

# When to Use Gender-Biased Semen: Economics

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1 Victor E. Cabrera, DCRC Nov. 13-14 & 19-20, 2009



# Introduction

- **Gender-biased = sexed-semen = sex-sorted semen**
- **Sexed semen = ↑ Female Calf Ratio**
- **Sexed semen economically attractive**
- **Sexed semen = ↓ Fertility**
- **Consequently, sexed semen has an increased proportion of females, but with a lower CR**

# Introduction

- **Decision should be based on careful economic analysis**
- **A number of other factors impact the economics**
- **Sexed semen could be used with any open cow**
- **However, it seems to be more appropriated for virgin heifers**
- **Wisconsin dairy producers are using it with virgin heifers in first and second services**

# Objectives

- **Propose a methodological framework to evaluate systematically the economics of sexed semen**
- **Document the latest biological and economic parameters to perform the evaluation**
- **Assess the economic value of sexed semen on heifers**
- **Transform the analysis framework into a user-friendly decision support system**

- **Partial budgeting of survival curves using net present values (NPV) to estimate the economic value (EV) of sexed semen programs**
- **Partial budgeting = additional revenues, additional costs, revenues foregone, reduced costs**
- **NPV = Fair comparison between conventional sexed semen programs**
- **EV = Difference of sexed and conventional semen**

- **Assumption 1: The reproductive program starts on 14-mo old heifers (420 d age)**
- **Assumption 2: Producers will attempt up-to 5 consecutive reproductive services on virgin heifers (Kuhn et al., 2006)**
- **Treatments: Sexed semen used in 1, 2, 3, 4, and 5 consecutive services.**
- **Control: Conventional semen**



- Calculation of the EV:

$$EV = NPV(X) - NPV(NX)$$

- Calculation of the NPV:

$$NPV = \sum_{s=1}^5 (\delta_s)(NPV_s) + (\delta_5)(HC - HR)(1 - PP_5)$$

**HC = heifer cull value; HR = value of a 20-mo pregnant heifer;  $PP_5$  = proportion of pregnant heifers after the fifth service,  $\delta$  discount**

- Calculation of the NPV after each service:

$$NPV_s = CR'_s * (CV - DC) - (1 - PP_s) * MC - AIC$$

**CR'** = conception rate achieved in service *s*

**CV** = Calf value dependent on heifer sex ratio

**DC** = Estimated dystocia cost

**MC** = Non-pregnant heifer maintenance

**AIC** = Cost of semen dose



- Survival curves calculated by conditional probabilities:

$$PP_1 = CR'_1 = CR_1$$

$$PP_s = PP_{s-1} + (1 - PP_{s-1}) * CR_s \quad \text{for } s = 2 \text{ to } 5$$

$$CR'_s = PP_s - PP_{s-1} \quad \text{for } s = 2 \text{ to } 5$$

- Concept of “Overall EV” :

$$\text{Overall EV} = \left( \sum_{t=1}^5 \sum_{CR=1}^3 EV_{t,CR} \right) / (5trt * 3CR)$$

# Reproductive Parameters

- **Conventional CR : 34% (low), 56% (avg.), 83% (high)**  
(DeJarnette et al., 2009)
- **Sexed semen CR: 80% of the conventional semen**  
(DeJarnette et al., 2009)
- **Decrease in CR: 2.5% points additional service**  
(Kuhn et al., 2006)
- **Conv. heifer calf rate: 46.7%** (Silva del Rio et al., 2007)
- **Sexed semen heifer calf rate: 89%** (DeJarnette et al., 2009)

# Economic Parameters

- **Premium paid for sex-sorted semen dose: \$30**  
(Olynk and Wolf, 2007)
- **Female/Male calf value: \$562 / \$48** (Wisconsin  
USDA Market Report, 2008)
- **Dystocia cost: \$28.53**  
(Dematawewa and Berger, 1997)
- **Male/Female dystocia cost: 1.57, \$ 34.91 / \$ 22.15**  
(Martinez et al., 1983)



# Other Economic Parameters



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	Conventional and Sexed Semen	Source
Maintenance (\$/d)	2.4	Zwald et al., 2007
Weight of a 20-mo non-pregnant heifer (kg)	505	NRC, 2001
Salvage value of 20-mo non-pregnant heifer (\$/kg)	1.79	Wisc. USDA (2008)
Value of 20-mo pregnant heifer (\$)	1,200	Wisc. USDA (2008)
Interest rate (%/yr)	12	

# Analyses

- **Calculation of Overall EV for baseline conditions**
- **Break-even**
- **Sensitivity**
- **Scenarios**
- **Optimal treatment**

# Results & Discussion

- Sexed semen justified for the first service for any CR (Overall EV = \$30.10/heifer)

Reproductive Program (Number of Sexed Semen Services)	Low CR (34 %)	Average CR (56 %)	High CR (83 %)	Conventional CR for positive EV %
	EV \$/heifer			
1	6.5	49.3	100.0	31
2	-3.4	57.8	111.6	36
3	-23.1	46.4	96.1	41
4	-48.9	24.7	71.7	48
5	-78.5	-2.7	43.9	58

