Optimization of insemination decisions and value of pregnancy in dairy cattle
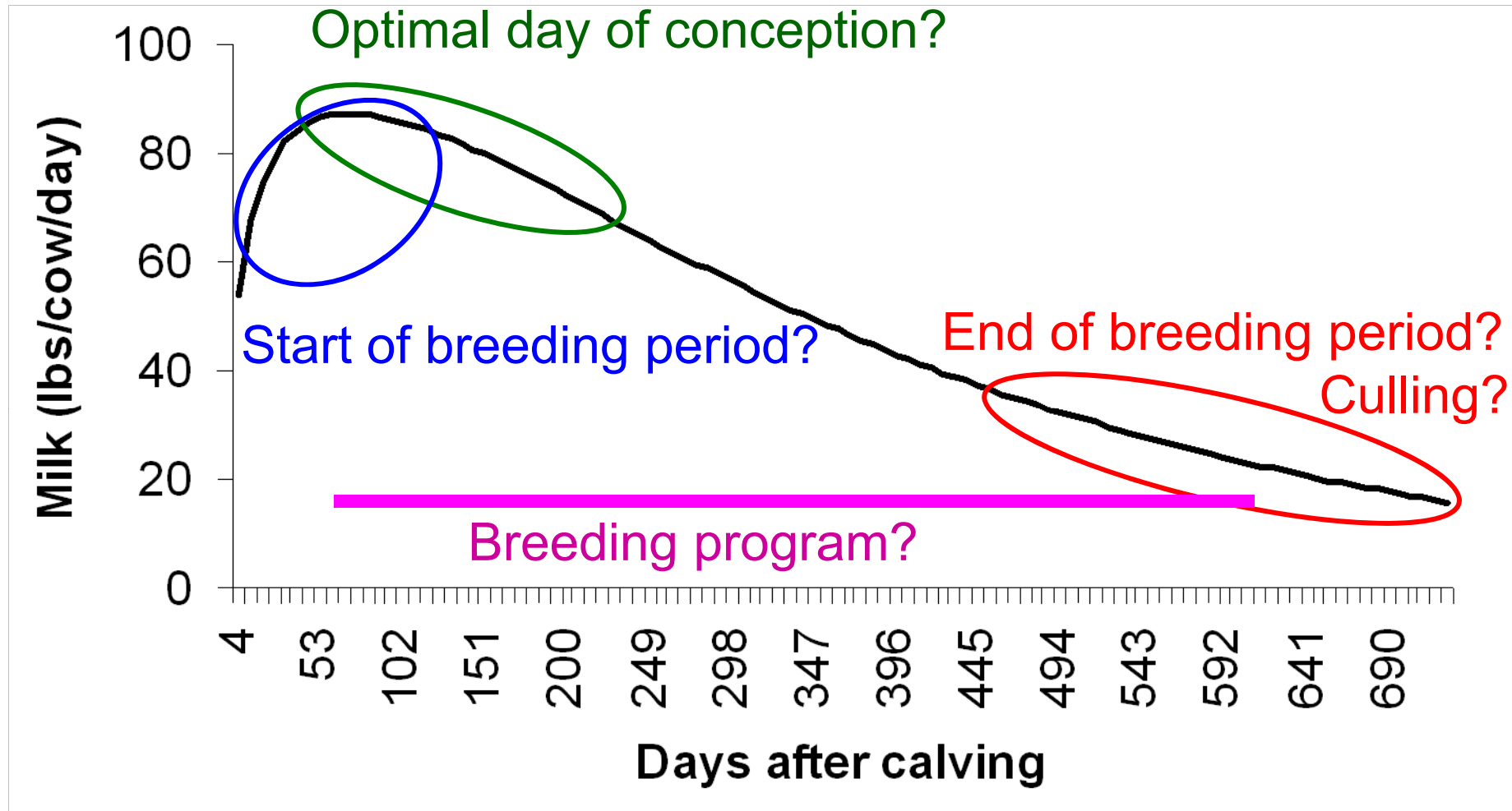
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59th Annual Meeting of the EAAP, Vilnius, Lithuania, August 24-27, 2008

