FUZZY ANALYTICS

AN ARTIFICIAL INTELLIGENCE APPROACH TO DETERMINISTIC / STOCHASTIC FEDERATED VIEW OF THE HUGE DATA SYSTEMS

STEP BY STEP APPROACH TOWARDS SUPERIOR LOGICAL DATA QUALITY AND DATA MANAGEMENT
Agenda of the Session

- The Pragmatic Fuzzy Data Analytics Approach
- Why are we here?
- Where are we now?
- Fuzzy Analytics Heuristic Model Analysis Approach
- Sample Examples
- Question and Answers
Key Considerations in Fuzzy Data Analysis

- Components of a Fuzzy Big Data Analysis Plan
- Distinguishing Fuzzy Big Data Types
- Distinguishing Different Types of Analyses

Overview of Different Statistical Tools for Fuzzy Big Data Case Studies:

- Stock Data Modeling with Online Behavior Approach
- Sales Statistical Data Model Analysis
- Manufacturing Models Big Data Fuzzy Analytics
- Big Data Factor Analysis a key to Modern AI approach for informed decision making
Where does Fuzzy Analytics fit for Financial Market Researchers?

- Sum up the experience of seasoned investor
- Indicators for different phases of business life cycle.
  - Recession $\rightarrow$ consolidation/ fiscal recovery $\rightarrow$ growth $\rightarrow$ fiscal decline
- Efficient market hypothesis
- Different methods of forecast eg. GARCH, ARCH, ARIMA, Neural Networks.
Flow Diagram and basic model of Fuzzy Analytics Neural Network

- Data Collection
- Data Preprocessing
- Extract Test Data Set
- Select Network Architecture
- Training
- Forecasting
- Result Analysis
Fuzzy Analytics Applied (for Finance Gurus)

- **Manage Risk** eg. Currency market average daily turnover is $X trillion as reported in April 2012.

- **Building up portfolio** eg. Hedge funds, mutual funds, fund managers use intelligent system to build up portfolio from different asset classes.

- **Forecast future returns.**

- **Analyze “risk-reward” ratio.**

- **Trend analysis and pattern recognition.**

- **Trading strategies and economic indicators** eg. Projecting Inflation and GDP figures.
What all things Intelligent Systems still can’t capture?

- Market sentiments eg. Natural calamities, Festive Situations etc.
- Emotional attachment to an investment.
- Market reaction to scams and scandals
<table>
<thead>
<tr>
<th>Why are we here? - Key Considerations in Fuzzy Analytics of Big Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Identify the purpose of Fuzzy Analytics of Big Data</td>
</tr>
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<td>• Understand the sample(s) under Fuzzy Analytics of Big Data</td>
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<td>• Understand the instruments being used to collect data for</td>
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<tr>
<td>Fuzzy Analytics of Big Data</td>
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<tr>
<td>• Be cognizant of data layouts and formats under Fuzzy</td>
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<tr>
<td>Analytics</td>
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<tr>
<td>• Establish a unique identifier if matching or merging is</td>
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<tr>
<td>necessary under Fuzzy Analytics</td>
</tr>
<tr>
<td>• Plan your work and work your Fuzzy Analytics plan!</td>
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Industrial Fuzzy Analytics Modeling Approach

- Big Data Frequency Distributions and Cross-Tabulations:
- Big Data Descriptive Statistics (Means, Std. Deviations, Correlations):
- Big Data T-tests and Analysis of Variance (ANOVA)
- Big Data Regression Analysis
- Big Data Principal Components/Factor Analysis (Data Reduction)
- Big Data Cluster and Discriminant Analyses (Segmentation)
- Big Data Latent Class Analysis (Classification)
- Big Data Hierarchical Linear Modeling (HLM)
- Big Data Differential Item Functioning (DIF)
Fuzzy Analytics Big Data Correlation Matrix

\[ T_{xy} = \frac{\sum_{i=1}^{n} (x_i - \bar{x})(y_i - \bar{y})}{(n - 1)s_x s_y} = \frac{\sum_{i=1}^{n} (x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_{i=1}^{n} (x_i - \bar{x})^2} \sqrt{\sum_{i=1}^{n} (y_i - \bar{y})^2}}, \]

where \( \bar{x} \) and \( \bar{y} \) are the sample means of \( X \) and \( Y \), and \( s_x \) and \( s_y \) are the sample standard deviations of \( X \) and \( Y \).

