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Ex Post Facto Analysis: A Method to Evaluate the Accuracy of Population Projection Estimated in 1970 for the 1990 Spatial Population Distribution in the North Central Texas Region of the US

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Contents

Abstracts

In 1968, the Regional Science Research Institute (RSAI) in Philadelphia was asked by the North Central Texas Council of Governments (NCTCOG) to estimate the impact of the proposed construction of the Dallas/Fort Worth International Airport on the socio-economic variables in the 10-county NCTCOG region, in order to provide local governments with information needed to form their basic policies. In 1970, the RSRI published its estimates of population in both 1975 and 1990 for the 80 subareas of the NCTCOG region. This paper conducts an *ex post facto* analysis to evaluate the accuracy of the 1990 population projection estimated by the RSRI. For this purpose, an index of judgment J^2 is proposed as a measure to indicate the degree of fitness of the projected values to the actual values. This index is a conceptual outgrowth of the coefficient of determination R^2, but can be applied to different situations which the traditional R^2 can not.

Keywords

Accuracy of Projection, Dallas/Fort Worth International Airport,
Ex Post Facto Analysis, Index of Judgment J^2, NCTCOG, Population Projection

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1 Introduction

More than thirty years ago towards the end of the 1960s, both the first and third authors [1] of this paper were graduate students at the University of Pennsylvania. They were at that time also associated with the Regional Science Research Institute which was located in the vicinity of the university, and were involved in the research projects in the field of spatial economics. It was then that they carried out, together with four other research scholars [2], a study of projecting long-run changes in population as well as those in manufacturing and non-manufacturing employment for the years of 1975 and 1990. Based on the Lowry (1966) model, forecasts were made on these variables for each of the 80 spatial units constituting the ten-county North Central Texas region with Dallas and Tarrant counties in its center, by taking into consideration the impact of the construction of the Dallas/Fort Worth International Airport upon the future spatial structure of the region. The airport was the world's largest when it was completed in 1974.

There is a report [3] of this impact study. It shows that the population of the North Central Texas region in 1968 was 2,258,000 and that the projected population of the region for 1990 was 4,415,000 with a 22-year growth rate of 96%. Since the actual population for 1990 turned out to be 4,163,000, the error of our projection was an over-estimation of only 6%. However, with more careful examination of the projection error for each of the 80 spatial units, we know that the mean of the errors (in absolute value) is 45% which is considerably higher than 6%. As a matter of fact, this result of the mean error of 45% seems to be rather unsatisfactory at first sight. Nevertheless, if we look at the two-dimension graph in which the forecast and actual data are plotted, we subjectively feel that the projections may not have been so bad.

In order to respond to this ambivalent feeling, we have tried to conduct an exploration into the development of a method through which we can evaluate "the accuracy of the projected values by comparing the actual values" (*i.e.*, projection accuracy). This paper is written in the context of this exploration.

In the following section, we discuss briefly the background to the above-mentioned impact study. In Section 3, through numerical examples, we construct "an index of judgment J^2" as an instrument for the evaluation of the projection accuracy. In Section 4, we apply the judgment index J^2 to the projected and actual data for the 1990 population of the North Central Texas region to test the applicability of this index and to evaluate, by means of J^2, the projection accuracy of our old study carried out more than thirty years ago. The paper closes with short concluding remarks in Section 5.

2 DFWIA, NCTCOG, RSRI and *Ex Post Facto* Analysis

2-1 Dallas/Fort Worth International Airport [4]

In 1968, the cities of Dallas and Fort Worth entered into an official contract and agreement to construct the Dallas/Fort Worth International Airport (DFWIA) at a site straddling the boundary between the Dallas and Tarrant counties. In 1974, the DFWIA, jointly owned by the cities of Dallas and Fort Worth opened with four terminals and three runways. The international airport covered around 70 km^2 to make it the world's largest at that time. At the end of 2000, the DFWIA was handling nearly 2,300 flights daily, serving 124 domestic and 30 international destinations.

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Since its start the DFWIA has experienced solid success and growth in both passenger and cargo-operation services. For the period between 1974 and 2000, the passengers and cargo tonnage have both increased at an annual rate of 6%. The growth rate of the DFWIA has, however, slowed in recent years due to the constraints of gate capacity.

2-2 NCTCOG and RSRI

In the course of the development of the DFWIA, referred to above, the North Central Texas Council of Governments (NCTCOG), consisting of Dallas and Fort Worth counties as well as their eight adjacent counties[5], recognized the importance of providing its member local governments with quantitative and objective[6] information on the projected long-term changes in the basic socio-economic variables which would be influenced by the construction and operation of the DFWIA. Consequently, the NCTCOG in 1968 asked the Regional Science Research Institute (RSRI) in Philadelphia to estimate the impact of the proposed construction and operation of the DFWIA on its region, in order to assist each of its local governments in their policy formations, planning operations, and determination of financial needs. In 1970, the RSRI published a report[7] of its estimates of population, manufacturing employment and non-manufacturing employment in both 1975 and 1990 for the 80 subareas of the NCTCOG region.

2-3 Motivation towards *Ex Post Facto* Analysis

The RSRI report says in its introduction; "In the process of performing this work, ... a clearer understanding was gained of the pattern of location and growth in the region. Such an understanding of the emerging urban structure is important ... for overall plans and policies for the rational development of the region." At the same time, the report says in its conclusion; "The projected urban pattern of 1990 depends heavily on assumptions about highway, sewer, and other planning decisions. By the same token, these decisions can be used to control and channel development into the rational urban patterns envisaged for the future."

In conjunction with the aforementioned, we have become interested in investigating the difference between the projected population figures and the actual population figures. More concretely, we have become interested in evaluating the "accuracy as a set[8]" of the spatial population distribution estimated by the RSRI for the year 1990 over the 80 subareas of the NCTCOG region.

3 Index of Judgment J^2 for the Evaluation of Projection Accuracy

3-1 Data Arrangement

For the construction of an index through which we can evaluate the projection accuracy (which shall be called the index of judgment J^2), we start with the preparation of the 10 cases of numerical examples as shown by Table 1-1. Each case in this table carries four zones as its constituent spatial units. The hypothetical "projected values for the 1990 population (1990 forecast population)" and the hypothetical "actual values for the 1990 population (1990 actual population)" are given respectively in columns ① and ②. The difference of the forecast population subtracted by the actual population is shown in column ③ and its absolute value in column ④. Based on these, we get the difference rate and its absolute value in

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Table 1-1 Data Set (Part I): Original and Derived Data for Numerical Examples

Case	Column Code	①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩
	Data	1990 Forecast Population	1990 Actual Population	Difference	Absolute Value of ③	Difference Rate (%)	Absolute Value of ⑤	Up-mapping (For Type-FX)	Down-mapping (For Type-FX)	Up-mapping (For Type-AX)	Down-mapping (For Type-AX)
	Calculation / Zone Code	(Original)	(Original)	①−②	|③|	③/②×100	|⑤|	①+④	①−④	②+④	②−④
1	1	1	1	0	0	0.0	0.0	1	1	1	1
	2	2	2	0	0	0.0	0.0	2	2	2	2
	3	3	3	0	0	0.0	0.0	3	3	3	3
	4	4	4	0	0	0.0	0.0	4	4	4	4
2	1	1	1	0	0	0.0	0.0	1	1	1	1
	2	2	3	-1	1	-33.3	33.3	3	1	4	2
	3	3	2	1	1	50.0	50.0	4	2	3	1
	4	4	4	0	0	0.0	0.0	4	4	4	4
3	1	1	1	0	0	0.0	0.0	1	1	1	1
	2	2	4	-2	2	-50.0	50.0	4	0	6	2
	3	3	1	2	2	200.0	200.0	5	1	3	-1
	4	4	4	0	0	0.0	0.0	4	4	4	4
4	1	1	1	0	0	0.0	0.0	1	1	1	1
	2	1	4	-3	3	-75.0	75.0	4	-2	7	1
	3	4	1	3	3	300.0	300.0	7	1	4	-2
	4	4	4	0	0	0.0	0.0	4	4	4	4
5	1	1	2	-1	1	-50.0	50.0	2	0	3	1
	2	2	3	-1	1	-33.3	33.3	3	1	4	2
	3	3	4	-1	1	-25.0	25.0	4	2	5	3
	4	4	5	-1	1	-20.0	20.0	5	3	6	4
6	1	1	3	-2	2	-66.7	66.7	3	-1	5	1
	2	2	4	-2	2	-50.0	50.0	4	0	6	2
	3	3	5	-2	2	-40.0	40.0	5	1	7	3
	4	4	6	-2	2	-33.3	33.3	6	2	8	4
7	1	1	4	-3	3	-75.0	75.0	4	-2	7	1
	2	2	5	-3	3	-60.0	60.0	5	-1	8	2
	3	3	6	-3	3	-50.0	50.0	6	0	9	3
	4	4	7	-3	3	-42.9	42.9	7	1	10	4
8	1	2	3	-1	1	-33.3	33.3	3	1	4	2
	2	3	4	-1	1	-25.0	25.0	4	2	5	3
	3	5	4	1	1	25.0	25.0	6	4	5	3
	4	6	5	1	1	20.0	20.0	7	5	6	4
9	1	2	4	-2	2	-50.0	50.0	4	0	6	2
	2	3	5	-2	2	-40.0	40.0	5	1	7	3
	3	7	5	2	2	40.0	40.0	9	5	7	3
	4	8	6	2	2	33.3	33.3	10	6	8	4
10	1	2	5	-3	3	-60.0	60.0	5	-1	8	2
	2	3	6	-3	3	-50.0	50.0	6	0	9	3
	3	9	6	3	3	50.0	50.0	12	6	9	3
	4	10	7	3	3	42.9	42.9	13	7	10	4

[Notes]
(1) FX : Arrangement of forecast values along the axis of abscissa (X)
(2) AX : Arrangement of actual values along the axis of abscissa (X)
(3) Up-mapping Data : The data obtained by transforming ① (or ②) to the domain of "①+④" (or "②+④")
(4) Down-mapping Data : The data obtained by transforming ① (or ②) to the domain of "①-④)" (or "②-④")

column ⑤ and ⑥ respectively. Furthermore, from columns ①,② and ④, we get the value for up-mapping (Type-FX) in column ⑦, down-mapping (Type-FX) in column ⑧, up-mapping (Type-AX) in column ⑨ and down-mapping (Type-AX) in column ⑩, where;

(1) Up-mapping data : The data obtained by transforming ① (or ②) to the domain of "① + ④" (or "② + ④"),

(2) Down-mapping data : The data obtained by transforming ① (or ②) to the domain of "① − ④" (or "② − ④"),

(3) FX : Arrangement of forecast values along the axis of abscissa (X),

(4) AX : Arrangement of actual values along the axis of abscissa (X).

Having done this preparation, we can now arrange the data with the "auxiliary data" (except the data in column AA), as shown by Table 1-2 for the calculation of R^2 , J^2_{ante}, J^2_{up} and J^2_{down} for Type-FX and Type-AX, where;

Table 1-2 Data Set (Part Ⅱ): With Auxiliary Data for Numerical Examples

Case	Column Code	AA		A		B		C		D		E		F	
	Preparation For:	R^2		J^2											
				J^2_{ante}		J^2_{up}		J^2_{down}		J^2_{ante}		J^2_{up}		J^2_{down}	
	Data Type	Type-FX and Type-AX		Type-FX		Type-FX		Type-FX		Type-AX		Type-AX		Type-AX	
	Data Composition / Zone Code	① + Nothing	② + Nothing	① + ①	② + ①	① + ①	⑦ + ①	① + ①	⑧ + ①	② + ②	① + ②	② + ②	⑨ + ②	② + ②	⑩ + ②
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	1	-	-	1	1	1	1	1	1	1	1	1	1	1	1
	2	-	-	2	2	2	2	2	2	2	2	2	2	2	2
	3	-	-	3	3	3	3	3	3	3	3	3	3	3	3
	4	-	-	4	4	4	4	4	4	4	4	4	4	4	4
2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	2	2	3	2	3	2	3	2	1	3	2	3	4	3	2
	3	3	2	3	2	3	4	3	2	2	3	2	3	2	1
	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	1	-	-	1	1	1	1	1	1	1	1	1	1	1	1
	2	-	-	2	2	2	2	2	2	3	3	3	3	3	3
	3	-	-	3	3	3	3	3	3	2	2	2	2	2	2
	4	-	-	4	4	4	4	4	4	4	4	4	4	4	4
3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	2	2	4	2	4	2	4	2	0	4	2	4	6	4	2
	3	3	1	3	1	3	5	3	1	1	3	1	3	1	-1
	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	1	-	-	1	1	1	1	1	1	1	1	1	1	1	1
	2	-	-	2	2	2	2	2	2	4	4	4	4	4	4
	3	-	-	3	3	3	3	3	3	1	1	1	1	1	1
	4	-	-	4	4	4	4	4	4	4	4	4	4	4	4
4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	2	1	4	1	4	1	4	1	-2	4	1	4	7	4	1
	3	4	1	4	1	4	7	4	1	1	4	1	4	1	-2
	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	1	-	-	1	1	1	1	1	1	1	1	1	1	1	1
	2	-	-	1	1	1	1	1	1	4	4	4	4	4	4
	3	-	-	4	4	4	4	4	4	1	1	1	1	1	1
	4	-	-	4	4	4	4	4	4	4	4	4	4	4	4
5	1	1	2	1	2	1	2	1	0	2	1	2	3	2	1
	2	2	3	2	3	2	3	2	1	3	2	3	4	3	2
	3	3	4	3	4	3	4	3	2	4	3	4	5	4	3
	4	4	5	4	5	4	5	4	3	5	4	5	6	5	4
	1	-	-	1	1	1	1	1	1	2	2	2	2	2	2
	2	-	-	2	2	2	2	2	2	3	3	3	3	3	3
	3	-	-	3	3	3	3	3	3	4	4	4	4	4	4
	4	-	-	4	4	4	4	4	4	5	5	5	5	5	5
6	1	1	3	1	3	1	3	1	-1	3	1	3	5	3	1
	2	2	4	2	4	2	4	2	0	4	2	4	6	4	2
	3	3	5	3	5	3	5	3	1	5	3	5	7	5	3
	4	4	6	4	6	4	6	4	2	6	4	6	8	6	4
	1	-	-	1	1	1	1	1	1	3	3	3	3	3	3
	2	-	-	2	2	2	2	2	2	4	4	4	4	4	4
	3	-	-	3	3	3	3	3	3	5	5	5	5	5	5
	4	-	-	4	4	4	4	4	4	6	6	6	6	6	6
7	1	1	4	1	4	1	4	1	-2	4	1	4	7	4	1
	2	2	5	2	5	2	5	2	-1	5	2	5	8	5	2
	3	3	6	3	6	3	6	3	0	6	3	6	9	6	3
	4	4	7	4	7	4	7	4	1	7	4	7	10	7	4
	1	-	-	1	1	1	1	1	1	4	4	4	4	4	4
	2	-	-	2	2	2	2	2	2	5	5	5	5	5	5
	3	-	-	3	3	3	3	3	3	6	6	6	6	6	6
	4	-	-	4	4	4	4	4	4	7	7	7	7	7	7

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Table 1-2 (Continued)

Case	Column Code	AA		A		B		C		D		E		F	
	Preparation For:	R^2		J^2											
	Data Type	Type-FX and Type-AX		Type-FX		Type-FX		Type-FX		Type-AX		Type-AX		Type-AX	
	Data Composition / Zone Code	① + Nothing	② + Nothing	① + ①	② + ①	① + ①	⑦ + ①	① + ①	⑧ + ①	② + ②	① + ②	② + ②	⑨ + ②	② + ②	⑩ + ②
8	1	2	3	2	3	2	3	2	1	3	2	3	4	3	2
	2	3	4	3	4	3	4	3	2	4	3	4	5	4	3
	3	5	4	5	4	5	6	5	4	4	5	4	5	4	3
	4	6	5	6	5	6	7	6	5	5	6	5	6	5	4
	1	-	-	2	2	2	2	2	2	3	3	3	3	3	3
	2	-	-	3	3	3	3	3	3	4	4	4	4	4	4
	3	-	-	5	5	5	5	5	5	4	4	4	4	4	4
	4	-	-	6	6	6	6	6	6	5	5	5	5	5	5
9	1	2	4	2	4	2	4	2	0	4	2	4	6	4	2
	2	3	5	3	5	3	5	3	1	5	3	5	7	5	3
	3	7	5	7	5	7	9	7	5	5	7	5	7	5	3
	4	8	6	8	6	8	10	8	6	6	8	6	8	6	4
	1	-	-	2	2	2	2	2	2	4	4	4	4	4	4
	2	-	-	3	3	3	3	3	3	5	5	5	5	5	5
	3	-	-	7	7	7	7	7	7	5	5	5	5	5	5
	4	-	-	8	8	8	8	8	8	6	6	6	6	6	6
10	1	2	5	2	5	2	5	2	-1	5	2	5	8	5	2
	2	3	6	3	6	3	6	3	0	6	3	6	9	6	3
	3	9	6	9	6	9	12	9	6	6	9	6	9	6	3
	4	10	7	10	7	10	13	10	7	7	10	7	10	7	4
	1	-	-	2	2	2	2	2	2	5	5	5	5	5	5
	2	-	-	3	3	3	3	3	3	6	6	6	6	6	6
	3	-	-	9	9	9	9	9	9	6	6	6	6	6	6
	4	-	-	10	10	10	10	10	10	7	7	7	7	7	7

[Notes]
(1) R^2 : Coefficient of determination
(2) J^2 : Index of judgement (or Joyce index)
(3) J^2_{ante} : J^2 calculated from the ante-mapping data
(4) J^2_{up} : J^2 calculated from the up-mapping data
(5) J^2_{down} : J^2 calculated from the down-mapping data
(6) See Table 1-1 for the data base expressed as ①, ② and ⑦~⑩ which present respectively the column codes used in that table.

(1) R^2 : Coefficient of determination,
(2) J^2 : Index of judgment (or, nickname: Joyce index),
(3) J^2_{ante} : J^2 calculated from the ante-mapping data,
(4) J^2_{up} : J^2 calculated from the up-mapping data,
(5) J^2_{down} : J^2 calculated from the down-mapping data,
(6) Ante-mapping data: The originally given data in ① (or ②).

3-2 Data Plotting

From Table 1-2, we get for the 10 cases Figure 1, based on column AA for the calculation of R^2, based on columns A and D for the calculation of J^2_{ante} (Type-FX) and J^2_{ante} (Type-AX) respectively, based on columns B and E for the calculation of J^2_{up} (Type-FX) and J^2_{up} (Type-AX) respectively, and based on columns C and F for the calculation of J^2_{down} (Type-FX) and J^2_{down} (Type-AX) respectively.

