



Machine Learning Based Regression Analysis on Women Safety in India

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ABSTRACT

Women status in the society gone through many changes from the Ancient days to modern society and they are promoted to equal status with man in many aspects by the reformers. Women in India facing many problems by the modern day society. Sharing 33% of equal responsibility in the social contribution, they are still living in the restless life. Increasing number of Violence and Crime rate against woman in India will set many unanswered questions to government and the society regarding women safety. Several data analysis projects have been sanctioned and used for crime detection, prediction and prevention; few have been done about crime against women in India and almost none with regards to different crimes against women. This paper describes an in-detail analysis of crimes against women from 2002 to 2011. This study uses regression as well as visualization for analyzing the crime patterns over the previously mentioned years and helps predict the possible age group to target with the awareness drives, the frequency of different crimes in different states and thus, evaluate the effectiveness of the current security measures in all the states of the country. The knowledge gained from these then can be given to the police and the various crime agencies to help them take better decisions regarding prevention of crimes against women in India. This approach can be quite effective and can be used globally.

1. INTRODUCTION

Violence against women (VAW)

Violence against women (VAW), also known as gender-based violence and sexual and gender-based violence (SGBV), are violent acts primarily or exclusively committed against women or girls. Such violence is often considered a form of hate crime, committed against women or girls specifically because they are female, and can take many forms.

VAW has a very long history, though the incidents and intensity of such violence has varied over time and even today varies between societies. Such violence is often seen as a mechanism for the subjugation of women, whether in society in general or in an interpersonal relationship. Such violence may arise from a sense of entitlement, superiority, misogyny or similar attitudes in the perpetrator, or because of his violent nature, especially against women.

The UN Declaration on the Elimination of Violence Against Women states, "violence against women is a manifestation of historically unequal power relations between men and women" and "violence against women is one of the crucial social mechanisms by which women are forced into a subordinate position compared with men."

Kofi Annan, Secretary-General of the United Nations, declared in a 2006 report posted on the United Nations Development Fund for Women (UNIFEM) website:

Violence against women and girls is a problem of pandemic proportions. At least one out of every three women around the world has been beaten, coerced into sex, or otherwise abused in her lifetime with the abuser usually someone known to her.

Types of violence

Violence against women can fit into several broad categories. These include violence carried out by individuals as well as states. Some of the forms of violence perpetrated by individuals are: rape, domestic violence, sexual harassment, acid throwing, reproductive coercion, female infanticide, prenatal sex selection, obstetric violence, online gender-based violence and mob violence; as well as harmful customary or traditional practices such as honor killings, dowry violence, female genital mutilation, marriage by abduction and forced marriage. There are forms of violence which may be perpetrated or condoned by the government, such as war rape; sexual violence and sexual slavery during conflict; forced sterilization; forced abortion; violence by the police and authoritative personnel; stoning and flogging. Many forms of VAW, such as trafficking in women and forced prostitution are often perpetrated by organized criminal



networks. Historically, there have been forms of organized WAW, such as the Witch trials in the early modern period or the sexual slavery of the Comfort women.

The World Health Organization (WHO), in its research on VAW, has analyzed and categorized the different forms of VAW occurring through all stages of life from before birth to old age.

In recent years, there has been a trend of approaching VAW at an international level through means such as conventions or, in the European Union, through directives (such as the directive against sexual harassment, and the directive against human trafficking).

Definition

A number of international instruments that aim to eliminate violence against women and domestic violence have been enacted by various international bodies. These generally start with a definition of what such violence is, with a view to combating such practices. The Istanbul Convention (Council of Europe Convention on preventing and combating violence against women and domestic violence) of the Council of Europe describes VAW "as a violation of human rights and a form of discrimination against women" and defines VAW as "all acts of gender-based violence that result in, or are likely to result in, physical, sexual, psychological or economic harm or suffering to women, including threats of such acts, coercion or arbitrary deprivation of liberty, whether occurring in public or in private life.

