THE NATIONAL SHORT LINE RAILROAD DATABASE PROJECT

1996-1997

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ABSTRACT

This project is dedicated toward creating an annual information base on short line and regional railroads. Due to the ever faster changing railroad system, the value of such information is becoming increasingly important. The collected data is a viable tool for depicting industry trends and providing industry bench marks for policy makers, railroad managers, financiers, potential suppliers, and transportation agencies. Three years of collection and analysis of this data is complete, with another year in process. In this report, techniques for collecting short line information by mail and electronically are discussed. Also included in this report are an indepth look at some of the statistical analysis techniques and reporting methods used.

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CHAPTER 1. INTRODUCTION

The economies of rural America depend directly on transportation links to major markets. Rail service is one of the major contributors in providing access to these markets. The short line railroad industry is a principal contributor in providing rail service between rural America and major markets. There exist different needs and requirements necessary to preserve this vital transportation link, and a broad range of information is required to distinguish the characteristics of the short line industry. The American Short Line Railroad Association's Annual Data Profile is a major source for information used in analyzing these needs and requirements, and contributes to the awareness of the many challenges that lie ahead for this industry.

In 1993, the Federal Railroad Administration (FRA), in conjunction with the American Short Line Railroad Association (ASLRA), the University Transportation Centers Program (UTCP), and the Upper Great Plains Transportation Institute (UGPTI) initiated the American Short Line Railroad Association's Annual Data Profile of the short line industry to provide statistical data for the industry and to illustrate the contribution made by the short line industry. The ASLRA's Annual Data Profile of the small railroad industry now includes short line railroad information from 1993, 1994, and 1995 calendar years, with the 1996 data collection process underway.

An important step in the development of the ASLRA database is to obtain consistent, credible information over time. To facilitate this process, the majority of the Annual Data Profile content will remain constant with minor additions and deletions only occurring in response to the changing needs of the industry. In spite of several minor changes to the survey content, information collected each year has remained virtually unchanged. Evaluation of responses and response rates to survey questions and changes in the industry allow for modifications to the survey. Survey stability allows railroads to become

familiar with the survey information that must be compiled each year, and allows for more effective and efficient analysis.

This report identifies the methods and techniques used in collecting and analyzing the short line data and presents results of the analysis. The first part of the report begins by describing the data collection methods used for the third annual data profile (1995) and the development of the fourth annual data profile (1996). Tasks described in the following sections of the report include the maintenance of the main database, data analysis efforts, programming efforts for the 1996 electronic survey, generation of annual reports, and distribution of the reports and the electronic survey. Several Appendices are included to provide a copy of the Annual Data Profile, the User's Guide for the electronic survey, show details of analysis techniques, and display the formulated plan for the Annual Data Profile Web site.

CHAPTER 2. DATA COLLECTION METHODS

The Mailing Process

The Annual Data Profile is sent to more than 400 short line railroads across the United States. These railroads include all American Short Line Railroad Association members, and any other short line railroads requesting inclusion in the survey. Included in each package were a paper copy of the survey, a set of four installation disks for Dentry 3.0, a paper copy of the survey glossary, a paper copy of the Dentry 3.0 User's Guide, a letter from the president of the ASLRA, a letter of instructions from the UGPTI, and a postage paid return envelope.

A second mailing was sent to each railroad that responded to the 1995 survey. This mailing included a disk with a copy of their 1995 survey response in Microsoft Access database format. Railroads can use this file in the Dentry 3.0 software program to assist in filling out their 1996 response. The 1995 data speeds up the filing process and can be viewed, printed, or copied to the 1996 database.

Collection Process

The 1996 survey content remained identical to the survey sent for the previous year. The electronic form, Dentry 3.0, also was identical in content to the previous version sent to collect 1995 data. There are, however, several new major features included with version 3.0 of Dentry, which include the following:

- Allow printing of the railroad's previous year data
- Allow print previewing of sections of the survey and print previewing of the entire survey
- Allow the user to send a completed survey back via a modem and electronic file transfer
- Addition of a context-sensitive help system for Dentry 3.0

These new features were implemented to increase ease of use of the software package, to reduce the resources needed to complete the comprehensive Annual Data Profile, and to provide the users with additional program functionality.

Inputting individual railroad responses into the main database remained unchanged from the previous year. The Microsoft Access interface program created to input 1994 data was used to input the 1995 and 1996 data surveys. The program is a Microsoft Access interface with data entry forms designed similarly to the survey pages. The only adjustments necessary to the Access interface is the addition and deletion of database fields as they change. Since one objective is to keep the database consistent, not many changes will be required unless the entire underlying database structure is modified.

The 1995 electronic collection effort involved the returning information on a floppy disk. A Visual Basic 4.0 program called Append was created to append a 1995 electronic survey from a floppy disk to the main database. This program copies the information saved to disk by a responding railroad to the corresponding tables in the main database. For 1996 information, both the database files returned on floppy disk and via an electronic file transfer are appended to the main database using the same Append program used for 1995 data.

CHAPTER 3. SURVEY RESPONSE

The 1995 survey response rate was slightly lower than that of the previous two years, although it was still about a 50 percent response rate, a good rate for a survey of this magnitude. However, due to the length of the survey, many small railroads reported not having the resources necessary to gather all the survey information in a timely fashion. For the majority of the questions, the number of valid responses actually consisted of about 25 to 40 percent of all small United States railroads.

The short line industry includes many different operational sizes of railroads operating in different economic regions of the United States. Each of the railroads in the survey is categorized by railroad type and by region of railroad operation. The railroad types used conform with the Surface Transportation Board's (STB) and the Association of American Railroads' (AAR). A "Regional" railroad is a line-haul railroad with $40 million to $255.9 million in operating revenues, and/or operating over 350 miles of road. In 1995 there were 30 Regional railroads. Line-hauls with less than $40 million in annual operating revenues and less than 350 miles of road are defined as "Local" as well as "Switching and Terminal" railroads. The majority of "Switching and Terminal" railroads' traffic movement is switching and terminal and they are self-designated as being "Switching and Terminal" railroads. Figure 3.1 displays the survey response by railroad type, and the total number of railroads by railroad type for each year of the Annual Data Profile.

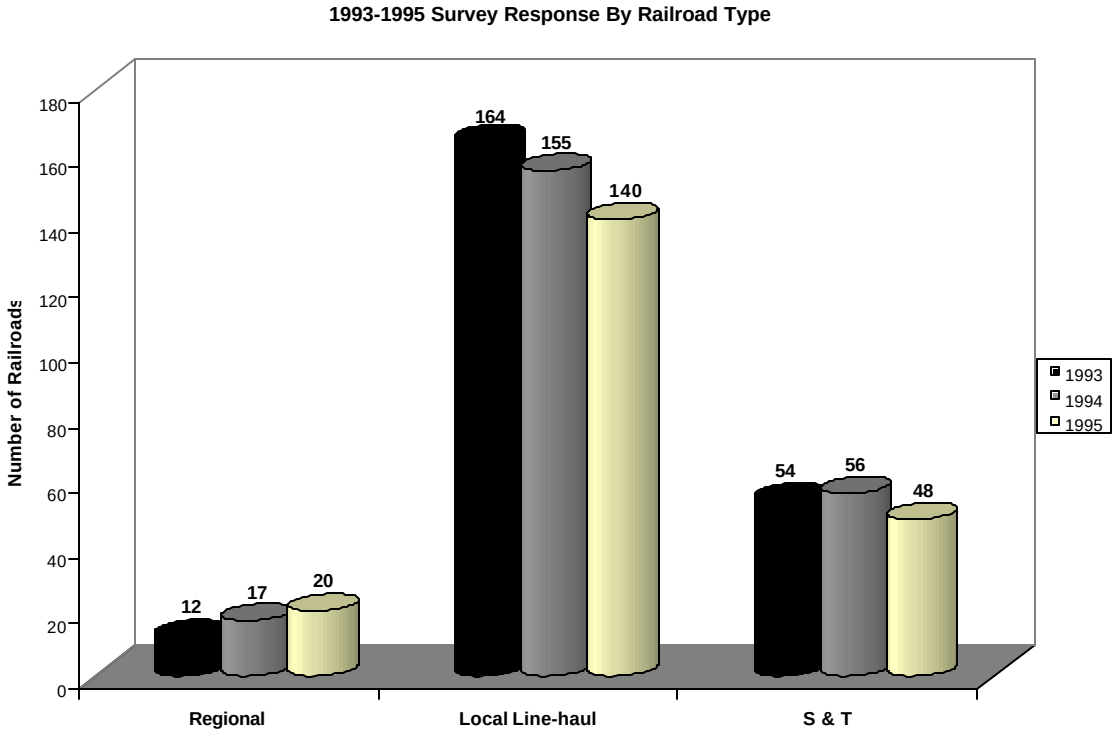
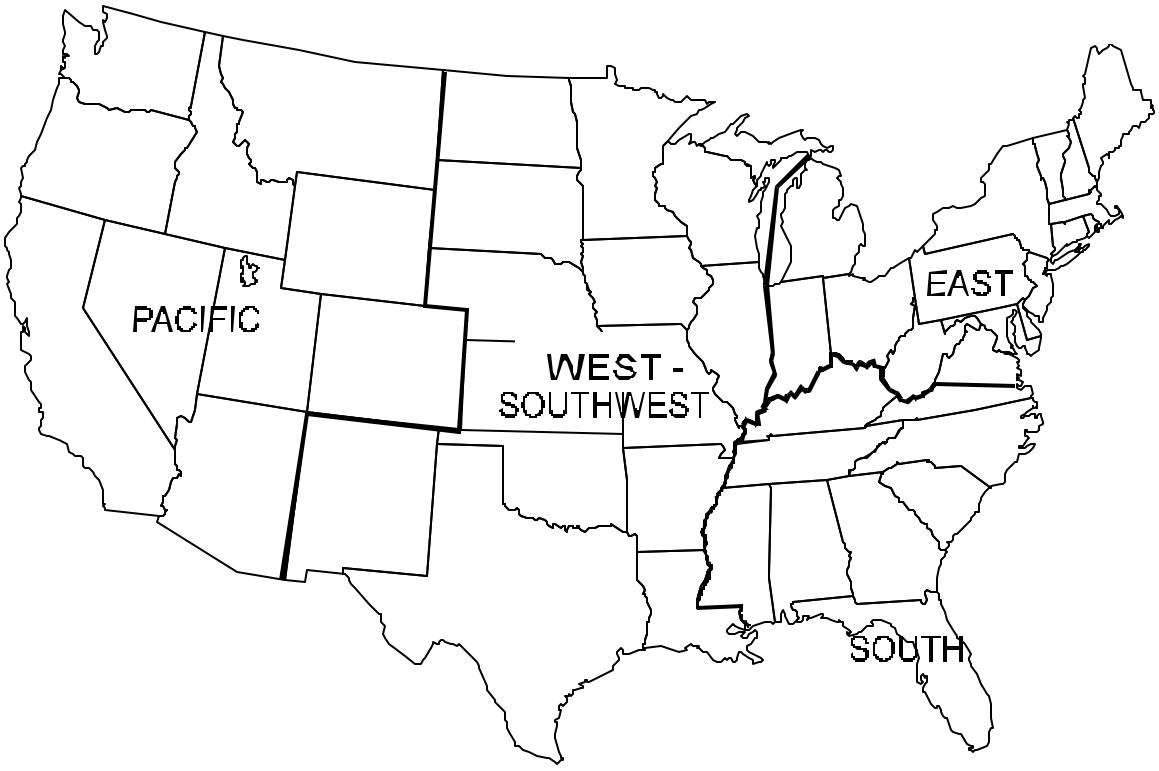

