

# Fuzzy Applications in Financial Management

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**Abstract:** Fuzzy set is used in all research fields because of its Uniqueness to define precisely as a methodology. Fuzzy set theory works for imprecision and subjectivity into the model formulation and solution process. As far as financial management is considered it is limited to lot of constraints and is controlled by the specification of model objectivities. As for as business is considered the decision of each point of view is not to be boasted as success nor as failure. It may be assumed as how for the strategy is close to success at present. In this point of view Fuzzy plays a big bass role in decision making in Finance sector. This paper provides a survey of the application Fuzzy set theory in financial management research. For this purpose many citations which had worked using Fuzzy set theory in bringing out the best results was studied and interpretation of it is done using different methods.

**Keywords:** Fuzzy, Financial Management, Fuzzy set theory, Fuzzy Mathematics

## 1. Introduction

The word fuzzy refers to things which are not clear or are vague. Any event, process, or function that is changing continuously cannot always be defined as either true or false, which means that we need to definesuch activities in a Fuzzy manner.

Fuzzy analysis represents a method for solving problems which are related to uncertainty and vagueness; it is used in multiple areas, such as engineering and has applications in decision making problems, planning.

As finance management is the backbone of all business global wise, research on this topic is continuing .Fuzzy helps to produce successful application and implementation in finance management summary of the findings of Fuzzy set theory in financial management research helps the upcoming researches in financial management field.

Fuzzy set theory has high ability to solve qualitative and quantitative model problems which involves vagueness and impression, so it has been suggested by many researches.

Karwowski and Evans (1986) identified the potential application of Fuzzy set theory in the following area of financial management:

- 1) New product development
- 2) Facilities of location and Layout.
- 3) Production scheduling and control.
- 4) Inventory management.
- 5) Quality and cost benefit analysis.
- 6) Income turnover competition.

The purpose of this paper is to

- a) Identify the application of Fuzzy set theory to financial management,
- b) Identified future research direction.

These are discussed under the topic

- a) Classification scheme for Fuzzy set theory application in financial management research.
- b) Interpretation using different methods.
- c) Conclusion to this study

### Classification scheme for Fuzzy set theory application in financial management research

S. No	Research Topic	Number of citations
1	Inventory	9
2	Cost management (CM)	10
3	Working capital Management & Pricing (WCM)	8
4	Facility Layout (FL)	10
5	Discounting & Payback	7
6	Production and Inventory planning a) Production process Plan selection planning (5) b) Inventory Lot Sizing models (4)	9
7	Forecasting of Business Outcomes a) Simulation b) Delphi Method c) Time series Analysis d) Regressive Analysis e) Fuzzy	(1) (3) (5) (2) (15)

Table 1 gives a classification scheme for the application of fuzzy set theory in financial management research. Seven major categories and the frequency of the citations are also mentioned. More citations (10) is given for Cost management, followed by Working Capital management (8) and facility layout (10). Under the seventh category, Forecasting of Business outcomes were studied by many experts using simulation, Delphi method, Time Series Analysis, Regressive Analysis and Fuzzy .Of this Fuzzy forecasting had been used in more citations.

