Final Report

INTERCITY BUS ROUTE EVALUATION FOR STATEWIDE PLANNING

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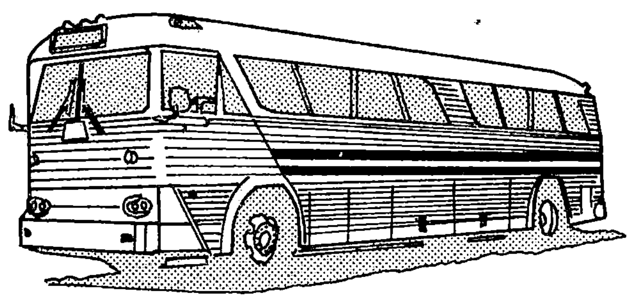
MAY 1981



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1. INTRODUCTION

Maintenance of an intercity bus service system is a crucial element in an effective transportation network. Intercity bus carriers offer the opportunity for mobility to all population segments, but especially to the transportation-disadvantaged. Furthermore, they provide a service that can minimize the adverse impact of vehicular travel on the environment, and they can offer a service that is energy-efficient when compared with other forms of passenger travel.

In spite of the general benefits, a pattern of decreasing utilization of these services is clear. Ridership and the economic viability of the carriers have steadily declined. Annual reports filed by the carriers with the Interstate Commerce Commission indicate that on a national scale, intercity bus ridership has declined approximately 25% in the past 10 years. The total regular route ridership on carriers serving Iowa has dropped 17% in a similar time period. Ridership in 1979 was only 4% of the peak volumes observed 35 years earlier. Although a cause and effect relationship has not been clearly established, the declining utilization of intercity carriers has been accompanied by decreases in the number of cities receiving service, reductions in service frequency, and lower quality of service at terminals.

In a regulated industry, when losses occur in segments of the regular route passenger service, charter and express revenues may be expected to provide the income necessary to cover the regular passenger service expense. In other cases, cross-subsidization of a route from other more profitable runs is necessary. However, due to the general affluence of today's population and the public's desire for the flexibility, comfort, convenience, and speed of automobile or air travel, even the more lucrative market corridors have difficulty generating profits that can support a carrier's weaker routes. A consequence is a request by the regulated carrier to either abandon public service to portions of the service area or to increase the rates.

Within Iowa, service has been reduced or lost completely in several corridors. The abandoned service connections are typically in the smaller communities. But in 1977, the last route between two metropolitan centers was also lost when a carrier dropped its regular route service completely. Four communities in the state with populations over 5,000 are currently without intercity bus service.

Several states, including Iowa, consider the operations of the intercity bus carriers part of the total state transportation planning effort. Some states have established a means of providing financial assistance. Similarly, the 1978 Surface Transportation Act demonstrated the federal government's concern for maintaining the viability of intercity bus carriers. This legislation authorized programs for operating assistance and terminal or facility development for intercity bus service. The federal operating assistance program was designed to make funds available to state and local governments for initiation, improvement, or continuation of intercity bus service. These grants were to be used to subsidize up to 50% of a route's deficit attributed to operating costs. The remaining moneys to cover the deficit were to be generated from other public funds.

Although the program never became a reality, it did generate interest in the intercity bus market. Additional studies have been initiated to examine market conditions and policy issues. Iowa and other states are evaluating their planning, regulatory, and financial roles in relation to statewide needs and the needs of carriers.

Research Objectives

The goal of this research is to evaluate the needs of the intercity common carrier bus service in Iowa. The purpose of this analysis is to provide a framework to be used by the Iowa Department of Transportation to identify potential costs and revenues on routes in which the state is interested in sustaining, improving, or initiating intercity bus service. Within the framework of the overall goal, the objectives are to:

1. Examine the detailed operating cost and revenue data of the intercity carriers in Iowa. The data would include specific information about individual routes, to the maximum extent possible.
2. Develop a model or models to estimate demand in cities and corridors served by the bus industry.
3. Develop a cost function model for estimating a carrier's operating costs. The cost model should consider the variations associated with carriers of different sizes.
4. Establish the criteria to be used in assessing the need for changes in bus service.
5. Outline the procedures for estimating route operating costs and revenues and develop a matrix of community and social factors to be considered in evaluation. The methodology would identify

the data needs and steps that state agencies would follow in fulfilling their roles in the evaluation process.

6. Present a case study to demonstrate the methodology.

Research Scope

Carriers Included in the Analysis

This research was developed to study the regular route intercity bus carriers identified in an initial study conducted by the Engineering Research Institution [1]. Because of a growing interest in the small-scale commuter bus carrier, the transit planners and regulatory personnel requested that a special effort be undertaken to assess the operations of commuter services. The research examines nine carriers that provide interlining service and seven additional carriers providing special services.

Data Sources for Operating Characteristics

A condition specified for the cost and demand models and the evaluation methodology was that the procedures be applicable using existing data sources. For model development, the researchers used data from annual reports and other special information that management could provide from their records. The estimation procedures do not require special ticket sampling, passenger surveys, or other more costly inventory techniques.

Similarly, the data used to structure the social or community interest evaluation were obtained from secondary data sources. A number of factors to be assessed in the evaluation of the state's interest when considering matters of funding or operation is developed in the research. The factors are based on information obtained through communications with other states that have assistance programs, from published reports, and from the experiences of the researchers. The states contacted directly were California, Georgia, Michigan, Oregon, Pennsylvania, New York, North Carolina, and Wisconsin.

The associated commuter bus study for this research required special contact with the carriers. Surveys were completed to determine start-up costs, marketing efforts, and other operating characteristics. Operating revenues and expenses were obtained from the special surveys as well as from the annual reports.

Time Period for Analysis

The details of the annual reports were examined for the period 1976 through 1979. The route-specific passenger data were assembled by the carriers and the staff for 1979 only. Commuter data were obtained for the first six months of 1980, where possible, because this represented the only experience of the newest carriers.

Methodology

The forecasting and evaluation methodologies were developed using readily available statistical tools. Model calibration was performed using computer facilities, but each application phase can be completed with a standard calculator.

The models use linear regression, classification, and/or matrix formulations that can be applied using data bases readily accessible to the Department of Transportation.

2. INTERCITY BUS RESEARCH AND DEVELOPMENT

Interest in the intercity bus industry appeared to swell with the passage of the 1978 Surface Transportation Act [2], which was designed to provide opportunities for financing intercity passenger carrier operations and facilities. However, interest had been evident before this as states acknowledged that energy shortages, lowered profitability for the carriers, and reduced services to communities were important factors in statewide transportation planning. Many states, including Iowa, had completed inventories and planning studies. Several states, including Michigan, Pennsylvania, New York, and New Jersey, were providing assistance before the federal programs were proposed; other states have continued in this direction. In addition, research had been undertaken to develop intercity demand models and cost analyses. The travel demand research has varied from detailed microeconomic studies of rail passenger potential in the Northeast Corridor to sketch planning forecasts for regional transit systems operating van programs. Cost estimation models have ranged from cost analyses using aggregate data from the Interstate Commerce Commission's annual reports to specific corridor studies completed by the carriers as they prepare to abandon routes.

This section reviews selected intercity bus studies, but the details of individual programs are not discussed. Reports with more extensive literature and program reviews are identified in the text.

Industry Status and Transportation Policy

Status and Issues

Pursuant to the 1978 Surface Transportation Act, the Secretary of the Department of Transportation submitted a report to detail the conditions that exist in the intercity passenger carrier industry [3]. The report primarily documents the condition of the industry and examines policy areas that should be examined to improve the potential for maintaining viable services.

The status report did not surprise those who had pressed for attention to the industry. The intercity bus industry carries over 50% of the common-carrier intercity passengers; yet it accounts for less than 2% of the passenger-miles because much of the travel is short-haul movement serving rural communities. The importance of providing this local, rural service is, in fact, why the government is concerned about the viability of the bus carriers. In most communities, bus service is the only remaining form of public transportation; the loss of this potentially energy-efficient means of transportation during an energy-awareness period has caused great concern.

The industry totals show that during the period from 1970 to 1978, the route-miles served decreased by 12%, bus-miles were reduced 11%, and passenger volume dropped 17%. The total revenues increased from $901 million to $1.389 billion (54%); but, at the same time, expenses rose from $812 million to $1.334 billion (64%). The net result is that the carriers' financial condition is deteriorating. The carriers must seek relief through increased rates, decreased service to communities in the high loss corridors, direct financial assistance through subsidy programs, or indirect assistance through tax reductions, marketing programs, or user subsidies. Each of these areas is currently an alternative.

As a regulated industry, route and fare adjustments must be approved by the Interstate Commerce Commission or a state regulatory agency, or both. Because the criteria used for evaluation are applied differently by the different regulatory bodies, the regulatory decisions often are not uniform. Regulatory reform is an issue receiving considerable attention [4,5]. The regulatory issues are beyond the scope of the current research project, but they cannot be separated completely from the analysis of corridor service.

Direct and indirect assistance programs also are not uniform among the states. Selected states provide direct subsidies from their own funds; others pass through Section 18 moneys available from the Urban Mass Transportation Act. Some states provide planning and marketing assistance; others have not addressed the problem in detail. Fravel [6] effectively summarized the major programs in the various states.

A single program that has provided a measure of relief for all carriers is the Energy Tax Act of 1978 [7]. This act exempts privately owned bus companies from payment of federal excise taxes on new buses and parts, and provides federal tax rebates on diesel fuel. This provision was expected to save the industry $17 million in 1978 [3].

Transportation Policy Analysis

The National Transportation Policy Study Commission (NTPSC) was mandated through the 1976 Federal Aid Highway Act to investigate U.S. transportation needs and the role of all transportation modes in meeting those needs through the year 2000 [8]. The main report [9] and a special report [10] on intercity bus transportation provide more resource materials on existing service and the role of bus travel. The bus sector is projected to increase in absolute numbers of passenger-miles by as much as 35% in high growth scenarios. Yet, as a portion of the total movement, bus usage would decline to approximately 1.1% of all intercity passenger-miles.

The NTPSC recommended that the role and financial viability of the bus industry be enhanced by adjusting the regulatory environment affecting bus rates, rate bureaus, and entry and exit procedures. The commission also advocated subsidies for certain uneconomic routes where social benefits exceeded the costs [10]. However, they did not state the criteria that should be used to determine the benefits.

Transportation Demand Models

Intercity travel forecasting models have ranged from simple estimates based on trips per capita to sophisticated models incorporating probabilistic estimates, price elasticities, cross-elasticities, service factors, socioeconomic characteristics and more. The simplest models are deficient because they cannot describe the effects of changes in service. The more complex models can provide information regarding service changes, but they frequently are poor estimators. In addition, the latter models may be data-intensive and intractable. Hartgen and Cohen [11] summarize several of the more sophisticated models that have been developed. These models have been used primarily for rail corridor analysis in the Northeast Corridor.

Applications in the bus market have similarly ranged from the simple to the complex. A Wisconsin study summarized several efforts in bus demand analysis, including three of the more complex models used in that state [12]. The models generally estimated travel between city pairs for all modes of concern. The equations were developed with regression techniques using only the system variables of time, price, and frequency. They concluded that travel cost was more important than time. Frequency was an important factor for rail and air modes, but the results were mixed for the bus mode. One model found frequency to be important; the others did not. In all cases, the frequency variable recognized a diminishing marginal utility for increased frequencies. The adjusted frequency was calculated as $F' = 1 - e^{-0.5f}$, where e is the base of Naperian logarithms and f is the actual daily frequency. The models were viewed as acceptable, even though only 60% of the variation in the dependent variable could be explained by the model.

Analyses in Iowa have previously examined passenger volume by bus from individual cities [1]. The selected regression model was able to explain 92% of the variation in ticket sales ($R^2 = 0.92$) using two community factors: retail sales, and number of physicians and dentists. However, there were no origin-destination pairs considered, so the analyses could not directly address relative price, time, or distance factors for bus travel. A service variable that incorporated departure frequencies, the number of competing carriers in the city, and an average travel-time estimate to other metropolitan centers was constructed. The level of service variable, however, always entered the equations with an inappropriate sign because of colinearity in the data. If the service level variable had been used alone, the appropriate interpretation would have been possible, but the percent of variation in ticket sales that could be explained would have been only 60%.

A Michigan study also developed ridership models at the city level by grouping cities into level of service categories and area [13]. The strongest models could incorporate only city population. Although R^2 values of 0.90 or higher were obtained, the estimates in individual cities frequently had errors of 400% or more. Based on these analyses, the Michigan study estimated that there would be 66 annual riders for each 100 persons in the city. The ridership would also increase by 10 persons per daily departure frequency. These conclusions, however, are based on the earlier-described unstable regression equations.

The most wide-range set of explanatory variables was established in Georgia [14]. Georgia researchers examined travel demand as a trip generation problem from individual cities as well as a network distribution problem. The generation equations considered city and area populations, population density, minority populations, age, income, average family size, and level of service variables similar to the Iowa concept. The results again indicated that a measure of city population was the only significant variable in regression models. Additional efforts to incorporate service characteristics only marginally improved the statistical strength. The actual prediction errors in individual cities could not be readily identified, but it was noted that all cities below 3,000 population would have a negative number of trips based on the equation.

The network distribution effort described the bus system in the format used in urban transportation analysis. Modifications were necessary to scale times and distances to levels acceptable within the model. The large variations in the total statewide system prevented the development of successful distributions. The model was also undesirable from the viewpoint of data input; the data were obtained by extensive sampling of ticket sales.

Burkhardt and Lago presented a series of regression models that address passenger flows on a route basis [15]. Although the data were related to commuter orientations around selected activity centers and the routes defined a general linear area instead of a specific path, the results were of interest because both community and service characteristics were included in the final models. Furthermore, the models used calibration procedures generally known and accepted in traditional planning offices.

The richest of the models, in terms of factors, was a system model to estimate monthly passengers. The explanatory variables were bus-miles of travel, service frequency, corridor population, fares, and competing carrier service in the corridor. All variables retained the correct sign, but the competing carrier service factor was not statistically significant. The researchers reported fare elasticity of -0.61 and a frequency elasticity of 0.49 (estimated at the sample means). The elasticities have the correct sign, but they are based on data from a single point in time rather than reflecting actual changes due to price or frequency adjustments. Between 60 and 80% of the total variation was explained in the selected models.

Operating Cost Formulation

The efforts to establish cost patterns for the intercity bus industry have focused on evaluation of the data reported in annual reports to the Interstate Commerce Commission (ICC) or to the state regulatory agencies. This approach is necessary because the carriers--particularly the smaller carriers--are not prepared to summarize or to directly allocate the various cost components to specific operations. The variations in wage rates, fringe benefits, insurance, and other management costs can be determined, but not normally on a route-by-route basis. The studies reviewed here were restricted to data obtained from annual reporting formats.

Van Der Walker examined the operator's cost patterns with a view towards establishing standards by which to compare carrier performance [16]. The hypothesis was that an average cost model could be developed and future regulatory decisions could be based on how well the carriers were meeting the standards.

The operating costs were examined as a total cost, as well as by the major cost categories, including maintenance of equipment, transportation, station, traffic solicitation and advertising, insurance and safety, administration and depreciation. The factors considered for predicting cost differences were a loading factor (passenger-miles/bus-miles), a scale factor (bus-miles), and density (an estimate of actual passenger-miles/total seat-miles). The size factor was not significant and the reported density factor had an illogical sign. Only the load factor appeared to be useful for explaining cost differences.

Yordan used the same data set and found entries (passengers per bus-mile) to be most important [17]. The percent of total miles operating in charter service was a significant explanatory variable, and wage rates were marginally significant. However, the model indicated that expenses per mile increased as the percentage of charter miles increased. This is contrary to conventional wisdom and is inconsistent with the current research findings.

The more complex Cobb-Douglas production function was applied by Fravel to examine carrier costs [18]. He argued that since the industry is regulated, the price of service and the output are controlled outside the firm. Therefore, he concluded, the industry must be a cost-minimizing industry. The inputs to minimize were vehicles, fuel, and labor costs. Nonlinear models were developed in the form of:

$$\text{Total expenses} = K\ (\text{bus-miles})^{a}\ (\text{fuel})^{b}\ (\text{hourly wages})^{c}$$

The major expense categories were analyzed separately. Only the bus-miles variable was a significant indicator. Fravel concluded that there were negative economies of scale for the largest Class I carriers (e.g., Greyhound and American) and constant returns to scale for the smaller Class I carriers in North Carolina. In other words, there were no cost advantages to having a large-scale operation.

Assistance Programs in the States

Contacts were made with other states that have assistance programs. The principal objective was to determine the criteria used by the states to evaluate funding decisions. More details on the individual programs are given by Fravel [6].

Michigan

Michigan has provided state funds for operating assistance, terminal improvements, and rolling stock. Several factors were identified regarding the selection of new routes for funding. These included:

- Potential to become self-sustaining within two years.
- Amount of existing service in the travel corridor.
- Type of service.
- Availability of connections to other routes.
- Population in the area to be served.
- Special market contributers, such as state institutions, colleges, and military bases.

The only quantifiable criterion was the desire to attain profitability within two years. The requirement was later dropped; generally the new routes were not meeting the standard. Although ridership did increase on selected routes, the overall financial condition of the carriers was not improved. A more complete evaluation of the program is given in the Michigan report [13].

Pennsylvania

Pennsylvania also uses funds of the commonwealth to assist the carriers. The transit planners have not identified set standards for selection, but they have established simple priorities. The priorities are:

1. To preserve existing service in rural and small communities.
2. To upgrade services if funds are available after Priority 1.

Although there are no fixed factors for evaluation, the state agency will consider an operation for funding only if there is a commitment of support from the local government and the carrier petitions for the assistance. It is not essential that the carrier be able to eventually cover all costs, but the state's interest is guarded by carefully reviewing the expenses and fare structure for the operation. The carrier's costs are evaluated by measuring cost components for driver's wages, fuel, terminals, etc., against current standards. Adjustments may be made for layover times, idle time, premium payments, dead-head miles, and other accountable elements.

New York

As part of the total transit system, intercity buses in New York are eligible for state funds. The allocation process has traditionally centered on fixed formulas based on passengers served and miles traveled. Studies have addressed other efficiency and effectiveness variables [19]. These factors address economic elements but do not address social considerations.

The distribution of funds to intercity carriers is hampered because the funds come through the counties. A carrier has to negotiate with several local units on a long-distance route in order to acquire funding. Consequently, carriers are discouraged about the required efforts to obtain public assistance.

California

A $1-million program for intercity carriers was implemented in California for fiscal year 1980. The factors considered in the evaluation process included, but were not limited to, the following [20]:

- Relative contribution to a statewide network.
- Practicality and ease of implementation.

- Need for service, considering low-mobility population elements and the availability of alternative services.
- Potential ridership.
- Potential costs.
- Ability of the applicant to provide the service.

The primary considerations were the potential for self-sufficiency and the long-term benefit. However, a definition of the long-term benefit was not, or could not, be defined. Unlike Pennsylvania and New York, California did not require the carriers to take the initiative. If a service were deemed desirable, the state would evaluate it as long as the project was consistent with the regional plans.

Summary

A wide variety of models has been developed for demand and cost estimation. Generally the models demonstrate statistical significance but fail to produce accurate estimates in individual communities or corridors. In some cases, the models addressed policy variables related to supply, but the models were simultaneously comparing modes and required a large data base. No models directly addressed the need for simple formulations that could provide accurate forecasts in all corridors.

Not all state evaluations are included in this review. Those shown, however, are sufficient to indicate their present status regarding priorities for distribution. To date, the states have been either unable to establish fixed criteria or have felt it was inappropriate to describe fixed criteria to define priorities.

3. OPERATING CHARACTERISTICS OF INTERCITY CARRIERS IN IOWA

Iowa is served by over 30 intercity passenger carriers that provide one or more of a group of services, including regular route passenger and express service, charter operations, commuter service, school-contract service, and more. The focus of the research was to assess the revenue and cost characteristics on a route basis for the scheduled regular route services. However, due to the importance of newer commuter operations, a special effort was undertaken during the course of the study to assess the operating characteristics of commuter carriers. The total number of systems examined was 16. Nine of these systems are listed in Russell's Official Bus Guide and they provide interlining capability. Another carrier, Inter-City Airport Transit, has throughout the analysis period provided scheduled service in a single intercity corridor, plus local service focusing on airport access; the others have more recently initiated commuter operations. The commuter operations are discussed separately in Section 4.

Carrier Classifications

The first-phase review of revenue and cost components clearly pointed out the need to group the data and exclude selected carriers from portions of the analyses. The reasons for the exclusions related to differences in services provided as well as differences in reporting of the data. The primary analysis groups were the national Class I carriers (Greyhound and American Bus Companies), a regional

Class I carrier (Jefferson), primary Class II and III carriers (Iowa Coaches, Midwest Coaches, Missouri Transit, and Scenic Hawkeye), and secondary Class II and III carriers (Inter-City Airport Transit, Reid Bus Lines, and River Trails Lines). The class designations used follow the definitions of the Interstate Commerce Commission (ICC), except for the primary and secondary notations added by the researchers. Class I carriers have an annual revenue in excess of \$3 million; Class II carriers have an annual revenue between \$1 million and \$3 million; and Class III carriers have annual revenues of less than \$1 million. The Iowa Transportation Regulation Board categorizes all carriers with revenues in excess of \$500,000 in a Class I group. This group would include ICC Class I carriers plus the primary Class II and III groups defined above. Other carriers are not included in the study either because they do not provide a significant inter-line service within the state or because their primary role is as a charter carrier. Carriers without express revenues in Iowa or with fewer than 1,000 Iowa regular-route passengers are not included.

