administrative boundaries, facilities, etc.) to create a .bds file that will be the [base data]
② Create data for "candidate location points", "distance between candidate location points", and "demand volume at demand points" required for optimal placement analysis
・Create [Input data] for Fortran from [base data] through a program such as VB
③・⑥ Optimal placement search...Search for optimal placement using GA
③ [Input] is created using the [Genetic Algorithm] program [Data_fortran] and find the optimal placement [Numerical data]
⑥ Create [Map data] depicting the optimal placement [Numerical data] with GIS
④～⑥ Support set search... Search for α% set using Nuopt
④ Create data required for analysis of α% set
Read the file in [Input data creation] with the program [Input data_fortran] and create [Input data_Nupot]
⑤ Read the file in [Input data_Nuopt] with the program in [Nuopt] and create [Numerical data] for the [Analysis results] of the α% set
⑥ Create [Numerical data] depicting the text-type [Numerical data] with GIS

①～② Creating base data

■ Folder □File

■ Analysis data

■ Original data □ Population data (txt) □ GIS administrative boundary data (bds) □ Facility data (xls)	①	■ Base data □ Population data/processing (csv) □ GIS target data/processing (bds)
Readily available data ・Downloads from the internet ・Commercially available GIS data from the lab		・Base data that was created by processing the original data using VB/Excel and integrating it into a GIS file

②	■ Input data_fortran □ fortran reading data (txt)
	・Fortran read data created through VB from GIS base data

-Branch- ③Optimal placement search ④Support set search

③ Searching for the optimal layout

■ Folder □File

■ Program

③	■ Genetic algorithm □ Optimal layout search program (for)	⑥
	2 types of programs -For those with existing facilities -For those without existing facilities	

④～⑤ Searching for Support Sets

■ Folder □File

④	■ α% set ■ Input data creation □ α% set search input Data creation program (for)	①	■ Analysis data ■ Input data_Nuopt □test_data.for (Only test data is saved due to large capacity)	② ■ α% set ■ Nuopt □comb_wcsp.smp □sum_wcsp.smp
	Two types of program files ・For those with existing facilities ・For those without existing facilities		- File written by the program used to create input data	・Nuopt program file for searching α% sets

-Branch- ③Optimal placement search ④Support set search

⑥ Organizing the results

■ Folder □File

■ Analysis results

⑥

■ Numerical data
□ Optimal placement and α% set resultsFile (csv)

・Data written out using Fortran and Nuoptorganized using Excel

①

■ Map data
□GIS based on numerical dataLink and write to data(swd,sis,bds)

・Output that links numerical data to base data

①～② Creating base data

Create data on "candidate locations," "distance between candidate locations," and "demand at demand points," which are necessary for analyzing optimal placement.1. Process and integrate the [original data] (population, administrative boundaries, facilities, etc.) to create a .bds file that will be the [base data].2. Create [input data] for Fortran from the [base data] through a program such as VB.

■ Original Data

■ Folder □File

	■ Virtual space	■ Taito ward	■ Metropolitan area
Population File	① Create population data using random numbers □ Virtual space population data.csv	① Obtain population data from the Statistics Center □ tblT000051C13106.txt ② Organize age categories using Excel □ Taito ward population data processing.csv	① Obtain population data from the Statistics Center ■ Census population statistics ② Organize population data by city, ward, town, and village using VB □ Metropolitan area population data processing.csv ○ Re_kokusei.vbp
Spatial files Administrative boundaries Mesh	②Create 500m mesh data □ 500mmesh.bds	① Create 200m mesh data ② Open PAREA-Town in SISLink to population data □ Taito-ku town-chome boundary.bds ③ Divide population data from chome to mesh □ 200m mesh.bds	① Open PAREA-Town in SIS and delete the analysis target(municipalities within a 70km radius of Chiyoda Ward) ② Link population data and GIS file □ Metropolitan Area Municipal Boundaries.bds
・Existing facilities ・Delaunay network		① Obtain facility address data from the Taito ward website □ Facility data.xls ② Convert addresses to latitude and longitude using the address matching service □ Facility junior high school.bds □ Facility kindergarten.bds □ Facility resident affairs.bds	③ Use VB to generate Delaunay triangles from the city, town, and village nodes to be analyzed. □ Delaunay mesh.bds ○ Drone.vbp

