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A Case for Using Excel in Scoring Multiple Choice Test Items and Conducting Item and Test Analysis

Abstract

Scoring of multiple choice objective test items and conducting item analysis has been a problem for teachers at all levels of Nigerian educational system. In view of the longer procedural steps it will take for item and test analysis coupled with complex mathematical / statistical computations involved, teachers nowadays jump the protocol of the normal procedure to be followed in constructing items for a credible, reliable and valid tests. The effect of this is that teacher-made tests are no longer yielding the true performance of examinees' ability. This problem persists because of the inability of making teachers to fully integrate ICT into the school assessment practices. This paper makes a case for the use of spreadsheet package (Microsoft Excel) in scoring multiple choice objective test items and conducting item / test analysis. Excel was used in this article to score hypothetical 15 students' responses to 20 items multiple choice questions. This same excel was later used to compute the difficulty index, discrimination index of the items and also validity and reliability of the test. The scoring and the analysis of both test and item statistics were performed at faster rate and with utmost great accuracy. It is hereby recommended that:

- 1. Government, University Management and Teaching Service Commission (TESCOM) should as a matter of urgency organize seminars and workshops for lecturers / teachers periodically so as to update their knowledge in ways of using spreadsheet package (Microsoft Excel) to score multiple choice objective test items and conducting item / test analysis.*
- 2. Curriculum of Teachers Training programme needed to be re-designed to enable prospective teachers have firsthand experience during their training programme on how to use computers to score their students' tests, analyze the psychometric properties of such tests and even familiar with the ways of using statistical packages like Excel, Lotus 1-2-2, SPSS and E-views in analyzing data emanated from their research project.*

Keywords: *Excel; Scoring; Multiple Choice Objective Test Items; Item and Test Analysis*

1-Introduction

Education in Nigeria has been adopted as an instrument for national development. It is an indicator for a community social well-being, standard of living and social justice. In the opinion of Akindutire (2010), education is regarded by many as the key that unlocks the development of personal and national potentials of individuals including their rights and powers. In view of the realization of these laudable goals of education to national development, educational institutions were established for the training of the individuals. Since the value and functionality of any educational system lies in its ability to actualize the goals of education, the machinery through which the extent of knowledge and skills acquisition is determined at each stage of education has been set up. This is in form of assessment.

Assessment is an important aspect of teaching and learning. Assessment provides information for decision-making about the students, schools, programmes and policies with which the sole purpose of ensuring that good results are obtained (Afemikhe, 2005). Assessment should be the true reflection of the knowledge gained in any educational institution (Atabong, Okpala, Abondem and Essombe, 2010); hence, any action that undermines assessment poses a great threat to the validity and reliability of assessment results and certification (Hassan and Ogunmakin, 2010). This assertion was earlier noticed by Charles Spearman in 1904 when he propounded Classical Test Theory (CTT). To Spearman, the observed score (X) of any student in any test is a composite function of his true score (T) and error score (E); expressed symbolically as $X = T \pm E$. The more the error score tends towards zero, the more the true score becomes the observed score.

Poor assessment culminating from faulty items of a test remains one of the most serious threats to the validity and reliability of teacher-made tests in Nigeria. Teachers' made tests have come under strong criticisms in recent time in Nigeria (Adeyemo, 2003; Osakuade, 2006). The basis for the criticisms was borne out of the fact that teachers' made tests lack sound psychometric properties.

There are five major basic procedures to follow while constructing good test items (Okpala, Onocha and Oyedeji, 1993). The steps are:

- identification of the purpose of the test;
- stating the general objectives;
- writing the table of specifications (test blue print);
- construction of the items; and
- item analysis.

Out of these five major steps, item analysis was the major problem teachers are facing because of complex mathematical steps involved. As a result of this, teachers end up selecting items from textbooks and past question papers to form their tests without mindful of the psychometric properties of such items. According to Kolawole (2006), item analysis attempts to find out the following about test items:

- discriminating power – its ability to discriminate between the brilliant students and poor students.
- Its difficulty level, that is, the proportion of the testees who answer an item correctly.

