Empirical Validation of Forage Models

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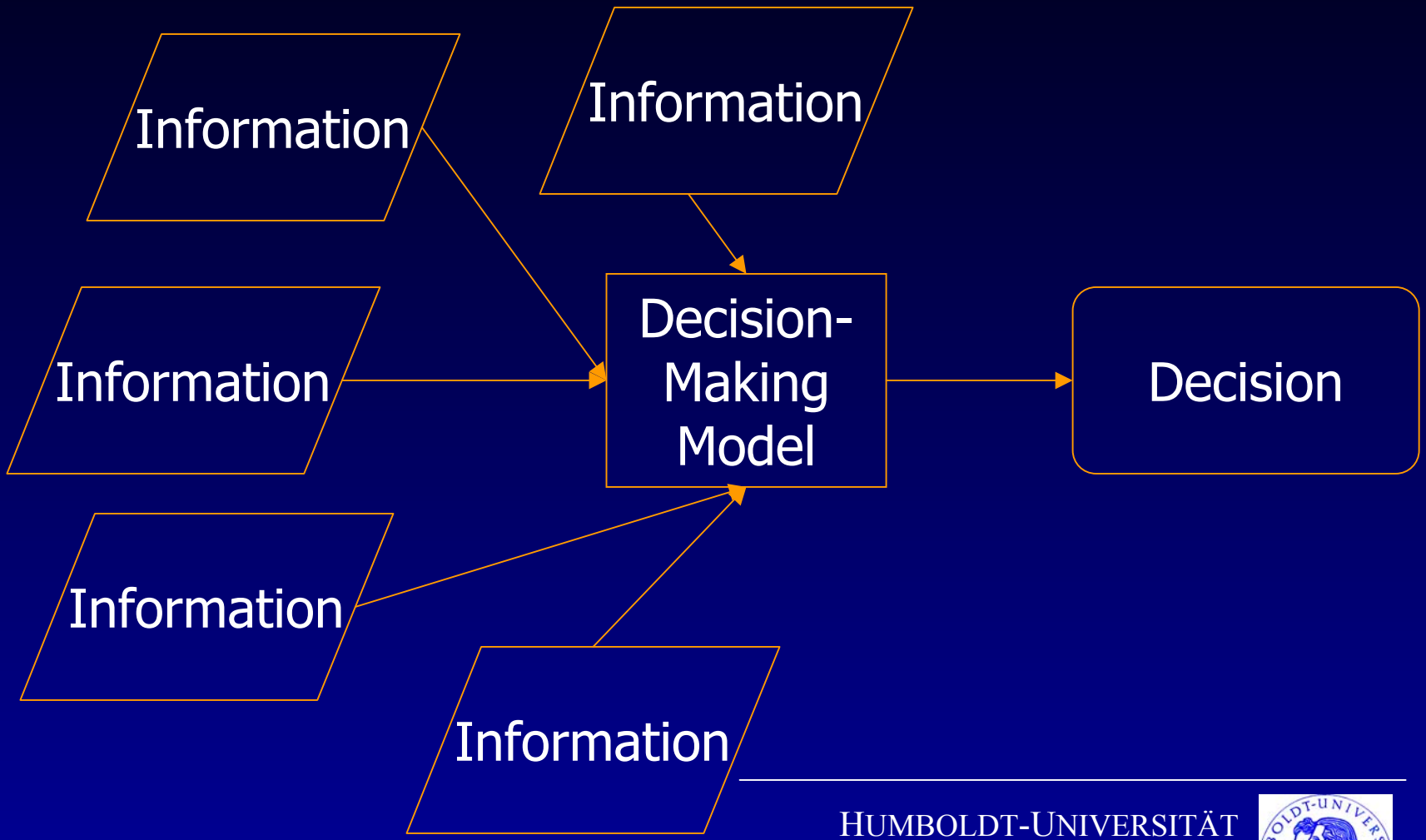
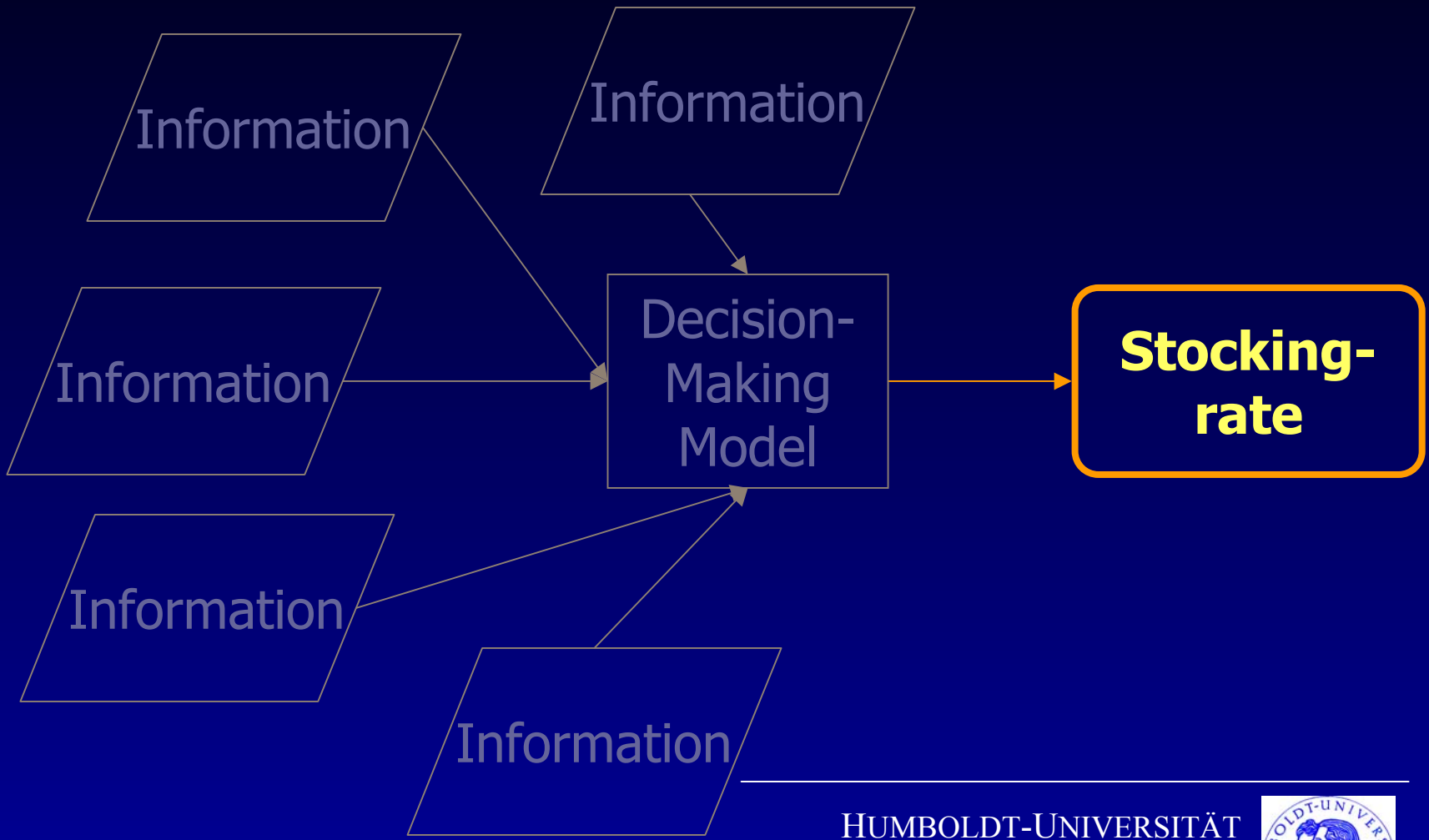
Decision-making process



