Optimal Airport Hub Locations (Southeast US)

1. We have used two very similar models consecutively to find the answer to our optimization problem.
   1. The first model is:

Indexes = I – County Index (I = 1,2,…,75)

J – Airport Index (J = 1,2,…,7)

Parameters =

– the distance (in meters) from county ,

= 1, the (chosen) number of optimal hubs we would like to locate

Decision Variables = is a binary variable, with 1 representing that county has been assigned to airport and a 0 representing it has not.

is a binary variable with 1 representing that airport is chosen to receive people.

(1)

(2)

(3)

(4)

(5)

(6)

* 1. The second model is:

Indexes = I – County Index (I = 1,2,…,1086)

J – Airport Index (J = 1,2,…,149)

Parameters =

– the distance (in meters) from county ,

= 4, the (chosen) number of optimal hubs we would like to locate

Decision Variables = is a binary variable, with 1 representing that county has been assigned to airport and a 0 representing it has not.

is a binary variable with 1 representing that airport is chosen to receive people.

(1)

(2)

(3)

(4)

(5)

(6)

(7)

* 1. The meaning of the constraints & objective functions is:
     1. For both objective functions (1), the goal is to minimize the sum of total distance between all people and the airports they’re assigned to. This is why population is multiplied by distance, and why it is then multiplied by the binary decision variable X where 1 represents people from county being assigned to airport and 0 represents them not being assigned to airport .
     2. For constraint (2) on both models, the sum of decision variable X on index J equaling 1 for each I ensures that each county is assigned to exactly 1 airport.
     3. For constraint (3) on both models, the sum of decision variable Y on index J equaling ensures that the number of airports selected is the proper amount.
     4. For constraint (4) on both models, decision variable X being less than or equal to decision variable Y for each I for each J ensures that a county isn’t assigned to unchosen airport .
     5. For constraint (5) on model 1 and (6) on model 2, as well as constraint (6) on model 1 and (7) on model 2 ensure that the decision variables act as binary options (only 0 and 1 are possible values).
     6. Finally, for the only difference between the two models besides index size, constraint (5) on model 2 ensures that the airport selected by the first model (which just happens to be index 51) is chosen in the second model, even if it wouldn’t have been the most optimal airport in the second model (i.e. the second model must choose the Arkansas airport chosen as optimal in the first model as an optimal location even though there may be more optimal locations for it)

1. Airport data was a .csv file from [data.gov](https://catalog.data.gov/dataset/airports-5e97a). Similarly, county population and geographic data was gathered from a .csv file from the [National Historical Geographic Information System](https://www.nhgis.org/). Data was then put into pandas data frames, filtered, and extracted into smaller csv’s. These were then used as indexes for counties and airports, as well as to determine the distance between counties and airports. This data was then put into the parameter while parameter (county population) was already in the data.