Exam 2 is this Friday, March 6, 2020 from 4:30pm–6:30pm!

Work-out Problems

Study tip: Show all your work!

Exercise 1. Consider the following experiment: First, a card is drawn from a well-shuffled standard 52-card deck and the suit is recorded. Next, a fair 3-sided die is rolled and the number showing uppermost is recorded. Use H, D, S, C to denote the suit of the card (hearts, diamonds, spades, clubs, respectively), and use $1, 2, 3$ to record the number showing uppermost. For example, we will write $D2$ to denote the outcome that a diamonds is chosen and then a 2 is rolled. $S = \{H1, H2, H3, D1, D2, D3, S1, S2, S3, C1, C2, C3\}$

$n(S) = 12$.

1. Is this a uniform sample space?

yes, because each outcome in the sample space is equally likely.

2. Find the probability of the event "A number greater than 3 is rolled."

Since the event "A number greater than 3 is rolled" $= \emptyset$, (impossible event)

$P($"A number greater than 3 is rolled"$) = P(\emptyset) = \underline{0}$.

3. Find the probability of the event "A red card is drawn."

$P($"A red card is drawn"$) = P(\{H1, H2, H3, D1, D2, D3\}) = \underline{\frac{6}{12}}$.

let $E :=$ the event "A 2 is rolled" $= \{H2, D2, S2, C2\}$

$F :=$ the event "A clubs is drawn" $= \{C1, C2, C3\}$

use this notation for parts 4 and 5.

4. Find the probability of the event "A 2 is rolled *and* a clubs is drawn."

$P(E \cap F) = P(\{C2\}) = \underline{\frac{1}{12}}$

5. Find the probability of the event "A 2 is rolled *or* a clubs card is drawn."

$P(E \cup F) = P(\{H2, D2, S2, C2, C1, C3\}) = \underline{\frac{6}{12}}$

Exercise 2. A randomly selected sample of 646 middle school students in your town was surveyed. They were classified according to grade level and their response to the question "How do you usually get to school?". The data collected is summarized in the table below.

	walk	bus	car	totals
6th grade	30	120	65	215
7th grade	◇25	170	△25	□220
8th grade	→40	130	41	211
totals	■95	•420	131	646

1. Find the probability that a randomly selected middle school student usually takes the bus to school.

$$P(\text{"student takes the bus"}) = \frac{n(\text{bus})}{n(S)} = \boxed{\frac{\bullet 420}{646}}$$

2. Find the probability that a randomly selected middle school student does not usually take the bus to school.

$$P(\text{"student does not take the bus"}) = 1 - P(\text{"student takes the bus"})$$
$$= 1 - \frac{420}{646} = \frac{646}{646} - \frac{420}{646} = \boxed{\frac{226}{646}}$$

△ 3. Find the probability that a randomly selected middle school student is in 7th grade and usually takes a car to school.

$$P(\text{"student is in 7th grade" AND "student takes a car"}) = \boxed{\frac{\triangle 25}{646}}$$

4. Find the probability that a randomly selected middle school student is at least in 7th grade or usually walks to school.

avoid double counting

$$P(\text{"student is in at least 7th grade" or "student walks"})$$
$$= P(\text{"7th" or "8th" or "walks"}) = \underbrace{\frac{\square 220}{646}}_{\text{all 7th grade}} + \underbrace{\frac{211}{646}}_{\text{all 8th grade}} + \underbrace{\frac{\blacksquare 95}{646}}_{\text{all walks}} - \frac{\Diamond 25}{646} - \frac{\rightarrow 40}{646} = \boxed{\frac{461}{646}}$$

5. Find the probability that a randomly selected middle school student is not in 8th grade and does not usually walk to school.

$$P(\text{"student is not in 8th grade" AND "student does not walk"})$$
$$= P(\text{"6th" AND "bus"}) + P(\text{"6th and car"}) + P(\text{"7th and bus"}) + P(\text{"7th and car"})$$
$$= \frac{120}{646} + \frac{65}{646} + \frac{170}{646} + \frac{25}{646} = \boxed{\frac{380}{646}}$$

