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Master Thesis

Residential Location Preferences in Rapidly Growing Cities:

—

A Discrete Choice Analysis of City-Center versus Urban-Edge Housing in Duhok

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Abstract

Rapid urban growth in Duhok has happened alongside outward expansion and increasing high-rise residential development, while limited empirical evidence is available on how residents trade off their competing residential needs. This study analyzes residential location preferences between city-center housing and urban-edge housing in Duhok and identifies the main factors influencing this choice, with a focus on accessibility, affordability, and comfortability. A stated preference approach using a Discrete Choice Experiment (DCE) was applied to quantify the trade-offs residents make between accessibility, housing cost, residential quality, and apartment size. The survey included 423 respondents, each evaluating eight choice sets that include two alternative housing options, and residential choices were analyzed using multinomial logit models.

The findings demonstrate that residential choice is influenced significantly by each of the four housing attributes. Residential utility is increased by larger apartment sizes and better residential quality, but it is decreased by poorer accessibility and higher housing costs. Accessibility has the largest absolute coefficient in the baseline model, followed by residential quality, apartment size, and housing cost. In the baseline model, a one-step worsening of accessibility corresponds to a compensating reduction in monthly housing cost of approximately $281 under the experimental coding. The negative effects of poorer accessibility are reduced by car ownership, but housing costs are less influential in the choices of higher-income respondents. Older respondents value residential quality more; in contrast, the interaction between family stage and apartment size is not statistically significant. With respondent-clustered standard errors, the final model finds no statistically significant difference in the remaining city-center preference between current center and edge residents. Despite the combined center constant being positive and significant in the current-center group, the comparison between groups does not provide enough evidence of a status quo or residential self-selection effect.

In general, the findings show that residential choice in Duhok is influenced by trade-offs between housing characteristics instead of by central or peripheral location alone. For residential development and urban transport planning, central development should provide appropriate housing sizes and good residential quality, while urban-edge development should be planned together with reliable public transport and access to important services. Housing affordability should also remain an important factor because different financial situations affect the residential choices that are available to households.

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List of Abbreviations

ASC	Alternative-Specific Constant
BRT	Bus Rapid Transit
CBD	Central Business District
DCE	Discrete Choice Experiment
IIA	Independence of Irrelevant Alternatives
IID	Independently and Identically Distributed
IQD	Iraqi Dinar
ITF	International Transport Forum
KRSO	Kurdistan Regional Statistics Office
MICS	Multiple Indicator Cluster Survey
MNL	Multinomial Logit
MoE	Margin of Error
MRS	Marginal Rate of Substitution
NIMBY	Not In My Backyard
RP	Revealed Preference
SP	Stated Preference
UNHCR	United Nations High Commissioner for Refugees
UNICEF	United Nations Children's Fund
WTP	Willingness to Pay

List of Mathematical Notation

Notation	Meaning
Sample-size calculation	
n	Required sample size.
N	Population size used in the sample-size calculation.
e	Nominal error parameter used for sample-size planning, expressed as a decimal.
Experimental design	
A	Number of attributes in the full factorial design formula.
L	Number of levels per attribute when all attributes have the same number of levels.
L^A	Number of possible profiles for one alternative when each of the A attributes has L levels.
Indices	
$i,\ j$	Indices identifying residential alternatives.
q	Index identifying an individual respondent.
k	Index identifying an attribute.
I	Number of alternatives in the choice set.
K	Number of attributes in the general systematic utility specification.
Utility and explanatory variables	
$U_{jq},\ U_{iq}$	Total utility of alternative j or i for individual q.
$V_{jq},\ V_{iq}$	Systematic (deterministic) component of utility for alternative j or i and individual q.
$\varepsilon_{jq},\ \varepsilon_{iq}$	Random component of utility for alternative j or i and individual q, representing unobserved influences.
U_i	Utility of alternative i in the baseline specification, with the respondent index omitted.
ε_i	Random component of utility for alternative i in the baseline specification, with the respondent index omitted.
X_k	Attribute k.
$X_{1j},\ X_{2j},\ X_{kj}$	Values of the first, second, and kth attributes, respectively, for alternative j.
$f(\cdot)$	Function applied to an attribute in the general systematic utility specification.
Utility coefficients	
β	General notation for an estimated utility coefficient.
β_{0j}	Alternative-specific constant for alternative j.
$\beta_{1j},\ \beta_{2j},\ \beta_{kj}$	Coefficients associated with the first, second, and kth attributes of alternative j in the general systematic utility specification.
β_1	Accessibility coefficient in the baseline utility equation.
β_2	Housing-cost coefficient in the baseline utility equation.

Notation	Meaning
β_3	Residential-quality coefficient in the baseline utility equation.
β_4	Apartment-size coefficient in the baseline utility equation.
β_k	Coefficient associated with attribute k in the marginal rate of substitution formula.
$\beta_{\text{Accessibility}}$	Accessibility coefficient used in the accessibility trade-off calculation.
β_{Cost}	Housing-cost coefficient used in the marginal rate of substitution calculations.
β_{Quality}	Residential-quality coefficient used in the residential-quality trade-off calculation.
β_{Size}	Apartment-size coefficient used in the apartment-size trade-off calculation.
$\beta_{\text{Accessibility}-\text{NoCar}}$	Accessibility coefficient for respondents who do not own a private vehicle.
$\beta_{\text{Accessibility}-\text{Car}}$	Combined accessibility coefficient for respondents who own a private vehicle.
Choice probabilities	
P_{jq}	Probability that individual q chooses alternative j.
P	Choice probability in the utility-comparison equation.
$\text{Prob}(\cdot)$	Probability of the event in parentheses.
$e^{V_{jq}}$, $e^{V_{iq}}$	Exponentiated systematic utility in the MNL probability formula. Here, e denotes Euler's number.
$\sum_{i=1}^{I}$	Summation over all I alternatives in the choice set.
Estimation and statistical inference	
G	Number of respondents, treated as clusters in the finite-sample correction.
N	Number of choice situations in the finite-sample correction. In the descriptive statistics, N instead denotes the number of respondents.
K	Number of estimated parameters in the finite-sample correction.
SE	Standard error of an estimate. The reported standard errors are clustered by respondent.
z	Wald test statistic used for statistical inference.
p	Two-sided p-value associated with a statistical test.
LL	Log-likelihood of the estimated model.
Pseudo-R^2	McFadden's measure of model fit relative to the null model.
Residential trade-offs	
MRS_k	Marginal rate of substitution between attribute k and housing cost, calculated as $-\beta_k/\beta_{\text{Cost}}$.
$\text{MRS}_{\text{Quality}}$	Marginal rate of substitution between residential quality and housing cost.
MRS_{Size}	Marginal rate of substitution between apartment size and housing cost.
$\text{MRS}_{\text{Accessibility}}$	Marginal rate of substitution between accessibility and housing cost.
$\text{MRS}_{\text{Accessibility}-\text{NoCar}}$	Accessibility–cost trade-off for respondents without a private vehicle, using the cost coefficient for the below- and average-income reference group.
$\text{MRS}_{\text{Accessibility}-\text{Car}}$	Accessibility–cost trade-off for respondents with a private vehicle, using the cost coefficient for the below- and average-income reference group.
WTP	Willingness to pay for a change in a residential attribute.

Note: The meanings of N, K, and e depend on the equation or context, as indicated above. Monetary trade-offs expressed in housing-cost code units are converted to monthly US dollars by multiplying by 100.

1. Introduction

Urban planning policy has promoted compact city development as a way of responding to rapid urbanization and sustainability pressures, which focuses on residential densities to improve land-use efficiency and support accessibility (Jenks et al., 1996; Jenks and Dempsey, 2005). However, empirical evidence shows that density alone does not guarantee better results (Berghauser Pont et al., 2021). Despite compact development being able to reduce travel distance and provide some efficiency benefits, its effects depend on maintaining the quality of accessibility, affordability, and environmental quality (Ewing and Cervero, 2010; Meyer and Miller, 2001; Berghauser Pont et al., 2021). In practical terms, living in a higher-density area does not automatically mean better residential satisfaction; many households may prefer lower-density environments (Howley, 2009). This causes a conflict between urban form that is promoted through planning policy and household-level residential behavior. From a behavioral perspective, residential location choice cannot be explained only by density, but by trade-offs among important factors of residential utility, such as housing, accessibility, and neighborhood characteristics (Schirmer et al., 2014; Bocarejo et al., 2017). In classical and behavioral economic theories, housing is understood as a bundle of attributes; households evaluate combinations of accessibility, cost, and residential environment when choosing where to live (Alonso, 1964; Lancaster, 1966). Accessibility refers to the ability of people to reach services, employment, and daily activities within acceptable time and constraints (Mokhtarian and Salomon, 2001; Zondag and Pieters, 2005). Affordability describes how housing and transport costs compare to household incomes; it can limit the available choices people can make (Glaeser, 2012; So et al., 2001). Comfortability is a multidimensional idea about how good the housing is, how much privacy there is, and whether there's enough living space (Adriaanse, 2007; Galster and Hesser, 1981; Saleem and Alchalabi, 2024). This means that residential choice can be seen as a constrained optimization process in which households choose the option that provides the highest overall utility and evaluate their options in existing structural conditions based on their needs (Marcucci et al., 2010). Despite this behavioral foundation, relationships between spatial structure and residential outcomes should not always be seen as direct effects of the built environment, because residential patterns may also be influenced by household preferences and residential self-selection (Bohte et al., 2009). Because housing choices are influenced by market constraints and the availability of alternatives, this approach becomes limited, instead of always reflecting people's unconstrained preferences (Ben-Akiva and Boccara, 1995; Timmermans et al., 1992). Residential patterns may result partly from limited choices and self-selection, rather than unrestricted preferences for specific urban forms (Cao et al., 2009). This is especially important in rapidly growing cities, where structural constraints can influence the residential options that are available to households.

Duhok, located in the Kurdistan Region of Iraq, provides a context where these dynamics become more intense. Rapid population growth in the city has occurred within a geographically constrained context by both outward urban expansion and increasing high-rise residential development (Mohammed, 2013; Dhuoki and Çağnan, 2021). Living in the city center can provide easier access to employment and services, but central Duhok also faces serious traffic congestion and pressure from high levels of private-vehicle use. Meanwhile, at the urban edge, limited public transport can make residents more dependent on private vehicles (Abdullah et al., 2020; Othman and Raswol, 2024). In Duhok, car dependency and limited public transport are also well documented even in central areas (Abdullah et al., 2020). The Kurdistan Region also hosts refugees and internally displaced populations (United Nations High Commissioner for Refugees (UNHCR), 2026; Kurdistan Region Statistics Office, 2021). This displacement may increase demand for infrastructure and public services. In this context, the relationship between density and accessibility becomes conditional. Contemporary planning frameworks, including the 15-minute city model, focus on proximity and local accessibility as important objectives (Moreno et al., 2021; ITF, 2024). However, accessibility

depends not only on spatial proximity but also on transport systems, service distribution, and conditions of travel. Central locations may not provide effective accessibility despite their spatial advantage when congestion, limited public transport, and uneven infrastructure exist. Research on residential location choice shows that households may accept lower accessibility in exchange for lower housing cost or better environmental and residential quality when comparing different locations (Bocarejo et al., 2017; Marcucci et al., 2010). These dynamics are more relevant in car-dependent environments. In car-dependent urban systems, outward urban development can encourage more private-vehicle ownership and use, which can then result in even more congestion (Pokharel et al., 2023). In Duhok, the weak public transport systems and the dominance of private vehicles have resulted in increased reliance on cars, affecting how people experience accessibility in the city (Abdullah et al., 2020; Othman and Raswol, 2024). These conditions suggest that the accessibility of central and peripheral locations should be assessed not only by distance, but also by travel time and the mobility conditions people face in their daily lives. Despite the importance of these interactions, there is limited empirical evidence on how households in Duhok balance between accessibility, affordability, and comfortability when choosing between housing in the city center and the urban edge. Based on the literature reviewed for this study, there is limited quantitative evidence that shows the relative importance of these factors and the extent to which households are willing to trade one attribute for another in Duhok. This limit makes it more difficult for planning strategies to connect spatial development with the way households make residential decisions.

To address this limitation, this study uses a stated preference approach using a discrete choice experiment (DCE) to model residential location choice. Participants are presented with controlled hypothetical housing scenarios; the method allows to estimate the trade-offs between key attributes and addresses some limitations of the revealed-preference approach, where observed choices may be restricted by availability, prices, and market conditions (Louviere et al., 2000; Train, 2009). This approach makes it possible to estimate the relative importance of accessibility, affordability, and comfortability, as well as the willingness of households to accept trade-offs among these factors.

1.1. Research Justification

Understanding the behavioral factors that drive urban expansion requires examining how residents balance competing residential needs. Rapid urban growth in Duhok has involved both outward expansion and high-rise residential development (Mohammed, 2013; Dhuoki and Çağnan, 2021). However, there is limited empirical evidence regarding how residents trade off these competing needs. From a theoretical perspective, this research is based on Bid Rent Theory, which explains the trade-off between accessibility, land or housing cost, and residential space, meaning that households may accept greater distance from central locations in exchange for lower land or housing costs and more living space (Alonso, 1964). Additionally, according to Lancaster's New Theory of Consumer Demand, individuals don't gain utility from goods themselves, but from the specific attributes of these goods. When applied to housing, this implies that households value attributes such as size, location, and price (Lancaster, 1966). In Duhok, this theoretical trade-off is relevant because rapid urban growth has taken place within a geographically restricted setting and has been accompanied by outward expansion (Mohammed, 2013). At the same time, the city's excessive dependence on private vehicles and limited public transport make daily accessibility an important factor when evaluating residential development outside central areas (Abdullah et al., 2020). However, lower accessibility at the urban edge can increase reliance on private vehicles even more, specifically in a city that has limited public transport and high car dependency (Abdullah et al., 2020). Understanding these preferences is essential for evaluating whether current development patterns align with residents' needs and long-term sustainability objectives.

1.2. Research Gap

Urban expansion and residential development processes are widely understood as the outcome of both structural constraints and individual decision-making processes. While studies focused more on planning have mainly focused on land-use patterns, density, strategies, and sustainability objectives, urban research also highlights that residential location outcomes cannot be fully explained without analyzing household preferences and trade-offs (Clark and Dieleman, 2017; van Wee, 2009). This is especially important in rapidly growing cities, because structural constraints and household preferences can shape residential outcomes differently from what spatial planning objectives alone might suggest. Furthermore, relying only on observed housing patterns can be misleading because actual residential choices do not always reflect unconstrained preferences. The alternatives available or considered by households may be limited by housing-market conditions, affordability, and other constraints (Ben-Akiva and Boccara, 1995; Timmermans et al., 1992). This issue is also acknowledged in transport and housing research, where residential self-selection makes the understanding of the relationship between where people live and how they travel more difficult (Cao et al., 2009). Based on the literature reviewed for this study, limited evidence was found on the quantitative trade-offs between accessibility, affordability, and comfortability in developing or post-conflict urban contexts. This lack of evidence is especially important in rapidly growing cities where limited public transport and car-dependent development can make accessibility an important constraint on residential location choice (Banister, 2008; Næss, 2012).

To address this, this study uses a stated preference experiment to quantify how residents assess the importance of accessibility, comfortability, and affordability when choosing between the city center and urban edge. By estimating these trade-offs, the study provides empirical evidence on residential decision-making in Duhok. This approach complements the traditional planning analyses and provides evidence relevant to sustainable residential and transport planning.

1.3. Research Aim and Objectives

The main aim of this research is to analyze public preferences for residential location choice between city-center and urban-edge housing in Duhok, and to identify the key factors influencing this decision.

1. Examine how accessibility, affordability, and comfortability influence residential location choice.
2. Quantify the relative importance of these factors in shaping preferences for city-center versus urban-edge housing.
3. Analyze trade-offs residents are willing to make between accessibility, housing cost, and residential comfort.
4. Provide policy-relevant perspectives to support sustainable residential planning and housing strategies in rapidly growing cities such as Duhok.

1.4. Research Questions

To address the research aim and objectives, the study is guided by the following research questions:

1. What is the relative influence of accessibility, affordability, and comfortability on residential location choice?
2. How do residents in Duhok choose between living in the city center and at the edge of the city?
3. To what extent are residents willing to trade lower accessibility for improved affordability or comfort?
4. How can the identified preferences inform residential development and urban transport planning policies?

1.5. Research Contributions

This study contributes to the analysis of residential location choice by providing context-specific evidence through a methodologically consistent approach. First, it provides empirical evidence on residential preferences in the city of Duhok, a rapidly growing city in the Kurdistan Region of Iraq, where housing choices are influenced by rapid urban growth and structural constraints. Second, the study measures the relative importance of accessibility, affordability, and comfortability in influencing residential location choice. By using a discrete choice experiment, it identifies the trade-offs individuals make between these attributes and analyzes how these trade-offs are related to preferences for city-center and urban-edge locations. Third, the study analyzes how residential preferences vary according to household and mobility characteristics, including income, car ownership, age, family stage, and current residential location. This helps explain how individual constraints and circumstances influence the trade-offs residents make between different housing attributes. Finally, the study links residential preferences to spatial structure and accessibility conditions, providing evidence relevant to urban planning and housing policy. These findings provide evidence that can guide strategies for planning residential development between central and peripheral areas and improving residential conditions.

2. Literature Review

This chapter reviews the literature needed to explain residential location choice between city-center and urban-edge housing. The review is structured around three main factors: accessibility, affordability, and comfortability, and examines how households trade these factors in rapid urban growth conditions. The chapter begins by introducing the theoretical foundations of urban spatial structure and residential sorting, including land rent logic and attribute-based housing choice. It discusses proximity-based planning and the compact city debate, with the focus on the difference between planning efficiency goals and residential satisfaction in dense environments. At household level, the review focuses on psychosocial and economic factors, including commuting trade-offs, housing cost constraints, privacy, noise/tranquility, and neighborhood residential and environmental quality. It then adds infrastructural reliability as a key factor influencing residential utility, especially in contexts where services are not always available. These processes are understood within post-conflict and topographically constrained urban trajectories relevant to Duhok, including patterns of urban-edge expansion, car dependence, and socio-cultural housing preferences in the Kurdistan Region. Finally, methodological developments from revealed-preference limitations to stated-preference and discrete choice methods, including heterogeneity and attention effects, are reviewed. A conceptual framework ends the chapter that translates the literature reviewed into a model of center–edge residential choice.