This can also be written as:

\[ T_{xy} = \frac{\sum x_i y_i - n \bar{x} \bar{y}}{(n - 1)s_x s_y} = \frac{n \sum x_i y_i - \sum x_i \sum y_i}{\sqrt{n \sum x_i^2 - (\sum x_i)^2} \sqrt{n \sum y_i^2 - (\sum y_i)^2}}. \]

If \( x \) and \( y \) are results of measurements that contain measurement error, the realistic limits on the correlation coefficient are not \(-1\) to \(+1\) but a smaller range.\(^6\)
The regression equation is a linear equation of the form: \( \hat{y} = b_0 + b_1x \). To conduct a regression analysis, we need to solve for \( b_0 \) and \( b_1 \). Computations are shown below.

\[
\begin{align*}
b_1 &= \frac{\sum (x_i - \bar{x})(y_i - \bar{y})}{\sum (x_i - \bar{x})^2} \\
b_0 &= \bar{y} - b_1 \times \bar{x}
\end{align*}
\]

\[
\begin{align*}
b_1 &= \frac{470}{730} = 0.644 \\
b_0 &= 77 - (0.644)(78) = 26.768
\end{align*}
\]
Measuring Variation Between Groups

The variation between group means is measured with a weighted sum of squared differences between the sample means and the overall mean of all the data. Each squared difference is multiplied by the appropriate group sample size, n_i, in this sum. This quantity is called sum of squares between groups or SS Groups.

$$SS_{Groups} = n_1(x_1 - x)^2 + n_2(x_2 - x)^2 + \ldots + n_k(x_k - x)^2 = \sum_{groups} n_j \bar{x}_j - \bar{x})^2$$

The numerator of the F-statistic for comparing means is called the mean square between groups or MS Groups, and it is calculated as:

$$MS_{Groups} = \frac{SS_{Groups}}{k - 1}$$

Measuring Variation Within Groups

To measure the variation among data points within the groups, find the sum of squared deviations between data values and the sample mean in each group, and then add these quantities. This is called the sum of squared errors, SSE, or sum of squares within groups.

$$SSE = (n_1 - 1)s_1^2 + (n_2 - 1)s_2^2 + \ldots + (n_k - 1)s_k^2 = \sum_{all\,groups} (n_j - 1)s_j^2$$
ANOVA Analysis: Basis for Factor analysis

For the single element x13, the difference variance elements are illustrated graphically.
ANOVA Analysis : Basis for Factor analysis

\[ F_{\alpha, n_1-1, n_2-1} \]

Critical Values for F Distributions

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<th>( \alpha )</th>
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<td>61.25</td>
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More Advanced the Analysis, Greater the Amount of Preparation

- Most analyses can be executed straight from a working data file.
- Some analyses may require transformations of the raw data, subsets, or specific input data to comply with statistical software.
Big Data Analytics: A Practical Research Example: Case Study 1

Big Data Analytics in action:
- Identifies future at-risk borrowers so that proactive measures can be taken to prevent delinquency and default
- Supports investigations into government regulatory filings for fraud
- Defines custom collection strategies based on risk score
- Prioritizes borrowers in the inbound ACD queue based on risk score
- Engages high-risk borrowers in multi-channel strategy to prevent delinquency
- Call Center Capacity Analytics

