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Evaluation of the modal choice behaviour and bus service preferences of commuters of the scheduled Golden Arrow Bus Services (Pty) Ltd using stated choice data

By

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ABSTRACT

Evaluation Problem

The Western Cape Provincial Government faces a public problem of declining service levels with respect of public bus transport services.

Stemming from the public problem is the management problem of modelling choice behaviour of commuter stated choices for utility maximisation and therefore as a means of optimising the allocation of the Public Transport Operating Grant (PTOG) expenditure.

> Historically, *differing perceptions amongst travellers, and the difficulties in quantifying these attributes, mean that they are rarely included (directly) within the modelling and appraisal process, or the associated utility computation* (Crockett, Sinclair and Whelan. 2008:11).

A combination of policies which would ensure that the discrete choices of commuters for an improved bus service are considered in a modal shift from the Golden Arrow Bus Services (Pty) Ltd (GABS) bus service to the MyCiTi Integrated Rapid Transit (IRT) service is required to be produced from this evaluation.

Evaluation Approach

The evaluation brings together data and analytical information on a broader, more inclusive, societal model of the public transport service in Cape Town.

It seeks to:

- identify the value aspects of the public bus transport infrastructure and services,
- identify and model choice behaviour of GABS bus service users,
- generate preference valuations for public transport service attributes and

- determine the effect of service attributes on modal choice namely GABS and a hypothetical MyCiTi service area

A discrete choice experiment models the stated choices of respondents who were made to choose between various combinations of service levels during the morning and afternoon peak commuting times. The commuters' willingness to pay for a switch to a new MyCiTi IRT-type service from their current choice of an existing GABS bus service is estimated. The choice data is collected by means of an on-board bus survey along three particular routes in Table View, a West Coast Region in the City of Cape Town, South Africa and where the new MyCiTi service is being introduced. The analyses will show which service attributes are significant in commuter mode choice behaviour, such as changes travel time, fare prices and other significant service attributes, as well as which level of service would maximise utility for the target population.

Major Evaluative Conclusions

The evaluation found that the DCE choice modelling approach used was unfamiliar to the respondents and would most likely not have been completely understood. Although the factorial approach to designing the experiment could identify an exhaustive list of value aspects to choose from, the need to adopt a fractional factorial in the final design does necessitate further experimentation to produce a more comprehensive choice model, inclusive of more service attributes and with the discrete choice models corroborated with revealed preference data.

Seat availability was by far the most significant choice determinant and the lack thereof would be a serious deterrent to a modal shift to using the new MyCiTi service. The number of transfers during the trip and the distance of the bus stop from home were also significant choice determinants. The choice models indicated that the female commuters particularly, were willing to pay for the new MyCiTi bus-type service. In the absence of suitable seating capacity, a reduced travel time would be required to reduce the standing times and make the MyCiTi service an attractive option.

The analysis produced inconclusive data for ridership predictions, although it can generally be said that provided sufficient seating, the GABS bus users will be willing to switch modes, as there is no indication in the data to suggest otherwise. Considering the preferences expressed for the service attributes, a hypothetical service can be proposed, with a service mix of R9.00 per trip, that would take 45 minutes and that offered the commuter a seat for the journey. The first bus stop would be no more than two kilometres away and the journey would consist of no more than one transfer to reach the final destination.

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List of Abbreviations

CL	Conditional Logit	DCE	Discrete choice experiment
MLE	Maximum likelihood estimation	MNL	Multinomial logit
GABS	Golden Arrow Bus Services (Pty) Ltd	CoCT	City of Cape Town
R	R Statistical Computing software	IRT	Integrated Rapid Transit bus service
PLTF	Provincial Land Transport Framework	SC	Stated choice
RP	Revealed Preference	WTP	Willingness to pay.

Table 1 Abbreviations

Chapter 1 Introduction

'An object can have no value unless it has utility. No one will give anything for an article unless it yields satisfaction. Doubtless people are sometimes foolish, and buy things, as children do, to please a moment's fancy, but at least they think that at that moment that there is a wish to be gratified.'

- *(*Taussig, 1912)via (Manski and McFadden, 1981:198)

In this view of economic rationality, preference maximization is a synonymous with choice.

1.1 Introduction and background to evaluation

The people using any mode of transportation are dynamic in their way of utilising their preferences which can be influenced by cost, safety, the time of the day they need transport and many other forces; the interplay between these factors. With commuters in the Cape Metropolitan area, we observe the following modal split between public transport and private motor vehicle in the City of Cape Town (DTPW, 2011c).

Public transport Mode	Modal split	Daily passengers
Rail	52%	630,000
Bus	19%	230,000
Minibus taxi	29%	350,000

Table 2-The Modal split between public transport modes in the City of Cape Town

For bus services being provided to the public, little customer feedback exists to provide a measure of value for money of the service. This feedback would produce information that could determine the future of the GABS routes affected by the implementation of the City of Cape Town Municipalities' Integrated Rapid Transit (IRT) Phase 1A in the Table View area, also known as the MyCiTi rapid bus service. The evaluation will reveal

an understanding of whether customers who use GABS bus services are willing to switch to the new MyCiTi-type service. The GABS customers will value service attributes of both the Golden Arrow Bus service and the hypothetical new MyCiTi service which will be an extension of the existing Table View to Civic Centre MyCiTi line haul service and feeder bus services.

Understanding behavioural change of individuals in response to implemented government programmes is of interest to the broader society (Louviere, Hensher and Swait, 2000). The use of choice experiments, where the customers will choose between a set of fixed or variable choice sets produces a discrete model of the commuter first preference choice between the two different services, as well as being able to choose 'neither of the two' services(Hensher, 1994). The choice experiments will use multiple service attributes which represent the primary and secondary choice drivers of the preferred choice of bus service and will produce stated choice data from the commuters which they would otherwise not reveal in revealed preference data, such as the number of clip-card tickets sold. Choice processes undertaken by commuters using the affected GABS bus services will be analysed to state the consumer behaviour underlying the choice of GABS as their first preference modal. The main effects of the dependant variable, the modal/service choice, will be the focus of the level of analysis.

In the next section, the evaluation problem is defined in more detail, the evaluation objectives are established, the literature is reviewed and the evaluation methodology described. An incremental data collection process will be followed, collecting data from the commuters specifically during the morning and peak travelling periods. The data collection and analysis is followed by a preliminary bibliography, listing the material read thus far.

1.2 Definition of the Problem

1.2.1 The Public Problem – declining bus service levels.

The Western Cape Province has seen a decline in the overall quality of the subsidised public bus service. As a competing mode of transport, the unsubsidised minibus taxi industry has had a major impact on the bus services, in terms of their frequency and the demand-responsive quality of service. This destructive competition, along with an underinvestment in the public transport system, has led to this gradual decline. The introduction of the MyCiTi service poses another serious threat to the sustainability of the other transport modes.

Provincial Government is interested in the evaluation of the bus services (e.g., the monetary value of time reduction in travel time). Current transport inefficiencies have significant negative impacts on the economy, society and the environment:

- Unaffordable public transport fares, especially for marginalized communities beyond Table View (due to travelling distances and the lack of an adequate and integrated transport system;
- Safety and security problems within the transport system networks – in both public and private transport;
- Inaccessible transport services and infrastructure for persons with special needs, further isolating already vulnerable individuals in communities; both bus and taxi services provide an ad hoc, disintegrated public transport system in the Western Cape.

These result in several components often operating in competition with one another, producing inefficiencies and sub-optimal operations of bus services. Public Transport also needs to support other strategic objectives and interventions relating to economic and employment growth. This support is through the provision of '*an efficient transport system which reduces the cost of doing business, allowing the private sector to minimise input costs*' (DTPW, 2011c:4), improves access to education and health

facilities, reduces crime, allows people to move freely, and to provide reasonable access to government grants.

(Constitution of the Republic of South Africa Act, No 108 of 1996, 1996:ch10 s195 ss1b) stipulates that public service '*must be governed by the democratic values and principles enshrined in the Act, including the promotion of efficient use of resources*.' It also includes the requirement that people's needs must be responded to, and that the public must be encouraged to participate in policy-making (DPSA, 2009), (Constitution of the Republic of South Africa Act, 1996).

Close to 10.9% of South Africa's population (5 342 832) live in the Western Cape. The population here has grown by 16.7% (DTPW, 2011c:8). Government's transport policy needs to ensure *'economic opportunity for all citizens, coupled with its policy to provide basic personal mobility for all, driving the demand for public transport requirements* (DTPW, 2011c:20).*'* Public transport services must be improved in both the urban and rural areas of the Western Cape, with a particular focus being on the captive commuter.

Governments' mandate is to ensure safe, efficient and affordable public transport. To respond to this mandate, public bus services in the City of Cape Town are currently provided in terms of an on-going interim contract, set to change with the move to a tendered or negotiated contracts as prescribed by the (NLTA, 2009). The (NLTA, 2009) also paves the way for the implementation of the Integrated Public Transport Networks (IPTN's) in all municipalities of the Western Cape, under custodianship of the municipalities – such as the MyCiTi Integrated Rapid Transit (IRT) system being rolled out by the City of Cape Town. The MyCiTi system envisages subsidised road-based public transport services to be provided by joint venture operating entities consisting of existing taxi and bus operators. MyCiTi rollout will seek to integrate all modal options into a coherent package for the customer (DTPW, 2011c).

GABS is the largest private bus company in the Province, with a fleet current of approximately 1126 buses. The company operates the only government subsidised

and scheduled bus service throughout the Cape Metropolitan Area on a single comprehensive permit. The National Treasury provides subsidies through conditional grants allocated to the Western Cape Provincial Department of Public Works and Transport (National Treasury of South Africa (Division of Revenue Act, No. , 2012). The subsidies, which are capped, are paid on the basis of 'live' kilometres completed according to a determined timetable and designated routes. Kilometres are reconciled by an independent monitoring agent to confirm the subsidy claim submitted by GABS for the completion of scheduled kilometres per month (TESS, 2011a). The subsidy allocation for rail, the backbone of public transport in the Western Cape, runs at a third of the cost of subsidised bus services (DTPW, 2011c:14). The PTOG grant being paid to GABS is therefore relatively expensive.

The City of Cape Town should provide public transport infrastructure along dedicated routes, in line with the Mobility Strategy. As part of its duty, the first phase (Phase 1A) of the MyCiTi rapid bus service, which includes the Inner City - Blaauwberg - MyCiTi service area, is currently being rolled out by the City of Cape Town. The development consists of the construction of dedicated trunk lanes and stations, feeder stops, new depots, investment in new vehicles, non-motorised transport infrastructure and Intelligent Transport Systems (ITS) investment.

A total of 146 different GABS current subsidised routes were identified that will be influenced by the IRT Milestone 0 Interim Routes. The Province would like to determine the impact of changes occurring in the project. Programme: Transport Operations, in assessing the value the customers place on the GABS bus service and MyCiTi services, would learn about its customers, but also the shape of the future back office operation.

1.2.2 The Management problem – Ensuring the efficient allocation of the PTOG to meet customer satisfaction

The problem experienced with the PTOG grant spending is the lack of certainty that the grant funding actually produces the intended benefits of making public transport,

particularly scheduled bus services, more affordable, accessible, safer and more efficient. To this end, very little stated choice data exists that can demonstrate the bus operator, GABS, provides a service which produces customer satisfaction, thereby justifying the costly subsidies being incurred to subsidise the bus operations

The use of stated choice experiments and rational utility theory to evaluated choice behaviour has not been used with the Department of Transport and Public Works and has seen limited application (Arentze, Borgers and Timmermans, 2003), (Van Zyl and Hugo, 2002) within practice in developing countries and South Africa as a whole.

To treat citizens as 'customers' implies adding value to their lives. Service delivery of provincial departments is required, among other things, to develop and implement: monitoring and evaluation mechanisms. Part of the role of the monitoring and evaluation mechanisms is to ascertain value creation in service delivery. Currently within the Department, monitoring and evaluation type reports are completed as a compliance measure rather than for usefulness. A Public Service Commission audit echoed the above findings. Departments must make service delivery a priority, where the monitoring and evaluation of this service delivery forms an important aspect thereof (DPSA, 1997). This places a requirement on decisions relating to supporting the MyCiTi rollout, which must take into account many parameters, or service attributes including fare levels, security levels, travel times, level of integration between modes, comfort of commuters. Attributes are the characteristics of the choices being made.

The evaluation will contribute in dealing with the management problem of understanding the results or benefits (value) realised from PTOG grant spending. In the public transport system, the value is created by increasing access to safe and efficient transport. Public Transport is seen as the economic path breaker, needing to support a growing metropolitan urban working force, described as the actively employed commuters and those actively seeking employment. In this regard, the

Western Cape Province has the lowest unemployment rate in the country, namely 22.2%, compared with the national average of 23.2% (Provincial Treasury, 2011).

The usual source of information on preferences for goods and services used by economists is revealed preference (RP) data and refers to the observation of preferences revealed by real market behaviour (Louviere, Hensher and Swait, 2000). One of the reasons why RP data is of perhaps of limited value for policy decision makers is that the commuting public is largely a captive one, where few choices exist for commuters. Furthermore, the South African public is not used to voicing their preferences, due to the history of the apartheid-style of service delivery, where the public were given services without due regarding for their preferences. RP data also reveals insufficient data for policy makers, where the best alternative would most likely be the most expensive alternative available to the public. *As On the other hand, in the SP survey, we ask what you would do if you faced the specific situation that the researcher specified (Sanko, 2001:6)*

Discrete choice experiments (DCE's) present individual commuters with choice sets of hypothetical combinations of bus services and for each choice set; their preferred combination (or scenario) is selected. DCE's are based on the theory that the consumer will seek utility maximization in their choices. In a bus mode choice model, the consumer will undertake a 'blind tasting' to choose a service that would produce individual greater utility compared with other modes. The choice is discrete and gives the individual the possibility of choosing only one alternative mode or service, which consists of a mix of service attributes. Each attribute is described by a number of attribute levels. By systematically varying the scenarios in the choice sets, assigning different levels to the attributes according to experimental design principles for main effects, it becomes possible to evaluate each attribute's influence on the choice of the commuter (Louviere, Hensher and Swait, 2000). The evaluation seeks to successfully implement DCE's in order to generate customer preferences in the changing bus service, a first for the Western Cape Province.

Problem statement:

The description of the main problem(s) to be investigated in this evaluation may be stated as: *Determining the service preferences of the commuters who use the GABS bus service.*

1.3 Evaluation aim

The intended aim of this evaluation:

> *There are currently no methods in place to measure customer satisfaction realised by the provision of transport infrastructure and related services. The evaluation 's aim is to contribute stated choice data that could eventually be used in the prediction of the impact of replacing the GABS bus service with a MyCiTi service through determining the possible market share for the new service:*

Existing Scenario 1: GABS bus service operating in conjunction with the MyCiTi in the Civic Centre-Table View Corridor, with some routes serviced exclusively by GABS.
Future possible Scenario 2: The GABS bus service is partly discontinued on certain routes and integrated into the MyCiTi system.
Future possible Scenario 3: The GABS bus service is discontinued to be replaced by the a hypothetical MyCiTi system

This evaluation will focus on contributing towards predicting the impact scenario 3 will have on customer satisfaction and demand. Rather than evaluating the entire scenario as a package, the DCE will break down the scenario into the relevant attributes and identify the commuter's preference for those attributes. The evaluation aims to provide clarity on the decision commuters make when selecting a travel mode in the MyCiTi service area.

1.4 Evaluation objectives

The evaluation objectives to be investigated are:

1. **Objective 1:** To identify the value aspects of the public transport infrastructure and services
2. **Objective 2**: To generate preference valuations for public transport service attributes
3. **Objective 3:** To identify and model choice behaviour of GABS bus users
4. **Objective4:** To determine the effect of service attributes on modal choice

1.5 Justification for evaluation

Impact evaluations provide a means to identify changes in society that has occurred as a result of service delivery. Public transport services provide an essential role of creating mobility. A benefits realised feedback mechanism for the Transport Operations is needed to measure the value created for their customers. Using stated choice experiments, coupled with a main effects level of analysis could be a useful method for measuring benefits realisation on Public Transport Operating Grant in the GABS bus service and future MyCiTi bus service implementations.

The PTOG was introduced as a conditional grant to provincial governments in terms of the DORA Act No. 5 of 2012, with the purpose of *'subsidizing roads based public transport services and to provide supplementary funding towards public transport services provided by provincial governments.'* The grant is thus key funding mechanisms for the successful implementation of MyCiTi rapid transit system. As the MyCiTi project phases into the City, the decision-makers need to understand the predicted market share for the replacement service.

This evaluation adopts a qualitative and quantitative method for use in the public sector integrated transport environment. Utility is measured for various customer satisfaction criteria and will be plotted onto utility graphs. Utility theory is proposed as a decision-making theory that can model the commuters' decision-making processes relating to the service public transport service on offer.

Of importance to the Province is a smooth transition of the management of public bus service to the City of Cape Town, while maintaining and improving the customer service offering in the process. From the customer's perspective, it is of no interest who manages the public transport service, as long as the service creates utility or benefits for the user.

The evaluation proposed will provide the needed programme self-assessment step for the expenditure on the PTOG. Self-assessment is a feedback mechanism in the value chain to understand how to increase value. It emphasises the focus on the inclusion of a learning, sense-making organisation, as opposed one that is solely performance achievement and target driven.

1.6 Contribution of the evaluation

Program performance management includes, among other aspects, measures of program outcomes. Management requires evaluation to understand the '*extent to which programs are reaching their target population, the quality and efficiency of service delivery and customer satisfaction, and the level and pattern of resource utilization* (National Treasury of South Africa, 2010:8).'

At present, there is no formal feedback loop from the communities, the intended programme beneficiaries, back to the programmes, detailing if 'value for money' is being achieved. It is thus considered proactive to expand the scope of the survey annually, as the possibility of phasing out of the GABS bus service become increasingly important. This would also ensure a wider perspective of what would constitute value-add for commuters using the GABS bus service.

Understanding the value being created for the customers being serviced by the affected routes could prove useful in negotiations between the Department and the City of Cape Town on the future of the GABS bus service in the MyCiTi service area. In addition to this, the learning opportunities include finding out competencies that need to be acquired, what is realistic and affordable in terms of improving the bus and

MyCiTi service, how to deliver against customer expectations, who the most important customers, the commuters, really are and how the commuters make modal choices on the public transport services, what the customers need and expect and what the capacity is for improved service delivery. The MyCiTi Milestone 0 Interim Routes implementation is near complete. The first phase of the Milestone 0 Interim Routes operation is underway and the next milestone under construction extending further towards the Atlantis settlement. To date, an evaluation was undertaken to identify the GABS routes influenced by the introduction of the MyCiTi. A total of 146different GABS current subsidised routes was identified that will be influenced by the IRT Milestone 0 Interim Routes. GABS services, it has been reported, can be discontinued and replaced with MyCiTi 'with no serious repercussions on the passengers (TESS, 2011b:2).' With such a conclusion, TESS, the supervisory monitoring firm highlights a degree of uncertainty in the pending management decision to discontinue the GABS routes.

Currently, no plan exists that details how to integrate public transport in the Cape Town functional region. Understanding which service attributes, whether tangible or intangible, commuters prefer, would enable a focused delivery across all the modes that would ensure utility maximization in the public transport system for the commuter.

1.7 Tentative outline of the evaluation report

The impact evaluation report is proposed to be structured in six chapters:

In **Chapter 1**, the background to evaluation, followed by the problems to be investigated, the hypothesis to be investigated, and the purpose of the evaluation, limits or boundaries of the evaluation, scope of the thesis and the plan of the development of the thesis

Chapter 2 includes a literature review, detailing the specific theoretical approach to be followed in the evaluation,

Chapter 3 includes the methodology and procedures followed for conducting the evaluation,

Chapter 4 the results are analysed of the findings of facts, the analysis and interpretation of the questionnaire survey data,

Chapter 5 details a discussion of findings, the concluding discussion, including a recommendation for practice. The recommendations would include guidance on gradually increasing the size of the survey from year to year. This is followed by a full list of References for the evaluation report and an appendix.

1.8 Resource requirements

- Processes: The processes described here relate to the evaluation execution phase. The two major processes under the execution phase include the data collection and analysis processes, as set out in the draft Results-based Monitoring and Evaluation Operational plan 2012-15. The data collection part of the evaluation process requires the use of survey questionnaires. The design of these questionnaires would require the need of language and translation services and legal services. Further data collection could be done via the Departmental Enterprise Content Management system, Livelink, which has survey capabilities. Data integrity for the evaluation will be addressed with through the hiring and familiarising the field workers with the norms and standards for completing the survey questionnaire. It is envisaged that the initial data collection will be conducted in-house, with subsequent iterations of data collection using additional field workers. Data analysis could require a selection of the technology listed below.
    - Technology: Data analysis would require the use of statistical computer software package and the R open-source software package, (R Foundation, 2012) is selected to perform the logistical regression calculation.
    - Human Resources: The management of the evaluation will be supported the Acting Assistant Manager for M&E: Integrated Transport and administratively by an M&E: Administrator. Five M&E staff will be rotated during a 2 week data collection period to survey commuters.

- Stakeholder buy-in: The evaluation process is one of social evaluation for the Transport Operations Programme, thus the organisational process assets will used in communicating with the customers of the bus service. Any participation in this evaluation by customers has been done so with consent. Once the collected data is analysed, the evaluation results will be written up into a report and its findings presented to the Transport Operations Programme.

1.9 Limitations and delineations

The service under evaluation consists of the experience of commuters and the choices they make to get from their households to the final work destinations. This constitutes part of the decision to use the GABS bus service and is thus of interest to the evaluation team. The evaluation is not envisaged to include surveying any MyCiTi, minibus taxi services or private vehicle commuters in the area.

Furthermore, the limits of the choice experiment method used in this evaluation will be considered and addressed during the data analysis. The major limitation is that the evaluation uses a fractional factorial design, using selected service attributes of selected public transport modes. The commuters do have other modes to choose from, such as a minibus-taxi or private motor vehicle. Another limitation of the adopted methodology is linked to the estimation of attribute alternative values and their confidence intervals for this evaluation. It is also important to note that the applicable utility theory is based on the assumption that customers would always seek to maximise their utility (Lancaster, 1966).

For the MyCiTi service in particular, which is designed using an IRT approach, high frequency timetable; improved reliability and vehicle speeds through dedicated rights-of-way and signal, priority on at least part of the route; high quality vehicles with more capacity and good ride quality; good vehicle access via low floor buses and / or raised platforms; lower local air and noise pollution via cleaner fuels and technologies; and high profile marketing and brand development attributes were not part of the SP

evaluation. Given the importance of these attributes to scheme design, it would have provided a more detailed evaluation to take specific account of them when estimating traveller willingness-to-pay for IRT services on the proposed route (Crockett, Sinclair, and Whelan. 2008).

Chapter 2 Literature Review

2.1 Purpose of the literature review

The relevant literature on the public problem of and management problems highlighted in Chapter 1 are themed in this evaluation's literature review. A systematic review was conducted to identify the three themes which run through the literature, namely:

- Utility and value theory; where value is determined by the importance the commuters place on a GABS bus service for the as a service that meets their desired ends of travelling between home and place of work.
- The estimation of the discrete choice model, the measurement of value for money specifically for on public transport services, derived from modelling the discrete choices of the commuters with DCE's.
- Public transport evaluation - The determination of service levels on public transport services

All three themes address the management problem of value management. The third theme, of public transport evaluation, details the application of the first two themes to address the public problem of inefficient public transport services.

2.2 Utility and value theory

Probabilistic choice theory has been developed by various authors (Luce 1959, (Tversky, 1972), (Coombs 1964), (Luce and Suppes 1965), (Bock and Jones 1968), (Krantz *et al.,* 1971), (Krantz 1974) via (Sanko, 2001). Conjoint measurement, or weighted measurement, consisting of a combination of object attributes, of these alternatives was introduced by (Luce and Tukey, 1964) via (Lancaster, 1966) with further elaboration on this with the economic theory of value.

(Green and Rao, 1971) is commonly regarded as introducing SP methodology, thereafter (Cattin and Wittink, 1982) having estimated over 1000 commercial applications in the 1970's in the US alone (Sanko, 2001).

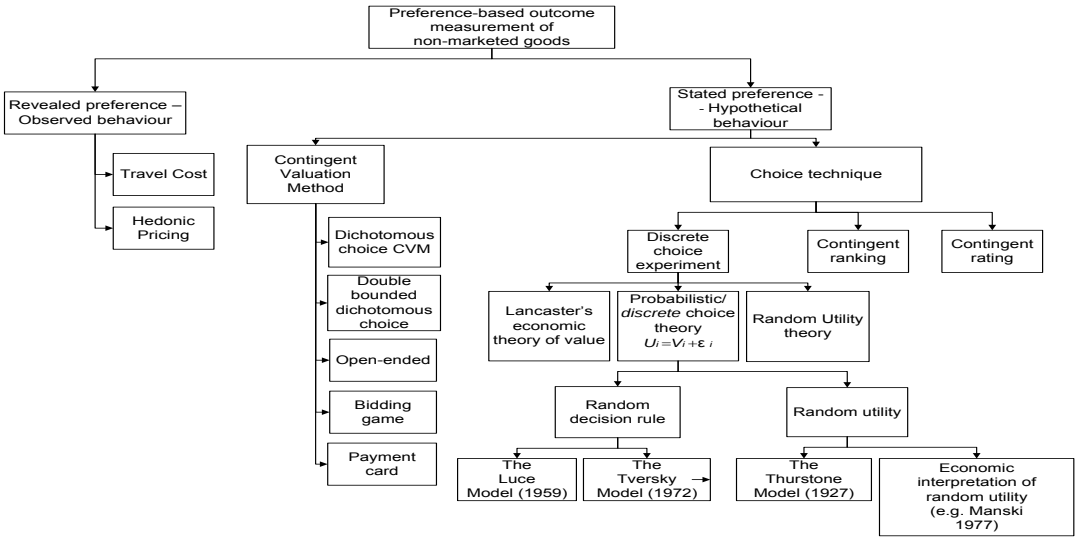

Figure 1 - Preference-based outcome measurements of non-marketed goods.

Thurstone (1931) via (Louviere, Hensher and Swait, 2010), estimated indifference curves in choice experiments where respondents chose between different combinations of consumer goods. Random utility theory of Thurstone, (1927) via (Lancaster, 1966), combined with the theory of value, is a common application of DCE's in the global transportation industry. Recent work in DCE theory and methods extends the original theory of paired comparisons to multiple comparisons e.g., (McFadden, 1986); (McFadden and Train, 2000); (McFadden, 1974); (Thurstone, 1927) via (Louviere, Hensher and Swait, 2010). It was the random utility theory development by McFadden (1986) that provided a firmer economic foundation for stated choice methods. Random utility theory states that:

> *Individuals will make choices based on the characteristics of the good (an object component) and randomness (random component). Randomness could be found in the preferences of the individual or the fact that the researcher may not have the complete information set available to the individual).*
>
> (Louviere, Hensher and Swait, 2010).

Arguments by against the use of this theory illustrate the notion that utility is an attempt to measure something which is not proven to be real and that it would be more useful to simply measure the choice made directly, the revealed preference. The reason for this view is that it is argued that the theory supposes that individuals are particularly rational about maximizing utility. Greene (2003) argues that utility theory is silent on the use of multinomial logit models as a means to model discrete choices.

Previous studies in the South African public sector (Jay and Bowen, 2009) (Jay, Bowen, and Cattell, 2009) focused on suggesting models for measuring value with using utility theory and utility graphs. By modelling value with utility graphs, with some variation according to one's own need, an organization can directly increase customer utility, through a process of engaging with the customers, resulting in improved service delivery. Applicable to this evaluation problem are the sequences of commuter's decision making under uncertainty, namely: *Which sequence of travel choices will allow me to get to and from work and work opportunities with the most benefit, given my travel budget?*

Utility, in this evaluation will refer to the perceived satisfaction that each stated choice provides to the commuter as the decision maker. The commuters must decide how much of each service attribute to consume so as to secure maximise total utility subject to his/her available travel budget.

2.3 Literature on the design and of the discrete choice model

2.3.1 Model Design

Louviere and Hensher (1983) deliberated about a dependency that multicriteria analysis in consumer research has on functional measurement or conjoint measurement methods, in making consumer preference judgements. Sources Abdel-aty *et al*. (1997) Hensher (1994), (2007), Jay and Bowen (2009) argue the practicality of using choice modelling to improve service delivery in South Africa.

It is generally agreed that choice analysis is a useful method of understanding how to measure customer value (Hensher, 2007). The literature differs widely in the required specifications of the SC experiment design (Louviere, *et al.,* 2010). In addition, finding a comprehensive, robust SC design process was rare. The random component of random utility theory in part relates to the modeller not having complete information about the commuters who form part of the respondents in the survey sample. Though there is no way to capture in an experiment all the information needed to eliminate the inherent limitations of the model, even if only the limitations of time-space, a repeatable, the lack of using clear method of model design and estimation does increase the random, or error component.

Many researchers have studied the value management aspect of programmes using the stated choice experiment, explored partly because of the shortcomings in the revealed preference (RP) data (Hensher, 1994). '*Revealed preference methods refer to the observations of preferences revealed by actual market behaviour and represents real world evidence on the choices that individuals exercise* (Accent, Rand Europe. 2010:8).' At times, RP data may be inappropriate as they cannot accommodate non-existent attributes or variability of attributes, which in turn does not permit the establishment of their influences (Phanikumar and Maitra, 2006). As a result, stated choice (SP) or stated choice (SC) data, which is information on preferences provided by hypothetical choice scenarios of the type of service (what commuters say they would choose rather than what they are observed to choose), have been commonly used in transport economics in developed countries.

At the early stages of stated choice, choice modelling and analysis of the data was limited to ranking and rating preferences lists. It was Louviere and Hensher (1983) who then developed choice experiments in which individuals chose preferences from choice sets, enabling estimation of a discrete-choice model and hence the direct prediction of individual probabilities which could be aggregated to derive an estimated market share

or demand. Hensher (1994) summarises the pros and cons of the various alternative response metrics, ranks, rates and choices in choice modelling.

Early applications of SC techniques in the field of transport were by market researchers, who used SC to forecast the demand for new services to examine preferences between service and product attributes (Sanko, 2001). From various aspects, many studies report that it is a widely used method in the transport sector (Hensher, 1994), (Louviere, *et al.*, 2000). Mode choice models which are developed from SC data can be used to estimate the probability and size in possible modal shifts when the consumer preferences change, as service levels change due to *'differences in intrinsic preferences and differences in sensitivity to level-of-service changes across individuals in the population* (Hensher, 1981, quoted by Bhat, 1998:1).'

Willingness to pay is the marginal rate of substitution of particular service attributes/levels for money (fare levels), as an indirect measure of attribute importance. A willingness to pay evaluation infers weight or importance by analysing the outcome measure of customer choices. Generally speaking the literature regarding the different estimations of willingness to pay (WTP) is classified into revealed and stated choice methods. In (Eboli and Mazzulla, 2008) specifically, the WTP method is used for measuring attribute importance and weighting.

(Abdel-aty *et al*., 1997) uses data from two choice experiments, one comprising of hypothetical binary choice sets for evaluating the effect of advanced traffic information on drivers' route choice.

A critical review of the literature would indicate a widespread focus on using the choice experiments methods for determining travel choices or in the choice modelling of complex decisions such as determining the location of an airport, to improving public transport services by modelling the choices of route and travel mode selections by commuters.

