

Dairy Farm Management



THE UNIVERSITY
of
WISCONSIN
MADISON

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What is Dairy Farm Management?



- Making and implementing decisions for maximum (production) profit
- Decision are required at very different levels and planning horizons
- Relies greatly on agricultural economics and subject to multiple restrictions
- Integrates biological, physical, and social sciences
- The significant unit of concern is the specific individual farm

A Wisconsin Dairy Farm



A Wisconsin Dairy Farm



Country Aire Farms

3,600 Ac.

850 Heifers

Tons of Feed

Manure management

1,800 Cows

16 full time employees

40-Cow

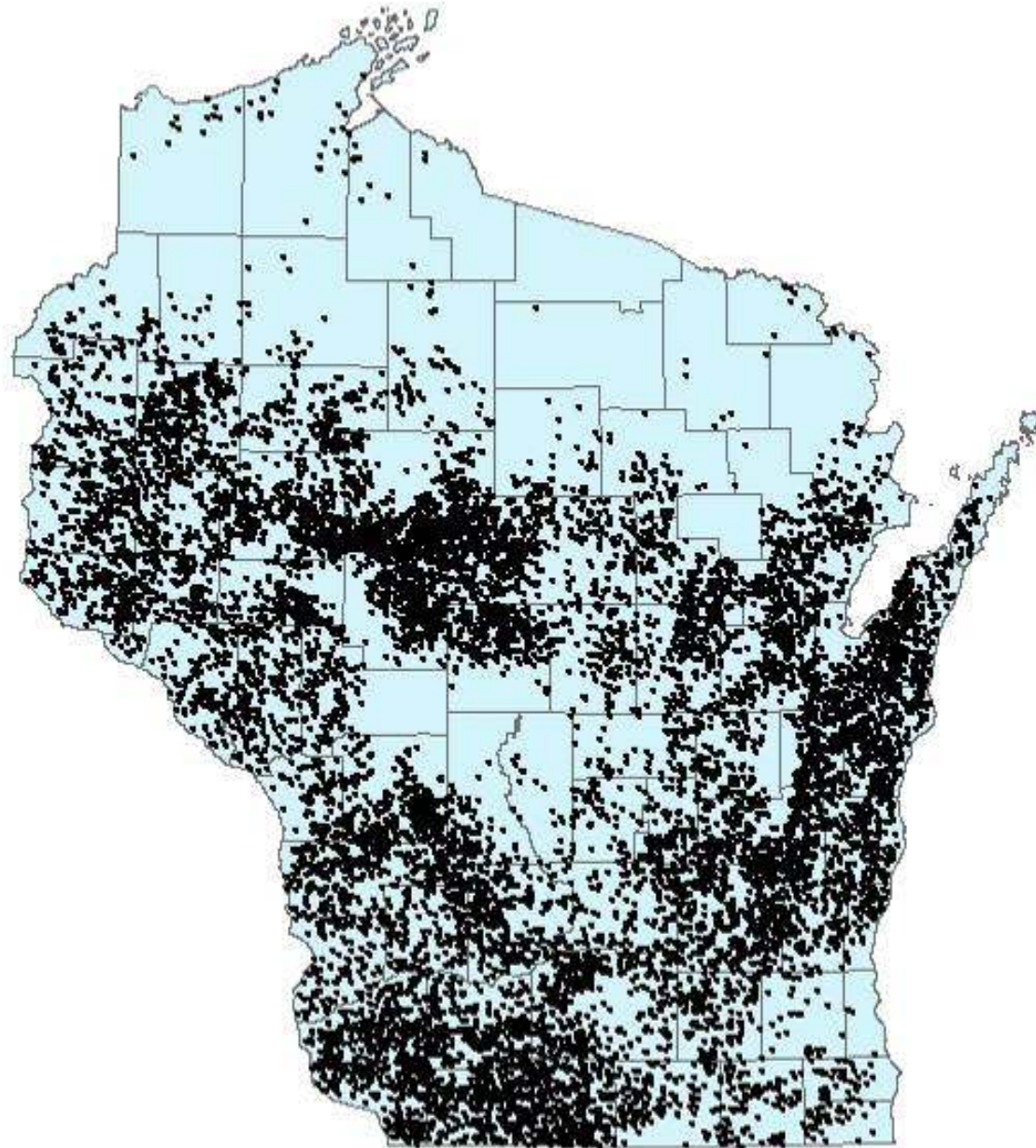
carousel parlor

+28,000 lb milk/cow

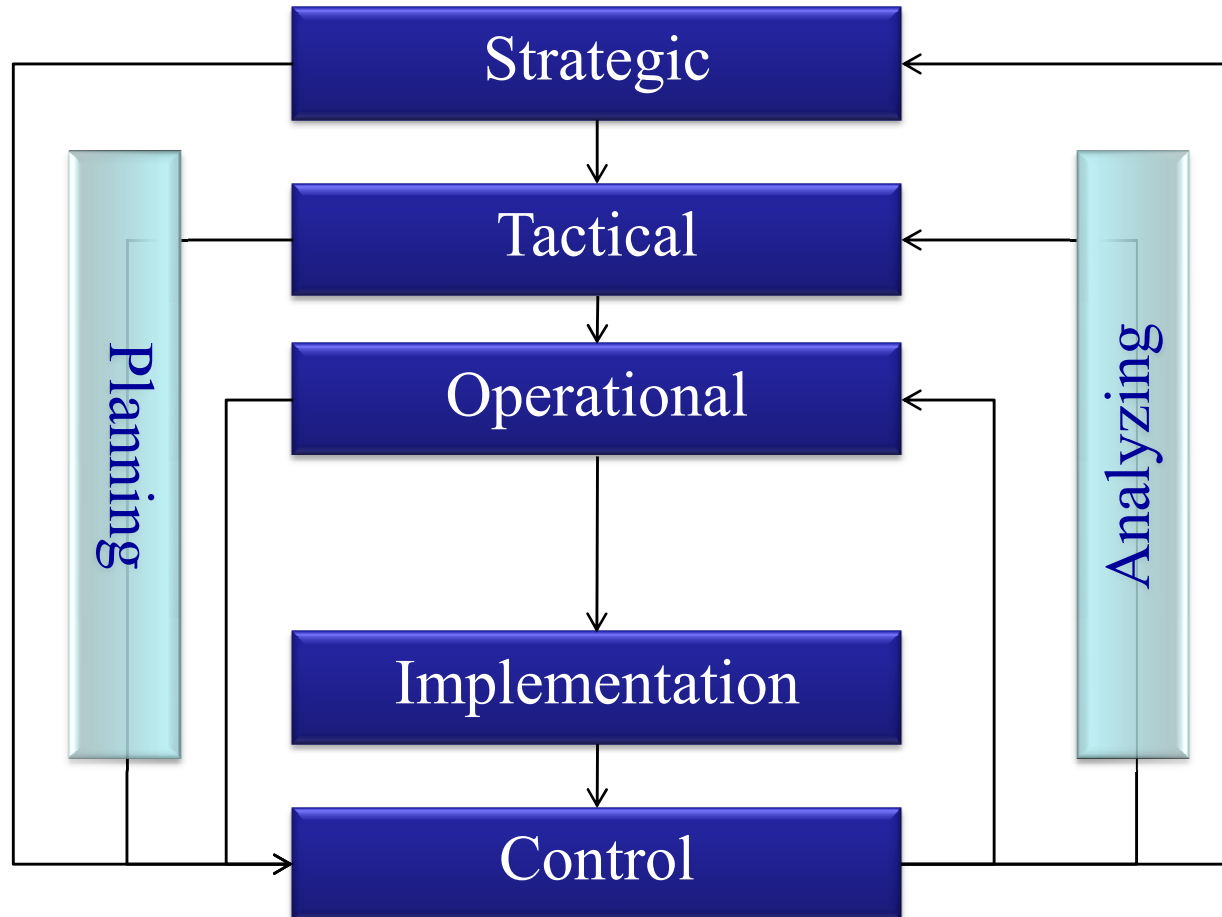
Marketing



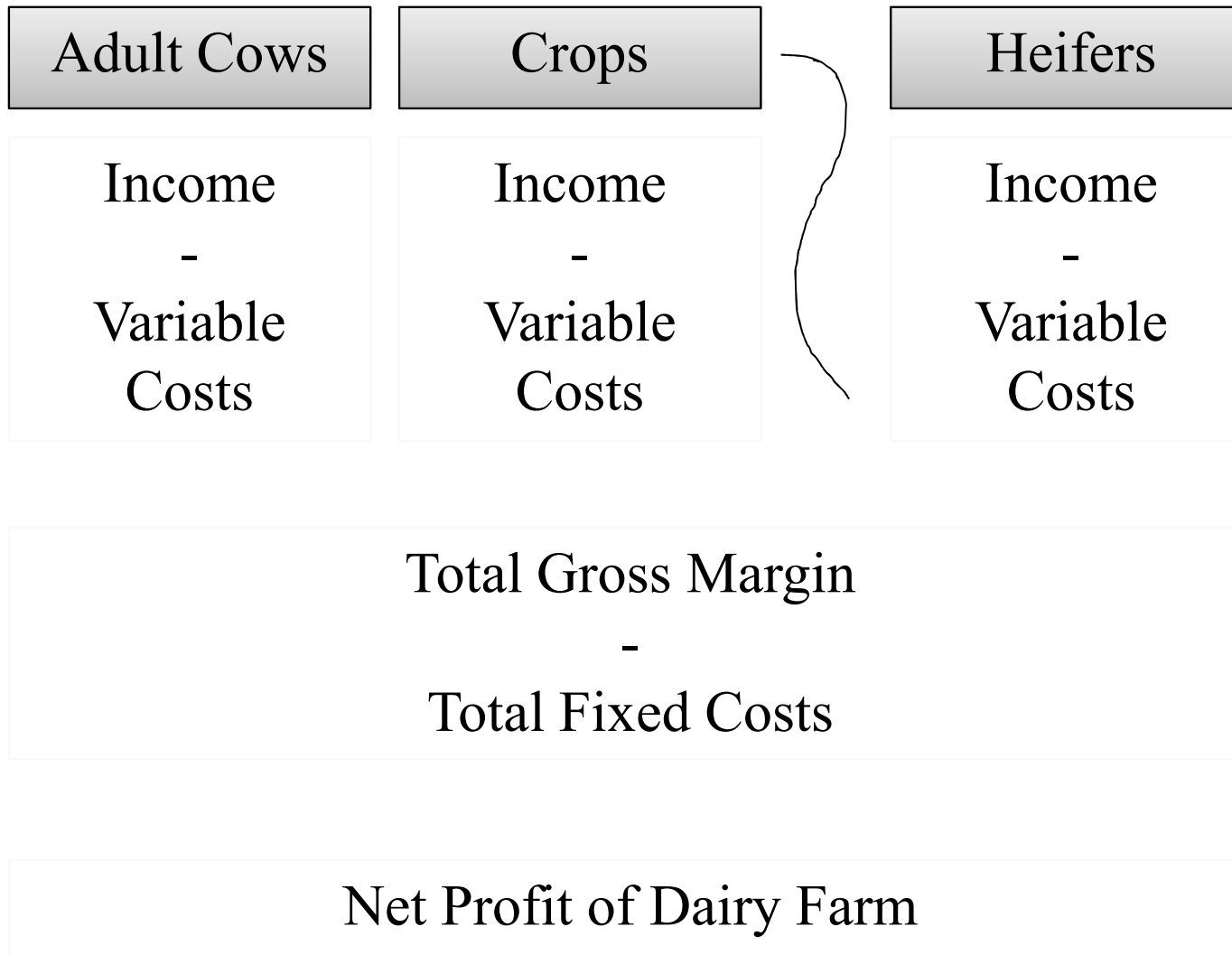
14,000 Wisconsin Dairy Farms



The Dairy Management Cycle



Enterprise Budgets



Partial Budgeting

- + Additional Returns
- + Reduced Costs
- Returns Foregone
- Additional Costs

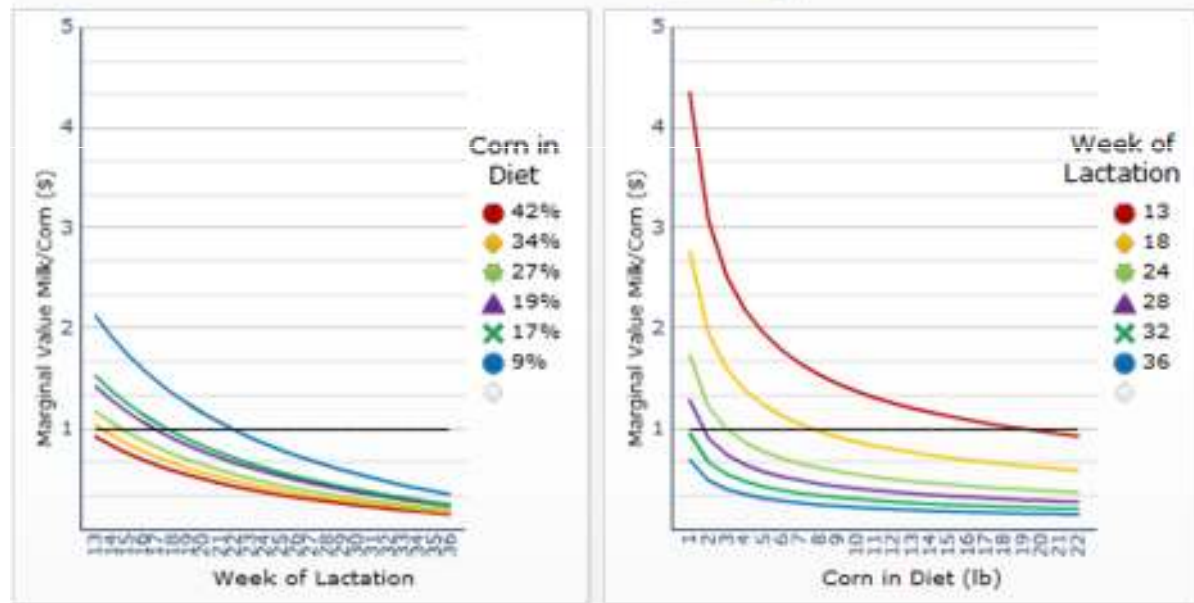
Optimal Corn Grain Feeding in Wisconsin Dairy Diets

Victor E. Cabrera v Cabrera@wisc.edu 608-265-

