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SPSS: An Effective Tool to Compute Learning Outcomes in Acadamics

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Abstract - OBJECTIVES: To determine how SPSS can be a useful tool to evaluate Course Learning Outcomes and analyze student's performance with the help of KS test, histogram and skewness of the tool. It is also contributing to facilitate Deep learning amongst students with the help of achievement of normal distribution of grades. **METHODS:** Comparative analysis is done using course specification, syllabus, assessment method(Final Exam Question paper is taken as tool) and result statistics for the course of STATISTICAL PROGRAMMING (217 CSM), 3rd year (level 5 course) that is part of BCS curriculum in department of Computer Science, College of computer Science in King Khalid University. Teaching strategies are compared for two years. i.e; 2013 and 2014. Moreover the research inferences the relevance of application of NCAAA standards in meeting Learning outcomes of any module for department of Computer Science, CCS, KKU. **RESULTS:** Comparison of question papers depict that now students are motivated to have deep learning in terms of understanding, solving, reasoning based questions as contrast to shallow learning (memorized questions) in the past. It is indeed improving Learning domains too (Knowledge, Cognitive, Interpersonal and Communication skills) more effectively than in the past. Also grade distribution is Normal with well-defined curve for 2014 as compared to 2013 having variation in Standard deviation too. Teacher centered learning lead to surface learning. After NCAA standards implementation, there is more focus on learned centered teaching. Design of learning assessments is in such a way that it should meet learning outcomes successfully. **CONCLUSIONS:** The research is contributing in flourishing the personality of the students to produce qualified graduates with excellence in communication, logically and technically capable enough to share their knowledge nationally and internationally with much more confidence at any platform. Also it is opening door for researchers to evaluate their performance with the help of SPSS in academics or anywhere where we want to gather.

I. INTRODUCTION

King Khalid University commits to providing relevant academic environments for high-quality education, conducting innovative scientific research, providing constructive community services, and maximizing the employment of knowledge techniques. According to program objectives of King Khalid University, College of Computer Science has defined that our graduates are able to

- Continue their higher studies and scientific research to analyze and solve complex problems in the field of computer science.
- Design, develop and test the solutions using contemporary technologies with full participation in profession and society.
- Communicate effectively in their work environment with multidisciplinary team for their lifelong learning, ethical and professional development.
- Participate in national mission through technical expertise, leadership and entrepreneurship.

Domains under NCAAA standards are as follow:
(A) Knowledge
(B) Cognitive skills
(C) Interpersonal skills and responsibility
(D) Communication, information technology and numerical skills
These domains are mapped with Program Learning outcomes as shown below:
Each course must contribute to achieve PLO in terms of different domains. Research is concentrating on one of Computer Science curriculum course that is being taught in level 5, 3rd Year of Bachelor Program; it is 217CS (Statistical Programming).Final term paper is taken for evaluating assessment method. Paper is divided into 3 sections.

PART I
Objective questions like Fill in the blanks, Choose the correct answer, Match the following or True or False. Any two of the above mentioned question types will be included. Maximum marks for each question is 1 mark

PART II
Short answer questions like Definitions, Differentiation, simple calculations, block diagrams

PART III
Detailed answer questions like Programs, Algorithms, Problems, and Explanations (based on the objectives of the subjects)
Same parts are seen in exam paper of both years except two changes.

- There are more reasoning based questions in 2014.
- Distribution of marks is more uniform in 2014 as shown below:

Chapter names are taken from syllabus and total marks of this paper is 50.