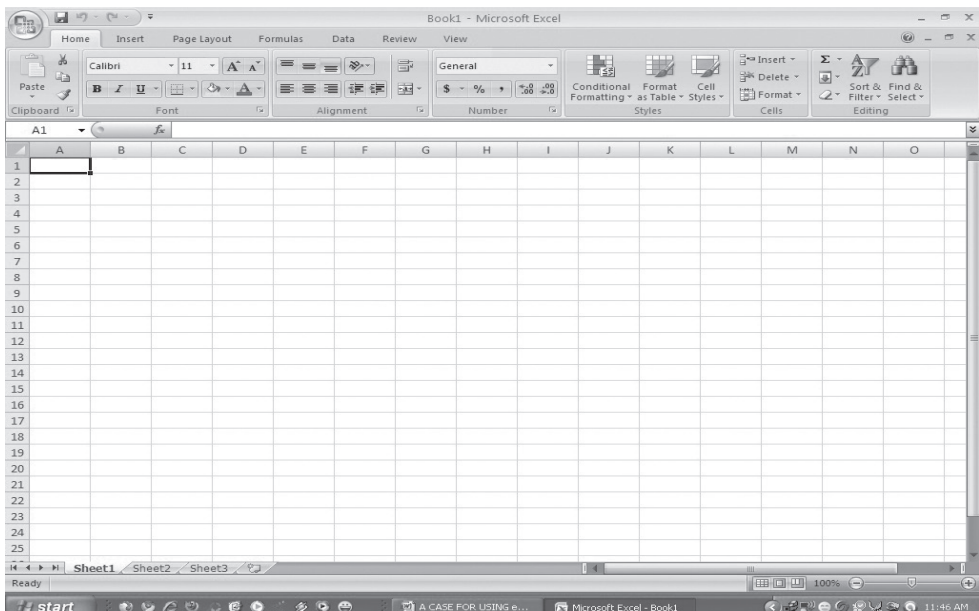
- number of testees who answer the item correctly
- number of the testees who choose the distractors, that is, distractors analysis.
- number of the testees who do not attempt an item.

The place of computer in item analysis cannot be over-emphasized. The spreading applications of sophisticated mathematical / statistical procedures in item analysis is an aspect of the computer revolution. Teachers in Nigeria today have not been able to realize that item analysis can be done with computer using a spreadsheet package (Microsoft Excel). This research paper is put in place to sensitize teachers on how to use Ms-Excel to score multiple choice objective test items and finding the psychometric properties of such items (i.e. difficulty index, discrimination index, validity index and reliability index).

2-Spreadsheet Structure

Ms-Excel like other spreadsheet packages is organized in a tabular structure with rows and columns. The intersection of a particular row and column designates a cell. The rows are usually numbered while the columns are lettered. Single letter identify the first 26 columns, double letters are used thereafter (A, B, C, ..., Z, AB, ...AZ, B, BA, ..., BZ, ..). Most spreadsheets permit up to 256 columns and over 8,000 rows. Three things can be entered into each cell. These are texts, numbers and formulars. Texts are usually in the form of labels used to identify rows and columns from each other. Numbers form the basis of calculations, unless otherwise specified, numeric entries are right justified on the right edge of each column, and text entries are left justified. However, one can specify what entries to be left- or right- justified or centered in the column. Formulars are used for calculations. A formular is always preceded by a plus (+) or equal to (=) sign.

Figure 1: MS-Excel Worksheet Structure



3-Materials and Methodology

The study made use of responses of 20 students to a 15-question multiple choice objective test items fed into Ms-Excel worksheet. This section of the paper is divided into three parts. The first part deals with the scoring of the responses using Excel, the second part deals with the preliminary item statistics using Point-Biserial Correlation (item discrimination) and P-Values (item difficulty), the third part deals with test statistics (validity and reliability power). Details of the analysis are shown forthwith.

