

Gender Equity on Public Transportation in Nairobi, Kenya

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APPROVAL PAGE

This report is being submitted as my senior project in the Department of Mathematics.

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TABLE OF CONTENTS

Introduction	3
Methods	4
Analysis and Results	11
Conclusion	24
References	26

INTRODUCTION: Preface and Acknowledgements

Gender equity in public spaces is an issue that is often overlooked by policy-makers and those required to enact change. In Nairobi City, Kenya, along with socio-structural disparities, women suffer from lack of safe and accessible public transportation [2]. Whether it be to care for their elders or children, seek employment, run errands, or simply leisure, data from the World Bank show that women have different travel patterns, and different concerns while using public transit than men [9]. In order to better the public transportation system for women, it is necessary to disaggregate gender data, and observe and compare the motivations and concerns of women on public transport. From the data it was clear that women were most concerned about safety on public transportation, sexual harassment being a large factor [1]. It was imperative to analyze safety data first, since it would be most beneficial to see change in. From there, identifying differences in interaction with different modes of transportation is important. The data provided by the world bank includes information on Matatus (private minibuses), walking, private cars, BodaBoda (private motorcycles/scooters), and public buses [6]. Understanding the ties between Nairobi's culture and the Matatus is key for this project. Matatus are operated privately, yet function as the city's primary transportation system, with bus owners setting fares and routes [11]. This adds an element of unpredictability and unreliability to an average trip. The World Bank also included a GIS data folder [3]. These data were very interesting, however it was not gender disaggregated so it was ultimately not useful for the mission of this project. However it did provide a resource for visualizing specific routes and connecting a name to landmarks and hotspots. Because of the links between transportation, convenience, cost, and access, income is also a primary factor in this project [7]. It was very important to look at how income groups were represented in the data. It was found that lower-income women were less represented on the popular routes that higher-income women were taking. These differences are instrumental in understanding how to better Nairobi's public transportation system. The intersecting factors of gender and class show that large structural systems are affecting women differently, and it is reflected in how they use public transportation. Since there are definite differences in the experiences of men and women on public transportation, it is now an imperative to create policy changes to better the experiences of women.

I'd like to thank Elise St. John from the Cal Poly Digital Transformation Hub for keeping us connected with the World Bank and being an excellent source of input and feedback. I'd also like to thank Akiko Kishue from the World Bank for giving me insight and resources to work with. I'd like to thank Dr. Joyce Lin for being a wonderful senior project advisor and providing meticulous feedback. Along those lines, I'd like to thank Sawyer Koelsch for providing support and structure to the project. Many thanks to Russel White from the Cal Poly GIS help desk, who was instrumental in implementing the ArcGIS platform in this project.

METHODS

The methods implemented in this project are as follows. Data were given in several excel files that were instructed to keep encrypted. Here is a snapshot of what those data files look like:

ginal ler	Location	Date	Response Number	Time of Interview 24hr (HH:MM)	1. a)			1. a)			1. b)			2. a)			2. a)			2. b)		
					Origin Neighbo rhood	City/Town	Purpose	Origin City/Town	Destinatio n Neighbo rhood	Destinatio n City/Town	Purpose	Destinatio n Neighbo rhood	Destinatio n City/Town	Purpose	Destinatio n Neighbo rhood	Destinatio n City/Town	Purpose	Destinatio n Neighbo rhood	Destinatio n City/Town	Purpose		
1	Kenyatta Avenue	10/4/16	1	7:11	Embakasi	Nairobi	Home		GPO	Nairobi	Work/Business											
2	Kenyatta Avenue	10/4/16	2	7:20	Kawangwai	Nairobi	Home		I&M Bank	Nairobi	Work/Business											
3	Kenyatta Avenue	10/4/16	3	7:30	Kirinyaga R	Nairobi	Work/Business		Kawangwai	Nairobi	Home											
4	Kenyatta Avenue	10/4/16	4	7:45	Westlands	Nairobi	Home		Teleposta	Nairobi	Work/Business											
5	Kenyatta Avenue	10/4/16	5	7:52	Uthiru	Nairobi	Home		Upper Hill	Nairobi	Work/Business											
6	Kenyatta Avenue	10/4/16	6	8:10	Jogoo Roa	Nairobi	Home		Nyayo Hou	Nairobi	Other											
7	Kenyatta Avenue	10/4/16	7	8:18	University c	Nairobi	Home		Kencom	Nairobi	Other											
8	Kenyatta Avenue	10/4/16	8	8:30	Kinoo	Nairobi	Home		Yaya centr	Nairobi	Work/Business											
9	Kenyatta Avenue	10/4/16	9	8:45	Allsopps	Nairobi	Home		Nyayo Hou	Nairobi	Work/Business											
10	Kenyatta Avenue	10/4/16	10	8:55	Donholm	Nairobi	Home		Posta Hou	Nairobi	Work/Business											
11	Kenyatta Avenue	10/4/16	11	9:02	Gikomba	Nairobi	Work/Business		Kawangwai	Nairobi	Work/Business											
12	Kenyatta Avenue	10/4/16	12	9:20	Kikuyu	Nairobi	Home		University c	Nairobi	Education											
13	Kenyatta Avenue	10/4/16	13	9:38	Kibera	Nairobi	Home		Kisumu	Kisumu	Home											
14	Kenyatta Avenue	10/4/16	14	9:45	Waiyaki W	Nairobi	Home		GPO	Nairobi	Work/Business											
15	Kenyatta Avenue	10/4/16	15	9:50	Uthiru	Nairobi	Home		Central Par	Nairobi	Social/Recreational											
16	Kenyatta Avenue	10/4/16	16	10:05	Kikuyu	Nairobi	Home		ICEA Buildi	Nairobi	Education											
17	Kenyatta Avenue	10/4/16	17	10:18	Upper Hill	Nairobi	Work/Business		Ambassad	Nairobi	Work/Business											
18	Kenyatta Avenue	10/4/16	18	10:30	University V	Nairobi	Work/Business		Machakos	Machakos	Home											

There were in total 3 file folders, each containing survey data information, as well as the data itself. The files with survey information included copies of the actual survey used in the study, which was used to motivate the understanding of the survey data. Here is what the BRT survey may have looked like for a survey respondent:

Traveler Interview questionnaire – Nairobi BRT Line 1

Surveyor Name: _____ Date: _____ Response number: _____

Location: Kenyatta Ave Moi Avenue/Haille Selassie Ave
 Westlands Nakumatt Mega (opp Nyayo)

Time of interview: 24hr, hh:mm :

We are conducting a survey of passenger travel in the Nairobi for KeNHA and MOTI. This will be used to help plan future transport projects in the City. We would like to find out about your trip today, and your reason for choosing the means of transport used for your journey.

SECTION A: Details of the last journey made (or if mid-transit the journey currently being made)

1. a) Origin: (Original origin, e.g. home location)
 Please tell me where your last or current journey started?
 Neighbourhood: _____
 City/Town: _____

1. b) What was your reason for being there?

Home Education
 Work/Business Social/Recreational
 Shopping Health Other

2. a) Destination: (Ultimate destination, e.g. workplace)
 Please tell me where your last or current journey finishes
 Neighbourhood: _____
 City/Town: _____

2. b) And what is your reason for going there?

Home Education
 Work/Business Social/Recreational
 Shopping Health Other

Articles and files of background information, as well as a Zoom conference on gender and mobility were also given. I based a lot of my initial ideas on the readings I had done. These were all instrumental in my initial understanding of the transportation issues that women face in Nairobi, as well as creating a sense of urgency for new policy and change to come about. Here is a snapshot of “Gender and Mobility of the Developing World” [10].

Seoul's Cheonggyecheon river restoration (before and after)

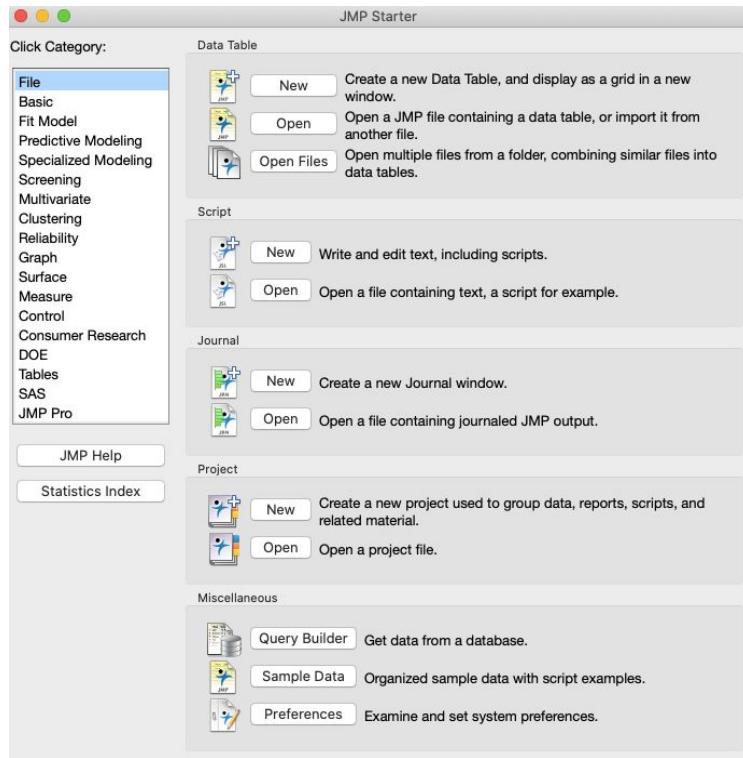


Box 8: Cheonggyecheon Restoration Project, Seoul

In the 1960s, as Korea embarked on rapid modernization, the Cheonggyecheon was entombed beneath a drab, concrete elevated expressway running through the heart of the city. The stunning success of the dismantling of this six-kilometer highway, and its replacement with the reclaimed river, high quality walkways and public space, holds many lessons for other cities about what it really means to “modernize”. The grand opening of the restored Cheonggyecheon took place on Oct. 1, 2005, accompanied by the World Mayor's Forum and street festivals around each of its 22 bridges—five of which are for the exclusive use of pedestrians and bicycles. The dismantling of the elevated expressway has been so popular that 84 other elevated roadways have been short-listed for demolition in coming years. Seoul's revitalization extends beyond the Cheonggyecheon restoration. Among the most striking urban transportation improvements are the five median busway corridors that became operational in July 2004. More than 80 kilometers of congested streets have been retrofitted with exclusive median bus lanes, providing faster transit services that are safe and comfortable.

