

Ramaiah Institute of Technology

(An Autonomous Institute, Affiliated to VTU)

MSR Nagar, MSRIT post, Bangalore-54

A Dissertation Report on

STUDY OF WOMEN'S REPRODUCTIVE HEALTH IN BACKWARD DISTRICTS

Submitted by

**RAHUL RAJ
SAIMA DEV
SIDDHARTHA C**

**1MS15CS098
1MS15CS105
1MS15CS123**

Bachelor of Engineering in Computer Science & Engineering

Under the guidance of

**SOWMYA B J
ASST.PROFESSOR
COMPUTER SCIENCE**



**DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING
M.S.RAMAIAH INSTITUTE OF TECHNOLOGY
(Autonomous Institute, Affiliated to VTU)
BANGALORE-560054**

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Introduction :

The Government of India has conducted some varied surveys concerning women's health and natal care in backward districts throughout the country. The Guna District from Madhya Pradesh is one such districts where the Annual Health Survey was conducted. The data obtained contains various attributes ranging from reproductive health to basic social necessities, for example the availability of bicycle facilities for women.



The location of Guna district in M.P and India (left). Some of the women surveyed for the dataset(right).

The health survey is conducted on annual basis and the results are hosted for public under the Right to Information act. The data available is accessible for analysts to try and predict solutions for some of the most common and easily solvable problems faced by Indian Women.

The dataset translates several general problems faced by rural female population. With the help of pictorial representation we try to infer some of these problems from general attributes. Through graphs we explore the common misconceptions amongst the rural women of the country. Finally we see how important natal care is for women using fuzzy logic and predict the outcome of pregnancy.. The government provides financial assistance for women from backward classes.

The implementation of Fuzzy logic is viewed in detail and implemented with the help of R language. All of the graphs and plots are derived with the help of R.

Data Classification : Data classification is the process of organizing data into categories for its most effective and efficient use. A well-planned data classification system makes essential data easy to find and retrieve. This can be of particular importance for risk management, legal discovery, and compliance. Written procedures and guidelines for data classification should define what categories and criteria the organization will use to classify data and specify the roles and responsibilities of employees within the organization regarding data stewardship.

Rule-based Classification : The term rule-based classification can be used to refer to any classification scheme that make use of IF-THEN rules for class prediction. Rule-based classification schemes typically consist of the following components:

1)Rule Induction Algorithm: This refers to the process of extracting relevant IF-THEN rules from the data which can be done directly using sequential covering algorithms or indirectly from other data mining methods like decision tree building or association rule mining.

2)Rule Ranking Measures This refers to some values that are used to measure the usefulness of a rule in providing accurate prediction. Rule ranking measures are often used in the rule induction algorithm to prune off unnecessary rules and improve efficiency.

Fuzzy Theory: Fuzzy logic is an extension of Boolean logic by Lotfi Zadeh in 1965 based on the mathematical theory of fuzzy sets, which is a generalization of the classical set theory. By introducing the notion of degree in the verification of a condition, thus enabling a condition to be in a state other than true or false, fuzzy logic provides a very valuable flexibility for reasoning, which makes it possible to take into account inaccuracies and uncertainties. It is a form of many-valued logic in which the truth values of variables may be any real number between 0 and 1. It is employed to handle the concept of partial truth, where the truth value may range between completely true and completely false. By contrast, in Boolean logic, the truth values of variables may only be the integer values 0 or 1. Furthermore, when linguistic variables are used, these degrees may be managed by specific (membership) functions. Classical logic only permits conclusions which are either true or false. However, there are also propositions with variable answers, such as one might find when asking a group of people to identify a color. In such instances, the truth appears as the result of reasoning from inexact or partial knowledge in which the sampled answers are mapped on a spectrum.

Humans and animals often operate using fuzzy evaluations in many everyday situations. In the case where someone is tossing an object into a container from a distance, the person does not compute exact values for the object weight, density, distance, direction, container height and width, and air resistance to determine the force and angle to toss the object. Instead the person instinctively applies quick "fuzzy" estimates, based upon previous experience, to determine what output values of force, direction and vertical angle to use to make the toss.

Both degrees of truth and probabilities range between 0 and 1 and hence may seem similar at first, but fuzzy logic uses degrees of truth as a mathematical model of vagueness, while probability is a mathematical model of ignorance.

Defining Fuzzy Sets:

A fuzzy set is a pair (U, m) where U is a set of $m: U \rightarrow [0,1]$ a membership function. For each $x \in U$, the value of $m(x)$ is called a grade membership of x in (U, m) . For a finite set $U = \{x_1, \dots, x_n\}$ the fuzzy set (U, m) is often denoted by $\{m(x_1)/x_1, \dots, m(x_n)/x_n\}$.

Let $x \in U$. Then x is called not included in the fuzzy set (U, m) if $m(x) = 0$, x is called fully included if $m(x) = 1$ and x is called a fuzzy member if $0 < m(x) < 1$. The set $\{x \in U \mid m(x) > 0\}$ is called the support of (U, m) and the set $\{x \in U \mid m(x) = 1\}$ is called its kernel or core. The function m is called the membership function of the fuzzy set (U, m) .

Fuzzy Logic

As an extension of the case of multi-valued logic, valuations $(\mu : V \rightarrow W)$ of propositional variables (V) into a set of membership degrees (W) can be thought of as membership functions mapping predicates into fuzzy sets (or more formally, into an ordered set of fuzzy pairs, called a fuzzy relation). With these valuations, many-valued logic can be extended to allow for fuzzy premises from which graded conclusions may be drawn.

This extension is sometimes called "fuzzy logic in the narrow sense" as opposed to "fuzzy logic in the wider sense," which originated in the engineering fields of automated control and knowledge engineering, and which encompasses many topics involving fuzzy sets and "approximate reasoning." Industrial applications of fuzzy sets in the context of "fuzzy logic in the wider sense" can be found at fuzzy logic.

Data Set description:

The original dataset is a compilation of various attributes entailing women's health during gestation period (both pre and post) in Guna District of Madhya Pradesh. The dataset also includes details of financial aid given by the govt, facilities available in the locality.

