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# **Expanding the North Dakota Input-Output Model to Include Recreation and Tourism**

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## Contents

	Page
<i>List of Tables</i> .....	iii
<i>List of Figures</i> .....	iii
<i>Highlights</i> .....	v
Need for Expanding the Input-Output Model .....	1
Adding the Recreation and Tourism Sector to the Input-Output Model .....	4
Data Collection .....	5
Technical Coefficient Development .....	5
Technical Coefficients Developmental Steps .....	6
Step 1: Average Expenditures and Revenues .....	6
Step 2: Total Expenditures and Revenues for the Population .....	7
Step 3: Aggregating Gross Expenditures and Revenues into Five Categories .....	7
Step 4: Total Recreation & Tourism Expenditures and Revenues .....	10
Step 5: Technical Input-Output Coefficients .....	12
Appending the Existing Input-Output Model .....	12
Technical Coefficients for the 18-Sector Input-Output Model .....	13
Interdependence Coefficients for the 18-Sector Input-Output Model .....	14
Productivity Ratios .....	14
References .....	17
Appendix A .....	19

See also: Randal C. Coon and Jay A. Leitch, "North Dakota 18-Sector Input-Output Model  
 (Includes Recreation and Tourism Sector)," Agricultural Economics Software  
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## List of Tables

Table	Page
1 ECONOMIC SECTORS AND ASSOCIATED STANDARD INDUSTRIAL CLASSIFICATION CODES FOR THE NORTH DAKOTA INPUT-OUTPUT MODEL . . . . .	2
2 NORTH DAKOTA SALES FOR FINAL DEMAND, BY INDUSTRY, (1980=BASE DOLLARS), 1987 . . . . .	3
3 BUSINESS TYPES INCLUDED IN THE EXPENDITURE/REVENUE CATEGORIES . . . . .	8
4 TRAVEL SPENDING IN NORTH DAKOTA BY EXPENDITURE CATEGORY, 1986 . . . . .	8
5 EXPENDITURE CATEGORIES AND ASSOCIATED BUSINESS AND SIC CODES . . . . .	11
6 GROSS REVENUE AND ASSOCIATED PROPORTION OF TOTAL REVENUE FOR R&T-RELATED BUSINESS IN DEVILS LAKE, MEDORA, AND FARGO, 1988 . . . . .	13
7 INPUT-OUTPUT INTERDEPENDENCE COEFFICIENTS, BASED ON TECHNICAL COEFFICIENTS FOR 18-SECTOR MODEL, NORTH DAKOTA . . . . .	15
8 GROSS BUSINESS VOLUME TO EMPLOYMENT (PRODUCTIVITY) RATIOS, BY ECONOMIC SECTOR, NORTH DAKOTA, 1989 . . . . .	16

## List of Figures

Figure	Page
1 Sales for Final Demand, by Industry (1980=Base Dollars), 1987 . . . . .	3



## Highlights

*A recreation and tourism sector was added to the North Dakota Input-Output model to facilitate analyzing economic impacts in this sector. Future expansion or development of tourist facilities and activities in North Dakota are a source of economic development as the state tries to diversify its economy. The additional sector was needed to standardize estimating the impacts from recreation and tourism.*

*Expenditures data were collected for businesses involved in retail- and service-type activities most often frequented by tourists. Questionnaires were administered through a combination of personal interview and mail survey methods to business owners in Fargo, Devils Lake, and Medora. The current 17-sector input-output model was expanded to 18 sectors by appending the recreation and tourism expenditures data to the original model. This operation was accomplished by deriving the 18-sector technical coefficients matrix and converting it to the input-output interdependence coefficients matrix.*





## **Expanding the North Dakota Input-Output Model to Include Recreation & Tourism**

Randal C. Coon, Theresa K. Golz, and Jay A. Leitch\*

Input-output analysis has been used extensively to quantify the North Dakota economy. With this technique the state's economy is divided into industrial sectors with multipliers that indicate the total gross business volume (gross receipts) generated in all sectors of the economy as a result of an increase in sales for final demand in that sector. Export sales of the state's products bring dollars into the state; these sales comprise the economic base for North Dakota. Applying the state's basic economic activity to the respective multipliers results in the total business activity, or gross business volume, for each economic sector. The previous version of the North Dakota Input-Output Model grouped the state's economic activities into seventeen industrial classifications (SIC) codes (Table 1). These groupings are used to categorize expenditures and to identify basic economic sectors.

Economic base activities in North Dakota include agriculture, mining, manufacturing, tourism, and federal government outlays (Coon, Leistritz, and Hertsgaard 1986). Recreation and tourism (R&T) has been a relatively small, but growing, component in the economic base. From 1958 to 1987, sales for final demand in the recreation and tourism sector increased from \$59.1 million (2.2 percent) to \$201.1 million (3.9 percent) of the economic base (Table 2) (Coon and Leistritz 1989). In future years as personal income increases, consumers will likely spend more time and money on leisure activities (i.e., leisure activities are income elastic) (Tomek and Robinson 1982). Therefore, R&T has the potential for becoming an increasingly important component in the state's economic base. This shift results in the need to develop an R&T sector for the input-output model. An R&T sector is needed in order to standardize estimating impacts of R&T on the state economy. State agencies as well as rural community development specialists will benefit from including the R&T sector because it will provide them with a tool capable of measuring impacts in economic terms.

