UNIVERSITY of GUELPH

ONTARIO AGRICULTURAL COLLEGE

DEPARTMENT OF ANIMAL BIOSCIENCES

PhD Defence

Python Based Genetic Evaluation System for the Improvement of Multi-Breed and Crossbred Beef Cattle

Kristin Lee

Date: August 29th 2024 at 2:00pm

The PhD Defence for Kristin Lee has been scheduled for August 29th, 2024 at 2:00pm. The defence will be held online via Teams and in room 101: https://teams.microsoft.com/l/meetup-join/19%3ameeting_M2JjNjI3ZjEtNTAyMS00YTkwLWI4ZGUtY2VkNTg3MjkxMmUw%40thread.v2/0?context=%7b%22Tid%22%3a%22be62a12b-2cad-49a1-a5fa-85f4f3156a7d%22%2c%22Oid%22%3a%22fbd28915-dda5-478f-8ecb-a3682dcf0c3a%22%7d

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Abstract:

The beef cattle industry faces the challenge of balancing sustainability and profitability. Technological advancements of
dress this challenge. AgSights provides a commercial, user-friendly genetic evaluation system (GES). However, its curre
tion in lower-level programming languages (C and Fortran) limits its adaptability. In contrast, Python is a high-level pr
guage designed for developer productivity. Its adoption could facilitate rapid integration of new functionalities and easi
over time. This thesis investigated the feasibility of using Python to update AgSights' GES. The Python GES was develope
encompasses functionalities for data cleaning, renumbering, and formatting. It can calculate relationship coefficients an
ces, including inbreeding coefficients and the inverse of the pedigree or hybrid (pedigree + genomic) relationship matri
employs a preconditioned conjugate gradient algorithm with iteration on data to predict breeding values. In addition to r
AgSights' current pedigree-based GES, the software also incorporated genomic information through single-step genomic
biased prediction (ssGBLUP) to modernize the current GES. Pedigree BLUP (Chapter 3) and ssGBLUP (Chapter 4) were app
trait models using simulated datasets representative of a beef breeding program for growth traits. In Chapter 3, the sol
for the prediction of over 2.9 million random effects took 12 minutes and 50 seconds. The addition of up to 10,000 genot
the evaluation increased computing time to 39 minutes and 28 seconds. Additionally, pedigree BLUP was tested u
collected data encompassing a crossbred and multi-breed population (Chapters 5 and 6). Chapter 5 employed a single-tr
uating 171,606 animals in approximately 2 minutes. Chapter 6 used a multiple-trait maternal model, evaluating over 3.2
in just over 11 hours. Across all scenarios, the entire genetic evaluation process was completed within a day, maintainin
predictions. Overall, it can be concluded that Python provides a suitable framework for developing flexible GES for mod
and crossbred beef cattle breeding programs and, more generally, livestock breeding programs. The shift towards Pyth
opportunity for more innovative and efficient genetic evaluation practices, ultimately promoting a more sustainable and
stock industry.