Bayou Adventure World Simulation

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Executive Summary:

SM Theme Parks requested a simulation model be created to represent a new major theme park called Bayou Adventure World. The theme park contains four distinct parks, known as Frog Pond, Skunk Hollow, Gator Island, and Raccoon Corner. Transportation is provided at each of the four parks as customers can enter from any of the parks.

The transportation within the system includes boats, a steam railroad, as well as horse and wagon. The main basic mode of transportation is the people-movers or the train system which are on a continuous loop. This simulation is running off of Type 1, 2, 3, and 4 performance categories, representing the train leaving with no people waiting to board, 1 to 24 people still waiting, 25 to 49 people still waiting, and with 50 or more people still waiting, respectively. The first car of each train has an operating cost of $800 per day while each additional car costs $500 per day. Each car is designed for a capacity of 25 people however, in some situations, the actual capacity could potentially vary since there are always a few extra people who choose to squeeze on the car rather than waiting for the next train.

The simulation for Bayou Adventure World is scheduled to be operating from 10:00AM-10:00PM daily. Estimated number of arrivals per hour of day were given to estimate the necessary vehicle requirements to maximize customer satisfaction.

The goal of this simulation is to generate the most cost effective solution, in terms of the number of trains and the number of cars per train.This simulation also takes into account that each train is not required to have the same number of cars, to further optimize the cost solution. Lastly, the simulation model was created with the intent to maximize customer satisfaction in the SM Theme Parks. The results of the simulation show that in order to best handle the trade-off between customer satisfaction and cost, Bayou Adventure World should purchase 8 trains with two total cars each.

I. Introduction:

SM Theme Parks is the parent company for a series of theme amusement parks that are primarily located in the southern part of the United States. The majority of the child company theme amusement parks are small to medium in size. Bayou Adventure World is an up and coming major theme park under SM Theme Parks. The current plans for Bayou Adventure World are to consist of four parks including Frog Pond, Skunk Hollow, Gator Island, and Raccoon Corner. Bayou Adventure World's proposal is to have the customers at any of the four parks be able to use their provided transportation system to travel to any of the other four parks. Since it is a theme amusement park, the transportation will be mostly theme oriented and will only carry a small proportion of the people who will want to move between the different theme parks.

The following simulation was designed to determine the most cost-effective transportation solution while also achieving the highest customer satisfaction rating. A simulation was chosen over other modeling options because it will represent real world variation within the system, as well as determine the optimal solution based on the estimates given.

II. Methods and Analysis:

The physical objects that were used to model the new transportation system for Bayou Adventure World is shown below in Table 1, below. There are four entities to represent people that enter the station for each of the four parks. The four sources are the entrances to each of the four stations which create the corresponding entities. There are a set of five transportation nodes per station which represent their home stations. There is one node which is used to proportion the amount of people that will wait for a Mover, Horse and Wagon, Air Bus, Boat, or Railroad. There are also five more transportation nodes, one for each vehicle, where entities wait to be loaded. There are four sinks to represent the entrance to each of the theme parks where entities are unloaded. In total, there are 44 path's used to connect sources and sinks to their corresponding transportation nodes.

There are 10 movers of different capacity to represent movers with one car of capacity 25, to 10 cars sequenced to represent a capacity of 250 people. The other four types of vehicles represent the current transportation system that exists for Bayou Adventure World. The five types of vehicles start on their corresponding transportation node at the station for Frog Pond and load entities. The vehicles then move in a clockwise direction within the overhead view of the simulation, on a set circuit to the sink representing Skunk Hollow to unload entities that desire to enter Skunk Hollow. The vehicles continue to their corresponding transportation node at the station for Skunk Hollow to load entities. They continue this clockwise direction circuit to Gator Island, Raccoon Corner, and back to Frog Pond to restart their transportation sequence. Time paths are used to control the given travel times between the four theme parks.

