

# Commentary

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## Can Parking Fees Influence People To Use the Metro Instead of Cars in Riyadh City?<sup>1</sup>

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**It is hypothesized that new parking fees encourage people in Riyadh to drive less**



**This study used a stated preference survey, which included nine unique situations based on different combinations of the fares/parking fees, travel times, walking times, and waiting times**

## Introduction

The Royal Commission for Riyadh City (RCRC), formerly known as the Arriyadh Development Authority, conducted a stated preference (SP) survey in 2013 to understand Riyadh citizens' metro preferences. An SP survey is used to understand people's preferences over a set of choices based on hypothetical scenarios or situations. The RCRC's survey included 520 participants who were provided with nine hypothetical scenarios. These scenarios were characterized by realistic and relevant public transit attributes (e.g., fare, travel time, walking time, waiting time, car parking fees and transfer requirements). The survey defined each of these attributes relative to those of the respondent's current mode of transportation. Furthermore, for each hypothetical scenario, participants were asked to choose between staying with their current transport mode or switching to a new public transit service.

This study explores whether new car parking fees would encourage people to switch from driving to using the metro. We investigate this question separately for five areas of Riyadh, namely, the north, south, east, west, and central areas. It has been hypothesized that people in Riyadh will drive less if new car parking fees impact travelers' car usage in most of these areas.

We focus on car parking fees because cars are used for approximately 92% of trips in Riyadh (Youssef et al. 2021). Kolomatskiy et al. (2020) find that parking fee policies can impact drivers' transport mode choices. In particular, they can influence up to 50% of demand-responsive transit users that previously parked in the city center for a long time (i.e., four to eight hours). A similar study also concludes that parking fees result in car users taking transit instead (Li et al. 2008, 69). Furthermore, parking reforms can reduce car dependency and allow city space to be used more efficiently (Franco 2020).

## Data

The RCRC developed six SP questionnaires, denoted as D1, D2, D3, D4, D5 and D6. The questionnaire type for each respondent was chosen based on the transport mode that the respondent used for the most recent trip. Table 1 describes the different questionnaire types.

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<sup>1</sup> This study is a part of an ongoing project entitled "KAPSARC Spatial Urban Energy System (KSUES)." The project comprises two components: an urban energy model and a spatial economic model. It also has three project objectives. The first is to improve energy efficiency through transit-oriented development (TOD) in the transportation and electricity sectors. The second is to gain additional efficiencies by realizing the potential opportunities of the innovative and smart technologies offered by TOD. The third is to investigate the energy and economic impacts (including on real estate development) of transportation, land use and urban planning interventions in Riyadh. This study falls within the first project component and addresses the first objective. The energy efficiency improvements provided by TOD are directly related to land use changes and modal shifts from private car use to public transport. In this context, imposing car parking fees is an important policy catalyst for this modal shift. Thus, it is imperative to better understand the effects of car parking fees in a highly urbanized and motorized city, such as Riyadh.

**Table 1.** Questionnaire type according to the most recent transport mode choice.

Most recent transport mode choice	Questionnaire type
(1) Driver or (2) car passenger	D1, D2, D3
(3) Taxi/limousine	D4
(4) Company bus	D5
(5) Bus or private van	D6

The respondents were placed into six groups based on the questionnaire type used, as follows.

Group 1 (Questionnaire type D1): car users who were asked to choose between their current mode of transportation and the metro without a transfer requirement

Group 2 (Questionnaire type D2): car users who were asked to choose between their current mode of transportation and the metro with a transfer requirement

Group 3 (Questionnaire type D3): car users who were asked to choose between their current mode of transportation and the bus

Group 4 (Questionnaire type D4): taxi or limousine users who were asked to choose between their current mode of transportation and the metro

Group 5 (Questionnaire type D5): company bus users who were asked to choose between their current mode of transportation and the metro

Group 6 (Questionnaire type D6): bus or private van users who were asked to choose between their current mode of transportation and the metro

The RCRC also designed nine unique hypothetical scenarios for each questionnaire type. In total, 54 scenarios were defined based on different combinations of the fares, travel times, walking times, waiting times, parking fees and transfers required to use public transit. Appendix A provides a detailed description of these scenarios.

