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OPTIMAL PARAMETER SELECTION FOR WOMEN SAFETY ANALYSIS

Priyanka Kohli[#1*], Kawaljeet Singh[#2], Brahmaleen K. Sidhu[#3]
[1]Research Scholar, Department of CSE, Punjabi University, Patiala
priyankagupta.pup@gmail.com
ORCID - 0000-0002-2090-5806
[2]Director, University Computer Centre, Punjabi University, Patiala
singhkawaljeet@rediffmail.com
ORCID - 0000-0002-5314-0301
[3]Assistant Professor, Department of CSE, Punjabi University, Patiala
brahmaleen.sidhu@gmail.com
ORCID - 0000-0001-6519-7957
*Corresponding Author - **Priyanka Kohli**

Abstract:
In today's world, women's safety is a significant and crucial problem. Even in these modern times, where technology has improved considerably, women's safety remains a worry. Incidences of rape, stalking, taunting, sexual assault, molestation, harassment, domestic abuse and other forms of violence are progressing daily. Many rules and regulations have been enacted to prevent these heinous acts. Despite this, the rate of crime is rapidly increasing. The Government has developed a number of devices and applications; however they do not make use of advanced technologies like Machine Learning, Data Science etc. The paper highlights various research papers in the context of women safety, women awareness and machine learning process. Machine learning has the power to predict and analyze the data in an effective and efficient way. As the quality of data plays a vital role during the analysis, so data preparation is a crucial step of machine learning process because the raw data may be noisy, incomplete or inconsistent. The collected data from women respondents is prepared and pre-processed to transform the raw data into a structured and understandable format. Lastly, the data is analyzed using principal component analysis, KMO and Bartlett's Test to predict the important and correlated parameters that influence the women safety.

Keywords: ***Women Safety; Machine Learning; Data Analysis; Principal Component Analysis; Women Empowerment; Violence against women; KMO and Bartlett's Test;***

1. INTRODUCTION

Women's safety is a vital and key issue in today's world. Even women are granted equal rights with men; still a lot of troubles are faced by them. They are not safe anywhere. They are facing problems like molestation, domestic violence, rape, harassment, robbery and sexual assault in untimed situations. Today, social media is very popular in connecting people but there are so many drawbacks. The boys who are not harassing girls physical, they found another of stalking / following via online. They torture them by creating fake profiles and blackmail girls to do friendship and build relations. Major violence faced by women is as follows: -

1. Harassment

Sexual harassment is a significant topic in the current situation. The number of women coming into society is increasing is increasing due to the openings of doors of different service areas. But many a time's women feel uncomfortable and unsafe at workplace because of harassing attitudes of male colleagues or from seniors. These conditions not only influence their work performance but also in their mental health. Incidents such as obscene/dirty/pornographic images, touching, tickling, wicked gestures, lust full stares, stalking are humiliating or degrading for any women.

2. Travelling

Working women face harassments while travelling. Men's lust full staring and unwanted touching on their private body parts makes women weaker to stay at home. Unwanted sexual behaviours of male leave a deep blow to the hearts of women. They experienced negative impacts on their emotional & mental health and got frightened for the whole life.

3. Freedom of Movement

Freedom of movement is a human right but for society its actual meaning is for men's right only. Women are still unable to move freely at any time and place with their own choice. In many houses women are restricted to visit their parental home or needs to take permission. Spending time on vacation at parental home sometimes becomes a challenge for the women.

4. Decision Making

Women have no choice from the birth to take any decision of their own. She has to ask her parents / husband / family for any decision. In today's world also many parents don't ask their daughter to take decision on choosing her life partner. She earns but she is unable to spend her own money by her choice. Speaking against injustice is quite impossible for women because from the beginning of life everybody prepares girl to bear the pain of other's decisions. If she speaks against crime then it counts as disrespect of her family in the society.

5. Gender Inequality

In a family perceptions and treatment for male and female is unequal. The inequality starts from the homes where lifestyle, education etc. is preference for males. Parents and relatives show discrimination at the time of spouse selection. Society still considers that male runs the home so their earnings are more important than women. Women job is not important because their main responsibility is to take care of their home and children.

6. Workplace Facilities

The workplace is the place where people spend most of the time. So the employer needs to ensure necessary facilities for every employee. The facilities like clean washrooms, safe drinking water, hygienic meals & disposal facility must provide especially for women. Maternity benefits, first aid and medical facilities must be provided for expecting women.

7. Domestic Violence

Domestic violence includes physical, sexual, mental, emotional, psychological stress etc. Women / girls are facing violence just after their birth as their families realize they are unnecessary at home. They are living with many restrictions such as choice of education, choice of life partner, job etc. When women got humiliated in front of others, it makes them into psychological stress. Sometimes husbands sexually force their wives because they think they are their private property.

8. Analysis

Women, especially young women from big cities feel much insecure and unsafe in all kind of localities as comparative to rural and small town women. This is because urban areas women are mainly working and they face lot of troubles while travelling. The most difficult for single working women is that they have to survive everything alone and has to face much more bad experiences in the society.

9. Health Safety

Women's health is at higher risk than men. Psychological, emotional, sexual harassment, verbal abuse all contribute to bad effects on their health. Most of the women used to face work load stress due to their working hours and conditions and house hold work. They usually ignore their health because of time constraints and by not taking nutritious meals during work.

10. REVIEW OF LITERATURE

Violence such as stalking, sexual harassment or assault, snatching at public places has been experienced by lot of women and girls. The authors (Kumar and Aggarwal, 2019) focused on the role of social media in helping the safety of women. Tweets on twitter can contain text and images which focus on safety of women. Various machine learning algorithms has been applied to analyze the huge amount of twitter data (Chandra and Srinath, 2020). SPC algorithm, linear algebraic factor model and support vector machine models can also be applied for better results.

Women are promoted to equal status with man but violence and crime against them is also increasing daily. The authors analysed social media data that is made of various forms of violence and threats against women (Ramamoorthy and Poorvadevi, 2019). Feedback system was used to give a clear picture of the crime against women. The data will be helpful in decreasing the crime rate. The authors used sentiment analysis with machine learning technique and k-means clustering to classify the dataset. The model recommends various precautionary efforts to save women from violence and to alter them in difficult times.

The crime against women is expanding at a rapid rate but in Tamil Nadu the pattern is on the down trend (Lavanyaa and Akila, 2019). According to the Crime Record Bureau, the crime against women has been declining from the past 7 years. Data mining pre processing model has been applied against crime data. Various techniques like cleaning, classification, investigation had been applied on the information and predicted that there is a downside in crime like harassment, snatching, murder, gang assault against women.

The aim of the authors is to create a women safety index for measuring their safety in pilot cities and use it for comparative analysis (Kaur et al., 2019). Parameters like transport,

security and infrastructure to provide a standardised, quantitative and transparent measure for ranking all cities are analyzed by various statistical techniques. Normalization, aggregation, arithmetic mean and geometric mean have been used in creating women safety index. The results produced give some hints to assist policy makers, urban local bodies, Municipalities and local authorities to improve women safety in urban cities.

Women feel less secure and face lots of problems when they go outside. They are harassed all the time either from front or from the back. To overcome these problems authors (Ramya and Vimal, 2020) developed a smart portable device to keep track of victim's location. The device records the pulse all the time. When heartbeat increases the device will send a misery message to the contacts already fed. The device can also be helpful in measuring haemoglobin and stress level. It is a wearable device and maybe not easy to carry and may not be affordable by every women.