(Eboli and Mazzulla, 2008), (Hensher, 2007), (Phanikumar and Maitra, 2006), (Hensher, 2004), (Yeh *et al*., 2000), (Hensher, 1994), (Ben-Akiva and Morikawa, 2002) propose common service attributes which are used to describe the experience of using the transport services in their transport studies and also similar to the attributes required by the transport policies of the Western Cape.

2.3.2 Model Estimation

The logit model uses the standard logistic probability distribution function. The Luce model, or multinomial logit (MNL) has been employed for market analysis in economics with reasonable success, notably in transportation planning where it has been used as an estimation of a discrete choice model to forecast market penetration of new travel modes (McFadden, 1980). This is application of the multinomial logit, or conditional logit, is core to this evaluation. The experiments conducted would contribute to the conducting of an impact assessment, in which a forecast of the new MyCiTi rapid bus service could be predicted.

Utility theory is used in this evaluation, to provide meaning to the choice probabilities derived from maximum likelihood estimations conducted of alternative choices made by the commuters who form part of the sample population. The CL can be used to evaluate problems with unordered categorical (nominal) dependent variables that have three or more categories. The estimation for a CL is commonly performed using the statistical method of maximum likelihood estimation (MLE). It estimates a CL model by maximising the conditional likelihood. The CL MLE is solved by the following maximization problem (McFadden, 1974):

$$\beta = \arg\max_{\beta} \log\left(\prod_{i=1}^{N} L_i\right) = \arg\max_{\beta} \sum_{i=1}^{N} \log(L_i)$$

$$L_i = \frac{\exp\left(\sum_{t=1}^{T} y_{it} x_{it} \beta\right)}{\sum_{\sum_{t=1}^{T} d_{it} = \sum_{t=1}^{T} y_{it}} \exp\left(\sum_{t=1}^{T} d_{it} x_{it} \beta\right)}$$

Figure 2 CL maximization problem

An assumption is made that the necessary conditions for optimality properties of maximum likelihood estimators are met, as the CL model produces probability estimates and is used as a demand forecasting tool. Because of the computational simplicity, the CL is a primary focus of attempts on functional generalizations (McFadden, 1974). Hensher (1983:8) states however that *'parameter estimates from this model will be consistent but confidence intervals about the parameters will be incorrect; hence, significance tests are to be interpreted very cautiously.'*

The probabilities describing the possible outcomes of the choice experiment are modelled, as a function of the explanatory (predictor) variables (or service attributes), using a logistic function. In the CL model, independent variables are service attributes of the unlabelled service choices.

The CL model form is commonly used as it is a good approximation to the economic principle of utility maximisation. Although MLE's are considered to be consistent and will therefore produce good estimates given a large number of samples, consideration must be given in the possibility that the model may overestimate the probability of choosing GABS, while at the same time underestimating the probability of choosing MyCiTi, through violating the irrelevant alternatives (IIA).

2.4 Literature on the public transport evaluation

The performance evaluation problem for urban public transport systems involves subjective and imprecise assessments, which are of a fuzzy nature (Yeh *et al.,* 2000). One area of application in which performance evaluations are conducted is that of maximizing bus subsidy, or PTOG spend. Benefit to society is associated with each rand of subsidy support from government and can be used as means of moving towards performance-based contracts (Hensher, 2004).

Earlier when mulling over utility and value theory, we discussed how the commuters decide the value of each service attribute to consume to maximise total utility subject to his/her available travel budget. In doing so, they provide enough data to estimate mode choice probabilities.

Previously conducted public transport multi-criteria assessment studies provide insight into how the public transport service attributes selected for the evaluation affect commuter mode choice and choice behaviour. Yeh *et al.* (2000), uses an analytical hierarchy of objectives approach in evaluating the performance of ten bus companies. Their focus is particularly on the operations, or the provision of the service. The research results would serve to improve the efficiency bus operations and which would in turn, increase the value for money expenditure on bus subsidies. In application to the PTOG, an operating grant that provides for the transfer of funding to subsidise the bus operating costs at a R17, 50 (South African Rands) per kilometre, the increase in value created by adjusting the significant bus service attributes would produce a service that is more preferred by the public and which therefore create more utility, for the users at large. It utilizes a fuzzy multicriteria analysis (MA) approach to performance evaluation for urban public transport systems involving multiple criteria of multilevel hierarchies and subjective assessments of decision alternatives. The performance evaluation problem for urban public transport systems involves subjective and imprecise assessments, which if expressed in linguistic terms are often the most intuitive and effective way for evaluation and still produce ranking outcomes

for the evaluation problem. The assessment of public transport services is categorised according to the services attributes in (DTPW, 2011c) and summarised in the table 3 below. Service attributes are classified into generic and elemental attributes, the latter being a more specific aspect of the generic attributes. (Arentze, Borgers and Timmermans 2003) indicate amongst their findings that the train mode is the least cost sensitive mode and that the attribute of security measures are most appreciated for bus and seat availability is most important for minibus. Train is the least expensive mode and bus and minibus have the most severe safety and security problems at present.

A key finding from (Phanikumar and Maitra, 2006) was that urban bus user's choice is also influenced by qualitative attributes as choice determinants and not just the quantitative attributes. In Hensher (2007), mode choice is studied, with new transport modes of heavy rail, light rail and a busway along the same corridor being included in the choice model for two specific trip purposes, commuting and non-commuting. In aggregating the data on trip purpose, the research aims to identify if the travel needs of the commuters are significantly different to that of the non-commuters.

Generic Attributes	**Elemental Attributes**
ACCESSIBLE (Eboli and Mazzulla, 2008) (Hensher, 2007) For existing/new public transport modes and car mode	Walking distance to the bus stop (Eboli and Mazzulla, 2008)
	Access mode, Walk time, Car time, Mini-Bus Taxi time (Hensher, 2007)
REGULAR (Phanikumar and Maitra, 2006) (Eboli and Mazzulla, 2008) (Hensher 1994) (Hensher, 2007)	Travel Speed (km/h), Waiting time (minutes) (Phanikumar and Maitra, 2006)
	Frequency (Eboli and Mazzulla, 2008)
	Waiting time (Hensher, 2007)
	Waiting time at bus shelter, Waiting time at stop (Hensher, 1994)
READILY AVAILABLE (Yeh *et al.,* 2000)	Operation (Yeh *et al.,* 2000)

EASY MOBILITY (Hensher, 2007)	In-vehicle travel time, Transfer waiting time, Egress time (Hensher, 2007)
SERVICES WORKING TOGETHER (DTPW, 2011c) (Arentze, Borgers and Timmermans, 2003)	Feeder required (Arentze, Borgers and Timmermans, 2003)
SECURE (Arentze, Borgers and Timmermans, 2003)	(Security guard availability)(Arentze, Borgers and Timmermans, 2003)
COMFORTABLE (Phanikumar and Maitra, 2006) (Eboli and Mazzulla, 2008) (Yeh *et al.,* 2000) (Arentze, Borgers and Timmermans, 2003) (Hensher, 1994)	Travel (dis)comfort, Noise level, Appearance (Phanikumar and Maitra, 2006)
	Bus crowding (Eboli and Mazzulla, 2008)
	Transit personnel attitude, Cleanliness, Comfort, Social Duty(Yeh *et al.,* 2000)
	Seat availability (Arentze, Borgers and Timmermans, 2003)
	Vehicle quality – Modernity, Seat material, Step height, Interior cleanliness, Leg room, Trip quality - Time to get a seat, Time to board bus, Express Service, Punctuality (Hensher, 1994)
RELIABLE (Yeh *et al.,* 2000)	Punctuality (Yeh *et al.,* 2000)
CONVENIENT (Eboli and Mazzulla, 2008), (Hensher, 1994)	Information (Eboli and Mazzulla, 2008)
	Convenience (Yeh *et al.,* 2000)
	Information quality: timetable, destination signs, source of timetable (Hensher, 1994)
Generic Attributes	**Elemental Attributes**
AFFORDABLE (Phanikumar and Maitra, 2006), (Arentze, Borgers and Timmermans, 2003), (Eboli and Mazzulla, 2008), (Hensher, 2007) For existing/new public	Travel cost (cents/km) (Phanikumar and Maitra, 2006)
	Fare level (Yeh *et al*., 2000)
	Fare (Eboli and Mazzulla, 2008)

transport modes and car mode	Fare (one-way), mini-bus fare, Access mode fare (one-way), Running cost, Toll cost (One way), Daily parking cost (Hensher, 2007)
ADEQUATE INFRASTRUCTURE (Eboli and Mazzulla, 2008)	Bus stop facilities (Eboli and Mazzulla, 2008)
SAFE (Yeh *et al.,* 2000)	Accident rate, average vehicle age (Yeh *et al.,* 2000)

Table 3 Bus Service attributes

(Eboli and Mazzulla, 2008) provides an example where passenger willingness-to-pay (WTP) estimates is examined for improving the quality levels of a bus service within a given bus operating budget. The implications (Ben-Akiva and Morikawa, 2002) used DCE's in two mode choice evaluations. This evaluation however presents itself in two case studies, which is not conducive to achieving the evaluation objective of reusability.

Accessible

Reviewing accessibility for existing/new public transport modes compared with the car mode, Hensher (2007) analyses the ways in which BRT could deliver levels of service that compete sufficiently well with the car to attract and retain a market segmented clientele. The author advocates rational ways of increasing the supply of public transport services. Increasing of service accessibility is studied, using access mode used, walking time, car travel time and mini-bus taxi travel time. Hensher (2007) found bus services to have shorter waiting times, compared to light rail. In (Eboli and Mazzulla, 2008), the WTP value of walking distance to the bus stop is estimated as the accessibility indicator.

Regular

Hensher (1994) hints at measures which could be used to ascertain the regularity of a transport service, including waiting time at bus shelter and waiting time at stop.

(Phanikumar and Maitra, 2006) presents marginal willingness-to-pay (WTP) estimates for various qualitative and quantitative attributes of experiencing the public bus transport service in Kolkata City, India, with marginal WTP values estimated for various service attributes, separately for commuting and non-commuting trips. Attributes considered important for a commuter included travel speed (measured in kilometres/hour) and waiting time (measured in minutes). By including waiting time there is a clear intention by the policy-makers to increase the frequency of the buses, so buses arrive to collect commuters at more regular intervals. Kolkata's public problem highlights the negative impact that higher oil prices had on the features of using the bus transportation system, which range from longer travel times, poor levels of comfort inside buses (based on crowding), poor appearance of buses (both internal and external), to high noise levels of the buses used. There are common features of the bus transportation system in Kolkata. The attribute of affordability, travel cost, is added to calculate willingness to pay estimates. The research illustrates an assessment of demand for trips based on the trip purpose, such as commuting (work and business) and non-commuting (recreation and social), and separate models are developed for estimating WTP values. Aggregating the analysis by trip purpose is used in this evaluation, as the Western Cape policy places an emphasis on the commuter.

In (Hensher 2007), a useful by-product is a new set of behavioural values of travel time savings for access, egress, line haul and wait times. The choice sets comprised all existing available main modes (i.e., subsets of bus, heavy rail, car, busway) and access modes (i.e., subsets of walk, bus, and car) plus two of the new modal options from the full set of three evaluated across the entire sample (i.e., new heavy rail, new light rail, and new busway).

Eboli and Mazzulla (2008) defined a WTP value of frequency of service, as a straight forward measure of service regularity.

Readily available

(Yeh *et al.,* 2000) uses an analytical hierarchy approach in evaluating the performance of ten bus companies. Their focus is particularly on the operations, or supply side, the results of which would serve to improve the bus operators' service. Their generic attributes are of safety, comfort, convenience, operation and social duty.

Easy mobility

The attributes of In-vehicle travel time, transfer waiting time and egress time are considered for travel mode comparison (Hensher 2007).

Services working together

In (Arentze, Borgers and Timmermans, 2003), feeder is the modal second-priority attribute and is selected in 50.6% of the cases, indicating that across individuals, the modal choices may be the same, with the only logical constraint being that the sum of shares is less than 100%.

Safety levels

The aspect of transport safety is described, where the accident rate (total number of accidents per million vehicle-kilometres) and average vehicle age is selected and average vehicle breakdown, the other attribute initially considered by (Yeh *et al.,* 2000).

Security levels

Security guard availability was the requested stated choice in (Arentze, Borgers and Timmermans, 2003), with the elements of the choice being as it is, or with guards. The study finds security is most appreciated for bus services.

Level of comfort

Hensher (1994) hints at measures of vehicle quality, an important aspect contributing to the overall comfort of the passengers. Vehicles are assessed for modernity of both functionality and comfort, from the time it takes and the step height to be endured to board a bus, from the interior cleanliness of the vehicle, time to get a seat, seat material leg room, express service and punctuality.

The Taipei Bus Administration produced specific and detailed measures for the various aspects of bus comfort, with air-conditioned vehicle rate, on-board information, vehicle cleanliness, seat comfort, driver's skills, driver's appearance, driver's friendliness being included as sub-criteria of comfort (Yeh *et al.,* 2000). The comfort criterion relates to the service level provided by the bus company and the service quality perceived by the passenger. Some of these sub-criteria are quantitative, and some are qualitative, with the latter being obtained by asking the passengers directly using structured questionnaire.

Seat availability was found to be the most important attribute for minibus-taxi mode (Arentze, Borgers and Timmermans, 2003). This is perhaps too obvious a finding to consider, as overloaded taxis would be not only illegal, but would be also almost be a pre-requisite for commuters, as the minibus-taxi vehicles allow for no standing space. Hensher (2007) analysed that buses can seat 75% of passengers compared with 25% on light rail. The attribute of seat availability is clearly an important consideration of mode choice.

During a preliminary investigation before the initial survey, (Phanikumar and Maitra, 2006) observed that the journey speed for buses is considerably low, comfort is less, appearance of buses is poor, and noise level is high. Therefore, the primary attributes of travel speed and travel cost and the secondary attributes of discomfort, waiting time, appearance of bus, and noise level were considered for the choice sets included in the study , all of which were found to have a significant effect on the choices made by the customers to use the service.

Bus crowding was also a major aspect of discomfort investigated by (Eboli and Mazzulla, 2008), which produced a WTP estimate for this service attribute.

Reliable

(Yeh *et al.,* 2000) discusses service reliability which is characterised by among other aspects, the quality of service punctuality. A novel service attribute include by (Yeh *et al.,* 2000) is that of social duty, characterised by the vehicle air pollution level and vehicle noise level.

Convenient

Hensher (1994), Yeh *et al.* (2000) and Eboli and Mazzulla (2008) discuss the aspects of convenience, albeit from various definitions of what it constitutes. Some research Hensher (1994) considered information quality, particularly addressing the service timetables, destination signs, as well as the source of timetable. Information to the users of the service was also seen as particularly important for the provision of convenience (Eboli and Mazzulla, 2008), which produced WTP estimate of this service attribute. Alternatively, convenience can be characterised to include attributes such as punctuality of the bus service, route transferability, terminal space and service reliability (Yeh *et al.,* 2000).

Affordable

Fare levels are usually included in studies to determine affordability levels. Alternatively, cost savings, which can be attributed to an efficient bus operation, also increases affordability levels. Cost efficiency, cost effectiveness and service efficiency have been widely used as performance indicators for evaluating the operational performance of public transport firms (Yeh *et al*., 2003). These measures ensure Provincial government that the operating grant spent on subsidising the bus service is receiving value for money.

(Phanikumar and Maitra, 2006), (Eboli and Mazzulla, 2008) includes the attribute of travel cost (cents/km), or fare levels, as a primary attribute to its valuation of the bus

transportation systems. As this study considers the willingness to pay, the inclusion of a financial attribute is required to complete the WTP estimates.

(Hensher 2007), in comparing the different modes of transport, relates fares (one-way) for existing public transport modes, to that of fares (one-way) for new public transport modes and the travel costs associated with private vehicle travel, including vehicle running cost, toll cost (One way) and daily parking cost.

Adequate infrastructure

In (Eboli and Mazzulla, 2008), WTP values for improvement of bus stop facilities are estimated, while Yeh *et al*. (2000) considered terminal space to be more relevant for their purposes of measuring the adequacy of infrastructure. The contrast in the two infrastructure types relates to the focus of the two studies, with Eboli and Mazzulla (2008) more concerned with the public transport users and Yeh *et al*. (2000) more concerned with a more efficient supply of operations of the bus companies.

The South African context

From a South African perspective, choice behaviour has been investigated as a means to evaluate public transport, particularly as a means to estimate service demand.

Choice experiments evaluations done in the field of public transport projects in South Africa in this regard include Arentze, Borgers and Timmermans (2003)describing the estimation results of a stated choice experiment involving the use of a focus group to determine the feasibility of applying choice experiments of transport mode for a work trip in the South-African context and Van Zyl and Hugo (2002) focusing more on the application of the choice experiment technique to evaluate modal attributes for various modes, including bus, taxi and train.

(Fourie and Lubbe, 2006) conducted studies in South Africa on factors that may influence business travellers in their selection of full-service airlines or low-cost carriers, similar to those conducted in UK and Brazil. On comparison of the studies, findings related to the influence of company size, loyalty programmes, in-flight service

and airport lounge facilities appear to coincide but some differences in conclusions drawn on the influence of variables such as price and flight frequency were evident in South Africa. Low cost carrier and full service airlines represent two modes, both consisting of attributes, investigating the differences in the attributes which impact the choice of service for the air travellers. The research aims to determine the choice factors between two types of travellers, those who are commuting and those who are travelling for leisure. Differences between the two groups are investigated, through the ranking of service attributes of the two modes. Results showed that South African travellers viewed the influence of service attributes in a similar way to the respondents in UK and Brazil, compared to other studies. Price was found not to be an important choice determinant.

In another developments in passenger transport evaluation in South Africa, (Behrens and Del Mistro, 2010) discuss the effects of life shocks, material events in one's life, on personal travel behaviour over time, where respondents in a retrospective survey which was conducted in Cape Town could easily identify salient events which occurred in their lives which influenced travel choice behaviour. The motive behind this research was to provide useful research to accommodate a post-apartheid policy shift in South Africa from supply to demand-based transport service strategies. A conclusion from this study is that choice behavioural research becomes far more accurate if one incorporates longitudinal studies data to interpret results, as these would include life changing events which would have a marked effect on travel choices.

(Behrens, 2004) reveals a real danger in the sampling bias related to transport policies which seek mainly to focus on improving the motorised modes of transport, particularly for services for commuters during morning and afternoon peak times. Using an activity-based survey which was administered in Cape Town, the findings of the research indicates that a considerable amount of non-motorised travel undertaken by the poor during off-peak periods and that there is a real risk of routine bias in the way the urban passenger transport problem is understood, with subsequent

interventions not addressing the needs of low-income households as a result. This is particularly relevant to the research problem in this evaluation, which explicitly focuses on sampling Table View commuters who use the GABS bus service during the morning and afternoon peak periods. It indicates a clear bias of this current evaluation and highlights the importance of considering its role in the perpetuation of social exclusion of the poor. The results of this evaluation and others with a similar bias would in effect not only exclude other modes of public transport, but also would not be as diverse in its capturing of the general travel choice behaviour, due to its focus on the commuter.

(Adjei and Behrens, 2012) adds to the research conducted in Cape Town on travel choice behaviour, looking specifically at the dynamics of travel behaviour patterns and what can be attributed in triggering a modal shift. The authors tests to what extent different attributes of travel choices such as mode, route and departure times are habitual and to what extent they are variable. These tests seeks to provide insight into how the travellers make travel choices and, in my opinion, provides a context to application and analysis of discrete choice models, as results which indicate that the majority of choices made are habitual in nature could invalidate the theory that travellers always maximise their utility in the travel choices made. The findings of the research seem to indicate that choices of mode use are habitual, and that sustained changes on modal shifts are triggered by the occurrence of life time events. The results indicate that mode use choices are fairly stable compared to route choice, departure and arrival times. Notably, most variability in mode choice were observed among public transport users, with on average commuters taking seven years before changing mode used for their commute. To this end, the key event changing mode choice was changes in employment and car ownership being the key event changing mode choice per occurrence. What is unfortunately not covered in the scope of this research is whether the introduction of a new mode of transport in the MyCiTi bus service could be considered a key event, sufficient enough to affect a modal shift.

2.5 Summary

Stated choice-experiments are a popular form of SC method in transportation (Hensher, 1994) and are suited to answer the evaluation questions posed

Shortcomings in the revealed preference data sets (Hensher, 1994) have necessitated investigation in stated choice techniques and combinations of revealed and stated choices. Experience as to the design and use of modal choice experiments in the context of South Africa and the Western Cape's public bus transport is still very limited. This is a crucial issue given the complexity of the choice processes undertaken by commuters, involving choices among a multitude of dimensions and the need for the Province to make decisions related to replacing the GABS service with the MyCiTi service.

(Ben-Akiva and Morikawa, 2002) used DCE's in two case studies where no evidence was found for preference for rail travel over bus when quantifiable service characteristics such as travel time and fares are equal, but bias arose when rail travel offered a higher quality service. Modal attributes that were found to be significant mode choice factors amongst private and public transport users in Cape Town (Van Zyl and Hugo, 2002)

Through the review of DCE literature, an indication is that it can be argued that where only main effects is included in analysis, particularly in its application within transport, that this would sufficiently explain most of the variation in preferences. Interaction effects would therefore be excluded from the final analysis, for the sake of simplicity.

Results of the literature review: Similar stated choice experiments particularly in the transport environment over the past 20 years were of most interest. The findings of the latest studies provide detail on pertinent application of stated choice experiments. The complexities of the South African context, relating to communication and educational barriers are discussed in section 2.5 below.

Chapter 3 Evaluation Methodology

In the previous chapters, it is explained that a need exists for there to be common ground between all stakeholders on what would constitute a public bus service which provides maximum utility, therefore necessitating a value trade-off exercise. Management is to assess multiple objectives and alternatives to meet or exceed customer needs which are to be traded-off among each other (Thiry, 2010) in a way that is reusable. Commuter values are captured based on service attributes of the GABS bus service in question. This form of stakeholder value management could therefore be used to reduce the ambiguity of conflicting needs by identifying and agreeing stakeholder needs and expectations and translating these into critical success factors that will constitute the scope of the modal change as utility curves.

3.1 Introduction

It is important to have a design when conducting evaluative research. The evaluation methodology refers to how the evaluator conducted the evaluation process in order to solve the problem and therefore, reflects the methods, techniques, tools and procedures that were used to conduct the evaluation. As discussed in Chapters 1 and2, a consultative approach of listening to and taking account of the customer views and needs, when deciding what standard of service should be followed by management in evaluation processes, Consultation with customers at minimum, should take place to confirm expectations and standards.

Modal choice models discussed in Chapter 2, which are developed from discrete choice experiments, could provide a tool to estimate modal shifts between GABS and MyCiTi by modelling aggregate demand for a particular bus service. The choice models will capture preference and sensitivity for levels-of-service with particular interest in commuters. Choice experiments are designed for unlabelled choice sets representing

two bus service choices (Service A and B) and an 'opt out' choice option. Outputs include a set of behavioural values of the service attributes selected.

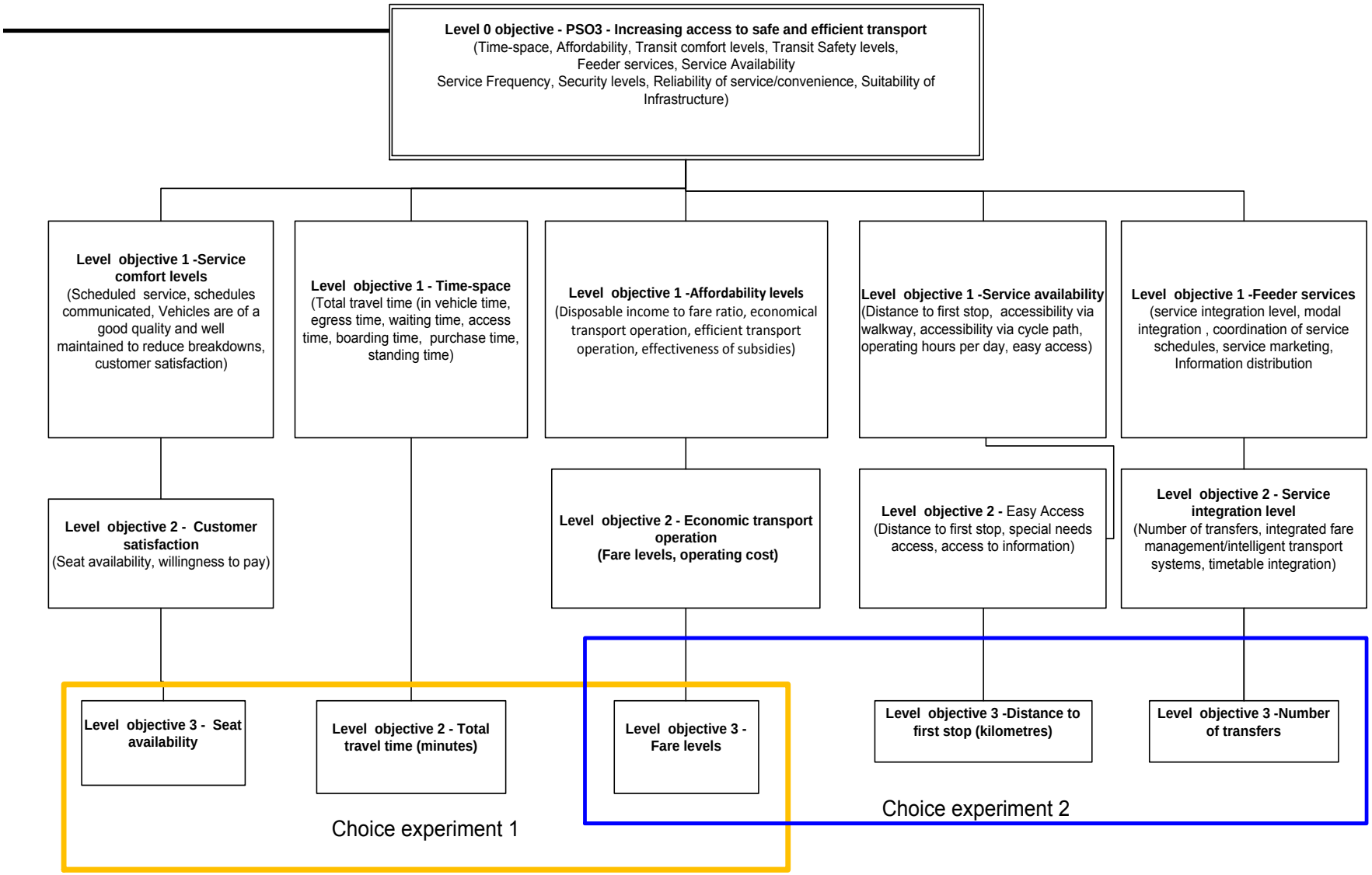

Figure 3 - Three-tiered hierarchy of objectives.

3.2 The discrete choice experiment (DCE)

A systematic literature review was conducted to identify published studies using stated choice DCE's within the public transport sector context between 2002 and 2012. The reference databases include Elsevier and Pergamon. Search words included 'conjoint analysis,' 'discrete choice experiments,' 'stated choice,' 'choice modelling,' 'choice experiments,' 'multinomial logit,' 'conditional logit,' 'rational utility theory' and 'utility curves.' Further searching included reviewing references from key journal articles as well as papers and consultant reports written for transport authorities across the world.

Studies were included if they were experimental or quasi-experimental and grounded in rational utility theory, if they were based on more than binary choice sets and if they were written in English. The connections, contradictions and gaps in the literature for each particular theme are discussed below. Extracts from the results of similar studies are critiqued in this evaluation.

This section details an approach Louviere and Hensher (1983) used in conducting the discrete choice experiment evaluation. The reason for this approach is that it provides a step-by-step qualitative evaluation method that can help identify appropriate policy responses, or service attributes, of relative importance and in relation to commuter choices. These service attributes influence the type of service they would choose and ultimately their mode choice. The approach of Louviere and Hensher (1983) is adapted and broken into the steps followed in Aizak and Nishimura (2008) to allow for the model estimation in the R statistical software package. The analysis to be conducted will incorporate a DCE framework, where an individual commuter chooses a service preference from each of the eight fixed choice sets, enabling estimation of a discrete-choice model and hence direct prediction of modal shift by aggregating individual choice probabilities. The result of the model estimation will be analysed with rational utility theory, which will provide meaning to the parameter estimations generated from running the model in R.

DCE's are a commonly used in transport evaluations, in which users of public transport are presented with alternative hypothetical public transport services consisting of a number of attributes with varying attribute levels and then asked to choose between these different scenarios in a way that requires them to make trade-offs between attributes. DCE's recreate existing markets or elicit preferences and values for the services being evaluated which currently do not exist (Lancsar and Louviere, 2008).

DCE's are grounded in utility theory, where the commuter will maximise their utility in their choices by choosing the scenario which they place the highest value on. DCE's also simulate the types of decisions that individuals are accustomed to make in everyday life.

The selected analytical method for choice data is primarily only one of the logit models. In this evaluation, we only treat the choice data using disaggregate choice model, the conditional logit. The analysis disaggregates to the individual as the basic unit of observation. Individual choice data is then aggregated, yielding a single set of parameters (coefficients) describing the choice behaviour of the commuters.

Step 1: Identification of the set of attributes for inclusion in the discrete choice experiment (DCE).

This step involves the identification of the service characteristics, or attributes, which are to form the independent variables of eight choice sets. These attributes and their levels of output would provide the basis for the customer valuation of the service and are considered when choosing between GABS and MyCiTi modes. In the majority of empirical studies, methods employed for performing this task have tended to revolve around either focus groups, interviews, unscientific syntheses of previous studies or even merely the feel or hypotheses of the researchers (Cullinane and Toy, 2000).

The attributes and levels describing the scenarios in the choice tasks were initially identified through a review of existing literature and policies and through interviews with the Supervisory Monitoring Firm. Now having a basis for a conceptual model of the two transport services, a meeting was held with a Supervisory Monitoring Firm, responsible for monitoring the GABS bus

service according to agreed timetabled services. Specific policy attributes (See Table 3 in Chapter 2) are selected relevant to commuters' decision model which it would use in selecting between the two modes.

For the purposes of the evaluation, each bus service is identical, except for the specific attributes selected and outlined in Table 4 and the attribute levels in Table 5 below.

Generic Attribute	Specific Attributes
Easy mobility, regular	Travel time-space
On board Comfort	Seat availability
Affordability levels	Fare levels
Easy mobility	Distance to the first stop
Feeder services working together	Amount of transfers

Table 4 - Specific service attributes and their generic service attributes counterparts

These specific attributes are the policy changes that to be assessed. A quasi-experimental approach is adopted in the design of SP experiment for the analysis of main effects. In a main-effects model, the travel time effect is the same at the different fare levels and the fare level effect is the same forth different travel times. Attributes selected are a combination of quantitative (e.g., fare levels, travel times) and qualitative (e.g., seat availability).

Attribute	Possible Changes to attribute levels
Travel time	Change in timetable/service might increase travel times
Seat availability	Change to the timetable service might reduce availability of seating for some customers
Fare levels	Costs of fares vary between MyCiTi and GABS service and vary within the services depending on peak/off-peak service.
Distance to the first stop	Distance to the first stop might increase due to service changes.
Amount of transfers	Number of transfers between trips might increase due to service change to MyCiTi.

