

Failure in Air Pressure System

Objective

- To obtain and compare the prediction accuracy Machine Failure by Sriya's Auto-AI and Sriya's SXI (Precision AI^2).
- Precision AI^2 using Target SXI based Random Forest trees. Minimum 20% target decrease in Machine failure rate from current levels.

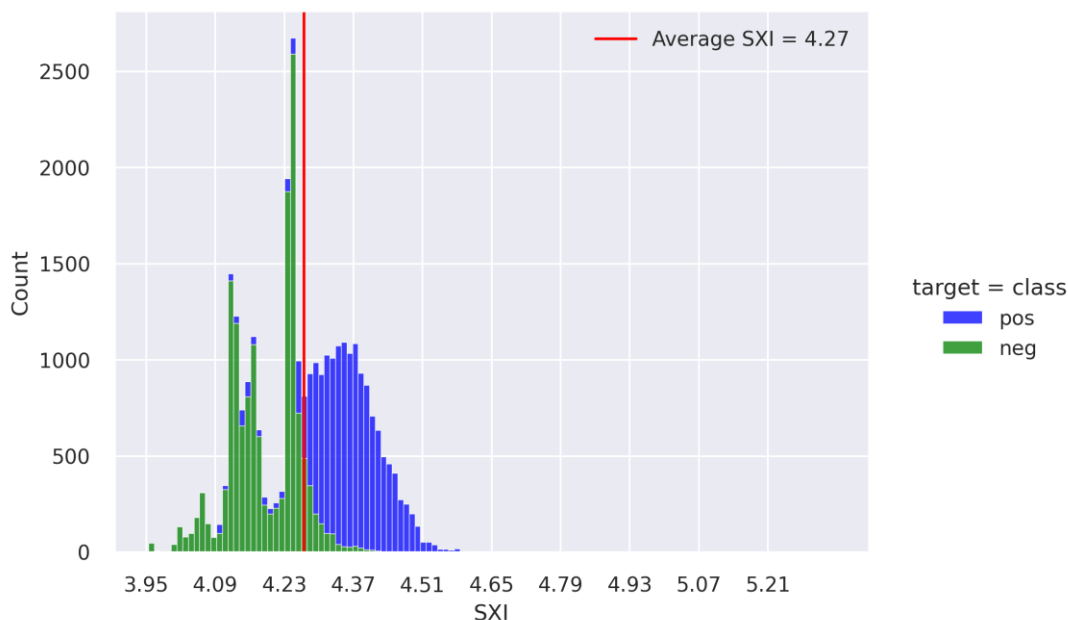
SXI Hypothesis

- SXI is a proxy/surrogate for all features responsible for ensuring decrease in Machine Failure rate. The lower the SXI, the better is the likelihood of Machine Working rate and hence decreasing SXI score should lead to lower Machine Failure rate.

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

29999 instances were distributed to **15,064** good and **14935** bad. Good (neg) are instances where machine didn't fail and Bad (pos) are instances where machine failed. So, **50.22%** machine didn't fail and **49.78%** is the machine failure rate.

2. SXI - Exploratory Data Analysis

Current Average SXI is **4.27**. No. of instances above 4.27 is **14,861** and of these **13,773** instances where machine failed **1128** instances where machine didn't fail. So, instances where machine didn't fail (%) is **7.59%** and machine failure rate is **92.41%**.

Correspondingly, No. of instances below 4.27 is **15,138** and of these **1202** instances where machine failed **13,936** instances where machine didn't fail. So, instances where machine didn't fail (%) is **92.06%** and machine failure rate is **7.94%**.

