FORECASTING MALAYSIAN AUTOMOTIVE INDUSTRY: THE CASE OF PROTON

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Brief Introduction of Proton

- **Established in May 1983, and entrusted to undertake the "Malaysian National Car" project.**
- **Began to produce the first model, SAGA, in 1985.**
- **Initially the components of the car were entirely manufactured by Mitsubishi, but slowly technologies were transferred to the local plant.**

Shah Alam Plant

- **Land Area : 250 acres**
- **Max : 230,000 cars / Year**

Tanjung Malim Plant

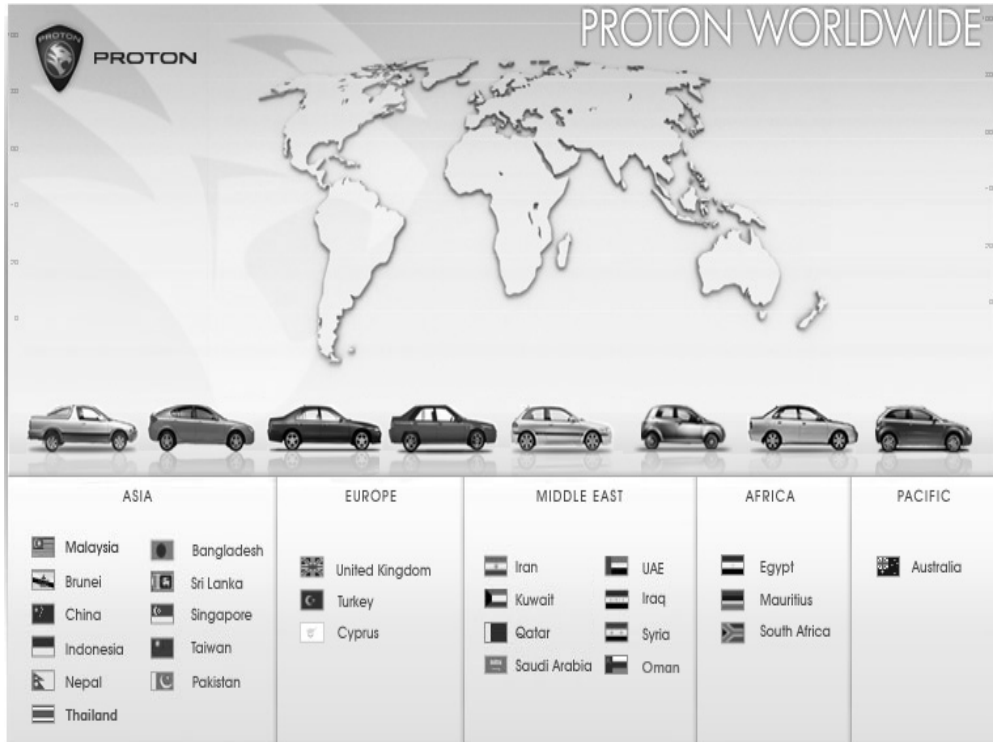
- Land Area : 1,280 acres
- Max : 1 million cars / Year

Weakness & Threat

- Poor quality control and management
- Rise in fuel price
- Tighter credit policies leading to less loans being approved
- Increasing local competitors
- Reduction on taxes for imported cars
- The implementation of AFTA pushed to more market liberalization

Strength and Opportunity

- The largest and most modern automobile manufacturer in Southeast
- Low labor and material cost
- Technique support from Mitsubishi
- Held over 60% of the domestic market share since 2002.
- Cars are exported to the countries in Europe, South Africa, Australia, and Asia



Literature Review

- In European car market, the income tax, oil price, wage and the standard of livings will affect the willingness of people buying a car.
- The fuel price will affect the demand of cars in countries.
- The sharp oil price is one of the external factors having a significant influence on Malaysian inflation in 1973 and 1974

~ Cheng and Tan (2002)

Literature Review

- Rising income leads to higher car ownership.