The authors stated that in reality violence against women in India is much more that it appears to us (Chakraborty et al., 2021). The paper was based on data published by National Crime Record Bureau from 2001-02 to 2014-15. The authors applied panel progression technique in identifying the factors that can control crime against women. Factors like economic growth, parental guidance and education can decrease the crime.

Crime against women is a major issue all over the world. Attempts have been made to prevent it but every year huge data is produced of different kinds of crime in different parts of the world (Prasad et al., 2021). Analyzing these datasets can identify major crime patterns and their time of occurrences. The authors used Huber regression to analyse the dataset and time series algorithm to visualize it.

As the crime against women is increasing daily, women safety issue must be the topmost priority of any Government. Nowadays people are using smart phone effectively. An app was developed that can send the message to the registered contact (Bhagwat et al., 2021). An application also keeps the user location when clicked. Crime pattern and important hidden relations can be analyzed from crime data.

The paper is based on the big data technology (Li, 2021). It established the application platform based on visualization for improving the intelligence level of University's safety management. The system was tested and the results show that the response time of the system is very good. It recognizes the digitalization and mobility of campus security management to progress campus security and offers a data basis for the decision-making of smart campus.

11. FEATURE ENGINEERING

There are set of observed variables in the dataset and correlation may also exist within them. In order to view interdependence among these variables, feature engineering has been applied. It explains the pattern of correlations within a set of observed variables. It is generally used in data reduction and classifies only those variables that explain similar variance.

Factor analysis picks only those variables having correlation between them and finds the best possible solution. Variables are the factors or features on which questionnaire is framed shown in Appendix-A. Only mild multicollinearity (i.e. very high correlated variables) factors are used during factor analysis as extreme multicollinearity and singularity (i.e. perfectly correlated variables) do not yield good results.

The questionnaire was designed specifically to gather the data from the women respondents. A preliminary study is conducted among the small sample to validate the framed questionnaire. The responses were analyzed using various techniques like Cronbach Alpha, KMO (Kaiser-Meyer-Olkin) and Bartlett's Test, mean and Standard deviation. The thrust of the results obtained in the study are based on the responses gathered according to the parameters of women safety in different situations.

12. OBJECTIVE AND SCOPE OF STUDY

The objectives of the study are as follows: -

- To investigate women expectations and preferences according to their safety and awareness on the basis of data collected from women respondents.
- To analyze and list the factors that helps to improve women safety and awareness.

13. RESEARCH METHODOLOGY

In the current scenario, women are facing problems like - rape, harassment, teasing, sexual assault, molestation, domestic violence etc. Many rules and regulations have been enacted to prevent these heinous acts. Despite this, the rate of crime is rapidly increasing. The Government has developed a number of devices and applications; however they do not make use of advanced technologies like Machine Learning, Data Science etc. Analysis of women at various regions is done to study women's perception and expectations. In order to gather the data, women were assessed according to the framed questionnaire-cum-interview process.

Following steps of Machine Learning are observed to find most relevant and suitable factors for women safety: -

- **Data Gathering:** Gather the data according to different women safety parameters.
- **Data Preparation:** It is the crucial step as the raw data may be noisy, incomplete or inconsistent. Data is pre-processed to transform the raw data into a structured and understandable format. Well-prepared data can improve the efficiency, reduce the blind spots and increase the accuracy of predictions.
- **Data Analysis:** Model needs to be selected according to the data. Data is analyzed using principal component analysis (PCA), KMO and Bartlett's Test to predict the important and correlated parameters that influence the women safety.
- **Inference:** The results obtained are analysed and important features / factors are listed that effect women safety.

14. ANALYSIS & FINDINGS

The data has been collected from the women respondents in order to analyze their perception regarding women safety. The analysis of data and findings are discussed below: -

15. Data Gathering

Data is gathered according to the questionnaire framed as shown in Appendix-A from women respondents. Likert scale (values 1 to 5) is used for recording the response of each

parameter. In the Table 6-1 various dimensions are shown that are surveyed during the data collection. As it is not possible to gather information of every individual, data from 350 women respondents was collected to analyze the problem.

Table 6-1 Dimensions surveyed

S. No.	Dimension	Abbreviation
Decision Making		
1.	Choice of your life partner	DM_CLP
2.	Control / Power over own earning	DM_CPE
3.	Spending money in your own way	DM_SMW
4.	Participation in use of spouse's earnings	DM_PSE
5.	Visit's to her family and relatives	DM_VFR
6.	Family planning / Family size	DM_FPS
7.	Family related matters	DM_FRM
8.	Speaking against injustice	DM_SAI
Freedom of Movement		
9.	Attending ceremonies of friends and relatives	FM_CFR
10.	Visiting health care centres for treatment	FM_HCC
11.	Participating in the community activities	FM_PCA
12.	Visiting local market alone	FM_VLM
13.	Spending time / vacation at parental home	FM_VPH
Domestic Violence		
14.	Humiliated in front of others	DV_HFO
15.	Threatened to harm	DV_THH
16.	Controlling for wealth expenditure	DV_CWE
17.	Physically forced	DV_PHF
18.	Psychological Stress	DV_PYS
19.	Emotional Violence	DV_EMV
20.	Not allowing for education and job	DV_NEJ
21.	Misbehaving / Hurting	DV_MBH
Dowry Reasons / Effects		
22.	Female foeticide	D_FF
23.	Delay of marriage	D_DoM
24.	Bride Burning / Committed Suicide	D_BBCS
25.	Interest of bride's parents	D_IBP
26.	Social prestige	D_SP
27.	Pressure of old traditions	D_POT
28.	Greed expectation	D_GE
Your feeling against Harassment		
29.	Unwanted touching	H_UT
30.	Sexual assault / Rape	H_SAR
31.	Verbal abuse / Comments	H_VAC

32.	Wicked gestures	H_WG
33.	Sinful messages on social media	H_SMSM
34.	Stalking / Following - Physically / Online	H_SF
35.	Lust full stare	H_LFS
36.	Obscene / Dirty / Pornographic images at work place	H_DPIW
Action taken after Harassment		
37.	Kept quite / feared retaliation from harasser	ATAH_KQF
38.	Communicate to family / friend / colleague	ATAH_CFFC
39.	Reported to police	ATAH_RP
40.	Reported to concerned authority	ATAH_RCA
Reasons for not taking action after Harassment		
41.	Trust it's her personal matter	RNTAAH_TPM
42.	Fear of Revenge	RNTAAH_FR
43.	Not significant enough to report	RNTAAH_NSR
44.	No desire to expose the culprit	RNTAAH_NEC
45.	Police cannot help successfully	RNTAAH_PHS
46.	Embarrass to answer others	RNTAAH_EAO
47.	Thinking of self-fault	RNTAAH_TSF
Awareness of Women Legal Rights		
48.	Marriage, Family and Property	AWLR_MFP
49.	Maternity and Child Care Leave	AWLR_MCCL
50.	Complaint Against Violence	AWLR_CAV
51.	Pregnancy and Abortion	AWLR_PA
52.	Education at any age	AWLR_EA
53.	Criminal Procedures (FIR/Bail/Arrest)	AWLR_CP
54.	Divorce and Maintenance	AWLR_DM
55.	Infanticide and feticide	AWLR_IF
56.	Dowry Tortures and Death	AWLR_DTD
Health Safety		
57.	Abortion for son preference	HS_ASP
58.	Rapid ultrasounds test for diagnostic purpose	HS _RUD
59.	Timely Vaccination	HS _TV
60.	Nutritious meals during work	HS _NMDW
61.	Unwanted and frequent pregnancy	HS _UFP
Gender Inequality		
62.	Equal Job opportunities and Salaries	GI_EJOS
63.	Spouse selection	GI_SS
64.	Choice of Education	GI_CE
65.	Life Style	GI_LS
66.	Safe mobility	GI_SM
Work Place Facilities		
67.	Insurance by the employer	WPF_IE

68.	Safe drinking water and food quality	WPF_SDWFQ
69.	First aid and medical facilities	WPF_MF
70.	Assure safe travel for work	WPF_ST
71.	Women harassment cell	WPF_WHC
72.	Maternity benefits	WPF_MB
73.	Old age and retirement benefits	WPF_ORB

16. Data Preparation

As the gathered data (raw data) may be noisy, missing or inconsistent. So it is prepared and transformed into a structured and understandable format. There are many methods like mean, median, mode, linear regression, interpolation, etc. to handle the missing values. As our data is based on Likert scale, mean method is used to replace the missing values. For filling the missing values in a parameter, IBM SPSS statistics21 has been used as shown in following figures.

