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RESEARCH ARTICLE

FORECASTING IMPORT DATA USING NON-LINEAR MODEL.

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Abstract

When Malaysia government implemented GST in 2015, it raised the import of Malaysia as GST minimized the production of local goods and drove up costs. But, too many imports in relation to exports can distort a nation's balance of trade and devalue its currency. In order to lower the possibility of the increasing imports, it is important to determine the future import value in advance. If the future import is forecasted, then action can be taken to reduce the consequence effects of the high imports. In this study, we predict the future import value using five empirical models of least square method: Linear model, Logarithmic model, Power model, Exponential model and Polynomial model. The method has shown that Quadratic model is the best fitted model for Malaysia import data.

Introduction:-

Import is to bring in (merchandise, commodities, workers, etc.) from a foreign country for use, sale, processing, re-export, or services. (dictionary.com, 2017). Imports help in the growth of any country's economy and expand the global market. It is important for businesses and individual consumer as goods or services that are not available domestically or are available cheaper overseas to be imported into the country. Imports can provide a better standard of living for the people by supplying products or services which could not be obtained in a country.

As imports and exports form the backbone of international trade, a higher value of imports compared to the value of exports could impact the balance of trade in the country negatively. A country would like to be net exporters rather than net importers. They will want more exports than imports because more money will be coming into the country than the amount that is leaving through import.

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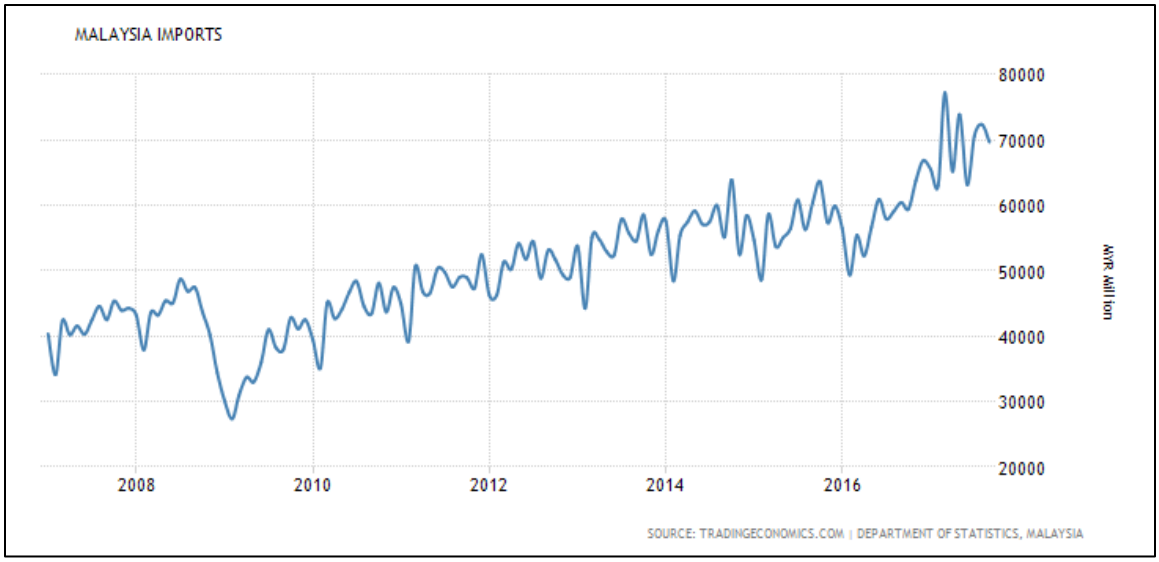

Figure 1:-Malaysia's Imports in past ten years

The import of Malaysia is always in upward trend after 2009. In February of 2009, there is a significant decrease of the import of Malaysia. Based on the publications of economic development 2009, one of the reasons led to such situation is cautious of the consumers in their spending on imported consumer durables and semi-durables. In March of 2017, import of Malaysia reached the highest record. More intermediate goods and imports of transport equipment and capital which were driven mostly by high-value items such as a floating structure, oil and gas vessels and several aircrafts has raised the imports of Malaysia to the peak. (Developments in the malaysian economy, 2017)

Import could indirectly contribute to economic growth and economic growth could also directly contribute to import. (Kogid, 2011) Low level of import shows that low domestic demand and shrinking economy. If exports are surging, but imports have decreased significantly, it may show that the domestic economy is worse than the rest of the world.

GST is an attractive method to get rid of deformation of the existing process of multiple taxation also government has promised that GST will reduce the compliance burden at present. In India, there is no distinction between imported and Indian goods andthe tax is maintained at the same rate (Kour, 2016). If this is the situation, then the import goods will likely to be decreased. Thus, this might be the reason of the falling imports.

Additionally, other factors such as domestic income and money supply might influence imports. According to the Keynesian approach, the real exchange rate affects the allocation of global expenditure between exports and imports, which not only affects the trade balance, but also adjusts inflationary situation and controls the real income in an economy (Dornbusch et al., 1976). When the real exchange rate and the national income starts to deteriorate, the allocation of expenditure on foreign goods will decrease, this causes imports to drop as well.

However, the exchange rate misalignment which were overvalued in the pre-crisis and undervalued in the crisis period found to have a significant positive impact on imports demand (Naseem et al., 2009). The exchange rate misalignment induce the growth of imports during pre-crisis and crisis period. Ghorbani and Motallebi (2009) studied and concluded that the import demand in Iran is elastic related to increasing of gross domestic income. Therefore it can be assumed that import demand decrease with the drop of gross domestic income. The demand for imports are affected by the divergence and instability in the exchange rate misalignment and volatility.

Since early 1970s, the Malaysia government carried out an import substitution strategy with the introduction of the Pioneer Industry Ordinance (1958) by promoting the foreign direct investment (FDI) in export-oriented firms. Foreign direct investment in export-oriented firms was promoted actively through the introduction of the Investment Incentives Act (1968), Free Trade Zone Act (1971), and the Promotion of Incentives Act (1986) (Yusof and

Bhattasali, 2008). Through success implementation of the strategy by the government, the usage on local goods increases, thus might causes demands of imports to decrease.

Trade happens when one country does not have one kind of resources while another country has it. Import and export are important for development of industrialized world. However, if a country imports more than it exports, there will be trade deficit. Most of the countries prefer to import less and export more.

