Diminishing Returns to Land; Combine Capacity

The objectives of this lab are:
1. to illustrate how diminishing marginal returns (yields) affect the most profitable number of acres
2. to show how the supply of labor and machinery capacity limits the number of crop acres

A. Diminishing Returns to Land.

As more land is farmed with the same labor supply and machinery capacity, later planting dates and a shorter growing season will cause crop yields to decline (see chart on the next page). This is an example of diminishing marginal returns (yield) to an added resource (land).

In this lab you will estimate how many acres you could plant before the marginal return from the last acre would no longer be large enough to pay the marginal costs of seed, fertilizer, pesticides, fuel, repairs, and cash rent.

1. Marginal costs per acre
   a. Input costs per acre (seed, fertilizer, pesticides, drying) (from your Year 1 FarmSim printout, Farm Business Analysis page, under Crops) $_______/a. $_______/a.
   b. Machinery variable cost per acre (from FarmSim printout, Farm Business Analysis) $_______/a. $_______/a.
   c. Land cost (use estimated long-run average cash rent) $115.00 $115.00
   d. Total of marginal costs per acre $_______/a. $_______/a.
2. Estimated long-run sale price, $/bu. $2.50/bu. $6.60/bu.
3. Breakeven yield needed to pay marginal costs (divide marginal costs by estimated selling price) _________bu/a. _________bu/a.
   (round to whole bushels)

The chart on the next page shows how yield per acre declines as the planting date becomes later.

4. Draw two horizontal lines on the chart to represent your breakeven yields, one for each crop.

5. Using the chart, on what approximate planting date does the expected yield curve cross the breakeven line? Estimate if you are between the vertical lines. This is where the marginal revenue per acre equals the marginal cost per acre, that is, you just break even on the last acre.

6. What is the approximate number of suitable field days normally elapsed by this date? (see bottom scale on chart)
B. Machinery Capacity

1. The next step is to estimate how many acres can be planted in the allowable number of field days. In Farmsim you can choose from 4 different machinery sets. The table below shows the hours needed for tillage and planting with each set. Labor for post-planting weed control is not considered.

2. How many hours of field time per day do you have available for crops? The operator provides a maximum of 14 hours per day during the crop season, but about 4 hours per day are needed for hogs, (27 hours/sow x 50 sows/365 days per year). Later you may have to subtract labor for cattle, as well. How many hours per day are left for your crops?

   Total hours per day \[14\] minus hog labor per day \[4\] = \[_______\] hours per day for crop labor.

3. Calculate the maximum acres that can be planted with each set of machinery, using the available hours of crop labor per field day. For example, using set 1 with 10 hours of labor per day for 25 days allows you to plant 333 acres of corn (see example below). After this date the expected yield on the last acre is too low to pay for all the variable costs, including the cash rent.

   Example: \[(25 \text{ days } \times 10 \text{ hours per day}) / .75 \text{ hours per acre} = 333 \text{ acres of corn with set 1}\]

   For your own calculations use the maximum number of field days you can afford to use, from question A.6, and the average field time per acre needed for tillage and planting that corresponds to each machinery set, shown below.

<table>
<thead>
<tr>
<th>Machinery Set</th>
<th>Corn Hours per Acre, tillage &amp; planting</th>
<th>Soybeans Hours per Acre, tillage &amp; planting</th>
<th>Maximum Acres</th>
</tr>
</thead>
<tbody>
<tr>
<td>Set 1</td>
<td>.75</td>
<td>.49</td>
<td>_________</td>
</tr>
<tr>
<td>Set 2</td>
<td>.56</td>
<td>.40</td>
<td>_________</td>
</tr>
<tr>
<td>Set 3</td>
<td>.45</td>
<td>.33</td>
<td>_________</td>
</tr>
<tr>
<td>Set 4</td>
<td>.35</td>
<td>.25</td>
<td>_________</td>
</tr>
</tbody>
</table>

Remember, this is the maximum acres of corn or soybeans, not both, with no extra hired labor. If you want to plant equal acres of corn and soybeans, then you could afford to plant half of the maximum of each one.
4. You can hire extra labor to help with crops. Hired labor can provide up to 14 extra field hours per day. Repeat question 3 assuming you hire the maximum amount of extra labor.