One of the most salient changes seen in the North Dakota economy in the past three decades has been the substantial relative decline in the value of the state's agricultural sectors (Coon and Leistritz 1989) from 68 percent of the economic base in 1958 to 43 percent in 1987 (Table 2). However, from 1958 to 1987 sales for final demand in the recreation sector (previously allocated to retail trade and business and personal service sectors) increased in both absolute and relative terms (Figure 1) so that by 1987 this sector was the fifth largest basic industry in the state based on sales for final demand. Growth in the R&T industry has contributed to the increased economic base of North Dakota during the past three decades.

### **Need for Expanding the Input-Output Model**

Because recreation and tourism is not one of the seventeen separate sectors in the existing North Dakota Input-Output (I-O) Model, it is not well-suited to estimate the economic impacts of R&T. The past procedure for estimating the economic impacts of R&T was to allocate 25 percent of these direct expenditures to the business and personal services sector, and 75 percent to the retail trade sector (Baltezore and Leitch 1988).

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TABLE 1. ECONOMIC SECTORS AND ASSOCIATED STANDARD INDUSTRIAL CLASSIFICATION CODES FOR THE NORTH DAKOTA INPUT-OUTPUT MODEL

Economic Sector	SIC Code
1. Agriculture, Livestock	Major Group 02 - Agricultural Production, Livestock
2. Agriculture, Crops	Major Group 01 - Agricultural Production Crops
3. Nonmetallic Mining	Major Group 14 - Mining and Quarrying of Nonmetallic Minerals, Except Fuels
4. Contract Construction	Major Groups 15, 16, 17 - Contract Construction
5. Transportation	Major Groups 40, 41, 42, 43, 44, 45, 46, and 47 - Transportation
6. Communications and Utilities	Major Group 48 - Communication, and Major Group 49 - Electric, Gas, and Sanitary Services, Except Industry No. 4911
7. Agricultural Processing and Miscellaneous Manufacturing	Major Group 50 and 51 - Wholesale Trade, Major Group 20 - Food and Kindred Products Manufacturing
8. Retail Trade	Major Groups 52, 53, 54, 55, 56, 57, 58, and 59 - Retail Trade
9. Finance, Insurance, and Real Estate	Major Group 60, 61, 62, 63, 64, 65, 66, and 67 - Finance, and Insurance, and Real Estate
10. Business and Personal Services	Major Groups 70, 72, 73, 75, 76, 78, and 79 - Business and Personal Services
11. Professional and Social Services	Major Groups 80, 81, 82, 83, 84, 86, 88, and 89 - Professional and Social Services
12. Households	Not Applicable
13. Government	Major Groups 91, 92, 93, 94, 95, 96, and 97 - Government
14. Coal Mining	Major Group 12 - Bituminous Coal and Lignite Mining
15. Thermal-Electric Generation	Major Group 491 - Electric Companies and Systems
16. Petroleum and Natural Gas Exploration and Extraction	Major Group 13 - Crude Petroleum and natural Natural Gas
17. Petroleum Refining	Major Group 20 - Petroleum Refining and Related Industries

SOURCE: Office of Management and Budget (1987).

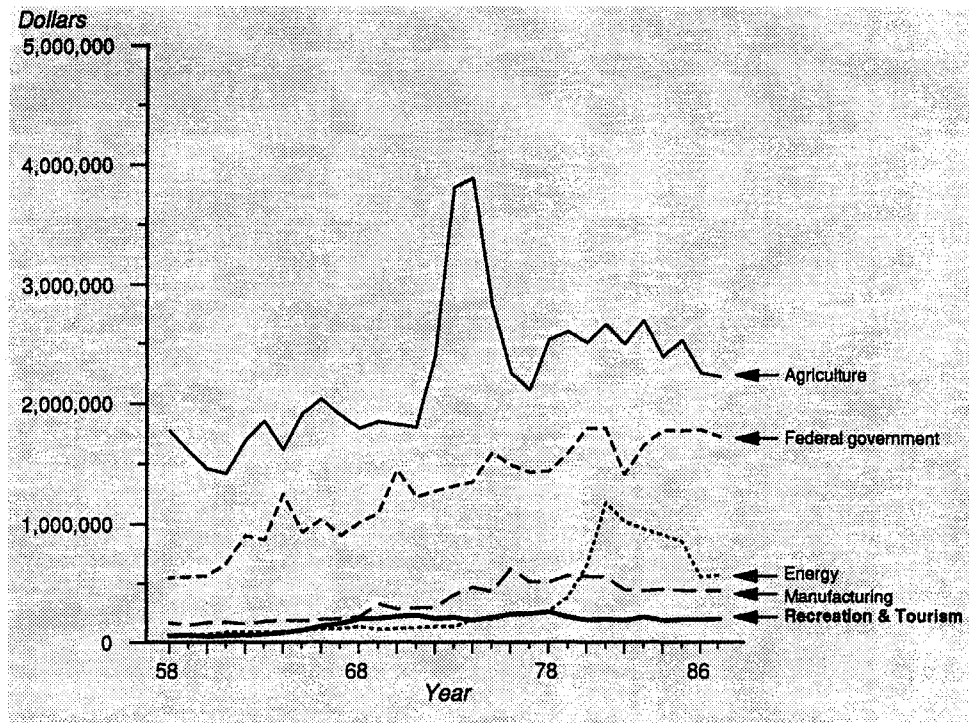


Figure 1. North Dakota Sales for Final Demand, by Industry (1980=Base Dollars), 1987

SOURCE: Coon and Leistritz 1989.