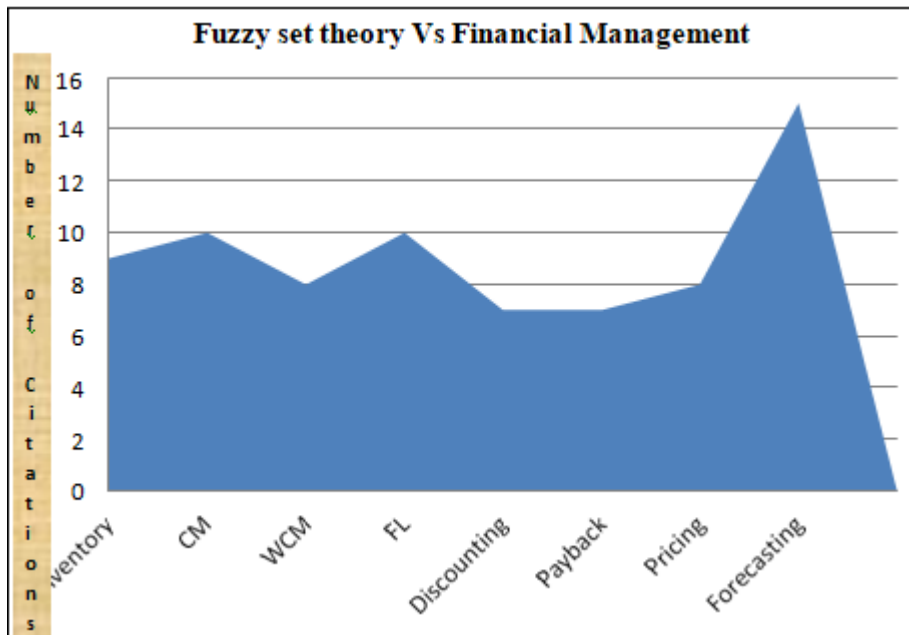


Figure 1

The above Table 1 data is represented in the area chart in which forecasting part uses the Fuzzy methodology in financial management than all other fields. It is an indication

that for business like stock market, the role of this methodology is more consistent.

**The representation of Fuzzy set in Financial Management using piechart**

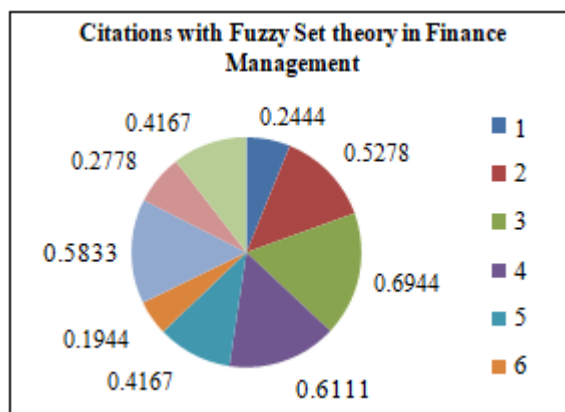


Figure 2

Table of study of P chart involving Fuzzy methods in various citations

S.No	C <sub>j</sub>	M <sub>j</sub> = C <sub>j</sub> /n	UCL <sub>p</sub>	CL <sub>p</sub>	LCL <sub>p</sub>
1	2.2	0.2444	0.5229	0.44073	0.35856
2	4.75	0.5278	0.5229	0.44073	0.35856
3	6.25	0.6944	0.5229	0.44073	0.35856
4	5.5	0.6111	0.5229	0.44073	0.35856
5	3.75	0.4167	0.5229	0.44073	0.35856
6	1.75	0.1944	0.5229	0.44073	0.35856
7	5.25	0.5833	0.5229	0.44073	0.35856
8	2.5	0.2778	0.5229	0.44073	0.35856
9	3.75	0.4167	0.5229	0.44073	0.35856

C<sub>j</sub> gives the average value of the methods used in very citations and respective M<sub>j</sub>, provided by the average sample fraction is given by M<sub>j</sub>= C<sub>j</sub>/n = 0.44073 and N<sub>j</sub> =1- M<sub>j</sub> = 0.5593. Therefore, 3-s control limits for p-Chart are M<sub>j</sub>+3√M<sub>j</sub> N<sub>j</sub> /n. Using the 3-s control limit p-chart we conclude the

limit as 0.5229 and 0.35856 from which UCL<sub>p</sub>= 0.5229, LCL<sub>p</sub>= 0.35856 and CL<sub>p</sub>= 0.44073.

