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A Method to Evaluating High Accuracy Measurement of Quality Characteristics On-line

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Background

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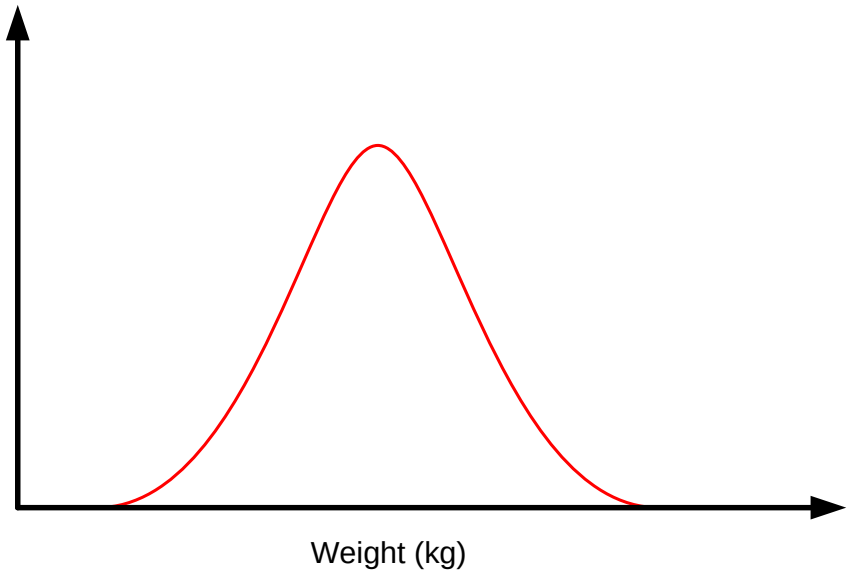
- New equipment to measure quality is continuously introduced
  - Often the measurements are performed in quite an indirect nature
  - Hard working environment
  - Only short time to perform the measurements
  - This often result in a substantial measuring error
  - We have developed a procedure to compute the value of such new measurements

Purpose of sorting

- Pigs are biological material
- Large variation in quality and size etc. are handled by sorting the raw materials in different sorting groups



Other examples of sorting criteria:

-colour

-pH

-lean meat percentage

-size

-specific placement of meat and fat

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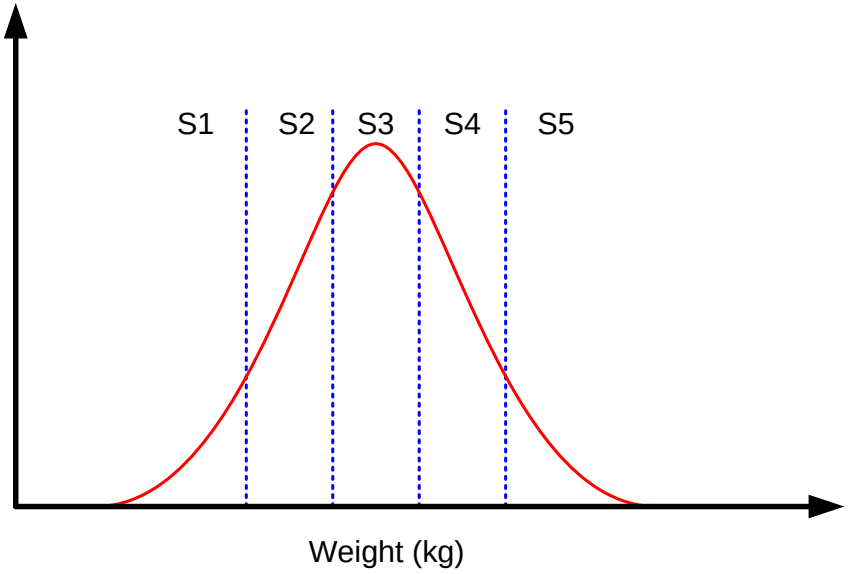


Other examples of sorting criteria:

-colour

-pH

-lean meat percentage

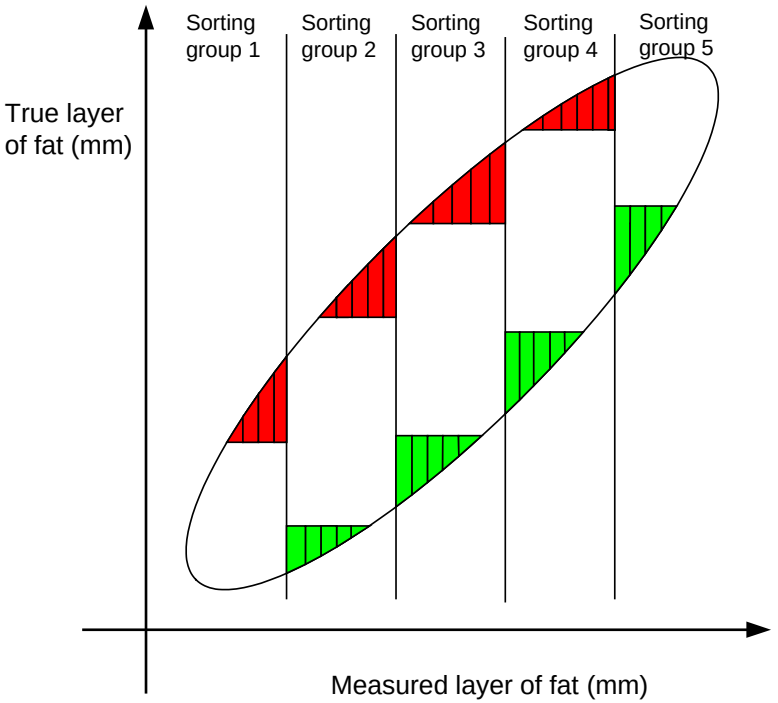
-size

-specific placement of meat and fat

Measurements and sorting

- The measuring accuracy is very important for how well it is possible to sort

Current measuring accuracy



- Illustration based on fat layer
- Most observations within the cigar shaped form
- The carcasses are sorted into 5 sorting groups
- Some carcasses does not quite live up to specifications (red)
- Other of “too good” a quality (green)

