Livestock Gross Margin for Dairy Insurance Policy

Step by Step Instructions to Calculate Premium

The premium is calculated by a determinant Monte Carlo simulation procedure. The procedure is determinant because the same random "draws" are used for every insured. Inputs into this simulation are projected monthly milk, corn, and soybean meal prices; 5,000 monthly milk, corn, and soybean meal price draws; state-level milk and corn basis numbers; a marketing plan that shows the amount of milk marketed in each of ten months; the amounts of corn and soybean meal-equivalent feed fed in each of ten months; and a deductible level.

Let *mep(m)* be the per-hundredweight expected milk price for month m, m = 2, 3, …, 11. Let *cep(m)* be the per-bushel expected corn price for month m, m = 2, 3, …, 11. Let *sep(m)* be per-ton expected soybean meal price for month m, m = 2, 3, …, 11. Let *mb(s,m)* be the per-hundredweight milk basis for state s and month m, m = 2, 3, …, 11. Let *cb(s,m)* be the per-bushel corn basis for state s and month m, m = 2, 3, …, 11. Let *mq(m)* be the number of hundredweight of milk marketed in each month under the producer's marketing plan, m = 2, 3, …, 11. Let *cq(m)* be the number of tons of corn or corn-equivalent feed fed in each month under the producer's marketing plan, m = 2, 3, …, 11. Let *sq(m)* be the number of ton of soybean meal or soybean meal-equivalent feed fed in each month under the producer's marketing plan, m = 2, 3, …, 11. Let *msp(i,m)* be the per-hundredweight simulated milk price i for month m; i = 1, 2, …., 5,000; m = 2, 3, …, 11. Let *csp(i,m)* be the per-bushel simulated corn price i for month m; i = 1, 2, …., 5,000; m = 2, 3, …, 11. Let *ssp(i,m)* be the per-ton simulated soybean meal price i for month m; i = 1, 2, …., 5,000; m = 2, 3, …, 11. Let *gm(i,m)* denote simulated gross margin i, for month m; i = 1, 2, …., 5,000; m = 2, 3, …, 11. Let *DL* equal the deductible level. Let EMG equal the Expected Total Gross Margin. Let *GMG* equal the Gross Margin Guarantee for the insurance period. Let *SGM* equal the Simulated Total Gross Margin. The factor (2000/56) adjusts the per-bushel corn price to a per-ton corn price.

Step 1. Calculate Expected Total Gross Margin (EGM) and Gross Margin Guarantee (GMG)

EGM(m) =

$$\mathrm{mq}(\mathrm{m})*\{\mathrm{mep}(\mathrm{m})+\mathrm{mb}(\mathrm{s},\mathrm{m})\}-\mathrm{cq}(\mathrm{m})*(2000/56)*\{\mathrm{cep}(\mathrm{m})+\mathrm{cb}(\mathrm{s},\mathrm{m})\}-\mathrm{sq}(\mathrm{m})*\mathrm{sep}(\mathrm{m})$$

(round to dollars and cents)

EGM = $\sum_{m=2}^{11}\left[\mathrm{EGM}(\mathrm{m})\right]$ (round to dollars and cents)

GMG = *EGM-DL** $\sum_{m=2}^{11}\mathrm{mq}(\mathrm{m})$ (round to dollars and cents)

Step 2. Calculate ten month Simulated Total Gross Margins (SGM)

SGM(i,m) =

$$mq(m)*\{msp(i,m)+mb(s,m)\}-cq(m)*(2000/56)*\{csp(i,m)+cb(s,m)\}-sq(m)*ssp(i,m)$$

(round to dollars and cents)

SGM(i) = $\sum_{m=2}^{11}\left[SGM(i,m)\right]$ (round to dollars and cents)

Step 3. Calculate simulated losses

Loss(i) = max(*GMG – SGM(i)*,0) (round to dollars and cents)

Step 4. Calculate premium

Premium = $\frac{1}{5{,}000}\sum_{i=1}^{5{,}000} loss(i)$ (round to dollars and cents)

Step 5. Calculate total premium

total premium = 1.03**premium* (round to whole dollar amount)

Worked Example of Premium Calculation

Here are the data for the worked example for a February to December insurance period in Iowa. The deductible level used is $0.00.