**Pictorial representation involving UCL<sub>p</sub>, CL<sub>p</sub>, LCL<sub>p</sub>**

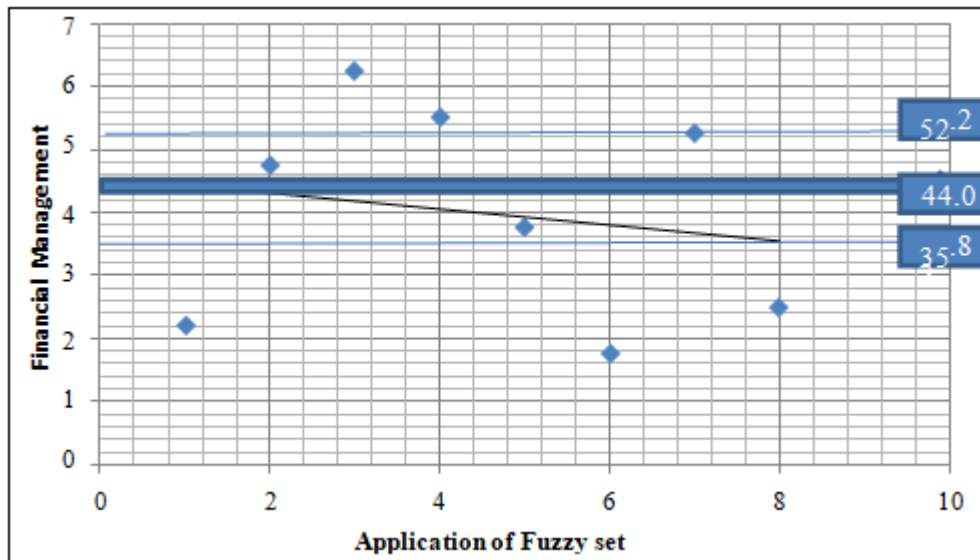


Figure 3

In the above chart a study of Fuzzy set theory usage in Financial management under various famous citations were considered and the same is studied using P-chart and scattering values for table 2. From this we may say that an average of 44% of citations are as said in our focus and a

minimum value of 35% whereas maximum of 52% are under our study. Our study also gave an insight that the business with crucial finance management outline get a helpline of this Fuzzy theory to cross the maximum loss.

Table 2: Table representing the various authors and various Fuzzy Method

Article	Authors	Journal	Publication Year	Purpose	Method
The use of fuzzy- clustering algorithm and self- organizing neural networks for identifying potentially failing banks: An experimental study	Alam, P;Booth, D; Lee, K; Thordarson, T	Expert Systems with Applications	2000	Early warning system for bank default	Fuzzy- clustering and neural networks
GenSo-EWS: a novel neural- fuzzy-based early warning system for predicting bank failures	Tung, WL;Quek, C; Cheng, P	Neural Networks	2004	Early warning system for bank default	Generic self- organizing fuzzy neural network (GenSoF NN)
A novel bankruptcy prediction model based on an adaptive fuzzy k-nearest neighbour method	Chen, HL;Yang, B; Wang, G; Liu, J; Xu, X; Wang, SJ;Liu, DY	Knowledge-Based Systems	2011	Predict bank failure	fuzzy k- nearest neighbor
Financial distress prediction in banks using Group Method of Data Handling neural network, counter propagation neural network and fuzzy ARTMAP	Ravisankar, P; Ravi, V	Knowledge-Based Systems	2010	Predict bank failure	Neural network and fuzzy ARTMAP

In fig3 the data gives an idea that Fuzzy theory has many dimensions and it is used in various levels by various authors. It is also notable that from 2000 onwards this fuzzy had been taken for research point of view. The authors had used Fuzzy-clustering and neural networks, Generic self-organizing fuzzy neural network, fuzzy k-nearest neighbor, Neural network and fuzzy ARTMAP, fuzzy neural network (FNN), Fuzzy refinement domain adaptation algorithm, Multistep fuzzy Bridged Refinement Domain Adaptation Algorithm, Fuzzy refinement domain adaptation algorithm, Fuzzy- DEMATEL, Fuzzy cognitive maps, Fuzzy model using fuzzy numbers to represent the balance sheet.

Fuzzy clustering in Financial Management In clustering data are arranged in groups. This will help to arrange same clusters in same type. It works on the principle of spatial distance between two nodes. Either multidimensional space or in a transformed space. This idea helps to reduce dimensionality and size of the value under different dimensions.

**Classical Clustering:**

Classical clustering techniques assign data points to clusters so that the clusters form a partition of the space. This means that the combination of all the clusters covers the entire space, there are no overlapping clusters, and every data point will belong to exactly one cluster and no more.