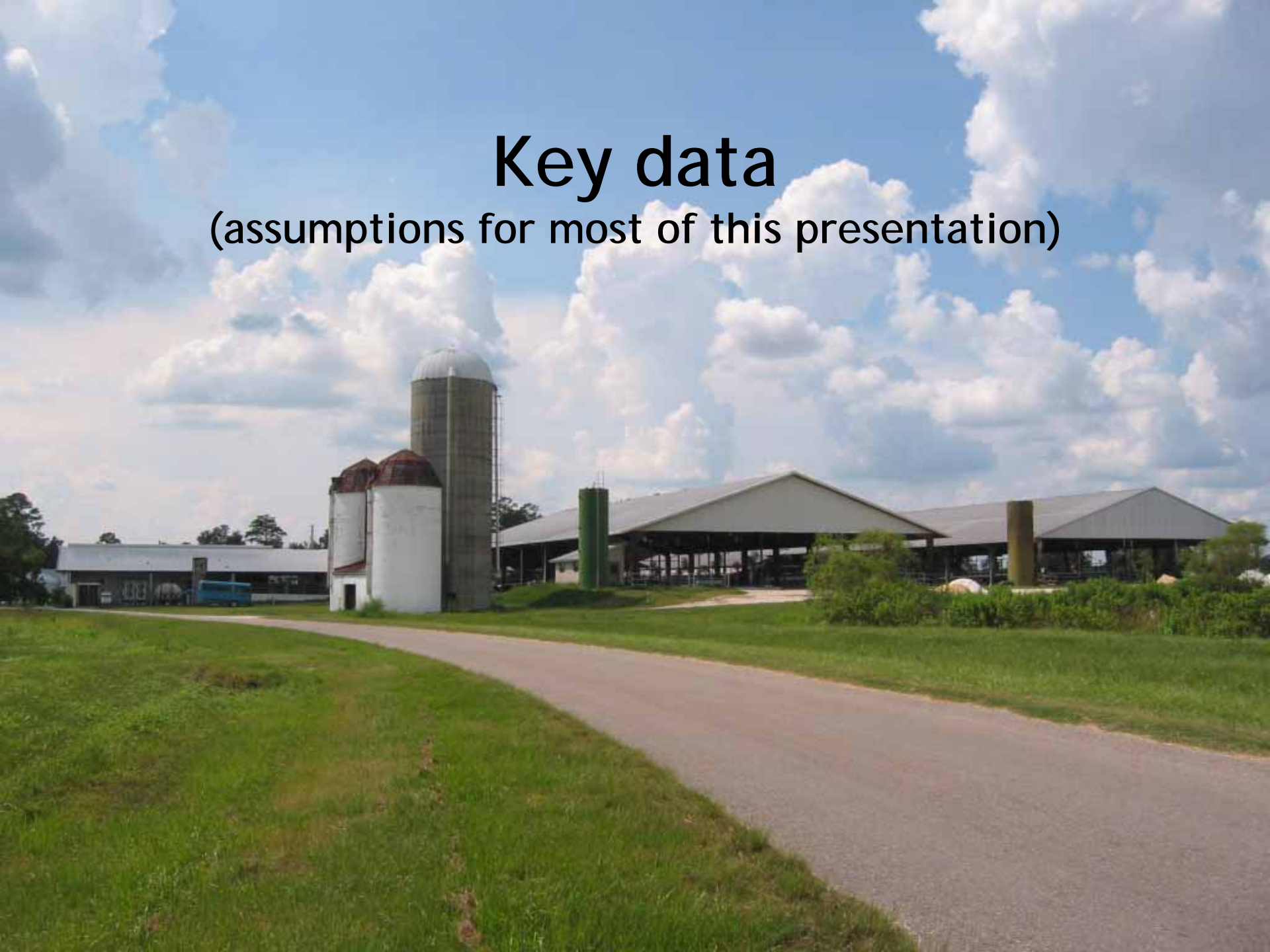# Decisions, decisions, decisions

Economic principles

- The economics of breeding and culling decisions is about <u>differences in cash flows</u> between cows:
  - Lactation curves (shape & repeatability of milk yield)
  - Service risk, conception risk
  - Feed intake, labor needs, …
  - Prices of heifers, cull cows, milk, feed, labor, …
- "Spreadsheets" to put all this together:
  - Calculate cash flows for cows and replacements
  - Goal: maximize profit/slot/year
  - Method: dynamic programming to solve sequential breeding and replacement decision problem
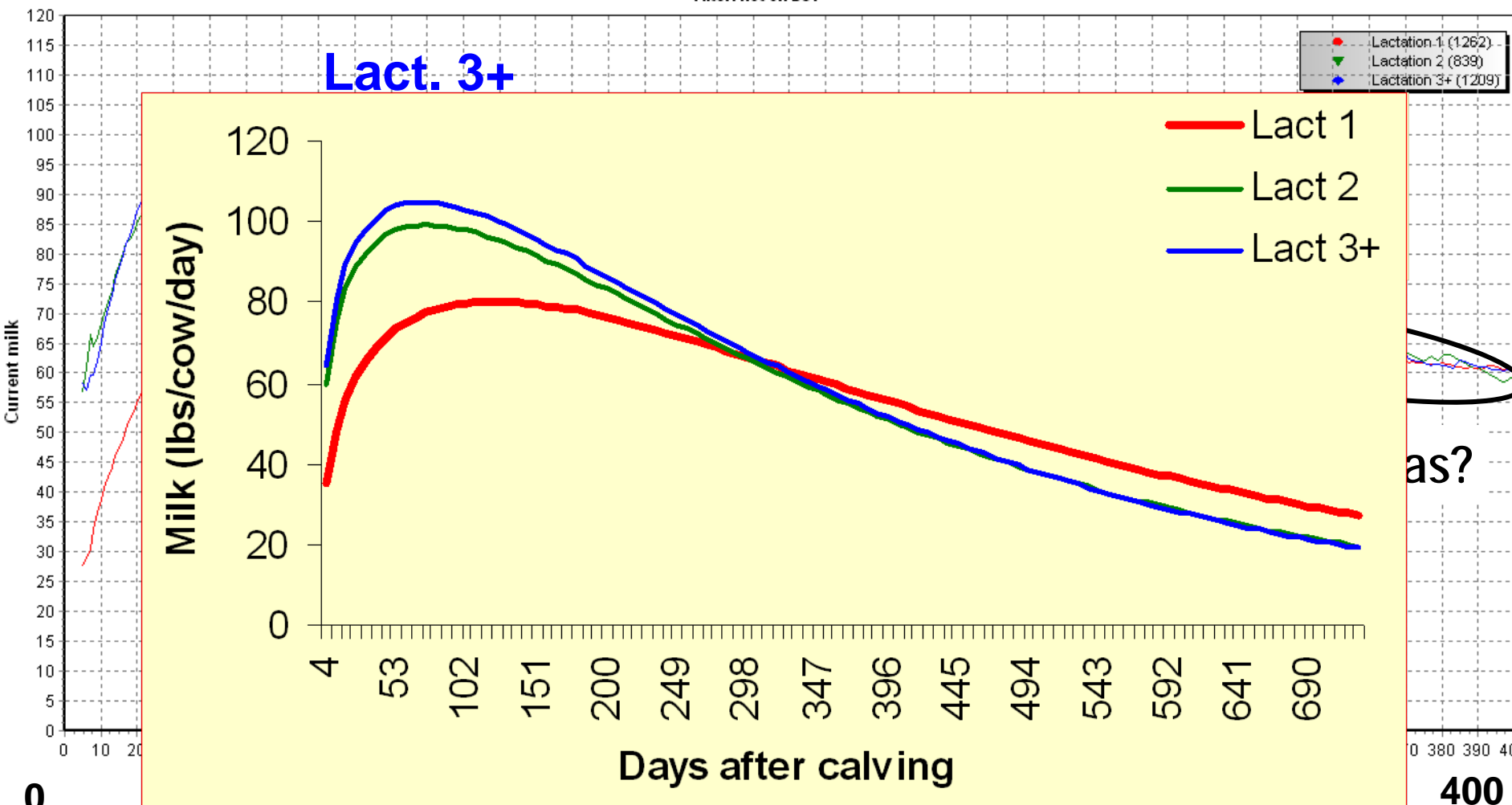
Key data
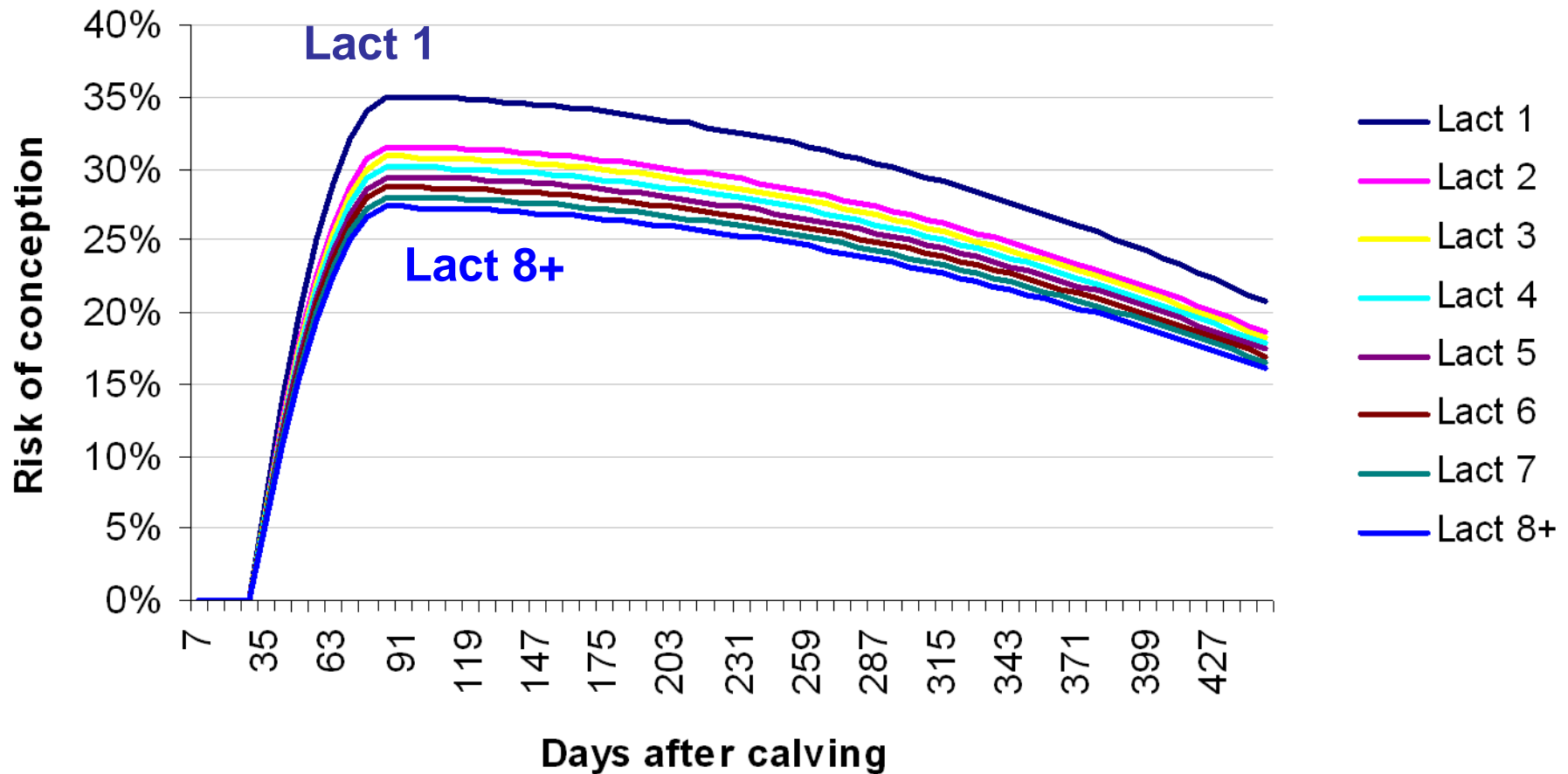## (assumptions for most of this presentation)

PCDART - NOT ON BST

Current milk vs Days in Milk
Filter: Not on BST

120 lbs = 54 kg

Lact. 3+

Lactation 1 (1262)
Lactation 2 (839)
Lactation 3+ (1209)

Lact 1
Lact 2
Lact 3+

Milk (lbs/cow/day)

Days after calving

Conception risk

Some key assumptions

Herd ME milk: 11,215 kg

21-d service risk: 55%

Conception risk: max 35%

Breeding cost: $20/breeding

Heifer price : $2000

Calf price: $300

Cull price: $88/100 kg

Milk price: $40/100 kg

Feed cost, lact: $26/100 kg DM

Feed cost, dry: $11/100 kg DM

+ lots of other reasonable inputs …

Optimal breeding and replacement decisions
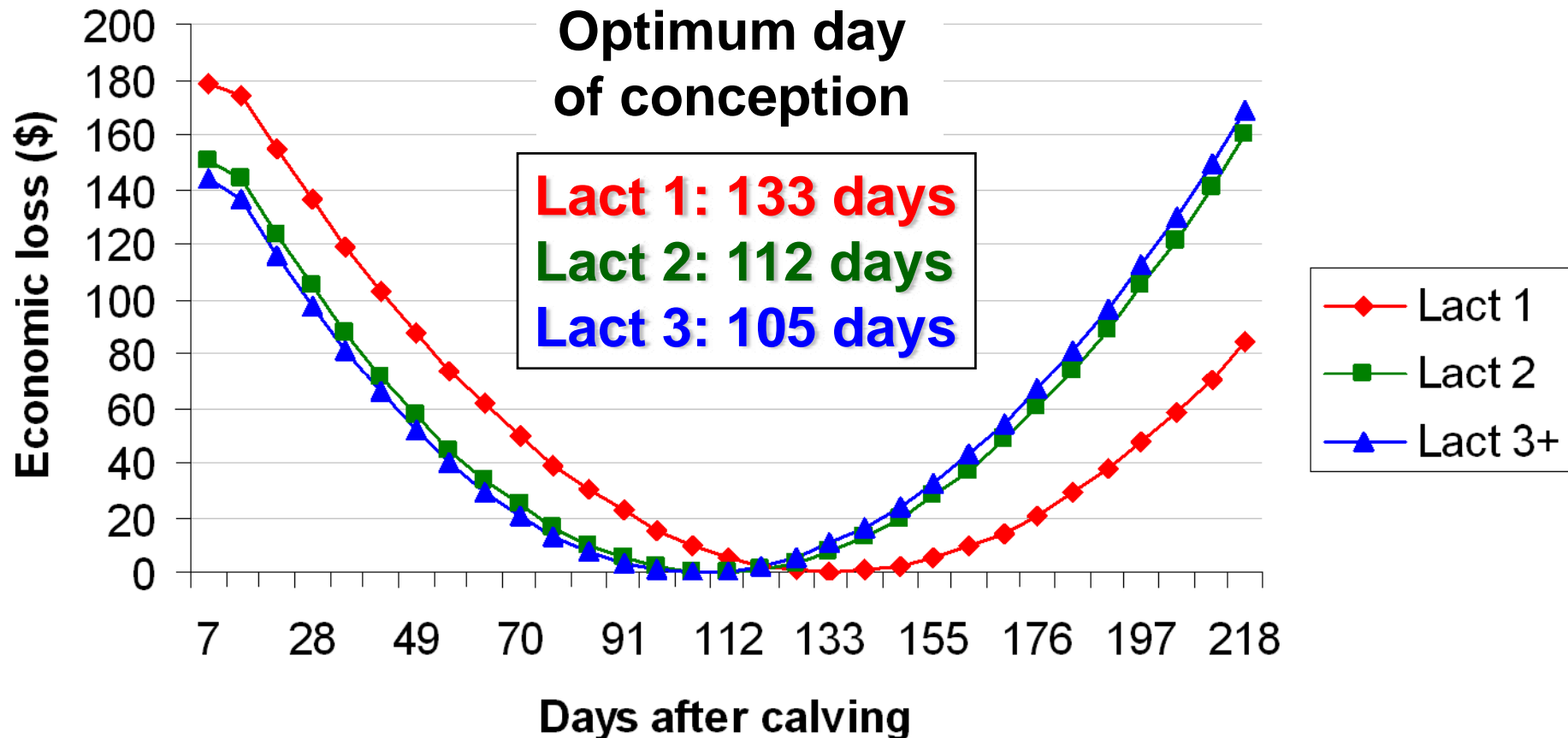
Steady-state results