TABLE 2. NORTH DAKOTA SALES FOR FINAL DEMAND, BY INDUSTRY, (1980=BASE DOLLARS), 1987

Industry	Sales for Final Demand		Percent of Economic Base		Rank	
	1958	1987	1958	1987	1958	1987
	-----\$000-----		----percent----			
Agriculture	1774.3	2223.3	68	43	1	1
Federal Government	551.5	1728.1	21	33	2	2
Energy	52.7	575.4	2	11	5	3
Miscellaneous manufacturing	167.9	444.7	7	9	3	4
Recreation & tourism	59.1	201.1	2	4	4	5

SOURCE: Coon and Leistritz 1989.

Changing and refining the I-O Model to reflect changes in the state's economic base make it more accurate and usable. This is for economic analyses, such as contribution studies and impact analyses.

The distinct R&T sector will contain components of the business and personal services, retail trade, and transportation sectors. State policymakers' realization of R&T as a viable economic sector could translate into legislative appropriations to develop or expand recreational facilities as an economic development tool in the state. Increased recreation and tourism activity could lead to increased levels of business activity, employment, personal income, and tax collections. Mittleider and Leitch (1984) concluded that North Dakota state parks generated over \$78 million in total business activity with over \$37 million in retail sales, personal income of nearly \$18 million, total employment (direct and secondary) of 1,822 persons, and estimated tax revenues in excess of \$1.6 million.

### **Adding the Recreation and Tourism Sector to the Input-Output Model**

Development of an input-output model for North Dakota began more than 20 years ago. For a detailed discussion of the model and its development see Coon et al. (1985). Input-Output interdependence coefficients have been developed at the state and regional level for North Dakota. These coefficients are commonly called multipliers because they measure the number of times a dollar of income "turns over" in the state. The multiplier effect results when each producing sector buys some fraction of its inputs from other sectors of the state's economy, and these sectors, in turn, use some fraction of that income to buy some of their inputs from still other sectors, and so on. The multiplier effect is due to the spending and respending within the state's economy of part of each dollar that enters the state. Because of the export of products from one state region to another (primarily energy products), a separate set of input-output interdependence coefficients was derived for the regional level.

The initial step in expanding the North Dakota Input-Output Model to include recreation and tourism was to collect expenditure data for firms in the new sector (Golz 1989). Recreation and tourism expenditures were estimated using primary data collected from R&T-related businesses in Fargo, Devils Lake, and Medora. The survey instrument (Appendix A) sought information for ten of the seventeen input-output sectors in which R&T-related businesses make purchases. It was assumed the R&T-related businesses do not make purchases in the following seven sectors: agriculture (livestock and crops), mining, and the four energy sectors. Business owners in the three areas were asked to estimate four items: (1) their annual expenditures in each of the sectors both within and outside their state planning region but within North Dakota, (2) gross revenue, (3) number of employees, and (4) percent of gross business receipts from tourists.

Because recreation and tourism-related businesses have similar purchases and sales patterns, R&T activities can be grouped into one sector. Standard Industrial Classification Codes (SIC codes) were used to group appropriate businesses into an R&T sector. Businesses included in the R&T sector are in the business and personal services, retail trade, and transportation sectors:

- gasoline service stations (SIC 5541),
- boat and recreational vehicle dealers (SIC 5551 and 5561),
- eating and drinking places (SIC 5812 and 5813),

- sporting goods stores (SIC 5941),
- souvenir shops (SIC 5947),
- lodging services (SIC 7011),
- entertainment (SIC 7999),
- marinas (SIC 4493), and
- travel agencies (SIC 4724).

Travel agencies could have been included in establishing an R&T input-output model sector, but no survey responses were received from Devils Lake agencies, and Medora had no travel agency business. Agencies responding from Fargo catered to recreation outside of the state, and were not applicable to this analysis. Therefore, travel agencies were not included in the data collected for the establishment of the R&T sector.

### **Data Collection**

Questionnaires were mailed to all 119 recreation and tourism businesses in Devils Lake, all 52 businesses in Medora, and a sample of 64 businesses in Fargo. A combination of reminder follow-up mailings and personal visits resulted in 38 usable surveys from Devils Lake, 30 from Medora, and 20 from Fargo. Many of the R&T businesses in Fargo were "chain" stores with corporate headquarters outside the state, which made it virtually impossible for local managers to provide necessary data.

### **Technical Coefficient Development**

Recreation and tourism expenditure data were aggregated into ten appropriate sectors of the North Dakota Input-Output Model (Coon et al. 1985) by business type and survey location--Devils Lake, Medora, and Fargo. Thirteen business types were used:

- recreation clubs (SIC 7997),
- gas stations (SIC 5541),
- gift shops (SIC 5947),
- drinking places (SIC 5813),
- liquor stores (SIC 5921),
- amusement and recreation (SIC 7999),
- boat dealers (SIC 5551),
- marinas (SIC 4493),
- eating places (SIC 5812),
- sporting goods (SIC 5941),
- motels (SIC 7011),
- campgrounds (SIC 7032), and
- unknowns (SIC 52).

"Unknowns" include R&T-related businesses that did not indicate which business type they were on their questionnaire.

### *Technical Coefficients Developmental Steps*

Five steps were used to transform expenditure and revenue data into technical coefficients. The steps are first summarized below and then described in detail in the following sections.

