Mann – Whitney U test as applied to the change in the mathematics exam method in Sudan" Case study of south Darfur state"

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Abstract

In 2005 Sudan ministry of education changed the system of mathematics examination for secondary certificate from two exam papers "two sessions" to one exam paper "one session". This change may affect student's academic attainment positively or negatively. Therefore, it is very important to test this effect, which is the main objective of this paper. The study covers south Darfur state in Sudan, as one of states far from the capital Khartoum. Data source is ministry of education in south Darfur state "Neyala office" for three years preceding new system and three years with new system. The statistical test will be use is Mann-Whitney U test. The most result obtained from the study is that there is no significant difference between attainment after and before applying the new system.

Key words:

Mann-Whitney; attainment

commonly usedfor comparisonbetweentwo independent samplesto determineif the samplesbelongto onepopulationsornot.Itis the firsttestto deal withcases ofunequalsamples.

Introduction:

In 2005 Sudan ministry of education changed the system of mathematics examination for secondary certificate from two exam papers "two sessions" to one exam paper "one session". This change may affect student's academic attainment positively or negatively. Therefore, it is very important to test this effect, which is the main objective of this paper.

The study covers south Darfur state in Sudan, as one of states far from the capital Khartoum. Data source is ministry of education in south Darfur state "Neyala office" for three years preceding new system and three years with new system. The statistical test will be use is Mann-Whitney U test.

Mann-WhitneyTest isone of the mostnonparametric tests used,

samplesandarrange them in ascending or descending orderandthe value ofUaccountequal to the sumof values of larger sample -ifsamples havedifferentsizes- which aresmaller thanall values ofthe smallersample. If thesample dataXissmallerandY is larger, then

Means values of Y less than all values of X, and

$$\sum_{\forall y} n(X < y)$$

Means values of X less than all values of Y.

And U takes the form:

$$U = \min \left[\sum_{\forall x} n(Y < x), \sum_{\forall y} n(X < y) \right]$$

Then use n1 and n2 and U to find critical value for given significant value α from Mann- Whitney table for small samples, this value associate with one side test, in case of two side test this value is multiplied.

Another way is to find out lower critical value (U-) from Mann-Whitney table for small samples using n2, n2 andsignificant value α and

$$\sum_{\forall x} n(Y < x)$$

Assumption to use Mann-Whitney U Test:

1. Samples should be independent and taken randomly and variable under study is continuous and ordinal.
2. should have independence of observations
3. Mann-Whitney U test can be used when two variables are not normally distributed

Test hypotheses:

Null hypotheses H0: both samples comes from same population

Alternative hypotheses HA: both samples comes from different population, also it can be one side test to the right or to the left indicating that one is better or worse than the other.

Test procedure:

There are three directionsdepending onthe size ofthe testsamples. If thesize ofthe firstsample datan1and the size ofthe secondsample datan2 (so that their sumis equal ton), the three directionsof the testare: Fist, Incase ofverysmallsamples(n1, n2 <8)thatanytwo samplesn1, n2is

Less than or equal to 8 , Thenmergethe two

In this case, U normally distributed with:

$$E(U) = \frac{n_1 n_2}{2} \text{ And}$$

$$Van(U) = \frac{(n_1 n_2)(n_1 + n_2 + 1)}{12}$$

And hence,

$$Z = \frac{U - E(U)}{\sqrt{Van(U)}} = \frac{U - \frac{(n_1 n_2)}{2}}{\sqrt{\frac{(n_1 n_2)(n_1 + n_2 + 1)}{12}}} ..$$

Then, compare Z to tabulated Z at a given α

However, in case that there are some values or ranks found in the tow samples, this will effect on the test, so that correction factor "CF" used where:

$$CF = \frac{n_1 n_2 (\sum(\tau^3 - \tau)}{12(n_1 + n_2)(n_1 + n_2 - 1)}$$

Where,τ the number of equal cases for each rank.

And modified Z is:

$$Z = \frac{U - \frac{(n_1 n_2)}{2}}{\sqrt{\frac{[n_1 n_2 (n_1 n_2 + 1)}{12} - CF}}$$

hence the upper value (U+) can obtained as U+= n1 n2 – U-.

Second in case 9≤ n ≤ 20:

In this case, Mann- Whitney test calculated as follows:

1. Merge both samples and find ranks for all values by giving each value its rank in the merged group and the average of ranks to those which are equal, then find sum of ranks for the first sample R1 and fro the second sample R2.
2. $R_1 + R_2 = \frac{(n1+n2)(n1+n2+1)}{2}$
3. The statistic U is:

$$U_1 = (n1\ n_2) + \frac{n1(n1+1)}{2} - R_1$$

$$U_2 = (n1 n_2) + \frac{n2(n2+1)}{2} - R_2$$

4. Find the critical value U from Mann- Whitney table associated with n1 and n2 and compare it to the smaller U1 and U2, if the smaller U is less than tabulated U then reject H0 and if its greater then, reject HA

Third, In case of n > 20:

Data description:

Table 1: data description

		year					
Boys school	school	2002	203	2004	2005	2006	2007
	Karari (boys)	55.52	57.54	63.10	60.36	63.53	65.30
	Technical school (boys)	57.38	61.8	63.62	60.64	61.42	66.04
	Neyala (boys)	65.74	65.86	68.16	65.46	66.02	66.00
	Almustafa (boys)	68.78	66.98	72.36	66.90	67.80	69.88
	Alkhair (boys)	64.36	65.54	64.12	60.36	62.44	63.34
	Maximum	68.78	66.98	72.36	66.90	67.80	69.88
	Minimum	55.52	57.54	63.10	60.36	61.42	63.34
	Mean	62.356	63.544	66.272	62.744	64.242	66.112
	Standard deviation	5.66	3.88	3.95	3.18	2.62	2.37
Girls school	Alwehda (girls)	57.64	54.20	56.44	62.98	62.28	62.70
	Alengaz (girls)	62.06	64.28	65.36	62.88	64.22	67.26
	Neyala (girls)	62.16	61.04	68.08	66.00	67.92	72.64
	Umelmominin (girls)	71.00	70.88	77.40	70.60	72.36	77.46
	Albirraghib(girls)	62.54	63.90	65.44	62.64	65.32	68.34
	Maximum	71.00	70.88	77.40	70.60	72.36	77.46
	Minimum	57.64	54.20	56.44	62.64	62.28	62.70
	Mean	63.08	62.86	66.544	65.02	66.42	69.68
	Standard deviation	4.86	6.04	7.50	3.41	3.90	5.60

It can observed from table 1 that the attainment of girls is higher than boys, the dispersion of data before the new system is higher than after applying the system indicating that there wasmore homogeneity in the attainment after applying new system .

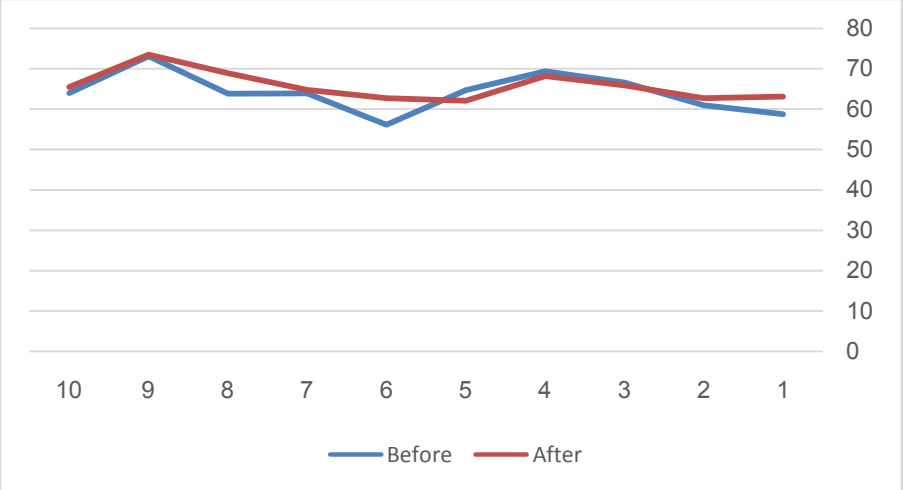
Modifying data:

Averages found for the years before new system and for the years after, to compare between them, the data take the following shape;

Table 2: Data before and after the new system

averages of attainment for the years Before new system	averages of attainment for the years after new system
58.72	63.06
60.93	62.70
66.58	65.82
69.37	68.193
64.67	62.046
56.09	62.65
63.90	64.78
63.76	68.85
73.09	73.47
63.96	65.43

Figure 1: comparison between attainment before and after the new system



Hypothesis:

H0: No significant difference between attainment after and before applying the new system.

HA: Attainment after applying new system is better than before

Model application:

Data fulfilled the requirements of Mann – Whitney test since its continuous and samples are independent and all variables in each sample are also independent.

Figure 1 shows that the two samples are not identical, so comparison between means is better than between medians.

SPSS output of Mann-Whitney U test:

Table 3: Ranks

	VAR00001	N	Mean Rank	Sum of Ranks
VAR00002	before	10	9.60	96.00
	after	10	11.40	114.00
	Total	20		

Table 4: Test Statistics[b]

	VAR00002
Mann-Whitney U	41.000
Wilcoxon W	96.000
Z	-.680-
Asymp. Sig. (2-tailed)	.496
Exact Sig. [2*(1-tailed Sig.)]	.529[a]

a. Not corrected for ties.

b. Grouping Variable: VAR00001

1. The attainment of girls is higher than boys in south Darfur state.
2. The attainment after applying the new system has less dispersion than before applying the new system.
3. There is no significant difference between attainment after and before applying the new system, then the only

Although, table 3 shows higher mean rank for "after", Mann-Whitney U test

As P>0.05, conclude that the data does not provide statistically significant

Evidence of a difference between after and before applying the new system.

Results:

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benefit gained from applying the new system is the reduction from two sessions to one session for the mathematics examination and hence reduction in time of correcting answer books.

Recommendation:

According to the above results , the study recommended that it's better to continue in applying the new system.

References:

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