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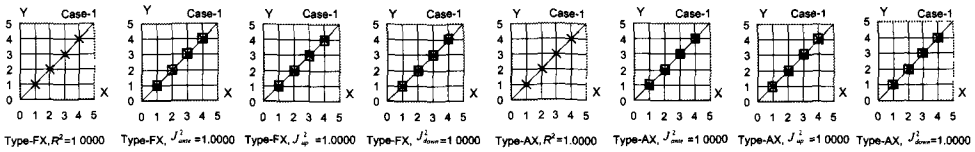
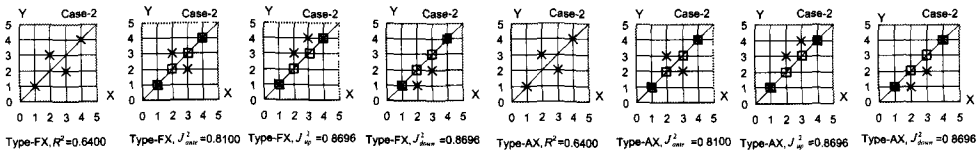
Figure 1 Plotted Data for Numerical Examples

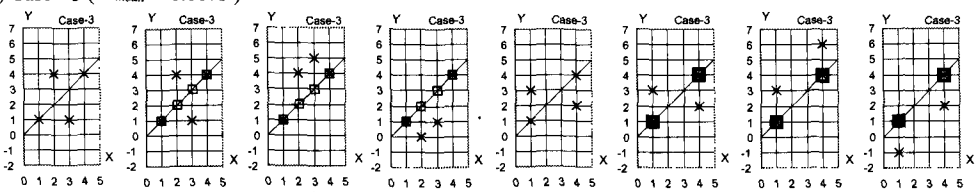
(a) Case－1 (J^2_{mean} = 1.0000)



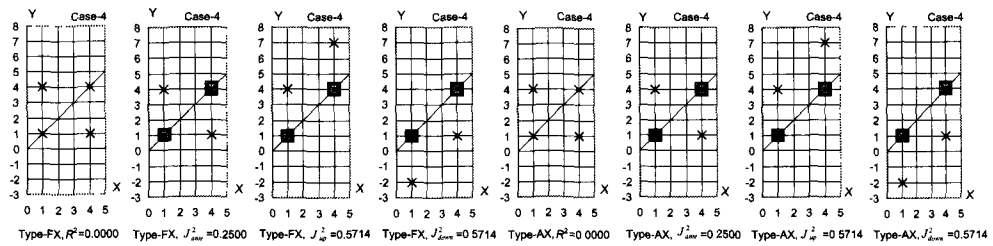
(b) Case－2 (J^2_{mean} = 0.8696)



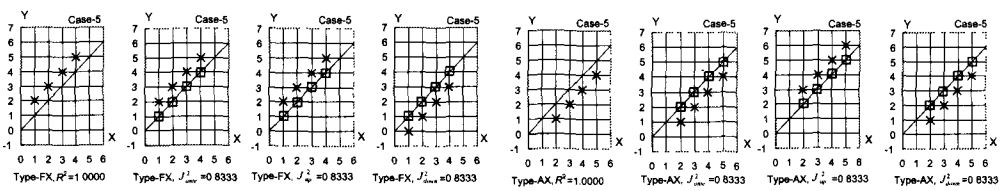
(c) Case－3 (J^2_{mean} = 0.6875)



(d) Case－4 (J^2_{mean} = 0.5714)



(e) Case－5 (J^2_{mean} = 0.8333)



(f) Case－6 (J^2_{mean} = 0.5556)

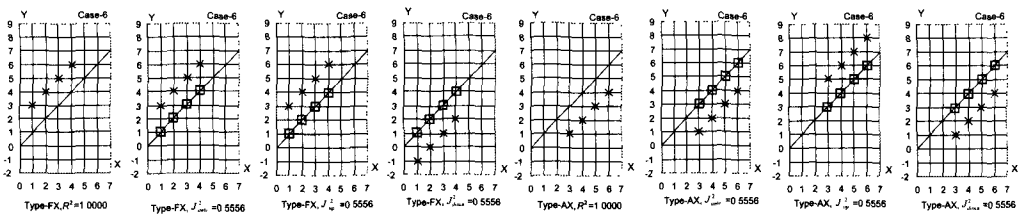


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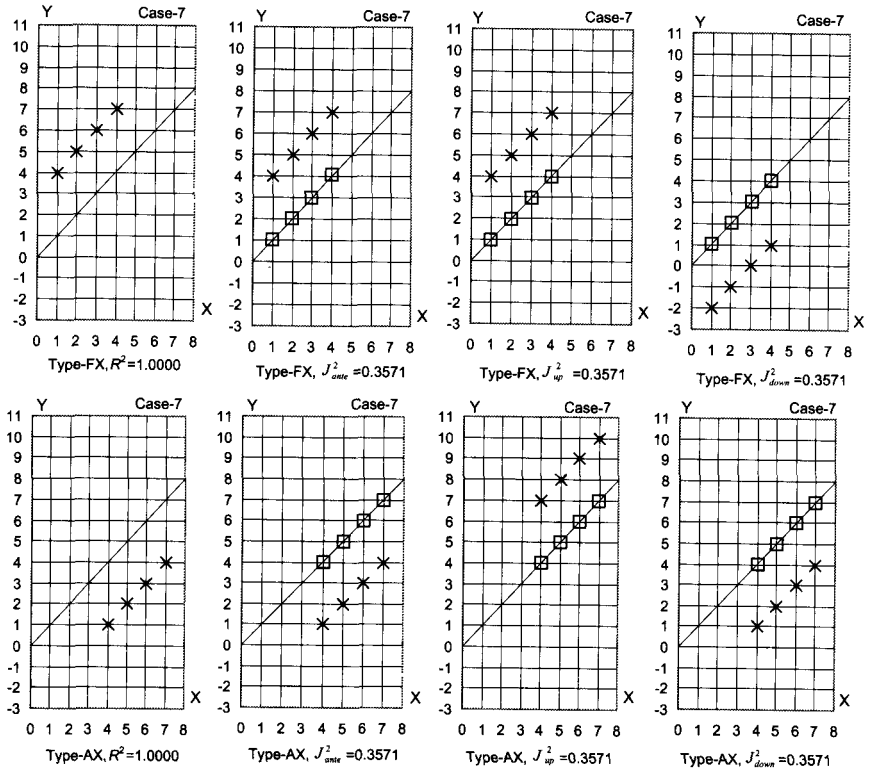
Figure 1 (Continued)

(g) Case−7 (J^2_{mean}= 0.3571)



(h) Case−8 (J^2_{mean}= 0.7879)

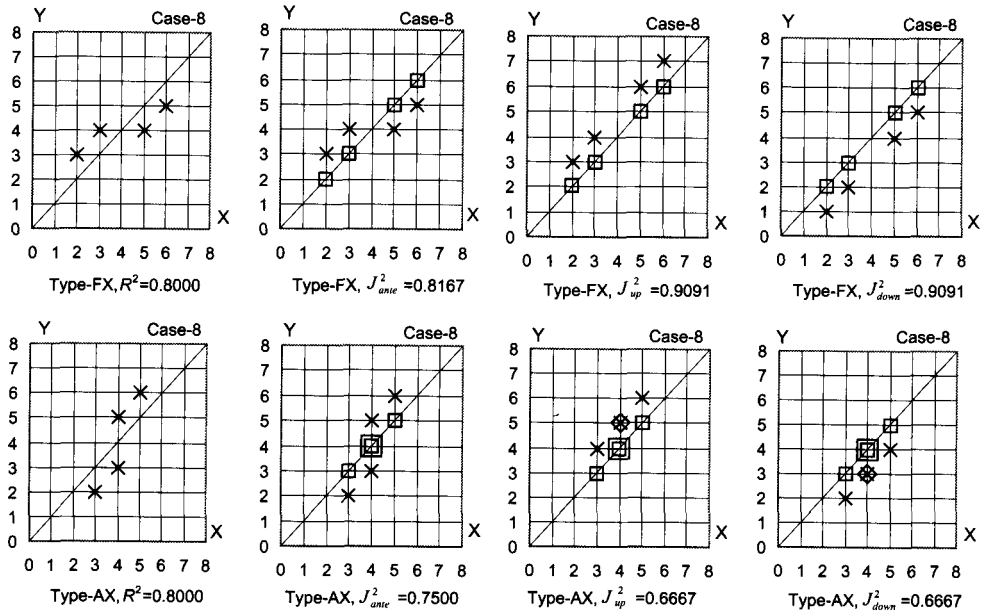


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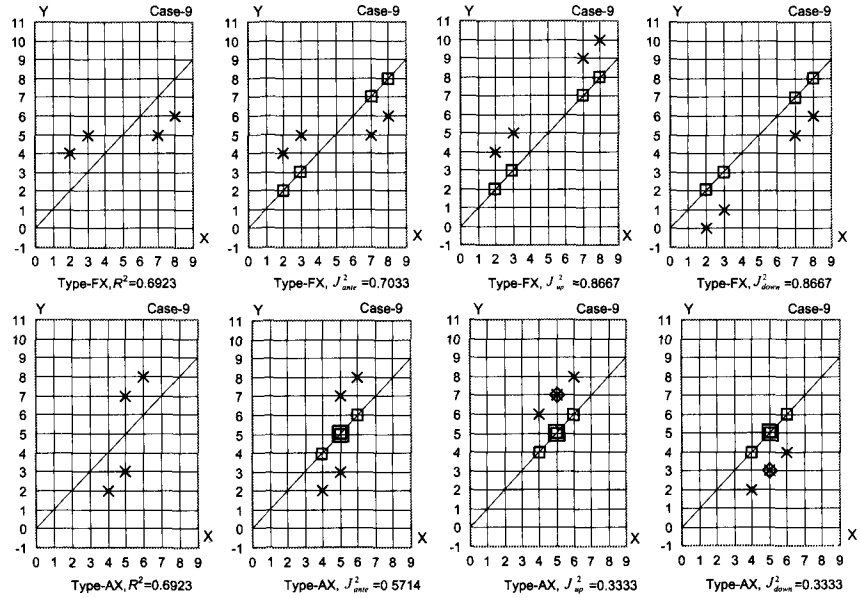
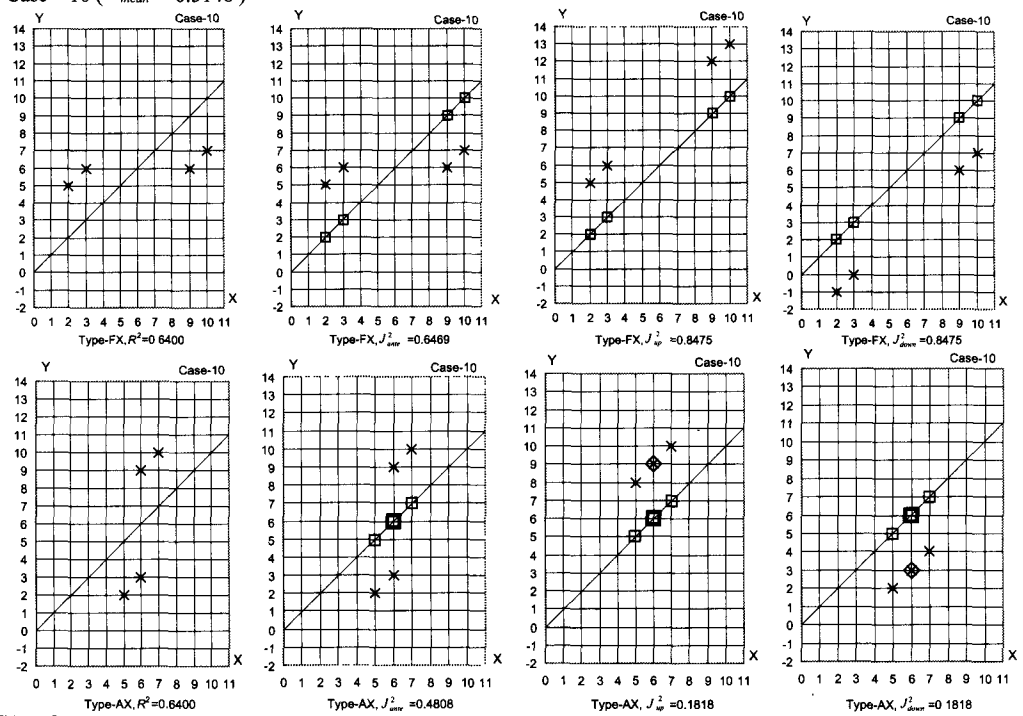
Figure 1 (Continued)

(i) Case – 9 (J^2_{mean} = 0.6000)



(i) Case – 10 (J^2_{mean} = 0.5146)



[Notes]

(1) □ : Auxiliary data

(2) ▣ : Two times □

(3) × : Original, up-mapping or down-mapping data

(4) ⊗ : Two times ×

3-3 Obtained Results for R^2 and J^2's

From Table 1-2, we obtain Table 2 showing the values of R^2 , J^2_{ante} , J^2_{up} and J^2_{down} for Type-FX and Type-AX as well as the value of J^2_{mean}, where the value for each type of J^2 (except J^2_{mean}) shall be calculated as the value of the coefficient of determination R^2 which can be obtained based on its corresponding data in Table 1-2. Careful observation of Figure 1 together with these figures, suggests to us that the arithmetic mean (J^2_{mean}) of J^2_{up} (Type-FX), J^2_{up} (Type-AX), J^2_{down} (Type-FX) and J^2_{down} (Type-AX) would become one of the appropriate indices of judgment.

Table 2 Results of R^2 and J^2's

Column Code	AA	A	B	C	D	E	F	G
Value of:	R^2	J^2						
		J^2_{ante}	J^2_{up}	J^2_{down}	J^2_{ante}	J^2_{up}	J^2_{down}	J^2_{mean}
Data Type / Case	Type-FX and Type-AX	Type-FX	Type-FX	Type-FX	Type-AX	Type-AX	Type-AX	
1	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2	0.6400	0.8100	0.8696	0.8696	0.8100	0.8696	0.8696	0.8696
3	0.2000	0.4571	0.6250	0.6250	0.5714	0.7500	0.7500	0.6875
4	0.0000	0.2500	0.5714	0.5714	0.2500	0.5714	0.5714	0.5714
5	1.0000	0.8333	0.8333	0.8333	0.8333	0.8333	0.8333	0.8333
6	1.0000	0.5556	0.5556	0.5556	0.5556	0.5556	0.5556	0.5556
7	1.0000	0.3571	0.3571	0.3571	0.3571	0.3571	0.3571	0.3571
8	0.8000	0.8167	0.9091	0.9091	0.7500	0.6667	0.6667	0.7879
9	0.6923	0.7033	0.8667	0.8667	0.5714	0.3333	0.3333	0.6000
10	0.6400	0.6469	0.8475	0.8475	0.4808	0.1818	0.1818	0.5146

(1) R^2 : Coefficient of determination
(2) J^2 : Index of judgement (or Joyce index)
(3) J^2_{ante} : J^2 calculated from the ante-mapping data
(4) J^2_{up} : J^2 calculated from the up-mapping data
(5) J^2_{down} : J^2 calculated from the down-mapping data
(6) J^2_{mean} : Arithmetic mean of the two kinds of J^2_{up} and the two kinds of J^2_{down} (*i.e.*, arithmetic mean of the four figures appearing in the columns of B, C, E and F respectively)

Based on Table 2, the following are indicated if we apply J^2_{mean} as index of judgment.

(1) Among the 10 cases, the projection accuracy is the highest for Case−1 (J^2_{mean} =1.0000) followed by Case−2 (J^2_{mean} =0.8696), Case−5 (J^2_{mean} =0.8333), and Case−8 (J^2_{mean} = 0.7879).

(2) Among the 10 cases, the projection accuracy is the lowest for Case−7 (J^2_{mean} = 0.3571) following Case−10 (J^2_{mean} =0.5146), Case−6 (J^2_{mean} =0.5556) and Case−4 (J^2_{mean} =0.5714).

(3) Among the 10 cases, the magnitude of projection accuracy is around in the middle for Case−3 (J^2_{mean} =0.6785) and Case−9 (J^2_{mean} =0.6000).

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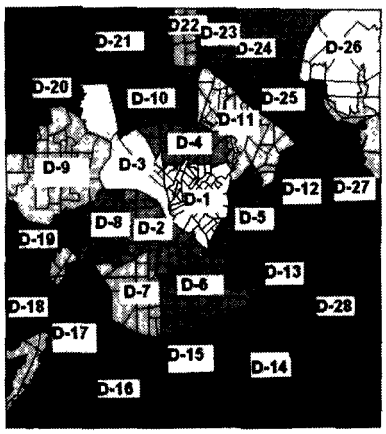
4 Projected versus Actual Values for the 1990 Population of the NCTCOG Region

4-1 Spatial Disaggregation and Original Data

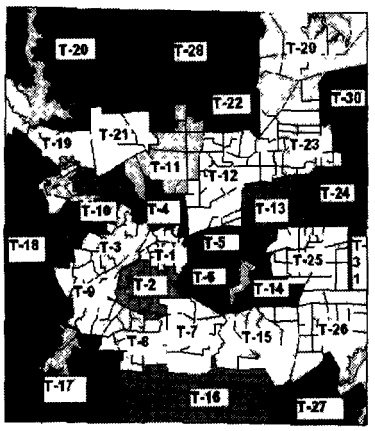
As shown by Figure 2, the RSRI report disaggregated the 10-county NCTCOG region into 80 subareas (zones); Dallas county into 28 zones [9], Tarrant county into 31 zones [10] and the ring counties [11] (ring area) into 21 zones [12]. The projected values for the 1990 population (1990 forecast population) for the all 80 zones in the NCTCOG region estimated by the RSRI, are given in column ① of Table A-1-1 in the Appendix. The actual values for the 1990 population (1990 actual population[13]) are given in column ② of the same table.

Figure 2 Study Zones in Dallas County, Tarrant County and Ring Area

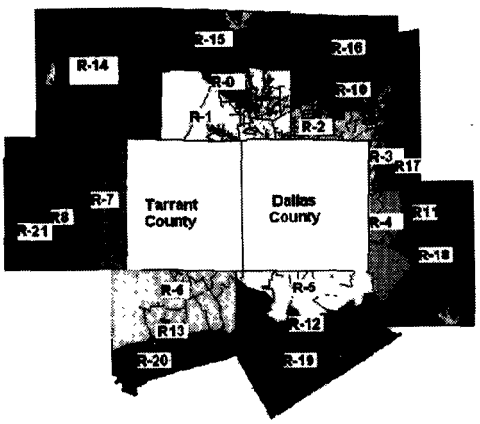
(a) Dallas County Zones



(b) Tarrant County Zones



(c) Ring Area Zones



[Notes]

This figure is based on "CensusCD 2000 Long Form" published by GeoLytics, Inc. (2002).

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4-2 Derived Data

For the purpose of conducting the accuracy-evaluation task, we arrange eight sets of data derived from the two sets of the original data. We have the difference of the forecast population subtracted by the actual population in column ③, and its absolute value in column ④. Based on them, we get the difference rate and its absolute value in columns ⑤ and ⑥ respectively. From column ⑤, we know that the projection errors of the forecast population range from -36.67% to 534.86% for Dallas county, from -67.32% to 111.15% for Tarrant county and from -67.04% to 58.52% for the ring area. We also know that the total projection error of the forecast population is 6.06% for the 80-zone NCTCOG region. Furthermore, from columns ①,② and ④, we obtain the values for up-mapping (Type-FX) in column ⑦, down-mapping (Type-FX) in column ⑧, up-mapping (Type-AX) in column ⑨ and down-mapping (Type-AX) in column ⑩.[14)]

We have, in the Appendix, the similar original and derived data for the 28 zones of Dallas county in Table A-2-1, 31 zones of Tarrant county in Table A-3-1 and 21 zones of the ring area in Table A-4-1.

4-3 Derived Data with "Auxiliary Data"

Table A-1-2 in the Appendix shows the derived data with the "auxiliary data" (except the data in column AA) for the all 80 zones in the NCTCOG region. The data are arranged for the calculation of R^2 in column AA, J^2_{ante} (Type-FX) in column A, J^2_{up} (Type-FX) in column B, J^2_{down} (Type-FX) in column C, J^2_{ante} (Type-AX) in column D, J^2_{up} (Type-AX) in column E and J^2_{down} (Type-AX) in column F. [15)] We have, in the Appendix, the similar derived data with "auxiliary data" for the 28 zones of Dallas county in Table A-2-2, 31 zones of Tarrant county in Table A-3-2 and 21 zones of the ring area in Table A-4-2.