1. Expenditures and revenues per sector from each usable questionnaire were totalled to represent total expenditures and revenues for each of the thirteen business types. Total expenditures and revenues were divided by the number of usable questionnaires to estimate average expenditures and revenues. Average expenditures and revenues of the thirteen business types were necessary to project expenditures and revenues for the population (every business of that business type in the survey location).
2. Average expenditures and revenues were multiplied by the total number of businesses in that business type to derive total expenditures/revenues for the population.
3. The thirteen business types were aggregated into five gross expenditures and revenues categories corresponding with the U.S. Travel Data Center's categories (U.S. Travel Data Center 1988).
4. These categories were multiplied by the appropriate weighted average of travel spending in North Dakota to estimate total traveler expenditures and revenues.
5. Total traveler expenditures by sector divided by total traveler revenues by sector results in the technical input-output coefficients.

#### *Step 1. Average Expenditures and Revenues*

Expenditures/revenues in each input-output sector were summed to arrive at the total expenditures/revenues for each of the 13 business types. Total expenditures in each I-O sector were divided by the number of usable questionnaires from each of the 13 business types to obtain the average expenditures by sector for each business type (equation 1):

$$AE_{ij} = TE_{ij} / N_j \quad (1)$$

where:

- $AE_{ij}$  = average expenditures in I-O sector  $i$  by business type  $j$
- $TE_{ij}$  = total expenditures in I-O sector  $i$  by business type  $j$
- $N_j$  = number of usable questionnaires in business type  $j$

Total revenues were summed for each business type. Average revenues were computed by dividing total revenues for each business type by the number of useable questionnaires of each type (equation 2).

$$AR_j = TR_j / N_j \quad (2)$$

where:

- $AR_j$  = average revenues of business type  $j$
- $TR_j$  = total revenues of business type  $j$
- $N_j$  = number of useable questionnaires in business type  $j$

### *Step 2. Total Expenditures and Revenues for the Population*

In order for expenditure/revenue data to represent the entire business type, average expenditures of each business type, by sector, from each useable questionnaire were multiplied by the number of businesses in that type. The result was an estimate of total expenditures for the population. Total expenditures for the population represent all businesses in that type even those that did not return their survey instrument (equation 3):

$$TEP_{ij} = AE_{ij} \times B_j \quad (3)$$

where:

- $TEP_{ij}$  = total expenditures for population in I-O sector  $i$  by business type  $j$
- $AE_{ij}$  = average expenditures in I-O sector  $i$  by business type  $j$
- $B_j$  = number of businesses in business type  $j$

Average revenues for each business type were multiplied by the number of businesses in that business type, resulting in an estimate of total revenue for the population (total revenue represents all businesses in that type even those that did not return their survey instrument) (equation 4):

$$TRP_j = AR_j \times B_j \quad (4)$$

where:

- $TRP_j$  = total revenue for population of business type  $j$
- $AR_j$  = average revenue of business type  $j$
- $B_j$  = number of businesses in type  $j$

### *Step 3. Aggregating Gross Expenditures and Revenues into Five Categories*

Expenditures and revenues for the thirteen business types were aggregated into five gross expenditures and revenues categories to be consistent with the U.S. Travel Data Center's classifications. Gross expenditures by sector for each expenditure category were calculated by adding appropriate business type expenses together (equations 5 through 9). The 13 business types were combined as shown in Table 3 to represent gross expenditure and revenue categories.

Because public transportation is not a major recreation and tourism expenditure in North Dakota, the distribution of travel expenditure was adjusted by dividing "percent of state total" (Table 4) for each of the remaining five travel categories by 0.83 to reach an adjusted figure. The sum of "percent of state totals" excluding public transportation is 83 percent.



TABLE 3. BUSINESS TYPES INCLUDED IN THE EXPENDITURE/REVENUE CATEGORIES

Expenditure/Revenue Category	Business Types Included
Auto transportation	gas stations (1) and boat dealers (2)
Lodging	motels (3) and campgrounds (4)
Food service	eating (5) and drinking places (6)
Entertainment/recreation	amusement and recreation (7), marinas (8), and recreation clubs (9)
General retail trade	liquor stores (10), sporting goods stores (11), gift shops (12), and unknowns (13)

TABLE 4. TRAVEL SPENDING IN NORTH DAKOTA BY EXPENDITURE CATEGORY, 1986

Expenditure Category	Expenditure (\$millions) <sup>a</sup>	Percent of State Total <sup>b</sup>	Adjusted Percentages
Public transportation	105.6	17.00	NA <sup>d</sup>
Auto transportation	177.4	28.57	34.42
Lodging	66.2	10.66	12.84
Food Service	163.2	26.28	31.66
Entertainment/recreation	45.6	7.34	8.85
General retail trade	<u>63.0</u>	<u>10.15</u>	<u>12.23</u>
Total	621.0	100.00	100.00

<sup>a</sup>U.S. Travel Data Center 1988.

<sup>b</sup>The sum excluding public transportation equals 83%.

<sup>c</sup>Adjusted figures were estimated by dividing percent of state total by .83.

