

# University of Mumbai

DEPARTMENT OF STATISTICS

VIDYANAGARI, MUMBAI-400098



## CERTIFICATE

This is to certify that,

**Pruthvi Jitendra Patane**

Of M.Sc. Part – II have successfully completed the project entitled.

**“PLASTI-LESS”**

**A STEP TOWARDS SUSTAINABLE FUTURE....!!**

During the academic year 2022-2023

Dr. Alok D. Dabade  
(Project Mentor)

Dr.(Mrs.) Vaijaynti U. Dixit  
(Head of the Department)

# **ACKNOWLEDGEMENT**

We would like to express our thankfulness to all the people who have helped us in completion of our project.

We would like to thank our Head and all the faculty member of M.Sc. statistics department of University of Mumbai for providing us the necessary infrastructure we needed.

We owe heartfelt and deepest gratitude to our guide and mentor **Dr. Alok D. Dabade Sir** for his continuous guidance. He has help us whenever we needed and has been a chief support to us.

And a huge THANK YOU to one and all those who took time out of their busy schedule and participated in our survey.

# **INDEX**

Sr. No.	Content	Page No.
1.	Introduction	4.
2.	Why This Topic...?	6.
3.	Objective	7.
4.	Methodology	8.
5.	Data Visualization	10.
6.	Variables	13.
7.	Analysis Of Data	14.
8.	Conclusion	46.
9.	Scope & Suggestion's	48.
10.	Statistical Codes	49.
11.	Questionnaire	52.
12.	Bibliography	56.

# **INTRODUCTION**

There is no exaggeration to say that we are living in the plastic or polythene Era. Plastic are typically organic polymers of high molecular mass and often contain other substances. The world's first fully synthetic plastic was Bakelite, invented in New York by Leo Baekeland who coined the term PLASTIC. In 1988, the Society of the Plastics Industry introduced the Resin Identification Code (RIC) system. There are mainly 7 types of plastic namely,

1. Acrylic or Polymethyl Methacrylate (PMMA)
2. Polycarbonate (PC)
3. Polyethylene (PE)
4. Polypropylene (PP)
5. Polyvinyl Chloride (PVC)
6. Acrylonitrile Butadiene Styrene (ARS)
7. Polyethylene Terephthalate (PET)

In above types, polyethylene or polyethene is the most commonly used plastic. About 80% of the plastic waste is polyethene (bags). Due to their low cost, ease of manufacture, versatility and impervious to water, plastics are used in a multitude of products of different scale. Due to its properties such as resistance to corrosion and chemicals, low electrical and thermal conductivity, high strength to weight ratio, resistance to shock, good durability, it has prevented over traditional materials.

Over the years, plastic has made its ways to most of our daily goods and we have become comfortable using these products. These products are also more affordable when compared to its other alternatives, causing millions of people to leave their comfort and adapt a different way of lifestyle where the alternatives are not just expensive but also do not solve the purpose as well as plastic.

The success and dominance of plastics starting in the early 20th century led to environmental concerns regarding the slow decomposition rate after being discarded as trash due to its composition of large molecules.

Plastic waste leads to the productions of many toxic gases. As a result, severe air pollution is produced which leads to cancer, inhibits physical development and causes terrible diseases. During the production of plastic, dangerous gases like ethylene oxide, benzene and xylene, etc. are generated, Dioxin also emerges on burning it which is very poisonous and produces cancer. Due to plastics in the pits, the environment is damaged, soil and ground water get toxic and gradually the ecological balance starts to deteriorate. It has even been contaminating the Himalayan valleys.

Studies prove that a cumulative human production of 8.3 billion tons of plastic of which 6.3 billion tons is waste, with a recycling rate only 9 percent. Plastic waste is causing a great havoc on aquatic creatures. Hazardous elements like micro plastic are usually caused by the use of waste such as plastic bags, bottle lids. Micro plastics absorb dangerous chemicals and when birds and fish eat it, it goes into their body. The latest study on Arctic Sea proves that plastic will be more in the three decades than the fishes or aquatic species.

In India, Sikkim was the first state to ban plastic. As per reports, after the plastic ban in 25 states, 15000 tons of plastic is still produced from cities on a daily basis. Maharashtra became 18th state to ban single use plastic below 50 microns. Maharashtra Government declared the ban on March 23, 2018 and the ban enforced from June 23, 2018 giving the window of 3 months to get rid of the existing stock. The materials such as bags, spoon, plates and other disposable items come under the ban. The ban also includes packaging material and thermocol. For the first time offender's the fine was ₹5000, for second time offender's the fine was ₹10,000 and for third time offender's fine was ₹25,000, along with imprisonment of 3 months.

A survey estimated that in 2017-18 alone, India consumed 16.5 million tons of plastic. The selfish and consumerist human has damaged the environment by the indiscriminate use of plastic. Our society is unaware of plastic's far reaching adverse effects and toxicity. Authorities will need to take initiatives to provide decent alternatives acceptable to all and educate the people about these alternatives. Only then the hazard can be clipped from its root. One of the other solutions of plastic waste is recycling. Besides this, the people have to come forward to prevent the pollution and everyone has to be involved in dealing with it at one's own level.

# **WHY THIS TOPIC...?**

A concern arises whether plastic ban will be an effective solution to overcome the problems. In order to understand people's perspectives about this plastic ban and what changes need to be done for making this ban worth remembering as people's perceptions and attitudes towards plastic usage play a significant role. So, it is important to consider a range of viewpoints. Some individuals may view a ban as an inconvenience, especially if alternatives are not easily accessible or affordable. It is important to address these concerns by promoting and facilitating the availability of viable alternatives to plastic products.

Education and awareness campaigns also play a crucial role in making a plastic ban effective. People need to understand the environmental consequences of plastic pollution and the importance of reducing their plastic consumption. By raising awareness about the impact of plastic on the environment and providing information on sustainable alternatives, individuals can make informed choices and actively participate in the ban's success. Moreover, the implementation of a plastic ban should involve cooperation from various stakeholders, including government bodies, businesses, and consumers. Governments should enact and enforce legislation that restricts the production, sale, and use of certain types of plastic. Businesses need to adapt and develop sustainable packaging solutions, while consumers must embrace the change by adopting reusable products and reducing their overall plastic consumption.

While a plastic ban can be a significant step towards a sustainable future of addressing plastic pollution, its effectiveness depends on factors like creating awareness, providing accessible alternatives, implementing strong legislation, and fostering cooperation among stakeholders. By considering these aspects and implementing comprehensive strategies, we can make a plastic ban a noteworthy and impactful solution to the problems associated with plastic usage.

# **OBJECTIVES**

1. To study the effect of socio-economic factors on use of plastic bag.
2. To check the association between socio-economic factor and usage of plastic.
3. To study the change in opinion of people about usage of plastic before and after ban.
4. To check whether the people are aware about banned products & harmful effects of plastic.
5. To understand the thoughts of people about role of Government in plastic ban from Consumers point of view.
6. To check simple & most affordable alternatives of plastic bags.
7. To check the association between type of shop and providing plastic bags.

# METHODOLOGY

Keeping our objective in mind and the techniques to be used, we have designed our questionnaire accordingly. In our survey, we have collected our data from selected areas like **Airoli, Virar, Ambernath**. We used convenient & Two stage cluster sampling in our study, as we collected **primary data** through google form from housing societies & retailer shops by personal visits. We have conducted pilot study on 100 samples & after modification in our questionnaire, we conducted the actual survey & have collected sample data of **400 Consumers & 75 Retailers**.

## Types Of Questions:

- Dichotomous
- Multiple Choice
- Likert Scale
- Categorical
- Open Ended

## Algorithm:

1. Multinomial Logistic Regression.
2. Pearson's  $\chi^2$ - Test & Cramer's V Test.
3. Wilcoxon Signed Rank Test.
4. Pareto Analysis.
5. Proportionality Test.
6. McNemar Test.
7. Fisher's Exact Test.

