Session 89

Optimizing rearing performance through algorithmic approaches to maximize meat quality in livestock

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Headline

Introduction

Introduction

Consumer is more concerned

- Animal rearing system
- Sensorial and nutritional quality
- Environmental impact

Introduction

Adapting to consumer preferences and meet consumer expectations is mandatory for the viability of the market

How to optimize breeding practices to respond for market demand

Multi-objective algorithm

Deterministic

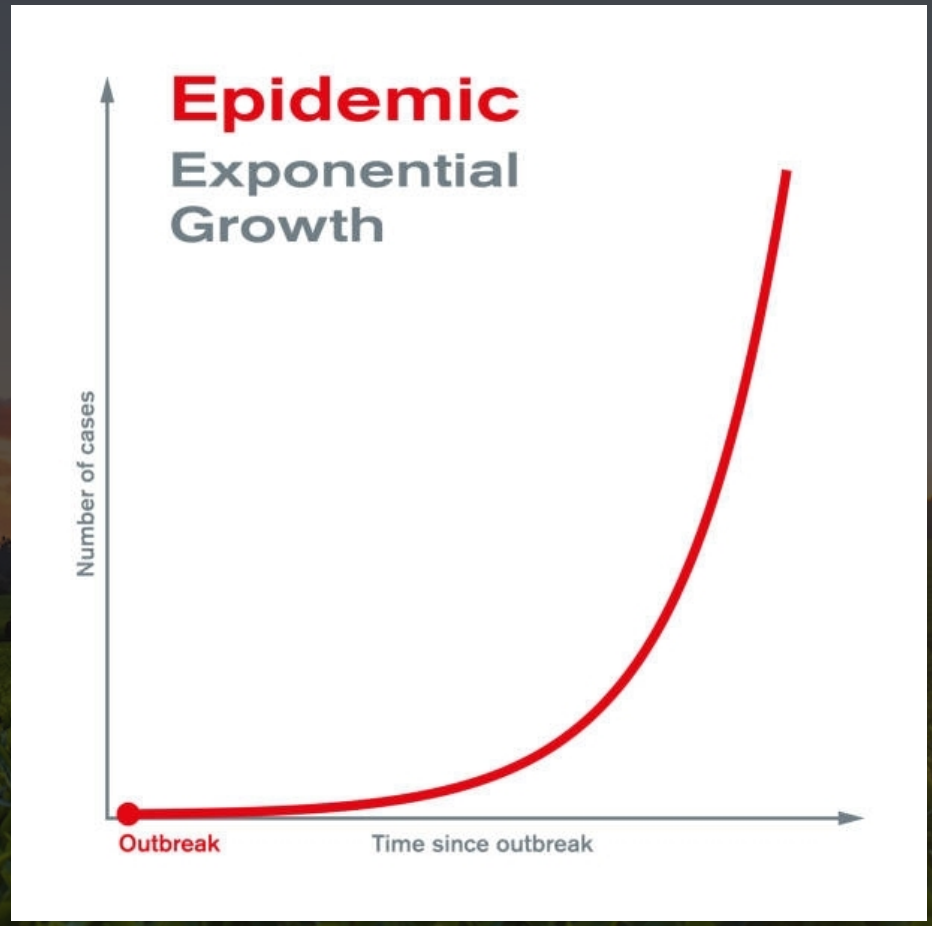
Object	Combinaison	Temps
5	32	0.0003 s
10	1024	0.0008 s
20	1 048 576	1 s
…		
77	23 722 485	5000 year