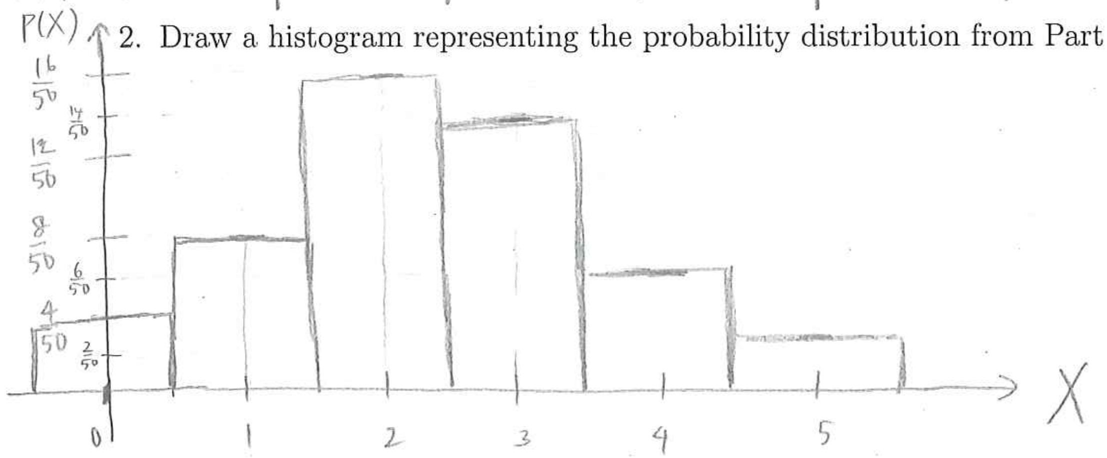
Exercise 3. A hospital researcher is interested in the number of times the average post-op patient will ring the nurse during a 12-hour shift. For a random sample of 50 patients, the following information was obtained. Let the random variable X = the number of times a patient rings the nurse during a 12-hour shift. Here, X can take on values $x = 0, 1, 2, 3, 4, 5$ (if a patient rings the nurse more than 5 times in a 12-hour shift, they are discharged from post-op care).

X	0	1	2	3	4	5
number of patients	4	8	16	14	6	2

1. Write a probability distribution table for the data, where $P(X)$ = the probability that X takes on value x.

X # of rings	0	1	2	3	4	5
P(X) probability	$\frac{4}{50}$	$\frac{8}{50}$	$\frac{16}{50}$	$\frac{14}{50}$	$\frac{6}{50}$	$\frac{2}{50}$

2. Draw a histogram representing the probability distribution from Part 1.



3. What is the probability that a randomly selected post-op patient will ring the nurse 0 or 5 times during a 12-hour shift? since the events are mutually exclusive

$P(\text{"}X=0\text{" or "}X=5\text{"}) = P(\text{"}X=0\text{"}) + P(\text{"}X=5\text{"}) = \frac{4}{50} + \frac{2}{50}$

$= \boxed{\frac{6}{50}}$

4. Find the expected number of times the average post-op patient will ring the nurse during a 12-hour shift.

$E(X) = X_1 \cdot P_1 + X_2 \cdot P_2 + \dots + X_6 \cdot P_6$

$= 0 \cdot \frac{4}{50} + 1 \cdot \frac{8}{50} + 2 \cdot \frac{16}{50} + 3 \cdot \frac{14}{50} + 4 \cdot \frac{6}{50} + 5 \cdot \frac{2}{50}$

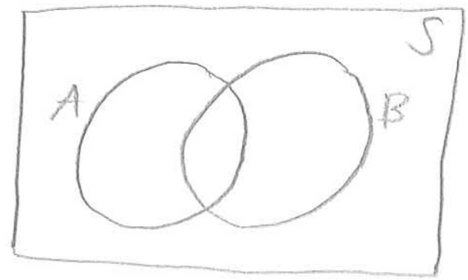
$= \frac{0 + 8 + 32 + 42 + 24 + 10}{50} = \frac{116}{50}$

The expected number of rings is $\boxed{\frac{116}{50}}$.

Exercise 4. Real estate records show that 64% of homes for sale have a garage, 21% have a swimming pool, and 17% of homes have both features.

Let A = "home for sale has a garage"

B = "home for sale has a pool"



Then from the info above,

$P(A) = 0.64$, $P(B) = 0.21$,

$P(A \cap B) = 0.17 = P(B \cap A)$

1. Are having a pool and having a garage mutually exclusive events? Explain.

Since $P(B \cap A) = 0.17 \neq 0$, $B \cap A \neq \emptyset$, so the two events are $\boxed{\text{not mutually exclusive}}$ (there are homes for sale with both a pool and a garage).

