Tuning results for the CVRP

K-nearest Neighbor (KNN)

1. Parameter grid/distribution
- scaler: [StandardScaler(), MinMaxScaler()]
- knn__n_neighbors: [7, 8, 9, 10, 11, 12]

2. Best parameters
- scaler: StandardScaler()
- knn__n_neighbors: 12

3. Tuning details
- Search type: GridSearchCV
- Parameter combinations: 12
- Total tuning time: 1m, 46s
- Total tuning fit time: 2s
- Total tuning prediction time: 6m, 14s

Random Forest

1. Parameter grid/distribution
- max_features: [15, 20, 25, 30, 35, None]
- max_depth: range(10, 26)
- max_leaf_nodes: [3000, 3500, 4000, 4500, None]
- min_samples_leaf: range(1, 26)
- min_samples_split: range(2, 21)
- min_impurity_decrease: [0.0001, 0.001]

2. Best parameters
- max_features: 35
- max_depth: 24
- max_leaf_nodes: None
- min_samples_leaf: 6
- min_samples_split: 16
- min_impurity_decrease: 0.0001

3. Tuning details
- Search type: RandomizedSearchCV
- Parameter combinations: 50
- Total tuning time: 27m, 9s
- Total tuning fit time: 1h, 46m
- Total tuning prediction time: 24s

Extreme Gradient Boosting (XGBoost)

1. Parameter grid/distribution

- max_depth: [5, 7, 9]
- learning_rate: [0.05, 0.1]
- subsample: [0.6, 0.8, 1.0]
- colsample_bytree: [0.6, 0.8, 1.0]

2. Best parameters
- max_depth: 7
- learning_rate: 0.05
- subsample: 0.8
- colsample_bytree: 0.6

3. Tuning details
- Search type: GridSearchCV
- Parameter combinations: 54
- Total tuning time: 19m, 35s
- Total tuning fit time: 1h, 13m
- Total tuning prediction time: 1m, 54s

Kernel Machine

1. Parameter grid/distribution
- scaler: [StandardScaler(), MinMaxScaler()]
- SVM__C: [10, 100, 200]
- SVM__gamma: ['scale', 'auto']
- SVM__epsilon: [0.01, 0.1, 1]

2. Best parameters
- scaler: MinMaxScaler()
- SVM__C: 100
- SVM__gamma: scale
- SVM__epsilon: 1

3. Tuning details
- Search type: GridSearchCV
- Parameter combinations: 36
- Total tuning time: 57m, 35s
- Total tuning fit time: 2h, 22m
- Total tuning prediction time: 1h, 20m

Neural Network (NN)

1. Parameter grid/distribution
- mlpregressor__alpha: [0.001, 0.01, 0.1, 1]
- mlpregressor__solver: ['sgd', 'adam']
- mlpregressor__batch_size: [32, 64, 128]
- mlpregressor__learning_rate_init: [0.0001, 0.0005]
- mlpregressor__early_stopping: [False]

2. Best parameters
   - mlpregressor__alpha: 1
   - mlpregressor__solver: sgd
   - mlpregressor__batch_size: 64
   - mlpregressor__learning_rate_init: 0.0005
   - mlpregressor__early_stopping: False

3. Tuning details
   - Search type: GridSearchCV
   - Parameter combinations: 48
   - Total tuning time: 4h, 44m
   - Total tuning fit time: 18h, 46m
   - Total tuning prediction time: 21s