



# OPTIMAL LIVESTOCK GROSS MARGIN FOR DAIRY INSURANCE (LGM-DAIRY) CONTRACT DESIGN



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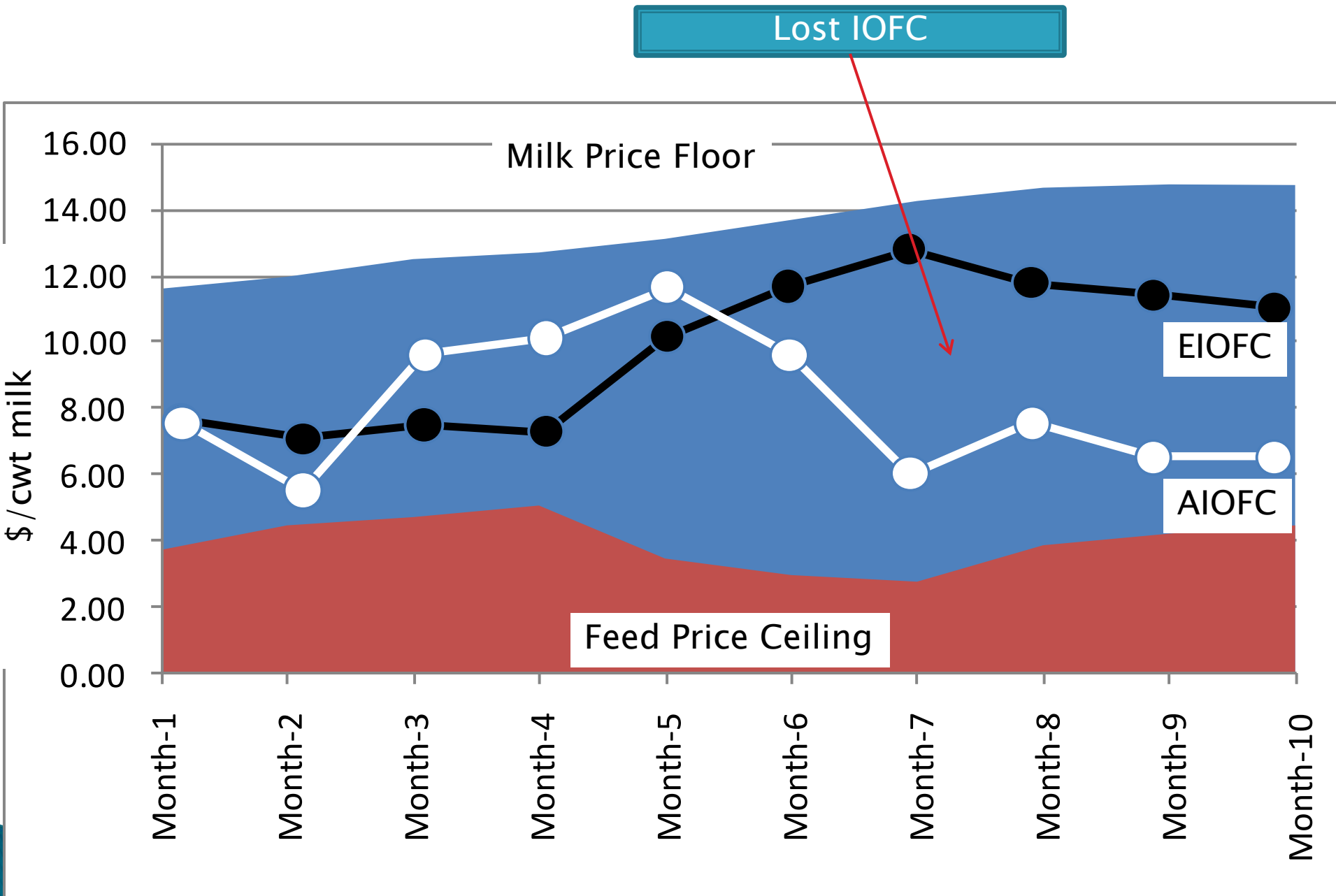
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# Introduction to LGM–Dairy

- Livestock Gross Margin for Dairy Insurance protects the *floor*  
“Gross Margin” = “Income Over Feed Cost” (Bundled Price Risk Option)
- Uses CME future prices (Class III, Corn, SBM)
- Works on 10–month cycles

