**Table 3** INE forecast result

| **MODEL** | **MAE** | **MSE** | **RMSE** |
| --- | --- | --- | --- |
| ALL\_GRU | 0.05117 | 0.00452 | 0.06720 |
| ALL\_LSTM | 0.05575 | 0.00501 | 0.07081 |
| ALL\_CNN-LSTM | 0.04892 | 0.00411 | 0.06410 |
| ALL\_BP | 0.06544 | 0.00730 | 0.08543 |
| ALL\_RNN | 0.05440 | 0.00489 | 0.06996 |
| ALL\_CNN | 0.05849 | 0.00573 | 0.07571 |
| ALL\_BiLSTM | 0.05443 | 0.00487 | 0.06975 |
| **ALL\_CNN-BiLSTM** | **0.04851** | **0.00427** | **0.06535** |
| ALL（mean） | 0.05464 | 0.00509 | 0.07104 |
|  |  |  |  |
| **ND\_GRU** | **0.04876** | **0.00391** | **0.06256** |
| ND\_LSTM | 0.06354 | 0.00628 | 0.07922 |
| ND\_CNN-LSTM | 0.05868 | 0.00561 | 0.07493 |
| ND\_BP | 0.08176 | 0.01003 | 0.10015 |
| ND\_RNN | 0.05066 | 0.00440 | 0.06631 |
| ND\_CNN | 0.06319 | 0.00632 | 0.07950 |
| ND\_BiLSTM | 0.06335 | 0.00626 | 0.07915 |
| ND\_CNN-BiLSTM | 0.06385 | 0.00627 | 0.07920 |
| ND（mean） | 0.06172 | 0.00614 | 0.07763 |
|  |  |  |  |
| NF\_GRU | 0.06052 | 0.00640 | 0.08000 |
| **NF\_LSTM** | **0.06000** | **0.00600** | **0.07744** |
| NF\_CNN-LSTM | 0.06097 | 0.00599 | 0.07742 |
| NF\_BP | 0.06264 | 0.00650 | 0.08063 |
| NF\_RNN | 0.06060 | 0.00607 | 0.07792 |
| NF\_CNN | 0.06118 | 0.00599 | 0.07738 |
| NF\_BiLSTM | 0.06004 | 0.00630 | 0.07935 |
| NF\_CNN-BiLSTM | 0.06143 | 0.00604 | 0.07773 |
| NF（mean） | 0.06092 | 0.00616 | 0.07848 |

**Table 4** INE\_1 forecast result

| **MODEL** | **MAE** | **MSE** | **RMSE** |
| --- | --- | --- | --- |
| ALL\_GRU | 0.01964 | 0.00062 | 0.02490 |
| ALL\_LSTM | 0.02353 | 0.00090 | 0.03000 |
| ALL\_CNN-LSTM | 0.03333 | 0.00165 | 0.04056 |
| ALL\_BP | 0.02129 | 0.00078 | 0.02800 |
| **ALL\_RNN** | **0.01953** | **0.00060** | **0.02455** |
| ALL\_CNN | 0.04339 | 0.00267 | 0.05164 |
| ALL\_BiLSTM | 0.02410 | 0.00098 | 0.03124 |
| ALL\_CNN-BiLSTM | 0.04104 | 0.00235 | 0.04847 |
| ALL（mean） | 0.02823 | 0.00132 | 0.03492 |
|  |  |  |  |
| ND\_GRU | 0.06560 | 0.00599 | 0.07737 |
| ND\_LSTM | 0.05694 | 0.00460 | 0.06782 |
| ND\_CNN-LSTM | 0.07422 | 0.00753 | 0.08675 |
| ND\_BP | 0.07724 | 0.00867 | 0.09311 |
| ND\_RNN | 0.07241 | 0.00739 | 0.08599 |
| ND\_CNN | 0.06357 | 0.00607 | 0.07791 |
| **ND\_BiLSTM** | **0.05238** | **0.00412** | **0.06422** |
| ND\_CNN-BiLSTM | 0.06199 | 0.00559 | 0.07479 |
| ND（mean） | 0.06554 | 0.00625 | 0.07850 |
|  |  |  |  |
| NF\_LSTM | 0.04745 | 0.00357 | 0.05977 |
| NF\_GRU | 0.03621 | 0.00212 | 0.04608 |
| NF\_CNN-LSTM | 0.04870 | 0.00365 | 0.06038 |
| NF\_CNN-BiLSTM | 0.04711 | 0.00357 | 0.05978 |
| NF\_BiLSTM | 0.04468 | 0.00305 | 0.05525 |
| NF\_CNN | 0.05023 | 0.00381 | 0.06170 |
| NF\_RNN | 0.03123 | 0.00150 | 0.03871 |
| **NF\_BP** | **0.02757** | **0.00130** | **0.03602** |
| NF（mean） | 0.04165 | 0.00282 | 0.05221 |

