FUNDAMENTALS

OF

EDUCATIONAL RESEARCH

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TABLE OF CONTENTS

CHAPTER ELEVEN

APPLICATION OF COMPUTER TO EDUCATIONAL RESEARCH

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Preliminaries

This chapter focuses on the application of computer in Educational research. Computer is extensively used in the area of Educational Research in term of data analysis and word processing. This chapter could form a volume of its own, but because of its limitation, attention is focused on aspects of data analysis. We may want at this point try to explain what a computer is, how we come about it and its usefulness.

A computer is an electronic device, which is capable of assessing data/information by means of a set instruction, process the information and produce a result. The information is passed into the computer through a device called the input device, processed by the central processing unit (CPU) and the result is displayed on the output device (Visual Display Unit – VDU or a printer).

The main characteristics of the computer are also seen as the advantages of using it as alternative to manual or other forms of processing data. These include:

Speed: The computer works at the speed of electricity. Speeds of computer operations are usually measured in milliseconds, microseconds, nanoseconds and picoseconds, i.e. 10^3, 10^6, 10^9 and 10^{12} respectively.

Accuracy: Results from computers are highly accurate. GIGO (Garbage in Garbage Out) is used to explain human source of errors.

Storage: A vital component of the computer is the Memory Unit. Memory is the capacity to store and release information when needed. Data can be manipulated when stored. This enables the computer to supply information to management timely and accurately.

Flexibility: Modern computers can be used for a variety of purposes, for example, batch processing; on line processing; and multi-

programming, Computers can also operate on a variety of application packages.

Consistency and Efficiency: The computer is very consistent i.e. it would produce the same result on the same data at any time given the same instruction. The computer does not suffer from human traits of being tired or lack of concentration. It performs the task with the same speed and accuracy as the first task no matter the number of tasks involved.

Historical Development of Computers

Computer is as old as mankind. Efforts have been made to invent machines that could be used for calculations. Toes, fingers, pebbles, stones and sticks have been used for calculations. Earlier calculating aids include Napiers logarithm, Qughested's slide rule, Pascals Digital Counter, Leibnitz's Calculating machine. What could be called the first computer was designed by John Neumann in 1946. John Neumann machine was prominent because of its stored program concepts. A computer that will store the program alongside the data.

Many attempts were made at designing calculating machine/ computer between 1946 and the late 50's: UNIVAC (Universal Automatic Computer) 1951, IBM (International Business and Machine) 1953/54. One general feature of these computers is the use of vacuum tube. They are identified as first generation computers. Between 1959 and 1960 other types of computer evolved and they are characterized by the use of transistors instead of vacuum tubes. The transistors are smaller, less expensive, generate less heat and requires little power. Examples include IBM 1402, IBM 1620, IBM 7090 – 7904. These are called the second generation computers. By mid 70s the production of small scale and medium scale integrated circuit gave birth to third generation computers. This resulted in compatibility of the computers i.e. computers that can be used to work on the same jobs. The forth generation computer came to being when the very large scale integrated circuits were produced. This made it possible for micro processors to be produced. A micro – processor is central processing unit that is fabricated on a chip. Mass production of micro-processors led to the production of micro computers. Micro computers are also referred to as computer on chips. Micro computers were smaller, faster and more efficient than 3rd generation

computers. They were also affordable. This led to the development of a wide variety of software tools. Such as Word processing, Spreadsheet, Database management and Graphic Packages. Local Area Network, Electronic mail and other capabilities were implemented. Fifth generation computer is as a result of researches by world powers like USA and Japan. Super computers – Computers which perform operations in the range of 10 billion instructions per seconds were built Also computers that could be made to think and act like human beings i.e. having capacities for sight, hearing and stimulate human thought (Artificial intelligence) were designed. It is believed that we are currently in the fifth generation of computers.

Computer Applications

It is practically impossible to exhaust every area where computer has found its applications useful.

Business: Banks, Insurance Companies, manufacturing firms, Stock Brokerage firms, firms involved with importation, buying, selling, and production for financial management, project management and human resources applications package and customized packages are used.

Government: Census – for compiling census and survey data. Licensing operation – vehicle license, driving license and locally produced goods. To facilitate storage and update information.

Police and Military: To keep record of crimes and related cases. For research and development of the military. Operations research used in the second world war from (1939) – 45) for allocation of scarce resources of man, machinery and money.

Education: For programmed instruction: Computer Aided instruction (CAI). Assessment of students performance.

