ANALYSING THE MENSTRUAL WASTE PRODUCED AND PROVIDING AN ENVIRONMENTAL AND INDUSTRIAL APPROACH

FERGUSSON COLLEGE

(AUTONOMOUS) , PUNE

DEPARTMENT OF STATISTICS

CERTIFICATE

This is to certify that Mr. Divyam machale Roll No. 4510 , student of Fergusson College , studying in T.Y.BSc. Statistics, has successfully completed his/her annual research work entitled as ANALYSING THE MENSTRUAL WASTE PRODUCED AND PROVIDING AN ENVIRONMENTAL AND INDUSTRIAL APPROACH and has satisfactorily reached the goals of the proposed work as laid down by the University of Pune.

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ACKNOWLEDGEMENT

We express our sense of gratitude to **Prof. Subhash Shende** for all the valuable guidance and support provided by him for successful completion of our project. We would like to thank all the members of department of Statistics for helping us out with all the difficulties. We would also like to thank **Dr. Kalpana Javir** ,a gynaecologist working in District Hospital, Aundh for their valuable guidance. We would like to thank **Mr. Nikhil Khomane** for guiding us to overcome difficulties faced during the project. Last but not the least, we would like to thank to fellow group members, each and everyone related to this project.

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MOTIVATION:

Menstruation is a natural phenomenon that occurs to every female. But issues regarding this topic is never discussed freely in the society as it is concerned to females only. Our community hardly take any efforts to solve the problems regarding menstruation. Due to this ignorance, there is rise in environmental issue caused by menstrual products. Lot of waste is generated monthly in India as there are **335 million** menstruating women in India. Even females have lack of information regarding various menstrual products, there quality, technique to use and how this waste is decomposed or managed after use. As females feel shy to discuss this topic, industries are not able to provide a better solution easily as they need a proper analysis whether females would like to approach toward new product.

Hence all this problems made us to do this project which will provide an industrial and environmental solution using statistical background.

ABSTRACT:

Menstrual waste management is a serious issue of the society due to Menstrual Products used by females during menstruation. Females use various menstrual products like cloth pads, sanitary napkins, menstrual cups and tampons. A basic study was done to know different menstrual product .**A primary data was collected to find which menstrual product is highly preferred by females in Pune.** It was found that Sanitary Napkins was the most preferred product compared to the other product. Hence, menstrual waste due to sanitary napkins was computed. Other products also contributed to menstrual waste but it was very small as compared to sanitary napkins, hence waste due to other product was not considered. Study of menstrual products suggested that menstrual cups produce least waste but majority of females in Pune didn't prefer it. Hence, each female of our sample was provided a proper guidance regarding the use of menstrual cups, price of menstrual cups and awareness was spread regarding the waste produced by sanitary napkins and menstrual cups. After proper knowledge, some females were ready to switch from sanitary napkins to menstrual cups. Females which were ready to switch helped the environment by reducing the menstrual waste. Therefore, **the amount of waste reduced was computed** and proper result was stated. If females of Pune are ready to switch towards menstrual cups then they need it easily available in the market. Any industry will manufacture menstrual cups, if females are willing to buy. So, to provide an industrial solution, willingness of females and reasons behind it were collected using primary data. Hence **this projectwill create awareness among females and provide an environmental and industrial solution.**

KEYWORDS

Menstrual Waste, Sanitary Napkins, Menstrual Cups, Menstrual Products, Industries, Environment,Awareness, etc.

INTRODUCTION:

Menstruation, also known as a **period** or **monthly**, is the regular discharge of blood and mucosal tissue (known as menses) from the inner lining of the uterus through the vagina. The flow of blood may be light, moderate or heavy and can vary in length from about 4-7 days. To deal with the regular discharge of blood and mucous during menstruation females use various menstrual products. These **Menstrual products** (also called "feminine hygiene" products) are made to absorb or catch menstrual blood. A number of different products are available - some are disposable, some are reusable. Where women can afford it, items used to absorb or catch menses are usually commercially manufactured products.

Disposable products include:

- **Sanitary Napkins** (also known as sanitary pads)- Rectangular pieces of material worn attached to the underwear to absorb menstrual flow, often with an adhesive backing to hold the pad in place.
- **Tampons**- Disposable cylinders of treated rayon/cotton blends or all-cotton fleece (fabric made using polyester), usually bleached, that are inserted into the vagina to absorb menstrual flow.

Reusable products include:

- **Menstrual Cups**- A firm, flexible bell-shaped device, made up of silicon, worn inside the vagina to collect menstrual flow.
- **Cloth Pads**-Pads that are made of cotton (often organic), terrycloth, or flannel, and may be hand sewn (from material or reused old clothes and towels) or store-bought.

Before collecting the data, a study of structure and composition of Sanitary Napkins and Menstrual Cup was done to spread awareness. Because,Cloth pads if not properly used, washed or dried it causes many infections and diseases. Even tampons are made up of plastic and it has to be inserted directly into vagina, which is very harmful. Also , government and private doctors suggested that using Menstrual Cup is goof for female's health and hygiene. Hence awareness regarding menstrual cup was only spread to our sample female

STUDY OF SANITARY NAPKINS AND MENSTRUAL CUP

- **Sanitary napkin's structure**

In general, a sanitary napkin consists of 3 layers made with different materials: a permeable top layer, an absorbent layer and an impermeable bottom layer. Its performance is affected by the design and the materials used.

The Top Layer: which is in direct contact with the skin and the genital area, its main function is to allow the menstrual flow to be instantly absorbed and isolated to ensure dryness of the skin and to avoid discomfort due to prolonged contact with the soaked napkin. The top layer is usually made of non-woven **polypropylene or polyethene fibres**. Pure cotton is rarely used.

The Absorbent (Middle) Layer: whose function is to absorb the fluid and then store and retain it. The layer is commonly made of the material **super absorbent polymer (SAP)**or SAP-containing paper. These polymer particles will expand rapidly once coming into contact with water thus can effectively absorb and then retain fluid. Other materials used include fluff pulp, pulp, wood pulp or cotton.

The Bottom Layer: whose main function is to prevent leakage, is generally made of **low-density polyethylene**to prevent fluid from seeping through the layer staining clothes.

Table-1

Section	**Plastic content(gm)**
Top Layer	1.1
Middle Layer	0.6
Bottom Layer	0.96
Outer covering plastic use to wrap the sanitary napkin	0.69
Total	3.35

Plastic content in each layer of Sanitary Napkin

Therefore, average plastic content in one sanitary napkin is 3.35gm.

MENSTRUAL CUPS

A menstrual cup is a feminine hygiene device that is inserted into the vagina during menstruation. Its purpose is to collect menstrual fluid (blood from uterine lining) and prevent its leaking onto clothes. Menstrual cups are usually made of flexible medical grade silicone and shaped like a bell with a stem. The stem is used for insertion and removal. The bell-shaped cup seals against the vaginal wall just below the cervix. Every 6–12 hours (depending on the amount of flow), the cup is removed, emptied, rinsed, and reinserted. After each period, the cup requires cleaning. **One cup can be used on an average of 5 years** depending on its quality. **Average weight of menstrual cup is 14.1748 gm.** But as menstrual cup is used for 5 years, if that menstrual cup is not recycled then waste produced in 5 year due to

menstrual cup is 14.1748gm.