**Table 5** INE\_2 forecast result

| **MODEL** | **MAE** | **MSE** | **RMSE** |
| --- | --- | --- | --- |
| ALL\_GRU | 0.03741 | 0.00230 | 0.04793 |
| ALL\_LSTM | 0.04169 | 0.00283 | 0.05317 |
| ALL\_CNN-LSTM | 0.04324 | 0.00296 | 0.05444 |
| ALL\_BP | 0.04815 | 0.00390 | 0.06249 |
| ALL\_RNN | 0.04584 | 0.00335 | 0.05786 |
| ALL\_CNN | 0.05930 | 0.00551 | 0.07422 |
| ALL\_BiLSTM | 0.03967 | 0.00264 | 0.05141 |
| **ALL\_CNN-BiLSTM** | **0.03579** | **0.00205** | **0.04525** |
| ALL（mean） | 0.04389 | 0.00319 | 0.05585 |
|  |  |  |  |
| **ND\_GRU** | **0.07276** | **0.00903** | **0.09501** |
| ND\_LSTM | 0.07920 | 0.01033 | 0.10164 |
| ND\_CNN-LSTM | 0.07709 | 0.00984 | 0.09920 |
| ND\_BP | 0.08176 | 0.01058 | 0.10285 |
| ND\_RNN | 0.07389 | 0.00861 | 0.09279 |
| ND\_CNN | 0.08092 | 0.01040 | 0.10200 |
| ND\_BiLSTM | 0.07770 | 0.01001 | 0.10004 |
| ND\_CNN-BiLSTM | 0.07731 | 0.00992 | 0.09961 |
| ND（mean） | 0.07758 | 0.00984 | 0.09914 |
|  |  |  |  |
| NF\_LSTM | 0.07937 | 0.01038 | 0.10186 |
| NF\_GRU | 0.07448 | 0.00926 | 0.09621 |
| NF\_CNN-LSTM | 0.07562 | 0.00941 | 0.09702 |
| NF\_CNN-BiLSTM | 0.07649 | 0.00964 | 0.09817 |
| NF\_BiLSTM | 0.07940 | 0.01037 | 0.10181 |
| NF\_CNN | 0.07729 | 0.00986 | 0.09928 |
| **NF\_RNN** | **0.04383** | **0.00322** | **0.05676** |
| NF\_BP | 0.05353 | 0.00468 | 0.06842 |
| NF（mean） | 0.07000 | 0.00835 | 0.08994 |