Object	Quantity
Entities	4
Source	4
Sink	4
Mover Vehicles	10
Other Vehicles	4
Path's	44
TimePath's	20
Transportation Nodes	24

Table 1 - Object List

The functions used to model the new transportation system for Bayou Adventure World are shown below in Table 2. There are a total of 15 controls in the system with 14 to represent the number of each vehicle in the system, and one to represent the load and unload time of a mover. There are also a total of eight Add-On Processes incorporated into the model. Four represent the entities decision probability of destination, and one for the Add-On Process for each of the four sources. The other four tally the occurrences of a Type 1, Type 2, Type 3, and Type 4 event; one Add-On Process for each of the four mover transportation nodes used for loading entities at a station. There are four state variables, which represented these Type 1 - 4 occurrences. A Type 1 Occurrence is defined as when a mover leaves a station with no people waiting to board. A Type 2 Occurrence is when a mover leaves with 1 - 24 people waiting to board. A Type 3 Occurrence is when a mover leaves with 25 - 49 people waiting to board. Finally, a Type 4 Occurrence is when a mover leaves with 50 or more people waiting to board.

There are four output statistics which take on the values of the four state variables for tracking Type 1 - 4 occurrences for experimental analysis. There is also a Transporter List that ensures entities waiting to load at a mover node can only load an available transporter that was on the list. In addition, there is an arrival table to represent the given expected hourly arrival rates of the entities at each park. The hourly rate was divided into 15 minute increments to model a smoother distribution of arrivals. Five sequence tables were created to control the movement of the five types of vehicles such that each travels between parks on their own circuit.

Function	Quantity
Controls	15
Add-On Processes	8
State Variables	4
Output Statistics	4
Transporter Lists	1
Arrival Tables	1
Sequence Tables	5

Table 2 - Function List

The input values for this model were given to the team within the case study. Various deterministic input values were determined and implemented into the model. These inputs include number of theme parks, types of transportation, transportation movement, mover quantity limit mover car capacity, Type 1-4 classification, cost figures for movers, travel time between theme parks, load/unload time and cost options, hourly arrival rate, and entity destination probability based on entrance into the system. The case states that these values are estimates and have variation but for the purposes of this model, these values are sufficient to represent the real world system. Therefore, the given information was treated as deterministic information.

When analyzing whether or not our model is working correctly, the team made sure to determine how the model should behave. This included debugging each submodel as the team progressed. At the start of building the model, the team made sure to make entities arrive to one of the four parks in a logical manner following the arrival distribution. From here, the team could use this submodel for the other three park arrivals. The team made sure that the model was not only making sense to them, but also to another simulationist as well (Teaching Assistant). When faced with the challenge of determining whether the output was reasonable or not, the team decided to run the simulation under a variety of settings. To achieve this, the team made 10 different model entities representing different mover total capacities, as mentioned above. This allowed the team to reason through each setting and make sure they made sense. These various settings also allowed the simulation to run the model under simplified assumptions rather easily by changing values.

Another technique the team used to aid the verification process was the use of status labels to keep track and "trace" the number of entities at each park, both visually and numerically. The team used this information to ensure the expected number of entities was leaving and entering at each appropriate node. Observing the animation was beneficial in verifying the model, especially in the case of the assumption that the movers would unload for a specified amount of time and then load until full/partially full. The team expected movers with a small number of trains to be faster than movers with a large number of trains. The reasoning for this assumption was that with a smaller number of trains, the movers would require less time to load before being able to depart. For the mover to be partially full, this meant that there aren't any more customers waiting to be loaded in the queue. When observing how the model was behaving, the team verified that the movers with a small number of trains covered more ground than movers with a large number of trains.

Along with verification techniques, there were also several validation techniques that were used within the simulation. First, the team kept a detailed list of assumptions made throughout the model construction. These assumptions helped to explain behavior that could not be explained by using only the information in the problem statement. The team also made sure to model aspects as close to the real world as they could be represented within reason. This helped to make more accurate decisions as the measures of performance would be more realistic. For example, in order to move closer to how the real world system would react, the hourly rate was divided into 15 minute increments. This ensured the model would have a smoother distribution of arrivals rather than arrivals in one hour increments.

Similar to one of the verification techniques mentioned above, another validation technique used was ensuring that through each change, the corresponding output made logical sense. If the output did not make sense, the team made sure to address this. Another overlapping technique used was observing the animation. Observing the status plots, for example, allowed the team to make sure that the right number of customers were being dropped off and picked up at each park. Walking through the model with the Teaching Assistant helped validate that the team's results made sense as well.