Source: Fjellstrom, 2005; used in Kumeda and Gauthier 2007.

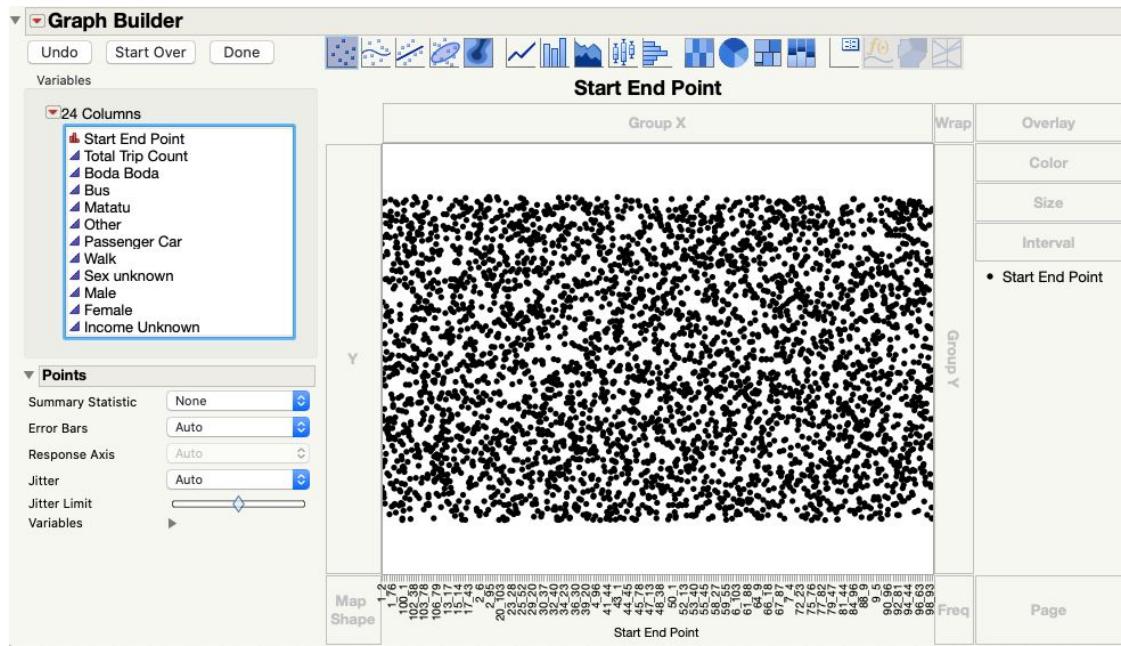
This project utilized the software JMP to create diagrams, graphs, and perform statistical analyses. JMP is a software available for free download through the Cal Poly University Portal. It is convenient, fast and very user-friendly. Its interface looks like this:



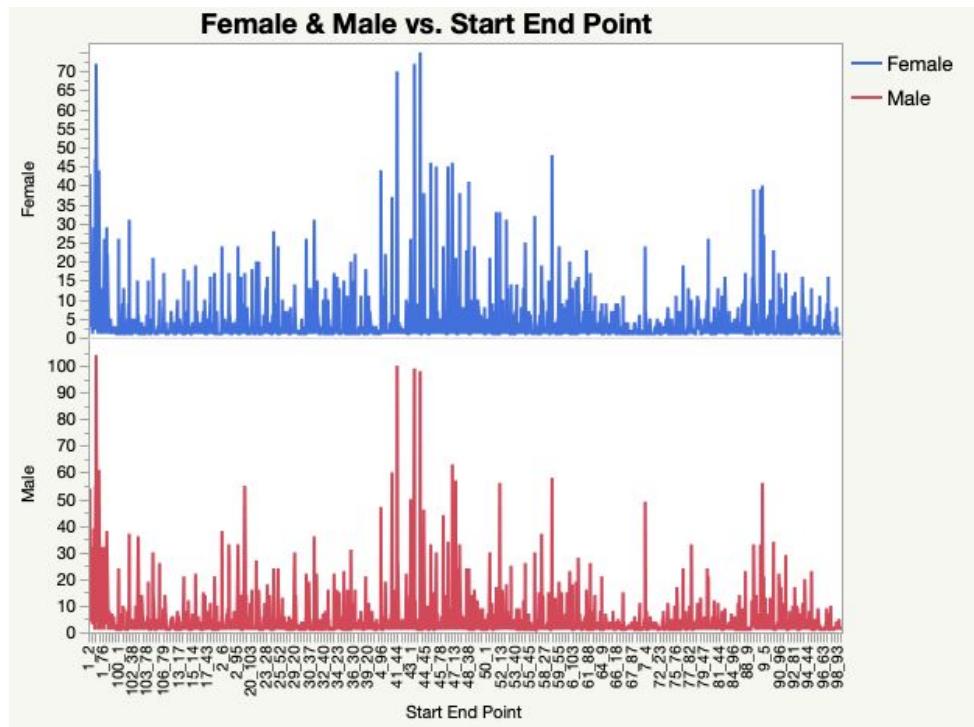
JMP was a very important tool to use for exploratory graphs and figures. Elementary visualization is important in order to find what to initially target. It helps to pinpoint what sticks out unusually or what looks like it is being modelled linearly or exponentially. For example, here is what a file looks like when uploaded to JMP:

	Start End Point	Total Trip Count	Boda Boda	Bus	Matatu	Other	Passe
1	1_44	176	2	45	73	6	
2	44_1	173	2	25	83	7	
3	43_41	171	17	12	34	14	
4	41_43	170	12	11	39	14	
5	1_47	112	1	29	61	3	
6	47_1	109	1	24	62	3	
7	59_1	106	2	29	50	4	
8	1_59	105	2	30	49	2	
9	1_40	97	2	28	37	2	
10	1_9	97	•	6	85	•	
11	41_1	97	2	31	29	13	
12	9_1	96	1	6	84	•	
13	1_41	94	•	25	34	9	
14	1_52	93	2	26	56	4	
15	40_1	91	1	24	40	2	
16	52_1	89	1	24	52	5	
17	41_44	85	4	22	23	13	
18	44_41	84	6	18	22	14	
19	1_45	82	•	31	34	5	
20	45_1	79	1	35	27	5	
21	47_20	78	1	26	38	4	
22	40_1	76	0	10	20	5	

Here is what JMP's graphing interface allows:



This interface helped create all of the graphs and diagrams that are included in the Analysis and Results section. Here is an example of a graph following the previous snapshot:



This project's focus was on GIS data, income, and interaction with different public transportation routes among gender and income groups. GIS stands for geographical information system, which means that there is data on how geography relates to transportation. It would be very useful to be

