Preface

The release of carbon dioxide and other greenhouse gases into atmosphere is on increase since last seven decades or so. Burning fossil fuels for generation of electricity, industrial activities and mobile transportation is responsible for the increase in Earth’s temperature. It is now established that apart from the natural causes, human activities has largely contributed to climate change which has direct effect on human health and ecosystem. The world is witnessing air and water pollution. Air pollution in Beijing, Delhi, Mumbai and so in many other cities has crossed the dangerous levels. “What causes what?” is a very difficult question to answer!

With an overall objective of establishing association between inhaling toxic air pollutants and incidence of respiratory diseases, the environmental professionals and medical practitioners have made significant contribution, using statistical mechanics in modeling epidemiological data, population characteristics, and pollution parameters. Broadly speaking, the studies have shown that the increase in vehicular traffic or mobile transportation on road has been one of the causes of respiratory diseases.

In spite of concerted efforts made to assess the relationship between long term exposure to combustion related fine particulate air pollution and all–cause, lung cancer, and cardiopulmonary mortality using statistical modelling of the parametric numeric data, WHO Special Program on Health and Environment European Centre for Environment and Health Bonn Office 2005, in their document states” there is little evidence for a causal relationship between asthma prevalence/incidence and air pollution
in general, though the evidence is suggestive of a causal association between the prevalence/incidence of asthma symptoms and living in close proximity to traffic”.

We believe that such an important issue could be approached using a different computation scheme wherein the domain expert perception could be modeled using non statistical approach. Why always use long period- say 20 years of data on pollution parameters and test the hypothesis? Instead why not model the knowledgebase of over 20 years of experienced Pulmonologists to arrive at their combined degree of belief and the plausibility, and more importantly, their ignorance in assigning the degree of belief for all the power sets of the respiratory diseases in numeric terms? The approach delineate in the research is simple and does not need much of past data which might sometimes be a happenstance data. Decision making process in a real world is invariably based on perceptions which are expressed in words or may be in numeric terms and not in probability terms.

In the research, an attempt has been made to model the perceptions of experienced pulmonologists in arriving at their combined degree of belief/plausibility/ignorance for all the possible combinations of identified respiratory diseases, using evidence theory and fuzzy relational calculus without collecting sizeable parametric data accumulated over a period of years.

The sequel also demonstrates the application of the computational formalism of fuzzy inference system with a degree of match concept—a level 1 complexity in computing with words for classifying air quality straightway in linguistic term with a linguistic degree of certainty attached to each description. The developed formalism is known as Zadeh-Deshpande formalism.

The exhaustive case study relates to classifying air quality in 14 cities with a total of 51 monitoring locations in Maharashtra State, India. It could be stated that straightway describing air quality in linguistic term based on the new formalism is in
agreement with the linguistic classification via conventional air quality index method. The study also concludes that the variability in experts’ perception on describing air quality varies from 80 to 98%.

The highlights of the research could be summarized as follows:

- Research efforts in cause-effect relationship between inhaling polluted air and respiratory diseases
- A new formalism in assessment of air quality straightway in linguistic terms instead of computing Air Quality Index (AQI)
- Modelling domain expert’s perception using non statistical approach
- No exhaustive past data required
- Application of Dempster-Shafer Theory of Evidence
- Ranking of experts perception using fuzzy relational calculus
- Fuzzy Logic based perception based modelling using ZD formalism
- Introducing the concept of “reference group” to compute weighting factor in FCM
- Practical application in clustering fifteen polluted cities in India