**HFS-SAFIN(FRIE)++**

Self-Adaptive Fuzzy Inference Network++ with Fuzzy Rule Interpolation and Extrapolation and Hierarchical Feature Selection empowered with

Reconstruction of Bank States via Longitudinal and Lateral Perspectives of Financial Records

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**Motivation**

Two main issues with FNN-based early warning systems:

1. Lack of online learning capability – required to retrain models to incorporate new data instances
2. Flaw in data pre-processing stage – discarded banks with missing data, reducing sample size to 3635 to 3103 banks

To propose an effective hybrid tool for bank failure prediction based on Neuro-fuzzy systems

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**Design & Implementation**

1. Financial Records with Missing Data
2. Financial Records with Reconstructed Data
3. Hierarchical Feature Selection
4. Online Learning with Optimal Feature Subset
5. Perform Bank Failure Prediction

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**Experimental Results & Analysis**

<table>
<thead>
<tr>
<th></th>
<th>S1: Last Available</th>
<th>S2: One-Year Prior</th>
<th>S3: Two-Year Prior</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Accuracy</td>
<td>Feature</td>
<td>Rules</td>
</tr>
<tr>
<td>Original data set</td>
<td>92.46</td>
<td>1.4</td>
<td>8.4</td>
</tr>
<tr>
<td>Reconstructed data set (simulated 20% missing data)</td>
<td>93.83</td>
<td>1.8</td>
<td>7.4</td>
</tr>
<tr>
<td>Fully reconstructed data set (actual missing data)</td>
<td>93.154</td>
<td>1.2</td>
<td>10</td>
</tr>
</tbody>
</table>

Superior prediction accuracy with reconstructed data set

More concise rule with reconstructed data set

"If PLAQLY is HIGH, the bank is going to FAIL with the probability of about 88% in one-year time."