2. Find the probability that a home for sale has either a pool or a garage.

Want: $P(B \cup A) = P(B) + P(A) - P(B \cap A)$

$= 0.21 + 0.64 - 0.17$

$= \boxed{0.68}$

3. Find the probability that a home for sale has neither a pool nor a garage.

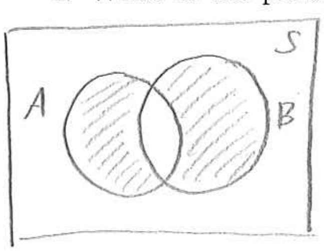
want: $P(B^c \cap A^c) = P((B \cup A)^c) = P((A \cup B)^c)$

$= 1 - P(A \cup B) = 1 - 0.68$ ← from part 2

$= \boxed{0.32}$

4. What is the probability that a home for sale has a pool or a garage, *but not both*?

want:



$P(B^c \cap A) + P(A^c \cap B)$

$= P(A \cup B) - P(A \cap B)$

$= 0.68 - 0.17$

$= \boxed{0.51}$

Exercise 5. You pay \$10 to roll two fair standard five-sided dice, noting the numbers rolled on each die. If you roll a double, you win \$25. If you roll different numbers with a sum less than 5, you win \$35. Otherwise you win nothing.

11	12	13	14	15
21	22	23	24	25
31	32	33	34	35
41	42	43	44	45
51	52	53	54	55

1. Find the probability distribution table for your net winnings.

There are $n(S) = 25$ outcomes in the sample space →

outcome	roll a double	roll different #s with sum less than 5	lose
X net winnings (in dollars)	$-10+25$ x_1	$-10+35$ x_2	-10 x_3
$P(X)$	$\frac{5}{25}$ p_1	$\frac{4}{25}$ p_2	$\frac{16}{25}$ p_3

check: • all probabilities are between 0 and 1, inclusive. ✓

• all probabilities sum up to 1. ✓

2. What are your expected net winnings? Round your answer to two decimal places, and use correct units.

$$E(X) = x_1 \cdot p_1 + x_2 \cdot p_2 + x_3 \cdot p_3$$

$$= +15 \cdot \frac{5}{25} + +25 \cdot \frac{4}{25} - 10 \cdot \frac{16}{25} = \frac{75 + 100 - 160}{25}$$

$$= \frac{+15}{25} = +0.60$$

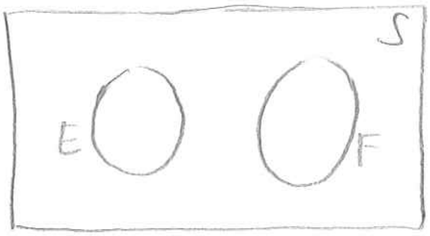
My expected net winnings are $\boxed{+\$0.60}$.

3. Based on your work, is this a "fair" game?

Since $E(X) \neq 0$, this is not a fair game.

Exercise 6. If E and F are two mutually exclusive events in a sample space S with $P(E) = 0.4$ and $P(F) = 0.3$, find each of the following probabilities.

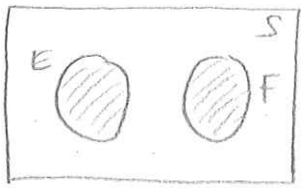
Have E and F mutually exclusive in a sample space S, so can illustrate with the following diagram:



1. $P(E \cup F)$

$P(E \cup F) = P(E) + P(F) = 0.4 + 0.3 = 0.7$

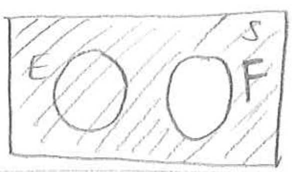
by the union rule, since E and F are mutually exclusive



2. $P(F^C)$

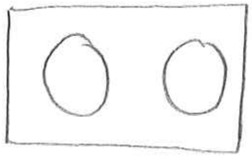
$P(F^c) = 1 - P(F) = 1 - 0.3 = \boxed{0.7}$

by the complement rule



3. $P(E \cap F)$

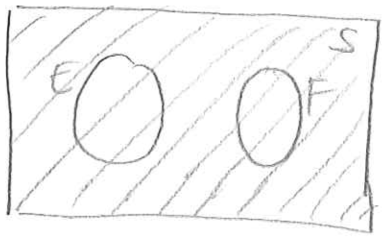
$P(E \cap F) = \boxed{0}$ since $E \cap F = \emptyset$ (E and F are mutually exclusive)



4. $P((E \cap F)^C)$

$P((E \cap F)^c) = 1 - P(E \cap F) = 1 - 0 = \boxed{1}$

by the complement rule



Exercise 7. Let $S = \{a, b, c, d, e, f\}$ with $P(\{b\}) = 0.3$, $P(\{c\}) = 0.15$, $P(\{d\}) = 0.05$, $P(\{e\}) = 0.2$, $P(\{f\}) = 0.13$. Let $E = \{a, b, c\}$ and $F = \{b, c, e, f\}$. Find each of the following probabilities.

