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Biostatistical Data Analysis

Report

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* These are the state names corresponding to the numbers. For the data analysis questions, sometimes only numbers would be written. Kindly refer this list to get the state name.

1 Andhra Pradesh
2 Arunachal Pradesh
3 Assam
4 Bihar
5 Chhattisgarh
6 Goa
7 Gujarat
8 Haryana
9 Himachal Pradesh
10 Jammu & Kashmir
11 Jharkhand
12 Karnataka
13 Kerala
14 Madhya Pradesh
15 Maharashtra
16 Manipur
17 Meghalaya
18 Mizoram
19 Nagaland
20 Odisha
21 Punjab
22 Rajasthan
23 Sikkim
24 Tamil Nadu
25 Telangana
26 Tripura
27 Uttarakhand
28 Uttar Pradesh
29 West Bengal

1. (Please zoom to see clearly)

	State	2011	2018	Population 2012	Population 2013	Population 2014	Population 2015	Population 2016	Population 2017
1	Andhra Pradesh	49379910	52020780	49757177.1	50134444.3	50511711.4	50888978.6	51266245.7	51643512.9
2	Arunachal Pradesh	1383727	1341000	1377623.1	1371519.3	1365415.4	1359311.6	1353207.7	1347103.9
3	Assam	31205576	33166000	31485636.6	31765697.1	32045757.7	32325818.3	32605878.9	32885939.4
4	Bihar	104099452	106192000	104398387.4	104697322.9	104996258.3	105295193.7	105594129.1	105893064.6
5	Chattisgarh	25545198	26488000	25679884.0	25814570.0	25949256.0	26083942.0	26218628.0	26353314.0
6	Goa	1458545	1564349	1473659.9	1488774.7	1503889.6	1519004.4	1534119.3	1549234.1
7	Gujarat	60439692	64222000	60980021.7	61520351.4	62060681.1	62601010.9	63141340.6	63681670.3
8	Haryana	25351462	28253000	25765967.4	26180472.9	26594978.3	27009483.7	27423989.1	27838494.6
9	Himachal Pradesh	6864602	7206000	6913373.1	6962144.3	7010915.4	7059686.6	7108457.7	7157228.9
10	Jammu and Kashmir	12541302	12665000	12558973.1	12576644.3	12594315.4	12611986.6	12629657.7	12647328.9
11	Jharkhand	32988134	34483000	33201686.3	33415238.6	33628790.9	33842343.1	34055895.4	34269447.7
12	Karnataka	61095297	63435000	61429540.3	61763783.6	62098026.9	62432270.1	62766513.4	63100756.7
13	Kerela	33406061	36062000	33785480.9	34164900.7	34544320.6	34923740.4	35303160.3	35682580.1
14	Madhya Pradesh	72626809	80042000	73686122.0	74745435.0	75804748.0	76864061.0	77923374.0	78982687.0
15	Maharashtra	112374333	122926000	113881714.0	115389095.0	116896476.0	118403857.0	119911238.0	121418619.0
16	Manipur	2855794	2646000	2825823.4	2795852.9	2765882.3	2735911.7	2705941.1	2675970.6
17	Meghalaya	2966889	2832000	2947619.1	2928349.3	2909079.4	2889809.6	2870539.7	2851269.9
18	Mizoram	1097206	1085000	1095462.3	1093718.6	1091974.9	1090231.1	1088487.4	1086743.7
19	Nagaland	1978502	2430000	2043001.7	2107501.4	2172001.1	2236500.9	2301000.6	2365500.3
20	Odisha	41974218	43132000	42139615.4	42305012.9	42470410.3	42635807.7	42801205.1	42966602.6
21	Punjab	27743338	29625000	28012146.9	28280955.7	28549764.6	28818573.4	29087382.3	29356191.1
22	Rajasthan	68548437	74884000	69453517.4	70358597.9	71263678.3	72168758.7	73073839.1	73978919.6
23	Sikkim	610577	660000	617637.4	624697.9	631758.3	638818.7	645879.1	652939.6
24	Tamil Naidu	72147030	70047000	71847025.7	71547021.4	71247017.1	70947012.9	70647008.6	70347004.3
25	Telangana	35192178	37670220	35546184.0	35900190.0	36254196.0	36608202.0	36962208.0	37316214.0
26	Tripura	3673917	3906000	3707071.7	3740226.4	3773381.1	3806535.9	3839690.6	3872845.3
27	Uttar Pradesh	199812341	224829000	203386149.4	206959957.9	210533766.3	214107574.7	217681383.1	221255191.6
28	Uttarkhand	10086292	10887000	10200678.9	10315065.7	10429452.6	10543839.4	10658226.3	10772613.1
29	West Bengal	91276115	94483000	91734241.4	92192367.9	92650494.3	93108620.7	93566747.1	94024873.6