When Malaysia government implemented GST in 2015, it raised the import of Malaysia as GST minimized the production of local goods and drove up costs. But, too many imports in relation to exports can distort a nation's balance of trade and devalue its currency. Malaysian will be suffered due to lower purchasing power and some industries lost from weakening ringgit. (Khoo, 2015)

In order to lower the possibility of the increasing imports, it is important to determine the future import value in advance. If the future import of Malaysia is forecasted, then action can be taken to reduce the consequence effects of the high imports of Malaysia. Domestic markets and national economies will not be eroded. Currency of Ringgit Malaysia will not be devalued too. Unemployment rate can be decreased because domestic markets need more workers in production instead of import from foreign countries to meet the local demand. Thus, in this study, several mathematical models will be developed and used to forecast the future import of Malaysia. Government can then take actions such as increase local production in order to meet local demand to prevent the bad consequences of either high or low imports.

Method:-

In order to achieve the objectives of this study, the monthly import data in Malaysia from August year 2007 to July year 2017 was used as the input. This data was obtained and gathered through secondary source from the Official Portal of Department of Statistics Malaysia. In this study, quantitative data analysis tool based on least square method will be used such as Microsoft Excel 2010 for data computation and an evaluation tool.

Five empirical models will be generated to obtain least square models; which includes linear model, logarithmic model, exponential model, power model and polynomial model. The models were computed to achieve the second objective through the formulation of the function in Microsoft Excel 2010. Following that, the model with the highest r^2(coefficient of determination) value will be selected as the best fitted least square model.Next, the best fitted model will be used to forecast the import data.

Results and Findings:-

In this study, the import monthly data in Malaysia from August of year 2007 to July of year 2017 were used. Data was collected from the Department of Statistics Malaysia. The data obtained is shown in the following table:

x	y		x	y		x	y		x	y		x	y
1	44.6		25	38.3		49	47.5		73	55.8		97	56.3
2	42.5		26	38.0		50	49.0		74	54.6		98	60.5
3	45.4		27	42.8		51	48.9		75	58.6		99	63.6
4	43.9		28	41.1		52	47.4		76	52.5		100	57.4
5	44.3		29	42.5		53	52.5		77	56.1		101	59.9
6	43.2		30	39.4		54	46.3		78	57.6		102	56.5
7	37.9		31	35.1		55	46.3		79	48.5		103	49.4
8	43.6		32	45.1		56	51.3		80	55.4		104	55.4
9	43.2		33	42.7		57	50.2		81	57.5		105	52.3
10	45.4		34	44.1		58	54.2		82	59.2		106	56.7
11	45.1		35	46.7		59	51.8		83	57.1		107	60.9
12	48.7		36	48.4		60	54.5		84	57.5		108	57.9
13	46.9		37	44.5		61	48.9		85	60.0		109	59.1
14	47.4		38	43.5		62	53.1		86	55.2		110	60.5
15	43.7		39	48.1		63	51.7		87	63.9		111	59.4
16	40.2		40	43.7		64	49.4		88	52.6		112	63.8
17	34.4		41	47.5		65	49.0		89	58.5		113	66.8

18	30.1		42	44.9		66	53.7		90	54.6		114	65.5
19	27.4		43	39.2		67	44.3		91	48.6		115	63.1
20	30.9		44	50.6		68	55.1		92	58.6		116	77.2
21	33.7		45	46.8		69	54.8		93	53.7		117	65.2
22	33.0		46	46.6		70	52.9		94	55.1		118	73.9
23	36.0		47	50.3		71	52.4		95	56.5		119	63.2
24	41.0		48	49.8		72	57.9		96	60.8		120	70.6

Table 1:-The Malaysia's Monthly Import Data from August 2007 to July 2017

Least Square Model:-

In order to predict the future import value, a model needs to be determined. To find the best model to fit our data, five types of empirical models were used:Linear Function, Logarithmic Function, Power Function, Exponential Function and Polynomial Function

The models above were visualized using the Trendline function in Ms Excel and shownas below:

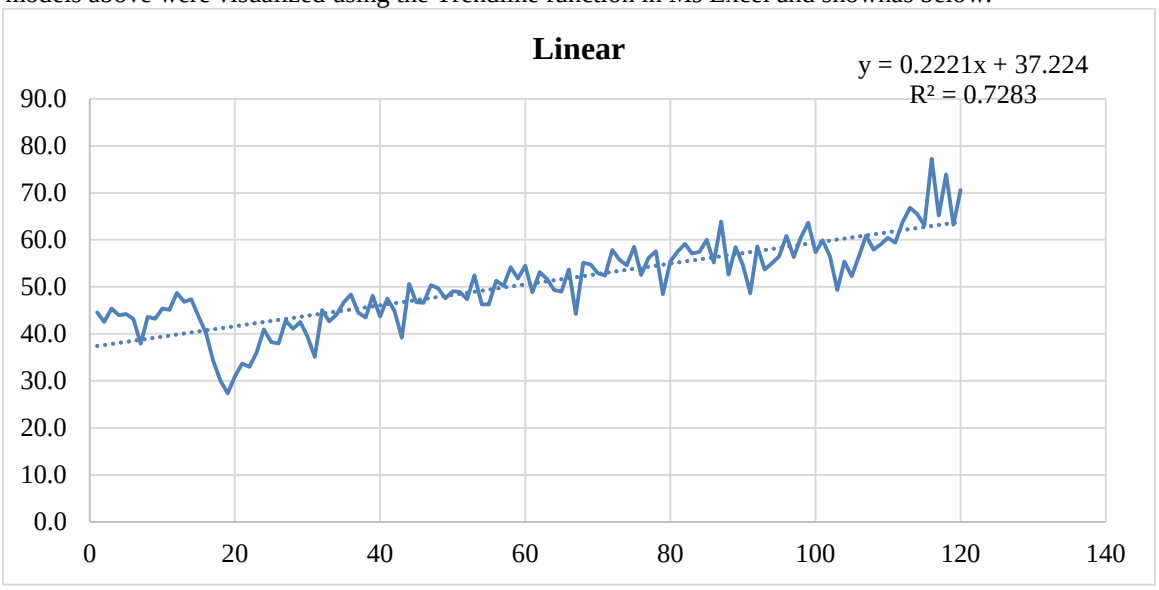

Figure 2:-Linear Model of the Monthly Import Data from August 2007 to July 2017

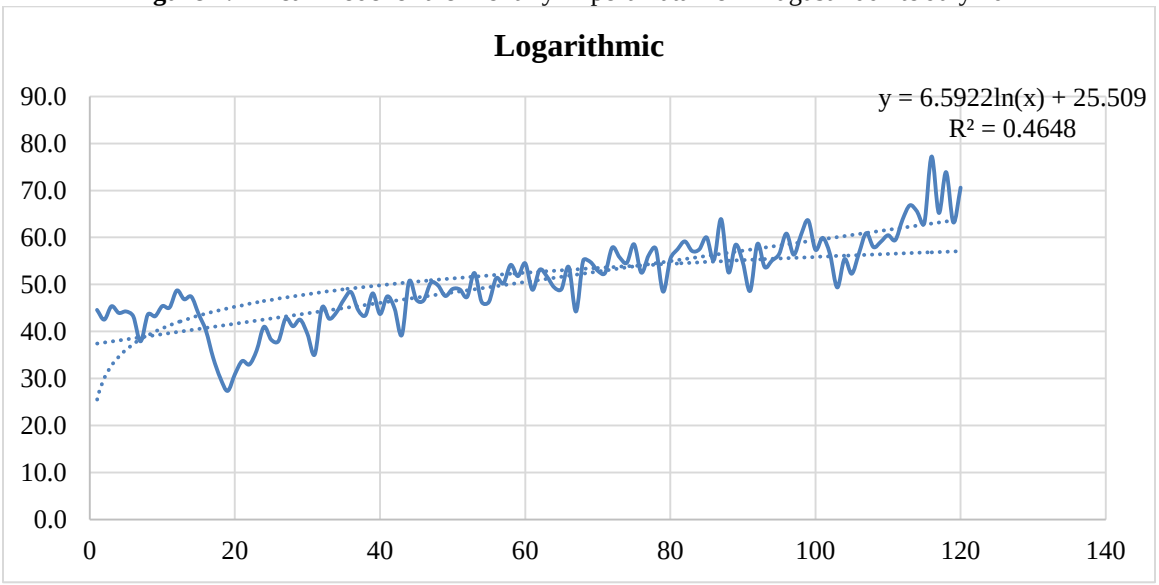

Figure 3:-Logarithmic Model of the Monthly Import Data from August 2007 to July 2017

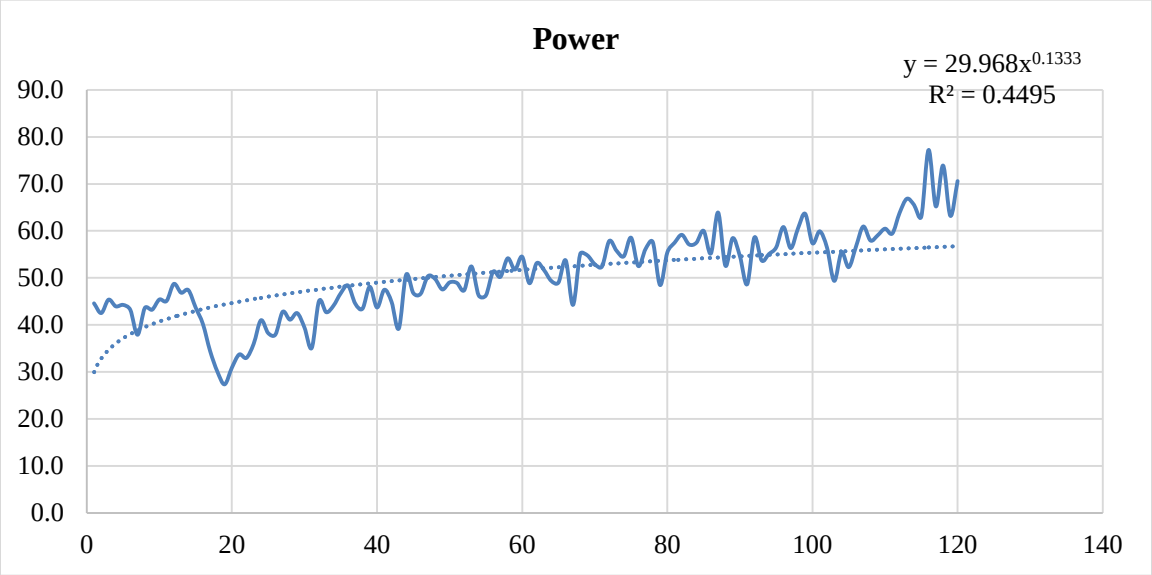

Figure 4:-Power Model of the Monthly Import Data from August 2007 to July 2017

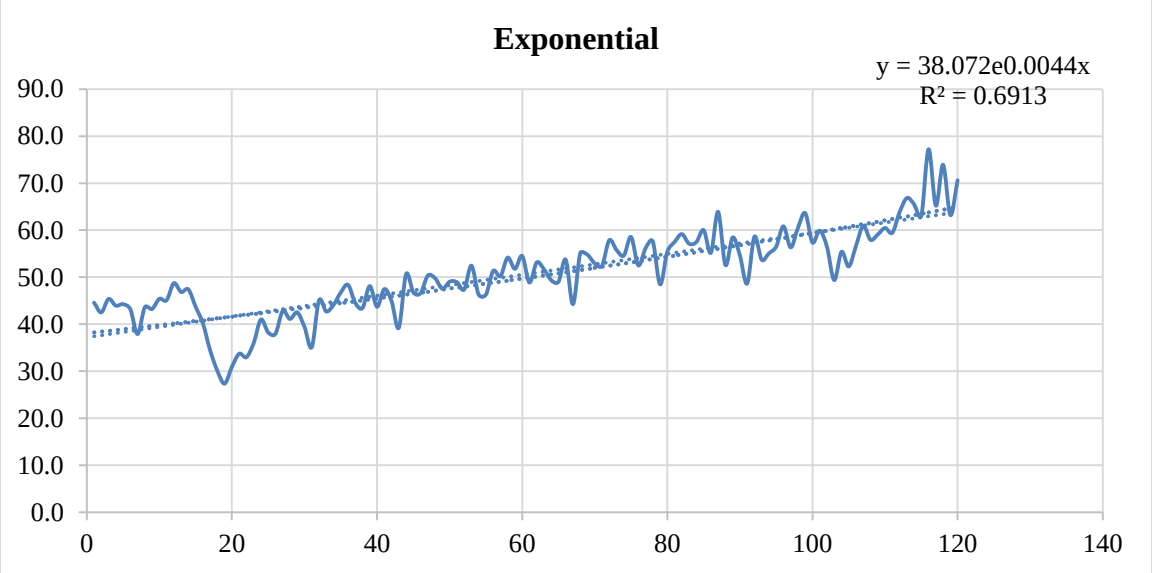

Figure 5:-Exponential Model of the Monthly Import Data from August 2007 to July 2017

