HOW TO DETERMINE THE OPTIMAL PRODUCTIVE LIFE OF A TERMINAL SIRE IN A COMPANY OWNED BOAR STUD

Introduction
Previous work in Fix et al. (2008ab) described a spreadsheet created to estimate the optimal length of time in production for a terminal sire in a boar stud with separate ownership than the commercial market hogs. However, there are many systems in which the ownership of the boar stud and commercial market hogs is the same.

Why would differences in ownership structure affect culling decisions?

When focusing on the boar stud itself, a preference for older boars that consistently produce large volumes of high-quality semen would be expected. On the other hand, from the commercial market hog side, the focus would be on receiving semen from genetically superior boars. With successful genetic programs, the genetically superior boars would typically be the youngest. As a result, the perspectives of the boar stud and commercial market hog segments with respect to economics are on different ends of the spectrum. If the two segments are under different ownership a balance must be reached between the two, because their profit is unrelated. However, when both segments are owned by the same entity, profit maximization for the entire firm can be taken into account. Because of these differences, a second spreadsheet was created to estimate the optimal productive life for a company owned boar stud. A summary of the spreadsheet design follows.

Spreadsheet Design
To determine the optimal length of time a boar should be in production, a spreadsheet was designed with the capability of adjusting future revenue and costs into today’s dollars using an assumed interest rate; more commonly referred to as the net present value (NPV). Models used build on principles applied by Perrin (1972) and Chavas et al. (1985) for maximizing the value of future returns by selecting the best time to cull or replace an asset. In general, a boar can be culled and replaced with a new boar each time the isolation facility is emptied. Eventually, if genetically superior boars are not available, the majority of boars will be culled for non-index reasons such as health, size, semen quality, etc. For our work, an assumed age was used for this non-index culling threshold: 156 weeks in production.

Due to isolation protocols, culling and replacement do not happen weekly. Therefore, the basis for culling decisions is every 5 weeks, beginning with the initial week of collection. Each culling decision or option is based on comparing NPV of future revenues minus costs (profit) across culling options. In more detail, a boar could be culled at week 5 and replaced with a new boar (average index of incoming boars) or week 10 and continued in 5 week increments up to 156 weeks in production. These potential options are compared, and the alternative with the highest NPV of profit is the suggested length of time a boar should be left in production. One option that is provided in the tool is different beginning index values for boars in the stud, since it is common for there to be variation in this measure. However, in reference to the boars that will be replacing those in stud, an average is used. An average was utilized to simplify assumptions about which boar would be replacing a given boar in stud. Also, no reference is made to differences in sow production traits; assumptions were made that boars would be used across similar sow populations and thus on average impact the same number of pigs per litter from sows of comparable quality.

To allow for an accurate depiction of the future revenues and costs of a boar, the tool needs to allow for the input of numerous data. Inputs for the tool are provided below, and formulas used to calculate future revenues and costs in today’s dollars are presented in Figure 1.
The tool provides outcomes that optimize several factors. First is the semen production curve of the boar; as boars become older, they typically produce a greater volume and thus, more doses of semen, which provide value to the company. Second is the rate of genetic improvement; the longer a boar is in production, the more genetically superior his replacement will be. Third is the beginning index value of the potential boar to be culled. Boars are not of equal genetic merit when they are placed in stud. The profit maximizing solution is obtained by choosing the culling age with maximum NPV.

Figure 2 provides a graphical depiction of the change in NPV of profit for each culling decision over the 156-week productive life. Inputs used to create Figure 2 were general averages provided by a genetic company. Also depicted are differences due to the initial index value; index values mirror the NPV. The lowest index, bottom curve on the graph, has the lowest NPV for each culling option. Each curve presented represents a difference in beginning index of two points. The curves do shift up and down, and the slopes do vary when comparing different inputs. However, regardless of inputs, the curves are quadratic in nature; they increase at a decreasing rate until reaching a maximum and then begin to decrease. Curves for boars with poorer beginning indexes reach their maximum quickest, approximately 40 weeks, and appear to experience a much greater decrease the longer they are left in production. More specifically, the penalty in terms of lost profit if boars are left in production too long is greatest for the boars with the least genetic merit and decreases to the point where, for the most superior boars, leaving them in production the entire 156 weeks is within a few percentage points of the maximum profit decision.

Based on the general inputs for Figure 2, there is considerable variation — 40 vs. 110 weeks — of suggested length in production. Exact culling suggestion would differ between actual inputs; however, the curves would be similar to those described by the authors herein.

**Implications**

This spreadsheet provides users with a resource to assist in managing the productive life of their terminal boars through estimation of the NPV of future profits. Because of the antagonistic relationship between the boar stud and commercial market hog with respect to productive life, the use of such a tool is even more imperative. Finally, because of the flexibility of the inputs, outcomes are directly related to the user’s production parameters.
Feed Manufacturing Short Course
May 14-15, 2010
Raleigh, NC

The Feed Science program at North Carolina State University will be hosting a short course covering feed manufacturing. The course will be held May 14-15, 2010 at the North Carolina State University Educational Feed Mill Unit. A variety of feed manufacturing topics will be covered in both a lab and lecture format. For more information please visit www.ces.ncsu.edu/depts/poulsci/feed_manufacturing.htm or contact:

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References

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### ON-FARM PERFORMANCE TESTING:
The following breeders with validated herds have tested animals in the past 30 days.

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<tr>
<th>Breeder</th>
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<tr>
<td>Bob Ivey*</td>
<td>314 NC 111 S, Goldsboro 27530</td>
<td>L, D, Y, CW</td>
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<tr>
<td>Wesley Looper*</td>
<td>4695 Petra Mill Rd., Granite Falls 28630</td>
<td>Y, L, H, D, X</td>
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<tr>
<td>Thad Sharp, Jr. &amp; Sons</td>
<td>5171 NC 581 Hwy., Sims 27880</td>
<td>Y, D, X</td>
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<tr>
<td>Thomas Farms</td>
<td>8251 Oxford Rd., Timberlake 27583</td>
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<tr>
<td>Tidewater Research Station*</td>
<td>207 Research Station Rd., Plymouth 27962</td>
<td>X</td>
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*Realtime Ultrasound

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