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RAJARATA UNIVERSITY OF SRI LANKA
FACULTY OF APPLIED SCIENCES

B.Sc. (General) Degree in Applied Sciences
First Year - Semester I Examination – March 2021

MAA 1302 – PROBABILITY AND STATISTICS I

Time: Three (3) hours

Answer **all** questions.
Note: Write all your answers on the question paper itself.

Write short answers to question numbers 1 to 3.

(marks: $4 \times 3 = 12$)

1. For the following two statements, state whether the underlined numbers are statistics or parameters. Give reasons for your answer.

   a) Of all Sri Lankan preschool teachers, 32% say that knowing the alphabet is an essential skill.

   .....

   b) Of the pooled 800 Sri Lankan preschool teachers, 34% say that knowing the alphabet is an essential skill.

   .....

2. National Health Institute of Sri Lanka (NHIS) claims that the among Sri Lankan adult population, 36% has an allergy. With the focus of re-evaluating the NHIIS claim, medical research institute conducted a study based on a sample of 1200 randomly selected adults and of them, 33.2% reported an allergy. Use this scenario to answer the following questions.

   a) Describe the population of interest.

   .....

   b) What is the sample?

   .....

   c) Identify the parameter and give its value.

   .....

   d) Identify the statistics and give its value.

   .....

3. In your own words, explain why the parameter is fixed and the statistic varies.

   .....

   .....

   .....

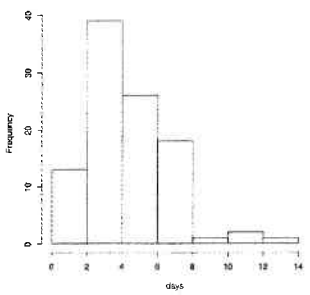
Choose the correct answer for question numbers 4 to17.
(marks: $2 \times 14 = 28$)

4. People generally lie to the questions on their personal income. This is an example of
   - ◯ a sampling bias.
   - ◯ a confounding.
   - ◯ a non-response bias.
   - ◯ a response bias.

5. Select the order of sampling schemes from best to worst.
   - ◯ stratified, convenience, simple random
   - ◯ simple random, stratified, convenience
   - ◯ stratified, simple random, convenience
   - ◯ simple random, convenience, stratified

6. A randomly selected sample of 1,000 university students was asked whether they had ever used the alcohol. Sixteen percent ($16\% or 0.16$) of the 1,000 students surveyed said they had. Which one of the following statement correctly explains the number 0.16?
   - ◯ It is a sample proportion.
   - ◯ It is a population proportion.
   - ◯ It is a margin of error.
   - ◯ It is a randomly chosen number.

7. The following histogram represents the lifespan of a random sample of a particular type of beetle (insect). Determine the correct relationship between the mean and median.



   - ◯ mean = median
   - ◯ mean $\neq$ median
   - ◯ mean < median
   - ◯ mean > median

8. Which of the following measurement explains spread of a data set.
   - ◯ measure of center
   - ◯ measure of location
   - ◯ measure of variability
   - ◯ non of above

9. A distribution is skewed to the right if a greater proportion of the measurements
   - ◯ lie to the left of the peak value.
   - ◯ lie to the right of the peak value.
   - ◯ lie to the center of the peak value.
   - ◯ lie to the outside of the peak value.

10. Null and alternative hypotheses are statements about:
   - ◯ population parameter
   - ◯ sample statistics
   - ◯ sometimes population parameters and sometimes sample statistics
   - ◯ probability distribution

11. Statistical inference is the process of making formal conclusions
   - ◯ about sample based on sample data.
   - ◯ about probability distribution based on sample data.
   - ◯ about population based on sample data.
   - ◯ all of above.

12. When the correlation coefficient, r, is close to one:
   - ◯ there is no relationship between the two variables.
   - ◯ there is a strong linear relationship between the two variables.
   - ◯ it is impossible to tell if there is a relationship between the two variables.
   - ◯ the slope of the regression line will be close to one.

13. Given IQ scores of the MAA 1302 class are approximately normally distributed with a mean of 100 and a standard deviation of 15. The proportion of people with IQs above 130 is:
   - ◯ 16%.
   - ◯ 8%.
   - ◯ 5%.
   - ◯ 2.5%.
   - ◯ 1%.
   - ◯ 0.5%.