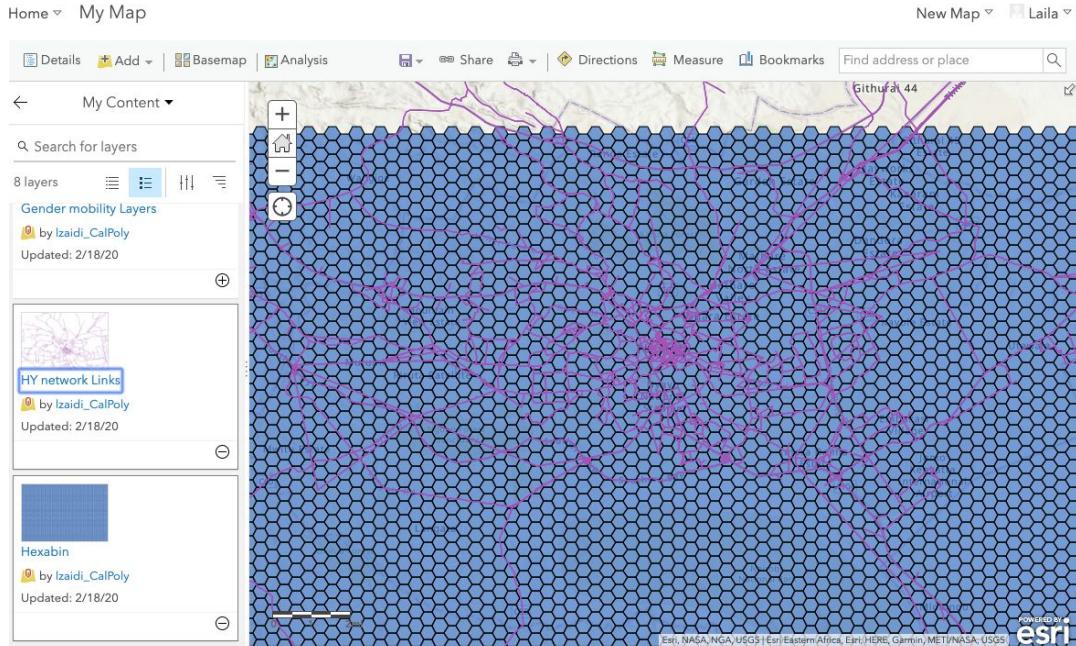
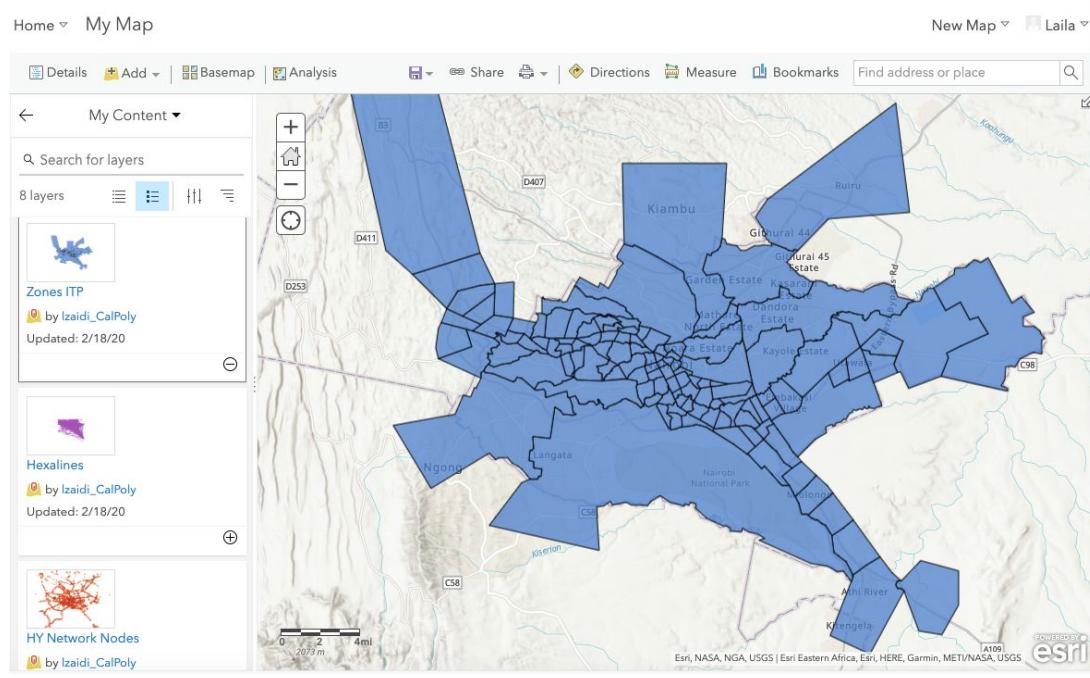
able to relate geographical systems to transportation issues. For example, from information on Nairobi's city structure, the informal settlements (slums) are all on the outskirts of the city, and the people who live there are very low-income [8]. This information can help inform how the geography of Nairobi influences how women of different classes and locations interact with public transportation, which is why GIS data is regarded as a very important tool. Using the Cal Poly arcGIS website [3] to upload the GIS data layers of Nairobi, analysis of the GIS data could be performed. Here is a snapshot of what that process may look like:

The screenshot shows the 'Gender mobility' group page. At the top, there are tabs for Overview, Content, Members, and Settings. Below the tabs, there are sections for Edit Thumbnail, Add a brief summary about the group, and a note that it is owned by Izaidi_CalPoly. To the right, there are buttons for Invite users and Share, and a link for Membership Requests. The 'Description' section contains the text 'Business Analyst Project Group'. The 'Recently added content' section shows two world maps: 'Gender mobility Preferences' and 'Gender mobility Layers', both uploaded by Izaidi_CalPoly. The 'Details' section provides information about the group's creation date (February 18, 2020), owner (Izaidi_CalPoly), and visibility (Only group members). It also lists the number of members (2) and provides links for social sharing on Facebook and Twitter. The 'Owner' section shows the profile picture of Izaidi_CalPoly. The 'Tags' section is currently empty.

Then the GIS data layers provided by the World Bank were added. This process was thanks to the GIS data expert Russel White at Cal Poly. Here is what that GIS layer creation process looked like:

The screenshot shows the 'My Map' page. At the top, there are buttons for Details, Add, Basemap, Analysis, Share, Directions, Measure, and Bookmarks, along with a search bar. The main area shows a map of Nairobi with several layers added. On the left, there is a sidebar with a list of layers: 'Archive' (by Izaidi_CalPoly, updated 3/3/20), 'census' (by Izaidi_CalPoly, updated 2/21/20), and 'Zones ITP'. The map itself shows the city of Nairobi with various neighborhoods labeled, including Kiambu, Ruiru, Githurai 44, Githurai 45 Estate, Kasarani, Dandora Estate, Mathare North Estate, Ngara Estate, Nairobi National Park, Langata, Mlolongo, Embakasi Village, Utawala, and Kitemba. Roads are labeled with codes like B3, D407, D411, D253, C58, and C59. A scale bar indicates distances in meters and miles. The bottom of the map includes credits for Esri, NASA, NGA, USGS, and others.

There were many layers to choose from, each relating to a locational service. Some gave visual information on Nairobi's Zones, as pictured below. Others gave visual information of trips, or created simpler ways of categorizing locations as "hexabins" (hexagonal bins that mark off points in the city), the latter picture.



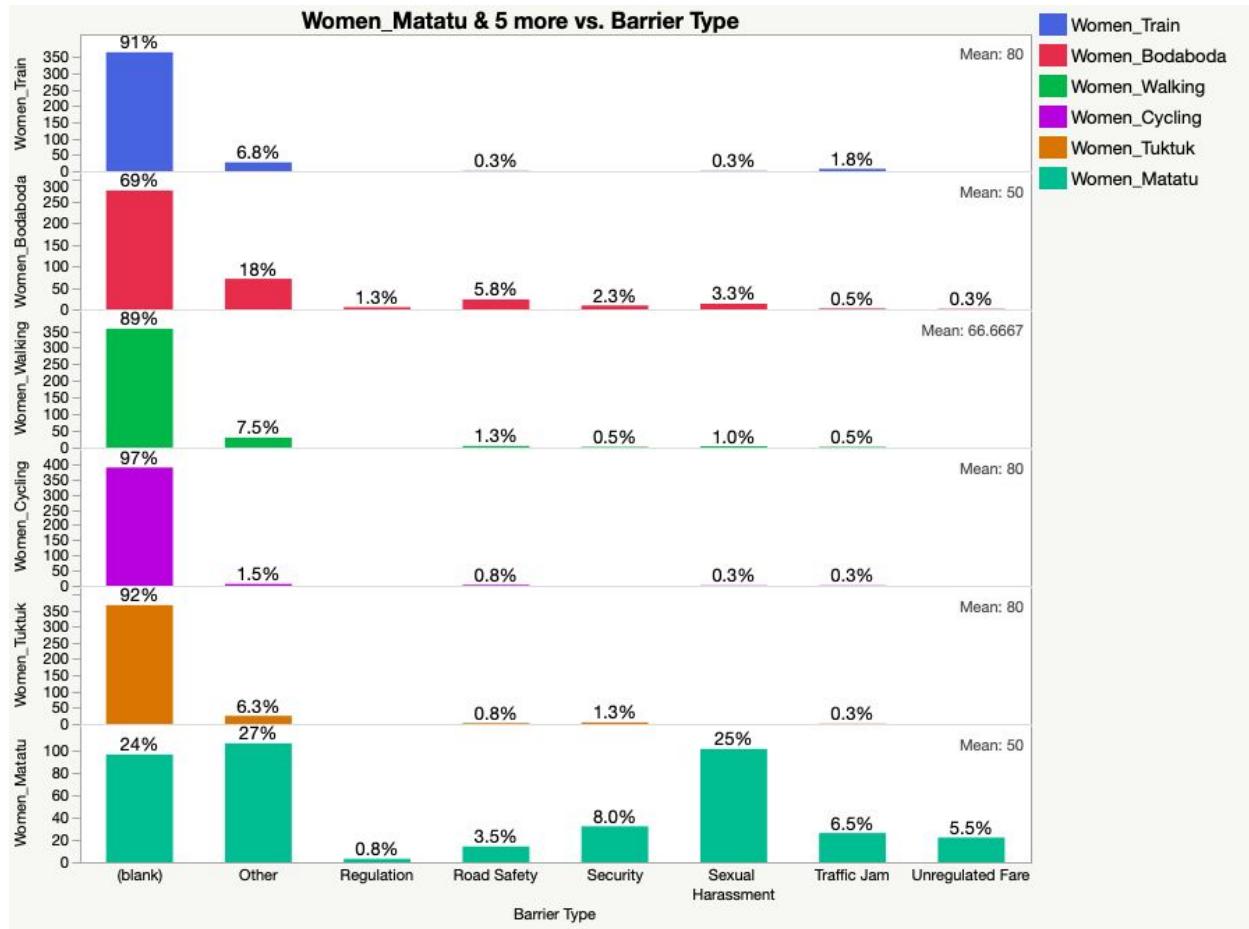
The GIS data layers were not segregated by gender, so they were ultimately not very useful. The overarching mission statement of this project is that it is problematic and harmful to women to not segregate gender data. Thus, it is not doing this project justice to analyze GIS data lacking

gender information. However, the arcGIS platform was used for census data, and connecting locations to landmarks.

The World Bank emphasized the need to analyze the data with the framework of a concept called “Mobility of Care”. This idea relates to how caring for children intersects with access to transportation. A trip taken for the purpose of care is four times more likely to be taken by a woman [5] in reported cases in Spain. Thus, transporting children to and from locations is an aspect of this project that needs attention. Provided by the world bank was a video [5] that discussed this very topic.