The 1979 Convention on the Elimination of All Forms of Discrimination Against Women (CEDAW) of the United Nations General Assembly makes recommendations relating to VAW,^[11] and the Vienna Declaration and Programme of Action mentions VAW.^[12] However, the 1993 United Nations General Assembly resolution on the Declaration on the Elimination of Violence Against Women was the first international instrument to explicitly define VAW and elaborate on the subject.^[13] Other definitions of VAW are set out in the 1994 Inter-American Convention on the Prevention, Punishment, and Eradication of Violence against Women and by the 2003 Maputo Protocol.

In addition, the term gender-based violence refers to "any acts or threats of acts intended to hurt or make women suffer physically, sexually or psychologically, and which affect women because they are women or affect women disproportionately". The definition of gender-based violence is most often "used interchangeably with violence against women" and some articles on VAW reiterate these conceptions by suggesting that men are the main perpetrators of this violence.¹ Moreover, the definition stated by the 1993 Declaration on the Elimination of Violence Against Women also supported the notion that violence is rooted in the inequality between men and women when the term violence is used together with the term 'gender-based.'

In Recommendation Rec(2002)5 of the Committee of Ministers to member states on the protection of women against violence, the Council of Europe stipulated that VAW "includes, but is not limited to, the following":

- a. violence occurring in the family or domestic unit, including, inter alia, physical and mental aggression, emotional and psychological abuse, rape and sexual abuse, incest, rape between spouses, regular or occasional partners and cohabitants, crimes committed in the name of honour, female genital and sexual mutilation and other traditional practices harmful to women, such as forced marriages;
- b. violence occurring within the general community, including, inter alia, rape, sexual abuse, sexual harassment and intimidation at work, in institutions or elsewhere trafficking in women for the purposes of sexual exploitation and economic exploitation and sex tourism;
- c. violence perpetrated or condoned by the state or its officials;
- d. violation of the human rights of women in situations of armed conflict, in particular the taking of hostages, forced displacement, systematic rape, sexual slavery, forced pregnancy, and trafficking for the purposes of sexual exploitation and economic exploitation.

These definitions of VAW as being gender-based are seen by some to be unsatisfactory and problematic. These definitions are conceptualized in an understanding of society as patriarchal, signifying unequal relations between men and women. Opponents of such definitions argue that the definitions disregard violence against men and that the term gender, as used in gender based violence, only refers to women. Other critics argue that employing the term gender in this particular way may introduce notions of inferiority and subordination for femininity and superiority for masculinity. There is no widely accepted current definition that covers all the dimensions of gender-based violence rather than the one for women that tends to reproduce the concept of binary oppositions: masculinity versus femininity.



Sexual and Gender-Based Violence (SGBV), collectively, also known as Violence Against Women (VAW), are violent acts that are predominantly committed against women and girls. This type of violence is gender-based, meaning that these crimes are committed against women and girls just because of the sole reason that they are female. Violence against women can be classified into several categories and these include violence carried out by "individuals" as well as "states". Some of the forms of violence carried out by individuals are: rape, domestic violence, sexual harassment, female infanticide, etc; as well as harmful customary or traditional practices such as dowry violence, honor killings, female genital mutilation, and forced marriage. Some forms of violence are inflicted by the state such as war rape, sexual violence and slavery during conflict, forced abortion, violence by the police and authoritative personnel, stoning and flogging. Often crimes like forced prostitution and trafficking in women are perpetrated by organized crime. This paper analyses these crimes based upon the age groups of the offenders and states they belong to by analyzing the data available. This analysis involves several steps like data processing, data cleaning, data modeling and analysis and finally, communication.

II. BACKGROUND

Access to justice for female victims of violence

International and regional instruments

Efforts to fight violence against women can take many forms and access to justice, or lack thereof, for such violence varies greatly depending on the justice system. International and regional instruments are increasingly used as the basis for national legislation and policies to eradicate violence against women.

