# THE EFFECTS OF ACCESSIBILITY ON THE ECONOMIC AND SOCIAL DEVELOPMENT IN THE STATE OF SAO PAULO, BRAZIL

BY

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## ABSTRACT

This thesis looks at the effects of accessibility on the economic and social development in the state of Sao Paulo, Brazil. Certain indicators, representative of economic and social development were obtained from the Brazilian National Census and these were plotted against distance from Sao Paulo City for analysis. In this case, distance being used as the measure of accessibility. Visual and regression analysis were then performed on the data to examine the relationship between the development parameters and the effects of distance.

During the course of the analysis, it was found that not only distance affected the level of development but town size also had an important role. The town size determined the degree of development that was going to occur, regardless of distance from Sao Paulo.

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# CHAPTER I

# INTRODUCTION

The purpose of this thesis is to examine the effects of accessibility on the economic and social development in the state of Sao Paulo, Brazil. But as Gould states 'accessibility is one of those terms that everyone uses until they are faced with the problem of trying to define and measure it' (1969, p. 64). A dictionary defines accessibility as 'coming into contact or presence'; and this definition is appropriate in the context of this study. Furthermore, accessibility can be viewed as being composed of two distinct and separate parts: (1) Network accessibility, this is a more general notion of accessibility and it refers to the accessibility of all surrounding points or locations from each other. (2) On the other hand, point to point accessibility is a more specific form. It refers to the accessibility of some particular point or location from all other points or locations. Pertinent to this study is point to point accessibility especially with respect to access to the City of Sao Paulo from its surrounding hinterland. Note that all figures (1-10) referred to in this thesis are located in Appendix C.

## 1-1 Conceptual Background

At this point, certain concepts need to be clarified in order to understand the significance of doing an accessibility study in Sao Paulo state. The theoretical basis of this study comes from the notion of the 'dual economy',

which is the most prevalent paradigm pertaining to development processes in developing countries. This paradigm views developing nations as being composed of two parts: (1) a dynamic, growing, innovative modern sector, characterized by high capital intensity, and high productivity such as modern industry and (2) a stagnant, declining, conservative traditional sector (Brown, 1981, p. 252). Within this framework, the modern sector can be associated with urban agglomerations and the traditional sector with rural areas and small towns.

The implicit spatial dimension of the dual economy model has been captured in works done by Friedmann (1966) in his centre-periphery model and by Hansen (1971) in his growth centre model which is based upon Growth Pole Theory. According to Brown, these models of the dual economy posit a socio-economic process of development with a distinct spatial component. This process involves the conversion of the traditional sector by modernization impulses emanating from the modern sector (1981, p. 254).

The transmission of these impulses generally involves two types of mechanisms : (1) Backwash or polarization effects. These direct growth impulses to the core or growth centre and in turn drain the periphery or hinterland. This type of movement is countered by (2) spread or trickle down effects which direct growth impulses to the periphery from the centre or core, thus reducing disparities between the centre and

periphery (Brown, 1981; Friedmann, 1966). But, evidence indicates that polarization effects have far outweighed trickle down effects in growth pole or core-periphery situations, thus leading to the extreme regional disparities characterizing Third World nations today (Brown, 1951, p. 255).

Another important concept that needs to be explained is the role of diffusion, since a major aspect of growth pole and core-periphery models is the transmission of growth impulses from the dominant urban centre to its hinterland. Various studies of spatial form have recognized three common patterns of diffusion - hierachical, neighbourhood or contagion and random. Important to this study are the hierarchical and contagion patterns. According to Brown,

> the pattern of diffusion throughout a landscape containing urban centres will exhibit the influence of both contagion and hierarchy as a result of, respectively the friction of distance and urban size filtering . (1981, p. 42)

In other words, growth or development occurs as a result of filtering of innovations downward through the urban hierarchy. In looking at the state of Sao Paulo which has a well-defined urban hierarchy and road transport network, we can assume that diffusion will have an important impact on the economic and social development of this region. That is, with respect to the transmission of growth impulses from Sao Paulo City to its surrounding hinterland.

## 1-2 Distance and Data Source

From a more practical point of view, the importance

of distance is almost self-evident. Other things being equal, the closer to the source of some stimulus or service, the greater its influence should be. Another reason for emphasizing distance is the high priority generally given by development planners to investments in transportation with the main objective of reducing effective distances (Wood, 1983, p. 201). Various studies of development in the Third World countries, of which Brazil is one example, have stressed the importance of transportation especially with respect to the effects of improved road transportation in accelerating economic and social development (Harris R.S. and Tingle E.D., 1981; Victor D.J. 1981). Consequently, it is important to know what extent improvements in transportation can enhance prospects for social and economic development (Wood, 1983, p. 201).

In this study, effective road distance is used as the measure of accessibility. These measurements were obtained from a road map of Sao Paulo State (see Figure 2). To take into account the effects of the various types of road surfaces found in the region, a weighting scheme was applied. For paved roads actual distances were used. For gravel roads distances are multiplied by 1.5, and for dirt roads the multiplication is by 2.0. In this way any variations in the curvature of the road is also accounted for by the actual road distance measures. We can also assume that the relief of the terrain is not a major factor in impeding

How sensitive are the final results of this study to these weights?

accessibility because Sao Paulo State is situated on a large plateau which really has no major physical barriers to movement.

Brazil which has an active Institute of Geography, within the federal government, has the added responsibility among its other functions for the compilation of national statistics, including the Census of Brazil. Consequently, the Institute has acquired vast amounts of data covering all parts of the country and selected and organized with a view to its utilization in geographical analysis (Wood, 1983, p. 198). It is from this census that the figures for the economic and social development indicators were obtained (see Appendix A).

1-3 Sao Paulo: The state and city

Sao Paulo state was selected to be the area of study ~~because of certain reasons~~. To begin with this region of Brazil is one of the most interesting areas, plus it also exemplifies the basic theoretical concepts of growth centre or core-periphery relationships. Sao Paulo City which is one of the two largest urban centres of Brazil, Rio De Janeiro being the other, has a population of over five million inhabitants. It is the one commercial centre for the coffee region in Brazil, and the hinterland that the city serves extends far to the north of Sao Paulo state. The city is also the political centre of one of the richest states

in Brazil, and it is the leading manufacturing city of all of Latin America (James, 1969).

The state of Sao Paulo, including the city, has one of the most modern and efficient transport networks. The state is also served by a well-developed urban hierarchy system in which the largest centre, Sao Paulo City, has a status of 1 (see Figure 1). The enormous pull of this metropolis is very evident as seen by the road pattern which radiates outwards from the city, thus the link between the city and its hinterland is fairly well established (see Figure 2). The selection of towns for study, with respect to distance and consequently access to Sao Paulo City, were chosen so as to cover all the micro-regions of the state (see Figure 1). A micro-region is a term coined by Brazilian geographers for the differentiation of small areas or regions within the larger region.

In examining urban-regional relations, it is helpful to distinguish between what one may call the process of sectorial complementation and the process of spatial polarization. The former has as its objective the commercialization and industrialization of the region's primary production so as to avoid waste, maintain fair price levels and minimize leakages of capital to other regions. The process of spatial polarization, on the other hand, has as its goal the diffusion of comparable levels of productivity and human well-being to the entire region (Wood, 1983, p. 200). In the remainder

of this study, this process is examined in more detail, with emphasis given to the effects of distance and the role of town size and how they both effect social and economic development in the state of Sao Paulo.

## 1-4 Structure

The general structure of the thesis is as follows: Chapter II contains a review of the relevant literature important to this study. Chapter III looks at the types of data and method used to do the analysis. Chapter IV embodies the actual analysis, this chapter is divided into two parts: Part A looks at aspects of social development whilst Part B looks at the aspects of economic development. And finally, Chapter V draws an overall conclusion about the various relationships that were found in the analysis.

# CHAPTER II

# LITERATURE REVIEW

## 2-1 Importance of Distance

The concept of distance is an important research area in geography because distance separates points or locations in space whereby necessitating movement or interaction between them. According to Lloyd and Dicken, geography is first and foremost a spatial discipline. Consequently, one of its central concerns is distance, especially that of the friction of distance where this refers to the impediment to movement which occurs because places, objects and people are spatially separate (1977, p.20).

## 2-2 Accessibility

Definitions of accessibility tend to vary widely, and sometimes these definitions are not always given explicitly. Jones in his study has listed a range of meanings that have been given to the word accessibility (1981, p. 4). In this study, accessibility is defined as 'coming into contact or presence' and it is measured using effective road distance taken from a road map of Sao Paulo, Brazil. Various accessibility studies have used other measures as surrogates for distance. For example, Gauthier (1968) and Ratford (1971), in their studies have both used travel costs as their measure of accessibility.

Some studies have been concerned solely with the

spatial separation of points or with the linkages between points as a result of their relative locations on a network; this approach is an attempt to make operational the concept that 'the accessibility of a point in a system is a function of its location in space with respect to all other points in the system' (Hack, as cited by Jones, 1981, p. 4), and 'accessibility will imply relative nearness either in the sense of a direct linkage or minimum expenditure of travel cost or time (Muraco, as cited by Jones, 1981, p. 4). This type of accessibility measures that are concerned here are network measures.

But you are only concerned with location relative to Sao Paulo.

The network used is usually a simplified road network. To illustrate this, in the study by Gauthier (1968) of the Sao Paulo economy, the highway network is viewed as a set of vertices (nodes) which are related by an incidence function according to a configuration of arcs (linkages). This is represented as a finite graph where the Sao Paulo highway network is seen as a planar, symmetrical and connected graph (Gauthier, ed. by Hoyle, 1973, pp. 167-171).

Other studies have defined accessibility in terms of travel costs of observed or expected trips, note that this is a shift from the network approach to the single journey approach, an example of this approach is the study by Radford (1971).



## 2-3 Spatial Discipline

Geography being a spatial discipline whereby geogra-

phers can be looked upon as being spatial theorists operate with a concept of a continuous development surface that exhibits certain characteristics of spatial structure (Friedmann, 1975, p. 793). From this viewpoint, and in the case of Sao Paulo, certain concepts need to be considered such as the spatial diffusion of innovation, geography of development and polarized development.

## 2-4 Spatial Diffusion of Innovation

The origin of spatial diffusion research is deeply indebted to the Swedish geographer, Torston Hagerstrand (Friedmann, 1975; Brown, 1981). At the onset, early diffusion studies were concerned with measuring the rate and direction of the diffusion of discrete innovations, such as a product, and with describing this process as it unfolded in geographic space (Friedmann, 1975, p. 793). Later on this work branched out in a number of directions that proved to be very important in regional planning. For example, Poul Ove Pedersen was able to relate the diffusion of successive waves of innovations through an urban system to the differential growth of cities and, by implication, of urban dominated regional economies (as cited by Friedmann, 1975, p. 794). Also in work done by Garst, who did a study of the diffusion of agricultural innovation in rural eastern Kenya in which he showed that there was a pronounced decline in adoption with increased distance from collection, marketing and processing sites (Discussion Paper Number 17).

## 2-5 Geography of Development

From this perspective, another group of geographers undertook to study the results of diffusion processes by mapping the spatial distribution of selected indices of social and economic development (Friedmann, 1975). For example, Brian Berry devised a simple method of measuring these indices along a series of traverses varying in length and passing through two or more cities in the United States. The graphs he obtained from these measurements revealed the influence of cities in the landscape of economic and social development, in general, positive measures of development came to a peak in cities and declined with distance from the centres (as cited by Friedmann, 1975, p. 794).

## 2-6 Polarized Development

The theory of polarized development is basically a theory about the role of power relations. Important to this idea of polarized development is the notion of core-periphery relationships. Friedmann in a book on regional policy proposed a core-periphery model, in which the core dominates the periphery in economic, political and innovative functions. (Friedmann, 1966; Brown, 1981). An illustration of this concept of core-periphery can be seen in the study done by Gauthier (1968) in which he viewed the Sao Paulo urban area as a growth centre and the state of Sao Paulo as its hinterland. Implicit to the core-periphery model is the notion of the transmission of growth impulses from the core to the

periphery (Brown, 1981).

Wood (1983) in his study of the role of middle sized cities looked at the idea of spatial polarization in some detail, paying special attention to the role of distance from Patos. What he observed was that the influence of Patos on its region, with respect to the transmission of economic and social stimuli, was both positive and negative and always selective. He found that for each stimulus, proximity to Patos was important for some municipalities and not for others, whilst in each case the list of distance-sensitive municipalities was different.

In conlusion, a comprehensive literature review is virtually impossible to do in a study of this magnitude. Consequently, the most relevant studies relating to the type of research undertaken in this thesis were reviewed. These studies will in turn be used to reinforce my area of analysis and this pertains to the concepts of accessibility, diffusion, geographic development and polarized development.

# CHAPTER III

## DATA AND METHOD OF ANALYSIS

### 3-1 Data

The data used in the analysis consists of road distance measurements, measured in kilometers, from a sample of forty-eight towns to Sao Paulo City. The sample of towns were in turn chosen so as to represent all the micro-regions of the state and all the different town size categories (see Figure 1).

Various indicators were plotted against distance on graphs for preliminary analysis. The indicators, under the careful direction of Dr. H. Wood, were chosen to represent various aspects of social and economic development. The social indicators are used to represent: (1) education; (2) basic services (water, sewage and electricity); (3) housing and (4) health aspects of social development. The various social indicators used are respectively (see Appendix A for data);

(1) The indicator used for education is the percentage of the total population who have completed their high school education.