TECHNICAL STATEMENTS:

- According to MHAI(Menstrual Hygiene Alliance of India), **Sanitary waste management was serious issue due to disposal of sanitary napkins as plastic content inside it was not biodegradable.** Hence, it was necessary to verify whether sanitary napkin is the most preferred menstrual product as compared to the other products by females in our sample staying in Pune and then to calculate the amount of waste produced.
- Other menstrual products like tampons, cloth pads, menstrual cups can be used during menstruation. But menstrual cups offer a long-term solution compared to some other feminine hygiene products because they do not need to be replaced monthly. The quality of the material also makes them reliable and provides healthy menstrual hygiene solution, as long as there is access to clean water for washing them. Hence, it was necessary to make our sample aware of menstrual cups and its usage for reduction of waste.
- Also, waste due to Sanitary Napkins can be reduced if its consumption and production is reduced. This can happen if
    1. Females are aware of other hygiene products like cups and will switch from sanitary napkins to menstrual cups.
    2. Industries increase the production of menstrual cups.
- Industries need to know willingness of female and factors that affect their willingness to change from their current product.

STATISTICAL STATEMENTS

- To find preferred menstrual product by females of Pune.
- To find percentage of Sanitary Napkins users.
- To find average waste produced in Pune due to Sanitary Napkins.
- To find percentage of females ready to switch from sanitary napkin to menstrual cup
- To find association of willingness to switch withAge and Occupation.

1. Ho: Women's Occupation and Willingness to Switch are independent

H1: Women's Occupation and Willingness to Switch are dependent

2. Ho: Women's Age and Willingness to Switch are independent
   H1: Women's Age and Willingness to switch are dependent.

- To find effects of various factors on willingness and unwillingness to switch using factorial experiment.

DATA COLLECTION METHOD

Menstruation is a phenomenon that begins at the age of 8-15 years and last until the age of 40-55 year. Hence our primary data was collected from females with different age group. It was collected from students of various colleges, working ladies (teachers, female employees, workers) and housewives. Since females from varied occupation and sector had varied thinking, economic status and mentality. Also, secondary data was collected to find average plastic content of sanitary napkin and weight of menstrual cup.

A pre designed questionnaire was used for the purpose of collection of desired data. While collecting data, each team member individually talked with the females, made female aware regarding serious issue of waste management of Sanitary Napkins. Then females were asked whether they knew about menstrual cups. Each team member provided accurate information regarding menstrual cup, its use and eco friendliness. After providing the necessary information about menstrual cup and sufficient time to think, females were asked about their willingness to switch and reasons behind it.

Questionnaire

1. Age
2. Occupation
3. Which menstrual product do you use during menstruation?
    - Sanitary Napkins
    - Organic Pads
    - Cloth Piece
    - Menstrual Cups
    - Tampons
4. What is the cost spent per cycle for your menstrual product?
5. If you use Sanitary Napkins, how many Sanitary Napkins are used per cycle?
6. Do you know about menstrual cups?
    - Yes
    - No

7. Would you like to switch to Menstrual Cup?

- Yes
- No

8. Why would you like to switch? (Multiple choice selection)
   - Hygienic to use
   - Cost effective
   - Eco-friendly (less waste produced)
   - None of the above
9. Why would you not like to switch? (Multiple Choice Selection)

- Uncomfortable (as it has to be inserted inside vagina)
- Not easily available in shops
- Not easy to use
- None of the above

Statistical Tools Used:

1. Simple Proportion
2. Chi Square Test
3. Proportion Test
4. Factorial Experiment
5. Other Computational Tools (R Software, MS Office Excel)

PRIMARY COLLECTED DATA:

Data was randomly collected and was arranged as per the menstrual product preferred.

Occupation	Which method do you prefer/use in periods?	If pads, how many average pads per cycle do u require?	Cost per cycle?	Do u know about menstrual cups?	Would you like to switch to Menstrual cups?	If yes, why?	If no, why?
Student	Synthetic pads	12	150	No	Yes	Hygienic	
Student	Synthetic pads	20	280	No	No		None of the above
Student	Synthetic pads	9	80	Yes	Yes	Hygienic;Eco friendly	
Student	Synthetic pads	7	70	No	Yes	Hygienic	
Housewife	Synthetic pads	15	30	Yes	Yes	Cost effective;Hygienic	
Student	Synthetic pads	15	80	Yes	Yes	Cost effective;Hygienic; Eco friendly	
Student	Synthetic pads	9	200	Yes	No		None of the above
Student	Synthetic pads	11	100	No	Yes	Eco friendly	
Student	Synthetic pads	12	250	Yes	No		Not easy to use;Uncomfortable
Student	Synthetic pads	10	120	Yes	No		None of the above
Student	Synthetic pads	10	70	Yes	Yes	Hygienic;Eco friendly	
Student	Synthetic pads	10	50	Yes	No		Uncomfortable
Housewife	Synthetic pads	15	364	No	No		Uncomfortable
Working	Synthetic pads	10	60	No	No		Not easy to use;Uncomfortable
Working	Synthetic pads	6	60	Yes	Yes	Eco friendly	
Housewife	Synthetic pads	16	120	No	No		None of the above

Student	Synthetic pads	12	100	No	No		Uncomfortable

Working	Synthetic pads	7	70	Yes	No		Not easily available
Student	Synthetic pads	10	60	Yes	Yes	Hygienic;Eco friendly	
Student	Synthetic pads	10	60	Yes	Yes	Hygienic;Eco friendly	
Student	Synthetic pads	8	60	Yes	No		Uncomfortable
Student	Synthetic pads	5	40	Yes	Yes	Cost effective;Hygienic;Eco friendly	
Student	Synthetic pads	23	120	Yes	No		Not easily available
Student	Synthetic pads	10	100	Yes	Yes	Cost effective;Hygienic;Eco friendly	
Housewife	Synthetic pads	7	80	Yes	Yes	Cost effective;Hygienic;Eco friendly	
Housewife	Synthetic pads	5	250	Yes	No		Not easy to use
Working	Synthetic pads	12	120	Yes	No		Not easily available;Not easy to use;Uncomfortable
Housewife	Synthetic pads	12	72	No	Yes	Cost effective	
Housewife	Synthetic pads	6	36	No	Yes	Cost effective;Hygienic	
Housewife	Synthetic pads	9	90	Yes	No		Not easy to use
Student	Synthetic pads	30	300	Yes	Yes	Hygienic	
Student	Synthetic pads	12	90	Yes	Yes	Eco friendly	
Student	Synthetic pads	10	100	Yes	No		Uncomfortable
Student	Synthetic pads	15	150	No	No		Not easy to use
Student	Synthetic pads	14	154	Yes	No		Uncomfortable
Student	Synthetic pads	10	100	Yes	Yes	Hygienic;Eco friendly	
Student	Synthetic pads	12	125	Yes	Yes	Cost effective;Hygienic;Eco friendly	
Student	Synthetic pads	6	75	No	Yes	Eco friendly	
Student	Synthetic pads	8	100	No	No		Not easily available
student	Synthetic pads	12	30	No	Yes	Eco friendly	
Student	Synthetic pads	7	70	No	Yes	Hygienic	
House wife	Synthetic pads	10	100	No	No		Not easy to use

