Effect Of Stress On Academic Performance
Among
Mechanical Engineering Students

BY

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CERTIFICATE OF APPROVAL

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We hereby recommend that the dissertation prepared under our supervision by: **Tehreem Tariq (NUST201362089MSMME62413F)** Titled: **"Effect Of Stress On Academic Performance Among Mechanical Engineering Students"** be accepted in partial fulfilment of the requirements for the award of MS degree with grade___.

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I hereby declare that this research study has been done for partial fulfilment of requirements for the degree of Master of Science in Biomedical Sciences. The intellectual content of this thesis is a product of my own work and no portion of the work referred to in this thesis has been submitted in any other degree or other institute of learning. I also certify that the thesis has been written by me. The help I received during my research work and preparation of the thesis, itself has been acknowledged. Moreover, I certify that all sources and literature used have been indicated in the thesis.

Tehreem Tariq

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DEDICATION

Dedicated to my universe

Mama

(For her unconditional love)

Abu G

(For his endless support)

Asim Abdullah

&

Mero & Nasar

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List of Abbreviations

Cumulative Grade point average	CGPA
Grade point average	GPA
Depression Anxiety Stress Scale	DASS
Social Package For Social Sciences	SPSS
Hypothalamus Pituitary Adrenal Axis	HPA axis
Corticotrophin-Releasing Hormone	CRH
Adrenocorticotropic Hormone	ACTH
World Health Organization	WHO
School of Mechanical and Manufacturing Engineering	SMME
National University of Sciences and Technology	NUST
CGPA scored by Normal students	NC
CGPA scored by Mildly Stressed students	MiS
CGPA scored by Moderately Stressed students	MoS
CGPA scored by Severely Stressed students	SS
CGPA scored by Extremely Stressed students	ES
Quiz score of Normal students	N
Quiz score of Mildly Stressed students	Mi
Quiz score of Moderately Stressed students	Mo
Quiz score of Severely Stressed students	SS
Quiz score of Extremely Stressed students	ES
Quiz score of Overall Stressed students group	S

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ABSTRACT

University students undertaking professional courses face general stress while being exposed to environmental, professional and academic challenges, which commonly subjects them to depression, anxiety and stress. This study was conducted to explore the effect of general stress on the academic performance of freshmen undergraduates, in cases of impromptu and long term examinations. General prevailing stress of the students was monitored though valid questionnaire; Depression Anxiety Stress Scale-21 (DASS-21), and categorized into five different stress levels i.e. Normal, Mild, Moderate, Severe and Extremely Severe. The cumulative grade point average (CGPA) of the students was utilized as a measure of long-term academic performance and the scores of correctly completed surprise quiz activity under strict time constraints was used for spontaneous short-term academic performance.

This study was conducted on 93 students, of age group 18 to 21 years, from School of Mechanical and Manufacturing Engineering (SMME), National University of Sciences and Technology (NUST), Islamabad, Pakistan, enrolled in the second semester of bachelors in mechanical engineering. Being an exploratory study sample did not comprise students from multiple disciplines and semesters. Convenient sampling was done based on the availability of students. Student's t-test was used to explore statistical associations.

Out of 93 participants, (97%) were males and (3%) were females. Average age of the participants was 18.8 years, 14 (15.0%) students had mild, 16 (17.2%) had moderate, 15 (16.1%) had severe while 5 (5.37%) had an extremely severe level of stress.

Through this analysis it was found that there is a significant difference between CGPA of normal and moderately stressed student's $F_{(1,57)} = 5.1066$, p=0.02767. In long term analysis of stress it was observed that CGPA of moderately stressed students was better as compared to students without stress, while on the other hand decline in performance was observed among students with increased or decreased stress level. While analysing short term impact of stress, stress was induced among students through surprise quiz, it was observed that students under high stress

performed relatively better in surprise quiz as compared to normal ones $F_{(1,91)} = 2.7021$, p=0.10367, though the results were not strongly significant.

Through this study we have identified that the students who experience moderate levels of general stress perform generally better in comparison to their fellows who experience much higher or much lower stress levels. Appropriate stress or appropriate level of challenge among students is necessary for optimal performance. Based on the findings, systematic conclusions are drawn and recommendations are compiled which would positively influence student's academic performance in particular and student's overall mental health in general.

Keywords: General Stress, DASS-21(depression-anxiety-stress scale), Academic performance, Cumulative Grade point average (CGPA), Short-term academic performance, Long-term academic performance.

CHAPTER 1

INTRODUCTION AND LITERATURE REVIEW

1.1. Background

Today's life is more complex than the previous times. Living in an age of immensely and rapidly changing with the passage of time we are exposed to various pressures and unavoidable stresses. We are subjected to ever increasing and persistently unavoidable pressures to cope with. As we are in race of competition for our survival than any other time, this needs to keep ourselves up for the basic survival. We have to maintain right equilibrium between excessive and low level of stress and to keep ourselves up and to compete for survival than at any other time. In this era of competition is of great importance in our daily life as no one is completely stressed free except dead.

Stress is most challenging syndrome of our society that is neglected instead of being a vital component of mental health. Internationally there is a significant research work conducted on the issue of mental health and peace but there was no innovative research available domestically. Mental health is an important performance enhancing factor of any society. [1]

1.2. History of stress

In our routine life tasks we are exposed to certain level of stress as only dead's are free from stress. Normal activities like a game of chess, completion of any official task, deadlines for projects, assignments, presentations, quizzes or exams can also induce an amount of stress that is quite considerable level.[1]

1.3. Defining stress through different studies

According to various studies several definitions of stress are known to us. Mostly it is defined as feeling of unpleasantness due to reaction of mind and body to any change which can be a trouble or unpleasant situation**.**[4]

Psychologists describe stress as an interaction of an organism with an environment through arousal of mind and body.[5]

Any disturbance upon body's internal balance or any challenge to homoeostasis is stress. [7] It is the way in which the body reacts to any kind of threat or any demand externally made upon it.

The word "STRESS" was devised to explain body's non-specific reaction to the stimuli of any demand made upon it.[2] This term of stress came from the science of mechanics and physics where it is described as physical pressure applied upon and between parts of a body and as a result this will cause a deformation termed as strain. These terms can be easily related to our life stresses and strains where they interrupt with the comfort zone of our lives. Perception of stress is linked with distress in common; this distress is a sort of condition which commonly causes frustration and tension in our life. In biological terms the word stress is referred to something which creates threat with an adverse outcome in organisms.[3]

There is no definition of stress which can conclusively, signify the complete concept stress which can be associated to the condition of humans. As Stress is not completely linked to a nervous tension as animals also suffer from stress though they have no nervous system. In every case it's not possible that stress is always an outcome of non-specific damage. As it can be associated to pleasant or unpleasant outcomes.[6]

1.4. Definition of stress

Webster new world dictionary defines stress, as a condition which is mainly categorized by various physical and mental symptoms which include tension or strain such as hypertension or depression that is an outcome of threatening or pressured situation [8, 9]

1.5. Outcomes of Stress

If triggered at appropriate times, stress is not always a bad thing as it is involved in activating body's different organs for response. As Dr. Hans Selye introduced the term stressor to differentiate between stimuli and response. Different stressors are involved in triggering stress; it includes a range of physical and psychological stressors.[1]Stress cannot be completely labelled as an illness, as every

individual faces some level of stress at some point in their lives, but in most of the situations its temporary state and one should get rid of it quickly. If this transitory state prolongs or not properly managed as early as possible it can literally be the reason of some serious consequences. Interpretation of stress according to a situation, through which person is going through, can predict stress as positive or negative stress

When stress, falls within the limitations of person's comfort zone it will be helpful. It will keep person motivated, focused and alert. This form of stress is helpful in meeting different challenges of life. It sharpens the skills of the person to fulfil particular tasks in our daily routine work of life.

But if this stress is beyond the person's comfort zone, it will be no more helpful and may lead to destruction of mind and as well as body.

1.6. Physiology of stress:

Adrenaline and cortisol are stress hormones, which play their significant role in preparing the body for an emergency situation. In other words, in case of situation when our body feels threat these hormones are activated.

Among somatic cells and neurons a complex signalling pathway is the part of human response in a stress situation. It includes activation of adrenaline and cortisol stress hormone. When our brain perceives any stressful situation a specific type of response occurs which is known as HPA (Hypothalamus Pituitary adrenal) axis. A hormone corticotrophin-releasing hormone (CRH) has been released by hypothalamus, which is a part of brain, activated in stress situation. This hormone triggers the release of another hormone Adrenocorticotropic hormone (ACTH) by the activation of pituitary gland. This will further activate adrenal cortex to release cortisol which will trigger hypothalamus for reduction of cortisol and this maintains body's balance in stress situation. Prolonged stress will lead to higher cortisol level circulation which in turn disturbs HPA axis response and can result in any neural damage. Network of interaction among pituitary, adrenal glands and hypothalamus is HPA axis and its increased and decreased activity is associated with different health issues.[10] Hence view of stress is both physiologically and neurologically body reacts in a state of stress.[5]

1.7. General Stressor

Stressor is basically the stimulus for the stress response. The agent or stimulus that elicits the stress reaction is referred as the stressor. Any stress weather it's from society or due to own fears, stimulated by some stressor. There are three main types of stressors:

- **Somatic Stressors** includes cold, heat, noise, injury, infection and pain.
- **Psychic Stressors** such as anxiety, fear, depression, danger, loneliness, over work and problem in love life.
- **Socio-Cultural-stress** involves difficulties at work, unsatisfactory living conditions, and trouble in family problems arising from interpersonal and social relationship, isolation and uprooting.[14]

1.8. Types of stress

Stress can be marked as either distress or as Eustress.[11,12] and one another type neustress.

- **Neustress** is neither positive nor negative. It refers to situation that is linked to the arousal of a body or a mind which has no impact on a person. This type of arousal is not harmful or helpful.[13]

- **Eustress** is a positive stress. This can be termed as good stress. It is manageable and motivational type of energetic arousal in order to attain peak performance. It will help a person in meeting deadlines and to fulfil particular tasks.

- **Distress** is a type of stress which is harmful or it can be a called as a bad stress, when it's difficult to cope up with good stress and it is no longer manageable it will tend to harm the person. This type of stress is not helpful in achieving goals as it plays role in hampering the performance.it affects the efficiency of an individual. And it can be cause of some serious psychological issues. Person may suffer from depression, severe anxiety, poor decision making power, delay in efficient work performance, a victim of disappointment and suicidal thoughts. [7, 12]

1.9. Sign and symptoms of mental distress:

Distress can lead to many physical problems that limit a person's intellectual abilities along with the behaviours. It may include:

- Headaches
- blood pressure elevation
- Trouble sleeping.
- Chest pain
- Upset stomach

It has been studied that stress can lead to worsening of certain symptoms or diseases. Several symptoms are related to harmful stress which may include:

- Depressiveness
- Hypertension
- Lack of focus
- Anxiety
- Unusual eating habits
- Fuzzy thinking
- Short-temperedness
- Tight shoulders
- Stomach churning
- Sore lower back
- Trembling hands.

1.10. General Causes of stress:

Mental capabilities of a person are affected by many biological, social and psychological factors. It's an individual coping ability with various causes of stress in a routine life. This will determine persons stressed or non-stressed state.[14] There are a lot of reasons which may cause stress in our daily life which may involve:

- Loss of a job
- Moving to a new home
- Getting married

- Emotional problems
- The death of a loved one
- Financial problems
- Divorce
- Chronic illness
- Stressful event, such as a natural disaster, mugging, rape, or violence

There are some inside reasons of stress which person faces rather than external environment for example:

- Fear and uncertainty
- Attitudes and perceptions.
- Unrealistic expectations.
- Sudden Change in life.

1.11. Academic performance And Stress:

In routine life, everyone is facing certain level of stress. It's not possible to completely get rid of it. Similarly our young population has been subjected to certain level of stress; this category of population is mostly students of schools, colleges and different universities leading to mental health issues in this portion of population.

Academic performance or achievement is related to an educational outcome, which is referred up to the level at which student can attain his or her academic goals. Academic performance is mostly recorded by exams or recurrent assessments but how it can be judged accurately is the most important fact which is still under study. Most researchers found that academic achievements are judged on the basis of scores attained in exams.[21-25]

1.12. Mental health

Mental health ,according to, world health organization (WHO 2005), is not only associated with the absenteeism of any psychological disorder ,rather it a state of stability in which an individual is capable of coping stresses which are normally the part of life or individual is able to contribute to the wellbeing of the community.[20]

A very positive link between mental health and academic achievement has been reported. As according to a study it was recognized that high achievers in terms of academics were mentally healthy. [20]

1.13. Stress as a major component of mental health

According to different studies, mental stress is an important public health issue all over the world and affecting our younger population mainly. Though problems regarding mental health are the prominent issue of whole society but the category of students belonging to university life shows trend of high prevalence of stress as compared to other population. This has been proved through different researches. [15-17]

1.14. Mental health explaining role of stress in academics

As mental health is considered, as a major contributor in academics, mainly during higher educational system. It has been reported by academic consultants, in this era of competition, students' performance is lot more affected by mental health issues than ever before. [63]. Noticeable association exists between mental health and academic performance and retaining capability[62].According to a study conducted on some random sample of college students explaining how mental health influences success in academics, it was found that depression is significantly associated with poor GPA especially among students associated with anxiety disorder. This lower GPA may have an association with other factors like eating disorders.[18]

Various studies of students mental depicts role of stress in their grades as according to a health survey report of year 2007 which was conducted among large sample of students from randomly selected colleges and universities of Minnesota. It was reported that among many Common health factors which were directly linked to grade point average (GPA) and may contribute in lowering of GPA, stress is considered one of these factors targeting undergraduates. According to survey it was reported that 69.9 % students believed that stress affects their academic performance where as 32.9% claimed that stress affects academics negatively. According to this study average GPA of students who claimed that stress has negative relation with

GPA was 3.12 which was slightly lower as compare to students without the stress issue having average GPA of 3.23.[19]

Modern literature reports that their findings that youngsters under mental health problems perform lower as compare to other students in schools and this associations retains throughout their career of early education in terms of poor academic performance.[26-28]

According to a study, by Miech and colleagues in 2005, they reported that the educational inconsistencies due to mental illness continue through life.[29] According to Woodward & Fergusson, 2001, anxiety disorders, which has role in stress generally and adverse educational outcomes are significantly associated. These outcomes can be failure; in attending college or being involved in some productive training programs in future.[30]

Depressiveness among students along with disruptive behaviours are responsible for failing grades and other school adjustment and proper functioning problems.[31, 32] Lower academic achievements were also discovered among the Chinese youth who had scored high on Children's Depression Inventory as compare to non-depressive students [33]

In another study the students' academic performance is influenced by the individual self-efficacy along with perceived stress. Furthermore the perceived stress and self-efficacy showed an inverse correlation among the various subjects under study. Whereas self-efficacy is positively correlated with academic success.[34]

As stress is studied as an extensive predictor of adjustments in terms of academics and has generally negative relation with academic success of specially freshmen undergraduates.

