I am a graduating senior – circle one: Yes  No

READ THE FOLLOWING GENERAL EXAMINATION RULES:

1) Do not put your completed work anywhere that it can be seen. 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 any pages of your work face down on your desk under your existing work, not on the floor next to you where it is visible.
2) Please remove your hat. If it is part of your head, turn it around backwards.
3) If your work is not legible, or if I cannot follow your logic at a glance, it will receive no credit. This paper must be written to acceptable engineering standards for credit. Please take this seriously as it will affect your grade.
4) You may work on the front or back of this paper. Just note if work is on the back.
5) You can use your own paper or paper supplied at the front of the room.
6) You MUST specify what you are doing every step of the way. ONLY if I can follow what you are trying to do and where you are getting your numbers from, will you receive partial credit should you go off track.
7) Write big and use lots of paper, leaving me room to grade your paper. If there is no room to tell you why points were deducted, I will only show you the point deduction and let you try and figure out why.

I have read and understand all of the above instructions: ____________  (Initials)

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"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) 10 points  A petroleum company operates two oil off-shore rigs in a particular site off the coast of Texas. Rig 4 produces at most 18,000 barrels of raw material per day. In the refining process, one barrel of this material produces 0.7 barrels of crude oil and 0.3 barrels of waste. Rig 7 has a maximum production of 15,000 barrels of raw material per day. It consists of 80% crude oil and 20% waste. To meet estimated demands, the petroleum company must produce at least 21,000 barrels of crude oil per day from the two rigs. In addition, due to environmental concerns and disposal restrictions, the company cannot produce any more than 8000 barrels of waste per day from these rigs. The company would like to plan how much raw material to produce at each of the two sites. A recent accounting report says that it costs the company $44.50 per barrel to get raw material out of Rig 4, and $50.00 per barrel for the material out of Rig 7. Set up the LP solution to solve this problem.
Problem 3) 10 points  A petroleum company operates two oil off-shore rigs in a particular site off the coast of Texas. Rig 8 produces at most 15,000 barrels of raw material per day. In the refining process, one barrel of this material produces 0.7 barrels of crude oil and 0.3 barrels of waste. Rig 5 has a maximum production of 18,000 barrels of raw material per day. It consists of 80% crude oil and 20% waste. To meet estimated demands, the petroleum company must produce at least 21,000 barrels of crude oil per day from the two rigs. In addition, due to environmental concerns and disposal restrictions, the company cannot produce any more than 8000 barrels of waste per day from these rigs. The company would like to plan how much raw material to produce at each of the two sites.

A recent accounting report says that it costs the company $34.50 per barrel to get raw material out of Rig 5, and $50.00 per barrel for the material out of Rig 8. Set up the LP solution to solve this problem.

<table>
<thead>
<tr>
<th>Rig 8</th>
<th>Rig 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>15,000</td>
<td>18,000</td>
</tr>
<tr>
<td>0.70</td>
<td>0.80</td>
</tr>
<tr>
<td>0.30</td>
<td>0.20</td>
</tr>
<tr>
<td>50.00</td>
<td>34.50</td>
</tr>
</tbody>
</table>

\[ \text{Cost} = \text{Z} \]
\[ A = \text{barrels produced from Rig 8 that are IUBEITM} \]
\[ B = \text{barrels produced from Rig 5 that are IUBEITM} \]
\[ \text{Min } Z = 50.00 \times A + 34.50 \times B \]

\[ \leq \text{ A } \leq 15,000 \]
\[ \leq \text{ B } \leq 18,000 \]
\[ 0.70 \times A + 0.80 \times B \geq 21,000 \]
\[ 0.30 \times A + 0.20 \times B \leq 8,000 \]
Problem 1) 10 points A petroleum company operates two oil off-shore rigs in a particular site off the coast of Texas. Rig 4 produces at most 18,000 barrels of raw material per day. In the refining process, one barrel of this material produces 0.7 barrels of crude oil and 0.3 barrels of waste. Rig 7 has a maximum production of 15,000 barrels of raw material per day. It consists of 80% crude oil and 20% waste. To meet estimated demands, the petroleum company must produce at least 21,000 barrels of crude oil per day from the two rigs. In addition, due to environmental concerns and disposal restrictions, the company cannot produce any more than 8000 barrels of waste per day from these rigs. The company would like to plan how much raw material to produce at each of the two sites. A recent accounting report says that it costs the company $44.50 per barrel to get raw material out of Rig 4, and $50.00 per barrel for the material out of Rig 7. Set up the LP solution to solve this problem.