Student	Synthetic pads	10	150	Yes	No		Uncomfortable
Student	Synthetic pads	12	80	Yes	Yes	Hygienic	
Student	Synthetic pads	12	160	Yes	No		Not easy to use;Uncomfortable
Student	Synthetic pads	10	160	Yes	No		Uncomfortable
Student	Synthetic pads	10	125	Yes	No		Uncomfortable
Student	Synthetic pads	20	360	Yes	No		Uncomfortable
Student	Synthetic pads	8	110	Yes	No		Not easy to use;Availability
Student	Synthetic pads	10	250	Yes	No		Not easy to use;Not easily available;Uncomfortable
Student	Synthetic pads	12	133	Yes	No		Uncomfortable
Student	Synthetic pads	14	44	Yes	No		Not easily available;Uncomfortable
Student	Synthetic pads	15	81	Yes	No		None of the above
Student	Synthetic pads	6	60	Yes	No		Uncomfortable
Student	Synthetic pads	20	350	Yes	No		None of the above
Student	Synthetic pads	9	75	Yes	No		Uncomfortable
Student	Synthetic pads	9	70	Yes	Yes	Cost effective;Hygienic;Eco friendly	
Student	Synthetic pads	9	100	Yes	No		None of the above
Student	Synthetic pads	8	35	Yes	No		Uncomfortable
Student	Synthetic pads	10	80	Yes	Yes	Cost effective;Hygienic;Eco friendly	
Student	Synthetic pads	10	80	Yes	Yes	Cost effective;Hygienic;Eco friendly	
Student	Synthetic pads	15	150	Yes	Yes	None of the above	
Student	Synthetic pads	11	200	Yes	No		Not easy to use
Student	Synthetic pads	14	200	Yes	No		None of the above
Student	Synthetic pads	10	100	No	No		Not easy to use

Student	Synthetic pads	15	300	Yes	No		Not easy to use
Student	Synthetic pads	10	75	Yes	Yes	Hygienic	

Student	Synthetic pads	20	100	Yes	Yes	Hygienic;Eco friendly	
Student	Synthetic pads	8	100	No	No		Not easy to use
Housewife	Synthetic pads	15	150	Yes	No		Not easy to use
Housewife	Synthetic pads	6	40	No	Yes	Cost effective;Hygienic	
Housewife	Synthetic pads	12	100	No	Yes	Cost effective;Eco friendly	
Housewife	Synthetic pads	15	150	No	No		Not easy to use
Working	Synthetic pads	12	120	Yes	No		Not easy to use
Working	Synthetic pads	8	48	Yes	Yes	Cost effective;Hygienic	
Working	Synthetic pads	15	150	Yes	No		Not easy to use
Working	Synthetic pads	6	36	No	Yes	Cost effective;Hygienic	
Housewife	Synthetic pads	12	110	Yes	Yes	Cost effective;Hygienic	
Housewife	Synthetic pads	9	54	No	No		Not easily available;Not easy to use
Housewife	Synthetic pads	12	70	No	Yes	Cost effective;Hygienic;Eco friendly	
Housewife	Synthetic pads	6	36	No	Yes	Cost effective;Hygienic	
Housewife	Synthetic pads	15	150	No	No		Not easily available;Not easy to use
Housewife	Synthetic pads	9	90	Yes	No		Not easily available;Not easy to use
Housewife	Synthetic pads	12	120	Yes	No		Not easily available;Not easy to use
Working	Synthetic pads	12	120	Yes	No		Not easily available
Housewife	Synthetic pads	9	90	Yes	No		Not easily available;Not easy to use
Working	Synthetic pads	12	120	Yes	Yes	Cost effective	
Working	Synthetic pads	9	90	Yes	No		Uncomfortable
Working	Synthetic pads	12	120	Yes	Yes	Cost effective;Hygienic	
Working	Synthetic pads	9	90	Yes	No		Not easy to use
Housewife	Synthetic pads	9	54	Yes	No		Not easily available

Working	Syntheti c pads	9	90	No	Yes	None of the above

Working	Synthetic pads	9	90	Yes	No		Not easy to use
Housewife	Synthetic pads	12	120	Yes	No		Not easily available;Uncomfortable
Housewife	Synthetic pads	10	50	Yes	No		Uncomfortable
Housewife	Synthetic pads	12	120	Yes	No		Not easily available;Not easy to use
Housewife	Synthetic pads	9	54	No	Yes	Cost effective	
Working	Synthetic pads	13	150	Yes	No		Uncomfortable
Housewife	Synthetic pads	10	55	Yes	No		Uncomfortable
Housewife	Synthetic pads	9	90	No	Yes	Cost effective;Hygienic	
Housewife	Synthetic pads	12	120	Yes	No		Not easily available;Not easy to use
Housewife	Synthetic pads	8	48	No	Yes	Cost effective;Hygienic	
Housewife	Synthetic pads	6	36	No	Yes	Cost effective;Hygienic	
Working	Synthetic pads	12	70	Yes	No		Uncomfortable
Housewife	Synthetic pads	12	120	Yes	Yes	Cost effective;Eco friendly	
Working	Synthetic pads	8	54	No	Yes	Cost effective ;Ecofriendly;Hygienic	
Working	Synthetic pads	15	150	No	Yes	Cost effective;Eco friendly	
Working	Synthetic pads	9	54	No	Yes	Cost effective;Hygienic	
Housewife	Synthetic pads	8	49	No	Yes	Hygienic;Eco friendly	
Housewife	Synthetic pads	10	80	No	No		Not easy to use
Working	Synthetic pads	8	50	No	Yes	Hygienic;Eco friendly	
Working	Synthetic pads	12	120	Yes	Yes	Eco friendly	
Housewife	Synthetic pads	14	160	Yes	No		Uncomfortable
Working	Synthetic pads	12	300	No	No		None of the above
Working	Synthetic pads	12	245	No	No		Not easy to use
Working	Synthetic pads	7	350	Yes	No		Uncomfortable
Housewife	Synthetic pads	12	200	Yes	No		Not easy to use

