MGOC20: Assignment 1 - Event Planning

The International Meeting of App Developers (IMAD) Project Management Report

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Introduction

Over the course of the past few years, events play a significant role towards a business. This year, in Toronto, we are organizing the *The International Meeting of App Developers (IMAD)*, which is a conference held for app developers, up-and-coming entrepreneurs, and many others to network and collaborate with each other.

As this is the thirteenth installment of IMAD, we expect that this meeting is going to be the biggest IMAD yet. With that being said, there are a lot of factors and involvement when planning for such of an event.

This report goes into detail as to how this conference will be managed and handled. As asked, our team will go into detail about two decisions that are heavily considered. **Financing and Planning.** With the numeric data given, and questions asked by many supervisors, this report will provide insight to the two topics.

Financing

As previously stated in our past meetings, there are two sources of revenue for the IMAD event: **Sponsorships and Registration fees**. This year, our sponsors have generously contributed **$1,000,000** to our event. As for registration fees, we agreed with the chair of IMAD conferences to charge the same price as last year, which is **CAD $500.00** (after taxes) per person.

As for expenses, however, it may be costly. The amount of expenses is approximately **$5,250,000** in total. To go into more detail, the highest cost of expenses is from the venue hire and food/beverages at **CAD $2,500,000**. The decisions for deciding where the venue is, and what food would be provided are from previous years' marketing strategy, predicting that there would be approximately 9,000 attendees showing up to the event.

Fortunately, as a team, we are able to predict a better estimate of attendees using our applicable knowledge from the course that we have taken, *MGOC20* from UTSC's management program. Likewise, here are the answers to the questions that were commonly asked by our supervisors:

Common Financing Questions

1. Is there a trend on the number of participants attending the conference? If so, why is there a trend occuring?

Given the data in **Exhibit 1**, **Exhibit 2** shows the data graphed. As follows, the number of attendees per year stably increases as time goes on. Given this assumption, it is fair to say that the number of participants attending the conference is trending; *There is a long-run increase over time in an upward movement.*

We can strongly believe that the number of attendees increase in an upward trend for one strong reason. It is because information technology is becoming a relevant resource that many businesses and organizations wish to obtain and practice. Having to network and collaborate with app developers may presumably help businesses obtain an upper advantage towards its competitors, obtaining effective/efficient ways to use technology for lower costs, and marginally gain more profit. Having ourselves to hold this conference may bring out larger technological projects from many businesses in future years.

2. Is it possible for your team to forecast the number of attendees this year? If so, can you tell us why you used a specific forecasting method, rather than others using some sort of analysis?

It is possible, however we have selected a few appropriate tools to determine which forecasting method is appropriate to determine how many attendees are participating this year. Being straight to the point, the appropriate forecasting method used was the **linear regression model.** We can expect that there will be approximately **7,295** attendees in IMAD. We shall showcase exhibit 1 here, but in a mathematical approach:

Conference years	**IMAD iteration**	**Attendees**
2004	1	6320
2005	2	6672
2006	3	6432
2007	4	6542
2008	5	6774
2009	6	6685
2010	7	6932
2011	8	6751
2012	9	6892
2013	10	7169
2014	11	7132
2015	12	7282

Using MAPE, we consider the formula:

$$MAPE = \sum_{i=1}^{n} \left(\frac{|Actual_i - Forecast_i|}{|Actual_i|}\right) \cdot \frac{100}{n}$$

Knowing this formula, we determine which method is "best" for forecasting the number of attendees this year. MAPE indicates how "off" the forecasting method is. For example, if $MAPE = 20.25$, then the forecasting method is 20.25% off of the actual value of attendees. We as a team evaluated each appropriate forecasting method, however the one that stands out the most is the one with the smallest MAPE value.

First, let's start off with the **weighted average method**. This method is used because we can appropriately use our weights for trends. We started off using this method with 3 weights in an excel file. The forecast formula for each iteration is:

$$Forecast_t = Attendees_{t-1} \cdot w_1 + Attendees_{t-2} \cdot w_2 + Attendees_{t-3} \cdot w_3$$

Where t represents the forecasting year and w represents each respective weight. Given this information, we have temporarily used arbitrary numbers for the weights to determine forecasts. As long as the sum of all weights equals to 1, and all weights are greater than or equal to 0, we are able to determine our forecasts. And we did so! We have calculated our forecasts for the years 2007 to 2015. This determines our MAPE value.

