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DATA MINING TECHNIQUES FOR INTRUSION DETECTION: A REVIEW

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ABSTRACT

With significant advancement of web, security of system activity is turning into a major issue PC system framework. Cyber attacks on system are expanding day-by-day. Intrusion is considered as most pitched attack on system traffic. Intrusion recognition framework has been utilized for finding out intrusion and to protect the security objectives of data from attacks. Data mining systems are utilized to screen and investigate extensive measure of system information and group this system information into anomalous and typical information. Since information originates from different sources, system traffic is substantial. Data mining methods such as classification and clustering are connected to design of intrusion detection framework. A viable Intrusion detection framework requires high recognition rate, low false caution rate and additionally high precision. This paper exhibits the audit on IDS and diverse Data mining methods connected on IDS for the powerful detection of pattern for both malicious and typical activities in the system, which creates secure data framework. This paper also presents two distinct clustering algorithms known as K-Means Clustering and Hierarchical Clustering Algorithm. K-Means clustering results indegeneracy and is not suitable for large databases.

INTRODUCTION

Data mining technology has been emerged as a means for identifying patterns and trends from large quantities of data. It is a withdrawal of hidden predictive information or knowledge from large databases. In Intrusion Detection System, information comes from various sources like online data, network log data, alarm messages etc. Since the variety of different data sources is too complex, the complexity of the operating system also increases. Also, network traffic is huge, so the data analysis is very hard. The data mining technology have the capability of extracting large databases; it is of great importance to use data mining techniques in intrusiondetection. By applying data mining technology, intrusion detection system can widely verify the data to obtain a model, thus helps to obtain a comparison between the abnormal pattern and the normal behaviour pattern. An important problem in intrusion detection is how effectively it can separate the attack patterns and normal data patterns from a large number of network data and how effectively it generates automatic intrusion rules after collected raw network data. To accomplish this various data mining techniques are used [16].

Instruction Detection System

Data security is essential for all organizations furthermore for home PC people. This security is required as every single noteworthy information is transferred and oversaw on the web. Subsequently it is essential to spare data from interlopers. Client requires checking best procedure to spare the framework from unmistakable sorts of attacks. Intrusionis a sort of attack. In various territories it is said by particular name. For instance in deficiency like any unapproved client login into other client profile, information driven assaults on applications, illicit access to mystery data, assaults against helpless administrations, host-based assaults like benefit heightening and numerous different infections like, Trojan stallions or worms and so on. The yield of any framework is transfer upon its execution; integrity, accessibility and privacy, so these sorts of Intrusions specifically attack on these variables to minimize framework execution.Instruction Detection System it is unrealistic to outline a totally secure framework. So a framework known as Intrusion Detection Systems (IDSs) is intended to improve security of PC framework [1]. To keep any further harm, an IDS is used to check, evaluate and report unlawful or unapproved system work with goal that important moves might be made to spare information [2]. Transfer on wellspring of information, IDS is isolated into 2 sorts;

Network-based - Network intrusion detection systems (NIDSs) finds network packets collected from a network segment.
Host-based - Host- based intrusion detection systems (HIDSs) for instance IDES (Intrusion Detection Expert System) [3] finds audit trails or framework calls generated by individual hosts.

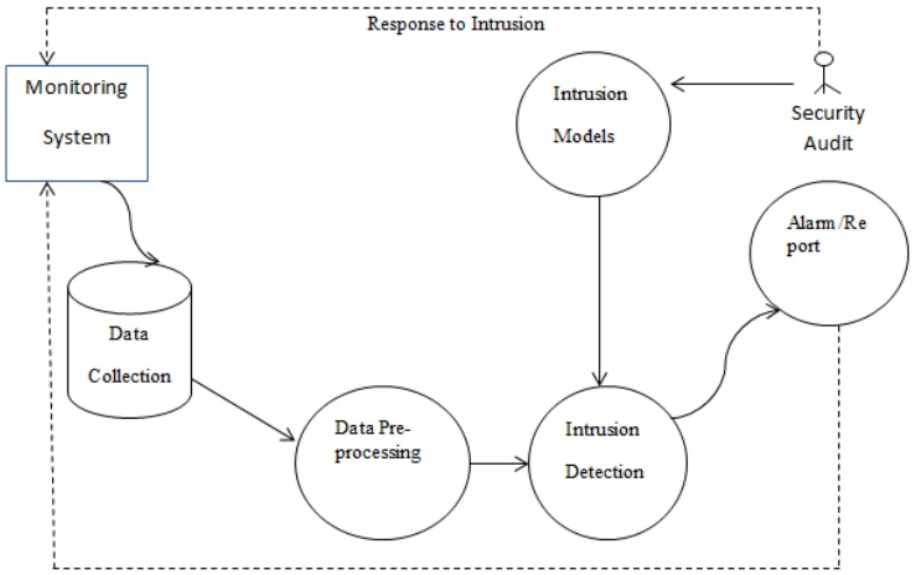

Figure1: Overall structure of Intrusion Detection System

1.1 Types of IDS

IDSs can likewise be ordered by recognition approaches they utilize. Essentially, there are two recognition techniques: misuse detection and anomaly detection. The significant reverence between the two techniques is that misuse detectiondistinguishes intrusions in view of components of known attacks while abnormality recognition dissects the properties of ordinary conduct. IDSs that utilize both recognition strategies are called hybrid detection-based IDSs. Case of hybrid detection-based IDSs are

Hybrid NIDS utilizing Random Forests [4] and NIDES [5]. The accompanying subsections clarify the two detection approaches.

1.1.1 Misuse Detection

Misuse detection gets intrusion as far as the attributes of known attacks. Any activity that complies with the example of a referred to attack or helplessness is considered as intrusive. The fundamental issues in abuse recognition framework are the manner by which to compose a mark that incorporates every single conceivable variety of the related attacks. Furthermore, how to compose marks that doesn‟t likewise coordinate non-nosy movement. Block diagram of abuse based recognition framework is as taking after. Abuse recognition distinguishes interruptions by coordinating checked occasions to examples or signature of assaults. The attack signatures are the qualities connected with effective known attacks. The real favorable position of abuse identification is that the strategy has high exactness in identifying known attacks. Be that as it may, its recognition capacity is restricted by the signature database. Unless new assaults are changed into signatureand added to the database, abuse based IDS can't recognize any assault of this write. Deferent procedures, for example, master frameworks, signature investigation, and state move examination are used in misuse detection.

1.1.2 Anomaly Detection System

It depends on the typical conduct of a subject (e.g. a client or a framework). Any activity that altogether goes amiss from the ordinary conduct is considered as intrusive. That implies on the off chance that we could set up an ordinary movement profile for a framework, then we can signal all framework states shifting from built up profile. There is a vital distinction between anomaly based and misuse based strategy that the anomaly based attempt to distinguish the compliment of terrible conduct and misuse based recognition framework attempt to perceive the known awful conduct. For this situation we have two potential outcomes: (1)False positive: Anomalous exercises that are not intrusive but rather are flagged as intrusive. (2) False Negative: Anomalous exercises that are intrusive yet are flagged as non-intrusive. The square graph of inconsistency location framework is as taking after:

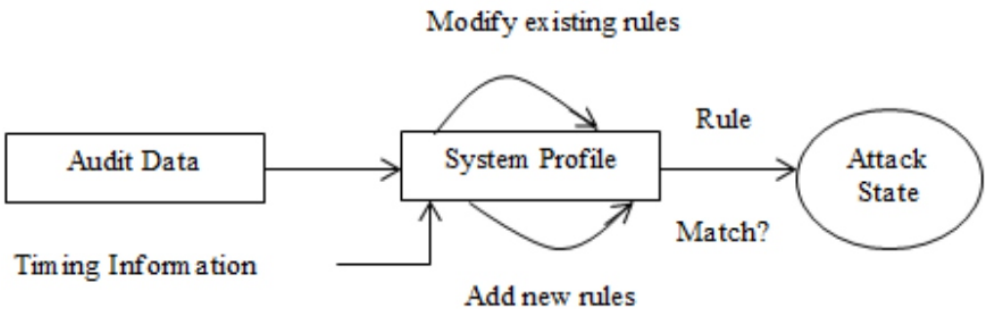

Fig 1.1 Misuse Detection Systems

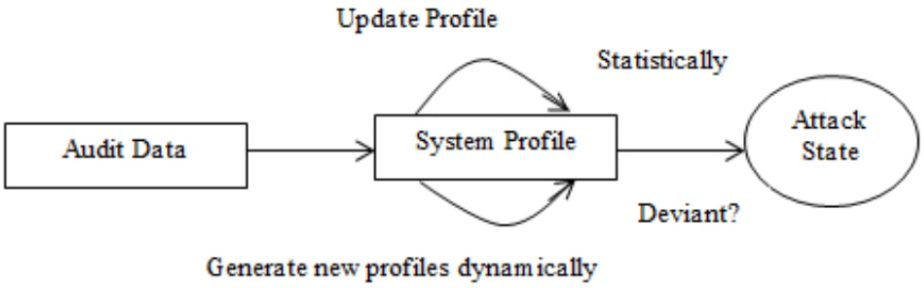

Fig 1.2 Anomaly Detection Systems

TABLE 1
Comparison between Misuse Detection and Anomaly Detection

Misuse Detection Systems	Anomaly Detection Systems
Advantages	**Advantages**
High detection rate, Accuracy for known behaviors	Can examine unknown and more complicated intrusions
Simplest and effective method	Rate of missing report is low
Low false alarm rate	Detect new and unforeseen voluntaries
Disadvantages	**Disadvantages**
It can detect only known attacks	Needs to be trained, and trained model carefully otherwise it tends to false positive
Need a regular update of the rule which are used	Low detection rate and high false alarm rate
Often never differentiate between an attack attempt and a successful attack	It can't identify new attack
Rate of missing report is high	intrusion detection depend upon new model

Data Mining Techniques for Network Intrusion Detection

Numerous analysts have researched the organization of data mining algorithms and systems for intrusion detection [13,15-23, 32,33]. Cases of these methods incorporate in [16-18]:

Feature selection data analysis:The fundamental thought in features determination is to evacuate highlights with practically no prescient data from the first arrangement of components of the review information to frame a subset of suitable elements [24]. Feature selection altogether decreases computational multifaceted nature coming about because of utilizing the full unique list of capabilities.

Classification analysis: The objective of arrangement is to appoint objects (intrusions) to classes in view of the estimations of the item's elements. Classification algorithms can be utilized for both misuse and anomaly detections [16]. In misuse detection, system movement information are gathered and named as "ordinary" or "intrusion". In anomaly detection, the typical conduct model is found out from the preparation dataset that are known not "ordinary" utilizing learning algorithms.

Clustering analysis:Clustering appoint objects (interruptions) to gatherings (groups) on the premise of separation estimations made on the items. Rather than order, clustering is an unsupervised learning

process subsequent to no data is accessible on the names of the preparation information. In inconsistency recognition, bunching and exception examination can be utilized to drive the ID model [16].

Association and correlation analysis:The principle target of association rule investigation is to find affiliation connections between particular estimations of elements in substantial datasets. This finds concealed examples and has a wide assortment of uses in business and exploration. Association rules can choose separating qualities that are valuable for intrusion detection. It can be connected to discover connections between framework traits depicting system information. New qualities got from amassed information may likewise be useful, for example, summary counts of trafficmatching a particular pattern.

Stream data analysis: Intrusions and malicious attacks are of element nature. In addition, information streams may identify intrusions as in an occasion might be typical all alone, yet thought to be malignant if saw as a feature of a succession of occasions [16]. In this way, it is important to perform intrusion detection in information stream, constant environment. This recognizes arrangements of occasions that are habitually experienced together, find consecutive examples, and distinguish exceptions.

iIntruders can work from a few unique areas and assault a wide range of destinations. Distributed data mining techniques might be used to break down system information from a few system areas, this distinguishes disseminated assaults and keep aggressors in better places from hurting our information and assets.

Visualization and querying tools: Visualization data mining devices that incorporate components to view classes, affiliations, bunches, and exceptions can be utilized for review any strange examples identified. Graphical UI connected with these apparatuses permits security investigators to comprehend intrusion detection results, assess IDS execution and settle on future upgrades for the framework.

LITERATURE SURVEY

Memon V I et al. [6] introduced work is a gathering of three data mining techniques to diminish false alarm rate in IDS that is known as a hybrid IDS which has k-Means, K-closest neighbor and Decision Table Majority strategy for anomaly detection. Displayed hybrid IDS assessed over the KDD-99 Data set; such kind of information set is utilized worldwide for computing the execution of different IDS. At first bunching executed by means of k-Means over KDD99 information sets then executed two-arrangement technique; KNN took after by DTM. The introduced framework can distinguish the intrusions and classify them into four sorts: Remote to Local (R2L), Denial of Service (DoS), User to Root (U2R) and Probe.

Wankhade K et al. [7] displays a hybrid data mining approach incorporating feature selection, clustering, bunching, partition and consolidation and grouping outfit. A methodology for assessing the quantity of the group centroid and selecting the appropriate early bunch centroid is exhibited.

Dhakar M et al. [8], in context to improve execution, the work displays a model for IDS. This enhanced model, known as REP (Reduced Error Pruning) based IDS Model provides yield with more noteworthy exactness alongside the expanded number of legitimately grouped occasions. It utilizes the two classification of grouping methodologies to be specific, K2 (BayesNet) and REP (Decision Tree). Here

REP gives a powerful grouping alongside the pruning of tree with speedy choice learning ability.