## Software:



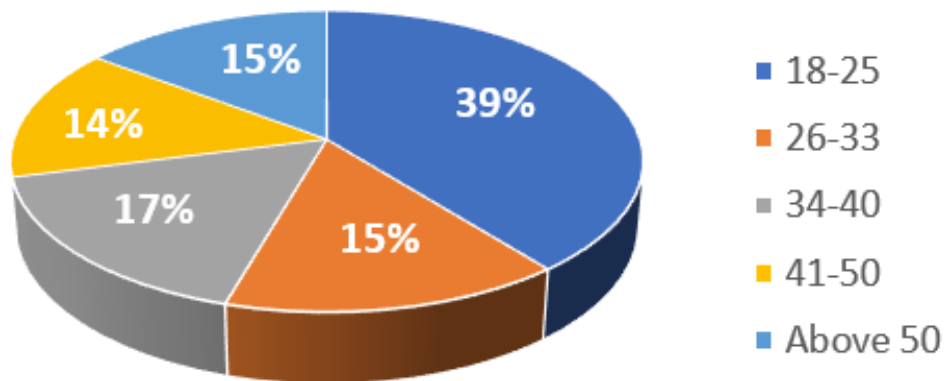


The steps in conducting survey are given below as,

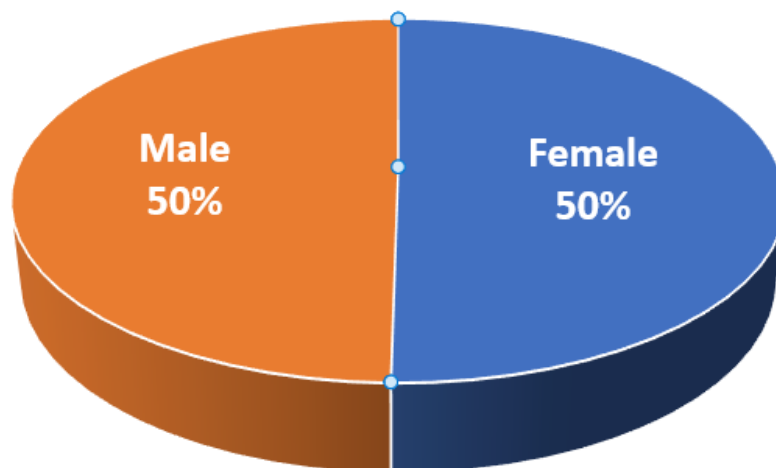


# DATA VISUALIZATION

## AGE



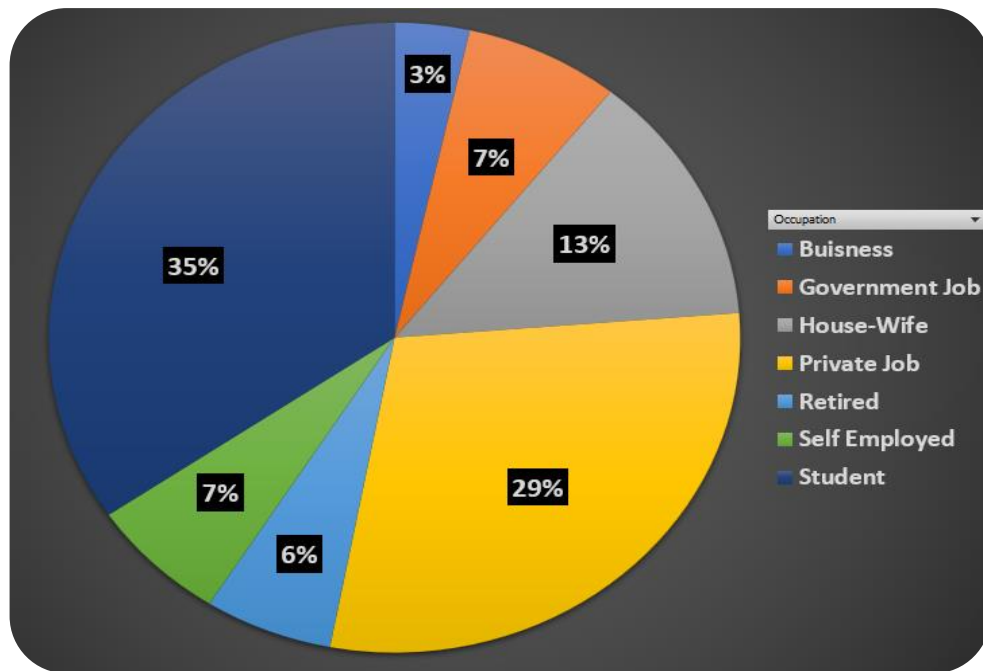
## GENDER



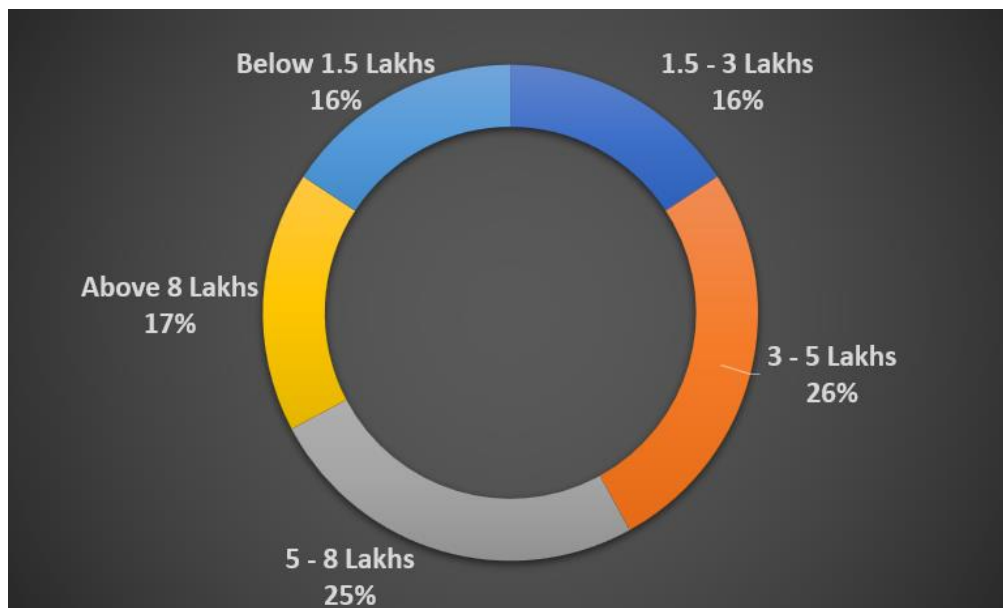
## Conclusion: -

- Majority proportion of a respondent belongs to age group **18-25**.
- We have received **equal** response for Males and Females.

## Occupation



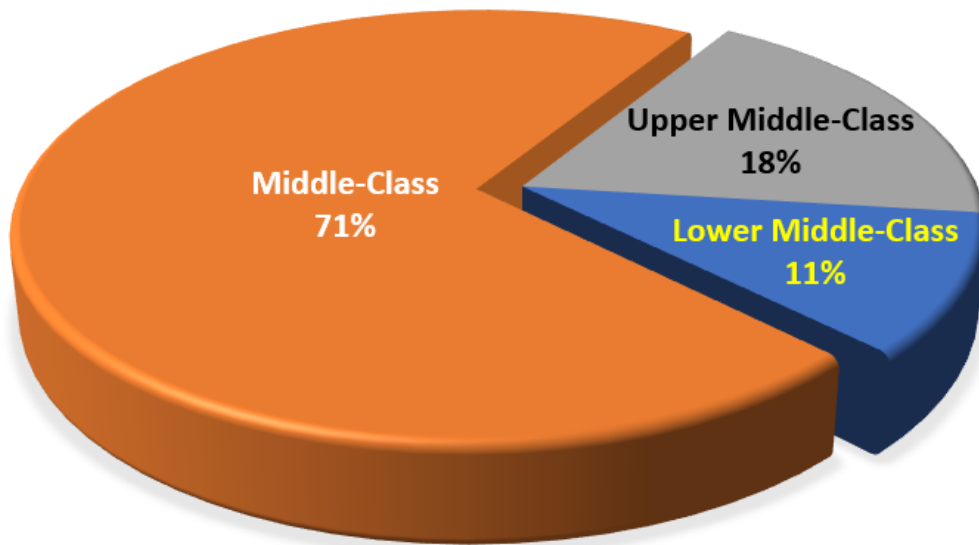
## Annual Family Income



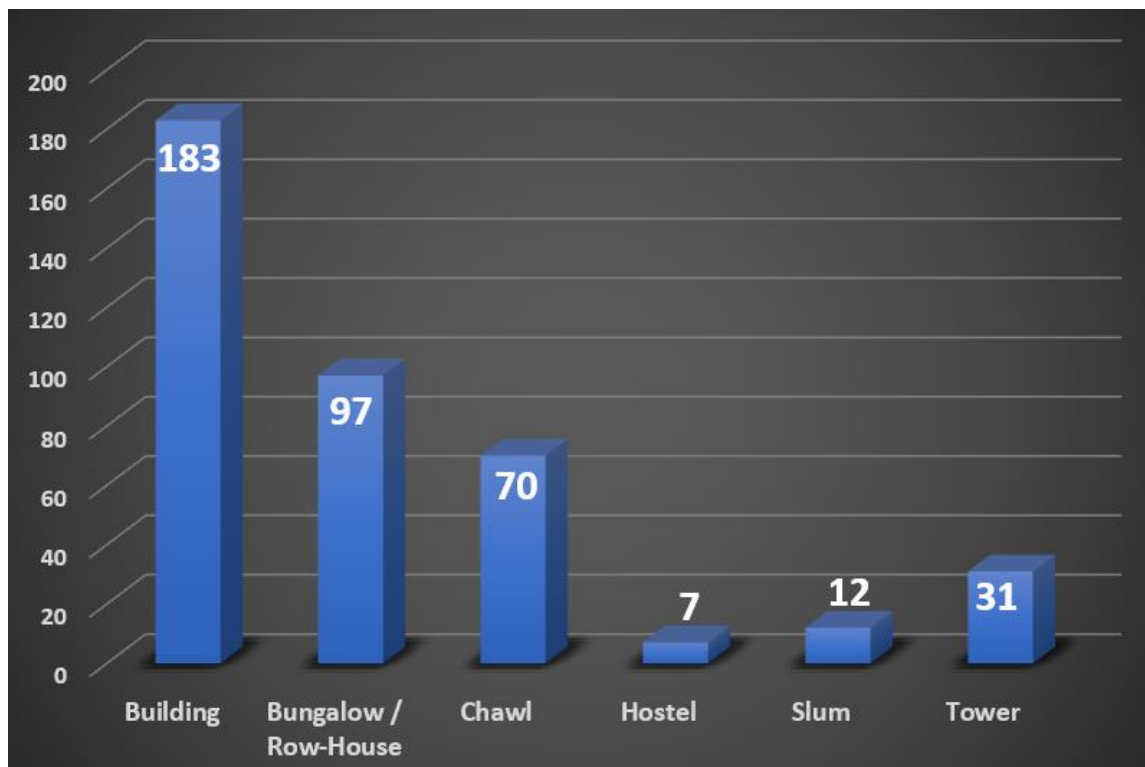
### Conclusion: -

- From above Pie chart we can infer that around 64% of peoples are either students or doing private jobs.
- In our data respondent in income bracket below 1.5 lakhs and 1.5-3 lakhs are in equal proportion & maximum income belongs to 3-5 lakhs.

## Area

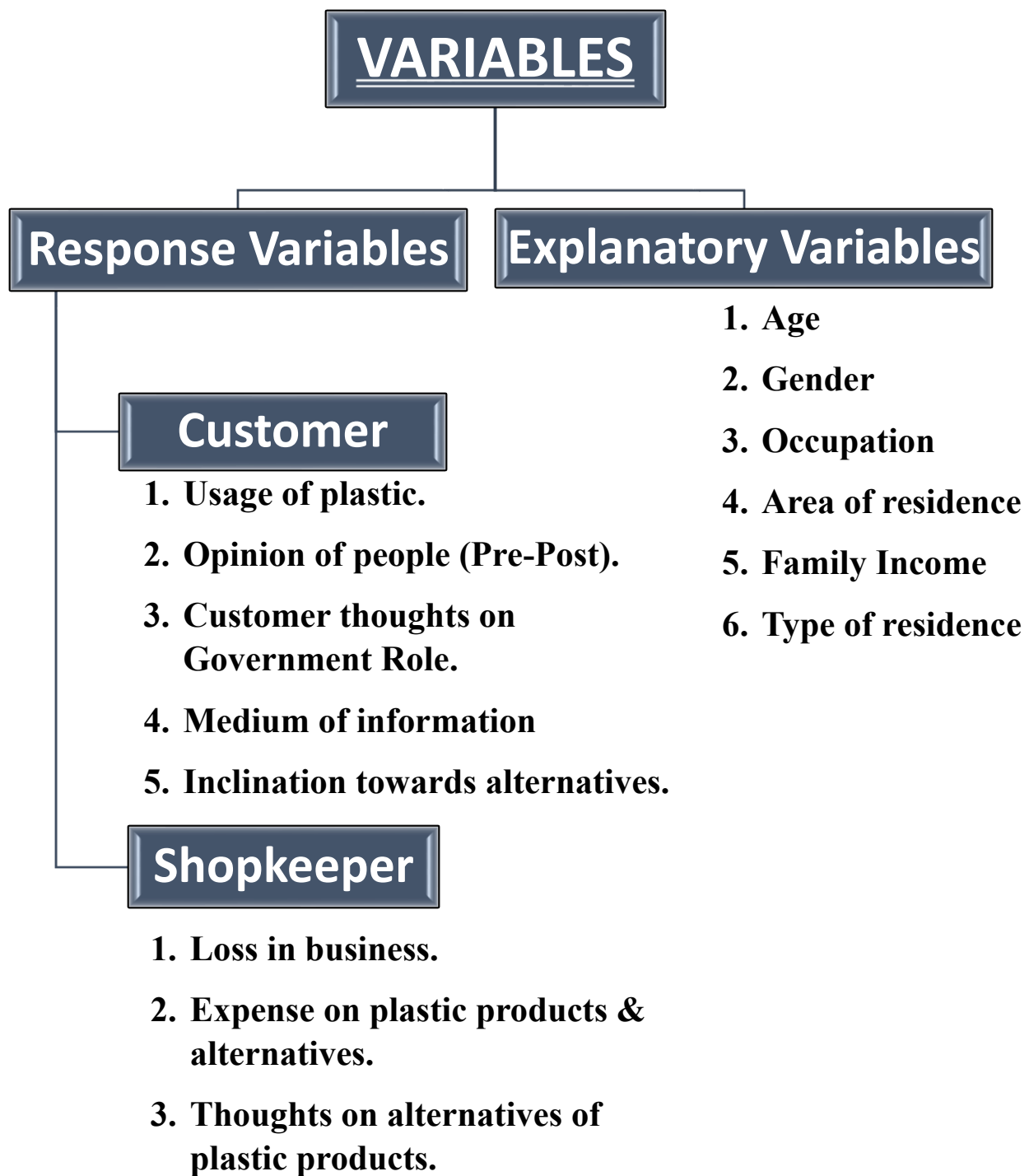


## Type Of Residence



## Conclusion: -

- Maximum of our respondents belongs to Middle-Class.
- From the bar plot of Type of Residence, we can see that majority of our respondents live in Buildings.



# **OBJECTIVE-1: To study the effect of socio-economic factors on use of plastic bag.**

Since, our data is Categorical with more than two independent explanatory variables. Hence, we use Multinomial Logistic Regression to test the hypothesis.