1993-1995 Survey Response By Railroad Type
Number of Railroads
180
160
140
120
100
80
60
40
20
0
164
155
140
54
56
48
12
17
20
Regional
Local Line-haul
S & T
1993
1994
1995

Figure 3.1



ASLRA Regions of Railroad Operation

Figure 3.2

The ASLRA has defined five different regions of railroad operations in the United States. A short line belongs to the region in which the majority of their operations take place. The regions are the East, Pacific, South, Southwest, and West. The map in figure 3.2 displays the borders of each region. The West and Southwest regions are combined for most of the *by region* analysis done on the database. Alaska and Hawaii are not shown on the map, but are included in the Pacific region.

CHAPTER 4. DATA ANALYSIS

Data Integrity

The first major step in the data analysis process is to evaluate and confirm the integrity of the reported data. Distributions of each variable in the database are reviewed and observations that appear to not fit the norm of the response are further scrutinized. These responses may be found to be accurate and other times are found to be data entry errors. An error is corrected if the corresponding valid response can be found, otherwise the error is treated as a missing observation in the data analysis calculations.

A second method of validating data compares results to previous years. A significant difference between the present data and the previous year's corresponding data would signal the need for further review of the data points included in each year. This review included a closer look at influential data points that may be affecting any calculations, and included examining whether the makeup of the database for each year may be the cause of the discrepancy. The number of observations eliminated by the data integrity validation was not significant.

Comparison with AAR Data

Another means of testing data integrity is to compare survey data with information from the American Association of Railroads (AAR) Profiles. The AAR has values for four variables — carloads handled, employees, miles owned and operated, average length of haul — for nearly all small railroads. A comparison of the average and median for each variable was conducted on 1995 data. Table 4.1 presents the results of the analysis comparing carloads handled between the 1995 AAR data and 1995 ASLRA

survey data. Results show that there is not a statistically significant difference between the results from the survey and the results from the AAR list for carloads handled.

Table 4.1 1995 Carloads Handled Statistics
(for railroads responding to both the survey and the AAR)

	Survey	AAR
Mean Carloads Handled	26,561	28,753
Median Carloads Handled	7,281	7,828
Sample Variance	5,141,344,828	6,648,330,342
Pearson Correlation	.67985	
Minimum	12	20
Maximum	594,344	621,745
Number of Observations	174	174

Table 4.2 presents the results of the analysis comparing the number of employees between the 1995 AAR data and 1995 ASLRA survey data. Results show that there is not a statistically significant difference between the results from the survey and the results from the AAR list for number of employees.

Table 4.2 1995 Number of Employees Statistics
(for railroads responding to both the survey and the AAR)

	Survey	AAR
Mean Employees	70	71
Median Employees	17	16

Sample Variance	35,904	35,130
Pearson Correlation	.883596	
Minimum	1	1
Maximum	1,765	1,641
Number of Observations	168	168

Table 4.3 presents the results of the analysis comparing miles owned and operated between the 1995 AAR data and 1995 ASLRA survey data. Results show that there is not a statistically significant difference between the results from the survey and the results from the AAR list for miles owned and operated.

Table 4.3 1995 Miles Owned & Operated Statistics
(for railroads responding to both the survey and the AAR)

	Survey	**AAR**
Mean Miles Owned and Operated	128	115
Median Miles Owned and Operated	50	44
Sample Variance	67,139	48,722
Pearson Correlation	.93389	
Minimum	2	2
Maximum	2,493	2,014
Number of Observations	174	174

Table 4.4 presents the results of the analysis comparing average length of haul between the 1995 AAR data and 1995 ASLRA survey data. Two data points from the ASLRA data survey were removed due to inaccurate data responses. After removing these two data points, results show that there is not a statistically significant difference between the results from the survey and the results from the AAR list for average length of haul.

Table 4.4 1995 Average Length of Haul Statistics (for railroads responding to both the survey and the AAR)		
	Survey	**AAR**
Mean Avg. Length of Haul	44	46
Median Avg. Length of Haul	20	20
Sample Variance	4,648	5,251
Pearson Correlation	.9616	
Minimum	.2	1
Maximum	486	486
Number of Observations	133	133

The comparison of the ASLRA data with the AAR data is a good indicator of the accuracy of the information going into both databases. The closer the two data sets match, the more assured we are that the ASLRA provides an accurate representation of the short line railroad industry. On the basis of the comparison of the ASLRA data with the AAR data, the data going into the ASLRA database is comparable with the AAR data.

Statistical Analysis Techniques Used

The ASLRA database has three years of small railroad data and continues with the collection of a fourth year. This multi-year information provides the opportunity to employ statistical techniques that analyze industry-wide impacts and trends across time and also allows the development of small railroad industry estimates of statistics for each year of the survey. Using these industry estimates, trends in the industry can be examined.

The main estimation approach uses a combination of the ASLRA data and the AAR profiles data (Bitzan, Byberg).[1] The AAR Profiles is the database compiled from an annual survey conducted on all railroads in the United States. It contains selected data items from nearly all railroads in the United States. If each sample is used in conjunction, fairly accurate industry estimates can be derived for the entire United States short line industry. The main approach used to estimate industry values for variables such as revenues, costs, and others is composed of roughly four steps. First, statistical models are estimated using ASLRA data with independent variables that also are contained in the AAR profiles data. Second, values of AAR profile data are multiplied by the parameter estimates obtained from the statistical models. Third, where AAR profile data for one of the independent variables is missing, regional or local averages are used. Finally, estimates obtained from this process are summed. The statistical models used for such estimation are strictly atheoretical. Only the statistical properties of the estimated models are used for model choice. The following paragraphs describe the process in more detail.

There are five variables that are included in both the ASLRA sample and the AAR profiles. These include:

- Miles Owned and Operated
- Carloads Handled
- Employees
- Average Length of Haul
- Type of Railroad

The first step in this process is to utilize the ASLRA survey sample to estimate a model. The variable to be estimated is regressed on the variables common to both surveys. The variable of interest can be any variable or combination of variables included in the ASLRA survey. To increase the estimating power, interaction terms between each independent variable and the railroad type are included.

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[1]Personal Communication. Discussion with John Bitzan, Upper Great Plains Transportation Institute, May 1997.

Also, some of the variables are transformed so their values fall in a range similar to the other variables used in the modeling technique. For example, values for carloads handled are much larger than values for average length of haul, employees, and miles owned and operated. If a regression is run without transforming carloads to a smaller number, the parameter estimate for carloads handled would be quite small with respect to the other parameter estimates. It is common practice to transform the variables so their values fall in a range similar to the other variables used in the model. Before running the regression, divide carloads handled by 1,000, and the range changes from “1 to 500,000" to “.0001 to 500"; a range similar to the other variables in the model. As an example, to obtain an estimate for freight revenue, the following model is first estimated:

$$freight = b_0 + b_1 * Tcar + b_2 * Emp + b_3 * MO + b_4 * Av + b_5 * RT + b_6 * (Tcar * RT) + b_7 * (Emp * RT) + b_8 * (MO * RT) + b_9 * (Av * RT)$$

where Tcar = (1/1,000) * carloads handled
freight = Annual Freight Revenue
Emp = Total Number of Employees
MO = Miles of Road Operated
Av = Average Length of Haul
RT = Railroad Type

Estimates for each of the β parameters are obtained by running the model on the ASLRA data. While fitting the model to the data, diagnostics are run on the data, which involves detection of outliers in the data. The following table lists cutoff values for diagnostic outlier checks on the data.

[2]

Table 4.5 General Cutoffs	
Diagnostic	**Cutoff Formula**
DFBETAS	$\frac{2}{\sqrt{n}}$
DFFITS	$2\sqrt{\frac{p}{n}}$
HAT DIAGONAL	$2p/n$
COOK'S D	$F(p, n-p)$
R-STUDENT	$t(n-p-1)$

The value of n in the table is the total number of observations used in calculating the model. Since response rates differ for each variable, each model may have a different n. The value p in the table stands for the number of estimated parameters in the model. The model described earlier in this section has 10 parameters in it. If possible outliers are detected by any of the above diagnostics, further analysis is required. One method used to determine which observations are truly significant outliers is to assign dummy variables to the suspect data points and fit them in the model. If the associated dummy variable is significant, then that observation is significantly influencing the model. During the analysis process, several outliers were found to be data entry errors and were removed from the data set.

After all the diagnostics are run on the model, the model providing the best fit on the data is chosen. Model adequacy is checked by looking at the adjusted R-Square value and root mean square error (RMSE). If the model provides a good fit to the data, the process continued.

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[2]Lantz, Brenda M., *A Model For the Vehicle Violation Rates of Trucking Companies*, North Dakota State University, May 1993.

The next step in the process is to calculate an estimate for each of the short line railroads in existence during the analysis year. Values are inserted into the model for the railroads that have a valid response to each of the five independent model variables. From this calculation, an estimate for the dependent variable is calculated for each railroad. To get a complete industry estimate, railroads that did not respond to each of the five AAR questions must be accounted for. To accomplish this, the average of the derived dependent variable estimates for regional railroads and the average of the derived dependent variable estimates for the local railroads are calculated. Next, the average estimate for regional railroads is added to the population estimate for each missing railroad that is a regional railroad, and the average estimate for local railroads is added to the population estimate for each missing railroad that is a local railroad. A short line industry estimate is then computed by adding up each of the individual railroad estimates.

Once a population estimate has been derived, the accuracy of the estimate must be computed. One of the most common indicators of estimation accuracy used is confidence intervals. To compute a confidence interval, the variance of the population estimate is needed. Measuring the variance of the sum of a number of point estimates is not a straight-forward process. The error attributed to using averages for the missing AAR data points also must be accounted for. Appendix F steps through the process of calculating the variance. The following table gives several industry estimates, along with a 95 percent confidence interval for the estimates.