On the either hand,, few studies failed to signify any association of academic performance with perceived stress.[38]

Self-efficacy is the measure of student's ability to perceive stressful and threatening scenario as a potential challenge for an individual growth. Furthermore increased external stress on an individual can potentially decrease the self-efficacy of

the student, as it has been observed that stress is inversely correlated with an individual's self-efficacy. A research, included traditional students enrolled in engineering courses to observe the combined effect of external stress and self-efficacy on the student's semester grade point average, concluded stress as lowering self-efficacy factor.[39-42] Mathematics self-efficacy, in particular, showed marked correlation with the academic performance whereas math anxiety had an indirect influence on student performance. [43]

Whereas there can be multiple reasons besides stress that leads to the ultimate failure such as inability to cope with stress and self-efficacy of an individual, particularly college undergraduate students, but stress certainly plays some role in the entire phenomenon. Significant and insignificant contribution of stress towards both, increase and decrease in the CGPA of students has been observed by various studies. [43]

1.15. Different stressors of students:[36, 47]

According to different studies many stressors are potentially associated to university life. And these stressors affect academic performance. Recent studies associated many factors related to the stress life of students. Some of these factors include:

- Age
- Gender
- ethnicity
- Study hours
- Staff or faculty
- Economic condition
- Family social status
- Living standards and health issues
- Accommodation problems like hostilities
- Loss of any friend or a close family member.
- Academic problems: academic discipline, performance, study year etc.

1.16. Major Stressors of University life

As university time period is known to be a challenging duration of someone's life. That's why it might be stressful experience for an individual.[15-17]. As discussed in many studies that university students experiences many type of academic stressors like deadlines for assignments, presentations. Quizzes and exams in a semester system as it have correspondence with the study in which major school stressors were highlighted as examinations and homework.[69]

According to various studies ,Shifting from the school setup to a university has been a great challenge in itself in higher educational system along with different stressors like time pressures which students mostly face in terms of deadlines for projects, assignments and quizzes, financial status and limited recreational activities due to tough schedule [48, 49]. University students are commonly subjected to stress due time limitation in terms of tasks and Exam [50]. And many sociodemographic factors are associated with student's psychological issues. [49, 51-54]**.**

Latest research analysis reported that over 50% students belonging to universities showed depressive symptoms just at the very beginning of their educational career. According to many studies higher ratio of mental disorder among students exists i.e. 30% in Canada, 41.9% in Malaysia, 53% in USA and Australia. Researches which were conducted in Europe and North America are pointing towards the alarming fact that students belonging to colleges and universities life are more prone to mental distress than other generalized population [55, 56]. It was reported that Illness during study period among students might be an outcome of excessive stress among college or university students as shown by the study indicating significant relation between illness and stress.[51].

In western societies mental health issues i.e. existence of anxiety and stress issues among university students leading to depressiveness, is of great concern as compare to eastern societies. As younger population is the vital portion of our society and mental health , is of great concern requiring our special attention.

1.17. Academic Performance as major stressor of university life

Academic performance is the most important stressor as compared to all other stressors of student life in terms of higher educational level. In a university system it is validated by grade point average (GPA) which is different from annual system as it is half year examination system.

As we are focusing,, on Mechanical engineering students, in this study who are subjected to stressors of semester system. According to previous studies it was reported that engineering students were comparatively at lower stress level, in comparison with medical students.[6, 57-59] **.** This has been proved by another study which concluded high occurrence of stress in medical students as compare to students belonging to other different professional courses i.e. students belonging to engineering field.[53] High level of this stress , is ranging from 30% to 50%.[60] has been reported in students belonging to medical field. This has been labelled as a Medical school syndrome. Health and life style factors may be one the reason of presence of higher stress among students.[64]

There exists variance of performance among students. Academic performance is basically affected by external and internal factors. Stress is one of the known major factor which has impact of educational system. [61]

As one cannot eliminate stress completely but can be reduced as it is the part of daily life ,similarly students are facing many stressors**.**[5, 61]

1.18. Positive and negative impact of stress on academic performance:

In academic situation like other daily life matters, stress has both positive [67] and negative consequences[61]

Stress hindering or suppressing learning, is unfavourable or negative type of stress and it will be associated with low academic performance.[47] However through proper management this stress can become positive and lead to the promotion of learning capabilities.

1.19. Statistical link among stress and field of education:

Many research work done in the past reported that significant correlation exists between achievements on academic ground and stress at student level.[65]

1.19.1. Negative relation between stress and academic performance:

Most studies reported negative impact of stress when we relate it with educational system and it was the common perception for stress effect that it reduces the academic performance.[66]

And the research showed negative significant relation of academics and stress but it was weak relation.[65]

1.19.2. Positive Relation of stress on education:

According to some studies negative concept of stress effect was denied as it was shown through the results of different studies that certain level of stress has role in achieving better performance and is helpful in the process of learning thus enhancing performance skills. This specific level of stress is positively connected to educational achievements and has been proved to be motivational.[47] stated this motivational level of stress as moderate stress which plays role in achievements in educational performance.[67] According to a study on undergraduate medical students it was reported that students in the category of severe and high level of stress attained good CGPA.[68]

1.20. Depression Anxiety Stress Scale

1.20.1 DASS 21

DASS-21is the depression, anxiety and stress scale which has been confirmed by many researchers as a screening tool in analysis of various sociodemographic conditions and has been used in many studies for analysis purpose.[70]

1.20.2. History of Dass-21:

Depression anxiety stress scale (DASS) is basically a questionnaire used for the data collection. In this study DASS -21 has been used which is the shorter form of questionnaire as compare to the original complete version which is based on 42-item and known as DASS-42.It has been reported through studies that Dass-21 has relatively enhanced psychometric properties as compare to DASS-42 .This DASS is an inventory accounting for the evaluation of negative affective conditions.[71]

Through past studies DASS has been reported as a valid tool known for its three scales, (stress anxiety and depression). This has been strongly supported for internal consistencies through psychometric analysis of DASS while its use on nonclinical samples. Mostly this type of analysis was done on non-patient sample for exploratory and confirmatory studies of DASS factors. [70]

 1.20.3.Properties of DASS -21 [72].

- It has served as an instrument for the measurement of severity.
- In past was related to self-analysis tool.
- It serves as numerical measurement tool as compared to categorical
- It has been considered as the most reliable globally
- And has been ranked as screening instrument which is easy in use.

1.20.4. Dass-21as a more reliable instrument

According to wide variety of literature it has been reported that DASS in both versions , either in form of DASS-42 or DASS-21 , has been validated as the most reliable tool for depression , anxiety and stress measures in case of clinical and non - clinical study of adults.[70-72, 76-79] this has also been accepted in case of different culture or ethnic group. Depending upon the outstanding psychometric properties in case of adults, it is the most concise questionnaire and more reliable tool to efficiently measure the stress among the young population [80] As its factors are short and more reliable in terms of stability and clarity.**[76]**

1.20.5. DASS study on clinical and non-clinical samples:

While studying DASS on clinical samples, high stress scores were associated to general anxiety disorders **,**whereas high anxiety scores were associated to panic disorders [74] This type of association between worrying in excess and stress has also been identified among non-clinical samples.[75]

This particular nature of stress scale of DASS was marked as a question by many researchers who claimed that it has been associated to generalize negative affect**,** which has been evidenced as a different and unique feature from general distress as well as depression and anxiety factors**.[72, 76]**. It was found that all the three scales Of DASS-21 are positively correlated and reflects the traits of general psychological distress but stress scale cannot be explained by factors specific to general distress**.[76]**

1.20.6. Stress as a unique feature of DASS:

Originally development purpose of such tool, i.e. DASS, was for the measure of depression and anxiety scales as it covers the wide range of essential symptoms of these two affective conditions in adults. As well as maximally discriminating these two states from each other. In most of the studies, where factors of both scales were analysed showed that DASS comprises of almost each symptom of anxiety : like arousals or anxious feelings , and symptoms of depression which includes lack of positivity , loss of hope , devaluing of life etc. [70]whereas it was reported numerous other symptoms were quite unique to depression and anxiety factors and have no strong linkage to them. These include disturbance in eating or sleeping habits or fatigue and lack of focus these factors were referred generally as emotional distress. Addition of these factors to the questionnaire enhanced its specificity and uniqueness. Including these discriminant factors in the questionnaire was of great importance and referred as stress scale of the DASS and considered as its unique feature. Due to its similarity with the description of stress syndrome as described by [73] it was categorized as the general stress scale including various symptoms i.e. lack of patience, hindrance in relaxation , state of tension and irritation.[70] Recently an interesting fact about this stress scale of DASS has been identified that it has been

associated to generalized stress in the form of excessive worrying as compare to stress associated with specific fears and phobias.

1.20.7. Steps to reduce stress among students:

Necessary steps should be unified with study curriculum for stress management according to many students' point of view. These steps may include concerns regarding students' mental health, elevation of their healthy lifestyle and dietary habits. Students themselves and specially faculty and parents should realize that extra ordinary expectations may lead to stress in terms of educational achievements. Aim should be minimize stress upto the level where it is student friendly and helpful in enhancing their productivity in terms of performance. Proper time management enough preparation with discipline in study will help to reduce stress among students.[53].

As of now there exists little to no research conducted which correlates the general stress and academic performance of freshmen undergraduate students.

1.21. Problem statement

To verify the extent to which different levels of general stress in students influences their academic performance.

1.22. Objective of study

To explore the effect of general stress on the academic performance of students in cases of impromptu, pre-prepared and long term examinations.

1.23. Significance of study

This study signifies general stress prevailing among university students specially undergraduates of Mechanical Engineering, which might be helpful in building new interventions for campus in regard of health services, helping their students to face challenging situations. We can conclude through this study that students, at which stress level, are able to achieve higher CGPA, as compare to their fellows who may experience much higher and lower levels of stress. Student's performance under long term and short term examinations when analysed may signify the fact that the level of stress which the students are experiencing may not be helpful in terms of academic performance of students undertaking professional courses.

CHAPTER 2

MATERIALS AND METHODOLOGY

2.1   Study Design

This study is of descriptive type in nature. It is an exploratory study based on convenient sampling including survey type of analysis providing data information about stress level and academic performance of students; through questionnaire and academic record respectively.

2.2   Study site

This study was conducted among the students of School of Mechanical and Manufacturing Engineering (SMME), National University of Sciences and Technology (NUST) Islamabad.

2.3   Study Duration

The duration of this was **from June 2015 to September 2016.**

2.4   Participants

Participants involved in this analysis were the first year undergraduate students of age group between 18-21 years, from the discipline of Mechanical Engineering studying at School of Mechanical and Manufacturing Engineering (SMME), National University of Sciences and Technology (NUST) Islamabad. All students included in this study were from second semester of BE Mechanical at the time of data collection. From the student's perspective, anonymity was maintained regarding the nature and purpose of this study.

2.5   Sample size

Total 93 undergraduate students of mechanical engineering from second semester of SMME-NUST were included in this study. (N=93).

2.6   Descriptive statistics

The descriptive statistics of the test subjects, such as age, gender and categorical distribution among various stress levels were performed through STATISTICA®.

2.7   Sampling technique

Technique adopted for the sampling of this study was simple non-random sampling technique.

2.8   Ethical consideration

Institutional consent was taken from institutional ethical committee, National University of sciences and technology (NUST). The student data was kept confidential and strictly for academic purpose. The teaching faculty was informed about the survey and the observations, results, findings and conclusions of this research were shared with the faculty after the termination of the study.

2.9   Selection criteria for the target sample of the study:

2.9.1   Mechanical engineering discipline: This research is based on the purposive selection of undergraduates based on their specific discipline. As undergraduates undertaking professional courses might be having more stress in concern of their jobs in future.

2.9.2.   Fresh undergraduates were considered for the study: This study was conducted on first year undergraduate students, as in comparison with senior level in university, juniors had greater tendency of stressful responses due to adjustment problems in new atmosphere of university life

2.9.3Exception from different disciplines: Being an exploratory study the sample did not comprise of students from multiple disciplines and semesters. Convenient

sampling was done based on the available second semester undergraduate students of Mechanical Engineering from School of Mechanical and Manufacturing Engineering (SMME), National University Sciences and Technology (NUST) Islamabad.

2.10   Students' academic record collection:

As in this study we are focusing on the impact of stress on performance of students. The students long-term academic performance was estimated through their cumulative grade point average (CGPA), collected through the institutional records. This performance record was obtained through the following:

2.10.1 CGPA

Cumulative grade point average is for the measure of student's average performance across all subjects being taught. In a semester based system of education CGPA is used to represent student's performance numerically in his or her university career. Average Grade of the student in all courses in a specific semester is represented as the grade point average GPA of a student in that specific semester and by averaging up the semester-wise GPA of a student in all of his or her semesters we will get CGPA which is used as a standard metric of performance of individuals enrolled in a professional education course. GPA is the weighted average of all grade points earned by the students. CGPAs of the participants included in this study were obtained from the exam cell of the school of Mechanical and Manufacturing Engineering (SMME) of National University of Sciences And Technology (NUST) Islamabad. The CGPA of all the students was recorded in the database maintained in a Microsoft® Excel™ spread sheet.

2.10.2 Surprise quiz Activity

The estimation of short-term academic performance of the students was measured through their scores in an unannounced and impromptu quiz exam. This activity was performed in the class by distributing a general mathematics quiz among the students involved in the study. This quiz activity comprised of 12 questions based on simple addition subtraction multiplication and division .Time limitation was of 8

minutes to complete the quiz. Task performance was calculated by the correct completion of 12-item math task. Subjects were given time pressure and were conditioned as they had a limited amount of time 8 minutes to complete the task and were continuously reminded of this time pressure, to induce a sense of challenge and difficulty in the subjects and maintain a stressful environment. This activity was helpful in determining students' skills to complete quiz timely and its association with their stress levels. Utilization of mathematics quiz has been used to induce a sense of stress among the test subjects in past as well, as documented by Orfus and Shauna while studying, time pressure effect on performance. [81].

2.11 Stress levels associations with academic performance:

According to the methodology of this study we associated students stress level with their academic performance mainly through two different associations:

2.11.1. Long term impact of stress:

First level of association was the relation of stress level with cumulative grade point average of students. (CGPA), which is long term analysis of stress levels effect on their performance.

2.11.2 Short term impact of stress:

Secondary association was linking the students 'stress level with the performance which we calculated in terms of scores obtained, in the surprise quiz activity of general mathematics against certain time pressure, by the students. This is considered as the short term impact of stress on student's task performance including time limitation.

2.12 Stress Level Data Collection:

The quantitative study was performed by distributing DASS-21 questionnaire among the target students and they were asked to fill the questionnaire without any time constraints as best as they can. Complete anonymity in the collection of the data was ensured to the students and it was also maintained afterwards.

2.13   Stress Level Categorization:

The students were grouped into different stress levels based on their DASS-21 questionnaires and this categorization was performed by using the data analysis and clustering tool Statistical Package for Social Sciences (SPSS) version 20.

2.14   Quiz Distribution, Collection and Grading

The unannounced quiz was conducted immediately after the DASS-21 questionnaire was submitted by each student. The time duration allowed for the 12 question general mathematics quiz was 8 minutes. Upon completion of the quiz or the completion of the allocated time, whichever occurred sooner, the mathematical quiz was withdrawn from each student. After the collection of all the quiz exams the quizzes were scored and the results were recorded in the database maintained on Microsoft® Excel™.

2.15   Quiz Data Analysis:

The Unannounced Quiz Score Data was analysed using the STATISTICA version 10 (StatSoft).

2.16   Statistical analysis:

Student's t-test was used to explore association between students stress levels and their performance using STATISTICA version 10 (StatSoft). Data related to stress was collected through DASS-21 and students were distributed among different levels of stress using SPSS version 20.

2.17   Investigation tool for the students stress level:

Depression Anxiety Stress Scale-21, as a valid tool, was selected for the evaluation of stress levels among target sample. Valid tool DASS-21 which was selected for the assessment of stress levels is basically a questionnaire of four point Likert scales ranging from strongly disagree to strongly agree.

