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USING THE TI-59 PROGRAMMABLE CALCULATOR TO ESTIMATE OPERATING COSTS AND HAULING RATES FOR BULK MILK ASSEMBLY

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PREFACE TO THE SECOND
REVISED EDITION

This bulletin is a revision of an earlier one of the same name dated June 1980 (A.E. Res. 80-12--yellow cover). This edition contains two changes over its predecessor--a removal of income tax considerations from the program and an updating of the cost figures in the example. In all other respects, the two bulletins are identical, and this one should be used in place of the earlier version.

Reasons for the Revision

The Economic Recovery Tax Act of 1981 incorporated several fundamental changes in federal tax codes, including the allowances for depreciation and investment credits. These two factors are important for bulk milk assembly because they affect the after-tax returns from the enterprise. In the original or 1980 program, the "savings" due to investment credits and depreciation allowances were credited against the hauling costs. That is, the calculated route costs were reduced by the amount that taxes were reduced. Thus, that program provided a partial after-tax cost estimate.

The 1981 Tax Act changed substantially the allowable amounts of depreciation and investment credits. The effect of this change is to make the tax savings more sensitive to the incomes (and hence effective tax rates) of individual users. The TI-59 program in its present form is not designed to provide the appropriate analysis for calculating individual benefits. Instead, a decision was made to omit tax considerations altogether so that this revised program provides a before-tax estimate of costs.

Effects of the Change

Changing from partial after-tax cost estimates to pre-tax estimates increases the calculated hauling costs. This is because the hauler will realize additional cash flow after taxes which, in the revised program, is not credited against expenses. The increased cash flow is the result of investment tax credits and depreciation allowances applied against income tax liability. These sums must be reinvested back into the business if the hauler is to have sufficient reserves to replace the truck and tank when needed.

The dollar amounts of the change in the program can be seen using the input data from the 1980 example. The original estimate of fixed costs was \$33,885.96. With the present revision, using the same cost data, the estimated value is \$36,848.10. Thus the annual fixed hauling cost estimate rose by nearly \$3,000.00 due to the program change. Variable costs are unaffected.

It is also interesting to see what effect the 1981 Tax Act would have. This Act reduced the depreciation period for rolling stock to three years. Thus the tax savings are greater. In dollars, using the same 1980 figures applied above, the new tax codes provide approximately \$2,000 additional dollars annually in tax savings at the assumed tax rates. Haulers with higher and lower tax rates would find their after-tax savings had to be adjusted accordingly.

INTRODUCTION AND PURPOSE

The New York State dairy industry is vitally dependent on an efficient and competitive transportation system for assembling and transporting milk from farms to processing plants. Much of the state's milk assembly operation is carried out by independent contract haulers who operate their own truck(s). The independent owner-operator has often proved the best as well as the lowest-cost option for accomplishing the hauling function. The use of a relatively large number of independent haulers over a wide range of route conditions does, however, create significant coordination needs for the participants. This publication is directed to assisting with one aspect of the coordination requirements; the determination of equitable hauling rates.

The rate paid to haulers for bulk milk assembly is, ideally, negotiated on a route-by-route basis. Typically in practice the request for a rate change is initiated by a hauler and justified on the basis of an increase in labor, fuel or other costs. But since many cost increases affect all haulers, what began as a request for a rate change by an individual hauler often becomes a concurrent request by all haulers. If the handler agrees to a rate increase while lacking specific information about the effect of the cost increase on individual routes, the increase is often applied as a flat, across-the-board adjustment. Such uniform rate changes in assembly systems with highly divergent route conditions tend to favor some haulers over others. As a result some assembly routes can be substantially more profitable than others, while the system as a whole is neither efficient nor equitable for either the dairymen or the haulers. A detailed knowledge of assembly costs is essential for operating an efficient system.

At the same time, rapidly rising transportation costs have placed the small contract hauler at a competitive disadvantage to larger operators as the management function becomes more critical. The small operator, who drives and maintains the truck, has less time available for analyzing the business. A quick means of

estimating changing route costs should prove an essential management tool during these inflationary times.

The purpose of this publication is to present a ready means of estimating the effect of a change in the cost of one factor, like fuel, on overall operating costs. The resultant estimates are useful to both handlers and haulers. Handlers may use the estimates in planning for anticipated future cost changes. Haulers must keep track of costs to be sure that rates are sufficient to accumulate capital for timely replacement of the tank truck fleet. Together the estimates provide a common basis from which rate negotiations can be started.

The estimates are developed using economic engineering techniques by combining individual item costs, from fuel and tires to purchase price and maintenance, into uniform operating costs per unit of product, time and distance. These estimates may be broken out into fixed and variable cost components. To make the calculations speedy and accurate a TI-59 programmable calculator is used^{*/(1)}. With its assistance the effect of a fuel price increase on total per mile costs, to mention one example, can be determined within seconds.

The program is kept relatively short by omitting much of the detail and special considerations which are a part of day-to-day operations. Thus the results should be viewed as approximations only. The estimates include operating costs only; other factors such as returns to management and risk are not included. The appropriate payments for management and risk vary widely from firm to firm so that no rule-of-thumb figure can be established. Allowances for these factors and other items specific to particular routes must be established during negotiations.

