

**A STATISTICAL ANALYSIS OF SELECTED POPULATION CHARACTERISTICS  
FOR NINETY SETTLEMENTS IN MANITOBA**

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## ABSTRACT

The purpose of this thesis is to develop a methodology whereby a large volume and variety of population data can be selected and organized to present a comprehensive picture of the settlements in Manitoba. In particular, 74 variables are used to analyse the socio-economic and demographic conditions of the 90 major settlements. The main source of data is the 1961 Dominion Bureau of Statistics Census Enumeration Area 'print-outs'. The data are arranged in the form of a matrix and analysed statistically with the aid of a computer. The analysis is conducted in the following steps; (a) the interrelationships of the 74 variables are studied systematically by means of correlation analysis; (b) the settlements are then classified into groups according to their regional distribution, population size and change, family income and economic functions, and the variation of these characteristics between the settlement groups are examined; and (c) a multivariate analytic approach is applied to the data matrix in order to identify a set of basic, independent dimensions for the settlements. Based on these resulting dimensions, a system of classification and a principal component regression model is designed.

The results of the analysis indicate that the settlements behave like interdependent entities of a general system because they are characterised by patterns and associations of functionally interrelated variables. The demographic characteristics such as the age structure of settlements are statistically related to many socio-economic variables. For example, settlements with an aged population structure are generally

associated with a large proportion of population immigrated to Canada before 1946, and their labour force is made up of a large percentage of self-employed and unpaid family workers engaged mainly in agriculture and tertiary industries. On the other hand, settlements with a younger population structure are associated with a rapid rate of population growth, a relatively large family size and location in the northern parts of the province.

The settlement system is sub-divided into a number of internally homogeneous sub-systems by the identification of the underlying dimensions or factors which influence and characterise the settlements. Principal component analysis shows that eight independent factors together explain approximately 70.0 per cent of the variance of the original variables. The first two of these factors - economic status and aging population - are subsequently used to classify the 90 settlements into a total of seven groups characterised by four major sets of dimensions; (i) those having high economic status and youthful population, such as the major mining and manufacturing centres of the province; (ii) those having youthful population and low economic status, such as the native and Metis communities; (iii) those having intermediate conditions with respect to age structure and economic status, such as the service centres; and (iv) those having aged population structure and intermediate economic status, such as the small farming communities of south and south-west Manitoba.

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## CHAPTER I

### INTRODUCTION

#### A. OBJECTIVES

Until recently, very few comparative settlement studies were undertaken by geographers. With the advent of computer technology, it has become much more practicable to analyse a large mass of data in a relatively short period of time. The objective of this thesis is the development of a computerised model, which, by employing standard statistical methods, will assist in the analysis of certain population characteristics of settlements.

#### B. THE NEED FOR A SYSTEMATIC ANALYSIS

The need for a population-settlement model became apparent in the summer of 1968 when the writer assisted in a population and labour force study undertaken for the Royal Commission on Transportation in Northern Manitoba. In this study, it was found that the statistical inference based on the interrelationships such as population size and change, road-distance between the settlements and other major urban centres, and the regional distribution of settlements were not very representative of the study area<sup>1</sup>. Later, in the preparation of this thesis, the writer,

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<sup>1</sup>Province of Manitoba, Royal Commission Inquiry into Northern Transportation, (Province of Manitoba: Queen's Printer, 1969), pp. 63-92.

using a similar approach, undertook a further study of the population growth trends of all Manitoban settlements having a population of over 50 persons in 1966. The main findings of this analysis are presented in Chapter II.

The experience gained from these two studies suggested to the writer that in the analysis of settlements, the forces moulding and sustaining the complex settlement systems are multi-dimensional. Many factors such as the demographic factors - age and sex structure, marital status, etc.; social factors - ethnic origins, education, family structure etc.; and economic factors - labour force compositions, the industrial structure etc. need to be taken into consideration. Thus, it is not very easy for the researcher to conduct a meaningful yet comprehensive study unless he adopts a systematic approach to the study. According to Berry, ".....the object of systematic geography is to find those fundamental patterns and associations characterising a limited range of functionally interrelated variables over a wide range of places....."<sup>2</sup> The utilization of a model is an effective means of arriving at this objective.

Analysing geographical phenomena by means of a model is becoming increasingly more common in recent years. Such endeavours are extremely useful as they can lead to relevant generalizations of complex empirical situations. Furthermore, as a system of analysis, a model can be applied

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<sup>2</sup>B. J. L. Berry, "Approaches to Regional Analysis: A Synthesis", Annals of the Association of American Geographers, LIV (1964), p. 9.

and reapplied to study the conditions of different parts of the world. According to Chorley and Haggett<sup>3</sup>, three characteristics of a model determine its usefulness. Firstly, the construction involves a highly selective attitude to information. Secondly, the model is carefully 'structured' in its construction, so that the information or data selected are organised into interrelated blocks or parts; and "significant aspects of the 'web of reality' are exploited in terms of their connections".<sup>4</sup> Thirdly, the model can further be manipulated mathematically to form an objective system of classification of the units under study.