~ J.M. Dargay (2001)

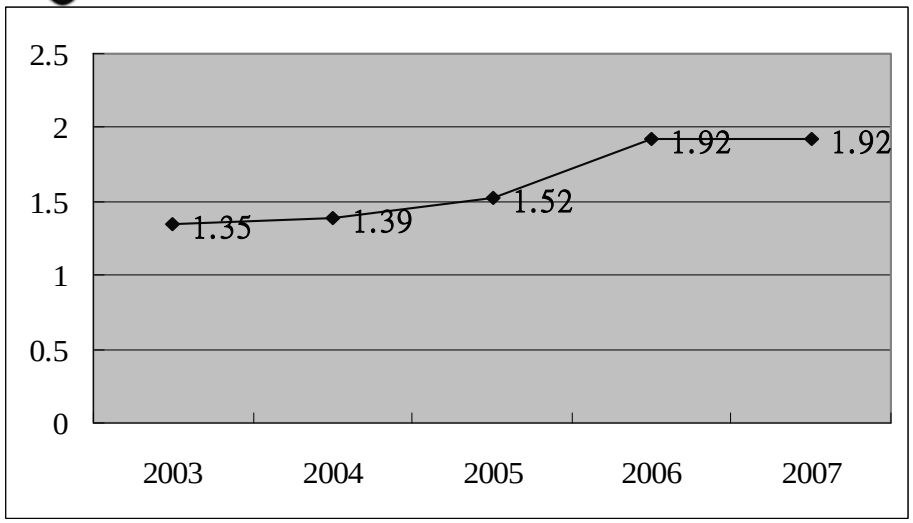
- The effect of price on fuel consumption and on motorists' demand and the demand for owning cars is heavily dependent on income.

~Graham & Glaister (2002)

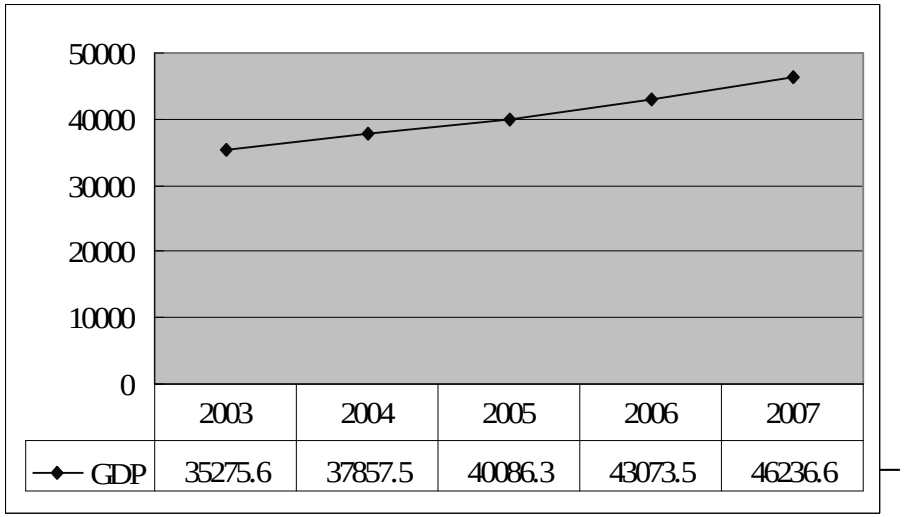
Malaysian Fuel price / GDP / Inflation Rate 2003-2007

Year	Fuel Price	GDP Percapita (Ringgit Malaysia)	Inflation (%)
2003	1.35	35275.6	1.1
2004	1.39	37857.5	1.4
2005	1.52	40086.3	3
2006	1.92	43073.5	3.6
2007	1.92	46236.6	2.7

Malaysian Fuel Price 2003~2007



GDP Per-capita 2003~2007 (Ringgit Malaysia)



Research Objectives

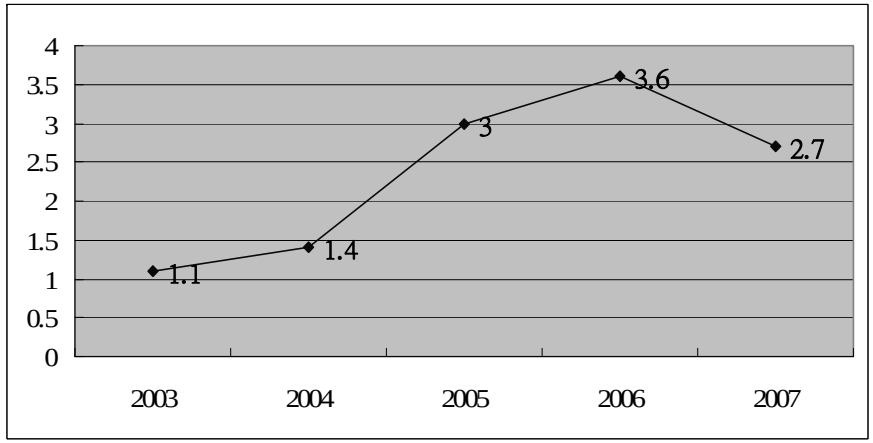
The first objective

To develop and measure the strength of correlation between Proton sales and three variables of fuel price, the GDP Per-capita and inflation rate