4-4 Data Plotting

From Table A-1-2, we get Figures 3-1(a) and 3-1(e) based on column AA for the calculation of R^2 , Figures 3-1(b) based on column A and 3-1(f) based on column D for the calculation of J^2_{ante} (Type-FX) and J^2_{ante} (Type-AX) respectively, Figures 3-1(c) based on column B and 3-1(g) based on column E for the calculation of J^2_{up} (Type-FX) and J^2_{up} (Type-AX) respectively, and Figures 3-1(d) based on column C and 3-1(h) based on column F for the calculation of J^2_{down} (Type-FX) and J^2_{down} (Type-AX) respectively.

Similarly, we get Figures 3-2(a)～3-2(h) for the 28 zones in Dallas county, Figures 3-3(a)～3-3(h) for the 31 zones in Tarrant county and Figures 3-4(a)～3-4(h) for the 21 zones in the ring area.

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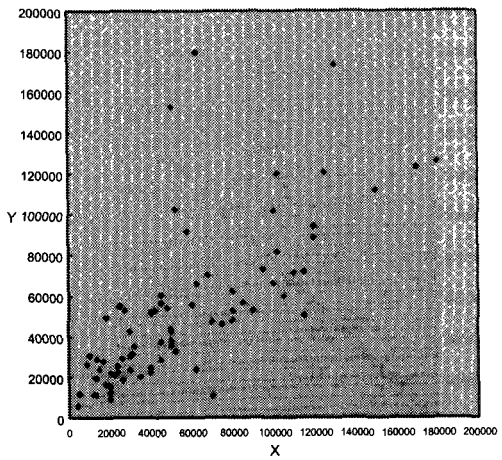
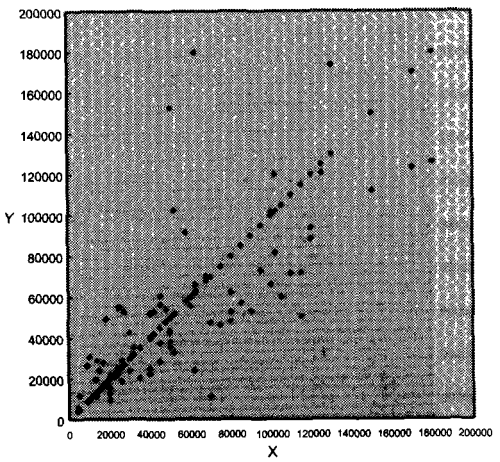
Figure 3-1 1990 Forecast Population (F) and 1990 Actual Population (A) of *All 80 Zones in the NCTCOG Region*

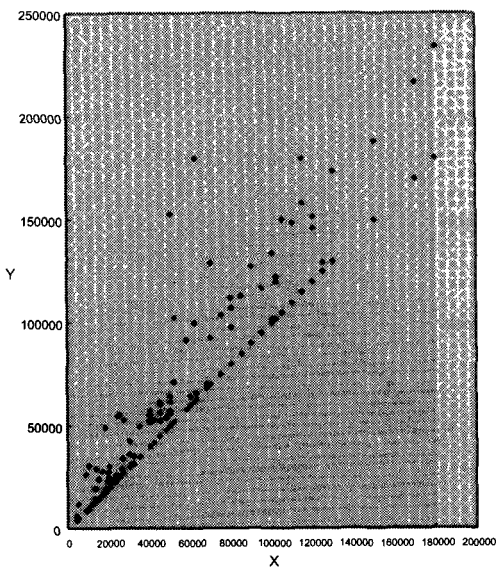
(a) Original Data of (F,A) for (X,Y) to Calculate R^2



(b) Pooled Data of (F,A) and (F,F) for (X,Y) to Calculate J^2_{ante}



(c) Pooled Data of (F,F+|F-A|) and (F,F) for (X,Y) to Calculate J^2_{up}



(d) Pooled Data of (F,F-|F-A|) and (F,F) for (X,Y) to Calculate J^2_{down}

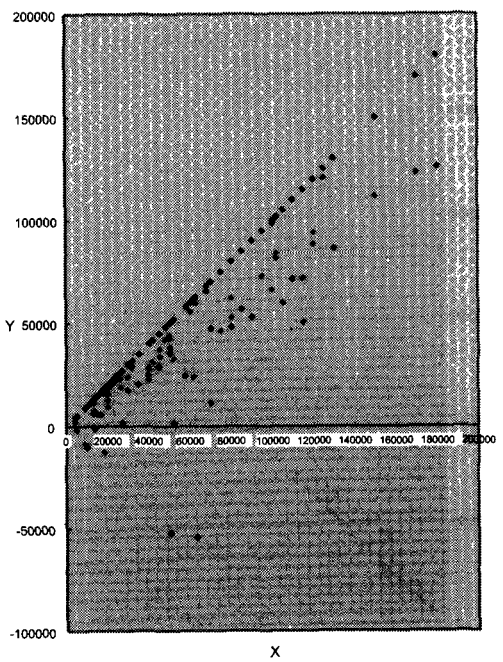


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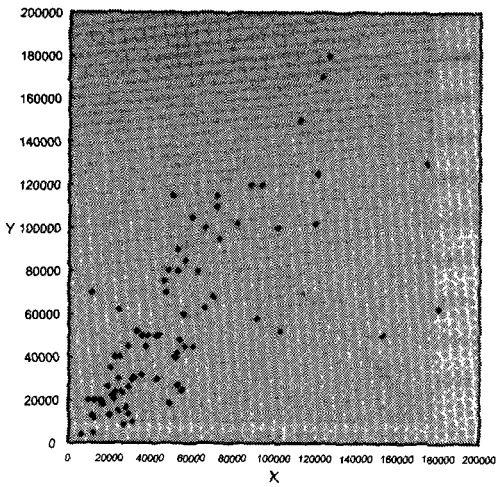
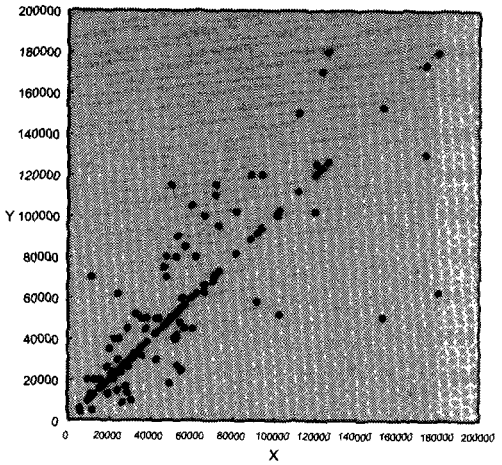
Figure 3-1 *(Continued)*

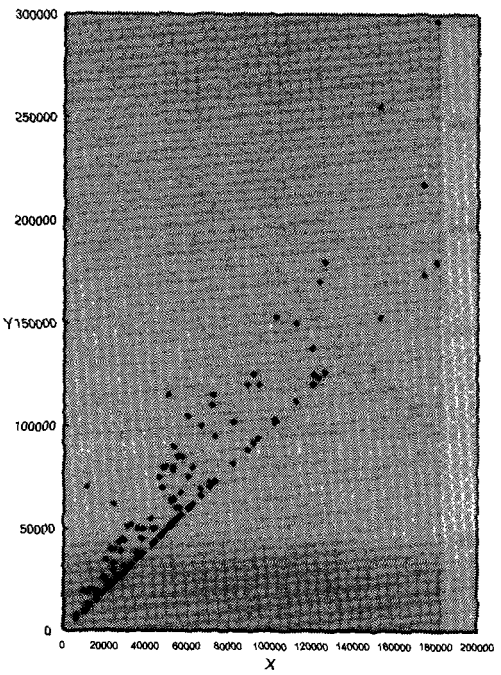
(e) Original Data of (A,F)
for (X,Y) to Calculate R^2



(f) Pooled Data of (A,F) and (A,A)
for (X,Y) to Calculate J^2_{ante}



(g) Pooled Data of (A,A+|F-A|) and (A,A)
for (X,Y) to Calculate J^2_{up}



(h) Pooled Data of (A,A-|F-A|) and (A,A)
for (X,Y) to Calculate J^2_{down}

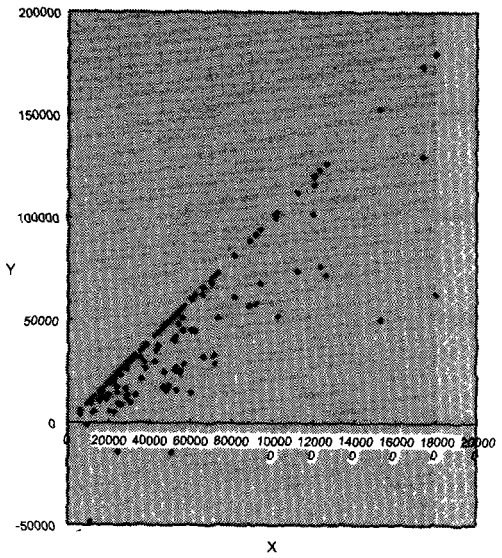


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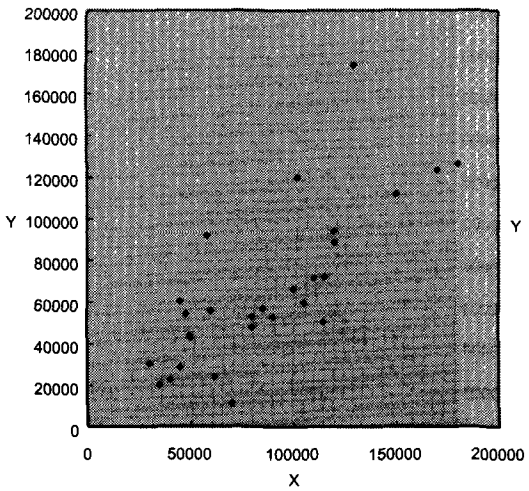
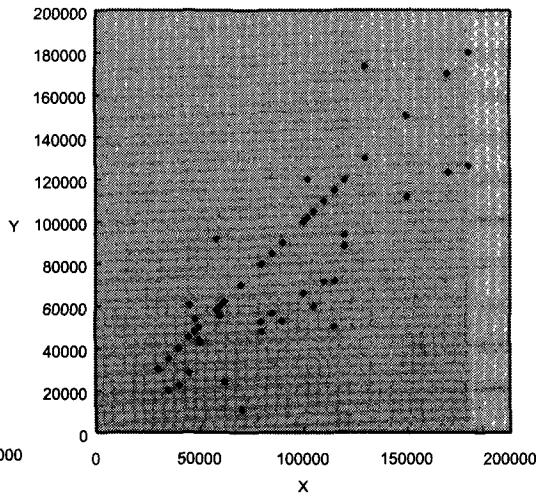
Figure 3-2 1990 Forecast Population (F) and 1990 Actual Population (A) of 28 Zones in Dallas County

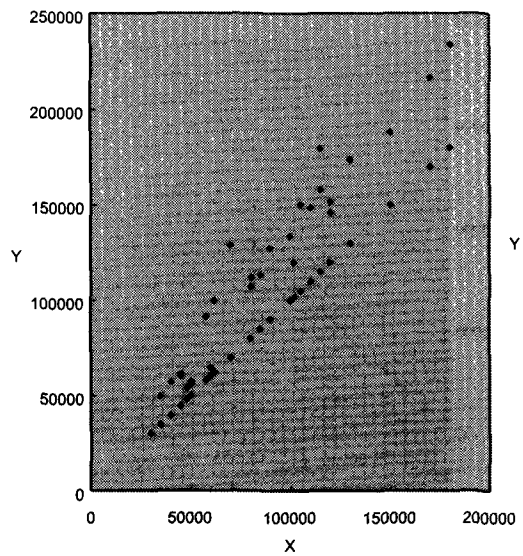
(a) Original Data of (F,A) for (X,Y) to Calculate R^2



(b) Pooled Data of (F,A) and (F,F) for (X,Y) to Calculate J^2_{ante}



(c) Pooled Data of (F,F+|F-A|) and (F,F) for (X,Y) to Calculate J^2_{up}



(d) Pooled Data of (F,F-|F-A|) and (F,F) for (X,Y) to Calculate J^2_{down}

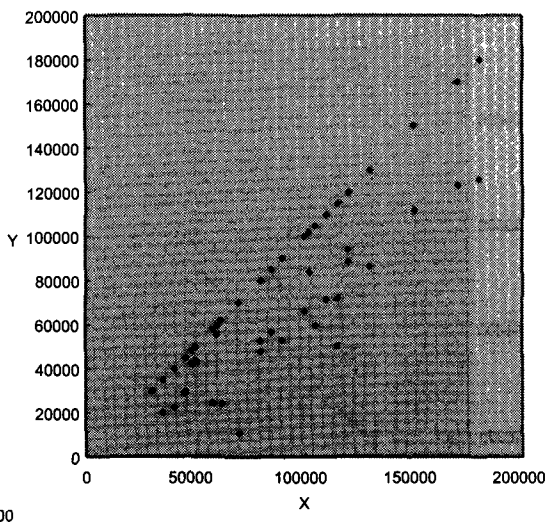
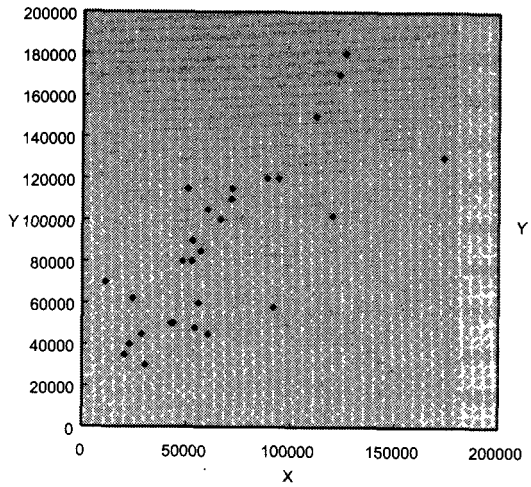
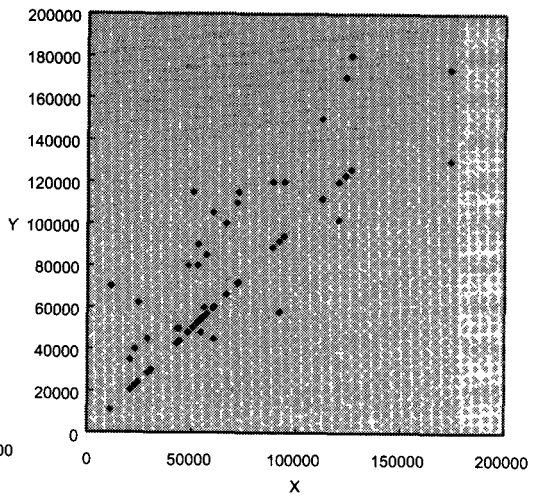


Figure 3-2 (Continued)

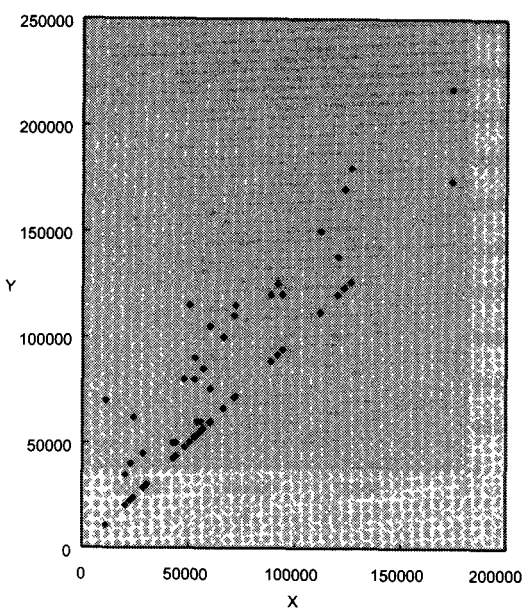
(e) Original Data of (A,F) for (X,Y) to Calculate R^2



(f) Pooled Data of (A,F) and (A,A) for (X,Y) to Calculate J^2_{ante}



(g) Pooled Data of (A,A+|F-A|) and (A,A) for (X,Y) to Calculate J^2_{up}



(h) Pooled Data of (A,A-|F-A|) and (A,A) for (X,Y) to Calculate J^2_{down}

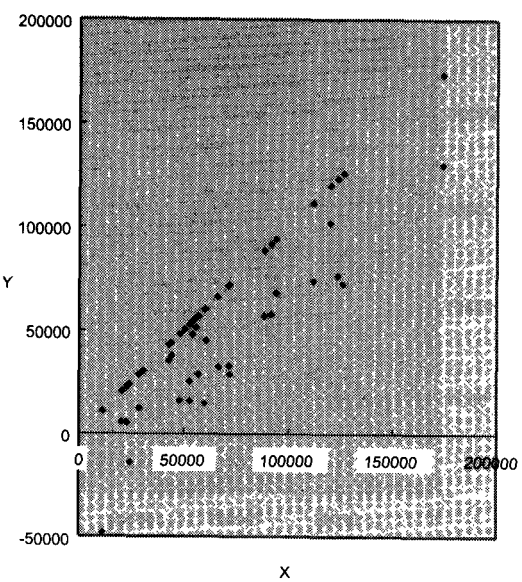


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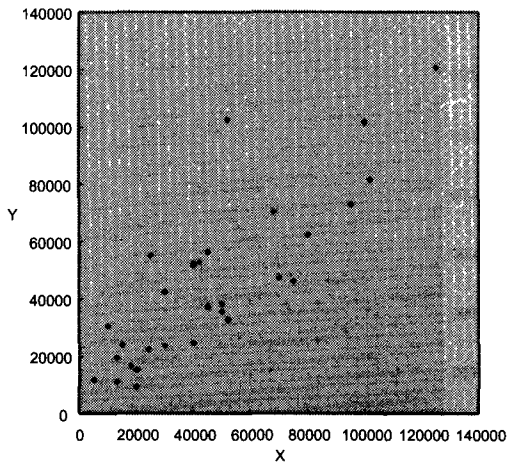
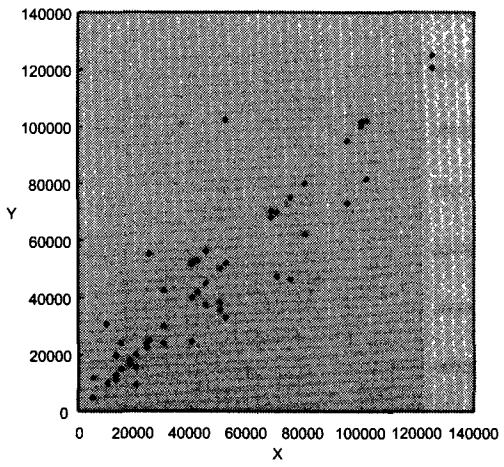
Figure 3-3 1990 Forecast Population (F) and 1990 Actual Population (A) of 31 Zones in Tarrant County

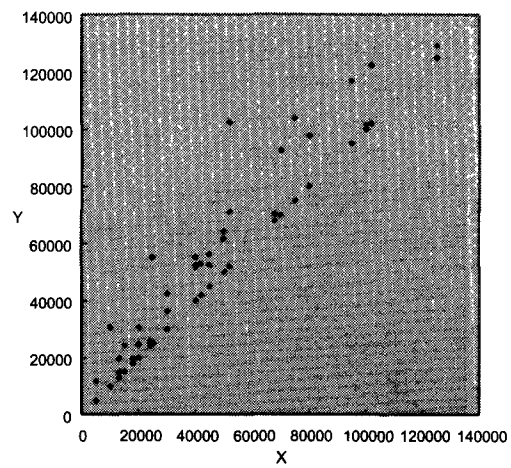
(a) Original Data of (F,A) for (X,Y) to Calculate R^2



