**Table 3:** The optimal combinations for five machine learning regression models based on input-enter scenario training and validation

**ARAMT model**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Train | | | | | | Test | | | | | |
| Combinations | **CC** | **MAE** | **RMSE** | **RAE** | **RRSE** | **Combinations** | **CC** | **MAE** | **RMSE** | **RAE** | **RRSE** |
| 1 | 0.9815 | 0.1102 | 0.1909 | 0.14144 | 0.19496 | **1** | 0.1304 | 4.2600 | 5.786 | 5.339 | 6.338 |
| 2 | 1 | 0.0001 | 0.0002 | 0.00015 | 0.000166 | **2** | -0.4238 | 5.3730 | 9.626 | 6.733 | 10.545 |
| 3 | 1 | 0 | 0 | 0.000047 | 0.000045 | **3** | -0.5643 | 7.6590 | 13.504 | 9.598 | 14.793 |
| 4 | 1 | 0 | 0 | 0.000051 | 0.000048 | **4** | 0.4439 | 1.9630 | 2.465 | 2.463 | 2.701 |
| 5 | 1 | 0 | 0.0001 | 0.000053 | 0.000056 | **5** | 0.3802 | 2.1410 | 2.617 | 2.683 | 2.868 |
| 6 | 1 | 0 | 0.0001 | 0.000059 | 0.000057 | **6** | 0.3371 | 2.1420 | 2.479 | 2.685 | 2.716 |
| 7 | 1 | 0 | 0 | 0.000045 | 0.000041 | **7** | 0.5699 | 2.2800 | 3.406 | 2.858 | 3.732 |
| 8 | 1 | 0 | 0 | 0.000036 | 0.000035 | **8** | -0.3391 | 1.6340 | 2.177 | 2.048 | 2.385 |
| 9 | 1 | 0 | 0 | 0.000037 | 0.000036 | **9** | 0.2506 | 2.0148 | 2.836 | 2.525 | 3.108 |
| 10 | 1 | 0 | 0 | 0.000036 | 0.000036 | **10** | 0.1522 | 2.6270 | 3.510 | 3.293 | 3.845 |
| 11 | 1 | 0 | 0 | 0.000035 | 0.000035 | **11** | 0.9085 | 0.6343 | 0.739 | 0.795 | 0.809 |
| 12 | 1 | 0 | 0 | 0.000035 | 0.000035 | **12** | 0.9096 | 0.6346 | 0.738 | 0.795 | 0.809 |
| 13 | 1 | 0 | 0 | 0.000035 | 0.000035 | **13** | 0.8992 | 0.0698 | 0.796 | 0.875 | 0.872 |
| 14 | 1 | 0 | 0 | 0.000035 | 0.000035 | **14** | 0.9938 | 0.5261 | 0.632 | 0.659 | 0.692 |

**AMT model**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Train | | | | | | Test | | | | | |
| Combinations | **CC** | **MAE** | **RMSE** | **RAE** | **RRSE** | **Combinations** | **CC** | **MAE** | **RMSE** | **RAE** | **RRSE** |
| 1 | 0.9517 | 0.1776 | 0.3006 | 0.22796 | 0.30706 | **1** | 0.1407 | 2.308 | 3.835 | 2.89223 | 4.2012 |
| 2 | 0.9896 | 0.0989 | 0.141 | 0.12693 | 0.14404 | **2** | -0.426 | 5.68 | 9.781 | 7.11844 | 10.71485 |
| 3 | 0.9983 | 0.0352 | 0.0582 | 0.04516 | 0.05945 | **3** | 0.2957 | 4.365 | 5.668 | 5.47045 | 6.20899 |
| 4 | 0.9981 | 0.0377 | 0.0602 | 0.04837 | 0.061509 | **4** | 0.3941 | 1.0767 | 1.4571 | 1.34919 | 1.59618 |
| 5 | 0.9956 | 0.0378 | 0.0925 | 0.04849 | 0.09445 | **5** | 0.2718 | 3.722 | 5.687 | 4.6646 | 6.23038 |
| 6 | 0.9942 | 0.0609 | 0.1059 | 0.07814 | 0.10813 | **6** | 0.2724 | 3.519 | 5.032 | 4.41006 | 5.51311 |
| 7 | 0.9995 | 0.024 | 0.0313 | 0.030814 | 0.03195 | **7** | 0.7259 | 1.441 | 1.617 | 1.80637 | 1.77223 |
| 8 | 0.999 | 0.0071 | 0.0117 | 0.009132 | 0.01192 | **8** | -0.1942 | 1.646 | 2.038 | 2.06367 | 2.28274 |
| 9 | 0.999 | 0.0108 | 0.021 | 0.01383 | 0.02141 | **9** | 0.3642 | 1.868 | 2.994 | 2.34177 | 3.28056 |
| 10 | 0.999 | 0.0208 | 0.0273 | 0.02674 | 0.02787 | **10** | 0.307 | 1.677 | 1.768 | 2.10232 | 1.93682 |
| 11 | 1 | 0.0034 | 0.0049 | 0.004386 | 0.00499 | **11** | 0.8581 | 0.737 | 0.78 | 0.9245 | 0.85445 |
| 12 | 1 | 0.0031 | 0.0038 | 0.00396 | 0.00389 | **12** | 0.8825 | 0.69 | 0.7509 | 0.86466 | 0.82259 |
| 13 | 1 | 0.0025 | 0.0032 | 0.00321 | 0.003295 | **13** | 0.886 | 0.684 | 0.7859 | 0.85712 | 0.86093 |
| 14 | 0.999 | 0.0092 | 0.0113 | 0.01176 | 0.01152 | **14** | 0.8082 | 0.8096 | 0.9973 | 1.01452 | 1.09253 |