Source of Dataset :

<https://data.gov.in/resources/annual-health-survey-woman-schedule-section-ii-district-guna-madhya-pradesh/>

Attribute Description :

Variable	Description
w_id	Unique Identification Number
district	which district does the woman belong to
Psu_id	This field has been provided to hide the identification of record below District level. It is a seven digit number to uniquely identify each record.
age	Age
Marital_status	Marital status
w_preg_no	Pregnancy No.
out_come_of_preg	Outcome of Pregnancy
year_of_abortion	in which month & year you had abortion? -Year
kind_of_birth	What kind of birth is / was it?

previous_current_diff	What is the interval between the previous and current live births? (If more than 99 months, record '99' only)
gender	Gender
year_of_marriage	the year in which woman got married ???
who_conducted_del_at_home	In case of delivery at home, who conducted your delivery?
check_up_with_48_hours_of_del	Did you have any check-up within 48 hours of delivery?
maternity_financial_asistance	Did you avail any Maternity Financial assistance?
weight_of_baby_kg	Weight of Baby-Kg
last_preg_no	Last Pregnancy No.
social_group_code	Code according to SC or ST ?

no_of_dpt_injection	Number of Dpt injections
immunization_card	Do you have an Immunization/ MCH card for your baby?
no_of_anc	How many ANC's did you receive during pregnancy associated with each birth?
no_of_months_first_anc	How many months were you pregnant at the time of first ANC?
consumption_of_ifa	For how many days did you consume Iron & Folic Acid (IFA) tablets/ tablespoons of IFA syrup during pregnancy?
type_of_delivery	Was the delivery normal, caesarean or assisted?
baby_checkup_aftr_birth	checkup of baby after birth
financial_asistance_amount	What was the total amount received by you during pregnancy and/or after delivery?
no_of_polio_doses_ri	Number of Polio doses in Routine Immunization (RI) other than the Birth dose

no_of_polio_dose_pp	Number of polio doses in Pulse Polio (PP) immunization during last one year
delivered_any_baby	Have you delivered a live baby
born_alive_total	How many children have been born alive ever ?-Total
surviving_female	How many children have been born alive ever are surviving ?-Female
surviving_male	How many children have been born alive ever are surviving ?-male
mother_age_when_baby_was_born	What was your age at first live birth? (In completed years)
outcome_pregnancy	Has the outcome of any pregnancy(s) resulted in live birth/still birth/abortion
is_emergency_contraceptive	Modern Method-Emergency contraceptive Pill
want_more_children	Would you like to have another child?
year_of_birth	year in which the baby was born
religion	which religion does the woman belong to ?

Data Set size in terms of Bytes and Number of Tuples : 926 tuples , 3,01,056 bytes .

Inferences that you can draw considering each attribute :

Out of all the attributes we've used the following 10 attributes for fuzzy evaluation and to draw other general inferences.

Kind_of_birth: The kind of birth, either Live Birth Not Surviving, Live Birth, StillBirth. The attribute is used to further predict the kind of birth can expect depending on her age and the antenatal care received.

weight_of_baby_kg: Describes the weight of the baby at the time of birth in kg. We can predict the health and nutritional facts of the baby and those of the mother using the baby weight.

no_of_months_firt_anc: The period of gestation at the time of first antenatal care.

no_of-anc: No of antenatal care checkups received.

previous_current_diff: The difference between consecutive pregnancies if any.

financial_asitance_amount: The financial assistance received by the govt at the time of childbirth.

age: Age of the woman at the time of the survey. Most of the women are in their 20s, indicating the level of fertility of the women.

out_come_of_preg: Description of the outcome of pregnancies, that is, Stillbirth, Live Birth, Induced Abortion, Spontaneous Abortion.

year_of_marriage: The year in which the woman got married.

INFERENCES:

- By analysing the data we drew certain rules for the fuzzy logic to predict the outcome of pregnancy. The outcome can be induced abortion, still birth, spontaneous birth and live birth. We've based these inferences by analysing :
 - Age of the female,
 - The first Antenatal care received,
 - number of sessions for antenatal tests.

- The median year of birth of the women using a bar graph. Which is found to be 1985.
- The mean year of marriage of the women which in turn indicates that women from the rural and backward districts prefer not to raise the child as a single parent.
- Women who have had multiple pregnancies have a mean gap of 28 months, that is, an average woman from Guna district prefers to have at least two years before she can conceive again.

Algorithm Description

The fuzzy logic algorithm is described as:

1. Define the linguistic variables and terms (Initialization):

Initialization is the process of setting the various fuzzy values to the variables by observing the various data trends and the range of the universe.

2. Construct the membership functions (Initialization):

Membership functions define the fuzzy membership of each variable. The value of fuzzy membership ranges from 0.0. to 1.0.

3. Construct the rule base (Initialization)

After the data is analysed, the rules are constructed in the fuzzy rules. These rules are in the form of ‘if/then’. The inferences for the dataset can be drawn from these rules.

4. Convert crisp input data to fuzzy values using the membership functions (Fuzzification):

Fuzzification is the first step in the fuzzy inferencing process. This involves a domain transformation where crisp inputs are transformed into fuzzy inputs.