Diagram:
- Customer/End User-centric Apps:
  - Mobile/Text/IVR Call Center
- ETL and Data Warehousing:
  - Record Keeping Data
  - Web, Chat, CRM, Call, Transcriptions
  - External Data
  - Medical/RX Claims Lab/Biometrics
- Raw Data
  - Transactional Data
  - Analytics, Predictions
    - Batch Predictions
    - Daily Predictions
    - Real-time Predictions
    - Real-time Data
    - Affinity Routing Simulator
  - Backend Operations
    - Contact Center Organization
    - Call and Contact Routing
    - Agent/Caller Affinity Routing
    - Topic Prediction
  - Dynamic Dashboards
    - Client Facing
    - SLA and Customer Feedback Dashboards
- Analytics and Predictions
- Backend Operations
- Dynamic Dashboards
- Actionable Intelligence
Big Data Analytics: A Practical Research Example: Case Study 1

Fig. 1. Diagram outlining 3 phases of methodology and corresponding data sets: (1) creation and validation of OpinionFinder and GPOMS public mood time series from October 2008 to December 2008 (Presidential Election and Thanksgiving), (2) use of Granger causality analysis to determine correlation between DJIA, OpinionFinder and GPOMS public mood from August 2008 to December 2008, and (3) training of a Self-Organizing Fuzzy Neural Network to predict DJIA values on the basis of various combinations of past DJIA values and OF and GPOMS public mood data from March 2008 to December 2008.
Big Data Analytics: A Practical Research Example: Case Study 1

User Response and Impact on Market Stock Index
Let us assume the following variables:

- \( C \) = Cash Collection per Counter at one business unit
- \( TC \) = Total Cash Collection at one business unit
- \( t \) = Unit Transaction Amount per POS Counter at one business unit
- \( FSH \) = FASHION Division
- \( S\) (Total_UAE) = Total Sales in UAE
- \( S\) (Total_Kuwait) = Total Sales in Kuwait
- \( S\) (Total_South_Africa) = Total Sales in South Africa
- \( S\) (Total Group) = Total Sales in ABCD LLC Group

Suppose there are 5 Business Locations of Business Units in UAE namely A, B, C, D and E.

For Location A, has 10 POS counters namely Counter 1, Counter 2, Counter 3, ........................, Counter 10.

Total Cash Collected at midnight at Outlet: \( TC(A) = \sum_{i=1}^{10} C(i) \)
Let us assume the following variables:

- $C =$ Cash Collection per Counter at one business unit
- $TC =$ Total Cash Collection at one business unit
- $t =$ Unit Transaction Amount per POS Counter at one business unit
- $FSH =$ FASHION Division
- $S_{(Total\_UAE)} =$ Total Sales in UAE
- $S_{(Total\_Kuwait)} =$ Total Sales in Kuwait
- $S_{(Total\_South\_Africa)} =$ Total Sales in South Africa
- $S_{(Total\_Group)} =$ Total Sales in ABCD LLC Group

Suppose there are 5 Business Locations of Business Units in UAE namely A, B, C, D and E. For Location A has 10 POS counters namely Counter 1, Counter 2, Counter 3, ......................, Counter 10. 

Total Cash Collected at midnight at Outlet: $TC(A) = \sum_{i=1}^{n} C(i)$

$n = 10$
Total Cash per Business Unit
= Summation of all unit Transactions over all POS counters at midnight at Outlet : TC(A)

\[ n = 10 \]

\[ \text{Total Cash Collected at midnight at Outlet : } TC(A) = \sum_{i=1}^{n} C(i) \]

\[ n = 10 \quad j = N \]

\[ = \sum_{i=1}^{n} \sum_{j=1}^{j=N} t(j) \text{ in UAE Dirhams} \]