The Inter-American Convention to Prevent, Eradicate and Punish Violence Against Women – also known as the Belém do Pará Convention, for instance, has been applied by the Inter-American Commission on Human Rights (IACHR) in its first case of domestic violence to condemn Brazil in the Maria da Penha case. This led the Brazilian government to enact in 2006 the Maria da Penha Law, the country's first law against domestic violence against women. There is also, for instance, the South Asian Agreement on Regional Cooperation's (SAARC) Protocol to End Trafficking in Women and Children.

Examples of measures put in place

As violence is often committed by a family member, women first started by lobbying their governments to set up shelters for domestic violence survivors. The Julia Burgos Protected House established in Puerto Rico in 1979 was the first shelter in Latin America and the Caribbean for "battered women". In 2003, 18 out of the 20 countries in the region had legislation on domestic or family violence, and 11 countries addressed sexual violence in their laws. Legislative measures to protect victims can include restraining orders, which can be found in Colombia, El Salvador, Guatemala, Paraguay, Venezuela, Turkey, the United States and many western European countries for instance.

Courts can also be allowed by law (Germany, 2001) to order the perpetrator to leave the home so that victims do not have to seek shelter. Countries were urged to repeal discriminatory legislation by 2005 following the review of the Beijing Declaration and Platform for Action in 2000. Egypt, for instance, abolished a law that exempted men from rape charges when marrying their victims. However, the goal of antiviolence legislation is often to keep the families together, regardless of the best interests of women, which perpetuate domestic violence.

Innovative measures have been pioneered in a number of countries to end violence against women. In Brazil and Jordan, women's police stations have been introduced, and one-stop women's shelters were created in Malaysia and Nicaragua.

Marital rape has been illegal in every American state and the District of Columbia since 1993, but is rarely prosecuted in America.

In 2013 the UN General Assembly passed its first resolution calling for the protection of defenders of women's human rights. The resolution urges states to put in place gender-specific laws and policies for the protection of women's human rights defenders and to ensure that defenders themselves are involved in the design and implementation of these measures, and calls on states to protect women's human rights defenders from reprisals for cooperating with the UN and to ensure their unhindered access to and communication with international human rights bodies and mechanisms.

Challenges faced by women in accessing justice and limitations of measures.

There can be a de jure or de facto acceptance of violent behaviors and lack of remedies for victims.



- **Lack of criminalization:** in many places, acts of abuse, especially acts such as female genital mutilation, marital rape, forced marriage and child marriage, are not criminalized, or are illegal but widely tolerated, with the laws against them being rarely enforced. There are instances where crimes against women are also categorized as minor offenses.
- **Lack of awareness of the existing laws:** in many places, although there are laws against violence on the books, many women do not know of their existence. This is especially the case with marital rape - its criminalization being very recent in most countries.
- **Challenges in making a case in court:** the burden of proof can be placed on the victim. For instance in the Philippines, before a change in law in 1997, rape used to be described as a crime against chastity; and virginity played an important role in court. In various countries, such as Bangladesh, a woman's past sexual experience continues to be very important in a case of rape. Bangladesh has received criticism for its employment of the "two-finger test" in rape investigations. This test consists in a physical examination of women who report rape during which a doctor inserts two fingers in the woman's vagina to determine whether the woman is "habituated to sex". This examination has its origin in the country's British colonial-era laws dating back to 1872. This deters many women from reporting rape. More than 100 experts, including doctors, lawyers, police, and women's rights activists had signed a joint statement in 2013 asking for the test, which they called "demeaning", to be abolished, as it "does not provide any evidence that is relevant to proving the offence". This test is also performed in several other countries in the region, including India. It can also be difficult to make a case of sexual assault in court, when members of the judiciary expect evidence of severe struggle and injury as determinative evidence of non-consent. On the other hand, there are measures, such as the 2012 law in Brazil, that allow for cases to be filed even without the representation of the victim.
- **Existing laws are insufficient, conflicting, and have no effect in practice:** some laws on domestic violence, for instance, conflict with other provisions and ultimately contradict their goals. Legal frameworks can also be flawed when laws that integrate protection do so in isolation, notably in relation to immigration laws. Undocumented women in countries where they would have, in theory, access to justice, don't in practice for fear of being denounced and deported. The CEDAW Committee recommends that a State authority's obligation to report undocumented persons be repealed in national legislation.
- **The attitude of the police:** women who report acts of violence most often come into contact first with police workers. Therefore, police attitudes are crucial in facilitating a sense of safety and comfort for women who have been victimized. When police officers have hostile attitudes towards victimized women, these women are prevented from obtaining justice. Recognizing these problems, some countries have enacted women's police station, which are police stations that specialize in certain crimes, such as sexual violence, harassment, domestic violence committed against women.