(b) Pooled Data of (F,A) and (F,F) for (X,Y) to Calculate J^2_{ante}



(c) Pooled Data of (F,F+|F-A|) and (F,F) for (X,Y) to Calculate J^2_{up}



(d) Pooled Data of (F,F-|F-A|) and (F,F) for (X,Y) to Calculate J^2_{down}

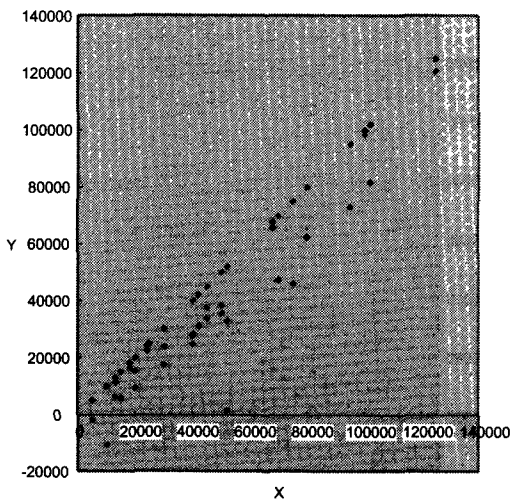


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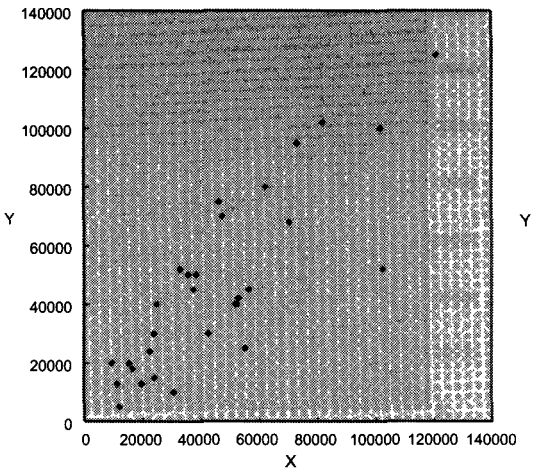
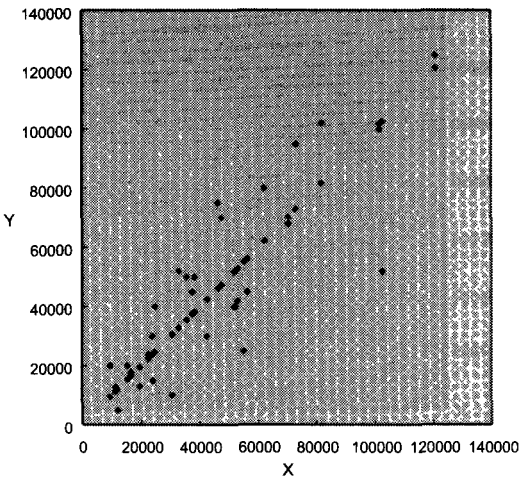
Figure 3-3 (Continued)

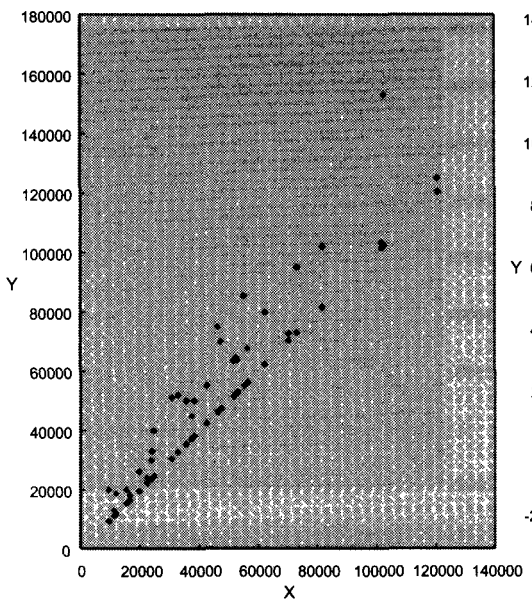
(e) Original Data of (A,F) for (X,Y) to Calculate R^2



(f) Pooled Data of (A,F) and (A,A) for (X,Y) to Calculate J^2_{ante}



(g) Pooled Data of (A,A+|F-A|) and (A,A) for (X,Y) to Calculate J^2_{up}



(h) Pooled Data of (A,A-|F-A|) and (A,A) for (X,Y) to Calculate J^2_{down}

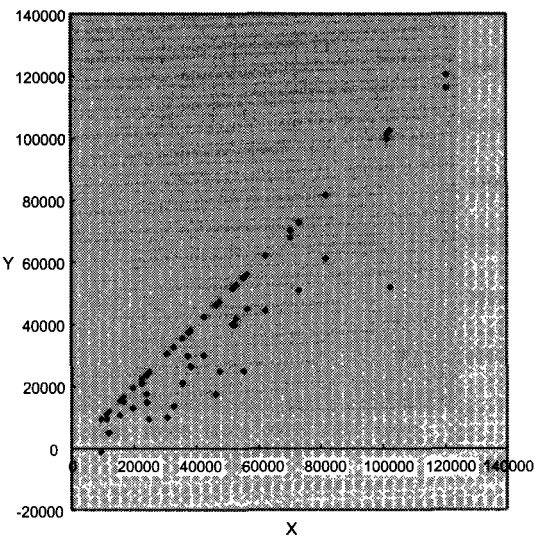


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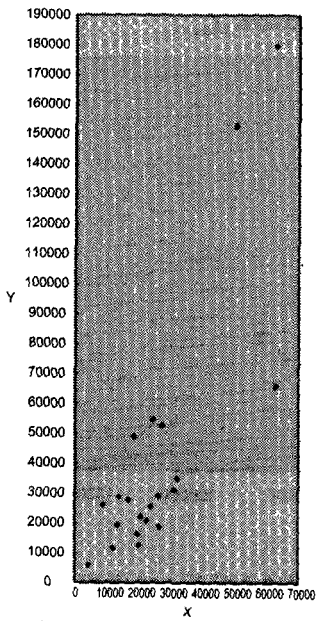
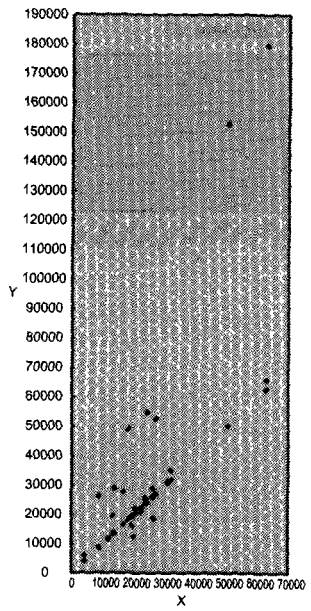
Figure 3-4 1990 Forecast Population (F) and 1990 Actual Population (A) of 21 Zones in Ring Area

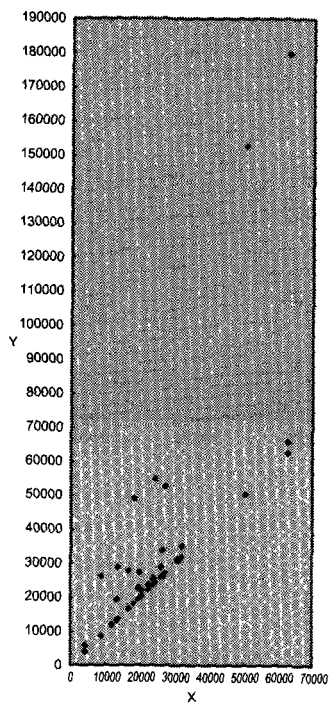
(a) Original Data of (F,A) for (X,Y) to Calculate R^2



(b) Pooled Data of (F,A) and (F,F) for (X,Y) to Calculate J^2_{ante}



(c) Pooled Data of (F,F+|F-A|) and (F,F) for (X,Y) to Calculate J^2_{up}



(d) Pooled Data of (F,F-|F-A|) and (F,F) for (X,Y) to Calculate J^2_{down}

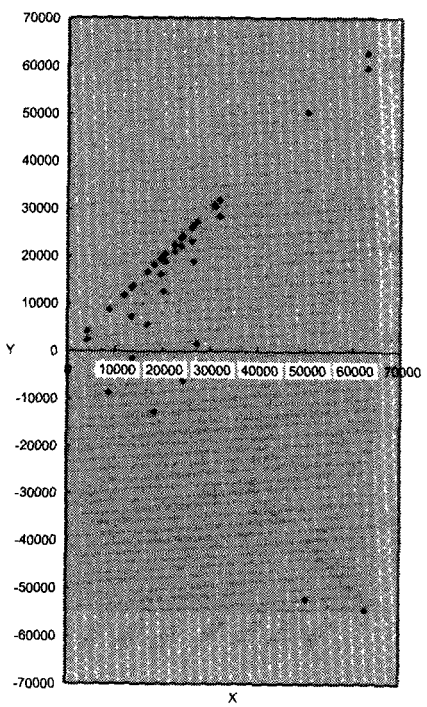
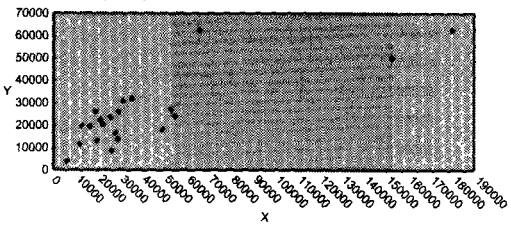
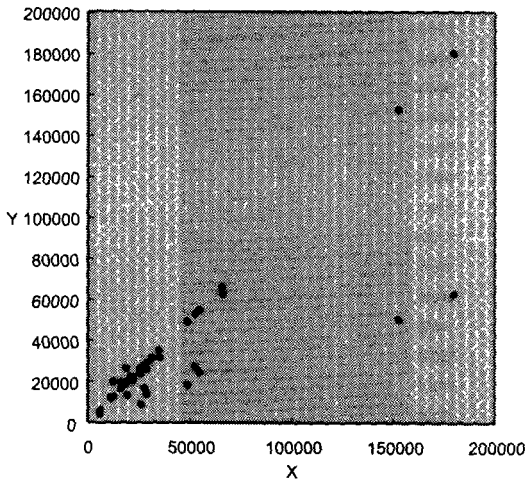


Figure 3-4 (Continued)

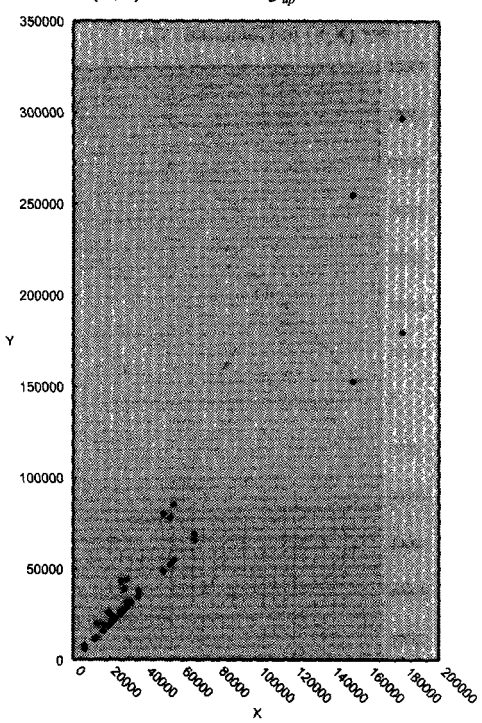
(e) Original Data of (A,F) for (X,Y) to Calculate R^2



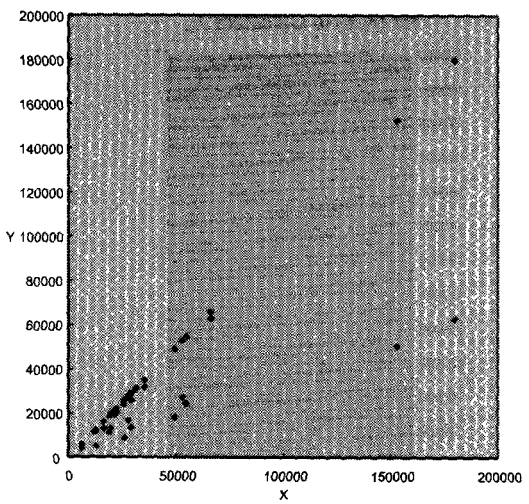
(f) Pooled Data of (A,F) and (A,A) for (X,Y) to Calculate J^2_{ante}



(g) Pooled Data of (A,A+|F-A|) and (A,A) for (X,Y) to Calculate J^2_{up}



(h) Pooled Data of (A,A-|F-A|) and (A,A) for (X,Y) to Calculate J^2_{down}



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4-5 Obtained Results for R^2 and J^2's

From Tables A-1-2, A-2-2, A-3-2 and A-4-2, we respectively obtain Tables 3(a) for the NCTCOG region, 3(b) for Dallas county, 3(c) for Tarrant county and 3(d) for the ring area. Each of them shows the values of R^2 , J^2_{ante} , J^2_{up} , J^2_{down} and J^2_{mean} for the Type -FX and Type -AX.

Table 3 Results for R^2 and J^2 's

(a) For All 80 Zones in the NCTCOG Region

Data for (X,Y)	Data Size	Data Type	R^2	J^2		
				J^2_{ante}	J^2_{up}	J^2_{down}
(F, A)	80	FX	0.5147	–	–	–
(F, A) and (F, F)	160	FX	–	0.7437	–	–
(F, F + |F − A|) and (F, F)	160	FX	–	–	0.8709	–
(F, F − |F − A|) and (F, F)	160	FX	–	–	–	0.8022
(A, F)	80	AX	0.5147	–	–	–
(A, F) and (A, A)	160	AX	–	0.7270	–	–
(A, A + |F − A|) and (A, A)	160	AX	–	–	0.8749	–
(A, A − |F − A|) and (A, A)	160	AX	–	–	–	0.7685
					J^2_{mean} = 0.8291	

(b) For 28 Zones in Dallas County

Data for (X,Y)	Data Size	Data Type	R^2	J^2		
				J^2_{ante}	J^2_{up}	J^2_{down}
(F, A)	28	FX	0.5883	–	–	–
(F, A) and (F, F)	56	FX	–	0.7321	–	–
(F, F + |F − A|) and (F, F)	56	FX	–	–	0.8665	–
(F, F − |F − A|) and (F, F)	56	FX	–	–	–	0.7825
(A, F)	28	AX	0.5883	–	–	–
(A, F) and (A, A)	56	AX	–	0.7193	–	–
(A, A + |F − A|) and (A, A)	56	AX	–	–	0.8207	–
(A, A − |F − A|) and (A, A)	56	AX	–	–	–	0.7748
					J^2_{mean} = 0.8111	

(c) For 31 Zones in Tarrant County

Data for (X,Y)	Data Size	Data Type	R^2	J^2		
				J^2_{ante}	J^2_{up}	J^2_{down}
(F, A)	31	FX	0.6969	–	–	–
(F, A) and (F, F)	62	FX	–	0.8460	–	–
(F, F + |F − A|) and (F, F)	62	FX	–	–	0.9090	–
(F, F − |F − A|) and (F, F)	62	FX	–	–	–	0.8980
(A, F)	31	AX	0.6969	–	–	–
(A, F) and (A, A)	62	AX	–	0.8349	–	–
(A, A + |F − A|) and (A, A)	62	AX	–	–	0.9037	–
(A, A − |F − A|) and (A, A)	62	AX	–	–	–	0.8791
					J^2_{mean} = 0.8975	

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Table 3 (Continued)

(d) For 21 Zones in Ring Area

Data for (X,Y)	Data Size	Data Type	R^2	J^2		
				J^2_{ante}	J^2_{up}	J^2_{down}
(F, A)	21	FX	0.6436	–	–	–
(F, A) and (F, F)	42	FX	–	0.5570	–	–
(F, F + |F − A|) and (F, F)	42	FX	–	–	0.5599	–
(F, F − |F − A|) and (F, F)	42	FX	–	–	–	0.0661
(A, F)	21	AX	0.6436	–	–	–
(A, F) and (A, A)	42	AX	–	0.6867	–	–
(A, A + |F − A|) and (A, A)	42	AX	–	–	0.9055	–
(A, A − |F − A|) and (A, A)	42	AX	–	–	–	0.6951
					J^2_{mean} = 0.5567	

[Notes]

(1) X : Coordinate value on the axis of abscissa

(2) Y : Coordinate value on the axis of ordinate

(3) F : Forecast value of the population

(4) A : Actual value of the population

(5) FX : Arrangement of forecast values along the axis of abscissa (X)

(6) AX : Arrangement of actual values along the axis of abscissa (X)

(7) R^2 : Coefficient of determination

(8) J^2 : Index of judgement (or Joyce index)

(9) J^2_{ante} : J^2 calculated through the ante-mapping data

(10) J^2_{up} : J^2 calculated through the up-mapping data

(11) J^2_{down} : J^2 calculated through the down-mapping data

(12) J^2_{mean} : Arithmetic mean of the two kinds of J^2_{up} 's and the two kinds of J^2_{dowm} 's (*i.e.*, arithmetic mean of the four figures enclosed with the thick broken lines in this table)

(13) NCTCOG: North Central Texas Council of Governments

Judging from the values of J^2_{mean}, the following are pointed out concerning the 1990 population projections made by the RSRI in 1970 to meet the requests from the NCTCOG.

(1) Among the three subregions of the NCTCOG region, the accuracy of the population projection is the highest for Tarrant county (J^2_{mean} = 0.8975) followed by Dallas county (J^2_{mean} = 0.8111) and the ring area (J^2_{mean} = 0.5667)

(2) The value of J^2_{mean} for the NCTCOG region as a whole is 0.8291, which would imply that the projection accuracy for the NCTCOG region is within the acceptance range.

5 Conclusion

We have tried in this paper to develop an index which may be useful for the investigation of the degree of accuracy of the projected spatial distribution of population over a set of spatial units. Several types of the index of Judgment J^2 have been constructed through considerations based on numerical examples. Then, we have applied these indices to the empirical data for the North Central Texas region. Though we

of course hesitate to say that the J^2_{mean} index is one of the best in its kind, we feel that this index is probably better than other presently existing substitutional instruments to evaluate the accuracy of population projections.

If this is so, then what we have to do next is to become accustomed to numbers of actually obtained values of J^2_{mean} through the empirical analyses of "projection fitness" in such a way that we can establish satisfactorily which levels of J^2_{mean} would be at least appropriate for judging the projection reasonebly accurate and in what kinds of situation.

Notes

1) R.C. Douglas and T. Kawashima.
2) Professors B.H.Stevens and R.E.Miller at the University of Pennsylvania as well as Dr.R.E. Coughlin and Dr.T.W. Langford Jr.
3) Douglas *et al.* (1970).
4) This subsection is based primarily on the web-site information of "Dallas/Fort Worth International Airport: Competition Plan" (2000).
5) These eight counties are Wise, Denton, Collin, Rockwall, Kaufman, Ellis and Johnson.
6) "The quantitative and objective information" here carries the following sense; "Forecasts can be qualitative as well as quantitative, but the real needs for forecasts, are for systematic, *quantitative* forecasts. If possible, they should be *objective, non-doctrinal*, and, most of all, *replicable*." (Klein, 2002).
7) Douglas *et al.* (1970).
8) "A set" here implies a set of population projections for each subarea of a cluster of subareas.
9) Zone code: D1～D28.
10) Zone code: T1～T31.
11) The ring counties are the eight counties, in the NCTCOG region, surrouding the Dallas and Fort Worth counties.
12) Zone code: R1～R21.
13) The data source for the 1990 actual population: GeoLytics, Inc. (2002).
14) For the meanings of up-mapping data, down-mapping data, FX and AX, see the notes of Table A-1-1.
15) For the meanings of J^2_{ante}, J^2_{up} and J^2_{down}, see the notes of Table A-1-2.

