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16. Abstract

The objective of this study was to assess the effects of labor disputes on transit ridership in Texas using statistical analysis of selected variables. However during the 1979-1983 study period only one transit system in Texas experienced a strike. Therefore it was necessary to examine what happened to systems outside the state which had labor strikes during this period. The results of this study and the effects of labor strikes on transit ridership on systems outside Texas can serve as an indicator of what might be expected to occur to transit ridership for Texas systems following a strike. Indeed Dallas, which did experience a strike during the study period, lost riders after its settlement.

Previous studies which addressed this issue have tended to examine the effect of a specific strike, and the effects included a wide range of variables, ridership being only one of several. Most of these studies observed and documented the effects of the strike, both during and after the dispute. The findings of the previous studies as they relate to transit ridership were generally confirmed by this work.

It is apparent that transit systems do experience a loss of riders following a labor strike. In light of increasing costs and declining productivity, lost ridership can be a critical factor for transit management. While there are negative implications for both management and labor as results of a strike, it is, perhaps, the public which incurs the major inconvenience.

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EFFECT OF LABOR DISPUTES ON TRANSIT RIDERSHIP

Jack Lamkin
Joanne Saunders
Linda Hearne-Locke

Technical Report 1076-1F
from
Technical Study 2-10-84-1076

Sponsored by

State Department of Highways and Public Transportation
in cooperation with
United States Department of Transportation
Urban Mass Transportation Administration

October 1984

Texas Transportation Institute
The Texas A&M University System
College Station, TX 77843

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DISCLAIMER

The authors are wholly responsible for the views, interpretations, and analysis presented in this report. Any errors or omissions are the responsibility of the authors.

EXECUTIVE SUMMARY

The objective of this study was to assess the effects of labor disputes on transit ridership in Texas using statistical analysis of selected variables. However during the 1979-1983 study period only one transit system in Texas experienced a strike. Therefore it was necessary to examine what happened to systems outside the state which had labor strikes during this period. The results of this study and the effects of labor strikes on transit ridership on systems outside Texas can serve as an indicator of what might be expected to occur to transit ridership for Texas systems following a strike. Indeed Dallas, which did experience a strike during the study period, lost riders after its settlement.

Previous studies which addressed this issue have tended to examine the effect of a specific strike, and the effects included a wide range of variables, ridership being only one of several. Most of these studies observed and documented the effects of the strike, both during and after the dispute. The findings of the previous studies as they relate to transit ridership were generally confirmed by this work.

Lost, or slow return of riders to a transit system is perhaps the most critical and long lasting effect of a strike. While this aspect was the focus of this study the findings of previous studies furnish insight into other dimensions of this problem.

The findings of this study indicate the following:

- Labor strikes in the transit industry have a negative impact on ridership. Of the ten systems examined only two did not show a loss of riders for the following twelve month post-strike period.
- Strikes of extended duration tend to require a longer recovery period. This study examined transit systems which experienced

strikes ranging from 2 to 55 days. Although there are exceptions it was generally found that the longer the strike duration the greater the loss of riders during both the first post-strike quarter as well as for the following twelve months.

- The first post-strike quarter is the most critical period for the transit systems to regain ridership. Ridership levels for the second, third, and fourth post-strike quarter tend to move toward the corresponding pre-strike quarter.
- The prediction equation of transit ridership tended to fit the actual ridership for most of the systems examined.

It is apparent that transit systems do experience a loss of riders following a labor strike. In light of increasing costs and declining productivity, lost ridership can be a critical factor for transit management. Certainly, labor strikes in the transit industry will continue to occur. Management and labor representatives should, however, recognize that riders will be lost and be aware of the implications of these losses. While there are negative implications for both management and labor as results of a strike, it is, perhaps, the public which incurs the major inconvenience.

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INTRODUCTION

Labor disputes in the transit industry have far-reaching impacts on various aspects of the community it serves. The greatest impact, however, is on the transit system itself. Ridership lost to a competing mode during a strike is difficult to regain once service is restored and, in some cases, may never be fully regained.

During a transit strike, riders must make other arrangements for transportation. Often, there are few, if any, viable alternatives besides the use of private automobiles or car pools which may be more costly. On the other hand, riders may find that they prefer their alternate mode and not return to transit after the strike. Once the strike is settled, it is imperative that transit management re-establish, or expand, service levels and attempt to regain previous ridership levels. It is unlikely that ridership will immediately return to previous levels once service is resumed, however, it is essential to regain ridership in the shortest time possible in order to maintain a successful transit operation. The speed with which ridership is regained appears to be a function of several factors, some of which can be controlled by management while other are external to the system. Among these are the duration of the strike, alternatives used during the strike, level of service, fare changes, rider characteristics, and population and income variables. It is important for transit management to recognize the effects of these factors on regaining ridership levels and develop appropriate strategies to speed ridership recovery.

The objective of this study is to assess the effects of labor disputes on transit ridership. This was done by selecting a sample of transit systems in which a labor strike had occurred within the past five years.

These systems were then sent a questionnaire to obtain information pertaining to their operations and ridership before and after the strike and about the strike itself. The data collected was statistically analyzed to identify those variables which had a significant effect on transit ridership recovery and the readjustment time period after a strike. The results were reported and conclusions drawn from this analysis. The transit systems which are examined in this Report are located in the following cities: Ann Arbor, Columbus, Dallas, Denver, Jacksonville, Pittsburgh, Scaramento, Salt Lake City, San Diego, and Santo Cruz. Each of these cities experienced a disruption of transit service during the 1979-1983 study period. In addition, although they experienced no strikes, information was developed and is presented on all transit systems in Texas.

BACKGROUND

In order to analyze the impact that labor disputes, especially strikes, have on the transit industry, it is important to review the background of the industry. Texas transit differs from the U.S. transit industry in the fact that there is only one mode of transit, the motor bus. The U.S. transit statistics in the following tables include all principle modes of transit, heavy and light rail, trolley coach, and motor bus.

Transit Ridership

Transit ridership in the U.S. had been steadily declining from 1945 to 1972. Some of the factors contributing to this decline were: [1]

1) Trend toward low-density development,
2) Growing affluence,
3) Increased highway spending programs, and
4) A continued commitment to the automobile.

Since 1972, however, overall transit ridership has been on the rise. Financial assistance from federal, state, and local governments has helped to rehabilitate and expand transit service and started the ridership increase. The continuing growth of ridership has been spurred by the increasing costs of operating private automobiles, more public recognition of the convenience of riding transit, and publicly owned transit systems operating as a public service [2]. Only in the last few years has ridership started to decline and level off. This ridership trend is illustrated in Figure 1.

Transit ridership in Texas has followed the national trend except for a slight decrease in 1974 (Table 1). This decrease is probably due to the fact that the transit systems of Houston, San Antonio, and El Paso all had significant service interruptions due to employee strikes in 1974. Table 2

Figure 1

TREND OF U.S. TRANSIT RIDERSHIP

Table 1. TEXAS TRANSIT RIDERSHIP

Calendar Year	Bus Transit (thousands)
1973	117,451
1974	116,876
1975	120,734
1976	122,185
1977	128,108
1978	136,253
1979	147,454
1980	151,816
1981	153,921
1982	155,565
1983	152,703*

Source: Texas Transit Statistics, 1977 & 1982 Texas Department of Highways and Public Transportation.

*Preliminary

shows estimates of the effects of these strikes. Overall, there was a 30% increase in ridership from 117.5 million passengers carried in 1973 to 152.7 million in 1983 [3]. However, ridership declined in 1983, which may indicate a future downward trend or be only the results of reduced economic activity in Texas.

TABLE 2: ESTIMATED EFFECT OF EMPLOYEE STRIKES ON TRANSIT IN TEXAS-1974

Transit Systems Affected	Decreases in:			
	Passengers	Vehicle Miles	Passenger Revenues	Operating Expenses
El Paso	1,056,000	311,000	$ 228,000	$ 246,000
Houston	5,270,000	2,006,000	1,716,000	893,000
San Antonio	1,971,000	505,000	434,000	299,000
Total Estimated Decreases	8,297,000	2,822,000	$2,378,000	$1,438,000

Source: Texas Transit Operations, 1974 State Department of Highways and Public Transportation

Looking at the recent Texas transit situation in more detail, Figures 2 through 19 show transit ridership by month for each of the eighteen Texas systems from 1979 through 1983. The figures show that over the 5 year period ridership for most of the systems either stayed about the same or increased. Five systems (Austin, Corpus Christi, Ft. Worth, Galveston and Wichita Falls) had a decrease in ridership. The three largest cities, Houston, Dallas, and San Antonio, account for close to 80% of all transit ridership in Texas.

Figure 2

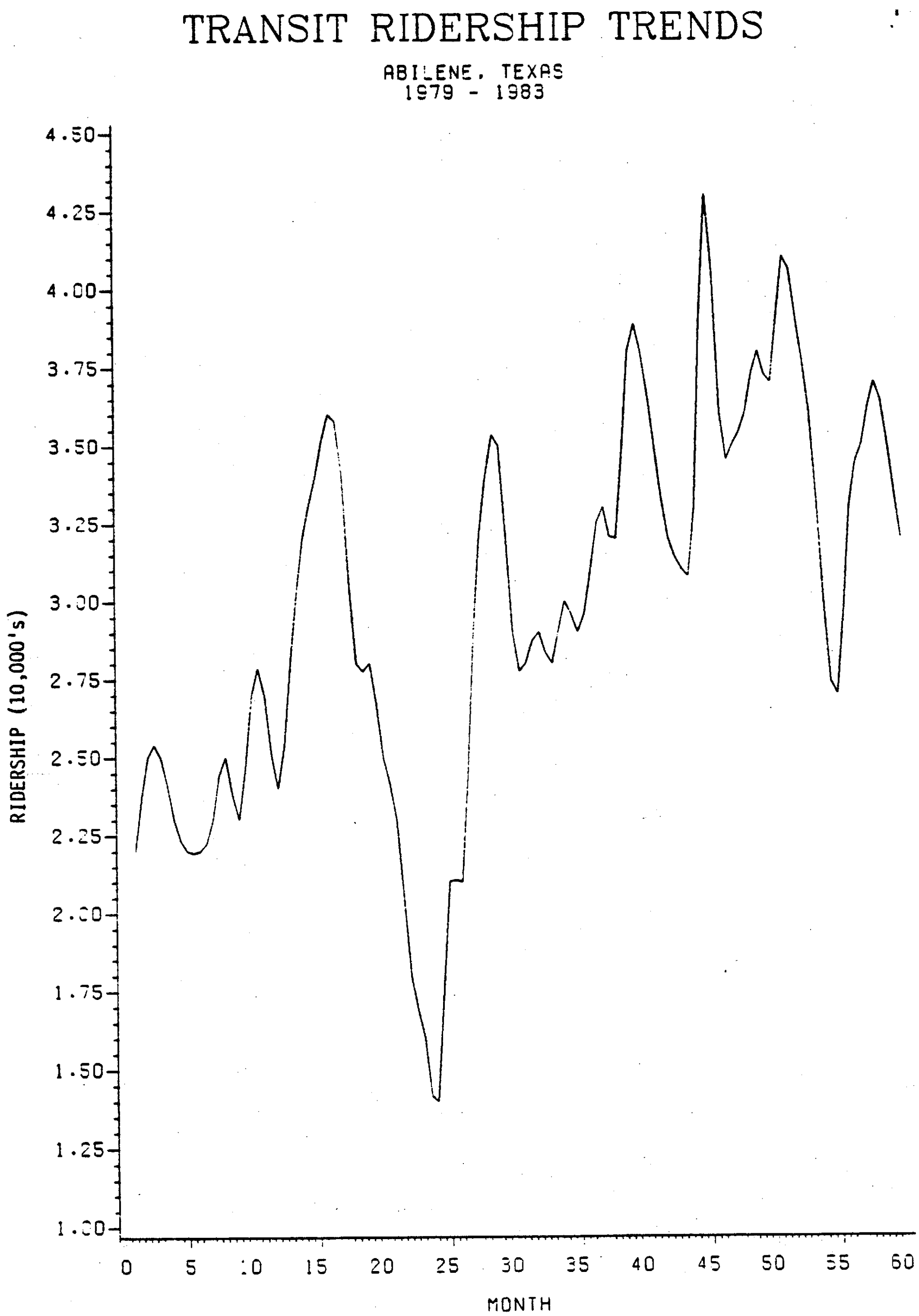
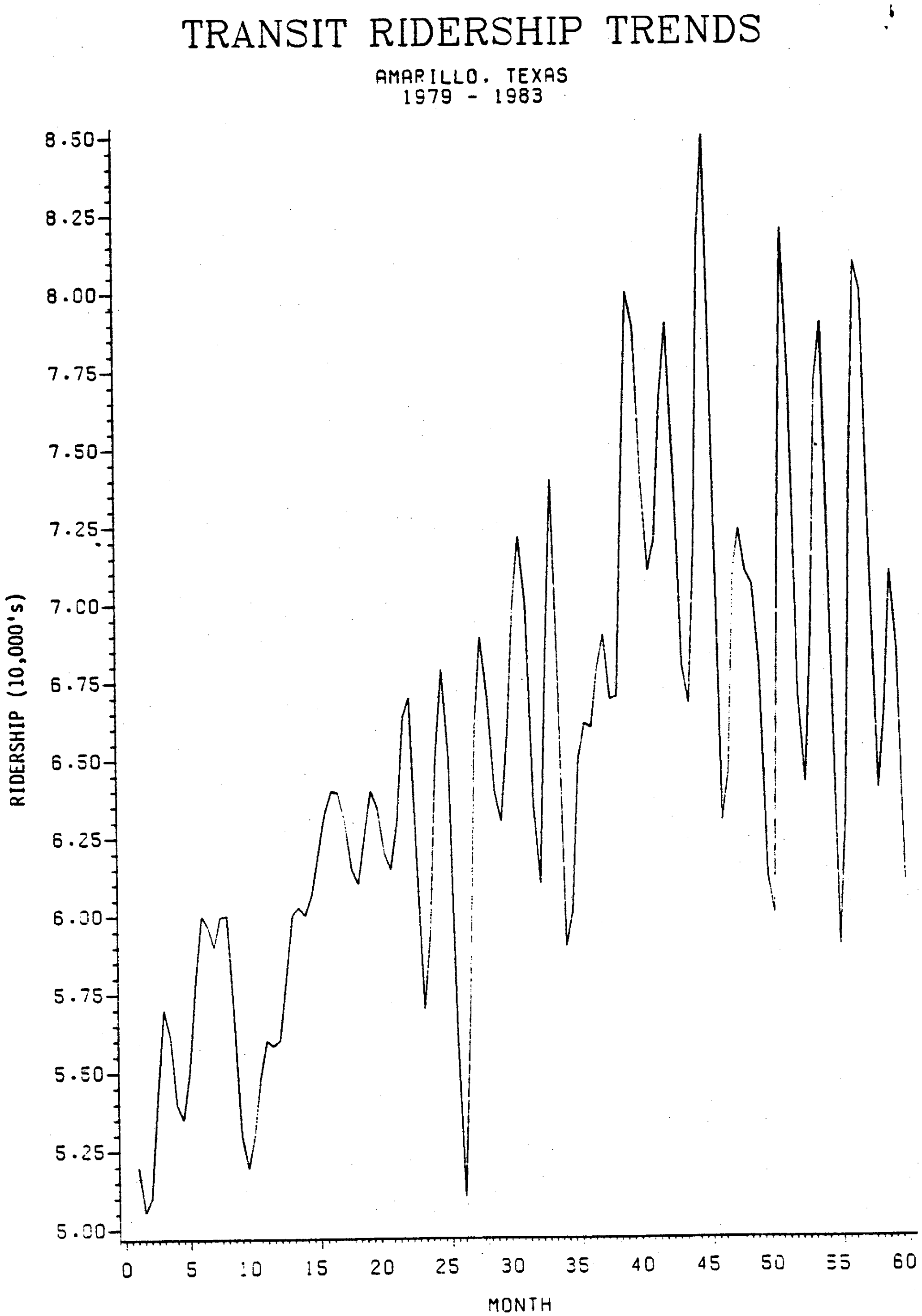

TRANSIT RIDERSHIP TRENDS
ABILENE, TEXAS
1979 - 1983
RIDERSHIP (10,000's)
4.50
4.25
4.00
3.75
3.50
3.25
3.00
2.75
2.50
2.25
2.00
1.75
1.50
1.25
1.00
0
5
10
15
20
25
30
35
40
45
50
55
60
MONTH

Figure 3



TRANSIT RIDERSHIP TRENDS
AMARILLO, TEXAS
1979 - 1983
RIDERSHIP (10,000's)
8.50
8.25
8.00
7.75
7.50
7.25
7.00
6.75
6.50
6.25
6.00
5.75
5.50
5.25
5.00
0
5
10
15
20
25
30
35
40
45
50
55
60
MONTH

Figure 4

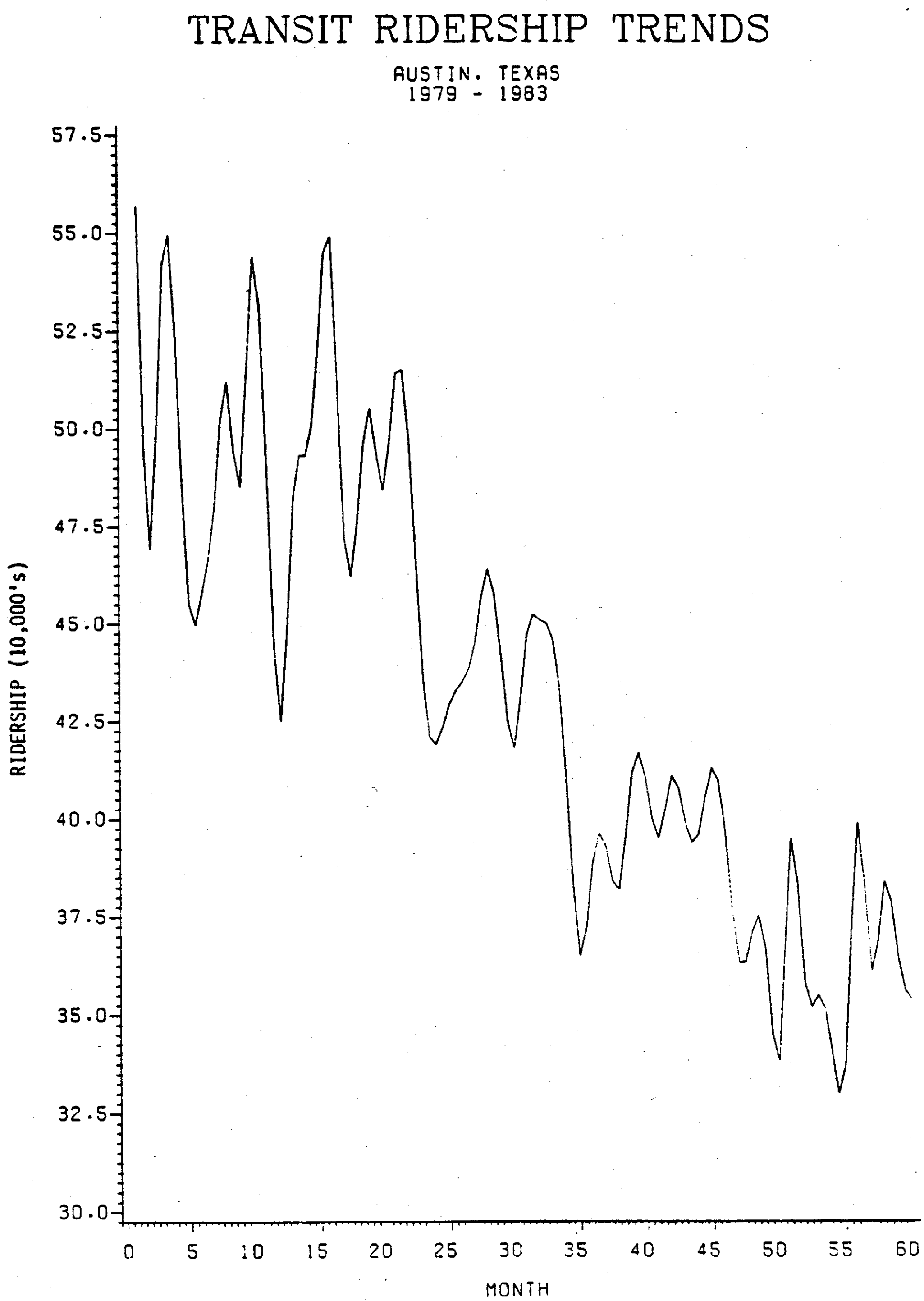

TRANSIT RIDERSHIP TRENDS
AUSTIN, TEXAS
1979 - 1983
RIDERSHIP (10,000's)
57.5
55.0
52.5
50.0
47.5
45.0
42.5
40.0
37.5
35.0
32.5
30.0
0
5
10
15
20
25
30
35
40
45
50
55
60
MONTH