\[
\begin{align*}
\text{Rig 4} & \quad \leq 18,000 \\
0.7 (\text{Rig 4}) & \quad = \text{oil} \quad ; \quad 0.3 (\text{Rig 4}) = \text{waste} \\
\text{Rig 7} & \quad \leq 15,000 \\
0.8 (\text{Rig 7}) & \quad = \text{oil} \quad ; \quad 0.2 (\text{Rig 7}) = \text{waste} \\
\text{oil Rig 4} + \text{oil Rig 7} & \quad \geq 21,000 \\
\text{waste Rig 4} + \text{waste Rig 7} & \quad \leq 8,000 \\
\text{Min} \quad z = 44.50 \text{Rig 4} + 50 \text{Rig 7} \\
\text{ST} \quad 0.7 \text{Rig 4} + 0.8 \text{Rig 7} & \quad \geq 21,000 \\
0.3 \text{Rig 4} + 0.2 \text{Rig 7} & \quad \leq 8,000 \\
\text{Rig 4} & \quad \leq 18,000 \\
\text{Rig 7} & \quad \leq 15,000 \\
\end{align*}
\]

Notes: 
- Rig 4 is the number of barrels of raw material that I find in my best economic interest to receive.
- The variable type is double for Rig 4 is double.
Problem 2) 10 points A contractor is responsible for moving fill from a borrow pit to a construction site. He has two different types of hauling trucks available: 3-axle (single unit) trucks and 5-axle (trailer) trucks. The hauling contractor only has 15 truck drivers who are equally skilled on both truck types, and his cash flow only allows him to spend $6400/day. The trucks have the following properties:

<table>
<thead>
<tr>
<th></th>
<th>Axles - 3</th>
<th>Axles - 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of trucks available</td>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td>Cost ($/day)</td>
<td>300</td>
<td>550</td>
</tr>
<tr>
<td>Capacity (cy/day)</td>
<td>150</td>
<td>350</td>
</tr>
</tbody>
</table>

a) Set up the solution to determine the least expensive choice of trucks to get the job done. Do not attempt to solve.

b) Set up the solution to determine the quickest way to get the job done. Do not attempt to solve.
MOR/LP

Date: 12/16/15                      Time: 09:12:19
J:\axlecheck.bos

MODEL DESCRIPTION
*******************************************************************************

min z = 300x3 + 550x5
st
300x3 + 550x5 <= 6400
x3+x5 <= 15
x3<=20
x5<=10
150x3 + 350x5 >= 1000

*******************************************************************************

Gomory Dual All-Integer Algorithm

OPTIMAL ALL INTEGER SOLUTION

  Z     =     1650
  X3    =     0
  X5    =     3

  NUMBER OF DUAL PIVOTS IS  3

Compile time:  0.16 (Secs.)
Run time : 0.00 (Secs.)
MOR/LP

Date: 12/16/15                Time: 09:06:56
J:\axlequik.bos

MODEL DESCRIPTION

*******************************************************************************

max \ z = 150x3 + 350x5
st
300x3 + 550x5 <= 6400
x3+x5 <= 15
x3<=20
x5<=10

*******************************************************************************

Gomory Dual All-Integer Algorithm

OPTIMAL ALL INTEGER SOLUTION

\ Z \ = \ 3950
\ x3 \ = \ 3
\ x5 \ = \ 10

NUMBER OF DUAL PIVOTS IS \ 4

Compile time: \ 0.17 (Secs.)
Run time : \ 0.00 (Secs.)
Problem 2) 10 points. A contractor is responsible for moving fill from a borrow pit to a construction site. He has two different types of hauling trucks available: 3-axle (single unit) trucks and 5-axle (trailer) trucks. The hauling contractor only has 3 truck drivers who are equally skilled on both truck types, and his cash flow only allows him to spend $6400/day. The trucks have the following properties:

