General examination rules:

1) NOTE THAT THE ONLY THINGS YOU CAN HAVE IN YOUR POSESSIOIN DURING THIS EXAM IS YOUR ECONOMICS REFERENCE MANUAL AND YOUR BOSS TYPICAL COMMAND PACKET INCLUDING THE SAMPLE PROBLEMS LISTED AS A PART OF THE PACKET.
2) DO NOT UNSTAPLE THIS EXAM. You can work on both sides of the pages. Simply note that you have additional work on the back, or on additional attached paper.
3) Do not put any work on a desk or on the floor next to you or anywhere else it can be seen by others. If any part of your work can be seen by others it will be confiscated and you will not be permitted to rework those problems. Place it face down on your desk under your existing work.
4) Please remove your hat. If it is part of your head, turn it around backwards.
5) If your work not legible, or if I cannot follow your logic at a glance, it will receive no credit. This paper will be written to acceptable engineering standards or it will receive no credit.
6) You may work on your own paper or use paper supplied at the front of the room.
7) If you feel that any additional information is necessary to work these problems, you may make a reasonable engineering estimate for that value, as long as you state it clearly.
8) Fully document your LP variables sufficiently that there is no question as to their meaning, and comment your BOSS code if you want me to understand what you are trying to do.

Ethical Standards:

Upon accepting admission to Texas A&M University, a student immediately assumes a commitment to uphold the Honor Code, to accept responsibility for learning, and to follow the philosophy and rules of the Honor System. Students will be required to state their commitment on examinations, research papers, and other academic work. Ignorance of the rules does not exclude any member of the TAMU community from the requirements or the processes of the Honor System.

"On my honor, as an Aggie, I have neither given nor received unauthorized aid on this exam."

_________________________________________________________
Signature of student

Please do not open this exam until you are told to do so.
Problem 1) (30 points) I run a wood sawing operation. The logs we buy are 20 feet long. They have a mean diameter of 27 inches normally distributed with a sigma = 2 inches. They are loaded onto a feed table exponentially distributed with a mean of 3 minutes. From there they are pushed into the saw and cut into boards. If the saw is busy, they must wait until it finishes cutting the previous log, but loading onto the feed table can continue. The limit on the number of logs which will fit onto the feed table is 10.

We have found that we can cut the trees into the following numbers of boards, depending on the diameter:

<table>
<thead>
<tr>
<th>Tree diameter (inches)</th>
<th># of 2”x12” boards resulting</th>
<th># of 2”x8” boards resulting</th>
<th># of 2”x4” boards resulting</th>
<th># of 2”x2” boards resulting</th>
<th>Cost to cut a tree of this diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 25”</td>
<td>7</td>
<td>6</td>
<td>4</td>
<td>2</td>
<td>$ 15/tree</td>
</tr>
<tr>
<td>25” to 30”</td>
<td>12</td>
<td>8</td>
<td>6</td>
<td>4</td>
<td>$ 20/tree</td>
</tr>
<tr>
<td>Over 30”</td>
<td>16</td>
<td>14</td>
<td>8</td>
<td>6</td>
<td>$ 27/tree</td>
</tr>
<tr>
<td>Income per board of this size</td>
<td>$8</td>
<td>$6</td>
<td>$4</td>
<td>$1</td>
<td></td>
</tr>
</tbody>
</table>

Logs cost $0.12*D^2 and take a mean of 0.1*D minutes to cut, with a sigma = 0.12 minutes, where D is the tree diameter in inches. After the boards are cut from the tree, the scrap is sold for particle board. Nothing is wasted. I sell every cubic inch for something. The scrap sells for $0.50 per cubic foot (note the units.)

Write a BOSS program to determine the profit from our operation and a count of the total number of each size of board at the end of an 8 hour day. If you feel any information necessary to work these problems, you may make a reasonable engineering estimate for that value, as long as you state it clearly.
PROGRAM
"cut trees"

DEFINITION
profit = 0;
twelve = 0; "count twelve inch boards"
eight = 0;
four = 0;
two = 0;
d = 0; "diameter of tree being cut"
areaoftree = 0;
areaofscrap = 0;
volumeofscrap = 0;
LABELS = {small, medium, large, nofeed};
saw: RESOURCE = {};
feedtable: RESOURCE = {CAPACITY = 10};

CONTROL
STOPTIME = 8*60; "minutes"
RANDOMIZE = ON;
WATCHLIST = {feedtable, saw};

