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**AN INTEGRATED FRAMEWORK OF SYSTEM DYNAMICS
AND STRUCTURAL EQUATION MODELING FOR
HOUSING PRICE TRENDS**



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**DOCTOR OF PHILOSOPHY
UNIVERSITI UTARA MALAYSIA
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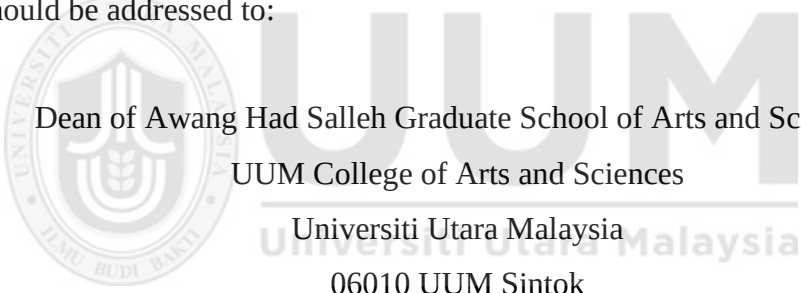
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Abstrak

Harga rumah di Malaysia terus meningkat akibat permintaan yang tinggi, penawaran yang terhad, dan isu kemampuan pembeli. Walaupun inisiatif kerajaan seperti skim perumahan mampu milik telah dilaksanakan, ramai masih tidak mampu membeli rumah akibat pertumbuhan pendapatan yang perlahan dan syarat pinjaman yang ketat. Akibatnya, kenaikan harga rumah terus dilihat sebagai punca utama masalah perumahan. Cabaran utama termasuk kesukaran mendapatkan pembiayaan perumahan, kebimbangan tentang kemampuan membeli, dan memastikan pembayaran balik pinjaman tidak melebihi satu pertiga daripada pendapatan bulanan. Isu-isu ini menyukarkan pembeli untuk mendapatkan pinjaman. Kajian lepas menggunakan pelbagai pendekatan pemodelan tunggal untuk mengenal pasti faktor-faktor yang mempengaruhi harga rumah. Sehubungan itu, kajian ini menyelidik faktor-faktor yang mempengaruhi harga rumah di Malaysia dengan mengintegrasikan Pemodelan Persamaan Berstruktur (SEM) dan Sistem Dinamik (SD). Integrasi SEM dan SD menggunakan model konseptual, dengan soal selidik sebagai instrumen pengumpulan data. Sampel terdiri daripada pengguna yang telah membeli rumah. SEM digunakan untuk menguji hipotesis yang dicadangkan dengan memeriksa hubungan antara faktor-faktor yang mempengaruhi harga rumah. Terdapat empat kumpulan faktor utama yang mempengaruhi harga rumah iaitu kepuasan terhadap perumahan (HS), pembiayaan perumahan (HF), dasar perumahan (HP), dan pendapatan isi rumah (HI). Setiap faktor utama mempunyai set soalan masing-masing: kepuasan terhadap perumahan dan pembiayaan perumahan masing-masing mengandungi 17 soalan, dasar perumahan mengandungi 10 soalan, dan pendapatan isi rumah mempunyai 5 soalan. Dapatan dari SEM digunakan untuk membangunkan model SD pada peringkat awal. Setelah model SD disahkan, fasa seterusnya adalah untuk menilai pelbagai strategi intervensi dan kesannya terhadap harga rumah. Intervensi strategi-strategi tersebut termasuk perubahan kadar cukai, kadar faedah pinjaman pemaju, dan pendapatan isi rumah menunjukkan impak terhadap harga rumah di Malaysia. Kajian ini menyediakan kerangka komprehensif untuk memahami kesan maklum balas antara faktor-faktor yang mempengaruhi harga rumah, menggunakan pendekatan bersepadu. Kerangka ini menunjukkan tingkah laku dinamik pasaran perumahan dan menilai strategi, memberikan maklumat bermanfaat kepada pihak berkuasa, terutamanya Kementerian Perumahan dan Kerajaan Tempatan (KPKT), dalam menangani isu-isu perumahan.