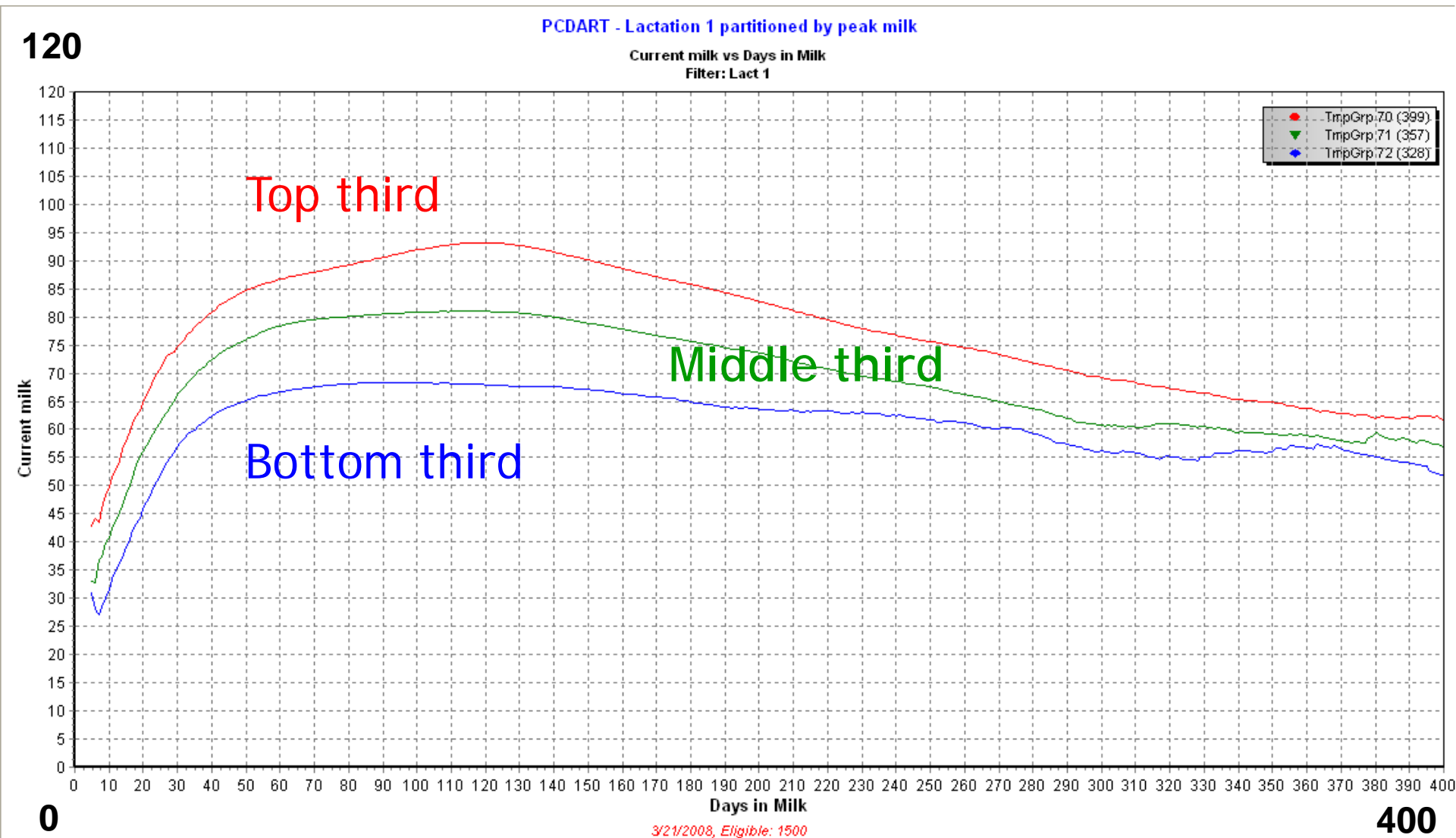|	Per slot per year	Per 100 kg
Milk sales	4621	39.60
Cow sales	114	0.97
Calf sales	299	1.98
Feed cost	1999	17.14
Heifer purchase cost	617	5.28
Breeding cost	59	0.51
Labor cost	587	5.04
Other cost	1214	10.41
Net return	557	4.77
Annual cull rate	31%	

