APPENDIX A

**Monthly dengue cases and climate features dataset during 2000-2021**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Data set 1: Monthly dengue cases and climate features dataset during January 2000- December 2021** | | | | | | | | | |
| Year | Months | Cases | x1 | x2 | x3 | x4 | x5 | x6 | x7 |
| 2000 | Jan | 0 | 18.45 | 8.02 | 28.19 | 62.06 | 0.34 | 101.31 | 7.66 |
| 2000 | Feb | 0 | 20.55 | 10.82 | 29.9 | 52.38 | 0.77 | 101.2 | 8.55 |
| 2000 | Mar | 0 | 25.77 | 14.5 | 36.07 | 55.94 | 2.49 | 100.85 | 10.73 |
| 2000 | Apr | 0 | 29.44 | 22.97 | 39.67 | 67.94 | 5.17 | 100.44 | 11.93 |
| 2000 | May | 0 | 28.51 | 22.91 | 37.55 | 81.62 | 13.24 | 100.29 | 10.77 |
| 2000 | Jun | 0 | 28.33 | 25.14 | 33.16 | 88.88 | 7.83 | 100.05 | 12.21 |
| 2000 | Jul | 565 | 28.22 | 25.28 | 32.94 | 88.81 | 6.49 | 99.93 | 11.88 |
| 2000 | Aug | 2290 | 28.01 | 25.34 | 32.76 | 90 | 12.69 | 100.09 | 12.92 |
| 2000 | Sep | 951 | 27.13 | 22.53 | 32.05 | 89.5 | 5.08 | 100.42 | 11.25 |
| 2000 | Oct | 835 | 26.76 | 19.4 | 32.62 | 83.81 | 6.41 | 100.67 | 9.14 |
| 2000 | Nov | 724 | 22.51 | 15.06 | 29.68 | 77.44 | 0.35 | 101.17 | 5.43 |
| 2000 | Dec | 186 | 18.12 | 10.78 | 26.35 | 70.94 | 0 | 101.32 | 7.37 |
| 2001 | Jan | 0 | 16.59 | 8.22 | 27.58 | 59 | 0 | 101.26 | 7.42 |
| 2001 | Feb | 0 | 22.19 | 11.16 | 32.69 | 48.81 | 1.08 | 101.02 | 9.82 |
| 2001 | Mar | 0 | 26.9 | 15.67 | 38.12 | 45.19 | 0.6 | 100.87 | 9.32 |
| 2001 | Apr | 0 | 30.74 | 21.52 | 40.98 | 53.12 | 2.15 | 100.63 | 12.37 |
| 2001 | May | 5 | 28.67 | 23.8 | 35.62 | 81.62 | 11.39 | 100.24 | 9.62 |
| 2001 | Jun | 24 | 27.89 | 24.32 | 32.71 | 90.5 | 16.66 | 99.93 | 14.17 |
| 2001 | Jul | 152 | 27.95 | 25.16 | 31.65 | 90.75 | 10.55 | 99.96 | 10.12 |
| 2001 | Aug | 310 | 28.26 | 25.51 | 32.56 | 90.06 | 6.34 | 100.08 | 11.53 |
| 2001 | Sep | 655 | 27.87 | 24.04 | 32.89 | 86.81 | 5.94 | 100.46 | 8.85 |
| 2001 | Oct | 611 | 26.63 | 20.93 | 31.11 | 86.25 | 6.52 | 100.83 | 6.65 |
| 2001 | Nov | 514 | 22.91 | 13.87 | 29.98 | 80.19 | 1.1 | 101.28 | 8.07 |
| 2001 | Dec | 159 | 17.81 | 10.48 | 25.73 | 74 | 0.36 | 101.57 | 7.2 |
| 2002 | Jan | 0 | 18.61 | 9.48 | 29.04 | 64.5 | 0.46 | 101.44 | 8.23 |
| 2002 | Feb | 0 | 21.86 | 10.01 | 33.09 | 48.62 | 0.03 | 101.42 | 7.31 |
| 2002 | Mar | 0 | 27.07 | 15.66 | 36.87 | 49.25 | 2.29 | 100.92 | 10.12 |
| 2002 | Apr | 0 | 29.44 | 21.5 | 38.76 | 64.38 | 3.7 | 100.66 | 10.43 |
| 2002 | May | 0 | 29.79 | 24.01 | 39.64 | 75.5 | 7.35 | 100.2 | 10.7 |
| 2002 | Jun | 0 | 28.49 | 25.07 | 34.01 | 88.31 | 13.33 | 100.08 | 14.38 |
| 2002 | Jul | 566 | 28.43 | 25.48 | 33.03 | 90.81 | 13.85 | 99.95 | 12.24 |
| 2002 | Aug | 3281 | 27.63 | 24.75 | 31.8 | 90.81 | 8.24 | 100.13 | 10.73 |
| 2002 | Sep | 1713 | 27.32 | 23.21 | 32.6 | 88.38 | 5.85 | 100.56 | 9.86 |
| 2002 | Oct | 541 | 25.79 | 18.02 | 32.4 | 81.81 | 1.65 | 100.92 | 8.41 |
| 2002 | Nov | 121 | 22.71 | 15.27 | 30.16 | 79.25 | 4.04 | 101.16 | 9.72 |
| 2002 | Dec | 10 | 18.97 | 9.78 | 27.04 | 73.38 | 0.14 | 101.42 | 6.84 |
| 2003 | Jan | 0 | 16.51 | 7.81 | 27.15 | 64.56 | 0.62 | 101.57 | 8.04 |
| 2003 | Feb | 0 | 21.78 | 12.43 | 32.34 | 58.69 | 0.93 | 101.32 | 8.2 |
| 2003 | Mar | 0 | 25.32 | 13.48 | 35.9 | 57.69 | 3.64 | 101.03 | 9.21 |
| 2003 | Apr | 2 | 29.73 | 21.54 | 37.96 | 66.88 | 3.59 | 100.68 | 11.54 |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Monthly dengue cases and climate features dataset during January 2000- December 2021 (Cont.)** | | | | | | | | | | | | | | | |
| Year | | Months | | Cases | x1 | | x2 | | x3 | | x4 | | x5 | x6 | x7 |
| 2003 | | May | | 1 | 30.76 | | 23.94 | | 40.1 | | 67.12 | | 3.98 | 100.32 | 11.26 |
| 2003 | | Jun | | 0 | 28.71 | | 25.44 | | 39.07 | | 86.19 | | 16.89 | 99.9 | 15.29 |
| 2003 | | Jul | | 4 | 28.38 | | 25.88 | | 33.04 | | 89.62 | | 6.01 | 100.15 | 10.84 |
| 2003 | | Aug | | 4 | 28.51 | | 25.48 | | 33.31 | | 88.44 | | 5.84 | 100.15 | 9.95 |
| 2003 | | Sep | | 3 | 27.8 | | 25.08 | | 32.04 | | 88.75 | | 6.16 | 100.42 | 11.95 |
