



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 = \uparrow Female Calf Ratio**
- **Sexed semen economically attractive**
- **Sexed semen = \downarrow 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**



Methodological Framework



- **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**



Methodological Framework



- **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**



Methodological Framework



- 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, δ = discount



Methodological Framework



- 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



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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



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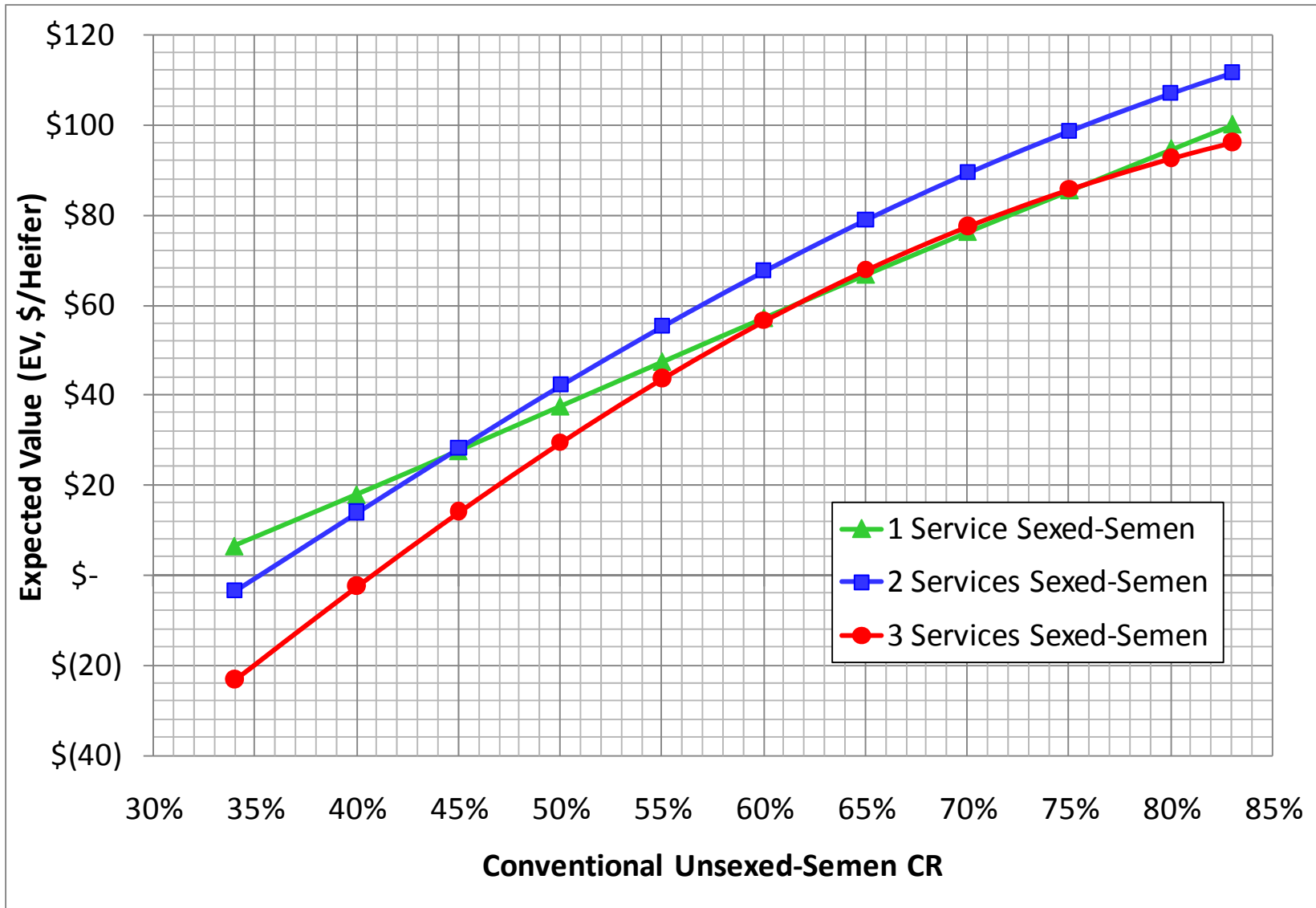
Scenario	Number of Services with Positive and Maximum Expected Value (EV)		
	Low CR (34 %)	Average CR (56 %)	High CR (83 %)
Baseline	1	2	2
1) X Semen CR at 85 %	1	2	2
2) X Semen CR at 75 %	None	2	2
3) X Semen to have 95 % heifer Calves	1	2	2
4) X Semen to have 78 % heifer Calves	None	1	1
5) Male calf 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



