Bargains and Rip-Offs: Assessing the Economic Value of Feedstuffs Using Market Prices

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Summary

In many instances, nutritionists, feed manufacturers, dairy producers and their advisors need an estimate of what a feed is worth on a nutritional basis to facilitate the formulation of balanced diets and the purchase of appropriate and price competitive feedstuffs. Up until now, all methods used shared common flaws. We derived a maximum likelihood method that uses composition and prices of all feedstuffs traded in a given market to estimate unit costs of nutrients and break-even prices of feedstuffs. The method was programmed as a Windows® application named ***SESAME.*** The software can be used (1) to rapidly and accurately identify commodity purchasing opportunities, and (2) to benchmark feed costs from nutrient requirements and nutrient unit prices. Examples are presented that contrast the pricing of important nutrients in the Southeast compared to the Midwest in mid December 2003.

Introduction

The annual volume of grains and oilseeds processed in the Unites States is steadily increasing, resulting in a greater availability and a broader variety of by-product feeds to the food animal industries. A more judicious use of by-product feeds, especially in ruminant diets, can result in significant reductions in feeding costs without concomitant reduction in animal productivity. In general, by-product feeds do not possess unique, mystical and inexplicable nutritional properties. Their economic values are primarily determined by their content of valuable nutrients Therefore, assessing the economic value of by-product feeds does not raise any unique challenge beyond that of valuing conventional feed ingredients. In both instances, the process involves an intermediate step which consists in estimating the economic value of the nutrients contained in the feeds. Essentially, one must either explicitly or implicitly determine the unit cost of each "valuable" nutrient. A variety of methods have been proposed to estimate unit costs of nutrients and, consequently, the break-even price of feedstuffs. All methods fall into one of two general categories: equation-based (**EBM**) and inequation-based methods (**IBM**).

For EBM, a set of equations developed from the nutritional composition of referee feeds is solved using their market prices. The best-known method among this

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group is the Petersen Method (**PM**), in which the energy and protein compositions of corn grain and soybean meal are equated to their respective prices, creating a set of two equations with two unknowns. The method dates back to 1932 (Petersen, 1932) and is presented and discussed at length by Morrison (1956). Although widely used, the method is fundamentally flawed:

1. It assumes perfect markets in corn and soybean trading (i.e., corn and soybean meal are always priced exactly at the value of their nutrients),
2. It does not value some important nutrients while valuing irrelevant ones, and
3. It implies economically incoherent behavioral patterns by buyers and sellers of commodities in the long-run.

The second series of methods, IBM, are basically constrained optimization models solved using mathematical programming techniques (Beneke and Winterboer, 1973; St-Pierre and Glamocic, 2000). Linear programming (**LP**) is the best-known member of this group and became widely used in animal nutrition with the discovery of an efficient algorithm (Dantzig, 1960) and the advent of high-speed computers. Within an LP model, a cost function is minimized subject to a series of inequations forcing the solution to meet the nutritional requirements of the animal for which the diet is being optimized.

Many have assumed that linear (and nonlinear) optimization models yield accurate and precise estimates of break-even prices of feedstuffs (shadow prices). This thinking is erroneous:

1. Optimization models are not reality but more or less abstract conceptualization (models) of the real world which itself is far more complicated. As an example of the simplification induced by models, one can think of road maps which are simplified models of the complex geography of a given State. Road maps are useful and generally allow one to travel between two cities rather efficiently. But they are worthless at locating traffic congestion, potholes, and certainly underground oil deposits. Their usefulness in identifying an optimal route does not imply correctness for other uses. The same is true of optimization models. That is, their ability to determine a feasible and optimal combination of ingredients to form a “balanced” diet does not imply that the calculated marginal values of feedstuffs are accurate estimates of their economic values.
2. Optimization programs suffer from being very case specific, and they deliver little information on the unit costs of nutrients.
3. Optimization models assume perfect knowledge of unit prices of feedstuffs, nutrient requirements, and nutrient composition of feedstuffs. In practice, none of these assumptions are met and complex stochastic optimization models must be used to solve correctly in the presence of uncertainty in nutrient composition (St-Pierre and Harvey, 1986).
4. Even when the solution is deemed optimal, nutrients with non-binding constraints have an implicit unit cost of zero. Shadow costs of binding nutrients provide information on unit costs that can only be valid at the margin.

5. The information delivered has a very narrow inference range because it provides estimates that are applicable only to one group of animals in a given herd, under a set of arbitrary constraints imposed by the nutritionist or the producer. Even under the same economic conditions (i.e., same farm, same animals, same feeds), two different nutritionists would produce two different sets of shadow prices.

Consequently, IBM are limited in providing estimates of aggregate unit costs of nutrients within a given market and, consequently, the economic value of a variety of feedstuffs traded in a given market. To circumvent these problems, we developed a new procedure that provides estimates of aggregate unit costs of nutrients and break-even prices of feedstuffs based on the trading of all feed commodities in a given market (St-Pierre and Glamocic, 2000).