Overall, there were six responses of interest in the experimental analysis. Type 1 Probability, Type 2 Probability, Type 3 Probability, Type 4 Probability, Cost of Trains per Day, and Alpha. The Alpha response is a variable developed to measure customer satisfaction and cost with a ratio of 1:1. Alpha is defined as the average deviation from the ideal value for both customer satisfaction and cost. Customer satisfaction was measured with Type 1 Probability while cost was measured with Cost of Trains per Day. The ideal Type 1 Probability was set to 60% after running a series of test trials to determine Type 1 Probability couldn't be greater than 60%. The ideal Cost of Trains per Day was set at $9,000 after running a series of test trials to determine Cost of Trains per Day couldn't be less than $9,000. There were 10 experimental constraints added to the simulation. One constraint was set on the total number of movers such that the system could handle at most eight movers. The remaining nine constraints were set on the types of movers; all except the mover type with a capacity of 150 people. These constraints were based off an pilot run of 100 scenarios at five replications using the OptQuest for Simio. The data was filtered such that scenarios with a Type 1 Probability of at least 25%, a Type 4 Probability of at most 35%, and a Cost of Trains per Day of at most $30,000. This data filter resulted in 19 scenarios out of the 100 ran to give information on the number of each type of mover chosen. For example, none of these scenarios used a mover with a capacity of 25 people so this type of mover was constrained at a value of 0. This analysis eliminated any unnecessary scenarios that wouldn't be considered in the final experiment run. In the final run of the experiment, the primary response was set as the Alpha variable with the objective to minimize the average deviation from the ideal values.

There were numerous animations that were used to help distinguish the different aspects of the simulation model. A carousel, bumper car, roller coaster, and ferris wheel were used to animate the four different parks in the theme park. Entities were represented within the system through the use of human people. To aid identifying the transportations, the team used a bus, horse and buggy, boat, and two trains as the representation of vehicles. Time paths were animated with the combination of roads and train tracks to categorize vehicles to trains and boats.

III. Results and Discussion:

The final analysis consisted of comparing unloading and loading for option 1 and option 2. This was accomplished by running two separate simulation experiments, one for each option. Both experiments consisted of 100 scenarios at five replications. The scenarios with an Alpha value of at most 0.50 were extracted and considered for potential solutions.

Figure 1, below, displays the Cost and Type 4 probability of each of the final scenarios being compared for Option 1. Option 1 included a 30 second unload time with a 45 seconds load time. The dashed line represents the cut-off point of Type 4 probability for being considered, 0.2. As seen in the graph, there are two scenarios, Scenario 2 and Scenario 3 that fall below the dashed line. By further investigating these two scenarios, the team determined that Scenario 2 would be the best scenario under option 1. This scenario would result in significantly lower cost, while also only having a slightly higher probability of Type 4 occurrences.

