ASSIGNMENT 2
TG-2307

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Question

We have simple random sample Sample1: $X_1,\ldots,X_n$ of number of active cases of COVID-19 infections, and random sample $Y_1,\ldots,Y_n$ of vaccinations completed on the same day during the October 2021 and Sample2: $X_1,\ldots,X_n$ of number of active cases of COVID-19 infections, and random sample $Y_1,\ldots,Y_n$ of vaccinations completed on the same day during the November 2021. Denote the population mean of active cases in one sample by μ_X, and the population mean of active cases in 2nd sample by μ_Y. Denote the corresponding standard deviations by σ_X and σ_Y. These population means and standard deviations are unknown. The sample sizes are n.

STEP 1:DENOTING THE MEANS AND STANDARD DEVIATIONS OF THE TWO SAMPLES

Find mean using formula:

$$\bar{X} = \frac{1}{n}\sum_{i=1}^{n} X_i$$

Find standard deviation using formula:

$$s = \sqrt{\frac{1}{n-1}\sum_{i=1}^{n}(X_i - \hat{X})^2}$$

$\mu_X = 745.714$ $\sigma_X = 284.005$ $n_X = 14$

$\mu_Y = 2280.071$ $\sigma_Y = 84.253$ $n_Y = 14$

$H_0 : \mu_X - \mu_Y \geq 0$ $H_1 : \mu_X - \mu_Y \leq 0$

November 2021		October 2021	
Sample 1		Sample 2	
Active Cases	Vaccinations	Active Cases	Vaccination
1303	632,896	2185	482,863
1203	633,464	2192	492,817
1085	640,721	2233	501,834
870	643,231	2321	504,342
803	649,166	2335	512,357
753	654,487	2342	519,567
729	661,216	2192	492,817
702	668,251	2225	539,811
627	673,578	2226	547,214
526	684,698	2311	552,265
480	692,315	2284	563,695
494	699,622	2263	564,543
444	707,278	2501	572,565
421	715,979	2311	552,265

STEP 2:DETERMINE THE DEGREE OF FREEDOM

Assume both samples follow the normal distribution. Has an approximate Student's *t* distribution with *v* degree of freedom,

$$v = \frac{\left[\frac{s_x^2}{n_x} + \frac{s_y^2}{n_y}\right]^2}{\frac{\left(\frac{s_x^2}{n_x}\right)^2}{n_x - 1} + \frac{\left(\frac{s_y^2}{n_y}\right)^2}{n_y - 1}}$$

Using the means and standard deviations obtained in the previous step,

$$v = \frac{\left[\frac{284.005^2}{14} + \frac{84.253^2}{14}\right]^2}{\frac{\left(\frac{284.005^2}{14}\right)^2}{13} + \frac{\left(\frac{84.253^2}{14}\right)^2}{13}}$$

$v = 15.27$

$v \approx 15$

STEP 3:CALCULATE THE T-TEST STATISTICS

The H_0 was taken as μ_X - μ_Y = 0. The t-test statistics is then calculated,

$$t = \frac{(\bar{X} - \bar{Y}) - 0}{\sqrt{\frac{s_x^2}{n_x} + \frac{s_y^2}{n_y}}}$$

$$= \frac{(745.714 - 2280.071) - 0}{\sqrt{\frac{284.005^2}{14} + \frac{84.253^2}{n_y}}}$$

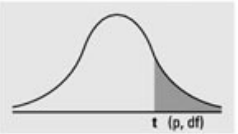
= -19.38

STEP 4: DETERMINE ITS P VALUE

With 15 degree of freedom and t-value of -19.38, from the t table on the figure, P value is not able to be identified.

From the highlighted area, t-value of -19.38 is too large and not determined on the table.

Numbers in each row of the table are values on a *t*-distribution with (*df*) degrees of freedom for selected right-tail (greater-than) probabilities (*p*).



df/p	0.40	0.25	0.10	0.05	0.025	0.01	0.005	0.0005
1	0.324920	1.000000	3.077684	6.313752	12.70620	31.82052	63.65674	636.6192
2	0.288675	0.816497	1.885618	2.919986	4.30265	6.96456	9.92484	31.5991
3	0.276671	0.764892	1.637744	2.353363	3.18245	4.54070	5.84091	12.9240
4	0.270722	0.740697	1.533206	2.131847	2.77645	3.74695	4.60409	8.6103
5	0.267181	0.726687	1.475884	2.015048	2.57058	3.36493	4.03214	6.8688
6	0.264835	0.717558	1.439756	1.943180	2.44691	3.14267	3.70743	5.9588
7	0.263167	0.711142	1.414924	1.894579	2.36462	2.99795	3.49948	5.4079
8	0.261921	0.706387	1.396815	1.859548	2.30600	2.89646	3.35539	5.0413
9	0.260955	0.702722	1.383029	1.833113	2.26216	2.82144	3.24984	4.7809
10	0.260185	0.699812	1.372184	1.812461	2.22814	2.76377	3.16927	4.5869
11	0.259556	0.697445	1.363430	1.795885	2.20099	2.71808	3.10581	4.4370
12	0.259033	0.695483	1.356217	1.782288	2.17881	2.68100	3.05454	43178
13	0.258591	0.693829	1.350171	1.770933	2.16037	2.65031	3.01228	4.2208
14	0.258213	0.692417	1.345030	1.761310	2.14479	2.62449	2.97684	4.1405
15	0.257885	0.691197	1.340606	1.753050	2.13145	2.60248	2.94671	4.0728
16	0.257599	0.690132	1.336757	1.745884	2.11991	2.58349	2.92078	4.0150
17	0.257347	0.689195	1.333379	1.739607	2.10982	2.56693	2.89823	3.9651
18	0.257123	0.688364	1.330391	1.734064	2.10092	2.55238	2.87844	3.9216
19	0.256923	0.687621	1.327728	1.729133	2.09302	2.53948	2.86093	3.8834
20	0.256743	0.686954	1.325341	1.724718	2.08596	2.52798	2.84534	3.8495
21	0.256580	0.686352	1.323188	1.720743	2.07961	2.51765	2.83136	3.8193
22	0.256432	0.685805	1.321237	1.717144	2.07387	2.50832	2.81876	3.7921
23	0.256297	0.685306	1.319460	1.713872	2.06866	2.49987	2.80734	3.7676
24	0.256173	0.684850	1.317836	1.710882	2.06390	2.49216	2.79694	3.7454
25	0.256060	0.684430	1.316345	1.708141	2.05954	2.48511	2.78744	3.7251
26	0.255955	0.684043	1.314972	1.705618	2.05553	2.47863	2.77871	3.7066
27	0.255858	0.683685	1.313703	1.703288	2.05183	2.47266	2.77068	3.6896
28	0.255768	0.683353	1.312527	1.701131	2.04841	2.46714	2.76326	3.6739
29	0.255684	0.683044	1.311434	1.699127	2.04523	2.46202	2.75639	3.6594
30	0.255605	0.682756	1.310415	1.697261	2.04227	2.45726	2.75000	3.6460
z	0.253347	0.674490	1.281552	1.644854	1.95996	2.32635	2.57583	3.2905
CI	———	———	80%	90%	95%	98%	99%	99.9%

CONCLUSION

The null hypotheses can neither be rejected or accepted due to the high value of t-test statistic

The is possibly due the large difference between the two samples.

Hence, it cannot be concluded whether that vaccination rate improved the COVID-10 infection in the country or not.