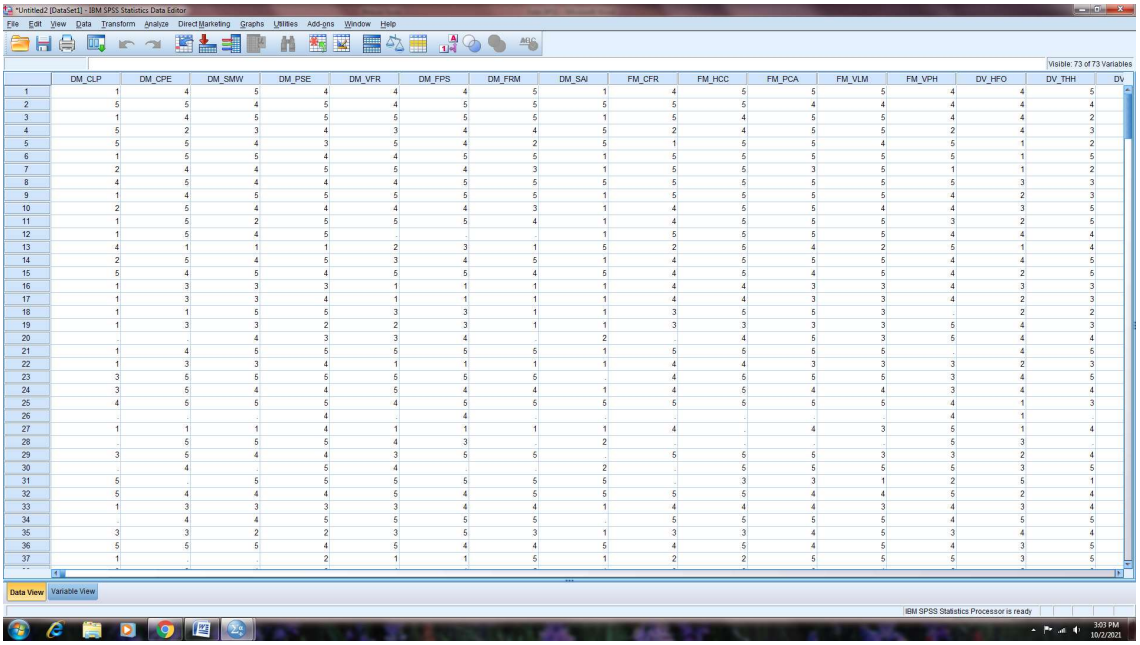

Figure 6-1 Data Set

In the Transform Menu, click Replace Missing Values

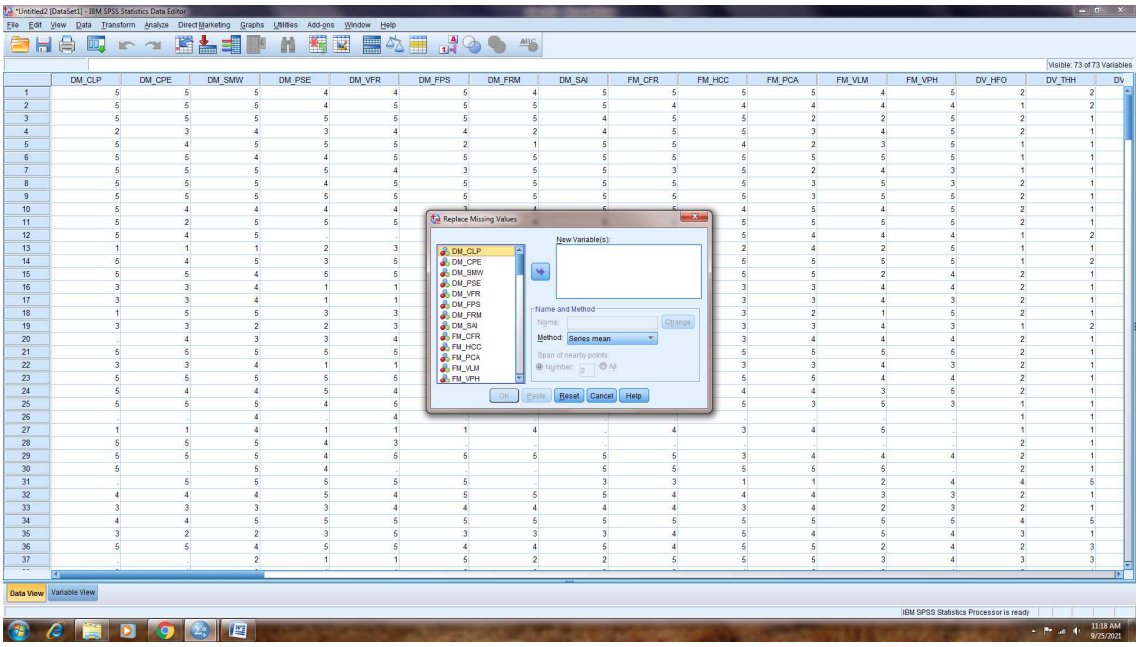

Figure 6-2 Replace missing values

Select Series mean method. Then Select all the variables from the left pane, click the arrow. You will see that all the variables are now in right pane.