Measures to address violence against women range from access to legal-aid to the provision of shelters and hotlines for victims. Despite advances in legislation and policies, the lack of implementation of the measures put in place prevents significant progress in eradicating violence against women globally. This failure to apply existing laws and procedures is often due to the persisting issue of gender stereotyping.

III. PROPOSED SYSTEM

This section talks about the datasets used, tools used and the model built. The objective of this paper is to identify certain age groups or certain states of India which tend to commit each crime and also to build a model which will help predict the number of arrests that can be expected to be made for each crime, state wise and age - group wise.

Data Collection and Preprocessing. Input data plays a very important role in the field of any data pattern analysis, especially crime. In our proposed model, the datasets are used for deducing the hidden knowledge and patterns from it and then used for ratifying the predictive model built. The data used for this paper has been collected from the National Crime Records Bureau (NCRB) [7] crime data, which provides data and documents for public use. The collected data contains crime information, in the form of number of arrests, of all the 29 states and 7 union territories. Initially, the dataset classified crimes under several different categories like 'kidnapping and abduction', 'rape', 'insult to the modesty of women', 'dowry death', 'cruelty by husband or his relatives', 'assault on women with intent to outrage her modesty', 'importation of girls from foreign country', 'immoral traffic', 'dowry prohibition act', 'commission of sati' and 'indecent representation of women'. But for every year in the dataset, the data for the crime types 'dowry prohibition act', 'indecent representation of women', 'immoral traffic' do not hold any consequential value. So they have been removed and the remaining 8 categories have been considered for analyzing the dataset. Thus the dataset has been readied for the proposed crime data analysis.

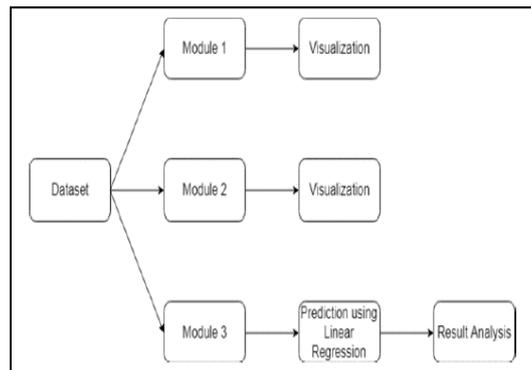


Fig. 1: System Modules

Tools Used

For this analysis, R programming language has been used with RStudio, a free and open-source integrated development environment (IDE). Also, Tableau, a data visualization software, was used to create interactive visualizations.

System Design

This could predict what future trends may look like in different states which will allow for a better and more concentrated approach on these states system. Each module attempted to answer a different question or attempted to build a predictive model. Module 1 attempted to answer the question “Which Age Group has a tendency to commit each Crime?” through interactive visualization. Here, the data for different states was summarized so as to give only 2 dependent variables to work with. It gave several different answers for different types of crimes against women. Module 2 attempted to answer the question “People from which State have a tendency to commit each Crime?” through interactive visualization. Here, the data for different age groups was summarized so as to give only 2 dependent variables to work with. It gave several different answers for different types of crimes against women. Module 3 attempted to build a model which would help predict the crime rate across the country for various different crimes against women, depending upon the data up to the previous year i.e. 2001 to 2012. The model would give an estimate in terms of number of arrests that are expected to be made in the upcoming year (2012). This predicted value would then be compared with the actual data for the year 2012 to see the accuracy. Figure 1 shows the structure of the entire system consisting of all the modules and their steps to final result.