This study examines the contexts in which car users in the south, north, east, west and central areas of Riyadh prefer to use public transit. Thus, groups 1 and 2 are the relevant groups for our analysis. However, we focus on group 1 because this group has no transfer requirements. In other words, members of this group do not need to change modes or transfer from one metro line to another to reach their destinations. In addition to parking fees, the transfer requirements faced by group 2 may highly influence their responses. Thus, focusing on group 1 allows us to robustly analyze whether preferences for transport modes shift toward the metro when parking fees are levied. Group 1 includes 119 respondents, and Table 2 shows the hypothetical scenarios for this group (D1).

**Table 2.** Descriptions of situations 1–9 presented in the SP survey for group 1 (D1).

Situation	Mode	Choice attributes			
		Fare / parking fee	Wait time	Travel time	Walk time
Situation 1	Metro	3 SAR	7 mins	Last trip minus 15 mins	Same as last trip
	Car	Free	None	Same as last trip	Same as last trip
Situation 2	Metro	5 SAR	7 mins	Last trip minus 8 mins	Last trip plus 5 mins
	Car	10 SAR	None	Same as last trip	Same as last trip
Situation 3	Metro	3 SAR	4 mins	Last trip minus 8 mins	Last trip plus 3 mins
	Car	Free	None	Same as last trip	Same as last trip
Situation 4	Metro	7 SAR	2 mins	Last trip minus 8 mins	Same as last trip
	Car	Free	None	Same as last trip	Same as last trip
Situation 5	Metro	7 SAR	7 mins	Last trip minus 5 mins	Last trip plus 3 mins
	Car	Free	None	Same as last trip	Same as last trip
Situation 6	Metro	7 SAR	4 mins	Last trip minus 15 mins	Last trip plus 5 mins
	Car	Free	None	Same as last trip	Same as last trip
Situation 7	Metro	5 SAR	2 mins	Last trip minus 15 mins	Last trip plus 3 mins
	Car	10 SAR	None	Same as last trip	Same as last trip
Situation 8	Metro	3 SAR	2 mins	Last trip minus 5 mins	Last trip plus 5 mins
	Car	Free	None	Same as last trip	Same as last trip
Situation 9	Metro	5 SAR	4 mins	Last trip minus 5 mins	Same as last trip
	Car	10 SAR	None	Same as last trip	Same as last trip

Source: Arriyadh Development Authority stated preference survey, 2013.  
 Note: SAR = Saudi Arabian riyals; mins = minutes.

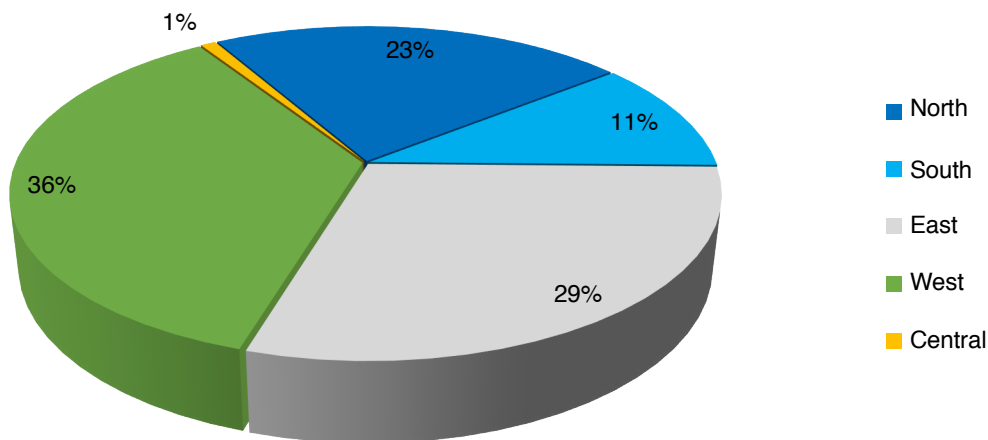


The results of the analysis are described in the following sections and are illustrated by six figures. Figure 1 shows the distribution of group 1 respondents' locations in Riyadh. Figures 2–6 describe the likelihood of a modal shift by location and situation.