| 2003 | | Oct | | 0 | 26.68 | | 21.28 | | 32.26 | | 84.94 | | 4.87 | 100.93 | 8.95 |
| 2003 | | Nov | | 372 | 21.83 | | 13.59 | | 29.37 | | 78.12 | | 0.08 | 101.3 | 6.07 |
| 2003 | | Dec | | 100 | 18.91 | | 10.3 | | 27.47 | | 76.69 | | 1.28 | 101.51 | 8.35 |
| 2004 | | Jan | | 0 | 17.94 | | 8.11 | | 27.43 | | 67.88 | | 0.07 | 101.43 | 7.94 |
| 2004 | | Feb | | 0 | 21.37 | | 9.97 | | 34.45 | | 54.25 | | 0.09 | 101.25 | 8.09 |
| 2004 | | Mar | | 1 | 27.54 | | 15.57 | | 39.94 | | 53.06 | | 0.47 | 100.86 | 11.33 |
| 2004 | | Apr | | 0 | 29.37 | | 22.19 | | 39.78 | | 67.88 | | 5.93 | 100.61 | 14.71 |
| 2004 | | May | | 1 | 30.74 | | 22.73 | | 40.32 | | 68.12 | | 3.83 | 100.24 | 10.66 |
| 2004 | | Jun | | 143 | 29.23 | | 25.25 | | 35.85 | | 81.81 | | 10.52 | 100.14 | 13.8 |
| 2004 | | Jul | | 1209 | 27.98 | | 24.65 | | 33.33 | | 89.5 | | 11.09 | 100.13 | 11.07 |
| 2004 | | Aug | | 1261 | 28.05 | | 25.42 | | 32.5 | | 90.12 | | 7.45 | 100.03 | 9.68 |
| 2004 | | Sep | | 511 | 27.19 | | 23.29 | | 31.6 | | 90.38 | | 22.23 | 100.56 | 12.89 |
| 2004 | | Oct | | 362 | 25.1 | | 17.59 | | 31.23 | | 86.31 | | 5.9 | 101.13 | 14.27 |
| 2004 | | Nov | | 395 | 21.55 | | 15.13 | | 28.24 | | 79.06 | | 0.01 | 101.36 | 6.67 |
| 2004 | | Dec | | 51 | 19.58 | | 8.38 | | 26.86 | | 74.44 | | 0.01 | 101.44 | 7.17 |
| 2005 | | Jan | | 1 | 17.87 | | 9.62 | | 29.01 | | 69.75 | | 0.2 | 101.41 | 8.52 |
| 2005 | | Feb | | 0 | 23.08 | | 9.29 | | 34.53 | | 56.38 | | 0.16 | 101.23 | 9.71 |
| 2005 | | Mar | | 0 | 27.69 | | 17.8 | | 38.23 | | 59.19 | | 4.28 | 100.97 | 12.4 |
| 2005 | | Apr | | 0 | 29.15 | | 19.7 | | 38.12 | | 64.38 | | 2.93 | 100.83 | 9.58 |
| 2005 | | May | | 0 | 29.69 | | 22.9 | | 39.12 | | 73.19 | | 6.06 | 100.39 | 9.72 |
| 2005 | | Jun | | 2 | 30.08 | | 25.23 | | 37.3 | | 78.88 | | 4.71 | 99.9 | 12.03 |
| 2005 | | Jul | | 3 | 28.36 | | 24.46 | | 32.83 | | 88.38 | | 12.15 | 100.09 | 10.26 |
| 2005 | | Aug | | 174 | 28.48 | | 25.51 | | 33.47 | | 88.88 | | 11.11 | 100.01 | 9.89 |
| 2005 | | Sep | | 337 | 27.87 | | 24.54 | | 33.13 | | 88.38 | | 10.67 | 100.46 | 11.44 |
| 2005 | | Oct | | 325 | 26.08 | | 19.23 | | 31.73 | | 86.12 | | 9.46 | 100.97 | 10.77 |
| 2005 | | Nov | | 187 | 21.38 | | 12.8 | | 28.77 | | 82.5 | | 0.13 | 101.2 | 7.47 |
| 2005 | | Dec | | 19 | 18.12 | | 10.67 | | 26.22 | | 81.62 | | 0.03 | 101.31 | 8 |
| 2006 | | Jan | | 0 | 17.26 | | 8.74 | | 27.46 | | 70.44 | | 0 | 101.38 | 8.82 |
| 2006 | | Feb | | 0 | 23.66 | | 13.93 | | 36.3 | | 61.31 | | 0.09 | 101.14 | 9.5 |
| 2006 | | Mar | | 0 | 27.67 | | 17.12 | | 39.43 | | 46.06 | | 0.05 | 100.89 | 8.15 |
| 2006 | | Apr | | 0 | 30.1 | | 21.85 | | 39.03 | | 61.88 | | 4.16 | 100.59 | 10.23 |
| 2006 | | May | | 0 | 29.97 | | 23.08 | | 39.56 | | 72 | | 9.98 | 100.38 | 10.59 |
| 2006 | | Jun | | 100 | 28.42 | | 25.6 | | 32.92 | | 89.06 | | 9.83 | 100.15 | 12.65 |
| 2006 | | Jul | | 972 | 28.36 | | 25.22 | | 33.1 | | 89.5 | | 8.62 | 99.92 | 11.02 |
| 2006 | | Aug | | 680 | 27.81 | | 24.16 | | 32.44 | | 89 | | 7.26 | 100.13 | 11.11 |
| 2006 | | Sep | | 211 | 27.62 | | 23.91 | | 32.7 | | 88.25 | | 13.57 | 100.51 | 12.98 |
| 2006 | | Oct | | 145 | 26.33 | | 18.05 | | 32.37 | | 82.56 | | 2 | 101.02 | 6.98 |
| 2006 | | Nov | | 92 | 22.39 | | 12.16 | | 30.05 | | 76.94 | | 0.1 | 101.25 | 6.41 |
| 2006 | | Dec | | 0 | 19.26 | | 10.76 | | 27.73 | | 71 | | 0.01 | 101.46 | 8.38 |
| 2007 | | Jan | | 0 | 17.56 | | 9.01 | | 29.18 | | 59.62 | | 0 | 101.55 | 8.61 |
| 2007 | | Feb | | 0 | 21.48 | | 12.3 | | 30.44 | | 61.38 | | 1.8 | 101.29 | 8.84 |
| 2007 | | Mar | | 0 | 25.91 | | 14.47 | | 37.48 | | 45.88 | | 0.19 | 100.99 | 8.96 |
| 2007 | | Apr | | 0 | 29.33 | | 22.8 | | 38.89 | | 65.94 | | 6.02 | 100.73 | 10.38 |
| 2007 | | May | | 0 | 29.51 | | 23.44 | | 37.87 | | 74.44 | | 6.39 | 100.31 | 10.58 |
| 2007 | | Jun | | 0 | 28.42 | | 25.49 | | 33.45 | | 89.25 | | 17.91 | 100.12 | 10.76 |
| 2007 | | Jul | | 85 | 28.09 | | 25.35 | | 33.15 | | 91 | | 22.63 | 100.01 | 12.77 |