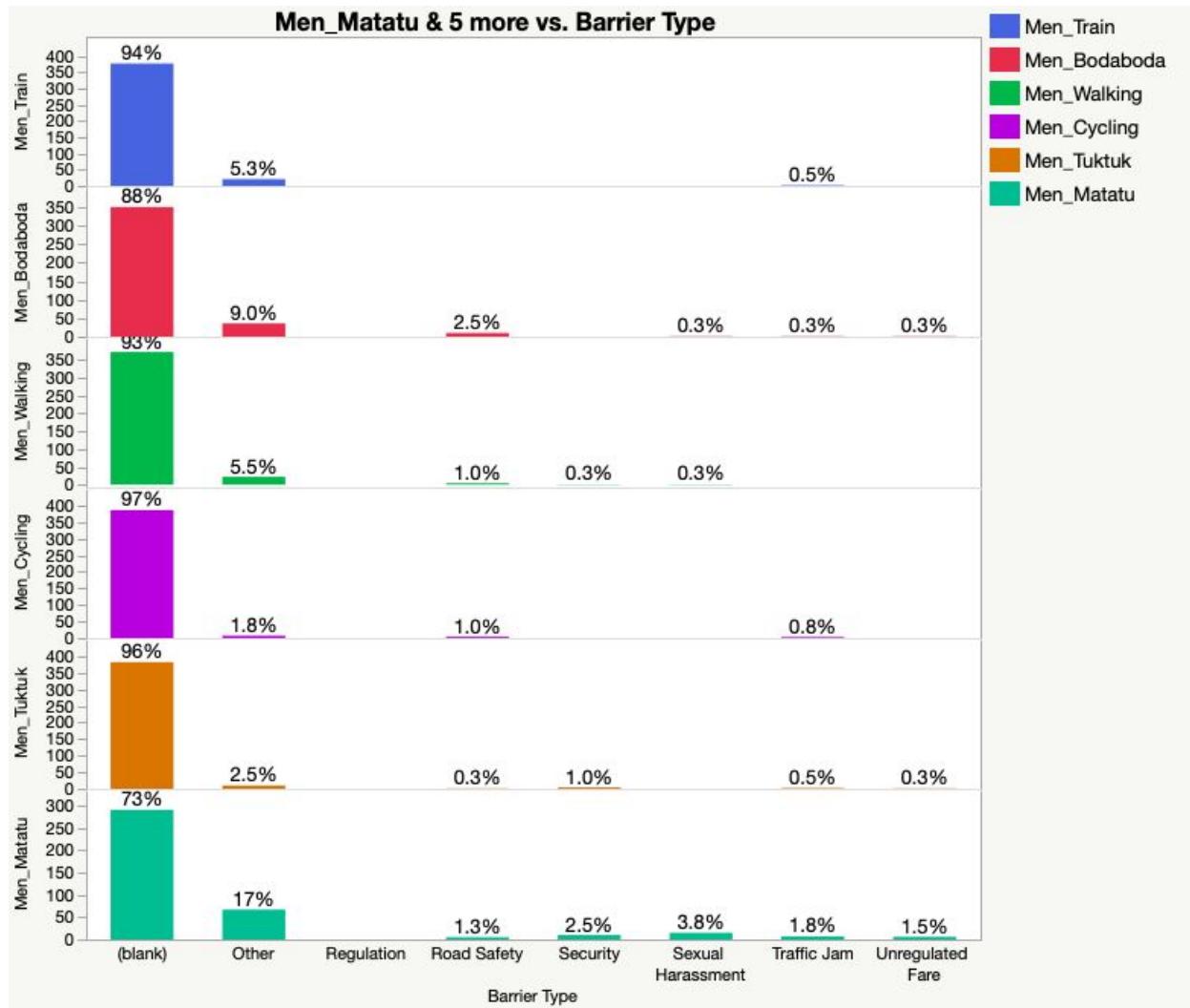
ANALYSIS and RESULTS

At first, looking at what the primary concerns of women were on different modes of transportation seemed to be a good place to start. This analysis was more explorative than analytical.



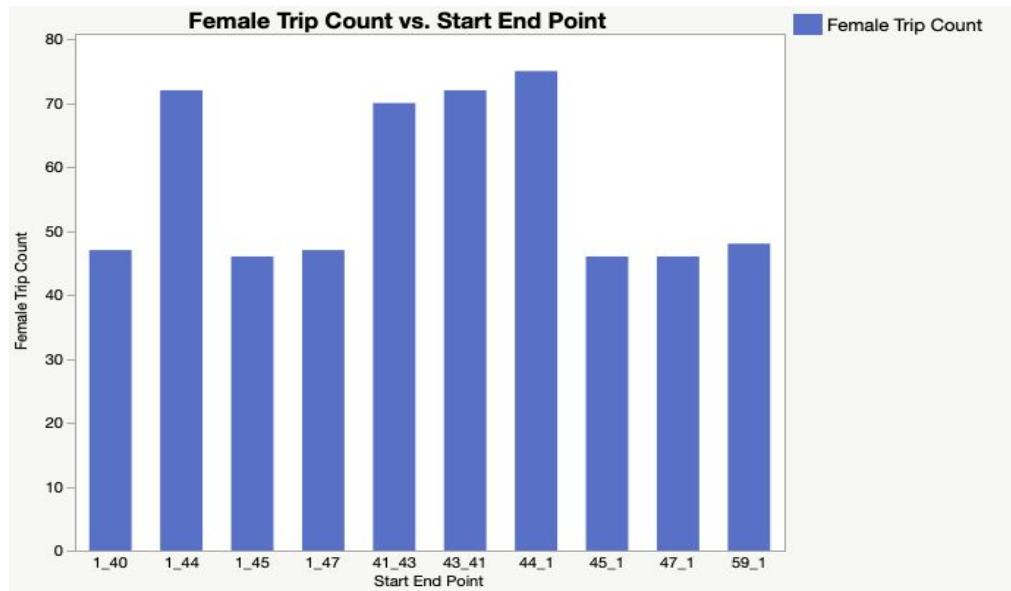
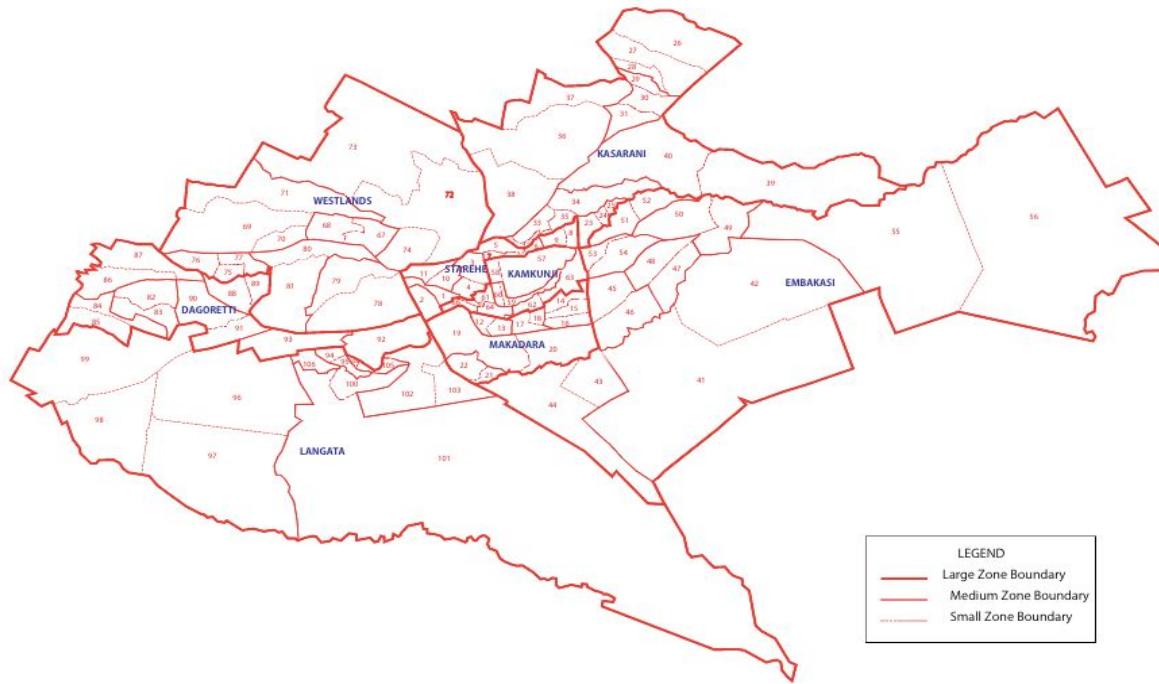
It was found that this data was not useful for the amount of blank answers left by the respondents. However, it did show that the data for women using the Matatus was different. In fact, the women who used matatus were largely more concerned about overarching issues with the system, which brought up the idea that Matatu data was the most useful for this project, since it needed the most reform.

Then it became relevant to look at the results for men, to see if this was a gender issue or a structural issue with the way the Matatus are designed, marketed, and operated.



It was found that men were seemingly just as apathetic about the other modes of public transportation, aside from Matatus, which may indicate that this is an issue with the Matatus, as well as gender.

From there, what became interesting were the specific trips that women were taking. It would be useful to know if there were popular routes that differed among men and women, among lower and higher income women, and if those routes gave any information to relay to the GIS data. Nairobi is chopped up into numbered regions, pictured below, which relay directly to the data given.