**Table 6** INE\_R forecast result

| **MODEL** | **MAE** | **MSE** | **RMSE** |
| --- | --- | --- | --- |
| **ALL\_GRU** | **0.05240** | **0.00445** | **0.06674** |
| ALL\_LSTM | 0.05340 | 0.00477 | 0.06905 |
| ALL\_CNN-LSTM | 0.05768 | 0.00529 | 0.07271 |
| ALL\_BP | 0.05414 | 0.00496 | 0.07045 |
| ALL\_RNN | 0.05668 | 0.00481 | 0.06932 |
| ALL\_CNN | 0.06713 | 0.00630 | 0.07936 |
| ALL\_BiLSTM | 0.05254 | 0.00454 | 0.06740 |
| ALL\_CNN-BiLSTM | 0.05536 | 0.00480 | 0.06925 |
| ALL（mean） | 0.05616 | 0.00499 | 0.07053 |
|  |  |  |  |
| ND\_GRU | 0.06215 | 0.00590 | 0.07679 |
| ND\_LSTM | 0.06230 | 0.00643 | 0.08019 |
| ND\_CNN-LSTM | 0.06885 | 0.00682 | 0.08257 |
| ND\_BP | 0.07242 | 0.00831 | 0.09114 |
| **ND\_RNN** | **0.05904** | **0.00539** | **0.07340** |
| ND\_CNN | 0.07301 | 0.00742 | 0.08613 |
| ND\_BiLSTM | 0.08353 | 0.00969 | 0.09845 |
| ND\_CNN-BiLSTM | 0.06212 | 0.00590 | 0.07684 |
| ND（mean） | 0.06793 | 0.00698 | 0.08319 |
|  |  |  |  |
| NF\_LSTM | 0.05776 | 0.00521 | 0.07221 |
| NF\_GRU | 0.05697 | 0.00526 | 0.07253 |
| NF\_CNN-LSTM | 0.05820 | 0.00528 | 0.07269 |
| NF\_CNN-BiLSTM | 0.05682 | 0.00523 | 0.07230 |
| NF\_BiLSTM | 0.05724 | 0.00524 | 0.07238 |
| NF\_CNN | 0.05317 | 0.00466 | 0.06827 |
| **NF\_RNN** | **0.05011** | **0.00448** | **0.06697** |
| NF\_BP | 0.05085 | 0.00428 | 0.06540 |
| NF（mean） | 0.05514 | 0.00496 | 0.07034 |

**Table 7** Predicted results for INE using a filtered sample set

| **MODEL** | **MAE** | **MSE** | **RMSE** |
| --- | --- | --- | --- |
| GBM\_GRU | 0.05595 | 0.00518 | 0.07198 |
| GBM\_LSTM | 0.05883 | 0.00564 | 0.07508 |
| **GBM\_CNN-LSTM** | **0.05512** | **0.00519** | **0.07201** |
| GBM\_BP | 0.05757 | 0.00530 | 0.07279 |
| GBM\_RNN | 0.05631 | 0.00572 | 0.07560 |
| GBM\_CNN | 0.05675 | 0.00544 | 0.07379 |
| GBM\_BiLSTM | 0.05699 | 0.00547 | 0.07393 |
| GBM\_CNN-BiLSTM | 0.05747 | 0.00544 | 0.07374 |
| GBM（mean） | 0.05687 | 0.00542 | 0.07361 |
|  |  |  |  |
| RF\_GRU | 0.05923 | 0.00551 | 0.07423 |
| RF\_LSTM | 0.05644 | 0.00551 | 0.07421 |
| RF\_CNN-LSTM | 0.05615 | 0.00539 | 0.07340 |
| RF\_BP | 0.05639 | 0.00523 | 0.07231 |
| **RF\_RNN** | **0.05428** | **0.00496** | **0.07044** |
| RF\_CNN | 0.05762 | 0.00589 | 0.07672 |
| RF\_BiLSTM | 0.05696 | 0.00566 | 0.07524 |
| RF\_CNN-BiLSTM | 0.05953 | 0.00573 | 0.07568 |
| RF（mean） | 0.05708 | 0.00548 | 0.07403 |
|  |  |  |  |
| XGB\_GRU | 0.05718 | 0.00526 | 0.07251 |
| XGB\_LSTM | 0.05667 | 0.00571 | 0.07558 |
| XGB\_CNN-LSTM | 0.05751 | 0.00531 | 0.07288 |
| **XGB\_BP** | **0.05582** | **0.00536** | **0.07324** |
| XGB\_RNN | 0.05678 | 0.00572 | 0.07565 |
| XGB\_CNN | 0.05731 | 0.00549 | 0.07410 |
| XGB\_BiLSTM | 0.05659 | 0.00563 | 0.07501 |
| XGB\_CNN-BiLSTM | 0.05662 | 0.00528 | 0.07267 |
| XGB（mean） | 0.05681 | 0.00547 | 0.07396 |
|  |  |  |  |
| NF\_GRU | 0.06052 | 0.00640 | 0.08000 |
| **NF\_LSTM** | **0.06000** | **0.00600** | **0.07744** |
| NF\_CNN-LSTM | 0.06097 | 0.00599 | 0.07742 |
| NF\_BP | 0.06264 | 0.00650 | 0.08063 |
| NF\_RNN | 0.06060 | 0.00607 | 0.07792 |
| NF\_CNN | 0.06118 | 0.00599 | 0.07738 |
| NF\_BiLSTM | 0.06004 | 0.00630 | 0.07935 |
| NF\_CNN-BiLSTM | 0.06143 | 0.00604 | 0.07773 |
| NF（mean） | 0.06092 | 0.00616 | 0.07848 |

