When to Use Gender-Biased Semen: Economics

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**

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

Methodological Framework

- **Survival curves calculated by conditional probabilities:**

$$PP_1 = CR_1^{'} = CR_1$$

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

$$CR_s^{'} = PP_s - PP_{s-1} \quad \textbf{for s = 2 to 5}$$

- **Concept of "Overall EV" :**

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

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

	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

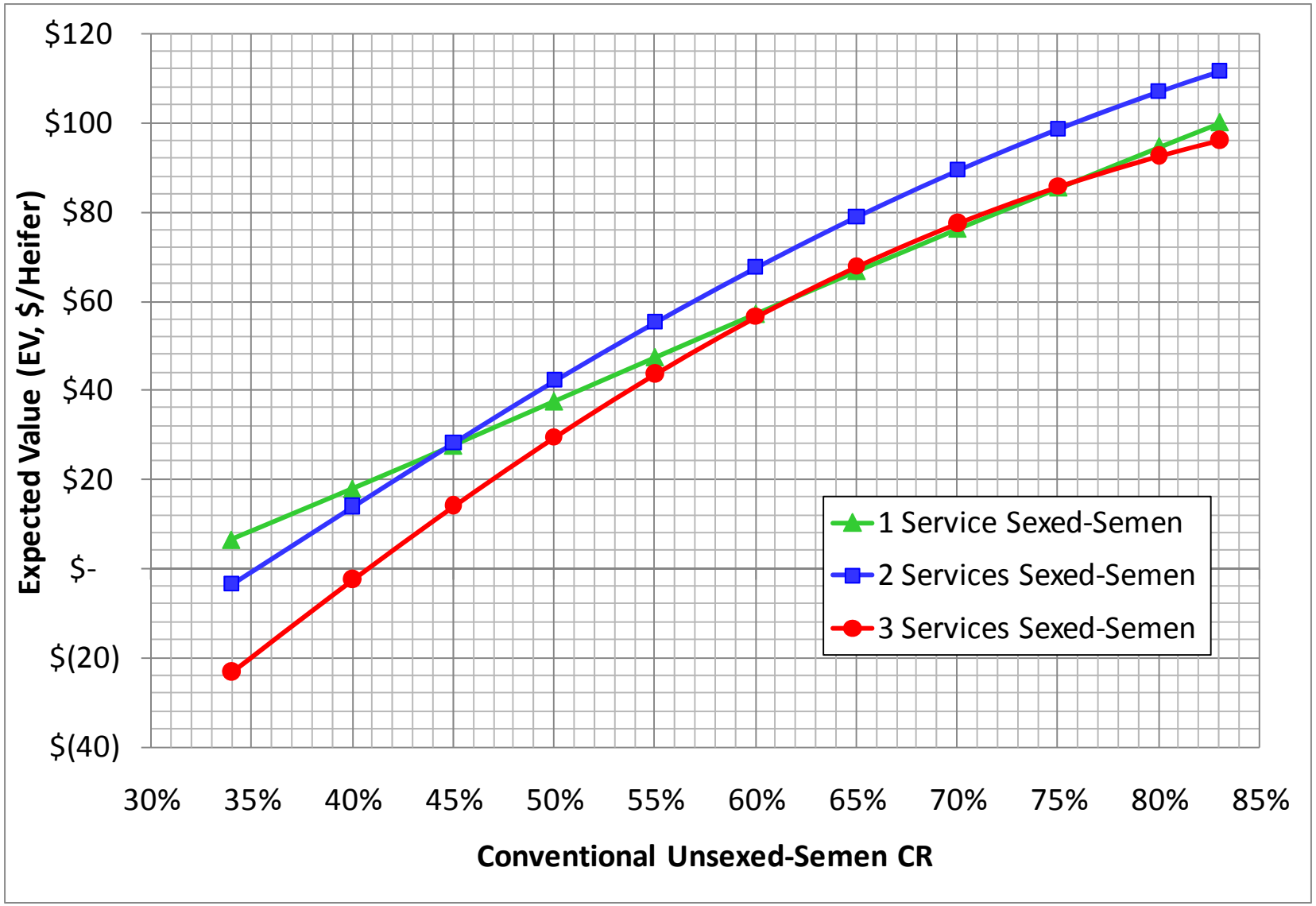
Scenario	Over-all EV ($/hfr)	Break-Even CR* (%)	Number of Consecutive Services Positive EV		
			Low CR (34 %)	Average CR (56 %)	High CR (83 %)
Baseline	30.10	31	1	4	5
X Semen CR at 85 %	46.40	31	2	5	5
X Semen CR at 75 %	12.50	36	0	4	5
X Semen 95 % heifer ratio	52.40	27	2	5	5
X Semen 78 % heifer ratio	-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