# Results & Discussion

Scenario	Over- all EV (\$/hfr)	Break- Even CR* (%)	Number of Consecutive Services Positive EV		
			Low CR (34%)	Average CR (56%)	High CR (83%)
Baseline	30.10	31	1	4	5
X Semen CR at 85 %	46.40	31	2	5	5
X Semen CR at 75 %	12.50	36	0	4	5
X Semen 95 % heifer ratio	52.40	27	2	5	5
X Semen 78 % heifer ratio	-10.90	41	0	3	4
Male calf value at \$0	45.20	28	2	5	5
Female calf value at \$700	69.30	25	3	5	5
Female calf value at \$280	-50.10	59	0	0	2
Premium X semen at \$40	1.1	37	0	3	4
Premium X semen at \$20	59.1	26	3	5	5
Dystocia cost at \$42.8	32.40	30	1	5	5
Dystocia cost at \$14.27	27.70	31	1	4	5

\* Required CR for positive EV with 1 X semen service



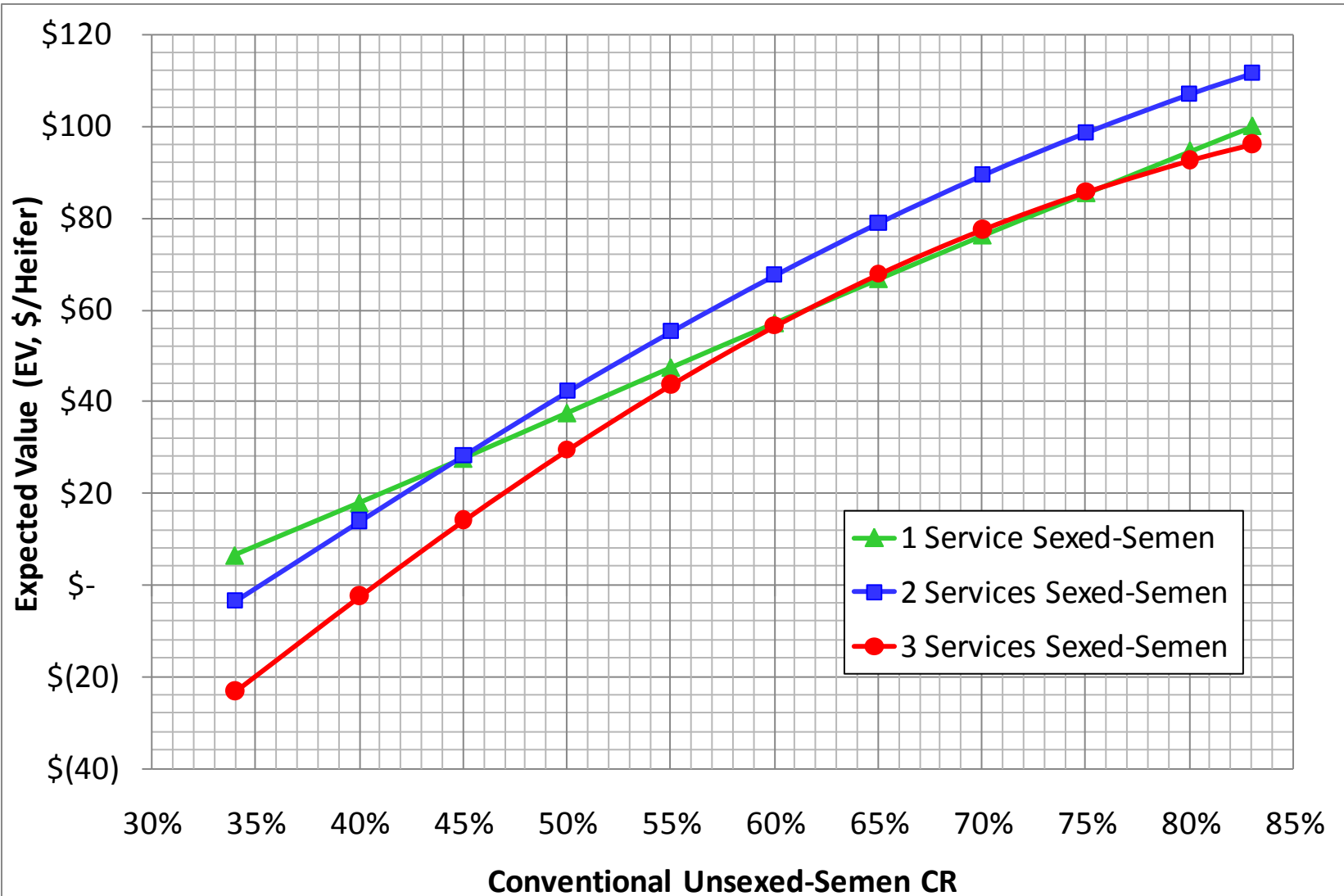


# Results & Discussion



Scenario	Number of Services with Positive and Maximum Expected Value (EV)		
	Low CR (34 %)	Average CR (56 %)	High CR (83 %)
Baseline	1	2	2
1) X Semen CR at 85 %	1	2	2
2) X Semen CR at 75 %	None	2	2
3) X Semen to have 95 % heifer Calves	1	2	2
4) X Semen to have 78 % heifer Calves	None	1	1
5) Male calf value at \$0	1	2	2
6) Female calf value at \$700	1	2	2
7) Female calf value at \$280	None	None	1
8) Dystocia cost at \$42.8	1	2	2
9) Dystocia cost at \$14.27	1	2	2
10) X semen premium \$40	None	1	2
11) X semen premium \$20	1	2	2
1) and 3)	2	2	2
3) and 6)	2	2	2
1) and 6)	2	2	2
1) and 3) and 6)	2	3	2
1) and 3) and 6) and 11)	3	3	2
2) and 4)	None	1	1
4) and 7)	None	None	1
2) and 4) and 7)	None	None	None

# Results & Discussion



# Results & Discussion

- **Maintenance cost (\$2.4/d): -\$1/+\$0.1**
- **Salvage value (\$1.79/kg): -\$1/+\$0.1**
- **Pregnant heifer value (\$1,200): -2.84/+\$100**
- **Dystocia cost (\$28.53): +\$1.44/+\$10**
- **Premium of sexed semen (\$30): -\$14.50/+\$5**
- **Discount rate (12%): -\$0.1/+10%**

# Conclusions

- **Gender-biased or sexed-semen has a higher economic value than conventional semen**
- **The single most important factor is the current or expected conventional semen heifer CR:**
  - **If the CR is between 31 and 44%, the optimal is to use sexed-semen for only first service**
  - **If the CR is above 44%, the optimal would be to use sexed-semen for the 2 first services**

# Conclusions

- **Other important parameters in the decision: CR of sexed-sexed semen (+); expected proportion of female calves (+); female calf value (+); premium of sexed-semen (-)**
- **Other parameters will only have limited impact on the decisions**

# Conclusions

- **Some other considerations:**
  - **Greater incidence of stillbirths**
  - **Longer gestation period**
  - **Faster genetic improvement possibilities**
  - **Implications for farm herd expansion**
  - **Decreased bio-security risks**
  - **Implications for US herd expansion**

# Decision Support Challenge

- **Results not applicable for all farm and market conditions**
- **Every farm is different**
- **Market conditions are permanently changing**
- **Challenge: Provide the same analysis as a decision support system for practitioners or final users**
- **Spreadsheets are good and popular, but sometimes could deter users for a series of reasons**