Student	Synthetic pads	9	40	Yes	No		None of the above
Working	Synthetic pads	12	192	Yes	No		None of the above
Working	Synthetic pads	8	100	No	Yes	Cost effective;Hygienic	
Working	Synthetic pads	10	60	Yes	Yes	Eco friendly	
Housewife	Synthetic pads	17	70	No	Yes	None of the above	
Student	Synthetic pads	12	100	Yes	Yes	Cost effective	
Housewife	Synthetic pads	14	60	Yes	No		Not easy to use;Uncomfortable
Student	Synthetic pads	13	110	Yes	Yes	Cost effective	
Housewife	Synthetic pads	12	50	No	No		Not easy to use;Uncomfortable;Not easily available
Working	Synthetic pads	11	80	Yes	Yes	Hygienic	
Student	Synthetic pads	8	150	Yes	Yes	Hygienic;Cost effective	
Working	Synthetic pads	10	80	Yes	No		Uncomfortable;Not easily available
Student	Synthetic pads	8	60	No	Yes	Hygienic;Cost effective	
Student	Synthetic pads	16	30	Yes	Yes	Cost effective;Eco friendly	
Housewife	Synthetic pads	11	45	No	Yes	Hygienic	
Student	Synthetic pads	9	50	Yes	Yes	Cost effective;Eco friendly	
Working	Synthetic pads	12	100	Yes	No		Not easy to use;Not easily available
Housewife	Synthetic pads	13	40	No	No		Not easy to use;Uncomfortable
Housewife	Synthetic pads	8	36	Yes	Yes	Eco friendly	
Housewife	Synthetic pads	9	55	No	Yes	Eco friendly	
Student	Synthetic pads	11	80	Yes	Yes	Cost effective;Eco friendly	
Student	Tampons	10	100	Yes	No		Uncomfortable
Student	Tampons	8	170	Yes	Yes	Hygienic	
Student	Tampons	8	150	Yes	No		Uncomfortable

Student	Cloth/rags	4	0	Yes	No		None of the above
Housewife	Cloth/rags	6	36	No	Yes	Cost effective	
Working	Cloth/rags	8	48	Yes	Yes	Cost effective;Hygienic	

Working	Cloth/rags	12	65	No	Yes		Not easy to use
Working	Cloth/rags	8	48	No	Yes	Eco friendly	
Student	Menstrual cup	0	270	Yes	Yes	Cost effective;Hygienic;Eco friendly	
Student	Menstrual cup	0	400	Yes	Yes	Cost effective;Hygienic;Eco friendly	
Student	Menstrual cup	0	595	Yes	Yes	Cost effective;Eco friendly	
Working	Menstrual cup	0	350	Yes	Yes	Hygienic	Not easy to use
Working	Menstrual cup	0	550				
Student	Organic pads	6	120	Yes	Yes	Hygienic	
Student	Organic pads	7	60	Yes	Yes	Hygienic	
Student	Organic pads	10	360	Yes	No		None of the above
Student	Organic pads	18	200	Yes	Yes	Cost effective;Hygienic;Eco friendly	
Student	Organic pads	3	35	No	No		Not easily available
Student	Organic pads	15	70	Yes	No		Not easy to use;Uncomfortable

DATA SUMMARY AND EXPLORATORY ANALYSIS

Data was collected from 157 females staying in Pune. The collected data was divided into different stratum on the basis of Occupation. Students, Working Lady and Housewife were the strata.

Occupation	Frequency	Percentage
Student	77	49.04%
Housewife	44	28.03%
Working Lady	36	22.93%

Table-2(N=157)

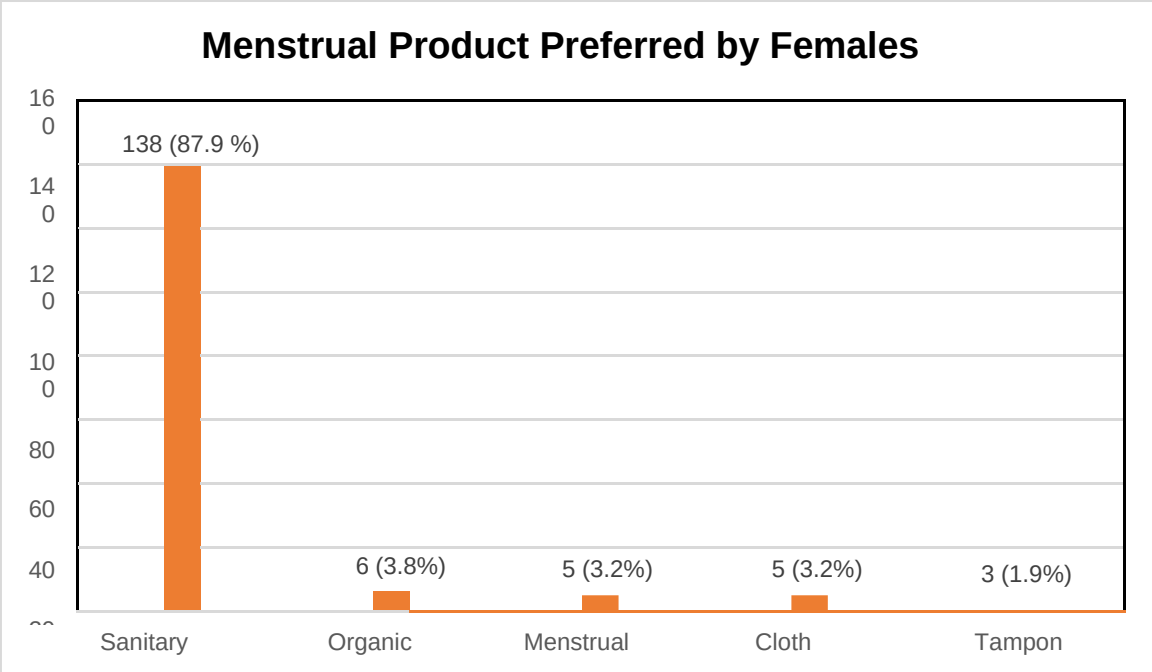


Chart 1- Bar diagram of preferred menstrual product by female in Pune

Therefore, it can be observed that majority of females prefer Sanitary Napkins.