Table 5 - Specific service attributes and their generic service attributes counterparts

Research in stated choice consumer transport mode choice decisions frequently revealed interactions among such attributes as travel time, fare, walking distance to/from stops and frequency of service (Louviere, Hensher and Swait, 2000). For the purposes of this choice experiment, service attributes not selected from Table 5 for inclusion in the choice sets are considered *ceteris paribus*. In reality however, this would not be the case as safety levels, feeder services etc., would almost certainly differ between the services. The objective here is to capture those service attributes which would be integral to the modal choice of the commuter.

A hierarchy of objectives is established to ensure a logical link between Provincial Strategic Objective 3. Bus services have real physical properties and these are represented by service characteristics, or attributes. Service attributes are set out for the desired service levels (DTPW, 2011c). These attributes are linked to the provincial strategic objective via a two tier objective hierarchy, which is selected for this evaluation (See Figure 4).

Step 2: Selecting measurement units for each attribute.

It is important to note that the GABS service has the more favourable attribute levels of the two services in all attributes, with the exception of the distance to the first stop, as this attribute is largely beyond the control of the operators. It is therefore an expectation that the commuters would prefer the GABS service, based on attribute levels only. In reality however, the MyCiTi bus services operate new vehicles, has more security features, a smartcard payment system and brand recognition amongst other attributes not selected that could play a key factor in the modal choice. Scale Parameters from real world observations of the GABS and MyCiTi service, discussed in the attribute selection meeting with the Supervisory Monitoring Firm of the bus service are detailed in Table 6 below.

Attribute	Units of measurement	Levels
Travel time	Minutes duration of total travel time	35min/45min/60min
Comfort	Seat availability during trip	Yes/No
Fare levels	Amount of Rands per trip	R7.50/R9.00/R10.00/R15.00
Distance to the first stop	Kilometres (km) walked/driven/other	1/2/3
Amount of transfers	Number of transfers between trips from one vehicle to the other	None/2/3

Table 6 - Attribute units of measurement

An unlabelled mode-specific approach is used to model the attribute mix of Service A and Service B.

Step 3: Specification of the number and magnitudes of attribute levels.

One challenge to the respondents of the survey is to be asked to evaluate a service which has not yet been used, namely the MyCiTi. When new alternatives are being evaluated, making the attribute levels believable and deliverable to the respondents becomes a primary consideration of the evaluator (Hensher, 1994).

Full-factorial designs allow you to estimate all main effects and all possible interactions. As the full factorial design would take too long for respondents to complete, a fractional factorial design is used to generate existing GABS and MyCiTi scenarios of service levels as a future modal option, which will have fewer runs than full-factorial design. Fewer runs is could create the problem that effects becomes confounded, making them indistinguishable from one another. All possible attribute numbers and levels are set out in the table 7 below; with the 2^3 x 2^3 attribute profile, preferred due to it being less complex for the respondent.

Task type		Factors	
# Alternatives	# Attributes	Choice set	Attribute Profile
2	3	3	2^3 x 2^3
2	5	3	2^5 x 2^5

Table 7 - Experimental design specifications for main effects

For this evaluation, a fixed choice set design approach is taken, where the number of alternatives (Service A, B, or 'neither of the two', which is Option 'C',) is always the same throughout all eight choice sets of the experiment. Fixed choice set designs are the most common type of SC application in the transportation research (Toner *et al*., 1999) via (Sanko, 2001)

Choice sets consist of alternatives, attributes and attribute levels that are available to the respondents to choose between, per choice. DCE sets out three requirements for choice sets:

- The set of alternatives must be made exhaustive by including all the possible commuting alternatives. The respondent therefore has to choose an alternative from the set.
- Alternatives must be mutually exclusive, where the respondent chooses only one alternative from the choice set.
- Choice sets must contain a finite number of alternatives, distinguishing the discrete choice analysis from forms of regression analysis with infinite number of values for the dependant variable (Train, 2009).

In this evaluation, the choice set for a respondent that needs to decide on a particular mode of transport to take to work could hypothetically include using their current preferred mode of transport, the GABS bus service, or any other transport service available to them, given their financial constraints. This includes a multi-modal trip using the MyCiTi bus, a minibus taxi, cycling and the private vehicle. The option of a multi-modal trip, such as driving a car to a MyCiTi bus station and then taking bus to work adds further complication to the choice model. In this evaluation, of interest are the GABS and MyCiTi bus services, the two primary modes. A

third option is added, 'Neither of the two services,' which represents all the other modes, to make the choice set exhaustive. Respondents may however opt out to avoid making a difficult decision, providing less information their relative preferences (WHO, 2012)

In the first fractional factorial, respondents' preferences towards fare levels, travel time, and seat availability is captured, fares on three levels and the other two attributes each with two levels. In the second fractional factorial, respondents' preferences towards fare levels, distance to first stop and number of transfers is captured, with fares again on three levels and the other two attributes each with two levels.

A full factorial is created, using R- statistical software (R Foundation, 2012) and thereafter, a fractional factorial is then created from the full factorial.

Full factorial 1

Scenarios	Attributes		
	Seat	Travel time (minutes)	Fare price (in Rands)
1	YES	35	R7.35
2	NO	35	R7.35
3	YES	45	R7.35
4	NO	45	R7.35
5	YES	60	R7.35
6	NO	60	R7.35
7	YES	35	R9
8	NO	35	R9
9	YES	45	R9
10	NO	45	R9
11	YES	60	R9
12	NO	60	R9
13	YES	35	R10
14	NO	35	R10
15	YES	45	R10
16	NO	45	R10
17	YES	60	R10
18	NO	60	R10
19	YES	35	R15
20	NO	35	R15
21	YES	45	R15
22	NO	45	R15
23	YES	60	R15
24	NO	60	R15

Fare levels which represent Service A (existing bus service)

Fare levels which represent Service B (expansion of new proposed bus service)

Full factorial 2

Scenarios	Attributes		
	Walking distance to stop (km)	No of transfers	Fare price (in Rands)
1	1	None	R7.35
2	2	2	R7.35
3	1	2	R7.35
4	2	None	R7.35
5	1	2	R9
6	2	None	R9
7	1	None	R9
8	2	2	R9
9	1	None	R10
10	2	2	R10
11	1	2	R10
12	2	None	R10
13	1	2	R15
14	2	None	R15
15	1	None	R15
16	2	2	R15

Fare levels which represent Service A (existing bus service)

Fare levels which represent Service B (expansion of new proposed bus service)

Table 8 - Full factorial designs

The full factorial array is designed with properties of orthogonal array; with service attributes that are statistically independent each other and exhibits level balance, or attribute levels which appear an equal number of times. As can be seen above, the full factorials meet the criterion of being level balanced, ensuring that all levels have an equal chance of being chosen. If used, all the possible effects of both main and interactions could be estimated.

The fractional factorial, which was randomly generated from the full factorial is however not an orthogonal array due to imbalance, not an optimal design and could therefore contain possible correlations between factors. Some possible attribute-level combinations could be implausible or inconsistent with rational choice. Illogical combinations could increase the potential for hypothetical bias, unobserved, heterogeneous interpretations by respondents and lower response efficiency.

Step 4: Statistical design.

The statistical design of the DCE includes the construction of hypothetical alternatives and choice scenarios presented to respondents. The statistical design of the evaluation should allow for interrogation of stated choice data of those who use the bus service to commute, as well as for analysing for gender-specific choices made by the respondents. The statistical design steps achieves this by combining attributes and attribute levels into a DCE and supplement this data with data about the respondents.

The utility equation.

An interpretation of the data on individual choices is provided by the random utility theory model. Utility is broken down into 2 components, V and ε.

$$\left(U_{ni} = (\beta V_{ni} + \varepsilon_{ni}) \right) \quad \text{.....utility equation}$$

Where,

i refers to the mode (GABS, represented by Service A or hypothetical MyCiTi, represented by Service B),

n is the decision-maker, or individual

U is the overall utility of choice i for commuter n,

β is a corresponding vector of coefficients of the observed variables

V is the systematic or measurably utility which is a function of x_n and i for commuter n and choice i

ε includes idiosyncrasies and taste variations, combined with measurement or observations errors made by modeller, and is the random utility component.

The decision maker n chooses the alternative (Service A, B or 'Neither of the two services') from which he derives the greatest utility, allowing the evaluator to assign a utility curve to each individual.

U_a represents the utility of choosing travel mode Service A, and U_b that of Service B. The observed choice between the two reveals which one provides the greater utility, but not the unobservable utilities (Greene, 2003).

In this binomial choice case, the decision-maker, commuter n, chooses the travel mode Service A alternative if and only if:

$$\left(\text{or when:} \quad \begin{array}{l} U_{an} \geq U_{bn} \\ V_{an} + \varepsilon_{an} \geq V_{bn} + \varepsilon_{bn} \end{array} \right)$$

The completion of the model for the determination of the observed outcome, or modal choice, is the revelation of the ranking of the preferences by the choice the individual makes (Greene, 2003).

The base alternative.

'Neither of the two services' is a third alternative present in each choice set and serves as a base alternative. The 'Neither of the two services 'option is a constant in each choice set and

provides a convenient way of coding a base alternative. As a base alternative in all choice sets, an estimation of a single CL model is possible. The design approach ensures orthogonality when a constant base alternative is used in every choice set. The estimation approach, however, introduces correlations into the design matrix by the use of choice-set dummy variables and alternative-specific dummy variables. (Louviere and Woodworth, 1983) reports that the estimation properties are scarcely affected by this method.

The evaluator does not possess complete information about all elements considered important in the decision making process by all individuals making a choice. The error term,ε, therefore allows for a couple of important cases: Two individuals with the same measured attributes and facing the same choice set make different decisions. Some individuals do not select the best alternative in terms of utility maximisation. This represents the stochastic elements that are specific to and known only by the individual, but not by the evaluator (Greene, 2003). It might therefore represent an intangible, general preference for a particular travel mode.

An alternative to (Thurstone, 1927) assumption that the error term is normally and identically distributed is to assume independent and identically distribution, which yields the multinomial logit model (MNL). CL models are appropriate when the choice among the alternatives is modelled as a function of the characteristics of the alternatives. The logit model in this evaluation will represent the log ratio of the probability of commuters choosing a bus service, the aggregation of individual choice probabilities. The conditional logit (CL) model, an extension of the MNL, assumes that the error term (ε) in the utility equation, exhibits the extreme value distribution.

Main effects design.

Selecting orthogonal main effects plans from the factorial generally will lead to a logical selection of a small number of choice sets that will permit estimation. An important limitation of these main effects plans, however, is that they allow no tests of the CL model because most rejection tests require the estimation of cross-alternative interaction effects. The orthogonal, main effects, fractional factorial designs proposed generally produces more accurate parameter

estimates than the all-pairs design for the same number of subjects while requiring fewer responses per subject (Louviere and Woodworth, 1983).

In consideration of the statistical design of the experiments for the evaluation, the factorial design for main effects level of analysis was the optimal design planned for. A factorial design allows for the analysis of the effects of multiple independent variables, represented by the service attributes, on the dependent variable, which is in this case, the modal choice made by the commuters, in particular.

A three-way quasi-experimental design chosen is so characterised by the number of independent variables or service attributes, the number of levels of each independent variable and whether the independent variable chosen is for a within-subjects or between subjects design. In this evaluation, there are three independent variables for each fractional factorial designs, which is therefore a three-way design. The independent variable in both fractional factorial designs are within-subjects (or repeated measures) design as opposed to a between subjects design, as each commuter is exposed to the same choice sets, which are then compared during analysis to ascertain which service attribute had the greatest effect on the choice of mode. The experiments exhibited a before treatment (Service A) and an after treatment (Service B, the hypothetical IRT rapid bus service), with the commuters stating their preference for their particular service. This evaluation would like to establish if the commuters will choose Service B, as this could be an indication that introducing a MyCiTi service would not increase customer satisfaction. Generally, the within-subjects design does not require half the sample size that of a between-subjects design (Sanko, 2001). Drawbacks of using a within-subjects design include the carryover effect as well as respondent fatigue. Respondents experience both fatigue and the carryover effect when taking part in one choice scenario impacts performance or behaviour on the seven other choice scenarios. The first two days of data collection took place with a specific focus on testing the survey instrument to detect carryover effects with the respondents and to ascertain whether these would materially affect the quality of the data collected.

Further design problems faced and which need to be addressed when using factorial designs include the use of a full factorial design which could produce too many choice scenarios. In the case of an orthogonal array, the standard errors of parameter estimates would be low. Full factorial designs however, is not a practical approach for this evaluation, as it would require too many choice sets for the respondent to complete and take too long. In the full factorial design1, it can be seen that there are 24 (or $4^1*3^1*2^1$) scenarios which represent the different service mixes, and 16 scenarios (or, 4^1*2^2) for full factorial design 2. The second major problem in the full factorial design is dominant scenarios, which are always chosen.

To address these design problems, a fractional factorial is randomly generated from the full factorial designs (Aizak and Nishimura, 2008), using a random generator function in R software. This fractional factorial design used needs ensure that the attributes which are presented to respondents are varied independently from one another, avoiding multi-colinearity between attributes. The result is that the effect of each attribute level upon responses is more easily isolated. Experimental designs are not all equally good, and a measure of statistical design goodness is called efficiency. The randomly generated fractional factorial is not optimal in the orthogonal sense. It is therefore important to use linear-model design efficiency to make choice design

Each fractional factorial design chosen consists of four scenarios, which provide a total of 32 observations per respondent. An attribute profile of 24 scenarios ($4^1*3^1*2^1$) for fractional factorial 1 and 16 scenarios (4^1*2^2) for fractional factorial 2 is selected.

The choice experiment will be conducted in surveys on the following nine geographical market segments, during morning and afternoon commuting times:

Killarney to City – via Parklands	Killarney to City – via Marine Drive	City to Killarney – via Parklands
Killarney to City – via Montague Gardens	City to Atlantis – via Milnerton	City to Killarney – via Marine Drive

Table 9 - Route Market segments Morning and afternoon peak times:

Furthermore, policy requires that this evaluation 'be gender sensitive and adequate mechanisms of consultation, implementation and evaluation must be employed' as well as focusing on a specific public transport customer, the commuter (DTPW, 2011c:20).

Step 5: Questions and choice-cards for execution in the data collection phase.

Factors considered in the design of the response form include a choice between a ranking design, rating, choice or degree of preference. Choice data was selected for this evaluation to be analysed for choice preferences and behaviours.

The structure of the interview consists of two main parts, the collection of demographic data and the collection of stated choice data. The population is defined as all the commuters in the Table View area, who travel to and from Cape Town on their commute and who currently use the GABS service. Sample to be collected:

Variable	Number (%)
Total sample	Number of persons interviewed
Total observations	X number of observations.
Gender	1, male, 0, female
Age (years)	<15/15–25/ 26–40/ 40–60/>60
Trip purpose	Work/Other
Concessionaire	Pensioner/Scholar/Other
Stop of boarding bus service	Stop name
Stop of alighting bus service	Stop name
Final destination	Destination name

Table 10 - Sample Summary Statistics

An estimated sample size *n* is calculated, with a 95% confidence level, i.e. 1.96:

$$n = \frac{1.96^2 \, x \, 0.5}{8 \, x \, 0.5 \, x \, 0.10^2} \approx 48$$

Since two modes are coded in the choice set, *p*= 0.5, which makes *1-p* =0.5. Eight choice sets will be used, and a 10% margin of error on *p* is provided for. A total of 48 respondents are thus required for this evaluation. Taking into account the number of interviews required to return statistically significant results, on the basis of previous surveys by CoCT and the high expected response rates, a sample of 92 individuals was interviewed on-board the bus using a systematic sampling approach stratified by route and time, so that the data offered results representing the commuter population along these particular routes.

All of the policies that will be tested will be on the current GABS bus services in the morning and afternoon peaks between Table View and Cape Town CBD,

A total of eight designs of the questionnaire were originally drafted for this evaluation. Design #1 was selected to be used with the following attribute service mix.

Fractional factorial 1	Question 1		Question 2		Question 3		Question 4	
Attributes (Unit)	**A**	**B**	**A**	**B**	**A**	**B**	**A**	**B**
Seat availability	NO	NO	YES	NO	YES	NO	NO	NO
Fare (Rand)[2]	R9	R10	R7.35	R15	R9	R15	R7.35	R10
Total time (hr.)[3]	45 min	35 min	45 min	35 min	45 min	45 min	60 min	45 min
Fractional factorial 2	**Question 5**		**Question 6**		**Question 7**		**Question 8**	
Attributes (Unit)	**A**	**B**	**A**	**B**	**A**	**B**	**A**	**B**
Fare (Rand)[2]	R9	R9	R15	R9	R7.35	R9	R10	R7.35
1st stop distance (km)	3 km	1 km	1 km	1 km	3 km	1 km	1 km	2 km
Number of transfers	2	2	2	2	None	3	2	3

Table 11 -Choice card designs

The experiment includes eight scenarios where the respondents are asked at each scenario, 'Which of these Service would you choose?' The choices made in the choice games are between alternatives, of which there are three, 'Service A,' 'Service B' and 'Neither of the two services.' This experiment is 'in-product' and therefore does not reveal the GABS and MyCiTi brands to the respondents.

Supplemental demographical information is gathered from respondents, with a basic questionnaire that elicits personal information. Information in three important domains was collected: demographics, including sex and age, as well as information about their trip such as purpose of trip, the boarding and alighting bus stops used and the final destination. For this reason, six supplemental questions were asked prior to conducting the choice experiment.

Data collection took into account four primary considerations, namely costs, data quality, duration, and manageability. Each of these considerations is affected by the selected method of data collection, namely on-board bus interview surveys. Four survey workers were used in the Directorate Departmental Monitoring and Evaluation from the Department of Transport

and Public Works. They were recruited as part of the mandate and job responsibilities for the Department. Training was conducted by the author, which consisted of a detailed explanation of the survey instrument, a discussion on survey worker code of conduct and on-the-job training where supervision was provided during interviews which took place at a designated bus stop in the City of Cape Town CBD. Two survey workers were deployed in the field to cover the Table View to Cape Town CBD bus routes, during both the morning and afternoon peak periods. Since the bus operator was aware of the survey being conducted, the bus driver was accommodating to the needs of the survey workers and their safety. Due to only two major survey workers, the quality of the work could be closely monitored to ensure that the survey data capture instruments were being completed correctly. Due to direct contact between survey workers and the GABS bus users, friendly, courteous, and engaging survey workers can achieve response rates equal to or greater than response rates for other types of surveys. Survey workers also provide an added benefit of being able to answer questions and assist respondents as necessary.

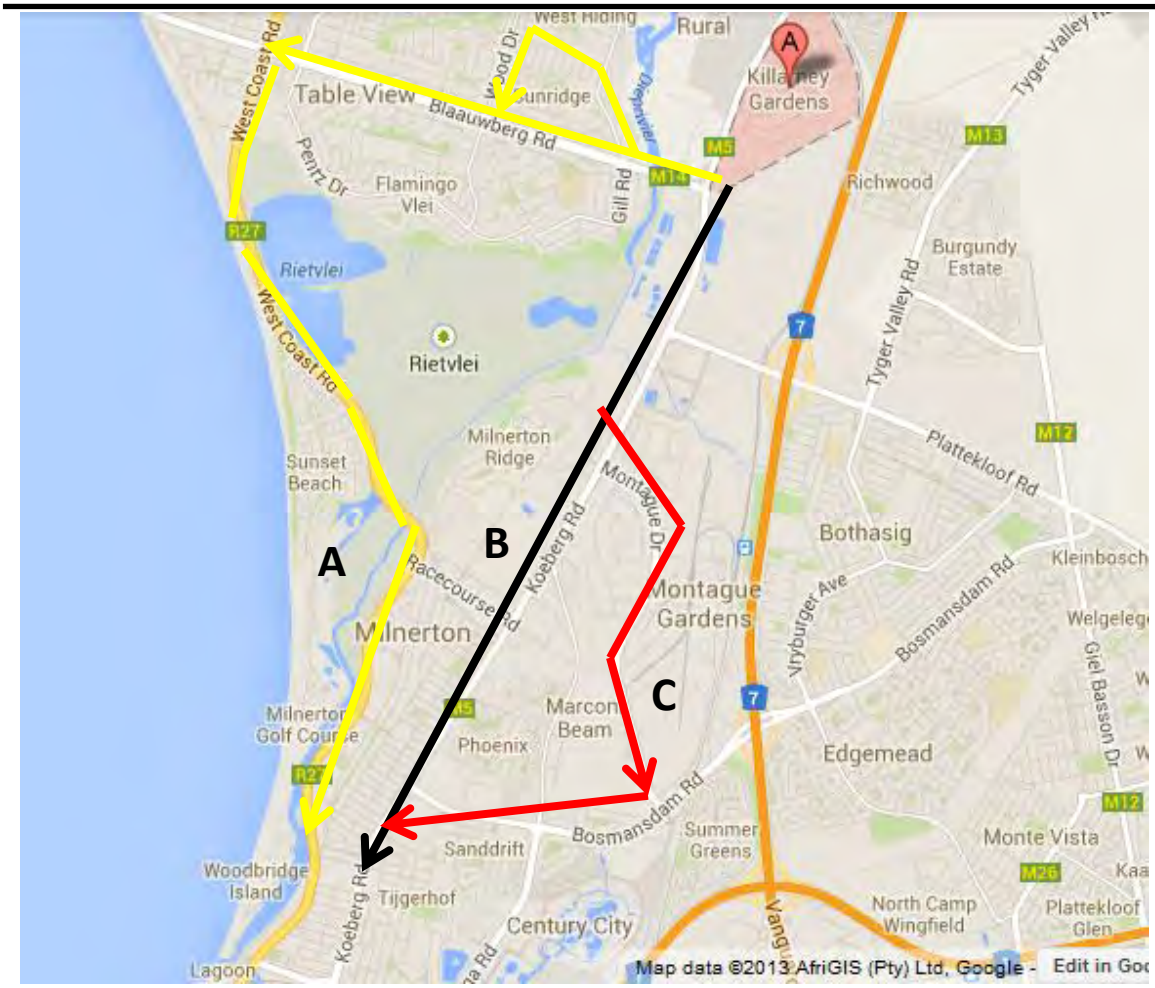

Figure 4- The surveyed routes (Killarney bus terminus to Cape Town CBD)

A – Killarney to Cape Town CBD via Marine Drive
B - Killarney to Cape Town CBD via Koeberg Road
C - Killarney to Cape Town CBD via Montague Gardens

The main data collection activities took place between February and March 2012, where bus passengers were interviewed on board the bus, during the morning and afternoon peak periods. No incentives were given for the respondents to complete the survey questionnaire. Surveys were administered manually during the respondent interview, using a printed choice card and data capture sheet. Before beginning the DCE, all respondents were given an introduction by the interviewer, to introduce the choice games they were about to play.

Respondents were then first asked the six demographical and trip-related questions and then were to make the eight hypothetical service choices, taking into account only the attributes described. Respondents then made the eight choices at their own pace, with the assistance of the interviewer, while the interviewer captured their choices on the data capture sheets. Each interview took on average five minutes. All respondents provided consent before participating in the evaluation. All questions and DCE scenarios were presented in English, with the exception of four respondents, who preferred the Xhosa choice cards.

CBD Inbound Bus route (morning peak)	**Day 1**	**Day 2**	**Day 3**	**Day 4**	**Day 5**	**Day 6**	**Day 7**
Killarney to City – via Marine Drive	8						
City (Dorp Street to City (Civic Centre)		12					
Killarney to City – via Montague Gardens			5			6	
Killarney to City – via Parklands				7		9	
Blaauwberg to City CBD via Killarney					8		8
CBD outbound Bus route (afternoon peak)	**Day 1**	**Day 2**	**Day 3**	**Day 4**	**Day 5**	**Day 6**	**Day 7**
City CBD to Killarney – via Marine Drive	10					10	
City CBD to Killarney – via Parklands							
City CBD to Atlantis – via Milnerton			6		7		7
City CBD to Atlantis via Killarney				7		7	
TOTAL (92)	**18**	**12**	**11**	**14**	**15**	**7**	**15**

Table 12- Schedule for the DCE conducted

The first bus on arrival at the bus terminal at the scheduled time was taken. Survey staff must be recruited and trained. Supervision and monitoring must be arranged for geographically dispersed survey workers.

Step 6: Select an appropriate estimation procedure.

The choice of which econometric estimation procedure to use is vast. As a non-parametric estimation, strong assumptions are relaxed, but at the cost of weakening the conclusions that can be drawn from the stated choice data (Greene, 2003). Appropriate choice models are

sometimes able to predict with some accuracy how individuals would react in a particular situation. The outputs from the analysis are mathematical functions whose parameters are precise descriptions of the strength of the relationship between a given services attribute and the likelihood of that service being selected from its competitors. The logit model uses the standard logistic probability distribution function. The estimation procedure selected for this evaluation the conditional logit (CL). The CL can be used to evaluate problems with unordered categorical (nominal) dependent variables that have three or more categories.

The maximum likelihood estimation (MLE).

The estimation for a CL is commonly performed using the statistical method of maximum likelihood estimation (MLE). It estimates a CL model by maximising the conditional likelihood. The CL MLE is solved by the following maximization problem (McFadden, 1974)

:

$$\beta = \arg\max_{\beta} \log\left(\prod_{i=1}^{N} L_i\right) = \arg\max_{\beta} \sum_{i=1}^{N} \log(L_i)$$

$$L_i = \frac{\exp\left(\sum_{t=1}^{T} y_{it} x_{it} \beta\right)}{\sum_{\sum_{t=1}^{T} d_{it} = \sum_{t=1}^{T} y_{it}} \exp\left(\sum_{t=1}^{T} d_{it} x_{it} \beta\right)}$$

Figure 5 CL maximization problem

An assumption is made that the necessary conditions for optimality properties of maximum likelihood estimators are met.

This analysis that will be conducted on the estimation will employ the CL model as a forecasting device. Because of the computational simplicity, the CL is a primary focus of attempts on functional generalizations (McFadden, 1974). Hensher (1983:8) states however that *'parameter*

estimates from this model will be consistent but confidence intervals about the parameters will be incorrect; hence, significance tests are to be interpreted very cautiously.'

The probabilities describing the possible outcomes of the choice experiment are modelled, as a function of the explanatory (predictor) variables (or service attributes), using a logistic function. In the CL model, independent variables are service attributes of the choices

In this evaluation, an individual makes a multinomial choice among more than two choices, which provides the greatest utility, thereby maximising it (Greene, 2003). Multinomial choice allows a rich specification of consumer preferences, in which the observed response is simply a label for the selected choice. We will assume that the GABS commuters will act rationally, therefore maximise their utility, which is subject to prices and travel budget constraints. The CL model form is commonly used as it is a good approximation to the economic principle of utility maximisation. Although MLE is considered to be consistent and will therefore produce good estimates given a large number of samples, using an MLE does come with drawbacks. Sample sizes that are too small produce bad or inaccurate estimates. The method also does not allow the incorporation of any additional knowledge one may have about the values of unknown parameters and the final estimations of the parameters are determined by the data alone.

The independence from irrelevant alternatives (IIA) assumes that the probability ratio of individuals choosing between two alternative services does not depend on the availability or attributes of the other alternatives. Although realistic in some situations, in general, however, it is argued that the IIA assumption is too restrictive, especially when the number of alternatives in the choice set is large such as the different modes of transport available to commuters. Where IIA is a reasonable approximation of reality, simple discrete choice produces good forecasts. Violating the assumption of IIA may however lead to incorrectly predicted probabilities of modal choice. As an example to this, the official forecast of projected Bay Area Rapid Transit (BART) ridership was 15%, (McFadden, 2001) reports a projected share of 6.2%, made and the actual ridership amounted to 6.3%. Consideration must be given in the possibility that the model may overestimate the probability of choosing GABS, while at the same time underestimating the probability of choosing MyCiTi.

Influencing factors and limits of the evaluation – data validity investigation.

Since a select number of service attributes were chosen to represent the two modes, key variables in deciding between the GABS and a hypothetical MyCiTi modes could have likely of have been omitted. DCEs can rarely include all of the important service attributes, but it is important that the most important ones relevant to the majority of respondents are included. If this is not the case, respondents can make assumptions about excluded attributes, which can affect the validity of the experiment. This could be considered a material if inferences are drawn from fractional factorials. It is also important to note that the choices could have varied if the commuters were asked to choose between GABS and MyCiTi directly. It is relevant and not unlikely that the idea of using a MyCiTi new bus, with a new service, the use of a smartcard, a new brand and new fare rules could all influence the perception of the choices offered to the respondents. Variations in the choice set could also possibly have a significant effect on the model estimation, for e g. and option of 'Either of the two services' could have been included, which would bring another dimension into the preference estimates and choice behaviour.

Furthermore, it is important to state that estimation issues can arise when determining the sensitivity of the service attributes and ultimately, the elasticity of demand for services based on the estimates for the service attributes. The DCE requires substantial knowledge and testing to not only select the appropriate attributes, but also to correctly estimate the interval used to specify attribute levels.

If the attributes in the fractional factorial design displays high levels of multi-colinearity between each other, it is not possible to identify what attribute is driving preferences and the CL model could possibly not run and produce results (WHO, 2012). For the purposes of this evaluation, it is assumed that the goodness of fit of the CL model is acceptable and that there is minimal confounding between attributes.

The precision of a survey is determined by the amount of error created in the process of taking a sample and conducting data collection. Sampling error, which arises from surveying a sample of the evaluation population rather than the entire population, is often the focus of discussion

of survey error issues. Most notably in this context, is that only GABS bus users were surveyed, to the exclusion of other members of the population in Table View. This sampling strategy could present material flaws in the overall choice preferences generated for the GABS and MyCiTi bus services.

The questionnaires were piloted to a sample of 10 commuters in order to assess which type of questionnaire was more likely to be accepted, whether the sample understood the questionnaire, whether the responses were internally consistent and whether the experiment didn't take into account other relevant attributes. Three respondents identified other attributes which they felt may be important such as the passenger safety and the service reliability or whether the bus is on time. Apart from these last two, no other attributes different from those included in the DCE were considered as relevant.

Step 7: Choice Probabilities.

'*Statistical analysis of DCE data is based on the random utility model* (WHO, 2012:43).' In probabilistic terms, the probability that hypothetical MyCiTi or IRT bus service, or 'Service B,' is chosen is given by:

$$\begin{aligned} \Pr(\text{Service B}) &= \Pr(U_B \geq U_A),\ A \neq B \\ &= \Pr(V_B + \varepsilon_B \geq V_A + \varepsilon_A),\ A \neq B \\ &= \Pr(\varepsilon_B - \varepsilon_A \leq V_B - V_A),\ A \neq B \end{aligned}$$

Given β, the choice probability is the probability that the random terms, εnj − εni is less than β. The choice probability depends only on the difference in utilities between alternatives, not on the absolute level of utilities.

The conditional logit model is selected for the parameter estimation. These parameter estimates, or coefficients, will be analysed and used to identify preferences for service attributes and to determine how GABS bus users are willing to pay for service improvements. An attempt will be made to determine the probability of commuters using a bus service with specific service attribute levels.

When determining the probability, an assumption has to be made about the distribution of the error term E, with the conditional logit assuming a logistical regression form (WHO, 2012).

3.3 Ethical considerations.

The ethical guidelines adopted for this evaluation considers the internal values from the Department. The corporate ethical values of the Department are Caring, Compassion, Accountability, Integrity and Responsiveness (DTPW, 2011c). Ethical issues identified were addressed with: consent by the commuters for the interview to take place. Openness of the interviewer with the survey was demonstrated in sharing with the commuters the purpose of the survey and the intent of generating results.

The data generated from this survey is also completely anonymous and not traceable to any of the respondents.