2.1. Theoretical Foundation of Urban Spatial Structure and Residential Sorting

In order to understand the residential sorting that is now influencing Duhok, it is important to examine the foundational economic principles that control urban form first. The foundational idea for understanding where people choose to live is the Monocentric City Model, which is based on the Bid Rent Theory that was first proposed by Alonso (1964). Alonso showed that people choose where to live based on a balance between proximity to the Central Business District (CBD) and having more land or space (Alonso, 1964). In this classical framework, the center has the highest rents of land because of the proximity to daily services, making it expensive for households that prefer larger living spaces. As a result, residential sorting may appear as households trade higher accessibility and land rents near the center against lower land costs and more space at more peripheral locations (Alonso, 1964). This monocentric model continues to be a useful theoretical starting point for examining the center-edge residential trade-off in Duhok. However, the simple nature of Alonso's economic trade-off has been questioned by other behavioral theories, which argue that housing is not merely a commodity of space but a bundle of attributes that generate utility. Kelvin Lancaster's New Theory of Consumer Demand moves the attention from the product as a whole to the characteristics it provides, which suggests that consumer preferences are based on these characteristics rather than on goods alone (Lancaster, 1966). In the housing market, this suggests that a resident does not only choose a house but rather chooses a specific bundle of attributes such as visual privacy, neighborhood safety, architectural modernity, and social status. This theoretical difference is important for explaining the current urban dynamics in developing cities. When applied to residential location choice, this suggests that interest in urban-edge housing may reflect not only differences in land or housing cost, but also the value households place on the wider bundle of housing and neighborhood attributes available in alternative locations. Furthermore, the evaluation of these attributes is more often implicit than explicit, a concept developed by Sherwin Rosen in his hedonic pricing theory (Rosen, 1974). Rosen formalized hedonic pricing by showing that the market price of

a differentiated good can be represented as a function of its characteristics, making it possible for the implicit marginal value of individual attributes to be identified (Rosen, 1974). For residential location choice, this theoretical approach suggests that attributes such as quietness, newer housing, or other aspects of residential quality may have implicit value that partially compensates for the disadvantage of more distance from the city center. From this perspective, accessibility is compared with the utility provided by the residential environment, which reflects the trade-off examined in this study. A broader understanding of this trade-off is that residential accessibility depends not only on proximity to the center, but on the opportunities households can reach while taking their mobility conditions into account. Recent accessibility research argues for making sure to have an adequate level of accessibility to important services instead of evaluating urban performance by spatial proximity alone (Ryan and Martens, 2023; ITF, 2024). This perspective is consistent with Lancaster's attribute-based utility logic: the value of location depends on the achievable bundle of jobs, education, and services at acceptable time and monetary cost, not on being centrally located alone. For this study, these perspectives support viewing the center–edge choice in Duhok as a trade-off between reachability and the broader residential environment rather than as a pattern based only on distance from the city center (Mazzulla and Pirrone, 2024).

While Alonso, Lancaster, and Rosen provide foundations for understanding residential sorting, recent planning research gives more attention to whether residents have a good enough level of accessibility to important services (Ryan and Martens, 2023; ITF, 2024). This matters because it treats accessibility as a capability related to well-being rather than only a spatial characteristic (Ryan and Martens, 2023). When applied to the center-edge context, this shows that the accessibility advantage that is linked with central location may depend on transport conditions, service distribution, travel time, and reliability rather than on proximity alone (ITF, 2024). Recent research also shows that accessibility is measured in different ways. These include both place-based measures, such as travel time or distance to opportunities, and behaviorally informed measures that take individual constraints and perceptions into account (Mazzulla and Pirrone, 2024). Notably, perceived accessibility can differ from accessibility indicated by objective spatial measures, because individual experiences, preferences, transport conditions, and socioeconomic characteristics can affect how access is evaluated (Mazzulla and Pirrone, 2024). For this study, this supports making the accessibility attribute more precise so it reflects reachability of key opportunities (job, education, services) rather than only a generic center-edge concept.

Proximity-based planning, including the 15-minute city, is not treated only as a vision but as a measurement problem: what is considered close, for which daily needs, by which modes, and for which group. A systematic review by Carvalho et al. (2025) shows methodological variations in how 15-minute city accessibility is assessed. Studies use different travel-time limits, assumptions about walking and cycling, selected transport modes, the types of essential amenities included, and the indicators used to measure accessibility. These methodological choices can influence how neighborhood accessibility is evaluated and if an area is considered to have enough services (Carvalho et al., 2025). More importantly, proximity is not automatically equitable. Empirical research from global south cities shows that access to daily services is often not equally distributed across areas, with inner urban areas usually performing better than peripheral areas and some areas with poor accessibility also experiencing social disadvantages (Badakhshan et al., 2025). In a study of seven major Iranian cities, the results show that 15-minute accessibility varies a lot both between and within cities, and they evaluate social equity in who is likely to live more than a 15-minute walk from opportunities (Badakhshan et al., 2025). This supports treating accessibility as related to equity outcomes instead of only as a description of spatial proximity.

These findings support treating accessibility in the experiment as reachability of key opportunities under local mobility conditions, not just distance from the center (Carvalho et al., 2025). The same physical distance can result in different experiences of access when congestion and car dependence affect travel times (Mazzulla and Pirrone, 2024). Research focused on applying the 15-minute city concept outside the city center also shows that implementation depends on factors beyond population density alone. Important conditions include the distribution of services, pedestrian and cycling infrastructure, public transport connectivity, individual needs, and context-appropriate governance and service models (Arias-Molinares et al., 2025).

2.2. The Compact City: Urban Efficiency and Residential Preferences

To address the concerns related to urban sprawl and continued urban expansion, the global planning debate has focused more on the Compact City model. Promoted by scholars such as Jenks and Dempsey (2005), this model promotes dense, mixed-use development as a way to limit land consumption, support accessibility, and improve the efficiency of urban infrastructure and public transport. The theoretical argument is that concentrating development can support more efficient land use, improve accessibility to employment and key services, and create conditions that encourage public transport, walking, and cycling (Jenks and Dempsey, 2005). Compact urban development has also been discussed in relation to the Kurdistan Region. For Duhok, Hajani (2019) identifies compactness, density, mixed land use, accessibility, and other spatial characteristics as relevant criteria for supporting more sustainable urban development. Despite the sustainability rationale behind it, implementation of the Compact City can show a tension between planning objectives and residential preferences, specifically where high-density living does not align with households' preferred residential environments. In a study of residents living in high-density housing in central Dublin, Howley (2009) found that the majority preferred lower-density locations, creating uncertainty about the long-term residential attractiveness of urban intensification. This assumption is also challenged by Neuman (2005) in his criticism of the "Compact City Fallacy", arguing that urban form alone is neither necessary nor sufficient to achieve the sustainability objectives connected with the compact city. When applied to Duhok, this indicates that the expected benefits of compact development may be reduced where central locations also experience congestion, inadequate accessibility, or low residential quality.

Recent evidence from Europe shows that residents' acceptance of densification often depends on certain conditions and on the characteristics and local impacts of specific projects. In their study of densification projects in Munich, Bauer and Duschinger (2024) showed that residents did not reject densification itself, but assessed projects according to their local contexts, with changes to urban green space, social mix, parking, and density among important factors. For Duhok, these results suggest that acceptance of central densification may depend on whether increased density is accompanied by adequate open space and manageable daily mobility conditions. Such responses help explain why the compact city paradox can continue when densification is not combined with measures that protect livability. This tension becomes intense when analyzing the relationship between urban form and travel behavior. A meta-analysis by Ewing and Cervero (2010) analyzes built environment characteristics often grouped under the 5Ds: Density, Diversity, Design, Destination accessibility, and Distance to transit. Their results show that destination accessibility has an important relationship with vehicle travel, while the effects of individual built environment characteristics vary. When applied to a car-dependent context such as Duhok, these results suggest that increasing density in central areas alone may not be enough to improve effective accessibility where transport alternatives remain limited. In these conditions, the accessibility benefits in practice of central locations may be reduced, while peripheral housing may remain attractive for other residential reasons.

An updated meta-analysis on built environment impacts on public transport use shows that elasticities vary across designs and settings, which means that density alone does not change transport choice reliably. More generally, Aston et al. (2021) find that several built environment characteristics, including density, diversity, design, and accessibility, are related to transit use, although the strength of these relationships varies across indicators and study settings. Their results suggest that density is one of several factors instead of a sufficient explanation of public transport use on its own. For Duhok, this suggests that densification without viable transport alternatives may have limited effects on reducing car dependency.

One main reason that the compact city debate is not limited to the physical density is that densification is also experienced through changes in the daily use and perception of local public spaces. In a field experiment, Honey-Rosés and Zapata (2021) studied how increasing the level of use in a residential public space affected residents' perceptions of its quality and found that more use could reduce the perceived overall quality. This shows that changes linked to densification may include perceptual trade-offs in daily residential life, even when the overall quality of the public space continues to be positively evaluated. Urban densification can create both positive and

negative views among residents because improvements in neighborhood attractiveness may happen with concerns about social cohesion, accessibility, and daily well-being. Using a participatory system-dynamics approach in a Rotterdam neighborhood that is becoming more dense, Barsties et al. (2025) showed that residents reported both positive and negative effects of densification. While more attractiveness was seen as a potential benefit, participants also linked neighborhood change to reduced social cohesion and accessibility, as well as concerns about stress, loneliness, and reduced enjoyment of living. These results show that the residents' experience of densification depends not only on physical growth but also on how social and neighborhood conditions change with it. Also, Li and Wang (2025) used social media sentiment analysis to study how public streets are viewed in Shanghai. Their results show that highly rated public spaces are more commonly located in central areas and are connected with high density, multifunctionality, cultural or historical characteristics, commercial activity, and walkability. This suggests that high density alone is not always connected to poor public space experience, because perceptions also vary with the functional mix, cultural and historical character, walkability, and other factors of the street environment. Altogether, these results focus on the importance of considering residents' lived experience of neighborhood and public space conditions when evaluating densification strategies. These conditions are also related to residents' well-being, especially where changes in accessibility, social cohesion, and everyday enjoyment happen together with densification (Barsties et al., 2025). Their implications for acceptance are considered in studies investigating how residents evaluate the local costs and benefits of densification projects (Herdt and Jonkman, 2023). The public debate around densification also often shows a structured conflict between broader objectives and concerns about housing costs, place identity, social cohesion, public and green space, and the distribution of local costs and benefits (Herdt and Jonkman, 2023). Evidence suggests that opposition is not only based on "NIMBY" (Not In My Backyard) concerns, but often also includes arguments about justice and local conditions, which helps explain why acceptance continues to depend on certain conditions and is not universal (Herdt and Jonkman, 2023). When applied to a car-dependent context such as Duhok, these results suggest that acceptance of densification may also depend on whether residents expect additional development in central areas to improve accessibility and neighborhood conditions or instead to make traffic, congestion, and other daily pressures worse. From this perspective, the local response to densification may depend on the balance between its broader planning benefits and its effects on daily residential experience.

2.3. Psychosocial and Economic Determinants of Housing Consumption

Looking beyond the macro-level center-edge debate, it is necessary to study the factors that influence individual residential choices. Accessibility is an important part of this decision and is commonly understood as how well a location allows households to reach employment, services, and other relevant opportunities (Chen et al., 2008). However, Mokhtarian and Salomon (2001) question the traditional view that travel is always only a derived demand and a source of disutility, arguing that travel itself can provide positive utility in certain conditions. When applied to residential choice in Duhok, this indicates that extra travel time may not be evaluated equally negatively by all households when other characteristics of a residential location are valued more. Where the residential qualities linked to an edge location are valued highly enough, households may therefore be willing to accept additional travel time as part of a broader residential trade-off (Chen et al., 2008). Affordability can also act as a major limitation on residential choice, because households make decisions about where to live within the housing alternatives they can afford in reality. Housing price is itself an important part of residential location trade-off, with higher housing costs reducing the utility of locations that are attractive in other ways (Chen et al., 2008; So et al., 2001). Glaeser (2012) argues that when housing supply does not increase enough to meet high demand in attractive cities, increasing prices can turn them into "boutique cities" that become increasingly accessible mainly to wealthier households. Such affordability pressures can limit the residential options that are available to lower and middle-income households and increase the attractiveness of less expensive locations outside the most expensive

urban areas (Glaeser, 2012). The choice that follows is therefore not necessarily a simple expression of locational preference, since households may value accessibility while still being limited by the cost and availability of appropriate housing (Zondag and Pieters, 2005; Coulter et al., 2016). In these conditions, accessibility may remain valued but could also be balanced against affordability, which may lead households to accept longer commutes in exchange for lower housing costs (So et al., 2001).

Residential satisfaction and perceived residential quality are multidimensional, reflecting conditions at both the housing and neighborhood levels and residents' personal evaluation of their residential environment as well (Adriaanse, 2007; Galster and Hesser, 1981; Lu, 1999). For this study, these connected dimensions are combined under the broader concept of comfortability, including quality of homes, privacy, environmental conditions, and the reliability of basic residential services. Privacy is relevant to the Duhok context, where Saleem and Alchalabi (2024) studied how apartment layout and spatial configurations influence residents' perceptions of privacy, functionality, and the experience of living. Residential choice therefore includes trade-offs among housing, neighborhood, environmental, and accessibility characteristics. The size of the house and neighborhood conditions can be important together with commuting accessibility (Chen et al., 2008), while environmental attributes such as noise and air pollution can also influence evaluations of other residential locations (Marcucci et al., 2010). This focus on housing and neighborhood conditions is consistent with a life-course approach to residential mobility, which views residential decisions as developing through linked biographies, transitions, relationships, and structural conditions over time instead of as a single static optimization problem (Coulter et al., 2016). In this framework, changes in household composition can change housing requirements and encourage residential mobility. Specifically, the need for more space and the birth of children can increase the likelihood of moving (Clark et al., 1984), while a lack of appropriate housing in central locations may lead some households to look for housing in other areas (Mulder, 2006). Central urban locations can also provide advantages for consumption through the concentration of utilities and opportunities linked with urban density. Glaeser et al. (2001) argue that the role of urban density in supporting consumption is important and that successful cities depend not only on their productive advantages but also on their attractiveness as centers of consumption. However, as household size and family situations change, residential mobility can indicate changes in housing needs, specifically the need for sufficient living space (Clark et al., 1984). Neighborhood conditions also include more than physical characteristics of housing. Social resources found in neighborhood networks may support residents' well-being (Carpiano, 2006), while local conditions and quality of life characteristics are connected with levels of neighborhood satisfaction (Lee and Guest, 1983). These perspectives together support the argument that evaluation of residential conditions reflects social and neighborhood qualities as well as the physical dwelling. Residential choice models also show that households respond differently to location characteristics. Bhat and Guo (2004) show the importance of taking into account the differences in household preferences and spatial relationships between residential alternatives when measuring the effects of transport, land use, and socio-demographic characteristics on residential location choice.

Another process that supports this framework is the joint decision made together about residential and job locations. So et al. (2001) show that households make residential and job location decisions by balancing wages, housing prices, and commuting costs. Their results show that lower housing prices outside metropolitan areas can make up for some of the extra burden of commuting, showing how affordability and accessibility can influence residential location decisions together. Similarly, Zondag and Pieters (2005) show that accessibility affects residential decision making at different stages, although its importance varies across different household types and generally has less influence than demographic characteristics, neighborhood amenities, and dwelling attributes. They also observe that housing market conditions and planning constraints can cause households to live in less accessible locations than they might choose. Research on residential self-selection also shows that residential choice and travel-related attitudes can change over time. van de Coevering et al. (2018) show that people adjust both their residential environments and their attitudes, while also observing that income, household circumstances, housing market supply, and competing residential preferences can limit full residential self-selection. Considering all this together, this study suggests that trade-offs between accessibility, affordability, and comfortability should be

understood as choices influenced by household circumstances, housing market constraints, and changes that happen over time instead of a single decision made at a time (Coulter et al., 2016; Zondag and Pieters, 2005; van de Coevering et al., 2018).

A study from Zhao et al. (2025) shows that perceived tranquility in high-density residential environments depends on both soundscape characteristics and wider environmental conditions, instead of on acoustic intensity by itself. Their study also shows that residential tranquility is influenced by residents' perceptions of restorativeness and pleasantness, which means that a tranquil environment cannot be understood only through low sound pressure levels (Zhao et al., 2025). Natural sounds, specifically sounds from wind, leaves, and birds, were positively linked with these aspects of tranquility (Zhao et al., 2025). These results show that the experience of high-density residential environments can be improved by paying attention to soundscape and environmental design, including natural sounds, vegetation, less vehicle activity, and measures for noise management (Zhao et al., 2025). Another perspective comes from Yang and Kwon (2025), who studied inter-floor noise perception in a cross-sectional survey of 2,090 South Korean residents. Their results show that residential acoustic experience is influenced not just by physical housing characteristics but also by individual sensitivity, neighborhood communication, and household characteristics. The study finds that individual environmental sensitivity is the most important influence, with neighborhood communication and demographic characteristics, while housing type reported by residents had a relatively smaller effect on inter-floor noise perception (Yang and Kwon, 2025). When applied to dense residential development, these results suggest that only physical characteristics cannot explain residents' acoustic experience, because individual sensitivity and social relations can also influence how residential noise is perceived.

Together, these studies show that residential quality in dense environments is experienced through subjective environmental conditions to some extent, such as tranquility and noise perception, instead of through physical density or building characteristics alone (Zhao et al., 2025; Yang and Kwon, 2025). Within the broader residential-choice framework of this study, these environmental characteristics are part of the residential attribute bundle that households evaluate with accessibility and affordability. In city-center housing, which is viewed as noisier or less tranquil, changes in residential quality may play a role in the trade-off between accessibility and other characteristics of other residential locations (Chen et al., 2008; Marcucci et al., 2010).

In the empirical design of this study, the concept of comfortability is represented mainly through the residential quality and apartment size attributes. Privacy, noise and tranquility, environmental quality, and service reliability are described in the literature as relevant aspects of residential experience, but they are not estimated as separate DCE attributes in this study. This way of representing the concept is consistent with stated preference discrete choice methods, in which alternatives are described by observed differences in attributes, allowing their contribution to utility and choice to be estimated (Hensher et al., 2015; Train, 2009). This understanding of residential quality is also relevant to Duhok, where Saleem and Alchalabi (2024) link apartment spatial configuration and privacy conditions to residents' evaluations of functionality and the experience of living.

2.4. Infrastructural Reliability and Residential Sorting (Splintering Urbanism)

Classical urban location theory explains residential choice as a trade-off between accessibility and housing or land costs (Alonso, 1964). In rapidly growing cities where infrastructure and public services are provided unevenly, this classical framework can be expanded to include the quality and reliability of everyday services as part of the residential environment (Demir and Mukhlis, 2017; Saadoon and Othman, 2019). The concept of Splintering Urbanism shows how networked infrastructures can be organized unevenly across urban areas, creating different levels of connection and contributing to the fragmentation of the urban fabric (Graham and Marvin, 2001). For Duhok, this perspective suggests that residential choices between the center and the urban edge may be shaped not only by differences in accessibility and housing costs, but also by how households view the broader residential and service conditions found in different locations.

