


## Evaluating Sustained Cow Production: Alternate Definitions for Stayability

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## Overview

- ▶ Brief Stayability introduction
- ▶ Challenges associated with the evaluation of Stayability
- ▶ Progression toward improvement
- ▶ Random Regression
  - What is it?
  - What does it mean for Stayability?
- ▶ Project with the Red Angus Association

## Stayability

- ▶ Stayability Defined
  - Probability of surviving to a specific age given the opportunity to reach that age.
- ▶ Initial Impetus
  - Cows need to remain in production to generate enough revenue to offset the costs of development and maintenance.
    - 5 calves → 6 years of age
  - Herd profitability
    - Cows remaining past their break even age must compensate for those culled.
    - 53 - 77% of the value of maternal indexes

## Challenges with Evaluating Stayability

- ▶ Age at which observations are measured
  - Widely accepted definition of 6 years of age
  - Sires will be 8 years of age
- ▶ Binary nature
  - Reported as Success or Failure to reach the endpoint
  - In terms of a Contemporary Group of Females
    - All succeed
    - All fail
    - Somewhere in the middle
- ▶ Incomplete Reporting – From a longevity standpoint
  - Success at 6, we do not know the true value of the individual

## Challenges with Evaluating Stayability

- ▶ Definitions
  - Present in the data as a 6 yr old with a calf
  - Weaned a calf at 6 years of age
  - Weaned a calf given they calved at 2
  - 5-consecutive calves
- ▶ Breed Association Definition Differences
  - Red Angus, Gelbvieh
    - 5 consecutive calf requirement, same calving season
  - Limousin, Simmental, Salers
    - Presence of a weaned calf at 6 years of age
- ▶ Similar contemporary group definitions

## Total Herd Reporting

- ▶ Cow inventory program
  - Required submission of records on all individuals enrolled in the program
    - Calves
    - Culling – Reason for removal, pregnancy status, etc.
  - Goals
    - Improvement of the quality of data submitted to the association
    - More accurate EPD
      - Particularly female traits such as Stayability and Heifer Pregnancy
- ▶ Not all associations have similar policies.
  - Some required
  - Some optional
  - Some have no such program

## How have these challenges been addressed?

### Aggregate Stayability

- Stayability to 6 years of age is heritable.
- So is 3 year, 4 year and 5 year
- What is their "genetic" relationship to 6 year stayability?

	Stay3	Stay4	Stay5	Stay6
Stay3	0.10	0.84	0.46	0.49
Stay4		0.11	0.85	0.70
Stay5			0.11	0.60
Stay6				0.11

### Four separate evaluations

- Combine ST3, ST4, ST5, ST6 using index techniques into an aggregate ST6 evaluation.
- Minimum, average, maximum accuracy increase
- 0.00, 0.07, 0.32

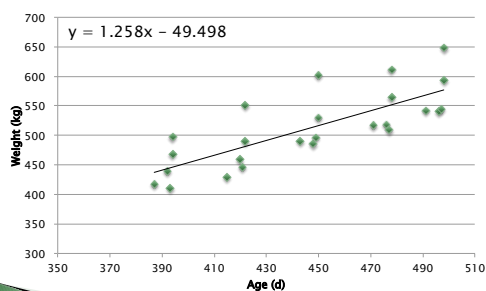
## Random Regression

- Predict a regression equation for each animal.

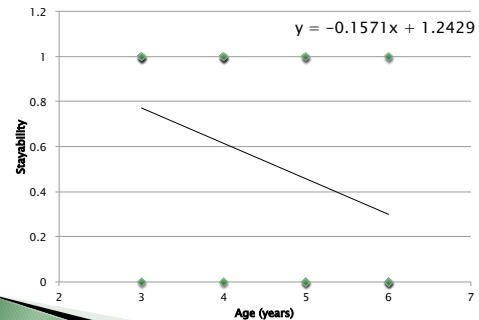
$$y = \text{Intercept} + \text{Slope} * (\text{Information})$$

- Predicting an animal's genetic merit over time
- Genetic Evaluation
  - Breeding values for regression parameters
  - Individual animal regression line genetic predictions
    - Allows for a genetic prediction for any endpoint in the data range.

