Use of livestock quality estimates for improved product allocation planning to meat processing locations

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Presentation overview

- Problem description
- Supply strategies
- Supply plan evaluation criteria
- Results
- Conclusion and further research
Problem description

- Differences in farmer production systems lead to variation in meat quality features
- Market segments differ in
  - demand for quality features
  - demand for logistics services
  - market constraints
- These combined features affect location specific yield of animal batches
Problem description

- A meat company owning multiple slaughterhouses transports animals to the nearest processing location without using quality information in supply planning.
- Use of quality information in supply planning might improve overall profitability
Problem description

- 5 slaughterhouses
- Carcasses sorted into 12 different classes
- Location-specific value of different classes
- Farmers differ in
  - Geographic location
  - # of animals they deliver
  - Quality features of animals they deliver
Basic scenario: current supply strategy

Allocation based on:
- Animals required at slaughterhouse
- Optimum based on
  - Transport costs
    km x € 0.0074 x #
Advanced scenario: quality based supply strategy

Allocation based on:
- Animals required at slaughterhouse
- Optimum based on
  - transport costs km x € 0.0074 x #
  - carcass yield specific value x #
Supply plan evaluation criteria

- Allocation plan for 1 day, 49 livestock batches
- Quality a farmer will deliver predicted based on historical data
- MILP model optimized allocation plan for both supply strategies

KPI: ‘net value’ of allocation plan

- Carcass yield: (specific value x #) minus
- Transport costs: (km x € 0.0074 x #)
Supply plan evaluation criteria

- Scenario 1: basic supply strategy
  \[ \min \sum_i \sum_j \{ X_{ij} \times a_i \times d_{ij} \} \]

- Scenario 2: quality based allocation strategy
  \[ \max \left\{ \sum_i \sum_j \sum_k \sum_l \{ X_{ij} \times a_i \times p_{jk} \times q_{kl} \times m_{il} \} - \sum_i \sum_j \{ X_{ij} \times a_i \times d_{ij} \} \right\} \]

- Net value of allocation plan
  \[ \left\{ \sum_i \sum_j \sum_k \sum_l \{ X_{ij} \times a_i \times p_{jk} \times q_{kl} \times m_{il} \} - \sum_i \sum_j \{ X_{ij} \times a_i \times d_{ij} \} \right\} \]
## Results

<table>
<thead>
<tr>
<th>Supply strategy</th>
<th>Transport costs</th>
<th>Carcass value</th>
<th>Net value of allocation plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current supply strategy</td>
<td>€ 6055</td>
<td>€ 516499</td>
<td>€ 510444</td>
</tr>
<tr>
<td>Quality based supply strategy</td>
<td>€ 8824 + 45.7 %</td>
<td>€ 526720 + 1.98 %</td>
<td>€ 517896 + 1.46 %</td>
</tr>
</tbody>
</table>
Results: sensitivity analysis

Improvement of allocations net value with varying transport costs
Results: sensitivity analysis

Improvement of allocations net value with varying location specific values

<table>
<thead>
<tr>
<th>Improvement of Net Value [%]</th>
<th>Variation of prices [%]</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>2</td>
<td>200</td>
</tr>
<tr>
<td>3</td>
<td>300</td>
</tr>
</tbody>
</table>

The graph illustrates the linear relationship between the improvement of net value and the variation of prices.
Conclusion and further research

Conclusion

Use of quality information in slaughterhouse supply planning has the potential to improve profitability of meat processors

Further research is suggested to:

- Analyze larger dataset
- Include more operational variables, e.g.
  - Combined livestock transports
  - Include market – farmer constraints
- Evaluate use of quality information in other areas of pork supply chains
Questions, remarks and recommendations

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