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</tr>
</tbody>
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a) Set up the solution to determine the least expensive choice of trucks to get the job done. Do not attempt to solve.

b) Set up the solution to determine the quickest way to get the job done. Do not attempt to solve.

\[ \text{Min } z = 300A_3 + 550A_5 \]

Subject to:

\[ A_3 \leq 20 \]

\[ A_5 \leq 10 \]

\[ A_3 + A_5 \leq 15 \]

\[ 150A_3 + 350A_5 \geq 100,000 \]

This will not work because there is not enough trucks to haul this much dirt in a day.

\[ \text{Max } z = 150A_3 + 350A_5 \]

Subject to:

\[ A_3 \leq 20 \]

\[ A_5 \leq 10 \]

\[ A_3 + A_5 \leq 15 \]

\[ 300A_3 + 550A_5 \leq 6400 \]
Problem 3) 50 points  Outside of my office I see the following digging, stacking, filling, and hauling operation. The small track hoe on the right (a backhoe loader on tracks) is working close to the existing foundation, where she has the precision (skill?) not to damage it. She is stacking her material into a little pile to her left, for transfer by the large track hoe on the left to trucks waiting in queue. She cannot reach the trucks from her current location. The large track hoe, a Homatsu 480, is working 5 feet and farther away from the foundation, scooping and filling the trucks. Whenever an empty truck comes in, I note that the Homatsu first checks to see if the small track hoe’s pile of dirt is over 5 cubic yards, before going to get more dirt from his area away from the foundation.

I have counted a total of five trucks in the system, two white, and three red. I wasn’t here, but I assume that they all showed up this morning at 8:00 am. They must be taking the dirt to two different places, since I notice that the white trucks take a round trip of 45 minutes to haul out the dirt, dump it, and return, whereas the red trucks are taking 30 minutes. Sigma on both of these times is 10% of the round trip time.

Dr. Mander was in my office while I was watching and he mentioned that he had done this type of work for several years in New Zealand. He gave me the following specs for the trucks and track hoe loaders. The Homatsu 480 is using a 1.5 cubic yard bucket. Volume of dirt moved each time ranges between 1.5 cy to 2 cy, normally distributed, due to overloading. Overloading is not a problem. It is just more than the level capacity of the bucket. The ability to do this depends on the angle of internal friction of the soil. The small track hoe carries a 0.5 cy bucket, and is moving between 0.5 cy to 0.8 cy per scoop, normally distributed.

Time for the Homatsu to scoop, raise, rotate, dump, and level a scoop of soil into the truck from either the little pile or his area is 30 seconds. For the small track hoe to scoop, raise, rotate, and dump the scoop in a pile is 20 seconds. Looking at what they are working on, I don’t think they will run out of dirt for a year.

The dump trucks about 12 cy capacity, although an extra-large scoop at the end of loading will fit OK. Another limit is that the total unloaded weight of the truck is 32,000 pounds, and the bridges in the area are restricted to a max load of 52,000 pounds. To be safe, put no more dirt in the truck then around 50,000 pounds. Then a large scoop as the last scoop won’t overload the truck. Soil weighs 100 pounds/cubic foot.

As far as I can tell, we can assume that the availability of dirt for both loaders is essentially unlimited as they work around the building. However, once the pile of dirt from the small loader reaches 20 cubic yards, she quits for ten minutes and sees if it is less than 20 cy. I assume that is because the pile is getting unstable.

About once every 8 weeks, exponentially distributed, you get a 14 inch rain like we got last night, which shuts down work and you have to suck out the hole. Using two 3” diameter hoses they have the capacity to pump out 2000 cubic feet of water per hour. The hole is about 17 feet deep and 80 feet wide by 30 feet wide, accounting for deductions for what you see sticking out of the water.
Write a BOSS program to study the operation for 4 months. The operation is planned to operate 24/7 once underway. An extra blank sheet is included on the next page.
Write a BOSS program to study the operation for 4 months. The operation is planned to operate 24/7 once underway. An extra blank sheet is included on the next page.