Zubair Md. Fadlullah et al. [9], in this article, they highlighted the significance on outlining suitable intrusion detection frameworks to battle assaults against cognitive radio systems. Additionally, we proposed a basic yet viable ID, which can be effectively actualized in the auxiliary clients' cognitive radio programming. Authorsdesigned IDS utilizes non-parametric cusumalgorithm, which offers anomaly detection. By taking in the typical method of operations and sys-tem parameters of a CRN, the proposed IDS can distinguish suspicious (i.e., strange or anomalous) conduct emerging from an attacks. Specifically, we displayed a case of a jamming attack against a CRN auxiliary client, and exhibited how our proposed IDS can identify the assault with low recognition latency. In future, their work will perform further examinations on the most proficient method to upgrade the detection sensitivity of IDS.

MueenUddin,et al [10], This paper has concentrated on the proficiency and execution of new IDS: known as signature-based multi-layer IDS utilizing mobile agents. It then talks about the advancement of another signature based ID utilizing mobile agents. The proposed framework utilizes mobile agents to exchange rule-based signatures from substantial reciprocal database to little signature database and after that consistently overhaul those databases with new signatures recognized.

R. China Appala Naidu et al. [12] utilized three Data mining systems SVM, Ripper rule and C5.0 tree for Intrusion detection furthermore looked at the proficiency. By test result, C5.0 decision tree is proficient than other. All the three Data mining system gives higher than 96% detection rate.

RoshanChitrakar et al. [13] Proposed a hybrid approach to intrusion detection by utilizing kModelIDS grouping with Naïve Bayes classification and watched that it gives preferred execution over K-Means clustering procedure took after by Naïve Bayes classification additionally time unpredictability increments when expand the quantity of information focuses.

RoshanChitrakar et al. [14] proposed a hybrid approach of consolidating k-methodclustering with Support Vector Machine Machineprocedure and delivered better execution contrasted withk-model IDS with Naïve Bayes classification. The methodology demonstrates change in both Accuracy and Detection Rate while diminishing False Alarm Rate when contrasted with the kmodel ids grouping approach took after by Naïve bayesclassification procedure.

SumaiyaThaseen et al. [15] Analyzed distinctive tree based characterization systems for IDS. Exploratory results demonstrate that Random tree model lessens false alert rate and has most elevated level of accuracy.

ALGORITHM

K-Means: K-Means algorithm is veryfamoustechniqueof clustering checking that motive to divide „n“ information objects into „k“ clusters in which each information object refers to cluster with nearest mean. It utilizes Euclidean metric as anequal measure. Distance equation to find distance among2 objects is:

$$L(x,y) = L(y,x) = |x-y| = \sqrt{\sum_{j=1}^{m}(xj-yj)^2}$$

Procedure K-Means

Step 1: Choose k objects from L as initial cluster centers
Step 2: Assign every object to cluster according to mean value of objects in cluster.
Step 3: Update cluster means, i.e., calculate mean value of objects for everycluster.
Step 4: Until no change

Important properties of K-Means algorithm:

1. Efficient in processing large data sets.

2. Works only on numerical values.

3. Clusters have convex shapes.

Hierarchical Clustering

In suggested agglomerative clustering scheme, start by Mclusters at level q=1 as given by optimized GGM model of $l(s)$which in case of supervised learning is$l\,(s) = \sum_{d=1}^{A}\sum_{M=1}^{M_d} l\big(s|m,d\;L\,(m)L(d)\big)$where M_d is optimal number of components forClass$d$. At everylargerstage in hierarchy two clusters iscombineddepends on aequalitymeasure among pairs of clusters. Processis repeated until we reach one cluster attop level. That is, at level $q = 1$ there are M clusters and 1 cluster at last level,$l = 2M - 1$. let$l_q\ (s|m)$be density for $k'th$ cluster at level$q$ j and $l_q\,(m)$as its mixingproportion, i.e., density model at level j is $l\,(s) = \sum_{m=1}^{M-q+1} L_q\,(m)L_q(s|q)$If clusters m and n at level q are merged into$g$at level $q+1$ then.

$$l_{q+1}(s|g) = \frac{l_q(s|m)\,.\;l_q(m) + l_q(s|n)\,.L_q(n)}{L_q(m) + L_q(n)}\,, L_{q+1}(g) = L_q(m) + L_q(n)$$

Natural distance measure among cluster densities is Kullback-Leibler (KL) divergence[11], since it reflects dissimilarity among densities in probabilistic space.Problem is that KL only obtains an analytical expression for first level in hierarchy while distances for subsequently levels have to be approximated.

Conclusion

Since investigation of intrusion detection started to pick up energy in the security group approximately ten years ago, various differing thoughts have developed for standing up to this issue. Intrusion detection frameworks differ in the sources they use to acquire information and in the particular methods they utilize to examine this information. Most frameworks today group information either by misuse detection or anomaly detection: every methodology has its relative merits and is joined by an arrangement of restrictions. It is likely not reasonable to expect that an intrusion detection framework be prepared to do effectively grouping each occasion that happens on a given framework. Immaculate discovery, similar to impeccable security, is basically not a feasible objective given the many-sided quality and quick advancement of current frameworks. An IDS can, in any case try to lift the bar for intrusion or attacks by plunging the viability of enormous classes of interruption or assaults and rising the work issue required to get a framework compromise. A decent intrusion detection framework guarantees to permit more prominent trust in the aftereffects of and to enhance the scope of intrusion detection, making this a basic segment of any exhaustive security architecture.

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INVESTIGATION OF QUALITY IN REDISTILLED DIESEL FUEL

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ABSTRACT

Generally, the ignition quality of diesel fuel is quantified by the Cetane number. Cetane number of diesel fuel is a measure of the fuel's delay of ignition time. Delay time is the amount of time between the injection of fuel into the combustion chamber and the actual start of combustion of the fuel charge. A parameter called Calculated Cetane Index (CCI) based on the distillation curve of diesel fuel is widely used in the diesel fuel operated automobiles. The CCI gives reasonable assessment of the cetane number. In this research, diesel fuel was re-distilled and mixed with super diesel according to knowing fraction. Then find the cetane index and that given higher value than existing cetane number of diesel. Again diesel mixed with gasoline and finds the cetane index. Compare the all cetane values of samples individually. An attempt was made in this exercise to assess the influence of redistilled diesel fuel quality on exhaust emissions. The emission concentration and the noise level were compared with the re-distilled diesel fuel with ordinary diesel fuel. It was revealed that the soot emission concentration is low, when the engine is running on redistilled diesel fuel.

Keywords: Cetane Number, Calculated Cetane Index (CCI), Re-distilled Diesel Fuel

INTRODUCTION

Diesel is a very important automobile fuel used in heavy and light vehicles. Diesel is produced from petroleum (hydrocarbon mixture) by using the fractional distillation of crude oil between 200 °C and 400 °C at atmospheric pressure after distillation on gasoline and kerosene features of diesel fuel. The density of petroleum diesel is about 0.85 kg/l whereas gasoline has a density of about 0.72kg/l, about 15% less. When burnt, diesel typically release about 38.6MJ/l, whereas gasoline released 34.9 MJ/l, about 11% less. Petroleum-derived diesel is composed of about 75% saturated hydrocarbons (primarily paraffins including n-, iso-, and cycloparaffins), and 25% aromatic hydrocarbons (including naphthalenes and alkylbenzenes). The average chemical formula for common diesel fuel is $C_{12}H_{23}$, ranging from approximately $C_{10}H_{20}$ to $C_{15}H_{28}$.

In the spark ignition engine the fuel and the air are supplied pre-mixed to the cylinder. But in a diesel engine the fuel is not injected into the air until shortly before top dead center (TDC). Consequently, there is considerably less time for completion of the mixing and evaporation processes. Furthermore, the diesel engine is controlled by regulating the quantity of fuel injected per induction stroke. Because diesel engine having no throttle valve. The fact that ignition cannot occur until the temperature generated by compressionis high enough to operate them. Therefore, it becomes obvious that fuel quality is even more important for the diesel fuel than the spark ignition engine.

Generally, the ignition quality of diesel fuelmainly depends on the quality of diesel fuel. But the quality of diesel depends on the cetane number. Cetane number of diesel fuel is a measure of the fuel's delay of ignition time. Delay time is the amount of time between the injection of fuel into the combustion chamber and the actual start of combustion of the fuel charge. The aim of the project is to assess the influence of redistilled diesel fuel quality on exhaust emissions. It is known that diesel fuel and other hydrocarbon fuels are received from crude oil after fractional distillation process. Hence the term "redistilled diesel fuel" for this new distilled diesel fuel will be used.

Cetane number is defined as the percentage of *n*-cetane + 0.15times the percentage of heptamethylnonane contents of the blend of reference fuel having the same ignition quality as the fuel under test. Ignition quality is determined by varying the compression ratio to give the same ignition delay period for the test fuel and two blends of reference fuels. The cetane index is calculated from API (American Petroleum Institution) gravity and volatility.

But this value originally was taken as represented by its mid-volatility, or mid-boiling point (50% recovery temperature, T50).Then cetane number is very important in explain of diesel engine performance, which is similar to the octane number rated ignition stability of gasoline engine.

2. LITERATURE SURVEY

Distillation is an important commercial process that is used in the purification of a large variety of materials. The process of heating a substance until it is vaporized, cooling the vapors, and collecting the condensed liquid is the base of a commonly used purification technique called distillation. The process by which a substance is transformed from the condense phase to the gas phase. For liquid, this process is called vaporization and for solid it is called sublimation. Both processes require heat to change their phases. Both vaporization and sublimation are process that can be used to purify compounds. Also determination of vapor pressure and boiling point is very important for distillation.

There are three main distillation processes available in industry and laboratory situations. Distillation processes are specified according to their distillation substance and distillation temperature ranges.

- Simple Distillation
- Vacuum Distillation
- Fractional Distillation

Therefore simple distillation process will be used for distillation of diesel fuel. Simple distillation method is used to distillate low and some special boiling point liquids, as such as water and some hydrocarbons. It has low boiling point. Boiling point is the very important property of any liquid for distillation. Simple distillation process consists of the thermometer, the distillation head distillation flask, heat element and the arrangement of the flow of the cooling water (condenser).

Gasoline and diesel engines are a major source of the urban air pollution. The exhaust gases from these engines contain oxides of nitrogen (nitric dxide –NO, and nitrogen dioxide-NO_2, collectively known as No_x), carbon monoxide (CO) and organic compounds, which are un-burnt or partially burnt hydrocarbon (C_xH_y).

The emission of hydrocarbons from a diesel engine is at a significant level though it is lower than the emission of hydrocarbon from a typical gasoline engine. Diesel engines convert the chemical energy contained in the fuel into mechanical energy. Diesel fuel is injected under pressure into the engine cylinder where it mixes with air and where the combustion occurs. The exhaust gases which are discharged from the engine contain several constituents that are harmful to human health and to the environment. Following table given typical output emissions of the basic toxic material in diesel fuel.

The lower values can be found in new, clean diesel engines, while the higher values are characteristic of older diesel engines. Soot and noise are other main emission characteristics of the diesel fuel. The soot mainly depends on the cetane number and other various factors.

Table 1: Emissions of Diesel fuel

Cetane Index

Cetane index is a calculated quantity that is intended to approximate the cetane number. There are two methods of computing the cetane index and it represented by equation 1, 2.

Method - 01

Equation 01

$$Cetane\ Index\ = 454.74\ -\ 1641.416D\ + 774.74D^2\ -\ 0.554\,T50\ +\ 97.603\,[log_{10}(T50)]^2$$

Where,

D – Fuel density at 150 ◦C
T50 – The temperature corresponding to the 50% point on the distillation curve in degree celsius

Method – 02

Equation 02

$$Cetane\ Index = 45.2 + 0.0892(T10N) + 0.131(T50N) + 0.0523(T90) + 0.901B(T50N) - 0.420B(T90N) + 4.9 \times 10^{-4}(T10)^2 - 4.9 \times 10^{-4}(T90)^2 + 107B + 6B^2$$

Where,

T10N=T10-215

T50N=T50-260

T90N=T90-310

When T10, T50 and T90 are temperatures at 10%, 50%, and 90% volume distilled in degree celsius

$$B = \{\exp(-3.5DN)] - 1$$

When DN = density at 150 ◦C (kg/l) – 0.85

3. OBJECTIVES

A parameter called Calculated Cetane Index (CCI) based on the distillation curve of diesel fuel is used in the automobile industry. The CCI gives a reasonable assessment of the Cetane number. In this research going to measure CCI in re-distilled and remixed diesel fuel.

In this project, an attempt will be made to assess the influence of redistilled diesel fuel quality on exhaust emissions. The emission concentration and the noise level were compared for the re-distilled diesel fuel with ordinary auto diesel. This study will be conducted as a screening analysis to determine cetane number of redistilled diesel fuel, which was mixing same quantity in all fractions (10% to 90%) and could have an impact on the engine performance and emission in diesel vehicle. This research will be developing emission free diesel fuel by using the ordinary diesel fuel with distillation method. This will be introduced proper diesel fuel and emissions identification method, which was mainly concern about soot content in redistilled diesel fuel. Finally, I will be comparing the noise level of the distilled diesel fuel and ordinary diesel fuel by using diesel engine.

4. METHODOLOGY

The apparatus of the system was arranged as indicated in following figure 1. A 200ml of normal diesel and boiling chips were put in to a 250 ml distillation flask and distillation was started. Boiling chips are used to accelerate vaporization.