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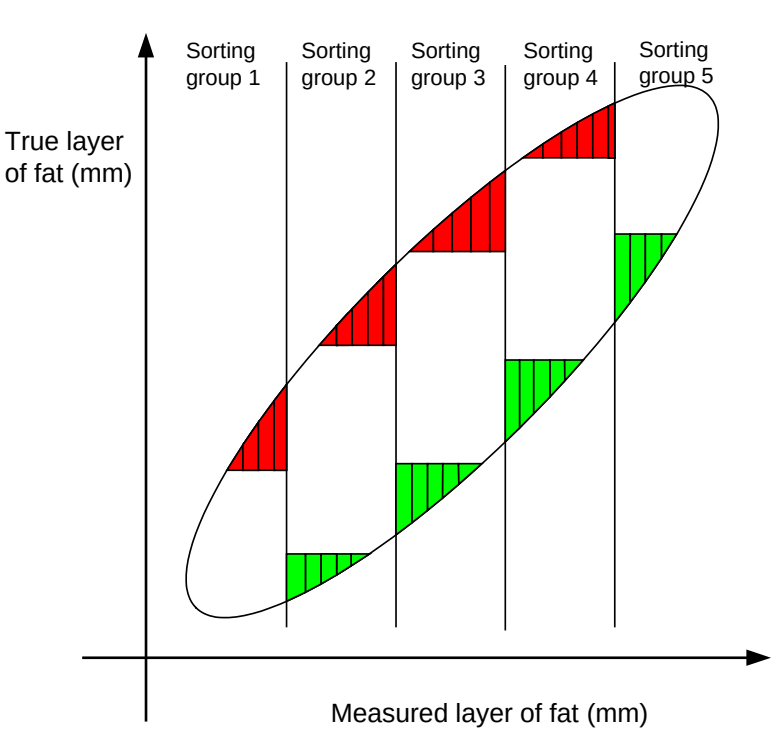
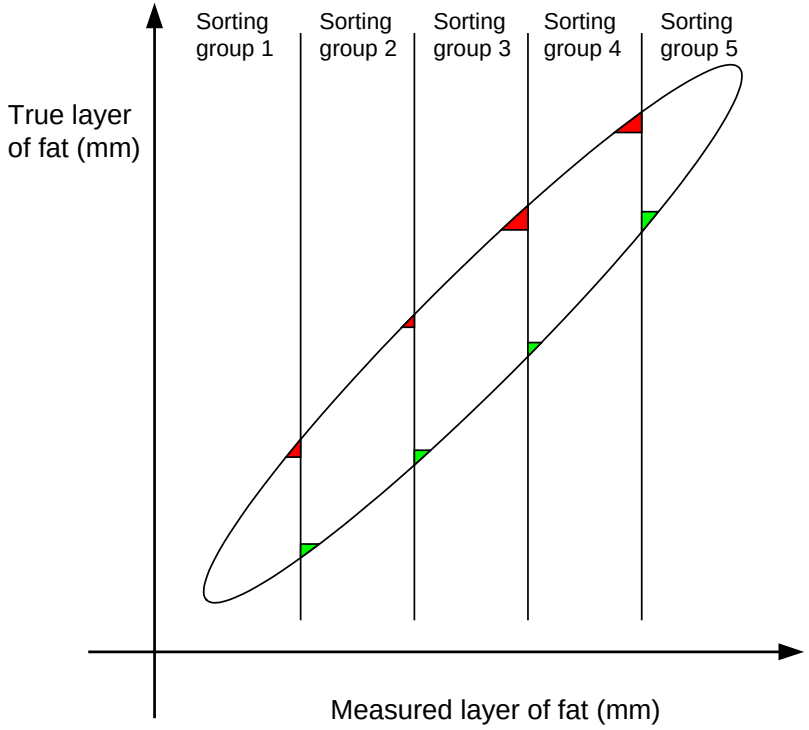
Current measuring accuracy

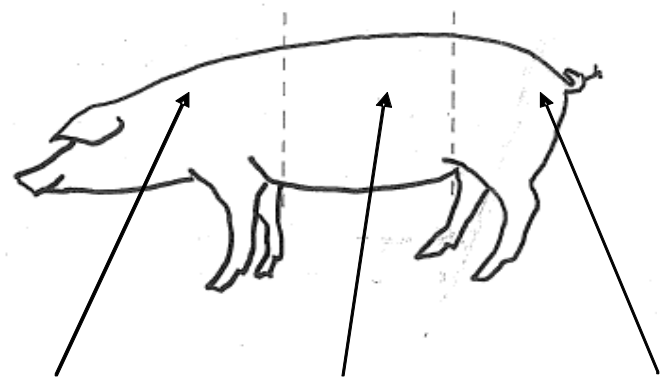


Improved measuring accuracy



Model

- Product alternatives:



Fore-end	**Middle piece**	**Ham**
Alternative 1	*Alternative 1*	*Alternative 1*
Schoulder	Backs (with bones)	Ham
Neck	Breast 1	Sundry 4
CutOff 1	CutOff 2	
Sundry 1	Sundry 2	
	Alternative 2	*Alternative 2*
	Backs (boneless)	Ham (boneless)
	Breast 2	CutOff 5
	CutOff 3	Sundry 5
	Sundry 3	

Model

Objective function:

1) Maximize $Z = \sum_{k,n} ValueBar_{k,n} * y_{k,n}$

- The objective function is to maximize the total net value of the carcasses
- For each carcass the product weights are estimated for each alternative use
- Net price per kg for the different products depends on the quality

