Evaluation of Shock in Students Perception of Lecturing Skills through Stochastic Modeling

Ahmed Al Kuwaiti, Vinoth Raman, Ola Ibrahim Ramzi, Arun Vijay Subbarayalu, Sivasankar Prabaharan, Palanivel R. M., Royce Kurian, Ajayan Kamalasanan, Goparaju Anumolu

***Abstract*— In recent times, higher education institutions (HEIs) are seeking more attention in conducting surveys to improve the quality of teaching and achieve academic accreditation. In this regard, Imam Abdulrahman Bin Faisal University (IAU) also conducting various surveys to meet the requirements of the National Center for Academic Accreditation and evAluation (NCAAA), Saudi Arabia for attaining academic accreditation. Among those surveys, a survey named "Students Survey on Lecturing Skills (SSLS)" is conducted to reveal the students' perception of lecturing skills of instructors. In SSLS, the policymakers should reach the fixed new target benchmark for overall students' satisfaction during every academic year. Therefore, this study aimed to use stochastic modeling to predict the exact parameters which are to be focused by the instructors to improve their quality of teaching and enhance the overall students' satisfaction towards instructors' lecturing skills. The results showed that the instructors should focus on "Interest and motivation" (μ) to enhance the overall students' satisfaction towards the lecturing skills by 99% in the presence of a 5% increase in target benchmark as per NCAAA standards during the upcoming academic year. This study indicates that the policymakers can make use of stochastic modeling in higher education to predict the exact parameters to be focused so that the cost and time spent would be reduced and make the process easier to achieve academic accreditation.**

***Keywords*— Higher Education, Lecturing skills, Saudi Universities, Stochastic Modeling**

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I. INTRODUCTION

The word "Stochastic" was derived from the Greek word named "stokhastikos. Stochastic models are one of the mathematical models which are given by random variables whose outcomes are uncertain and where it is possible only to find out the probabilities of the possible outcomes. These models provide more information about statistical uncertainties [1]. This modeling has been applied in various fields such as physics, engineering, life sciences, social sciences, and finance. Previous studies have discussed the use of stochastic modeling in the field of computer science, especially on traffic networks [2,3]. Likewise, stochastic modeling was applied in the field of engineering for dealing with sparse signal recovery and shareholder maximization [4,5].

Moreover, few studies have utilized the stochastic approach in the urban traffic system, mine valuations, and finance [6,7,8]. Presently, the application of stochastic modeling has been extended into the field of higher education. A recent study by Brezavscek et al. [9] has developed a stochastic model to estimate and continuously monitor the various quality and effectiveness indicators in a Slovenian higher education institution. It is concluded that such a model applies to all higher education stakeholders and useful for higher education institutions (HEIs)' administrators. It provides useful information to plan improvements regarding the quality and effectiveness of their study programs, thereby achieve a better position in the education market.

Moreover, various students' evaluation surveys are conducted in higher education to capture the students' experience and their ratings of teaching quality; and evaluate the courses, programs, and learning resources offered. Knol et al. [10] also stated that student ratings are often used to evaluate and improve the quality of the

faculty's instructional skills in higher education. On the other hand, several accreditation agencies use these ratings as one of the measures to understand the quality.

In Saudi Arabia, the National Center for Academic Accreditation and evAluation (NCAAA), is responsible for granting and monitoring the academic accreditation processes of HEIs. As such, it is mandatory for HEIs in Saudi Arabia to assess its performance by conducting various evaluations by the students and faculty members in order to meet NCAAA requirements for academic accreditation. On these facets, Imam Abdulrahman Bin Faisal University (IAU), Saudi Arabia, also conducting evaluations among students/faculty to improve the quality in higher education. To accomplish this, Deanship of Quality and Academic Accreditation (DQAA) of IAU has developed a questionnaire named 'Students Survey on Lecturing Skills (SSLS)' to capture students' perception of lecturing skills of each faculty. SSLS consist of five main parameters as follows: (i) Organization and Structure of the lectures (OS), (ii) Effect of lectures on learning and Understanding (LU), (iii) Levels of Students' Interest and Motivation (IM), (iv) Professional Interaction & Support (PIS), (v) Presentation and Classroom Atmosphere (PCA). This questionnaire is administered to all the students on both terms during each academic year using an online application named "UDQuest."