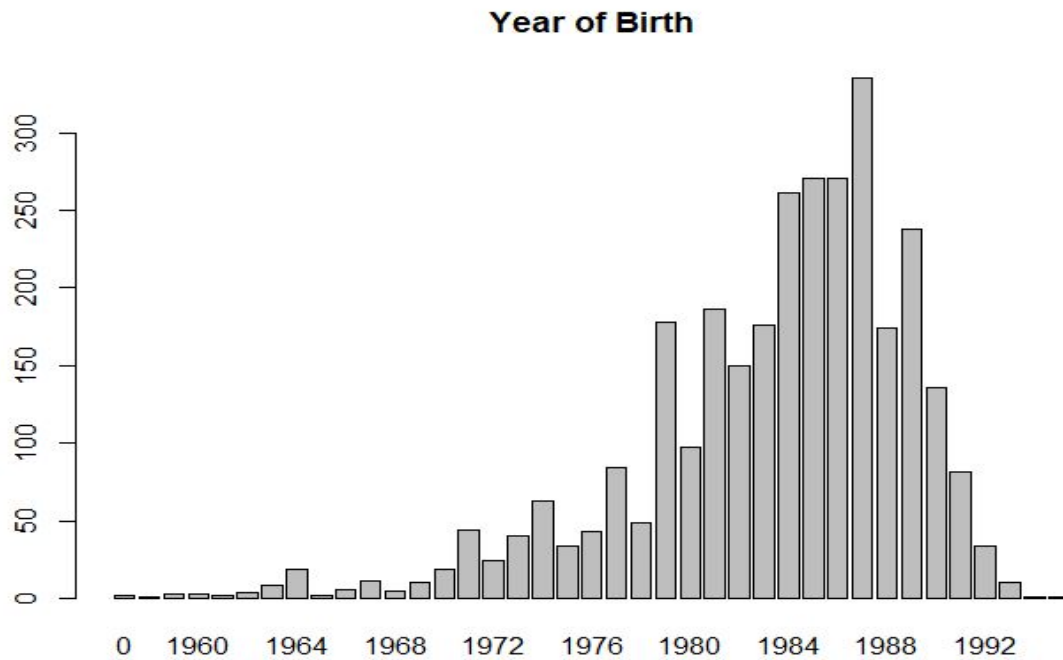
5. Evaluate the rules in the rule base (Inference)

6. Combine the results of each rule (Inference)

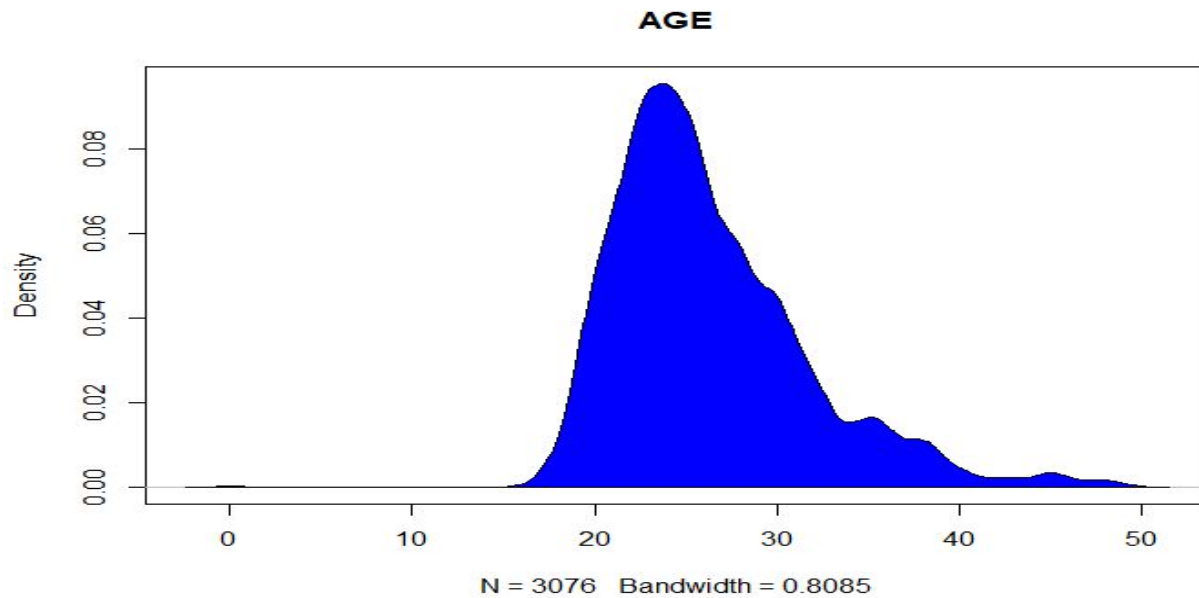
7. Convert the output data to non-fuzzy values (Defuzzification):

Defuzzification involves the process of transposing the fuzzy outputs to crisp outputs. There are a variety of methods to achieve this

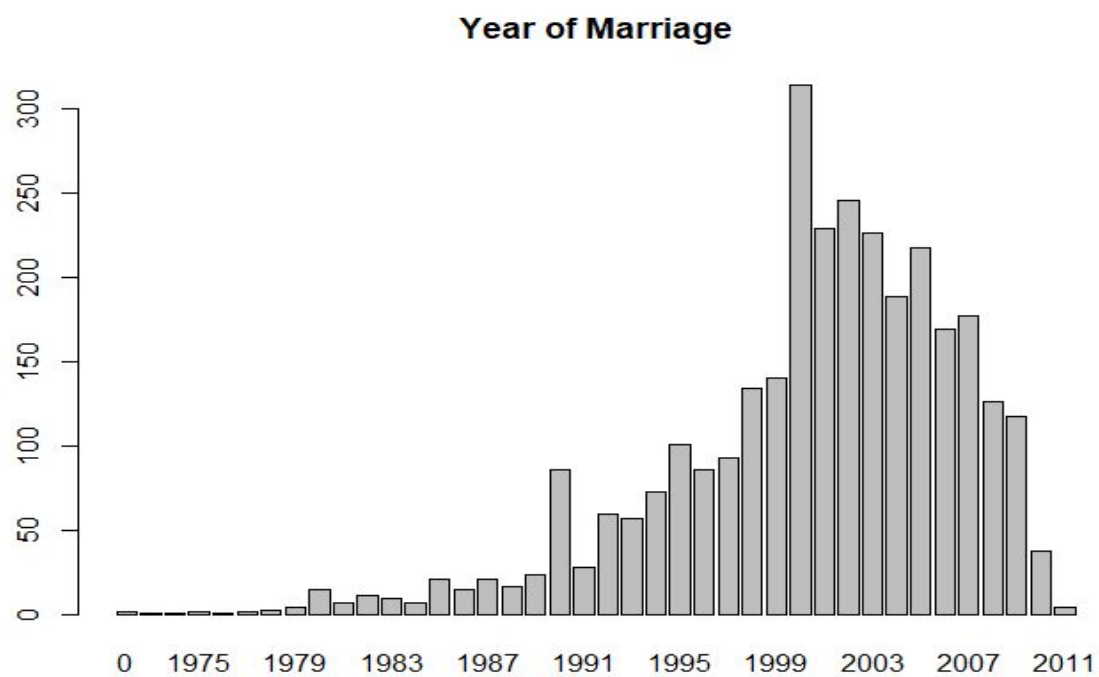
Attribute Graphs :