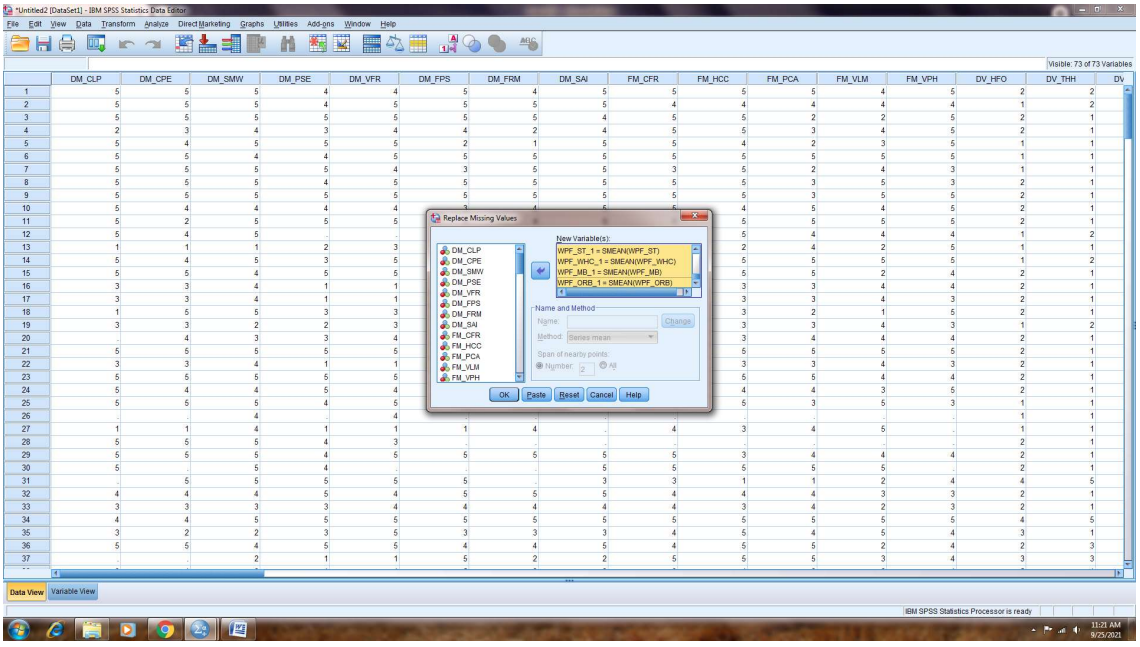

Figure 6-3 Selecting series mean methos

Click ok. The Data view will contain all the old 73 variables and new 73 variables (named as old names concatenated with "_1)

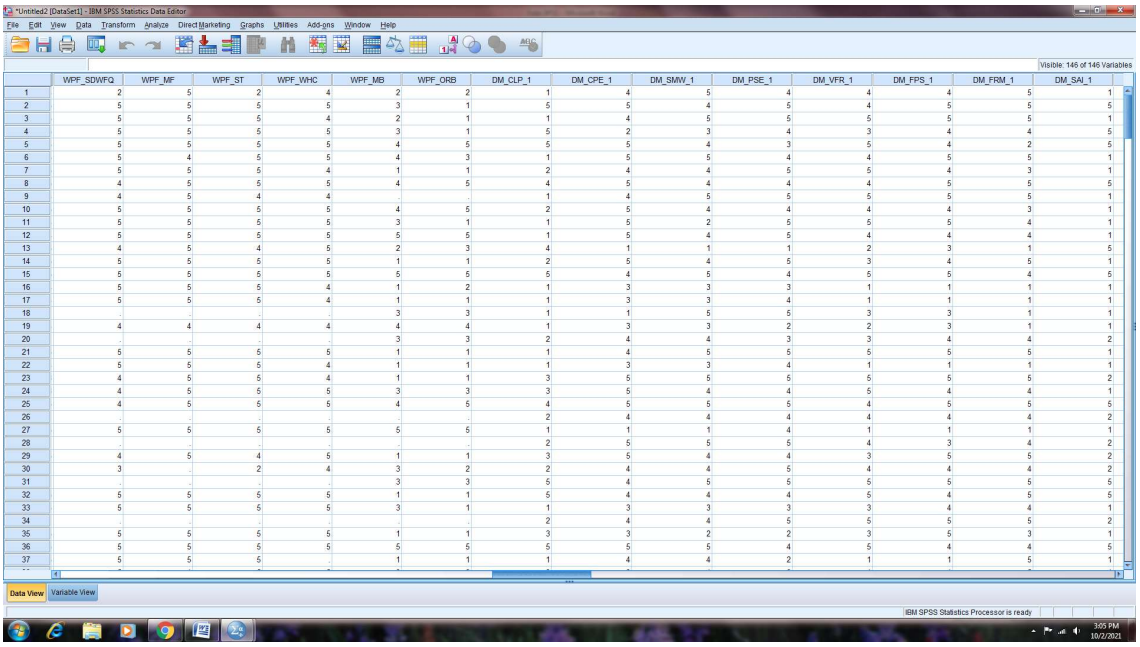

Figure 6-4 Data Set with old and new variables

The following table will appear showing result variable, number of missing values in corresponding column, case number of first and last non-missing values, Number of valid cases and lastly function used to replace missing values i.e. SMEAN means series mean as selected.

Table 6-2 Result Variables

	Result Variable	N of Replaced Missing Values	Case Number of Non-Missing Values		N of Valid Cases	Creating Function
			First	Last		
1	DM_CLP_1	43	1	350	350	SMEAN(DM_CLP)
2	DM_CPE_1	21	1	350	350	SMEAN(DM_CPE)
3	DM_SMW_1	18	1	350	350	SMEAN(DM_SMW)
4	DM_PSE_1	12	1	350	350	SMEAN(DM_PSE)
5	DM_VFR_1	25	1	350	350	SMEAN(DM_VFR)
6	DM_FPS_1	20	1	350	350	SMEAN(DM_FPS)
7	DM_FRM_1	26	1	350	350	SMEAN(DM_FRM)
8	DM_SAI_1	47	1	350	350	SMEAN(DM_SAI)
9	FM_CFR_1	25	1	350	350	SMEAN(FM_CFR)
10	FM_HCC_1	21	1	350	350	SMEAN(FM_HCC)
11	FM_PCA_1	8	1	350	350	SMEAN(FM_PCA)
12	FM_VLM_1	9	1	350	350	SMEAN(FM_VLM)
13	FM_VPH_1	16	1	350	350	SMEAN(FM_VPH)
14	DV_HFO_1	0	1	350	350	SMEAN(DV_HFO)
15	DV_THH_1	12	1	350	350	SMEAN(DV_THH)
16	DV_CWE_1	10	1	350	350	SMEAN(DV_CWE)

17	DV_PHF_1	3	1	350	350	SMEAN(DV_PHF)
18	DV_PYS_1	0	1	350	350	SMEAN(DV_PYS)
19	DV_EMV_1	20	1	350	350	SMEAN(DV_EMV)
20	DV_NEJ_1	3	1	350	350	SMEAN(DV_NEJ)
21	DV_MBH_1	1	1	350	350	SMEAN(DV_MBH)
22	D_FF_1	5	1	350	350	SMEAN(D_FF)
23	D_DoM_1	26	1	350	350	SMEAN(D_DoM)
24	D_BBCS_1	27	1	350	350	SMEAN(D_BBCS)
25	D_IBP_1	34	1	350	350	SMEAN(D_IBP)
26	D_SP_1	3	1	350	350	SMEAN(D_SP)
27	D_POT_1	37	1	350	350	SMEAN(D_POT)
28	D_GE_1	26	1	350	350	SMEAN(D_GE)
29	H_UT_1	29	1	350	350	SMEAN(H_UT)
30	H_SAR_1	27	1	350	350	SMEAN(H_SAR)
31	H_VAC_1	37	1	350	350	SMEAN(H_VAC)
32	H_WG_1	2	1	350	350	SMEAN(H_WG)
33	H_SMSM_1	31	1	350	350	SMEAN(H_SMSM)
34	H_SF_1	36	1	350	350	SMEAN(H_SF)
35	H_LFS_1	37	1	350	350	SMEAN(H_LFS)
36	H_DPIW_1	16	1	350	350	SMEAN(H_DPIW)
37	ATAH_KQF_1	38	1	350	350	SMEAN(ATAH_KQF)
38	ATAH_CFFC_1	28	1	350	350	SMEAN(ATAH_CFFC)
39	ATAH_RP_1	35	1	350	350	SMEAN(ATAH_RP)
40	ATAH_RCA_1	36	1	350	350	SMEAN(ATAH_RCA)
41	RNTAAH_TPM_1	39	1	350	350	SMEAN(RNTAAH_TPM)
42	RNTAAH_FR_1	36	1	350	350	SMEAN(RNTAAH_FR)
43	RNTAAH_NSR_1	23	1	350	350	SMEAN(RNTAAH_NSR)
44	RNTAAH_NEC_1	17	1	350	350	SMEAN(RNTAAH_NEC)
45	RNTAAH_PHS_1	23	1	350	350	SMEAN(RNTAAH_PHS)
46	RNTAAH_EAO_1	18	1	350	350	SMEAN(RNTAAH_EAO)
47	RNTAAH_TSF_1	21	1	350	350	SMEAN(RNTAAH_TSF)
48	AWLR_MFP_1	31	1	350	350	SMEAN(AWLR_MFP)
49	AWLR_MCCL_1	28	1	350	350	SMEAN(AWLR_MCCL)
50	AWLR_CAV_1	28	1	350	350	SMEAN(AWLR_CAV)