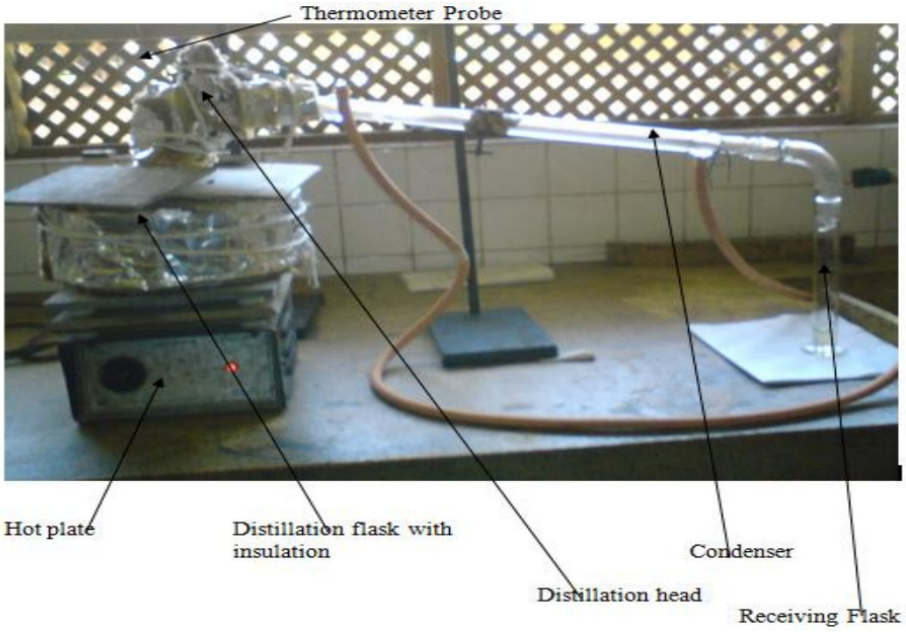

Figure 1: Complete Experimental Distillation System

Distillation head and insulating cup (around the distillation flask) were fully insulated for reduce heat dissipation to the environment. The distillation flask was dipped into the sand bath which is shown in figure 1.Temperature of distillation flask was measured by a thermometer, when the first drop fallen into the receiving flask.

Thermometer Specifications

Digital thermocouple thermometer, working range -250 °C to 400 ° Caccuracy of thermometer

Below -238 ° F (-150 ° C)

+ or – 0.25%

Above -238 ° F (-150 ° C)

+ or – 0.1%

After that, inside temperature of the distillation flask was measured, when the receiving flask was filled with 20ml of distilled diesel. That was 10% of the initial diesel quantity in receiving flask. Then take the average of both temperature values as a distillation temperature. Continue the same procedure until finishing diesel amount inside the distillation flask. The distilled diesels mixed with gasoline and super diesel and continue same procedure. Then again temperature was measured and samples were collected according to separate fractions. Analysis of Distillation curve with temperature in redistilled diesel, diesel mixed with gasoline and super diesel. Investigate the effect of exhaust emission each diesel categories. The noise level for each fuel categories was analyzed. The performance of vehicle was investigated with each fuel categories.

5. OBSERVATION

Total observation summery

Table 2: Experimental Data in Diesel, Super Diesel and mixture of Diesel & Gasoline

Fuel Type	Test No	Fraction (%)										
		0	10	20	30	40	50	60	70	80	90	100
Normal Diesel	1	163	259	274	291	301	316	330	348			
	2	170	265	284	301	311	330	348				
	3	208	251	270	285	299	316	328	346	370		
	4	173	264	279	293	307	323	341				
	5	175	262	283	296	310	320	330				
	6	198	274	291	304	317	329	345	366	390		
	7	190	265	287	302	313	327	345	366	389		

	8	190	270	290	301	315	325	338	356	376	397	
Super	1	184	223	251	272	289	304	320	335	354	376	
Diesel	2	163	221	253	268	286	303	320	340	358	380	
Diesel mix with Gasoline	1	183	255	273	296	305	315	325	339	355	372	395

2. Soot analysis

This is the main part of my project, which is the analysis the soot of diesel engine.

Specification of Vehicle:

Model = Mazda T3500, Canter, four-cylinder, overhead-valve engine, Inline Pump

Manufacturing year = 1990

Cylinder Bore = 100 mm

Cylinder Stroke = 110 mm

Engine Power = 66.2 kW

Rated Speed = 2000 rpm

Maximum Torque =227Nm

Fuel type =Diesel (Naturally aspirated)

Specification of noise Meter

Frequency range = 20Hz – 8 kHz

Measuring Level =30dB – 130dB

Operating Temperature= 0 °C – 40 °C

Accuracy = + or – 1.5 dB

According to standard specification of diesel soot [10]

Maximum K value 2.50 m^{-1}

K: - Index of absorption (density) of smoke (m^{-1})

Normal diesel

Table 3: K values of ordinary diesel in Step 01

min^{-1}	rpm	s	K max (m^{-1})
690	3640	0.9	3.88
700	3640	0.7	5.76
700	3700	1.0	3.67

Maximum Deviation = 2.09 m^{-1} Mean Value = 4.44 m^{-1}

Table 4: K values of ordinary diesel in Step 02

min^{-1}	rpm	s	K max (m^{-1})
690	3670	0.8	3.93
690	3670	0.8	2.94
700	3710	0.9	3.29

Maximum Deviation = 0.99 m^{-1}
Mean Value = 3.38 m^{-1}

Distillation diesel

Table 5: K values of re-distilled diesel in Step 01

min^{-1}	rpm	s	K max (m^{-1})
650	3320	0.7	1.32
660	3460	0.8	3.14
670	3310	0.8	1.53

Maximum Deviation = 1.61 m^{-1}
Mean Value = 1.99 m^{-1}

Table 6:K values of re-distilled diesel in Step 02

min^{-1}	rpm	s	K max (m^{-1})
650	3450	0.8	2.17
650	3380	0.8	2.29
650	3440	1.0	2.09

Maximum Deviation = 0.20 m^{-1}
Mean Value = 2.18 m^{-1}

3. Noise Analysis

Noise of the enginewas measured by using noise meter that located in four side of the engine.

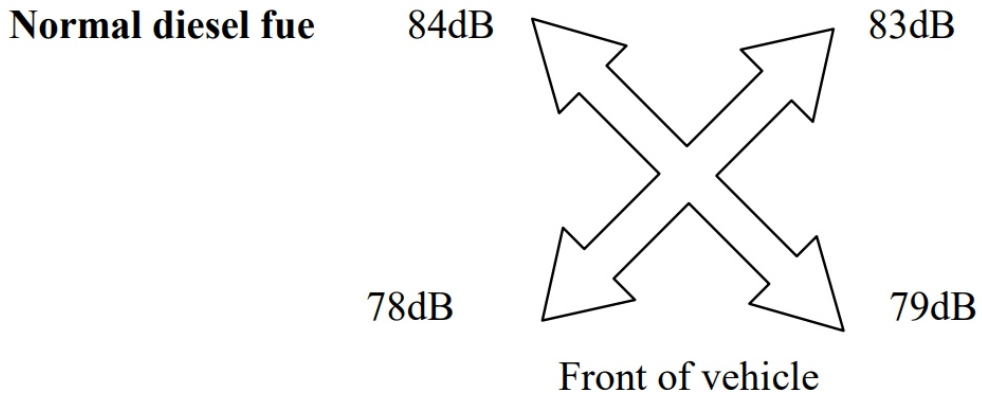

Figure 1: Noise level of normal diesel

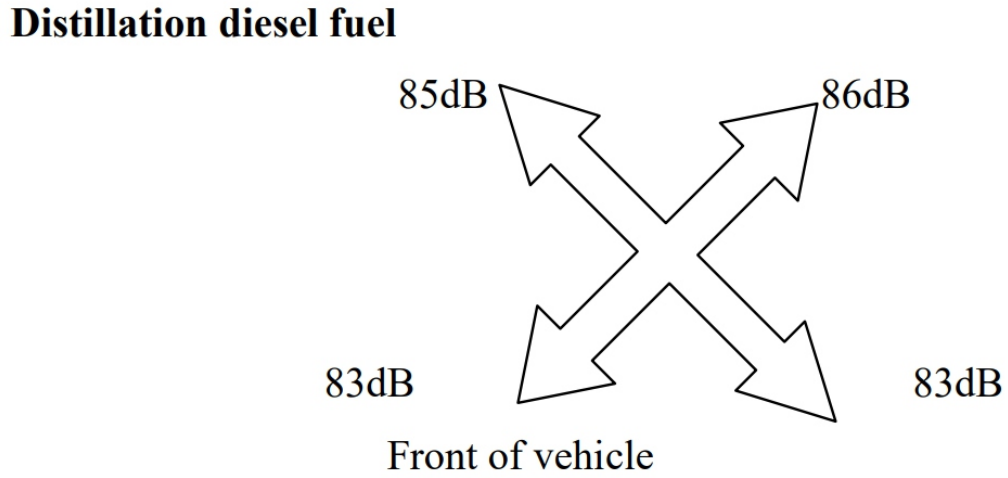

Figure 2: Noise level of distillation diesel

6. CALCULATIONS

Following equation is used for calculate cetane index in each samples. This equation was developed in MS excel platform according to theory.

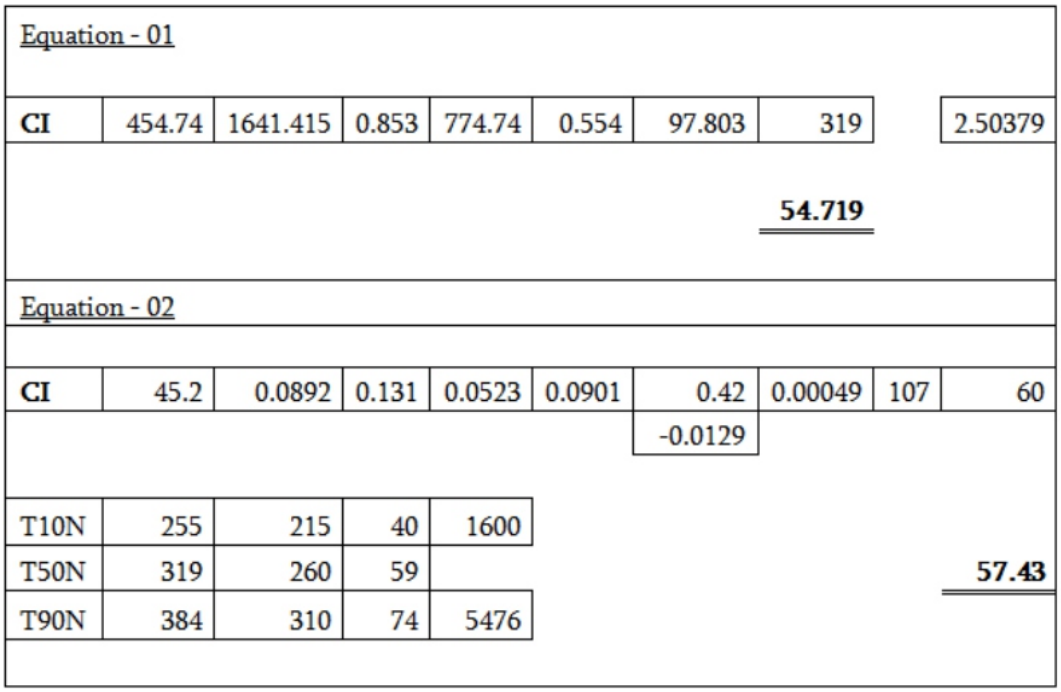

Figure 3: MS excel based mathematical equationwith sample calculation

7. RESULTS

Summary of Calculation

Table 7: Summary of Cetane Index Values

Sample / Method	1	2	3	4	5	6	7	8	SD 9	SD 10	Average
CI -1	54.0	55.6	54.0	55.0	54.7	55.7	55.3	54.9	52.4	52.7	**54.7**
CI - 2	57.6	60.1	56.5	59.1	58.4	61.3	59.8	59.9	51.9	51.6	**57.4**

CI – Cetane Index calculated method 1and 2
SD – Super Diesel

Table 07 is shown in calculated values of cetane index for each sample. There are the maximum values in data range. Therefore I selected data range is 10% to 90%. Now we can tabulate the data for average value of the temperatures and fractions. Then drawn graphs by using tabulated data for various samples. Therefore select the sample 03 and sample 08 for draw the graphs.

Cetane index values are calculated for various fraction ranges, which are 10% to 50%, 20% to 70%, 10% to 90% etc. Since, from 10% to 90% fraction range were given most optimal or maximum values for cetane index. There for, it is the most suitable fraction of this experiment.

Table 08 : Temperatures for Average Diesel Fuel, Average Super Diesel and mixture of diesel & gasoline samples according to fraction

Fraction %	Temperatures (Average normal diesel sample)	Temperatures (Super diesel sample)	Temperatures (Mixture of normal diesel and Gasoline)
0	181	174	183
10	255	222	255
20	276	252	273
30	291	270	296
40	305	288	305
50	319	304	315
60	335	320	325
70	351	338	339
80	373	356	355
90	384	378	372
100	Not accepted	Not accepted	395

Table 08 is shown in temperatures with fraction in normal diesel, super diesel and mixture of normal diesel and super diesel samples. Then plot the distillation curves for each sample and analysis boiling ranges in these curves.

