

(ELI20215)

M.Sc. DEGREE EXAMINATION, APRIL 2019.

Second Semester

Electronics and Instrumentation

Paper II — STATISTICAL TOOLS

(Regulation 2015)

Time : Three hours

Maximum : 70 marks

Answer ALL questions.

1. (a) The following are six measurements on a check standard, with the check standard measurements being resistivities at the center of a 100 ohm.cm wafer: 96.920, 97.118, 97.034, 97.047, 97.127 and 96.995.
- (i) Compute the average and the standard deviation of the measurements.
- (ii) Could the average have easily been computed without having to enter the numbers as given in a computer or calculator (e.g., by entering integers in a calculator)? Explain.
- (iii) Similarly, assume that one wished to compute the variance without using the numbers as given. Could this be done?
- (b) Show that the sample variance and sample standard deviation are unaltered when 1000 is added to each of the numbers 10, 20, 30, 40 and 50. Explain why the variance and standard deviation are unchanged, supporting your argument by using the formulas for the variance and standard deviation.

Or

- (c) In statistics compiled by the Major League Baseball Players Association for the year 2000, 126 starting pitchers (with 19 or more starts) had an average salary of \$3,064,021, whereas 165 relief pitchers (10 or fewer starts and 25 or more relief appearances) had an average salary of \$1,220,412. Assume that you want to compare the variability of salaries of starting pitchers versus relief pitchers. Could you simply compute their respective standard deviations and compare them? Explain.
- (d) Calculate the appropriate measure of skewness from the following cumulative frequency distribution:

| | | | | | | |
|---------------------|----|----|----|----|----|-----|
| Age (under years) : | 20 | 30 | 40 | 50 | 60 | 70 |
| No. of persons : | 12 | 29 | 48 | 75 | 94 | 106 |

2. (a) Represent the following data in a bar chart.

| | | | | | | | | |
|---------------------------|-----|-----|------|------|------|------|------|------|
| Months | Jan | Feb | Mar | Apr | May | June | July | Aug |
| No. of buses manufactured | 600 | 800 | 1000 | 1200 | 1400 | 1600 | 1800 | 1500 |

- (b) Display the following data in a pie chart and pictogram.

| | | | | |
|----------------|-------|--------|-------|----------|
| Marks division | First | Second | Third | Failures |
| % of students | 20% | 56% | 40% | 4% |

Or

- (c) Comparing the two representations, Pie chart and Pictogram, list some advantages and disadvantages of each.
- (d) Represent the following data in a Scatter diagram.

| | | | | | | | | | |
|-----------------------|----|----|----|----|----|----|----|----|----|
| Height | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 |
| Shoe size (in inches) | 3 | 3 | 4 | 4 | 5 | 5 | 6 | 6 | 7 |

3. (a) Describe various components of a time series and the ways in which they are supposed to combine in such a series.
- (b) Calculate the trend values by the method of the least squares for the following time series :

| | | | | | | | | |
|-------------------------|------|------|------|------|------|------|------|------|
| Year | 2004 | 2005 | 2007 | 2008 | 2009 | 2012 | 2013 | 2014 |
| Production ('000 units) | 451 | 366 | 352 | 400 | 218 | 420 | 450 | 518 |

Estimate the likely production for the year 2017.

$$[Y = 406.84 + 21.23 X; Y_{2017} = 579.91]$$

www.kvrssgroup.com

Or

- (c) Calculate 5-yearly moving average trend for the time series given below.

| | | | | | | | | | | | |
|----------|------|------|------|------|------|------|------|------|------|------|------|
| Year | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 |
| Quantity | 239 | 242 | 238 | 252 | 257 | 250 | 273 | 270 | 268 | 288 | 284 |
| Year | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | |
| Quantity | 282 | 300 | 303 | 298 | 313 | 317 | 309 | 329 | 333 | 327 | |

- (d) Below are given the figures of production (in thousand quintals) of a sugar factory :

| | | | | | | | |
|------------|------|------|------|------|------|------|------|
| Year | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
| Production | 77 | 88 | 94 | 85 | 91 | 98 | 90 |

- (i) Fit a straight line by the least squares method and tabulate the trend values.
- (ii) What is the yearly increase in the production of sugar?
1. (a) Which of the following descriptions are correct? The solutions x of

$$A_X = \begin{bmatrix} 1 & 1 & 1 \\ 1 & 0 & 2 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \end{bmatrix}.$$

Form (i) a plane (ii) a line (iii) a point (iv) a sub space (v) the null space of A (vi) the column space of A .

Or

- (b) Solve the non-singular triangle system

$$\begin{aligned} u + v + w &= b_1 \\ v + w &= b_2 \\ w &= b_3 \end{aligned}$$

Show that your solution gives a combination of the columns that equals the column on the right.

5. (a) If a body fall freely from rest in a vacuum, the distance through which it falls is approximately $s = 16t^2$, where s is in feet. and t in seconds. Find the velocity and acceleration. What is the velocity after 1 second? After 4 seconds? After 10 seconds?
- (b) When is the fraction $x^3 / x^2 + a^2$ increasing at the same rate as x ?

Or

- (c) Determine the equation of a curve through the point (4, 3), at every point of which the slope of the tangent is equal to the reciprocal of twice the ordinate of the point contact.
- (d) Investigate the sequence $\{a_n\}$ defined by the recurrence relation $a_1 = 2a_{n+1} = \frac{1}{2}(a_n + 6)$ for $n = 1, 2, 3 \dots$