51	AWLR_PA_1	31	1	350	350	SMEAN(AWLR_PA)
52	AWLR_EA_1	28	1	350	350	SMEAN(AWLR_EA)
53	AWLR_CP_1	36	1	350	350	SMEAN(AWLR_CP)
54	AWLR_DM_1	39	1	350	350	SMEAN(AWLR_DM)
55	AWLR_IF_1	39	1	350	350	SMEAN(AWLR_IF)
56	AWLR_DTD_1	35	1	350	350	SMEAN(AWLR_DTD)
57	HS_ASP_1	32	1	350	350	SMEAN(HS_ASP)
58	HS_RUD_1	32	1	350	350	SMEAN(HS_RUD)
59	HS_TV_1	29	1	350	350	SMEAN(HS_TV)
60	HS_NMDW_1	33	1	350	350	SMEAN(HS_NMDW)
61	HS_UFP_1	35	1	350	350	SMEAN(HS_UFP)
62	GI_EJOS_1	27	1	350	350	SMEAN(GI_EJOS)
63	GI_SS_1	40	1	350	350	SMEAN(GI_SS)
64	GI_CE_1	37	1	350	350	SMEAN(GI_CE)
65	GI_LS_1	27	1	350	350	SMEAN(GI_LS)
66	GI_SM_1	36	1	350	350	SMEAN(GI_SM)
67	WPF_IE_1	35	1	350	350	SMEAN(WPF_IE)
68	WPF_SDWFQ_1	28	1	350	350	SMEAN(WPF_SDWFQ)
69	WPF_MF_1	38	1	350	350	SMEAN(WPF_MF)
70	WPF_ST_1	28	1	350	350	SMEAN(WPF_ST)
71	WPF_WHC_1	32	1	350	350	SMEAN(WPF_WHC)
72	WPF_MB_1	37	1	350	350	SMEAN(WPF_MB)
73	WPF_ORB_1	35	1	350	350	SMEAN(WPF_ORB)

Remove all the previous variables from the variable view and sheet will be shown as below.

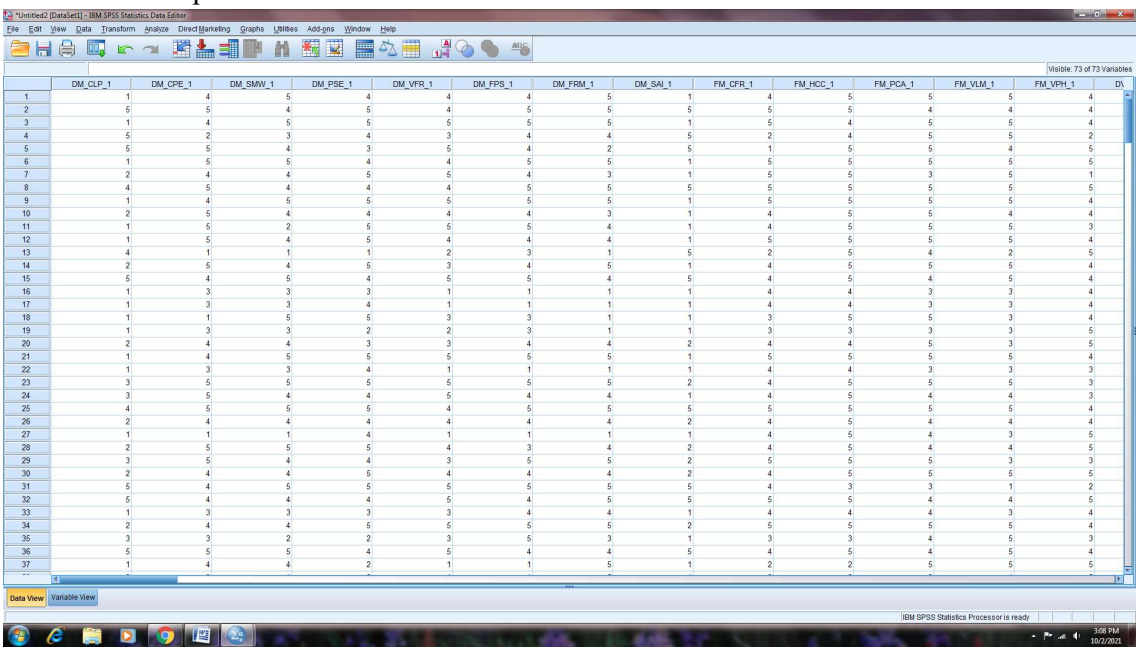

Figure 6-5 Data Set with replaced missing values

17. Cronbach's Alpha (α)

It is used to estimate the ratio of variance. It can range from 0.00 (if no variance is consistent) to 1.00 (if all variance is consistent). For example, if the value of Cronbach alpha for any data set comes to be 0.91, it means that the test is 91% reliable and 9% unreliable.

The range of its values that are good, acceptable or unacceptable are shown in following in Table 6-3

Table 6-3 Cronbach's Alpha Values

Cronbach's Alpha	Internal Consistency
α >= 0.9	Excellent
0.9 > α >= 0.8	Good
0.8 > α >= 0.7	Acceptable
0.7 > α >= 0.6	Questionable
0.6 > α >= 0.5	Poor
0.5 > α	Unacceptable

According to the responses, the value of Cronbach alpha came to be 0.897 as shown in Table 6-4, means internal consistency between the factors is good/excellent.

Table 6-4 Cronbach's Alpha

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
0.897	0.904	73

18. Data Analysis

19. Descriptive Statistics

Descriptive statistics of all the dimensions like mean, standard deviation is shown in the Table 6-5 below.