However, after calculating the MAPE value with the arbitrary weight values, it does not properly allocate an optimal MAPE for this method. So, to optimally allocate our weights, we use Microsoft Excel's **solver** function to determine our weights while minimizing the MAPE value. As shown in **Exhibit 3**, we see that only two weights are necessary (weight 1 ≈ 0.542, weight 2 ≈ 0.458, weight 3 $= 0$), to optimally minimize MAPE at 1.900%.

Next, we consider the **exponential smoothing forecast method** to determine a MAPE value. This particular method is heavily considered as it is derived from the weighted average method. To determine a forecasting value, we consider the exponential smoothing formula:

$$Forecast_t = Forecast_{t-1} + \alpha \cdot (Forecast_{t-1} - Attendees_{t-1})$$

Where t represents the forecasting year, and α is any value between 0 and 1. Given this information, we have temporarily used an arbitrary α for our forecasts, and assumed that the forecast for the first IMAD iteration is at a constant of 6320. Thus, we have calculated a MAPE value with the formula.

However, choosing an arbitrary number for α is not always the optimal case for the lowest MAPE value. We used Microsoft Excel's **solver** to determine the minimizing MAPE value with α being mutable. Thus, as shown in **Exhibit 4**, our optimal α value is $\alpha \approx 0.652$, and our MAPE value is $MAPE \approx 2.389\%$.

Next, we consider the **exponential smoothing forecast method with trends.** This method is more likely to be considered as this method incorporates a 'trend factor'. As indicated from the first frequently asked questions in financing, we have acknowledged that the number of attendees is trending upward, thus this method is a well-thought out variation of exponential smoothing and suitable for our purposes. We consider the formulas:

$$ES_t = \alpha \cdot (Attendees_{t-1}) + (1-\alpha) \cdot (Forecast_{t-1} + TF_{t-1})$$

$$TF_t = \beta \cdot (ES_t - Forecast_{t-1}) + (1-\beta) \cdot TF_{t-1}$$

$$Forecast_t = ES_t + TF_t$$

Where t represents the forecasting year, α and β are values between 0 and 1, ES_t represents exponential smoothing for the year of, TF_t represents 'Trending Factor', and $Forecast_t$ is a forecasting value of the year of.

For our forecasts, we assumed that the first forecast iteration is at a constant of 6320, and α and β are arbitrary values between the range of $0 < \alpha, \beta < 1$. After the arbitrary values have been set, we have calculated each year's forecasts and obtained a MAPE value.

Likewise in our Exponential Smoothing model, using arbitrary numbers for α and β are not optimal when minimizing the MAPE value. Thus, we use Microsoft Excel's **solver** to determine the minimizing value of our MAPE, while our α and β values are mutable. After running Excel's solver, we have optimized our MAPE value at $MAPE \approx 1.722$ with our α and β values at $\alpha \approx 0.218$ and $\beta \approx 0.459$. The exhibit that show this process appear on **Exhibit 5**

Lastly, we shall consider the most reasonable forecasting method out of all forecasting methods used. **Linear Regression Model**. This model is used because there appears to be a strong correlation with the regression model itself, and the trending past data. Given our data, we shall consider the following formulas when preparing a regression analysis:

$$b = \frac{\sum_i (x_i y_i) - n\bar{x}\bar{y}}{\sum_i x_i^2 - n\bar{x}^2}$$

$$a = \bar{y} - b\bar{x}$$

$$y = a + bx$$

Where x_i is the respective IMAD iteration, $\bar{x}$ is the average number of IMAD iterations, n is the number of iterations thus far, y_i is the respective number of attendees based on past data, $\bar{y}$ is the average number of attendees, and $y = a + bx$ is the regression model function that depends on what iteration IMAD is in.

Unlike our previous examples, we do not need to use the excel solver in order for us to minimize MAPE. However, in regards to the process, **Exhibit 6** follows and shows the forecasted values. Here is how we were able to get the linear regression formula:

$$b = \frac{\sum_i (x_i y_i) - n\bar{x}\bar{y}}{\sum_i x_i^2 - n\bar{x}^2} = \frac{541194 - 12 \cdot (6.5) \cdot (6798.58\bar{3})}{650 - 12 \cdot 6.5^2} \approx 76.25524$$

$$a = 6798.58\bar{3} + 76.25524 \cdot 6.5 \approx 6302.924$$

Making our model:

$$y = a + bx = 6302.924 + 76.25524x$$

Where x represents the IMAD iteration. Through this process, we determined the forecasted values, and eventually a MAPE value of $MAPE \approx 1.403$.