Optimal days to conception

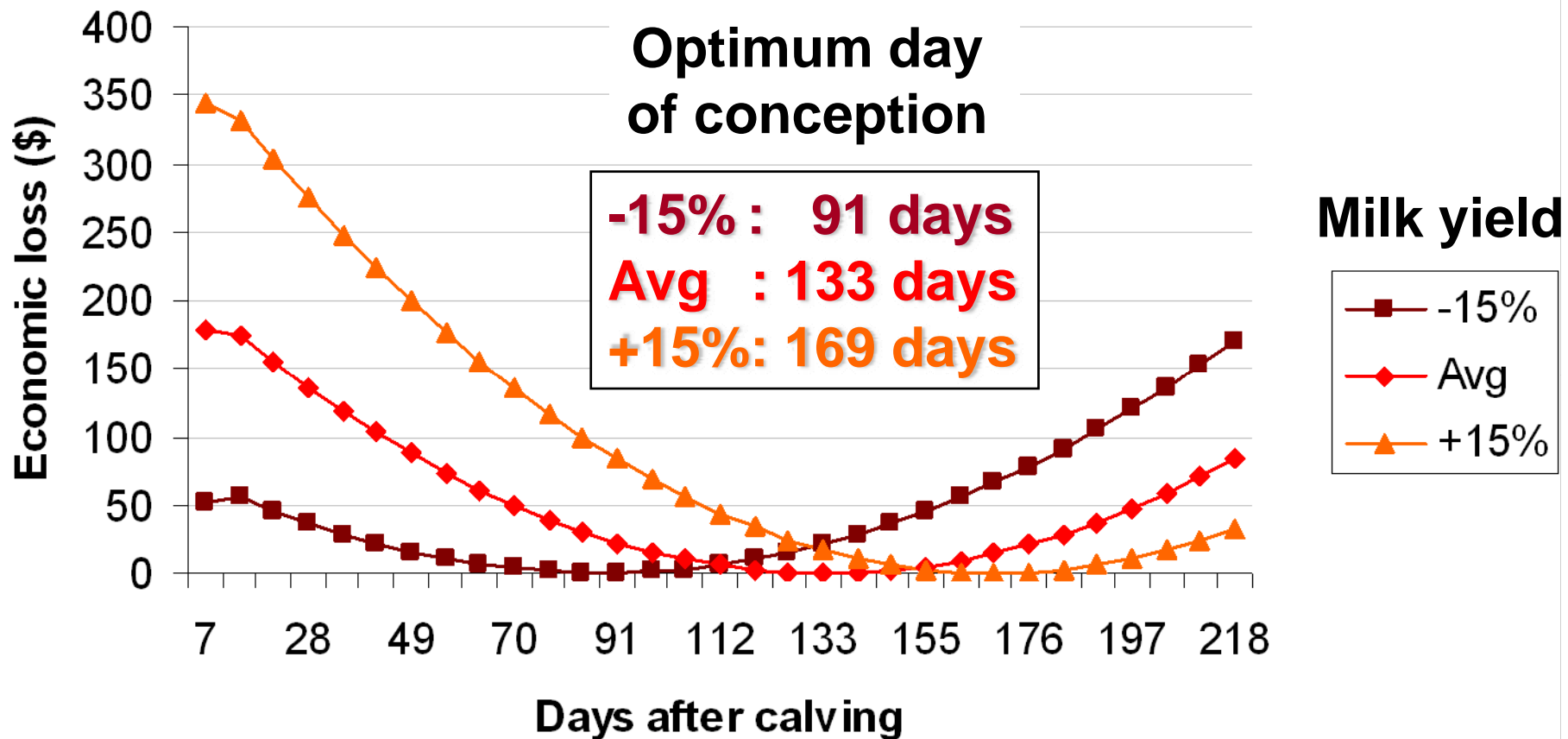# Economic loss by day of conception

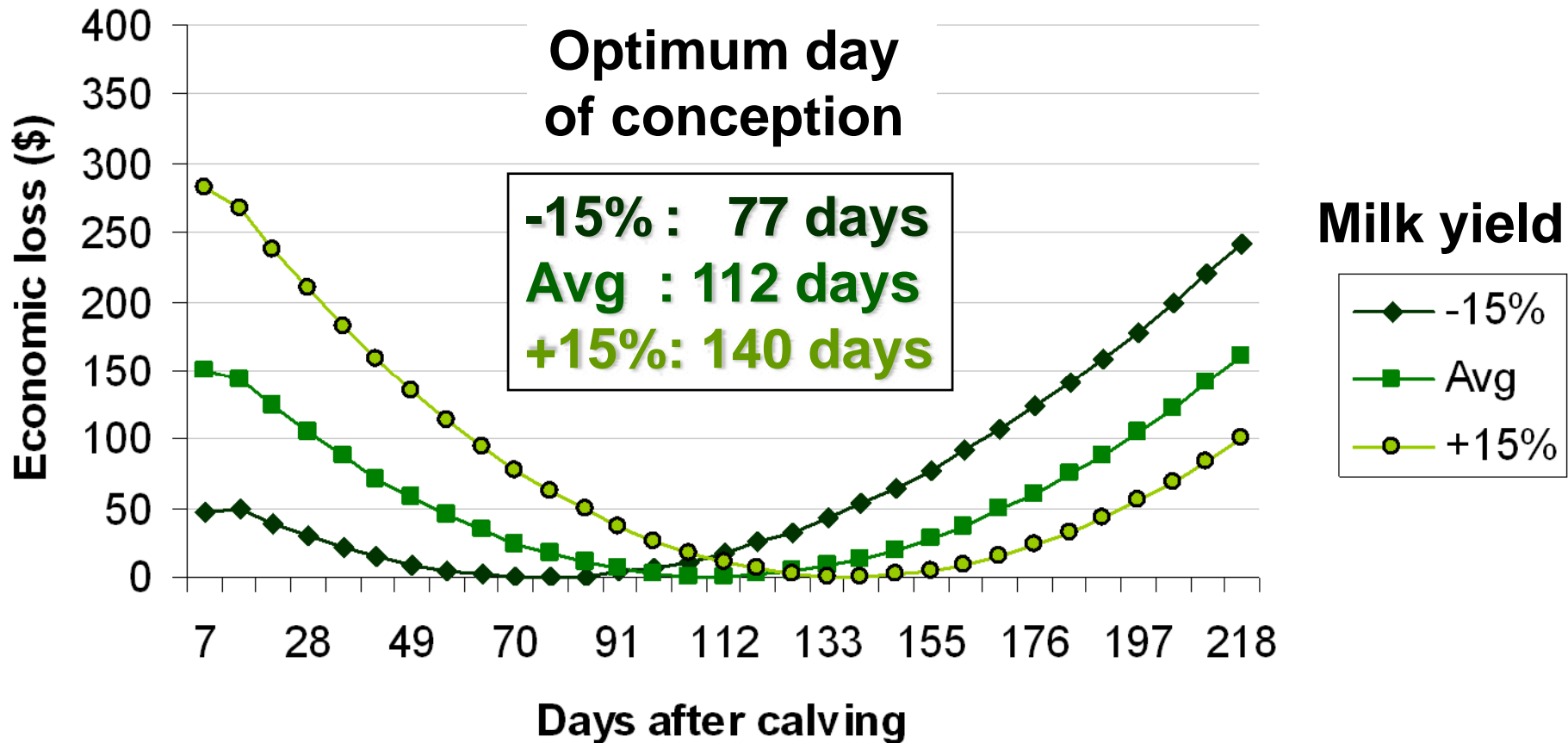# Lactation 1 – partitioned by peak milk
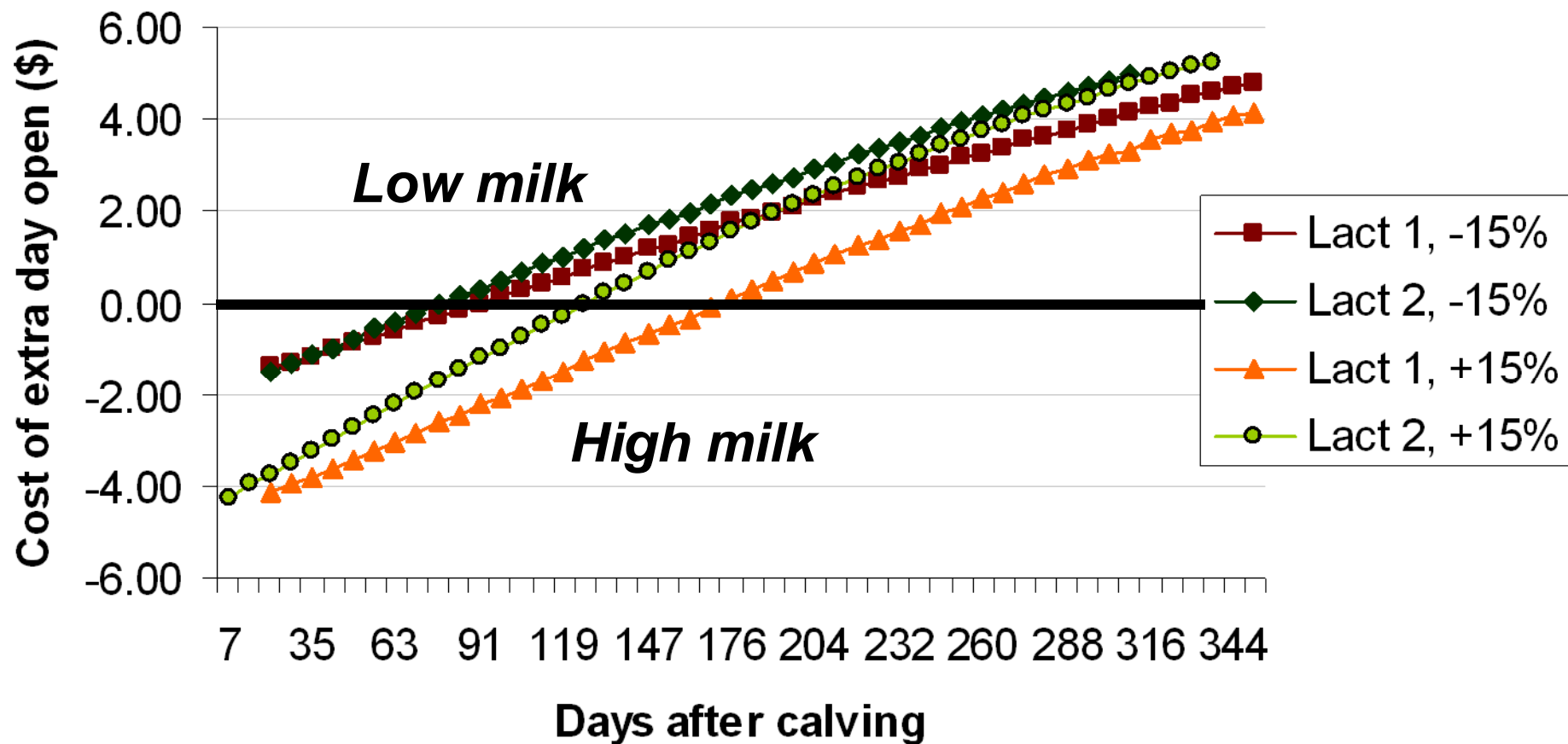
Economic loss by day of conception
Lactation 1

Economic loss by day of conception
Lactation 2

Cost of an extra day open
Level of milk production

Start of the breeding period

VWP survey of 4000 herds in USA

VWP = voluntary waiting period
   = interval from calving to start of breeding period
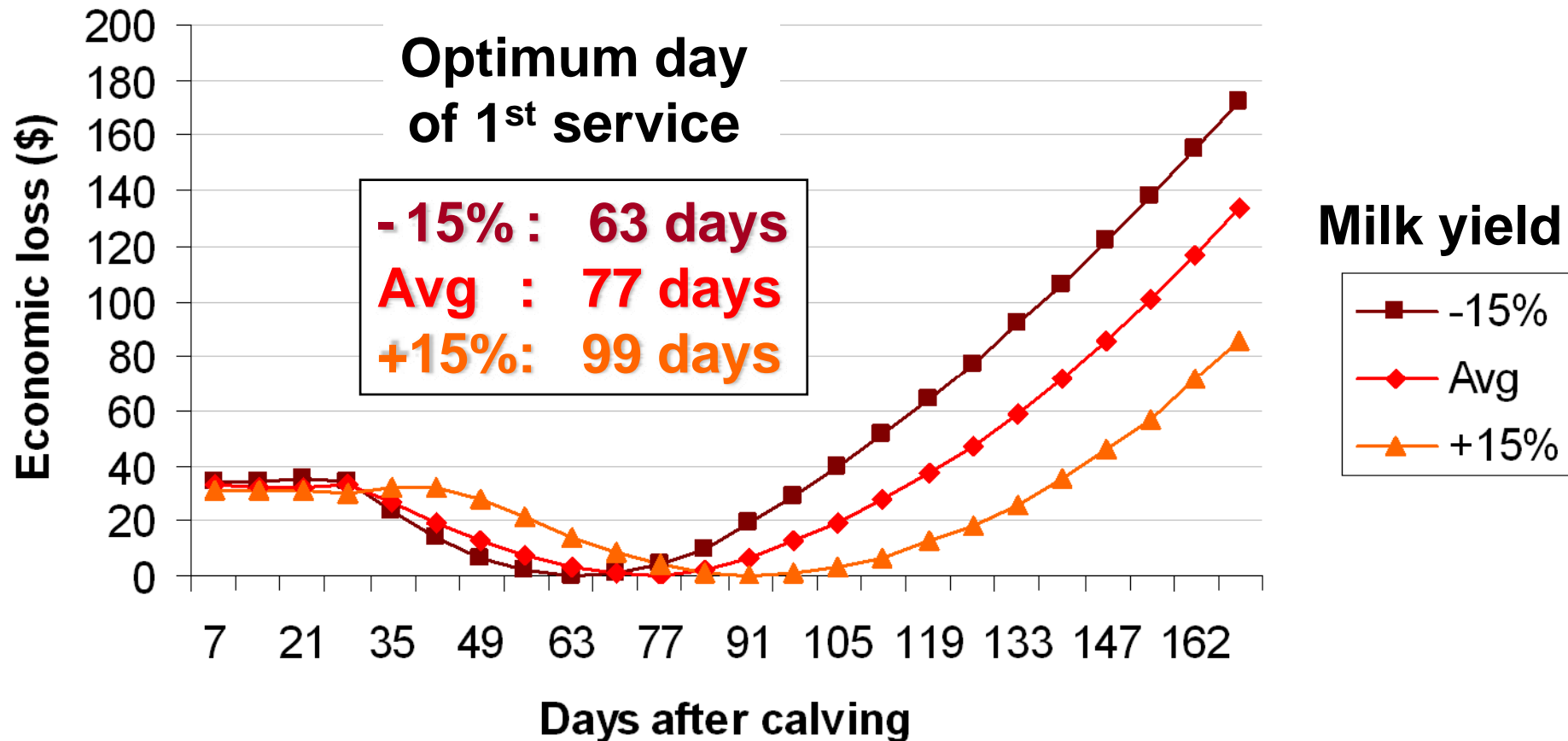- Average VWP 56 days, days to first service 86 days