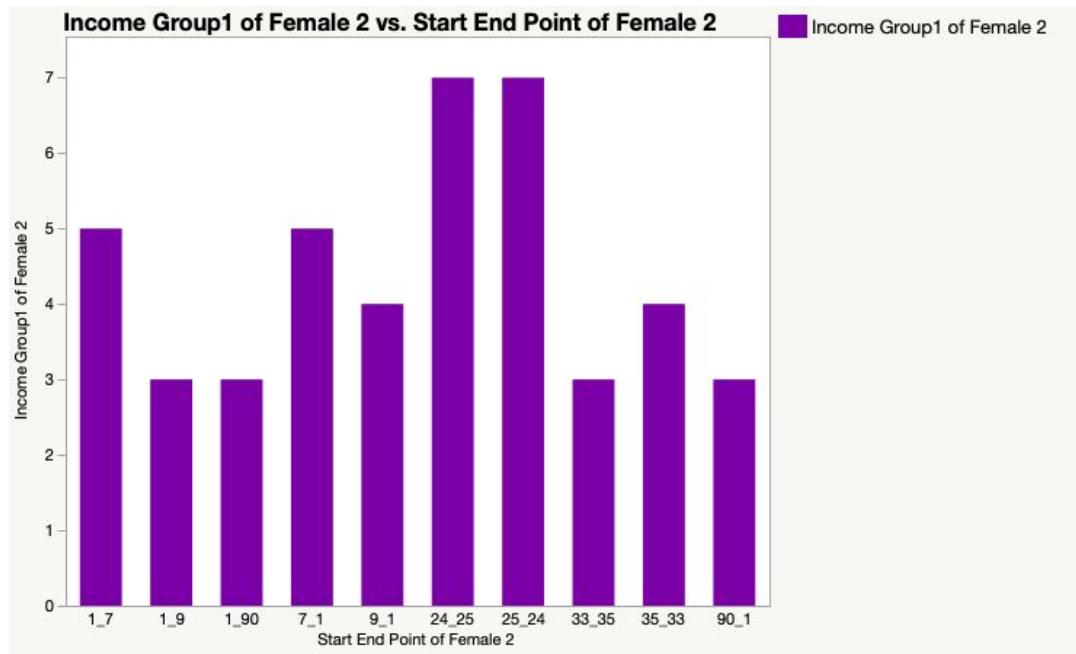


These were the overall top 10 routes that women were taking. After cross-referencing with the GIS data, the trips that included zone 1 were to or from the central business district (CBD). Upon further research, the CBD hosts many jobs, shopping centers, and is the transportation transfer location. Meaning that in order to transfer to a different bus line, one must first travel to the CBD (Zone 1) and transfer there. This could be why 8/10 of the overall top 10 routes for women are either to or from zone 1. It may also be because there are many jobs and shopping centers in that area. These top 10 routes only account for 6% of the overall total number of recorded trips, therefore it may not be representative of the entire population.

The CBD is very central to Nairobi, so it could be that richer women would live closer to the center, since housing would probably be more expensive the closer one gets, due to convenience. Since this data is not segregated by income, it was then imperative to see if the top 10 routes are disproportionate with income.

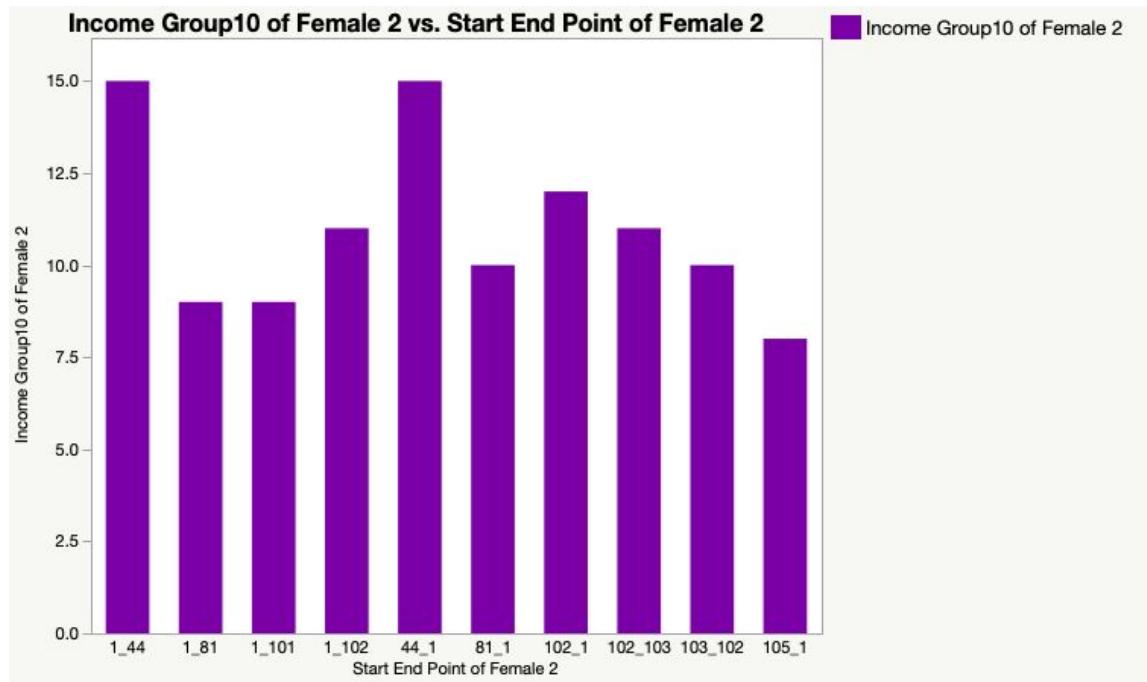


In this case, income Group 1 is the poorest, and income Group 10 is the wealthiest. This shows that out of the top 10 overall most popular routes for women, lower income women are not equally represented. This lack of representation could hinder policy makers from creating change that benefits low income women, and only enact change that could benefit middle-upper income women. Because of this, it is important to do a representative analysis. Next, it was important to analyze the different income group's interaction with public transportation routes.

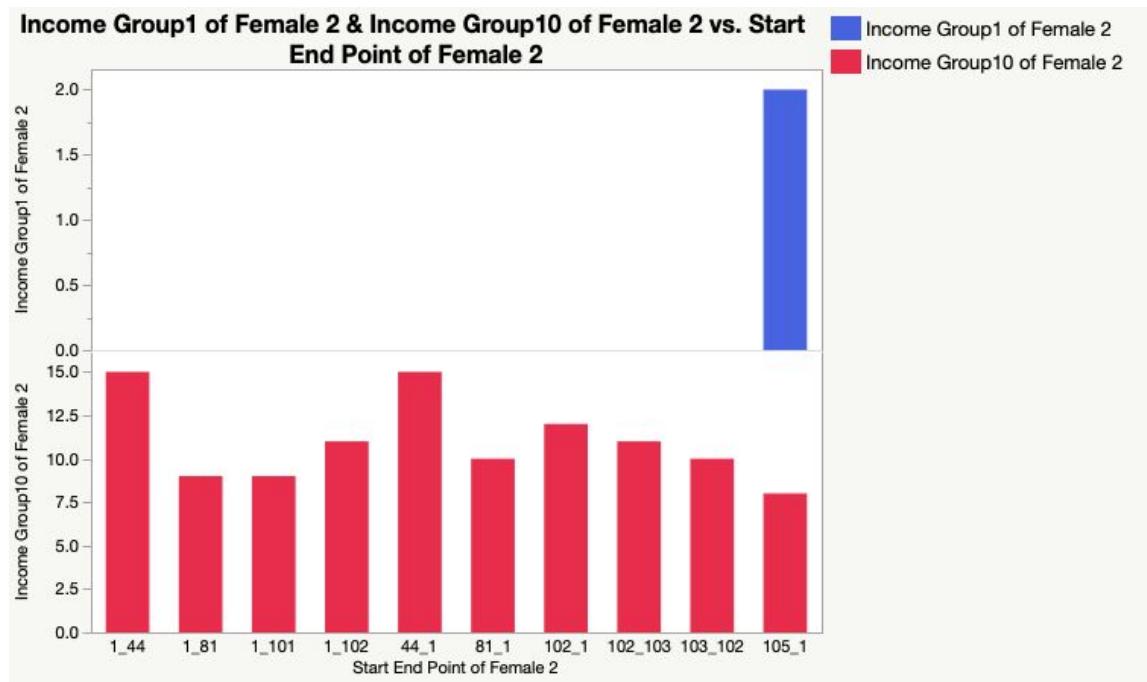


Above are the top 10 routes for the lowest income group of women. While 60% of the top 10 routes are to and from the Central Business District (Zone 1), the other most popular routes are not taken by the higher income women. Cross-referencing the GIS data for information on zones 24 and 25, it showed that the distance between these two zones is just about less than 2 miles. That distance is moderately walkable, and low income women would probably walk the trip over paying the fare for such a small distance. Thus, this route will probably not be walked as much by the high income women. Below is a table comparing the top 10 low income group trips with how they line up with high-income women.