Now that we have completed and calculated all MAPE values, here is a comparison of the forecasting methods along with the MAPE values:

Forecasting method	**MAPE value**
Weighted Average Method	1.900%
Exponential Smoothing Forecast Method	2.389%
Exponential Smoothing Forecast Method with trends	1.722%
Linear Regression Model	**1.403%**

At this point we shall consider the rule "The lower, the better", as MAPE is a value that determines how 'off' a model is compared to the actual value. Thus, in this case, it is fair to say that the Linear Regression Model is the best suited for determining the number of attendees. In this case, we can expect that there would be approximately 7,295 attendees.

3. Based on your forecasting method, is the budget appropriate for covering expenses? Can you give us three possible ways to decrease costs, or obtain more revenue? What is the upside to each suggestion? What is the downside to each one too?

Based off of our Linear Regression model, we are going to calculate net profit/loss:

$Revenue = Sponsorships + Ticket\ Prices \cdot number\ of\ attendees = 1,000,000 + \$500 \cdot 7295 = \$4,647,500$
$Expenses = Food/Beverage/Venue\ fees + \ Otherexpenses = 2,500,000 + 2,750,000 = \$5,250,000$
$Net\ Loss = Revenue - Expenses = \$4,647,500 - \$5,250,000 = \$-602,500$

Thus, this project is under-budgeted. However, as a team, we have came up with three possible solutions to lower costs or gain more revenue:

1. As food and beverages contribute a large amount towards expenses, **we can decrease the amount spent on food, or not have food as a complementary item to our event. Rather, we can have outside vendors sell their food the attendees.** The downside of this happening is that the venue would have less space, and attendees would have their expectations lowered as previous years did have food. This varies depending on the quality of previous years' food too. The upside to this, however, is that we would have commission revenue if vendors were to sell their food at our event. Our costs would be lowered by this, and our revenue would be increased.

2. As venue costs also contribute to the large expense fee of $\$2,500,000$, **we can have a smaller venue**. The only possible downside is the possibility of under-estimating the number of attendees this year (as there may be technological booms these past few months), leading to a decrease of satisfaction. However, with our model discussed in the second question, we are confident that the estimate of $9,000$ attendees is an over-estimate. Our costs will decrease due to this.

3. Instead of a constant \$500 price, **we can sequence the fee based on time.** For example, we can have an early bird price of \$500, and gradually increase our prices as the deadline for registration falls closer

to the event (i.e. $5 per month). The possible downside to this is to potentially have less attendees than previous years. However, the upside to having a sequenced pricing model is that we would monetize and stabilize our revenue through each sequence. Another potential upside to this is that we would have larger profits due to the increase in price.

Planning

As indicated from previous years, this event involves a lot of strategic planning and strategic timing. Given the state that we are supposed to be punctual, we have created an optimal way to determine which tasks need to completed on which dates. As previously stated in past meetings here are a list of items that need to be completed:

Activity	Description	Activity Predecessors	Optimistic Duration (weeks)	Likely Duration (weeks)	Pessimistic Duration (weeks)
1	Confirm venue reservation	-	0	0	0
2	Install equipment in venue	1	6	8	10
3	Develop IMAD website	1	3	6	9
4	Recruit Staff	1	1	3	5
5	Test equipment	2	2	4	12
6	Registration Period	3	2	3	4
7	Train Staff	4	3	4	5
8	Advertise meeting in companies/schools	4	2	2	2
9	Solve registration and payment issues	2,6,7	3	7	11
10	Reserve transportation	2,6,7	2	4	6
11	Install equipment on venue	2	1	4	7
12	Plan and reserve food/beverage	8,9,10	1	10	13
13	Simulate conference	11,12	0	0	0

Exhibit 7

Common Planning Questions

4. Given the tasks at hand, how many weeks are we expected to complete all tasks required for the event?

Using a statistical method, we shall assume that the table above is using a beta distribution. We shall consider the formulas:

$$t = \frac{a + 4m + b}{6}$$

$$\sigma^2 = (\frac{b - a}{6})^2$$

Where t is the expected duration time for each activity, a is the optimistic duration, m is the likely duration, b is the pessimistic duration, and σ^2 is the variance, which is a measure of accuracy.