Easier to tabulate the information in a probability distribution table.

outcome	a	b	c	d	e	f
probability		0.3	0.15	0.05	0.2	0.13

missing!

1. $P(\{a\})$

$P(\{a\}) = 1 - (0.3 + 0.15 + 0.05 + 0.2 + 0.13)$

$= \boxed{0.17}$

(since sum of all probabilities of simple events in sample space is 1.)

2. $P(E)$

since simple events in a probability distribution table are mutually exclusive

$P(E) = P(\{a, b, c\}) = P(\{a\}) + P(\{b\}) + P(\{c\})$

$= 0.17 + 0.3 + 0.15 = \boxed{0.62}$

3. $P(F)$

$P(F) = P(\{b, c, e, f\}) = P(\{b\}) + P(\{c\}) + P(\{e\}) + P(\{f\})$

$= 0.3 + 0.15 + 0.2 + 0.13 = \boxed{0.78}$

4. $P(E \cap F)$

$P(E \cap F) = P(\{b, c\}) = P(\{b\}) + P(\{c\})$

$= 0.3 + 0.15 = \boxed{0.45}$

Exercise 8. A company is trying to decide how much to charge for a year-long air conditioner repair service agreement. The average cost for repairing an air conditioner is \$350 and 1 in every 100 people who purchase agreements have air conditioners that require repair in the year. What is the minimum the company should charge for this repair service agreement?

Let $p :=$ price to charge for service agreement, in dollars.

Let $X :=$ the net earnings for the repair company.

outcome	need to repair	don't need to repair
X net earnings in \$	$-350 + p$	$+p$
$P(X)$ probability	$\frac{1}{100}$	$\frac{99}{100}$

Then $E(X) = (-350+p)\cdot\frac{1}{100} + p\cdot\frac{99}{100} \overset{\text{want}}{=} 0$

$\Rightarrow \quad -3.5 + \frac{p}{100} + \frac{99p}{100} = 0$

$\Rightarrow \quad -3.5 + p = 0$

$\Rightarrow \quad p = 3.5$

The company should charge a minimum of $\boxed{\$3.50}$ for this repair service agreement.

Multiple Choice Problems

Study tip: Write out all your work when you complete the multiple-choice problems.

B

Multiple Choice 1. Let E and F be two events of an experiment with sample space S. Suppose that $P(E) = 0.4$, $P(F) = 0.3$, and $P(E \cup F) = 0.6$. Find $P(E^C \cap F)$.

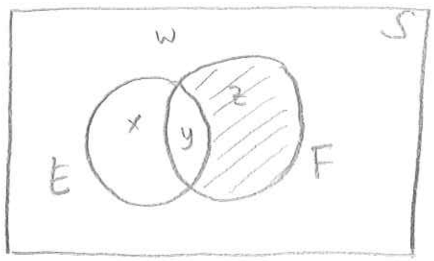
(a) $P(E^C \cap F) = 0.1$

(b) $P(E^C \cap F) = 0.2$

(c) $P(E^C \cap F) = 0.3$

(d) $P(E^C \cap F) = 0.4$

(e) $P(E^C \cap F) = 0.5$



write $S = \{w, x, y, z\}$.

Then $E^c = \{w, z\}$

$\cap\ F = \{y, z\}$

$E^c \cap F = \{z\}$

So $P(E^c \cap F) = P(E \cup F) - P(E) = 0.6 - 0.4 = 0.2$.

C

Multiple Choice 2. Determine whether the given simplex tableau is in final form. If so, find the optimal solution to the associated linear programming problem. If not, find the pivot element to be used in the next iteration of the simplex method.