## **Multinomial Logistic Regression:**

To fit Multinomial Logistic Regression, we coded the variables as,

**For the response variable Y i.e., The Usage of plastic,**

- No  $\rightarrow$  0
- Maybe  $\rightarrow$  1
- Yes  $\rightarrow$  2

**For the categorical variables,**

### **1. Age**

- 18-25  $\rightarrow$  1
- 26-33  $\rightarrow$  2
- 34-40  $\rightarrow$  3
- 41-50  $\rightarrow$  4
- Above 50  $\rightarrow$  5

### **2. Gender**

- Male  $\rightarrow$  1
- Female  $\rightarrow$  2

### **3. Area**

- Lower-Middle Class  $\rightarrow$  1
- Middle Class  $\rightarrow$  2
- Upper-Middle Class  $\rightarrow$  3

### **4. Occupation**

- Student  $\rightarrow$  1
- Self Employed  $\rightarrow$  2
- Government Job  $\rightarrow$  3
- Business  $\rightarrow$  4
- House Wife  $\rightarrow$  5
- Retired  $\rightarrow$  6
- Private Job  $\rightarrow$  7

Testing Global Null Hypothesis: BETA=0			
Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	53.8037	8	<.0001
Score	55.6617	8	<.0001
Wald	49.8269	8	<.0001

**H<sub>0</sub>:** All independent variables are insignificant.

**H<sub>1</sub>:** At least one of the independent variables is significant.

## **Conclusion:**

$\therefore$  The P-value of Likelihood ratio test is  $< 0.05$ , we reject the null hypothesis and conclude that, at least one variable is significant at 5% of level of significance.

To fit Multinomial Logistic Regression, we use CATMOD procedure in SAS.

The CATMOD Procedure			
Data Summary			
Response	Y	Response Levels	3
Weight Variable	None	Populations	83
Data Set	O2	Total Frequency	400
Frequency Missing	0	Observations	400

Response Profiles	
Response	Y
1	0
2	1
3	2

Maximum Likelihood Analysis			
Maximum likelihood computations converged.			
Maximum Likelihood Analysis of Variance			
Source	DF	Chi-Square	Pr > ChiSq
Intercept	2	2.12	0.3471
Age	2	13.96	0.0009
Gender	2	9.19	0.0101
Occupation	2	2.61	0.2712
Area	2	11.84	0.0027
Likelihood Ratio	156	197.33	0.0140

## Conclusion:

- ∴ From above overall Maximum Likelihood Analysis of Variance we can conclude that,
- ∴ P-value of variables Age, Gender & Area is less than 0.05.
- ∴ The socio-economic factors Age, Gender & Area is significant.

Analysis of Maximum Likelihood Estimates						
Parameter	Y	DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept	0	1	-0.0174	0.9813	0.0003	0.9859
Intercept	1	1	0.8802	0.8017	1.2053	0.2723
Age	0	1	-0.3690	0.1422	6.7354	0.0095
Age	1	1	-0.4352	0.1170	13.8282	0.0002
Gender	0	1	-0.9820	0.3596	7.4567	0.0063
Gender	1	1	-0.1961	0.2857	0.4710	0.4925
Occupation	0	1	0.1165	0.0872	1.7865	0.1814
Occupation	1	1	0.0189	0.0736	0.0663	0.7968
Area	0	1	0.9735	0.3333	8.5330	0.0035
Area	1	1	0.8705	0.2688	10.4902	0.0012

To obtain Goodness of Fit & Model Odds Ratio Estimates in Multinomial Logistic Regression, we can use LOGISTIC Procedure in SAS.

The LOGISTIC Procedure	
Model Information	
Data Set	PROJECT.O2
Response Variable	Y
Number of Response Levels	3
Model	generalized logit
Optimization Technique	Newton-Raphson

Response Profile		
Ordered Value	Y	Total Frequency
1	0	72
2	1	253
3	2	75

Logits modelled use Y='2' as the reference category.

Model Convergence Status
Convergence criterion (GCONV=1E-8) satisfied.



To obtain Goodness of Fit we use the Hosmer & Lemeshow Goodness-of-Fit Test.

**H<sub>0</sub>:** The Multinomial Logistic Regression fits the expected data well.

**H<sub>1</sub>:** The Multinomial Logistic Regression does not fit the expected data well.

Partition for the Hosmer and Lemeshow Test							
Group	Total	Observed Y = 0	Observed Y = 1	Observed Y = 2	Expected Y = 0	Expected Y = 1	Expected Y = 2
1	40	5	13	22	5.24	15.0	19.7
2	42	9	25	8	8.62	20.6	12.8
3	41	7	23	11	7.96	23.4	9.60
4	42	5	27	10	7.10	27.2	7.68
5	33	10	19	4	7.63	20.3	5.03
6	64	6	53	5	6.10	49.8	8.12
7	33	11	21	1	7.91	21.4	3.64
8	48	8	30	10	9.20	34.2	4.59
9	57	11	42	4	12.3	41.0	3.79

Hosmer and Lemeshow Goodness-of-Fit Test		
Chi-Square	DF	Pr > ChiSq
17.7497	14	0.2184

## Conclusion:

∴ The chi-square test statistic is 17.7497 with 14 degrees of freedom, and the associated P-value = 0.2184 > 0.05

∴ There is no strong evidence to suggest a lack-of-fit in the Multinomial Logistic Model based on the Hosmer & Lemeshow Test hence, we do not reject null hypothesis at 5% level of significance.

∴ The Multinomial Logistic Regression fits the expected data well.

∴ The Multinomial Logistic Regression Models are given by,

$$P(Y=0|X) = \frac{e^{-0.0174-0.3690age-0.9820gender+0.1165occupation+0.9735area}}{1+e^{-0.0174-0.3690age-0.9820gender+0.1165occupation+0.9735area}+e^{0.8802-0.4352age-0.1961gender+0.0189occupation+0.8705area}}$$

$$P(Y=1|X) = \frac{e^{0.8802-0.4352age-0.1961gender+0.0189occupation+0.8705area}}{1+e^{-0.0174-0.3690age-0.9820gender+0.1165occupation+0.9735area}+e^{0.8802-0.4352age-0.1961gender+0.0189occupation+0.8705area}}$$

To obtain Model Odds Ratio Estimates in Multinomial Logistic Model,

Odds Ratio Estimates				
Effect	Y	Point Estimate	95% Wald Confidence Limits	
Age	0	0.691	0.523	0.914
Age	1	0.647	0.514	0.814
Gender	0	0.375	0.185	0.758
Gender	1	0.822	0.469	1.439
Occupation	0	1.124	0.947	1.333
Occupation	1	1.019	0.882	1.177
Area	0	2.647	1.378	5.087
Area	1	2.388	1.410	4.044

## Conclusion:

- In category age, people not using plastic bag are 0.691 less likely as compared to people daily using plastic bags.
- In category age, people sometimes using plastic bag are 0.647 less likely as compared to people daily using plastic bags.
- In category gender, people not using plastic bag are 0.375 less likely as compared to people daily using plastic bags.
- In category gender, people sometimes using plastic bag are 0.822 less likely as compared to people daily using plastic bags.
- In category occupation, people not using plastic bag are 1.124 more likely as compared to people daily using plastic bags.
- In category occupation, people sometimes using plastic bag are 1.019 more likely as compared to people daily using plastic bags.
- In category area, people not using plastic bag are 2.647 more likely as compared to people daily using plastic bags.
- In category area, people sometimes using plastic bag are 2.388 more likely as compared to people daily using plastic bags.

## Conclusion:

∴ From Odds Ratio estimates we conclude that, the variable occupation and area had more impact on less usage of plastic.

To obtain Individual Odds Ratio Estimates in Multinomial Logistic Regression, we can use LOGISTIC Procedure in SAS.

The LOGISTIC Procedure	
Model Information	
Data Set	PROJECT.02
Response Variable	Y
Number of Response Levels	3
Model	generalized logit
Optimization Technique	Newton-Raphson

Number of Observations Read	400
Number of Observations Used	400

Response Profile		
Ordered Value	Y	Total Frequency
1	0	72
2	1	253
3	2	75

Logits modeled use Y='2' as the reference category.

Class Level Information							
Class	Value	Design Variables					
Age	1	0	0	0	0		
	2	1	0	0	0		
	3	0	1	0	0		
	4	0	0	1	0		
	5	0	0	0	1		
Gender	1	0					
	2	1					
Occupation	1	0	0	0	0	0	0
	2	1	0	0	0	0	0
	3	0	1	0	0	0	0
	4	0	0	1	0	0	0
	5	0	0	0	1	0	0
	6	0	0	0	0	1	0
	7	0	0	0	0	0	1
Area	1	0	0				
	2	1	0				
	3	0	1				

Here, to fit the Logistic procedure to the Multinomial data, the optimization technique used is Newton-Raphson Algorithm.

The reference category for response variable Y is Yes.

&

For explanatory variables,

- The reference category for class Age is 18-25.
- The reference category for class Gender is Male.
- The reference category for class Occupation is Student.
- The reference category for class Area is Lower Middle-Class.

Model Convergence Status
Quasi-complete separation of data points detected.

Odds Ratio Estimates				
Effect	Y	Point Estimate	95% Wald Confidence Limits	
Age 2 vs 1	0	0.911	0.114	7.303
Age 2 vs 1	1	0.596	0.090	3.935
Age 3 vs 1	0	0.926	0.118	7.267
Age 3 vs 1	1	0.563	0.087	3.623
Age 4 vs 1	0	0.469	0.063	3.474
Age 4 vs 1	1	0.262	0.043	1.581
Age 5 vs 1	0	1.199	0.128	11.236
Age 5 vs 1	1	1.141	0.155	8.425
Gender 2 vs 1	0	1.068	0.425	2.679
Gender 2 vs 1	1	2.466	1.149	5.294
Occupation 2 vs 1	0	4.842	0.414	56.642
Occupation 2 vs 1	1	2.048	0.211	19.841
Occupation 3 vs 1	0	0.797	0.063	10.035
Occupation 3 vs 1	1	1.327	0.159	11.061
Occupation 4 vs 1	0	>999.999	<0.001	>999.999
Occupation 4 vs 1	1	>999.999	<0.001	>999.999
Occupation 5 vs 1	0	0.363	0.038	3.431
Occupation 5 vs 1	1	0.149	0.021	1.037
Occupation 6 vs 1	0	0.202	0.013	3.040
Occupation 6 vs 1	1	0.175	0.019	1.594
Occupation 7 vs 1	0	2.830	0.390	20.540
Occupation 7 vs 1	1	1.822	0.311	10.663
Area 2 vs 1	0	3.233	0.997	10.477
Area 2 vs 1	1	3.825	1.590	9.203
Area 3 vs 1	0	2.743	0.612	12.296
Area 3 vs 1	1	3.753	1.169	12.045

## Conclusion For Category Age: -

- The odds of category No with reference category Yes for customer with Age group 26-33 is estimated to be 0.911 with reference Age group 18-25.  
∴ A customer with Age 26-33 is less likely to not use plastic bag as compared to Age 18-25.
- The odds of category Maybe with reference category Yes for customer with Age group 26-33 is estimated to be 0.596 with reference Age group 18-25.  
∴ A customer with Age 26-33 is less likely to sometimes use plastic bag as compared to Age 18-25.
- The odds of category No with reference category Yes for customer with Age group 34-40 is estimated to be 0.926 with reference Age group 18-25.  
∴ A customer with Age 34-40 is less likely to not use plastic bag as compared to Age 18-25.
- The odds of category Maybe with reference category Yes for customer with Age group 34-40 is estimated to be 0.563 with reference Age group 18-25.  
∴ A customer with Age 34-40 is less likely to sometimes use plastic bag as compared to Age 18-25.
- The odds of category No with reference category Yes for customer with Age group 41-50 is estimated to be 0.469 with reference Age group 18-25.  
∴ A customer with Age 41-50 is less likely to not use plastic bag as compared to Age 18-25.
- The odds of category Maybe with reference category Yes for customer with Age group 41-50 is estimated to be 0.262 with reference Age group 18-25.  
∴ A customer with Age 41-50 is less likely to sometimes use plastic bag as compared to Age 18-25.
- The odds of category No with reference category Yes for customer with Age group > 50 is estimated to be 1.199 with reference Age group 18-25.  
∴ A customer with Age above 50 is more likely to not use plastic bag as compared to Age 18-25.
- The odds of category Maybe with reference category Yes for customer with Age group > 50 is estimated to be 1.141 with reference Age group 18-25.  
∴ A customer with Age above 50 is more likely to sometimes use plastic bag as compared to Age 18-25.