64% of respondents changed VWP based on:
- Post partum health (50%)
  - Delay if difficult birth or post partum metabolic disease
- Season (18%)
  - 78% avoid breeding and/or calving in summer
- Milk yield (18%)
  - Delay high producing group
- Lactation number (14%)
  - 65% longer VWP first lactation, 35% longer VWP later lactations
- Other reasons (14%)
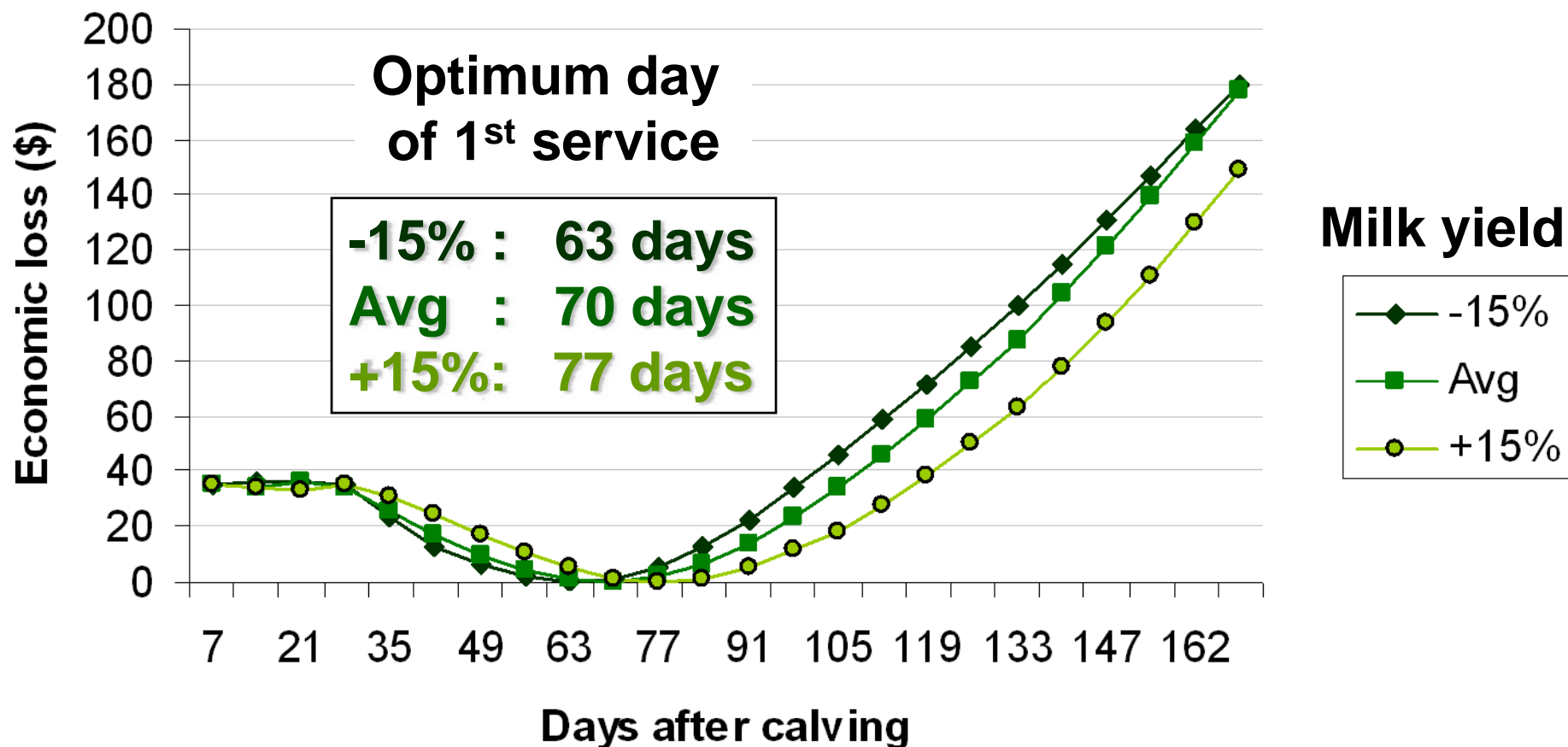 - Body condition score

DeJarnette et al., 2007

Economic loss by day of 1ˢᵗ service
Lactation 1

Optimum day of 1ˢᵗ service

- 15% :   63 days
Avg   :   77 days
+15% :   99 days

Economic loss ($) vs Days after calving

Milk yield
- -15%
- Avg
- +15%

Economic loss by day of 1ˢᵗ service
Lactation 2

Insemination value

Future cash flow: **breed** now + keep cow until optimum time of culling, then replace with heifer
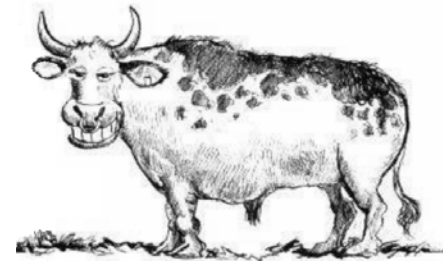
Future cash flow: **do-not-breed** now + keep cow until optimum time of culling, then replace with heifer
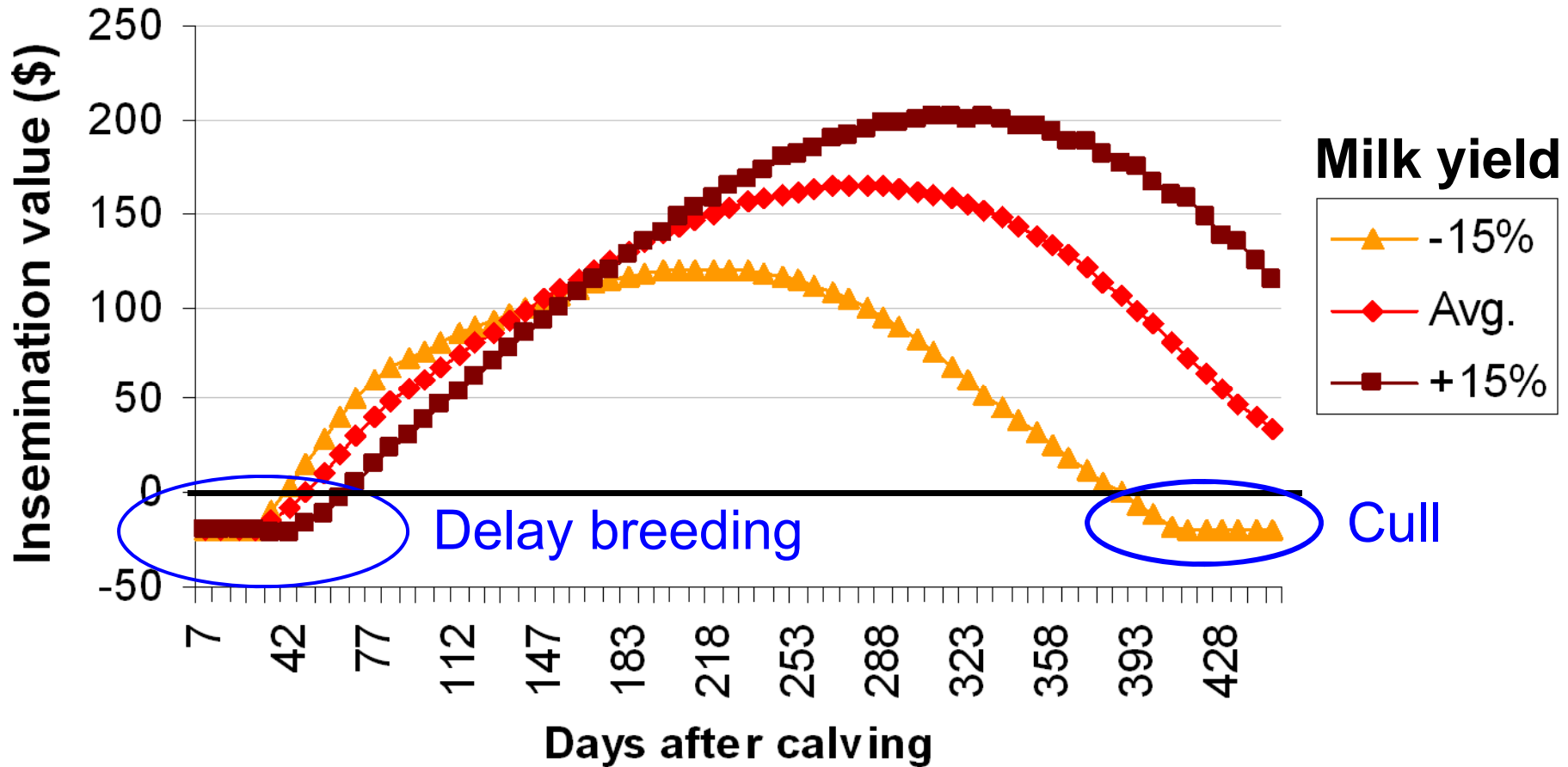
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Insemination value

Insemination value > $0 → breed cow

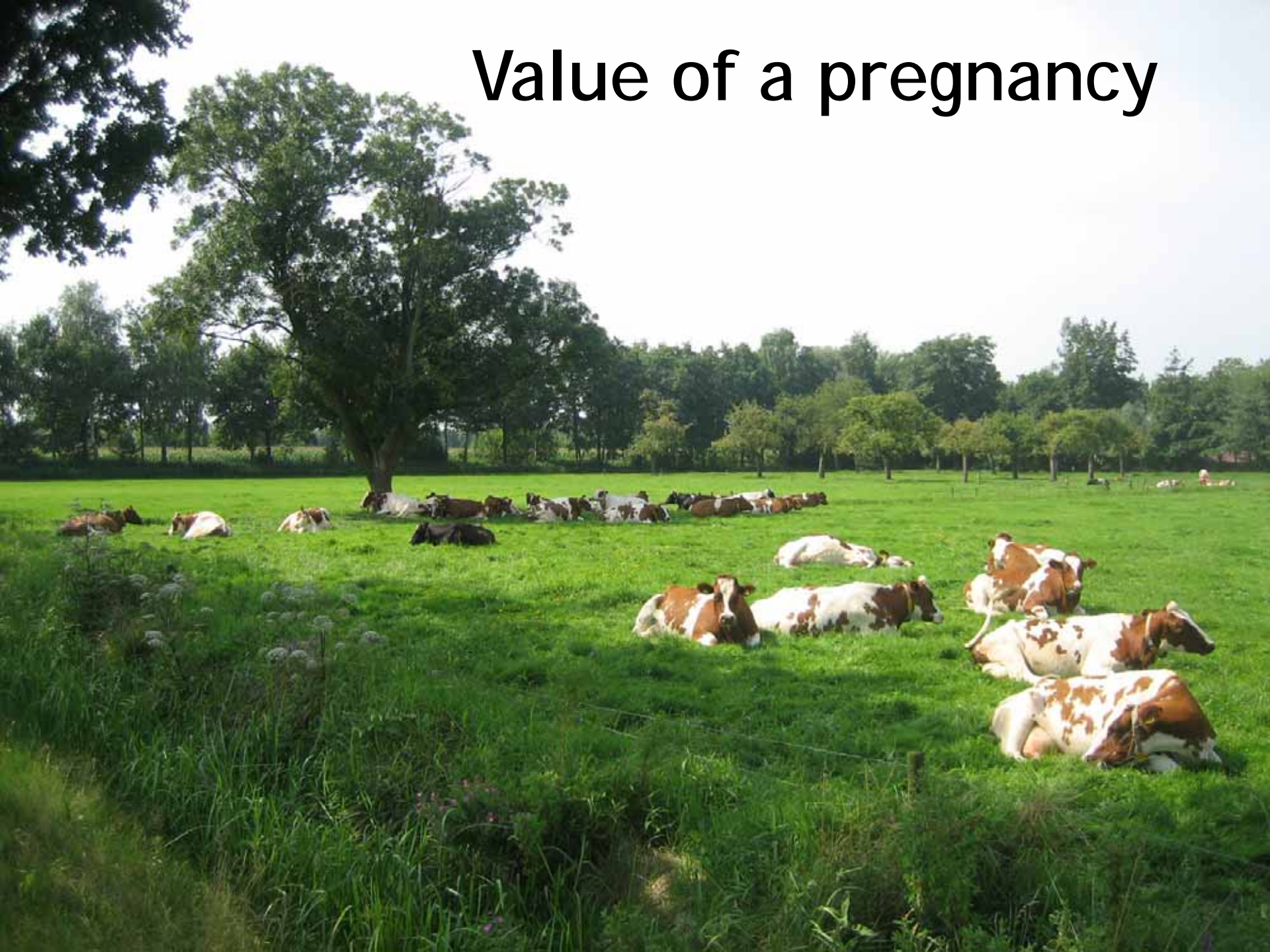Insemination value < $0 → do not breed cow

