FARMING WITH COMPUTERS: What Are the Alternatives?

Extension Bulletin 0953

Cooperative Extension

College of Agriculture
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Pullman, Washington
Production agriculture has benefited greatly from technological advance during the 1970s. While these advances are likely to continue, the big breakthroughs during the next decade are most likely to occur in the method and efficiency by which farm management decisions are made. These breakthroughs will be based on the continued development and widespread adoption of computerized tools by farm managers. These tools will make it possible for farmers to analyze the large amounts of information needed for effective decision making.

Computers have been reduced in size, complexity, and cost to the point where many farmers are finding them a profitable investment. Certainly, farm computers will become an even better investment in the years to come. There are currently three basic kinds of computer systems available for on-farm use: (1) programmable calculators; (2) remote terminals; and (3) the microcomputer. Each system has its own strengths and weaknesses and to a certain degree, they complement each other. This publication will discuss the strengths and weaknesses of programmable calculators, remote terminals, and microcomputers for the purpose of facilitating system selection.

Programmable Calculators

These are hand-held machines similar in appearance to the small calculators used by millions of Americans to solve traditional mathematical problems. In addition to performing all the functions of the conventional calculator, the programmable, as suggested by its name, can be programmed. This means the machine has the ability to accept a sequence of directions and use these directions to automatically solve a mathematical problem. The sequence of directions, or program, is punched on the keyboard of the calculator and then recorded on a magnetic card about the size of a stick of gum. The program is recorded by passing the card through a slot on the side of the calculator. Since the program is permanently recorded on the card, the next time the program is needed it is re-entered into the machine by simply once again passing the card through the same slot.

Answers derived from the programmable calculator are displayed on the calculator's visual display panel and/or by a printout. Printers are available for use with the more advanced programmable calculators. The printer gives the user the option of getting a printed copy of data and/or programs.

A large number of agricultural programs have been developed for the more popular programmable calculator models and are available from various land-grant universities. For example, Iowa State University, Cornell University, Kansas State University, Oregon State University, and Washington State University currently have libraries containing numerous programs. Examples of programs available in these libraries are estimates of machinery cost, ration formulation, lease versus buy of various farm assets, loan amortization,
enterprise analysis, etc. A listing of programs available from Washington State University, Iowa State University, and Cornell University appears below.

The advantages of the programmable calculator are its low cost ($200-$800), portability, simplicity, and availability of a large number of prepared programs. Because of its limited size and capacity, the programmable calculator is not suitable for storing and processing large volumes of data. Thus, the ability of programmable calculators to process farm records is quite limited. The comparative advantage of programmables lies with analyzing management problems that can be reduced to mathematical formulas. They represent a good alternative for the farmer wanting to get started with computers on a modest scale.

WASHINGTON STATE UNIVERSITY
PROGRAMMABLE CALCULATOR LIBRARY
Programs for the TI-58

Gross Margins Analysis for Evaluating Alternative Crops. This program calculates gross margins (returns over variable costs) for up to five crops at a time and allows systematic comparison of crop pairs with a break-even yield and price analysis. Work sheets are provided to record program results including gross margins, break-even analysis and crop acreage assignments. For a given crop mix, the program calculates total revenue, total variable cost and total gross margins.

Analysis of Land Value. This program estimates land value based on the major land value determinants. These determinants are after-tax annual returns from farming, the tax benefits from real estate loan interest deductions, and the after-tax market value of land at the end of the investor's planning period.

Analysis of Ability to Pay for Land. This program determines the maximum financially feasible price that can be paid for additional farm land. The maximum price is based on: equity funds available for down payment, cash flow generated from the farm operation, other financial commitments, the interest rate on the loan used to finance the real estate acquisition, and the number of years over which the loan is amortized.

Estimating Farm Machinery Costs. This program calculates the per-acre and per-hour cost of owning and operating farm machinery. It will calculate costs for self propelled equipment and a combination of power units and implements.

Investment Analysis—Net Cash Flow and Present Value, Debt Recovery and Investment Payback Periods. This program calculates four important measures for evaluating alternative investments including after-tax net cash flow, net present value of the after-tax cash flow for both debt and equity financing, and also the debt recovery and investment payback periods. The program can be run for debt and equity financing or both.