| 2007 | | Aug | | 179 | 28.2 | | 24.81 | | 33.69 | | 89.44 | | 8.79 | 100.07 | 12.89 |
| 2007 | | Sep | | 163 | 27.44 | | 23.91 | | 32.15 | | 89.75 | | 7.61 | 100.32 | 14.98 |
| 2007 | | Oct | | 39 | 25.57 | | 17.53 | | 32.03 | | 85.69 | | 9.76 | 100.78 | 9.68 |
| 2007 | | Nov | | 0 | 22.54 | | 15.17 | | 29.07 | | 84.12 | | 2.59 | 101.14 | 14.18 |
| 2007 | | Dec | | 0 | 17.42 | | 9.48 | | 26.04 | | 80.5 | | 0 | 101.35 | 7.26 |
| 2008 | | Jan | | 0 | 17.51 | | 9.37 | | 26.47 | | 73.88 | | 1.05 | 101.33 | 7.9 |
| 2008 | | Feb | | 0 | 19.26 | | 7.83 | | 31.05 | | 62.5 | | 0.63 | 101.29 | 8.52 |
| 2008 | | Mar | | 0 | 26.87 | | 15.82 | | 37.4 | | 60.94 | | 0.96 | 100.84 | 9.68 |
| 2008 | | Apr | | 0 | 30.09 | | 19.51 | | 40.48 | | 56.44 | | 1.6 | 100.58 | 9.99 |
| 2008 | | May | | 0 | 30.72 | | 25.44 | | 39.23 | | 66.38 | | 5.19 | 100.21 | 9.8 |
| 2008 | | Jun | | 160 | 28.46 | | 24.97 | | 34.5 | | 85.25 | | 9.73 | 100.01 | 13.85 |
| 2008 | | Jul | | 475 | 28.16 | | 25.24 | | 32.73 | | 89.38 | | 10.17 | 100 | 10.47 |
| 2008 | | Aug | | 334 | 27.88 | | 24.81 | | 32.77 | | 89.88 | | 9.12 | 100.17 | 11.9 |
| 2008 | | Sep | | 184 | 27.51 | | 23.71 | | 32.92 | | 88.88 | | 5.95 | 100.42 | 10.09 |
| 2008 | | Oct | | 0 | 25.98 | | 17.55 | | 32.19 | | 85.12 | | 7.26 | 100.88 | 17.21 |
| 2008 | | Nov | | 0 | 22.43 | | 14.55 | | 29.98 | | 78.19 | | 0.01 | 101.2 | 6.91 |
| 2008 | | Dec | | 0 | 20.31 | | 12.88 | | 28.52 | | 76.44 | | 0.68 | 101.33 | 7.36 |
| 2009 | | Jan | | 0 | 19.51 | | 10.14 | | 29.26 | | 67.94 | | 0.03 | 101.44 | 7.84 |
| 2009 | | Feb | | 0 | 22.13 | | 11.62 | | 34.58 | | 54.19 | | 0.69 | 101.08 | 8.54 |
| 2009 | | Mar | | 0 | 27.27 | | 14.26 | | 38.01 | | 48.56 | | 1.22 | 100.86 | 9.46 |
| 2009 | | Apr | | 0 | 30.61 | | 22.54 | | 40.65 | | 60.94 | | 1.48 | 100.54 | 10.7 |
| 2009 | | May | | 1 | 29.86 | | 24.5 | | 40.03 | | 73.31 | | 7.98 | 100.32 | 19.84 |
| 2009 | | Jun | | 0 | 29.03 | | 25.24 | | 35.01 | | 85.44 | | 9.21 | 100.01 | 9.49 |
| 2009 | | Jul | | 4 | 28.53 | | 25.48 | | 33.8 | | 88.81 | | 15.46 | 99.91 | 11.87 |
| 2009 | | Aug | | 127 | 28.33 | | 24.51 | | 34.01 | | 88.81 | | 13.69 | 100.26 | 9.99 |
| 2009 | | Sep | | 188 | 27.74 | | 23.96 | | 33.12 | | 89.25 | | 7.07 | 100.42 | 12.74 |
| 2009 | | Oct | | 154 | 25.63 | | 17.74 | | 31.87 | | 85.62 | | 4.42 | 100.82 | 10.96 |
| 2009 | | Nov | | 0 | 22.69 | | 13.07 | | 30.31 | | 80.06 | | 0.87 | 101.2 | 7.74 |
| 2009 | | Dec | | 0 | 18.48 | | 9.55 | | 27.44 | | 75.44 | | 0.04 | 101.43 | 7.94 |
| 2010 | | Jan | | 0 | 17.58 | | 9.14 | | 28.38 | | 65.94 | | 0 | 101.51 | 9.34 |
| 2010 | | Feb | | 0 | 21.55 | | 10.72 | | 32.05 | | 51.38 | | 0.81 | 101.25 | 8.02 |
| 2010 | | Mar | | 0 | 28.22 | | 16.89 | | 39.08 | | 52.88 | | 0.94 | 100.87 | 12.62 |
| 2010 | | Apr | | 0 | 31.1 | | 23.02 | | 42 | | 64.25 | | 2.33 | 100.61 | 13.39 |
| 2010 | | May | | 0 | 29.73 | | 23.76 | | 39.15 | | 76.5 | | 9.86 | 100.32 | 11.14 |
| 2010 | | Jun | | 0 | 28.63 | | 25.57 | | 33.34 | | 90 | | 14.13 | 100.17 | 12.09 |
| 2010 | | Jul | | 35 | 28.41 | | 25.39 | | 33.65 | | 89.25 | | 6.32 | 100.26 | 11.98 |
| 2010 | | Aug | | 183 | 28.24 | | 25.23 | | 33.88 | | 88.31 | | 8.55 | 100.35 | 8.17 |
| 2010 | | Sep | | 165 | 27.65 | | 23.91 | | 32.58 | | 89.19 | | 6.38 | 100.52 | 8.27 |
| 2010 | | Oct | | 21 | 26.62 | | 18.43 | | 33.15 | | 86.38 | | 7.71 | 100.64 | 12.7 |
| 2010 | | Nov | | 5 | 23.78 | | 13.77 | | 30.69 | | 79 | | 0.54 | 101.1 | 7.92 |
| 2010 | | Dec | | 0 | 18.63 | | 10.01 | | 28.26 | | 77.56 | | 2.19 | 101.11 | 7.54 |
| 2011 | | Jan | | 0 | 16.89 | | 7.58 | | 27.88 | | 68.44 | | 0 | 101.3 | 8.27 |
| 2011 | | Feb | | 0 | 21.81 | | 12.13 | | 32.32 | | 55.06 | | 0.06 | 101.14 | 10.62 |
| 2011 | | Mar | | 0 | 26.89 | | 14.42 | | 37.83 | | 54.38 | | 1.47 | 100.87 | 13.46 |
| 2011 | | Apr | | 0 | 29.09 | | 21.05 | | 38.65 | | 61.69 | | 2.98 | 100.78 | 9.04 |
| 2011 | | May | | 0 | 29.2 | | 24.45 | | 37.2 | | 78.25 | | 9.71 | 100.36 | 9.41 |
