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)

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) Our company cuts 28" diameter logs into two styles. Cut A produces four 2x10, four 2x16, and nine 2x18 boards. Cut B produces four 1x8, four 1x12, four 1x14, and four 1x16, along with eight 1x18 and five 2x18 boards. The shaded boards in the sketch are 2" thick, while those not shaded are 1" thick. Not drawn to scale. The logs are all 30 feet long, and cost $220 each. Boards sell for the following prices after cutting costs are deducted: 2x10 = $10, 2x16 = $16, 2x18 = $24, 1x8 = $5, 1x12 = $7, 1x14 = $12, 1x16 = $18, and 1x18 = $20. After cutting, the remainder of the log is chipped for particle board and sells for $5/ft³. This month we have 900 logs available to cut. Due to existing contracts we need at least 6500 2x18’s and 1000 1x18’s. Solve the problem of what to do this month using linear programming.
"322 Quiz B 11/6/13 - Cut 28" logs problem"

Max \( Z = (4*10 + 4*16 + 9*24) *A \)  
\[ \rightarrow 4 \circ 2'10" \times \frac{\#10' S"BOARDS}{each} \quad + \quad 9 \circ 2'18" \times \frac{\$24}{each} \]

\[ + (4*5 + 4*7 + 4*12 + 4*18 + 8*20 + 5*24) *B \quad \text{Same for B} \]

Area logs  
\[ (616 - 4*20 - 4*32 - 9*36) *30*5*A/144 \]

\[ + (616 - 4*8 - 4*12 - 4*14 - 4*16 - 8*18 - 5*36) *30*5*B/144 \]

\[ - 220*(A+B) \quad \text{log cost} \]

"Or, \( Z = 320A + 448B + 87.50A + 95.83B - 220*(A+B)"\]

ST  
\[ A+B \leq 900 \]
\[ 9A + 5B \geq 6500 \]
\[ 8B \geq 1000 \]

"Calculate volume of chips in the logs:"  
\[ \text{Chips in } A - (616 - 4*20 - 4*32 - 9*36) \times \frac{30}{144} = 0 \quad \text{"cubic ft"} \]
\[ \text{Chips in } B - (616 - 4*8 - 4*12 - 4*14 - 4*16 - 8*18 - 5*36) \times \frac{30}{144} = 0 \]

Also see other exam for more detailed calculations.
Problem 2) I work in engineering for a company that manufactures and sells dozers. The signs on the dozers in the yard currently read D1200 Dozer, $210,000 cash, financing available at 7% nominal for 100 months. By watching car dealers we recently realized that we would sell far more dozers if we offer them at a zero percent interest rate. Thus they are printing up new signs that say D1200 Dozer, $unknown cash, zero percent financing for 100 months. Marketing brought me a proof sign saying that they needed a number to replace the word “unknown”, since they had no idea what to put there. What did I tell them? I.E. at what price will we have to market the dozer, if we wish to realize the same profit as before? As you see from our previous financing offer, our MARR is 7%.
\[ A_1 = 2.777 \, \text{$/mo}$

\[ n = 100 \]

\[ \text{P}_1 \]

\[ 7\% / 12 \]

\[ \text{P}_1 = 210^K \]

\[ A_2 \text{ must } = 2.777 \, \text{$/mo}$

to get same income from sale

\[ 0\% \]

\[ n = 100 \]

\[ \text{P}_2 = 2.777 \, ^K \times 100 = 277.7777 \]

\[ A_1 = \text{P}_1 \left( \frac{A/P, 7\% / 12, 100 \text{ months}}{} \right) = 210 \left( 0.013227 \right) = 2.77765 \, ^K / \text{month} \]

Since \( \text{P}_1 = \text{P}_2 \), \[ A_2 \text{ must } = A_1 = 2.777 \, ^K / \text{month} \]

Then \( \text{P}_2 \text{ must } = 2.77765 \, ^K / \text{month} \times 100 \text{ months} = 277.7777 \, ^K \text{ for dozer} \]

\[ \left( \frac{A/P, 7\% / 12, 100}{(1+i)^m-1} \right) = \left( \frac{0.07}{12} \left( 1 + \frac{0.07}{12} \right)^{100} \right) \]

\[ = 0.0104356 \]

\[ \frac{0.78897}{0.013227} = 0.013227 \]
Problem 3) We are upgrading internet access in our building. An employee from the company doing the work just showed up in my office and handed me the following information, and said "Your boss said to give you this and you would call us back within two days and tell us how you want to proceed."