Beef Feeder Stocker Break-Even Analysis. This program calculates the break-even purchase price for feeders or the break-even selling price for stocker cattle. Feed requirements are calculated using the net energy system and initial weight, sex, and desired rate of gain. Work sheets are provided to assist with comparative analysis.
Break-Even and Culling Point Analysis for Dairy Herds. This is a program that can be used with DHIA records and business records to help determine which cows should be culled due to low milk production and indicate when is the most economical time to cull.

Machine Buy, Machine Lease, Machine Rent/Custom-Hire. This is a package of three routines that can be used to compare the economic benefits associated with four machinery financing alternatives: (1) cash or credit purchase; (2) lease; (3) rent; and (4) custom hire. The programs calculate the present value of after-tax costs for the four alternatives.

Dairy Cow Investment Analysis. This program analyzes the profitability and liquidity of a proposed investment in dairy cows. The program computes: (1) the value of the cow to the business, or the maximum bid price, and (2) the years needed to recapture debt capital used to finance a cow purchase.

Lease vs. Purchase of Farm Land Analysis. This program analyzes the profitability and cash flow aspects of lease versus purchase of farmland.

Animal Science Programs
Beef Carcass Evaluation
Beef Carcass Evaluation (Dressing percent)
Swine Carcass Evaluation (Days to produce 85# of muscle)
Swine Carcass Evaluation (% muscle)
Lamb Carcass Evaluation
Feed Evaluation Program
Feed Evaluation Program (Based on NPN)
Feed Evaluation Program (Based on vegetable protein and NPN)
Ration Formulation Program (Includes price)
Average Daily Gain Calculation
Weight Per Day of Age Calculation
Adjusted Weaning Weight (Additive)
Adjusted Weaning Weight (Multiplicative)
Adjusted Yearling Weight
Irregular Yearling Weight Adjustment
Weaning and Yearling Weights
Feeder Heifer Break Even Price Analysis

*Programs can be obtained from Herb Hinman and Gayle Willett, 203 Ag Sciences, Washington State University, Pullman, WA 99164, or Dick Carkner, Western Washington Research and Extension Center, Puyallup, Washington 98371. Many of these programs and others are available for the HP41-C from David Holst, Department of Agricultural and Resource Economics, Oregon State University, Corvallis, Oregon 97331.

IOWA STATE UNIVERSITY PROGRAMMABLE
CALCULATOR LIBRARY*

Programs for the TI-59

Agricultural Engineering
Sprayer Calibration
Measuring Corn Harvesting Losses
Measuring Soybean Harvesting Losses
Field Work Sheet for Measuring Corn Harvesting Losses (reverse side for measuring soybean harvesting losses)

Agronomy
Determining Fertilizer Needs to Supplement Liquid Manure
Crop Yield Calculation
Soybean Yield Contest
Corn Yield Contest
Field Population
Field Population: Planter Calibration
Field Size: Acres/Hectares for Rectangular Fields
Soil Erosion of Corn Fields: Quantitative Estimate
Soil: Agricultural Lime Recommendations
Corn: Early Freeze Yield Reductions
Growing Degree Days: Weather Service Method
Universal Soil Loss Equation
Corn: Estimate of Yield

Animal Science
Net Energy for Feedlot Cattle
Ration Analyzer for Feedlot Cattle
Protein Supplementation for Feedlot Cattle
Metabolizable Protein and UFP Determination of Feedstuffs and Protein Supplements
Adjusting British Breed Weaning Weights with No Birth Weights
Adjusting Exotic Breed Weaning Weights with No Birth Weights
Adjusting Calf Weaning Weights with Known Birth Weights
Weaning Weight Ratios and Sire Summary
Yearling Weight Adjustment and Weight per Day of Age Determination
On-Farm Bull Test Record
Ration Analyzer for Beef Cows
Adjusting Beef Cattle Weaning Weights
Month Data Tape
Yield Grade, Cutability and Percent Lean Determination in Beef Cattle
NPPC Pork Carcass Evaluation
NPPC Swine Carcass Evaluation Age Units Required to Produce 85 lbs. of Muscle
Ration Formulation (Pearson Square)
Standardizing Swine Carcass Measurements
Swine Ration Analyzer
Adequacy of Swine Ration
Comparative Value of Various Feeds for Swine
Scoring Judging Cards
Ration Analysis for Swine and Poultry
Sow Productivity Index
Gestation and Livestock Management Calendar
Ration Analyzer Utilizing Master Library
Module Program 03
Ration Formulation and Premix Balance with
FM-09 (Agricultural Module)