The primary analyses will consider the Iowa Class I definition carriers. However, throughout this section, revenue and cost comparisons will also be provided for the other group.

Iowa Volume and Revenue Trends

The annual reports submitted to the Transportation Regulation Board of the Iowa Department of Transportation were obtained for the period 1976 to 1979. Detailed analyses of year-to-year changes were made for both the cost and revenue components. The pattern of change for operations directly attributed to Iowa is presented in Table 3.1 for the seven Iowa Class I carriers.

The amount of service provided within the state by these carriers has remained relatively constant during this period, while the regular route passenger ridership has gained slightly. These data are consistent with recent national trends, but the decline in charter passengers in the state is contrary to the trends these carriers are reporting on a systemwide basis.

Revenues for passenger movement have increased more rapidly than total passenger volumes in the state, but the carriers have not experienced substantial real gains because of increased operating costs. The operating expenses shown have increased at a faster rate than have the revenues. Comparisons drawn from this table are not complete, because not all expense items are given. The Iowa report only asks the carriers to break out the operating costs for the 4,000-series elements in the ICC report, i.e., maintenance, transportation, station, advertising and solicitation, insurance, and general administration. Depreciation and operating taxes are not defined by the carriers within Iowa unless they choose to do so. This in itself poses a problem because some carriers allocate a portion of the latter elements in the summary sheet, without referencing this addition, while other carriers do not. These differences can easily go undetected in computer summaries.

Comparisons at the state level are limited in a second way because the cost components are clearly not based on detailed tabulations of cost within the state; rather, they are often direct, proportionate

Table 3.1. Iowa travel, revenue, and cost trends for selected carriers.[a]

Characteristic[b]	1976	1979	Percent Change
Bus-Miles	10,287	10,346	0.6
Regular Route Passengers	1,138	1,210	6.3
Charter Passengers	111	110	- 1.0
Regular Route Passenger Revenue	$ 6,650	$ 9,142	37.5
Express Revenue	$ 2,086	$ 2,642	26.6
Charter Revenue	$ 1,822	$ 2,090	14.7
Total Revenue[c]	$10,589	$13,850	30.8
Operating Expenses[d]	$ 8,733	$11,608	33.9

[a]Carriers included are Greyhound, American, Jefferson, Iowa Coaches, Midwest Coaches, Missouri Transit and Scenic Hawkeye.

[b]Totals for all factors are expressed in thousands.

[c]The sum of the subelements does not equal the total revenue, as mail revenue and other special revenues are included in the total.

[d]The data shown do not include depreciation and operating taxes because the Iowa report does not require these to be identified within the state. Iowa Coaches data are not included in these totals because the Iowa data are incomplete.

allocations. For example, Greyhound allocates all cost components simply on the basis of the percent of bus-miles provided in Iowa. Jefferson apparently has allocated costs using bus-miles in some years and passenger revenue in other years. Scenic Hawkeye makes an effort to attribute the costs to the operating factor they feel is most highly associated with the cost component. Fuel, oil, equipment repair, and transportation costs were allocated in the same proportion as bus-miles. Insurance, advertising, and administration were based on passenger-mile data. Since the Iowa cost components are often either undefined or simple allocations, the remaining comparisons deal with total system figures.

Total System Cost and Revenue Components

A general view of the cost of operating a service is given in Fig. 3.1, where total operating costs are converted to a unit basis (dollars per bus-mile). Examination of the figure as a whole suggests that there are no clear, discernible variations in operating costs with increasing operating mileage. Low mileage carriers, such as Midwest Transportation, have costs exceeding those of the largest carrier, Greyhound. On the other hand, another low mileage carrier, Reid Bus Lines, reports operating costs at less than 30% of Greyhound's costs. Carriers 11-14 on the graph represent the commuter group. These operators have widely varying cost patterns, which can be explained at least partially by the fact that in some cases they have operated for less than a year.

A better assessment may be obtained by examining only established carriers. Figures 3.2 and 3.3 show the unit cost and revenue trends for the seven largest carriers. Table 3.2 provides a detailed summary

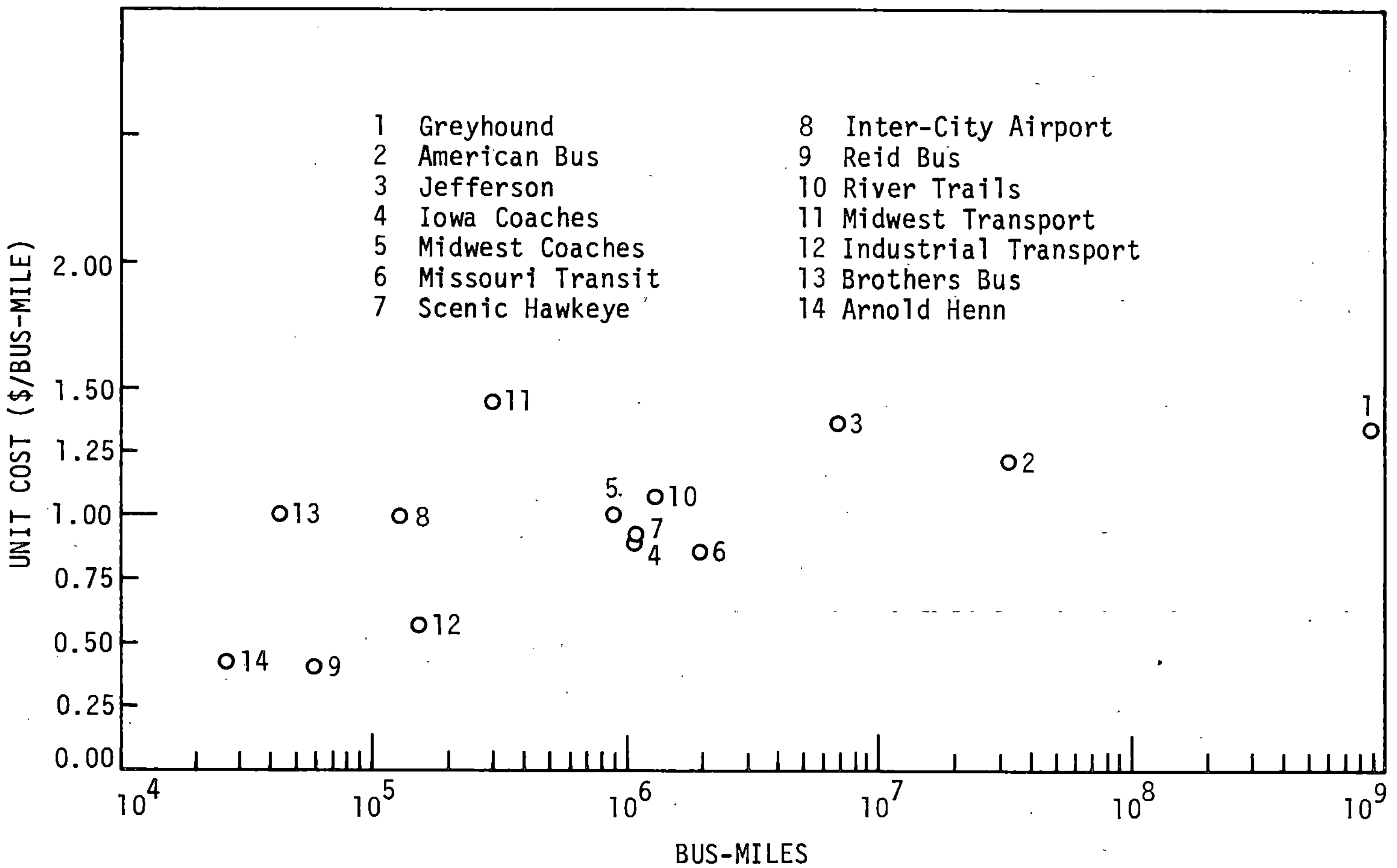

Fig. 3.1. Operating cost distribution for all carrier types in 1978.

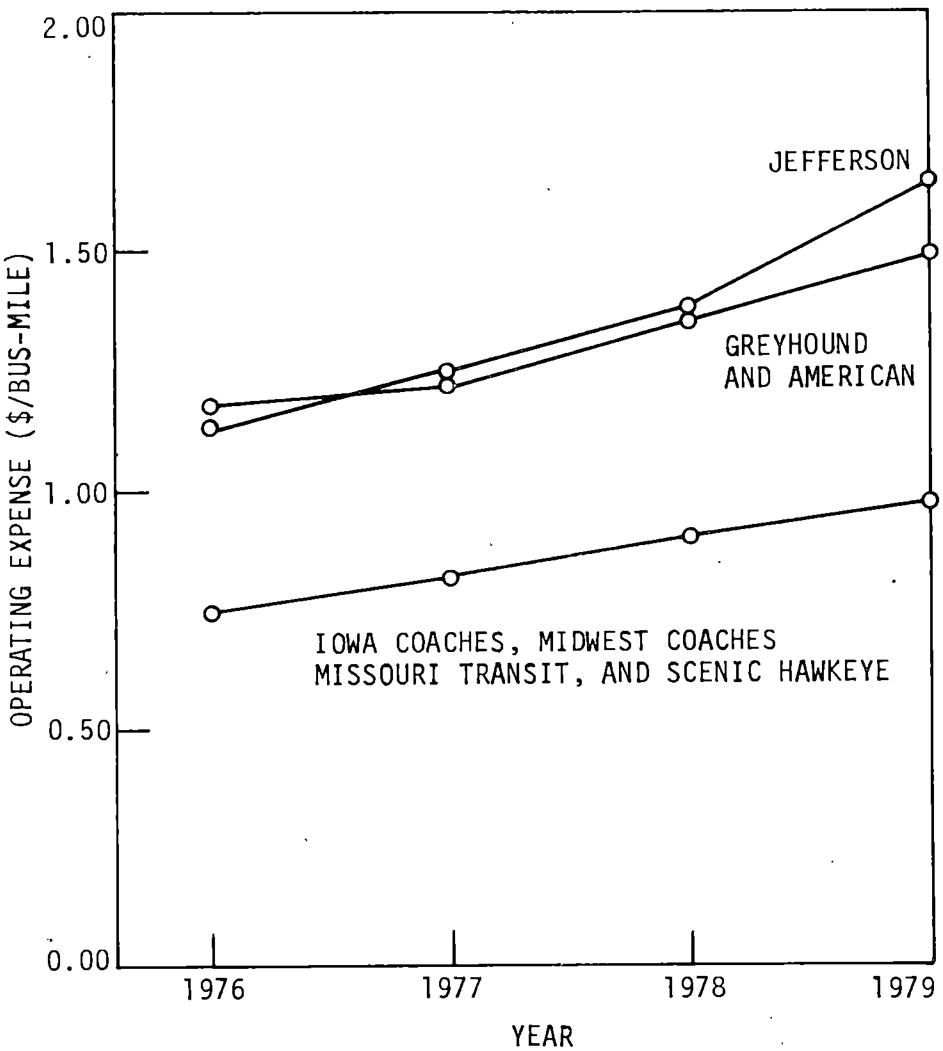

Fig. 3.2. Operating expense trends for carrier groups.

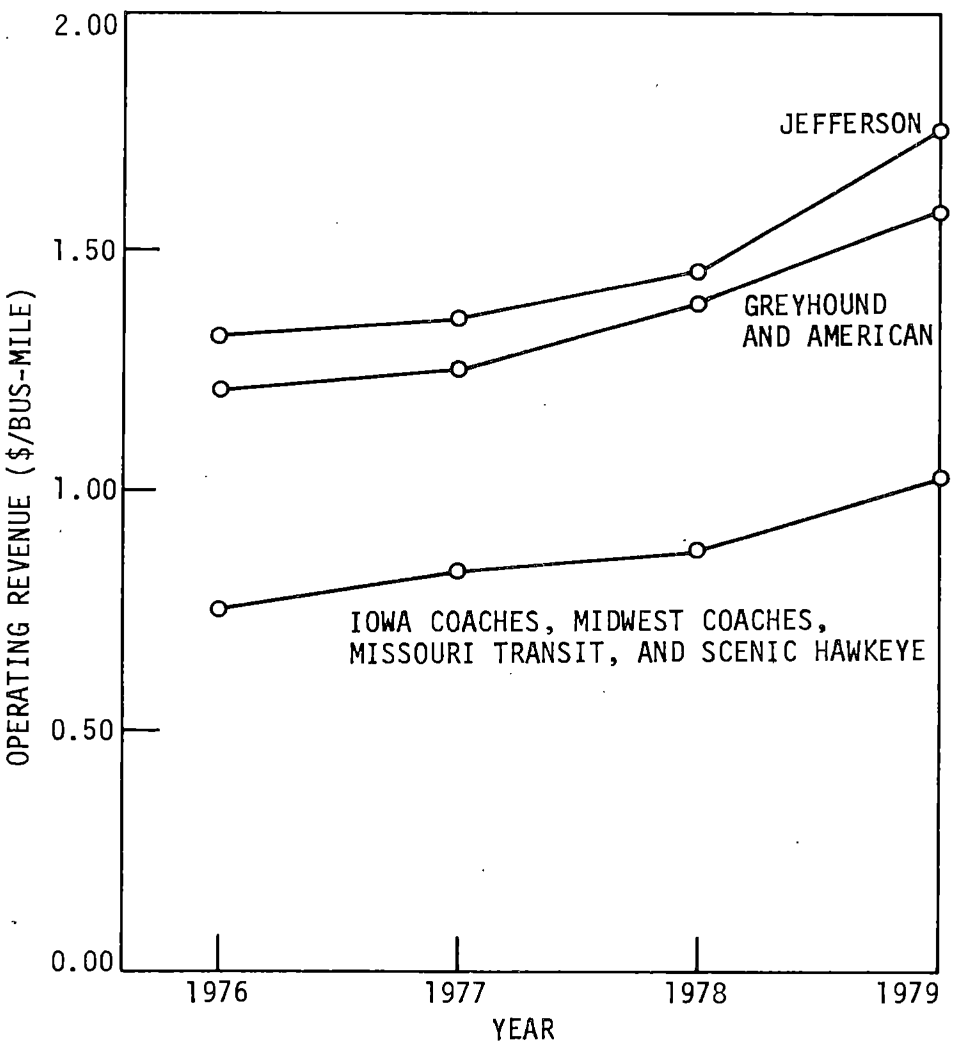

Fig. 3.3. Operating revenue trends for carrier groups.

Table 3.2. Unit operating expenses for total system.

Carrier	Yearly Expenses Per Bus-Mile (Dollars) 1976	1977	1978	1979	Percent Change 1976 to 1979
Greyhound	1.21	1.23	1.36	1.51	24
American	0.99	1.08	1.23	1.37	38
Jefferson	1.13	1.23	1.38	1.63	44
Iowa Coaches	0.77	0.81	0.90	1.03	34
Midwest Coaches	0.87	0.91	1.01	1.09	25
Missouri Transit	0.69	0.77	0.87	0.92	33
Scenic Hawkeye	0.72	0.81	0.92	0.95	32
Inter-City Airport	0.76	0.81	1.00	1.07	41
Reid Bus Lines	0.38	0.38	0.41	0.41	8
River Trails	0.38	0.83	1.09	1.16	40[a]

[a]The percentage change for River Trails used 1977 as a base.

of unit costs and Table 3.3 provides unit revenues from all sources. The ICC Class I carriers exhibit costs substantially higher than the Class II and III carriers ($1.50 compared to $0.95 for 1979). The Reid Bus Line operation is a major outlier in the latter group, lowering the unweighted average nearly 10 cents per mile. Similar trends occur for the revenue data.

One can also note that the percentage increase in revenue and expenses for the individual carriers averages approximately 33%, but there was a wide range in the increases experienced by individual carriers. To put these increases in perspective, the Consumer Price Index increased from 170.5 in 1976 to 217.7 in 1979, an increase of 27.7% [21].

As seen in Fig. 3.2, the most dramatic change was the cost increase for Jefferson Lines. The 44% increase in unit cost changed the operating expenses in the four-year period from a point that was 7% lower than their closest competitor to a point 8% above that competitor. Other carriers experiencing large cost increases were the small Class II carriers, Inter-City and River Trails.

Revenue Data by Service Type

The profit margin for charter operations is usually greater than the profit margin for regular route service because ticketing and stationing costs are reduced. Unfortunately, it was not possible to assign costs to the different service types, but the unit revenue-generating rates were analyzed. Complete tables showing passenger revenue per regular route-mile, express revenue per regular route-mile, and charter revenue per charter-mile are presented in Appendix A. A combined

Table 3.3. Unit operating revenues for total system.

Carrier	Yearly Operating Revenue Per Bus-Mile (Dollars) 1976	1977	1978	1979	Percent Change 1976 to 1979
Greyhound	1.25	1.28	1.41	1.61	29
American	0.98	1.11	1.20	1.30	33
Jefferson	1.32	1.36	1.44	1.74	32
Iowa Coaches	0.82	0.89	0.93	1.09	33
Midwest Coaches	0.88	0.96	1.03	1.14	29
Missouri Transit	0.67	0.70	0.79	0.90	34
Scenic Hawkeye	0.74	0.82	0.90	1.02	38
Inter-City Airport	0.75	0.82	1.02	1.10	47
Reid Bus Lines	0.43	0.47	0.50	0.47	9
River Trails	0.44	1.02	1.22	1.29	26[a]

[a]The percentage change for River Trails used 1977 as a base.

summary for 1979 is given in Table 3.4. The revenue picture clearly shows that for the smaller carriers, the charter potential is greater. However, for the long-haul carrier, the regular route service does nearly as well or better than charter operations.

Revenue Data by Route

The variations in average revenue potential for the different sized carriers is apparent. In addition, the variation between corridors served by the same carrier can be substantial. Table 3.5 shows the differences in load factors and passenger revenue on selected routes of a single carrier. The passenger revenues per bus-mile vary by nearly a 3 to 1 ratio. The passenger demand models in Section 5 attempt to explain these variations.

Cost Items by Category

Detailed cost analyses are presented in Section 6; the general categories of operating costs are presented here. Table 3.6 shows the 4,000-series items of the ICC reports, plus a column combining other factors considered as operating expense but not summarized specifically in the Iowa summary sheets. Depreciation, and operating taxes and licenses constitute the major portion of the latter group. There are wide variations in the carrier cost components, but some consistencies exist if the carriers are identified by group. The carrier group previously identified as secondary Class II and III carriers exhibits a range of values that does not fit the pattern of the larger carriers. The variance between these groups of carriers can be attributed either to reporting differences from year to year or to actual differences. These carriers generally confounded the interpretations that might be

Table 3.4. Unit revenues for regular route and charter services.

Carrier	1979 Regular Route Revenue Per Regular Route-Mile (Dollars)	1979 Charter Revenue Per Charter-Mile (Dollars)
Greyhound	1.61	1.43
American	1.25	1.41
Jefferson	1.84	1.50
Iowa Coaches	1.04	1.10
Midwest Coaches	1.12	1.22
Missouri Transit	0.87	1.01
Scenic Hawkeye	0.70	1.31
Inter-City Airport	--[a]	--[b]
Reid Bus Lines	0.48	--[b]
River Trails	0.55	1.30

[a]Local service and intercity miles cannot be separated.

[b]No charter operations are performed.

Table 3.5. 1979 revenue characteristics of selected short-haul Greyhound routes in Iowa.

Route	Average Passenger Load	Passenger Revenue Per Passenger-Mile (Dollars Per Passenger-Mile)	Passenger Revenue Per Bus-Mile (Dollars Per Bus-Mile)	Operating Expense Per Bus-Mile (Dollars Per Bus-Mile)[a]
A	11.5	0.073	0.847	1.51
B	15.6	0.075	1.175	1.51
C	6.6	0.064	0.425	1.51
D	14.7	0.078	1.430	1.51
E	9.2	0.082	0.756	1.51

[a]Operating expense represents only the systemwide average for 1979 and is not an estimate of the expenses on these specific runs.

Table 3.6. 1979 unit operating costs for major categories.

	Dollars Per Bus-Mile							
Carrier	Maintenance	Transportation	Station	Advertising	Insurance	Administration	Depreciation and Operating Taxes	Total
Greyhound	0.173	0.577	0.284	0.051	0.061	0.209	0.155	1.509
American	0.180	0.522	0.214	0.058	0.059	0.165	0.174	1.372
Jefferson	0.208	0.540	0.324	0.040	0.052	0.280	0.189	1.633
Iowa Coaches	0.177	0.404	0.085	0.017	0.062	0.128	0.157	1.030
Midwest Coaches	0.126	0.444	0.170	0.013	0.054	0.149	0.131	1.087
Missouri Transit	0.128	0.414	0.118	0.024	0.043	0.084	0.111	0.922
Scenic Hawkeye	0.160	0.386	0.054	0.019	0.046	0.143	0.157	0.947
Inter-City Airport	0.081	0.789	0.022	0.005	0.076	0.016	0.081	1.070
Reid Bus Lines	0.034	0.207	0.121	0.017	0.034	0.000	0.001	0.414
River Trails	0.084	0.528	0.026	0.001	0.049	0.201	0.272	1.161
<u>Group I</u>[a]								
Mean ($\bar{x}$)	0.187	0.546	0.274	0.050	0.057	0.218	0.173	1.504
Standard Deviation (s_x)	0.019	0.028	0.056	0.009	0.005	0.058	0.017	0.135
$(s_x/\bar{x}) \times 100$	10.2	5.1	20.4	18.1	8.2	26.6	9.9	9.0
<u>Group II</u>[b]								
Mean ($\bar{x}$)	0.148	0.408	0.107	0.018	0.051	0.126	0.139	0.996
Standard Deviation (s_x)	0.025	0.031	0.050	0.005	0.008	0.029	0.022	0.076
$(s_x/\bar{x}) \times 100$	16.9	7.5	46.7	25.6	16.7	23.0	15.8	7.6

[a]Group I carriers include Greyhound, American, and Jefferson.