Kata Kunci: Pembeli rumah, Harga rumah, Pemodelan persamaan berstruktur, Sistem dinamik

Abstract

Housing prices in Malaysia are rising due to high demand, limited supply, and affordability issues. Despite government initiatives such as affordable housing schemes, many are still unable to purchase homes due to stagnant income growth and stringent loan requirements. As a result, rising housing prices continue to be seen as the main cause of housing problems. Key challenges include difficulty securing housing financing, affordability concerns, and ensuring mortgage repayments stay below one-third of monthly income. These issues make it increasingly difficult for buyers to secure loan options. Previous studies have used various single modeling approaches to identify the factors influencing housing prices. This study, therefore, examines the factors affecting housing prices in Malaysia by integrating Structural Equation Modeling (SEM) with System Dynamics (SD). The integration of SEM and SD uses a conceptual model, with a questionnaire as the data collection instrument. The sample consists of consumers who have purchased a house. SEM is employed to test the proposed hypotheses by examining the relationships between factors influencing housing prices. There are four main group factors affecting housing prices which are housing satisfaction (HS), housing financial (HF), housing policy (HP) and household income (HI). Each main factor has its own set of questions: Housing Satisfaction and Housing Financial each contain 17 questions, Housing Policy includes 10 questions, and Household Income has 5 questions. The SEM results were used to initially develop the SD model, which will then be refined based on the influencing factors. Once the SD model is validated, the next phase involved evaluating various intervention strategies and their impact on housing prices. The intervention of various strategies includes tax rate changes, developer loan interest rate, and household income shows impacts on house pricing in Malaysia. This study provides a comprehensive framework for understanding the feedback effects between factors influencing housing prices, using an integrated approach. It captures the dynamic behavior of the housing market and evaluates strategies, offering valuable insights for authorities, particularly the Ministry of Housing and Local Government (KPKT), in addressing housing issues.

Keywords: Homebuyer, Housing price, Structural equation modeling, System dynamics

Acknowledgements

In the name of Allah, the Most Gracious and the Most Merciful. Alhamdulillah, all praises to Allah for the strength and blessings in completing this thesis.

First and foremost, I would like to express my deepest appreciation to my supervisors, Assoc. Prof. Dr. Hasimah Sapiri and Assoc. Prof. Dr. Zahayu Md Yusof, for their continuous support, patience, motivation, and extensive knowledge given throughout my PhD journey. Without their motivation, enthusiasm, and persistent guidance, this thesis would not have come to fruition.

To my life-partner; Mohd Hamizan and my children; Hakimi, Haydani and Medina: I owe a lot to you all. You made my day and thank you for having my back completely, as this journey had started as early as 2020! I am indebted to my family members, for being with me every step of the way, through good times and bad. Without their love, patience and support over the years, none of this would have been possible. My late father, who throughout his lifetime had etched in the walls of my heart the importance of education. May Allah grant him Jannah.

My appreciation also extends to all academic and non-academic staff in the School of Quantitative Sciences and Awang Had Salleh Graduate School, UUM for their advice, guidance and assistance which benefited this research. My utmost appreciation goes to UiTM for providing me the opportunity and means to complete this research.

My sincere thanks also go to all my friends and my superiors at my workplace for their support morally, spiritually, and emotionally. Last but not least, my deepest gratitude goes to those who indirectly contributed to this research; your kindness means a lot to me. Thank you very much.

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List of Abbreviations

BNM	Bank Negara Malaysia
CFA	Confirmatory Factor Analysis
CLD	Causal Loop Diagram
EFA	Exploratory Factor Analysis
KPKT	Kementerian Perumahan dan Kerajaan Tempatan Ministry of Housing and Local Government of Malaysia
MHPI	Malaysian Housing Price Index
MIDF	Malaysian industrial development finance berhad
NAPIC	National Property Information Centre
REHDA	Real Estate and Housing Developers Association Malaysia
SD	System Dynamics
SEM	Structural Equation Modeling



CHAPTER ONE

INTRODUCTION

1.1 Introduction

This chapter is made up of several sections. Section 1.1 addresses the research background whilst Section 1.2 specifies the problem statement. Section 1.3 presents the research questions while Section 1.4 presents the research objectives. Section 1.5 clarifies the research significance, followed by the scope of study in Section 1.6. Section 1.7 defines and interprets the key terminologies used in the study, and finally Section 1.8 summarises the chapter.

1.2 Research Background

One of the most basic necessities for humans is shelter or specifically, a house. A house plays an important role as a place of experiential space (Mariadas et al., 2016), that provides a sense of unity, fulfils individual needs for a family or social relationship, and functions as a protective shelter. A shelter makes up the first base of Maslow's theory of human needs. People living in environments, neighbourhoods or areas that do not meet their criteria of needs will find it difficult to live as healthy or well-adjusted individuals (Kaur, 2013). Hence, apart from food and clothing, housing also represents a fundamental human need (Nayeri & Rostami, 2018). It is not surprising that housing issues have been receiving much interest worldwide, as the demand for housing has increased over time (Monkkonen, 2013; UN-Habitat, 2009). The unbalanced ratio between housing supply and housing demand is a rampant phenomenon (Chan & Lee, 2016). Based on definition, demand refers to the rate of the desire of consumers to

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Appendix A

Questionnaire for Factors Affecting Housing Prices



QUESTIONNAIRE SURVEY:

FACTORS EFFECTING HOUSING PRICE IN MALAYSIA

School of Quantitative Sciences

Dear Participant,

My name is Norani Amit. I am a researcher from Universiti Utara Malaysia (UUM). I am currently conducting research to find factors that affecting the housing price in Malaysia.