2.18   DASS 21

Is known as depression, anxiety and stress scale and has been confirmed by many researchers as a screening tool in analysis of various sociodemographic conditions and has been used in many studies for analysis purpose. [70]

2.18.1 Sub-Scales of Dass-21

Three subscales are known to Dass-21, as Depression, Anxiety and stress. Each scale is comprised of 7-items or questions. Through summation of the relevant items scores, each sub-scale score has been obtained. Each scale is the indicator of specific measures, like

2.18.2 Depression Scale

Thoughts of negativity, failure, and self-criticism, lack of focus or devotion, feeling of aimlessness, low self-esteem and mood have been indicated by depression scale of Dass.

2.18.3 Anxiety scale

Anxiety sub-scale of Dass measures feelings of anxiousness and restlessness. It has been related to autonomic stimulations

2.18.4 Stress scale

Whereas stress scale is an indicator, of various responses to situations of stress or intolerant conditions, when person is, having negative feelings. It has been related to the traits like irritated personality, easy to get emotionally upset, over- responsive, and lack of patience and relaxation difficulties.

2.18.5 Level of stress obtained through DASS-21

On the basis of Scores obtained from DASS-21, students were categorized among 5 different levels of stress. It includes normal, mild, moderate, severe and extremely severe level.

2.18.6 Four point likert scale

The target sample is required to use four point scale, 0-3. Where 0 means that the respondent totally disagrees with the situation and 3 is for the strong agreement of the respondent according to the condition mentioned in the given item.

2.18.7 Scores distribution of DASS-21

According to the scores obtained against each sub scale different categories were obtained and were named as the normal, mild, moderate, severe and extremely severe.

As our scale of interest is stress, so depending upon the scores different categories of stress among students were obtained. [70].

1. Scores of normal students:

If the stress score is less than 14, student will lie in the category of normal.

2. Scores of mildly stressed students:

It the score is in the range of 15 to 18, respondent will be considered as mildly stressed.

3. Scores of moderately stressed students:

If the score level is in the range of 19 to 25, students will fall in the category of moderate stress.

4. Scores of severely stressed:

If the score is between 26 and 33 then students are in the category of severely stressed.

5. Scores of extremely stressed student:

If the score is more than 34, it indicates that students are extremely stressed.

2.19   Research Methodology Summary

The complete overview of the research methodology is described graphically in the Figure 1. The Major steps in the research study are described briefly following the Figure 1.

| DASS-21 Questionnaire filled by target sample | → | Students distribution among different levels of stress | → | Unannounced Quiz Conducted under constrained time | → | Cross-comparison of stress level with CGPA and Quiz performance among students in different stress levels | → | Correlation of Academic Perfroamce with general stress in the students |
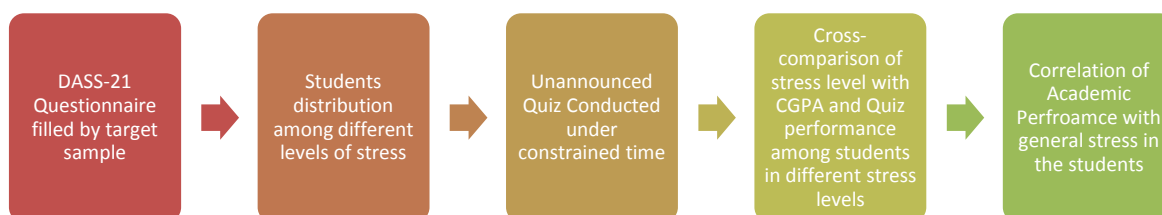
Figure 1. The Different Steps of the Complete Research Methodology

1-   Stress Level Data Collection DASS-21

The Stress Level Data was collected through the questionnaire DASS-21 and all the individual data was recorded in a Microsoft® Excel™ database.

2-   Stress Level Categorization

The students were categorized among the 5 levels of general stress; Normal (No Stress), Mild Stress, Moderate Stress, Severe Stress and Extreme Stress.

3-   Short-Term and Long-Term Academic Performance Data Collection

The Short-term academic performance data was collected through the unannounced quiz conducted among the test subjects. The Long-term academic performance data was collected from the exam-cell of the respective institute SMME, NUST.

4-   Academic Performance Comparison

The Academic Performance of students grouped in different categories was compared for both the Long-term and Short-term performances analysis.

5- Correlation Analysis of Academic Performance and General Stress

Statistical analysis of data obtained through; questionnaire (Dass-21), CGPA record and quiz performance of students included in our target sample, was done using statistica version10 (StatSoft). Students t-test was used to look for an association between different stress levels and students performance which we calculated in terms of their CGPA's and scores of quiz performance. As our variable of interest is stress, we get its data from questionnaire Dass-21 using SPSS version 20 software. Distribution of students among different levels of stress was done. This stress would be considered as independent whereas students' performance (CGPA, quiz) would be considered as dependent variable in this study. Association between students' academic performance and stress will decide at which level students are able to perform well. Results were considered significant if $p<0.05$.

CHAPTER 3

RESULTS

In this section the comparison results of the data acquired through this research study are tabulated and analyzed. In some cases the results show the data variation in the tests performed is insignificant but in other cases (particularly Moderate Stress levels) the variation in academic performance show significant evidence to draw appropriate conclusions in the discussions section.

Statistica® was used to perform the comparison between the various metrics analyzed in this research study. 2 metrics were analyzed to generate the datasets for the performance comparison.

1- Cumulative Grade Point Average (CGPA)   Long-term Academic Performance

2- Unannounced Surprise Quiz (Pre-Quiz) Scores Short-term Academic Performance

3.1.   Descriptive Statistics

Out of 93 Engineering students, 93 students returned the questionnaire. As such 93 respondents were included in this study, giving a response rate of 100%. 3 out of 93 (3.2%) were female and 90 out of 93(96.8%) were male. Gender distribution among the test subjects is shown in Figure 2.
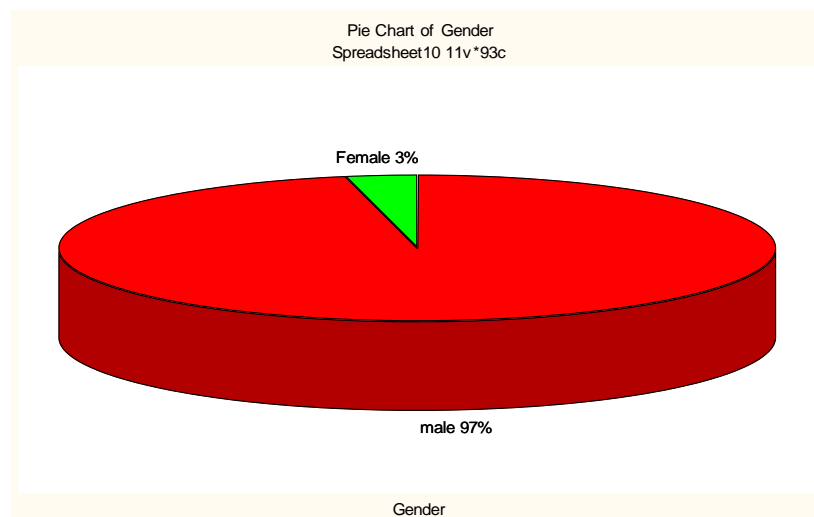
Figure 2. Number of Male and Female students included in the study.

3.1.1. Five Major Categories Of Students

DASS-21 will distribute students among the following five categories depending upon the scores of DASS-21:

- Normal students
- Mildly stressed students
- Moderately stressed students
- Severely stressed students
- Extremely stressed students

The number of students falling in each category of stress, as determined by DASS-21 score, is as shown in the pie-chart in Figure 3.
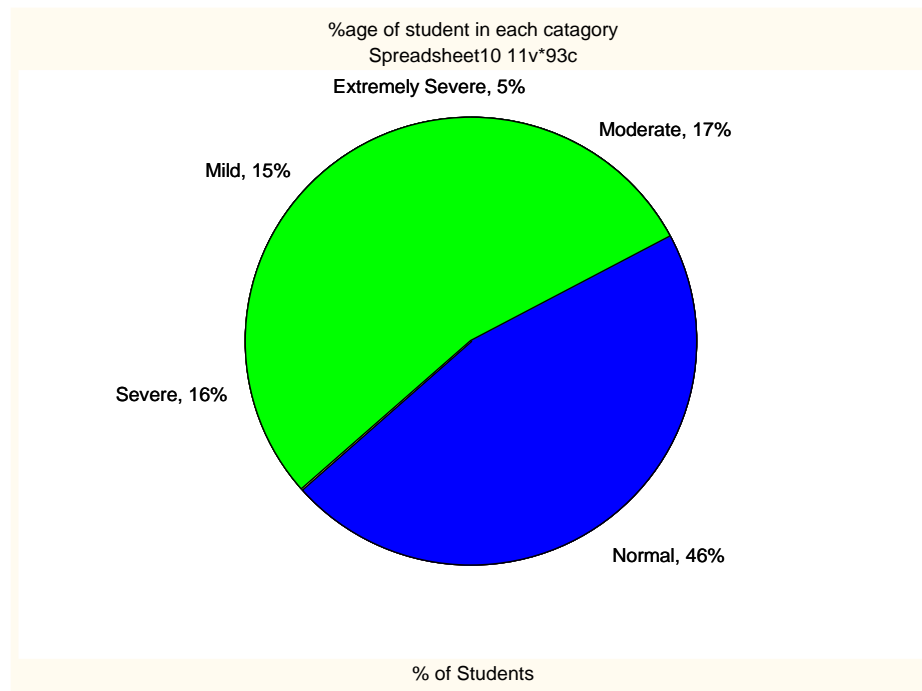
Figure 3. Number of students falling in each category of stress.

3.2 Case I   Cumulative Grade Point Average

The CGPA of all the students was analyzed for the purpose of this study. Long-term academic performance was estimated using CGPA. The mean CGPA of students in different categories is shown in Figure 4. The Average CGPA of each student category is tabulated in Table 1.

Category	Average CGPA
Normal Students	3.32
Mildly Stressed Students	3.38
Moderately Stressed Students	3.52
Severely Stressed Students	3.38
Extremely Stressed Students	3.36

Table 1. Average CGPA of students falling under different categories of stress.
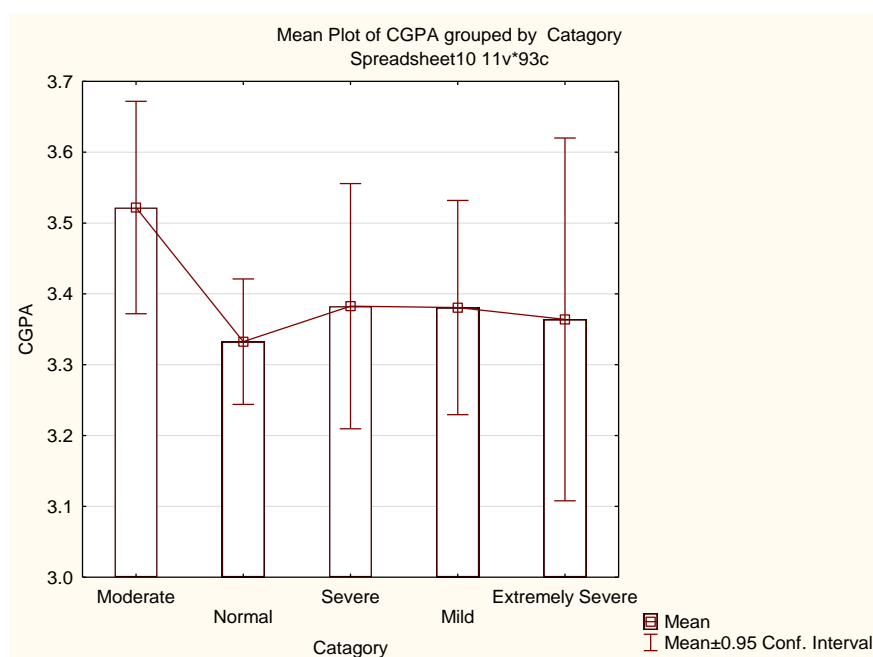
Figure 4. Average CGPA of all the students accumulated in different categories of stress.

From the Average CGPA of different stress categories of the students it can be observed that the students experiencing moderate levels of stress had better long-term academic performance as compared to the students experiencing much lower and much higher levels of stress.

For the results explaining the research study of the CGPA comparisons among different student categories following annotations will be used;

NC   -   CGPA scored by ***Normal*** students (Control Group)

MiS   -   CGPA scored by ***Mildly Stressed*** students

MoS   -   CGPA scored by ***Moderately Stressed*** students

SS   -   CGPA scored by ***Severely Stressed*** students

ES   -   CGPA scored by ***Extremely Stressed*** students

In each of the comparison cases the data spreads are compared and the resulting variations are explained along with the plots.

3.2.1 CGPA   :   NC   vs.   MiS

The confidence interval Plot for the performance comparison of Normal Students (NC) and Mildly Stressed Students (MiS) is shown in figure 5 and the comparison and analysis results are shown in Table 2.

**Figure 5. The Confidence Interval plot for the CGPA comparison
between Normal Control Group and Mildly Stressed Students**

Effect	SS	Degr. of Freedom	MS	F	p	Partial eta-squared	Non-centrality	Observed power (alpha=0.05)
Univariate Tests of Significance, Effect Sizes, and Powers for NC-MiS (Sheet2) Sigma-restricted parameterization Effective hypothesis decomposition								
Intercept	475.9816	1	475.9816	5992.382	0.000000	0.990905	5992.382	1.000000
NC-MiS	0.0245	1	0.0245	0.308	0.580950	0.005575	0.308	0.084747
Error	4.3687	55	0.0794					

Table 2. Comparison of CGPA of Normal Control Group with Mildly Stressed Students

As observed from the p-value the result doesn't show any significant correlation between the performance variation and stress among the normal students and mildly stressed students.

3.2.2 CGPA : NC vs. MoS

The confidence interval plot for the performance comparison of Normal Students (NC) and Moderately Stressed Students (MoS) is shown in figure 6 and the comparison analysis results are tabulated in Table 3.

Figure 6. The Confidence Interval plot for the CGPA comparison between Normal Control Group and Moderately Stressed Students

Effect	Univariate Tests of Significance, Effect Sizes, and Powers for NC-MoS (Sheet2) Sigma-restricted parameterization Effective hypothesis decomposition							
	SS	Degr. of Freedom	MS	F	p	Partial eta-squared	Non-centrality	Observed power (alpha=0.05)
Intercept	547.8725	1	547.8725	6694.173	0.000000	0.991557	6694.173	1.000000
NC-MoS	0.4179	1	0.4179	5.107	0.027674	0.082223	5.107	0.603211
Error	4.6651	57	0.0818					

Table 3. Comparison of CGPA of Normal Control Group with Moderately Stressed Students

From the p-value observed (0.027674) the result shows that a significant correlation exists between the performance variation and stress among the normal students and moderately stressed students. In general Moderate levels of Stress can be linked to a higher average CGPA.