The second objective

To answer the transportation problems to Proton distribution channel

Malaysia Inflation Rate 2003~2007



Research Hypotheses

Hypothesis 1:

There is strong correlation between escalations in fuel prices, increase in GDP per-capita and inflation rate with Proton sales volume.

Hypothesis 2:

Increase in GDP per-capita has strong influence on Proton sales volume.

Theoretical framework

Escalation in fuel prices

Increase in income (GDP per-capita)

Changes in Inflation rate

Methodology

Vogel's Approximate Method

The second objective

To answer the transportation problems to Proton distribution channel

Methodology

The first objective

To develop and measure the strength of correlation between Proton sales and three variables of fuel price, the GDP Per-capita and inflation rate

Multiple Regression

Data collection

- **Proton's annual report**
- **Company newsletters**
- **Local literature**

There is strong correlation between fuel prices, GDP per capita and inflation rate with Proton sales volume?

The Regression Equation

	Coefficients	Std. Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	394215.96	77984.31	5.06	0.32	-596668.68	1385100.60
Fuel Price	-169117.11	65626.40	-2.58	0.02	-1002979.54	664745.31
GDP	-0.73	3.89	-0.19	0.04	-50.21	48.74
Inflation Rate	20717.76	8929.46	2.32	0.03	-92741.76	134177.28

$\hat{Y} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3$

$\hat{Y} = 394215.96 - 169117.11X1 - 0.73X2 + 20717.76X3$

1. Fuel prices ↑ → Proton sales volume ↓
2. GDP per capita ↑ → Proton sales volume ↓
3. Inflation rate ↑ → Proton sales volume ↑

Result of Regression Statistics

Regression Statistics	
Multiple R	0.98743
R Square	0.97501
Adjusted R Square	0.90004
Standard Error	11247
Observations	5

ANOVA					
	df	SS	MS	F	Significance F
Regression	3	4935104162	1645034721	13.0048	0.04043937
Residual	1	126494801.7	126494801.7		
Total	4	5061598964			

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Inflation Rate	20717.76	8929.46	2.32	0.03

Result of Regression Statistics

Regression Statistics	
Multiple R	0.987425402
R Square	0.975008925
Adjusted R Square	0.900035698
Standard Error	11246.99078
Observations	5

ANOVA					
	df	SS	MS	F	Significance F
Regression	3	4935104162	1645034721	13.0048	0.04043937
Residual	1	126494801.7	126494801.7		
Total	4	5061598964			

R^2 = 0.975, significance F= 0.04

97.5% of variation in sales is explained by these three variables of fuel price, GDP per-capita, and inflation rate.

Evaluating the Model

	Coefficients	Std. Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	394215.96	77984.31	5.06	0.32	-596668.68	1385100.60
Fuel Price	-169117.11	65626.40	-2.58	0.02	-1002979.54	664745.31
GDP	-0.73	3.89	-0.19	0.04	-50.21	48.74
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The tests for X1 (fuel price), X2 (GDP), and X3 (inflation rate)

$H_0 : ß_1 , ß_2 , ß_3 = 0$, $H_1 : ß_1, ß_2 , ß_3 \neq 0$

Select the level of significance: $\alpha = 0.05$

all null hypotheses are rejected because

P-value of fuel price is 0.02 < $\alpha = 0.05$

P-value of GDP per capita is 0.04 < $\alpha = 0.05$

P-value of inflation rate is 0.03 < $\alpha = 0.05$

Increase in GDP per capita has strong influence on Proton sales volume?

