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A STATISTICAL ANALYSIS ON
LABOUR FORCE PARTICIPATION RATE IN MALAYSIA
FOR THE LAST FOUR DECADES

Statistics for Industry

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Abstract: Without labour, nothing prospers. Labour force is crucial in driving a country's economic growth as well as its infrastructure development. With respect to Malaysia's Twentieth Plan and Industrial Revolution 4.0, the stability of Malaysia's labour market is the key component for sustainable developments. Our focus of this study will be on analysing the trend of labour force participation rate (LFPR) in Malaysia from the year 1982 to 2021 by gender, age group, educational attainments and marital status. The data is originated from Department of Statistics Malaysia. Time series analysis and Simple Exponential Smoothing (SES) Method will be performed to forecast the LFPR for the upcoming few years. Besides, we are interested to study how different socio-demographic factors of labour force impact the overall LFPR across states and federal territories from the year 2016 to 2021 using the panel data analysis. The time series plot showed that LFPR hovered between 62% and 68% for the past 40 years and it hit the peak at 68.7% in 2019. At all time, male LFPR was significantly higher than female LFPR. It was also discovered that the demographic factors such as marital status and education level do possess different relationship with LFPR by gender. In summary, the outcomes of this study may serve as a reference for the policymakers to come up with essential decisions regarding education, training and creation of jobs for the labour market.

Keywords: workforce; economy growth; industrial revolution; time series.

1.0 Introduction

Malaysia's economy has been taking place by leaps and bounds since its independence declaration in the year of 1957. It has effectively diversified from just depending solely on agriculture and commodity-based to one that today includes robust manufacturing and service sectors. Nowadays, Malaysia has become one of the prominent exporters of electrical appliances, parts, and components across the globe. [1] Malaysia is ranked fourth among 17 economies in an assessment comparing the economy's competitiveness as a manufacturing hub, which is ahead of other countries in Asia such as China, Japan, Vietnam and India, according to a joint study by KPMG and The Manufacturing Institute in the US entitled "Cost of Manufacturing Operations Around the Globe". [2]

The labour market is a part and parcel of Malaysia's progressive and positive economic growth. Labour market in an advanced nation is characterised by effective market clearance that matches supply with demand and a comprehensive labour market support system. During the Tenth Malaysia Plan which was carried out from the year 2011 to 2015, we observed an increment in the job creation and strengthening of the labour market institutions. In the Eleventh Malaysia Plan implemented from the year 2016 to 2020, strategic shifts have been formulated to elevate the labour market efficiency which aims to improve the productivity, wage structure and create quality jobs; improve labour market legislation and information; and effectively manage low-skilled foreign workers. Emphasis will be given to fulfil the labour requirements of industry in the economy. [3]

To determine the stability of the labour market, labour force participation rate, also known as LFPR was introduced to measure the proportion of a country's working-age population that engages actively in the labour market, either by working or looking for work. It provides an indication of the size of the supply of labour available to engage in the production of goods and services, relative to the population at working age. [4] At any point in time in Malaysia, the working age population is defined to be all persons between the ages of 15-64 years old. In general, the working age population who are not in the labour force are those persons who are in learning or training institutions; those who are retired and have no intention of rejoining the labour market; those who are physically or mentally or health-wise unable to work and those who are otherwise not actively looking for work. [5] LFPR can be expressed and calculated in the following way.

$$LFPR = \frac{Size\ of\ the\ labour\ force}{Size\ of\ the\ working\ age\ population\ (15-64\ years\ old)}$$

According to the statistics collected from the monthly Labour Force Survey conducted by Department of Statistics, Malaysia, it was explicitly observed that the male labour forces dominated the labour market while the female LFPR was in the range of 25.2% to 40.8% lower than the male LFPR for the past forty

years. Even though women in Malaysia have shown significant educational attainment, they are still disproportionally represented in the workplace, compared to Malaysia neighbours such as Philippines, Indonesia and Myanmar. While educational attainment is important for economic and social mobility as evidenced by high proportion of women with formal education, it has not been effectively translated into strong women participation in the productive aspect of the economy. [6] We shall investigate further on the factors of this gap in the later section.

This study will work mainly on determining the trend of the LFPR for the last four decades and investigating the relationship between multiple determining factors such as gender, marital status and educational attainment with LFPR. There are a few research working on the same theme in various countries. For instance, graphical analysis of "Factors Affecting the Labor Force Participation of People Ages 25 to 54 in United States" conducted by Congressional Budget Office and research on investigating variables that affected the female LFPR in Pakistan conducted by Zaheer and Qaiser in 2016. Since our study will be focusing on data only in Malaysia and we are using the latest data up to the year of 2021, the results of this study may provide different insights and serve as a guideline for the policymakers to come up with strategical decisions regarding education, training and creation of jobs for the labour market.

2.0 Objectives

The objectives of this study are to

- perform time series analysis on LFPR from 1982 to 2021 and forecast the rate for next few years
- carry out panel data analysis to identify the relationship between the determining factors such as gender, marital status and educational attainment with LFPR

3.0 Material & Methodology

3.1 Data

The data of this study is originated from two sources. The first source is from Department of Statistics, Malaysia (DOSM) at Labour Force Participation Rate (LFPR) Dataset [DOSM] where it covers LFPR from the year 1982 to 2020 while the second source is from eStatistik at Labour Force Participation Rate (LFPR) Dataset [eStatistik] where it covers the LFPR for last year which is the year 2021. The data from both sources is collected from the Labour Force Survey which closely adheres to guidelines and recommendations of the International Labour Organization (ILO) with reference to the Surveys of Economically Active Population, Employment, Unemployment and Underemployment: An ILO Manual on Concepts and Methods.

3.2 Method

The method used in this study to perform the time series modeling on the LFPR data from the year 1982 to 2021 will be the Simple Exponential Smoothing method. We lack data in 1991 and 1994 thus we will apply linear interpolation method to fill in the missing values hence we can produce the time series data.

To find the relationship between social demographic factors with LFPR by gender, we will use panel data analysis that are pooled OLS model and fixed effects model In this case, our data for PDA will span over thirteen states and three federal territories in Malaysia for five years from 2016 to 2021.

Age groups from 15 to 34 are clustered as young age, age groups from 35 to 54 are clustered as middle age while age groups from 55 to 64 are clustered as old age to ease our analysis thereafter.

R programming language was utilized to implement the whole analysis

3.3 Linear Interpolation

In the mathematical field of numerical analysis, interpolation is a method of constructing new data points within the range of a discrete set of known data points. A few data points from the original function can be interpolated to produce a simpler function that is still fairly close to the original.

Let say we have two points (x_0, y_0) and (x_1, y_1), if we have a point (x, y) in between, then, by taking the slopes of the straight line, we have,

$$\frac{y - y_0}{x - x_0} = \frac{y_1 - y_0}{x_1 - x_0}$$

By doing some modifications on the above formula, we can find that,

$$y = y_0 + (x - x_0)\frac{y_1 - y_0}{x_1 - x_0}$$

3.4 Simple Exponential Smoothing

The Error, Trend, Seasonality (ETS) models are a family of time series models with an underlying state space model consisting of a level component, a trend component (T), a seasonal component (S), and an error term (E).

Simple exponential smoothing is the simplest of the ETS models In ETS terms, it corresponds to the (A, N, N) model, that is, a model with additive errors, no trend, and no seasonality. In mathematical form, the formulas are as follows:

$$s_0 = x_0$$

$$s_t = \alpha x_t + (1 - \alpha) s_{t-1}$$

where α represents the smoothing factor which is between 0 and 1 exclusively,

s_t represents the simple weighted average of the current observation and previous smoothed statistic,

x_t represents the raw data sequence beginning at time $t = 0$.

The smoothing factor, α, controls the rate at which the influence of the observations at prior time steps decay exponentially. Larger values closer to 1 mean that the model pays attention mainly to the most recent past observations, whereas smaller values approaching 0 mean more of the history is considered when making a prediction.

3.5 Pooled OLS Model

Pooled data occur when we have a "time series of cross sections," but the observations in each cross section do not necessarily refer to the same unit. In panel data, Pooled OLS (Ordinary Least Squares) can be used to derive unbiased and consistent estimates of parameters even when time constant attributes are present. The pooled OLS model estimation we will use in this case will be as follows:

$$lfpr_{male} = \beta_0 + \beta_1 primary_{it} + \beta_2 secondary_{it} + \beta_3 tertiary_{it} + \beta_4 single_{it} + \beta_5 married_{it} + \beta_6 widowed_{it} + \beta_7 divorced_{it} + \beta_8 young_{it} + \beta_9 middle_{it} + \beta_{10} old_{it} + \varepsilon_{it}$$

$$lfpr_{female} = \beta_0 + \beta_1 primary_{it} + \beta_2 secondary_{it} + \beta_3 tertiary_{it} + \beta_4 single_{it} + \beta_5 married_{it} + \beta_6 widowed_{it} + \beta_7 divorced_{it} + \beta_8 young_{it} + \beta_9 middle_{it} + \beta_{10} old_{it} + \varepsilon_{it}$$

where $t = 2016, 2017, \dots, 2021$, $i = 1,2, \dots, 16$ and ε_{it} represents the error terms.