### Distribution of respondents by location

The SP survey respondents are located in the north, south, east, west and central areas of Riyadh. Figure 1 shows their distribution across these five areas. The greatest percentage (36%) of the survey participants are located in the west area, followed by the east (29%), north (23%) and south (11%) areas. Only 1% of the group 1 respondents are located in the central area.

**Figure 1.** Respondents' locations.



Source: Arriyadh Development Authority stated preference survey, 2013.

### Public transit preferences by location

#### North

- Respondents in the north area of Riyadh prefer to shift to the metro the most in situation 7 and the least in situation 6. **Situation 7** includes parking fees at a minimum of 10 SAR and a 5 SAR fare to use public transit. Metro use takes 15 minutes less than a regular trip does, with two minutes of waiting time and three additional minutes of walking time. **Situation 6** offers free parking with a 7 SAR metro fare. Metro use again takes 15 minutes less than a regular trip does, with four minutes of waiting time and three additional minutes of walking time (Figure 2).

#### South

- **Situations 6, 7 and 8** lead the greatest proportion of respondents who live in the south area of Riyadh to shift modes of transportation. **Situation 3** influences the fewest respondents to shift to public transit. Situations 6, 7 and 8 are characterized by the highest reduced travel times (15 mins in situations 6 and 7). They also have the lowest metro fares (3 SAR in situation 8) and include parking fees (10 SAR in situation 7). Situation 3 offers free parking along with the lowest reduction in travel time (eight minutes) (Figure 3).

#### East

- Like those in the north area, respondents in the east area of Riyadh shift to public transit the most in **situation 7** and the least in **situation 6** (Figure 4).

**The introduction of parking fees was the biggest catalyst for car users switching to public transport**



### West

- **Situation 8** leads the highest proportion of respondents in the west area of Riyadh to shift to public transit. This situation has the lowest metro fare (3 SAR) and the shortest wait time (two minutes). **Situation 5** leads the lowest proportion of respondents to switch to public transit. It is characterized by the highest metro fare (7 SAR) and the longest wait time (7 minutes) (Figure 5).

### Central

- The central area only covers 1% of survey participants and, thus, it is difficult to draw conclusions. However, the data for this area are illustrated in Figure 6.

Figure 2. North.

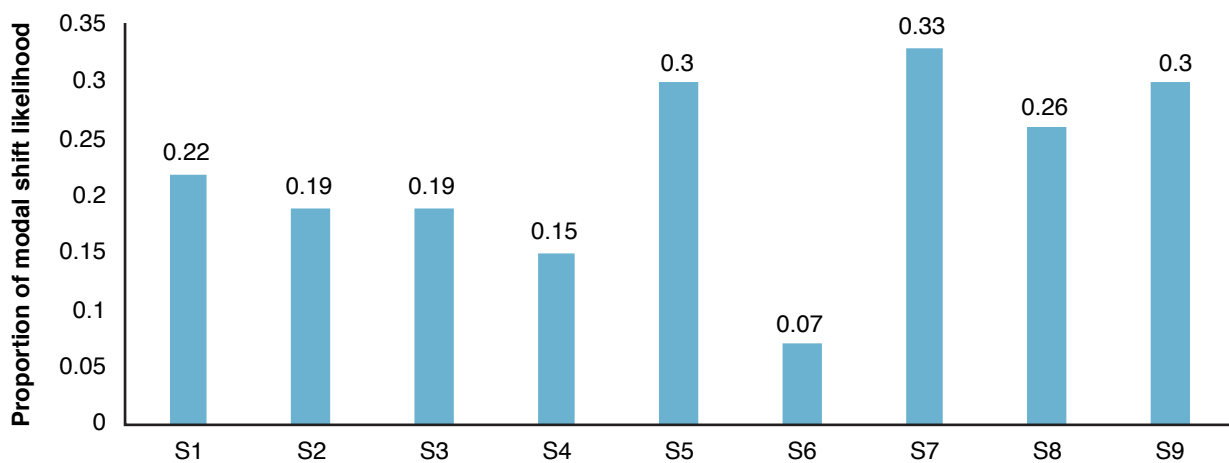


Figure 3. South.