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II. METHODOLOGY

The course 217CS is about modern, computationally-intensive methods in statistics. It designed to teach the fundamental concepts of statistical methods. The course is geared toward a computer science audience. It emphasizes the role of computation as a fundamental tool of discovery in data analysis of statistical inference which includes descriptive statistics, regression, correlation and probability. It focuses on the aspects that are specific to Computer Science applications on through the implementation of statistical tool such as SPSS. Following Course Learning Outcomes have been constructed:

Domain	CODE	*Program learning Outcomes*
A	a1	Define mathematical concepts, algorithmic principles, and computer science fundamentals
	a2	Recognize mathematical foundations, algorithmic principles, and computer science theory in the modeling and design of computer-based systems in a way that demonstrates comprehension of the tradeoffs involved in design choices
B	b1	An ability to apply design and development principles in the construction of software systems of varying complexity.
	b2	An ability to design, implement, and evaluate a computer-based system, process, component, or program to meet desired needs
	b3	An ability to analyze a problem, and identify and define the computing requirements appropriate to its solution
	b4	An ability to analyze the local and global impact of computing on individuals, organizations, and society
C	c1	An ability to function effectively on multi-disciplinary teams to accomplish a common goal
	c2	An understanding of professional, ethical, legal, security and social issues and responsibilities
	c3	Recognition of the need for and an ability to engage in lifelong learning
	c4	An ability to use current techniques, skills, and tools necessary for computing practice
D	d1	An ability to communicate effectively in oral with range of audiences
	d2	An ability to communicate effectively in written with range of audiences

Chapter	Chapter Names	q1 a	q1 b	q2	q3	T6 8
1	Definition - Applications - Types - data classification	1.5	1.5		5	8
2	Data visualization			3	5	8
3	Descriptive Measure - Individual Data	0.5	2.5	3		6
4	Descriptive Measure - Group Data			3	5	8
5	Correlation	0.5	2.5	3		6
6	Regression	2.5	0.5	3		6
7	Probability		3		5	8

Course Learning Outcomes

1	Define the statistical terms and its measures
2	Describe the procedure to compute descriptive statistical measure
3	Recognize the applications of Statistical measure
4	Compare data using descriptive measures
5	Analysis the data relationship using correlation
6	Predict the variation using regression
7	Measure the probability of an events
8	Demonstrate the procedure to compute statistical measure using statistical software tool (SPSS)

The National Qualification Framework provides five learning domains. Course learning outcomes are required. Normally a course has should not exceed eight learning outcomes which align with one or more of the five learning domains. Some courses have one or more program learning outcomes integrated into the course learning outcomes to demonstrate program learning outcome alignment. The program learning outcome matrix map identifies which program learning outcomes are incorporated into specific courses. NQF and CLO are embedded for 217CS as follow:

Mapping of CLO with PLO is shown in given matrix:

Map course LOs with the program LOs. (Place course LO #s in the left column and Program LO #s across the top.)												
Course LOs #	Program Learning Outcomes Use LOs Codes											
	a1	a2	b1	b2	b3	b4	c1	c2	c3	c4	d1	d2
1	✓											
2	✓	✓										
3	✓	✓										
4					✓							
5					✓							
6					✓							
7					✓							
8										✓		

	NQF Learning Domains And Course Learning Outcomes	Course Teaching Strategies	Course Assessment Methods
1.0	**Knowledge**		
1.1	Define the statistical terms and its measures	Lecture and Laboratory	Exam , Assignment
1.2	Describe the procedure to compute descriptive statistical measure		
1.3	Recognize the applications of Statistical measure		
2.0	**Cognitive Skills**		
2.1	Compare data using descriptive measures	Lecture and Laboratory	Exam , Assignment
2.2	Analysis the data relationship using correlation		
2.3	Predict the variation using regression		
2.4	Measure the probability of an events		
3.0	**Interpersonal Skills & Responsibility**		

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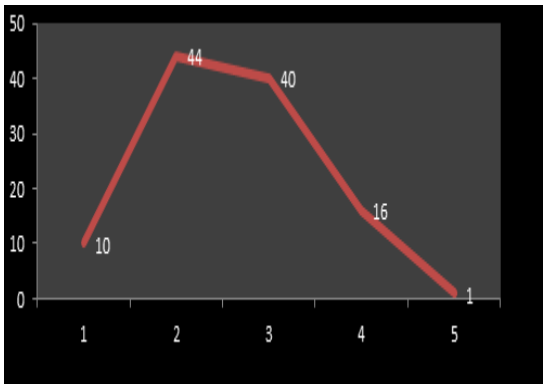
4.0	**Communication, Information Technology, Numerical**		
4.1	Demonstrate the procedure to compute statistical measure using statistical software tool (SPSS)	Lecture ,Lab	Exam
5.0	**Psychomotor**		
5.1	NA		