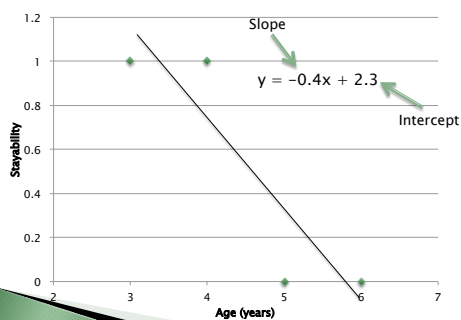
## What is Regression?



## Regression with Stayability

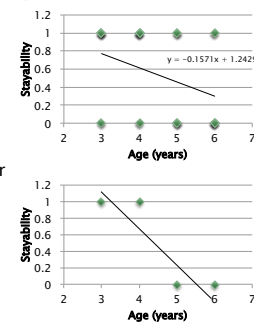


## Regression with Stayability



## What is Random Regression?

- $y = -0.4x + 2.3$
- Deviate the individual prediction from the CG mean.
- Include genetic variance for the intercept and slope.
- Obtain EPD for intercept and Slope
  - For each animal



## Random Regression for Stayability

- Predictions
    - EBV / EPD for Intercept and Slope from the regression of calf presence on age.
- $$\text{Stay EPD} = \text{Intercept EPD} + \text{Slope(EPD)} * \text{Age}$$
- Observed EPD – Genetic influence on having a calf at a specific age given a calf at 2
    - 3, 4, 5 and 6 years of age
    - Summed to get genetic influence of having 5 calves by 6 years of age

## Random Regression for Stayability

- Random Regression models more robust than traditional methods
  - Greater data usage
  - Prediction to any age endpoint
- More informative data usage
  - Stayability Endpoint → 2 3 4 5 6
  - Successful 6 year stay → 1 1 1 1 1
  - Unsuccessful → 1 0 0
  - 1 1 1 1 0
- Greater accuracy....

## Random Regression for Stayability

- Issues discussed earlier
  - Binary nature, can have a lot of Groups with no variation
  - Incomplete reporting of data
- Random regression allows for the inclusion of groups with no variation
  - At a particular endpoint, these groups are informative
- Easily add additional data points (ages) into the evaluation.

## Impact of alternate models on relationship to Stayability

- Red Angus Association asked for a quantification of the impact of alternate models on the Stayability prediction
- Standard Prediction
  - Red Angus Definition – Aggregate Model
    - 5 – Consecutive calves
    - Cannot switch seasons
  - Contemporary Group
    - Breeder of the dam
    - Breeder of each calf
    - Birth year of the dam

## Impact of alternate models on relationship to Stayability

- Standard Prediction
  - Comparisons will be made to
    - ST3, ST4, ST5 and ST6
- Aggregate – Index of ST3, ST4, ST5 and ST6
  - Independent data sets

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## Random Regression Models

### ► Different Models Used

- Red Angus Definition
  - Red Angus Criteria for Successful Observation
  - Red Angus Contemporary Group Definition
- Red Angus Definition - Modified
  - Above criteria plus
  - Age at first calving and calving year (Fixed Effects)
- IGS Definition
  - Red Angus Criteria however subsequent ages after unsuccessful are treated as unknown
  - Red Angus Contemporary Group Definition
- IGS Definition Modified
  - Above criteria plus
  - Age at first calving and calving year (Fixed Effects)