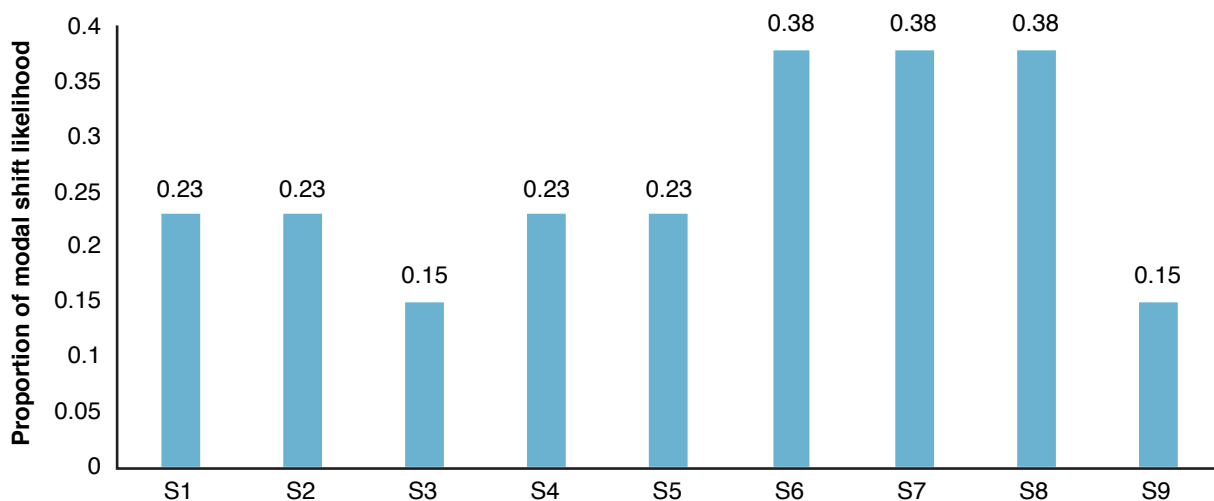


Figure 4. East.

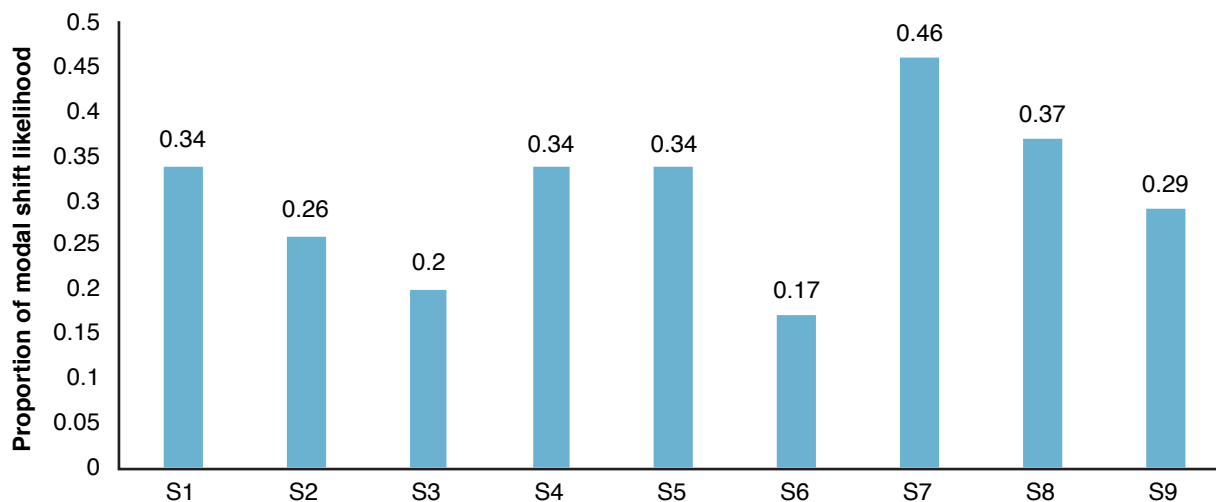


Figure 5. West.

