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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

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Problem 1) I just had another email exchange regarding our $15 million, 7 year, monthly repayment loan. Determine the required “balloon” payment at the end of 7 years. Note: >> indicates the old email.

>> From: Lowery Jr, Lee L [mailto:lowery@civil.tamu.edu]
>> Sent: Wednesday, September 23, 2015 11:02 AM
>> To: Ramiro Galindo <ramiro@galindogroup.com>
>> Subject: Regency Gardens Venture documents
>> Ram:
>> What was the final interest rate? As expected?
>> Lee

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Problem 2) We own two cattle feed lots located on Clear Creek, flowing into the Brazos river. The first (Plant 1) is 2 miles upstream from the Brazos. The second (Plant 2) is 0.5 miles from the Brazos. The EPA just tested the creek’s quality for nitrates and found that we are currently out of compliance. EPA specifies that nowhere along the stream can the nitrate concentration exceed 2 tons per million gallons of stream flow. The water upstream of our first plant has a nitrate concentration of essentially zero, so there is no real question of who is a fault here.

Plant 1 discharges 20 tons of nitrates per day into the creek, with Plant 2 discharging 14 tons per day.

Clear Creek has a flow rate immediately above Plant 1 equal to 5 million gallons/day. That flow increases by the time it reaches Plant 2 to 7 million gallons/day. Thus our discharge of 20 tons of nitrate/day from Plant 1 into the 5 million gallon/day stream yields a pollution level of 4 tons/million gallons, far above the EPA limit.

We have the ability to collect, haul, and spread nitrate from Plant 1 to adjacent fields as fertilizer, at a cost of $1000/ton. The same can be done at Plant 2 at a cost of $1800/ton. The owners of the fields will pay us $100/ton for the fertilizer. Natural processes in the stream also reduce the pollutant load by 20% per mile, as it flows downstream.

Set up the LP model to determine the least expensive way to bring our feed lots into compliance with EPA regulations.

http://www2.epa.gov/nutrientpollution/sources-and-solutions-agriculture
http://www.mda.state.mn.us/protecting/conservation/practices/feedlotrunoff.aspx
http://livestocktrail.illinois.edu/dairynet/paperDisplay.cfm?ContentID=6569
http://tammi.tamu.edu/Sweeten.pdf
https://books.google.com/books?id=HS4LAAAJQBAJ&pg=PA101&lpg=PA101&dq=solutions+for+feedlot+problems&source=bl&ots=erVyluidxh&sig=LoFj4ROPo012f3Pt04G9D66TzRM&hl=en&sa=X&ved=0CBwQ6AEwADgKahUKEwj1x-e10fniAhXDbz4KHxRGw0Uq#v=onepage&q=solutions%20for%20feedlot%20problems&f=false
https://books.google.com/books?id=KJO7n2LnCR0C&pg=PA50&lpg=PA50&dq=solutions+for+feedlot+problems&source=bl&ots=1pPvDL0BUF&sig=DAZT_vpOtou-wBGsrCBst3b12IO&hl=en&sa=X&ved=0CDQ6AEw8BiKahUKEwj1x-e10fniAhXDbz4KHxRGw0Uq#v=onepage&q=solutions%20for%20feedlot%20problems&f=false
https://store.extension.iastate.edu/Product/Solutions-For-Open-Feedlot-Operators-Developing-Whole-Farm-Nutrient-Plans-for-Feedlots
http://wps.prenhall.com/wps/media/objects/2234/2288589/ModB.pdf
"Quiz B1, Problem 2"

Min Z = (1000-400)M1 + (1800-400)M2

"EPA permits 2 Tons of nitrates per 100,000 gallons flowing water"

ST
20-M1 <= 2*5
"Keep tons inserted at plant 1 <= the EPA permitted 2 tons per million gallons in the 5 million gals of water flowing"

(20-M1)*(1 - 0.2*1.5) + (14 - M2) <= 2*7
"Keep EPA happy @ 14 tons in 7 million gallons of flowing water per day at the mouth of Plant #2"

" Fun stuff "
"Tons after Plant 1"
TonsAfter1 - (20-M1) = 0
"Tons removed between Plant 1 and Plant 2"
TonsRemovedStream - (20-M1)*(0.2*1.5) = 0
"Tons above Plant 2"
TonsBefore2 - (20-M1)*(1 - 0.2*1.5) = 0
"Tons after Plant 2"
TonsAfter2 - (20-M1)*(1 - 0.2*1.5) - 14 + M2 = 0