3.6 Fixed Effects Model

Fixed-effects models are a class of statistical models in which the values of independent variables are assumed to be fixed that is to remain constant and only the dependent variable changes in response to the levels of independent variables. The independent variables, like age, sex, or ethnicity, don't change or change at a constant rate over time. For instance, a person's gender and his or her eyes' colour. The fixed effects model estimation we will use in this case is same as pooled OLS model stated earlier above.

4.0 Results

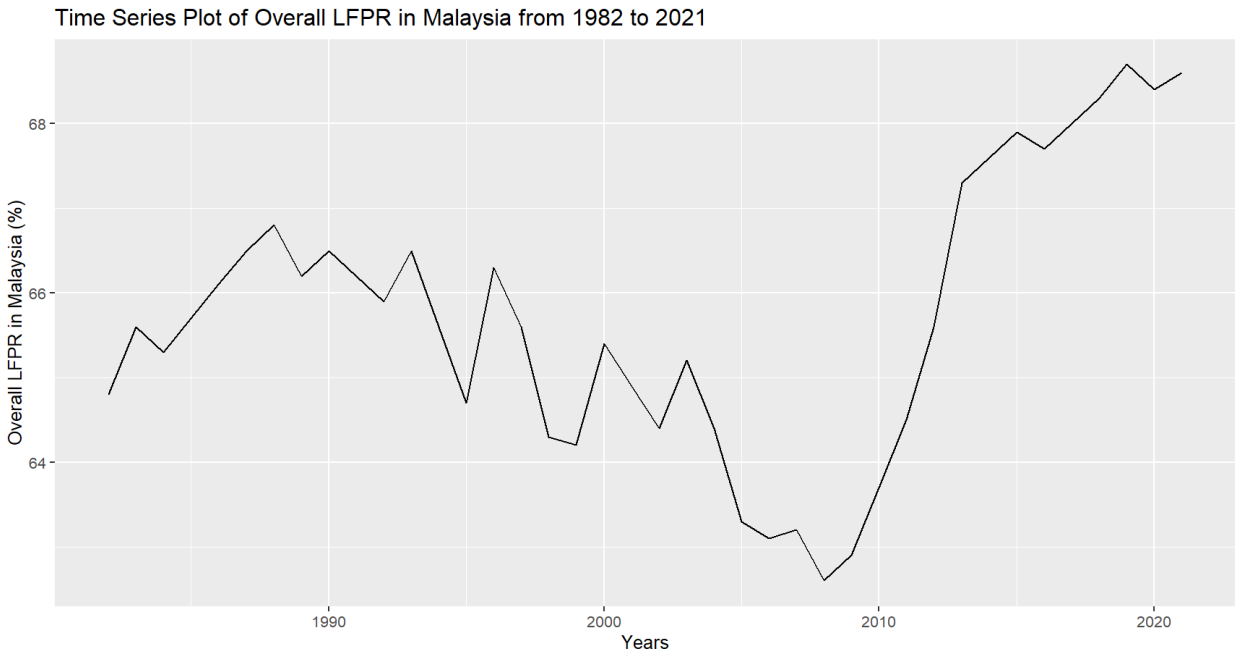

Figure 1. Time Series Plot of Overall LFPR in Malaysia from 1982 to 2021

The above figure showed the time series plot of overall labour force participation rate in Malaysia for forty years from the year 1982 to 2021. (Also referring to Appendix A1 and A2) Overall LFPR reached its peak at 68.7% in the year 2019 and its trough at 62.6% in the year 2008. Hovering in the range of 62% to 69% which is only a minor change of 7% throughout the long period, we observed the LFPR was gradually increasing for the recent years and there was a drastic increase for a period of five years from 2009 to 2013.

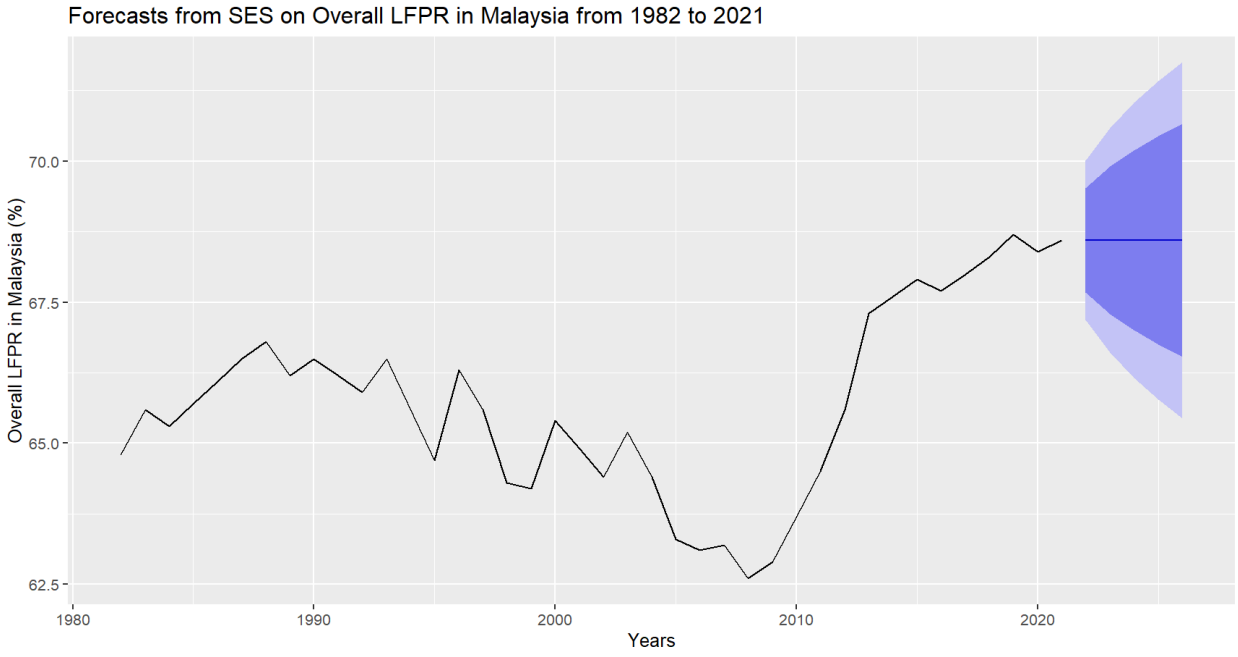

Figure 2. Next Five Years Forecasts of Overall LFPR in Malaysia (Graph)

	Point Forecast	Lo 80	Hi 80	Lo 95	Hi 95
2022	68.59998	67.67817	69.52179	67.19020	70.00976
2023	68.59998	67.29641	69.90355	66.60635	70.59361
2024	68.59998	67.00347	70.19649	66.15833	71.04163
2025	68.59998	66.75650	70.44346	65.78063	71.41933
2026	68.59998	66.53892	70.66104	65.44786	71.75210

Figure 3. Next Five Years Forecasts of Overall LFPR in Malaysia (Values)

Figure 2 and Figure 3 gave us insights into how the overall LFPR may go beyond for the upcoming five years (2022 to 2026). The dark blue region indicates 80% confidence interval for the forecast values while the light blue region provides 95% confidence interval for the forecast values. The average forecasted value will be approximately 68.6% throughout the years and by the year of 2026, we are 95% confident that LFPR may go up to 71.8% and down to 65.4%. On the other hand, the lower bound and upper bound for the 80% confidence interval of the forecast values by year 2026 will be 66.5% and 70.7% respectively. (Refer Appendix A3 and A4) By using sample points from the year 2016 to 2021 to be our test data, we found that the mean absolute percentage error for SES method in forecasting overall LFPR is approximately 0.66%. Further checking on the residuals, we see that the top plot shows residuals that have no observable pattern and seem to be white noise, the bottom left plot shows only a lag that exceeds the 95% confidence interval, bottom right plot shows the residuals to be approximately normally distributed.