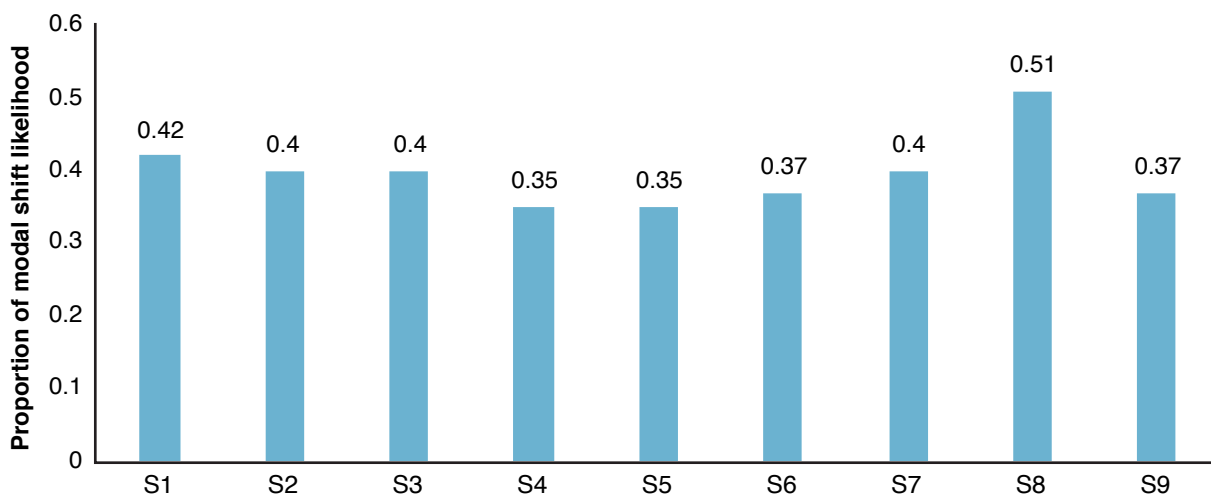
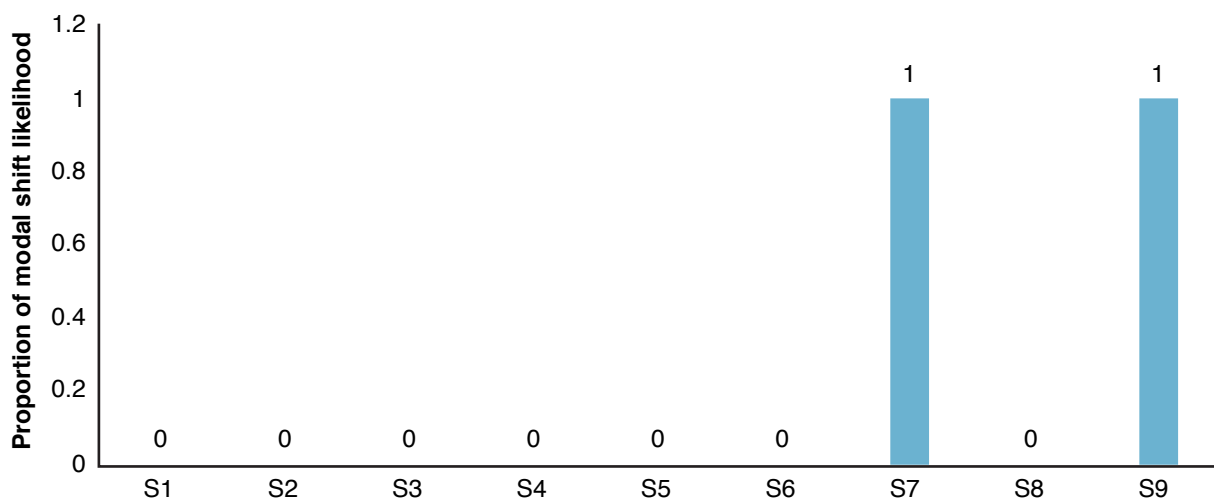


Figure 6. Central.



Source: Arriyadh Development Authority stated preference survey, 2013.  
Note: S = situation.

## Car usage restrictions or fees should be enacted in Riyadh to increase metro ridership and ensure the Riyadh metro project's success

### Conclusion

**North:** It is reasonable to conclude that introducing parking fees may reduce car use and, thus, increase metro ridership.