2. Lethality of each state for corresponding years:

State	Lethality 2013	Lethality 2014	Lethality 2015	Lethality 2016	Lethality 2017	Lethality 2018
1	0.0031709972	9.717617e-04	0.000000e+00	0.0011375640	0.0093582888	0.0080360196
2	0.0279720280	0.000000e+00	2.726034e-03	0.0080321285	0.0016077170	0.0000000000
3	0.0037701975	8.878128e-03	6.975122e-04	0.0092683889	0.0073868883	0.0066584082
4	0.0000720072	3.021909e-04	8.507453e-06	0.0005177994	0.0003518958	0.0010677423
5	0.0010378827	1.374570e-03	4.293873e-05	0.0044692737	0.0036264733	0.0070517126
6	0.0094637224	2.439024e-02	0.000000e+00	0.0000000000	0.0295389049	0.0186480186
7	0.0021881838	2.453988e-03	0.000000e+00	0.0030864198	0.0027894003	0.0004325260
8	0.0007135212	2.445586e-03	0.000000e+00	0.0013706140	0.0002577984	0.0017741935
9	0.0059556037	5.152134e-03	1.836800e-04	0.0050895566	0.0055857920	0.0072000000
10	0.0001100433	3.478745e-05	0.000000e+00	0.4849568574	0.7057709447	0.0009439899
11	0.0008853475	2.090592e-03	1.506818e-04	0.0002495010	0.0019317450	0.0016406891
12	0.0190249703	8.810069e-03	0.000000e+00	0.0164296224	0.0130924961	0.0057618438
13	0.0029271862	4.053712e-03	0.000000e+00	0.0098314607	0.0035928144	0.0064850843
14	0.0011169025	1.348250e-03	5.144386e-05	0.0018764543	0.0015579295	0.0017465724
15	0.0001580778	9.250694e-04	0.000000e+00	0.0006229559	0.0002273761	0.0024849865
16	0.0000000000	0.000000e+00	0.000000e+00	0.0000000000	0.0000000000	0.0000000000
17	0.0056509946	1.453575e-02	0.000000e+00	0.0246056782	0.0219880898	0.0085378869
18	0.0334572491	1.195952e-02	0.000000e+00	0.0198412698	0.0210135970	0.0076142132
19	0.0007668712	0.000000e+00	0.000000e+00	0.0000000000	0.0000000000	0.0014598540
20	0.0102504922	8.227551e-03	5.716513e-04	0.0110918817	0.0106961907	0.0140570090
21	0.0007642923	5.206977e-04	5.633803e-05	0.0027659039	0.0021311864	0.0017056530
22	0.0007135212	1.694111e-03	0.000000e+00	0.0006401179	0.0004026893	0.0006154623
23	0.0086956522	0.000000e+00	0.000000e+00	0.0016501650	0.0000000000	0.0000000000
24	0.0003604903	8.134490e-04	0.000000e+00	0.0047122181	0.0389986376	0.0483667208
25	NaN	NaN	0.000000e+00	0.0007507508	0.0000000000	0.0000000000
26	0.0074925075	8.050604e-03	0.000000e+00	0.0229885057	0.0170068027	0.0117449664
27	0.0000000000	2.883091e-04	2.971238e-04	0.0011963617	0.0000000000	0.0000000000
28	0.0013873095	2.982975e-03	8.202336e-04	0.0002505324	0.0010696365	0.0008034240
29	0.0123147419	6.557574e-03	1.543895e-04	0.0058646672	0.0035494155	0.0020005492

Average lethality of each state -
1: 0.0037791052
2: 0.0067229845
3: 0.0061099204
4: 0.0003866905
5: 0.0029338086
6: 0.0136734816
7: 0.0018250863
8: 0.0010936188
9: 0.0048611277
10: 0.1986361038