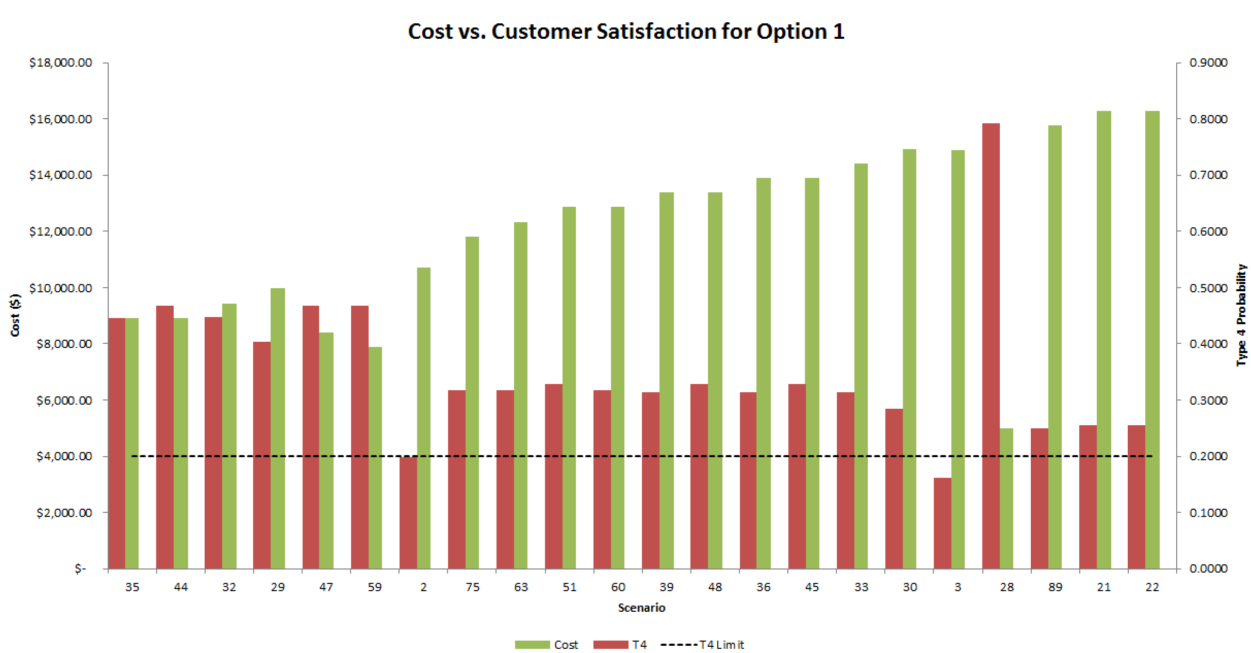

Figure 1

Figure 2 below displays the Cost and Type 4 probability of each of the final scenarios being compared for Option 2. Option 2 included a total of 2 minutes and 10 seconds for the loading and unloading processes combined. The dashed line represents the cut-off point of Type 4 probability for being considered, 0.2. As seen in the graph there are two scenarios, Scenario 2 and Scenario 3, that fall below the dashed line. By further investigating these two scenarios, the team determined that Scenario 2 would again be the best scenario due to it having a significantly lower cost while only having a slightly higher probability of Type 4 occurrences. Overall, there wasn't a large difference between Option 1 and Option 2. The optimal scenario remained the same while there were only small differences in the performance statistics of the other scenarios.