LOGIC
[ 1] ARRIVE {TIME=EXPD(3)}; "born trees"
[ 2] SEIZE{NAME = feedtable, REXCESS = nofeed}; "put a tree on the feed table if possible"
[ 3] "If feed table is full, throw that log away"
[ 4] "(actually, just stop adding logs to feed table and hold on to that log)"
[ 5] SEIZE{NAME = saw}; "seize the saw"
[ 6] RELEASE{NAME = feedtable}; "release feed table for placement of next tree"
[ 7] d = 0 MAX NORMAL(27,2); "determine tree diameter"
[ 8] IF d <= 25 THEN GOTO small; "send to small tree code"
[ 9] IF d <= 30 THEN GOTO medium; "send to medium tree code"
[10] GOTO large; "send to large tree code"
[11]
[12] small:
[13] WAIT{TIME = 0 MAX normal(0.1*d, 0.12)}; "wait to cut log"
[14] profit = profit + 7*8 + 6*6 + 4*4 + 2*1; "add profit from boards"
[15] profit = profit - 0.12*d^2 - 15; "subtract cost of board and cutting cost"
[16] areaoftree = 3.14*(d^2)/4; "original square inches of tree"
[17] areaofscrap = areaoftree - 7*2*12 - 6*2*8 - 4*2*4 - 2*2*2; "cross-sectional area of scrap in^2"
[18] volumeofscrap = areaofscrap*(20*12)/1728; "20 foot long, cubic feet of scrap"
[19] profit = profit + volumeofscrap*0.5; "add profit from scrap"
20: twelve = twelve + 7; "count twelve inch boards"
21: eight = eight + 6;
22: four = four + 4;
23: two = two + 2;
24: RELEASE(NAME = saw); "release saw for next log"
25: DEPART();
26: medium:
27: WAIT(TIME = 0 MAX normal(0.1*d, 0.12)); "wait to cut log"
28: profit = profit + 12*8 + 8*6 + 6*4 + 4*1; "add profit from boards"
29: profit = profit - 0.12*d^2 - 20; "subtract cost of board and cutting cost"
30: areaoftree = 3.14*(d^2)/4; "original square inches of tree"
31: areaofscrap = areaoftree - 12*2*12 - 8*2*8 - 6*2*4 - 4*2*2; "cross-sectional area of scrap"
32: volumeofscrap = areaofscrap*(20*12)/1728; "20 feet long, cubic feet of scrap"
33: profit = profit + volumeofscrap*0.5; "add profit from scrap"
34: twelve = twelve + 12; "count twelve inch boards"
35: eight = eight + 8;
36: four = four + 6;
37: two = two + 4;
38: RELEASE(NAME = saw); "release saw for next log"
39: DEPART();
40: large:
41: WAIT(TIME = 0 MAX normal(0.1*d, 0.12)); "wait to cut log"
42: profit = profit + 16*8 + 14*6 + 8*4 + 6*1; "add profit from boards"
43: profit = profit - 0.12*d^2 - 27; "subtract cost of board and cutting cost"
44: areaoftree = 3.14*(d^2)/4; "original square inches of tree"
45: areaofscrap = areaoftree - 16*2*12 - 14*2*8 - 8*2*4 - 6*2*2; "cross-sectional area of scrap"
46: volumeofscrap = areaofscrap*(20*12)/1728; "20 feet long, cubic feet of scrap"
47: profit = profit + volumeofscrap*0.5; "add profit from scrap"
48: twelve = twelve + 16; "count twelve inch boards"
49: eight = eight + 14;
50: four = four + 8;
51: two = two + 6;
52: RELEASE(NAME = saw); "release saw for next log"
53: DEPART();
54: nofeed: DEPART();
55: END.
Simulation Clock : 480.00