**South:** Citizens in the south area of Riyadh are more likely to increase their metro use with a package that includes reduced travel time, the lowest metro fare and parking fees. This combination of attributes significantly impacts their decisions to switch transport modes. The fewest respondents shift transport modes if parking is free.

**East:** As in the north area, parking fees may help to increase shifts to public transit use in the east area.

**West:** The lowest fare and a shorter wait time are the most important determinants of increased metro use in the west area.

**Central:** As the central area only covers around 1% of the sample, we cannot draw robust conclusions.

In summary, new parking fees, reduced travel times, the lowest metro fares and shorter wait times are leading factors in car-owning households' decisions to change transport modes. Given this study's focus, we discuss only the importance of parking fees. We found that new parking fees are important catalysts for switching to public transit in most areas of Riyadh. Such fees may influence people to switch from using their cars to using the metro in the north, south and east areas of Riyadh. These areas cover 63% of the respondents in our sample. In contrast, the lowest fare and shorter wait times are the most important factors in the west area, which covers 36% of group 1 respondents. Consequently, imposing new parking fees may lead almost two-thirds of the respondents in group 1 to change their current transport mode to new metro services.

Clearly, other factors may be important, and people may not always choose their mode of transport based on parking fees. Nonetheless, parking fees are very common catalysts for respondents choosing between the hypothetical scenarios in our analysis. In addition, research and practice support parking fees as a key policy measure for discouraging car use. Kolomatskiy et al. (2020) observe that paid parking is an important constraint on private car usage. Specifically, about 20% of car users may change their transport mode to public transit under different parking policies. The higher a parking fee is, the more car users switch to transit. Similarly, Ding and Zhang (2017) find that higher parking fees impact car users' decisions to switch transport modes the most, followed by managed bus lanes.

Thus, policies can aim to discourage private car use through fees or restrictions on driving and parking. For instance, Oslo in Norway and Sevilla in Spain have introduced measures to make parking more difficult in targeted areas. These measures include converting parking spaces to cycle lanes or pedestrian areas and increasing parking fees. Other cities, including San Francisco and Mexico City, have introduced demand-based parking fees, through which parking fees are greater when demand is high. Thus, car usage restrictions or fees should be enacted in Riyadh to increase metro ridership and ensure the Riyadh metro project's success.



## References

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## Appendix A

Diadro Consulting Espana, a Spain-based consulting firm, was commissioned to administer the SP survey for evaluating preferences for the metro. Diadro used six questionnaires, denoted D1, D2, D3, D4, D5 and D6, and each questionnaire contained nine unique situations. Accordingly, a total of 54 situations were considered, as shown in the following tables.

Attributes	Questionnaire type D1: car users (SP: Car to metro without transfer consideration)																	
	S1		S2		S3		S4		S5		S6		S7		S8		S9	
	Metro	Car	Metro	Car	Metro	Car	Metro	Car	Metro	Car	Metro	Car	Metro	Car	Metro	Car	Metro	Car
Fare / parking fee	3 SAR	Free	5 SAR	10 SAR	3 SAR	Free	7 SAR	Free	7 SAR	Free	7 SAR	Free	5 SAR	10 SAR	3 SAR	Free	5 SAR	10 SAR
Wait time	7 mins	None	7 mins	None	4 mins	None	2 mins	None	7 mins	None	4 mins	None	2 mins	None	2 mins	None	4 mins	None
Travel time	Last trip – 15 mins	Same as last trip	Last trip – 8 mins	Same as last trip	Last trip – 8 mins	Same as last trip	Last trip – 8 mins	Same as last trip	Last trip – 5 mins	Same as last trip	Last trip – 15 mins	Same as last trip	Last trip – 15 mins	Same as last trip	Last trip – 5 mins	Same as last trip	Last trip – 5 mins	Same as last trip
Walk time	Same as last trip	Same as last trip	Last trip + 5 mins	Same as last trip	Last trip + 3 mins	Same as last trip	Same as last trip	Same as last trip	Last trip + 3 mins	Same as last trip	Last trip + 5 mins	Same as last trip	Last trip + 3 mins	Same as last trip	Last trip + 5 mins	Same as last trip	Same as last trip	Same as last trip