### Conclusion:

∴ From Odds ratio of Age we conclude that, the age group 26-33 & 34-40 are mostly using plastic bags as compared to age group 18-25. Whereas, age group 41-50 are moderately using the plastic bags & the age group above 50 is least using plastic bags as compared to age group 18-25.

## Conclusion For Category Gender: -

- The odds of category No with reference category Yes for Females is estimated to be 1.068 with reference to Males.  
∴ Females are more likely to not use plastic bag as compared to Males.
- The odds of category Maybe with reference category Yes for Females is estimated to be 2.466 with reference to Males.  
∴ Females are more likely to sometimes use plastic bag as compared to Males.

### Conclusion:

∴ From Odds ratio of Gender we conclude that, on daily basis Females are less using plastic bags as compared to Males.

## Conclusion For Category Occupation: -

- The odds of category No with reference category Yes for the Self-Employed persons is estimated to be 4.842 with reference to Students.  
∴ The Self-Employed persons are more likely to not use plastic bag as compared to Students.
- The odds of category Maybe with reference category Yes for the Self-Employed persons is estimated to be 2.048 with reference to Students.  
∴ The Self-Employed persons are more likely to sometimes use plastic bag as compared to Students.
- The odds of category No with reference category Yes for the Government Job persons is estimated to be 0.797 with reference to Students.  
∴ The Government Job persons are less likely to not use plastic bag as compared to Students.
- The odds of category Maybe with reference category Yes for the Government Job persons is estimated to be 1.327 with reference to Students.  
∴ The Government Job persons are more likely to sometimes use plastic bag as compared to Students.
- The odds of category No with reference category Yes for the Business persons is estimated to be very high with reference to Students.  
∴ The Business persons are more likely to not use plastic bag as compared to Students.
- The odds of category Maybe with reference category Yes for the Business persons is estimated to be very high with reference to Students.  
∴ The Business persons are more likely to sometimes use plastic bag as compared to Students.
- The odds of category No with reference category Yes for the House Wife's is estimated to be 0.363 with reference to Students.  
∴ The House Wife's are less likely to not use plastic bag as compared to Students.

- The odds of category Maybe with reference category Yes for House Wife's is estimated to be 0.149 with reference to Students.  
∴ The House Wife's are less likely to sometimes use plastic bag as compared to Students.
- The odds of category No with reference category Yes for the Retired persons is estimated to be 0.202 with reference to Students.  
∴ The Retired persons are less likely to not use plastic bag as compared to Students.
- The odds of category Maybe with reference category Yes for Retired persons is estimated to be 0.175 with reference to Students.  
∴ The Retired persons are less likely to sometimes use plastic bag as compared to Students.
- The odds of category No with reference category Yes for the Private Job persons is estimated to be 2.830 with reference to Students.  
∴ The Private Job persons are more likely to not use plastic bag as compared to Students.
- The odds of category Maybe with reference category Yes for Private Job persons is estimated to be 1.822 with reference to Students.  
∴ The Private Job persons are more likely to sometimes use plastic bag as compared to Students.

## **Conclusion:**

∴ From Odds ratio of Occupation we conclude that, the House Wife's are mostly using plastic bags as compared to Students. Whereas, Government Job persons, Private Job persons & Self-Employed persons are moderately using the plastic bags & the Business person is least using plastic bags as compared to age group Students.

## Conclusion For Category Area: -

- The odds of category No with reference category Yes for Middle-Class People is estimated to be 3.23 with reference to Lower Middle-Class People.  
∴ Middle-Class People are more likely to not use plastic bag as compared to Lower Middle-Class People.
- The odds of category Maybe with reference category Yes for Middle-Class People is estimated to be 3.83 with reference to Lower Middle-Class People.  
∴ Middle-Class People are more likely to sometimes use plastic bag as compared to Lower Middle-Class People.
- The odds of category No with reference category Yes for Upper Middle-Class People is estimated to be 2.74 with reference to Lower Middle-Class People.  
∴ Upper Middle-Class People are more likely to not use plastic bag as compared to Lower Middle-Class People.
- The odds of category Maybe with reference category Yes for Upper Middle-Class People is estimated to be 3.75 with reference to Lower Middle-Class People.  
∴ Upper Middle-Class People are more likely to sometimes use plastic bag as compared to Lower Middle-Class People.

### Conclusion:

∴ From Odds ratio of Area we conclude that, the Middle-Class People & Upper Middle-Class People are less using plastic bags as compared to the Lower Middle-Class People.



## **OBJECTIVE-2: To check the association between socio-economic factor and usage of plastic.**

Since, we need to test the association between the socio-economic factors & usage of plastic where, the socio-economic factors are categorial in nature. Hence, we can use Pearson's  $\chi^2$  – Test of Association.

### **Pearson's $\chi^2$ – Test & Cramer's V Test:**

To test the association between Gender & Usage of plastic.

$H_{01}$ : There is no association between the usage of plastic & gender.

$H_{11}$ : There is association between the usage of plastic & gender.

Statistics for Table of Y by Gender			
Statistic	DF	Value	Prob
Chi-Square	2	10.2012	0.0061
Likelihood Ratio Chi-Square	2	10.3590	0.0056
Mantel-Haenszel Chi-Square	1	4.9422	0.0262
Phi Coefficient		0.1597	
Contingency Coefficient		0.1577	
Cramer's V		0.1597	

### **Conclusion:**

∴ The chi-square test statistic is 10.2012 with 2 degrees of freedom, and the associated P-value = 0.0061 < 0.05

∴ We reject null hypothesis and this indicates that there is a significant association between the usage of plastic & gender.

The Phi Coefficient is calculated as 0.1597 suggests a positive association between gender & usage of plastic.

Cramer's V is a measure of association calculated as 0.1597, which is the same as the Phi coefficient suggests that a positive association between gender & usage of plastic.

**To test the association between Age & Usage of plastic.**

**H<sub>02</sub>:** There is no association between the usage of plastic & age.

**H<sub>12</sub>:** There is association between the usage of plastic & age.

Statistics for Table of Y by Age			
Statistic	DF	Value	Prob
Chi-Square	8	39.5500	<.0001
Likelihood Ratio Chi-Square	8	38.1268	<.0001
Mantel-Haenszel Chi-Square	1	6.6552	0.0099
Phi Coefficient		0.3144	
Contingency Coefficient		0.3000	
Cramer's V		0.2223	

## Conclusion:

∴ The chi-square test statistic is 39.55 with 8 degrees of freedom, and the associated P-value = 0.0001 < 0.05

∴ We reject null hypothesis and this indicates that there is a significant association between the usage of plastic & age.

The Phi Coefficient is calculated as 0.3144 suggests a positive association between age & usage of plastic.

Cramer's V is a measure of association calculated as 0.2223 suggests that a positive association between age & usage of plastic.

**To test the association between Occupation & Usage of plastic.**

**H<sub>03</sub>:** There is no association between the usage of plastic & occupation.

**H<sub>13</sub>:** There is association between the usage of plastic & occupation.

Statistics for Table of Y by Occupation			
Statistic	DF	Value	Prob
Chi-Square	8	77.0555	<.0001
Likelihood Ratio Chi-Square	8	69.0676	<.0001
Mantel-Haenszel Chi-Square	1	4.3166	0.0377
Phi Coefficient		0.4389	
Contingency Coefficient		0.4019	
Cramer's V		0.3104	

## Conclusion:

∴ The chi-square test statistic is 77.0555 with 8 degrees of freedom, and the associated P-value = 0.0001 < 0.05

∴ We reject null hypothesis and this indicates that there is a significant association between the usage of plastic & age.

The Phi Coefficient is calculated as 0.4389 suggests a positive association between occupation & usage of plastic.

Cramer's V is a measure of association calculated as 0.3104 suggests that a positive association between occupation & usage of plastic.

**To test the association between Residential Area & Usage of plastic.**

**H<sub>04</sub>:** There is no association between the usage of plastic & residential area.

**H<sub>14</sub>:** There is association between the usage of plastic & residential area.

Statistics for Table of Y by Area			
Statistic	DF	Value	Prob
Chi-Square	4	34.9784	<.0001
Likelihood Ratio Chi-Square	4	27.9032	<.0001
Mantel-Haenszel Chi-Square	1	10.8691	0.0010
Phi Coefficient		0.2957	
Contingency Coefficient		0.2836	
Cramer's V		0.2091	

## Conclusion:

∴ The chi-square test statistic is 34.9784 with 8 degrees of freedom, and the associated P-value = 0.0001 < 0.05

∴ We reject null hypothesis and this indicates that there is a significant association between the usage of plastic & residential area.

The Phi Coefficient is calculated as 0.2957 suggests a positive association between residential area & usage of plastic.

Cramer's V is a measure of association calculated as 0.2091 suggests that a positive association between residential area & usage of plastic.

## Conclusion:

**∴ There is positive association between the socio-economic factors & usage of plastic.**

## **OBJECTIVE-3: To study the change in opinion of people about plastic before and after ban.**

### **Pre-Ban:**

- X1 → Shopkeeper not giving plastic bag.
- X2 → Using reusable bags at Grocery/Vegetable store.
- X3 → Carrying your own bag (except plastic) for clothes shopping.
- X4 → Using plastic products while travelling.
- X5 → Using plastic products in occasion or function

### **Post-Ban:**

- Y1 → Shopkeeper not giving plastic bag.
- Y2 → Using reusable bags at Grocery/Vegetable store.
- Y3 → Carrying your own bag (except plastic) for clothes shopping.
- Y4 → Using plastic products while travelling.
- Y5 → Using plastic products in occasion or function.

Since, The data collected to check the impact of ban is ordinal. So, we cannot use Paired t-test. Since ordinal data is used in non-parametric, we choose the alternative to Paired t-test which is Wilcoxon signed rank test.

## **Wilcoxon Signed Rank Test:**

**H<sub>01</sub>:** There is no change in providing plastic bag by shopkeeper after ban.

**H<sub>11</sub>:** There is reduction in providing plastic bag by shopkeeper after ban.

### **wilcoxon signed rank test**

```
data: 03$Y1 and 03$X1
V = 27145, p-value = 1
alternative hypothesis: true location shift is less than 0
```

## **Conclusion:**

∴ P-value = 1 > 0.05

∴ We do not reject null hypothesis and conclude that, there is no change in providing plastic bag by shopkeeper after ban.

**H<sub>02</sub>:** There is no change in usage of reusable bags at grocery/vegetable stores after ban.

**H<sub>12</sub>:** There is reduction in usage of reusable bags at grocery/vegetable stores after ban.

```
wilcoxon signed rank test  
  
data:  O3$Y2 and O3$X2  
V = 20232, p-value = 1  
alternative hypothesis: true location shift is less than 0
```

## Conclusion:

∴ P-value = 1 > 0.05

∴ We do not reject null hypothesis and conclude that, there is no change in usage of reusable bags at grocery/vegetable stores after ban.

**H<sub>03</sub>:** There is no change in people carrying their own bag (except plastic) for clothes shopping after ban.

**H<sub>13</sub>:** There is reduction in people carrying their own bag (except plastic) for clothes shopping after ban.

```
wilcoxon signed rank test  
  
data:  O3$Y3 and O3$X3  
V = 13279, p-value = 1  
alternative hypothesis: true location shift is less than 0
```

## Conclusion:

∴ P-value = 1 > 0.05

∴ We do not reject null hypothesis and conclude that, there is no change in people carrying their own bag (except plastic) for clothes shopping after ban.

**H<sub>04</sub>:** There is no change in usage of plastic products while travelling after ban.

**H<sub>14</sub>:** There is reduction in usage of plastic products while travelling after ban.

wilcoxon signed rank test

data: O3\$Y4 and O3\$X4  
V = 3365.5, p-value = 8.219e-16  
alternative hypothesis: true location shift is less than 0

## Conclusion:

∴ P-value = 8.219e-16 < 0.05

∴ We reject null hypothesis and conclude that, is reduction in usage of plastic products while travelling after ban.

