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COVID-19 AND THE WORLD- AN ECONOMIC ANALYSIS

Kanchan Datta

Associate Professor of Economics, University of North Bengal, E-mail: kanchan.datta@gmail.com

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INTRODUCTION

One event that shattered that rhythm of human civilization is the covid pandemic. Reported in December last by Chinese govt. which was first seen in Wuhan province of China and spreaded all most all nations of the world. It is assumed that free movement of labour, capital, and tourists are primary responsible reason for this spread. Moreover global warming, el-nino, melting of ice and resulting misbalance in the ecosystem may be another reason for the spread of this highly contagious virus. Now covid crises surpass the world war, great depression etc. in terms of income, employment, standard of living and apprehension among people all over the world. In spite of high level of literacy, sound health care infrastructure it stuck the developed nations heavily initially but now the developing world (like India , Brazil)are also not running neck to neck. This paper tries to enquire does there exist any mean difference of number of covid cases (infections), number of deaths, number of tests, number of recovery etc. among different continents? It is important to say few words about covid-19. The COVID-19 virus spreads primarily through droplets of saliva or discharge from the nose when an infected person coughs or sneezes, experience mild to moderate respiratory illness and it affects all people irrespective of income, color, and power. Older people and those with underlying some common medical problems (age related) are more likely to attack. At present (up to 12th June 2020) there have been 6,912,751 confirmed cases of COVID-19, including 400,469 deaths all over the world (WHO). The hypothesis of the study are as follows.

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HYPOTHESIS

1. There is no mean difference of the number of cases /million populations among different continents
2. There is no mean difference of the number of death cases /million populations among different continents
3. There is no mean difference of the number of tests /million populations among different continents
4. There is no mean difference of the % of recovery from Covid infections among different continents

DATA AND METHODOLOGY

Data are taken from Novel Corona virus (2019-nCoV) situation reports - World Health Organization (WHO). This study used the sample upto 13th June 2020. The variables are no of covid cases/one million population similarly no of deaths, no of tests, % of recovery etc. in all the cases except recovery the data are number per million population and for recovery it is the percentage of recovery out of total no of infected cases.one way ANOVA technique have been used in this study. One way ANOVA has the robustness properties such as it is robust to moderate violations of the normality assumption, it is also reasonably robust to moderate violations of the equal standard deviations assumption.

Generally, the normal probability plots are effective in detecting gross violations of the normality assumption. The equal standard deviations assumption is usually more difficult to check. As a rule of thumb, we consider that assumption satisfied if the ratio of the largest to the smallest sample standard deviation is less than 2.Additionally, we can assess the normality and equal standard deviations assumptions by performing a residual analysis. In ANOVA the residual of an observation is the difference between the observation and the mean of the sample containing it. If the normality and equal standard deviations assumptions are met, a normal probability plot of the residuals should be roughly linear. Moreover, a plot of the residuals against the sample means should fall roughly in a horizontal band centered and symmetric about the horizontal axis. To make the process precise, we need quantitative measures of variation among the sample means and the variation within the samples. We also need an objective method for deciding whether the variation among the sample means is large relative to the variation within the samples.

We first consider the measure of variation among the sample means. In one way ANOVA, we measure the variation among the sample means by a weighted average of their squared deviations about the mean, $\bar{x}$ of all the

sample data. That measure of variation is called the treatment mean square, TRMS and is defined as TRMS = TRSS/(k-1),

Where *k* is the number of populations being sampled and TRSS is the treatment sum of square

$$TRSS + n_1(\bar{x}_1 - \bar{x})^2 + n_2(\bar{x}_2 - \bar{x})^{-2} + \cdots.. + n_k(\bar{x}_k - \bar{x})^2$$

Now TRMS is similar to the sample variance of the sample means. Now we consider the measure of variation within the samples. This measure is the pooled estimate of the common population variance ,?2. it is called EMS that is Error Mean Square. And is defined by EMS= ESS /n-k, n= total number of observations and ESS = $(n_1-1)s_1^2 + (n_2-1)s_2^2 + \ldots. + (n_k-1)s_k^2$

Where ESS is called the Error Sum of Square. Finally, we consider how to compare the variation among the sample means, TRMS, to the variation within the samples, MSE. To do this we use F statistic. F statistic = TRMS/ EMS. Large values of F indicate that the variation among the sample means is large relative to the variation within the samples and hence the null hypothesis of equal population means should be rejected.