Regional studies provide empirical support for including service conditions as part of residential quality. In gated communities in Sulaimaniyah, Demir and Mukhlis (2017) found that several aspects of product quality influenced residents' perceived quality, with serviceability as the most important factor; this included electricity and water provision, maintenance, repairs, and related facilities. Similarly, Saadoon and Othman (2019) identified serviceability and reliability as the main aspects influencing perceived quality across gated communities in the Kurdistan Region. Together, these results show that service conditions play an important role in perceived residential quality in the regional setting. Their importance for center–edge residential choice is therefore better understood as an additional contextual aspect of housing evaluation, rather than as a confirmed factor influencing relocation to peripheral areas. Recent studies in Duhok and Erbil support the view that housing preferences are multidimensional. In apartment housing in Duhok, privacy and spatial layout strongly influence how spaces function and how residents experience their homes (Saleem and Alchalabi, 2024). A broader systematic review by Saleem and Alchalabi (2025) views residential satisfaction as a multidimensional construct influenced by architectural and functional qualities, as well as economic and social conditions, including residents' access to necessary services. In Erbil, Salih et al. (2026) document weaknesses in how environmental factors are included in post-war mass housing planning. Their analysis of eight housing developments shows the importance of adequate infrastructure, reliable access to basic services such as water and electricity, affordability, and the provision of green areas, showing that housing quality also depends on neighborhood-level planning and implementation. Evidence on relocation behavior also shows a dual process: stronger architectural attributes are positively linked to a willingness to move, while stronger neighborhood social ties are negatively related to intentions to move (Yuns and Qaradaghi, 2025). The same study also reports a positive relationship between location/accessibility and relocation intention (Yuns and Qaradaghi, 2025).

For this study, these results mainly influence how residential quality is understood. The literature shows that infrastructure and service conditions form part of the broader residential environment in which households evaluate housing quality, together with housing and neighborhood characteristics. Therefore, this study considers infrastructure and service conditions as contextual aspects of residential quality instead of separate factors estimated independently in the choice experiment. Service reliability is not included as a separate attribute in the present DCE, which means that its independent marginal effect on residential choice cannot be estimated in this study. Instead, infrastructural and service conditions provide context for understanding residential quality in the regional setting. Future stated-choice research could analyze service reliability as a separate attribute when its independent contribution to residential location choice is the main focus.

2.5. Urbanization Trajectories in Rapidly Growing and Topographically Constrained Contexts

These urban theories are also useful for understanding Duhok, where rapid urban growth and geographical constraints have influenced urban development. Duhok's urban development has been shaped by rapid population growth with significant constraints. Mohammed (2013) describes Duhok as located in a NW-SE elongated valley, with mountains to the north, south, and east. Within this limited setting, population growth and the increase in housing demand have put more pressure on urban land and the housing market. This physical limitation may produce more pressure on the urban land and housing market, as geographical constraints can limit the land available for development and contribute to higher housing prices as housing demand continues to increase (Saiz, 2010; Albouy and Ehrlich, 2018). Duhok's outward growth must also be understood in relation to its transport system. Abdullah et al. (2020) identify the private vehicle as the city's main mode of transport and explain that its accessibility and flexibility advantages are largely related to the lack of convenient public transport. As a result, residential development at the urban edge in Duhok takes place within mobility conditions where car dependence is high and public transport options are limited. These conditions also make transport poverty an important concept to consider. Alonso-Epelde et al. (2023) explain that transport vulnerability involves both affordability and accessibility,

especially when households spend a disproportionate amount on transport while lacking viable transport alternatives. Recent research shows indicators for measuring transport poverty by using household budget data, showing that mobility affordability and accessibility interact to produce vulnerability. When applied to Duhok, this suggests that lower housing costs at urban-edge locations should not be considered separately from the additional transport costs and accessibility limitations that may come with car-dependent residential locations. For residential choice analysis, this means that housing affordability and transport affordability may need to be considered together when analyzing center-edge trade-offs. This issue is important in Duhok because recent local research shows that rapid urban growth, increasing vehicle ownership, limited alternative transport options, and continued investment in car-oriented infrastructure are linked to continuing congestion and environmental pressure (Othman and Raswol, 2024).

2.5.1. Urban Expansion as the Dominant Growth Mechanism and its Policy Implications

Recent research shows that outward urban growth is not only a result of development, but also one of the main ways cities accommodate population growth (Angel, 2023). Angel (2023) explains that densification and outward growth are two complementary forms of urban growth. Based on evidence from 200 cities between 1990 and 2014, the study reports that approximately 23% of population growth was accommodated through the densification of existing urban areas, while 77% was accommodated through outward expansion. This process is also related to the lower land costs at the urban edge compared to the city centers (Angel, 2023).

For Duhok, this evidence provides a useful framework for understanding the outward growth reported by Mohammed (2013), while the city's geographical constraints create specific local conditions for this expansion. Othman and Raswol (2024) describe how land use and transport influence each other in Duhok, where car-oriented development and limited public transport alternatives encourage continued investment in infrastructure for private vehicles. This relationship is important in Duhok because the decline of the previous public transport systems has occurred with increasingly car-oriented development. Othman and Raswol (2024) estimate that the number of vehicles per family increased from 0.47 in 2009 to 0.94 in 2023, showing the extent of the city's move toward car-dependency.

2.5.2. Contextual Socio-Cultural Housing Preferences

Residential location and housing form in the Kurdistan Region are influenced not only by price and accessibility, but also by household structure and socio-cultural norms related to family life and privacy (Saleem and Alchalabi, 2024). Household structure provides an important demographic factor in housing preferences. The 2018 Iraq MICS, which sampled 3,240 households in the Kurdistan Region, reported a national average family size of 6.3 persons, showing that relatively large families are common across Iraq (UNICEF, 2018). In this context, adequate living space and privacy may be important when households evaluate housing, although the MICS itself does not measure housing preferences. Privacy is an important housing attribute in residents' experience. Research on apartments in Duhok shows that privacy and spatial layout are strongly related to perceived efficiency and resident satisfaction, especially through the organization of internal spaces and movement between them (Saleem and Alchalabi, 2024).

At a broader urban and social level, the distinction between private and public space can also be culturally important and related to gender. In Sulaimaniyah, Alizadeh et al. (2021) found that a feminist installation that brought private issues and women's bodies into public space caused strong negative reactions and showed continuing cultural, religious, and social barriers related to gender inequality and public visibility in public spaces. Although the study does not directly examine housing choice, it provides sociocultural context for understanding the importance of privacy and the separation of private and public spaces in the Kurdish context.

2.6. Methodological Evolution

To examine these residential trade-offs, housing choice research has used both revealed preference (RP) and stated preference (SP) approaches. Revealed-preference approaches use observed housing choices in real markets, while stated-preference approaches examine preferences or choices expressed in hypothetical residential situations (Timmermans et al., 1994). An important limitation of revealed preference data is that observed housing choices do not necessarily show what households would prefer without constraints. Actual choices reflect not only what people want, but also the market conditions and the options available to them, which makes it difficult to separate household preferences from market constraints using observed residential choices alone (Timmermans et al., 1992, 1994). When applied to center versus edge housing choices, this means that choosing a dwelling at the urban edge cannot automatically be understood as a preference for living there. The household may instead be responding to the higher cost or limited availability of suitable housing in the city center.

The stated preference approach provides another way to examine these preferences by asking respondents to evaluate or choose between systematically designed hypothetical alternatives. The analysis of these choices can be based on random utility theory, which assumes that individuals select the alternative that provides the highest utility, while this utility itself includes both observed and unobserved components (McFadden, 1978). In stated preference research, experimental designs can systematically vary combinations of attribute levels and use respondents' evaluations or choices to estimate how each of those attributes contributes to preference or utility (Louviere, 1988; Timmermans et al., 1994). In this study, this approach makes it possible to examine how residents trade accessibility, housing cost, residential quality, and apartment size when choosing between center and edge alternatives. Ratios between the estimated attribute coefficients can also be used to calculate marginal rates of substitution, providing understandable measures of the trade-offs respondents are willing to make between attributes, such as housing cost and accessibility (Hensher et al., 2015). An important development in stated-choice research is the recognition of residential preferences as heterogeneous rather than assuming that all households share the same average preference structure (Li et al., 2025). Latent class models provide one way of identifying subgroups whose residential choices reflect different patterns of preference structures (Li et al., 2025). For example, Li et al. (2025) identify three household groups with different preferences for accessibility, greenery, and housing price. When these group-specific preferences are included in land-use allocation, the resulting development pattern differs from a pattern based on average preferences and provides a higher overall housing value for residents. For Duhok, this research shows the importance of examining whether residential preferences differ among household groups rather than assuming that the estimated average coefficients apply equally to all residents.

Another methodological concern is attribute non-attendance, which occurs when respondents may ignore or give very little weight to some attributes when completing stated choice tasks. Gonçalves et al. (2022) show that ignoring attribute non-attendance can lead to model misspecification and affect willingness-to-pay and welfare estimates. They discuss common statistical methods for identifying and addressing this issue. For this study, this issue requires caution when interpreting marginal trade-offs. Respondents may not consider every attribute in the same way, and willingness-to-trade estimates should be understood as model-based averages instead of evidence that every respondent considered every attribute equally. Recent methodological research has also developed more flexible approaches for separating residential self-selection from the effects of the built environment in studies of travel behavior. For example, Ding et al. (2024) apply double machine learning to separate the effects of residential location from residential self-selection when explaining household driving distance around BRT neighborhoods in Jinan. Their results show that residential self-selection accounts for about 40% of the observed difference in driving distance. This result shows the need for caution when interpreting relationships between residential environments and travel behavior as effects of the built environment alone, because part of the observed relationship may result from residential self-selection. Recent research also examines residential location, mobility resources, and transport choice as connected decisions rather than separate steps. Schmid et al. (2023) show that residential accessibility, income, mobility tool ownership, and transport choice interact in ways that may be hidden when each

decision is modeled separately. In their simultaneous model, accounting for longer-term residential and mobility tool decisions greatly reduces the estimated short-term effect of level-of-service attributes on transport choice. Research on relocation also shows that travel behavior cannot always be understood as a one-way response to the built environment. Ramezani et al. (2021) identify two-way relationships among travel attitudes, car and bicycle ownership, and travel behavior after residential relocation, while also showing that changes in the built environment can affect travel attitudes and the dispersion of activity space. When applied to Duhok, these results suggest that residential relocation and changes in mobility resources may influence each other over time. However, the direction and strength of these relationships cannot be determined directly from a cross-sectional residential choice experiment.

2.7. Conceptual Framework

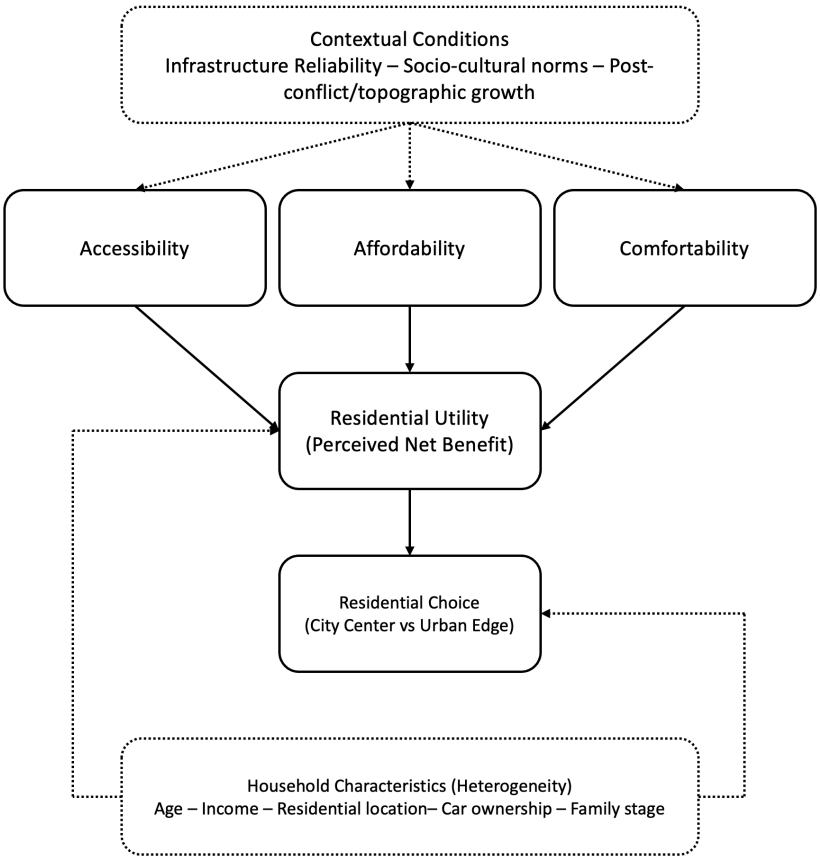


Figure 2.1.: Conceptual Framework

Based on the literature, the conceptual framework presents a model for examining residential location choice in Duhok. Residential choice is modeled as a utility-based trade-off among accessibility, affordability, and comfortability under local conditions and constraints. In simple terms, households compare residential alternatives and

choose the location that gives higher overall benefit, which is referred to here as residential utility. This framework connects the theoretical discussion to the variables used in the discrete choice model.

In this framework, accessibility refers to how easily households can reach jobs, services, education, and daily activities (Mokhtarian and Salomon, 2001; Zondag and Pieters, 2005). Affordability refers to housing costs in relation to household resources and financing constraints (Glaeser, 2012; So et al., 2001). Comfortability is treated as a multidimensional concept that includes housing quality, privacy, environmental conditions, spatial adequacy, and other aspects of the residential environment (Adriaanse, 2007; Galster and Hesser, 1981; Lu, 1999; Saleem and Alchalabi, 2024). In the experimental design, these elements are combined and represented by the main attributes of residential quality and apartment size. All of this occurs under local conditions, including infrastructure reliability, sociocultural housing norms in the Kurdistan Region, post-conflict development, and geographical constraints on urban growth (Angel, 2023; Graham and Marvin, 2001; UNICEF, 2018).

Figure 2.1 represents the framework as a structured flow. The solid lines show the direct decision path: accessibility, affordability, and comfortability contribute to residential utility, which then determines the final choice between the city center and the urban edge. The dashed lines show contextual factors rather than separate choice attributes. Contextual factors influence how strongly the three main factors affect residential utility, and household characteristics explain why these effects are different among households. Therefore, the framework assumes that households choose the housing alternative that provides higher perceived utility. Residential utility is influenced by accessibility, affordability, and comfortability together rather than only by one factor. The direction and strength of these effects depend on local conditions, such as service reliability, household social norms, and the form of urban growth. Household characteristics (age, income, car ownership, family stage, and current residential location) show heterogeneity and also help to explain why households that are facing similar alternatives may still choose differently. Hence, observed center-edge choices are understood as decisions made under constraints and changing conditions over time, rather than as direct evidence of what households would prefer without constraints (Bhat and Guo, 2004; van de Coevering et al., 2018).

The empirical analysis represents the framework through four experimental attributes and selected respondent characteristics:

- Accessibility: walking time to services (5, 15, or 30 minutes).
- Affordability: monthly housing cost ($300, $400, or $500).
- Comfortability: residential quality (poor, moderate, or good) and apartment size (80 or 160 square meters).
- Preference heterogeneity: age, household income, private car ownership, family stage derived from household type, and current residential location.

Privacy, noise, and service reliability provide contextual dimensions of comfortability; their separate effects are not estimated in this experiment.

3. Methodology

This chapter presents the methods used to examine residential location preferences in Duhok, focusing on the trade-offs residents make when choosing between city-center and urban-edge housing. The study uses a quantitative research approach based on a stated preference (SP) survey that includes a Discrete Choice Experiment (DCE). This method does not only rely on where people live, because their current locations may be limited by housing market conditions and affordability. Instead, it examines stated preferences by asking respondents to evaluate controlled, hypothetical housing scenarios. In the experiment, participants are asked to select their preferred residential tower based on four attributes: accessibility to services, monthly housing cost, residential quality, and apartment size. Data were collected from Duhok residents through an online questionnaire. The questionnaire was provided in both English and Kurdish (Badini) to reduce language barriers and was distributed using a snowball sampling method.

Based on Random Utility Theory (McFadden, 1978), the collected responses are analyzed using a Multinomial Logit (MNL) model. This model estimates the relative value respondents place on different housing attributes and examines how household characteristics, such as household income and private car ownership, are related to these preferences. The following sections present the study area, the design of the choice experiment, the data collection procedures, and the methods used to analyze the data.

3.1. Research Framework

Rapid urban development and the growing number of residential towers in different parts of Duhok provide the context for examining preferences for city-center and urban-edge housing. The study does not assume that either location has fixed characteristics. Instead, it examines how respondents balance accessibility, housing cost, residential quality, and apartment size when choosing between residential alternatives.

Using the concepts discussed in the literature review as a foundation, this research framework applies the three main factors of housing choice: accessibility, affordability, and comfortability. Rather than observing these factors separately, the framework evaluates them together as a ”bundle” of attributes that influence an overall residential utility for the household. To achieve this, the research strategy is divided into three connected phases:

- **Contextual Baseline:** Describing the main socio-demographic characteristics and mobility conditions of Duhok residents, such as income, car ownership, and family structure, to understand the conditions that may influence their residential preferences.
- **Experimental Simulation:** Using a stated-preference experiment, which respondents make trade-offs between city-center and urban-edge housing conditions. This makes it possible for the study to estimate how they value differences in accessibility, housing cost, residential quality, and apartment size.
- **Model-Based Analysis:** Applying discrete choice models to estimate the effects of the residential attributes and measure the Marginal Rate of Substitution (MRS), which shows the trade-offs respondents are willing to make between housing attributes and housing cost.

Through this approach, the research framework connects the concepts discussed in the literature review with the empirical analysis and helps to identify the factors that influence residential choice in Duhok.

3.2. Study Area

The study is conducted in Duhok, a major and rapidly growing urban area in the Kurdistan Region of Iraq. Othman and Raswol (2024) report a population of 450,313 for Duhok city in 2023. The city provides a useful case for examining residential preferences because of its geographical constraints, outward urban growth, and recent development of high-rise housing. Historically, Duhok's urban expansion has been influenced by its geographical setting. The city is located in an elongated NW-SE valley, having mountains to the north, south, and east, which limits the land available for continued urban growth (Mohammed, 2013). Within these geographical limits, Duhok has continued to expand outward while the development of high-rise housing has also increased (Mohammed, 2013; Dhuoki and Çağnan, 2021). At the same time, private vehicles have become the main transport mode in Duhok, while convenient public transport alternatives remain limited (Abdullah et al., 2020). These conditions are important for residential development outside central areas because accessibility to services and daily activities may depend more on private vehicles in areas with limited public transport.