Table 4.6 Industry Estimate Analysis

Variable	1995 Estimate	R-Square	RMSE	Lower Bound	Upper Bound
Carloads	10,526,687	.7783	37,062.60	7,241,888	13,811,486
Freight Revenue	$2,936,795,783	.9632	2,744,830.00	$2,595,795,211	$3,277,796,355
Employees	24,039	.8613	75.88	17,320	30,759

Ties Laid in Replacement	3,080,586	.8817	8,418.00	2,277,226	3,883,947

Validating criteria must be set to select estimates for publication. The following criteria had to be met to use the model's estimate.

- After running different models on the data, the model that best fit the data was selected.
- The R-Square value had to be above 0.70.
- Influential observations were all accounted for.

More 1995 industry estimates that met validation criteria can be found in Appendix A, on page 23.

Other important statistics that can be utilized to measure the characteristics of the short line industry are ratios and indexes. Ratios and indexes commonly used to measure characteristics of different industries can be used to measure similar traits in the short line railroad industry. Financial measures such as the operating ratio, density measures such as carloads handled per mile of track operated, traffic diversity measures such as a concentration index, and many others can be applied to the 1995 ASLRA database. Appendix G contains several charts and tables displaying results of these analysis techniques.

Specialized Data Analysis Requests

Over the past year specialized data requests utilizing the database have been made by several organizations and railroads. The requests are for data analysis using the database and information not reported in the Annual Data Profile. Those making such requests include but are not limited to:

- A.T. Kearney
- Bain & Company
- Canadian Pacific Railroad
- Federal Railroad Administration
- Fort Worth & Western Railroad
- Lewis, Hinckley & Brod
- Rail Management & Consulting Corporation

- Red River Valley and Western Railroad
- Southern Electric Railroad

The specialized data requests are only performed if approved by the American Short Line Railroad Association (ASLRA) and if the results of the analysis can be presented in an aggregate form preventing the identification of any individual railroad's data.

The first step in the process of a specialized data analysis is a request forwarded to the ASLRA that outlines the desired analysis. After approval has been granted, a preliminary analysis is conducted on the data request. The preliminary analysis involves using a variety of diagnostic checks on the data necessary for the analysis. The diagnostic checks ensure the validity and the integrity of the data, and highlight the observations whose presence in the data set strongly impacts the results. The next step involves the analysis itself which may include computing univariate statistics, inferential statistics, models, estimations or other statistical techniques. Next, the preliminary results are reviewed by the ASLRA, and several minor adjustments to the analysis may be requested. Upon approval, the analysis results are sent to the requesting railroad or organization.

During the data request process, the only participants are the short line railroad project team at the Upper Great Plains Transportation Institute (UGPTI) and the requesting organization. The ASLRA does not participate in the analysis, but does review the results and may request minor adjustments to the analysis. Data integrity is an important issue and is assured to each railroad that responds to the survey. To ensure this data integrity, only the project team members at the UGPTI are allowed to see individual railroad records. The following list is an example of the statistics calculated for specialized data analysis and information requests using the database:

Average Annual Hours Worked Per Employee
Average Annual Cost of Health/Pension/Benefit Plans Per Employee
Average Carloads Per Operating Employee
Average Carloads Per Route Mile
Average Employees Per Route Mile

Average Gross Revenues Generated Per Hour Worked
Average Locomotives Per Mile of Track
Average Operating Ratios
Average Revenue Per Operating Employee
Average Revenue Per Route Mile
Average Revenue Per Carload
Average Wage Per Hour
Average Wages for Supervisory and Non-supervisory employees
Expense Breakdown
Percent of railroads providing a 401(k) plan
Percent of laborer covered by a labor agreement
Percent of Total Operating Expenses attributed to Health/Pension/Benefit Plans
Road, Equipment, and Other Investments
Total Annual Compensation Paid
Total Employees (Exempt vs. Non-Exempt
Total Gallons of Locomotive Fuel Consumed
Total Man-Hours Worked

CHAPTER 5. PROGRAMMING EFFORTS

Dentry 3.0

The latest version of Dentry, version 3.0, was developed utilizing the same fundamental design in the previous version of Dentry. Version 3.0 has nearly identical survey pages and content to version 2.0, and most of the previous functionality remains the same. However, several major enhancements to the program were added. A decision to replace R&R Report Writer with Crystal Reports 5.0 was made to facilitate the printing of the survey. One major advantage in making this change is Crystal Reports' capabilities of handling the entire report with one file. This report also will handle both the 1995 and 1996 survey data, giving the user the opportunity to print the previous year's survey and the current year's survey.

Another new feature is the file transfer option. Crescent Software's PDQComm 3.0 was the third party Visual Basic product used to assist in creating the file transfer capabilities of Dentry 3.0. This feature allows the user to return a completed electronic 1996 survey via modem. The end-user is required to enter the correct modem model, type, and maximum baud rate. This information is then stored in a script file so the user does not need to enter it again, unless they wish to change the modem type. Next, the user enters the server's phone number and presses the dial command. The program will connect to the server and automatically upload the database file containing the railroad's survey responses.

The 1996 Dentry software package also features a new electronic help file. This file was created using a text editor and a help compiler. Three source files were created — a topic file, a project file, and an index file. The topic file is a rich text format file that contains the text for the help file and the code required to link topics and display graphics. Each page in this document contains a link to another topic in the source file or to a topic in another source file. The project file lists the text files and graphics

files required, and gives formatting instructions used during the compilation process. The index file contains the index numbers for each topic that has context-sensitive help capability. Once these files are finished, they are compiled into one .hlp file, which can be referenced by Dentry 3.0.

The help file contains the same content that is included with the paper version of Dentry 3.0's User's Guide. Also included are all the definitions of the survey questions found in the paper version of the survey glossary. Access to the help file and glossary is gained by the help menu, the help command button or by context sensitive help. The help menu lists a table of contents that can be browsed to find information on a topic. The search functionality allows a user to search the help file by a specific topic. Context-sensitive help functionality displays the definition of a survey question by double-clicking on the question's corresponding label.

Web Site

Another programming objective for the past year was to place ASLRA survey information on a web site. Information was placed on the world wide web, WWW, to increase the knowledge of the existence of this database and to disseminate analysis results to interested parties. Increased awareness of this data source on short line and regional railroads would increase the use of the data and increase the utility of this database. Appendix D describes the general plan for the National Short Line Railroad Database Project.

Appendix A:

1995

Annual Data Profile

of the

American Short Line

and Regional Railroad Industry

Developed by the American Short Line Railroad Association

and the

Upper Great Plains Transportation Institute

Appendix B:

1995 Selected Survey Totals

PART I. RAILROAD AND CUSTOMER PROFILE

Railroad Profile

Railroad Name **Survey Totals - 209 Railroads Note: Not all railroads completed every data item**.

Railroad Type (Regional/Local - Line-haul/S&T) **20 Regionals, 141 Local-Line-haul, 48 S&T**

Name of Principal Owner

Survey Contact Person

Year established as a Short Line

Region

Customer Profile

Total Number of Customers Served **7,958**

Number of Customers Served by Commodity Group

Commodity Group	
Coal	**172**
Farm Products	**1,424**
Chemicals and Allied Products	**1,499**
Food and Kindred Products	**956**
Non-metallic Minerals	**341**
Transportation Equipment	**353**
Lumber and Wood Products	**1,219**
Pulp, Paper and Allied Products	**772**
Petroleum/Coke Products	**354**
Stone, Clay and Glass Products	**417**
Metallic Ores	**74**
Primary Metal Products	**572**
Waste and Scrap Material	**672**
Other (Please list commodities below)	

Please list the Other Commodities **978**

PART II. INVENTORY OF ROADWAY, TRACK, AND STRUCTURES

Miles of Road Owned and Operated, by State			
State	Total Route Miles Owned	Route Miles Owned with 90 Pound Rail or Greater	Total Route Miles Operated under Trackage Rights
	20,356	**15,887**	**3,953**

Miles of Road, By FRA Track Class	
Class	Miles of Road
1	**3,806**
2	**8,189**
3	**5,595**
4	**1,814**
Excepted	**2,486**

Number of Bridges

- Concrete **1,194**
- Steel ~~**2,960**~~
- Wood ~~**5,194**~~
- Combination ~~**1,235**~~

Ties Laid in Replacement

- New ties ~~**1,184,293**~~
- Used ties **336,213**

Rails Laid in Replacement (in Track feet)

- 90 Pounds or Greater - track feet **1,038,810**
- Less than 90 Pounds - track feet **170,138**

Rail laid in new lines, extensions, or sidings (in Track feet)

- 90 Pounds or Greater - track feet **114,817**
- Less than 90 Pounds - track feet **2,620**

Number of Highway Grade Crossings

- Public **20,021**
- Private **12,365**
- Equipped with Automatic Warning Devices **6,310**

Grade Crossing Improvements

- New Automatic Warning Devices Installed **194**
- Automatic Warning Devices Improved **241**

➥ Number of Grade Crossings Resurfaced **769**

Intermodal Terminal Facilities

- ➥ Number of Facilities **38**
- ➥ Type of Facilities:
  - Number of Circus Ramps **16**
  - Number of Top Pickup **30**
  - Number of Bottom Pickup **17**

Transloading Facilities

- ➥ Number of Facilities **260**
- ➥ Type of Facilities:
  - Number of Rail to Truck **204**
  - Number of Truck to Rail **183**
  - Number of Rail to Water **39**
  - Number of Water to Rail **38**

PART III. EQUIPMENT INVENTORY

Freight Cars Owned and Leased					
Car Type	Total Units Owned	Total Units Leased	Units <10 Years Old	Units 10-20 Years Old	Units >20 Years Old
Box Cars	**5,239**	**15,949**	**984**	**11,178**	**7102**
Gondolas	**6,502**	**4,361**	**550**	**3,414**	**6,678**
Covered Hoppers	**3,167**	**6,798**	**2,229**	**3,717**	**2,972**
Open Top Hoppers	**11,091**	**3,368**	**80**	**3,269**	**11,024**
Flat Cars	**3,474**	**2,608**	**255**	**1,190**	**4,525**
All Others	**1,560**	**813**	**50**	**70**	**1,601**

Locomotives Owned And Leased, by Age and Horsepower					
Locomotive Type	Total Units Owned	Total Units Leased	Units <10 Years Old	Units 10-20 Years Old	Units >20 Years Old
Less than 1,500 HP	**442**	**38**	**4**	**28**	**331**
1,500 - 3,000 HP	**1,046**	**385**	**9**	**185**	**1,058**
Greater than 3,000 HP	**213**	**23**	**8**	**21**	**207**