**Table 8** Predicted results for INE\_1 using a filtered sample set

| **MODEL** | **MAE** | **MSE** | **RMSE** |
| --- | --- | --- | --- |
| GBM\_GRU | 0.04519 | 0.00361 | 0.06009 |
| GBM\_LSTM | 0.04480 | 0.00313 | 0.05595 |
| GBM\_CNN-LSTM | 0.04889 | 0.00350 | 0.05920 |
| GBM\_BP | 0.04479 | 0.00319 | 0.05647 |
| GBM\_RNN | 0.04439 | 0.00313 | 0.05596 |
| GBM\_CNN | 0.04735 | 0.00336 | 0.05800 |
| **GBM\_BiLSTM** | **0.04235** | **0.00298** | **0.05457** |
| GBM\_CNN-BiLSTM | 0.04725 | 0.00331 | 0.05757 |
| GBM（mean） | 0.04563 | 0.00328 | 0.05723 |
|  |  |  |  |
| RF\_GRU | 0.05045 | 0.00361 | 0.06011 |
| RF\_LSTM | 0.04277 | 0.00307 | 0.05536 |
| RF\_CNN-LSTM | 0.04616 | 0.00344 | 0.05864 |
| RF\_BP | 0.04984 | 0.00364 | 0.06030 |
| RF\_RNN | 0.05977 | 0.00590 | 0.07684 |
| **RF\_CNN** | **0.04241** | **0.00284** | **0.05333** |
| RF\_BiLSTM | 0.04539 | 0.00363 | 0.06021 |
| RF\_CNN-BiLSTM | 0.04650 | 0.00351 | 0.05927 |
| RF（mean） | 0.04791 | 0.00370 | 0.06051 |
|  |  |  |  |
| **XGB\_GRU** | **0.04632** | **0.00340** | **0.05835** |
| XGB\_LSTM | 0.05750 | 0.00457 | 0.06762 |
| XGB\_CNN-LSTM | 0.04929 | 0.00372 | 0.06096 |
| XGB\_BP | 0.05165 | 0.00411 | 0.06414 |
| XGB\_RNN | 0.04956 | 0.00409 | 0.06393 |
| XGB\_CNN | 0.05023 | 0.00402 | 0.06337 |
| XGB\_BiLSTM | 0.06181 | 0.00522 | 0.07226 |
| XGB\_CNN-BiLSTM | 0.05195 | 0.00409 | 0.06395 |
| XGB（mean） | 0.05229 | 0.00415 | 0.06432 |
|  |  |  |  |
| CR\_GRU | 0.05001 | 0.00447 | 0.06682 |
| CR\_LSTM | 0.04713 | 0.00324 | 0.05691 |
| CR\_CNN-LSTM | 0.04366 | 0.00301 | 0.05485 |
| CR\_BP | 0.04448 | 0.00307 | 0.05540 |
| CR\_RNN | 0.04499 | 0.00313 | 0.05594 |
| CR\_CNN | 0.04662 | 0.00369 | 0.06076 |
| CR\_BiLSTM | 0.04276 | 0.00322 | 0.05672 |
| **CR\_CNN-BiLSTM** | **0.04189** | **0.00309** | **0.05557** |
| CR（mean） | 0.04519 | 0.00336 | 0.05787 |

