

Population to be located so as to minimize the total distance walked to population. Assume that each person taking an uptown bus trip walks to the nearest bus stop, gets on the bus, rides, gets off at the stop nearest his destination, and walks the rest of the way. During the day, exactly B_j people from block j start uptown bus trips, and C_j complete uptown bus trips at block j . (Of course, $\sum_{j=1}^m B_j = \sum_{j=1}^m C_j$.) Write a functional equation whose solution places the bus stops so as to minimize the total distance walked by the population of bus users. (Curiously, the data B_j and C_j suffice for this purpose; the number of people wishing to go from block i to block j need not be determined.)

5. Continuing the bus-stop problem, suppose that each block takes 3 minutes to walk. At full speed, the bus covers five blocks per minute. The bus takes 2 minutes to decelerate to a stop, unload passengers, load, and accelerate back to full speed. Assume that passengers walk to and from the bus stops nearest their points of origin and destination. Write a functional equation whose solution gives the number and location of bus stops that minimize the total travel time of the population.
6. Plants 1 through N are located along the Weladare River, with plant $n + 1$ downstream from plant n . A volume Q of pure water and $0.1Q$ of waste flows down the river, the waste coming from upstream sources. The water is to be consumed by the N plants. Each unit of water consumed by plant n produces a_n units of waste. The cost of consuming q units of water at plant n depends on the product of q and the quantity w of waste produced upstream; this is indicated by the cost function $c_n(q \cdot w)$. The problem is to allocate the water to the plants so as to minimize total regional cost. Set up a functional equation whose solution accomplishes this.