# 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, $\delta$ 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

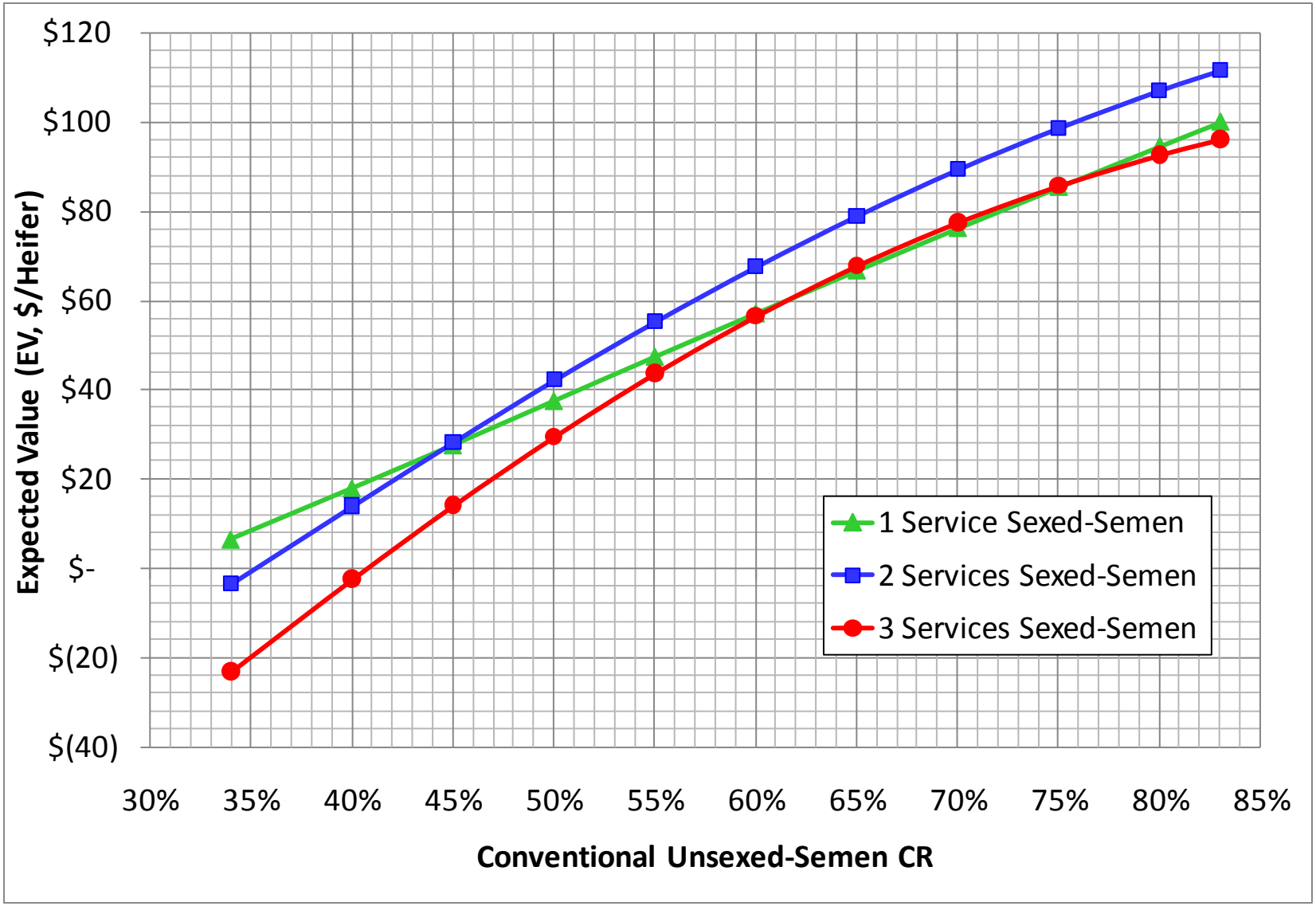
| Scenario | Over-all EV ($/hfr) | Break-Even CR* ( %) | Number of Consecutive Services Positive EV | | |
|---|---|---|---|---|---|
| | | | Low CR (34 %) | Average CR (56 %) | High CR (83 %) |
| Baseline | 30.10 | 31 | 1 | 4 | 5 |
| X Semen CR at 85 % | 46.40 | 31 | 2 | 5 | 5 |
| X Semen CR at 75 % | 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