**Table 9** Predicted results for INE\_2 using a filtered sample set

| **MODEL** | **MAE** | **MSE** | **RMSE** |
| --- | --- | --- | --- |
| ALL\_GRU | 0.03741 | 0.00230 | 0.04793 |
| ALL\_LSTM | 0.04169 | 0.00283 | 0.05317 |
| ALL\_CNN-LSTM | 0.04324 | 0.00296 | 0.05444 |
| ALL\_BP | 0.04815 | 0.00390 | 0.06249 |
| ALL\_RNN | 0.04584 | 0.00335 | 0.05786 |
| ALL\_CNN | 0.05930 | 0.00551 | 0.07422 |
| ALL\_BiLSTM | 0.03967 | 0.00264 | 0.05141 |
| **ALL\_CNN-BiLSTM** | **0.03579** | **0.00205** | **0.04525** |
| ALL（mean） | 0.04389 | 0.00319 | 0.05585 |
|  |  |  |  |
| GBM\_GRU | 0.07837 | 0.01029 | 0.10142 |
| GBM\_LSTM | 0.07691 | 0.00988 | 0.09938 |
| GBM\_CNN-LSTM | 0.07728 | 0.00985 | 0.09926 |
| GBM\_BP | 0.07708 | 0.00960 | 0.09796 |
| **GBM\_RNN** | **0.07490** | **0.00879** | **0.09375** |
| GBM\_CNN | 0.07751 | 0.00980 | 0.09897 |
| GBM\_BiLSTM | 0.07684 | 0.00984 | 0.09922 |
| GBM\_CNN-BiLSTM | 0.07766 | 0.00998 | 0.09991 |
| GBM（mean） | 0.07707 | 0.00975 | 0.09873 |
|  |  |  |  |
| RF\_GRU | 0.07278 | 0.00911 | 0.09542 |
| RF\_LSTM | 0.07139 | 0.00876 | 0.09361 |
| RF\_CNN-LSTM | 0.06622 | 0.00772 | 0.08785 |
| RF\_BP | 0.07036 | 0.00836 | 0.09143 |
| **RF\_RNN** | **0.06408** | **0.00713** | **0.08446** |
| RF\_CNN | 0.07591 | 0.00963 | 0.09811 |
| RF\_BiLSTM | 0.07303 | 0.00875 | 0.09353 |
| RF\_CNN-BiLSTM | 0.06569 | 0.00755 | 0.08692 |
| RF（mean） | 0.06993 | 0.00838 | 0.09142 |
|  |  |  |  |
| XGB\_GRU | 0.07726 | 0.00992 | 0.09962 |
| XGB\_LSTM | 0.07807 | 0.01019 | 0.10096 |
| XGB\_CNN-LSTM | 0.07948 | 0.01062 | 0.10303 |
| XGB\_BP | 0.07976 | 0.01009 | 0.10044 |
| **XGB\_RNN** | **0.07454** | **0.00903** | **0.09501** |
| XGB\_CNN | 0.07994 | 0.01046 | 0.10228 |
| XGB\_BiLSTM | 0.07808 | 0.01015 | 0.10076 |
| XGB\_CNN-BiLSTM | 0.07823 | 0.01026 | 0.10127 |
| XGB（mean） | 0.07817 | 0.01009 | 0.10042 |
|  |  |  |  |
| CR\_GRU | 0.07966 | 0.01027 | 0.10132 |
| CR\_LSTM | 0.07734 | 0.00997 | 0.09986 |
| CR\_CNN-LSTM | 0.07915 | 0.01041 | 0.10204 |
| CR\_BP | 0.08287 | 0.01059 | 0.10289 |
| CR\_RNN | 0.07765 | 0.00953 | 0.09764 |
| CR\_CNN | 0.07859 | 0.01010 | 0.10050 |
| **CR\_BiLSTM** | **0.07699** | **0.00986** | **0.09928** |
| CR\_CNN-BiLSTM | 0.07939 | 0.01054 | 0.10268 |
| CR（mean） | 0.07895 | 0.01016 | 0.10077 |