Similarly for other locations:

\[ n = 10 \quad j = \]

\[ TC(B) = \sum_{i=1}^{n} \sum_{j=1}^{j=N} t(j) \text{ in UAE Dirhams} \]

\[ n = 10 \quad j = \]

\[ TC(C) = \sum_{i=1}^{n} \sum_{j=1}^{j=N} t(j) \text{ in UAE Dirhams} \]
Fuzzy Analytics Model: Practical Example Contd…

\[
TC(D) = \sum_{i=1}^{10} \sum_{j=1}^{10} t(j) \text{ in UAE Dirhams}
\]

\[
TC(E) = \sum_{i=1}^{10} \sum_{j=1}^{10} t(j) \text{ in UAE Dirhams}
\]

\[
S \text{ (Total\_UAE)} = \text{Total Sales in UAE} = \sum_{k=1}^{5} \sum_{i=1}^{10} \sum_{j=1}^{10} t(j) \text{ in UAE Dirhams for 5 Business Units}
\]

\[
S \text{ (Total\_UAE)} = \text{Total Sales in UAE} = \sum_{k=1}^{X} \sum_{i=1}^{10} \sum_{j=1}^{10} t(j) \text{ in UAE Dirhams for X no of Business Units}
\]
Total Sales in ABCD Group
= S (Total_UAE) + S (Total_South_Africa) + S (Total_Kuwait)
= 
\[ \sum_{k=1}^{X} \sum_{i=1}^{10} \sum_{j=1}^{10} t(j) \cdot d_l \]
in UAE Dirhams for Y no of Business Units in three countries

Now \( t(j) = f(X,Y) = A(X,Y) \), i.e. every transaction unit is an Account function of Fashion Products and Food items defined in different classes called Transaction types like Credit Card - Visa, Void, Foreign Currency types.
Thus, Total Sales in ABCD LLC Group
= \text{S(Total}_{-}\text{UAE}) + \text{S(Total}_{-}\text{South}_{-}\text{Africa}) + \text{S(Total}_{-}\text{Kuwait) }
= \sum_{k=1}^{n=10} \sum_{j=1}^{10} \sum_{i=1}^{j} t(j) \ dl
= \sum_{k=1}^{n=10} \sum_{j=1}^{10} \sum_{i=1}^{j} A(x,y) \ dl

Total Sales Revenue (ABCD Group) = P
= \sum_{k=1}^{n=10} \sum_{j=1}^{10} \sum_{i=1}^{j} A(x,y) \ dl

Total Expenses = Summation of all expenses from GL Expenses = Q (say)
Gross Margin = P - Q
### Recommendations from the Fuzzy Analytics Model

- End to end Account Creation the way ERP is done to reflect homogeneous Solution Architecture in terms of Business Intelligence and Reporting.
- Report Formats to be mapped as per the Manual Reporting executed at the branches as provided by Tiger Inc Finance Department.
- Regarding the Reporting Architecture it is indispensable to present the same in a Web-Intelligence mechanism.
- The Finance team must have complete transparency in getting all required data with no latency gap.
## Input Financial Statements for Fuzzy Analytics

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<tr>
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<th>1993</th>
<th>1994</th>
<th>1995</th>
<th>AVG</th>
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<td></td>
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<tr>
<td>Cash</td>
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<td>Accounts receivable</td>
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<td>11.8</td>
<td>12.5</td>
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<td>Inventory</td>
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<td>Prepaid expenses</td>
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<td>Other current</td>
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<td>0.9</td>
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<td>Total current</td>
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<td>Fixed assets</td>
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<td>65.4</td>
<td>72.1</td>
<td>65.60</td>
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<th>1995</th>
<th>AVG</th>
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<td>Accounts payable</td>
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<td>7.90</td>
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<td>Total current</td>
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<td>9.2</td>
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<td>24.3</td>
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<td>Shareholders' equity</td>
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<td><strong>TOTAL</strong></td>
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<td>65.4</td>
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## Working 1: Calculation of Profit from Additional Sales

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<td>Price</td>
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<td>1.75</td>
<td>1.80</td>
<td>1.86</td>
<td>1.91</td>
<td>1.97</td>
<td>2.03</td>
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<td>7,606</td>
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<td>8,069</td>
<td>8,311</td>
<td>8,560</td>
<td>8,817</td>
<td>9,082</td>
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<td>Avg Profit Margin (1993-95)</td>
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<td>Profit on Added Sales</td>
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<td>812</td>
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<td>1,142</td>
<td>1,176</td>
<td>1,211</td>
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<td>1,285</td>
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## Working 2: Calculation of Additional Working Capital Needs