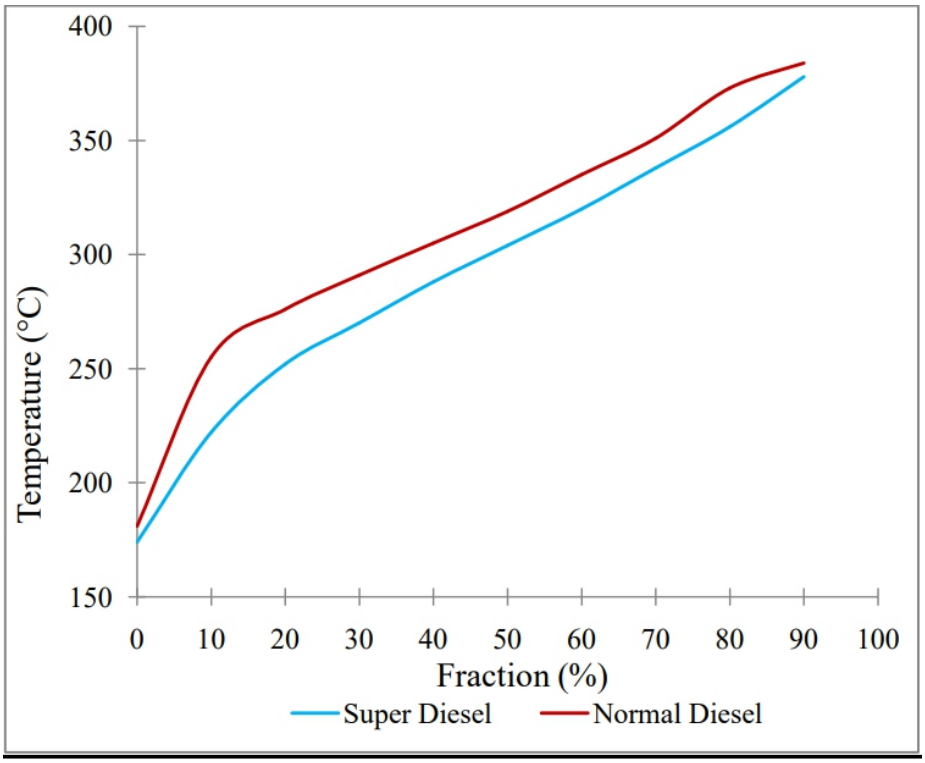

Figure 4 Distillation curves for Normal diesel and super diesel

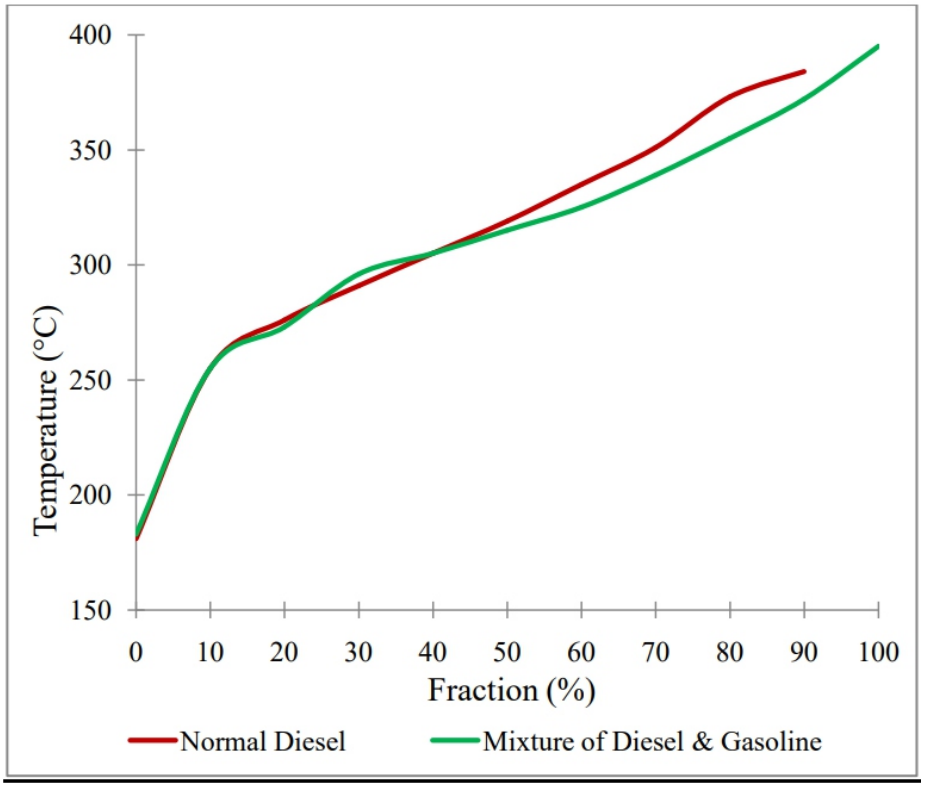

Figure 5 Distillation curves for Normal diesel and mixture of diesel & gasoline

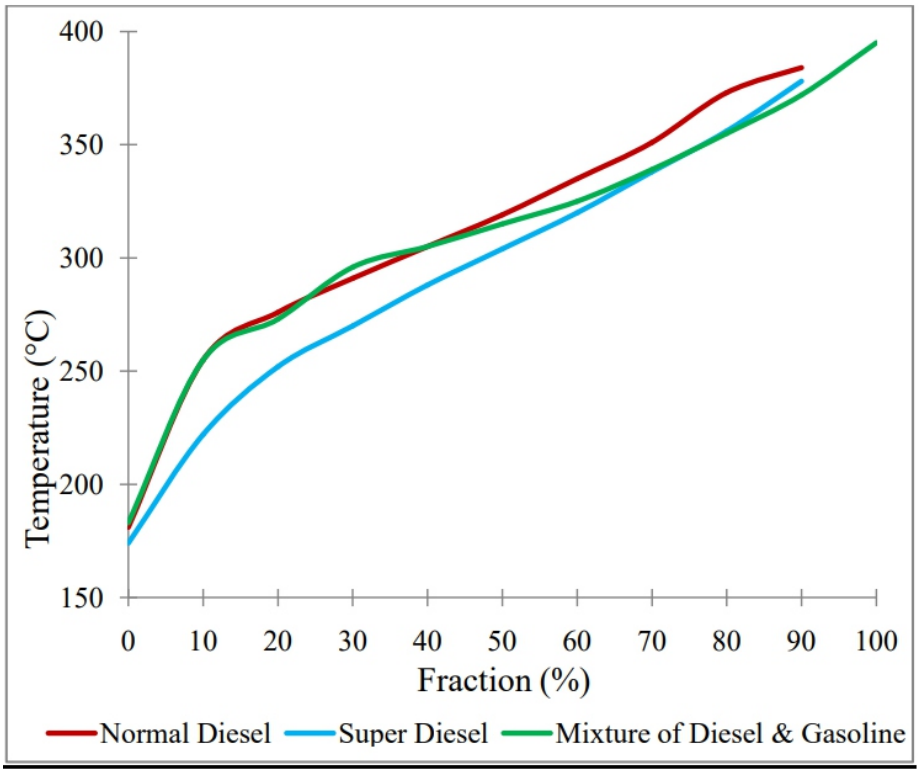

Figure 6 Distillation curves for ordinary diesel, super diesel and mixture of diesel & gasoline

8. CONCLUSION

In the spark ignition engine the fuel and air are supplied pre-mixed to the cylinder. But in diesel engine the fuel is not injected into the air until shortly before TDC. Consequently, there is considerably less time for completion of the mixing processes. Furthermore, the diesel engine, having no throttle, is controlled by regulating the quantity of fuel injected per induction stroke. Add to this the fact that ignition cannot occur until the temperature generated by compression is high enough, and it becomes obvious that fuel quality is even more important for the diesel than the spark ignition engine.

Since diesel fuel contains hydrocarbons with a higher boiling point, hence with higher molecular weight, some pyrolysis already occurs when the fuel is atomized. This contributes to the grater complexity of the unburnt and partially burnt hydrocarbons found in diesel exhausts and which cover a wider spectrum of molecular compositions. Moreover, most of the heavier hydrocarbons are absorbed on the soot particles in the form of soluble organic factions.

Then most familiar emission from a diesel engine is the characteristic smoke or soot particles produced when the vehicle operates under load. The smoke or soot is comprised of solid particles and liquid droplets generated by poor combustion of the fuel. In following parameters are effects to the diesel emissions. There are viscosity, density and distillation interval, cetane number (indirectly aromatics contents), sulfur content, additives etc.

In addition, the properties of manufactured diesel fuels are generally closely inter correlated. Efforts made to totally separate the aromatics, cetane, sulfur content and distilled points are not always successful.

With increasing kinematic viscosity, smoke and unburnt HC emissions increase and Nox emissions decrease. The kinematic viscosity has little influence on the soluble organic fraction, but dry soot increases with an increase in kinematic viscosity. Also the higher density of diesel fuel results in greater particulate emissions.

Fuel densities above the engine calibration range produce an over fueling effect and a sharp increase in emissions. This effect has been observed on the atmospheric or turbocharged direct injection engine.

The distillation intervals also affect particulate emissions. In this project that is the 80% distilled point must be under 370 0C and the 65% distilled point above 330 0C. In that change from a fuel with a 90% distilled at 374 0C to a fuel at 384 0C does not change the gaseous emissions but increases particulate emissions by about 12 to 50% depending on the cetane number.

The aromatics content of diesel fuel directly affects the cetane number. The two parameters are antagonistic. Only the addition of procetane additives helps to break the relationship. Unburnt hydrocarbons, particles, and the extractable soluble organic fractions increase with the aromatics content. Increasing the aromatics content of the fuel from 25 to 45% could cause a threefold increase in CO and HC emissions. NOx is relatively unaffected. On a light duty engine, transient operation enhances the influence of fuel characteristics on pollutants. CO, HC and particulate emissions increase with the aromatic content. However for an engine already displaying low emissions and for fuels with a cetane number higher than 50, the effect of fuel quality on pollutants is not pronounced.

The lengthening of the ignition delay caused by a drop in the cetane number leads to increased emissions of unburnt hydrocarbons, particulates and CO, but decreased emissions of smoke and dry soot.

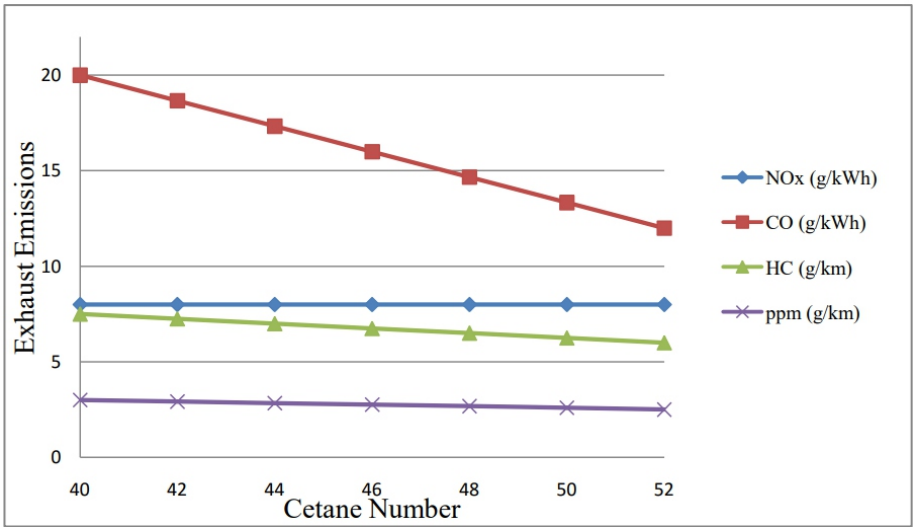

Figure 06:- Effect of cetane number on diesel engine emissions [3]

Figure 6 shows effects of the cetane number on the pollutants emitted by a diesel engine Noxis the least sensitive to the cetane number. However, it may result in an increase in the dry soot emissions as the pre-mixed burnt fraction decreases. An increase in the cetane number results in a decrease in CO, HC, Nox and soot, with little effect on particulates. On diesel engines, the effect of the cetane number essentially concerns the extractable soluble organic fraction part and the insoluble carbon fraction remains practically unaffected[3].

The cetane number also affects emissions of blue and white smoke, which are exhaust mists consisting of droplets of unburnt diesel produced when starting and at high altitude due to a drop in the barometric pressure. The tendency for this process to occur, as identified by the negative pressure in the manifold when it appears, is grater as the cetane number decreases.Another means to reduce the scale of soot formation is to lengthen the ignition delay by using a fuel with a low cetane number. However, this may present serious drawbacks.

Besides, the unacceptable noise already mentioned, if ignition is excessively delayed, droplets of liquid fuel may reach the cylinder walls and form deposits that burn very poorly and generate unburnt hydrocarbons and soot. Redistilled diesel fuel has low emissions than ordinary diesel fuel and super diesel fuel. Mainly its soot content is very low. Therefore redistilled diesel fuel is environmental friendly and has no effect on humans. It can be conducted that redistilled diesel fuel is more suitable for vehicles. However it is costly since the distillation process is an expensive process.

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REVIEW ON COMPARATIVE EMOTION RECOGNITION SYSTEM FROM TEXT USING CLASSIFIER TECHNIQUES

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ABSTRACT

The emotion recognition system is a generic model based on text and real-world knowledge. Recognition of Emotion from Text has noticeable and big problem in the Text-Processing Systems. In this paper, we proposed a review on emotion recognition from text with different types of classifier like Fuzzy Logic, Artificial Neural Network, and Support Vector Machine classifier. Most important methodology such as fuzzy logic towards Emotion Recognition from text using neural network has been discussed in this paper. Emotions are indescribable things; however, there are lot of factors which can be used to recognized emotion from the text. In order to simplify the model by reducing the amount of data required to evaluate the propose model, we make use of fuzzy logic with neural network. Emotions and opinions have enormous impact on customers to make their choices regarding online -shopping, choosing-events, products and entities. These opinions also help the banks to propose plans and schemes for insurance zone. Application of the proposed work has high utility in detecting email spams by using the emotion recognition from the text data and artificial neural network enhanced the recognition efficiency of proposed module. By using the comparative study to recognize emotion from text we can achieve more accuracy as compare to previous work.

KEYWORDS – Accuracy, Artificial Neural Network, Emotion Recognition System, Fuzzy Logic Text Data, , Support Vector Machine, Rule Sets.

INTRODUCTION

To detect an emotional state of human being through text document is a challenging task [1]. However, this concept is essential number of times because most of the times, the expressions of texts not only direct by emotion words , even through the concept interpretation with the interaction meaning given in the text document. Recognize the text emotion has a major role in„human computer‟ interaction. The basic architecture [2] of emotion recognition is shown in figure 1 that is categorized into two parts namely, Emotion Word Ontology with Emotion Ontology. Ontology is a term that describes the concepts with the relationships for some entity or number of entities. Basically, an understanding of particular domain is described in this. Emotion hierarchy is a conversion of emotion word ontology. The algorithm for emotion detection is used for recognizing the textual data emotions. The algorithm gives weights for every emotion through the addition of weights at every level of hierarchy that is shown in figure 2.

