4. 2 Elvira's Equations

A Solidify Understanding Task

Elvira, the cafeteria manager, likes to keep track of the things she can count or measure in the cafeteria. She hopes this will help her improve the efficiency of the cafeteria. To remind herself to keep track of important quantities, she has made a table of variables and descriptions of the things she wants to record. Here is a table of things she has decided to keep track of.

Symbol	Meaning (description of what the symbol means in context)	Units (what is counted or measured)
S	Number of students that buy lunch in the salad line	Students
W	Number of students that buy lunch in the sandwich line	Students
P	Number of students that buy lunch in the pizza line	Students
F	Number of food servers in the cafeteria	servers
M_T	Number of minutes it takes to serve lunch to all students	minutes
C	Number of classes in the school	classes
P_L	Price per lunch	dollars per lunch
A	Average Class Size	students per class
R	Revenue	dollars
T	Total # of students who eat lunch	students
D_F	Revenue per Server	dollars
M	# of minutes to serve each student	minutes

Elvira has written the following equation to describe a cafeteria relationship that seems meaningful to her. She has introduced a new variable A to describe this relationship.

Salad line, #sandwich line, # pizza line

Average Class Size → $A = \frac{S+W+P}{C}$ ← # classes

$S+W+P$ → total # of students or lunches sold

Students

Classes

1. What does A represent in terms of the school and the cafeteria? Record this information in the table above.

Average Class Size

2. Using what you know about manipulating equations, solve this equation for *S*. Your solution will be of the form *S = an expression written in terms of the variables A, C, W and P.*

$A = \frac{S+W+P}{C}$ (C) $AC - P = S + W$ $-W \quad -W$

$AC = S + W + P$ $AC - P - W = S$
$-P \quad -P$

3. Does your expression for *S* make sense in terms of the meanings of the other variables? Explain why or why not.

(Average Class Size)(classes)

$S = AC - P - W$ ← # student sandwich
↑ # student salads ↑ Total students ↑ # students pizza

Here is another one of Elvira's equations.

Price per lunch, #sandwiches

Revenue → $R = P_L(S+W+P)$
salad, # pizza

4. What does *R* represent in terms of the school and the cafeteria? Record this information in the table above.

R - Revenue

5. Using what you know about manipulating equations, solve this equation for P_L.

$\frac{R}{(S+W+P)} = \frac{P_L(S+W+P)}{(S+W+P)}$ $\frac{R}{(S+W+P)} = P_L$

6. Does your expression for P_L make sense in terms of the meanings of the other variables? Explain why or why not.

Price/Lunch → $P_L = \frac{R}{(S+W+P)}$ ← Revenue
← Total lunches/students

7. Elvira notices that she uses the expression $S + W + P$ a lot in writing other expressions. She decides to represent this expression using the variable *T*, so that $T = S + W + P$. What does *T* represent in terms of the school and the cafeteria? Record this information in the table above.

T - Total # of students
or
Total # of lunches sold

Elvira is having a meeting with the staff members who work in the lunchroom. She has created a couple of new equations for the food servers.

Revenue per food server → $D_F = \frac{T \cdot P_L}{F}$ (T: Total # students; P_L: Price Per lunch; F: # of food servers)

$M = \frac{M_T}{T}$ (M: minutes per student; M_T: # of minutes to serve all students; T: # of students)

8. a. What does D_F represent in terms of the school and the cafeteria? Record this information in the table above.

D_F – Revenue per food server

b. Solve this equation for P_L. Describe why your solution makes sense in terms of the other variables.

$(F)\ D_F = \frac{T \cdot P_L}{F}(F)$

$F \cdot D_F = T \cdot P_L$

$\frac{F \cdot D_F}{T} = \frac{T \cdot P_L}{T}$

$P_L = \frac{F \cdot D_F}{T}$ (P_L: price per lunch; F: # of servers; D_F: Revenue per server; T: Total # students)

9. a. What does M represent in terms of the school and the cafeteria? Record this information in the table above.

M – # of minutes to serve each student

b. Solve this equation for T. Describe why your solution makes sense in terms of the other variables.

$(T)\ M = \frac{M_T}{T}(T)$

$TM = \frac{M_T}{M}T$

$\frac{TM}{M} = \frac{M_T}{M}$

$T = \frac{M_T}{M}$ (T: Total # of students; M_T: # of minutes to serve all students; M: # of minutes to serve each student)

10. One of the staff members suggests that they need to write expressions for each of the following. Using the variables in the table, what would these expressions look like?

a. The average number of students served each minute $A_m = \frac{M_T}{T}$

b. The average number of minutes students wait in the pizza line

$P_m = \frac{P}{M}$ (P_m: pizza minutes)