[b]Group II carriers include Iowa Coaches, Midwest Coaches, Missouri Transit, and Scenic Hawkeye.

made for the remainder of the intercity bus industry and, therefore, were not included in model development.

Jefferson and the two national carriers share comparable cost patterns, and the remaining four carriers are generally similar. The table displays the means ($\bar{x}$), standard deviations (s_x), and the ratio of these measures, expressed as a percentage. Using a one-way analysis of variance statistical model, the differences in costs between groups for maintenance, insurance, and the depreciation and operating taxes were found not to be significant ($\alpha = 0.05$). However, for each of these categories, the three Class I carriers have the highest cost. The Class I carriers clearly have larger unit costs for transportation, stations, advertising and administration.

The ratio of the standard deviation to the mean is useful for selecting factors to estimate cost. The smaller the ratio, the more stable the cost component for the carriers. This concept is used in Section 6 to select representative cost components.

Financial Condition of Carriers

The financial viability of the carrier is determined by the carrier's ability to generate sufficient revenues to meet expenses and develop a return on the investment. The standard evaluation factor for passenger and freight motor carriers has been the operating ratio. This is the ratio of operating expenses to operating revenue, expressed as a percentage. A carrier must have a ratio of less than 100 to meet expenses. In a regulatory environment, the ratio is monitored so that it is neither so low that excessive profits are attained nor so high that the carrier cannot achieve a reasonable profit. An appropriate operating ratio becomes a policy issue in regulation. The Iowa Transportation Regulation Board (TRB) currently views a ratio of 93.25 to be an acceptable level for rate-making decisions.

A second measure of financial strength is the rate of return on the investment. This is the ratio of net operating income to the total tangible assets, expressed as a percentage. This value may be compared with the rate of return that could be obtained from other investments.

Tables 3.7 and 3.8 depict the trends in operating ratios and return on investment, respectively. The total system operating ratios indicate that American and Missouri Transit have consistently shown operating expenses exceeding the revenues. The other carriers have ratios above 90%. But in 1979, a year generally considered a strong year for intercity buses, only one carrier had an operating ratio better than the 93.25 cutoff considered by the regulation board.

The condition is even more critical if one examines the operating ratio of the Iowa portion only. In this case, no operator for whom a ratio could be computed was able to meet operating expenses in 1979. The Iowa ratio is subject to greater manipulation by the manner in which the costs are allocated to the Iowa operation. Even so, the carriers, planners, and regulators need to address the reasons for these conditions in order to assess the long-term impact of this deficit relationship.

The data in Table 3.8 paint the same picture, but with a different brush. Two carriers are regularly operating at a loss. The returns for

Table 3.7. Operating ratios for Iowa Class I intercity carriers.

Carrier	1976		1977		1978		1979	
	Iowa	Total System	Iowa	Total System	Iowa	Total System	Iowa	Total System
Greyhound	107.4	97.3	105.3	96.6	105.9	96.7	100.8	93.7
American	---[a]	101.2	---	97.4	---	102.7	---	105.8
Jefferson	86.0	85.4	90.5	90.5	95.2	95.2	101.3	93.9
Iowa Coaches	---	93.7	---	91.0	---	97.3	---	94.2
Midwest Coaches	---	98.6	---	94.5	---	97.6	---	95.0
Missouri Transit	---	102.5	---	108.9	---	110.6	---	104.2
Scenic Hawkeye	107.3	96.3	115.3	98.9	112.5[b]	96.7	106.1[b]	92.9

[a]Iowa ratios could not be computed for several carriers because of their method of reporting.

[b]Computed by the Engineering Research Institute. The reporting procedure changed in 1978, but calculations were based on cost allocation procedures previously used by the company.

Table 3.8. Return on investment for Iowa Class I intercity carriers.[a]

Carrier	Year 1976	1977	1978	1979
Greyhound	5.7	6.7	6.7	14.5
American	(3.7)[b]	8.4	(8.2)	(19.4)
Jefferson	29.0	16.4	9.9	18.6
Iowa Coaches	7.5	3.2	11.0	7.1
Midwest Coaches	11.1	5.8	15.2	3.0
Missouri Transit	(17.4)	(35.4)	(34.2)	(8.4)
Scenic Hawkeye	21.9	8.7	2.7	9.5

[a]Net operating income and depreciated value of tangible properties were obtained from annual reports. All values are expressed in percent.

[b]Numbers in parentheses indicate losses and are not truly meaningful as a return on investment.

the other carriers have varied widely. Only Jefferson Lines has consistently shown returns at or above the opportunity rates generally obtained from other low-risk investments in current money markets.

4. COMMUTER CARRIERS

The predominance of the private automobile for traveling has created traffic congestion, fuel shortages, shortages of parking facilities, and greater noise and air pollution. These conditions, combined with the energy shortages in the winter of 1973-1974, gave impetus to the national concern for more efficient use of energy resources and, in particular, to promotion of car pools and other higher occupancy modes of travel, such as buses or vans.

The commuter bus service is one of the modes that has been promoted and developed in Iowa to reduce gasoline consumption. This service is tailored to serve travelers who use the bus on a regular basis, usually for daily trips to and from work. Several services have been organized in and around Iowa urban areas to serve groups of people whose travel needs apparently are not being served adequately by either conventional mass transportation services or the private automobile.

Because of the unique nature of the commuter operations, they cannot be analyzed directly with other regular route common carriers. Indeed, because these operations are fairly new, special surveys were necessary to obtain background data. The service data reflect operations reported in annual reports and/or in special surveys covering the first six months of 1980. This section reviews general cost and operating characteristics for this group of carriers and examines the carriers in relation to standard intercity bus operations. More details of the commuter operations are presented by Hamad [22].

Providers and Types of Service

Commuter bus services in Iowa have been initiated in two different ways:

1. The private operator initiated the service after the need was established by consulting with employers and/or employees through interviews and surveys.
2. The service was started following recommendations based on studies conducted by the Department of Transportation or other government agencies.

The providers of commuter bus services in Iowa include carriers of different sizes and different fields of operations. They can be grouped as follows:

- Group 1: Iowa Class I carriers, whose main operation is the regularly scheduled bus service. This group includes two main carriers: Jefferson Lines and Scenic Hawkeye Stage Lines.
- Group 2: Iowa Class II carriers, which provide charter bus service and school bus service in addition to their commuter operations. This category includes Midwest Transportation Company only.
- Group 3: Class II carriers, whose primary operation is the commuter bus service. The survival of these operators is thus based on the success and continuation of the commuter bus service. This group includes Industrial Transportation, Brothers Bus Company, Arnold Henn, Guttenberg Coach Lines, and Best Cab.

The cities served by these carriers are identified in Table 4.1.

Table 4.1. List of cities served by selected commuter buses in Iowa.[a]

Carrier	Employment Center (City)	Cities Served by Commuter Bus
Jefferson	Waterloo	Charles City, Nashua, Plainfield, Waverly, Washburn, LaPorte City, Vinton, Janesville
Scenic Hawkeye	Waterloo	Oelwein, Hazelton, Fairbank, Independence, Jesup, New Hampton, Sumner
Midwest Transportation	Ames	Boone, Nevada, Gilbert, Story City, Jordan, Napier, Roland
Industrial Transportation	Amana	Cedar Rapids, Fairfax, Walford, Belle Plaine, Luzerne, Blairstown, Marengo, Brooklyn, Victor, Ladora
Brothers Bus Company	Des Moines	Indianola, Carlisle, Norwalk, Knoxville, Pleasantville, Hartford, Martensdale, Winterset, Ankeny, etc.[b]
Arnold Henn	Charles City	Stacyville, Osage, Orchard, Floyd, Bassett, New Hampton, Nashua, Plainfield
Guttenberg Coaches	Dubuque	Guttenberg, Millville, Luxemberg, Midway, Rickardsville
Best Cab	Woodward	Perry

[a]Services listed are for operations existing in 1979 or begun in the first six months of 1980, as reported by the carriers.

[b]Brothers Bus Company serves about 25 communities around Des Moines.

The services offered can be classified in two ways. The first is a bus service along a regular certificated route, as in the case of the Jefferson commuter bus service. Before initiating the commuter service in the Waterloo area, Jefferson operated a regularly scheduled bus in the same corridor where their commuter service was offered. The carrier needed only to add more runs and additional stops along that route to meet the needs of the commuters at the John Deere Plant.

The second type of service, which represents the majority of the commuter bus operations, is a bus service along a special route. The carrier in this case had to acquire a certificate from the Transportation Regulation Board to initiate the service, unless it already possessed operating authority in that corridor, as in Scenic Hawkeye's case. Both types of operations serve commuters whose work trips generally range between 10 and 40 miles one-way. The commuter bus service appears to be acceptable for relatively longer trips because the fare per mile decreases with increasing distance, and excess travel time is a small fraction of the total trip time. The commuter carrier service is also viewed more favorably than the regular route service because the latter is less likely to be available for long trips at service levels comparable to the commuter bus service.

Almost all of these services are offered five days a week with three to eight round trips per day. Several commuter services meet the requirements of day and night shifts. However, most of the trips are offered in the morning and afternoon peak hours.

Service Characteristics

Commuter operators are generally providing lower-cost service than are regular route intercity carriers. This lower cost can be clearly understood by looking at some of the characteristics of the commuter bus service. A detailed description of the factors that have a significant impact on the reduction of the service cost will be presented here.

Drivers

Commuter operators usually employ part-time, nonunion drivers. A common arrangement is to select a driver from the riders using the service. A driver's wages may be a free ride to and from work or the free ride plus a daily fixed amount. This procedure is used when the bus is scheduled to rotate with the work shifts, thus eliminating the need to pay layover time or split-shift premium pay that would be incurred if the drivers were employees of the carrier. Two companies using this arrangement pay approximately $10 per day to their drivers.

In other cases, the drivers are carrier employees. However, the drivers are not eligible for company benefits and they receive a lower rate per mile or a lower hourly rate than full-time employees of the regular route carriers. For example, Jefferson Line commuter run operators earn approximately 80% of the rate earned by full-time employees. In another case, an hourly pay schedule was used in which minimum wage-law rates were paid.

One carrier currently shows no expense for drivers because the owner is also the driver and no charges were assessed for these services.

This carrier has been operating for seven months only and is likely to change that practice after the company is established.

Vehicles

The majority of the vehicles used in commuter services are buses with average capacities that range from 36 to 43 seats (Table 4.2). Best Cab is the only company using a van with 12 seats. Most of the buses are older (10 years or more), low-cost vehicles; a few of them are fully depreciated.

The condition of the vehicles used, which is usually reflected by the price, has a great influence on the cost. The vehicles used in Iowa range in price from $1,000 to almost $30,000. The annual rate of depreciation of these vehicles varies from 10 to 33%. Often the older buses are depreciated over three to five years and the newer buses over five to ten years. The fact that Scenic Hawkeye buses were fully depreciated when placed into the commuter service would help in reducing total operating expenses, since no depreciation cost is added.

Most vehicles in commuter operation are owned by the carrier, although some are leased. A recent study [23] has shown that the cost of services provided with vehicles obtained under contract is likely to be substantially higher than the cost of services provided with vehicles owned by the operator. It must be noted, however, that the purchase of equipment with moneys on which interest rates are 14% and higher can substantially increase the per mile cost of equipment for commuter operators, particularly since the number of miles of service is low.

Intercity regular route carriers usually have their own mechanics and garages, and thus maintain their own vehicles. All commuter bus

Table 4.2. Characteristics of the vehicles used in the commuter operations in 1979.

Carrier	Number of Buses	Number of Vans	Average Number of Seats Per Vehicle	Vehicles Fully Owned	Vehicles Leased	Price Range When Placed in Service (Dollars)	Average Price Per Vehicle (Dollars)
Jefferson	2	0	39	2	0	25,000	25,000
Scenic Hawkeye	6	0	41	6	0	Fully depreciated[a]	-[b]
Midwest Transportation[c]	-	-	-	-	-	-	-
Industrial Transportation	8	0	43	5	3	2,925-3,595	3,152
Brothers Bus Company	7	0	40	7	0	4,073-29,362	19,203
Arnold Henn	4	0	36	4	0	1,000-1,100	1,025
Guttenberg Coaches	2	0	39	2	0	1,500-15,000	8,250
Best Cab	0	1	12	1	0	12,000	12,000

[a] Fully depreciated means that there is no depreciation cost encountered by using these vehicles; but if Scenic Hawkeye had to sell these vehicles, their price would range from $12,000 to $18,000 (as indicated by the carrier).

[b] Data not available.

[c] According to the 1978 Annual Report submitted by Midwest Transportation to the Transportation Regulation Board, the company has 41 vehicles (vans, school buses and coaches). It was difficult to classify the vehicles that were providing the commuter bus service.

service providers, except Jefferson and Scenic Hawkeye, which have more extensive regular route service, and Midwest Transportation, which also has a large school bus fleet, maintain their vehicles at private garages, which may result in high maintenance costs when problems are encountered. Industrial Transportation had its own maintenance shop for a short period, then the management determined it was not feasible for a small carrier to absorb the cost of operating a maintenance facility.

Dead-Head Mileage and Station Cost

Dead-head mileage is nonproductive mileage that increases cost. The costs incurred due to dead-heading are usually passed on to the customer. This problem can become particularly severe for shorter trips. Among the four carriers that submitted the requested information (Scenic Hawkeye, Jefferson, Guttenberg Coaches, and Best Cab), Scenic Hawkeye is the only carrier that incurred dead-head mileage in its operation. The dead-head mileage was estimated to be 160 miles weekly. This represented 4.4% of their total weekly commuter mileage. In most cases, dead-head mileage was avoided by keeping the buses parked at the work place or at the central office after work.

The station cost for commuter bus services is substantially less than that experienced by the intercity regular route service. In some cases, station cost for commuter carriers was zero. The need for a station was minimized because of the following:

- Riders were picked up from locations close to their residences along the bus route.
- Buses were parked at the users' place of work or at the driver's home.

- Drivers also acted as ticket agents to sell passes, collect fares, keep ridership records, and other activities.

Reducing terminal services also reduces the operating costs. The station expenses represent approximately 10% of the operating cost for regular route carriers.

Load Factors

The fare charged per passenger trip depends on both the vehicle trip costs and the average number of passengers per bus (load factor). Higher bus occupancy figures will lower per-passenger trip costs and make it possible to cover costs with lower fares. Table 4.3 shows that the occupancy rates on commuter buses ranged between 61 and 92%. These load factors are considered good compared with other bus operations. Table 3.5 showed five routes where the occupancy rates ranged from 15 to 25%. The higher commuter occupancy rates are made possible by scheduling buses mostly during peak periods to attract a large number of users. The use of weekly and monthly passes helps to guarantee a fixed number of riders for a specified period, which tends to keep the daily load factors equal.

Fares

The effect of the various service characteristics discussed in this section can be seen easily by examining the average per-mile fares charged by the commuter carriers as indicated in Table 4.4. As expected, the fare per mile decreases with trip length. Arnold Henn has the lowest fares, ranging from 3.1 to 4.3 cents per mile. The low fares are possible because no wages are paid to the drivers, vehicle depreciation is low, and the station cost is zero. The highest fare per mile

Table 4.3. Load factors on commuter services for the first six months of 1980.

Carrier	Average Number of Riders Per Bus	Average Bus Seating Capacity	Load Factor (Percent)
Jefferson	27	39	69
Scenic Hawkeye	34[a]	41	83
Midwest Transportation	-[b]	-	-
Industrial Transportation	-	43	-
Brothers Bus Company	-	40	-
Arnold Henn	22	36	61
Guttenberg Coaches	27	39	69
Best Cab	11	12	92

[a]This estimate was based on the daily ridership data for February and May of 1980.

[b]Data not available.

Table 4.4. Average fare per mile for the commuter bus service.

Carrier	Distance (Miles) 0-9	10-19	20-29	30-39	40-49
Jefferson	10.0[a]	6.7	6.9	5.9	6.2
Scenic Hawkeye	-	8.0	5.7	3.7	-
Midwest Transportation	9.2	5.3	-	-	-
Industrial Transportation	9.8	7.4	5.2	4.6	-
Brothers Bus Company	-	9.3	6.9	5.2	-
Arnold Henn	-	4.3	4.0	3.1	-
Guttenberg Coaches	-	8.3	6.5	4.9	-
Best Cab	-	10.4	-	-	-

[a]All values are expressed in cents per mile.

(10.4 cents per mile) was experienced by the smallest carrier, Best Cab. Its operations consist of three round trips per day on a 12-mile route. The difference between the rates of Jefferson and Scenic Hawkeye can be explained by the difference in the vehicles used and drivers' wages. Scenic Hawkeye had fully depreciated commuter buses and paid their drivers $9.50 per round trip, which amounts to about 12 cents per mile. Jefferson Lines valued its two buses at $50,000 and paid their drivers 25 cents per mile.

Table 4.5 indicates the average fares per mile for the regular route intercity operations of two carriers. As one would expect, the fares for the intercity operation are much higher than those of the commuter services. Labor rules and type of vehicles used for the intercity operations play an important role in this difference. The use of full-time union drivers with higher wages and associated benefits and the use of newer, more expensive vehicles add significantly to the operating costs of the service. Moreover, station cost is more substantial for the regular intercity carriers. These variations in costs can be seen easily by comparing the rates that Scenic Hawkeye charges on its intercity and commuter operations. According to Tables 4.4 and 4.5, Scenic Hawkeye's rates for intercity operations are between 36% and 146% higher than those charged for commuter operations of the same trip length. The differences in rates are as follows:

	One-Way Trip (Miles)		
	10-19	20-29	30-39
Commuter Rates (¢/mile)	8.0	5.7	3.7
Intercity Rates (¢/mile)	10.9	9.0	9.1
Difference (Percent)	36	58	146

Operating Revenues and Expenses

Detailed and accurate operating expenses and revenues are not available for all commuter operations. Some carriers started their commuter services very recently (late 1979 or early 1980), and sufficient data have not been accumulated on their operations. Other carriers did not provide the information, either because their services included regular and charter operations and separate records were not available, or simply because they did not want to disclose this information.

Most of the carriers are relatively small, and their expenses and revenues vary widely. Table 4.6 indicates that the unit operating expenses in 1978 for the commuter carriers varied from \$0.44 to \$1.46, while unit operating revenues ranged from \$0.39 to \$1.56. In 1979, these variations were \$0.39 to \$1.84 for unit operating expenses and \$0.49 to \$1.67 for unit operating revenues. Arnold Henn had the lowest unit cost and understandably so, since the company had no station cost, no driver wages, and the least expensive vehicles. Brothers Bus had the highest cost per mile in 1979 due to high driver wages, costly equipment, and large interest payments. Midwest Transportation had the

Table 4.5. Average fare per mile for selected intercity carriers.

Carrier	Distance (Miles)				
	0-9	10-19	20-29	30-39	40-49
Greyhound	29.0[a]	14.6	12.1	11.4	11.4
Scenic Hawkeye	18.1	10.9	9.0	9.1	9.2

[a]All values are expressed in cents per mile.

Table 4.6. Unit operating expenses and revenues for the commuter bus service.[a]

Carrier	1978			1979		
	Operating Expenses (Excluding Depreciation and Taxes) Per Bus-Mile	Operating Expenses (Including Depreciation and Taxes) Per Bus-Mile	Operating Revenue Per Bus-Mile	Operating Expenses (Excluding Depreciation and Taxes) Per Bus-Mile	Operating Expenses (Including Depreciation and Taxes) Per Bus-Mile	Operating Revenue Per Bus-Mile
Jefferson	--	--	--	--	--	--
Scenic Hawkeye	NA	NA	NA	NA	NA	0.83[b]
Midwest Transportation	1.21	1.46	1.56	NA	NA	NA
Industrial Transportation	0.54	0.58	0.89	0.69	0.71	0.77
Brothers Bus Company	0.87	1.02	1.01	1.58	1.84	1.67
Arnold Henn	0.41	0.44	0.39	0.38	0.39	0.46
Guttenberg Coaches	--	--	--	0.84[b]	1.06[b]	0.49[b]
Best Cab	--	--	--	0.58[b]	0.75[b]	0.56[b]

[a]Values shown with a dash indicate the carrier was not in operation. Values shown with NA indicate the data were not available.

[b]An estimated value provided by the carrier.

highest unit cost in 1978, but this cost is not purely for the commuter operations, since the largest portion of the carrier's operations is charter service.

One would usually expect that the operators of small-scale commuter carriers can provide a service at a lower cost than can regular intercity carriers. A comparison of the unit costs in Table 4.7 with those of the intercity carriers in the previous section (Table 3.6) shows that this is not always true. Midwest Transportation had a unit cost in 1978 of $1.46, which is higher than those of all other carriers, including the regular route carriers. (Unfortunately this value does not represent the commuter cost. No meaningful data were provided by the carrier in 1979 or 1980 when the commuter services were more extensive.) In 1979, Brothers Bus had the highest unit cost of $1.84. These high unit costs do not represent the costs of the majority of the commuter services. They are due to special characteristics of the two respective operations.

