

# Livestock Gross Margin 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 gross margin levels, 5,000 monthly gross margin draws, a marketing plan that shows the number of hogs marketed in each of five months, and a coverage level.

Let  $p(m)$  be per-head Expected Gross Margin ( $EGM$ ) for month  $m$ ,  $m = 2, 3, \dots, 5$ . Let  $h(m)$  be the number of hogs marketed in each month under the producer’s marketing plan,  $m = 2, 3, \dots, 5$ . Let  $gm(i, m)$  denote simulated gross margin  $i$ , for month  $m$ ;  $i = 1, 2, \dots, 5000$ ;  $m = 2, 3, \dots, 5$ . Let  $CL$  equal the coverage level. Let  $GMG$  equal the Gross Margin Guarantee for the insurance period. Let  $SGM$  equal the simulated Gross Margin.

### Step 1. Calculate projected gross margin and gross margin guarantee

$$EGM = \sum_{m=1}^5 p(m) * h(m) \text{ (round to dollars and cents)}$$

$$GMG = CL * EGM \text{ (round to dollars and cents)}$$

### Step 2. Calculate five month simulated Gross Margins (SGM)

$$SGM(i) = \sum_{m=1}^5 gm(i, m) * h(m) \text{ (round to dollars and cents)}$$

### Step 3. Calculate simulated losses

$$loss(i) = \max(GMG - SGM(i), 0) \text{ (round to dollars and cents)}$$

### Step 4. Calculate premium

$$premium = \frac{1}{5000} \sum_{i=1}^{5000} loss(i) \text{ (round to dollars and cents)}$$

### Step 5. Calculate total premium

$$total\ premium = 1.03 * premium \text{ (round to whole dollar amount)}$$

### Worked Example of Premium Calculation

Here are the data for the worked example for a Feb. to July insurance period. The coverage level used is 100%.

p(m)						
Expected Gross Margin Per Head	February	March	April	May	June	July
		p(2)	p(3)	p(4)	p(5)	p(6)
		71.12	71.62	78.05	84.59	81.30

h(m)						
Marketing Plan	February	March	April	May	June	July
		h(2)	h(3)	h(4)	h(5)	h(6)
		0	500	0	500	1000

First 11 rows of simulated Gross Margins  
Simulated Gross Margins

February	March	April	May	June	July
	59.52	52.88	51.77	50.70	48.96
	68.28	66.00	71.81	77.43	83.79
	69.32	66.71	79.93	91.78	88.63
	64.22	59.75	62.47	64.16	50.49
	80.03	83.89	87.21	88.68	87.51
	73.43	73.07	73.17	72.67	63.89
	79.34	81.43	92.71	103.79	84.08
	76.74	83.91	89.13	93.55	102.41
	79.92	85.15	91.56	96.98	88.15
	81.92	91.53	100.49	109.15	103.91
	65.01	60.97	61.71	61.55	61.16

#### Step 1. Calculate Expected Gross Margin

$$EGM = 71.12 * 0 + 71.62 * 500 + 78.05 * 0 + 84.59 * 500 + 81.30 * 1000$$

$$= 159,405.00$$

$$GMG = 1.0 * 159,405.00$$

## Step 2. Calculate six month simulated Gross Margins

Here the results for the first 11 rows are shown.

February	March	April	May	June	July	Simulated Gross Margin
	59.52	52.88	51.77	50.70	48.96	100750.00
	68.28	66.00	71.81	77.43	83.79	155505.00
	69.32	66.71	79.93	91.78	88.63	167875.00
	64.22	59.75	62.47	64.16	50.49	112445.00
	80.03	83.89	87.21	88.68	87.51	173795.00
	73.43	73.07	73.17	72.67	63.89	136760.00
	79.34	81.43	92.71	103.79	84.08	176690.00
	76.74	83.91	89.13	93.55	102.41	191140.00
	79.92	85.15	91.56	96.98	88.15	179215.00
	81.92	91.53	100.49	109.15	103.91	204250.00
	65.01	60.97	61.71	61.55	61.16	122420.00

## Step 3. Calculate simulated losses

Again the first 11 rows of calculations are shown.

Simulated Gross Margin	loss
100750.00	58655.00
155505.00	3900.00
167875.00	0.00
112445.00	46960.00
173795.00	0.00
136760.00	22645.00
176690.00	0.00
191140.00	0.00
179215.00	0.00
204250.00	0.00
122420.00	36985.00

## Step 4. Calculate premium

The average of all losses equals 15,376.82

## Step 5. Calculate total premium

*total premium* =  $1.03 \times 15,376.82 = 15,838.12$  which is rounded to 15,838.