Dairy Science
Dairy Ration Balancer
Dairy Ration Analyzer
Grain Mix Formulator
Comparative Feed Pricing

Farm Management
Cattle Feeding Work Sheet
Feeder Pig Work Sheet
Grain Marketing Costs and Returns
Estimating Farm Machinery Costs
Income Tax Estimation
Farm Loan Analysis: Installment Loans
Combine Ownership or Custom Hire: After-Tax Cost
Gross Margin Equating Formula for Corn and an
Alternative Crop
Farm Depreciation and Investment Credit
Feeder Lamb Work Sheet
Discounting a Combination of Uniform and/or Non-
Uniform Series
Internal Rate of Return for a Combination of
Uniform and/or Non-Uniform Series
Land Purchase: Financial and Economic Analysis
(an extended version of FM-1730 (4)—TI)
Investment Payback Period Determination
Break-Even Price for Stored Grain Compared to
Selling Wet or Drying
Cow-Calf Work Sheet
Time Series Deflator
Motor Vehicle Cost Analysis
Moving Average
Feeder Pig Production Work Sheet
Ewe Work Sheet
Farrow-to-Finish Work Sheet
Farm Business Record Analysis
1979 Feed Grain Program Work Sheet
Investment Repayment Capacity Analysis
Cost Comparison for Fertilizer Application
Triangular Probability Distribution

Marketing
Feeding Cattle to Higher Grade
Economics of Feeding Hogs to Heavier Weights
Evaluation of Live and Hot Carcass Weight
Alternatives for Fed Steers

*Subscription available at Iowa State University, Publications Dist., Ames, Iowa 50011. Send check
or money order made out to ISU for $30 for the subscription.
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*Subscription available from: Programmable Calculator Library, NRAES, Riley-Robb Hall, Cornell University, Ithaca, New York 14853. Cost is $20 for the first subscription and $10 for each additional subscription sent to the same address. Send check or money order made out to NRAES.
Remote Terminals

Remote terminals can be used in the farmer’s office to access a large, centralized computer via a phone line. The terminals resemble a typewriter and have a keyboard for entering instructions and data. Work done by the centralized computer is printed on paper and/or displayed on a cathode ray tube (TV-like screen) by the terminal. Terminals can be purchased for $800-$3,000. They can also be leased. The main difference in terminals is their data input and output capabilities. Some terminals even possess memory capability so input can be loaded into the terminal, then entered immediately into the computer system at the time of telephone hook-up. With these memory terminals, data output from the computer can also be stored in the memory and be recalled after the terminal is disconnected from the computer. These “smart” terminals save on-computer time and on-phone time.

Currently, there are three major remote terminal-centralized computer systems being used by farmers. These are AGNET, University of Nebraska; TELPLAN, Michigan State University; and CMN, Virginia Polytechnic State University. Several states participate in these programs so farmers don’t have to reside in the originating state to participate. AGNET, for example, covers six states, including Washington. AGNET terminals are located in all of Washington’s Cooperative Extension county offices. Thus, in lieu of acquiring their own terminal, Washington residents have the option of accessing AGNET through their local Extension office. Examples of programs found in these systems are: (1) ration formulation; (2) enterprise analysis; (3) irrigation scheduling; and (4) market reports and analysis. A listing of AGNET programs appears below. In addition to the cost of the terminal, there are expenses for long distance phone calls and computer time each time the system is accessed. Participating members of these systems use the central computer on a “time-share” basis and are, therefore, billed for only the time they actually use the computer.

