factsheet

Pork Information Gateway

Performance Records and Their Use in Genetic Improvement

Authors
Ronald O. Bates, Michigan State University

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Reviewers
Mark Brubaker, Whiteshire Hamrock, Inc., Albion, IN
Michael Woltmann, Illini Swine Inc., Kingston, IL
William Simmons, North Carolina State University, Trenton, NC

Introduction

Recording performance data is common place within many swine businesses in the United States. Information such as sow farrowing and weaning data and changes in feed and pig inventories are used regularly for both tactical and strategic planning.

Animal performance data within the commercial pork industry is primarily used to monitor production system dynamics and to pinpoint strengths and weaknesses within each phase of production. A secondary use, chiefly for sows and boars, is evaluation of past performance of individual animals within the system.

Within seedstock farms, animal records are used primarily to monitor the performance of individuals for the prediction of genetic breeding values. Monitoring production system status is of secondary nature. All pigs within purebred or nucleus systems are uniquely identified whereas in commercial systems, individual identification occurs primarily for sows and boars. Seedstock programs implement unique production protocols to standardize conditions so individuals within a group experience similar production and environmental circumstances. Differences in genetic merit between animals are more notable when individuals compared are exposed to similar environmental challenges.

The comparison of differences in performance records between individuals is a key element in identifying genetically superior individuals. To accomplish this objective, data collection must follow specific protocols so that differences observed between individuals more accurately reflect their differences in genetic merit versus differences due to non-genetic factors.

Data Collection and Recording

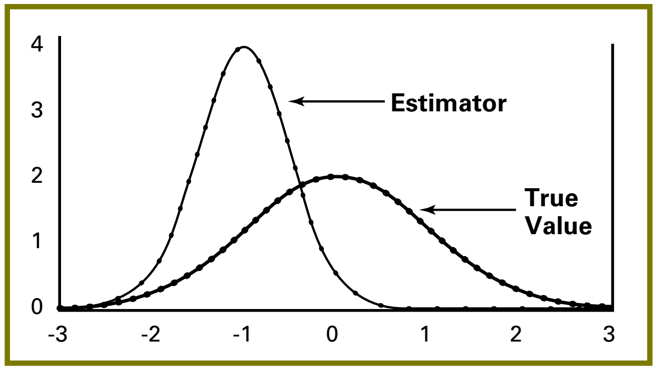
Collection of data for use in genetic improvement programs must be done in an exact manner. Maintaining the exact identification of an animal throughout its lifetime and its identity to its parents is crucial. Misidentification of animals can lead to selection of parents that are inferior and will reduce improvement of genetic merit. It is not uncommon for misidentification rates to be 2-20% of all animals within a seedstock system. It has been reported that when misidentification rates were 20%, genetic change was reduced by 4-12% per generation, depending on the trait analyzed. Misidentification can lead to serious genetic shortcomings. Maintaining proper identification of individuals must be an important priority.

Complete data recording is likewise critical within genetic evaluation and improvement schemes. Genetic evaluation tools used today often evaluate several traits simultaneously. If an animal has some but not all of its data reported within the data set (e.g. weight but not backfat at the end of gain test), the animal's record may be eliminated from the analyses. If the incomplete record remains, genetic merit for a nonrecorded trait can sometimes be estimated through information from relatives and relationships with other traits that have some genetic control in common. However, the estimate of the non-recorded trait is less accurate. Data collection should be as complete as possible whenever possible.

Data errors can also occur during transcription and while coding data into computer files from data collection forms. This can happen through a variety of operations such as: keyboard mistakes, misreading information, poor penmanship, or adulteration of the original copy by such things as fly specs or smears. These types of errors can be further minimized through the use of hand-held electronic data recording devises. Data can be directly keyed into a data file and then electronically transferred to computer systems. These hand held devices are often modified to recognize radio frequency electronic identification tags that can be used to further reduce animal identification errors. Many of these devices are rugged enough for use within swine farms and do eliminate many transcription and translation errors that occur within data recording systems.

