

Chapter 3 Review, #18

We'll need to keep track of both the district and the school, which suggests a double index. For the two schools, we'll take Cooley as 1 and Whitman as 2.

Now we can define two sets of variables- one for minority students and one for other students- Respectively, we'll use M and N so that

$$M_{ij} = \text{Number of minority students who live in district } i \text{ and attend school } j$$

So that the other students will be denoted by N_{ij} .

The miles traveled using Table 54 will give the following, and the objective function will be the sum of the six values:

District	School 1	School 2
1	$1 \cdot (M_{11} + N_{11})$	$2 \cdot (M_{12} + N_{12})$
2	$2 \cdot (M_{21} + N_{21})$	$1 \cdot (M_{22} + N_{22})$
3	$1 \cdot (M_{31} + N_{31})$	$1 \cdot (M_{32} + N_{32})$

The purpose of Table 53 is to put some values on the variables- These will be equalities since the number of students in each case is known. From the table, we have:

District	Minority Students	Nonminority Students
1	$M_{11} + M_{12} = 50$	$N_{11} + N_{12} = 200$
2	$M_{21} + M_{22} = 50$	$N_{21} + N_{22} = 250$
3	$M_{31} + M_{32} = 100$	$N_{31} + N_{32} = 150$

The stuff written about percentages means that the percentage of minority students in each school should be between 20 and 30 percent. For Cooley High, that means:

$$0.20 \leq \frac{M_{11} + M_{21} + M_{31}}{M_{11} + M_{21} + M_{31} + N_{11} + N_{21} + N_{31}} \leq 0.30$$

Similarly,

$$0.20 \leq \frac{M_{12} + M_{22} + M_{32}}{M_{12} + M_{22} + M_{32} + N_{12} + N_{22} + N_{32}} \leq 0.30$$

And we should have between 300 and 500 students at each school:

$$300 \leq M_{11} + N_{11} + M_{21} + N_{21} + M_{31} + N_{31} \leq 500$$

$$300 \leq M_{12} + N_{12} + M_{22} + N_{22} + M_{32} + N_{32} \leq 500$$

Note that each double inequality should be written out as two inequalities, the fractions ought to be simplified to linear constraints, and all variables are non-negative.