PROGRAM  "Earthwork Problem"

DEFINITION
loadstation : RESOURCE {} ;
pile = 0 ; "cubic yards"
rain : GATE = {STATUS=OPEN} ;
ATTRIBUTES = {truck cap = 0 , truck color = 0} ; "0 is white 1.5 x
hot-mix scoop=0 ; "cy of dirt in scoop, gets RESET everytime"
LABELS = {checkpile , moredirt , rainagain , test ,cat , load , leave , white
hauled = 0 ;

CONTROL
STOPTIME = 4 X 30 X 24 X 60 ; "4 months in minutes"
RANDOMIZE = 0 ;

LOGIC
"logic for small track hoe"
ARRIVE = {TIME=0 , LIMIT=1} ;
checkpile :
TESTGATE = {NAME= rain} ;
IF pile < 20 THEN GOTO moredirt ;
WAIT {TIME = 10} ;
GOTO checkpile ;
moredirt :
WAIT {TIME = 1/3} ;
pile = pile + NORMAL (1.3/2 , 0.05) ;
GOTO checkpile ;

"logic for rain"
rainagain :
ARRIVE = {TIME = EXPD (8 X 7 X 24 X 60)} ;
SETGATE = {NAME= rain , STATUS = CLOSE} ;
WAIT = {TIME = 10.2 X 60} ;
SETGATE = {NAME= rain , STATUS = OPEN} ;
DEPART {} ;
GOTO rainagain ;
"logic for HOMATSU 480 and trucks"

```
ARRIVE {TIME = 0, LIMIT = 2};
TEST GATE = {NAME = rain};
SEIZE = {NAME = load station};
```

```
cat:
IF pile > 5 THEN GOTO load
ELSE WAIT {TIME = 10};
GOTO cat;
```

```
load:
IF truck cap >= 20/3 THEN GOTO leave;
WAIT {TIME = 0.5}; "Homatsu moves dirt"
homatsu scoop = NORMAL (-7/4, 1/4); "distribution for scoop, cy"
pile = pile - homatsu scoop;
truck cap = truck cap + homatsu scoop; "add dirt to truck"
GOTO cat;
```

```
leave:
IF truck color = 0 THEN GOTO white "checks color"
ELSE GOTO red;
```

```
white:
RELEASE {NAME = load station};
WAIT {TIME = NORMAL (45, 45)}; "white truck travels, unloads, comes
truck cap = 0; "unload truck"
hauled = hauled + 1;
GOTO test;
```

```
red:
RELEASE {NAME = load station};
WAIT {TIME = NORMAL (30, 3)};
truck cap = 0; "unload truck"
hauled = hauled + 1
GOTO test;
```

```
END.
```

"NOTE"
"combined HOMATSU 480 and trucks into 1 logic because there is too much going on with the movement of dirt, so only the trucks are considered entities, but the HOMATSU's information is still used"
PROGRAM
"Zachry Engineering hauling dirt - Final exam 12/15/15 - 322 USING SEIZE RESOURCES AS CONTROL"

DEFINITION
  fullload = (50000-32000)/(100*27); "Calculate volume for full truck"
  dirtinlittlepile = 0;
  dirt_hauled = 0; "total dirt hauled"
  ATTRIBUTES = {dirtinmytruck = 0, mycolor = 1}; "define attributes"
  dirtinscoop = 0;
  dewater_time = 17*80*30/2000; "calculate dewatering time"
  bigloader: RESOURCE = {}; "define the bigloader as a resource"
  LABELS = {fillagain, getdirt, littlehill, myarea, takeaload, adddirt, checkagain, testdirt};
  badweather: GATE = {STATUS = OPEN}; "gate closes upon bad weather"

CONTROL
  STOP_TIME = 24*60; "4*30*24*60; run shorter time - minutes"

LOGIC
  "Logic for arriving truck color:"
  ARRIVE {TIME=0,LIMIT=2}; "Bring in white trucks"
  mycolor = 1;
  GOTO fillagain;
  ARRIVE {TIME=0,LIMIT=3}; "Bring in red trucks"
  mycolor = 2;
  GOTO fillagain;