Attributes	Questionnaire type D2: car users (SP: Car to metro with transfer consideration)																	
	S1		S2		S3		S4		S5		S6		S7		S8		S9	
	Metro	Car	Metro	Car	Metro	Car	Metro	Car	Metro	Car	Metro	Car	Metro	Car	Metro	Car	Metro	Car
Fare / parking fee	5 SAR	Free	7 SAR	10 SAR	3 SAR	Free	3 SAR	Free	7 SAR	10 SAR	5 SAR	Free	5 SAR	Free	4 SAR	Free	5 SAR	Free
Wait time	7 mins	None	7 mins	None	7 mins	None	2 mins	None	2 mins	None	2 mins	None	7 mins	None	5 mins	None	2 mins	None
Travel time	Last trip – 12 mins	Same as last trip	Last trip – 5 mins	Same as last trip	Last trip – 12 mins	Same as last trip	Last trip – 5 mins	Same as last trip	Last trip – 12 mins	Same as last trip	Last trip – 12 mins	Same as last trip	Last trip – 5 mins	Same as last trip	Last trip – 8 mins	Same as last trip	Last trip – 5 mins	Same as last trip
Walk time	Same as last trip	Same as last trip	Same as last trip	Same as last trip	Last trip + 5 mins	Same as last trip	Same as last trip	Same as last trip	Last trip + 5 mins	Same as last trip	Same as last trip	Same as last trip	Last trip + 5 mins	Same as last trip	Last trip – 2 mins	Same as last trip	Last trip + 5 mins	Same as last trip
Transfer required	No	None	Yes	None	Yes	None	No	None	No	None	Yes	None	No	None	No	None	Yes	None

Attributes	Questionnaire type D3: car users (SP: Car to public bus)																	
	S1		S2		S3		S4		S5		S6		S7		S8		S9	
	Public bus	Car	Public bus	Car	Public bus	Car	Public bus	Car	Public bus	Car	Public bus	Car	Public bus	Car	Public bus	Car	Public bus	Car
Fare / parking fee	3 SAR	Free	5 SAR	10 SAR	3 SAR	Free	6 SAR	7 SAR	6 SAR	7 SAR	6 SAR	7 SAR	5 SAR	10 SAR	3 SAR	Free	5 SAR	10 SAR
Wait time	2 mins	None	2 mins	None	8 mins	None	4 mins	None	2 mins	None	8 mins	None	4 mins	None	4 mins	None	8 mins	None
Travel time	Last trip + 10 mins	Same as last trip	Last trip + 5 mins	Same as last trip	Last trip + 5 mins	Same as last trip	Last trip + 5 mins	Same as last trip	Same as last trip	Same as last trip	Last trip + 10 mins	Same as last trip	Last trip + 10 mins	Same as last trip	Same as last trip	Same as last trip	Same as last trip	Same as last trip
Walk time	Same as last trip	Same as last trip	Last trip + 2 mins	Same as last trip	Last trip + 5 mins	Same as last trip	Same as last trip	Same as last trip	Last trip + 5 mins	Same as last trip	Last trip + 2 mins	Same as last trip	Last trip + 5 mins	Same as last trip	Last trip + 2 mins	Same as last trip	Same as last trip	Same as last trip

Questionnaire type D4: taxi/limousine users (SP: Taxi/limousine to metro)																		
Attributes	S1		S2		S3		S4		S5		S6		S7		S8		S9	
	Metro	Taxi	Metro	Taxi	Metro	Taxi	Metro	Taxi	Metro	Taxi	Metro	Taxi	Metro	Taxi	Metro	Taxi	Metro	Taxi
Fare	3 SAR	Same as last trip	5 SAR	Same as last trip	3 SAR	Same as last trip	7 SAR	Same as last trip	7 SAR	Same as last trip	7 SAR	Same as last trip	5 SAR	Same as last trip	3 SAR	Same as last trip	5 SAR	Same as last trip
Wait time	7 mins	Same as last trip	7 mins	Same as last trip	4 mins	Same as last trip	2 mins	Same as last trip	7 mins	Same as last trip	4 mins	Same as last trip	2 mins	Same as last trip	2 mins	Same as last trip	4 mins	Same as last trip
Travel time	Last trip – 13 mins	Same as last trip	Last trip – 7 mins	Same as last trip	Last trip – 7 mins	Same as last trip	Last trip – 7 mins	Same as last trip	Last trip – 4 mins	Same as last trip	Last trip – 13 mins	Same as last trip	Last trip – 13 mins	Same as last trip	Last trip – 4 mins	Same as last trip	Last trip – 4 mins	Same as last trip
Walk time	5 mins	Same as last trip	8 mins	Same as last trip	12 mins	Same as last trip	5 mins	Same as last trip	12 mins	Same as last trip	8 mins	Same as last trip	12 mins	Same as last trip	8 mins	Same as last trip	5 mins	Same as last trip