(2) For basic services, three indicators were combined to arrive at the one basic service indicator. These are: (a) the percentage of dwellings with some kind of water supply (water main, well spring); (b) percentage of dwellings with electricity; (c) percentage of dwellings

with some kind of sanitary facility (sewer, septic tank, pit, latrine or other).

(3) For housing, the indicator is the percentage of housing classed as "non-durable". (expand)

(4) For health conditions, a direct indicator does not exist in the census; the best one and the one used for this purpose by Brazilian geographers is the children still alive as a percentage of the children born to women still alive.

On the other hand, the economic indicators are used to represent: (1) commercial; (2) industrial and (3) agricultural aspects of economic development. The various economic indicators used are respectively (see Appendix A for data):

(1) The indicator for commercial development is the value of commercial sales in cruzeiros. ← perhaps this should be per capita.

(2) The indicator used to represent industrial development is workers in industry as a percentage of the total 'active' population.

(3) The indicators used to represent agricultural development is the value of annual production per farm worker in cruzeiros.

(4) Finally, two indicators were used to represent the overall level of agricultural technology and these are: (a) percentage of farms which uses machinery and (b) percentage of farms which uses fertilizers, this indicator is represent by the various symbol colors.

According to Wood, because the situation is dynamic, the ideal indicators should also be dynamic: the movement of people, goods, capital and information. But nowhere in Latin America is such information routinely collected with the degree of geographic differentiation that is required in a study of this type. Special data collection would be necessary at a high cost in money and time (1983, p. 201).

Therefore, it is reasonable to make most of such data as are normally collected, processed and published for all parts of the country, namely, those from the national census. And even though census data are essentially static, the distribution patterns they reveal can shed much light on urban regional interactions (Wood, 1983, p. 201).

## 3-2 Method of Analysis

In the method used here to analyze these interactions, the units of analysis are individual municipalities within the region. All of Brazil is divided into municipalities (municipios) each named for its chief town (cabecera). Depending on local population densities, the area of a municipality may range from less than 50 $km^2$ to over 100,000 $km^2$, and the population of the chief town from over a million to less than a hundred (Wood, 1983).

Distances are measured by road weighted according to the type of surfaces (see Section 1-2). The values for the various development indicators were derived from the national census and plotted on graphs for preliminary analysis. Reference numbers are then placed beside each symbol. These

reference numbers then serve two useful functions, their first function indicates the relative location of the towns within the region and secondly, after some experimentation and preliminary analysis it was found that not only distance but the relative size of towns also had an affect on certain aspects of development. Accordingly, the largest town was designated #1, whilst the others follow in rank order (see Figure 1).

It should also be mentioned that the way the graphs are constructed are similar and yet different in certain respects. For instance, for all the social and economic indicators the graphs are all designed the same way. Each of the graphs were constructed to show four characteristics: (1) distance to Sao Paulo City on the X-axis; (2) the selected development indicator on the Y-axis; (3) relative town size and location of the towns by their reference numbers; (4) division of the various size towns into categories or groups with respect to population sizes, represented by symbol shape.

The difference arises when looking at the last economic indicator ; that is the one for the level of agricultural technology. For this indicator a fifth characteristic is included to represent a second related characteristic and this is represented by the symbol colors.

For the initial analysis, all forty-nine towns were included on every graph, and at first glance, they seemed

to reveal nothing. The points representing the different towns were scattered so haphazardly that conventional analysis would indicate no relation between distance to Sao Paulo and any of the indicators. But by including every town on every graph, groups of towns were identified which appeared to show some relationship of accessibility which I then analyzed. As a matter of record and as an example, I have included a preliminary graph with all the forty-eight towns plotted (seeDiagram 3.1). On the advice of Dr. Wood, I was advised to exclude Santos from the analyses, reference #2 (see Figure 1) because Santos being the chief port of the region has created its own internal relationships.

From the various categories of towns which were then identified, these were analyzed visually and in most cases quantitatively using regression analysis, in order to try and establish if any relationship existed between accessibility and the levels of social and economic development. The statistical analyses were used in the study as an aid to complement the visual interpretations of the graphs. The regression analysis was not used as the chief means of data analysis.

Furthermore, the various categories of towns in the analyses are not the same for all the indicators. After the initial analysis, it was found that different groups of towns responded in different ways to a given urban influence, and by searching for the characteristics which unify response

groups, it was possible to differentiate the towns based on population categories. For example, in Figure 3, the various symbols are used to represent the different groupings of towns based on population sizes of the municipality.

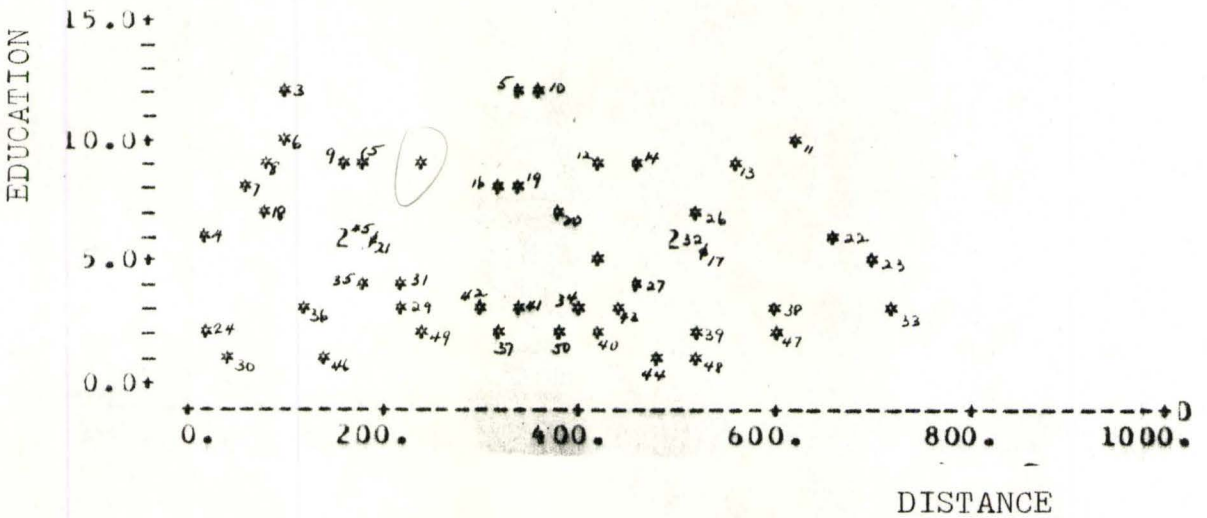



DIAGRAM 3.1 PLOT OF FIFTY TOWNS

# CHAPTER IV

## 4-1 Introduction

The analysis which follows covers the city and region of Sao Paulo in the state of Sao Paulo, Brazil. The intention is not to provide a complete coverage of internal relations there, nor to use more than a small fraction of what the Census of Brazil has to offer. What the thesis is to demonstrate is that a relatively simple and practical method can provide at least preliminary answers to the question: How does Sao Paulo City serve its region?

This chapter analyzes the effects of distance from Sao Paulo City on the level of social and economic development found in the region. Other than distance, the role of town size with respect to population is also examined. This is to determine what underlying effects, if any, town size also has on the level of development in the region.

The chapter is divided into two parts, In part A, the four indicators of social development are analyzed and in part B, the four indicators of economic development are analyzed. From here onwards when reference is made to Sao Paulo what is meant is the city of Sao Paulo and not the state.

## (A) ANALYSIS OF SOCIAL DEVELOPMENT

## 4-2 Percentage of High School Education

Figure 3 and the corresponding statistical analysis

reveals that for the towns taken all together there appears to be no relationship between distance and the percentage of high school education. But on closer inspection of the graph, it can be seen that for towns of Group A with a population size greater than 100,000 inhabitants, there is a positive linear relationship. This relationship is significant at a 95% confidence level (Appendix B). For these towns, each 100 km of increasing distance away from Sao Paulo, there is a corresponding 3% increase in the percentage of high school education. A complementary observation which can be drawn from this is that Sao Paulo is draining the high school graduates away from those towns which are in close proximity. This drainage occurs at a rate of 3% for every 100km decreasing distance to Sao Paulo. The conclusion which can be drawn from this observation with respect to diffusion is that polarization effects dominates the spread effects in the transmission of educational stimuli from Sao Paulo. So it is not the provision of educational services, but the draining of educated people that is at issue.

Consequently, from the above analysis it would appear that is is beneficial for towns within Group A to be farther away from Sao Paulo than to be in close proximity because of the strong attraction Sao Paulo has on their high school graduates. This is in contrast to a study done by Wood (1983) in which he showed that proximity to the city of Patos does provide an educational advantage.

For towns of Group B, the corresponding statistical

analysis was not significant at a 95% confidence level (see Appendix B). Visually though, the relationship appears to be quite similar to that of Group A, but the relationship is much weaker in contrast to the former and it is beyond the scope of this study to explain why this is so.

Group C, towns with a population between 49,999 and 18,000 inhabitants, the corresponding statistical analysis was also not significant at the 95% confidence level (Appendix B). But what can be observed visually from the graph is that for towns of Group C, the overall percentage of high school education is fairly uniform regardless of distance from Sao Paulo. A hypothesis which can be drawn from this observation is that there is no evidence that distance has any effect on the percentage of high school education for towns within this population size range.

In looking at a more general overview of the relationship between distance to Sao Paulo and the percentage of high school education, we can observe a pattern whereby Sao Paulo is draining high school graduates from those towns with a population size greater than 60,000 inhabitants as distance decreases to Sao Paulo (reference numbers 3 to 14). For towns with a population range between 60,000 and 30,000 inhabitants (reference numbers 15 to 18), the effect of distance is uncertain or ambivalent. Below a town size of 30,000 inhabitants the drainage of high school graduates ceases and distance does not appear to have any effect.

Therefore, from the overall analysis, we can conclude that the effect of distance is continuous for towns with a population size greater than 60,000 inhabitants, and the influence of Sao Paulo upon these towns is negative. We can also conclude that the influence Sao Paulo has on draining high school graduates from these towns is selective in that it only effects those towns with a population size of greater than 60,000. A probable reason for the effect of Sao Paulo on draining high school graduates is that, in the bigger towns, the people tend to be more mobile. Consequently, they would have the means to migrate more easily as compared to the more rural towns in which people are less mobile and probably more tied to their land.

The mechanism that can be deduced from this is that the better trained people tend to be attracted to Sao Paulo. The attraction of Sao Paulo and hence the migration to the city also tends to be selective. Selective in the sense that migration to Sao Paulo occurs only from those towns with a population size greater than 60,000, regardless of distance. maybe, but you have no evidence of this.
The migration pattern therefore appears to be stepwise in nature, that is, people don't migrate from the smaller to the larger towns, migration occurs only between those towns with a population size greater than 60,000 inhabitants. For those towns with a population size below 30,000, it would appear that migration from these towns does not depend on distance or town size but probably on local factors of the

municipality.

4-3 Basic Services

Figure 4 and the corresponding statistical analyses that were carried out on the data for the various groups of towns revealed that proximity to Sao Paulo provides no advantages with respect to the provision of basic urban services. This though should not be surprising because these services tend not to be linked physically in space, therefore, the level of basic services provided does not depend on distance but probably on factors such as population size of the town, the availability of funds or revenue to provide these services which in turn will depend on local factors in the town itself.

From a visual analysis of Figure 4, we can observe that for the whole range of towns with a population size greater than 1800 inhabitants (reference numbers 3 to 26), the variation in the level of basic services is very small. This variation ranges between a value of 240 and 300 units regardless of distance from Sao Paulo. Although for Group A their level of basic services can be seen to be slightly higher than that of Groups B and C. For Groups B and C, there appears to be no variation in the level of basic services regardless of distance from Sao Paulo or town size.

For those towns with a population size of less than 18,000 inhabitants, we observe a dramatic decline in their level of basic services. We can interpret from this observa-

tion that the threshold value for the provision of basic urban services is 18,000 inhabitants regardless of distance. We can also conclude from our observation and regression analysis that accessibility does not have a significant effect on the level of basic services, but what appears to be the important determining factor for high levels of basic services is town size. A possible explanation for this phenomenon is such that for towns with a population size greater than 18,000 inhabitants, possible urbanization economies sets in which allow for the provision of better basic urban services.

4-4 Housing

Turning now to housing quality (Figure 5), like the indicator for basic services, the corresponding statistical analyses that were done on the data for the various groups of towns proved not to be significant at the 95% confidence level (see Appendix B). But from a visual analysis of Figure 5 for housing quality some general observations can be made.

Towns in Group A do not stand out as having any better quality housing than towns of Group B or C, regardless of distance from Sao Paulo. The threshold town size in this case is also not as clear for housing quality as it was for basic services. Whilst it is observable that towns with a population size greater than 18,000(reference numbers 3 to 26) do have a higher percentage of good quality housing, we can also observe that quite a number of small towns, that is, towns with a population size of less than 18,000, also

tend to have a comparable percentage of good quality housing (see Figure 5: reference numbers 50, 34, 49, 28, 27).

From these general observations and from the fact that the regression analyses were not significant at the 95% confidence level , we can therefore state that proximity to Sao Paulo does not provide any housing benefits. Even the effect of town size appears to be limited although not completely absent when it comes to housing.

Again, be careful. In effect, you are accepting a null hypothesis here.

Generally, the quality of housing in towns with a population size of greater than 18,000 inhabitants is quite 'good' when compared to that of the smaller towns. But there are certain small towns with a population size of less than 18,000 that also have equivalent levels of 'good' housing. Furthermore, towns below the population size range of 18,000 can be considered an open range with respect to housing quality. This is due to the fact that the percentage of housing quality for these small towns varies from having the best quality housing comparable to that of the bigger towns to having the worst quality housing, irrespective of distance to Sao Paulo.