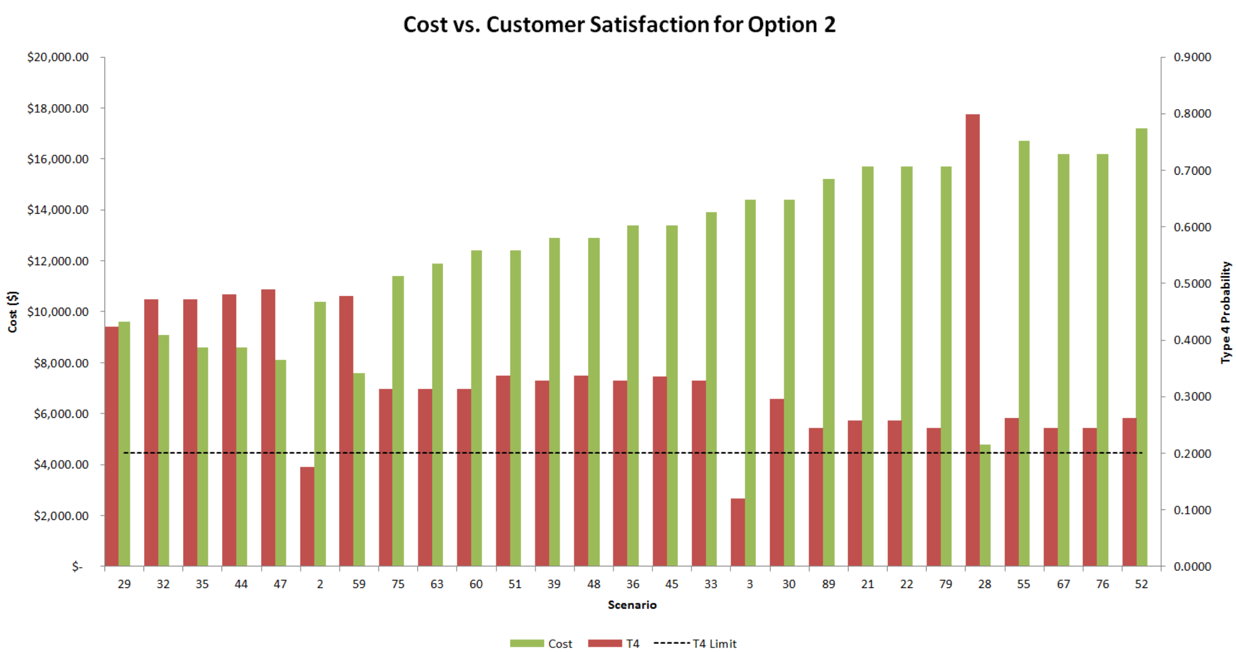

Figure 2

Table 3, below, compares the top scenario for each unload and load option chosen. There are slight differences in the values of T1, T2, T3, T4, and Cost between the resulting statistics from Option 1 and Option 2. However, over time these slight daily differences will compile into significant differences in the system's performance. To aid in choosing the best scenario from these two, focus was placed on the probability of Type 4 occurrences and Cost. From here it was determined that Option 2, eight movers with two cars operating with a 2 minutes unload and load time, is the most desirable solution for Bayou Adventure World given this model.

Table 3 - Comparing Options

Scenario	Dwell Time	NumMover50	T1	T2	T3	T4	Cost	Alpha	Total
2	Option 2	8	0.4138	0.2735	0.1376	0.1751	$10,400.00	0.1709	8
2	Option 1	8	0.4189	0.2473	0.1353	0.1985	$10,720.00	0.1861	8

This solution indicates that a high quantity of low capacity movers will satisfy customers in a cost effective manner. This solution is validated as a mover with a low capacity will reach its capacity quickly, to be able to leave the current station sooner than the expected unload/load period of 2 minutes. All of the extracted scenarios due to Alpha values greater than 0.50 resulted in Type 1 Probabilities ranging between 37%-52% and Cost less than $17,200 per day. When only looking at the Alpha value, Type 1 probability could show desired values, while Type 4 would show values that were undesirable. When the team made the decision on the optimal solution, they decided to look at values for Alpha, Type 1, and Type 4 probabilities to ensure customer satisfaction was ensured. This importance was exposed in Figure 1 and Figure 2 by most scenarios violating the 20% limit for Type 4. Through a final comparison between Type 4 probability and Cost, Scenario 2 under Option 2 proved to be the optimal system for Bayou Adventure World to implement.

IV. Conclusions and Recommendations

From the results of this simulation, it can be concluded that in order to provide the greatest customer satisfaction, Bayou Adventure World should invest in 8 movers, each with 2 cars. It was determined that customer satisfaction is largely affected by the total size of the waiting queue. The resulting simulation aims to minimize the total waiting queue size throughout the day. This solution results in a total cost of $10,400 per day, and all customers being picked up from their park entrance 41% of the time the park is open (Type 1).

Several small capacity movers benefit the customers as customers who board will have a short delay before the train departs. In terms of the real world system, the smaller the amount of time customers spend traveling between the parks, the more time customers can spend enjoying the parks. From a cost perspective, small capacity movers benefit Bayou Adventure World with only 16 cars needed to be purchased and maintained. Lastly, if any damage were to occur to a mover, minimal impact would take place on the overall capacity of the transportation system. Overall, this decision will maximize customer satisfaction, while minimizing cost from the based simulation model of Bayou Adventure World.