An abbreviated coverage map is shown below for reference only, along with a photo of a C style unit. Actual internet coverage for each room was determined by positioning a mobile unit at various locations in the building, turning up its power to that of a standard A, B, C, or D unit, and measuring the resulting strength in each room in the building with a hand held receiver/transmitter. The results of these tests are shown in the following table where, for example, B3 means a Module B unit was positioned at location 3 in the building and gave either acceptable or unacceptable strengths in the rooms tabulated. Many of the rooms have been omitted for this example. I figured out what the Ys and Ns meant, but had to ask the lady about the 1/2. She said that it was hard to reach that room and that the tests showed only 1/2 strength for those potential installation points. She also noted that it would take two of them to give acceptable signal strength in the room. The A units cost $600 each, B = $1200, C = $2200, and D = $3000. Installation costs for the various units listed depend on the model number, where it is located in the building, and the wiring required for that unit. Installation costs are listed in the table. Solve the problem using linear programming.

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"Internet Quiz B1"

\[ \text{MIN } z = 100A1 + 800A2 + 600A3 + 400A4 + 200A5 + 900A6 + 1200A7 + 500B1 + 700B3 + 2100B5 + 800B6 + 600B7 + 200C2 + 800C6 + 3000D4 \]

\[ + 600(A1+A2+A3+A4+A5+A6+A7) + 1200(B1+B3+B5+B6+B7) + 2200(C2+C6) + 3000D4 \]

"MIN Z = 700A1 + 1400A2 + 1200A3 + 1000A4 + 800A5 + 1500A6 + 1800A7 + 1700B1 + 1900B3 + 3300B5 + 2000B6 + 1800B7 + 2400C2 + 3000C6 + 6000D4"

\[ \text{st} \]
A1 + A2 + A5 + A7 + B5 + B7 + C3 + C6 + D4 \[\geq 1 \quad "\text{ROOM 110}" \]
A1 + A4 + A6 + B1 + B3 + B6 + C2 + D4 \[\geq 1 \quad "\text{ROOM 118}" \]
B1 + C6 + D4 \[\geq 1 \quad "\text{ROOM 106}" \]
A1 + A3 + A5 + A6 + A1 + B6 + B7 + C2 + D4 \[\geq 1 \quad "\text{ROOM 103}" \]
A2 + A3 + A5 + A6 + B3 + B5 + C2 + D4 \[\geq 1 \quad "\text{ROOM 140}" \]
A3 + A4 + A5 + A7 + B1 + B5 + B6 + B7 + C6 \[\geq 1 \quad "\text{ROOM 139}" \]
A1 + A2 + A7 + B3 + B7 + C2 + C6 + D4 \[\geq 1 \quad "\text{ROOM 136}" \]
A2 + A5 + A6 + B1 + B3 + B5 + B7 + C2 + C6 + D4 \[\geq 1 \quad "\text{ROOM 131}" \]
B5 + D4 + EXTRA \[\geq 1 \quad "\text{ROOM 126}" \]
EXTRA - A1 \[\geq 0 \]
EXTRA - A5 \[\geq 0 \]
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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) Our building is currently undergoing an internet upgrade. One of the employees from the company doing the work just showed up in my office and handed me the following information, saying “Your boss said to give you this and you would call us back within two days and tell us how you want to proceed.”