4-Experimentation and Procedure

4.1-Part A: (Using Excel To Score Multiple Choice Objective Test Items)

To score the responses of 20 hypothetical students in a 15 question multiple choice objective test items using excel, the first thing is to open blank Excel worksheet in which we will designate the rows for individual students. In row 1 starting with cell A1, we type in the following labels for columns: "item", "key", "S1", "S2", ... "S15". For column A starting with cell A2, we type in the following labels for rows: "Q#1", "Q#2", ... "Q#20". The data table is now set and ready for entering student responses. First enter the keys to all the 20 multiple choice questions. Then enter students' responses (e.g., A, B, C, D). You have now created your data table and ready to score the responses with respect to the keys. The key and the pattern of students' responses to the items are as shown below in table 1

Table 1: Responses of 20 students to 15 Questions Multiple Choice Objective Items

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1	item	key	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15
2	Q#1	A	A	A	A	A	A	A	A	A	A	B	A	A	A	A	C
3	Q#2	C	C	C	C	C	C	C	C	A	C	C	C	B	C	C	A
4	Q#3	B	B	B	B	B	B	B	A	B	A	B	B	B	C	B	B
5	Q#4	A	A	A	A	A	A	A	C	A	A	A	A	D	A	A	C
6	Q#5	B	A	B	B	B	B	B	A	B	A	B	B	B	C	B	B
7	Q#6	C	C	C	C	A	C	B	C	C	C	C	C	C	C	A	A
8	Q#7	C	C	C	C	C	C	C	C	A	C	C	C	C	B	C	A
9	Q#8	B	B	B	B	B	B	B	A	A	A	B	B	B	C	B	B
10	Q#9	C	A	A	C	C	B	C	A	C	C	C	C	C	C	C	A
11	Q#10	D	D	D	D	C	D	D	B	C	D	C	D	D	C	D	D
12	Q#11	A	A	C	A	C	A	A	C	A	B	A	B	A	A	A	C
13	Q#12	C	C	C	A	C	C	C	C	A	C	A	C	B	B	C	A
14	Q#13	B	B	B	B	B	B	B	A	A	A	C	B	A	C	B	B
15	Q#14	A	A	A	A	A	A	A	C	C	B	A	D	D	A	A	C
16	Q#15	B	B	B	C	B	A	B	A	A	A	B	B	B	C	A	B
17	Q#16	C	C	C	C	A	A	B	B	C	C	A	C	B	C	A	A
18	Q#17	A	A	A	A	C	D	D	B	B	B	A	C	A	A	C	A
19	Q#18	B	A	B	C	B	B	D	B	C	C	B	A	A	C	A	B
20	Q#19	C	A	A	B	B	B	C	A	B	C	C	D	A	B	C	A
21	Q#20	D	D	D	B	C	D	A	B	C	D	C	C	A	C	B	C

4.2-Scoring Students Responses

To begin scoring the responses of the students, first, we will copy column and row headings together with key in table 1 above and paste in another area of the worksheet. To achieve this, we will highlight cells A1 to Q21, select Copy from the pull-down menu of Edit, click cell A22, then select Paste from the pull-down menu of Edit. Click at cell C23, type in the formula dialogue box “=IF(C2=\$B2,1,0)” and then press Enter, cell C2 is now scored and displayed in cell C23. Click at cell C23, place your cursor at the lower right-hand corner of cell C23 until your cursor changes to a cross, press down your mouse and while keeping it pressed, drag the mouse forward to cell Q23, release your mouse. Without clicking, place your cursor at the lower right hand corner of cell Q23 until it changes to a cross, press down your mouse and while keeping it pressed, drag the mouse downward to cell Q42 (the response to the last multiple-choice question by the last student in Q21), release your mouse. Now all students’ responses to multiple-choice question have been scored. The above mouse dragging and releasing process is called AutoFill. The final analysis of scoring is to calculate each student’s total score on the test. Click at cell C44, click at the summation sign *E* on the tool bar, use your mouse to select cells C23 to C42 then press Enter. The total score for the first student (S1) is now calculated. Use Autofill to calculate the total scores for other students. We can equally calculate the total number of students that answer each item correctly. To achieve this, click at cell R24, click at the summation sign *E* on the tool bar, use your mouse to select cells C23 to Q23 then press Enter. The total score on item 1 (Q#1) is now calculated. Use Autofill to calculate the total scores on the remaining items. We have now completed scoring all students’ responses and it is been shown in table 2 below.