If you are a Malaysian, you are eligible to take part in this study. I would appreciate if you could fill out this form which may take around 10 minutes of your time. It would help me a lot in making this research a success. Your feedback to this questionnaire is extremely important towards completing this research.

All information you provide will be considered confidential and will not be identified by name in any thesis, report, or publication resulting from this study. All the information is strictly for the purpose of this research study and will only be used for statistical and mathematical analyses only.

Thank you. Norani Amit
PhD Candidate
School of Quantitative Sciences
Universiti Utara Malaysia
012-2423143
noraniamit19@gmail.com



QUESTIONNAIRE SURVEY:

FACTORS EFFECTING HOUSING PRICE IN MALAYSIA

School of Quantitative Sciences

Part A: Respondent's profile. Please tick one (✓) in the appropriate box.

1. Which category is your age?

☐
☐

24 years old or below

25-34

☐
☐

35-44

45-54

☐
☐

55-64

65 years and above

2. What is your gender:

☐

Male

☐

Female

3. What is your ethnic:

☐
☐

Malay

Indian

☐
☐

Chinese

Other (please specify)

4. What is your marital status?

☐
☐

Single

Married

☐
☐

Divorced

Widow/Widower

5. What is your highest education level?

☐
☐

Bachelor's degree

Master's Degree

☐
☐

Doctor of Philosophy

Other (please specify)

6. Do you have your own house?

☐

Yes

☐

No



QUESTIONNAIRE SURVEY:

FACTORS EFFECTING HOUSING PRICE IN MALAYSIA

School of Quantitative Sciences

Part B: Your employment background. Please tick one (✓) in the appropriate box.

7. What is your occupation?

- | | |
|--------------------------|-------------------------|
| ☐ | Self employed |
| ☐ | Private sector employee |
| ☐ | Public sector employee |
| ☐ | Other (please specify) |
-

8. How much is your current gross monthly salary?

- | | |
|--|---|
| ☐ Below RM2,000 | ☐ RM6,001 - RM7,000 |
| ☐ RM2,000 - RM3,000 | ☐ RM7,001 - RM8,000 |
| ☐ RM3,001 - RM4,000 | ☐ RM8,001 - RM9,000 |
| ☐ RM4,001 - RM5,000 | ☐ RM9,001 - RM10,000 |
| ☐ RM5,001 - RM6,000 | ☐ Above RM10,001 |

9. How many years of your working experience?

- | | |
|---|---|
| ☐ Less than 1 year | ☐ 11-15 years |
| ☐ 1-5 years | ☐ 16-20 years |
| ☐ 6-10 years | ☐ More than 20 years |



QUESTIONNAIRE SURVEY:

FACTORS EFFECTING HOUSING PRICE IN MALAYSIA

School of Quantitative Sciences

Part C: Your current residence. Please tick one (✓) in the appropriate box.

10. What type of house is your current residence?

☐ Flat/Apartment	☐ Semi-detached
☐ Condominium/Service Residence	☐ Bungalow
☐ Single Storey Terrace house	☐ Town house
☐ Double Storey Terrace house	☐ Other (please specify)

11. How long have you lived at your current residence?

☐ Less than 1 year	☐ 11-15 years
☐ 1-5 years	☐ 16-20 years
☐ 6-10 years	☐ More than 20 years

12. Which of the following best describes your current residence?

☐ Own	(please answer question 14-16 and proceed to Part D)
☐ Rent	(please proceed to Part D)
☐ Family Residence	(please proceed to Part D)
☐ Other (please specify)	(please proceed to Part D)

13. What is the price of your house?

☐ Less than RM100,000	☐ RM300,001 - RM350,001
☐ RM100,001 - RM150,000	☐ RM350,001 - RM400,000
☐ RM150,001 - RM200,000	☐ RM400,001 - RM450,000
☐ RM200,001 - RM250,000	☐ RM450,001 - RM500,000
☐ RM250,001 - RM300,000	☐ More than RM500,000



QUESTIONNAIRE SURVEY:

FACTORS EFFECTING HOUSING PRICE IN MALAYSIA

School of Quantitative Sciences

14. Location of your house?

- | | |
|--------------------------|------------------------|
| ☐ | Perlis |
| ☐ | Kedah |
| ☐ | Pulau Pinang |
| ☐ | Perak |
| ☐ | Selangor |
| ☐ | Kuala Lumpur/Putrajaya |
| ☐ | Negeri Sembilan |