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<td>Avg Inventory Days (1994-96)</td>
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<td>Inventory Requirements</td>
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<td>480</td>
<td>494</td>
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<td>524</td>
<td>540</td>
<td>556</td>
<td>573</td>
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<td>Avg Receivables/Sales (1993-95)</td>
<td>12.34%</td>
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<tr>
<td>Receivables Increase</td>
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<td>668</td>
<td>911</td>
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<td>1,121</td>
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<td>Avg Payables/Sales (1993-95)</td>
<td>8.22%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Payables Increase</td>
<td>(237)</td>
<td>(445)</td>
<td>(607)</td>
<td>(625)</td>
<td>(644)</td>
<td>(663)</td>
<td>(683)</td>
<td>(703)</td>
<td>(724)</td>
<td>(746)</td>
</tr>
<tr>
<td>Working Capital Needs</td>
<td>301</td>
<td>564</td>
<td>770</td>
<td>793</td>
<td>817</td>
<td>842</td>
<td>867</td>
<td>893</td>
<td>920</td>
<td>947</td>
</tr>
<tr>
<td>Change in Working Capital</td>
<td>301</td>
<td>263</td>
<td>206</td>
<td>23</td>
<td>24</td>
<td>25</td>
<td>25</td>
<td>26</td>
<td>27</td>
<td>28</td>
</tr>
</tbody>
</table>

## Working 3: Calculation of Company WACC

<table>
<thead>
<tr>
<th></th>
<th>Return on Equity</th>
<th>Return on Debt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk-free Rate</td>
<td>8.06% (10-year Bond)</td>
<td>8.06% (10-year Bond)</td>
</tr>
<tr>
<td>Beta</td>
<td>0.85</td>
<td>2%</td>
</tr>
<tr>
<td>Market Risk Premium</td>
<td>6%</td>
<td>10.06%</td>
</tr>
<tr>
<td>Return on Equity</td>
<td>13.16%</td>
<td>10.06%</td>
</tr>
<tr>
<td>WACC</td>
<td><strong>10.5%</strong></td>
<td></td>
</tr>
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</table>

Fuzzy Analytics: Practical Analytics for Decision Makers
### Evaluation of Expansion Project at Tiger Inc

All amounts are in Thousands of Dollars

<table>
<thead>
<tr>
<th></th>
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<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Project consultancy</td>
<td>40,000</td>
<td></td>
<td></td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>Salaries and administrative expenses</td>
<td></td>
<td>223,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Building Expansion</td>
<td>(1,300)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spiral Freezer</td>
<td>(1,600)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Processing Line</td>
<td>(1,300)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Warehouse</td>
<td>(600)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>600</td>
</tr>
<tr>
<td>Contingency needs</td>
<td>(400)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Land Cost</td>
<td>(250)</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CF from Added Sales (W-1)</td>
<td>282</td>
<td>528</td>
<td>720</td>
<td>742</td>
<td>764</td>
<td>787</td>
<td>811</td>
<td>835</td>
<td>860</td>
<td>886</td>
<td></td>
</tr>
<tr>
<td>Depreciation Tax Shield</td>
<td>102</td>
<td>102</td>
<td>102</td>
<td>102</td>
<td>102</td>
<td>102</td>
<td>102</td>
<td>102</td>
<td>102</td>
<td>102</td>
<td></td>
</tr>
<tr>
<td>Capital Expenditures</td>
<td>(290)</td>
<td>(290)</td>
<td>(290)</td>
<td>(290)</td>
<td>(290)</td>
<td>(290)</td>
<td>(290)</td>
<td>(290)</td>
<td>(290)</td>
<td>(290)</td>
<td>(290)</td>
</tr>
<tr>
<td>Tax Shield on CCA</td>
<td>152</td>
<td>269</td>
<td>208</td>
<td>161</td>
<td>126</td>
<td>100</td>
<td>80</td>
<td>65</td>
<td>53</td>
<td>606</td>
<td></td>
</tr>
<tr>
<td>Other Savings</td>
<td>90</td>
<td>92</td>
<td>95</td>
<td>98</td>
<td>101</td>
<td>104</td>
<td>107</td>
<td>110</td>
<td>114</td>
<td>117</td>
<td></td>
</tr>
<tr>
<td>Net Cash Flow</td>
<td>(5,450)</td>
<td>115</td>
<td>566</td>
<td>767</td>
<td>928</td>
<td>917</td>
<td>916</td>
<td>922</td>
<td>933</td>
<td>950</td>
<td>5,028</td>
</tr>
</tbody>
</table>