Figure 5

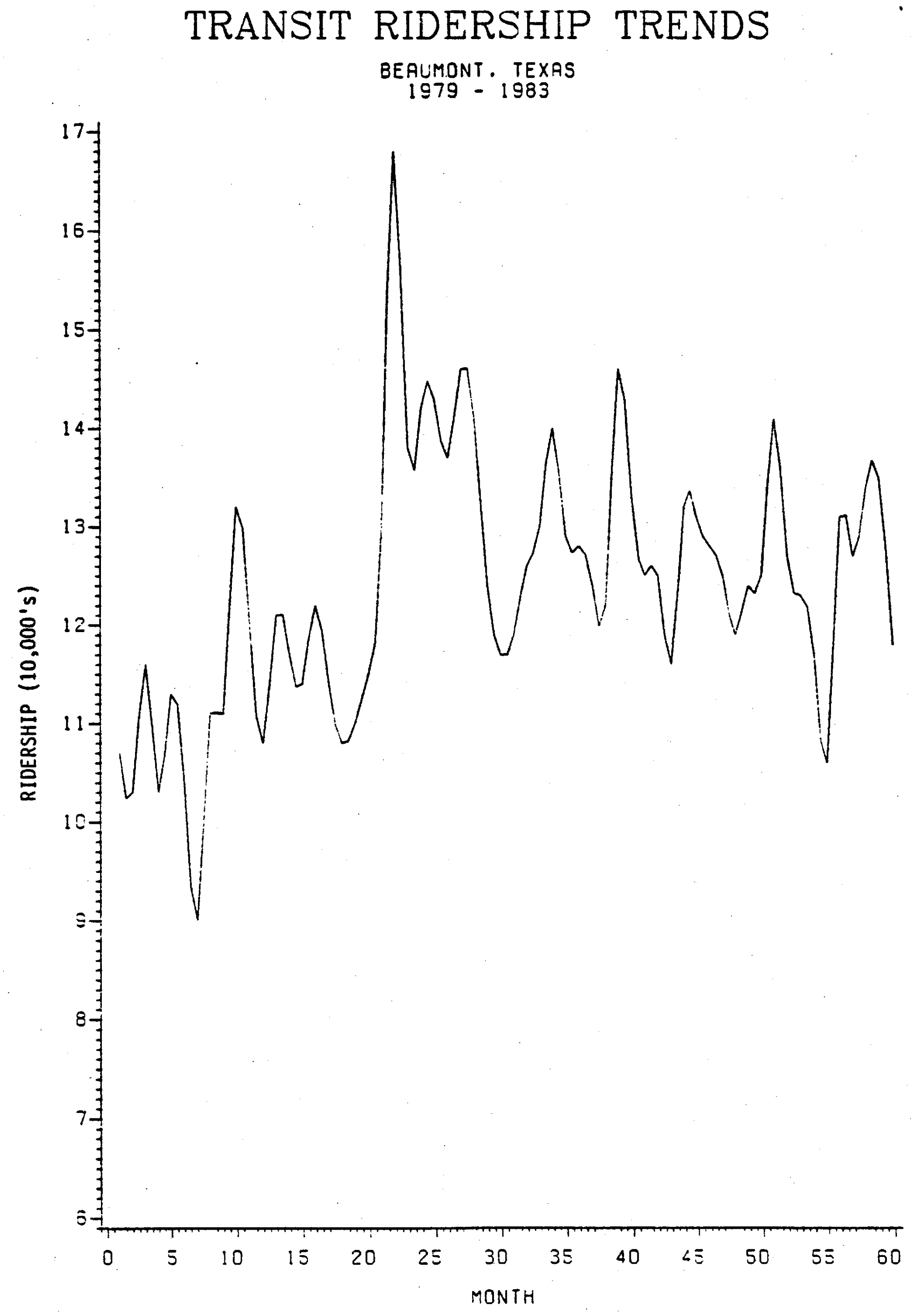

TRANSIT RIDERSHIP TRENDS
BEAUMONT, TEXAS
1979 - 1983
RIDERSHIP (10,000's)
17
16
15
14
13
12
11
10
9
8
7
6
0
5
10
15
20
25
30
35
40
45
50
55
60
MONTH

Figure 6

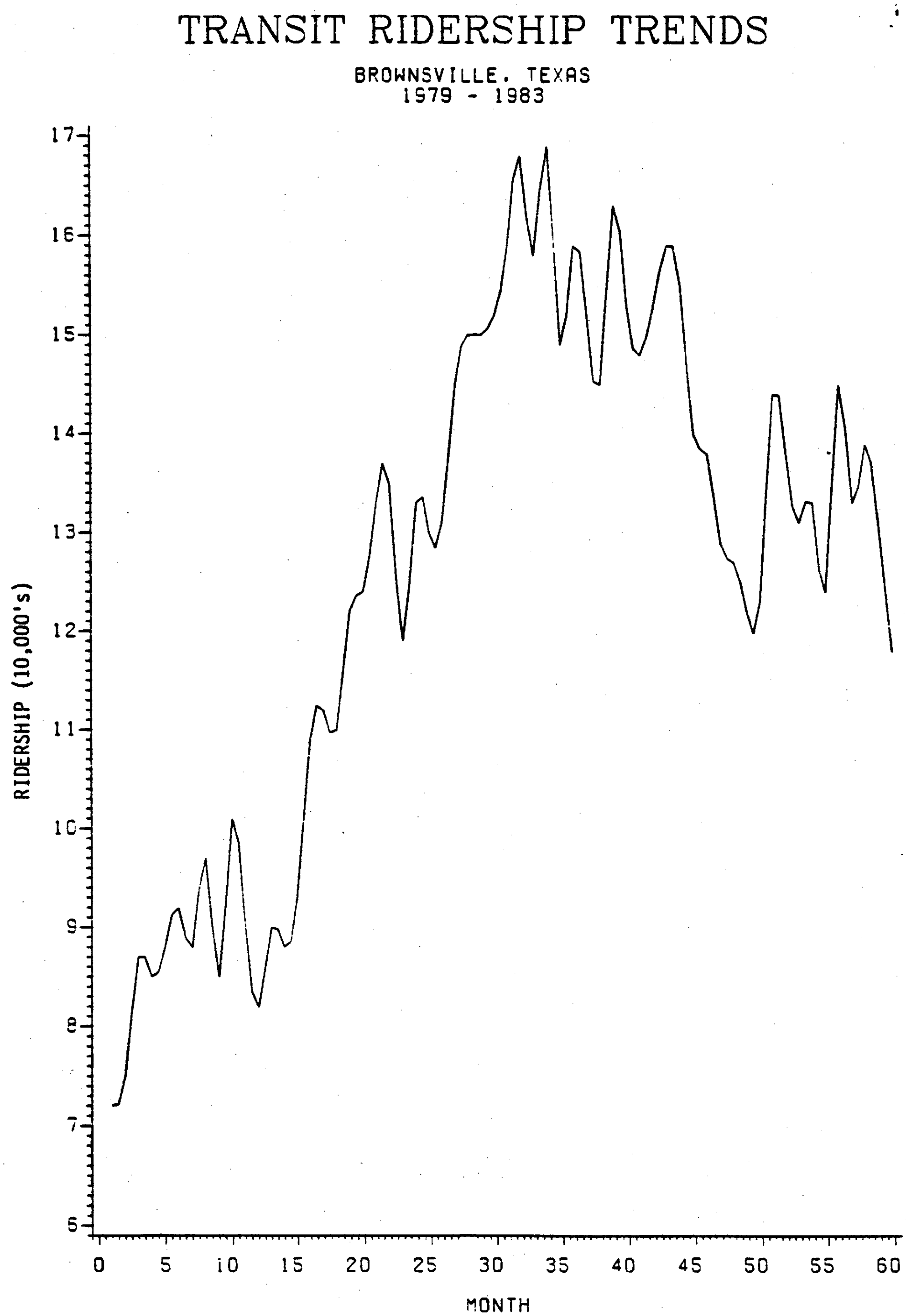

TRANSIT RIDERSHIP TRENDS
BROWNSVILLE, TEXAS
1979 - 1983
RIDERSHIP (10,000's)
6
7
8
9
10
11
12
13
14
15
16
17
0
5
10
15
20
25
30
35
40
45
50
55
60
MONTH

Figure 7

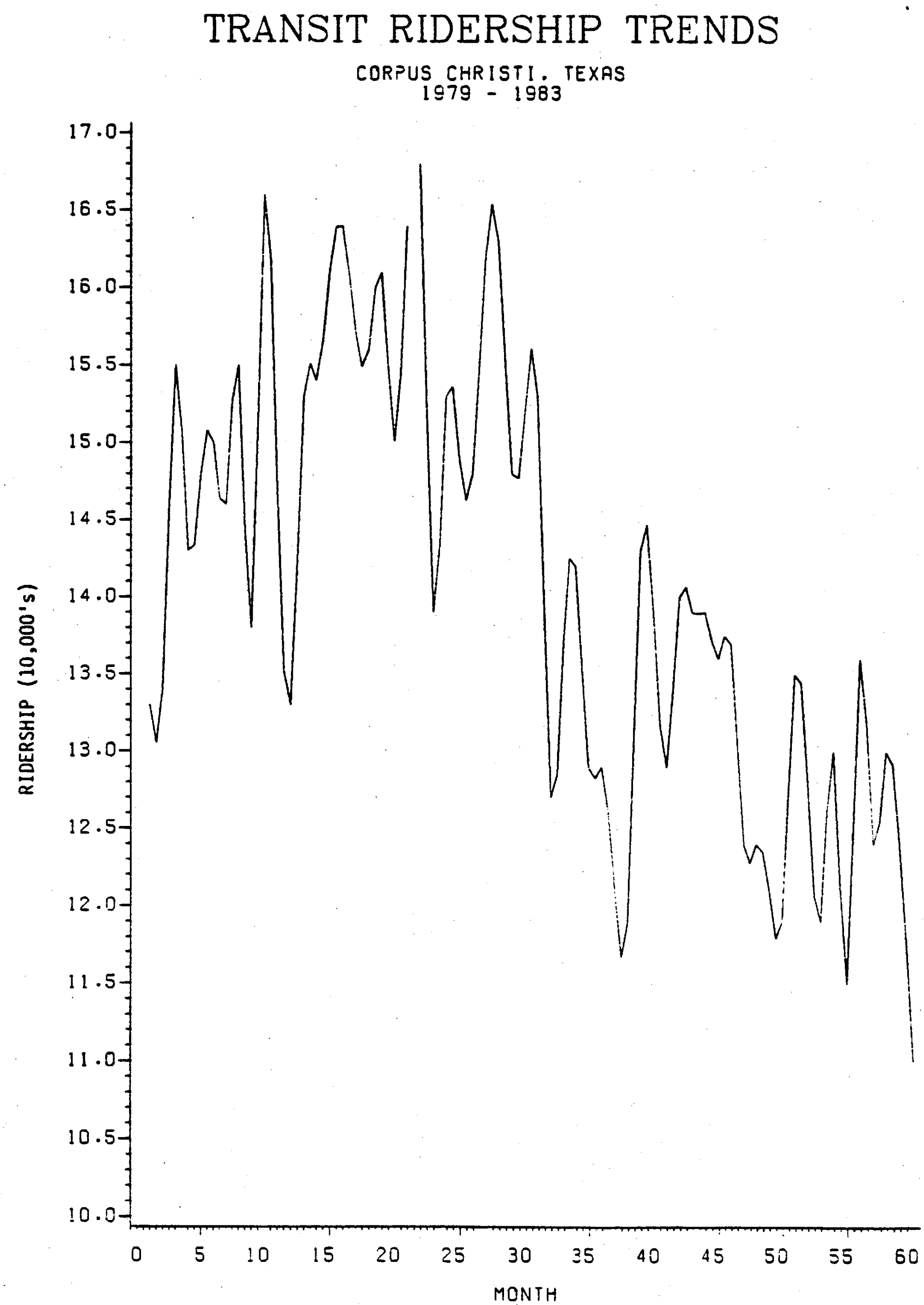

TRANSIT RIDERSHIP TRENDS
CORPUS CHRISTI, TEXAS
1979 - 1983
17.0
16.5
16.0
15.5
15.0
14.5
14.0
13.5
13.0
12.5
12.0
11.5
11.0
10.5
10.0
RIDERSHIP (10,000's)
0
5
10
15
20
25
30
35
40
45
50
55
60
MONTH

Figure 8

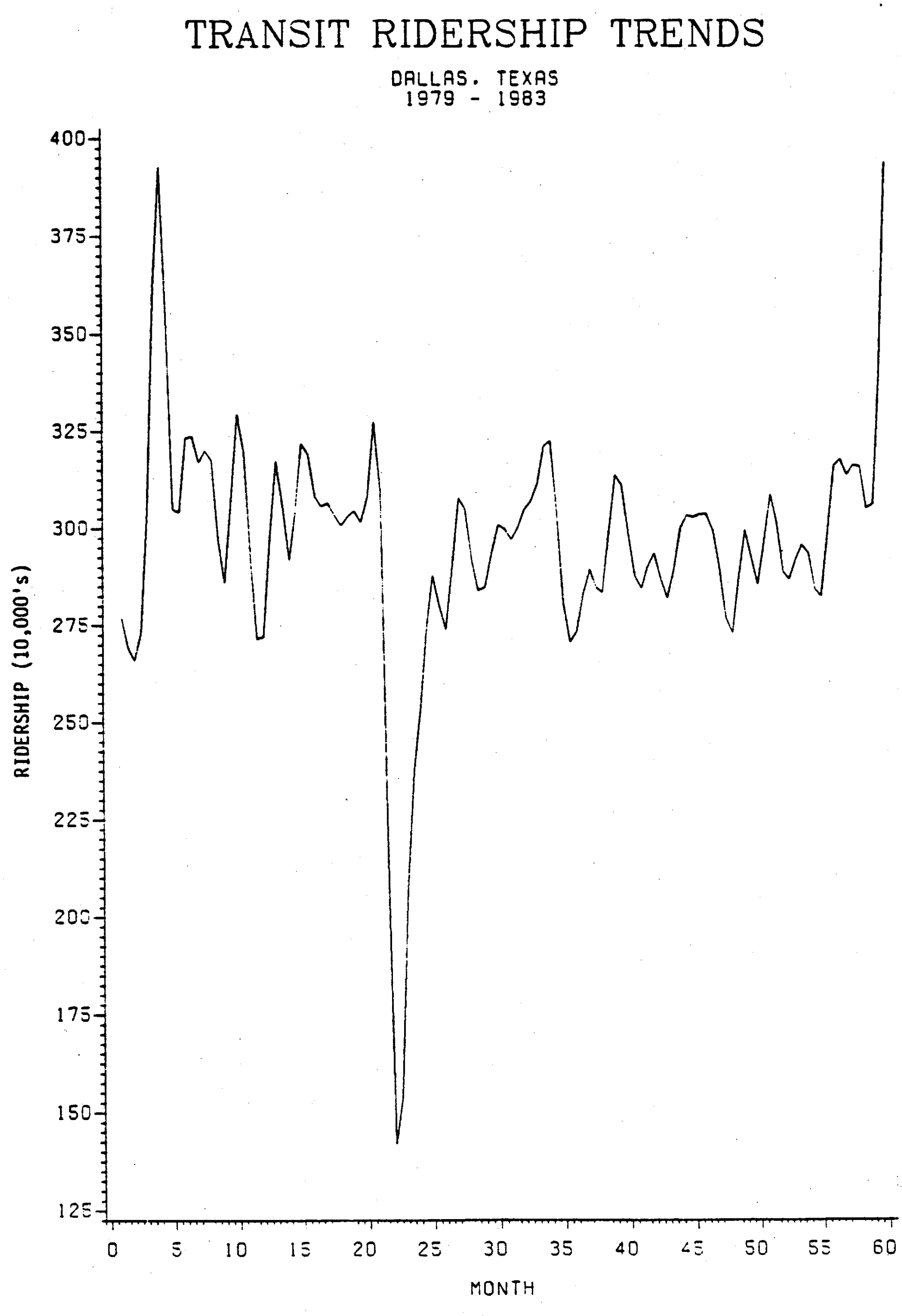

TRANSIT RIDERSHIP TRENDS
DALLAS, TEXAS
1979 - 1983
RIDERSHIP (10,000's)
400
375
350
325
300
275
250
225
200
175
150
125
0
5
10
15
20
25
30
35
40
45
50
55
60
MONTH

Figure 9

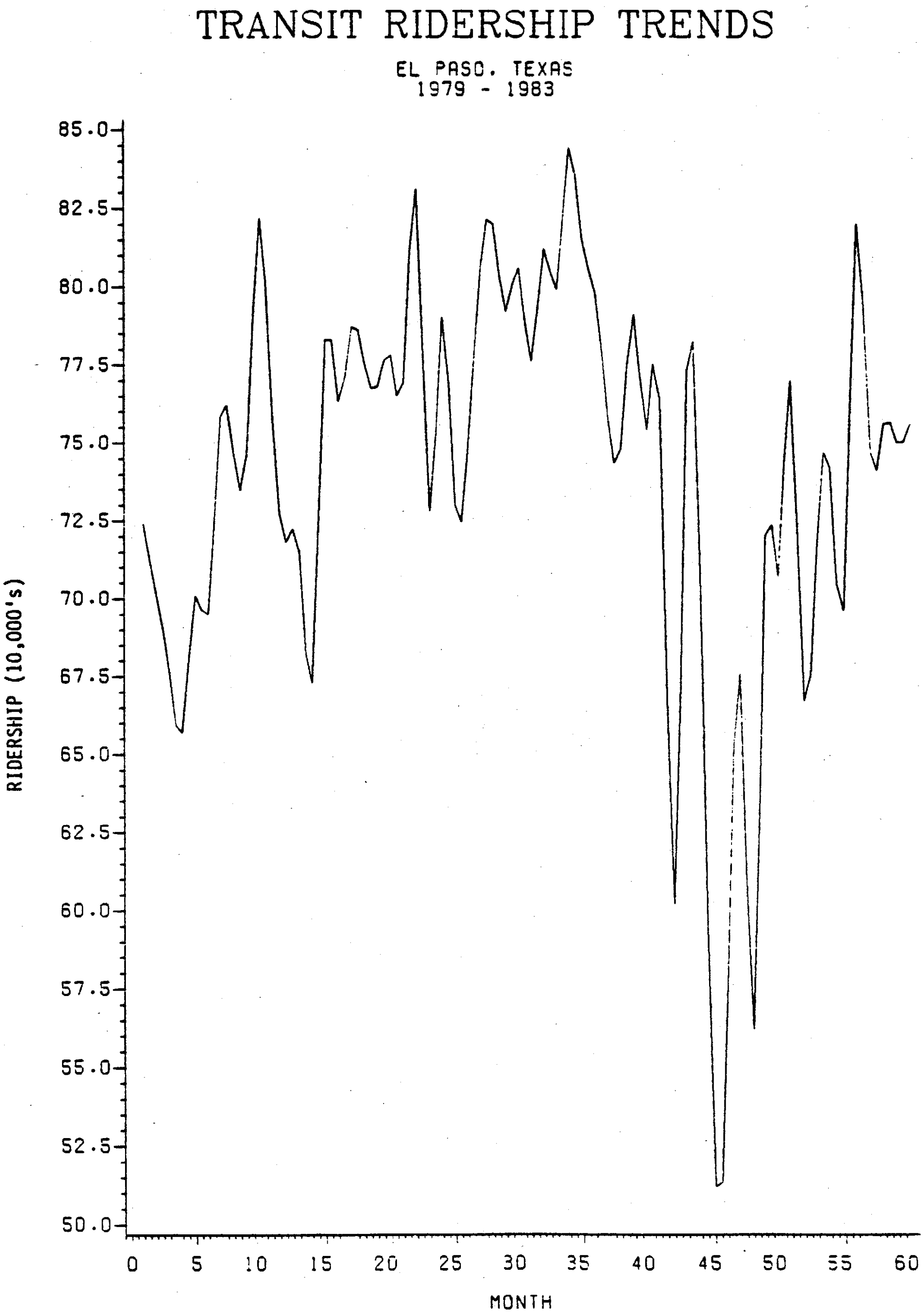

TRANSIT RIDERSHIP TRENDS
EL PASO, TEXAS
1979 - 1983
RIDERSHIP (10,000's)
85.0
82.5
80.0
77.5
75.0
72.5
70.0
67.5
65.0
62.5
60.0
57.5
55.0
52.5
50.0
0
5
10
15
20
25
30
35
40
45
50
55
60
MONTH

Figure 10

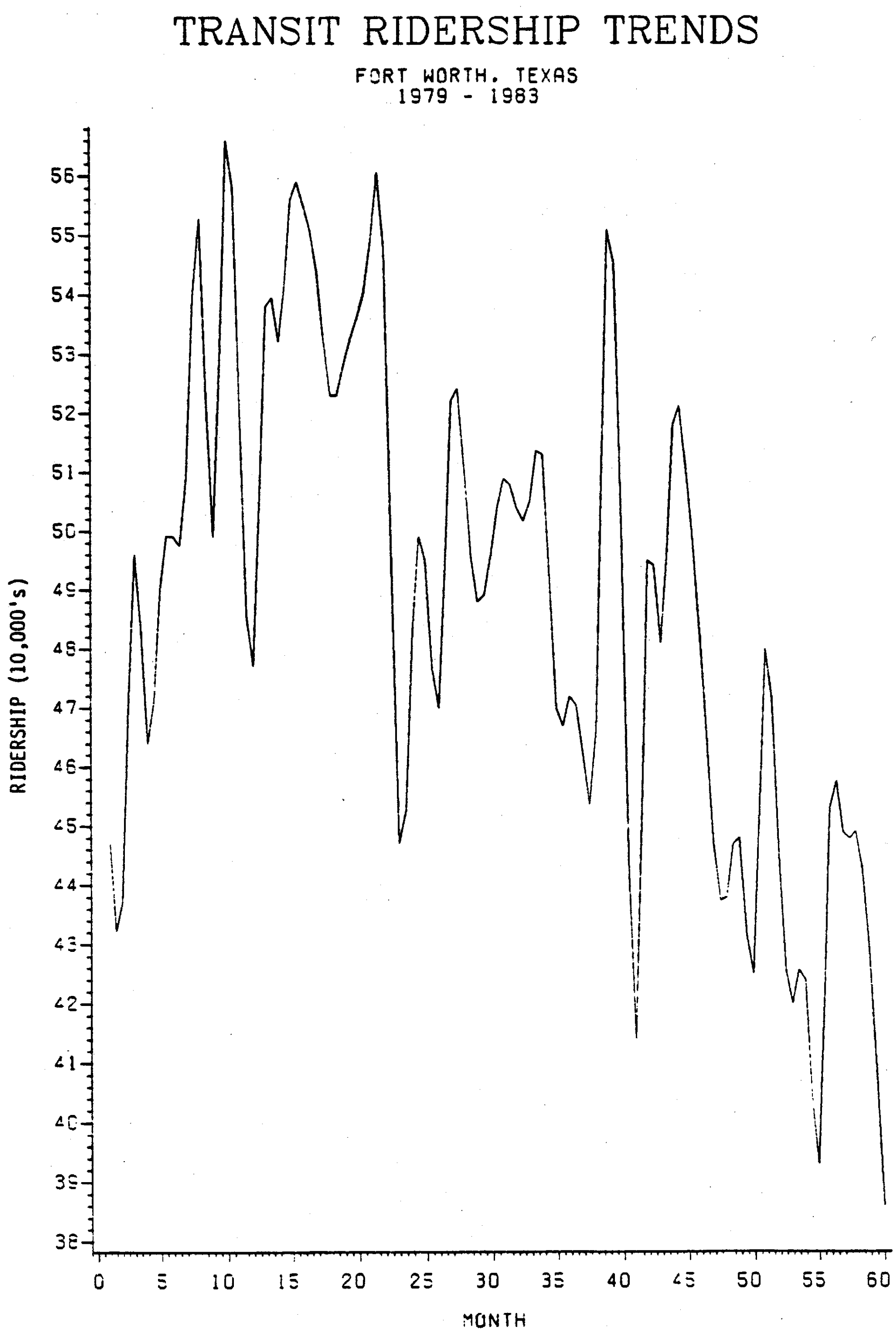

TRANSIT RIDERSHIP TRENDS
FORT WORTH, TEXAS
1979 - 1983
RIDERSHIP (10,000's)
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
0
5
10
15
20
25
30
35
40
45
50
55
60
MONTH