When is the next breeding opportunity?

Insemination value (lactation 1)

Value of a pregnancy

Value of a pregnancy

Future cash flow: **pregnant** cow + keep cow until
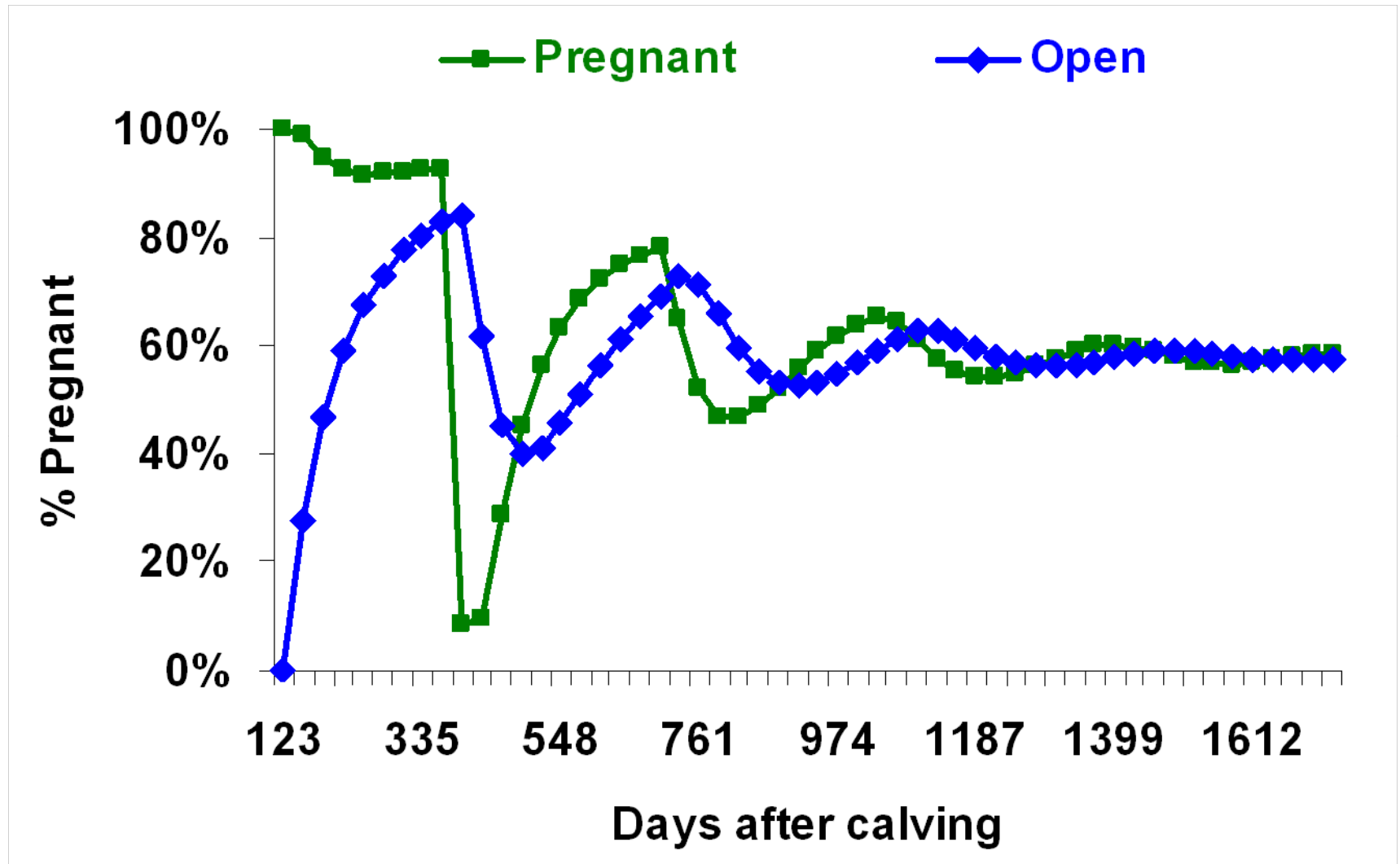optimum time of culling, then replace with heifer

Future cash flow: **open** cow + keep cow until
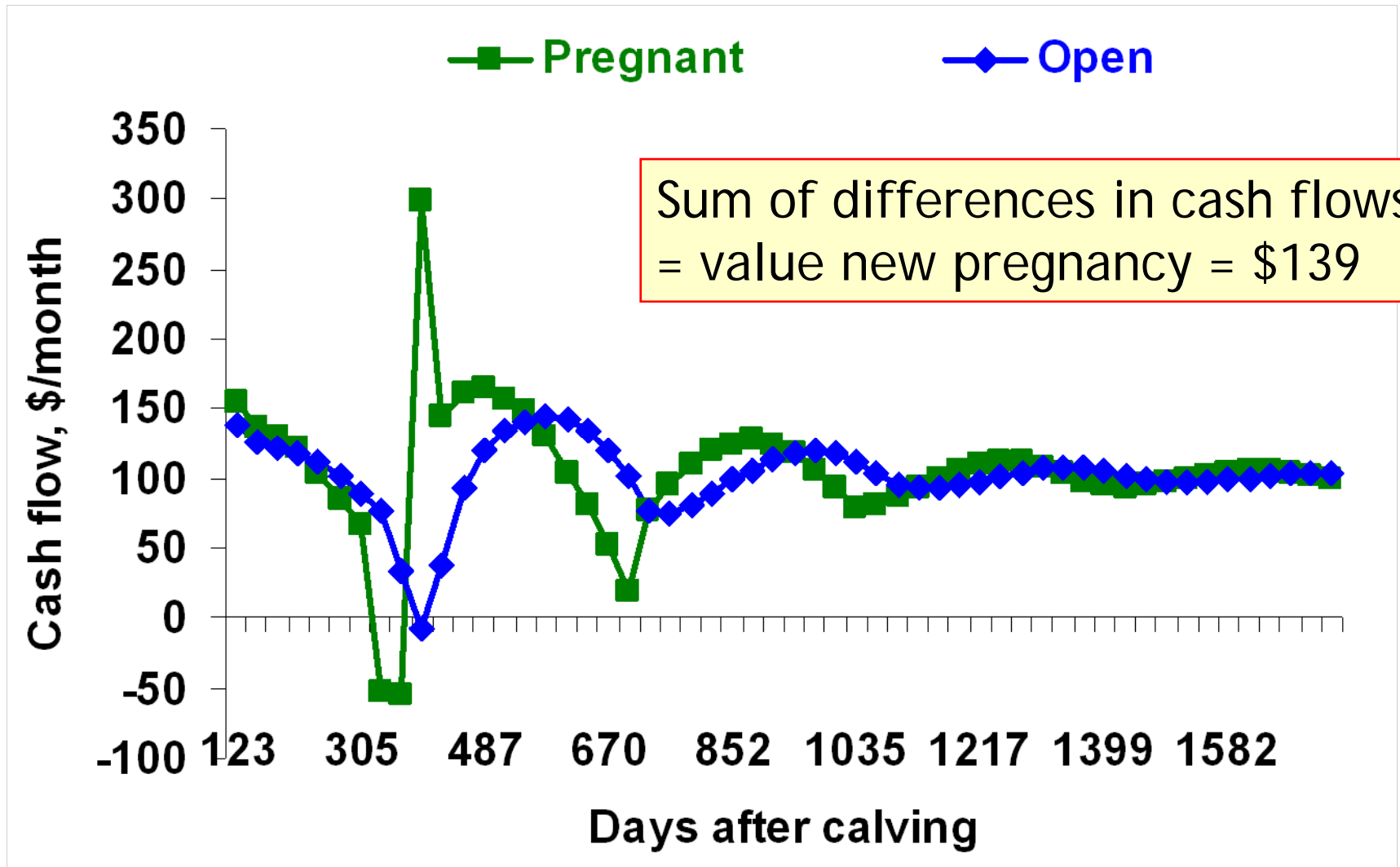optimum time of culling, then replace with heifer

