Drinking Behaviour Patterns in Dairy Cattle

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CPSC 547 Final Presentation - Fall 2021
Individual level cattle behaviour

- Farms are incentivised to re-evaluate their best management practices
- Water deprivation can adversely affect their health, behavior, and performance
- Significant behavior differences amongst individual cows
- Critical in making optimal decisions for housing and water access
InsenTec System
Peek-a-Moo
<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
<th>Scale</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cow</td>
<td>Categorical</td>
<td>A unique 4 digit number assigned to each cow</td>
<td></td>
<td>n=53</td>
</tr>
<tr>
<td>Start</td>
<td>Ordinal</td>
<td>The date and time when the visit starts</td>
<td></td>
<td>Range = 15/7/2020 - 3/5/2021</td>
</tr>
<tr>
<td>Duration</td>
<td>Quantitative</td>
<td>The time spent in the water bin</td>
<td>seconds</td>
<td>0-250</td>
</tr>
<tr>
<td>Intake Amount</td>
<td>Quantitative</td>
<td>The amount of water consumed</td>
<td>Kg</td>
<td>0-30</td>
</tr>
<tr>
<td>Bin</td>
<td>Categorical</td>
<td>The number of water bin</td>
<td></td>
<td>101,102,103, 104,105</td>
</tr>
</tbody>
</table>
### Derived:

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
<th>Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daily Duration</td>
<td>Quantitative</td>
<td>Sum of all durations of visits during the day</td>
<td>seconds</td>
</tr>
<tr>
<td>Daily Intake</td>
<td>Quantitative</td>
<td>Sum of all water intake amount of visits during the day</td>
<td>Kg</td>
</tr>
<tr>
<td>Average Daily Duration</td>
<td>Quantitative</td>
<td>Average of daily water intake for all days</td>
<td>seconds</td>
</tr>
<tr>
<td>Average Daily Intake</td>
<td>Quantitative</td>
<td>Average of daily water intake for all days</td>
<td>Kg</td>
</tr>
</tbody>
</table>
Why?  

**Task Abstraction**

- **T1**: Intake-Duration Correlation
  - Explore the correlation between the Daily Duration and Daily Intake
    - Discover the similarities and patterns in herd-level
      - Groups of cows that are similar
      - Pattern for each individual
    - Compare the behaviour of all cows
Why? → **Task Abstraction**

- **T2:** Seasonality
  - Explore the correlation between time and visits
  - Discover
    - Seasonality of the data
    - Distribution of visits in time
    - Similarities between herd and each individual

- **T3:** Individuals
  - Present the consistent drinking behaviours in individuals
How?

The Solution
How? 

The Solution (Intake Duration Correlation)

Intake Duration Correlation

Daily Duration and Intake Correlation

Herd Summary

Cow Clusters

Bin Usage among Clusters
How?  **The Solution** (Seasoning)

Seasonality

Group’s Time Spent in the Drinker

Individuals’ Time Spent in the Drinker

Time of Drinking
How?  

The Solution (Individuals)

Individuals

Cow: 4044

Time Interval: August 6, 2020 to March 12, 2021

Daily Duration and Intake Correlation

Preferred Bin

Time of Drinking

Visit Duration and Intake Correlation

Visits Summary
Limitations and Future Work

- **Time**
- The dataset contains data from different time intervals for different cows
  - limits the comparisons
    - time filter
    - compare

- **Visit-Level Analysis**
  - high density of short visits
  - important
    - time
    - sequence
    - frequency
Limitations and Future Work (cont.)

- Aggregation
  - Different time scales
- Clustering
- Evaluation and interactive refinements
Thank you!
Backup Slides
Dataset

- A dynamic group of 48 cows being watched for 10 months
- All visits to the water bins during 10 months of monitoring

<table>
<thead>
<tr>
<th>Cow ID</th>
<th>Bin Number</th>
<th>Time</th>
<th>Duration</th>
<th>Intake</th>
</tr>
</thead>
<tbody>
<tr>
<td>Categorical</td>
<td>Categorical</td>
<td>Ordinal</td>
<td>Quantitative</td>
<td>Quantitative</td>
</tr>
</tbody>
</table>
What? The Data

- all the information for 10 months of all visits to the water bins
- The monitored cows were not the same during these 10 months and were being replaced
  - target group: 53 cows which were monitored more than 4 months
What is the question?

- Consistent individual differences in drinking behavior of cows
- Relationship between frequency and duration of visits and feed/water intake
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Task Abstraction

Discover and Compare
- the correlation between the duration of time spent in the water bins with the amount of water intake

Discover
- the seasonality of the data and the effect of the time on drinking behaviour

Summarize
- the drinking behavior of the all individuals based on duration of time spent in water bins and their water intake

Group Level

Clusters

Individuals