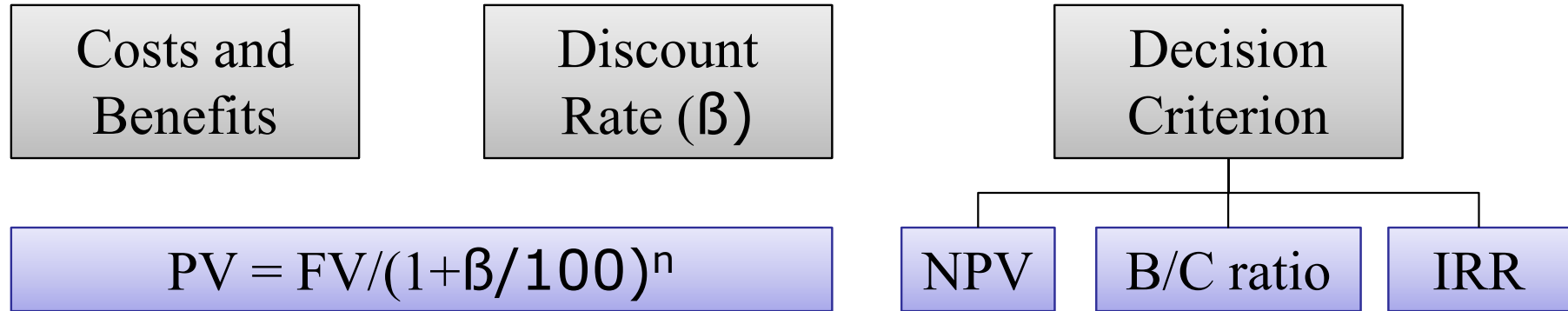
<http://www.uwex.edu/ces/dairym>

Milk Price (\$/cwt) 18

Corn Price (\$/bu) 5



Cost-Benefit Analysis



Year	Strategy A		Strategy B	
	Costs	Benefits	Costs	Benefits
1	20	0	2	1
2	10	8	2	3
3	7	14	4	6
4	0	23	6	14
Interest Rate				5%

	A	B
NPV	14.72	9.6
B/C	1.39	1.60
IRR	23.90	>80

Decision Analysis



- Uncertainty is part of the decision process. Chances of outcomes can be included in the analysis

Mathematical Techniques

Payoff Matrices

Process Diagrams

Decision Trees

DA-Mathematical Techniques



$$A_i = f(A_i, S_1 \dots S_j, P_1 \dots P_j, V_{i1} \dots V_{ij})$$

A_i = Decision option (action)
 S_j = State of nature
 P_j = Probability of occurrence S_j
 V_{ij} = Value of outcome of option i and state j

$$\text{Max EMV}(A_i) = \text{Max} \sum_{(j)} (P_j V_{ij})$$

A_i = Standard vs. Improved AI
 S_j = Pregnant, Non-Pregnant

$$A_1 = \text{EMV}(\text{Insemination}_1; \text{pregnant}, 0; 0.16, 0.84; \$5, \$47)$$
$$A_2 = \text{EMV}(\text{Insemination}_2; \text{pregnant}, 0; 0.25, 0.75; \$15, \$57)$$

$$\text{EMV}(A_1) = 0.16 * 5 + 0.84 * 47 = \$40.28$$
$$\text{EMV}(A_2) = 0.20 * 15 + 0.75 * 57 = \$45.75$$