- **Hurdle Rate**: 18%
- **WACC (W-3)**: 10.5%
- **NPV at Hurdle Rate**: (1,548)
- **NPV at WACC**: 481
- **IRR**: 11.9%

**Assumptions:**
- **Tax Rate**: 35%
- **Inflation Rate**: 3%

* For simplicity it is assumed that the expansion will be completed by year end 1995 and regular sales will incur in 1996
* If the inflation is increased from 3 to 5, then price can be moved-up, so the NPV & IRR will increase
* or considering the business potential, executive committe should approve lower (11%) hurdle rate
Fuzzy Analytics Project Phases

- Big Data Source Analysis Phase
- Statement of research questions
- Methods used to answer research questions
- File restructuring procedures (syntax creation, adding new variables as needed)
- Algorithms for scoring, equating, etc.
- Data cleaning procedures (e.g. removing outliers)
- Quality control procedures at every step in the project
Sample Project Gantt Chart: A practical suggestion to Business

Data Gathering Phase (3 Months)

Sessions on Data Analysis (3 Months): Heavy duty statistical data analysis support

Iterative Data Analysis Checks till Finalization / Data Quality (4-5 Months)

Final Report Preparation: 2 Months
What is the role of Fuzzy Analytics in data mining?

What is the nature of Fuzzy Analytics’ contribution towards Business?

What is the role of an Fuzzy Analytics in manufacturing?
Fuzzy Analytics in Manufacturing: Merits Unleashed

- Production Scheduling
- Advanced Planning and Scheduling
- Production Reporting
- Inventory Management
- Production Accounting
- Production Capacity Planning
- Materials Requirements Planning
- Production Process Control
<table>
<thead>
<tr>
<th>Traditional SCADA for pipelines, power distribution or anything that spans great distances</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typical</td>
</tr>
<tr>
<td>Stand-Alone</td>
</tr>
<tr>
<td>Networked</td>
</tr>
<tr>
<td>Local control SCADA for plant or unit operations or any architecture that is within a defined boundary</td>
</tr>
<tr>
<td>DCS</td>
</tr>
<tr>
<td>PC based</td>
</tr>
<tr>
<td>HMI / PLC</td>
</tr>
</tbody>
</table>

Fuzzy Analytics : From Mfg Plant Critical Infrastructure Big Data Perspective
Fuzzy Analytics …

The dashboard solutions, from the production line to the bottom line.
Typical SCADA Platform

- RTU
- WAN Hub
- Operator Stations
  - Microsoft
- Programming/Engineering Stations
  - UNIX or Microsoft
- Enterprise PCs
- SCADA/History/Application Servers
- Communications Servers
- Web Interface Server
- B & W Printer
- Color Printer
- Dual 100BaseT Ethernet
- OPTOnet
- IED
- Telecommunications Circuits (Multiple Protocols)
Fuzzy Networked SCADA Data
Production Plant Control

Corporate Network – TCP/IP, DecNet, NFS, SNA, X.25, OSI, Novell

Workstations

Computers

Fault Tolerant Process LAN (HSE 100MB Fiber)

Personal Workstation

Table-Top Workstation

Fault Tolerant Fieldbus

Spectrum PLC

Single Station Controllers

Fault Tolerant Fieldbus

PCs
Networked HMI/PLC

Corporate Network – TCP/IP, DecNet, NFS, SNA, X.25, OSI, Novell

PC's

Server

Control Room

Process LAN

Programming

PLC

RTU’s
Scales
Bar Code
Scanners
Etc...