<sup>d</sup>Public transportation is not a major recreation and tourism expenditure in North Dakota; thus, it is not included as a travel expenditure.

$$GET_{ik} = \sum_{i=1}^{10} \sum_{j=1}^2 TEP_{ij} \quad (5)$$

where:

$GET_{ik}$  = gross expenditures in I-O sector  $i$  by expenditure category  $k$ , auto transportation

$TEP_{ij}$  = total expenditures for population in I-O sector  $i$  by business types  $j$  (business types 1 and 2 in Table 3)

$$GEL_{ik} = \sum_{i=1}^{10} \sum_{j=3}^4 TEP_{ij} \quad (6)$$

where:

$GEL_{ik}$  = gross expenditures in I-O sector  $i$  by expenditure category  $k$ , lodging

$TEP_{ij}$  = total expenditures for population in I-O sector  $i$  by business types  $j$  (business types 3 and 4)

$$GEF_{ik} = \sum_{i=1}^{10} \sum_{j=5}^6 TEP_{ij} \quad (7)$$

where:

$GEF_{ik}$  = gross expenditures in I-O sector  $i$  by expenditure category  $k$ , food service

$TEP_{ij}$  = total expenditures for population in I-O sector  $i$  by business types  $j$  (business types 5 and 6)

$$GEE_{ik} = \sum_{i=1}^{10} \sum_{j=7}^9 TEP_{ij} \quad (8)$$

where:

$GEE_{ik}$  = gross expenditures in I-O sector  $i$  by expenditure category  $k$ , entertainment/recreation

$TEP_{ij}$  = total expenditures for population in I-O sector  $i$  by business types  $j$  (business types 7, 8, and 9)

$$GER_{ik} = \sum_{i=1}^{10} \sum_{j=10}^{13} TEP_{ij} \quad (9)$$

where:

$GER_{ik}$  = gross expenditures in I-O sector  $i$  by expenditure category  $k$ , general retail trade

$TEP_{ij}$  = total expenditures for population in I-O sector  $i$  by business types  $j$  (business types 10, 11, 12, and 13)

Gross revenues for each business type were calculated by adding the appropriate business type revenues together (Table 3) (equations 10 through 14).

$$GRT_k = \sum_{j=1}^2 TRP_j \quad (10)$$

where:

GRT<sub>k</sub> = gross revenue by revenue category *k*, auto transportation  
 TRP<sub>j</sub> = total revenue for population of business types *j* (business types 1 and 2)

$$GRL_k = \sum_{j=3}^4 TRP_j \quad (11)$$

where:

GRL<sub>k</sub> = gross revenue by revenue category *k*, lodging  
 TRP<sub>j</sub> = total revenue for population of business types *j* (numbers 3 and 4)

$$GRF_k = \sum_{j=5}^6 TRP_j \quad (12)$$

where:

GRF<sub>k</sub> = gross revenue by revenue category *k*, food service  
 TRP<sub>j</sub> = total revenue for population of business types *j* (numbers 5 and 6)

$$GRE_k = \sum_{j=7}^9 TRP_j \quad (13)$$

where:

GRE<sub>k</sub> = gross revenue by revenue category *k*, entertainment/recreation  
 TRP<sub>j</sub> = total revenue for population of business types *j* (numbers 7, 8, and 9)

$$GRR_k = \sum_{j=10}^{13} TRP_j \quad (14)$$

where:

GRR<sub>k</sub> = gross revenue by revenue category *k*, general retail trade  
 TRP<sub>j</sub> = total revenue for population of business types *j* (numbers 10, 11, 12,

and 13)

The thirteen business types were aggregated into five categories according to classification of the U.S. Travel Data Center; the categories are automobile, lodging, food service, entertainment/recreation, and general retail trade industries. The Data Center's classifications were adopted for use in this study (Table 5) with the appropriate weighted averages calculated from Table 4.

#### Step 4. Total Recreation & Tourism Expenditures and Revenues

Gross expenditures and revenues of the five expenditure/revenue categories (auto transportation, lodging, food service, entertainment/recreation, and general retail) were multiplied by the appropriate weighted average of travel spending in North Dakota (U.S. Travel Data Center 1988) (Table 4). Adding the five category totals of expenditures and revenues resulted in total recreation and tourism expenditures and revenues, respectively (equations 15 and 16).

TABLE 5. EXPENDITURE CATEGORIES AND ASSOCIATED BUSINESS TYPES AND SIC CODES

Expenditure Category	Business Types	SIC Code	Weighted Average <sup>a</sup>
			-%-
Auto transportation	gasoline service station boat dealers	5541 5551	34.42
Lodging	hotels and motels campgrounds	701 703	12.84
Food Service	eating and drinking	58	31.66
Entertainment/recreation	amusement and recreation recreation clubs marinas motion picture theaters	79 79 4493 783	8.85
General retail trade	liquor stores sporting goods stores gift shops unknowns (assumed retail trade)	5921 5941 5947 52	12.23

<sup>a</sup>Adjusted figures from Table 4.

$$TTE = GET_{ik} \times WAT + GEL_{ik} \times WAL + GEF_{ik} \times WAF + GEE_{ik} \times WAE + GER_{ik} \times WAR \quad (15)$$

where:

- TTE = total recreation and tourism expenditures
- GET<sub>ik</sub> = gross expenditures in I-O sector *i* by expenditure category *k*, auto transportation
- WAT = weighted average for auto transportation category
- GEL<sub>ik</sub> = gross expenditures in I-O sector *i* by expenditure category *k*, lodging
- WAL = weighted average for lodging category
- GEF<sub>ik</sub> = gross expenditures in I-O sector *i* by expenditure category *k*, food service
- WAF = weighted average for food service category
- GEE<sub>ik</sub> = gross expenditures in I-O sector *i* by expenditure category *k*,
- WAE = weighted average for entertainment/recreation category

