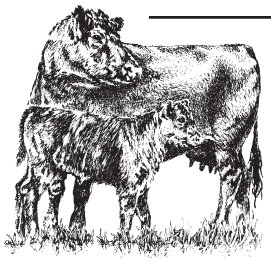

Western Beef Resource Committee

Cattle Producer's Library

Nutrition Section CL380

Computers for Cattle Nutrition

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Computers have been used in livestock nutrition for more than 30 years, but they are still not used extensively by cow and calf producers. Cow and calf producers can lower feed costs and improve nutrition by using computers.

The value of computers for calf producers differs from the feedlot or dairy operator. The most useful information may be computer evaluation of alternative feeds or assistance in selecting supplements. This article describes nutrition information available on computers, ration evaluation and formulation, and evaluation of alternative feeds.

The value of computers arises from their ability to store vast amounts of information about feeds and animal nutrient requirements along with their powerful mathematic capabilities. The chemical composition or "feed analysis" of hundreds of feeds can be stored on diskettes or a computer's hard disk. Often this information is provided when computer nutrition programs are purchased. Feed analysis can be changed or added, adapting the information to specific conditions. Basic feed analysis includes moisture, energy, protein, calcium, and phosphorus concentration. However, many programs include 20 or more specific nutrients for each feed.

Prices for feeds may also be stored and changed as needed by the user. Prices should estimate the cost to actually get the feedstuff in front of cattle. This might include the cost of transportation, wastage, feed bunks, prorated costs of feed mills, and labor. Commodities such as hay must be transported, sometimes further processed by milling or grinding, and fed in hay bunks or feeders. These costs should be included in the cost of the feed.

Frequently, purchased supplements are relatively expensive compared to commodities such as hay, but the supplements may include all costs associated with getting the feed to the cattle. It is possible to use commodity prices and not the "processed" price; however, caution must be used if those results are then used to compare to other types of feed, such as purchased, prepared supplements. The important point is to use feed prices established on the same basis, either "processed" to get the feed in front of the cattle or some other price, but to remain consistent on all feeds.

Animal requirements may be stored on the computer or calculated for each use from formulas stored in the computer. Animal requirements are based on the class of livestock, for example adult cow, replacement heifer, bull, weight, and sex. Additional definitions may include lactation stage, use of implants, weather, and other environmental factors, such as mud or wind.

Often the nutrition program makes an estimate of the quantity of feed consumed. The user may use a different value. Consumption is usually the most difficult value to estimate, and it is important because the amount of feed consumed greatly influences the required concentration of nutrients. Concentration is the amount of a specific nutrient in the total feed (amount of nutrient per unit of ration; e.g., percent).

Livestock need specific *amounts* of nutrients (e.g., grams of calcium), not specific *concentrations* of nutrients (percent calcium). Intake is critical because the total amount of a specific nutrient depends on its concentration and consumption.

Some nutrition programs also store feeding logic such as constraints or limitations about specific feeds, nutrients or nutrient ratios. For example, wheat products that could include wheat grain, wheat mill run, bakery waste plus other wheat products, may want to be limited as a group due to the specific digestive properties of wheat. Beet products may also have constraints due to their laxative properties. Ratios of nutrients may also be important feeding logic, for example the calcium and phosphorus ratio.

Having all of this information readily available and adaptable to local conditions is a vast improvement and advantage over finding values in books or relying on memory. The extent of stored information varies considerably among nutrition programs. What is appropriate or needed depends on the needs of the user. This stored information is used in several distinct nutrition applications.

Ration Evaluation

One use of computers is to calculate the specific amount of individual nutrients for a complete ration. For example, the cattle producer may want to know the energy, protein, calcium, and phosphorus concentration of a ration of alfalfa hay and corn grain. By entering the specific amount of each feedstuff, the computer will calculate the amount of each nutrient in the complete ration. Computer nutrition programs usually accept the amount of feedstuffs as either specific amounts or percent. Depending on the specific computer program, the number of feedstuffs and nutrients available for calculations will vary.

