

KEDGE

KEDGE BUSINESS SCHOOL

MACHINE LEARNING

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INDONESIAN RED CROSS SOCIETY

SOME CONTEXT..

Operational Enhancement through Data Analytics and AI

PMI leverages data analytics and artificial intelligence to streamline operations and improve performance, ensuring a more efficient response to humanitarian crises.

Optimizing Humanitarian Supply Chain Network

PMI's supply chain network, spanning regional, provincial, and district warehouses, is optimized for sourcing, transporting, replenishing, and distributing emergency supplies, bolstering its capacity to address crises effectively and swiftly.



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PROBLEM FRAMING



1.5 million
interventions
during Covid



Predictive Readiness Forecasting for Humanitarian Response

Using deep learning to anticipate readiness levels during humanitarian crises up to 10 days in advance, enhancing proactive response planning and resource allocation.

Extended Demand Coverage Forecasting for Crisis Response

Predict demand coverage beyond the initial 10 days of a crisis, aiding in proactive resource management and optimization of humanitarian supply chains.

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MODELS

Model
1

Demand
Readiness
(10 days) - ANN

A deep learning model
predicting the final
readiness value in
advance, up to 10 days
after the start of a
humanitarian crisis.



Model
2

Demand
Coverage Curve
(10 days) - CNN

A deep learning model
predicting the
subsequent demand
coverage curve, up to 10
days after the start of a
humanitarian crisis.

Model
3

Demand
Readiness
(5 days) - ANN

A deep learning model
predicting the final
readiness value in
advance, up to 5 days
after the start of a
humanitarian crisis.



Model
4

Demand
Coverage Curve
(5 days) - CNN

A deep learning model
predicting the
subsequent demand
coverage curve, up to 5
days after the start of a
humanitarian crisis.



MODELS

Models

1. Load the dataset
2. Data cleaning
3. Define the label variables and features
4. Scale the features
5. Split the dataset in train, test and validation
6. Create the Neural Network Class
7. Train the model
8. Apply hyper-parameters
9. Display test loss, RMSE, R² results

RESULTS

Use MSELoss, learning rate = 0.01, Adam Optimizer, epochs = 500

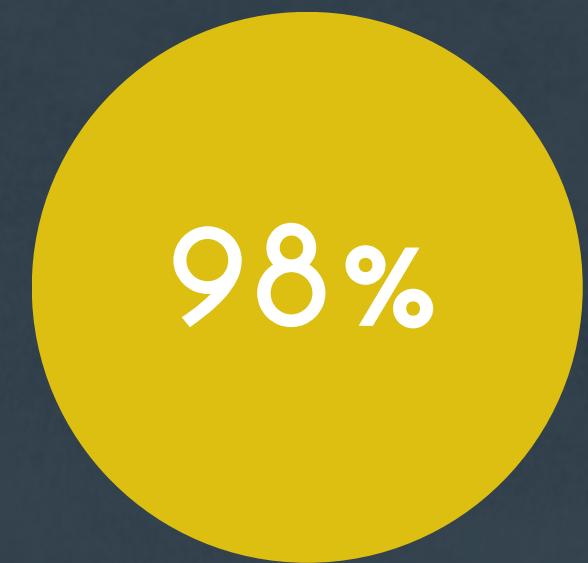


Model 1
R-Squared

The model R-squared values indicate an excellent fit of the model to the data.



Use MSELoss, learning rate = 0.01, Adam Optimizer, epochs = 1000, early stopping patience = 20 , factor =0.1, patience = 10



Model 2
R-Squared

The model R-squared values indicate an even better fit of the model to the data.

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RESULTS

95 %

Model 3 R-Squared

The model R-squared values indicate a good fit of the model to the data despite being less accurate than model 1, knowing that we lost some features it is logical