100%

Stochastic

Objet	Combinaison	Temps
77	23 722 485	1.7 s

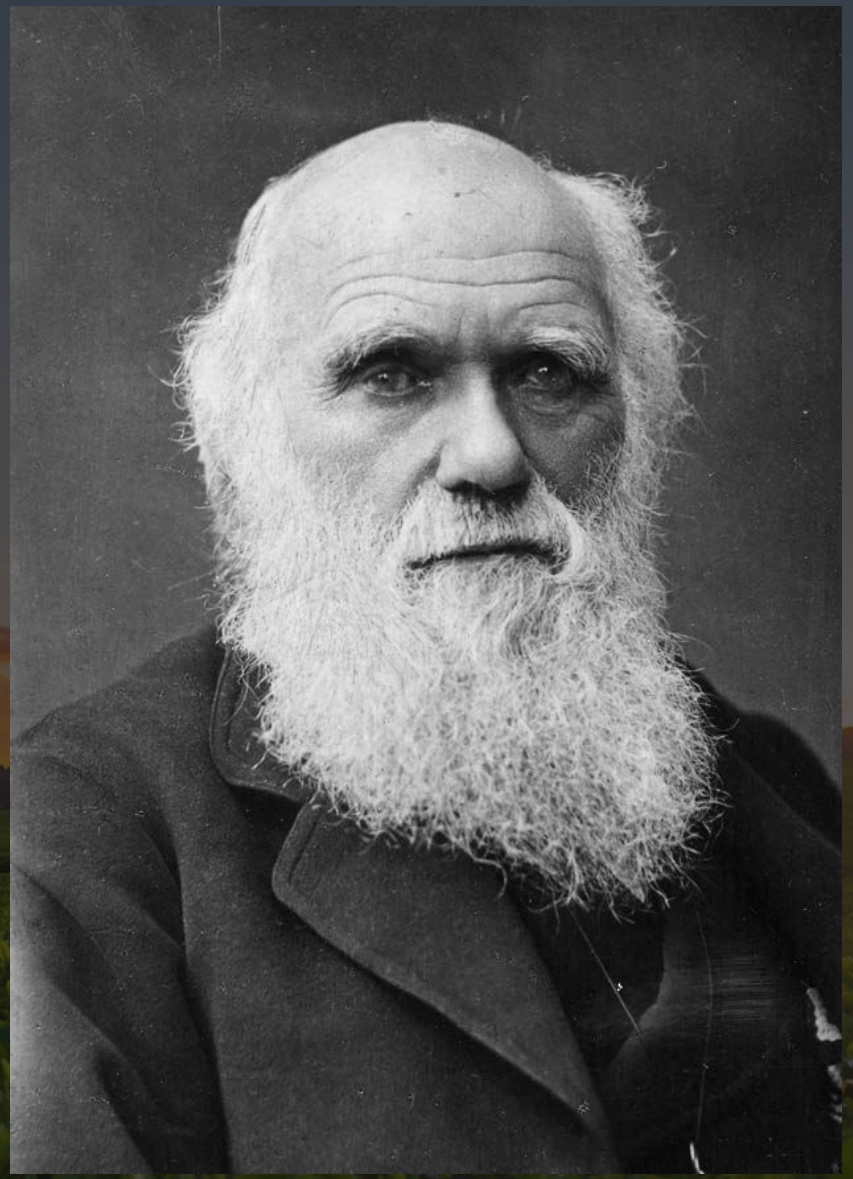
93%



Genetic Algorithm

Stochastic Optimization
Methods
Darwin's theory

Often used to find the best solution to a problem, when there is no deterministic method to calculate the exact solution.



OptiMeat V.1

OptiMeat v.1

INPUT

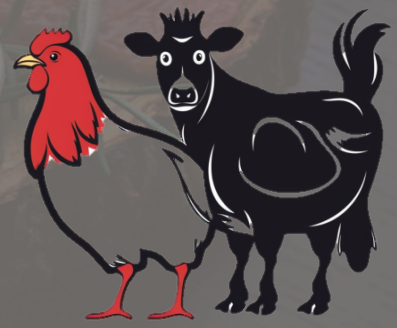
Decision Matrix

Body weight
Metabolizable Energy
Ageing
Feed consumption

Objective Matrix

Maximization Minimization

Tenderness
Juiciness
Flavor
Lipid



OptiMeat v.1

Decision Matrix			Objective Matrix	
ME	BW	Ageing	Tenderness *Maximization*	Flavor *Maximization*
10	2	3	4.3	12.4
12	3	5	6.3	20.4
11	7	6	14.3	24.4

OptiMeat v.1

$$\text{Tenderness} = 2 + 0.3\ \text{BW}$$

$$\text{Flavor} = 4 + 0.4\ Ageing + 0.2\ ME$$

Decision Matrix			Objective Matrix	
ME	BW	Ageing	Tenderness	Flavor
10	2	3	4.3	12.4
12	3	5	6.3	20.4
11	7	6	14.3	24.4