−

Value of pregnancy

Risk of pregnant cow in slot

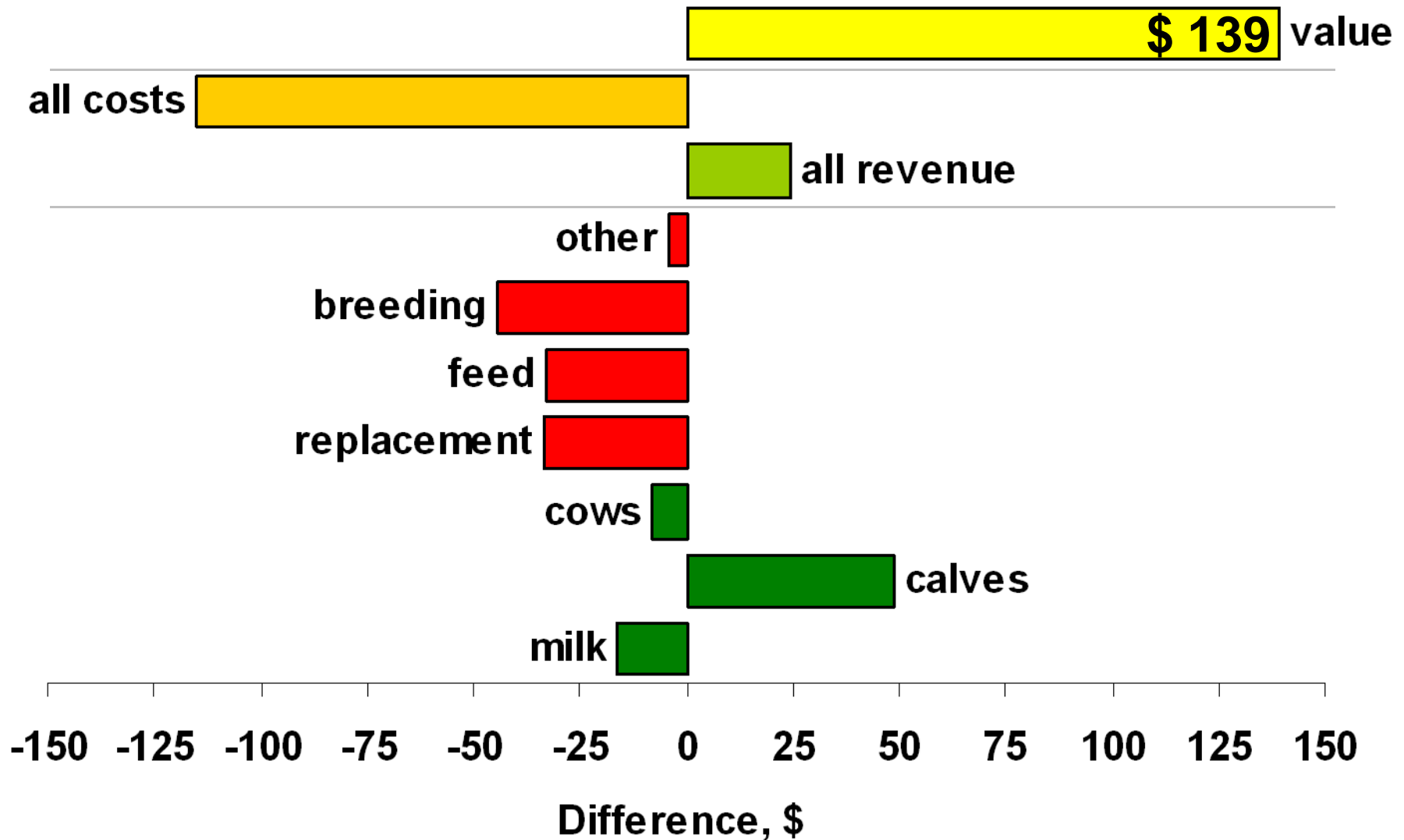Example: day 123 after calving, 1st lactation, average cow

Cash flow of slot

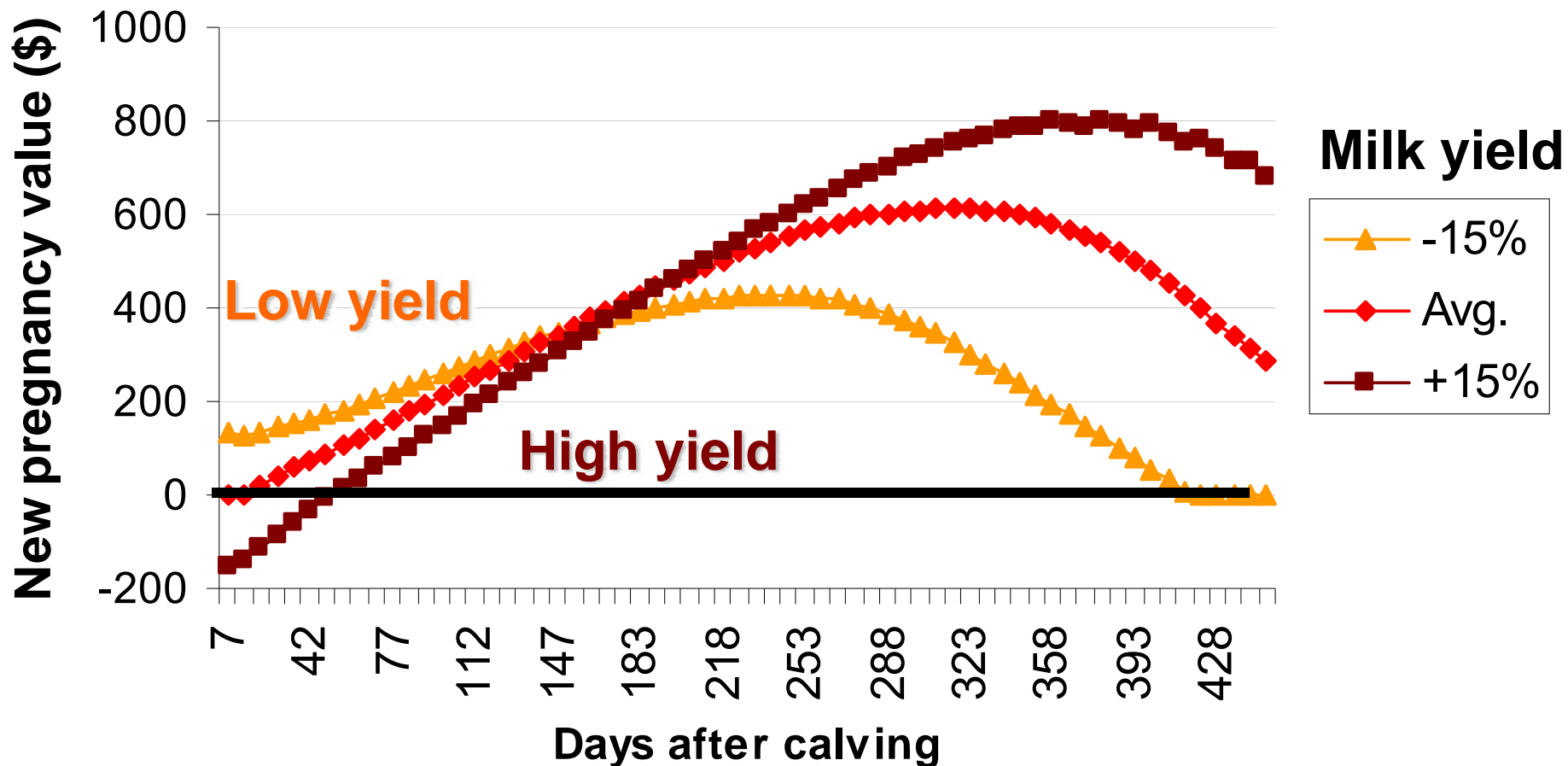Example: day 123 after calving, 1st lactation, average cow

Partitioning the value of new pregnancy
Day 123 after calving, 1st lactation, average cow

$ 139	value
all costs	
	all revenue
other	
breeding	
feed	
replacement	
cows	
	calves
milk	

-150 -125 -100 -75 -50 -25 0 25 50 75 100 125 150
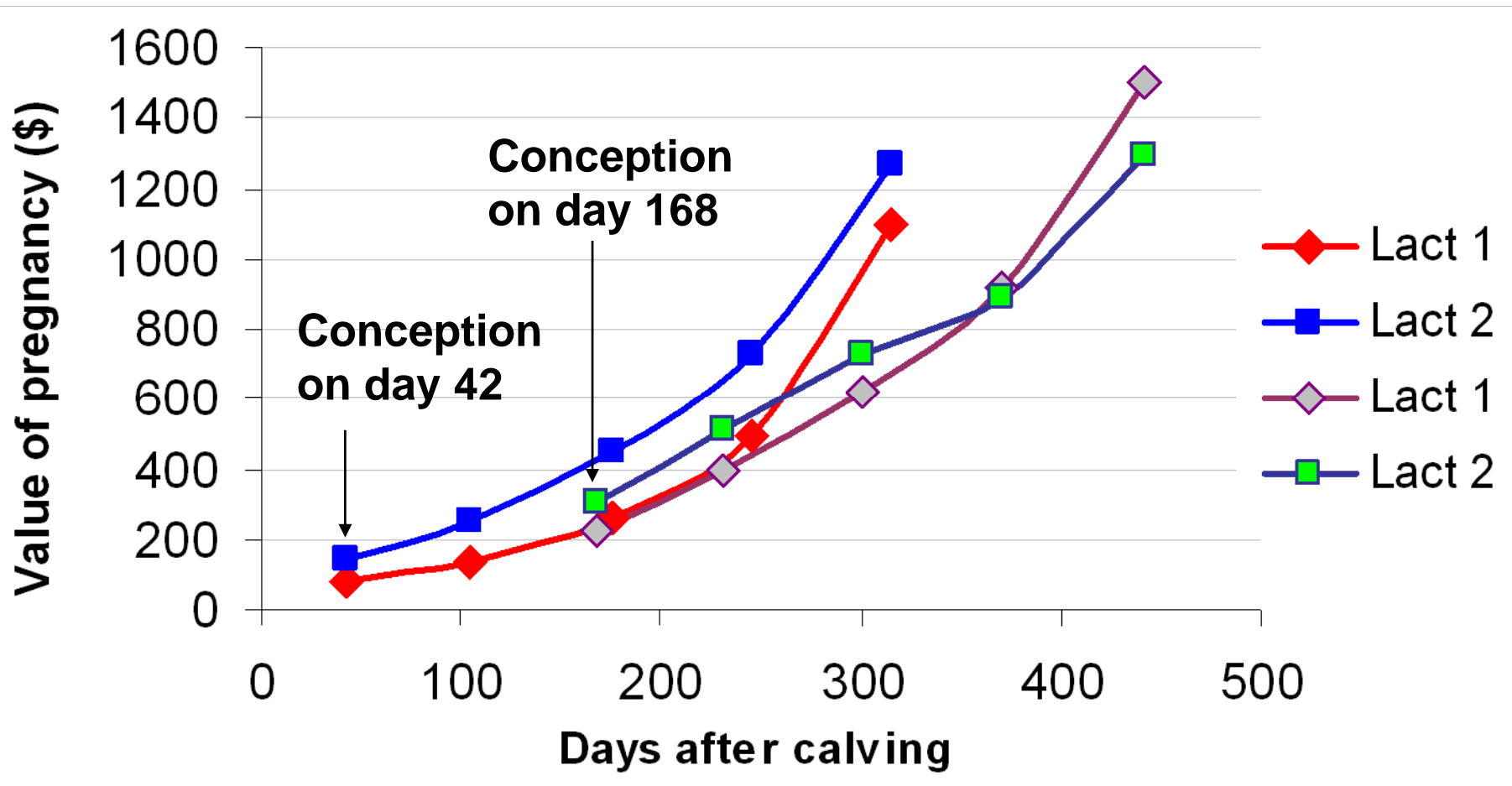
Difference, $