3. Predictive AI

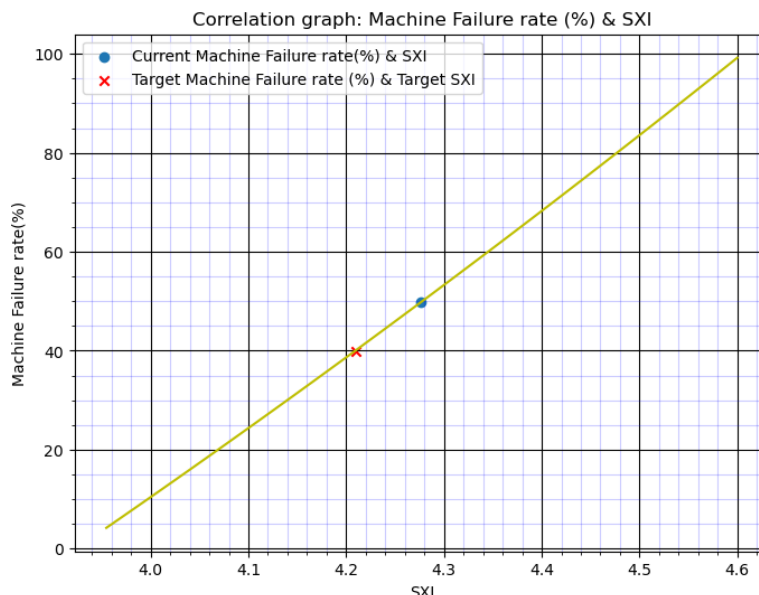
- Sriya's Auto-AI Prediction accuracy is **99.12%** and the best performing algorithm is **XGBoost**. **Auto-AI is a standard AI-ML process and uses AI to learn from past data and predict future outcomes.**
- **SXI AI² Prediction accuracy of machine failure rate is 99.81%. SXI uses AI 2 times instead of 1 and hence uses AI to improve AI's predictions accuracy with precision too.**
- Ratio of SXI/Auto-AI prediction accuracy is **1**.

4. Precision AI

The desired decrease in target variable which is machine failure rate is 20%. The original machine failure rate is **49.78 %** so a **20%** decrease should lead to a **39.82%** overall Machine Failure rate, which means **18,077** of the instances from 29,999 would become the number of instances where machine didn't fail than the current **15064**.

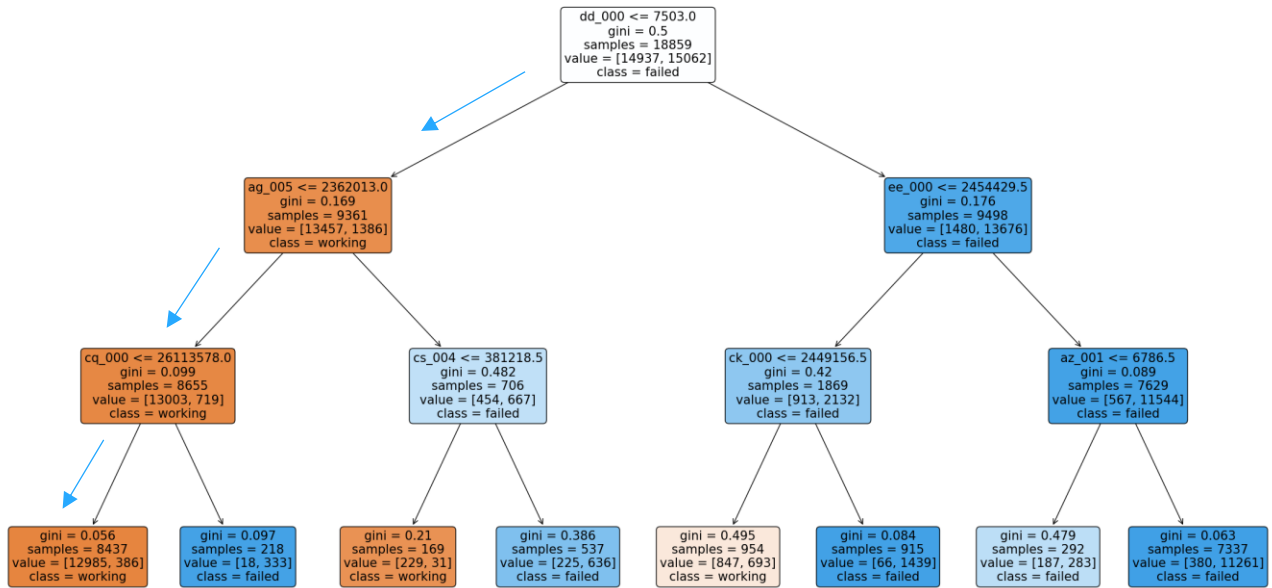
Data shows that SXI acts as a perfect proxy for machine failure rate and there is 12 times less likelihood of machine failure below average SXI than above average SXI.

The correlation between SXI and Machine Failure rate is **1**. This implies that SXI and Machine Failure Decrease Rate are highly positively correlated to each other. Hence, a decrease in SXI will result in a decrease in Machine Failure rate.



Current SXI and Target SXI Decision Trees

a. Current SXI Decision Tree



Interpretation: -

Node 1: dd_000 < 7503 (No. of instances where machine didn't fail in parent node: 14,937)

Left split: 13,457- majority positive class; gini:0.169, Right Split: 1480; gini:0.176

(Total value for the next split: 13,457)

Node 2: ag_005 <= 23,62,013.