Moreover in this study Tukey Multiple comparison method is applied obtain confidence intervals for the differences between all possible pairs of population means. Two means are declared different if the confidence interval for their difference does not contain 0. If a confidence interval for the difference between two population means does not contain 0, we can reject the null hypothesis that the two means are equal.

EMPIRICAL FINDINGS

Table 1
One way Analysis of Variance

Variable	*Source*	*DF*	*Adj SS*	*Adj MS*	*F-Value*	*P-Value*	*Model Summary*			
							S	*R-sq*	*R-sq (adj)*	*R-sq (pred)*
No of cases/ million population versus location Method	Location	5	246819	49363881	5.61	0.000	2966.79	11.93%	9.80%	7.68%
	Error	207	182198	8801853						
	Total	212	206880							
No of Deaths/ million population versus location Method	Location	5	101343	202687	9.97	0.000	142.608	22.16%	19.94%	18.07%

contd. table 1

Variable	*Source*	*DF*	*Adj SS*	*Adj MS*	*F-Value*	*P-Value*	*Model Summary* *S*	*R-sq*	*R-sq (adj)*	*R-sq (pred)*
	Error	175	355900	20337						
	Total	180	457243							
No of total tests/million population versus Location Method	Location	5	1.20545 E+11	241090 69641	8.18	0.000	54277.3	18.11%	15.90%	13.48%
	Error	185	5.45014 E+11	294602 0754						
	Total	190	6.65559 E+11							
% of Recovery	Location	5	34129	6825.8	11.09	0.000	24.8049	21.05%	19.16%	16.97%
	Error	208	127979	615.3						
	Total	213	162108							

From the above findings it is clear that there exists mean difference for the no of covid cases per million populations, no of deaths, no of tests and finally no of recovery. Since the F statistic is significant for all the variables.

Basic statistics on number of covid cases among world

Location	*N*	*Mean*	*St Dev*	*95% CI*
Europe	48	3281	3775	(2437, 4125)
North America	39	915	1304	(-21, 1852)
Asia	49	1793	4348	(957, 2629)
South America	14	2319	2614	(756, 3883)
Africa	57	482	1276	(-293, 1257)
Oceania	6	149.3	134.4	(-2238.5, 2537.2)

Pooled StDev = 2966.79

Tukey Pairwise Comparisons Grouping Information Using the Tukey Method and 95% Confidence

Location	*N*	*Mean*	*Grouping*	
Europe	48	3281	A	
North America	14	2319	A	B
Asia	49	1793	A	B
South America	39	915		B
Africa	57	482		B
Oceania	6	149.3	A	B

Means that do not share a letter are significantly different.

Tukey Simultaneous Tests for Differences of Means (no of cases)

Difference of Levels	*Difference of Means*	*SE of Difference*	*95% CI*	*T-Value*	*Adjusted P-Value*
2 - 1	-2365	640	(-4206, -525)	-3.70	0.004
3 - 1	-1488	602	(-3222, 246)	-2.47	0.138
4 - 1	-961	901	(-3555, 1632)	-1.07	0.894
5 - 1	-2799	581	(-4471, -1126)	-4.82	0.000
6 - 1	-3131	1285	(-6829, 566)	-2.44	0.148
3 - 2	878	637	(-955, 2710)	1.38	0.740
4 - 2	1404	924	(-1256, 4064)	1.52	0.653
5 - 2	-433	617	(-2208, 1341)	-0.70	0.981
6 - 2	-766	1301	(-4510, 2978)	-0.59	0.992
4 - 3	526	899	(-2061, 3114)	0.59	0.992
5 - 3	-1311	578	(-2974, 352)	-2.27	0.212
6 - 3	-1644	1283	(-5337, 2049)	-1.28	0.795
5 - 4	-1837	885	(-4384, 709)	-2.08	0.304
6 - 4	-2170	1448	(-6336, 1996)	-1.50	0.665
6 - 5	-333	1273	(-3997, 3332)	-0.26	1.000

Individual confidence level = 99.56%

From the above results it is clear that pairs 2-1 and 5-1 are significant. This means 1 that is Europe is different with respect to no of covid cases among other continents.

