**O’Dare Airport Simulation Report**

**Introduction and Initial Setup**

Our simulation was structured around a 20-hour day framework, during which we analyzed various key metrics to gauge wasted fuel and fees collected. These parameters enabled us to derive a preliminary estimate of the financial inflow and outflow for each simulation. Three distinct scenarios were configured, all conforming to the 20-hour constraint. The initial simulation reflected the existing scenario, where a single runway accommodates all incoming planes. Subsequent simulations introduced a second runway, with one scenario featuring a combination of half and full-length runways, and the other employing two full-length runways. Simulations were then run using the data we collected to simulate an entire year of plane traffic to the airport. From those numbers, we took statistics and used that data to make our recommendations.

**Logic of Simulation, Assumptions, and Justification of model**

The columns and variables of the models were created based on the templets and data provided in the instruction guide. Variables including request time, request gap, jet type, request type, runway available, service start time, service time, service end time, wait time, runway idle time, wasted fuel cost, fees collected were creased by using the 3 main distribution theories including probability distribution, uniform distribution, and normal input distribution. Using the combination of random values and 3 types of distributions to build the simulation models for project and control the total operation hour of 3 models to close to 1200 minutes with enough number of plane records to calculate the statistics of number counts, min, max, average, standard deviation for different variables to run the actual simulation for 365 days, which is a year. Above each model we built, we create templets to create the output statistic for the models that calibrated to 20 hours’ time scale of operation. Templets including the count of time gap between requests in minutes, number of each type of jet, number of different type of requests including landing and take-off, total operation time in minutes, total hours of operation, runway utilization, number of planes for 24 hours, number of completion times for each type of planes, the number associated with each arrival gap, and number of different types of fees collected. And finally, calculated the statistics including minimum, maximum, average, standard deviation for operation time, wait time, runway idle time, wasted fuel cost, fees collected for the input as our simulation for 365 days in the later steps using data table feature in Excel.

**Recommendation, Results, and Analysis of Results**

Below are outputs from our simulations looking at the amount of fees collected and total wasted fuel cost. From top to bottom the rows show minimum, maximum, average, and standard deviation. The row highlighted in yellow indicates a sample output for 1 day.

**1 Runway:**

A screenshot of a computer

Description automatically generated

**2 full length runways:**

A screenshot of a computer

Description automatically generated

**1 full length runway and 1 half-length runway:**

A screenshot of a computer

Description automatically generated

Looking at this data we simulated a few observations can be made. First the 1 runway model is definitely not feasible in the long term. That model collects only slightly less fess than that of the other two models but when looking at the wasted fuel cost it becomes clear that the current situation of one runway is losing far more money than the others. The average wasted fuel cost for the 1 runway simulation shows an estimated $50,099.67 per day. This still allows O’Dare airport to be collecting a fair amount of fees over the wasted fuel cost. But the amount of wasted fuel cost is still bound to upset aircraft companies. As such, we can look at the two other models. Around $5,307.79 is wasted each day in fuel costs using the 1 full length and one-half length runway model as opposed to only around $772.22 in the 2 full runway model. As such our recommendation is to build two full-length runways. Doing so will maximize profits in the long run by reducing the wasted fuel for planes drastically. Also, outside of cost savings, the two-runway model allows for the airport to service more planes than it currently is. This would be beneficial since the problem originates from the city’s rapid growth. So, building a new runway that can accommodate for that growth would help in the long run.

**1 Runway:**

A screenshot of a graph

Description automatically generated

**1 full runway 1 half runway:**

A screenshot of a graph

Description automatically generated

**2 full runways:**

A screenshot of a computer

Description automatically generated

The above data shows the utilization of the runways. This is looking at the percentage of usage time for the runway models. The first models as expected from the wasted fuel cost is near maximum utilization. But when comparing the other two models the 2 full runway model is more appealing because both runways are utilized in a similar fashion. Whereas the half runway in the other simulation is at about half the utilization of the full runway. Meaning it makes more sense to fully utilize the two full runway model. However, if it were feasible to have O’Dare airport bring in more smaller air traffic the 1 full 1 half runway model could see more benefit. This is also backed up from the payback period calculations,

**1 full runway 1 half runway:**

A close-up of a number

Description automatically generated

**2 full runways:**

A close up of a number

Description automatically generated

With the payback period we calculated the payback period if the minimum daily excess revenue is used everyday, the max, and the average. Based upon the data on average, it will take 75 more days to pay off the two full runway model as opposed to the 1 half one full runway model. And though this is a significant amount of time in the short term, in the long term this difference is not that major and further reinforces the validity of picking the two full runway model. So, based upon the information we have collected and simulated we believe the two-runway model is more effective.

**Critical data analysis – where to get more accurate data/quality of data/unrealistic values)**

The accuracy of the data we use is key to the success of our simulation. Though our data was given to us, if we had had to collect it ourselves it would have been most efficient to first contact O’Dare airport. It is likely that the airport already has past data records so that we would not have to start our collection from scratch. Though it would be prudent to collect our data separately so that we would better understand the data and possibly mitigate any errors in the previous data. As for getting more accurate data, air traffic control likely keeps records of previous and ongoing air traffic which could be used to accurately simulate plane patterns and tendencies. Our given data has the drawback of only a few possible times for plane request gaps and completion times for requests. This would not follow the same logic in reality because the planes could come in at many variable times. It also does not account for weather conditions or technical issues that could cause delays. So, while the given simulation can create a good model, the biggest drawback is that the simulation assumes that nothing ever goes wrong. And in everything something almost always goes wrong at some point.

**Alternate suggestions**

An alternative suggestion we came up with for O’dare airport is to accept less air traffic as to not overload the airport. As previously discussed, the data shows that the single runway model is not that much less profitable than the other two models. Only about a rough difference in $50,000 in fees separates the simulations. Therefore, the airport could shift its focus from building a new runway to handling less air traffic. This way the wasted fuel costs would be minimized, and profits would remain the same if not better. Making the current one runway model profitable on the same scale as the other two models. It’s important to note that this solution only works under the assumption that issues with the city would not arise. Because the growing population is what is increasing the air traffic. So, if you reduce the air traffic the population could get upset or cause issues. Regardless, lowering the air traffic to a single runway is an option still that would have a slightly lower revenue but keep fuel costs low.

**Overall learning from project**

Overall, the project felt very beneficial for a learning tool to get into simulation. The set up and distinguishing between the different models gave ample opportunity to look at the data and make a selection based on the prior work. This not only reinforced our understanding of key concepts for simulations but also honed our problem-solving skills and decision-making abilities. The interactive nature of the simulation allowed for practical experimentation, enabling us to grasp the intricacies of the simulations matter more comprehensively. One area where I feel the project falls short is in the collection of data. We did have to find data for fuel prices and covert the given data to gallons to apply the fuel price. But a large part of simulation is figuring out what data values are needed. I think for the purposes of a school project obviously this cannot be too extreme or realistic but perhaps having the information as a word problem rather than give the data tables directly. This is not to say however that the project was not a challenge as the difficulty level felt appropriate, and some aspects such as the initial set up of variables and finding the appropriate statistics to make note of did prove a challenge. But the ease of finding the variables is something that stuck out to us when beginning the project. Overall, the project was very effective and improved our subject matter knowledge of us greatly. And it served as a great bridge between theory and practice to get our feet wet.