Accuracy and Precision

Data collected should reliably represent the performance of an animal for a characteristic of interest. The average of the performance data should estimate the true average. If it does not, the procedure used to collect the data is said to be biased or has poor accuracy. This may be best understood with an example. In Figure 1 are two curves that demonstrate the true mean and variation for a trait as well as the estimated mean and variation for the trait. The estimated mean and variation were calculated from collected data while the true mean and variation are the underlying scale.



Example 1. Calculate the inbreeding coefficient of Z (F_Z)

In this example, the data underestimated the true mean. If the data either underestimates or overestimates the true mean, incorrect assumptions regarding the population can be made which can influence selection decisions.

The other noticeable difference in these two curves is the difference in variation. The curve representing the estimated data has a much smaller range with most data points clustered closely around the mean. The data has underestimated the true variation, suggesting that only small performance differences separate average and superior animals. However, the true case indicates a different scenario. Larger differences do separate the average and superior animals. Since the estimated data does not reflect the true scale, a larger percentage of animals that are near average, and less desirable for that trait would potentially be selected as parents. This causes genetic improvement to be less than what is possible.

Precision. Another important aspect of data collection is that methodology and equipment used should provide repeatable results. This implies that repeated estimates taken on the same animal will be the same or nearly so. For instance, single animal weigh scales usually are rated for repeatability or precision. If a scale is rated for 1% or less, this implies that the body weight of an animal will not vary by more than 1% when weighed repeatedly. For example, if the true weight of a pig is 250lb, the weight estimated from the scale would vary no more than +2.5lb (1%). Pig weight could range from 247.5 to 252.5 and be within the limits of the rating.

Known and Unknown Non-Genetic Effects

The difference in performance between animals can be broken into genetic and non-genetic components. The non-genetic component can be further separated into known and unknown factors that can change animal performance. These non-genetic variables can over shadow the genetic component and change performance in either a desirable or undesirable direction. This can lead to selection of parents that are not genetically superior. It is unfortunate that all individual pieces of the non-genetic component are never fully known. However, known components can be accounted for through the use of correction factors. Unknown components can be managed by standardizing production practices and contemporary grouping. This allows the genetic component of performance differences between individuals to be estimated more accurately and genetically superior individuals more correctly identified.

Known Effects. Known non-genetic effects are those that have been traditionally corrected for when collecting and summarizing performance records. For example, litter weight for a target lactation age is adjusted for the known non-genetic effects of parity of the dam, number nursed and age of lactation when the litter was weighed. Correcting the litter weight for these known nongenetic effects further improves the comparison of two sows for litter weight.

Gilt ID	Weight (lb)	Backfat (in.)	Age (days)	Age Adjusted to 250lb	Backfat Adjusted to 250lb
46-2	223	0.80	157	171	0.90
32-7	234	0.89	155	163	0.95
14-6	232	1.05	159	168	1.13
23-10	249	0.87	160	160	0.87

Table 1. Adjustment of age and backfat to 250lb.

Postweaning traits are typically corrected for weight at measurement and the records are adjusted to acommon weight for comparison purposes (Table 1). Gilts within Table 1 differed 5 days in age when they were weighed. However, the difference in age adjusted to 250lb was 11. Differences in performance adjusted for age at weighing better reflect the difference in age if all animals were weighed at 250lb. Another important issue is the rank of animals when evaluating unadjusted and adjusted performance information. Animals often will switch rank after their data are adjusted for known sources of variation. This improves theopportunity to know true genetic differences between animals.

Other known effects are often corrected for in the statistical procedures to estimate breeding values (EBVs) or expected progeny deviations (EPDs). These include herd of origin of performance records and season of the year in which the records were collected.

For examples of specific adjustment equations and formulas to adjust for known non-genetic effects, consult the National Swine Improvement Federation's (NSIF) Guidelines for Uniform Swine Improvement Programs.