Not done, negatives in bottom row

Pivot column: Column 2

pivot row: Row 1

Pivot element: 2 in R1, C2.

x	y	z	s_1	s_2	s_3	P	
1/4	2	1	0	0	7	0	16
1	1/3	0	1	0	−1	0	6
−2	−2	0	0	1	1/3	0	8
−2	−5	0	0	0	−1	1	80

↑ pivot col

ratios

$\frac{16}{2} = 8 \leftarrow$ pivot row

$6/(\frac{1}{3}) = 18$

×

(a) Yes, the simplex tableau is in final form. The system has a maximum value of 80 at (16, 6, 8).

(b) Yes, the simplex tableau is in final form. The system has a maximum value of 80 at (0, 0, 16).

(c) No, the simplex tableau is not in final form. The next pivot element is the 2 in the first row, second column.

(d) No, the simplex tableau is not in final form. The next pivot element is the −2 in the third row, second column.

(e) No, the simplex tableau is not in final form. The pivot element is the 7 in the first row, sixth column.

B

Multiple Choice 3. The sandwich shop "That Wich!" tracks the number of veggie wraps sold each day in the last month (30 days). During the past month, they sold from zero to 8 wraps per day, with the frequencies indicated in the following table.

number of wraps sold per day	0	1	2	3	4	5	6	7	8
number of days	2	0	6	7	9	1	0	3	2
Probability	$\frac{2}{30}$	$\frac{0}{30}$	$\frac{6}{30}$	$\frac{7}{30}$	$\frac{9}{30}$	$\frac{1}{30}$	$\frac{0}{30}$	$\frac{3}{30}$	$\frac{2}{30}$

What is the probability that "That Wich!" sold at least 5 veggie wraps and less than 8 veggie wraps on a randomly selected day?

(a) 3/30

(b) 4/30

(c) 5/30

(d) 6/30

(e) 26/30

Let X = # of veggie wraps sold on a day.

want $P(5 \le X < 8)$

$= P(X=5) + P(X=6) + P(X=7)$

$= \frac{1}{30} + \frac{0}{30} + \frac{3}{30}$

$= \frac{4}{30}$

E

Multiple Choice 4. Solve the linear programming problem.

Minimize $P = 4x + 5y$

$$\text{subject to} \begin{cases} 5x + 3y \ge 19 \\ x + 2y \le 8 \\ x \ge 0,\ y \ge 0 \end{cases}$$

(a) $P = 10$ at $(x, y) = (0, 2)$.

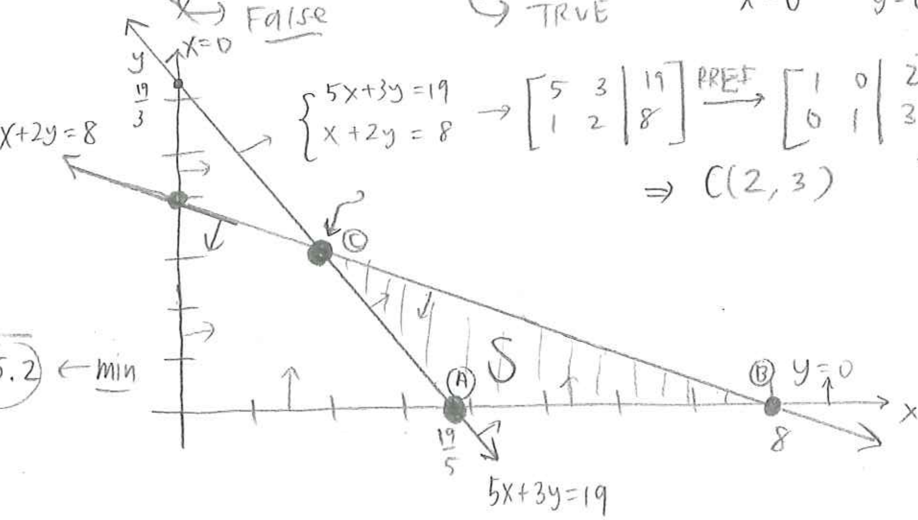
(b) $P = 20$ at $(x, y) = (0, 4)$.

(c) $P = 23$ at $(x, y) = (2, 3)$.

(d) There is no optimal solution.