PART IV. ANNUAL OPERATING STATISTICS

Carloads Handled by Commodity Code

STCC	Commodity Code	Carloads Originated and Terminated on-line (local)	Interline Carloads Originated	Interline Carloads Terminated	Bridge Carloads
11	Coal	**175,091**	**212,070**	**322,867**	**40,567**
01	Farm Products	**69,587**	**167,670**	**84,495**	**114,866**
28	Chemicals and Allied products	**45,317**	**94,595**	**103,485**	**34,632**
20	Food and Kindred products	**85,745**	**102,920**	**51,412**	**59,029**
14	Non-metallic Minerals	**86,762**	**61,361**	**24,515**	**14,854**
37	Transportation Equipment	**16,147**	**39,593**	**20,348**	**183,039**
24	Lumber and Wood products	**72,287**	**94,296**	**74,403**	**48,359**
26	Pulp, Paper and Allied products	**53,395**	**128,691**	**87,203**	**64,666**
29	Petroleum products	**100,516**	**157,477**	**116,111**	**17,456**
32	Stone, Clay, and Glass products	**43,102**	**64,555**	**66,403**	**36,151**
10	Metallic ores	**538,773**	**116,116**	**82,016**	**59,235**
33	Primary Metal products	**280,598**	**246,231**	**80,785**	**21,488**
40	Waste and Scrap Material	**108,925**	**61,227**	**74,180**	**19,594**
	Other	**76,231**	**107,187**	**111,791**	**99,646**

Of the carloads listed in the table above, how many moved with hazardous materials commodity code (STCC 49)? **250,997**

If you ship intermodally, how many trailers or containers did you ship? Trailers **89,871**
Containers **193,178**

Annual Line-Haul Operating Statistics

Train Miles	**40,119,928**
Yard Miles	**3,961,644**
Locomotive Miles	**47,475,063**
Average Length of Haul	**42.95**
Average Revenue per Carload	**$ 323.36**
Average Weight per Carload	**85.11**
Revenue Ton-Miles	**34,290,000,000**

What End of Train Devices do you employ in Road Train Service?

❑ Caboose **18**

❑ One-Way End of Train Device **58**

❑ Two-Way End of Train Device (Telemetry) **27**

❑ Other **39**

Annual Fuel Consumption

Total Gallons of Locomotive Diesel Fuel Consumed	**119,326,056**
Average Cost per Gallon ($)	**$ 0.7418**

PART V. FINANCIAL DATA

Note: If no money has been expended for a category, enter 0.

Items From Income Statement

Gross Railway Operating Revenue		
Freight	~~$ 1,126,000,000~~	
Other	~~$ 167,363,636~~	
Total: Gross Railway Operating Revenue		~~$ 1,294,000,000~~
Railway Operating Expenses		
Way and Structures		
Way	~~$ 72,778,488~~	
Bridges	$ 4,118,806	
Facilities	$ 13,803,632	
Other	$ 23,600,760	
Total: Way and Structures		$ 178,571,093
Equipment		
Freight Cars	$ 49,340,853	
Locomotives	$ 57,086,758	
Maintenance of Way	$ 4,178,879	
Other	$ 16,891,508	
Total: Equipment		$ 222,291,665
Transportation	$ 342,791,072	
General & Admin.	$ 169,164,043	
Other	$ 100,815,064	

Total: Railway Operating Expenses		**$ 1,023,000,000**
Net Railway Operating Income		**$ 248,881,612**
Capital Expenditures		
Road	**$ 19,819,919**	
Equipment	**$ 11,966,010**	
Other	**$ 11,040,327**	
Items From Balance Sheet		
Current Assets	**$ 634,415,503**	
Current Liabilities	**$ 446,427,313**	
Net Working Capital		**$ 161,796,444**
State and Federal Grants/Loans		**$ 34,612,431**
Total Assets		**$ 2,129,000,000**
Long-Term Debt (Non-Current Liabilities)		**$ 878,528,442**
Stockholders Equity		**$ 638,914,922**
Application of Funds		
Capital Expenditures		**$ 118,884,051**
Depreciation/Amortization and Retirement		**$ 304,187,101**
Other Expense		**$ 506,416,114**

Projected Capital Investment for Next Five-Year Period (1996-2000)

Note: If no money has been expended for a category, enter 0.

	Projected Five-Year Investment	Percentage Funded Internally from Cash Flow
Equipment		
Locomotive	**$ 60,333,788**	**83 %**
Rolling Stock	**$ 69,329,597**	**84 %**
Road		
Track	**$ 357,107,604**	**83 %**
Structures	**$ 45,914,695**	**88 %**
Other		
Other	**$ 101,651,028**	**94 %**

PART VI. EMPLOYEE AND BENEFIT DATA

Employee Data

Total Employees (average mid-month count for 1995)

Supervisory	**2,142**
Non-Supervisory	**11,364**

Total Annual Compensation Paid

Supervisory	**$ 95,809,391**
Non-Supervisory	**$ 351,123,593**

Number of Employees Covered by Labor Agreement **7,196**

Total Man-Hours Worked **26,438,808**

Benefit Plans

Does your company provide health and insurance plans? ❑ Yes ❑ No **186**

If yes, please answer the following questions.

What is the percentage of the Employer contribution for the following health and insurance plans? (ie., 100%,75%,etc.)

	Single	Family
Medical	**93.05 %**	**84.09 %**
Dental	**80.29 %**	**76.28 %**
Life Insurance	**86.18 %**	**71.87 %**

Does your company provide a 401(k) pension plan? ❑ Yes ❑ No ~~**116**~~

Does your company also contribute to the employee 401(k) pension plan? ❑ Yes ❑ No **73**

Does your company provide a defined pension plan? ❑ Yes ❑ No **47**

Please list any other pension plans except Railroad Retirement.	**33**
Total annual cost of health/pension/benefit plans	**$ 90,129,588**

PART VII. PASSENGER SERVICES

Is passenger or excursion train service operated over your track? ❑ Yes ❑ No **~~29~~**

Type of services

Seasonal excursion	❑ Yes ❑ No	**~~21~~**
Dinner train	❑ Yes ❑ No	**~~5~~**
Other	❑ Yes ❑ No	**~~12~~**

Annual Revenues from Services	**$ 15,299,064**
Total (Annual) Number of Revenue Passengers	**815,236**

PART VIII. COMPUTER SYSTEMS AND APPLICATIONS

Computer Systems

Please indicate the types of computers used by your railroad.

❑	286 **34**	❑	Minicomputer **16**		
❑	386 **90**	❑	Mainframe **25**		
❑	486 **149**	❑	Other	**20**	
❑	Pentium **91**	❑	Do Not Use Computers		**6**
❑	MacIntosh **5**				

What personal computer operating systems do you use?

148 ❑	DOS	❑	Unix **5**		
142 ❑	Windows 3.0/3.1	❑	Apple **5**		
36 ❑	Windows 95	❑	Other	**4**	
3 ❑	OS/2				

Do your computers have any of the following?

118 ❑	Fax/Modem **69**	❑	CD-ROM		

Does your railroad connect your computers through a local area network? ❑ Yes ❑ No **81**

Does your railroad subscribe to an online service?

32 ❑	CompuServe	❑	Prodigy	**3**	
17 ❑	Internet	❑	Other	**17**	

Computer Applications

What applications are performed by your computer system?

147 ❑	EDI	❑	Car Orders		**42**
110 ❑	Inventory Control	❑	Car Hire	**130**	
137 ❑	Accounting/Payroll	❑	Yard Operations	**94**	
136 ❑	Waybills	❑	Traffic Statistics	**116**	
92 ❑	Car Repair Billing	❑	Budget/Cost Control	**87**	
68 ❑	Personnel Records	❑	Other	**7**	
38 ❑	FRA Safety Reporting				

What EDI functions does your railroad use?

97 ❑	Bills of Lading (404)	❑	Connect with Shippers	**27**	
55 ❑	Freight Bills (410)	❑	Rate-EDI Network (REN)	**12**	
132 ❑	Waybills (417)	❑	Other	**7**	
122 ❑	Car Consist (418)	❑	Do Not Use EDI		
29 ❑	ISS				

Does your railroad develop its own computer programs and applications? ❑ Yes ❑ No **80**

Please list any areas into which your railroad plans to expand its computer applications. **42**

Appendix C:

1996 Dentry 3.0 User's Guide

Chapter 1 - Getting Started

This chapter explains how to install and start the Dentry on your system.

Before You Begin

Before installing Dentry, you must have an IBM compatible computer with a 486 or better processor, Microsoft Windows version 3.0 or higher, Windows for Workgroups, or Windows95, a 3.5" floppy drive, a mouse, and a VGA or super VGA monitor. You will also need to have 5MB to 11MB of free disk space on your hard drive in order to install Dentry on your computer.

Installing Dentry

1. To install Dentry, insert program disk #1 into the appropriate floppy drive. Please close all applications before you begin installing Dentry.
2. In the program manager, select ***file*** menu, and select ***run*** command from that menu.
3. In the ***run*** dialogue box type:
   a:\setup
   (if the disk drive is A:)
   b:\setup
   (if the disk drive is B)

*[**WARNING:** When the installation procedure prompts you for a directory to install the program to, **DO NOT CHANGE IT FROM C:\DENTRY3**!! The program will not work correctly if it is installed in another directory.]*

Installing 1995 Data

If you sent in a survey response for the 1995 data profile, you will receive a fifth disk in the mail. On this disk will be one file, ***slrd95.mdb***. This file should be copied to ***c:\dentry3***.