**Fuzzy Clustering**

Whereas in Fuzzy Clustering, the clusters have no exact borders. Every point might be an element of more than one cluster to a certain degree. So overlapping is seen with high probability.

**Financial Fuzzy Clustering:**

Financial data comes under complex dimensionality. Theoretically and computationally it is a high risk task to deal with such data. Fuzzy clustering here helps the business experts because it simultaneously decreases dimensionality and the value range. When we apply Fuzzy clustering, we obtain a small number of low-dimensional typical data points

and at the same time with membership values.

For example, consider a financial model involving two concepts:

Profitability and Extension. Some fundamental metrics related to this area are-income, net sales and earnings per share, are related to profitability market capitalization and capital expenses to other financial aspects. It may be more convenient and may for the above metric if fuzzy clustering is performed using “profitable” and “not profitable,” for profitability-related metrics, and similarly “growing” and “not growing” for growth-related metrics. Using two simple concepts, we can obtain a characterization for each Company and meet the needs of our financial model. The figure 4 gives the clear picture of Classical clustering and fuzzy clustering of the scattered data graphically. In classical clustering the grouping alone can be seen whereas in fuzzy clustering graph we can see grouping under different shades and the location of the area which gives the idea of the truthiness of the case studied. For example some X value lies in inner circle is commend to all the three but far from blue circle. In helps to conclude a result very pin pointedly.