$$\text{Breakeven for } (A_2) = 0.4$$

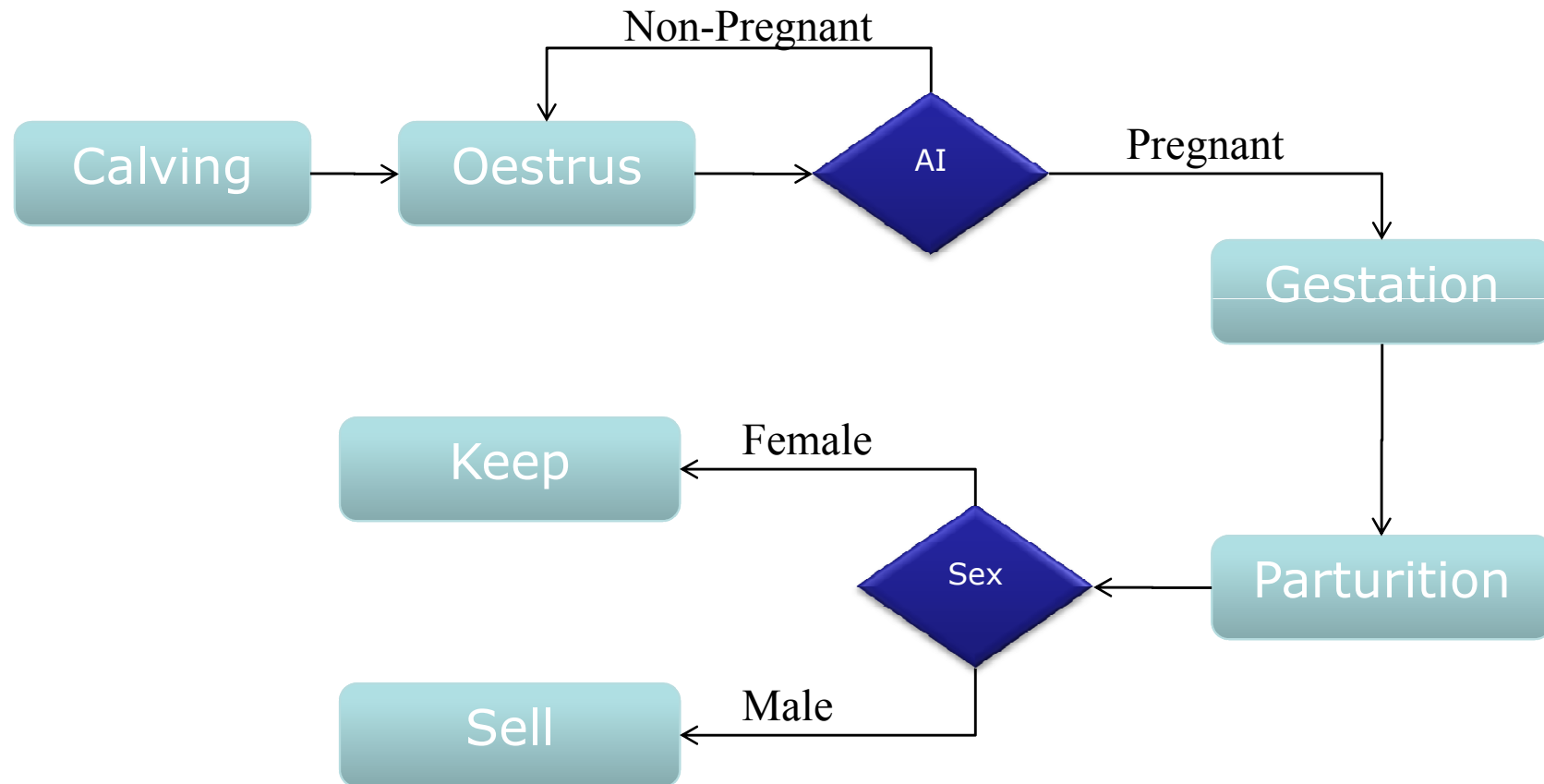
Payoff Matrices



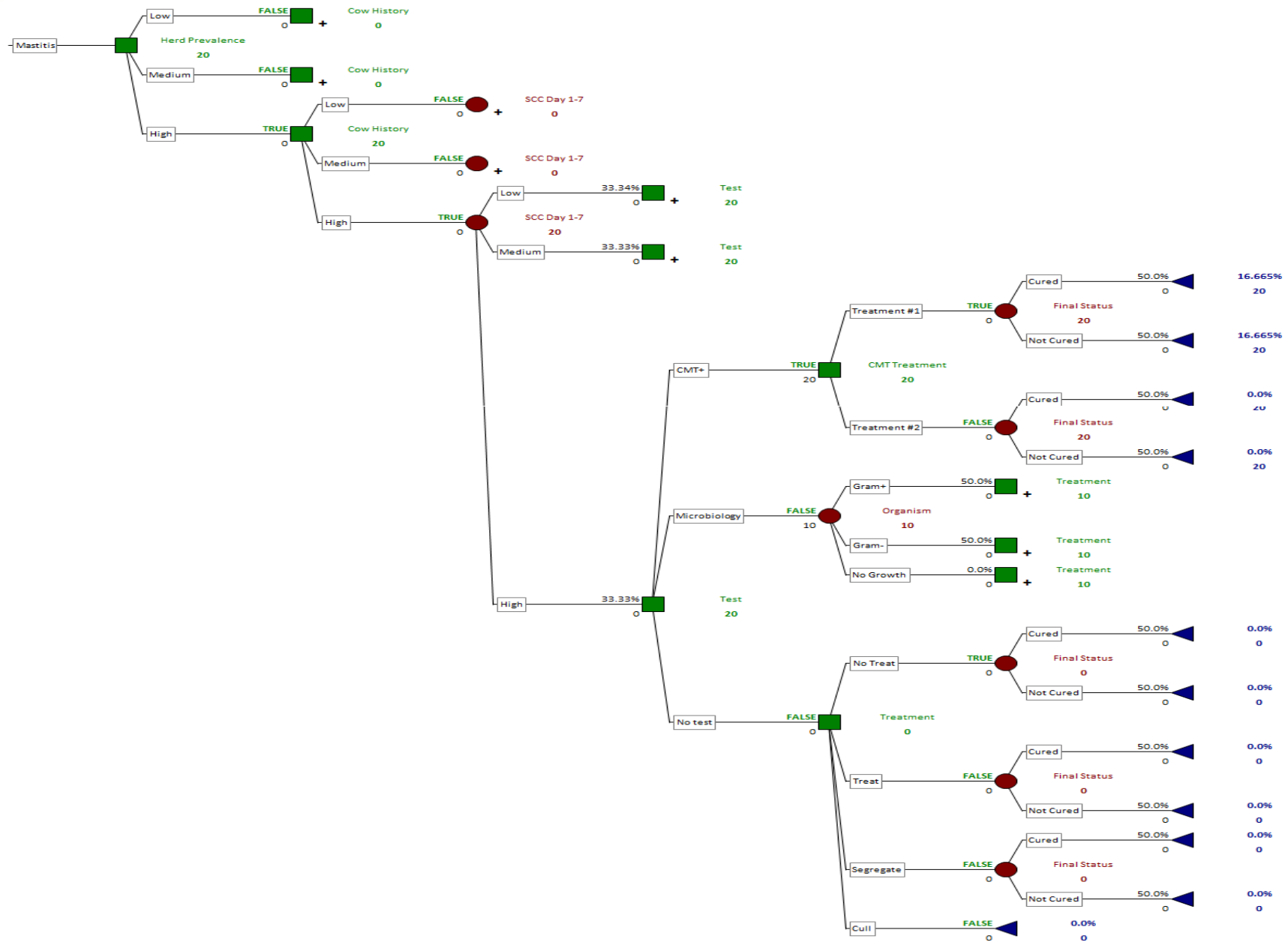
		Milk Price \$/cwt					
			13.6	15.3	17.0	18.7	20.4
		P()	0.1	0.1	0.1	0.4	0.3
Corn	6.10	0.1	741	1081	1421	1761	2101
Price	6.80	0.1	661	1001	1341	1681	2021
\$/bu	7.60	0.2	581	921	1261	1601	1941
	8.30	0.3	501	841	1181	1521	1861
	9.10	0.3	421	761	1101	1441	1781

Return to Labor (\$/cow/year)	1,451
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Process Diagrams



Decision Trees

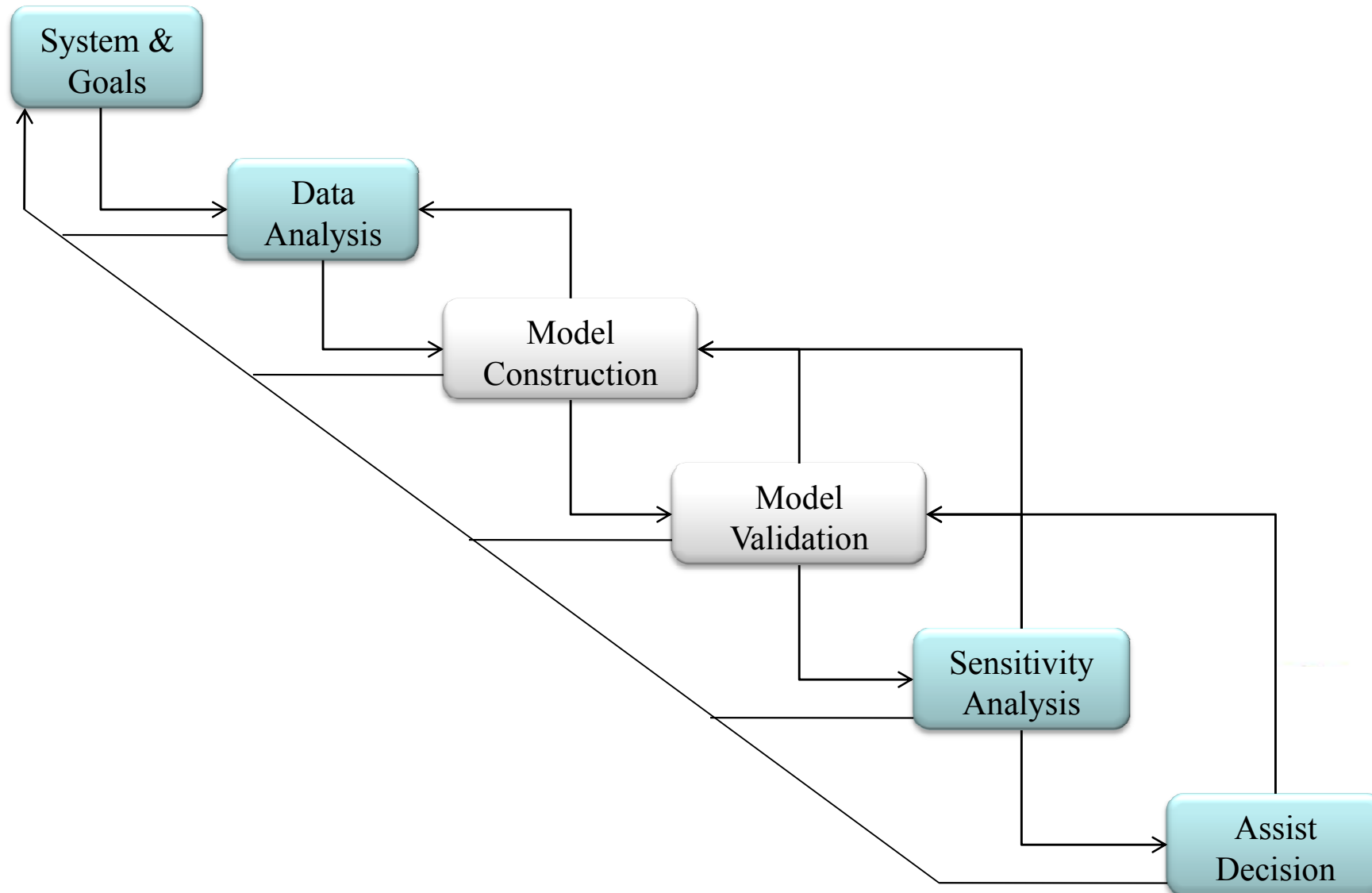


Simulation of Dairy Systems



- Essential to informed decision-making
- Useful to describe interrelated parts of systems of the real world
- Provide the basis for assessing and assimilating available information of the system
- Detect where essential knowledge is lacking or inadequate
- Assist in the management control of the system

Simulation of Dairy Systems



Dairy Modeling Techniques



	Static	Dynamic	Deterministic	Probabilistic	Random	Optimization	Simulation
Gross Margin	Y	N	Y	N	N	N	Y
Partial Budgeting	Y	N	Y	N	N	N	Y
Cost-Benefit	N	Y	Y	N	N	N	N
Linear Programming	Y	N	Y	N	N	Y	N
Dynamic Programming	N	Y	N	Y	N	Y	N
Markov-chain	N	Y	N	Y	N	N	Y
Monte Carlo	N	Y	N	N	Y	N	Y