**H<sub>05</sub>:** There is no change in usage of plastic products in occasions or functions after ban.

**H<sub>15</sub>:** There is reduction in usage of plastic products in occasions or functions after ban.

wilcoxon signed rank test

data: O3\$Y5 and O3\$X5  
V = 3926, p-value < 2.2e-16  
alternative hypothesis: true location shift is less than 0

## Conclusion:

∴ P-value = 2.2e-16 < 0.05

∴ We reject null hypothesis and conclude that, there is reduction in usage of plastic products in occasions or functions after ban.

## **OBJECTIVE-4: To check whether the people are aware about banned products & harmful effects of plastic.**

Since in our objective the data has a nominal variable with dichotomous categories, so the McNemar test is used. Also, we use Proportionality test for further conclusions.

### **Proportionality & McNemar Test:**

#### **Gender**

- Male → 1
- Female → 2

#### **Level of consciousness (LOC)**

- Not Aware → 0
- Aware → 1

#### **Social Problems**

- X1 → Blockage of sewage & dumping issues.
- X2 → Effect on marine & death of livestock.
- X3 → Cause of cancer, skin and respiratory problem.
- X4 → Recycling problem.
- X5 → Deteriorating beauty of tourist places.



**H<sub>01</sub>:** The proportion of awareness about blockage of sewage & dumping issues in males and females is equal.

**H<sub>11</sub>:** The proportion of awareness about blockage of sewage & dumping issues in males and females is not equal.

McNemar's Chi-squared test with continuity correction

data: genx1\$t

McNemar's chi-squared = 139.61, df = 1, p-value < 2.2e-16

Total Observations in Table: 400

O2\$Gender	O4\$X1		Row Total
	0	1	
1	10	189	199
	1.109	0.083	
	0.050	0.950	0.497
	0.357	0.508	
2	0.025	0.472	
	18	183	201
	1.098	0.083	
	0.090	0.910	0.502
Column Total	0.643	0.492	
	0.045	0.458	
	28	372	400
	0.070	0.930	

## Conclusion:

From McNemar test,

Since P-value =  $2.2e-16 < 0.05$ .

∴ We reject the null hypothesis and conclude that, proportion of awareness about blockage of sewage & dumping issues in males and females is not equal.

∴ From proportionality table we can conclude that, 95% of males & 91% of females are aware.

**H<sub>02</sub>:** The proportion of awareness about effect on marine & death of livestock due to consumption of plastic in males and females is equal.

**H<sub>12</sub>:** The proportion of awareness about effect on marine & death of livestock due to consumption of plastic in males and females is not equal.

McNemar's Chi-squared test with continuity correction

data: genx2\$t

McNemar's chi-squared = 71.837, df = 1, p-value < 2.2e-16

Total Observations in Table: 400

O2\$Gender	O4\$X2		
	0	1	Row Total
1	25	174	199
	3.268	0.717	
	0.126	0.874	0.497
	0.347	0.530	
	0.062	0.435	
2	47	154	201
	3.236	0.710	
	0.234	0.766	0.502
	0.653	0.470	
	0.117	0.385	
Column Total	72	328	400
	0.180	0.820	

## Conclusion:

From McNemar test,

Since P-value =  $2.2e-16 < 0.05$ .

∴ We reject the null hypothesis and conclude that, proportion of awareness about effect on marine & death of livestock due to consumption of plastic in males and females is not equal.

∴ From proportionality table we can conclude that, 87.4% of males & 76.6% of females are aware.

**H<sub>03</sub>:** The proportion of awareness about cause of cancer, skin and respiratory problem in males and females is equal.

**H<sub>13</sub>:** The proportion of awareness about cause of cancer, skin and respiratory problem in males and females is not equal.

McNemar's Chi-squared test with continuity correction

data: genx3\$t  
 McNemar's chi-squared = 17.062, df = 1, p-value = 3.619e-05

Total Observations in Table: 400

02\$Gender	04\$X3		Row Total
	0	1	
1	63	136	199
	0.466	0.245	0.497
	0.317	0.683	
	0.457	0.519	
2	0.158	0.340	0.502
	75	126	
	0.461	0.243	
	0.373	0.627	
Column Total	0.543	0.481	400
	0.188	0.315	
	138	262	
	0.345	0.655	

## Conclusion:

From McNemar test,

Since P-value = 3.619e-05 < 0.05.

∴ We reject the null hypothesis and conclude that, proportion of awareness about cause of cancer, skin and respiratory problem in males and females is not equal.

∴ From proportionality table we can conclude that, 68.3% of males & 62.7% of females are aware.

**H<sub>04</sub>:** The proportion of awareness about recycling problem in males and females is equal.

**H<sub>14</sub>:** The proportion of awareness about recycling problem in males and females is not equal.

McNemar's Chi-squared test with continuity correction

data: genx4\$t  
 McNemar's chi-squared = 52.281, df = 1, p-value = 4.809e-13

Total Observations in Table: 400			
O2\$Gender	O4\$X4		
	0	1	Row Total
1	48	151	199
	0.001	0.000	
	0.241	0.759	0.497
	0.500	0.497	
	0.120	0.378	
2	48	153	201
	0.001	0.000	
	0.239	0.761	0.502
	0.500	0.503	
	0.120	0.383	
Column Total	96	304	400
	0.240	0.760	

## Conclusion:

From McNemar test,

Since P-value =  $4.809e-13 < 0.05$ .

∴ We reject the null hypothesis and conclude that, proportion of awareness about re cycling problem in males and females is not equal.

∴ From proportionality table we can conclude that, 75.9% of males & 76.1% of females are aware.

**H<sub>05</sub>:** The proportion of awareness about deteriorating beauty of tourist places in males and females is equal.

**H<sub>15</sub>:** The proportion of awareness about deteriorating beauty of tourist places in males and females is not equal.

McNemar's Chi-squared test with continuity correction

data: genx5\$t  
 McNemar's chi-squared = 105.72, df = 1, p-value < 2.2e-16

Total Observations in Table: 400			
	O4\$X5		
O2\$Gender	0	1	Row Total
1	19	180	199
	1.186	0.166	
	0.095	0.905	0.497
	0.388	0.513	
	0.048	0.450	
2	30	171	201
	1.174	0.164	
	0.149	0.851	0.502
	0.612	0.487	
	0.075	0.427	
Column Total	49	351	400
	0.122	0.877	

## Conclusion:

From McNemar test,

Since P-value =  $2.2e-16 < 0.05$ .

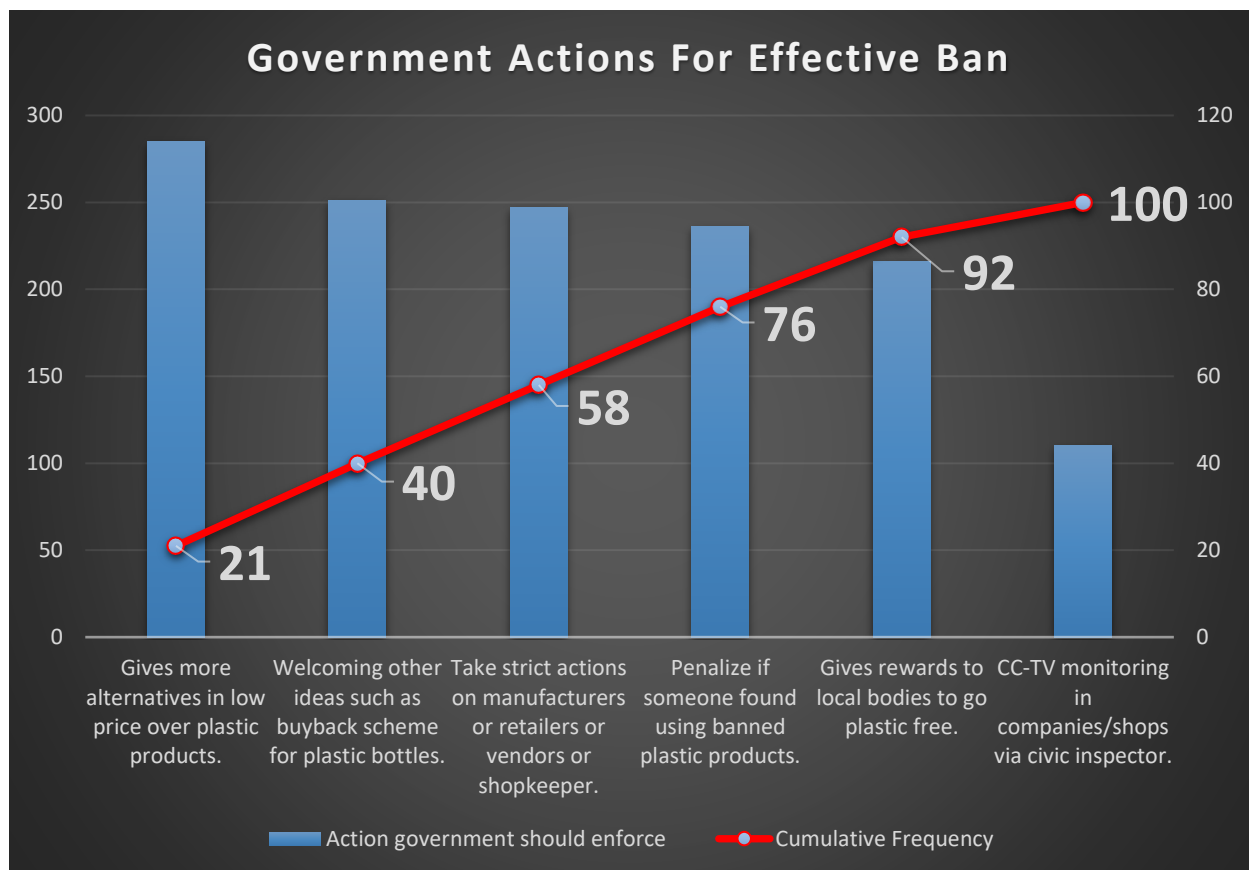
∴ We reject the null hypothesis and conclude that, proportion of awareness about deteriorating beauty of tourist places in males and females is not equal.

∴ From proportionality table we can conclude that, 90.5% of males & 85.1% of females are aware.

## **OBJECTIVE-5: To understand the thoughts of people about role of Government in plastic ban from Consumers point of view.**

Pareto analysis, also known as the 80/20 rule or the principle of factor sparsity, which we use for a decision-making to prioritize and focus efforts on the most significant factors or inputs.