References

Douglas, R.C., B.H.Stevens, T.Kawashima and R.E.Miller, 1970, *The Future Spatial Structure of the North Central Texas Metropolitan Region*, Report, Regional Science Research Institute, Philadelphia, Pennsylvania, USA.

GeoLytics, Inc., 2002, *Census CD 2000 Long Form: User Guide*, GeoLytics, East Brunswick, New Jersey, USA.

Klein, L.R., 2002, "An Essay on the Accuracy of Economic Prediction," Presented at the Ceremony of Conferment of an Honorary Degree to Professor Klein, Keio University, Tokyo, Japan.

Lowry, I., 1966, *Migration and Metropolitan Growth: Two Analytical Models.*

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Appendix

Table A-1-1 Data Set (Part I): Original and Derived Data for All 80 Zones in the NCTCOG Region

Column Code	①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩
Data	1990 Forecast Population	1990 Actual Population	Difference	Absolute Value of ③	Difference Rate (%)	Absolute Value of ⑤	Up-mapping (For Type-FX)	Down-mapping (For Type-FX)	Up-mapping (For Type-AX)	Down-mapping (For Type-AX)
Calculation / Zone Code	(Original)	(Original)	①-②	| ③ |	③/②×100	| ⑤ |	①+④	①-④	②+④	②-④
D 1	170,000	123,248	46,752	46,752	37.93	37.93	216,752	123,248	170,000	76,496
D 2	150,000	111,908	38,092	38,092	34.04	34.04	188,092	111,908	150,000	73,816
D 3	35,000	20,296	14,704	14,704	72 45	72.45	49,704	20,296	35,000	5,592
D 4	115,000	71,962	43,038	43,038	59.81	59 81	158,038	71,962	115,000	28,924
D 5	100,000	66,170	33,830	33,830	51.13	51.13	133,830	66,170	100,000	32,340
D 6	85,000	56,809	28,191	28,191	49.62	49.62	113,191	56,809	85,000	28,618
D 7	90,000	52,855	37,145	37,145	70.28	70 28	127,145	52,855	90,000	15,710
D 8	48,000	54,012	-6,012	6,012	-11.13	11 13	54,012	41,988	60,024	48,000
D 9	180,000	126,117	53,883	53,883	42 72	42.72	233,883	126,117	180,000	72,234
D10	120,000	88,527	31,473	31,473	35.55	35 55	151,473	88,527	120,000	57,054
D11	130,000	173,632	-43,632	43,632	-25.13	25 13	173,632	86,368	217,264	130,000
D12	120,000	94,032	25,968	25,968	27 62	27.62	145,968	94,032	120,000	68,064
D13	50,000	43,835	6,165	6,165	14.06	14.06	56,165	43,835	50,000	37,670
D14	70,000	11,026	58,974	58,974	534.86	534.86	128,974	11,026	70,000	-47,948
D15	45,000	28,607	16,393	16,393	57 30	57.30	61,393	28,607	45,000	12,214
D16	60,000	55,656	4,344	4,344	7.81	7.81	64,344	55,656	60,000	51,312
D17	80,000	52,666	27,334	27,334	51 90	51.90	107,334	52,666	80,000	25,332
D18	30,000	30,322	-322	322	-1.06	1 06	30,322	29,678	30,644	30,000
D19	80,000	47,996	32,004	32,004	66.68	66.68	112,004	47,996	80,000	15,992
D20	115,000	50,389	64,611	64,611	128 22	128.22	179,611	50,389	115,000	-14,222
D21	110,000	71,425	38,575	38,575	54 01	54.01	148,575	71,425	110,000	32,850
D22	45,000	60,327	-15,327	15,327	-25.41	25 41	60,327	29,673	75,654	45,000
D23	50,000	42,682	7,318	7,318	17.15	17.15	57,318	42,682	50,000	35,364
D24	102,000	119,985	-17,985	17,985	-14.99	14.99	119,985	84,015	137,970	102,000
D25	105,000	59,815	45,185	45,185	75.54	75.54	150,185	59,815	105,000	14,630
D26	58,000	91,581	-33,581	33,581	-36.67	36.67	91,581	24,419	125,162	58,000
D27	62,000	24,114	37,886	37,886	157.11	157.11	99,886	24,114	62,000	-13,772
D28	40,000	22,592	17,408	17,408	77.05	77.05	57,408	22,592	40,000	5,184
T 1	40,000	24,711	15,289	15,289	61.87	61.87	55,289	24,711	40,000	9,422
T 2	95,000	73,021	21,979	21,979	30 10	30.10	116,979	73,021	95,000	51,042
T 3	45,000	37,416	7,584	7,584	20.27	20.27	52,584	37,416	45,000	29,832
T 4	75,000	46,221	28,779	28,779	62 26	62.26	103,779	46,221	75,000	17,442
T 5	50,000	38,265	11,735	11,735	30.67	30 67	61,735	38,265	50,000	26,530
T 6	70,000	47,398	22,602	22,602	47.69	47.69	92,602	47,398	70,000	24,796
T 7	52,000	32,827	19,173	19,173	58 41	58.41	71,173	32,827	52,000	13,654
T 8	25,000	55,150	-30,150	30,150	-54.67	54 67	55,150	-5,150	85,300	25,000
T 9	80,000	62,251	17,749	17,749	28 51	28.51	97,749	62,251	80,000	44,502
T10	68,000	70,297	-2,297	2,297	-3.27	3.27	70,297	65,703	72,594	68,000
T11	40,000	52,293	-12,293	12,293	-23.51	23.51	52,293	27,707	64,586	40,000
T12	125,000	120,618	4,382	4,382	3.63	3.63	129,382	120,618	125,000	116,236
T13	50,000	35,592	14,408	14,408	40 48	40.48	64,408	35,592	50,000	21,184
T14	40,000	51,891	-11,891	11,891	-22 92	22.92	51,891	28,109	63,782	40,000
T15	42,000	52,879	-10,879	10,879	-20.57	20.57	52,879	31,121	63,758	42,000
T16	24,000	22,465	1,535	1,535	6.83	6.83	25,535	22,465	24,000	20,930
T17	5,000	11,881	-6,881	6,881	-57.92	57 92	11,881	-1,881	18,762	5,000
T18	18,000	16,574	1,426	1,426	8 60	8.60	19,426	16,574	18,000	15,148
T19	13,000	11,260	1,740	1,740	15.45	15.45	14,740	11,260	13,000	9,520
T20	20,000	15,391	4,609	4,609	29.95	29.95	24,609	15,391	20,000	10,782
T21	13,000	19,616	-6,616	6,616	-33.73	33 73	19,616	6,384	26,232	13,000
T22	45,000	56,321	-11,321	11,321	-20.10	20 10	56,321	33,679	67,642	45,000
T23	102,000	81,655	20,345	20,345	24 92	24.92	122,345	81,655	102,000	61,310
T24	30,000	42,520	-12,520	12,520	-29.44	29 44	42,520	17,480	55,040	30,000
T25	100,000	101,654	-1,654	1,654	-1.63	1.63	101,654	98,346	103,308	100,000
T26	52,000	102,477	-50,477	50,477	-49.26	49.26	102,477	1,523	152,954	52,000
T27	15,000	24,033	-9,033	9,033	-37.59	37.59	24,033	5,967	33,066	15,000
T28	10,000	30,604	-20,604	20,604	-67.32	67.32	30,604	-10,604	51,208	10,000
T29	40,000	51,703	-11,703	11,703	-22.64	22.64	51,703	28,297	63,406	40,000
T30	30,000	23,795	6,205	6,205	26.08	26.08	36,205	23,795	30,000	17,590
T31	20,000	9,472	10,528	10,528	111.15	111.15	30,528	9,472	20,000	-1,056
R 1	50,342	152,723	-102,381	102,381	-67.04	67.04	152,723	-52,039	255,104	50,342
R 2	62,734	179,813	-117,079	117,079	-65.11	65.11	179,813	-54,345	296,892	62,734

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Table A-1-1 (Continued)

Column Code	①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩
Data	1990 Forecast Population	1990 Actual Population	Difference	Absolute Value of ③	Difference Rate (%)	Absolute Value of ⑤	Up-mapping (For Type-FX)	Down-mapping (For Type-FX)	Up-mapping (For Type-AX)	Down-mapping (For Type-AX)
Calculation / Zone Code	(Original)	(Original)	①-②	|③|	③/②×100	|⑤|	①+④	①-④	②+④	②-④
R 3	13,391	19,550	-6,159	6,159	-31.50	31.50	19,550	7,232	25,709	13,391
R 4	11,876	11,696	180	180	1.54	1.54	12,056	11,696	11,876	11,516
R 5	13,727	28,967	-15,240	15,240	-52.61	52.61	28,967	-1,513	44,207	13,727
R 6	18,234	49,150	-30,916	30,916	-62.90	62 90	49,150	-12,682	80,066	18,234
R 7	8,792	26,256	-17,464	17,464	-66.51	66.51	26,256	-8,672	43,720	8,792
R 8	20,534	22,215	-1,681	1,681	-7.57	7.57	22,215	18,853	23,896	20,534
R 9	62,791	66,010	-3,219	3,219	-4.88	4.88	66,010	59,572	69,229	62,791
R10	27,183	52,847	-25,664	25,664	-48.56	48.56	52,847	1,519	78,511	27,183
R11	19,974	12,600	7,374	7,374	58.52	58.52	27,348	12,600	19,974	5,226
R12	22,496	21,000	1,496	1,496	7.12	7.12	23,992	21,000	22,496	19,504
R13	26,382	18,863	7,519	7,519	39.86	39 86	33,901	18,863	26,382	11,344
R14	23,812	25,604	-1,792	1,792	-7.00	7.00	25,604	22,020	27,396	23,812
R15	24,306	54,792	-30,486	30,486	-55.64	55.64	54,792	-6,180	85,278	24,306
R16	30,921	31,376	-455	455	-1.45	1.45	31,376	30,466	31,831	30,921
R17	4,182	6,054	-1,872	1,872	-30.92	30.92	6,054	2,310	7,926	4,182
R18	16,755	27,924	-11,169	11,169	-40.00	40.00	27,924	5,586	39,093	16,755
R19	31,886	35,200	-3,314	3,314	-9.41	9.41	35,200	28,572	38,514	31,886
R20	26,147	29,152	-3,005	3,005	-10.31	10.31	29,152	23,142	32,157	26,147
R21	19,573	16,314	3,259	3,259	19.98	19.98	22,832	16,314	19,573	13,055
Total	4,415,038	4,162,943	252,095	1,626,243	6.06	3,577	6,041,281	2,788,795	5,789,186	2,536,700
Mean	55,188	52,037	3,151	20,328	6.06	45	75,516	34,860	72,365	31,709
STDEV	39,900	37,237	29,099	21,058	-	62	53,308	35,060	53,393	28,449
COFVTN	0.7230	0.7156	-	1.0359	-	1.3875	0.7059	-	0.7378	-

[Notes]
(1) NCTCOG : North Central Texas Council of Governments
(2) D1～D28 : Zones in Dallas County
(3) T1～T31 : Zones in Tarrant County
(4) R1～R21 : Ring Counties
(5) FX : Arrangement of forecast values along the axis of abscissa (X)
(6) AX : Arrangement of actual values along the axis of abscissa (X)
(7) Up-mapping Data : The data obtained by transforming ① (or ②) to the domain of "①+④" (or "②+④")
(8) Down-mapping Data : The data obtained by transforming ① (or ②) to the domain of "①-④)" (or "②-④")
(9) STDEV : Standard deviation
(10) COFVTN : Coefficient of variation

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Table A-1-2 Data Set (Part Ⅱ): With Auxiliary Data for All 80 Zones in the NCTCOG Region

Column Code	AA		A		B		C		D		E		F	
Preparation For:	R^2		J^2											
			J^2_{ante}		J^2_{up}		J^2_{down}		J^2_{ante}		J^2_{up}		J^2_{down}	
Data Type	Type-FX and Type-AX		Type-FX		Type-FX		Type-FX		Type-AX		Type-AX		Type-AX	
Data Com-position	① +	② +	① +	② +	① +	⑦ +	① +	⑧ +	② +	① +	② +	⑨ +	② +	⑩ +
Zone Code	Nothing	Nothing	①	①	①	①	①	①	②	②	②	②	②	②
D 1	170,000	123,248	170,000	123,248	170,000	216,752	170,000	123,248	123,248	170,000	123,248	170,000	123,248	76,496
D 2	150,000	111,908	150,000	111,908	150,000	188,092	150,000	111,908	111,908	150,000	111,908	150,000	111,908	73,816
D 3	35,000	20,296	35,000	20,296	35,000	49,704	35,000	20,296	20,296	35,000	20,296	35,000	20,296	5,592
D 4	115,000	71,962	115,000	71,962	115,000	158,038	115,000	71,962	71,962	115,000	71,962	115,000	71,962	28,924
D 5	100,000	66,170	100,000	66,170	100,000	133,830	100,000	66,170	66,170	100,000	66,170	100,000	66,170	32,340
D 6	85,000	56,809	85,000	56,809	85,000	113,191	85,000	56,809	56,809	85,000	56,809	85,000	56,809	28,618
D 7	90,000	52,855	90,000	52,855	90,000	127,145	90,000	52,855	52,855	90,000	52,855	90,000	52,855	15,710
D 8	48,000	54,012	48,000	54,012	48,000	54,012	48,000	41,988	54,012	48,000	54,012	60,024	54,012	48,000
D 9	180,000	126,117	180,000	126,117	180,000	233,883	180,000	126,117	126,117	180,000	126,117	180,000	126,117	72,234
D10	120,000	88,527	120,000	88,527	120,000	151,473	120,000	88,527	88,527	120,000	88,527	120,000	88,527	57,054
D11	130,000	173,632	130,000	173,632	130,000	173,632	130,000	86,368	173,632	130,000	173,632	217,264	173,632	130,000
D12	120,000	94,032	120,000	94,032	120,000	145,968	120,000	94,032	94,032	120,000	94,032	120,000	94,032	68,064
D13	50,000	43,835	50,000	43,835	50,000	56,165	50,000	43,835	43,835	50,000	43,835	50,000	43,835	37,670
D14	70,000	11,026	70,000	11,026	70,000	128,974	70,000	11,026	11,026	70,000	11,026	70,000	11,026	-47,948
D15	45,000	28,607	45,000	28,607	45,000	61,393	45,000	28,607	28,607	45,000	28,607	45,000	28,607	12,214
D16	60,000	55,656	60,000	55,656	60,000	64,344	60,000	55,656	55,656	60,000	55,656	60,000	55,656	51,312
D17	80,000	52,666	80,000	52,666	80,000	107,334	80,000	52,666	52,666	80,000	52,666	80,000	52,666	25,332
D18	30,000	30,322	30,000	30,322	30,000	30,322	30,000	29,678	30,322	30,000	30,322	30,644	30,322	30,000
D19	80,000	47,996	80,000	47,996	80,000	112,004	80,000	47,996	47,996	80,000	47,996	80,000	47,996	15,992
D20	115,000	50,389	115,000	50,389	115,000	179,611	115,000	50,389	50,389	115,000	50,389	115,000	50,389	-14,222
D21	110,000	71,425	110,000	71,425	110,000	148,575	110,000	71,425	71,425	110,000	71,425	110,000	71,425	32,850
D22	45,000	60,327	45,000	60,327	45,000	60,327	45,000	29,673	60,327	45,000	60,327	75,654	60,327	45,000
D23	50,000	42,682	50,000	42,682	50,000	57,318	50,000	42,682	42,682	50,000	42,682	50,000	42,682	35,364
D24	102,000	119,985	102,000	119,985	102,000	119,985	102,000	84,015	119,985	102,000	119,985	137,970	119,985	102,000
D25	105,000	59,815	105,000	59,815	105,000	150,185	105,000	59,815	59,815	105,000	59,815	105,000	59,815	14,630
D26	58,000	91,581	58,000	91,581	58,000	91,581	58,000	24,419	91,581	58,000	91,581	125,162	91,581	58,000
D27	62,000	24,114	62,000	24,114	62,000	99,886	62,000	24,114	24,114	62,000	24,114	62,000	24,114	-13,772
D28	40,000	22,592	40,000	22,592	40,000	57,408	40,000	22,592	22,592	40,000	22,592	40,000	22,592	5,184
T 1	40,000	24,711	40,000	24,711	40,000	55,289	40,000	24,711	24,711	40,000	24,711	40,000	24,711	9,422
T 2	95,000	73,021	95,000	73,021	95,000	116,979	95,000	73,021	73,021	95,000	73,021	95,000	73,021	51,042
T 3	45,000	37,416	45,000	37,416	45,000	52,584	45,000	37,416	37,416	45,000	37,416	45,000	37,416	29,832
T 4	75,000	46,221	75,000	46,221	75,000	103,779	75,000	46,221	46,221	75,000	46,221	75,000	46,221	17,442
T 5	50,000	38,265	50,000	38,265	50,000	61,735	50,000	38,265	38,265	50,000	38,265	50,000	38,265	26,530
T 6	70,000	47,398	70,000	47,398	70,000	92,602	70,000	47,398	47,398	70,000	47,398	70,000	47,398	24,796
T 7	52,000	32,827	52,000	32,827	52,000	71,173	52,000	32,827	32,827	52,000	32,827	52,000	32,827	13,654
T 8	25,000	55,150	25,000	55,150	25,000	55,150	25,000	-5,150	55,150	25,000	55,150	85,300	55,150	25,000
T 9	80,000	62,251	80,000	62,251	80,000	97,749	80,000	62,251	62,251	80,000	62,251	80,000	62,251	44,502
T10	68,000	70,297	68,000	70,297	68,000	70,297	68,000	65,703	70,297	68,000	70,297	72,594	70,297	68,000
T11	40,000	52,293	40,000	52,293	40,000	52,293	40,000	27,707	52,293	40,000	52,293	64,586	52,293	40,000
T12	125,000	120,618	125,000	120,618	125,000	129,382	125,000	120,618	120,618	125,000	120,618	125,000	120,618	116,236
T13	50,000	35,592	50,000	35,592	50,000	64,408	50,000	35,592	35,592	50,000	35,592	50,000	35,592	21,184
T14	40,000	51,891	40,000	51,891	40,000	51,891	40,000	28,109	51,891	40,000	51,891	63,782	51,891	40,000
T15	42,000	52,879	42,000	52,879	42,000	52,879	42,000	31,121	52,879	42,000	52,879	63,758	52,879	42,000
T16	24,000	22,465	24,000	22,465	24,000	25,535	24,000	22,465	22,465	24,000	22,465	24,000	22,465	20,930
T17	5,000	11,881	5,000	11,881	5,000	11,881	5,000	-1,881	11,881	5,000	11,881	18,762	11,881	5,000
T18	18,000	16,574	18,000	16,574	18,000	19,426	18,000	16,574	16,574	18,000	16,574	18,000	16,574	15,148
T19	13,000	11,260	13,000	11,260	13,000	14,740	13,000	11,260	11,260	13,000	11,260	13,000	11,260	9,520
T20	20,000	15,391	20,000	15,391	20,000	24,609	20,000	15,391	15,391	20,000	15,391	20,000	15,391	10,782
T21	13,000	19,616	13,000	19,616	13,000	19,616	13,000	6,384	19,616	13,000	19,616	26,232	19,616	13,000
T22	45,000	56,321	45,000	56,321	45,000	56,321	45,000	33,679	56,321	45,000	56,321	67,642	56,321	45,000
T23	102,000	81,655	102,000	81,655	102,000	122,345	102,000	81,655	81,655	102,000	81,655	102,000	81,655	61,310
T24	30,000	42,520	30,000	42,520	30,000	42,520	30,000	17,480	42,520	30,000	42,520	55,040	42,520	30,000
T25	100,000	101,654	100,000	101,654	100,000	101,654	100,000	98,346	101,654	100,000	101,654	103,308	101,654	100,000
T26	52,000	102,477	52,000	102,477	52,000	102,477	52,000	1,523	102,477	52,000	102,477	152,954	102,477	52,000
T27	15,000	24,033	15,000	24,033	15,000	24,033	15,000	5,967	24,033	15,000	24,033	33,066	24,033	15,000
T28	10,000	30,604	10,000	30,604	10,000	30,604	10,000	-10,604	30,604	10,000	30,604	51,208	30,604	10,000
T29	40,000	51,703	40,000	51,703	40,000	51,703	40,000	28,297	51,703	40,000	51,703	63,406	51,703	40,000
T30	30,000	23,795	30,000	23,795	30,000	36,205	30,000	23,795	23,795	30,000	23,795	30,000	23,795	17,590
T31	20,000	9,472	20,000	9,472	20,000	30,528	20,000	9,472	9,472	20,000	9,472	20,000	9,472	-1,056
R 1	50,342	152,723	50,342	152,723	50,342	152,723	50,342	-52,039	152,723	50,342	152,723	255,104	152,723	50,342
R 2	62,734	179,813	62,734	179,813	62,734	179,813	62,734	-54,345	179,813	62,734	179,813	296,892	179,813	62,734