Like the programmable calculator, remote terminals are primarily an analytical tool. However, because of the greater capacity of the centralized computer, the terminal system can analyze larger and more complex problems than the programmable calculator. Due to a lack of farm accounting programs in time-sharing, centralized computer libraries, and to the high cost of purchasing a terminal with memory capabilities, opportunities for farmers to process business records with a remote terminal system are currently quite limited.
GENERAL AGNET PROGRAMS

BASIS — Develops historical “basis” patterns for certain crops
BEEF — Simulation and economic analysis of feeder’s performance
BEEF ADVISORY — Beef feedlot placement and sales advisory report
BEEFBUY — Comparison of alternative methods of purchasing beef
BESTCROP — Provides equal return yield & price analysis between crops
BINDRY — Predicts results of natural air & low temp. corn drying
BROILER — Simulation and economic analysis of broiler’s performance
BUSPAK — Package of financial analysis programs
ANNUITY — Solves problems involving periodic payments
BUDGET — Capital budgeting
CAPITAL — Cost of capital
CASHFLOW — Discounted cash flow
DEP — Depreciation
DEP3 — Depreciation (3 methods solved simultaneously)
EQUITY — Loan equity
FUTVAL — Future value
GROWTH — Rate of growth in equity
IRR — Internal rate of return
LOAN — Single loan
LUMPSUM — One-time investment
MULTLOAN — Multiple loan
NETDEP — Net declining balance depreciation
RETURN — Return on investment
COWCOST — Examines the costs and returns for beef cow-calf enterprise
COWGAME — Beef genetic selection simulation game
CROPBUDGET — Analyzes the costs of producing a crop
CROSSTREED — Evaluates beef crossbreeding systems & breed combinations
DAIRYCO — Analyzes the monthly costs and returns with milk production
DIETCHECK — Food intake analysis
DIETSUMMARY — Summary of analysis saved from DIETCHECK
DRY — Simulation of grain drying systems
DUCTLOCATION — Determines ducts to aerate grain in flat storage bids
ECON — Package of teaching programs dealing with economic concepts
EDPAK — Demo programs illustrating computer assisted instruction
EWECOST — Analyzes the costs & returns of sheep production enterprise
EWESALE — Lists sheep for sale
FAIR — Scoring and tabulation of judging contests
FAN — Determination of fan size and power needed for grain drying
FEEDMIX — Least cost feed rations for beef, dairy, sheep, swine, and poultry
FILLEDIT — Constructs and modifies files for use in FILLIN
FILLIN — A “fill in the blank” quiz routine
GAMES — Package of game programs
GRASSFA — Analyzes costs and returns associated with pasturing calves
HAYLIST — Lists hay for sale
HELP — Lists available programs & items of interest to general user
HOUSE — Estimates the costs of heating and cooling a house
INPUTFORMS — Prints available input forms
IRRIGATE — Irrigation scheduling
JOBSEARCH — Matches abilities and interests to occupations
LANDPAK — Package of programs to assist in land management decisions
BUYLAND — Estimates maximum price you can afford to pay for land
CASHRENT — Estimates maximum cash rent you can afford to pay for land
MINCOME — Calculates minimum net cash income required to make payments
MACHINEPAK — Machinery analysis package
CUSTOM — Calculates break-even acreage and custom rates
FIXEDCOST — Estimates machinery costs as a percent of new purchase price
GRAINDRILL — Least-cost grain drill analysis
MACHINE — Determination of field machine costs
SEMITRUCK — Estimates costs of operating a tractor-trailer rig
MAILBOX — Used to send and receive mail
MARKETCHART — Prints bar, moving ave., or point & figure charts on futures
MARKETS — Various market reports and specialists’ comments
MC — A multiple choice quiz routine
MCEDIT — Constructs and modifies files for use in MC
MONEYCHECK — Financial budgeting comparison for families
NEWSRELEASE — A program for rapid dissemination of news stories
PIPSIZE — Computes most cost-effective size irrigation pipe to install
PLANTAX — Income tax planning/management program
PREMIUM — Compiles and summarizes fair premiums
PRICEDATA — Prints selected historic cash and/or futures prices
PRICEPLOT — Designed to plot market prices in graphic form
PUMP — Determination of irrigation costs
RANCHADVISORY — Ranch (cow-calf) marketing advisory report
RANGECOND — Calculates the range condition and carrying capacity
SEEDLIST — List seed stocks for sale
SOYBEANPROD — Demonstration soybean production management model
SPRINKLER — Examines feasibility of installing sprinkler irrigation
STATPAK — Package of programs for statistical analysis of data
STOREGRAIN — Cost analysis of on-farm and commercial grain storage
SWINE — Simulation and economic analysis of feeder’s performance
SWINEADVISORY — Feeder pig and slaughter hog marketing advisory report
TESTPLOT — Standard analysis of variance
TRACTORSELECT — Assists in determining suitability of tractors to enterprise
TREE — Summarization of community forestry inventory
TREESALE — Listing of Clarke-McNary available inventory
TURKEY — Simulation and economic analysis of turkey’s performance
VITAMINCHECK — Checks the level of vitamins & trace minerals in swine diet
WEAN — Performance testing of weaning weight calves
YEARLING — Performance testing of yearling weight calves