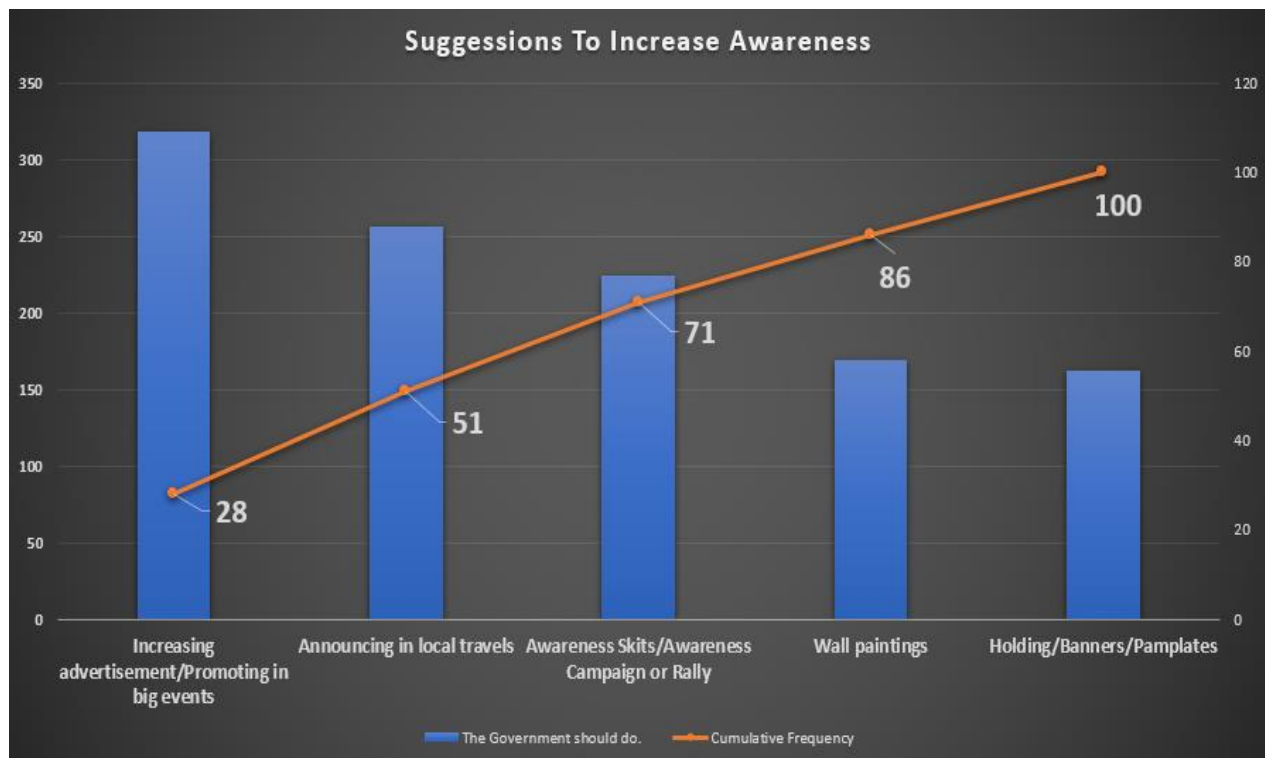
### **Pareto Analysis:**



### **Interpretation:**

From Pareto analysis, we can see that the steps government should take are,

1. Gives more alternatives in low price over plastic products.
2. Welcoming other ideas such as buyback scheme for plastic bottles.
3. Take strict actions on manufacturers or retailers or vendors or shopkeeper.
4. Penalize if someone found using banned plastic products.



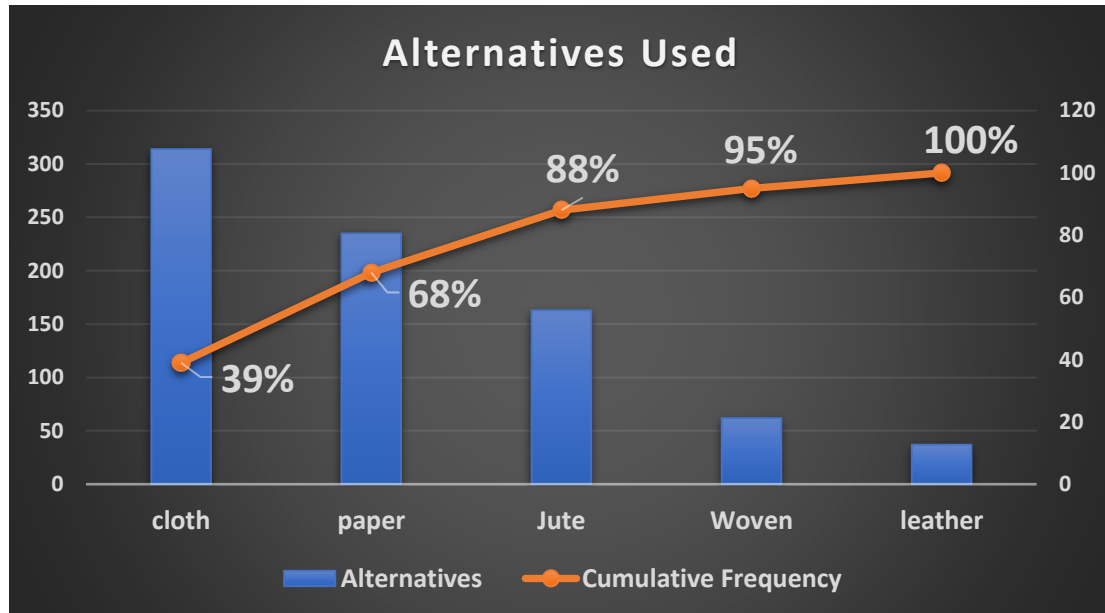
## Interpretation:

From Pareto analysis, the suggestions to increase awareness are,

1. Increase advertisement or Promoting in big events.
2. Announcing in local travels.
3. Awareness Skits, Awareness Campaign or Rally.

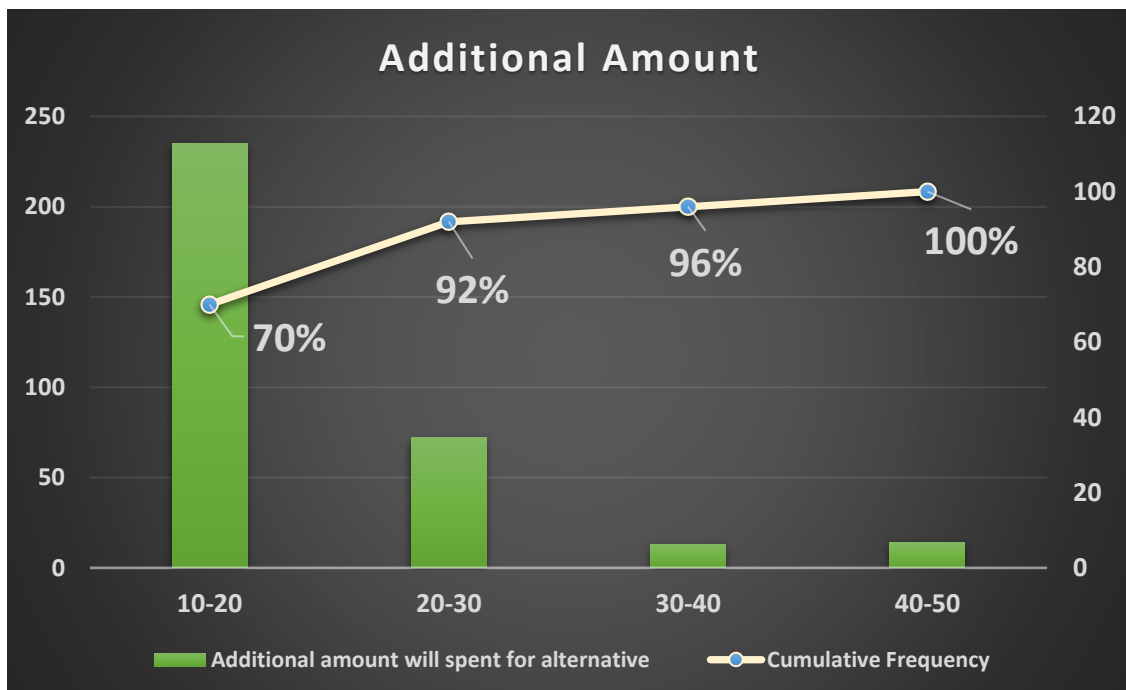
## **OBJECTIVE-6: To check simple & most affordable alternatives of plastic bags.**

### **Pareto Analysis:**



### **Interpretation:**

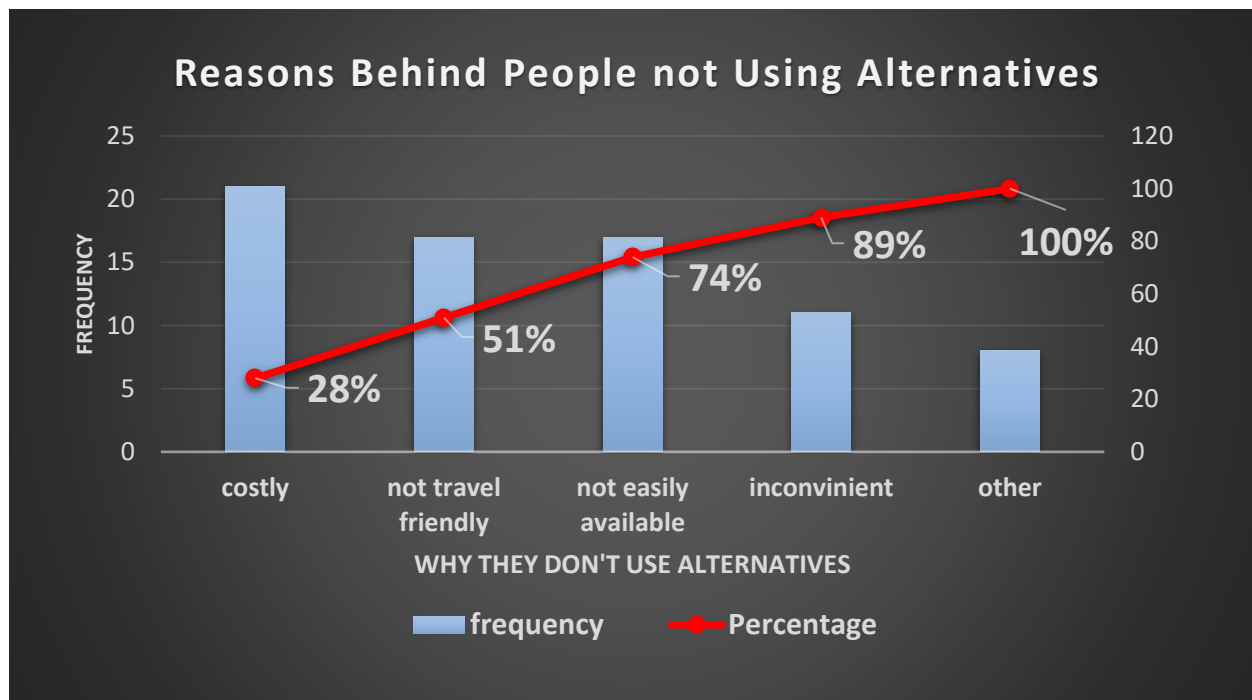
From Pareto analysis, the most used alternatives are Cloth & Paper Bags.



### **Interpretation:**

From Pareto analysis, the additional amount people are ready to spend for alternatives is 10-20 rupee.





### Interpretation:

From Pareto analysis, for the people that don't use alternatives has reasons behind are, as per them alternatives are costly, not travel friendly and not easily available.

## **OBJECTIVE-7: To check if there is association between type of shop and providing plastic bag.**

$H_0$ : There is no association between type of shop and providing plastic bags.

$H_1$ : There is association between type of shop and providing plastic bags.

For analysis of this objective, we use FREQ Procedure in SAS.

Table of providing_bag by shop							
providing_bag	shop						
	Bakery	Clothes	Grocery	Other	Supermar	vegetabl	Total
no	4	15	5	4	0	2	30
	5.33	20.00	6.67	5.33	0.00	2.67	40.00
	13.33	50.00	16.67	13.33	0.00	6.67	
	28.57	100.00	45.45	44.44	0.00	11.11	
yes	10	0	6	5	8	16	45
	13.33	0.00	8.00	6.67	10.67	21.33	60.00
	22.22	0.00	13.33	11.11	17.78	35.56	
	71.43	0.00	54.55	55.56	100.00	88.89	
Total	14	15	11	9	8	18	75
	18.67	20.00	14.67	12.00	10.67	24.00	100.00

Frequency  
Percent  
Row Pct  
Col Pct

Statistics for Table of providing_bag by shop			
Statistic	DF	Value	Prob
Chi-Square	5	35.0649	<.0001
Likelihood Ratio Chi-Square	5	44.1187	<.0001
Mantel-Haenszel Chi-Square	1	12.0227	0.0005
Phi Coefficient		0.6838	
Contingency Coefficient		0.5644	
Cramer's V		0.6838	
WARNING: 33% of the cells have expected counts less than 5. Chi-Square may not be a valid test.			

∴ The expected count value of 33% of the cells of contingency table are less than 5 in the shopkeeper data.

∴ The Chi-Square test may not be valid in this case

In such cases, The Fisher's exact test is used.