3.4 Summary.

In this chapter the DCE evaluation methodology for conducting the evaluation was described. All the methods, techniques and procedures followed to solve the evaluation problems were explained and justified. The manner in which the collected data was analysed also received attention. Measures to ensure that the collected data were valid and reliable during the on-board survey were given. The following two chapters will present the findings for the two evaluation questions using the data collected.

The evaluation of various policies and market segments with a stated choice model will explain where the value added services are and whether a decision to reduce the GABS service would increase commuter utility and fulfil the vision of the Western Cape Government. It would predict whether the policies aimed at rescheduling the seven markets segments to optimally integrate the MyCiTi and GABS services would achieve a certain level of success in relation to customer satisfaction.

The progressive elaboration of the choice modelling across larger sample sizes would identify all the service attributes that are liked and/or preferred by their consumers and would include

more data about previously known choice determinants which could not be accommodated in the conditional logit model estimates.

The challenge is to capture these service attributes in the bus service to consistently provide the consumer with the same quality of service that would affect a sufficient modal shift. This evaluation also revealed that the seat availability of the bus service must be readily available for the commutes longer than 45 minutes.

Chapter 4 Findings of stated choice data for bus services by trip purpose and gender

4.1 Introduction

The purpose of this chapter is to summarize the collected data and the statistical treatment for an analysis in response to the evaluation objectives two and evaluation objective three. It details the findings generated from the data collected on-board the GABS buses. The presentation of the data completes the *data collection phase of DCE step 5* and *DCE step 6: Select and appropriate estimation procedure*. The data collection (a schedule for the choice experiments conducted is presented Table 13 and 14) and formatting is detailed in section 4.2. The bulk of the raw data collected and formatted is in Appendices 4 to 8.

Demographic and choice behaviour data will be presented in section 4.3, beginning with choice and demographic profiles of GABS passengers (Table 15) and a summary of survey stated choice responses (Table16). This is followed by the CL model estimations in section 4.4.

4.2 Data collection and formatting

Data collection for the DCE was took place and in turn was then processed on a sample of 92 commuters who use the GABS service to make a return trip from Table View to Cape Town CBD (See Tables 13 and 14).

Two fundamental goals drove the collection and formatting of the data and the subsequent data analysis:

- The increasing importance of flexible and time-responsive methods in public transport evaluation, capturing heterogeneity in commuter preferences in order for it to be considered as part of the design a bus service which can maximise utility for its users. This necessitates an evaluation process which can ensure a balance of commuter

preferences are captured, over a broad array of discrete choices within a target population.

No of Commuters	Route Name	Trip length	Point of origin
5	Killarney to Cape Town CBD via Koeberg Rd	Short	Brooklyn
1	Killarney to Cape Town CBD via Koeberg Rd	Short	Rugby Cambridge
1	Killarney to Cape Town CBD via Koeberg Rd	Medium	Milnerton
3	Atlantis to Cape Town CBD via Killarney Gardens	Long	Atlantis
5	Killarney to Cape Town	Long	Table View
5	Killarney to Cape Town CBD via Marine Drive	Long	Parklands
2	Killarney to Cape Town CBD via Marine Drive	Long	Blaauwberg

Table 13- Routes surveyed Cape Town CBD inbound morning peak: 5h35 and 7h00

No of Commuters	Route Name	Trip length	Outbound Destination
4	Cape Town CBD to Killarney via Koeberg Rd	Medium	Milnerton
6	Cape Town CBD to Killarney via Montague Dr	Medium	Montague Gardens
5	Cape Town CBD to Atlantis via Killarney Gardens	Long	Atlantis
9	Cape Town CBD to Killarney	Long	Table View
1	Cape Town CBD to Killarney via Marine Drive	Long	Melkbos
5	Cape Town CBD to Killarney via Marine Drive	Long	Parklands

Table 14 - Routes surveyed Cape Town Central Business District outbound afternoon peak: 15h00 and 16h30

- Secondly, to provide policy-specific feedback to policy implementers, service preferences of different GABS bus users were obtained, with the emphasis on

distinguishing the findings of the commuters and women, as well as the relative importance assigned by respondents to various service attributes.

Tables 13 and 14 presents detail of the routes and trips surveyed, particularly the commuters along the affected areas, which constitutes 79% of all the commuters surveyed. As the main affected routes, these were the only routes surveyed. The Cape Town CBD to Killarney via Marine Drive is the only route that runs parallel with the MyCiTi bus service, which also operates a service on Marine Drive. Short trips indicate respondents who boarded the bus along the route, the detail of which can be found in Appendix D, Datasets: Demographic and respondent trip data.

The demographic data collected was captured for a pivot table analysis. The stated choice data collected, was converted to a specific DCE format to prepare for statistical analysis (Appendix E). Each respondent is assigned 24 (8x3) rows of data in the final DCE dataset, based on the multiple choice sets (including the opt-out choice) presented to them. The categorical dependent variable, which is the mode choice made by the respondent, is coded 1 only if a subject chooses that particular service. In this case, the dependent variable is not a quantitative measure of some economic outcome, but rather an indicator of whether or not some outcome occurred (Greene, 2003). Three dummy variables in fractional factorial 1 (fares, seat availability and travel time) and fractional factorial 2 (fares, number of kilometres to first stop and number of transfers), are flagging the corresponding levels of service preferred per choice made by the respondents.

Missing data was encountered as a result of a few data capture sheets not being completed in full. Although minimal data is missing, some of the choices as well as demographic data were not captured. Imputation was used to estimate those missing data values.

4.3 Characteristics and choice patterns of the of primary respondents

McFadden (1974) highlights that choice behaviour is described by:

- the observed attributes of GABS users,

- the objects of choice and sets of alternatives available to the GABS users and
- the model of individual choice and behaviour and distribution of behaviour patterns in the population.

The findings and analysis of those findings will be presented and analysed similarly, with observed attributes of GABS users and the objects of the choices made and sets of alternatives presented in this section and the choice behaviour models and distribution patterns in section 4.4. This will provide the findings to address the evaluation objectives.

4.3.1 Observed attributes of GABS users

Collected from the preliminary questions asked to each respondent, the individual choice data in will be analysed by grouping the respondent data to promote homogeneity (e.g., sex, age, purpose of trip). The findings obtained from the demographic data were calculated into percentages in Table 15 to simplify interpretation. A summary of the demographic profile of the 92 respondents is presented the detail of which can be found in Appendix D, Datasets: Demographic and respondent trip data:

Total number of observations:2994						
Variable	**Number of respondents**					
Sample size	92(100%)					
Trip purpose	**Work**			**Other**		
	71(71%)			21(23%)		
Gender of commuters	**Male**			**Female**		
	22(31%)			49(69%)		
Age category (years)	**<21**	**21-30**	**31-40**	**41–60**	**61-80**	**Total**
	10(11%)	36(39%)	18(20%)	25(27%)	3(3%)	92(100%)
Concession	**Pensioner**		**Scholar**		**No concession**	
	1 (1%)		3 (3%)		**88 (96%)**	

Table 15 - Demographic profiles of GABS passengers/respondents

The age profile shows that the active working force of the sample population represents 82 of 92 (or 89%) of the respondents, with the average age of the respondents being 34 years, with the youngest participant 14 years and eldest 76 years. Females, whose needs are highlighted in provincial transport policy, represent a significant 49 of 71 (or 69%) of the commuters who participated in the choice experiment.

The demography depicts that 71 of 92 respondents (or 77%), represent the targeted commuter market, whose trip purpose is for work.

Places of origin:		**Place of origin**	**Cape Town CBD**
Atlantis	4	**Places of destination Outbound:**	
Blaauwberg	1	Brooklyn (School)	3
Brooklyn	7	Atlantis	5
Cape Town	2	Brooklyn	1
Cape Town (Dorp Street)	1	Gie Road	2
Gie Road	1	Melkbos	1
Milnerton	3	Milnerton	1
Parklands	5	Montague Gardens	6
Rugby Cambridge	2	Parklands	5
Table View	1	Table View	3
Table View (Gie Road)	4	Table View (Gie Road)	2
Place of destination inbound:	**Cape Town CBD**		
Grand Total	**31**	**Grand Total**	**29**

Table 16 - Places of origin and destination

Table 16 presents the origin-destination breakdown of the respondents who are captive to the Table View area. The inbound trips were always surveyed in the morning peak times and the outbound trips, during the afternoon peak times. Excluded from the this breakdown are the

respondents who had final destination in other areas of the City of Cape Town Cape Town. From the table, it can be seen that they represent 65% of all respondents (60 of the 92 respondents).

4.3.2 Objects of choice sets and of service attributes available to GABS users

Table17 below depicts the summary of the response rates per question (1-8) from the two choice experiments and represents a generalised pattern of the respondent choice behaviour.

	GABS (existing service)	MyCiTi (hypothetical service)	Neither service	Blank choice cards	Total choices
Fractional Factorial 1 (seat availability, fare levels, travel time)					
Choice set 1	15 (16.3%)	32 (34.8 %)	45 (48.9%)	-	92 (100%)
Choice set 2	72 (78.3%)	11 (12.0%)	9 (9.8%)	-	92 (100%)
Choice set 3	77 (83.6%)	4 (4.3%)	11 (11.9%)	-	92 (100%)
Choice set 4	20 (21.7%)	24 (26.1%)	48 (52.2%)	1 (1.1%)	92 (100%)
Total	**184 (50.0%)**	**71 (19.3%)**	**113 (30.7%)**	**1 (0.2%)**	**368(100%)**
Fractional Factorial 2 (fare levels, distance to the first bus stop, number of transfers)					
Choice set 5	20 (21.7%)	22 (23.9%)	50 (54.3%)	-	92 (100%)
Choice set 6	6 (6.5%)	43 (46.7%)	42 (45.7%)	1 (1.1%)	92 (100%)
Choice set 7	48 (52.2%)	10 (10.9%)	33 (35.9%)	1(1.1%)	92 (100%)
Choice set 8	30 (32.6%)	13 (14.1%)	**47** (51.1%)	2 (2.2%)	92 (100%)
Total	**104(28.5%)**	**88(23.9%)**	**172(46.7%)**	**4 (1.1%)**	**368(100%)**

Table 17 - Summary of survey stated choice responses

The detailed data can be found in Appendix D– Datasets: Fractional factorial datasets. Below are Tables 18-25, which provide a breakdown per choice set. An additional pivot analysis was used for further observations (Appendix G). From the tables it is evident the GABS service was the preferred service in fractional factorial 1 and MyCiTi was the preferred service in fractional factorial 2. The choice sets in fractional factorial 1, which included service attributes of seat availability, fare levels and travel time is regarded as evaluating the aspects of ease of mobility, comfort, regularity of services and affordability of services. Notable choice patterns observed

include:

Trip purpose	Gender	A -existing service	B -Hypothetical service	C Neither service	Total
Other	Female	1	3	6	10
	Male	2	4	5	11
Other Total		**3 (14.3%)**	**7 (33.3%)**	**11 (52.4%)**	**21**
Work	Female	7	20	22	49
	Male	5	5	12	22
Work Total		**13 (19.7%)**	**24 (36 6%)**	**34(43.7%)**	**71**
Total		**15 (%)**	**32 (%)**	**45(%)**	**92**

Table 18 - Findings for Choice set 1

In choice set 1, the predominant choice was for option C, neither of the two services. Also, 32%of the respondents preferred the Service B, the hypothetical IRT rapid bus service, twice the amount selected for Service A. A third of the commuters are therefore willing to pay at least 10% more fares for a 23% reduction in travel time. Service B appealed to both male and female similarly, as the ratio of those who chose the hypothetical IRT rapid bus service is similar. Both males and females in general did not want to stand, as 47.4% % of females and 51.5% of the males opted out of the two standing options (Choice A and B).

Trip purpose	Gender	A -existing service	B -Hypothetical service	C -Neither service	Blank	Total
Other	Female	7	2	1	-	10
	Male	8	1	2	-	11
Other Total		**15 (71.4%)**	**3 (14.3%)**	**3 (14.3%)**	**-**	**21**
Work	Female	37	6	6	1	49
	Male	20	2	0	-	22
Work Total		**56 (78.9%)**	**8 (11.3%)**	**6 (8.5%)**	**1(1.4%)**	**71**
Total		**71 (77.2%)**	**11 (12.0%)**	**9 (9.8%)**	**1(1.1%)**	**92**

Table 19 - **Findings for Choice set 2**

In choice set 2, a dominant 77.2% of the respondents' choosing Service A, the option of a seat during peak times. It is observed that ratios of choices between the two classes of trip purpose are reasonably similar.

Trip purpose	Gender	A -existing service	B -Hypothetical service	C -Neither service	Blank	Total
Other	Female	8	0	2	-	10
	Male	8	1	2	-	11
Other Total		**16 (76.2%)**	**1 (4.8%)**	**4 (19%)**	**-**	**21**
Work	Female	**40**	**2**	**7**	**1**	**49**
	Male	21	1	0	1	22
Work Total		**61 (86.0%)**	**2 (2.8%)**	**7 (9.9%)**	**2(2.8%)**	**71**
Total		**75 (81.5%)**	**4 (4.3%)**	**11 (12.0%)**	**2(2.2%)**	**92**

Table 20 - Findings for choice set 3

In choice set 3, the fare level was raised from R7.35 to R 9.00 but four more females and one extra male chose a seating option, making a total of 81.5% of the respondents. It is observed that ratios of the two classes of trip purposes are reasonably similar.

Trip purpose	Gender	A -existing service	B -Hypothetical service	C-Neither service	Blank	Total
Other	Female	2	1	7	-	10
	Male	3	3	5	-	11
Other Total		**5 (23.8%)**	**4 (19.0%)**	**12 (57.1%)**	**-**	**21**
Work	Female	11	13	25	1	49
	Male	4	7	11	-	22
Work Total		**15 (21.1%)**	**20 (28.2%)**	**36 (50.1%)**	**1(1.4%)**	**71**
Total		**20 (21.7%)**	**24 (26.1%)**	**48 (52.2%)**	**1(1.1%)**	**92**

Table 21 - Findings for choice set 4

In choice set 4, half of the respondents (52.2%) opted out of choosing between the two services. Slight differences in choice patterns can be observed between the two commuting classes.

The choice sets in fractional factorial 2, which included service attributes of fare levels, distance to the first bus stop and the number of transfers is regarded as evaluating the aspects of bus services working together, bus feeder services and affordability of services Notable choice patterns observed include:

Trip purpose	Gender	A -existing service	B -Hypothetical service	C Neither service	Total
Other	Female	2	2	6	10
	Male	5	2	4	11
Other Total		**7 (33.3%)**	**4 (19.0%)**	**10(47.6%)**	**21**
Work	Female	10	11	28	49
	Male	3	7	12	22
Work Total		**13(18.3%)**	**18 (25.6%)**	**42 (59.2%)**	**71**
Total		**20(21.7%)**	**22 (23.9%)**	**50 (54.3%)**	**92**

Table 22 - Findings for choice set 5

In choice set 5, half (54.3%) of the respondents' chose option C, with 84% of those being commuters in particular. With 34 female respondents to 16 male respondents, option C is preferred by both females and commuters in particular.

Trip purpose	Gender	A -existing service	B -Hypothetical service	C Neither service	Blank	Total
Other	Female	0	5	5	-	10
	Male	1	5	5	-	11
Other Total		**1(4.8%)**	**10 (47.6%)**	**10 47.6(%)**	**-**	**21**
Work	Female	**2**	**23**	**24**	**-**	**49**
	Male	3	10	8	1	22
Work Total		**5(7.0%)**	**33(46.5%)**	**32(45.1%)**	**1(1.4%)**	**71**
Total		**6(6.5%)**	**43 (46.7%)**	**42 (45.7%)**	**1(1.1%)**	**92**

Table 23 - Findings for choice set 6

In choice set 6, a dominant 92.4% of the respondents' chose either the hypothetical IRT rapid bus service, or neither of the two services. Notably contributing, 76.5% of those choices for either choice option B or C were the commuters.

Trip purpose	Gender	A -existing service	B -Hypothetical service	C Neither service	Blank	Total
Other	Female	5	1	4	-	10
	Male	5	2	4	-	11
Other Total		**10 (47.6%)**	**3(14.3%)**	**8 (38.1%)**	**-**	**21**
Work	Female	28	5	17	-	49
	Male	10	2	8	1	22
Work Total		**38 (53.5%)**	**7(9.9%)**	**25 (35.2%)**	**1(1.4%)**	**71**
Total		**48(63.0%)**	**10(10.9%)**	**33 (35.9%)**	**1(1.1%)**	**92**

Table 24 - Findings for choice set 7

In choice set 7, a significant 63% of the respondents expectantly chose the existing bus service, with lower fares and a service with no transfers'. With only 10.9% choosing the hypothetical IRT rapid bus service, the three transfers it offers seems to have evidently dissuaded the respondents. A third of the respondents opted out of choosing between the two services. Both male and female notably has a similar choice pattern.

Trip purpose	Gender	A -existing service	B -Hypothetical service	C Neither service	Blank	Total
Other	Female	5	0	5	-	10
	Male	5	1	5	-	11
Other Total		**10 (47.6%)**	**1 (4.7%)**	**10 (47.6%)**	**-**	**21**
Work	Female	15	6	27	1	49
	Male	5	6	10	1	22
Work Total		**20 (28.2%)**	**12 (16.9%)**	**37 (52.1%)**	**2(2.8%)**	**71**
Total		**30 (32.6%)**	**13 (40.2%)**	**47 (45.7%)**	**2(2.2%)**	**92**

Table 25 - Findings for choice set 8

In choice set 8, including three transfers was the only change made to the existing bus service, from the previous choice set. Nearly half of the respondents (45.7%) opted out of choosing between the two services.

Four (respondents 11, 28, 70, 92) selected 'Service B' or the hypothetical IRT rapid bus service option in question 3 and seven (respondents 5, 12, 23, 45, 67, 68 and 81) selected 'Service A' option in question 6. These responses are regarded as irrational and consideration will be given whether to remove them from further analysis. The choices are considered irrational due to the fact that the respondents did not select the choice which maximises their utility.

Since each respondent completed both experiments, this totals choices from 11 respondents. What is however evident is that although the respondents chose irrational choices in one fractional factorial design, they have managed to make what is considered rational choices in the second fractional factorial design. Since the order followed during the interview was always fractional factorial design 1 and then fractional factorial design 2, the respondents could have experienced interview fatigue during the fractional factorial design 2. Another possible reason for the irrational choices could be that there was a misinterpretation of the attributes for the particular experiment.

4.3.3Conditional logit model estimations with main effect terms

This section presents the CL model estimation findings of stated choices made by GABS bus users. A choice model is developed from stated choice data to:

- model the individual or discrete choices with parameters that could be transferred to the target population of Table View at large
- include a 'none of the above' alternative in the models so that individual demand could be estimated, and
- to extend the models, with external validation, to forecast aggregate demand for the total interested and affected GABS commuter population in the Table View Area.

The estimation for conditional logistic regression is performed using the statistical method of maximum likelihood estimation. An algorithm can be used to estimate the utility functions of each respondent, using the coefficients estimated with the CL model. Utility functions indicate the perceive value of the attributes by the commuters and the sensitivity to the attributes. The model coefficients (or preference weights) are used in Chapter 5 to calculate the relative importance of the different attributes against the changes in fare levels (that is, inferred by the ratio of the coefficients). In that way, the valuations of the different attributes across the experiments were given a consistent quantitative value (Pearmian *et al*., 1991).

The conditional logit (CL) estimation method used for model estimation takes into account that we only observe first choice (rather than a rank or rating). A CL model estimation is run for each fractional factorial to fit data from the 92 respondents-for a total of 2994 observations. The CL model is thereafter run again to determine if the estimate for the coefficients are significantly different for commuters and women. The stated choices captured from respondents assume that the representative utility components for a bus service are to be a linear combination of the ranked (or ordinal) independent variables (seat, time, fare) for fractional factorial 1 and (fare, distance to first stop and number of transfers) for fractional factorial 2. The representative component of utility for the neither-of-the-two services option is normalized to be 0. Internal validity of the data is assumed. The software R statistics survival

package tool was used to analyse the stated choice data, as it had the capability to run a CL model fitted to the stated choice data from 92 respondents surveyed. Scripts for applying the conditional logit model estimation in R can be found in Appendix F. The results of the CL model estimation for fractional factorial design1 (seat, time, fare) and fractional factorial design2 (fare, distance to first bus stop, number of transfers):

fractional factorial design1	Coefficient	Exponent (coefficient)	Standard error (coefficient)	Z value	P value
ASC	0.0760	1.079	1.3380	0.0568	9.5e-01
Seat	2.6781	14.558	0.3233	8.2829	1.1e-16
Travel time	-0.0225	0.978	0.0172	-1.3028	1.9e-01
Fare	0.0302	1.031	0.0695	0.4349	6.6e-01
Likelihood ratio test=206 on 4 df, p=0 n= 1116, number of events= 373					
fractional factorial design 2	**Coefficient**	**Exponent (coefficient)**	**Standard error (coefficient)**	**Z value**	**P value**
ASC	4.858	128.769	0.7428	6.54	6.2e-11
Fare	-0.283	0.753	0.0593	-4.77	1.8e-06
distance to bus stop	-0.717	0.488	0.1400	-5.12	3.1e-07
number of transfers	-0.836	0.433	0.1161	-7.20	6.0e-13
Likelihood ratio test=106 on 4 df, p=0 n=1104, number of events= 364					

Table 26–Main effects of conditional logit estimates and standard errors for (seat, time, fare, distance to first bus stop, number of transfers)

Interpreting the model:

P-values are probability of choosing one thing; 1-p is the probability of choosing the other. In the interpretation of the p-values, small enough p-values are required as an indication that the service attributes included in the experiment design were significant determinants of choice. In this model estimate generated, all the p-values could be considered small. Of note is that an alternate specific constant (ASC) is included in the model (Aizak and Nishimura, 2008), to account for mode-specific attributes which vary between modes.

Coefficients are indicative of the preference weights of the service attributes. The exponents of the coefficients are calculated by the software by back-transforming the coefficients to plain probability through removing a log and exponentiating the coefficients both sides, i.e. by calculating the exponent of p/1-p. Standard errors of the coefficients are the parameter estimates of the service attributes. In interpreting the coefficients (or parameter estimates), the sign indicates how a unit increase in attribute level experienced by the commuters using a bus service affects the likelihood of choosing to use a service. Based on the data, the following observations can be made, with significant differences in the values highlighted:

- The coefficient for the attribute **seat** is 2.6781, meaning that for a one-unit increase in seat availability (going from standing to seated); we expect a 2.6781increase in the log-odds of the dependent variable, more choices for a particular mode, holding all other independent variables constant.
- The coefficient for the attribute **travel time** is -0.225, meaning that for a one-unit increase in travel time , we expect -0.225 less in the log odds of the dependent variable, more choices for a particular mode, holding all other independent variables constant.
- The coefficient for the attribute **fare** is0.0302 in the first fractional factorial, meaning that for a one rand increase in fare levels; we expect a 0.0302increase in the log-odds of the dependent variable, more choices for a particular mode, holding all other independent variables constant. The coefficient for the variable **fare** of -0.283 in the second fractional factorial has an expected negative value. Compared to the fare

coefficient estimate in the first factorial, there appears to be far more sensitivity to changes in fare levels. Fare price was therefore found to have dissimilar coefficient estimates across the two fractional factorials, in terms of sign and size.

- The coefficient for the attribute **distance to bus stop** of -0.717 has an expected negative value. It is the third most influential attribute, after seat availability and number of transfers.
- The coefficient for the variable '**number of transfers'** of -0.836has an expected negative value. After seat availability, it is the second most influential service attribute.

It is noted that the amount with which the ASC and seat coefficient varies from the standard error could be problematic. It is also important to note that further tests were not conducted to identify to what extent the separate coefficients added to the model

Considering the effects of individual characteristics on their valuation:

fractional factorial design1	Coefficient	Exponent (coefficient)	Standard error (coefficient)	Z value	P value
ASC	0.1879	1.207	1.3290	0.141	8.9e-01
seat	2.6304	13.879	0.3210	8.194	2.2e-16
time	-0.0256	0.975	0.0173	-1.479	1.4e-01
fare	0.0516	1.053	0.0747	0.690	4.9e-01
fare:female	-0.0397	0.961	0.0273	-1.456	1.5e-01
fare:commuters	0.0249	1. 025	0.0314	0.793	4.3e-01
fare:triplength	-0.0244	0.976	0.0258	-0.944	3.5e-01
Likelihood ratio test=198 on 7df, p=0 n=1104, number of events=368					

fractional factorial design 2	Coefficient	Exponent (coefficient)	Standard error (coefficient)	Z value	P value
ASC	4.9665	147.768	0.7480	6.679	2.4e-11
fares	-0.1885	0.828	0.0638	-2.957	3.1e-03
distance to bus stop	-0.7220	0.486	0.1402	-5.150	2.6e-07
number of transfers	-0.8375	0.433	0.1162	-7.208	5.7e-13
fares:female	-0.0472	0.954	0.0253	-1.866	6.2e-02
fares:commuters	-0.0835	0.920	0.0299	-2.789	5.3e-03
fares: trip_length	-0.0227	0.978	0.0240	-0.948	3.4e-01
Likelihood ratio test=121 on 7 df, p=0 n=1104, number of events= 364					

Table 27 -main effects of conditional logit estimates and standard errors for (seat, time, fare, distance to first bus stop, number of transfers including trip purpose and gender influence)

A CL model estimate was generated for a second round of observation to determine if the estimates for the coefficients are significantly different for commuters and women. Trip lengths were added to the model, to distinguish if there were any material differences between those who travelled further and therefore took longer to reach their destinations.

Based on the data, the following observations can be made, with significant differences in the values highlighted:

The coefficients for the demographic and trip characteristics for **female** of-0.0472, for **commuters** of-0.0835 and for **trip_length** of-0.0227 are all relatively small, indicating no significant differences in preferences between females and males and between commuters and non-commuters, whether undertaking a short or long trip.

In closing this section, due to the small p-values, all the coefficients of the logit models estimations are significant and most have the predicted negative sign, with the seat availability coefficient having an expected positive sign.

4.4Summary

Findings for evaluation objectives two (choice behaviour models and patterns) and evaluation objective three (preference valuations) were presented, as the data required for conducting the analysis for evaluation objective one was covered in Chapter 3. Furthermore, inferences will be drawn from the findings of objectives two and three in this chapter and analysed and discussed for analysis required to address objective four, the modal preferences of respondents.

An analysis and discussion of the findings for each evaluation objective is now covered in chapter 5.

Chapter 5 Analysis of stated choice data for bus services by trip purpose and gender

5.1 Introduction

The purpose of this chapter is to analyze and discuss the findings presented in response to each of the evaluation objectives. Value aspects for bus services in particular, choice behaviour of the GABS users, preferences for service attributes and their influence on modal choice patterns of the respondents will now be analysed and discussed. The discussion of the findings is structured to address the evaluation objectives, namely:

- **Objective 1:** To identify the value aspects of the public transport infrastructure and services
- **Objective 2**: To generate preference valuations for public transport service attributes
- **Objective 3:** To identify and model choice behaviour of GABS bus users
- **Objective4:** To determine the effect of service attributes on modal choice, between the GABS bus service and a hypothetical MyCiTi service.

Statistical analysis of DCE data is based on the random utility theory. The model for choice between two outcomes provides the framework for a large proportion of the analysis of microeconomic data (Greene, 2003). Choice behaviour, which described in Chapter 4 according the structure proposed by (McFadden, 1974) is now further discussed. The analysis concludes with addressing DCE step 7: choice probabilities in section 5.5, where the main effects of the service attributes used on the modal choice discussed.

5.2 Evaluation objective 1: To identify the value aspects of the public transport infrastructure and services

In recapping the methodology, a stepped approach for designing the DCE (Louviere and Hensher, 1983) was used to identify the value aspect of the public transport services in general and the bus services more specifically. The DCE method revealed the underlying theories of value and rational utility theory, upon which the DCE method is based. Utility was specifically defined to represent, in theory, a measure of value the user of the bus services rationally applies in choosing a service which maximises utility. The utility theory broke the service down into a systematic and random component, with the conditional logistic regression providing estimates for the distribution of the random, unobserved component of utility. All the coefficients used in the choice design tested to be significant, with relatively small p-values, an indication that the selected attributes were key choice determinants used by respondents in placing a value on the service.

Even though a distinguishing aspect of the conditional logit to that of a multinomial logit model is that the choice determinants that are modelled are primarily those relating the qualities of the bus service and not necessarily those of the respondents, it was however necessary to distinguish between gender and trip purpose in the model results, as those were priorities in public transport policy. Included in the findings was trip distance, as spatial patterns of Cape Town reflect the legacy of the former apartheid government policies, which resulted in marginalised communities, such as Atlantis, being situated further from the Cape Town CBD.

The demographics of the primary respondents are now discussed. Since the focus of the evaluation was to determine whether the current bus service was providing sufficient utility and whether the commuters were willing to switch to the MyCiTi service, those who were using the service for purposes other than work, were not of primary interest in this analysis. Coefficient estimates however, were not significantly different between the different demographic profiles of respondents.

Summarised from table 17, we observe that the participant respondents were the GABS bus users in the Table View area, most of whom were using the bus services between the Killarney and Cape Town routes.

		Gender		
Trip purpose		**F**	**M**	**Total**
Other	Respondent Count	10	11	21
	Average of Age	29.70	30.45	30.10
	Min of Age	14	13	13
	Max of Age	76	66	76
Work	Respondent Count	49	22	71
	Average of Age	35.47	35.23	35.39
	Min of Age	16	17	16
	Max of Age	55	67	67
Total Count of respondents		59	33	92
Total Average of Age		34.49	33.64	34.18
Total Min of Age		14	13	13
Total Max of Age		76	67	76

Table 28- Gender profile of commuters

Initially when presented in table 17, the age categories were split into five groups. However, since the upper tail consists of three respondents, of 66 years, 67 years and 76 years old respectively, and the lower tail consisting of only two respondents of 13 years and 14 years old, the age categories could be interpreted more intuitively by collapsing them into two classes: those 30 years old and older and those younger than 30 years old. The age of 30 years old is close to the median, as 41 respondents are younger than 30 years old and 51 respondents, older. As can be observed from the table, the average age of females is 34.4 years old and that of males 33.64, indicating a slightly younger male profile than that of the female of GABS bus users.

There is a clear dominance of the ratio of women to men on board the GABS buses, as women prefer to use buses to other modes of public transport in South Africa. Although not specifically

investigated in this evaluation, this can most likely be attributed to a safer and more secure environment on-board the bus, as access is far more controlled and the presence of the bus driver provides a major deterrent to any security threats to the users of the service.

The range of ages of the women commuters are expected to represent people in the active workforce between the ages of 16 and 65 years of age. What is evident in the graph is that the oldest female commuter is 55 years old, ten years younger than retirement age. This indicates a market of 55 to 65 year old females not catered for by the GABS service. It is inconclusive as to why this is occurring. It could possibly be attributed to a general lack of accessibility to bus services to the older female generation, who is less inclined to use the bus services for various reasons, including among others, safety and security, comfort, ease of mobility.
The differences in socioeconomic variables were found to be insignificant in choice determination, with negative signs on the female gender and commuters, and for the service attributes, implying that women are prepared and able to afford service levels changes of the general population but with females more likely to use the service, given the ratio of men to women on-board the bus.