**GP model**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Train | | | | | | Test | | | | | |
| Combinations | **CC** | **MAE** | **RMSE** | **RAE** | **RRSE** | **Combinations** | **CC** | **MAE** | **RMSE** | **RAE** | **RRSE** |
| 1 | 0.0939 | 0.7799 | 0.977 | 1.00123 | 0.99797 | **1** | 0.1725 | 0.7885 | 0.909 | 0.98809 | 0.99577 |
| 2 | 0.1365 | 0.7789 | 0.976 | 0.99992 | 0.99702 | **2** | 0.1208 | 0.7903 | 0.919 | 0.99035 | 0.99709 |
| 3 | 0.2681 | 0.7701 | 0.967 | 0.98867 | 0.98841 | **3** | 0.2764 | 0.77 | 0.9005 | 0.96524 | 0.9864 |
| 4 | 0.2997 | 0.7657 | 0.9647 | 0.98298 | 0.98547 | **4** | 0.1337 | 0.7749 | 0.9072 | 0.97093 | 0.99374 |
| 5 | 0.4203 | 0.7608 | 0.9518 | 0.97664 | 0.97222 | **5** | 0.3601 | 0.7837 | 0.8965 | 0.98206 | 0.98208 |
| 6 | 0.4779 | 0.7595 | 0.9445 | 0.97496 | 0.96479 | **6** | 0.6175 | 0.7596 | 0.8741 | 0.95186 | 0.95753 |
| 7 | 0.6533 | 0.7342 | 0.9113 | 0.9425 | 0.930913 | **7** | 0.9027 | 0.7441 | 0.8379 | 0.93237 | 0.91785 |
| 8 | 0.6776 | 0.7328 | 0.9066 | 0.940702 | 0.92607 | **8** | 0.9035 | 0.7379 | 0.8446 | 0.92463 | 0.92516 |
| 9 | 0.7925 | 0.6961 | 0.862 | 0.89367 | 0.88088 | **9** | 0.7897 | 0.6957 | 0.8067 | 0.87173 | 0.88369 |
| 10 | 0.8292 | 0.686 | 0.855 | 0.88059 | 0.87341 | **10** | 0.7621 | 0.6897 | 0.8064 | 0.86421 | 0.88331 |
| 11 | 0.9125 | 0.6591 | 0.8211 | 0.84618 | 0.83874 | **11** | 0.8167 | 0.6845 | 0.7842 | 0.85769 | 0.85901 |
| 12 | 0.911 | 0.662 | 0.826 | 0.85025 | 0.84403 | **12** | 0.8096 | 0.6951 | 0.7941 | 0.87096 | 0.8699 |
| 13 | 0.9109 | 0.6591 | 0.8237 | 0.84611 | 0.84139 | **13** | 0.7915 | 0.6992 | 0.7943 | 0.87613 | 0.87006 |
| 14 | 0.9159 | 0.6598 | 0.8215 | 0.84708 | 0.83915 | **14** | 0.8209 | 0.6871 | 0.7834 | 0.861 | 0.85816 |