Figure 11

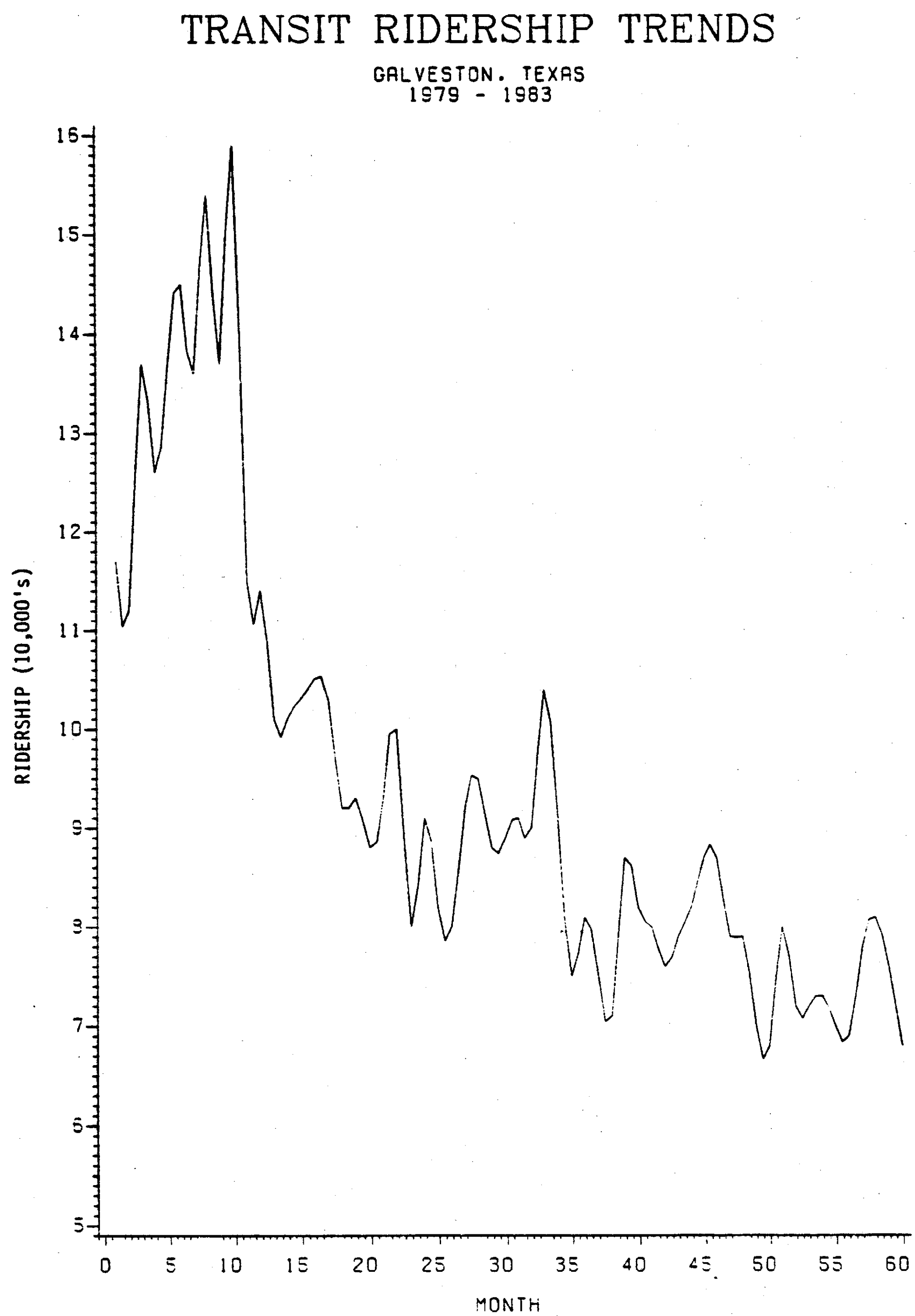

TRANSIT RIDERSHIP TRENDS
GALVESTON, TEXAS
1979 - 1983
RIDERSHIP (10,000's)
16
15
14
13
12
11
10
9
8
7
6
5
0
5
10
15
20
25
30
35
40
45
50
55
60
MONTH

Figure 12

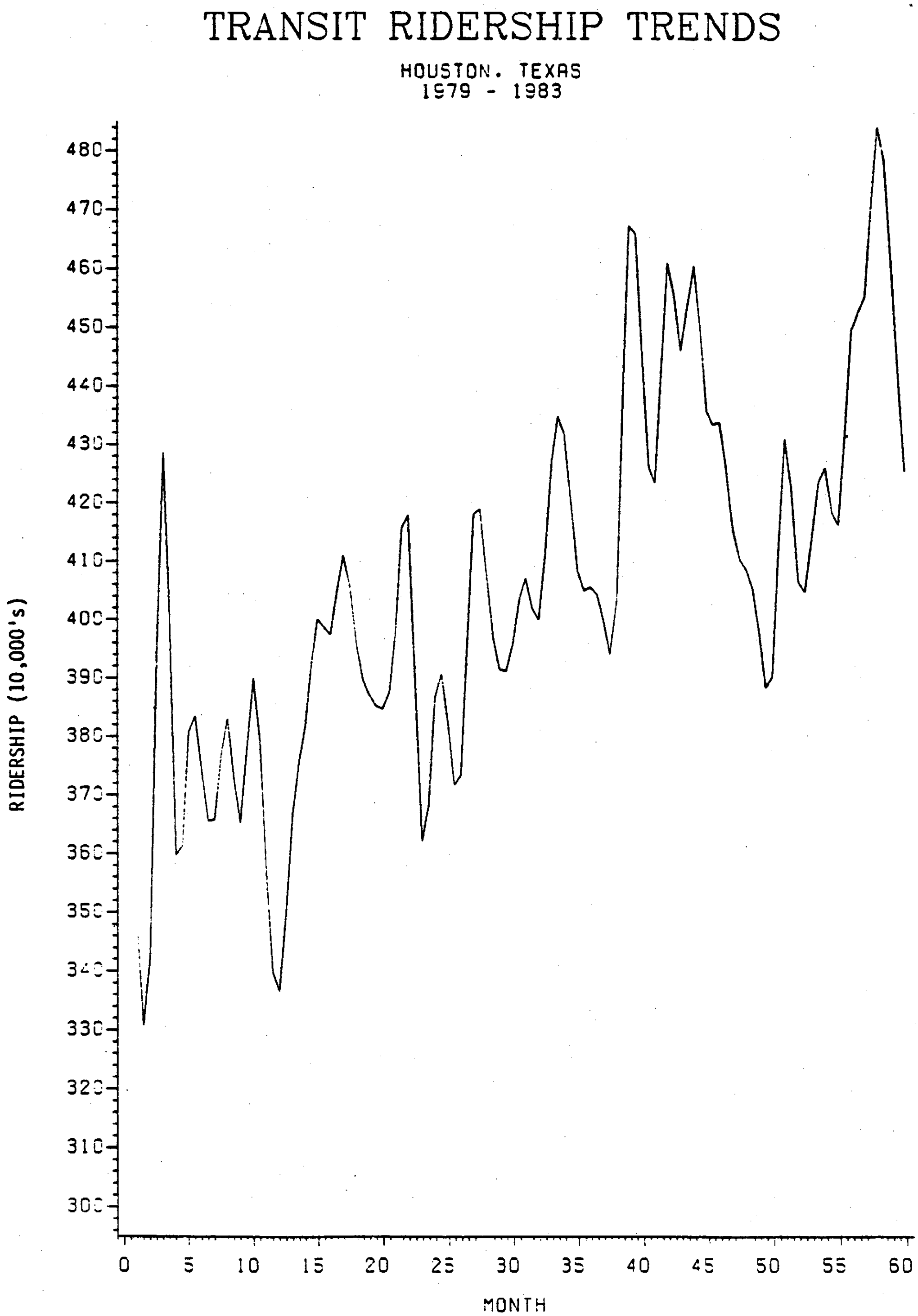

TRANSIT RIDERSHIP TRENDS
HOUSTON, TEXAS
1979 - 1983
RIDERSHIP (10,000's)
480
470
460
450
440
430
420
410
400
390
380
370
360
350
340
330
320
310
300
0
5
10
15
20
25
30
35
40
45
50
55
60
MONTH

Figure 13

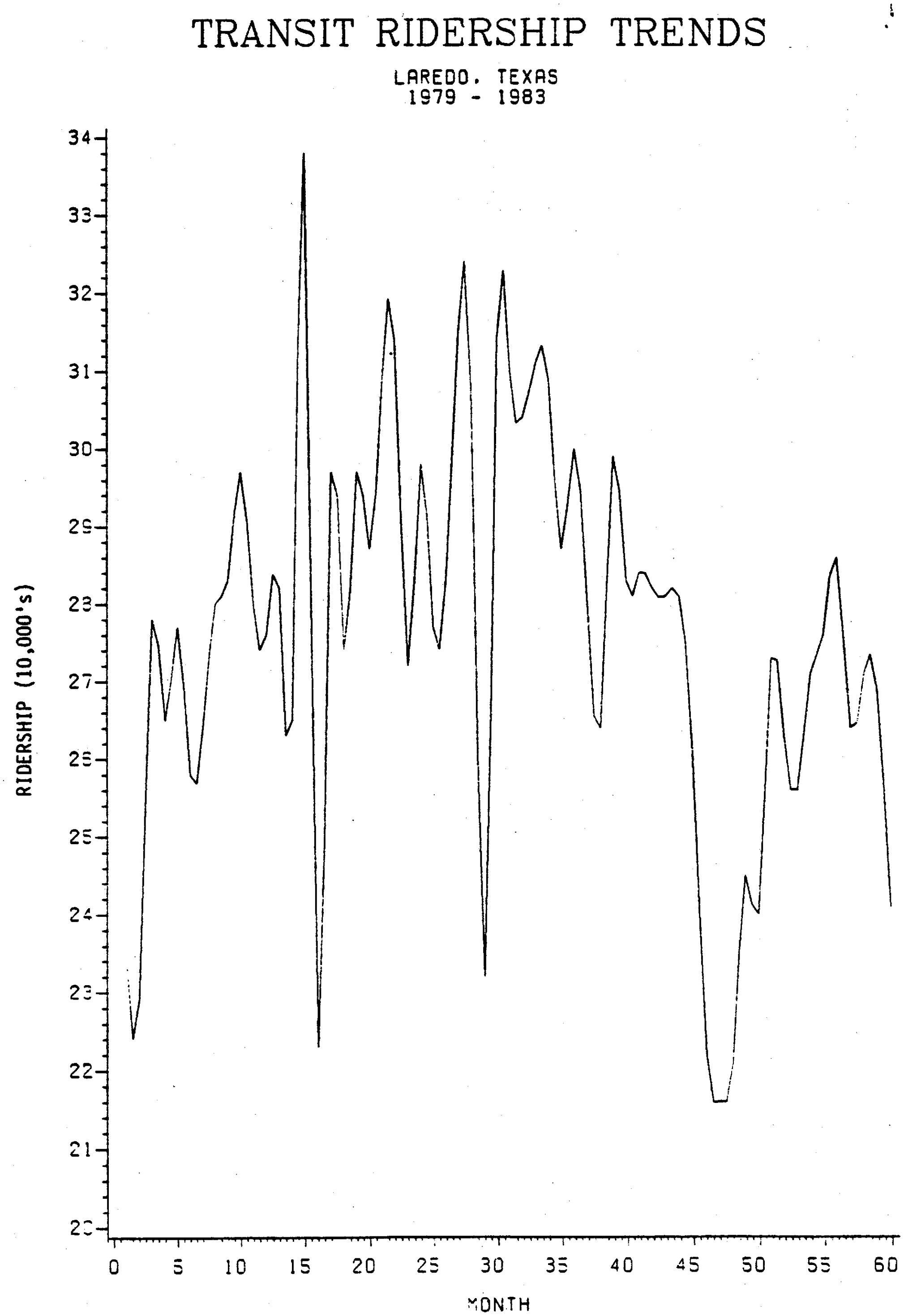

TRANSIT RIDERSHIP TRENDS
LAREDO, TEXAS
1979 - 1983
RIDERSHIP (10,000's)
34
33
32
31
30
29
28
27
26
25
24
23
22
21
20
0
5
10
15
20
25
30
35
40
45
50
55
60
MONTH

Figure 14

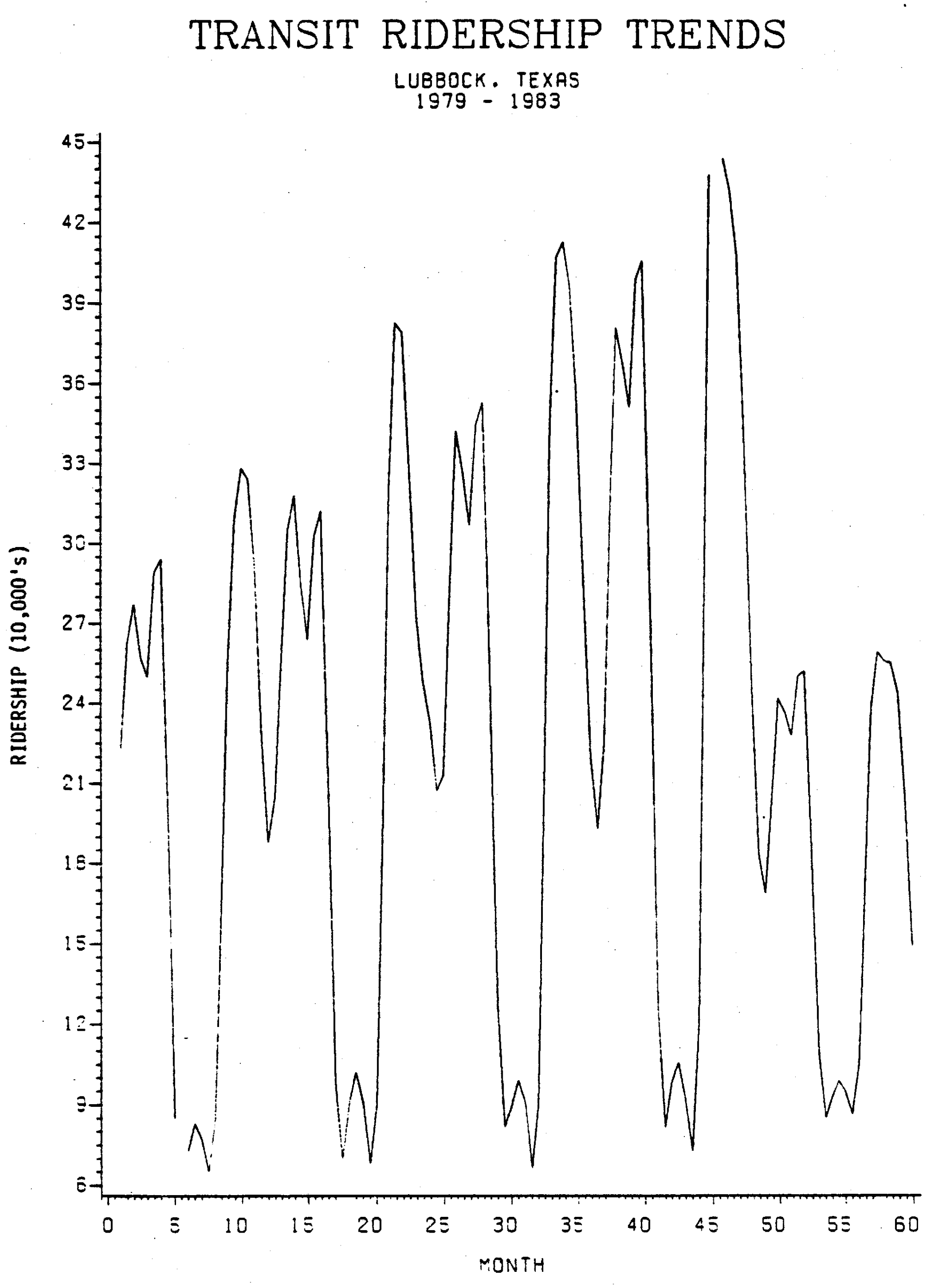

TRANSIT RIDERSHIP TRENDS
LUBBOCK, TEXAS
1979 - 1983
RIDERSHIP (10,000's)
45
42
39
36
33
30
27
24
21
18
15
12
9
6
0
5
10
15
20
25
30
35
40
45
50
55
60
MONTH

Figure 15

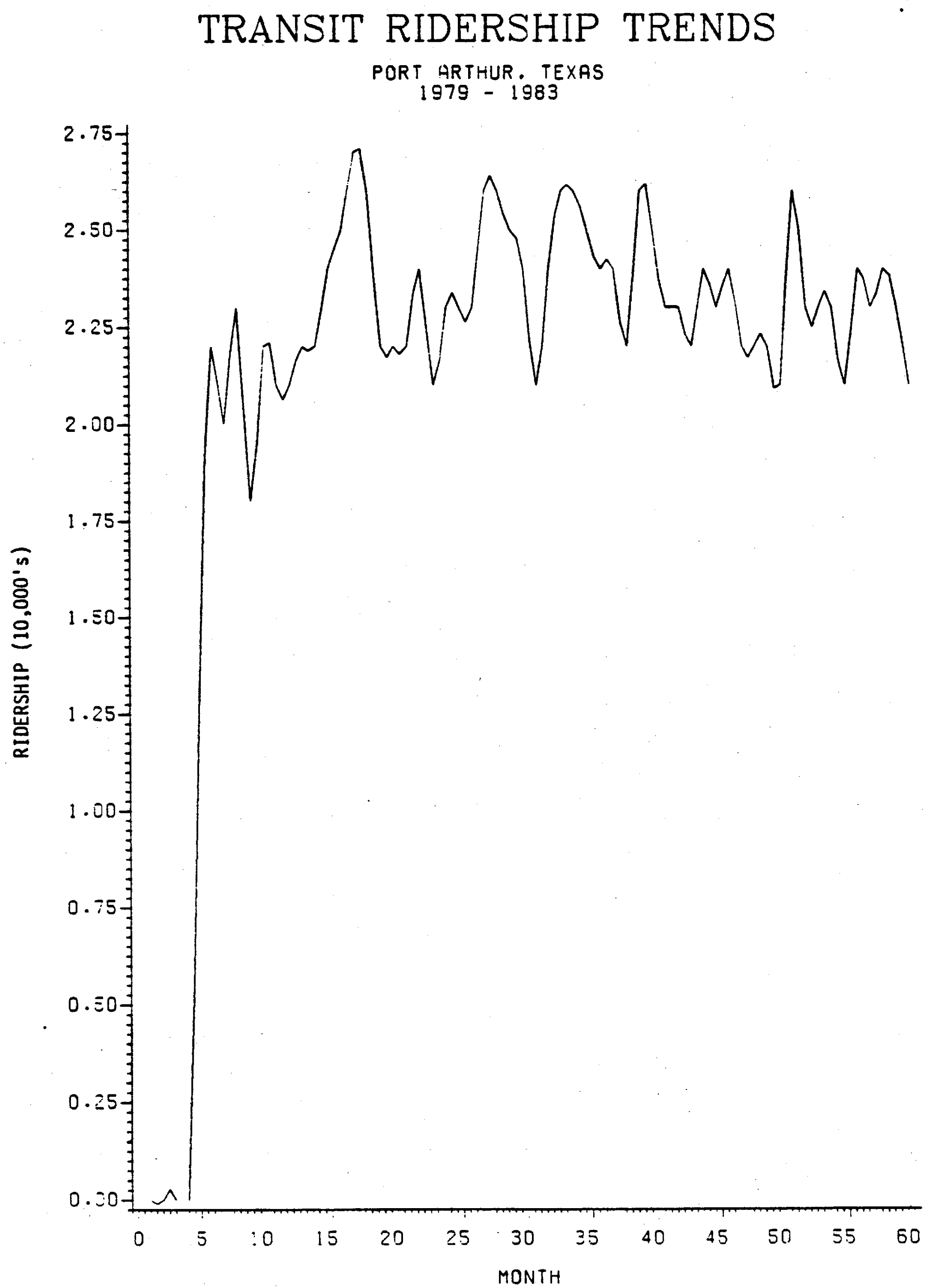

TRANSIT RIDERSHIP TRENDS
PORT ARTHUR, TEXAS
1979 - 1983
RIDERSHIP (10,000's)
2.75
2.50
2.25
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.00
0
5
10
15
20
25
30
35
40
45
50
55
60
MONTH