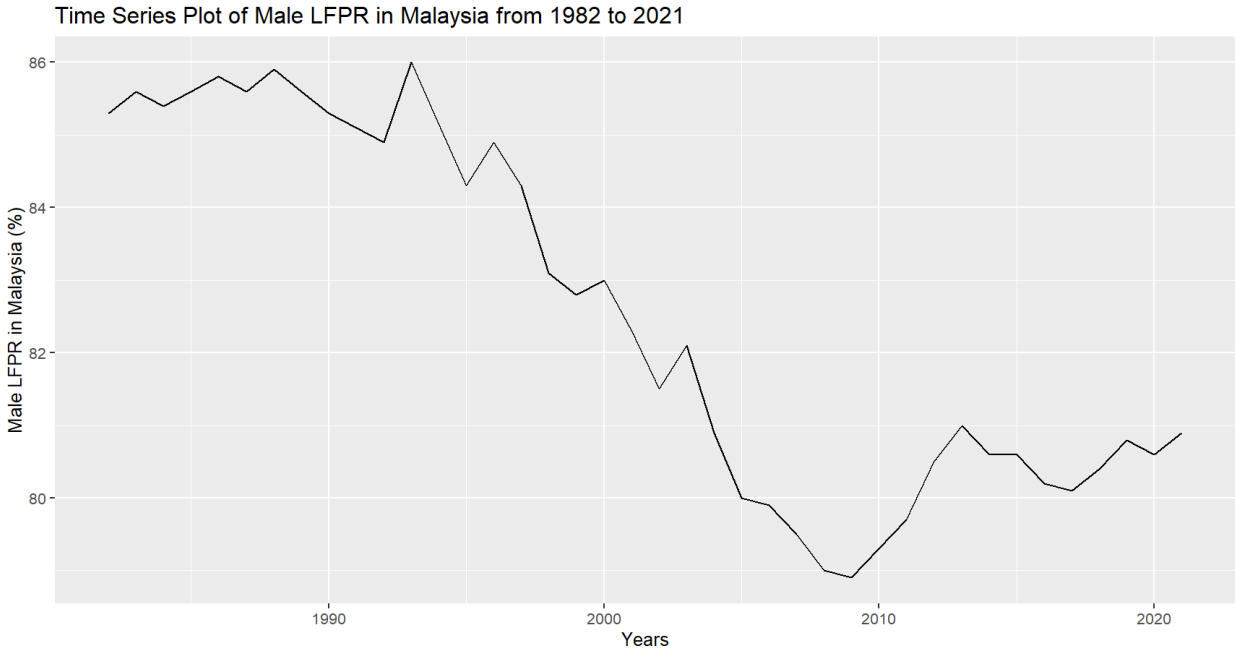

Figure 4. Time Series Plot of Male LFPR in Malaysia from 1982 to 2021

Figure 4 showed the time series plot of male labour force participation rate in Malaysia for forty years from the year 1982 to 2021. (Also referring to Appendix A1 and A2) Male LFPR reached its peak at 86.0% in the year 1993 and its trough at 78.9% in the year 2009. From the time series plot, we can observe that the male LFPR values overall experienced a decreasing trend since 1982 until 2009 with a few ups and downs in between. In the recent five years from 2017 to 2021, there was no much change where the LFPR lay between 80% and 81%.

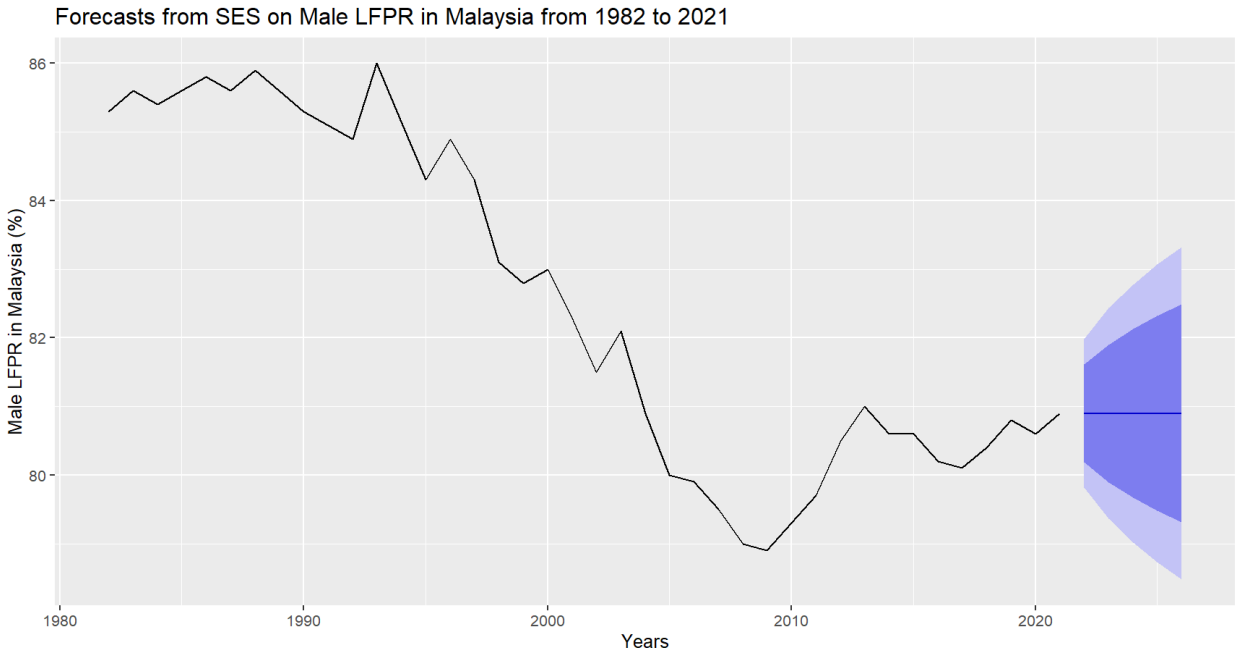

Figure 5. Next Five Years Forecasts of Male LFPR in Malaysia (Graph)

	Point Forecast	Lo 80	Hi 80	Lo 95	Hi 95
2022	80.89997	80.19083	81.60911	79.81544	81.98450
2023	80.89997	79.89715	81.90279	79.36628	82.43366
2024	80.89997	79.67179	82.12815	79.02163	82.77831
2025	80.89997	79.48180	82.31814	78.73107	83.06887
2026	80.89997	79.31441	82.48553	78.47507	83.32487

Figure 6. Next Five Years Forecasts of Male LFPR in Malaysia (Values)

Figure 5 and Figure 6 gave us insights into how the male LFPR may go beyond for the upcoming five years (2022 to 2026). The dark blue region indicates 80% confidence interval for the forecast values while the light blue region provides 95% confidence interval for the forecast values. The average forecasted value will be approximately 80.9% throughout the years and by the year of 2026, we are 95% confident that LFPR may go up to 78.5% and down to 83.3%. On the other hand, the lower bound and upper bound for the 80% confidence interval of the forecast values by year 2026 will be 79.3% and 82.5% respectively. (Refer Appendix A5 and A6) By using sample points from the year 2016 to 2021 to be our test data, we found that the mean absolute percentage error for SES method in forecasting male LFPR is approximately 0.33%. Further checking on the residuals, we see that the top plot shows residuals that have no observable pattern and seem to be white noise, the bottom left plot shows only a lag that exceeds the 95% confidence interval, bottom right plot shows the residuals to be approximately normally distributed.

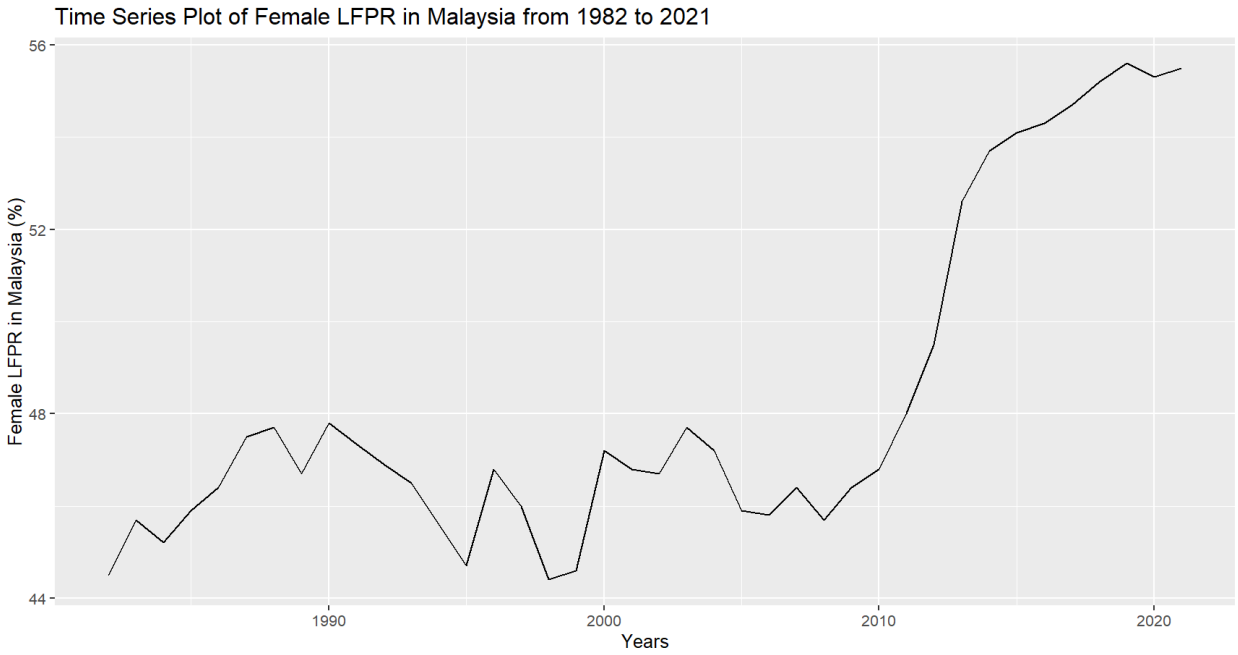

Figure 7. Time Series Plot of Female LFPR in Malaysia from 1982 to 2021

Figure 7 showed the time series plot of female labour force participation rate in Malaysia for forty years from the year 1982 to 2021. (Also referring to Appendix A1 and A2) Female LFPR reached its peak at 55.6% in the year 2019 and its trough at 44.4% in the year 1998. From the time series plot, we can observe that the female LFPR values overall fluctuated (camel hump shape) between 44% to 48% in the first thirty years since the year 1982. Starting from the year 2010, we can explicitly observe that the female LFPR values experiencing a logistic growth where there was a big jump of approximately 7% to 8% from the year 2010 to 2015.