Block Information

<table>
<thead>
<tr>
<th>Stmt_Line</th>
<th>Label</th>
<th>Name</th>
<th>Total</th>
<th>Current</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>ARRIVE</td>
<td>154</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>SEIZE</td>
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<tr>
<td>3</td>
<td>5</td>
<td>SEIZE</td>
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<td>4</td>
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<td>5</td>
<td>7</td>
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<td>152</td>
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<tr>
<td>6</td>
<td>8</td>
<td>IF</td>
<td>152</td>
<td>0</td>
</tr>
<tr>
<td>7</td>
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<td>GOTO</td>
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<td>0</td>
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<td>11</td>
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<td>12</td>
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<td>16</td>
<td>ASSIGNMENT</td>
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<td>24</td>
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<td>23</td>
<td>25</td>
<td>DEPART</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>24</td>
<td>27</td>
<td>MEDIUM</td>
<td>127</td>
<td>1</td>
</tr>
<tr>
<td>25</td>
<td>29</td>
<td>ASSIGNMENT</td>
<td>126</td>
<td>0</td>
</tr>
<tr>
<td>26</td>
<td>30</td>
<td>ASSIGNMENT</td>
<td>126</td>
<td>0</td>
</tr>
<tr>
<td>27</td>
<td>31</td>
<td>ASSIGNMENT</td>
<td>126</td>
<td>0</td>
</tr>
<tr>
<td>28</td>
<td>32</td>
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<td>126</td>
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<tr>
<td>33</td>
<td>37</td>
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</tr>
<tr>
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<td>38</td>
<td>ASSIGNMENT</td>
<td>126</td>
<td>0</td>
</tr>
<tr>
<td>35</td>
<td>39</td>
<td>RELEASE</td>
<td>126</td>
<td>0</td>
</tr>
<tr>
<td>36</td>
<td>40</td>
<td>DEPART</td>
<td>126</td>
<td>126</td>
</tr>
</tbody>
</table>
Saw
Capacity = 1    Current Units = 1
Total Number = 152    Maximum Entities = 1
Maximum  Average  Average  Std Dev  Average
Units  Util.  Units  Units  Time
1  0.851  0.85  0.36  2.71

Default Queue Statistics
Capacity = Inf    Current Number = 1
Maximum  Total  Average  Std Dev  Average
Number  Number  Number  Number  Time
7  130  1.30  1.38  4.83

Feedtable
Capacity = 10    Current Units = 1
Total Number = 153    Maximum Entities = 7
Maximum  Average  Average  Std Dev  Average
Units  Util.  Units  Units  Time
7  0.130  1.30  1.38  4.10

Default Queue Statistics
No entries.

----------------- Global Variables -----------------
PROFIT = 10094.80
TWELVE = 1732.00
EIGHT = 1198.00
FOUR  = 876.00
TWO   = 574.00
D     = 27.11
AREAOFTREE = 456.41
AREAOFSCRA = 152.41
VOLUMEOFSC = 21.17

Compile time: 0.00 (Secs.)
Run time : 0.71 (Secs.)
Total memory available : 198202
Memory used by model : 13215
Maximum dynamic memory used: 1592
Total memory used : 14807
Problem 2) I run an exotic wood sawing operation. The logs are 20” in diameter, and I have found that I can cut a tree into the following:

<table>
<thead>
<tr>
<th>Cut Style</th>
<th># of 4”x18” boards resulting</th>
<th># of 1”x2” boards resulting</th>
<th># of 1”x4” boards resulting</th>
<th># of 2”x6” boards resulting</th>
<th>Cost to cut each tree in this style</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1</td>
<td>4</td>
<td>36</td>
<td>4</td>
<td>$15/tree</td>
</tr>
<tr>
<td>B</td>
<td>0</td>
<td>80</td>
<td>30</td>
<td>2</td>
<td>$20/tree</td>
</tr>
<tr>
<td>C</td>
<td>0</td>
<td>0</td>
<td>40</td>
<td>10</td>
<td>$17/tree</td>
</tr>
</tbody>
</table>

After the numbers of boards listed above are cut from the tree, the remainder is chipped and used in making particle board. Nothing is wasted. I sell every cubic inch for something. The logs are 20 feet long and wood weighs 30 pounds/cubic foot. Logs cost me $100 each, and I have 5000 logs to cut. Gross income from the sale of an item, before expenses, and minimum number of boards needed for existing orders, is:

\[
\text{Tree.} = \frac{\pi (20)^2}{4} = 314.16
\]

\[
\text{Cut. A} = 4 \times 8 + 4 \times 1 \times 2 + 36 \times 1 \times 4 + 4 \times 2 \times 6
\]

\[
= 272.16
\]

\[
\text{CUT A} = 314 - 272 = 42.16
\]

\[
\text{Scrap.}
\]

Set up the LP solution to determine what to do to maximize my profit.