Questionnaire type D5: company bus users (SP: Company bus to metro)																		
Attributes	S1		S2		S3		S4		S5		S6		S7		S8		S9	
	Metro	Company bus	Metro	Company bus	Metro	Company bus	Metro	Company bus	Metro	Company bus	Metro	Company bus	Metro	Company bus	Metro	Company bus	Metro	Company bus
Fare	3 SAR	None	5 SAR	None	3 SAR	None	7 SAR	None	7 SAR	None	7 SAR	None	5 SAR	None	3 SAR	None	5 SAR	None
Wait time	7 mins	Same as last trip	7 mins	Same as last trip	4 mins	Same as last trip	2 mins	Same as last trip	7 mins	Same as last trip	4 mins	Same as last trip	2 mins	Same as last trip	2 mins	Same as last trip	4 mins	Same as last trip
Travel time	Last trip – 10 mins	Same as last trip	Last trip – 5 mins	Same as last trip	Last trip – 5 mins	Same as last trip	Last trip – 5 mins	Same as last trip	Same as last trip	Same as last trip	Last trip – 12 mins	Same as last trip	Last trip – 10 mins	Same as last trip	Same as last trip	Same as last trip	Same as last trip	Same as last trip
Walk time	Last trip – 12 mins	Same as last trip	Last trip – 5 mins	Same as last trip	Same as last trip	Same as last trip	Last trip – 12 mins	Same as last trip	Same as last trip	Same as last trip	Last trip – 5 mins	Same as last trip	Same as last trip	Same as last trip	Last trip – 5 mins	Same as last trip	Last trip – 12 mins	Same as last trip

Questionnaire type D6: bus/private van users (SP: Bus/private van to metro)																		
Attributes	S1		S2		S3		S4		S5		S6		S7		S8		S9	
	Metro	Bus/private van	Metro	Bus/private van	Metro	Bus/private van	Metro	Bus/private van	Metro	Bus/private van	Metro	Bus/private van	Metro	Bus/private van	Metro	Bus/private van	Metro	Bus/private van
Fare	3 SAR	Same as last trip	5 SAR	Same as last trip	3 SAR	Same as last trip	7 SAR	Same as last trip	7 SAR	Same as last trip	7 SAR	Same as last trip	5 SAR	Same as last trip	3 SAR	Same as last trip	5 SAR	Same as last trip
Wait time	7 mins	Same as last trip	7 mins	Same as last trip	4 mins	Same as last trip	2 mins	Same as last trip	7 mins	Same as last trip	4 mins	Same as last trip	2 mins	Same as last trip	2 mins	Same as last trip	4 mins	Same as last trip
Travel time	Last trip – 10 mins	Same as last trip	Last trip – 5 mins	Same as last trip	Last trip – 5 mins	Same as last trip	Last trip – 5 mins	Same as last trip	Same as last trip	Same as last trip	Last trip – 10 mins	Same as last trip	Last trip – 10 mins	Same as last trip	Same as last trip	Same as last trip	Same as last trip	Same as last trip
Walk time	Last trip – 12 mins	Same as last trip	Last trip – 5 mins	Same as last trip	Same as last trip	Same as last trip	Last trip – 12 mins	Same as last trip	Same as last trip	Same as last trip	Last trip – 5 mins	Same as last trip	Same as last trip	Same as last trip	Last trip – 5 mins	Same as last trip	Last trip – 12 mins	Same as last trip

Note: SAR = Saudi Arabian riyal; mins = minutes.

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