Table 2: Sample scoring worksheet of the 15 students in 20 Questions Multiple Choice Objective Items

Item	key	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	TOT
Q#1	A	1	1	1	1	1	1	1	1	1	0	1	1	1	1	0	13
Q#2	C	1	1	1	1	1	1	1	1	0	1	1	0	1	1	0	12
Q#3	B	1	1	1	1	1	1	1	0	1	0	1	1	1	0	1	12
Q#4	A	1	1	1	1	1	1	1	0	1	1	1	1	0	1	1	12
Q#5	B	0	1	1	1	1	1	1	0	1	0	1	1	1	0	1	11
Q#6	C	1	1	1	0	1	0	1	1	1	1	1	1	1	0	0	11
Q#7	A	1	1	1	1	1	1	1	1	0	1	1	1	0	0	1	11
Q#8	B	1	1	1	1	1	1	1	0	0	1	1	1	1	0	1	11
Q#9	C	0	0	1	1	0	1	0	1	1	1	1	1	1	1	0	10
Q#10	D	1	1	1	0	1	1	1	0	1	0	1	1	1	1	1	10
Q#11	A	1	0	1	1	1	0	1	0	1	0	1	1	1	1	1	10
Q#12	B	1	1	0	1	1	1	1	1	0	1	0	1	0	0	1	9
Q#13	C	1	1	1	1	1	1	1	0	0	0	1	0	0	0	1	9
Q#14	D	1	1	1	1	1	1	1	0	0	0	1	0	0	1	1	9
Q#15	B	1	1	0	1	0	1	0	0	0	1	1	1	0	0	1	8
Q#16	B	1	1	1	0	0	0	0	0	1	1	0	1	0	0	0	7
Q#17	A	1	1	1	0	0	0	0	0	0	1	0	1	1	0	1	7
Q#18	A	0	1	0	1	1	0	1	0	0	1	0	0	0	0	1	6
Q#19	B	0	0	0	0	0	0	1	0	0	1	1	0	0	0	1	4
Q#20	C	1	1	0	0	1	0	0	0	1	0	0	0	0	0	0	4
TOT SCORE		16	17	15	14	15	14	7	7	12	13	15	10	9	14	8	

4.3-Part B: Conducting Item Analysis – Item Difficulty and Item Discrimination

We will now calculate item difficulty and discrimination for each of the items on the test. First, use mouse to select cells A1 to A21 from table 1 above and paste in cell A47. in cell B47 type “Points”, in cell C47 type “Difficulty”, and D47 type “Discrimination”. Type in maximum point for each of the items (in this case “1”) in column “Points”. Click at cell C48 to begin calculating item difficulty. Type “=SUM(C23:Q23)/(15*B48)” in the formula dialog box and press Enter (15 is the total number of students), the difficulty index for item 1 is calculated. Use AutoFill to calculate the item difficulties for other items. Now click at cell D48 to begin calculating item discrimination. Type in the formular “=CORREL(C23:Q23,C\$44:Q\$44)” and press Enter. The item discrimination for item 1 is now calculated. Use AutoFill to calculate item discrimination for the rest of items. The results of item difficulty and item discrimination is as shown below:

Table 3: Item Difficulty and Item Discrimination

47	Item	MAX. PTS	DIFFICULTY	DISCRIMINATION
48	Q#1	1	0.9	0
49	Q#2	1	0.8	1
50	Q#3	1	0.6	0
51	Q#4	1	0.8	1
52	Q#5	1	0.7	0
53	Q#6	1	0.5	0
54	Q#7	1	0.7	0
55	Q#8	1	0.8	0
56	Q#9	1	0.8	0
57	Q#10	1	0.6	1
58	Q#11	1	0.2	0
59	Q#12	1	0.7	0
60	Q#13	1	0.7	0
61	Q#14	1	0.6	1
62	Q#15	1	0.7	0
63	Q#16	1	0.5	1
64	Q#17	1	0.7	1
65	Q#18	1	0.6	0
66	Q#19	1	0.7	1
67	Q#20	1	0.6	0
68				
69				
70				
71				

4.4- Conducting Test Analysis – Test Validity

Calculating correlational coefficient is very paramount in validation. The analysis requires two sets of scores – one is from the test under validation, and another is from a different test that is considered to be credible thus the criterion. To achieve this, create another four rows labeled as “Student”, “Test score”, “Criterion Score”, and “Pearson Correlation Coefficient”. Type in the four headings at cells A71, A72, A73, and A74 accordingly. Enter the students identification numbers, their total scores and their criterion scores. The criterion scores used for this article were the students’ performances in their previous examinations / tests believed to be valid. To calculate the correlation coefficient, at cell C74 type “=CORREL(C72:Q72,C73:Q73)” and press Enter. The validity index is now calculated and shown in the table below

Table 4: Test Validity

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
74	STUD	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15		
75	T SCORE	10	4	13	8	10	8	10	7	10	11	10	10	9	14	8	9	
76	CRIT SC	60	45	65	43	20	33	56	42	43	60	44	58	44	42	51		
77	PEARS	=	0.4															

4.5-Conducting Test Analysis – Test Reliability

To calculate reliability coefficient, just revisit table 2 above and create additional column in “S”. at cell S22 type “Var”. at cell S23, type “=VAR(C23:Q23)” at the formular dialog box and then press Enter. The variance for item 1 is now calculated. Use AutoFill to calculate the variances of other items and of total test scores. The variance for total test score is displayed in cell S44. Now type in any blank cell e.g cell S45 “Cronbach Alpha=”, click at a cell on its right (cell U44) and type in the formular dialogue box “=(20/19)*(1-SUM(S23:S42)/S44)” and press Enter. The Cronbach’s alpha is now calculated and the result is as shown in table 5 below:

Table 5: Test Reliability

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
22	Item	key	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	TOT	VAR	
23	QR1	A	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	13	0.12	
24	QR2	C	0	1	1	0	1	1	1	1	1	1	1	0	1	1	1	12	0.17	
25	QR3	B	1	0	0	1	1	0	1	0	1	1	1	1	1	1	1	9	0.26	
26	QR4	A	0	1	1	0	1	1	1	1	1	1	1	1	1	1	1	10	0.17	
27	QR5	B	1	0	1	0	1	0	1	0	1	1	0	1	1	1	1	10	0.24	
28	QR6	C	0	1	1	1	1	1	0	0	1	1	0	1	0	1	0	8	0.27	
29	QR7	A	0	1	0	0	0	0	1	1	1	1	1	1	1	1	1	10	0.24	
30	QR8	B	0	1	1	1	1	0	1	1	1	1	1	0	1	1	1	12	0.17	
31	QR9	C	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	12	0.17	
32	QR10	D	1	1	0	0	1	0	1	0	1	1	1	1	1	1	0	9	0.26	
33	QR11	A	0	0	1	0	0	0	0	0	1	1	0	0	0	0	0	3	0.17	
34	QR12	B	1	0	1	1	1	0	1	0	1	1	0	1	1	1	1	11	0.21	
35	QR13	C	1	1	0	0	1	1	0	0	1	1	1	1	1	1	1	10	0.24	
36	QR14	D	0	0	1	0	1	0	1	0	1	1	1	1	1	1	1	9	0.26	
37	QR15	B	1	1	1	0	1	1	1	0	0	1	1	1	1	0	1	11	0.21	
38	QR16	B	0	1	1	0	1	0	1	0	0	1	1	0	0	1	1	8	0.27	
39	QR17	A	1	1	1	0	1	0	1	0	0	1	1	1	1	1	1	10	0.24	
40	QR18	A	0	1	0	1	1	1	0	1	0	1	1	1	0	0	1	9	0.26	
41	QR19	B	0	1	1	1	1	1	1	0	1	1	0	0	1	1	1	11	0.21	
42	QR20	C	0	1	1	0	1	1	0	1	0	0	1	1	0	1	1	9	0.26	
44	TOT SCORE		8	15	15	8	18	10	15	7	13	19	17	14	11	16	12		14.2	
45	VAR																			Cronbach
46																				0.727