From the above analyses of housing quality and basic services, it appears we can have towns which have low levels of basic urban services but a high level of good quality housing.

4-5 Health Conditions

In the case of health conditions (Figure 6), the

corresponding statistical analysis for towns in Group A was not significant at the 95% confidence level (Appendix B). Also, from the visual analysis of towns in Group A and from the inference obtained from the regression analysis, we can conclude that distance is not a factor in determining the survival rate of children in terms of this group.

For Group B (reference numbers 11 to 26) the corresponding statistical analysis was significant at a 95% confidence level. Therefore, what we do find is a significant relationship between distance and health (confidence level of 95%) for those towns which have a population size between 100,000 and 18,000 inhabitants. Strangely though, the influence of Sao Paulo is the opposite of what one might have expected. For each 100km of increasing distance from Sao Paulo, one finds an increase of 10% in the proportion of surviving children. From the graph and regression results (see Appendix B), we can therefore state that distance from Sao Paulo is an important determining factor in the health conditions found in these towns.

The reasons for the above findings of health conditions probably relates to three factors:

(1) living conditions within these towns

(2) the availability of medical care

(3) migration patterns

As mentioned above, for towns in Group B as distance increases away from Sao Paulo health conditions tend to improve in a

linear fashion. An alternative explanation to this phenomenon is that proximity to Sao Paulo has a negative effect on health conditions. A possible explanation for this concerns migration. It is a documented fact that the highest proportion of migrants tend to be young people within the age group of 25 to 30 years. In this case we can hypothesize that the young people migrate from the more rural towns to Sao Paulo. Therefore, any benefits the city could provide to its surrounding region, with respect to the diffusion of medical care is offset by the fact that living conditions within the big towns are more hazardous than in rural areas. As a result, more young people tend to die in cities rather than in rural areas due to the greater exposure of more hazardous urban conditions. For example, higher levels of pollution, crime and traffic.

This suggests that in towns with a population size greater than 100,000, migration patterns to these towns are offset by local urban conditions. These towns create their own unique health conditions and consequently, this is not affected by distance from Sao Paulo.

From the above analysis, we can conclude that the effect of distance on health conditions is important only for those towns within a certain population size between 100,000 and 18,000 inhabitants. Within this group of towns, the effects of distance to Sao Paulo on health conditions is negative. The probable cause of mechanism for this effect is due to the migration of young people into Sao Paulo and

within the city there occurs a higher mortality rate than in the rural towns.

For those towns of Group A, the effect of distance on health conditions is not noticeable because local conditions are so variable within these towns that the effects of migration are hidden.

For the smallest towns with a population size below 18,000, there is no evident effect of distance or town size on the health conditions found there.

## (B) ANALYSIS OF ECONOMIC DEVELOPMENT

### 4-6 Value of Commercial Sales

For commercial sales (Figure 7), the statistical analyses that were performed on the towns of Group A and B revealed that there was a positive relationship between distance from Sao Paulo and the value of commercial sales. The regression analyses were significant at the 95% confidence level for both groups of towns under study. From their respective $r^2$ scores we can also note that for the towns of Group A, these towns have a much higher correlation than that of the towns of Group B (see Appendix B). From this we can conclude that the influence of Sao Paulo is more diffused for towns within the population size range of 100,000 to 18,000, that is, the effect of proximity to Sao Paulo is more pronounced for Group A than for Group B.

An alternative interpretation of this relationship is to say that Sao Paulo has a negative influence on the value

of commercial sales and like that of education, Sao Paulo is pulling or draining businesses from nearby towns right through to the farthest ones. A possible explanation for this occurence is that people living in towns close to Sao Paulo are probably patronizing Sao Paulo and not their own businesses. Consequently, those towns in relative proximity to Sao Paulo have lower values of commercial sales. The main difference between towns of Group A and B is the difference in the intensity of the drainage that is occuring.

For the smallest towns, those with a population size of less than 18,000, there appears to be no effect of distance on the value of commercial sales. As can be seen from Figure 7, all of the towns within this population range have a fairly uniform value of commercial sales. From this observation we can assume that the threshold size is approximately 18,000 inhabitants and consequently, if a town attains a size greater than 18,000, Sao Paulo will begin to drain away its business. This phenomenon is probably due to the fact that as the towns grow, economies of scale sets in which will create greater population mobility and thus, more patronizing of Sao Paulo's businesses.

From the above, it can be concluded that in general if we increase accessibility to Sao Paulo, we will in turn increase the city's economic power. This is due to the effect that Sao Paulo has on attracting business. Following from this conclusion is the idea that with increased economic

power, Sao Paulo will continue to retain its dominance over the region.

4-7 Percentage 'Active' Population in Industry

Turning next to industrial development (Figure 8), a completely different picture emerges. The corresponding statistical analysis revealed that for those municipalities with the largest towns, as in Group A, the influence of Sao Paulo is postive. For these towns the statistical analysis was significant at a 95% confidence level (see Appendix B). For towns in this group, the closer they are to Sao Paulo, the higher the percentage of workers that are found in industry and consequently, the more industrial activity we find occuring. What can also be observed is that the rate of decrease of industry is 7% for every 90 km increasing distance away from Sao Paulo.

For towns in Group B, the corresponding regression analysis was not significant at the 95% confidence level (see Appencix B). Therefore, from this we can infer that distance does not have any effect in stimulating industrial development in towns within this population size range.

From a visual inspection of the graph, distance does not appear to have any affect on the percentage of workers in industry for those towns which has a value of less than 8% of their workers employed in industry. Above this 8% threshold value, one notices for the biggest cities the level of industrialization declines quite rapidly away from Sao

Paulo. This observation has been confirmed by the corresponding regression analysis done on the towns of Group B, For the towns of this group, distance does not appear to have effect on the industrialization level and again this has been confirmed by the regression analysis. In the smallest towns, Group C, there is no evidence to indicate that distance influences the level of industrialization.

In conclusion, it would appear that the benefit of Sao Paulo in stimulating industrial employment is only diffused to the larger towns but with quite a rapid distance decay of 36% to 8%.

4-8 Annual Production Per Farm Worker in Cruzeiros

In the case of agricultural productivity (Figure 9), for towns of Group A, there was no evidence to indicate that a relationship existed between distance and the desired indicator. The regression analysis for this group proved not to be significant at the 95% confidence level (see Appendix B). This corresponds to the findings done on the previous indicator, that is, with respect to industrialization. As mentioned from above, towns in Group A were the only set of towns which showed any relationship between distance and industrialization. Now, with agricultural productivity, this set of towns do not show any relationship between distance and agricultural productivity.

For Group B, the corresponding statistical analysis revealed that there existed a negative relationship between

distance and agricultural productivity (see Appendix B). A complementary conclusion is that the influence of Sao Paulo is positive, that is, for those towns within this group which are in close proximity to Sao Paulo, they tend to have higher levels of agricultural productivity and as distance increases this level of productivity decreases. A reasonable explanation is probably because these towns are the food supply source for Sao Paulo. Thus, Sao Paulo acts as a market for the agricultural products of these towns and the closer the town is to Sao Paulo, the better access to a large market leading to reduced transportation costs and hence, bigger profits.

In contrast to Group B, Group C and its corresponding statistical analysis revealed that there existed a postive relationship between distance and the level of agricultural productivity (see Appendix B). As distance increases away from Sao Paulo, the level of productivity correspondingly, increases. This suggest that for the towns in Group C, those with a population size of less than 18,000, the influence of Sao Paulo is negative with respect of agricultural development. any idea of why this happens?

In conclusion, the evidence would indicate that for towns with a population greater than 100,000, the effect of distance is insignificant. Also, from this evidence, it would appear that towns within this population range are more industrialized. For towns in Group B, distance has a negative

effect, negative in the sense that as distance from Sao Paulo increases, agricultural productivity decreases. For Group C, in contrast to Group B, the effect of distance is positive. It is positive because as distance increases from Sao Paulo so does the level of agricultural productivity. From the above analyses, it would appear that town size is very important in determining if there is going to be any relationship, whether positive, negative or absent between distance and the level of agricultural productivity.

4-9 Percentage of Farms Using Machinery and Fertilizers

Figure 10 and the corresponding statistical analyses that were carried out on the data for the various groups of towns revealed that proximity to Sao Paulo provided no mechanization advantages (see Appendix B). For Group A, the regression analysis was not significant at the 95% confidence level. But from a visual analysis of the graph for Group A, there appears to be a very weak relationship between distance from Sao Paulo and the level of mechanization. However, it is beyond the scope of this analysis to explain the reasons behind this weak relationship.

For towns in Group B, the statistical analysis also proves to be insignificant at the 95% confidence level (see Appendix B). From a visual inspection of the graph for towns within this population range, the towns seem to be scattered haphazardly. But if we look closely enough, a pattern becomes apparent. For those towns which are 360 km from

Sao Paulo, the level of farm mechanization is low ranging from 15% to 30%. Between 360 and 570 km, the level of mechanization is much higher ranging from 30% to 60%. Beyond 570 km, the level of farm mechanization drops off drastically to below 15%. Therefore, distance does appear to have an effect on the level of farm mechanization, however, the relationship is not linear.

For those towns below 18,000, the corresponding regression analysis was significant at the 95% confidence level (see Appendix B). The relationship is positive, as distance increases away from Sao Paulo, machinery usage also increases. This is contrary to what one might expect. A reasonable explanation for this is that close to Sao Paulo, land is scarce and so, plots are smaller making it unfeasible to utilize a lot of machinery. In rural areas where the plots are naturally larger, it becomes necessary to utilize more machinery to plant and harvest the agricultural produce.

In looking at fertilizer usage, for Group A, those towns with a population size greater than 100,000, these farms appear to use a much higher percentage of fertilizers. This is probably due to a more intensive form of agricultural land usage necessitating high amounts of fertilizer use.

Generally, it would appear that for those towns in which the farms are more highly mechanized, that is, machinery usage greater than 15%, these towns also have a relatively high percentage of fertilizer usage. This relation-

ship though becomes less apparent at a distance of 480 km in which fertilizer usage decreases but not machinery usage. Beyond 580 km, fertilizer usage then drops off to its lowest level, although machinery usage remains fairly high.

In drawing an overall conclusion, distance appears to effect both the level of machinery and fertilizer usage in different ways and from the analysis, various threshold values of distance were recognized.

# CHAPTER V

# CONCLUSION

## 5-1 The Purpose Restated

The purpose of this thesis was to examine the effect of accessibility on the economic and social development of Sao Paulo, Brazil. By using effective road distances as my measure of accessibility, various indicators representative of social and economic development were plotted against distance from Sao Paulo for analysis. During the course of the analysis it was observed that distance affected only certain indicators, what also became apparent is the importance of town size with respect to the number of inhabitants and the effect this had on the level of development.

## 5-2 Reiteration

In bringing the overall analysis to a close, I will reiterate the effects of distance and town size on the economic and social development in Sao Paulo, Brazil, by means of two diagrams. One that shows which indicators distance affects (diagram 5.1) and the other that shows which indicators distance does not affect (diagram 5.2). Diagrams 5.1 and 5.2 can be found at the end of this chapter.

In looking at diagram 5.1, we can see that the distance from Sao Paulo on social and economic development affects only certain indicators and certain groups of towns. It should also be observed that where distance from Sao

Paulo is a factor in development, there are both positive and negative influences. The former pertaining to the fact that proximity to Sao Paulo brings higher levels of development whilst the latter is just the opposite. The negative influences tend to be more predominant as can be seen from 5.1 in as much that proximity to Sao Paulo has no tangible benefits with respect to development.

Diagram 5.2, on the other hand, illustrates those indicators and groups in which distance is not an important factor but town size is. In this case, town size is important with respect to the reception of the form and scale of development that occurs. For example, with respect to the indicators for basic services, it would appear from the analysis that the bigger the towns, the better the level of basic urban services and this is irrespective of distance from Sao Paulo.

Therefore, from the analysis, we can see that although transportation and consequently, better access, may be an important input into development and growth of a region it would appear that transportation investment is not the primary factor leading to development. What might be more desirable if social and economic development is a primary policy goal in regional planning is investment packages, that is, roads in conjunction with other types of investments which will stimulate better development.