Users of Sanitary Napkins on basis of Occupation(n=138)

Occupation	**Frequency**
Student	64
Housewife	43
Working Lady	31

TABLE-3

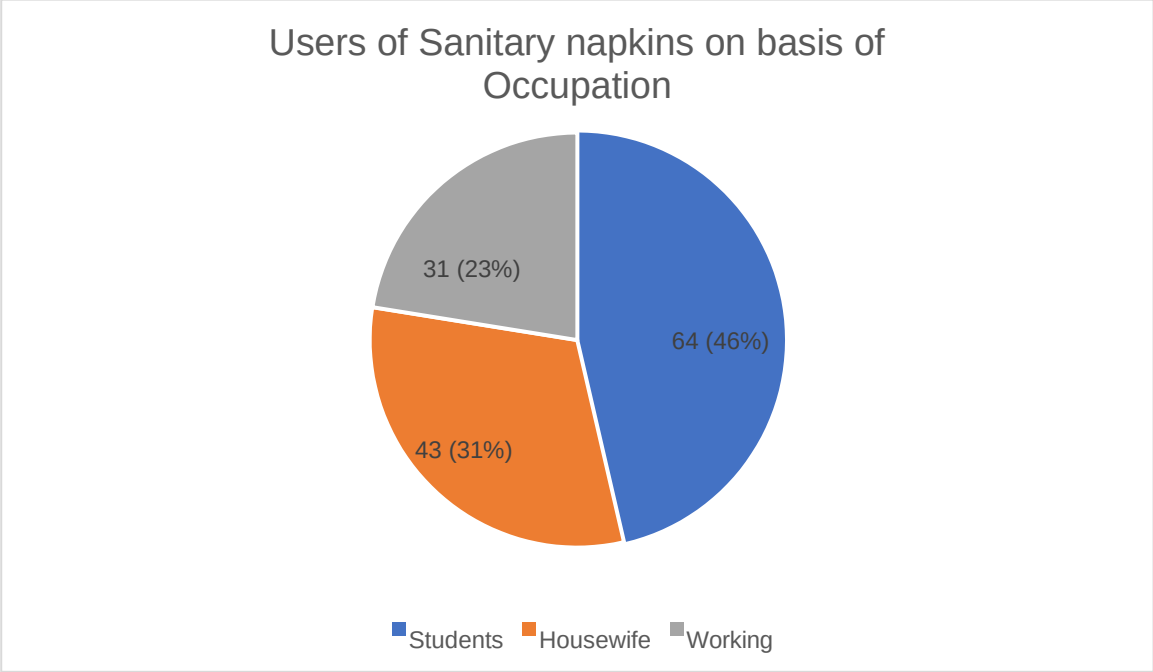


Chart 2- Pie Chart

This pie chart describes percentage users of sanitary napkins as per occupation

i.e. 23% contribution towards use of Sanitary Napkin is due to working ladies

31% contribution towards use of Sanitary Napkin is due to Housewives

46% contribution towards use of Sanitary Napkin is due to Students

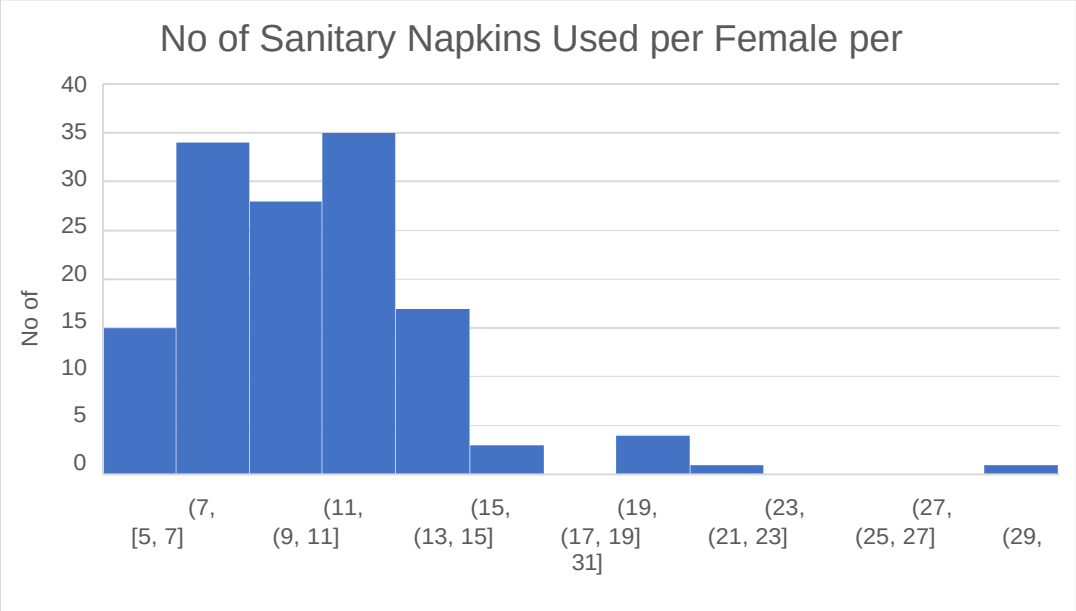


Chart 3 - Histogram of no of Sanitary Napkins used per Female per menstrual cycle