The method is based on maximum likelihood estimation of nutrient costs. Similar approaches have been used in many other industries to estimate the implicit pricing of product characteristics, a process known as hedonic pricing (Deaton and Muellbauer, 1980; Gorman, 1956; Griliches, 1971; Stigler and Becker, 1977). The objectives of this paper are (1) to explain briefly the estimation method that we developed, (2) to describe the computer software that we wrote to make our procedure available to the industry, and (3) to show examples of how this information can be used to establish economic values of conventional and by-product feddstuffs.

Method Development

Understanding the Method

In the Petersen method, prices of ground shelled corn (**GSC**) and soybean meal (**SBM**) are equated to their composition in energy and protein. Using NRC (2001) composition at 3x maintenance and \$100/ton for GSC and \$200/ton for SBM (these prices are examples), the resulting equations are:

$$\begin{aligned} \text{GSC:} \quad & \$100.00 = 1612\ \text{NE\$} + 165.6\ \text{CP\$} \\ \text{SBM:} \quad & \$200.00 = 1794\ \text{NE\$} + 963.0\ \text{CP\$} \end{aligned} \qquad [1]$$

where

NE\$ = cost per Mcal of NE_L (unknown)
CP\$ = cost per lb of CP (unknown)

In words, the first equation in this system says that one ton of GSC has 1612 Mcals of NE_L. If we knew the cost per Mcal (NE\$), the multiplication of 1612 by this unit cost would represent the economic value of the energy in one ton of corn. Likewise, the equation states that one ton of corn contains 165.6 lbs of CP. If we knew the cost per lb of CP, the multiplication of 165.6 by this unit cost would represent the economic value of CP in one ton of GSC. This system of equations is easily solved, with the result that

NE_L is implicitly priced at $0.050/Mcal and CP at $0.114/lb. These nutrient costs can then be used for calculating break-even prices of other feedstuffs.

The PM method contains fundamental flaws that cannot be ignored:

1. The referee feeds (GSC and SBM) are never either well or poorly priced. That is, the method implicitly assumes that referee feeds are always priced at their breakeven prices. Invariably, one finds other commodities that are priced under their own breakeven prices. Hence, one would conclude that corn and soybean meal should never be purchased based on a PM evaluation. This is an odd conclusion because the method implicitly assumes that referee feeds are market movers and set the prices of other commodities in the marketplace.

2. PM assumes perfectly competitive markets. This implies that those trading corn and SBM have perfect market information, with trading occurring at a perfect equilibrium point between supply and demand.

3. The application of PM over a long period of time (years) identifies fundamental incoherence in the economic behavior of buyers and sellers. That is, buyers keep purchasing some commodities well above their breakeven prices while sellers keep selling other commodities at prices considerably less than their breakeven prices.

4. It is difficult to augment PM to accommodate additional nutrients, not because of the algebra involved, but because of the difficulty in identifying proper referee feeds. That is, one must assume near-perfect knowledge of the composition of referee feeds. This assumption may be reasonable for CP, a poor indicator of biological value in ruminants, but is greatly challenged when nutrients with more uncertain characteristics, such as digestible RUP and NE_L are being considered.

Some of the problems associated with the PM can be alleviated by considering more than two feedstuffs for the estimation of the unit costs of two nutrients. For example, we could evaluate the unit costs of NE_L and CP using GSC, SBM, corn hominy (**HOM**) and canola meal (**CAM**) and use the standard nutritional composition reported by NRC (2001). If we use HOM and CAM, and $110.00/ton and $144.00/ton as their respective prices, we get:

$$\begin{aligned} &\text{HOM:} \quad \$110.00 = 1510\ NE\$ + 210.6\ CP\$ \\ &\text{CAM:} \quad \$144.00 = 1442\ NE\$ + 682.7\ CP\$ \end{aligned} \qquad [2]$$

resulting in estimates of $0.062/Mcal and $0.081/lb of NE_L and CP, respectively. It is easy to see that we could pair any two feeds to produce a set of equations as in [1] and [2] to get estimates of NE_L and CP. We can also introduce the concept of price-error, which is the difference between the market price of a feedstuffs and the value of its nutrients (i.e., the markets are not perfect price discoverers). Using SBM, for example, we can set the following equation:

SBM: $200.00 = 1794 NE$ + 963.0 CP$ + ε_1 [3]

Using this approach, the four equations for the four feedstuffs can be rewritten as:

GSC: $100.00 = 1612 NE$ + 165.6 CP$ + ε_1
SBM: $200.00 = 1794 NE$ + 963.0 CP$ + ε_2 [4]
HOM: $110.00 = 1510 NE$ + 210.6 CP$ + ε_3
CAM: $144.00 = 1442 NE$ + 682.7 CP$ + ε_4