Some carriers show operating expenses higher than their revenues, and consequently no profit is made. In most cases, this is due to the fact that the carriers had started their operation in that same year. Usually one would anticipate additional initial expenses, referred to as start-up costs. These include permits, licenses, market studies, etc. These expenses will affect the cost of operation in the first year, but their influence will be minimal in subsequent years. In the case of Brothers Bus, the loss was due to high driver wages and costly equipment that generated relatively high depreciation costs. It is important here to note the way in which the equipment was obtained.

Table 4.7. Operating expenses of selected commuter carriers.

Carrier/Item	Dollars Per Bus-Mile 1978	Dollars Per Bus-Mile 1979
Brothers Bus Company		
Equipment maintenance and garage expenses	0.185	0.299
Transportation expenses	0.417	0.801
Station expenses	0.056	0.034
Traffic solicitation and advertising expenses	0.028	0.016
Insurance and safety expenses	0.126	0.208
Administration and general expenses	0.063	0.223
Depreciation, rent and operating taxes	0.143	0.258
Total expense	1.17	1.843
Industrial Transportation		
Equipment maintenance and garage expenses	0.100	0.087
Transportation expenses	0.225	0.313
Station expenses	-[a]	0.020
Traffic solicitation and advertising expenses	-	0.008
Insurance and safety expenses	0.093	0.099
Administration and general expenses	0.118	0.053
Depreciation, rent and operating taxes	0.042	0.127
Total expense	0.579	0.707
Arnold Henn		
Equipment maintenance and garage expenses	0.131	0.083
Transportation expenses	0.137	0.162
Station expenses	-	-
Traffic solicitation and advertising expenses	0.000	-
Insurance and safety expenses	0.133	0.076
Administration and general expenses	0.012	0.064
Depreciation, rent and operating taxes	0.023	0.010
Total expense	0.426	0.394

[a]Data not available.

During fiscal year 1978, the company paid $1,045 for interest on loans. The interest was included in administration expense, which was still reasonable ($0.063 per mile). In fiscal year 1979, the company purchased equipment with loans totaling $109,000 and the interest payments increased to $10,231. This raised the administration cost to $0.223 per mile, which is nearly four times the administration cost experienced by Industrial Transportation and Arnold Henn.

One thing that is interesting to note is the ability of the carrier to manipulate its operating expenses. Most of the owners of the commuter carriers are employees of their own company. They could be drivers, bookkeepers, managers, or a combination of these. If outside personnel were hired to do these jobs, the result would be an increase in the operating expenses. Instead, many owners perform these jobs and do not charge the company any wages if the company is not making enough profit. In other situations, a salary may be charged for these services. For example, the owner of Guttenberg Coaches drives the bus and with the help of his wife handles all administrative responsibilities, yet he does not charge the carrier. The owner of Industrial Transportation charged the company a salary in 1978, when revenues were high; when revenues went down in 1979, no wages were charged for general officers. The manipulation of the operating expenses in this fashion will enable commuter operators to keep costs down. However, this does not reflect the true cost of the commuter service.

Summary

Although commuter bus services are small-scale and fairly new, the services have proven to be an acceptable alternative to the driving alone and carpooling modes which had been used by the subscribers of the commuter bus for their work trips. Generally commuter operators are providing lower cost service than regular route intercity service. The reasons for this have been due to the use of part-time and nonunion labor, low capital investment in equipment, minimized dead-head mileage expense, minimal or zero station costs, and the manipulation of operating expenses. Commuter carriers that varied from these general operating conditions experienced costs as high or higher than other regular route carriers.

5. PASSENGER AND REVENUE FORECASTING MODELS

Decisions regarding operating or financing policies need to be made with the best possible information. Carriers, planning agencies, and regulatory bodies would ideally base their actions regarding service to communities on detailed evaluations of the effects of pricing, service frequency, travel times, population characteristics and other factors affecting the demand for the service. However, these relationships have never been clearly identified due to the complexity of the interactions and a host of uncontrolled factors that may affect the utilization of a community service. Even the actual demand or utilization on existing routes cannot always be clearly assigned to specific cities or route segments within a corridor.

As discussed in Section 2, previous research efforts to model intercity bus movements have ranged in scope from macro-level analysis based on annual reports of systemwide characteristics, to micro-level models based on trip data between individual city pairs. The macro-level analysis is useful for establishing general relationships, but the results are not applicable for corridor analyses. The micro-level analyses are more relevant to analysis of individual trip-making decisions, but have the disadvantages of being less stable and more expensive to develop due to the data sampling requirements. Since the focus of this research is to examine the potential of intercity bus service in corridors, the forecasting efforts focus on the passenger volume and revenue potential associated with the unique characteristics within those corridors. Classification models and linear regression tools were used to examine the relationships between service and community characteristics and demand. Conceptually, this demand could be measured by the number of passengers, passenger revenues, express revenues, passenger-miles, load factors or other elements relating to the intensity of use. Practically, the measures of demand are limited by the adequacy of the data and the ability to assign these factors to discrete points or route segments. Conceptually, the factors that explain demand variations would include demographic characteristics of the communities, socioeconomic factors and service characteristics such as frequency, fare and quality. Practically, the demographic factors are highly correlated with each other and often do not provide distinctly different elements for modeling purposes. Furthermore, bus frequency, fares per mile, and operating speed from several cities may be nearly equal and therefore do not help explain demand variations among those cities.

Modeling efforts were completed to identify volume variations at the city level and the corridor level. The recommended forecasting procedure focuses on the corridor or route analysis, but the city analysis is also presented.

Revenue Analysis from Individual Cities

Although revenue data are reported to the regulatory bodies only on a systemwide basis, the individual carriers do maintain data regarding income from individual ticket agents. This information is needed to determine commissions, but can also be used for evaluating demand variations. However, these data are not continuously compiled by all the carriers and are not used regularly for the latter purpose. As an example of the difficulty in tabulating the data for this research, in one case it was necessary to search 10 ledger pages to identify the receipts from seven agents for a single month of the year. In another case, an agent did not request payment of the commission during an entire 12-month period. Since an objective of the research was to develop a methodology using only data that was readily accessible to the Department of Transportation, no additional effort was undertaken to obtain these data from all carriers.

The revenue-generating capability from individual cities was analyzed by comparing the sales data obtained from Greyhound and from Scenic Hawkeye for 1979. These revenue data are limited by several factors, including:

1. The agents do not necessarily report sales for a full year or a full month. An estimating procedure was necessary to factor the sales for Scenic Hawkeye agents. The partial-year sales were adjusted on the basis of the fraction of the total revenues received from regular route operations during the reporting period, compared to the total regular route revenues for the year.
2. The passenger revenue recorded by an agent may not represent the total revenue obtained from passengers from a particular city. Discussions with the manager pointed out a tendency of some passengers to obtain a short-distance ticket from a local agent and then obtain the continuing trip ticket at a larger terminal. As a result, although the bus industry eventually

accounts for the revenue, the generating source may not appear to be the actual origin city.

3. The revenue-generating potential from a city with more than one carrier is incomplete because data were seldom available from all competing carriers. The effect of a competing carrier was analyzed as an independent variable in some analyses and was controlled in other analyses by studying only those cities served by a single carrier.

Passenger and express revenues were compiled from 53 Iowa cities served by Greyhound and 21 cities served by Scenic Hawkeye. Each carrier was examined separately. The revenues from the cities exhibited tremendous variations; statistical efforts were undertaken to explain those variations.

Variables Considered in the Analysis

Independent Variables

The variables used to explain revenue variations focused on community and supply factors. The principal community factors were city and county populations, college enrollments, and elderly population. Service characteristics included service frequency by carrier, presence or absence of competitors, and service level by competitors.

Dependent Variables

Due to the large variation in city size, the revenues vary widely. The standard deviation for total revenues was twice as large as the mean value. To reduce the variance, revenue per person was also evaluated. The variance for per capita revenues is substantially lower than for total revenues, but even here the standard deviation was over 50% of the mean value. The revenue range was from \$0.10 per resident to over \$9.00 per resident. Countywide rate data and logarithmic transformations were also examined, but these did not aid the analyses.

Regression Models

Regression models were developed for total passenger revenue. On first examination these appeared to be strong models. Over 90% of the variation could be explained ($R^2 = 0.92$), and the variables were significant at the 0.001 level. The model for cities served by Greyhound was:

$$\text{Annual passenger revenue (\$)} = -5760 + 5.77\ \text{(college enrollment)} + 3.67\ \text{(city population)}$$

Unfortunately, this model is not effective for policy planning because service variables were not significant. Furthermore, the models are less than desirable for estimating in individual cities, because errors of 300% and more were evident in selected cities.

Models using unit revenue data and transformed variables were also ineffective as predictors. Hence, the efforts were switched to general classification models to examine variations by grouping cities of comparable sizes.

Classification Models for Revenue Analysis

The 53 cities served by Greyhound were classified into six population classes. The unit passenger, express and total revenue data (dollars per 1970 city resident) are shown in Table 5.1. These data show a tendency toward increasing revenues with increasing city size, but no definite trend was identifiable. The variations within and

Table 5.1. Unit revenue characteristics in cities served by Greyhound.[a]

		City Population						
		Less than 2,000	2,000 to 5,000	5,000 to 10,000	10,000 to 20,000	20,000 to 50,000	More than 50,000	Total
Passenger Revenue	Minimum	0.10	0.21	2.20	2.38	1.11	0.86	0.10
	Maximum	7.99	5.10	7.49	5.56	9.09	4.96	9.09
	Average	2.97	2.35	4.40	3.55	4.31	3.49	3.33
Express Revenue	Minimum	0.01	0.03	0.20	0.37	0.23	0.22	0.01
	Maximum	1.24	4.10	4.41	1.73	1.15	2.33	4.41
	Average	0.36	1.02	1.35	0.89	0.73	1.20	0.86
Total Revenue	Minimum	0.12	0.42	2.48	2.76	1.33	1.08	0.12
	Maximum	8.00	8.40	8.40	7.11	10.16	6.78	8.40
	Average	3.34	3.37	5.75	4.44	5.04	4.69	4.19
Sample Size		15	12	8	4	7	7	53

[a]All revenue values are given in 1979 dollars per 1970 resident population.

between classes were examined using a one-way analysis of variance model. This test indicated that the variation between groups was not significantly different than the variance within each group ($\alpha = 0.05$). The practical interpretation is that an estimate of revenue per person in any city based on the overall average would be as good as an estimate based on the average of the city-size group to which it belongs. For these cities, the overall average values were \$3.33 and \$0.86 for passenger and express revenues, respectively. The range in the costs is also shown in Table 5.1.

The possible variations created by having a competing carrier were examined by deleting cities with competitive service. Although the average values changed approximately 3%, the interpretation was the same. Of greater concern was the variation found between the national carrier and the regional carrier. The range of revenues per person from the cities was comparable for both carriers, but the average rates for Scenic Hawkeye were \$1.72 and \$0.77 for unit passenger and express revenues, respectively. This most clearly demonstrates the potential differences between long-haul and short-haul carriers. Even though the two carriers may attract passengers equally within a community, the actual revenues achieved may be substantially different. In many cases, the local carrier generates revenues only from the origin to a connecting carrier station, whereas the national carrier can more readily serve as the single source provider. This suggests that a more consistent forecasting approach would be to examine passenger demand and then apply trip length and fare per mile factors for the specific company being analyzed. This approach is addressed in the corridor analyses that follow.

Model Development for Route Analysis

The initial impetus of this study was to develop a methodology for estimating potential revenues and costs on specific routes so that the viability of these routes could be assessed. Route-specific cost data are virtually nonexistent. Route-specific volume data are more readily defined, although the data analyses are easily clouded unless the routes in question are nearly closed-system entities. An example of a route that is sufficiently identifiable is Iowa Coaches' operation from Prairie du Chien, Wisconsin, to Cedar Rapids, Iowa. On the other hand, the main Greyhound operations from Salt Lake City, Utah, to Chicago, Illinois, are summarized only for that entire distance, thus precluding any meaningful analysis in Iowa.

Through the cooperation of the carriers, it was possible to identify passenger volumes along several Iowa routes. The variability of demand on these routes was examined to establish a procedure for estimating potential demand in proposed corridors.

Variables Considered in Model Development

Independent Variables

The factors considered to explain corridor travel variations included community characteristics and intercity service characteristics. Service factors considered included daily service frequency, fares, fare per mile, average bus speed, distance, travel time ratios between bus and automobile, and carrier competition in the corridor. The community demographic factors considered included population of the origin and destination cities, population in the corridor between cities, county populations, elderly population, college enrollment, and business employment. Various combinations and transformations of these variables were evaluated, but only the principal factors are presented in the following sections.

Dependent Variables

The choice of dependent variables was largely constrained by the availability of data from the carriers. Passengers, passenger-miles, passenger revenues, and express revenues for each route were available only from one carrier. Even in this case the measures were not all independent because the passengers and passenger-miles were related by a constant fare per mile factor, which was independent of the route considered. The only measure consistently available from all carriers was annual passenger number, so this measure was used as the primary analysis variable. To minimize the relative variance between corridors, the passenger variable was also evaluated on three different rate bases, passengers per bus-mile, passengers per round trip, and passengers per person in the service area. Only the principal models are detailed in this report.

Routes Included in the Analysis

Eleven routes were included in the model development phase; four additional routes were used to check the model. The routes used represent services provided by Greyhound, Iowa Coaches, Jefferson Lines, Missouri Transit, and Scenic Hawkeye. Table 5.2 lists the data abbreviations used in the study; Table 5.3 provides the data summaries for the 11 routes used in model development; and Table 5.4 gives the means and standard deviations for selected characteristics. The bus-mile

Table 5.2. Abbreviations used for route analysis.

Abbreviation	Definition
BM	Annual bus-miles on route, in thousands
COMP	Dummy variable indicating presence (1) or absence (0) of a competing carrier in the same general corridor
CORPOP	Population in the corridor, in thousands (This included the population of all cities over 5,000 on the route between origin and destination. Also included were cities less than 5,000, if those cities were county seats.)
DIST	Distance in miles between the end points
FARE	One-way fare in dollars
FPM	Fare per mile in dollars per mile
FREQ	Number of daily round trips
OBS	Observation number associated with the route for identification purposes
PAS	Annual passengers, in thousands
PASPBM	Passengers per bus-mile, PAS/BM
PASPFR	Passengers per round trip, in thousands, PAS/FREQ
PASPTP	Passengers per population served where population is the sum of POPI, POPJ, and CORPOP
POPI	Population in origin city from 1970 census data, in thousands (The city population included all incorporated cities immediately adjacent to the central city. The origin was assumed to be the largest of the two cities.)
POPJ	Population in destination city from 1970 census data, in thousands (The city population included all incorporated cities immediately adjacent to the central city.)
SPEED	Average overall bus speed in miles per hour, or distance between origin and destination divided by time
STUDS	College student enrollment, in thousands (1979 enrollment) in all cities served by the route
TIME	Bus-time in hours between cities

Table 5.3. Data summaries for the 11 routes used in model development.

	Route (OBS)										
	1	2	3	4	5	6	7	8	9	10	11
BM[a]	141.5	186.8	131.6	78.8	59.4	121.0	82.00	121.0	59.0	109.0	83.0
PAS	26.2	32.2	12.7	17.9	7.6	46.0	5.7	8.7	2.8	14.0	6.7
POPI	238	238	238	130	216	130	39	113	130	130	113
POPJ	31	113	30	62	130	53	10	48	6	39	25
CORPOP	57.1	31.9	18.0	4.4	4.8	0.0	13.2	18.9	6.2	135.0	20.3
STUDS	32.7	20.4	10.8	7.4	5.0	27.0	2.0	13.0	4.0	17.2	13.0
FREQ	2	2	2	2	1	6	1	1	1	1	1
COMP	1	0	1	0	1	1	0	0	0	1	1
DIST	90	108	83	74	77	28	103	157	81	132	115
TIME	2.50	3.00	2.40	2.00	1.90	1.00	2.75	4.50	2.50	4.50	3.90
FARE	8.05	11.20	7.95	7.90	7.90	2.00	7.00	17.05	11.60	9.60	18.85
SPEED	36.0	36.0	34.6	37.0	40.5	28.0	37.4	34.9	32.4	29.3	29.5

[a]Units are defined in Table 5.2.

Table 5.4. Characteristics of selected factors for study routes.

	PAS[a]	BM	FREQ	FARE	FPM	DIST	SPEED	PASPTP	PASPFR	PASPBM
Mean	16.4	106.6	1.82	9.92	0.102	95.3	34.1	0.075	8.88	0.144
Standard Deviation	13.3	38.9	1.47	4.71	0.030	33.8	3.9	0.064	3.97	0.096

[a]Units are defined in Table 5.2.

and passenger data were generally provided directly by the carrier; however, an approximation was necessary to allocate traffic to a portion of a route with a through-route component. The allocation was based on data provided by the carrier.

Regression Models of Corridor Travel

An ideal model for estimating passengers in the corridors would contain factors related to the community and factors related to the bus service. Models containing only service factors, such as frequency or fares, do not allow the operator and the planner to determine variations due to the differences in the cities served. On the other hand, models that do not incorporate frequency or fare elements do not provide decision makers with a basis for evaluating scheduling or fare policies. Linear-form and product-form models using totals and rate variables were analyzed. Several models were statistically valid and explained 80% to 90% of the variance in the dependent variable. Unfortunately, most models did not include policy-sensitive variables, such as relative travel time or fares.

The prediction errors for passenger movement in any single corridor were considerably lower than the errors from revenue models in individual cities, but still the errors were nearly 70% in one or more corridors. The exception was a model using annual passengers per daily round trip as the dependent variable and bus-miles and population factors as independent variables.

The recommended model for passenger estimation is:

$$\begin{aligned} \text{PASPFR} = -0.1 &+ 0.050\ \text{BM} + 0.041\ \text{POPJ} + 0.056\ \text{CORPOP} \\ &(\alpha = 0.007) \quad (\alpha = 0.015) \quad (\alpha = 0.004) \end{aligned} \tag{5.1}$$

The percent of variation explained was 90% and the coefficient of variation was 17%. The coefficient of variation is the ratio of the standard error of the estimate to the mean of the dependent variable. It is an indicator of the variation about the regression line and must be low for the equation to have strong estimating potential in individual corridors. The values shown below the coefficients represent the significance level for each parameter.

Eight of the 11 routes had estimating errors of less than 15%; two more were in the range of 15% to 25%; the largest error was 38%. Considering the large variation in route demand, these estimates are well within the range expected for estimates of discrete observations.

Validation of the Model

A useful evaluation of regression models is to develop estimates in cases not used for the calibration of the model. Four routes were used in this evaluation stage. These included the Reid Bus Line route from Harlan, Iowa, to Omaha, Nebraska; the River Trails route from Davenport to Dubuque; the Iowa Coaches line from Dubuque to Sioux City; and the former Sedalia-Marshall-Boone line (SMB) from Des Moines to Sioux City. The Dubuque to Sioux City run is somewhat different from the other routes because it is an entire cross-state route, while the other routes represent shorter corridors with limited intervening population centers. The Reid operation is also nontypical. This carrier is an owner-operator system, comparable to newer commuter operations. It serves a corridor with a very low population density. The two daily round trips increase the bus-miles of travel beyond the marginal passenger potential for this run. Passenger revenues account for only 25% to 30% of the system revenue. The carrier currently relies more on its express business than on passenger revenue.

Table 5.5 shows the key variables for these routes. Estimation errors for three of the four routes centered around the 25% value, with the major outlier of concern being the Reid operation. As expected, the population density in the service area was too low to generate a demand consistent with the amount of bus-miles traveled in the corridor. The second daily round trip has low passenger potential. If the operator provided only one round trip with the bus-miles reduced to 29, the passenger estimate would have been 1600 persons compared to the 2400 actually served. This suggests that a 100% increase in the service frequency had only increased the demand by 50%.

The 25% error for other routes is within the range established for regular route carriers used in the calibration phase. The combined estimated trips on the four routes is within 11% of the observed volumes.

Application of the Forecasting Models

The route evaluation phase considers impacts for both new and existing routes. Passengers, passenger revenues, and express revenues are addressed on a route basis.

Treatment of Frequency Adjustments on New Routes

The passenger estimation equation implies that the number of passengers per round trip is a direct function of the number of bus-miles. On

Table 5.5. Model validation for passenger model.[a]

Route	BM	POPJ	CORPOP	FREQ	PAS	Thousands of Passengers (Estimated)	Percent Error
Harlan-Omaha	58	58	0	2	2.4	6.0	+ 150
Dubuque-Davenport	53	62.3	62.3	1	6.9	5.4	- 22
Dubuque-Sioux City	256	62.3	214.0	1	38.0	27.3	- 28
Des Moines-Sioux City[b]	154	45.9	13.1	1	9.7	11.9	+ 22

[a]Units are defined in Table 5.2.

[b]Based on the 1977 report, the last year service was offered by the carrier.

the surface it would appear that if one round trip per day were added, there would be a dramatic increase in the number of total passengers. First, the dependent variable PASPFR would increase, because the bus-miles increased. Secondly, the number of total passengers would increase again because the passengers per trip would be multiplied by the number of trips. For example, consider a single route with the following characteristics:

BM = 75
CORPOP = 50
POPJ = 30
FREQ = 1

The estimated PASPFR = 7,700 (7.7 × 1000). Therefore, total passengers = 7,700 × 1 = 7,700. After adding a second trip (so BM is increased to 150), the estimated PASPFR = 11,400 and total passengers = 11,400 × 2 = 22,800. It would appear that the new demand would be nearly 200% higher.

The above extrapolation cannot function in this manner, however, because the model was not based on observations of actual frequency changes on individual routes. Instead, the model was based on routes in which the frequency and bus-miles per trip had a unique distribution that was not a positive linear function. Indeed, there was a negative correlation between bus-miles and frequency. This relationship must be retained in the analysis methodology if valid estimates are to be obtained.