(e) None of these

	solid	solid	solid	solid
inequality	$5x+3y \ge 19$	$x+2y \le 8$	$x \ge 0$	$y \ge 0$
boundary line	$5x+3y=19$	$x+2y=8$	$x=0$	$y=0$
x-int	$(\frac{19}{5}, 0)$	$(8, 0)$	y-axis	x-axis
y-int	$(0, \frac{19}{3})$	$(0, 4)$		
test point	$(0,0)$: $0+0 \overset{?}{\ge} 19$ $0 \ge 19$? False	$(0,0)$: $0+0 \overset{?}{\le} 8$ $0 \le 8$? TRUE	want x-values to the right of $x=0$	want y-values above $y=0$



$\begin{cases} 5x+3y=19 \\ x+2y=8 \end{cases} \rightarrow \left[\begin{array}{cc|c} 5 & 3 & 19 \\ 1 & 2 & 8 \end{array}\right] \xrightarrow{\text{RREF}} \left[\begin{array}{cc|c} 1 & 0 & 2 \\ 0 & 1 & 3 \end{array}\right]$

$\Rightarrow C(2,3)$

corner point	* minimize * $P = 4x+5y$
A $(\frac{19}{5}, 0)$	$P = 4(\frac{19}{5}) + 5(0) = \frac{76}{5} = 15.2 \leftarrow$ min
B $(8, 0)$	$P = 4(8) + 5(0) = 32$
C $(2, 3)$	$P = 4(2) + 5(3) = 23$

B

Multiple Choice 5. A fair coin is tossed three times and the face that lands uppermost is recorded. Let the random variable X represent the number of heads that is recorded. Which of the following represents the probability distribution for this experiment?

(a)

X	0	1	2	3
$P(X)$	1/4	1/4	1/4	1/4

(b)

X	0	1	2	3
$P(X)$	1/8	3/8	3/8	1/8

(c)

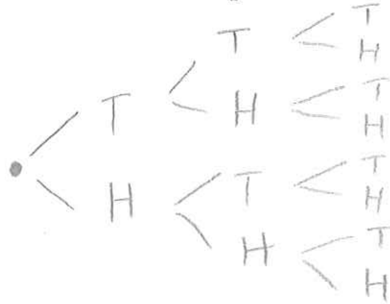
X	0	1
$P(X)$	1/2	1/2

(d)

X	0	1	2	3
$P(X)$	0	3/8	3/8	1/4

(e)

X	0	1	2	3	4	5	6	7	8
$P(X)$	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8



$\Rightarrow S = \{$ TTT, TTH, THT, THH, HTT, HTH, HHT, HHH $\}$

1 outcome with 0 heads
3 outcomes with 1 head
3 outcomes with 2 heads
1 outcome with 3 heads

Out of 8 outcomes total.

A

Multiple Choice 6. Consider the given system of linear inequalities:

$$\begin{cases} 2x + 2y \leq 8 \\ 6x + 2y \leq 12 \\ x \geq -3, y \geq 0 \,. \end{cases}$$

Which of the following statements is **false**? (There is only one false statement.)

(a) There are 3 corner points. X There are 4 corner points

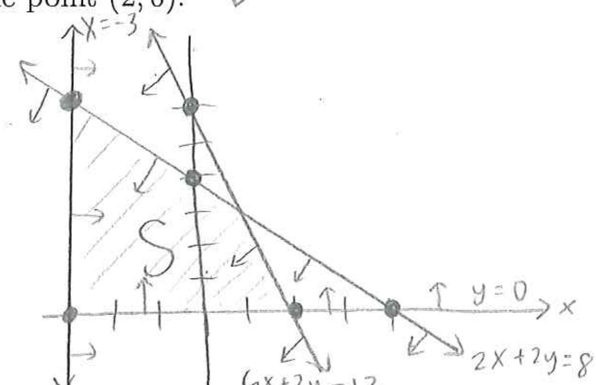
(b) All boundary lines of the solution set are solid. ✓

(c) The solution set is bounded. ✓

(d) The point $(0, 4)$ is in the solution set. ✓

(e) The x-intercept of the boundary line $6x + 2y \leq 12$ is the point $(2, 0)$. ✓

	solid	solid		
inequality	$2x+2y \leq 8$	$6x+2y \leq 12$	$x \geq -3$	$y \geq 0$
boundary line	$2x+2y=8$	$6x+2y=12$	$x=-3$ vertical line	$y=0$ horiz. line
x-int	(4,0)	(2,0)	all pts to right of x=-3	all pts above y=0
y-int	(0,4)	(0,6)		
test point	(0,0): 0+0 ≤ 8? ↳ true ✓	(0,0): 0+0 ≤ 12? ↳ true ✓		



A

Multiple Choice 7. Which of the following represents an initial simplex tableau for the given linear programming problem?