Image scattering in classical clustering

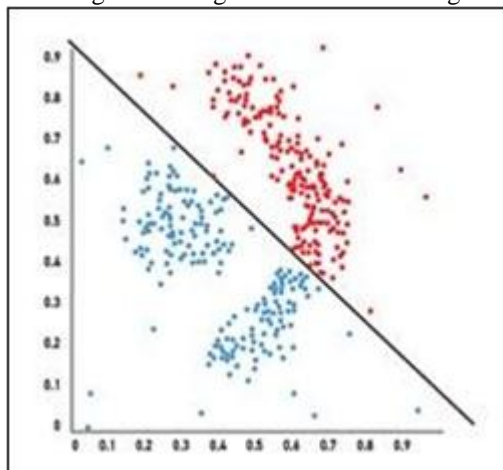


Figure 3

Image scattering in Fuzzy clustering

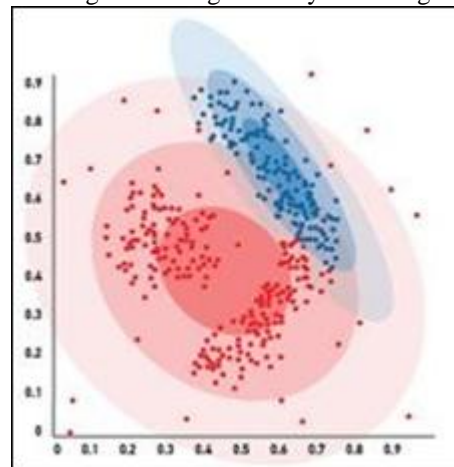


Figure 4

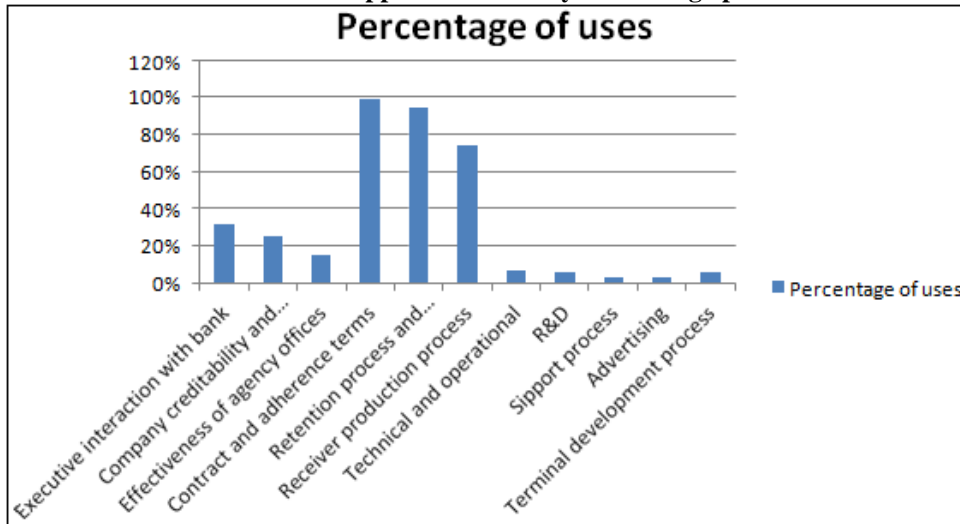
**Use of Fuzzy in Banking**

Bank is a place where fund flow is heavy. Large amount of deposits and withdrawals are done under various limitations for all business people. Also other activities like gold loan, personal loan, vehicle loan and Mortgage loan are in active form in all areas which will be of very much service to public. So considering all these in we can use fuzzy which will be an interesting method in banking sector. In case of banking, the main services were taken into account and have been tabulated.

**A Survey table of focused areas in Banking**

Banking operation involving Fuzzy methods	Percentage of uses
Executive interaction with bank	32%
Company creditability and power	25%
Effectiveness of agency offices	14.8%
Contract and adherence terms	99%
Retention process and receiver satisfaction	94%
Receiver production process	74%
Technical and operational	7.1%
R&D	6.4%
Support process	3.1%
Advertising	3.1%
Terminal development process	6%

**Some of the main application of fuzzy in banking operations**



In the an analysis it was found that about 99% of analysis in Contract and adherence terms used this type. Secondly Retention process and receiver satisfaction used 94%, Following it Receiver production process had used 74%. A minimum usage had been seen in the area of Sippot process, Advertising, Terminal development process. Following this alerting and bank theft alarm also involves fuzzy calculation to a largertextend.

## 2. Conclusion

The study of this topic has given a clarity that above 70 percent of the research in finance management usesthe fuzzy methodology. Out of the above discussions we can also say that banking network needs the fuzzycalculation to a larger extend. The citations discussed in the study also emphasizes that the role of fuzzy calculation is vital in the complex and multiple variable study. In grouping also it helps to conclude the exact point of location. The authors who had used the calculation from 2000 since date .This can be extended in future for tourism management, share marketing fluctuations and journalism which are also an important parameter for Indian economy development.

## References

- [1] J.J. Buckley: Fuzzy Mathematics of Finance, Fuzzy Sets and Systems, 21 (1987), pp. 257–273.
- [2] M. Bojadziev and G. Bojadziev: Fuzzy Logic for Business, Finance and Management, World Scientific Press, Singapore, 1997.
- [3] J.J. Buckley: Fuzzy Mathematics of Finance, Fuzzy Sets and Systems, 21 (1987), pp. 257–273.
- [4] Fuzzy Mathematics of Finance, in: D. Dubois, H. Prade and R. Yager (Eds.), Fuzzy Sets for Intelligent Systems, Morgan Kaufman, San Francisco, 1993, pp. 840–848.
- [5] M. Tarrazo: Practical Applications of Approximate Equations in Finance and Economics, Quorum Books, Westport, Conn., 2001.
- [6] ělohlávek, R.; Dauben, J.W.; Klir, G.J. Fuzzy Logic and Mathematics: A Historical Perspective; Oxford University Press: Oxford, UK, 2017
- [7] Gil-Lafuente, A.M. Fuzzy Logic in Financial Analysis; Springer: Berlin, Germany, 2005
- [8] Antoniou, A., Guney, Y & Paudyal, K. 2006. The determinants of debt maturity structure, evidence from France, Germany and UK. European Financial Management, 12(2): 161- 194.
- [9] Bessler, W., Drobetz, W. & Gruninger, M.C. 2011. International Review of Finance. 11(1): 123- 154.
- [10] Cox, Earl (1994). The fuzzy systems handbook: a practitioner's guide to building, using, maintaining fuzzy systems. Boston: AP Professional. ISBN 978-0-12-194270-0.