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Table A-1-2 (Continued)

Column Code	AA		A		B		C		D		E		F	
Preparation For:	R^2		J^2											
			J^2_{ante}		J^2_{up}		J^2_{down}		J^2_{ante}		J^2_{up}		J^2_{down}	
Data Type	Type-FX and Type-AX		Type-FX		Type-FX		Type-FX		Type-AX		Type-AX		Type-AX	
Data Composition	① +	② +	① +	② +	① +	⑦ +	① +	⑧ +	② +	① +	② +	⑨ +	② +	⑩ +
Zone Code	Nothing	Nothing	①	①	①	①	①	①	②	②	②	②	②	②
R 3	13,391	19,550	13,391	19,550	13,391	19,550	13,391	7,232	19,550	13,391	19,550	25,709	19,550	13,391
R 4	11,876	11,696	11,876	11,696	11,876	12,056	11,876	11,696	11,696	11,876	11,696	11,876	11,696	11,516
R 5	13,727	28,967	13,727	28,967	13,727	28,967	13,727	-1,513	28,967	13,727	28,967	44,207	28,967	13,727
R 6	18,234	49,150	18,234	49,150	18,234	49,150	18,234	-12,682	49,150	18,234	49,150	80,066	49,150	18,234
R 7	8,792	26,256	8,792	26,256	8,792	26,256	8,792	-8,672	26,256	8,792	26,256	43,720	26,256	8,792
R 8	20,534	22,215	20,534	22,215	20,534	22,215	20,534	18,853	22,215	20,534	22,215	23,896	22,215	20,534
R 9	62,791	66,010	62,791	66,010	62,791	66,010	62,791	59,572	66,010	62,791	66,010	69,229	66,010	62,791
R10	27,183	52,847	27,183	52,847	27,183	52,847	27,183	1,519	52,847	27,183	52,847	78,511	52,847	27,183
R11	19,974	12,600	19,974	12,600	19,974	27,348	19,974	12,600	12,600	19,974	12,600	19,974	12,600	5,226
R12	22,496	21,000	22,496	21,000	22,496	23,992	22,496	21,000	21,000	22,496	21,000	22,496	21,000	19,504
R13	26,382	18,863	26,382	18,863	26,382	33,901	26,382	18,863	18,863	26,382	18,863	26,382	18,863	11,344
R14	23,812	25,604	23,812	25,604	23,812	25,604	23,812	22,020	25,604	23,812	25,604	27,396	25,604	23,812
R15	24,306	54,792	24,306	54,792	24,306	54,792	24,306	-6,180	54,792	24,306	54,792	85,278	54,792	24,306
R16	30,921	31,376	30,921	31,376	30,921	31,376	30,921	30,466	31,376	30,921	31,376	31,831	31,376	30,921
R17	4,182	6,054	4,182	6,054	4,182	6,054	4,182	2,310	6,054	4,182	6,054	7,926	6,054	4,182
R18	16,755	27,924	16,755	27,924	16,755	27,924	16,755	5,586	27,924	16,755	27,924	39,093	27,924	16,755
R19	31,886	35,200	31,886	35,200	31,886	35,200	31,886	28,572	35,200	31,886	35,200	38,514	35,200	31,886
R20	26,147	29,152	26,147	29,152	26,147	29,152	26,147	23,142	29,152	26,147	29,152	32,157	29,152	26,147
R21	19,573	16,314	19,573	16,314	19,573	22,832	19,573	16,314	16,314	19,573	16,314	19,573	16,314	13,055
D 1	-	-	170,000	170,000	170,000	170,000	170,000	170,000	123,248	123,248	123,248	123,248	123,248	123,248
D 2	-	-	150,000	150,000	150,000	150,000	150,000	150,000	111,908	111,908	111,908	111,908	111,908	111,908
D 3	-	-	35,000	35,000	35,000	35,000	35,000	35,000	20,296	20,296	20,296	20,296	20,296	20,296
D 4	-	-	115,000	115,000	115,000	115,000	115,000	115,000	71,962	71,962	71,962	71,962	71,962	71,962
D 5	-	-	100,000	100,000	100,000	100,000	100,000	100,000	66,170	66,170	66,170	66,170	66,170	66,170
D 6	-	-	85,000	85,000	85,000	85,000	85,000	85,000	56,809	56,809	56,809	56,809	56,809	56,809
D 7	-	-	90,000	90,000	90,000	90,000	90,000	90,000	52,855	52,855	52,855	52,855	52,855	52,855
D 8	-	-	48,000	48,000	48,000	48,000	48,000	48,000	54,012	54,012	54,012	54,012	54,012	54,012
D 9	-	-	180,000	180,000	180,000	180,000	180,000	180,000	126,117	126,117	126,117	126,117	126,117	126,117
D10	-	-	120,000	120,000	120,000	120,000	120,000	120,000	88,527	88,527	88,527	88,527	88,527	88,527
D11	-	-	130,000	130,000	130,000	130,000	130,000	130,000	173,632	173,632	173,632	173,632	173,632	173,632
D12	-	-	120,000	120,000	120,000	120,000	120,000	120,000	94,032	94,032	94,032	94,032	94,032	94,032
D13	-	-	50,000	50,000	50,000	50,000	50,000	50,000	43,835	43,835	43,835	43,835	43,835	43,835
D14	-	-	70,000	70,000	70,000	70,000	70,000	70,000	11,026	11,026	11,026	11,026	11,026	11,026
D15	-	-	45,000	45,000	45,000	45,000	45,000	45,000	28,607	28,607	28,607	28,607	28,607	28,607
D16	-	-	60,000	60,000	60,000	60,000	60,000	60,000	55,656	55,656	55,656	55,656	55,656	55,656
D17	-	-	80,000	80,000	80,000	80,000	80,000	80,000	52,666	52,666	52,666	52,666	52,666	52,666
D18	-	-	30,000	30,000	30,000	30,000	30,000	30,000	30,322	30,322	30,322	30,322	30,322	30,322
D19	-	-	80,000	80,000	80,000	80,000	80,000	80,000	47,996	47,996	47,996	47,996	47,996	47,996
D20	-	-	115,000	115,000	115,000	115,000	115,000	115,000	50,389	50,389	50,389	50,389	50,389	50,389
D21	-	-	110,000	110,000	110,000	110,000	110,000	110,000	71,425	71,425	71,425	71,425	71,425	71,425
D22	-	-	45,000	45,000	45,000	45,000	45,000	45,000	60,327	60,327	60,327	60,327	60,327	60,327
D23	-	-	50,000	50,000	50,000	50,000	50,000	50,000	42,682	42,682	42,682	42,682	42,682	42,682
D24	-	-	102,000	102,000	102,000	102,000	102,000	102,000	119,985	119,985	119,985	119,985	119,985	119,985
D25	-	-	105,000	105,000	105,000	105,000	105,000	105,000	59,815	59,815	59,815	59,815	59,815	59,815
D26	-	-	58,000	58,000	58,000	58,000	58,000	58,000	91,581	91,581	91,581	91,581	91,581	91,581
D27	-	-	62,000	62,000	62,000	62,000	62,000	62,000	24,114	24,114	24,114	24,114	24,114	24,114
D28	-	-	40,000	40,000	40,000	40,000	40,000	40,000	22,592	22,592	22,592	22,592	22,592	22,592
T 1	-	-	40,000	40,000	40,000	40,000	40,000	40,000	24,711	24,711	24,711	24,711	24,711	24,711
T 2	-	-	95,000	95,000	95,000	95,000	95,000	95,000	73,021	73,021	73,021	73,021	73,021	73,021
T 3	-	-	45,000	45,000	45,000	45,000	45,000	45,000	37,416	37,416	37,416	37,416	37,416	37,416
T 4	-	-	75,000	75,000	75,000	75,000	75,000	75,000	46,221	46,221	46,221	46,221	46,221	46,221
T 5	-	-	50,000	50,000	50,000	50,000	50,000	50,000	38,265	38,265	38,265	38,265	38,265	38,265
T 6	-	-	70,000	70,000	70,000	70,000	70,000	70,000	47,398	47,398	47,398	47,398	47,398	47,398
T 7	-	-	52,000	52,000	52,000	52,000	52,000	52,000	32,827	32,827	32,827	32,827	32,827	32,827
T 8	-	-	25,000	25,000	25,000	25,000	25,000	25,000	55,150	55,150	55,150	55,150	55,150	55,150
T 9	-	-	80,000	80,000	80,000	80,000	80,000	80,000	62,251	62,251	62,251	62,251	62,251	62,251
T10	-	-	68,000	68,000	68,000	68,000	68,000	68,000	70,297	70,297	70,297	70,297	70,297	70,297
T11	-	-	40,000	40,000	40,000	40,000	40,000	40,000	52,293	52,293	52,293	52,293	52,293	52,293
T12	-	-	125,000	125,000	125,000	125,000	125,000	125,000	120,618	120,618	120,618	120,618	120,618	120,618
T13	-	-	50,000	50,000	50,000	50,000	50,000	50,000	35,592	35,592	35,592	35,592	35,592	35,592
T14	-	-	40,000	40,000	40,000	40,000	40,000	40,000	51,891	51,891	51,891	51,891	51,891	51,891

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Table A-1-2 (Continued)

Column Code	AA		A		B		C		D		E		F	
Preparation For:	R^2		J^2											
			J^2_{ante}		J^2_{up}		J^2_{down}		J^2_{ante}		J^2_{up}		J^2_{down}	
Data Type	Type-FX and Type-AX		Type-FX		Type-FX		Type-FX		Type-AX		Type-AX		Type-AX	
Data Com-position	① +	② +	① +	② +	① +	⑦ +	① +	⑧ +	② +	① +	② +	⑨ +	② +	⑩ +
Zone Code	Nothing	Nothing	①	①	①	①	①	①	②	②	②	②	②	②
T15	-	-	42,000	42,000	42,000	42,000	42,000	42,000	52,879	52,879	52,879	52,879	52,879	52,879
T16	-	-	24,000	24,000	24,000	24,000	24,000	24,000	22,465	22,465	22,465	22,465	22,465	22,465
T17	-	-	5,000	5,000	5,000	5,000	5,000	5,000	11,881	11,881	11,881	11,881	11,881	11,881
T18	-	-	18,000	18,000	18,000	18,000	18,000	18,000	16,574	16,574	16,574	16,574	16,574	16,574
T19	-	-	13,000	13,000	13,000	13,000	13,000	13,000	11,260	11,260	11,260	11,260	11,260	11,260
T20	-	-	20,000	20,000	20,000	20,000	20,000	20,000	15,391	15,391	15,391	15,391	15,391	15,391
T21	-	-	13,000	13,000	13,000	13,000	13,000	13,000	19,616	19,616	19,616	19,616	19,616	19,616
T22	-	-	45,000	45,000	45,000	45,000	45,000	45,000	56,321	56,321	56,321	56,321	56,321	56,321
T23	-	-	102,000	102,000	102,000	102,000	102,000	102,000	81,655	81,655	81,655	81,655	81,655	81,655
T24	-	-	30,000	30,000	30,000	30,000	30,000	30,000	42,520	42,520	42,520	42,520	42,520	42,520
T25	-	-	100,000	100,000	100,000	100,000	100,000	100,000	101,654	101,654	101,654	101,654	101,654	101,654
T26	-	-	52,000	52,000	52,000	52,000	52,000	52,000	102,477	102,477	102,477	102,477	102,477	102,477
T27	-	-	15,000	15,000	15,000	15,000	15,000	15,000	24,033	24,033	24,033	24,033	24,033	24,033
T28	-	-	10,000	10,000	10,000	10,000	10,000	10,000	30,604	30,604	30,604	30,604	30,604	30,604
T29	-	-	40,000	40,000	40,000	40,000	40,000	40,000	51,703	51,703	51,703	51,703	51,703	51,703
T30	-	-	30,000	30,000	30,000	30,000	30,000	30,000	23,795	23,795	23,795	23,795	23,795	23,795
T31	-	-	20,000	20,000	20,000	20,000	20,000	20,000	9,472	9,472	9,472	9,472	9,472	9,472
R 1	-	-	50,342	50,342	50,342	50,342	50,342	50,342	152,723	152,723	152,723	152,723	152,723	152,723
R 2	-	-	62,734	62,734	62,734	62,734	62,734	62,734	179,813	179,813	179,813	179,813	179,813	179,813
R 3	-	-	13,391	13,391	13,391	13,391	13,391	13,391	19,550	19,550	19,550	19,550	19,550	19,550
R 4	-	-	11,876	11,876	11,876	11,876	11,876	11,876	11,696	11,696	11,696	11,696	11,696	11,696
R 5	-	-	13,727	13,727	13,727	13,727	13,727	13,727	28,967	28,967	28,967	28,967	28,967	28,967
R 6	-	-	18,234	18,234	18,234	18,234	18,234	18,234	49,150	49,150	49,150	49,150	49,150	49,150
R 7	-	-	8,792	8,792	8,792	8,792	8,792	8,792	26,256	26,256	26,256	26,256	26,256	26,256
R 8	-	-	20,534	20,534	20,534	20,534	20,534	20,534	22,215	22,215	22,215	22,215	22,215	22,215
R 9	-	-	62,791	62,791	62,791	62,791	62,791	62,791	66,010	66,010	66,010	66,010	66,010	66,010
R10	-	-	27,183	27,183	27,183	27,183	27,183	27,183	52,847	52,847	52,847	52,847	52,847	52,847
R11	-	-	19,974	19,974	19,974	19,974	19,974	19,974	12,600	12,600	12,600	12,600	12,600	12,600
R12	-	-	22,496	22,496	22,496	22,496	22,496	22,496	21,000	21,000	21,000	21,000	21,000	21,000
R13	-	-	26,382	26,382	26,382	26,382	26,382	26,382	18,863	18,863	18,863	18,863	18,863	18,863
R14	-	-	23,812	23,812	23,812	23,812	23,812	23,812	25,604	25,604	25,604	25,604	25,604	25,604
R15	-	-	24,306	24,306	24,306	24,306	24,306	24,306	54,792	54,792	54,792	54,792	54,792	54,792
R16	-	-	30,921	30,921	30,921	30,921	30,921	30,921	31,376	31,376	31,376	31,376	31,376	31,376
R17	-	-	4,182	4,182	4,182	4,182	4,182	4,182	6,054	6,054	6,054	6,054	6,054	6,054
R18	-	-	16,755	16,755	16,755	16,755	16,755	16,755	27,924	27,924	27,924	27,924	27,924	27,924
R19	-	-	31,886	31,886	31,886	31,886	31,886	31,886	35,200	35,200	35,200	35,200	35,200	35,200
R20	-	-	26,147	26,147	26,147	26,147	26,147	26,147	29,152	29,152	29,152	29,152	29,152	29,152
R21	-	-	19,573	19,573	19,573	19,573	19,573	19,573	16,314	16,314	16,314	16,314	16,314	16,314
Total	4,415,038	4,162,943	8,830,076	8,577,981	8,830,076	10,456,319	8,830,076	7,203,833	8,325,886	8,577,981	8,325,886	9,952,129	8,325,886	6,699,643
Mean	55,188	52,037	55,188	53,612	55,188	65,352	55,188	45,024	52,037	53,612	52,037	62,201	52,037	41,873
STDEV	39,900	37,237	39,900	38,624	39,900	48,168	39,900	38,909	37,237	38,624	37,237	47,138	37,237	34,660
COFVTN	0.7230	0.7156	0.7230	0.7204	0.7230	0.7371	0.7230	-	0.7156	0.7204	0.7156	0.7578	0.7156	-

[Notes]

(1) NCTCOG : North Central Texas Council of Governments
(2) D1～D28 : Zones in Dallas County
(3) T1～T31 : Zones in Tarrant County
(4) R1～R21 : Ring Counties
(5) R^2 : Coefficient of determination
(6) J^2 : Index of judgement (or Joyce index)
(7) J^2_{ante} : J^2 calculated from the ante-mapping data
(8) J^2_{up} : J^2 calculated from the up-mapping data
(9) J^2_{down} : J^2 calculated from the down-mapping data
(10) STDEV : Standard deviation
(11) COFVTN : Coefficient of variation
(12) See Table A-1-1 for the data base expressed as ①, ② and ⑦～⑩ which present respectively the column codes used in it.