3.2.3 CGPA   :   NC   vs.   SS

The confidence interval Plot for the performance comparison of Normal Students (NC) and Severely Stressed Students (MoS) is shown in figure 7 and the comparison and analysis results are tabulated in Table 4.
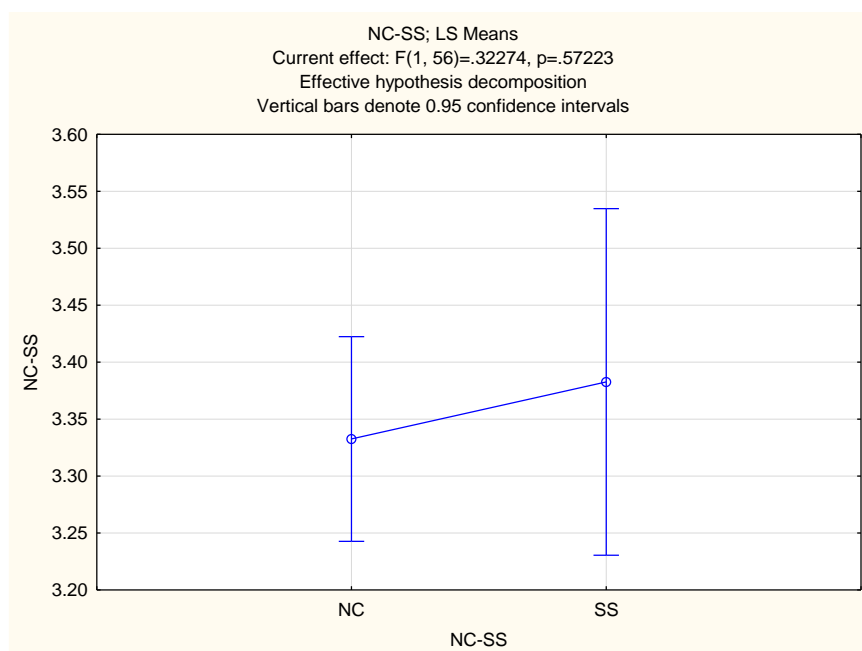
Figure 7. The Confidence Interval plot for the CGPA comparison between Normal Control Group and Severely Stressed Students

Univariate Tests of Significance, Effect Sizes, and Powers for NC-SS (Sheet2)							
Sigma-restricted parameterization							
Effective hypothesis decomposition							
Effect	SS	Degr. of Freedom	MS	F	p	Partial eta-squared	Non-centrality	Observed power (alpha=0.05)
Intercept	501.4791	1	501.4791	5796.355	0.000000	0.990431	5796.355	1.000000
NC-SS	0.0279	1	0.0279	0.323	0.572235	0.005730	0.323	0.086420
Error	4.8449	56	0.0865					

Table 4. Comparison of CGPA of Normal Control Group with Severely Stressed Students

The high p-value (0.572235) suggests that no significant correlation exists between the academic performance and general severe stress of students. However a less significant influence is present, since the mean CGPA of severely stressed students is slightly higher than that of the control group.

3.2.4 CGPA   :   NC   vs.   ES

The confidence interval Plot for the performance comparison of Normal Students (NC) and Extremely Stressed Students (ES) is shown in figure 8 and the comparison and analysis results are tabulated in Table 5.
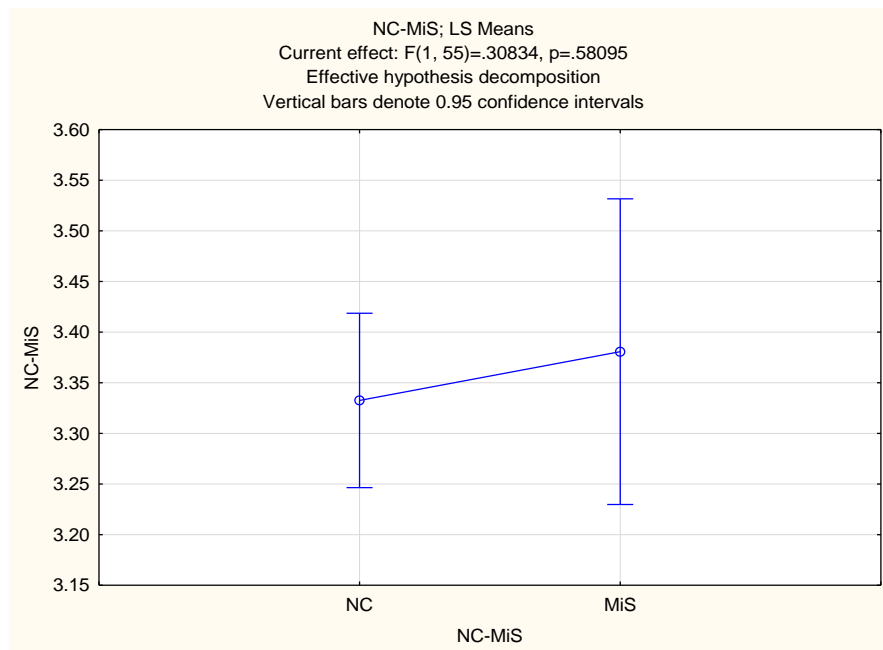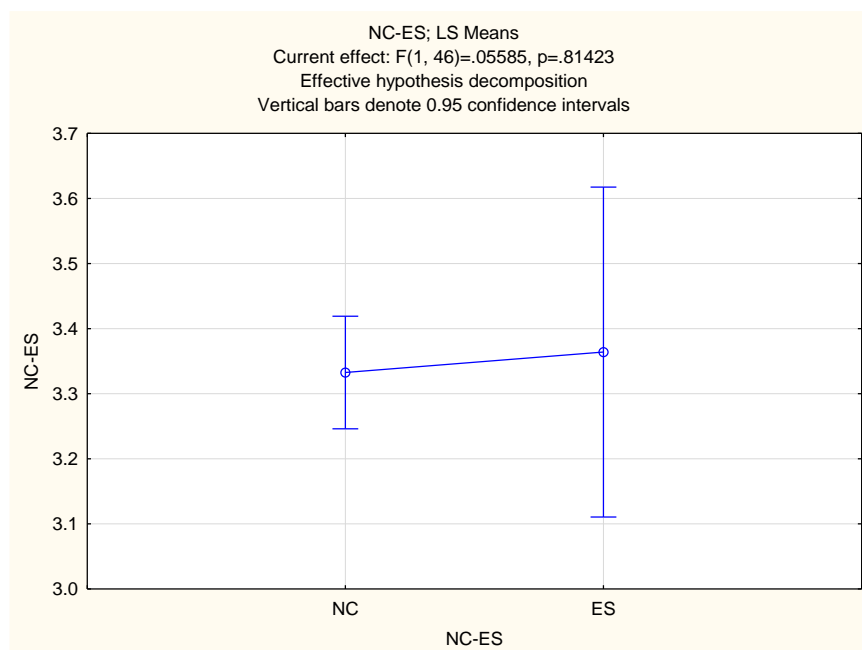

Figure 8 The Confidence Interval plot for the CGPA comparison between Normal Control Group and Extremely Stressed Students

Effect	Univariate Tests of Significance, Effect Sizes, and Powers for NC-ES (Sheet2) Sigma-restricted parameterization Effective hypothesis decomposition							
	SS	Degr. of Freedom	MS	F	p	Partial eta-squared	Non-centrality	Observed power (alpha=0.05)
Intercept	200.8633	1	200.8633	2533.275	0.000000	0.982166	2533.275	1.000000
NC-ES	0.0044	1	0.0044	0.056	0.814235	0.001213	0.056	0.056158
Error	3.6473	46	0.0793					

Table 5. Comparison of CGPA of Normal Control Group with Extremely Stressed Students

Again as expected from the very high p-value (0.814235) there exists no significant correlation between the CGPA of normal control group and extremely stressed students.

3.2.5 CGPA   :   MiS vs.   MoS

The confidence interval Plot for the performance comparison of Mildly Stressed Students (MiS) and Moderately Stressed Students (MoS) is shown in figure 9 and the comparison results are tabulated in Table 6.
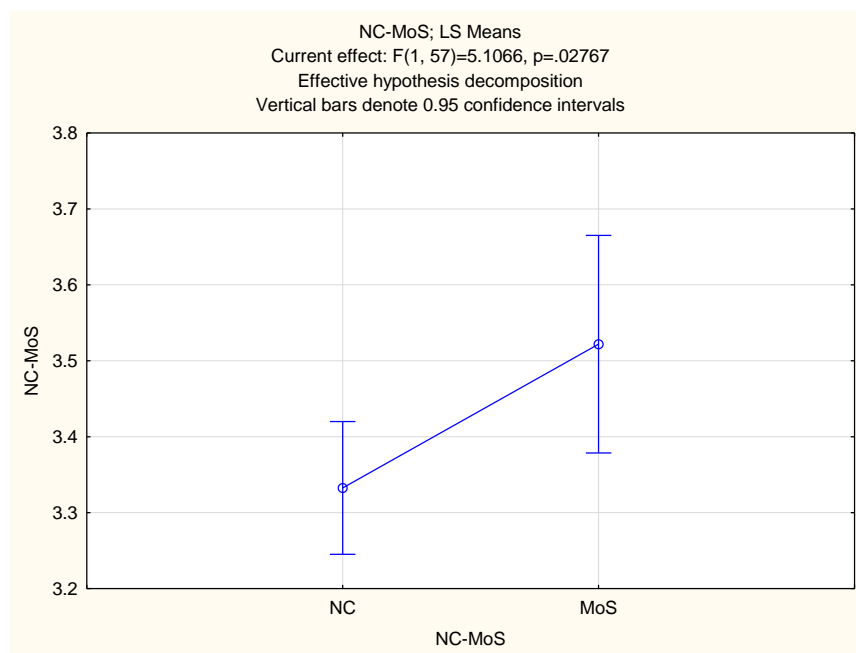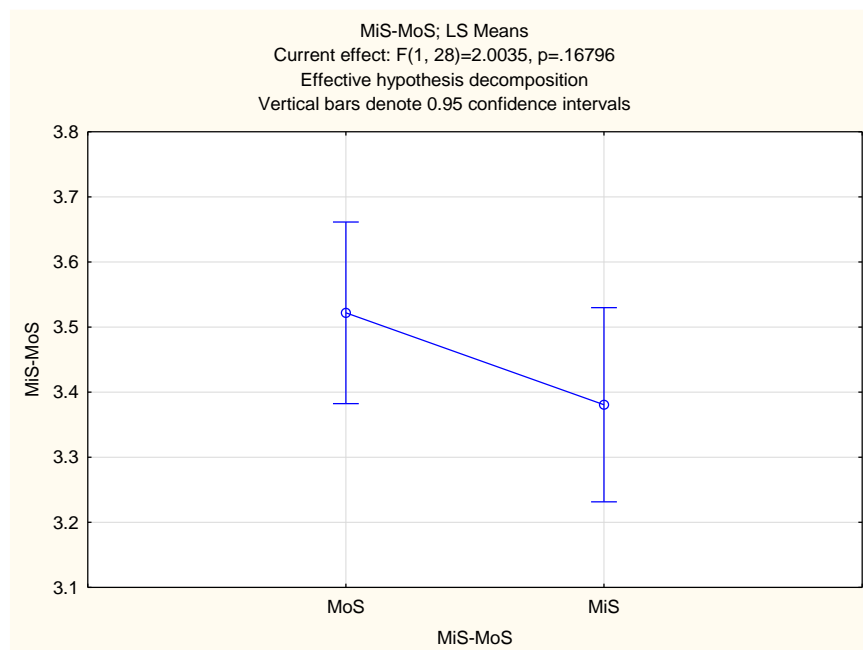

Figure 9. The Confidence Interval plot for the CGPA comparison between Mildly Stressed Students and Moderately Stressed Students

Univariate Tests of Significance, Effect Sizes, and Powers for MiS-MoS (Tehreem_Stress.sta) Sigma-restricted parameterization Effective hypothesis decomposition							
Effect	SS	Degr. of Freedom	MS	F	p	Partial eta-squared	Non-centrality	Observed power (alpha=0.05)
Intercept	355.7549	1	355.7549	4790.535	0.000000	0.994189	4790.535	1.000000
MiS-MoS	0.1488	1	0.1488	2.003	0.167964	0.066775	2.003	0.277073
Error	2.0793	28	0.0743					

Table 6. Comparison of CGPA of Mildly Stressed Students with Moderately Stressed Students

The high p-value demonstrates that there exists no significant correlation between the CGPA of Mildly Stressed Students and Moderately Stressed Students.

3.2.6 CGPA :   MiS vs. SS

The confidence interval Plot for the performance comparison of Mildly Stressed Students (MiS) and Severely Stressed Students (MoS) is shown in figure 10 and the comparison results are tabulated in Table 7.

Figure 10. The Confidence Interval plot for the CGPA comparison between Mildly Stressed Students and Severely Stressed Students

	Univariate Tests of Significance, Effect Sizes, and Powers for MiS-SS (Tehreem_Stress.sta) Sigma-restricted parameterization Effective hypothesis decomposition							
Effect	SS	Degr. of Freedom	MS	F	p	Partial eta-squared	Non-centrality	Observed power (alpha=0.05)
Intercept	331.2447	1	331.2447	3958.774	0.000000	0.993226	3958.774	1.000000
MiS-SS	0.0000	1	0.0000	0.000	0.985643	0.000012	0.000	0.050035
Error	2.2592	27	0.0837					

Table 7. Comparison of CGPA of Mildly Stressed Students with Severely Stressed Students

As opposed to the expected pattern, the CGPA of Mildly Stressed Students shows no significant correlation with that of the Severely Stressed Students, based on stress levels.

3.2.7 CGPA   :   MiS   vs.   ES

The confidence interval Plot for the performance comparison of Mildly Stressed Students (MiS) and Extremely Stressed Students (ES) is shown in figure 11 and the analysis results are tabulated in Table 8.

Figure 11. The Confidence Interval plot for the CGPA comparison between Mildly Stressed Students and Extremely Stressed Students

Effect	Univariate Tests of Significance, Effect Sizes, and Powers for MiS-ES (Tehreem_Stress.sta) Sigma-restricted parameterization Effective hypothesis decomposition							
	SS	Degr. of Freedom	MS	F	p	Partial eta-squared	Non-centrality	Observed power (alpha=0.05)
Intercept	167.5991	1	167.5991	2683.826	0.000000	0.993706	2683.826	1.000000
MiS-ES	0.0010	1	0.0010	0.016	0.899354	0.000969	0.016	0.051687
Error	1.0616	17	0.0624					

Table 8. Comparison of CGPA of Mildly Stressed Students with Extremely Stressed Students

The CGPA of the Mildly Stressed Students is not significantly correlated with the CGPA of Extremely Stressed Students, p-value 0.899354.

3.2.8 CGPA : MoS vs. SS

The confidence interval Plot for the performance comparison of Moderately Stressed Students (MoS) and Severely Stressed Students (SS) is shown in figure 12 and the comparison and analysis results are tabulated in Table 9.


MoS-SS; LS Means
Current effect: $F_{(1, 29)}=1.7025$, p=.20222
Effective hypothesis decomposition
Vertical bars denote 0.95 confidence intervals

Figure 12. The Confidence Interval plot for the CGPA comparison between Moderately Stressed Students and Severely Stressed Students

Effect	SS	Degr. of Freedom	MS	F	p	Partial eta-squared	Non-centrality	Observed power (alpha=0.05)
Univariate Tests of Significance, Effect Sizes, and Powers for MoS-SS (Tehreem_Stress.sta) Sigma-restricted parameterization Effective hypothesis decomposition								
Intercept	369.0789	1	369.0789	4188.274	0.000000	0.993124	4188.274	1.000000
MoS-SS	0.1500	1	0.1500	1.703	0.202217	0.055453	1.703	0.243180
Error	2.5555	29	0.0881					

Table 9. Comparison of CGPA of Moderately Stressed Students with Severely Stressed Students

There exists no significant correlation between the CGPA of Moderately Stressed Students and Severely Stressed Students.