Architecture and Engineering: In the design of bridges, buildings and machines. Eliminate problems associated with complex calculations and precision.

Law: For storing and retrieving information. Storing previous cases so as to argue new ones.

Medicine: Medical record of patients. Artificial Intelligence software for diagnosis and prescription.

Classification of the Computer

Computers are classified using different parameters, like function (analog, digital and hybrid); purpose (general purpose and special purpose). Another major classification of computer is by capability i.e mainframe; mini computers; and micro computers.

Mainframe is the most expensive of all these. It is very big in size and offer the maximum computing power. It occupies large space and has capacities for running large programme. It has a large main memory and performs operation very fast. They are kept in specially prepared and equipped with powerful air-conditioners rooms.

Mini Computers are smaller versions of mainframe, they can be differentiated from mainframe physically because of size; processing capability processor design; memory capability; and number of peripherals.

Micro Computers are the smallest in the range of computers, they are also referred to as Personal Computers (PC). Majority of the earlier designs are called Desktop Computers but they now come in different sizes and shapes. Today we have different types of micro computers namely: notebook; laptop; desktop; mini tower; and tower system.

Computer Hardware and Software

A computer is made up of the Hardware and Software. Hardware is the name given to the physical component of a computer, for example, the visual display unit (monitor or screen) system unit, key board, mouse etc. Software is the programme written to accomplish a specific task.

The Software

There are two types of software, these are the system software and the application software. Systems software is a set of instructions that are written for or by the user in order to facilitate speedy operation of a specific task. Application software is also divided into two, we have the user's application programmes which are written in variety of programme languages by the user in order to accomplish a task and the software packages which are the generalized programmes for solving problems. Examples are the MS word, MS Dos, spreadsheet, accounting packages

etc. The type of software relevant to this chapter is on data analysis.

There are so many software packages in data analysis. Some of them are SCORBATT, SAS, SPSS, MSTART and so on. The emphasis of this chapter is the application of SPSS to Educational Research. SPSS is an acronym for Statistical Package for Social Sciences. We have the DOS versions (version 1 to version 5) and the WINDOWS versions (version 6.0 to the latest for now Version 11.0). Since the WINDOWS versions are learners friendly, attempt will be made to discuss a version in WINDOWS. A basic assumption the author is making here is that the readers are familiar with at least WINDOWS '95, since attempt will not be made to teach or discuss WINDOWS operations.

File menu commands

What does File menu commands do? File menu contain the following:

Open -this command allows you to open either an existing file or a new file.

Read ASCII Data -this command allows you to transform ASC II data i.e. data from DOS into the one for WINDOWS.

Close -this command allows you to close a file you are currently working with.

Save-this command allows you to save a file you are currently working with.

Save As-this command allows you to save a file you are currently working with using another name.

Print-this command allows you to print a file you are currently working with.

Exit -this command allows you to close down this application software.

There are other commands you will need to know in order to execute SPSS for WINDOWS, we may meet them as we progress.

Statistics Menu Commands

There are two fields of statistics: The descriptive and the inferential. Attempt will not be made here on how to perform such functions as analyzing data because of the limitation of this chapter. However, important issues on the computer itself will be discussed. Illustrations will be made from computer print outs of certain analysis in both descriptive and inferential statistics. Such illustrations will cover such aspects as frequency; descriptive statistics, t-test, cross tabulation and analysis of variance.

The statistics commands are organized into submenus according to the type of analysis performed.

1. **Descriptive Statistics**

Frequency

Frequency is used to make tables and displays that show how often different values of a variable occur in the data. You can also use it to obtain summary statistics that describe the typical value and the spread of the observations. For examples, if you have done a customer satisfaction survey, you can make a table which shows how many of your customers selected each of the possible responses. From this table you can tell that 70% of your customers, for example, are "highly satisfied" with your services. The bar chart display turns your table into a chart in which the length of the bar corresponds to the number of people selecting a particular response. For a variable like income which can have many possible ordered values, you can use a histogram to see how often different values occur. The following print out is an example of frequency analysis.

		Frequency	Pe.cent	Valid Percent	Cumulative Percent
Valid	Male	155	44.3	44.3	44.3
	Female	195	55.7	55.7	100.0
	Total	350	100.0	100.0	

Descriptives

Descriptive is used to calculate statistics that summarize the values of a variable. For example, you can calculate the average income of your customers and see how much spread or variability there is around this average value. You can also calculate values above which and below which certain percentages of your cases fall. For example, you might find that 25% of your clients have incomes less than ₦5,000, 50% have incomes less than ₦70,000 and 75% have incomes less than ₦125,000. You should not use this procedure for variables which are nominal. That is do not compute average colour preference or average brand of car driven.

