

MULTITRAIT ANIMAL MODEL EVALUATION FOR STATION TESTED PIGS

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SUMMARY

A multitrait animal model evaluation for pigs is described. The procedure will replace the old selection index in Finnish station testing practice. Traits in the analyses are daily gain, feed conversion efficiency, fat% in back and loin, meat% in carcass, and meat quality. The model includes station-year cluster, sex, and starting age. Accuracies of the indices are approximated using sparse inversion of the coefficient matrix. The correlation between old indices and the animal model evaluations was .79. Of the discrepancy, 9% was estimated to be due to improper handling of comparison groups and 16% due to ignorance of relationships and mate selection in the old index.

INTRODUCTION

The Finnish pig breeding program for production traits is relying on three sources of information. In 1993 altogether 58,800 breeding pigs were tested for growth and ultrasonic fat depth in 2,426 farms. However, the main selection is on results from progeny testing stations, where last year 1,145 full sib groups (2 gilts and 2 castrates) were tested. In addition, the AI cooperatives have boar testing stations where 368 boars were tested in 1992. Until now the data from progeny testing stations has been analyzed using multitrait selection index procedures. For boars the official progeny testing results have required minimum of three full sib groups, whereas for sows, indices with one group have been permitted.

Although the genetic progress in the program has been more than satisfactory, several limitations have been recognized. Since most traits were expressed as deviations from the rolling averages within station, the results from different stations were not totally comparable. This also yielded indices that could not be compared over years. The biggest problem, however, had been the inability of the progeny testing index to cope with mate selection. The evaluations of sows have been completely confounded with the breeding values of the mates, and the same has been true for sire, although, because of larger progeny groups, in somewhere smaller degree.

There are few reports describing animal model BLUP applications in national breeding programs (see, Brandt, 1992). The models as in France (Ducos, et al., 1992), and in Denmark (Sorensen and Andersen, 1992) have considered mate selection, different environmental and genetic levels of stations, and the genetic trend. This paper briefly describes the animal model procedures that are implemented in Finland to replace the old progeny testing selection index. An attempt is done to estimate the improvement in accuracy due to proper accounting of mate selection and station differences.

MATERIALS AND METHODS

Station test data in February 1994 consisted of 49,783 records of animals that had completed the test since 1982. All animals had records on daily gain (DG), feed conversion ratio (FCR), fat-% in back and loin (F%), percentage of high valued cuts in carcass with head (M%), and meat quality index (MQI). Measure of DG is g/day from 25 kg to 100 kg, starting age determined

by average group weight and finishing date derived from slaughter weight, FCR is a full sib average of FU/kg live weight gain (FU = Finnish feed unit ~ 13.2 MJ ME). The measure of MQI consists of meat color scores, both a measured and a subjective one, and the meat pH, and is expressed as a deviation from slaughter day average. The means of the traits were 915 g/d, 2.56 FU/kg, 20.3%, and 54.0% for DG, FCR, F%, and M%, respectively. The same animal model was used for all traits. It included fixed contemporary group, sex, and the age of group at the beginning of the test. Contemporary groups were defined by station and entry dates using the clustering procedure by Schmitz et al. (1991). After 1993 stations have changed to all-in all-out system, thus the fill-in groups were used as clusters. The average cluster period was 23.5 days, and the average number of pigs in cluster 59. The starting age was categorized into 5 classes. Altogether 18 genetic groups were defined to replace unknown or non-informative parents. They were specified by breed (Landrace, Large White, unknown), sex, and birth year (divided within three groups). The variance parameters were directly adapted from the earlier selection index procedures, e.g. the heritabilities of .40, .40, .45, .60, and .15 were used for DG, FCR, F%, M%, and MQI, respectively. The computing strategy was iteration on explicitly formed sparse equations, and prior to the analysis traits were made uncorrelated using canonical transformation. The accuracy of the indices (r) was estimated using approximate inverse of the coefficient matrix computed using sparse matrix inversion (Thompson, 1992). Since, the correlation between r of total merit index and single trait r for the canonical variate 'growth' was almost unity, the single trait measure was computed and regressed ($b = .83$) towards multitrait accuracy.