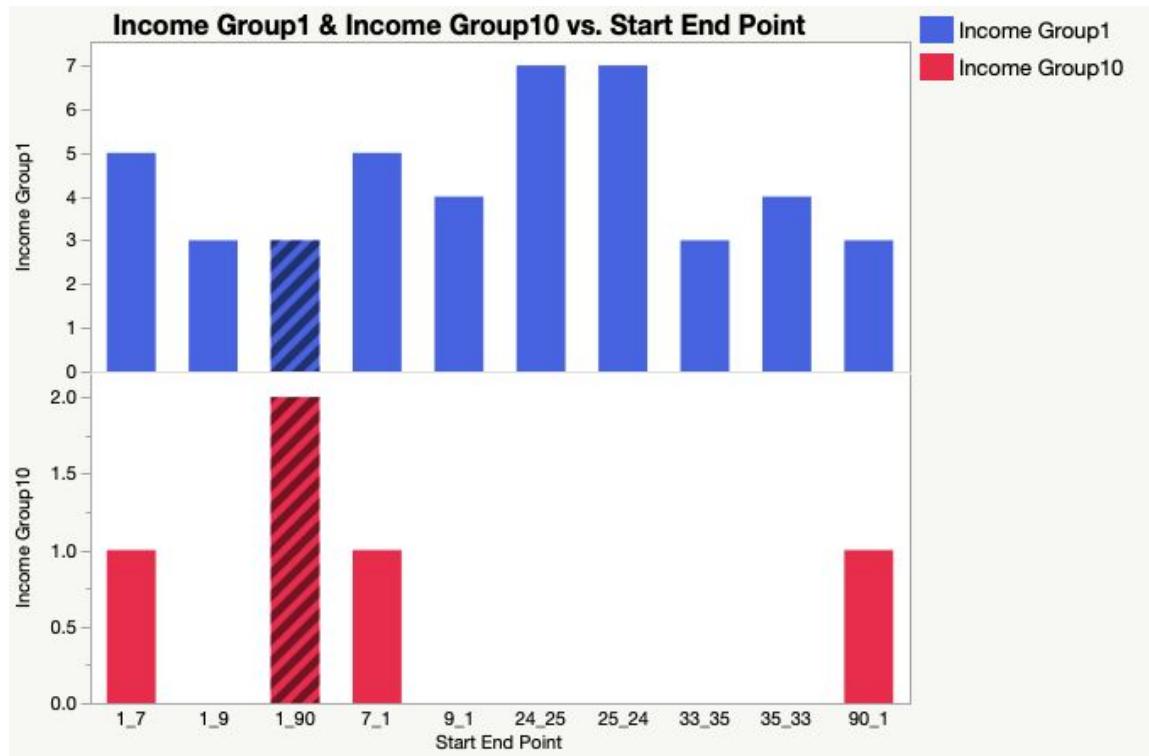
		Start End Point									
		1_7	1_9	1_90	7_1	9_1	24_25	25_24	33_35	35_33	90_1
Income Group1	Sum	5	3	3	5	4	7	7	3	4	3
Income Group10	Sum	1	.	2	1	1



It was shown that high income women are not taking this route, which could mean that the top 10 overall routes are not proportional among income groups. From this mirrored histogram, it looks like higher income women are commuting to and from Zone 1, like low-income women, but from entirely different routes, which leads me to believe that their motivations are completely different.

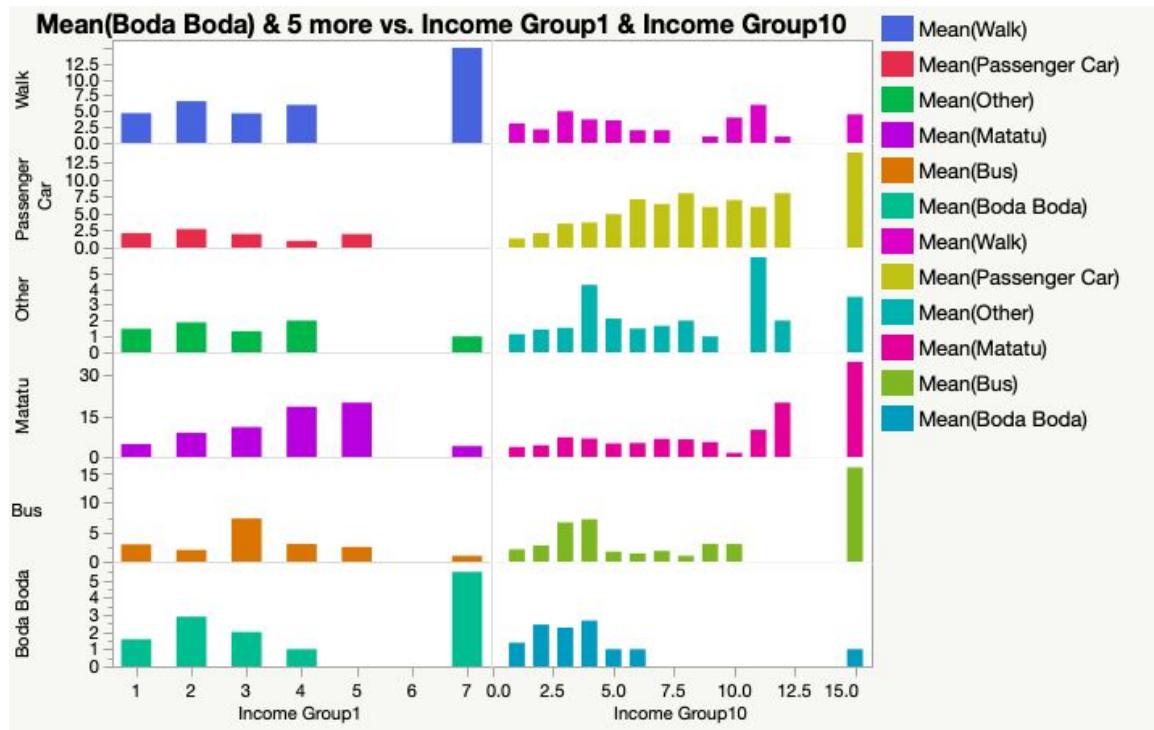


This diagram above shows that there are only two recorded trips of low-income women taking only one of the top ten most ridden trips for higher-income women. Upon referencing the GIS data, zones 102/103/105 are residential areas. According to Wikipedia, the regions with European names, such as Bellevue Estate in zone 102, tend to correspond to where the European settlers stayed. It also corresponds to the areas of higher income, leading one to believe that zones 102/103/105 are residential areas for the high income population. This supports the claim that high income women are using transportation to and from their residences.



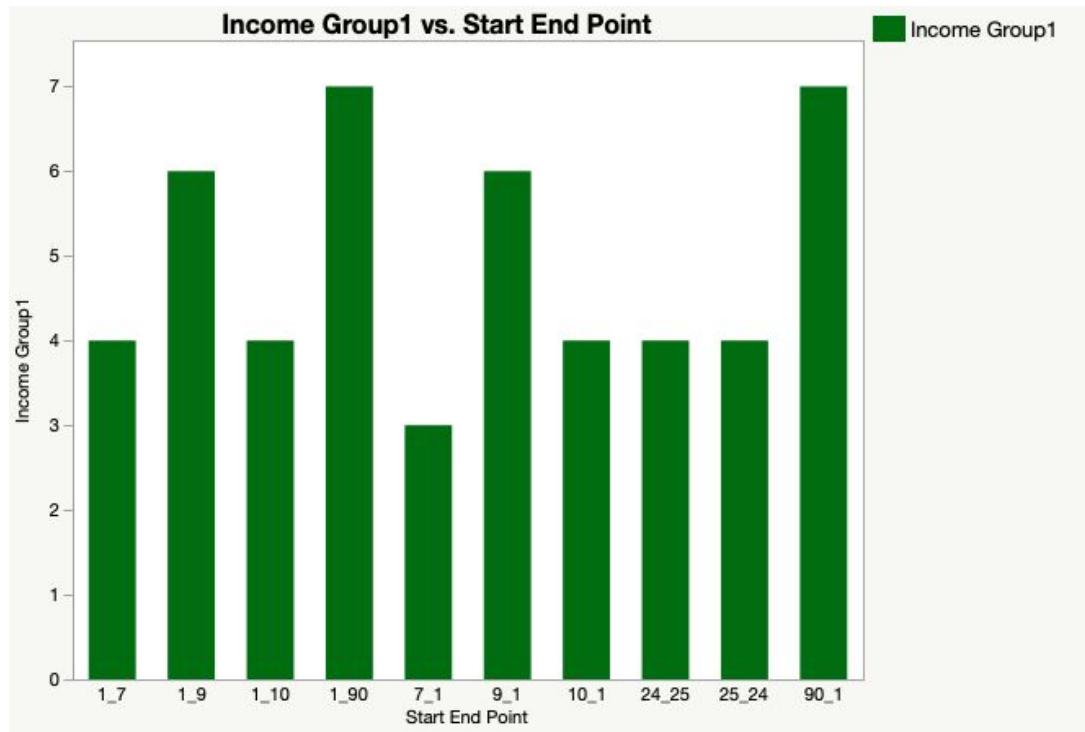
Then, in comparing how high income women relate to the most popular routes for low income women, they shared routes to and from the business district. This is mostly inconclusive, because the routes to and from the business district are popular regardless of income, since they involve transfers, and are included in the overall most popular trips for women regardless of income. There is something more telling about the fact that low income women do not share many routes of the popular high income routes, than some high income women taking routes that most low income women take.

The ways in which women of the most differing income groups were travelling became a topic of interest because of this disparity.

