How to Work the Model

Step. 1

Fill in the time, distance and cost of traveling to travel to each city using each mode of transportation. This information needs to be filled in the appropriate excel sheet labeled airfare, train and driving.

Step 2

Fill in the hotel cost information in the hotel tab.

Step 3

Under each city fill in the dates for which there is an event that you want to attend

Step 4

Go to the “TSP + Events + Min Time + Min Cost” spreadsheet and run the solver model.

Step 5

Go to the itinerary page, select only column A. The other cells will auto fill.

Then read your itinerary

Definition of Problem

1. Objective- see a baseball game in each of the 12 cities over the summer
   1. List out each of the 12 cities

Assumptions/Constraints

1. Modes of transportation
   1. Drive, fly or take the train
   2. Explain how costs were researched and arrived at (model to come up with the cost of driving places, including meals, accommodations, gas)
2. Tried to minimize the amount of time in each city
   1. Had to leave on a Wed or Sat
   2. Originally we tried to do the model with a 3 day stay, but it was not feasible
3. We want to minimize the cost of travel
   1. Transportation costs
   2. Certain cities are more expensive depending on the time of year
   3. Certain modes of transportation cost more depending on the day of travel
4. Constraint is that we had to see a baseball game in each city
   1. Chart for the baseball event date (calendar, etc)
   2. Highlight the important games, as some cities only have a four day span with which you can see a game

Sources of Information

Kayak- flights

Best western- hotel costs

Amtrak- Train information

MLB.com- game information

Google Maps- Distances, travel time

Note on the additional sheets:

As we had various objectives in our model we created one model for our first objective and then added on the additional constraints. What we did with each spreadsheet is below.

# Basic TSP

We started with the basic TSP model, which is not very hard to do. Decided that NY would be the home base, so travel would start from NY and end in NY.

# Basic TSP + Minimize Time + Wed/Sat Travel

The next attempt was to enhance the TSP model, to include the 3-day minimum and Wed/Sat constraint. We wanted to calculate how long the trip would take.

* Used a few date functions here to figure out if a travel date is falling on a wed/sun. Assumed that the travel would start on 7/1/09 from NY.
* The initial choices we made were to assign 3 days in each city.
* Arbitrarily, we assumed that it would take a day to travel from one city to another. Later on, this would have to be based off of the travel options that we have, but for this second model, I assumed a static 1-day travel time would do.
* The departure date would be arrival date in a city + stay.
* The arrival date in the next city would be departure date + stay + travel time.
* As you can see, this will lead into some circular dependencies between the different cities, and when initially, we tried to do this with regular solver, it was not able to handle it. It would either fail to converge, or complain that the model is non-linear, or complain that the model is too large. At this point, we had to switch to using Evolutionary solver.
* This worked a little better in that it was able to give me a solution, but the Wed/Sat constraint was not being satisfied most of the time.
* We had to impose a large penalty on the objective function to get this to work and the model finally converged to a solution that we can live with, which is we leave on Wed/Sat on 11 of the occasions and the total trip time is 70 days.
* If you play with the penalties a bit, then you can reduce the trip duration, but you will see that the Wed/Sat constraint gets violated.

# Basic TSP + Minimize Time + Attend as many events as possible

* This is similar to the previous model, except that we now want to attend as many events as possible in the various cities that we attend.
* For each of the cities, we ordered the events by time, and checked if we are going to be in the city on any of the days that the event will be organized. If we are, then it will result in a 1 in the matrix “Attending an Event?” from row 95 to 112. If we are attending at least 1 event, then on line 58, we use a IF statement to get a 0. The use of 0, is the inverse of how the row is titled, but we needed this to calculate a penalty when we do not attend an event, rather than when we attend it.
* Once we did this, we tried to run evolutionary solver and see how the solution looks. Unfortunately, by making NY as the base was causing some issues. The model assumes that we are in NY and we will stay there for some time before leaving to our next destination. But, doing this means that we will have to stay in NY for a long time until the first event in the city or just decide to skip seeing an event and go to the next city. Because of this, we ended up attending only 5 or 6 events, where as the potential was that we could attend 12.
* To overcome this, we made LA as the starting point. I used LA since the first event for MLB for these months occurs on Jun 10 in LA. I arbitrarily chose Jun 11 as the arrival date in LA.
* The next problem we ran into was the Wed/Sat constraint. It was getting difficult to keep this and still catch as many events as we want, so we reduced the penalty on this constraint, so it is easier for the solver to optimize.
* The next issue was there were a few critical cities, which only had a single event, meaning we have to be in that city for those dates, otherwise, we don’t get another chance to attend an MLB event. To force solver to give these cities a priority, we used rows 115 to 128 to figure out if we are attending the critical events. Then used this information in the objective function to impose a huge penalty if we don’t attend these events. This forced solver to treat them as more important than all other city events.
* Finally, the last issue we had was the 3 day min stay constraint. This does not let us attend all the critical events, since some of the critical cities have events happening at the same time. So, I had to relax it. But at the end, it looks like it did not really make a huge difference. We still are spending at least 3 days in every city.

# Basic TSP + Minimize Time + Attend as many events as possible + Minimize Cost

* The final model includes the cost of travel. This pretty much follows from the previous model, except that there are some nasty formulae for calculating the costs.
* For travel, since it either falls on a weekday/weekend, we used the corresponding costs. Wed is for weekday travel and sat is for weekend travel.
* The cost of staying in a hotel should ideally reflect the number of weekdays + number of weekends, but I took a shortcut and decided to use the weekday number.
* The time taken for travel, we used the weekday travel time. Ideally this should be reflected in the travel time to destination row (row 54), and should drive the total trip time. But, we left it out for now.
* The constraints are pretty much the same as before, but somehow the stay row changes, and it looks like we are only staying in Atlanta for a single day.