1. To install the 1995 data, insert the database disk into the appropriate floppy drive.
2. In the file manager, select ***file*** menu, and select ***copy*** command from that menu.
   If you are using Windows95, you can use the Windows Explorer to copy the file.
3. In the ***copy from*** dialogue box type:
   a:*.*
(if the disk drive is A:)
   b:*.*
(if the disk drive is B)
4. In the ***copy to*** dialogue box type:

c:\dentry3

5. Then click on OK with the mouse.

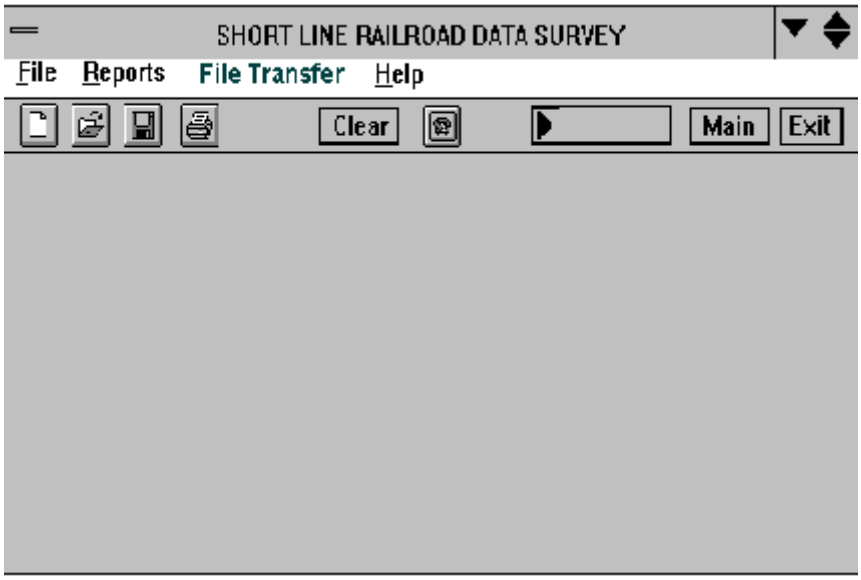
Dentry will now allow you to view and print 1995 data. If you did not respond to the 1995 data survey, the 1995 data option in the program will not function.

Starting Dentry

Once the program is installed, you will need to start the program using one of several options.

1. If you are using Windows 3.0 or 3.1, you can use the ***File Run*** menu command in program manager. In the text box labeled Command Line, type: **c:\dentry3\dentry3.exe -** then click OK. The program should start if the installation process was successful.
2. File Manager can be used if you are using Windows 3.0 or 3.1 or Windows95. First, find the File Manager icon and click on it. Look for a directory folder called **dentry3** on the c: drive. Double-click on the **dentry3** folder to open it. In the list box on the right there should be a file called **dentry3**. Click on this file to run the program.
3. If you are using Windows95, the Windows Explorer can be used to start the program. Go to Start, then to Programs. The Windows Explorer folder should be located here. Once you find it, click on it. Look for the **dentry3** directory on the c: drive. Click on this folder to open it. In the list box on the right you should find a file called **dentry3**. Click on this to start the program.
4. If you are familiar with the Windows environment, you can create your own program group or shortcut to the program.

Chapter 2 - Introduction



(Dentry's Main Window)
the Menu bar appears just below the title bar.
the Tool bar appears just below the Menu bar.

The Menu Bar

Each option in the Menu bar calls up a drop down menu of commands that you can use to create, modify, save, and print the database.

File This menu includes the commands to create a new record, open and close an existing one, save a record, and save the record to a different drive. The exit command exits the Dentry program. These commands can be enabled either using a mouse click or a keyboard stroke. The keyboard strokes are activated with a ALT and the underlined letter in the file menu.

Reports The report menu allows you to print the entire survey or just a section of the survey. If you responded to the 1995 survey, and have properly installed the 1995 data, the option to print the 1995 data response will also be available.

File Transfer This menu allows you to transfer completed surveys to us through a modem.

About Displays information about your copy of Dentry, including the version number.

The Toolbar

Command buttons exist on the toolbar for some of the more commonly used functions of Dentry. Each command button displays a graphic that visually describes the command. You can activate the toolbar commands by clicking on the center of the appropriate button one time with the left mouse button. After running the program, you will notice that certain commands are not always available. When they are not available to the user, they will either be invisible or they will have a dimmed appearance and will not function when pressed.

The buttons on the button bar perform the following functions:

New Record:

A new, blank record is created by a click on this button. A new record must be created for each railroad you are filling out a survey for.

Open Existing Record:

Clicking on this button opens an existing record. A dialogue box will appear showing the list of existing records you can choose from to view or edit. You can select a particular record by double clicking on the corresponding railroad name in the list.

Save:

Saves changes made to the current record onto the database in the c:\dentry2 directory.

Print:

To print a hard copy of the survey or parts of the survey, click on this button. When clicked, a dialogue box prompts the user to select a survey. Then you can choose whether you want to print a specific section of the survey or print the entire survey by clicking on the corresponding button. To exit from print, click on the ***exit*** button at the bottom.

File Transfer:

To transfer all of the surveys you have completed to us electronically, click on this button. You will be requested to fill in some information about your modem, and then be able to dial into our server. Once connected with our server, the rest of the file transfer process is automatic.

Clear:

Clears the fields in the current form.

Scrollbar:

Allows the user to scroll through the various pages of the survey (the quickest way to move through the survey).

Main:

Brings you back to the main survey page.

Exit:

Exits the Dentry program.

1995 Button:

Displays the 1995 data for the current form, if available. When the 1995 data is displayed, a 1996 button appears. The 1996 button brings back the 1996 information. This allows you to make changes to the 1995 data, and save them to the 1996 survey. Remember, the changes made to the data in the form are not permanent until you use the save command button, or File Save menu.

Chapter 3 - Filling Out Parts of the Survey

Please fill out the survey as accurately as possible. If you leave a question blank, it is assumed that information is not available. If your response is 0, please fill in the corresponding text box with a 0. At any stage you can clear all the fields of the current form using the ***clear*** button. No changes to the survey are permanent until the ***save*** button or the ***save menu*** command are used.

Moving Around the Survey

There are several ways you can move between the fields and pages of Dentry. After you enter data in one field, you can use the ***Tab*** key or the ***Enter*** key to continue to the next field. If you want to go to a previous field, hold the ***shift*** button down while pressing the ***tab*** button. To go to the next survey page, click the left mouse button while the pointer is over the right arrow of the scrollbar. To go to the previous survey page, click the left mouse button while the pointer is over the left arrow of the scrollbar. To move more than one page at a time, click and hold the left mouse button on the slider box between the arrows and slide it either left or right.

Main Page

The main page contains general information about the railroad and the connections to the various pages or various parts of Dentry.

Railroad Name: Enter the Railroad name (enter Alphanumeric Characters).

Name of the Principal Owner: Enter the name of the principal owner (Enter Alpha numeric characters).

Survey Contact Person: Person to be contacted regarding survey.

Year Established as a Short Line: Enter any years between 1850 - 1996 (when your railroad became classified as a short-line railroad) or enter a 0 if unknown.

Railroad Type: Enter Railroad type (Select from a list of types).

Railroad Region: Enter Region of Railroad Operation (Select from a list of ASLRA designated regions).

To continue after filling out the entire main page, either choose from one of the section titled option boxes, or use the scroll bar to move through the pages.

The following section briefly describes the types of information requested in each section of the survey:

Customer Profile

Provide information on the types of customers served in 1996.

Road and Track Inventory

Provide information on the amount of road & track owned and operated by state. Any two letter state abbreviation is accepted in the state fields and illegal entries are not accepted. In all other fields the numeric values entered are rounded off to two decimal places.

Structures

Provide information pertaining to track and structures.

All the fields accept integer values.

Intermodal Transloading Facilities

Provide information on the number and types of intermodal and transloading facilities.

All the fields accept integer values.

Equipment Inventory

Provide information on train equipment owned or leased.

All the fields accept integer values.

Annual Operating Statistics

Provide information on different types of commodities shipped.

All fields in the Annual Operating Statistics section are rounded off to the nearest integer value.

Financial Data

Provide auxiliary, base, and future financial information.

All fields in the Financial Data section accept real values.

Employee Benefit Data

Provide information about employees, annual compensation paid, benefit plans, pension plans, insurance plans, etc.

Passenger Services

Provide information about the kind of passenger services provided over your track and check in appropriate boxes.

Computer Systems

Provide information on the various computer systems and applications utilized. Check the appropriate boxes to provide information about the computers, and the computer related information that are used by your railroad.

Comments and Recommendations

Provide any comments or suggestions about the survey or program, if you have any.

Chapter 4 - Printing

To print the survey, click on the ***print*** button on the toolbar, or click ***Report***, then ***Print*** from the ***file*** menu. A dialog box will appear displaying three command buttons. If you wish to print the 1995 survey, click the ***Print 1995 Survey*** button. If you want to print the 1996 survey, click the ***Print 1996 Survey*** button. If you want to cancel the print operation, click on the ***Cancel*** button.

If you choose to print either the 1995 or 1996 survey, a list of the different railroad records you can print will appear on a new form. Double-click on a railroad to print that railroad's survey. The next form displayed is shown in Figure A.

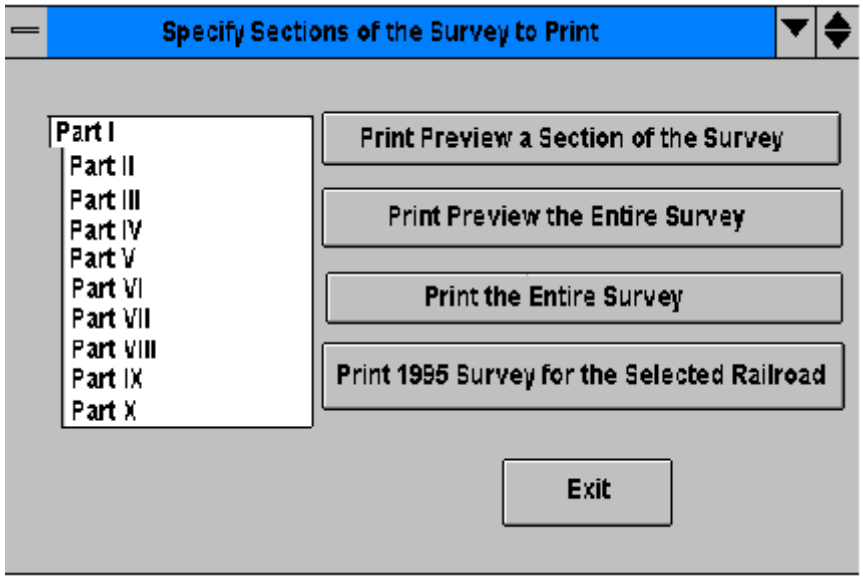


Figure A. Print Window

If you are printing a 1995 survey, only the Print 1995 Survey for the Selected Railroad command is available. If you are printing a 1996 survey, the first three command button options are available. If you choose to Print the Entire Survey, the survey report will be sent directly to your windows default

printer. Otherwise, the survey or section of the survey will be displayed in a print preview window. Figure B shows how the print preview window will look.