In past years it was common for rates to reflect the haulers out-of-pocket costs plus a premium for management and risk. This meant among other things that

^{*/}The bracketed numbers refer to additional information on this point included with the footnotes on page 17 following the text.

haulers were compensated based on what they actually paid for their truck. During periods of relatively stable prices this approach proved adequate but problems began to appear when replacement truck prices started moving up sharply. The hauler who had to replace his truck with a much more expensive new one found that he had no accumulated reserves to use to allow purchase at the higher price and had to drop out of the industry. One solution to this situation would be to raise the rate whenever a new truck is purchased. This would, however, not be equitable and would provide a strong incentive for all haulers to buy new equipment! A second and preferable procedure is to provide on going payments with which the hauler may build some equity for the time when a replacement must be purchased. A reasonable improvement in equity should be assured if the rates are periodically adjusted to reflect the "current replacement" of a similar vehicle. This "replacement cost" approach is used in this bulletin. It will generally give a good approximation to the long term costs faced by a hauler but may not be appropriate in some cases, such as a route which would not be economical once the present truck wears out (2).

Data requirements for the program are substantial. In some cases a considerable initial effort will be required to establish a system for collecting and updating the necessary information. If it is done properly this data collection procedure should lead to better record keeping and an improved understanding of the hauling system and the major factors influencing costs. If not, the estimates provided by the program will be inaccurate and misleading.

This report is organized as follows. The first section involves the estimation of hauling costs and includes a description of the basic program, an example application, suggested procedures for collecting data, and an overview of ways of adapting the model for a range of different conditions. The second section describes the use of the program to calculate stop charges and allocation of costs based on time, distance and volume. The program itself is included in the Appendix.

SECTION I

Estimating Hauling Costs

Steps for operating the TI-59 program are detailed in Figure 1. This figure also includes an example which may be run to check to see that the program has been typed in correctly. The data for the example have been developed from information supplied by a group of handlers and haulers in upstate New York, as well as from a study of milk hauling in New York State by Professor Bruce Anderson (3). They represent with reasonable accuracy the aggregate cost conditions for that area for mid-1982. These data do not, however, necessarily represent actual costs for any one specific route and are not intended to be used in any application of the program to an actual situation.

Definitions and Guidelines for Data Collection

The results of the program are, of course, only as good as the data which are entered by the user. A strict adherence to the definitions and collection guidelines listed below will help to assure that the program results are valid and compatible for cross-firm comparisons.

01. Average Daily Route Miles - Use the total average daily miles traveled from garage to garage. In the case where more miles are traveled one day than another, total the two days and divide by two.

Ex. Day 1 - 110 miles
Day 2 - 170 miles

Total $280/2 = 140$ Avg. miles per day

02. Average CWT Delivered Per Day - Use average daily deliveries over the entire year taking into consideration all routes and the flush period, if any.
03. Truck Costs - Trucks are available with an extremely large selection of optional equipment from engines, axles and transmissions, down to radios, air conditioners and seats. To standardize cost estimates the specifications of a serviceable truck must be agreed upon by haulers and handlers. Examples of such specifications are listed in Figure 2. With these specifications, prices can be collected from cooperating new truck dealers. In most cases fleet prices will be assumed to apply.

Truck investment costs are frequently lumpy with a large initial investment (down payment), a stream of interest and repayment costs and finally a return in the form of the salvage value (trade-in or scrap value). In order to make a nonuniform series of costs and returns comparable they are converted to an equivalent uniform annual series of payments (4).

Figure 1: Operating Instructions for Part I of the TI-59 Program

Entering the Program from Magnetic Cards:

Turn calculator off. Turn calculator on.
 Press Key 1. insert side 1
 Press Key 2. insert side 2

DATA INPUT						
Item*	Example Value	Press Key	Example Display	Your Value	Press Key	Your Display
Fixed Costs						
Average Daily Route Miles	139	STO 01	139	_____	STO 01	_____
Average CWT Delivered Per Day	477	STO 02	477	_____	STO 02	_____
Truck Chassis Cost (\$)	55000	STO 03	55000	_____	STO 03	_____
Chassis Expected Life (years)	6	STO 04	6	_____	STO 04	_____
Chassis Salvage Value (\$)	11000	STO 05	11000	_____	STO 05	_____
Tank Cost (\$)	20000	STO 06	20000	_____	STO 06	_____
Tank Expected Life (years)	10	STO 07	10	_____	STO 07	_____
Tank Salvage Value (\$)	4000	STO 08	4000	_____	STO 08	_____
Insurance	1400	STO 09	1400	_____	STO 09	_____
Registration Fees	280	STO 10	280	_____	STO 10	_____
Highway Tax	120	STO 11	120	_____	STO 11	_____
Interest Rate	.16	STO 12	.16	_____	STO 12	_____
Miscellaneous Costs	1300	STO 13	1300	_____	STO 13	_____
Driver Hourly Wage (\$/hr.)	7.50	STO 14	7.50	_____	STO 14	_____
Hours/Day for Driver(s)	9	STO 15	9	_____	STO 15	_____
Variable Costs						
Miles Per Gallon	5	STO 20	5	_____	STO 20	_____
Fuel Cost (\$/gallon)	1.20	STO 21	1.20	_____	STO 21	_____
Cost New Tire	225	STO 22	225	_____	STO 22	_____
Cost Recapped Tire	100	STO 23	100	_____	STO 23	_____
Number of Tires	10	STO 24	10	_____	STO 24	_____
Bias or Radial Ply Tires - Enter 1 if Radial, 0 if Bias	0	STO 25	0	_____	STO 25	_____
Ton-Mile Tax Rate	.017	STO 26	.017	_____	STO 26	_____
Annual Maintenance	1000	STO 27	1000	_____	STO 27	_____
Average Annual Repair in \$/Mile	.12	STO 28	.12	_____	STO 28	_____
Miscellaneous Variable Costs	0	STO 29	0	_____	STO 29	_____