\[
\text{Max Z} = (60 + 4 \times 4 + 36 \times 10 + 4 \times 16)A + (80,4 \times 4 + 30 \times 10 + 2 \times 16)B + (-421,4 \times 20 \times 30 \times 0.4)C + 0 \quad \text{for} \quad B \quad \text{and} \quad C
\]

\[
\text{ST} \quad A + B + C \leq 5000
\]

\[
A \geq 200
\]

\[
4A + 80B \geq 2000
\]

\[
36A + 30B + 40C \geq 400
\]

\[
4A + 2B + 10C \geq 600
\]

... includes subtracting the cost of the trees and costs of the logs.
Problem 2) (25 points) I run an exotic wood sawing operation. The logs are 20" in diameter, and I have found that I can cut a tree into the following:

<table>
<thead>
<tr>
<th>Cut Style</th>
<th># of 4&quot;x18&quot; boards resulting</th>
<th># of 1&quot;x2&quot; boards resulting</th>
<th># of 1&quot;x4&quot; boards resulting</th>
<th># of 2&quot;x6&quot; boards resulting</th>
<th>Cost to cut each tree in this style</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1</td>
<td>4</td>
<td>36</td>
<td>4</td>
<td>$15/tree</td>
</tr>
<tr>
<td>B</td>
<td>0</td>
<td>80</td>
<td>30</td>
<td>2</td>
<td>$20/tree</td>
</tr>
<tr>
<td>C</td>
<td>0</td>
<td>0</td>
<td>40</td>
<td>10</td>
<td>$17/tree</td>
</tr>
</tbody>
</table>

After the numbers of boards listed above are cut from the tree, the remainder is chipped and used in making particle board. Nothing is wasted. I sell every cubic inch for something. The logs are 20 feet long and wood weighs 30 pounds/cubic foot. The logs cost me $100 each and I have 5000 to cut. Gross income from the sale of an item, before expenses, and minimum number of boards needed for existing orders, is:

<table>
<thead>
<tr>
<th></th>
<th>Gross income before expenses</th>
<th>Minimum number required</th>
</tr>
</thead>
<tbody>
<tr>
<td>4&quot;x18&quot; boards</td>
<td>$70 each</td>
<td>300</td>
</tr>
<tr>
<td>1&quot;x2&quot; boards</td>
<td>$5 each</td>
<td>2100</td>
</tr>
<tr>
<td>1&quot;x4&quot; boards</td>
<td>$20 each</td>
<td>500</td>
</tr>
<tr>
<td>2&quot;x6&quot; boards</td>
<td>$26 each</td>
<td>700</td>
</tr>
<tr>
<td>Particle board chips</td>
<td>$0.60 per pound</td>
<td></td>
</tr>
</tbody>
</table>

Set up the LP solution to determine what to do to maximize my profit:

\[
\begin{align*}
\text{MAX } Z &= (70 \times 1 + 5 \times 4 + 20 \times 36 + 2 \times 4) \times A + (5 \times 80 + 20 \times 50 + 2 \times 2) \times B + (20 \times 40 + 2 \times 10) \times C \\
-15 \times A &- 20 \times B - 17 \times C - 100 \times 5000 + (75.06 \times A \times 0.6) + (42.73 \times B \times 0.6) + (42.73 \times C \times 0.6)
\end{align*}
\]

ST

\[
\begin{align*}
A + B + C &\leq 5000 \\
1 \times A &\geq 300 \\
4 \times A + 80 \times B &\geq 2100 \\
30 \times A + 30 \times B + 40 \times C &\geq 5000 \\
4 \times A + 2 \times B + 10 \times C &\geq 700
\end{align*}
\]
Problem 3) (15 points) I run a wood sawing operation. To surface finish the rough-cut boards, I am planning on buying either a McDermott plane or a Cavette sander. The McDermott plane costs $200,000, has a 12 year life, and a salvage value of $30,000. It will cost $20,000/year for maintenance. The Cavette sander will last for 14 years, cost $280,000, have a salvage value of $60,000, and cost $15,000/year to operate. Determine which of the two machines I should purchase. Use a MARR of 12% per year with yearly payments.