Table A-2-1 Data Set (Part I): Original and Derived Data for 28 Zones in Dallas County

Column Code	①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩
Data	1990 Forecast Population	1990 Actual Population	Difference	Absolute Value of ③	Difference Rate (%)	Absolute Value of ⑤	Up-mapping (For Type-FX)	Down-mapping (For Type-FX)	Up-mapping (For Type-AX)	Down-mapping (For Type-AX)
Calculation / Zone Code	(Original)	(Original)	①-②	|③|	③/②×100	|⑤|	①+④	①-④	②+④	②-④
D 1	170,000	123,248	46,752	46,752	37.93	37.93	216,752	123,248	170,000	76,496
D 2	150,000	111,908	38,092	38,092	34.04	34.04	188,092	111,908	150,000	73,816
D 3	35,000	20,296	14,704	14,704	72.45	72.45	49,704	20,296	35,000	5,592
D 4	115,000	71,962	43,038	43,038	59.81	59.81	158,038	71,962	115,000	28,924
D 5	100,000	66,170	33,830	33,830	51.13	51.13	133,830	66,170	100,000	32,340
D 6	85,000	56,809	28,191	28,191	49 62	49.62	113,191	56,809	85,000	28,618
D 7	90,000	52,855	37,145	37,145	70.28	70.28	127,145	52,855	90,000	15,710
D 8	48,000	54,012	-6,012	6,012	-11 13	11 13	54,012	41,988	60,024	48,000
D 9	180,000	126,117	53,883	53,883	42.72	42 72	233,883	126,117	180,000	72,234
D10	120,000	88,527	31,473	31,473	35.55	35.55	151,473	88,527	120,000	57,054
D11	130,000	173,632	-43,632	43,632	-25.13	25.13	173,632	86,368	217,264	130,000
D12	120,000	94,032	25,968	25,968	27.62	27.62	145,968	94,032	120,000	68,064
D13	50,000	43,835	6,165	6,165	14 06	14.06	56,165	43,835	50,000	37,670
D14	70,000	11,026	58,974	58,974	534.86	534.86	128,974	11,026	70,000	-47,948
D15	45,000	28,607	16,393	16,393	57 30	57 30	61,393	28,607	45,000	12,214
D16	60,000	55,656	4,344	4,344	7.81	7.81	64,344	55,656	60,000	51,312
D17	80,000	52,666	27,334	27,334	51.90	51.90	107,334	52,666	80,000	25,332
D18	30,000	30,322	-322	322	-1 06	1 06	30,322	29,678	30,644	30,000
D19	80,000	47,996	32,004	32,004	66.68	66.68	112,004	47,996	80,000	15,992
D20	115,000	50,389	64,611	64,611	128 22	128 22	179,611	50,389	115,000	-14,222
D21	110,000	71,425	38,575	38,575	54.01	54.01	148,575	71,425	110,000	32,850
D22	45,000	60,327	-15,327	15,327	-25 41	25.41	60,327	29,673	75,654	45,000
D23	50,000	42,682	7,318	7,318	17.15	17.15	57,318	42,682	50,000	35,364
D24	102,000	119,985	-17,985	17,985	-14.99	14.99	119,985	84,015	137,970	102,000
D25	105,000	59,815	45,185	45,185	75.54	75.54	150,185	59,815	105,000	14,630
D26	58,000	91,581	-33,581	33,581	-36.67	36.67	91,581	24,419	125,162	58,000
D27	62,000	24,114	37,886	37,886	157.11	157.11	99,886	24,114	62,000	-13,772
D28	40,000	22,592	17,408	17,408	77.05	77.05	57,408	22,592	40,000	5,184
Total	2,445,000	1,852,586	592,414	826,132	32.0	1,837	3,271,132	1,618,868	2,678,718	1,026,454
Mean	87,321	66,164	21,158	29,505	32 0	66	116,826	57,817	95,669	36,659
STDEV	40,040	37,459	26,562	16,813	-	96	53,155	30,762	45,668	35,864
COFVTN	0 4585	0.5662	-	0.5698	-	1.4699	0.4550	-	0 4774	-

[Notes]
(1) D1～D28 : Zones in Dallas County
(2) FX : Arrangement of forecast values along the axis of abscissa (X)
(3) AX : Arrangement of actual values along the axis of abscissa (X)
(4) Up-mapping Data : The data obtained by transforming① (or ②) to the domain of "①+④" (or "②+④")
(5) Down-mapping Data : The data obtained by transforming ① (or ②) to the domain of "①-④" (or "②-④")
(6) STDEV : Standard deviation
(7) COFVTN : Coefficient of variation

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Table A-2-2 Data Set (Part Ⅱ): With Auxiliary Data for 28 Zones in Dallas County

Column Code	AA		A		B		C		D		E		F	
Preparation For.	R^2		J^2											
			J^2_{ante}		J^2_{up}		J^2_{down}		J^2_{ante}		J^2_{up}		J^2_{down}	
Data Type	Type-FX and Type-AX		Type-FX		Type-FX		Type-FX		Type-AX		Type-AX		Type-AX	
Data Com-position	① +	② +	① +	② +	① +	⑦ +	① +	⑧ +	② +	① +	② +	⑨ +	② +	⑩ +
Zone Code	Nothing	Nothing	①	①	①	①	①	①	②	②	②	②	②	②
D 1	170,000	123,248	170,000	123,248	170,000	216,752	170,000	123,248	123,248	170,000	123,248	170,000	123,248	76,496
D 2	150,000	111,908	150,000	111,908	150,000	188,092	150,000	111,908	111,908	150,000	111,908	150,000	111,908	73,816
D 3	35,000	20,296	35,000	20,296	35,000	49,704	35,000	20,296	20,296	35,000	20,296	35,000	20,296	5,592
D 4	115,000	71,962	115,000	71,962	115,000	158,038	115,000	71,962	71,962	115,000	71,962	115,000	71,962	28,924
D 5	100,000	66,170	100,000	66,170	100,000	133,830	100,000	66,170	66,170	100,000	66,170	100,000	66,170	32,340
D 6	85,000	56,809	85,000	56,809	85,000	113,191	85,000	56,809	56,809	85,000	56,809	85,000	56,809	28,618
D 7	90,000	52,855	90,000	52,855	90,000	127,145	90,000	52,855	52,855	90,000	52,855	90,000	52,855	15,710
D 8	48,000	54,012	48,000	54,012	48,000	54,012	48,000	41,988	54,012	48,000	54,012	60,024	54,012	48,000
D 9	180,000	126,117	180,000	126,117	180,000	233,883	180,000	126,117	126,117	180,000	126,117	180,000	126,117	72,234
D10	120,000	88,527	120,000	88,527	120,000	151,473	120,000	88,527	88,527	120,000	88,527	120,000	88,527	57,054
D11	130,000	173,632	130,000	173,632	130,000	173,632	130,000	86,368	173,632	130,000	173,632	217,264	173,632	130,000
D12	120,000	94,032	120,000	94,032	120,000	145,968	120,000	94,032	94,032	120,000	94,032	120,000	94,032	68,064
D13	50,000	43,835	50,000	43,835	50,000	56,165	50,000	43,835	43,835	50,000	43,835	50,000	43,835	37,670
D14	70,000	11,026	70,000	11,026	70,000	128,974	70,000	11,026	11,026	70,000	11,026	70,000	11,026	-47,948
D15	45,000	28,607	45,000	28,607	45,000	61,393	45,000	28,607	28,607	45,000	28,607	45,000	28,607	12,214
D16	60,000	55,656	60,000	55,656	60,000	64,344	60,000	55,656	55,656	60,000	55,656	60,000	55,656	51,312
D17	80,000	52,666	80,000	52,666	80,000	107,334	80,000	52,666	52,666	80,000	52,666	80,000	52,666	25,332
D18	30,000	30,322	30,000	30,322	30,000	30,322	30,000	29,678	30,322	30,000	30,322	30,644	30,322	30,000
D19	80,000	47,996	80,000	47,996	80,000	112,004	80,000	47,996	47,996	80,000	47,996	80,000	47,996	15,992
D20	115,000	50,389	115,000	50,389	115,000	179,611	115,000	50,389	50,389	115,000	50,389	115,000	50,389	-14,222
D21	110,000	71,425	110,000	71,425	110,000	148,575	110,000	71,425	71,425	110,000	71,425	110,000	71,425	32,850
D22	45,000	60,327	45,000	60,327	45,000	60,327	45,000	29,673	60,327	45,000	60,327	75,654	60,327	45,000
D23	50,000	42,682	50,000	42,682	50,000	57,318	50,000	42,682	42,682	50,000	42,682	50,000	42,682	35,364
D24	102,000	119,985	102,000	119,985	102,000	119,985	102,000	84,015	119,985	102,000	119,985	137,970	119,985	102,000
D25	105,000	59,815	105,000	59,815	105,000	150,185	105,000	59,815	59,815	105,000	59,815	105,000	59,815	14,630
D26	58,000	91,581	58,000	91,581	58,000	91,581	58,000	24,419	91,581	58,000	91,581	125,162	91,581	58,000
D27	62,000	24,114	62,000	24,114	62,000	99,886	62,000	24,114	24,114	62,000	24,114	62,000	24,114	-13,772
D28	40,000	22,592	40,000	22,592	40,000	57,408	40,000	22,592	22,592	40,000	22,592	40,000	22,592	5,184
D 1	-	-	170,000	170,000	170,000	170,000	170,000	170,000	123,248	123,248	123,248	123,248	123,248	123,248
D 2	-	-	150,000	150,000	150,000	150,000	150,000	150,000	111,908	111,908	111,908	111,908	111,908	111,908
D 3	-	-	35,000	35,000	35,000	35,000	35,000	35,000	20,296	20,296	20,296	20,296	20,296	20,296
D 4	-	-	115,000	115,000	115,000	115,000	115,000	115,000	71,962	71,962	71,962	71,962	71,962	71,962
D 5	-	-	100,000	100,000	100,000	100,000	100,000	100,000	66,170	66,170	66,170	66,170	66,170	66,170
D 6	-	-	85,000	85,000	85,000	85,000	85,000	85,000	56,809	56,809	56,809	56,809	56,809	56,809
D 7	-	-	90,000	90,000	90,000	90,000	90,000	90,000	52,855	52,855	52,855	52,855	52,855	52,855
D 8	-	-	48,000	48,000	48,000	48,000	48,000	48,000	54,012	54,012	54,012	54,012	54,012	54,012
D 9	-	-	180,000	180,000	180,000	180,000	180,000	180,000	126,117	126,117	126,117	126,117	126,117	126,117
D10	-	-	120,000	120,000	120,000	120,000	120,000	120,000	88,527	88,527	88,527	88,527	88,527	88,527
D11	-	-	130,000	130,000	130,000	130,000	130,000	130,000	173,632	173,632	173,632	173,632	173,632	173,632
D12	-	-	120,000	120,000	120,000	120,000	120,000	120,000	94,032	94,032	94,032	94,032	94,032	94,032
D13	-	-	50,000	50,000	50,000	50,000	50,000	50,000	43,835	43,835	43,835	43,835	43,835	43,835
D14	-	-	70,000	70,000	70,000	70,000	70,000	70,000	11,026	11,026	11,026	11,026	11,026	11,026
D15	-	-	45,000	45,000	45,000	45,000	45,000	45,000	28,607	28,607	28,607	28,607	28,607	28,607
D16	-	-	60,000	60,000	60,000	60,000	60,000	60,000	55,656	55,656	55,656	55,656	55,656	55,656
D17	-	-	80,000	80,000	80,000	80,000	80,000	80,000	52,666	52,666	52,666	52,666	52,666	52,666
D18	-	-	30,000	30,000	30,000	30,000	30,000	30,000	30,322	30,322	30,322	30,322	30,322	30,322
D19	-	-	80,000	80,000	80,000	80,000	80,000	80,000	47,996	47,996	47,996	47,996	47,996	47,996
D20	-	-	115,000	115,000	115,000	115,000	115,000	115,000	50,389	50,389	50,389	50,389	50,389	50,389
D21	-	-	110,000	110,000	110,000	110,000	110,000	110,000	71,425	71,425	71,425	71,425	71,425	71,425
D22	-	-	45,000	45,000	45,000	45,000	45,000	45,000	60,327	60,327	60,327	60,327	60,327	60,327
D23	-	-	50,000	50,000	50,000	50,000	50,000	50,000	42,682	42,682	42,682	42,682	42,682	42,682
D24	-	-	102,000	102,000	102,000	102,000	102,000	102,000	119,985	119,985	119,985	119,985	119,985	119,985
D25	-	-	105,000	105,000	105,000	105,000	105,000	105,000	59,815	59,815	59,815	59,815	59,815	59,815
D26	-	-	58,000	58,000	58,000	58,000	58,000	58,000	91,581	91,581	91,581	91,581	91,581	91,581
D27	-	-	62,000	62,000	62,000	62,000	62,000	62,000	24,114	24,114	24,114	24,114	24,114	24,114
D28	-	-	40,000	40,000	40,000	40,000	40,000	40,000	22,592	22,592	22,592	22,592	22,592	22,592
Total	2,445,000	1,852,586	4,890,000	4,297,586	4,890,000	5,716,132	4,890,000	4,063,868	3,705,172	4,297,586	3,705,172	4,531,304	3,705,172	2,879,040
Mean	87,321	66,164	87,321	76,743	87,321	102,074	87,321	72,569	66,164	76,743	66,164	80,916	66,164	51,411
STDEV	40,040	37,459	40,040	40,189	40,040	49,315	40,040	38,632	37,459	40,189	37,459	44,295	37,459	39,526
COFVTN	0.4585	0.5662	0.4585	0.5237	0.4585	0.4831	0.4585	-	0.5662	0.5237	0.5662	0.5474	0.5662	-

[Notes]
(1) D1~D28 : Zones in Dallas County
(2) R^2 : Coefficient of determination
(3) J^2 : Index of judgement (or Joyce index)
(4) J^2_{ante} : J^2 calculated from the ante-mapping data
(5) J^2_{up} : J^2 calculated from the up-mapping data
(6) J^2_{down} : J^2 calculated from the down-mapping data
(7) STDEV : Standard deviation
(8) COFVTN : Coefficient of variation
(9) See Table A-2-1 for the data base expressed as ①, ② and ⑦~⑩ which present respectively the column codes used in that table.

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Table A-3-1 Data Set (Part I): Original and Derived Data for 31 Zones in Tarrant County

Column Code	①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩
Data	1990 Forecast Population	1990 Actual Population	Difference	Absolute Value of ③	Difference Rate (%)	Absolute Value of ⑤	Up-mapping (For Type-FX)	Down-mapping (For Type-FX)	Up-mapping (For Type-AX)	Down-mapping (For Type-AX)
Calculation / Zone Code	(Original)	(Original)	①-②	|③|	③/②×100	|⑤|	①+④	①-④	②+④	②-④
T 1	40,000	24,711	15,289	15,289	61.87	61.87	55,289	24,711	40,000	9,422
T 2	95,000	73,021	21,979	21,979	30.10	30 10	116,979	73,021	95,000	51,042
T 3	45,000	37,416	7,584	7,584	20.27	20.27	52,584	37,416	45,000	29,832
T 4	75,000	46,221	28,779	28,779	62.26	62.26	103,779	46,221	75,000	17,442
T 5	50,000	38,265	11,735	11,735	30 67	30.67	61,735	38,265	50,000	26,530
T 6	70,000	47,398	22,602	22,602	47.69	47.69	92,602	47,398	70,000	24,796
T 7	52,000	32,827	19,173	19,173	58 41	58 41	71,173	32,827	52,000	13,654
T 8	25,000	55,150	-30,150	30,150	-54.67	54.67	55,150	-5,150	85,300	25,000
T 9	80,000	62,251	17,749	17,749	28.51	28.51	97,749	62,251	80,000	44,502
T10	68,000	70,297	-2,297	2,297	-3.27	3.27	70,297	65,703	72,594	68,000
T11	40,000	52,293	-12,293	12,293	-23.51	23.51	52,293	27,707	64,586	40,000
T12	125,000	120,618	4,382	4,382	3.63	3.63	129,382	120,618	125,000	116,236
T13	50,000	35,592	14,408	14,408	40.48	40.48	64,408	35,592	50,000	21,184
T14	40,000	51,891	-11,891	11,891	-22.92	22.92	51,891	28,109	63,782	40,000
T15	42,000	52,879	-10,879	10,879	-20.57	20.57	52,879	31,121	63,758	42,000
T16	24,000	22,465	1,535	1,535	6 83	6.83	25,535	22,465	24,000	20,930
T17	5,000	11,881	-6,881	6,881	-57.92	57.92	11,881	-1,881	18,762	5,000
T18	18,000	16,574	1,426	1,426	8.60	8 60	19,426	16,574	18,000	15,148
T19	13,000	11,260	1,740	1,740	15.45	15.45	14,740	11,260	13,000	9,520
T20	20,000	15,391	4,609	4,609	29.95	29.95	24,609	15,391	20,000	10,782
T21	13,000	19,616	-6,616	6,616	-33 73	33.73	19,616	6,384	26,232	13,000
T22	45,000	56,321	-11,321	11,321	-20.10	20.10	56,321	33,679	67,642	45,000
T23	102,000	81,655	20,345	20,345	24.92	24.92	122,345	81,655	102,000	61,310
T24	30,000	42,520	-12,520	12,520	-29.44	29.44	42,520	17,480	55,040	30,000
T25	100,000	101,654	-1,654	1,654	-1.63	1.63	101,654	98,346	103,308	100,000
T26	52,000	102,477	-50,477	50,477	-49.26	49.26	102,477	1,523	152,954	52,000
T27	15,000	24,033	-9,033	9,033	-37.59	37.59	24,033	5,967	33,066	15,000
T28	10,000	30,604	-20,604	20,604	-67.32	67.32	30,604	-10,604	51,208	10,000
T29	40,000	51,703	-11,703	11,703	-22.64	22.64	51,703	28,297	63,406	40,000
T30	30,000	23,795	6,205	6,205	26 08	26.08	36,205	23,795	30,000	17,590
T31	20,000	9,472	10,528	10,528	111.15	111.15	30,528	9,472	20,000	-1,056
Total	1,434,000	1,422,251	11,749	408,387	0.83	1,051	1,842,387	1,025,613	1,830,638	1,013,864
Mean	46,258	45,879	379	13,174	0.83	34	59,432	33,084	59,053	32,705
STDEV	29,894	27,771	16,697	10,266	-	23	33,347	29,768	32,761	26,076
COFVTN	0.6463	0.6053	-	0.7793	-	0.6805	0.5611	-	0.5548	-

[Notes]
(1) T1～T31 : Zones in Tarrant County
(2) FX : Arrangement of forecast values along the axis of abscissa (X)
(3) AX : Arrangement of actual values along the axis of abscissa (X)
(4) Up-mapping Data : The data obtained by transforming ① (or ②) to the domain of "①+④" (or "②+④")
(5) Down-mapping Data : The data obtained by transforming ① (or ②) to the domain of "①-④" (or "②-④")
(6) STDEV : Standard deviation
(7) COFVTN : Coefficient of variation

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Table A-3-2 Data Set (Part Ⅱ): With Auxiliary Data for 31 Zones in Tarrant County