5.3 Evaluation objective 2: To identify and model choice behaviour of GABS bus users

In the design of experiments and analysis of variance, a main effect is the effect of an independent variable or service attribute on the dependent variable of modal choice, averaging across the levels of any other independent variables. The main effect of the independent variable is a simple effect, and as such is independent of the levels of the other attributes in question.

Because all possible choice questions cannot be used, empirically feasible choice designs support identifying only main effects and some interactions; however, some higher-order effects are necessarily confounded. A main effect test will merely look at whether overall there is something about a particular service attribute that is making a difference, examining differences amongst the levels of a single service attribute (averaging over the other service

attributes), the overall effect of a service attribute. In contrast, an evaluation would consider the interactions effects if the effect on the dependant variable is analysed with two or more independent variables included, where the effect of one variable, or attribute, is dependent on the level of the other. As in the case of the hypothetical service, for e.g. the higher levels of comfort and safety on the IRT rapid bus service necessitates higher fare prices.

The choice sets in fractional factorial 1, which included service attributes of seat availability, fare levels and travel time is regarded as evaluating the **aspects of ease of mobility, comfort, regularity of services and affordability of services.** From the choice patterns observed in section 4.3.2, the following can be deduced:

The main effect of fare levels on modal choice

Fares were the one service attribute chosen to be common to all the choice sets and it therefore to an extent confounded with the other service attributes. The fare discussion is therefore covered in discussing the remainder of the attributes and will be used in section 5.4 to generate the preference valuations for the service attributes.

Of specific interest was a choice pattern produced which reflected a supposed irrational choice, where respondents were willing to pay extra to stand when there was an option to sit for a lower fare. It was possible that they might have misunderstood the survey instrument, or could have played the choice games as a reflection of their realities and not necessarily with a hypothetical service in mind. This requires further investigation.

In choice set 6: only fare price differs in the choice set (R9 and R15), with the other attributes kept constant. Unexpectedly, 45.6% of respondents opted out of choosing. This could be a possible irrelevant alternatives error.

The main effect of seat availability on modal choice

The main effect of seat availability on modal choice is the difference between the average numbers of respondents each choosing either a trip where they are seated or standing, ignoring the other service attributes.

The choice behaviour pattern of choice set 3, with 83.6% of respondents choosing a seating option, appears to confirm seat availability as a significant service preference and determinant of modal choice. Both fare prices and travel times were considered realistic, a strong indication that respondents who opted-out of choosing between the existing bus service and the hypothetical IRT rapid bus service were not willing to stand and pay the current prices. In the presence of a seat, 45 minutes travel time is not an issue for respondents. Most of the commuters surveyed, who use the existing GABS service would pay R1, 50 more, or R9 per trip, and add 10 minutes to their journey times for a seat. It could therefore possible to raise the fare levels to cover the cost of providing additional service capacity, as standing is not an attractive option for the GABS bus users.

In choice set 4, 54.2% of female respondents did not want to stand and opted out of choosing a standing option, closely followed by 48.5% males who opted out. The female respondents are expected by the evaluator to exhibit a choice behaviour which shows a higher requirement for the level of comfort, a tribute to the tradition of males offering their seat to females who stand. A possible cause for the high opt out ratio is the presence of a viable modal alternative not covered in this evaluation.

The main effect of travel time on modal choice

The main effect of travel time on modal choice is the difference between the average numbers of respondents each choosing either a trip time of 35 minutes, 45 minutes, or 60 minutes, ignoring the other service attributes.

In choice set 1, a third of the commuters are willing to pay at least 10% more fares for a 23% reduction in travel time, which can considered a bargain to respondents and an obvious choice. Further investigations should therefore change the ordinal scale of the service attributes to more carefully measure travel time elasticity. Furthermore, only 16.3% of the respondents indicated that they were willing to travel for 45 minutes.

In choice set 3, 11.9% of the respondents opted out, with 52.2% of the respondents opting out of choosing in choice set 4. In both instances, this is possibly due to travel times being too long

in these choice sets, with the high opt out ratio in choice set 4 being attributed to the shortest time in the set being 45 minutes. These choice behaviour patterns provide a possible indication that travel times beyond the threshold of 35 to-40 minutes significantly reduce the attractiveness of the service and would have a negative influence on the choice of a particular mode.

The choice sets in fractional factorial 2, which included service attributes of fare levels, distance to the first bus stop and the number of transfers is regarded as evaluating the aspects of **bus services working together, bus feeder services** and **affordability of services** Notable choice patterns observed include:

The main effect of distance to the first bus stop on modal choice

The main effect of the distance to the first bus stop on modal choice is the difference between the average numbers of respondents each choosing a distance of 1, 2 or 3 kilometres, ignoring the other service attributes.

In choice set 5, the distance to the first stop range of 1 to 3 kilometres did not seem to be an issue for respondents, including females. This could be due to actual distances experienced from the existing bus stop being 3 km or more from their homes. It is possible that the respondents could have also interpreted the question as needing to state what the existing situation is. In context, half the respondents (55% of the female and 42% of the males) did however opt out of choosing between the two services.

In choice set 7, the distance of 3 km to the first stop did not seem to be an issue. This is surprising as 92% of the respondents had indicated in this survey that they walked to their first bus stop, with 64%of those respondents being female. The distance of three kilometres would have expected to be a deterrent for walking. In support of this deemed rationality, 35% respondents opted out. There is no apparent explanation for opting out, but this could be attributed to both the extreme levels of 3 km's to the first stop in the existing bus service and 3 transfers required for the hypothetical IRT rapid bus service that were both unacceptable as

service parameters. Both male and female had similar choice patterns in relation to the bus stop attribute.

It appears as if there are mixed responses in relation to which distances is a threshold for an attractive service. It is therefore unclear what the main effect of the distance to the first us stop would be on modal choice. Since 92% of the respondents had indicated walking, it is likely that 2 kilometres (an estimated 15 to 20 minute walk) is a possible threshold distance.

The main effect of the number of transfers on modal choice

The main effect of the number of transfers to complete a journey on modal choice is the difference between the average numbers of commuters each choosing no transfers, two transfers or three transfers, ignoring the other service attributes.

In choice set 5, 54.3% of the respondents opted out of choosing a service, perhaps an indication of the reluctance to undertake two bus transfers, which would be the case if either service was chosen in the choice game. In choice set 6, the choices were split mostly between the hypothetical IRT rapid bus service and opting out of choosing. The responses to this choice set was expected to have a similar profile to choice set 5, as both sets had the 'number of transfers' set at 2 for both the existing bus service and the hypothetical IRT rapid bus service. The expected responses were to reject this in their stated choices, especially since they do not currently have to transfer to reach their final destinations.

It is important to note that the GABS users are not required to make any transfers currently, which has most likely contributed to their measure of value. Their choice behaviour patterns provide a possible indication that having to make more than one transfer could significantly reduce the attractiveness of the service and have a negative effect on the modal choice.

5.4 Evaluation objective 3: To generate preference valuations for public transport service attributes

The CL model estimations of the coefficients of the service attributes, which were presented in section 4.3.3, are now analyzed to generate preference valuations. The findings depict that all

variables were found to have intuitively plausible signs. All independent variables, or service attributes, in the model are significant at the 95% confidence level, with the majority at the 99% confidence level, but these significance levels should be interpreted cautiously because of the repeated measures nature of the data.

Service attributes	Coefficient	Exponent (coefficient)	Preference Rank
Seat availability	2.6781	0.3233	1st
Number of transfers	-0.836	0.1161	2nd
Distance to bus stop	-0.717	0.1400	3rd
$Fares_{1,2}$	-0.283	0.0593	4th
	0.0302	0.0695	
Travel time	-0.0225	0.0172	5th

Table 29 - Ranking of service attributes

Service attributes are ranked in terms of the size of their coefficients (Table 29). From Table 29, is can be seen that the most influential service attribute, seat availability has a significantly positive coefficient, implying that commuters are 260% more likely to use a service that offers a seat relative to a service where they need to stand during the trip. In other words, the exponent of the coefficient for seat availability indicates that commuters are about 15 times more likely to choose a service if there is a seat available.

Of the five service attributes, time is ranked as the least important, indicating that commuters are willing to use a bus service at the current travel times. Excluded from the analysis was a determination of the interaction effects between the service attributes. However, when one considers the interaction effects of the service attributes, the importance of a seat is expected to drop significantly when the travel time decreases, as commuters would be more willing to stand for shorter periods of time. Commuters are 2.2% less likely to choose a service if the travel times increase from 35-45 minutes, a reasonably small decrease. This is confirmed by the small exponent of the coefficient. Although interesting, it is inconclusive from the data for which period of travel time they be willing to stand. This should be investigated in future research.

As most the coefficients are negative, with the exception of seat availability and to an extent, fares, and also the fact that the attributes are significant means that we can be confident that the commuter will be less likely to use the bus service, as increases in transfers, travel times, fares and walking distance to the bus stop materialises.

How much of the respondents willing to pay for improvements in certain service attributes?

Willingness to pay (WTP), or mean-centred priceestimates are calculated, placing financial values on how commuters trade-off service attributes of a bus service, to determine how much of one attribute they are willing to give up for improvements in another, as well as how much commuters are willing to pay for improvements in others attributes of a bus service (Louviere and Islam, 2008). The equation for WTP is calculated as follows:

$$WTP = -\frac{Attribute\ \ Level\ Coeff.}{\Pr ice\ Coeff.}$$

Using the coefficients estimated from the CL model, the following WTP estimates are calculated per unit of service, for each service attribute:

Service attributes	Coefficient	Price (fare) coefficient	WTP estimate (in Rands)
Seat	2.6781	0.0302	R 88,67
Number of transfers	-0.836	-0.283	R 2,95
Distance to bus stop	-0.717	-0.283	R 2,53
Travel time	-0.0225	0.0302	R 0,07

Table 30 - Willingness-to-pay estimates for service attributes

Significantly, respondents were willing to pay R88, 67 for the option of a seat. This would most likely make this option more expensive than the private motor vehicle. This is a clear indication that respondents would switch modes if there is no seat available.

Furthermore, they were willing to pay R2, 95 to prevent having to transfer between buses and pay R2.53 per kilometre to have the bus stop closer to their homes. While in theory, this could be accurate, in practice however; this appears to be a bargain for the Gabs bus users as it relates to adding bus stops to a particular route. This WTP estimate should possibly be tested further with larger intervals.

At R 0, 07 cents per minute, travel time appears undervalued. Further investigations should be conducted to determine the accuracy of the estimate.

5.5 Evaluation objective 4: To determine the effect of service attributes on modal choice

In the comprehensive understanding the stated choices for various service attribute levels and their effect on modal choice, it becomes evident that which mode of transport maximizes theoretical commuter utility. As rational utility theory assumes that individuals are rational when they need to maximize utility, the service which provides the highest utility to them is most likely the service they would prefer. Customer choices and values for the public transport service attributes ultimately indicate which service the commuters' value most. The willingness to pay estimates provided insight into how the service attributes selected for the evaluation affect choices made to use a particular bus service.

Revealed in the execution of the DCE however, was the need to use a fractional factorial to design the choice sets, an inherently incomplete dataset for demand prediction. Additionally, since only GABS users were surveyed on-board buses, this could seriously jeopardize the accuracy of such prediction. Consideration must be given in the possibility that the model may overestimate the probability of choosing GABS, while at the same time underestimating the probability of choosing MyCiTi, or vice versa.

The results obtained from the analysis of the general margins in choice patterns however could provide a more robust method of measuring value, without the need to ranked service attributes individually. From this data, there is an indication of no significant preference

difference between the service from GABS and MyCiTi, with GABS being the dominant mode choice in questions 1 to 4 and with the MyCiTi service being the dominant choice in questions 5 to 8.

On the importance of seat availability: Cautiously considering the coefficient estimates of the CL model estimation, preference valuations of the GABS bus users indicate that users would switch to MyCiTi, on condition that seats are available for the duration of the trip. The willingness to pay R 88, 67 (Rands) is a clear indication that seat availability is the dominant choice determinant. In analysing the margins on the general choice patterns, corroborating evidence shows that the GABS bus service was the dominant choice by female commuters, with the exception where there was no seat. None of the female respondents preferred to stand, regardless of the time and fare price.

In favour of the MyCiTi service is the fare coefficient estimate that commuters are 3% more likely to use a service if there is slight increase in fares, along with service improvements, such as seating and travel time, as the willingness to pay more is in relation to a confounding attribute, which has influenced the valuation of the fare levels. The serves the MyCiTi service, as it provides a new look and feel to public transport, with modern buses and payment systems. The service should however not lose sight of providing the fundamental value explained in the service attributes. In analysing both the general choice pattern, which indicates that the vast majority of respondents walked, and the coefficient estimate for the distance preferred for the bus stop from home, it is likely that bus stop further than 3 km away could begin to significantly affect mode choice. Finally, commuters were willing to pay no more than R2.95 more than what they were currently paying on fares not to undergo a transfer from one bus to the next. Although transfers are evidently not preferred, this is an indication that one transfer would not be a significant deterrent to using the MyCiTi service.

5.6 Summary

In this chapter the findings generated from the data of the92 respondents was analysed and discussed. Firstly, the demographic profile of the primary respondents indicated the majority of

the respondents were commuting between Table View and Cape Town daily during the working week. The majority over the commuters were female and are of working age, with the average age being 34 years and almost all of the respondents spoke English.

The analysis provides evidence that GABS bus users (including commuters and women) find that seat availability the most significant determinant of choice in deciding to use a bus service and also that expectedly prefer few transfers during the trip. We interpret these results as suggesting that no more than one additional transfer should be introduced to the GABS bus users and that as a minimum, similar seating capacity that is provided in the new service.

Using stated choice experiment, a main effects analysis could provide a more objective and useful method for measuring benefits realisation on making decisions for existing GABS bus services and future MyCiTi phase rollouts.

Chapter 6 Conclusion of the evaluation

6.1 Introduction

In the previous chapter, the evaluation findings were analysed and discussed. This final chapter concludes the evaluation by providing interpretations of the analysis and discussion and then by drawing conclusions from those interpretations as it relates to each evaluation objective. The recommendations of the evaluation then follow. A review of the evaluation will be discussed and presented under each evaluation objective, followed by a section on suggested DCE improvements are mentioned in section 6.4. Finally, suggested areas to be considered for further research in section 6.5 close off the evaluation.

6.2 Summary of findings and conclusions

Evaluative conclusion for objective 1: To identify the value aspects of the public transport infrastructure and services

The DCE used did not include all of the important service attributes, but was limited to what was considered the most important choice determinants for respondents choosing between the GABS and MyCiTi bus services. Key variables such as safety and brand recognition could have been considered of significant value too. No evidence was found to ensure that choices could not have varied if the commuters were asked to choose between GABS and MyCiTi directly. It cannot be ignored that respondents would have made assumptions about excluded attributes, possible affect the validity of this field experiment. Furthermore, even though the choice cards were pilot tested to assess whether the respondents would understand the choice games, the DCE approach was a new concept to the respondents and would most likely not have been completely understood.

The application of rational utility theory played a central role by providing the evaluation with axioms that supposed individuals made rational choices about an abstract measure of value, or utility, which would ultimately be maximised, based on their choices. Although a logical

approach is to assigning a certain amount of value to a service by identifying the attributes of characteristics which constitute that service, it is the interaction effects analysis of these attributes would become significantly complex in analysis. It was therefore the approach to focus attention on providing accurate generalisation of value aspects and using the coefficient estimates generated only as corroborating evidence to observed choice patterns in the margins. In the achievement of objective 1, it can be said that the factorial approach used could identify an exhaustive list of value aspects, but due to the need to adopt a fractional factorial approach, the experiment was materially weakened.

Evaluative conclusion objective 2: To identify and model choice behaviour of GABS bus users

The findings of the choice patterns and modal choice preferences presented in chapter 4 were analysed according to the observed attributes of GABS users, the objects of choice and sets of alternatives available to the GABS users and the model of individual choice and behaviour and distribution of behaviour patterns in the population.

Margins of choice patterns were analysed with main effects analysis, initially to supplement CL model estimates. In reality, the observations and analyses as a result appear more useful and intuitive in evaluation, taking into account an analysis of general choice patterns, which would inherently include all the value aspects in the choice.

It should be noted that variations in the choice set could have had a significant effect on the choice patterns. It could therefore be argued that restrictive regression models, such as the CL model used, always be confirmed with revealed preference data and general choice pattern observations, such as a simple main effects analysis.

The main effects of each service attribute, with the exclusion of the confounding fare level attribute, was presented and analysed to determine their effects on modal choice. Seat availability and the number of transfers were seen to have a significant effect on modal choice. To a lesser extent the data revealed that travel times and distance to the first bus stop was not

a major choice determinant, but both attributes had limits, which when exceeded, became unacceptable as a service level.

Only GABS bus users were surveyed, to the exclusion of other members of the population in Table View. This sampling strategy could be considered a material flaw in the overall choice patterns observed. It could therefore be a reflection that the evaluation objective itself, although addressed, was too restrictive and that other Table View members of the public should have been included. The demographics also revealed that the age profile of the GABS bus users identified had no females and few male workers over 55 years old. This requires further investigation in future research.

Evaluative conclusion objective 3: To generate preference valuations for public transport service attributes

A as general conclusion and based on the findings of similar DCE's, the findings support the expectations of what constitutes an aggregate demand estimation for commuter bus services. The CL model generated coefficient estimates which generally had expected values and which could be analysed to generate a preference ranking using willingness to pay estimates for each service attribute.

Any elasticity of demand conclusions deduced from the model estimation should however be approached with the utmost of caution, as estimation issues could easily be unwillingly introduced with inefficient design parameters. The DCE requires substantial knowledge and testing to not only select the appropriate attributes, but also to correctly estimate the interval used to specify attribute levels.

Having stated this, seat availability was by far the most significant choice determinant, followed by the number of transfers and the distance of the bus stop from home. The models have also demonstrated that commuters expectedly prefer direct services to those which require transfers. Logically, standing is not an attractive option.

Considering the preferences expressed for the service attributes, a hypothetical service can be proposed, with a service mix of R9.00 per trip, that would take 45 minutes and that offered the commuter a seat for the journey. The first bus stop would be no more than two kilometres away and the journey would consist of no more than one transfer to reach the final destination.

Evaluative conclusion objective 4: To determine the effect of service attributes on modal choice namely GABS and a hypothetical MyCiTi service area

One of the main aims of this evaluation was to use the experimental procedures of DCE as an econometric discrete choice forecasting framework to apply to bus service demand estimation, for **Future possible Scenario 3**: The GABS bus service is discontinued to be replaced by the a hypothetical MyCiTi system. This was in response to addressing the public problem of reversing the declining service levels with respect of public bus transport services. A key aspect of this evaluation was to ascertain which service attributes levels were most important for commuters in order to focus service improvements to those particular aspects of the service in the hypothetical MyCiTi service to be introduced.

In this evaluation, the choice patterns have showed inconclusive evidence of a dominant mode preference, when comparing the hypothetical MyCiTi system and the existing bus service. The CL model estimation was able to identify willingness to pay for service improvements, or to avoid certain service characteristics, thereby maximising their individual utility. Direct services were important to commuters in determining which mode they would prefer to commute with, although this did not seem to be an absolute service requirement. What was apparent is the willingness to pay over R88 per trip for a seat, which in reality is not realistic, as this would most likely be more expensive than a private motor vehicle. One can therefore assume that lack of seating and comfort levels during the trip in general, would be a serious deterrent to a modal shift to MyCiTi. The choice data, however, indicated that the female commuters more than males particularly, were willing to pay for the new MyCiTi bus service, if there was sufficient seating capacity.

The analysis produced inconclusive data on for ridership predictions. This can be attributed to the formatting of the data that was processed by the CL model, which was stratified by respondents only and did not allow for choice probability estimates for varying levels of service attributes. As a noted limitation however, there is no indication that this could not be done, given the data collected. Noting the major concerns external validity concerns of using a fractional factorial approach, further analysis could most likely produce demand forecasts, but should be validated with corroborating revealed preference data. Assuming sufficient seating capacity in MyCiTi, it can generally be said that the GABS bus users will be willing to switch modes, as there is no indication in the data to suggest otherwise.

6.3 Recommendations for public transport operations and evaluation

- Modal choice is influenced simultaneously by many interrelating factors and these must be viewed together and not separately as they are often addressed and discussed. It is, therefore, important to gain an understanding of all the factors that influence modal choice for primary market of commuters.
- Pay particular attention to seating capacity in the new MyCiTi service, particularly on trips longer than 35 minutes. It could be possible to raise the existing fare levels to cover the cost of providing additional seating capacity required for any new service. Subsequently, operators optimise the service by increasing the frequent bus services which would have the effect of increasing seating capacity to justify raised fare levels.
- Current policy requires that public transport planning, design implementation and review make specific reference to female requirements. In general, this is acceptable, taking into account key service requirements such as safety and security. This is however not sufficient enough when considering certain service aspects, as the evaluation found a clear lack of 55year old to 65 year old female commuters using the GABS service. It therefore implies that future market segmentation disaggregate the female market into age-related groups, to ensure that the entire workforce of the province is catered for when using public transport. Furthermore, females are the

dominant users of the bus services and have higher levels of comfort as a requirement, a tribute to the tradition of males offering their seat to females who stand.

- As seating capacity is such a significant choice determinant, it should be investigated for which period of travel time users would be willing to stand.
- From this evaluation it is evident that an affordable service plays an important role in commuter decision-making in the choice of a service. It is, therefore, recommended that the Department should focus on keeping any new introduced MyCiTi fares levels at current GABS fares also confirm that commuters generally know what they can afford.
- Although on insignificant certain commuters at times found it difficult to make what are supposed rational choices when faced with some choice sets. (Lancsar and Louviere, 2008) argue that such responses may in fact be valid and was therefore included in the computations, as random utility it was argued, is robust enough to account for any errors made by the individual in stating their preferences. Further investigations should be made into understanding the supposed irrational choices made by those individuals and whether the cause is attributed to not understanding the choice games played.
- A DCE should be followed by real-world experiments that present the preferred package to the target population. DCE should therefore be seen as one component of broader policy review and planning of transport subsidy maximisation. The bus service administrators should therefore follow up results of the survey with a qualitative process of conducting focus groups, which is suited to generate ides and probe issues to ensure that the commuters are satisfied and that expectations have been met. It should also be corroborated with revealed preference data, which would calibrate stated choice models

6.4 DCE Evaluation review

We began this evaluation with a quote from (Taussig, 1912) via (McFadden, 1981:198), who proposed the idea that preferences may be volatile and context dependent. What is missing from this theory is an explanation for the process that generates commuter preferences. Rational utility theory provided the explanation of the choice behaviour and with the use of the

choice experiment method, several usually non-value market bus service attributes were assigned a value or utility. DCE's and the supporting random utility theory illustrate a variety of factors that can influence the choice, acceptability and the preference of a bus service.

This evaluation has contributed to the understanding and description of the choice behaviour of commuters who use the GABS bus service daily to commute between Table View and City of Cape Town CBD in South Africa. It produced stated choice information of the commuters in the City of Cape Town in South Africa additional to the revealed preference data of Current Public Transport Records (CPTR 2003) of commuters in the City of Cape Town, South Africa, to implement transport systems which create value to the users.

Method improvements to consider:

It can be said that the factorial approach used could identify an exhaustive list of value aspects, but due to the need to adopt a fractional factorial approach, the experiment was materially weakened. More careful consideration should go into the design of the DCE. A focus group could be useful in this regard. The range of feasible and affordable policy interventions or incentive packages to meet the commuter preference in Table View could be collected during this qualitative research phase, before starting the major data collection phase of the DCE. This would significantly increase the accuracy of any model estimations. Focus group could also be useful to ascertain whether qualitative findings would support the findings of the choice experiments post the quantitative analysis of the CL model estimates. In short, more effort should be dedicated in the selection of service attributes and the design of the choice cards.

On-board bus surveys are effective as a means of localising respondents. The amount of data loss with a manual survey can be considered nominal, but could however be significantly reduced with an electronic on-board survey. The use of electronic devices and multimedia can also visually improve and reduce interpretation errors from respondents the presentation of the choice cards to the respondents.

In closing, it could be said that DCEs, if conducted with great care, can be used to estimate the effect of policies yet to be implemented, such as rolling out the MyCiTi service. Ideally, DCEs should be followed by real-world proof of concepts that present the stated choices modelled to the target population. The key improvement that could be made in conducting future stated choice surveys is that of experiment design efficiency

6.5 Suggestions of further research

The following future evaluations can be recommended:

- It would be of interest to include safety into the service characteristics. Branded choice experiments could also play a key role in model accurate demand, as the new public transport network becomes a single integrated system.
- Further research could include road price reform evaluations, which would seek to determine the willingness of private motor vehicle users switch to public transport. Future surveys could include asking the commuters whether they are car owners, as it has been widely assumed in this evaluation that the commuters are captive to public transport. Since two main modal options were omitted from selection for this evaluation, namely the private motor vehicle and minibus taxi, it is likely that commuters could opt for those modes in the event of a change in the bus service.
- The GABS bus services, although monitored, does not operate in terms of a performance-based contract. DCE's could be used to determine service level benchmarks, based on commuter preferences, particularly adherence to timetables.

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Appendix B Survey Questionnaire choice card

English questionnaire:

THE STATED DESIGNQUESTIONS (Sections A-C to be completed on the data capture spread sheet)

Section A: Observation

1. Observe and record Gender
2. Observe and record passengers who are (Scholars/Disabled).

Section B: Preliminary Questions

Preliminary Question 1: What is your date of birth?
Preliminary Question 2: Is this a work or non-work trip?
Preliminary Question 3: Disabled/Scholar/Pensioner?
Preliminary Question 4: Where did you board the bus?
Preliminary Question 5: How did you get to this stop (Walk/Car/Other)?
Preliminary Question 6: Where will you disembark this bus?
Preliminary Question 7: Where is your final destination?

Section C: State Preferences

We have listed two possible 'service mixes'. Service A, and Service B,, which are to be considered. Each 'service mix' (Service A and Service B) listed has a different mix of service characteristics. We have listed below for 'service mix' an estimated cost per person to purchase a journey ticket.

.

We would like you to examine each of the two (Service A and Service B) 'service mix' choices in each choice situation (1-8) and simply circle the one you most probably would select (A or B) or circle 'C', 'Neither of the two services' if you probably wouldn't use any of the 'service mixes' options.

DESIGN #1

Please choose the service listed below that you are most likely to purchase a ticket(s) for:

Question 1:

	Service A	Service B
Seat	NO	NO
Travel time	45 min	35 min
Fare price	R9.00	R10.00

A. Service A B. Service B C. Neither of the two services

Question 2:

	Service A		Service B
Seat	YES		NO
Travel time	45 min		35 min
Fare price	R7.35		R15.00

B. Service A B. Service B C. Neither of the two services

Question 3:

	Service A		Service B
Seat	YES		NO
Travel time	45 min		45 min
Fare price	R9.00		R15.00

A. Service A B. Service B C. Neither of the two services

Question 4:

	Service A		Service B
Seat	NO		NO
Travel time	60 min		45 min
Fare price	R7.35		R10.00

A. Service A B. Service B C. Neither of the two services

Question 5:

	Service A		Service B
Fare price	R9		R9
Distance to first stop (km)	3		1
Number of transfers	2		2

A. Service A **B. Service B** **C. Neither of the two services**

Question 6:

	Service A		Service B
Fare price	R15		R9
Distance to first stop (km)	1		1
Number of transfers	2		2

A. Service A **B. Service B** **C. Neither of the two services**

Question 7:

	Service A		Service B
Fare price	R7.35		R9
Distance to first stop (km)	3		1
Number of transfers	None		3

A. Service A **B. Service B** **C. Neither of the two services**

Question 8:

	Service A		Service B
Fare price	R10		R7.35
Distance to first stop (km)	1		2
Number of transfers	2		3

A. Service A **B. Service B** **C. Neither of the two services**

THANK YOU FOR YOUR TIME. HAVE A GOOD JOURNEY

Afrikaans questionnaire:

THE STATED DESIGNQUESTIONS (Sections A-C to be completed on the data capture spread sheet)

Section A: Observation

3. See data capture sheet.

Section B: Preliminary Questions

Preliminary Question 1: Wat is u geboortedatum?
Preliminary Question 2: Is hierdiereisvirna/van werk or nie?
Preliminary Question 3: Is u gestrem/skolier/pensionaris of nie?
Preliminary Question 4: Waar het u hierdie bus gehaal?
Preliminary Question 5: Hoe het u by die bushaltegekom?
Preliminary Question 6: Waargaan u van hierdie bus afklim?
Preliminary Question 7: Tot waarreis u? / Wat is u finale bestemming?

Section C: State Preferences

Ons het twee moontlikeopenbarevervoer 'dienstekombinasies' gelys.DiensA en Diens B kanoorweeg word. Elke 'dienskombinasie' (Diens A en Diens B) gelys, het 'n verskillendekwaliteitsdienskombinasie. Onderelkeopenbarevervoer 'dienskombinasie' het ons 'n beraamdekoste per persoon per ritkaartjiegelys.

Onswilgraaghedat u elk van die twee 'dienskombinasies' keusessowel as die koste per reisigerom die ritvolgens die verskillendekeuses van 'dienstekombinasies' (1-8) teonderneem, ondersoek. Dui aandusslegs die 'dienstekombinasie' wat u soukies (A of B), of sirkel die woorde 'Geeneen van die twee dienstenie' (keuse 'C'), indien u van geeneen van die 'dienstekombinasies' gebruiksoumaaknie.

ONTWERP#1

Trek asb. 'nsirkelom die dienshieronderwaarvoor u soukiesom 'n kaartjietekoop:

Vraag 1:

	Diens A	Diens B
Sitplek	NEE	NEE
Reistyd	45 min	35 min
Prys van kaartjie	R9.00	R10.00

DiensA **Diens B** **C. Geen van die twee dienstenie**

Vraag 2:

	Diens A	Diens B
Sitplek	JA	NEE
Reistyd	45 min	35 min
Prys van kaartjie	R7.35	R15.00

DiensA **Diens B** **C. Geen van die twee dienstenie**

Vraag 3:

	Diens A	Diens B
Sitplek	JA	NEE
Reistyd	45 min	45 min
Prys van kaartjie	R9.00	R15.00

DiensA **Diens B** **C. Geen van die twee dienstenie**

Vraag 4:

	Diens A	Diens B
Sitplek	NEE	NEE
Reistyd	60 min	45 min
Prys van kaartjie	R7.35	R10.00

DiensA **Diens B** **C. Geen van die twee dienstenie**

Vraag 5:

	Diens A		Diens B
Prys van kaartjie	R9		R9
Afstand van die eerstebushalte (km)	3		1
Aantalkerewat u moetoorklim	2		2

A. Diens A **B. Diens B** **C. Geen van die twee dienstenie**

Vraag 6:

	Diens A		Diens B
Prys van kaartjie	R15		R9
Afstand van die eerstebushalte (km)	1		1
Aantalkerewat u moetoorklim	2		2

A. Diens A **B. Diens B** **C. Geen van die twee dienstenie**

Vraag 7:

	Diens A		Diens B
Prys van kaartjie	R7.35		R9
Afstand van die eerstebushalte (km)	3		1
Aantalkerewat u moetoorklim	Geen		3

A. Diens A **B. Diens B** **C. Geen van die twee dienstenie**

Vraag 8:

	Diens A		Diens B
Prys van kaartjie	R7.35		R9
Afstand van die eerstebushalte (km)	3		1
Aantalkerewat u moetoorklim	Geen		3

A. Diens A **B. Diens B** **C. Geen van die twee dienstenie**

DANKIE VIR U TYD. GENIET U REIS.