Appendices

Assumptions

1. 90% of the ppl will use the mover, and 10% of the ppl will use the other 4 transportation methods (2.5% each)
2. Boats, railroad, horse and wagon, and bus follow same continuous loop as mover (on their own pathway)
3. All movers start at the same transportation node at the station for frog pond
4. Simio naturally follows the complex logic of option three by loading until capacity is reached or until there aren't any people waiting to load
5. The model is deterministic
6. Any quantity of people can load into a mover if there is available capacity
7. The unload and load events happen at separate nodes
8. Each car holds exactly 25 people
9. The unload/load time of option 2 always included a 10 [s] delay
10. The travel time between parks is exactly as specified in the given table in the case study
11. The system starts exactly at 10am and ends at exactly 10pm
12. The transportation system meets average demand by having a Type 1 probability less than 100%
13. The hourly arrival table is split into 15 minute increments of arrivals
14. A system with a high probability of Type 1 is an expensive system

Option 1 Final Scenarios for Consideration:

Scenario	Dwell Time	NumMover25	NumMover50	NumMover75	NumMover100	NumMover125	NumMover150	NumMover175	NumMover200	NumMover225	NumMover250	T1	T2	T3	T4	Cost	Alpha	Total
35	0.625	0	0	0	0	0	0	0	2	0	0	0.4662	0.0597	0.0274	0.4466	$ 8,920.00	0.0713	2
44	0.625	0	0	0	0	0	0	1	0	1	0	0.4424	0.0539	0.0358	0.4679	$ 8,920.00	0.0832	2
32	0.625	0	0	0	0	0	0	0	1	1	0	0.4667	0.0588	0.0275	0.4471	$ 9,440.00	0.0911	2
29	0.625	0	0	0	0	0	0	0	0	2	0	0.5213	0.0486	0.0275	0.4026	$ 9,960.00	0.0927	2
47	0.625	0	0	0	0	0	0	1	1	0	0	0.4406	0.0557	0.0362	0.4675	$ 8,400.00	0.1130	2
59	0.625	0	0	0	0	0	0	2	0	0	0	0.4242	0.0707	0.0380	0.4671	$ 7,880.00	0.1501	2
2	0.625	0	8	0	0	0	0	0	0	0	0	0.4189	0.2473	0.1353	0.1985	$ 10,720.00	0.1861	8
75	0.625	0	0	0	0	0	0	3	0	0	0	0.4229	0.2324	0.0265	0.3183	$ 11,820.00	0.2452	3
63	0.625	0	0	0	0	0	0	2	1	0	0	0.4229	0.2324	0.0265	0.3183	$ 12,340.00	0.2741	3
51	0.625	0	0	0	0	0	0	1	2	0	0	0.4530	0.1951	0.0242	0.3277	$ 12,860.00	0.2879	3
60	0.625	0	0	0	0	0	0	2	0	1	0	0.4229	0.2324	0.0265	0.3183	$ 12,860.00	0.3030	3
39	0.625	0	0	0	0	0	0	0	3	0	0	0.4705	0.1976	0.0184	0.3136	$ 13,380.00	0.3081	3
48	0.625	0	0	0	0	0	0	1	1	1	0	0.4530	0.1951	0.0242	0.3277	$ 13,380.00	0.3168	3
36	0.625	0	0	0	0	0	0	0	2	1	0	0.4705	0.1976	0.0184	0.3136	$ 13,900.00	0.3370	3
45	0.625	0	0	0	0	0	0	1	0	2	0	0.4556	0.1927	0.0239	0.3278	$ 13,900.00	0.3444	3
33	0.625	0	0	0	0	0	0	0	1	2	0	0.4715	0.1964	0.0184	0.3138	$ 14,420.00	0.3654	3
30	0.625	0	0	0	0	0	0	0	0	3	0	0.5077	0.1899	0.0184	0.2840	$ 14,940.00	0.3761	3
3	0.625	0	0	8	0	0	0	0	0	0	0	0.4149	0.3716	0.0515	0.1621	$ 14,880.00	0.4192	8
28	0.625	0	0	0	0	0	0	0	0	1	0	0.0950	0.0719	0.0415	0.7916	$ 4,980.00	0.4758	1
89	0.625	0	0	0	0	0	0	4	0	0	0	0.3791	0.3506	0.0199	0.2504	$ 15,760.00	0.4860	4
21	0.625	0	0	0	0	0	1	1	2	0	0	0.4268	0.2966	0.0208	0.2557	$ 16,280.00	0.4910	4
22	0.625	0	0	0	0	0	1	2	0	1	0	0.4268	0.2966	0.0208	0.2557	$ 16,280.00	0.4910	4