Example: \((14 - 4 + 14) = 24 \text{ labor hours per day available}\)
\((25 \text{ days} \times 24 \text{ hours per day}) / .75 \text{ hours per acre} = 800 \text{ acres of corn with set 1}\)

<table>
<thead>
<tr>
<th>Machinery Set</th>
<th>Corn Hours per Acre, tillage &amp; planting</th>
<th>Maximum Acres</th>
<th>Soybeans Hours per Acre, tillage &amp; planting</th>
<th>Maximum Acres</th>
</tr>
</thead>
<tbody>
<tr>
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<td>.75</td>
<td></td>
<td>.49</td>
<td></td>
</tr>
<tr>
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<td></td>
<td>.33</td>
<td></td>
</tr>
<tr>
<td>Set 4</td>
<td>.35</td>
<td></td>
<td>.25</td>
<td></td>
</tr>
</tbody>
</table>

When you get this lab back, save it. You can use these estimates to help you decide how many acres you can profitably farm with the machinery and labor that you have available. Remember that if you produce more hogs or buy cattle, less labor will be available for crops.

C. Combine Capacity

As a rule of thumb in the Midwest you can count on about 30 good field days for harvesting corn and soybeans before field losses become excessive. The table below shows the labor requirements per acre for corn and soybeans for each of the four sizes of combines that you can purchase in FarmSim. For each one, calculate how many acres you could harvest in 30 working days if you had 10 hours of operator labor and 14 hours of hired labor available each day.

<table>
<thead>
<tr>
<th>Combine size 1</th>
<th>Corn Hours per Acre</th>
<th>Maximum Acres</th>
<th>Soybeans Hours per Acre</th>
<th>Maximum Acres</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>.98</td>
<td></td>
<td>.57</td>
<td></td>
</tr>
<tr>
<td>Combine size 2</td>
<td>.79</td>
<td></td>
<td>.41</td>
<td></td>
</tr>
<tr>
<td>Combine size 3</td>
<td>.66</td>
<td></td>
<td>.37</td>
<td></td>
</tr>
<tr>
<td>Combine size 4</td>
<td>.49</td>
<td></td>
<td>.31</td>
<td></td>
</tr>
</tbody>
</table>

D. Combine Ownership versus Custom Harvest
In Farmsim you can hire your crops harvested by a custom operator or you can buy your own combine. To make this decision you must first calculate the ownership and operating costs of the combine. This exercise will analyze the smallest combine available (size 1), but the same procedure can be used for the other three sizes. Assume the combine will be used on 50% corn acres and 50% soybean acres.

Use the following information:

- Purchase price of small combine: $92,000
- Salvage value (29% of list price): $26,680
- Ownership life of combine in years: 8
- Interest rate (90% borrowed @ 9%, 10% own funds @ 5%): Calculate the weighted cost of capital. ______%  
- Diesel fuel price per gallon: $0.85
- Labor cost per hour: $10.00
- Custom combining rate per acre: $25.00
- Average combine hours required per acre for harvesting corn and soybeans: 0.44 hrs/acre

**COMBINE COSTS**

1. Estimate the average **ownership costs** associated with the combine over the eight years you will own it. The costs of owning a combine include depreciation, interest, insurance and housing. Use the formulas explained in class or on pages 445-446 of your textbook. **Show your work.**

   a. Depreciation
      $____________

   b. Interest (on average of purchase cost and salvage value)
      (calculate the average value first)

      average value = ________________
      $__________

   c. Insurance and housing (use 1% of average value of the combine)
      $__________

   d. Total ownership costs
      $__________

   e. Total ownership costs per acre on 300 acres
      $__________/acre

2. Estimation of **operating costs**.

   a. Repairs: (assume repair costs to be 1.33% (.0133) of the purchase price, for each 100 hours of use--page 449 of textbook)

      Average repair cost per acre =
      $.0133 x purchase price x average hrs/acre for harvesting/100 = $__________/acre

   b. Fuel costs:
1.25 gallons used per acre $_________ = __________/acre

c. Lubrication costs per acre: Lubrication costs are usually calculated as 15% of the fuel costs per acre. = __________/acre

d. Labor costs per acre: Labor requirements for operating the combine are .44 hours per acre, plus .34 hours per acre for hauling and storing.

Labor cost per hour @ $10.00 = __________/acre

e. Total operating costs per acre $_________/a.

3. Total of ownership and operating costs per acre $_________/a.

CUSTOM HIRE COSTS
4. If crops are custom harvested, you have to pay the custom operator $25 per acre. $________/acre

You also have to provide .34 hours of labor per acre for hauling and storing $________/acre

Total for custom hiring $________/acre

Which is cheaper, owning or custom hiring? ____________________________________________________________________________________
Assume that revenue will not change.

5. Calculate the breakeven number of crop acres you would need to justify owning a size 1 combine (number of acres for which costs of owning would be just equal to those for custom hire). Use acres as your unknown value. Show your work.

Set: combine ownership (fixed) costs ($/year) + (operating (variable) cost per acre x acres) = (custom hire cost per acre x acres).

Solve for acres. (Page 459 in the text gives an example.)

_________ acres

If you have more acres than this, it is cheaper to own a combine than to custom hire.