Xhosa questionnaire:

IMIBUZO EYILIWEYO (Icandelo A-C mayiphendulwekwiphephaleenkcukacha)

Icandelo B: Imibuzoyokutshayelela

Umbuzowokutshayelela 1: Wazalwanini?

Umbuzowokutshalela 2: Ingabaoluhambololomsebenzi?

Umbuzowokutshayelela 3: Uyikhwelelephiibhasi?

Umbuzowokutshayelela 4: Ufikenjanikulendawoyokukhwela?

Umbuzowokutshayelela 5: Uzakuhla phi?

Umbuzowokutshayelela 6: Luzakuyophelela phi uhambolwakho?

Icandelo C: IzintoezikhethwanguRhulumente

Sidwelise ‘umxubeweenkonzo’ ezimbiniezinokubakho.InkonzoA, kunyeneNkonzo B, ekufunekazithathelweingqalelo. ‘Umnxubeweenkonzo’ ngamnye (Inkonzo A neNkonzo B) okuluhluunomxubeweempawuzenkonzoezokuhlukeneyo.Okukubandakanyaimaliyokuhamba, ukubakhokwendawoyokuhlala, ixeshalokuhambalilonke, umgamaonokuwuhambaukuyakwindawoyokumisakunyenezihlandlozogqithiselongexeshalokuthathau hambo.

Singathandaukubauphononongeenyekwezinkonzozimbini ‘zingumxubeweenkonzo’onokuthiukhethekuzo (Inkonzo A neNkonzo B) kunyenexabisolomkhwelingamnyelohambokwimekonganyeyenkonzoanokukhethakuyo (1-8) zeurhangqele le ongayikhethawena (u-A okanye u-B) okanye u-C, ‘Akukhonanyekwezinkonzozimbini’ ukubamhlawumbiawunosebenzisananyekwezizinikiweyo.

UYILO#1

Ncedaurhangqeleinkonzoedwelisweaphangezantsiongathandaukuthengaitikilayo:

Umbuzo 1:

	Inkonzo A	Inkonzo B
Isitulo	EWE	HAYI
Ixeshalohambo	Imizuzu engama-45	Imizuzu engama-35
Imaliyokuhamba	R9	R10

A. Inkonzo A B. Inkonzo B C. Akukhonanyekwezinkonzozimbini

Umbuzo 2:

	Inkonzo A	Inkonzo B
Isitulo	EWE	HAYI
Ixeshalohambo	Imizuzu engama-45	Imizuzu engama-35
Imaliyokuhamba	R7.35	R15

A. Inkonzo A B. Inkonzo B C. Akukhonanyekwezinkonzozimbini

Umbuzo 3:

	Inkonzo A	Inkonzo B
Isitulo	EWE	HAYI
Ixeshalohambo	Imizuzu engama-45	Imizuzu engama-45
Imaliyokuhamba	R9	R15

A. Inkonzo A B. Inkonzo B C. Akukhonanyekwezinkonzozimbini

Umbuzo 4:

	Inkonzo A	Inkonzo B
Isitulo	EWE	HAYI
Ixeshalohambo	Imizuzu engama-60	Imizuzu engama-45
Imaliyokuhamba	R7.35	R10

A. Inkonzo A B. Inkonzo B C. Akukhonanyekwezinkonzozimbini

Umbuzo 5:

	Inkonzo A	Inkonzo B
Imaliyokuhamba	R9	R9
Umgamaonokuwuhambaukuyakwindawoyokumisa (km)	3	1
Inomboloyogqithiselo	2	2

A. Inkonzo A B. Inkonzo B C. Akukhonanyekwezinkonzozimbini

Umbuzo 6:

	Inkonzo A	Inkonzo B
Imaliyokuhamba	R15	R9
Umgamaonokuwuhambaukuyakwindawoyokumisa (km)	1	1
Inomboloyogqithiselo	2	2

A. Inkonzo A B. Inkonzo B C. Akukhonanyekwezinkonzozimbini

Umbuzo 7:

	Inkonzo A	Inkonzo B
Imaliyokuhamba	R7.35	R9
Umgamaonokuwuhambaukuyakwindawoyokumisa (km)	3	1
Inomboloyogqithiselo	Azikho	3

A. Inkonzo A B. Inkonzo B C. Akukhonanyekwezinkonzozimbini

Umbuzo 8:

	Inkonzo A	Inkonzo B
Imaliyokuhamba	R10	R7.35
Umgamaonokuwuhambaukuyakwindawoyokumisa (km)	1	2
Inomboloyogqithiselo	2	3

A. Inkonzo A B. Inkonzo B C. Akukhonanyekwezinkonzozimbini

ENKOSI NGEXESHA LAKHO. UBE NOHAMBO OLUMNANDI

Appendix C Data collection sheets

Day 1 Data Capture test 13 November 2011

GOLDEN ARROW BUS SERVICES STATED PREFERENCE SURVEY

Date	
Route number	
Route Description	
Scheduled Time	

Interviewer	
Fleet no	
Seating Capacity	
Total Passengers	

Choice Card Design #

														Choice 1			Choice 2			Choice 3			Choice 4			Choice 5			Choice 6			Choice 7			Choice 8		
1	M	F		Work	Other	Disabled	Scholar	Pen	Other	N/A		Walk	Car	Other		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
2	M	F		Work	Other	Disabled	Scholar	Pen	Other	N/A		Walk	Car	Other		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
3	M	F		Work	Other	Disabled	Scholar	Pen	Other	N/A		Walk	Car	Other		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
4	M	F		Work	Other	Disabled	Scholar	Pen	Other	N/A		Walk	Car	Other		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
5	M	F		Work	Other	Disabled	Scholar	Pen	Other	N/A		Walk	Car	Other		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
6	M	F		Work	Other	Disabled	Scholar	Pen	Other	N/A		Walk	Car	Other		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
7	M	F		Work	Other	Disabled	Scholar	Pen	Other	N/A		Walk	Car	Other		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
8	M	F		Work	Other	Disabled	Scholar	Pen	Other	N/A		Walk	Car	Other		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
9	M	F		Work	Other	Disabled	Scholar	Pen	Other	N/A		Walk	Car	Other		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
10	M	F		Work	Other	Disabled	Scholar	Pen	Other	N/A		Walk	Car	Other		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
11	M	F		Work	Other	Disabled	Scholar	Pen	Other	N/A		Walk	Car	Other		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
12	M	F		Work	Other	Disabled	Scholar	Pen	Other	N/A		Walk	Car	Other		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
13	M	F		Work	Other	Disabled	Scholar	Pen	Other	N/A		Walk	Car	Other		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
14	M	F		Work	Other	Disabled	Scholar	Pen	Other	N/A		Walk	Car	Other		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
15	M	F		Work	Other	Disabled	Scholar	Pen	Other	N/A		Walk	Car	Other		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
16	M	F		Work	Other	Disabled	Scholar	Pen	Other	N/A		Walk	Car	Other		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
17	M	F		Work	Other	Disabled	Scholar	Pen	Other	N/A		Walk	Car	Other		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
18	M	F		Work	Other	Disabled	Scholar	Pen	Other	N/A		Walk	Car	Other		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
19	M	F		Work	Other	Disabled	Scholar	Pen	Other	N/A		Walk	Car	Other		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
20	M	F		Work	Other	Disabled	Scholar	Pen	Other	N/A		Walk	Car	Other		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
21	M	F		Work	Other	Disabled	Scholar	Pen	Other	N/A		Walk	Car	Other		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
22	M	F		Work	Other	Disabled	Scholar	Pen	Other	N/A		Walk	Car	Other		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
23	M	F		Work	Other	Disabled	Scholar	Pen	Other	N/A		Walk	Car	Other		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
24	M	F		Work	Other	Disabled	Scholar	Pen	Other	N/A		Walk	Car	Other		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
25	M	F		Work	Other	Disabled	Scholar	Pen	Other	N/A		Walk	Car	Other		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
26	M	F		Work	Other	Disabled	Scholar	Pen	Other	N/A		Walk	Car	Other		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
27	M	F		Work	Other	Disabled	Scholar	Pen	Other	N/A		Walk	Car	Other		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
28	M	F		Work	Other	Disabled	Scholar	Pen	Other	N/A		Walk	Car	Other		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
29	M	F		Work	Other	Disabled	Scholar	Pen	Other	N/A		Walk	Car	Other		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
30	M	F		Work	Other	Disabled	Scholar	Pen	Other	N/A		Walk	Car	Other		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
31	M	F		Work	Other	Disabled	Scholar	Pen	Other	N/A		Walk	Car	Other		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
32	M	F		Work	Other	Disabled	Scholar	Pen	Other	N/A		Walk	Car	Other		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
33	M	F		Work	Other	Disabled	Scholar	Pen	Other	N/A		Walk	Car	Other		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
34	M	F		Work	Other	Disabled	Scholar	Pen	Other	N/A		Walk	Car	Other		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
35	M	F		Work	Other	Disabled	Scholar	Pen	Other	N/A		Walk	Car	Other		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
36	M	F		Work	Other	Disabled	Scholar	Pen	Other	N/A		Walk	Car	Other		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
37	M	F		Work	Other	Disabled	Scholar	Pen	Other	N/A		Walk	Car	Other		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
38	M	F		Work	Other	Disabled	Scholar	Pen	Other	N/A		Walk	Car	Other		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
39	M	F		Work	Other	Disabled	Scholar	Pen	Other	N/A		Walk	Car	Other		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
40	M	F		Work	Other	Disabled	Scholar	Pen	Other	N/A		Walk	Car	Other		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
41	M	F		Work	Other	Disabled	Scholar	Pen	Other	N/A		Walk	Car	Other		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
42	M	F		Work	Other	Disabled	Scholar	Pen	Other	N/A		Walk	Car	Other		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
43	M	F		Work	Other	Disabled	Scholar	Pen	Other	N/A		Walk	Car	Other		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
44	M	F		Work	Other	Disabled	Scholar	Pen	Other	N/A		Walk	Car	Other		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
45	M	F		Work	Other	Disabled	Scholar	Pen	Other	N/A		Walk	Car	Other		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
46	M	F		Work	Other	Disabled	Scholar	Pen	Other	N/A		Walk	Car	Other		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
47	M	F		Work	Other	Disabled	Scholar	Pen	Other	N/A		Walk	Car	Other		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3

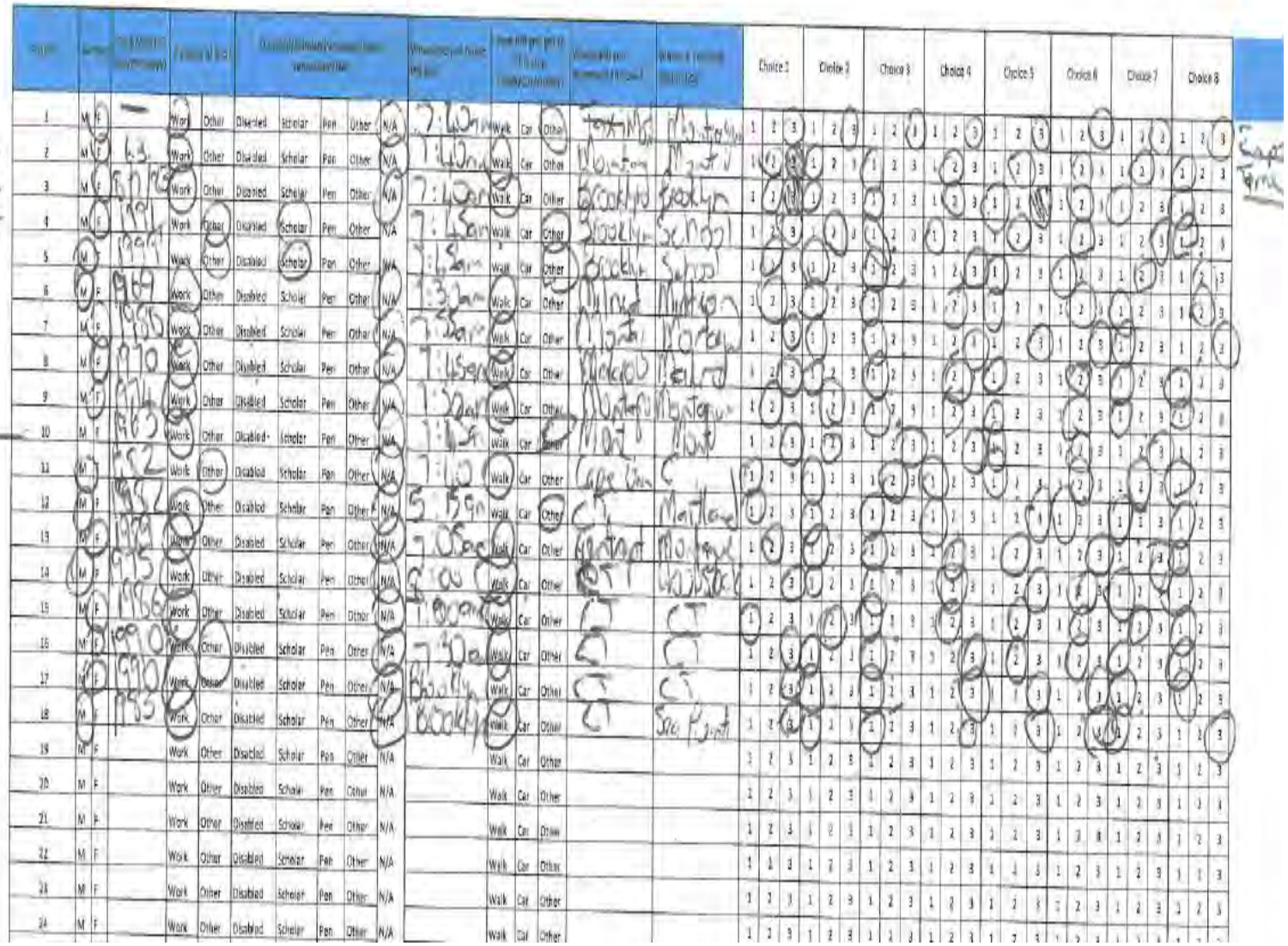
Day 2 Data Capture test 28February 2012

GOLDEN ARROW BUS SERVICES STATED PREFERENCE SURVEY

Date	28-Feb-12
Route number	DAC 3
Route Description	City to Killarney
Scheduled Time	07:00 AM

Interviewer	B Clarke
Fleet no	
Seating Capacity	
Total Passengers	

Choice Card Design #	1



Day 3 Data capture training afternoon - 15 Mar 2012

GOLDEN ARROW BUS SERVICES STATED PREFERENCE SURVEY

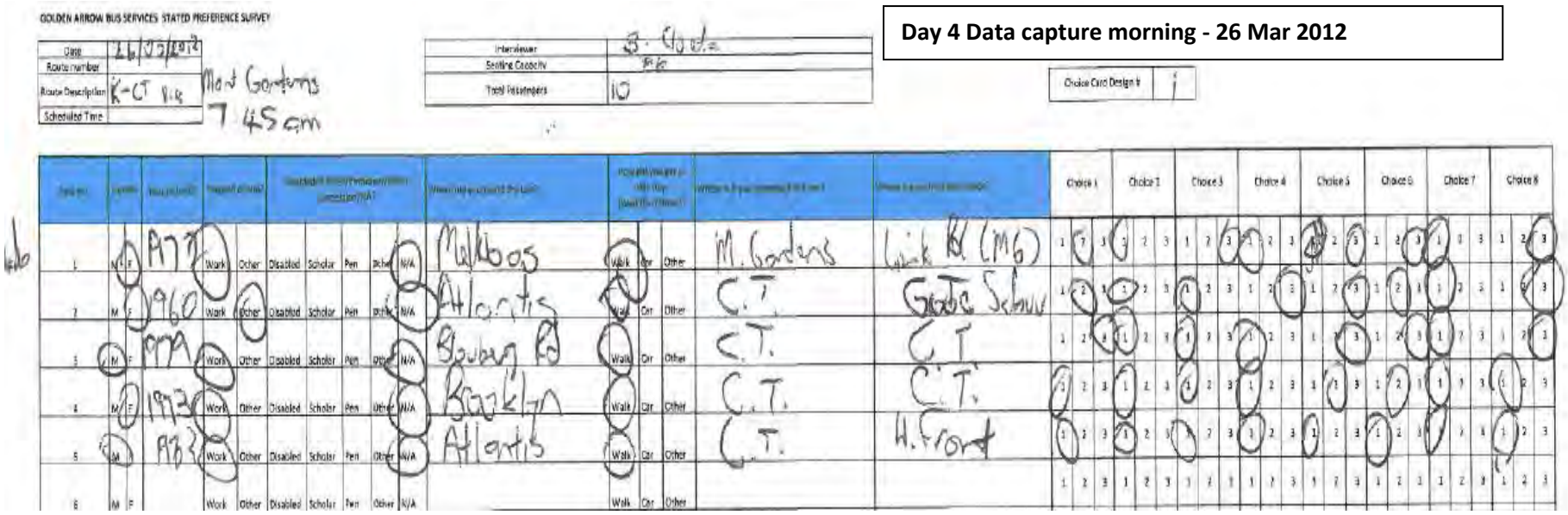
Date	15/03/2012
Route number	Dep – Civic
Route Description	M4C,T1
Scheduled Time	14h10

Interviewer	B Clarke, Mayke
Seating Capacity	
Total Passengers	N/A

Choice Card Design # 1

															Choice 1			Choice 2			Choice 3			Choice 4			Choice 5			Choice 6			Choice 7			Choice 8		
1	M	X	1990	Work	X	Disabled	Scholar	Pen	Other	N/A	Dep	Walk	Car	Other	Civic	Table View	1	2	X	X	2	3	X	2	3	1	X	3	1	X	3	1	2	X	X	2	3
2	M	X	1961	X	Other	Disabled	Scholar	Pen	Other	N/A	Dep	X	Car	Other	"	~~Table View~~ Saddon	1	2	X	X	2	3	X	2	3	1	2	X	1	X	3	1	X	3	X	2	3	X	2	3
3	M	X	1980	Work	X	Disabled	Scholar	Pen	Other	N/A	Dep	X	Car	Other	loopstreet	Table View	1	X	3	X	2	3	X	2	3	1	X	3	1	X	3	1	X	3	X	2	1	1	X	3
4	M	X	1964	Work	X	Disabled	Scholar	Pen	Other	N/A	Dep	X	Car	Other	Waterfront	Waterfront	1	X	3	X	2	3	1	X	3	1	X	3	1	2	X	1	X	3	X	2	3	X	2	3
5	M	F		Work	Other	Disabled	Scholar	Pen	Other	N/A		Walk	Car	Other			1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
6	M	F		Work	Other	Disabled	Scholar	Pen	Other	N/A		Walk	Car	Other			1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3

Day 4 Data capture morning - 26 Mar 2012



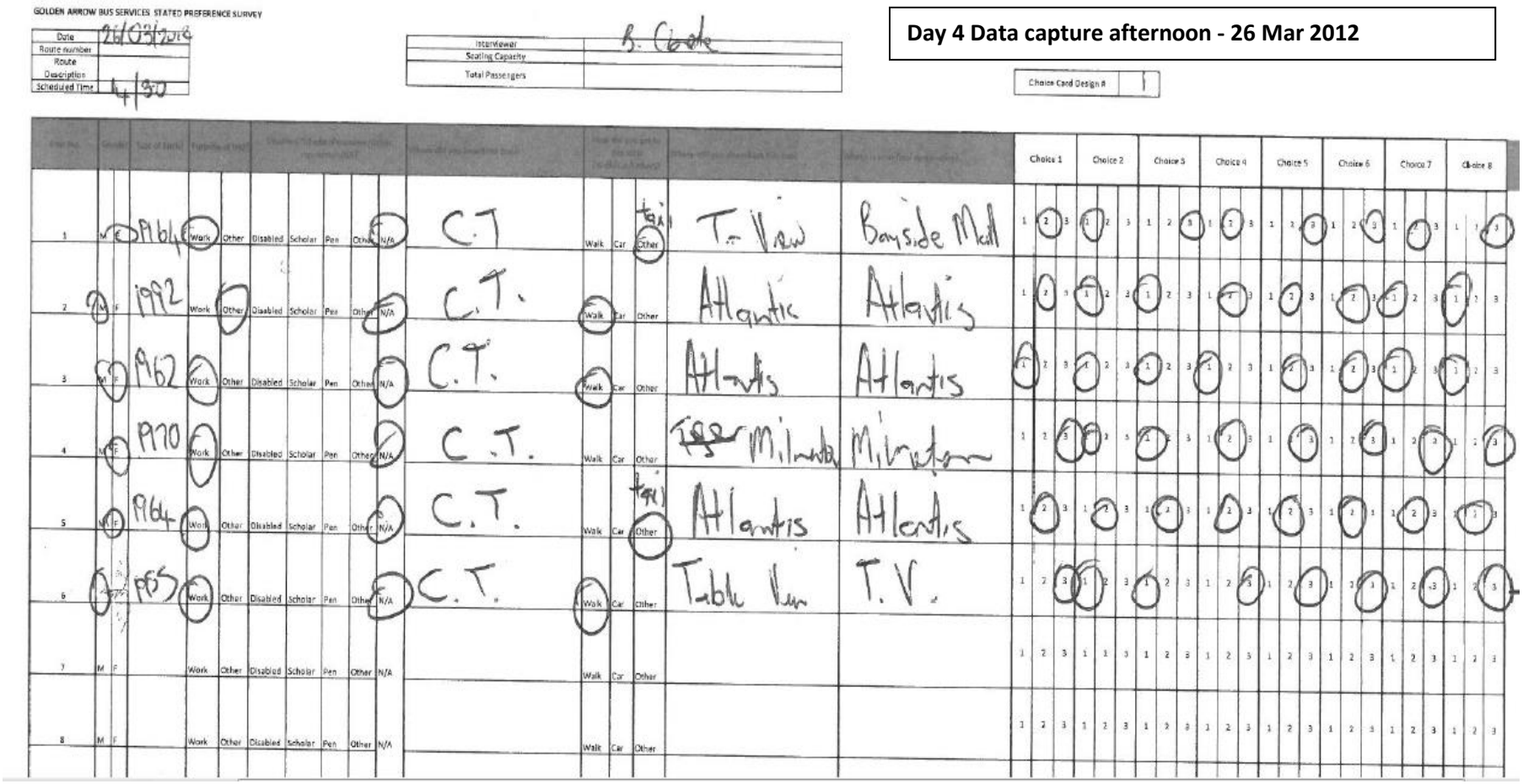
GOLDEN ARROW BUS SERVICES STATED PREFERENCE SURVEY

Date	26/03/2012
Route number	
Route Description	K-CT via Mont Gardens
Scheduled Time	7.45 am

Interviewer	S. Goliath
Seating Capacity	56
Total Passengers	10

Choice Card Design # | 1

											Choice 1	Choice 2	Choice 3	Choice 4	Choice 5	Choice 6	Choice 7	Choice 8
1	M	F	A77	Work	Other	Disabled	Scholar	Pen	Other	N/A	Melkbos	Walk Car Other	M. Gardens	Link K (MG)	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3
2	M	F	1960	Work	Other	Disabled	Scholar	Pen	Other	N/A	Atlantis	Walk Car Other	C.T.	Gate Scholar	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3
3	M	F	1994	Work	Other	Disabled	Scholar	Pen	Other	N/A	Boubag Rd	Walk Car Other	C.T.	C.T.	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3
4	M	F	1972	Work	Other	Disabled	Scholar	Pen	Other	N/A	Brooklyn	Walk Car Other	C.T.	C.T.	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3
5	M	F	A83	Work	Other	Disabled	Scholar	Pen	Other	N/A	Atlantis	Walk Car Other	C.T.	H. Front	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3
6	M	F		Work	Other	Disabled	Scholar	Pen	Other	N/A		Walk Car Other			1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3



GOLDEN ARROW BUS SERVICES STATED PREFERENCE SURVEY

Date	26/03/2012
Route number	
Route Description	
Scheduled Time	14:30

Interviewer	B. Cele
Seating Capacity	
Total Passengers	

Day 4 Data capture afternoon - 26 Mar 2012

Choice Card Design # 1

	Sex	Year of birth	Purpose of trip		Disabled	Scholar	Pen	Other	N/A	Where did you board the bus?	How did you get to the bus stop?			Where will you alight the bus?	Where is your final destination?	Choice 1	Choice 2	Choice 3	Choice 4	Choice 5	Choice 6	Choice 7	Choice 8
1	M F	1964	Work	Other	Disabled	Scholar	Pen	Other	N/A	C.T	Walk	Car	taxi Other	T. View	Bayside Mall	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3
2	M F	1992	Work	Other	Disabled	Scholar	Pex	Other	N/A	C.T.	Walk	Car	Other	Atlantic	Atlantis	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3
3	M F	1962	Work	Other	Disabled	Scholar	Pen	Other	N/A	C.T.	Walk	Car	Other	Atlantis	Atlantis	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3
4	M F	1970	Work	Other	Disabled	Scholar	Pen	Other	N/A	C.T.	Walk	Car	Other	Tiger Milnerton	Milnerton	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3
5	M F	1964	Work	Other	Disabled	Scholar	Pen	Other	N/A	C.T.	Walk	Car	taxi Other	Atlantis	Atlantis	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3
6	M F	1965	Work	Other	Disabled	Scholar	Pen	Other	N/A	C.T.	Walk	Car	Other	Table View	T.V.	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3
7	M F		Work	Other	Disabled	Scholar	Pen	Other	N/A		Walk	Car	Other			1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3
8	M F		Work	Other	Disabled	Scholar	Pen	Other	N/A		Walk	Car	Other			1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3

Day 5 Data capture morning - 27 Mar 2012

GOLDEN ARROW BUS SERVICES STATED PREFERENCE SURVEY

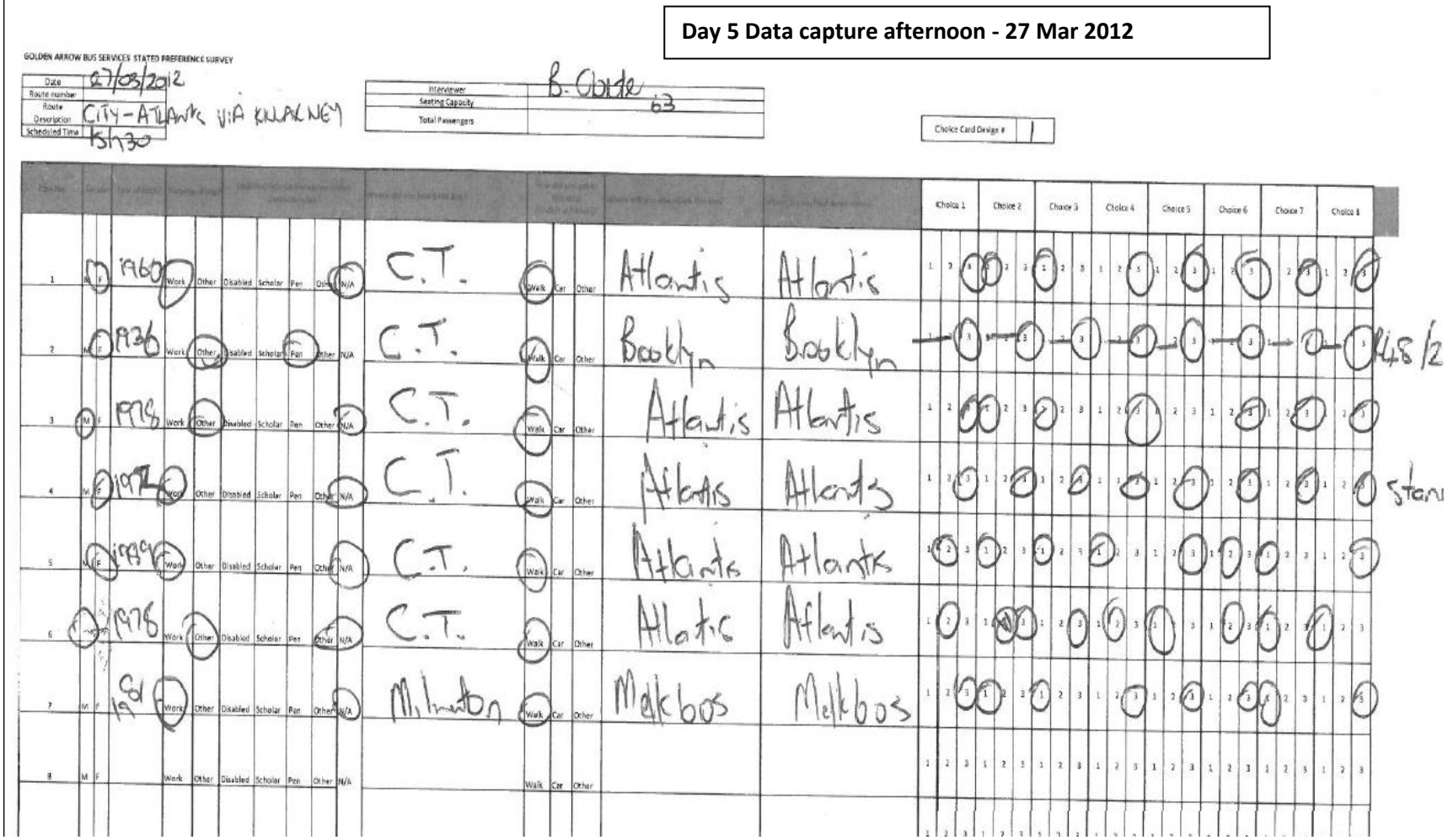
Date	29/03/2012
Route number	
Route Description	Kill-C via Parklands
Scheduled Time	7:15am

Interviewer	B. Ciorta
Seating Capacity	
Total Passengers	

Choice Card Design # 1

												Choice 1	Choice 2	Choice 3	Choice 4	Choice 5	Choice 6	Choice 7	Choice 8
1	M F	1990	Work	Other	Disabled	Scholar	Pen	Other	N/A	Bic Road	Walk Car Other	Sunset Beach	Sunset Beach	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3
2	M F	1986	Work	School	Disabled	Scholar	Pen	Other	N/A	Bic Rd/Pkld Mall	Walk Car Other	C.T	C.T.	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3
3	M F	1980	Work	Other	Disabled	Scholar	Pen	Other	N/A	Parkland	Walk Car Other	C.T.	C.T.	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3
4	M F	1955	Work	Other	Disabled	Scholar	Pen	Other	N/A	Parkland	Walk Car Other	C.T. Addaly	C.T.	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3
5	M F	1970	Work	Sch	Disabled	Scholar	Pen	Other	N/A	Parkland	Walk Car Other	C.T.	C.T.	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3
6	M F	1967	Work	Other	Disabled	Scholar	Pen	Other	N/A	Parklands	Walk Car Other	C.T.	Bayside	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3
7	M F	1976	Work	Other	Disabled	Scholar	Pen	Other	N/A	Parklands	Walk Car Other	C.T.	Mowbray	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3
8	M F		Work	Other	Disabled	Scholar	Pen	Other	N/A		Walk Car Other			1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3