New pregnancy value (lactation 1)

Loss of pregnancy Abortion

Value of pregnancy by
time of conception (day 42, 168) and
stage of gestation (days 1, 64, 134, 204, 274)

On-farm decision making

Example: University of Florida Dairy Research Unit herd

August 22, 2007

Milking 449 cows

Goal

Every day, for each cow, provide a list of parameters to support decisions making:

- Retention value
- Insemination value(s)
- Pregnancy value
- Cost of day open
- Optimal day of conception
- Income over feed cost

- Cull value
- Time left in breeding period
- Risk of culling in lactation
- Dry-off value
- Treatment values
- ...

Cow 5263 on 8/22/2007

Date:	8/22/2007
Cow:	5263
Lact.:	1
Current DIM:	377
Milk (lbs):	62
Status:	Bred
DIM last bred:	358
Insemination value:	$31
Pregnancy value:	$351
Retention value:	$1825

Dry-off if pregnant

Calving if pregnant
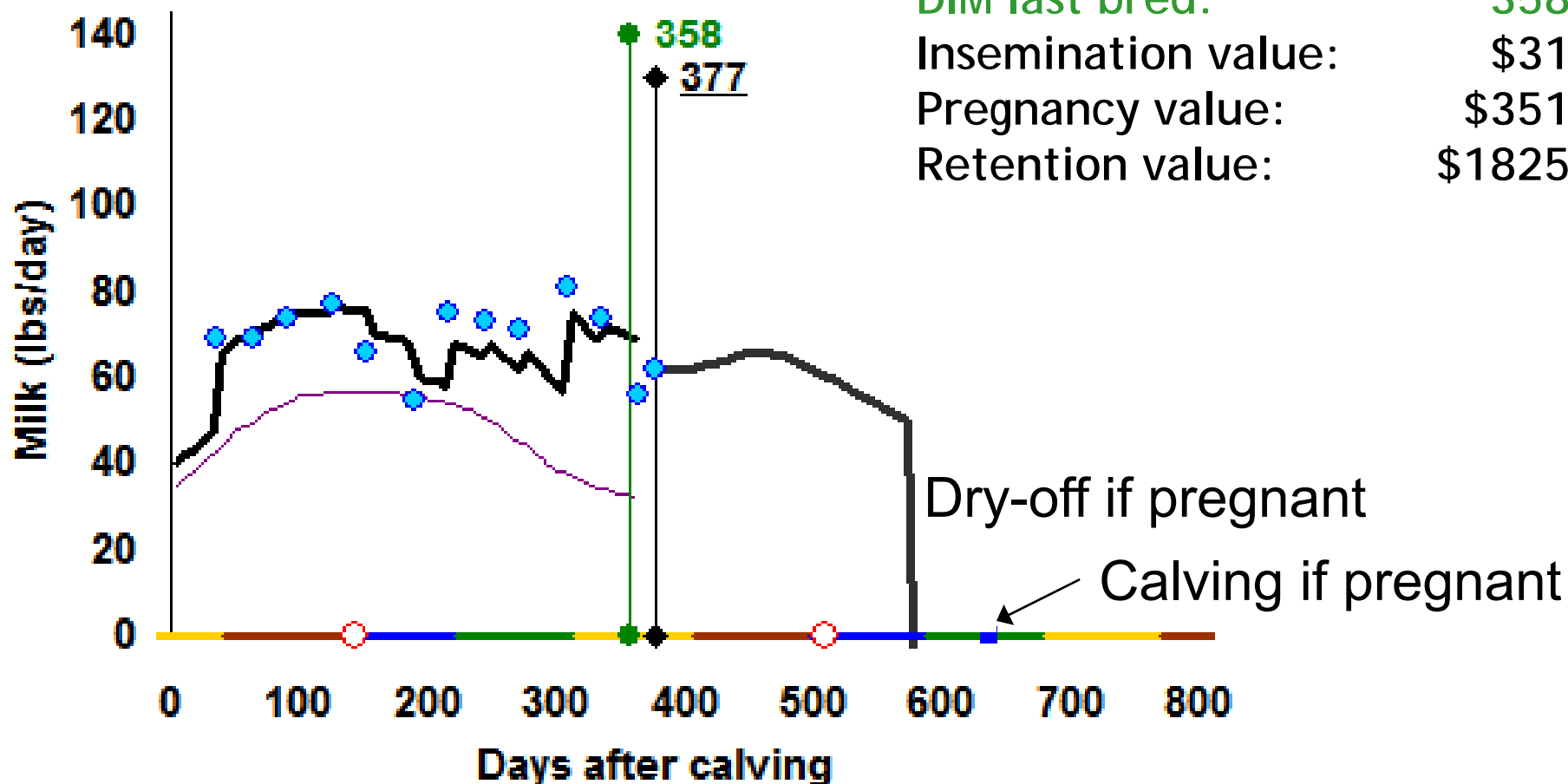
Cow 4825 on 8/22/2007

Date: 8/22/2007
Cow: 4825
Lact.:   3
Current DIM: 363
Milk (lbs):   27
Status: Open
DIM last bred: 246
Insemination value: -$15
Pregnancy value: $0
Retention value: $27
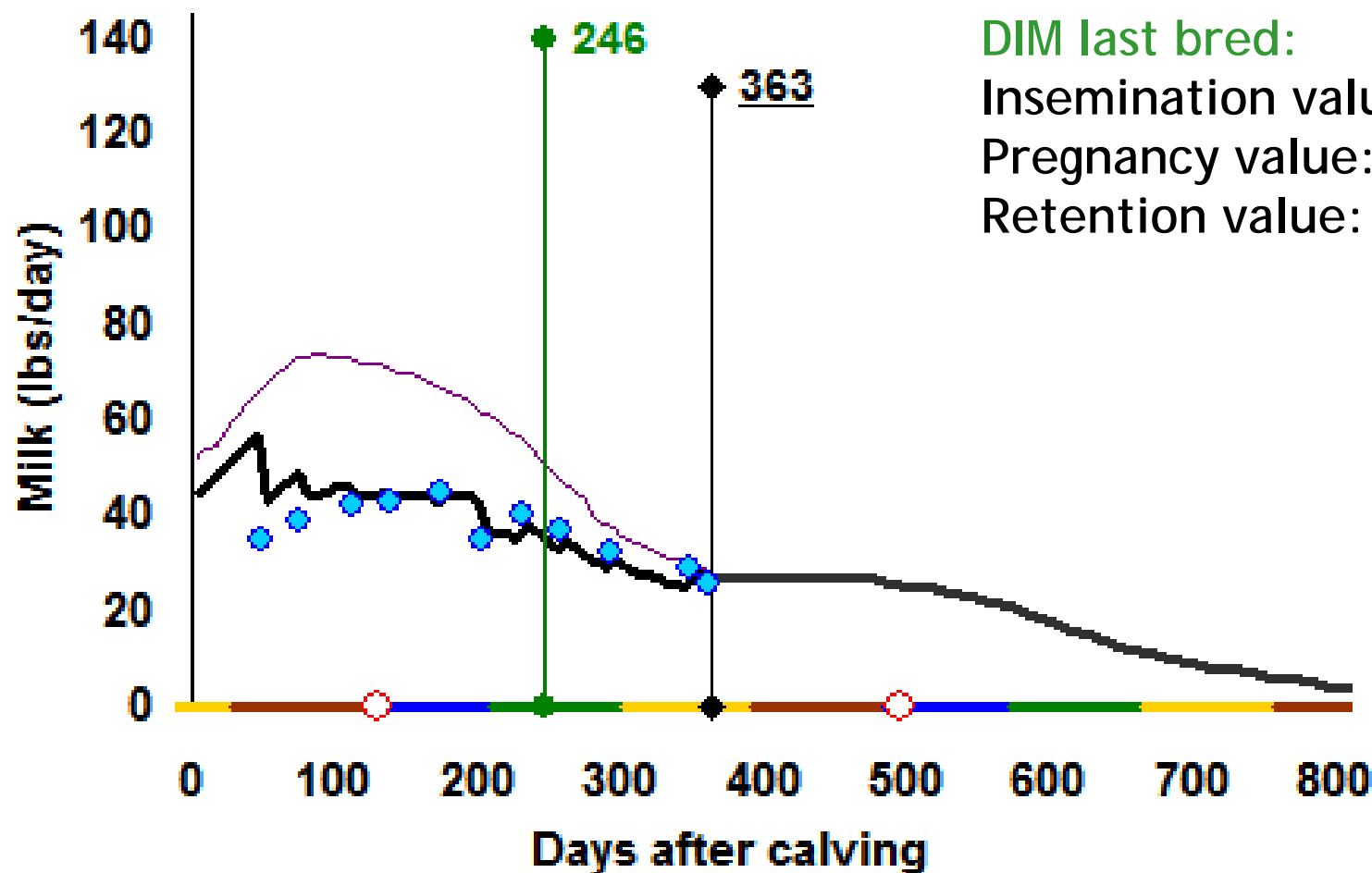
Thank you

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