

Objective

- To get the prediction accuracy of machine running without any fail by Auto-AI and SXI and compare.
- Precision AI using Target SXI based Random Forest trees. Target increase in machine running rate without failing is **20%** up from current levels.

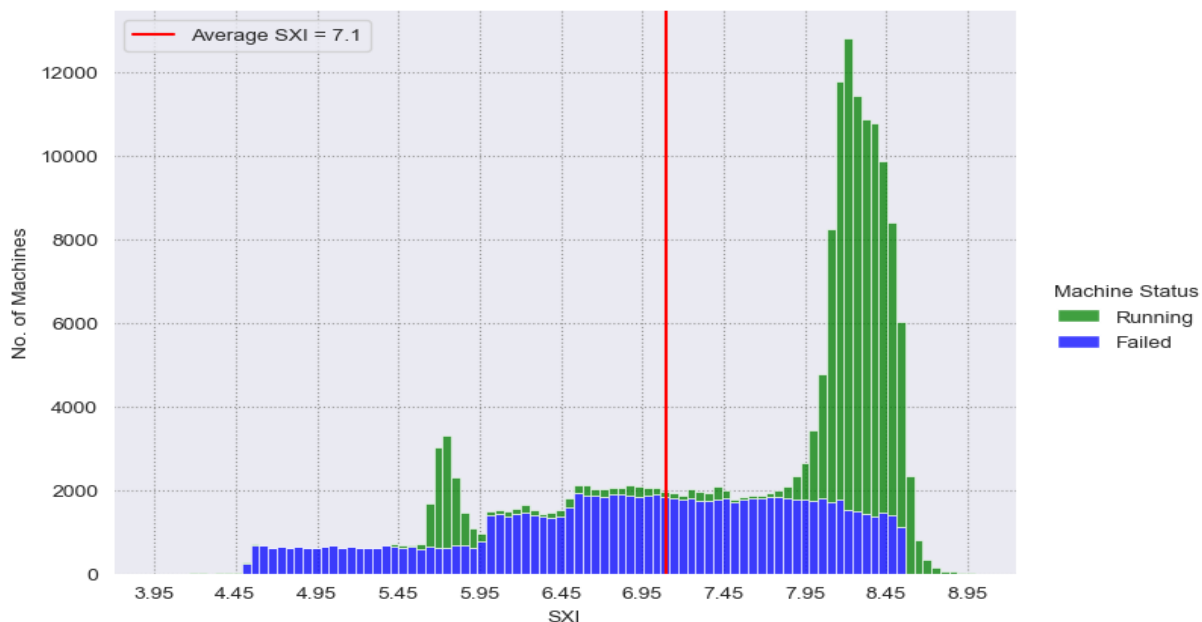
SXI Hypothesis

- SXI is a proxy/surrogate for all features responsible for ensuring whether Machine ran without any failure or if the machine failed. The higher the SXI, the better is the Machine running without any failure and hence increasing SXI score should lead to higher Machine running rate without any failure.

SXI Definition

- **Sriya Expert Index (SXI):** Dynamic score/index obtained from a proprietary formula consisting of weights from 10 ML algorithms. SXI is a super feature and is a true weighted representative of all important features. Converts a multi-dimensional hard to solve problem into a simpler 2-dimensional solution (problem solved).
- **SCORE + CORRELATE = IMPROVE**

Discussion & Results



1. Exploratory Data Analysis

200,000 machines were distributed to 1,02,213 good and 97,787 bad. Good represents those machines running without any failure and Bad represents machines that failed. So, **51.1%** is the machines running without any failure and **49.9%** is machines with failure.

2. SXI - Exploratory Data Analysis

The current Average SXI is **7.1**. No. of total machines above 7.1 is **121849** and of these **87895** are machines running without any failure and **33954** are those machines that failed. So, machine running rate without any failure (%) is **72.13%** and machines failure rate is **27.87%**.

Correspondingly, the No. of total machines below 7.1 is **78151** and of these **14318** are machines running without any failure and **63833** are machines that failed. So, the machine running rate (%) is **18.32 %** and machine failure rate is **81.68%**.