Table 6-5 Descriptive Statistics

	Mean	Std. Deviation
DM_CLP	2.26	1.361
DM_CPE	3.75	1.280
DM_SMW	3.89	1.145
DM_PSE	3.98	1.092
DM_VFR	3.52	1.403
DM_FPS	3.73	1.221
DM_FRM	3.68	1.460
DM_SAI	1.91	1.418
FM_CFR	3.86	1.054
FM_HCC	4.52	.757
FM_PCA	4.19	.871
FM_VLM	3.91	1.096

FM_VPH	3.85	1.157
DV_HFO	2.84	1.345
DV_THH	3.65	1.045
DV_CWE	3.61	1.164
DV_PHF	2.50	1.222
DV_PYS	2.89	1.123
DV_EMV	3.96	.964
DV_NEJ	2.15	.939
DV_MBH	2.30	1.120
D_FF	1.85	1.191
D_DoM	2.76	.960
D_BBCS	2.75	1.314
D_IBP	3.25	1.343
D_SP	2.16	1.514
D_POT	3.18	1.341
D_GE	3.28	1.493
H_UT	2.21	1.311
H_SAR	2.33	1.432
H_VAC	2.35	1.309
H_WG	1.40	1.091
H_SMSM	2.40	1.415
H_SF	1.99	1.432
H_LFS	1.85	1.102
H_DPIW	3.75	1.113
ATAH_KQF	2.71	1.256
ATAH_CFFC	3.31	1.385
ATAH_RP	2.34	1.464
ATAH_RCA	2.61	1.256
RNTAAH_TPM	2.49	1.452
RNTAAH_FR	2.34	1.373
RNTAAH_NSR	3.82	1.397
RNTAAH_NEC	3.84	1.235
RNTAAH_PHS	3.98	1.110
RNTAAH_EAO	4.12	.986
RNTAAH_TSF	3.67	1.294
AWLR_MFP	3.33	1.224
AWLR_MCCL	3.61	1.188
AWLR_CAV	3.61	1.188
AWLR_PA	3.79	1.190
AWLR_EA	4.11	1.053
AWLR_CP	4.50	.871
AWLR_DM	3.32	1.226

AWLR_IF	3.24	1.273
AWLR_DTD	3.48	1.245
HS_ASP	4.61	.713
HS_RUD	4.65	.562
HS_TV	1.78	1.292
HS_NMDW	2.39	1.328
HS_UFP	4.25	1.063
GI_EJOS	3.35	1.102
GI_SS	4.43	.866
GI_CE	4.59	.764
GI_LS	4.48	.847
GI_SM	4.40	1.012
WPF_IE	4.27	.850
WPF_SDWFQ	4.54	.698
WPF_MF	4.63	.690
WPF_ST	4.58	.703
WPF_WHC	4.56	.616
WPF_MB	2.60	1.248
WPF_ORB	2.24	1.387

20. KMO (Kaiser-Meyer-Olkin) and Bartlett's Test

The KMO and Bartlett's Test is used to measure the strength of the relationship among variables. The range of KMO is between 0 and 1. The value close to 0 represents that the sum of partial correlations is large comparative to sum of correlations, which signifies scattering in the pattern of correlations. Subsequently factor analysis is expected to be unsuitable. The value close to 1 depicts that patterns of correlation are moderately condensed and so factor analysis will produce diverse and consistent factors.

Kaiser suggested that values greater than 0.5 are acceptable, values between 0.5 and 0.7 are average, values between 0.7 and 0.8 are goof, values between 0.8 and 0.9 are great and values above 0.9 are outstanding.

Bartlett's test is used to measure null hypothesis and gives signal to the potency of relationships among variables. For factor analysis to be successful this test should be significant having value less than 0.05. KMO and Bartlett's Test are shown in Table 6-6. The value KMO is 0.837 that implies it is in great range and is appropriate for factor analysis. Bartlett's test is significant as its value is 0.000 which is less than 0.05.

Table 6-6 KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.837
Bartlett's Test of Sphericity	Approx. Chi-Square	26395.980
	Df	2628
	Sig.	.000

21. Factor Extraction

The eigenvalues with each linear component before extraction, after extraction and after rotation is listed in the Table 6-7. The eigenvalues associated with each component represents variance explained by that particular linear component and displays the eigenvalue in terms of the percentage of variance. It is clear that the large amount of variance is explained by first few components whereas rest of components explain only small amount of variance. Only 5 components are extracted as shown. In the next column, Extractions Sums of Squared Loadings, the values are the same as the values before extraction, except values for the discarded components are ignored. In the last column Rotation Sums of Squared Loadings, the eigenvalues of the components after rotation are displayed.

Table 6-7 Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	12.716	17.419	17.419	12.716	17.419	17.419	8.852	12.126	12.126
2	6.664	9.129	26.548	6.664	9.129	26.548	7.093	9.716	21.842
3	6.045	8.281	34.829	6.045	8.281	34.829	6.603	9.046	30.888
4	4.815	6.596	41.425	4.815	6.596	41.425	5.598	7.668	38.556
5	4.377	5.997	47.421	4.377	5.997	47.421	5.119	7.012	45.568
6	3.912	5.358	52.780	3.912	5.358	52.780	4.476	6.132	51.700
7	2.969	4.068	56.848	2.969	4.068	56.848	3.757	5.147	56.848
8	2.242	3.071	59.919						
9	1.807	2.475	62.394						
10	1.618	2.217	64.611						
11	1.557	2.133	66.744						
12	1.517	2.078	68.822						
13	1.360	1.862	70.685						

14	1.340	1.835	72.520						
15	1.238	1.695	74.215						
16	1.114	1.526	75.741						
17	1.074	1.471	77.211						
18	1.020	1.398	78.609						
19	.907	1.242	79.851						
20	.891	1.220	81.072						
21	.871	1.194	82.266						
22	.792	1.085	83.350						
23	.780	1.069	84.419						
24	.702	.961	85.380						
25	.690	.945	86.325						
26	.633	.867	87.192						
27	.631	.864	88.056						
28	.600	.822	88.878						
29	.506	.694	89.572						
30	.489	.670	90.242						
31	.462	.633	90.875						
32	.425	.582	91.457						
33	.404	.553	92.010						
34	.397	.544	92.554						
35	.374	.513	93.067						
36	.339	.465	93.532						
37	.337	.462	93.993						
38	.321	.440	94.433						
39	.308	.423	94.856						
40	.271	.371	95.227						
41	.258	.353	95.579						
42	.238	.326	95.905						
43	.225	.308	96.213						
44	.216	.296	96.509						
45	.207	.284	96.793						
46	.196	.268	97.061						

47	.186	.255	97.316						
48	.178	.244	97.561						
49	.173	.237	97.798						
50	.158	.217	98.015						
51	.136	.186	98.201						
52	.135	.185	98.385						
53	.126	.172	98.557						
54	.116	.159	98.716						
55	.104	.143	98.859						
56	.097	.133	98.993						
57	.092	.125	99.118						
58	.085	.116	99.234						
59	.083	.113	99.347						
60	.071	.098	99.445						
61	.063	.086	99.531						
62	.058	.079	99.611						
63	.048	.066	99.677						
64	.041	.056	99.732						
65	.035	.048	99.781						
66	.032	.044	99.825						
67	.028	.038	99.863						
68	.024	.033	99.895						
69	.022	.030	99.925						
70	.019	.026	99.952						
71	.016	.022	99.973						
72	.011	.015	99.988						
73	.008	.012	100.000						

Before rotation component 1, component 2, component 3, component 4, component 5, component 6 and component 7 contributes for 17.419%, 9.129%, 8.281%, 6.596%, 5.997%, 5.358% and 4.068% respectively, whereas after rotation the values of respective components is 8.852%, 7.093%, 6.603%, 5.598%, 5.119%, 4.476% and 3.757% respectively.

Communalities show the extent of the variance in the variables has been accounted for by the extracted factors. The value of communalities is listed below in the Table 6-8.