$GER_{ik}$  = gross expenditures in I-O sector  $i$  by expenditure category  $k$ , retail trade

$WAR$  = weighted average for retail trade category

$$TTR = \frac{GRT_k \times WAT + GRL_k \times WAL + GRF_k \times WAF + GRE_k \times WAE + GRR_k \times WAR}{WAE + GRR_k \times WAR} \quad (16)$$

where:

$TTR$  = total recreation and tourism revenues

$GRT_k$  = gross revenue by revenue category  $k$ , auto transportation

$GRL_k$  = gross revenue by revenue category  $k$ , lodging

$GRF_k$  = gross revenue by revenue category  $k$ , food service

$GRE_k$  = gross revenue by revenue category  $k$ , entertainment/recreation

$GRR_k$  = gross revenue by revenue category  $k$ , retail trade

#### Step 5. Technical Input-Output Coefficients

Total recreation and tourism expenses divided by total recreation and tourism revenues are the technical input-output coefficients (equation 17). Technical coefficients indicate the fraction of total inputs of the R&T column sector obtained from the row sector. Technical input-output coefficients for the R&T sector have been generated for ten pertinent input-output sectors.

$$A_{ij} = TTE/TTR \quad (17)$$

where:

$A_{ij}$  = technical input-output coefficients

$TTE$  = total recreation and tourism expenditures

$TTR$  = total recreation and tourism revenues

#### Appending the Existing Input-Output Model

Technical and interdependence coefficients for the 17-sector North Dakota Input-Output Model were available from previously collected data (Hertsgaard et al. 1977). Technical coefficients show the payments (or receipts) of each economic sector to (or from) every other sector expressed in decimal fractions of column totals. Each coefficient in this table indicates the fraction of total inputs that the sector in each column purchased from the sector in each row. The interdependence coefficients table is derived from the technical coefficients table. Computationally, the interdependence coefficients table is the inverse of the I-A matrix, or  $[I-A]^{-1}$ . This table shows the total (direct and indirect) input requirements that must be obtained from the row sector per dollar of output for final demand by the column sector (Coon et al. 1985). Each coefficient includes the direct input requirement (from the technical coefficients) and the indirect requirement (from the multiplier effect).

The ND I-O interdependence coefficients, originally for a 17-sector model, were calculated using the following formula (Chase et al. 1982):

$$([I-A]_{17 \times 17})^{-1}$$

where:

$A_{17 \times 17}$  = technical coefficients table for 17 sectors  
 $I$  = identity matrix (one in the diagonal)

### Technical Coefficients for the 18-Sector Input-Output Model

Expenditure data collected from Devils Lake, Medora, and Fargo recreation- and tourism-related businesses provided the information necessary to develop technical coefficients for an additional economic sector. Technical coefficients developed for the three study sites were aggregated to construct one set of coefficients for the R&T sector.

A weighted average based on gross revenue in each of the three study areas was used to develop the R&T technical coefficients. Gross revenues were summed from each of the survey instruments returned by Devils Lake, Medora, and Fargo R&T-related businesses to obtain the weighted gross revenues (Table 6). The weighted revenue for each city was multiplied by the technical coefficient of that city in each I-O sector across the row and then summed to equal the weighted average technical coefficient.

Recreation and tourism in Devils Lake, Medora, and Fargo represent three different types of R&T in North Dakota. Technical coefficients were generated for each of the three study areas, but aggregated to represent the state because the three area coefficients would not have represented all types of R&T in the state. In order for the coefficients to capture the three different types of R&T, a weighted average based on gross revenue in each of the three study areas was used to represent the R&T sector.

The original 17-sector technical coefficients table  $[A]_{17 \times 17}$  was expanded to  $[A]_{18 \times 17}$  by adding zeros to the R&T sector row in the matrix. The last row is all zeros because it was assumed the 18-column sectors do not purchase anything from the R&T row. Also, people that purchase anything from the R&T sector were assumed to come from outside the area. The main expansion of the original 17-sector technical coefficients table was the addition of the R&T sector column to the matrix, increasing it to  $[A]_{18 \times 18}$ .

TABLE 6. GROSS REVENUE AND ASSOCIATED PROPORTION OF TOTAL REVENUE FOR R&T-RELATED BUSINESSES IN DEVILS LAKE, MEDORA, AND FARGO, 1988

City	Gross Revenue	Proportion of Total
Devils Lake	\$29,021,263	.4902
Medora	2,685,265	.0454
Fargo	<u>27,492,127</u>	<u>.4644</u>
Total	\$59,198,655	1.0000

$$[A]_{18 \times 17} + [A]_{18 \times 1} = [A]_{18 \times 18}$$

where:

$$\begin{aligned} [A]_{18 \times 1} &= \text{recreation and tourism sector technical coefficients table} \\ [A]_{18 \times 18} &= \text{18-sector technical coefficients table} \end{aligned}$$

$$\text{thus, } I - [A]_{18 \times 18} = [I - A]_{18 \times 18}$$

$$\text{and } ([I - A]_{18 \times 18})^{-1} = \text{interdependence coefficients for 18 sectors (Table 7)}$$

### Interdependence Coefficients for the 18-Sector Input-Output Model

The technical coefficients matrix is subsequently used to derive interdependence coefficients, which indicate the total (direct and indirect) input requirements per unit of output. The interdependence coefficients matrix by definition is  $[I - A]^{-1}$ , where  $A$  is the matrix of technical coefficients and  $I$  is an identity matrix. Expansion of the I-O model from 17 to 18 sectors required the use of a computerized matrix inversion program.