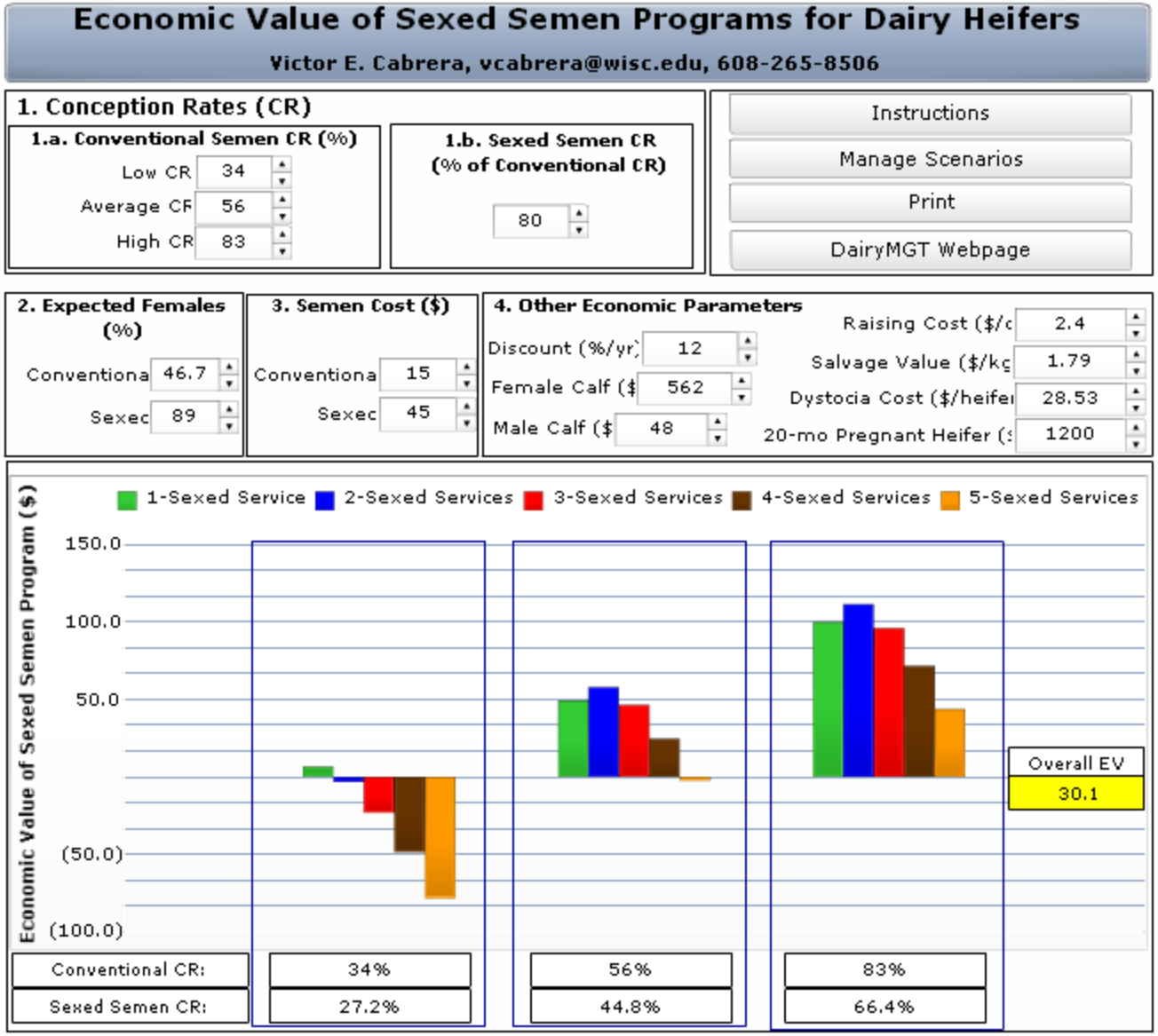
Decision Support Challenge

- **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**

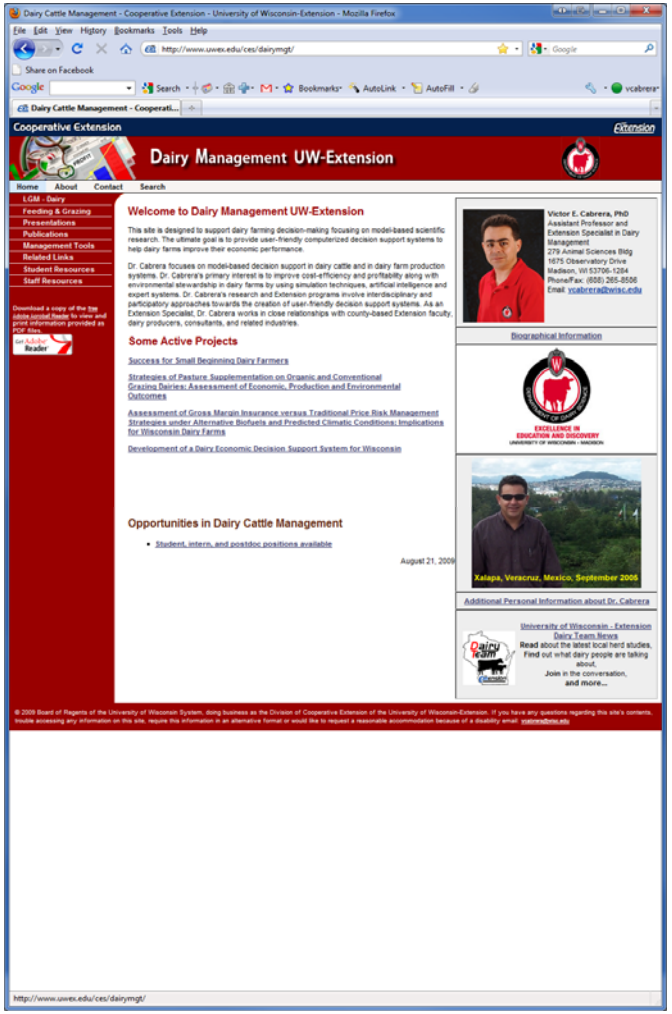
Decision Support Challenge

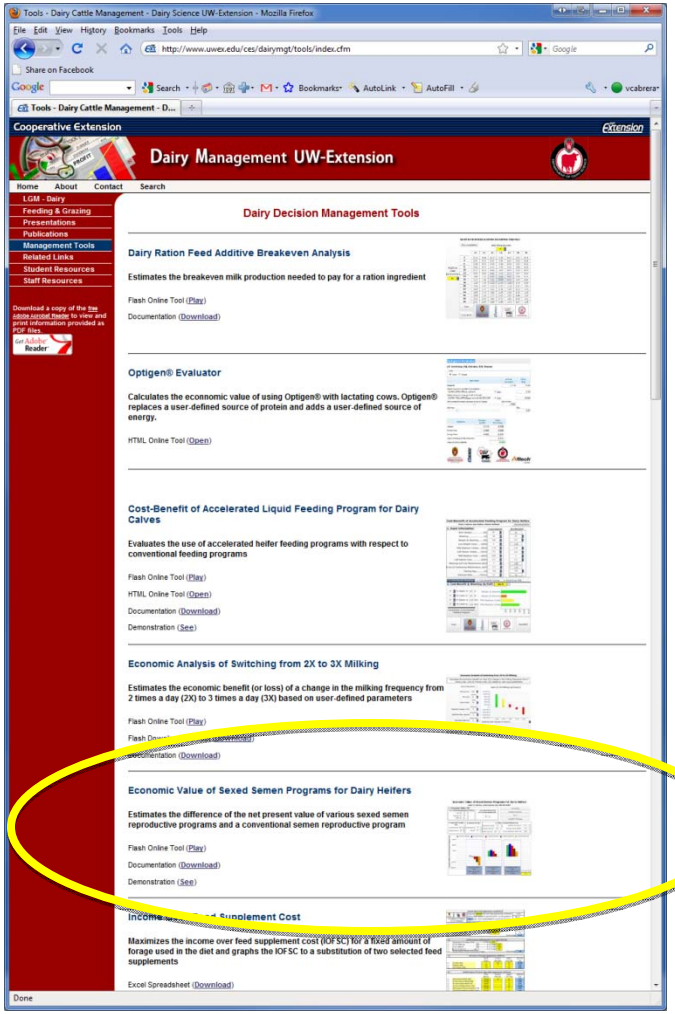
- Decision support system should be:
  - Visually attractive
  - Interactive
  - Robust
  - Preferably online
  - Self-contained
  - Scenario-driven
- Decision support system should have:
  - Secured calculations. Users characterize their situation by defining parameters
  - Clear instructions
  - Technical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

Decision Support Challenge



Thanks





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