3.2.9 CGPA   :   MoS vs. ES

The confidence interval Plot for the performance comparison of Moderately Stressed Students (MoS) and Extremely Stressed Students (ES) is shown in figure 13 and the comparison and analysis results are tabulated in Table 10.
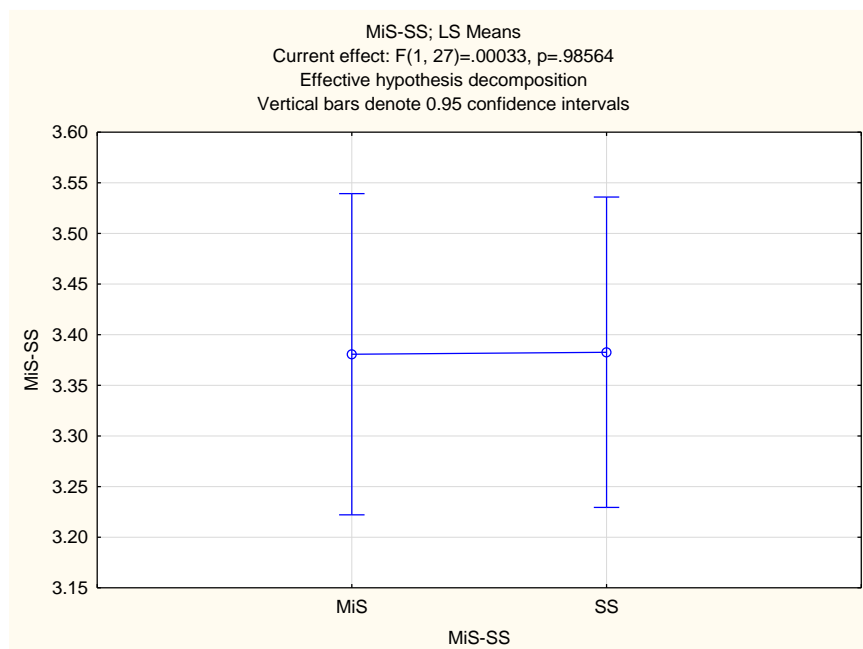

Figure 13. The Confidence Interval plot for the CGPA comparison between Moderately Stressed Students and Extremely Stressed Students

Effect	SS	Degr. of Freedom	MS	F	p	Partial eta-squared	Non-centrality	Observed power (alpha=0.05)
	Univariate Tests of Significance, Effect Sizes, and Powers for MoS-ES (Tehreem_Stress.sta) Sigma-restricted parameterization Effective hypothesis decomposition							
Intercept	180.6296	1	180.6296	2527.286	0.000000	0.992538	2527.286	1.000000
MoS-ES	0.0950	1	0.0950	1.329	0.263367	0.065352	1.329	0.194646
Error	1.3580	19	0.0715					

Table 10. Comparison of CGPA of Moderately Stressed Students with Extremely Stressed Students

As obvious from the high p-value (0.263367) there exists no significant correlation between the CGPA of Moderately Stressed Students and Extremely Stressed Students.

3.2.10 CGPA : SS vs. ES

The confidence interval Plot for the performance comparison of Severely Stressed Students (SS) and Extremely Stressed Students (ES) is shown in figure 14 and the comparison and analysis results are tabulated in Table 11.

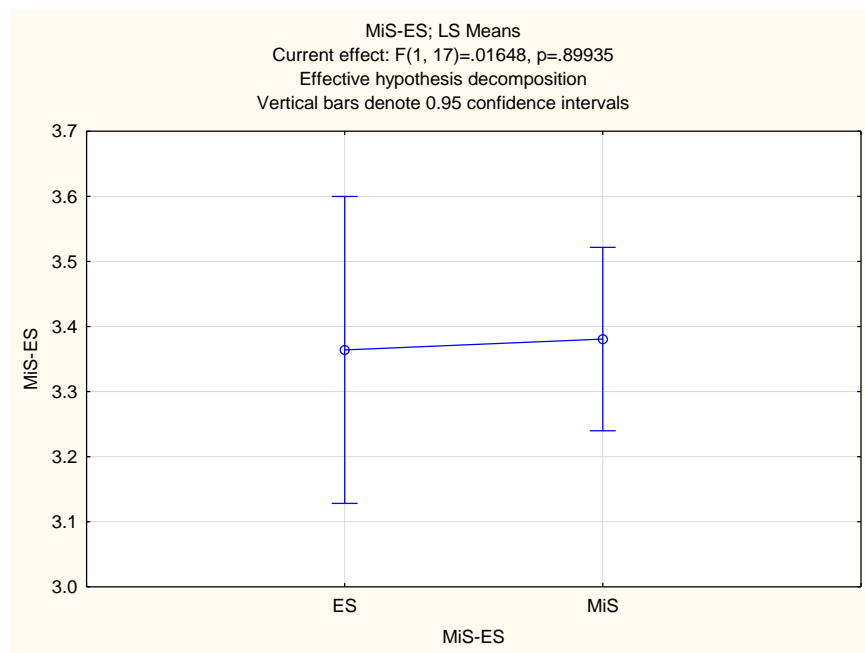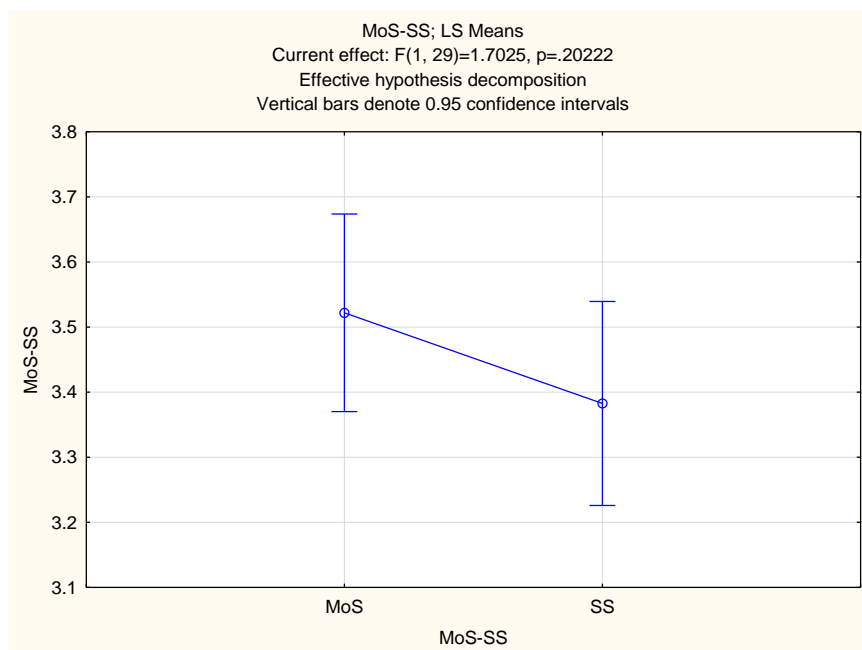**Figure 14. The Confidence Interval plot for the CGPA comparison between Severely Stressed Students and Extremely Stressed Students**

Effect	SS	Degr. of Freedom	MS	F	p	Partial eta-squared	Non-centrality	Observed power (alpha=0.05)
	Univariate Tests of Significance, Effect Sizes, and Powers for SS-ES (Tehreem_Stress.sta)							
	Sigma-restricted parameterization							
	Effective hypothesis decomposition							
Intercept	170.6907	1	170.6907	1997.923	0.000000	0.991071	1997.923	1.000000
SS-ES	0.0013	1	0.0013	0.015	0.902947	0.000849	0.015	0.051575
Error	1.5378	18	0.0854					

Table 11. Comparison of CGPA of Severely Stressed Students with Extremely Stressed Students

Again in this case the CGPA of the Severely Stressed Students and Extremely Stressed Students is not significantly correlated with respect to stress levels of the students.

Summary Of CGPA Comparison Results

Table 12 shows the summary of CGPA comparison results and after the analyses were performed, the significant relations are italicized.

	Normal Students CGPA	Mildly Stressed Students CGPA	Moderately Stressed Students CGPA	Severely Stressed Students CGPA	Extremely Stressed Students CGPA
Normal Students CGPA	--------	**P**=0.5810 F=0.308	**P=0.0277 * F=5.107**	**P**=0.5722 F=0.323	**P**=0.8142 F=0.056
Mildly Stressed Students CGPA	P=0.5810 F=0.308	--------	P=0.1686 F=2.003	P=0.9856 F=0.00	P=0.8994 F=0.016
Moderately Stressed Students CGPA	**P=0.0277 F=5.107**	P=0.1686 F=2.003	--------	P=0.2022 F=1.703	P=0.2634 F=1.329
Severely Stressed Students CGPA	P=0.5722 F=0.323	P=0.9856 F=0.00	P=0.2022 F=1.703	--------	P=0.9029 F=0.015
Extremely Stressed Students CGPA	P=0.8122 F=0.056	P=0.8994 F=0.016	P=0.2634 F=1.329	P=0.9024 0.015	-------

Table 12. Comparison Matrix of the CGPA of different categories of the students (based on their stress levels).

As observed earlier the dominant role Moderate stress plays in better long-term performance is also obvious in the comparison matrix.

3.3. CASE II   Unannounced Quiz Scores

For the short-term academic performance estimation of the students the scores of the unannounced quiz was used as a metric. The students were given 8 minutes to complete a mathematics quiz and their scores were recorded for analysis.

As in the first case of CGPA comparison the unannounced quiz scores comparison results will be explained in this section. For the results explaining the research study conducted on the students for unannounced quiz scores comparisons among different student categories again the following annotations will be used;

N   -   Quiz score of **Normal** students (Control Group)

Mi   -   Quiz score of **Mildly Stressed** students

Mo   -   Quiz score of **Moderately Stressed** students

SS   -   Quiz score of **Severely Stressed** students

ES   -   Quiz score of **Extremely Stressed** students

In each of the comparison cases the data spreads are compared and the resulting variations are explained along with the plots.

3.3.1 Pre-Quiz : N vs. Mi

The confidence interval Plot for the Unannounced Quiz Performance comparison of Normal Students / Control Group (N) and Mildly Stressed Students (Mi) is shown in figure 15 and the comparison and analysis results are tabulated in Table 13.

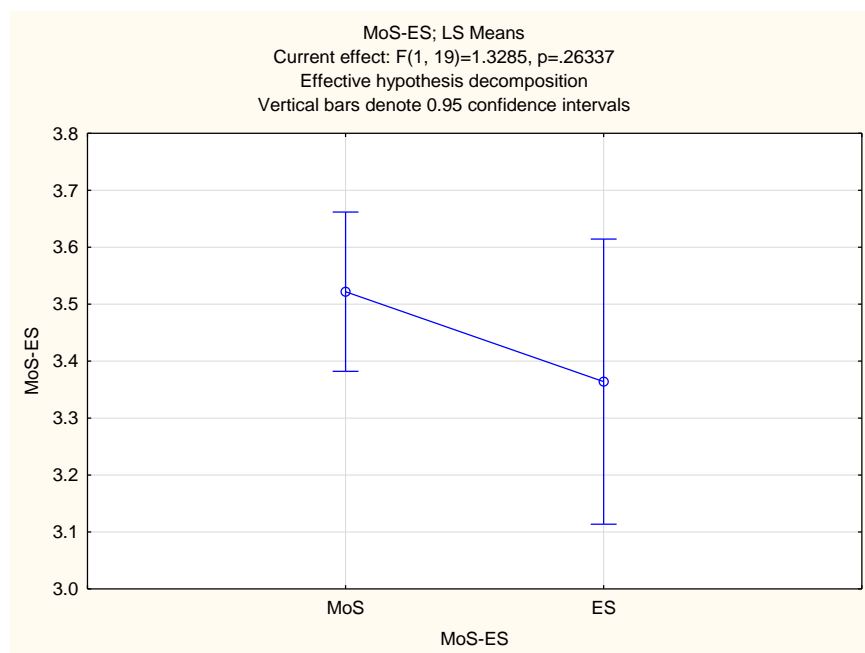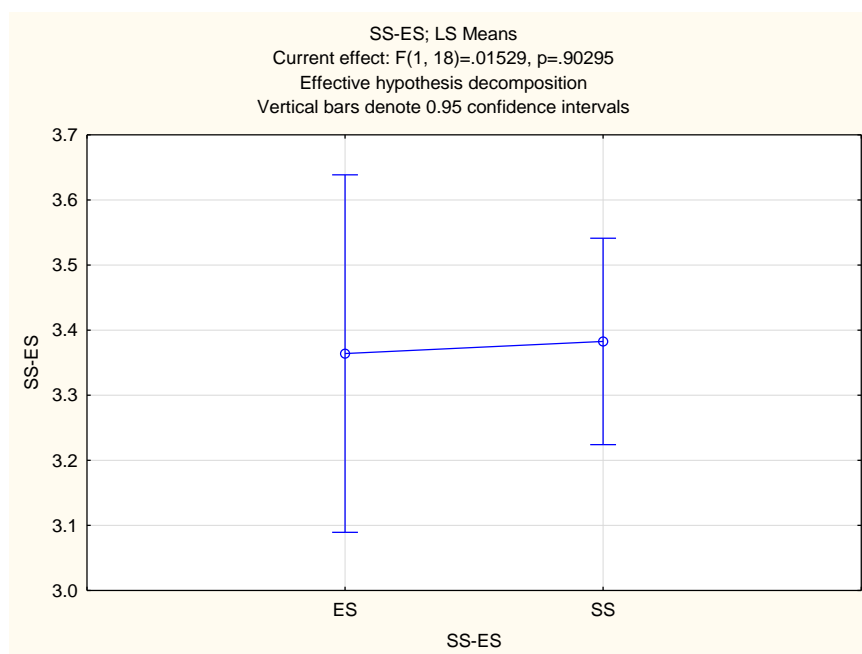**Figure 15. The Confidence Interval plot for the Pre-Quiz Performance comparison between Normal Students and Mildly Stressed Students**

	Univariate Tests of Significance, Effect Sizes, and Powers for N-Mi (Sheet1 in pre quiz of each category) Sigma-restricted parameterization Effective hypothesis decomposition							
Effect	SS	Degr. of Freedom	MS	F	p	Partial eta-squared	Non-centrality	Observed power (alpha=0.05)
Intercept	2015.383	1	2015.383	1831.814	0.000000	0.970850	1831.814	1.000000
N-Mi	0.366	1	0.366	0.332	0.566678	0.006005	0.332	0.087490
Error	60.512	55	1.100					

Table 13. Comparison of Pre-Quiz Performance of Normal Students with Mildly Stressed Students

In this case the Pre-Quiz Performance of the Normal Students and Mildly Stressed Students is not significantly correlated with respect to stress levels of the students.

3.3.2 Pre-Quiz   :   N   vs.   Mo

The confidence interval Plot for the Unannounced Quiz Performance comparison of Normal Students / Control Group (N) and Moderately Stressed Students (Mo) is shown in figure 16 and the comparison and analysis results are tabulated in Table 14.