**McDermott**

\[ P = 200,000 \]

\[ A_1 = 20k \]

\[ A_2 = 200k \left( \frac{A_2}{P} \right)_{12%, 12} = 200 \left( 0.1614 \right) = -32,280 \text{ K/yr} \]

\[ A_3 = 30k \left( \frac{A_3}{F} \right)_{12%, 12} = 30 \left( 0.0414 \right) = +1,242 \text{ K/yr} \]

\[ A_1 + A_2 + A_3 = -20 - 32,280 + 1,242 = -31,038 \text{ K/yr} \]

**Cavette**

\[ P = 280,000 \]

\[ A_1 = 15k/yr \]

\[ A_2 = 280k \left( \frac{A_2}{P} \right)_{12%, 14} = -280 \left( 0.1509 \right) = -42,252 \text{ K} \]

\[ A_3 = 60k \left( \frac{A_3}{F} \right)_{12%, 14} = +60 \left( 0.0309 \right) = +1,854 \text{ K} \]

\[ A_1 + A_2 + A_3 = -15 - 42,252 + 1,854 = -55,398 \text{ K/yr} \]

Buy McDermott
Problem 4) (15 points) I run a wood sawing operation. Assuming that I purchase the McDermott plane (Cavette went out of business so the purchase was not based on economics) set up a table telling me exactly how much money I will have in my bank account at the end of each year for the life of the machine. The actual salvage value of the plane turned out to be $40,000. MARR = 12%, and inflation is running at 3%/year. The machine is classed as 7 year property, and I will be using MACRS as the most advantageous depreciation method. I anticipate that the machine will bring in $80,000 each year for the first 5 years, and $120,000/year thereafter, until its sale. 

<table>
<thead>
<tr>
<th>Year</th>
<th>Actual Cash Flow $K</th>
<th>Deprec Income</th>
<th>Taxable Income</th>
<th>Tax</th>
<th>After Tax Cash Flow $K</th>
<th>Inflation Real Cash Flow $K</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>-200</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>-200</td>
<td>-200</td>
</tr>
<tr>
<td>1</td>
<td>+80 - 20 = +60</td>
<td>0.143 * 200</td>
<td>0.2 45 + 200</td>
<td>11.304</td>
<td>548,696</td>
<td>47.28</td>
</tr>
<tr>
<td>2</td>
<td>60</td>
<td>0.175 * 200</td>
<td>11.0</td>
<td>3.96</td>
<td>56,04</td>
<td>(1.03)^2 = 52.82</td>
</tr>
<tr>
<td>3</td>
<td>60</td>
<td>0.125 * 200</td>
<td></td>
<td></td>
<td>(See Table)</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>60</td>
<td>0.089 * 200</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>60</td>
<td>0.089 * 200</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>-120 - 20 = 100</td>
<td>0.089 * 200</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>100</td>
<td>0.089 * 200</td>
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<td></td>
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</tr>
<tr>
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<td></td>
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</tr>
<tr>
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</tr>
<tr>
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<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>12</td>
<td>120 + 40 - 20 = 140</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Year</td>
<td>Actual Cash Flow</td>
<td>Depreciation Rate</td>
<td>Depreciation</td>
<td>Taxable Income</td>
<td>Tax Paid</td>
<td>After Tax Cash Flow</td>
</tr>
<tr>
<td>------</td>
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<td>-------------------</td>
<td>--------------</td>
<td>----------------</td>
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</tr>
<tr>
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<tr>
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<tr>
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<td>$15.19</td>
<td>$44.81</td>
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<td>0.089</td>
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<td>$29.59</td>
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<tr>
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<td>0.089</td>
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<td>$29.59</td>
<td>$70.41</td>
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<td>$100.00</td>
<td>$36.00</td>
<td>$64.00</td>
</tr>
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<td>$0.00</td>
<td>$100.00</td>
<td>$36.00</td>
<td>$64.00</td>
</tr>
<tr>
<td>11</td>
<td>$100.00</td>
<td>0</td>
<td>$0.00</td>
<td>$100.00</td>
<td>$36.00</td>
<td>$64.00</td>
</tr>
<tr>
<td>12</td>
<td>$140.00</td>
<td>0</td>
<td>$0.00</td>
<td>$140.00</td>
<td>$50.40</td>
<td>$89.60</td>
</tr>
</tbody>
</table>
Problem 5) (15 points) Write a BOSS program to simulate this class taking this exam today. Make whatever estimates you feel appropriate, but justify them with logic and/or calculations and state them clearly.
PROGRAM

"class final" Typical solution. There were many good solutions turned in.