Figure 16

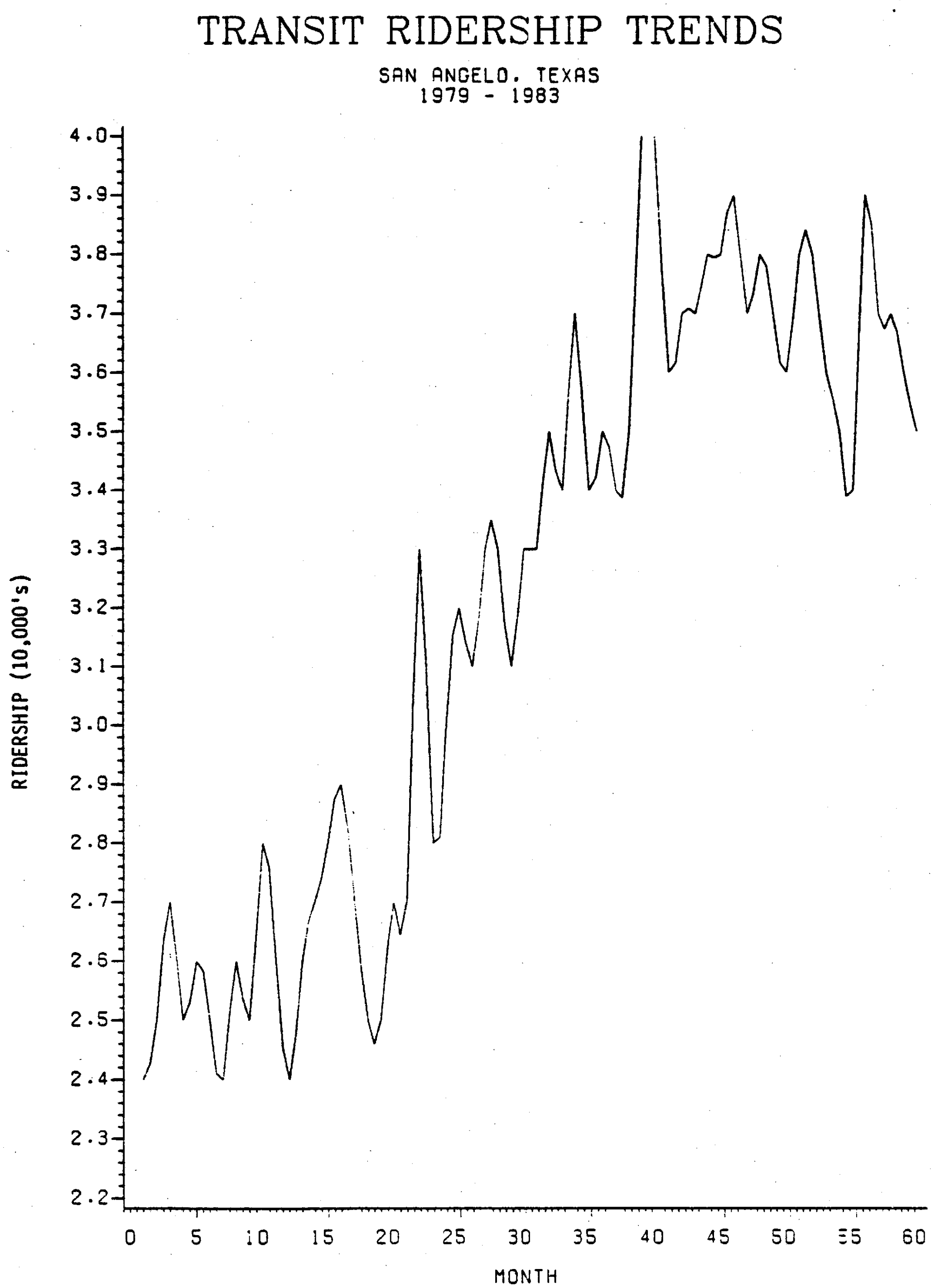

TRANSIT RIDERSHIP TRENDS
SAN ANGELO, TEXAS
1979 - 1983
RIDERSHIP (10,000's)
4.0
3.9
3.8
3.7
3.6
3.5
3.4
3.3
3.2
3.1
3.0
2.9
2.8
2.7
2.6
2.5
2.4
2.3
2.2
0
5
10
15
20
25
30
35
40
45
50
55
60
MONTH

Figure 17

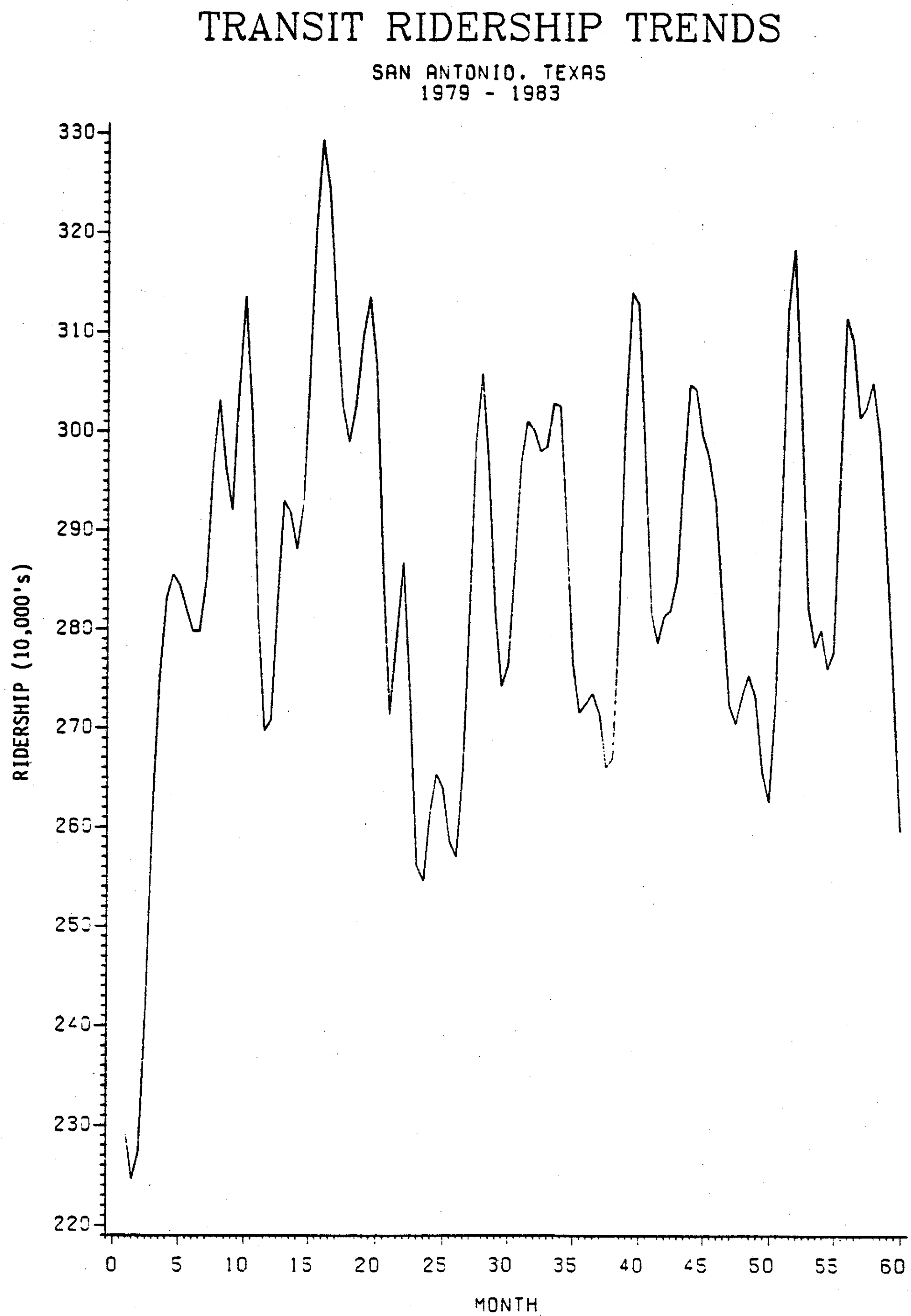

TRANSIT RIDERSHIP TRENDS
SAN ANTONIO, TEXAS
1979 - 1983
RIDERSHIP (10,000's)
330
320
310
300
290
280
270
260
250
240
230
220
0
5
10
15
20
25
30
35
40
45
50
55
60
MONTH

Figure 18

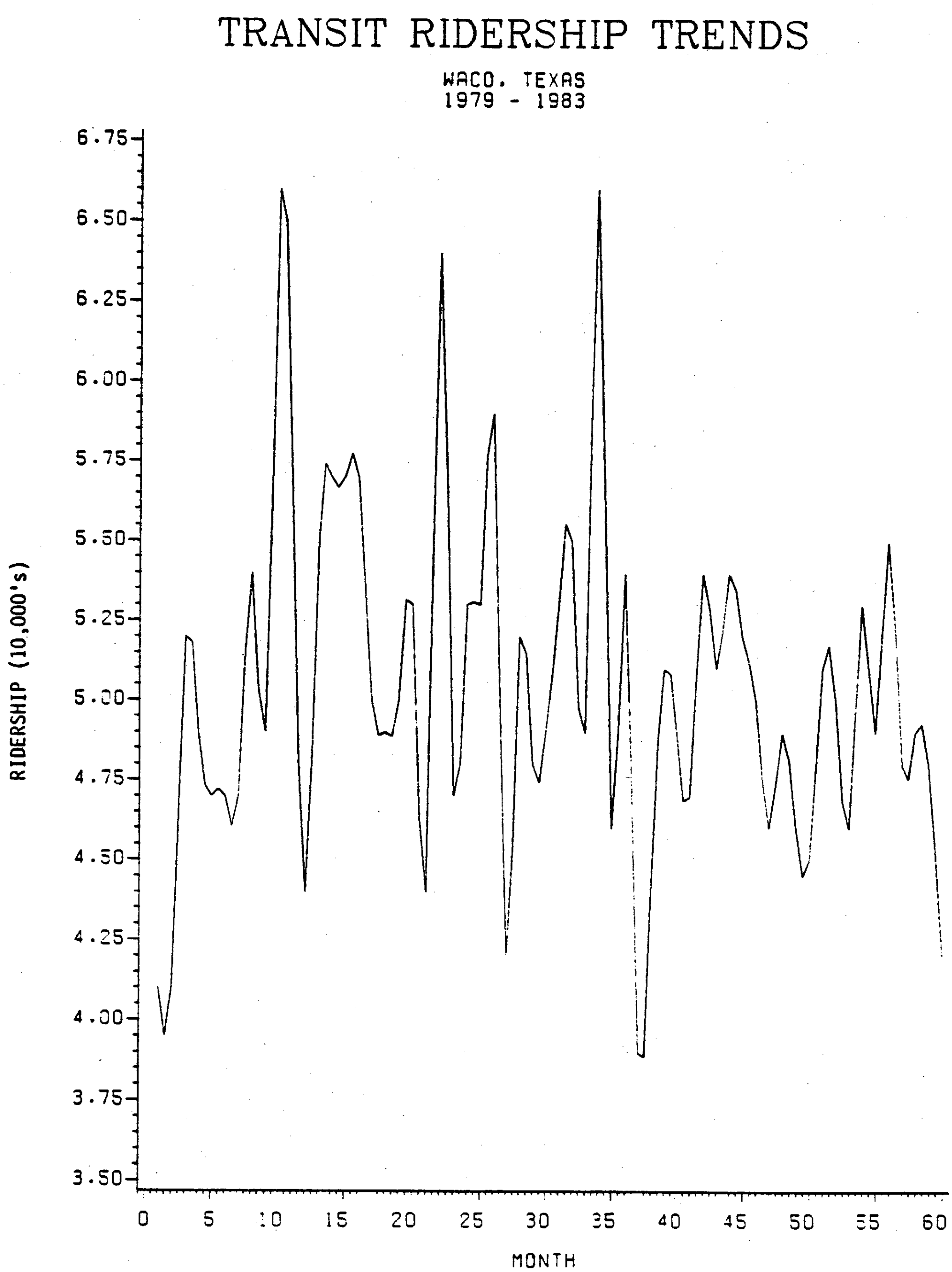
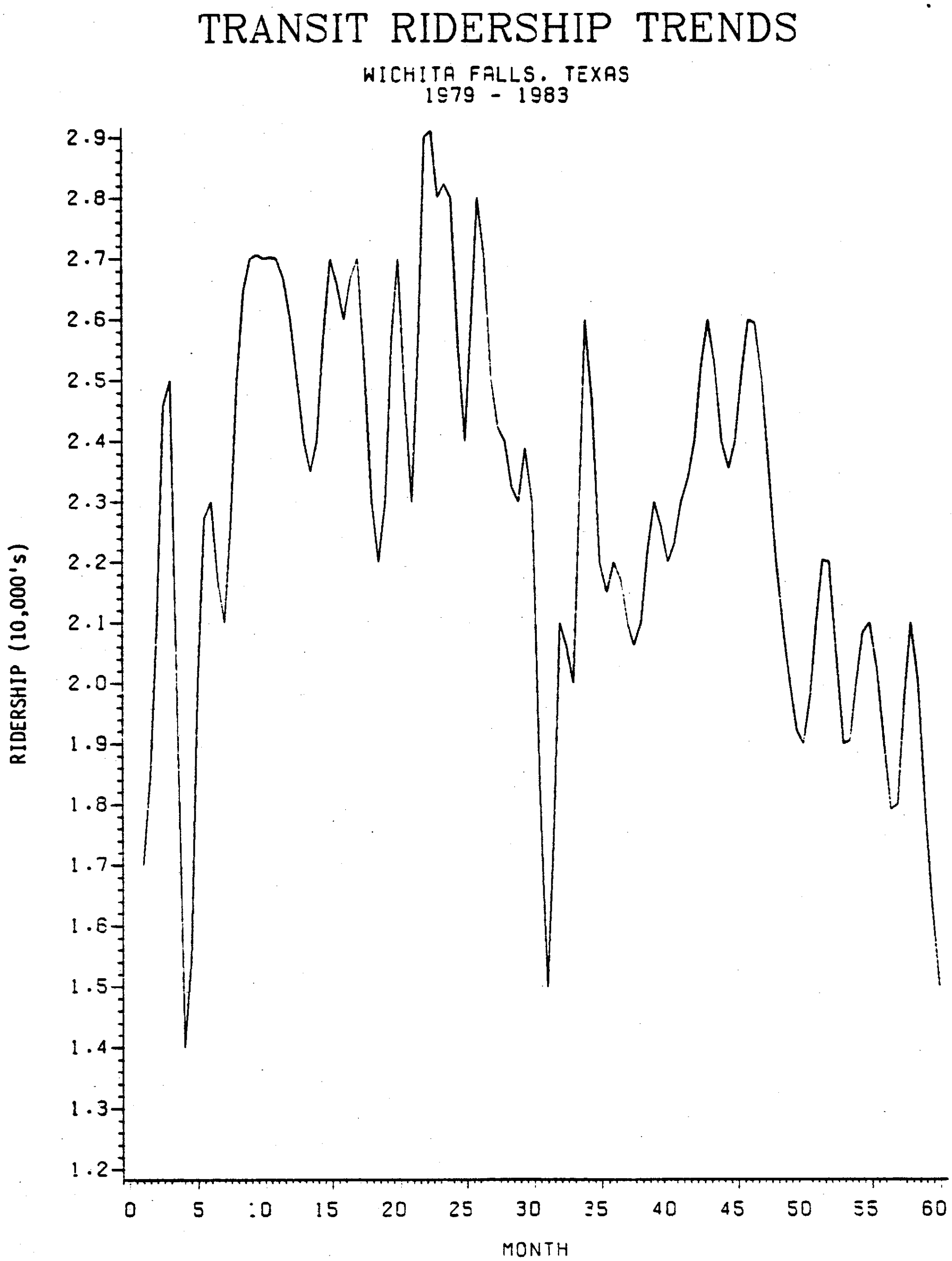

TRANSIT RIDERSHIP TRENDS
WACO, TEXAS
1979 - 1983
RIDERSHIP (10,000's)
6.75
6.50
6.25
6.00
5.75
5.50
5.25
5.00
4.75
4.50
4.25
4.00
3.75
3.50
0
5
10
15
20
25
30
35
40
45
50
55
60
MONTH

Figure 19



TRANSIT RIDERSHIP TRENDS
WICHITA FALLS, TEXAS
1979 - 1983
RIDERSHIP (10,000's)
2.9
2.8
2.7
2.6
2.5
2.4
2.3
2.2
2.1
2.0
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
0
5
10
15
20
25
30
35
40
45
50
55
60
MONTH

The figures reveal that there is a significant amount of fluctuation from month to month for all the systems. There are any number of reasons for these changes. Most of the systems have similar ridership patterns, but a few are somewhat irregular.

Figure 8 shows a sharp decrease in ridership at one particular point for the Dallas system. This reflects the loss of patronage due to a work stoppage in October and November 1980. Ridership returned to somewhat normal levels soon afterward. Transit ridership in Lubbock (Figure 14) has a definite pattern of variation. This is due to the high percentage of student riders which decreases substantially every summer and during holiday periods. Figure 15 shows Port Arthur's ridership which starts out at zero and rises to a steady pattern of a fairly low ridership level. This is explained by the fact that the system had just begun operations in May 1979.

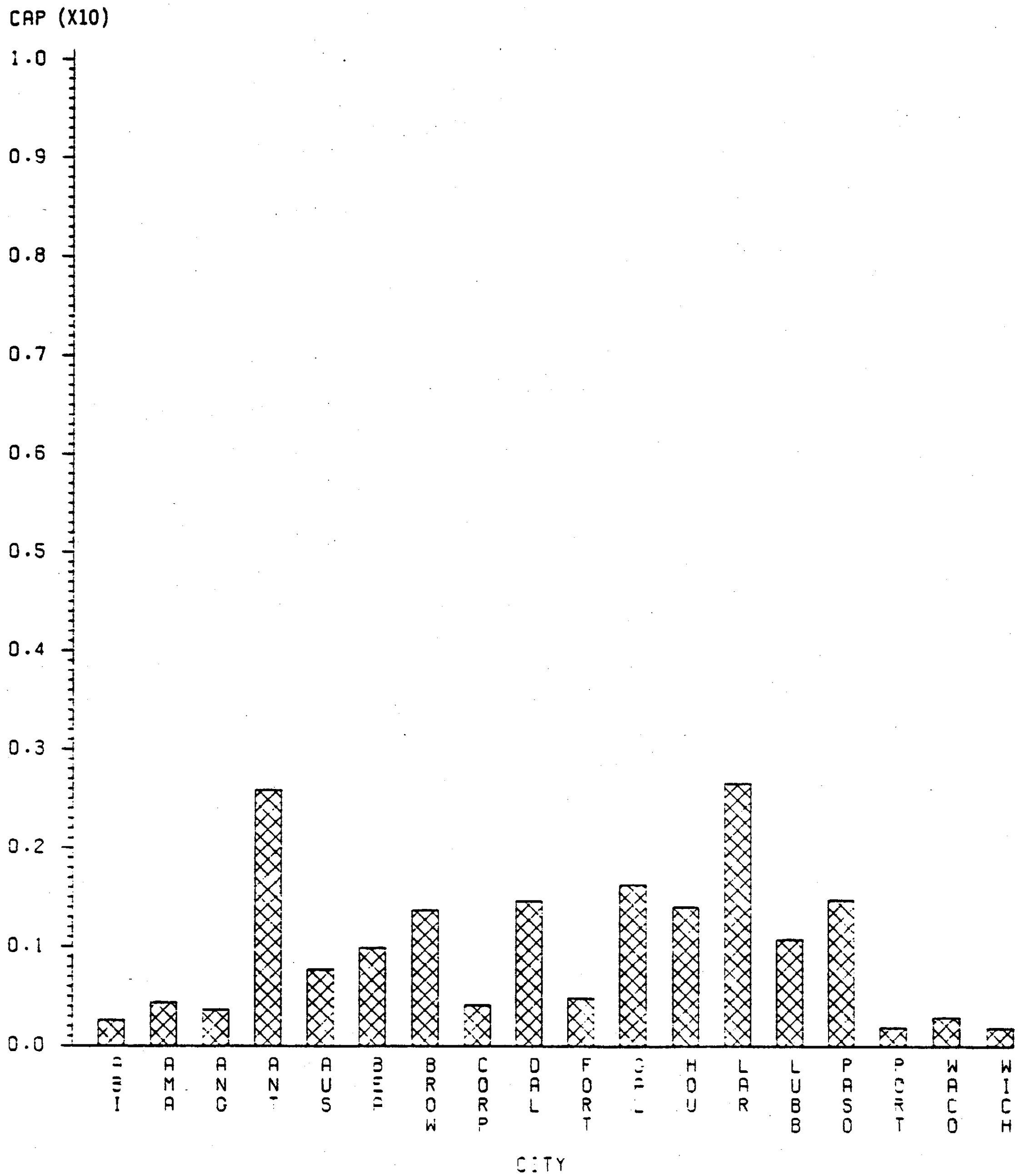
The relationship between area population and transit ridership is presented in Figure 20. This figure shows the average monthly per capita ridership over the five year period (1979-1983) for each system. It appears that San Antonio and Laredo have the highest per capita ridership while Port Arthur and Wichita Falls have the lowest.

Another factor that influences transit ridership is the amount each passenger has to pay for the service. Transit ridership and fares are directly but inversely related. As fares go up, ridership declines and if ridership declines, fares must go up to cover costs. One of the major goals of government assistance to transit was to stabilize fares at levels that would restore and increase ridership [4].

Between 1975 and 1980, U.S. transit ridership increased 18% and the average fare increased only 7.4%, or about 1 1/2 cents per year. Since then, however, overall transit ridership has declined while fares have been

Figure 20

AVERAGE MONTHLY PER CAPITA RIDERHSIP: TEXAS CITIES



increasing close to 6 cents per year. This is partly due to certain public assistance cutbacks and increasingly high operating costs. Most transit systems are trying to compensate by redesigning fare structures to increase cost recovery. Some of the pricing strategies being used are: distance-based or zone fares, service-based fares, and time-of-day fares. These complex fare structures are not suited for smaller areas, but almost all of the large transit systems now use a form of differentiated pricing [4].

Operating Costs and Revenues

Due to low ridership levels and increasing operating costs in the U.S. transit industry, operating expenses have exceeded operating revenues since 1964. Even during periods of increased transit ridership, the net operating deficit for the transit industry has increased year after year [2]. Table 3 shows this trend. The Texas transit industry has also experienced increasing operating losses over the years (Table 4). This has led to an increase in average transit fares and a need for increased government funding.

The majority of government financial assistance for capital expenses comes from the federal government while operating assistance comes mainly from state and local governments. A substantial increase in federal funding of mass transit came with the National Mass Transportation Assistance Act of 1974 and the Federal-Aid Highway Act of 1973 [1]. Table 5 shows U.S. government capital and operating grant approvals for mass transportation from 1975 to 1980. Table 6 shows federal, state and local assistance for Texas transit.

Very recently there have been declines in federal assistance to public transit which have required actions that lead to ridership losses, such as fare increases and service reductions. Efforts are being made to offset

Table 3. TRANSIT OPERATIONS - U.S.

Calendar Year	Operating Revenue (millions)	Operating Expense (millions)	Net Operating Revenue (Deficit) (millions)
1950	$1,452	$1,386	$ 66
1955	1,426	1,371	56
1960	1,407	1,377	31
1965	1,444	1,454	(11)
1970	1,707	1,996	(288)
1975	2,002	3,753	(1,750)
1976	2,161	4,083	(1,922)
1977	2,280	4,367	(2,087)
1978	2,381	4,789	(2,408)
1979	2,524	5,611	(3,087)
1980	2,568	6,514	(3,946)

Source: Transit Fact Book, 1981 American Public Transit Association.