Basic Statistics on the no of deaths per million populations

location	*N*	*Mean*	*StDev*	*95% CI*
Europe	44	194.6	266.2	(152.1, 237.0)
North America	30	80.0	115.8	(28.6, 131.4)
Asia	42	15.03	23.12	(-28.40, 58.46)
South America	13	67.1	84.9	(-10.9, 145.2)
Africa	50	8.00	16.84	(-31.80, 47.81)
Oceania	2	4.000	0.000	(-195.018, 203.018)

Tukey Simultaneous Tests for Differences of Means related to No of deaths per million Populations

Difference of Levels	*Difference of Means*	*SE of Difference*	*95% CI*	*T-Value*	*Adjusted P-Value*
2 - 1	-114.6	33.8	(-212.0, -17.2)	-3.39	0.011
3 - 1	-179.5	30.8	(-268.3, -90.8)	-5.84	0.000
4 - 1	-127.4	45.0	(-257.3, 2.4)	-2.83	0.057
5 - 1	-186.6	29.5	(-271.6, -101.5)	-6.33	0.000
6 - 1	-191	103	(-488, 107)	-1.85	0.438

contd. table

Difference of Levels	*Difference of Means*	*SE of Difference*	*95% CI*	*T-Value*	*Adjusted P-Value*
3 - 2	-64.9	34.1	(-163.3, 33.4)	-1.91	0.402
4 - 2	-12.8	47.4	(-149.5, 123.8)	-0.27	1.000
5 - 2	-72.0	32.9	(-167.0, 23.0)	-2.19	0.250
6 - 2	-76	104	(-376, 224)	-0.73	0.978
4 - 3	52.1	45.3	(-78.5, 182.7)	1.15	0.859
5 - 3	-7.0	29.8	(-93.1, 79.1)	-0.24	1.000
6 - 3	-11	103	(-309, 287)	-0.11	1.000
5 - 4	-59.1	44.4	(-187.2, 69.0)	-1.33	0.767
6 - 4	-63	108	(-376, 249)	-0.58	0.992
6 - 5	-4	103	(-301, 293)	-0.04	1.000

Individual confidence level = 99.56%

Again from the above table it is clear that with respect to number of covid deaths per million populations Europe is different from the rest of the world.

Basic statistics regarding the number of tests per million populations

Location	*N*	*Mean*	*StDev*	*95% CI*
Europe	47	77005	78680	(61385, 92624)
North America	36	23978	46714	(6131, 41825)
Asia	45	34630	55099	(18667, 50593)
South America	14	26340	50181	(-2279, 54959)
Africa	43	7616	17780	(-8713, 23946)
Oceania	6	29028	29260	(-14689, 72744)

Pooled StDev = 54277.3

Tukey Pairwise Comparisons
Tukey Simultaneous Tests for Differences of Means(number of of tests)

Difference of Levels	*Difference of Means*	*SE of Difference*	*95% CI*	*T-Value*	*Adjusted P-Value*
2 - 1	-53026	12021	(-87623, -18430)	-4.41	0.000
3 - 1	-42374	11320	(-74953, -9796)	-3.74	0.003
4 - 1	-50664	16526	(-98225, -3104)	-3.07	0.030
5 - 1	-69388	11454	(-102352, -36424)	-6.06	0.000
6 - 1	-47977	23531	(-115696, 19742)	-2.04	0.325
3 - 2	10652	12137	(-24277, 45581)	0.88	0.951
4 - 2	2362	17096	(-46838, 51562)	0.14	1.000
5 - 2	-16362	12262	(-51650, 18926)	-1.33	0.766
6 - 2	5049	23934	(-63831, 73930)	0.21	1.000
4 - 3	-8290	16610	(-56093, 39513)	-0.50	0.996
5 - 3	-27014	11575	(-60325, 6298)	-2.33	0.186
6 - 3	-5603	23590	(-73492, 62287)	-0.24	1.000
5 - 4	-18724	16702	(-66789, 29342)	-1.12	0.872
6 - 4	2687	26485	(-73533, 78908)	0.10	1.000
6 - 5	21411	23654	(-46664, 89486)	0.91	0.945