DEFINITION

    seat: RESOURCE = {CAPACITY=118};
    prof: RESOURCE = {};
    notyet: GATE = {STATUS = CLOSED};
    LABELS = {goawaymad};

CONTROL

    STOPTIME=3*60*60; "time = seconds"

LOGIC

    ARRIVE {TIME = EXPD(10), LIMIT = 88}; "Students arrive about every 10 seconds"
    TESTGATE{NAME = notyet}; "wait until 3:00 pm"
    SEIZE{NAME=prof}; "grab a quiz"
    WAIT{TIME = 0 MAX NORMAL(3,2)}; "pick up a quiz"
    RELEASE{NAME=prof};
    WAIT{TIME = EXPD(15)}; "go to seat"
    SEIZE{NAME=seat};
    WAIT{TIME = 0 MAX NORMAL(1.5*60*60, 0.1*60*60)}; "take exam"
    RELEASE{NAME=seat};
    DEPART{ };

    ARRIVE {TIME = 0, LIMIT = 18}; "Prof arrives 20 minutes early"
    WAIT{TIME = 20}; "quiz starts in 20 minutes"
    SETGATE {NAME = notyet, STATUS = OPEN}; "prof hands out exam"
    WAIT{TIME = 3*60*60}; "waits around for 3 hours"
    DEPART{ };

END.
General examination rules:

1) NOTE THAT THE ONLY THINGS YOU CAN HAVE IN YOUR POSESSION DURING THIS EXAM IS
YOUR ECONOMICS REFERENCE MANUAL AND YOUR BOSS TYPICAL COMMAND PACKET
INCLUDING THE SAMPLE PROBLEMS LISTED AS A PART OF THE PACKET.
2) DO NOT UNSTAPLE THIS EXAM. You can work on both sides of the pages. Simply note that you have
additional work on the back, or on additional attached paper.
3) Do not put any work on a desk or on the floor next to you or anywhere else it can be seen by others. If any
part of your work can be seen by others it will be confiscated and you will not be permitted to rework those
problems. Place it face down on your desk under your existing work.
4) Please remove your hat. If it is part of your head, turn it around backwards.
5) If your work not legible, or if I cannot follow your logic at a glance, it will receive no credit. This paper will
be written to acceptable engineering standards or it will receive no credit.
6) You may work on your own paper or use paper supplied at the front of the room.
7) If you feel that any additional information is necessary to work these problems, you may make a
reasonable engineering estimate for that value, as long as you state it clearly.
8) Fully document your LP variables sufficiently that there is no question as to their meaning, and
comment your BOSS code if you want me to understand what you are trying to do.

Ethical Standards:

Upon accepting admission to Texas A&M University, a student immediately assumes a commitment to
uphold the Honor Code, to accept responsibility for learning, and to follow the philosophy and rules of the
Honor System. Students will be required to state their commitment on examinations, research papers, and
other academic work. Ignorance of the rules does not exclude any member of the TAMU community from
the requirements or the processes of the Honor System.

"On my honor, as an Aggie, I have neither given nor received unauthorized aid on this exam."

_______________________________
Signature of student

Please do not open this exam until you are told to do so.
Problem 1) (15 points) Write a BOSS program to simulate this class taking this exam today. Make whatever estimates you feel appropriate, but justify them with logic and/or calculations and state them clearly.
PROGRAM
"class final"

DEFINITION
    seat: RESOURCE = {CAPACITY=118};
    prof: RESOURCE = {};
    notyet: GATE = {STATUS = CLOSED};
LABELS = {goawaymad};

CONTROL
    STOPTIME=3*60*60; "time = seconds"

LOGIC
    ARRIVE {TIME = EXPD(10), LIMIT = 88}; "Students arrive about every 10 seconds"
    TESTGATE{NAME = notyet}; "wait until 3:00 pm"
    SEIZE{NAME=prof};"grab a quiz"
    WAIT{TIME = 0 MAX NORMAL(3,2)}; "pick up a quiz"
    RELEASE{NAME=prof};
    WAIT{TIME = EXPD(15)}; "go to seat"
    SEIZE{NAME=seat};
    WAIT{TIME = 0 MAX NORMAL(1.5*60*60, 0.1*60*60)}; "take exam"
    RELEASE{NAME=seat};
    DEPART{ };

    ARRIVE {TIME = 0, LIMIT = 18}; "Prof arrives 20 minutes early"
    WAIT{TIME = 20}; "quiz starts in 20 minutes"
    SETGATE {NAME = notyet, STATUS = OPEN}; "prof hands out exam"
    WAIT{TIME = 3*60*60}; "waits around for 3 hours"
    DEPART{ };