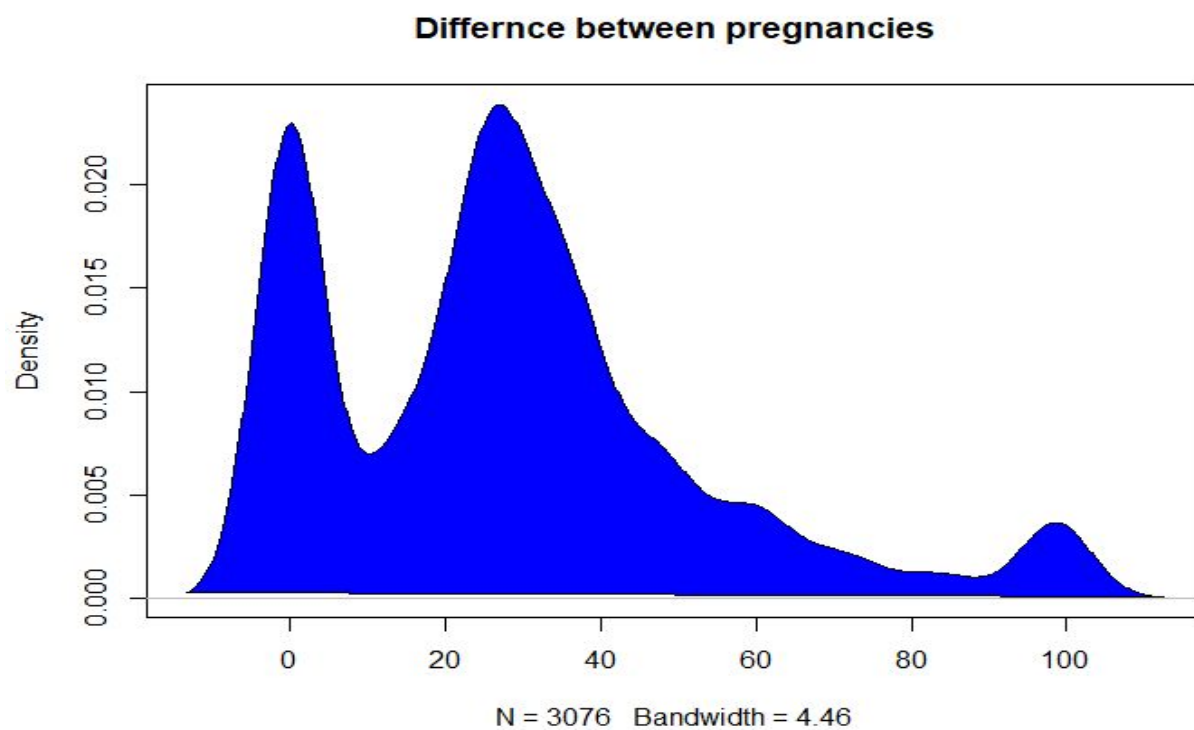
The bar plot indicating the median year of birth of the women.
[The no of women are plotted against the year]



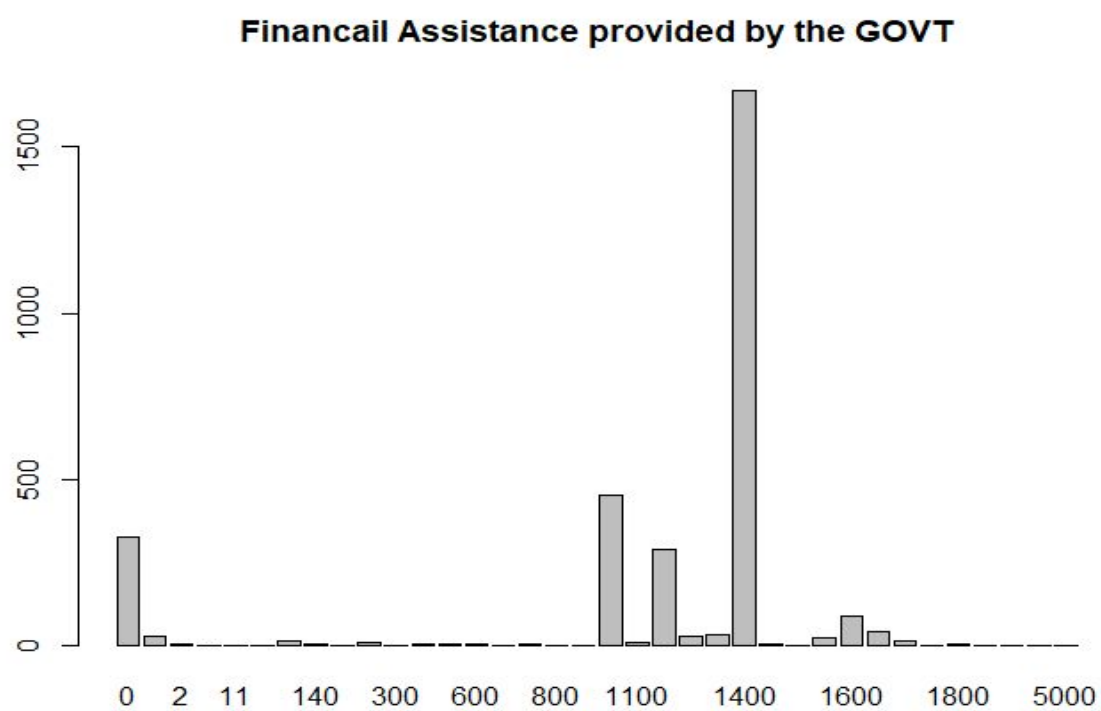
A density plot for the age of women.
[The density is taken on the y-axis and the age on the x-axis]



A bar plot representing the year in which the woman was married. [The no of women on the y-axis and the year of marriage on the x-axis.]



