Math 141 Exam 2A Fall 2015
Print Name
Section or Class time

There are 17 multiple choice problems worth 6 points each.

‘An Aggie does not lie, cheat or steal or tolerate those who do.’

Good Luck!

1. On your scantron, be sure you have bubbled in your UIN and your name and section or classtime.

2. Make sure test form A is bubbled in on your scantron.

3. Circle your answers on the test form and bubble the scantron. You will not get the scantron back.

4. Do not open this page until told to do so.
1. The inequalities that describe the region S below are
   a) \(x + y \leq 10, \ x - 3y \leq 2, \ 3x - y \leq 6\)
   \[\text{b) } x + y \leq 10, \ x - 3y \leq 2, \ 3x - y \geq 6\]
   c) \(x + y \geq 10, \ x - 3y \geq 2, \ 3x - y \geq 6\)
   d) \(x + y \geq 10, \ x - 3y \leq 2, \ 3x - y \leq 6\)
   e) \(x + y \leq 10, \ x - 3y \geq 2, \ 3x - y \leq 6\)

2. The region T is described by the inequalities:
   \(x \geq 0, \ y \geq 0, \ x + y \geq 10, \ x + 3y \geq 18\)
   Find the maximum and minimum of \(P = x + 4y\) on T, if possible.

   a) The minimum is 18 and the maximum is 40.
   b) The minimum is 10 and the maximum is 40.
   c) The minimum is 26 and the maximum does not exist.
   d) The minimum is 18 and the maximum does not exist.
   e) The minimum is 24 and the maximum is 40.
Use the following for problems 3 and 4. A meal is prepared from two foods A and B. Each ounce of Food A provides 50 units of vitamin C, 30 units of calcium and 4 grams of protein. Each ounce of food B provides 25 units of vitamin C, 30 units of calcium and 5 grams of protein. The meal should provide at least 400 units of vitamin C at least 300 units of calcium and no more than 60 grams of protein. Each ounce of food A has 15 calories and each ounce of food B has 20 calories. How many ounces of each food should the meal contain to meet the requirements and minimize the calories?

3. Define variables and state the objective.

(a) \( x = \) number of ounces of food A, \( y = \) number of ounces of food B
Minimize \( C = 15x + 20y \)

(b) \( x = \) the number of units of vitamin C, \( y = \) the number of units of calcium, \( z = \) the number of grams of protein
Minimize \( C = 200x + 300y + 50z \)

(c) \( x = \) the number of units of vitamin C, \( y = \) the number of units of calcium, \( z = \) the number of grams of protein
Minimize \( C = 15x + 20y + 50z \)

(d) \( x = \) the number of ounces of food A, \\
\( y = \) the number of ounces of food B
Maximize \( P = 15x + 20y \)

(e) none of these

4. The inequalities that define the region of problem 3 are \( x, y \geq 0 \) and:

(a) \( 50x + 30y + 4z \geq 400, \quad 25x + 30y + 5z > 300, \quad 4x + 5y \leq 60 \)

(b) \( 50x + 25y \leq 400, \quad 30x + 30y \leq 300, \quad 4x + 5y \leq 60 \)

(e) \( 50x + 25y \leq 400, \quad 30x + 30y \leq 300, \quad 4x + 5y \leq 60 \)

(d) \( 50x + 25y \leq 400, \quad 30x + 30y \geq 300, \quad 4x + 5y \leq 60 \)

(e) none of these
5. Which describes the set that is shaded in the Venn diagram below?

a) \( C \cup (A^C \cap B^C) \)  
   b) \( C \cup (A \cap B)^C \)  
   c) \( C \cap (A \cup B)^C \)  
   d) \( C \cap (A \cap B)^C \)  
   e) \( (C \cap A \cap B^C) \cup (C \cap B \cap A^C) \)

6. Fill in the blanks in the appropriate order with symbols chosen from 
\( \in, \subseteq, \cup, \cap, \emptyset \) for the sets \( U = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\} \) 
\( A = \{1, 2, 3, 4, 5\} \)  
\( B = \{2, 4, 6, 8\} \)

6  \( \in \{6, 8\} = (B \cap A^C) \subseteq \{2, 4, 6, 8\} \)

(a)  \( \in \cap \subseteq \)  
(b)  \( \subseteq \cup \emptyset \)  
(c)  \( \in \cap \cup \)  
(d)  \( \subseteq \cap \subseteq \)  
(e)  \( \in \cup \subseteq \)
Use the following for problems 7 and 8.