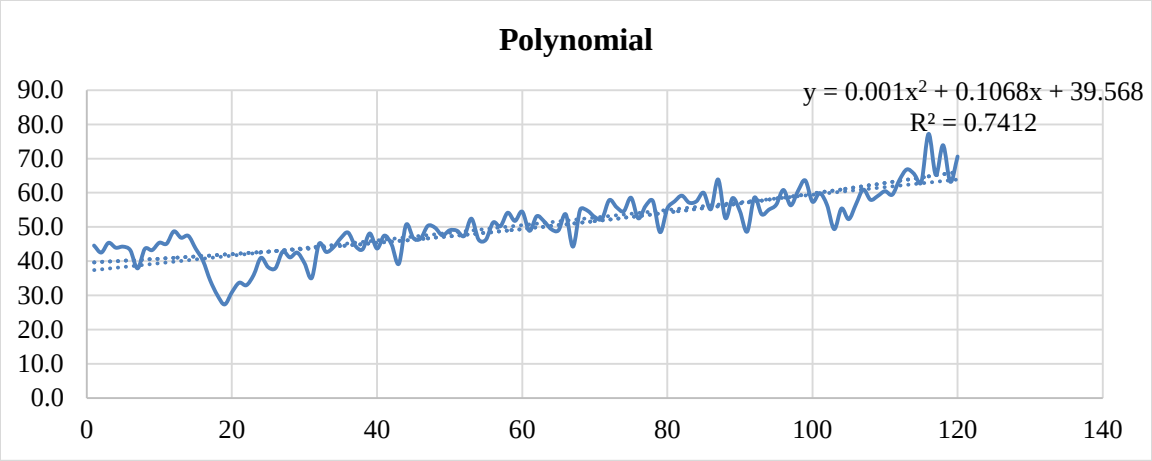

Figure 6:-Polynomial Model of the Monthly Import Data from August 2007 to July 2017

By comparing their coefficient of determination,r^2, the highest r^2 value will be chosen as the best fitted model for this data set.

Empirical Model	r^2
Linear	0.7283
Logarithm	0.4648
Power	0.4495
Exponential	0.6913
Polynomial	0.7412

Table 2:-The coefficient of determination values of the five empirical models.
Note: The highlighted value is the highest value.

From the result above, the polynomial function will be the best fitted model to represent the respective import data and can be used to predict the future value.

The idea behind this method is minimizing the sum of the absolute deviations, Given a set of data (x_i, y_i) = i = 1, 2, …, m and the estimated model y = f (x). Let $e_i = |y_i - f(x_i)|$, which is absolute that denote the deviation between the observed and predicted values. The $\sum_{i=1}^{m} e_i$ is the sum of absolute deviations. Therefore minimize $\sum_{i=1}^{m} e_i$ would give f(x) the best fitted model for the respective data.

From a graphical analysis, a quadratic polynomial function has been chosen as the best fitted model for the import data. Therefore the analytical model proposed is given as:

$$Q = \sum_{i=1}^{m}(y_i - (c_1 x_i^2 + c_2 x_i + c_3)^2)$$

With a necessary condition given by

$$\frac{\partial Q}{\partial C_1} = \frac{\partial Q}{\partial C_2} = \frac{\partial Q}{\partial C_3} = 0$$

Thus

$C_1(\sum x_i^2) + C_2(\sum x_i) + C_3(\sum m) = \sum y_i$
$C_1(\sum x_i^3) + C_2(\sum x_i^2) + C_3(\sum x_i) = \sum x_i y_i$
$C_1(\sum x_i^4) + C_2(\sum x_i^3) + C_3(\sum x_i^2) = \sum x_i^2 y$

Solving the required systems of equities for the least-square quadratic fit give the following equation with the obtained solution of C1.

$C_1 = 0.001$, $C_2 = 0.1068$, $C_3 = 39.568$
$f(x) = 0.001x^2 + 0.1068x + 39.568$

Least Square Model has featured the quadratic equation as best fitted model for the import data as shown in Figure 6.

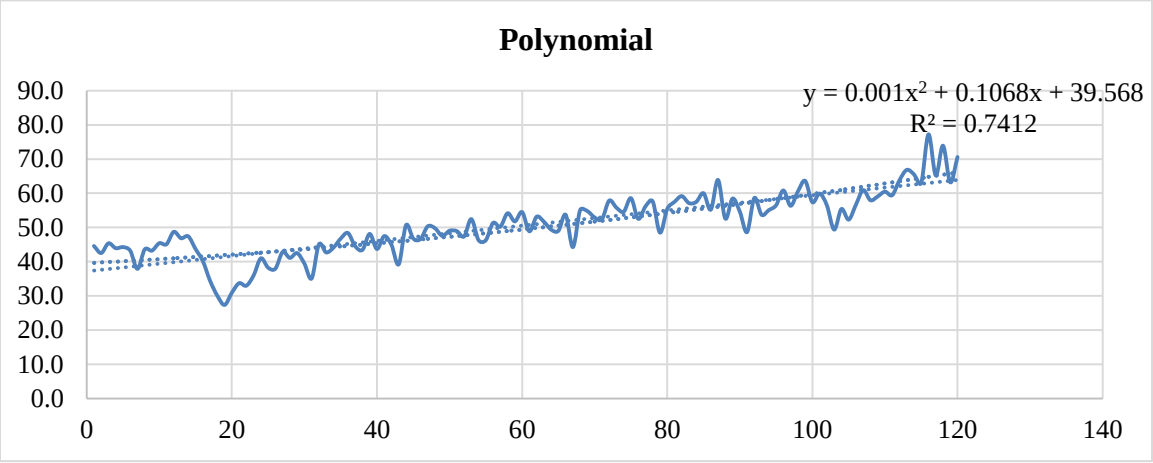

Figure 7:-Polynomial Model of the Monthly Import Data from August 2007 to July 2017

Data Projection:-
Graph below shows the combination line graphs of actual value and predicted value by least square model.