The set of four equations in [4] has eight unknowns and, thus, has an infinite number of solutions. However, only one solution among this infinite set of solutions minimizes the sum of the squared errors (sum of ε_i squared). Intuitively, this is appealing because this solution determines unit values of NE$ and CP$ that make market prices of feedstuffs as close as possible to the values of their nutrients. Statistically, this solution produces the least-squares estimates of nutrient unit costs. Under certain conditions (independent ε_i, normally distributed) the least-square estimates are also maximum-likelihood (ML) estimates. Maximum likelihood estimates have known properties which are well defined statistically. With this approach, it is easy to expand the equations in [4] to accommodate any number of m feedstuffs for the evaluation of n nutrients (for m > n). The algebra required to do this is explained at length in St-Pierre and Glamocic (2000) and is easily implemented in modern high-speed computers.

In is important to understand that the estimation is market driven. Animal requirements are not directly factored in the evaluation. In essence, if animals have requirements for certain nutrients, then these requirements should be translated in the form of market demands for these nutrients that would be reflected in the prices of feedstuffs. Thus, our ML method should produce very good aggregate estimates of the economic value of feedstuffs in a given market. At the enterprise level (farms), it is possible that short-term, non-nutritional constraints (inventory, contracts, etc.) can alter the economic value of feedstuffs away from the ML estimates. This would not be true in the long-run. Therefore, ML estimates produced by our method can act as good proxies for purchasing decision at the farm level.

Maximum likelihood properties are obtained under the following conditions:

1. Buyers and sellers of commodities act rationally; that is, a buyer would not keep buying an overpriced commodity and a seller would not keep selling commodities at discount prices over time.

2. The value of a feedstuff is equal to the sum of the values of its nutrients. Feedstuffs are used exclusively as sources of nutrients. Feedstuffs with valuable characteristics other than nutrient content (e.g., mold inhibitors) are not evaluated properly.

3. The errors are independently and normally distributed. In the software, we insure that this assumption is met by eliminating any outlier feedstuffs.

SESAMEÔ Release 2.05

SESAME is a Windows® based program. In its development, we tried as much as possible to keep the software users friendly to non-economists and non-statisticians.

Nutrient Composition: The Feedstuffs Menu

By default, *SESAME* contains the full NRC (2001) feed library, a few commercial feedstuffs whose nutritional composition are reasonably known, and a few additional byproduct commodities primarily from California. All of these feedstuffs are "protected" in that they can be used by users to set-up a problem, but their composition cannot be directly edited. The user can customize the nutritional composition of a feedstuffs by first copying it to his library where it can be edited. A set of feedstuffs forms a *group.* In *SESAME*, we have defined various groups of feedstuffs primarily on a regional basis. Likely, a frequent user would set-up a personal group of feedstuffs to regroup the protected feedstuffs of interest with user-defined feedstuffs.

Nutrient Definition: The Configuration Menu

Over 140 nutrients are defined in *SESAME* to cover applications in a multitude of species. Nutrients can be defined as direct entries (e.g. crude protein), or as calculated nutrients (e.g. NFC). Calculated nutrients are defined using equations inserted in the **Formula** section of the program. Most users will never have to use this section of the program because all nutrients commonly used in dairy nutrition are already defined.

Market Prices of Feedstuffs: The Price List Menu

Various price lists can be set to reflect different prices across space (markets) or time. Feedstuffs can be added to a price list using a convenient drag-and-drop feature. There are no limits to the number of price lists.

Setting up a Problem and Finding Break-Even Prices: The Solver Menu

The core engine resides within the **Solver** section of the program (Figure 1). To create a problem, the user must indicate which feedstuffs, nutrients and prices are part of a problem. The calibration set contains all feedstuffs traded in a given market. Feedstuffs are added or deleted from this set through a simple drag-and-drop function. Alternatively, the user can identify in the appraisal set those feedstuffs for which he has no current price but for which estimated break-even prices are desired.