Table 6-8 Communalities

	Initial	Extraction
DM_CLP	1.000	.893
DM_CPE	1.000	.748
DM_SMW	1.000	.760
DM_PSE	1.000	.778
DM_VFR	1.000	.723

DM_FPS	1.000	.729
DM_FRM	1.000	.778
DM_SAI	1.000	.862
FM_CFR	1.000	.618
FM_HCC	1.000	.781
FM_PCA	1.000	.743
FM_VLM	1.000	.664
FM_VPH	1.000	.672
DV_HFO	1.000	.853
DV_THH	1.000	.739
DV_CWE	1.000	.692
DV_PHF	1.000	.767
DV_PYS	1.000	.867
DV_EMV	1.000	.803
DV_NEJ	1.000	.670
DV_MBH	1.000	.834
D_FF	1.000	.605
D_DoM	1.000	.814
D_BBCS	1.000	.838
D_IBP	1.000	.872
D_SP	1.000	.745
D_POT	1.000	.855
D_GE	1.000	.845
H_UT	1.000	.844
H_SAR	1.000	.884
H_VAC	1.000	.850
H_WG	1.000	.769
H_SMSM	1.000	.859
H_SF	1.000	.854
H_LFS	1.000	.607
H_DPIW	1.000	.558
ATAH_KQF	1.000	.739
ATAH_CFFC	1.000	.800
ATAH_RP	1.000	.864
ATAH_RCA	1.000	.759
RNTAAH_TPM	1.000	.876
RNTAAH_FR	1.000	.881
RNTAAH_NSR	1.000	.709
RNTAAH_NEC	1.000	.639
RNTAAH_PHS	1.000	.581
RNTAAH_EAO	1.000	.543
RNTAAH_TSF	1.000	.587
AWLR_MFP	1.000	.836

AWLR_MCCL	1.000	.849
AWLR_CAV	1.000	.744
AWLR_PA	1.000	.764
AWLR_EA	1.000	.832
AWLR_CP	1.000	.871
AWLR_DM	1.000	.815
AWLR_IF	1.000	.814
AWLR_DTD	1.000	.794
HS_ASP	1.000	.863
HS_RUD	1.000	.880
HS_TV	1.000	.737
HS_NMDW	1.000	.776
HS_UFP	1.000	.694
GI_EJOS	1.000	.728
GI_SS	1.000	.813
GI_CE	1.000	.772
GI_LS	1.000	.838
GI_SM	1.000	.856
WPF_IE	1.000	.726
WPF_SDWFQ	1.000	.885
WPF_MF	1.000	.808
WPF_ST	1.000	.835
WPF_WHC	1.000	.762
WPF_MB	1.000	.774
WPF_ORB	1.000	.857

The component matrix contains the loading of each variable onto each factor. The Table 6-9 shows the component matrix before rotation. In the given table loadings less than 0.5 are suppressed and as a result almost 50% factors are suppressed.

Table 6-9 Component Matrix

	Component						
	1	2	3	4	5	6	7
DM_CLP							
DM_CPE							
DM_SMW							
DM_PSE			.562				
DM_VFR			.531				
DM_FPS							
DM_FRM							
DM_SAI	.527						
FM_CFR	.527						
FM_HCC							

FM_PCA							
FM_VLM							
FM_VPH							
DV_HFO							
DV_THH						.501	
DV_CWE				.538		.511	
DV_PHF						.529	
DV_PYS				.653			
DV_EMV				.664		.549	
DV_NEJ							
DV_MBH				.693			
D_FF					.677		
D_DoM							
D_BBCS					.624		
D_IBP					.525		
D_SP					.585		
D_POT					.593		
D_GE					.575		
H_UT	.513	.672					
H_SAR	.550	.684					
H_VAC		.655					
H_WG	.537	.633					
H_SMSM	.526	.662					
H_SF	.532	.674					
H_LFS	.530	.676					
H_DPIW	.501	.649					
ATAH_KQF							
ATAH_CFFC							
ATAH_RP							
ATAH_RCA							
RNTAAH_TPM							
RNTAAH_FR							
RNTAAH_NSR							
RNTAAH_NEC							.525
RNTAAH_PHS							
RNTAAH_EAO							
RNTAAH_TSF							
AWLR_MFP	.553						
AWLR_MCCL	.599						
AWLR_CAV	.567						
AWLR_PA	.719						
AWLR_EA	.576						
AWLR_CP	.634						

AWLR_DM	.550						
AWLR_IF	.617						
AWLR_DTD	.616						
HS_ASP							
HS_RUD							-.505
HS_TV							
HS_NMDW							
HS_UFP	.550						
GI_EJOS	.683						
GI_SS	.643		-.505				
GI_CE	.673						
GI_LS	.736						
GI_SM	.732						
WPF_IE	.573						
WPF_SDWFQ	.585		-.514				
WPF_MF	.615						

The scree plot indicates the point of inflexion on the curve as shown in Appendix-B. The graph is useful in determining the number of factors to be retained.

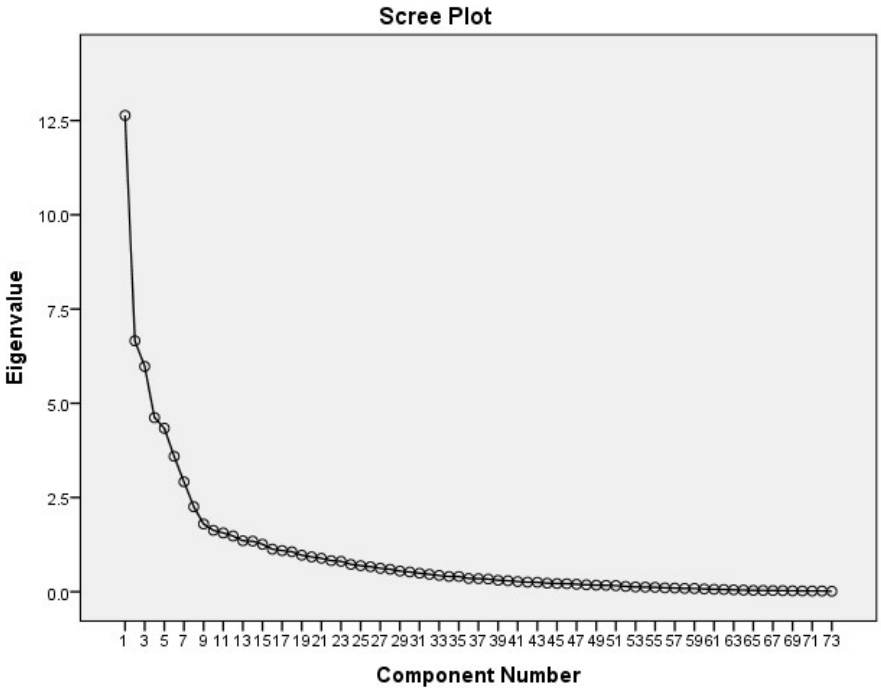

Figure 6-6 Scree Plot

22. Factor Rotation

The rotation is used to lessen the number of features on which the variables under study have high loadings. It crafts the understanding of the analysis simpler and does not amend

anything. Rotated component matrix is the matrix of the factor loadings for each variable onto each factor and is listed in Table 6-10. Values less than 0.7 are masked. About 50% factors are not included in any component as their values are less than 0.7. The component plot in rotated space is also depicted in Figure 6-7.