Research has analyzed Syllabus and Course Specification of two Years with Domains of Learning and Assessment method. Final Exam question paper is assessed for two years and relationship is find out that whether assessment method has contributed in achieving CLO in terms of Domains of Learning or not. Result statistics is collected for these two years and relationship is drawn that what change has occurred in these two years in terms of grades, percentage of passing students and is the grades normally distributed or not with the help of histogram, skewness and KS test.

III. EXPERIMENTS AND RESULTS

SPSS 17 various is used to collect data of two years and then perform various testing techniques on it.
For 2013, total number of students were 111. According to data , these are the result statistics in terms of grades:

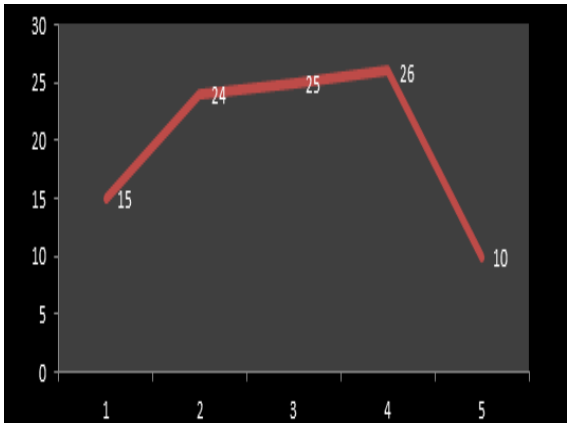
No. of Students	% Pass	A	B	C	D	F
111	99.10	10	44	40	16	1



For 2014 total no. of students were 100. According to data, these are the result statistics in terms of grades:

No. of Students	%	A	B	C	D	F
100	91.84	15	24	25	26	10

As we can see graph, 2013 has shown less variation as compared to 2014. Now we will evaluate skewness of data using SPSS. Skewness is used for testing the assumption that a metric variable is normally distributed or not. In addition to visual inspection, we can calculate summary statistics that measure skewness. For Skewness measure, a perfectly normal distribution should return a score of 0. Otherwise: A positive skewness value indicates positive (right) skew; a negative value indicates negative (left) skew. The higher the absolute value, the greater the skew. We are getting these results of skewness:



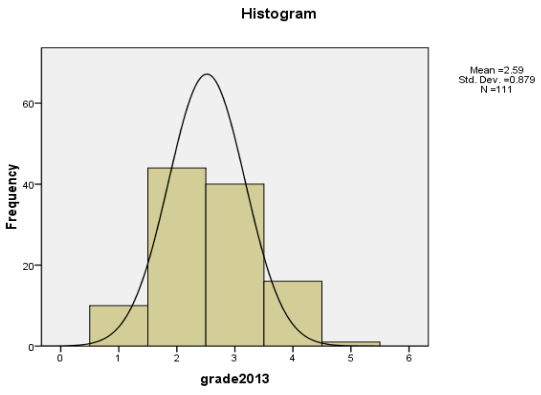
grade2013

N	Valid	111
	Missing	0
Skewness		.184
Std. Error of Skewness		.229

grade2014

N	Valid	100
	Missing	11
Skewness		-.012
Std. Error of Skewness		.241

As we can see, 2013 is having positive skewness and 2014 is having negative skewness but in both cases we are getting value higher or lower than 0, it means we are not having normal distribution. This is confirmed by visual inspection of the histogram of the same data shown below. This is a rather crude test as it is affected by the size of the sample so it should always be complemented by visual inspection.