①

■ Base Data

①

■ Folder ☐File

■ Virtual space

☐ Base data Virtual space.swd

■ Taito ward

☐ Base data Taito-ku.swd

■ Metropolitan area

☐ Base data capital region.swd

■ Input data_fortran

②

■ Folder ☐File

■ Virtual space

☐ DId.txtResidential mesh ID + population
☐ SId.txtLocation mesh ID
☐ DList.txtStraight-line distance between location/residential mesh
○ Dist.vbp

■ Taito ward

☐ DId_youcihen.txt
Residential mesh ID + population in the 0-4 age group
☐ DId_chugakko.txt
Residential mesh ID + population in the 10-14 age group
☐ DId_kumin_jim.txt
Residential mesh ID + population of all ages
☐ SId.txt
Location mesh ID
☐ DList.txt
Straight line distance between location/residential mesh
○ Dist.vbp
☐ point_youchien.txt
Existing facility (kindergarten) locatedLocation mesh ID
☐ point_chugakko.txt
Existing facility (junior high school) locatedLocation mesh ID
☐ point_kumin_jim.txt
Existing facility (ward affairs) located Location mesh ID

■ Metropolitan area

☐ DId.txt
City, town, and village node ID + population
☐ SId.txt
City, town, and village node ID
☐ DList.txt
Network distance between locations/residential meshes
○ Dist_network.vbp
☐ point.txt
Node ID where existing facilities are located(10 points generated randomly)

Branching
③Search for optimal placement
④Search for α% set

③ & ⑥ Search for optimal placementRead

[Input data_fortran] in the program in [Genetic algorithm] and search for the optimal placement and evaluation value

■ Input data_fortran

・Data created in ①～②

③

■ Genetic Algorithms

■ Folder □File

・The following program file reads the file in [Input data_fortran] and searches for the location ID and evaluation value of the optimal layout.

■ No existing facilities
□ p_median.for ... Program for median problems
□ p_coverage.for ... Program for coverage problems
□ p_center.for ... Program for center problems
■ Existing facilities
□ r_p_median.for ... Program for median problems
□ r_p_coverage.for ... Program for coverage problems
□ r_p_center.for ... Program for center problems

Program supplement
・The following conditions are manually entered according to the program display
GA genetic input values
＜Lines 55 to 62＞
Write(*,*) '[Number of locations][Number of demand points]'
Read(*,*) SNum,Dnum
Write(*,*) '[Number of facilities placed][Number of genetic rounds to converge][Number of genes]'
Read(*,*) LONum,CNum,Gnum
Write(*,*) '[Mutation][Crossover][Elite selection]'
Read(*,*) VNum,CrNum,ElNum

⑥

■ Numerical data (optimal placement)

■ Folder □File

- A file that organizes the location ID and evaluation value of the optimal placement after the search is completed

■ Taito ward
□ Taito ward Optimal Value.txt
...No existing facilitiesMedian problem (p=2)

■ Metropolitan Area Analysis

■ Existing facilities available
□ r_opt_center.txt
□ r_opt_covgerage.txt
□ r_opt_median.txt

■ No existing facilities
□ opt_center.txt
□ opt_covgerage.txt
□ opt_median.txt

■ Virtual space
□ Virtual space optimum value.txt
...Existing facilities Median problem (p=2)

Example of output file
Number of facilities/Evaluation value/Optimal location (location ID)

p=2 /	70128.5096/	233. 129.
p=3 /	58289.7482/	158. 184. 219.
p=4 /	46092.8724/	104. 187. 280. 7.

■ Map data (optimal layout)

・Mapping the optimal layout: Explained in the section on mapping the α％ set (later)

④～⑥ Search for support sets

Find the α% set using the program in [Nuopt]
④ Read [Input data_fortran] using the program in [Input data creation_Nuopt] and create location combinations and their evaluation values
⑤ Read the created [Input data_Nuopt] using the program in [Nuopt] and search for the α% set

■ Input data_fortran

・Data created in ①～②

④

■ Input data creation_Nuopt

■ Folder □File

・Read the file in [Input data_fortran] with the following program fileCreate the data (combinations of placements and their evaluation values) to be used for α% set search