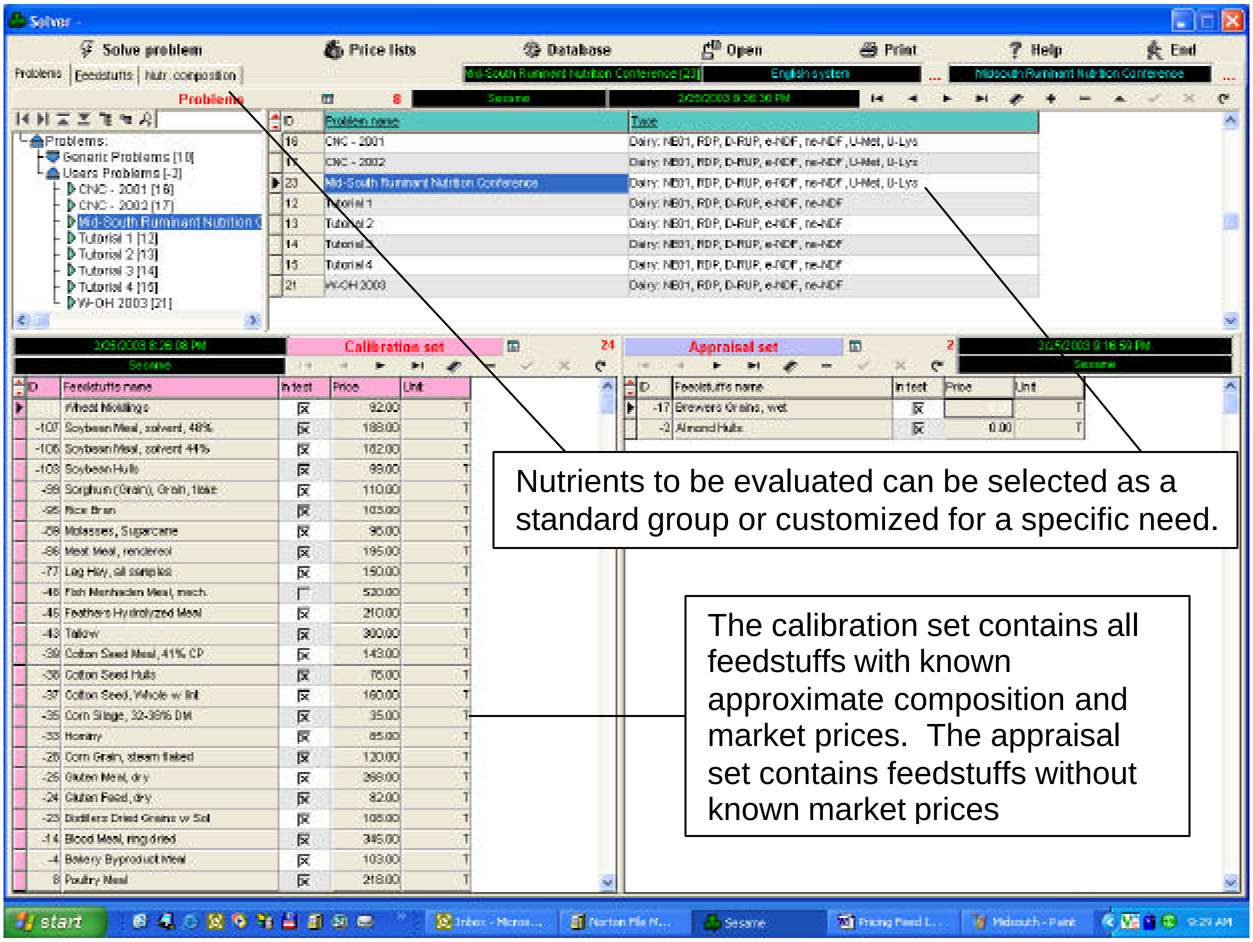

Figure 1. Solver section showing the selected problem, Calibration, and Appraisal sets of feedstuffs. Tabs and buttons allow users to select feedstuffs, nutrients, and prices to build a problem. A solution is found by pressing the "Solve problem" button.

The **nutrient composition** tab allows the selection of the specific nutrients whose values are to be estimated. Active prices of feedstuffs are selected using the price list button.

Applications

Table 1 reports the nutritional composition of 37 commodity feedstuffs actively traded in either the Southeast or Midwest markets. Prices reported are for mid December, 2003 and do not include normal margins and transportation charges. Feed composition values are from NRC (2001), or from samples that were analyzed in our laboratory.

Table 1. Nutrient composition and market prices of 37 feedstuffs, FOB Atlanta (GA) or Okeechobee (FL) for the Southeast market, and FOB Chicago (IL) or Minneapolis (MN) for the Midwest market; December, 2003. Composition values are on an as-fed basis.[a,b]