"Level after Plant 1"
LevelAfter1 - (20-M1)/5 = 0
"Level after Plant 2"
LevelAfter2 - ((20-M1)*(1 - 0.2*1.5) + 14 - M2)/7 = 0

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

Simplex Method

^^^^ Optimal Solution ^^^

Z = 12000.0006
M1 = 20.0000
M2 = 0.0000
TONS After1 = 0.0000
TONS Removed = 0.0000
TONS Before2 = 0.0000
TONS After2 = 14.0000
LEVEL After1 = 0.0000
LEVEL After2 = 2.0000
Problem 3) You have been asked to transport the maximum amount of medical supplies as possible to the villages on the map shown. You start with 10,000# of supplies from your base at Village A. Thereafter, you are forced by terrain, rebel forces, and other problems, only to travel along roads in the directions shown. Before rebels infiltrated the area you could double back on a previously travelled road to pick up additional villages. Now, however, once you go down a road they close it behind you and wait for you to come back, with disastrous results.

The villages have the following current needs, in pounds of supplies.

Village (needs) in pounds: A(400#), B(300#), C(200#), D(500#), E(900#), F(800#), G(700#), H(2200#), I(1600#), J(1200#), K(800#), L(1400#), M(1200#).

Breakage and spoilage are also a problem. Due to temperatures and poor roads you can count on losing the following pounds of supplies as you travel: Supplies lost if travel down road (pounds lost): AB(20#), AC(10#), BC(12#), CE(15#), CF(2#), BD(35#), FK(8#), DE(16#), EH(11#), DG(7#), GJ(3#), GI(13#), IL(12#), IM(6#), DH(4#).

Set up the LP solution to determine which roads to travel in order to maximum number of pounds of medical supplies distributed.

Maximize 
\[ Z = 400 + 300AB + 200AC + 200BC + 500BD + 900CE + 800CF + 900DE + 700DG + 2200DH + 2200EH + 800FK + 1600GI + 1200GJ + 1400IL + 1200IM \]

Subject to:
1. \( AB - AC = 0 \)
2. \( AB - BC - BD = 0 \)
3. \( AC + BC - CE - CF = 0 \)
4. \( BD - DE - DH - DG = 0 \)
5. \( CE + DE - EH = 0 \)
6. \( CF - FK = 0 \) (Don't need K since nothing comes out)
7. \( DG - GJ - GI = 0 \)

ST. Some as ST above, change 300 AB to 300 + 20
200 AC to 200 + 10
ETC. Same for all roads going into nodes.
I am a graduating senior—circle one: Yes No

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Signature of student

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The villages have the following current needs, in pounds of supplies.

Village(needs in pounds): A(300#), B(200#), C(100#), D(400#), E(800#), F(700#), G(600#), H(200#), I(180#), J(1000#), K(900#), L(1400#), M(1600#).

Due to temperatures and poor roads you can count on losing the following pounds of supplies as you travel: Supplies lost if travel down road(pounds lost): AB(20#), AC(10#), AE(12#), BC(15#), CG(2#), GD(35#), EF(8#), FG(16#), FI(11#), FL(7#), IH(3#), IK(13#), KJ(12#), JH(6#), KM(4#).

Set up the LP solution to determine which roads to travel in order to maximum number of pounds of medical supplies distributed.
"QB2 Problem 1"
"Run under Gomory Cut"

Max Z = 300+200AB+100AC+100BC+800AE+600CG+400GD+700EF+
600FG+1400FL+180FI+200IH+900IK+1000KJ+2000JH+1600KM

ST

1-AB-AC-AE=0  "Allow only one truck to exit all nodes"
ab-bc = 0
ac+bc-cg = 0
ae-ef = 0
ef - fi-fl-fg = 0
cg + fg - gd = 0
fi-ih-ik = 0
kj - jh = 0
ik-kj-km = 0

"Limiting supply available on truck"
300+(20+200)ab +(16+100)AC+(15+100)BC+(12+800)AE+(2+600)CG+
(3+400)GD+(8+700)EF+(16+600)FG+(7+1400)FL+(11+180)FI+(3+200)IH+
(13+900)IK+(12+1000)KJ+(6+200)JH+(4+1600)KM \leq 8000

" Fun stuff  Check total amount used  "
300+(20+200)ab +(16+100)AC+(15+100)BC+(12+800)AE+(2+600)CG+
(3+400)GD+(8+700)EF+(16+600)FG+(7+1400)FL+(11+180)FI+(3+200)IH+
(13+900)IK+(12+1000)KJ+(6+200)JH+(4+1600)KM - TotalUsedUp = 0