It can be seen that majority of females use 11 to 13 napkins per cycle

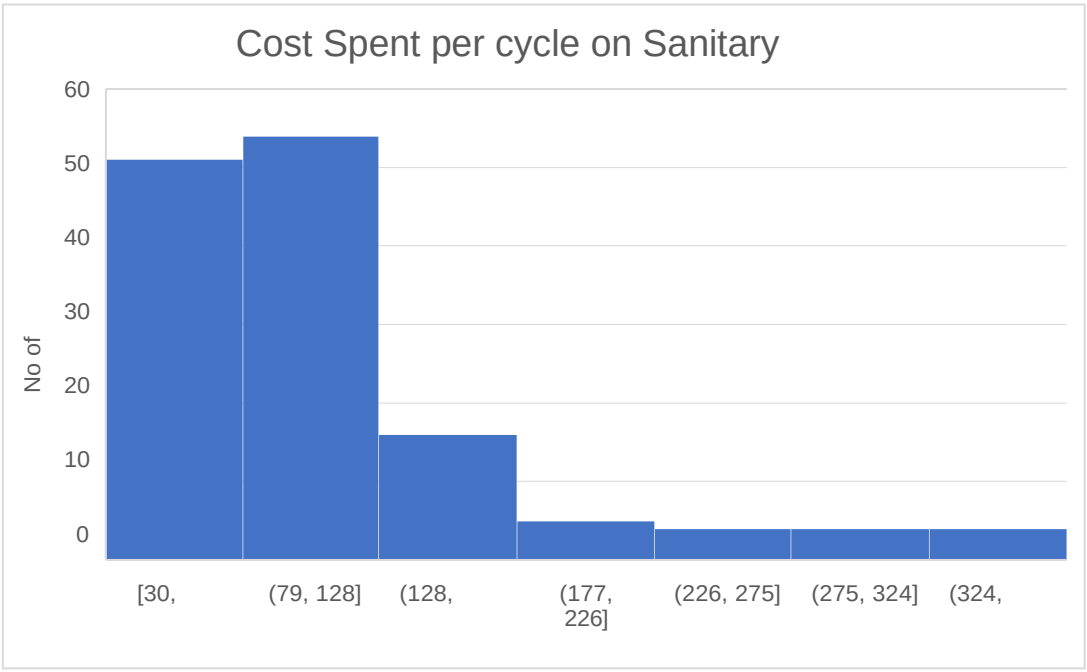


Chart 4- Histogram of Cost Spent per Cycle on Sanitary Napkins

Most of the females spent Rs 79-128 on Sanitary Napkin per cycle

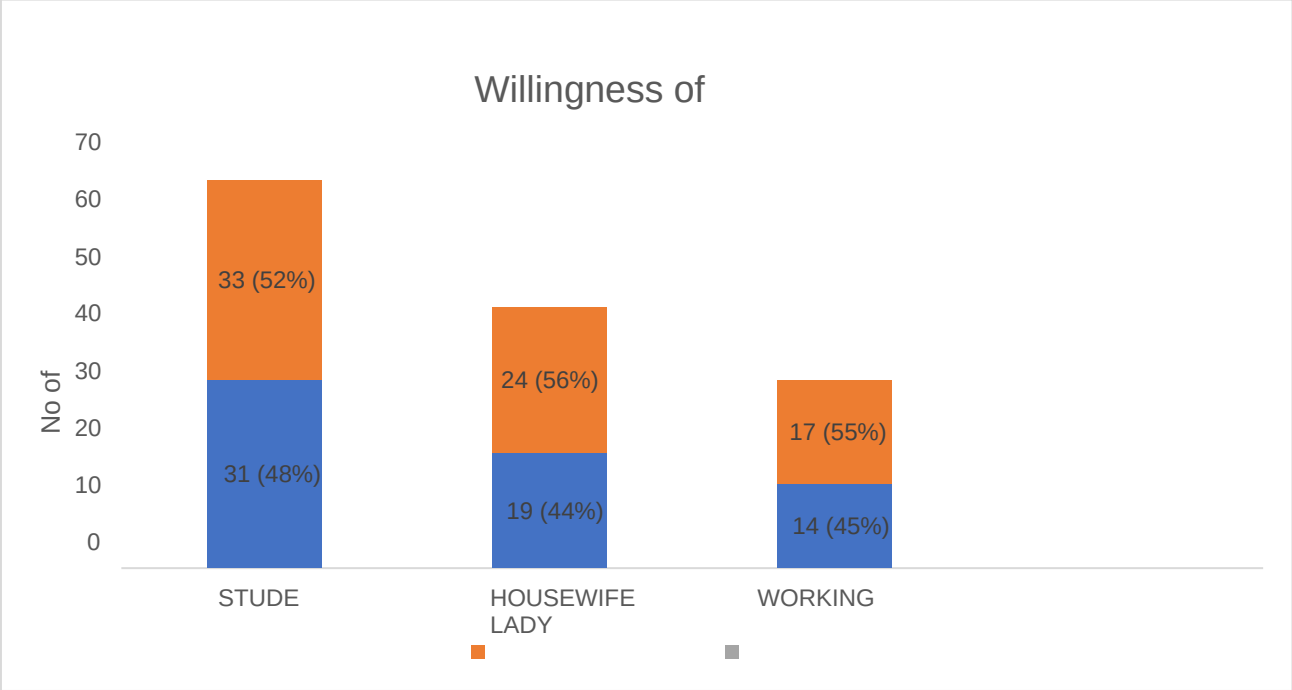


Chart 3- Willingness of Females to switch from Sanitary Napkins to Menstrual Cups

STATISTICAL ANALYSIS

From Chart 1, it is cleared that 138 females use sanitary napkins out of 157. i.e. 87.89% of females prefer sanitary napkins which are not bio-degradable. A 2015-2016 report by National Family Health Survey (NHFS) shows that the use of sanitary napkins among Indian Women is 77.5% in Urban area. Hence, it is necessary to verify whether proportion of females using sanitary napkins has increased in 2020. (As data was collected in month of January and February)

Therefore, Proportion test was used to verify the claim

To test: Ho: P=0.775 against H1: P>0.775

>prop.test(138,157,alternative=”greater”,conf.level=0.95)

p- value= 0.00756 **α**=0.05

Decision: We reject Ho at 5% level of significance as p-value approaches towards 0 and is less than α

Therefore, Proportion of females using Sanitary Napkins has increased. Hence, it can be observed large no of females uses sanitary napkins instead of other product.

For further analysis, we will consider sample of size 138 only as we want to calculate average amount of non- biodegradable waste produced due to sanitary napkins and provide solution for its reduction.

Plastic waste generated due to sanitary napkins per female

Average no. of non-biodegradable sanitary napkins used per female-**11 napkins**

From table 1,

Average Plastic Content in one Sanitary Napkin-3.35gm

Time(in years)	Average no. of pads used per female	Average plastic waste generated (in gm)
1	132	442.2
5	660	2211
30	3960	13266

Table 4-Waste Produced per female

Therefore, waste produced by 138 females in period of 5 years=**305118gm (305.118kg)**

This waste is too huge as it consumes lot of space and needs 500-800 years to decompose.

After computing the waste produced, further statistical analysis was done on how this waste can be reduced. Therefore, females were asked whether they would like to switch from sanitary napkins.

Initially, it was observed that **66% of females had heard about menstrual cups**. But they had lack of information about menstrual cup, so they never tried using it. When females got aware and gained proper knowledge of menstrual cups, it was observed 64 females were ready to switch from sanitary napkin to menstrual cup (from Chart 3). i.e. **46.38% of females were willing to switch**.

If 1 menstrual cup is used it produces 14.1748gm of waste if not recycled

Waste produced due to menstrual cup in 5 years by 64 females is 907.1872gm (0.9 kg)

Waste produced due to sanitary napkins in 5 years by 64 females is 141504gm(141.504kg)

From the basic study of menstrual cup, it was observed that 1 cup can be used on an average for 5 years. Then instead of using 660 pads only one menstrual cup can be used for 5 years. Hence the waste produced in 5 years will be reduced from **305.118kg to 163.614kg if 1 menstrual cup is used.**

Cost Effectiveness

From collected primary data,

Average cost spent per menstrual cycle **(for 1 month)** per female on Sanitary Napkin is