| 2011 | | Jun | | 74 | 28.52 | | 24.67 | | 33.64 | | 87.12 | | 10.69 | 99.93 | 13.2 |
| 2011 | | Jul | | 296 | 28.28 | | 24.76 | | 33.94 | | 88 | | 7.52 | 100.09 | 11.35 |
| 2011 | | Aug | | 800 | 27.69 | | 24.41 | | 34.55 | | 90.69 | | 14.66 | 100.22 | 9.85 |
| 2011 | | Sep | | 131 | 27.67 | | 23.5 | | 32.97 | | 90.12 | | 6.79 | 100.28 | 10.05 |
| 2011 | | Oct | | 58 | 26.75 | | 18.95 | | 32.51 | | 82.12 | | 1.5 | 100.83 | 8.54 |
| 2011 | | Nov | | 0 | 23.15 | | 15.3 | | 30.93 | | 71.62 | | 0.01 | 101.19 | 6.81 |
| 2011 | | Dec | | 0 | 19.76 | | 9.66 | | 30.4 | | 68.19 | | 0.02 | 101.33 | 8.08 |
| 2012 | | Jan | | 0 | 18.55 | | 8.34 | | 28.28 | | 60.38 | | 0.44 | 101.36 | 9.01 |
| 2012 | | Feb | | 0 | 21.8 | | 9.24 | | 34.97 | | 45.94 | | 0.39 | 101.07 | 8.96 |
| 2012 | | Mar | | 0 | 27.3 | | 15.6 | | 39.71 | | 48.81 | | 0.41 | 100.83 | 9.06 |
| 2012 | | Apr | | 0 | 29.33 | | 21.33 | | 38.98 | | 68.88 | | 7.13 | 100.6 | 11.71 |
| 2012 | | May | | 0 | 30.12 | | 23.24 | | 37.55 | | 73.5 | | 4.22 | 100.26 | 9.2 |
| 2012 | | Jun | | 16 | 29.55 | | 25.81 | | 35.76 | | 83.25 | | 7.51 | 99.81 | 11.77 |
| 2012 | | Jul | | 108 | 28.58 | | 25.56 | | 33.86 | | 87.25 | | 9.56 | 99.9 | 12.45 |
| 2012 | | Aug | | 138 | 28.12 | | 25.64 | | 32.74 | | 89.31 | | 9.73 | 100.1 | 9.38 |
| 2012 | | Sep | | 262 | 27.72 | | 24.12 | | 32.33 | | 89.69 | | 5.65 | 100.45 | 13.27 |
| 2012 | | Oct | | 90 | 25.4 | | 15.39 | | 32.04 | | 84.19 | | 2.05 | 100.91 | 9.85 |
| 2012 | | Nov | | 57 | 21.55 | | 10.51 | | 31.06 | | 76.25 | | 2.22 | 101.1 | 7.7 |
| 2012 | | Dec | | 0 | 17.2 | | 6.11 | | 27.62 | | 69.38 | | 0.07 | 101.27 | 8.73 |
| 2013 | | Jan | | 0 | 16.59 | | 3.43 | | 28.48 | | 58.38 | | 0.01 | 101.44 | 8.73 |
| 2013 | | Feb | | 0 | 21.58 | | 10.12 | | 34.44 | | 48.75 | | 0.23 | 101.21 | 10.78 |
| 2013 | | Mar | | 0 | 27.55 | | 13.54 | | 38.91 | | 49.31 | | 0.67 | 100.9 | 8.73 |
| 2013 | | Apr | | 0 | 30.4 | | 20.54 | | 40.8 | | 57.94 | | 2.27 | 100.56 | 10.25 |
| 2013 | | May | | 4 | 28.69 | | 23.73 | | 40.5 | | 83.44 | | 15.9 | 100.22 | 14.05 |
| 2013 | | Jun | | 44 | 28.63 | | 25.76 | | 33.83 | | 88.81 | | 10.91 | 99.97 | 10.81 |
| 2013 | | Jul | | 220 | 28.3 | | 25.37 | | 33.08 | | 89.31 | | 7.75 | 99.89 | 15.28 |
| 2013 | | Aug | | 353 | 27.87 | | 24.65 | | 32.65 | | 90.06 | | 8.09 | 100.14 | 11.3 |
| 2013 | | Sep | | 495 | 27.9 | | 24.49 | | 33.06 | | 88.44 | | 8.69 | 100.36 | 10.59 |
| 2013 | | Oct | | 363 | 26.37 | | 19.35 | | 31.69 | | 87.19 | | 5.15 | 100.88 | 8.2 |
| 2013 | | Nov | | 212 | 22.33 | | 14.33 | | 29.93 | | 80.81 | | 0 | 101.18 | 7.87 |
| 2013 | | Dec | | 58 | 19.46 | | 10.39 | | 29.28 | | 74.5 | | 0.05 | 101.32 | 8.23 |
| 2014 | | Jan | | 15 | 17.96 | | 7.99 | | 29.35 | | 68.06 | | 0 | 101.55 | 7.87 |
| 2014 | | Feb | | 7 | 21.31 | | 10.05 | | 32.12 | | 54.44 | | 0.41 | 101.18 | 8.14 |
| 2014 | | Mar | | 2 | 26.8 | | 15.05 | | 41.2 | | 49.31 | | 0.53 | 101.04 | 9.59 |
| 2014 | | Apr | | 0 | 31.9 | | 21.86 | | 42.54 | | 51.25 | | 1.64 | 100.66 | 11.05 |
| 2014 | | May | | 8 | 31.19 | | 25.4 | | 41.61 | | 67.69 | | 7.85 | 100.42 | 11.3 |
| 2014 | | Jun | | 9 | 29.39 | | 26.34 | | 35.22 | | 86.5 | | 14.63 | 99.89 | 10.16 |
| 2014 | | Jul | | 82 | 28.59 | | 25.5 | | 33.01 | | 89.38 | | 7.81 | 99.93 | 14.55 |
| 2014 | | Aug | | 80 | 28.14 | | 24.58 | | 33.16 | | 89.56 | | 11.51 | 100.19 | 11.88 |
| 2014 | | Sep | | 76 | 27.85 | | 23.37 | | 32.69 | | 88.25 | | 8.5 | 100.46 | 10.57 |
| 2014 | | Oct | | 63 | 26.51 | | 18.83 | | 32.94 | | 79.81 | | 2.24 | 101.01 | 5.59 |
| 2014 | | Nov | | 22 | 23.08 | | 14.09 | | 31.94 | | 71.88 | | 0.01 | 101.13 | 5.73 |
| 2014 | | Dec | | 11 | 19.08 | | 9.39 | | 28.83 | | 69.44 | | 0.13 | 101.39 | 8.24 |
| 2015 | | Jan | | 0 | 19.3 | | 9.3 | | 29.72 | | 60.38 | | 0.11 | 101.48 | 8.1 |
| 2015 | | Feb | | 0 | 22.56 | | 9.69 | | 33.9 | | 54.81 | | 0.83 | 101.31 | 8.99 |
| 2015 | | Mar | | 2 | 26.87 | | 13.62 | | 37.73 | | 46.75 | | 0.73 | 101.13 | 8.7 |