Forecasting the Sales

$$\hat{Y} = 394215.96 - 169117.11X1 - 0.73X2 + 20717.76X3$$

Assuming

the fuel price = RM1.5,
GDP per capita = RM50,000,
Inflation rate = 1%

$$Y = 394215.96 - 169117.11(1.5) - 0.73\,(50000) + 20717.76\,(0.01)$$

The Proton sales = 104,247

Result of Regression Statistics

Regression Statistics	
Multiple R	0.968881928
R Square	0.93873219
Adjusted R Square	0.908098285
Standard Error	11948.73194
Observations	4

ANOVA					
	df	SS	MS	F	Significance F
Regression	1	4375049672.70	4375049672.70	30.64	0.03
Residual	2	285544390.05	142772195.03		
Total	3	4660594062.75			

	Coeff.	Std. Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	573395.57	79434.88	7.22	0.22	231614.86	915176.29
GDP per capita	-10.49	1.89	-5.54	0.03	-18.64	-2.34

GDP per-capita & Sales volume

The regression equation :

$\hat{Y}$ = 573395.57 – 10.49X1

With an increase of customer GDP per capita will negatively affected Proton sales.

	Coeff.	Std. Error	t Stat	P-value
Intercept	573395.57	79434.88	7.22	0.22
GDP	-10.49	1.89	-5.54	0.03

GDP per-capita & Sales volume

Regression Statistics	
Multiple R	0.96888
R Square	0.93873
Adjusted R Square	0.90809
Standard Error	11948.73
Observations	4

ANOVA					
	df	SS	MS	F	Significance F
Regression	1	4375049672.70	4375049672.70	30.64	0.03
Residual	2	285544390.05	142772195.03		
Total	3	4660594062.75			

r^2 = 0.938 represents 93.8% of variability in Proton sales is explained by the regression equation based on GDP per capita.

Testing the model for significance

1. **Specify the null & alternative hypotheses:**
   - **$H_0 : ß_1 = 0$**
   - **$H_1 : ß_1 \neq 0$**
2. **Select the level of significance: α =0.05**
3. **F = 30.64**
4. **P(F > 30.64) = 0.03 < α =0.05 reject H_0**

There is a statistically significant relationship between Proton sales and GDP per capita.

SURWRQ WUDQVSRUWDWLRQ FRVW SHU XQLW

DVVXPSWLRQ

41 Surwrq rqo| xvhg wkuhhp dlq idfldwlhv wr surgxfh lw yhklfdnvÈ Vkdk Doop /Wdqmxqj P ddp dqg Flndudqj1

51 Wkhuh z huh rqo| 43 Vwdwhv riz duhkrxvhv2ghvwlqdwlrq fhqwh1

61 Dqowkh surgxfwlrq iru Surwrq xqlw ri yhklfdnv duh sulp duo| iru wkh P dod|vldq p dunhw/z klovwkh xqvrog z looeh h{sruwhg ryhuvhdv1

71 Wkh frvwshuxqlwriSurwrq yhklfdnv z looeh wkh vdp h/ uhjdugdnvv iru lwp rghorip dnh1

81 Wkh rwkhuv frvwvxfk dv z djhv/wd{hv dqg sulfhv iru wkh ixhoduh frqvwdqw1

VDOHVSHU UHJLRQ

No	Distribution Channel	Total Sales	Population	Population (%)	Sales/Region
1	Johor	*115500*	2,565,701	13.08%	*15103*
2	Kedah	115500	1,572,107	8.01%	*9254*
3	Kelantan	115500	1,289,199	6.57%	*7589*
4	Kuala Lumpur	115500	1,297,526	6.61%	*7638*
5	Pahang	115500	1,231,176	6.27%	*7247*
6	Perak	115500	2,030,382	10.35%	*11952*
7	Pulau Pinang	115500	1,225,501	6.25%	*7214*
8	Sabah	115500	2,449,389	12.48%	*14418*
9	Sarawak	115500	2,012,616	10.26%	*11847*
10	Selangor	115500	3,947,527	20.12%	*23237*
			19,621,124		115500

FDSDFLW\

Factory Capacity			
No	**Name**	**Capacity/year**	**Percentage**
1	Shah Alam Plant	200000	51.28%
2	Tanjung Malim	150000	38.46%
3	Cikarang	40000	10.26%
		390000	100%