As per NCAAA's requirements, a target benchmark has to be fixed for overall students' satisfaction gathered from the SSLS survey. Usually, the new target benchmark for the upcoming academic year is fixed, with a 5% increase from the previous year's target benchmark. With a focus on achieving this, the policymakers are taking necessary steps to improve the instructors' lecturing skills by exposing them to routine teaching enrichment training programs and workshops; and offering suitable rewards. In order to execute this practice efficiently, there is a need to analyze or predict the exact parameters of SSLS on which an instructor should focus to improve students' positive feedback on instructors' lecturing skills. Recent studies have also stated that there is a prerequisite to realize the dimensions which influence the students' expectations and their satisfaction with learning [11,12]. Moreover, there are no previous studies conducted on how to improve the students' perception of lecturing skills by predicting the exact parameter to be focused by the respective instructors. Thus, this study aimed to use stochastic modeling to predict the exact parameters which are to be focused by the instructors to improve their quality of teaching, thereby enhance the overall students' satisfaction. As such, this study would aid the policymakers to focus on precise parameters of SSLS to improve the students' satisfaction on lecturing skills, thereby achieve the new target benchmark by saving time and cost. For this study purpose, the data on SSLS both at Term 1 and 2 for the past five years (i.e., 2014 to 2018) was retrieved from the quality measurement and evaluation department of DQAA (Table I). The diagrammatic representation of students' process to SSLS is described in Fig. 1. As per NCAAA standards, a new target benchmark is set with a 5% increase from the target benchmark of the previous academic year. In this manner, our study did a 5% increase to each parameter values to trace the parameter in which the shock/damage occurs.

TABLE I
NUMBER OF STUDENTS RESPONDED TOWARDS SSLS

Year	Term 1	Term 2	Total
2014	38,717	70,436	1,09,153
2015	90,662	1,30,658	2,21,320
2016	1,55,305	1,58,336	3,13,641
2017	2,03,872	2,12,279	4,16,151
2018	1,64,786	1,82,124	3,46,910
Total	6,53,342	7,53,833	14,07,175

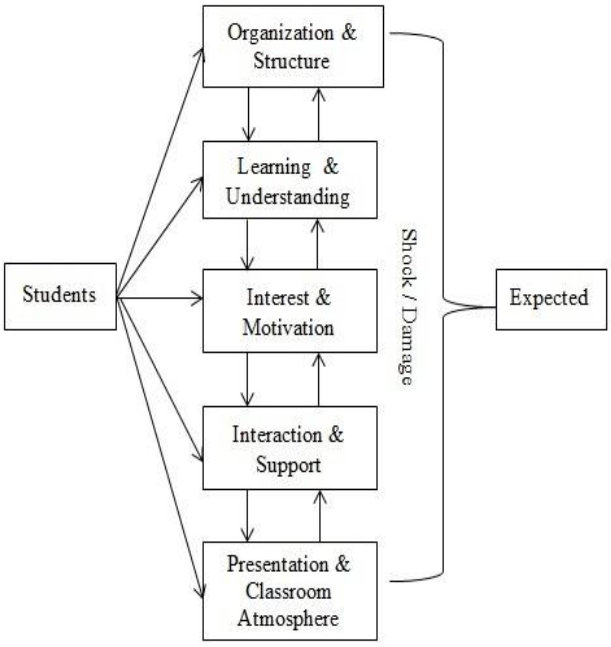

Fig. 1. Students' process to SSLS

II. Application of Stochastic Modeling in SSLS

Any models are of importance if the goodness of model fit with specific, predictable facts and retain an acceptable point of computational tractability, improvement, and control.