The tradeoff between bus-miles and frequency was examined using a product-form model, which yielded the following statistically significant ($\alpha = 0.01$) equation:

$$BM = \beta(FREQ)^{-0.68} \tag{5.2}$$

When using the model for a new route, the value of the coefficient β would be simply the estimated bus-miles for a single daily trip. The bus-miles value to incorporate in the forecasting model would be, for the above example,

$$BM = \beta(FREQ)^{-0.68} = (75)\ (1)^{-0.68} = 75$$

Note that there is no change. However, if a daily run is added, the BM for the forecasting model would be

$$BM = 75(2)^{-0.68} = 46.5$$

The forecasted passengers per trip, PASPFR, would change to 6,250, and the number of total passengers would be 12,500. In this example, the additional daily bus trip attracts an additional 4,800 passengers, an increase of approximately 60%.

Table 5.6 shows the adjustment factors needed to evaluate proposed routes on which additional round trips may be considered. The simplified relationship is

$$BM_p = BM_1\ (factor)_p \tag{5.3}$$

where

BM_1 = bus-miles for one daily round trip

BM_p = bus-miles to place in model for p proposed round trips, and

$(factor)_p$ = adjustment factor for p round trips

Table 5.6. Bus-mile adjustment factors for new route analysis.

	Frequency (p) Daily Round Trips				
	1	2	3	4	5
Adjustment Factor, $(\text{factor})_p$	1	0.62	0.47	0.39	0.33

Treatment of Frequency Adjustments on Existing Routes

If adjustments in frequency are to be considered for existing routes for which passenger data are available, the appropriate base to use is the known passenger demand. The demand equation is not necessary. The anticipated passenger demand on proposed runs can be determined using the same general relationship found for service frequency and bus-miles noted earlier. The expression is

$$PAS_p = PAS_e \frac{FREQ_p^{0.68}}{FREQ_e^{0.68}} \tag{5.4}$$

where

PAS_p = passengers on proposed system with $FREQ_p$ daily trips

PAS_e = passengers on existing service with $FREQ_e$

$FREQ_p$, $FREQ_e$ = proposed and existing daily round trips, respectively

The appropriate adjustment factors may be determined directly from Fig. 5.1, so

$$PAS_p = PAS_e \text{ (adjustment factor)} \tag{5.5}$$

The figure clearly shows the decreasing return obtained for increased daily operations. As should be expected, the increased volume obtained by adding another run when there are already several in service is significantly less than the increment achieved when there is only one round trip. Although any number of additions or deletions

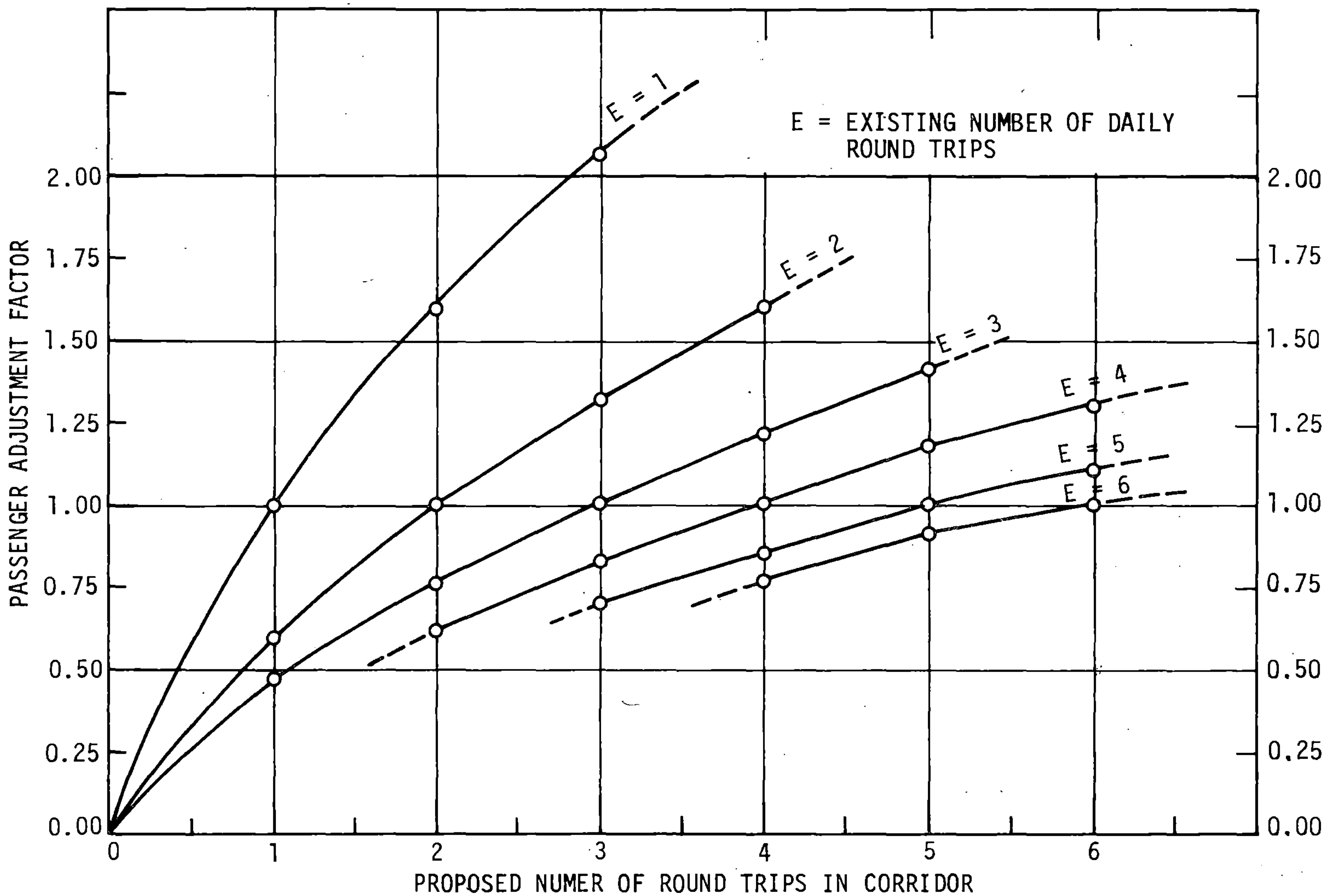

Fig. 5.1. Adjustment factors for trip frequency on existing routes.

could be analyzed, it is recommended that the incremental change should be no greater than two.

The researchers identified one case that could be used to test the existing service model for frequency adjustment impacts. The SMB Stagelines dropped one of two daily trips from Des Moines to Sioux City in 1977. In 1976, regular route passengers totaled 16,700. The model would estimate a new passenger demand as

$$\begin{aligned} PAS_{(1)} &= PAS_{(2)} \text{ (adjustment factor from Fig. 5.1)} \\ &= 16{,}700\ (0.62) \\ &= 10{,}350 \end{aligned}$$

The actual number of passengers served in 1977 was 9,700. This comparison shows a difference of only 6.7%.

Revenue Estimation in the Corridor

Passenger Revenues

The passenger revenue may be estimated from the expression

$$\text{Annual passenger revenues} = \text{passengers} \times \text{fare per mile} \times \text{average trip length} \qquad (5.6)$$

The fare per mile would be based on the existing or proposed fare structure in the corridor being analyzed. On a new route, the average trip length can be reasonably estimated by determining the weighted average distance of the population centers from the largest end-point city. The expression is

$$\text{Average trip length (in miles)} = \frac{\sum_j POP_j \times DIST_{ij}}{\sum_j POP_j} \tag{5.7}$$

where

POP_j = population in cities served by the carrier in the corridor; only county seats or cities over 5,000 population were considered

$DIST_{ij}$ = distance from the origin (the largest city on either end of the route) to other cities, measured in miles

This expression was tested on five Greyhound routes for which average trip lengths were known. A paired observation t-test indicated no significant difference between the actual and the estimated trip lengths. The aggregate error was less than 5% for these routes.

Express Revenues

The ability to estimate express revenues was severely curtailed due to lack of input from the carriers. Only Jefferson Lines and Iowa Coaches were readily able to provide express revenue data. Even if the carriers had been able to generate these data, it is not certain whether more meaningful route-specific estimates could have been obtained because the available data identified large variations in express revenues in the corridors.

The route data indicated a strong correlation between passenger and express revenues. Therefore, the procedure suggested for estimating express revenue evaluates the express revenues as a proportion of passenger revenues on a system basis.

The data for the medium-sized carriers produced the following average ratios of express revenues to passenger revenues for the period 1976 to 1979: Iowa Coaches (0.338), Midwest Coaches (0.362), Missouri Transit (0.303), and Scenic Hawkeye (0.281). The overall mean for this group was 0.321, with a standard deviation of 0.0394. The standard deviation is only 12% of the mean value, which indicates reasonable stability on a system basis.

The comparable data for the larger carriers were: Greyhound (0.235), American (0.204), and Jefferson (0.451). The mean value for this group (0.297) was very close to the value for the other carriers, but the standard deviation was 0.112 or 37% of the mean.

As a first-level approximation, the express revenues on a new route could be estimated as a fraction of the estimated passenger revenue. The appropriate fraction should be based on previous experience of the carrier, but lacking that information, the express revenue may be estimated as 30% of the forecasted passenger revenue.

Summary

The analyses have considered several community and supply characteristics, but only a small number of variables are incorporated in the final model. Passenger estimation tools are provided for analyzing new routes and existing service. The passenger revenue capability is tied into the demand forecasts by applying average trip length and average fare per mile factors. Route-specific express revenues were not identifiable on all systems. An estimation methodology based on the current average fraction of express revenue to passenger revenue is recommended.

Each forecasting tool will be applied in a case study example. These analyses appear in Section 8.

6. OPERATING COST RELATIONSHIPS

Background

The objective of this phase of the research was to develop a mathematical relationship to forecast the operating costs of an intercity bus carrier operating in Iowa. Essential input for such a forecast is a record of historical costs for that carrier and price trends affecting the intercity bus industry. It was intended that a single model would be applicable to any carrier that provides regular route intercity service operating in the state. Such a model would be useful, for example, to assess the costs that would be incurred as a result of improvements or expansions in intercity bus service.

Several components of operating costs have been reported annually by intercity bus companies to the Transportation Regulation Board of the Iowa Department of Transportation. These include 63 separate operation and maintenance expense items grouped into six general categories:

4100 Equipment maintenance and garage expense

4200 Transportation expense

4300 Station expense

4400 Traffic, solicitation, and advertising expense

4500 Insurance and safety expense

4600 Administrative and general expenses

Additionally, other expenses are reported in the following categories:

5000 Depreciation expense

5100 Amortization of carrier operating property

5200 Operating taxes and licenses

5300 Operating rents

Operating costs vary significantly among carriers. In 1979, for example, total expenses per bus-mile for the highest-cost carrier among the seven largest carriers serving Iowa were \$1.63. The lowest-cost carrier in this group operated for an average of \$0.92 per bus-mile, a ratio of 1.77 to 1 for these two carriers. Given this disparity in operating costs among carriers, it is apparent that an acceptable model must be capable of using as input the historical data on operating expenses for the specific carrier that is the subject of the analysis being undertaken. What is required, then, is a practical method for updating these costs so that they may be projected to current or future costs.

An Operating Cost Model

Certain desirable characteristcs were established for an operating cost model that would be applicable to any carrier operating within the state. First, the model would include a limited number of expense components, each of which could be updated with reasonable confidence by using a generally recognized price index. Collectively these components should represent a significant portion of the total expenses for an intercity bus operation. These expense components should also bear a direct relationship to the variable costs of providing intercity bus service and should be relatively free of influence by ownership or operating characteristics that might be unique to specific carriers.

Furthermore, the relationship between these expense components and the total costs of a bus operation should be constant over time and the same for all carriers.

Many individual expense items are not reported each year by all of the intercity carriers operating in Iowa. For example, in 1978 five of the seven carriers that afforded the basis for the cost model did not report expenses in the following categories:

- Expenses of general office employees.
- Other regulatory commission expenses.

Several other categories were omitted by at least one carrier. Other items are reported in a form that is not consistent from one carrier to another, either because of different operating characteristics or because of different accounting methods. Examples, taken from 1978 for the same seven carriers, include the following:

- [Station] salaries and commissions, from zero to 10.4 percent of expenses.
- Commissions paid, from 4.5 to 14.0 percent.
- Salaries for general officers, from zero to 7.4 percent.
- Operating rents, from a credit equal to 0.36 percent of expenses to a cost equal to 3.3 percent of the total expenses.

Hence, an initial effort was made to identify those cost elements that appeared to be consistently reported by all of the intercity bus carriers filing reports in Iowa for the period 1976-1979. All of the cost items that were investigated are listed in Table 6.1.

As a result of this investigation, nine expense items were identified that were most consistently reported by the carriers. These items

Table 6.1. Expense items considered for inclusion in operating cost model.

Code	Expense Item	Models Tested	Final Model
4110	Supervision of shop and garage		
4122	Operation and maintenance of service equipment		
4140	Repairs to revenue equipment	X	X
4160	Tire and tube revenue equipment	X	X
4210	Supervision of transportation		
4220	Drivers' wages and bonuses	X	X
4230	Fuel for revenue equipment	X	X
4240	Oil for revenue equipment		
4311	[Station] salaries and commissions		
4331	Commissions paid	X	
4340	Interline commissions paid		
4350	Interline commissions earned (credit)		
4410	[Traffic, etc.] salaries and expenses		
4470	Advertising		
4520	Public liability and property damage insurance	X	
4611	Salaries of general officers		
4612	Expenses of general officers		
4613	Salaries of general office employees		
4616	Expenses of general office employees		
4620	Law expenses		
4630	General office supplies and expenses		
4651	Outside auditing expenses		

Table 6.1. (continued)

Code	Expense Item	Models Tested	Final Model
4673	Other regulatory commission expenses		
5000	Depreciation expenses	X	X
5200	Operating taxes and licenses	X	
5300	Operating rents	X	

are indicated in the "models tested" column in Table 6.1. All of the other expense items either were frequently not reported by some carriers or their proportionate contribution to operating expenses tended to be highly erratic. Models including these expense items were then tested for conformance with the desirable characteristics described previously.

It was also necessary at this stage to identify those carriers whose reported expenses also conformed with the established criteria for reporting consistency. As a result of this analysis, it was concluded that only data from the seven Class I and Class II carriers should be used in the subsequent process of model development. Data reported by the Class III carriers generally exhibited a distribution of operating expenses that was substantially different from the pattern for the larger carriers. Furthermore, these expenses were not consistent within the group of Class III carriers itself.

To determine the most suitable model, two or more cost elements were summed for each of the seven carriers for each year, 1977-1979. The proportion of total expenses represented by these cost elements for each such sum was calculated. This process was repeated using different combinations of cost elements until, through trial and error, the combination was identified that best satisfied the evaluation criteria.

As part of the evaluation process, the standard deviation and mean were calculated for the proportion of total expenses represented by that combination of expense elements. This was done for each annual period 1977-1979 using the sample of seven Class I and Class II carriers.

The coefficient of variation (the ratio of standard deviation to the mean) was used as a quantitative measure of consistency of the data.

The model selected used the five cost elements that are indicated in Table 6.1 under the column heading "final model." These, on the average, accounted for nearly half (48.0%) of the total expenses that were reported by the seven carriers included in the analysis for the period 1977-1979. Inclusion of additional cost elements, with two exceptions, tended to lessen the reliability of the model in reproducing the historical experience during the period analyzed.

The inclusion of the operating taxes and licenses component and/or the operating rents component produced models that included a greater proportion of total expenses. Coefficients of variation for these models were substantially the same as for the model selected. However, these cost elements were not included in the final model since there is no suitable price index for operating taxes and licenses or operating rents. It may also be noted that operating rents appear as a credit rather than as an expense in the reports of some carriers included in this analysis. Data relating to the model selected are displayed in Table 6.2.

As measured by the coefficient of variation, there was no significant difference in the predictive capability of the model selected and the one that included only four variables, omitting depreciation expense. However, the model selected included a greater proportion of total expenses than the four-item model. It also provided greater sensitivity for quantifying future price trends if depreciation expenses change over time at a rate different from the rate for other cost components.

Table 6.2. Details of expense components.[a]

	Carrier						
	Greyhound	American	Jefferson	Iowa Coaches	Midwest Coaches	Missouri Transit	Scenic Hawkeye
1977							
Subtotal (five items)	109,421.9	16,313.8	3,465.5	411.0	431.1	772.2	444.3
Total Expense	242,771.3	36,677.0	8,086.2	861.2	844.5	1,443.2	894.8
Percent (five items)	45.1	44.5	42.9	47.7	51.0	53.5	49.7
1978							
Subtotal (five items)	113,656.4	16,442.1	4,136.0	479.8	437.5	853.2	458.3
Total Expense	258,490.2	38,489.6	9,406.5	922.7	896.7	1,682.4	952.2
Percent (five items)	44.0	42.7	44.0	52.0	48.8	50.7	48.1
1979							
Subtotal (five items)	135,322.7	20,937.2	4,603.0	525.7	500.7	930.5	542.7
Total Expense	301,791.9	46,220.0	10,483.9	973.6	987.2	1,735.7	1,074.1
Percent (five items)	44.8	45.3	44.0	54.0	50.7	53.6	50.5
1977-1979							
Subtotal (five items)	358,401.0	53,693.1	12,204.5	1,416.5	1,369.3	2,555.9	1,445.3
Total Expense	803,053.4	121,386.6	27,976.6	2,757.5	2,728.4	4,861.3	2,921.1
Percent (five items)	44.6	44.2	43.6	51.4	50.2	52.6	49.5

[a] Costs are given in thousands of dollars.

An average of about 80% of the depreciation expense for intercity carriers consists of the depreciation associated with revenue equipment. Although a price index for motor coaches was previously reported by the Bureau of Labor Statistics, this index has not been calculated since July 1979. However, a suitable proxy exists in the form of the index for heavy trucks, an index that tended to change at the same rate as the index for motor coaches, when both were being reported.

Shown in Table 6.3 are the standard deviations and the means for the parameter used for evaluation, the percentage of total expenses represented by the five expense elements selected for the model. Also shown in Table 6.3 is the coefficient of variation for each year of the period of the analysis and for the combined three-year period. The proportion of each cost component included in the sample data is displayed in Table 6.4.

The equation developed from these data is as follows:

$$C = (A)\ (M)\ (C_R + C_T + C_W + C_F + C_D)$$

where

C = cost of bus service per bus-mile

A = adjustment factor to account for the proportion of costs in selected categories; for ICC Class I carriers (Greyhound, American, Jefferson), $A = 2.27$; for ICC Class II carriers (Iowa Coaches, Midwest, Missouri, Scenic Hawkeye), $A = 1.96$

M = multiplier for updating costs

Table 6.3. Analyses of five expense components as percentages of total expenses.

Year	Percent of Total Expense: Standard Deviation	Percent of Total Expense: Mean	Coefficient of Variation
1977	3.84	47.8	0.080
1978	3.64	47.2	0.077
1979	4.24	49.0	0.086
1977-1979	3.77	48.0	0.078

Table 6.4. Average proportion of total expenses attributable to each expense component (1977-1979).

Component	Percent	
	Total Expenses	Subtotal (Five Items)
Repairs to Revenue Equipment	8.2	17.1
Tire and Tube Revenue Equipment	1.4	3.0
Drivers' Wages and Bonuses	24.9	51.8
Fuel for Revenue Equipment	7.4	15.5
Depreciation Expenses	6.1	12.6
Total	48.0	100.0

C_R, etc. = component cost per mile for repairs to revenue equipment, tires, driver's wages, fuel, and depreciation expense

Updating of the Model

The multiplier or updating factor included in the equation is based upon the average proportionate costs of each of the five components for the seven carriers included in the analysis for the period 1977-1979. It is also a function of the appropriate price index for each factor. The base period for selecting these indices was August 1979.

The equation for M, the updating multiplier, is as follows:

$$M = 0.00070\ CPI_R + 0.00013\ PPI_T + 0.00204\ HEI_{TPU} + 0.00031\ PPI_F + 0.00057\ PPI_D$$

where

CPI_R = consumer price index, automobile maintenance and repair

PPI_T = producer price index, truck tires (code 07120105)

HEI_{TPU} = hourly earnings index, seasonally adjusted, for transportation and public utilities

PPI_F = producer price index, diesel fuel to commercial consumers (code 05730301)

PPI_D = producer price index, motor trucks, 10,001 lbs gross vehicle weight and over (code 14110281)

Indices for updating 1979 costs may be obtained from the following sources, each a publication of the U.S. Department of Labor, Bureau of Labor Statistics:

- CPI detailed report (CPI_R).
- Producer prices and price indexes (PPI_T, PPI_F, and PPI_D).
- Employment and earnings (HEI_{TPU}).

Values of the price indices used were as follows for August 1979:

CPI_R = 245.7

PPI_T = 222.9

HEI_{TPU} = 254.3

PPI_F = 505.8

PPI_D = 222.4

To demonstrate the calculation of the multiplier, the following calculation is shown using the component indices for June 1980:

$$M_{1980} = 0.00070\ (267.3) + 0.00013\ (249.1) + 0.00204\ (270.6) + 0.00031\ (690.2) + 0.00057\ (246.9) = 1.13$$

Thus, operating expenses for June 1980 are 1.13 times those for 1979.