People shopping for pastry can buy apple, blueberry and/or cherry in any combination. Let $A$ be the set of people who bought apple, $B$ the set of people who bought blueberry, and $C$ the set of people who bought cherry.

7. Which set describes the people who bought only apple pastry?
   a) $A \cap (B \cup C)^C$  
   b) $A \cap B^C \cap C^C$  
   c) both $a$ and $b$  
   d) $A \cap (B \cap C)^C$  
   e) both $b$ and $d$

8. There were 42 people who bought apple, blueberry and/or cherry pastry. 5 bought all 3 flavors. 15 bought blueberry and cherry, possibly apple also. 20 bought apple and exactly one other flavor.

How many bought at least two flavors?
   a) 30  
   b) 35  
   c) 25  
   d) 20  
   e) 18
9. A group of 50 people were surveyed about whether or not they belong to a certain movie club or a certain book club.

5 of the people said they belong to neither club.

25 people said they belong to the book club and 30 people said they belong to the movie club. How many of the people belong to the movie club but not the book club?

a) 10  b) 25  c) 15  d) 20  e) none of these

\[\begin{align*}
c + b &= 25 \\
a + c &= 30 \\
a + b + c + e &= 55 \\
a + b + c &= 45 \\
\end{align*}\]

so \( c = 10 \)

so \( a = 20 \)

10. How many distinguishable arrangements of the word sassafrass are there?

a) 3628800  b) 5040  c) 2520  d) 3540  e) none of these

\[
\frac{10!}{5! \cdot 3!} \quad \text{or} \quad \binom{10}{5} \binom{5}{3} \cdot 2
\]
For problems 11 and 12, a person forms a **seven space code** consisting of **three** letters chosen from the eight letters, a, b, c,d, e, f, g, h, and **four** digits chosen from the ten digits 0 through 9.

11. How many codes can be made from three letters followed by four digits if letters may be repeated but digits may not be repeated.

   a) 1693440     b) 120960     c) 33067440     d) 2580480     e) 1377810

\[8^3\times 10^4 = 2580480\]

12. How many codes can be made if the letters must be all different, the digits must be all different and the seven different symbols may be in any order?

   1a) 11760     b) 59270400     c) 1693440     d) 5040     e) 355622400

\[(8\times 3)\times (10\times 4)\times 7!\]

or \[(7\times 3)\times (8!\times 3)\times (10\times 4)\]
For problems 13, 14 and 15, a person chooses six marbles from a box containing 7 blue marbles, 8 green marbles and 10 red marbles.

13. How many ways can he choose six of the same color?
   a) 245  b) 41160  c) 171367  d) 560  e) 150
   \[ 7B + 8C_6 + 10C_6 \]

14. How many ways can he choose exactly 3 blue and exactly 1 green, still choosing 6 marbles?
   a) 3360  b) 280  c) 12600  d) 151200  e) none of these
   \[ (7C_3)(8C_1)(10C_2) \]

15. How many ways can he choose at least one green or at least one blue?
   a) 176890  b) 323260  c) 11760  d) 23540  e) none of these
   \[ \text{Total - all red} = (25C_6) - (10C_6) \]
For problems 16 and 17: an experiment consists of rolling a 6-sided die and observing the top number and choosing one of 4 colors, red, blue, green or yellow.

16. How many outcomes are in the sample space?

a) 12  

b) 24

c) 10  

d) 15

e) none of these

\[ S = \{(x, y) : x \in \{1, 2, 3, 4, 5, 6\} \text{ and } y \in \{r, b, g, y\}\} \]

17. How many outcomes correspond to the event that the die shows 5 or the color is green?

a) 12  

b) 9

c) 10  

d) 23

e) 11

\[ 1 \times 4 + 6 \times 1 - 1 = 9 \]
There are 17 multiple choice problems worth 6 points each.

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Good Luck!