END.→
Problem 2) (25 points) I run an exotic wood sawing operation. The logs are 20” in diameter, and I have found that I can cut a tree into the following:

<table>
<thead>
<tr>
<th>Cut Style</th>
<th># of 4”x18” boards resulting</th>
<th># of 1”x2” boards resulting</th>
<th># of 1”x4” boards resulting</th>
<th># of 2”x6” boards resulting</th>
<th>Cost to cut each tree in this style</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1</td>
<td>4</td>
<td>36</td>
<td>4</td>
<td>$15/tree</td>
</tr>
<tr>
<td>B</td>
<td>0</td>
<td>80</td>
<td>30</td>
<td>2</td>
<td>$20/tree</td>
</tr>
<tr>
<td>C</td>
<td>0</td>
<td>0</td>
<td>40</td>
<td>10</td>
<td>$17/tree</td>
</tr>
</tbody>
</table>

After the numbers of boards listed above are cut from the tree, the remainder is chipped and used in making particle board. Nothing is wasted. I sell every cubic inch for something. The logs are 20 feet long and wood weighs 30 pounds/cubic foot. The logs cost me $100 each and I have 5000 to cut. Gross income from the sale of an item, before expenses, and minimum number of boards needed for existing orders, is:

<table>
<thead>
<tr>
<th></th>
<th>Gross income before expenses</th>
<th>Minimum number required</th>
</tr>
</thead>
<tbody>
<tr>
<td>4”x18” boards</td>
<td>$70 each</td>
<td>300</td>
</tr>
<tr>
<td>1”x2” boards</td>
<td>$5 each</td>
<td>2100</td>
</tr>
<tr>
<td>1”x4” boards</td>
<td>$20 each</td>
<td>500</td>
</tr>
<tr>
<td>2”x6” boards</td>
<td>$26 each</td>
<td>700</td>
</tr>
<tr>
<td>Particle board chips</td>
<td>$0.60 per pound</td>
<td></td>
</tr>
</tbody>
</table>

Set up the LP solution to determine what to do to maximize my profit.

Same as previous exam with slightly different numbers

See previous exam
Problem 3) (30 points) I run a wood sawing operation. The logs we buy are 20 feet long. They have a mean diameter of 27 inches normally distributed with a sigma = 2 inches. They are loaded onto a feed table exponentially distributed with a mean of 3 minutes. From there they are pushed into the saw and cut into boards. If the saw is busy, they must wait until it finishes cutting the previous log, but loading onto the feed table can continue. The limit on the number of logs which will fit onto the feed table is 20.

We have found that we can cut the trees into the following numbers of boards, depending on the diameter:

<table>
<thead>
<tr>
<th>Tree diameter (inches)</th>
<th># of 2&quot;x12&quot; boards resulting</th>
<th># of 2&quot;x8&quot; boards resulting</th>
<th># of 2&quot;x4&quot; boards resulting</th>
<th># of 2&quot;x2&quot; boards resulting</th>
<th>Cost to cut a tree of this diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 25&quot;</td>
<td>7</td>
<td>6</td>
<td>4</td>
<td>2</td>
<td>$15/tree</td>
</tr>
<tr>
<td>25&quot; to 30&quot;</td>
<td>12</td>
<td>8</td>
<td>6</td>
<td>4</td>
<td>$20/tree</td>
</tr>
<tr>
<td>Over 30&quot;</td>
<td>16</td>
<td>14</td>
<td>8</td>
<td>6</td>
<td>$27/tree</td>
</tr>
<tr>
<td>Income per board of this size</td>
<td>$18</td>
<td>$16</td>
<td>$14</td>
<td>$11</td>
<td></td>
</tr>
</tbody>
</table>

Logs cost $0.14*D^2 where D is the tree diameter in inches, and take a mean of 0.1*D minutes to cut, with a sigma = 0.12 minutes. After the boards are cut from the tree, the scrap is sold for particle board. Nothing is wasted. I sell every cubic inch for something. The scrap sells for $0.50 per cubic foot (note the units.)

Write a BOSS program to determine the profit from our operation and a count of the total number of each size of board at the end of an 8 hour day. A second blank page is included on the next page if you need it.