OUTPUT			
Press Key	Value Output	Example Display	Your Display
A	Total Annual Fixed Costs (TFC)	45389.00	_____
R/S	TFC/Mile	.895	_____
R/S	TFC/CWT	.261	_____
R/S	TFC/Minute	.230	_____
B	Total Annual Variable Costs (TVC)	22875.24	_____
R/S	Total Annual Costs (TC)**	68264.31	_____
R/S	TC/CWT	.392	_____
R/S	TC/Mile	1.346	_____
R/S	TVC/CWT	.131	_____
R/S	TVC/Mile	.451	_____

*Definitions of these terms and suggested sources of information are included in the following section.

**TC = TFC + TVC.

Figure 2: Truck Specifications: Single Chassis

Specifications for a Single Chassis Truck
Suitable for a 4,000 Gallon, Farm Pickup Truck

Cab:	151" conventional	
Wheel base:	Approx. 218"	
Engine:	Detroit diesel - 671 N Low oil pressure warning Spin-on oil filter Spin-on water filter Plastic fan blade Jake brake	Engine heater Vertical exhaust Luberfiner - 750 Farr air cleaner Delco Remy H.D. alternator Ammeter
Clutch:	14" double disc	
Transmission:	Fuller R.T.O. 915	
Rear Axle:	Timken 38,000# 4:44 ratio	
Suspension:	Hendrickson spring & saddle mount. Extended leaf, 50" aluminum beam	
Front Axle:	Rockwell FL 901 - 18,000 lb., Shepard power steering	
Brakes:	S-Cam. Rear - 16 1/2" x 7 8" dia. Front - 16 1/2" x 5" Hand valve for all wheels Front wheel limiting valve Alcohol kit	
Tires:	Front - General high miler - 11:00 x 20 Rear - General D.C.L. 10:00 x 20	
Other Options:	Double frame or frame reinforcement Dual 50 gal. step tanks Stemco hubs Tow hooks, front and rear Bostrom Viking driver seat Passenger seat Air horn Electric wiper motor Radiator shutters West Coast mirrors	

Source: Dennis R. Lifferth and Walter C. Wasserman, Milk Transportation and Processing: Analysis of Alternative Milk Marketing Systems
USDA Farmer Cooperative Service, mimeograph, undated, p. 139.

04. Truck Life - The expected number of miles of service would be available from service managers. Dividing this figure by the annual route miles will give the expected life in years.
05. Truck Salvage Value - This figure will perhaps be one of the more difficult to estimate accurately. Dealers can give a good indication of what a particular five year old truck is worth today. This, however, will not necessarily indicate future salvage values since new truck prices have been rising rapidly in recent years, carrying used and junk truck prices up with them. The problem of estimating future salvage values is therefore one of projecting the rate of inflation for this equipment. Individual judgment must be used. A 20% of replacement cost rule-of-thumb is being used by some individuals in the industry.
- 06 & 07. Tank Cost and Tank Life - Available from the suppliers. Annual costs are calculated in the same manner as truck costs (see above).
08. Tank Salvage Value - Use current scrap metal values which have remained relatively constant over time, or if tanks are rehabilitated, use expected net value.
09. Insurance - Annual rates for liability and cargo, available from insurance agents and brokers. A standardized policy should be used. Such a policy might include \$300,000 - \$500,000 liability, collision for the value of the truck with \$200 - \$500 deductible and cargo coverage in case of upset. Some states, like New York, mandate other coverage.
10. Registration Fees - Annual fees available from the New York State Department of Motor Vehicles or comparable department in other states.
11. Highway Tax - Listed in New York State Department of Taxation and Finance Highway Tax Law Bulletin, October 1, 1974, or similar bulletins from other states, and in Federal tax codes. The tax should be calculated on an annual basis.
12. Interest Rate - The interest rate reflects the value and cost of capital tied up in the truck and tank over their service lives (5). Due to continued interest rate fluctuation, no standardized procedure is recommended for determining the appropriate rate. Your local lending institution can assist you in determining the appropriate current rate.
13. Miscellaneous Fixed Costs - These costs should include annual garaging, bookkeeping, heat, office, and other expenses which are necessary to operate the milk hauling business. These items are likely to differ from operator to operator so that the actual costs should be used if available. Other fixed costs which do not fit into the above categories may also be included here. A lease contract on trucks or tanks may be included here on an annual cost basis. See the following section for several examples.
14. Drivers' Wages - The average hourly wage rate including fringe benefits should be used. If a significant number of drivers are unionized the rate stipulated in the contract may be used. Wages should include the value of all fringe benefits and payroll taxes. If the drivers are not unionized or a significant number are independent owner-operators, then the prevailing local rate (including fringes) must be used. In a situation where there is