The effects of different error sources in earlier selection index were quantified from a subset of data using incomplete animal models. First the data was precorrected with respect to fixed effects using their LS solutions. Next the precorrected data was used in the evaluation but by ignoring the contemporary groups, or the dam of the test group, or both. These incomplete evaluations were compared to full animal model ones from the same data.

RESULTS

The data were augmented with records of 19,766 breeding animals that contributed informative relationships. These included 1,714 Landrace and 1,819 Large White boars and 6,169 Landrace and 6,487 Large White sows. Standard deviations for breeding values for animals born after 1989 and reported still in active use (1,550 pigs) were 27.9 g/d, .076 FU/kg 1.54%, 1.13%, and .67 points for DG, FCE, F%, M%, and MQI, respectively. For these active animals r was on average .71 for boars and .66 for sows. With one full sib group tested, the value of r reached on average .65, with 2 groups .69, and with 3 groups .71. For animals with more than 40 offspring, r was on average .81.

A clear genetic progress was observed in all traits (Table 1). For MQI the improvement has been only moderate (Figure 1), which might be because of lower heritability but also because of unfavorable correlation between MQI and M% (see, Ducos, 1992). The correlation with old selection indices results were relatively high. When compared within active animals the correlation was .66 between old production trait index and a new production index, where DG and FCE were combined with relative weights 1:2. The correlation between old carcass quality index and new index where F% and M% were combined 1:4, was .68, and the correlation between old and new MQIs was .57. With the incomplete animal model, 9% of the discrepancies in sire evaluations were due to having station-year clusters in the model instead of precorrection, and 16% due to ignorance of relationships other than own progeny. The main part of the latter is supposedly explained by different genetic levels of mates of the sires. If all the discrepancy of the selection index and the animal model evaluations can be assumed to be due to inaccuracy of the earlier procedure, an additional raise of 30-35% to the genetic improvement can be expected.

To form a total merit index, all the breeding values were multiplied by anticipated economic values of the traits. That yielded relative weights of .20, .39, .07, .22, and .12 for DG, FCR, F%, M%, and MQI. In terms of the total merit index, the genetic progress in Finnish pig population has been 12 Fmk a year.

Table 1. Average BLUP values of breeding animals by breed (Landrace = L, Large White = Y) and birth year.

	DG		FCE		F%		M%		MQI	
	L	Y	L	Y	L	Y	L	Y	L	Y
1987	50.70	41.47	-0.16	-0.15	-2.78	-2.71	1.94	1.62	0.43	0.94
1988	62.05	49.48	-0.20	-0.18	-3.47	-3.27	2.38	1.95	0.65	0.78
1989	70.78	54.11	-0.23	-0.19	-4.15	-3.91	2.89	2.36	0.68	0.77
1990	78.14	64.43	-0.26	-0.23	-4.61	-4.45	3.13	2.77	0.78	0.74
1991	88.44	70.60	-0.29	-0.24	-4.95	-4.87	3.44	3.04	0.94	0.71
1992	98.52	77.94	-0.32	-0.27	-5.53	-5.51	3.87	3.45	1.05	0.69

DG = daily gain, FCR = feed conversion ratio, F% = fat in back and loin, M% = proportion high valued cuts, MQI = meat quality index.

Acknowledgements. The computer programs for the evaluation were largely based on the DMU package developed by J. Jensen and P. Madsen in Denmark.

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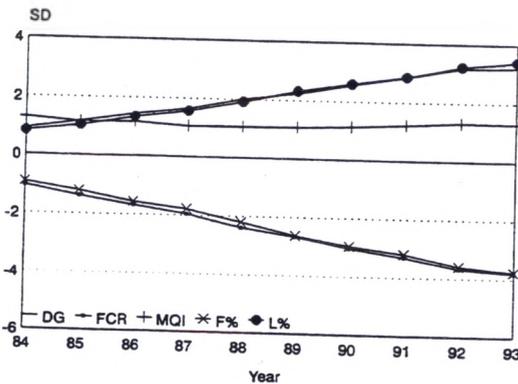


Figure 1. Yearly means of BLUPs of daily gain (DG), feed conversion ratio (FCR), back and loin fat-% (F%), carcass meat-% (M%), and meat quality (MQI) expressed in units of standard deviations of estimated breeding values.