In Random variable, X_i (continuous random variable) questioners that are asked about the trial and answerable based on the accessible information. In this study, the accessible information permitted to assign probabilities to the event (1=Strongly disagree, 2=Disagree, 3=True sometimes, 4=Agree, 5=Strongly agree). A stochastic process, $\{X_i, i \geq 1\}$ system of identically independent distributed random variable, with Modified Weibull Distribution (MWD) [13], function $F(.)$. The additive maximum of probability, is the fraction of time occurring of an event to the probability of the event. The threshold level of the parameters is Y.

The cumulative $F(x)$ and probability $f(x)$ density function of MWD is

$$F(x;\alpha,\beta,\gamma) = 1 - e^{-\alpha x - \beta x^{\gamma}},\ x > 0$$

$$f(x;\alpha,\beta,\gamma) = 2\alpha\lambda x e^{-\lambda x^2}\left[1 - e^{-\lambda x^2}\right]^{\alpha-1}, x > 0$$

In the survival analysis for any loss of parameter, $t = 0$ for the loss time T of an object is a random variable with Survival probability $S(t) = \mathrm{P}\,(T > t)$. The failure-rate function of T is defined by $\lambda(t) = f(t)/S(t)$ for t such that $S(t) = 1 - F(t)$. The notations for probability density function in MWD is $g(.)$, the k-fold convolution of $g(.)$ represented by $g_k(.)$, and Laplace transform of $g_k(.)$ is $g_k{}^*(.)$ which is derived as an expected value.

$$P\left(\sum_{i=1}^{k} X_i < Y\right) = \int_0^{\infty} g_k(x)\ \lambda(t)dt \qquad (1)$$

The renewal process developed here for solving problems is associated with the failure of the parameter. From the renewal process, it is known that $V_k(t) = F_k(t) - F_{k+1}(t)$. Considering a renewal process with identically independent distribution, life, or cycle times that are exponentially distributed with mean $1/\lambda$, here all the lifetimes are integer-valued random variables. The lifetime is denoted by $L(T)$, $L(T) = 1 - S(t)$. In SSLS, the length of the life-time into which the observer arrives is six months, i.e., one semester. The inter-arrival time (c) of SSLS is six months in the regular interval following the exponential distribution. The Laplace transformation of the exponential distribution is given by $\frac{\mu}{\mu+\lambda}$.

$$Survival\ probability\ S(t) = \sum_{k=0}^{\infty} V_k(t) * P\left(\sum_{i=1}^{k} X_i < Y\right) \qquad (2)$$

$$= \sum_{k=0}^{\infty} [F_k(t) - F_{k+1}(t)][g^*\lambda(1-\mu)^2]^k$$

The lifetime is denoted as $L(T) = 1 - S(t)$, with Laplace transformation on both sides for $L(T)$, we get

$$l^*(s) = \frac{[1 - g^*(\lambda + \lambda\mu^2 - 2\lambda\mu)]f^*(s)}{[1 - g^*(\lambda + \lambda\mu^2 - 2\lambda\mu)f^*(s)]}$$

To trace out where the shocks are highly possible to occur among the five parameters, we derived the predictable mean E(T) as follows.

$$Predicted\ mean\ E(T) = \frac{\mu + (\alpha_2 + \beta_2)}{c(\alpha_2 + \beta_2)} + \frac{\mu + (\alpha_1 + \beta_1)}{c(\alpha_1 + \beta_1)} + \frac{\mu + (\alpha_2 + \beta_2)(\alpha_1 + \beta_1)}{c(\alpha_2 + \beta_2)(\alpha_1 + \beta_1)} \qquad (3)$$

Where;

$c =$ interarrival time per six months
$\alpha_1 = Organization\ and\ Structure$
$\alpha_2 = Learning\ and\ Understanding$
$\mu = Interest\ and\ motivation$
$\beta_1 = Interaction\ and\ support$
$\beta_2 = Presentation\ and\ Classroom\ atmosphere$

III. ILLUSTRATION

In Stochastic modeling, the observed data is substituted in the equation (3), and a gradual increase in the mean score was found from the academic year 2014 to 2018 (see Table II). For the observed data, the predicted R^2 value (from the regression model) indicated that 81% of students are satisfied with the SSLS before applying a 5% increase in each parameter in the SSLS model (see Fig. 2).