The interdependence coefficients for the R&T sector are derived from the technical coefficients. These 18-sector interdependence coefficients were calculated as follows:

$$\begin{aligned} ([I - A]_{18 \times 18})^{-1} &= [I - A]_{18 \times 18} \\ I - [I - A]_{18 \times 18} &= A_{18 \times 18} \end{aligned}$$

Computationally, the interdependence coefficients are the inverse of the  $I - A$  matrix, or  $[I - A]^{-1}$ . This table shows the total (direct and indirect) input requirements that must be obtained from the row sector per dollar of output for final demand by the R&T sector (Coon et al. 1985). Each coefficient includes the direct input requirement (from the technical coefficients) and the indirect requirement (from the multiplier effect). The R&T column total of Table 7 is the total requirements of all the row sectors per dollar of output for final demand by the R&T sector. The column total is termed the gross receipts multiplier.

The gross receipts multiplier for the R&T sector is 3.3. The multiplier measures the total gross business volume (gross receipts) generated in all sectors of the economy for each dollar spent in a sector. Therefore, for each dollar spent in the R&T sector, two and one-third dollars are created, giving a total business volume of three and one-third dollars when the original dollar is included.

### Productivity Ratios

The ratio of gross business volume to employment is called the productivity ratio. This ratio indicates the required business volume in each sector necessary to generate one more worker in that sector. Productivity ratios have previously been developed for North Dakota (Coon, Leistritz, and Hertsgaard 1989). These values were incorporated into the 18-sector North Dakota Input-Output Model (Table 8). Productivity ratios presented in the table are in terms of 1989 dollars.

TABLE 7. INPUT-OUTPUT INTERDEPENDENCE COEFFICIENTS BASED ON TECHNICAL COEFFICIENTS FOR 18-SECTOR MODEL, NORTH DAKOTA

Economic Sector	AGL	AGC	METM	CONS	TRAN	C&PU	MMFG	RET	FIRE	B&PS	P&SS	HH	GOVT	COAL	ELEC	PEXP	PREF	R&T
AGL	1.2072	0.0774	0.0445	0.0343	0.0455	0.0379	0.1911	0.0889	0.0617	0.0384	0.0571	0.0674	0.0000	0.0375	0.0250	0.0159	0.0040	0.0761
AGC	0.3938	1.0922	0.0176	0.0134	0.0179	0.0152	0.6488	0.0318	0.0368	0.0152	0.0230	0.0267	0.0000	0.0285	0.0321	0.0063	0.0016	0.1917
METM	0.0084	0.0069	1.0396	0.0303	0.0092	0.0404	0.0063	0.0025	0.0050	0.0044	0.0051	0.0058	0.0000	0.0031	0.0019	0.0045	0.0007	0.0039
CONS	0.0722	0.0794	0.0521	1.0501	0.0496	0.0653	0.0619	0.0348	0.0740	0.0546	0.0787	0.0902	0.0000	0.0514	0.0320	0.1148	0.0168	0.0547
TRAN	0.0151	0.0113	0.0284	0.0105	1.0079	0.0135	0.0128	0.0104	0.0120	0.0118	0.0100	0.0093	0.0000	0.0082	0.0046	0.0180	0.0053	0.0127
C&PU	0.0921	0.0836	0.1557	0.0605	0.0840	1.1006	0.0767	0.0529	0.1322	0.1104	0.1192	0.1056	0.0000	0.0707	0.0375	0.0510	0.0106	0.0869
MMFG	0.5730	0.1612	0.0272	0.0207	0.0277	0.0239	1.7402	0.0452	0.0704	0.0237	0.0363	0.0417	0.0000	0.0617	0.0781	0.0097	0.0025	0.5043
RET	0.7072	0.8130	0.5235	0.4101	0.5476	0.4318	0.6115	1.2735	0.6765	0.4526	0.6669	0.7449	0.0000	0.3975	0.2256	0.1839	0.0458	0.4288
FIRE	0.1526	0.1677	0.1140	0.0837	0.1205	0.1129	0.1322	0.0578	1.1424	0.1085	0.1401	0.1681	0.0000	0.0767	0.0976	0.0388	0.0101	0.1052
B&PS	0.0562	0.0684	0.0430	0.0287	0.0461	0.0375	0.0514	0.0194	0.0766	1.0509	0.0455	0.0605	0.0000	0.0287	0.0200	0.0139	0.0035	0.0552
P&SS	0.0711	0.0644	0.0560	0.0402	0.0519	0.0527	0.0531	0.0276	0.0816	0.0497	1.1026	0.0982	0.0000	0.0491	0.0300	0.0210	0.0055	0.0476
HH	1.0459	0.9643	0.8428	0.6091	0.7878	0.7953	0.7862	0.4036	1.2019	0.7161	1.0438	1.5526	0.0000	0.6630	0.3953	0.3206	0.0828	0.6733
GOVT	0.0987	0.0957	0.0853	0.0519	0.2583	0.0999	0.0796	0.0395	0.1071	0.0774	0.0881	0.1080	1.0000	0.0508	0.0443	0.0280	0.0094	0.0724
COAL	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.1582	0.0003	0.0000	0.0000
ELEC	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000	0.0000	0.0000
PEXP	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0016	0.0010	1.0981	0.0954	0.0000
PREF	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0168	0.0102	0.0000	1.0000	0.0000
R&T	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000
Gross receipts multiplier	4.4931	3.6851	3.0284	2.4430	3.0534	2.7901	4.4509	2.0871	3.6778	2.7133	3.4159	3.0783	1.0000	2.5664	2.2057	1.9245	2.5693	3.3128