fillagain: SEIZE{NAME = bigloader};
getdirt: TESTGATE{NAME = badweather}; "see if must stop"
  IF(dirtinlittlepile >= 5) THEN GOTO littlehill ELSE GOTO myarea;
littlehill: WAIT{TIME = 30/60}; "Pick up dirt from little pile and put in truck"
  dirtinscoop = NORMAL((1.5+2)/2, (2-1.5)/6); "Volume of this scoop"
  dirtinlittlepile = dirtinlittlepile - dirtinscoop; "Subtract it from littlehill"
  dirtinmytruck = dirtinmytruck + dirtinscoop; "Add it to dirtinmytruck"
  IF dirtinmytruck >= 6.667 then GOTO takeaload; "haul it away"
  GOTO getdirt;
myarea: TESTGATE{NAME = badweather}; "see if must stop"
  WAIT{TIME = 30/60}; "Pick up dirt from myarea and put in truck"
  dirtinscoop = NORMAL((1.5+2)/2, (2-1.5)/6); "Volume of this scoop"
  dirtinmytruck = dirtinmytruck + dirtinscoop; "Add it to dirtinmytruck"
  IF dirtinmytruck >= 6.667 then GOTO takeaload; "haul it away"
  GOTO getdirt;
takeaload: RELEASE{NAME = bigloader};
  dirt_hauled = dirt_hauled + dirtinmytruck; "calculate total dirt hauled"
IF mycolor = 1 THEN WAIT \{TIME = 0 MAX NORMAL(45,4.5)\};
IF mycolor = 2 THEN WAIT \{TIME = 0 MAX NORMAL(30,3.0)\}; "trip time
as appropriate"
GOTO fillagain; "go get more dirt. stand in line if necessary"

"Born the little loader to add to the little pile of dirt"
ARRIVE \{TIME = 0, LIMIT = 1\};
testdirt:
TESTGATE\{NAME = badweather\}; "see if must stop"
IF dirtinlittlepile >= 20 THEN GOTO checkagain ELSE GOTO adddirt;
checkagain:
WAIT \{TIME = 10/60\}; "wait 10 minutes to see if can continue"
GOTO testdirt; "try again"
adddirt:
WAIT \{TIME = 20/60\}; "get dirt and dump it in the little pile"
dirtinlittlepile = dirtinlittlepile + NORMAL((0.5+0.8)/2, (0.8-
0.5)/6); "Add a scoop"
GOTO testdirt;

"Born bad weather"
ARRIVE \{TIME = EXPD(8*24*60)\};
SETGATE\{NAME = badweather, STATUS = CLOSE\};
WAIT \{TIME = 1224\}; "delay in minutes to dewater hole"
SETGATE\{NAME = badweather, STATUS = OPEN\};
DEPART;

END.
Problem 4) 30 points  I have now maxed out my 3 credit cards, a VISA, a Master charge, and a Discover. I haven't bought anything on credit for 6 months, but still currently owe, in order, $6,200, $8,400, and $19,600 on the three cards. The interest rate I am being charged, in order, is 8%, 20%, and 24%. I am currently able to pay nothing but the interest on these cards. That's just all the money I can come up with. All rates are nominal.

Another credit card company has offered me the opportunity to consolidate all of these loans into a single loan at 6%. Assuming that I make no new credit card purchases (which you can be sure I will not) and that I make the same monthly payment to the new company as I am currently making to the old, about how long will it take me to pay off this horrible mess I have gotten into? No interpolation is required. You tell me about how long it will take, and the calculation required to get an exact answer, and I will know if you know how to work this problem.
<table>
<thead>
<tr>
<th>Owed</th>
<th>Nominal Rate</th>
<th>Monthly Payment</th>
</tr>
</thead>
<tbody>
<tr>
<td>$6,200.00</td>
<td>8.00%</td>
<td>$41.33</td>
</tr>
<tr>
<td>$8,400.00</td>
<td>20.00%</td>
<td>$140.00</td>
</tr>
<tr>
<td>$19,600.00</td>
<td>24.00%</td>
<td>$392.00</td>
</tr>
</tbody>
</table>
| $34,200.00 | 6.00%        | $573.33         | Old minimum payment 
\( \{p/a,l,n\} = 59.65 \) = between 60 and 100 months. 