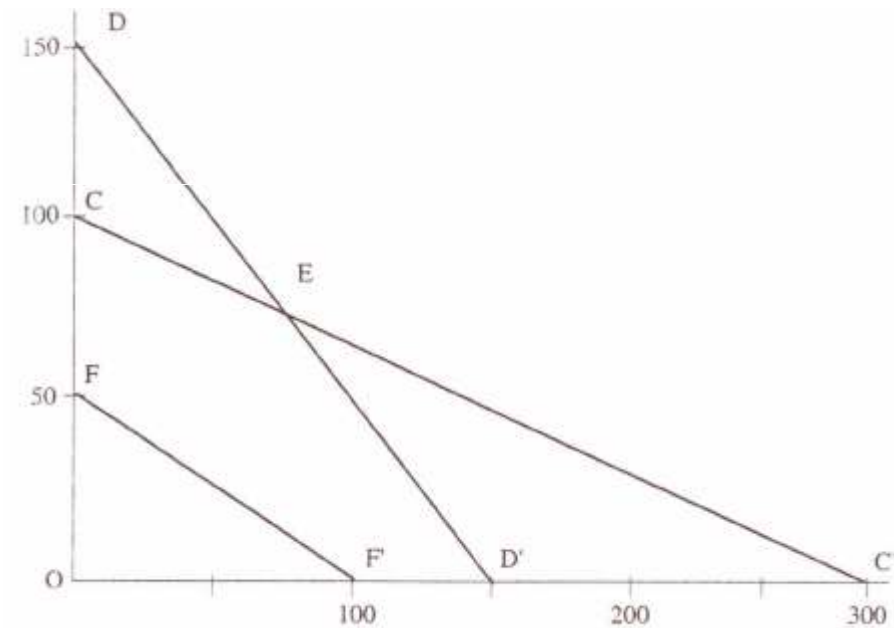
Linear Programming



Objective Function
Constraints
Solving Procedure
Feasible Solution

Max $P = 20x + 40y$
 $2x + 6y \leq \$600$ max investment
 $x + y \leq 150$ max animals treated
 $x + y \geq 0$

x	y		
75	75		
2	$6 \leq$	600	600
1	$1 \leq$	150	150
20	$40 \geq$		4500



Linear Programming

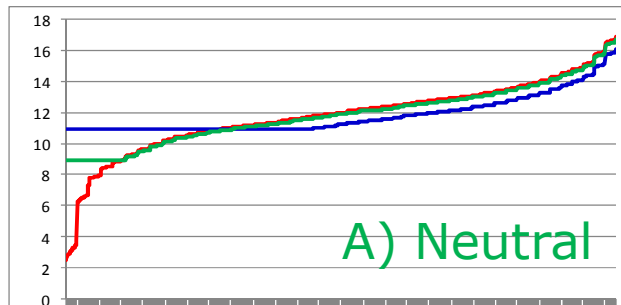


Max $E(u)=$

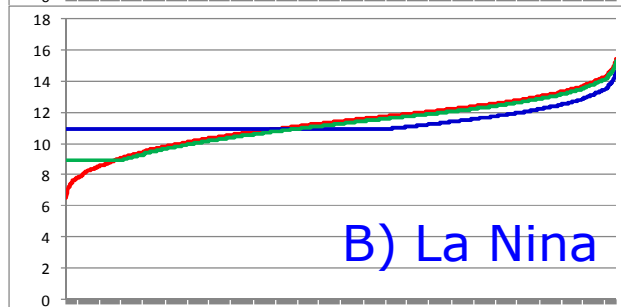
$SGM_{(IMQ,DL)} + INDEMNITY_{(IMQ,DL)} - PREMIUM_{(IMQ,DL)}$

IMQ \leq Target Milk Marketing per month (cwt)

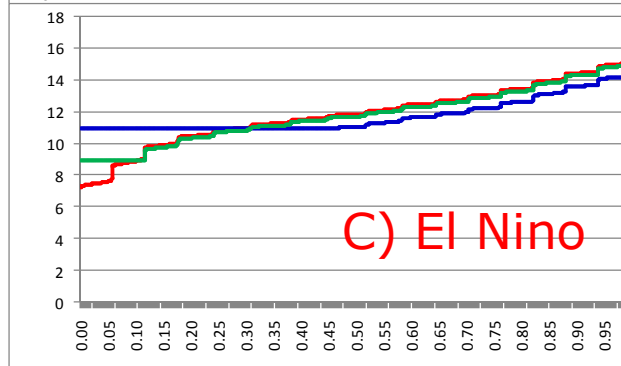
DL \leq Deductible Level (0, 0.1, 0.2, ..., 1.5)



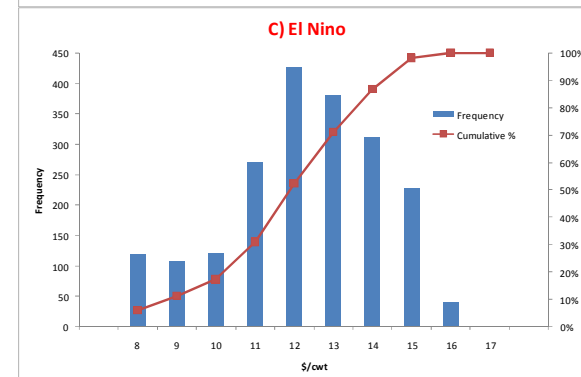
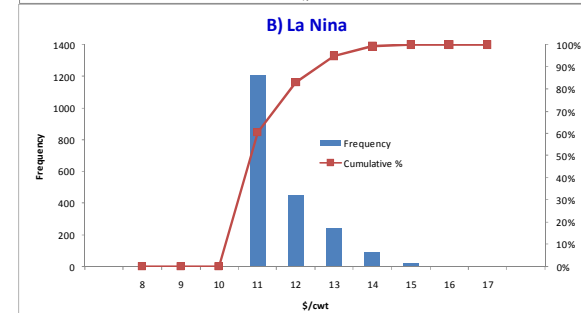
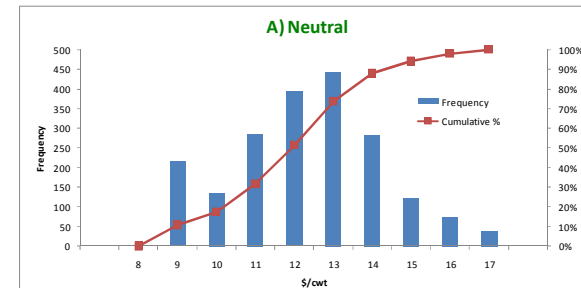
80% IMQ
\$0.5 DL
\$11.88±1.85,
min \$8.91
premium \$0.13