5-Summary and Conclusion

This paper examines ways of reducing the problems associated with the teachers' analyzing the psychometric properties of a test during test construction. It introduces the practical application of a computer spreadsheet package – Microsoft Excel in the scoring of multiple choice objective test items and the computation of item analysis of the test at a faster rate with maximum accuracy irrespective of the number of items in the test and the number of students that took part in the test. Teachers, Lecturers, test experts and post graduate students in tests and measurement who are constantly familiar with the use of manual method of computation of item analysis will find this paper more useful to generate valid and reliable tests so as to produce the results that will be true reflection of the examinees.

5.1-Recommendations

Based on the roles of Spreadsheet package – Ms-Excel in reducing the problems associated with the scoring of multiple choice objective test items and the analysis of the psychometric properties, it is hereby recommended that:

1. Government, University Management and Teaching Service Commission (TESCOM) should as a matter of urgency organize seminars and workshops for lecturers / teachers periodically so as to update their knowledge in ways of using spreadsheet package (Microsoft Excel) to score multiple choice objective test items and conducting item / test analysis.

2. Application of computers in teachers training programs cannot be brushed aside. Teachers Training program needed to be re-designed to enable prospective teachers have first hand experience during their training program on how to use computers to score their students' tests, analyze the psychometric properties of such tests and even familiar with the ways of using statistical packages like Excel, Lotus 1-2-3, SPSS and E-views in analyzing data emanated from their research project.

3. This paper was only limited to the scoring of multiple choice objective test items and the analysis of the psychometric properties like the difficulty index, discrimination index, validity index and reliability index using excel, it is hereby recommended to future researchers to replicate this work by calculating item response patterns, student performance by group of items

With these practices, true score of an examinee can be reliably estimated.

REFERENCES

Afemikhe, O.A. (2005). Reflections on quality of assessment in large classes in Nigeria. A paper presented at the 31st Annual Conference of the International Association for Education Assessment held at the Nicon Hilton Hotel, Abuja, Nigeria. (Sept. 4th – 9th)

Akindutire, I.O. (2010). Teacher education in a democratized government in Nigeria: Challenges and the way forward. A lead paper delivered at the national conference of the South West Zonal congress of Colleges of Education Academic Staff Union (COEASU) , 6th July, 2010, pg. 2.

Atabong, T.A., Okpala, M.C., Abondem, A.L., & Essombe, C.E. (2010). Eliminating examination malpractice in Africa with automated test taking, marking and result printing. *Tropical Journal of Biomedical and Allied Sciences Research* 4(1), 452-469

Hassan, T. & Ogunmakin, A.O. (2010). Emotional intelligence, academic self-efficacy, academic stress as predictors of potential for academic cheating among some Nigerian undergraduate students. *Proceedings of International Conference of Education, Research & Innovation (ICERI 2010)*, Madrid, Spain, 13th-17th Nov., 2010.

Osakuade, J.O. (2006). The predictive validity of continuous assessment in Junior Secondary School Certificate Examination. Unpublished, M.Ed. thesis, Faculty of Education, Adekunle Ajasin University, Akungba Akoko, Ondo State.