#### C. ORGANIZATION OF THE MODEL

Based on the three characteristics mentioned above, Chapters III, IV and V of this thesis present a model designed to analyse 90 settlements in Manitoba. In Chapter III, a total of 74 socio-economic and spatial variables is selected to present a comprehensive picture of the settlements. The interrelationships of these variables are also discussed. In the following chapter, the settlements are organized for analysis into smaller groups according to five major characteristics:- regional distribution, size, population change, family income and functional specializations. The main objective of this chapter is to see whether there are significant similarities within settlements of the same groups and differences between settlements of different groups. Chapter V presents a 'genetic classification' of settlements using the statistical technique

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<sup>3</sup>R. J. Chorley and P. Haggett, (eds.) Socio-Economic Models in Geography (London: Methuen, 1967), p. 23.

<sup>4</sup>Ibid.

of principal component analysis. This classification system differs from those employed in Chapter IV in the following ways. Firstly, the 'genetic classification' represents specifically the results of analysis of data whereas those used in Chapter IV termed 'empirical classification' by Cole and King<sup>5</sup>, are simply "preliminary ordering of data prior to their analysis". Secondly, the classification of settlements by principal component analysis eliminates much of the arbitrariness which is common of the 'empirical classification'.

#### D. BASIC TECHNICAL CONSIDERATION FOR THE CONSTRUCTION OF THE MODEL

1. The source of data. Since this thesis analyses detailed population characteristics for a large number of settlements, small-area data in the form of the Dominion Bureau of Statistics Census Enumeration Areas 'print-outs' are used rather than the published Census Bulletins, as the latter do not give detailed break-downs of demographic and socio-economic characteristics for settlements of under 10,000. In the 1961 Enumeration Areas (EA) 'print-outs' detailed break-downs of population characteristics including age and sex, marital status, birthplace and immigration periods, ethnic origins, religion, education, households and family compositions, labour force by class of workers by sex, by income levels, and by industrial divisions, etc. are available for all 77 incorporated centres in Manitoba as well as about 15 unincorporated centres such as Thompson, Lynn Lake, Grand Rapids, etc.<sup>6</sup>

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<sup>5</sup>J. P. Cole and C. A. M. King, Quantitative Geography, (London: John Wiley and Sons, Ltd., 1968), p. 574.

Despite these advantages, a few limitations of the EA data should be appreciated. Firstly, for the purpose of this thesis, the 1961 data are used instead of the more recent 1966 data because the 1966 Census enumerated only basic population characteristics and did not include such characteristics as ethnic origins, birthplace, education and labour force compositions, etc. However, since one of the aims of the thesis is to develop methodology, the 1961 data are chosen as the base of the analysis despite the fact that they are somewhat dated. Secondly, since the enumeration of this type of data was based on 'small areas', those units located in the isolated parts of the province e.g. the northern Indian Reserves, would more likely be subjected to a higher degree of errors such as sampling and response errors. Therefore, the researcher, in using the EA data, should be able to appreciate the merits as well as the limitations of this type of data and to justify his result accordingly.<sup>7</sup>

2. The Number and Types of Settlements studied. As suggested above, the choice of settlements for analysis was restricted by the availability of data. Altogether, 90 settlements were chosen. With the exception of Metropolitan Winnipeg, Brandon and the Indian Reserves, they represent all settlements for which EA data are available. Winnipeg and

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<sup>6</sup>For most of the northern unincorporated centres, the local government districts' data is used, but in all cases virtually all of the local government districts' population lives in the unincorporated centres.

<sup>7</sup>For a more detailed account on the merits and limitation of the EA data, see J. R. Rogge, "The Use of D. B. S. Enumeration Areas 'print-outs' for Population and Labour Force Studies: The Case of Northern Manitoba" in The Musk-Ox, (University of Saskatchewan, Institute for Northern Studies), Publication No.5, 1969, pp. 16-25.

Brandon are excluded from the study because of their large population size and the corresponding complex social and economic conditions. The Indian Reserves are not included in the study because the data for many of the reserves, particularly the northern ones, are very deficient.<sup>8</sup>

3. Methods of Analysis. Since a major objective of this thesis is to analyse the patterns and associations between types of settlements and their characteristics, standard statistical techniques have been used to examine the nature of the relationships and their magnitudes. The University of Manitoba IBM 360/65 computer was used to handle the massive and laborious process of calculation, tabulation and statistical computation. The majority of the graphical materials presented in this thesis were also prepared with the aid of the computer. Specific techniques dealing with the preparation of the data matrix, the rank-order matrix, the classification of settlements by their size, growth regional distribution, income levels, functions and by principal component analysis will be discussed in later chapters.