TABLE II
MEAN SCORE OF PARAMETERS IN SSLS FROM 2014 TO 2018

Year/Term c		α_1	α_2	μ	β_1	β_2	$E(T)$
2014	1	4.09	3.88	3.67	3.94	3.98	3.98
	2	4.18	4.05	3.89	4.09	4.1	4.01
2015	3	4.15	3.93	3.79	4.01	3.98	4.00
	4	4.22	4.03	3.91	4.1	4.07	4.01
2016	5	4.16	4.05	3.89	4.07	4.09	4.00
	6	4.18	4.09	3.97	4.11	4.13	4.02
2017	7	4.1	4	3.9	4	4	4.02
	8	4.1	4.1	4	4.1	4.1	4.04
2018	9	4.19	4.1	3.98	4.11	4.12	4.03
	10	4.18	4.11	3.99	4.11	4.13	4.04

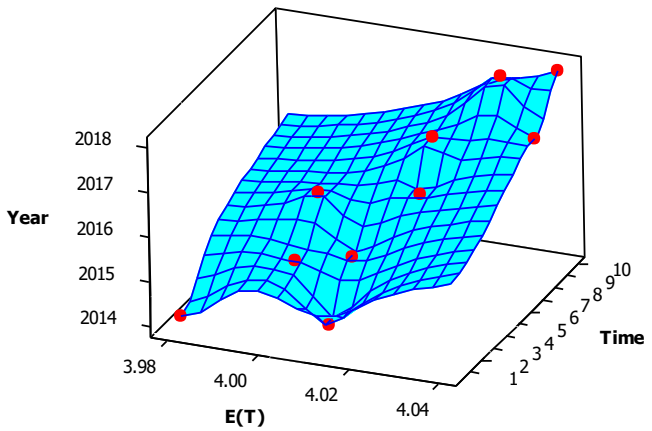

Fig. 2. The Trend showing the prediction of the percentage of overall students' satisfaction towards SSLS before applying a 5% increase

Furthermore, the results obtained from the application of Stochastic modeling over each parameter of the SSLS model following a 5% increase; and by keeping the other remaining parameters as constant (Tables III-VII). The obtained results are illustrated in Fig. 3-7. Our study predicted that overall students' satisfaction towards instructors' lecturing skills would reach 99% (R^2 value predicted from the regression model) by concentrating on the parameter "Interest and motivation" (μ) for the upcoming academic year (see Table III and Fig. 3). Next, if the parameter "Organization and structure" (α_1) is focused during the upcoming academic year, the students' overall satisfaction is predicted to increase up to 98% (R^2 value) (see Table IV and Fig. 4). Besides, the remaining three parameters such as "Learning and Understanding" (α_2), "Interaction and Support" (β_1) and "Presentation and Classroom atmosphere" (β_2) are observed to increase the overall satisfaction of students up to 96% (R^2 value) individually (see Table V-VII) and are shown in Fig. 5-7.

TABLE III
MEAN SCORE OF SSLS PARAMETERS FOLLOWING A 5% INCREASE ESPECIALLY IN "INTEREST AND MOTIVATION" (μ)

Year/Term c		α_1	α_2	μ	β_1	β_2	$E(T)$
2014	1	4.09	3.88	3.85	3.94	3.98	4.09
	2	4.18	4.05	4.08	4.09	4.1	4.11
2015	3	4.15	3.93	3.98	4.01	3.98	4.15
	4	4.22	4.03	4.11	4.1	4.07	4.17
2016	5	4.16	4.05	4.08	4.07	4.09	4.19
	6	4.18	4.09	4.17	4.11	4.13	4.21
2017	7	4.1	4	4.1	4	4	4.23
	8	4.1	4.1	4.2	4.1	4.1	4.25
2018	9	4.19	4.1	4.18	4.11	4.12	4.28
	10	4.18	4.11	4.19	4.11	4.13	4.31