So SXI is a perfect proxy/surrogate for machine running rate without any failure and above average SXI the ratio of good outcome is **1.41x** overall average and below average SXI, this ratio of good outcome is **0.36** overall average. So, the increase in SXI leads to increase in rate of machines running without any failure.

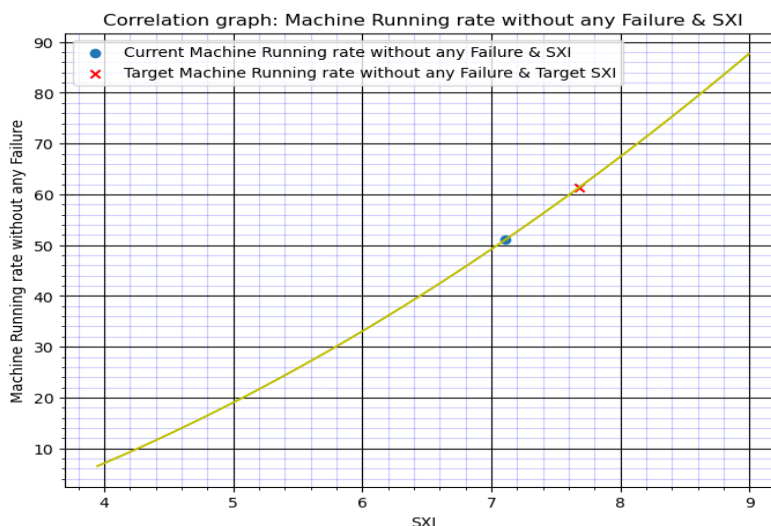
3. Predictive AI

- Auto-AI Prediction accuracy is **99.99%** and the best performing algorithm is **XGBoost**.
- SXI Prediction accuracy of machines running without any failure is **100%**.

4. Precision AI

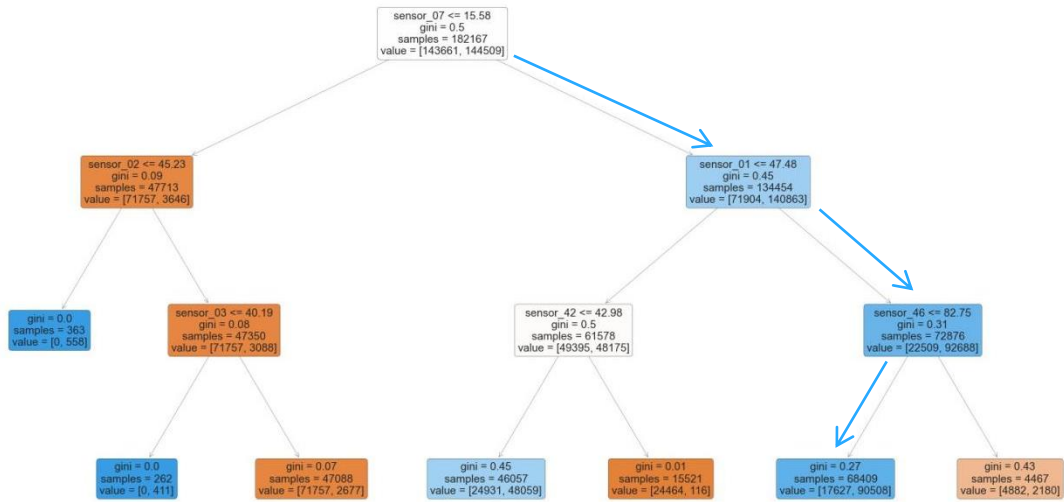
Desired increase in target outcome which is machine running rate without any failure is **20%**. Original machine running rate without any failure is **51.1%** so a **20%** increase should lead to a **61.32%** overall machine running without any failure (51.1×1.2), which means **1,22,640** of the machines from **2,00,000** would become machines running without any failure rather than current **102,000**.

The correlation between SXI and machine running rate without any failure is **0.99**. This implies that SXI and machine running without any failure are highly positively correlated to each other. Hence, an increase in SXI will result in increase in machine running rate without any failure.