| 2015 | | Apr | | 6 | 28.21 | | 21.97 | | 36.78 | | 71.88 | | 7.09 | 100.81 | 10.16 |
| 2015 | | May | | 10 | 29.53 | | 23.6 | | 37.66 | | 77.38 | | 5.17 | 100.44 | 9.72 |
| 2015 | | Jun | | 28 | 28.96 | | 24.82 | | 35.72 | | 85.06 | | 14.65 | 100.13 | 10.26 |
| 2015 | | Jul | | 171 | 28.04 | | 24.78 | | 33.03 | | 91.06 | | 23.14 | 99.91 | 15.68 |
| 2018 | Aug | | 1796 | | | 28.37 | | 25.5 | | 32.24 | | 90.31 | 9.95 | 99.95 | 10.27 |
| 2018 | Sep | | 3087 | | | 28.21 | | 24.78 | | 32.98 | | 87.19 | 5.77 | 100.52 | 11.55 |
| 2018 | Oct | | 2406 | | | 25.94 | | 18.19 | | 32.62 | | 78.75 | 2.02 | 101.06 | 7.84 |
| 2018 | Nov | | 1192 | | | 23.19 | | 14.83 | | 30.68 | | 71.88 | 0.78 | 101.3 | 6.36 |
| 2018 | Dec | | 293 | | | 19.03 | | 7.17 | | 27.9 | | 68.81 | 1.06 | 101.42 | 8.02 |
| 2019 | Jan | | 38 | | | 19.04 | | 9.06 | | 30.24 | | 57.31 | 0 | 101.53 | 7.71 |
| 2019 | Feb | | 18 | | | 22.07 | | 10.65 | | 32.81 | | 56.31 | 3.8 | 101.34 | 8 |
| 2019 | Mar | | 17 | | | 25.64 | | 10.55 | | 36.01 | | 61.44 | 2.28 | 101.05 | 10.81 |
| 2019 | Apr | | 58 | | | 29.35 | | 21.85 | | 40.49 | | 67.38 | 2.93 | 100.72 | 12.37 |
| 2019 | May | | 193 | | | 29.9 | | 22.65 | | 39.05 | | 78.88 | 11.45 | 100.41 | 16.2 |
| 2019 | Jun | | 1884 | | | 28.96 | | 24.76 | | 34.33 | | 88.25 | 11.31 | 100.1 | 9.62 |
| 2019 | Jul | | 16253 | | | 28.5 | | 25.38 | | 32.96 | | 90.5 | 24.03 | 100.04 | 11.98 |
| 2019 | Aug | | 52636 | | | 28.52 | | 25.23 | | 33.06 | | 89.25 | 17.5 | 100.06 | 12.06 |
| 2019 | Sep | | 16856 | | | 28.12 | | 23.24 | | 33.62 | | 87.94 | 11.95 | 100.61 | 9.84 |
| 2019 | Oct | | 8113 | | | 26.2 | | 19.5 | | 31.29 | | 86.19 | 7.86 | 101.01 | 7.2 |
| 2019 | Nov | | 4011 | | | 23.6 | | 16.53 | | 30.07 | | 82 | 4.47 | 101.17 | 9.21 |
| 2019 | Dec | | 1247 | | | 18.01 | | 8.36 | | 27.2 | | 82.19 | 0.56 | 101.55 | 7.34 |
| 2020 | Jan | | 111 | | | 16.95 | | 8.39 | | 27.28 | | 79.69 | 2.34 | 101.51 | 8 |
| 2020 | Feb | | 45 | | | 19.42 | | 8.73 | | 30.58 | | 66.31 | 0.09 | 101.49 | 7.02 |
| 2020 | Mar | | 27 | | | 25.44 | | 17.15 | | 37.22 | | 59.19 | 2.07 | 101.07 | 9.42 |
| 2020 | Apr | | 25 | | | 28.01 | | 21.49 | | 37.94 | | 71.69 | 9.75 | 100.89 | 9.3 |
| 2020 | May | | 10 | | | 28.51 | | 22.94 | | 33.64 | | 82.56 | 15.13 | 100.5 | 20.59 |
| 2020 | Jun | | 23 | | | 28.47 | | 25.78 | | 32.06 | | 90.44 | 14.07 | 100.22 | 10.44 |
| 2020 | Jul | | 68 | | | 28.61 | | 25.59 | | 32.37 | | 90.44 | 13.53 | 100.21 | 9.79 |
| 2020 | Aug | | 163 | | | 28.4 | | 25.21 | | 33.84 | | 90.19 | 12.2 | 100.03 | 14.82 |
| 2020 | Sep | | 47 | | | 28.49 | | 24.94 | | 33.74 | | 89.06 | 11.73 | 100.39 | 12.25 |
| 2020 | Oct | | 109 | | | 27.81 | | 21.66 | | 33.26 | | 86.81 | 13.05 | 100.59 | 11.2 |
| 2020 | Nov | | 546 | | | 22.84 | | 12.62 | | 30.51 | | 82.5 | 1.49 | 101.3 | 6.36 |
| 2020 | Dec | | 19 | | | 18.23 | | 7.73 | | 26.9 | | 82.5 | 0.07 | 101.38 | 6.18 |
| 2021 | Jan | | 32 | | | 17.58 | | 7.58 | | 27.62 | | 75.81 | 0.17 | 101.33 | 6.59 |
| 2021 | Feb | | 9 | | | 20.91 | | 7.99 | | 34.07 | | 59.44 | 0 | 101.25 | 8.3 |
| 2021 | Mar | | 13 | | | 28.02 | | 16.23 | | 39.27 | | 54.31 | 0.17 | 100.88 | 10.48 |
| 2021 | Apr | | 3 | | | 30.94 | | 21.54 | | 40.22 | | 53.94 | 1.5 | 100.73 | 10.14 |
| 2021 | May | | 43 | | | 30.1 | | 22.84 | | 38.37 | | 71.56 | 9.49 | 100.46 | 15.02 |
| 2021 | Jun | | 272 | | | 28.35 | | 24.17 | | 32.36 | | 88.88 | 16.7 | 100.15 | 10.56 |
| 2021 | Jul | | 2286 | | | 28.62 | | 25.87 | | 33.18 | | 88.94 | 14 | 100.04 | 17.12 |
| 2021 | Aug | | 7698 | | | 28.27 | | 25.08 | | 33.74 | | 90.38 | 12.61 | 100.27 | 11.58 |
| 2021 | Sep | | 7841 | | | 27.8 | | 23.69 | | 33.26 | | 88.56 | 9.22 | 100.49 | 11.57 |
| 2021 | Oct | | 5458 | | | 26.94 | | 18.05 | | 32.5 | | 84.31 | 6.58 | 100.77 | 8.9 |
| 2021 | Nov | | 3567 | | | 21.72 | | 12.76 | | 28.12 | | 81.25 | 24.95 | 101.17 | 6.75 |
| 2021 | Dec | | 1207 | | | 18.72 | | 8.94 | | 27.87 | | 82.75 | 131.03 | 101.52 | 9.85 |