Table 4. TRANSIT OPERATIONS - TEXAS

Calendar Year	Operating Revenue (thousands)	Operating Expense (thousands)	Not Operating Revenue (Deficit) (thousands)
1975	$37,253	$ 55,359	$(18,106)
1976	35,614	60,291	(24,677)
1977	41,708	70,521	(28,813)
1978	44,135	93,894	(49,759)
1979	49,368	115,857	(66,489)
1980	57,280	147,360	(90,080)
1981	69,179	183,854	(114,674)
1982	75,693	212,075	(136,382)

Source: Texas Transit Statistics, 1975-1982 Texas Department of Highways and Public Transportation.

Table 5. U.S. GOVERNMENT GRANT APPROVALS FOR MASS TRANSPORTATION

Fiscal Year	Capital (millions)	Operating (millions)	Total (millions)
1965-1969	$ 548	$ -	$ 548
1970-1974	2,749	-	2,749
1975	1,287	143	1,430
1976	1,955	412	2,367
1977	1,724	572	2,296
1978	2,037	685	2,722
1979	2,102	869	2,970
1980	2,787	1,121	3,908

Source: Transit Fact Book, 1981 American Public Transit Association.

Table 6. FINANCIAL ASSISTANCE TO TEXAS TRANSIT

(thousands)

Calendar Year	Federal	State	Local	Total
1975	$17,796	$ 2,199	$ 5,020	$ 25,016
1976	33,125	3,661	8,240	45,026
1977	53,959	5,912	25,225	85,095
1978	94,928	10,441	59,876	165,245
1979	38,361	2,776	35,385	76,502
1980	89,050	14,583	59,253	162,886
1981	70,807	9,865	43,650	124,323
1982	93,961	3,124	196,000	293,086

Source: Texas Transit Statistics, 1975-1982 Texas Department of Highways and Public Transportation.

this situation by increasing the search for innovative techniques for managing, planning, budgeting, and other processes [5].

One example of this is the Queen City Metro system in Cincinnati. Management recognized the need for some new strategies to maintain the organization's effectiveness and efficiency despite funding cutbacks. Some objectives of their new management plan were to [6]:

1. Develop a plan for stabilization of long-term funding.
2. Improve awareness and support for bus transportation in the community.
3. Reduce costs through management and operation efficiencies.
4. Allow rational decision-making by completing a strategic five-year plan.
5. Improve industrial safety measures.
6. Enhance management and technical skills of employees.
7. Improve management/labor relations.

Labor compensation is the major operating cost element in most transit systems, usually representing from 60% to 80% of all operating costs for the system [7]. Employment in the U.S. transit industry has declined overall since 1950. With the increase in federal aid and transit ridership since the 1970's, the average number of employees has gradually risen from 138,040 in 1970 to 189,300 in 1980 [3]. The average number of employees in the Texas transit systems has also risen in recent years.

Even with the financial troubles of the transit industry over the years, the average compensation of transit workers has steadily increased. Most of these wage increases have been offset by inflation, resulting in minimal gains in real wages for some transit workers. However, the wage increases obtained by workers of some major transit systems seem excessive given the condition of the industry and compared to the wage gains of other workers in the same areas [1].

One reason for these increasing wages is the strength of the unions representing transit employees. The U.S. transit industry is almost completely unionized and the major increases in worker compensation in past years are due to their bargaining power [1].

Labor-Management Relations

Increasingly, since the late 1950's, many transit systems were reorganized as publicly owned systems [7]. This tended to erode the bargaining position of public transit employees since the right to strike is illegal in most publicly owned organizations. With the labor protection provisions of the Urban Mass Transportation Act of 1964 and recent changes in state laws, the bargaining position of public transit employees has greatly improved. However, even though the unions representing public transit employees have been successful using other bargaining tactics, illegal strikes have occurred [1].

Labor-management relations are important in achieving performance goals because they govern many decisions that affect transit performance. The need to maintain a transit system capable of attracting and servicing a diverse ridership requires stable, or improving, levels of performance, which in turn depends on labor productivity and efficiency [8].

Transit labor productivity can be measured in various ways. Table 7 shows the transit productivity trend from 1950 using three different output measures. These figures show that worker productivity in the transit industry has declined or remained constant over the years. Other studies, using a variety of productivity measures, have reached similar conclusions. Innovations to improve productivity such as larger capacity equipment and exclusive bus lanes have had limited effect [1].

Table 7. LABOR PRODUCTIVITY - U.S.

Calendar Year	Operating Expense Per Employee	Vehicle Miles Per Employee	Total Passengers Per Employee
1950	$ 5,774	12,532	71,858
1960	8,801	13,734	60,070
1965	10,030	13,850	56,917
1970	14,457	13,642	53,115
1975	23,482	12,451	43,630
1976	25,054	12,435	43,455
1977	26,869	12,438	44,834
1978	28,953	12,263	46,046
1979	31,392	11,443	45,483
1980	34,412	11,067	43,465

Source: Transit Fact Book, 1981 American Public Transit Association.

Studies have shown that neither system size nor ownership type (private vs. public) have much effect on labor productivity. However, work rules and compensation patterns have a major influence on the productivity of a certain system. Out-dated work rules that stifle productivity and union demands for wage increases that ignore the financial condition of the industry increase efforts to further substitute government assistance for labor in the industry. Labor and management must try to resolve their differences and work together if the industry is to be revitalized. Transit employee's attitudes and actions can influence potential customers and have an effect on the system's ability to attract and hold passengers [1].

LITERATURE REVIEW AND PREVIOUS CASE STUDIES

The following is a review of several strike-induced transit shutdowns and the effects on ridership as well as other variables and characteristics such as retail sales. These studies utilized many different data gathering methods and analysis techniques. This overview is intended to provide a better understanding of the impact transit strikes may have on the short and long-run demand for transit service.

In 1977 members of the University of Tennessee conducted a study on the impacts of the Knoxville Transit Corporation (KTC) strike [9]. This six week strike stranded 7,000-8,000 daily riders of regular bus routes and 600 daily riders of the express bus service. Small sample surveys were performed during and immediately after the strike in the form of mail questionnaires, telephone interviews, and personal interviews.

The study concluded that, for captive transit riders, many discretionary trips were not taken. Few cases of severe hardship were reported, however. Most riders were able to find alternative arrangements by relying on relatives and friends, social service agencies, and to a lesser extent on taxi service. Those most affected were the elderly and economically disadvantaged. Many downtown merchants reportedly lost substantial business during the strike and some were forced to lay off personnel. Business levels returned to about normal within two months after the end of the strike. There was no evidence of excessive traffic congestion, but parking in the CBD area was cited as a problem. The transit system itself felt the most adverse and continuing effect of the strike. The decline of ridership on regular routes was estimated in the range of 16 to 17.2 percent and for express buses the drop was about 15 percent. Although some operating costs were deferred during the strike, the loss of ridership and revenue offset any savings. Most captive and choice riders did return to transit after the strike, while a small percentage switched to other modes. Overall, everyone involved with public transportation would have benefited more by averting the strike or at least shortening its duration [9].

A study by the State of California Department of Transportation [10] specifically analyzed the impact of a 1974 transit bus strike on private vehicle usage and traffic congestion in the Los Angeles area. A comparison was made of the traffic volumes and congestion during and after the strike with volumes before the strike. It was found that the increased volumes due to the bus strike were less than the 5.0 percent fluctuations due to normal seasonal variations in the "non-strike" years of 1972 and 1973. Also, a "congestion index" used to measure traffic delay showed little deviation from the two previous years. Therefore, it was concluded that the strike had no significant effect on traffic volumes or congestion.

One study of the 1983 New Jersey Transit rail strike explained how an emergency contingency plan was implemented to provide alternative transportation during the strike [11]. This was done by contacting other rail and bus transit services in the area to help out by re-routing, increasing service, and providing park and ride services. The alternate transportation plan was formed <u>before</u> the actual strike, so that it was ready to be put into effect when the strike did occur. Because there was this alternative means of transit available, the majority of rail commuters continued to use transit as the preferred mode of travel during the strike. Seventy percent used alternate mass transit while 30.0 percent either carpooled or drove alone. This retention of mass transit transportation during the strike prevented a significant increase in traffic congestion and enabled rail ridership levels to return quickly after the strike.

Another case where alternate transit services were implemented during a strike was in 1983 when a 108-day strike halted service on 12 rail lines in Philadelphia operated by the Southeastern Pennsylvania Transportation Authority (SEPTA). Before the strike, these lines carried 50,000 daily commuters. It was expected that during the strike the majority of commuters would turn to the automobile as an alternate means of transport, and this would cause an increased in traffic congestion. However, to offset the effects of the strike, SEPTA scheduled extra buses and subway service along the struck train routes. As a result of this action, most commuters used the alternate transit system and therefore the strike never significantly affected rush hour traffic in and around Philadelphia [12].

Providing alternate transportation during a transit strike is one way to maintain ridership after service is resumed. Another method which has proved effective for some transit systems is to offer free service for the first day or two after the strike. The Metro-North Commuter Railroad in New York and the Central Ohio Transit Authority are two examples of systems recently using this strategy to win back daily riders [13, 14].

Another study, entitled "The Effects of Labor Strikes on Bus Transit Use" conducted by Purdue University [7], analyzed transit strike impacts nation-wide by sending a questionnaire to selected transit companies across the U.S. This report also presented several case studies on the subject. Following is a summarization of the results of those studies plus a more in-depth look at the Purdue study and their conclusions.

The consulting firm of Barrington and Company evaluated the impact of seven New York City transit properties that went out on strike in January 1966. The study was conducted through telephone and home interviews.

The conclusions were:

1) After the strike 2.1 percent of regular transit-using workers stopped using the system. Most had driven their own cars during the strike rather than car-pooling.

2) Shoppers who did not return to using transit reverted to walking in over half the cases.

3) Over 50.0 percent of persons not returning to transit for social and personal activities shifted to their own cars and taxis after the strike.

4) After the strike, 5.0 percent of suburban users stopped using the system for any purpose.

Another well-known study was an analysis of the 1974 Southern California Rapid Transit District Strike. The survey methodology included selected interviews, a random ride survey, a shopping center survey, traffic data, a busway survey, a carpooling program report, and state-wide data.

Significant results were:

1) Ten to thirty percent losses in retail sales in transit-related areas.

2) Traffic effects were minimal overall.

3) Car occupancy rates increased from 1.35 to 1.5 persons per car in the downtown area.

4) There were some employment impacts.

5) Most affected were the poor, elderly, and handicapped.

6) Only 1 out of 15 residents were directly affected indicating that a gradual recovery of most or all pre-strike riders should occur.

One study entitled "Impact of Strikes on Transit Riding" analyzed the relationship between system patronage and strike length. An analysis was conducted of transit strikes by 18 different properties. The report did in fact conclude that a direct relationship does exist between strike duration and ridership return rates. This study found that for strikes of less than one week, there is no discernible permanent ridership loss. For strikes lasting longer than one week, during the first two post-strike months permanent riding loss is about 2.0 percent of the projected ridership for each week of the strike's duration. This figure is reduced to 1.5 percent per week of strike duration for the next three months, and 1.0 percent per week for the rest of the post-strike year.

In 1972, employees of the Transport of New Jersey bus system declared a strike that lasted 75 days. A study was conducted to analyze the ridership effects during the morning peak period hours (8 a.m. - 9 a.m.). The study found that:

1) A few weeks after the strike settlement ridership was down approximately 20.0 percent.

2) During the strike, competing modes experienced a significant increase in ridership, especially competing bus modes.

3) Persons diverted to rail were the most likely to stay with that mode after the strike. The automobile was the least used alternative.

An analysis of the Golden Gate transit strike in 1976 was undertaken using questionnaires and telephone interviews during and after the strike. Study results indicated that there was a substantial increase in car-pooling during and after the strike. This was considered to be the result of a program started during the strike which involved a toll suspension for any vehicle crossing the Golden Gate Bridge carring 3 or more persons during the morning rush hour. After the strike settlement this toll-free operation was permanently established. This was believed to increase the permanent loss of transit ridership after the strike. The telephone survey of selected households revealed that:

1) Twenty-three percent felt a definite adverse impact due to the strike.

2) Eleven percent reported some inconvenience.

3) Sixty-six percent suffered little or no inconvenience.

Another study used a Stochastic Model to estimate passenger losses related to the Madison Bus Company strike of 1967. The model compared actual and forecasted post-strike demands. The variables used were: number of bus-miles operated, number of weekdays, number of college enrollment school-days, and the average adult fare; all for a given month. The results using this model indicated that ridership losses of 17.9 and 13.9 percent in the two years following the strike were directly caused by the strike.

Although the previous case studies used different variables and interactive factors, there were several similar conclusions [7]:

1) A transit strike does appear to effect post-strike system ridership.

2) A transit strike has far-reaching impacts. Other transportation modes, automobile occupancy, number of shopping and work trips, and traffic congestion among others have been influenced to some extent.

3) Transit recovery from a strike is greatly dependent on many different factors: competition from other modes, diversion options and geographic location of pre-strike riders, demographic characteristics and others.

4) Transit strikes affect various socio-economic groups in varying degrees. The elderly, young, poor, and handicapped appear to be the most severely affected.

Since the study conducted by Purdue University [7] is most closely related to this report, a more in-depth review is presented. This study addressed the effects of transit strikes on short and long-term demand for mass transportation services with an emphasis on changes in system pricing and service variables. This was accomplished through the use of a questionnaire sent to selected transit companies across the U.S.

First, the population size of the area served by a transit system was chosen as the determining factor of which systems were to be surveyed. A population of 40,000 was chosen as the cutoff point. Then, six variables were chosen for analysis: average adult fare, route length, vehicle hours of operation, daily ridership, and two derived service indices. The questionnaire asked for information collected immediately before the strike (labeled "reporting date"), immediately after the strike, and one year after the reporting date. Information to use as control data for natural trends in the transit industry were obtained from industry-wide bus transit statistics.

During the survey analysis, several difficulties with the survey procedure were encountered:

1) Some of the questions were not specific enough.
2) Data collection procedures varied greatly between transit systems, making analysis more difficult.
3) Some systems were unable to furnish data because of the lack of staff and/or financial resources necessary for the investigative effort.

The results of the study were grouped into different variables and their relationship to the strike. Following is a summary of the study results.

One area of analysis dealt with the influence of area population size and management type (public or private) on strike potential. The results showed that the probability of a strike is significantly influenced by service area population size, but not by management type. Service area population size is directly related to transit system size and the larger the system, the greater the probability of a strike. However, the probability of more than one strike does not vary with system size. Also, service area population size and the occurance of a strike are strongly related to current weekly ridership. System size and management type were found to have little correlation with the length of a strike. The average strike length in this study was found to be 34.1 days.

The study also found that the number of strikes has increased since the 1960's. One explaination mentioned for this increase was that with the extra funds available to transit systems from the 1964 Urban Mass Transportation Act and subsequent legislations, labor may have expected higher salaries and greater benefits. However, since most of these subsidies were for capital improvements, the labor expectations could not be met.

The strike impact on average adult fares was shown to be an immediate and long term fare increase to compensate for higher operating costs created by the settlement agreement. Medium and large transit systems were found to have similar fare increases, while smaller systems had the lowest increase. Even taking into account the average industry-wide fare increase over the long run, there was still a strike impact.

The study results indicated that a strike has no significant impact on vehicle hours of operation, total system miles of route, or level of service. This lack of service reductions could be due to increased subsidies since it is more desirable to raise the level of subsidy than to cutback service.

One of the main parts of the study dealt with the strike impact on average daily ridership. A 9.0 to 26.0 percent decrease in ridership was reported immediately after a strike. This ridership decrease varied with service population size. One year after the strike, ridership was down an average of 4.3 percent. This decline was found not to vary with population size. The immediate decrease was primarily caused by fare increases after the strike. A year after the strike, small transit systems recovered more of their riders than larger systems, most likely because they had more "captive" riders.

The study found that if transit service is increased immediately after a strike, it reduces the long-term recovery time of the system. However, if service is increased <u>one year</u> after the strike, the recovery time is longer. Long-term ridership decline was determined to be affected more by changes in service area, population size, and level of service than fare increases.

DATA COLLECTION

The data used in the analysis for the study was collected through the use of a questionnaire and secondary sources. The questionnaire used in this study was designed to provide the information needed from each transit system to analyze the effect of a transit strike or work stoppage on transit ridership. A sample of the questionnaire is found in the Appendix.

The questionnaires were sent to the general managers of the eighteen transit systems in Texas and fourteen out-of-state transit systems. These out-of-state systems were chosen on the basis of the fact that they had a strike within the past five years and the transit system did not include rail transport. This information was obtained from the American Public Transit Association Monthly Transit Ridership published by the APTA Statistics Department [15] which contains ridership data and work stoppage information for most transit systems in the country.

Out of the total questionnaires sent to Texas transit systems, eleven were returned for a response rate of 61%. Eight of the out-of-state questionnaires were returned for a 57% response rate. Together, the combined return rate was 59%.

For those transit systems that did not respond, or returned incomplete questionnaires, the information needed was obtained from secondary sources. For some systems it was impossible to get all the necessary information and these , consequently, were not included in the analysis. Other information obtained from secondary sources needed for analysis was general statistical data for each individual city in which the transit systems were located. In the final analysis all 18 Texas transit systems were examined as well as 9 out-of-state systems.

The data used in the analysis came from many different sources. Most of the information came from the returned questionnaires which provided the following statistics for the years 1979-1983:

1) System miles operated per year
2) Number of revenue vehicles operated per year
3) Basic adult cash fare for each year
4) If employees are represented by a union or association
5) If there were any strikes or work stoppages and if so, the date and duration
6) If there was a fare increase after the strike and how much
7) Transit ridership by month, 12 months before and after the strike.

For those with incomplete information on system miles operated and number of revenue vehicles, the necessary information for out-of-state systems was obtained from the National Urban Mass Transportation Statistics Section 15 Report, November 1981, June 1982, and May 1983 [16]. This document contains statistics about various aspects of transit operations for individual transit systems nationwide. For transit systems in Texas the information was obtained from Texas Transit Statistics 1979 through 1983 [3] which contains similar information reported each year by the Texas systems. Information about fare increases for certain years was gotten from the APTA Transit Fare Summary [27] which is a summary of adult cash fares for local base period service by transit system. Information about strikes and monthly transit ridership was obtained from the APTA Monthly Transit Ridership, 1979-1983 [15]. For those systems that had transit strikes, only the ridership 12 months before and after the strike was needed. For all the Texas systems, monthly ridership for the complete 5 year period (1979-1983) was obtained from the Texas Department of Highways and Public Transportation.

The general information for each city used in the analysis included the yearly population and the percentage of minority groups, the monthly unemployment rate, and the yearly per capita income. This information was obtained from various sources.

The yearly population data was acquired from the U.S. Department of Commerce, Bureau of Economic Analysis. However, data for the year 1983 was unavailable, so estimates were calculated using a derived population increase of 1.5%. The percentage of minority groups in the city population was obtained from 1980 Census data [18].

The monthly unemployment rates for each city in Texas were obtained from the Texas Labor Market Review [19], a publication distributed by the Texas Employment Commission. For the out-of-state cities this information was acquired from the state employment commissions (or equivalent) of the states in which these cities were located.

The yearly per capita income for each city was obtained from the Survey of Current Business published by the U.S. Department of Commerce, Bureau of Economic Analysis [20]. The most recent data, however, was not available. Therefore, income for 1983 was estimated using an adjusted increase rate of 6%.

ANALYSIS OF STRIKE EFFECTS

Introduction

As mentioned previously, data were collected for transit systems which had experienced a labor strike during the 1979-1983 time period, and for all transit systems within Texas. Only one Texas transit system, Dallas, had experienced a labor dispute during the study period. The objective of collecting data on non-strike transit systems was to pose "what if" questions regarding the effects of labor disputes on ridership for non-strike systems in Texas. A review of the data, however, indicated that differences between the Texas systems and the strike systems precluded such an approach. Therefore the analysis focuses on the systems which experienced a labor dispute.

Objective

The objective of this study was to assess the effects of labor disputes in Texas. Since only one system in the state met the requirement of having a labor dispute within the five year study period it was obvious that systems outside the state would need to be examined.

There are two basic approaches to analyzing the effects of labor disputes which have been utilized previously. One is primarily conducted in "real time" (during or immediately after a labor dispute) and the other is a historical approach. For this study the second approach was selected. There were no Texas systems which had recently experienced or were anticipating a labor dispute. Also, since the objective was to assess the effects on ridership rather than the loss of business by firms patronized by transit riders, the historical approach was deemed appropriate.

Variable Selection and Description:

Determining the consequences of a labor dispute on transit ridership is a relatively complex problem. System characteristics and attributes of the population served by transit systems must be documented. In addition, pre and post-strike changes in both system and population characteristics must be considered. In many cases data of sufficient detail are not available to the researcher.

Table 8 defines the variables used in the analysis. The symbols indicate pre or post-strike condition of the variable. Although these are the variables which were identified and collected for the analysis, several were rejected since they were found to be basically constants. For example, the minority population data was a constant.

Statistical Methodology:

It was determined that regression techniques in conjunction with a factor analysis were appropriate for the study objective. The regression technique provides the researcher with a basis to identify the effects of the labor dispute as well as determine the effects of the various variables on ridership return. For example, are there characteristics of a transit system or the population served which influence ridership return? Do riders return to large systems at a greater rate than to small systems? Do cities characterized by low per capita income tend to maintain riders after service is resumed?

Factor analysis provides the researcher with a tool for identifying and grouping variables having common characteristics. If the variables do indeed have common characteristics, it is then possible to reduce the total number of variables in the analysis. By using factor scores a regression model can then be developed.

Table 8: VARIABLES SELECTED

VARIABLE NAME	SYMBOL	DESCRIPTION
Ridership	(T)	Monthly transit system ridership
Population	(PO; SPO)	Annual population estimate for city
Unemployment	(UN; SUN)	Monthly reported unemployment for city
Minority Population	(M; SM)	Annual minority population estimate for city
Strike	(S)	Dummy variable to indicate pre and post-strike months
Strike Duration	(SD)	Length of strike in days
System Route Miles	(RM; SRM)	Annual reported system route miles
Number of Vehicles	(V; SV)	Annual reported number of revenue vehicles
Union	(U; SU)	Dummy variable to indicate if system employees represented by union
Fare	(F; SF)	Dummy variable to indicate if there was post strike fare increase
Per Capita Income	(I; SI)	Annual per capita income for city population
Per Capita Ridership	(CAP; SCAP)	Cities monthly per capita ridership
Route Miles Per Vehicle	(RMV; SRMV)	System route miles per vehicle
Time Period	(SD10-SD13)	Dummy variable for first through fourth quarters after strike

Although the interpretation of factor analysis may not always be as straight forward as an ordinary least squares regression model, there are certain advantages to its use. It is especially useful in the identification and grouping of variables with common characteristics. Factor analysis is used primarily to identify and describe an underlying structure beneath a set of multivariate data. Factor analysis is a covariance/correlation analysis which behaves similarly to linear models. It condenses a set of observed variables into a reduced number of conceptual variables which have not been measured [21].