Insured quantities

Hundredweight of Milk Insured, mq(m)

Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1560	1560	1560	1560	1560	1560	1560	1560	1560	1560

Corn Equivalent Fed per Month (tons), cq(m)

Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
20.5	20.5	20.5	20.5	20.5	20.5	20.5	20.5	20.5	20.5

Soybean Meal Fed per Month (tons), sq(m)

Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
6	6	6	6	6	6	6	6	6	6

Expected prices

Per-Hundredweight of Milk, mep(m)

Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
17.08	16.40	16.17	16.11	16.28	16.46	16.62	16.38	16.21	16.20

Per-Bushel of Corn Equivalent Feed, cep(m)

Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
5.01	5.07	5.13	5.17	5.21	5.18	5.15	5.13	5.12	5.10

Per-Ton of Soybean Meal Equivalent Feed, sep(m)

Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
337.07	340.09	343.10	345.45	347.80	344.57	339.37	325.10	324.80	324.50

State Basis Numbers

Per-Hundredweight of Milk, mb(s,m)

Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1.76	0.96	1.07	1.05	1.09	1.02	1.21	1.71	1.93	1.65

Per-Bushel of Corn Equivalent Feed, cb(s,m)

Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
-0.18	-0.17	-0.17	-0.16	-0.21	-0.24	-0.18	-0.22	-0.22	-0.19

Expected Gross Margins, EGM(m)

Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
23831.73	21453.56	21204.37	21028.86	21349.69	21584.59	22139.83	22674.98	22762.10	22304.18

As an example, the expected gross margin for March is given by:
EGM(March) = 1560*(17.08 + 1.76) – 20.5*(2000/56)*(5.01 – 0.18) – 6*337.07 = 23831.73

Step 1. Calculate Expected Total Gross Margin and Gross Margin Guarantee

EGM = 23831.73 + 21453.56 + 21204.37 + 21028.86 + 21349.69 + 21584.59 + 22139.83 + 22674.98 + 22762.10
+ 22304.18
= 220,333.90

GMG = 220,333,90 – 0.00*(1560+1560+1560+1560+1560+1560+1560+1560+1560+1560) = 220,333.90

Step 2. Calculate ten month Simulated Total Gross Margins

Example of 1st 3 rows of simulated prices

Per-Hundredweight of Milk, msp(i,m)

Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
16.87	16.72	16.02	14.01	15.68	16.79	15.39	13.81	17.40	18.41
15.19	14.62	14.68	14.93	14.57	14.50	14.22	12.85	13.36	14.63
18.12	16.30	15.62	16.18	16.06	16.20	16.74	18.63	15.50	16.06

Per-Bushel of Corn Equivalent Feed, csp(i,m)

Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
5.63	6.14	6.64	6.29	5.93	6.43	6.93	7.08	7.22	7.37
4.32	4.04	3.75	4.12	4.49	4.38	4.27	3.90	3.52	3.15
4.11	4.40	4.68	4.03	3.38	3.27	3.15	3.41	3.68	3.94

Per-Ton of Soybean Meal Equivalent Feed, ssp(i,m)

Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
353.04	401.76	450.48	448.74	446.99	477.93	538.53	546.86	563.21	579.56
285.71	256.61	227.51	256.20	284.88	281.95	256.80	237.29	211.26	185.22
328.86	329.66	330.46	337.69	344.92	306.96	338.84	324.87	354.83	384.78

Simulated Gross Margins, SGM(i,m)

Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
22954.38	20799.35	19220.56	16313.12	19291.4	20384.06	17722.86	15907.54	21650.54	22559.45
21696.67	19931.75	20583.87	20492.31	19586.75	19488.43	19535.54	18595.57	20168.77	22118.34
26162.32	21850.68	20751.68	22019.27	22363.59	22803.05	23794.5	27445.64	22528.61	22573.38

As an example, the simulated gross margin for March in the 2nd simulation is given by:
SGM(2,March) = 1560*(15.19 + 1.76) – 20.5*(2000/56)*(4.32 – 0.18) – 6*285.71 = 21696.67

Simulated Total Gross Margins, SGM(i)

SGM(i)
196,803.30
202,198.00
232,292.70

Step 3. Calculate simulated losses

Using the simulations from above:

SGM(i)	Loss(i)
196,803.30	23,530.63
202,198.00	18,135.89
232,292.70	0.00

Step 4. Calculate premium

The average of all simulated losses equals 12,470.74. Thus, *Premium* = 12,470.74.

Step 5. Calculate total premium

Total Premium = 1.03 * 12,470.74 = 12,844.86, which is rounded to 12,845.