DIAGRAM 5.1 DISTANCE A FACTOR

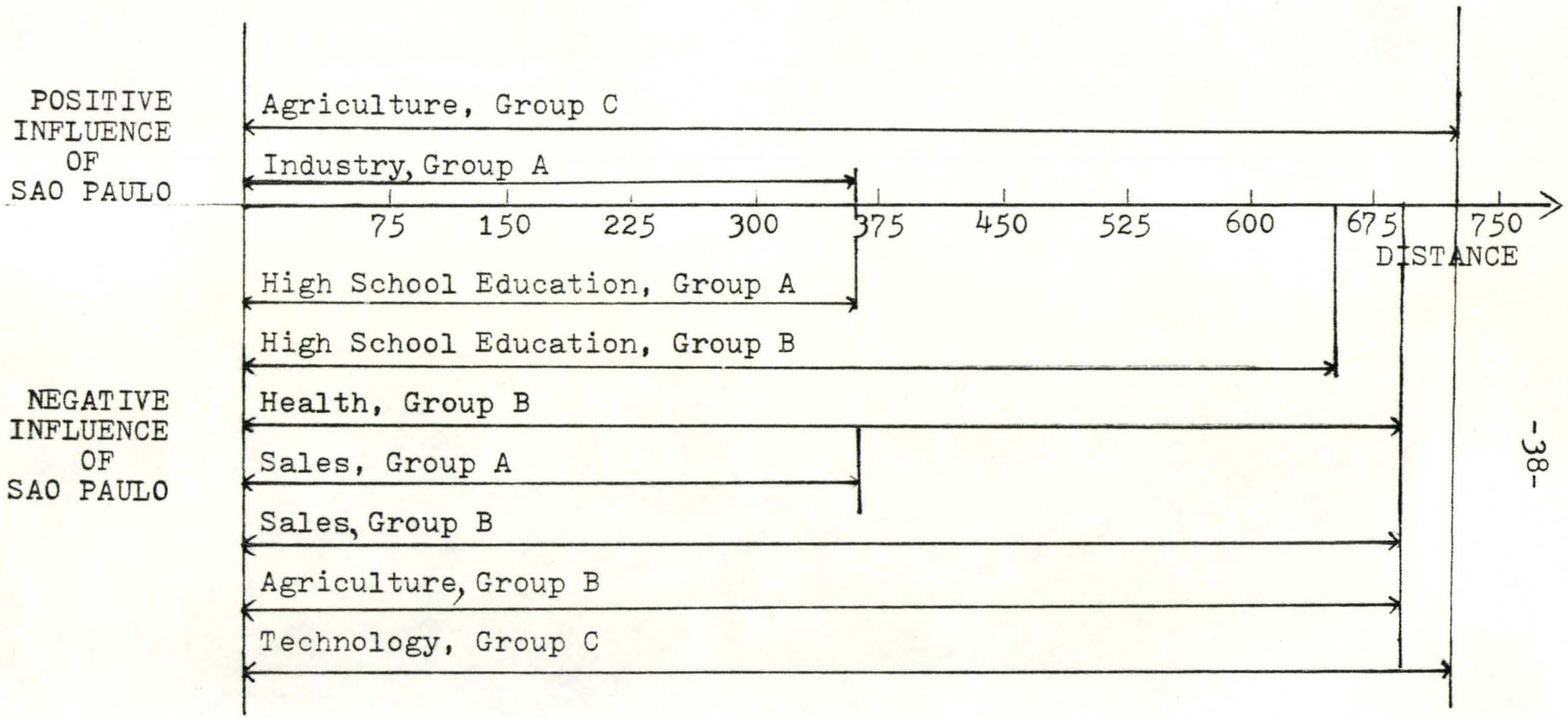
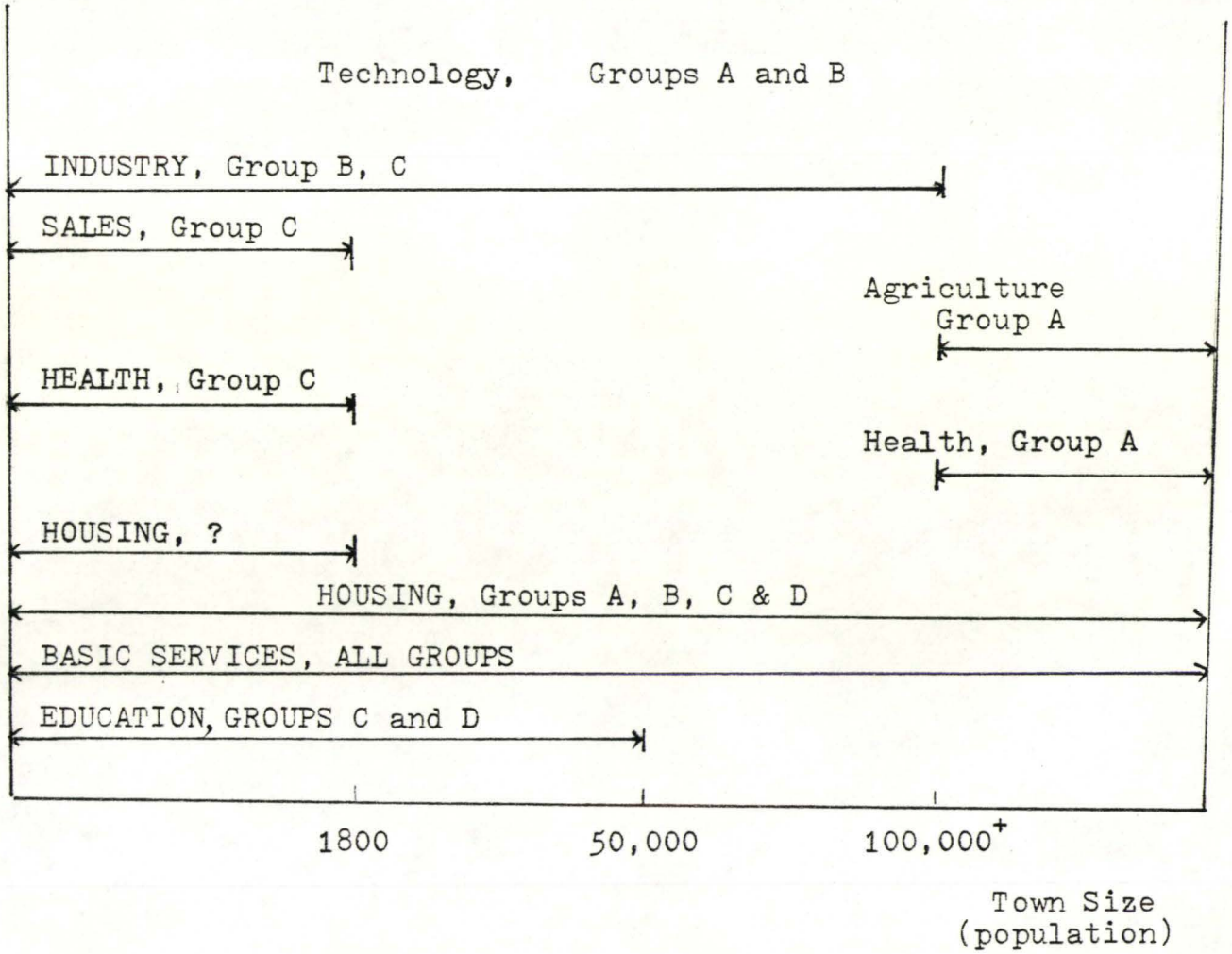


DIAGRAM 5.2 DISTANCE NOT A FACTOR



# APPENDIX

# APPENDIX A

DATA FOR ANALYSIS OF THE GEOGRAPHY OF SAO PAULO, BRAZIL

Reference No. TABLE 1A

| | Municipality | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|
| 48 | Alto Alegre | 518 | 1.40 | 69.5 | 25.4 | 50.6 | 145.5 |
| 37 | Apiai | 321 | 2.44 | 42.2 | 19.6 | 54.7 | 116.5 |
| 13 | Aracatuba | 551 | 8.90 | 94.9 | 73.8 | 93.2 | 261.9 |
| 19 | Avare | 331 | 7.62 | 87.5 | 72.7 | 85.6 | 245.8 |
| 41 | Bananal | 333 | 3.23 | 42,7 | 31.0 | 51.3 | 125.0 |
| 10 | Bauru | 358 | 11.96 | 94.7 | 89.9 | 97.7 | 282.3 |
| 20 | Bebedouro | 383 | 6.60 | 93.6 | 75.9 | 91.2 | 260.7 |
| 42 | Boa Esperanca | 293 | 3.30 | 84.6 | 67.2 | 65.2 | 217.0 |
| 18 | Braganca Paulista | 89 | 6.60 | 88.2 | 76.8 | 81.4 | 246.4 |
| 34 | Caconde | 390 | 2.97 | 72.9 | 59.4 | 63.6 | 195.9 |
| 3 | Campinas | 94 | 11.57 | 94.2 | 91.7 | 95.8 | 281.7 |
| 43 | Cananeia | 449 | 2.89 | 48.5 | 26.2 | 40.7 | 115.4 |
| 29 | Capao Bonito | 225 | 2.52 | 35.4 | 28.0 | 52.7 | 116.1 |
| 33 | Cardoso | 711 | 2.62 | 79.0 | 26.0 | 75.0 | 180.0 |
| 28 | Casa Branca | 235 | 8.99 | 86.0 | 78.2 | 82.9 | 247.1 |
| 50 | Cassia dos Coqueiros | 375 | 1.79 | 36.5 | 31.8 | 33.8 | 102.1 |
| 44 | Columbia | 481 | 0.57 | 86.1 | 32.8 | 76.6 | 195.5 |
| 49 | Corumbatai | 233 | 2.07 | 89.9 | 59.2 | 63.7 | 212.8 |
| 22 | Dracena | 662 | 5.95 | 90.3 | 66.5 | 93.0 | 249.8 |
| 12 | Franca | 424 | 8.84 | 89.3 | 76.4 | 97.1 | 262.8 |
| 30 | Francisco Morato | 38 | 1.32 | 90.0 | 54.1 | 77.4 | 221.5 |
| 24 | Franco da Rocha | 28 | 2.39 | 92.1 | 84.5 | 93.9 | 270.5 |
| 15 | Guaratingueta | 173 | 9.46 | 89.3 | 75.8 | 86.7 | 251.8 |
| 4 | Guarulhos | 10 | 5.85 | 93.0 | 83.8 | 94.9 | 271.7 |
| 40 | Itabera | 425 | 1.64 | 41.4 | 15.5 | 47.2 | 104.1 |

1 Actual distance from Sao Paulo. A weighting scheme was applied to the gravel and dirt road. For the gravel road, actual road distance is multiplied by 1.5, whilst for the dirt road, actual road distance is multiplied by 2.

SOCIAL INDICATORS

2 High school graduates as a percentage of the total population = education indicator.

3 Percentage of dwellings with some kind of water supply (water main, well spring).

DATA FOR THE ANALYSIS OF THE GEOGRAPHY OF SAO PAULO, BRAZIL

Reference No. TABLE 1B

| | Municipality | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|
| 21 | Itapira | 163 | 6.33 | 84.6 | 75.3 | 81.6 | 241.5 |
| 23 | Jales | 695 | 4.79 | 93.2 | 44.1 | 85.7 | 223.0 |
| 16 | Jau | 324 | 7.74 | 95.0 | 92.8 | 85.3 | 273.1 |
| 7 | Jundiai | 58 | 7.72 | 98.0 | 96.8 | 97.9 | 292.7 |
| 47 | Magda | 601 | 2.23 | 86.2 | 26.5 | 65.1 | 177.8 |
| 39 | Maracai | 513 | 1.94 | 81.6 | 43.3 | 90.2 | 225.1 |
| 14 | Marilia | 464 | 8.64 | 90.0 | 82.0 | 86.5 | 258.5 |
| 32 | Monte Aprazivel | 501 | 6.18 | 90.5 | 54.5 | 87.2 | 232.2 |
| 27 | Novo Horizonte | 464 | 3.69 | 86.8 | 41.7 | 83.9 | 212.4 |
| 26 | Olimpia | 518 | 6.97 | 86.3 | 64.3 | 84.8 | 235.4 |
| 17 | Ourinhos | 505 | 6.36 | 95.2 | 80.2 | 90.4 | 265.8 |
| 38 | Palestina | 603 | 2.95 | 74.3 | 30.8 | 65.4 | 170.5 |
| 36 | Parabuna | 118 | 2.74 | 73.1 | 35.1 | 63.4 | 171.6 |
| 45 | Pereiras | 165 | 5.55 | 77.4 | 38.4 | 57.4 | 173.2 |
| 35 | Peruibe | 189 | 4.36 | 72.2 | 46.4 | 70.3 | 188.9 |
| 9 | Piracicaba | 164 | 8.86 | 94.9 | 87.2 | 92.1 | 274.2 |
| 11 | Presidente Prudente | 619 | 10.02 | 92.1 | 79.5 | 93.8 | 265.4 |
| 5 | Ribeirao Preto | 330 | 12.41 | 96.1 | 91.7 | 96.5 | 284.3 |
| 2 | Santos | 89 | 17.04 | 99.2 | 98.1 | 99.2 | 296.5 |
| 25 | Sao Joaquim da Barra | 419 | 5.30 | 94.7 | 78.3 | 89.1 | 262.1 |
| 8 | Sao Jose dos Campos | 81 | 8.78 | 92.5 | 84.6 | 91.8 | 268.9 |
| 1 | Sao Paulo | 0 | 0 | 0 | 0 | 0 | |
| 46 | Saraqui | 144 | 1.09 | 51.1 | 18.1 | 29.4 | 98.6 |
| 6 | Sorocabe | 99 | 9.57 | 97.8 | 89.1 | 97.1 | 282.0 |
| 31 | Ubatuba | 227 | 3.98 | 81.2 | 34.0 | 63.8 | 179.0 |