Day 5 Data capture afternoon - 27 Mar 2012



GOLDEN ARROW BUS SERVICES STATED PREFERENCE SURVEY

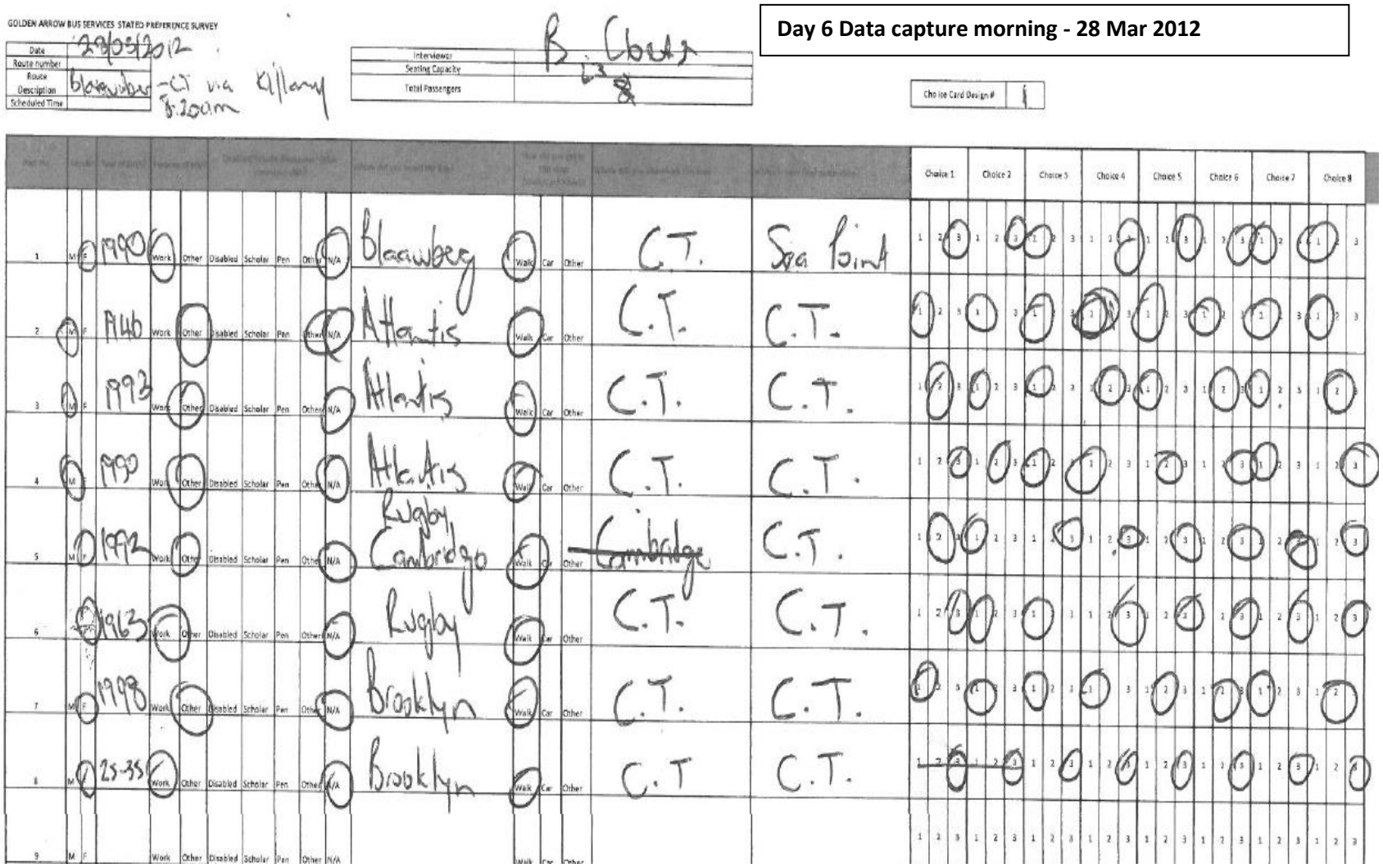
Date	27/03/2012
Route number	
Route Description	CITY - ATLANTIS VIA KUILSRIVER
Scheduled Time	15h30

Interviewer	B. Oberholzer
Seating Capacity	63
Total Passengers	

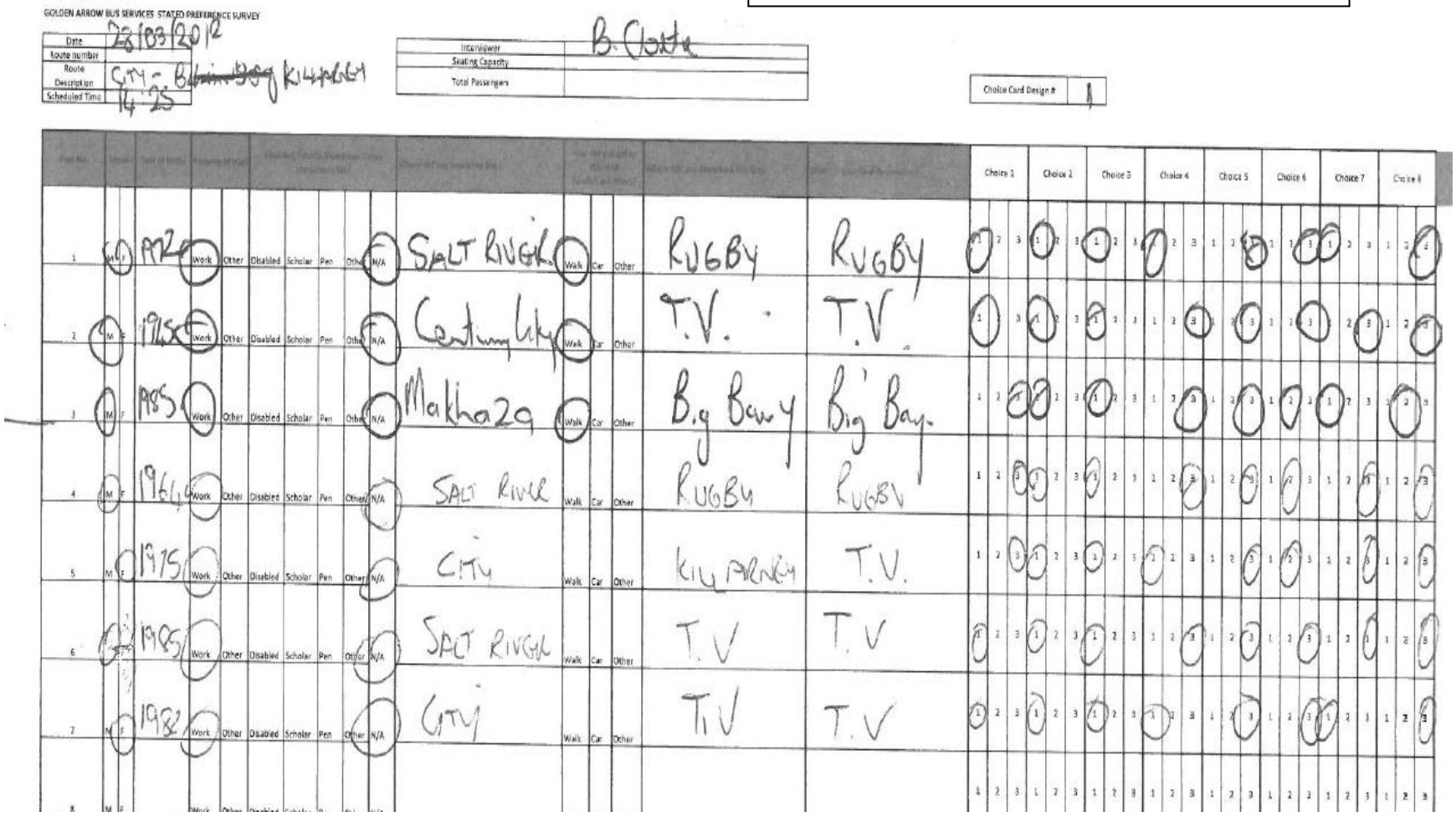
Choice Card Design # 1

1	M	F	1960	Work	Other	Disabled	Scholar	Pen	Other	N/A	C.T.	Walk	Car	Other	Atlantis	Atlantis	1	2	3
2	M	F	1936	Work	Other	Disabled	Scholar	Pen	Other	N/A	C.T.	Walk	Car	Other	Brooklyn	Brooklyn	1	2	3
3	M	F	1974	Work	Other	Disabled	Scholar	Pen	Other	N/A	C.T.	Walk	Car	Other	Atlantis	Atlantis	1	2	3
4	M	F	1974	Work	Other	Disabled	Scholar	Pen	Other	N/A	C.T.	Walk	Car	Other	Atlantis	Atlantis	1	2	3
5	M	F	1966	Work	Other	Disabled	Scholar	Pen	Other	N/A	C.T.	Walk	Car	Other	Atlantis	Atlantis	1	2	3
6	M	F	1978	Work	Other	Disabled	Scholar	Pen	Other	N/A	C.T.	Walk	Car	Other	Atlantic	Atlantis	1	2	3
7	M	F	19 Sd	Work	Other	Disabled	Scholar	Pen	Other	N/A	Milnerton	Walk	Car	Other	Melkbos	Melkbos	1	2	3
8	M	F		Work	Other	Disabled	Scholar	Pen	Other	N/A		Walk	Car	Other			1	2	3

Day 6 Data capture morning - 28 Mar 2012



Day 6 Data capture afternoon - 28 Mar 2012



GOLDEN ARROW BUS SERVICES STATED PREFERENCE SURVEY

Date	28/03/2012
Route number	
Route Description	CITY - ~~B~~ KILLARNEY
Scheduled Time	14:25

Interviewer	B. Clarke
Seating Capacity	
Total Passengers	

Choice Card Design # 1

	Gender	Year of Birth	Purpose of trip	Disabled	Scholar	Pen	Other	N/A	Where did you board the bus?	How did you get to the bus stop (walk/car/other)?	Where will you disembark the bus?	Other - specify	Choice 1	Choice 2	Choice 3	Choice 4	Choice 5	Choice 6	Choice 7	Choice 8
1	M F	1972	Work Other	Disabled	Scholar	Pen	Other	N/A	SALT RIVER	Walk Car Other	RUGBY	RUGBY	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3
2	M F	1945	Work Other	Disabled	Scholar	Pen	Other	N/A	Century City	Walk Car Other	T.V.	T.V	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3
3	M F	1985	Work Other	Disabled	Scholar	Pen	Other	N/A	Makhaza	Walk Car Other	Big Bay	Big Bay	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3
4	M F	1961	Work Other	Disabled	Scholar	Pen	Other	N/A	SALT RIVER	Walk Car Other	RUGBY	RUGBY	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3
5	M F	1975	Work Other	Disabled	Scholar	Pen	Other	N/A	CITY	Walk Car Other	KILLARNEY	T.V.	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3
6	M F	1985	Work Other	Disabled	Scholar	Pen	Other	N/A	SALT RIVER	Walk Car Other	T.V	T.V	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3
7	M F	1982	Work Other	Disabled	Scholar	Pen	Other	N/A	CITY	Walk Car Other	T.V	T.V	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3
8	M F		Work Other	Disabled	Scholar	Pen	Other	N/A		Walk Car Other			1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3

GOLDEN ARROW BUS SERVICES STATED PREFERENCE SURVEY

Date: 29/03/2012
Route number:
Route Description: Kill – City via Parklands
Scheduled Time: 6:30 am

B. Clarke

Interviewer	
Seating Capacity	64
Total Passengers	

Day 7 Data capture morning - 29 Mar 2012

Choice Card Design # 1

1	M	25-34	Work / Other / Disabled / Scholar / Pen / Other / N/A	KILLARNEY	Walk / Car / Other	Epping	Epping
2	F	1967	Work / Other / Disabled / Scholar / Pen / Other / N/A	Hanover Park	Walk / Car / Other	Sunset Beach	Sunset Beach
3	M / F	1996	Work / Other / Disabled / Scholar / Pen / Other / N/A	Gie Road	Walk / Car / Other	Adderley Street	C.T.
4	M	1979	Work / Other / Disabled / Scholar / Pen / Other / N/A	Gie Road	Walk / Car / Other	C.T.	C.T.
5	M / F	1973	Work / Other / Disabled / Scholar / Pen / Other / N/A	Parklands	Walk / Car / Other	C.T.	C.T.
6	M	1983	Work / Other / Disabled / Scholar / Pen / Other / N/A	Gie Rd	Walk / Car / Other	C.T.	C.T.
7	M / F	1995	Work / Other / Disabled / Scholar / Pen / Other / N/A	Gie Rd	Walk / Car / Other	C.T.	C.T.
8	M	1980	Work / Other / Disabled / Scholar / Pen / Other / N/A	Parklands	Walk / Car / Other	C.T.	Woodstock
9	M / F	1983	Work / Other / Disabled / Scholar / Pen / Other / N/A	Parkland	Walk / Car / Other	C.T.	C.T.

Choice 1 · Choice 2 · Choice 3 · Choice 4 · Choice 5 · Choice 6 · Choice 7 · Choice 8 (1 / 2 / 3 each)

Day 7 Data captureafternoon - 29 Mar 2012

GOLDEN ARROW BUS SERVICES STATED PREFERENCE SURVEY

Date	29/03/2012
Route number	
Route Description	City – Killarney (Marine Drive)
Scheduled Time	16h15 pm

Interviewer	B. Hoett
Seating Capacity	
Total Passengers	

Choice Card Design # 1

Pass No.	Gender	Year of birth?	Purpose of trip?	Disabled/Scholar/Pensioner/Other concession/NA?	Where did you board the bus?	How did you get to this stop (Walk/Car/Other)?	Where will you disembark this bus?	Where is your final destination?	Choice 1	Choice 2	Choice 3	Choice 4	Choice 5	Choice 6	Choice 7	Choice 8
1	M F	1959	Work Other	Disabled Scholar Pen Other N/A	C.T.	Walk Car Other	Gie Road	Gie Rd	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3
2	M F	1986	Work Other	Disabled Scholar Pen Other N/A	C.T.	Walk Car Other	Parklands	P/lands	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3
3	M F	1985	Work Other	Disabled Scholar Pen Other N/A	C.T.	Walk Car Other	Parklands	Parklands	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3
4	M F	1985	Work Other	Disabled Scholar Pen Other N/A	C.T.	Walk Car Other	Gie Rd	Gie Road	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3
5	M F	1975	Work Other	Disabled Scholar Pen Other N/A	C.T.	Walk Car Other	Gie Rd.	Gie Road	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3
6	M F	1970	Work Other	Disabled Scholar Pen Other N/A	C.T.	Walk Car Other	T.V	T.V	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3
7	M F	1992	Work Other	Disabled Scholar Pen Other N/A	C.T.	Walk Car Other	Parklands	Parklands	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3
8	M F	1982	Work Other	Disabled Scholar Pen Other N/A	C.T.	Walk Car Other	Parklands	Parklands	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3
9	M F	1973	Work Other	Disabled Scholar Pen Other N/A	C.T.	Walk Car Other	Tyne (T.V.)	Gie (T.V.)	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3
10	M F	1961	Work Other	Disabled Scholar Pen Other N/A	C.T.	Walk Car Other	Parklands	Parklands	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3
11	M F		Work Other	Disabled Scholar Pen Other N/A		Walk Car Other			1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3

GOLDEN ARROW BUS SERVICES STATED PREFERENCE SURVEY

Date	30/03/2012
Route number	
Route Description	
Scheduled Time	

Interviewer	M. Pretorius
Seating Capacity	
Total Passengers	

Choice Card Design # 1

Telephone Interviews

Pass No.	Gender	Year of birth?	Purpose of trip?	Disabled/Scholar/Pensioner/Other concession/NA?	Where did you board the bus?	How did you get to this stop (Walk/Car/Other)?	Where will you disembark this bus?	Where is your final destination?	Choice 1	Choice 2	Choice 3	Choice 4	Choice 5	Choice 6	Choice 7	Choice 8
1	M F	1990	Work Other	Disabled Scholar Pen Other N/A	Milnerton	Walk Car Other	Cape Town	Cape Town	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3
2	M F	1991	Work Other	Disabled Scholar Pen Other N/A	Milnerton	Walk Car Other	"	"	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3
3	M F	1990	Work Other	Disabled Scholar Pen Other N/A	"	Walk Car Other	"	Nrede Beach	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3
4	M F	1992	Work Other	Disabled Scholar Pen Other N/A	T/View	Walk Car Other	"	"	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3
5	M F	1991	Work Other	Disabled Scholar Pen Other N/A	"	Walk Car Other	"	Rondebeech	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3
6	M F	1992	Work Other	Disabled Scholar Pen Other N/A	Killarney	Walk Car Other	"	Plumstead	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3

Appendix D Datasets

Demographic and respondent trip data

Idno	Gender	Year of Birth	Age	age Cat	ageNew Cat	Commuters	Concessions	Where did you Board the bus?	Board reduced	Where will you disembark this bus?	disembark reduced	Where is your final destination?	Trip Begin End	ShortMed Begin End
1	F	1986	26	21 to 30	LessThan30	Other	NA	Cape Town	Cape T	V&A Waterfront		V&A Waterfront	Short	ShortMed
2	M	1988	24	21 to 30	LessThan30	Other	NA	Cape Town	Cape T	V&A Waterfront		V&A Waterfront	Short	ShortMed
3	M	1985	27	21 to 30	LessThan30	Work	NA	Cape Town	Cape T	Cape Town	Cape T Dis	Milnerton	Medium	ShortMed
4	F	1990	22	21 to 30	LessThan30	Work	NA	Cape Town	Cape T	Cape Town	Cape T Dis	Milnerton	Medium	ShortMed
5	F	1967	45	41 to 60	MoreThan29	Work	NA	Cape Town	Cape T	Cape Town	Cape T Dis	Milnerton	Medium	ShortMed
6	F	1990	22	21 to 30	LessThan30	Work	NA	Cape Town	Cape T	Montague Gardens		Montague Gardens	Long	Long
7	F	1963	49	41 to 60	MoreThan29	Work	NA	Cape Town	Cape T	Montague Gardens		Montague Gardens	Long	Long
8	F	1970	42	41 to 60	MoreThan29	Work	NA	Cape Town	Cape T	Brooklyn		Brooklyn (School)	Medium	ShortMed
9	F	1994	18	Less T 21	LessThan30	Other	ar (Conce	Cape Town	Cape T	Brooklyn		Brooklyn (School)	Medium	ShortMed
10	M	1999	13	Less T 21	LessThan30	Other	ar (Conce	Cape Town	Cape T	Brooklyn		Brooklyn (School)	Medium	ShortMed
11	M	1969	43	41 to 60	MoreThan29	Work	NA	Cape Town	Cape T	Milnerton		Milnerton	Medium	ShortMed
12	F	1980	32	31 to 40	MoreThan29	Work	NA	Cape Town	Cape T	Montague Gardens		Montague Gardens	Long	Long
13	F	1970	42	41 to 60	MoreThan29	Work	NA	Cape Town	Cape T	Montague Gardens		Montague Gardens	Long	Long
14	F	1974	38	31 to 40	MoreThan29	Work	NA	Cape Town	Cape T	Montague Gardens		Montague Gardens	Long	Long
15	F	1963	49	41 to 60	MoreThan29	Work	NA	Cape Town	Cape T	Montague Gardens		Montague Gardens	Long	Long
16	M	1982	30	21 to 30	MoreThan29	Other	NA	Brooklyn		Cape Town	Cape T Dis	Cape Town	Short	ShortMed
17	M	1982	30	21 to 30	MoreThan29	Work	NA	Brooklyn		Cape Town	Cape T Dis	Maitland	Short	ShortMed
18	F	1989	23	21 to 30	LessThan30	Work	NA	Brooklyn		Montague Gardens		Montague Gardens	Medium	ShortMed
19	M	1975	37	31 to 40	MoreThan29	Work	NA	Brooklyn		Cape Town	Cape T Dis	Woodstock	Short	ShortMed
20	F	1986	26	21 to 30	LessThan30	Work	NA	Brooklyn		Cape Town	Cape T Dis	Cape Town	Short	ShortMed
21	F	1990	22	21 to 30	LessThan30	Other	NA	Brooklyn		Cape Town	Cape T Dis	Cape Town	Short	ShortMed
22	F	1990	22	21 to 30	LessThan30	Work	NA	Brooklyn		Cape Town	Cape T Dis	Cape Town	Short	ShortMed
23	M	1983	29	21 to 30	LessThan30	Work	NA	Brooklyn		Cape Town	Cape T Dis	Sea point	Medium	ShortMed
24	M	1990	22	21 to 30	LessThan30	Work	ar (Conce	spe Town (Dorp Stree	Cape T	ɔe Town (Civic Cen	Cape T Dis	Table View (School)	Long	Long
25	M	1961	51	41 to 60	MoreThan29	Other	NA	ape Town (Dorp Stree	Cape T	ɔe Town (Civic Cen	Cape T Dis	Padox (Paddock)	Short	ShortMed
26	M	1980	32	31 to 40	MoreThan29	Work	NA	ape Town (Dorp Stree	Cape T	pe Town (Loopstre	Cape T Dis	Table View	Long	Long
27	M	1964	48	41 to 60	MoreThan29	Work	NA	ape Town (Dorp Stree	Cape T	Waterfront		Waterfront	Short	ShortMed
28	F	1972	40	31 to 40	MoreThan29	Work	NA	Melkbos		Montague Gardens		Montague Gardens	Long	Long
29	F	1960	52	41 to 60	MoreThan29	Other	NA	Atlantis		Cape Town	Cape T Dis	Groote Schuur Hospital	Long	Long
30	M	1979	33	31 to 40	MoreThan29	Work	NA	Blaawberg		Cape Town	Cape T Dis	Cape Town	Long	Long
31	F	1973	39	31 to 40	MoreThan29	Work	NA	Brooklyn		Cape Town	Cape T Dis	Cape Town	Short	ShortMed
32	M	1982	30	21 to 30	MoreThan29	Work	NA	Atlantis		Cape Town	Cape T Dis	Waterfront	Long	Long
33	F	1964	48	41 to 60	MoreThan29	Work	NA	Table View		Table View		Table View (Bayside Mall	Short	ShortMed
34	M	1992	20	Less T 21	LessThan30	Other	NA	Atlantis		Cape Town		Cape Town	Long	Long
35	F	1962	50	41 to 60	MoreThan29	Work	NA	Atlantis		Cape Town		Cape Town	Long	Long
36	F	1970	42	41 to 60	MoreThan29	Work	NA	Milnerton		Milnerton		Milnerton	short	ShortMed
37	F	1964	48	41 to 60	MoreThan29	Work	NA	Atlantis		Atlantis		Atlantis	Long	Long
38	M	1955	57	41 to 60	MoreThan29	Work	NA	Table View		Table View		Table View	Short	ShortMed
39	F	1990	22	21 to 30	LessThan30	Work	NA	Gie Road		Sunset Beach		Sunset Beach	Medium	ShortMed
40	F	1986	26	21 to 30	LessThan30	Other	NA	Gie Road		Cape Town	Cape T Dis	Cape Town	Long	Long
41	F	1988	24	21 to 30	LessThan30	Work	NA	Parklands		Cape Town	Cape T Dis	Cape Town	Long	Long
42	F	1985	27	21 to 30	LessThan30	Work	NA	Parklands		Cape Town	Cape T Dis	Cape Town	Long	Long
43	M	1990	22	21 to 30	LessThan30	Other	NA	Parklands		Cape Town	Cape T Dis	Cape Town	Long	Long
44	F	1967	45	41 to 60	MoreThan29	Work	NA	Parklands		Cape Town	Cape T Dis	able View (Bayside Mall	Medium	ShortMed
45	F	1976	36	31 to 40	MoreThan29	Work	NA	Parklands		Cape Town	Cape T Dis	Mowbry	Long	Long
46	F	1960	52	41 to 60	MoreThan29	Work	NA	Cape Town	Cape T	Atlantis		Atlantis	Long	Long
47	F	1936	76	61 to 80	MoreThan29	Other	on (Conce	Cape Town	Cape T	Brooklyn		Brooklyn	Medium	ShortMed
48	M	1978	34	31 to 40	MoreThan29	Other	NA	Cape Town	Cape T	Atlantis		Atlantis	Long	Long
49	F	?	50	41 to 60	MoreThan29	Work	NA	Cape Town	Cape T	Atlantis		Atlantis	Long	Long
50	F	1989	23	21 to 30	LessThan30	Work	NA	Cape Town	Cape T	Atlantis		Atlantis	Long	Long
51	M	1978	34	31 to 40	MoreThan29	Other	NA	Cape Town	Cape T	Atlantis		Atlantis	Long	Long
52	M	1981	31	31 to 40	MoreThan29	Work	NA	Cape Town	Cape T	Melkbos		Melkbos	Long	Long
53	F	1990	22	21 to 30	LessThan30	Work	NA	Blaawberg		Cape Town	Cape T Dis	Sea Point	Long	Long
54	M	1946	66	61 to 80	MoreThan29	Other	NA	Atlantis		Cape Town	Cape T Dis	Cape Town	Long	Long
55	M	1993	19	Less T 21	LessThan30	Other	NA	Atlantis		Cape Town	Cape T Dis	Cape Town	Long	Long
56	M	1990	22	21 to 30	LessThan30	Other	NA	Atlantis		Cape Town	Cape T Dis	Cape Town	Long	Long