more than one driver during the day and the hourly rates are different, use a weighted average hourly rate:

$$\begin{array}{r} \text{Ex. Driver 1 - } \$ 7.40/\text{hr.} \times 8 \text{ hrs.} = \$ 60 \\ \text{Driver 2 - } \$ 10.00/\text{hr.} \times 7 \text{ hrs.} = \$ 70 \\ \hline \$ 130 \div 15 \text{ hrs.} = \$ 8.67/\text{hr.} \end{array}$$

Relief driver wages should be included in calculating the average rate.

15. Hours/Day for Driver - An eight-hour day may be assumed unless information from the hauler or contract specifications indicate that a different length of day should be used.
20. Fuel Consumption in MPG - Available from operators or as estimates from truck dealers.
21. Fuel Cost (\$/Gallon) - Use average local pump prices.
- 22 & 23. Cost of New Tire and Cost of Recapped Tire - Use fleet prices collected from local dealer (6).
24. Number of Tires - Part of the specifications under (03) above.
25. Type of Tire (Bias Ply or Radial) - Indicate most common type of tire used by pressing 0 for bias ply or 1 for radials (7).
26. Ton-Mile Tax Rate - Rates are listed in the New York State Department of Taxation and Finance Truck Mileage Tax and Fuel. Use Tax bulletin, Regulations 21, April 1, 1970, or similar publications for other states. If fuel is bought outside the state of operation a fuel use tax must also be paid (not included in program).
27. Annual Periodic Maintenance - This figure includes oil, chassis lubrication, filters, plugs and points (if necessary). This cost is available from local service stations and can be calculated on an annual basis according to expected mileage and service intervals recommended by the manufacturer.
28. Average Annual Repair Cost Per Mile - Repair costs are among the most difficult costs to determine. The rate would be best determined for several trucks over more than one year. Repair costs should include parts and labor on an annual basis divided by annual miles driven. If field data are not available applicable cost information may be collected from fleet service managers with similar type hauls.
29. Miscellaneous Variable Cost - To be used for items related to operating the truck but included elsewhere. Examples included mileage based rental rates for the truck or tank.

After punching in all these values, you can easily check to see that the correct numbers were entered by punching in the following sequence of steps:

01

INV

2nd LST

This will cause the calculator to print out a list of values stored in each register beginning with the first. These numbers can be checked with the values you intended to enter. In case of an error, simply press the correct figure and STO --. To stop the list once it is running simply press R/S.

ADAPTING THE MODEL FOR DIFFERENT CONDITIONS

The basic program applies to the simplest possible bulk hauling situation; the hauler follows one or more route per day using self-owned equipment. This section contains explanations for adapting the basic program for different conditions such as leased rather than owned equipment. The changes include straight-forward modifications in the input data and increase in complexity up to permanent changes in the program itself. The following examples indicate how several kinds of changes may be made. They should be used as guidelines for other modifications of the program to meet specific user requirements.

Changing Constants Incorporated in the Program: Tire Life

To keep the user-supplied data inputs down to a reasonable number, several values are stored internally in the program as "constants." An example is tire life. The stored values, however, may not be appropriate for all routes and would need to be changed; routes with many hills and curves, for example, may give tire life below the assumed averages. These changes may be made by following the example below.

Example: Tire Life

On a rough, curvey route a hauler finds that radial tires last on average only 90,000 miles rather than the 100,000 miles assumed. To make the adjustment the proper program location must first be found and the following changes made:

<u>Press</u>	<u>Display</u>	<u>Object</u>
GTO 229	---	Locate part of program requiring change
LRN	229 04	Put calculator in mode to make changes
3	230 00	Insert new number which reduces life by 10,000 miles. (The calculator automatically shows you the next step, not the one you have just completed. To see it push BST - you should get 229 03).
LRN		Return to operating mode

The way this change works is to reduce 40,000 to 30,000; pushing 3 replaces the 4. The 30,000 is the difference in mileage of a radial over the 60,000 miles assumed for a bias ply. The new total is thus 90,000 rather than 100,000 miles.

If this change is to be permanent it may be stored on a magnetic card by following these steps:

Press 1 2nd WRT - insert card, turn over

Press 2 2nd WRT - insert card

If the display number does not flash the program has been transferred properly.