“Insurance Months”





# Rationale

- Guarantee IOFC (GIOFC) and Premium depend on program configuration
- Factors that impact GIOFC and Premiums:
  - Market controlled:
    - Futures prices
    - Volatility of futures prices
  - Producer controlled:
    - Insured milk (%C<sub>m</sub>)
    - Insured feed (should reflect farm feed efficiency)
    - Deductible level (least relative premium at highest deductible (Cabrera et al.,2009))



# Objectives

- To develop and demonstrate an algorithm to identify the **least cost strategy** for guaranteeing a desired IOFC via use of the LGM–Dairy insurance contract
- To compare a non–optimal with an optimal strategy one in terms of the cost of insurance and protection level





# Materials and Methods

- Premium Calculation
  - LGM–Dairy premium is set equal to the long–term expected (average) indemnity
  - 5,000 simulated indemnities are obtained using random draws of Class III, corn and SBM future prices and the specific contract design under consideration
    - 3 commodities x 10 mo x 5,000 prices = 150,000 variables
  - Random draws are obtained from assumed lognormal distributions and closed form probability density functions as detailed by RMA insurance policy



# Formulation of the Optimization Problem

$$LGM\_Premium = \frac{(1.03)(LGM\_Indemnity)}{\sum_{m=1}^{10} Milk\_Insured_m}$$

$$FARM\_Premium = \frac{(1.03)(LGM\_Indemnity)}{\sum_{m=1}^{10} Milk\_Produced_m}$$

$$LGM\_Indemnity = \frac{\sum_{t=1}^{5,000} Max[(GIOFC_t - SIOFC_t), 0]}{5,000}$$

$$\begin{aligned} GIOFC = \%C_m [ & (Milk\_Produced_m)(ECL3P_m) \\ & - (C_m)(ECP_m) - (SBM_m)(ESBMP_m) \\ & - (DL)(Milk\_Produced_m) \end{aligned}$$



# Formulation of the Optimization Problem

$$\text{Least\_Cost\_LGM\_Premium} = \frac{\text{Min}}{(\%C_m)} [\text{FARM\_Premium}]$$

*Subject to:*

$$\text{TGIOFC} \geq \text{GIOFC} - \text{FARM\_Premium}$$

$$\sum_{m=1}^{10} \text{Milk\_Insured}_m \leq 240,000 \text{ cwt}$$

Valvekar, M., Cabrera, V.E., Gould, B.W. 2010. Identifying optimal strategies for guaranteeing target dairy income over feed cost. *Journal of Dairy Science* 93:3350–3357.





# Analysis: Non-Optimal Contract

## Premium Calculator

Input your planned feed and milk production for LGM Dairy Insurance. This program will calculate your estimated premium for various deductible levels to aid you in your decision. For the month of **Apr 2010** we use the latest available data to estimate the premiums.

Insurance contract month:

Choose your deductible level (\$/cwt)

If you wish to upload a currently existing csv file containing your farm's data instead of typing it in, please [click here](#)

Default Feeding values?

<input checked="" type="checkbox"/> Coverage Month	Production (cwt)	Corn Equiv (tons)	Soybean Equiv (tons)	% covered
<input checked="" type="checkbox"/> Jun 2010	<input type="text" value="4000"/>	<input type="text" value="56"/>	<input type="text" value="8"/>	<input type="text" value="50"/>
<input checked="" type="checkbox"/> Jul 2010	<input type="text" value="4000"/>	<input type="text" value="56"/>	<input type="text" value="8"/>	<input type="text" value="50"/>
<input checked="" type="checkbox"/> Aug 2010	<input type="text" value="4000"/>	<input type="text" value="56"/>	<input type="text" value="8"/>	<input type="text" value="50"/>
<input checked="" type="checkbox"/> Sep 2010	<input type="text" value="4000"/>	<input type="text" value="56"/>	<input type="text" value="8"/>	<input type="text" value="50"/>
<input checked="" type="checkbox"/> Oct 2010	<input type="text" value="4000"/>	<input type="text" value="56"/>	<input type="text" value="8"/>	<input type="text" value="50"/>
<input checked="" type="checkbox"/> Nov 2010	<input type="text" value="4000"/>	<input type="text" value="56"/>	<input type="text" value="8"/>	<input type="text" value="50"/>
<input checked="" type="checkbox"/> Dec 2010	<input type="text" value="4000"/>	<input type="text" value="56"/>	<input type="text" value="8"/>	<input type="text" value="50"/>
<input checked="" type="checkbox"/> Jan 2011	<input type="text" value="4000"/>	<input type="text" value="56"/>	<input type="text" value="8"/>	<input type="text" value="50"/>
<input checked="" type="checkbox"/> Feb 2011	<input type="text" value="4000"/>	<input type="text" value="56"/>	<input type="text" value="8"/>	<input type="text" value="50"/>
<input checked="" type="checkbox"/> Mar 2011	<input type="text" value="4000"/>	<input type="text" value="56"/>	<input type="text" value="8"/>	<input type="text" value="50"/>

