Bảng 6.2: Kết quả thực nghiệm chuỗi dữ liệu Passengers

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Model** | **MAE** | **MSE** | **MAPE** |
| **ANN** | Nơron(6,6,1), Algorithm=RPROP, Residual=0.0001, default\_update=0.1, max\_update=10, epoches= 210 | 47.1 | 3412 | 9.1 |
| Nơron(6,6,1),Algorithm=Back Propagation, Residual=0.0001, learning\_rate=0.4, momemtum = 0,2, epoches = 1000 | 39.5 | 2849 | 7.9 |
| **SARIMA** | SARIMA(1, 1, 1)(1, 1, 0)12 | **15.9** | **323** | **3.3** |
| **Hybrid** | ARIMA(1, 1, 0)(1, 1, 0)12 Nơron(6,6,1), Algorithm=RPROP, Residual=0.0001, default\_update=0.1, max\_update=10, epoches= 160 | **16.6** | **385** | **3.5** |
| ARIMA(1, 1, 0)(1, 1, 0)12 Nơron(6,6,1),Algorithm=Back Propagation, Residual=0.0001, learning\_rate=0.4, momemtum = 0,2, epoches = 300 | **16.7** | **411** | **3.5** |

Bảng 6.3: Kết quả thực nghiệm chuỗi dữ liệu Paper

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Model** | **MAE** | **MSE** | **MAPE** |
| **ANN** | Nơron(6,6,1), Algorithm=RPROP, epoches=800, Residual=0.00001, default\_update=0.1, max\_update=10 | 88.0 | 11351 | 11.5 |
| Nơron(6,6,1),Algorithm=Back Propagation, epoches=800, Residual=0.00001, learning\_rate=0.4, momemtum = 0,2 | 123.2 | 30904 | 14.2 |
| **SARIMA** | SARIMA(0, 0, 3)(0, 1, 0)12 | 44.7 | 2762.3 | 4.44 |
| **Hybrid** | ARIMA(0, 0, 0)(0, 1, 0)12 Nơron(6,6,1),Algorithm=RPROP, epoches=800, Residual=0.00001, default\_update=0.1, max\_update=10 | 51.9 | 3991 | 5.6 |
| ARIMA(0, 0, 0)(0, 1, 0)12 Nơron(6,6,1),Algorithm=Back Propagation, epoches=156, Residual=1E-6, learning\_rate=0.4, momemtum = 0,2 | **42.6** | **2563.6** | **4.1** |

### Bộ dữ liệu có tính mùa

Bảng 6.4: Kết quả thực nghiệm chuỗi dữ liệu Deaths

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Model** | **MAE** | **MSE** | **MAPE** |
| **ANN** | Nơron(5,5,1), Algorithm=RPROP, epoches=610, Residual=0.0001, default\_update=0.1, max\_update=10 | 141.1 | 20984 | 8.8 |
| Nơron(5,5,1),Algorithm=Back Propagation, epoches=1000, Residual=0.0001, learning\_rate=0.4, momemtum = 0,2 | 108.9 | 17754 | 8.1 |
| **SARIMA** | SARIMA(2, 0, 2)(0, 1, 1)12 | 206.5 | 70725 | 13.8 |
| **Hybrid** | ARIMA(2, 0, 0)(0, 1, 1)12 Nơron(5,5,1),Algorithm=RPROP, epoches=600, Residual=0.0001, default\_update=0.1, max\_update=10 | 168.5 | 41429 | 12.3 |
| ARIMA(2, 0, 0)(0, 1, 1)12 Nơron(5,5,1),Algorithm=Back Propagation, epoches=857, Residual=1E-8, learning\_rate=0.4, momemtum = 0,2 | **179.1** | **46216** | **12.6** |

Bảng 6.5: Kết quả thực nghiệm chuỗi dữ liệu Maxtemp

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Model** | **MAE** | **MSE** | **MAPE** |
| **ANN** | Nơron(5,5,1), Algorithm=RPROP, epoches=60, Residual=0.0001, default\_update=0.1, max\_update=10 | 0.93 | 1.24 | 4.65 |
| Nơron(5,5,1),Algorithm=Back Propagation, epoches=40, Residual=0.0001, learning\_rate=0.4, momemtum = 0,2 | 0.79 | 0.93 | 3.9 |
| **SARIMA** | ARIMA(0, 0, 0)(0, 1, 0)12 | 0.97 | 1.40 | 4.65 |
| **Hybrid** | ARIMA(0, 0, 0)(0, 1, 0)12 Nơron(5,5,1),Algorithm=RPROP, epoches=71, Residual=1E-6, default\_update=0.1, max\_update=10 | **0.97** | **1.42** | **4.68** |
| ARIMA(0, 0, 0)(0, 1, 0)12 Nơron(5,5,1),Algorithm=Back Propagation, epoches=7, Residual=1E-6, learning\_rate=0.4, momemtum = 0,2 | **1.19** | **2.3** | **5.92** |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Model** | **MAE** | **MSE** | **MAPE** |
| **ANN** | Nơron(6,6,1), Algorithm=RPROP, epoches=50, Residual=0.0001, default\_update=0.1, max\_update=10 | 0.37 | 0.24 | 2.16 |
| Nơron(6,6,1),Algorithm=Back Propagation, epoches=98, Residual=0.0001, learning\_rate=0.4, momemtum = 0,2 | **0.29** | **0.15** | **1.62** |
| **SARIMA** | SARIMA(2, 0, 2)(1, 1, 1)7 | 0.35 | 0.22 | 1.78 |
| **Hybrid** | SARIMA(2, 0, 2)(1, 1, 1)7 Nơron(6,6,1),Algorithm=RPROP, epoches=130, Residual=50, default\_update=0.1, max\_update=10 | **0.31** | **0.17** | **1.62** |
| SARIMA(2, 0, 2)(1, 1, 1)7 Nơron(6,6,1),Algorithm=Back Propagation, epoches=145, Residual=0.0001, learning\_rate=0.4, momemtum = 0,2 | 0.36 | 0.19 | 2.00 |