Id	Gender	Year of Birth	Age	ageCat	ageNewCat	Commuter	Concessions	Where did you Board the bus?	Board reduced	Where will you disembark this bus?	disembark reduced	Where is your final destination?	Trip Begin	Trip End	ShortMed Begin	ShortMed End
1	M	1988	24	21 to 30	LessThan30	Other	NA	Cape Town	Cape T	V&A Waterfront		V&A Waterfront	Short	Short	ShortMed	ShortMed
2	M	1960	52	41 to 60	MoreThan29	Work	NA	Cape Town	Cape T	Atlantis	Cape T Dis	Atlantis	Long	Long	Long	Long
3	F	1990	22	21 to 30	LessThan30	Work	NA	Cape Town	Cape T	Cape Town	Cape T Dis	Milnerton	Medium	Short	ShortMed	ShortMed
4	F	1957	75	61 to 80	MoreThan29	Other	NA	Cape Town	Cape T	Cape Town	Cape T Dis	Brooklyn	Medium	Short	ShortMed	ShortMed
5	F	1998	22	21 to 30	LessThan30	Other	NA	Cape Town	Cape T	Montague Gardens		Montague Gardens	Long	Long	Long	Long
6	F	1953	49	41 to 60	MoreThan29	Work	NA	Cape Town	Cape T	Montague Gardens		Montague Gardens	Long	Long	Long	Long
7	M	1978	34	31 to 40	MoreThan29	Other	NA	Cape Town	Cape T	Atlantis		Brooklyn (School)	Long	Long	Long	Long
8	F			Less T 21	LessThan30	Other	NA	Cape Town	Cape T	Brooklyn		Brooklyn (School)	Medium	Short	ShortMed	ShortMed
9	F	?	50	41 to 60	MoreThan29	Work	NA	Cape Town	Cape T	Atlantis		Brooklyn (School)	Medium	Short	ShortMed	ShortMed
10	M			41 to 60	MoreThan29	Work	NA	Cape Town	Cape T	Milnerton		Milnerton	Medium	Short	ShortMed	ShortMed
11	F	1980	33	31 to 40	MoreThan29	Work	NA	Cape Town	Cape T	Montague Gardens		Montague Gardens	Long	Long	Long	Long
12	F	1993	42	41 to 60	MoreThan29	Work	NA	Cape Town	Cape T	Montague Gardens		Montague Gardens	Long	Long	Long	Long
13	F	1974	38	31 to 40	MoreThan29	Work	NA	Cape Town	Cape T	Montague Gardens		Montague Gardens	Long	Long	Long	Long
14	M	1978	34	31 to 40	MoreThan29	Other	NA	Cape Town	Cape T	Montague Gardens		Montague Gardens	Long	Long	Long	Long
15	M	1982	30	21 to 30	MoreThan29	Other	NA	Brooklyn		Cape Town	Cape T Dis	Cape Town	Short	Short	ShortMed	ShortMed
16	M	1983	29	21 to 30	LessThan30	Other	NA	Brooklyn		Cape Town	Cape T Dis	Sea point	Medium	Short	ShortMed	ShortMed
17	M	1989	23	21 to 30	LessThan30	Work	NA	Brooklyn		Cape Town	Cape T Dis	Table View (School)	Long	Long	Long	Long
18	M	1975	37	31 to 40	MoreThan29	Work	NA	Brooklyn		Cape Town	Cape T Dis	Woodstock	Short	Short	ShortMed	ShortMed
19	F	1990	22	21 to 30	LessThan30	Work	NA	Blaauwberg		Cape Town	Cape T Dis	Sea Point	Long	Long	Long	Long
20	F	1990	22	21 to 30	LessThan30	Other	NA	Brooklyn		Cape Town	Cape T Dis	Cape Town	Short	Short	ShortMed	ShortMed
21	M	1946	66	61 to 80	MoreThan29	Other	NA	Atlantis		Cape Town	Cape T Dis	Cape Town	Long	Long	Long	Long
22	M	1983	29	21 to 30	LessThan30	Work	NA	Brooklyn		Cape Town	Cape T Dis	Sea point	Medium	Short	ShortMed	ShortMed
23	M	1989	23	21 to 30	LessThan30	Work	NA	ar (Concespe Town (Dorp Stree	Cape T	e Town (Civic Cen	Cape T Dis	Table View (School)	Long	Long	Long	Long
24	M	1967	45	Less T 21	MoreThan29	Other	NA	Atlantis	Cape T	Cape Town	Cape T Dis	Parklands (Brackl	Short	Short	ShortMed	ShortMed
25	M	1980	32	31 to 40	MoreThan29	Work	NA	pe Town (Dorp Stree	Cape T	pe Town (Loopstre	Cape T Dis	Table View	Long	Long	Long	Long
26	M	1990	22	21 to 30	LessThan30	Other	NA	pe Town (Dorp Stree	Cape T	Cape Town	Cape T Dis	Cape Town	Long	Long	Long	Long
27	F	1972	40	31 to 40	MoreThan29	Work	NA	Melkbos		Montague Gardens		Montague Gardens	Long	Long	Long	Long
28	F	1990	22	Less T 21	LessThan30	Other	NA	Rugby Cambrige		Cape Town	Cape T Dis	Groote Schuur Hospital	Short	Short	ShortMed	ShortMed
29	M	1975	37	31 to 40	MoreThan29	Other	NA	Blaauwberg		Cape Town	Cape T Dis	Cape Town	Short	Short	ShortMed	ShortMed
30	F	1973	39	31 to 40	MoreThan29	Work	NA	Brooklyn		Cape Town	Cape T Dis	Cape Town	Short	Short	ShortMed	ShortMed
31	M	1963	49	41 to 60	MoreThan29	Work	NA	Rugby Cambrige		Cape Town	Cape T Dis	Woodstock	Short	Short	ShortMed	ShortMed
32	F	1964	48	41 to 60	MoreThan29	Work	NA	Table View		Table View		Table View (Bayside Mall	Short	Short	ShortMed	ShortMed
33	M	1998	14	Less T 21	LessThan30	Other	NA	Brooklyn		Cape Town	Cape T Dis	Cape Town	Short	Short	ShortMed	ShortMed
34	F	1936	76	61 to 80	MoreThan29	Other	NA	Atlantis		Cape Town		Cape Town	Long	Long	Long	Long
35	F	?	55	41 to 60	MoreThan29	Work	NA	Brooklyn		Cape Town	Cape T Dis	Cape Town	Short	Short	ShortMed	ShortMed
36	F	1967	51	41 to 60	MoreThan29	Work	NA	Atlantis		Cape Town		Cape Town	Long	Long	Long	Long
37	M	1955	57	41 to 60	MoreThan29	Work	NA	Table View		Table View		Table View	Short	Short	ShortMed	ShortMed
38	F	1990	22	21 to 30	LessThan30	Work	NA	Salt River		Rugby Cambrige		Rugby Cambrige	Medium	Short	ShortMed	ShortMed
39	F	1986	26	21 to 30	LessThan30	Other	NA	Gie Road		Cape Town	Cape T Dis	Cape Town	Long	Long	Long	Long
40	M	1945	67	61 to 80	MoreThan29	Work	NA	Makhaza		Table View	Cape T Dis	Table View	Long	Long	Long	Long
41	F	1985	27	21 to 30	LessThan30	Work	NA	Parklands		Cape Town	Cape T Dis	Cape Town	Long	Long	Long	Long
42	M	1985	27	21 to 30	LessThan30	Other	NA	Parklands		Cape Town	Cape T Dis	Cape Town	Long	Long	Long	Long
43	F	1967	45	41 to 60	MoreThan29	Work	NA	Parklands		Cape Town	Cape T Dis	Table View (Bayside Mall	Medium	Short	ShortMed	ShortMed
44	F	1976	36	31 to 40	MoreThan29	Work	NA	Parklands		Cape Town	Cape T Dis	Mowbry	Long	Long	Long	Long
45	M	1964	48	41 to 60	MoreThan29	Work	NA	Salt River	Cape T	Rugby Cambrige		Rugby Cambrige	Short	Short	ShortMed	ShortMed
46	F	1936	76	61 to 80	MoreThan29	Other	NA	Cape Town	Cape T	Brooklyn		Brooklyn	Medium	Short	ShortMed	ShortMed
47	M	1975	37	31 to 40	MoreThan29	Other	NA	Cape Town	Cape T	Table View		Table View	Long	Long	Long	Long
48	F	1973	39	31 to 40	MoreThan29	Work	NA	Cape Town	Cape T	Atlantis		Atlantis	Long	Long	Long	Long
49	M	1982	32	21 to 30	LessThan30	Work	NA	Cape Town	Cape T	Atlantis		Atlantis	Long	Long	Long	Long
50	M	1908	74	61 to 80	MoreThan29	Other	NA	Salt River	Cape T	Table View		Table View	Long	Long	Long	Long
51	M	1981	31	31 to 40	MoreThan29	Work	NA	Cape Town	Cape T	Melkbos		Melkbos	Long	Long	Long	Long
52	F	1982	30	21 to 30	MoreThan29	Work	NA	Cape Town	Cape T	Table View	Cape T Dis	Table View	Long	Long	Long	Long
53	M	1946	66	61 to 80	MoreThan29	Other	NA	Atlantis		Cape Town	Cape T Dis	Cape Town	Long	Long	Long	Long
54	M	?	60	41 to 60	MoreThan29	Other	NA	Century City		Cape Town	Cape T Dis	Cape Town	Long	Long	Long	Long
55	F	1992	20	Less T 21	LessThan30	Other	NA	Rugby Cambrige		Cape Town	Cape T Dis	Cape Town	Short	Short	ShortMed	ShortMed
56	F	1967	45	41 to 60	MoreThan29	Work	NA	Hanover Park		Sunset Beach	Cape T Dis	Sunset Beach	Medium	Short	ShortMed	ShortMed
57	F	1998	14	Less T 21	LessThan30	Other	NA	Brooklyn		Cape Town	Cape T Dis	Cape Town	Short	Short	ShortMed	ShortMed
58	F	1996	16	Less T 21	LessThan30	Work	NA	Table View (Gie Road)		Cape Town	Cape T Dis	Cape Town	Long	Long	Long	Long
59	F	1972	40	31 to 40	MoreThan29	Work	NA	Salt River		Rugby Cambrige		Rugby Cambrige	Short	Short	ShortMed	ShortMed
60	M	1946	66	61 to 80	MoreThan29	Work	NA	Makhaza		Table View		Table View	Long	Long	Long	Long
61	M	1983	33	31 to 40	LessThan30	Work	NA	Table View (Gie Road)		Cape Town	Cape T Dis	Cape Town	Long	Long	Long	Long
62	M	1964	48	41 to 60	MoreThan29	Work	NA	Salt River		Rugby Cambrige		Rugby Cambrige	Short	Short	ShortMed	ShortMed
63	F	1973	39	31 to 40	MoreThan29	Work	NA	Parklands	Cape T	Cape Town	Cape T Dis	Cape Town	Long	Long	Long	Long
64	M	1985	27	21 to 30	LessThan30	Work	NA	Salt River		Table View		Table View	Long	Long	Long	Long
65	F	1983	33	31 to 40	LessThan30	Work	NA	Table View (Gie Road)	Cape T	Cape Town	Cape T Dis	Cape Town	Long	Long	Long	Long
66	M	1983	33	31 to 40	LessThan30	Work	NA	Century City		Epping		Epping	Short	Short	ShortMed	ShortMed
67	F	1967	45	41 to 60	MoreThan29	Work	NA	Hanover Park		Sunset Beach		Sunset Beach	Medium	Short	ShortMed	ShortMed
68	M	1995	17	Less T 21	LessThan30	Work	NA	Table View (Gie Road)		Cape Town	Cape T Dis	Cape Town	Long	Long	Long	Long
69	F	1979	33	31 to 40	MoreThan29	Work	NA	Table View (Gie Road)		Cape Town	Cape T Dis	Cape Town	Long	Long	Long	Long
70	M	1980	32	31 to 40	MoreThan29	Work	NA	Parklands		Cape Town	Cape T Dis	Woodstock	Long	Long	Long	Long
71	F	1983	29	21 to 30	LessThan30	Work	NA	Table View (Gie Road)		Cape Town	Cape T Dis	Cape Town	Long	Long	Long	Long
72	M	1985	27	Less T 21	LessThan30	Work	NA	Table View (Gie Road)		Cape Town	Cape T Dis	Cape Town	Long	Long	Long	Long
73	M	1982	32	21 to 30	LessThan30	Work	NA	Parklands		Cape Town	Cape T Dis	Cape Town	Long	Long	Long	Long
74	M	1983	33	31 to 40	LessThan30	Work	NA	Parklands		Cape Town	Cape T Dis	Cape Town	Long	Long	Long	Long
75	M	1983	29	21 to 30	LessThan30	Work	NA	Parklands		Cape Town	Cape T Dis	Cape Town	Long	Long	Long	Long
76	F	1959	53	41 to 60	MoreThan29	Work	NA	Cape Town	Cape T	Gie Road		Table View (Gie Road)	Long	Long	Long	Long
77	F	1964	48	41 to 60	MoreThan29	Work	NA	Cape Town	Cape T	Parklands		Parklands	Long	Long	Long	Long
78	F	1983	33	31 to 40	MoreThan29	Work	NA	Cape Town	Cape T	Parklands		Parklands	Long	Long	Long	Long
79	M	1959	57	41 to 60	MoreThan29	Work	NA	Cape Town	Cape T	Gie Road		Gie Road	Long	Long	Long	Long
80	F	1980	32	31 to 40	MoreThan29	Work	NA	Cape Town	Cape T	Gie Road		Gie Road	Long	Long	Long	Long
81	F	1992	20	Less T 21	LessThan30	Work	NA	Cape Town	Cape T	Parklands		Parklands	Long	Long	Long	Long
82	M	1985	37	21 to 30	MoreThan29	Work	NA	Cape Town	Cape T	Gie Road		Gie Road	Long	Long	Long	Long
83	M	1993	39	31 to 40	MoreThan29	Work	NA	Cape Town	Cape T	Table View (Gie Road)		Table View (Gie Road)	Long	Long	Long	Long
84	F	1982	30	21 to 30	MoreThan29	Work	NA	Cape Town	Cape T	Parklands		Parklands	Long	Long	Long	Long
85	F	1973	39	31 to 40	MoreThan29	Work	NA	Cape Town	Cape T	Gie Road	Cape T Dis	Cape Town	Long	Long	Long	Long
86	F	1986	26	21 to 30	LessThan30	Work	NA	Cape Town	Cape T	Parklands		Parklands	Long	Long	Long	Long
87	F	1990	22	21 to 30	LessThan30	Other	NA	Milnerton		Cape Town	Cape T Dis	Cape Town	short	Short	ShortMed	ShortMed
88	F	1991	21	21 to 30	LessThan30	Other	NA	Milnerton		Cape Town	Cape T Dis	Cape Town	short	Short	ShortMed	ShortMed
89	M	1990	22	21 to 30	LessThan30	Work	NA	Milnerton		Cape Town	Cape T Dis	Cape Town	short	Short	ShortMed	ShortMed
90	F	1992	20	Less T 21	LessThan30	Work	NA	Table View		Cape Town	Cape T Dis	Cape Town	Long	Long	Long	Long
91	F	1991	21	21 to 30	LessThan30	Work	NA	Table View		Cape Town	Cape T Dis	Rondebosh	Long	Long	Long	Long
92	F	1990	22	21 to 30	LessThan30	Work	NA	Killarney		Cape Town	Cape T Dis	Pluimstead	Long	Long	Long	Long

Fractional factorial 1 dataset (choice sets1-4)

STR	Choice set 1	STR	Choice set 2	STR	Choice set 3	STR	Choice set 4
101	B	102	B	103	A	104	B
201	C	202	C	203	C	204	C
301	B	302	B	303	A	304	C
401	B	402	A	403	A	404	B
501	C	502	A	503	A	504	C
601	C	602	C	603	C	604	C
701	B	702	A	703	A	704	B
801	B	802	A	803	A	804	B
901	C	902	B	903	A	904	A
1001	B	1002	A	1003	A	1004	C
1101	B	1102	A	1103	A	1104	B
1201	C	1202	A	1203	A	1204	C
1301	C	1302	A	1303	A	1304	B
1401	B	1402	B	1403	A	1404	B
1501	C	1502	B	1503	C	1504	C
1601	A	1602	A	1603	B	1604	A
1701	A	1702	A	1703	A	1704	A
1801	B	1802	A	1803	A	1804	B
1901	C	1902	A	1903	A	1904	B
2001	A	2002	B	2003	A	2004	B
2101	C	2102	A	2103	B	2104	C
2201	C	2202	A	2203	A	2204	C
2301	C	2302	A	2303	A	2304	C
2401	C	2402	A	2403	A	2404	B
2501	C	2502	A	2503	A	2504	C
2601	B	2602	A	2603	A	2604	B
2701	B	2702	A	2703	B	2704	B
2801	B	2802	A	2803	C	2804	A
2901	B	2902	A	2903	A	2904	C
3001	C	3002	A	3003	A	3004	A
3101	A	3102	A	3103	A	3104	A
3201	A	3202	A	3203	A	3204	A
3301	B	3302	A	3303	C	3304	B
3401	B	3402	A	3403	A	3404	B

3501	A	3502	A	3503	A	3504	A
3601	C	3602	A	3603	A	3604	B
3701	B	3702	B	3703	B	3704	B
3801	C	3802	A	3803	A	3804	C
3901	B	3902	C	3903	A	3904	B
4001	C	4002	A	4003	A	4004	C
4101	B	4102	A	4103	A	4104	C
4201	B	4202	A	4203	A	4204	C
4301	C	4302	A	4303	A	4304	C
4401	C	4402	C	4403	A	4404	C
4501	B	4502	A	4503	A	4504	C
4601	A	4602	blank	4603	blank	4604	blank
4701	C	4702	A	4703	A	4704	C
4801	C	4802	C	4803	C	4804	C
4901	C	4902	A	4903	A	4904	C
5001	C	5002	C	5003	C	5004	C
5101	B	5102	A	5103	A	5104	A
5201	B	5202	C	5203	C	5204	B
5301	C	5302	A	5303	A	5304	C
5401	C	5402	C	5403	A	5404	C
5501	A	5502	A	5503	A	5504	A
5601	B	5602	A	5603	A	5604	B
5701	C	5702	B	5703	A	5704	A
5801	B	5802	A	5803	C	5804	C
5901	C	5902	A	5903	A	5904	C
6001	A	6002	A	6003	A	6004	A
6101	C	6102	C	6103	C	6104	C
6201	A	6202	A	6203	A	6204	A
6301	A	6302	A	6303	A	6304	C
6401	C	6402	A	6403	A	6404	C
6501	C	6502	A	6503	A	6504	C
6601	C	6602	A	6603	A	6604	A
6701	A	6702	A	6703	A	6704	C
6801	A	6802	A	6803	A	6804	A
6901	C	6902	A	6903	A	6904	C
7001	C	7002	A	7003	A	7004	A
7101	C	7102	A	7103	A	7104	C
7201	B	7202	A	7203	A	7204	B
7301	B	7302	B	7303	C	7304	C

7401	B		7402	A		7403	A		7404	B
7501	C		7502	A		7503	A		7504	A
7601	C		7602	A		7603	A		7604	C
7701	B		7702	B		7703	A		7704	B
7801	C		7802	A		7803	A		7804	C
7901	C		7902	A		7903	A		7904	C
8001	B		8002	B		8003			8004	C
8101	C		8102	A		8103	A		8104	C
8201	B		8202	A		8203	A		8204	A
8301	A		8302	A		8303	A		8304	A
8401	B		8402	A		8403	A		8404	B
8501	C		8502	A		8503	A		8504	C
8601	C		8602	A		8603	A		8604	C
8701	C		8702	A		8703	A		8704	C
8801	C		8802	A		8803	A		8804	C
8901	A		8902	A		8903	A		8904	B
9001	A		9002	A		9003	A		9004	C
9101	C		9102	A		9103	A		9104	C
9201	B		9202	A		9203	A		9204	A
STR	**Choice set 5**		**STR**	**Choice set 6**		**STR**	**Choice set 7**		**STR**	**Choice set 8**
101	A		102	A		103	A		104	B
201	C		202	C		203	C		204	C
301	C		302	C		303	A		304	C
401	A		402	A		403	A		404	B
501	C		502	A		503	A		504	C
601	C		602	C		603	C		604	C
701	A		702	A		703			704	B
801	A		802	A		803	A		804	B
901	A		902	A		903	C		904	B
1001	A		1002	B		1003	A		1004	A
1101	A		1102	A		1103	A		1104	A
1201	C		1202	C		1203	A		1204	C
1301	A		1302	A		1303	A		1304	B
1401	A		1402	A		1403	A		1404	B
1501	A		1502	A		1503	C		1504	blank
1601	A		1602	A		1603	A		1604	B
1701	C		1702	B		1703	A		1704	B

1801	A	1802	C	1803	C	1804	B
1901	C	1902	A	1903	A	1904	B
2001	A	2002	A	2003	A	2004	B
2101	A	2102	A	2103	A	2104	B
2201	C	2202	C	2203	A	2204	B
2301	C	2302	C	2303	A	2304	C
2401	A	2402	A	2403	C	2404	B
2501	A	2502	A	2503		2504	B
2601	A	2602	A	2603	A	2604	A
2701	C	2702	A	2703	A	2704	B
2801	C	2802	C	2803	A	2804	C
2901	C	2902	A	2903	A	2904	C
3001	C	3002	C	3003	A	3004	C
3101	A	3102	A	3103	A	3104	B
3201	A	3202	B	3203	A	3204	B
3301	C	3302	C	3303	A	3304	C
3401	A	3402	A	3403	A	3404	B
3501	A	3502	A	3503	A	3504	B
3601	C	3602	C	3603	C	3604	C
3701	A	3702	A	3703	A	3704	A
3801	C	3802	C	3803	C	3804	C
3901	A	3902	A	3903	A	3904	B
4001	C	4002	C	4003	C	4004	C
4101	A	4102	A	4103	A	4104	B
4201	A	4202	A	4203	C	4204	A
4301	A	4302	A	4303	A	4304	B
4401	C	4402	C	4403	A	4404	C
4501	C	4502	C	4503	C	4504	C
4601	C	4602	C	4603	C	4604	C
4701	C	4702	C	4703	C	4704	C
4801	A	4802	C	4803	C	4804	C
4901	C	4902	C	4903	C	4904	C
5001	C	5002	A	5003	A	5004	C
5101	A	5102	A	5103	A	5104	B
5201	C	5202	C	5203	A	5204	C
5301	C	5302	C	5303	A	5304	B
5401	A	5402	B	5403	A	5404	B
5501	A	5502	A	5503	A	5504	A
5601	A	5602	C	5603	A	5604	C
5701	C	5702	C	5703	C	5704	C

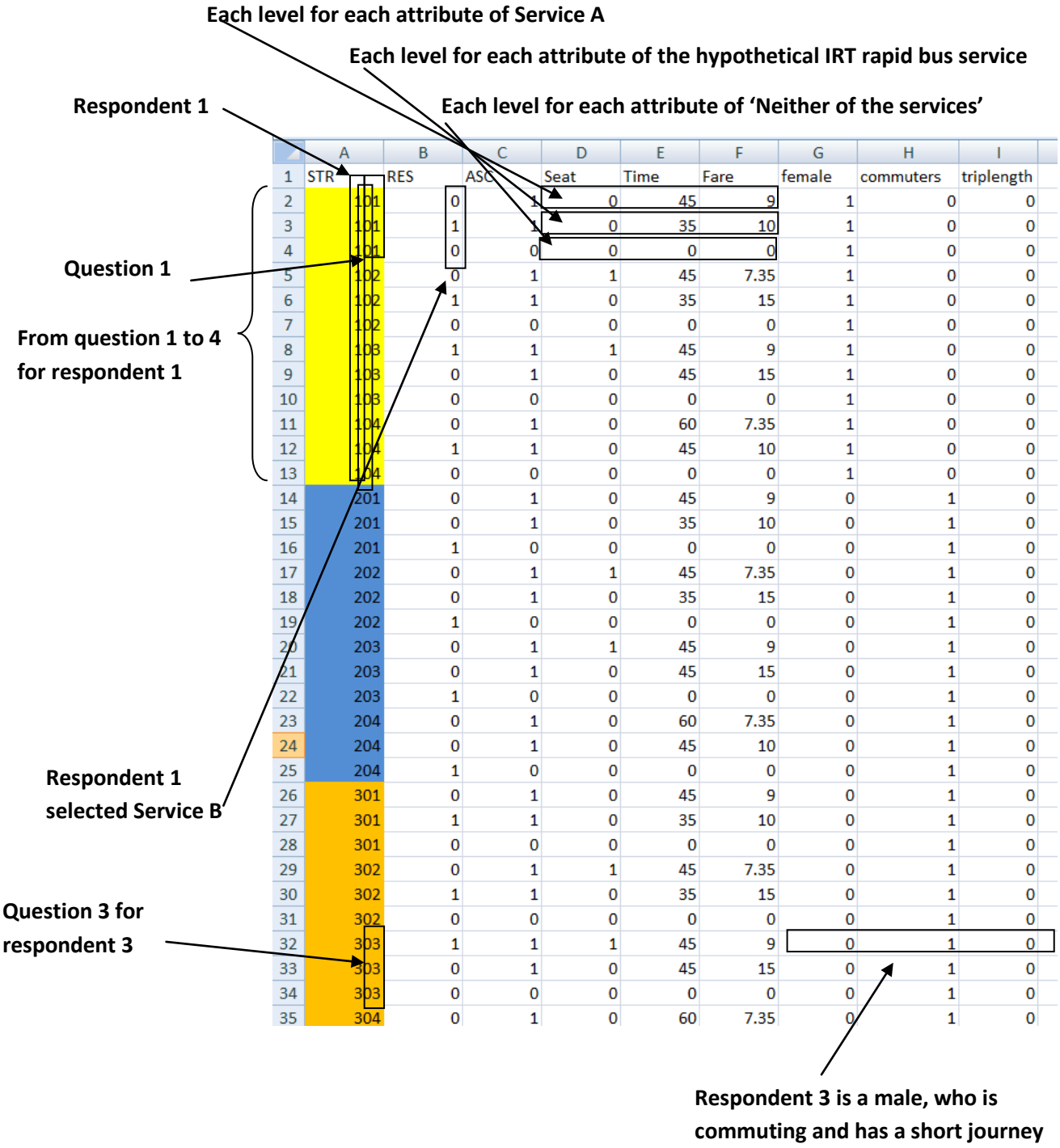
5801	C	5802	C	5803	C	5804	C
5901	A	5902	A	5903	A	5904	A
6001	C	6002	C	6003	C	6004	C
6101	C	6102	C	6103	A	6104	C
6201	C	6202	C	6203	C	6204	C
6301	C	6302	A	6303	A	6304	A
6401	C	6402	A	6403	C	6404	C
6501	C	6502	A	6503	C	6504	C
6601	C	6602	C	6603	C	6604	C
6701	C	6702	C	6703	A	6704	C
6801	A	6802	blank	6803	blank	6804	blank
6901	C	6902	C	6903	A	6904	C
7001	C	7002	C	7003	A	7004	C
7101	C	7102	C	7103	C	7104	B
7201	A	7202	A	7203	A	7204	B
7301	A	7302	A	7303	A	7304	B
7401	A	7402	A	7403	A	7404	B
7501	C	7502	C	7503	C	7504	C
7601	A	7602	A	7603	A	7604	A
7701	A	7702	A	7703	A	7704	B
7801	C	7802	C	7803	C	7804	C
7901	A	7902	A	7903	A	7904	B
8001	A	8002	A	8003	C	8004	B
8101	C	8102	C	8103	C	8104	C
8201	C	8202	A	8203	C	8204	C
8301	A	8302	A	8303	A	8304	A
8401	C	8402	C	8403	C	8404	C
8501	C	8502	C	8503	A	8504	C
8601	C	8602	A	8603	A	8604	C
8701	C	8702	C	8703	A	8704	C
8801	A	8802	B	8803	A	8804	A
8901	A	8902	A	8903	C	8904	B
9001	A	9002	A	9003	A	9004	B
9101	C	9102	C	9103	A	9104	C
9201	A	9202	A	9203	C	9204	B

Summary of choices

Respondent	choice 1	choice 2	choice 3	choice 4	choice 5	choice 6	choice 7	choice 8
1	B	B	A	B	B	B	B	A
2	C	C	C	C	C	C	C	C
3	B	B	A	C	C	C	A	C
4	B	A	A	B	B	B	A	A
5	C	A	A	C	B	B	A	C
6	C	C	C	C	C	C	C	C
7	B	A	A	B	B	B	B	A
8	B	A	A	B	A	B	A	A
9	C	B	A	A	B	B	C	A
10	B	A	A	C	A	A	B	B
11	B	A	A	B	A	B	A	B
12	C	A	A	C	C	C	A	C
13	C	A	A	B	A	B	A	A
14	B	B	A	B	A	B	A	A
15	C	B	C	C	A	B	C	blank
16	A	A	B	A	A	B	B	A
17	A	A	A	A	C	A	A	A
18	B	A	A	B	B	C	C	A
19	C	A	A	B	B	B	B	A
20	A	B	A	C	B	B	A	A
21	C	A	A	C	C	C	A	A
22	C	A	A	C	C	C	A	C
23	C	A	A	C	C	C	A	C
24	C	A	A	B	B	B	C	A
25	C	A	A	C	B	B	A	A
26	B	A	A	B	B	B	A	B
27	B	A	B	B	C	B	A	C
28	B	A	C	A	C	C	A	C
29	B	A	A	C	C	B	A	C
30	C	A	A	A	C	C	A	C
31	A	A	A	A	B	B	A	B
32	A	A	A	A	A	A	A	B
33	B	A	C	B	C	C	B	C
34	B	A	A	B	B	B	A	A
35	A	A	A	A	B	B	A	A
36	C	A	A	B	C	C	C	C
37	B	B	B	B	B	B	B	B
38	C	A	A	C	C	C	C	C
39	B	C	A	B	C	C	C	C
40	C	A	A	C	C	C	C	C
41	B	A	A	C	A	C	C	C
42	B	A	A	C	C	C	C	C
43	C	A	A	C	C	B	A	A
44	C	C	A	C	A	C	A	C
45	B	A	A	C	C	C	A	C
46	C	A	A	C	C	B	A	A
47	C	C	C	C	C	C	C	C
48	C	A	A	C	A	B	A	A
49	C	C	C	C	C	B	C	B
50	B	A	A	A	C	B	A	A
51	B	C	C	B	A	C	A	C
52	C	A	A	C	C	C	C	C
53	C	C	A	C	C	C	C	C
54	A	A	A	A	C	C	C	C
55	B	A	A	B	C	C	C	C
56	C	B	A	A	A	C	C	C
57	B	A	C	C	C	C	C	C
58	C	A	A	C	C	B	A	C
59	A	A	A	A	A	B	A	A

Respondent	choice 1	choice 2	choice 3	choice 4	choice 5	choice 6	choice 7	choice 8
31	A	A	A	A	B	B	A	B
32	A	A	A	A	A	A	A	B
33	B	A	C	B	C	C	B	C
34	B	A	A	B	B	B	A	A
35	A	A	A	A	B	B	A	A
36	C	A	A	B	C	C	C	C
37	B	B	B	B	B	B	B	B
38	C	A	A	C	C	C	C	C
39	B	C	A	B	C	C	C	C
40	C	A	A	C	C	C	C	C
41	B	A	A	C	A	C	C	C
42	B	A	A	C	C	C	C	C
43	C	A	A	C	C	B	A	A
44	C	C	A	C	A	C	A	C
45	B	A	A	C	C	C	A	C
46	C	A	A	C	C	B	A	A
47	C	C	C	C	C	C	C	C
48	C	A	A	C	A	B	A	A
49	C	C	C	C	C	B	C	B
50	B	A	A	A	C	B	A	A
51	B	C	C	C	A	C	C	C
52	C	A	A	C	C	C	C	C
53	C	C	A	C	C	C	C	C
54	B	A	A	B	B	B	A	C
55	B	A	A	B	C	C	C	C
56	C	B	A	A	B	C	C	C
57	B	C	C	C	C	C	C	C
58	C	A	A	C	C	B	A	C
59	A	A	A	A	B	B	A	A
60	B	A	A	B	A	B	A	A
61	A	A	A	A	C	C	A	C
62	A	A	A	C	C	C	C	A
63	B	A	A	C	A	A	B	B
64	C	A	A	C	C	B	C	C
65	C	A	A	A	C	B	C	C
66	A	A	A	C	C	C	A	C
67	A	A	A	A	C	C	A	C
68	C	A	A	C	B	blank	blank	blank
69	C	A	A	A	C	B	A	C
70	C	B	C	C	A	B	C	blank
71	B	A	A	B	C	C	C	A
72	B	B	C	C	A	B	B	A
73	A	A	A	A	C	A	A	A
74	C	A	A	A	B	B	A	A
75	C	A	A	C	C	C	C	C
76	B	A	A	B	B	B	B	A
77	C	A	A	C	A	B	A	A
78	C	A	A	C	C	C	C	C
79	B	A	A	C	B	B	A	A
80	C	A	A	C	B	B	C	A
81	B	A	A	A	C	C	C	C
82	A	A	A	A	C	B	A	C
83	C	A	A	C	B	B	C	A
84	C	A	A	C	C	C	C	C
85	C	A	A	C	B	B	A	A
86	B	A	A	B	B	B	A	B
87	C	A	A	C	C	C	A	C
88	C	A	A	C	A	B	A	A
89	B	A	C	A	C	C	A	C
90	A	A	A	C	A	A	A	B
91	C	A	A	C	C	B	A	C
92	C	A	A	A	C	C	A	C

Appendix E Format of datasets for function clogit() in R



	A	B	C	D	E	F	G	H	I
1	STR	RES	ASC	Seat	Time	Fare	female	commuters	triplength
2	101	0	1	0	45	9	1	0	0
3	101	1	1	0	35	10	1	0	0
4	101	0	0	0	0	0	1	0	0
5	102	0	1	1	45	7.35	1	0	0
6	102	1	1	0	35	15	1	0	0
7	102	0	0	0	0	0	1	0	0
8	103	1	1	1	45	9	1	0	0
9	103	0	1	0	45	15	1	0	0
10	103	0	0	0	0	0	1	0	0
11	104	0	1	0	60	7.35	1	0	0
12	104	1	1	0	45	10	1	0	0
13	104	0	0	0	0	0	1	0	0
14	201	0	1	0	45	9	0	1	0
15	201	0	1	0	35	10	0	1	0
16	201	1	0	0	0	0	0	1	0
17	202	0	1	1	45	7.35	0	1	0
18	202	0	1	0	35	15	0	1	0
19	202	1	0	0	0	0	0	1	0
20	203	0	1	1	45	9	0	1	0
21	203	0	1	0	45	15	0	1	0
22	203	1	0	0	0	0	0	1	0
23	204	0	1	0	60	7.35	0	1	0
24	204	0	1	0	45	10	0	1	0
25	204	1	0	0	0	0	0	1	0
26	301	0	1	0	45	9	0	1	0
27	301	1	1	0	35	10	0	1	0
28	301	0	0	0	0	0	0	1	0
29	302	0	1	1	45	7.35	0	1	0
30	302	1	1	0	35	15	0	1	0
31	302	0	0	0	0	0	0	1	0
32	303	1	1	1	45	9	0	1	0
33	303	0	1	0	45	15	0	1	0
34	303	0	0	0	0	0	0	1	0
35	304	0	1	0	60	7.35	0	1	0

Appendix F Scripts for applying the conditional logit model estimation in R

```
Library(Rcmdr)                                  // loads the  R Commander package in R

library(survival)                               // loads the  survival package in R

                                                //FACTORIAL 1 (SEAT, TIME, FARE):

factorial1_dataset<- read.  delim('f:/Datasets/factorial1_dataset.  txt')   // loads the factorial 1 dataset

clogit(RES~ASC+seat+time+fare+fare:female+fare:commuters+fare:triplength+strata(STR),data=factorial
1_dataset)                                      //runs conditional logit model estimation

                                //FACTORAIL 2 (FARES, DISTANCE TO FIRST STOP, NUMBER OF TRANSFERS)

factorial2_dataset <- read.  delim('f:/Datasets/ factorial2_dataset.  txt')  // loads the factorial 2 dataset

clogit(RES~ASC+fares+distance+transfers+fares:female+fares:commuters+fares:triplength+strata(STR),d
ata= factorial2_dataset)                        //runs conditional logit model estimation
```

Appendix G Pivot table analysis of choice patterns by gender

Gender

Count of Idno	Gender		
choi ce1	F	M	Grand Total
A	8	7	15
B	23	9	32
C	28	17	45
Grand Total	**59**	**33**	**92**

Count of Idno	Gender		
choi ce2	F	M	Grand Total
A	44	28	72
B	8	3	11
C	7	2	9
Grand Total	**59**	**33**	**92**

Count of Idno	Gender		
choi ce3	F	M	Grand Total
A	48	29	77
B	2	2	4
C	9	2	11
Grand Total	**59**	**33**	**92**

Count of Idno	Gender		
choi ce4	F	M	Grand Total
A	13	7	20
B	14	10	24
C	32	16	48
Grand Total	**59**	**33**	**92**

Count of Idno	Gender		
choi ce5	F	M	Grand Total
A	12	8	20
C	34	16	50
B	13	9	22
Grand Total	**59**	**33**	**92**

Count of Idno	Gender		
choi ce6	F	M	Grand Total
A	2	4	6
B	28	15	43
blank		1	1
C	29	13	42
Grand Total	**59**	**33**	**92**

Count of Idno	Gender		
choi ce7	F	M	Grand Total
A	33	15	48
blank		1	1
C	20	13	33
B	1		1
B	5	4	9
Grand Total	**59**	**33**	**92**

Count of Idno	Gender		
choi ce8	F	M	Grand Total
A	20	10	30
B	6	7	13
blank	1	1	2
C	32	15	47
Grand Total	**59**	**33**	**92**