Save this Data

Calculate LGM Premium

Insurance Contract Month : 2010-04

The data is derived from futures and options prices from dates: 2010-04-14, 2010-04-15, 2010-04-16

# Analysis: Non-Optimal Contract Results

Insured Months	Covered Production (cwt)	Covered Corn Equiv (Tons)	Covered Soybean Equiv (Tons)	Avg. Milk Futures (\$/cwt)	Avg. Corn Futures (\$/bu)	Avg. Soybean Meal Futures (\$/ton)	Gross Margin Guarantee @ Base Deductible (\$)	
							Total \$	\$/cwt
Jun 2010	2,000	28.0	4.0	13.34	3.67	278.90	18,894	9.45
Jul 2010	2,000	28.0	4.0	14.00	3.72	278.77	20,165	10.08
Aug 2010	2,000	28.0	4.0	14.63	3.77	275.49	21,387	10.69
Sep 2010	2,000	28.0	4.0	15.05	3.82	269.82	22,200	11.10
Oct 2010	2,000	28.0	4.0	14.99	3.86	261.49	22,077	11.04
Nov 2010	2,000	28.0	4.0	14.72	3.89	260.80	21,503	10.75
Dec 2010	2,000	28.0	4.0	14.72	3.93	260.12	21,469	10.73
Jan 2011	2,000	28.0	4.0	14.64	3.97	260.92	21,266	10.63
Feb 2011	2,000	28.0	4.0	14.57	4.01	261.95	21,081	10.54
Mar 2011	2,000	28.0	4.0	14.55	4.05	262.98	20,997	10.50
<b>Total</b>	<b>20,000</b>	<b>280</b>	<b>40</b>				<b>211,018</b>	<b>10.55</b>

# Analysis: Non-Optimal Contract Results

The Premium at \$1.5 /cwt deductible level is **\$3,214** (\$0.16 /cwt).

## Sensitivity Analysis

GMG = IOFC

Deductible Level (\$/cwt)	Total Premium (\$)	Prem/cwt (\$/cwt)	Gross Margin Guarantee (\$)	Premium as % of GMG (%)	GMG/cwt (\$/cwt)	% Prem/cwt change	% GMG Change
0.0	14,024	0.70	241,038	5.82	12.05	-	-
0.1	12,968	0.65	239,038	5.43	11.95	-7.53	-0.83
0.2	11,964	0.60	237,038	5.05	11.85	-14.69	-1.66
0.3	11,011	0.55	235,038	4.68	11.75	-21.48	-2.49
0.4	10,105	0.51	233,038	4.34	11.65	-27.94	-3.32
0.5	9,246	0.46	231,038	4.00	11.55	-34.07	-4.15
0.6	8,430	0.42	229,038	3.68	11.45	-39.89	-4.98
0.7	7,663	0.38	227,038	3.38	11.35	-45.35	-5.81
0.8	6,946	0.35	225,038	3.09	11.25	-50.47	-6.64
0.9	6,280	0.31	223,038	2.82	11.15	-55.22	-7.47
1.0	5,659	0.28	221,038	2.56	11.05	-59.65	-8.30
1.1	5,087	0.25	219,038	2.32	10.95	-63.73	-9.13
1.2	4,556	0.23	217,038	2.10	10.85	-67.51	-9.96
1.3	4,068	0.20	215,038	1.89	10.75	-70.99	-10.79
1.4	3,621	0.18	213,038	1.70	10.65	-74.18	-11.62
<b>1.5</b>	<b>3,214</b>	<b>0.16</b>	<b>211,038</b>	<b>1.52</b>	<b>10.55</b>	<b>-77.08</b>	<b>-12.45</b>

