**Bush Walking**

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**Goal of Model**

This model aims to figure out the time of which a faster paced walker should continue past their slower partner who is walking with them, so that both walkers in this trip get back to the end position at the same time. There are plenty of variables that are considered when deriving this model. The goal of this paper is to try and clear up this model’s derivation and make it easier to follow.

**Solving the Model**

Here the variables of this model are defined and used to derive the mathematical model. For starters, the distance that is referred to as is the spot in the walk at which both walkers separate due to their different speeds. This first equation relates the distance that is walked by both walkers before the point at which they separate due to a difference in speed. With abbreviating for “Distance traveled by both walkers to arrive at point *C*” and standing for the velocity of the walkers until they separate. The last variable for the time that it takes both walkers to walk this distance before they separate we have the following first equation,

(1)

Denoting the distance traveled before separating. The next equation relates the distance that the faster walker walks at the original speed of both walkers and the time that this walk takes. This time there is a new variable that is the scaling factor for how much faster the faster walker walks compared to the slower walker. This equation has the abbreviation of being short for, “Distance traveled by the faster walker from point ” to a point where the faster walker will walk back to the end for both walkers in this trip. The second new variable in this equation is which is the time this walk takes by the faster walker to occur. With these new variables we have the second equation,

(2)

Giving us a definitive relationship for how far this distance is for the faster walker. This third equation gives the distance traveled by the slower walker walked while the faster walker continues in their path. This equation has the abbreviation of standing for, “Distance traveled by the slower walker from point back to the beginning by the slower walker ” helping us define our third equation. Using variables that are from both equations (1) and (2) we have our third equation,

(3)

Relating the distance traveled by the slower walker with variables that could already be known. From these three equations we can create the final two that will help in the aid of developing a mathematical model. This fourth equation defines the total distance traveled by faster walker on the whole trip. This equation which stands for, “Distance traveled by the faster walker to reach the beginning point ” is created from two prior equations so no new variables are needed here. This fourth equation is,

(4)

Which can be also written as the following from both equations (1) and (2),

(5)

Giving us the fifth equation of this model. The same can be done for the slower walkers’ total distance. This sixth equation as the abbreviation of standing for, “Distance traveled by slower walker to reach the beginning point ” serving the same purpose as equations (4) and (5). The sixth equation is,

(6)

And for all intensive purposes can be also rewritten like equation (5) was. The seventh equation can be defined as follows,

(7)

Yielding another equation that is needed in this model derivation. It was assumed that there was a relationship between both equations (5) and (7). To reiterate this relationship it is stated here,

(8)

Giving the last equation needed in this model derivation. Now that all the equations and relationships are needed in for this model, the simplified model can begin to be derived. From equation (8) we can then say the following,

(9)

Where result (9) can have the ’s killed off giving,

(10)

With a simplified result in relationship (10). The goal when solving this model with these relationships is to get the equation to be equal to with only variables of and in it. So, doing some algebra we have the following next couple of steps. First, multiplying both sides of (10) by ,

(11)

Distributing the in (11),

(12)

Combing ’s in (12),

(13)

Combining ’s in (13) and simplifying,

(14)

And finally solving for ,

(15)

Where equation 15 gives us the final equation used in this model. Equation (15) tells the walkers who would use this model the time that the faster walker needs to continue walking when they separate from the slower walker. The value in (15) is the scaling factor for the faster walker compared to the slower walker. The value in equation (15) is the time that both walkers are walking at the same speed as one another. This equation is now ready to be implemented.

**Evaluating the Model**

When evaluating this model another variable is put into the equation to address the original problem. This variable defines a time window such that it follows, where the “difference in arrival times” is the time difference between both walkers when they arrive back at the starting point. From some previous equations we can say that when the walkers separate the faster walker travels ( at a speed of ( to reach base . So, using distance over speed to calculate the time the resulting equation comes about,

(16)

And a can be killed off giving the simplified equation of,

(17)

Giving the time that the two walkers walk before they separate due to a difference in speed. Once the two walkers separate, the slower walker will walk back to the base at a speed of and reach it at a time . From previous relationships we can state that the faster walker will reach the base at a time,

(18)

After has arrived at the base. From this we need,

(19)

That is,

(20)

Gives,

(21)

And,

(22)

Will combine to give,

(23)

Finally giving,

(24)

That will help gauge the times that these walkers should be waiting around for one another. For instance, it (12 minutes) with the other values of, , , the result will be,

(25)

Meaning that if the faster walker doesn’t want the slower walker to have to wait more than 12 minutes (The value) at the starting point of the end of the walk, then the waster walker should continue for about 15 to 20 minutes. The 0.25 of result (25) yields the 15 minutes estimation and the 0.35 part yields the 20 minutes estimation. The values in (25) are fractions of an hour. One full hour would be considered 1.0 in (25).