A density plot representing the difference between two subsequent pregnancies.
[The no of months between pregnancies on the x-axis and the density on the y-axis]

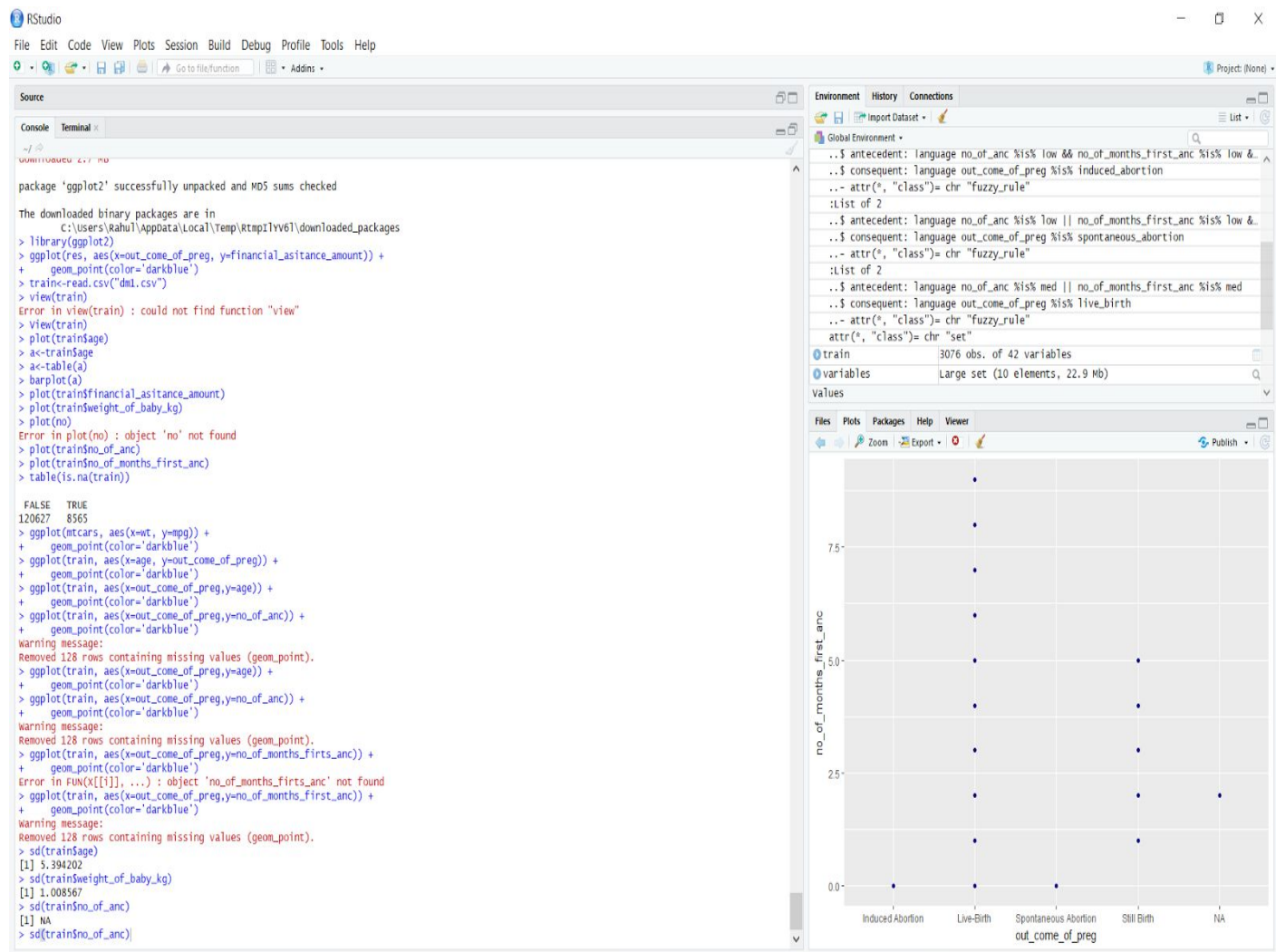


The financial aid (in rs) provided by the govt. of India at the end of pregnancy.

Snapshot of the code:

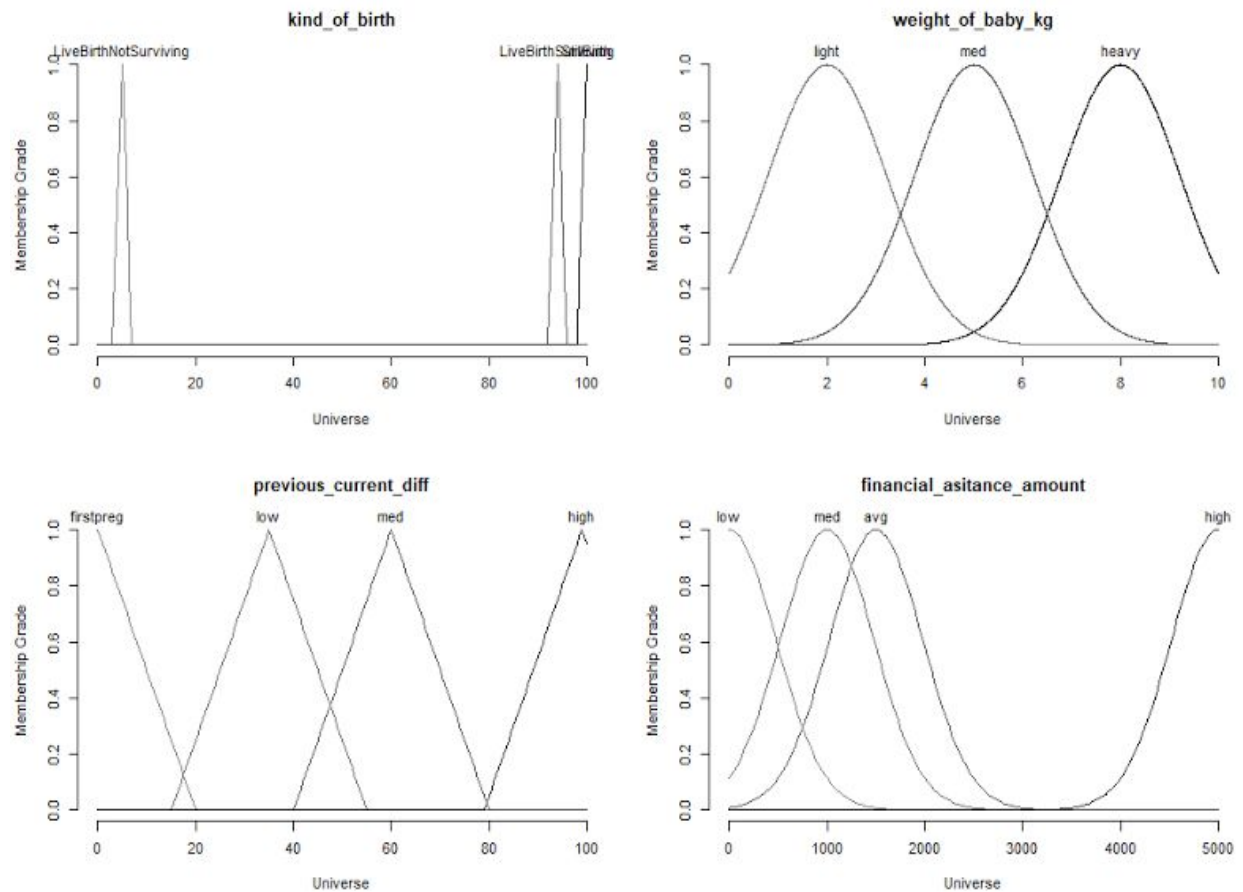
```
1 install.packages("sets")
2 library(sets)
3 U1 <- seq(from = 0, to = 10, by = 0.001)
4 U2<- seq(from = 0, to = 100, by = 0.5)
5 U3<- seq(from = 0, to = 5000, by = 25)
6 U4<- seq(from=0, to = 70, by = 0.035)
7 U5<- seq(from=1960, to= 2020, by=1)
8
9
10 variables <- set(
11   age = fuzzy_partition(varnames = c(teen =19 , young = 30, middle.aged = 40, old=50),
12     sd = 5.26308, universe=U4),
13   previous_current_diff = fuzzy_partition(varnames = c(firstpreg = 0, low = 35, med = 60,high=99),
14     FUN = fuzzy_cone, radius = 20, universe=U2),
15   weight_of_baby_kg = fuzzy_partition(varnames = c(light = 2.0, med = 5.0, heavy = 8.0),
16     sd =1.212626, universe=U1),
17   financial_asitance_amount = fuzzy_partition(varnames = c(low = 0, med = 1000, avg = 1500, high = 5000),
18     sd=479.6217, universe=U3),
19   year_of_marriage = fuzzy_partition(varnames = c(Seventies = 1970, Eighties = 1980, Ninties = 1990, Milenium = 2000, NewDecade = 2010),
20     sd=51.36475, universe=U5),
21   no_of_polio_dose_pp = fuzzy_partition(varnames = c(low=2, med=4, adequate=7, accurate=9),
22     sd = 1.730009, universe = U1),
23   kind_of_birth = fuzzy_partition(varnames = c(LiveBirthNotSurviving = 5, LiveBirthSurviving = 94, stillbirth = 100),
24     FUN = fuzzy_cone , universe=U2),
25   no_of_anc = fuzzy_partition(varnames = c(low=0, med=2, avg=3, high=9),
26     sd = 1.730009, universe = U1),
27   no_of_months_first_anc = fuzzy_partition(varnames = c(low=0, med=3, adequate=4, high=9),
28     sd = 1.730009, universe = U1),
29   out_come_of_preg = fuzzy_partition(varnames = c(induced_abortion=1, spontaneous_abortion=2, still_birth=3, live_birth=6),
30     sd=1, universe=U1)
31 )
32
33 rules <- set(
34   fuzzy_rule(no_of_anc %is% low && no_of_months_first_anc %is% low && age %is% young, out_come_of_preg %is% induced_abortion),
35   fuzzy_rule(no_of_anc %is% low && no_of_months_first_anc %is% low && age %is% old, out_come_of_preg %is% still_birth),
36   fuzzy_rule(no_of_anc %is% low || no_of_months_first_anc %is% low && age %is% middle.aged, out_come_of_preg %is% spontaneous_abortion),
37   fuzzy_rule(no_of_anc %is% med || no_of_months_first_anc %is% med, out_come_of_preg %is% live_birth)
38 )
39
40
41
42 |
```

The fuzzy variables and rules set for the current dataset used to predict the outcome of the pregnancy.