[Download Excel File](#)

# Farm IOFC

- 50% production covered @ \$1.5/cwt deductible
  - LGM\_Premium = \$3,214 = \$0.16/cwt insured milk
  - Farm\_Premium = 50% \* \$0.16/cwt = \$0.08/cwt
  - Net Farm GIOFC = 50% \* \$10.55/cwt - \$0.08/cwt =

**\$5.2/cwt**



# Analysis: Optimal Contract

## Optimum Coverage for LGM Insurance

Input your planned feed and milk production for LGM Dairy Insurance. This program will calculate the optimum coverage for lowering your premium for various deductible levels to aid you in your decision. For the month of **Apr 2010** we use the latest available data to estimate the premiums.

Change the Insurance contract month: 2010 ▾ Apr ▾

Target NGIOFC (\$/cwt) 5.2

Choose your deductible level (\$/cwt) 1.5 ▾

If you wish to upload a currently existing csv file containing your farm's data instead of typing it in, please [click here](#)

Default Feeding Values?

Coverage Month	Production (cwt)	Corn Equiv (tons)	SBM Equiv (tons)
Jun 2010	4000	56	8
Jul 2010	4000	56	8
Aug 2010	4000	56	8
Sep 2010	4000	56	8
Oct 2010	4000	56	8
Nov 2010	4000	56	8
Dec 2010	4000	56	8
Jan 2011	4000	56	8
Feb 2011	4000	56	8
Mar 2011	4000	56	8

Save this Data

Calculate coverages to minimize premium for a target NGIOFC





# Analysis: Optimal Contract Results

Insured Months	Production (cwt)	Corn Equiv (tons)	SBM Equiv (tons)	Recommended Coverage (%)
Jun 2010	4,000	56.0	8.0	100.00
Jul 2010	4,000	56.0	8.0	100.00
Aug 2010	4,000	56.0	8.0	100.00
Sep 2010	4,000	56.0	8.0	16.07
Oct 2010	4,000	56.0	8.0	0.00
Nov 2010	4,000	56.0	8.0	63.80
Dec 2010	4,000	56.0	8.0	27.55
Jan 2011	4,000	56.0	8.0	22.77
Feb 2011	4,000	56.0	8.0	4.70
Mar 2011	4,000	56.0	8.0	74.62

Premium

\$2,296

-29%

\$0.06

Decision Variables

Avg. %C<sub>m</sub>=50.1%

[Download Excel File](#)

This gives you a premium of \$2,296 (\$0.06 /cwt of Farm Milk). The GIOFC is \$210,296 (\$5.26 /cwt of Farm Milk). The NGIOFC is \$208,000 (5.20 \$/cwt of all milk)

If you would like to evaluate premium costs using other coverage percentages, you can change the coverages above and estimate the LGM insurance premium using our [Premium Calculator](#)

[Return to the Optimization Input Page](#)

# Sensitivity

	Non-Optimal			Optimal			
	Farm	Total	Farm	Total	Farm	Farm	Farm
% Coverage	NGIOFC	Premium	Premium	Premium	Premium	Savings	Savings
	\$/cwt	\$	\$/cwt	\$	\$/cwt	\$	%
20%	\$2.08	\$1,285	\$0.03	\$594	\$0.01	\$691	54%
30%	\$3.12	\$1,928	\$0.05	\$1,046	\$0.03	\$882	46%
40%	\$4.16	\$2,517	\$0.06	\$1,645	\$0.04	\$872	35%
50%	\$5.20	\$3,214	\$0.08	\$2,296	\$0.06	\$918	29%
60%	\$6.23	\$3,856	\$0.10	\$3,004	\$0.08	\$852	22%
70%	\$7.27	\$4,499	\$0.11	\$3,764	\$0.09	\$735	16%
80%	\$8.31	\$5,142	\$0.13	\$4,595	\$0.11	\$547	11%
90%	\$9.35	\$5,785	\$0.14	\$5,476	\$0.14	\$309	5%
100%	\$10.39	\$6,427	\$0.16	\$6,427	\$0.16	\$0	0%