Individual confidence level = 99.55%

From the above results it is clear that with respect to number of tests per million population Europe is different from the rest of the world.

Basic Statistical information with respect to number of recovery

Location	*N*	*Mean*	*StDev*	*95% CI*
Europe	48	77.05	20.10	(70.00, 84.11)
North America	40	73.15	25.83	(65.42, 80.89)
Asia	49	65.94	26.37	(58.96, 72.93)
South America	14	48.80	27.75	(35.73, 61.87)
Africa	57	49.15	26.57	(42.67, 55.62)
Oceania	6	97.80	2.98	(77.84, 117.76)

Pooled StDev = 24.8049

Tukey Simultaneous Tests for Differences of Means (with respect to % of recovery)

Difference of Levels	*Difference of Means*	*SE of Difference*	*95% CI*	*T-Value*	*Adjusted P-Value*
2 - 1	-3.90	5.31	(-19.18, 11.38)	-0.73	0.977
3 - 1	-11.11	5.04	(-25.61, 3.39)	-2.21	0.240
4 - 1	-28.25	7.53	(-49.93, -6.57)	-3.75	0.003
5 - 1	-27.91	4.86	(-41.89, -13.92)	-5.74	0.000
6 - 1	20.7	10.7	(-10.2, 51.7)	1.93	0.386
3 - 2	-7.21	5.29	(-22.42, 8.00)	-1.36	0.748
4 - 2	-24.35	7.70	(-46.52, -2.18)	-3.16	0.022
5 - 2	-24.01	5.12	(-38.73, -9.28)	-4.69	0.000
6 - 2	24.6	10.9	(-6.6, 55.9)	2.27	0.211
4 - 3	-17.14	7.52	(-38.77, 4.49)	-2.28	0.207
5 - 3	-16.80	4.83	(-30.70, -2.89)	-3.48	0.008
6 - 3	31.9	10.7	(1.0, 62.7)	2.97	0.039
5 - 4	0.34	7.40	(-20.95, 21.64)	0.05	1.000
6 - 4	49.0	12.1	(14.2, 83.8)	4.05	0.001
6 - 5	48.7	10.6	(18.0, 79.3)	4.57	0.000

Individual confidence level = 99.56%

From the above table it is clear that,3, 4 and 5 that is Asia, South America and Africa is different from the rests of the continents with respect to recovery as percentage of total infection.

SUMMARY

This study shows that there exists mean difference for the no of covid cases per million populations, no of deaths, no of tests and finally no of recovery. Since the F statistic is significant for all the variables. Moreover Tukey's multiple comparison results shows Europe is different with respect to

number of covid cases, number of deaths and tests per million populations among other continents. Asia, South America and Africa is different from the rests of the continents with respect to recovery as percentage of total infection. Though these results are relative since these results are based on the data up to 12th June 2020. That means these results may change since the variables are changing very rapidly day by day. So it is very difficult to generalize these results until the coid19 vaccine or medicines are developed and applied all over the world.

This paper also shows how we can apply ANOVA techniques and Tukey Multiple comparison to analysis some important variables related to Covid 19 among different destination. This is one factor ANOVA analysis. It can be extended to factorial, ANOVA, Multivariate Analysis of Variance by incorporation more dependent and independent factors. The other potential objective is to highlight if we divide the whole world into continents then we can be able to extract that it is not the level of development, but some other factors are playing role behind the mean difference of the variables that is no of new cases, no of recovery no of active cases, no of deaths etc. Future researchers can think on these factors.

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