These urban and transport conditions make Duhok a useful case for examining residential location preferences between city-center and urban-edge housing and how residents balance accessibility, affordability, and comfortability when choosing between residential alternatives.

3.3. Survey Design and Data Collection

To examine the residential location choices of Duhok's residents, the study uses a structured data collection process. This phase converts the research objectives into measurable variables by collecting information on residents' socioeconomic conditions and their stated housing preferences in different urban locations.

3.3.1. Sampling Method and Sample Size Justification

To determine the target sample size, the Yamane formula was used (Louangrath, 2017). The formula is as follows:

$$n = \frac{N}{1 + Ne^2} \tag{3.1}$$

where:

- n is the required sample size,
- N is the total population size,
- e is the margin of error (MoE), expressed as a decimal.

For sample-size planning, an approximate population of 400,000 was used. With a nominal error parameter of 5%, the formula yielded a numerical target of approximately 400 respondents. The final sample included 423 respondents and therefore exceeded this target. However, because the study used non-probability snowball sampling, the 5% was used only to calculate a numerical target and should not be understood as an achieved sampling margin of error. It also does not establish that the sample is representative of, or that the results can be generalized to the entire population of Duhok.

3.3.2. Data Collection Method

The study uses a questionnaire to collect data from residents of Duhok. The questionnaire consists of two main sections: (1) socioeconomic characteristics, and (2) residential preference attitudes. The questionnaire was designed to evaluate respondents' preferences regarding residential towers located near the city center and at the edge of the city. The questionnaire was distributed to residents of Duhok from different backgrounds between 2

July and 3 August 2026. Data collection ended on 3 August 2026, when responses from 423 participants had been collected. The survey targeted residents from different socioeconomic statuses to ensure differences in residential preferences and demographic characteristics. In order to achieve more socioeconomic and spatial diversity, the questionnaire was distributed online through different university, school, and alumni communication channels, as well as professional networking platforms. The study also used a snowball sampling approach by which participants were encouraged to share the questionnaire through their personal, family, and social networks in Duhok (Biernacki and Waldorf, 1981). This helped the survey to reach a larger and more varied group of residents. The questionnaire was prepared and distributed in both English and Kurdish (Badini) to reduce language barriers and make participation easier for residents with different educational and linguistic backgrounds. The English and Kurdish versions of the questionnaire are provided in the appendices (A.1) and (A.2). Before participation, respondents were provided with a short explanation of the purpose and academic nature of the research. Participation in the survey was fully voluntary and anonymous, and no personally identifiable information was collected. This information was included in the questionnaire in the introductory message of the online questionnaire.

The main part of the questionnaire included a stated preference experiment in which respondents were asked to choose between two housing options. Each alternative was described using simple and clear language to help respondents understand the difference between them. Option A represented a housing unit in a residential tower located in the city center, while Option B represented a housing unit at the edge of the city. Each alternative was also accompanied by an image to help respondents understand and imagine the type and location of housing presented.

3.3.3. Questionnaire Design

Socioeconomic Characteristics

The first section of the questionnaire collects respondents' demographic and socioeconomic information, including gender, age, education level, employment status, household income, household type, current housing type, residential location, and private car ownership. These variables are used to describe the sample characteristics, while selected variables are included in the choice model as interaction terms to test preference heterogeneity. To reduce respondent discomfort and improve survey completion rates, household income was measured using three broad, researcher-defined categories rather than exact values. The categories were informed by regional socioeconomic conditions reported in the Demographic Survey of the Kurdistan Region of Iraq, although the exact thresholds used in this questionnaire, including the "Average" category of 700,000–1,050,000 IQD, were defined specifically for this study (KRSO et al., 2018). This ensures the approach is appropriate for the local context while still effectively allowing economic variation for the analysis.

To examine whether housing preferences differ according to socioeconomic conditions and life-cycle stages, selected demographic categories were recoded as binary dummy variables and included as interaction terms in the MNL model.

- High Income: Coded as 1 for households earning 'Above Average', and 0 otherwise.
- Family Stage: Coded as 1 for respondents who were married with children, single parents with children, or members of extended families (household-type categories 4–6), and 0 otherwise, including respondents in the "Other" category.
- Older Adults (46+): Coded as 1 for respondents aged 46 years or older, and 0 otherwise.
- Car Owner: Coded as 1 for respondents who own a private car, and 0 otherwise.
- Current Center Resident: Coded as 1 for respondents currently living near the city center, and 0 for respondents living at the urban edge.

Residential Preference Attitudes

This section provides behavioral understandings into respondents' residential preferences by focusing on specific housing characteristics. Instead of relying on traditional Likert-scale ratings, it examines respondents' views of residential attributes such as accessibility, cost, quality, and size. Then, the section concludes the questionnaire with a final question about their general preference for living in residential towers near the city center versus the edge of the city. This provides a general measure that can be compared with the choices respondents make under the different attribute combinations in the experiment.

Pilot Testing

Before the final survey distribution, a pilot test was conducted with approximately 15 respondents to evaluate the clarity, readability, and overall understanding of the questionnaire and discrete choice scenarios. Feedback from the pilot survey was used to identify unclear wording and improve the presentation of the choice tasks before the final data collection stage.

3.4. Discrete Choice Experiment Formulation

The main method used to examine residential trade-offs is the stated preference experiment. By presenting controlled hypothetical housing scenarios, this approach allows the effects of attributes such as accessibility and housing cost on stated residential preferences to be estimated. The experimental design was structured to support statistical estimation while keeping the choice tasks understandable and manageable for respondents.

3.4.1. Discrete Choice Experiment (DCE)

A Discrete Choice Experiment (DCE), also referred to as a stated choice or preference experiment, is a commonly used research method for evaluating individual preferences among a set of alternatives (Street and Burgess, 2007). A DCE consists of multiple choice sets, each containing two or more alternatives. The number of alternatives within a set is referred to as the choice set size. These alternatives may represent existing options, hypothetical future options, or a mix of both. Each alternative is characterized by a set of attributes, which may be either alternative-specific, meaning that they apply only to specific alternatives, or generic, meaning that they apply to all alternatives in the choice set. These attributes have various levels, which vary across choice sets based on an experimental design framework. These differences make it possible to estimate the effect of each attribute on the respondent's decision-making process, including the calculation of marginal effects using statistical methods (Cleland et al., 2018; Louviere et al., 2000).

In a DCE, respondents are presented with a series of hypothetical choice scenarios and are asked to select their preferred alternative in each set (Schaafsma, 2011). Since the outcome of interest is a discrete selection, only one alternative is chosen for each choice set. This approach makes it possible to model and quantify the trade-offs that individuals are willing to make between different attribute levels, which means providing insights into the factors influencing choice behavior (Abdullah et al., 2025).

3.4.2. Stated Preference Experiment Design

The main part of the questionnaire consists of a stated preference (SP) experiment designed using hypothetical residential choice scenarios. In each scenario, respondents are asked to select between two alternatives:

- a city-center residential tower,
- an edge-of-city residential tower.

The alternatives are described using a set of residential attributes and corresponding attribute levels.

Attributes and Attribute Levels

Based on the literature review and the characteristics of residential developments in Duhok, four attributes were selected for the discrete choice experiment: accessibility to services (walking), housing cost, residential quality, and apartment size. In this study, comfortability is represented mainly by residential quality and apartment size, which reflect important dimensions identified in the literature while keeping the DCE tasks manageable for respondents. The selected attributes and their corresponding levels are presented in Table 3.1.

Table 3.1.: Attributes and attribute levels used in the DCE

Attribute	Description and levels
Accessibility to services (walking)	5 min / 15 min / 30 min
Housing cost	\$300 / \$400 / \$500 per month
Residential quality	Poor / Moderate / Good
Apartment size	80 m^2 / 160 m^2

Accessibility was included because accessibility to employment, services, education, and daily activities is identified as one of the most important factors of residential location choice in urban planning and residential choice literature (Monteiro et al., 2021; Zondag and Pieters, 2005). In Duhok, differences between central and peripheral residential areas have different travel times and service reachability due to congestion, car dependence, and uneven spatial development (Othman and Raswol, 2024). The selected levels (5, 15, and 30 minutes) were chosen to represent realistic variations in accessibility between centrally located and peripheral residential developments while also keeping the choice tasks simple for respondents.

Housing cost was included because affordability can limit residential choices, especially in rapidly growing urban areas where housing in central areas is generally more expensive than at the urban edge (Marwal and Silva, 2023; Hassan and Kotval-K, 2019). Monthly housing payment was used as the operational measure because it is a direct housing expense and respondents can easily understand it. The selected levels (\$300, \$400, and \$500 per month) were designed to reflect realistic differences between lower-cost and higher-cost residential alternatives in the local market while providing enough variation to estimate the trade-offs between affordability, accessibility, and residential quality. These levels were based on commonly observed monthly rental and residential payment ranges in apartment developments in Duhok. While affordability can theoretically include both housing and transport costs, transport costs were not included as a separate experimental attribute. The housing cost attribute therefore represents direct residential expenses only, while accessibility is measured separately through travel time to services.

Residential quality was included because many aspects of the living environment affect residential satisfaction, such as housing conditions, neighborhood experience, environmental perception, and overall residential comfort (Adriaanse, 2007; Galster and Hesser, 1981). The selected levels (poor, moderate, and good) were designed intentionally as general rather than technical measurements in order to make them easier for respondents to evaluate during the choice experiment. These perception-based levels were used because residential choices often depend on personal assessments of living conditions rather than precise technical measurements, as well as the intention to keep the choice tasks clear and reduce respondent fatigue.

Apartment size was included because living space and spatial adequacy are important parts of residential comfort and household satisfaction (Huang et al., 2023), especially for family housing contexts in the Kurdistan Region. Selected residential developments in Duhok include apartments exceeding 100 m^2 (Alothman et al., 2024). The selected levels (80 m^2 and 160 m^2) were therefore used to represent a clear difference between compact urban

apartments and larger family-oriented residential units in the regional housing market. The levels were also selected to create clear trade-offs that matter to respondents when choosing between residential space, accessibility, and housing cost in the discrete choice experiment.

3.4.3. Experimental Design

The experimental design determines how attributes and their levels are combined to form alternatives and choice sets (Schaafsma, 2011). These combinations create hypothetical housing scenarios in which respondents choose between alternatives and make trade-offs between attributes.

A full factorial design is a method used to combine attribute levels. It includes every possible combination of the attribute levels. When each of the A attributes has the same number of levels, L, the number of possible profiles for one alternative is calculated as L^A, where L is the number of levels and A is the number of attributes (Hensher et al., 2015). However, a full factorial design can produce too many possible profiles and choice sets. Presenting respondents with too many choice tasks can make it mentally more demanding and may reduce the reliability of their responses. The number of choice sets can be reduced by using a fractional factorial design, dividing the design into blocks, or combining a fractional factorial design with blocking (Hensher et al., 2015; Louviere et al., 2010; Street et al., 2005).

Fractional Factorial Design

A fractional factorial design is a strategy used to reduce the number of profiles generated by the full factorial design. This design uses only a selected fraction of the possible attribute combinations. It is usually designed to estimate the main effects of the attributes, although some selected interaction effects may also be estimated (Louviere et al., 2000). The main effects of the attributes show how one attribute affects choice across the levels of the other attributes. An interaction effect happens when the effect of one attribute changes according to the level of another attribute. The fraction of combinations may be selected randomly. However, random selection is likely to produce a statistically inefficient design (Hensher et al., 2015). Statistical design methods are therefore used to select a more efficient fraction of the possible combinations. These methods include orthogonal and D-efficient designs (Hensher and Button, 2007).

Reduced Experimental Design

In this study, after the alternatives, attributes, attribute levels, and the type of discrete choice experiment (DCE) were determined, the design of the DCE was created to generate the required profiles and choice sets. Initially, a full factorial design was generated by combining the levels of the four attributes. Given that three attributes with three levels and one attribute with two levels were involved, the total number of possible attribute profiles was calculated by multiplying the number of levels for each attribute, resulting in $(3 \times 3 \times 3 \times 2) = 54$ possible profiles per alternative. However, it was observed that the full factorial design produced an excessive number of possible profiles. Table 3.2 below summarizes the selected attributes and their levels.

Table 3.2.: Coded attribute levels used in the DCE

Attribute	**Description and levels**	
	City-Center Residential Tower	**Edge-of-City Residential Tower**
Accessibility to services (walking)	Three levels [1, 0, −1]	Three levels [1, 0, −1]
Housing cost	Three levels [1, 0, −1]	Three levels [1, 0, −1]
Residential quality	Three levels [1, 0, −1]	Three levels [1, 0, −1]
Apartment size	Two levels [1, −1]	Two levels [1, −1]

To reduce the number of choice sets presented to respondents, the 54 profiles were first organized into blocks, and Python was then used to randomly select the profile combinations used to construct eight paired choice scenarios. Each scenario contained a city-center residential-tower alternative and an edge-of-city residential-tower alternative. Following the initial selection, the final scenarios were manually reviewed for variation in the attribute levels, diversity of attribute combinations, and reasonable representation across the two alternatives. The values $[-1, 0, 1]$ and $[-1, 1]$ were used as numerical codes for the attribute levels; their use does not imply that the design is orthogonal. The final design is therefore described as a reduced, randomly selected design that was subsequently reviewed for attribute variation and level representation. Because the scenarios were produced through random reduction and manual review rather than formal orthogonal or efficiency-based optimization, some correlation may remain among the attribute columns and may reduce estimation precision. Table 3.3 presents the eight choice scenarios used in the questionnaire.

Table 3.3.: Coded profiles used in the eight choice sets.

Accessibility	Housing cost	Residential quality	Apartment size	Choice set
−1	1	0	−1	**Choice 1**
1	−1	1	1	
0	0	0	−1	**Choice 2**
1	−1	1	1	
−1	1	−1	−1	**Choice 3**
0	0	0	1	
0	1	0	1	**Choice 4**
1	0	1	−1	
−1	0	−1	−1	**Choice 5**
1	−1	1	1	
0	−1	1	1	**Choice 6**
−1	1	0	−1	
1	−1	1	1	**Choice 7**
0	0	0	−1	
−1	1	0	−1	**Choice 8**
0	0	−1	1	

Respondents' preferences toward the two housing alternatives were measured using choice sets constructed from the selected attributes and their levels. To keep the choice tasks manageable and reduce respondent fatigue, the experimental design was reduced to eight choice sets. Therefore, each participant evaluated eight choice sets. This approach balanced the need for data collection with the need to minimize respondent fatigue. Because the experimental design allows the attribute levels to vary across the alternatives, it can produce combinations that may appear unusual, such as an urban-edge location with a 5-minute walking time to services. Although some combinations may differ from current conditions in Duhok, they were retained to maintain variation across the scenarios. These combinations also required respondents to evaluate the trade-offs between the attributes rather than relying only on their existing assumptions about city-center and urban-edge housing.

The final choice sets were included in the questionnaire as a stated preference experiment. In each choice set, respondents selected their preferred option from the two housing alternatives. Each housing alternative was accompanied by a fixed illustrative image representing its general residential setting. The images were included to help participants visualize the difference between city-center and edge-of-city housing, while the differences in accessibility, housing cost, residential quality, and apartment size were presented separately in the choice table. The same two images were used across all eight choice sets and were not treated as experimental attributes. Figure 3.1 shows an example of a choice set presented in the questionnaire.

Scenario 1
Please choose the option you would most prefer based on the presented characteristics.

Attribute	City Center Residential Tower	Edge-of-City Residential Tower
		
Accessibility to services (walking)	5 min	30 min
Housing cost	$500/month	$300/month
Residential quality	Moderate	Good
Apartment size	80 m²	160 m²
Choose your preferred option in each scenario.	☐ City Center	☐ Edge-of-City

Figure 3.1.: Example of one of the scenarios presented to respondents

Image sources: The city-center image was obtained from Miami Residence Realty's webpage for RISE Brickell at Brickell City Center (`https://www.miamiresidence.com/brickell-city-centre/rise-brickell.htm`*). The edge-of-city image is a CGI visualization credited to Tevir Group and reproduced in the BBC News article (Luxury seafront apartment block approved), published on 9 December 2024 (*`https://www.bbc.com/news/articles/cn85xpzx1zgo`*). The images were used as illustrative materials in the questionnaire and do not depict residential projects in Duhok.*

3.5. Analytical Approach and Model Specification

To analyze the survey responses and understand respondents' choice behavior, the study uses an econometric foundation. This approach assumes that individuals opt for the housing alternative that provides the highest overall utility, making it possible to estimate how each residential attribute affects their choices.

3.5.1. Random Utility Theory

The most common fundamental theory that describes the individuals' behavior assumptions when selecting their preferred alternative from a set of alternatives and the basic theory behind creating discrete-choice models is random utility theory. This theory is based on some assumptions, which are: the individual selects an alternative from a set of alternatives that maximizes their utility; each alternative is described by a random utility function that is associated with the individual preference (Andrei et al., 2022). The random utility is a function of explanatory variables (attributes) and individual variables (socioeconomic variables), but an unobserved effect can affect the choice-making, which describes everyone's particular tastes. So, the utility function U_{jq} of alternative j associated with individual q is composed of two components (Hensher et al., 2015):

The systematic component V_{jq} is specified using observed attributes and, where included, interactions with respondent characteristics.

The unobserved component ε_{jq} represents influences on utility that are not captured by the specified systematic component. Equation 3.2 shows the utility function for an alternative (Hensher et al., 2015).

$$U_{jq} = V_{jq} + \varepsilon_{jq} \tag{3.2}$$

Where,

U_{jq} represents the utility function of individual q and alternative j; V_{jq} represents the observed component; ε_{jq} represents an unobserved component.

The decomposition separates the utility component specified by the analyst, V_{jq}, from unobserved influences, ε_{jq}. The systematic component is identified as a function of observed attributes and estimated parameters, as illustrated in equation 3.3 (Train, 2009).

$$V_{jq} = \beta_{0j} + \beta_{1j} f(X_{1j}) + \beta_{2j} f(X_{2j}) + \cdots + \beta_{kj} f(X_{kj}) \tag{3.3}$$

Where,

β_{0j} is called the alternative-specific constant for alternative j, which represents the mean effect of all unobserved factors affecting utility (Katayama et al., 2009).

β_{kj} is the coefficient (parameter) associated with attribute X_k of alternative j, where $k = 1, 2, \ldots, K$ indexes the attributes and K denotes the number of attributes.