N-Mo; LS Means
Current effect: F(1, 57)=.42205, p=.51852
Effective hypothesis decomposition
Vertical bars denote 0.95 confidence intervals

Figure 16. The Confidence Interval plot for the Pre-Quiz Performance comparison between Normal Students and Moderately Stressed Students

Effect	SS	Degr. of Freedom	MS	F	p	Partial eta-squared	Non-centrality	Observed power (alpha=0.05)
	Univariate Tests of Significance, Effect Sizes, and Powers for N-Mo (Sheet1 in pre quiz of each category. Sigma-restricted parameterization. Effective hypothesis decomposition							
Intercept	2225.217	1	2225.217	2326.795	0.000000	0.976089	2326.795	1.000000
N-Mo	0.404	1	0.404	0.422	0.518525	0.007350	0.422	0.097897
Error	54.512	57	0.956					

Table 14. Comparison of Pre-Quiz Performance of Normal Students with Moderately Stressed Students

Again in this case we see that, the Pre-Quiz Performance of the Normal Students and Moderately Stressed Students is not significantly correlated with respect to stress levels of the students.

3.3.3 Pre-Quiz   :   N   vs.   SS

The confidence interval Plot for the Unannounced Quiz Performance comparison of Normal Students / Control Group (N) and Severely Stressed Students (SS) is shown in figure 17 and the comparison and analysis results are tabulated in Table 15.

Figure 17. The Confidence Interval plot for the Pre-Quiz Performance comparison between Normal Students and Severely Stressed Students

Effect	Univariate Tests of Significance, Effect Sizes, and Powers for N-SS (Sheet1 in pre quiz of each category Sigma-restricted parameterization Effective hypothesis decomposition							
	SS	Degr. of Freedom	MS	F	p	Partial eta-squared	Non-centrality	Observed power (alpha=0.05)
Intercept	2184.002	1	2184.002	2227.290	0.000000	0.975474	2227.290	1.000000
N-SS	1.657	1	1.657	1.690	0.198902	0.029298	1.690	0.248179
Error	54.912	56	0.981					

Table 15. Comparison of Pre-Quiz Performance of Normal Students with Severely Stressed Students

We observe in this case the Pre-Quiz Performance of the Normal Students and Moderately Stressed Students is not significantly correlated with respect to stress levels of the students.

3.3.4 Pre-Quiz : N vs. ES

The confidence interval Plot for the Unannounced Quiz Performance comparison of Normal Students / Control Group (N) and Extremely Stressed Students (ES) is shown in figure 18 and the comparison and analysis results are tabulated in Table 16.
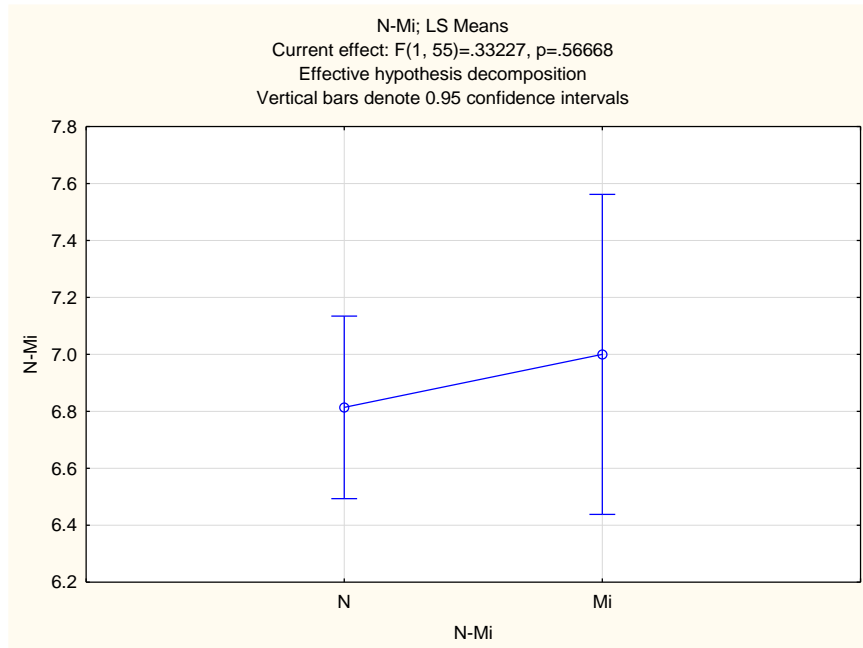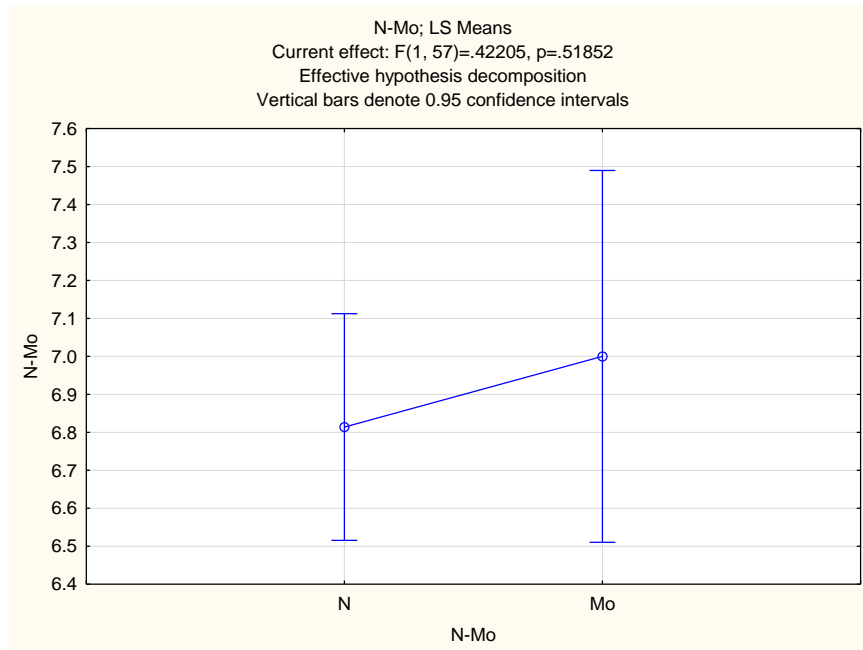

Figure 18. The Confidence Interval plot for the Pre-Quiz Performance comparison between Normal Students and Extremely Stressed Students

	Univariate Tests of Significance, Effect Sizes, and Powers for N-ES (Sheet1 in pre quiz of each category) Sigma-restricted parameterization Effective hypothesis decomposition							
Effect	SS	Degr. of Freedom	MS	F	p	Partial eta-squared	Non-centrality	Observed power (alpha=0.05)
Intercept	982.9675	1	982.9675	1116.137	0.000000	0.960418	1116.137	1.000000
N-ES	6.3009	1	6.3009	7.154	0.010320	0.134598	7.154	0.744933
Error	40.5116	46	0.8807					

Table 16. Comparison of Pre-Quiz Performance of Normal Students with Extremely Stressed Students

The very small p-value (0.010320) here demonstrates that there is a strong correlation between the performance of the students in the unannounced quiz and normal students (control group) and extremely stressed students show a marked difference in performance. Here the

observation drawn is in cases of impromptu examination the students who suffered from extreme stress showed significantly better results as compared to normal students. In such a case extreme levels of general stress has led to far better short-term examination performance in the entire group. A shift in the entire data range is observed as the highest score achieved by the normal students is comparable to the lowest score acquired by the extremely stressed students.

3.3.5 Pre-Quiz   :   Mi   vs.   Mo

The confidence interval Plot for the Unannounced Quiz Performance comparison of Mildly Stressed Students (Mi) and Moderately Stressed Students (Mo) is shown in figure 19 and the comparison and analysis results are tabulated in Table 17.
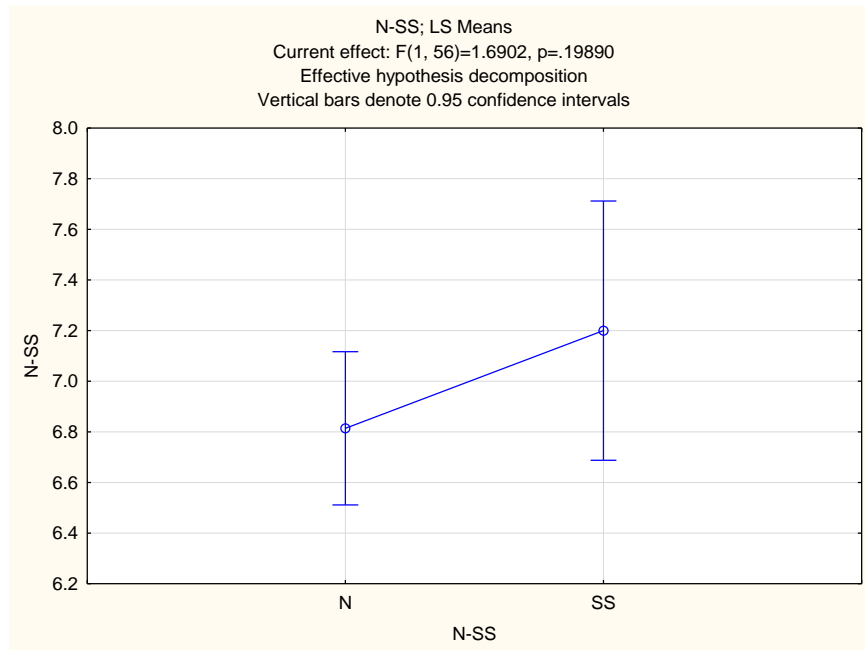

Figure 19. The Confidence Interval plot for the Pre-Quiz Performance comparison between Mildly Stressed Students and Moderately Stressed Students

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Univariate Tests of Significance, Effect Sizes, and Powers for Mi-Mo (Sheet1 in prequiz.stw) Sigma-restricted parameterization Effective hypothesis decomposition							
Effect	SS	Degr. of Freedom	MS	F	p	Partial eta-squared	Non-centrality	Observed power (alpha=0.05)
Intercept	1463.467	1	1463.467	1205.208	0.000000	0.977295	1205.208	1.000000
Mi-Mo	0.000	1	0.000	0.000	1.000000	0.000000	0.000	0.050000
Error	34.000	28	1.214					

Table 17. Comparison of Pre-Quiz Performance of Mildly Stressed Students with Moderately Stressed Students

In this case the unannounced quiz performance of both groups, mildly stressed students and moderately stressed students doesn't show significant variation with difference in levels of stress.

3.3.6 Pre-Quiz : Mi vs. SS

The confidence interval Plot for the Unannounced Quiz Performance comparison of Mildly Stressed Students (Mi) and Sevely Stressed Students (SS) is shown in figure 20 and the comparison and analysis results are tabulated in Table 18.

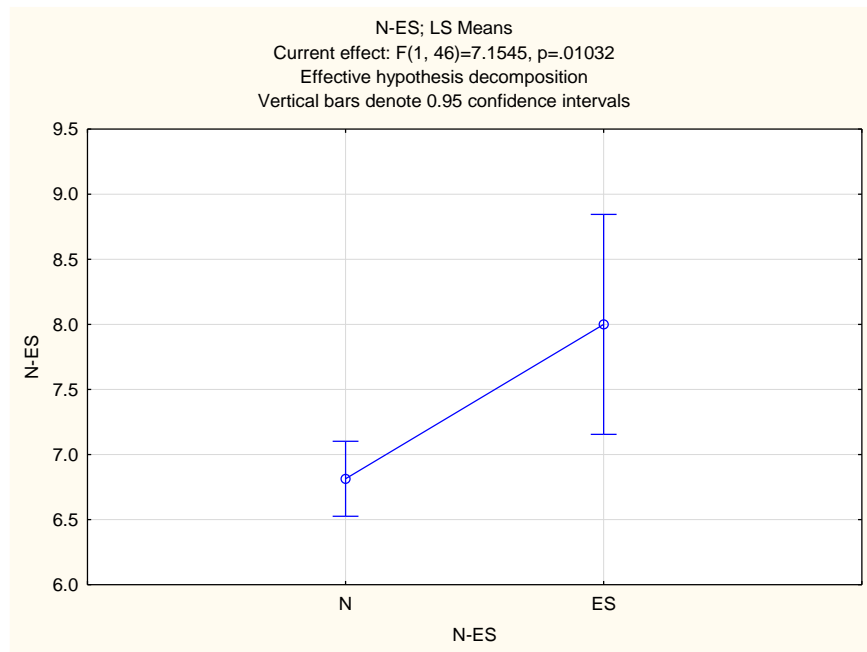**Figure 20. The Confidence Interval plot for the Pre-Quiz Performance comparison between Mildly Stressed Students and Severely Stressed Students**

Effect	SS	Degr. of Freedom	MS	F	p	Partial eta-squared	Non-centrality	Observed power (alpha=0.05)
Univariate Tests of Significance, Effect Sizes, and Powers for Mi-SS (Sheet1 in prequiz.stw) Sigma-restricted parameterization Effective hypothesis decomposition								
Intercept	1460.152	1	1460.152	1146.049	0.000000	0.976983	1146.049	1.000000
Mi-SS	0.290	1	0.290	0.227	0.637336	0.008350	0.227	0.074581
Error	34.400	27	1.274					

Table 18. Comparison of Pre-Quiz Performance of Mildly Stressed Students with Severely Stressed Students

Again, as explained by the high p-value the unannounced quiz performance of both groups, mildly stressed students and severely stressed students doesn't show significant variation with difference in levels of stress.

3.3.7 Pre-Quiz : Mi vs. ES

The confidence interval Plot for the Unannounced Quiz Performance comparison of Mildly Stressed Students (Mi) and Extremely Stressed Students (ES) is shown in figure 21 and the comparison and analysis results are tabulated in Table 19.
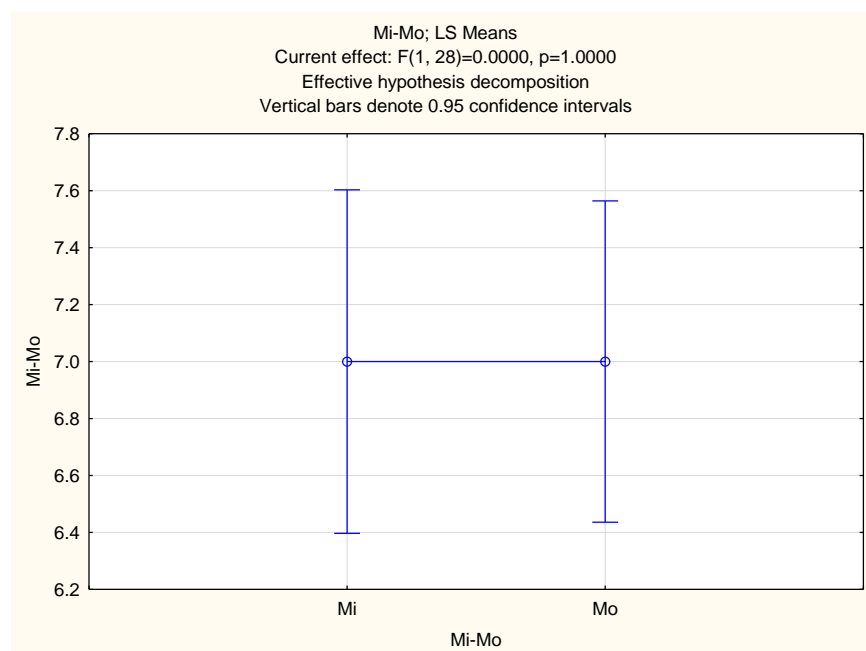

Figure 21. The Confidence Interval plot for the Pre-Quiz Performance comparison between Extremely Stressed Students and Severely Stressed Students

Effect	SS	Degr. of Freedom	MS	F	p	Partial eta-squared	Non-centrality	Observed power (alpha=0.05)
Univariate Tests of Significance, Effect Sizes, and Powers for Mi-ES (Sheet1 in prequiz.stw) Sigma-restricted parameterization Effective hypothesis decomposition								
Intercept	828.9474	1	828.9474	704.6053	0.000000	0.976441	704.6053	1.000000
Mi-ES	3.6842	1	3.6842	3.1316	0.094723	0.155556	3.1316	0.385988
Error	20.0000	17	1.1765					

Table 19. Comparison of Pre-Quiz Performance of Mildly Stressed Students with Extremely Stressed Students

No significant difference is observed in the unannounced quiz performance of mildly stressed and extremely stressed students, as suggested by a high p-value.