100% IMQ
\$0 DL
\$11.36±0.72
min \$10.92
premium \$0.81

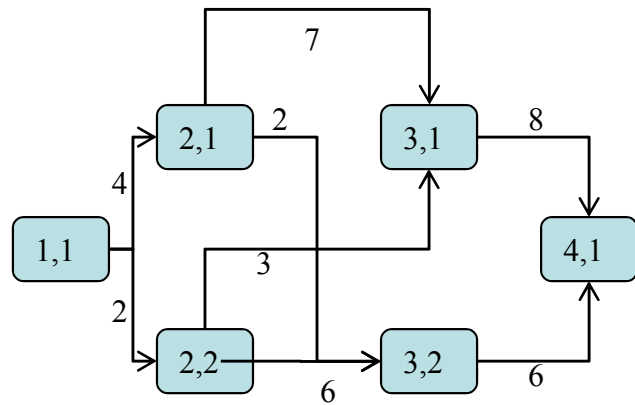


0% IMQ
\$0 DL
\$11.81±0.04
min \$7.23
premium \$0

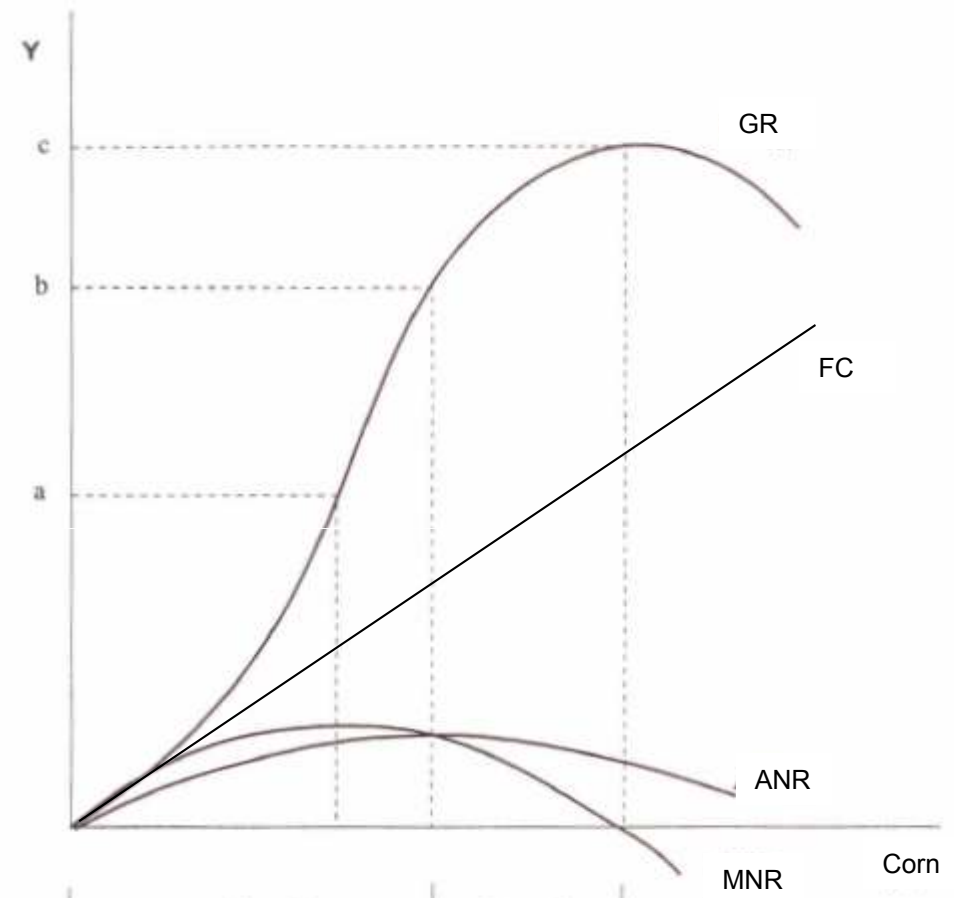


Dynamic Programming

Policy
Stages
States
Objective Function



Least Cost = 12



Dynamic Programming



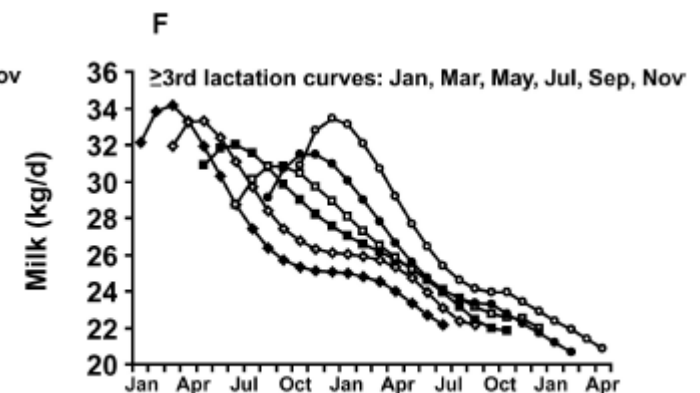
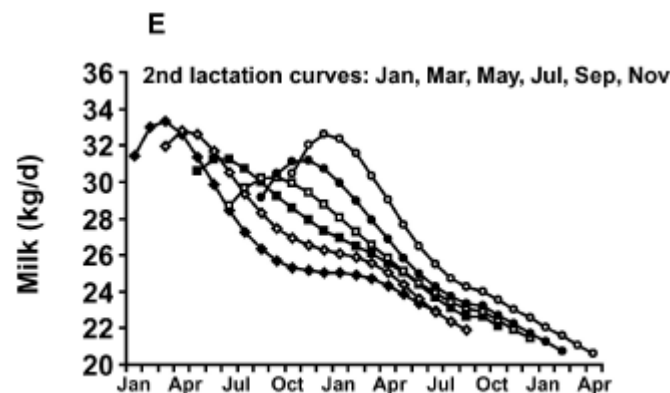
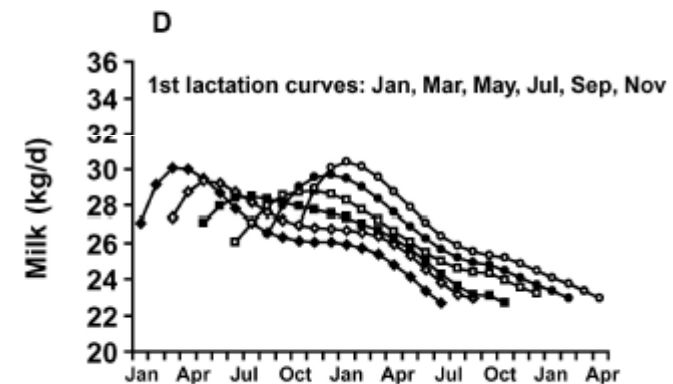
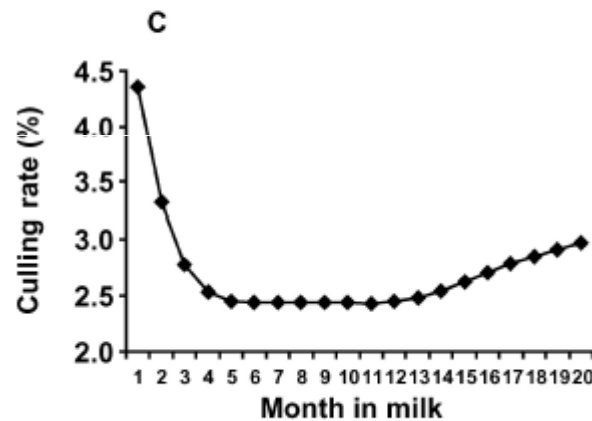
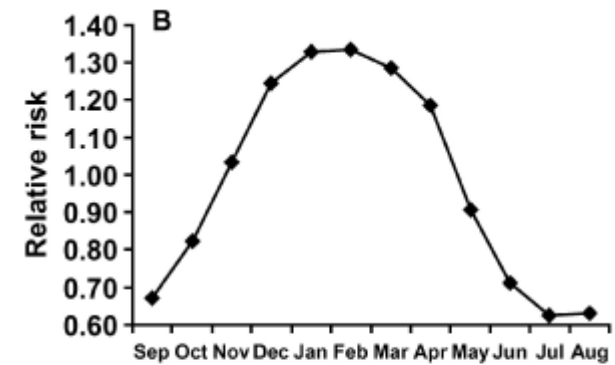
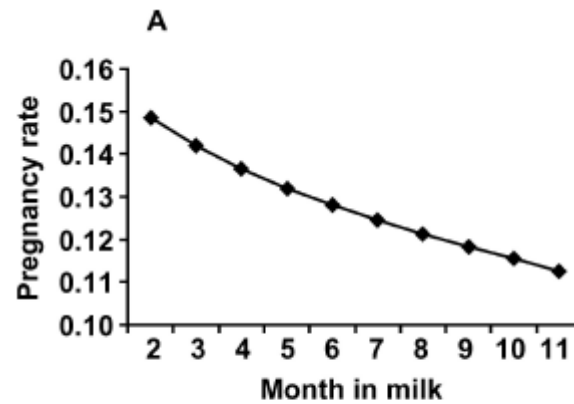
Rn	Ps	Pd	C			Retention Payoff (\$)									
\$	prob	prob	\$		Policy	Par	1	2	3	4	5	6	7	8
0	0	0	0		K	1	900	900	900	900	900	900	900	900	
1800	0.6	0.4	1500		K	2	518	533	540	503	517	539	546	490	
1900	0.65	0.35	1500		K	3	201	224	248	217	190	229	262	210	
2000	0.7	0.3	1500		K	4	71	64	100	87	65	59	112	87	
2100	0.75	0.25	1500		R	5	-91	-98	-63	-76	-97	-104	-50	-75	
2200	0.8	0.2	1500		R	6	-199	-206	-170	-183	-205	-211	-158	-183	
2300	0.85	0.15	1500		R	7	-301	-308	-273	-286	-307	-314	-260	-285	
2400	0.9	0.1	1500		R	8	-399	-406	-370	-383	-405	-411	-358	-383	
2500	0.95	0.05	1500		R	9	-38421	-36392	-34356	-32356	-30343	-28308	-26267	-24279	

- **Stage** = Time
- **State** = Characteristics of cow or group of cows
- **Transition** = Probabilities that determine the flow from one state to another state

- All potential **states** a cow (or group of cows) can be in a specific **stage**
- Example: (5,400 states)
 - 9 parities
 - 20 month in milk
 - 10 pregnancy (0-non-preg., 1-9 preg.)
 - 3 production levels
 - 12 months in a year

Markov-Chains

Some
Biological
Data Needs



Monte Carlo Simulation



Events Simulated by Chance

Chance represented by RANDOM numbers

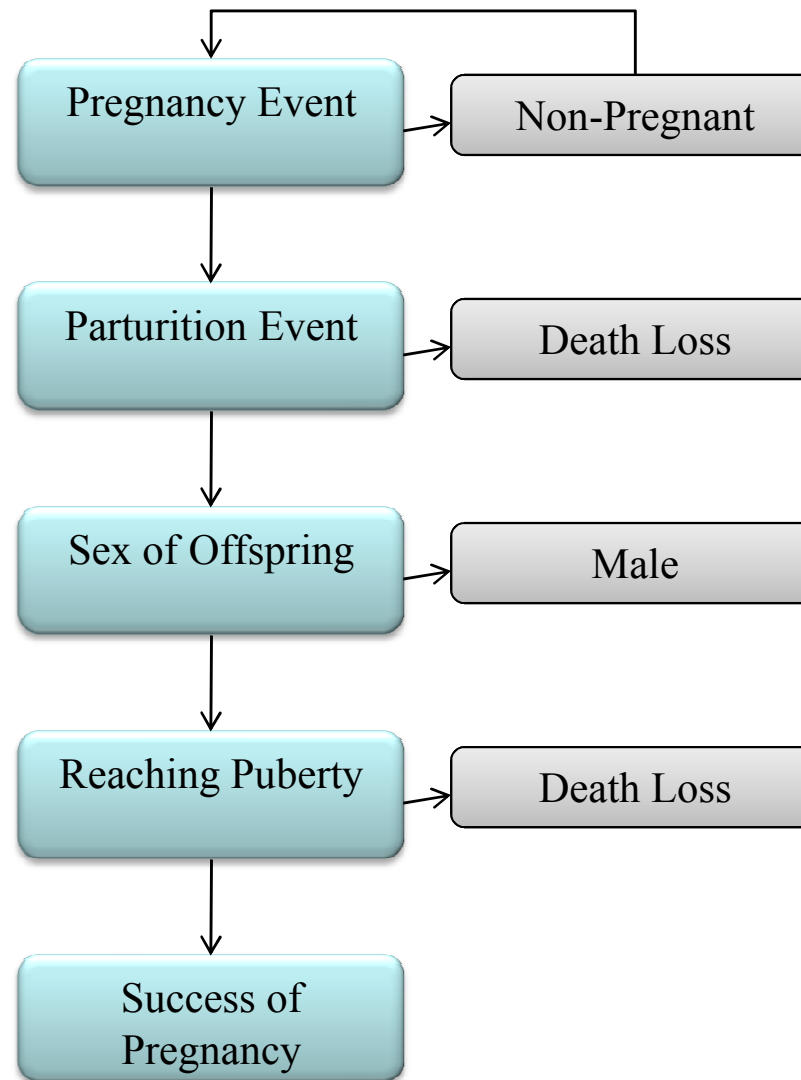
Offspring	Frequency	Cumulative
Female	0.4837164	0.4837164
Male	0.5058836	0.9896000
Female-Female	0.0025418	0.9921418
Male-Male	0.0026582	0.9948000
Male-Female/ Female-Male	0.0052000	1.0000000

Sex of Offspring = Random() within cumulative frequency
E.g., Random()=0.7526632 THEN the offspring is MALE