APPENDICX B

**Socio-demographic dataset**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Data set 2:** Socio-demographic dataset | | | | | | | | | | | |
| Year | x8 | x9 | x10 | x11 | x12 | x13 | x14 | x15 | x16 | x17 | x18 |
| 2000 | 981 | 53.37 | 440 | 48.9 | 52.8 | 3.3 | 32 | 18 | 2 | 1331369 | 2.07 |
| 2001 | 981 | 53.37 | 440 | 48.9 | 52.8 | 3.3 | 32 | 18 | 2 | 1331369 | 2.07 |
| 2002 | 1018 | 54.72 | 440 | 46 | 49.6 | 3.9 | 37.9 | 20 | 1.8 | 1536102 | 2.26 |
| 2003 | 1018 | 54.72 | 440 | 46 | 49.6 | 3.9 | 37.9 | 20 | 1.8 | 1536102 | 2.26 |
| 2004 | 1052 | 65.11 | 510 | 43.2 | 51.6 | 4.3 | 40.6 | 22 | 1.6 | 1650276 | 2.34 |
| 2005 | 1052 | 65.11 | 510 | 43.2 | 51.6 | 4.3 | 40.6 | 22 | 1.6 | 1650276 | 2.34 |
| 2006 | 1083 | 71.82 | 570 | 39.1 | 53.7 | 3.6 | 50.5 | 24 | 1.3 | 1729451 | 2.48 |
| 2007 | 1083 | 71.82 | 570 | 39.1 | 53.7 | 3.6 | 50.5 | 24 | 1.3 | 1729451 | 2.48 |
| 2008 | 1109 | 91.63 | 660 | 36.3 | 56.9 | 4.6 | 54.7 | 26 | 1.1 | 1224222 | 2.49 |
| 2009 | 1109 | 91.63 | 660 | 36.3 | 56.9 | 4.6 | 54.7 | 26 | 1.1 | 1224222 | 2.49 |
| 2010 | 1134 | 115.28 | 800 | 31.5 | 58.6 | 3.4 | 55.3 | 28 | 1.1 | 1818901.019 | 2.68 |
| 2011 | 1134 | 115.28 | 800 | 31.5 | 58.6 | 3.4 | 55.3 | 28 | 1.1 | 1818901.019 | 2.68 |
| 2012 | 1160 | 133.36 | 970 | 29.5 | 60.7 | 4.1 | 66.2 | 31 | 1.2 | 2195061.68 | 2.75 |
| 2013 | 1160 | 133.36 | 970 | 29.5 | 60.7 | 4.1 | 66.2 | 31 | 1.2 | 2195061.68 | 2.75 |
| 2014 | 1187 | 172.89 | 1110 | 26.7 | 61.4 | 4.4 | 62.4 | 33 | 1.1 | 3051914.733 | 2.66 |
| 2015 | 1187 | 172.89 | 1110 | 26.7 | 61.4 | 4.4 | 62.4 | 33 | 1.1 | 3051914.733 | 2.66 |
| 2016 | 1214 | 265.24 | 1430 | 24.3 | 72.3 | 4.3 | 75.9 | 35 | 1.1 | 3815869 | 2.47 |
| 2017 | 1214 | 265.24 | 1430 | 24.3 | 72.3 | 4.3 | 75.9 | 35 | 1.1 | 4660739.038 | 2.47 |
| 2018 | 1240 | 321.38 | 2040 | 21.8 | 73.9 | 4.4 | 91.8 | 37 | 1.1 | 5677396 | 2.51 |
| 2019 | 1240 | 321.38 | 2040 | 21.8 | 73.9 | 4.4 | 91.8 | 37 | 1.1 | 5677396 | 2.51 |
| 2020 | 1265 | 373.9 | 2340 | 42.1 | 74.9 | 5.4 | 96.2 | 39 | 1 | 2984121.694 | 2.5 |
| 2021 | 1265 | 373.9 | 2340 | 42.1 | 74.9 | 5.4 | 96.2 | 39 | 1 | 2984121.694 | 2.5 |

APPENDIX C

**Landscape dataset**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Data set 3: Landscape dataset** | | | | |
| Year | x19 | x20 | x21 | x22 |
| 2000 | 14.75 | 72.21 | 64.15 | 11085.5 |
| 2001 | 14.73 | 72.24 | 63.79 | 11263.1 |
| 2003 | 14.68 | 71.66 | 63.21 | 12683.8 |
| 2004 | 14.65 | 71.62 | 62.56 | 13055.1 |
| 2005 | 14.63 | 71.53 | 60.77 | 13330 |
| 2006 | 14.61 | 71.29 | 60.54 | 14831.1 |
| 2007 | 14.58 | 71.18 | 60.04 | 15912.7 |
| 2008 | 14.56 | 71.08 | 59.94 | 17155.8 |
| 2009 | 14.53 | 71.03 | 59.89 | 18237.5 |
| 2010 | 14.51 | 70.99 | 59.85 | 18947.8 |
| 2011 | 14.5 | 70.12 | 58.98 | 20546.1 |
| 2012 | 14.49 | 70.08 | 58.92 | 21627.8 |
| 2013 | 14.48 | 71.28 | 58.98 | 22693.3 |
| 2014 | 14.48 | 71.56 | 58.92 | 23688 |
| 2015 | 14.47 | 72.4 | 59.4 | 26099.8 |
| 2016 | 14.47 | 72.99 | 59.65 | 28230.8 |
| 2017 | 14.47 | 73.29 | 59.59 | 30378 |
| 2018 | 14.47 | 73.77 | 59.71 | 32525.2 |
| 2019 | 14.47 | 75.63 | 61.2 | 34672.4 |
| 2020 | 14.47 | 76.06 | 61.46 | 36819.6 |
| 2021 | 14.47 | 72.1 | 60.7 | 38773.1 |