Unknown effects. Unknown effects are those that influence animal performance but occur without prior knowledge. These can range from changes in the weather, acute or chronic sickness, changes in behavior within the pen, along with other conditions not known. These unknown effects can never be eliminated. Strategies to manage their impact on animal performance and genetic evaluation have centered around the use of standardized management practices and the designation of contemporary groups.

Implementation of standard management practices within a group of animals necessitates all animals to be treated similarly. Unknown influences should change performance uniformly within a contemporary group.

Contemporary groups. The concept of contemporary grouping is a simplistic one that becomes more complex as put into practice. In general, contemporary groups should be animals who are of similar age (e.g. postweaning performance) or express their record during a similar time interval (e.g. reproductive or farrowing traits). Implementation of this simple definition within grow-finish and farrowing or reproductive groups can be complex. Following are guidelines for designation of postweaning and reproductive contemporary groups.

Postweaning traits. Pigs within a contemporary group should have the following in common:

1. Be of the same breed or breed composition,
2. Be of the same gender
3. Be of similar age
4. Have had similar care,
5. Have eaten similar feeds within gender and phase of growth and
6. Be of similar health status. In general, a postweaning contemporary group should be all healthy pigs that were weaned from a distinct farrowing group.

Optimum Guidelines. Optimum guidelines for postweaning contemporary groups are:

1. Age difference among pigs should be seven days or less and be managed within an all-in/all-out group.
2. Pigs of the same gender must be housed within the same facility at each phase of production.
3. Pigs should be fed alike within gender and phase of growth.
4. Pigs should be from six or more litters which represent three or more sires.
5. Pigs should be weighed and ultrasound measurements taken within 15-20 pounds of the target weight (e.g. 250lb).

Sometimes pigs of the same gender are housed in different facilities. Even though these pigs are of the same age and gender and may have been fed and managed by the same production practices, they should not be recorded as a part of the same contemporary group. Pigs in different facilities are different groups and should be designated as such.

Another issue worthy of further discussion is the gathering of final test information such as final weight and backfat depth. Pigs that are of similar age can differ in weight at any point in time. The range in weight does increase as pigs grow older. It is not uncommon for pigs that are within seven days of age to vary by 50 pounds or more as they reach 5-6 months of age. This does complicate data collection within 20lbs of the target weight. Completion of final test data collection is often a compromise of optimum data collection guidelines and accommodation of the work schedule. It is recommended that if scanning is done by outside personnel (e.g. Commercial NSIF Certified Scanners), then all pigs within a contemporary group should be weighed and scanned on the same day. If scanning is performed by competent farm personnel, who are adequately trained and NSIF certified, then pigs within a contemporary group can complete performance test at two or more different dates, to accommodate differences in weight between the faster and slower growing pigs. However, pen density should remain constant between test completion dates.

Within a production system, optimal characteristics for contemporary grouping may be compromised. Breeders should take every opportunity to incorporate optimum guidelines into their contemporary group planning. Contemporary group planning should begin when sows are bred. Not only is the number of litters within a contemporary group important, but also the age difference among them and the number of sires they represent.

Minimum guidelines. Seedstock producers should make every effort to follow optimum guidelines; however, in some cases it is impossible to do so. Compromises can be made in contemporary group designation so that performance data is meaningful and comparisons can be made among prospective parents with confidence. The following are minimum guidelines that are essential for each designation of a postweaning contemporary group:

1. Pigs must be from two or more litters.
2. Two or more pigs per gender must be tested.
3. Pigs must be from two or more sires.
4. Maximum age difference within the group must be less than 30 days.

Using both optimum and minimum guidelines, breeders can successfully develop contemporary groups that fit their farm management system.

One further note regarding contemporary group formation: To reliably evaluate a sire within a herd, he should have progeny in three or more contemporary groups to improve the accuracy of his EBV or EPD predictions. Sires represented within a contemporary group should never be unique to that contemporary group alone. Within a contemporary group at least one sire should have progeny in another contemporary group. This will likewise improve the evaluation of a boar in both a within and across herd evaluation.