Given these formulas, we determine the expected duration of each activity, and its respective variances. These can be shown here:

Activity	Description	Activity Predecessors	Optimistic Duration (weeks)	Likely Duration (weeks)	Pessimistic Duration (weeks)	expected time (t)	variance (σ^2)
1	Confirm venue reservation	-	0	0	0	0	0
2	Install equipment in venue	1	6	8	10	8	$0.\bar{4}$
3	Develop IMAD website	1	3	6	9	6	1
4	Recruit Staff	1	1	3	5	3	$0.\bar{4}$
5	Test equipment	2	2	4	12	5	$2.\bar{7}$
6	Registration Period	3	2	3	4	3	$0.\bar{1}$
7	Train Staff	4	3	4	5	3	$0.\bar{4}$
8	Advertise meeting in companies/schools	4	2	2	2	2	0
9	Solve registration and payment issues	2,6,7	3	7	11	7	$1.\bar{7}$
10	Reserve transportation	2,6,7	2	4	6	4	$0.\bar{4}$
11	Install equipment on venue	2	1	4	7	4	1
12	Plan and reserve food/beverage	8,9,10	1	10	13	9	4
13	Simulate conference	11,12	0	0	0	0	0

Exhibit 8

Given this table, we are able to show an AON (Activity-On-Node) graph! The AON is showed in **Exhibit 9**. In each circle, there are 6 numbers. The top left number indicates the earliest start time, the top middle number indicates the respective activity, and the top right number indicates the earliest completion time. Likewise, the bottom left number indicates the latest finish time, the bottom number indicates the expected activity duration, and the bottom right number indicates the latest completion time.

Given the information on **Exhibit 9**, the expected finish time is approximately 25 weeks!

5. Based on what you said, what activities **cannot be delayed** *as to finish within the expected completion time? How did you find those tasks?*

Based on the information on **Exhibit 9**, the activities cannot be delayed are the activities that have no 'slack'. Given this knowledge, the path that has absolutely no slack is called a *Critical path.* Slack is indicated as follows in each node:

$$Slack_n = Latest\ completion\ time - Earliest\ completion\ time = Lateststart\ time - Earliest\ start\ time$$

Where n indicates each respective activity. Let's determine the 'slack' value for each activity:

Activity	Latest start time - Earliest Start time	Slack value
1	$0-0$	0
2	$9-8$	1
3	$6-6$	0
4	$5-3$	2
5	$25-13$	12
6	$9-9$	0
7	$9-7$	2
8	$16-5$	11
9	$16-16$	0
10	$16-13$	3
11	$25-12$	13
12	$25-25$	0
13	$0-0$	0

Exhibit 10

From the information from **Exhibit 9**, we see the following paths:

$$1-2-5$$

$$1-2-11-13$$

$$1-2-9-12-13$$

$$1-2-10-12-13$$

$$1-3-6-9-12-13$$

$$1-3-6-10-12-13$$

$$1-4-7-10-12-13$$

$$1-4-8-12-13$$

Given all of these paths, we want to pick the critical path with no slack. Thus, our critical path with no slack is

$$1-3-6-9-12-13$$

Thus the variance of the critical path is

$$\sigma_{cp}^2 = \sum \sigma_n^2 = 0 + 1 + 0.\bar{1} + 1.\bar{7} + 4 + 0 = 6.\bar{8}$$

where n represents each variance of the critical path.

6. We promised the meeting chair that we would start all activities 30 weeks before the actual conference. Is this a reasonable timeline?

Yes, it is! Statistically, we are still considering this model as a Beta distribution. Considering that we, as a team, have taken the course, MGOC20 in UTSC, we are going to use a Z-formula and a z-value to determine the probability:

$$Z = \frac{deadline - ExpectedTime}{\sigma_{cp}} = \frac{30-25}{\sqrt{6.\bar{8}}} \approx 1.90500$$

When we look at the table of normal distribution, we find that 1.90500 is in between 1.91 and 1.90. Thus, we take the average p-value of the two. The likeliness of the project completing in time is at 97.16%, and therefore, 30 weeks is a reasonable time.

7. One of the teams suggested to changing the venue fore a less-costly one. This would leave us with 22 weeks to complete all 13 tests. Is this possible?

Let's statistically evaluate this:

$$Z = \frac{deadline - ExpectedTime}{\sigma_{cp}} = \frac{22-25}{\sqrt{6.\bar{8}}} \approx -1.14300$$

When we look at the the table of normal distribution, we find that -1.143 is in between -1.14 and -1.15, so we take the average p-value of the two. The likeliness of the project completing in time is at 12.67%. Thus, this is not a reasonable deadline as it may be risky to complete.

8. Given the alternatives you proposed in the financing portion, would your propositions impact the timeline of the tasks?

