TABLE III. Models and their parameters

|  |  |  |
| --- | --- | --- |
| Models | Parameters | Value |
| ARIMA | Order of the autocorrelation function (p)Degree of the differentiation operator (d)Order of the partial autocorrelation function (q) | p = 0: 1: t (t<2 times standard deviation)d = 0: 1: 2q = 0: 1: t (t<2 times standard deviation) |
| SARIMA | Order of the autoregression procedure (p)Degree of the differentiation operator (d)Order of the average moving procedure (q)Order of the seasonal autoregression procedure (P)Degree of the seasonal differentiation operator (D)Order of the seasonal moving average procedure (Q)Number of observations that make up a seasonal period (S) | p = 0: 1: d = 0: 1: 2q = 0: 1: P = 0:1: D = 0: 1: 2Q = 0: 1: S = 12 |
| Lasso | Coefficient of the regularization term (α) | α = 0.1 |
| ANN | OptimizerActivation functionLearning rate | AdamRelu1e-5 |
| DT | Depth | 300 |
| GBDT | LossLearning ratemax depth | Deviance0.0053 |
| CNN | Convolution Layer SizeReluLayer SizePooling Layer SizeDropout Layer SizeOptimizerMiniBatchSizeMaxEpochsInitial Learn RateLearnRateDrop FactorLearnRate Drop PeriodValidation Frequency | 3\*3Relu2\*220%Adam820-3000.0050.01201000 |
| RNN | trainfunctiontrainParam.epochstrainParam.goaltrainParam.max\_fail | Traingdx20-3000.000015 |
| LSTM | MaxEpochsGradientThresholdInitialLearnRateLearnRateDropPeriodLearnRateDropFactor | 20-30010.0051250.2 |

Appendix

Evaluation Indices (Fly)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | ARIMA | SARIMA | LASSO | ANN | DT | GBDT | CNN | RNN | LSTM |
| RMSE | **38.88** | **13.87** | 74.65 | 85.50 | 138.41 | 85.50 | **45.20** | 91.03 | 74.49 |
| R | **0.89** | **0.99** | 0.40 | 0.41 | 0.08 | 0.41 | **0.84** | -0.05 | 0.36 |
| POCID | **0.77** | **0.85** | 0.62 | 0.62 | 0.15 | 0.62 | **0.85** | 0.23 | 0.46 |
| MPCE | **0.871196** | **1.161124** | 0.333508 | 0.299553 | 0.005196 | 0.299553 | **0.856869** | 0.024673 | 0.253946 |

Evaluation Indices (Bicycle)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | ARIMA | SARIMA | LASSO | ANN | DT | GBDT | CNN | RNN | LSTM |
| RMSE | 206.63 | **34.73** | 54.42 | **34.34** | 49.02 | **34.34** | **28.08** | 24.67 | 36.10 |
| R | -0.32 | **0.96** | 0.90 | **0.95** | 0.90 | **0.95** | **0.96** | 0.97 | 0.94 |
| POCID | 0.39 | **0.78** | 0.68 | **0.77** | 0.52 | **0.77** | **0.84** | 0.68 | 0.80 |
| MPCE | 0 | **1.036027** | 0.837305 | **1.02195** | 0.735245 | **1.02195** | **1.113998** | 1.000086 | 1.011739 |

Evaluation Indices (Exchange)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | ARIMA | SARIMA | LASSO | ANN | DT | GBDT | CNN | RNN | LSTM |
| RMSE | 0.06 | 0.06 | 0.31 | 0.03 | 0.03 | 0.04 | **0.01** | **0.02** | **0.01** |
| R | 0.18 | 0.18 | -0.18 | 0.56 | 0.56 | 0.39 | **0.92** | **0.89** | **0.99** |
| POCID | 0.41 | 0.41 | 0.36 | 0.27 | 0.24 | 0.20 | **0.64** | **0.36** | **0.69** |
| MPCE | 0.244854 | 0.244854 | 0 | 0.400912 | 0.381513 | 0.263705 | **0.930458** | **0.661961** | **1.023252** |

Evaluation Indices (Temperature)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | ARIMA | SARIMA | LASSO | ANN | DT | GBDT | CNN | RNN | LSTM |
| RMSE | 4.07 | 3.62 | 3.90 | **1.61** | 3.72 | **1.72** | 3.65 | 3.15 | 2.48 |
| R | 0.27 | 0.46 | 0.28 | **0.92** | 0.56 | **0.94** | 0.55 | 0.61 | 0.77 |
| POCID | 0.47 | 0.48 | 0.48 | **0.86** | 0.48 | **0.86** | 0.48 | 0.50 | 0.47 |
| MPCE | 0.054949 | 0.170066 | 0.080939 | **1.113362** | 0.180466 | **1.14131** | 0.190462 | 0.311822 | 0.503751 |

Evaluation Indices (SML 2010)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | ARIMA | SARIMA | LASSO | ANN | DT | GBDT | CNN | RNN | LSTM |
| RMSE | 3.04 | 3.24 | **0.27** | 1.74 | 1.74 | 1.82 | 0.12 | **0.04** | **0.14** |
| R | 0.49 | 0.49 | **0.99** | 0.91 | 0.91 | 0.84 | 0.99 | **0.99** | **0.99** |
| POCID | 0.71 | 0.84 | **0.96** | 0.96 | 0.85 | 0.52 | 0.98 | **0.98** | **0.98** |
| MPCE | 0.183121 | 0.178228 | **1.195221** | 0.757843 | 0.692171 | 0.450463 | 1.160283 | **1.281718** | **1.254925** |

Evaluation Indices (Solar Energy)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | ARIMA | SARIMA | LASSO | ANN | DT | GBDT | CNN | RNN | LSTM |
| RMSE | 115.83 | 108.96 | 46.48 | 75.74 | 76.20 | - | **2.95** | **7.33** | **2.63** |
| R | -0.03 | 0.00 | 0.03 | -0.38 | -0.38 | - | **1.00** | **0.99** | **1.00** |
| POCID | 0.20 | 0.00 | 0.20 | 0.03 | 0.03 | - | **0.35** | **0.27** | **0.35** |
| MPCE | 0 | 0 | 0.063612 | 0.004601 | 0.004548 | - | **0.734469** | **0.638687** | **0.736122** |

Evaluation Indices (electricity)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | ARIMA | SARIMA | LASSO | ANN | DT | GBDT | CNN | RNN | LSTM |
| RMSE | 7.30E+15 | 8.10E+15 | 2.19E+16 | 4.70E+15 | 4.88E+15 | - | **3.21E+15** | **3.67E+15** | **2.31E+15** |
| R | 0.17 | 0.00 | 0.17 | 0.69 | 0.67 | - | **0.85** | **0.79** | **0.93** |
| POCID | 0.50 | 0.00 | 0.50 | 0.52 | 0.53 | - | **0.85** | **0.32** | **0.79** |
| MPCE | 0.253025 | 0 | 0.036806 | 0.615388 | 0.60521 | - | **1.015155** | **0.556742** | **1.062916** |

- the results are difficult to obtain due to large datasets