As Hair and others note:

"The general purpose of factor analytic techniques is to find a way of condensing (summarizing) the information contained in a number of original variables into a smaller set of new composite dimensions (factors) with a minimum loss of information. That is, to search for and define the fundamental constructs or dimensions assumed to underlie the original variables. More specifically, four functions factor analysis techniques can perform are:

(1) Identify a set of dimensions that are latent (not easily observed) in a large set of variables; also referred to as "R" factor analysis.

(2) Devise a method of combining or condensing large numbers of people into distinctly different groups within a larger population; also referred to as "Q" factor analysis.

(3) Identify appropriate variables for subsequent regression, correlation or discriminant analysis from a much larger set of variables.

(4) Create an entirely new set of a smaller number of variables to partially or completely replace the original set of variables for inclusion in subsequent regression, correlation or discriminant analysis.

Approaches (1) and (2) take the identification of the underlying dimensions or factors as ends in themselves; the estimates of the factor loadings are all that is required for the analysis. Method (3) also relies on the factor loadings, but uses them as the basis for identifying variables for subsequent analysis with other techniques. Method (4) requires that estimates of the factors themselves (factor scores) be obtained; then the factor scores are used as independent variables in a regression, discriminant, or correlation analysis" [22].

The fourth approach was used in this study. However, both the regression equation using the variables as well as the factor analysis and the regression equation using the factor loading are presented.

It should be noted that not all variables which were initially considered and for which data were collected entered into the final model selected. The twelve (12) variables which were used in the analysis of strike effects are:

- Income, prior to strike (I)
- Income, after strike (SI)
- Population, prior to strike (PO)
- Population, after strike (SPO)
- Strike duration (SD)
- Per capita ridership, prior to strike (CAP)
- Per capita ridership, after strike (SCAP)
- Route miles per vehicle, prior to strike (RMV)
- Route miles per vehicle, after strike (SRMV)
- Union (SU)
- Unemployment, after strike (SUN)
- 1st quarter after strike (SDIO)

Regression Model: First, using ordinary least squares regression the model

$$y = B_1 I + B_2 SD + B_3 PO + B_4 CAP + B_5 RMV + B_6 SUN + B_7 SI + B_8 SU + B_9 SPO + B_{10} SCAP + B_{11} SRMV + B_{12} SD10$$

rendered the results presented in Table 9. Although this model fit data with an adjusted R^2 of .91 several of the variables are not significant.

Table 9: PARAMETER ESTIMATES OF STRIKE EFFECTS ON TRANSIT RIDERSHIP: REGRESSION MODEL

VARIABLE	PARAMETER ESTIMATE	STANDARD ERROR	T FOR HO: PARAMETER=0	PROB > T
INTERCEP	-212.021	53.014	-3.999	0.0001
I	-8.942	4.816	-1.856	0.0647
SD	0.181	0.730	0.249	0.8036
PO	0.249	0.012	20.334	0.0001
CAP	1371.482	84.942	16.146	0.0001
RMV	-25.112	68.385	-0.367	0.7138
SUN	-19.595	3.694	-5.303	0.0001
SI	1.933	6.405	0.302	0.7631
SU	192.605	81.105	2.375	0.0184
SPO	-0.047	0.017	-2.634	0.0090
SCAP	264.883	137.486	1.927	0.0553
SRMV	-211.187	102.113	-2.068	0.0398
SD10	12.824	18.673	0.687	0.4929

Adjusted R^2 = 0.91: "F" Value 210 (0.0001)

The use of numerous variables, many of which were non-significant, and the high R^2 presents serious concern regarding the use of this model. Cross sectional and time series data also presents a problem of multicollinearity.

There are, however, several observations which should be made and can aid in the interpretation of the factor analysis following. While the pre-strike income coefficient is negative, the post-strike income is positive.

At first this may seem a contradiction. For those systems and cities in the analysis, however, it would appear that transit is considered an inferior good. That is, as per capita income increases ridership declines. After a transit strike, income has a positive, but non-significant effect. By comparison post-strike unemployment levels have a negative impact on the return of riders to the system.

It was found that the duration of a strike was not a significant variable in the regression analysis. The first quarter following a strike is critical to the systems. It is during this time period that ridership loss is most noticeable. Also, this is the post-strike quarter with the highest ridership return rate. Although only the first quarter is included in the final analysis, three additional quarters were examined and their parameter estimates were found not to be significant from zero.

While many of the aspects of the regression equation provide insight into ridership return in a post-strike situation, it furnishes little understanding of the basic structure associated with transit ridership. Also, twelve variables tend to add to the complexity of the problem. With these issues in mind it was decided to conduct a factor analysis of the same variables used in the regression analysis.

Factor Analysis: As previously mentioned factor analysis is a procedure for identifying and grouping variables with commonality of characteristics and thereby reducing the number of variables considered. Using this new set of variables regression estimates can then be developed.

The analysis indicated that four factors should be retained. These four explained .8477 of the variance of the twelve variables. Table 10 shows the factor pattern and factor loading scores.

Table 10: FACTOR PATTERN

VARIABLES	FACTOR1	FACTOR2	FACTOR3	FACTOR4
INCOME	0.34309	-0.22908	*0.54965	-0.22959
DURATION	0.08394	*0.88986	-0.01722	-0.14665
POPULATION	-0.02592	0.07653	*0.92148	0.06412
PERCAP RIDES	-0.02006	-0.18164	0.47985	*0.76082
RM PER VEH	0.10657	-0.02270	-0.28318	*0.85233
POST STRIKE UNEMP	*0.92569	0.14478	0.01839	-0.06735
POST STRIKE INCOME	*0.97135	0.10472	0.08410	-0.09855
POST STRIKE UNION	*0.96986	0.17221	-0.00236	-0.06711
POST STRIKE POP	*0.78189	0.17137	0.44890	-0.05970
POST STRIKE CAP	*0.89537	-0.01168	0.18438	0.26782
POST STRIKE RMV	*0.91368	0.11412	-0.11257	0.23920
1ST QTR POST STRIKE	0.25479	*0.85900	0.01953	0.01903
VARIANCE EXPLAINED BY FACTOR	5.191028	1.725689	1.720314	1.535270

*Identifies variables in each factor

Factor 1 is defined as "Post Strike Characteristics". All of the variables in this factor have the common basis of describing post-strike conditions of the transit systems and cities. The variance explained by this factor is 5.191028.

Factor 2 is defined as "Strike Effects". This factor includes the strike duration and the first quarter after strike variables. The variance explained by this factor is 1.725689.

Factor 3 is defined as "Population Characteristics" and includes both the population and income variables. The variance explained by this factor 1.720314.

Factor 4 is defined as "System Characteristics" and is composed of the two variables: route miles per vehicle and per capita ridership. The variance explained by this factor is 1.535270.

It should be noted that the variables grouped in the expected manner; that is, those with common underlying structure are in the same factors. While it is of interest that there is commonality between the variables, that alone does not aid in understanding transit ridership. It does, however, provide a reduced set of new variables which can be further analyzed. These new variables were subject to a regression analysis which is discussed in the next section.

Regression Analysis: Factor Analysis:

The factor analysis procedure reduced to four the number of variables to be considered. Using regression analysis techniques parameter estimates were developed and are presented in Table 11. This model had an adjusted R^2 of .86 and all variables were significant.

Table 11: PARAMETER ESTIMATES OF STRIKE EFFECTS ON TRANSIT RIDERSHIP: FACTOR ANALYSIS REGRESSION

VARIABLE	PARAMETER ESTIMATE	STANDARD ERROR	T FOR HO: PARAMETER=0	PROB > T
INTERCEP	246.126	5.629597	43.720	0.0001
POST STRIKE CHARACTERISTICS	-10.143286	5.641562	-1.798	0.0735
STRIKE EFFECTS	-6.232961	5.641562	-1.105	0.2704
POPULATION CHARACTERISTICS	190.555	5.641562	33.777	0.0001
SYSTEM CHARACTERISTICS	105.285	5.641562	18.662	0.0001

Adjusted R^2 = 0.86: "F" Value 373. (0.0001)

The variable Post Strike Characteristics is composed of the initial variables SUN, SI, SU, SPO, SCAP and SRVM. This variable has a negative impact on returning ridership. This was expected due to the inclusion of SUN and SI.

The Strike Effect variable which includes strike duration and first quarter after the strike has a negative value. Although during the first quarter after a strike is the time period in which most riders return to the system, longer strikes tend to reduce this effect.

Population and System Characteristics variables both have a positive sign. Larger systems serving larger populations would be expected to recover ridership and the regression confirms this expectation.

A comparison of pre and post-strike ridership by quarters is presented in Table 12. Due to missing data no first quarter comparison is shown for Ann Arbor. For seven of the systems ridership during the first quarter following the strike was below the same pre-strike quarter. Two of the systems, Sacramento and San Diego, had increased ridership during the first post-strike quarter as compared to the same period before the strike. Generally, ridership during the second, third, and fourth quarters after the strike corresponded favorably with ridership during the comparable pre-strike quarter. Also, total ridership for the twelve months after the strike tended to be below pre-strike ridership. Dallas (-10.9%), Denver (-19.1%), and Jacksonville (-9.0%) had relatively large ridership losses for the entire post-strike year.

Table 13 presents a comparison of strike duration with ridership for the first post-strike quarter and the post-strike year. Except for Sacramento and Salt Lake City, larger percentage losses of ridership correspond with longer strike durations.

TABLE 12: COMPARISON OF STRIKE SYSTEMS RIDERSHIP BY QUARTERS (RIDERSHIP IN 10,000's)

SYSTEM			
Quarters	Pre-Strike Ridership	Post-Strike Ridership	Percent Change
Ann Arbor			
	1st Year	2nd Year	%
1st*			
2nd	46.8	60.8	+29.9
3rd	57.2	46.4	-18.9
4th	56.6	62.4	+10.3
TOTAL	160.6	169.6	+ 5.6
Columbus			
1st	530	451.2	-14.9
2nd	566.9	589.8	+ 4.0
3rd	583.8	583.3	+ 0.1
4th	620.7	622.1	+ 0.2
TOTAL	2,301.4	2,246.4	- 2.4
Dallas			
1st	893.3	601.6	-32.7
2nd	930.5	869.2	- 6.6
3rd	912.5	877.6	- 3.8
4th	921.9	913.1	- 1.0
TOTAL	3,660.9	3,260.8	-10.9

TABLE 12 Continued

Quarters	Pre-Strike Ridership	Post-Strike Ridership	Percent Change
		SYSTEM	
		Denver	
	1st Year	2nd Year	%
1st	1,060.8	650.6	-38.7
2nd	1,102.7	970.6	-12.0
3rd	1,141.4	999.9	-12.0
4th	1,081.3	929.3	- 1.4
TOTAL	4,386.2	3,550.4	-19.1
		Jacksonville	
1st	378.3	323.1	-14.6
2nd	400.9	392.9	- 2.0
3rd	388.9	342.2	-12.0
4th	381.5	351.3	- 7.9
TOTAL	1,549.5	1,409.5	- 9.0
		Pittsburgh	
1st	2,818.4	2,621.7	- 7.0
2nd	2,697.0	2,431.5	- 9.9
3rd	2,773.5	2,617.9	- 5.6
4th	2,577.4	2,448.8	- 5.0
TOTAL	10,866.3	10,119.9	- 6.9
		Sacramento	
1st	311.5	365.0	+17.2
2nd	398.2	415.4	+ 4.3
3rd	385.4	421.9	+ 9.5
4th	499.1	500.0	+ 0.2
TOTAL	1,594.2	1,702.3	+ 6.9

TABLE 12 Continued

SYSTEM			
Quarters	Pre-Strike Ridership	Post-Strike Ridership	Percent Change
	Salt Lake City		
	1st Year	2nd Year	%
1st	482.4	382.3	-20.8
2nd	447.4	435.9	- 2.6
3rd	373.0	360.4	- 3.4
4th	396.2	397.1	+ 0.2
TOTAL	1,699.0	1,575.7	- 7.3
	San Diego		
1st	749.9	838.4	+11.8
2nd	836.7	820.1	- 2.0
3rd	901.6	785.1	-12.9
4th	868.3	731.8	-15.7
TOTAL	3,356.5	3,175.5	- 5.4
	Santa Cruz		
1st	144.5	125.8	-12.9
2nd	157.8	178.0	+12.8
3rd	168.2	178.1	+ 5.9
4th	163.2	165.3	+ 1.3
TOTAL	633.7	642.5	+ 1.4

*Data for 1st pre-strike quarter not available.

Dallas, which had a fifty-five day strike had a 32.7 percent loss of ridership during the first post-strike quarter. Denver, after an eighteen day strike exhibited a 38.7 percent decline in ridership during the first post-strike quarter.

TABLE 13: COMPARISON OF STRIKE DURATION AND RIDERSHIP DURING POST-STRIKE PERIOD

City	Strike Duration	Percent Change in Ridership During Post-Strike 1st Quarter	Percent Change in Ridership Post Strike-Year
Columbus	18	-14.9%	- 2.4
Dallas	55	-32.7	-10.9
Denver	18	-38.7	-19.1
Jacksonville	12	-14.6	- 9.0
Pittsburgh	2	- 7.0	- 6.9
Sacramento	22	+17.2	+ 6.9
Salt Lake City	4	-20.8	- 7.3
San Diego	2	+11.8	- 5.4
Santa Cruz	17	-12.9	+ 1.4

Figures 21 through 30 show the actual and predicted ridership for the twelve months before and twelve months after a strike. The predicted values are based on the regression estimates developed from the factor analysis. From a review of these figures it is apparent that the model does not fit some transit systems as well as others. For example, the predicted values for Ann Arbor are negative for both the pre and post-strike period. This, however, is the only system in this condition.

There are some observations which can be made regarding the comparison of actual versus predicted ridership for many of the systems. However, actual and predicted ridership for Columbus, Ohio correspond very closely prior to the strike. After the strike, ridership returned to a much higher level than predicted. Basically, post-strike ridership returned to pre-strike levels. The same observation can be made regarding the

Figure 21

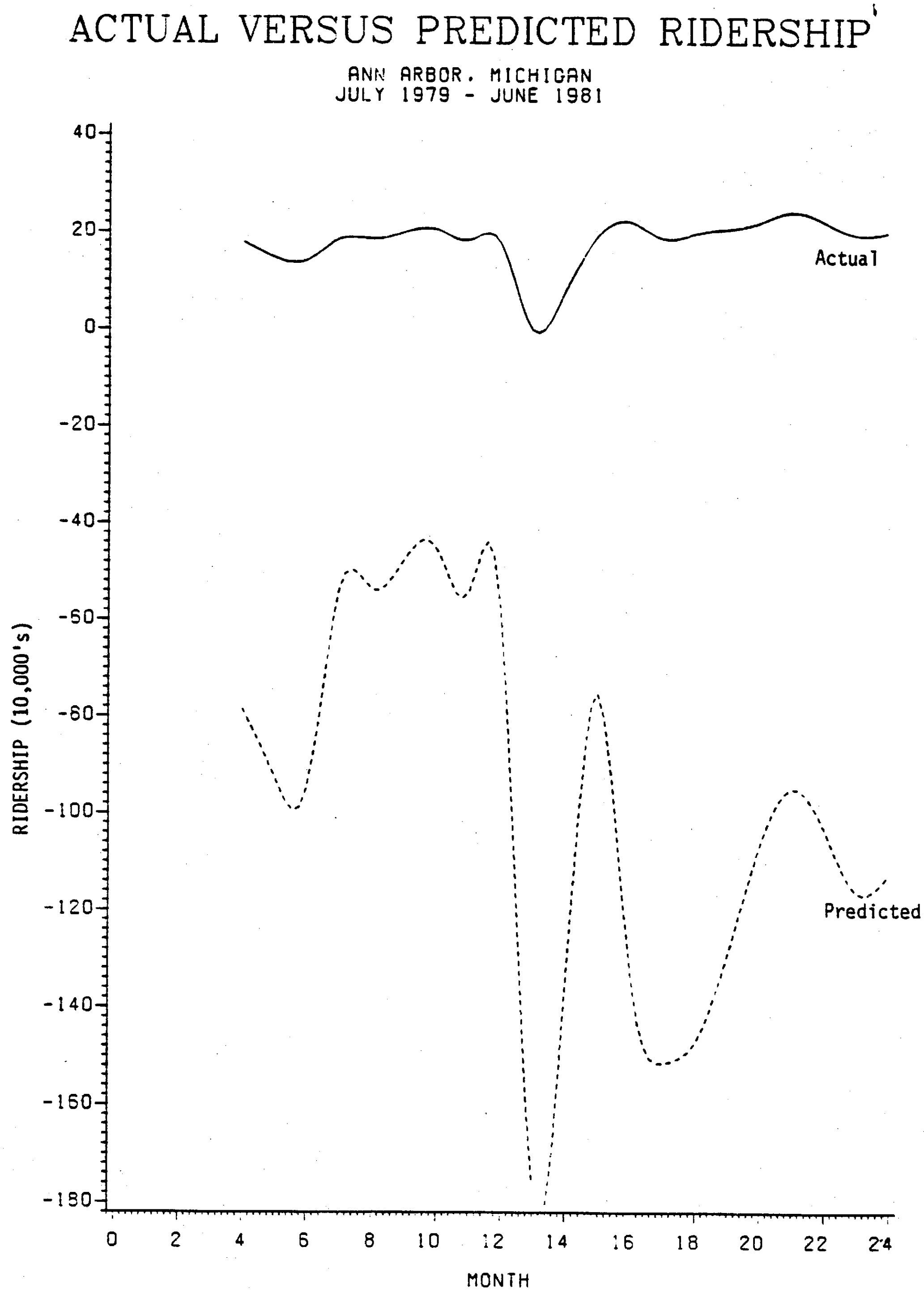

ACTUAL VERSUS PREDICTED RIDERSHIP
ANN ARBOR, MICHIGAN
JULY 1979 - JUNE 1981
RIDERSHIP (10,000's)
40
20
0
-20
-40
-60
-80
-100
-120
-140
-160
-180
Actual
Predicted
0
2
4
6
8
10
12
14
16
18
20
22
24
MONTH

Figure 22

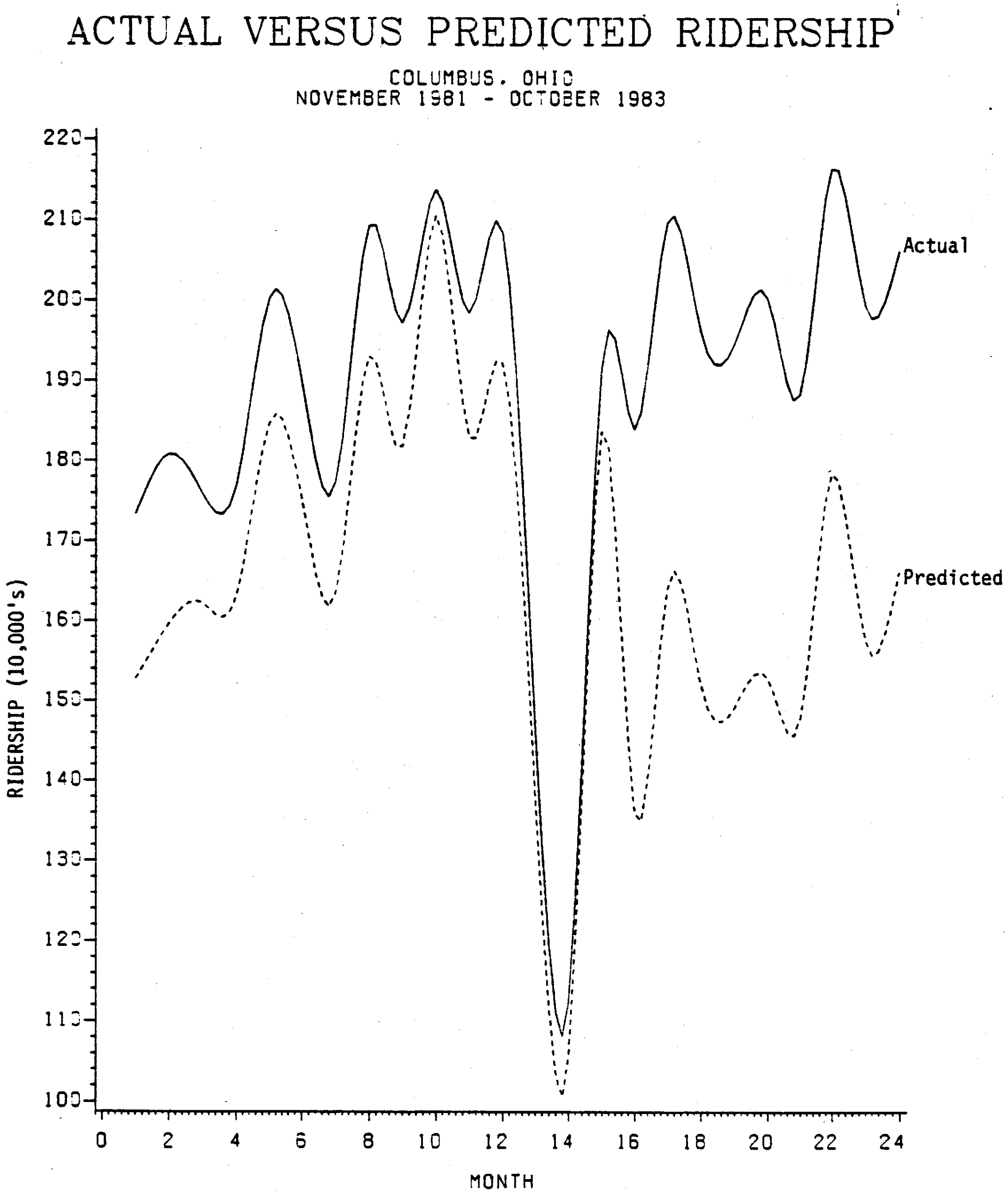

ACTUAL VERSUS PREDICTED RIDERSHIP
COLUMBUS, OHIO
NOVEMBER 1981 - OCTOBER 1983
RIDERSHIP (10,000's)
100
110
120
130
140
150
160
170
180
190
200
210
220
MONTH
0
2
4
6
8
10
12
14
16
18
20
22
24
Actual
Predicted