As indicated from the financing portion of this report we proposed three solutions: **1. decrease the amount spent on food/replace complementary food with vendors, 2. Have a smaller venue, 3. Sequence fees based on time.**

1. If we decrease the amount spent on food, we would have to forecast a suitable budget specifically for food and beverages. This may impact our time as we have to outsource credible employees (like us!) for budgeting food; activity 12 (planning and reserving food/beverages) may change to be a longer process as the outsourced employees have to account for a less flexible budget. The amount of time would be longer. If we were to contact external vendors for commission costs, it would be more reasonable that activity 12 (planning and reserving food/beverages) can change.

2. Likewise in the previous question, if we obtain a smaller venue, then it is likely that the project will not succeed at all.

3. If we sequence fees based on time, the IMAD webside would have to continuously update with different prices for payment. We can consider that changing prices is not so much of a problem as verified payment sites are easily able to change their prices (i.e. PayPal). However, due to this process, we do have to account for more potential registration and payment issues (as indicated on Acitivity 9), and our times would be delayed a bit.

Exhibit 1 (Basic table of conference years, IMAD and attendees)

Conference years	IMAD iteration	Attendees
2004	1	6320
2005	2	6672
2006	3	6432
2007	4	6542
2008	5	6774
2009	6	6685
2010	7	6932
2011	8	6751
2012	9	6892
2013	10	7169
2014	11	7132
2015	12	7282

Exhibit 2 (Graphical representation of Attendees respect to the conference years)

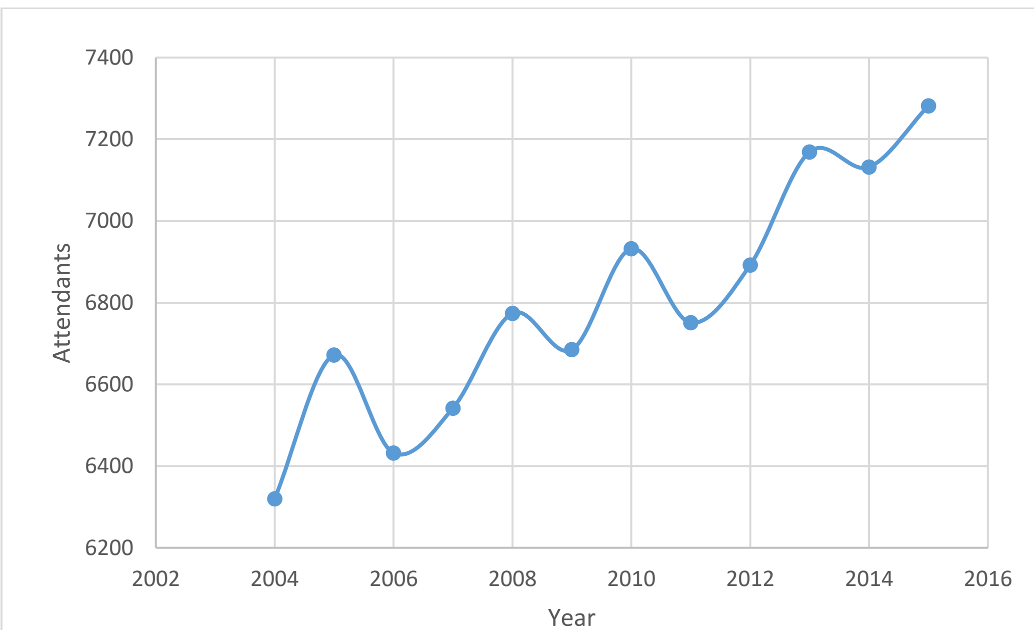

Exhibit 3 (Attendees Weighted Moving Average)

IMAD ITERATION	ATTENDEES	Forecasted value	ERROR = |Actual – Forecasted value|	ERROR/ATTENDEES
1	6320			
2	6672			
3	6432			
4	6542	6541.995759	0.004240599	6.48211E-07
5	6774	6491.585235	282.4147647	0.04169099
6	6685	6667.670709	17.32929113	0.002592265
7	6932	6725.790075	206.2099248	0.029747537
8	6751	6818.795971	67.79597145	0.01004236
9	6892	6833.955127	58.04487313	0.008422065
10	7169	6827.377445	341.6225555	0.047652749
11	7132	7042.046497	89.95350304	0.012612662
12	7282	7148.957653	133.0423474	0.018270028

n =	3
w3 =	0
w2 =	0.458315782
w1 =	0.541684214
Total weight	1
MAPE =	1.900347817

n represents a 3 year moving average
w3 represents the weight for the (forecasting year – 1)
w2 represents the weight for the (forecasting year – 2)
w1 represents the weight for the (forecasting year – 3)