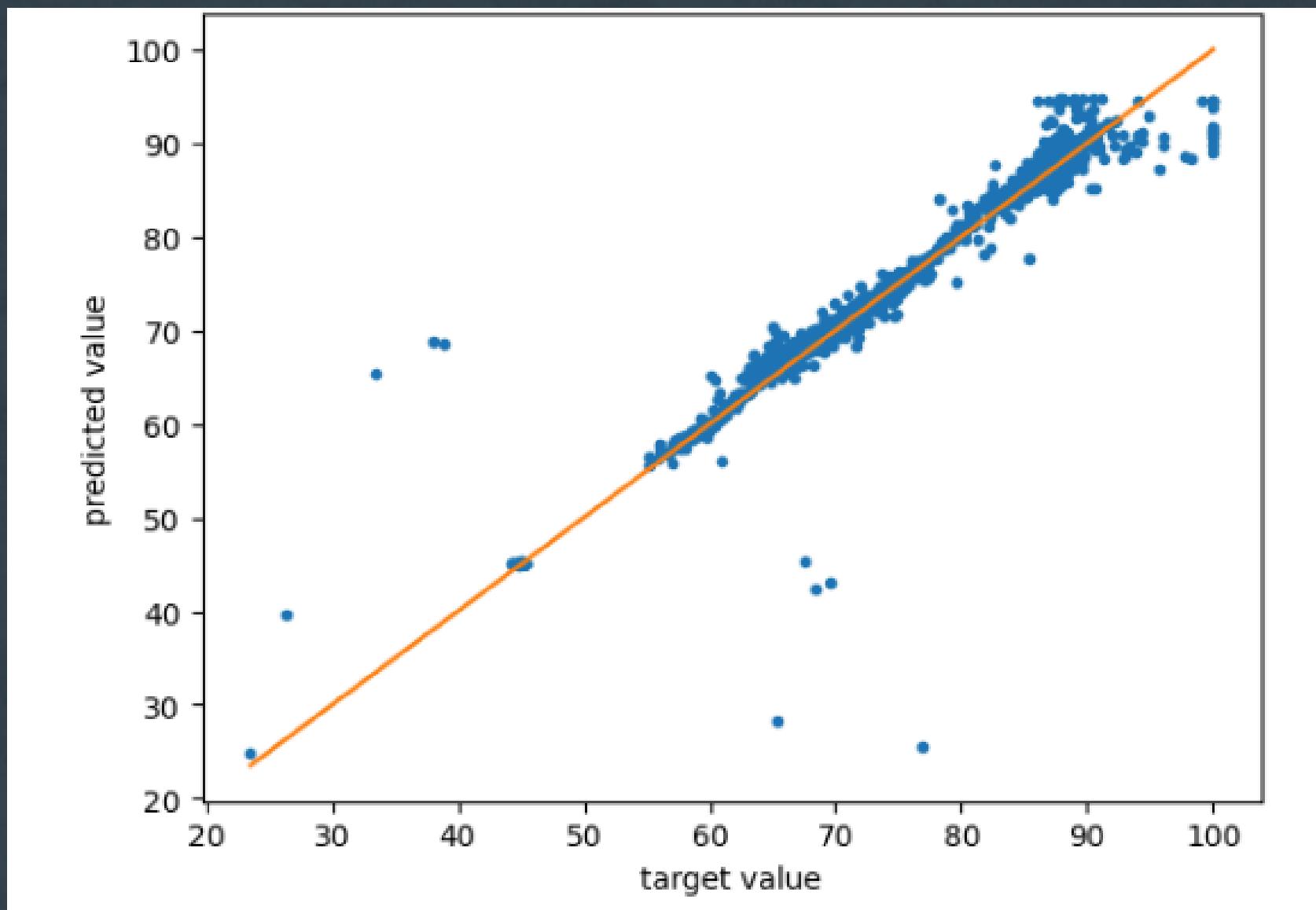
97 %

Model 4 R-Squared

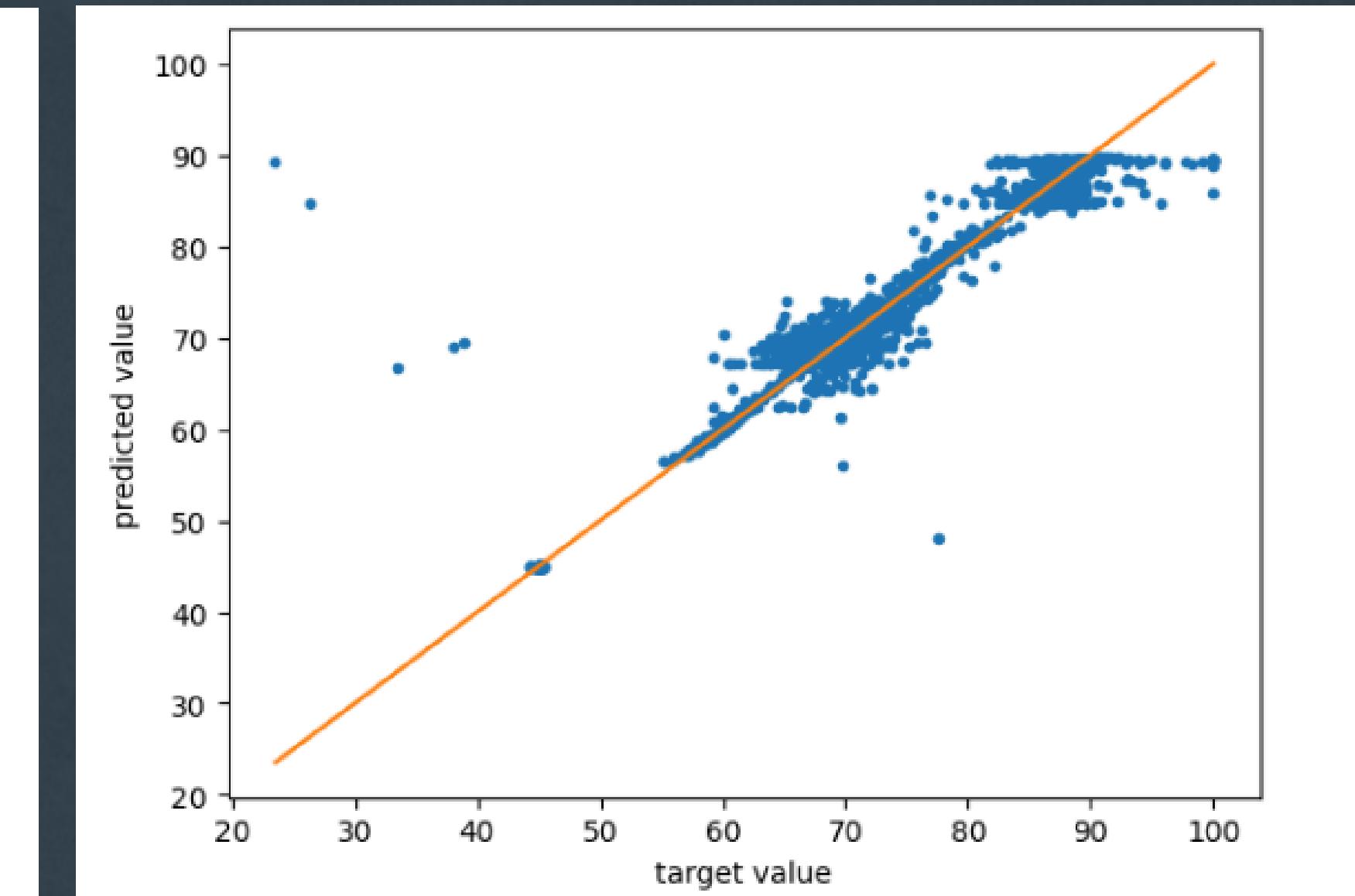
The model R-squared values indicate a less significant dropdown of the accuracy in comparison to Model 3 and overall an excellent fit.

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RESULTS



Model 1



Model 3

HOW TO IMPLEMENT ?



INTEGRATION INTO OPERATIONS

Once trained and validated, the models should be integrated into PMI's operational workflow. This may involve developing user-friendly interfaces or APIs that allow staff to input relevant crisis parameters and receive predictions in real-time.



DECISION SUPPORT AND RESOURCE ALLOCATION