X_{kj} is the value of attribute k for alternative j.

V_{jq} is the deterministic (observable) component of the utility of alternative j for individual q (Schaafsma, 2011).

ε_{jq} is the random error term representing unobserved factors affecting the utility of alternative j for individual q.

U_{jq} is the total utility of alternative j for individual q.

P_{jq} is the probability that individual q chooses alternative j.

Random utility theory assumes that individuals aim to obtain the highest possible utility. Therefore, individual q chooses alternative j if and only if:

$$U_{jq} \geq U_{iq} \quad \Longleftrightarrow \quad V_{jq} + \varepsilon_{jq} \geq V_{iq} + \varepsilon_{iq}, \qquad \forall i \neq j. \tag{3.4}$$

So, the probability of choosing alternative j over other alternatives i is illustrated in equation 3.5

$$P = \mathrm{Prob}(U_{jq} \geq U_{iq}) = \mathrm{Prob}(V_{jq} - V_{iq} \geq \varepsilon_{iq} - \varepsilon_{jq}) \tag{3.5}$$

The difference between the random utility components, $\varepsilon_{iq} - \varepsilon_{jq}$, cannot be observed directly. Therefore, the probability of choosing alternative j depends on the difference between the observed utility components and the random utility components. Choice probabilities are derived by assuming a specific probability distribution for the random error terms (Cleland et al., 2018).

3.5.2. Multinomial Logit Model

The multinomial logit (MNL) model is one of the popular and standard models used by many researchers (Abdullah et al., 2025). As explained in Section 3.5.1, utility is a function of observed components and unobserved components (random component). The MNL model is based on the assumption that random utility components follow a Gumbel distribution and are independently and identically distributed (IID) across alternatives (Hensher and Button, 2007). As a result of IID, the MNL has a property called independence of irrelevant alternatives (IIA) (Ortúzar and Willumsen, 2011). The concept behind this property is that the ratio of the probabilities of two alternatives is independent of the presence or attributes of other alternatives (Schaafsma, 2011). Another property of MNL, which is equality of error variance across alternatives (Hensher and Button, 2007), means that the utility of each alternative has an equal variance of the error components and this error is uncorrelated across alternatives. So, the formula of MNL models in equation 3.6 is derived based on the properties mentioned above.

$$P_{jq} = \frac{e^{V_{jq}}}{\sum_{i=1}^{I} e^{V_{iq}}} \tag{3.6}$$

where:

P_{jq}: The probability that individual q chooses alternative j.

V_{jq}: The systematic (deterministic) utility of alternative j for individual q.

The MNL model uses exponentiated utility scores to calculate the probability that a specific alternative is chosen. The more attractive an option (i.e., higher utility), the higher its probability, while still considering the relative attractiveness of all options in the choice set.

3.5.3. Data Analysis Method

The data were prepared and analyzed using Python 3.14.6, with pandas 3.0.3 used for data handling and NumPy 2.5.1 for numerical computation. All the fields in the questionnaire were required, which means that submitted responses contained complete answers to all questions. The data were converted from the original respondent-level format into long format, with one row for each alternative in each choice situation. Before the analysis, the datasets were checked for consistency between the raw and long-format datasets and completeness of each choice task. The final long-format dataset contained 6,768 alternative-level observations, corresponding to 3,384 choice situations.

The collected data are analyzed using the Multinomial Logit (MNL) model. The MNL model is commonly used in transportation and urban planning studies to analyze individual choice behavior between discrete alternatives.

The baseline utility specification for each residential alternative is expressed as:

$$U_i = \beta_1 Accessibility + \beta_2 Cost + \beta_3 Residential\ Quality + \beta_4 Apartment\ Size + \varepsilon_i \tag{3.7}$$

where:

- U_i represents the utility associated with residential alternative i,
- β represents the estimated coefficients of the explanatory variables,
- ε_i represents the random error term.

Each housing attribute enters the model through a single numerical coefficient using the codes in Table B.3. For accessibility and residential quality, this imposes equal utility changes between adjacent coded levels. Accessibility is therefore modeled per coded step, not per minute: the changes from 5 to 15 minutes and from 15 to 30 minutes each represent one coded step. For apartment size, the change from $80\,\mathrm{m}^2$ to $160\,\mathrm{m}^2$ spans two code units.

The model estimates how each residential attribute affects respondents' housing choices. When other factors are held constant, a positive coefficient indicates that an attribute increases residential utility and the probability of choosing an alternative. A negative coefficient indicates that it reduces residential utility and choice probability.

To analyze differences in preferences between respondents, sociodemographic characteristics collected in the first section of the questionnaire, such as age, household income, and private car ownership, are included in the MNL model. These variables are interacted with selected residential attributes to know whether the importance of accessibility, housing cost, residential quality, and apartment size differs according to individual and household characteristics.

The extended models additionally include selected interaction terms to examine preference heterogeneity, while the final model also includes a city-center alternative-specific constant (ASC) and the current-residence interaction.

The models were estimated in Python using NumPy. Each respondent completed eight choice tasks. Standard errors were calculated using a sandwich covariance estimator clustered by respondent, allowing responses from the same person to be correlated while assuming independence across respondents. A finite-sample correction of $\frac{G}{G-1}\frac{N-1}{N-K}$ was applied, where G is the number of respondents, N is the number of choice situations, and K is the number of estimated parameters. Statistical inference uses two-sided Wald z-tests. This adjustment changes the estimated uncertainty, but not the model coefficients (Cameron and Miller, 2015).

To quantify the marginal trade-offs respondents are willing to make between non-monetary attributes (accessibility, residential quality, apartment size) and monthly housing cost, the Marginal Rate of Substitution (MRS) or Willingness to Pay (WTP) is calculated as the ratio of an attribute's parameter estimate (β_k) to the cost parameter (β_{Cost}):

$$MRS_k = -\frac{\beta_k}{\beta_{Cost}} \tag{3.8}$$

Despite the advantages of the stated preference and discrete choice approach, some limitations should be acknowledged. The hypothetical nature of DCE scenarios may not fully reflect real-world residential behavior, because respondents evaluate simulated alternatives instead of real world housing decisions (Louviere et al., 2000; Train, 2009). In addition, actual residential choices are limited by housing market conditions, availability, affordability, and other contextual factors that cannot be fully represented in simplified experimental scenarios (Ben-Akiva and Boccara, 1995; Timmermans et al., 1994). However, the DCE approach stays appropriate for identifying relative preferences and trade-offs between key residential attributes under controlled experimental conditions (Hensher et al., 2015).

4. Results and Analysis

This chapter presents the results of the Discrete Choice Experiment (DCE) used to analyze residential location preferences in Duhok. The analysis focuses on the effects of accessibility, housing cost, residential quality, and apartment size on respondents' choices between residential alternatives. It also analyzes whether these preferences vary according to different household and individual characteristics, including car ownership, income, family stage, current residential location, and age.

The analysis first shows the baseline multinomial logit (MNL) model, which estimates the main effects of the residential attributes. Then, it uses interaction models to examine differences in preferences among respondent groups. These models are used to identify how car ownership affects the importance of accessibility, how income affects sensitivity to housing cost, and whether family stage changes the value of apartment size. The chapter then presents the final model, which includes the main interaction effects, the city-center alternative-specific constant (ASC), and the current residence interaction. This model is used to know whether a general preference for the city center remains after accounting for the main housing attributes and observed sources of preference heterogeneity. Finally, the chapter presents the main trade-offs between the residential attributes using marginal rate of substitution (MRS) and willingness to pay (WTP) measures where appropriate. These results provide the evidence used to discuss the research questions, theoretical implications, and planning implications in chapter 5.

4.1. Descriptive Statistics and Sample Profile

Before estimating the discrete choice models, a descriptive analysis of the sample (N=423) was conducted to establish the socioeconomic background, current living constraints, and baseline preferences of the respondents.

4.1.1. Socioeconomic and Demographic Characteristics

The sample was relatively young and highly educated. Most respondents (58.6%) were aged 20–35, followed by respondents under 20 years old (23.6%). The sample showed more male respondents (66.0%) than female (34.0%). For education, over two-thirds of the sample had a university-level degree (44.4% Bachelor's, 24.3% Master's or higher). Employed respondents represented the largest occupational group (42.3%), followed by students (31.0%). Economically, most households reported an average monthly net income (61.0%), while 22.7% identified as above average and 16.3% as below average. These sample characteristics are shown in the figures below.

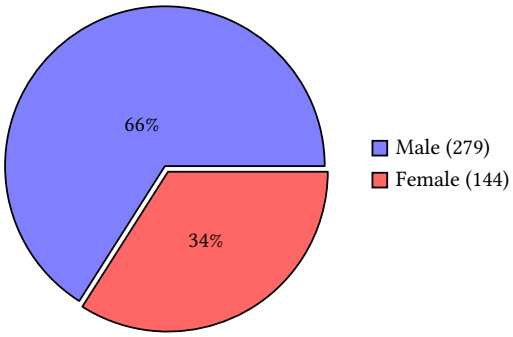


Figure 4.1.: Gender distribution of respondents

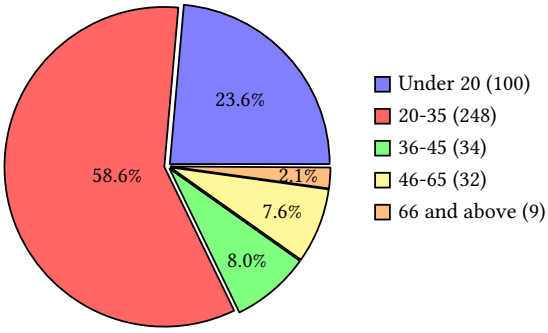


Figure 4.2.: Age distribution of respondents
Note: Percentages may not sum to 100% due to rounding.

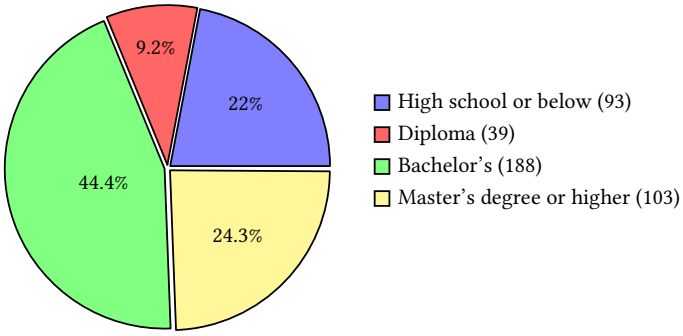


Figure 4.3.: Education level of respondents
Note: Percentages may not sum to 100% due to rounding.

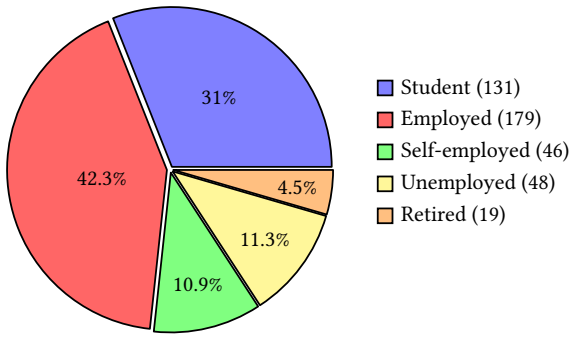


Figure 4.4.: Employment status of respondents

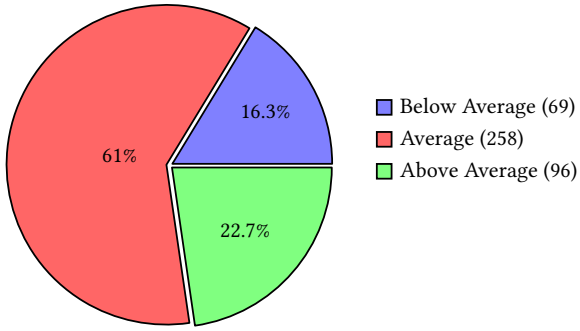


Figure 4.5.: Monthly household net income of respondents

As shown in Figure 4.6, most respondents lived in multi-person households. The most common living arrangement was single respondents living with parents or relatives (40.2%), followed by married couples with children (23.2%) and three-generation or extended families (18.2%). Only 4.0% of respondents lived alone. These household arrangements provide context for examining preferences for residential space, but the counts themselves do not show how much respondents value space or privacy.

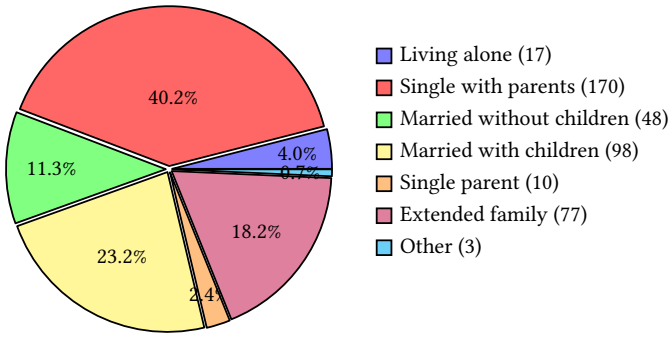


Figure 4.6.: Household type of respondents

4.1.2. Current Housing and Mobility Constraints

Current housing conditions and residential location provide important context for understanding respondents' housing preferences. Most respondents lived in an owned house (64.8%), while 20.8% lived in owned apartments and 13.0% in rented apartments. As for the location, about three-quarters of the sample (74.7%) lived near the city center, compared to 25.3% at the urban edge.

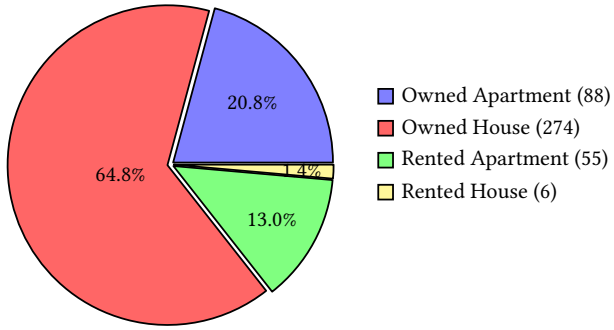


Figure 4.7.: Current housing type of respondents

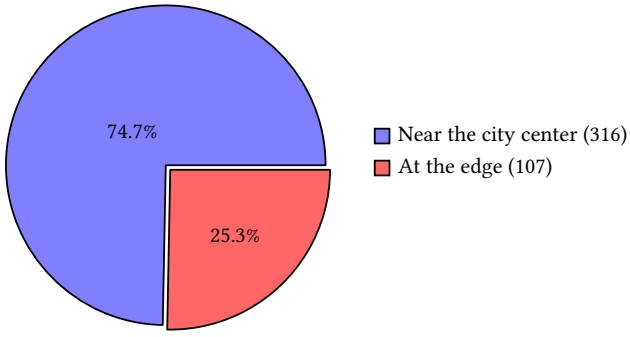


Figure 4.8.: Current residential location of respondents

Private car ownership was selected by 62.6% of respondents, while 37.4% selected the option that they did not own a private vehicle. The following models examine whether sensitivity to walking accessibility varies between these two groups.

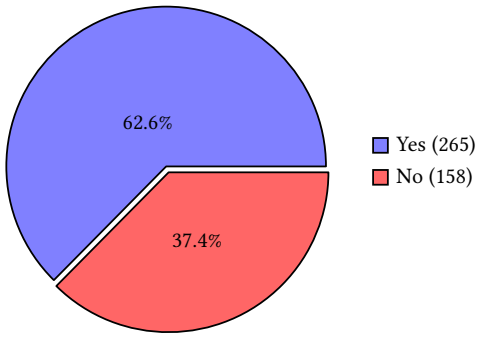


Figure 4.9.: Private car ownership among respondents

4.1.3. General Stated Preference

When asked about their general housing preference, 50.1% of respondents preferred living in residential towers near the city center. About 29.6% preferred the urban edge, while 20.3% had no strong preference. These descriptive statistics show respondents' general stated preferences. The following discrete choice models examine how these preferences change when respondents are required to make trade-offs between housing attributes.

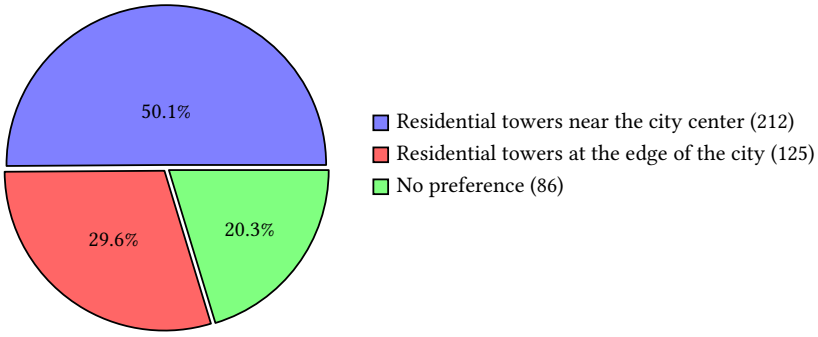


Figure 4.10.: General residential preference of respondents

4.2. Model-Based Analysis: Revealing Residential Trade-offs

While the descriptive statistics describe the general profile of the respondents, stated preference data together with the multinomial logit (MNL) model provide a more detailed examination of their housing choices. The experiment requires respondents to choose between hypothetical scenarios, and the MNL model estimates the trade-offs they make between accessibility, affordability, and comfortability.

4.2.1. Base (MNL) Model Estimation Results: The Core Drivers of Choice

The baseline MNL model in Table 4.1 estimates the average effects of the four main housing attributes before socioeconomic interaction terms are included. The results show that all four residential attributes significantly affect location choice in Duhok ($p < 0.001$). Accessibility has a negative coefficient ($\beta = -1.0422$), indicating that longer times reduce residential utility. Housing cost also has a negative coefficient ($\beta = -0.3709$), meaning that higher housing costs reduce utility. However, Residential Quality ($\beta = 0.7363$) and Apartment Size ($\beta = 0.4728$) have positive effects, showing that better residential quality and larger apartments increase residential utility. These baseline results are consistent with Lancaster's New Theory of Consumer Demand discussed in the literature review; residents in Duhok do not just choose a location, but they choose a bundle of housing attributes instead. Also, the baseline model has a Pseudo R-squared of 0.129, which increases in the following models after socioeconomic interaction terms are introduced.

Table 4.1.: Baseline MNL model evaluating core housing attributes

Attribute	Coefficient (β)	Clustered SE	z-value	p-value
Accessibility	−1.0422	0.104	−10.053	<0.001
Housing Cost	−0.3709	0.071	−5.260	<0.001
Residential Quality	0.7363	0.054	13.695	<0.001
Apartment Size	0.4728	0.028	16.775	<0.001
Log-likelihood (LL)	−2,042.102			
McFadden's pseudo-R^2	0.129			

Note: The model uses 3,384 choice situations from 423 respondents, with each respondent completing eight choice tasks. Standard errors are clustered by respondent, with the finite-sample correction described in Section 3.5.3. The reported p-values are based on two-sided Wald z-tests.