Fisher's Exact Test	
Table Probability (P)	<.0001
Pr <= P	<.0001

## Conclusion:

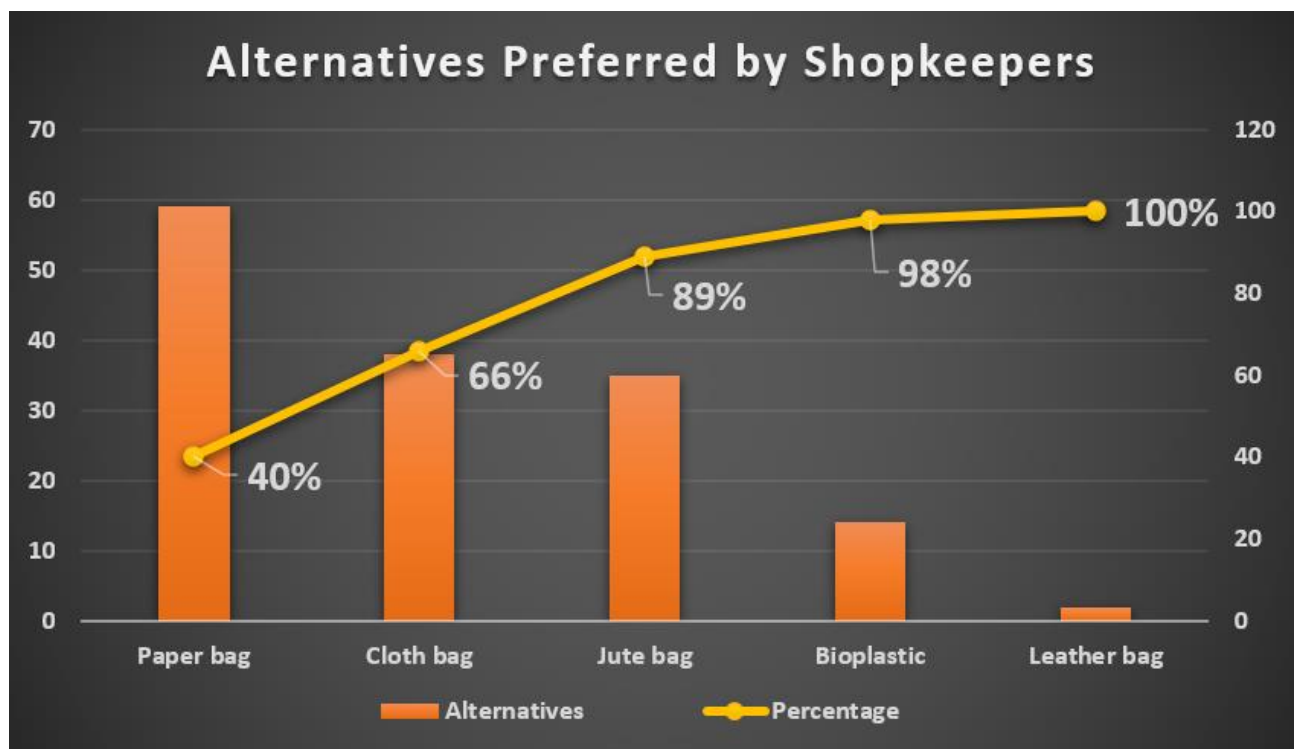
Since, P-value < 0.05, so we reject the null hypothesis and conclude that there is association between type of shop and providing plastic bag.

∴ The Phi coefficient is 0.6838, suggesting a relatively strong positive association.

Also, The contingency coefficient is 0.5644 & The Cramer's V is 0.6838, indicating a relatively strong association between the variables.

∴ From Fisher's Exact Test, Phi coefficient, There is relatively strong association between type of shop and providing plastic bag.

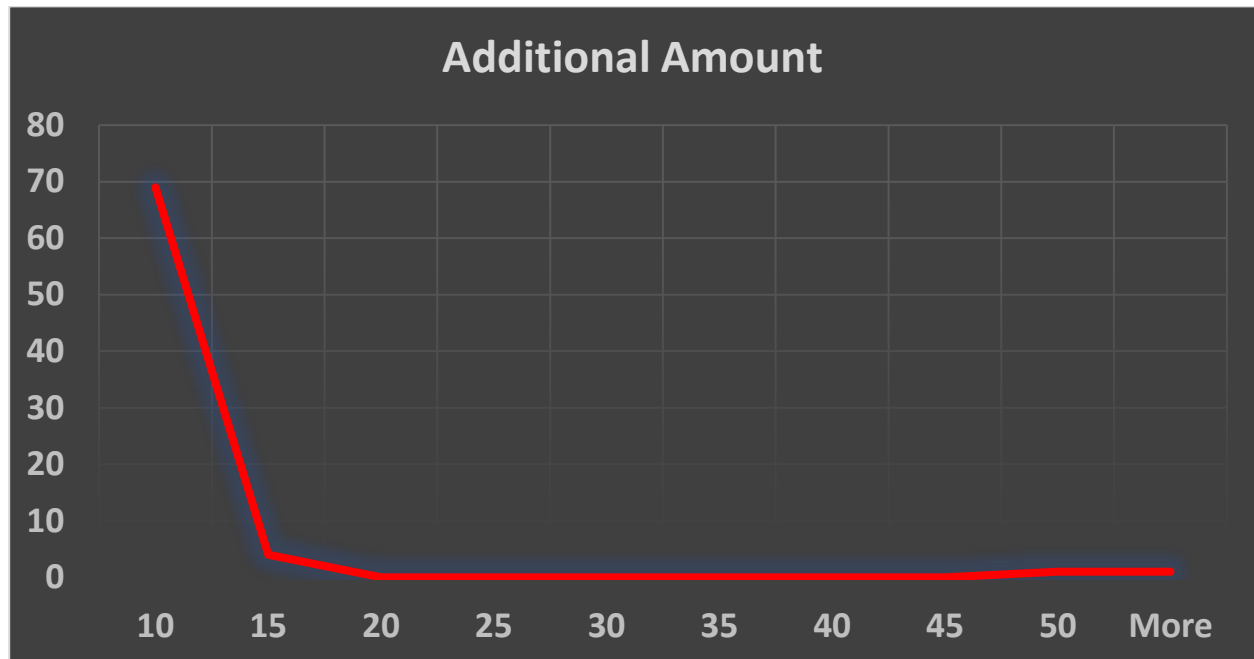
## Pareto Analysis for Alternatives Preferred by Shopkeepers:



## Interpretation:

From Pareto analysis, we can see that the most alternatives preferred by shopkeepers are paper and cloth bag.

## Frequency Graph for Additional Amount Ready to Spend by Shopkeeper:



### Interpretation:

From frequency graph, we can conclude that the average additional amount shopkeepers are ready to spend for alternatives is 10 rupees.

07\$what.kind.of.shop.do.you.have	07\$After.the.ban.of.plastic.bag.do.you.suffer.any.loss.due.to.unsold.stock.of.plastic.		
	No	Yes	Row Total
Bakery	5	9	14
	1.623	2.724	
	0.357	0.643	0.187
	0.106	0.321	
	0.067	0.120	
clothes	9	6	15
	0.017	0.029	
	0.600	0.400	0.200
	0.191	0.214	
	0.120	0.080	
Grocery	5	6	11
	0.520	0.873	
	0.455	0.545	0.147
	0.106	0.214	
	0.067	0.080	
other	7	2	9
	0.328	0.550	
	0.778	0.222	0.120
	0.149	0.071	
	0.093	0.027	
supermarket	6	2	8
	0.194	0.326	
	0.750	0.250	0.107
	0.128	0.071	
	0.080	0.027	
vegetable	15	3	18
	1.227	2.059	
	0.833	0.167	0.240
	0.319	0.107	
	0.200	0.040	
column Total	47	28	75
	0.627	0.373	

## Conclusion:

From above table we can conclude that due to plastic ban the bakery shops has suffered excess loss 64.3%. and the least loss is suffered by vegetable store 16.7% due to unsold stock of plastic.

# **Conclusion**

Our project gave us a wide insight about the ban on plastic bags, role of Government and opinion of common people about the ban.

We conclude that the socio-economic factors like Age, Gender & Area are significant. And they have a huge impact on the amount of plastic usage and effectiveness of plastic ban.

We conclude that,

- The people in age group 26-33 & 34-40 are mostly using plastic bags. Whereas, the people in age group 41-50 are moderately using the plastic bags & the people having age above 50 is least using plastic bags as compared to people in age group 18-25.
- On daily basis the plastic usage in Females is lesser than the Males.
- The House Wife's are mostly using plastic bags. Whereas, Government Job persons, Private Job persons & Self-Employed persons are moderately using the plastic bags & the Business person is least using plastic bags as compared to Students.
- The Middle-Class people & Upper Middle-Class people are less using plastic bags as compared to the Lower Middle-Class people.

The Socio-economic factors such as Age, Gender, Occupation & Area has positive association with usage of plastic.

We conclude that there is no reduction in provision of plastic bags by retailer i.e., they still continue the use of plastic bag after the plastic ban. It can be seen that the customers use the reusable bags at grocery or vegetable stores also carry their own bag (except plastic) for clothing shopping. We observe that after banning plastic there is reduction in usage of plastic products by people while travelling or in occasions & functions.

We can conclude that, the most of the people are aware about the harmful effects of plastic bags on environment, animals and humans, etc. and also getting aware about plastic waste relatively cause problems like death of livestock's, blockage of sewage, damage caused to marine life, the causes of cancer disease.

Though the Government has implemented the ban, but it lacks preparedness in many aspects. From our survey, with customer's point of view we can conclude that strict steps Government should take are:

1. Gives more alternatives in low price over plastic products.
2. Welcoming other ideas such as buyback scheme for plastic bottles.
3. Take strict actions on manufacturers or retailers, vendors or shopkeeper who are using plastic.
4. Penalize if someone found using banned plastic products.

Also, the most suggestions by people for Government to increase awareness are,

1. Increase advertisement & promote in big events.
2. Announcing in local travels.
3. Awareness Skits, Awareness Campaign or Rally.

We can conclude that the most of the people are using cloth or paper bags as an alternative to plastic also the access of people are ready to spend at the most 10-20 rupee additional for alternatives.

For the people that don't use alternatives has reasons behind are, as per them alternatives are costly, not travel friendly and not easily available.

We conclude that there is relatively positive association between type of shop and providing plastic bag. Also, the most preferred alternatives by the retailers are paper and cloth bags over plastic bag.

We can conclude that the average additional amount retailers are ready to spend for alternatives is 10 rupees.

We can conclude that due to plastic ban the bakery shops has suffered excess loss 64.3%. and the least loss is suffered by vegetable store 16.7% due to unsold stock of plastic.

# **SCOPE AND SUGGESTIONS**

The sample data used for our study was from Ambernath, Airoli and Virar. We can extend this survey to different regions of Maharashtra and can check the effectiveness of the ban and give more suggestions to improve the implementation of ban. Major problems can be identified and worked upon by finding good solutions.

To implement the ban more effectively Government should provide alternatives for plastic in low price, buyback scheme for plastic bottles, take strict actions against manufacturers.

Government with the help of Environmental agencies and NGOs can also take following initiatives to aware people about adverse effects of plastic:

- ❖ A team should be appointed to aware people from rural areas and slums.
- ❖ Frequency of advertisements of plastic ban on different mediums should be increased.
- ❖ Government can engage a popular face for campaigns such as '*GO PLASTIC FREE*'.
- ❖ Various initiatives should be taken in schools to educate children so that they reduce the consumption of plastic.

Several campaigns conducted in India and around the globe are:

- In India Big Bazaar has taken an initiative of rewarding customers by slogan, "*Plastic Lao, Recycle Karao, Or ₹ 10 Cashback le Jao*"
- A Scotland based company called MacRebur came up with a way to create roads using recycled plastic which are stronger and durable. Along with this it also solves the problem of growing plastic pollution.

On the basis of our analysis, we also think plastic waste needs to be collected separately and recycling should be introduced which will help in reducing the problem of improper disposal of plastic waste. Also, people should change their USE AND THROW mentality so that we make our Mother Earth a better place to live and sustain our environment for our future generation.

