University of British Columbia/Statistics

Characterizing dominance in free stall housed dairy cattle based on competitive behavior at the water trough

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Abstract

★ This research study aims to check:
- ○ The reliability of the water bin data compared to feed bin data.
- ○ The THI (Temperature and humidity index) effect on water bin.

★ After statistical analysis, we conclude that:
- ○ There is insufficient evidence to say the replacements recorded at water bins may be reliable in predicting cows' dominance hierarchy.
- ○ THI actually seems to affect the dominance measure at water bins.

Introduction

★ Improve herd management and animal welfare.

★ Electronic feed bin and water bin data for agonistic interactions were recorded from July 2020 to May 2021 among the population of 48 Holstein dairy cows in a dynamic group.

★ Variables used in each replacement: date, hour, bin type, actor cow id, reactor cow id and THI max.

Method

★ Elo rating algorithm to calculate dominance scores for cows.

★ Spearman's rank correlation test for comparing the similarity between ranks in each comparison group.

★ Fisher's z-test to test if the difference between two correlation coefficients are statistically significant.

★ VAH algorithm used to account for inconsistencies introduced through random sampling.

Results

	Group 1	Group 2	Average Spearman's rank correlation ($\bar{\rho}$)
Test 1	Feed bins	Water bins	0.59
Test 2	Feed bins & high THI	Water bins & high THI	0.52
Test 3	Feed bins & low THI	Water bins & low THI	0.58
Test 4	Water bins & high THI	Water bins & low THI	0.55
Test 5	Feed bins & high THI	Feed bins & low THI	0.83

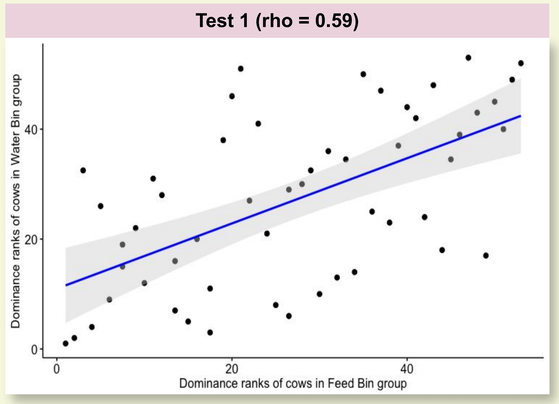

Figure 1: Correlation between the dominance ranks at Feed Bin and Water Bin (Overall)

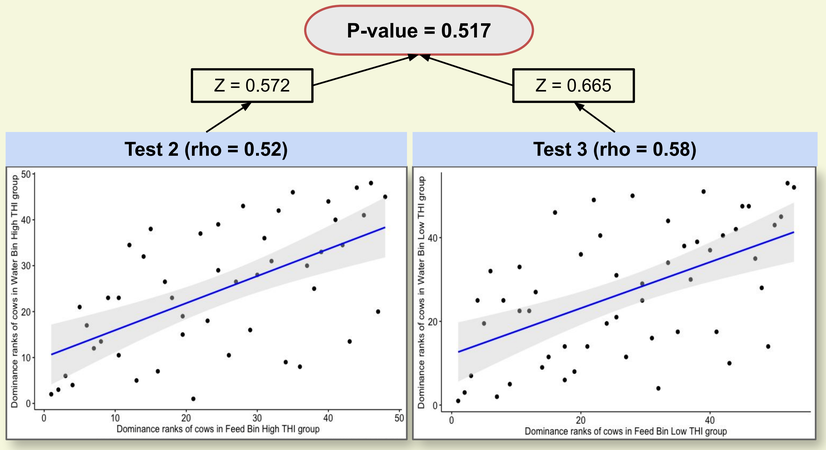

Figure 2: Correlation between the dominance ranks at Feed Bin and Water Bin under High THI (>= 65)

Figure 3: Correlation between the dominance ranks at Feed Bin and Water Bin under Low THI (< 65)

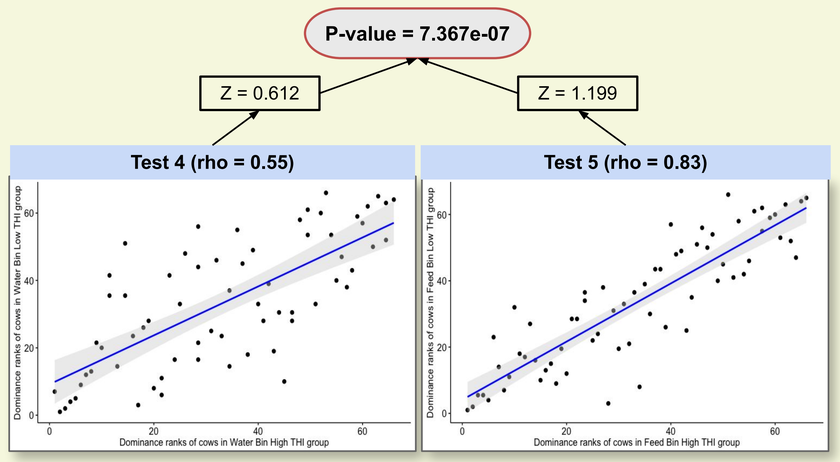

Figure 4. Correlation between the dominance ranks at Water Bin under High THI vs under Low THI

Figure 5. Correlation between the dominance ranks at Feed Bin under High THI vs under Low THI

Conclusions

★ We could not confidently say the use of replacements at the water bins is as reliable as the use of replacements at the feed bins for accessing cows' dominance hierarchy.

★ The structure of the dominance hierarchy at water bins will be affected by THI levels.

Discussion

★ Another approach to balance out sample size and parameter k is optimizing k for each group by maximizing the log-likelihood of cow's winning probabilities.

★ Since we only have the hourly timestamp, the relative order of replacements happened in the same hour is unknown. However, we experimented with several different orders and it turned out having a minor effect on cow's dominance measure.

References

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