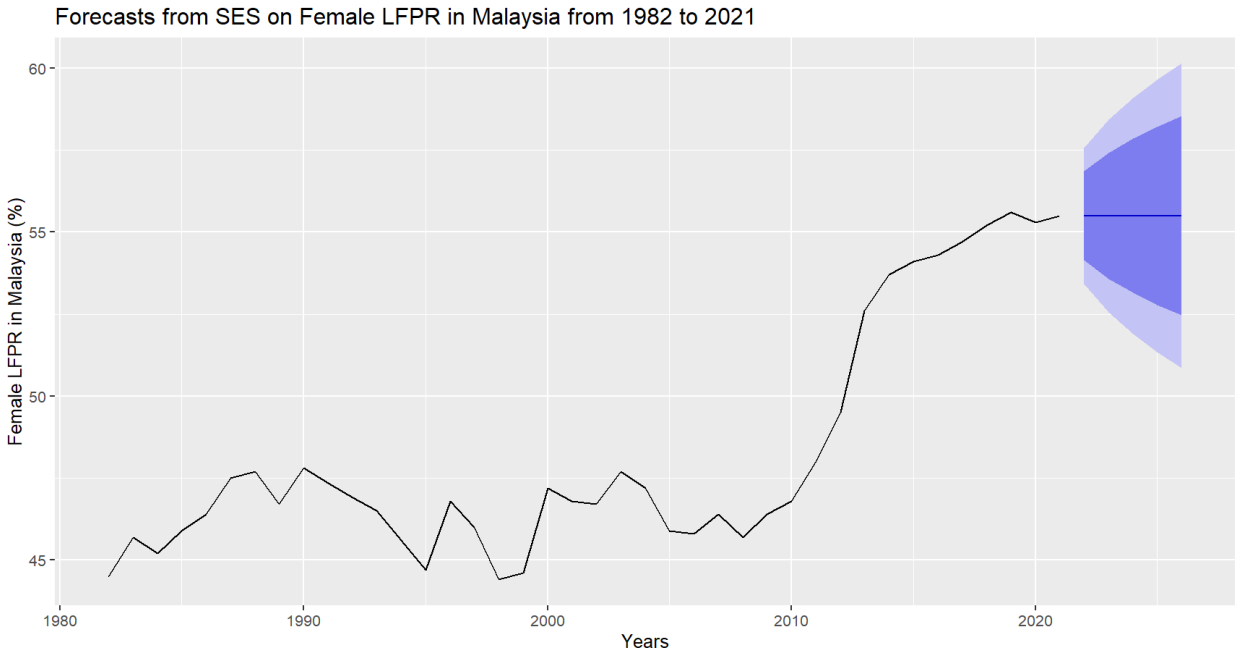

Figure 8. Next Five Years Forecasts of Female LFPR in Malaysia (Graph)

	Point Forecast	Lo 80	Hi 80	Lo 95	Hi 95
2022	55.49998	54.14103	56.85893	53.42164	57.57832
2023	55.49998	53.57823	57.42173	52.56092	58.43904
2024	55.49998	53.14636	57.85360	51.90044	59.09952
2025	55.49998	52.78228	58.21768	51.34362	59.65634
2026	55.49998	52.46152	58.53844	50.85305	60.14691

Figure 9. Next Five Years Forecasts of Female LFPR in Malaysia (Values)

Figure 8 and Figure 9 gave us insights into how the female LFPR may go beyond for the upcoming five years (2022 to 2026). The dark blue region indicates 80% confidence interval for the forecast values while the light blue region provides 95% confidence interval for the forecast values. The average forecasted value will be approximately 55.5% throughout the years and by the year of 2026, we are 95% confident that LFPR may go up to 60.1% and down to 50.9%. On the other hand, the lower bound and upper bound for the 80% confidence interval of the forecast values by year 2026 will be 52.5% and 58.5% respectively. (Refer Appendix A7 and A8) By using sample points from the year 2016 to 2021 to be our test data, we found that the mean absolute percentage error for SES method in forecasting female LFPR is approximately 1.81%. Further checking on the residuals, we see that the top plot shows residuals that have no observable pattern and seem to be white noise, the bottom left plot shows no lag that exceeds the 95% confidence interval, bottom right plot shows the residuals to be approximately normally distributed.

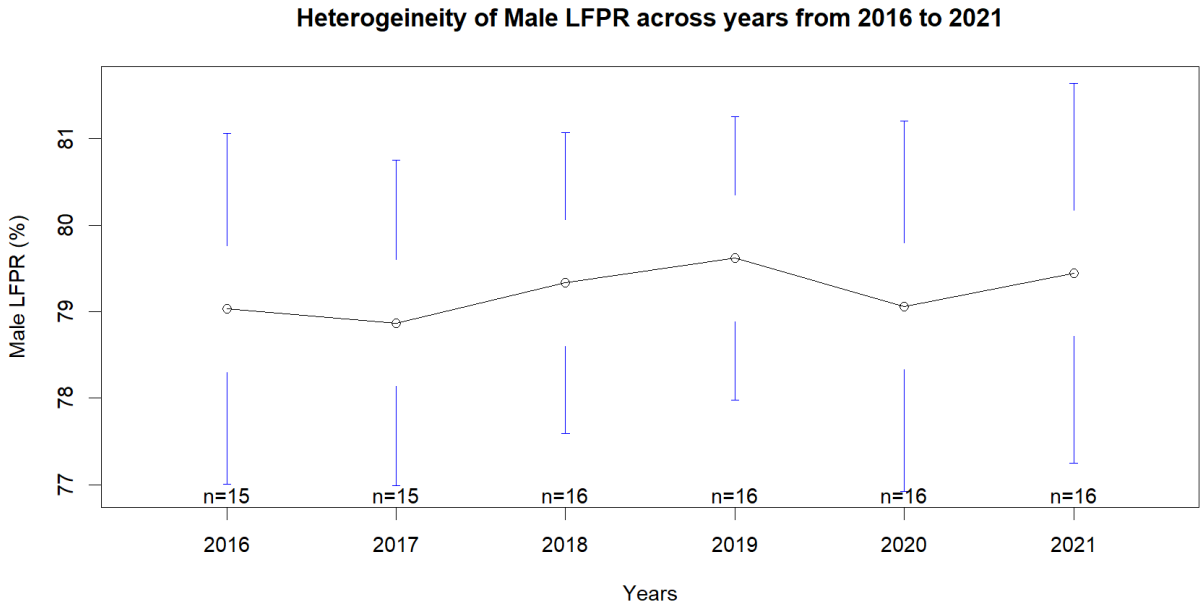

Figure 10. Heterogeneity of Male LFPR Across States and Federal Territories in Malaysia from 2016 to 2021

Figure 10 showed the mean of male LFPR across thirteen states and three federal territories in Malaysia from 2016 to 2021. The blue line expanding two ways from the dot indicates the 95% confidence interval for the actual male LFPR at that particular year. It can be observed that during the past six years, the LFPR did not show a clear trend and hovered between 77% and 82%. (95% C.I.)

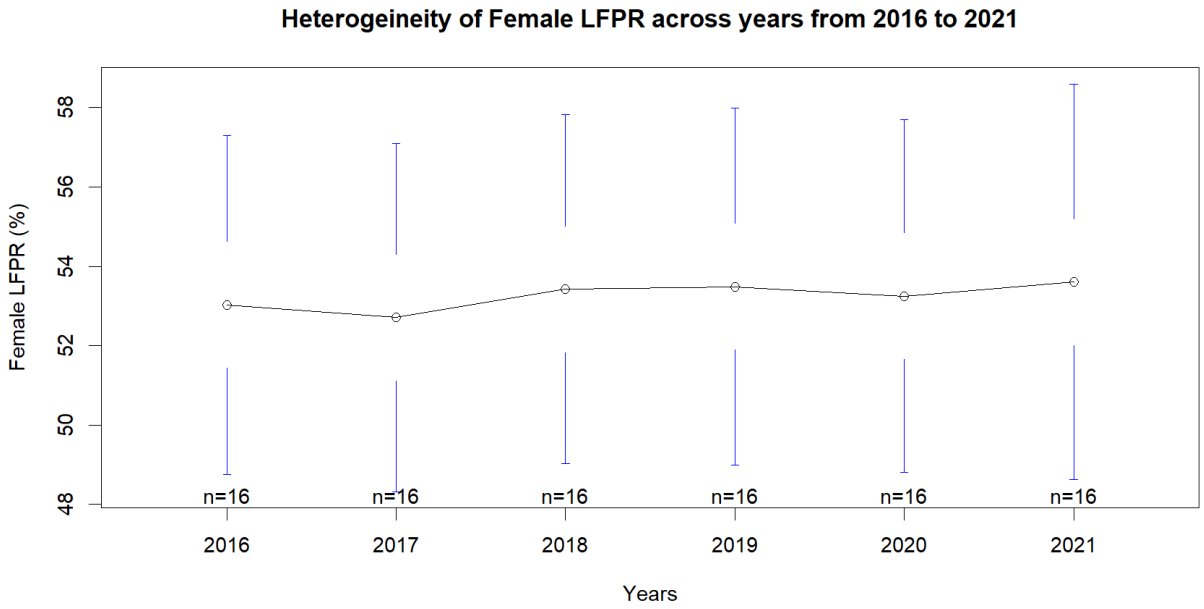

Figure 11. Heterogeneity of Female LFPR Across States and Federal Territories in Malaysia from 2016 to 2021

Figure 11 showed the mean of female LFPR across thirteen states and three federal territories in Malaysia from 2016 to 2021. The blue line expanding two ways from the dot indicates the 95% confidence interval for the actual male LFPR at that particular year. It can be observed that during the past six years, the LFPR fluctuated and hovered between 48% and 58%. (95% C.I.)