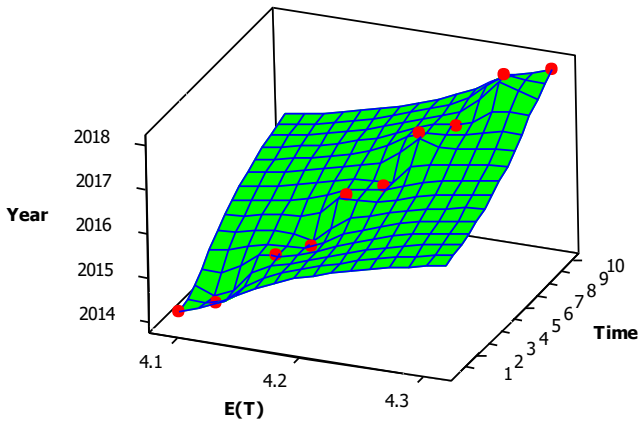

Fig. 3. Year-wise prediction of the percentage of students' overall satisfaction towards SSLS following a 5% increase in "Interest and Motivation" (μ)

TABLE IV
MEAN SCORE OF SSLS PARAMETERS FOLLOWING A 5% INCREASE ESPECIALLY IN "ORGANIZATION AND STRUCTURE" (α_1)

Year/Term c		α_1	α_2	μ	β_1	β_2	$E(T)$
2014	1	4.29	3.88	3.67	3.94	3.98	3.99
	2	4.39	4.05	3.89	4.09	4.1	4.04
2015	3	4.36	3.93	3.79	4.01	3.98	4.08
	4	4.43	4.03	3.91	4.1	4.07	4.08
2016	5	4.37	4.05	3.89	4.07	4.09	4.16
	6	4.39	4.09	3.97	4.11	4.13	4.19
2017	7	4.31	4	3.9	4	4	4.23
	8	4.31	4.1	4	4.1	4.1	4.23
2018	9	4.40	4.1	3.98	4.11	4.12	4.29
	10	4.39	4.11	3.99	4.11	4.13	4.32

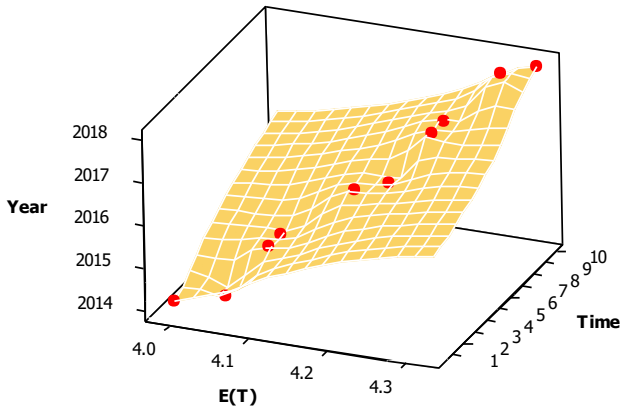

Fig. 4. Year-wise prediction of the percentage of students' overall satisfaction towards SSLS following a 5% increase in "Organization and structure" (α_1)

TABLE V
MEAN SCORE OF SSLS PARAMETERS FOLLOWING A 5% INCREASE ESPECIALLY IN "LEARNING AND UNDERSTANDING" (α_2)