- | | |
|--------------------------|------------|
| ☐ | Melaka |
| ☐ | Johor |
| ☐ | Pahang |
| ☐ | Terengganu |
| ☐ | Kelantan |
| ☐ | Sabah |
| ☐ | Sarawak |

15. Area of your house?

☐ Urban

☐ Rural

16. How did you own the house?

☐ Financial institution

☐ Paid by cash

17. What is the monthly mortgage for your house? (Please state below)

Monthly mortgage

RM _____



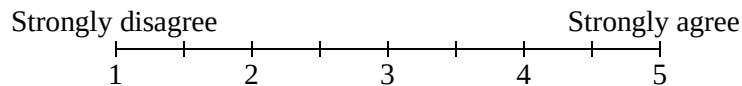
QUESTIONNAIRE SURVEY:

FACTORS EFFECTING HOUSING PRICE IN MALAYSIA

School of Quantitative Sciences

Part D: Factors related to housing price

Using the scale below, please indicate the extent of your agreement or disagreement by placing a (✓) in the appropriate box.



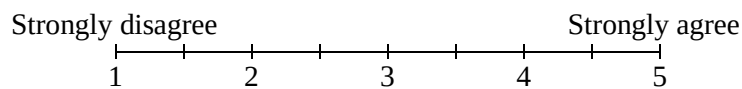
Items	1	2	3	4	5
1. I believe that houses are not affordable if I need to pay more than 30% of my monthly income to purchase a house					
2. I believe that my monthly income is insufficient to save on the housing deposit for purchasing the house					
3. I believe that houses are not affordable because of my financial commitments					
4. I have difficulties to purchase a house because my income is not enough to secure a housing loan					
5. I have difficulties to purchase a house because my income is not enough to pay the monthly mortgage					
6. I would consider the distance of shops when I purchase a house					
7. I would consider the availability of supermarket or retail centers when I purchase a house					
8. I would consider the existence of public infrastructures (health care centre) when I purchase a house					
9. I would consider the existence of public transportation when I purchase a house					
10. I would consider the presence of schools when I purchase a house					
11. I would consider the distance travelled to work when I purchase a house					
12. I would consider the level of crime rate when I decide to purchase a house					
13. I would consider the safety of the neighborhood when I decide to purchase a house					
14. I would consider the level of pollutants (air, water, noise) when I decide to purchase a house					
15. I would consider a society of the neighbourhood when I decide to purchase a house					
16. I would consider the built-up size when I decide to purchase a house					



QUESTIONNAIRE SURVEY:

FACTORS EFFECTING HOUSING PRICE IN MALAYSIA

School of Quantitative Sciences



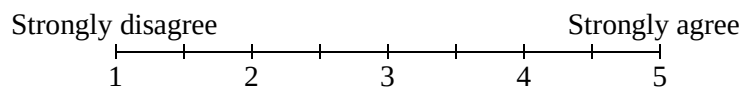
Items	1	2	3	4	5
17. I would consider the size of the living area when I decide to purchase a house					
18. I would consider the size of the dining area when I decide to purchase a house					
19. I would consider the number of bathrooms when I decide to purchase a house					
20. I would consider the number of rooms when I decide to purchase a house					
21. I would consider the internal structure of a house when decide to purchase a house					
22. I would consider the external structure of a house when I decide to purchase a house					
23. I would consider the effects of Real Property Gains Tax (RPGT) when I decide to purchase a house					
24. I would consider the Developer Interest Bearing Scheme (DIBS) given by developers when I decide to purchase a house					
25. I would consider the Base Lending Rate (BLR) when I decide to purchase a house					
26. I would consider the importance of Mortgage Loan to Value Ratio (LTV) before making a decision to purchase a house					
27. I would consider the property cooling measures set by the government when I make a decision to purchase a house					
28. I invest in a house property because it gives an attractive financial return for a long-term period					
29. I invest in a house property because it is an investment instrument to hedge against inflation					
30. I invest in a house property because it's a necessity for everyone					
31. I invest in a house property because I would like to reselling the house that I bought					
32. I invest in a house property at early working age (1 to 5 years working experience)					
33. I believe that the current house price is expensive for me to purchase a house in the housing market					
34. I believe that the rising of house price is because of overvaluation of the house property					



QUESTIONNAIRE SURVEY:

FACTORS EFFECTING HOUSING PRICE IN MALAYSIA

School of Quantitative Sciences



Items	1	2	3	4	5
35. I believe that housing costs are expensive in accordance to my household income					
36. I believe that there is volatility of house prices in the current housing market					
37. I believe that the housing price in the housing market was affected by an increasing of cost of material					
38. I believe that the housing price in the housing market was affected by an increasing cost of construction					
39. I believe that the housing price in the housing market was affected by an increasing of foreign investors					
40. I realize the existence of National Housing Policy evolve by government					
41. I believe that National Housing Policy was established to provide adequate housing					
42. I believe that National Housing Policy was established to provide comfortable housing					
43. I believe that National Housing Policy was established to provide quality housing					
44. I believe that National Housing Policy was established to provide affordable housing					
45. I realize of every new changes made by the government on housing policy					
46. I believe that financial literacy programmes should be incorporated in housing policy and schemes					
47. I realize of housing schemes such as PR1MA and My First Home Scheme (MFHS)					
48. I believe that housing schemes can assist in home ownership among tenants and buyers					
49. I believe that there should be a policy on controlling a segment of housing market					

END OF QUESTIONNAIRE

THANK YOU FOR YOUR TIME

Appendix B

Assessment of Outliers

Univariate Outliers

Z score	N	Minimum	Maximum
Zscore(i1)	311	-1.602	1.741
Zscore(i2)	311	-1.598	1.997
Zscore(i3)	311	-1.644	1.629
Zscore(i4)	311	-1.509	1.987
Zscore(i5)	311	-1.592	1.552
Zscore(sc4)	311	-1.537	1.650
Zscore(sc7)	311	-1.615	1.081
Zscore(sc8)	311	-1.608	1.537
Zscore(sc9)	311	-1.532	1.926
Zscore(sc10)	311	-1.924	1.341
Zscore(sc11)	311	-1.664	1.601
Zscore(sc12)	311	-1.754	1.557
Zscore(sc13)	311	-1.968	1.570
Zscore(sc14)	311	-1.733	1.848
Zscore(sc15)	311	-1.952	1.425
Zscore(sc16)	311	-1.309	1.442
Zscore(sc17)	311	-1.979	1.528
Zscore(Fi1)	311	-2.252	1.299
Zscore(Fi2)	311	-2.323	1.411
Zscore(Fi3)	311	-2.368	1.177
Zscore(Fi4)	311	-2.404	1.239
Zscore(Fi5)	311	-2.278	1.269
Zscore(Fi9)	311	-2.263	1.412
Zscore(Fi10)	311	-2.516	1.090
Zscore(Fi11)	311	-2.224	1.020
Zscore(Fi12)	311	-2.101	1.228
Zscore(Fi13)	311	-1.904	1.559
Zscore(Fi14)	311	-1.939	1.619
Zscore(Fi15)	311	-1.945	1.294
Zscore(Fi16)	311	-1.988	1.296
Zscore(HP1)	311	-2.220	1.198
Zscore(HP2)	311	-2.244	1.079
Zscore(HP3)	311	-2.295	1.116
Zscore(HP4)	311	-2.338	0.941
Zscore(HP5)	311	-2.154	1.017
Zscore(HP6)	311	-1.755	1.672
Zscore(HP7)	311	-2.354	1.035
Zscore(HP8)	311	-2.413	1.127
Zscore(HP9)	311	-2.415	1.183

Z score	N	Minimum	Maximum
Zscore(HP10)	311	-2.597	0.918
Zscore(Price)	311	-1.627	1.774