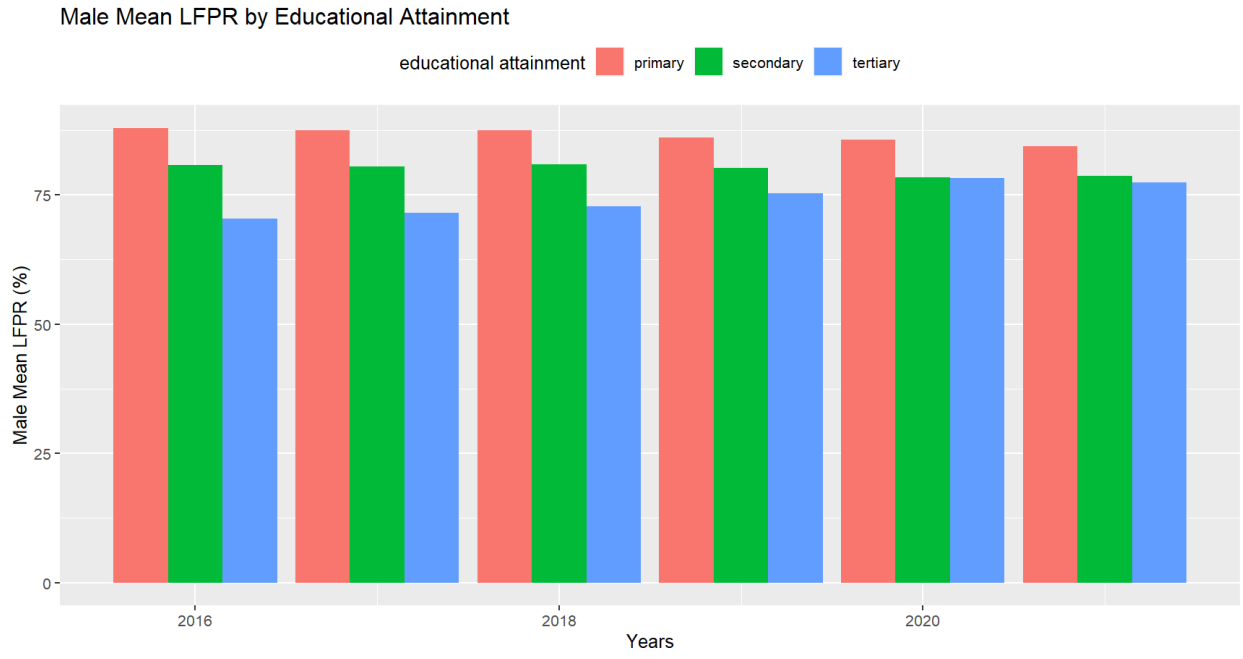

Figure 12. Male Mean LFPR by Educational Attainment Across States and Federal Territories in Malaysia from 2016 to 2021

Figure 12 showed the mean of male LFPR by educational attainment across thirteen states and three federal territories in Malaysia from 2016 to 2021. It depicted that throughout the years, LFPR for men labour force with only primary education and secondary education declined steadily while LFPR for men labour force who achieved tertiary education increased gradually in the meantime.

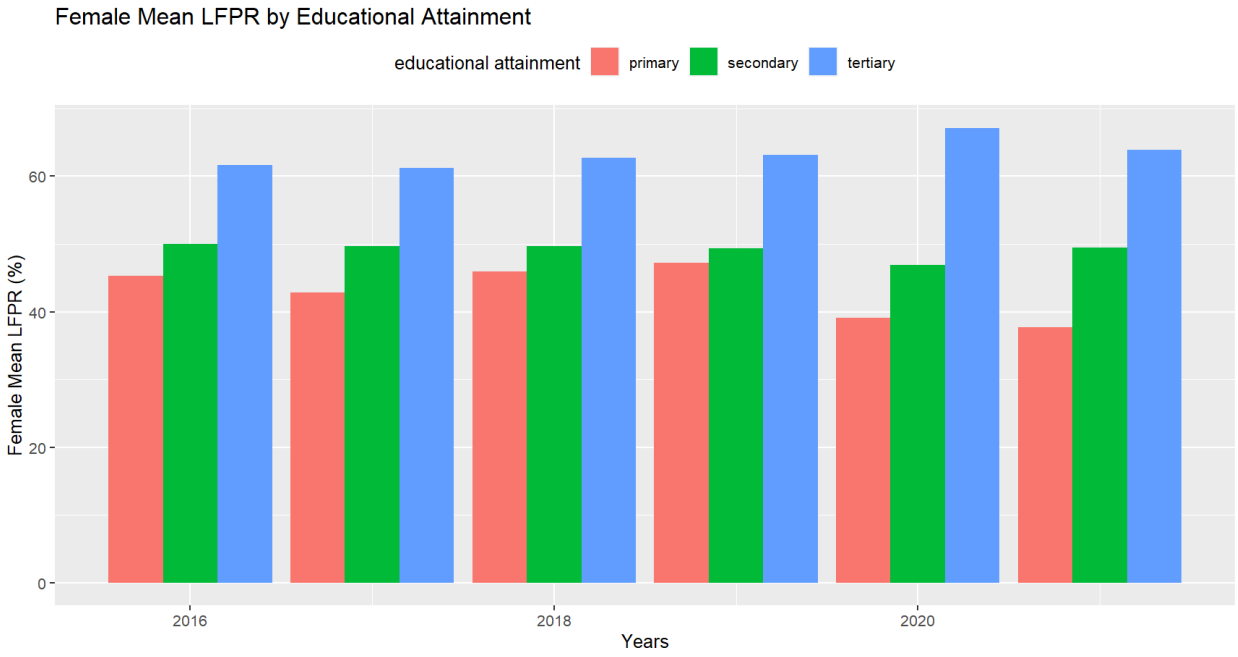

Figure 13. Female Mean LFPR by Educational Attainment Across States and Federal Territories in Malaysia from 2016 to 2021

Figure 13 showed the mean of female LFPR by educational attainment across thirteen states and three federal territories in Malaysia from 2016 to 2021. It depicted that in the recent two years, LFPR for women labour force with only primary education experienced a slump while LFPR for men labour force who achieved tertiary education rose overall slowly in the meantime.

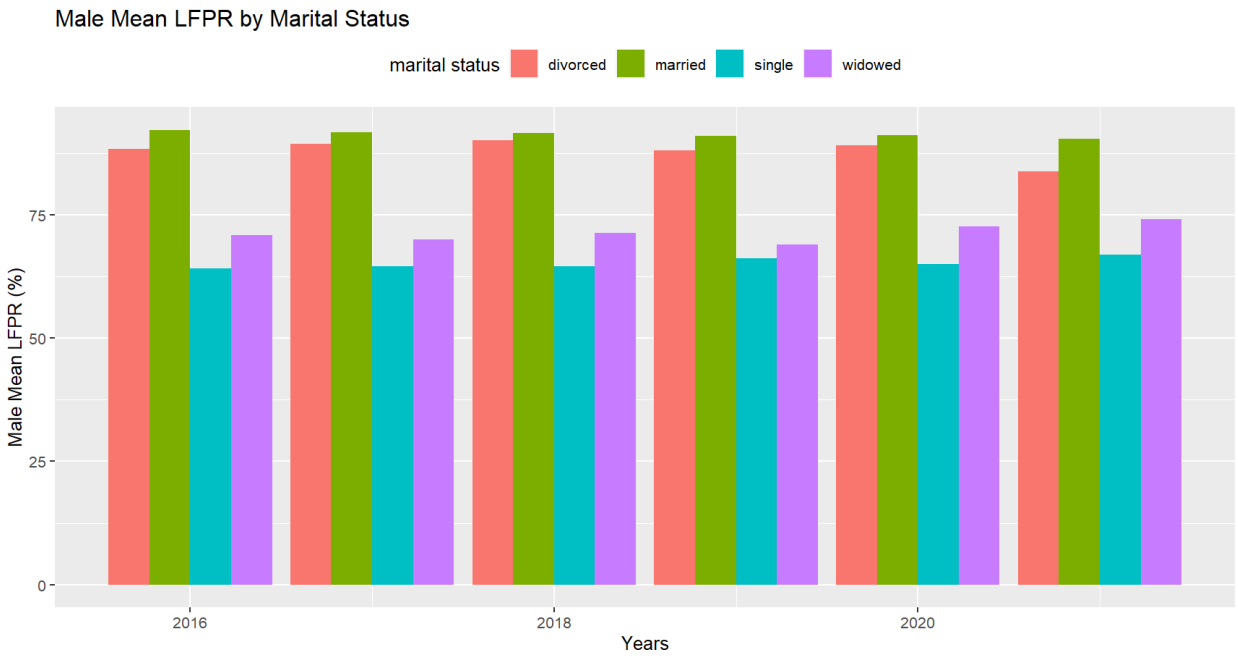

Figure 14. Male Mean LFPR by Marital Status Across States and Federal Territories in Malaysia from 2016 to 2021

Figure 14 showed the mean of male LFPR by marital status across thirteen states and three federal territories in Malaysia from 2016 to 2021. It illustrated that married men among the most active involving in the labour market followed by divorced men throughout the six years. LFPR for single men remained lowest and was almost constant where the widowed men accounted for the second lowest.