D-M process: forage-budget



D-M process: forage-budget

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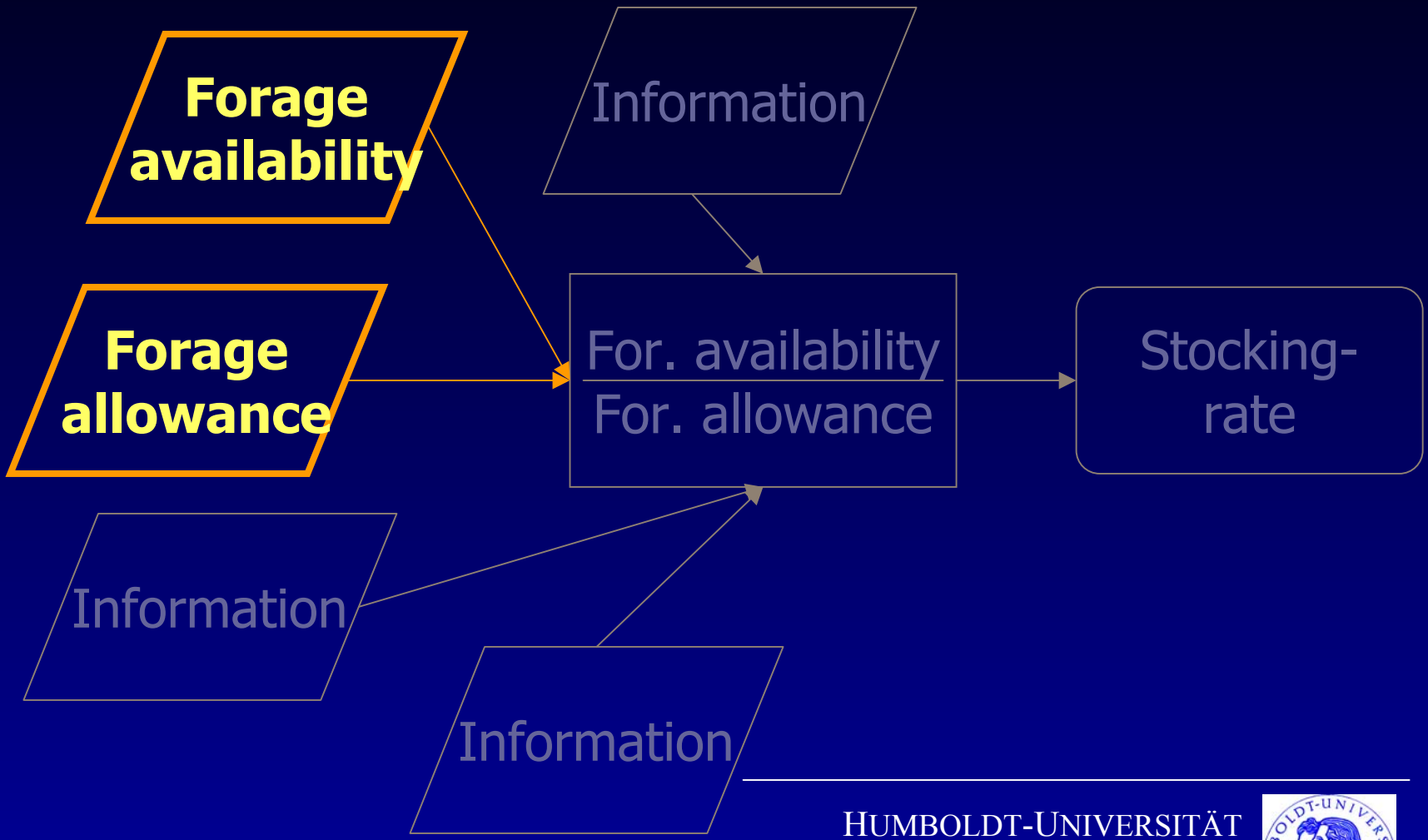
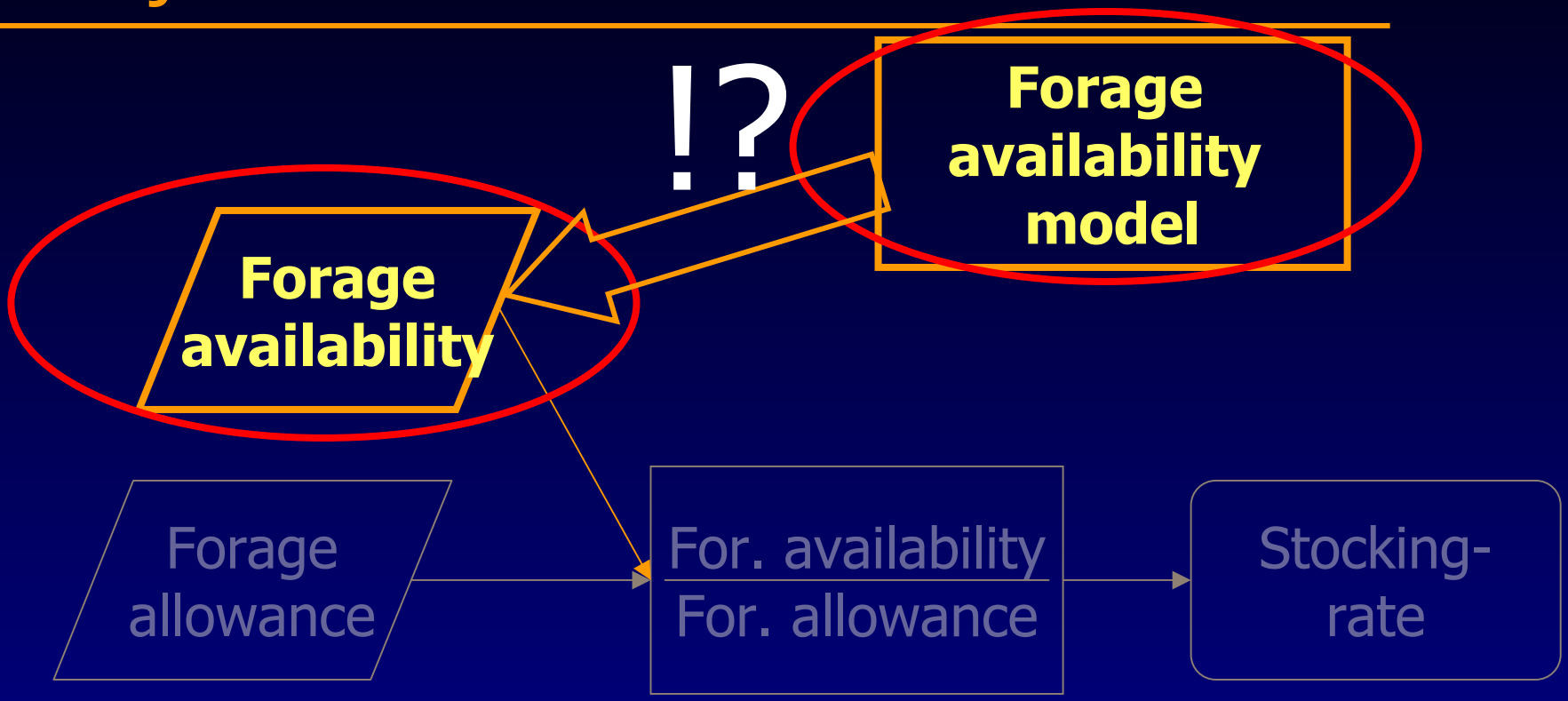


Objective

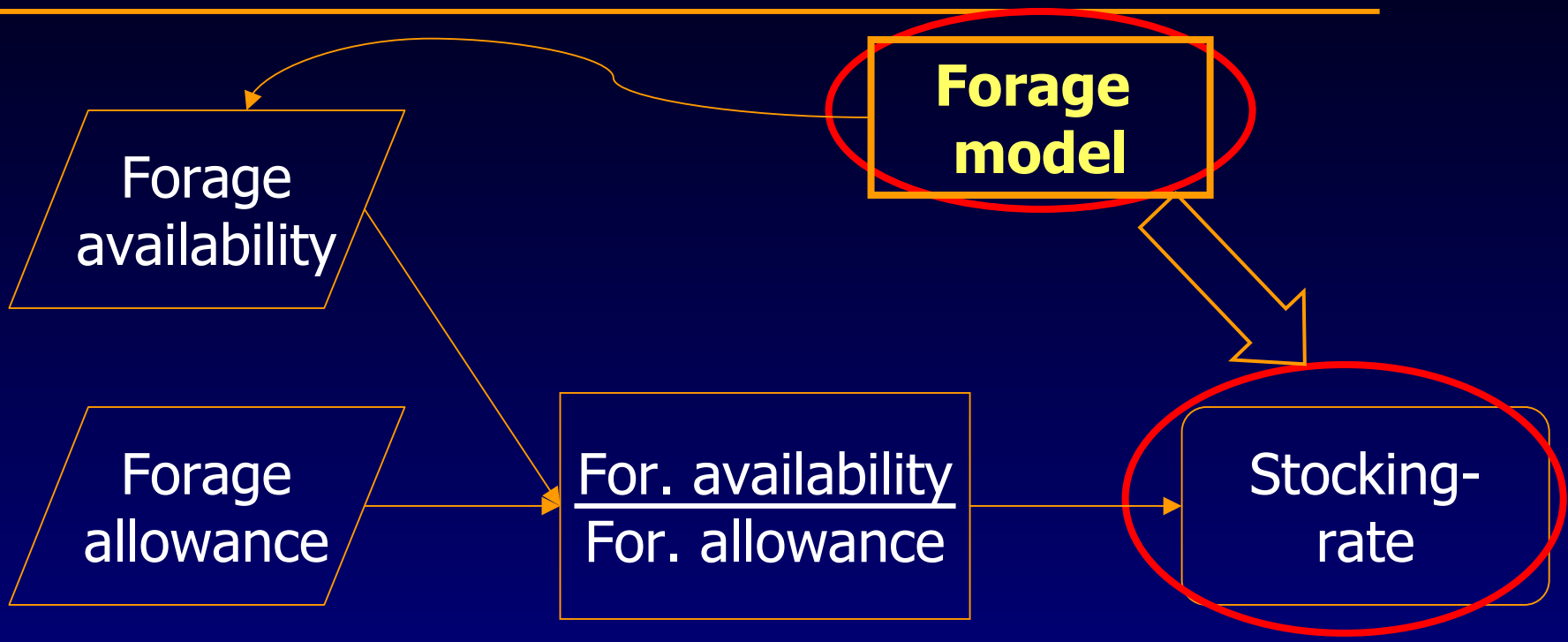

!?
Forage availability model
Forage availability
Forage allowance
For. availability
For. allowance
Stocking-rate