Option 2 Final Scenarios for Consideration:

Scenario	***Dwell Time***	***NumMover25***	***NumMover50***	***NumMover75***	***NumMover100***	***NumMover125***	***NumMover150***	***NumMover175***	***NumMover200***	***NumMover225***	***NumMover250***	***T1***	***T2***	***T3***	***T4***	***Cost***	***Alpha***	***Total***
29	1.083333333	0	0	0	0	0	0	0	0	2	0	0.5083	0.0458	0.0219	0.4240	$ 9,600.00	0.0792	2
32	1.083333333	0	0	0	0	0	0	0	1	1	0	0.4475	0.0562	0.0250	0.4714	$ 9,100.00	0.0818	2
35	1.083333333	0	0	0	0	0	0	0	2	0	0	0.4423	0.0614	0.0250	0.4714	$ 8,600.00	0.1011	2
44	1.083333333	0	0	0	0	0	0	1	0	1	0	0.4222	0.0529	0.0441	0.4808	$ 8,600.00	0.1111	2
47	1.083333333	0	0	0	0	0	0	1	1	0	0	0.4098	0.0539	0.0466	0.4896	$ 8,100.00	0.1451	2
2	1.083333333	0	8	0	0	0	0	0	0	0	0	0.4138	0.2735	0.1376	0.1751	$10,400.00	0.1709	8
59	1.083333333	0	0	0	0	0	0	2	0	0	0	0.4015	0.0660	0.0552	0.4773	$ 7,600.00	0.1770	2
75	1.083333333	0	0	0	0	0	0	3	0	0	0	0.4763	0.1851	0.0253	0.3133	$11,400.00	0.1952	3
63	1.083333333	0	0	0	0	0	0	2	1	0	0	0.4763	0.1851	0.0253	0.3133	$11,900.00	0.2230	3
60	1.083333333	0	0	0	0	0	0	2	0	1	0	0.4763	0.1851	0.0253	0.3133	$12,400.00	0.2508	3
51	1.083333333	0	0	0	0	0	0	1	2	0	0	0.4564	0.1807	0.0254	0.3375	$12,400.00	0.2607	3
39	1.083333333	0	0	0	0	0	0	0	3	0	0	0.4614	0.1943	0.0167	0.3276	$12,900.00	0.2860	3
48	1.083333333	0	0	0	0	0	0	1	1	1	0	0.4564	0.1807	0.0254	0.3375	$12,900.00	0.2885	3
36	1.083333333	0	0	0	0	0	0	0	2	1	0	0.4614	0.1943	0.0167	0.3276	$13,400.00	0.3138	3
45	1.083333333	0	0	0	0	0	0	1	0	2	0	0.4564	0.1811	0.0275	0.3351	$13,400.00	0.3163	3
33	1.083333333	0	0	0	0	0	0	0	1	2	0	0.4614	0.1943	0.0167	0.3276	$13,900.00	0.3415	3
3	1.083333333	0	0	8	0	0	0	0	0	0	0	0.5098	0.3222	0.0477	0.1203	$14,400.00	0.3451	8
30	1.083333333	0	0	0	0	0	0	0	0	3	0	0.5014	0.1882	0.0146	0.2958	$14,400.00	0.3493	3
89	1.083333333	0	0	0	0	0	0	4	0	0	0	0.3917	0.3445	0.0190	0.2449	$15,200.00	0.4486	4
21	1.083333333	0	0	0	0	0	1	1	2	0	0	0.4172	0.3060	0.0188	0.2581	$15,700.00	0.4636	4
22	1.083333333	0	0	0	0	0	1	2	0	1	0	0.4172	0.3060	0.0188	0.2581	$15,700.00	0.4636	4
79	1.083333333	0	0	0	0	0	0	3	1	0	0	0.3917	0.3445	0.0190	0.2449	$15,700.00	0.4764	4
28	1.083333333	0	0	0	0	0	0	0	0	1	0	0.0896	0.0700	0.0420	0.7985	$ 4,800.00	0.4885	1
55	1.083333333	0	0	0	0	0	0	1	3	0	0	0.4594	0.2587	0.0191	0.2629	$16,700.00	0.4981	4
67	1.083333333	0	0	0	0	0	0	2	2	0	0	0.3917	0.3445	0.0190	0.2449	$16,200.00	0.5042	4
76	1.083333333	0	0	0	0	0	0	3	0	1	0	0.3917	0.3445	0.0190	0.2449	$16,200.00	0.5042	4
52	1.083333333	0	0	0	0	0	0	1	2	1	0	0.4594	0.2587	0.0191	0.2629	$17,200.00	0.5259	4