Emotions are expressed as happiness, joy, fear, anger, sadness, hate, surprise and so on. Still standard emotion word hierarchy is not created yet. In 2001, W. GerrodParrot [3], composed a new book "Emotions in Social Psychology", that clear the feeling framework and arranged the feelings of human via feeling chain of six classes which are Joy, Love, Anger, Surprise, Fear and Sadness. Some additional words also added in this hierarchy. Numbers of scientists have concentrated in this area . An attempt to get sentiment data for examining and to shorten the opinions communicated directly via PCs. Sentiment analysis (SA) [4] is also known as sentiment mining of huge information. SA is the computational investigation of Opinions[5], conclusions, subjectivity toward an element. The element represents the people, occasions or points.

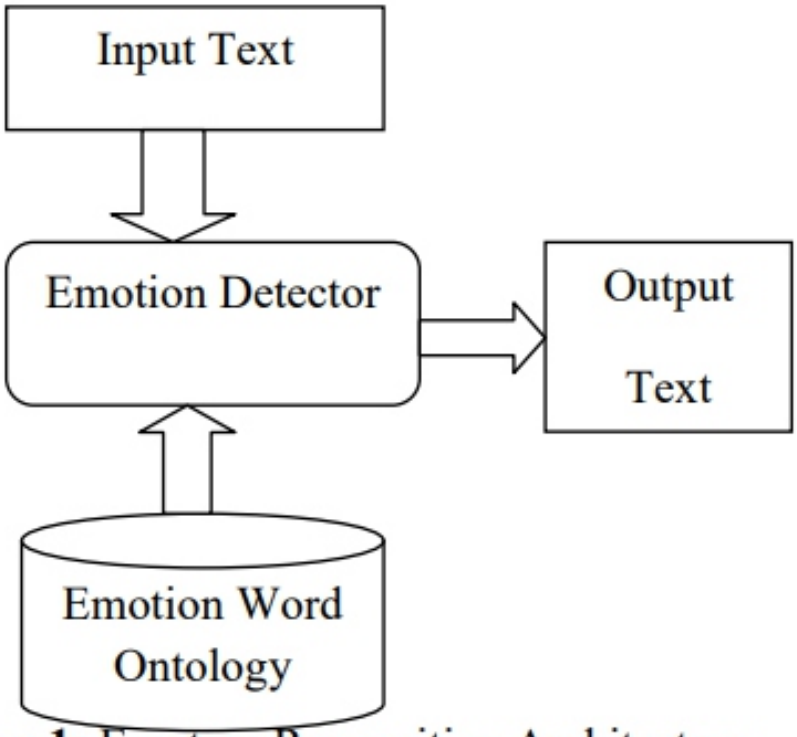

Figure 1: Emotion Recognition Architecture

Emotional analysis is a text classification problem [6] which deals with extracting information present within the text. This extracted information can be then further classified according to its polarity as positive, negative or neutral. It can be defined as a computational task of extracting sentiments from the opinion.

Emotional analysis is a natural language processing and information extraction task. This technique aims to extract writer‟s feelings expressed in comments or reviews. Emotional analysis does not only deal with extracting polarity but also deals with extracting features from the text[7].

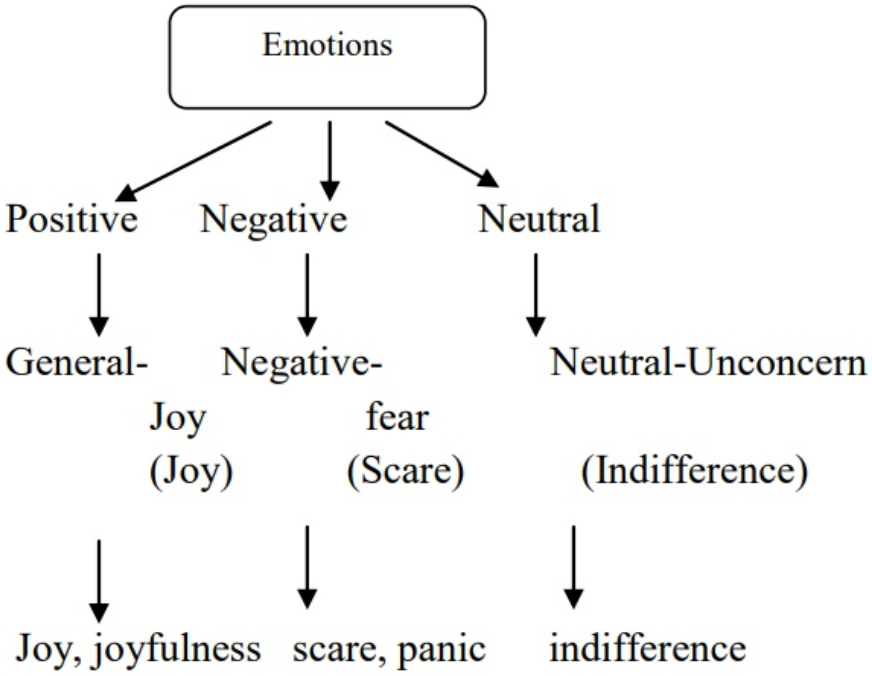

Figure 2: Emotional Hierarchy

Some opinions represent sentiments and some opinions do not represent any sentiment.

i. Sentiments: Opinions or in other sense can be recognized as someone‟s linguistic expressions of emotions, beliefs, evaluations etc.
ii. Analysis: To capture the opinions from a pool of users whether the opinion is positive, negative or neutral.
iii. Benefit: Provide efficient information in decision making

Some of the definitions given by different authors with respect to emotion detection are:

i. Opinion mining of big data as a computational task: Given a set of evaluative text documents D that contains opinions or sentiments about an object (person, organization, product etc.), opinion mining of big data aims to extract attributes and components of the object that have been commented on each document d in the set D and to determine whether the comments are positive, negative or neutral [8].
ii. Another definition of the opinion proposed by the author Bing Liu who defined “feature based Emotional analysis”. According to the author: an opinion on a feature f is a positive or negative view, attitude, emotion or appraisal on f from an opinion holder.

2. A GLANCE OF EXISTING TECHNIQUES

A lot of work exists in emotion recognition field. The work includes: to find the sentiment orientation, to determine fine-grained distinctions, to differentiate the texts from subjective portions and so on.

P. Ekman [9] has explained the emotions as mental states that are accompanied with the physiological changes. The author has identified six emotions that are: Happiness, anger, surprise, sadness, fear and

disgust. Mohamed Yassine[10] et al have proposed emotional interactions from social networks by using the characteristics for differentiating the friends from the acquaintances. Main objective was the emotional content extraction of texts from the social networks. Text mining techniques are used for retrieving the comments from the social networks. David Garcia [11] et al have proposed a model for the analysis of statistical analysis for the review of the product. The research has only extracted the emotional matrices like unhelpfulness, helpfulness as well as rating. The main objective of this work is the customer satisfaction by giving the guidelines for manufacturing. Esuli Baccianella [12] Stefano et al have focused on the study of challenges proposed by the sentiment analysis with the aim of enabling new applications for the procedure of subjective language. Turney Mohammad [13] et al have explained the lexico-based methods for computing sentiment score by mean of texts. The estimation of the customer‟s sentiment orientation by using sentiment orientation score for constituent adjective is proposed and the orientation is calculated by the frequency on Web by number of positive as well as negative adjectives. Isa Maks [14] et al has defined lexicon model. The model has described the detail of relations which are existed among the participants of verbs with their attitudes. A framework that provides a definition of Dutch verbs that should develop the sentiment analysis with the applications of the opinion mining on the basis of deep syntactic semantic technique. The validation is given by the annotation research that clarifies that the subtle subjectively relations came out to be more reliable.

3. STATISTICAL AND MACHINE CLASSIFIER TECHNIQUES FOR EMOTION DETECTION

Number of statistical and machine classifier techniques for affective computing has been developed like SVM (Support Vector machine), NN (Neural Network), and Fuzzy logic and so on.

3.1 Fuzzy Logic

Fuzzy logic is the difficult mathematical model for understanding and gives the uncertainty in reasoning [15]. In the fuzzy logic, the knowledge of experts is used by F-THEN rules. A fuzzy logic is a sub- set with the membership functions as subsets. Fuzzy logic mainly depends on the three features, namely, fuzzy values, linguistic variables and probability distribution [16]. The mathematical methods for fuzzy reasoning are simple and precise. Fuzzy reasoning builds the common understanding for process rather appending it to the end [17]. Fuzzy is a natural language logic model. The fuzzy logic is easy like human communication. The main features of fuzzy logic are as follows:

- It contains matter of degree.
- Fuzzy logic is flexible
- Any system can be fuzzified
- Information is decomposed into collection of variables.There are five attributes associated with fuzzy expert systems:

i. Variables for Input
ii. Variables of Output
iii. Subset of input and the output. Also the membership functions that correspond to the different subsets leading to fuzzy set
iv. Rules that connect the input and output fuzzy subset
v. Procedure for the defuzzification of Output

3.2 Support Vector Machines (SVM)

SVM is developed by VAPNIK to describe the classification algorithms. Some features of the SVM include that it is easy to implement, it consumes less training time, robust with high accuracy [18]
SVM classifies the various variables as shown below.
Equation of hyperplane is described below [19]

$$x \cdot y + a = 0 \quad (1)$$

Proposed method for hyperplane introduce the function

$$g(b) = sign(f \cdot d1 + m1) \quad (2)$$

It classifies the training of data and the hyper canonical plane described as:

$$bi \cdot f + m \geq +1 \, when \, vi = +1 \quad (3)$$

$$bi \cdot f + m \leq -1 \, when \, vi = -1 \quad (4)$$

or more compactly:

$$vi \, (bi \cdot f + m) \geq 1 \, \forall i \quad (5)$$

Basic operations that utilize the SVM
Multiplication by scalar

Consider vector $b = \{ b_1, b_2 \ldots\ldots\ldots\ldots b \}$ and a scalar d is described below.

$$\{ db_1, db_2 \ldots\ldots\ldots\ldots db_n \} \quad (6)$$

Addition of Vectors

Consider a vector $b = \{ b_1, a_2 \ldots\ldots\ldots\ldots b_n \}$ and$c = \{ c_1, c_2 \ldots\ldots\ldots\ldots c \}$, then addition ca be shown as below:

$$\{b_1 + c_1, b_2 + c_2 \ldots\ldots\ldots\ldots b_n + c_n\} \quad (7)$$

Subtraction of Vectors

Consider a vector $b = \{ b_1, b_2 \ldots\ldots\ldots\ldots b_n \}$ and $c = \{ c_1, c_2 \ldots\ldots\ldots\ldots c \}$, then subtraction ca be shown as below:

$$\{b_1 - c_1, b_2 - c_2 \ldots\ldots\ldots\ldots b_n - c_n\} \quad (8)$$

Euclidean Distance

Consider a vector $b = \{ b_1, b_2 \ldots\ldots\ldots\ldots b_n \}$
Then it can be written as:

$$\|b\| = \sqrt{b_1^{\,2} + b_n^{\,2}} \quad (9)$$

Dot Product

Consider vector $b = \{ b_1, b_2 \ldots\ldots\ldots\ldots b_n \}$ and $c = \{ c_1, c_2 \ldots\ldots\ldots\ldots c \}$, then dot product can be shown as below:

$$\{ b_1 . c_1, b_2 . c_2 \ldots\ldots\ldots\ldots b_n . c_n\} \quad (10)$$

3.3 Neural Network

Neural network is composed of simple elements which operate in parallel [20]. A neural network can be trained to perform a particular function by adjusting the values of the weights between elements. Network function is determined by the connections between elements. There is an activation functions used to produce relevant output. Input processes with a neural network that including weights produced output. The output is compared with the target, if the produced output compatible with output, then the input is correct otherwise that output adjust with weight. Neural network basically worked with weights [21].

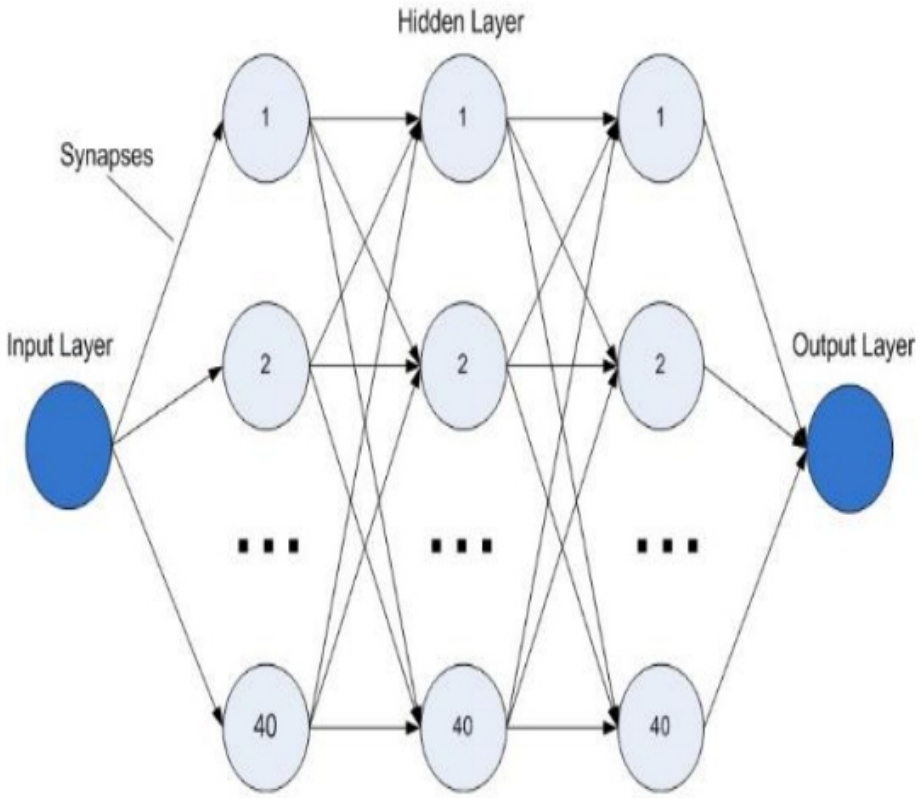

Figure 3: Neural Network

As per in their nature, the connections amongst numerous components, mostly define the specific network function. An individual could easily train a NN to accomplish a particular function by means of amending the values of the weights (connections) amongst several components [22].Normally, neural networks are trained, or adjusted, so in a particular input directs to a precise target output. The subsequent figure demonstrates such a circumstance. At this point, the network is adjusted, depends on a comparison of the Output in addition to the target, unless the network Output matches the actual target. Typically, much such type of input/target pairs is required to train a network.