## Random Regression Models

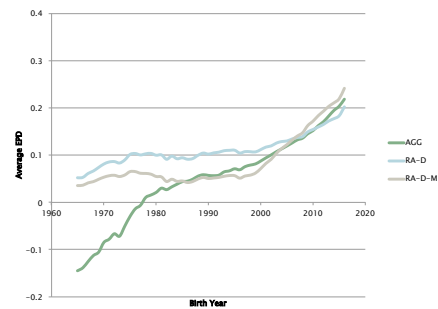
### ► Different Models Used

- IGS Definition 1
  - Red Angus Criteria however subsequent ages after unsuccessful are treated as unknown
  - Fixed effects age at first calving and calving year
  - Contemporary Group
    - Birth Workgroup and Birth Management Group of Dam
    - Birth Workgroup and Birth Management Group of 2yo calf
- IGS Definition 2
  - Above criteria plus
  - Individuals with no contemporary group variation included
- Total Herd Reporting versus All Data

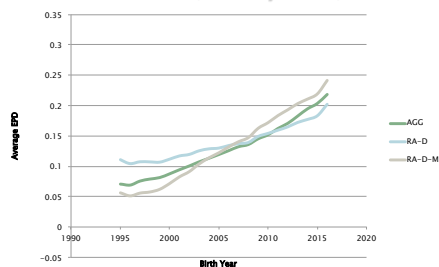
## EPD Correlations - THR Data

		RA-D	RA-D-M	IGS-D	IGS-D-M	IGS-D-1	IGS-D-2
AGG	N	2,625,287					
	Pearson	0.58	0.61	0.59	0.62	0.55	0.62
ST6	Pearson	0.64	0.67	0.65	0.67	0.61	0.67
	Spearman	0.62	0.68	0.63	0.68	0.62	0.69
ST5	Pearson	0.67	0.68	0.67	0.68	0.62	0.67
	Spearman	0.66	0.58	0.66	0.70	0.64	0.68
ST4	Pearson	0.69	0.69	0.69	0.69	0.63	0.67
	Spearman	0.69	0.72	0.68	0.71	0.65	0.69
ST3	Pearson	0.64	0.64	0.64	0.63	0.59	0.62
	Spearman	0.64	0.67	0.64	0.66	0.61	0.64