New minimum payment: \( \approx 71.01 \)
I am a graduating senior – circle one: Yes  No

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SAME AS QUIZ #1
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</tr>
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</tr>
<tr>
<td>$625.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$171.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$34,200.00</td>
<td>6.00%</td>
<td></td>
</tr>
</tbody>
</table>

\[
\frac{(p/a,l,n)}{2} = 54.72 = \text{between 60 and 100 months.}
\]

EXACT = 64.09 years
Problem 2) 30 points I have now maxed out my 3 credit cards, a VISA, a Master charge, and a Discover. I haven’t bought anything on credit for 6 months, but still currently owe, in order, $6,200, $8,400, and $19,600 on the three cards. The interest rate I am being charged, in order, is 18%, 20%, and 24%. I am currently able to pay nothing but the interest on these cards. That’s just all the money I can come up with. All rates are nominal.

Another credit card company has offered me the opportunity to consolidate all of these loans into a single loan at 6%. Assuming that I make no new credit card purchases (which you can be sure I will not) and that I make the same monthly payment to the new company as I am currently making to the old, about how long will it take me to pay off this horrible mess I have gotten into? No interpolation is required. You tell me about how long it will take, and the calculation required to get an exact answer, and I will know if you know how to work this problem.

Owe

- VISA = $6,200, i = 18%
- Master = $8,400, i = 20%
- Discover = $19,600, i = 24%

VISA:

interest paid each month = $6,200 * \frac{18}{12} = $93/month

Master:

interest paid each month = $8,400 * \frac{20}{12} = $140/month

Discover:

interest paid each month = $19,600 * \frac{24}{12} = $392/month

monthly payments $/old = 93 + 140 + 392 = $625/month ✓

* Since only interest has been paid we still have each principal amount of $6,200, $8,400, $19,600 to pay off.

New company:

i = \frac{.06}{12} = .005

A = $625

n = ?

\begin{align*}
34,200 - 34,200 + 625\left[ P_a, .005, n \right] &= 0 \\
\text{exact formula for answer, } n &= \frac{34,200}{625} \\
\text{solve for } n &= 54.72
\end{align*}

Using chart \[ [P_a, .005, n] = \frac{34,200}{625} = 54.72 \]

between 60 and 100. It is closer to 60.

where n is a little over 60 months to pay off.
Problem 3) 10 points  A petroleum company operates two oil off-shore rigs in a particular site off the coast of Texas. Rig 8 produces at most 15,000 barrels of raw material per day. In the refining process, one barrel of this material produces 0.7 barrels of crude oil and 0.3 barrels of waste. Rig 5 has a maximum production of 18,000 barrels of raw material per day. It consists of 80% crude oil and 20% waste. To meet estimated demands, the petroleum company must produce at least 21,000 barrels of crude oil per day from the two rigs. In addition, due to environmental concerns and disposal restrictions, the company cannot produce any more than 8000 barrels of waste per day from these rigs. The company would like to plan how much raw material to produce at each of the two sites. A recent accounting report says that it costs the company $34.50 per barrel to get raw material out of Rig 4, and $50.00 per barrel for the material out of Rig 7. Set up the LP solution to solve this problem.
Problem 3) 10 points  A petroleum company operates two oil off-shore rigs in a particular site off the coast of Texas. Rig 8 produces at most 15,000 barrels of raw material per day. In the refining process, one barrel of this material produces 0.7 barrels of crude oil and 0.3 barrels of waste. Rig 5 has a maximum production of 18,000 barrels of raw material per day. It consists of 80% crude oil and 20% waste. To meet estimated demands, the petroleum company must produce at least 21,000 barrels of crude oil per day from the two rigs. In addition, due to environmental concerns and disposal restrictions, the company cannot produce any more than 8000 barrels of waste per day from these rigs. The company would like to plan how much raw material to produce at each of the two sites. A recent accounting report says that it costs the company $34.50 per barrel to get raw material out of Rig 5, and $50.00 per barrel for the material out of Rig 8. Set up the LP solution to solve this problem.