Monte Carlo Simulation

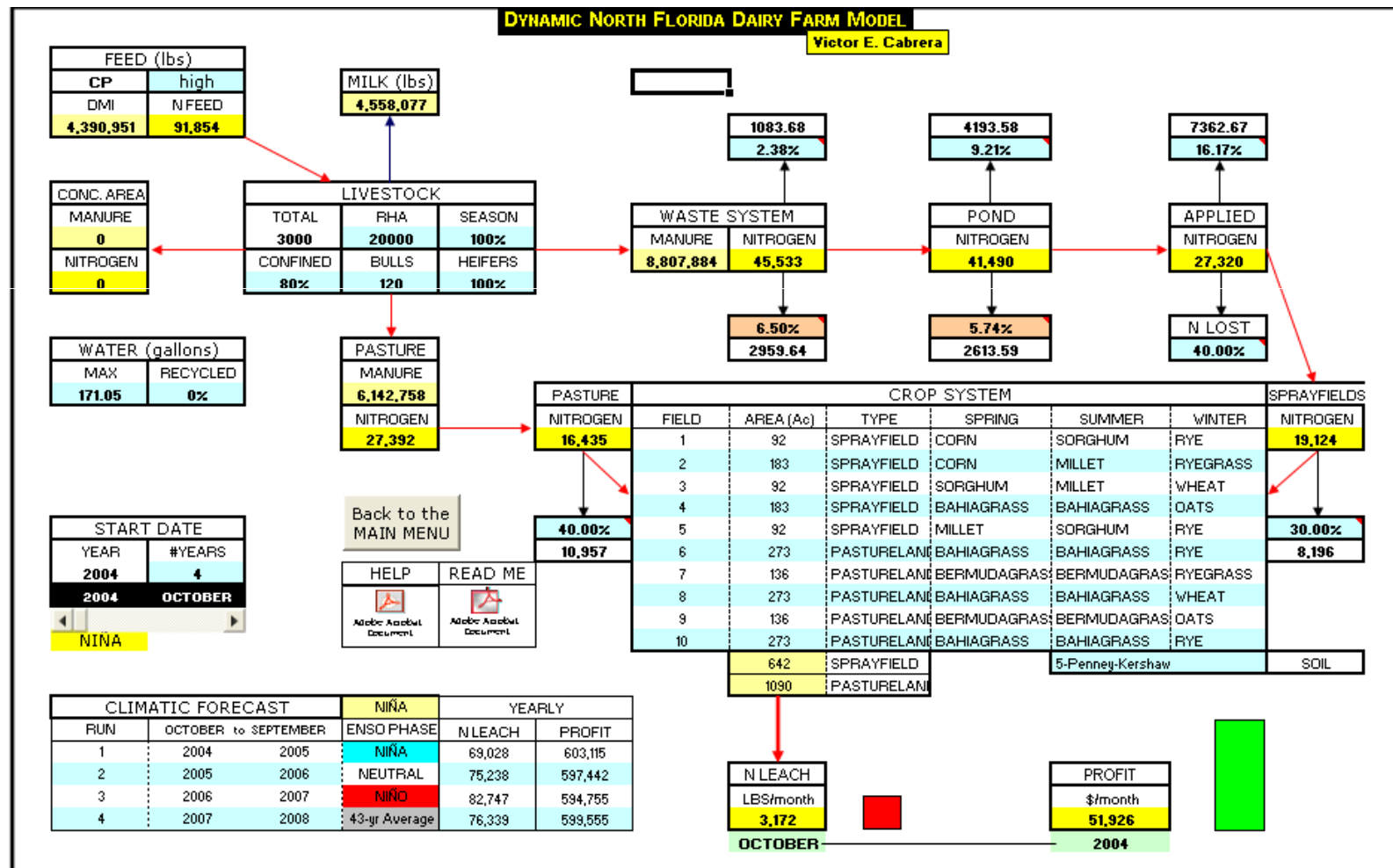
Every Event has a chance probability of occur

Markov-Chain	Monte Carlo
1 RUN	Several Runs
Easy to Perform Sensitivity	Difficult to Perform Sensitivity
Does not Output SD	Results in form of Means and SD
Better suited for DSS	Difficult to Integrate user-friendly



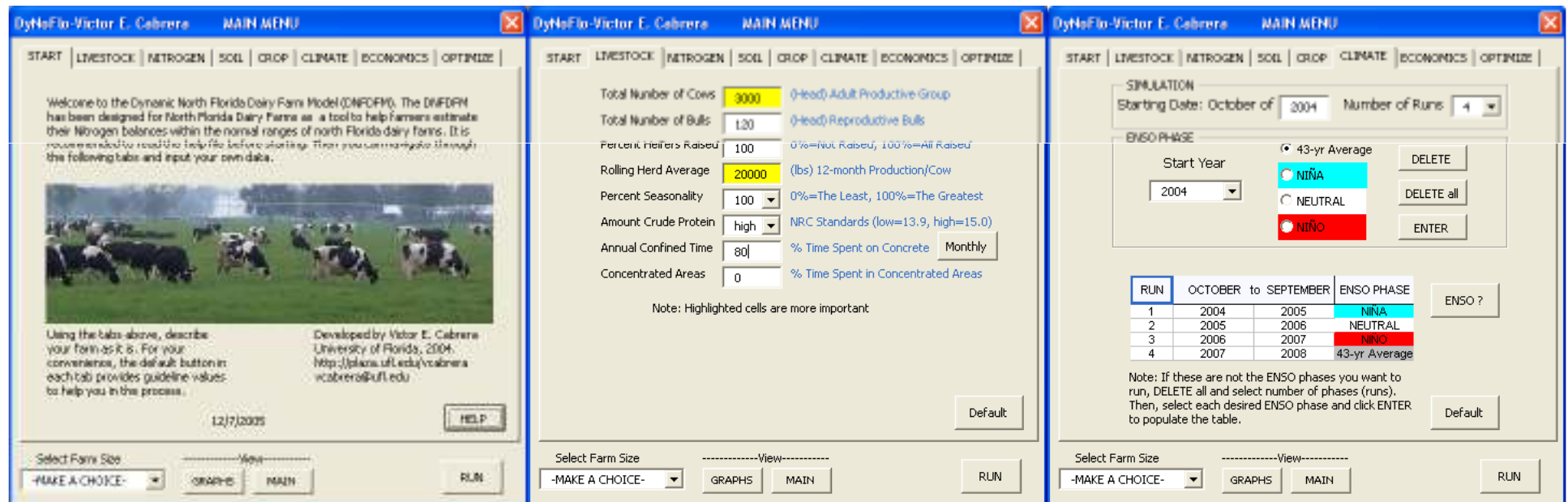
Decision Support Systems

Integration of models and modules into an application for decision-making



Decision Support Systems

Integration of models and modules into an application for decision-making



The image displays three screenshots of the DyNaFlo software interface, which is a decision support system for dairy farm management. The interface is titled "DyNaFlo-Victor E. Cabrera" and has a "MAIN MENU" with tabs for START, LIVESTOCK, NITROGEN, SOIL, CROP, CLIMATE, ECONOMICS, and OPTIMIZE.

Left Screenshot (START tab): This screen provides a welcome message and a brief overview of the model. It includes a photograph of a dairy farm and a "HELP" button. The date "12/7/2005" is displayed.

Middle Screenshot (LIVESTOCK tab): This screen allows users to configure farm parameters. The following table summarizes the input fields and their values:

Parameter	Value	Description
Total Number of Cows	3000	(Head) Adult Productive Group
Total Number of Bulls	120	(Head) Reproductive Bulls
Percent Heifers Raised	100	0%=Not Raised, 100%=All Raised
Rolling Herd Average	20000	(lbs) 12-month Production/Cow
Percent Seasonality	100	0%=The Least, 100%=The Greatest
Amount Crude Protein	high	NRC Standards (low=13.9, high=15.0)
Annual Confined Time	80	% Time Spent on Concrete Monthly
Concentrated Areas	0	% Time Spent in Concentrated Areas

A note indicates: "Note: Highlighted cells are more important". A "Default" button is located at the bottom right.

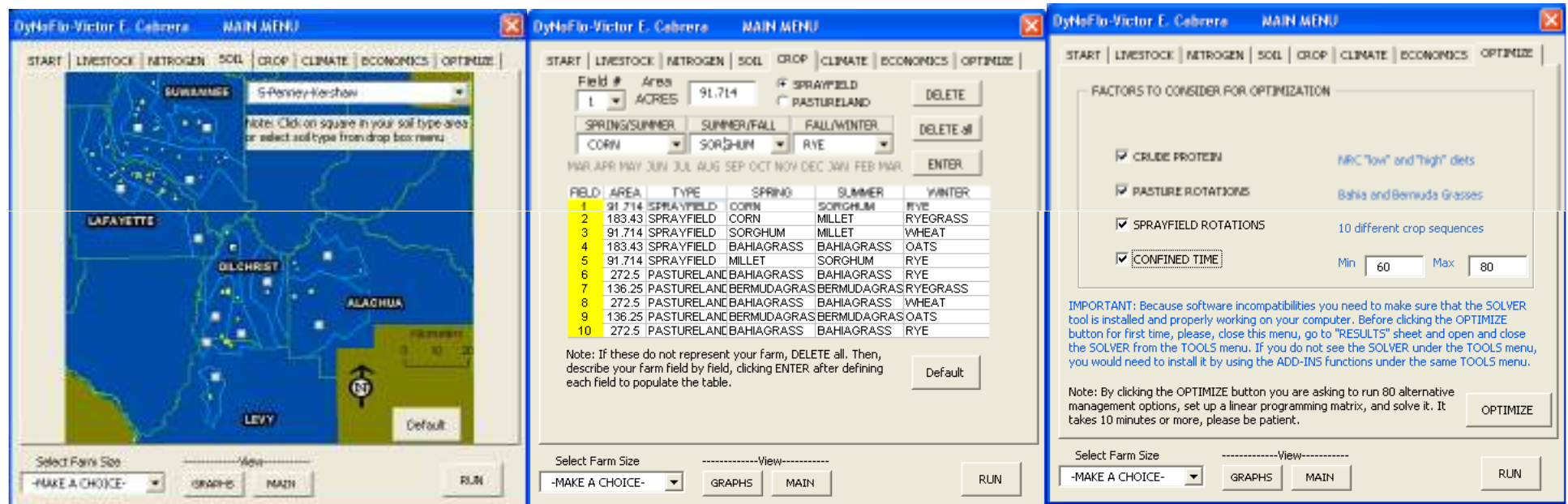
Right Screenshot (ECONOMICS tab): This screen is used for simulation configuration. It includes a "SIMULATION" section with a "Starting Date" of October 2004 and "Number of Runs" set to 4. The "ENSO PHASE" section allows selection of "43-yr Average", "NIÑA", "NEUTRAL", or "NIÑO". A table below shows the simulation schedule:

RUN	OCTOBER	to	SEPTEMBER	ENSO PHASE	ENSO ?
1	2004		2005	NIÑA	
2	2005		2006	NEUTRAL	
3	2006		2007	NIÑO	
4	2007		2008	43-yr Average	

A note explains: "Note: If these are not the ENSO phases you want to run, DELETE all and select number of phases (runs). Then, select each desired ENSO phase and click ENTER to populate the table." A "Default" button is at the bottom right.

Decision Support Systems

Integration of models and modules into an application for decision-making



The image displays three screenshots of the DyNoFlo software interface, showing the integration of models and modules into an application for decision-making.