SOURCE: NATIONAL CENSUS OF BRAZIL

SOCIAL INDICATORS con't

4 Percentage of dwellings with electricity

5 Percentage of dwellings with some kind of sanitary facility (sewer, septic tank, pit, latrine or other).

6 Summation of columns 3, 4 and 5. Represents basic services.

DATA FOR ANALYSIS OF THE GEOGRAPHY OF SAO PAULO, BRAZIL

Reference No. TABLE 2A

| | Municipality | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|
| 48 | Alto Alegre | 21.4 | 84.4 | 113 | 0.47 |
| 37 | Apiai | 54.1 | 76.3 | 369 | 0.64 |
| 13 | Aracatuba | 13.0 | 82.7 | 2122 | 6.72 |
| 19 | Avare | 14.9 | 79.5 | 1795 | 4.06 |
| 41 | Bananal | 44.0 | 82.6 | 419 | 5.58 |
| 10 | Bauru | 9.0 | 82.4 | 4896 | 8.01 |
| 20 | Bebedouro | 4.9 | 84.4 | 1590 | 7.31 |
| 42 | Boa Esperanca | 9.1 | 84.2 | 366 | 3.10 |
| 18 | Braganca Paulista | 8.4 | 78.9 | 1769 | 8.12 |
| 34 | Caconde | 2.9 | 80.6 | 425 | 1.19 |
| 3 | Campinas | 7.6 | 84.0 | 4550 | 18.49 |
| 43 | Cananeia | 66.0 | 90.0 | 425 | 8.27 |
| 29 | Capao Bonito | 49.0 | 78.7 | 761 | 1.26 |
| 33 | Cardoso | 36.8 | 84.8 | 580 | 1.19 |
| 28 | Casa Branca | 7.2 | 84.6 | 909 | 2.79 |
| 50 | Cassia dos Coqueiros | 12.6 | 89.9 | 151 | 0.37 |
| 44 | Columbia | 34.0 | 85.5 | 298 | 4.32 |
| 49 | Corumbatai | 1.1 | 91.8 | 325 | 6.12 |
| 22 | Dracena | 13.9 | 80.8 | 2327 | 4.84 |
| 12 | Franca | 8.9 | 83.4 | 1482 | 25.40 |
| 30 | Francisco Morato | 22.6 | 80.0 | 276 | 4.45 |
| 24 | Franco da Rocha | 10.0 | 77.9 | 438 | 4.83 |
| 15 | Guarantingueta | 11.5 | 78.7 | 1490 | 13.8 |
| 4 | Guarulhos | 12.1 | 81.2 | 1688 | 34.88 |
| 40 | Itabera | 38.0 | 80.3 | 302 | 0.80 |

7 Percentage of housing classed as "non-durable'.

8 Children still alive as a percentage of the children born to women still alive.

ECONOMIC INDICATORS

9 Value of Commercial Sales.

10 Workers in industry as a percentage of the total 'active' population.

DATA FOR ANALYSIS OF THE GEOGRAPHY OF SAO PAULO, BRAZIL

Reference No. TABLE 2B

| | Municipality | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|
| 21 | Itapira | 7.4 | 82.0 | 1025 | 12.55 |
| 23 | Jales | 28.1 | 82.8 | 1512 | 2.40 |
| 16 | Jau | 5.2 | 85.6 | 2270 | 20.28 |
| 7 | Jundiai | 5.7 | 83.3 | 2015 | 34.53 |
| 47 | Magda | 41.1 | 81.4 | 201 | 0.74 |
| 39 | Maracai | 10.0 | 83.1 | 461 | 6.49 |
| 14 | Marilia | 8.2 | 81.6 | 2203 | 11.65 |
| 32 | Monte Aprazivel | 11.3 | 83.3 | 1276 | 3.05 |
| 27 | Novo Horizonte | 8.7 | 84.1 | 996 | 2.75 |
| 26 | Olimpia | 5.4 | 84.3 | 1559 | 6.13 |
| 17 | Ourinhos | 14.1 | 81.2 | 4712 | 10.50 |
| 38 | Palestina | 34.7 | 85.1 | 446 | 1.33 |
| 36 | Paraibuna | 41.8 | 80.2 | 362 | 1.31 |
| 45 | Pereiras | 11.8 | 81.1 | 195 | 2.74 |
| 35 | Peruibe | 43.7 | 74.6 | 658 | 6.92 |
| 9 | Piracicaba | 4.1 | 84.3 | 2507 | 21.54 |
| 11 | Presidente Prudente | 9.6 | 82.3 | 4371 | 8.53 |
| 5 | Ribeirao Preto | 4.9 | 84.6 | 3838 | 11.29 |
| 2 | Santos | 6.1 | 83.2 | 10328 | 6.03 |
| 25 | Sao Joaquim da Barra | 8.1 | 83.0 | 1570 | 5.38 |
| 8 | Sao Jose dos Campos | 7.4 | 80.1 | 1525 | 35.70 |
| 1 | Sao Paulo | 0 | 0 | 0 | 0 |
| 46 | Saraqui | 39.8 | 82.0 | 154 | — |
| 6 | Sorocaba | 4.7 | 80.7 | 2270 | 21.97 |
| 31 | Ubatuba | 37.7 | 80.4 | 845 | 4.0 |

SOURCE: NATIONAL CENSUS OF BRAZIL

DATA FOR ANALYSIS OF THE GEOGRAPHY OF SAO PAULO, BRAZIL

Reference No. TABLE 3A

| | Municipality | 11 | 12 | 13 |
|---|---|---|---|---|
| 48 | Alto Alegre | 1543 | 16.18 | 40.84 |
| 37 | Apiai | 2571 | 4.01 | 29.63 |
| 13 | Aracatuba | 5435 | 47.59 | 32.84 |
| 19 | Avare | 3147 | 27.48 | 40.47 |
| 41 | Bananal | 4474 | 7.47 | 36.08 |
| 10 | Bauru | 6299 | 32.37 | 48.36 |
| 20 | Bebedouro | 7332 | 62.88 | 79.91 |
| 42 | Boa Esperanca | 4413 | 46.76 | 53.95 |
| 18 | Braganca Paulista | 2597 | 15.77 | 40.11 |
| 34 | Caconde | 3108 | 3.61 | 66.04 |
| 3 | Campinas | 5243 | 35.06 | 71.31 |
| 43 | Cananeia | 4374 | 0 | 0 |
| 29 | Capao Bonito | 1897 | 8.97 | 45.08 |
| 33 | Cardoso | 4910 | 38.25 | 19.49 |
| 28 | Casa Branca | 3044 | 38.62 | 69.03 |
| 50 | Cassia dos Coqueiros | 3100 | 42.91 | 70.04 |
| 44 | Columbia | 7008 | 61.05 | 40.88 |
| 49 | Corumbatai | 3595 | 12.77 | 53.01 |
| 22 | Dracena | 1206 | 6.09 | 49.10 |
| 12 | Franca | 4032 | 31.20 | 72.69 |
| 30 | Francisco Morato | 2307 | 3.89 | 10.39 |
| 24 | Franco da Rocha | 12246 | 20.29 | 47.82 |
| 15 | Guaratingueta | 3499 | 19.13 | 49.45 |
| 4 | Guarulhos | 10465 | 47.77 | 72.14 |
| 40 | Itabera | 2318 | 7.91 | 51.04 |

ECONOMIC INDICATORS con't

11 Value of annual production per farm worker, in cruzeiros.

12 Percentage of farms which uses machinery.

13 Percentage of farms which uses fertilizers.

NOTE: Indicators 12 and 13 represents agricultural development.

DATA FOR ANALYSIS OF THE GEOGRAPHY OF SAO PAULO, BRAZIL

Reference No. TABLE 3B

| | Municipality | 11 | 12 | 13 |
|---|---|---|---|---|
| 21 | Itapira | 3683 | 43.96 | 17.55 |
| 23 | Jales | 1605 | 7.39 | 25.63 |
| 16 | Jau | 5876 | 31.06 | 65.16 |
| 7 | Jundiai | 4592 | 28.12 | 80.81 |
| 47 | Magda | 4598 | 40.51 | 32.48 |
| 39 | Maracai | 5110 | 51.68 | 41.28 |
| 14 | Marilia | 2621 | 22.49 | 53.47 |
| 32 | Monte Aprazivel | 2040 | 22.22 | 38.76 |
| 27 | Novo Horizonte | 3625 | 30.56 | 70.34 |
| 26 | Olimpia | 3540 | 66.34 | 57.80 |
| 17 | Ourinhos | 4355 | 38.43 | 38.62 |
| 38 | Palestina | 2913 | 47.55 | 19.39 |
| 36 | Paraibuna | 2237 | 6.22 | 41.37 |
| 45 | Pereiras | 2345 | 9.24 | 17.78 |
| 35 | Periube | 1477 | 5.10 | 13.77 |
| 9 | Piracicaba | 4499 | 44.20 | 78.55 |
| 11 | Presidente Prudente | 2354 | 9.88 | 18.21 |
| 5 | Ribeirao Preto | 6118 | 44.73 | 82.73 |
| 2 | Santos | 2148 | 6.04 | 41.21 |
| 25 | Sao Joaquim da Barra | 5891 | 55.02 | 83.93 |
| 8 | Sao Jose dos Campos | 6244 | 28.74 | 45.69 |
| 1 | Sao Paulo | 0 | 0 | 0 |
| 46 | Saraqui | 2270 | 6.76 | 51.86 |
| 6 | Sorocaba | 2606 | 15.39 | 81.20 |
| 31 | Ubatuba | 1638 | 9.31 | 10.64 |

SOURCE: NATIONAL CENSUS OF BRAZIL

APPENDIX B

REGRESSION EQUATION: $y = bo \pm b1Xi$

| INDICATORS | GROUPS | bo | b1 | t-cal | t-tab | $r^2$ | Significant |
|---|---|---|---|---|---|---|---|
| HIGH SCHOOL EDUCATION | | 7.46 | .0143 | 3.29 | 2.447 | | Yes |
| | | 7.32 | .0025 | 0.94 | 2.447 | | No |
| | | 4.80 | .0024 | 0.87 | 2.447 | | No |
| | | 3.56 | -.0015 | -0.68 | 2.074 | | No |
| BASIC SERVICES | | 277 | .0171 | 1.84 | 2.447 | | No |
| | | 249 | .0299 | 2.14 | 2.447 | | No |
| | | 265 | -.0406 | -1.83 | 2.447 | | No |
| | | 170 | .0041 | 0.07 | 2.070 | | No |
| HOUSING | | 7.64 | -.0047 | -0.57 | 2.447 | | No |
| | | 7.95 | .0049 | 0.81 | 2.447 | | No |
| | | 4.93 | .0166 | 1.43 | 2.447 | | No |
| | | 27.5 | .0022 | 0.10 | 2.074 | | No |
| CHILDREN | | 81.7 | .0058 | 1.16 | 2.447 | | No |
| | | 79.6 | .0056 | 2.20 | 2.145 | | Yes |
| | | 80.1 | .0077 | 1.66 | 2.074 | | No |

| INDICATORS | GROUPS | bo | b1 | t-cal | t-tab | $r^2$ | Significant |
|---|---|---|---|---|---|---|---|
| SALES | | 1784 | 7.55 | 2.61 | 2.447 | .729 | Yes |
| | | 905 | 2.80 | 2.25 | 2.145 | .515 | Yes |
| | | 419 | .147 | 0.41 | 2.074 | | No |
| INDUSTRY | | 34.4 | -.0746 | -4.58 | 2.447 | | Yes |
| | | 12.0 | -.0061 | -0.77 | 2.145 | | No |
| | | 3.73 | -.0022 | -0.78 | 2.074 | | No |
| AGRICULTURE | | 6066 | -2.06 | -0.29 | 2.447 | | No |
| | | 7081 | -6.91 | -2.28 | 2.145 | | Yes |
| | | 1812 | 3.91 | 2.67 | 2.074 | | Yes |
| TECHNOLOGY | | 32.5 | .0140 | 0.41 | 2.447 | | No |
| | | 33.3 | -.0044 | -0.17 | 2.145 | | No |
| | | -.162 | .0620 | 3.29 | 2.074 | | Yes |

NOTE: GENERAL HYPOTHESIS

$H_0$: There is no relationship between distance and development

$H_1$: There is a relationship between distance and development

NOTE: STATISTICAL TEST

T - test

NOTE: Significance Level = .05

# APPENDIX C

INDEX TO MUNICIPALITIES IN SAO PAULO SAMPLE

| Reference No. | Name of Municipality | Population of largest town | Hierarchical status | Elevation above sea level |
|---|---|---|---|---|
| 1 | São Paulo | 5,876,527 | 1 | 4 |
| 2 | Santos | 340,855 | 3a | 1 |
| 3 | Campinas | 328,173 | 2a | 4 |
| 4 | Guarulhos | 221,569 | 5 | 4 |
| 5 | Ribeirão Preto | 191,472 | 2a | 4 |
| 6 | Sorocaba | 165,799 | 2b | 4 |
| 7 | Jundiaí | 145,740 | 3b | 4 |
| 8 | São José dos Campos | 129,980 | 3a | 4 |
| 9 | Piracicaba | 125,384 | 3a | 4 |
| 10 | Bauru | 120,229 | 2a | 4 |
| 11 | Presidente Prudente | 91,474 | 2b | 3 |
| 12 | França | 86,863 | 3a | 5 |
| 13 | Araçatuba | 85,616 | 2b | 3 |
| 14 | Marília | 73,217 | 2b | 4 |
| 15 | Guaratinguetá | 54,773 | 3b | 4 |
| 16 | Jaú | 41,009 | 3a | 4 |
| 17 | Ourinhos | 40,763 | 2b | 3 |
| 18 | Bragança Paulista | 39,565 | 3b | 5 |
| 19 | Avaré | 29,891 | 3b | 4 |
| 20 | Bebedouro | 28,787 | 3b | 4 |
| 21 | Itapira | 25,733 | 5 | 4 |
| 22 | Dracena | 23,976 | 3b | 3 |
| 23 | Jales | 21,479 | 3b | 4 |
| (24) | Franco da Rocha | 19,930 | 4b | 4 |
| 25 | São Joaquim da Barra | 19,716 | 4a | 4 |
| 26 | Olímpia | 19,588 | 3b | 4 |
| 27 | Novo Horizonte | 13,082 | 4b | 4 |
| 28 | Casa Branca | 11,664 | 4b | 4 |
| 29 | Capão Bonito | 10,741 | 4b | 4 |
| 30 | Francisco Morato | 9,013 | 5 | 5 |
| 31 | Ubatuba | 8,773 | 5 | 1 |
| 32 | Monte Aprazível | 8,694 | 3b | 3 |
| 33 | Cardoso | 7,700 | 4b | 3 |
| 34 | Caconde | 6,402 | 5 | 4 |
| 35 | Peruíbe | 6,063 | 5 | 1 |
| 36 | Paraibuna | 5,008 | 5 | 4 |
| 37 | Apiaí | 3,767 | 4b | 5 |
| 38 | Palestina | 3,741 | 5 | 4 |
| 39 | Maracaí | 3,188 | 4b | 3 |
| 40 | Itabera | 2,673 | 5 | 1 |
| 41 | Bananal | 2,165 | 5 | 4 |
| 42 | Boa Esperança do Sul | 1,941 | 5 | 4 |
| 43 | Cananéia | 1,769 | 5 | 1 |
| 44 | Colombia | 1,561 | 5 | 3 |
| 45 | Pereiras | 1,466 | 5 | 4 |
| 46 | Saraquí | 1,389 | 5 | 4 |
| 47 | Magda | 1,005 | 5 | 3 |
| 48 | Alto Alegre | 999 | 5 | 4 |
| 49 | Corumbataí | 949 | 5 | 4 |
| 50 | Cassia dos Coqueiros | 589 | 5 | 5 |

Notes: The smaller the hierarchical status number, the more important the town as a trade centre. Towns with an "a" designation are relatively better equipped commercially than those designated "b".
Elevations are indicated as follows: 1 - 0 to 100 m; 3 - 200 to 500 m; 4 - 500 to 800 m; 5 - over 800 m (No towns in the sample are at elevations of 100 - 200 m).