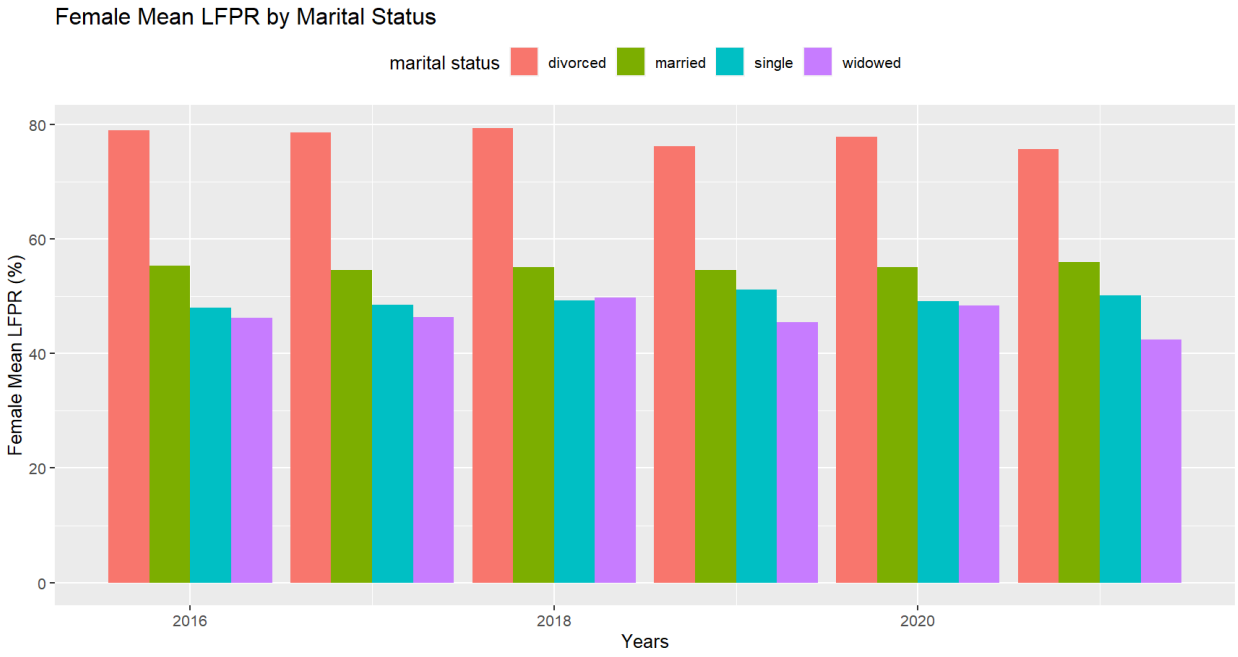

Figure 15. Female Mean LFPR by Marital Status Across States and Federal Territories in Malaysia from 2016 to 2021

Figure 15 showed the mean of female LFPR by marital status across thirteen states and three federal territories in Malaysia from 2016 to 2021. It illustrated that divorced women among the most active involving in the labour market followed by married women with a large gap throughout the six years. LFPR for single and widowed women were almost the same except that single women's LFPR surpassed widowed women's LFPR by approximately 7% to 8% in the year 2021.

Panel regressions, clustered SEs

	Dependent variable:			
	male_lfpr		female_lfpr	
	Pooled OLS	Fixed Effects	Pooled OLS	Fixed Effects
	(1)	(2)	(3)	(4)
primary	0.0036	0.0352***	0.0131***	0.0076
	(0.0321)	(0.0066)	(0.0026)	(0.0058)
secondary	0.2327***	0.1718***	-0.0491	0.0903*
	(0.0807)	(0.0316)	(0.0429)	(0.0492)
tertiary	0.1905***	0.1058***	0.0215	0.0583**
	(0.0340)	(0.0172)	(0.0234)	(0.0247)
single	0.1679***	0.1227***	0.3709***	0.2875***
	(0.0544)	(0.0266)	(0.0165)	(0.0376)
married	0.3857***	0.1980***	0.6099***	0.4964***
	(0.1196)	(0.0531)	(0.0450)	(0.0530)
widowed	0.0321***	0.0035	0.0369*	0.0111
	(0.0111)	(0.0032)	(0.0194)	(0.0247)
divorced	0.0074	-0.0067**	0.0385***	0.0224***
	(0.0108)	(0.0032)	(0.0082)	(0.0068)
young	0.0934**	0.1628***	-0.0250	-0.0046
	(0.0405)	(0.0222)	(0.0496)	(0.0483)
middle	0.1118	0.1477***	0.0320	0.0246
	(0.0997)	(0.0564)	(0.0334)	(0.0312)
old	-0.0314	0.0039	-0.0070	0.0167
	(0.0230)	(0.0060)	(0.0153)	(0.0199)
Constant	-18.2825**		-3.3007***	
	(7.9370)		(0.9055)	
Observations	94	94	96	96
R2	0.9584	0.9743	0.9977	0.9761
Adjusted R2	0.9534	0.9649	0.9974	0.9676
F Statistic	191.2439***	258.2985***	3,616.7380***	285.8070***
Note:				*p<0.1; **p<0.05; ***p<0.01

Figure 16. Pooled OLS and FE Models for Male and Female LFPR

Figure 16 showed Pooled Ordinary Least Squares (OLS) and Fixed Effects (FE) Models for male and female LFPR based on the data across thirteen states and three federal territories from the year 2016 to 2021. In both models, we did discover that there was a negative correlation between young age group and female LFPR. p-values which are less than 0.01 (labelled by three asterisks) signify that the results are somehow significant. We shall interpret the results in the discussion section.

5.0 Discussion

In this case study, we were interested in how the time series plots of LFPR differ between male and female and its overall trend throughout the past four decades. We also aimed to find out how the determinants of labour force such as educational attainment, age group and marital status towards the LFPR based on gender differences of thirteen states and three federal territories in Malaysia from year 2016 until 2021.

Based on the time series plot we obtained earlier, we found that the male LFPR was fluctuating between 80% to 81% and the female LFPR was incrementing substantially from approximately 47% to 55% for the past ten years. This is a good indication that involvement of women in labour force is actively growing. Nevertheless, there was still a large gap between the male LFPR and female LFPR in Malaysia that is female LFPR never surpassed male LFPR and lagged by a percentage of 23.3% to 41.6%.

The huge difference between LFPR by gender perhaps can be explained by several reasons as outlined below.

- **Marital Status**

  Married men are more likely to participate in the labour force compared to married women since they need to earn a living for their own family while some married women will need to care for their children and elders at home. Overall, both women and men did come to a consensus that the biggest barrier for women in paid work is the struggle to balance it with famil1y responsibilities. Work such as childcare, cleaning and cooking is necessary for a household's welfare and therefore for the well-being of societies, women still need to shoulder the brunt of this often invisible and undervalued workload. [7]

- **Gender Discrimination**

  According to the Global Gender Gap Index (GGGI) 2021, our country stayed at 104th place for economic participation and opportunity at the score of 0.638 lagged behind our neighbours, Singapore at 33rd place (Score of 0.749) and Thailand at 22nd place (Score of 0.787). This means that only 63.8% of the gender gap was closed. [8] The New Survey Research conducted by Women's Aid Organisation (WAO) in 2021 had shown that more than 50 percent of Malaysian women experienced gender discrimination in the workplace. WAO's Head of Campaigns, Natasha Dandavati, highlighted that 47 percent of women were asked about their marital status during a job interview, while 1 in every 5 women were questioned on their ability to perform certain tasks. [9] The 2020 Salaries and Wages

Statistics from the Department of Statistics Malaysia reported that male and female salaries decreased, but the monthly salaries of male employees were still higher than women. [10]

- **Sexual Harassment**

  In a survey by Women's Aid Organisation, 62% out of the 1,010 Malaysian women surveyed reported that they experienced some form of sexual harassment in their workplace. [11] Women even are at high risk facing harassment and even sexual assault on their daily commute to work. Thus, some women decided to not involve themselves in labour market and take care of their family members at home instead.