An evaluation of a ration is more complete when the computer also compares the ration to specific animal nutrient requirements. Animal nutrient requirements may be entered by the user or supplied by the computer. Whatever the source, these requirements would be compared to those supplied by the ration. Surpluses or deficiencies are easily denoted. Some programs will use the specified ration to estimate animal performance, usually rate of gain.

It is important to recognize that evaluations are conducted either on a concentration or amount basis, or both. A ration may provide 14 percent protein that may be adequate compared to the animal requirement. However, consumption may vary and ultimately specific amounts of protein or some other nutrient are the critical factor. Computer programs may calculate and estimate intake or permit user entry of consumption.

Ration evaluation is useful for determining the adequacy of feeding programs, but do not calculate or formulate a "best" or better feeding program. In some cases amounts of feeds can be adjusted by trial and error to "test" different rations. Frequently when feeding options are few this is an acceptable method for improving the feeding program. However, computer nutrition programs are available specifically designed to formulate rations.

Ration Formulation

The real power of computers is formulating rations and the information provided from the formulation process. The simplest formulation process is simply trial and error (as mentioned previously). The user enters various amounts of each feedstuff, and the computer calculates the concentration of nutrients in the ration. The computer can greatly speed this process, which can be completed by hand but takes much longer. To "formulate" a ration by trial and error, the user merely tries different amounts of each feed until fnding a suitable ration.

A more desirable formulation method is by using linear programming. The user specifies the feeds to consider in the ration, the cost of each feed, and animal requirements (or animal factors such as weight, sex, and condition).

The computer considers all of these factors simultaneously to select the optimum ration. Usually the optimum ration is the ration that meets the animal requirements at the least cost. These are termed "least cost rations." These types of rations and the linear programming process are powerful tools because it is an algebraic method that considers all of the requirements, feed analysis, and costs at the same time. This is impractical to perform by hand, but can be easily and quickly prepared on the computer.

Least cost rations generally provide information about the amount of each feed selected for the ration, nutrient content of the ration, nutrient requirements of the livestock, surpluses and deficiencies of nutrients, and cost of ration (Table 1). The ration will provide an adequate or surplus of each nutrient specified as a requirement in the formulation process. For example, the user may want a ration that considers or solves for energy, protein, calcium, and phosphorus.

That is, the computer program will find a ration that satisfies those nutrient requirements. Such a least cost ration will provide adequate or surplus amounts for each of those nutrients. In addition, other nutrients will be provided by the ration, and the amount of those nutrients is provided to the user. These other nutrients not specified with required amounts may be provided in surplus, adequate, or deficient amounts since they were not specifically "solved" for, by the computer.

Since a least cost ration targets costs, and minimizing costs, additional information is provided about the cost and monetary value of feeds. These are usually listed as

Table 1. Computer nutrition programs will usually provide the amount of feeds on an as fed and 100 percent dry matter basis.

Feeds in the ration	As fed basis		Dry matter basis	
	(lb/day)	(%)	(lb/day)	(%)
Wheat straw	10.0	45.9	8.9	46.5
Alfalfa, mid bloom	6.1	28.1	5.5	28.8
Corn, grain	2.6	11.9	2.3	12.1
Molasses	2.5	11.7	1.9	10.0
Fat, animal	0.4	1.8	0.4	2.0
Calcium, dical	0.1	0.4	0.1	0.5
Total ration	21.7		19.1	
Cost, $/day	0.87			
Cost, $/ton	80.02		91.08	

"price ranges," "opportunity prices," or "shadow prices." For feeds used in the ration an "incoming or outgoing" price (or lower and upper range) is provided (Table 2). Incoming prices (lower range) indicate the cost of a feed at which the computer would select more of that feed in the ration. When the actual cost of the feed equals or is lower than the incoming price, and all other parts of the ration remain the same, then more of that feed would be used.

For example, a ration might use corn grain that costs $125 per ton. In Table 2 example the incoming price is $122.01 per ton. If the price of corn dropped to $122.01 or less, and everything else remained the same, then a less expensive ration could be formulated using more corn. Without performing the new formulation, we don't know how much more corn or how much less expensive the ration would be.