FRVWSHUXQLW

No	Distribution Channel	Ware House								
		Shah Alam			*Tanjung Malim*			*Cikarang*		
		Distances	RM	Cost/Car	Distances	RM	Cost/Car	Distances	RM	
1	Johor	*356*	*6234*	*0.41*	437	7653	0.51	929	16269	1.08
2	Kedah	436	7635	0.83	355	6217	0.67	1512	26478	2.86
3	Kelantan	477	8353	1.10	452	7916	1.04	1465	25655	3.38
4	Kuala Lumpur	28.2	494	0.06	84	1471	0.19	1194	20910	2.74
5	Pahang	219	3835	0.53	228	3993	0.55	1238	21680	2.99
6	Perak	233	4080	0.34	152	2662	0.22	1367	23939	2.00
7	Pulau Pinang	345	6042	0.84	264	4623	0.64	1472	25778	3.57
8	Sabah	1707	29893	2.07	1726	30226	2.10	1682	29456	2.04
9	Sarawak	1268	22206	1.87	1280	22416	1.89	1188	20805	1.76
10	Selangor	61.8	1082	0.05	37	648	0.03	1230	21540	0.93
		5131	89855		5015	87824		13277	232510	

FRVW SHU XQLW

Distribution Cost **RM 410189**

Total Distances **23423 KM**

Distribution cost/Distance

e.g. Johor **= 356 KM / 23423 KM x RM 410189**

= *RM 6234* – Total cost for transporting vehicles to Johor

Cost per unit **= RM 6234 / 15103 total units demanded/sales in Johor**

= *RM 0.41*

Degeneracy Problems

To / From	Johor Bahru	Kedah	Kelantan	Kuala Lumpur	Pahang	Perak	Pulau Pinang	Sabah	Sarawak	Selangor	*Dummy*	*Supply*
Shah Alam	*0.41* 15103	*0.83* x	*1.10* x	*0.06* 7639	*0.53* *7247*	*0.34* x	*0.84* x	*2.07* x	*1.87* x	*0.05* x	0 170011	200000
Tanjung Malim	*0.51* x	*0.67* 9254	*1.04* 7589	*0.19* x	*0.55* x	*0.22* 11952	*0.64* 7214	*2.10* x	*1.89* x	*0.03* 23237	0 90754	150000
Cikarang	*1.08* x	*2.86* x	*3.38* x	*2.74* x	*2.99* x	*2.00* x	*3.57* x	*2.04* *14418*	*1.76* 11847	*0.93* x	0 13735	40000
Demand	15103	9254	7589	7639	7247	11952	7214	14418	11847	23237	274500	390000

The number of occupied route must be equal to 10+3-1=12 squares used, but only *10 squares* routes occupied.

PHDVXULQJ GLVWDQFH

Example – Distance from Proton Manufacturing (Shah Alam to Kuala Lumpur) = 28.2KM

Result of Transportation Problems by VAM & Stepping-stone Methods

Iteration 1

To / From	Johor Bahru	Kedah	Kelantan	Kuala Lumpur	Pahang	Perak	Pulau Pinang	Sabah	Sarawak	Selangor	*Dummy*	*Supply*
Shah Alam	*0.41* 15103	*0.83* x	*1.10* x	*0.06* 7639	*0.53* x	*0.34* x	*0.84* x	*2.07* x	*1.87* x	*0.05* x	0 177258	200000
Tanjung Malim	*0.51* x	*0.67* 9254	*1.04* 7589	*0.19* x	*0.55* 7247	*0.22* 11952	*0.64* 7214	*2.10* 14418	*1.89* (-) 11847	*0.03* 23237	0 (+) 57242	150000
Cikarang	*1.08* x	*2.86* x	*3.38* x	*2.74* x	*2.99* x	*2.00* x	*3.57* x	*2.04* x	*1.76* x (+)	*0.93* x	0 (-) 40000	40000
Demand	15103	9254	7589	7639	7247	11952			11847	23237	274500	390000