Figure 23

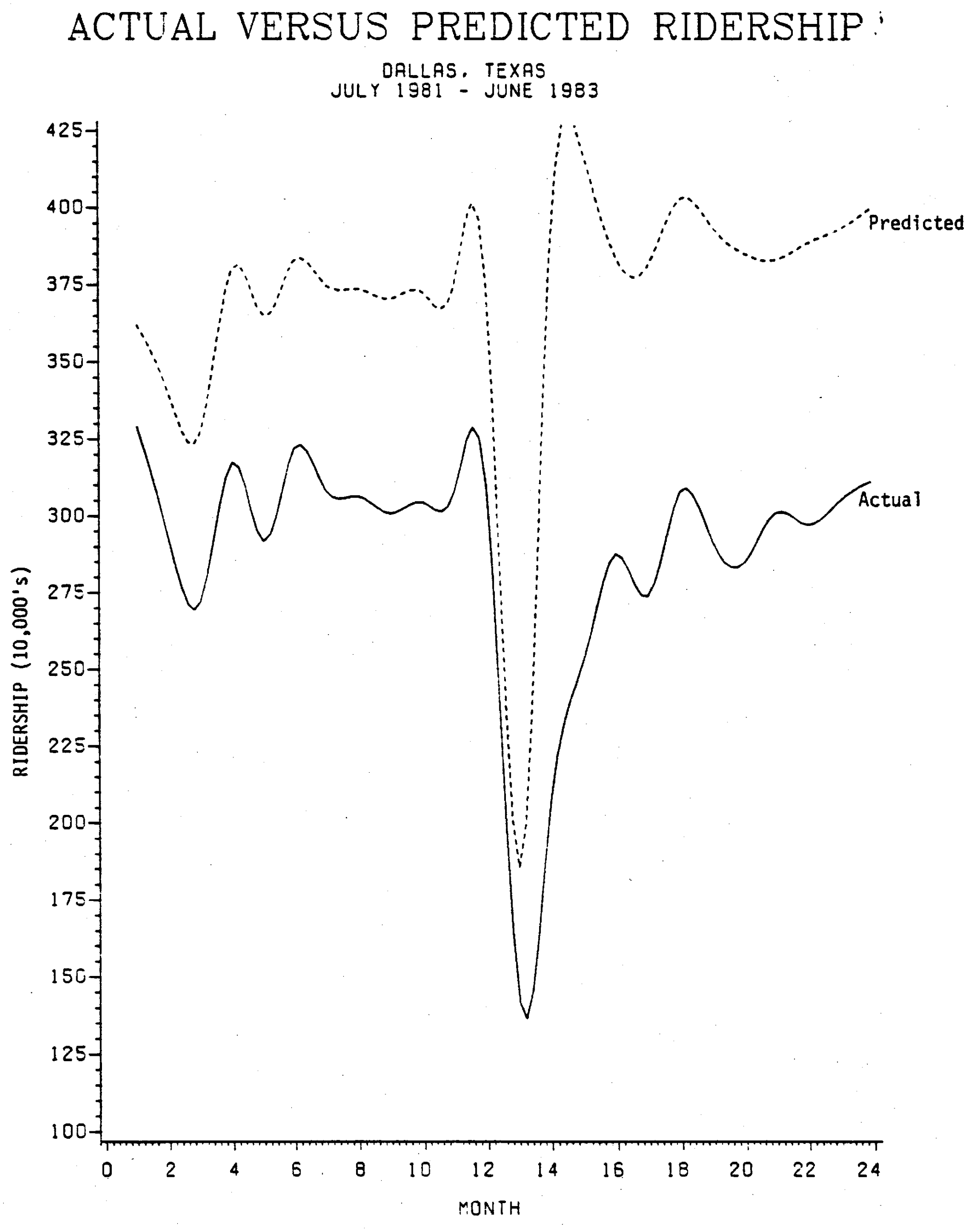

ACTUAL VERSUS PREDICTED RIDERSHIP
DALLAS, TEXAS
JULY 1981 - JUNE 1983
RIDERSHIP (10,000's)
425
400
375
350
325
300
275
250
225
200
175
150
125
100
0
2
4
6
8
10
12
14
16
18
20
22
24
MONTH
Predicted
Actual

Figure 24

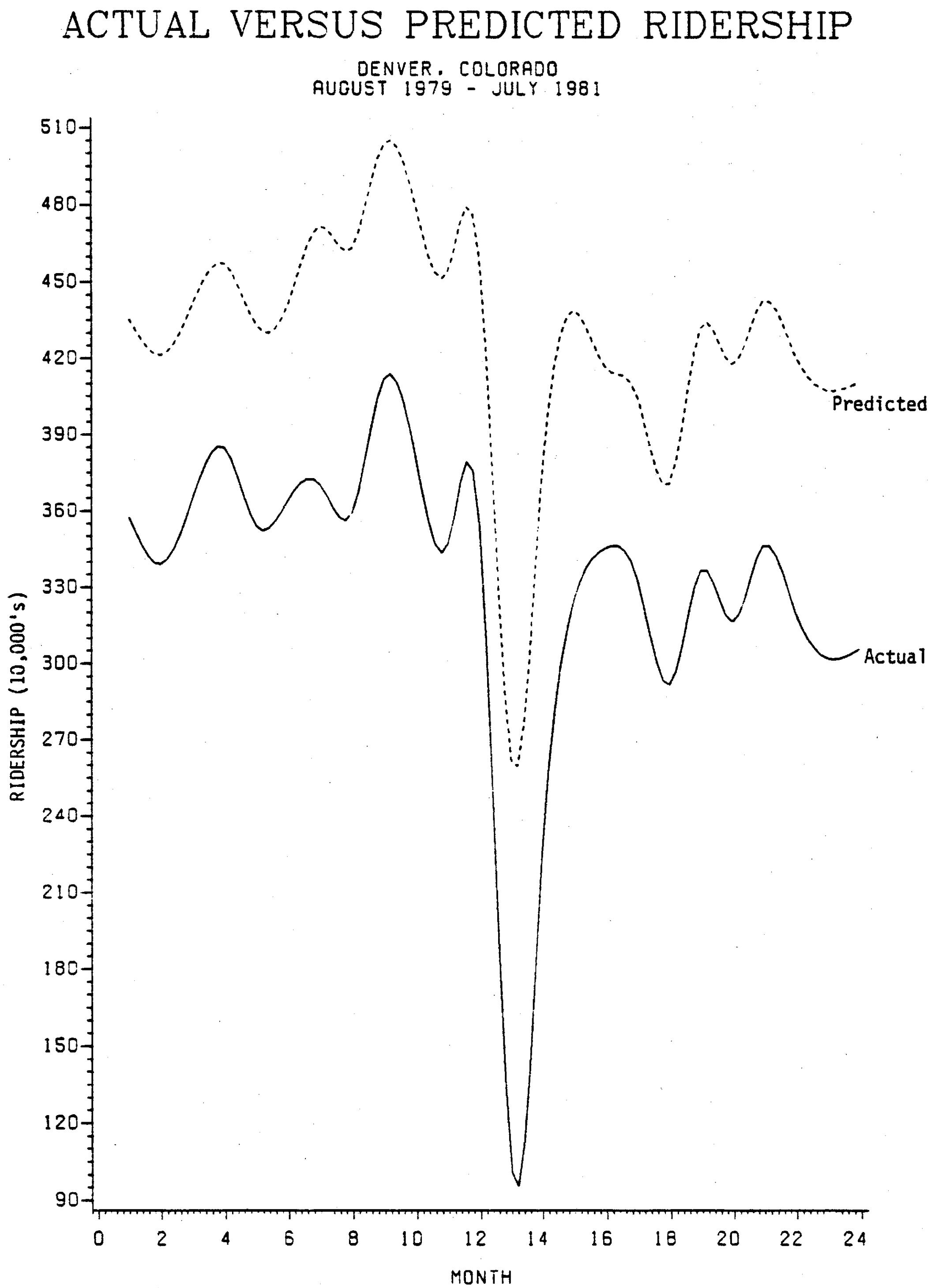

ACTUAL VERSUS PREDICTED RIDERSHIP
DENVER, COLORADO
AUGUST 1979 - JULY 1981
RIDERSHIP (10,000's)
510
480
450
420
390
360
330
300
270
240
210
180
150
120
90
0
2
4
6
8
10
12
14
16
18
20
22
24
MONTH
Predicted
Actual

Figure 25

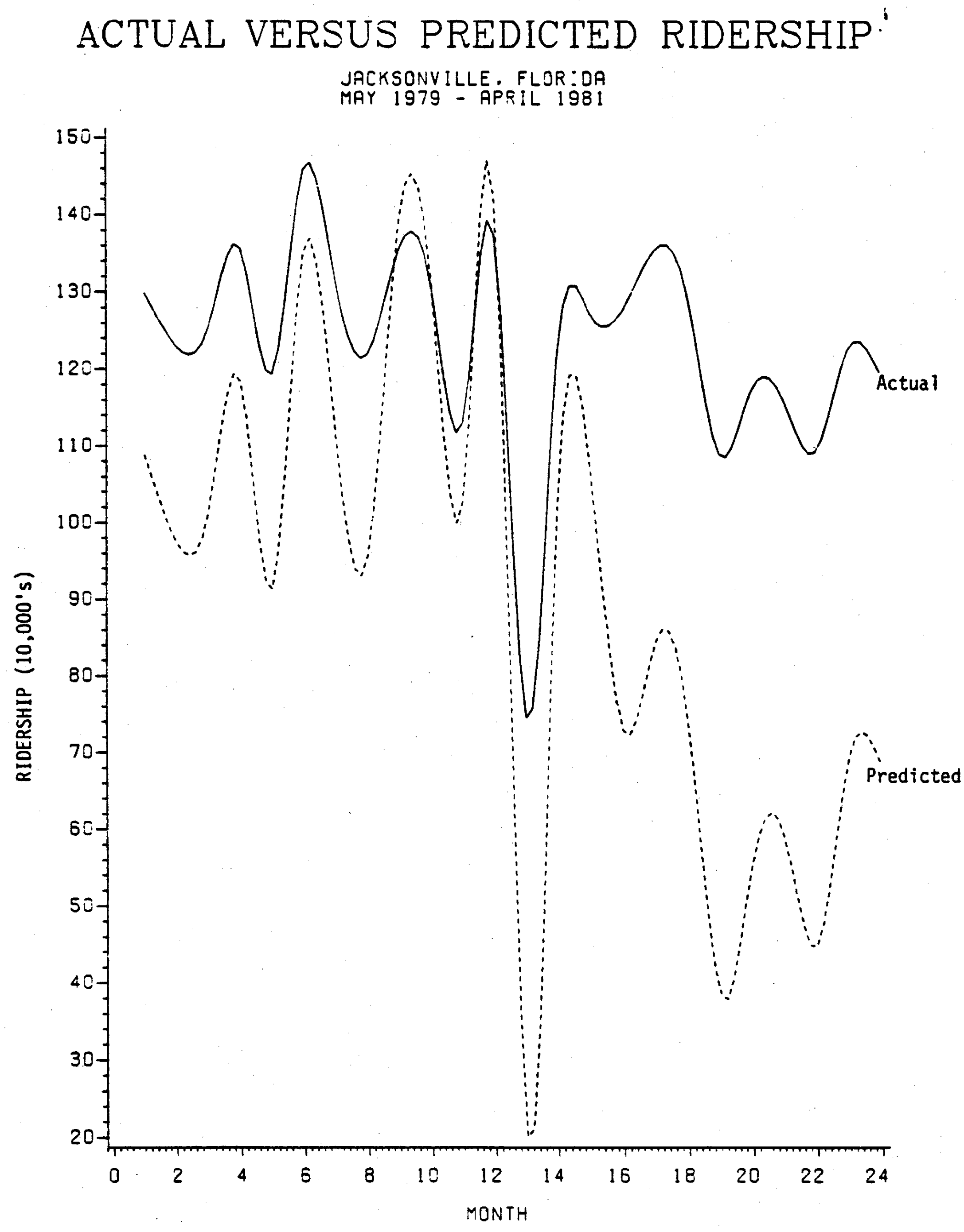

ACTUAL VERSUS PREDICTED RIDERSHIP
JACKSONVILLE, FLORIDA
MAY 1979 - APRIL 1981
RIDERSHIP (10,000's)
150
140
130
120
110
100
90
80
70
60
50
40
30
20
0
2
4
6
8
10
12
14
16
18
20
22
24
MONTH
Actual
Predicted

Figure 26

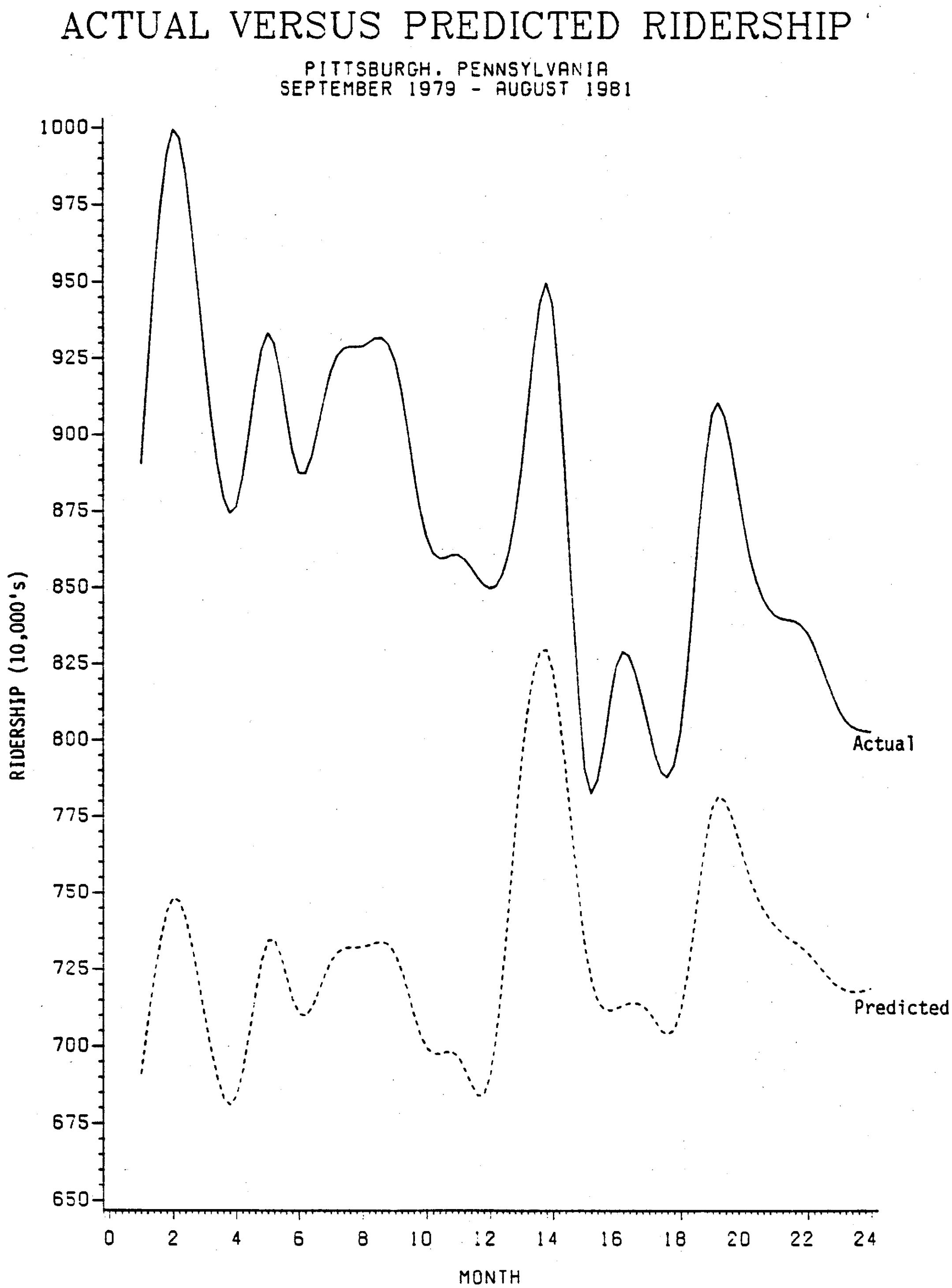

ACTUAL VERSUS PREDICTED RIDERSHIP
PITTSBURGH, PENNSYLVANIA
SEPTEMBER 1979 - AUGUST 1981
RIDERSHIP (10,000's)
1000
975
950
925
900
875
850
825
800
775
750
725
700
675
650
0
2
4
6
8
10
12
14
16
18
20
22
24
MONTH
Actual
Predicted

Figure 27

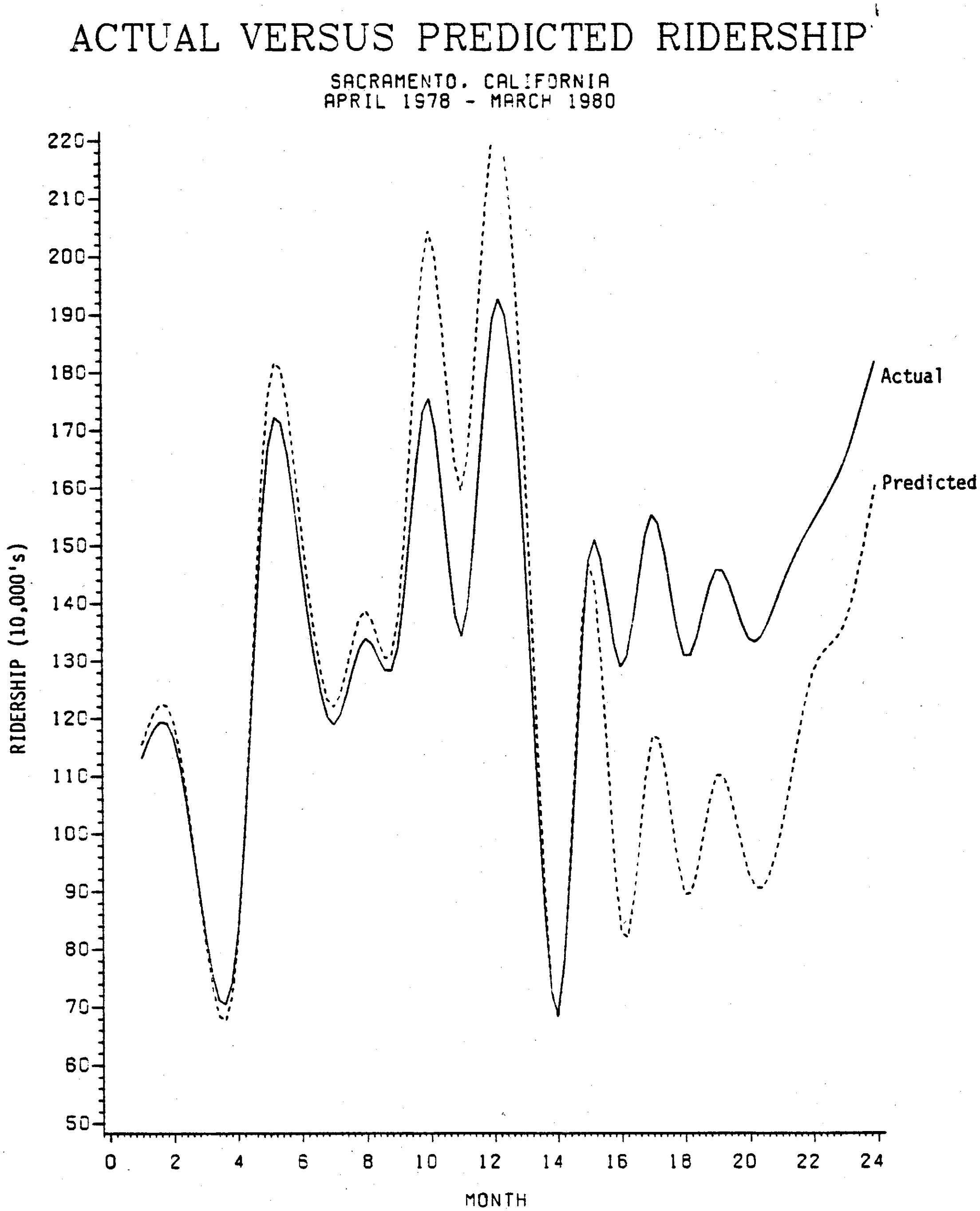

ACTUAL VERSUS PREDICTED RIDERSHIP
SACRAMENTO, CALIFORNIA
APRIL 1978 - MARCH 1980
RIDERSHIP (10,000's)
220
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
0
2
4
6
8
10
12
14
16
18
20
22
24
MONTH
Actual
Predicted