It may be anticipated that the proportionate contribution of various cost elements may change during a period when prices are increasing rapidly. Under such circumstances, the model should be recalculated not less frequently than every three years. It is recommended, for example, that the adjustment factor, A, and the equation for the updating multiplier, M, be revised in 1983 using operating cost data and the appropriate cost indices for 1982. Each coefficient in the equation for M may be calculated from the following relationship:

$$K = \frac{R}{I}$$

where

K = coefficient for a specific price index

R = ratio, specific cost component to total cost in the five designated cost components

I = price index applicable to a specific cost component

For example, the coefficient associated with repairs to revenue equipment was determined in 1979 as follows:

The ratio, R, was obtained from Table 6.4, which indicates 17.1% of the cost of the five components is associated with this element, so R = 0.171. The consumer price index, I, was reported to be CPI_R = 245.7. Therefore

$$K = \frac{R}{I} = \frac{0.171}{245.7} = 0.00070$$

Application of the Model

In addition to operating costs, other factors are also relevant to the determination of the incremental costs associated with an improvement in service or an additional route. Such determination might be made to establish the appropriate reimbursement for a carrier providing such services under a purchase of service agreement, for example. Various policy decisions are necessary, including to what extent is a carrier afforded a contribution toward fixed costs and permitted to realize a profit.

The specific services that are likely to be carried out under such an arrangement would normally constitute only a relatively minor addition to the total service conducted by a carrier. Given a typical relationship between fixed and variable costs for intercity bus carriers, a rate of reimbursement equal to the total average costs per bus-mile would probably be more than sufficient for a carrier to achieve a satisfactory return on the marginal investment. Although such a determination is beyond the scope of this research, the variable portion of total costs appears to vary significantly among the seven largest carriers providing bus service in Iowa. The range probably varies from about 65% to over 80% variable costs within this group of companies. If a median value of 75% is assumed for the variable component of costs, reimbursement at a rate of 83% of the average total costs would yield an operating ratio of about 90% on the incremental service. It may be seen that the capability to project separately the expenses for an intercity carrier will not preclude the necessity for difficult policy decisions in making determinations as to the appropriate reimbursement for additional bus services.

Summary

It is possible to calculate with reasonable assurance the operating expenses of an intercity bus carrier, given historical data concerning key cost components for that carrier. However, this calculation does not necessarily provide a complete answer as to what would constitute the appropriate reimbursement for additional bus services that might be performed under a purchase-of-service agreement. A policy decision is still required to establish the extent to which reimbursement for incremental services should contribute to fixed costs and provide a return on equity.

7. SOCIAL AND GENERAL WELFARE ASPECTS OF INTERCITY BUS SERVICE

Introduction

Personal mobility has long been recognized as a basic need for achieving a satisfactory quality of life in the United States. The concentration of our population into an urban setting with specialized economic and social character has made travel a necessity if individuals and households are to accomplish selected activities which 50 years ago were accomplished within the local farmstead (e.g., caring for an elderly relative). Burkhardt suggested in 1973 that the need for mobility (trip-making below the national average per capita travel) by residents of rural and small community areas become the basic criterion for transportation planning [24]. Burkhardt's analysis was addressed to special interest groups with definite transportation characteristics differing from the overall aggregate transportation consumer (e.g., the elderly, the low income, the handicapped). Minnesota and Missouri were included in these analyses.

Different levels of mobility needs were considered in an economic analysis of statewide rural bus service for Pennsylvania. In that study, a small fraction of the mobility need was projected to be satisfied by bus service [25]. Relating personal mobility levels, the need to travel to carry out basic lifestyle functions, the availability of public bus transportation, and the cost of providing bus system service suggest that any subsidy to bus service may have to undergo economic analysis. Therefore, any consideration of the social and general welfare aspects of intercity bus service in Iowa must be made in light of the type of system that can be reasonably assumed to exist through the economic marketplace outside Iowa.

Assumed Minimum Viable System in the Absence of Economic Regulation

Intercity bus travel from the other 47 contiguous continental states was assumed to generate sufficient travel demand to assure continuity of service along Interstates 29, 35, 80, and 380. Service along these corridors was presumed to be of sufficient interest to justify a route stop: Sioux City, Council Bluffs, Des Moines, Newton, Iowa City, Davenport, Cedar Rapids, Waterloo, Ames, and Mason City (served through Clear Lake at I-35). These communities have sufficient concentrations of population (10,000 or more persons), social activity and economic activity to produce intercity bus traffic justifying interruption of interstate route service.

A case could be developed to argue that other communities and other interstate routes should be included in a minimum economically viable system. However, in this section, we are examining intercity bus service from a social and general welfare point of view. In that context, when Iowa is considered as one area within a multistate region, only the Interstate Highway System represents sufficiently dense travel corridors to guarantee extensive intercity bus service in the absence of economic regulation. All other communities and areas within Iowa become candidates for social and general welfare justification of support for intercity bus service or as feeder services to the longer-haul routes.

Review of Selected State Programs

California

An extensive analysis was conducted on behalf of the California Department of Transportation to identify transit performance measures that could be related to the economic, social, and functional value of providing public transportation service [26]. A total of 168 performance measures were reviewed; 11 were selected for further analysis:

1. Cost per passenger
2. Employment served
3. Reliability
4. Headway
5. Transit dependents served
6. Population served
7. Transit utilization rate
8. Transit supply rate
9. Productivity
10. Self-support ratio
11. Connectivity

A cumbersome expression for weighted worth of transit service was developed. The detailed results are of little value in examining social and general welfare benefits of intercity bus service in Iowa. However, the 11 variables considered do contain social-welfare characteristics: employment, population, transit dependents, and self-support of service. These factors were considered for inclusion in the Iowa analyses.

The legislative intent was to allow three options to utilize the intercity funding, including [27]:

1. Fare reductions (with the goal of increased ridership).
2. Increased frequency of existing service.
3. Increased access to other transportation systems.

The legislative program assumed that the route system existing prior to the program was considered an economically justified structure. The subsidy had to be associated with an expansion of service, reduction of fare-box income, or some management change intended to reduce operating costs and/or increase revenue. Apparently no direct consideration was given to social-welfare analyses, except through the traditional transportation planning process in providing consideration to community needs and desires.

Michigan

An analysis of the intercity bus industry and the impact of a subsidy program on the industry in Michigan was completed in 1978 [28]. Clearly, the intent of the Michigan program was to utilize social and welfare measures to guide the expenditure of public funds. The program policy sought to discourage abandonment of low-volume rural intercity routes, because these operations provide service to a unique clientele that cannot afford, or does not have access to, other public transportation modes.

Results from national travel surveys and Michigan bus rider surveys were used to show that persons with incomes of less than $7500 per year utilized bus, rail, and air travel modes in the following proportion: 4:2:1. Furthermore, persons over 65 years of age used the bus as much as rail and air combined. A strong philosophical case was made for the social value of rural intercity bus service.

However, careful scrutiny of the report indicates that application of the subsidy money was assigned more on cost considerations and self-support criteria than on social-welfare indicators. One of the key criteria in initiating the program was that ridership estimates and cost projections be such that any subsidized route was to be self-paying at the end of two years. Since at the end of two years only subsidized routes along major travel corridors had gained a significant number of riders, the self-sufficiency criterion was dropped. This change in policy did not appear to be the result of social or welfare function evaluation, but more a recognition that certain routes selected for funding would never be financially self-sufficient.

Wisconsin

The Wisconsin Department of Transportation conducted an extensive analysis of intercity bus passengers in June 1976 prior to making any legislative recommendation about the need for subsidization of intercity bus service [29]. Among the findings applicable to Iowa were the following points.

Almost three-fourths of the tickets purchased were one-way rather than round trip. Persons beginning a trip on the bus had "home" as an objective 41.4% of the time, "visiting friends" 18.7% of the time, and "work" 10.8% of the time. Persons who terminated a trip on the bus had "home" as an objective 30.7% of the time, "visiting friends" 33.7% of the time, and "vacation" 9.5% of the time as the most dominant activities.

Clearly, recreational travel is an important component of intercity bus demand in Wisconsin.

Over 60% of the Wisconsin bus riders were female; 32% were in the 18-24 age range (the most common response). Since no children were surveyed and questions about the "number of persons in the traveling party" were so poorly worded that children were not identified, no accurate estimate can be made of age, except to note that most riders are either young (25 years or younger) or old (55 years or older). Middle-aged people are notably absent.

Student was the most common occupation at 30.8%, followed by professional/technical at 17.7% and retired at 12.2%. It was also noted that 18.8% of all persons reported a 1975 income of less than $5,000 per year and 35.6% reported incomes of less than $10,000 per year. When bus travelers are mostly students and the elderly with low incomes, it is not surprising that this same sample most often gave "inconvenience" and "it takes too long" as reasons for not using a bus on a one-way trip of 100 miles or more. The elderly in particular have difficulty remaining seated for long periods of time.

In spite of having a significant body of information related to social-welfare characteristics of the intercity bus users in Wisconsin, the Wisconsin Department of Transportation concluded in 1977 that no overwhelming justification existed to institute a subsidy program for intercity routes at that time [30]. They concluded that pricing policies associated with alternative transportation modes would have a greater impact on bus ridership than would the changes that could be attained by a bus subsidy program.

New York

The New York State Department of Transportation has conducted a number of studies to evaluate public transportation, but all measures used are "performance" measures in terms of engineering, economy, and management efficiency [31].

Application to Iowa

A reasonable extrapolation is that intercity bus passengers in Iowa are similar to those in Wisconsin. It is likely that there is a social need for more mobility in Iowa rural and small-town areas. It is also obvious that it is easier to discuss social and welfare values of intercity bus service than it is to quantify these values in a way related to providing bus service.

Definition of Iowa Social-Welfare Parameters

Population

Cities and communities in Iowa having various characteristics deemed significant are shown in Table 7.1. The primary factor to be considered has to be community population. It is the simplest aggregate measure of social need for mobility. How large should a city without intercity bus service be before some social-economic structure penalty is incurred? Burkhardt indicated that sufficient demand for public transportation services would be generated in cities of 5,000 or more [24]. Table 7.1 indicates Creston, Perry, Centerville, and Chariton as cities of 5,000 or more persons without intercity bus service.

Table 7.1. General social-welfare indicator values for selected Iowa communities.[a]

Community	Population	Highway Access	Employees of a Major Public Employer	Private Employers (With more than 1000 Employees)	Full-Time Students: Community College	Full-Time Students: 4-Year College	State Institution (Facility Residents)	Resident Elderly: Percent[b]	Resident Elderly: Persons	County Seat	Urban Bus Service	Daily Departures Each Direction: E	W	N	S
Des Moines	201,404	US 69/65 @ I 35/80; US 6; End IA 141, IA 5, IA 90	3800	7	58	7,651		7.38	25,838	X	X	16	12	8	4
West Des Moines	20,712										X	via metro bus			
Urbandale	16,410										X	via metro bus			
Windsor Heights	6,303										X	via metro bus			
Clive	2,928										X	via metro bus			
Cedar Rapids	108,987	US 30 @ US 218 and I 380; End IA 149, IA 150, US 151		7	2,817	1,119		3.35	11,748	X	X	5	4	5	10
Marion	18,190										X	via metro bus			
Davenport	99,836	US 61 @ US 6; I 80; End I 74, IA 130, IA 22		3	710	300		3.37	11,820	X	X	18	17	2	0
Bettendorf	24,290										X	via metro bus			
Sioux City	85,925	US 20 @ I 29 and US 77 and US 75; End IA 12, US 73			1,029	2,831		3.12	10,931	X	X	1	2	8	5
Waterloo	73,064	US 20 @ US 218 and I 380 and US 63; End IA 21, IA 57, IA 58, IA 281		3	1,631			2.66	9,322	X	X	2	1	3	4
Cedar Falls	33,154		1000			10,382					X	via metro bus			
Evansdale	5,038										X	via metro bus			
Dubuque	62,309	US 20 @ US 61 and US 52; End IA 3		2		3,476		2.06	7,229	X	X	6	4	0	1
Council Bluffs	60,348	I 29 @ I 80 and US 6 and US 275; End IA 92, IA 183, IA 191			1,328	274		1.95	6,825	X	X	12	12	6	2
Iowa City	47,744	US 218 @ I 80 and US 6 and IA 1	5000			23,374		0.88	3,092	X	X	6	6	8	4
Coralville	6,605											via metro bus			
Oakdale							88				X	via metro bus			
Ames	43,561	US 30 @ US 69 and I 35	5000			23,486		0.62	2,172		X	2	2	4	5

Table 7.1. (continued)

Community	Population	Highway Access	Employees of a Major Public Employer	Private Employers (With more than 1000 Employees)	Full-Time Students: Community College	Full-Time Students: 4-Year College	State Institution (Facility Residents)	Resident Elderly: Percent[b]	Resident Elderly: Persons	County Seat	Urban Bus Service	Daily Departures Each Direction: E	W	N	S
Clinton	34,719	US 30 @ US 67; End IA 136		2	428			1.19	4,166	X		2	2	1	1
Burlington	32,366	US 34 @ US 61;		1				1.32	4,628	X		2	2	2	2
West Burlington	3,139	End IA 99			917			0.08	269			via urban bus			
Mason City	31,839	US 18 @ US 65 and I 35			1,289			1.11	3,872	X	X	0	1	6	5
Fort Dodge	31,263	US 20 @ US 169; End IA 7			1,392			1.17	4,095	X		1	1	1	2
Ottumwa	30,263	US 34 @ US 63; End IA 23		1	990			1.29	4,530	X	X	2	4	2	2
Marshalltown	26,506	US 30 @ IA 14; End IA 330		1	643		573	0.98	3,434	X	X	3	3	2	2
Muscatine	23,166	US 61 @ IA 22; End IA 38		1	492			0.77	2,711	X		3	3	2	2
Newton	15,619	I 80 and US 6 @ IA 14		1				0.56	1,952	X		4	4	0	0
Keokuk	15,173	US 61/218		1	271			0.58	2,019	X		0	0	2	2
Fort Madison	13,991	US 61; End IA 2, IA 88, IA 103		1	90		998	0.54	1,875	X		0	0	2	1
Ankeny	13,212	US 69; I 35			2,867			0.08	265			0	0	2	1
Boone	12,468	US 30			435			0.69	2,418	X		2	2	0	0
Oskaloosa	11,224	US 63 @ IA 92				542		0.61	2,121	X		2	3	0	2
Spencer	10,374	US 18 @ US 71			16			0.43	1,490	X		1	0	2	2
Indianola	9,611	US 65/69 @ IA 92				830		0.33	1,159	X		0	0	2	2
Carroll	9,218	US 30 @ US 71			36			0.33	1,159	X		2	2	0	0

Table 7.1. (continued)

Community	Population	Highway Access	Employees of a Major Public Employer	Private Employers (With more than 1000 Employees)	Full-Time Students: Community College	Full-Time Students: 4-Year College	State Institution (Facility Residents)	Resident Elderly: Percent[b]	Resident Elderly: Persons	County Seat	Urban Bus Service	Daily Departures Each Direction: E	W	N	S
Charles City	9,119	US 18 @ US 218		1	52			0.42	1,482	X		0	0	3	3
Fairfield	8,715	US 34 @ IA 1						0.38	1,333	X		2	2	0	0
Grinnell	8,685	US 6 and IA 146; IA 110				1,232		0.33	1,151			4	4	0	0
Storm Lake	8,591	US 71 @ IA 7; End IA 110			23	2,076		0.34	1,176	X		1	1	2	2
Webster City	8,488	US 20 @ IA 17			149			0.34	1,196	X		1	3	0	2
Creston	8,234	US 34 @ End IA 25			430			0.45	1,589	X		0	0	0	0
Le Mars	8,159	US 75 @ IA 3; End IA 60				603		0.33	1,142	X		1	0	4	4
Estherville	8,108	IA 9 @ IA 4			394			0.33	1,151	X		0	0	3	3
Knoxville	7,755	IA 92 @ IA 14 and IA 5						0.42	1,457	X		4	3	0	0
Oelwein	7,735	IA 3 and IA 150						0.38	1,322			0	0	1	1
Decorah	7,703	IA 3 and IA 150				2,072		0.35	1,215	X		1	1	1	1
Waverly	7,351	US 218 @ IA 3				1,098		0.28	979	X		0	0	3	3
Atlantic	7,306	US 6 and IA 83 @ US 71			27			0.39	1,366	X		3	3	0	0
Cherokee	7,272	US 59 and IA 3			29		297	0.33	1,141	X		1	1	0	0
Mount Pleasant	7,007	US 34 and US 218				602	362	0.30	1,051	X		2	2	0	0
Perry	6,906	IA 141 @ End IA 144						0.36	1,263			0	0	0	0
Clear Lake	6,876	US 18 @ End IA 107; I 35						0.29	1,009			1	1	0	0

Table 7.1. (continued)

Community	Population	Highway Access	Employees of a Major Public Employer	Private Employers (With more than 1000 Employees)	Full-Time Students: Community College	Full-Time Students: 4-Year College	State Institution (Facility Residents)	Resident Elderly: Percent[b]	Resident Elderly: Persons	County Seat	Urban Bus Service	Daily Departures Each Direction: E	W	N	S
Pella	6,784	IA 163		1		1,545		0.31	1,100			0	2	0	2
Centerville	6,531	IA 2 @ IA 5			273			0.40	1,410	X		0	0	0	0
Iowa Falls	6,454	US 20 @ US 65			776			0.27	948			1	1	2	2
Washington	6,317	IA 92 @ IA 1			9			0.36	1,257	X		2	1	0	0
Shenandoah	6,242	US 59 @ IA 2			1			0.33	1,163			0	0	3	3
Denison	6,218	US 30 @ US 59			8			0.25	888	X		2	2	2	2
Red Oak	6,210	US 34 @ IA 48						0.38	1,347	X		0	0	2	2
Algona	6,032	US 18 @ US 169			6			0.29	1,019	X		1	2	0	1
Independence	5,910	US 20 @ IA 150						0.25	880	X		1	1	1	1
Maquoketa	5,677	US 61 @ IA 64						0.31	1,101	X		0	0	1	1
Clarinda	5,312	US 71 @ IA 2			241			0.34	1,176	X		0	3	0	3
Harlan	5,251	US 59 @ IA 44			21			0.25	888	X		0	0	0	2
Chariton	5,009	US 34 @ IA 14						0.32	1,122	X		0	0	0	0
Glenwood	5,002	US 275 @ US 34					746	0.15	524	X		0	0	3	3
Vinton	4,962	US 218 @ End IA 101				97		0.26	910	X		0	0	2	2
Sheldon	4,535	US 18 @ IA 60			419			0.21	743			0	0	1	1
Eagle Grove	4,489	IA 17			55			0.23	803			0	0	0	0
Anamosa	4,389	US 151 @ End IA 64					779	0.14	500	X		2	2	0	0
Emmetsburg	4,150	US 18 @ IA 4			512			0.20	701	X		1	1	1	0
Orange City	4,017	IA 10				861		0.16	575	X		0	0	2	2
Sioux Center	3,996	US 75				1,218		0.13	458			0	0	1	1
Monticello	3,669	US 151 @ IA 38			18			0.19	649			2	2	0	0

Table 7.1. (continued)

Community	Population	Highway Access	Employees of a Major Public Employer	Private Employers (With more than 1000 Employees)	Full-Time Students		State Institution (Facility Residents)	Resident Elderly		County Seat	Urban Bus Service	Daily Departures Each Direction			
					Community College	4-Year College		Percent[b]	Persons			E	W	N	S
Mount Vernon[c]	3,268	US 30 @ IA 1				898		0.10	344			0	0	1	1
Eldora	3,223	IA 175 @ End IA 215					204	0.17	596	X		0	0	0	0
Onawa	3,154	IA 175; I 29			7			0.18	637	X		0	0	3	3
Lamoni	2,540	US 69; I 35				1,349		0.09	312			0	0	3	2
Rockwell City	2,396	US 20 @ IA 4					94	0.16	543	X		0	0	0	0
Toledo	2,356	US 63 and US 30					73	0.11	370			2	2	0	0
Bellevue	2,336	US 52 @ End IA 62			1			0.11	397			0	0	0	0
Ida Grove	2,261	US 59 @ IA 175			1			0.14	486	X		0	0	0	0
Fayette	1,947	IA 150 @ End IA 93				520		0.06	202			0	0	1	1
Williamsburg	1,807	IA 149; IA 80			6			0.10	347			0	0	2	2
Mapleton	1,647	IA 141; IA 175			13			0.11	375			0	0	0	0
Center Point[c]	1,456	IA 150; I 380			10			0.07	231			0	0	0	0
Mitchellville	1,341	US 6; I 80					63	0.04	150			1	1	0	0
Woodward	1,010	IA 89; End IA 141					584	0.06	197			0	0	0	0
Calmar	1,008	US 52 @ End IA 150, IA 24			434			0.07	258			0	0	1	1
Peosta[c]	116	US 20			445			0.01	50			0	0	0	0
Amana[c]	--[d]	IA 149/220		1				--	--			0	0	0	0

[a]Source: References 32-40.

[b]Percent of state's elderly.

[c]Flag-stop bus route service available.

[d]Data not available.

While this by no means implies a bus line should run through these cities, it does suggest that transportation access in these areas should be examined for adequacy if social criteria are applied to transportation development and regulation.