4.2.2. Willingness to Trade: Putting a Price on Comfort and Convenience

To make the estimated utility coefficients easier to understand, the marginal rate of substitution (MRS) is calculated between each residential attribute and housing cost. This measure expresses the estimated trade-offs in monetary terms and shows how much respondents are willing to pay for a change in an attribute. Because the model's cost levels were structured in $100 increments, a 1-unit increase in the cost code represents an increase of $100.

The Value of Residential Quality:

$$\mathrm{MRS}_{\mathrm{Quality}} = -\frac{\beta_{\mathrm{Quality}}}{\beta_{\mathrm{Cost}}} \approx 1.9852.$$

In the baseline model, a one-step improvement in residential quality corresponds to an MRS of approximately $199 per month under the experimental coding.

The Value of Space (Apartment Size):

$$\mathrm{MRS}_{\mathrm{Size}} = -\frac{\beta_{\mathrm{Size}}}{\beta_{\mathrm{Cost}}} \approx 1.2748.$$

Under the experimental coding, the two-step change from $80\,\mathrm{m}^2$ to $160\,\mathrm{m}^2$ corresponds to an MRS of approximately $255 per month in the baseline model.

The Walkability Penalty (Accessibility Trade-off):

$$\mathrm{MRS}_{\mathrm{Accessibility}} = -\frac{\beta_{\mathrm{Accessibility}}}{\beta_{\mathrm{Cost}}} = -\frac{-1.0422}{-0.3709} \approx -2.81.$$

In the baseline model, a one-step worsening in accessibility requires an estimated reduction of approximately $281 in monthly housing cost to keep residential utility unchanged, holding the other attributes constant. This is a model-based trade-off under the experimental coding, and should not be understood as a monetary value for each additional minute of walking time. These monetary figures are point estimates based on the fitted utility function. The accessibility and full-size trade-offs exceed the $200 difference between the lowest and highest experimental housing costs, so the estimated compensation amounts extend beyond the price differences directly presented in the choice tasks.

4.2.3. Preference Heterogeneity: The Role of Car Ownership and Income

Residential preferences may vary according to household resources and circumstances. To examine this heterogeneity, the model was expanded to include interactions for private car ownership and household income (Table 4.2).

Table 4.2.: MNL Model with Socioeconomic Interactions

Attribute	Coefficient (β)	Clustered SE	z-value	p-value
Accessibility (Base)	−1.1976	0.125	−9.560	<0.001
Housing Cost (Base)	−0.4502	0.077	−5.882	<0.001
Residential Quality	0.7415	0.054	13.648	<0.001
Apartment Size	0.4754	0.028	16.765	<0.001
Accessibility X Car Owner	+0.2343	0.092	2.550	0.011
Cost X High Income	+0.3212	0.118	2.717	0.007
Log-likelihood (LL)	−2,028.596			
McFadden's pseudo-R^2	0.135			

Note: The model is based on 3,384 choice situations from 423 respondents, with each respondent completing eight choice tasks. Standard errors are clustered by respondent, and include the finite-sample correction described in Section 3.5.3. The reported p-values use two-sided Wald z-tests. The main accessibility coefficient refers to respondents who do not own a private car; the main cost coefficient refers to the below- and average-income group.

Car Ownership and the Accessibility Trade-off

$$MRS_{Accessibility-NoCar} = -\left(\frac{\beta_{Accessibility-NoCar}}{\beta_{Cost}}\right) = -\left(\frac{-1.1976}{-0.4502}\right) \approx -2.66 \text{ (\$266 per step)}$$

For respondents without a private vehicle, the accessibility coefficient is $\beta = -1.1976$. Using the cost coefficient for the below- and average-income group, a one-step worsening of accessibility means a compensating reduction in monthly housing cost of approximately $266. The monetary comparison with car owners below uses the same income reference group.

$$MRS_{Accessibility-Car} = -\left(\frac{\beta_{Accessibility-Car}}{\beta_{Cost}}\right) = -\left(\frac{-0.9633}{-0.4502}\right) \approx -2.14 \text{ (\$214 per step)}$$

For car-owning respondents, the accessibility coefficient is less negative ($-1.1976 + 0.2343 = -0.9633$). The interaction remains statistically significant when standard errors are clustered by respondent ($\beta = 0.2343$, $p = 0.011$). Using the cost coefficient for the below- and average-income group, this means approximately $214 per accessibility step, compared with $266 for respondents who do not own a private vehicle in the same income group. The positive interaction with car ownership shows that respondents who own a private vehicle are less sensitive to poorer local accessibility. This interaction suggests that car ownership reduces the disadvantage associated with poorer local accessibility and may make urban-edge residential alternatives more acceptable to households owning vehicles.

Income and Housing Cost Sensitivity

The interaction between housing cost and high income is positive and statistically significant when standard errors are clustered by respondent ($\beta = 0.3212$, $p = 0.007$). This shows a less negative cost response among higher-income respondents than among those in the below- and average-income categories. Adding the main cost coefficient and the interaction gives an estimated high-income cost coefficient of -0.1290. This coefficient together is not statistically distinguishable from zero (clustered SE = 0.1128, $p = 0.253$), so the model supports a difference in cost sensitivity between the income groups, but it does not show a statistically significant negative cost coefficient for the high-income group.

4.2.4. Preference for Apartment Size and the Role of Family Stage

Life-course research suggests that demand for residential space may change with household composition and family stage, including when households have children. To examine whether preferences for apartment size differ among family-oriented households, an interaction between apartment size and family-oriented household status was included in the model (see Table 4.3).

Table 4.3.: Comprehensive Model (Including Family Stage Interaction)

Attribute	Coefficient (β)	Clustered SE	z-value	p-value
Accessibility	−1.1952	0.126	−9.523	<0.001
Housing Cost	−0.4518	0.077	−5.901	<0.001
Residential Quality	0.7416	0.054	13.645	<0.001
Apartment Size	0.4641	0.035	13.113	<0.001
Accessibility X Car Owner	+0.2300	0.093	2.486	0.013
Cost X High Income	+0.3274	0.117	2.796	0.005
Size X Family Stage	0.0261	0.054	0.485	0.628
Log-likelihood (LL)	−2,028.372			
McFadden's pseudo-R^2	0.135			

Note: The model is based on 3,384 choice situations from 423 respondents, each respondent completing eight choice tasks. Standard errors are clustered by respondent and include the finite-sample correction described in Section 3.5.3. Reported p-values use two-sided Wald z-tests. The main accessibility and cost coefficients refer to respondents who do not own a private car and the below- and average-income group. The main size coefficient applies to respondents coded as 0 for family stage, as defined in Section 3.3.3.

The interaction between family stage and apartment size is not statistically significant ($\beta = 0.0261, p = 0.628$), while the baseline effect of apartment size remains positive and statistically significant ($p < 0.001$). This shows that larger apartments are generally preferred in the sample, but the model does not provide evidence that this preference has a significant difference between the family-stage groups in the analysis.

4.2.5. Baseline Biases and Residential Self-Selection

Finally, the model examines whether a baseline preference for the city center remains after accounting for the main housing attributes and observed preference heterogeneity. The final model includes a city-center alternative-specific constant (ASC) and a current-residence interaction (Table 4.4).

Table 4.4.: Final Master Model

Attribute	Coefficient (β)	Clustered SE	z-value	p-value
ASC (City Center)	0.0979	0.118	0.827	0.408
Accessibility	−0.7996	0.105	−7.618	<0.001
Housing Cost	−0.2920	0.072	−4.040	<0.001
Residential Quality	0.6044	0.055	11.007	<0.001
Apartment Size	0.4355	0.027	16.363	<0.001
Accessibility X Car Owner	+0.1965	0.094	2.101	0.036
Cost X High Income	+0.3545	0.120	2.942	0.003
Center Bias X Current Center Resident	+0.1797	0.134	1.342	0.180
Quality X Older Adults (46+)	+0.4120	0.154	2.676	0.007
Log-likelihood (LL)	−2,014.085			
McFadden's pseudo-R^2	0.141			

Note: The model is based on 3,384 choice situations from 423 respondents, each respondent completing eight choice tasks. Standard errors are clustered by respondent and include the finite-sample correction described in Section 3.5.3. Reported p-values use two-sided Wald z-tests. The city-center ASC refers to current urban-edge residents. The main accessibility, cost and quality coefficients refer to respondents who do not own a private vehicle, the below- and average-income group, and respondents younger than 46.

The final model also includes an interaction between the residential quality and being aged 46 or older; the family-stage interaction examined in Table 4.3 is not included in this model.

The city-center ASC is positive but not statistically significant for the reference group of respondents that are living at the urban edge ($\beta = 0.0979, p = 0.408$). The interaction between current center residence and the city-center alternative is also positive, but it is not statistically significant after clustering standard errors by respondent ($\beta = 0.1797, p = 0.180$; 95% confidence interval: -0.0827 to 0.4422). Therefore, the model does not provide enough evidence that the remaining preference for the center has a difference between the two current-residence groups. This interaction should not be understood as an established status quo or residential self-selection effect. For respondents who currently live in the city center, the combined city-center effect is calculated as the sum of the ASC and the interaction with current residential location, which is positive and statistically significant ($\beta = 0.2776$, clustered $SE = 0.0778, p < 0.001$). However, a statistically significant effect within this group

does not show that the difference between current city-center and urban-edge residents is statistically significant. Preferences for residential quality also vary by age. Respondents aged 46 years or older have a positive interaction with residential quality ($\beta = 0.4120$, $p = 0.007$), showing that they value residential quality more than younger respondents. However, because residential quality is represented as a general attribute, the model cannot identify which aspects of residential quality explain this difference.

5. Discussion and Conclusion

This chapter explains how the main findings relate to the study's aim, research questions, and theoretical framework. The analysis examined how accessibility, housing cost, residential quality, and apartment size influence residential location preferences between city-center and urban-edge housing in Duhok. It also examined whether these preferences vary according to car ownership, income, family stage, current residential location, and age.

The discussion first summarizes the main findings and answers the four research questions. It then discusses accessibility, affordability, residential space, and city-center preference, followed by the theoretical implications of the results. The chapter also presents the main limitations of the study and suggestions for future research. Finally, the conclusion brings together the main findings and their implications for residential development and urban transport planning in Duhok.

5.1. Fulfilling the Research Aim

The main aim of this research was to examine residential location preferences between city-center and urban-edge housing in Duhok and to identify the main factors influencing this choice. The study focused on three main dimensions of residential choice: accessibility, affordability, and comfortability. The findings show that residents do not make residential decisions only based on location, but they evaluate many housing characteristics at the same time and make trade-offs between accessibility, housing cost, residential quality, and apartment size.

The baseline MNL model shows that all four housing attributes have a statistically significant effect on residential choice. Accessibility and housing cost have negative coefficients, which means that respondents are less likely to choose alternatives with longer walking times or higher housing costs. On the other hand, residential quality and apartment size have positive coefficients, which shows that respondents value better-quality housing and larger apartments more. The baseline coefficients were -1.0422 for accessibility, -0.3709 for housing cost, 0.7363 for residential quality, and 0.4728 for apartment size.

These results support the main idea of the research framework: residential location choice is a trade-off between different housing attributes rather than a simple preference for either the city center or the urban edge. This is consistent as well with the literature discussed in Chapter 2 and with Lancaster's view that households evaluate housing as a bundle of attributes instead of a single product (Lancaster, 1966). However, the results also show that these preferences are not the same for all respondents. Car owners are less affected negatively by longer walking times, while higher-income respondents are less sensitive to housing costs. Older respondents value residential quality more. At the same time, the interaction between family stage and apartment size is not statistically significant. In the final model, the city-center ASC is not statistically significant for current urban-edge residents, and the difference in center preference between current center and edge residents is also not statistically significant.

Overall, the findings suggest that residential choice in Duhok is influenced by a combination of housing needs, financial resources, and mobility options. Neither centrality nor greater residential space determines the preferred location alone. The preferred location depends on the bundle of attributes available to each household.

5.2. Answers to the Research Questions

RQ1: What is the relative influence of accessibility, affordability, and comfortability on residential location choice?

The results show that all three dimensions are important, but they do not have the same effect. Longer walking times to daily services and higher housing costs reduce residential utility. At the same time, better residential quality and larger apartment sizes increase residential utility. This means that residents value convenient access, affordable housing, good residential conditions, and sufficient space simultaneously. Among the main attributes in the baseline model, accessibility has the largest absolute coefficient, followed by residential quality, apartment size, and housing cost. This comparison applies only to the coded changes in the experiment and should not be understood as a general ranking of attribute importance that is independent of their scale. This shows that accessibility is an important part of residential choice. However, the positive coefficients for residential quality and apartment size show that residents also value good living conditions and sufficient living space. Therefore, RQ1 can be answered by stating that residential choice in Duhok is based on a clear trade-off between accessibility, affordability, and comfortability, with accessibility playing an important role, while better residential quality and larger apartment size also increase residential utility.

RQ2: How do residents in Duhok choose between living in the city center and at the edge of the city?

The results show that respondents consider accessibility, housing cost, residential quality, and apartment size when choosing between central and urban-edge housing. In the separate general preference question, 50.1% preferred residential towers near the center, 29.6% preferred the urban edge and 20.3% reported no preference. These responses describe a general stated preference, while the DCE requires respondents to make trade-offs among specific housing attributes.

In the final model, the city-center ASC applies to respondents who currently live at the urban edge and is not statistically significant ($\beta = 0.0979$, $p = 0.408$). The interaction between the city-center alternative and current city-center residence is positive but also not statistically significant ($\beta = 0.1797$, $p = 0.180$). For current city-center residents, the sum of the ASC and interaction is positive and statistically significant ($\beta = 0.2776$, $p < 0.001$), but the difference between the two residence groups is not statistically significant.

These results do not show that all respondents lack a preference for the city center, nor do they establish a status quo effect. They show that the housing attributes affect residential choice, while the difference related to current residential location remains uncertain.

RQ3: To what extent are residents willing to trade lower accessibility for improved affordability or comfort?

The DCE shows that residents are willing to make trade-offs between accessibility, housing cost, and residential quality. In the baseline model, the accessibility coefficient is -1.0422 and the housing cost coefficient is -0.3709. The estimated MRS between accessibility and housing cost is approximately -2.81 cost-code units, which means that a one-step worsening in accessibility requires an estimated reduction of $281 in monthly housing cost under the experimental coding. This should be understood specifically as the baseline-model MRS, not as the same value of accessibility for every household. The later models show why this value should be understood as an average rather than as the same trade-off for every household. Car ownership influences the accessibility effect, and income influences the effect of housing cost. In the socioeconomic interaction model, using the cost coefficient for the below- and average-income group, the accessibility trade-off is approximately $266 per coded step for non-owners and $214 for car owners.

The final model has different coefficients from the baseline model. The main accessibility coefficient is -0.7996 and its housing cost coefficient is -0.2920. Therefore, the $281 estimate should not be presented as a single value of accessibility in the discussion. It is more accurate to describe it as the WTP/MRS estimate from the baseline model, while the later models show that the value of accessibility varies across household characteristics.

RQ4: How can the identified preferences inform residential development and urban transport planning policies?

The results suggest that residential planning in Duhok should not focus only on central densification or outward expansion. Housing policy should consider accessibility, affordability, space, and residential quality together.

In central areas, new housing should provide adequate apartment sizes and residential quality instead of relying only on high density. At the urban edge, housing development should be coordinated with reliable transport and access to services. Improving public transport is important because respondents without private cars are more negatively affected by longer walking times to services. At the same time, affordability should also be considered because respondents with lower incomes are more sensitive to housing costs than high-income respondents. Therefore, the main policy message is that Duhok needs housing that is both accessible and livable, rather than simply housing that is central or peripheral.

5.3. Accessibility and the Role of Car Ownership

Accessibility is one of the main findings of the study. In the baseline model, longer walking times to services reduce residential utility. This shows that residents value being able to reach daily services in a reasonable walking time. However, the interaction between accessibility and car ownership shows that this effect is not the same for all residents. In the socioeconomic model, the accessibility coefficient for the base group is -1.1976, while the interaction with car ownership is $+0.2343$. This reduces the negative accessibility effect for car owners.

This result has an important planning implication. A household without a private vehicle depends more on services within walking distance. Therefore, poor access to services creates a greater disadvantage for this group. Car owners have another way to reach services and activities when they are not easily accessible by walking. This result is also consistent with the literature on residential location and mobility. Accessibility is not experienced in the exact same way by all households because transport resources affect the ability to reach opportunities. In Duhok, the availability of a private vehicle can therefore make urban-edge housing more acceptable. However, the result should not be understood as a proof that car ownership causes urban sprawl. The study uses stated preference data and an MNL model to identify a relationship between car ownership and the effects of accessibility on residential choice. A more careful interpretation is that car ownership may reduce the disadvantage of longer walking times to services and may help explain preferences for urban-edge housing.

This is important for Duhok because the literature review identifies car dependence and limited public transport as important characteristics of the city's urban development. Therefore, the result supports the need to consider housing and transport planning together rather than treating them as separate issues.

5.4. Income and Housing Cost

Housing cost is an important limitation in residential choice. Its coefficient is negative in the baseline model and for the below- and average-income reference group in the final model, although sensitivity to housing cost changes according to income. The positive interaction between housing cost and high income shows that the estimated cost coefficient is higher for high-income respondents than for the below- and average-income groups. In the socioeconomic interaction model, the combined coefficient is $-0.4502 + 0.3212 = -0.1290$ and it is not statistically distinguishable from zero ($p = 0.253$). In the final model, the combined coefficient is a bit positive ($-0.2920 + 0.3545 = +0.0625$). The significant interaction does not establish a statistically significant positive cost effect within the high-income group. This result supports the idea that households make residential choices within financial limits. A higher-income household has more flexibility to choose a location or housing type with better quality even when the monthly cost is higher. Lower- and middle-income households have fewer options because price becomes a major limitation. This difference is important when interpreting urban-edge housing. A household living at the urban edge may not prefer the edge when all constraints are removed. If an urban-

edge alternative offers lower housing costs, this may make it a more realistic option for cost-sensitive households. Therefore, living at the urban edge should not automatically be understood as a preference for suburban or low-density living. This supports the argument in the literature review that residential choice should be understood as a constrained decision. Households choose from the options that are financially and practically available to them.

This finding also has implications for social equity. Policies that encourage central development without considering housing prices may benefit higher-income households more than lower-income households. Therefore, affordable housing needs to be part of the strategies that aim at improving residential development in central areas.