Incorporating Different Operating Characteristics: Leased Equipment

If equipment is leased rather than owned the lease rate may be included in register 13 or 29, or if the lease includes both fixed and variable aspects both may be used. (If all equipment is leased with a service contract an interest rate - register 12 - still must be entered for the program to operate.) A fixed rental rate should be entered in register 3. If the rate is established on a monthly basis it must be adjusted to reflect the actual annual fee (8). Rates which vary according to distance or other factors should be included as a variable cost in register 29. Costs which are variable by the mile must be multiplied by total annual miles or, if the tank payment is based on the volume of milk delivered, by the cwt. delivered. Instructions for inserting into the program new instructions for calculating variable costs per mile and similar changes are described following the example.

Example

A hauler signs a seven-year lease for a bulk tank which includes a \$1,500 nonrefundable payment plus one-half cent per hundredweight delivered.

There are two steps needed to incorporating these new conditions. First, the initial payment is a partial payment for the tank and should be treated as any other cost by inserting the payment, \$1,500, into register 06 with the life

established at 7 years placed in register 07. Second, the cwt rental rate must be multiplied by hundred pounds delivered to determine the rental fee. Average daily pounds delivered is stored in register 02 which must be multiplied by 365 to calculate the annual total. These steps can be accomplished as follows:

<u>Press</u>	<u>Display</u>	<u>Function Performed</u>
GTO 261	---	Locate appropriate place in the program
LRN	261 95	Put in learn mode
2nd INS	261 00	Clear space (this instruction moves all the following steps ahead by one place)
x	262 95	Multiply rate times capacity (the calculator automatically advances you by one step so that you do not see what was just inserted)
2nd INS	262 00	Clear space
RCL	263 95	Recall average daily cwt delivered
2nd INS	263 00	Clear space
02	264 95	Completes RCL command
2nd INS	264 00	Clear space
x	265 95	Multiply by 365 to give annual value
2nd INS	265 00	Clear space
3	266 95	Begin inserting 365
2nd INS	266 00	Clear space
6	267 95	
2nd INS	267 00	Clear space
5	268 95	
LRN	---	Exit learn mode

When using this modification it is important that register 29 is not used for anything but the rental rate. If it is the entire value stored in this register will be treated as the rental rate, leading to a substantial over-estimate of the cost.

If this change is to be permanent it may be stored on a magnetic card by following these steps:

Press 1 2nd WRT - insert card, turn over

Press 2 2nd WRT - insert card

If the display number is not flashing, the program was transferred properly.

SECTION II

Determining Hauling Rates from the Program Estimates

Hauling costs may be divided into three categories - on-farm, travel, and volume - based on where they are incurred. These categories take account of variable costs of travel (fuel, tires and maintenance) and the fixed costs of the tank, truck, insurance and the scheduled driver. Fixed costs including labor are substantial, comprising approximately two-thirds of total assembly route costs, and must be allocated across a full day's activities on a cost per minute basis.

On-farm costs are fixed costs which include the time required to perform routine chores at each stop. These chores include hooking up, agitating the milk, sampling, and rinsing the farm tank. The driver's personal time for lunch and rest breaks is also included with the on-farm costs.

Travel or mileage costs include both fixed and variable cost segments. The variable costs are related to the miles traveled while the fixed costs include the proportionate share of the overhead costs for the time the truck is traveling. The final category, volume costs, involves pumping time at the farm and plant.

These three components of the hauler rate are summarized in Figure 3 below. For completeness, this figure also indicates how the producer rate is related to hauler payments. Producers are assessed in a slightly different fashion than the haulers are paid so that there is not a direct pass-through of each cost item, as shown in the Figure.

Figure 3: Cost Components Included in the Hauler Rate and Producer Payment

<u>Hauler Rate</u>	<u>Route Costs</u>	<u>Producer Rate</u>
Stop Payment	[On-farm labor, excluding pumping time, plus share of fixed cost, plus waiting and personal time]	Stop Charge
Mileage Payment	[Transport (garage to first farm, last farm to plant and plant to garage) cost]	Location Differential
	[Assembly (first to last farm) costs plus share of fixed cost and labor]	
Volume Payment	[Plant pumping and wash time plus farm pumping time]	Volume Charge

Steps for making these calculations using the TI-59 program are outlined in Figure 4.

This portion of the program uses estimates from the program described above and consequently cannot be run unless steps A and B have been run previously. The steps for this program are included in the Appendix beginning at 322.

Figure 4: Operating Instructions for Part II of the TI-59 Program
After Running Part I:

Item	Example Value	Press Key	DATA INPUT			
			Example Display	Your Value	Press Key	Your Display
Number of Farm Stops	14	STO 30	14	_____	STO 30	_____

OUTPUT			
Press Key	Value Output	Example Display	Your Display
C	Stop Payment	3.54	_____
R/S	Mileage Payment/Mile	.727	_____
R/S	Volume Payment/cwt	.076	_____

The procedure followed in the program can best be explained by manually running through the calculating it makes internally.