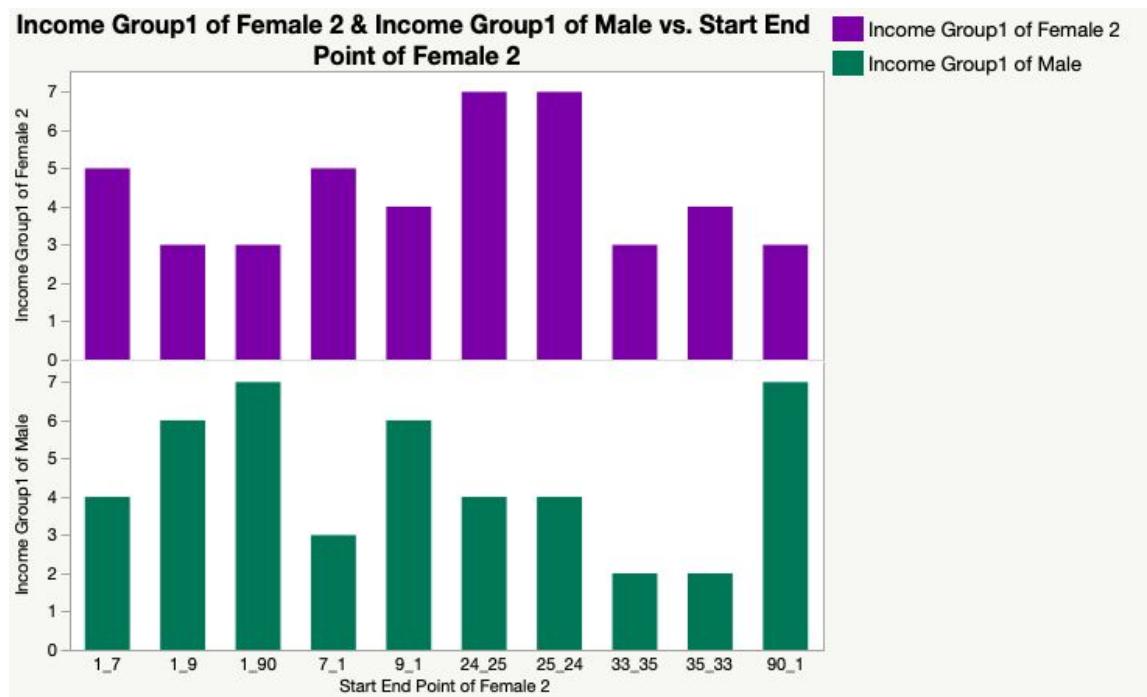


From these above histograms, it shows that the overall trends of women interacting with different modes of transportation are slightly similar among the highest and lowest income groups.

To investigate the intersection between income and gender, it was important to draw conclusions on how men of differing incomes interacted with routes. Drawing conclusions from this would ground the claim that men and women interact with public transportation differently.

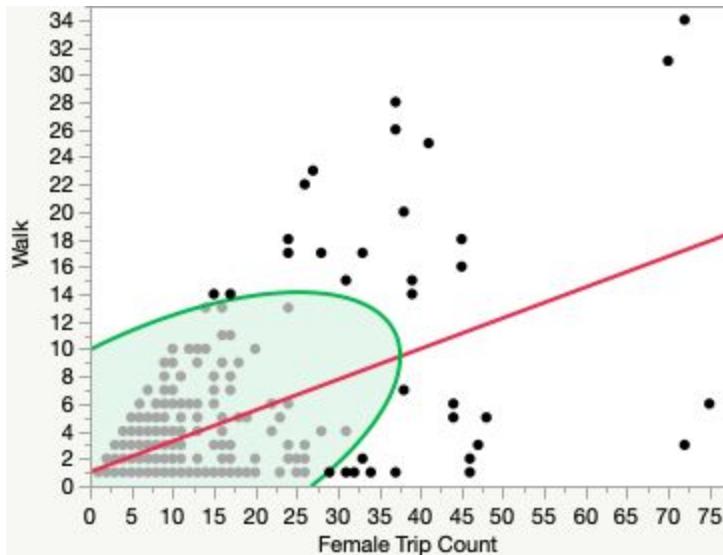


For the lowest income men, it looked very similar to lowest income women. The same 24-25 zone trip was represented, as well as the trips to and from zone 1. This led to a deeper analysis, and the hypothesis that the income group influences trip routes much deeper than gender.



This histogram depicts the top 10 routes of lowest income women, and how lowest income men relate to these trips. Overall, they are very similar, aside from route 33-35.

It was now important to ask if the number of walking trips can be predicted from the total trips. That is, is walking proportional to the number of trips? Or is there a larger proportion of women walking their trips? This question pertains to income especially, since trips that are walked do not cost money. Women and men of lower incomes may not be able to justify the tradeoff between convenience and price.



$$\text{Walk} = 1.0195465 + 0.2245732 * \text{Female Trip Count}$$

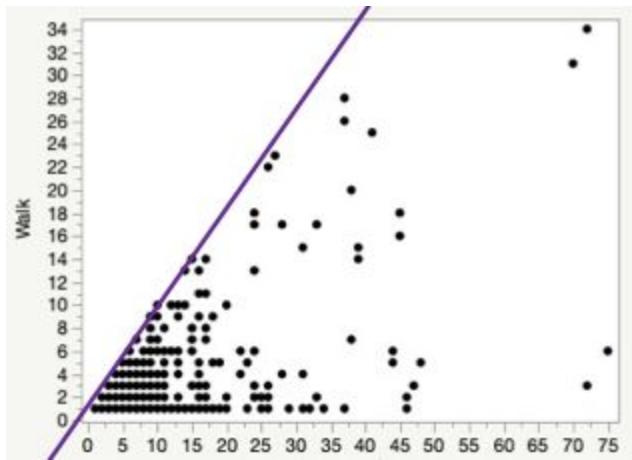
Summary of Fit

RSquare	0.349386
RSquare Adj	0.348438
Root Mean Square Error	3.040012
Mean of Response	2.700581
Observations (or Sum Wgts)	688

The red line is the regression line, and the green curve marks where 99% of observations lie. While it may not seem like 99% of observations lie in such a small region, there are duplicates which make the values in the bottom left weighted higher. Notice that from this scatterplot and regression line there are outliers in the bottom right corner that are skewing the plot. The equation above shows that 1.02 is the intercept, and 0.224 is the slope. That is, as total female trip count increases by one, the number of walking trips is expected to increase by 0.22. To put this in perspective, if one notices a trip that forty women have taken, about 10 of those 40 trips (about 25%) are expected to be walked. In other words, if there is a data point $(x,y) = (40,10)$ it means that of a singular trip taken by 40 women, 10 of those women walked the trip. This scatterplot would be especially interesting if income were factored in.

The R Square value of approximately 0.35 means that about 35% of the variance in the data can be accounted for by a linear model. Because this value is not high, a linear model is not a good predictor of the number of trips walked by women.

Using point slope-form, the equation for the bounding line is found.



This line is approximately:

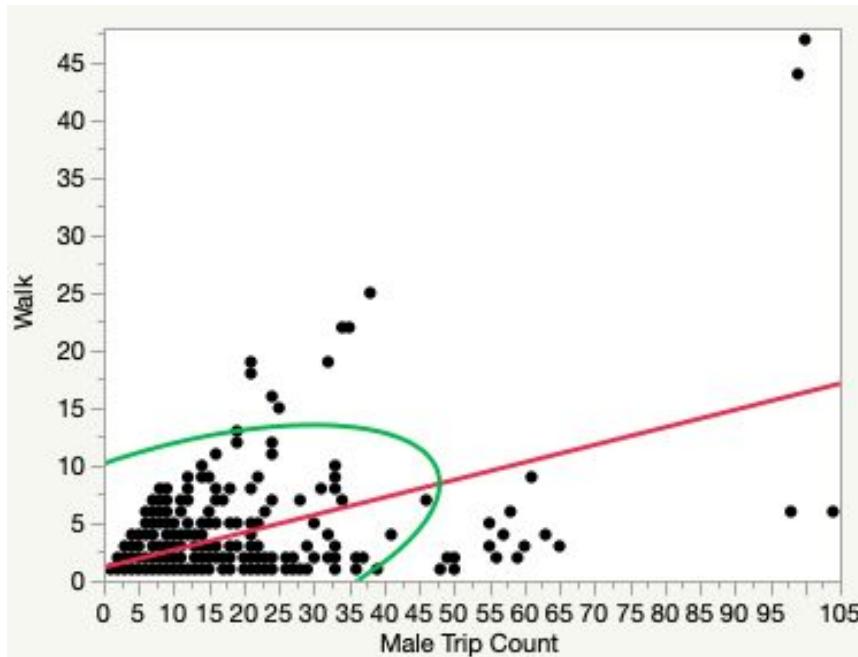
$$y=0.7+0.8365x, \text{ or more relevant:}$$

$$\text{walk}=0.7+0.8365*\text{trip count}$$

The slope is increasing, which indicates that there is a directly proportional relationship between the number of total trips and the number being walked. Taking a simple derivative of this slope shows the rate of change of women walking their trips, which is $y=0.8365$. This means that as the number of trips increases by one, the maximum number of those trips being walked is about 0.8365. The equation itself models how the maximum number of women that walk a trip out of a certain number of total trips. Meaning that, for example, the maximum expected number of walked trips out of 20 is $(0.7+17.73)=18.43$. This shows that there exists a situation where a woman would rather use other means of transportation than walking. Considering that the margin between 20 and 18.43 is very small, this shows that the public transportation agency could be collecting revenue from a larger margin if using public transportation was incentivized. If that margin is expanded such that women are using public transportation more and walking less, it would be beneficial to the city's economy.

The density ellipse also shows that 99% of trips recorded in the survey were taken by about 40 or less other women, a relatively small number of trips. This means that while there are popular routes, most routes were recorded as being taken by a moderate amount of women.