Maximize $P = 3a + 2b - 4c$

$$\text{subject to} \begin{cases} 3a - 2b - c \leq 120 \\ 10b + 15c \leq 245 \\ a \geq 0,\ b \geq 0,\ c \geq 0 \end{cases}$$

$3a - 2b - c + s_1 = 120$

$10b + 15c + s_2 = 245$

$-3a - 2b - 4c + P = 0$

a	b	c	s_1	s_2	P	constant
3	-2	-1	1	0	0	120
0	10	15	0	1	0	245
-3	-2	-4	0	0	1	0

(a)

a	b	c	s_1	s_2	P	
3	−2	−1	1	0	0	120
0	10	15	0	1	0	245
−3	−2	4	0	0	1	0

(b)

a	b	c	s_1	s_2	s_3	P
3	−2	−1	1	0	0	120
0	10	15	0	1	0	245
0	0	0	0	0	1	0
−3	−2	4	0	0	0	1

X

(c)

a	b	c	s_1	s_2	P	
3	−2	−1	1	0	0	120
10	15	0	0	1	0	245
−3	−2	4	0	0	1	0

X

(d)

a	b	c	s_1	s_2	P	
3	−2	−1	1	0	0	120
0	10	15	0	1	0	245
1	1	1	0	0	0	0
−3	−2	4	0	0	1	0

X

(e)

a	b	c	P	
3	−2	−1	0	120
0	10	15	0	245
3	2	−4	1	0

X

A

Multiple Choice 8. One constraint for a standard maximization problem is $y \geq \frac{3}{5}(x + y) - \frac{2}{5}$. What is the correct way to arrange this as an equation (including slack variable s_1) in order to enter it into an initial simplex tableau?

(a) $\frac{3}{5}x - \frac{2}{5}y + s_1 = \frac{2}{5}$

(b) $-\frac{3}{5}x - \frac{8}{5}y + s_1 = \frac{2}{5}$

(c) $-\frac{3}{5}x + \frac{2}{5}y + s_1 = -\frac{2}{5}$

(d) $\frac{3}{5}x + \frac{8}{5}y + s_1 = -\frac{2}{5}$

(e) None of these

constraints in a standard maximization problem look like

(linear expression in variables) $\leq$ positive constant

So $y \geq \frac{3}{5}(x+y) - \frac{2}{5}$ becomes

$y \geq \frac{3}{5}x + \frac{3}{5}y - \frac{2}{5}$

$-\frac{3}{5}x + y - \frac{3}{5}y \geq -\frac{2}{5}$

$-\frac{3}{5}x + \frac{2}{5}y \geq -\frac{2}{5}$

modified constraint:

$\Rightarrow$ $\frac{3}{5}x - \frac{2}{5}y \leq \frac{2}{5}$ $\Rightarrow$ $\boxed{\frac{3}{5}x - \frac{2}{5}y + s_1 = \frac{2}{5}}$

D

Multiple Choice 9. A company invests money in two projects, project A and project B. If x is the amount of money a company invests in project A and y the amount invested in project B, then which of the following inequalities represents the constraint "the amount invested in B should be no more than 40% of the overall investment"?

(a) $y \geq 0.4(x + y)$

(b) $x \leq 0.4(x + y)$

(c) $x \geq 0.4(x + y)$

(d) $y \leq 0.4(x + y)$

(e) None of these

x := amount invested in project A

y := amount invested in project B

"The amount invested in project B should be no more than 40% of the total investment."

Total investment: $x + y$

40% of total investment: $0.40(x+y)$

want y to be no more than 40% of total investment

$\Rightarrow$ $y \leq 0.40(x+y)$

Use the following set up for both Multiple Choice 10 and Multiple Choice 11.
Oily Oil Company has decided to introduce three oil mixes made from blending two or more oils. One jar of olive-vegetable oil requires 6 oz each of olive and vegetable oils. One jar of vegetable-peanut oil requires 10 oz of vegetable oil and 6 oz of peanut oil. Finally, one jar of olive-vegetable-peanut oil requires 3 oz of olive oil, 7 oz of vegetable oil, and 2 oz of peanut oil. The company has decided to allot 15 thousand ounces of olive oil, 23 thousand ounces of vegetable oil, and 6000 oz of peanut oil for the initial production run. Its profit on one jar of olive-vegetable oil is \$1.10, its profit on one jar of vegetable-peanut oil is 70 cents and its profit on one jar of olive-vegetable-peanut oil is \$0.60. To realize a maximum profit, how many jars of each blend should Oily Oil Company produce?

in table

C

Multiple Choice 10. Let

$x :=$ the number of jars of olive-vegetable oil produced

$y :=$ the number of jars of vegetable-peanut oil jars produced

$z :=$ the number of jars of olive-vegetable-peanut oil jars produced

$P :=$ Oily Oil Company's profit from sales of oil jars, in dollars.