11: 0.0011580928
12: 0.0105198335
13: 0.0044817095
14: 0.0012829254
15: 0.0007364110
16: 0.0000000000
17: 0.0125530659
18: 0.0156476418
19: 0.0003711209
20: 0.0091491292
21: 0.0013240119
22: 0.0006776503
23: 0.0017243029
24: 0.0155419193
25: 0.0001876877
26: 0.0112138977
27: 0.0002969658
28: 0.0012190185
29: 0.0050735563

Average lethality of all states = 0.01162041

Confidence interval - SD for each state:

1: -9.495110e-04
2: -2.589496e-03
3: -7.886880e-04
4: -9.150260e-05
5: -6.254893e-04
6: -2.993774e-03
7: -3.085813e-04
8: -2.246009e-04
9: -5.782376e-04
10: -7.539376e-02
11: -2.034474e-04
12: -1.692060e-03

13: -8.014308e-04
14: -1.583784e-04
15: -2.203579e-04
16: 0.000000e+00
17: -2.293608e-03
18: -2.803405e-03
19: -1.472013e-04
20: -1.100977e-03
21: -2.495873e-04
22: -1.342551e-04
23: -8.321869e-04

24: -5.278414e-03
25: -8.980506e-05
26: -1.920159e-03
27: -1.108567e-04
28: -2.252396e-04
29: -1.021911e-03

Confidence interval + SD for each state:

1: 0.0069881943
2: 0.0190581244
3: 0.0058045719
4: 0.0006734392
5: 0.0046034653
6: 0.0220335224
7: 0.0022710908
8: 0.0016530135
9: 0.0042557025
10: 0.5548816539
11: 0.0014973285
12: 0.0124531925
13: 0.0058983559
14: 0.0011656306
15: 0.0016217860
16: 0.0000000000
17: 0.0168804552
18: 0.0206324481
19: 0.0010833696
20: 0.0081029526
21: 0.0018369083
22: 0.0009880885
23: 0.0061247141
24: 0.0388479734
25: 0.0006609457
26: 0.0141319524
27: 0.0008158812

28: 0.0016577142
29: 0.0075210403

Overall Confidence interval – SD: -0.01556906

Overall Confidence interval + SD: 0.1145849

Literature value of this disease is the average lethality value = 0.01162041

Confidence interval does not include this value.

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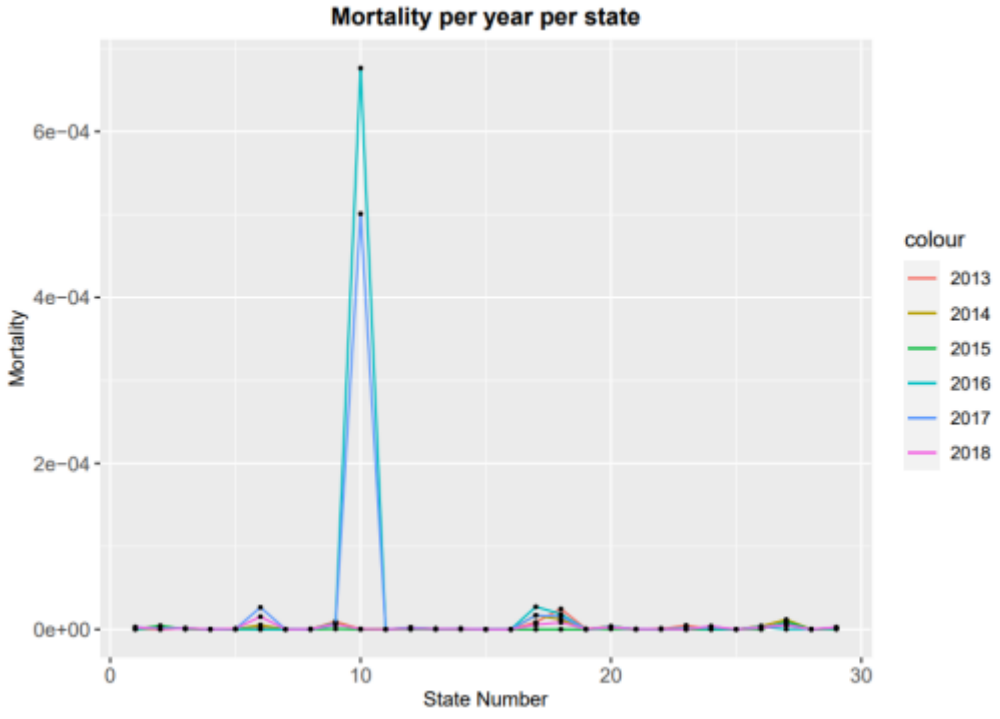
3. Mortality of each state per year:

State	Mortality 2013	Mortality 2014	Mortality 2015	Mortality 2016	Mortality 2017	Mortality 2018
1	1.336407e-06	3.365556e-07	0.000000e+00	2.730842e-07	2.710892e-06	2.710455e-06
2	2.916474e-06	0.000000e+00	4.413999e-06	1.477970e-06	7.423333e-07	0.000000e+00
3	6.610905e-07	1.373037e-06	9.280508e-08	1.441458e-06	1.216325e-06	1.296508e-06
4	1.910269e-08	5.714489e-08	9.497110e-09	7.576179e-08	3.777396e-08	8.475215e-08
5	1.549513e-07	2.312205e-07	3.833776e-08	6.102531e-07	4.553507e-07	7.928118e-07
6	2.015080e-06	5.319540e-06	0.000000e+00	0.000000e+00	2.646469e-05	1.534185e-05
7	3.250957e-08	3.222652e-08	0.000000e+00	3.167497e-08	3.140621e-08	1.557099e-08
8	7.639281e-08	3.760108e-07	0.000000e+00	1.823221e-07	3.592148e-08	3.893392e-07
9	9.479838e-06	7.559640e-06	5.665974e-07	7.315230e-06	5.449036e-06	6.244796e-06
10	2.385374e-07	7.940090e-08	0.000000e+00	6.764237e-04	5.008963e-04	4.737465e-07
11	5.985293e-08	8.920927e-08	5.909756e-08	2.936349e-08	8.754153e-08	5.799959e-08
12	2.331463e-06	1.239975e-06	0.000000e+00	2.134896e-06	1.711548e-06	8.512651e-07
13	4.683169e-07	4.631731e-07	0.000000e+00	7.931301e-07	2.522239e-07	5.546004e-07
14	4.414985e-07	6.200139e-07	3.902994e-08	9.624840e-07	6.203891e-07	4.997376e-07
15	8.666330e-09	5.988204e-08	0.000000e+00	3.335801e-08	8.235969e-09	9.761971e-08
16	0.000000e+00	0.000000e+00	0.000000e+00	0.000000e+00	0.000000e+00	0.000000e+00
17	8.537233e-06	1.684382e-05	0.000000e+00	2.717259e-05	1.683460e-05	5.649718e-06
18	2.468642e-05	1.190504e-05	0.000000e+00	1.837412e-05	1.564306e-05	8.294931e-06
19	4.744955e-07	0.000000e+00	0.000000e+00	0.000000e+00	0.000000e+00	4.115226e-07
20	3.569317e-06	3.296413e-06	5.159982e-07	3.294300e-06	2.653224e-06	2.503941e-06
21	1.767974e-07	7.005312e-08	3.469984e-08	3.781708e-07	3.065793e-07	2.362869e-07
22	3.695355e-07	1.052430e-06	0.000000e+00	4.515980e-07	3.108994e-07	5.208055e-07
23	4.802322e-06	0.000000e+00	0.000000e+00	1.548277e-06	0.000000e+00	0.000000e+00
24	8.386093e-08	8.421405e-08	0.000000e+00	1.981683e-07	3.255291e-06	3.826003e-06
25	0.000000e+00	0.000000e+00	0.000000e+00	1.893826e-07	0.000000e+00	0.000000e+00
26	4.010452e-06	3.710200e-06	0.000000e+00	3.125252e-06	2.582081e-06	1.792115e-06
27	0.000000e+00	9.499664e-09	2.335275e-08	3.123832e-07	0.000000e+00	0.000000e+00
28	5.913680e-06	1.179352e-05	9.199685e-06	1.876485e-07	6.312303e-06	5.051897e-06
29	1.965664e-06	1.176464e-06	8.592115e-08	1.688634e-06	1.776126e-06	2.698898e-06