OptiMeat v.1

Decision Matrix		
ME	BW	Ageing
10	2	3
12	3	5
11	7	6

Fitness

$$\text{Tenderness} = 2 + 0.3\ \text{BW}$$

$$\text{Flavor} = 4 + 0.4\ Maturatin + 0.2\ ME$$

OptiMeat v.1

Initial Population

Fitness

Genetic operator

Best solution

Decision Matrix

$$f(X) = a_1x_1 + a_2x_2 + a_3x_3$$

Genetic operator


Genetic operator
Generation: n times
Initial Population
Decision Matrix
CrossOver
Mutation
Children = N size
Fitness
Population N x2
Selection

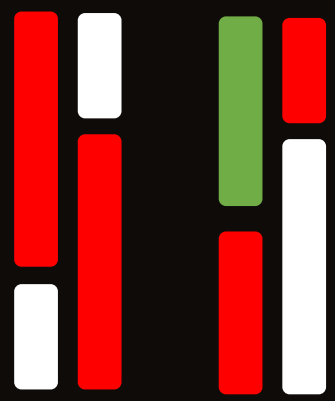

CrossOver

Crossover

(Bloc Swap)

Individual	ME	BW	Ageing
Parent 1	42	500	5
Parent 2	50	300	15

Child 1	**42**	500	**15**
Child 2	50	300	5



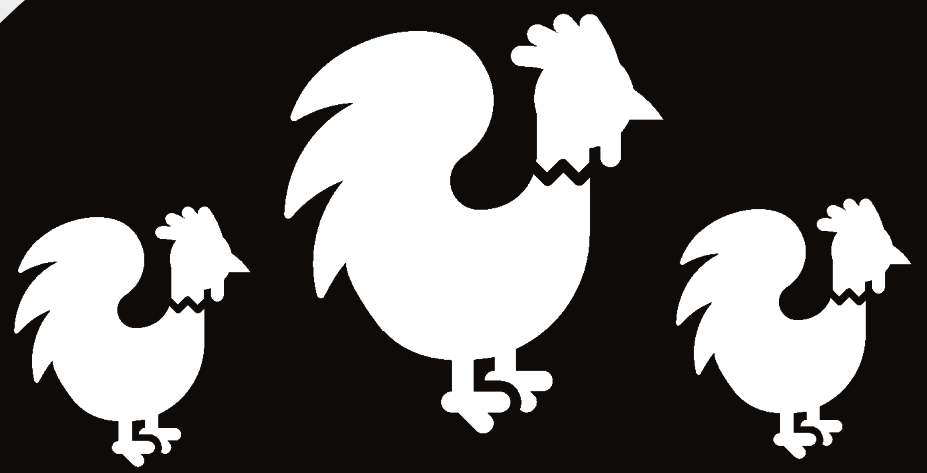
Mutation

Mutation

Maximum-Minimum

	minimum	maximum
BW	200	400

Individual	ME	BW	Ageing
Parent 1	42	500	5
Child 2	42	300	5



Children

= N size

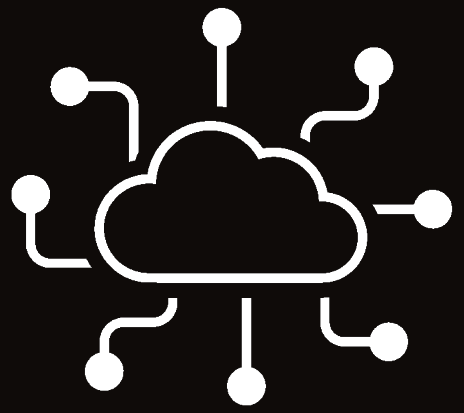
Population

Parent = Decision Matrix		
ME	BW	Ageing
10	2	3
12	3	5
11	7	6

Children = Decision Matrix		
ME	BW	Ageing
42	500	15
50	300	5
50	300	5

Population

	Decision Matrix		
	ME	BW	Ageing
Parent	10	2	3
	12	3	5
	11	7	6
Child	42	500	15
	50	300	5
	50	300	5



Fitness

Fitness

	Decision Matrix		
	ME	BW	Ageing
Parent	10	2	3
Parent	12	3	5
Parent	11	7	6
Child	42	500	15
Child	50	300	5
Child	50	300	5

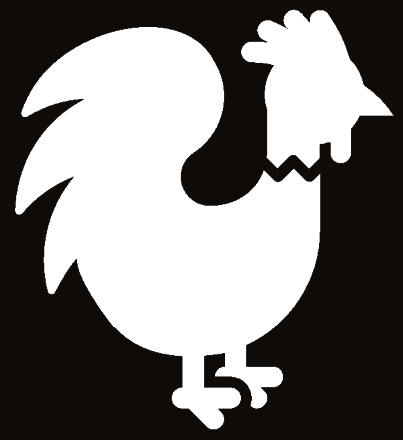
	Objective Matrix	
	Tenderness	Flavor
Parent	4.3	12.4
Parent	6.3	20.4
Parent	14.3	24.4
Child	?	?
Child	?	?
Child	?	?