	NEl – 3X (2001) Mcal/lb	RDP (%)	Digestible RUP (%)	ne-NDF (%)	e-NDF (%)	Southeast[c] Price ($/ton)	Midwest Price ($/ton)
Bakery Byproduct Meal	0.849	8.08	2.26	11.77	0.00	$125	$105
Beet Pulp, dried	0.589	2.09	5.39	27.10	13.35	t.b.d.	$130
Blood Meal, ring dried	0.953	19.38	53.05	0.00	0.00	$810	$720
Brewers Grains, dried	0.704	11.49	11.99	35.25	7.74	t.b.d.	$95
Brewers Grains, wet (22% DM)	0.169	4.00	1.86	8.42	1.85	--	t.b.d.
Canola Meal	0.721	21.95	9.14	20.72	6.19	t.b.d.	$162
Cereal Byproduct	0.791	6.39	1.25	8.85	0.00	--	t.b.d.
Chocolate Byproduct	1.105	9.28	1.85	20.39	2.27	t.b.d.	t.b.d.
Citrus Peel, wet (15% DM)	0.120	0.71	0.26	2.43	1.20	$13	--
Citrus Pulp, dried	0.685	4.40	1.50	13.91	6.85	$80	t.b.d.
Corn Grain, ground dry	0.803	4.36	3.53	8.37	0.00	$128	$100
Corn Silage, 35% DM	0.231	2.00	0.76	4.58	11.21	$40	$35
Cotton Seed Hulls	0.194	2.44	1.54	37.83	37.83	$92	$167
Cotton Seed Meal, 41% CP	0.702	21.17	17.91	17.84	10.04	$165	$213
Cotton Seed, whole with lint	0.793	16.33	3.88	0.00	45.32	$153	$170
Distillers Dried Grains	0.806	13.18	10.89	33.60	1.40	$152	$130
Feathers Hydrolyzed Meal	0.910	29.70	36.49	0.00	0.00	$325	$315
Fish Menhaden Meal	0.964	21.37	37.00	0.00	0.00	$500	$550
Gluten Feed, dry	0.702	14.89	5.43	20.31	11.43	$127	$110
Gluten Meal, dry	0.933	14.27	38.54	6.14	3.45	$392	$332
Hominy	0.755	7.25	2.96	16.99	1.68	$117	$90
Legume Hay, mid, 40 NDF	0.506	14.15	2.51	2.78	31.99	$140	$120
Linseed Meal, solvent	0.643	13.84	13.26	26.08	6.52	$215	$200
Malt Sprouts	0.612	13.21	3.99	28.07	14.46	--	$77
Meat Meal, rendered	0.941	28.56	20.42	0.00	0.00	$330	$299
Molasses, Sugarcane	0.593	3.53	0.78	0.30	0.00	$80	$98
Potato Byproduct Meal	0.297	0.88	2.55	7.04	0.78	--	t.b.d.
Rice Bran	0.842	7.34	4.35	23.53	0.12	$110	--
Soybean Hulls	0.602	7.00	3.95	53.72	1.10	$110	$100
Soybean Meal, solvent 44%	0.861	29.08	14.31	10.22	3.05	$256	$223
Soybean Meal, solvent 48%	0.897	27.642	19.08	6.75	2.02	$266	$233
Soybean seeds, whole roasted	1.123	23.71	13.11	0.00	20.11	--	$300
Sunflower Meal, solvent	0.577	22.02	3.75	33.81	3.34	--	$110
Tallow	2.051	0.00	0.00	0.00	0.00	$400	$460
Tomato Pomace, dried, ground	0.655	14.60	5.42	37.62	19.38	t.b.d.	--
Wheat Bran	0.651	12.22	2.39	37.11	0.76	$121	$93
Wheat Middlings	0.678	12.66	3.53	32.19	0.66	$116	$93

[a]*SESAME*: Nutritional Composition of feedstuffs.
[b]DRUP = Post-ruminally digestible rumen undegradable protein, RDP = rumen degradable protein, NEl – 3X = Net energy lactation at 3X maintenance, ne-NDF = non-effective NDF, and e-NDF = effective NDF.
[c]t.b.d. = to be determined by the software; - indicates non-available feedstuffs.

All feedstuffs with known market prices are used to simultaneously estimate the unit costs of net energy for lactation, RDP, digestible RUP, effective NDF, and non-effective NDF. Neither the composition nor the price of a given feedstuff has to be known with certainty; only reasonable estimates are needed. The break-even values of all byproducts with a "--" symbol in the price column (i.e., feedstuffs for which we do not have market prices) are estimated using their nutrient composition and the estimated unit values of the nutrients selected. Figure 2 shows the results using mid December, Midwest prices. Because the method is based on statistical methods, nutrient costs are reported as estimates (standard errors of nutrient costs are provided in the long report format). Similar results are reported in Figure 3 for the Southwest market. Clear differences between the two markets can be drawn from these two tables. In late Fall 2003, the unit cost of energy was lower in the Southeast (5.45 ¢/Mcal) than in the Midwest (6.08 ¢/Mcal) <u>although the price of corn is less in the Midwest</u>. So, although Midwest producers can tactically reduce the cost of dietary energy in their diets by using principally corn grain as an energy source, on an average, net energy for lactation costs more in the Midwest than in the Southeast. However, the costs per unit of digestible RUP (24.6 ¢/lb vs. 30.1 ¢/lb), and non-effective NDF (-3.7 ¢/lb vs 0.2 ¢/lb) are lower in the Midwest market, whereas the costs per unit of RDP and effective NDF are essentially the same in both markets. These differences explain why some feedstuffs are neutrally priced (e.g., molasses, soybean hulls) in the Southeast market, but clearly over-priced in the Midwest market. When applied over time, feedstuffs would trade position from neutral to over-priced, to under-priced, etc., a behavior typical of imperfect markets, i.e. when trading is done with imperfect information.