Left split: 13,003- majority positive class; gini:0.099, Right Split: 454; gini:0.482

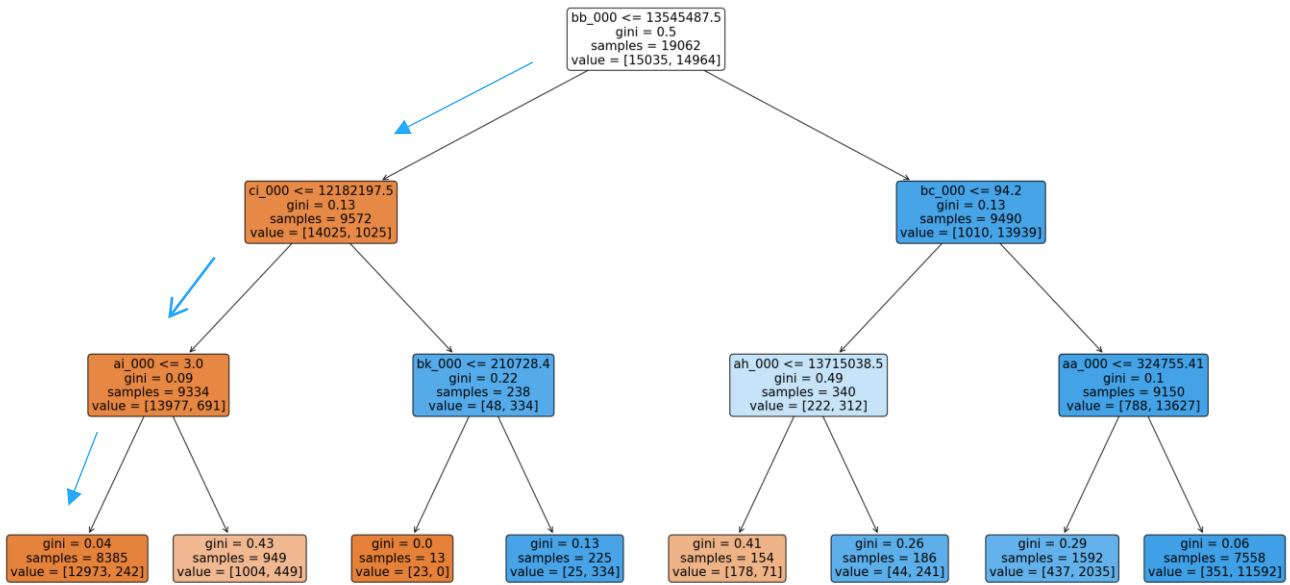
(Total value for the next split: 13,003)

Node 3: cq_000 <= 2,61,13,578

Left split: 12,985- majority positive class; gini:0.056, Right Split: 18; gini:0.097- Final Leaf Node.

✓ Machine didn't fail / Machine fail ratio is **33.64**

b. Target SXI Decision Tree



Target SXI from correlation curve for 20% decrease in target outcome of Machine Failure rate is **4.21**.

Interpretation: -

Node 1: $bb_000 < 1,354,5,487.5$ (No. of instances where machine didn't fail in parent node: 15,035)

Left split: 14,025- majority positive class; gini:0.13. **Right Split:** 1010; gini:0.13

(Total value for the next split: 14,025)

Node 2: $cl_000 <= 1,21,82,197.5$.

Left split: 13,977- majority positive class; gini:0.09. **Right Split:** 48; gini:0.22

(Total value for the next split: 13,977)

Node 3: $ai_000 <= 3$

Left split: 12,973- majority positive class; gini:0.04. **Right Split:** 18; gini:0.43- Final Leaf Node.

✓ Machine didn't fail / Machine fail ratio is **53.61**

Conclusion

- 12 times less likelihood of machine failure below average SXI than above average SXI
- Target **20%** decrease in Machine Failure rate is achievable by reducing target SXI to **4.21** from current **4.27** levels. This would result in **18,077** where machine didn't fail from current **15064** levels.

Initial Increase from
current levels:
20% or 3,013

SXI Impact
Potential

- Target Machine didn't fail / Machine fail ratio is **53.61** while the current ratio is **33.64**. This represents a **potential 59.36% compounded increase** if all recommendations in target SXI are completely implemented.

Compounding Increase
from current levels:
59.36% or 8,942

SXI Impact
Potential