1. On your scantron, be sure you have bubbled in your UIN and your name and section or classtime.
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Use the following for problems 1 and 2. A meal is prepared from two foods A and B. Each ounce of Food A provides 50 units of vitamin C, 30 units of calcium and 4 grams of protein. Each ounce of food B provides 25 units of vitamin C, 30 units of calcium and 5 grams of protein. The meal should provide at least 400 units of vitamin C at least 300 units of calcium and no more than 60 grams of protein. Each ounce of food A has 15 calories and each ounce of food B has 20 calories. How many ounces of each food should the meal contain to meet the requirements and minimize the calories?

1. Define variables and state the objective.

a) \( x = \text{the number of ounces of food A,} \)
\( y = \text{the number of ounces of food B} \)
Maximize \( P = 15x + 20y \)

b) \( x = \text{the number of units of vitamin C,} \)
\( y = \text{the number of units of calcium,} \)
\( z = \text{the number of grams of protein} \)
Minimize \( C = 200x + 300y + 50z \)

c) \( x = \text{the number of units of vitamin C,} \)
\( y = \text{the number of units of calcium,} \)
\( z = \text{the number of grams of protein} \)
Minimize \( C = 15x + 20y + 50z \)

d) \( x = \text{number of ounces of food A,} \)
\( y = \text{number of ounces of food B} \)
Minimize \( C = 15x + 20y \)

e) none of these

2. The inequalities that define the region of problem 3 are \( x, y \geq 0 \) and:

\[ \text{a) } 50x + 25y \geq 400, \quad 30x + 30y \geq 300, \quad 4x + 5y \leq 60 \]

\[ \text{b) } 50x + 30y + 4z \geq 400, \quad 25x + 30y + 5z \geq 300, \quad 4x + 5y \leq 60 \]

\[ \text{c) } 50x + 25y \leq 400, \quad 30x + 30y \leq 300, \quad 4x + 5y \leq 60 \]

\[ \text{d) } 50x + 25y \leq 400, \quad 30x + 30y \leq 300, \quad 4x + 5y \geq 60 \]

\[ \text{e) none of these} \]
3. The inequalities that describe the region S below are

a) \( x + y \leq 10, \quad x - 3y \geq 2, \quad 3x - y \leq 6 \)

b) \( x + y \leq 10, \quad x - 3y \leq 2, \quad 3x - y \leq 6 \)

c) \( x + y \leq 10, \quad x - 3y \leq 2, \quad 3x - y \geq 6 \)

d) \( x + y \geq 10, \quad x - 3y \geq 2, \quad 3x - y \geq 6 \)

e) \( x + y \geq 10, \quad x - 3y \leq 2, \quad 3x - y \leq 6 \)

4. The region T is described by the inequalities:

\[ x \geq 0, \quad y \geq 0, \quad x + y \geq 10, \quad x + 3y \geq 18 \]

Find the maximum and minimum of \( P = x + 4y \) on T, if possible.

a) The minimum is 26 and the maximum is 40.

b) The minimum is 26 and the maximum does not exist.

c) The minimum is 18 and the maximum is 40.

\( x + y = 10 \)

\( 3x - y = 2 \)

\( 3x - y = 6 \)

\( x + y = 10 \)

\( x - 3y = 2 \)

d) The minimum is 10 and the maximum does not exist.

e) The minimum is 18 and the maximum does not exist.
Use the following for problems 5 and 6.

People shopping for pastry can buy apple, blueberry and/or cherry in any combination. Let \( A \) be the set of people who bought apple, \( B \) the set of people who bought blueberry, and \( C \) the set of people who bought cherry.

5. Which set describes the people who bought only apple pastry?

   a) \( A \cap (B \cap C)^C \)    b) \( A \cap B^C \cap C^C \)    c) both \( a \) and \( b \)
   
   d) \( A \cap (B \cup C)^C \) (e) both \( b \) and \( d \)

6. There were 42 people who bought apple, blueberry and/or cherry pastry. 5 bought all 3 flavors. 15 bought blueberry and cherry, possibly apple also. 20 bought apple and exactly one other flavor.