" Check amount distributed  "
300+(200)ab +(100)AC+(100)BC+(800)AE+(600)CG+
(400)GD+(700)EF+(600)FG+(1400)FL+(180)FI+(200)IH+
(900)IK+(1000)KJ+(200)JH+(1600)KM - TotalDistributed = 0

" Check amount lost on roads due to breakage/spoilage  "
(20)ab +(10)AC+(15)BC+(12)AE+(2)CG+
(35)GD+(8)EF+(16)FG+(7)FL+(11)FI+(3)IH+
(13)IK+(12)KJ+(6)JH+(4)KM - TotalLost = 0

Allinteger

Gomory Cut - Mixed Integer Linear Programming
^^^ Optimal Solution ^^^

Integer solution has been obtained

\[
\begin{align*}
Z &= 4480.0001 \\
AB &= 0.0000 \\
AC &= 0.0000 \\
BC &= -0.0000 \\
AE &= 1.0000 \\
CG &= -0.0000 \\
GD &= 0.0000 \\
EF &= 1.0000 \\
FG &= 0.0000 \\
FL &= 0.0000 \\
FI &= 1.0000 \\
IH &= 0.0000 \\
IK &= 1.0000 \\
KJ &= 0.0000 \\
JH &= 0.0000 \\
KM &= 1.0000 \\
TOTALUSEDUP &= 4528.0000 \\
TOTALDISTRIBUTE &= 4480.0000 \\
TOTALLOST &= 48.0000
\end{align*}
\]
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\[ i = 0.0478 \times \frac{1}{12} = 0.003983 \% \text{/month} \]
\[ a = \frac{5110}{12} \]
\[ n = 7 \times 12 = 84 \text{ months} \]

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\[ n = 7 \times 12 = 84 \text{ months} \]

\[ F = \frac{1 + (1 + 0.003983)^{84}}{0.003983} - 1 \times 100(1 - 0.003983)^{84} \]
\[ = 71,271,947,779 \]

\[ F = \frac{1 + (1 + 0.003983)^{84}}{0.003983} - 1 \times 100(1 - 0.003983)^{84} \]
\[ = 71,271,947,779 \]

"Balloon" Payment = 5998722.24
Problem 3) We own two cattle feed lots located on Black Bear Creek, flowing into the Navasota river. The first (Plant 1) is 4 miles upstream from the Brazos. The second (Plant 2) is 2.5 miles downstream from Plant 1. The EPA just tested the creek’s quality for nitrates and found that we are currently out of compliance. EPA specifies that nowhere along the stream can the nitrate concentration exceed 2 tons per million gallons of stream flow. The water upstream of our first plant has a nitrate concentration of essentially zero, so there is no real question of who is a fault here.

Plant 1 discharges 40 tons of nitrates per day into the creek, with Plant 2 discharging 28 tons per day.

Clear Creek has a flow rate immediately above Plant 1 equal to 10 million gallons/day. That flow increases by the time it reaches Plant 2 to 14 million gallons/day. Thus our discharge of 40 tons of nitrate/day from Plant 1 into the 10 million gallon/day stream yields a pollution level of 2 tons/million gallons, well above the EPA limit.

We have the ability to collect, haul, and spread nitrate from Plant 1 to adjacent fields as fertilizer, at a cost of $2000/ton. The same can be done at Plant 2 at a cost of $3600/ton. The owners of the fields will pay us $400/ton for the fertilizer. Natural processes in the stream also reduce the pollutant load by 20% per mile, as it flows downstream.

Set up the LP model to determine the least expensive way to bring our feed lots into compliance with EPA regulations.
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Plant 1 discharges $40$ tons of nitrates per day into the creek, with Plant 2 discharging $28$ tons per day.

Clear Creek has a flow rate immediately above Plant 1 equal to $10$ million gallons/day. That flow increases by the time it reaches Plant 2 to $14$ million gallons/day. Thus our discharge of $40$ tons of nitrate/day from Plant 1 into the $10$ million gallon/day stream yields a pollution level of $2$ tons/million gallons, well above the EPA limit.

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Set up the LP model to determine the least expensive way to bring our feed lots into compliance with EPA regulations.

\[
\text{Min } Z = 1600P_1 + 3200P_2
\]

\[
\text{ST: } \begin{align*}
40 - P_1 & \leq 20 \\
(40 - P_1) - (40 - P_1)(0.2 \cdot 2.5) + (28 - P_2) & \leq 28
\end{align*}
\]