In *SESAME*, results can be presented graphically as in Figure 4. Using the Southeast market as an example, this figure partitions feedstuffs into three separate groups: over-priced (e.g., cottonseed hulls, gluten meal, legume hay, linseed meal, meat meal, soybean meal 44%), neutrally-priced (e.g., bakery by-product, corn grain, corn silage, whole cottonseed, hominy, molasses, soybean hulls, soybean meal 48%, wheat bran, and wheat middlings), and under-priced (e.g., citrus peel, citrus pulp, cottonseed meal, distillers dried grains, hydrolyzed feather meal, gluten feed, and rice bran). This knowledge does not imply that feedstuffs in the over-priced category should not be used when formulating dairy diets, or that under-priced feedstuffs should automatically be used. The method identifies purchasing opportunities. From a diet standpoint, it implies that the use of over-priced feedstuffs should be minimized while the use of under-priced feedstuffs should be maximized in diet formulation.

Break-even Price of Non-conventional By-products

Any feedstuffs with a known (or approximately known) nutrient composition but without a known price can be appraised using the estimates of nutrients unit costs. For example, we appraised the following feedstuffs in each of our two example markets: sugar beet pulp, canola meal, and cereal by-product in the Southeast market, and wet brewers grains (22% DM), cereal byproduct, chocolate byproduct, dried citrus pulp cottonseed hulls, potato byproduct, and wet tomato pomace in the Midwest market. The estimated break-even prices appear in the "Predicted" column of the Appraisal set table in Figures 2 and 3. Various nutrient composition scenarios can rapidly be evaluated and compared.

The results reported in this paper are for illustration purpose only. First, as mentioned earlier, we did not add normal margins, handling, and transportation costs to the wholesale prices. These vary substantially based on location, volume, terms of payment, etc. Seasonality and short-term market fluctuations can also distort the picture substantially.

Limitations

The framework used in the ML method is entirely different than the conventional approach which uses shadow prices from optimization models. This frees the economic evaluation from most of the drawbacks associated with the conventional methods. Other limitations, however, must be recognized:

1. All economically important nutrients must be factored in the evaluation to get unbiased estimates. The specific identity of these nutrients is still under investigation.

2. The evaluation does not account for the specific fit to a particular nutritional situation. For example, it would not value properly purchasing opportunities in situations were a large proportions of feedstuffs are either home-grown or are already under contractual obligations. In the long-run, however, the evaluation would point correctly to alternate feeding programs, including the economic value of a specific cropping program.

3. The method can be very sensitive to collinearity. That is, there are instances where the composition of feedstuffs is not different enough to uniquely identify the values of all nutrients. This problem can be alleviated by a careful selection of the feedstuffs used in the assessment, a process that can introduce a certain element of subjectivity.

4. The method does not factor the effect of nutrient variation within feedstuffs. We know that this is incorrect but the mathematics needed to account for this effect is not trivial and the solution is dependent on the specific amount used in a particular diet. This problem, however, is entirely shared by conventional least-cost programs (St-Pierre and Harvey, 1986).

5. The method does not account for non-nutritional factors that can add or reduce the calculated economic value. For example, the value of molasses is underestimated in situations where molasses is used to agglomerate (glue) components of a total mixed ration. Likewise, the value of highly perishable feedstuffs is overestimated.

Economic Midwest *12/30/2003 8:52:08 AM*

Price Prediction Reliability	26.781

The Price Prediction Reliability is a measure of error in the model.

Estimate of Nutrient Unit Costs		
Nutrient name	Estimate	
NEl - 3X (2001)	0.060837	**
RDP	0.088249	~
Digestible RUP	0.246207	**
ne-NDF	-0.037284	~
e-NDF	0.039793	~

- A blank means that the nutrient unit cost is likely equal to zero
- ~ means that the nutrient unit cost may be close to zero
- * means that the nutrient unit cost is unlikely to be equal to zero
- ** means that the nutrient unit cost is most likely not equal to zero

This section reports the estimated unit price of the nutrients selected for evaluation.