Along this vein, the same analysis can be done for men as well, to see if there are any stark differences in walking trips by gender. Here is a model of men's total trips vs. the number of those trips that are walked.



$$\text{Walk} = 1.1459721 + 0.1520988 * \text{Male Trip Count}$$

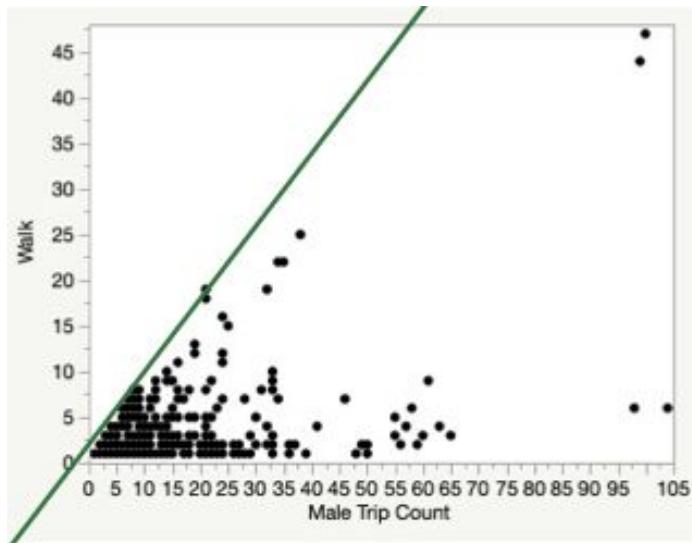
Summary of Fit

RSquare	0.28868
RSquare Adj	0.287654
Root Mean Square Error	3.059825
Mean of Response	2.522302
Observations (or Sum Wgts)	695

In the same vein as before, one can see that the intercept of the regression line is at 1.146, and its slope is approximately 0.152. This means that as the trip count increases by one, the number of expected trips to be walked increases by approximately 0.152. For example, if there is a trip that 40 men are taking, about 8 (rounded up) are expected to walk that trip. That is 2 less people than the model for women. If one compares walking trips solely by their linear models, since the slope on the model for women's trips is steeper, more women are expected to be walking a randomly selected trip. The value of R Square shows that about 28.8% of variance can be accounted for by a linear model, which is not ideal. This shows that a linear model is not a good fit for this data. Just like before, it may seem like there are not 695 data points, but many are duplicates. The density ellipse is more skewed left than the density ellipse for women, which may show that there is a greater density of men taking high volume trips, but walking those trips less. This may be due to the fact that if a family gains access to a motorbike or Boda Boda, it is

mostly driven by men due to gender roles [5]. This may account for why there are less trips walked in a high volume total trip.

Here is a visualization and explication of the bounding curve for this relationship.



Using point-slope form the equation for this bounding line is:

$y = 1.000 + 0.9286x$, or more relevant:

$walk = 1.000 + 0.9286 * trip\ count$

This equation shows that as the number of men taking a trip increases by one, the maximum number of men walking a trip of that size increases by 0.9286. For example, if 20 men are taking a trip, the maximum number of those trips being walked is 19.592. Just like before, there is a small margin between 20 and 19.592. This perhaps shows that there is less of a margin between men walking a trip and choosing not to. This may be because they feel safer walking, or are not accompanied by children. Regardless, they are interacting with their trips differently than women.

While more women are walking trips in the long run, in a maximum number of walking trips, men are more likely to walk. This analysis shows that there is so much more going into a walking trip. If there was a way to incentivize using public transportation over walking, there may be a greater margin between total trips and walking. This would not only serve the city's economy, but it may also help women reach their destinations with convenience and care. If they were able to make public transportation more affordable, convenient and safer for women, they would see a decrease in women walking, which would boost fare sales.

These changes have major effects in empowering women to seek employment outside the home, and do errands and tasks with ease, convenience and peace of mind. Details of these incentivization ideas are discussed on the next page of this paper.

CONCLUSION

In order to better the experiences of women on public transport, it would be beneficial to see changes in public policy and the empowerment of agency among women.

With increased safe and inexpensive access to contraception, women will be less inclined to have children, more inclined to seek employment and education outside of the home, which empowers structural and social change. Fighting a patriarchal structure in society is something that takes a long time. Aiming for slow incremental changes is crucial for changing long standing social structures. Something that empowers this fight is a woman's right to safe and confidential reproductive health tools. When women have a choice whether or not to start a family and commit to taking care of children, they have the option to choose a different path for their professional life as well. In Nairobi, women account for 52% of the population [3], yet often feel powerless in their family planning [4]. If less women were burdened to care for children at younger ages, they would most likely be motivated to pursue higher education, which grants them access to higher-paying and more demanding jobs. In Kenya, unplanned pregnancy rates are increasing and access to free birth control and contraceptives are waning. This creates a sense of stagnancy for women, as they cannot seek the employment, education or family planning that they need. According to Global Citizen, "The 2019 study revealed that unplanned pregnancies have increased to 44% within the last two years, and the use of contraceptives among married women has declined from 62% to 56%...Also, women in the workforce were more likely to be on birth control than unemployed women"[4]. This shows that unemployed women can benefit from birth control, and perhaps improve their quality of health and professional life. Having more employed women in general can create change in public policy. If more women need to commute to a place of employment, this would affect demand for public transport. This may alter the statistics for the mobility of care issue. If more women are employed, they may need to share the responsibility of childcare with their partners. As it stands, women are four times or 400% more likely to take a trip with a child than men [5].

Also, this may employ more women in the public policy sector itself [9]. Having more women employed in sectors that need a woman's input is extremely valuable. For example, if a bill on safety in public transportation wants to be passed, having a woman's account of their own safety would make the discussion of the bill inclusive and more three-dimensional. If women have children later in life this change is entirely more possible.

The city should incentivize public transportation use by decreasing fares and increasing bus frequency. Making public transportation extremely affordable, or even free, creates mobility for those at disadvantages. If transportation were ever a limiting factor in a woman's ability to seek employment or education, it can now be accessed. This goes along with low-income people as well. Funding from this can come from corporations that wish to subsidize their employee's

transportation fares. It can also come from corporations or organizations abroad who wish to sponsor those who need free access to public transportation. There should be public services that connect people in need with the mobility that they require.

Having subsidized, reduced, or free public transportation is important for creating jobs through access and mobility, as well as the ability to use public transportation without financial repercussion. Since it was shown that on average 75% of women's daily trips are not walked, it is important to take into account how much of their income is spent on taking necessary trips. Being able to choose to save the money one would've spent on transport creates not only a sense of security but the option to spend money elsewhere. In a study done in Mumbai, India, subsidized fares directly decrease middle and lower class spending, "the study conducted in Greater Mumbai during the winter of 2003-2004 shows that the implementation of Public Transport policy has decreased the average spending of low-income households salaries to 17% while middle-income to 13% after three years of its implementation" [9]. This empowers a disposable income, which classifies a growing middle class. While these are changes one would definitely not see overnight, small incremental change is important. Most importantly, if free public transportation were allowed for women, they would save money, which could be spent on other necessary expenses. This could improve the quality of life for women, which would likely change the results if this analysis were repeated after these changes were enacted.

As for the issue of road safety and sexual harassment, implementing new public transport in safe public spaces could benefit these issues. Having safe public spaces drastically improved the experiences of women in Iran, and creating safe and accessible public plazas or parks that are attached to public transportation routes could benefit women in Nairobi. From "Gender and Mobility and the Developing World", Iranian women making efforts to take up space in public places was meant to "emphasize how frequent presence in the different public spaces gave women a new consciousness about themselves and their individual and citizen rights in the society" [10]. Implementing safe public spaces for women to use will likely improve their experiences on public transportation and in life.

Using linear regression and statistical analyses, it was determined that low-income women are being misrepresented in popular routes. There needs to be a deeper analysis of the way women are walking trips, in order to understand how the government can provide assistance in terms of public transportation. Recognizing that, it would be worthwhile to provide low-income women free or reduced fares. Women in Nairobi should have access to safe, economical, and convenient public transportation.

REFERENCES

1. Allen, Heather. 2018. “Approaches for Gender Responsive Urban Mobility”. GIZ-SUTP. 2nd Edition.
2. Abidemi, Asiyanbola. “Gender Differences in Intra-Urban Travel Behaviour: a Preliminary Survey in Ibadan, Nigeria.”, Olabisi Onabanjo University.
3. *Calpoly.maps.arcgis.com*, calpoly.maps.arcgis.com/home/index.html.
4. Caruso, Catherine. “Unplanned Pregnancies Are Increasing in Kenya as Family Planning Services Decline.” *Global Citizen*, 2 Mar. 2020, www.globalcitizen.org/en/content/unplanned-pregnancies-are-increasing-in-kenya/.
5. de Madriaga, Ines Sanchez. “Mobility of Care” *YouTube*, uploaded by UN-Habitat worldwide, 2 October 2018, <https://www.youtube.com/watch?v=Mgt8S33GFno>.
6. Deborah Salon & Sumila Gulyani (2010) Mobility, Poverty, and Gender: Travel ‘Choices’ of Slum Residents in Nairobi, Kenya, *Transport Reviews*, 30:5, 641-657, DOI: 10.1080/01441640903298998.
7. Nakamura, Shohei, and Paolo Avner, November 2018, “Spatial Distributions of Job Accessibility, Housing Rents, and Poverty in Nairobi, Kenya.”, World Bank Group.
8. Quiros, Tatiana, et al, February 2014, “Gender, Travel and Job Access: Evidence from Buenos Aires.”
9. Sultan, Zahid and Obu, Isaac Faiko and Kana, Samson and Joseph, Jerry, Subsidy for Public Transport in Developing Countries – A Case Study of Lae, PNG (June 14, 2019). Available at SSRN: <https://ssrn.com/abstract=3119616> or <http://dx.doi.org/10.2139/ssrn.3119616>
10. Uteng, Tanu Priya, February 2011, “Gender and Mobility in the Developing World.”, Norwegian University of Science and Technology.
11. World Bank. *Making Transport Work for Women and Men: Challenges and Opportunities in the Middle East and North Africa (MENA) Region*. World Bank Report, June 2012.