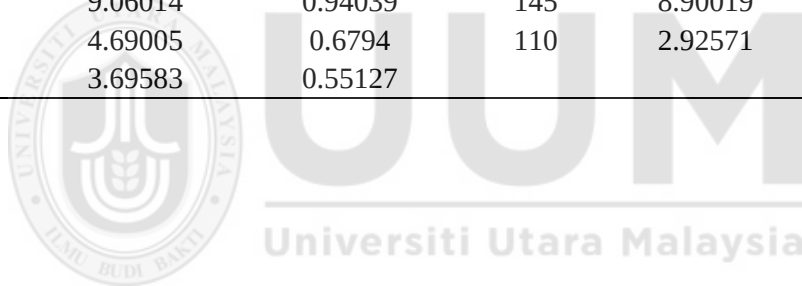
Multivariate Outliers

id	md	pvalue	id	md	pvalue
184	0.1651	0.00323	193	1.14612	0.11311
211	0.2019	0.00477	188	1.16874	0.11678
225	0.33967	0.01289	41	1.24876	0.12999
36	0.34028	0.01293	155	1.25882	0.13168
234	0.4341	0.02041	156	1.30255	0.13906
185	0.51249	0.02773	162	1.30862	0.14009
173	0.5349	0.02998	128	1.31158	0.14059
175	0.5677	0.03342	186	1.3174	0.14158
288	0.56922	0.03358	37	1.31805	0.14169
229	0.60802	0.03783	169	1.32233	0.14242
233	0.66073	0.04392	22	1.34695	0.14664
206	0.669	0.0449	231	1.36264	0.14934
179	0.67259	0.04533	200	1.37365	0.15124
295	0.68127	0.04638	216	1.39104	0.15425
178	0.68716	0.0471	87	1.39515	0.15496
5	0.70594	0.04941	223	1.39544	0.15501
172	0.72259	0.05149	271	1.40529	0.15673
251	0.7308	0.05252	241	1.41202	0.1579
182	0.77383	0.05808	291	1.41449	0.15833
20	0.79982	0.06153	205	1.44425	0.16353
40	0.80377	0.06206	287	1.46981	0.16802
189	0.8144	0.06349	245	1.49806	0.17301
153	0.82517	0.06496	24	1.51561	0.17613
204	0.83739	0.06663	198	1.52524	0.17784
160	0.83826	0.06675	165	1.54118	0.18068
177	0.87892	0.07243	163	1.56612	0.18513
236	0.89071	0.07411	170	1.61026	0.19305
238	0.96552	0.08502	309	1.64028	0.19847
202	0.96671	0.0852	159	1.64536	0.19938
213	1.00831	0.09147	174	1.65576	0.20126
191	1.0124	0.09209	286	1.70492	0.21018
195	1.02961	0.09473	221	1.71225	0.21151
201	1.06616	0.1004	143	1.77251	0.22249
164	1.07039	0.10106	305	1.803	0.22807
199	1.07093	0.10114	18	1.81705	0.23064
244	1.08394	0.10319	255	1.85004	0.23669
19	1.10689	0.10682	239	1.85139	0.23693
297	1.12753	0.11012	166	1.88317	0.24276
151	2.15557	0.29283	208	1.88928	0.24389
246	2.16115	0.29385	89	1.92874	0.25114

id	md	pvalue	id	md	pvalue
219	2.18251	0.29777	141	1.97306	0.25929
146	2.18837	0.29884	268	1.98351	0.26121
28	2.19286	0.29966	306	1.99822	0.26391
212	2.19609	0.30025	157	2.08374	0.27964
224	2.19894	0.30078	171	2.10042	0.2827
90	2.21704	0.30409	209	2.10153	0.28291
168	2.23606	0.30757	232	2.11387	0.28518
116	2.23826	0.30797	227	2.13716	0.28945
138	2.2619	0.31229	279	2.92837	0.43012
126	2.30735	0.32057	273	2.94133	0.43231
91	2.33319	0.32527	48	2.94497	0.43292
118	2.33956	0.32642	242	2.94602	0.4331
237	2.35146	0.32858	262	3.00827	0.44356
190	2.41894	0.34079	76	3.01886	0.44533
83	2.42691	0.34223	55	3.02388	0.44616
215	2.43593	0.34386	136	3.03727	0.44839
293	2.45103	0.34657	147	3.07855	0.45523
301	2.49584	0.35462	14	3.10145	0.45901
132	2.49695	0.35482	129	3.11234	0.4608
86	2.52129	0.35917	292	3.12081	0.46218
260	2.52321	0.35952	261	3.12809	0.46338
217	2.52362	0.35959	302	3.16659	0.46966
3	2.58162	0.36992	54	3.17229	0.47058
58	2.58323	0.3702	73	3.18451	0.47256
257	2.59945	0.37308	269	3.21193	0.47699
240	2.62893	0.37829	85	3.24036	0.48156
187	2.65758	0.38334	7	3.24712	0.48265
52	2.67615	0.38661	123	3.31042	0.49272
299	2.67871	0.38705	82	3.34845	0.49871
47	2.69352	0.38965	125	3.35006	0.49896
265	2.72287	0.39478	17	3.36733	0.50166
70	2.74415	0.39849	92	3.39607	0.50614
57	2.7547	0.40032	154	3.42362	0.51041
65	2.77823	0.4044	59	3.45333	0.51499
300	2.78223	0.4051	298	3.46972	0.5175
280	2.79866	0.40794	26	3.4852	0.51987
144	2.80089	0.40832	272	3.54418	0.52881
61	2.81047	0.40997	13	3.55334	0.53019
267	2.82194	0.41195	112	3.57684	0.53371
49	2.84099	0.41522	135	3.57719	0.53376
115	2.86342	0.41906	161	3.5973	0.53676
294	2.86811	0.41987	4	3.646	0.54397
283	2.92475	0.4295	121	3.6587	0.54584
256	2.92772	0.43001	281	3.70106	0.55203
207	3.78941	0.56474	117	4.71137	0.68179
218	3.79613	0.5657	56	4.72663	0.68349
62	3.80309	0.56669	303	4.74922	0.68599

