Busville -

Introduction:

The town of Busville has three school districts. The numbers of black students are about 120,30 and 150 in district one, two and three respectively. Due to the Supreme Court’s requirements, the schools in Busville should be racially balanced. And also, each school must meet the number of students in 300 per school. Additionally, the number of black students should be equal. In order to make the target, we need to allocate different racial of students in different regions of schools properly with the minimization of the total distance that students must be bussed.

Solution:

 In this case, I use Network model as a clarification to explain the subject. Network model is to allocate each subject (students in this case) to a proper distance from origin (region in this question) to destination (schools in this question). In the business problems, we usually take the subjects as products made by company, and the origin and destination as place of suppliers and place of costumers.

 It is special in this case that there are two different merchandises in this case. In other words, we distinguish the different racial of students as different kinds of products, which is white and black students. We set of the following constraints which are compulsory by the Supreme Court. First, the number of African students should be assigned equally. Second, each of the students in each region and racial should remain the same.

 To analyze the shortest distance for students who study in diverse regions, we arrangement our number of students relocate from their own regions as our decision variables. Also, we set our objective function as the miles between different region times the number of transmissions between different racial of students.

 In order to solves the problem, we use the following models and excels to decipher the issue.

Parameters:

$$D\_{ijk}:distance miles from region i to school j ,i \in \left(regions1, 2 and 3\right),i \in \left(1, 2,3\right) ,j \in \left(school of regions1, 2 and 3\right),j \in \left(1, 2,3\right)$$

$$C\_{j}:capability of each school$$

$$N\_{ijk}:number of students from region i to school j in racial k, k \in \left(white, black\right), k \in \left(1, 2\right)$$

$$R\_{ik}:number of students from region i in racial k$$

Decisions variables:

$$X\_{ijk}:number of students from region i to school j in racial k$$

Objective functions:

$$\min\_{X\_{ijk}}\sum\_{i=1}^{3}\sum\_{j=1}^{3}\sum\_{k=1}^{2}\left\{D\_{ijk}\*N\_{ijk}\right\}:number of students from region i in racial k$$

Constraints:

$$\left(1\right). N\_{12}=N\_{22}=N\_{32}(number of students are the same between each school )$$

$$\left(2\right).\sum\_{j=k}^{2}N\_{jk}=C\_{j},∀j=1,2,3$$

$$ (number of students for each school required as 300)$$

$$\left(3\right). \sum\_{j=k}^{2}N\_{ik}=R\_{ik}$$

$ (number of students are equal to the students from region i in racial k$)

$\left(4\right). D\_{ijk }, N\_{ijk}\geq 0$ (all of the variables are non negative)