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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



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Economic Value of Sexed Semen Programs for Dairy Heifers

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1. Conception Rates (CR)

1.a. Conventional Semen CR (%)

Low CR	34
Average CF	56
High CR	83

1.b. Sexed Semen CR (% of Conventional CR)

80

Instructions

Manage Scenarios

Print

DairyMGT Webpage

2. Expected Females (%)

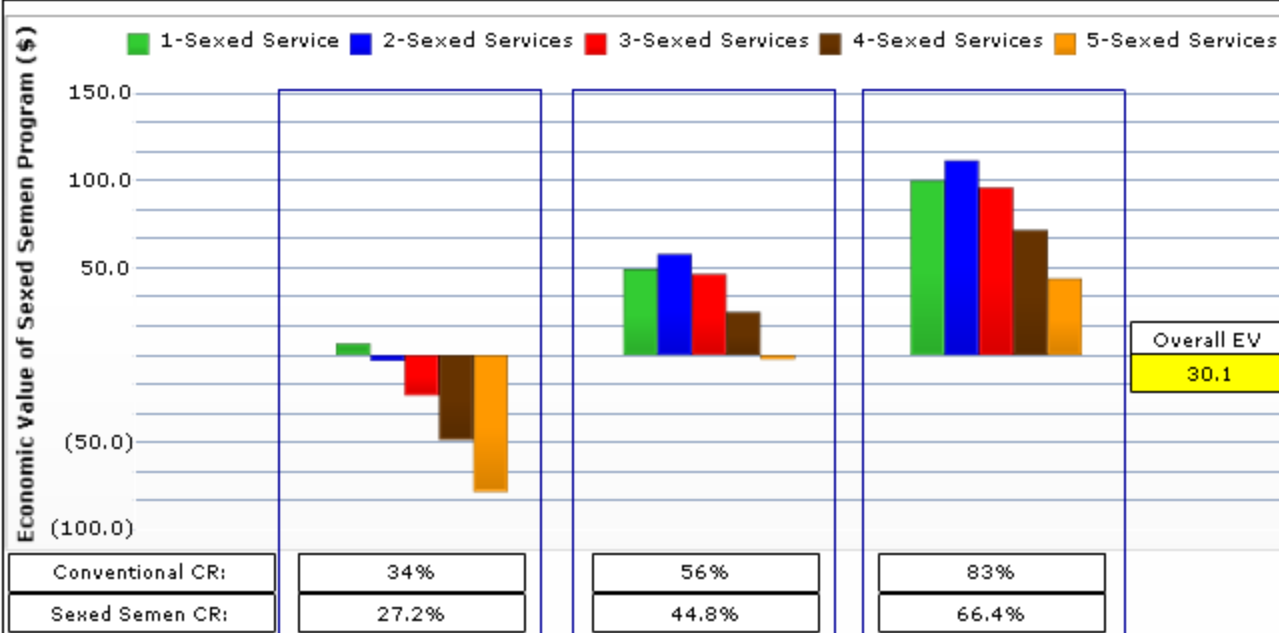
Conventional	46.7
Sexec	89

3. Semen Cost (\$)

Conventional	15
Sexec	45

4. Other Economic Parameters

Discount (%/yr)	12	Raising Cost (\$/c)	2.4
Female Calf (\$)	562	Salvage Value (\$/kg)	1.79
Male Calf (\$)	48	Dystocia Cost (\$/heifer)	28.53
		20-mo Pregnant Heifer (\$)	1200





Thanks



UW Extension

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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.

Dr. 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 industries.

Some Active Projects

- Success for Small Beginning Dairy Farmers
- Strategies of Pasture Supplementation on Organic and Conventional Grazing Systems: Assessment of Economic, Production and Environmental Outcomes
- Assessment of Goats 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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University of Wisconsin - Extension Dairy Team News
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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 Documentation (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/>