Year/Term c		α_1	α_2	μ	β_1	β_2	$E(T)$
2014	1	4.09	4.07	3.67	3.94	3.98	4.01
	2	4.18	4.25	3.89	4.09	4.1	4.04
2015	3	4.15	4.13	3.79	4.01	3.98	4.04
	4	4.22	4.23	3.91	4.1	4.07	4.09
2016	5	4.16	4.25	3.89	4.07	4.09	4.11
	6	4.18	4.29	3.97	4.11	4.13	4.12
2017	7	4.1	4.2	3.9	4	4	4.15
	8	4.1	4.31	4	4.1	4.1	4.16
2018	9	4.19	4.31	3.98	4.11	4.12	4.16
	10	4.18	4.32	3.99	4.11	4.13	4.19

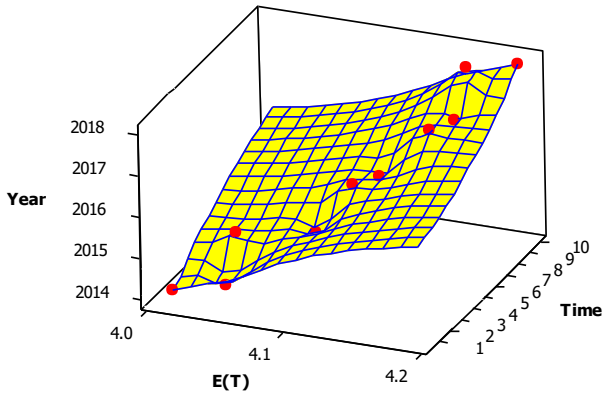

Fig. 5. Year-wise prediction of the percentage of students' overall satisfaction towards SSLS following a 5% increase in "Learning and Understanding" (α_2)

TABLE VI
MEAN SCORE OF SSLS PARAMETERS FOLLOWING 5% INCREASE ESPECIALLY IN "INTERACTION AND SUPPORT" (β_1)

Year/Term c		α_1	α_2	μ	β_1	β_2	$E(T)$
2014	1	4.09	3.88	3.67	4.14	3.98	4.01
	2	4.18	4.05	3.89	4.29	4.1	4.04
2015	3	4.15	3.93	3.79	4.21	3.98	4.04
	4	4.22	4.03	3.91	4.31	4.07	4.09
2016	5	4.16	4.05	3.89	4.27	4.09	4.11
	6	4.18	4.09	3.97	4.32	4.13	4.12
2017	7	4.1	4	3.9	4.2	4	4.15
	8	4.1	4.1	4	4.31	4.1	4.16
2018	9	4.19	4.1	3.98	4.32	4.12	4.16
	10	4.18	4.11	3.99	4.32	4.13	4.19

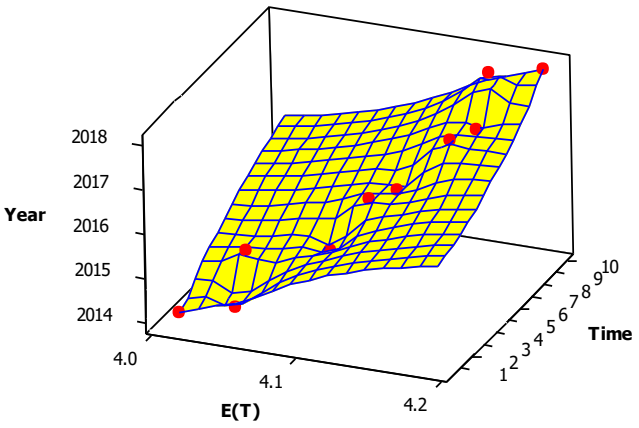

Fig. 6. Year-wise prediction of the percentage of students' overall satisfaction towards SSLS following a 5% increase in "Interaction and Support" (β_1)

TABLE VII
MEAN SCORE OF SSLS PARAMETERS FOLLOWING A 5% INCREASE ESPECIALLY IN "PRESENTATION AND CLASSROOM ATMOSPHERE" (β_2)

