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Course: Neural Network and Fuzzy Logic

Assingment # 2

Mehak Topic: Fuzzy Metric Approach for Fuzzy Time Series Forecasting based on Frequency Density Based Partitioning

Short Summary

This paper presents a new fuzzy time series forecasting method for predicting student enrollments at the University of Alabama.

Unlike traditional models that use equal-length partitions, this method introduces frequency density based partitioning: intervals with more data points are divided into finer sub-intervals, while sparse intervals remain broad. This makes fuzzy sets better match the real distribution of data.

The model then uses triangular membership functions to fuzzify enrollment numbers, builds fuzzy logical relationships, and forecasts future enrollments.

Results show that the proposed method achieves the lowest error ($MSE \approx 41,426$, $AFER \approx 1.02\%$), outperforming existing fuzzy time series methods.

Application area: Fuzzy Logic → Forecasting & Prediction → Fuzzy Time Series Forecasting (Education Enrollment Planning).

Tahrim Topic: A Comparison of First and Second Order Training Algorithms for Artificial Neural Networks

Short Summary

This paper compares first-order and second-order optimization methods for training feedforward neural networks with backpropagation, using financial share rate data as a test case. The authors evaluate Gradient Descent, Conjugate Gradient techniques, Quasi-Newton (BFGS), and the Levenberg-Marquardt algorithm, measuring convergence speed, efficiency, and forecasting accuracy. Results show that Gradient Descent is slow and inefficient, while second-order methods—especially Conjugate Gradient and Quasi-Newton—achieve much faster and more stable convergence. Among them, the Levenberg-Marquardt algorithm stands out as particularly effective for financial forecasting, offering second-order performance without requiring explicit Hessian computation

Yumna Topic: A New Quantile Based Fuzzy Time Series Forecasting Model

Short Summary

This paper introduces a new quantile-based fuzzy time series forecasting model that blends quantile regression with fuzzy logic to deal with noisy and uncertain data. The model identifies future trends—whether the data is moving up, down, or staying steady—and then makes predictions using fuzzy rules. It was tested on TAIFEX (Taiwan Futures Exchange) data, where it proved to be more accurate and easier to use than many existing methods. Beyond finance, this approach can also be applied in areas like weather forecasting, education, traffic, and healthcare.

Rimsha Topic: Conceptual Fuzzy Temporal Relational Model (FTRM) for Patient Data

Short Summary

The fuzzy logic application used in this paper is in **healthcare information systems**, specifically for **managing imprecise (fuzzy) and time-varying (temporal) patient data**. The paper proposes the **Fuzzy-Temporal Extended Entity Relationship Model (FT-EERM)**, which allows healthcare databases to represent vague concepts (like "mild fever", "low risk") along with temporal aspects (past, present, future patient states).

Title: Review of Fuzzy Logic Research Papers by Dr. Tehseen Jillani

1. Introduction

Fuzzy logic provides a way to handle imprecision and uncertainty in real-world data. Dr. Tehseen Jillani has contributed significantly in applying fuzzy logic to various domains, especially forecasting, optimization, and healthcare systems. This report reviews selected papers authored/co-authored by Dr. Tehseen Jillani and identifies their application areas.

2. Reviewed Papers and Applications

Paper 1: Fuzzy Metric Approach for Fuzzy Time Series Forecasting based on Frequency Density Based Partitioning (Mehak)

Application: Student enrollment forecasting (Education Planning)

Contribution: Improved partitioning method (frequency-density based) for fuzzy time series.

Impact: Achieved lower forecasting error compared to traditional fuzzy time series methods.

Paper 2: A Comparison of First and Second Order Training Algorithms for Artificial Neural Networks (Tahrim)

Application: Financial forecasting (Stock/Share rates)

Contribution: Compared optimization algorithms (Gradient Descent, Conjugate Gradient, Quasi-Newton, Levenberg-Marquardt).

Impact: Showed that second-order algorithms (especially LM) are more efficient for financial prediction.

Paper 3: A New Quantile-Based Fuzzy Time Series Forecasting Model (Yumna)

Application: Financial forecasting (TAIFEX data), with potential for weather, education, traffic, healthcare.

Contribution: Introduced quantile regression into fuzzy time series to handle noisy/uncertain data.

Impact: Improved accuracy and usability compared to traditional fuzzy time series methods.

Paper 4: Conceptual Fuzzy Temporal Relational Model (FTRM) for Patient Data (Rimsha)

Application: Healthcare information systems (patient records with fuzzy and temporal attributes).

Contribution: Proposed FT-EERM to model vague and time-varying patient states.

Impact: Enhanced representation of patient data in medical databases, improving decision support.

3. Application Areas of Dr. Tehseen Jillani's Work

From the reviewed papers, Dr. Jillani's fuzzy logic research can be categorized into:

Forecasting & Prediction

Education (student enrollment forecasting)

Finance (stock/share rate forecasting, TAIFEX data)

General uncertain time series forecasting

Healthcare Systems

Patient data management with fuzzy and temporal aspects

Artificial Neural Networks & Optimization

Training algorithms for better prediction performance

4. Major Focus Areas

Dr. Jillani has worked **most extensively in fuzzy time series forecasting**, particularly applying fuzzy partitioning, quantile methods, and hybrid approaches to **financial and education data**.

Another significant application area is **healthcare databases**, where fuzzy logic is used to model uncertainty in patient records.

5. Conclusion

Dr. Tehseen Jillani's contributions highlight the flexibility of fuzzy logic in addressing real-world uncertainty. His primary research focus has been **forecasting (finance and education)**, with secondary but impactful applications in **healthcare information systems**. These works demonstrate the potential of fuzzy logic in improving prediction accuracy and decision-making in complex domains.