**Table 10** Predicted results for INE\_R using a filtered sample set

| **MODEL** | **MAE** | **MSE** | **RMSE** |
| --- | --- | --- | --- |
| **ALL\_GRU** | **0.05240** | **0.00445** | **0.06674** |
| ALL\_LSTM | 0.05340 | 0.00477 | 0.06905 |
| ALL\_CNN-LSTM | 0.05768 | 0.00529 | 0.07271 |
| ALL\_BP | 0.05414 | 0.00496 | 0.07045 |
| ALL\_RNN | 0.05668 | 0.00481 | 0.06932 |
| ALL\_CNN | 0.06713 | 0.00630 | 0.07936 |
| ALL\_BiLSTM | 0.05254 | 0.00454 | 0.06740 |
| ALL\_CNN-BiLSTM | 0.05536 | 0.00480 | 0.06925 |
| ALL（mean） | 0.05616 | 0.00499 | 0.07053 |
|  |  |  |  |
| **GBM\_GRU** | **0.05967** | **0.00580** | **0.07617** |
| GBM\_LSTM | 0.06070 | 0.00604 | 0.07769 |
| GBM\_CNN-LSTM | 0.06085 | 0.00562 | 0.07499 |
| GBM\_BP | 0.06326 | 0.00623 | 0.07895 |
| GBM\_RNN | 0.06205 | 0.00593 | 0.07698 |
| GBM\_CNN | 0.06436 | 0.00611 | 0.07819 |
| GBM\_BiLSTM | 0.06089 | 0.00569 | 0.07542 |
| GBM\_CNN-BiLSTM | 0.07059 | 0.00721 | 0.08492 |
| GBM（mean） | 0.06280 | 0.00608 | 0.07792 |
|  |  |  |  |
| RF\_GRU | 0.06026 | 0.00570 | 0.07549 |
| RF\_LSTM | 0.06103 | 0.00601 | 0.07751 |
| **RF\_CNN-LSTM** | **0.05867** | **0.00548** | **0.07403** |
| RF\_BP | 0.06336 | 0.00627 | 0.07921 |
| RF\_RNN | 0.06768 | 0.00643 | 0.08020 |
| RF\_CNN | 0.06417 | 0.00643 | 0.08018 |
| RF\_BiLSTM | 0.06140 | 0.00577 | 0.07596 |
| RF\_CNN-BiLSTM | 0.07543 | 0.00811 | 0.09005 |
| RF（mean） | 0.06400 | 0.00628 | 0.07908 |
|  |  |  |  |
| XGB\_GRU | 0.06957 | 0.00701 | 0.08374 |
| XGB\_LSTM | 0.05882 | 0.00594 | 0.07704 |
| XGB\_CNN-LSTM | 0.06032 | 0.00568 | 0.07539 |
| XGB\_BP | 0.06640 | 0.00673 | 0.08206 |
| XGB\_RNN | 0.06067 | 0.00561 | 0.07489 |
| XGB\_CNN | 0.06678 | 0.00785 | 0.08860 |
| **XGB\_BiLSTM** | **0.05857** | **0.00589** | **0.07674** |
| XGB\_CNN-BiLSTM | 0.06065 | 0.00573 | 0.07569 |
| XGB（mean） | 0.06272 | 0.00631 | 0.07927 |
|  |  |  |  |
| CR\_GRU | 0.05957 | 0.00566 | 0.07521 |
| CR\_LSTM | 0.05987 | 0.00565 | 0.07514 |
| CR\_CNN-LSTM | 0.05898 | 0.00554 | 0.07443 |
| CR\_BP | 0.06324 | 0.00599 | 0.07741 |
| **CR\_RNN** | **0.05784** | **0.00565** | **0.07518** |
| CR\_CNN | 0.06249 | 0.00645 | 0.08030 |
| CR\_BiLSTM | 0.06304 | 0.00679 | 0.08240 |
| CR\_CNN-BiLSTM | 0.05976 | 0.00567 | 0.07531 |
| CR（mean） | 0.06060 | 0.00592 | 0.07692 |