Item	Includes	Amount	
Stop Payment	On-farm labor time (excluding pumping time) plus share of waiting and personal time (9)	10	mns. per farm labor time
		$\times 14$	no. farm stops
		140	
		+ 75	waiting and personal time
		215	total stop time
		$\times .2302$	FC/Mn (from Figure 1)
		49.49	total stop cost
Mileage Payment	Assembly time plus mileage costs	$\div 14$	stops
		\$ 3.54	stop payment
		540	total minutes in day
		- 215	stop time
		- 85	farm pump time (10)
		- 43	plant pump time (11)
		- 30	wash time (12)
167	total route time		
$\times .2302$	FC/Mn (from Figure 1)		
\$ 38.44	time cost		

<u>Item</u>	<u>Includes</u>	<u>Amount</u>	
		139	miles
		x .45	VC/mile (from Figure 1)
		<u>62.55</u>	mileage cost
		62.55	mileage cost
		+38.44	time cost
		<u>100.99</u>	total cost
		÷ 139	miles
		<u>.727</u>	mileage payment/mile (13)
Volume Payment	Plant pumping and washing time plus on-farm pumping time	85	farm pump time (10)
		+ 43	plant pump time (11)
		+ 30	wash time (12)
		<u>158</u>	total volume time
		x.230	FC/Min.(from Figure 1)
		<u>36.34</u>	total volume cost
		÷ 477	cwt delivered
		<u>.076</u>	volume payment

CONCLUSIONS

The calculated hauling cost of 39 cents per hundredweight must be used only as a base or guideline rate. There are numerous other factors that should be considered in arriving at an actual rate. The actual rate must include a return for hauler management and risk not included in the cost estimates as well as including differentials for specific route characteristics such as road conditions and grade. Thus each route or group of routes served by a hauler must be analyzed separately with the final rate determined through individual negotiations.

The procedure described above if properly implemented is a means of achieving a closer correlation between hauling rates and actual route costs. It should provide an incentive for both producers and haulers to improve efficiency in the milk assembly system and serve the long-run interests of all participants.

FOOTNOTES

- 1/ The program is readily transferable to another programming language such as that used on the HP-97 calculator. Some knowledge of programming is needed.
- 2/ More precisely the appropriate rate should fall somewhere between the replacement cost and the "actual" cost based on current equipment costs. The replacement cost figure is utilized here because there is often a substantial lag in incorporating replacement cost figures in the hauling rate. This lag is a result of the time necessary to assemble the cost figures and negotiate rates, which then remain in effect for a year. At the end of this period during a time when equipment costs are rising rapidly the rate is actually below the true replacement cost rate and is assumed to approximate the minimum rate needed to keep haulers in the industry.
- 3/ Anderson, B., "The Structure and Characteristics of the Milk Assembly System in New York State." Cornell University, Department of Agricultural Economics, A.E. Res. 81-16, September 1981.

4/ The Annual Equivalent Cost (AEC) formula used in the program is:

$$AEC = EC \frac{i(1+i)^n}{(1+i)^n - 1} - SV \frac{i}{(1+i)^n - 1}$$

EC - equipment cost

SV - salvage value at end of nth year

i - interest rate

Source: Gerald W. Smith, Engineering Economy: Analysis of Capital Expenditures. Iowa State University press, Ames, 1968, p. 99.

For further information see Smith or another book on engineering economy.

- 5/ With the annual equivalent cost figure the annuity represents partially debt servicing and partially an increase in equity. Thus over the life of the good the interest rate must represent, in different proportions, both the cost of borrowed capital and the value of equity to the owner. Typically for small operators equity has a higher opportunity cost than borrowed capital because the risk is greater, and it should receive a higher return.
- 6/ Tire costs are calculated assuming that an average carcass is retreadable once and that a bias ply carcass has a total service life of 60,000 miles and a radial a life of 100,000 miles. These are averages for all the tires on a truck since the actual mileage depends on which axle it is placed on as well as road conditions, etc.

- 7/ Operationally, this entry provides a "switch" which changes the base of the cost from 60,000 miles for bias ply tires to 100,000 miles for radials.
- 8/ Some leases require a substantial payment at the beginning of the contract. If this payment is nonrefundable it should be entered in register 3 or 7 as equipment cost. Even if the payment is refunded at the expiration of the lease the compounded interest figure over the period can be substantial. This amount too, should be entered as a cost.
- 9/ The figures for this example are based on a 1978 study of hauling routes in the New York State order area and on the Anderson study.
- 10/ On the farm milk is assumed to be pumped at the rate of 560 pounds/minute.
- 11/ At the plant milk is assumed to be pumped at the rate of 1,100 pounds/minute.
- 12/ A truck is assumed to be washed only once a day.
- 13/ Figures may not match exactly these in Figure 4 because of rounding error.