# Sensitivity

		Non-Optimal		Optimal			
	Farm	Total	Farm	Total	Farm	Farm	Farm
Coverage	NGIOFC	Premium	Premium	Premium	Premium	Savings	Savings
Month	\$/cwt	\$	\$/cwt	\$	\$/cwt	\$	%
Apr-10	5.00	2,592	0.06	1,663	0.04	929	36
Oct-09	5.00	3,047	0.08	1,732	0.04	1,315	43
Apr-09	5.00	6,302	0.16	4,055	0.10	2,247	36
Oct-08	5.00	4,594	0.11	2,875	0.07	1,719	37
Apr-08	5.00	5,678	0.14	3,284	0.08	2,394	42
Oct-07	5.00	2,581	0.06	1,580	0.04	1,001	39
Apr-07	5.00	2,283	0.03	1,225	0.03	1,058	46
Oct-06	5.00	1,556	0.04	814	0.02	742	48
Apr-06	5.00	892	0.02	457	0.01	435	49



# DairyMGT.info



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## Dairy Management

Dairy Management site is designed to support dairy farming decision-making focusing on model-based scientific research. The ultimate goal is to provide user-friendly computerized decision support systems to help dairy farms improve their economic performance. Dr. Victor Cabrera focuses on model-based decision support in dairy cattle and in dairy farm production systems. Dr. Cabrera's primary interest is to improve cost-efficiency and profitability along with environmental stewardship in dairy farms by using simulation techniques, artificial intelligence, and expert systems. Dr. Cabrera's research and Extension programs involve interdisciplinary and participatory approaches towards the creation of user-friendly decision support systems. As an Extension Specialist, Dr. Cabrera works in close relationships with county-based Extension faculty, dairy producers, consultants, and related industry.

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**LGM Dairy** LGM LeastCost LGM Premium LGM Equivalent

## LGM Dairy

Livestock Gross Margin for Dairy (LGM-Dairy) is a new risk management tool available for dairy producers. The LGM-Dairy protects a farmer's defined income over feed cost. This insurance program may become an important tool to control increased volatility of milk and feed prices. With uncertain and volatile milk prices and feed costs, there is a greater need for effective risk management strategies that can prevent producer's potential losses due to prices and cost risks. Some risk management tools like futures and option trading can protect producers against low milk prices. However, they do not protect them against high production costs. Furthermore, a better option is a coverage based on the gross margins or protection of the milk income over feed costs rather than milk prices or the feed costs alone. The LGM-Dairy offers a better alternative as a risk management strategy.

In collaboration with Professor Brain W. Gould of the Department of Agricultural and Applied Economics we have developed a series of resources to decide in the use of LGM-Dairy from a farm practical point of view:

- LGM-Dairy email list:** This section sends notifications of new LGM-Dairy materials, software upgrades, new data, etc.
- Materials Explaining the LGM-Dairy:** This section has white papers, extension reports, brochures, and power point presentations to better understand the LGM-Dairy insurance program.
- Underlying Data:** This section provides a wide collection of historical and future data on commodity prices used for implementing LGM-Dairy.
- Supporting Software:** This section provides a comprehensive set of unique decision support tools to help in the decision of engaging in LGM-Dairy.

We have a Premium Calculator that allows users to assess the coverage level and premium price of alternative LGM-Dairy contracts. One of these calculators is capable to perform web-based simulation using daily future prices, the other calculator that uses historical contracts is capable to compare the performance of the LGM-Dairy with actual price data.

We feature our **Optimizer** or **LGM-Dairy-Least-Cost** tool capable to minimize the LGM-Dairy premium cost to a defined level of income over feed cost protection. This web-based optimization model used to identify the insurance contract design that minimizes the premium cost per cwt of total farm milk of generating a predefined guaranteed income over feed cost. The decision variables are the percentage of farm milk to insure for each month of the insurance contract. This program uses the latest 3 days of trading data to provide an estimate of the costs of next month's LGM-Dairy insurance contract. An User's Manual is available for download.

Please visit the [Understanding Dairy Markets LGM-Dairy](#) for more information related to LGM-Dairy.

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Thanks