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<sup>8</sup> However, any reference to places such as Cross Lake, Norway House Thicket Portage etc. refers only to the non-treaty Indian population in those settlements. The reasons for this is that for the treaty Indians, the E.A.s are not uniform from one census to another census or that in some cases one E.A. refers to two reserves. Nevertheless, references made regarding the non-treaty population may in part be true of the treaty Indians living in the same settlement.



## CHAPTER II

### A PRELIMINARY ANALYSIS OF POPULATION TRENDS

1956-1966

#### A. INTRODUCTION

The settlements of Manitoba are undergoing a period of rapid change. As a result of mechanization, farm consolidation, changes in transportation and other sectors of the economy, people from the small farming communities are gradually moving to larger urban centres where better opportunities for employment and education are found. According to the Census, the proportion of population living in towns of over 1,000 in Manitoba has been increasing at a growing rate since 1901. This trend has become most prevalent during the last twenty years (Table I).

TABLE I  
CHANGES OF URBAN POPULATION IN MANITOBA<sup>1</sup>

YEAR	TOTAL	URBAN (1000+)	PER CENT
1901	255,211	62,634	24.5
1911	461,394	179,198	38.8
1921	610,118	239,221	39.2
1931	700,139	294,491	42.1
1941	729,744	359,678	49.3
1951	776,541	439,580	56.6
1961	921,686	588,807	63.9

<sup>1</sup>Until 1931, urban population was defined by the Census as persons living in incorporated places of over 1,000. Since then, persons living in cities, towns and villages of over 1,000 are classified as urban.

Although Table I shows that the number of urban dwellers has increased substantially over the years, it does not necessarily indicate that the small settlements are declining while the large ones are growing. Metropolitan Winnipeg alone accounts for about half of the population of Manitoba, and it is possible that the majority of the increase of urban population occurred there. In order to establish more meaningful trends of population change, many other characteristics of the settlements must be considered. This chapter used three sets of independent variables, namely, population size, geographical location and road-accessibility to Winnipeg, to analyse the trends of population change of the settlements.

The choice of a sufficiently representative sample of settlements for analysis over a period of time is largely dependent upon the availability of data. Before 1956, the Census of Canada published only the population figures for incorporated cities, towns and villages (about 77 in Manitoba). Since then, data for approximately 337 unincorporated places with a population of over 50 are also included in the Census Bulletins. Thus it is felt that the period of 1956 to 1966 should be adopted for this analysis.<sup>2</sup>

The method of analysis of population trends is relatively simple. Based upon similar studies in the United States,<sup>3</sup> the following three

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<sup>2</sup>A total of 416 settlements are listed in the Census Bulletins between 1956 and 1966 but only 361 of them were chosen for study. Winnipeg and Brandon were excluded because of their large population size. The remainder of those not included were omitted because they appeared only in one of the census, thus making it impossible to calculate their respective rates of population change.

hypotheses were tested for their validity in Manitoba: i) population size as a function of change, ii) geographical location as a function of change, and iii) road-accessibility to Winnipeg as a function of change. In designing a system of analysis, these three factors or hypotheses were treated as independent variables while population change was treated as the dependent variable. The objective of the design was to establish the degree to which the dependent variable was related to the independent variables. Cartographic techniques as well as correlation and regression analysis were employed to test the hypotheses.

#### B. POPULATION SIZE AND CHANGE

Many studies have used the factor of size to explain trends in population change. According to Hart and Salisbury, "The population of a place is one of the most efficient statistical predictors of the population of that place at a different census".<sup>4</sup> In this section, the

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<sup>3</sup>For example, see E. Brunner, "The Small Village: 1940-1950", Rural Sociology, XVII (1952), pp. 127-131; A. H. Robinson, J. B. Lindberg and L. W. Brinkman, "A Correlation and Regression Analysis Applied to Rural Farm Population Densities in the Great Plains", Annals of the Association of American Geographers, LI (1961), pp. 211-221; R. M. Northam, "Declining Urban Centres in the United States, 1940-1960", Annals of the Association of American Geographers, LIII (1963), pp. 50-59; J. F. Hart and N. E. Salisbury, "Population Change in Middle-Western Villages: A Statistical Approach", Annals of the Association of American Geographers, LV (1965), pp. 140-160; N. E. Salisbury and G. Rushton, Growth and Decline of Iowa Villages: A Pilot Study, Department of Geography, No. 4 (Iowa City: State University of Iowa, 1963); J. F. Hart, N. E. Salisbury and E. G. Smith, Jr., "The Dying Village and some Notions about Urban Growth", Economic Geography, XLIV (1968), pp. 343-349; K. Rikkinen, "Change in Village and Village Population with Distance from Duluth", Economic Geography, XLIV (1968), pp. 312-325.

<sup>4</sup>J. F. Hart and N. E. Salisbury, op.cit., p. 153.