Besides, it was also observed that there was a big drop for male and female LFPR in Malaysia during the 2007 to 2009 recession period. During periods of economic weakness, a lack of good job opportunities discourages some people from searching for employment mainly because they believe that they could not find a job even if they looked and this encourages them to instead pursue other activities, such as staying at home to care for a family member. As a result, the labor force participation rate tends to decline during economic downturns and rebound during recoveries. Starting from the year 2010 at the end of the recession, the rate then escalated rapidly. It can be said that the New Economic Model (NEM) introduced by the sixth prime minister of Malaysia, Dato' Sri Najib Tun Razak in 2010 bore fruit. Under this plan, private sectors were empowered and to fiscal disparity between the wealthiest and poorest of Malaysians were reduced.

One surprising result that we can derive from our findings will be there is no much change in LFPR for both male and female during the Covid-19 pandemic period (2020-2021), instead they only experienced a slight decrement and then bounced back in the year of 2021. Again, we may say that the National Economic Recovery Plan (PENJANA) did a good job in boosting the whole growth of labour market through a multitude of initiatives such as wage subsidy programme and fund aids to assist SMEs.

According to the bar plots, it was observed that during the past six years, the number of labour force with tertiary school education increased steadily whereas the number of labour force with only primary education showed a downward trend. This can be easily explained by the fast-changing world and competitiveness of the labour market in the 21st century today. It also showed that more people are getting the chances to gain their tertiary education in the higher learning institutions and the society today is putting much weight into education. Thus, the youth shall consistently raise their competencies and skills to fullfil the demand of the emerging jobs and fight for a spot in this rat race era.

We had also used Pooled OLS and FE models to observe how the determining factors such as marital status, age, and education level influence LFPR by gender. To choose the best model among both, we conducted F-statistics test for both male and female LFPR. (Refer to Appendix B1 and B2) From the results, we obtained our p-values as less than 2.2e-16 and 1.544e-05 respectively which are small enough for the test to be statistically significant and allow us to reject the null hypothesis where OLS is better than FE

model. Hence, we are going to dive deep into the FE model rather than the OLS. For male labour force, we can see that involvement of old age group in labour market was almost negligible and married men carried the biggest portion of LFPR followed by secondary education level. Men with divorced state even led negative correlations with LFPR. On the other hand, from the perspective of female LFPR, young female showed negative associations with LFPR and highest proportion of female LFPR was filled by married female.

6.0 Conclusions

This study focused on the time series analysis and forecasts of overall, male and female LFPR in Malaysia based on forty-years of data. It was found that there was still a considerable gap between male and female LFPR throughout the period even though male and female almost had the same level of educational attainment nowadays thanks to the advancement of technology. Thus, the policy makers should take all the associated factors into account and develop relevant policies to boost the equality of gender involving in the labour market. Firstly, to promote overall LFPR in Malaysia, policy makers should continuously and actively conduct more programme, for instance, job-oriented training at every nook and cranny to enhance soft skills of the youth before they enter the labour market. These new skills will be very useful for them to embrace the challenges in the real industrial world and increase their chances to be employed. Secondly, focusing on the female LFPR, policies such as maternity leave, job quota and wage per working hour should be revised from time to time and be amended if necessary. Not only that, gender discrimination and sexual harassment shall be reduced by taking initiatives such as conducting public awareness campaigns, enforcing the laws, and two-way peaceful negotiations. Thirdly, the welfare of the workers shall also be prioritised all the time, that is, they have the rights to have sufficient paid leaves, reasonable working hours, and other essential social protection measures. All in all, closing gender gaps in the labour force is not just good for women and their households, but also for a country’s economy growth.

7.0 Acknowledgement

This study has successfully come to its wrap, made possible through a lot of guidance and assistance from different parties. At the end of this study, we would like to extend our sincere thanks to all of them.

First and foremost, we would like to express our special thanks of gratitude to our lecturer, Professor Dr. Ibrahim Bin Mohamed for the valuable and constructive suggestions throughout the project. We appreciate the time he spared to guide us for better improvements om our works.

Lastly, we would also like to acknowledge with much appreciation to Department of Statistics Malaysia for providing the time series data of LFPR by gender, strata, education attainment and marital status to be used in our study.

8.0 References

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9.0 Appendices

You may find the datasets and codes here.

Appendix A1: Time Series Values of Malaysia LFPR (Overall, Male, Female)

Years	Labour Force Participation Rate (%)		
	Malaysia	Male	Female
1982	64.8	85.3	44.5
1983	65.6	85.6	45.7
1984	65.3	85.4	45.2
1985	65.7	85.6	45.9
1986	66.1	85.8	46.4
1987	66.5	85.6	47.5
1988	66.8	85.9	47.7
1989	66.2	85.6	46.7
1990	66.5	85.3	47.8
1992	65.9	84.9	46.9
1993	66.5	86.0	46.5
1995	64.7	84.3	44.7
1996	66.3	84.9	46.8
1997	65.6	84.3	46.0
1998	64.3	83.1	44.4
1999	64.2	82.8	44.6
2000	65.4	83.0	47.2
2001	64.9	82.3	46.8
2002	64.4	81.5	46.7
2003	65.2	82.1	47.7
2004	64.4	80.9	47.2
2005	63.3	80.0	45.9
2006	63.1	79.9	45.8
2007	63.2	79.5	46.4
2008	62.6	79.0	45.7
2009	62.9	78.9	46.4
2010	63.7	79.3	46.8
2011	64.5	79.7	48.0
2012	65.6	80.5	49.5
2013	67.3	81.0	52.6
2014	67.6	80.6	53.7
2015	67.9	80.6	54.1
2016	67.7	80.2	54.3
2017	68.0	80.1	54.7
2018	68.3	80.4	55.2

2019	68.7	80.8	55.6
2020	68.4	80.6	55.3
2021	68.6	80.9	55.5

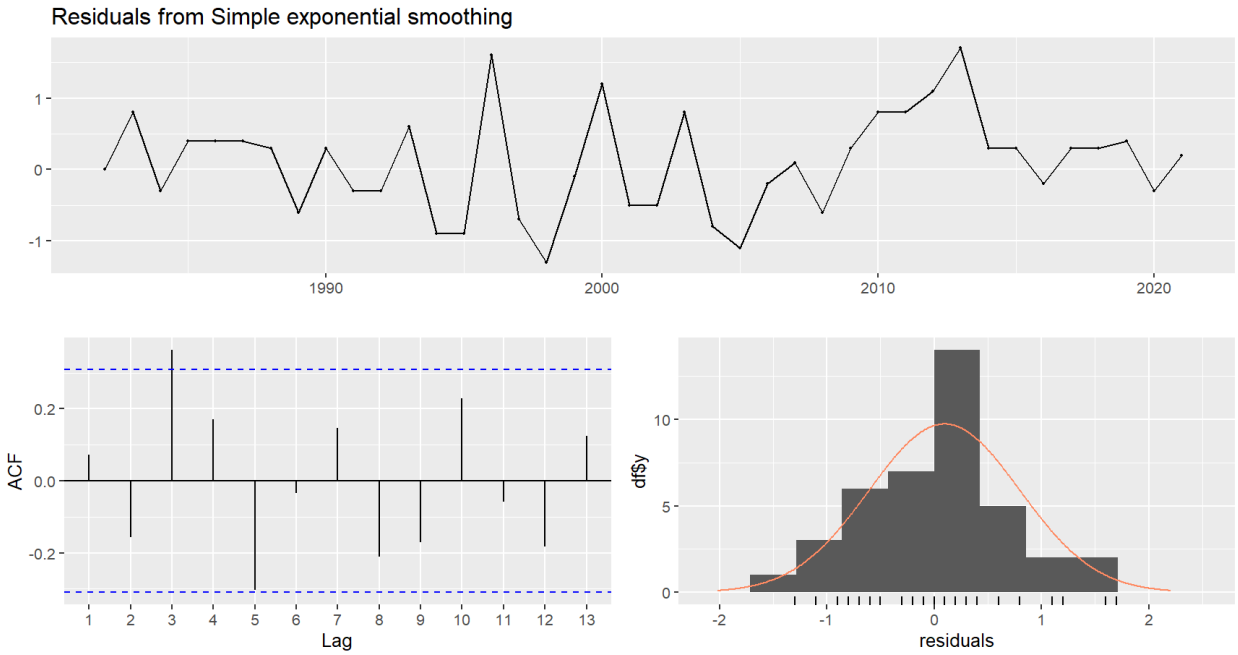
Appendix A2: Descriptive Analysis of Malaysia LFPR (Overall, Male, Female)

	LFPR (Malaysia)	**LFPR (Male)**	**LFPR (Female)**
Min	62.60 %	78.90 %	44.40 %
1st Quartile	64.42 %	80.42 %	45.92 %
Median	65.60 %	81.80 %	46.80 %
3rd Quartile	66.72 %	85.20 %	49.12 %
Max	68.70 %	86.00 %	55.60 %
Mean	65.70 %	82.43 %	48.38 %