The following print out is an example of descriptive;

Descriptive Statistics

	N	Range	Mean		Std. Deviation	Variance	Skewness		Kurtosis	
	Statis.	Statis.	Statis.	Std. Error	Statistic	Statistic	Statis.	Std. Error	Statis.	Std. Error
TOTAL	350	162.00	116.1571	1.5701	29.3736	862.809	127	130	-355	260
Valid N (listwise)	350									

Crosstabs

Crosstabs is used to count the number of cases that have different combinations of values of two or more variables, and to calculate summary statistics and tests. For example, if you want to know if there is a relationship between the region of the city in which a person lives and the person's willingness to buy your product, you can make a table that shows how many people say they would buy your product, and how many say they would not, for each of the regions. Or you can look at the relationship between job satisfaction and job performance ratings separately for males and females.

			JSENG			
			Low	Moderate	High	Total
SEX	Male	Count	26	68	61	155
		Expected Count	26.6	63.8	64.7	155.0
		%within SEX	16.8%	43.9%	39.4%	100.0%
		%Within JSENG	43.3%	47.2%	41.8%	44.3%
		% of Total	7.4%	19.4%	17.4%	44.3%
	Female	Count	34	76	85	195
		Expected Count	33.4	8.2	81.3	195.0
		%within SEX	17.4%	39.0%	43.6%	100.0%
		%Within JSENG	56.7%	52.8%	58.2%	55.7%
		% of Total	9.7%	21.7%	24.3%	55.7%
TOTAL		Count	60	144	146	350
		Expected Count	60.0	144.0	146.0	350.0
		%within SEX	17.1%	41.1%	41.7%	100.0%
		%Within JSENG	100.0%	100.0%	100.0%	100.%
		% of Total	17.1%	41.1%	41.7%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2 – sided)
Pearson Chi-Square	.897(a)	2	.639
Likelihood ratio	.896	2	.639
Linear-by-Linear Association	.208	1	.648
N of Valid Cases	350		

a 0 cells (.0%) have expected count less than 5. The minimum expected count is 26.57

2. Inferential statistics

The ANOVA Models submenu provides techniques for testing univariate and multivariate Analysis – of – Variance models. Simple Factorial performs an analysis of variance for factorial designs. You can specify covariates and choose alternate methods for partitioning sums of squares. For example, a simple factorial design can be used to test if five different coaching methods result in the same average test score for students in three different majors. In this example, the dependent variable is the test score, and the factors (the variables used to from the

groups) are the coaching methods and the students' majors. You can test the hypothesis that the coaching methods are equally effective, that the majors respond in the same way, and that there is no interaction between the major and the coaching method.

In a simple factorial design you test the effects of each of the factors individually, and of the interactions. The Simple Factorial ANOVA procedure allows you to specify the highest order of the interactions and then build a model containing all interactions of that order and lower.

If you want to include only some of the interactions of a particular order you should use the General factorial ANOVA procedure. If you have only one factor you should used the One-Way ANOVA procedure.

General Factorial analyzes more general univariate analysis-of-variance designs. Allows great flexibility in specifying the model, and offers a great variety of statistical output. This command is in the Advanced Statistics option. For example, if you are interested in the effects of three incentive structures on the productivity of two classes of employees in four locations of your company you might design a factorial experiment to test the hypotheses of interest. Since baseline productivity prior to the introduction of new incentive structures may be a strong predictor of subsequent productivity, you might want to use baseline productivity as a covariate. (That is, you might want to adjust the observed productivity for baseline values.) You may also want to see whether the effect of the covariate is the same for the two classes of employees. (That is, you want to see if there is a factor by covariate interaction). The following print outs are examples of one (one way) factor analysis of variance and two (two way) factors analysis of variance.