Definition

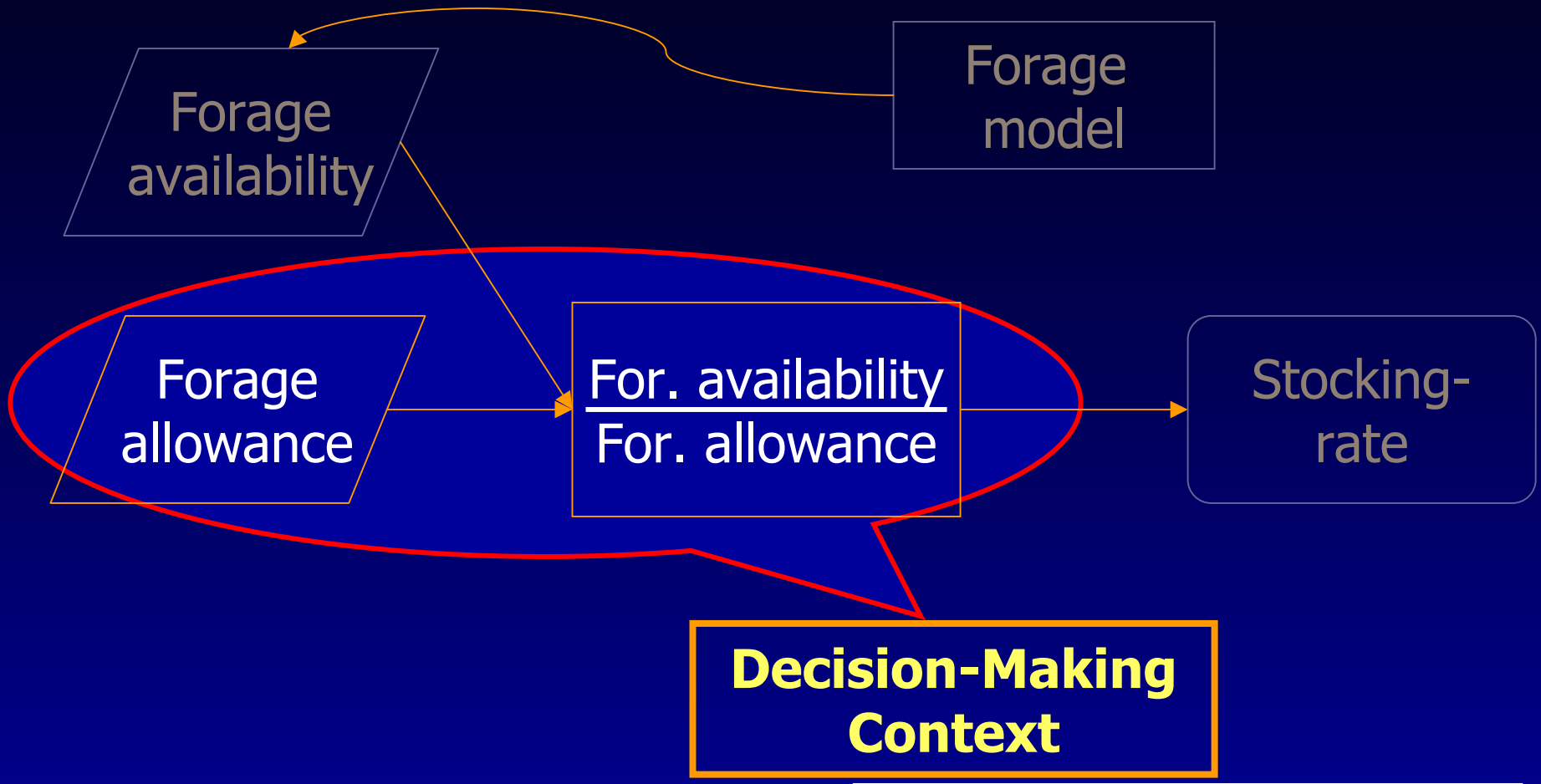
Validation:

Procedure to establish the usefulness of a model to reach the objectives pursued in its development.

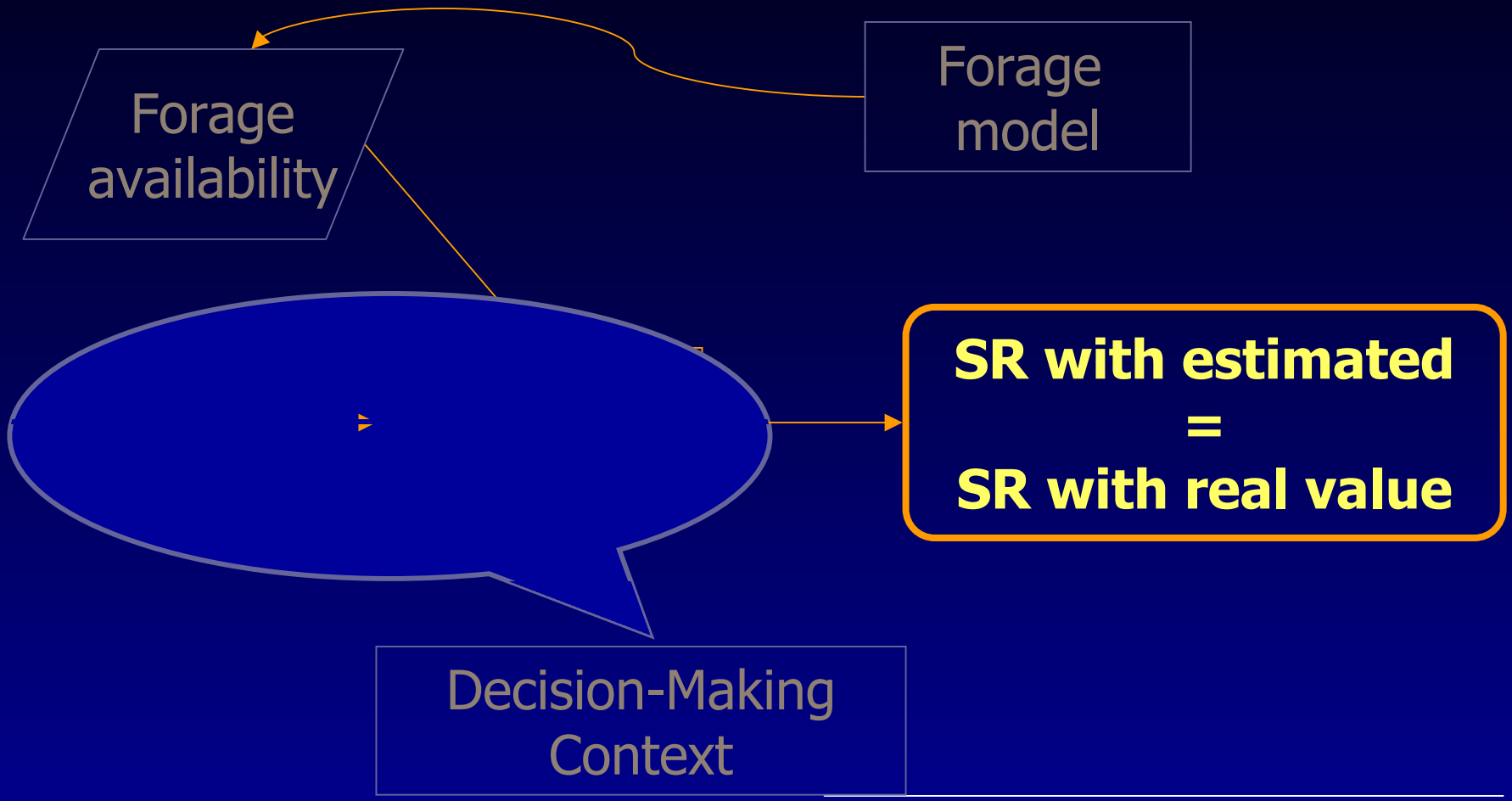
Objectives pursued...



Objectives pursued...



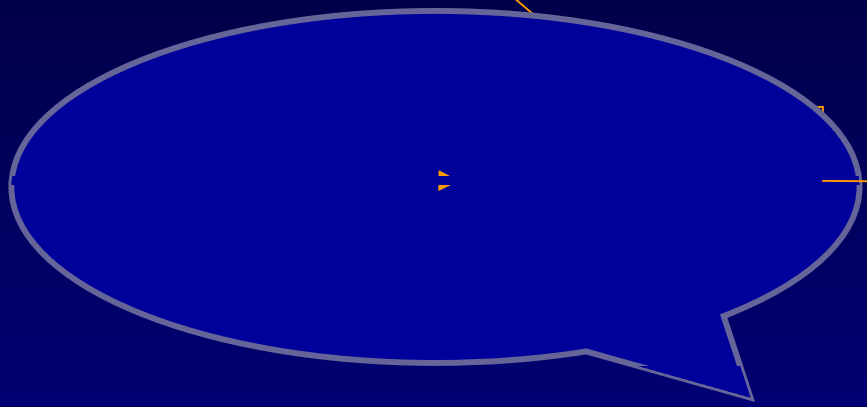
When is it useful?



When is it useful?

~~**Estimated value = real one?**~~

Forage model



Decision-Making Context

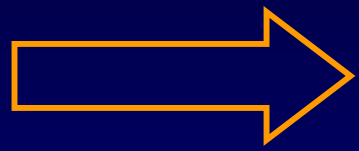
SR with estimated = SR with real value

In a given Decision-Making context

500 [kg DM.ha^{-1}]

or

510 [kg DM.ha^{-1}]



Same stocking-rate

In a given Decision-Making context

Certain variability around the estimated value does not change the decisions made

Maximum Admissible Error of the forage model (MAE)

Example of admited variability

- MAE is the highest of:
  - Intake estimation error
  - Forage estimation error
  - Continuity error
  - Inflexibility error

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Daily feed intake:
2 – 2.5 % LW.day^{-1}
For a 400 kg cow, with a SR of 0.5 h.ha^{-1} =
1 kg DM. ha^{-1}.day^{-1}

Example of admited variability

- MAE is the highest of:
  - Intake estimation error
  - Forage estimation error
  - Continuity error
  - Inflexibility error

Instrumental error
1 g in 0.25 m^2
every 45 days means:
0.89 kg DM. ha^{-1}.day^{-1}

Example of admited variability

- MAE is the highest of:
  - Intake estimation error
  - Forage estimation error
  - Continuity error
  - Inflexibility error