5.5. Apartment Size and the Demand for Residential Space

Apartment size has a positive and statistically significant effect on residential choice. In the final model, the coefficient for apartment size is 0.4355 with a p-value below 0.001. This result shows that adequate residential space is valued by respondents.

This finding is important for Duhok because the literature review identifies space, privacy, and family-oriented housing needs as important parts of residential choice. The study also tested whether the value of apartment size changes according to family stage. The interaction between apartment size and family stage was not statistically significant (β = 0.0261, $p = 0.628$). At the same time, the main effect of apartment size remained statistically significant. This result means that the study does not find statistical evidence that family stage changes the importance of apartment size in this sample. However, it does not disprove life-course theory. The expected difference between family-stage groups was not supported by the results of this model and sample. One possible interpretation is that sufficient residential space is important across different household types in Duhok. This may be related to local housing expectations, household structures, privacy needs, and preferences for flexibility in the use of space within the home.

For planning, the result suggests that central densification should not rely only on very small apartments. Increasing the number of housing units without providing sufficient residential space may not reflect the preferences identified in this study.

5.6. City-Center Preference, Self-Selection and Policy Implications

Interpreting the final model requires distinguishing between a center preference within a residence group and a difference between residence groups. For respondents that currently live at the urban edge, the city-center ASC is positive but not significant ($\beta = 0.0979$, $p = 0.408$). For current city-center residents, the combined center constant is positive and significant ($\beta = 0.2776$, $p < 0.001$). However, the interaction that directly compares the groups is not significant when standard errors are clustered by respondents ($\beta = 0.1797$, $p = 0.180$). Therefore, the study does not show that current city-center residents have a stronger remaining preference for central housing than current edge residents. The model also does not identify a causal process of residential self-selection.

These results do not support abandoning central development or encouraging outward growth. Instead, housing in central areas should provide the attributes that residents value. Accessibility alone may not be enough if city-center housing has poor residential quality, congestion, noise, or insufficient living space.

Urban-edge development should also consider accessibility and transport. If households choose urban-edge housing because it provides larger apartments or better residential quality, while access to services depends heavily on private vehicles, continued outward growth may increase car dependence.

For Duhok, two policy directions appear to be relevant:

Central residential development

- provide adequate apartment sizes;
- maintain residential and environmental quality;

- reduce negative effects of noise and congestion;
- improve the everyday livability of central areas;
- avoid treating very small apartments as the only solution to densification.

Urban-edge development

- coordinate housing development with public transport;
- improve access to employment, education, and daily services;
- avoid developing large residential areas without adequate transport connections;
- consider the long-term transport costs associated with urban-edge housing.

The results support a balanced approach rather than a simple choice between compact development and urban expansion.

5.7. Theoretical Implications

The results have implications for several theories discussed in the literature review. They do not fully confirm or reject a single theory. Instead, they show how different theories help explain different parts of residential choice in Duhok.

5.7.1. Alonso and the Accessibility–Space–Cost Trade-off

The results are consistent with parts of Alonso's Bid Rent Theory because accessibility, housing cost, and residential space are all involved in the residential trade-off. Respondents value accessibility, but they also value larger apartments and better residential quality. However, the results show that transport resources are related to this classical trade-off as well. Owning a car reduces the negative effect of poor accessibility. This means that the cost of living away from accessible services is not the same for households with and without vehicles.

The findings support the general logic of Alonso's theory but show that the accessibility–space trade-off is also influenced by transport resources. In Duhok, car ownership can make urban-edge housing more acceptable because households can compensate for longer walking times by using their private vehicles.

5.7.2. Lancaster and Housing as a Bundle of Attributes

The results support Lancaster's theory of consumer demand. Lancaster's main idea is that people value the characteristics of a product rather than the product itself. This fits the results of the DCE because respondents did not simply choose between center and edge. They responded to accessibility, cost, residential quality, and apartment size all together.

The statistically significant housing-attribute coefficients support this interpretation. However, the non-significant city-center ASC applies only to the current urban-edge reference group and should not be understood as evidence that location is unimportant to all respondents. The main result is that respondents evaluate several housing characteristics together. City-center and urban-edge housing choices in Duhok can be understood as choices between different bundles of housing attributes.

5.7.3. Compact City Theory

The results also have implications for the compact city debate. Compact development is often promoted because it can improve land-use efficiency and accessibility. However, the results show that residents also value residential quality and apartment size. Density or a central location alone may not be sufficient to make city-center housing attractive. If central development provides good accessibility but poor residential quality or insufficient living space, residents may still prefer alternatives that provide a better overall bundle of housing attributes. This does not mean that compact-city development is not suitable for Duhok. But instead, it suggests that densification should be combined with residential quality, adequate living space, and good transport conditions. The result is consistent with the literature reviewed in Chapter 2, which shows that the benefits of compact development depend partially on the quality of the residential environment.

5.7.4. Life-Course Theory

The family-stage result provides a more specific theoretical finding. Life-course approaches suggest that housing needs can change as households move through different stages of life. For example, a growing family may require more living space.

The study found no statistically significant interaction between family stage and apartment size. The expected difference between family-oriented and other households was not supported by the data. However, this result does not reject life-course theory as a whole. The model only tests whether the effect of apartment size differs by family stage in this sample. A possible interpretation is that living space is important across different household groups in Duhok. Local housing expectations and preferences for larger homes may mean that apartment size is valued not only by households with children but also by other types of households.

5.7.5. Residential Self-Selection

The interaction with current residential location is positive but not statistically significant when repeated choices are accounted for by clustering standard errors at the respondent level ($\beta = 0.1797$, $p = 0.180$). This means that the study does not provide sufficient evidence that current city-center residents have a stronger remaining preference for central housing than current urban-edge residents. Although the combined city-center effect is statistically significant for current city-center residents, this does not mean a difference between the groups or identify a process of self-selection. Residential self-selection remains a possible explanation for future research, but it is not an established finding of this study. The supported results concern trade-offs among the housing attributes and differences in preference connected with car ownership, income, and age.

5.8. Limitations of the Study

Several limitations should be considered when interpreting the findings.

5.8.1. Sampling and Representativeness

The questionnaire was distributed online and used a snowball sampling approach. This helped the study to reach respondents, but the sample cannot be assumed to accurately represent the whole population of Duhok. The sample was relatively young and highly educated, about 70% holding a university degree and 58.6% aged between 20 and 35. These characteristics may influence the preferences and trade-offs reported in the study. For this reason, the results should be interpreted as evidence from the surveyed respondents rather than as exact estimates of the preferences of the entire population of Duhok.

5.8.2. Limited Coverage of Housing Attributes

The DCE included four main attributes: accessibility, housing cost, residential quality, and apartment size. This was useful for keeping the choice tasks manageable, but it also means that some factors discussed in the literature were not tested separately. For example, privacy, noise, service reliability, environmental quality, and transport conditions may affect residential choice as single attributes, but these factors were not all included as separate experimental attributes. Instead, some of them are reflected in the broader residential quality attribute. This means that the estimated effects of the included attributes may also reflect preferences for factors that were not measured separately. Including separate attributes such as noise, environmental quality, privacy, building quality, and service reliability would have made the choice tasks longer and more complex. For this reason, comfortability was represented mainly by residential quality and apartment size in order to keep the questionnaire understandable and manageable for respondents.

The choice tasks included only two residential tower alternatives. They did not include a detached house, respondents' current dwellings, or a (neither) option. The estimates describe preferences when respondents are required to choose between the two tower alternatives. They do not measure willingness to relocate or preferences for apartments over detached houses.

The same images were used with each location label and may have affected respondents' choices. This means that the estimated alternative-specific effects cannot separate preferences related to the location labels from responses to the images.

Residential density was also not included as a separate attribute. The implications for densification are based on the findings for the included housing attributes rather than on a direct estimate of density preferences.

5.8.3. Hypothetical Nature of the DCE

The DCE asked respondents to choose between hypothetical housing alternatives. This is useful because it isolates specific trade-offs, but hypothetical choices may not be identical to real housing decisions. Real housing decisions are limited by housing availability, income, prices, family circumstances, and the available alternatives provided by the housing market. For example, a respondent may prefer a large apartment in the city center, but that option may not exist or may not be affordable. Therefore, the MRS and WTP estimates should be understood as stated trade-offs under the experimental conditions rather than as amounts that respondents would pay in real-world housing markets.

5.8.4. MNL Model Assumptions

The study uses the MNL choice-probability model and its assumptions about the unobserved utility. Standard errors are clustered by respondent to allow dependence in the eight choices made by the same respondent. This affects the standard errors and statistical tests, but it does not model differences in unobserved preferences, correct model misspecification, or remove possible sampling bias. The model also assumes that respondents are independent of each other. Possible dependence among members of the same household or recruitment network is not modeled separately. The results should be understood within the limitations of the selected model and survey sample.

5.8.5. Generalizability

The study focuses on Duhok and should not automatically be generalized to all cities in the Kurdistan Region or to other cities with different housing markets, transport systems, or social conditions. The findings are relevant to Duhok's context of rapid urban growth, topographical constraints, changing housing development, and car dependence. Applying the results to other locations would require additional empirical evidence.

5.9. Recommendations for Future Research

The findings suggest several directions for future research. First, future studies could use stated-preference data with revealed-preference data together. The current study measures what respondents choose in hypothetical scenarios. Future research could compare these results with actual housing purchases, rental decisions, or residential moves in Duhok. This would help determine whether the trade-offs identified in the DCE are also visible in real housing behavior. Second, future DCE studies could include additional attributes such as public transport reliability, privacy, noise, environmental quality, parking, and service reliability. This would allow researchers to separate different factors of residential quality rather than combining several factors into one attribute. Third, future research could examine public transport more directly. Since car ownership reduces the effect of poor accessibility, an important step would be to test whether a reliable and affordable public transport can provide a similar alternative to private car ownership. Future DCEs could test different levels of bus frequency, travel time, reliability, and cost. Fourth, future studies could also use larger and more diverse samples such as respondents from a wider range of age groups, income groups, education levels, and residential areas, this would provide more data for understanding how preferences vary across the entire Duhok population. Finally, future research could use models that allow for greater preference heterogeneity, such as mixed logit or latent class models. These approaches could identify resident groups that have different residential priorities and provide more evidence for housing and transport policy.

5.10. Conclusion

This study examined residential location preferences between city-center and urban-edge housing in Duhok using a stated-preference Discrete Choice Experiment and multinomial logit models. The results show that residential choice involves trade-offs between accessibility, housing cost, residential quality, and apartment size, and cannot be explained by the city-center and urban-edge distinction alone.

Accessibility has an important role in residential choice, but its effect varies based on car ownership. Car owners are less negatively affected by longer walking times to services, suggesting that private car ownership can make urban-edge housing more acceptable. Income also changes residential choice, with higher-income respondents showing lower sensitivity to housing cost. Apartment size has a strong positive effect, while the interaction between family stage and apartment size is not statistically significant in this sample. Older respondents also value residential quality more. The final model does not show a statistically significant difference in the remaining city-center preference between current center and edge residents, meaning that a status-quo or residential self-selection effect cannot be established from these results.

The results suggest that Duhok's residential development cannot be understood only as a choice between compact central development and outward expansion. Residents value accessibility, but they also value living space, residential quality, and affordability. The attractiveness of a location depends on whether these characteristics are provided together.

For planning, development in central areas should not focus only on increasing density, but should also provide adequate housing sizes and good residential quality. At the same time, urban-edge development should be supported by reliable public transport and access to daily services. Housing affordability remains an important factor because financial resources affect the choices available to households.

In the end, respondents in Duhok do not choose housing based on city-center or urban-edge location alone. They choose the bundle of housing characteristics that best fits their accessibility needs, financial resources, and expectations for residential quality and space. Residential planning should respond to these trade-offs rather than assuming that one form of urban development will meet the needs of all households.

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Part I.

Appendices

A. Questionnaire Survey

A.1. English Language

Preferences Toward Residential Units in Different Areas of Duhok City

Dear Participant,
This questionnaire is part of a Master's thesis conducted at TU Dortmund University, supervised by Prof. Dr. Joachim Scheiner (Urban Development Group) and Dr. Pires Abdullah. The study investigates preferences for residential towers located near the city center and at the edge of Duhok. Participation is voluntary and anonymous, and responses will be used solely for academic purposes. Residents of Duhok aged 18 years and above are invited to participate. Completing the questionnaire takes approximately 8–10 minutes.
Thank you for your participation.

Section 1: Socioeconomic Information

1. Gender
□ Male
□ Female

---

2. Age
□ Under 20
□ 20–35
□ 36–45
□ 46–65
□ 66 years and above

---

3. Education Level
□ High school or below
□ Diploma
□ Bachelor's degree
□ Master's degree or higher

---

4. Employment Status
□ Student
□ Employed
□ Self-employed
□ Unemployed
□ Retired

---

5. Monthly Household Net Income
□ Below Average
□ Average (700,000 IQD – 1,050,000 IQD)
□ Above Average

---

6. Household Type
□ Single/ living alone
□ Single/ living with parents or relatives
□ Married without children
□ Married with child(ren)
□ Single Parent with child(ren)
□ Three-generation family/ extended family
□ Other

---

7. Current Housing Type
□ Owned Apartment
□ Owned House
□ Rented Apartment
□ Rented House

---

8. Current Residential Location
□ Near the city center
□ At the edge/suburban area of the city

---

9. Do you own a private car?
□ Yes
□ No

Section 2: Residential Preference Attitudes

Scenario 1

Please choose the option you would most prefer based on the presented characteristics.

Attribute	City Center Residential Tower	Edge-of-City Residential Tower
		
Accessibility to services (walking)	5 min	30 min
Housing cost	$500/month	$300/month
Residential quality	Moderate	Good
Apartment size	80 m²	160 m²
Choose your preferred option in each scenario.	☐ City Center	☐ Edge-of-City

Figure A.1.: Scenario 1 (English)

Scenario 2

Please choose the option you would most prefer based on the presented characteristics.

Attribute	City Center Residential Tower	Edge-of-City Residential Tower
		
Accessibility to services (walking)	15 min	30 min
Housing cost	$400/month	$300/month
Residential quality	Moderate	Good
Apartment size	80 m²	160 m²
Choose your preferred option in each scenario.	☐ City Center	☐ Edge-of-City

Figure A.2.: Scenario 2 (English)

Scenario 3

Please choose the option you would most prefer based on the presented characteristics.

Attribute	City Center Residential Tower	Edge-of-City Residential Tower
		
Accessibility to services (walking)	5 min	15 min
Housing cost	$500/month	$400/month
Residential quality	Poor	Moderate
Apartment size	80 m²	160 m²
Choose your preferred option in each scenario.	☐ City Center	☐ Edge-of-City

Figure A.3.: Scenario 3 (English)

Scenario 4

Please choose the option you would most prefer based on the presented characteristics.

Attribute	City Center Residential Tower	Edge-of-City Residential Tower
		
Accessibility to services (walking)	15 min	30 min
Housing cost	$500/month	$400/month
Residential quality	Moderate	Good
Apartment size	160 m²	80 m²
Choose your preferred option in each scenario.	☐ City Center	☐ Edge-of-City

Figure A.4.: Scenario 4 (English)

Scenario 5

Please choose the option you would most prefer based on the presented characteristics.

Attribute	City Center Residential Tower 	Edge-of-City Residential Tower 
Accessibility to services (walking)	5 min	30 min
Housing cost	$400/month	$300/month
Residential quality	Poor	Good
Apartment size	80 m²	160 m²
Choose your preferred option in each scenario.	☐ City Center	☐ Edge-of-City

Figure A.5.: Scenario 5 (English)

Scenario 6

Please choose the option you would most prefer based on the presented characteristics.

Attribute	City Center Residential Tower 	Edge-of-City Residential Tower 
Accessibility to services (walking)	15 min	5 min
Housing cost	$300/month	$500/month
Residential quality	Good	Moderate
Apartment size	160 m²	80 m²
Choose your preferred option in each scenario.	☐ City Center	☐ Edge-of-City

Figure A.6.: Scenario 6 (English)

Scenario 7

Please choose the option you would most prefer based on the presented characteristics.

Attribute	City Center Residential Tower	Edge-of-City Residential Tower
		
Accessibility to services (walking)	30 min	15 min
Housing cost	$300/month	$400/month
Residential quality	Good	Moderate
Apartment size	160 m²	80 m²
Choose your preferred option in each scenario.	☐ City Center	☐ Edge-of-City

Figure A.7.: Scenario 7 (English)

Scenario 8

Please choose the option you would most prefer based on the presented characteristics.

Attribute	City Center Residential Tower	Edge-of-City Residential Tower
		
Accessibility to services (walking)	5 min	15 min
Housing cost	$500/month	$400/month
Residential quality	Moderate	Poor
Apartment size	80 m²	160 m²
Choose your preferred option in each scenario.	☐ City Center	☐ Edge-of-City

Figure A.8.: Scenario 8 (English)

Final Question

Overall, which residential location do you generally prefer?

□ Residential towers near the city center

□ Residential towers at the edge of the city

□ No preference

Closing Statement

Thank you very much for participating in this survey.

Your responses are highly valuable for understanding residential preferences and supporting future urban and residential planning strategies in Duhok.

A.2. Kurdish (Badini) Language

خواستا خەلکی ژ بۆ یەکەیێن ئاکنجیبوونێ ل تاخێن جودا یێن باژێرێ دهۆکێ

پشکداریێ هێژا،
ئەڤ راپرسییە پشکەکە ژ تێزا ماستەریێ کو ل زانکۆیا تەکنیکی یا دۆرتمۆندێ دهێتە ئەنجامدان، ل ژێر سەرپەرشتیا پرۆفیسۆر دکتۆر یواکیم شاینەر (گروپێ گەشەپێدانا باژێری) و دکتۆر پیرس عەبدوللا. ئەڤ ڤەکۆلینە وێ دکەتە ئارمانج دا کو د وان هۆکارا بگەهیت یێن کاریگەریێ ل سەر هەلبژارتنا جهێن ئاکنجیبوونێ دکەن. پشکداریکرن د ڤێ راپرسیێ دا یا خۆبەخشێ و بەرسڤێن تە د پاراستینە و بتنێ بۆ مەرمێن ئەکادیمی دێ هێنە بکارئینان. ئاکنجییێن دهۆکێ یێن تەمەنێ وان ١٨ سال و پتر دهێنە داخوازکرن بۆ پشکداریکرنێ. تژیکرنا ڤێ راپرسیێ دێ نێزیکی ٨-١٠ خولەکان ڤەکێشیت.
سوپاس بۆ پشکداریا تە.