TI-59
Bulk Milk Hauling Cost
Worksheet

TRUCK NO. _____
DATE _____

REP. ROUTE
DATA _____

INDIVIDUAL
HAULER DATA _____

<u>PRESS</u>	<u>DESCRIPTION</u>
STO 01	Average Daily Route Miles
STO 02	Average CWT Delivered Per Day
STO 03	Truck Chassis Cost (\$)
STO 04	Chassis Expected Life (years)
STO 05	Chassis Salvage Value (\$)
STO 06	Tank Cost (\$)
STO 07	Tank Expected Life (years)
STO 08	Tank Salvage Value (\$)
STO 09	Insurance Payments (liability & cargo)
STO 10	Registration Fees
STO 11	Highway Tax (federal)
STO 12	Interest Rate
STO 13	Miscellaneous Costs (garage, bookkeeping, etc.)
STO 14	Driver Hourly Wage (\$/hr.)
STO 15	Hours/Day for Driver (s)
STO 20	Miles Per Gallon
STO 21	Fuel Cost (\$/gallon)
STO 22	Cost New Tire
STO 23	Cost Recapped Tire
STO 24	Number of Tires
STO 25	Bias or Radial Ply Tires - Enter 1 if Radial, 0 if Bias
STO 26	Ton-Mile Tax Rate
STO 27	Annual Maintenance
STO 28	Average Annual Repair in \$/Mile
STO 29	Miscellaneous Variable Costs

<u>REP. ROUTE</u>	<u>INDIVIDUAL HAULER</u>	<u>PRESS</u>	<u>DISPLAY/PRINT</u>
_____	_____	A	Total Annual Fixed Costs (TFC)
_____	_____	R/S	TFC/Mile
_____	_____	R/S	TFC/Cwt.
_____	_____	R/S	TFC/Minute
_____	_____	B	Total Annual Variable Costs (TVC)
_____	_____	R/S	Total Costs (TC)
_____	_____	R/S	TC/Cwt.
_____	_____	R/S	TC/Mile
_____	_____	R/S	TVC/Cwt.
_____	_____	R/S	TVC/Mile
_____	_____	C	Stop Payment
_____	_____	R/S	Mileage Payment/Mile
_____	_____	R/S	Volume Payment/Cwt.

Guide For Calculating Individual Basic Hauling Cost Rate

A. Stop charge x avg. no. of stops per day = while stopping at farms. Daily cost of truck and labor
 _____ x _____ = _____

B. 1. Daily route miles x mileage payment/mile (TC/mile) = Daily cost of running the truck and fixed cost of truck and labor while driving.
 _____ x _____ = _____

C. Daily cwt. of milk x volume payment/cwt. = Volume related cost at plant & farm.
 _____ x _____ = _____

Total Daily Route Cost (TDRC) = _____
 (A + B + C = TDRC)

TDRC ÷ No. of miles = TDRC per mile = _____

TDRC ÷ No. of cwt. = TDRC per cwt. = _____

BULK MILK ASSEMBLY PROGRAM

000	76	LHL	050	43	RCL	100	06	..
001	11	..	051	08	..	101	05	..
002	43	RCL	052	54	..	102	54	..
003	03	..	053	55	..	103	95	..
004	65	..	054	43	RCL	104	99	PIT
005	71	SHR	055	07	..	105	91	R/S
006	89	..	056	54	..	106	43	RCL
007	75	..	057	85	..	107	50	..
008	43	RCL	058	43	RCL	108	55	..
009	05	..	059	09	..	109	53	..
010	65	..	060	85	..	110	43	RCL
011	71	SHR	061	43	RCL	111	15	..
012	33	..	062	10	..	112	65	..
013	75	..	063	85	..	113	02	..
014	00	..	064	43	RCL	114	01	..
015	00	..	065	11	..	115	09	..
016	65	..	066	85	..	116	00	..
017	53	..	067	43	RCL	117	00	..
018	53	..	068	13	..	118	54	..
019	43	RCL	069	85	..	119	95	..
020	03	..	070	43	RCL	120	99	PIT
021	75	..	071	14	..	121	42	..
022	43	RCL	072	65	..	122	41	..
023	05	..	073	03	..	123	91	R/S
024	54	..	074	06	..	124	61	..
025	55	..	075	05	..	125	02	..
026	43	RCL	076	65	..	126	00	..
027	07	..	077	43	RCL	127	00	..
028	54	..	078	15	..	128	00	..
029	85	..	079	95	..	129	00	..
030	43	RCL	080	42	..	130	76	LHL
031	06	..	081	50	..	131	89	..
032	65	..	082	99	PIT	132	53	..
033	71	SHR	083	91	R/S	133	53	..
034	89	..	084	43	RCL	134	43	RCL
035	75	..	085	50	..	135	12	..
036	43	RCL	086	55	..	136	65	..
037	08	..	087	71	SHR	137	71	SHR
038	65	..	088	35	..	138	34	..
039	71	SHR	089	95	..	139	54	..
040	33	..	090	99	PIT	140	55	..
041	75	..	091	91	R/S	141	53	..
042	00	..	092	43	RCL	142	43	RCL
043	00	..	093	50	..	143	49	..
044	65	..	094	55	..	144	75	..
045	53	..	095	53	..	145	01	..
046	53	..	096	43	RCL	146	54	..
047	43	RCL	097	02	..	147	54	..
048	06	..	098	65	..	148	92	R/S
049	75	..	099	03	..	149	76	LHL