FIGURE 1

FIGURE 2

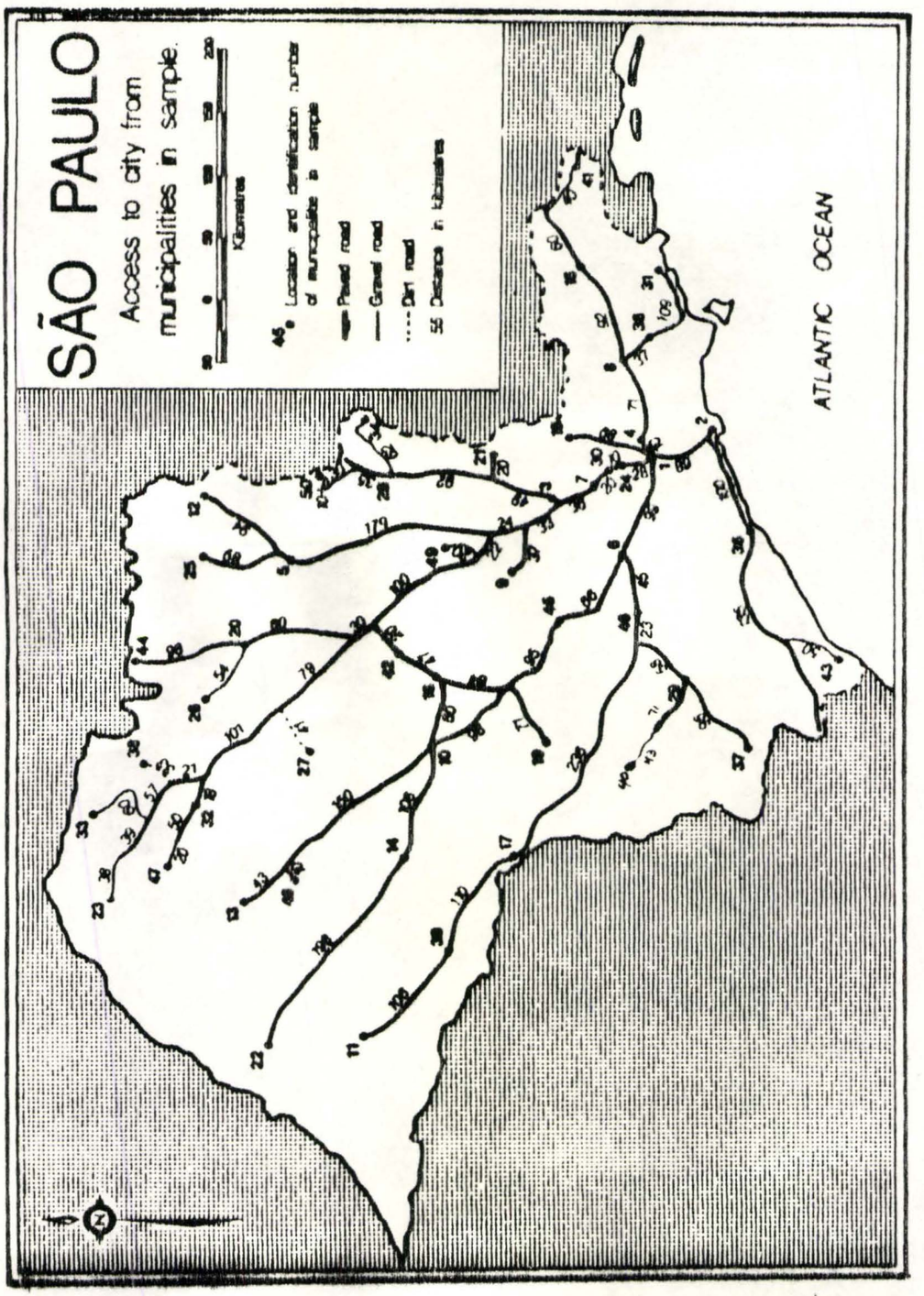
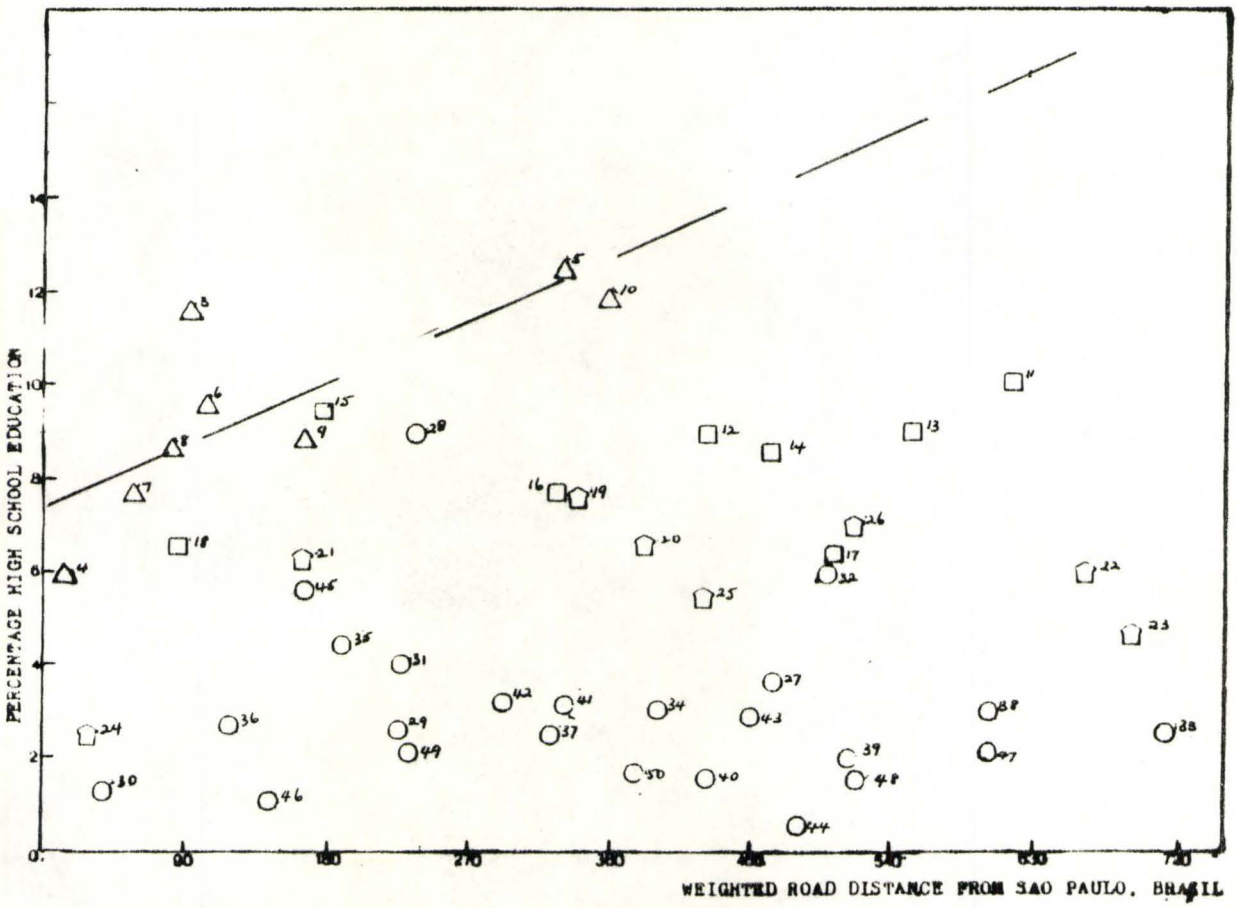

SÃO PAULO
Access to city from municipalities in sample
Kilometres
Paved road
Gravel road
Dirt road
ATLANTIC OCEAN

FIGURE 3

Influence of Sao Paulo City on Education in its Region




The small numbers above the symbols are reference numbers. They refer to the relative location of the chief town of the municipality.

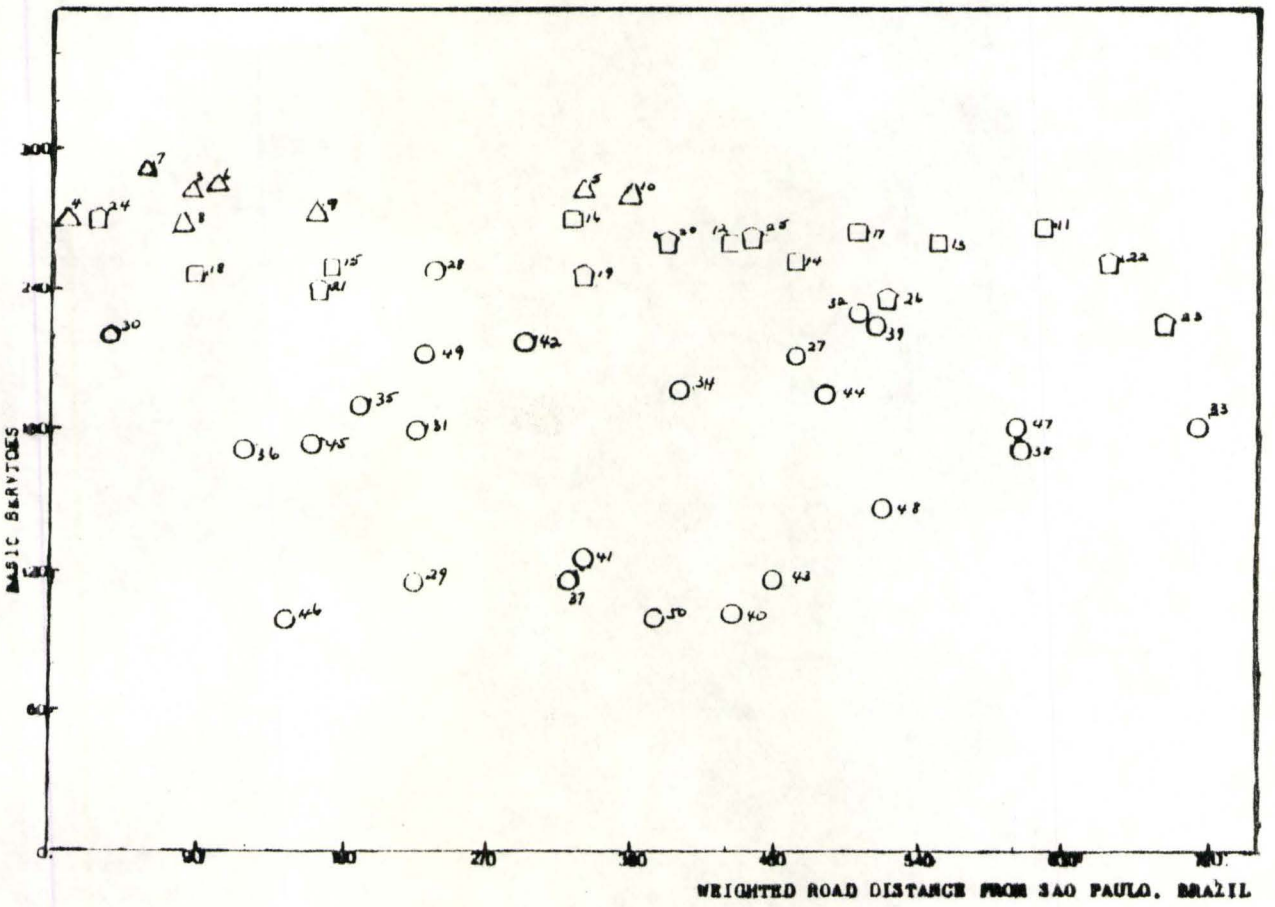
△ Group A: represents towns with a population greater than 100,000
□ Group B: represents towns with a population size between 50,000 and 99,999
⬠ Group C: represents towns with a population size between 49,999 and 18,000
○ Group D: represents towns with a population less than 17,999

Regression Equations

Group A: $y=7.46 + .0143X1$, significant at $\alpha=.05$
Group B: $y=7.32 + .0025X1$, not significant at $\alpha=.05$
Group C: $y=4.80 + .0024X1$, not significant at $\alpha=.05$
Group D: $y=3.56 - .0015X1$, not significant at $\alpha=.05$

FIGURE 4

Influence of Sao Paulo City on level of Basic Services in its Region




The small numbers above the symbols are reference numbers. They refer to the relative location of the chief town of the municipality.