Bảng 6.6: Kết quả thực nghiệm chuỗi dữ liệu Chemical

Bảng 6.7: Kết quả thực nghiệm chuỗi dữ liệu Prices

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Model** | **MAE** | **MSE** | **MAPE** |
| **ANN** | Nơron(6,6,1), Algorithm=RPROP, epoches=250, Residual=0.0001, default\_update=0.1, max\_update=10 | 6.17 | 51.1 | 1.72 |
| Nơron(6,6,1),Algorithm=Back Propagation, epoches=1000, Residual=0.0001, learning\_rate=0.4, momemtum = 0,2 | 7.21 | 90.1 | 2.05 |
| **SARIMA** | SARIMA(2, 1, 2)(0, 0, 0)0 | **6.57** | **58.8** | **1.82** |
| **Hybrid** | ARIMA(2, 1, 2)(0, 0, 0)0 Nơron(6,6,1),Algorithm=RPROP, epoches=35, Residual=0.0001, default\_update=0.1, max\_update=10 | **6.49** | **59.6** | **1.82** |
| ARIMA(2, 0, 2)(0, 0, 0)0 Nơron(6,6,1),Algorithm=Back Propagation, epoches=600, Residual=0.0001, learning\_rate=0.4, momemtum = 0,2 | 6.56 | 69.47 | 1.84 |

### Bộ dữ liệu có tính phi tuyến

Bảng 6.8: Kết quả thực nghiệm chuỗi dữ liệu Sunspots

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Model** | **MAE** | **MSE** | **MAPE** |
| **ANN** | Nơron(8,8,1), Algorithm=RPROP, epoches=200, Residual=0.0001, default\_update=0.1, max\_update=10 | **15.87** | **342.75** | **31.8** |
| Nơron(8,8,1),Algorithm=Back Propagation, epoches=1000, Residual=0.0001, learning\_rate=0.4, momemtum = 0,2 | 16.28 | 450.5 | 32.2 |
| **SARIMA** | SARIMA(2, 0, 2)(1, 1, 1)10 | 33.33 | 2518 | 41.85 |
| **Hybrid** | SARIMA(2, 0, 2)(1, 1, 1)10 Nơron(8,8,1),Algorithm=RPROP, epoches=189, Residual=0.00001, default\_update=0.1, max\_update=10 | **19.1** | **748.3** | **40.35** |
| SARIMA(2, 0, 2)(1, 1, 1)10 Nơron(8,8,1),Algorithm=Back Propagation, epoches=1000, Residual=0.00001, learning\_rate=0.4, momemtum = 0,2 | 19.9 | 802.6 | 42.3 |

Bảng 6.9: Kết quả thực nghiệm chuỗi dữ liệu Kobe

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Model** | **MAE** | **MSE** | **MAPE** |
| **ANN** | Nơron(6,6,1), Algorithm=RPROP, epoches=688, Residual=0.0001, default\_update=0.1, max\_update=10 | 779.3 | 803193 | 41.4 |
| Nơron(6,6,1),Algorithm=Back Propagation, epoches=1000, Residual=0.0001, learning\_rate=0.4, momemtum = 0,2 | 665.5 | 569332 | 35.6 |
| **SARIMA** | SARIMA(2, 0, 2)(0, 0, 0)0 | 798.6 | 888736 | 36.3 |
| **Hybrid** | SARIMA(2, 0, 2)(0, 0, 0)0 Nơron(6,6,1),Algorithm=RPROP, epoches=170, Residual=0.0001, default\_update=0.1, max\_update=10 | 521.4 | 348118 | 34.9 |
| SARIMA(2, 0, 2)(0, 0, 0)0 Nơron(6,6,1),Algorithm=Back Propagation, epoches=1000, Residual=0.0001, learning\_rate=0.4, momemtum = 0,2 | **442.98** | **291443** | **30.13** |