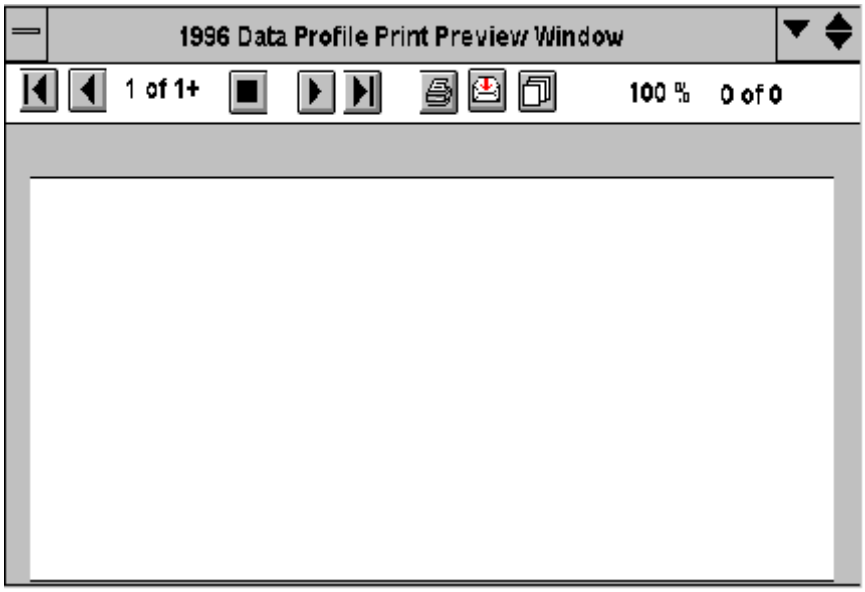


Figure B. Print Preview Window

Once the survey or survey section is displayed, the following options are available:

Print Preview Browse buttons: Used to scroll through the pages of the print preview.

Print button: Click on this to print a copy of the pages in the print preview window.

Export button: Click on this to export a copy of the survey to a different format. When exporting the survey, some of the formatting may be lost. Example - If you export to an MS Word document, the lines and alignment will not be the same as the actual survey report.

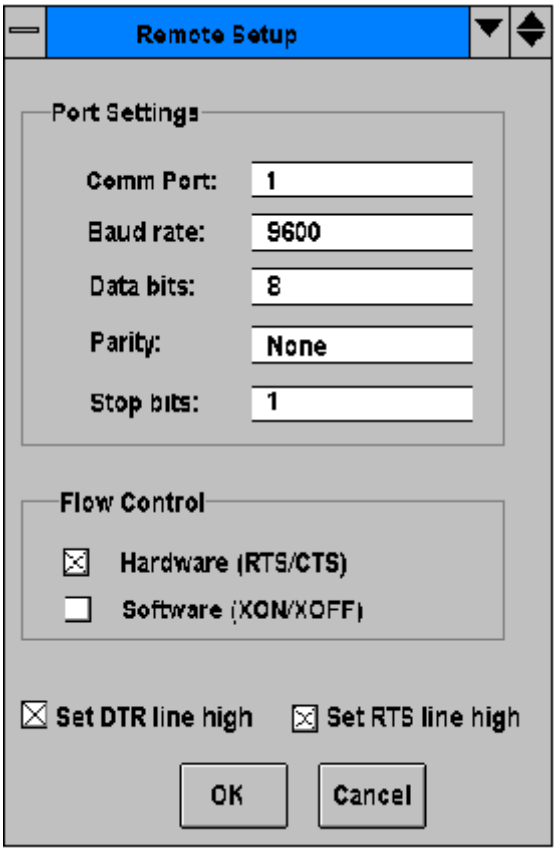
Zoom button: Click on this to increase or decrease the view size of the print preview window. The alignment may look slightly off in the smaller viewing windows.

When done viewing and/or printing the survey, double click on the upper left corner of the window. This should bring you back to the screen in Figure A. Then click ***Exit*** on this form to return to the Dentry program.

Chapter 5 - Returning the Completed Survey

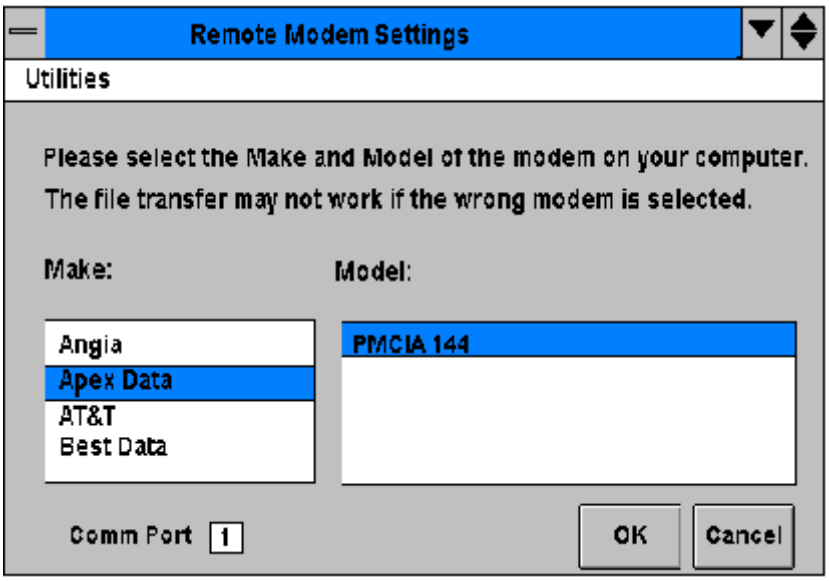
When the entire survey has been completed and saved, you will have two electronic options for sending the data back to us.

1. **Return Disk**: Place a blank floppy disk in either drive a: or drive b:. While in the program, go to the file menu and click on ***SaveAs***. Then click the drive letter corresponding to the drive containing the blank floppy disk. The information you have entered for your railroad or railroads will be copied to the floppy disk. Seal the disk in the envelope supplied, and promptly return it by mail with the appropriate postage.
2. **File Transfer via your Modem**: Once the information is completed for each railroad you enter data for, send us the information directly through your modem. **Warning! Before choosing this option, be sure that you know the model and make of your modem, the comm port your modem is located on, and the maximum baud rate your modem can accept.** Once you have this information, click on either the ***command*** button with a telephone on it, or, from the menu, click on the ***File Transfer, Send Database via Modem*** command. When you do this, the following screen should appear.



Set the Comm Port, maximum baud rate your modem can accept, and switch the flow control to Hardware(RTS/CTS), then click OK.

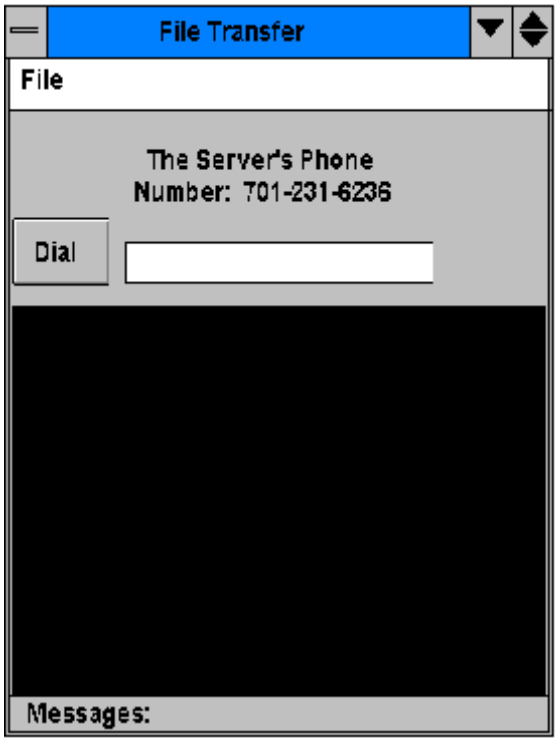
If there were no errors with your port selection, the following Remote Modem Settings screen will appear:



There are two list boxes on this form. Select the make of your modem in the list box on the left. When you make this selection, several models for that modem will be displayed in the list box on the right. The models usually describe the different modem speeds available for that particular make. Select the model that matches your modem. Click OK.

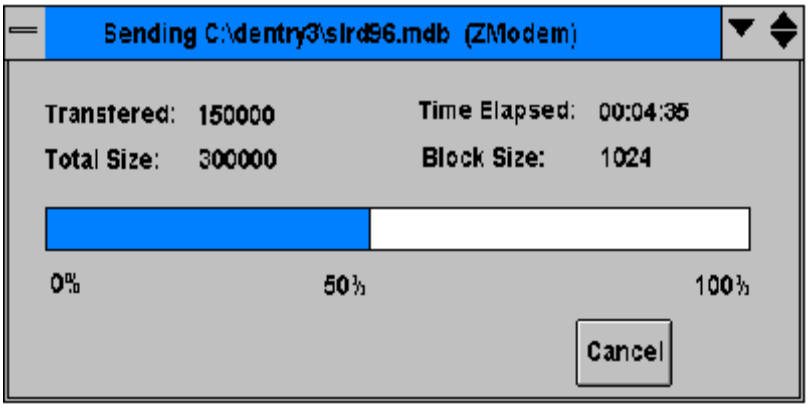
The program will now run a test to check your make and model selected with your modem. If your modem is not compatible with your selection, you will receive an error message and be requested to make another modem selection.

If there are no error messages, the following File Transfer screen will appear:



On this screen, type the phone number of our server into the text box, 1-701-231-6236, and then press the ***Dial*** command button. Be sure to include any number you need to dial out from your phone system. The program will then dial and attempt to connect to our server.

If the program connects, there will be messages displayed in the black box area on the bottom of the File Transfer form. Once the actual file transfer begins, the following will be displayed on your screen:



If the transfer is working properly, the number of bytes transferred and the percent completed gauge should both be increasing. If the maximum baud rate was set too high when you set the modem port settings, you will notice the following on the screen: the bytes transferred and percent complete will increase for a while, then abruptly go back to zero. If this condition repeats itself several times, you will need to cancel the transfer, reset the baud rate to a lower rate in the Port Settings form, and re-attempt dialing up our system. If the file transfer is completed without error, this form will close, and you will return to the File Transfer form. A message will appear in the message area saying "Upload Successful." If you get this message you are finished; the data has been transferred successfully to our server.

Chapter 6 - Help System

A Help Guide is included with Dentry 3.0. After starting the program, you can access the help file through the menu. There is a Table of Contents section and also a Search Facility available. General assistance, such as definitions and information similar to the information found in this Help Guide are available electronically.

The Survey Glossary included in the mailing defines the terms of each survey question. Built into the program this year is context-sensitive help. If you have a question on a definition of a particular question asked, all you need to do is double-click on the corresponding label in the program, and a small box will appear with the definition for that term. Most of the labels in the program have the context-sensitive help feature.

[Warning: The Technical Support option in the Help menu is not working. To get technical support read Chapter 7 of this guide, or if using the electronic help system's Table of Contents, jump to the TroubleShooting section.]