So, the Government and NGOs should educate people with low educational qualification, people with less Privilege about 'why the ban has been implemented...' through mediums such as television, social media and newspaper. Moreover, the Government should also make people aware about the 3 R's,

- Reduce
- Reuse
- Recycle

which will also help in controlling the plastic waste seen at various places such as beaches, market places and crowded residential areas.

Passing legislation is not sufficient to curb the problem of plastic bags. According to us, the perceptions of plastic bags need to be removed completely from our society. An initiative should be taken by us. Unless the change is brought in us, movement taken by Government will not be successful. So, let's beat the problem of plastic bags together and say,

**प्लास्टिक हटाओ, पर्यावरण बचाओ!!!**



# **CODING**

## **OBJECTIVE 1 (SAS CODE)**

```
proc catmod data=project.o2;
direct age gender occupation area;
model y=age gender occupation area;
run;
#for model gof and model odds ratio#;
proc logistic data=project.o2;
model y=age gender occupation area / link=glogit lackfit;
run;
#for odds ratio#;
proc logistic data=project.o2;
class Age(ref='1') Gender(ref='1') Occupation(ref='1') Area(ref='1') /
param=reference;
model y=age gender occupation area / link=glogit lackfit;
run;
```

## **OBJECTIVE 2 (SAS CODE)**

```
proc freq data=project.o2_new;
tables y*gender/all;
run;
```

```
proc freq data=project.o2_new;
tables y*age/all;
run;
```

```
proc freq data=project.o2_new;
tables y*occupation/all;
run;
```

```
proc freq data=project.o2_new;
tables y*area/all;
run;
```

```
proc freq data=project.o2;
tables y*occupation/all;
run;
```

## **OBJECTIVE 3 (R CODE)**

```
O3=read.csv(file.choose())
```

```
View(O3)
```

```
wilcox.test(O3$Y1,O3$X1,alternative = "less",paired = T)
```

```
wilcox.test(O3$Y2,O3$X2,alternative = "less",paired = T)
```

```
wilcox.test(O3$Y3,O3$X3,alternative = "less",paired = T)
```

```
wilcox.test(O3$Y4,O3$X4,alternative = "less",paired = T)
```

```
wilcox.test(O3$Y5,O3$X5,alternative = "less",paired = T)
```

## **OBJECTIVE 4 (R CODE)**

```
install.packages("gmodels")
```

```
library(gmodels)
```

```
genx1=CrossTable(O2$Gender,O4$X1)
```

```
mcnemar.test(genx1$t)
```

```
genx2=CrossTable(O2$Gender,O4$X2)
```

```
mcnemar.test(genx2$t)
```

```
genx3=CrossTable(O2$Gender,O4$X3)
```

```
mcnemar.test(genx3$t)
```

```
genx4=CrossTable(O2$Gender,O4$X4)
```

```
mcnemar.test(genx4$t)
```

```
genx5=CrossTable(O2$Gender,O4$X5)
```

```
mcnemar.test(genx5$t)
```

## **OBJECTIVE 5 & OBJECTIVE 6 (EXCEL)**

Pareto Analysis Steps:

1. Sort the Factors.
2. Calculate Cumulative Impact.
3. Plot the factors on a Pareto chart & analyze the factors.
4. Identity the Vital factors and Prioritize the Action.

## OBJECTIVE 7 (SAS CODE)

```
data s;  
input providing_bag $ shop $ freq;  
cards;  
yes Grocery 6  
yes vegetable 16  
yes Bakery 10  
yes Clothes 0  
yes Supermarket 8  
yes Other 5  
no Grocery 5  
no vegetable 2  
no Bakery 4  
no Clothes 15  
no Supermarket 0  
no Other 4  
;  
run;  
proc freq data=s;  
table providing_bag*shop/all fisher;  
weight freq;  
run;
```

## OBJECTIVE 7 (R CODE)

```
CrossTable(O7$What.kind.of.shop.do.you.have,O7$After.the.ban.of.plastic.bag.do  
.you.suffer.any.loss.due.to.unsold.stock.of.plastic.)
```

# QUESTIONNAIRE

We the students of *Dept. of Statistics*, thank you for participating in our survey. The objective of this survey is to assess the impact of plastic ban, to check awareness about plastic, role of Government and your contribution towards society. Your views are extremely important for success of this survey. We assure you that the information provided by you will be confidential and strictly used for educational purpose only. It will take a maximum 5 minutes of your time.

## (\*All Questions Are Compulsory)

1. Age: ☐ 18-25 ☐ 26-33 ☐ 34-40 ☐ 41-50 ☐ above 50
2. Gender: ☐ Male ☐ Female ☐ Other
3. Occupation: ☐ Student ☐ Self-Employed ☐ Government job  
☐ Private job ☐ Business ☐ House-Wife ☐ Retired
4. Annual Family Income: ☐ below 1.5 lakhs ☐ 1.5-3 lakhs ☐ 3-5 lakhs  
☐ 5-8 lakhs ☐ above 8 lakhs
5. Type of Residence: ☐ Slum ☐ Chawl ☐ Building ☐ Tower  
☐ Bungalow/Row-house ☐ Hostel
6. Area of Residence: ☐ Lower-middle class ☐ Middle class ☐ Uppper-middle class
7. Do you support plastic ban?  
☐ Yes ☐ No ☐ Maybe
8. Do you think government should take some effective steps to educate people about banned products its reuse and recycle?  
☐ Yes ☐ No ☐ Maybe
9. What are the different kind of items you usually use plastic for?  
☐ Plastic bottle/bags  
☐ Cups/Straws/Ice-cream Spoons/Plastic plates/cutlery such as forks/knives.  
☐ Cigarette packets  
☐ Polystyrene (Thermocol) for decoration  
☐ Wrapping or packing films
10. Do you know which of the following plastic products are banned?  
☐ Plastic bags (below 50 micron)  
☐ Cups/Straws/Ice-cream spoons/Plastic plates/cutlery such as fork/knives  
☐ Polystyrene(Thermocol) for decoration  
☐ Wrapping or packing films  
☐ Cigarette packets  
☐ PVC banners less than 100 Micron/plastic flags

11. From which medium did you get the information about plastic ban?

- ☐ Television ☐ Social media ☐ Radio ☐ Newspaper ☐ Banners/pamphlets  
☐ others

12. According to you which places are seriously polluted by plastic waste?

- ☐ Crowded residential areas ☐ Parks ☐ Beaches ☐ Market places/railway station  
☐ other

13. Are you aware about following problems due to plastic?

Issues	Aware	Not aware
Blockage of Sewage/Dumping issues	<input type="radio"/>	<input type="radio"/>
Affects Marine life/Death of livestock(cows,sheeps,etc)due to consumption of plastic	<input type="radio"/>	<input type="radio"/>
Causes cancer/skin problem/respiratory problems	<input type="radio"/>	<input type="radio"/>
Recycling problems	<input type="radio"/>	<input type="radio"/>
Deteriorating beauty of tourist places	<input type="radio"/>	<input type="radio"/>

14. Do you still use plastic bag?

- ☐ Yes ☐ No ☐ Sometimes

15. Why do you prefer using plastic bag?

- ☐ Affordable ☐ Easily Available ☐ Light weight ☐ Strength ☐ Durability

16. Do you think you reduce your rate of consumption of plastic bag?

- ☐ Yes ☐ No ☐ Maybe

17. What do you generally do after initial use of plastic bags?

- ☐ Reuse ☐ Throw away in dustbin ☐ Give for Recycle ☐ Other

18. Which actions Government should take to enforce the plastic ban more effectively?

- ☐ Penalise if someone found using banned plastic products  
☐ Give more alternative in low price over plastic products  
☐ CC-TV monitoring in companies/shops via civic inspector  
☐ Take strict actions on manufacturers or retailers or vendors or shopkeepers  
☐ Welcoming other ideas such as buyback scheme for plastic bottles  
☐ Gives rewards to local bodies to go plastic free

19. What should the government do to increase the awareness of plastic ban?

- ☐ Increasing advertisement/Promoting in big events  
☐ Holding/Banners/Pamphlets  
☐ Awareness Skits/Rally/Campaign  
☐ Wall Paintings  
☐ Announcing in local travels

20. Do you use alternative for plastic bag?

- ☐ Yes (skip to Question-21) ☐ No (skip to Question-24)

If Yes then,

21. What are the alternative you use for plastic bag?

- ☐ Wooven bag ☐ Jute bag ☐ Paper bag ☐ Cloth bag ☐ Leather bag

22. Are you ready to spent additional amount for alternative to plastic products?

- ☐ Yes ☐ No ☐ Maybe

23. How much additional amout you will spent for alternative to plastic products?

- ☐ ₹ 10-20 ☐ ₹ 20-30 ☐ ₹ 30-40 ☐ ₹ 40-50

If No then,

24. Why you don't use reusable plastic bags?

- ☐ Costly ☐ Inconvinient ☐ Not easily available ☐ Not travel friendly ☐ Other

25. Choose an appropriate option for following situation (preban & postban)

	Pre-Ban			Post-Ban		
Situation	Always	Never	Sometimes	Always	Never	Sometimes
Shopkeeper not giving plastic bag	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Using reusable bag at grocery/vegetable store	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Carrying own bag(except plastic) for cloth shopping	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Using plastic product while Travelling	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Using plastic product on occasion or functions	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

26. If shopkeeper is giving you a plastic bag then

	Pre-Ban			Post-Ban		
Situation	Always	Never	Sometimes	Always	Never	Sometimes
Will you Accept?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Will you Reject?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

27. While buying plastic products did you check if the product is banned or not?

- ☐ Yes ☐ No ☐ Maybe

# Questionnaire (Shopkeeper)

1. Which type of shop do you have?

- ☐ Grocery ☐ Vegetable ☐ Bakery ☐ Clothes ☐ Supermarket ☐ Other

2. Are you aware of plastic ban?

- ☐ Yes ☐ No ☐ Maybe

3. Do you feel that banning plastic is good initiative?

- ☐ Yes ☐ No

4. Are you aware of which type of plastic is ban?

- ☐ Less than 50 micron ☐ More than 50 micron ☐ Other

5. Do you still provide single use plastic bag?

- ☐ Yes ☐ No

6. In what quantity do you buy plastic?

- ☐ <500 nag ☐ >500 nag ☐ >1000nag ☐ Other

7. How much amount you spent for plastic bag per month?

-----

8. How many single use plastic bag you provide per day?

- ☐ <100 ☐ >100 ☐ Deny to provide

9. Do you support to reduce the use of plastic bags?

- ☐ Yes ☐ No

If Yes then Question 10 else skip to 11

10. How much amount do you currently spend for alternative to plastic product per month?

-----

11. What prevents you from selling reusable plastic bag?

☐ Too expensive ☐ Not easily available ☐ People don't buy because reusable bag is costly

12. Which of the following are you ready to sell for alternative to plastic bag?

- ☐ Wooven bag ☐ Jute bag ☐ Paper bag ☐ Cloth bag ☐ Leather bag

13. How much can you afford to spend more on alternative to plastic products?

-----

14. After the ban of plastic bag do you suffer any loss due to unsold stock of plastic?

- ☐ Yes ☐ No

15. After the ban, What did you do with the left-over plastic?

- ☐ Returned to government ☐ Suffered loss ☐ Sold even though ban was initiated  
☐ Other

# **BIBLIOGRAPHY**

## ❖ **News Reference:**

- Lokmat (Date: 04/06/2023)
- Hindustan Times (Date: 02/12/2022)
- Times of India
- Economic Times

## ❖ **Sites Used:**

- <https://m.youtube.com>
- <https://learn.eartheasy.com/guides/the-best-eco-friendly-alternatives-for-the-plastic-in-your-life/>
- <https://www.hindustantimes.com/cities/mumbai-news/state-lifts-ban-on-single-use-plastic-items-101669922646938.html>
- <https://support.sas.com>

## ❖ **Book Used:**

- Applied Logistic Regression (3rd Edition)  
-by David Hosmer, Jr. Stanley Lemeshow and Rodney Sturdivant.
- Multinomial Logistic Regression Models  
Wayne State School of Social Work <https://socialwork.wayne.edu> ›...PDF