All weights are $0 \leq w_t \leq 1$, $\sum_{t=1}^{n} w_t = 1$, where t represents the year of. Thus, the forecasting formula for each year is:

$$Forecast_t = Attendees_{t-1} \cdot w_1 + Attendees_{t-2} \cdot w_2 + Attendees_{t-3} \cdot w_3$$

MAPE was conducted using the formula, where n = 9 (the number of forecasting IMAD iterations):

$$MAPE = \sum_{i=1}^{n} \left(\frac{|Actual_i - Forecast_i|}{|Actual_i|}\right) \cdot \frac{100}{n}$$

Excel Solver was used to minimize the MAPE value, having our weights as changing variables, and having to use $0 \leq w_t \leq 1$, $\sum_{t=1}^{n} w_t = 1$ as constraints.

Exhibit 4 (Exponential Smoothing)

IMAD iteration	**Attendees**	Forecasted value	ERROR = |Actual – Forecasted value|	ERROR/ATTENDEES
1	6320	6320	0	0
2	6672	6320	352	0.052757794
3	6432	6549.636102	117.6361016	0.018289195
4	6542	6472.893216	69.10678414	0.010563556
5	6774	6517.976774	256.0232259	0.037794985
6	6685	6685	6.45741E-11	9.65955E-15
7	6932	6685	247	0.035631852
8	6751	6846.136696	95.13669629	0.014092238
9	6892	6784.071867	107.9281334	0.015659915
10	7169	6854.481514	314.5184862	0.043872016
11	7132	7059.665602	72.33439799	0.010142232
12	7282	7106.854776	175.1452242	0.024051802

Alpha	0.652375289
MAPE =	2.389596226

For this method, we consider the formula:

$$Forecast_t = Forecast_{t-1} + \alpha \cdot (Forecast_{t-1} - Attendees_{t-1})$$

Where *t* represents the forecasting year of, and $0 \leq \propto \leq 1$. We assume the first IMAD iteration forecast is constant at 6320, representing the number of attendees for the year of.

MAPE was conducted using the formula, where n = 11 (the number of forecasting IMAD iterations):

$$MAPE = \sum_{i=1}^{n} \left(\frac{|Actual_i - Forecast_i|}{|Actual_i|} \right) \cdot \frac{100}{n}$$

Excel Solver was used to minimize the MAPE value, having $\propto$ as the changing variable, and $0 \leq \propto \leq 1$ as the constraints.

Exhibit 5 (Exponential Smoothing with Trend)

IMAD iteration	Attendees	ES_t	TF_t	Forecast with trends	ERROR = |Actual – Forecasted value|	ERROR/Attendees
1	6320	6320	0	6320	0	0
2	6672	6320	0	6320	352	0.052757794
3	6432	6396.785211	35.21478868	6432	5.27507E-10	8.20129E-14
4	6542	6459.533042	31.69183032	6491.224872	50.77512814	0.007761408
5	6774	6527.079529	33.60096185	6560.680491	213.3195091	0.031490923
6	6685	6633.485222	51.58036714	6685.065589	0.06558873	9.81133E-06
7	6932	6725.379917	46.41360174	6771.793519	160.2064811	0.023111148
8	6751	6843.029877	57.79767049	6900.827548	149.8275476	0.022193386
9	6892	6913.333894	37.02642566	6950.360319	58.3603192	0.008467835
10	7169	6966.579099	27.48374367	6994.062843	174.9371574	0.024401891
11	7132	7053.712045	42.23528004	7095.947325	36.05267478	0.005055058
12	7282	7136.833933	41.61675976	7178.450693	103.5493073	0.014219899

Alpha =	0.218139805
Beta =	0.458614205
MAPE =	1.722446847

For this method, we consider using the following formulas:

$$ES_t = \alpha \cdot (Attendees_{t-1}) + (1-\alpha) \cdot (Forecast_{t-1} + TF_{t-1})$$

$$TF_t = \beta \cdot (ES_t - Forecast_{t-1}) + (1-\beta) \cdot TF_{t-1}$$

$$Forecast_t = ES_t + TF_t$$

Where t represents the forecasting year of, $0 \leq \propto, \beta \leq 1$, ES_t representing exponential smoothing for the year of, TF_t representing trending factor for the year of, and $Forecast_t$ represents the forecasting value of the year of. We assume the first IMAD iteration forecast is constant at 6320, representing the number of attendees for the year of, and a trending factor of 0.

MAPE was conducted using the formula, where n = 11 (the number of forecasting IMAD iterations):

$$MAPE = \sum_{i=1}^{n} \left(\frac{|Actual_i - Forecast_i|}{|Actual_i|}\right) \cdot \frac{100}{n}$$

Excel Solver was used to minimize the MAPE value, having $\propto$ and β as changing variables, and $0 \leq \propto, \beta \leq 1$ as the constraints.