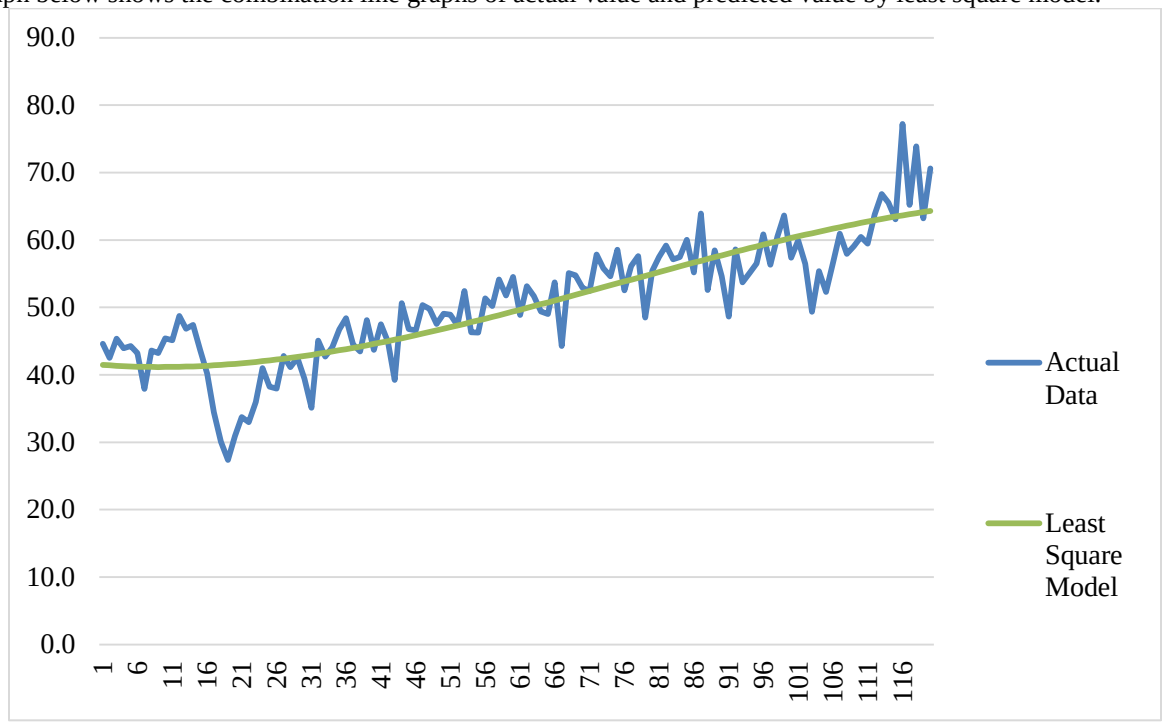

Figure 8:-The Actual Value and Predicted Value

The Appendix B shows the actual value, and predicted value using least square model for data obtained from August 2007 until July 2017. The results have been compared with the results obtained using Discrete Dynamical System modelling technique. Based on the results in Appendix B, the predicted future import data shows an increasing trend.

Since the comparative results shows that the least square model is the best fitted model for the respective data, therefore it is used to forecast the import value from August 2017 until July 2018.
Table below shows the forecasted value from August 2017 until July 2018.

Year	Month	x	Forecasted Value
2017	August	121	62.925
	September	122	63.1683
	October	123	63.414
	November	124	63.6621
	December	125	63.9127
2018	January	126	64.1657
	February	127	64.4213
	March	128	64.6794
	April	129	64.9401
	May	130	65.2035
	June	131	65.4695
	July	132	65.7382

Table 3:-The forecasted import value from August 2017 to July 2018

Based on the forecasted value computed, it shows that import Malaysia will increase to the predicted numbers on the next following years.

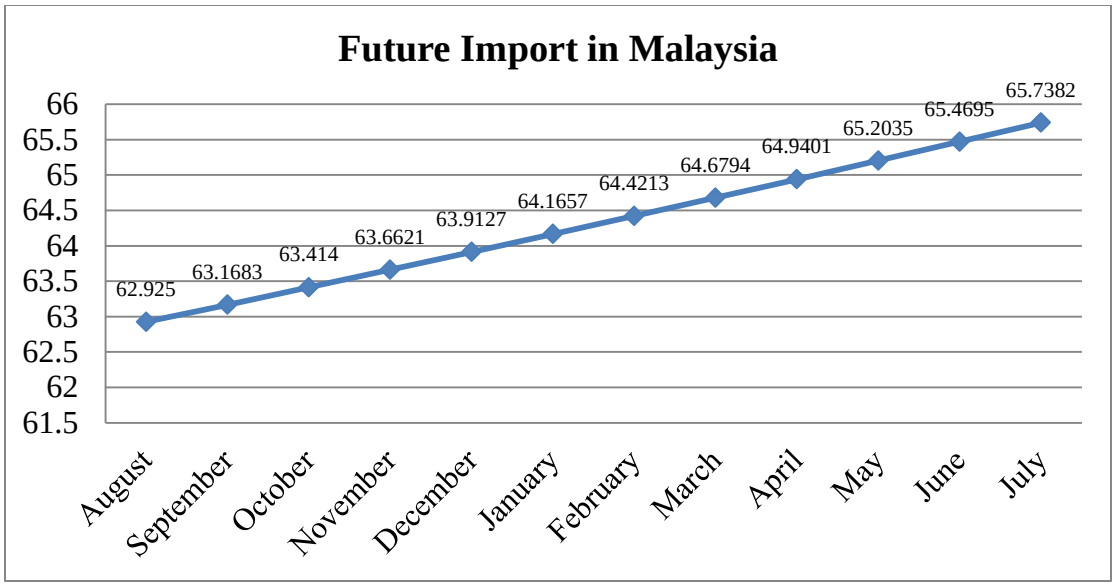

Figure 9:-The Forecasted Import Value from August 2017 to July 2018

Conclusion:-

Among the five different types of empirical model which are linear model, logarithmic model, exponential model, power model and polynomial model, the polynomial model provides the largest coefficient of determination, r^2 value. This implied that the polynomial model is the most significant model among the others. Later, different order of polynomial were tested in order to determine the best fitted model for Malaysia's monthly import data. Based on the results, a polynomial of order three has shown the smallest error compared to other polynomials. Hence, the best fitted least square model was determined by computing the coefficient of the cubic equation.Lastly, by using the cubic polynomial least square model, the future import value was calculated which shows an increasing trend from August 2017 until July 2018. This results may help the authority to plan an action or policy for controlling the import in order to improve the national economy.