Fitness

$$\text{Tenderness} = 2 + 0.3\ \text{BW}$$
$$\text{Flavor} = 4 + 0.4\ Maturatin + 0.2\ ME$$

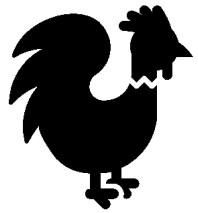
	Decision Matrix		
	ME	BW	Ageing
Parent	10	2	3
	12	3	5
Child	11	7	6
	42	500	15
	50	300	5
	50	300	5

	Objective Matrix	
	Tenderness	Flavor
Parent	4.3	12.4
	6.3	20.4
Child	14.3	24.4
	4.3	12.4
	6.3	20.4
	14.3	24.4




Selection

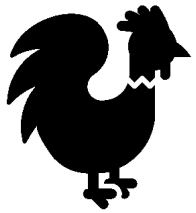
Selection (Pareto Front)



	Objective Matrix	
	Tenderness	Flavor
A	4.3	12.4
B	6.3	20.4
C	14.3	24.4
D	14.3	24.4
E	4.3	12.4
F	6.3	20.4
G	14.3	24.4

Selection

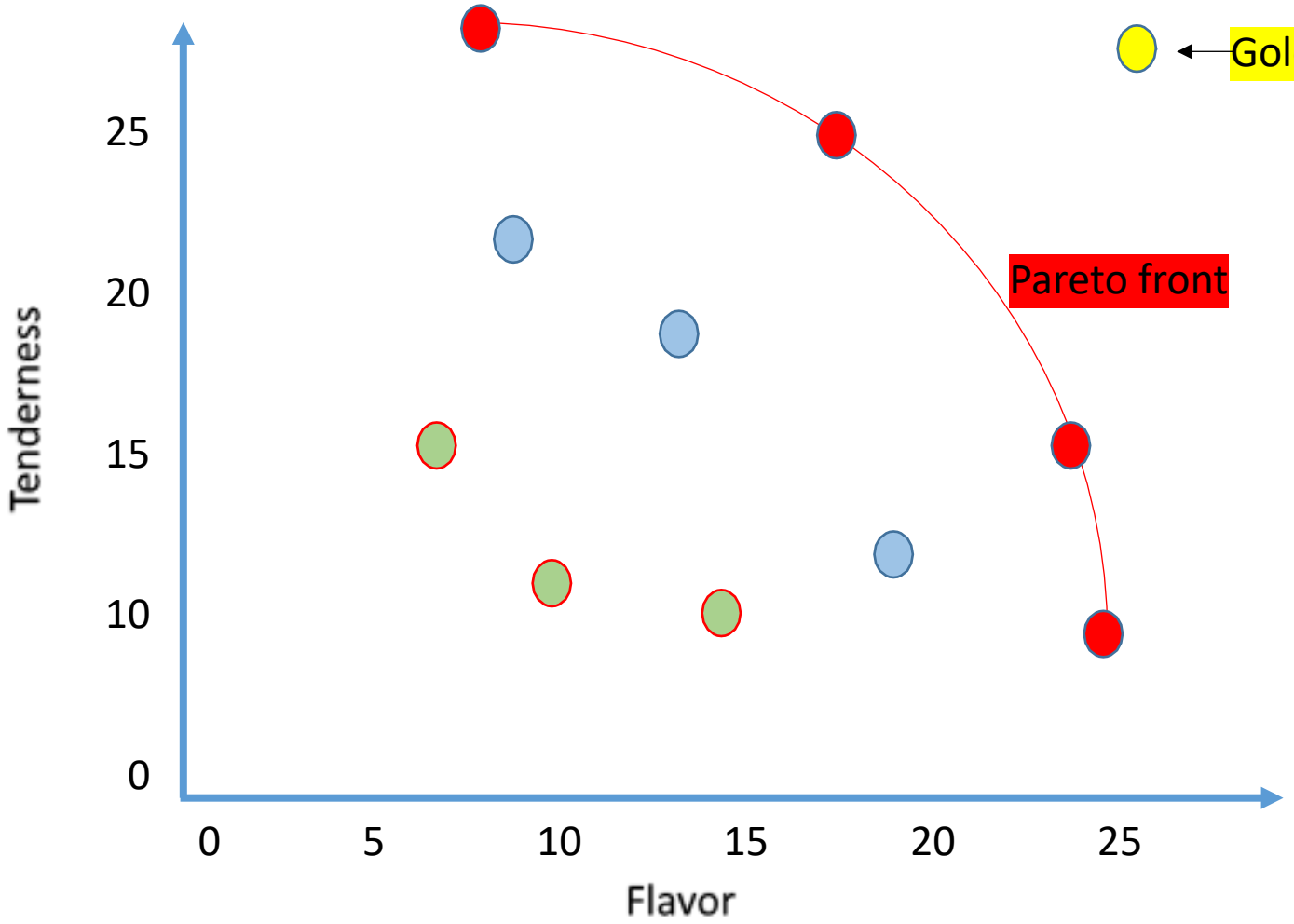
(Pareto Front)