College Students

A population subset that can be a strong indicator of bus travel demand (and that represents a population element strongly dependent on bus service) is the resident student population. Iowa student populations consist of two types: community college and four-year colleges. Four-year college students generally live on or near a campus away from their nuclear family home, tend to purchase or borrow transportation, and travel mostly on weekends and during holiday seasons. In contrast, community college students tend to travel to and from school on a daily basis by personal automobile and live in their family home. Their daily schedules may be quite variable and not consistent with the service schedule offered by a regular route carrier. Thus, for intercity bus transportation, four-year college students have a more significant need for public service and provide the larger demand. After examining some communities in Iowa, approximate values of 500 full-time, four-year college students and 1000 full-time two-year community college students were established as the minimum levels of student population to create a significant social factor. As Table 7.1 indicates, no communities in Iowa having this level of student population are without intercity bus service.

Different types of bus service are generally required by the two types of students. Due to the nature of the travel, community college students need a localized or commuter-type bus service, while four-year college students typically need access to a regional or national transportation system (i.e., regular intercity carriers).

Elderly Persons

As previously cited, the elderly are major users of bus service. They also are generally low-income, with restricted access to automobile transportation, and dependent upon others. The question to be answered is, "How many elderly make a socially significant concentration?". Since "retired" was listed as an occupation about half as often (40%) as "student," an elderly population level was based on this student-to-elderly ratio. If 500 full-time, four-year college students is taken to be socially significant, then 1000 (or more) elderly persons is a liberal estimate of social significance. Cities listed in Table 7.1 with more than 1000 elderly and no intercity bus service include Creston, Perry, Centerville, and Chariton. It is unlikely that 1000 persons over 65 years of age are going to generate very many trips per person, but it is a measure of social need.

State Institutions

When persons are detained in state institutions, a social need exists for traveling to and from these institutions. In some cases the institutionalized person is permitted to travel, but not to drive. Eldora and Woodward are two communities in Iowa with state institutions and no intercity bus service.

Major Employers

A large employment complex does not assure any significant demand for intercity bus service. However, if energy conservation is considered to be a social value, then major employer concentrations create a potential for commuter-type bus services that may take on a social character. Des Moines, Cedar Rapids, Davenport, Waterloo, Dubuque, Iowa City, Ames, Clinton, Burlington, Ottumwa, Marshalltown, Muscatine, Newton, Keokuk, Fort Madison, Charles City, Pella, and Amana are areas with candidate employer concentrations. Since 60 miles is often considered a reasonable automobile commuting range and bus service is typically only half as efficient in time and reliability from the individual perspective, a 30-mile bus commuting range is a good radius for seeking concentrations of employees for commuter buses. If employee concentrations and job concentrations cannot be found within the 30-mile radius, then the presence of a large employer may not warrant the intercity bus service.

Ridership data on commuter routes serving John Deere employees in Waterloo and Dubuque indicate that 15% to 35% of the employees who could ride the service were using it [41]. Based on data from the East-Central Iowa Council of Governments, the researchers have estimated that on four of the routes serving the Amana Refrigeration Industries, approximately 17% of the eligible factory workers are using the commuter service [42].

Offsetting Factors

Two other factors that should be considered in weighing the evaluation of the social value of providing bus service to a community are presence of a county seat of government and location at a major highway crossroads. Being a county seat does not make a community socially significant, except within its own county, but if a community has other indications of social significance and is <u>not</u> a county seat, some lesser importance must be associated with the other factors. Anything that dissipates the focus of social interaction in an area reduces the social urgency of providing intercity bus service.

A major highway crossroads is desirable to permit both north-south and east-west routing of bus service. If this is not possible, then the social interest in bus service has to be examined from a hub-and-spoke route pattern. The hub at which directional travel may change must be examined for importance to the social need identified. For example, if Creston and Chariton were communities targeted for needing social interaction, but the intercity bus routes provided through a regulated structure were Creston-Des Moines and Chariton-Des Moines, the indirectness of this hub-and-spoke pattern would substantially reduce the social value of such a bus service.

<u>Adequate Service</u>

No literature documents a definition of adequate service for social-welfare purposes. Flag stops are <u>not</u> adequate, because the persons considered to be in social-welfare need will neither tolerate nor utilize flag stops. Some have argued that to be socially adequate, a morning and evening connection should exist in each direction of service (i.e., two departures per day in each of four directions). Denison is the only city smaller than Muscatine with such a level of bus service. If this concept of service is even remotely correct, then only the larger Iowa cities have sufficient intercity bus services to be socially attractive.

Case Study Examination

Southeast Iowa

In examining all of the social-welfare factors mentioned, one corridor appears to have some merit for consideration of increased bus service. The Iowa City-Washington-Mount Pleasant-Fort Madison north-south corridor has strong aggregate social merit, even though it does not have any single isolated social need previously mentioned. Mount Pleasant has east-west bus service, a four-year college with more than 500 students, and a state resident institution. Fort Madison has a major state institution and has north-south service. Iowa City has major east-west service, unique state social service facilities, and excellent bus connections to the north. Washington has limited east-west service. All of the communities have more than 1000 elderly persons. North-south service in this corridor would create four-direction bus service in all of the cities and would permit direct bus travel for socially relevant needs. Whether or not these needs would generate actual travel can only be determined by an economic demand estimate. This is one corridor, however, with a combination of socially important travel needs.

Southwest Iowa

Creston sits in a unique location surrounded by corridors of relatively high levels of intercity bus service. Interstate 80 north of the Creston area, Interstate 35 on the east side of the area, and the US 71 and 275 routes west of Creston provide a reasonable level of service to communities along those corridors. A study conducted in the early 1970's identified the degree of social and economic isolation of

Creston as a regional center community [43]. However, in terms of the social indicator values outlined in this section, it has only population (8,234 in 1970) and number of elderly (1,589 in 1970) in its favor. The student population in the area results from a small community college only. Creston is a county seat, but it is not located on a major highway crossroads. No large employer or state institution is there. Thus, the social value of intercity bus service to Creston must be considered in the context of a more regional system along US 34 between larger hubs.

East-Central Iowa

A corridor from Iowa City-Cedar Rapids-Waterloo-Mason City is another interesting area to examine for its potential social value for intercity bus service. In the general area, there are major social service facilities and a large university at Iowa City, an institutional facility at Anamosa, an institutional school at Vinton, a large university at Cedar Falls, a small college at Waverly, large community colleges in Cedar Rapids, Waterloo, and Mason City, and large employers in Iowa City, Cedar Rapids, Waterloo, Cedar Falls, and Charles City.

Certain short shuttles between high concentrations of activity also exist. Cedar Rapids and Iowa City are within 30 miles of each other and offer an opportunity for a high accessibility bus corridor for either employment or social services. Independence, Waverly, and Cedar Falls are all within 30 miles of Waterloo, which fits the criteria for shuttle bus access to Waterloo for employment and education. Clear Lake and Mason City have the potential for a more limited commuter-type bus shuttle corridor, perhaps for employment and education. This segmented analysis then leaves a corridor with nodes at Iowa City, Cedar Rapids, Waterloo, and Mason City. This service may tie the localized intercity services having a social value to the larger hubs. In this study, intervening communities, such as Vinton and Charles City, must be examined for their social value and economic potential along a corridor already justified by the presence of much larger or more dominant communities.

Summary

In examining these three different regional corridors from a social value perspective, a heuristic pattern of analysis has been illustrated. No definite social value scale or welfare index can be constructed. The general and approximate guidelines presented in this section can be applied to a single community to identify the characteristics that may contribute social value to intercity bus service. A more useful application of these ideas is to examine a series of communities within a corridor to provide some insight into the social merit of providing services to communities along the corridor. In any case, the reader is cautioned to bear in mind that no part of this analysis is based on primary (first-hand) data for Iowa.

8. CASE STUDY ANALYSIS

The procedures for estimating ridership in a corridor and operating costs were discussed in Sections 5 and 6, respectively. Section 7 identified social, community, and other locational factors that should be considered for route evaluation. That section also detailed characteristics of selected corridors throughout the state. In this section the analysis is completed by applying the revenue and cost models to specific corridors. The principal case study involves service to an area not presently served. A second analysis shows the calculations for an existing route.

Analysis in a New Service Corridor

The corridor selected for analysis was a north-south service area from Mount Pleasant to Iowa City and Cedar Rapids. Mount Pleasant, the county seat of Henry County, has only east-west bus service provided by Trailways (American Bus Company), operating between Burlington and Des Moines. East-west rail passenger service is also provided by Amtrak.

The community of 7,000 is the home of a private college, as well as a state mental health institution. A northerly route is particularly relevant to serve the needs of these institutions. Iowa City, located 50 miles north of Mount Pleasant, is the home of the University of Iowa Medical Center and the University of Iowa. Service connections between the Medical Center and the Mental Health Institute had been recommended previously during informal discussions. The continuation of service to Cedar Rapids would provide access to the largest regional center in the area.

Selection of Route

Transit service between Iowa City and Cedar Rapids is now provided by Missouri Transit and Trailways; the more extensive service is by Missouri Transit. The most feasible method of acquiring service in the new corridor was the diversion of an existing run to this corridor. The route analyzed considered an operation originating in Ottumwa and served by Missouri Transit. Missouri Transit currently has one round trip each day between Ottumwa, Iowa City, and Cedar Rapids and a second round trip taking a more direct route between Ottumwa and Cedar Rapids, but not connecting to Iowa City. Within these corridors, the only city that has a population of over 5,000 or is a county seat is Sigourney, a county seat with a population of 2,300. One proposal is to divert the Iowa City run from Sigourney to a Mount Pleasant corridor. The proposed route would run from Ottumwa on US 34 to Fairfield, a county seat community of 8,700, and continue to Mount Pleasant. The trip would continue north on US 218 to Ainsworth and then divert west eight miles on IA 92 to serve Washington, another county seat with a population of 6,300. IA 1 would be used to complete the trip to Iowa City and Interstate 380 could be used from there to Cedar Rapids.

Demand Estimation

Factors in Demand Model

The three components for the demand estimation were the bus-miles of travel, the corridor population, and the population at the destination.

These data are summarized in Table 8.1. For the demand model, all variables are expressed in thousands. Corridor populations count only those cities with 5,000 or more persons, or cities serving as the county seat. Bus-miles were approximated by the expression

$$\text{Annual bus-miles} = \frac{365 \times \text{one-way road miles} \times 2}{1000}$$

This assumes one round trip daily. Road miles were taken from the state road map.

Passenger Demand Equation

Based on the demand model for a single round trip (Eq. 5.1)

$$\text{PASPFR} = -0.1 + 0.050\ \text{BM} + 0.041\ \text{POPJ} + 0.056\ \text{CORPOP}$$

so

$$\text{PASPFR} = -0.1 + 0.050\ (100.7) + 0.041\ (29.6) + 0.056\ (75.0)$$

That is, the expected ridership would be 10,400 per year.

If one were to consider the impact of a second daily trip in the same corridor, the bus-miles value would need to be adjusted. Referring to Table 5.6, the bus-mile adjustment factor for new routes when going from 1 to 2 is 0.62. The adjusted bus-miles would be 0.62 (100.7) = 62.4. Therefore,

$$\text{PASPFR} = -0.1 + 0.050\ (62.4) + 0.041\ (29.6) + 0.056\ (75) = 8.4$$

Since there are now two trips, the new passenger estimate is 16,800. The additional run would increase the ridership approximately 62%, if the route represented the only service throughout the corridor.

Table 8.1. Data for proposed route through Mount Pleasant.[a]

Summary of Data		Total
Route-Miles		138
BM (Annual Bus-Miles)[b]		100.7
POPJ (Population of Ottumwa)		29.6
CORPOP (Population in the Corridor)		75.0
Fairfield (County Seat)	8.7	
Mount Pleasant (County Seat)	7.0	
Washington (County Seat)	6.3	
Iowa City (County Seat)	46.9	
Coralville	6.1	
Total	75.0	

[a]All values, except route-miles, are in thousands.

[b]Based on one round trip per day.

Passenger Revenue

The passenger revenue would be estimated by calculating the average trip length and multiplying by the average fare per mile.

The average trip length is (Eq. 5.7)

$$\text{Average trip length (miles)} = \frac{\sum_j POP_j \times DIST_{ij}}{\sum_j POP_j}$$

where

POP_j = population of cities in the corridor over 5,000, or county seats

$DIST_{ij}$ = distance in miles along the route from the origin city (largest end-point city) to the city in question

The distances from Cedar Rapids to the other cities are: Iowa City and Coralville (28), Washington (59), Mount Pleasant (90), Fairfield (112), and Ottumwa (138). Using these values and the populations from Table 8.1, the average trip length is 72 miles.

The average fare for Missouri Transit operations in Iowa in 1980 was determined to be \$0.075 per passenger-mile. On that basis, when a single round trip is offered,

Annual passenger revenues = \$0.075 per passenger-mile × 10,400 passengers × 72 miles = \$56,160 or \$56,000.

Express Revenues

The express revenue components were more difficult to identify on a route basis. A first approximation may be based on the data in Section 5. In this case, the Missouri Transit overall express revenues were noted to be approximtely 30% of the passenger revenues. This value was also the average recommended for calculation if the carrier had not been specified. On this basis,

Annual express revenue = $56,000 × 0.30 = $16,800 or $17,000

Therefore, the total revenue would be $73,000 for this run.

Other Considerations for Revenue

This case study has posed the possibility of diverting an existing run from a lower density corridor to the study corridor. Portions of the existing run and the new run have common segments. In this case, not all of the revenues calculated would be new.

The existing route through Iowa City passes through Sigourney (population of 2,300, located 84 route-miles from Cedar Rapids). The demand model would estimate a total of 8,500 persons using this route. The average trip length is 60.5 miles. The lower demand and shorter average trip length on this route indicate that a relatively greater portion of the activity would be centered in the Iowa City-Cedar Rapids corridor, because of the lower density on the route extension. The passenger revenue on that route would be $39,000, the freight revenue would be $12,000, and the total revenue would be $51,000. It is estimated, therefore, that by switching to the more populous corridor, a net gain of $22,000 would be realized. The tradeoff requires an increase in bus-miles, from 85,400 to 100,700. If the costs do not exceed the revenues, or if other community benefits are sufficient to justify the change, the service in the corridor should be pursued.

Cost Development

The Cost Model

The cost estimation model determines future cost on the basis of present cost patterns, adjusted by consumer price index changes. The model was given in Section 6 as

$$\text{Unit operating cost} = (A)(M)(C_R + C_T + C_W + C_F + C_D)$$

The terms were previously defined and the example calculation was given to determine the multiplier M for the period June 1980. The multiplier estimated the June 1980 costs to be 1.13 times the 1979 levels.

If Missouri Transit is considered the provider, the latest unit costs for that carrier would be determined. In 1979, these were determined from the annual report:

C_R = repair to revenue equipment	= \$155,188/1,883,180	= \$0.0824/mile
C_T = tires	= \$29,791/1,883,180	= \$0.0148/mile
C_W = drivers' wages	= \$494,493/1,883,180	= \$0.2626/mile
C_F = fuel	= \$174,064/1,883,180	= \$0.0924/mile
C_D = depreciation	= \$76,938/1,883,180	= \$0.0409/mile
		\$0.4931/mile

The total unit cost for June 1980 would then be

$$C = 1.96\,(1.13)(\$0.4931) = \$1.09/\text{mile}$$

where the 1.96 factor is A for the smaller category group. The unit cost value can be compared with the \$0.92 per mile value experienced in 1979.

In case the analyst is examining only general cost levels, not the cost for a particular company, an average cost may be determined. For example, Table 6.2 summarizes the components of costs for all carriers. The bus-miles traveled by Iowa Coaches, Midwest, Missouri, and Scenic Hawkeye, were (in thousands) 946, 908, 1,883, and 1,134, respectively. The unit costs for these carriers were \$0.55, \$0.55, \$0.49, and \$0.48. The unweighted average is \$0.52. Using this, one would expect the average total cost for a carrier in this group to be

$$C = 1.96\ (1.13)(\$0.52) = \$1.15/\text{mile}$$

<u>Total Cost Calculation</u>

The total costs for operating the proposed Missouri Transit route and the current route are shown in Table 8.2. The forecasts show that the proposed route would be beneficial when one examines the incremental changes. The incremental revenues exceed the costs by \$5,300. The unit revenues for the entire route are improved by 20%. Overall, however, the proposed route still generates revenues less than the fully allocated cost of operation. From the company's viewpoint, the route change would still be advantageous because of the additional revenue and the potential to connect the new riders with other longer trips. From the regulator's viewpoint, the cost and revenue tradeoff must still receive attention. Even if only the direct operating cost, estimated to be approximately 75% of the total unit cost, were assigned to the route, the expenses would be \$82,300, which still exceeds the total route revenue. Passenger and freight rate increases of 13% would be needed to cover even these costs.

Table 8.2. Revenue and cost comparisons for proposed route.

	Bus-Miles	Revenue (Dollars)	Cost (Dollars)	Unit Revenue (Dollars Per Mile)
Existing Route Through Sigourney	85,400	51,000	93,100	0.60
Proposed Route Through Mount Pleasant	100,700	73,000	109,800	0.72
Incremental Increases (Differences Between Proposed and Existing Routes)	15,300	22,000	16,700	0.12

Additional Service Considerations

The integration of the proposed route into an existing run must also address schedule coordination. The proposed route is 20 miles longer than the existing service and, in one direction, would have to connect with another run. This can be accomplished by reducing the number of intermediate stops. Station stops on this route are recommended only in the communities included in the corridor population component, plus Kalona. Kalona, with a population of 1,600, is located at the intersection of two state highways and is on the direct path of the bus.

Another factor to be addressed is the potential conflict between carriers. Trailways currently serves east-west travel from Burlington to Des Moines, including the corridor from Mount Pleasant to Ottumwa. Trailways may object to the proposed service, indicating unfair competition. In reality, the two operations are not serving the same demand, but a second alternative could be examined to evaluate the potential for Trailways to provide the north-south service. In this case, a possibility is to divert one of two runs going from Burlington to Iowa City through Muscatine. This route would become a Burlington-Mount Pleasant-Iowa City operation. The potential benefits for this alternative would certainly be lower, because Muscatine, a city of 23,000, would have reduced service. The two towns receiving additional service have a total population of 13,000. Furthermore, the operating costs for this carrier would be higher than they would be for the Missouri Transit operation.

Validation of Ridership Estimates

There are no data available to verify the accuracy of demand in the corridor, but some guidance is given by past experience. The demand model estimated 8,500 passengers for a single round trip on the existing route through Sigourney. The carrier's data indicated that the northerly run served 3,050 persons in 1979. The southerly run in this corridor aggregates all operations from Cedar Rapids to Springfield, Missouri, but the researchers estimated Iowa intrastate ridership on the basis of the carrier's input. Based on those data, a combined total of 7,000 riders was estimated in the corridor. Therefore, the forecast is approximately 21% higher than the estimate. However, a second, shorter trip is available between Cedar Rapids and Ottumwa that does not serve Iowa City. Part of the total corridor demand is accommodated on that run, rather than the Iowa City run. The volumes could not be determined, but overall, the model appears to be representing the volumes in the corridor satisfactorily.

Analysis in an Existing Corridor

A second corridor is briefly analyzed here to show the application of the models in a corridor with existing service. Only minor adjustments are needed. The principal difference is that known demand and costs are used as the base.

The corridor selected is the Cedar Rapids to Mason City corridor served by Jefferson Lines. The principal cities served in the corridor are Vinton, Waterloo, Cedar Falls, Waverly, and Charles City. The relevant community and travel characteristics in this corridor were discussed in Section 7. The bus demand data on one route were available, but the total demand is not known because of routing variations in the corridor.

Existing Travel in the Corridor

Travel in the Mason City to Cedar Rapids corridor is not as clearly defined as would be desired, because there is not a true balance in the service. Jefferson Lines summarizes the passenger data by links within major corridors. The links appear as run numbers in the Russell's Guide schedules. To obtain round-trip information in the corridor, it is necessary to combine two or more runs. Runs 201 and 202 can be combined to show round-trip activity in the Mason City to Waterloo corridor. A second daily connection between the cities is possible in each direction, but a transfer is necessary. In addition, the runs are not strictly equivalent because the southbound runs begin or end in the study cities, but the main northbound run terminates in Minneapolis, Minnesota, thereby confounding the passenger and revenue mix. The picture is further clouded because of other imbalances in the service. In particular, Mason City may be reached from Waterloo three times each day, but the reverse movement is possible only twice each day. Since it was impossible to segregate the reported data for all runs partially covering the corridor of interest, the analysis is based on the single round-trip combination clearly reported, i.e., Runs 201 and 202.

Demand Analysis

Although the passenger volumes are known for the routes considered, it may be useful to compare the given data with the demand model. The corridor characteristics are summarized in Table 8.3. The estimated demand is

$$\text{Annual passengers} = -0.1 + 0.050\ (109) + 0.041\ (39) + 0.056\ (135) = 14.5$$

The forecasted number of passengers is 14,500, compared to the reported value of 14,000, resulting in an error of 3.5%. The accuracy of this estimate is partially a reflection of the fact that this route was one of the 11 considered in the calibration phase.

Expanded Service Projection

Considering a second daily round trip, passenger demand would be based on the known condition and then adjusted using Fig. 5.1. The equation is

$$PAS_p = PAS_e \times (\text{adjusted factor}) \tag{5.5}$$

From Fig. 5.1, the adjustment factor when going from one daily trip to two is 1.60. Therefore,

$$PAS_{(2)} = 14.0 \times (1.60) = 22.4 \text{ or } 22{,}400$$

Passenger and express revenues would be expected to increase by the same ratio. One should note that this route has significantly higher express revenues than does the average route. The ratio of express revenues to passenger revenues (0.76) was significantly higher than the average

Table 8.3. Travel characteristics for the existing route case study.[a]

Summary of Data		
Route-Miles		145
BM (Annual Bus-Miles)[b]		109
POPJ (Population of Mason City and Clear Lake)		39
CORPOP (Population in the Corridor)		135
Vinton (County Seat)	4.9	
Waterloo Area		
Waterloo	73.0	
Cedar Falls	33.1	
Evansdale	5.0	
Waverly (County Seat)	7.3	
Charles City (County Seat)	9.1	
Total	135	
PAS (Passengers on Runs 201 and 202)[b]		14
Passenger Revenue[b]		68
Express Revenue[b]		52
Passenger-Miles[b]		1082

[a]All values except route-miles are in thousands.