Table 6-10 Rotated Component Matrix

	Component						
	1	2	3	4	5	6	7
DM_CLP		.888					
DM_CPE							
DM_SMW							
DM_PSE							
DM_VFR							
DM_FPS							
DM_FRM							
DM_SAI		.877					
FM_CFR							
FM_HCC							
FM_PCA							
FM_VLM							
FM_VPH							.712
DV_HFO						.903	
DV_THH							
DV_CWE							
DV_PHF						.775	
DV_PYS						.828	
DV_EMV							
DV_NEJ							
DV_MBH						.883	
D_FF							
D_DoM							
D_BBCS					.837		
D_IBP					.791		
D_SP							
D_POT					.804		
D_GE					.826		
H_UT		.808					
H_SAR		.856					
H_VAC		.823					
H_WG							
H_SMSM				.842			
H_SF				.840			
H_LFS							

H_DPIW							
ATAH_KQF					.787		
ATAH_CFFC							
ATAH_RP							
ATAH_RCA					.775		
RNTAAH_TPM							
RNTAAH_FR		.888					
RNTAAH_NSR							
RNTAAH_NEC							.725
RNTAAH_PHS							
RNTAAH_EAO							
RNTAAH_TSF							
AWLR_MFP			.829				
AWLR_MCCL							
AWLR_CAV							
AWLR_PA							
AWLR_EA							
AWLR_CP	.831						
AWLR_DM			.780				
AWLR_IF							
AWLR_DTD			.736				
HS_ASP	.890						
HS_RUD	.868						
HS_TV							
HS_NMDW							
HS_UFP							
GI_EJOS							
GI_SS	.847						
GI_CE							
GI_LS	.843						
GI_SM	.799						
WPF_IE							
WPF_SDWFQ				.871			
WPF_MF							

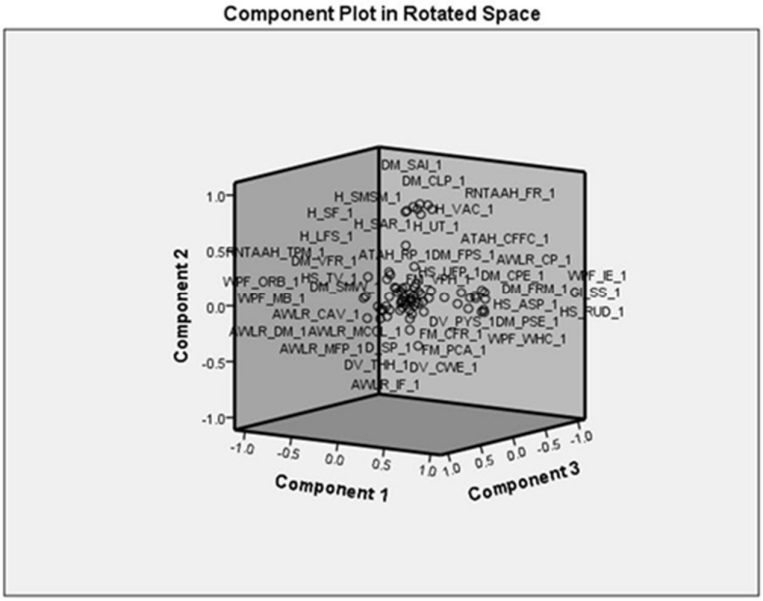

Figure 6-7 Component Plot in rotated space

The following Table 6-11 depicts the association of each factor and its corresponding component. In order to provide women safety, these extracted factors may be reviewed by the Government, NGO's and women in order to decline the violence and crime rate against women. Necessary steps and action must be taken so that women should feel safe.

Table 6-11 Associated Factors

Component	Factors
1	Criminal Procedures -FIR/Bail/Arrest (AWLR_CP)
	Abortion for son preference (HS_ASP)
	Rapid ultrasounds test for diagnostic purpose (HS_RUD)
	Spouse selection (GI_SS)
	Life Style (GI_LS)
	Safe Mobility (GI_SM)
2	Choice of your life partner (DM_CLP)
	Speaking against injustice (DM_SAI)
	Unwanted touching (H_UT)
	Sexual assault / Rape (H_SAR)
	Verbal abuse / Comments (H_VAC)
	Fear of Revenge (RNTAAH_FR)
3	Marriage, Family and Property (AWLR_MFP)
	Divorce and Maintenance (AWLR_DM)
	Dowry Tortures and Death (AWLR_DTD)
4	Sinful messages on social media (H_SMSM)
	Stalking / Following - Physically / Online (H_SF)

	Safe drinking water and food quality (WPF_SDWFQ)
5	Bride Burning / Committed Suicide (D_BBCS)
	Interest of bride's parents (D_IBP)
	Pressure of old traditions (D_POT)
	Greed Expectations (D_GE)
	Kept quite / feared retaliation from harasser (ATAH_KQF)
	Reported to concerned authority (ATAH_RCA)
6	Humiliated in front of others (DV_HFO)
	Physically forced (DV_PHF)
	Psychological Stress (DV_PYS)
	Misbehaving / Hurting (DV_MBH)
7	Spending time / vacation at parental home (FM_VPH)
	No desire to expose the culprit (RNTAAH_NEC)

23. CONCLUSION & FUTURE SCOPE

According to the study it is analysed that women are afraid to go out. They are being humiliated and harassed in front of others. Their health issue both at home and workplace is a major issue. According to the data they are not given choice to select life partner. Majority of the women gets hurt and misbehaved due to dowry. Many of women remain in stress because of stalking, sexual assault, verbal abuse, rape etc. They are not allowed to visit parental house, markets and to spend in their own way. All these things should be minimized and one should promote gender equality. The Government, NGO's, people should come forward to stop such kind of violence. The Government has developed a number of devices and applications; however they do not make use of advanced technologies like Machine Learning, Data Science etc.

The findings in the paper may help in reducing the crime rate against women and promote gender equality. Women should move freely and proper safety measures needs to be taken not only by the Government but also from NGO's and people. A more sophisticated mobile based application need to be developed by making use of advanced technologies like Machine Learning, Data Science etc. Women safety is the major issue all over the world and everyone should support women in order to make them feel safe and secure.

BIOGRAPHICAL NOTES

Er. Priyanka Kohli, is currently pursuing Ph.D after serving as Software Engineer at EVA Solutions Pvt. Ltd., Patiala. She had completed her M.Tech, B.Tech in Computer Science & Engineering from PTU, Jalandhar, India. She has over 9 years of experience – as a Software Engineer as well as in Guest Faculty at various Universities. Her research interests include Machine Learning, Android, Data Mining, Information Systems, Knowledge Management and Data Science. She had supervised and developed many apps, projects and websites. She is on editorial board of various Journals. She can be contacted at: priyankagupta.pup@gmail.com

Dr. Kawaljeet Singh completed his Ph.D (2001) and MCA (1988) both from Thapar Univerity, Patiala. Twelve(12) of his research scholars have been awarded Ph. D. Presently, he has 06research scholars registered with him who are actively working on Data Science, Machine Learning, Agile Practices, Meta-heuristics and Grid Computing. He has also guided nine(09) M Phil Candidates. Eighteen (18) M.Tech candidates have carried out their research projects under his supervision. He has to his contribution 40+ papers published in international / national journals, 4 textbooks, 5 monographs, 40+ papers in national level conferences, 4 abstracts in international conferences and 12 at national level conferences. He has a few radio/TV talks on Career Consultancy to IT students. His subjects of interest are Simulation & Modelling, Intelligent Databases, Theoretical Computer Science and Operating Systems. His total teaching experience to date is of 30+ years. He can be contacted at: singhkawaljeet@pbi.ac.in

Dr. Brahmaleen K. Sidhu is an Assistant Professor in the Department of Computer Science and Engineering, Punjabi University, Patiala and has around 15 years of teaching experience. She holds a Ph.D. degree in Faculty of Engineering and Technology from Punjabi University, an M.Tech. degree in Computer Science and Engineering from the Punjab Technical University and a B.Tech. degree in Computer Science and Engineering from Punjabi University. Her research interests include software architecture, software evolution, software quality, refactoring, model-driven development, data science and machine learning. Dr. Sidhu has around 47 research papers in international journals and conferences. She can be contacted at: brahmaleen.sidhu@gmail.com

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