ANOVA

TOTAL					
	Sum of squares	**df**	**Mean Square**	**F**	**Sig.**
Between Groups	50971.276	2	25485.638	35.353	.000
Within Groups	250149.081	347	720.891		
Total	301120.357	349			

Post Hoc Tests

Multiple Comparisons

Dependent Variable: TOTAL

Scheffe

(I) JSENG	(J)JSENG	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Low	Moderate	-12.8278(*)	4.1257	.099	-22.9701	-2.6855
	High	-31.7943(*)	4.1173	.000	-41.9161	-21.6724
Moderate	Low	12.8278(*)	4.1257	.009	2.6855	22.9701
	High	-18.9665(*)	3.1534	.000	-26.7186	-11.2144
High	Low	31.7943 (*)	4.1173	.000	21.6724	41.9161
	Moderate	18.9665(*)	3.1534	.000	11.2144	26.7186

* The mean difference is significant at the .05 level

Homogeneous Subsets

Total scheffe

	N	Subset for alpha = .05		
JSENG		**1**	**2**	**3**
Low	60	97.6167		
Moderate	144		110.4444	
High	146			129.4110
Sig.		1.000	1.000	1.000

Means for groups in homogeneous subsets are displayed

a. Uses Harmonic Mean Sample Size = 98.488

b. The groups sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

Between – Subjects Factors

		Value **Label**	**N**
SEX	1	Male	155
	2	Female	195
JSENG	1.00	Low	60
	2.00	Moderate	144
	3.00	High	146

Tests of Between – Subjects Effects
Dependent Variable: TOTAL

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	53852.479(a)	5	10770.496	14.984	.000
Intercept	3699255.740	1	3699255.740	5146.418	.000
SEX	2017.444	1	2017.444	2.807	095
JSENG	51499.173	2	25749.586	35.823	.000
SEX * JSENG	287.366	2	143.683	.200	.819
Error	247267.878	344	718.802		
TOTAL	5023489.000	350			
Corrected Total	301129.357	349			

a. R Squared = .179 (Adjusted R Squared = .167)

The Regression Techniques

Linear is used to examiner the relationship between a dependent variable and a set of independent variables. For example you can try to predict a salesperson's total yearly sales (the dependent variable) from independent variables such as age, education, years of experience, and sales territory. Or you can try to predict a student's score on the Graduate Records Exam based on undergraduate GPA, IQ score and major. Both the dependent and independent variables must be measured on an interval scale. Nominal variables such as religion, major, or region of residence must be recoded to binary (dummy) variables or other types of contrast variables. If you've collected a large number of independent variables and want to build a regression model, which includes only variables, which are statistically related to the dependent variable, you can use one of the variables selection methods to select the independent variables. To see how well the regression model fits your data, you can examine the residuals and other types of diagnostics that this procedure provides. The following print out is an example of regression.

Model Summary (b)

Model	R	R Square	Adjusted R Square	Std. error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.918(a)	.842	.840	3.65	842	460.397	4	345	.000

a. Predictors: (Constant), ESS _ISCD_, JS2_ISC_, JS3_ ISC, JSi_ ISC
b. Dependent Variable: FIN_ ISC

ANOVA (b)

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	24542.051	4	6135.513	460.397	000(a)
	Residual	4597.663	345	13.327		
	Total	29139.714	349			

a. Predictors: (Constant), ESS_ISC_, JS2_ISC, JS3_ISC, JS1_ISC

b. Dependent Variable: FIN_ISC

Coefficients (a)

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations		
	B	Std. Error	Beta			Zero-order	Partial	Part
(Constant)	10.937	.983		11.122	.000			
JS1_ISC	3.467E-02	.016	.056	2.216	.027	.402	.118	.047
1 JS2_ISC	3.135E-03	.007	.010	.451	.652	.022	.024	.010
JS3_ISC	2.288E-02	.014	.039	1.627	.105	.265	.087	.035
ESS_ISC	1.733	.045	.885	38.315	.000	.915	.900	.819

(i) Dependent Variable: FIN_ISC

(ii) the df (n-1) is 6; so we look at the value at the degree of freedom 6. The critical value is 2.447.

For adequate analysis of the print out, a researcher could consult those who are experts or more knowledgable in statistical analysis for necessary assistance.

Review Questions

i. Discuss some of the advantages of using computer for data processing.

ii. Attempt a classification of the computer and discuss same.

iii. Explain what you understand by the following concepts:
   (a) Hardware (b) Software
   (c) File Menu Commands (d) Statistics Menu Commands

BIBLIOGRAPHY

Best, J. W. (1981): *Research in Education*, New Jersey, Prentice hall Inc.

Chen, L. (1974): *Educational Research in Classrooms and Schools: A Manual of Materials and Methods*, London. Harper and Row.

Cay, L. R. (1976): *Educational Research; Competencies for Analysis and Application* Columbus, Merrill Publishing Co.

Kerlinger, F. N. (1979): *Scientific Behavioural Research: A Conceptual Printer*, New York, Hot, Rinchart & Watson.