<table>
<thead>
<tr>
<th>Rig 8</th>
<th>Rig 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>15,000</td>
<td>18,000</td>
</tr>
<tr>
<td>70%</td>
<td>80%</td>
</tr>
<tr>
<td>30%</td>
<td>20%</td>
</tr>
<tr>
<td>50.00</td>
<td>34.50</td>
</tr>
</tbody>
</table>

\[ Z = \text{Cost} \]
\[ A = \text{barrels produced from Rig 8 that are crude} \]
\[ b = \text{barrels produced from Rig 5 that are crude} \]
\[ \text{Min } Z = 50.00 \times A + 34.50 \times B \]
\[ \leq \]
\[ A \leq 15,000 \]
\[ B \leq 18,000 \]
\[ 0.70 \times A + 0.80 \times B \geq 21,000 \]
\[ 0.30 \times A + 0.20 \times B \leq 8,000 \]
Problem 4) 10 points  A contractor is responsible for moving fill from a borrow pit to a construction site. He has two different types of hauling trucks available: 3-axle (single unit) trucks and 5-axle (trailer) trucks. The hauling contractor only has 30 truck drivers who are equally skilled on both truck types, and his cash flow only allows him to spend $12,800/day. The trucks have the following properties:

<table>
<thead>
<tr>
<th></th>
<th>Axles - 3</th>
<th>Axles - 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of trucks available</td>
<td>40</td>
<td>20</td>
</tr>
<tr>
<td>Cost ($/day)</td>
<td>300</td>
<td>550</td>
</tr>
<tr>
<td>Capacity (cy/day)</td>
<td>150</td>
<td>350</td>
</tr>
</tbody>
</table>

a) Set up the solution to determine the least expensive choice of trucks to get the job done. Do not attempt to solve.

b) Set up the solution to determine the quickest way to get the job done. Do not attempt to solve.
\[
\begin{align*}
\text{min } z &= 300x_3 + 550x_5 \\
\text{st} & \quad 300x_3 + 550x_5 \leq 12800 \\
& \quad x_3 + x_5 \leq 60 \\
& \quad x_3 \leq 40 \\
& \quad x_5 \leq 20 \\
& \quad 150x_3 + 350x_5 \geq 1000 \quad \text{"cut down from 100000 so would run"} \\
&& \text{all integer} \\
&& \text{boundonsum} = 40
\end{align*}
\]
max z = 150x3 + 350x5
st
300x3 + 550x5 <= 12800
x3 + x5 <= 60
x3 <= 40
x5 <= 20

allinteger
boundonsum = 40

change to 30
Problem 4) 30 points  I have now maxed out my 3 credit cards, a VISA, a Master charge, and a Discover. I haven’t bought anything on credit for 6 months, but still currently owe, in order, $6,200, $8,400, and $19,600 on the three cards. The interest rate I am being charged, in order, is 8%, 20%, and 24%. I am currently able to pay nothing but the interest on these cards. That’s just all the money I can come up with. All rates are nominal.

Another credit card company has offered me the opportunity to consolidate all of these loans into a single loan at 6%. Assuming that I make no new credit card purchases (which you can be sure I will not) and that I make the same monthly payment to the new company as I am currently making to the old, about how long will it take me to pay off this horrible mess I have gotten into? No interpolation is required. You tell me about how long it will take, and the calculation required to get an exact answer, and I will know if you know how to work this problem.

\[
\begin{align*}
\text{VISA} & \quad i = 8\% \quad i = \frac{8}{12} = \frac{2}{3} \% \\
\text{Master charge} & \quad i = 20\% \quad i = \frac{20}{12} = \frac{5}{3} \% \\
\text{Discover} & \quad i = 24\% \quad i = 24 \quad \% = 2 \quad \% \\
\text{P} = 6,200 & \quad P = 8,400 \\
I/\text{month} = 41.33 & \quad I/\text{month} = 140 \\
\text{I}_{\text{total}} = \text{I}_{\text{VISA}} + \text{I}_{\text{Master}} + \text{I}_{\text{Discover}} = 573.33/\text{month} \\
\text{New Company} & \quad i = 6\% \quad i = \frac{6}{12} = 0.5 \% \\
P = P_{\text{total}} = 34,700 \\
A = 573.33/\text{month} \\
\text{R} = 34,700 - 573.33(P_{A, 0.5, n}) \\
34,700 = 573.33(P_{A, 0.005, n})
\end{align*}
\]

\[
\left(P_{A, 0.005, n}\right) = 59.6515 \\
\text{it will take about 70 months}
\]

The exact number could be found from
\[
\frac{1 - (1.005)^{-n}}{0.005(1.005)^n} = 59.6515 \quad \text{and solving for } n