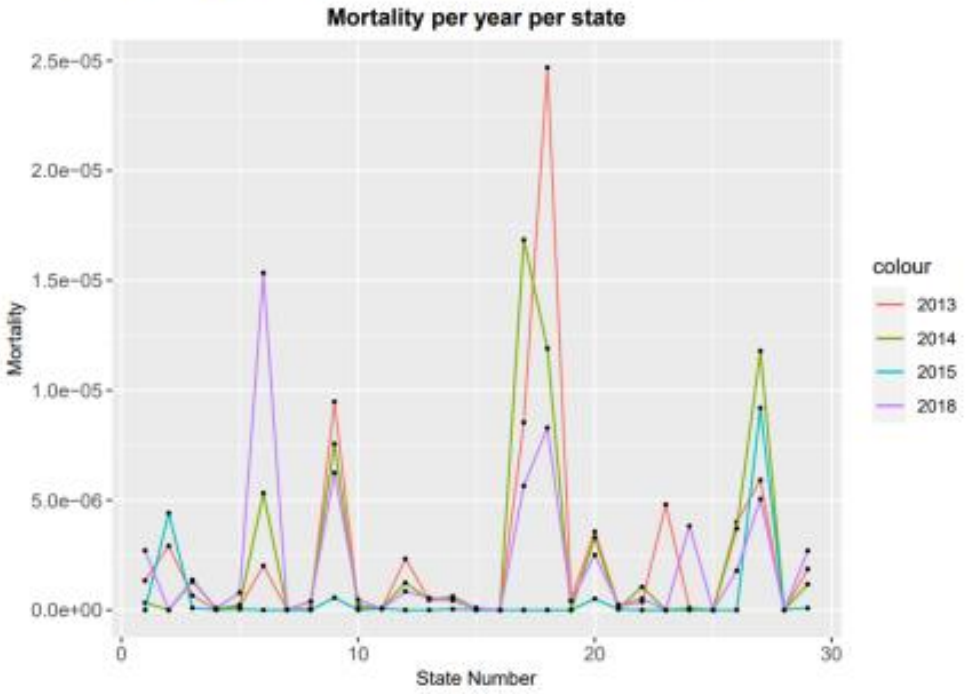
Graph of Mortality per year and state:



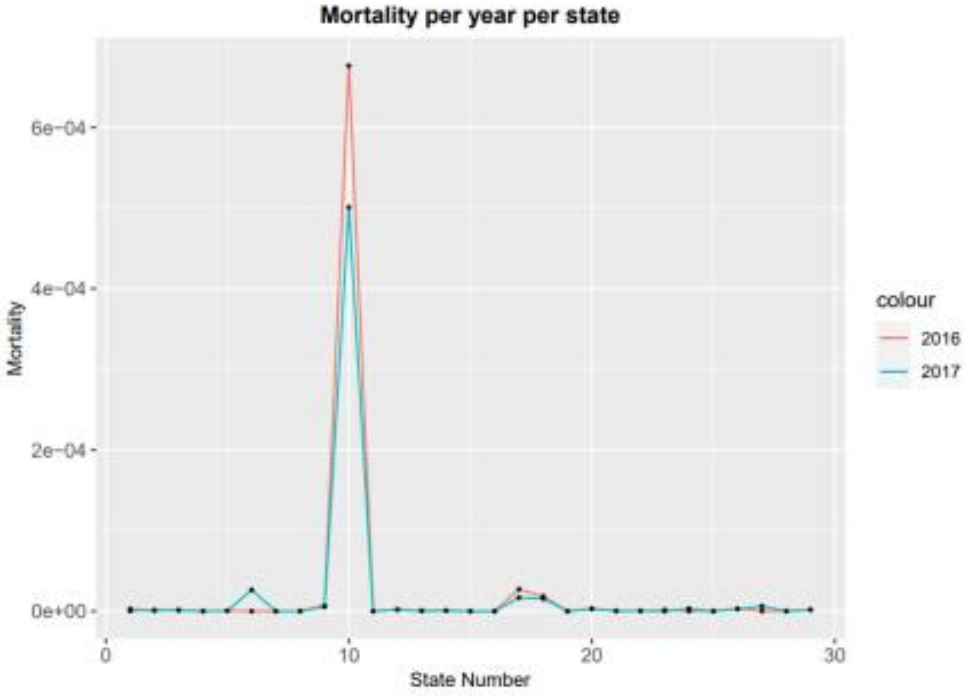
As the mortality in 2016 and 2017 was very high in comparison to other years, thus the plots of other years can't be seen clearly.

For better understanding, graphs of 2016 and 2017 have been plotted separately also.