4. KEYAPPLICATIONS

Numbers of applications are there in emotion detection in different areas that are described below

4.1 Online Commerce

The broadest utilization of feeling examination is in ecommerce exercises. A site permits their clients to present their experience about shopping and item qualities. They give rundown to the item and diverse elements of the item by allocating appraisals or scores. Graphical rundown of the general item and its elements is displayed to clients. Prominent trader sites like amazon.com gives audit from editors furthermore from clients with rating data. http://tripadvisor.in is a prominent site that gives audits on lodgings, travel destinations. They contain 75 million feelings and audits around the world. Assumption examination helps such sites by changing over disappointed clients into promoters by examining this gigantic volume of suppositions.

4.2 Voice of the Market (VOM)

Voice of the Market is about figuring out what clients are feeling about items or administrations of contenders. Precise and opportune data from the Voice of the Market helps in increasing aggressive advantage and new item advancement. Identification of such data as right on time as could be expected under the circumstances helps in direct and target key promoting effort. Opinion Analysis helps corporate to get client‟s feeling progressively. This ongoing data helps them to outline new advertising systems and can anticipate odds of item disappointment. There are business and free assumption examination administrations like Radiant6, Sysomos, Viralheat, Lexalytics, and so on. Some free apparatuses like www.tweettfeel.com, www.socialmention.com are additionally accessible.

4.3 Voice of the Customer (VOC)

It worries about what singular client is saying in regards to items or administrations. It implies investigating the audits and input of the clients. VOC is a key component of Customer Experience Management. VOC helps in distinguishing new open doors for item creations. Removing client feelings likewise recognizes utilitarian necessities of the items and some nonpractical necessities like execution and expense.

4.4 Brand Reputation Management

Brand Reputation Management worries about dealing with user‟s notoriety in business sector. Assessments from clients or some other gatherings can harm or upgrade your notoriety. Brand Reputation Management (BRM) is an item and it is organization concentrated instead of client. Presently, one-to-numerous discussions are occurring online at a high rate. That makes open doors for associations to oversee and fortify brand notoriety. Brand discernment is resolved not just by promoting, advertising and corporate informing.

4.5 Government

Supposition examination helps government in surveying their quality and shortcomings by breaking down sentiments from open. For instance, "In the event that this is the state, how do you anticipate that truth will turn out? The MP who is examining 2g trick himself is profoundlydegenerate.” This case plainly demonstrates negative notion about government. Whether it is following nationals' assessments on another 108 framework, recognizing qualities and shortcomings in an enrollment battle in

government work, evaluating achievement of electronic accommodation of assessment forms, or numerous different zones, we can see the potential for conclusion examination [32].

5. CONCLUSION

In this survey paper, the concept of emotion detection is discussed and this can be concluded that this concept plays an important role by means of systems of human computer interaction. Emotion detection as of texts is able to find the suitable emotion by surveying the Input text. This paper has studied the concept of emotion recognition from text using different type of classifier like Fuzzy Logic, Artificial Neural Network, and Support Vector Machine classifier because the efficiency of single classifier does not provide the best solution for emotion recognition system. So we have used a comparative work for the emotion recognition system to achieve more accuracy than the previous work. This comparative method has many advantages like High speed in processing of recognition, high accuracy of text emotion recognition due to the use of different types of classifier and less probability of errors.

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THE ARA∞ MODEL FOR THE ADRENOCORTICAL RESPONSIVENESS TO INFUSIONS OF PHYSIOLOGICAL DOSES

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ABSTRACT

In this paper we discussed theinitial intensity, minimal wear intensity of failure process without repair is supposed to be a Non Homogeneous Poisson Process (NHPP). The repair effect is characterized by the change induced on the failure intensity before and after failure. The magnitude and time course of changes in concentrations of plasma cortisol and DHEA in response to bolus infusions ofphysiological doses of ACTH in PTSD patients and control subjects and no evidence for PTSD-related alterations in cortisol or DHEA secretion in response to stimulation by low doses of ACTH and conclude that adrenocortical responsiveness is normal in PTSD.The occurrence of defects in HPA function in PTSD may be specific responses to particular combinations of trauma type, genetic susceptibility,and individual history.

Keywords: ACTH,NHPP,DHEA,PTSD

INTRODUCTION

Attribution of relationships between posttraumatic stress disorder (PTSD) and hypothalamic–pituitary–adrenocortical (HPA) dysfunctionis intuitively apposite because of the importance of theHPA axis in the mediation of stress responses, and several earlystudies of PTSD reported HPA dysregulation .

This study was approved by the institutional review board atthe University of Washington, and all subjects provided writteninformed consent. All subjects underwent a medical history, screeningphysical examination, 12-lead electrocardiogram, and screeninglaboratory tests of blood samples for electrolytes, glucose, blood urea nitrogen, creatinine, serum glutamic oxaloacetic transaminase, serum glutamic pyruvic transaminase, thyroid function tests, andcomplete blood count, and of urine samples for routine urinalysis, urine toxicology screen, and for female subjects of child bearing potential, urine pregnancy test. Use of any psychoactive medication or any medication knownto affect the HPA axis within 2 weeks of the study was exclusionary for all subjects. These medications included antidepressants, antipsychotics,anticonvulsants, tranquilizers, sedative/hypnotics, antihypertensives, and oral or inhaled glucocorticoids. The only medications taken by participants in the study were ibuprofen, the antihistamines cetirizine and loratadine, and glucosamine andchondroitin for treatment of osteoarthritis.Participants taking medications to treat PTSD were withdrawn from those medications,

under medical supervision, for up to 30days. The period required for withdrawal was dependent on thebiological half-life of each medication and management of potentialwithdrawal symptoms. Female subjects of childbearing potential underwent urinepregnancy tests on each study day to ensure that no pregnant participantswere exposed to ACTH. Female subjects of child bearing potential agreed to use a non-hormonal barrier form of birth control for the period of the study. Hormonal contraceptives were not allowed for at least 3 months prior to the study because of their stimulation of corticosteroid-binding globulin (CBG) that results in elevated levels of total plasma cortisol.All participants were free of current (past 6 months) acuteor chronic Axis I psychiatric disorders (with the exception of PTSD in the PTSD subject group) based on SCID assessment. Two control and one PTSD subject had past histories of depression. Absence of substance abuse within 3 months of the study by subject report and urine toxicology screen was required. Onecontrol and seven PTSD subjects had a past history of alcohol abuse, and one individual in each group had a history of alcohol dependence. Two control and one PTSD participant had pasthistories of substance abuse (cannabis). One subject in each group was a current smoker; no information about past smoking history was requested. Participants included nine PTSD subjects:

eight males with combat trauma PTSD and one female with civilian trauma PTSD,50.3 ± 2.5 years old [mean ± standard error of the mean (SEM)].There were nine healthy non-trauma exposed aged-matched controls: six males and three females, 41.2 ± 3.5 years old. The ages ofthe two groups did not differ significantly. The PTSD participants had moderately severe symptoms according to the CAPS.Blood samples were collected every 5 min for 60 min following ACTH administration and then every 15 min for the next 90 min. Blood was collected into chilled tubes containing ethylenediaminetetraacetic acid; the tubes were placed on ice until processed. The samples were cold-centrifuged within 1 h of collection. The plasma was aliquoted and stored at −80°C until assayed. For each hormone, all samples from a given subject were included in a single assay, and each assay contained samples from an equal number of subjects from each group.The peak ACTH concentrations achieved after the higher of our two doses were approximately which are comparable to those reached after administration ofthe standard insulin tolerance test to control subjects.

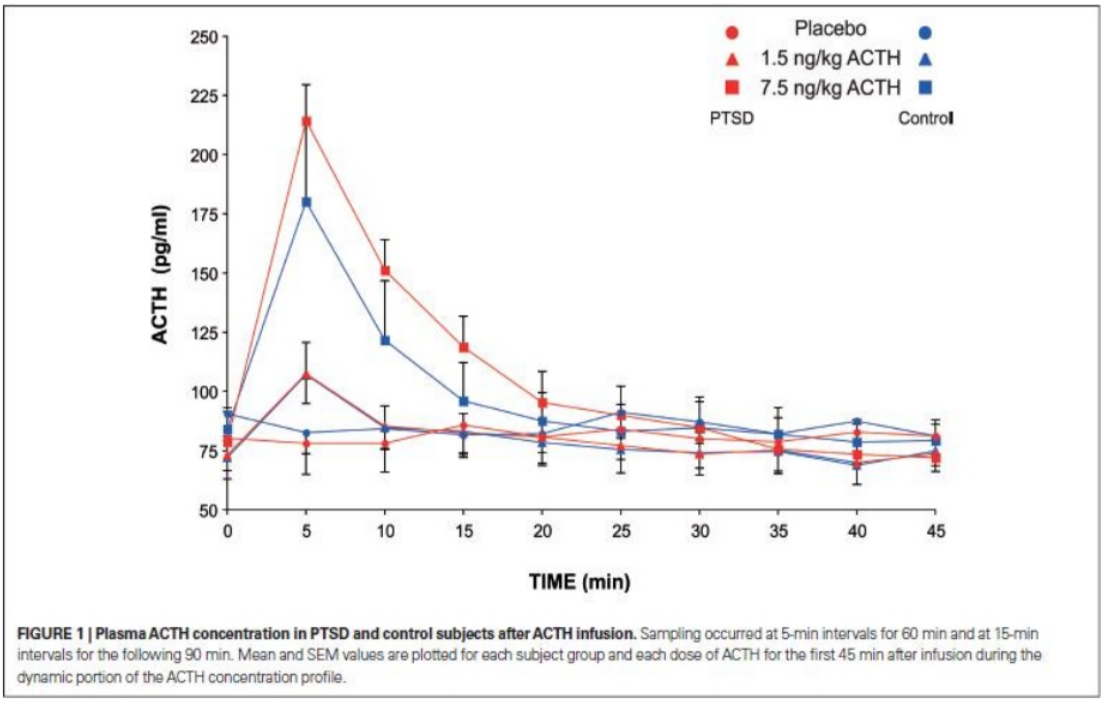

FIGURE 1 | Plasma ACTH concentration in PTSD and control subjects after ACTH infusion. Sampling occurred at 5-min intervals for 60 min and at 15-min intervals for the following 90 min. Mean and SEM values are plotted for each subject group and each dose of ACTH for the first 45 min after infusion during the dynamic portion of the ACTH concentration profile.

Mathematical model

Some important industrial systems (like nuclear power plants, planes, trains) come to the end of their planned life, but they seem to be still in normal working conditions. To extend their functioning life, one must justify some reliability requirements. One way to do it is to take into account the effect of repair actions or corrective maintenance. Repair is carried out after a failureand intends to put the system into a state in which it can perform its function again. Modelling the effect of these repair actions is of great practical interest and is the first step in order to be able to assess maintenance efficiency.The basic assumptions on repair efficiency are known as minimal repair or As Bad As Old (ABAO) and perfect repair or As Good As New (AGAN). In the ABAO case, each repair leaves the system in the same state as it was before failure. In the AGAN case, each repair is perfect and leaves the system as if it were new. Obviously, reality is between these two extreme cases: standard maintenance reduces failure intensity but does not leave the system as good as new. This is sometimes known as imperfect or better-than-minimal repair.

Assumptions

The distribution of these processes is completely given by the failure intensity defined as:

T_i - be the time of stress effect.
N_t - be the number of stress effect in time t.
H_t - be the past stress effect in time t.

$$\forall t \geq 0, \quad \lambda_t = \lim_{dt \to 0} \frac{1}{dt} P(N_{t+dt} - N_t = 1 | \mathcal{H}_t)$$

We assume that before the first failure, the failure intensity is a deterministic

and continuous function of time λ(t) called the initial intensity. In addition, the considered system is supposed to wear out continuously, so the initial intensity is strictly increasing

For any stochastic point process $\{E_t\}_{t \geq 0}$ wedefine E_{Ti}^{+} (resp. E_{Ti}^{-}) as the

left (resp. right) limit, if it exists, of E_t when t tends to T_i

Definition:

For a model with failure intensity λt, the minimal wear intensity is, if it exists, the deterministic function λmin (t) defined as:

$$\forall t \in \mathbb{R}^+, \; P(\lambda_t \geq \lambda_{min}(t)) = 1$$

$$\forall \epsilon > 0, \; \forall t \in \mathbb{R}^+, \; P(\lambda_t \leq \lambda_{min}(t) + \epsilon) > 0$$

(2) means thatλ_t is greater than λ_{min} (t)and (3) means that λ_t can be asclose as possible to λ_{min} (t).The minimal wear intensity can be viewed as the maximal lower bound for failure intensity. The wear out of

all system with failure intensity λ_t is greater than that of a system with failure intensity $\lambda_{min}(t)$.