# Decision Support Challenge

- **Decision support system should be:**
  - **Visually attractive**
  - **Interactive**
  - **Robust**
  - **Preferably online**
  - **Self-contained**
  - **Scenario-driven**
- **Decision support system should have:**
  - **Secured calculations. Users characterize their situation by defining parameters**
  - **Clear instructions**
  - **Technical support available**



# Decision Support Challenge



# Thanks

**Welcome to Dairy Management UW-Extension**

This 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.

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**Some Active Projects**

- Successes for Small Beginning Dairy Farmers
- Strategies of Pasture Supplementation on Organic and Conventional Grain-Dairy: Assessment of Economic, Production and Environmental Outcomes
- Assessment of Gross Margin Insurance versus Traditional Price Risk Management Strategies under Alternative Biofuels and Predicted Climatic Conditions: Implications for Wisconsin Dairy Farms
- Development of a Dairy Economic Decision Support System for Wisconsin

**Opportunities in Dairy Cattle Management**

- Student, intern, and postdoc positions available

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**Additional Personal Information about Dr. Cabrera**

University of Wisconsin - Extension  
Dairy Team News  
Read about the latest local herd studies, find out what dairy people are talking about, join in the conversation, and more...

**Dairy Decision Management Tools**

**Dairy Ration Feed Additive Breakeven Analysis**

Estimates the breakeven milk production needed to pay for a ration ingredient

Flash Online Tool (Play)  
Documentation (Download)

**Optigen® Evaluator**

Calculates the economic value of using Optigen® with lactating cows. Optigen® replaces a user-defined source of protein and adds a user-defined source of energy.

HTML Online Tool (Open)

**Cost-Benefit of Accelerated Liquid Feeding Program for Dairy Calves**

Evaluates the use of accelerated heifer feeding programs with respect to conventional feeding programs

Flash Online Tool (Play)  
HTML Online Tool (Open)  
Documentation (Download)  
Demonstration (See)

**Economic Analysis of Switching from 2X to 3X Milking**

Estimates the economic benefit (or loss) of a change in the milking frequency from 2 times a day (2X) to 3 times a day (3X) based on user-defined parameters

Flash Online Tool (Play)  
Flash Demonstration (Download)  
Documentation (Download)

**Economic Value of Sexed Semen Programs for Dairy Heifers**

Estimates the difference of the net present value of various sexed semen reproductive programs and a conventional semen reproductive program

Flash Online Tool (Play)  
Documentation (Download)  
Demonstration (See)

**Income over Feed Supplement Cost**

Maximizes the income over feed supplement cost (IOFSC) for a fixed amount of forage used in the diet and graphs the IOFSC to a substitution of two selected feed supplements

Excel Spreadsheet (Download)

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