Exhibit 6 (Linear Regression Model)

IMAD ITERATION	Attendees	Forecasted Value	ERROR = |Actual – Forecasted Value|	ERROR / Attendees
1	6320	6379.17924	59.17924	0.009363804
2	6672	6455.43448	216.56552	0.032458861
3	6432	6531.68972	99.68972	0.015499024
4	6542	6607.94496	65.94496	0.010080245
5	6774	6684.2002	89.7998	0.01325654
6	6685	6760.45544	75.45544	0.011287276
7	6932	6836.71068	95.28932	0.013746295
8	6751	6912.96592	161.96592	0.023991397
9	6892	6989.22116	97.22116	0.014106378
10	7169	7065.4764	103.5236	0.014440452
11	7132	7141.73164	9.73164	0.001364504
12	7282	7217.98688	64.01312	0.008790596
13		7294.24212		

MAPE	1.403211424

With the Linear Regression Model, we consider the following formulas:

$$b = \frac{\sum_i (x_i y_i) - n\bar{x}\bar{y}}{\sum_i x_i^2 - n\bar{x}^2}$$

$$a = \bar{y} - b\bar{x}$$

$$y = a + bx$$

Where n represents the number of IMAD iterations, x̄ representing the average number if IMAD iterations thus far, $\bar{y}$ representing the number of average attendees thus far, x representing the IMAD iteration, and y representing the forecasting formula depending on the IMAD iteration. We have calculated the forecasting formula with the following:

$$b = \frac{\sum_i (x_i y_i) - n\bar{x}\bar{y}}{\sum_i x_i^2 - n\bar{x}^2} = \frac{541194 - 12 \cdot (6.5) \cdot (6798.58\bar{3})}{650 - 12 \cdot 6.5^2} \approx 76.25524$$

$$a = 6798.58\bar{3} + 76.25524 \cdot 6.5 \approx 6302.924$$

$$y = a + bx = 6302.924 + 76.25524x$$

From here, *y* was used to forecast the values, and then we calculated MAPE with the formula:

$$MAPE = \sum_{i=1}^{n} \left(\frac{|Actual_i - Forecast_i|}{|Actual_i|}\right) \cdot \frac{100}{n}$$

Where n = 12 forecasted IMAD iterations

Exhibit 7 (Activity Table)

Activity	Description	Activity Predecessors	Optimistic Duration (weeks)	Likely Duration (weeks)	Pessimistic Duration (weeks)
1	Confirm venue reservation	-	0	0	0
2	Install equipment in venue	1	6	8	10
3	Develop IMAD website	1	3	6	9
4	Recruit Staff	1	1	3	5
5	Test equipment	2	2	4	12
6	Registration Period	3	2	3	4
7	Train Staff	4	3	4	5
8	Advertise meeting in companies/schools	4	2	2	2
9	Solve registration and payment issues	2,6,7	3	7	11
10	Reserve transportation	2,6,7	2	4	6
11	Install equipment on venue	2	1	4	7
12	Plan and reserve food/beverage	8,9,10	1	10	13
13	Simulate conference	11,12	0	0	0

Exhibit 8 (Activity Table with expected time and variance)

Activity	Description	Activity Predecessors	Optimistic Duration (weeks)	Likely Duration (weeks)	Pessimistic Duration (weeks)	expected time (t)	variance (σ^2)
1	Confirm venue reservation	-	0	0	0	0	0
2	Install equipment in venue	1	6	8	10	8	$0.\bar{4}$
3	Develop IMAD website	1	3	6	9	6	1
4	Recruit Staff	1	1	3	5	3	$0.\bar{4}$
5	Test equipment	2	2	4	12	5	$2.\bar{7}$
6	Registration Period	3	2	3	4	3	$0.\bar{1}$
7	Train Staff	4	3	4	5	3	$0.\bar{4}$
8	Advertise meeting in companies/schools	4	2	2	2	2	0
9	Solve registration and payment issues	2,6,7	3	7	11	7	$1.\bar{7}$
10	Reserve transportation	2,6,7	2	4	6	4	$0.\bar{4}$
11	Install equipment on venue	2	1	4	7	4	1
12	Plan and reserve food/beverage	8,9,10	1	10	13	9	4
13	Simulate conference	11,12	0	0	0	0	0