پشکا ١ : پێزانینێن جڤاکی و ئابووری

1. رەگەز
- نێر
- مێ

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2. تەمەن
- کێمتر ژ 20
- 20–35
- 36–45
- 46–65
- 66 سالی و پتر

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3. ئاستێ خواندنێ
- ئامادەیی یان کێمتر
- باوەرناما دیپلۆمێ
- باوەرناما بکالۆریۆسێ
- باوەرناما ماستەریێ یان بلندتر

---

4. بارێ کارکرنێ
- قوتابی
- فەرمانبەر (میری و کەرتێ تایبەت)
- خودانکار
- بێکار
- خانەنشین

5. داهاتێ هەیڤانە یێ خێزانێ
- ▫ کێمتر ژ ناڤنجی
- ▫ ناڤنجی (700,000 IQD – 1,050,000 IQD)
- ▫ پتر ژ ناڤنجی

6. جورێ خێزانێ
- ▫ تاکە کەس/ بتنێ دژی
- ▫ تاکە کەس/ دگەل خێزانێ دژی
- ▫ خێزاندار بێ زاروک
- ▫ خێزاندار دگەل زاروکان
- ▫ دەیک بتنێ یان باب بتنێ دگەل زاروکان
- ▫ خێزانا سێ نەوەی (دگەل باپیر و داپیران یان کەس و کاران)/ خێزانا بەرفرە
- ▫ جورەکێ دیتر

7. جورێ یەکەیا ئاکنجیبوونێ
- ▫ شوقەیا مۆلک
- ▫ خانیێ مۆلک
- ▫ شوقەیا ب کرێ
- ▫ خانیێ ب کرێ

8. جهێ ئاکنجیبوونا تە یا نوکە
- ▫ نێزیکی ناڤەراستا باژێری
- ▫ ل دەوروبەرێن باژێری

9. تە ترۆمبێلەکا تایبەت هەیە؟
- ▫ بەلی
- ▫ نەخێر

پشکا ۲: هزر و هەلوێستێن تە یێن حەزکرنا جهێ ئاکنجیبوونێ

1 سیناریۆ
تەکیش بژاردە پتر دڤێت لسەر بنیاتێ وان تایبەتمەندییێن هاتینە دیارکرن، وێ بەهەلبژێرە.

تایبەتمەندی	تاوەرێ ئاکنجیبوونێ ل ناڤەندا باژێری	تاوەرێ ئاکنجیبوونێ ل دەوروبەرێن باژێری
		
دەمێ گەهشتنێ بو خزمەتگوزاریان (ب پێیان)	خولەک 5	خولەک 30
بهایێ یەکەیا ئاکنجیبوونێ	د هەیڤێ دا/$500	د هەیڤێ دا/$300
کوالیتیا ئاکنجیبوونێ	ناڤنجی	باش
قەبارێ یەکەیا ئاکنجیبوونێ	80 m²	160 m²
	☐ ناڤەندا باژێری	☐ دەوروبەرێن باژێری

د هەر سیناریویەکێ دا، ئەو بژاردە یا تو پتر حەز ژێ دکەی هەلبژێرە

Figure A.9.: Scenario 1 (Kurdish)

2 سیناریۆ
تەکیش بژاردە پتر دڤێت لسەر بنیاتێ وان تایبەتمەندییێن هاتینە دیارکرن، وێ بەهەلبژێرە.

تایبەتمەندی	تاوەرێ ئاکنجیبوونێ ل ناڤەندا باژێری	تاوەرێ ئاکنجیبوونێ ل دەوروبەرێن باژێری
		
دەمێ گەهشتنێ بو خزمەتگوزاریان (ب پێیان)	خولەک 15	خولەک 30
بهایێ یەکەیا ئاکنجیبوونێ	د هەیڤێ دا/$400	د هەیڤێ دا/$300
کوالیتیا ئاکنجیبوونێ	ناڤنجی	باش
قەبارێ یەکەیا ئاکنجیبوونێ	80 m²	160 m²
	☐ ناڤەندا باژێری	☐ دەوروبەرێن باژێری

د هەر سیناریویەکێ دا، ئەو بژاردە یا تو پتر حەز ژێ دکەی هەلبژێرە

Figure A.10.: Scenario 2 (Kurdish)

3 سیناریۆ
تەکیش بژاردە پتر دڤێت لسەر بنیاتێ وان تایبەتمەندییێن هاتینە دیارکرن، وێ بەهەلبژێرە.

تاوەرێ ئاکنجیبوونێ ل دەوروبەرێن باژێری	تاوەرێ ئاکنجیبوونێ ل ناڤەندا باژێری	تایبەتمەندی
		
خولەک 15	خولەک 5	دەمێ گەهشتنێ بو خزمەتگوزاریان (ب پێیان)
د هەیڤێ دا/$400	د هەیڤێ دا/$500	بهایێ یەکەیا ئاکنجیبوونێ
ناڤنجی	خراب	کوالیتیا ئاکنجیبوونێ
160 m²	80 m²	قەبارێ یەکەیا ئاکنجیبوونێ
دەوروبەرێن باژێری ☐	ناڤەندا باژێری ☐	د هەر سیناریویەکێ دا، ئەو بژاردە یا تو پتر حەز ژێ دکەی هەلبژێرە

Figure A.11.: Scenario 3 (Kurdish)

4 سیناریۆ
تەکیش بژاردە پتر دڤێت لسەر بنیاتێ وان تایبەتمەندییێن هاتینە دیارکرن، وێ بەهەلبژێرە.

تاوەرێ ئاکنجیبوونێ ل دەوروبەرێن باژێری	تاوەرێ ئاکنجیبوونێ ل ناڤەندا باژێری	تایبەتمەندی
		
خولەک 30	خولەک 15	دەمێ گەهشتنێ بو خزمەتگوزاریان (ب پێیان)
د هەیڤێ دا/$400	د هەیڤێ دا/$500	بهایێ یەکەیا ئاکنجیبوونێ
باش	ناڤنجی	کوالیتیا ئاکنجیبوونێ
80 m²	160 m²	قەبارێ یەکەیا ئاکنجیبوونێ
دەوروبەرێن باژێری ☐	ناڤەندا باژێری ☐	د هەر سیناریویەکێ دا، ئەو بژاردە یا تو پتر حەز ژێ دکەی هەلبژێرە

Figure A.12.: Scenario 4 (Kurdish)

5 سیناریۆ
تەکیش بژاردە پتر دڤێت لسەر بنیاتێ وان تایبەتمەندییێن هاتینە دیارکرن، وێ بەهەلبژێرە.

تاوەرێ ئاکنجیبوونێ ل دەوروبەرێن باژێری	تاوەرێ ئاکنجیبوونێ ل ناڤەندا باژێری	تایبەتمەندی
		
خولەک 30	خولەک 5	دەمێ گەشتێ بو خزمەتگوزاریان (ب پێیان)
د هەیڤێ دا/$300	د هەیڤێ دا/$400	بهایێ یەکەیا ئاکنجیبوونێ
باش	خراب	کوالیتیا ئاکنجیبوونێ
160 m²	80 m²	قەبارێ یەکەیا ئاکنجیبوونێ
دەوروبەرێن باژێری☐	ناڤەندا باژێری ☐	د هەر سیناریویەکێ دا، ئەو بژاردە یا تو پتر حەز ژێ دکەی هەلبژێرە

Figure A.13.: Scenario 5 (Kurdish)

6 سیناریۆ
تەکیش بژاردە پتر دڤێت لسەر بنیاتێ وان تایبەتمەندییێن هاتینە دیارکرن، وێ بەهەلبژێرە.

تاوەرێ ئاکنجیبوونێ ل دەوروبەرێن باژێری	تاوەرێ ئاکنجیبوونێ ل ناڤەندا باژێری	تایبەتمەندی
		
خولەک 5	خولەک 15	دەمێ گەشتێ بو خزمەتگوزاریان (ب پێیان)
د هەیڤێ دا/$500	د هەیڤێ دا/$300	بهایێ یەکەیا ئاکنجیبوونێ
نافنجی	باش	کوالیتیا ئاکنجیبوونێ
80 m²	160 m²	قەبارێ یەکەیا ئاکنجیبوونێ
دەوروبەرێن باژێری☐	ناڤەندا باژێری ☐	د هەر سیناریویەکێ دا، ئەو بژاردە یا تو پتر حەز ژێ دکەی هەلبژێرە

Figure A.14.: Scenario 6 (Kurdish)

7 سیناریۆ

تەکیش بژاردە پتر دڤێت لسەر بنیاتێ وان تایبەتمەندیێن هاتینە دیارکرن، وێ بەهەلبژێرە.

تایبەتمەندی	تاوەرێ ئاکنجیبوونێ ل ناڤەندا باژێری	تاوەرێ ئاکنجیبوونێ ل دەوروبەرێن باژێری
		
دەمێ گەشتێ بو خزمەتگوزاریان (ب پێیان)	خولەک 30	خولەک 15
بهایێ یەکەیا ئاکنجیبوونێ	د هەیڤێ دا/$300	د هەیڤێ دا/$400
کوالیتیا ئاکنجیبوونێ	باش	ناڤنجی
قەبارێ یەکەیا ئاکنجیبوونێ	160 m²	80 m²
د هەر سیناریویەکێ دا، تەو بژاردە یا تو پتر حەز ژێ دکەی هەلبژێرە	☐ ناڤەندا باژێری	☐ دەوروبەرێن باژێری

Figure A.15.: Scenario 7 (Kurdish)

8 سیناریۆ

تەکیش بژاردە پتر دڤێت لسەر بنیاتێ وان تایبەتمەندیێن هاتینە دیارکرن، وێ بەهەلبژێرە.

تایبەتمەندی	تاوەرێ ئاکنجیبوونێ ل ناڤەندا باژێری	تاوەرێ ئاکنجیبوونێ ل دەوروبەرێن باژێری
		
دەمێ گەشتێ بو خزمەتگوزاریان (ب پێیان)	خولەک 5	خولەک 15
بهایێ یەکەیا ئاکنجیبوونێ	د هەیڤێ دا/$500	د هەیڤێ دا/$400
کوالیتیا ئاکنجیبوونێ	ناڤنجی	خراب
قەبارێ یەکەیا ئاکنجیبوونێ	80 m²	160 m²
د هەر سیناریویەکێ دا، تەو بژاردە یا تو پتر حەز ژێ دکەی هەلبژێرە	☐ ناڤەندا باژێری	☐ دەوروبەرێن باژێری

Figure A.16.: Scenario 8 (Kurdish)

دوماهیک پرسیار

ب گشتی، تو پتر حەز دکەی ل کیژ دەڤەرێ بژی؟

- ☐ یەکەیێن ئاکنجیبوونێ ل نێزیکی ناڤەندا باژێری
- ☐ یەکەیێن ئاکنجیبوونێ ل دەوروبەرێن باژێری
- ☐ چ جوداهی نینە

پەیڤا دوماهیێ

زۆر سوپاس کو تە پشکداری د ڤێ راپرسیێ دا کری.

بەرسڤێن تە گەلەک د گرنگن بۆ هندێ ئەم تێبگەهین کا خەلک ل دهۆکێ حەز دکەن ل کیرێ و چەوا بژین، و دێ هاریکار بن بۆ داناننا پلانێن ئاڤەدانکرنێ یێن پاشەرۆژێ.

B. Sample of Datasets

B.1. Sample of Raw Survey Responses

To prepare survey data, all the responses that were collected were systematically changed to numeric codes. This numerical coding is a necessary step that makes the creation of the long-format dataset easier. Table B.1 shows the coding dictionary, detailing the numeric values assigned to each multiple-choice option from the questionnaire. Following the legend is a sample of the raw dataset. In this raw structure, each row represents a single respondent's complete set of answers, providing a direct representation of their selections (see Table B.2).

Table B.1.: Coding Legend for Survey Variables

Variable	Coding Legend
Gender	(1 = Male) (2 = Female)
Age	(1 = Under 20) (2 = 20-35) (3 = 36-45) (4 = 46-65) (5 = 66 and above)
Education Level	(1 = High school or below) (2 = Diploma) (3 = Bachelor's degree) (4 = Master's degree or higher)
Employment Status	(1 = Student) (2 = Employed) (3 = Self-employed) (4 = Unemployed) (5 = Retired)
Income	(1 = Below Average) (2 = Average) (3 = Above Average)
Household Type	(1 = Single/ living alone) (2 = Single/ living with parents or relatives) (3 = Married without children) (4 = Married with child(ren)) (5 = Single Parent with children) (6 = Three-generation family/ extended family) (7 = Other)
Housing Type	(1 = Owned Apartment) (2 = Owned House) (3 = Rented Apartment) (4 = Rented House)
Residential Location	(1 = Near the city center) (2 = At the edge/suburban area of the city)
Owner of Private Car	(1 = Yes) (2 = No)
Scenarios	(1 = City Center) (2 = Edge-of-city)
General-Preference Question	(1 = Residential towers near the city center) (2 = Residential towers at the edge of the city) (3 = No Preference)

Table B.2.: Sample of Raw Survey Dataset

ID	Gender	Age	Education Level	Employment Status	Monthly household Income	Household Type	Current Housing Type	Current Residential Location	Do you own a private car?	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6	Scenario 7	Scenario 8	Final Question
1	1	1	2	1	3	2	2	2	2	1	1	2	1	2	1	2	1	1
2	2	2	2	2	3	4	2	1	1	1	1	1	1	1	2	2	1	3
3	1	4	3	5	2	4	2	1	1	2	2	2	1	2	1	1	1	1
4	2	2	3	4	1	2	2	2	1	1	1	2	1	2	1	1	1	1
5	2	2	3	2	2	4	2	2	2	2	2	2	2	2	1	1	1	2
6	1	2	4	2	2	4	1	2	1	2	2	2	1	1	1	1	2	3
7	2	2	4	1	3	2	2	1	1	1	2	2	1	2	1	1	1	1
8	2	2	3	3	2	4	2	2	1	1	2	1	1	1	1	2	2	3
9	1	1	1	1	1	2	2	2	1	2	2	1	2	2	1	1	1	2
10	1	1	1	1	1	2	1	1	2	1	1	1	1	1	1	1	1	1

B.2. Sample of Long-Format Data Structure for MNL Analysis

The Multinomial Logit (MNL) model requires restructuring the dataset from raw format into a long format. In discrete choice analysis, the model evaluates the trade-offs between competing options; therefore, the data structure must treat each individual alternative as a separate row. Because in the experimental design each participant was presented with eight choice sets, and each set contained two housing alternatives, a single respondent's survey data is expanded into exactly sixteen different rows, resulting in 6,768 alternative-level rows for all 423 respondents. These 6,768 rows represent 3,384 choice situations (423 respondents × 8 choice sets), with each choice situation having two alternatives.

The coding legend below shows what each numeric value represents. It details how the experimental attributes are expressed using the defined numerical codes (such as -1, 0, and 1). Additionally, it identifies the dependent variable used to record the actual decision, where 1 is the selected alternative and 0 is the rejected option. The following data table provides a sample of this expanded structure, showing how the choice tasks for two different respondents are mapped across 32 rows for final estimation (see Table B.4).

Table B.3.: Coding Legend for Experimental Attributes

Variable	Coding Legend
Choice	(1 = Selected Alternative) (0 = Not Selected)
Alternative (Alt)	(1 = City Center) (2 = Edge-of-City)
Accessibility	(−1 = 5 min) (0 = 15 min) (1 = 30 min)
Cost	(−1 = \$300) (0 = \$400) (1 = \$500)
Quality	(−1 = Poor) (0 = Moderate) (1 = Good)
Size	(−1 = 80 m^2) (1 = 160 m^2)

Table B.4.: Sample of Long-Format Dataset

	ID	Scenario	Alt	Accessibility	Cost	Quality	Size	Choice	Gender	Age	Education	Employment	Income	Household Type	Current Housing	Current Location	Car Ownership
1																	
	1	1	1	−1	1	0	−1	1	1	1	2	1	3	2	2	2	2
	1	1	2	1	−1	1	1	0	1	1	2	1	3	2	2	2	2
	1	2	1	0	0	0	−1	1	1	1	2	1	3	2	2	2	2
	1	2	2	1	−1	1	1	0	1	1	2	1	3	2	2	2	2
	1	3	1	−1	1	−1	−1	0	1	1	2	1	3	2	2	2	2
	1	3	2	0	0	0	1	1	1	1	2	1	3	2	2	2	2
	1	4	1	0	1	0	1	1	1	1	2	1	3	2	2	2	2
	1	4	2	1	0	1	−1	0	1	1	2	1	3	2	2	2	2
	1	5	1	−1	0	−1	−1	0	1	1	2	1	3	2	2	2	2
	1	5	2	1	−1	1	1	1	1	1	2	1	3	2	2	2	2
	1	6	1	0	−1	1	1	1	1	1	2	1	3	2	2	2	2
	1	6	2	−1	1	0	−1	0	1	1	2	1	3	2	2	2	2
	1	7	1	1	−1	1	1	0	1	1	2	1	3	2	2	2	2
	1	7	2	0	0	0	−1	1	1	1	2	1	3	2	2	2	2
	1	8	1	−1	1	0	−1	1	1	1	2	1	3	2	2	2	2
	1	8	2	0	0	−1	1	0	1	1	2	1	3	2	2	2	2
2																	
	2	1	1	−1	1	0	−1	1	2	2	2	2	3	4	2	1	1
	2	1	2	1	−1	1	1	0	2	2	2	2	3	4	2	1	1
	2	2	1	0	0	0	−1	1	2	2	2	2	3	4	2	1	1
	2	2	2	1	−1	1	1	0	2	2	2	2	3	4	2	1	1
	2	3	1	−1	1	−1	−1	1	2	2	2	2	3	4	2	1	1
	2	3	2	0	0	0	1	0	2	2	2	2	3	4	2	1	1
	2	4	1	0	1	0	1	1	2	2	2	2	3	4	2	1	1
	2	4	2	1	0	1	−1	0	2	2	2	2	3	4	2	1	1
	2	5	1	−1	0	−1	−1	1	2	2	2	2	3	4	2	1	1
	2	5	2	1	−1	1	1	0	2	2	2	2	3	4	2	1	1
	2	6	1	0	−1	1	1	0	2	2	2	2	3	4	2	1	1
	2	6	2	−1	1	0	−1	1	2	2	2	2	3	4	2	1	1
	2	7	1	1	−1	1	1	0	2	2	2	2	3	4	2	1	1
	2	7	2	0	0	0	−1	1	2	2	2	2	3	4	2	1	1
	2	8	1	−1	1	0	−1	1	2	2	2	2	3	4	2	1	1
	2	8	2	0	0	−1	1	0	2	2	2	2	3	4	2	1	1

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A Discrete Choice Analysis of City-Center versus Urban-Edge Housing in Duhok

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