Rs110

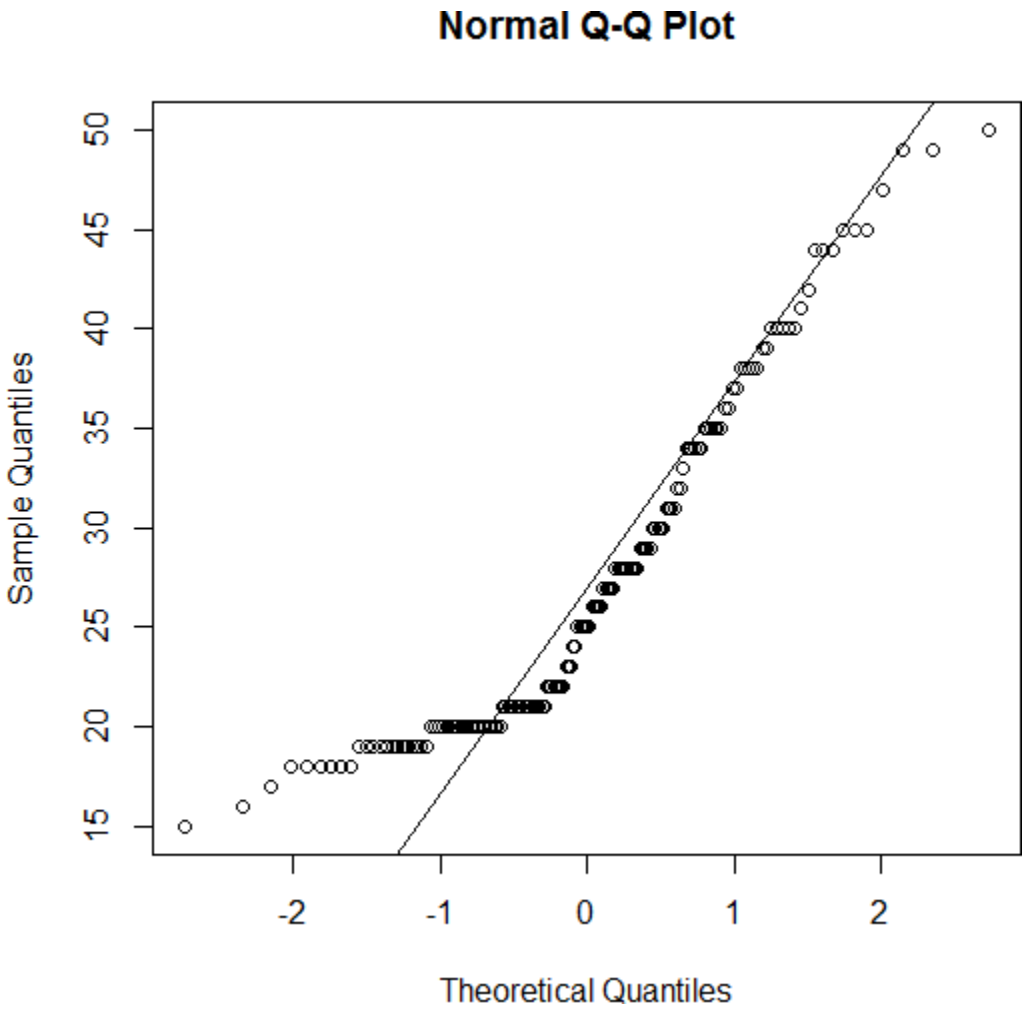
Average Cost spent on menstrual cup per female for **5years** is **Rs 433**

Average Cost spent on menstrual cup per female **per month** is **Rs 7.22**

Therefore, Menstrual Cups are too cost effective

Also, it was necessary to check whether willingness to switch from sanitary napkins to menstrual cups depend on occupation or age. Hence chi-square test was performed.

Before performing Chi-Square test, normality was checked using Q-Q plot.



As all points appear to lie on a straight line, we may assume that the sample comes from normally distributed population

Chi-Square Tests

To test:

Ho: Women's Occupation and Willingness to Switch are independent

H1: Women's Occupation and Willingness to Switch are dependent

	Housewife	Working lady	Student
Willing	19 (44%)	14 (45%)	31 (48%)
Not Willing	24 (56%)	17 (55%)	33 (52%)

Using Chi-Square test,

Chi-square(calc)= 5.2052

Chi-square(2,0.05)=5.991

Decision: Since chi-square(calc)< chi-square(2,0.05), we accept Ho.

Therefore, at 5% level of significance, Women's Occupation and Willingness to Switch are independent.

To test:

Ho: Women's Age and Willingness to Switch are independent

H1: Women's Age and Willingness to switch are dependent.

Age group ⟶	15-21	22-35	36 and above
Willing	23 (45%)	37 (60%)	4 (16%)
Not willing	28 (55%)	25 (40%)	21 (84%)

After performing Chi-square test,

Chi-square(calc)= 13.720

Chi-square(2,0.05)=5.991

Decision: Since chi-square(calc)> chi-square(2,0.05), we reject Ho.

Therefore,At 5% level of significance, Age and willingness to switch are dependent.

Now, we want to know what are the significant reasons (factors) behind willingness and non-willingness to switch.

So, we perform **Factorial Analysis.** As our data follows normality we can carry out factorial experiment.

2^3 Factorial Experiment was performed to check if there are some significant reasons due to which women switch/do not switch to menstrual cups.

REASONS FOR SWITCHING TO MENSTRUAL CUPS

A- Hygiene

B-Cost effectiveness

C-Eco friendly

(None of the above reasons means absence of all the above factors)

MODEL

Y_{ijkl}= No of women willing to switch to menstrual cup due to ith factor of A ,jth factor of B, kth factor of C.

$$\mathbf{Y_{ijkl}= \mu+ \alpha_i+ \beta_j+ (\alpha\beta)_{ij} + \gamma_k + (\beta\gamma)_{jk} + (\alpha\gamma)_{ik}+ (\alpha\beta\gamma)_{ijk} +\theta_l +\varepsilon_{ijkl}}$$

where

μ = General effect

α_i , β_j ,γ_k = Main effects of A , B , C respectively

$(\alpha\beta)_{ij}$, $(\beta\gamma)_{jk}$,$(\alpha\gamma)_{ik}$ = Interaction effects of AB ,BC ,AC respectively

$(\alpha\beta\gamma)_{ijk}$ = ijk 'th interaction of factor ABC

θ_l = effect due to l'th block (i , j , k =1,2)

ε_{ijkl}= error component (l =1,2,3 ; r=3)

HYPOTHESES

H_{01}: Allmain and interaction effects are not significant.

H_{11}: All main and interaction effects are significant.

H_{02}: Block means are same.

H_{12}: Not all block means are same

	BLOCK 1 (STUDENT)	BLOCK 2 (HOUSEWIFE)	BLOCK 3 (WORKING)	Total
1	1	1	1	3
a	6	1	1	8
b	2	2	1	5
ab	2	8	5	15
c	4	2	3	9
ac	6	1	1	8
bc	3	2	1	6
abc	7	2	1	10
	31	19	14	**64**

YATES TABLE

	SUM	**I**	**II**	**III**	**SS= III^2 / 8r**
1	3	11	31	64	170.66667
a	8	20	33	18	13.2
b	5	17	15	8	2.66667
ab	15	16	3	10	4.166667
c	9	5	9	2	0.16667
ac	8	10	-1	-12	6
bc	6	-1	5	-10	4.16667
abc	10	4	5	0	0

Total SS= 107.3333

Block SS= 19.0833

Error SS= 57.883

ANOVA TABLE

Source	**df**	**SS**	**MSS**	**Fcalculated**	**Fcritical 5% 1%**	**Decision**

Block	2	19.0833	9.54165	2.307	3.74	6.5	Accept H_{01} H_{02}
A	1	13.2	13.2	3.19264	4.6	8.86	
B	1	2.6667	2.6667	0.6448			
AB	1	4.16667	4.16667	1.00778			
C	1	0.16667	0.16667	0.0403			
AC	1	6	6	1.45			
BC	1	4.16667	4.16667	1.0078			
ABC	1	0	0	0			
Error	14	57.88329	4.1345				
Total	23	107.333					

Since we accept H_{01} and H_{02} it means the reasons selected by females are not significant. Also, all block means are same i.e. all the females, though they have varied occupation, their approach towards switching is same. Above factors or their interaction effect are not significant.