Each of these programs can be executed by typing the program name. Also see SPECIALIZED for a list of available programs which require additional materials and/or training by program author(s) to run.

Microcomputers

The latest farm computer aid to appear on the market is the microcomputer. These are stand-alone units with the capability to store and analyze significant amounts of data. While there is considerable flexibility in the components of a microcomputer system, a common unit would include the microcomputer itself — plus a printer, a cathode ray tube (a TV-like screen), a keyboard, and one or two disc drives. Numerous makes and models are currently available but costs for the basic system start at around $3,000 and increase with the capacity of the computer and the amount and size of peripheral equipment.

Microcomputers and their peripheral equipment come in many different sizes. The size of the computer’s central processing unit and its storage areas are measured in terms of bytes. A byte is essentially the computer space required to store a character in storage or in the central processing unit. Byte capacity is typically measured in terms of 1,000 bytes. Therefore, when a person speaks of a central processing unit having a capacity of 32K, he essentially means that the central processing unit can hold up to 32,000 bytes of information in memory (this includes program and data storage space). Microcomputers come with various processing capacities ranging from 2K to over 64K. For agricultural applications, few programs will require the central processing unit to have more than 48K.

Most microcomputer systems use either cassette tapes or “floppy discs” to store and retrieve program instructions and data. The main difference between the two storage systems is the time involved to read and load data, with the floppy disc being the considerably more efficient system. The floppy disc system is also
more costly. Programs and data stored on and retrieved from cassette tapes are transferred by means of a tape recorder hooked into the microcomputer. Large programs may take from 15 to 20 minutes to input. If an input error occurs, you must start over. Floppy discs, which resemble 45 rpm records within protective coverings, are inserted within disc drives. A system with two disc drives gives optimal programming capabilities since it allows large programs to be read from one disc while allowing access to data from the other disc. Most programs on disc drives take from 1 to 2 minutes to input. The size of disc drives needed depends upon the data requirements of the programs to be used with the unit. However, a unit with two combined disc drives that store 600K, or more, is not unusual.

Several different types and sizes of printers and cathode ray tubes are available. The cathode ray tube (TV screen) presents a visual display of the computer input and output. The printer provides a printed copy of the desired input and output information. The type of printer and/or cathode ray tube to purchase with a microcomputer unit depends basically upon the type of output required.

The typical computer keyboard used to enter data and instructions resembles a standard typewriter. Keyboards can be purchased that also have a 10-key numerical pad constructed like an adding machine keyboard to aid in inputting numerical information.

Microcomputers have the ability to store and process farm records, and this feature is attracting farmer interest. Washington farmers who own microcomputers emphasize the role of their systems in helping with the record keeping chores. They have a high appreciation for the role of records in improving the control they have over their business. In the words of one farmer, "If I'm going to make it in this business, it is essential that I know where I am making and losing money in my farming operation and what are likely to be my most profitable options."