Chapter 7 - Troubleshooting

1. When you click on the 1994 data, if the data is either not in the correct directory or its not installed, a dialogue box appears prompting the user to copy the 1994 data into the C:\Dentry2\ directory. Copy the 1994 data into C:\Dentry2\ and try clicking on 1994 again.

2. If the program doesn't run at all, or quits after you press Continue from the startup form, you may want to check to make sure the program was installed in the c:\Dentry2\ directory. If it wasn't, you will have to reinstall the program, and make sure to install it to the c:\Dentry2\ directory.

If you have any further questions, please feel free to call:

Trent Byberg at (701) 231-1075
or, Doug Benson at (701) 231-8388

between 7:30 A.M. and 4:00 P.M. Central Standard Time

or send e-mail to:

Trent at byberg@badlands.nodak.edu
or, Doug at benson@plains.nodak.edu

Appendix D:

World Wide Web Design Background

Purpose

To disseminate information on the distinctive characteristics of the small railroad industry and to increase knowledge of the intrinsic role small railroads play in maintaining an effective and efficient national transportation system.

Audience

The main audience on the internet will be short line railroad managers and owners, policy makers, industry representatives, government officials, researchers, and others interested in transportation.

Web Site Content List

Section 1: Information on the survey, who supported the effort, how to obtain a survey, participate in the survey, etc.
Section 2: Industry Total Estimates
Section 3: Weighted Averages over the three years of information
Section 4: 3-year ratios computed directly from the database
Section 5: Survey Response Rates

Index Page and Site Organization

First page contains Introduction
Second page contains the Index
Other pages contain different information, graphs, and tables from the survey

Background Color or Texture

Remain consistent with the UGPTI web site color scheme

Basic Page Elements

Basic elements of the pages are graphs, charts, and tables.

Web Site Maintenance

Identify where ongoing changes need to be addressed. Generally, the ongoing changes will be the addition of new survey information and the updating of existing survey information on the web site.

Adding New Information

The site must maintain its audience. Those interested will not come back if information is not updated at regular intervals. Information should be updated at least every two weeks. Also keep a *What's New* tab in the UGPTI area to attract attention to the web pages that recently have been updated or added.

Interaction Plan

Solicit comments from the readers of this information. Feedback on the content and design of the database web pages is useful. Other information of interest is the audience. Minor adjustments can be applied to the web site to better fit the background of the audience.

APPENDIX E:

Computing the Variance of the Sum of Point Estimates

Computation of Variance

In 1995, there were 72 missing local line-haul railroad data points, and 1 missing regional railroad data point. The variance of the sum of 457 data points and 73 missing data points is derived as follows:[3]

Let n = the number of valid responses.
l = the number of missing local line-haul railroads
r = the number of missing regional railroads
$\bar{\hat{x}}_{loc}$ = the average point estimate for all known local line-haul railroads
$\bar{\hat{x}}_{reg}$ = the average point estimate for all known regional railroads

$$Var\left(\hat{x}_1+\hat{x}_2+\ldots+\hat{x}_n+l*\bar{\hat{x}}_{loc}+r*\bar{\hat{x}}_{Reg}\right)$$

$$= Var\left(\begin{array}{l}\left(\begin{array}{l}a_1+\hat{b}_1 TCar_1+\hat{b}_2 Emp_1+\hat{b}_3 MO_1+\hat{b}_4 Av_1+\hat{b}_5 RT_1+\\ \hat{b}_6 TCar_1*RT_1+\hat{b}_7 Emp_1*RT_1+\hat{b}_8 MO_1*RT_1+\hat{b}_9 Av_1*RT_1\end{array}\right)\\ +\left(\begin{array}{l}a_1+\hat{b}_1 TCar_2+\hat{b}_2 Emp_2+\hat{b}_3 MO_2+\hat{b}_4 Av_2+\hat{b}_5 RT_2+\\ \hat{b}_6 TCar_2*RT_2+\hat{b}_7 Emp_2*RT_2+\hat{b}_8 MO_2*RT_2+\hat{b}_9 Av_2*RT_2\end{array}\right)\\ +\quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\\ +\left(\begin{array}{l}a_1+\hat{b}_1 TCar_n+\hat{b}_2 Emp_n+\hat{b}_3 MO_n+\hat{b}_4 Av_n+\hat{b}_5 RT_n+\\ \hat{b}_6 TCar_n*RT_n+\hat{b}_7 Emp_n*RT_n+\hat{b}_8 MO_n*RT_n+\hat{b}_9 Av_n*RT_n\end{array}\right)\\ +l*\bar{\hat{x}}_{loc}+r*\bar{\hat{x}}_{reg}\end{array}\right)$$

[3]Personal Communication: Discussion with Dr. M.B. Rao, North Dakota State University, September 1997.

$$= \left(n\,Var\left(\hat{a}\right) \right) + Var(\hat{b}_1)\left[\left(\sum_{i=1}^{n-(l+r)} TCar_i \right) + l * \overline{\hat{TCar}}_{loc} + r * \overline{\hat{TCar}}_{reg} \right] +$$

$$Var(\hat{b}_2)\left[\left(\sum_{i=1}^{n-(l+r)} Emp_i \right) + l * \overline{\hat{Emp}}_{loc} + r * \overline{\hat{Emp}}_{reg} \right] +$$

$$Var(\hat{b}_3)\left[\left(\sum_{i=1}^{n-(l+r)} MO_n \right) + l * \overline{\hat{MO}}_{loc} + r * \overline{\hat{MO}}_{reg} \right] +$$

$$Var(\hat{b}_4)\left[\left(\sum_{i=1}^{n-(l+r)} Av_i \right) + l * \overline{\hat{AV}}_{loc} + r * \overline{\hat{AV}}_{reg} \right] +$$

$$Var(\hat{b}_5)\left[\left(\sum_{i=1}^{n-(l+r)} RT_i \right) + l * \overline{\hat{RT}}_{loc} + r * \overline{\hat{RT}}_{reg} \right] +$$

$$Var(\hat{b}_6)\left[\left(\sum_{i=1}^{n-(l+r)} TCar_i * RT_i \right) + l * \overline{\hat{TCar} * RT}_{loc} + r * \overline{\hat{TCar} * RT}_{reg} \right] +$$

$$Var(\hat{b}_7)\left[\left(\sum_{i=1}^{n-(l+r)} Emp_i * RT_i \right) + l * \overline{\hat{Emp} * RT}_{loc} + r * \overline{\hat{Emp} * RT}_{reg} \right] +$$

$$Var(\hat{b}_8)\left[\left(\sum_{i=1}^{n-(l+r)} MO_i * RT_i \right) + l * \overline{\hat{MO} * RT}_{loc} + r * \overline{\hat{MO} * RT}_{reg} \right] +$$

$$Var(\hat{b}_9)\left[\left(\sum_{i=1}^{n-(l+r)} Av_i * RT_i \right) + l * \overline{\hat{Av} * RT}_{loc} + r * \overline{\hat{Av} * RT}_{reg} \right] +$$

$$2Cov(\hat{a}, \hat{b}_1) * n * \left(\sum_{i=1}^{n-(l+r)} TCar_i \right) + 2Cov(\hat{a}, \hat{b}_2) * n * \left(\sum_{i=1}^{n-(l+r)} Emp_i \right) +$$

$$\ldots \quad + \text{the 43 other covariances}$$

This formula is quite long, and appears complex. There is, however, a straightforward way to calculate the variance. This large formulation can be put into matrix form and any software capable of doing matrix algebra can calculate the resulting variance. Using the SAS statistical software package, the first matrix needed is calculated automatically. The resulting model gives us 10 parameter estimates,

$$\hat{a}, \hat{b}_1, \hat{b}_2, \hat{b}_3, \hat{b}_4, \hat{b}_5, \hat{b}_6, \hat{b}_7, \hat{b}_8, \hat{b}_9$$

Each of these parameter estimates has a variance associated with it and each combination of any two of these estimates has an associated covariance. The resulting variance and covariances are outputted by SAS to a 10x10 matrix.

VarCov =

$$\begin{pmatrix}
Var(\hat{a}) & Cov(\hat{a},\hat{b}_1) & Cov(\hat{a},\hat{b}_2) & Cov(\hat{a},\hat{b}_3) & Cov(\hat{a},\hat{b}_4) & Cov(\hat{a},\hat{b}_5) & Cov(\hat{a},\hat{b}_6) & Cov(\hat{a},\hat{b}_7) & Cov(\hat{a},\hat{b}_8) & Cov(\hat{a},\hat{b}_9) \\
Cov(\hat{b}_1,\hat{a}) & Var(\hat{b}_1) & Cov(\hat{b}_1,\hat{b}_2) & Cov(\hat{b}_1,\hat{b}_3) & Cov(\hat{b}_1,\hat{b}_4) & Cov(\hat{b}_1,\hat{b}_5) & Cov(\hat{b}_1,\hat{b}_6) & Cov(\hat{b}_1,\hat{b}_7) & Cov(\hat{b}_1,\hat{b}_8) & Cov(\hat{b}_1,\hat{b}_9) \\
Cov(\hat{b}_2,\hat{a}) & Cov(\hat{b}_2,\hat{b}_1) & Var(\hat{b}_2) & Cov(\hat{b}_2,\hat{b}_3) & Cov(\hat{b}_2,\hat{b}_4) & Cov(\hat{b}_1,\hat{b}_5) & Cov(\hat{b}_2,\hat{b}_6) & Cov(\hat{b}_2,\hat{b}_7) & Cov(\hat{b}_1,\hat{b}_8) & Cov(\hat{b}_2,\hat{b}_9) \\
Cov(\hat{b}_3,\hat{a}) & Cov(\hat{b}_3,\hat{b}_1) & Cov(\hat{b}_3,\hat{b}_2) & Var(\hat{b}_3) & Cov(\hat{b}_3,\hat{b}_4) & Cov(\hat{b}_3,\hat{b}_5) & Cov(\hat{b}_3,\hat{b}_6) & Cov(\hat{b}_3,\hat{b}_7) & Cov(\hat{b}_3,\hat{b}_8) & Cov(\hat{b}_3,\hat{b}_9) \\
Cov(\hat{b}_4,\hat{a}) & Cov(\hat{b}_4,\hat{b}_1) & Cov(\hat{b}_4,\hat{b}_2) & Cov(\hat{b}_4,\hat{b}_3) & Var(\hat{b}_4) & Cov(\hat{b}_4,\hat{b}_5) & Cov(\hat{b}_4,\hat{b}_6) & Cov(\hat{b}_4,\hat{b}_7) & Cov(\hat{b}_4,\hat{b}_8) & Cov(\hat{b}_4,\hat{b}_9) \\
Cov(\hat{b}_5,\hat{a}) & Cov(\hat{b}_5,\hat{b}_1) & Cov(\hat{b}_5,\hat{b}_2) & Cov(\hat{b}_5,\hat{b}_3) & Cov(\hat{b}_5,\hat{b}_4) & Var(\hat{b}_5) & Cov(\hat{b}_5,\hat{b}_6) & Cov(\hat{b}_5,\hat{b}_7) & Cov(\hat{b}_5,\hat{b}_8) & Cov(\hat{b}_5,\hat{b}_9) \\
Cov(\hat{b}_6,\hat{a}) & Cov(\hat{b}_6,\hat{b}_1) & Cov(\hat{b}_6,\hat{b}_2) & Cov(\hat{b}_6,\hat{b}_3) & Cov(\hat{b}_6,\hat{b}_4) & Cov(\hat{b}_6,\hat{b}_5) & Var(\hat{b}_6) & Cov(\hat{b}_6,\hat{b}_7) & Cov(\hat{b}_6,\hat{b}_8) & Cov(\hat{b}_6,\hat{b}_9) \\
Cov(\hat{b}_7,\hat{a}) & Cov(\hat{b}_7,\hat{b}_1) & Cov(\hat{b}_7,\hat{b}_2) & Cov(\hat{b}_7,\hat{b}_3) & Cov(\hat{b}_7,\hat{b}_4) & Cov(\hat{b}_7,\hat{b}_5) & Cov(\hat{b}_7,\hat{b}_6) & Var(\hat{b}_7) & Cov(\hat{b}_7,\hat{b}_8) & Cov(\hat{b}_7,\hat{b}_9) \\
Cov(\hat{b}_8,\hat{a}) & Cov(\hat{b}_8,\hat{b}_1) & Cov(\hat{b}_8,\hat{b}_2) & Cov(\hat{b}_{8_1},\hat{b}_3) & Cov(\hat{b}_8,\hat{b}_4) & Cov(\hat{b}_8,\hat{b}_5) & Cov(\hat{b}_8,\hat{b}_6) & Cov(\hat{b}_8,\hat{b}_7) & Var(\hat{b}_8) & Cov(\hat{b}_8,\hat{b}_9) \\
Cov(\hat{b}_9,\hat{a}) & Cov(\hat{b}_9,\hat{b}_1) & Cov(\hat{b}_9,\hat{b}_2) & Cov(\hat{b}_9,\hat{b}_3) & Cov(\hat{b}_9,\hat{b}_4) & Cov(\hat{b}_9,\hat{b}_5) & Cov(\hat{b}_9,\hat{b}_6) & Cov(\hat{b}_9,\hat{b}_7) & Cov(\hat{b}_1,\hat{b}_8) & Var(\hat{b}_9)
\end{pmatrix}$$