Same as previous exam with slightly different numbers

See previous exam
Problem 4) (15 points) I run a wood sawing operation. To surface finish the rough-cut boards, I am planning on buying either a McDermott plane or a Cavette sander. The McDermott plane costs $400,000, has a 12 year life, and a salvage value of $60,000. It will cost $40,000/year for maintenance. The Cavette sander will last for 14 years, cost $560,000, have a salvage value of $120,000, and cost $30,000/year to operate. Determine which of the two machines I should purchase. Use a MARR of 12% per year with yearly payments.

\[ A = 40,000 \] \[ n = 12 \] \[ i = 12\% \]

\[ A = -40,000 - 400,000 \left[ \frac{1}{(1+i)^n} \right] + 60,000 \left[ \frac{1}{(1+i)^n} \right] \]

\[ A_{net} = -102,076 \]

\[ A = 30,000 \] \[ n = 14 \] \[ i = 12\% \]

\[ A = -30,000 - 560,000 \left[ \frac{1}{(1+i)^n} \right] + 120,000 \left[ \frac{1}{(1+i)^n} \right] \]

\[ A_{net} = -110,796 \]

Choose the McDermott, it's cheaper per year.
Problem 5) (15 points) I run a wood sawing operation. Assume that I purchased the McDermott plane of the previous problem (Cavette went out of business so the purchase was not based on economics). Set up a table telling me the value of the money I will have in my bank account at the end of each year for the life of the machine. The actual salvage value of the plane turned out to be $80,000. MARR = 12%, and inflation is running at 3%/year. The machine is classed as 7 year property, and I will be using MACRS as the most advantageous depreciation method. I anticipate that the machine will bring in $160,000 each year for the first 5 years, and $240,000/year thereafter, until its sale. Other expenses are stated on the previous problem. Our company pays taxes at a rate of 34%.
<table>
<thead>
<tr>
<th>Year</th>
<th>Flow</th>
<th>Rate</th>
<th>Depreciation</th>
<th>Taxable Income</th>
<th>Tax Paid</th>
<th>After Tax Cash Flow</th>
<th>Inflation Factor</th>
<th>Real cash flow after inflation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>-$400.00</td>
<td>0</td>
<td>$0.00</td>
<td>$0.00</td>
<td>$0.00</td>
<td>$0.00</td>
<td>1.03^A2</td>
<td>-$200.00</td>
</tr>
<tr>
<td>1</td>
<td>$120.00</td>
<td>0.143</td>
<td>$57.20</td>
<td>$62.80</td>
<td>$22.61</td>
<td>$97.39</td>
<td>1.03</td>
<td>$94.56</td>
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<tr>
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<td>$120.00</td>
<td>0.245</td>
<td>$98.00</td>
<td>$22.00</td>
<td>$7.92</td>
<td>$112.08</td>
<td>1.06</td>
<td>$105.65</td>
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<tr>
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<td>$120.00</td>
<td>0.175</td>
<td>$70.00</td>
<td>$50.00</td>
<td>$18.00</td>
<td>$102.00</td>
<td>1.09</td>
<td>$93.34</td>
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<tr>
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<td>$120.00</td>
<td>0.125</td>
<td>$50.00</td>
<td>$70.00</td>
<td>$25.20</td>
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<td>1.13</td>
<td>$84.23</td>
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<tr>
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<td>$35.60</td>
<td>$84.40</td>
<td>$30.38</td>
<td>$89.62</td>
<td>1.16</td>
<td>$77.30</td>
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<td>$200.00</td>
<td>0.089</td>
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<td>$200.00</td>
<td>0.089</td>
<td>$35.60</td>
<td>$164.40</td>
<td>$59.18</td>
<td>$140.82</td>
<td>1.23</td>
<td>$114.50</td>
</tr>
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<td>0.045</td>
<td>$18.00</td>
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<td>$65.52</td>
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<td>1.27</td>
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<td>$0.00</td>
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<td>$98.10</td>
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<tr>
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<td>0</td>
<td>$0.00</td>
<td>$200.00</td>
<td>$72.00</td>
<td>$128.00</td>
<td>1.34</td>
<td>$95.24</td>
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<tr>
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<td>$200.00</td>
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<td>$0.00</td>
<td>$200.00</td>
<td>$72.00</td>
<td>$128.00</td>
<td>1.38</td>
<td>$92.47</td>
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<td>$0.00</td>
<td>$280.00</td>
<td>$100.80</td>
<td>$179.20</td>
<td>1.43</td>
<td>$125.69</td>
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</table>