

LEAST COST SUPPLEMENTATION

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- 1) a current weight for a mother cow and a target weight for that cow 12 months in the future
- 2) expected nutrient analysis for range forages over the year
- 3) nutrient analyses and costs for possible supplements **what is the least cost supplement plan to insure that the mother cow meets or exceeds her target weight?**

Supplementation decisions are one of the critical tasks in managing a range cow herd. Should I supplement? When should I supplement? What should I supplement? These are all common and important questions that a rancher must answer. The purpose of this report is to describe a decision aid that can help in answering these questions. A copy of the decision aid in Excel spreadsheet format can be obtained from the author.

The question answered by this decision aid is given:

This is an extension of the least cost ration problem described earlier and uses the same basic spreadsheet techniques to solve the problem. The major difference is that instead of constraints on nutrients in the ration we now have constraints on cow weight. To do this we need a way of predicting cow weights. The method used is a modified net energy method. The modifications were to add minerals and protein to the gain formula and to vary the energy requirements as a func-

Figure 1

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1														
2	Month		1	2	3	4	5	6	7	8	9	10	11	12
3	cow weight	lbs	800	790	781	774	773	798	824	835	832	821	811	800
4	pg_energy_req	ratio	1.32	1.6	1.6	1.6	1.6	1.6	1.49	1.38	1.25	0.95	0.95	1.12
5				Calve					Breed					
6	lbs energy	lbs/day	6.00	5.92	5.86	5.82	5.87	6.07	6.23	6.28	6.24	6.16	6.08	6.00
7	pounds_protein	lbs/day	0.75	0.74	0.73	0.73	0.77	0.80	0.80	0.79	0.78	0.77	0.76	0.75
8	pounds minerals	lbs/day	0.00	0.00	0.00	0.01	0.04	0.04	0.03	0.01	0.00	0.00	0.00	0.00
9														
10	net energy for maintenance	lbs/day	6.24	5.76	5.29	4.76	3.61	3.70	4.47	5.32	6.43	6.37	6.30	6.24
11	net energy for gain	lbs/day	-0.24	0.17	0.57	1.06	2.26	2.37	1.76	0.96	-0.19	-0.21	-0.23	-0.24
12														
13	gain-energy	lbs/day	-0.12	0.09	0.31	0.62	1.63	1.66	1.06	0.51	-0.09	-0.10	-0.11	-0.12
14	gain-minerals	lbs/day	-0.99	-1.05	-1.12	-0.89	1.77	2.02	0.46	-0.74	-1.04	-1.02	-1.01	-0.99
15	gain-protein	lbs/day	-0.22	-0.23	-0.23	-0.24	-0.23	-0.27	-0.30	-0.30	-0.25	-0.24	-0.23	-0.22
16														
17	expected gain	lbs/day	-0.35	-0.29	-0.22	-0.06	0.84	0.87	0.36	-0.09	-0.36	-0.36	-0.35	-0.35
18														
19	cost	\$/month	2.00	2.00	2.00	2.15	3.15	3.25	2.77	2.25	2.00	2.00	2.00	2.00
20														
21	cost per year		27.56											
22														
23														
24	range forage	lbs consumed	15.00	14.80	14.64	14.52	14.49	14.96	15.45	15.65	15.60	15.40	15.20	15.00
25	hay	lbs fed/day	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26	cottonseed	lbs fed/day	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
27	block	lbs fed/day	0.00	0.00	0.00	0.02	0.15	0.17	0.10	0.03	0.00	0.00	0.00	0.00
28	mineral supplement	lbs fed/day	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

tion of the pregnancy and lactation state of the cow.

Because of the added complexity of this model compared to the simpler ration formulation model, not all spreadsheet solvers will solve this problem. You may have to experiment with the solver option in your spreadsheet to check if it works. The template is available in Excel format and the Excel solver does solve this problem albeit slowly. If you would like current information on what spreadsheets can solve this problem you might consider posting a question to the IRM electronic highway mailing list. (See the Ranchers' Management Guide article on the electronic highway information sources for details on how to do this.)

The basic spreadsheet is displayed in Figures 1 and 2.

How to use the supplement decision guide.

1. Input the starting weight of your cows in cell C3.

2. Input the expected nutrient values and costs for your range forage in rows 30 through 33. This is not a trivial task as the species composition of the diet as well as the nutrient values of the components of the diet vary over the year. However, insight can be gained into the supplement problem by inputting a reasonable estimate of these values based on your experience or perhaps information from extension, blm, forest service or soil conservation service range management professionals.

3. Input the nutrient values and costs for the possible supplements you would like to consider. Commercial supplements have this information on their tags. Values for other feeds such as hay and cottonseed can be obtained for your local extension agent.

Set all of the supplement fed cells (C25:N28) to zero. At this point the

Figure 2

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
29														
30	range forage	% protein	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
31		% energy	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
32		% phosphorus	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
33		\$/au day	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
34														
35	hay	% protein	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12
36		% energy	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
37		% phosphorus	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
38		\$/lb	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
39														
40	cottonseed	% protein	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
41		% energy	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
42		% phosphorus	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
43		\$/lb	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
44														
45	block	% protein	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
46		% energy	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
47		% phosphorus	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
48		\$/lb	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
49														
50	mineral supplement	% protein	0	0	0	0	0	0	0	0	0	0	0	0
51		% energy	0	0	0	0	0	0	0	0	0	0	0	0
52		% phosphorus	0.185	0.185	0.185	0.185	0.185	0.185	0.185	0.185	0.185	0.185	0.185	0.185
53		\$/lb	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
54														