Appendix A3: Details of SES Implementation for Overall LFPR in Malaysia

```
Forecast method: Simple exponential smoothing

Model Information:
Simple exponential smoothing

Call:
 ses(y = overall_lfpr_ts, h = 5)

  Smoothing parameters:
    alpha = 0.9999

  Initial states:
    l = 64.7997

  sigma:  0.7193

     AIC     AICc      BIC
125.1442 125.8108 130.2108

Error measures:
                     ME      RMSE       MAE        MPE      MAPE      MASE        ACF1
Training set 0.09501759 0.7010769 0.5750136 0.1367413 0.8776369 0.975023 0.07310329


> accuracy(ses(train, h = 6), test)
                     ME      RMSE       MAE        MPE      MAPE      MASE        ACF1
Training set 0.09119481 0.7504973 0.6264883 0.1308633 0.9593336 0.9706157 0.08417687
Test set     0.38336334 0.5148039 0.4500200 0.5589064 0.6573653 0.6972141 0.35725490
             Theil's U
Training set        NA
Test set      1.812104
```

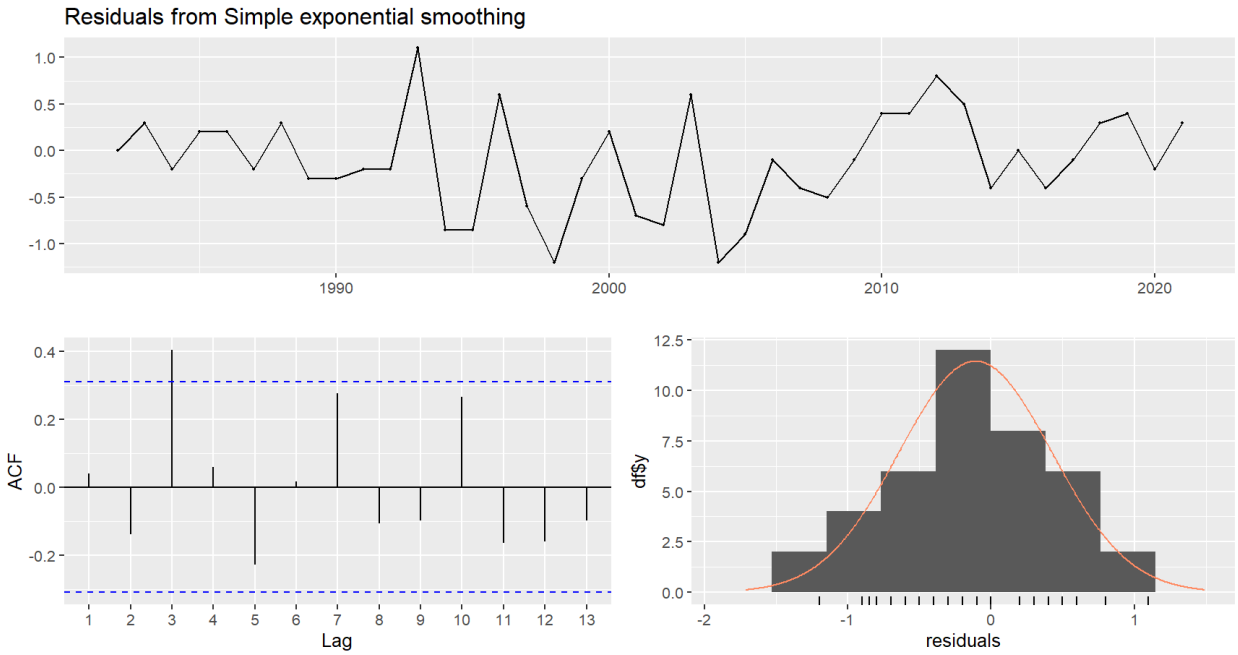
Appendix A4: Residuals of SES Implementation for Overall LFPR in Malaysia



Appendix A5: Details of SES Implementation for Male LFPR in Malaysia

```
Forecast method: Simple exponential smoothing

Model Information:
Simple exponential smoothing

Call:
 ses(y = male_lfpr_ts, h = 5)

  Smoothing parameters:
    alpha = 0.9999

  Initial states:
    l = 85.2999

  sigma:  0.5533

     AIC     AICc      BIC
104.1614 104.8280 109.2280

Error measures:
                     ME      RMSE       MAE         MPE      MAPE      MASE       ACF1
Training set -0.1100081 0.5393328 0.4400112 -0.1345418 0.5335656 0.9750247 0.03940502

> accuracy(ses(train2, h = 6), test2)
                     ME      RMSE       MAE         MPE      MAPE      MASE       ACF1
Training set -0.1382448 0.5709949 0.4676602 -0.1690867 0.5656434 0.9706155 0.02967072
Test set     -0.1000000 0.3109126 0.2666667 -0.1255627 0.3316803 0.5534591 0.38461538
             Theil's U
Training set        NA
Test set      1.039265
```

Appendix A6: Residuals of SES Implementation for Male LFPR in Malaysia

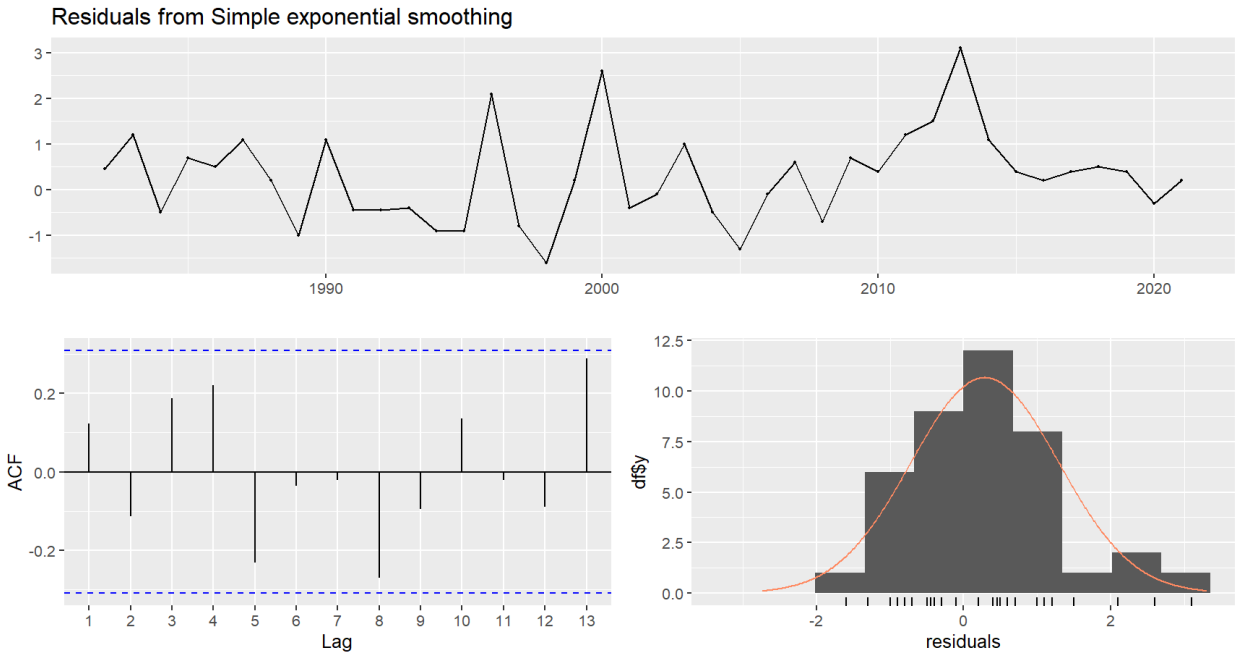


Appendix A7: Details of SES Implementation for Female LFPR in Malaysia

```
Forecast method: Simple exponential smoothing

Model Information:
Simple exponential smoothing

Call:
 ses(y = female_lfpr_ts, h = 5)

  Smoothing parameters:
    alpha = 0.9999

  Initial states:
    l = 44.0395

  sigma:  1.0604

     AIC     AICc      BIC
156.1948 156.8614 161.2614

Error measures:
                    ME      RMSE      MAE        MPE     MAPE      MASE      ACF1
Training set 0.28654 1.033545 0.80652 0.5548766 1.684855 0.9891283 0.1233918
```

```
> accuracy(ses(train3, h = 6), test3)
                    ME      RMSE       MAE       MPE     MAPE     MASE      ACF1
Training set 0.2959247 1.111287 0.8900212 0.578003 1.875482 0.985594 0.1244187
Test set     1.0000400 1.100036 1.0000400 1.808125 1.808125 1.107427 0.4047619
             Theil's U
Training set        NA
Test set      3.193799
```

Appendix A8: Residuals of SES Implementation for Female LFPR in Malaysia



Appendix B1: F-Statistics Test for Male LFPR OLS and FE Models

```
        F test for individual effects

data:  male_lfpr ~ primary + secondary + tertiary + single + married +  ...
F = 33.422, df1 = 15, df2 = 68, p-value < 2.2e-16
alternative hypothesis: significant effects
```

Appendix B2: F-Statistics Test for Female LFPR OLS and FE Models

```
        F test for individual effects

data:  female_lfpr ~ primary + secondary + tertiary + single + married +  ...
F = 4.2629, df1 = 15, df2 = 70, p-value = 1.544e-05
alternative hypothesis: significant effects
```