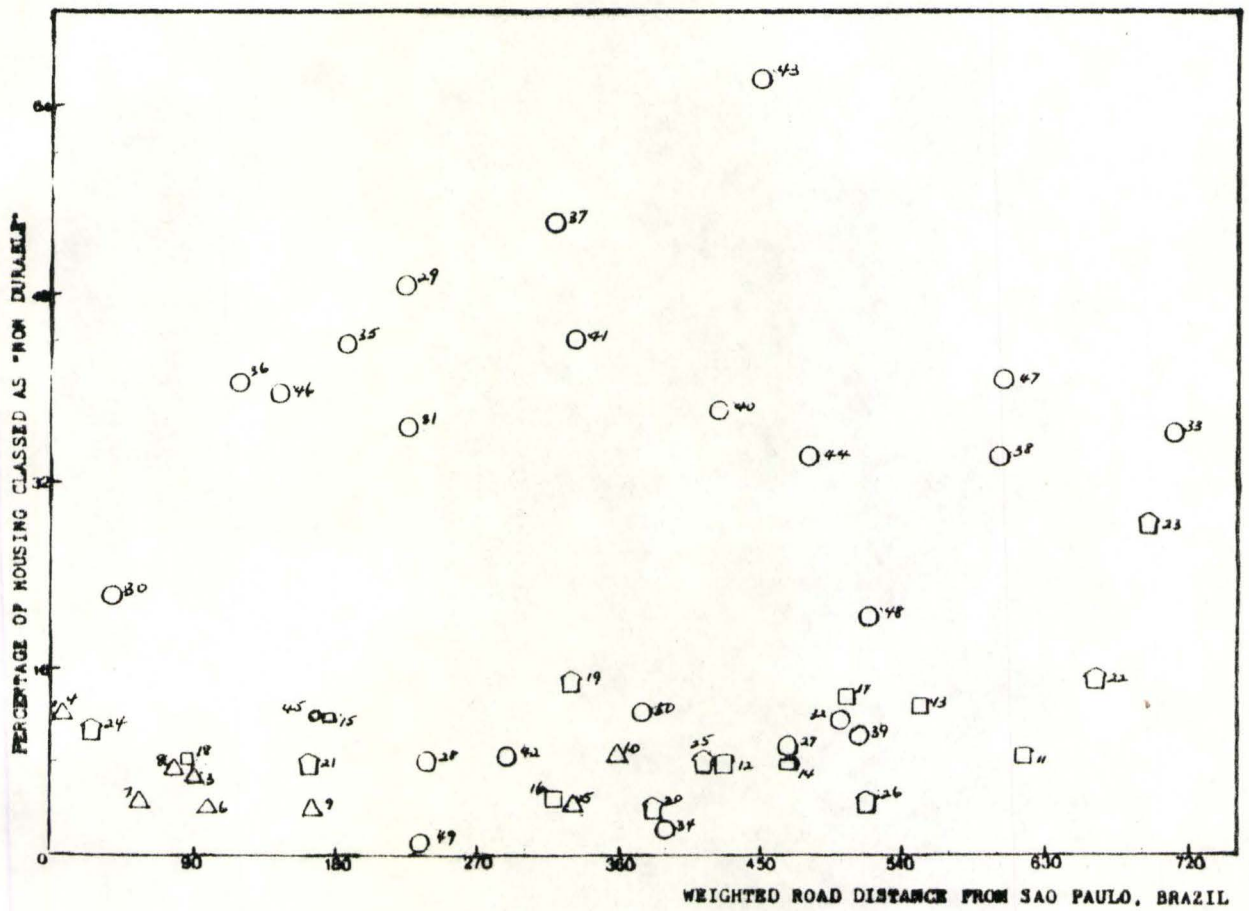
△ Group A: represents towns with a population size > 100,000
□ Group B: represents towns with a population size between 50,000 and 99,999
⬠ Group C: represent towns with a population size between 49,999 and 18,000
○ Group D: represents towns with a population size < 17,999

## Regression Equations

Group A: $y=277 + .0171X1$, not significant at $\alpha = .05$
Group B: $y=249 + .0299X1$, not significant at $\alpha = .05$
Group C: $y=265 - .0406X1$, not significant at $\alpha = .05$
Group D: $y=170 + .0041X1$, not significant at $\alpha = .05$

FIGURE 5

Influence of Sao Paulo City on the level of housing in its Region




The small numbers above the symbols are reference numbers. They refer to the relative location of the chief town of the municipality.

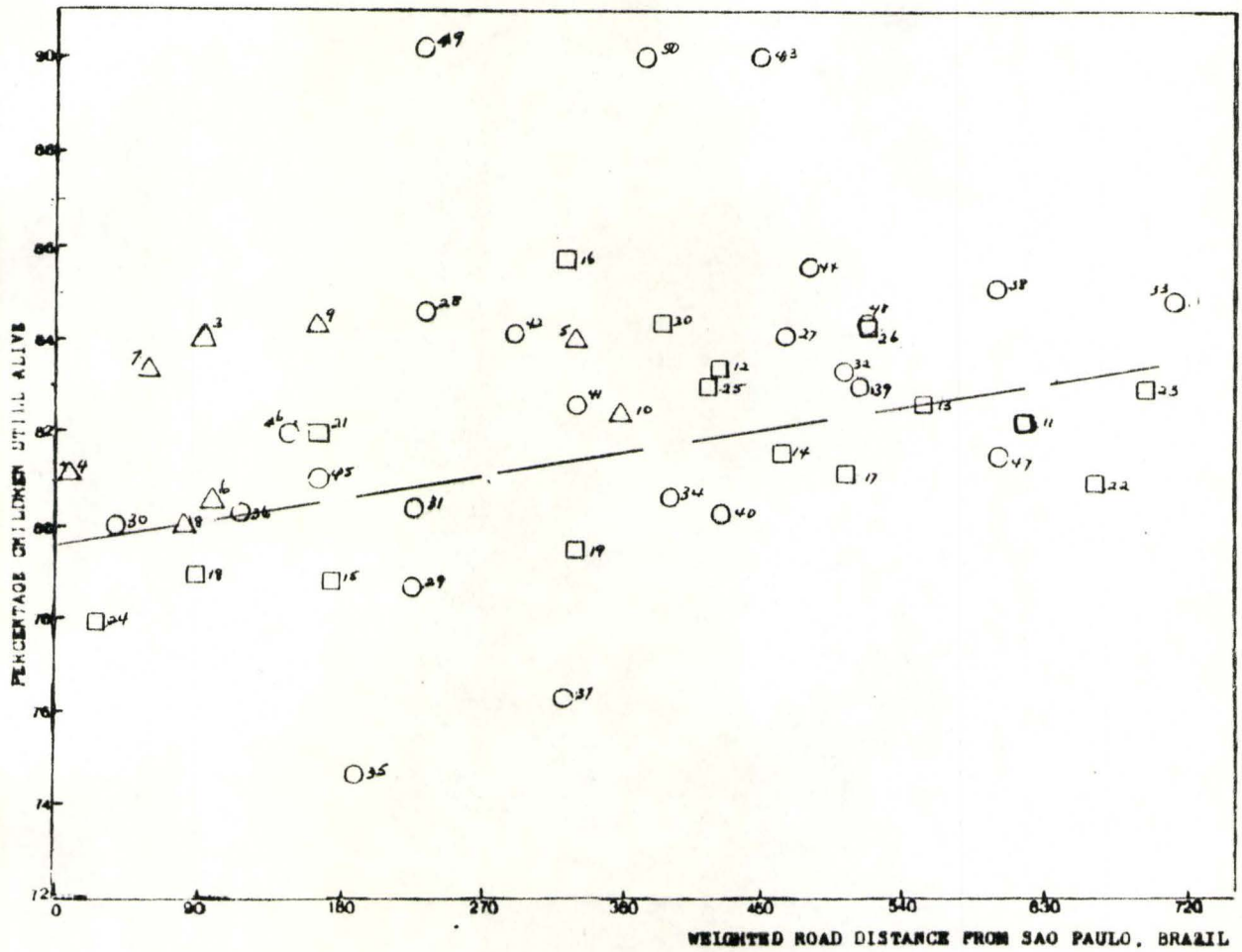
△ Group A: represents towns with a population size > 100,000
□ Group B: represents towns with a population size between 50,000 and 99,999
⌂ Group C: represents towns with a population size between 49,999 and 18,000
○ Group D: represents towns with a population size < 17,999

Regression Equations

Group A: $y=7.64 - .0047X1$, not significant at $\alpha = .05$
Group B: $y=7.95 + .0049X1$, not significant at $\alpha = .05$
Group C: $y=4.93 + .0166X1$, not significant at $\alpha = .05$
Group D: $y=27.5 + .0022X1$, not significant at $\alpha = .05$

FIGURE 6

Influence of Sao Paulo City on Health in its Region




The small numbers above the symbols are reference numbers. They refer to the relative location of the chief town of the municipality.

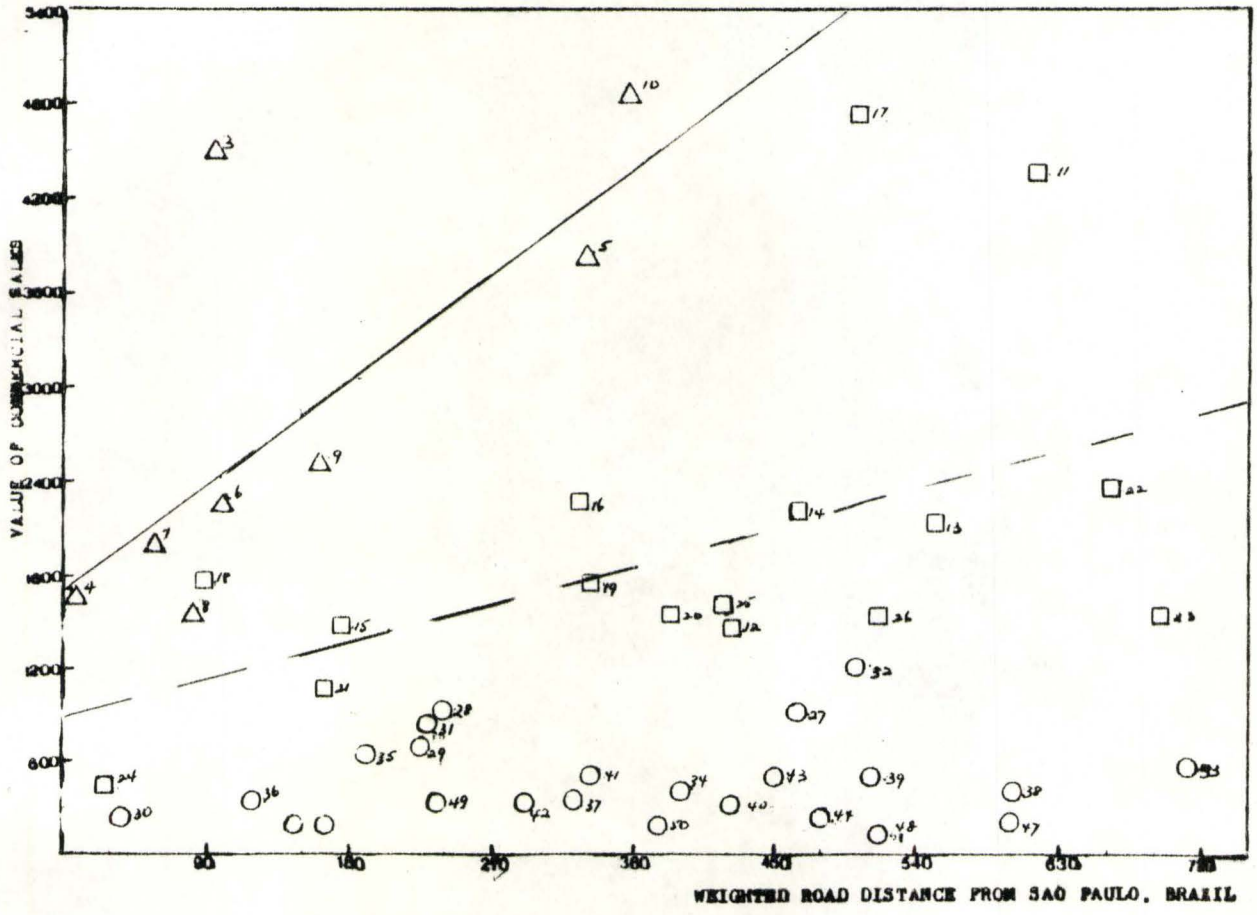
△ Group A: represents towns with a population size > 100,000
□ Group B: represents towns with a population size between 18,000 and 99,999
○ Group C: represents towns with a population size < 17,999

Regression Equations

Group A: $y=81.7 + .0058X1$, not significant at $\alpha = .05$
Group B: $y=79.6 + .0056X1$, signigicant at $\alpha = .05$
Group C: $y=80.1 + .0077X1$, not significant at $\alpha = .05$

FIGURE 7

Influence of Sao Paulo City on Commercial Sales in its Region




The small numbers above the symbols are reference numbers. They refer to the relative location of the chief town of the municipality.