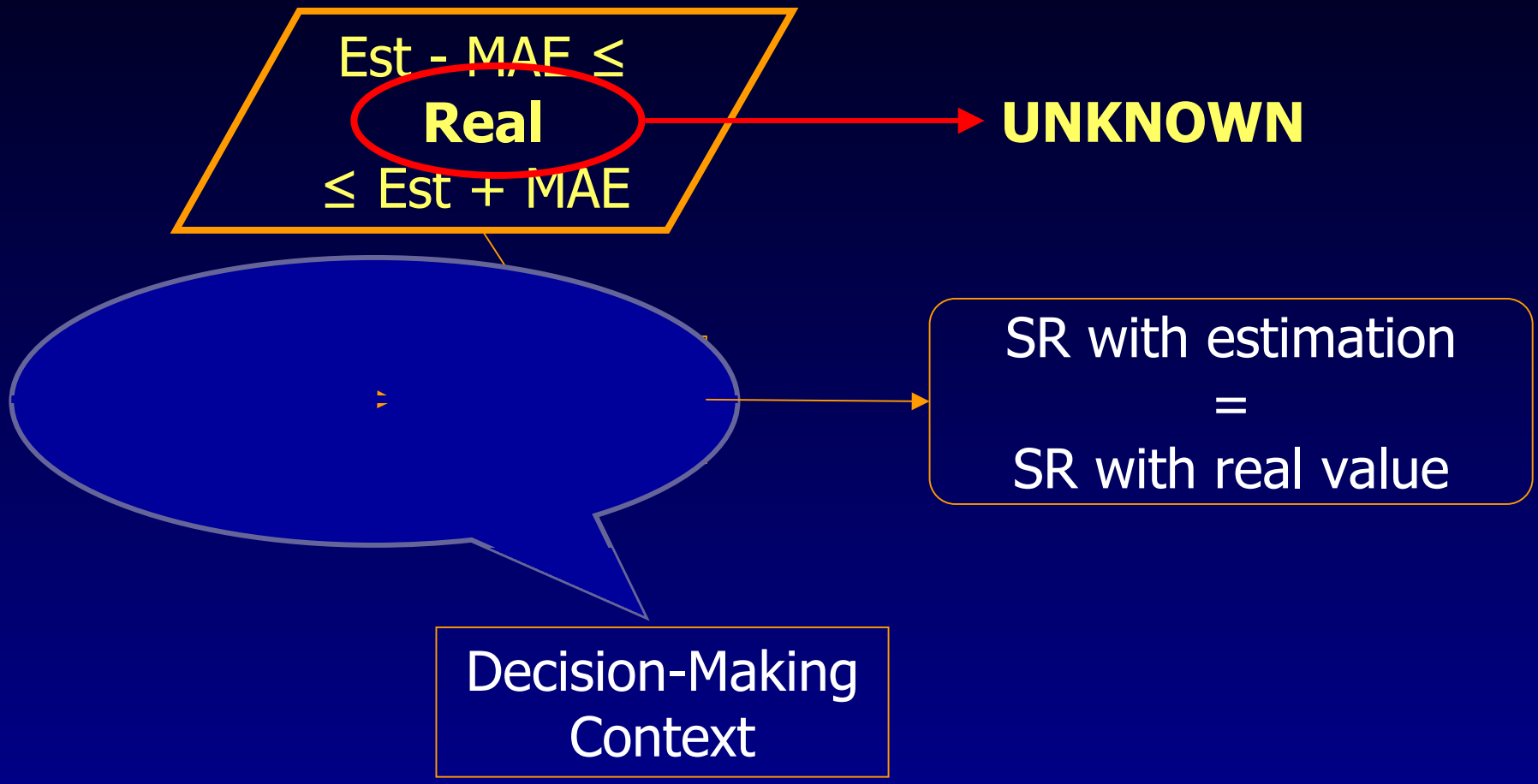
Number of animals is discrete:
For a 10 ha paddock =
0.90 kg DM. ha^{-1}.day^{-1}

Example of admited variability

- MAE is the highest of:
  - Intake estimation error
  - Forage estimation error
  - Continuity error
  - Inflexibility error

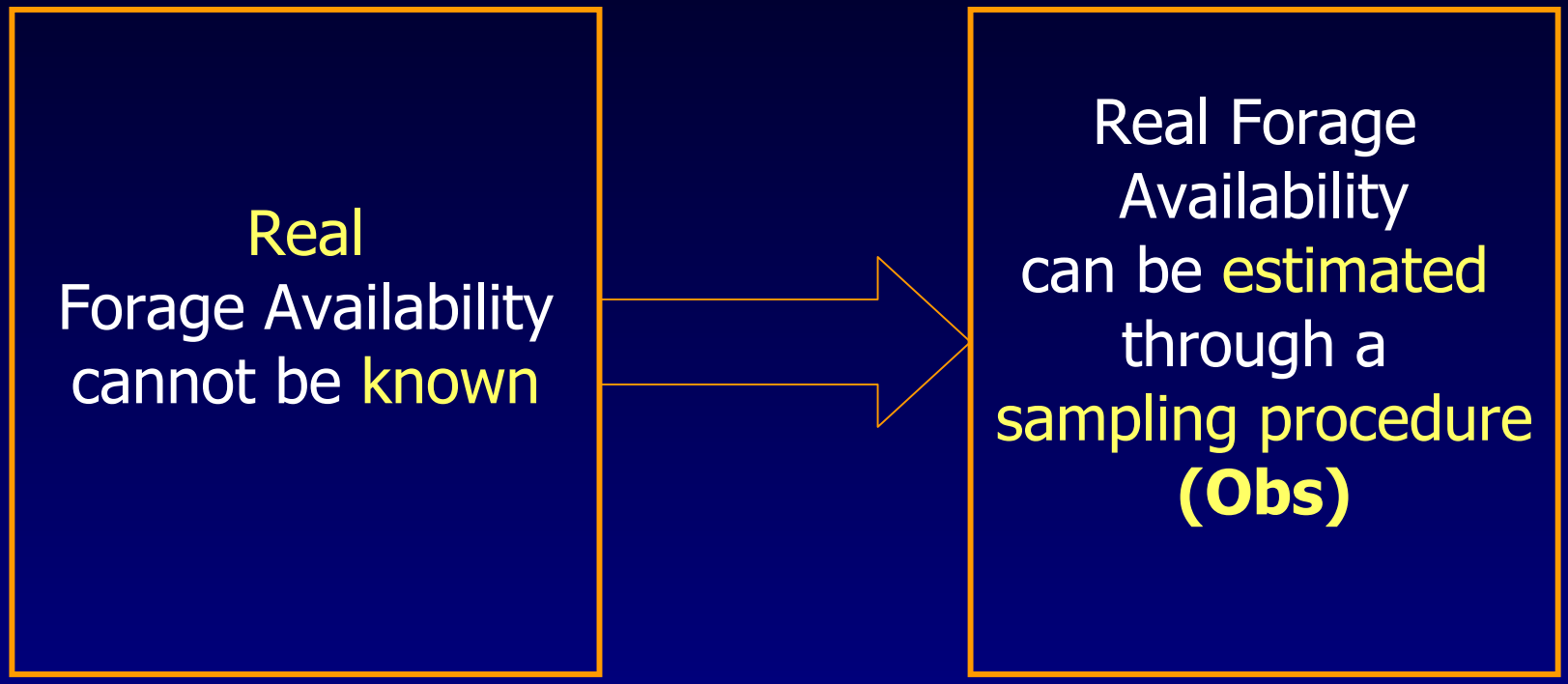
Mgmt incovenience:
20 cows in a 100 ha paddock =
1.80 kg DM. $ha^{-1}.day^{-1}$

When is it useful?



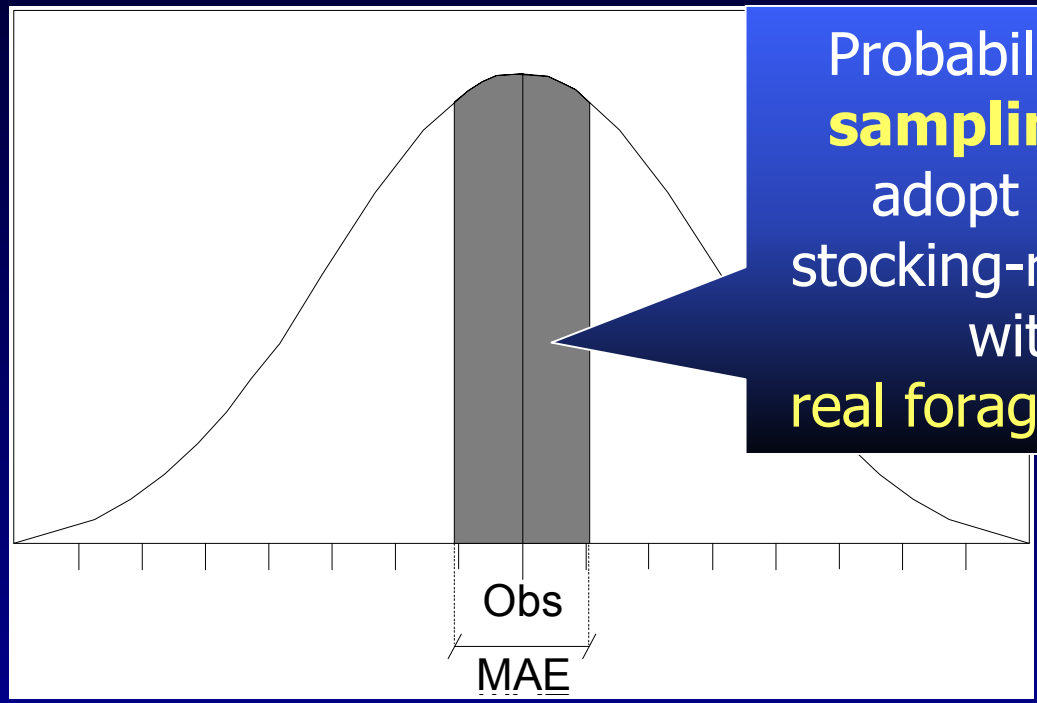
Forage availability, example

Paddock 1 (100 ha)



Proposed method

- Sampling value of forage availability (Obs) follows a t-distribution:

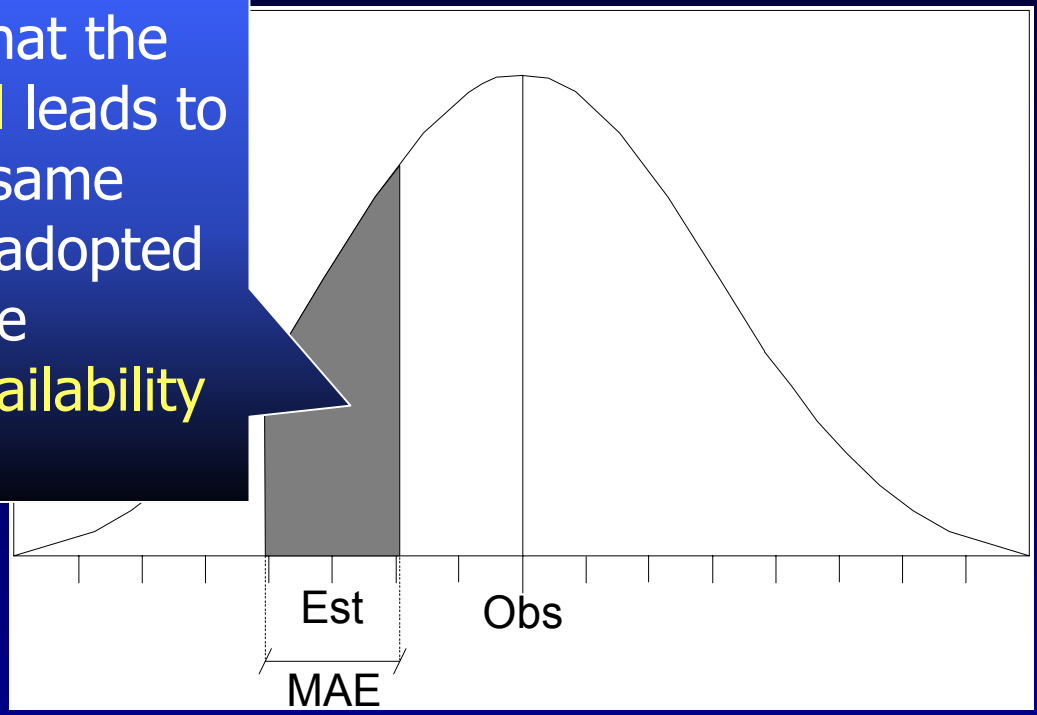


Probability that the **sampling** leads to adopt the same stocking-rate adopted with the real forage availability

Proposed method

- Given an estimation of Obs with the forage model (Est):

Probability that the **forage model** leads to adopt the same stocking-rate adopted with the real forage availability (p_i)



Proposed method

- Probability that the model leads to adopt the same stocking-rate adopted with real values:

$$P = \frac{1}{n} \sum_{i=1}^{n} p_i$$

Example

- Assess the usefulness of a deterministic forage model
- The forage model estimates the mean forage availability per hectare with the weather data
- Three (3) samples of forage availability, after 66 days of forage growth

Example

	Sampling Values	Model value
Sample 1		
Sample 2		
Sample 3	132.0	
Mean	129	90

Deterministic Model
=>
Estimates only the mean

Example

	Sampling Values	Model value
Sample 1	168.0	
Sampl	88.0	
Sampl	132.0	
Mean	129	90

Obs

Est

Example

- MAE is the highest of:
  - Intake estimation error = 1.0 [kg DM.ha^{-1}.d^{-1}]
  - Estimation error = 0.9 [kg DM.ha^{-1}.d^{-1}]
  - Continuity error = 0.9 [kg DM.ha^{-1}.d^{-1}]
  - Inflexibility error = 1.8 [kg DM.ha^{-1}.d^{-1}]

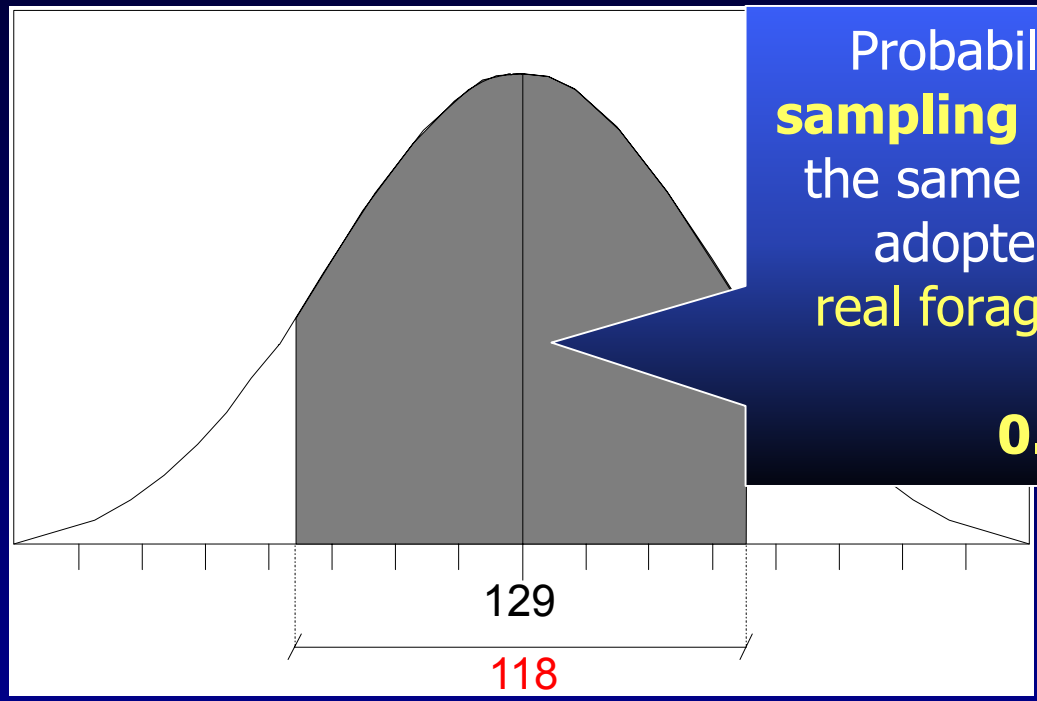
Example

- MAE is the highest of:
  - Intake estimation error = 1.0 [kg DM.ha^{-1}.d^{-1}]
  - Estimation error = 0.9 [kg DM.ha^{-1}.d^{-1}]
  - Continuity error = 0.9 [kg DM.ha^{-1}.d^{-1}]
  - Inflexibility error = 1.8 [kg DM.ha^{-1}.d^{-1}]

For 66 days of growth,
1.8 * 66 =
118 [kg DM.ha^{-1}]

Example

- Obs = 129, MAE = 118

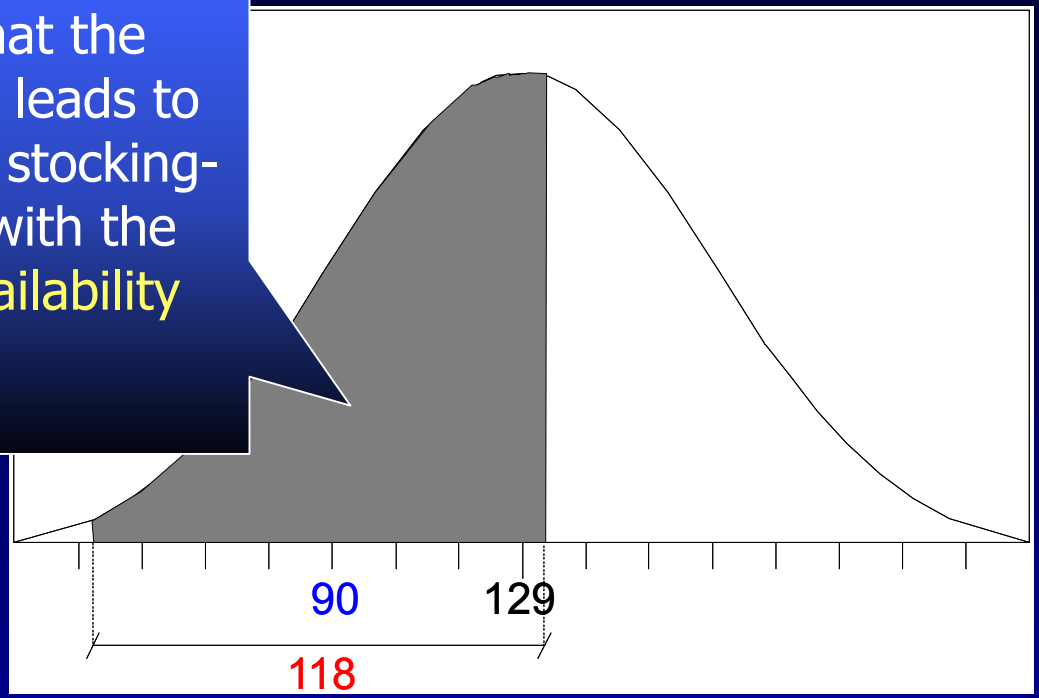


Probability that the **sampling** leads to adopt the same stocking-rate adopted with the real forage availability = **0.876**