Calibration set				
Name	Actual [/T]	Predicted [/T]	Lower limit	Upper limit
Bakery Byproduct Meal	105.000	119.911	104.552	135.270
Beet Sugar Pulp, dried	130.000	92.288	78.726	105.851
Brewers Grains, dried	95.000	144.808	133.043	156.573
Canola Meal, mech. extracte	162.000	160.928	150.826	171.031
Corn Grain, ground, dry	100.000	116.554	100.411	132.696
Corn Silage, 32-38% DM	35.000	40.884	34.681	47.088
Cotton Seed Meal, 41% CP	213.000	205.635	195.353	215.918
Cotton Seed, Whole w lint	170.000	180.452	157.563	203.341
Distillers Dried Grains w Sol	130.000	151.005	140.807	161.203
Feathers Hydrolyzed Meal	315.000	342.805	324.033	361.577
Gluten Feed, dry	110.000	132.310	124.802	139.819
Gluten Meal, dry	332.000	326.632	302.287	350.977
Hominy	90.000	107.843	96.104	119.582
Leg Hay, all samples	120.000	122.253	105.913	138.592
Linseed Meal, solvent	200.000	153.709	144.704	162.714
Malt Sprouts	77.000	107.941	98.095	117.787
Meat Meal, rendered	299.000	265.501	250.769	280.232
Molasses, Sugarcane	98.000	82.020	68.226	95.814
Soybean Hulls	100.000	65.841	48.761	82.922
Soybean Meal, solvent 44%	223.000	221.319	207.127	235.510
Soybean Meal, solvent, 48	233.000	248.451	235.890	261.012
Soybean Seeds, whole roa	300.000	258.995	244.349	273.641
Sunflower Meal, solvent	110.000	104.989	89.187	120.791
Wheat Bran	93.000	85.460	74.003	96.916
Wheat Middlings	93.000	98.699	88.555	108.842

This portion of the output reports actual market prices and predicted prices (i.e., breakeven prices) of traded feedstuffs. The lower and upper limits identify the 75% confidence range. A feedstuffs whose actual price is within these two limits is considered neutrally-priced. If the actual price is less than the lower bound, it is under-priced; above the upper bound, it is over-priced.

Appraisal set		
Name	Actual [/T]	Predicted [/T]
Blood Meal, ring dried	720.000	413.186
Brewers Grains, wet	0.000	31.999
Cereal Byproduct	0.000	107.053
Chocolate Byproduct	0.000	146.567
Citrus Pulp dried	0.000	92.951
Cotton Seed Hulls	167.000	37.357
Fish Menhaden Meal, mech.	550.000	337.161
Potato Byproduct Meal	0.000	45.640
Tallow	460.000	249.513
Tomato Pomace	0.000	27.081

Fish Menhaden Meal was deemed an outlier and was removed from the calibration set during the solution process. The Predicted column lists the estimated break-even prices of feedsuffs with known composition but unknown market prices. For example, wet brewers grains has an estimated value of $32.00/ton.

Calculation log	
Action	Reason
Feedstuffs "Blood Meal, ring dried" removed	Outlier
Feedstuffs "Fish Menhaden Meal, mech." removed	Outlier
Feedstuffs "Tallow" removed	Outlier

Figure 2. Solution output for the Midwest market. Actual prices are wholesale FOB Chicago (IL) or Minneapolis (MN) for the week of December 15, 2003.

Economic - Southeast

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Price Prediction Reliability	29.451

Estimate of Nutrient Unit Costs		
Nutrient name	Estimate	
NEI - 3X (2001)	0.054532	**
RDP	0.085766	~
Digestible RUP	0.300771	**
ne-NDF	0.002449	
e-NDF	0.040268	~

- A blank means that the nutrient unit cost is likely equal to zero
- ~ means that the nutrient unit cost may be close to zero
- * means that the nutrient unit cost is unlikely to be equal to zero
- ** means that the nutrient unit cost is most likely not equal to zero

Note the differences in the estimated unit costs of nutrients between the Southeast and the Midwest (Figure 2). Standard errors can be shown in an optional "long" report.

Calibration set				
Name	Actual [/T]	Predicted [/T]	Lower limit	Upper limit
Bakery Byproduct Meal	125.000	120.621	105.920	135.323
Citrus Peel, wet (15%DM)	13.000	16.935	14.758	19.113
Citrus Pulp dried	80.000	96.871	84.414	109.328
Corn Grain, ground, dry	128.000	116.705	100.567	132.844
Corn Silage, 32-38% DM	40.000	42.453	35.957	48.949
Cotton Seed Hulls	92.000	66.886	41.690	92.083
Cotton Seed Meal, 41% CP	165.000	229.544	217.692	241.397
Cotton Seed, Whole w lint	153.000	174.306	149.228	199.384
Distillers Dried Grains w Sol	152.000	178.779	166.688	190.870
Feathers Hydrolyzed Meal	325.000	369.675	348.982	390.367
Gluten Feed, dry	127.000	144.894	135.384	154.404
Gluten Meal, dry	392.000	361.133	331.990	390.276
Hominy	117.000	114.712	103.113	126.312
Leg Hay, all samples	140.000	120.422	102.925	137.919
Linseed Meal, solvent	215.000	180.170	169.818	190.522
Meat Meal, rendered	330.000	274.499	257.960	291.038
Molasses, Sugarcane	80.000	75.452	61.838	89.066
Rice Bran	110.000	131.918	118.681	145.156
Soybean Hulls	110.000	104.904	84.509	125.299
Soybean Meal, solvent 44%	256.000	232.784	214.638	250.929
Soybean Meal, solvent, 48	266.000	261.967	246.955	276.980
Wheat Bran	121.000	108.756	94.078	123.434
Wheat Middlings	116.000	118.962	106.196	131.727