id	md	pvalue	id	md	pvalue
29	3.86007	0.57473	51	4.78376	0.68979
284	3.86109	0.57487	75	4.79101	0.69058
68	3.94077	0.58592	11	4.85667	0.69768
133	3.96928	0.58982	264	5.01964	0.71471
122	3.97049	0.58999	107	5.03736	0.71651
27	3.98516	0.59198	45	5.03738	0.71652
88	3.99123	0.59281	181	5.0975	0.72256
32	4.0232	0.59712	81	5.13007	0.72579
71	4.07479	0.60402	176	5.21676	0.73423
104	4.07752	0.60438	108	5.33444	0.74533
259	4.10402	0.60789	50	5.35165	0.74692
140	4.13902	0.61248	98	5.3694	0.74855
142	4.15748	0.61489	150	5.43919	0.75487
66	4.16669	0.61608	120	5.49104	0.75948
220	4.19438	0.61966	148	5.53152	0.76303
270	4.21227	0.62196	282	5.53791	0.76358
263	4.23774	0.62521	30	5.57431	0.76673
277	4.29026	0.63185	43	5.62002	0.77062
74	4.30022	0.6331	210	5.70983	0.77811
124	4.31793	0.63532	196	5.75148	0.78151
167	4.32247	0.63588	53	5.81088	0.78628
16	4.34364	0.63851	183	5.85775	0.78997
95	4.34621	0.63883	35	5.87597	0.7914
130	4.38817	0.64399	114	5.87633	0.79142
254	4.43858	0.65011	64	6.02124	0.80243
69	4.46217	0.65294	38	6.04215	0.80398
33	4.51628	0.65938	228	6.06267	0.80548
67	4.51777	0.65955	226	6.08419	0.80705
60	4.51909	0.65971	235	6.09158	0.80759
109	4.53868	0.66201	1	6.23517	0.81774
100	4.5401	0.66218	2	6.24939	0.81872
258	4.55325	0.66372	79	6.25014	0.81877
278	4.56976	0.66564	80	6.36244	0.82633
103	4.5781	0.66661	101	6.37015	0.82684
84	4.59073	0.66808	99	6.4201	0.83011
214	4.61298	0.67064	307	6.5036	0.83544
15	4.61812	0.67123	308	6.58043	0.84021
131	4.63038	0.67263	44	6.61744	0.84246
304	4.63174	0.67279	97	6.64522	0.84413
275	4.68014	0.67828	137	6.72245	0.8487
197	9.13229	0.94212	9	6.82897	0.85479
249	4.69199	0.67962	266	6.94397	0.86112
106	4.70282	0.68083	113	7.03923	0.86617
119	4.70418	0.68098	77	7.05757	0.86712
296	7.1337	0.87101	102	9.13844	0.94227
31	7.13879	0.87127	289	9.23948	0.94462
311	7.15589	0.87212	94	9.37891	0.9477

id	md	pvalue	id	md	pvalue
248	7.17373	0.87301	21	9.44318	0.94907
6	7.18076	0.87336	274	9.51935	0.95065
158	7.1845	0.87355	285	9.67111	0.95365
139	7.20709	0.87466	149	9.84514	0.95688
12	7.31257	0.87974	276	9.88584	0.9576
243	7.42543	0.88496	230	9.9311	0.9584
8	7.42701	0.88503	78	10.01806	0.95988
310	7.49612	0.88812	42	10.07248	0.96078
23	7.56888	0.89129	96	10.19962	0.9628
252	7.66964	0.89554	111	10.21276	0.96301
222	7.72386	0.89777	250	10.76864	0.97071
46	7.79713	0.9007	203	10.99788	0.97341
253	7.85099	0.90281	290	12.01478	0.98276
152	7.94147	0.90625	10	12.04651	0.98299
192	7.95197	0.90665	39	12.0541	0.98305
127	8.09247	0.91175	134	13.53886	0.99108
194	8.09897	0.91198	63	8.65098	0.92956
34	8.16964	0.91444	247	8.68821	0.93062
93	8.28825	0.91843	180	8.86106	0.93533
105	9.06014	0.94039	145	8.90019	0.93636
72	4.69005	0.6794	110	2.92571	0.42967
25	3.69583	0.55127			



Appendix C

Sub-Model Equations

Household income

average household amount=7e-007

Units: 1/people

average household disposable income=average household income

Units: RM

average household income=(household*GDP rate)*(0.9256*Malaysian income)

Units: RM

birthrate=Population*fractional birthrate

Units: people/year

change demand house=(household*average household amount)*average household disposable income

Units: RM

deathrate=fractional deathrate*Population

Units: people/year

fractional birthrate=0.06

Units: 1/year

fractional deathrate=0.05

Units: 1/year

GDP rate=1e-005

Units: 1/people

household=Population

Units: people

housing price= INTEG (increase in price-decrease in price,170000)