APPENDIX D

**R codes for imputing missing value**

# KNN missing data imputation.

install. packages("colorspace")

install.packages("grid")

install.packages("VIM")

library(colorspace)

library(grid)

library(VIM)

?kNN()

data<- kNN (data, variable = c (data$X12, data$X18,data$X16), k=6 )

APPENDIX E

**R codes for descriptive analysis**

#Boxplot#

dataw<-read.csv(file.choose());dataw

attach(dataw)

dataw

data\_long<-melt(dataw)

head(data\_long)

str(data\_long)

p1<-ggplot(data\_long, aes(x = variable, y = value))+

geom\_boxplot(col="black",fill="red",outlier.size=2)+xlab("Months")+ylab("X1")+ylim(5,50)+stat\_summary(fun=mean, geom="point", shape=16, size=4, color="blue", fill="blue")+

theme(text=element\_text(size = 25));p1

p2<-ggplot(data\_long, aes(x = variable, y = value))+

geom\_boxplot(col="black",fill="red",outlier.size=2)+xlab("Months")+ylim(5,50)+ylab("X2")+stat\_summary(fun=mean, geom="point", shape=16, size=4, color="blue", fill="blue")+

theme(text=element\_text(size = 25));p2

p3<-ggplot(data\_long, aes(x = variable, y = value))+

geom\_boxplot(col="black",fill="red",outlier.size=2)+ xlab("Months")+ ylim(5,50)+theme(text=element\_text(size = 25))+

ylab("X3")+stat\_summary(fun=mean, geom="point", shape=16, size=4, color="blue", fill="blue");p3

p4<-ggplot(data\_long, aes(x = variable, y = value))+

geom\_boxplot(col="black",fill="red",outlier.size=2)+ xlab("Months")+theme(text=element\_text(size = 25))+

ylab("X4")+stat\_summary(fun=mean, geom="point", shape=16, size=4, color="blue", fill="blue");p4

p5<-ggplot(data\_long, aes(x = variable, y = value))+

geom\_boxplot(col="black",fill="red",outlier.size=2)+ xlab("Months")+theme(text=element\_text(size = 25))+

ylab("X5")+stat\_summary(fun=mean, geom="point", shape=16, size=4, color="blue", fill="blue");p5

p6<-ggplot(data\_long, aes(x = variable, y = value))+theme(text=element\_text(size = 25))+

geom\_boxplot(col="black",fill="red",outlier.size=2)+xlab("Months")+ylab("X6")+stat\_summary(fun=mean, geom="point", shape=16, size=4, color="blue", fill="blue");p6

p7<-ggplot(data\_long, aes(x = variable, y = value))+

geom\_boxplot(col="black",fill="red",outlier.size=2)+ xlab("Months")+theme(text=element\_text(size = 25))+

ylab("X7")+stat\_summary(fun=mean, geom="point", shape=16, size=4, color="blue", fill="blue");p7

#combine plot

install.packages("ggpubr")

library(ggpubr)

figure1<-ggarrange(p1,p2,p3,

labels = c("A", "B", "C"),nrow = 1);figure1

figure2 <-ggarrange(p4,p5,p6,p7,

labels = c("D","E","F","G"),

ncol=2,nrow = 2

);figure2

figure3<-ggarrange(p1,p2,p3,p4,p5,p6,p7,

labels = c("A", "B", "C","D","E","F","G"),

ncol=3,nrow = 3);figure3

#combine plot same x axis

library(grid)

grid.newpage()

grid.draw(rbind(ggplotGrob(p1), ggplotGrob(p2),ggplotGrob(p3), size = "last"))

grid.draw(rbind(ggplotGrob(p4), ggplotGrob(p5),ggplotGrob(p6), ggplotGrob(p7),size = "last"))

#time series

library(ggplot2)

library(lattice)

datas<-read.csv(file.choose());datas

datas

attach(datas)

t1<-ggplot(datas, aes(x = Year))+geom\_line(aes(y = x8),size=1, color = "red")+ xlab("Year")+

ylab("Population density");t1

t2<-ggplot(datas, aes(x = Year))+geom\_line(aes(y = x9), size=1,color = "red")+ xlab("Year")+

ylab("Gross Domestic Product ( Billion US$)");t2

t3<-ggplot(datas, aes(x = Year))+geom\_line(aes(y = x10), size=1,color = "blue")+ xlab("Year")+

ylab("Gross National Income ( K US$)");t3

t4<-ggplot(datas, aes(x = Year))+geom\_line(aes(y = x11), size=1, color = "blue")+ xlab("Year")+

ylab("Poverty head-count ratio (% of population)");t4

t5<-ggplot(datas, aes(x = Year))+geom\_line(aes(y = x12), size=1, color = "orange")+ xlab("Year")+

ylab("Adult literacy rate (% of population)");t5

t6<-ggplot(datas, aes(x = Year))+geom\_line(aes(y = x13), size=1, color = "orange")+ xlab("Year")+

ylab("Total unemployment (% of total labor force)");t6

t7<-ggplot(datas, aes(x = Year))+geom\_line(aes(y = x14), size=1, color = "purple")+ xlab("Year")+

ylab("Access to electricity (% of population)");t7

t8<-ggplot(datas, aes(x = Year))+geom\_line(aes(y = x15), size=1, color = "purple")+ xlab("Year")+

ylab("Safe sanitation service");t8

t9<-ggplot(datas, aes(x = Year))+geom\_line(aes(y = x16), size=1, color = "green")+ xlab("Year")+

ylab("Population Growth");t9

t10<-ggplot(datas, aes(x = Year))+geom\_line(aes(y = x17), size=1,color = "green")+ xlab("Year")+

ylab("Air transport, Passengers Carried");t10

t11<-ggplot(datas, aes(x = Year))+geom\_line(aes(y = x18), size=1,color = "brown")+ xlab("Year")+

ylab("Current health expenditure");t11

t12<-ggplot(datas, aes(x = Year))+geom\_line(aes(y = x19), size=1,color = "blue");t12

t13<-ggplot(datas, aes(x = Year))+geom\_line(aes(y = x20), size=1,color = "brown");t13

t14<-ggplot(datas, aes(x = Year))+geom\_line(aes(y = x21), size=1,color = "orange");t14