Though different in various aspects, the farm record keeping programs developed by several farmers who have microcomputers are quite similar. Each expense or receipt item is entered from the keyboard and coded according to a particular enterprise and field. On command any time during the year, the computer automatically prints a summary of expenses and receipts for the entire operation and/or for each enterprise and field. One farmer who operates several tracts of leased land with different landowners is also able to get a breakdown by landowner. In addition, each farmer has developed programs that compare whole-farm expenditures, as well as enterprise and field expenditures, with previously constructed budgets, and therefore, is able to determine at any point in time where the business is relative to the budget plan.

The main inputs for these systems are accurate records on the amount and cost of materials, labor, and equipment use time on a field-by-field basis. This requires keeping records on each worker indicating how much equipment time is spent on each enterprise and field. One farmer accomplishes this by placing a tape recorder in the cab of his tractors and combines.
These farmers indicate that their computer systems give them the capability to spot areas where they are making or losing money. Armed with this information, they have been able to make changes that have increased profitability. Moreover, their computer programs have been helpful in preparing tax returns, documenting loan requests, and keeping lenders and landowners informed. Additional programs developed by one farmer check invoices for arithmetic errors and double billing and compare current grain prices with those for the next 30 and 60 day markets to help determine the best time to sell.

While the ability of computers to assist in record keeping is important for all types of farms, the more intensive operations will find the greatest benefit from using computers to analyze day-to-day problems. For example, a dairy operation can use a microcomputer to keep track of milk production, breeding, and feeding data for individual cows, groups of cows, and/or the entire herd. Such information is very valuable in determining how much to feed cows, when to breed them, and when they should be dried off or culled.

Microcomputers costing $3,000-$5,000 have the capacity to use programs written for programmable calculators, as well as the majority of the programs in the libraries of terminal-accessed central computers. However, because of computer language incompatibility problems, these programs will have to be rewritten. The expense and time of rewriting programs in centralized computer libraries (for example AGNET, TELPLAN, CMN) can be overcome by purchasing an acoustic coupler for the microcomputer for around $300. This would give the farmer the ability to use the microcomputer in the same manner as previously described for the remote terminal.

Deciding on a Microcomputer or Other System

There are several different microcomputers on the market today. The main problem is that farm management related software (the computer instructions) for many of these computers is currently not available. In addition, most software available is written for a particular make of computer and not usable by other brands. Therefore, many purchasers of microcomputers have found that unless they are willing to learn to program or to invest in hiring a programmer, they have little more than an expensive instrument for electric ping pong.

Of the three Washington farmers interviewed, two have learned to program their own computers and have developed their own package of programs. The third hired a programmer, and to date has invested slightly more in program development than he paid for the computer.

Therefore, if you are a farmer interested in investing in a microcomputer and are not willing to develop your own programs, there are certain guidelines to follow in determining the best microcomputer for your business. These same guidelines also apply if you are considering purchasing a programmable calculator or joining a remote terminal-centralized computer system.

Determine what you want the computer to accomplish for you. If you are primarily interested in an accounting program, be able to specify the exact type of accounting system you desire. General accounting packages that are currently widely available may not be of much value to you. Likewise, be able to specify the additional functions you desire your computer to perform.
Search the market for software programs that do what you desire. The Joint Personal Computer Task Force of the Southern Extension Farm Management Marketing Committee recently surveyed land-grant universities concerning software availability. Results of this survey can be obtained by contacting J. Robert Strain, Cooperative Extension Service, University of Florida, Gainesville, Florida 32611. This survey lists over 200 programs that have been developed at various land-grant universities, the type of computer they operate on, and who to contact for more information. Another good place to begin searching for desired software is within your own community. Microcomputers have been around long enough that generally within each community at least one enterprising farmer has purchased a computer and has obtained his own package of programs. By virtue of being from the same area, it is quite likely that this program package could easily be adapted to your farm business.

Identify needed microcomputer equipment. After you have accomplished the above two steps, you should be able to determine the type of microcomputer needed to accomplish what is desired and the cost of purchasing needed software and equipment. With this information, you can then determine if the returns gained from purchasing the computer equipment justify the necessary investment.

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