3.3.8 Pre-Quiz : Mo vs. SS

The confidence interval Plot for the Unannounced Quiz Performance comparison of Moderately Stressed Students (Mo) and Severely Stressed Students (SS) is shown in figure 22 and the comparison and analysis results are tabulated in Table 20.
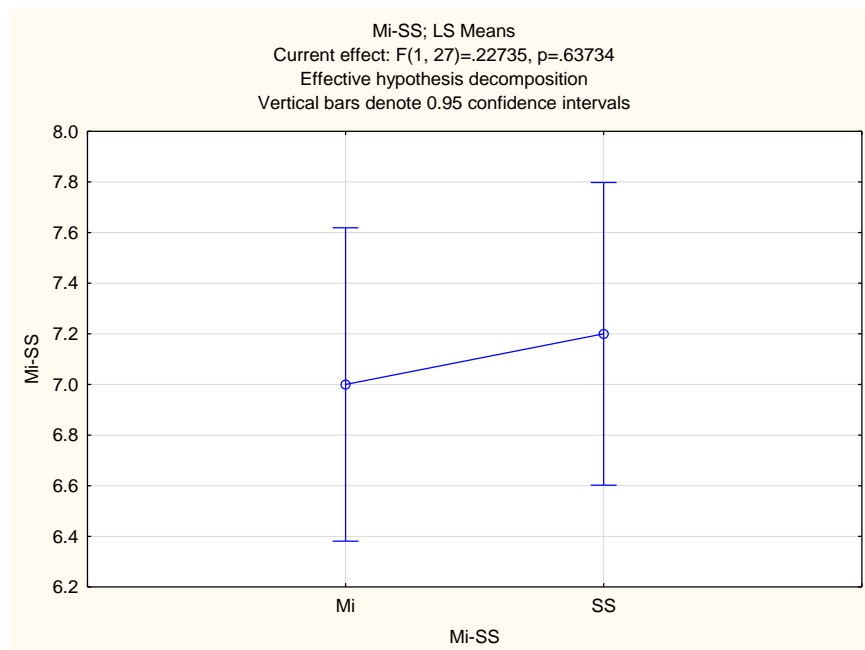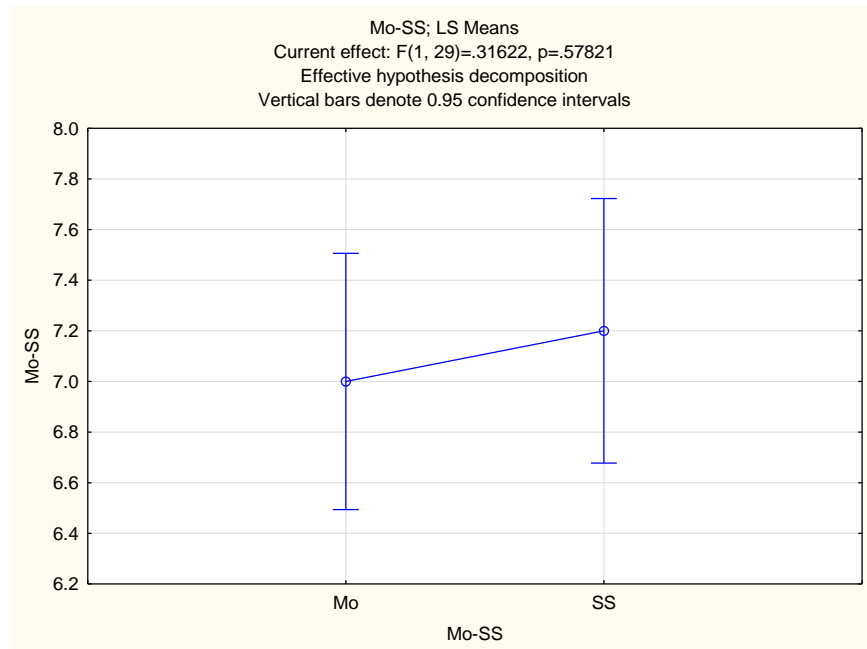

Figure 22. The Confidence Interval plot for the Pre-Quiz Performance comparison between Moderately Stressed Students and Severely Stressed Students

Effect	SS	Degr. of Freedom	MS	F	p	Partial eta-squared	Non-centrality	Observed power (alpha=0.05)
	Univariate Tests of Significance, Effect Sizes, and Powers for Mo-SS (Sheet1 in prequiz.stw)							
	Sigma-restricted parameterization							
	Effective hypothesis decomposition							
Intercept	1561.084	1	1561.084	1594.065	0.000000	0.982133	1594.065	1.000000
Mo-SS	0.310	1	0.310	0.316	0.578210	0.010787	0.316	0.084524
Error	28.400	29	0.979					

Table 20. Comparison of Pre-Quiz Performance of Moderately Stressed Students with Severely Stressed Students

No significant difference is observed in the unannounced quiz performance of moderately stressed and severely stressed students, as suggested by a high p-value.

3.3.9 Pre-Quiz : Mo vs. ES

The confidence interval Plot for the Unannounced Quiz Performance comparison of Moderately Stressed Students (Mo) and Extremely Stressed Students (ES) is shown in figure 23 and the comparison and analysis results are tabulated in Table 21.
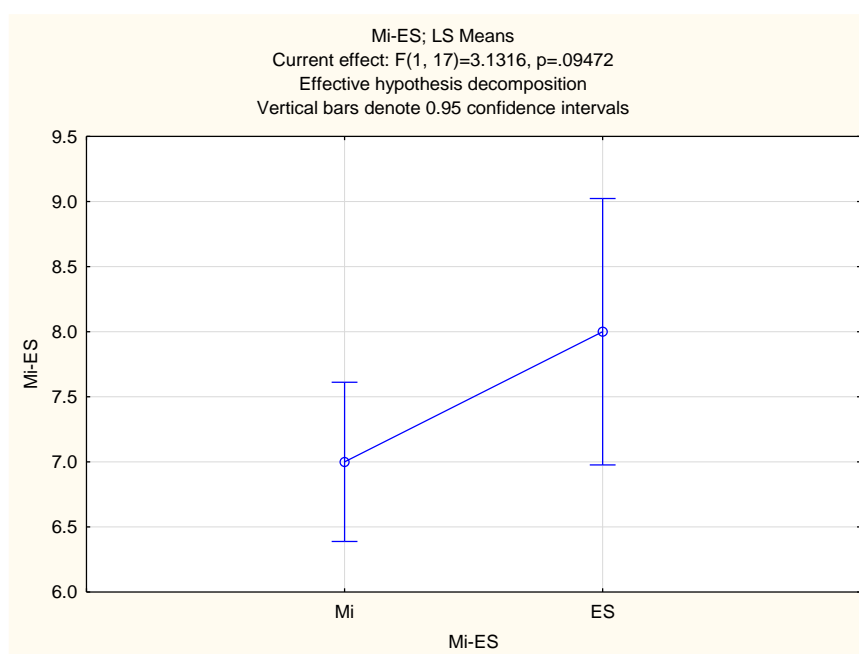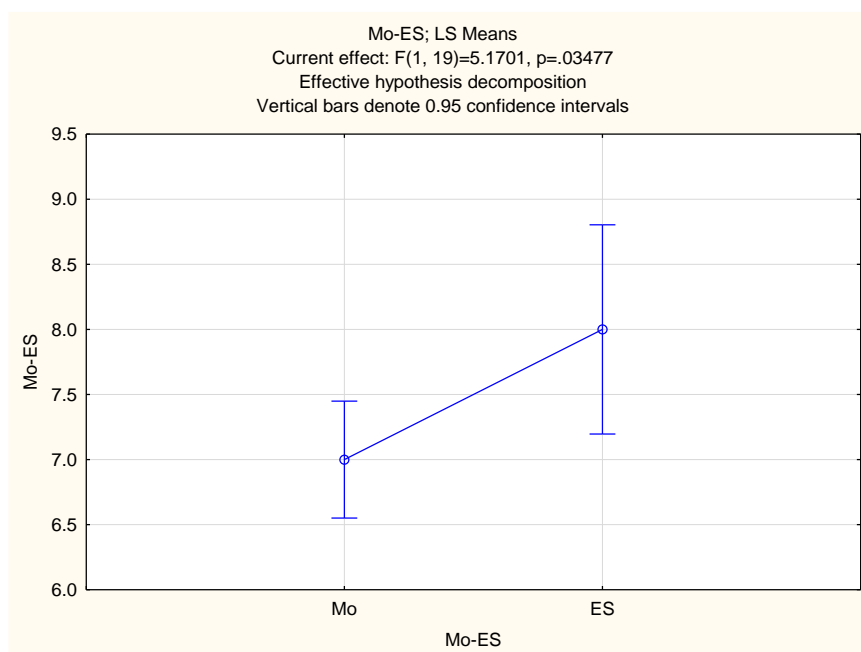

Figure 23. The Confidence Interval plot for the Pre-Quiz Performance comparison between Moderately Stressed Students and Extremely Stressed Students

Effect	SS	Degr. of Freedom	MS	F	p	Partial eta-squared	Non-centrality	Observed power (alpha=0.05)
Univariate Tests of Significance, Effect Sizes, and Powers for Mo-ES (Sheet1 in prequiz.stw) Sigma-restricted parameterization Effective hypothesis decomposition								
Intercept	857.1429	1	857.1429	1163.265	0.000000	0.983929	1163.265	1.000000
Mo-ES	3.8095	1	3.8095	5.170	0.034768	0.213904	5.170	0.578522
Error	14.0000	19	0.7368					

Table 21. Comparison of Pre-Quiz Performance of Moderately Stressed Students with Extremely Stressed Students

A very low p-value (0.034768) is observed again in the case of Moderately Stressed Students and Extremely Stressed Students performance in the unannounced quiz. This again shows that the students who were experiencing extreme stress performed markedly better than the students who suffered from moderate levels of stress with regards to their stress level. The severity of the stress levels in certain cases has driven the group towards an overall better performance in impromptu scenarios.

3.3.10 Pre-Quiz : SS vs. ES

The confidence interval Plot for the Unannounced Quiz Performance comparison of Severely Stressed Students (SS) and Extremely Stressed Students (ES) is shown in figure 24 and the comparison and analysis results are tabulated in Table 22.

SS-ES; LS Means
Current effect: F(1, 18)=3.0000, p=.10037
Effective hypothesis decomposition
Vertical bars denote 0.95 confidence intervals
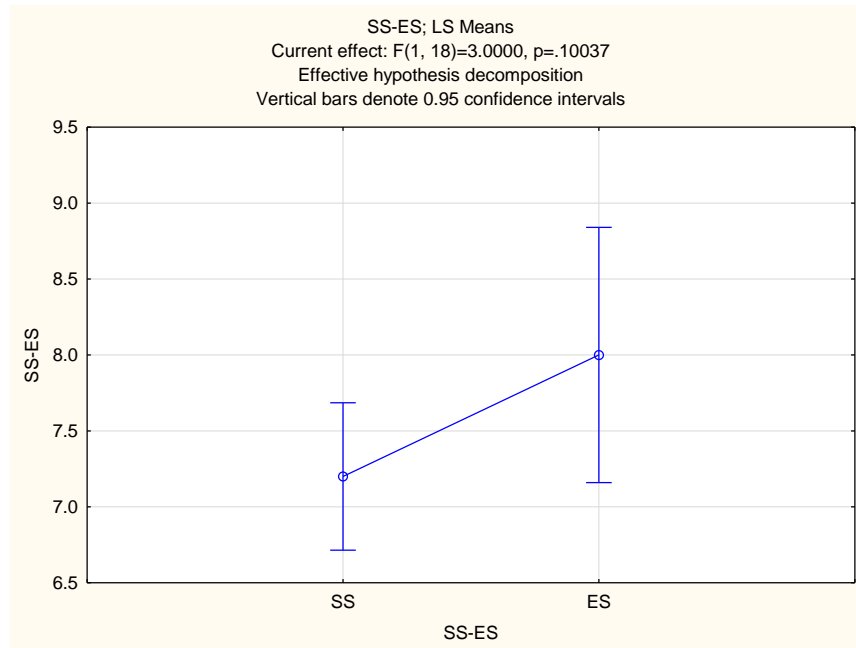
**Figure 24. The Confidence Interval plot for the Pre-Quiz
Performance comparison between Severely Stressed Students
and Extremely Stressed Students**

	Univariate Tests of Significance, Effect Sizes, and Powers for SS-ES (Sheet1 in prequiz.stw) Sigma-restricted parameterization Effective hypothesis decomposition							
Effect	SS	Degr. of Freedom	MS	F	p	Partial eta-squared	Non-centrality	Observed power (alpha=0.05)
Intercept	866.4000	1	866.4000	1083.000	0.000000	0.983651	1083.000	1.000000
SS-ES	2.4000	1	2.4000	3.000	0.100366	0.142857	3.000	0.374585
Error	14.4000	18	0.8000					

**Table 22. Comparison of Pre-Quiz Performance of Severely Stressed Students
with Extremely Stressed Students**

No significant variation in unannounced quiz performance was observed between the students with severe levels of stress and extreme levels of stress with regards to their stress levels.

3.3.11   Pre-Quiz :   N   vs.   S (All Stressed Students)

As a special case of comparison in CASE-II we compared the performance of Normal Students with all Stressed Students (S), the

confidence interval plot for this comparison is shown in Figure 25 and the results are tabulated in Table 23.
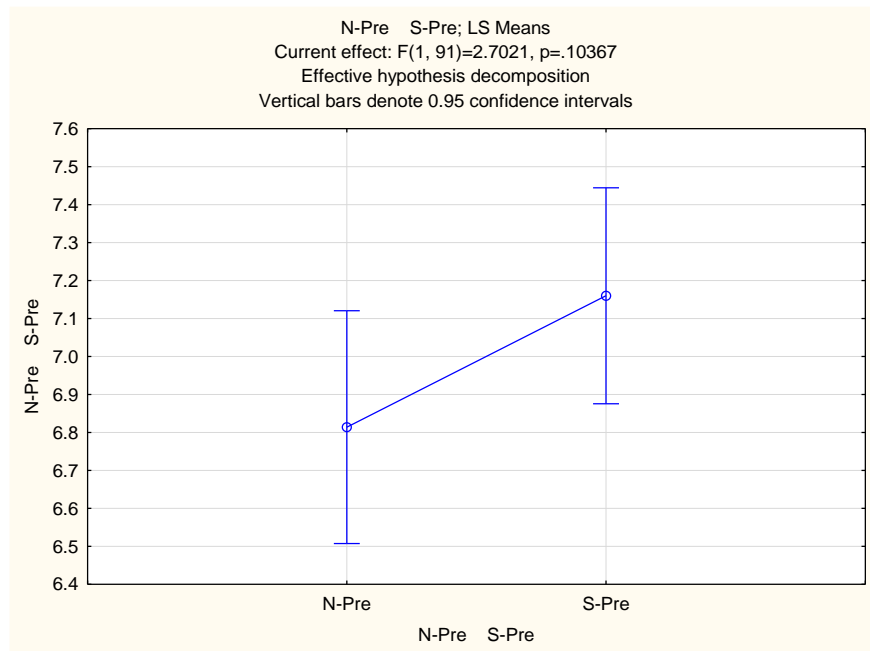
Figure 25. The Confidence Interval plot for the Pre-Quiz Performance comparison between Normal Students and Overall Stressed Students

Effect	Univariate Tests of Significance, Effect Sizes, and Powers for N-Pre S-Pre (Sheet2) Sigma-restricted parameterization Effect hypothesis decomposition							
	SS	Degr. of Freedom	MS	F	p	Partial eta-squared	Non-centrality	Observed power (alpha=0.05)
Intercept	4514.338	1	4514.338	4406.281	0.000000	0.979766	4406.281	1.000000
N-Pre S-Pre	2.768	1	2.768	2.702	0.103666	0.028837	2.702	0.369546
Error	93.232	91	1.025					

Table 23. Comparison of Pre-Quiz Performance of Normal Students with Overall Stressed Students

A p-value of 0.103666 suggests that there is no particular significant correlation between the unannounced quiz performance of the normal students and the overall stressed students, however the mean value of the scores suggests that the stressed students in general performed slightly better than the normal students in the unannounced quiz.