An abbreviated coverage map is shown above for reference only, along with a photo of a D style unit. Actual internet coverage for each room was determined by positioning a mobile unit at various locations in the building, turning up its power to that of a standard A, B, C, or D unit, and measuring the resulting strength in each room in the building with a hand held receiver/transmitter. The results of these tests are shown in the following table where, for example, B3 means a Module B unit was positioned at location 3 in the building and gave either acceptable or unacceptable strengths in the rooms tabulated. Many of the rooms have been omitted for this example. I figured out what the Ys and Ns meant, but had to ask the lady about the ½. She said that it was hard to reach that room and that the tests showed only ½ strength for those potential installation points. She also noted that it would take two of them to give acceptable signal strength in the room. The A units cost $1200 each, B = $2400, C = $4400, and D = $5000. Installation costs for the various units listed depend on the model number, where it is located in the building, and the wiring required for that unit. Installation costs are listed in the table. Solve the problem using linear programming.
"Internet Quiz B2"

\[ \text{MIN } z = 100A1 + 800A2 + 600A3 + 400A4 + 200A5 + 900A6 + 1200A7 + 500B1 + 700B3 + 2100B5 + 800B6 + 600B7 + 200C2 + 800C6 + 3000D4 \]

\[ + 1200(A1 + A2 + A3 + A4 + A5 + A6 + A7) + 2400(B1 + B3 + B5 + B6 + B7) + 4400(C2 + C6) + 5000D4 \]

\[
\begin{align*}
st \\
A1 + A2 + A5 + A7 + B5 + B7 + C3 + C6 + D4 & \geq 1 \quad \text{"ROOM 110"} \\
A1 + A4 + A6 + B1 + B3 + B6 + C2 + D4 & \geq 1 \quad \text{"ROOM 118"} \\
B1 + C6 + D4 & \geq 1 \quad \text{"ROOM 106"} \\
A1 + A3 + A5 + A6 + A1 + B6 + B7 + C2 + C6 + D4 & \geq 1 \quad \text{"ROOM 103"} \\
A2 + A3 + A5 + A6 + B3 + B5 + B7 + C2 + D4 & \geq 1 \quad \text{"ROOM 140"} \\
A3 + A4 + A5 + A7 + B1 + B5 + B6 + B7 + C6 & \geq 1 \quad \text{"ROOM 139"} \\
A1 + A2 + A7 + B3 + B7 + C2 + C6 + D4 & \geq 1 \quad \text{"ROOM 136"} \\
A2 + A5 + A6 + B1 + B3 + B5 + B7 + C2 + C6 + D4 & \geq 1 \quad \text{"ROOM 131"} \\
B5 + D4 + EXTRA & \geq 1 \quad \text{"ROOM 126"} \\
\end{align*}
\]

EXTRA - A1 \geq 0

EXTRA - A5 \geq 0
Problem 2) I work in engineering for a company that manufactures and sells dozers. The signs on the dozers in the yard currently read D1200 Dozer, $310,000 cash, financing available at 8% nominal for 100 months. By watching car dealers we recently realized that we would sell far more dozers if we offer them at a zero percent interest rate. Thus they are printing up new signs that say D1200 Dozer, $unknown cash, zero percent financing for 100 months. Marketing brought me a proof sign saying that they needed a number to replace the word “unknown”, since they had no idea what to put there. What did I tell them? I.E. at what price will we have to market the dozer, if we wish to realize the same profit as before? As you see from our previous financing offer, our MARR is 8%.
CALCS:

\[ A_1 = P_1 \left( \frac{A/P, 8/12, 100}{m} \right) = 310 \cdot 0.0137331 = 4.257 \text{ K/month} \]

Since \( P_1 = P_2 \), \( A_2 \text{ must} = A_1 = 4.257 \text{ K/month} \)

Then \( P_2 \text{ must} = 4.257 \text{ K/month} \times 100 \text{ months} \)