Reproductive traits. Reproductive or farrowing traits are typically those collected on females at farrowing, weaning, and rebreeding. Females are often of different parities and ages. A reproductive contemporary group or farrowing group are those females of the same breed and have minimal age differences among litters. All females that farrow a litter should be measured. Furthermore, litter size should be standardized soon after farrowing. Thus, if litter size between sows is relatively the same, differences in the number and weight of pigs at a target lactation age will more reflect genetic differences for milking ability among sows. Designation of farrowing groups must occur with the same if not more forethought as that of post-weaning contemporary groups. The number of sows within a farrowing group are fewer than a post-weaning contemporary group. Therefore, it is more critical that guidelines used to establish sow contemporary groupings match optimum characteristics to further improve the reliability of maternal comparisons.

Optimum guidelines. Optimum characteristics for farrowing group designations are as follows:

1. All-in/all-out farrowing group of sows that are of the same breed with a difference in litter age of seven days or less.
2. All litters should be the same genotype. Sows with crossbred litters (e.g. Yorkshire-Landrace and Yorkshire-Hampshire) should be designated as different reproductive or farrowing groups.
3. Litters should be weighed within 4 days of the target lactation age (e.g. 21 days).
4. There should be 3 or more sires represented among the sows within the group.

Minimum guidelines. Designation of farrowing groups can be more constraining than postweaning groups. This is especially so when multiple breeds are managed within the same production schedule. To better balance what is optimum and what is possible within farm management the following minimum criteria are provided:

1. Two or more sows of the same breed sired by at least two different boars.
2. All litters should be the same genotype. Purebred sows of the same breed or line with crossbred litters should be a separate farrowing group.
3. All litters must be weighed within 7 days of the target lactation age (e.g. 21 days).
4. Age difference among litters should be less than 30 days.

Planning for farrowing group designation must begin when gilts are retained as replacements and as sows are bred. In those cases where sows of multiple breeds are farrowed side by side, specific procedures must be in place to form contemporary groups. Sufficient females of the same breed should be mated such that a reasonable farrowing group can be formed. Specifically, a minimum of 3-4 females of the same breed should be mated to carry the same litter genotype so that 2-3 will farrow within a farrowing group. This is especially true for herds that farrow in all-in/all-out batch systems. Herds that farrow weekly may have to form farrowing groups across weekly groups. The age difference among litters within a farrowing group should never be more than 30 days. Attention to proper formation of farrowing groups will improve the reliability of maternal data. This will improve maternal comparisons between sows and lead to more rapid genetic improvement for maternal characteristics.

Whole-Herd Testing

The concept of whole herd testing is one of fairness. All healthy animals should express the trait(s) of interest so true differences from the average can be calculated to determine the best possible estimate of genetic merit. Whole-herd testing can be simply defined as collecting the information of interest on all healthy animals within a group. This concept has not always been practiced. In the past, it was not unusual for had potential merit for selection or marketing purposes should be tested. However, this approach typically reduces the magnitude of genetic merit estimates. This is true for both potential replacement parents and their sires and dams. Breeding values or EPDs estimated from incomplete testing data will less accurately reflect true genetic merit. This further causes incorrect comparisons among potential replacement animals and leads to incorrect selection decisions. There are times when facilities facilities are not available to test the entire group of animals. It is important then to develop performance testing schemes that will maximize genetic improvement within the production schedule restriction. One option that has been used over time has been testing only boars and gilts and not barrows. Before decisions are made when testing space is limited, care should be taken to investigate the impact possible testing schemes can have on genetic improvement.

Summary

Individual performance records are used to estimate genetic differences of prospective parents. Procedures used to collect these records will impact the relative value of the differences in genetic merit estimated from them. Testing procedures can enhance or hinder genetic change. Protocols used to collect and record performance information should be periodically reviewed and improved as needed in a timely manner.

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