Single Station Controllers

Remote PC

I/O

I/O
Fuzzy Critical Networks Analytics
Critical Fuzzy Factor Analytics: ANOVA
ERP Production Application Solution Architecture

: An outcome of Fuzzy Analytics of Critical Networks

PLCs

1. Markiton OPC
2. ABB KM
Critical Infrastructure Issues Resolution Survey

- Issue was addressed promptly: 95%
- Issue was resolved to my satisfaction: 87.5%
- Technician was courteous: 90%
- Overall experience was positive: 92.5%

Target: 75%

- 100% = very satisfied
- 75% = Satisfied
- 50% = Somehow Satisfied
- 25% = Not Satisfied
Critical Infrastructure Issues Resolution Time

Issue Resolution Analytics

- Low (<16 hr): 79%
- Medium (<8 hr): 86%
- High (<4 hr): 81%

% Tickets within SLA

Average: 82%
Target: >75%
Uptime Rate: 99.94%

- Uptime: 1850/1860min (99.94%)
- Downtime: 10/1860min (0.06%)
- Target: 99.9%

* 8 AM to 9 PM
Fuzzy SCADA Analytics: Beyond the Big Data Analytics

For a large scale manufacturer, informed decision making is leveraged in the following areas:

- Distributed Control into the field
- Distributed Computing
- Distributed I/O into the field
- Services, Applications, Solutions
- Industry Standards
- Configurator tools
- Asset Management
- Performance guarantees ($)
- Life Cycle Costs (scalability / migration / upgrades)
- Digital bus selection
FUZZY ANALYTICS : BIG DATA FACTOR ANALYSIS
Big Data Factor analysis is commonly used in:

- Data reduction
- Scale development
- The evaluation of the psychometric quality of a measure, and
- The assessment of the dimensionality of a set of variables.
Fuzzy Analytics Big Data factor analysis as an exploratory and confirmatory multivariate

- Regardless of purpose, factor analysis is used in:
  - the determination of a small number of factors based on a particular number of inter-related quantitative variables.

- Unlike variables directly measured such as speed, height, weight, etc., some variables such as egoism, creativity, happiness, religiosity, comfort are not a single measurable entity.

- They are constructs that are derived from the measurement of other, directly observable variables.
• Generally, the number of factors is much smaller than the number of measures.
• Therefore, the expectation is that a factor represents a set of measures.
• From this angle, factor analysis is viewed as a data-reduction technique as it reduces a large number of overlapping variables to a smaller set of factors that reflect construct(s) or different dimensions of construct(s).
The assumption of factor analysis is that underlying dimensions (factors) can be used to explain complex phenomena.

Observed correlations between variables result from their sharing of factors.

Example: Correlations between a person’s test scores might be linked to shared factors such as general intelligence, critical thinking and reasoning skills, reading comprehension etc.
Ingredients of a Good Factor Analysis Solution

• A major goal of factor analysis is to represent relationships among sets of variables parsimoniously yet keeping factors meaningful.

• A good factor solution is both simple and interpretable.

• When factors can be interpreted, new insights are possible.
### Fuzzy Analytics: Big Data Operations Recommendations – A Human Touch Factor

- Major executive involvement and vertical (up/down) communication is crucial to success
- Objectives (KPIs) / metrics/issues should drive the project
- BPR (Business Process Reengineering) should be done up front
- Have a Go / No Go decision point concerning operations
- Effective training is needed at all levels in improving the Data Quality.
- Major communications i.e. Thorough Conference Room Pilot, Frequent User Meetings / Handshakes Conference Calls, Involvement of users in the User testing, simulation are needed, including stress testing
- Have multiple Contingency Plans e.g. Resource Contingencies
- Scope Control during the implementation phase of the project
- Reward contributors any way you can—with praise, training, coveted team assignments, promotions, etc. Your good people are your finest asset.
Questions or Comments