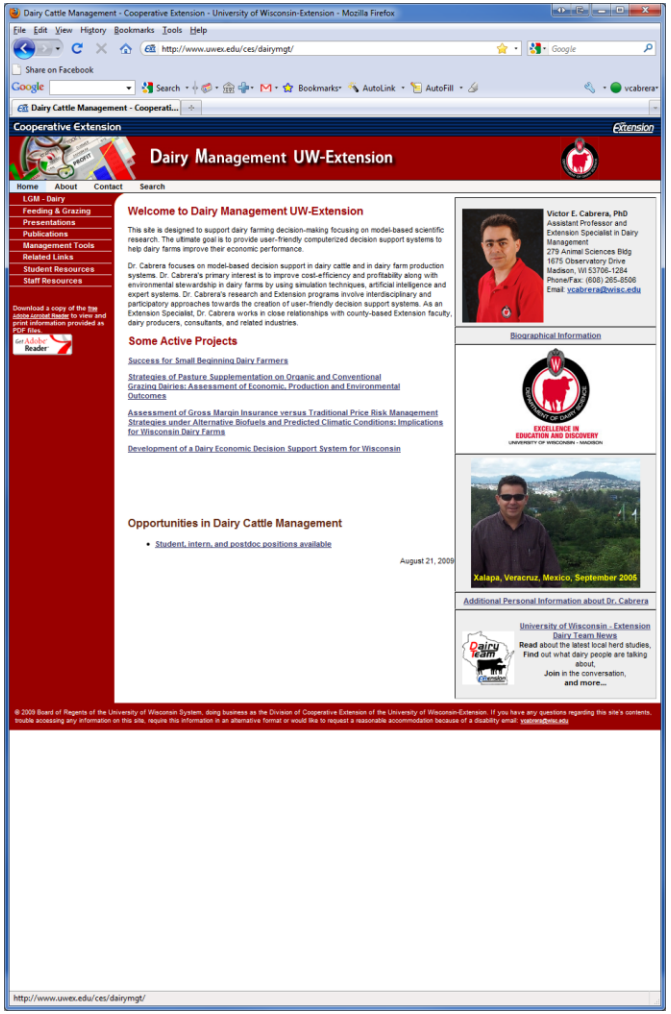
- Results not applicable for all farm and market conditions
- Every farm is different
- Market conditions are permanently changing
- Challenge: Provide the same analysis as a decision support system for practitioners or final users
- Spreadsheets are good and popular, but sometimes could deter users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

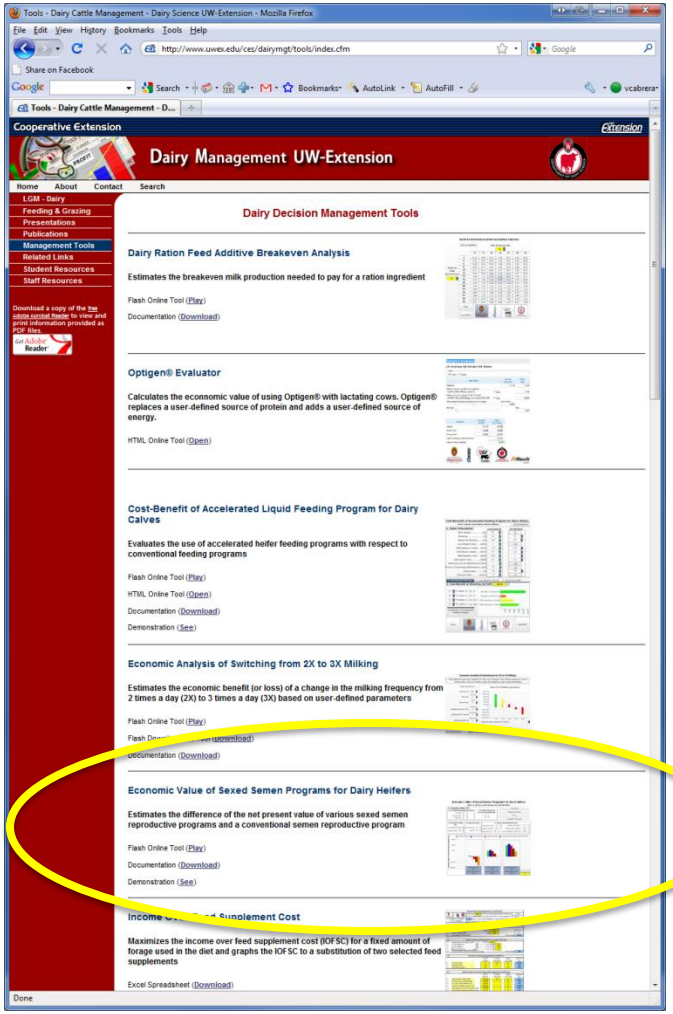
# Decision Support Challenge

- 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/