The ARA$_\infty$ model

The ARA$_\infty$ assumption is that repair reduces the virtual age of the system of an amount proportional to its age just before repair:

$$A_{T_i^+} = A_{T_i^-} - \rho A_{T_i^-}$$

Then, by analogy with the ARI$_\infty$ model, the failure intensity of the Arithmetic Reduction of Age model with infinite memory (ARA$_\infty$) is:

$$A_{T_i^-} - A_{T_{i-1}^+} \text{ to } (1-\rho)[A_{T_i^-} - A_{T_{i-1}^+}]:$$

The minimal wear intensity is equal to zero.

This model appears to be the same as the one introduced by Brown-Mahoney-Sivazlian .

Property

If λ is convex (resp. concave), for the same parameter $\rho \in [0; 1]$,the minimal wear intensity of the ARI$_1$ model is greater (resp. less) than thatof the ARA$_1$ model.

Proof

Since λ is convex and $\rho \in [0; 1]$, $\forall t \geq 0$, $\lambda'(t) \geq \lambda' (1-\rho)t)$.

By integrating the previous inequality on [0,t] we obtain:

$$(1-\rho)\lambda(t) \geq \lambda((1-\rho)t)$$

And the property is proved for λ convex. A imilar proof holds for λ concave.

When the initial intensity is that of a Power Law Process (PLP: $\lambda(t) = \alpha \beta t^{\beta-1}$,

there exists two parameters ρI_1 and ρA_1 uch that the ARI$_1$ model with parameters $(\alpha, \beta, \rho I_1)$ and

the ARA1 model with parameters $(\alpha, \beta, \rho A_1)$ have the same minimal wear intensity.

$$\rho_{I1} = 1 - (1 - \rho_{A1})^{\beta-1}$$

The proof is immediate since:

$$(1 - \rho_{I1})\alpha\beta t^{\beta-1} = \alpha\beta[(1 - \rho_{A1})t]^{\beta-1} \Rightarrow \rho_{I1} = 1 - (1 - \rho_{A1})^{\beta-1}$$

Conclusion

Here we found the initial intensity, minimal wear intensity of failure process without repair for The occurrence of defects in HPA function in PTSD may be specific responses to particular combinations of trauma type, genetic susceptibility, and individual history.

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Fuzzy Optimization Model on Maintaining Inventory for Roadside Caterers of Fast Food

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ABSTRACT

This paper studies the maintenance of inventory for fast food sellers of roadside caterers using fuzzy set theory which helps in modeling any inventory problem for its ability to overcome vagueness and imprecision. We develop a fuzzy model applicable to single period inventory problem. Uncertain demand causes uncertain total cost function. In this paper we find an analytical method for determining the exact expected value of total cost function for a fuzzy single period inventory problem for roadside caterers. The optimum order quantity that minimizes the fuzzy total cost function is determined using the expected value of a fuzzy function based on credibility theory and hence closed form solutions to optimum order quantities & corresponding to total cost values are derived.

Keywords: Fuzzy demand, membership function, uncertainty, inventory problem.

INTRODUCTION

Inventory management is an important aspect of all business undertakings as it is a function of directing the movement of goods through the entire manufacturing cycle from the requirement of raw materials to the inventory of finished goods so as to meet the objective of maximum customer service with minimum investment and efficient low cost plant operation with simultaneous balance between over-stocking and under-stocking.In single period inventory problem, product orders are given before the selling period begins. There is no option for an additional order during the selling period or there will be apenalty cost for this re-order. The assumption of the single period inventory problem is that if any inventory remains at the end of the period, either a discount is used to sell it if it is nonperishable item or it is disposed of, if it is perishable item. Fast food items served hot by roadside caterer refers to single period inventory problem as it is valuable for a limited time. Customers are only interested in consuming freshly prepared hot cooked food item. The fast food vendor in a roadside eatery has to sell all of the prepared fast food items, then it becomes worthless the next day. So he ends up in a loss as the inventory in stock to prepare the food items are perishable.In the literature survey, most of the extensions have been made in the probabilistic framework in which the uncertainty of demand is described by probability distribution. But in realistic terms, the probability distributions of the demands for products are difficult to acquire due to lack of information and data in which case the demands are specified approximately based on the experience and managerial subjective judgements. In such cases, the fuzzy set theory introduced by Zadeh is the best form that adapts all the uncertainty in the model. The fuzzy set modeling using possibility instead of probability theory, can represent linguistic data which cannot be easily modeled by other methods.

Our paper intends to find an analytical method for determining the exact expected value of total cost function for a single-period inventory problem under uncertainty. To determine the optimal order quantity that minimizes the fuzzy total cost function we use the expected value of a function of a fuzzy variable with a continuous membership function .

2 Preliminaries

In this paper the optimization of single period inventory problem of food items prepared for each day is analyzed. If there is less preparation of that particular foodie thenthere is possibility of less profit as the customers are lost and if there is more preparation and no consumption then it becomes obsolete and it cannot be used the next day as it is perishable item and there is loss again for the seller. Our goal is to find an analytical method to determine the exact expected value of total cost function for single period inventory problem under uncertainty. The source of the uncertainty in the analyzed problem results from the imprecise demand. The preliminary concepts about the fuzzy set theory and the credibility theory which will be useful for understanding the proposed model and the solution procedure are elucidated. Fuzzy logic provides solutions to complex problems through a similar approach as human reasoning. The major characteristic of fuzzy logic is its ability to eradicate ambiguity in human thinking, subjectivity and knowledge to the model.

Fuzzy Set

L.A.Zadeh invented fuzzy sets in mathematical terminology to represent ambiguity and vagueness as a generalization of crisp set. It is a class of objects with membership grades defined by a membership function. A fuzzy set can be mathematically represented as

$\tilde{A} = \{(x, \mu_{\tilde{A}}(x)) : x \in X\}$ whereX is the universal set and $\mu_{\tilde{A}}(x)$ is the membership function.

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Fuzzy Number It is a common fuzzy set whose membership function is piecewise continuous. If $\tilde{X}$ is a generalized fuzzy number (known as L-R type fuzzy number), whose membership function $\mu_{\tilde{X}}(x)$ satisfies the following conditions with $0 < w \leq 1$ and $-\infty < l < m < n < u < \infty$.

1) $\mu_{\tilde{X}}(x)$ is a continuous mapping from $\Re$, to the closed interval [0,1],

2) $\mu_{\tilde{X}}(x) = 0, -\infty < x < l$,

3) $\mu_{\tilde{X}}(x) = L(x)$, is strictly increasing on $[l, m]$,

4) $\mu_{\tilde{X}}(x) = w, m < x < n$,

5) $\mu_{\tilde{X}}(x) = R(x)$, is strictly decreasing on $[n, u]$,

6) $\mu_{\tilde{X}}(x) = 0, u < x < \infty$.

This type of generalized fuzzy number is denoted as $\tilde{X} = (l, m, n, u; w)_{LR}$. When $w = 1$, it can be simplified as $\tilde{X} = (l, m, n, u)_{LR}$.

Lattice of Fuzzy Numbers

The linear ordering of real numbers does not extend to fuzzy numbers. In order to define the lattice operations of fuzzy numbers corresponding to those of crisp numbers we have to define MIN and MAX for any two fuzzy numbers A and B as follows:

$$MIN\left(\tilde{A}, \tilde{B}\right)(Z) = \sup_{Z=\min(x,y)} \min\left[\tilde{A}(x), \tilde{B}(\mathrm{y})\right]$$

$$MAX\left(\tilde{A}, \tilde{B}\right)(Z) = \sup_{Z=\max(x,y)} \max\left[\tilde{A}(x), \tilde{B}(\mathrm{y})\right]$$

The symbol MIN and MAX are continuous operation and hence are different from the symbols of min and max of the crisp sets.

Credibility Theory

The credibility theory developed as a branch of mathematics for studying the behavior of fuzzy phenomena. The possibility theory was proposed by Zadeh[2], and developed by many researchers such as Dubois and Prade[18]. In the possibility theory, there are two measures including possibility and necessary measures. A fuzzy event may fail even though its possibility achieves 1, and hold even though its necessity is 0. Possibility measure isthought as a parallel concept of probability measure. However, as many researchers mentioned before, these two measures have partial differences. Necessity measure is the dual of possibility measure. However, either possibility measure nor necessity measure has self duality property. A self-dual measure is absolutely needed in both theory and practice. In order to define a self-dual measure, Liu[14] introduced the concept of credibility measure in 2002. In this concept credibility measure resembles the similar properties by probability measure. Credibility measure plays the role of probability measure in fuzzy world.

Let $\{\xi_i, i = 1, 2, \ldots n\}$ be a fuzzy variable with the membership function $\mu(x)$ and r be a real number, then the possibility and necessity measure of the fuzzy event $\{\xi_i \le r\}$ can be respectively represented as follows:

$$Pos\{\xi_i \le r\} = \sup_{x \le r} \mu(x) \tag{1}$$

$$Nec\{\xi_i \le r\} = 1 - Pos\{\xi_i > r\} = 1 - \sup_{x > r} \mu(x) \tag{2}$$

The credibility measure which is introduced by Liu is the average of possibility measure and necessity measure. The credibility measure of the fuzzy event $\{\xi_i \le r\}$ can be represented as follows:

$$Cr\{\xi_i \le r\} = \frac{1}{2}\left(Pos\{\xi_i \le r\} + Nec\{\xi_i \le r\}\right) \quad (4)$$

Similarly the credibility measure of the fuzzy event $\{\xi_i \ge r\}$ can be represented as follows:

$$Cr\{\xi_i \ge r\} = \frac{1}{2}\left(Pos\{\xi_i \ge r\} + Nec\{\xi_i \ge r\}\right)$$

Expected Value of a Function of a Fuzzy Variable

Several ranking methods for fuzzy numbers are used to find the expected value of a fuzzy number which was a complex process for researchers in previous years. Now the expected value is usually computed using simulation techniques or heuristic algorithms which result in errors. Hence, Xue et al. introduced an analytical method which uses the properties of the credibility measure, to calculate the expected value of a function of a fuzzy variable.

Let ξ_i be a fuzzy variable and r be a real number, the expected value of a fuzzy variable $E[\xi_i]$ can be calculated as follows:

$$E[\xi_i] = \int_0^{+\infty} Cr\{\xi_i \ge r\}dr - \int_{-\infty}^{0} Cr\{\xi_i \le r\}dr \quad (5)$$

provided that at least one of the two integrals is finite.

Let ξ_i be a fuzzy variable with a continuous membership function $\mu_{\xi_i}(x)$, and $f : \Re \to \Re$ is a strictly monotonic function. If the Lebesgue integrals, $\int_0^{+\infty} Cr\{\xi_i \ge r\}dr$ and $\int_{-\infty}^{0} Cr\{\xi_i \le r\}dr$ are finite, then the expected value of a function of a fuzzy variable $E[f(\xi_i)]$ can be calculated as follows:

$$E[f(\xi_i)] = \int_{-\infty}^{+\infty} f(r)dCr\{\xi_i \le r\} \quad (6)$$

Let ξ_i, be a fuzzy variable with a continuous membership function $\mu(x)$ and $f : \Re \to \Re$ and $g : \Re \to \Re$ be two different strictly monotonic functions. If the expected values of $\xi_i, f(\xi_i)$ and $g(\xi_i)$ exist, the following properties can be defined for any numbers p and q,

$$E[pf(\xi_i) + q] = pE[f(\xi_i)] + q \quad (7)$$

$$E[f(\xi_i) + g(\xi_i)] = E[f(\xi_i)] + E[g(\xi_i)] \quad (8)$$

Let ξ_i be a fuzzy variable whose support is $[a,b]$ and $f:\Re\to\Re$ is a strictly monotonic function. If the Lebesgue integrals, $\int_0^{+\infty} Cr\{\xi_i \geq r\}dr$ and $\int_{-\infty}^{0} Cr\{\xi_i \leq r\}dr$ are finite, then the expected value of a function of a fuzzy variable $E[f(\xi_i)]$ can be calculated as follows:

$$E[f(\xi_i)] = \int_a^b f(r)dCr\{\xi_i \leq r\} \tag{9}$$

Methodology

A. Expected Value of a Function of a Fuzzy Variable

Consider a single-period inventory problem where the demand is subjectively believed to be imprecise and represented by a generalized fuzzy number($\tilde{X}$)with the following membership function given by (10) and Fig.1;

$$\mu_x(x) = \begin{cases} L(x), & l \leq x \leq m \\ 1, & m \leq x \leq n \\ R(x), & n \leq x \leq u \\ 0, & other \end{cases} \tag{10}$$

Here [m,n] are the most likely values of fuzzy number $\bar{X}$,l and u are the lower and upper values; L(x) and R(x) are the left and right shape functions, respectively.

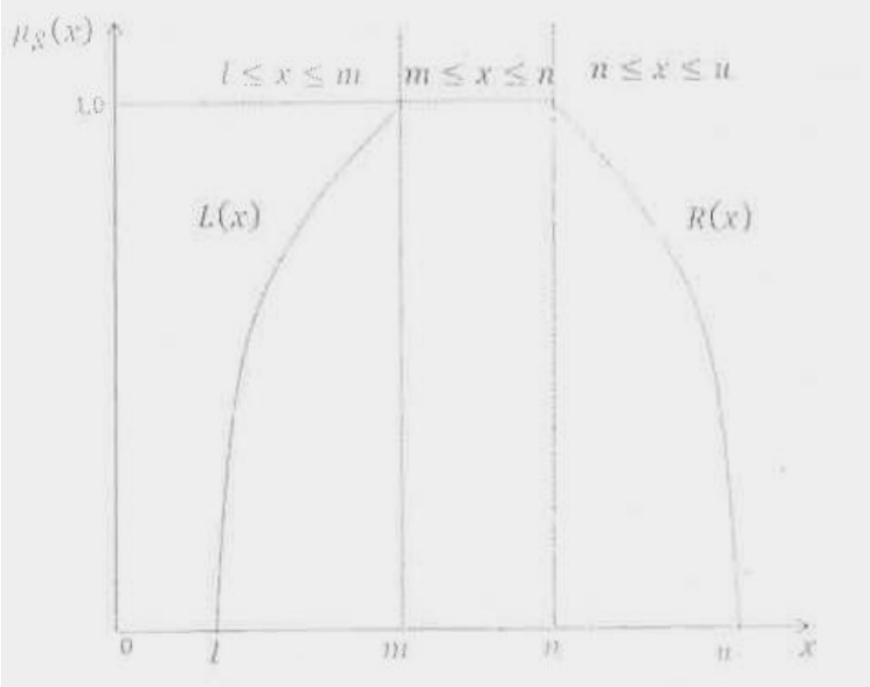

Fig. 1 Membership function of a generalized fuzzy number

Contrary a demand, inventory cost coefficients are known precisely. A roduct is produces (or produced) at a cost of v for a single–period. h is the unit inventory holding cost per unit remaining at the end of the period ,(h< 0 represents have salvage value per remaining unit), normally the salvage value is less than the unit production cost, i.e. (v>-h) [12]. The selling price per unit is assumed to be equal to the unit inventory shortage cost which is represented by b in the model ($b > v$) . We assume that there is no on-hand inventory at the beginning of the period.