To calculate expected time (t) and variance (σ^2) for each activity, we use the following formulas:

$$t = \frac{a + 4m + b}{6}$$

$$\sigma^2 = (\frac{b-a}{6})^2$$

Exhibit 9 (Activity-On-Node Model)

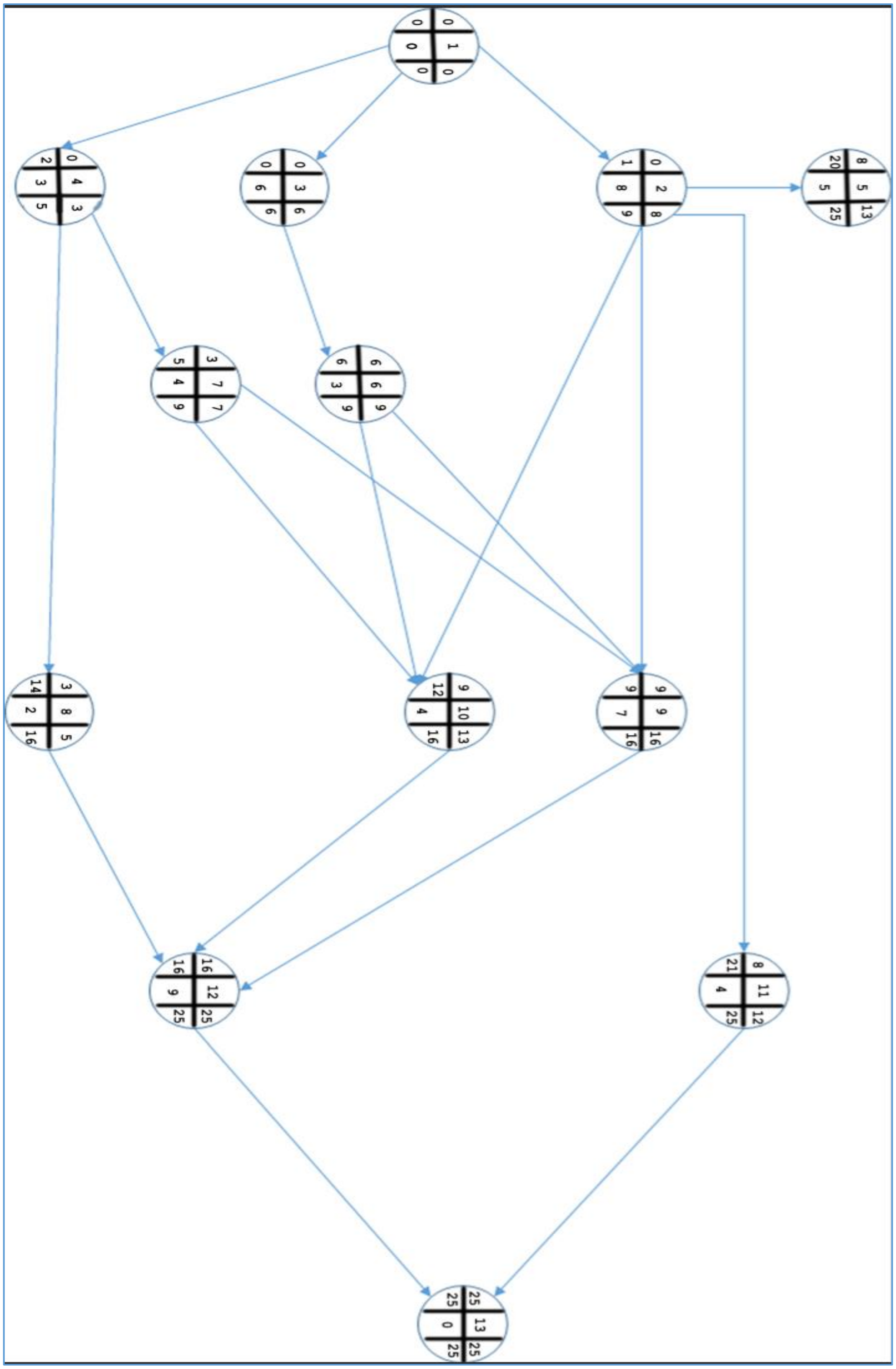

Exhibit 10 (Activity's Slack Times)

Activity	Latest start time - Earliest Start time	Slack value
1	$0-0$	0
2	$9-8$	1
3	$6-6$	0
4	$5-3$	2
5	$25-13$	12
6	$9-9$	0
7	$9-7$	2
8	$16-5$	11
9	$16-16$	0
10	$16-13$	3
11	$25-12$	13
12	$25-25$	0
13	$0-0$	0