Bibliography:-

1. *Import Of Vegetables, Fruits To Be Reduced By 2020*. (2014, Marcg 21). Retrieved November 5, 2017, from MalaysianDigest.Com: http://malaysiandigest.com/news/493921-import-of-vegetables-fruits-to-be-reduced-by-2020.html
2. *Malaysian-grown fragrant rice to help reduce imports*. (2016, December 3). Retrieved November 5, 2017, from The Rakyat Post: http://www.therakyatpost.com/business/2016/12/03/malaysian-grown-fragrant-rice-to-help-reduce-imports/
3. *Developments in the malaysian economy*. (2017). Retrieved November 5, 2017, from Bank Negara Malaysia: https://www.bnm.gov.my/files/publication/qb/2017/Q1/p3.pdf
4. *Interesting Facts About Imports and Exports*. (2017, May 1). Retrieved November 7, 2017, from Investopedia: http://www.investopedia.com/articles/investing/100813/interesting-facts-about-imports-and-exports.asp
5. *S&P expects Malaysia's economy to grow over 4% up to 2020*. (2017, June 22). Retrieved November 6, 2017, from The Star Online: https://www.thestar.com.my/business/business-news/2017/06/22/sp-expects-malaysia-economy-to-grow-over-4pct-up-to-2020/
6. *The World Bank In Malaysia*. (2017, September). Retrieved November 6, 2017 , from The World Bank: http://www.worldbank.org/en/country/malaysia/overview
7. Amadeo, K. (2017, July 1). *The 2008 Financial Crisis*. Retrieved November 6, 2017, from The Balance: https://www.thebalance.com/2008-financial-crisis-3305679
8. A. Jayakumar, K. (2014). Impact of Foreign Direct Investment, Imports and Exports. *International Review of Research in Emerging Markets and the Global Economy (IRREM)*, 51-58.
9. *Import*. (n.d.). Retrieved November 15, 2017, from Investopedia: https://www.investopedia.com/terms/i/import.asp
10. *Import*. (n.d.). Retrieved November 1, 2017, from Dictionary.com: http://www.dictionary.com/browse/import

11. *Importing and Exporting in a Global Market: Definition, Process & Importance*. (n.d.). Retrieved November 15, 2017, from Study.com: http://study.com/academy/lesson/importing-and-exporting-in-a-global-market.html
12. Khoo, D. (2015, June 13). *Impact of weakening ringgit*. Retrieved November 6, 2017, from The Star Online: The star online: https://www.thestar.com.my/business/business-news/2015/06/13/impact-of-weakening-ringgit/
13. Kogid, M. M. (2011). Does Import Affect Economic Growth in Malaysia. *Research Gate*, 298-307.
14. Kour, M. C. (2016). A STUDY ON IMPACT OF GST AFTER ITS IMPLEMENTATION. *Kour, M. C. (2016). A STUDY ON IMPACT OF GSInternational Journal of Innovative Studies in Sociology and Humanities*, 17-24.
15. Lewis, L. M. (2016). Causes of the Global Trade Slowdown. *International Finance Discussion Paper Note*, 1-17.
16. Naseem, N. A.-B. (2009). Exchange Rate Misalignment, Volatility and Import Flows in Malaysia. *Journal of Economics and Management*, 130-150.
17. Nykamp, D. Q. (n.d.). *An Introduction to discrete dynamical system*. Retrieved November 15, 2017, from Main Insight: http://mathinsight.org/discrete_dynamical_system_introduction
18. Nykamp, D. Q. (n.d.). *Discrete dynamical system definition*. Retrieved November 15, 2017, from Math Insight: http://mathinsight.org/definition/discrete_dynamical_system
19. Ruban, A. (2016, May 25). *Why Malaysia imports vegetables.* Retrieved November 5, 2017, from Malaymail Online: http://www.themalaymailonline.com/malaysia/article/why-malaysia-imports-vegetables#X4iKT2PtgiOWvfD1.97
20. Shagar, L. K. (2013, November 11). *All set for Visit Malaysia 2014*. Retrieved November 6, 2017, from The Start Online: https://www.thestar.com.my/news/nation/2013/11/11/visit-malaysia-2014/

Appendix A:-Calculation of the value of carrying capacity (k)

Year	Month	n	P_n	ΔP_n	$(Max - P_n)(P_n)$	$\frac{\Delta P_n}{(Max - P_n)(}$		Year	Month	n	P_n	ΔP_n	$(Max - P_n)(P_n$	$\frac{\Delta P_n}{(Max - P_n)(}$
2007	Aug	0	44.6	-2.1	1455.2	-0.00141572106159		2012	Aug	60	48.9	4.3	1385.7	0.00308240305961
	Sept	1	42.5	2.8	1475.6	0.00192731939880			Sept	61	53.1	-1.5	1279.8	-0.00113803667380
	Oct	2	45.4	-1.4	1445.2	-0.00098664511556			Oct	62	51.7	-2.3	1320.0	-0.00174903727318
	Nov	3	43.9	0.3	1462.4	0.00021542831856			Nov	63	49.4	-0.4	1375.0	-0.00025810181398
	Dec	4	44.3	-1.1	1459.0	-0.00072269544286			Dec	64	49.0	4.7	1382.5	0.00340091655450
2008	Jan	5	43.2	-5.3	1469.8	-0.00361037482643		2013	Jan	65	53.7	-9.5	1262.5	-0.00750064428854
	Feb	6	37.9	5.7	1490.4	0.00383118556582			Feb	66	44.3	10.9	1459.1	0.00744082471295
	Mar	7	43.6	-0.4	1465.9	-0.00026077709669			Mar	67	55.1	-0.3	1218.7	-0.00027919943222
	Apr	8	43.2	2.2	1469.6	0.00147863513185			Apr	68	54.8	-1.8	1229.8	-0.00150330637832
	May	9	45.4	-0.3	1444.8	-0.00020881377556			May	69	52.9	-0.5	1286.1	-0.00038819700415
	June	10	45.1	3.6	1448.8	0.00250241430240			June	70	52.4	5.4	1300.2	0.00418464859818