CHAPTER 4

DISCUSSION

A study was performed to observe and analyze the effects of **general stress** as opposed to **academic stress** on the **academic performance** of the students enrolled in the Second Semester of Bachelors of Mechanical Engineering at School of Mechanical and Manufacturing Engineering (SMME), National University of Sciences and Technology (NUST), Islamabad, Pakistan.

Stress is among the primary factors which influences the individual's performance in various fields and professional education is also affected though stress. Furthermore some stress contributes towards greater levels of success whereas high or low levels of stress tend to, generally, decrease the level of success.

In past many studies have been performed that correlate academic stress to academic performance for students [65] however there exists very little research which studies the impact of general stress on student performance. We have conducted the research to study the influence of **general stress** on the **long-term** and **short-term academic performance** of the undergraduate students.

Yerkes-Dodson Law

An interesting phenomenon reported initially by Robert M. Yerkes and John Dillingham Dodson in 1908 is that; increase in the physiological or mental stress induces a general increase in individual performance, but only to a certain extent. According to this law, quantitatively the performance of an individual demonstrates a bell-curve and peaks at a moderate level of stress before falling down and decreases with either very little or very high levels of stress. This is demonstrated in the Figure 26 [84]. From Figure 4, our results match the Yerkes-Dodson curve and it is observed that peak academic performance in the long-term examinations is obtained by the students experiencing moderate stress, with the gradual increase or decrease in the stress levels, the academic performance also falls down on either side of the spectrum.
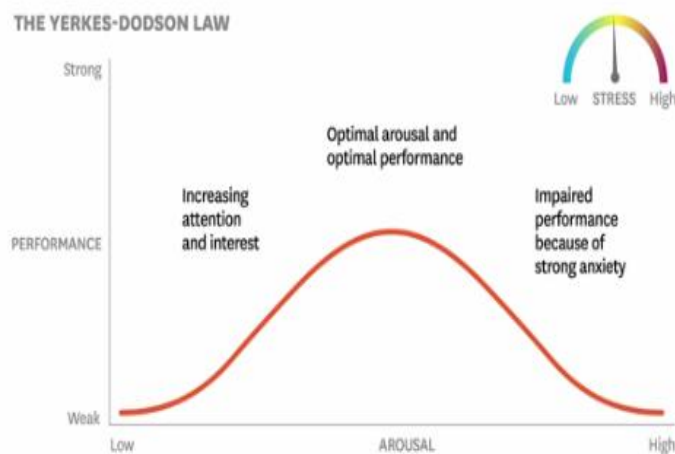
Figure 26. Graphical Representation of the Yerkes-Dodson Law Bell-Curve

Effect of Stress on Studies

Stress necessarily generates pre-occupation in the individual's brain and the ability to concentrate and focus is hampered. Students who are enrolled in professional education courses are also subjected to stress from various sources, such as academic, physiological, psychological, emotional and spiritual, etc.

Contrary to the general outlook of stress, it can be used an instrument to drive an individual towards better performance, just as well it can be used to decrease the individual's capability. The effect of academic stress on student growth and performance has been documented in various studies. [67]**,** that students who experience moderate levels of stress perform slightly better than all other stress levels. Higher levels of stress once managed can also lead towards better academic performance on the part of the individual.[82]**.**

In our study we have documented the effect of **general stress** on the **student's academic performance**, both in **short-term** and **long-term** examination scenarios.

4.1 Our Findings Regarding General Stress & Its Influence on Academic Performance

In the study we conducted, a few trends were observed in the individual's performance, these results are also supported by the surveyed literature for academic stress. A special case of student's performance in impromptu circumstances demonstrates a slightly different trend as opposed to long-term performance analysis.

4.2 Moderate Level of Stress and Long-Term Performance

In our research the students who experienced moderate levels of stress generally showed a higher level of academic performance in the long-term examination. In order to gauge the long-term performance we have used CGPA as a measurement metric.

Particularly important is the case of comparison between students who experienced no stress and students who experienced moderate stress. It would be naturally rational to assume that students who do not have any stress perform better, but that is not the case in our findings.

Explanation

The students who experience moderate levels of stress consistently undergo a continued growth in their ability to cope with problems. Thus in the long-term the effect of continued stress over a long duration (4 to 5 months), accumulates into a very positive outcome, and a consistent growth is observed in the individual. From previous research people have concluded that a positive perception of stress can lead towards a higher motivation to perform better [67] and grow as an individual, whereas a negative perception of stress can do the exact opposite and hamper the individual's growth [61] and [47]

The students who manage to regulate their stress convert it into a positive driving force which leads them towards higher accomplishments; furthermore this

also reduces the intensity of the stress which they perceive. Hence their perceived general stress would necessarily lie within the moderate stress levels.

On the other hand , students who fail to manage their stress, suffer the negative consequences of harmful distress. **Dr. Hans Selye** has recommended that stress as a part of the individual's routine should not be ignored instead it should be regulated to achieve optimal results.

Also the students, who do not experience any stress at all, lie on the other end of the spectrum, as there is no challenge to motivate them towards higher accomplishments and as a consequence they do not tend to grow as individuals rather stay stagnant at the level of achievement which they have already acquired. This could also be due to an attitude of indifference towards stress which explains the mediocre performance of students who do not experience any stress at all and they purposefully avoid difficult circumstances altogether.

4.3. Control Group And their performance in Quiz

Control Group performed poorly in the Unannounced Impromptu Examination, a special observation which is worth mentioning here is that in the case of impromptu examination the students who experienced any stress, generally performed better than the students who experienced no stress at all. This also reinforces the postulate in the previous finding that the students who experience no stress have an attitude of indifference towards stress and success in general.

4.4 Extreme Stress and Short Term Performance

The students who experience extreme and severe levels of stress demonstrated far higher performance in the impromptu/unannounced quiz as compared to their less-stressed colleagues. This finding is slightly different from the results attained in the comparison of long-term performance of the students, in the sense that students who experience extreme stress outperformed even those students who experienced moderate levels of stress in a short-term examination.

Explanation

The students who experience severe to extreme levels of stress are naturally trained to perceive their scenarios as challenging events, thus an unannounced quiz stimulated a case of a challenging event. This also leads to the conclusion that individuals who experience higher levels of stress are naturally adapted to perform better in short-term tasks and short-term examinations. This increase in performance will show a marked difference for only shorter durations of examinations.

As the duration of testing and examination lengthens the performance of individuals who experience extreme levels of stress will necessarily decrease, as the physiological and psychological effects of stress start to make themselves, more prominent in the individual's performance.

4.5. Dichotomy of Stress (Short-Term vs. Long-Term)

In our observations we have estimated the general stress of students and how it impacts their academic performance. The fundamental observations which generate a difference of conclusions are;

1- Students who experience moderate levels stress, perform well in the long-term.
2- Students who experience extreme levels of stress, perform exceptionally well in the short-term.

This is an apparent incoherence of the results; however the short-term performance of extremely stressed students is only short-lasting. If it is extended to longer durations it becomes harmful. The extreme levels of stress are already due to a mismanaged stress on the individual's part and they will only progress into destructive **distress** thereby causing temporary or even permanent damage to the individual's mental health.

The reason behind relatively poor performance of extremely stressed students in the long-term academic evaluations (CGPA) is perhaps best explained by a continuous amassing of negative impedances which hinder the individual's growth. An extreme level of stress if maintained for extended durations will result in very

harmful effects which have far severe consequences than academic demise; this ultimately leads to the poor performance of the individual in the long-term.

4.5.1 Optimal Role of the Faculty

To induce a consistent growth on part of each individual student, the academic faculty should promote moderate levels of stress as they culminate in higher long-term performances, whereas they should discourage the accumulation of severe and extreme stress which only generates short-term results and long-term demise.

4.5.2 Optimal Role of the Student

Instead of ignoring stress altogether students should adapt a positive outlook towards stress, and perceive stressful events as potential opportunities to grow beyond their current level of academic proficiency. The students should acknowledge the stress they experience and regulate that stress, thereby effectively managing their individual challenges for better growth in general. The students should also recognize that too much stress and too little stress can both be harmful and they need to balance this stress in their daily routines.

Appropriate level of challenge (inducing proportionate stress) is necessary for optimal performance.

Study Limitations

- The research study we conducted was limited in scope of subjects, as only second semester mechanical engineering students were surveyed. A diverse study will cater for a wider spectrum of students in different semesters, undergoing different curricular and extra-curricular calendars.

- A limited sample size is used to generate the comparison results, thus the conclusions drawn from this research cannot be generalized to a broader spectrum of students.

- The clinical data and medical history for the test subjects was not recorded in this study, and the perception of Stress was performed through non-invasive and non-clinical techniques.

- No record about the nutritional habits and daily routine of the test subjects was collected,, these parameters have been known to influence the levels of stress in an individual. A broader study would incorporate the daily routine of the individual as well.

- It is assumed that academics have some impact on the overall general stress of a student, whereas there can be multiple non-academic factors as well which influence the general stress in an individual student.

FUTURE RECOMMENDATIONS

- A future study which targets a wider set of subjects should be performed, thereby enabling researchers to draw more generic conclusions.

- Investigation of stressors in a semester system- deadlines, quizzes, assignments, presentations, vivas etc.

- There is a possibility to devise a strategy by teaching faculty to decide the optimal level of challenge based on the student's response in preliminary Exams/Quizzes. This would however require generation of multiple questions having varying degree of difficulty level. As a result Exam conducted in subsequent stages may result in better performance by the students when the faculty is more informed about their optimal stress level.

- In long term study, same students can be re-evaluated at the end of their degree year i.e. 4th year. This would help in checking their performance and its association with their behavior.

- A broader study encompassing all three scales of DASS-21 Depression, Anxiety and Stress should be conducted to study the influence of all three parameters jointly on the academic performance of the students.

- A study including clinical history and medical backgrounds of the students will culminate in a broader and diverse set of conclusions which can be utilized for further benefit of the students.

- A temporal study exploring the gradual change in the students' performance, subjected to varying levels of stress, can be conducted which tracks the individual's performance over an extended duration of time, with periodic data collection. This will generate quantitative results which can be compared to give statistical backing to the positive and negative influence of stress on the student performance in curricular activities.

CONCLUSION

Through this study we observed the effect of **general stress** on the **academic performance** of students and the ensuing short-term and long-term performances were tabulated. A diverse range of comparisons between the performances of different student categories were conducted and the resulting influence was observed. DASS-21 was used to estimate the level of general stress the students were experiencing and their short-term and long-term academic performance was measured through their scores in an unannounced quiz and their cumulative grade point average (CGPA) respectively.

Students who undergo moderate stress perform noticeably better than their unstressed and severely or extremely stressed counterparts in the long-term examinations, particularly interesting was the observation that moderately stressed students performed better than both unstressed and extremely stressed in accordance with the Yerkes-Dodson bell-curve. In the unannounced quiz, performance of the extremely stressed students was markedly better than the students who were less stressed or unstressed, with a considerably high average score. But this increase in performance is short-lived because the extended exposure to extreme levels of stress degrades the individual's performance in the long-term.

Stress can be manipulated as an instrument of individual growth thereby generating positive results for the student; this should be emphasized so that the academic faculty as well as the students, are aware of the positive and negative consequences of stress. A negative perception of stress can have harmful long-term effects which are far diverse and severe than a general decline in academic performance. A perception of stressful events as challenging scenarios of potential growth opportunities can result in far better performances on part of the students and upon completion a general sense of accomplishment will prevail in the individual.

"Meaningful Growth Requires Challenge and Stress."

- **Jeffrey Siegel**

CHAPTER 5

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ANNEXURE

ANNEX 1A   DASS-21   Modified   Score   Table   for   General Stress

CATEGORIES OF STRESS	STRESS SCORE
Normal	0 -14
Mild	15 -18
Moderate	19 - 25
Severe	26 -33
Extremely severe	34+

Stress Scores, DASS-21 [83]

ANNEX 1B   DASS-21 Questionnaire for Analysing General Stress

DAS S 21 *Name:*   *Date:*

Please read each statement and circle a number 0, 1, 2 or 3 which indicates how much the statement applied to you *over the past week*. There are no right or wrong answers. Do not spend too much time on any statement.

The rating scale is as follows:

0 Did not apply to me at all

1 Applied to me to some degree, or some of the time

2 Applied to me to a considerable degree, or a good part of time

3 Applied to me very much, or most of the time

1	I found it hard to wind down	0	1	2	3
2	I was aware of dryness of my mouth	0	1	2	3
3	I couldn't seem to experience any positive feeling at all	0	1	2	3
4	I experienced breathing difficulty (eg, excessively rapid breathing, breathlessness in the absence of physical exertion)	0	1	2	3
5	I found it difficult to work up the initiative to do things	0	1	2	3
6	I tended to over-react to situations	0	1	2	3
7	I experienced trembling (eg, in the hands)	0	1	2	3
8	I felt that I was using a lot of nervous energy	0	1	2	3
9	I was worried about situations in which I might panic and make a fool of myself	0	1	2	3
10	I felt that I had nothing to look forward to	0	1	2	3
11	I found myself getting agitated	0	1	2	3
12	I found it difficult to relax	0	1	2	3
13	I felt down-hearted and blue	0	1	2	3
14	I was intolerant of anything that kept me from getting on with what I was doing	0	1	2	3
15	I felt I was close to panic	0	1	2	3
16	I was unable to become enthusiastic about anything	0	1	2	3
17	I felt I wasn't worth much as a person	0	1	2	3
18	I felt that I was rather touchy	0	1	2	3
19	I was aware of the action of my heart in the absence of physical exertion (eg, sense of heart rate increase, heart missing a beat)	0	1	2	3
20	I felt scared without any good reason	0	1	2	3
21	I felt that life was meaningless	0	1	2	3

ANNEX 2   General Mathematics Quiz for Short-term academic performance estimation [81].

Name: _____

Time: 8mins

Math Test

Addition/ Subtraction

1.   1455
      +   3466
      =

2.   106422445
      +   569302029
      =

3.   897645
      -    34652
      =

4.   985637388
      -   874526212
      =

Multiplication/ Division

5.   36
      X   18
      =

6.   4567
      X   456
      =

7.   24/6 =

8.   225/5 =