Current SXI and Target SXI Decision Trees

a. Current SXI Decision Tree



Interpretation

Node 1: sensor_07 (Motor Apparent Power) >= 15.58 Watt (Total value for the split from parent node: 144509)

- Left split:3646; gini:0.09, **Right Split: 140863- majority class; gini:0.45**

(Total value for the next split: 140863)

Node 2: sensor_01 (Motor Frequency A) >= 47.48 hertz

- Left split: 48175; gini:0.5, **Right Split: 92688- majority class; gini:0.31**

(Total value for the next split: 92688)

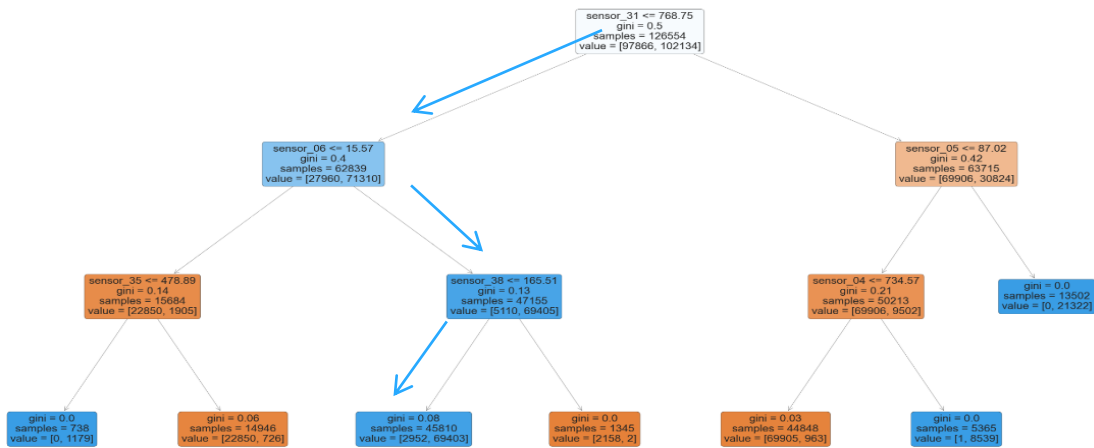
Node 3: sensor_46 (Pump Non-Drive End Radial Bearing Temp 2) <= 82.75 °C

- **Left split: 90508- majority class; gini:0.27**, Right Split: 2180; gini:0.45 – Final Leaf Node

- ✓ Success Ratio is: **64.25%** (90508/140863) *100 – (Total value of the positive class in the final leaf node/Total value of the positive class after first split) *100

- ✓ Machine Not Failed/Failed ratio is **5.13**

b. Target SXI Decision Tree



Target SXI from correlation curve for 20% increase in target outcome of Machine running without any failure is **7.68**.

Interpretation

Node 1: sensor_31 (Pump Stage 2 Impeller Speed) <= 768.75 (Total value for the split from parent node: 102134)

- **Left split: 71310- majority class; gini:0.04, Right Split: 30824; gini:0.42**

(Total value for the next split:71310)

Node 2: sensor_6 (Motor Active Power) >= 15.57 Watt

- **Left split:1905; gini:0.14, Right Split: 69405- majority class; gini:0.13**

(Total value for the next split:69405)

Node 3: sensor_38 (Pump Lube Oil Return Temp) <= 165.51 °C.

- **Left split: 69403- majority class; gini:0.08, Right Split: 2; gini:0 – Final Leaf Node**

✓ Success Ratio is: **97.33%** $(69403/71310) * 100$ – (Total value of the positive class in the final leaf node/Total value of the positive class after first split) * 100

✓ Machine Not Failed/Failed ratio is **23.51**

Conclusion

- Machines whose SXI score is higher than current average SXI score of **7.1** have **41%** more machines running without any failure than the overall average of machines running without any failures.
- The correlation between SXI and machine running rate without any failure is **0.99**. **So SXI is a perfect proxy for machine failure and can help in reducing failure rates.**
- Target **20%** increase in machines' running rate without any failure is achievable by raising target SXI to **7.68** from current **7.1** levels. This would result in **1,22,690** machines running from current **102,000** levels.

Initial Increase from
current levels:
20% or 20,690

SXI Impact
Potential

- Based on the inference from the correlation graph w.r.t SXI there is a **potential 72.21% compounded increase** if all recommendations in target SXI are completely implemented.

Compounding Increase
from current levels:
72.21% or 73,656

SXI Impact
Potential