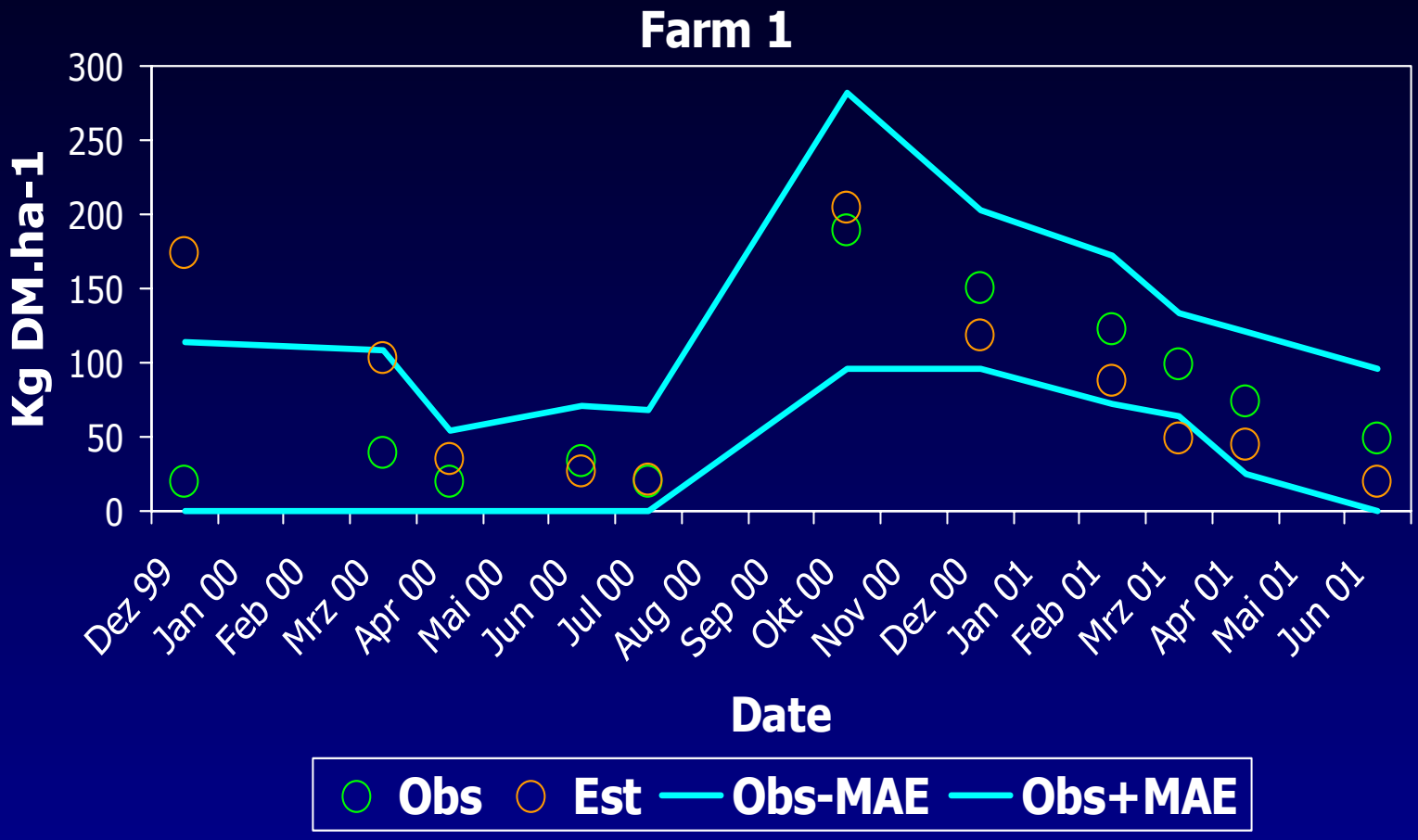
Example

- Obs = 129, Est = 90, MAE = 118

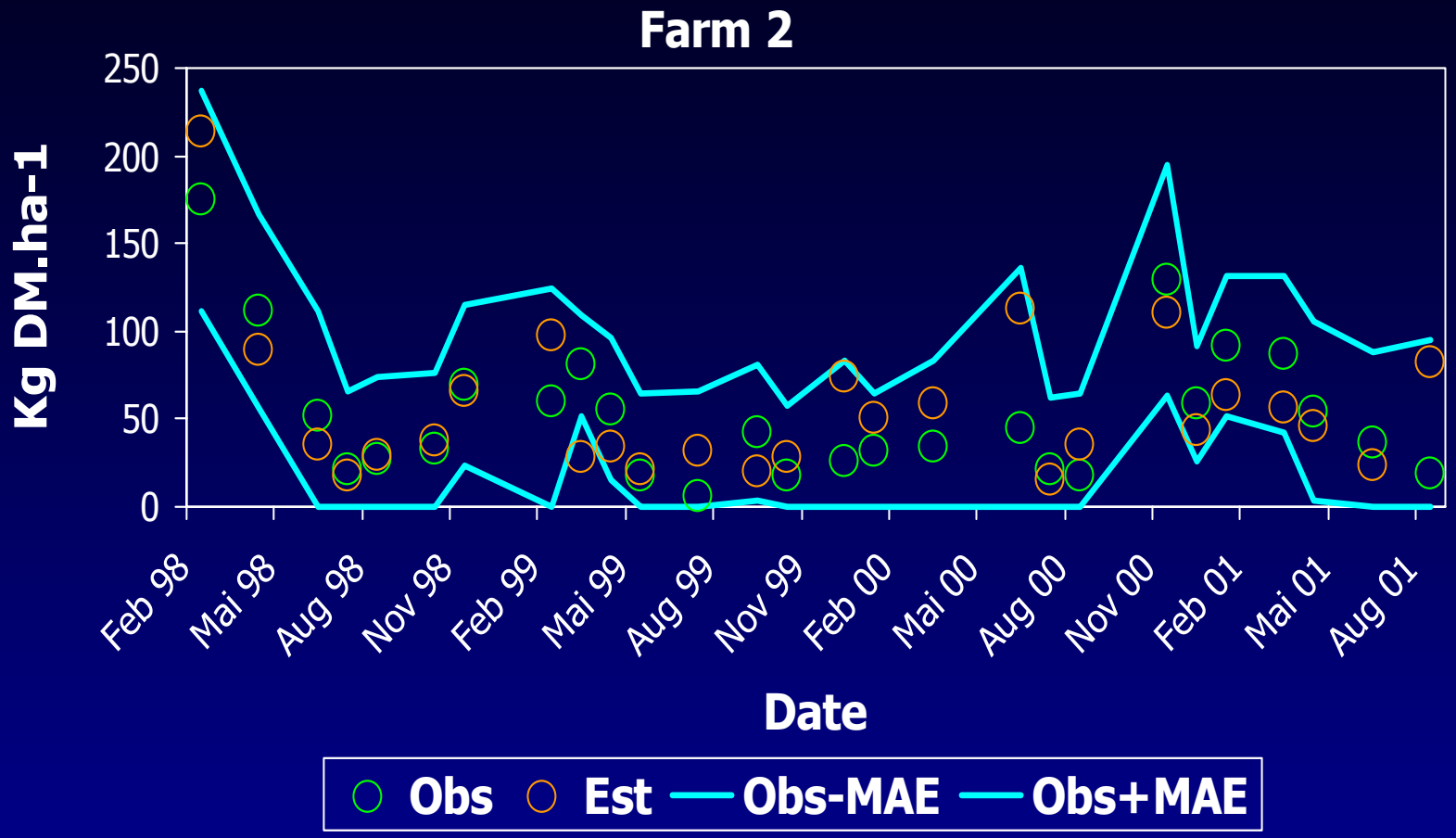
Probability that the **forage model** leads to adopt the same stocking-rate adopted with the real forage availability = **0.740**



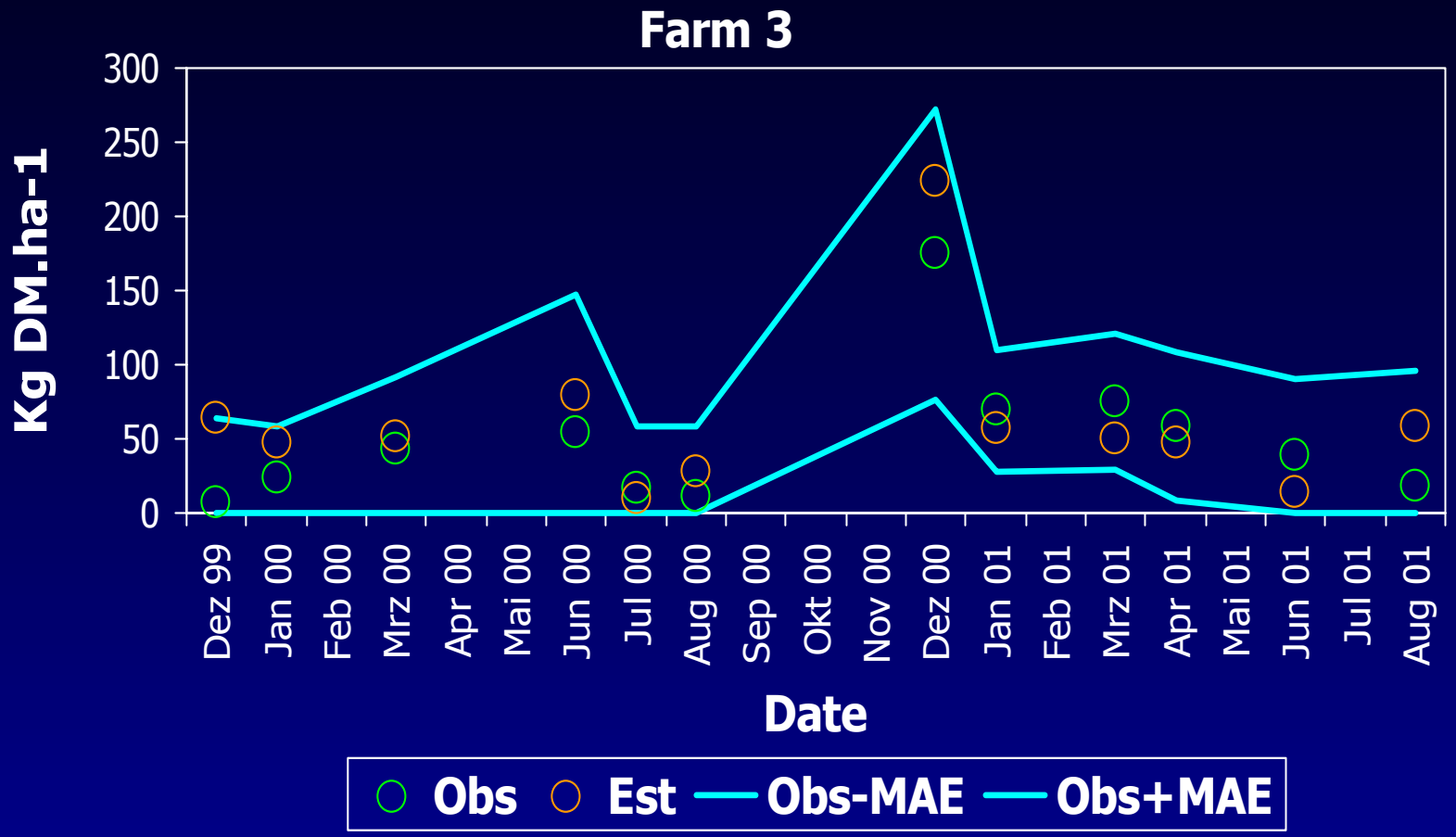
Example


Farm 1
Kg DM.ha-1
300
250
200
150
100
50
0
Dez 99
Jan 00
Feb 00
Mrz 00
Apr 00
Mai 00
Jun 00
Jul 00
Aug 00
Sep 00
Okt 00
Nov 00
Dez 00
Jan 01
Feb 01
Mrz 01
Apr 01
Mai 01
Jun 01
Date
Obs
Est
Obs-MAE
Obs+MAE