**M5P model**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Train | | | | | | Test | | | | | |
| Combinations | **CC** | **MAE** | **RMSE** | **RAE** | **RRSE** | **Combinations** | **CC** | **MAE** | **RMSE** | **RAE** | **RRSE** |
| 1 | 0.8675 | 0.4324 | 0.487 | 0.55508 | 0.49744 | **1** | 0.1473 | 1.045 | 1.181 | 1.3105 | 1.2941 |
| 2 | 0.646 | 0.5939 | 0.7471 | 0.7624 | 0.76311 | **2** | 0.3312 | 0.8172 | 0.9414 | 1.024 | 1.03124 |
| 3 | 0.7295 | 0.4566 | 0.66696 | 0.58617 | 0.68397 | **3** | 0.6723 | 0.4681 | 0.6964 | 0.58656 | 0.76283 |
| 4 | 0.7706 | 0.409 | 0.6239 | 0.52503 | 0.63735 | **4** | 0.929 | 0.282 | 0.379 | 0.35366 | 0.41535 |
| 5 | 0.7254 | 0.4223 | 0.6448 | 0.54207 | 0.65866 | **5** | 0.5268 | 0.525 | 0.787 | 0.65818 | 0.86253 |
| 6 | 0.7524 | 0.4223 | 0.6448 | 0.54207 | 0.65866 | **6** | 0.5268 | 0.525 | 0.787 | 0.65818 | 0.86253 |
| 7 | 0.8853 | 0.3338 | 0.4552 | 0.42857 | 0.46499 | **7** | 0.7046 | 0.5036 | 0.789 | 0.63099 | 0.86432 |
| 8 | 0.9365 | 0.2668 | 0.3434 | 0.34248 | 0.35079 | **8** | 0.3864 | 1.1008 | 1.1386 | 1.37937 | 1.24725 |
| 9 | 0.8331 | 0.3475 | 0.5414 | 0.44608 | 0.55308 | **9** | 0.5041 | 0.8317 | 1.187 | 1.04214 | 1.30041 |
| 10 | 0.84 | 0.3315 | 0.5312 | 0.42554 | 0.54259 | **10** | 0.5649 | 0.849 | 1.192 | 1.06384 | 1.3059 |
| 11 | 0.8822 | 0.2707 | 0.461 | 0.34749 | 0.47089 | **11** | 0.8692 | 0.8039 | 0.9428 | 1.00738 | 1.03281 |
| 12 | 0.8721 | 0.2795 | 0.4791 | 0.35878 | 0.48941 | **12** | 0.8844 | 0.8348 | 0.9497 | 1.04602 | 1.04034 |
| 13 | 0.8909 | 0.2235 | 0.4446 | 0.28696 | 0.45414 | **13** | 0.8074 | 0.7941 | 0.8616 | 0.99499 | 0.94386 |
| 14 | 0.8909 | 0.2235 | 0.4446 | 0.28696 | 0.45414 | **14** | 0.8074 | 0.7941 | 0.8616 | 0.99499 | 0.94386 |

**RF model**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Train | | | | | | Test | | | | | |
| Combinations | **CC** | **MAE** | **RMSE** | **RAE** | **RRSE** | **Combinations** | **CC** | **MAE** | **RMSE** | **RAE** | **RRSE** |
| 1 | 0.9485 | 0.3307 | 0.4629 | 0.42448 | 0.47281 | **1** | 0.345 | 0.866 | 0.958 | 1.08518 | 1.04987 |
| 2 | 0.9617 | 0.3393 | 0.4541 | 0.43553 | 0.46382 | **2** | 0.5535 | 0.6763 | 0.7756 | 0.84739 | 0.84966 |
| 3 | 0.9638 | 0.338 | 0.45 | 0.43394 | 0.45972 | **3** | 0.702 | 0.5973 | 0.672 | 0.74846 | 0.73616 |
| 4 | 0.9645 | 0.3422 | 0.4581 | 0.43927 | 0.46791 | **4** | 0.6731 | 0.6176 | 0.6845 | 0.77387 | 0.74981 |
| 5 | 0.96 | 0.3811 | 0.4873 | 0.48919 | 0.49778 | **5** | 0.8387 | 0.4579 | 0.5374 | 0.57378 | 0.58874 |
| 6 | 0.968 | 0.3655 | 0.4698 | 0.46927 | 0.47988 | **6** | 0.7097 | 0.5436 | 0.6583 | 0.68121 | 0.72108 |
| 7 | 0.9682 | 0.3595 | 0.4633 | 0.46148 | 0.47323 | **7** | 0.8723 | 0.4681 | 0.5861 | 0.58656 | 0.64202 |
| 8 | 0.9732 | 0.3576 | 0.4455 | 0.459016 | 0.45512 | **8** | 0.661 | 0.6058 | 0.7 | 0.75913 | 0.76686 |
| 9 | 0.9751 | 0.3346 | 0.4204 | 0.42959 | 0.42942 | **9** | 0.8498 | 0.4571 | 0.5875 | 0.57283 | 0.64362 |
| 10 | 0.9811 | 0.3092 | 0.3945 | 0.39699 | 0.403 | **10** | 0.7234 | 0.527 | 0.6839 | 0.66035 | 0.74916 |
| 11 | 0.9868 | 0.2761 | 0.3464 | 0.35442 | 0.35381 | **11** | 0.7742 | 0.4593 | 0.6357 | 0.57549 | 0.69635 |
| 12 | 0.9818 | 0.3104 | 0.3792 | 0.39845 | 0.38737 | **12** | 0.7326 | 0.538 | 0.6905 | 0.67408 | 0.75639 |
| 13 | 0.9848 | 0.2945 | 0.3756 | 0.37812 | 0.38373 | **13** | 0.7412 | 0.5318 | 0.6843 | 0.66629 | 0.74963 |
| 14 | 0.9855 | 0.287 | 0.3674 | 0.36845 | 0.37525 | **14** | 0.8276 | 0.535 | 0.6344 | 0.67043 | 0.69949 |