In a similar manner, "outgoing prices" (or upper range) indicate when less of a single ingredient would be used and the ration would be more expensive. These "incoming" and "outgoing" prices or price ranges are useful for indicating how much prices can change before a new ration could be formulated to lower feed costs. When more than one feedstuff changes price then it is difficult to determine the direction of change and a new formulation is needed.

Feeds not used by the computer in the "least cost" ration are also given a price or value frequently called an opportunity price (Table 2). These indicate the price at which the computer would use them in the ration, instead of one or more feedstuffs currently in the ration.

Table 2. Typical information provided by least cost ration programs includes the monetary value or worth of feeds. These are called opportunity prices, shadow prices, or price ranges.

Feeds in ration	At formulation	Lower range	Upper range
		($/ton as fed)	
Alfalfa, mid bloom	90.00	84.38	92.31
Wheat straw	50.00	-9,999.99	59.30
Corn grain	125.00	122.01	132.94
Molasses	80.00	-58.63	82.49
Fat, animal	300.00	252.93	721.76
Calcium, dical	480.00	-0.04	1,003.58

Feeds not in ration	At formulation	Opportunity price
	($/ton as fed)	
Almond hulls	125.00	70.95
Oat hay	100.00	74.90
Wheat grain	200.00	125.53
Oystershell	100.00	1.18

Comparing Feeds and Selecting Alternative Feeds

In many practical-feeding situations feeding alternatives are limited. For example, long hay (unprocessed) must be fed and grain cannot be fed. Computers are helpful when formulating those rations, but the opportunity prices supplied for feeds not in the ration may be more valuable than the formulation. Opportunity prices are used to evaluate the value of alternative feeds. For example, if a ration is formulated using medium quality hay costing $75 per ton, how much is high quality hay worth?

The opportunity price for high quality hay estimates its value for this particular feeding situation. Another situation where a computer least cost formulation would be helpful is determining the value of a self-fed high-energy supplement when only hay and no grain can be fed. The estimated value of the supplement for this situation is its opportunity price. If the supplement can be purchased for its opportunity price (or lower) then its use would result in a less expensive ration and lower feed costs.

Without the computer, alternative feeds are often evaluated by comparing the cost per unit of nutrient. However, this approach only considers a single nutrient. A self-fed supplement may not be the least expensive source of energy, but when its total nutrient content is considered, it may be the best alternative feed.

When linear programs calculate least cost rations and provide opportunity prices for feeds not in the ration, those prices consider all of the feeds, their nutrients, animal requirements, and costs. Thus, they are a much better evaluation of the potential alternative feed than other methods, and they are specific to the given situation.

In practice, when ration-specific values of alternative feeds are desired, the cost of the alternative feeds being evaluated can be entered very high to make sure they are not used in the ration. Typical values are $999 per ton. Several alternative feeds at high prices can be entered. After formulation by the computer, opportunity prices for each of those feeds are provided. The user can compare those prices to actual prices. If any actual prices are lower than the opportunity price, then that feed is likely a valuable feed to use in the ration. In practice, the price of the alternative feed would be changed to the actual price and the ration re-formulated.

This method is particularly useful for planning purposes. For many cow-calf producers who raise hay, they can use their cost of production for the value of their hay. By including potential alternative feeds, they can be aware of potential "buys" on alternative feeds. This information could be helpful in marketing hay and/or selling raised hay to purchase alternative feed.

A Word of Caution

Even the most sophisticated computer nutrition program cannot completely replace experience and common sense. These programs are mathematical tools that

capture some feeding knowledge, such as constraints on specific feeds or other limitations. By virtue of their vast databases and mathematic capabilities, computer programs do provide information not available through any other process. At times, however, mathematic possibilities, such as a diet based totally on corn, are not practical rations. Users of computer nutrition programs need knowledge of feeds and nutrition to use these tools.

Sources of Computer Nutrition Programs

Computer nutrition programs are available from a variety and changing number of sources. Private companies and academic institutions offer this type of computer software with a wide range in price.

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