Appraisal set		
Name	Actual [/T]	Predicted [/T]
Beet Sugar Pulp, dried	0.000	112.300
Blood Meal, ring dried	810.000	458.484
Canola Meal, mech. extracte	0.000	177.245
Cereal Byproduct	0.000	105.159
Fish Menhaden Meal, mech.	500.000	364.317
Tallow	400.000	223.652

Calculation log	
Action	Reason
Feedstuffs "Blood Meal, ring dried" removed	Outlier
Feedstuffs "Fish Menhaden Meal, mech." removed	Outlier
Feedstuffs "Tallow" removed	Outlier

Sesame 2.05: Regression results ()

Figure 3. Solution output for the Southeast market. Actual prices are wholesale FOB Atlanta (GA) or Okeechobee (FL) for the week of December 15, 2003.

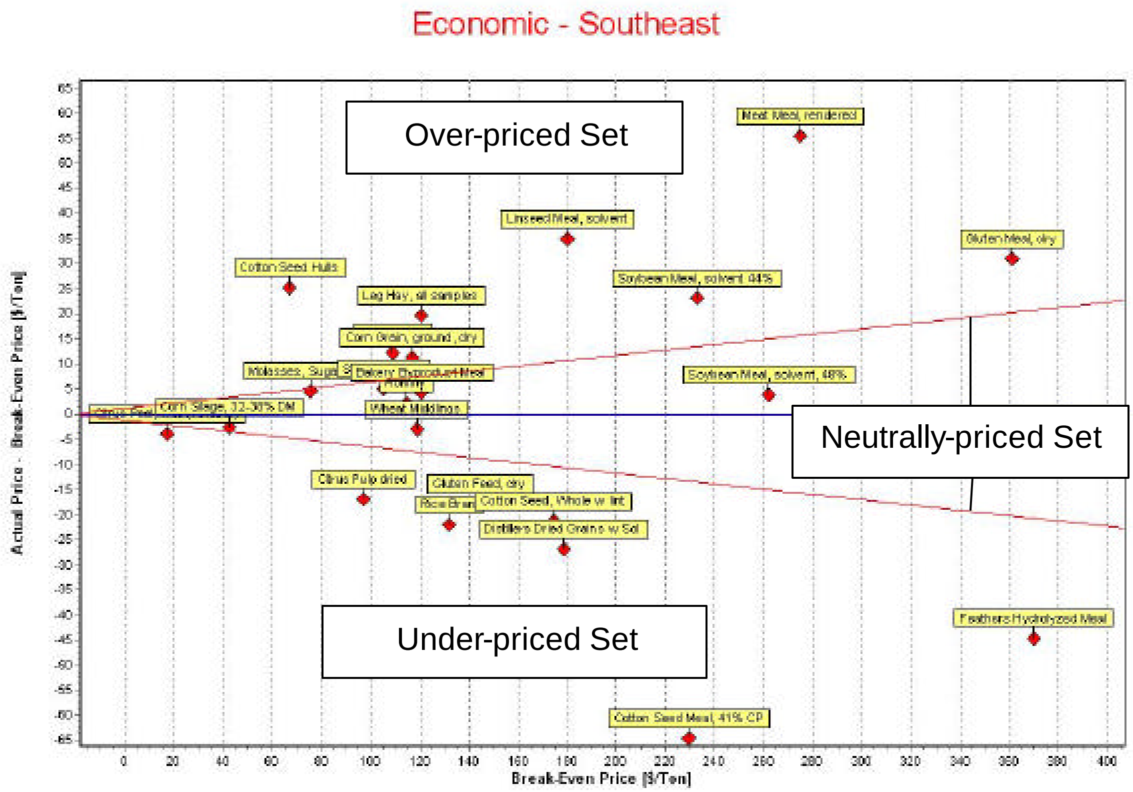

Figure 4. Partitioning of feedstuffs into over-priced, neutral and under-priced sets. Prices are wholesale prices, FOB Atlanta (GA) or Okeechobee (FL) for the week of December 15, 2003.

Conclusions

Our maximum likelihood method uses the prices of all feedstuffs traded in a given market to estimate the implicit (hedonic) costs of nutrients. Because it is based on statistical methods, it provides measures of dispersion of estimated nutrient costs and break-even prices. Also, because it does not use referee feeds (e.g., corn and soybean meal), each feedstuffs used in the estimation can potentially have a break-even price above or below its market price. The method can be used to identify purchasing opportunities and/or to estimate unit costs of nutrients.

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