\( (A/P, 8/12, 100) = \frac{i(1+i)^m}{(1+i)^m - 1} = \frac{0.08}{12} \left(1 + \frac{0.08}{12} \right)^{100} - 1 \)
Problem 1) Our company cuts 29" diameter logs into two styles. Cut A produces four 2x10, four 2x16, and nine 2x18 boards. Cut B produces four 1x8, four 1x12, four 1x14, and four 1x16, along with eight 1x18 and five 2x18 boards. The shaded boards in the sketch are 2" thick, while those not shaded are 1" thick. Not drawn to scale. The logs are all 40 feet long, and cost $280 each. Boards sell for the following prices after cutting costs are deducted: 2x10 = $20, 2x16 = $32, 2x18 = $48, 1x8 = $10, 1x12 = $14, 1x14 = $24, 1x16 = $36, and 1x18 = $40. After cutting, the remainder of the log is chipped for particle board and sells for $10/ft³. This month we have 1800 logs available to cut. Due to existing contracts we need at least 9500 2x18's and 2000 1x18's. Solve the problem of what to do this month using linear programming.
Problem 1) Our company cuts 29" diameter logs into two styles. Cut A produces four 2x10, four 2x16, and nine 2x18 boards. Cut B produces four 1x8, four 1x12, four 1x14, and four 1x16, along with eight 1x18 and five 2x18 boards. The shaded boards in the sketch are 2" thick, while those not shaded are 1" thick. Not drawn to scale. The logs are all 40 feet long, and cost $280 each. Boards sell for the following prices after cutting costs are deducted: 2x10 = $20, 2x16 = $32, 2x18 = $48, 1x8 = $10, 1x12 = $14, 1x14 = $24, 1x16 = $36, and 1x18 = $40. After cutting, the remainder of the log is chipped for particle board and sells for $10/ft³. This month we have 1800 logs available to cut. Due to existing contracts we need at least 9500 2x18's and 2000 1x18's. Solve the problem of what to do this month using linear programming.

\[
\begin{align*}
A & \quad 4 - 2 \times 10 @ \#20 \\
& \quad 4 - 2 \times 16 @ \#32 \\
& \quad 9 - 2 \times 18 @ \#48 \\
& \quad \frac{640}{} \\
B & \quad 4 - 1 \times 8 @ \#10 \\
& \quad 4 - 1 \times 12 @ \#14 \\
& \quad 4 - 1 \times 14 @ \#24 \\
& \quad 4 - 1 \times 16 @ \#36 \\
& \quad 8 - 1 \times 18 @ \#40 \\
& \quad 5 - 2 \times 18 @ \#48 \\
& \quad \frac{896}{}
\end{align*}
\]

\[
\text{Max } Z = 640 A + 896 B + 357 A + 379 B - 280 (A+B)
\]

\[
\begin{align*}
\text{ST } & \quad A + B \leq 1800 \\
& \quad 9A + 5B \geq 9500 \\
& \quad 8B \geq 2000
\end{align*}
\]

\[
\text{Max } Z = (4.20 + 4.32 + 9.48) A + (4.10 + 4.14 + 4.24 + 4.36 + 8.40 + 5.48) B \\
+ (35.7 \text{ ft}^3/\log \text{cut A}) (\$10/\text{ft}^3) A + 379 B
\]

Chips A = 128.5 in² = 0.892 ft²
Volume A = 0.892 ft² * 40 ft = 35.7 ft³
So Chips A = 35.7 ft³ * $10/ft³
= $357/\log

Chips B = $379/\log

136.5 in² = 37.92 ft²
Max \( Z = (4*10 + 4*16 + 9*24) *A \)
\[ + ( 4*5 + 4*7 + 4*12 + 4*18 + 8*20 + 5*24) *B \]
\[ + (661 - 4*28 - 4*32 - 9*36) *40 *10 *A /144 \]
\[ + (661 - 4*8 - 4*12 - 4*14 - 4*16 - 8*18 - 5*36) *40 *10 *B /144 \]
\[ - 280*(A+B) \]

"Or, MAX \( Z = 640 \ A + 896 \ B + 357 \ A + 379 \ B - 280*(A+B)" \]

ST

\[ A+B \leq 1800 \]
\[ 9A + 5B \geq 9500 \]
\[ 8B \geq 2000 \]

"Calculate volume of chips in the logs:")

\[ \text{Chips in A} = (661 - 4*20 - 4*32 - 9*36) *40 /144 = 0 \] "cubic ft"
\[ \text{Chips in B} = (661 - 4*8 - 4*12 - 4*14 - 4*16 - 8*18 - 5*36) *40 /144 = 0 \]