	July	11	48.7	-1.9	1388.6	-0.00134729514021			July	71	57.9	-2.1	1120.3	-0.00185238697848
	Aug	12	46.9	0.5	1422.9	0.00038234397544			Aug	72	55.8	-1.2	1195.9	-0.00099468016984
	Sept	13	47.4	-3.7	1413.7	-0.00261171479148			Sept	73	54.6	4.0	1235.3	0.00320759140545
	Oct	14	43.7	-3.5	1464.9	-0.00238690465287			Oct	74	58.6	-6.0	1092.9	-0.00552470218554
	Nov	15	40.2	-5.8	1488.4	-0.00387986215464			Nov	75	52.5	3.6	1297.4	0.00279501439729
	Dec	16	34.4	-4.4	1473.5	-0.00296359129851			Dec	76	56.1	1.5	1183.3	0.00123356997546
2009	Jan	17	30.1	-2.7	1417.9	-0.00190992939593		2014	Jan	77	57.6	-9.1	1130.0	-0.00808088618616
	Feb	18	27.4	3.5	1364.3	0.00259980195158			Feb	78	48.5	7.0	1393.6	0.00498746942283
	Mar	19	30.9	2.8	1431.6	0.00196010763704			Mar	79	55.4	2.1	1208.1	0.00170505966650
	Apr	20	33.7	-0.7	1466.9	-0.00049026363547			Apr	80	57.5	1.7	1134.6	0.00147581162396
	May	21	33.0	3.0	1459.4	0.00204493820901			May	81	59.2	-2.0	1068.6	-0.00191135688750
	June	22	36.0	5.0	1484.0	0.00337492027151			June	82	57.1	0.4	1148.4	0.00031015762898
	July	23	41.0	-2.7	1485.3	-0.00184063114769			July	83	57.5	2.5	1135.1	0.00224062260676
2009	Aug	24	38.3	-0.3	1490.8	-0.00019809546651		2014	Aug	84	60.0	-4.8	1032.6	-0.00467371129026
	Sept	25	38.0	4.8	1490.5	0.00324972755056			Sept	85	55.2	8.7	1216.0	0.00716309035016
	Oct	26	42.8	-1.7	1473.3	-0.00114553602910			Oct	86	63.9	-11.3	851.3	-0.01327980890029
	Nov	27	41.1	1.4	1484.6	0.00094106371190			Nov	87	52.6	5.9	1295.3	0.00452263847435
	Dec	28	42.5	-3.1	1475.7	-0.00207823231862			Dec	88	58.5	-3.8	1097.1	-0.00347820017204
2010	Jan	29	39.4	-4.3	1490.2	-0.00291304764822		2015	Jan	89	54.6	-6.0	1234.0	-0.00486012625546
	Feb	30	35.1	10.0	1478.6	0.00673381040375			Feb	90	48.6	10.0	1390.3	0.00716628254003
	Mar	3	45	-	1449.3	-			Mar	9	58	-	1091.1	-

		1	.1	2.4		0.00162467806772				1	.6	4.9		0.00449021899108
	Apr	32	42.7	1.4	1474.1	0.00094087133145			Apr	92	53.7	1.4	1263.0	0.00108403104834
	May	33	44.1	2.6	1460.9	0.00181390770835			May	93	55.1	1.4	1219.8	0.00116578764306
	June	34	46.7	1.6	1424.8	0.00115274659522			June	94	56.5	4.3	1171.0	0.00369894913759
	July	35	48.4	-3.9	1395.4	-0.00276857437785			July	95	60.8	-4.5	997.3	-0.00450997792190
	Aug	36	44.5	-1.1	1456.0	-0.00072818113074			Aug	96	56.3	4.2	1176.9	0.00354379818847
	Sept	37	43.5	4.7	1467.4	0.00317614863461			Sept	97	60.5	3.1	1011.7	0.00309620791023
	Oct	38	48.1	-4.4	1400.5	-0.00315866645068			Oct	98	63.6	-6.3	864.7	-0.00722861401261
	Nov	39	43.7	3.8	1465.0	0.00257798492266			Nov	99	57.4	2.5	1138.5	0.00222262336921
	Dec	40	47.5	-2.6	1412.3	-0.00182151597267			Dec	100	59.9	-3.5	1037.1	-0.00333175072013
2011	Jan	41	44.9	-5.7	1451.3	-0.00390776591422		2016	Jan	101	56.5	-7.1	1172.4	-0.00604922331750
	Feb	42	39.2	11.4	1490.5	0.00765666242794			Feb	102	49.4	6.0	1375.2	0.00438141027673
	Mar	43	50.6	-3.9	1346.1	-0.00287283324519			Mar	103	55.4	-3.1	1209.3	-0.00256481846298
	Apr	44	46.8	-0.2	1424.2	-0.00012196129451			Apr	104	52.3	4.4	1303.8	0.00335040024089
	May	45	46.6	3.7	1427.0	0.00261839621678			May	105	56.7	4.3	1165.2	0.00366622636142
	June	46	50.3	-0.6	1353.4	-0.00041363306262			June	106	60.9	-3.0	992.7	-0.00301104460668
	July	47	49.8	-2.2	1366.2	-0.00163353319691			July	107	57.9	1.1	1117.2	0.00101063571009
	Aug	48	47.5	1.5	1411.0	0.00105886856649			Aug	108	59.1	1.4	1072.3	0.00130533474154
	Sept	49	49.0	-0.1	1382.1	-0.00007483661962			Sept	109	60.5	-1.0	1013.1	-0.00101929124669
	Oct	50	48.9	-1.6	1384.3	-0.00114298274668			Oct	110	59.4	4.4	1057.2	0.00412298145804
	Nov	5	47	5.	1414.4	0.003601054			Nov	1	63	3.	856.6	0.00354422