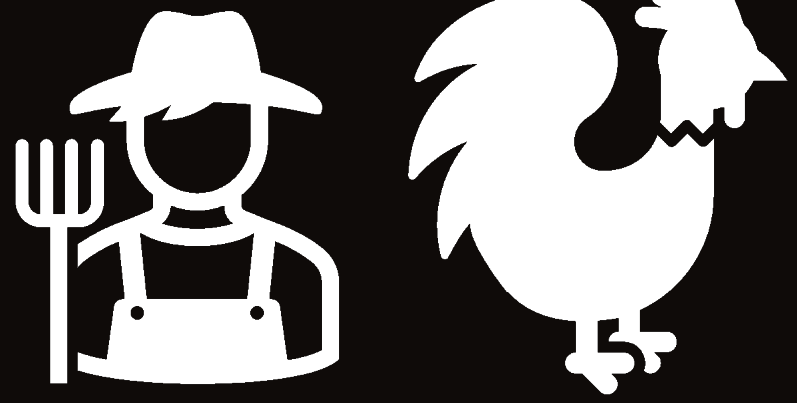
ME	BW	Ageing
10	2	3

Golden solution

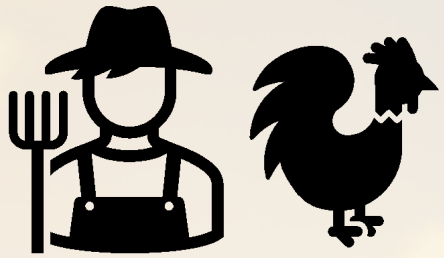
Pareto front



Headline



Application



Application

ITAVI INRAE

Label Rouge, Certified, Standard and Heavy Broilers

four main French production systems

7,843 Chicken Breast

Decision Matrix

BW (kg)
Age (day)
Carcass Holding Period (hour)

Objective Matrix

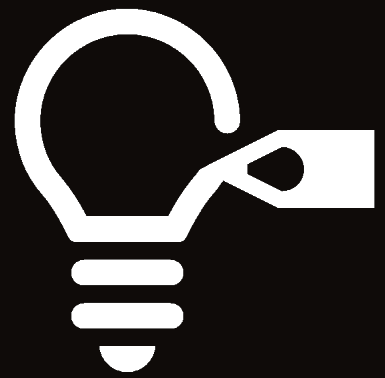
Minimization

Lipids (%)
Toughness (N)
Cooking loss (%)

Result

		Standard	Certified	Label	Heavy
	Generation	11	6	8	8
Breeding practices	*BW (kg)*	2.39	1.80	2.42	4.78
	Age (day)	35	44	92	N/A
	1. Carcass Holding Period (hour) DEBONING TIME PLUS EXPL	30	48	8	3
Objective	*Lipids (%)*	1.62	1.19	0.95	1.70
	Toughness (N)	9.50	17.15	20.02	15.04
	Cooking loss (%)	10.65	12.36	12.44	12.77

Headline



Next Step

Next Step

Evaluation

Nonparametric method
Random forest

Decision Matrix

Implementing
Qualitative variable

Thank you

Acknowledgments

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Jérôme Saracco

Jean-François Hocquette

SCAN ME