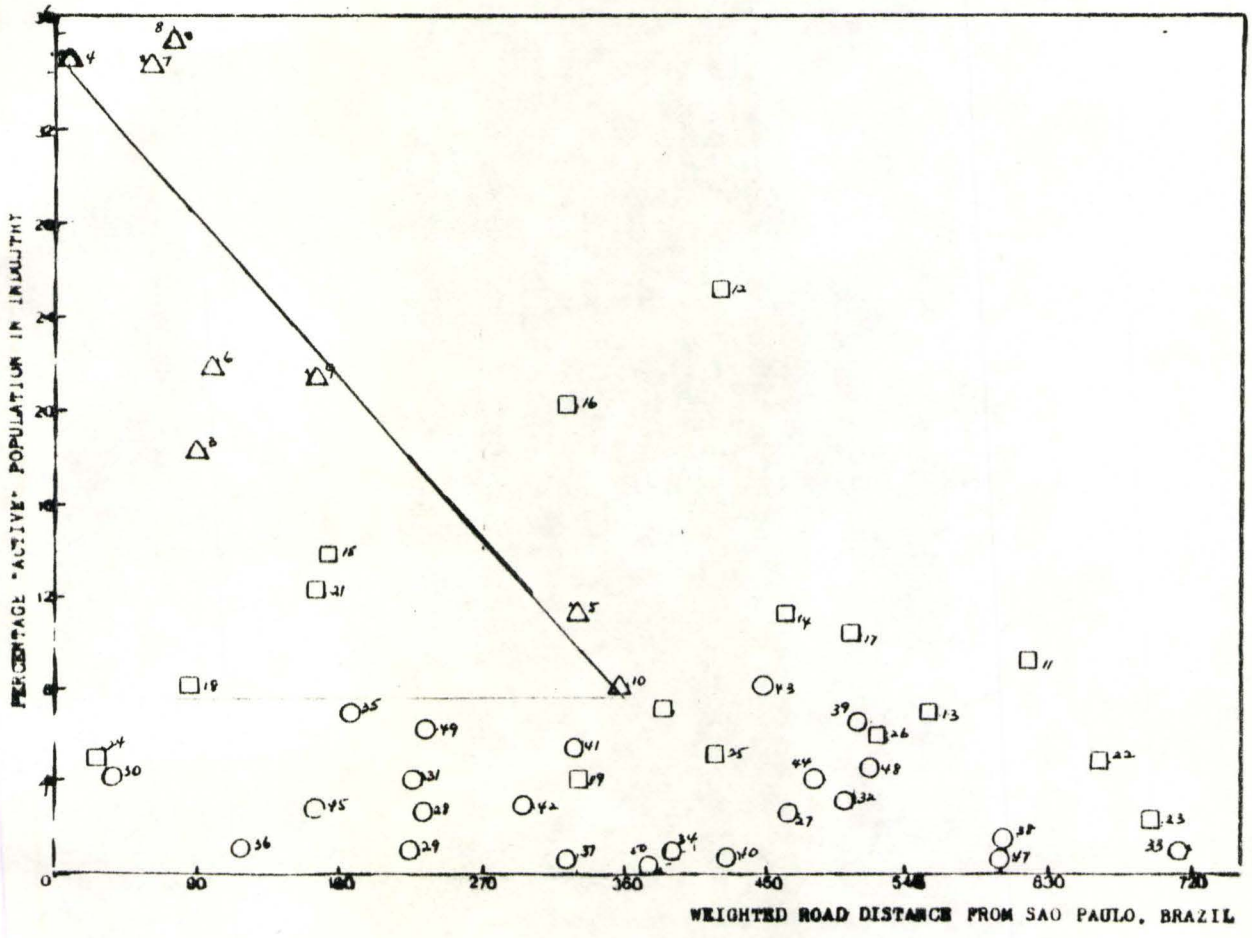
△ Group A: represents towns with a population size > 100,000
□ Group B: represents towns with a population size between 18,000 and 99,999
○ Group C: represents towns with a population size < 17,999

Regression Equations

—— Group A: $y=1784 + 7.55X1$, significant at $\alpha = .05$
--- Group B: $y=905 + 2.80X1$, significant at $\alpha = .05$
Group C: $y=419 + .147X1$, not significant at $\alpha = .05$

FIGURE 8

Influence of Sao Paulo City on Industrial development in its Region




The small numbers above the symbols are reference numbers. They refer to the relative location of the chief town in the municipality.

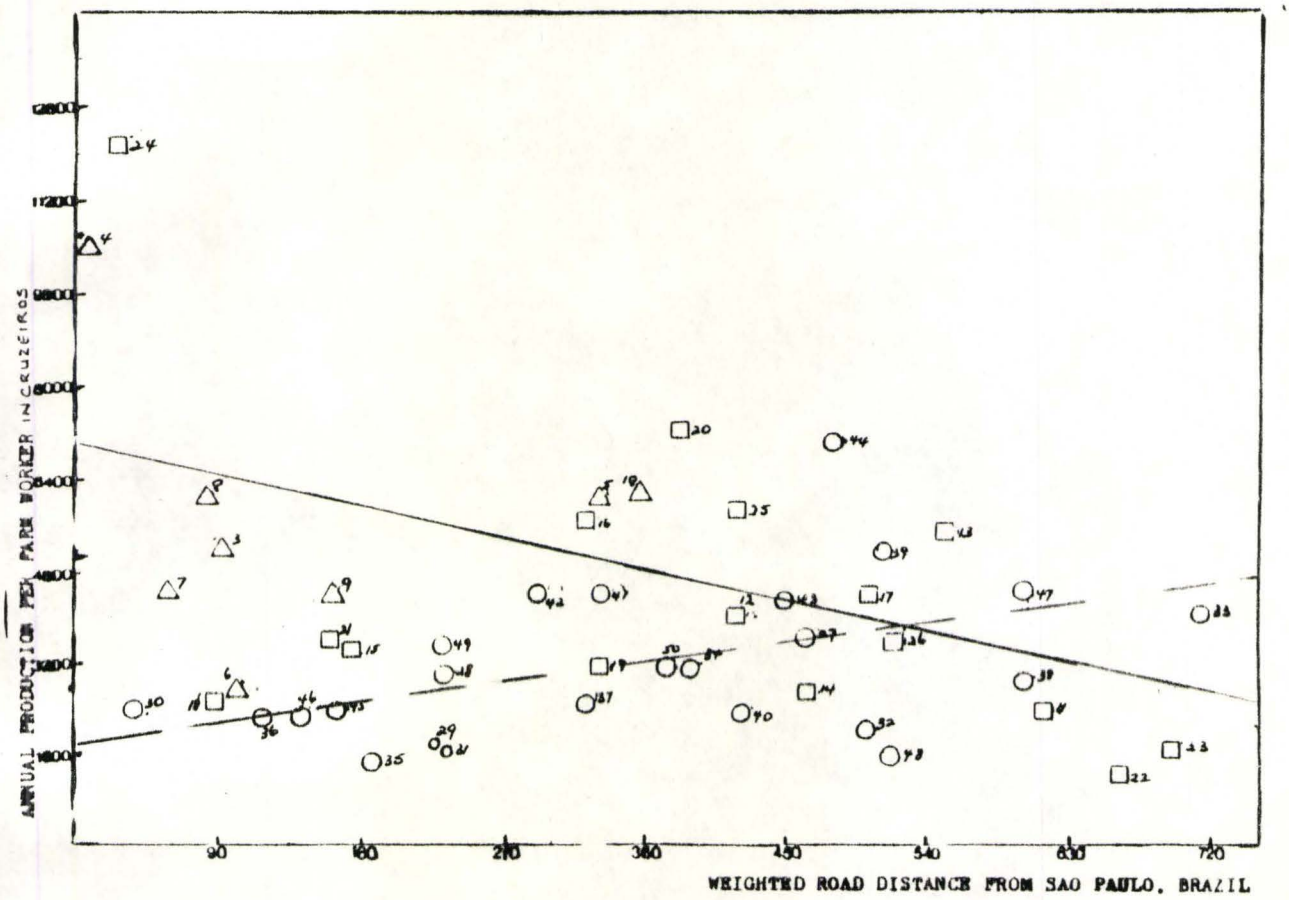
△ Group A: represents towns with a population size > 100,000
□ Group B: represents towns with a population size between 18,000 and 99,999
○ Group C: represents towns with a population size < 17,999

Regression Equations

——Group A: $y=34.4 - .0747X1$, significant at $\alpha = .05$
Group B: $y=12.0 - .0061X1$, not significant at $\alpha = .05$
Group C: $y= 3.73 - .0022X1$, not significant at $\alpha = .05$

FIGURE 9

Influence of Sao Paulo City on Agricultural Productivity in its Region




The small numbers above the symbols are reference numbers. They refer to the relative location of the chief town in the municipality.

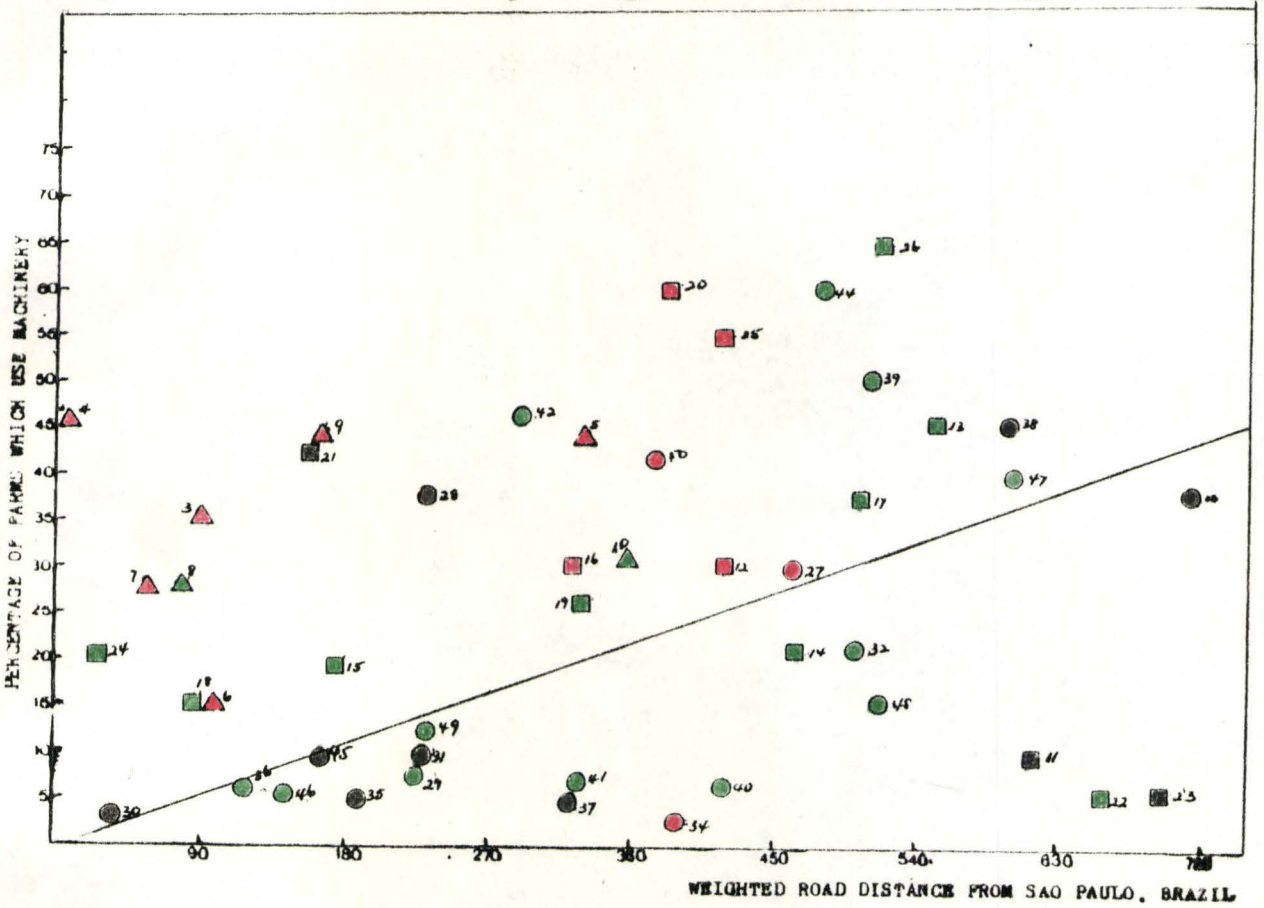
△ Group A: represents towns with a population size > 100,000
□ Group B: represents towns with a population size between 18,000 and 99,999
○ Group C: represents towns with a population size < 17,999

Regression Equations

Group A: $y=6066 - 2.05X1$, not significant at $\alpha=.05$
—— Group B: $y=7081 - 6.91X1$, significant at $\alpha=.05$
--- Group C: $y=1812 + 3.91X1$, significant at $\alpha=.05$

FIGURE 10

Influence of Sao Paulo City on Agricultural Technology in its Region




The small numbers above the symbols are reference numbers. They refer to the relative location of the chief town of the municipality.

△ Group A: represents towns with a population size > 100,000
□ Group B: represents towns with a population size between 18,000 and 99,999
○ Group C: represents towns with a population size < 17,999

Regression Equations

Group A: $y = 32.5 + .0140X1$, not significant at $\alpha = .05$
Group B: $y = 33.3 - .0044X1$, not significant at $\alpha = .05$
—— Group C: $y = -.162 + .0620X1$, significant at $\alpha = .05$

The small colors represent the second indicator, that is, the percentage of farms which uses fertilizers.

| Black | Green | Red |
|---|---|---|
| 0-30 | 30-60 | 60-90 |

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