Genetic Analysis of Pen Data: Validation Using Average Daily Gain and Application to Pen Feed Intake

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Jian Cheng, Graduate Research Assistant, ISU;
Xiang Ma, PhD student, Aarhus University, Denmark;
Jack Dekkers, Distinguished Professor, ISU

Summary and Implications

Individual feed intake is expensive to measure. Alternatively, pen feed intake could be used for genetic evaluation. In this study, the group genetic analysis model previously proposed was validated using average daily gain (ADG) records of nursery pigs and applied to pen average daily feed intake (ADFI) available on those same pigs. The results indicate that pen data can be used to estimate genetic parameters, though with larger standard errors than obtained using individual data. Thus, pen feed intake can be used for genetic evaluation in lieu of individual feed intake data.

Introduction

Electronic feeders are used to collect data on individual grow-finish pigs housed in pens for genetic evaluation of feed intake and feed efficiency. Although using electronic feeders has many benefits for improving genetic progress for feed efficiency, they are costly and require substantial labor to operate. As a result, their implementation is generally limited to nucleus herds. It is, however, feasible to record pen feed intake in commercial herds. Recently, a model for the use of pen data for genetic evaluation of individual animals by using genetic relationships of pigs within and between pens was proposed and validated using simulated data. The purpose of this study was to evaluate the application of this group model using actual pen growth and feed intake data.

Materials and Methods

All data and samples were collected by research staff from the Centre de développement du porc du Québec (CDPQ) in Canada. Phenotypic data included nursery average daily gain (ADG) on 1,499 individual pigs in 219 pens and pen average daily feed intake (ADFI) data from the same pens. The number of pigs per pen ranged from 5 to 12, while the numbers of litters and littermates per pen averaged 5.6 and 1.2, and ranged from 1 to 10 and from 1 to 5, respectively. All animals were genotyped with the 650k Affymetrix Axiom Porcine Genotyping Array by Delta Genomics (Edmonton, Canada). Genotypes were processed using the preGSf90 software from the BLUPF90 family of programs and used to construct an H matrix with a two-generation pedigree. To validate the group model, individual ADG phenotypes were summed by pen to obtain a pen record for each pen. Individual and pen phenotypes were analyzed using an individual and group animal model, respectively, with contemporary group (n=28) as a fixed effect and pen and animal (genetic) as random effects. Litter was not included because it only explained 0.2% of phenotypic variance for ADG. Variance components were estimated by single-step GBLUP, using the DMU package.

Results and Discussion

Estimates of variance components for nursery ADG and ADFI from pen or individual data are in Table 1. The heritability of ADG was estimated to be 0.26 based on individual data and 0.38 using the group model. The estimate of heritability for ADFI using the group model was 0.4. The estimate of pen variance was very small for individual ADG and 0 for pen ADG and pen ADFI. The estimate of genetic variance for ADG was almost doubled when based on pen data, probably because of the large standard error resulting from the lack of individual data. The estimate of phenotypic variance for ADG was also larger based on pen data than based on individual data.

Here, pigs were randomly sorted into pens with very few littermates. Previous simulation work has demonstrated that estimates of heritability based on pen data increased as the level of relationships between pen mates increased, as did the accuracy of estimated breeding values. Although the group model was able to separate variance components based on pen data, in order to obtain reliable estimates, a strategic plan for sorting pigs into pens may be necessary.

Acknowledgments

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Table 1. Estimates of variance components [mean (SE)] for nursery ADG and ADFI from pen or individual data

Phenotype (kg/d)	Pen	Genetic	Environ-mental	Pheno-typic	Herita-bility
Individual ADG	0.0007 (0.0002)	0.0019 (0.0004)	0.0048 (0.0003)	0.0074	0.26
Pen ADG	0 (0.0169)	0.0044 (0.003)	0.0072 (0.0037)	0.0116	0.38
Pen ADFI	0 (0.1112)	0.0195 (0.0155)	0.0294 (0.0173)	0.0489	0.40

ADG: average daily gain; ADFI: average daily feed intake