Column Code	AA		A		B		C		D		E		F	
Preparation For	R^2		J^2											
			J^2_{ante}		J^2_{up}		J^2_{down}		J^2_{ante}		J^2_{up}		J^2_{down}	
Data Type	Type-FX and Type-AX		Type-FX		Type-FX		Type-FX		Type-AX		Type-AX		Type-AX	
Data Com-position	① +	② +	① +	② +	① +	⑦ +	① +	⑧ +	② +	① +	② +	⑨ +	② +	⑩ +
Zone Code	Nothing	Nothing	①	①	①	①	①	①	②	②	②	②	②	②
T 1	40,000	24,711	40,000	24,711	40,000	55,289	40,000	24,711	24,711	40,000	24,711	40,000	24,711	9,422
T 2	95,000	73,021	95,000	73,021	95,000	116,979	95,000	73,021	73,021	95,000	73,021	95,000	73,021	51,042
T 3	45,000	37,416	45,000	37,416	45,000	52,584	45,000	37,416	37,416	45,000	37,416	45,000	37,416	29,832
T 4	75,000	46,221	75,000	46,221	75,000	103,779	75,000	46,221	46,221	75,000	46,221	75,000	46,221	17,442
T 5	50,000	38,265	50,000	38,265	50,000	61,735	50,000	38,265	38,265	50,000	38,265	50,000	38,265	26,530
T 6	70,000	47,398	70,000	47,398	70,000	92,602	70,000	47,398	47,398	70,000	47,398	70,000	47,398	24,796
T 7	52,000	32,827	52,000	32,827	52,000	71,173	52,000	32,827	32,827	52,000	32,827	52,000	32,827	13,654
T 8	*25,000*	*55,150*	*25,000*	*55,150*	*25,000*	*55,150*	*25,000*	*-5,150*	*55,150*	*25,000*	*55,150*	*85,300*	*55,150*	*25,000*
T 9	80,000	62,251	80,000	62,251	80,000	97,749	80,000	62,251	62,251	80,000	62,251	80,000	62,251	44,502
T10	68,000	70,297	68,000	70,297	68,000	70,297	68,000	65,703	70,297	68,000	70,297	72,594	70,297	68,000
T11	40,000	52,293	40,000	52,293	40,000	52,293	40,000	27,707	52,293	40,000	52,293	64,586	52,293	40,000
T12	125,000	120,618	125,000	120,618	125,000	129,382	125,000	120,618	120,618	125,000	120,618	125,000	120,618	116,236
T13	50,000	35,592	50,000	35,592	50,000	64,408	50,000	35,592	35,592	50,000	35,592	50,000	35,592	21,184
T14	40,000	51,891	40,000	51,891	40,000	51,891	40,000	28,109	51,891	40,000	51,891	63,782	51,891	40,000
T15	42,000	52,879	42,000	52,879	42,000	52,879	42,000	31,121	52,879	42,000	52,879	63,758	52,879	42,000
T16	24,000	22,465	24,000	22,465	24,000	25,535	24,000	22,465	22,465	24,000	22,465	24,000	22,465	20,930
T17	5,000	11,881	5,000	11,881	5,000	11,881	5,000	-1,881	11,881	5,000	11,881	18,762	11,881	5,000
T18	18,000	16,574	18,000	16,574	18,000	19,426	18,000	16,574	16,574	18,000	16,574	18,000	16,574	15,148
T19	13,000	11,260	13,000	11,260	13,000	14,740	13,000	11,260	11,260	13,000	11,260	13,000	11,260	9,520
T20	20,000	15,391	20,000	15,391	20,000	24,609	20,000	15,391	15,391	20,000	15,391	20,000	15,391	10,782
T21	13,000	19,616	13,000	19,616	13,000	19,616	13,000	6,384	19,616	13,000	19,616	26,232	19,616	13,000
T22	45,000	56,321	45,000	56,321	45,000	56,321	45,000	33,679	56,321	45,000	56,321	67,642	56,321	45,000
T23	102,000	81,655	102,000	81,655	102,000	122,345	102,000	81,655	81,655	102,000	81,655	102,000	81,655	61,310
T24	30,000	42,520	30,000	42,520	30,000	42,520	30,000	17,480	42,520	30,000	42,520	55,040	42,520	30,000
T25	100,000	101,654	100,000	101,654	100,000	101,654	100,000	98,346	101,654	100,000	101,654	103,308	101,654	100,000
T26	52,000	102,477	52,000	102,477	52,000	102,477	52,000	1,523	102,477	52,000	102,477	152,954	102,477	52,000
T27	15,000	24,033	15,000	24,033	15,000	24,033	15,000	5,967	24,033	15,000	24,033	33,066	24,033	15,000
T28	10,000	30,604	10,000	30,604	10,000	30,604	10,000	-10,604	30,604	10,000	30,604	51,208	30,604	10,000
T29	40,000	51,703	40,000	51,703	40,000	51,703	40,000	28,297	51,703	40,000	51,703	63,406	51,703	40,000
T30	30,000	23,795	30,000	23,795	30,000	36,205	30,000	23,795	23,795	30,000	23,795	30,000	23,795	17,590
T31	20,000	9,472	20,000	9,472	20,000	30,528	20,000	9,472	9,472	20,000	9,472	20,000	9,472	-1,056
T 1	-	-	40,000	40,000	40,000	40,000	40,000	40,000	24,711	24,711	24,711	24,711	24,711	24,711
T 2	-	-	95,000	95,000	95,000	95,000	95,000	95,000	73,021	73,021	73,021	73,021	73,021	73,021
T 3	-	-	45,000	45,000	45,000	45,000	45,000	45,000	37,416	37,416	37,416	37,416	37,416	37,416
T 4	-	-	75,000	75,000	75,000	75,000	75,000	75,000	46,221	46,221	46,221	46,221	46,221	46,221
T 5	-	-	50,000	50,000	50,000	50,000	50,000	50,000	38,265	38,265	38,265	38,265	38,265	38,265
T 6	-	-	70,000	70,000	70,000	70,000	70,000	70,000	47,398	47,398	47,398	47,398	47,398	47,398
T 7	-	-	52,000	52,000	52,000	52,000	52,000	52,000	32,827	32,827	32,827	32,827	32,827	32,827
T 8	-	-	25,000	25,000	25,000	25,000	25,000	25,000	55,150	55,150	55,150	55,150	55,150	55,150
T 9	-	-	80,000	80,000	80,000	80,000	80,000	80,000	62,251	62,251	62,251	62,251	62,251	62,251
T10	-	-	68,000	68,000	68,000	68,000	68,000	68,000	70,297	70,297	70,297	70,297	70,297	70,297
T11	-	-	40,000	40,000	40,000	40,000	40,000	40,000	52,293	52,293	52,293	52,293	52,293	52,293
T12	-	-	125,000	125,000	125,000	125,000	125,000	125,000	120,618	120,618	120,618	120,618	120,618	120,618
T13	-	-	50,000	50,000	50,000	50,000	50,000	50,000	35,592	35,592	35,592	35,592	35,592	35,592
T14	-	-	40,000	40,000	40,000	40,000	40,000	40,000	51,891	51,891	51,891	51,891	51,891	51,891
T15	-	-	42,000	42,000	42,000	42,000	42,000	42,000	52,879	52,879	52,879	52,879	52,879	52,879
T16	-	-	24,000	24,000	24,000	24,000	24,000	24,000	22,465	22,465	22,465	22,465	22,465	22,465
T17	-	-	5,000	5,000	5,000	5,000	5,000	5,000	11,881	11,881	11,881	11,881	11,881	11,881
T18	-	-	18,000	18,000	18,000	18,000	18,000	18,000	16,574	16,574	16,574	16,574	16,574	16,574
T19	-	-	13,000	13,000	13,000	13,000	13,000	13,000	11,260	11,260	11,260	11,260	11,260	11,260
T20	-	-	20,000	20,000	20,000	20,000	20,000	20,000	15,391	15,391	15,391	15,391	15,391	15,391
T21	-	-	13,000	13,000	13,000	13,000	13,000	13,000	19,616	19,616	19,616	19,616	19,616	19,616
T22	-	-	45,000	45,000	45,000	45,000	45,000	45,000	56,321	56,321	56,321	56,321	56,321	56,321
T23	-	-	102,000	102,000	102,000	102,000	102,000	102,000	81,655	81,655	81,655	81,655	81,655	81,655
T24	-	-	30,000	30,000	30,000	30,000	30,000	30,000	42,520	42,520	42,520	42,520	42,520	42,520
T25	-	-	100,000	100,000	100,000	100,000	100,000	100,000	101,654	101,654	101,654	101,654	101,654	101,654
T26	-	-	52,000	52,000	52,000	52,000	52,000	52,000	102,477	102,477	102,477	102,477	102,477	102,477
T27	-	-	15,000	15,000	15,000	15,000	15,000	15,000	24,033	24,033	24,033	24,033	24,033	24,033
T28	-	-	10,000	10,000	10,000	10,000	10,000	10,000	30,604	30,604	30,604	30,604	30,604	30,604
T29	-	-	40,000	40,000	40,000	40,000	40,000	40,000	51,703	51,703	51,703	51,703	51,703	51,703
T30	-	-	30,000	30,000	30,000	30,000	30,000	30,000	23,795	23,795	23,795	23,795	23,795	23,795
T31	-	-	20,000	20,000	20,000	20,000	20,000	20,000	9,472	9,472	9,472	9,472	9,472	9,472
Total	1,434,000	1,422,251	2,868,000	2,856,251	2,868,000	3,276,387	2,868,000	2,459,613	2,844,502	2,856,251	2,844,502	3,252,889	2,844,502	2,436,115
Mean	46,258	45,879	46,258	46,069	46,258	52,845	46,258	39,671	45,879	46,069	45,879	52,466	45,879	39,292
STDEV	29,894	27,771	29,894	28,853	29,894	32,346	29,894	30,550	27,771	28,853	27,771	31,075	27,771	27,731
COFVTN	0 6463	0 6053	0 6463	0.6263	0 6463	0 6121	0.6463	-	0.6053	0 6263	0 6053	0 5923	0 6053	-

[Notes]
(1) T1～T31 : Zones in Tarrant County
(2) R^2 : Coefficient of determination
(3) J^2 : Index of judgement (or Joyce index)
(4) J^2_{ante} : J^2 calculated from the ante-mapping data
(5) J^2_{up} : J^2 calculated from the up-mapping data
(6) J^2_{down} : J^2 calculated from the down-mapping data
(7) STDEV : Standard deviation
(8) COFVTN : Coefficient of variation
(9) See Table A-3-1 for the data base expressed as ①, ② and ⑦～⑩ which present respectively the column codes used in that table.

Table A-4-1 Data Set (Part I): Original and Derived Data for 21 Zones in Ring Area

Column Code	①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩
Data	1990 Forecast Population	1990 Actual Population	*Difference*	Absolute Value of ③	*Difference* Rate (%)	*Absolute* Value of ⑤	*Up-mapping* (For Type-FX)	*Down-mapping* (For Type-FX)	*Up-mapping* (For Type-AX)	*Down-mapping* (For Type-AX)
Calculation / Zone Code	(Original)	(Original)	①-②	|③|	③/②×100	|⑤|	①+④	①-④	②+④	②-④
R 1	50,342	152,723	-102,381	102,381	-67.04	67.04	152,723	-52,039	255,104	50,342
R 2	62,734	179,813	-117,079	117,079	-65.11	65.11	179,813	-54,345	296,892	62,734
R 3	13,391	19,550	-6,159	6,159	-31 50	31.50	19,550	7,232	25,709	13,391
R 4	11,876	11,696	180	180	1.54	1.54	12,056	11,696	11,876	11,516
R 5	13,727	28,967	-15,240	15,240	-52.61	52.61	28,967	-1,513	44,207	13,727
R 6	18,234	49,150	-30,916	30,916	-62.90	62.90	49,150	-12,682	80,066	18,234
R 7	8,792	26,256	-17,464	17,464	-66.51	66.51	26,256	-8,672	43,720	8,792
R 8	20,534	22,215	-1,681	1,681	-7.57	7.57	22,215	18,853	23,896	20,534
R 9	62,791	66,010	-3,219	3,219	-4 88	4.88	66,010	59,572	69,229	62,791
R10	27,183	52,847	-25,664	25,664	-48.56	48.56	52,847	1,519	78,511	27,183
R11	19,974	12,600	7,374	7,374	58 52	58.52	27,348	12,600	19,974	5,226
R12	22,496	21,000	1,496	1,496	7.12	7 12	23,992	21,000	22,496	19,504
R13	26,382	18,863	7,519	7,519	39 86	39.86	33,901	18,863	26,382	11,344
R14	23,812	25,604	-1,792	1,792	-7 00	7.00	25,604	22,020	27,396	23,812
R15	24,306	54,792	-30,486	30,486	-55.64	55.64	54,792	-6,180	85,278	24,306
R16	30,921	31,376	-455	455	-1.45	1 45	31,376	30,466	31,831	30,921
R17	4,182	6,054	-1,872	1,872	-30.92	30.92	6,054	2,310	7,926	4,182
R18	16,755	27,924	-11,169	11,169	-40.00	40 00	27,924	5,586	39,093	16,755
R19	31,886	35,200	-3,314	3,314	-9.41	9.41	35,200	28,572	36,514	31,886
R20	26,147	29,152	-3,005	3,005	-10.31	10.31	29,152	23,142	32,157	26,147
R21	19,573	16,314	3,259	3,259	19.98	19.98	22,832	16,314	19,573	13,055
Total	536,038	888,106	-352,068	391,724	-39.64	688	927,762	144,314	1,279,830	496,382
Mean	25,526	42,291	-16,765	18,654	-39.64	33	44,179	6,872	60,944	23,637
STDEV	15,284	43,080	32,141	31,084	-	24	42,160	24,943	73,342	16,285
COFVTN	0.5988	1.0187	-	1.6664	-	0.7325	0 9543	-	1.2034	-

[Notes]

(1) R1～R21 : Zones in Ring Area

(2) FX : *Arrangement of forecast values along the axis of abscissa* (X)

(3) AX : Arrangement of actual values along the axis of abscissa (X)

(4) Up-mapping Data : The data obtained by transforming ① (or ②) to the domain of "①+④" (or "②+④")

(5) *Down-mapping Data* : *The data obtained by transforming* ① (or ②) to the domain of "①-④)" (or "②-④")

(6) STDEV : Standard deviation

(7) COFVTN : Coefficient of variation

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Table A-4-2 Data Set (Part Ⅱ): With Auxiliary Data for 21 Zones in Ring Area

Column Code	AA		A		B		C		D		E		F	
Preparation For	R^2		J^2_{ante}		J^2_{up}		J^2_{down}		J^2_{ante}		J^2_{up}		J^2_{down}	
Data Type	Type-FX and Type-AX		Type-FX		Type-FX		Type-FX		Type-AX		Type-AX		Type-AX	
Data Composition	① +	② +	① +	② +	① +	⑦ +	① +	⑧ +	② +	① +	② +	⑨ +	② +	⑩ +
Zone Code	Nothing	Nothing	①	①	①	①	①	①	②	②	②	②	②	②
R 1	50,342	152,723	50,342	152,723	50,342	152,723	50,342	-52,039	152,723	50,342	152,723	255,104	152,723	50,342
R 2	62,734	179,813	62,734	179,813	62,734	179,813	62,734	-54,345	179,813	62,734	179,813	296,892	179,813	62,734
R 3	13,391	19,550	13,391	19,550	13,391	19,550	13,391	7,232	19,550	13,391	19,550	25,709	19,550	13,391
R 4	11,876	11,696	11,876	11,696	11,876	12,056	11,876	11,696	11,696	11,876	11,696	11,876	11,696	11,516
R 5	13,727	28,967	13,727	28,967	13,727	28,967	13,727	-1,513	28,967	13,727	28,967	44,207	28,967	13,727
R 6	18,234	49,150	18,234	49,150	18,234	49,150	18,234	-12,682	49,150	18,234	49,150	80,066	49,150	18,234
R 7	8,792	26,256	8,792	26,256	8,792	26,256	8,792	-8,672	26,256	8,792	26,256	43,720	26,256	8,792
R 8	20,534	22,215	20,534	22,215	20,534	22,215	20,534	18,853	22,215	20,534	22,215	23,896	22,215	20,534
R 9	62,791	66,010	62,791	66,010	62,791	66,010	62,791	59,572	66,010	62,791	66,010	69,229	66,010	62,791
R10	27,183	52,847	27,183	52,847	27,183	52,847	27,183	1,519	52,847	27,183	52,847	78,511	52,847	27,183
R11	19,974	12,600	19,974	12,600	19,974	27,348	19,974	12,600	12,600	19,974	12,600	19,974	12,600	5,226
R12	22,496	21,000	22,496	21,000	22,496	23,992	22,496	21,000	21,000	22,496	21,000	22,496	21,000	19,504
R13	26,382	18,863	26,382	18,863	26,382	33,901	26,382	18,863	18,863	26,382	18,863	26,382	18,863	11,344
R14	23,812	25,604	23,812	25,604	23,812	25,604	23,812	22,020	25,604	23,812	25,604	27,396	25,604	23,812
R15	24,306	54,792	24,306	54,792	24,306	54,792	24,306	-6,180	54,792	24,306	54,792	85,278	54,792	24,306
R16	30,921	31,376	30,921	31,376	30,921	31,376	30,921	30,466	31,376	30,921	31,376	31,831	31,376	30,921
R17	4,182	6,054	4,182	6,054	4,182	6,054	4,182	2,310	6,054	4,182	6,054	7,926	6,054	4,182
R18	16,755	27,924	16,755	27,924	16,755	27,924	16,755	5,586	27,924	16,755	27,924	39,093	27,924	16,755
R19	31,886	35,200	31,886	35,200	31,886	35,200	31,886	28,572	35,200	31,886	35,200	38,514	35,200	31,886
R20	26,147	29,152	26,147	29,152	26,147	29,152	26,147	23,142	29,152	26,147	29,152	32,157	29,152	26,147
R21	19,573	16,314	19,573	16,314	19,573	22,832	19,573	16,314	16,314	19,573	16,314	19,573	16,314	13,055
R 1	-	-	50,342	50,342	50,342	50,342	50,342	50,342	152,723	152,723	152,723	152,723	152,723	152,723
R 2	-	-	62,734	62,734	62,734	62,734	62,734	62,734	179,813	179,813	179,813	179,813	179,813	179,813
R 3	-	-	13,391	13,391	13,391	13,391	13,391	13,391	19,550	19,550	19,550	19,550	19,550	19,550
R 4	-	-	11,876	11,876	11,876	11,876	11,876	11,876	11,696	11,696	11,696	11,696	11,696	11,696
R 5	-	-	13,727	13,727	13,727	13,727	13,727	13,727	28,967	28,967	28,967	28,967	28,967	28,967
R 6	-	-	18,234	18,234	18,234	18,234	18,234	18,234	49,150	49,150	49,150	49,150	49,150	49,150
R 7	-	-	8,792	8,792	8,792	8,792	8,792	8,792	26,256	26,256	26,256	26,256	26,256	26,256
R 8	-	-	20,534	20,534	20,534	20,534	20,534	20,534	22,215	22,215	22,215	22,215	22,215	22,215
R 9	-	-	62,791	62,791	62,791	62,791	62,791	62,791	66,010	66,010	66,010	66,010	66,010	66,010
R10	-	-	27,183	27,183	27,183	27,183	27,183	27,183	52,847	52,847	52,847	52,847	52,847	52,847
R11	-	-	19,974	19,974	19,974	19,974	19,974	19,974	12,600	12,600	12,600	12,600	12,600	12,600
R12	-	-	22,496	22,496	22,496	22,496	22,496	22,496	21,000	21,000	21,000	21,000	21,000	21,000
R13	-	-	26,382	26,382	26,382	26,382	26,382	26,382	18,863	18,863	18,863	18,863	18,863	18,863
R14	-	-	23,812	23,812	23,812	23,812	23,812	23,812	25,604	25,604	25,604	25,604	25,604	25,604
R15	-	-	24,306	24,306	24,306	24,306	24,306	24,306	54,792	54,792	54,792	54,792	54,792	54,792
R16	-	-	30,921	30,921	30,921	30,921	30,921	30,921	31,376	31,376	31,376	31,376	31,376	31,376
R17	-	-	4,182	4,182	4,182	4,182	4,182	4,182	6,054	6,054	6,054	6,054	6,054	6,054
R18	-	-	16,755	16,755	16,755	16,755	16,755	16,755	27,924	27,924	27,924	27,924	27,924	27,924
R19	-	-	31,886	31,886	31,886	31,886	31,886	31,886	35,200	35,200	35,200	35,200	35,200	35,200
R20	-	-	26,147	26,147	26,147	26,147	26,147	26,147	29,152	29,152	29,152	29,152	29,152	29,152
R21	-	-	19,573	19,573	19,573	19,573	19,573	19,573	16,314	16,314	16,314	16,314	16,314	16,314
Total	536,038	888,106	1,072,076	1,424,144	1,072,076	1,463,800	1,072,076	680,352	1,776,212	1,424,144	1,776,212	2,167,936	1,776,212	1,384,488
Mean	25,526	42,291	25,526	33,908	25,526	34,852	25,526	16,199	42,291	33,908	42,291	51,618	42,291	32,964
STDEV	15,284	43,080	15,284	33,392	15,284	33,053	15,284	22,691	43,080	33,392	43,080	60,864	43,080	33,876
COFVTN	0 5988	1 0187	0 5988	0.9848	0 5988	0.9484	0.5988	-	1 0187	0.9848	1 0187	1 1791	1 0187	-

[Notes]
(1) R1～R21 : Zones in Ring Area
(2) R^2 : Coefficient of determination
(3) J^2 : Index of judgement (or Joyce index)
(4) J^2_{ante} : J^2 calculated from the ante-mapping data
(5) J^2_{up} : J^2 calculated from the up-mapping data
(6) J^2_{down} : J^2 calculated from the down-mapping data
(7) STDEV : Standard deviation
(8) COFVTN : Coefficient of variation
(9) See Table A-4-1 for the data base expressed as ①, ② and ⑦～⑩ which present respectively the column codes used in that table.

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