IV. EXPECTED RESULTS

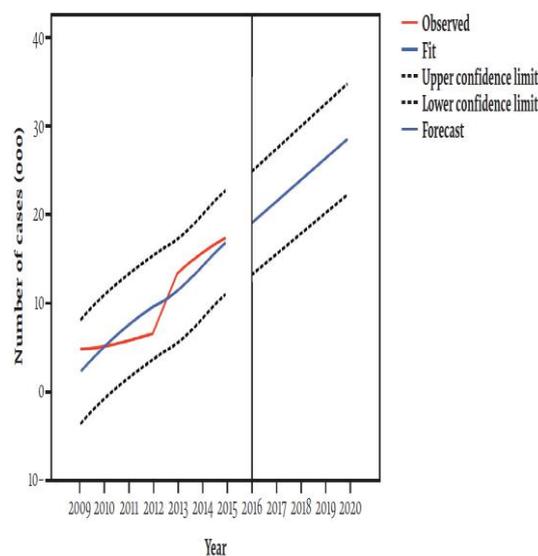




Figure 2. Historical (2009–2015; source: National Crime Record Bureau, India) and forecast (2016–2020) cognizable crime against women in New Delhi

Table 1. Projected cognizable crime against women in New Delhi, 2016–2020

Item	2016	2017	2018	2019	2020
No. of cases	18 991	21 409	23 827	26 245	28 663
UCL	24 889	27 423	29 955	32 485	35 013
LCL	13 092	15 395	17 699	20 005	22 314
Rate of total cognizable crime ^{ab}	204.69	230.70	256.76	282.81	308.87

UCL = upper confidence level; LCL= lower confidence level.

aRate = (reported cognizable crimes against women/female population) × 100 000.

bProjected female population (2015) in New Delhi used as base population (92.8 × 100 000).

Table 2. Selected parameters relating to women, New Delhi, 2015

Parameter	New Delhi (a)	India (b)	Proportion (a/b) (%)
Total projected mid-year population (100 000)	208.8	12 591.1	1.6
Female population (100 000)	92.8	6 070.8	1.5
Total registered cognizable crime (including crime against women) (No.)	191 377	2 949 400	6.5
Crime against women (registered cases) (No.)	17 104	327 394	5.2
Proportion of crime against women to total crime (%)	8.9	11.1	–

Source: National Crime Record Bureau, India.

Table 3. Pattern of cognizable crime committed against women, India and New Delhi, 2015

Crime	India (%)	New Delhi (%)
Outrage and insult to modesty	27.8	40.4
Kidnapping and abduction	18.1	25.0
Cruelty by husband and relatives	34.6	25.5
Rape and attempted rape	11.9	13.0
Dowry	5.4	0.3
Miscellaneous	2.2	0.8
Total	100	100

Source: National Crime Record Bureau, India.

CONCLUSION

The regression analysis on social networking sites is able to provide guidelines to the government so as to ensure security in a better way. On following the prescribed guidelines by the government gradual betterment in security of could be noticed.



This methodology of collecting opinions of people from social networking sites enables in collection of quantitative information across the globe including the rate of their sentimental feelings on harassment, providing a strong base for improving and empowering security. The objective of the analysis to provide efficient and clear solution was achieved, thus proving that the data is reliable enough to be used for framing new laws, preventing new crimes, bringing into place new strategies to curb these activities. As future work, newer datasets could be analyzed, so that new policies can be framed. Detection technologies can improve incident detection and engage safety resources for the public sooner. This will lead to improved response times and will help the general public. Technology will help increase accuracy and efficiency of incident response and reporting and, thus resources, like police force, can be allocated better. This in turn, will enhance incident investigation efficiency and help increase clearance rates. Analytics can also help discover and identify trends to improve operational effectiveness. Proactive policing can help stop crime before it actually happens.

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