TABLE 8. GROSS BUSINESS VOLUME TO EMPLOYMENT  
(PRODUCTIVITY) RATIOS, BY ECONOMIC SECTOR,  
NORTH DAKOTA, 1989

Sector	Productivity Ratio
(1) & (2) Agriculture	106,170
(3) Nonmetallic mining	222,201
(4) Construction	51,937
(5) Transportation	11,501
(6) Comm & Public Util	70,215
(7) Ag Proc & Misc Mfg	66,584
(8) Retail trade	91,214
(9) FIRE	96,448
(10) Bus & Pers Service	13,935
(11) Prof & Soc Service	13,219
(12) Households	--
(13) Government	11,640
(14) Coal mining	146,283
(15) Thermal-Elec Gen	397,524
(16) Pet Exp/Ext	189,560
(17) Pet Refining	461,779
(18) Rec & Tourism	65,457

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**Appendix A**  
Survey Instrument

CONFIDENTIAL

RECREATION AND TOURISM INDUSTRY EXPENDITURES SURVEY

INSTRUCTIONS

All information will be kept strictly confidential. Please do not write the name of your firm on the questionnaire. Individual firm's characteristics will not be disclosed in the final published tables. The following general instructions are suggested in completing the questionnaire.

1. Use your records from the most recently completed business accounting year.
2. Information should be recorded in whole dollars.
3. If your firm operates more than one establishment in North Dakota, it is preferred that you include only one establishment for each questionnaire. Common costs should be identified on at least one of the questionnaires.
4. If your firm is an affiliate of a national firm, then the data should be only for the North Dakota location.
5. When exact information is not available, please estimate.
6. A definition of existing economic sectors is included to help in determining which sectors expenditures should be allocated to.
7. If you have questions, please contact:

Theresa Golz, Graduate Assistant (701)-237-7441  
or  
Jay Leitch, Associate Professor (701)-237-7467

Department of Agricultural Economics  
North Dakota State University  
Fargo, North Dakota 58105

What was your gross revenue in your most recently completed business accounting year

\$ \_\_\_\_\_

Number of employees in full-time equivalents: \_\_\_\_\_

Percent of gross business from tourists \_\_\_\_\_

Please estimate your expenditures in each of the following business sectors for the most recently completed business accounting year.

Input-Output Sector	<u>Estimated Annual Expenditure in</u> Region 3 (Rolette, Towner, Cavalier, Ramsey, North Dakota, Benson, and Eddy but outside Counties) Local Region	

Contract Construction

\$ \_\_\_\_\_ \$ \_\_\_\_\_

Includes building construction-general contractors engaged in construction of residential, farm, industrial, public, and other buildings.

Transportation

\$ \_\_\_\_\_ \$ \_\_\_\_\_

Includes railroad, motor freight, water transportation, air transportation, pipeline transportation of petroleum, and other transportation to include packing and crating services, and rental of transportation equipment.

Communications and Utilities \$ \_\_\_\_\_ \$ \_\_\_\_\_

Includes establishments engaged in telephone, telegraph, radio, television, and other communication services. Also includes, natural gas companies engaged in the transmission, storage, or distribution of natural gas. Also, water supply and sanitary services are included.

Wholesale Trade and  
Miscellaneous Manufacturing \$ \_\_\_\_\_ \$ \_\_\_\_\_

Includes manufacturing or processing foods and beverages and related products for human consumption. Also, textile, apparel, lumber and leather products are included. Also includes, establishments engaged in manufacturing miscellaneous products not classified in another major group.

Retail Trade \$ \_\_\_\_\_ \$ \_\_\_\_\_

Includes establishments engaged in selling merchandise for personal, household, or farm consumption, and rendering services incidental to the sale of the goods.

Finance, Insurance, and  
Real Estate \$ \_\_\_\_\_ \$ \_\_\_\_\_

Includes institutions engaged in banking, or other financial institutions, insurance, and real estate.

Business and Personal  
Services \$ \_\_\_\_\_ \$ \_\_\_\_\_

Includes firms operating lodging services, repair, laundry, entertainment, other personal services predominantly to private individuals, credit collection, janitorial, and stenographic services.

Professional and Social  
Services \$ \_\_\_\_\_ \$ \_\_\_\_\_

Includes establishments engaged in furnishing health, medical, legal, educational, research and development, and other professional services.

Households \$ \_\_\_\_\_ \$ \_\_\_\_\_

Includes all payments to persons as rents, interest, wages and salaries, and profits (to self-employed and also dividends and royalties). Include your profit here.

Government \$ \_\_\_\_\_ \$ \_\_\_\_\_

Includes payments of user charges for municipal services, state and local taxes, and other government fees.

**Recreation and Tourism--"The New Sector"**

*Includes specific recreation and tourism businesses in the retail trade, business and personal services, and transportation sectors-- gasoline service stations, boat and recreational vehicle dealers, eating and drinking places, sporting goods stores, souvenir shops, lodging services, entertainment, marinas, and travel agencies.*

Thank You!