The predictive models can serve as decision support tools for PMI staff, providing valuable insights into expected readiness levels and demand patterns during crises. PMI can allocate resources more effectively, prioritize supply chain activities, and optimize warehouse inventory levels.



HOW TO GO FURTHER ?



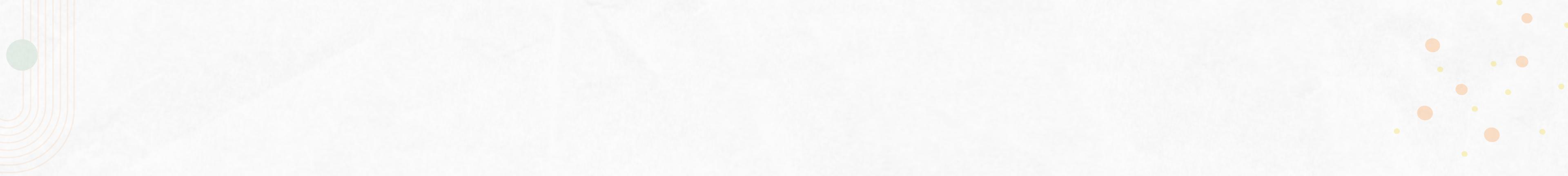
Multi-Objective Optimization

Extend the models to consider multiple objectives simultaneously, such as minimizing response time, maximizing resource utilization, and prioritizing vulnerable populations, to provide more nuanced decision support to PMI decision-makers.



Spatial-Temporal Analysis

Implement spatial-temporal analysis techniques to identify geographical and temporal patterns in demand for emergency supplies, enabling targeted resource allocation and proactive deployment of aid.



WE WANT TO SAY
THANK YOU

FOR YOUR ATTENTION