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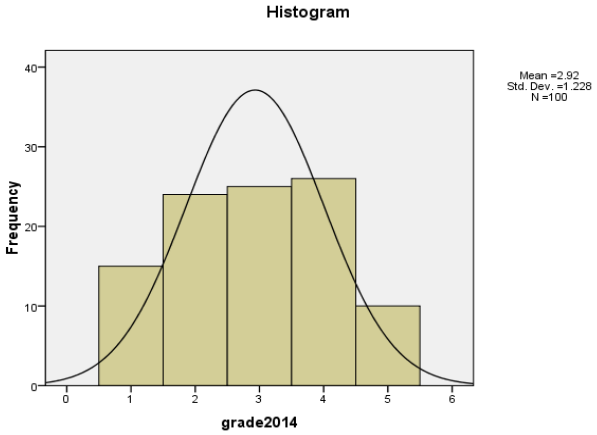
In 2013, curve is not normally distributed having standard deviation of 0.879. In 2014, we are getting following result indicating well defined curve as compared to 2013 with standard deviation of 1.228.



This distribution can be more strengthened with Kolmogorov-Smirnov test.The Kolmogorov-Smirnov test is used to decide if a sample comes from a population with a specific distribution.The Kolmogorov-Smirnov (K-S) test is based on the empirical distribution function (ECDF). Given *N ordered* data points $Y_1, Y_2, ..., Y_N$, the ECDF is defined as

$$EN=n(i)/N$$

Where $n(i)$is the number of points less than Y_i and the Y_i are ordered from smallest to largest value. This is a step function that increases by 1/*N*at the value of each ordered data point. For 2013 and 2014, we have following distribution using KS test:

One-Sample Kolmogorov-Smirnov Test

		grade2013
N		111
Normal Parameters[a,,b]	Mean	2.59
	Std. Deviation	.879
Most Extreme Differences	Absolute	.234
	Positive	.234
	Negative	-.195
Kolmogorov-Smirnov Z		2.464
Asymp. Sig. (2-tailed)		.000

a. Test distribution is Normal.

b. Calculated from data.

One-Sample Kolmogorov-Smirnov Test

		grade2014
N		100
Normal Parameters[a,,b]	Mean	2.92
	Std. Deviation	1.228
Most Extreme Differences	Absolute	.170
	Positive	.163
	Negative	-.170
Kolmogorov-Smirnov Z		1.704
Asymp. Sig. (2-tailed)		.006

a. Test distribution is Normal.

b. Calculated from data.

Result indicates that in both years, by evaluating 'Z' value is greater than 0.05 so we would accept the null hypothesis that the data come from a normally-distributed population. If we compare 'Z' value of two years, 2013 is having higher value than 2014 strengthening our result that in 2014 grades are distributed uniformly as compared to 2013.

IV. DISCUSSIONS

As skewness shows, for 2013 it is 0.184 and for 2014 its showing -0.12. Skewness result can be positive or negative skewness reflects that data variation from normality is not too extreme. In histogram curve is quite clearly curved with std.dev of 1.228 for year 2014 as compared to 2013 where std. dev is 0.879. It reflects 2014 as shown clear curve with all grade distribution. Under PLO and Course specification, it has motivated more deep learning as we can see from kind of assessments too. If the results of either test are significant (e.g. $p < 0.05$) rejecting the null hypothesis means rejecting the assumption of normality for the distribution. But here result indicates value >0.05, that why we can say that data is normally distributed.

V. CONCLUSION

Research has analyzed result of two years using SPSS. How CLO were mapped with PLO and their relationship with teaching strategies and assessment methods is find out. In 2014 we find Normal distribution more clearly as compared to 2013. So we can say that SPSS is the most effective tool to find out variation of data in academics. We have finalized the results using KS one sample test for 2013 and 2014 grades in 217CS, histogram of both years and skewness to check variability of data. So CLO are more effectively achieved in 2014.

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