Units: RM

income decrease=income decrease rate*Malaysian income

Units: RM/year

income decrease rate=0.01

Units: 1/year

income increase=income increase rate*Malaysian income

Units: RM/year

income increase rate=0.05

Units: 1/year

Malaysian income= INTEG ((income increase-income decrease),31456.2)

Units: RM

Population= INTEG (birthrate-deathrate,2.91705e+007)

Units: people

price and income ratio=housing price/average household disposable income

Units: 1

Housing Policy

decrease supply=housing supply*rate of decrease supply

Units: unit/year

demolition rate=Government programme*house life

Units: unit/year

developer loan interest rate=monetary and financial policies

Units: RM

Government programme= INTEG (sales rate-demolition rate,103989)

Units: unit

house life=0.005

Units: 1/year

housing demand= INTEG ((demand increase-demand decrease)*(change demand house*investment demand),272669)

Units: unit

housing price= INTEG (increase in price-decrease in price,170000)

Units: RM

housing supply= INTEG ((increase supply-decrease supply)*(rate of developer*loan amount of developers),92298)

Units: unit

increase supply=rate of increase supply*housing demand

Units: unit/year

loan amount of developers=developer loan interest rate

Units: RM

monetary and financial policies=0.127*housing price

Units: RM

rate of decrease supply=3.5e-005

Units: 1/year

rate of developer=0.001

Units: 1/RM

rate of increase supply=0.0002

Units: 1/year

sales per year=0.009

Units: 1/year

sales rate=sales per year*housing supply
Units: unit/year

Housing Satisfaction

change demand house=(household*average household amount)*average household disposable income
Units: RM

decrease in demand rate=0.0095
Units: 1/year

demand decrease=decrease in demand rate*housing demand
Units: unit/year

demand increase=demand per household
Units: unit/year

demand per household=0.1431*demand satisfaction rate
Units: unit/year

demand satisfaction rate=sales rate
Units: unit/year

housing demand= INTEG ((demand increase-demand decrease)*(change demand house*investment demand),272669)
Units: unit

investment demand=1e-007
Units: 1/RM

Potential buyers= INTEG (demand satisfaction rate,96730.7)
Units: unit

sales rate=sales per year*housing supply
Units: unit/year

Housing Financial

building price=0.001
Units: 1/unit

comprehensive cost=tax rate
Units: RM

decrease in price=decrease rate*housing price
Units: RM/year

decrease rate=0.001
Units: 1/year

housing demand= INTEG ((demand increase-demand decrease)*(change demand house*investment demand),272669)

Units: unit

housing price= INTEG (increase in price-decrease in price,170000)

Units: RM

housing supply= INTEG ((increase supply-decrease supply)*(rate of developer*loan amount of developers),92298)

Units: unit

increase in price=(comprehensive cost*increase rate)*(building price*supply and demand ratio)

Units: RM/year

increase rate=0.001

Units: 1/year

macro policy control=housing price

Units: RM

supply and demand ratio=housing demand-housing supply

Units: unit

tax policy=0.04*macro policy control

Units: RM

tax rate=tax policy

Units: RM



Appendix D

List of Publications

Journal

1. Amit, N., Sapiri, H. & Yusof, Z. M. (2020). Factors Affecting Housing Prices in Malaysia. *PalArch's Journal of Archaeology of Egypt/Egyptology*, 17(6), 11811-11823.
2. Amit, N., Sapiri, H., & Yusof, Z. M. (2022). Factors Affecting Housing Price in Malaysia Using Structural Equation Modeling Approach. *Sains Malaysiana*, 51(12), 4161-4173.

Conference Proceedings

1. Amit, N., Sapiri, H., & Yusof, Z. M. (2021, July). Logistic regression analysis on the determinants of homeownership. In *AIP Conference Proceedings* (Vol. 2365, No. 1, p. 060013). AIP Publishing LLC.
2. Adlee, N. F. K., Misiran, M., Yusof, Z. M., Sapiri, H., & Amit, N. (2022, June). Sustainable housing for Malaysian: A crowdfunding initiative through SEM perspective. In *AIP Conference Proceedings* (Vol. 2465, No. 1, p. 030005). AIP Publishing LLC.
3. Adlee, N. F. K., Misiran, M., Yusof, Z. M., Sapiri, H., & Amit, N. (2022, August). Perception on Malaysia fundmyhome crowdfunding initiative for affordable housing. In *AIP Conference Proceedings* (Vol. 2472, No. 1, p. 050001). AIP Publishing LLC.
4. Amit, N., Sapiri, H., & Yusof, Z. M. (2023, November). Determining factors that affecting housing price in Malaysia via factor analysis. In *AIP Conference Proceedings* (Vol. 2896, No. 1, p. 050003). AIP Publishing LLC.