[b]These data were provided by Jefferson Lines.

for all companies (0.30), and even much higher than the average for all Jefferson runs (0.45).

Trip Length Comparison

The average trip length may be estimated from the data in Table 8.3 to be

$$\text{Trip length} = \frac{\text{passenger-miles}}{\text{passengers}} = \frac{1082}{14} = 77 \text{ miles}$$

Using the trip length model (Eq. 5.7)

$$\text{Trip length} = \frac{\sum_j \text{POP}_j \times \text{DIST}_{ij}}{\sum_j \text{POP}_j}$$

The trip length was estimated to be 83 miles. This error is less than 8%. The trip length variable, however, is not needed because the passenger and freight revenues are known.

Data Expansion

In many cases, it is not possible to obtain complete annual data, but samples may be obtained for special analyses. For example, Greyhound may sample two-week periods, three to five times during a year, to monitor the flow in a particular corridor. Expansion of sampling data to obtain meaningful annual data is possible if it can be established that the time period sampled represents a consistent portion of the larger unit of measure. Table 8.4 presents the monthly distribution of passengers as determined from several independent sources. The monthly variations between carriers were tested using an analysis of variance model. The test showed that there are significant differences

Table 8.4. Monthly distribution of passengers on intercity carriers.

	Percent of Annual Passengers Carried Each Month											
	January	February	March	April	May	June	July	August	September	October	November	December
Greyhound[a]	7.26	6.42	7.72	7.39	7.43	9.15	10.45	10.34	7.43	8.28	8.27	9.87
Iowa Coaches[b]	6.35	5.42	6.81	7.60	8.23	9.92	10.98	10.93	7.44	7.96	8.78	9.58
Scenic Hawkeye[c]	6.78	5.64	6.96	7.39	7.74	9.46	10.64	10.10	7.57	8.76	8.41	10.22
Average	6.80	5.82	7.16	7.46	7.80	9.51	10.69	10.46	7.48	8.33	8.49	9.89

[a]Source: Engineering Research Institute [1].

[b]Source: Iowa Coaches data from four runs, 1979.

[c]Source: Scenic Hawkeye data for 1979. Percentages were actually estimated from revenue data.

between months of the year ($\alpha = 0.05$), but that there were no significant differences between the carriers. Thus, an average factor for each month could represent the portion of the annual value in that month, regardless of the carrier being examined.

Cost Development

The extrapolation of costs would be accomplished in the same manner as demonstrated in the first case study. The only difference is that Jefferson Lines is an ICC Class I carrier, and the adjustment factor would be 2.27.

Other Service in the Corridor

The general Waterloo-Cedar Rapids corridor was of special interest to the Iowa Department of Transportation because of the special interest in the commuter service to the John Deere Plant in Waterloo. Those commuter operations were more fully detailed in Section 4. The Jefferson commuter services were incorporated as part of Runs 201 and 202, but in other runs, the commuter data stand alone. The May 1980 data indicated the passenger revenues were averaging $0.82 per mile. This compares favorably with the passenger revenue of Runs 201 and 202 ($0.78) for the same month. The significant difference is that the regular routes generate another $0.52 in express revenues that the commuter service does not obtain.

Summary

The case study examples demonstrated the application of the revenue and cost models. These models may be used in conjunction with the evaluation of the community factors discussed in the previous section to help determine benefits that may accrue in a corridor. The models provide consistent results and help determine economic benefits, but there are no easy formulas for combining costing elements with community factors to arrive at a quantified decision. This responsibility still resides with the policy makers.

9. ADDITIONAL SERVICE CONSIDERATIONS AND RECOMMENDATIONS

One of the objectives of the federal financing program relating to intercity buses was to consider funding for initiation, improvement or continuation of intercity bus service. This report has developed a methodology for estimating potential demand for new or adjusted services, and the costs of providing those services. In addition, evaluation criteria that go beyond the financial considerations have been offered and discussed in relation to existing and potential service corridors in Iowa.

The scope of the research did not directly orient the study toward the many other aspects of concern in today's operating environment. For example, the study does not directly evaluate the reasonableness of a particular fare, the potential for coordinating the regional transit systems to provide service if a regular route line is abandoned, the implications of requiring more data or less data from the carriers, or the effect of certification procedures on the owners' decisions about service. Yet, during the course of the study, as the researchers dug through files, visited with private management and state planners and regulatory personnel, and analyzed the operations, many additional insights were obtained that were not included in the modeling or community evaluation phase. The factors are grouped in the general categories of service characteristics, data systems, and carrier-government interaction.

Service Factors

The effect of service frequency on passenger volume is directly assessed in the demand model. Other factors, such as fares, fare per mile, relative travel time between automobile and bus, or time of day, were not identified as statistically significant variables in demand analysis. One cannot conclude from this, however, that these factors do not affect individual decisions. One can more likely explain the absence of the variables on the basis of the data set used. In the study, the researchers examined cross-sectional data, i.e., data from several carriers at a single point in time. Thus, for example, even though there are variations in route fares between companies, the analysis does not examine the effects of changes in ridership on a specific route with changes in fares on that route over a period of time. To that extent, any interpretation is limited by the degree to which the aggregate, cross-sectional data are comparable to time series data for a single carrier. With that proviso, the following observations were noted regarding fares, time of service, and speed.

Fares

Using the corridor data, the price elasticity of demand was determined to be approximately -0.80, if only fare is considered. This indicates that a 10% increase in fare would result in an 8% decrease in ridership. This relationship is only suggestive of the possible order of magnitude because other relevant factors, such as frequency and distance, are not included. If one examines fare and distance in combination, the fare elasticity moves to -1.20; or if fare and frequency are taken together, the fare elasticity is +0.40. The latter indicates that under a given service condition, the ridership would increase with increasing fares. This is intuitively incorrect and appears this way only because of the intercorrelations in the cross-sectional data set.

The only safe conclusion to make regarding the fare increases on a route is that these data for a single point in time are insufficient to make a valid assessment. The -0.80 elasticity is the same general order of magnitude as the -0.60 value offered by Burkhardt and Lago [15]; but in order to make truly accurate statements, the ridership changes would need to be examined on individual routes over time while controlling for other decision variables, such as the costs of competing modes.

Perhaps the greater concern should be the effect fares might have on the operating policies of the individual company. An examination of the allowable rate structure of Midwest Coaches and Scenic Hawkeye is enlightening. Both of these carriers are ICC Class II carriers operating with small but major routes crossing state boundaries. Midwest is based in Minnesota; Scenic Hawkeye is based in Iowa. In each case, the allowable fare per mile rates on interstate movements are approximately 50% higher than for intrastate movements. The states have scrutinized rate increase requests carefully while presumably trying to protect the communities from arbitrary and unnecessary rate increases; the ICC has more frequently allowed the increases to take effect. In effect, the interstate routes are paying a higher proportion of the total system operating costs.

In the long run, this imbalance may actually create a situation in which some state residents lose, rather than gain, in the process. The following scenario describes the problem. Consider a carrier with one route serving only intrastate trips. This route provides connecting service to other carriers, but the unit revenues are only 70% of the average unit costs. A second route serves an equal-length interstate corridor. Because of the higher allowable fares in this corridor, the route generates revenues exceeding costs by 5%. If the company contemplates increasing service in one of these corridors to generate more revenue, the corridor to be selected is obvious. If the company has not generated sufficient profits to purchase the necessary rolling stock, the service in the intrastate corridor may be in jeopardy. Significant pressures may be placed on the state to abandon this unprofitable route so the equipment can be used in the higher return corridor. The intrastate corridor would then go from the lower-priced service to no service at all. The Transportation Regulation Board must examine the restricted intrastate fare structure from this viewpoint when considering the impacts of differential rate increases for interstate and intrastate routes.

Service Hours

The routes included in the analysis were almost exclusively operating between 6:00 a.m. and 9:00 p.m. No noticeable service hour factors were identifiable in those routes, but Jefferson Line data on other runs did provide some interesting insights.

A total of 16 northbound and southbound runs operate through Des Moines between Kansas City and Minneapolis. Although, as expected, the runs beginning during the period 6:00 p.m. to 6:00 a.m. have lower ridership rates than other prime-time departures, the average difference was only 10%. Even when departures are grouped between 10:00 p.m. and 6:00 a.m., ridership on these off-hour departures averages only 25% less than the other departure times.

This variation suggests that off-peak hours can still have substantial use. This interpretation, however, must be constrained to relatively long distance runs where departure time from any one city is not crucial to the decision to make the trip. Certainly a run from Iowa City to Des Moines at 11:00 p.m. would not be an attractive alternative for most travelers.

Travel Time

One of the points noted in the Jefferson data was that a Kansas City northbound run to Des Moines beginning at midnight served approximately 90% as many passengers as a similar run beginning about noon. The substantive difference in the schedule was that the noon run had 10 stops, plus three flag stops. The midnight run stopped only to discharge passengers as needed at the 10 stops. Travel time was thereby reduced 45 minutes, or 16%. Jefferson Lines has recognized the attractiveness of the express runs and has scheduled a regular limited-stop express run from Kansas City to Minneapolis.

Systems Data

The most consistent complaint among researchers and planners is that there are insufficient data to do a more thorough evaluation. In spite of the fact that the certified carriers are required to submit annual reports (which may be in excess of 50 pages), the "appropriate" data are often not available, or they are incomplete or inaccurate. On the other hand, the carrier generally feels the data-reporting burden is excessive and questions whether the data are ever used.

General problems with data reporting are known to planners and operators alike. The review in this section identifies only selected specific items related to the Iowa reporting system.

Bus-Miles

The analysis of regular route operations should be premised, to the maximum extent possible, on the data related to the regular route portion of the total service. The cost elements for regular route service are not directly identifiable because equipment, facilities, and even personnel are interchanged between the typical major activities of regular route and charter service. However, the revenue data can be, and are, identifiable by service category. Therefore, unit revenues (dollars per mile) can be calculated separately for these major categories. Unfortunately that is true only at the system level and not at the state level, because the supplemental Iowa report does not specify bus-mile data by type of operation. Therefore, variations in unit revenues for charter and regular route services can be analyzed only at the total system level. It is recommended that more complete identification be required in the state report, with state regular route miles listed apart from total state mileage.

Passenger-Miles

The same observation related to bus-miles is applicable to passenger-miles. A great deal of effort is expended by some, but not all, carriers to tabulate passenger-mile data on routes, but the relevance to the planner is lost when charter and regular route data are simply aggregated.

The relevance of the passenger-mile data is also suspect because not all carriers feel they can justify expending the resources needed to develop this factor. In at least one case, the passenger-mile estimate was determined to be simply passenger revenue divided by an estimated systemwide average fare per passenger-mile. Such a system does not allow the analysts to make any distinctions regarding the relative usage in the state beyond what can be interpreted from the revenue data.

It is felt that overall, the data collection costs could be reduced and the data quality could be improved by using a sampling procedure. Companies would not continually monitor each regular route, but instead would sample each route for a two-week period, three to five times per year, and extrapolate these values on the basis of past experience or on the factors given in Table 8.4. A suggested sampling schedule would include two weeks in February, May, July, and October. This schedule would allow an examination of seasonal variations. The seasonal samples could be extrapolated to annual totals based on the data in Table 8.4. The time saved by reducing the sampling load (at least for those carriers currently keeping daily records) could possibly be used to sample other data elements desired for planning purposes, such as limited origin-destination ticket sampling.

Charter passenger-miles should be monitored continuously, because the demand fluctuations are likely to be greater than for regular service.

Reported Expenses

Expense item summaries on the Iowa supplemental report are misleading because not all carriers include the same expense items. All carriers report the 4000-series expenses, but some carriers have also included the 5000-series data for depreciation, amortization, operating taxes, and rents. From year to year, an individual carrier may even change the reporting method. The state form should be adjusted to clarify the precise values desired. It is recommended that both the 4000 and 5000 series be included in the summary.

Other Carrier Input

Throughout the study, the carriers were generally most cooperative in providing operating details, as well as general input regarding their operations and their interactions with the Department of Transportation. There were no formal surveys or unofficial tallies, but the following comments highlight some elements affecting the operations of the carriers.

Data Requirements for Rate Analysis

The carriers' willingness to share data seemed to be strengthened by their desire to show that there were no capricious efforts to hide revenues or exaggerate costs when requesting rate increases. This was noted during initial contacts with the carriers, which occurred shortly after the Transportation Regulation Board had denied a rate increase for the smaller carriers. After a preliminary review, the board had required the carriers to submit monthly revenue statements for a previous year by source (passenger, charter, and express) and by origin (Iowa or interstate), and expense statements attributable to Iowa intrastate service. The statements were to include an allocated revenue and expense statement "itemized in detail by each function performed by the carrier, and the basis for each allocation," and more. These data had to be received at the state offices nine days following the date of the request!

Since most companies do not file records in a manner suitable for direct reporting and do not have computer retrieval systems, they could not provide a response in the time frame expected. Only Jefferson and Greyhound were able to provide the data and only those companies were allowed to increase the passenger rates at that time. The smaller carriers felt their needs were at least as great as the needs of the larger carriers, but they were rejected because of the inability to generate data.

To improve the understanding between planners, regulators, and operators, each must be more familiar with the needs and capabilities of the other. This information exchange is accomplished to some degree when government personnel meet with the carriers' association. However, it is recommended that one-on-one meetings be held. An excellent organizational framework already exists in the Iowa Public Transit Division to accomplish this direct contact. District managers now have responsibility for contacting urban and regional transit operators within specified areas of the state. These contacts should be expanded to include the intercity operators. State personnel should visit each carrier at least twice each year at the local operating office to review associated problems and progress. This should be a meaningful exchange mechanism to improve state-carrier interaction.

Vehicle Certification

Safety must be a high-priority item in transportation systems. However, two different carriers expressed dismay over the length of time required to certify a vehicle for service. One carrier noted that it took eight weeks to get a new vehicle certified; neither details nor explanations for the delay were provided. Again, improved communications are necessary to reduce this problem and the delay. Interest payments alone during a two-month period may be $3,000 for a new bus, and such a delay affords no opportunity to use the vehicle to recoup those costs.

The Iowa Department of Transportation, working with the counties, has now developed a program to significantly improve the vehicle certification process. Carriers may now complete the application process in one day.

Route Certificate Costs

The commuter carriers were asked to identify special start-up costs, including licensing and legal fees. In general, these costs were not identified as factors reducing the carrier's willingness to pursue an operation. However, one carrier discussed the fact that the $400 filing fee ($350 of which would be returned if no hearings were required) was part of the reason for not seeking permanent operating authority on a commuter route.

Ticket Agents

The final element to be discussed reflects the value of the local agent as a representative for the carrier. A general consensus is that the ticket agent, along with the driver, may be the most important person in a company because he or she is in direct contact with the customer. The ticket agent, however, is in many cases providing the facility more as a community service than as a business venture. In small communities, the commissions earned are miniscule compared to the frustrations encountered. Bus operators must involve city business bureaus and/or governments in identifying a local business willing to undertake the agent's role. Service to the community could be lost or reduced to flag-stop status unless that role is performed by someone in the city.

The potential effectiveness of the agent is best demonstrated by a case reported by the management of Midwest Coaches. After a new agent was selected in a particular community, the revenues from that community increased approximately five times from the previous level. Unlike typical bus-stop locations, such as restaurants, drugstores, or gasoline stations, this agent did not have frequent peak-period demands in his own business to prevent him from giving attention to the bus customer. On the contrary, low-demand periods did exist and the agent took those opportunities to call potential customers to acquaint them with the services. The effectiveness of the effort is clear and the example helps clarify why sales from individual cities are extremely difficult to model. The community potential was always there, but it was the marketing effort that brought that potential demand to the system. The real message here to planners and carriers is that one should not ignore the potential gains to be attained by marketing efforts. Carriers should assess the potential of personal contact as compared to exclusive use of standard advertising media.

Summary of Results

The demand models, cost models, and social need criteria developed in this study have provided a base for evaluating potential services in intercity corridors. A summary of these models is as follows:

Demand

- Passenger demand rates are more stable in the communities and corridors than is express demand.
- Service frequency, bus-miles of travel, corridor populations, and populations of the destination city are the principal factors that explain demand variations.
- The limiting magnitude of error in the corridor passenger demand is 25%.
- Passenger revenue can be based on calculated demand plus known fare structures and estimated trip lengths.
- Express revenue can best be estimated as a percentage of passenger revenue, but the error variations are larger.
- Fare changes and relative travel speed changes affect the consumer's evaluation and demand level, but the single time frame data available for this study cannot specifically isolate these effects.

Expenses

- Unit costs in subcategories vary substantially between carriers due to a combination of reporting and operating conditions.
- Cost elements for repairs to service equipment, tires and tubes, driver's wages, fuel and depreciation, provided a stable base for comparing carrier costs.
- Cost estimation should be completed by carrier class groups.
- Carrier cost increases should be in line with the changes in the Consumer Price Index. Excessive increases or decreases would merit special review.

Community Service Factors

- Principal evaluation elements include population, elderly, student enrollment, and presence of state institutions.
- The relative importance of the primary variables should be adjusted by the role of the city as the local government center (county seat) and the city location with respect to the major travel network.
- Specific weights to individual factors cannot be assigned from the secondary data sets used in the analyses of this research.
- Service evaluations should include an analysis of an entire corridor rather than just individual cities.

Recommendations

In order to successfully integrate the carrier and government concerns and to assess the operating environment, the following recommendations are suggested:

- The total reporting requirements should be reviewed to determine the need for the data items. Special sampling procedures are suggested to reduce routine summaries, with the possibility of acquiring other special data when needed. (p. 145)
- Time series data should be acquired on selected routes in order to assess fare impacts, if this item is of concern. This recommendation would be implemented more easily if data sampling were accepted. (p. 141)
- Modifications in annual reports are necessary at the state level to assure better consistency in the data. (pp. 143-146)
- Projected costs in rate requests may most readily be assessed by comparing cost increases with anticipated increases in the Consumer Price Index for selected items. Special considerations causing faster or slower cost changes should be supported with more complete documentation. (Section 6)
- State agencies should visit with the carriers on a regular basis. These meetings would serve to educate both the private and public sector. A minimum of two meetings per year at the carriers' facilities is recommended. (p. 147)

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APPENDIX. UNIT REVENUE CHARACTERISTICS FOR REGULAR ROUTE AND CHARTER SERVICE

Table A.1. Unit regular route passenger revenue trends for total system.

Carrier	Yearly Passenger Revenue Per Regular Route-Mile (Dollars) 1976	1977	1978	1979	Percent Increase 1976 to 1979
Greyhound	1.04	1.05	1.13	1.32	27
American	0.79	0.90	0.92	1.03	30
Jefferson	0.99	0.99	1.00	1.25	26
Iowa Coaches	0.59	0.58	0.59	0.80	36
Midwest Coaches	0.63	0.69	0.70	0.83	32
Missouri Transit	0.48	0.47	0.51	0.63	31
Scenic Hawkeye	0.49	0.45	0.47	0.56	14
Inter-City Airport	--[a]	--	0.50	0.41	--
Reid Bus Lines	0.12	0.14	0.12	0.12	0
River Trails	0.33	0.34	0.46	0.55	67

[a]Data not available.

Table A.2. Unit express revenue trends for total system.

Carrier	Yearly Express Revenues Per Regular Route-Mile (Dollars) 1976	1977	1978	1979	Percent Increase 1976 to 1979
Greyhound	0.25	0.25	0.28	0.29	19
American	0.15	0.17	0.20	0.22	49
Jefferson	0.41	0.42	0.49	0.59	46
Iowa Coaches	0.20	0.20	0.21	0.24	19
Midwest Coaches	0.22	0.24	0.28	0.29	30
Missouri Transit	0.13	0.14	0.18	0.18	44
Scenic Hawkeye	0.14	0.12	0.15	0.14	0.0
Inter-City Airport	--[a]	--	--	--	--
Reid Bus Lines	0.28	0.31	0.36	0.34	25
River Trails	--[b]	0.29	0.28	0.40	36[c]

[a]No express service available.

[b]No data available.

[c]The percentage change for River Trails used 1977 as a base.

Table A.3. Unit charter revenue trends for total system.

Carrier	Yearly Charter Revenue Per Charter-Mile (Dollars) 1976	1977	1978	1979	Percent Increase 1976 to 1979
Greyhound	0.89	1.01	1.22	1.43	61
American	1.05	1.14	1.49	1.41	34
Jefferson	1.14	1.23	1.36	1.50	32
Iowa Coaches	0.84	0.98	1.04	1.10	31
Midwest Coaches	1.11	1.14	1.31	1.22	10
Missouri Transit	0.79	0.87	0.95	1.01	28
Scenic Hawkeye	0.83	1.04	1.15	1.31	58
Inter-City Airport	--[a]	--	--	--	--
Reid Bus Lines	--[a]	--	--	--	--
River Trails	--[b]	1.05	1.24	1.30	24[c]

[a]No charter service available.

[b]No data available.

[c]The percentage change for River Trails used 1977 as a base.