14. If Z is a standard normal random variable, how does the area between $z = 0$ and $z = 1.25$ compare to the area between $z = 1.25$ and $z = 2.5$.
   - ◯ The latter area is half of the former area.
   - ◯ The two areas are the same.
   - ◯ The latter area is larger than the former area.
   - ◯ The latter area is smaller than the former area.

15. Which statement is not true about the 95% confidence level?
   - ◯ Confidence intervals computed by using the same procedure will include the true population value for 95% of all possible random samples taken from the population.
   - ◯ The procedure that is used to determine the confidence interval will provide an interval that includes the population parameter with the probability of 0.95.
   - ◯ The probability that the true value of the population parameter falls between the bounds of an already computed confidence interval is roughly 95%.
   - ◯ If we consider all possible randomly selected samples of the same size from a population, 95% is the percentage of those samples for which the confidence interval includes the population parameter.

16. Let X be the number of heads obtained in 40 independent tosses of a fair coin. Then X is a Binomial random variable with
    - ◯ $n = 40, p = 0$
    - ◯ $n = 0.5, p = 40$
    - ◯ $n = 40, p = 0.5$
    - ◯ $n = 100, p = 0.4$
17. Which of the following is not a property of a binomial experiment?
    - ◯ The experiment consists of a sequence of n identical trials.
    - ◯ Each outcome can be referred to as a success or a failure.
    - ◯ The probabilities of the two outcomes can change from one trial to the next.
    - ◯ The trials are independent.

Consider the following statement, write short answers for question numbers 18 to 21.
(marks: $2.5 \times 4 = 10$)

Suppose that A and B are two events such that $P(A) = 0.8$ and $P(B) = 0.7$.

18. Is it possible that $P(A \cap B) = 0.1$? If not give reasons?

    .....
    .....
    .....

19. What is the smallest possible value that can take for $P(A \cap B)$?

    .....
    .....
    .....

20. Is it possible that $P(A \cap B) = 0.77$? Either yes or no give reasons?

    .....
    .....

21. What it the largest possible value that can take for $P(A \cap B)$?

    .....
    .....
    .....

Question 22 to 25 required to provide detail answers.

(marks: $20 \times 4 = 80$)

22. A volunteer group, provides mentoring session from one to nine hours each week with disabled senior citizens. The program recruits among nursing college students, university students, and health care workers. Following table shows the information about the sample of the adult volunteers and the number of hours they volunteer per week.

Type of volunteer	1-3 Hours	4-6 Hours	7-9 Hours
Nursing college students	111	96	48
University students	96	133	61
Health care workers	91	150	53

Conduct an appropriate statistical test procedure to check, is the number of hours volunteered independent of the type of volunteer?

23. A manufacturer of salad dressings uses machines to dispense liquid ingredients into bottles that move along a filling line. The machine that dispenses salad dressings is working properly when 8 ounces are dispensed. Suppose that the average amount dispensed in a particular sample of 35 bottles is 7.91 ounces with a variance of 0.03 ounces, s^2. Is there evidence that the machine should be stopped and production wait for repairs? The lost production from a shutdown is potentially so great that management feels that the level of significance in the analysis should be 99%.

24. Rakesh, as an eight year old, established a mean time of 16.43 seconds for swimming the 25-yard butterfly stroke, with a standard deviation of 0.8 seconds. His mom, Susmitha, thought that Rakesh could swim the 25-yard freestyle faster using goggles. Susmitha bought Rakesh a new pair of expensive goggles and timed Rakesh for fifteen 25-yard butterfly stroke swims. For the 15 swims, Rakesh's mean time was 16 seconds. Susmitha thought that the goggles helped Rakesh to swim faster than the 16.43 seconds.

    Conduct an appropriate hypothesis test to validate Susmitha's thought at the 5% level of significance.

25. A study is done to determine if Company A retains its workers longer than Company B. It is believed that Company A has a higher retention than Company B. The study finds that in a sample of 11 workers at Company A, their average time with the company is four years with a standard deviation of 1.5 years. A sample of 9 workers at Company B, finds that the average time with the company was 3.5 years with a standard deviation of 1 year. Test this claim at the 5% level of significance.