Uncertain demand will cause an uncertain total cost function. If we order Q unit, the total cost function $\tilde{T}\tilde{C}(Q)$ will be as in (11);

$$\tilde{T}\tilde{C}(Q) = \begin{cases} Qv + h(Q - \bar{X}) & \bar{X} \le Q \\ Qv + b(\bar{X} - Q) & \bar{X} \ge Q \end{cases} \tag{11}$$

Since the demand is a generalized fuzzy number ($\bar{X}$) , the fuzzy total cost function $\tilde{T}\tilde{C}(Q)$ will also be a generalized fuzzy number with the same membership function of demand. The problem is to determine the optimal order quantity (Q*) that minimizes the fuzzy total cost. The membership function of demand the fuzzy total cost. The membership function of demand is represented as in fig. 1. According to this membership faction, it is obvious that the optimal order quantity (Q*) will remain between l and u, since (b>v>h).

B. Analytical Model and Solution Methodology

We consider the above single-period inventory problem where the demand and total cost faction, which are formulated as in (11), are generalized fuzzy numbers. The fuzzy total cost function, is strictly decreasing in l<x<Q and strictly increasing Q<x<u. In order to optimize the single-period inventory problem with fuzzy demand, we use the expected value method which is proposed by Xue et al. [20]. In this context, by using (6) and (8), the expected value of total cost function $E[\tilde{T}\tilde{C}(Q)]$ of fuzzy demand $\bar{X}$ will be formulated as in (12);

$$E[\tilde{T}\tilde{C}(Q)] = \int_l^Q [Qv + h(Q - r)]dCr\{\bar{X} \le r\} +$$

$$\int_Q^u [Qv + b(r - Q)]dCr\{\bar{X} \le r\} \tag{12}$$

$$= Qv + hQ\int_Q^u dCr\{\bar{X} \le r\} - h\int_l^Q rdCr\{\bar{X} \le r\}$$

$$+b\int_Q^u rdCr\{\bar{X} \le r\} - bQ\int_Q^u dCr\{\bar{X} \le r\}$$

The optimal order quantity (Q*), will be the value that minimizes the expected value of fuzzy total cost

function. The find the minimizing value of Q, we set

$$\frac{dE\left[\tilde{T}\tilde{C}(\mathrm{Q})\right]}{dQ}=0 \tag{13}$$

Thus, the following equations are obtained,

$$\frac{dE\left[\tilde{T}\tilde{C}(\mathrm{Q})\right]}{dQ}=v+h\int_{l}^{Q}dCr\left\{\bar{X}\le r\right\}-b\int_{Q}^{u}dCr\left\{\bar{X}\le r\right\}$$

$$0=v+(h+b)\mathrm{C}r\left\{\bar{X}\le Q\right\}-b, \tag{14}$$

$$Cr\left\{\bar{X}\le Q\right\}=\frac{b-v}{h+b} \tag{15}$$

To find the optimum order quantity, we will determine the value of $cr\left\{\bar{X}\le Q\right\}$. The credibility of fuzzy demand with the membership function as in (10) will be as in (16);

$$Cr\left\{\bar{X}\le Q\right\}=\begin{cases}0, & Q\le l\\ \dfrac{L(Q)}{2}, & l\le Q\le m\\ \dfrac{1}{2}, & m\le Q\le n\\ 1-\dfrac{R(\mathrm{Q})}{2}, & n\le Q\le u\\ 1, & Q\ge u\end{cases} \tag{16}$$

There are three cases to be analyzed for the value of Q in discussing the credibility value of fuzzy demand; $cr\left\{\bar{X}\le Q\right\}: l\le Q\le m, m\le Q\le n \text{ and } n\le Q\le u$

Case l: $l\le Q\le m$

$$Cr\left\{\bar{X}\le Q\right\}=\frac{b-v}{h+b}=\frac{L(Q)}{2} \tag{17}$$

Thus, the following equations are obtained,

$$L(Q)=\frac{2(b-v)}{h+b} \text{ and } Q^{*}=L^{-1}\left(\frac{2(b-v)}{h+b}\right) \tag{18}$$

Here, the value of $2(b-v)/(h+b)$ must lie between [0,1], thus we can say that under the conditions of

$b \geq v$ and $b - v \leq h + v, Q^*$ will lie in [l,m]. Moreover, the second derivative of

$E\left[\tilde{T}\tilde{C}(\mathrm{Q})\right]$ with respect to Q is

$$\frac{d^2 E\left[\tilde{T}\tilde{C}(Q)\right]}{dQ} = \frac{(h+b)}{2} L'(Q) \tag{19}$$

Since, L(Q) is an increasing function in [l,m], we find that $L'(Q)>0$. The values of h and b are positive, so that we obtain $\frac{d^2 E\left[\tilde{T}\tilde{C}(Q)\right]}{dQ} > 0$ which implies that Q^* is the optimum value which minimizes $E\left[\tilde{T}\tilde{C}(Q)\right]$. The expected fuzzy total cost value for the optimum order quantity will be as below;

$$\begin{aligned} E\left[\tilde{T}\tilde{C}(Q^*)\right] = -h & \int_{l}^{L^{-1}\left(\frac{2(b-v)}{h+b}\right)} rd\left(\frac{L(r)}{2}\right) \\ & + b \int_{L^{-1}\left(\frac{2(b-v)}{h+b}\right)}^{m} rd\left(\frac{L(r)}{2}\right) \\ & + b\int_{n}^{u} rd\left(1 - \frac{R(r)}{2}\right) \end{aligned} \tag{20}$$

Case 2:$m \leq Q \leq n$

$$Cr\left\{\bar{X} \leq Q\right\} = \frac{b-v}{h+b} = \frac{1}{2} \tag{21}$$

Optimum order quantity (Q*) is the value that the first derivative of the expected value of fuzzy total cost equals to zero, in this case,

$$\frac{dE\left[\tilde{T}\tilde{C}(Q)\right]}{dQ} = v + (h+b)Cr(X \leq Q\} - b$$

$$0 = v + (h+b)1/2 - b \tag{22}$$

If there exits b-$v = h$+v case, then $E\left[\tilde{T}\tilde{C}(Q)\right]$ will be minimized by $Q \in [m,n]$. There by under the condition of b-v=h+v, we can say that $Q^* \in [m,n]$. The expected fuzzy total cost value for the optimum order quantity will be as in (23);

$$E\left[\tilde{T}\tilde{C}(Q^*)\right] = -h\int_r^m rd\left(\frac{L(r)}{2}\right) + b\int_n^u rd\left(1-\frac{\mathrm{R}(r)}{2}\right) \tag{23}$$

Case 3: $n \le Q \le u$

$$Cr\left\{\bar{X} \le Q\right\} = \frac{b-v}{h+b} = 1-\frac{R(Q)}{2} \tag{24}$$

and the following equations are obtained,

$$R(Q) = \frac{2(\mathrm{h}+v)}{h+b} \text{ and } Q^* = R^{-1}\left(\frac{2(h+v)}{h+b}\right) \tag{25}$$

Since the value of $2(h+v)/(h+b)$ must be in the range of 0 and 1, under the conditions of $v \ge -h$ and b-$v \ge h$ +v, we can say that the value of Q^* will lie in $[n,u]$. additionally, the second derivative of $E\left[\tilde{T}\tilde{C}(Q)\right]$ with respect to Q will be,

$$\frac{d^2E\left[\tilde{T}\tilde{C}(Q)\right]}{dQ} = -\frac{(\mathrm{h}+b)}{2}R'(Q) \tag{26}$$

Since R(Q) is a decreasing function in the range of l and m, with $L'(Q) > 0$ and the values of h and be are positive, we obtain $\frac{d^2E\left[\tilde{T}\tilde{C}(Q)\right]}{dQ} > 0$ which implies that Q^* is the optimum value which minimize $E\left[\tilde{T}\tilde{C}(Q)\right]$. The excepted fuzzy total cost value for the optimum order quantity will be as in (27);

$$E\left[\tilde{T}\tilde{C}(Q^*)\right] = -h\int_l^m rd\left(\frac{L(r)}{2}\right)$$

$$-h\int_n^{R^{-1}\left(\frac{2(h+v)}{h+b}\right)} rd\left(1-\frac{R(r)}{2}\right) \tag{27}$$

$$+b\int_R^u rd\left(1-\frac{R(r)}{2}\right)$$

In the literature, trapezoidal fuzzy numbers are used commonly in the applications. Let the demand for the single-period inventory problem to be represented by a trapezoidal fuzzy number with the following membership function,

$$\mu_{\tilde{X}}(x)=\begin{cases}\dfrac{x-l}{m-l}, & l\le x\le m\\ 1, & m\le x\le n\\ \dfrac{u-x}{u-n}, & n\le x\le u\\ 0, & other\end{cases} \tag{28}$$

In this case, optimum order quantity will be calculated as in (29);

$$Q^*=\begin{cases}1+\left[\dfrac{2(b-v)}{h+b}\right](m-l) & b-v\le h+v\\ [m,n] & b-v=h+v\\ u-\left[\dfrac{2(h+v)}{h+b}\right](u-n) & b-v\ge h+v\end{cases} \tag{29}$$

The closed-form solutions for single-period inventorymodeldemand,for multi item case is given by the above equations under fuzzy demand. Optimum order quantity and the corresponding optimum cost values for singe-period inventory problem can be calculated easily by using the proposed approach. Moreover the closed-form solutions give the opportunity to analyze the effects of model parameters on optimum order quantity and optimum cost value.

Illustration

Suppose the roadside the caterer gets a regular demand for his food product in the form of the regular customers of the nearby commercial outlets in his vicinity.Let the demand be represented as a trapezoidal fuzzy number as follows:-

$$\tilde{X}=(30,\ 50,100,150)$$

The member of fuzzy demand is given below :-

$$\mu_{\tilde{X}}(x)=\begin{cases}\dfrac{x-30}{20}, & 30\le x\le 50\\ 1, & 50\le x\le 100\\ \dfrac{150-x}{50}, & 100\le x\le 150\\ 0 & otherwise\end{cases}$$

Suppose the unit product cost is v= ₹ 20 for a single period and inventory holding cost and shortage cost values are respectively h = ₹5 and b =₹ 30.Since the following equationholds 30-20 ≤ 5+20,the optimum order quantity will be in the interval [30,50].In this case Q^* can be calculated using (29)and we get Q^*=40 and Corresponding cost value for Q^* =40 can be calculated using (20) and we get

$$E[\tilde{T}\tilde{C}(Q^*)] = ₹\ 14{,}373.312$$

If we decrease the unit production cost to v = ₹10 then the second case will remain valid (b-v=h+v), and the value in the interval [50,100] will be optimal, that is $Q^* \in [50,100]$ and the corresponding cost will be equal to₹ 7173.317 .We can inference from the above calculations that the optimum order quantity and the corresponding cost values change according to the unit production cost values. As the unit cost values decrease, corresponding optimum cost values also decrease. We also observe that by decreasing the demand fuzziness the optimum order quantity increase and the total cost values decreases. The reason behind this,is that the less demand uncertainty causes less inventory overage and underage cost which lead to less total cost.

Conclusion

The proposed single-period inventory problem deals with finding the product‟s order quantity which minimizes the expected cost of seller with random demand. However, in real world, sometimes the probability distribution of the demand for products is difficult to acquire due to lack of information and historical data. This study focuses on possibilitic situations, where the demand causes an uncertain total cost function.The paper has proposed an analytical method to obtain the exact expected value of total cost function which is composed of inventory holding, inventory shortage and unit production costs for a singe-period inventory problem under uncertainty. It has determined optimum order quantity that minimizes the fuzzy total cost function, the expected value of a fuzzy function based on the credibility theory. By this method, closed-from solutions to the optimum order quantities and corresponding total cost values are derived. The advantages of the closed-from solutions obtained are those that they eliminate the need for enumeration over alternative values and give the opportunity order quantity and optimum cost value. The proposed methodology, used for optimization based on the credibility theory can be applied to the solution of other complex real world problems where this complexity arises from uncertainty in the form of vagueness.

In this enumerated model when we consider the unit inventory shortage cost as the cost of missed profit, the value of *b-v* epresents the unit profit gained from selling one unit of the item. On the other hand, the value of *h+v* vrepresents the loss incurred for each unsold item when the unit production cost isv. When the unit profit gained from selling one unit is smaller than the loss incurred for each item left unsold, the inventory policy of the management should consider reducing the leftover unit conservatively. In contrast, if the profit gained is larger than the loss incurred, then the inventory policy should be aggressive to meet the possible demand. When the profit equals the loss incurred, the order quantity should be equal to the most likely demand. This model has analyzed for multi product case develop from the case of single type of product enumerated by Behret and Kahraman and the solution procedure can be applied as a further research for the single period inventory problems of uncertainty besides imprecise demand.

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