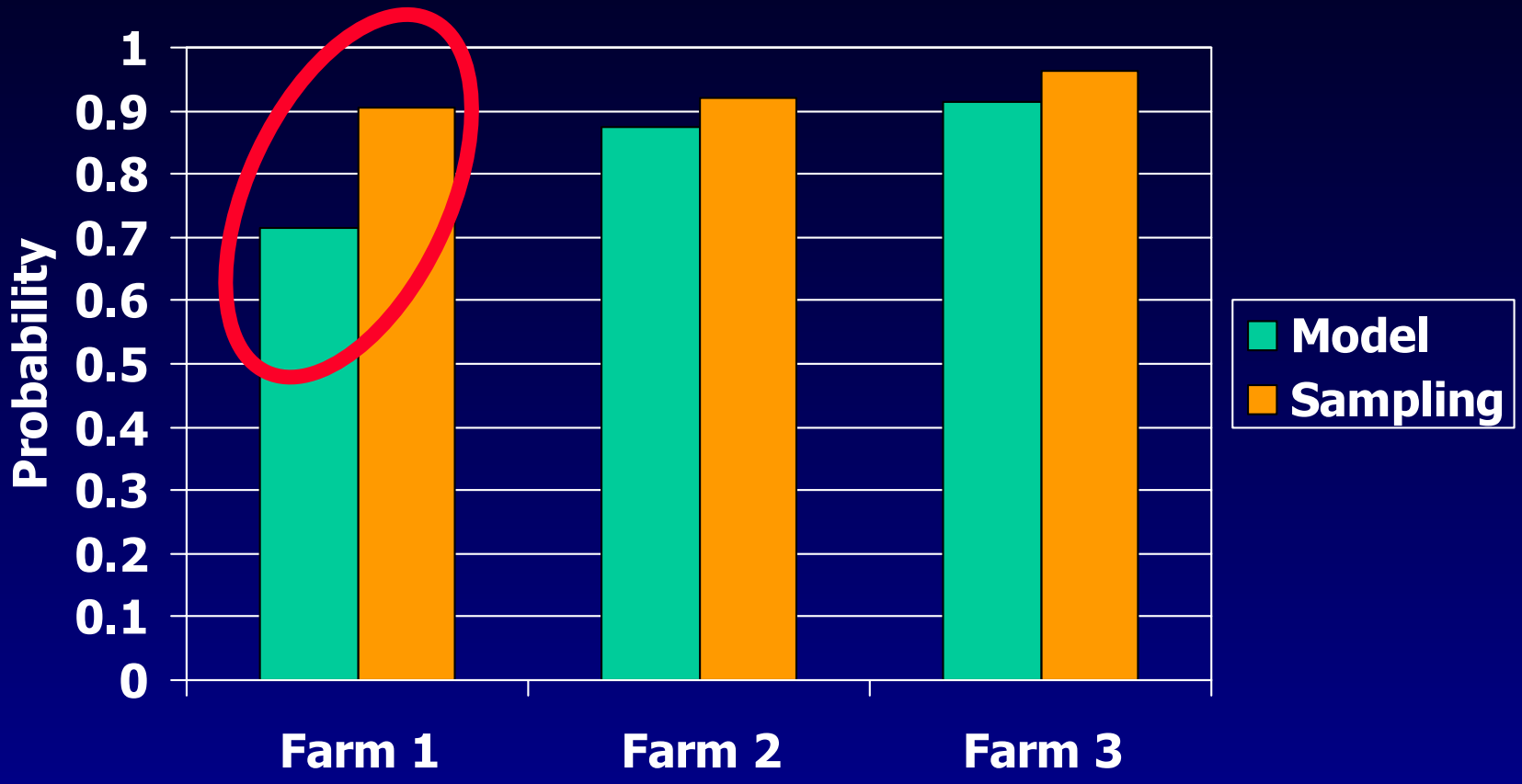
Example


Farm 2
Kg DM.ha-1
250
200
150
100
50
0
Feb 98
Mai 98
Aug 98
Nov 98
Feb 99
Mai 99
Aug 99
Nov 99
Feb 00
Mai 00
Aug 00
Nov 00
Feb 01
Mai 01
Aug 01
Date
Obs
Est
Obs-MAE
Obs+MAE

Example


Farm 3
Kg DM.ha-1
300
250
200
150
100
50
0
Dez 99
Jan 00
Feb 00
Mrz 00
Apr 00
Mai 00
Jun 00
Jul 00
Aug 00
Sep 00
Okt 00
Nov 00
Dez 00
Jan 01
Feb 01
Mrz 01
Apr 01
Mai 01
Jun 01
Jul 01
Aug 01
Date
Obs
Est
Obs-MAE
Obs+MAE

Example


Probability
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Farm 1
Farm 2
Farm 3
Model
Sampling

Proposed method: conclusions

Validation results expressed in terms of:

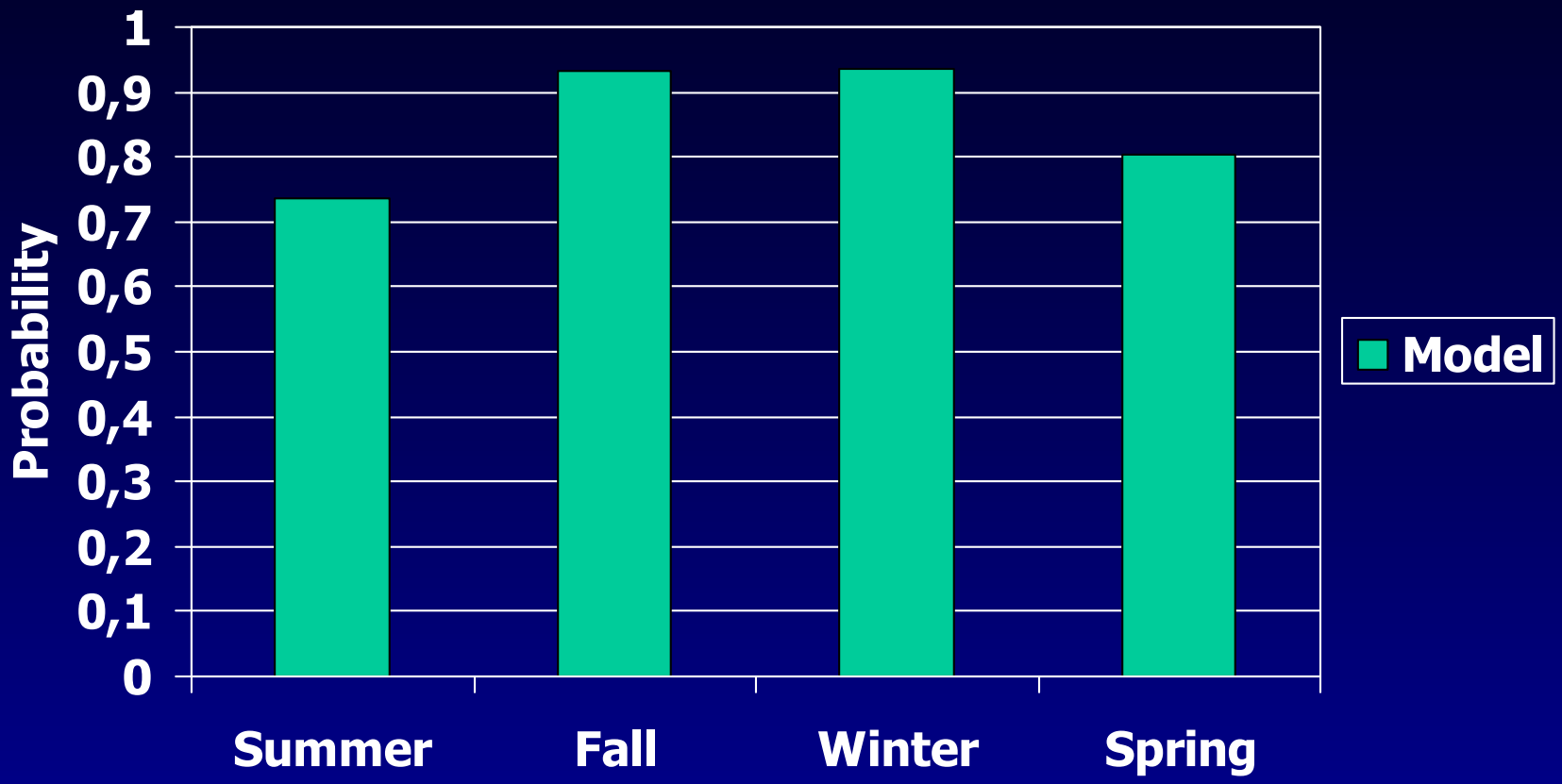
„Probability that the assessed model leads the decision-maker to take the decisions that would be taken with real values, given a certain decision-making context"