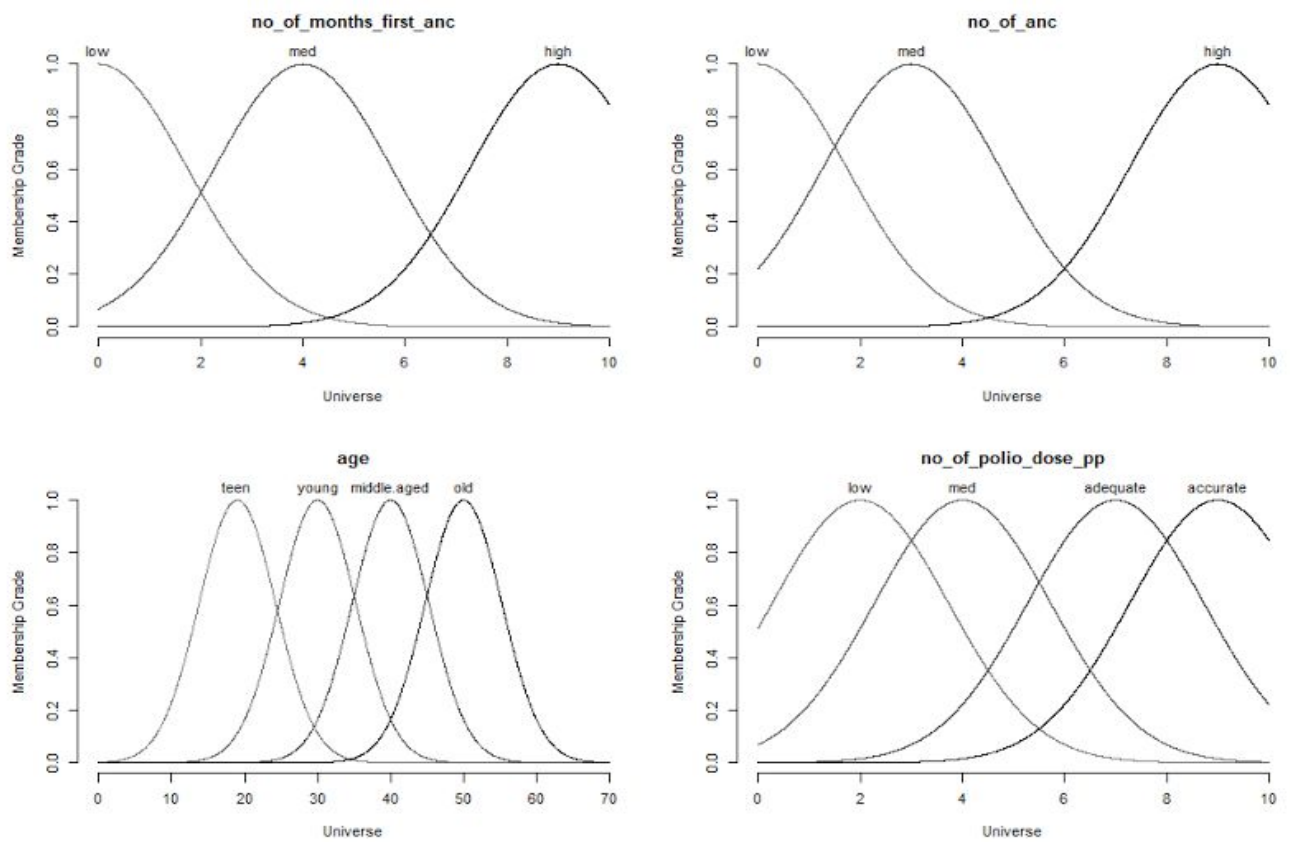


Result Snapshot and its description

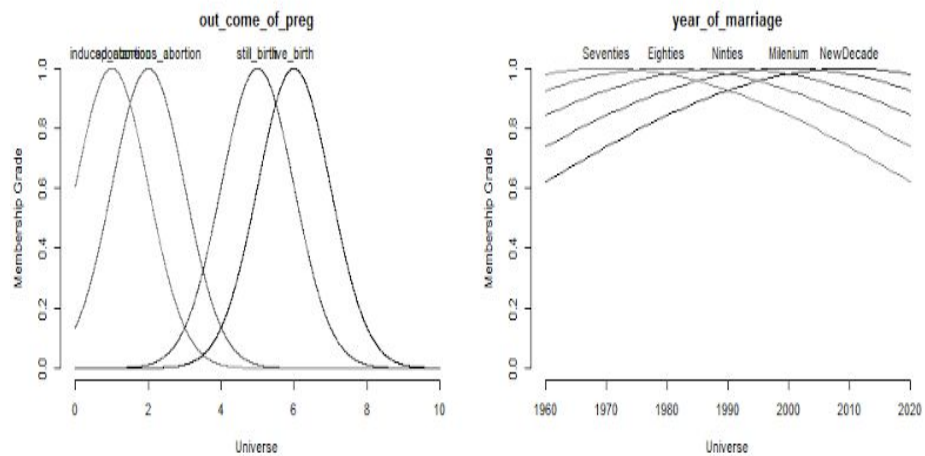
Plot Zoom



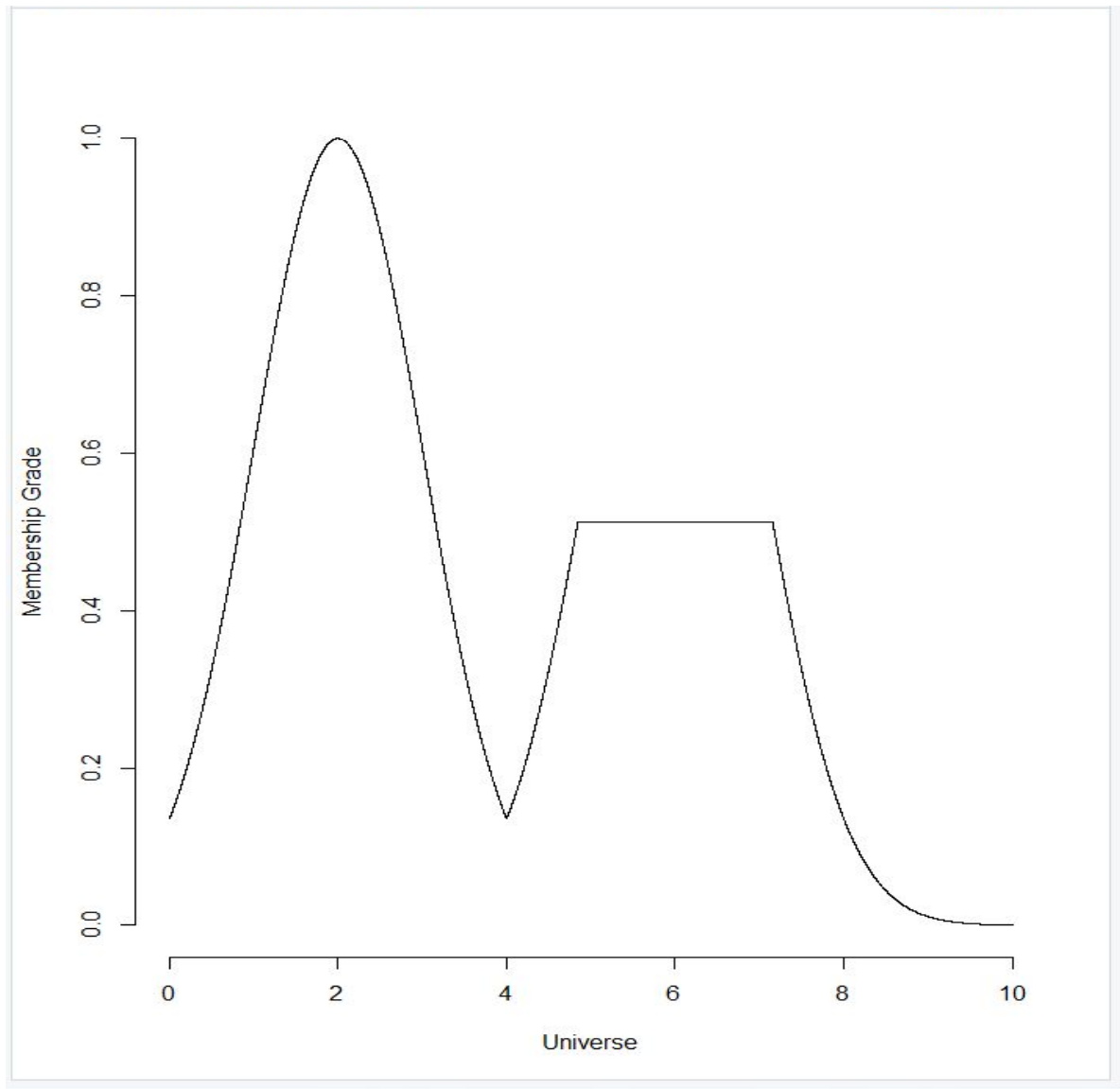
Fuzzification of some of the attributes. (Weight_of_the_baby, difference between pregnancies, financial aid provided by the govt, and the kind of birth.)