		1	.4	1		89203				11	.8	0		603793
	Dec	52	52.5	-6.2	1299.4	-0.00473432127875			Dec	112	66.8	-1.3	694.5	-0.00187773225703
2012	Jan	53	46.3	0.0	1431.8	-0.00001275524025		2017	Jan	113	65.5	-2.5	766.4	-0.00322118965442
	Feb	54	46.3	5.1	1432.1	0.00352650674202			Feb	114	63.1	14.2	893.2	0.01585765590939
	Mar	55	51.3	-1.1	1329.1	-0.00083407764642			Mar	115	77.2	-12.0	0.0	-
	Apr	56	50.2	3.9	1356.1	0.00290813612727			Apr	116	65.2	8.7	783.3	0.01109676377313
	May	57	54.2	-2.4	1249.0	-0.00191841068989			May	117	73.9	-10.7	245.3	-0.04364126532600
	June	58	51.8	2.7	1317.8	0.00207450550424			June	118	63.2	7.4	886.4	0.00834878372031
	July	59	54.5	-5.6	1238.4	-0.00454849435200			July	119	70.6	-	467.7	-
													Approximate Constant, k =	**-0.00009275811907**

Appendix B:-The actual data and predicted data.

x	Actual Value	Predicted Value			x	Actual Value	Predicted Value			x	Actual Value	Predicted Value	
		Logistics Growth Model	Least Square Model				Logistics Growth Model	Least Square Model				Logistics Growth Model	Least Square Model
0	44.59087	44.5909	41.4718		21	32.99622	41.7296	41.8085		42	39.23256	38.8327	45.2127
1	42.53076	44.4559	41.4003		22	35.98054	41.5922	41.9107		43	50.64502	38.6944	45.4306
2	45.37463	44.3208	41.3384		23	40.98887	41.4547	42.0197		44	46.77782	38.5561	45.6526
3	43.94875	44.1855	41.286		24	38.25505	41.3172	42.1354		45	46.60412	38.4178	45.8786
4	44.26380	44.0501	41.2429		25	37.95973	41.1796	42.2576		46	50.34068	38.2795	46.1083
5	43.20940	43.9145	41.209		26	42.80340	41.0419	42.3863		47	49.78089	38.1412	46.3417
6	37.90296	43.7788	41.1841		27	41.11563	40.9042	42.5213		48	47.54920	38.003	46.5787
7	43.61298	43.643	41.1682		28	42.51278	40.7663	42.6624		49	49.04331	37.8647	46.8191
8	43.23071	43.5071	41.1611		29	39.44593	40.6285	42.8096		50	48.93988	37.7265	47.0628

9	45.40368	43.371	41.1626		30	35.10486	40.4906	42.9627		51	47.35770	37.5882	47.3096
10	45.10199	43.2348	41.1726		31	45.06153	40.3526	43.1216		52	52.45114	37.45	47.5594
11	48.72748	43.0985	41.1911		32	42.70686	40.2146	43.2861		53	46.29937	37.3119	47.8121
12	46.85663	42.9621	41.2178		33	44.09384	40.0765	43.4561		54	46.28111	37.1737	48.0676
13	47.40069	42.8255	41.2526		34	46.74371	39.9384	43.6315		55	51.33142	37.0356	48.3257
14	43.70857	42.6889	41.2955		35	48.38614	39.8003	43.8121		56	50.22282	36.8976	48.5863
15	40.21190	42.5521	41.3462		36	44.52291	39.6621	43.9979		57	54.16656	36.7595	48.8493
16	34.43730	42.4153	41.4046		37	43.46270	39.5239	44.1887		58	51.77051	36.6216	49.1145
17	30.07050	42.2783	41.4707		38	48.12333	39.3857	44.3843		59	54.50424	36.4836	49.3818
18	27.36232	42.1413	41.5443		39	43.69977	39.2475	44.5846		60	48.87158	36.3458	49.6511
19	30.90936	42.0041	41.6252		40	47.47659	39.1092	44.7896		61	53.14273	36.2079	49.9222
20	33.71540	41.8669	41.7133		41	44.90400	38.971	44.999		62	51.68630	36.0702	50.195

x	Actual Value	Predicted Value			x	Actual Value	Predicted Value			x	Actual Value	Predicted Value	
		Logistics Growth Model	Least Square Model				Logistics Growth Model	Least Square Model				Logistics Growth Model	Least Square Model
63	49.37760	35.9325	50.4694		86	63.90366	32.7909	56.9144		109	60.47162	29.7253	62.5284
64	49.02271	35.7949	50.7453		87	52.59910	32.6557	57.1873		110	59.43899	29.5944	62.729
65	53.72459	35.6573	51.0225		88	58.45719	32.5207	57.4585		111	63.79764	29.4636	62.9248
66	44.25480	35.5198	51.3008		89	54.64129	32.3859	57.7279		112	66.83366	29.3331	63.1158
67	55.11151	35.3824	51.5802		90	48.64397	32.2512	57.9953		113	65.52964	29.2028	63.3019
68	54.77126	35.2451	51.8605		91	58.60709	32.1166	58.2606		114	63.06102	29.0727	63.4828
69	52.92249	35.1079	52.1416		92	53.70772	31.9823	58.5237		115	77.22463	28.9429	63.6584
70	52.42322	34.9707	52.4234		93	55.07689	31.848	58.7844		116	65.21347	28.8132	63.8287
71	57.86397	34.8336	52.7057		94	56.49896	31.714	59.0427		117	73.90545	28.6838	63.9935
72	55.78877	34.6967	52.9884		95	60.83035	31.5801	59.2983		118	63.20000	28.5547	64.1527
73	54.59925	34.5598	53.2714		96	56.33268	31.4464	59.5511		119	70.60000	28.4258	64.3061
7	58.5616	53.81698	53.5545		97	60.50	57.91	59.8					

4	8					338	317	011	
75	52.52355	53.97939	53.8376		98	63.63579	58.11007	60.0481	
76	56.14977	54.14311	54.1205		99	57.38493	58.30870	60.2919	
77	57.60951	34.0133	54.4033		100	59.91539	30.9134	60.5325	
78	48.47797	33.877	54.6856		101	56.46007	30.7806	60.7696	
79	55.42841	33.7408	54.9674		102	49.36815	30.648	61.0032	
80	57.48834	33.6047	55.2485		103	55.39357	30.5156	61.2332	
81	59.16281	33.4687	55.5289		104	52.29193	30.3833	61.4593	
82	57.12035	33.3329	55.8084		105	56.66011	30.2513	61.6815	
83	57.47653	33.1972	56.0868		106	60.93195	30.1195	61.8996	
84	60.01975	33.0616	56.364		107	57.94275	29.9879	62.1136	
85	55.19352	32.9262	56.6399		108	59.07188	29.8565	62.3232	