Proposed method: conclusions

- Decision-making context is stressed
- Method results are easy to interpret

Thank you for your attention

Example

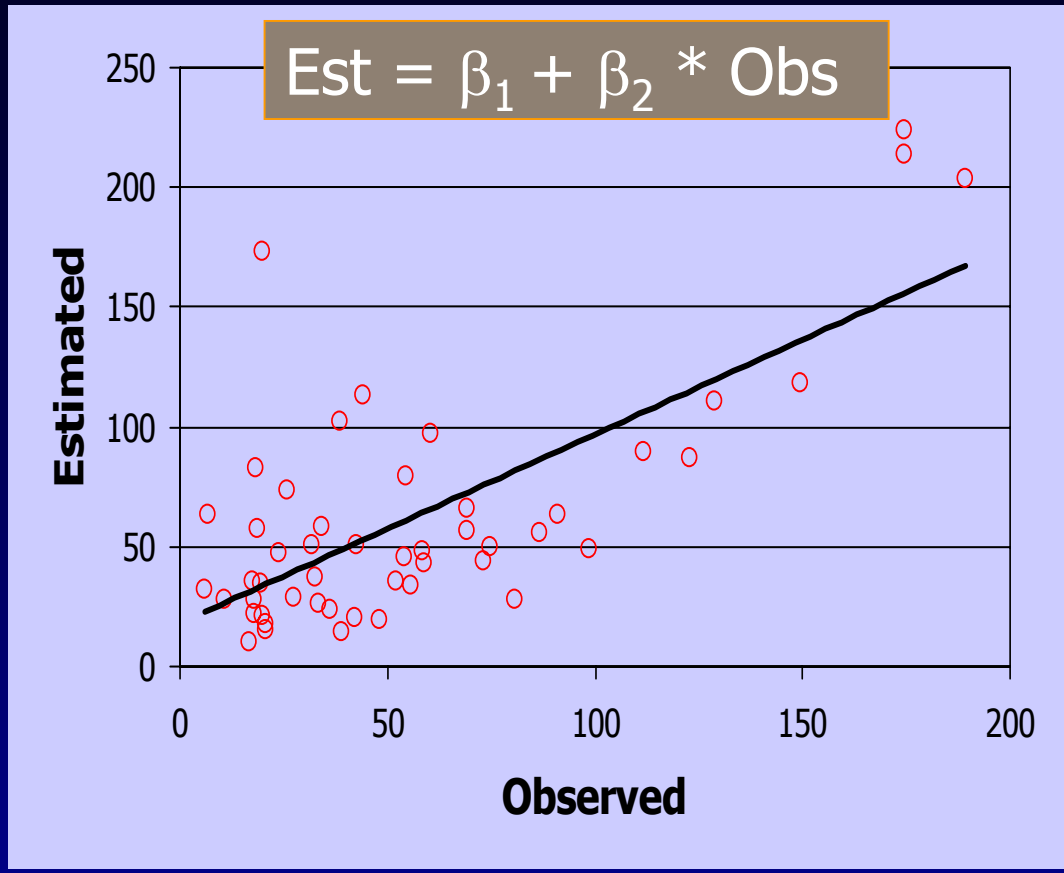

Probability
1
0,9
0,8
0,7
0,6
0,5
0,4
0,3
0,2
0,1
0
Summer
Fall
Winter
Spring
Model

Example

	Model Probability	Sampling Probability
Farm 1	0,715	0,905
Farm 2	0,873	0,920
Farm 3	0,915	0,962
Mean	**0,848**	**0,929**

Current validation methods

- Linear regression analysis
- Mitchell's method



Current validation methods

- Linear regression analysis
- Mitchell's method

$$Est = \beta_1 + \beta_2 * Obs$$

Simultaneous F-Test:

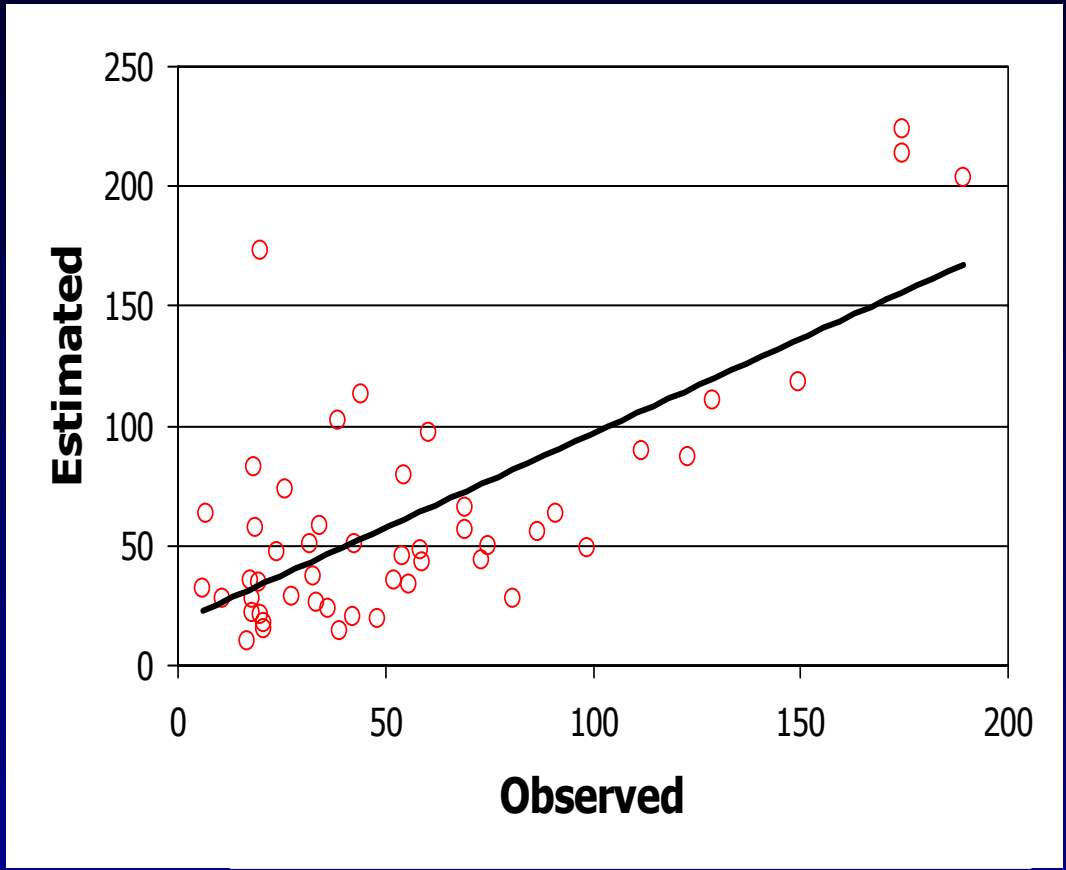
- H_0: $\beta_1 = 0$ and $\beta_2 = 1$
- H_1: $\beta_1 \neq 0$ or $\beta_2 \neq 1$, or both

Example: Regression analysis

- n = 50
- p = 0,0419

H0 Rejected

The model is INVALID



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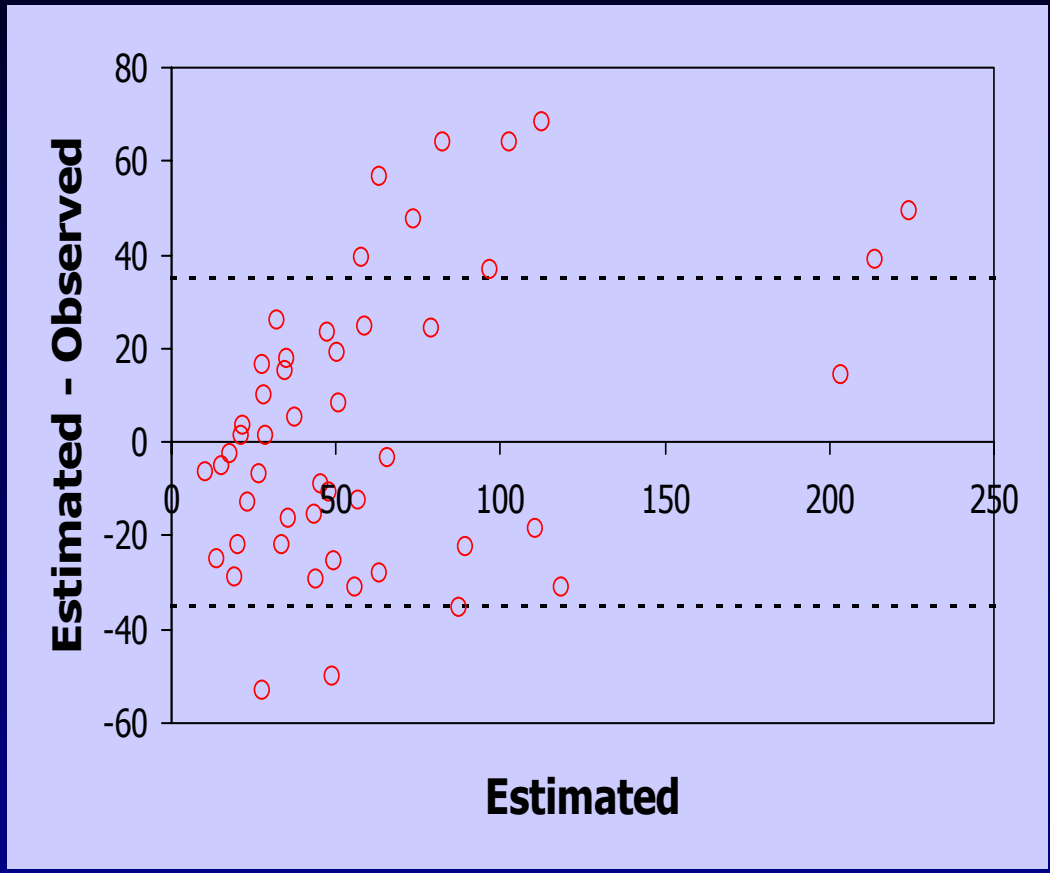

Example: Mitchell's method

	Model Probability
Farm 1	0,818
Farm 2	0,963
Farm 3	1,000
Mean	**0,940**