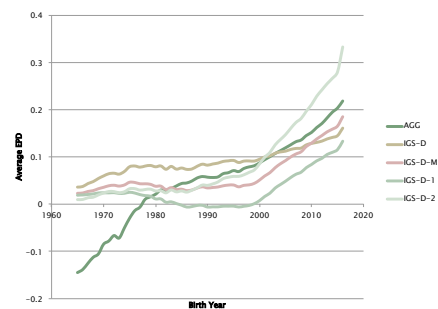
## Genetic Trends THR Data

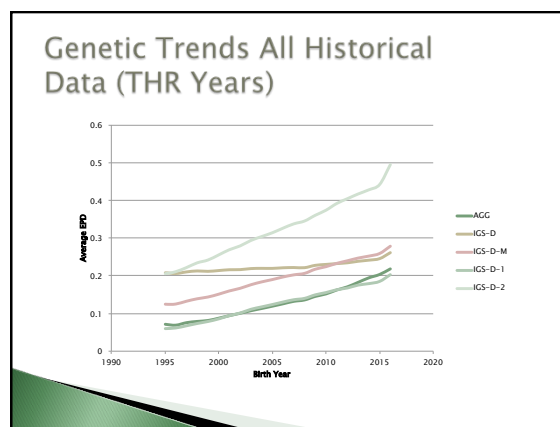
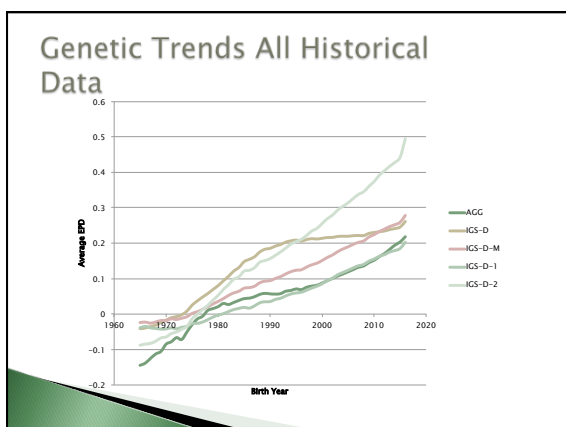
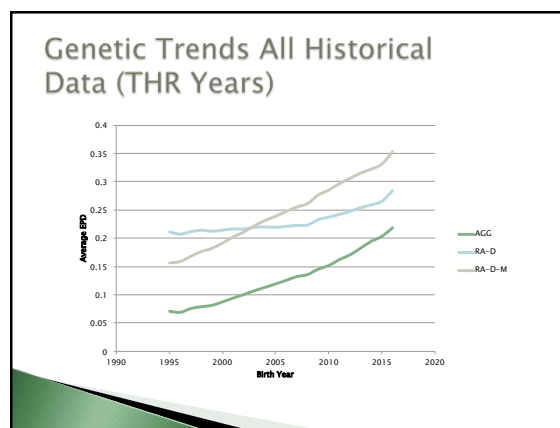
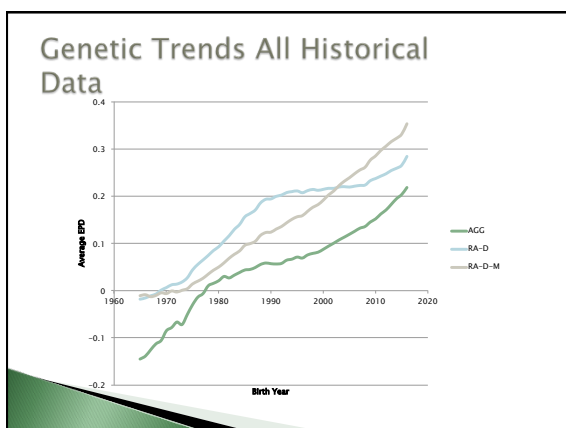
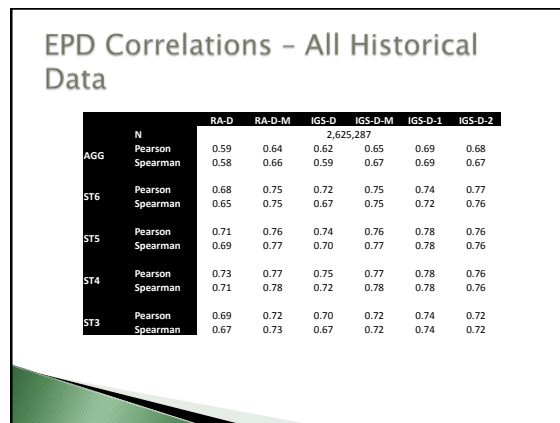
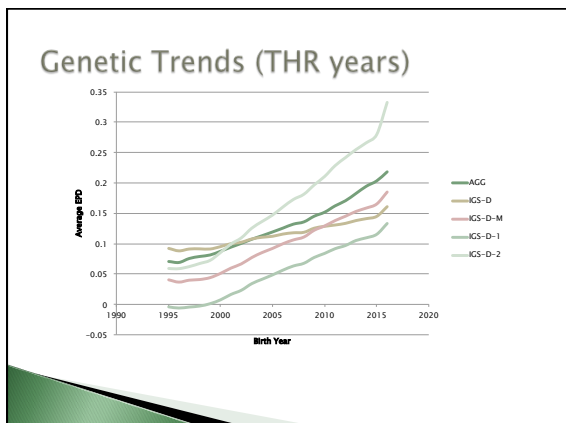


## Genetic Trends (THR years)



## Genetic Trends THR Data





## Conclusions

- ▶ Random regression models are robust to definition changes
  - Contemporary group
  - Effects
  - Definition
  - THR
- ▶ Random regression behaviors are indicative of data density
  - Amount of data included can stabilize predictions
- ▶ Behavior on multiple databases unknown
  - How these models will react to different definitions, data densities when combined is unknown.

## Questions?