The other matrix, call it A, contains the sums of the known quantities for each railroad.
A =

$$\begin{bmatrix} n-(l+r), \left(\sum_{i=1}^{n-(l+r)}(TCar_i)+l*\overline{TCar_i}+r*\overline{TCar_i}\right), \left(\sum_{i=1}^{n-(l+r)}(Emp_i)+l*\overline{Emp_i}+r*\overline{Emp_i}\right), \left(\sum_{i=1}^{n-(l+r)}(MO_i)+l*\overline{MO_i}+r*\overline{MO_i}\right) \\ \left(\sum_{i=1}^{n-(l+r)}(AV_i)+l*\overline{AV_i}+r*\overline{AV_i}\right), \left(\sum_{i=1}^{n-(l+r)}(RT_i)+l*\overline{RT_i}+r*\overline{RT_i}\right), \left(\sum_{i=1}^{n-(l+r)}(TCar_i*RT_i)+l*\overline{TCar_i*RT_i}+r*\overline{TCar_i*RT_i}\right) \\ \left(\sum_{i=1}^{n-(l+r)}(Emp_i*RT_i)+l*\overline{Emp_i*RT_i}+r*\overline{Emp_i*RT_i}\right), \left(\sum_{i=1}^{n-(l+r)}(MO_i*RT_i)+l*\overline{MO_i*RT_i}+r*\overline{MO_i*RT_i}\right), \\ \left(\sum_{i=1}^{n-(l+r)}(AV_i*RT_i)+l*\overline{AV_i*RT_i}+r*\overline{AV_i*RT_i}\right) \end{bmatrix}$$

Next, the variance is computed from the two matrices:

Variance(Industry Estimate) = (A)(VarCov)(A`)
where A` is the transpose of A.

This computation will result in a single answer that is the variance of the industry estimate.

Appendix F:

SAS Program For Model Estimation and Variance Computation

“Industry Estimate Variance.SAS”

```
libname slrd'd:\aslra';
data one;

set slrd.combo;

proc reg outest=CV covout;
model transfrt = mownop employes avg_leng transcar reg mownreg empreg lengreg treg;

proc iml;

/** 1995 variance-covariance matrix from the computed model is CV        **/
/** Keep necessary variance-covariance variables and place into matrix C **/

Use CV;
Read point {2 3 4 5 6 7 8 9 10 11} var{INTERCEP MOWNOP EMPLOYES AVG_LENG
        TRANSCAR REG MOWNREG EMPREG LENGREG TREG} into C;

/** Sum the Known variables from the AAR data and place the sums in matrix A **/
A = {530 46856 24103 18377 10192.99 500 27801 13089 13005 6189.68};

/** The order of the sums in matrix A are as follows:
       N
       Miles owned and operated
       Employees
       Average Length of haul
       Transformed carloads
       Reg
       Miles owned and operated * reg
       employees * reg
       Average length of haul * reg
       Transformed Carloads * Reg
*/

/** B = the transpose of A **/

B = T(A);

Test = A*C*B;

/** Test = the variance of the sum of N point estimates **/
print Test;

quit;
run;
```

Appendix G:

Results of Other Analysis

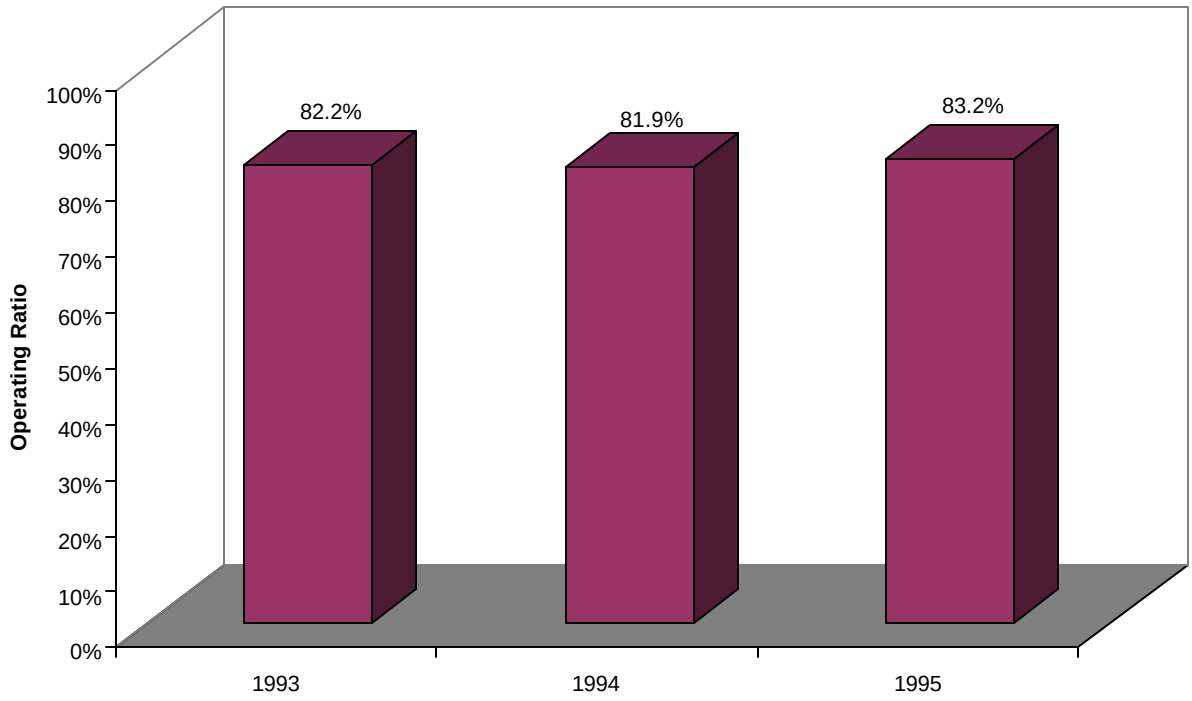
Table G1: Distribution of Traffic Flow 1993-1995

The following table displays the distribution of traffic by movement type for small railroads over the three-year period from 1993 to 1995. There are four movements listed — local, outbound, inbound, and bridge. Each value in the table represents the share each commodity has of the corresponding type of movement. The percentages are weighted by carloads over the three-year period.

Commodity	Average Percent of Local Traffic [1]	Average Percent of Outbound Traffic [2]	Average Percent of Inbound Traffic [3]	Average Percent of Bridge Traffic [4]
01 Farm Products	7%	11%	8%	12%
10 Metallic Ores	28%	9%	6%	5%
11 Coal	10%	13%	28%	6%
14 Non-metallic Minerals	4%	4%	2%	2%
20 Food & Kindred Products	5%	6%	4%	8%
24 Lumber & Wood Products	4%	5%	5%	8%
26 Pulp,Paper and Allied Products	3%	8%	6%	9%
28 Chemicals & Allied Products	3%	5%	8%	7%
29 Petroleum Products	4%	7%	6%	2%
32 Stone, Clay & Glass Products	2%	5%	5%	4%
33 Primary Metal Products	15%	13%	5%	3%
37 Transportation Equipment	1%	3%	2%	16%
40 Waste and Scrap Material	8%	3%	6%	3%
Other Commodities	6%	7%	7%	14%
Total	100%	100%	100%	100%

1. Local carloads are carloads, which both originated and terminated on the same railroad (a.k.a. single line movements).
2. Outbound traffic includes carloads that originated on the local railroad, but were interchanged to another carrier.
3. Inbound traffic includes carloads that were received from another carrier and then terminated on the local railroad.
4. Bridge traffic includes traffic received from one railroad, then delivered to another carrier on a different point in the local railroad's system.

Figure G1: 1993-1995 Average Operating Ratios
(all shortline survey respondents)



Operating Ratio	1993	1994	1995
N	175	184	162
Average	82.2%	81.9%	83.2%
Upper 10%	103.7%	108.4%	104.7%
Median	83.6%	80.7%	84.2%
Lower 10%	54.8%	53.0%	53.9%

Figure G2: 1993-1995 Freight Revenue per Car-Mile and Operating Expense per Car-Mile for Local Line-haul Railroads