Course Code: MT - 205	Course Name: Probability & Statistics
Instructor Name: Osama Bin Ajaz, Nadeem Khan, Fareeha Sultan, and Asma Maqsood	
Student Roll No:	Section No:

Instructions:

- Read each question completely before answering it. There are **04 questions and 2 pages.**
- In case of any ambiguity, you may make assumptions. But your assumption should not contradict any statement in the question paper.
- All the answers must be solved according to the sequence given in the question paper.
- Submit your own handwritten scripts in a single PDF file.
- The name of the answer file must start with Student ID and Name of the student followed by Course Code.
- Do not wait for the last moment to upload the answer scripts as there may be too much congestion around the end time

Time: 3 hrs. + (60 minutes for submission)   **Max. Points = 70 (50%)**

Q1)   Consider the data file "achievement" and solve the following questions: **[20]**

 (i)   Select any one pair of variables randomly, apply a suitable hypothesis test, and give the interpretation. **[7]**

 (ii)   Select any two variables randomly that can be considered independent, give a justification, and apply a suitable hypothesis test. **[7]**

 (iii)   Select at least two variables and do a regression analysis. Give **justification** of dependent and independent variable(s). Regression analysis must include **correlation** coefficient, parameter **estimation**, and **summary** of main findings. **[1+1+1+3=6]**

Q2)   **(i)** A new stain removal product claims to remove the stains on 70% of all stained garments. Assume that the product will be tested on 15 randomly selected stained garments, and let x denote the number of these garments from which the stains will be completely removed. Find $P(X < 12)$, if the stain removal product's claim is correct. If X actually turns out to be 10, what do you think of the claim? Also, find the mean and variance. **[5]**

 (ii) In a grocery store, an analyst finds the probabilities that a customer buys 0, 1, and 2 or more grocery items are 0.2, 0.5, and 0.3 respectively. If 8 customers arrive at the store, find the probability that one buys nothing, three buys one item, and 4 buys two or more items. **[3]**

(iii) The mean number of non-defective products manufactured in a factory in one day is 34. What is the probability that on a given day there are exactly 28 non-defective products? **[3]**

(iv) An institute conducted a mock test for a certain exam. A group of students appeared in that mock test and the grades have a mean of 65 and a standard deviation of 8. If the distribution is approximated by a normal distribution, what % of the students   **[3]**

a)   Scored higher than 75?
b)   Scored between 50 and 85?
c)   Less than 50 and failed the test?

Q3) (i)   A Polymer product has a quality rate A, B, and C. Polymer product is received from shipment 80% have an "A" quality 12 % have "B" quality and 8% have "C" quality. It is noted in previous cases that 5% product "A" failed to be an "A" quality.2% product "B" failed to be a "B" quality.1% product "C" failed to be a "C" quality. Find the probability that a failed product is received and have an "A" quality.   **[6]**

(ii) For the following data set. Draw boxplot, scatter plot, and dot plot and give interpretations.

[6+3.5+3.5=13]

575	542	530	539	570	565	593	590	579	610
600	651	610	637	629	725	700	715	685	710

Q4)   **(a)** Consider the following joint density function: **[2 + 5 + 2 = 9]**

$$f(\alpha, \beta) = k\alpha\beta, \ 0 < \alpha < 4, \ 1 < \beta < 5$$

$$= 0, \text{ else where}$$

(i)   Find the value of k
(ii)   Find the marginal distribution for α and β.
(iii)   Find P $(\alpha + \beta < 3)$

(b) Talha and Abid decided to meet between 2:00 P.M. and 3:00 P.M., with the understanding that each will wait no longer than 20 minutes for the other. Find the probability that they will meet?   **[4]**

(c) In a gambling scheme, there are 200 prizes of $5, 20 prizes of $25, and 5 prizes of $100. Suppose 5000 tickets are to be sold, what would be the reasonable price to pay for a ticket?   **[4]**