How many bought at least two flavors?

   a) 35    b) 25    c) 20    d) 18    e) 30
7. Which describes the set that is shaded in the Venn diagram below?

a) \((C \cap A \cap B^C) \cup (C \cap B \cap A^C)\)  
b) \(C \cup (A^C \cap B^C)\)  
c) \(C \cup (A \cap B)^C\)  
d) \(C \cap (A \cup B)^C\)  
e) \(C \cap (A \cap B)^C\)

8. Fill in the blanks in the appropriate order with symbols chosen from 
\(\in, \subseteq, \cup, \cap, \emptyset\) for the sets \(U=\{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}\)

\(A=\{1, 2, 3, 4, 5\}\) \(B=\{2, 4, 6, 8\}\)

\(6 \underline{\text{_____}} \{6, 8\} = (B \underline{\text{_____}} A^C) \underline{\text{_____}} \{2, 4, 6, 8\}\).

a) \(\in \cup \subseteq \underline{\text{b)} \in} \cap \subseteq \)  
c) \(\subseteq \cup \emptyset\)  
d) \(\in \cap \underline{\text{d)} \in} \cup\)  
e) \(\subseteq \cap \subseteq\)
9. A group of 50 people were surveyed about whether or not they belong to a certain movie club or a certain book club.

5 of the people said they belong to neither club.

25 people said they belong to the book club and 30 people said they belong to the movie club. How many of the people belong to the **movie club but not the book club**?

a) 25  b) 15  c) 20  d) 10  e) none of these

\[ a + c = 30 \]
\[ b + c = 25 \]
\[ a + b + c = 45 \]
\[ a + c + b + c = 55 \]
so \( c = 10 \)
\[ a = 20 \]

10. How many distinguishable arrangements of the word sassafrass are there?

a) 3628800  b) 5040  c) 2520  d) 3540  e) none of these

\[ \frac{10!}{5!3!} \]

**Mississippi formula**
For problems 11 and 12, a person forms a seven space code consisting of three letters chosen from the eight letters, a, b, c, d, e, f, g, h, and four digits chosen from the ten digits 0 through 9.

11. How many codes can be made if the letters must be all different, the digits must be all different and the seven different symbols may be in any order?

\[ \binom{8}{3} \binom{10}{4} \text{ Arranging the seven symbols } 7! \]

\[ (\binom{8}{3})(\binom{10}{4})7! \]

a) 11760  b) 59270400  c) 1693440  d) 5040  e) 355622400

12. How many codes can be made of three letters followed by four digits if the letters may be repeated but digits may not be repeated?

\[ 8^3 \cdot 10^4 \]

a) 1693440  b) 120960  c) 33067440  d) 2580480  e) 1377810
For problems 13, 14 and 15, a person chooses six marbles from a box containing 7 blue marbles, 8 green marbles and 10 red marbles.

13. How many ways can he choose six of the same color?
   a) 150  b) 245  c) 41160  d) 171367  e) 560
   \[ \binom{7}{6} + \binom{8}{6} + \binom{10}{6} \]

14. How many ways can he choose exactly 3 blue and exactly 1 green, still choosing six marbles?
   a) 280  b) 3360  c) 151200  d) 12600
e) none of these
   \[ (\binom{7}{3})(\binom{8}{1})(\binom{10}{2}) \]
   chooses so choose 2 red only 4

15. How many ways can he choose at least one green or at least one blue?
   a) 323260  b) 11760  c) 23540  d) 176890
e) none of these
   \[ \text{Total} - n(\text{all red}) \]
   \[ 25C_6 - 10C_6 \]
For problems 16 and 17: an experiment consists of rolling a 6-sided die and observing the top number and choosing one of 4 colors, red, blue, green or yellow.

16. How many outcomes are in the sample space?
   a) 15    b) 12    c) 24    d) 10    e) none of these

   $6 \times 4 \quad (\text{# of die}) \quad (\text{color})$
   $6 \times 4 \quad \text{4 colors}$

17. How many outcomes correspond to the event that the die shows 5 or the color is green?
   a) 9    b) 10    c) 23    d) 11    e) 12

   (5, any color) or (#, green)

   $2 + 6 - 1 = 9$
   This counts $\bigcirc$
   (5, green) twice so