spreadsheet will calculate the expected results for the scenario where no supplement is fed. You must analyze this result by inspection and common sense to see if the result is what you would expect to happen if you did not feed any supplement to your cows. If the results are about what your experience and common sense would expect to happen if no supplement were fed then you can proceed to the next step. If not, this problem needs to be fixed before you proceed. The most likely cause for the spreadsheet model and reality to be different is the intake of range forage amount. This value is initially set at 1.875% of the cows weight. This value varies as a function of the quality and availability of forage on your range. If your judgment indicates your cows should not gain as much as the original spreadsheet model indicates for a particular month you need to lower the intake percentage in the appropriate cell. For example if you expect that the November weight gain indicated is too high edit cell M24 and replace the .01875 in the formula with a lower number. The spreadsheet will now recalculate and the new results can be inspected. When you are satisfied that the results reflect what would happen on your ranch you are ready for the next step.

4. Check to see if the December weight meets your target weight. If it does then the problem is solved without any supplement. If not you need to follow the next steps to calculate a least cost supplement plan.

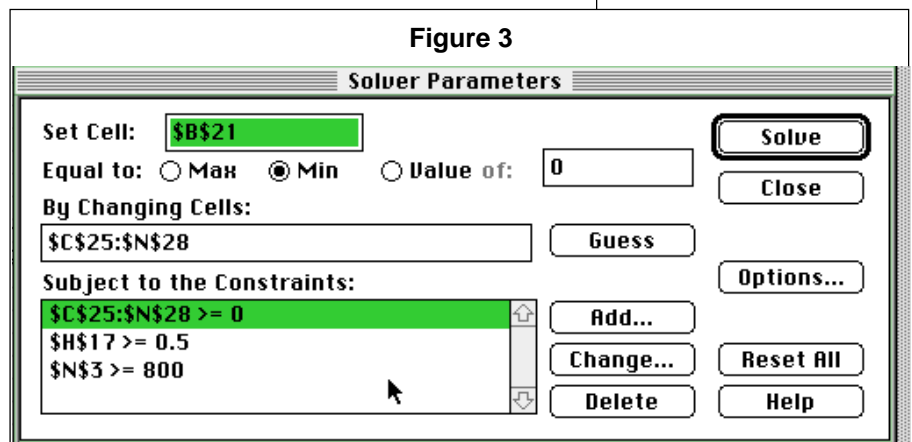
Choose **Solver** from the formula menu. The following dialog box should appear (Figure 3). If solver does not appear in your menu open the solver add-in in the Solver

sub-directory of the Macro Library directory.

Set cell is the cell the solver will attempt to minimize (or maximize depending on which check box is checked) subject to the constraints. In our case B21 is the cell that contains the total feed cost for the cow for the year.

By changing cells contains all of the things the program can manipulate in its search for an optimum solution. In our case it is the area where the timing and amounts of supplement will be reported. i.e., C25 TO N28.

Subject to the constraints contains all of the restrictions placed on the solution of the problem. In our case there are three basic constraints. First it is not possible to feed negative amounts of supplement so cells C25 to N27 must be equal to or greater than zero. Second we want to meet the target weight for the cow N3. Finally we want to insure that the cows are gaining at least .5 pounds per day in the period just before and during the breeding season. To do this we constrain H17 to be greater than or equal to .5. If you have a different breeding schedule than the example you will have to adjust this constraint and adjust the pregnancy energy requirements (row 4).



After checking to be sure the set cell, by changing cells and subject to constraints settings are correct click on the solve button. It will take a while for the problem to solve. In fact, it may indicate you have reached the time limit. If this happens just click on continue and let it run a few more minutes. When it finishes click on the option to display the results on the original spreadsheet. Now you should save the results and then analyze what the computer suggested as a supplement plan. Below is the recommendations from the sample problem. The optimal results are displayed in Figure 1, rows 25, 26, 27, and 28.

The computer's suggestions meet all of the constraints, and are the least cost manner of doing so. But you will probably want to use a bit of common sense to modify the computers suggestions. For example, the sample results suggest feeding .02 pounds of block per day per cow in April (cell F27 - Figure 1). Common sense would suggest that this would be more trouble than it was worth. One practical solution would be to feed .17 pounds of block per day per cow in May and none in April instead of the recommended amounts. If you enter this into the spreadsheet you can check to see that you still meet constraints. Other minor modifications in the computer's recommendations may slightly raise costs or cause the constraints to be not quite met. By putting these practical modifications into the spreadsheet and observing their impact on costs and constraints a practical supplement plan can be generated.

SUMMARY

The supplement recommendation spreadsheet can produce useful information to help you develop a sound supplement plan. The computer model is only a tool to help you think about supplement management. It is not an exact answer to be followed no matter what. The functional relationships between nutritional intake and gain are statistically derived approximations. The nutritional values for your range forage will be subject to weather and other random influences. The intake of range forage is an approximation. However, even with the uncertainties involved in the model it can serve as a reasonable starting point for your supplement decisions. As with any other ranching decision monitoring is necessary. If you happen to get great weather and the grass is much taller and greener on your range than it was depicted in the spreadsheet you will need to reevaluate your supplement planning. The spreadsheet model can, and should be used throughout the year. Adjustments to the intake function and the nutritional values of the range forage can be made to reflect actual conditions. The model can then be run allowing the remaining months supplement plan to vary to provide information on possible revisions in your supplement plan. To do this you would need to change the **By changing cells** selection under the Solver menu.

While it will take effort to set up the model and get it initially running it will get easier with time. As you use the model and develop information on the nutritional values obtained by your cows from the range forage on your ranch you will be able to fine tune it to your specific ranching conditions.

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