REASONS FOR NOT SWITCHING TO MENSTRUAL CUPS

A- Not easy to use

B-Uncomfortable

C-Not easily available in the market

MODEL

Y_{ijkl}= No of women not willing to switch to menstrual cup due to ith factor of A ,jth factor of B, kth factor of C.

$$\mathbf{Y_{ijkl}= \mu+ \alpha_i+ \beta_j+ (\alpha\beta)_{ij} + \gamma_k + (\beta\gamma)_{jk} + (\alpha\gamma)_{ik}+ (\alpha\beta\gamma)_{ijk} +\theta_l +\varepsilon_{ijkl}}$$

where

μ = General effect

α_i , β_j ,γ_k = Main effects of A , B , C respectively

$(\alpha\beta)_{ij}$, $(\beta\gamma)_{jk}$,$(\alpha\gamma)_{ik}$ = Interaction effects of AB ,BC ,AC respectively

$(\alpha\beta\gamma)_{ijk}$ = ijk 'th interaction of factor ABC

θ_l = effect due to l'th block (i , j , k =1,2)

ε_{ijkl}= error component (l =1,2,3 ; r=3)

HYPOTHESES

H_{01}: Allmain and interaction effects are not significant.

H_{11}: All main and interaction effects are significant.

H_{02}: Block means are same.

H_{12}: Not all block means are same

	BLOCK 1 (STUDENT)	BLOCK 2 (HOUSEWIFE)	BLOCK 3 (WORKING)	Total
1	8	1	2	11
a	5	7	5	17
b	14	4	4	22
ab	2	2	1	5
c	2	1	2	5
ac	1	6	1	8
bc	1	1	1	3
abc	1	1	1	3
	34	23	17	**74**

YATES TABLE

	SUM	**I**	**II**	**III**	**SS= III^2 / 8r**
1	11	28	55	74	228.16667
a	17	27	19	-8	2.66667
b	22	13	-11	-8	2.66667
ab	5	6	3	-26	28.166667
c	5	6	-1	-36	54
ac	8	-17	-7	14	8.16667
bc	3	3	-23	-6	1.5
abc	3	0	-3	20	16.6667

Total SS= 229.8333

Block SS= 18.5833

Error SS= 97.4163

ANOVA TABLE

Source	df	SS	MSS	Fcalculated	Fcritical 5% 1%	Decision
Block	2	18.5833	9.29165	1.3354	3.74 6.5	Accept H_{02}
A	1	2.66667	2.66667	0.3833		Accept H_0
B	1	2.66667	2.66667	0.3833		Accept H_0
AB	1	28.166667	28.166667	4.0481		Accept H_0
C	1	54	54	7.76	4.6 8.86	**Reject H_0 at 5%**
AC	1	8.16667	8.16667	1.1737		Accept H_0
BC	1	1.5	1.5	0.21558		Accept H_0
ABC	1	16.6667	16.6667	2.39533		Accept H_0
Error	14	97.4163	6.958			
Total	23					

We accept **H_{02}. All Block means are same.**All the females, though they have varied occupation, their approach towards non switching is same. Also we accept all H_{01} except for factor C. i.e. Not easily available in the market affects significantly for not switching towards menstrual cup. All other factors and their interaction effect do not have significant effect.

STATISTICAL INTERPRETATIONS:

1. After performing simple proportion, it was observed that 86.43% of females in Pune prefer Sanitary Napkins. Also, it was confirmed that the proportion of females using sanitary napkins have increased. Therefore, our sample is good representation of population as with population growth, menstruating females are increasing and use of sanitary napkins is also increasing.
2. Plastic waste produced due to use of sanitary napkins by 138 females in Pune is **305.118Kg in** span of 5 years. Decomposition of this waste needs 500-800 years .This waste is produced just by 138 females. Population of menstruating female in Pune is huge. Hence, if proper care is not taken this will create a great havoc for environment
3. After proper awareness about menstrual cups out of 138 females,64 females were ready to switch from sanitary napkins to Menstrual Cups. i.e. 46.38% of females are ready to switch. This will reduce sanitary napkin waste from**305.118kg to 163.614kg**Industries have huge scope for production of menstrual cups as 42.98% females are ready to switch.
4. At 5% level of significance, willingness to switch towards menstrual cup is independent of occupation. Therefore, if each female whether she is student, housewife or working lady is made aware of menstrual cups, she will switch toward menstrual cup. Hence, industries can sell their menstrual cups to any female regardless of her occupation
5. At 5% level of significance, willingness to switch depends upon age. Therefore, this shows that as per age guidance should be provided. Mentality and way of thinking depends upon age. Industries should approach in varied manner to convince female with different age groups.
6. Also, by factorial expt. it is observed females with different varied occupation have same mentality about to switch or not to switch. Also, reasons stated in this project in favour of switching don't have any significant effect. Menstrual Cups are not easily available in market is one of the reasons which have significant effect on females for not switching. This shows that there is large scope for industries to make menstrual cups available in local market.

CONCLUSION:

1. Most of the females in Pune are aware about sanitary napkins and prefer using that. Though Pune is an urban area, female don't have proper knowledge about menstrual waste and menstrual product. Females are ready to change their habits if proper knowledge is provided. Therefore, government and industries should primarily focus on educating females about menstruation. Comfort should be provided in society to females, so that they can freely talk about it.
2. As majority of females are using sanitary napkins, lot of non- biodegradable waste is produced which is harmful for environment. As this waste needs lot of time to decompose lot of landfills are filled of sanitary napkins and this pollute soil. Also, sometimes Sanitary Napkins are thrown away in lakes, rivers which contaminates water and harm aquatic life. When females came to know that sanitary napkins are non- biodegradable and harmful for environment due to plastic content in it and menstrual cups can be used as long for average of 5 years without creating waste and harming environment, 46.38% females were ready to change their habits for environment.
3. After awareness females are ready to switch toward menstrual cup. This provides an approach for industries to start production of Menstrual Cups. Industries influences the market and people preferences. Therefore, industries have scope for growth and to contribute to reduce menstrual waste due to sanitary napkins by reducing its production.
4. By using same methodology this project can be used for Indian population.

LIMITATIONS AND SCOPE:

LIMITATIONS

Menstruation is a sensitive topic to talk about . A lot of females are not comfortable to talk about it hence collection of data is difficult.

We have collected data by individually interacting with the females and providing them information about menstrual cup . Due to time and manpower constraints, we restricted our survey to females in Pune. Although the sample size was significant ,considering our factors under study, a larger sample size would have been preferable.

SCOPE

Our analysis can be generalised for females all over India.

Industries or start ups which wish to launch menstrual cups in the market can study such analysis to understand the opinions of various females.

This concept of menstrual cups should be brought in and made available easily in the market so that females can be accessible to it to stop the increasing menstrual waste crisis.

Considering the large population of menstruating females, this topic is of great importance in our country.

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