Left Screenshot: Map View

The map shows a farm layout with fields labeled: SUWANNEE, LAFAYETTE, DILCHRIST, ALACHUA, and LEVY. A dropdown menu is set to "SPenny-Wershow". A note reads: "Notes: Click on square in your soil type area or select soil type from drop box menu." A "Default" button is visible at the bottom right of the map area.

Middle Screenshot: Field Configuration

Field # 1, Area 91.714 ACRES. Options: SPRAYFIELD, PASTURELAND. Crop selection: SPRING/SUMMER: CORN, SUMMER/FALL: SORGHUM, FALL/WINTER: RYE. A table lists 10 fields with their area, type, and crop rotation schedule.

FIELD #	AREA	TYPE	SPRING	SUMMER	WINTER
1	91.714	SPRAYFIELD	CORN	SORGHUM	RYE
2	183.43	SPRAYFIELD	CORN	MILLET	RYEGRASS
3	91.714	SPRAYFIELD	SORGHUM	MILLET	WHEAT
4	183.43	SPRAYFIELD	BAHIAGRASS	BAHIAGRASS	OATS
5	91.714	SPRAYFIELD	MILLET	SORGHUM	RYE
6	272.5	PASTURELAND	BAHIAGRASS	BAHIAGRASS	RYE
7	136.25	PASTURELAND	BERMUDAGRASS	BERMUDAGRASS	RYEGRASS
8	272.5	PASTURELAND	BAHIAGRASS	BAHIAGRASS	WHEAT
9	136.25	PASTURELAND	BERMUDAGRASS	BERMUDAGRASS	OATS
10	272.5	PASTURELAND	BAHIAGRASS	BAHIAGRASS	RYE

Note: If these do not represent your farm, DELETE all. Then, describe your farm field by field, clicking ENTER after defining each field to populate the table. A "Default" button is present.

Right Screenshot: Optimization Options

FACTORS TO CONSIDER FOR OPTIMIZATION:

- CRUDE PROTEIN: NRC "low" and "high" diets
- PASTURE ROTATIONS: Bahia and Bermuda Grasses
- SPRAYFIELD ROTATIONS: 10 different crop sequences
- CONFINED TIME: Min 60, Max 80

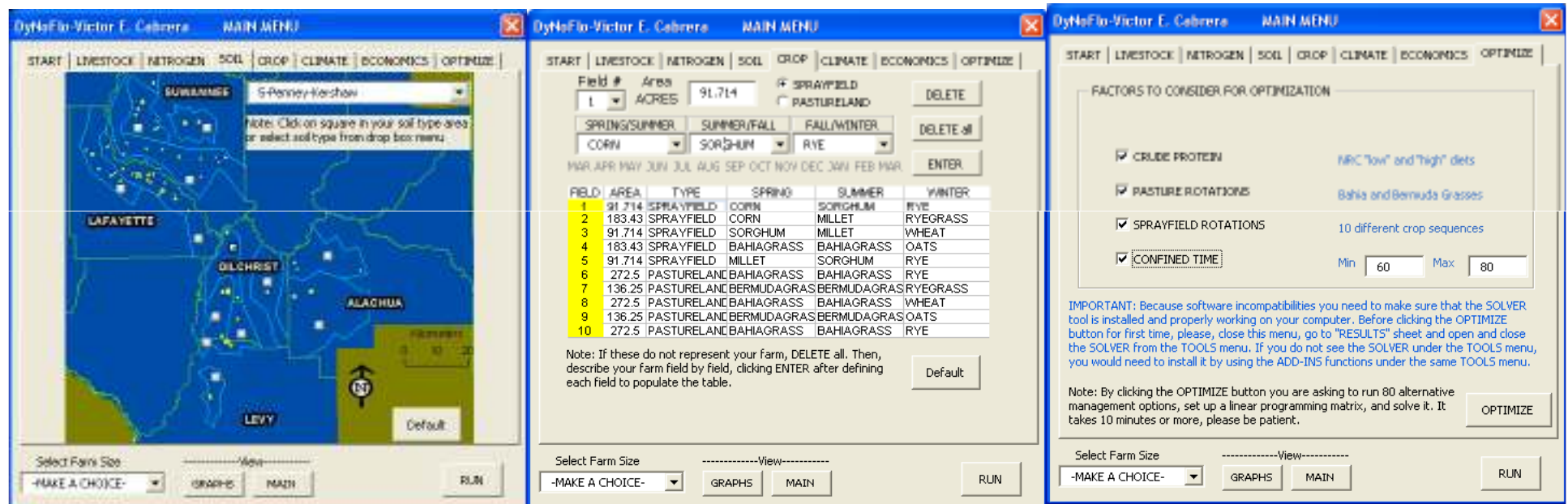
IMPORTANT: Because software incompatibilities you need to make sure that the SOLVER tool is installed and properly working on your computer. Before clicking the OPTIMIZE button for first time, please, close this menu, go to "RESULTS" sheet and open and close the SOLVER from the TOOLS menu. If you do not see the SOLVER under the TOOLS menu, you would need to install it by using the ADD-INS functions under the same TOOLS menu.

Note: By clicking the OPTIMIZE button you are asking to run 80 alternative management options, set up a linear programming matrix, and solve it. It takes 10 minutes or more, please be patient.

Buttons: OPTIMIZE, RUN, MAIN, GRAPH, MAKE A CHOICE.

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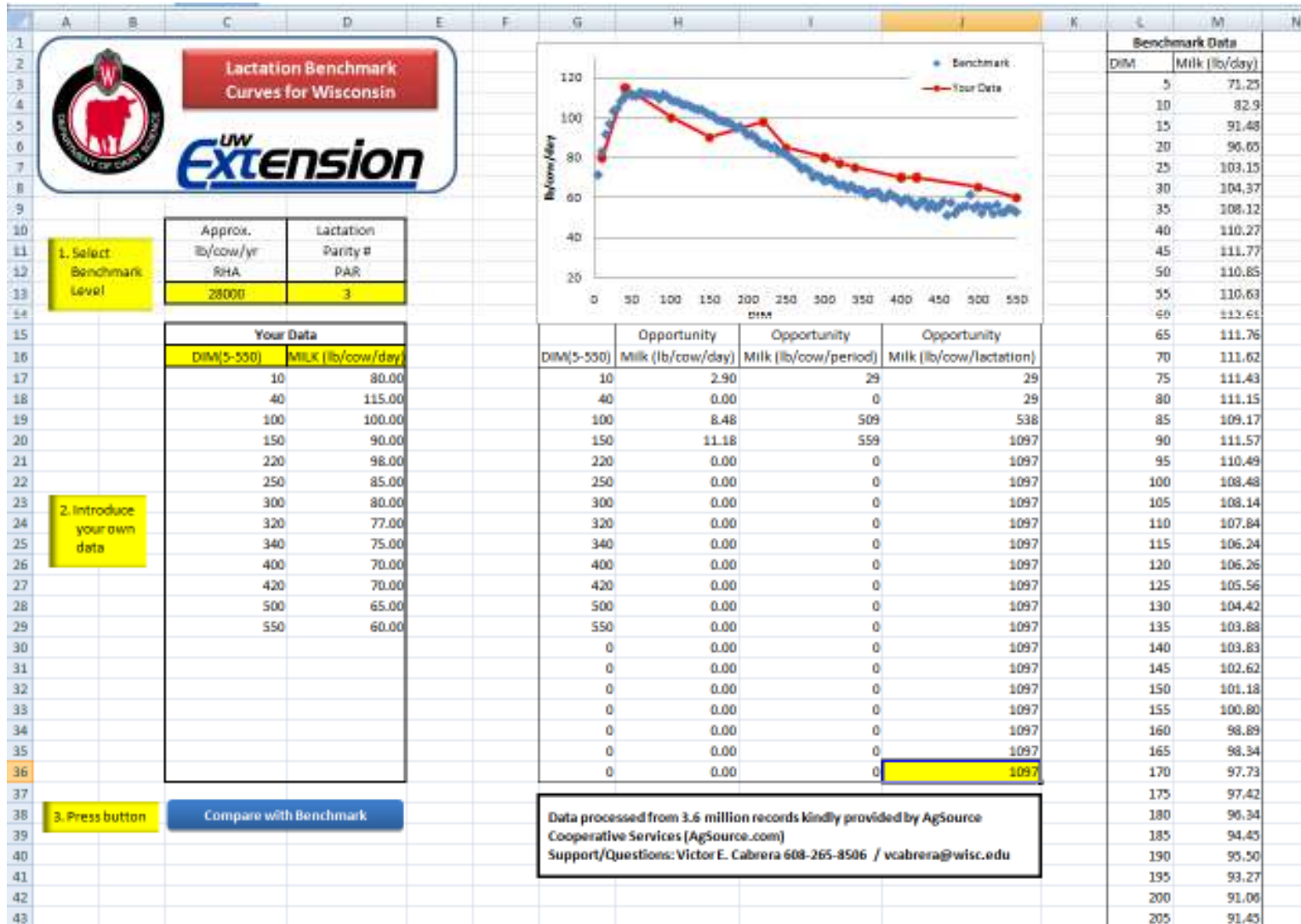
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Some Dairy Management Tools

<http://www.uwex.edu/ces/dairymgt/> Tools



Lactation Benchmark Curves for Wisconsin
UW Extension

1. Select Benchmark Level

Approx. lb/cow/yr RHA	Lactation Parity # PAR
28000	3

2. Introduce your own data

Your Data	
DIM(5-550)	MILK (lb/cow/day)
10	80.00
40	115.00
100	100.00
150	90.00
220	98.00
250	85.00
300	80.00
320	77.00
340	75.00
400	70.00
420	70.00
500	65.00
550	60.00

3. Press button Compare with Benchmark

Benchmark Data

DIM	Milk (lb/day)
5	71.25
10	82.9
15	91.48
20	96.05
25	103.15
30	104.37
35	108.12
40	110.27
45	111.77
50	110.85
55	110.63
60	112.61
65	111.76
70	111.62
75	111.43
80	111.15
85	109.17
90	111.57
95	110.49
100	108.48
105	108.14
110	107.84
115	106.24
120	106.26
125	105.56
130	104.42
135	103.88
140	103.83
145	102.62
150	101.18
155	100.80
160	98.89
165	98.34
170	97.73
175	97.42
180	96.34
185	94.45
190	95.50
195	93.27
200	91.06
205	91.45