Alpha Calculation

((Math.Abs(Cost - 9000) / 9000) + (.6 - (OutputStatistic1.Value / (OutputStatistic1.Value + OutputStatistic2.Value + OutputStatistic3.Value + OutputStatistic4.Value)))) / 2

Eliminating Scenario Options:

Scenario	DwellTime	NumMover25	NumMover50	NumMover75	NumMover100	NumMover125	NumMover150	NumMover175	NumMover200	NumMover225	NumMover250	T1	T2	T3	T4	Cost	NumMovers
10	0.625	0	0	0	0	4	0	1	3	0	0	0.458108	0.369902	0.014742	0.157248	27900	8
15	0.625	0	0	0	0	0	6	0	2	0	0	0.501417	0.333908	0.012317	0.152359	28400	8
20	0.625	0	0	0	0	0	2	0	0	2	0	0.535181	0.181171	0.024516	0.259132	16200	4
24	0.625	0	0	0	0	0	1	1	1	2	0	0.387902	0.381601	0.016703	0.213795	21000	5
26	0.625	0	0	0	0	0	1	1	2	2	0	0.361868	0.438427	0.013937	0.185768	25300	6
31	0.625	0	0	8	0	0	0	0	0	0	0	0.414866	0.371569	0.05145	0.162115	14400	8
32	0.625	0	0	0	0	0	0	1	3	1	0	0.461084	0.30936	0.014581	0.214975	21500	5
35	0.625	0	0	0	0	0	8	0	0	0	0	0.501417	0.333908	0.012317	0.152359	26400	8
36	0.625	0	0	0	0	8	0	0	0	0	0	0.458108	0.369902	0.014742	0.157248	22400	8
54	0.625	0	0	0	0	0	4	2	2	0	0	0.501417	0.333908	0.012317	0.152359	29400	8
60	0.625	0	0	0	0	0	0	5	1	1	0	0.322113	0.503944	0.011409	0.162535	28100	7
61	0.625	0	0	0	0	0	2	2	0	2	0	0.512708	0.282833	0.016396	0.188064	23800	6
64	0.625	0	0	0	0	0	0	2	1	1	0	0.379115	0.350614	0.019902	0.250369	16700	4
72	0.625	0	0	0	0	0	3	4	0	1	0	0.501417	0.333908	0.012317	0.152359	29900	8
87	0.625	0	0	0	0	0	0	3	0	0	0	0.422876	0.232353	0.026471	0.318301	11400	3
88	0.625	0	0	0	0	0	1	4	0	1	0	0.361868	0.438427	0.013937	0.185768	23300	6
90	0.625	0	8	0	0	0	0	0	0	0	0	0.418855	0.247337	0.135346	0.198462	10400	8
91	0.625	0	0	0	0	0	1	3	0	0	0	0.426828	0.296634	0.020838	0.2557	14700	4
92	0.625	0	0	0	0	1	1	1	1	0	0	0.519335	0.190159	0.022273	0.268233	14200	4

Min		0	0	0	0	0	0	0	0	0	0	0.322113	0.181171	0.011409	0.152359	10400	3
Max		0	8	8	0	8	8	5	3	2	0	0.535181	0.503944	0.135346	0.318301	29900	8
Avg		0	0.421052632	0.421052632	0	0.684210526	1.578947368	1.578947368	0.842105263	0.684210526	0	0.444552	0.331572	0.024553	0.199324	21336.84	6.210526316
Comment		eliminate	0 or 8	0 or 8	eliminate	0-8 by 4	no change	0-5	0-3	0-3	eliminate						3-8