■ Existing facilities available
□ Dist2_coverage_2.for (For coverage problem)
□ Dist2_median_2.for (For median problems)
□ Dist2_center_2.for (Program for center problem)
■ No existing facilities
□ Dist***_coverage.for (For coverage problem)
□ Dist***_median.for (Program for median problem)
□ Dist***_center (For center problem)

Program supplement
*The *** in the file name is the number of facilities (2,3,4)
* Use different programs depending on the number of facilities to be placed
As the amount of data increases with the number of facilities to be placed, if the number of facilities is 3 or 4, the analysis range is limited to points [within a radius of Xm from the optimal point].
*The following conditions are manually entered according to the program display
Write(*,*)'Minimum value’
Read(*,*)DistMin
Write(*,*)'Optimal point 1, optimal point 2, optimal point 3, optimal point 4’
Read(*,*) point(1),point(2),point(3),point(4)
Write(*,*)'[Target range within a radius of Xm from the optimal point]’
Read(*,*)bafa

■ Input data_Nuopt

・Data used for α% set search created in the above program (arrangement combinations and their evaluation values)Only test data is included due to the large file size

□ test_data.dat (test data)Location combinations and their evaluation values

Explanation of Input file

(File example)

```
cost =
[1, 1] 1
[1, 2] 0
[1, 3] 1
[1, 4] 0
...
```

```
cost=
[     ]
[1, 3]
[1, 3]  0
```

... variable name used in Nuopt programs
... brackets to define location ID as a character variable
... location ID for combination of placements
... location ID for combination of placements

⑤

⑤

■ Nuopt

・Nuopt program file for searching α% set
☐ comb***_wcsp.smp ... Maximize the number of location combinations
☐ sum***_wcsp.smp ... Maximize the number of location points

・How to use Nuopt1. Create an executable file from a program file on the command line(Command line example) mknuopt comb2_wcsp.smp(Executable file example) comb2_wcsp.exe2. Run the executable file and the load file in the order on the command line(Command line example) comb2_wcsp.exe testdata.dat3. Output the result file

Program details
*The *** in the file name is the number of facilities (2,3,4)
Use different programs depending on the number of facilities to be placed*
Use different programs depending on the objective function (maximizing the number of combinations/maximizing the number of locations)

⑥

■ Numerical data (α% set)

■ Folder ☐File

・Data of α% set where search was completed organized in Excel
Since the data written directly from the program is large, only test data is included (comb_wcsp2.sol)

■ Virtual space

☐ result.csv
...No existing facilitiesMedian problem (number of facilities: 2)

■ Taito ward

☐ r_p2_ward office facilities.csv
☐ r_p2_junior high school.csv
☐ r_p2_kindergarten.csv
...existing facilities
Median problem (number of facilities: 2)

■ Metropolitan area

■ Existing facilities
☐ r_p2_center.csv
☐ r_p2_covgerage.csv
☐ r_p2_median.csv

■ No existing facilities
☐ p2_center.csv
☐ p2_covgerage.csv
☐ p2_median.csv
☐ p3_center.csv
☐ p3_covgerage.csv
☐ p3_median.csv
☐ p4_center.csv
☐ p4_covgerage.csv
☐ p4_median.csv

How to read the file

ritti_id	n=102.5	n=105	n=107.5	n=110
1	0	0	0	0
2	100	0	0	0
3	0	0	1000	0
4	0	0	0	0
5	100	10	0	10
6	0	0	0	0
7	0	1	0	1000
8	10	0	0	10
9	0	0	1	10
:	:	:	:	:

Element of subset A: 1
Element of subset B: 10
Element of subset C: 100
Element of subset D: 1000

Location point of ID2 is Element of subset B of 102.5% set

⑤

■ Map data (α% collection)

■ Folder □File

・File linking the α% collection file above to GIS
*For mesh data, link the csv data above to the sis file
*For point data, create a point file from the csv data above

■ Numerical data

Create point data

■ Virtual space

□ Base.sis
□ modeling.swd

■ Taito ward

□ BaseTaitouku.sis
□ taitouku.swd
□ Optimal placement of residents' affairs.bds
□ Optimal placement junior high school.bds
□ Optimal placement kindergarten office.bds

■ Metropolitan area

□ Capital Region.sis
□ Capital Region Facility Count 2.swd
□ Capital Region Facility Count 3.swd
□ Capital Region Facility Count 4.swd
□ Existing Facility Capital Region Facility Count 2.swd