Fuzzification of some attributes. (age, polio doses received, antenatal care received.)



Fuzzification of outcome of pregnancy and th year of marriage.



The defuzzification of the outcome of pregnancy from drawn from the fuzzy rules.

```

RStudio
File Edit Code View Plots Session Build Debug Profile Tools Help
Source
Console Terminal
~/
> plot(train$weight_of_baby_kg)
> plot(no)
Error in plot(no) : object 'no' not found
> plot(train$no_of_anc)
> plot(train$no_of_months_first_anc)
> table(is.na(train))

  FALSE  TRUE
120627  8565
> ggplot(mtcars, aes(x=wt, y=mpg)) +
+   geom_point(color='darkblue')
> ggplot(train, aes(x=age, y=out_come_of_preg)) +
+   geom_point(color='darkblue')
> ggplot(train, aes(x=out_come_of_preg, y=age)) +
+   geom_point(color='darkblue')
> ggplot(train, aes(x=out_come_of_preg, y=no_of_anc)) +
+   geom_point(color='darkblue')
Warning message:
Removed 128 rows containing missing values (geom_point).
> ggplot(train, aes(x=out_come_of_preg, y=age)) +
+   geom_point(color='darkblue')
> ggplot(train, aes(x=out_come_of_preg, y=no_of_anc)) +
+   geom_point(color='darkblue')
Warning message:
Removed 128 rows containing missing values (geom_point).
> ggplot(train, aes(x=out_come_of_preg, y=no_of_months_firts_anc)) +
+   geom_point(color='darkblue')
Error in FUN(X[[1]], ...) : object 'no_of_months_firts_anc' not found
> ggplot(train, aes(x=out_come_of_preg, y=no_of_months_first_anc)) +
+   geom_point(color='darkblue')
Warning message:
Removed 128 rows containing missing values (geom_point).
> sd(train$age)
[1] 5.394202
> sd(train$weight_of_baby_kg)
[1] 1.008567
> sd(train$no_of_anc)
[1] NA
> model<-fuzzy_system(variables, rules)
> plot(model)
> example.1 <- fuzzy_inference(model, list(no_of_anc = 4,
+                                           age = 20))
> gset_defuzzify(example.1, "centroid")
[1] 5
> plot(example.1)
> example.1 <- fuzzy_inference(model, list(no_of_anc = 0, no_of_months_first_anc=0
+                                           age = 20))
Error: unexpected symbol in:
"example.1 <- fuzzy_inference(model, list(no_of_anc = 0, no_of_months_first_anc=0
age"
> example.1 <- fuzzy_inference(model, list(no_of_anc = 0, no_of_months_first_anc = 0,
+                                           age = 20))
> gset_defuzzify(example.1, "centroid")
[1] 3.721688
> plot(example.1)
>

```

The defuzzified value for the set of inputs provided.

Social Impact :

Advocates of abortion and early activists seeking abortion law reform, used arguments designed to persuade people that abortion would be beneficial for women in particular, and society as a whole. There have been many healthcare schemes implemented to help the women these women who have no say over their birth of their own child. such as Ladli laxmi yojana, deendayal mobile health care services. CARE India, through its earlier intervention “Join My Village (JMV) Maternal and Neonatal Health” initiative has been working to intensify integrated maternal and newborn health with a focus on assimilating gender interventions in selected districts of Uttar Pradesh. The goal of the project is to improve maternal health by engaging spouse, family and community and empower women from marginalized communities. Below we’ve attached a table showing us the healthcare facilities in the Guna District. This shows us that most of the women prefer to facilitate childbirth at their own homes which might lead to some complications.

Sr.No	Institutional	No.
1.	District Hospital	01
2.	Community Health Centers	06
3.	Primary Health Centers	15
4.	Sub-Health Centers	119

During your pregnancy, you’ll be offered a range of tests, including blood tests and ultrasound scans. These tests are designed to check for anything that may cause a problem during your pregnancy or after the birth. These are the Antenatal Tests. About 88.6% expecting mothers don’t get a complete antenatal care in Madhya Pradesh, making the state the third bad performer in maternal care after Bihar and Tripura in the country, according to the latest National Family Health Survey (NFHS). The survey reveals that only an average 11.4% women get a full antenatal care (ANC) in the state--about 8.3% in the rural areas and 19.5 % in the urban areas against the last time average of 4.7%. Bihar tops the list with the worst 3.3% antenatal care beneficiaries and Tripura follows it with 7.7%.