Start

Closed path for IShah Alam→Pahang= -0.0[illegible]ikarang→Sabah= -0.06

Closed path for IShah Alam→Sarawak= -0.02, for *ICikarang→Sarawak= -0.13*

Result of Transportation Problems by VAM & Stepping-stone Methods

Iteration 2

From \ To	Johor Bahru	Kedah	Kelantan	Kuala Lumpur	Pahang	Perak	Pulau Pinang	Sabah	Sarawak	Selangor	Dummy	Supply
Shah Alam	0.41 15103	0.83 X	1.10 X	0.06 7639	0.53 X	0.34 X	0.84 X	2.07 X	1.87 X	0.05 X	0 177258	200000
Tanjung Malim	0.51 X	0.67 9254	1.04 7589	0.19 X	0.55 7247	0.22 11952	0.64 7214	2.10 (-) 14418	1.89 X	0.03 23237	0 (+) 69089	150000
Cikarang	1.08 X	2.86 X	3.38 X	2.74 X	2.99 X	2.00 X	3.57 X	2.04 X (+)	1.76 11847	0.93 X	0 (-) 28153	40000
Demand	15103	9254	7589	7639	7247	11952	7214	14418	11847	23237	274500	390000

Start

Closed path for IShah Alam→Paha

Closed path for IShah Alam→Sabah= -0.03, for *ICikarang→Sabah = -0.06*

Result of Transportation Problems by VAM & Stepping-stone Methods

Iteration 4

From \ To	Johor Bahru	Kedah	Kelantan	Kuala Lumpur	Pahang	Perak	Pulau Pinang	Sabah	Sarawak	Selangor	Dummy	Supply
Shah Alam	0.41 15103	0.83 X	1.10 X	0.06 7639	0.53 7247	0.34 X	0.84 X	2.07 X	1.87 X	0.05 X	0 170011	200000
Tanjung Malim	0.51 X	0.67 9254	1.04 7589	0.19 X	0.55 X	0.22 11952	0.64 7214	2.10 X	1.89 X	0.03 23237	0 90754	150000
Cikarang	1.08 X	2.86 X	3.38 X	2.74 X	2.99 X	2.00 X	3.57 X	2.04 14418	1.76 11847	0.93 X	0 13735	40000
Demand	15103	9254	7589	7639	7247	11952	7214	14418	11847	23237	274500	390000

No closed path is with negative value.

Result of Transportation Problems by VAM & Stepping-stone Methods

Iteration 3

From \ To	Johor Bahru	Kedah	Kelantan	Kuala Lumpur	Pahang	Perak	Pulau Pinang	Sabah	Sarawak	Selangor	Dummy	Supply
Shah Alam	0.41 15103	0.83 X	1.10 X	0.06 7639	0.53 (+) X	0.34 X	0.84 X	2.07 X	1.87 X	0.05 X	0 (-) 177258	200000
Tanjung Malim	0.51 X	0.67 9254	1.04 7589	0.19 X	0.55 (-) 7247	0.22 11952	0.64 7214	2.10 X	1.89 X	0.03 23237	0 (+) 83507	150000
Cikarang	1.08 X	2.86 X	3.38 X	2.74 X	2.99 X	2.00 X	3.57 X	2.04 14418	1.76 11847	0.93 X	0 13735	40000
Demand	15103	9254	7589	7639	7247	11952	7214	14418	11847	23237	274500	390000

Start

Closed path for IShah Alam → Pahang = -0.02

Minimum Transportation Cost

- **Total Cost : RM82,754.36 (NTD774,878.73)**
  - **Shah→Johor: 15013 units*RM0.41 = RM6155.33**
  - **Shah→Kuala: 7639 units*RM0.06 = RM458.34**
  - **Shah→Pahang: 7247units*RM0.53 = RM3841**
  - **Tanjung→Kedah: 9245units*RM0.67 = RM6200.18**
  - **Tanjung→Kelantan: 7589units*RM1.04 = RM7892.56**
  - **Tanjung→Perak: 11952units*RM0.22 = RM2629.44**
  - **Tanjung→Pulau: 7214units*RM0.64 = RM4616.96**
  - **Tanjung→Selangor: 23237units*RM0.03 = RM697.11**
  - **Cikarang→Sabah: 14418units*RM2.04 = RM29412.72**
  - **Cikarang→Sarawak: 11847units*RM1.76 = RM20850.72**

Conclusion

- There is strong correlation between escalations in fuel prices, increase in GDP per-capita and inflation rate with Proton sales volume.
- Increase in GDP per-capita has strong but inverse influence on Proton sales volume.
- Future development of Proton Malaysia
  - partnership with Detroit to develop electric cars
  - Develop the most fuel efficient cars
  - Capture a larger market in China

Thank You for Your Attention