150	33	X	206	43	RIL	262	42	S'D
151	53	:	207	21	117	263	51	11
152	43	RIL	208	85	:	264	99	PIT
153	12	2	209	53	:	265	91	R'S
154	55	:	210	53	:	266	43	RIL
155	53	:	211	53	:	267	50	110
156	43	RIL	212	43	RIL	268	85	:
157	49	9	213	22	12	269	43	RIL
158	75	:	214	85	:	270	51	11
159	01	:	215	43	RIL	271	95	:
160	54	:	216	23	13	272	99	PIT
161	54	:	217	54	:	273	42	S'D
162	92	RIN	218	55	:	274	53	113
163	76	LIL	219	53	:	275	91	R'S
164	34	11	220	06	:	276	43	RIL
165	53	:	221	00	11	277	53	113
166	53	:	222	00	11	278	55	:
167	01	:	223	00	11	279	53	:
168	85	:	224	00	11	280	03	:
169	43	RIL	225	85	:	281	06	:
170	12	2	226	43	RIL	282	05	:
171	54	:	227	25	15	283	65	:
172	45	Y	228	65	:	284	43	RIL
173	43	RIL	229	04	:	285	02	112
174	04	114	230	00	11	286	54	:
175	54	:	231	00	11	287	95	:
176	42	S'D	232	00	11	288	99	PIT
177	49	9	233	00	11	289	91	R'S
178	43	RIL	234	54	:	290	43	RIL
179	07	117	235	54	:	291	53	113
180	48	ENC	236	65	:	292	55	:
181	04	114	237	71	SIR	293	71	SIR
182	48	ENC	238	35	1-X	294	35	1-X
183	07	117	239	65	:	295	95	:
184	43	RIL	240	43	RIL	296	99	PIT
185	49	9	241	24	14	297	91	R'S
186	92	RIN	242	54	:	298	43	RIL
187	76	LIL	243	85	:	299	51	11
188	35	1-X	244	43	RIL	300	55	:
189	53	:	245	26	16	301	53	:
190	43	RIL	246	65	:	302	43	RIL
191	01	11	247	71	SIR	303	02	112
192	65	:	248	35	1-X	304	65	:
193	03	:	249	85	:	305	03	:
194	06	:	250	43	RIL	306	06	:
195	05	:	251	27	17	307	05	:
196	54	:	252	85	:	308	54	:
197	92	RIN	253	43	RIL	309	95	:
198	76	LIL	254	28	18	310	99	PIT
199	12	:	255	65	:	311	91	R'S
200	71	SIR	256	71	SIR	312	43	RIL
201	35	1-X	257	35	1-X	313	51	11
202	55	:	258	85	:	314	55	:
203	43	RIL	259	43	RIL	315	71	SIR
204	20	110	260	29	19	316	35	1-X
205	65	:	261	95	:	317	95	:

318	99	PIT	366	71	SBR	414	43	RCL
319	42	S D	367	32	X T	415	02	U2
320	42	2	368	85	..	416	65	..
321	91	R S	369	03	..	417	01	..
322	76	LHL	370	00	..	418	00	..
323	13	..	371	54	..	419	00	..
324	53	..	372	54	..	420	54	..
325	53	..	373	65	..	421	55	..
326	43	RCL	374	43	RCL	422	05	..
327	30	NO	375	41	-1	423	06	..
328	65	..	376	85	..	424	00	..
329	01	..	377	43	RCL	425	54	..
330	00	..	378	01	U1	426	92	R N
331	85	..	379	65	..	427	76	LHL
332	07	..	380	43	RCL	428	32	X T
333	05	..	381	42	-2	429	53	..
334	54	..	382	54	..	430	53	..
335	65	..	383	55	..	431	43	RCL
336	43	RCL	384	43	RCL	432	02	U2
337	41	-1	385	01	U1	433	65	..
338	54	..	386	95	..	434	01	..
339	55	..	387	99	PIT	435	00	..
340	43	RCL	388	91	R S	436	00	..
341	30	NO	389	53	..	437	54	..
342	95	..	390	53	..	438	55	..
343	99	PIT	391	71	SBR	439	01	..
344	91	R S	392	23	LIIX	440	01	..
345	53	..	393	85	..	441	00	..
346	53	..	394	71	SBR	442	00	..
347	43	RCL	395	32	X T	443	54	..
348	15	5	396	85	..	444	92	R N
349	65	..	397	03	..			
350	06	..	398	00	..			
351	00	..	399	54	..			
352	75	..	400	65	..			
353	53	..	401	43	RCL			
354	43	RCL	402	41	-1			
355	30	NO	403	54	..			
356	65	..	404	55	..			
357	01	..	405	43	RCL			
358	00	..	406	02	U2			
359	85	..	407	95	..			
360	07	..	408	99	PIT			
361	05	..	409	91	R S			
362	85	..	410	76	LHL			
363	71	SBR	411	23	LIIX			
364	23	LIIX	412	53	..			
365	85	..	413	53	..			

NOTE: RTN is programmed as INV SBR