Assumptions for the computations

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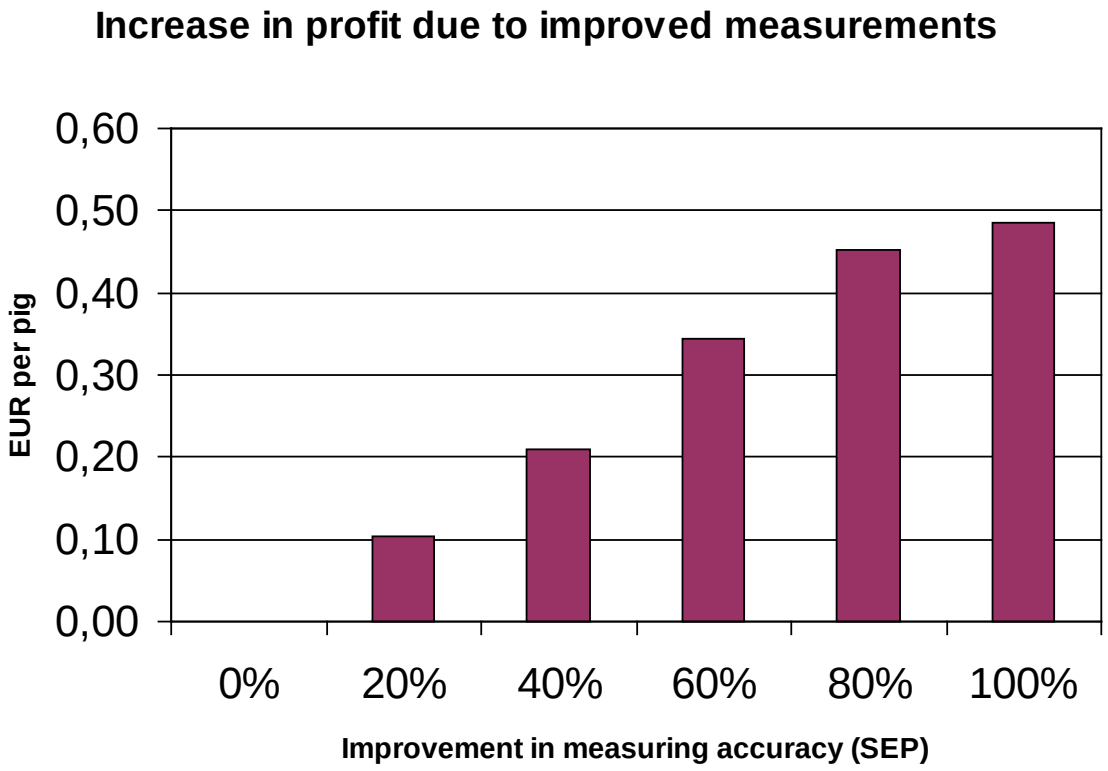
- Slaughter data for approx. 44.000 pigs
- Model solved twice: one time with the current measuring accuracy and one time with an improved level
  - The economic consequences then can be found as the difference between these two computations

Results

- The economic consequences are computed at 6 different levels of measuring accuracy



Conclusion

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- Mathematical programming and optimization can be used to compute the economic consequences of improved knowledge
- The information required has been identified
- In the example: improved measuring accuracy of e.g. 40% increases the profit by EUR 0.21 per pig
- Measuring new quality characteristics is not enough – it is important that the measurements are accurate as well

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Thank you for your attention

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Extras

Model

Objective function :

1) $\text{Maximize } Z = \sum_{k,n} \text{ValueBar}_{k,n} * y_{k,n}$

Subject to the following constraints :

2) $\sum_{n} y_{k,n} = 1 \qquad \forall\, k$

3) $y_{k,n} = \begin{cases} 1 \text{ if product alternative n is produced} \\ \text{by pigs placed on bar k, otherwise } 0 \end{cases}$

Parameters :

4) $\text{ValuePig}_{i,n} * \sum_{j} (\text{Price}_j + \text{PriceCoeff}_j * \text{measured quality}_i) * \text{ProdWeight}_{i,j} * U_{j,n}$

5) $\text{ValueBar}_{k,n} = \sum_{k} \text{ValuePig}_{k,n}$

Indices :

i : pig i k : bark k j : product j n : alternative use n