t15<-ggplot(datas, aes(x = Year))+geom\_line(aes(y = x22), size=1,color = "red");t15

library(ggpubr)

t<-ggarrange(t1,t2,t3,t4,t5,ncol = 1);t

t<-ggarrange(t6,t7,t8,t9,t10,t11,ncol = 1);t

t<-ggarrange(t12,t13,t14,t15,ncol = 1);t

APPENDIX F

**R codes for tree-based ML model and SHAP**

#random forest

library(e1071)

library(Matrix)

library(caret)

data<-read.csv(file.choose());data

data

summary(data)

attach(data)

dim(data)

train<-data[1:23,];train

test<-data[24:36,];test

head(train)

str(train)

dim(train)

head(test)

str(test)

dim(test)

dim(data)

m<-randomForest(lg\_cases~.,data=train);m

impr<-importance(m);impr

varImpPlot(m)

pred<-predict(m,newdata=test,type="class");pred

plot(pred)

install.packages("MLmetrics")

library(MLmetrics)

MAE(pred,test$lg\_cases)

RMSE(pred,test$lg\_cases)

MAPE(pred,test$lg\_cases)

MAE(pred,training$lg\_cases)

RMSE(pred,training$lg\_cases)

MAPE(pred,training$lg\_cases)

#XGBOOST model

library(ggplot2)

library(xgboost)

library(magrittr)

library(dplyr)

library(Matrix)

library(e1071)

library(dplyr)

library(car)

library(lattice)

library(caret)

library(SHAPforxgboost)

data1<-read.csv(file.choose());data1

data1

str(data1)

head(data1)

dim(data1)

attach(data1)

train1<-data1[1:23,];train1

test1<-data1[24:36,];test1

train1

dim(train1)

str(train1)

dim(test1)

str(test1)

test1

X\_train1 = data.matrix(train1[,-1]); X\_train1

y\_train1 = train1[,1];y\_train1

X\_test1 = data.matrix(test1[,-1]) ;X\_test1

y\_test1 = test1[,1];X\_test1

xgboost\_train1 =xgb.DMatrix(data=X\_train1, label=y\_train1);xgboost\_train1

xgboost\_test1 = xgb.DMatrix(data=X\_test1, label=y\_test1);xgboost\_test1

watchlist<-list(train=xgboost\_train1,test=xgboost\_test1); watchlist

head(xgboost\_train1)

params <- list(

objective = "reg:squarederror",

learning\_rate = 0.05,

subsample = 0.9,

colsample\_bynode = 1,

reg\_lambda = 2,

max\_depth = 5

)

set.seed(333)

model1 <- xgb.train(data = xgboost\_train1, max.depth = 3, watchlist=watchlist, nrounds = 100);model1

f\_model<- xgb.train(data = xgboost\_train1, max.depth = 3, watchlist=watchlist, nrounds = 86);f\_model

#new model

fit\_xgb<- xgb.train(

params,

data = xgboost\_train1,

watchlist = watchlist,

early\_stopping\_rounds = 20,

print\_every\_n = 100,

nrounds = 1000

);fit\_xgb

p<-predict(fit\_xgb,newdata =xgboost\_test1)

p

plot(p)

imp<-xgb.importance(colnames(xgboost\_test1),model=fit\_xgb)

print(imp)

#plot(imp)

xgb.plot.importance(imp,measure = "Gain",col="orange")

mean((y\_test1-p)^2)#mse

sqrt(mean((y\_test1-p)^2))#rmse

mean(abs((y\_test1-p)))#mAE

caret::MAE(y\_test1,p)

caret::RMSE(y\_test1,p)

library(MLmetrics)

MAPE(y\_test1,p)

shap <- shap.prep(fit\_xgb,X\_train= X\_train1);shap

shap.plot.summary(shap)

for (v in shap.importance(shap, names\_only = TRUE)) {

p <- shap.plot.dependence(shap, v, color\_feature = "auto",

alpha = 0.5, jitter\_width = 0.1) +

ggtitle(v)

print(p)

}

install.packages("treeshap")

library(treeshap)

pairs.panels(datal)

# To return the SHAP values and ranked features by mean|SHAP|

shap\_values <- shap.values(xgb\_model =fit\_xgb, X\_train = X\_train1);shap\_values

# The ranked features by mean |SHAP|

s<-shap\_values$mean\_shap\_score;s

sp<-shap\_values$shap\_score;sp

t<-sp;t

shap\_long <- shap.prep(shap\_contrib = t, X\_train = X\_train1);shap\_long

shap.plot.summary(shap\_long)

#LightGBM

library(ggplot2)

library(dplyr)

library(lattice)

library(caret)

library(SHAPforxgboost)

library(lightgbm)

datal<-read.csv(file.choose());datal

datal

dim(datal)

trainl<-datal[1:23,];trainl

testl<-datal[24:36,];testl

train\_xl = trainl[, -1];train\_xl

train\_xl = scale(train\_xl)[,];train\_xl

train\_yl = trainl[,1];train\_yl

test\_xl = testl[, -1];test\_xl

test\_xl = scale(testl[,-1])[,];test\_xl

test\_yl = testl[,1];test\_yl

y<-"lg\_cases";y

x<-c("x1","x2","x3","x4","x5","x6","x7");x

dtrainl = lgb.Dataset(train\_xl, label = train\_yl)

dim(dtrainl)

dtestl = lgb.Dataset.create.valid(dtrainl, test\_xl, label = test\_yl)

dim(dtestl)

params <- list(

objective = "regression",

learning\_rate = 0.05,

subsample = 0.9,

reg\_lambda = 2,

num\_leaves = 15

)

mlgb<-lgb.train(

params,

data = dtrainl,

valids = list(valid = dtestl),

early\_stopping\_rounds = 20,

eval\_freq = 100,

eval = "rmse",

nrounds = 500

);mlgb

pred\_yl = predict(mlgb, test\_xl)

pred\_yl

msel = mean((test\_yl - pred\_yl)^2)

msel

mael = caret::MAE(test\_yl, pred\_yl)

mael

rmsel = caret::RMSE(test\_yl, pred\_yl)

rmsel

library(MLmetrics)

MAPE(test\_yl,pred\_yl)

X <- data.matrix(datal[sample(nrow(datal)), x])

shap <- shap.prep(mlgb, X\_train =X)

shap.plot.summary(shap)

for (v in shap.importance(shap, names\_only = TRUE)) {

pl <- shap.plot.dependence(shap, v, color\_feature = "auto",

alpha = 0.5, jitter\_width = 0.1) +

ggtitle(v)

print(pl)

}

tree\_imp <- lgb.importance(mlgb);tree\_imp

lgb.plot.importance(tree\_imp, measure = "Frequency")

shap.values(mlgb, test\_xl)