Opportunity

DIM(5-550)	Milk (lb/cow/day)	Milk (lb/cow/period)	Milk (lb/cow/lactation)
10	2.90	29	29
40	0.00	0	29
100	8.48	509	538
150	11.18	559	1097
220	0.00	0	1097
250	0.00	0	1097
300	0.00	0	1097
320	0.00	0	1097
340	0.00	0	1097
400	0.00	0	1097
420	0.00	0	1097
500	0.00	0	1097
550	0.00	0	1097
0	0.00	0	1097
0	0.00	0	1097
0	0.00	0	1097
0	0.00	0	1097
0	0.00	0	1097
0	0.00	0	1097
0	0.00	0	1097
0	0.00	0	1097
0	0.00	0	1097
0	0.00	0	1097
0	0.00	0	1097
0	0.00	0	1097

Data processed from 3.6 million records kindly provided by AgSource Cooperative Services (AgSource.com)
Support/Questions: Victor E. Cabrera 608-265-8506 / vcabrera@wisc.edu

Some Dairy Management Tools



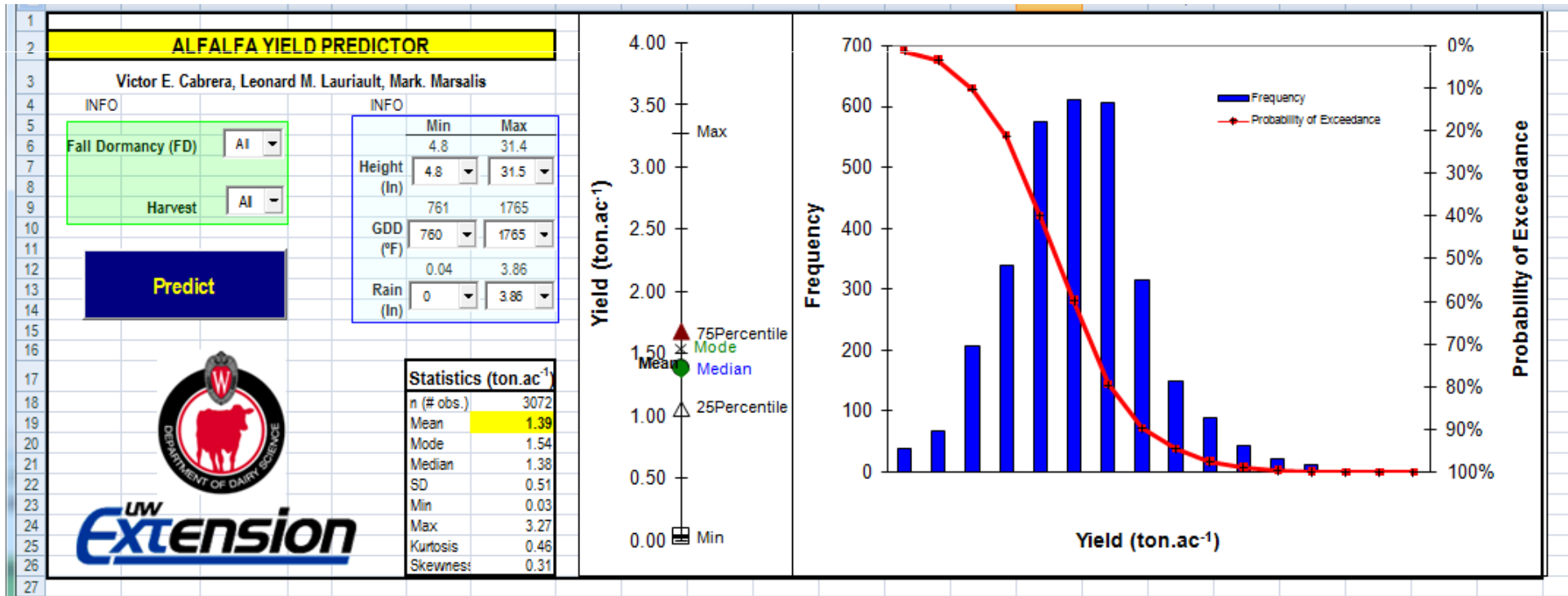
<http://www.uwex.edu/ces/dairymgt/> Tools

Dairy Annual Nutrient Manager						ClearAll				
Date	7/28/2008						 PLANNED	Nutrient Balance (lb)		
Dairy	El Lechero							N Loss	25%	
Crop_Year	2007							Nutrient Needed		
Field_ID	La Pampa									
Area (ac)	20		Victor E. Cabrera							
Month - Month	Crop	Unit	Yield	N	P			Crops		
1 st Crop	Mar-Jun	Sorghum, for silage (mature)	t/ac	5	814	136				
2 nd Crop	Jul-Sep	Corn-Field, for silage (mature)	t/ac	15	2325	679				
3 rd Crop	Oct-Feb	Wheat, for hay (mature)	t/ac	10	4300	698				
Total	Nutrient Needed				9,298	1,513				
						Soil Analyses				
Texture by Feel					N	P				
Nutrient Available in Soil			lb/ac			2				
Nutrient Still Needed				9,298	1,473			Effluent		
						Effluent Analyses				
Effluent Manure Application	NM Dairy Ponds 97% liq	ac-in	1	N	P					
		ac-in		3360	507					
		ac-in		0	0					
Nutrient Still Needed				5,938	966					
						Manure Analyses				
Dry Manure Application	NM Dairy Cattle 25% wet	t/ac	5	N	P					
		t/ac		2670	812					
		t/ac		0	0					
Nutrient Still Needed				3,268	154					
						Fertilizer Content				
Chemical Fertilizers Applied		lb/ac		N	P					
		lb/ac		0	0					
		lb/ac		0	0					
Annual Nutrient Balance				3,268	154					
CALCULATOR: How much more manure you could still apply										
				<input checked="" type="radio"/> ac-in Effluent <input type="radio"/> gallons Effluent <input type="radio"/> Dry Manure						
NM Dairy Ponds 97% liq				ac-in	1.0	0.3				

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Predicts seasonal manure excretion of lactating cows in New Mexico

For more information refer to the embedded document:

or contact:

Victor E. Cabrera

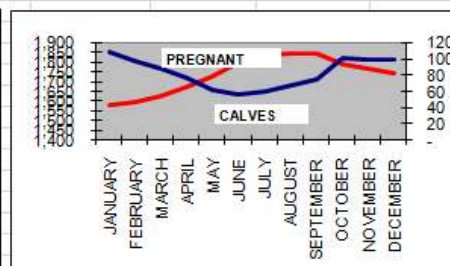
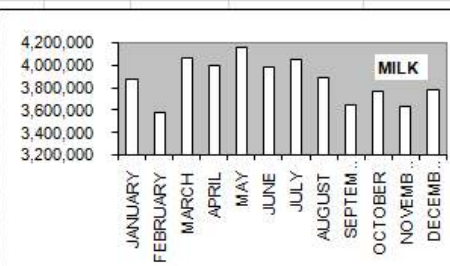
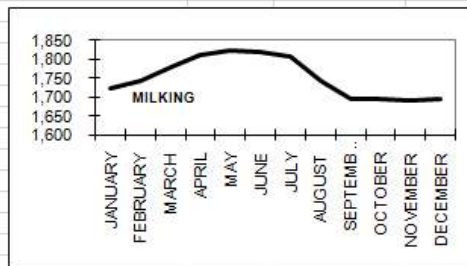
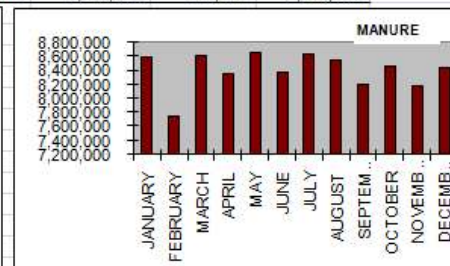
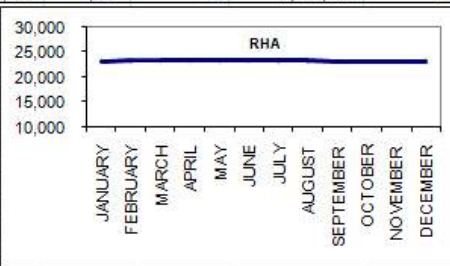
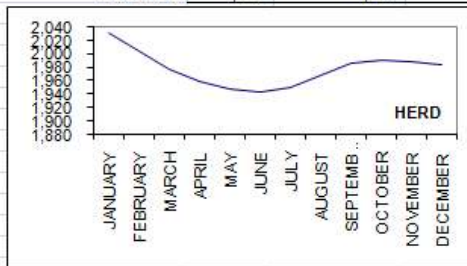
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Enter your data and hit the "Run Model" button.

Total Adult Cows (heads)	2,000	Pregnancy Rate (%)	21.63
Milk productivity or RHA (lbs/cow/year)	23,147	Involuntary Culling Rate (%)	30.67

Run Model

	Cows (head)	Heifers (head)	Pregnant (head)	Milking (head)	Calving (head)	Total Milk (lbs)	RHA (lbs/cow/year)	Milking Manure (lbs)	Dry Manure (lbs)	TOTAL Manure (lbs)
JANUARY	2,030	1,510	1,578	1,724	108	3,876,477	23,117	7,793,423	793,436	8,586,859
FEBRUARY	2,003	1,540	1,592	1,744	97	3,572,454	23,175	7,132,249	607,179	7,739,428
MARCH	1,977	1,560	1,628	1,779	87	4,058,272	23,227	8,081,171	514,293	8,595,463
APRIL	1,959	1,566	1,671	1,813	77	3,999,453	23,235	7,986,310	365,077	8,351,387
MAY	1,947	1,556	1,731	1,824	62	4,154,054	23,223	8,327,669	320,018	8,647,687
JUNE	1,943	1,536	1,794	1,818	57	3,981,493	23,222	8,043,948	313,114	8,357,062
JULY	1,950	1,509	1,833	1,809	60	4,050,538	23,196	8,262,516	367,838	8,630,354
AUGUST	1,968	1,480	1,845	1,746	68	3,889,777	23,169	7,962,716	576,970	8,539,686
SEPTEMBER	1,985	1,455	1,844	1,695	75	3,642,373	23,095	7,469,218	729,869	8,199,087
OCTOBER	1,989	1,464	1,793	1,694	101	3,761,602	23,055	7,693,839	766,382	8,460,221
NOVEMBER	1,989	1,473	1,763	1,692	99	3,634,150	23,091	7,416,618	745,598	8,162,216
DECEMBER	1,983	1,487	1,740	1,697	99	3,779,967	23,143	7,680,329	742,630	8,422,959



Print

Dairy Farm Management

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