(i) Graph of mortality per state in years 2013, 2014, 2015 and 2018:



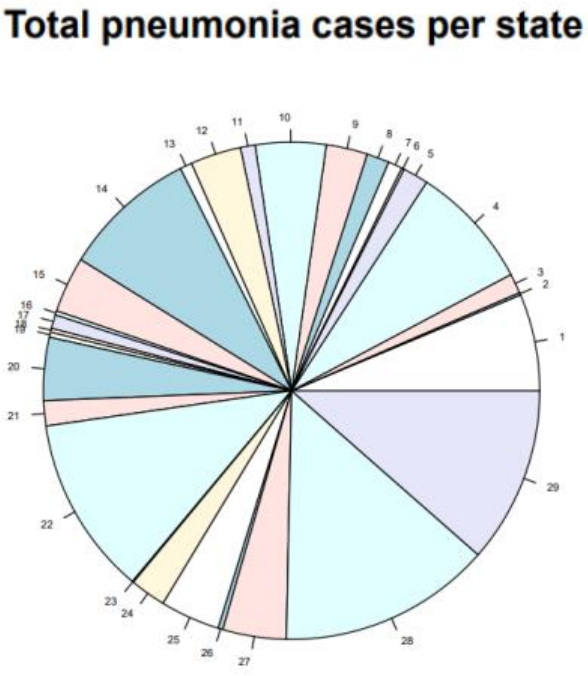
(ii) Graph of mortality per state in years 2016 and 2017:



4. Sum of cases over the years per state:

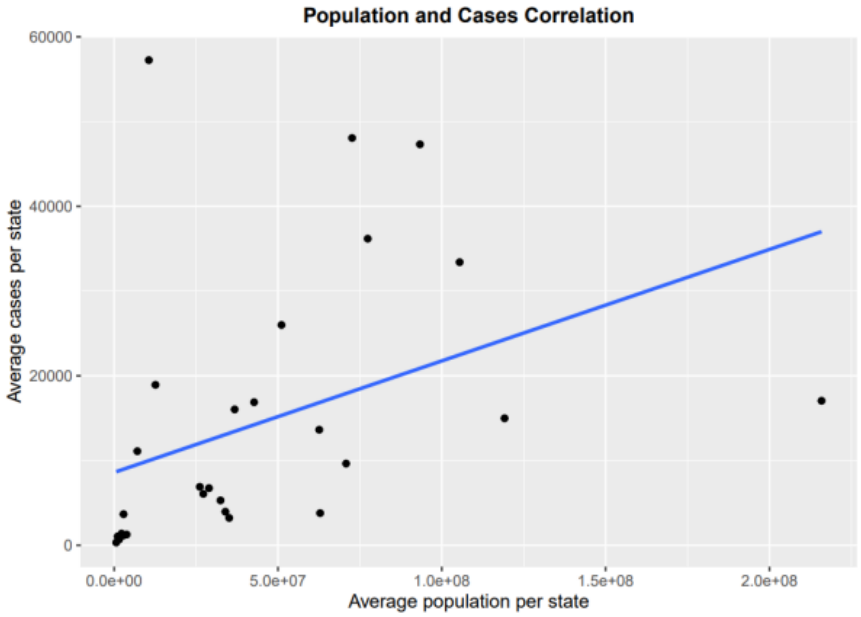
1: 155970
2: 4043
3: 31771
4: 200420
5: 41375
6: 4180
7: 22755
8: 36386
9: 66595
10: 113577
11: 23747
12: 81785
13: 19331
14: 217045
15: 89898
16: 6835
17: 22013
18: 6285
19: 8242
20: 101285
21: 40437
22: 288342
23: 1943
24: 57851
25: 96190
26: 7603
27: 102293
28: 343476
29: 283862

Pie chart with share of cases per state:



As the number of states is large (29), thus pie chart is not a very good representation of the data.

5.



From this graph, we can see that the population and number of cases in a state are positively correlated i.e., larger states have larger case numbers.

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6. Pearson correlation coefficient between mortality and population density:

Year 2013: - 0.3530725

Year 2014: - 0.3593936

Year 2015: - 0.1985770

Year 2016: - 0.1350782

Year 2017: - 0.1440551

Year 2018: - 0.3122924

This implies that mortality and population density have low negative correlation i.e., when population density increases, mortality decreases by only a small amount.

This is because mortality is inversely proportional to the population density.

$M = \frac{D}{N0}$; D: number of people died from a particular disease

N0: number of healthy people at beginning