Year/Term c		α_1	α_2	μ	β_1	β_2	$E(T)$
2014	1	4.09	3.88	3.67	3.94	4.18	4.01
	2	4.18	4.05	3.89	4.09	4.31	4.04
2015	3	4.15	3.93	3.79	4.01	4.18	4.04
	4	4.22	4.03	3.91	4.1	4.27	4.09
2016	5	4.16	4.05	3.89	4.07	4.29	4.11
	6	4.18	4.09	3.97	4.11	4.34	4.12
2017	7	4.1	4	3.9	4	4.2	4.15
	8	4.1	4.1	4	4.1	4.3	4.16
2018	9	4.19	4.1	3.98	4.32	4.32	4.16
	10	4.18	4.11	3.99	4.32	4.31	4.19

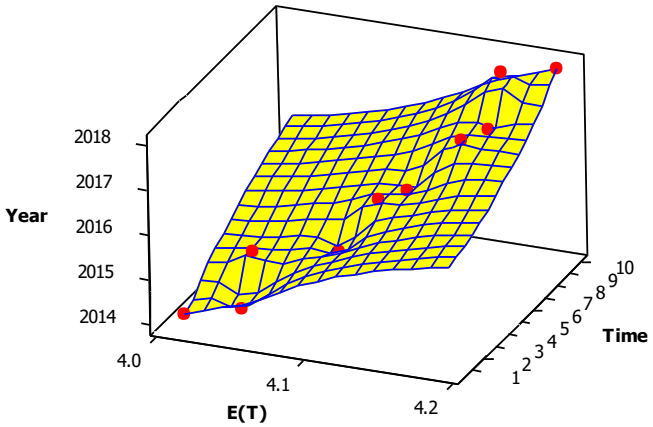

Fig. 7. Year-wise prediction of the percentage of students' overall satisfaction towards SSLS following a 5% increase in "Presentation and Classroom atmosphere" (β_2)

From the results, the exact parameter to be focused by the instructors is predicted from equation (3) as "Interest and motivation" (μ). This parameter would aid them in enhancing the overall students' satisfaction towards lecturing skills by 99% in the presence of a 5% increase in target benchmark as per NCAAA standards during the upcoming academic year. Hence, the instructors should mainly focus on their lectures and lecturing skills to influence the level of students' interest and motivation in classroom teaching. This finding is in line with the previous studies, which stated that lecturing skills play a prominent role in motivating students [14,15]. A recent study by Schiefele [16] also stated that the instructors could motivate the students using better class management and proper teaching methods.

Even though it is advised to focus on the parameter "Interest and motivation" (μ), the instructors should also focus on other parameters, which are predicting the overall students' satisfaction level below 99%. It implies that the instructors should organize as well as structure their lectures in a defined manner and prepare the userful lectures to positively

affect the students' learning and understanding to attain the overall students' satisfaction of its maximum. The instructors need to interact with the students actively as well as support them in the learning process. Besides, the instructors should regulate their pace of presentation and create a friendly classroom atmosphere to improve the students' overall satisfaction towards lecturing skills. In accord with this, previous studies also highlighted that the well-organized lectures, use of audio-visual aids for active learning and understanding, student-lecturer interaction, clarity of presentation, and friendly classroom environment have a substantial impact on the students' evaluation of effective teaching of their instructors [17,18,19,20]. Hence, the policymakers should drive the instructors to concentrate on these parameters, thereby the target benchmark regarding the students' overall satisfaction will be achieved to meet the NCAAA standards.

V. CONCLUSION

In this study, the application of stochastic modeling in higher education is observed as a valuable and exciting one since it assists policymakers in predicting the exact parameters that need to be focused by the instructors to enhance their quality of teaching, thereby improving the overall students' satisfaction towards the lecturing skills. Further, it also guides them to estimate the cost and time spent by adopting appropriate strategies to improve overall students' satisfaction score in SSLS. This study is limited to the application of stochastic modeling in SSLS. However, HEIs are conducting various other surveys such as course evaluation survey (CES), program evaluation survey (PES), student experience survey (SES), and academic job satisfaction survey (AJS) to monitor the quality of higher education. Therefore, the application of stochastic modeling in these surveys can be studied in further research, which would help the policymakers to meet accreditation standards successfully.

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