Figure 28

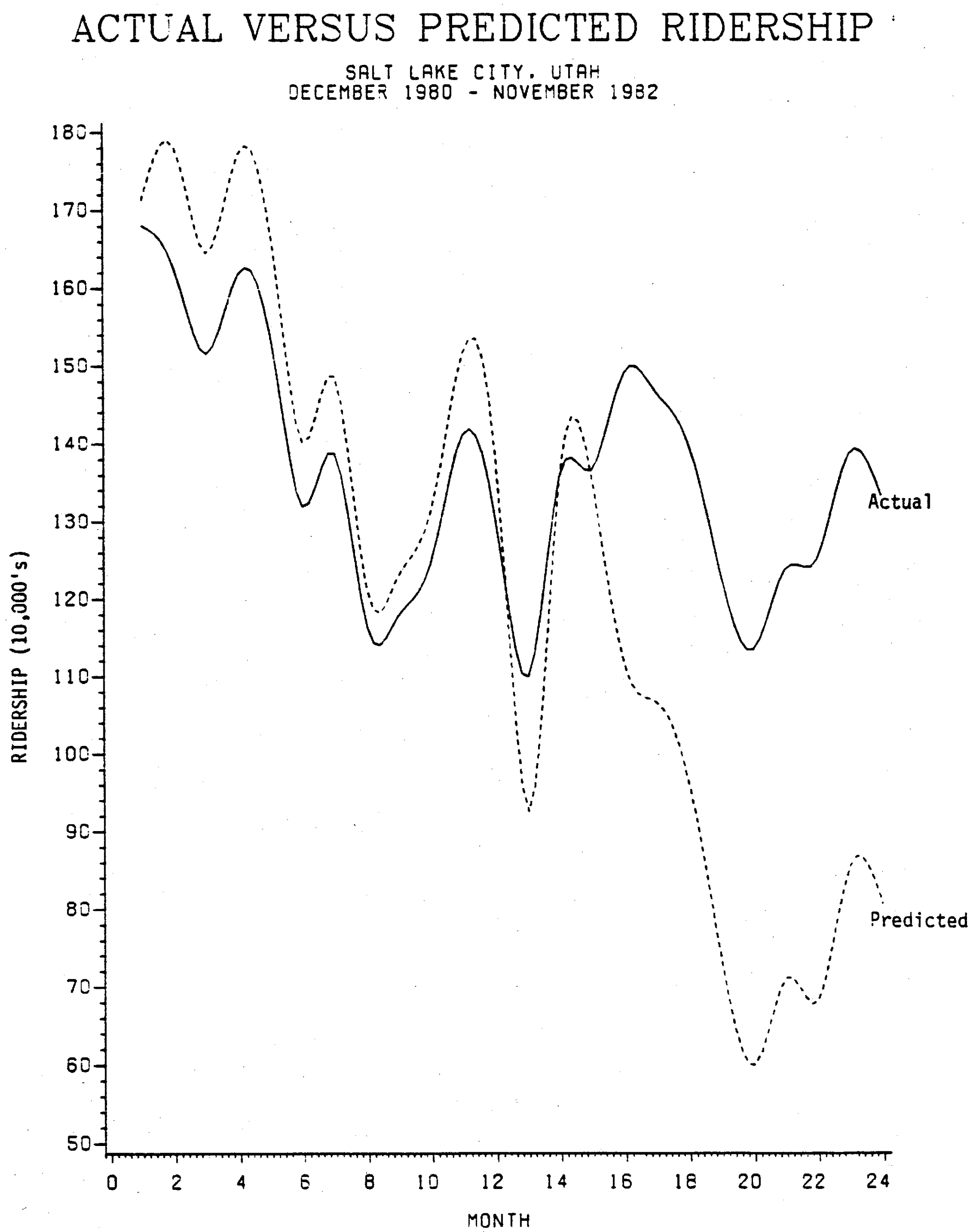

ACTUAL VERSUS PREDICTED RIDERSHIP
SALT LAKE CITY, UTAH
DECEMBER 1980 - NOVEMBER 1982
RIDERSHIP (10,000's)
180
170
160
150
140
130
120
110
100
90
80
70
60
50
0
2
4
6
8
10
12
14
16
18
20
22
24
MONTH
Actual
Predicted

Figure 29

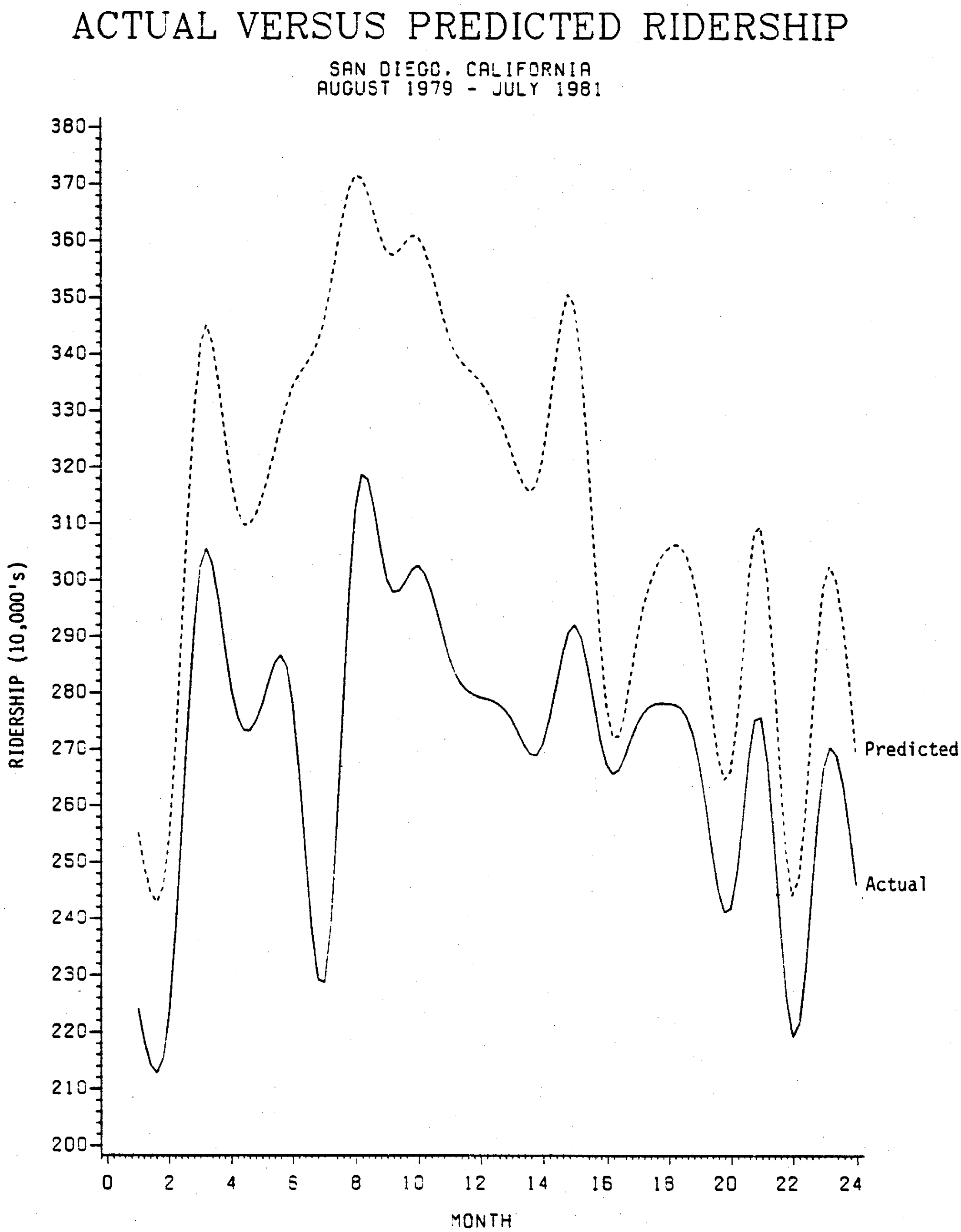

ACTUAL VERSUS PREDICTED RIDERSHIP
SAN DIEGO, CALIFORNIA
AUGUST 1979 - JULY 1981
RIDERSHIP (10,000's)
380
370
360
350
340
330
320
310
300
290
280
270
260
250
240
230
220
210
200
0
2
4
6
8
10
12
14
16
18
20
22
24
MONTH
Predicted
Actual

Figure 30

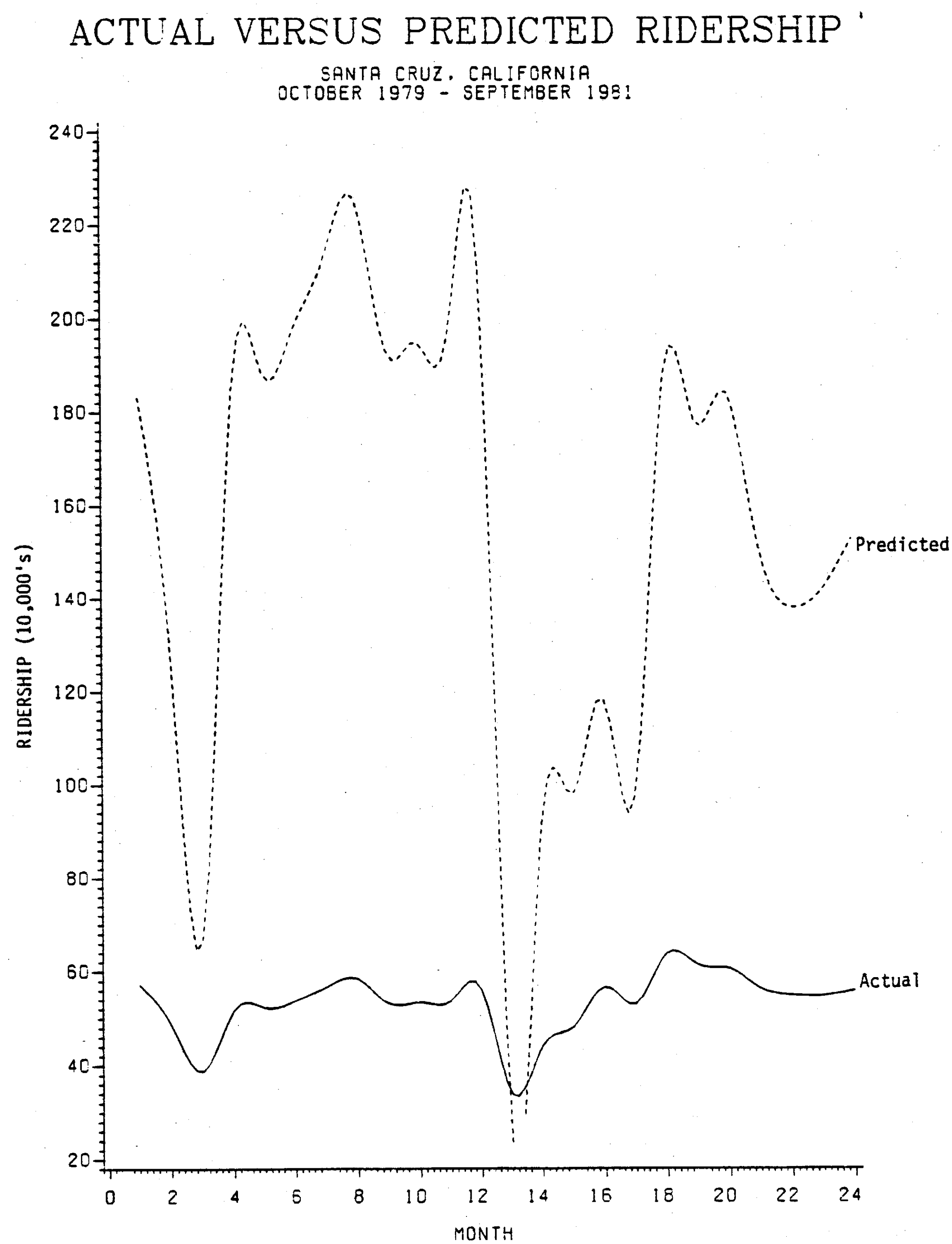
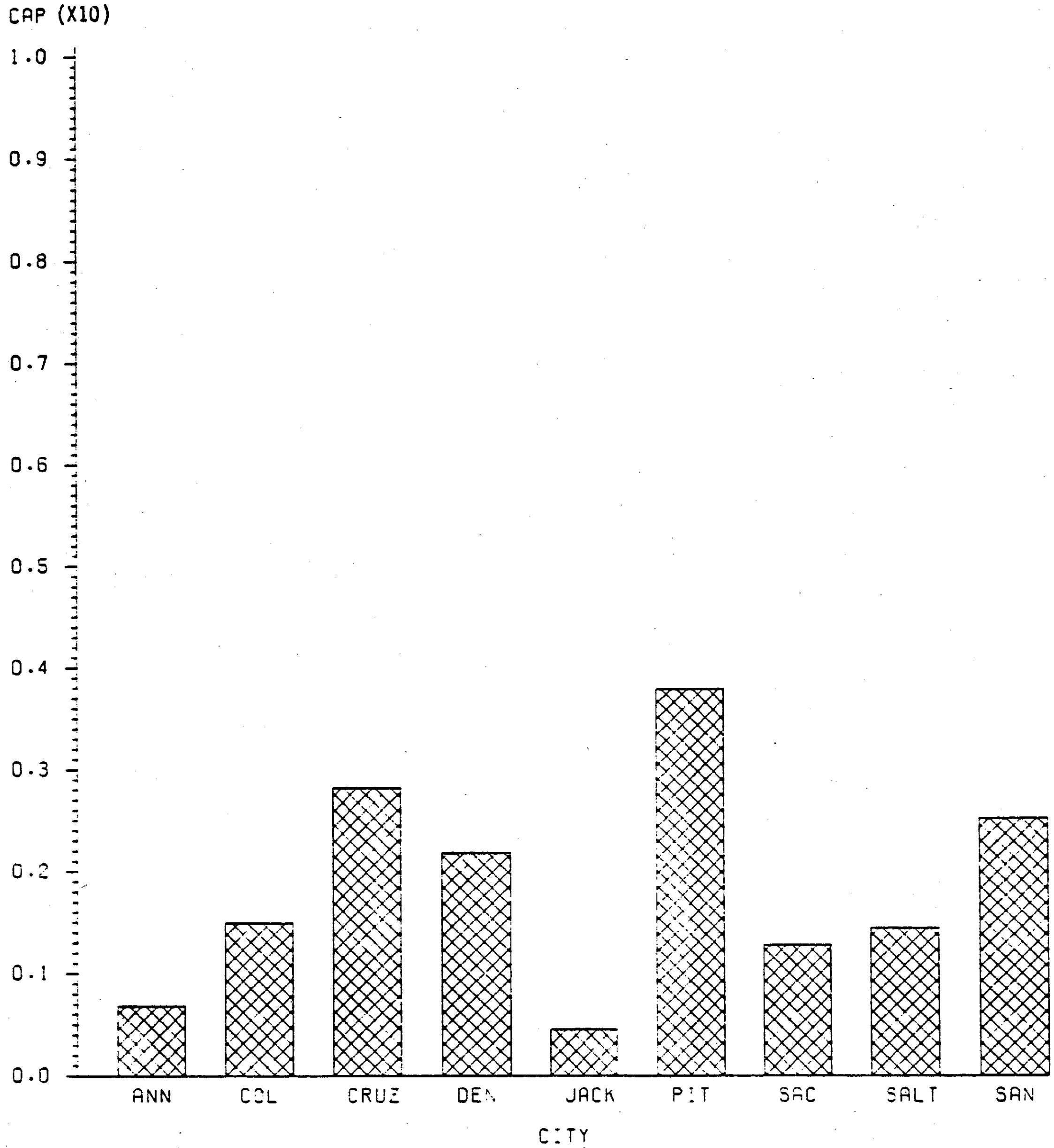

ACTUAL VERSUS PREDICTED RIDERSHIP
SANTA CRUZ, CALIFORNIA
OCTOBER 1979 - SEPTEMBER 1981
240
220
200
180
160
140
120
100
80
60
40
20
RIDERSHIP (10,000's)
0
2
4
6
8
10
12
14
16
18
20
22
24
MONTH
Predicted
Actual

Figure 31

AVERAGE MONTHLY PER CAPITA RIDERSHIP: STRIKE CITIES



Jacksonville, Sacramento and Salt Lake systems.

For some systems predicted ridership prior to the strike followed the actual ridership pattern, but returned to a higher than predicted level after the strike. This may be the result of the failure or inability to identify specific variables which influence post-strike performance. For example, management decisions and actions to counter and regain lost ridership were not identified. These actions could include an advertising campaign, reduced fares for a limited time, or similar procedures designed to recapture riders diverted to competing modes during the strike period.

CONCLUSIONS AND RECOMMENDATIONS

There can be little disagreement that labor disputes have a negative impact on transit ridership and the return of riders to a system. While the overall effect on ridership varies from system to system, and although some systems may experience no adverse effects, the general trend is a loss of riders and an extended recovery period. During the period of a labor dispute or strike of a transit system, riders who have used and depended on reliable and uninterrupted service and schedules must make other arrangements for both required and discretionary travel. Except in those relatively few cities which have both a bus and rail system, there are few, if any, viable alternatives other than private automobiles or car pools. The loss, even though temporary, of a public service may result in a negative image on the part of the users resulting in long term adverse effects. Once transit riders find it necessary to alter their travel mode they may decide they prefer the alternative and not return to the transit system once the strike is settled.

The objective of this study was to assess the effects of labor disputes on transit ridership in Texas using statistical analysis of selected variables. However during the 1979-1983 study period only one transit system in Texas experienced a strike. Therefore it was necessary to examine what happened to systems outside the state which had labor strikes during this period. The results of this study and the effects of labor strikes on transit ridership on systems outside Texas can serve as an indicator of what might be expected to occur to transit ridership for Texas systems following a strike. Indeed Dallas, which did experience a strike during the study period, lost riders after its settlement.

Previous studies which addressed this issue have tended to examine the effect of a specific strike, and the effects included a wide range of variables, ridership being only one of several. Most of these studies observed and documented the effects of the strike, both during and after the dispute. In contrast this study employed a cross-sectional approach (analyzing several transit systems throughout the country) using time series data. The finding of the previous studies as they relate to transit ridership were generally confirmed by this work.

Lost, or slow return of riders to a transit system is perhaps the most critical and long lasting effect of a strike. While this aspect was the focus of this study the findings of previous studies furnish insight into other dimensions of this problem. Findings and conclusions from previous studies indicate:

- A transit strike does affect post-strike system ridership. This affect may last and be identifiable for as long as one year.
- The recovery of a transit system from a strike is dependent on many factors such as competing modes and transport options, demographic characteristics, post-strike service levels and promotional programs.
- Increasing transit service levels immediately after settlement of a strike tends to reduce the long-term recovery period.
- Long-term ridership decline is affected more by changes in population size and level of service than fare increases.
- Transit strikes most severely affect the elderly, young, poor and handicapped. This group, usually termed captive riders, tends to have reduced access to alternatives to meet their travel requirements.

In this study a statistical technique known as factor analysis was used to determine the effects of strikes on ridership. Ten cities which experienced a transit strike during the period 1979-1983 were analyzed. Data were collected on variables which described the system as well as characteristics of the population during this period. Twelve variables which described both pre and post-strike conditions were selected for inclusion in the analysis. Using factor analysis these twelve variables were reduced to four factors. These four factors and the variables they include are:

- Post-strike characteristics: This factor is composed of variables which described the post-strike characteristics of both they system and the population served.
- Strike effects: This factor is composed of the strike duration variable and a "dummy" variable for the first post-strike quarter.
- Population characteristics: This factor is composed of pre-strike population and income variables.
- System characteristics: This factor is composed of variables which describe the pre-strike characteristics of the system.

Using factor analysis scores a regression equation was developed to predict the transit ridership in both the pre and post-strike condition. The prediction equation had an adjusted R^2 of 0.86 and fit most of the actual ridership data.

Based on the analysis there are several conclusions relating to this study. As stated previously, many of the finding of similar work are confirmed by this study.

- Labor strikes in the transit industry have a negative impact on ridership. Of the ten systems examined only two did not show a loss of riders for the following twelve month post-strike period.

Other studies which usually addressed the effect on a single system also found a loss of ridership following a labor strike. The use of cross sectional data tends to indicate that most transit systems can expect to experience a loss of ridership following the settlement of a labor strike.

- Strikes of extended duration tend to require a longer recovery period. This study examined transit systems which experienced strikes ranging from 2 to 55 days. Although there are exceptions it was generally found that the longer the strike duration the greater the loss of riders during both the first post-strike quarter as well as for the following twelve months.
- The first post-strike quarter is the most critical period for the transit systems to regain ridership. Ridership levels for the second, third, and fourth post-strike quarter tend to move toward the corresponding pre-strike quarter.
- The prediction equation of transit ridership tended to fit the actual ridership for most of the systems examined. However, for Ann Arbor and Santa Cruz, two system with relatively small ridership, there was considerable divergence between actual and predictive ridership.

It is apparent that transit systems do experience a loss of riders following a labor strike. In light of increasing costs and declining productivity, lost ridership can be a critical factor for transit management. Certainly, labor strikes in the transit industry will continue to occur. Management and labor representatives should, however, recognize that riders will be lost and be aware of the implications of these losses. While there are negative implications for both management and labor as results of a strike, it is, perhaps, the public which incurs the major inconvience.

While the results of a labor strike on ridership are documented, there are some questions in this area which need to be addressed. Since labor strikes within the transit industry will continue, information needs to be developed on the degree of success of programs designed to regain ridership in the shortest possible time. The fact that some systems performed better than expected in regaining ridership may be the result of management/labor programs, advertising campaigns, fare incentives or similar activities. These need to be identified and their results documented so that other systems may benefit from their experience.

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APPENDIX

TRANSIT SYSTEM QUESTIONNAIRE

I. Transit System Name ______________________________

II. System miles operated

a) Jan. 1, 1979 ____________

b) Jan. 1, 1980 ____________

c) Jan. 1, 1981 ____________

d) Jan. 1, 1982 ____________

e) Jan. 1, 1983 ____________

III. Number revenue vehicles operated

a) Jan. 1, 1979 ____________

b) Jan. 1, 1980 ____________

c) Jan. 1, 1981 ____________

d) Jan. 1, 1982 ____________

e) Jan. 1, 1983 ____________

IV. Basic adult cash fare

a) Jan. 1, 1979 $____________

b) Jan. 1, 1980 $____________

c) Jan. 1, 1981 $____________

d) Jan. 1, 1982 $____________

e) Jan. 1, 1983 $____________

V. Are employees represented by a labor union or employee association?

YES ________; NO ________

VI. Were there any strikes or work stoppages during

a) 1979; YES ____; NO ____; If yes, date ________ duration in days ____.

Did fare increase immediately after strike? YES _____; NO _____.

If yes; From $__________ to $ __________.

b) 1980; YES ____; NO ____; If yes, date ________ duration in days ____.

Did fare increase immediately after strike? YES _____; NO _____.

If yes; From $__________ to $__________.

c) 1981; YES ____; NO ____; If yes, date ________ duration in days ____.

Did fare increase immediately after strike? YES _____; NO _____.

If yes; From $__________ to $__________.

d) 1982; YES ____; NO ____; If yes, date ________ duration in days ____.

Did fare increase immediately after strike? YES _____; NO _____.

If yes; From $__________ to $__________.

e) 1983; YES _____; NO _____; If yes, date _______ duration in days _____.

did fare increase immediately after strike? YES ______; NO ______.

If yes; From $____________ to $____________.

VIII. If the system experienced a strike or work stoppage please provide information on the number of unlinked passenger trips for the twelve (12) months before and twelve (12) months after the strike. If more than one strike during the 1979-1983 period provide the information for the most recent strike.

RIDERSHIP

DATE	BEFORE STRIKE STARTED	DATE	AFTER STRIKE ENDED
_______	_______________	_______	_______________
_______	_______________	_______	_______________
_______	_______________	_______	_______________
_______	_______________	_______	_______________
_______	_______________	_______	_______________
_______	_______________	_______	_______________
_______	_______________	_______	_______________
_______	_______________	_______	_______________
_______	_______________	_______	_______________
_______	_______________	_______	_______________
_______	_______________	_______	_______________
_______	_______________	_______	_______________

VII. Name and phone number of person completing questionnaire.

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