Write a linear programming problem that can be used to answer the following question: "To realize a maximum profit, how many jars of each blend should Oily Oil Company produce?"

(a) Maximize $P = 15x + 23y + 6z$

$$\text{subject to} \begin{cases} 6x + 3z \leq (15000) \cdot (1.10) \\ 6x + 10y + 7z \leq (23000) \cdot (0.70) \\ 6y + 2z \leq (6000) \cdot (0.60) \\ x \geq 0,\ y \geq 0,\ z \geq 0 \end{cases}$$

(b) Maximize $P = 1.1x + 0.7y + 0.6z$

$$\text{subject to} \begin{cases} 6x + 3y \leq 15 \\ 6x + 10y + 7z \leq 23 \\ 6x + 2z \leq 6000 \end{cases}$$

(c) Maximize $P = 1.1x + 0.7y + 0.6z$

$$\text{subject to} \begin{cases} 6x + 3z \leq 15000 \\ 6x + 10y + 7z \leq 23000 \\ 6y + 2z \leq 6000 \\ x \geq 0,\ y \geq 0,\ z \geq 0 \end{cases}$$

(d) Maximize $P = 15x + 23y + 6000z$

$$\text{subject to} \begin{cases} 6x + 3y \leq 15000 \\ 6x + 10y + 7z \leq 23000 \\ 6x + 2z \leq 6000 \end{cases}$$

(e) None of these

	olive	vegetable	peanut
1 jar olive-vegetable	6 oz	6 oz	0 oz
1 jar vegetable-peanut	0 oz	10 oz	6 oz
1 jar olive-vegetable-peanut	3 oz	7 oz	2 oz
total (ounces)	15 000 oz	23 000 oz	6 000 oz

Objective: Maximize $P = 1.10x + 0.70y + 0.60z$

subject to:

$6x + 3z \leq 15000$ (total olive oil)

$6x + 10y + 7z \leq 23000$ (total vegetable oil)

$6y + 2z \leq 6000$ (total peanut oil)

$x \geq 0,\ y \geq 0,\ z \geq 0$

D

Multiple Choice 11. In solving the linear programming problem "To realize a maximum profit, how many jars of each blend should Oily Oil Company produce?" from above, recall that

$x :=$ the number of jars of olive-vegetable oil produced
$y :=$ the number of jars of vegetable-peanut jars produced
$z :=$ the number of jars of olive-vegetable-peanut jars produced
$P :=$ Oily Oil Company's profit from sales of oil jars, in dollars

and suppose we chose the slack variables so that

$s_1 :=$ the excess olive oil allotted, in ounces,
$s_2 :=$ the excess vegetable oil allotted, in ounces, and
$s_3 :=$ the excess peanut oil allotted, in ounces.

You are given the following simplex tableau. Which of the following statements about the optimal solution is **true**?

$$\left[\begin{array}{ccccccc|c} x & y & z & s_1 & s_2 & s_3 & P & \\ \hline 1 & 0 & 1/2 & 1/6 & 0 & 0 & 0 & 2500 \\ 0 & 1 & 2/5 & -1/10 & 1/10 & 0 & 0 & 800 \\ 0 & 0 & -2/5 & 3/5 & -3/5 & 1 & 0 & 1200 \\ \hline 0 & 0 & 23/100 & 17/150 & 7/100 & 0 & 1 & 3310 \end{array}\right]$$

basic
$x = 2500$
$y = 800$
$s_3 = 1200$
$P = 3310$

non basic
$z = 0$
$s_1 = 0$
$s_2 = 0$

(a) Oily Oil Company should produce 1200 jars of olive-vegetable-peanut jars to maximize their profit. False, $z = 0$

(b) There was no excess peanut oil allotted. False, since $s_3 = 1200$.

(c) Their maximum profit cannot be determined because the optimal solution has not been reached. False, the given tableau is the final simplex tableau.

(d) There is no excess olive oil and no excess vegetable oil allotted. True, since $s_1 = 0$, $s_2 = 0$

(e) Oily Oil Company should produce 23/100 jars of olive-vegetable-peanut jars to maximize their profit. False, since $z = 0$.