AMREF INTERNATIONAL UNIVERSITY

SCHOOL OF MEDICAL SCIENCES

DEPARTMENT OF REHABILIATION MEDICINE

BACHELOR OF SCIENCE IN PHYSIOTHERAPY

END OF TRIMESTER EXAMINATIONS SEPTEMBER TO DECEMBER 2025

UNIT CODE: PHT 315

UNIT NAME: Biostatistics (Main Exam)

DATE: 8th DECEMBER 2025

TIME: 9am-11am

INSTRUCTIONS

1. **All students will have two (2) hours to complete the examination**
2. **This is an online exam, Attempt all questions as per the instruction**
3. **It is the student's responsibility to report any page and number missing in this paper.**
4. **Check that the paper is complete**
5. **Total number of pages is 7 including the cover.**
6. **Read through the paper quickly before you start.**

SECTION A – MULTIPLE CHOICE QUESTIONS. Answer all the question (30 marks)

1. The primary purpose of biostatistics in clinical research is to:
   A. Describe personal opinions quantitatively
   B. Support decision-making through data-based inference
   C. Replace qualitative interpretation of findings
   D. Eliminate uncertainty completely
2. The best example of a continuous variable in physiotherapy research is:
   A. Type of sport
   B. Gender
   C. Blood pressure
   D. Nationality
3. Data on pain intensity measured by a 10-point Visual Analogue Scale (VAS) is classified as:
   A. Nominal
   B. Ordinal
   C. Interval
   D. Ratio
4. A physiotherapist recording "improved", "no change", or "worsened" gait status after therapy uses which measurement scale?
   A. Nominal
   B. Ordinal
   C. Interval
   D. Ratio
5. In a survey assessing physiotherapy service satisfaction, which data type is most appropriate?
   A. Quantitative continuous
   B. Qualitative ordinal
   C. Quantitative discrete
   D. Nominal numerical
6. A bar chart is most appropriate for presenting:
   A. Continuous numerical data
   B. Nominal categorical data
   C. Paired data
   D. Standard deviations
7. The histogram differs from the bar chart because:
   A. It displays gaps between bars
   B. It is used for continuous data without gaps
   C. It uses symbols instead of bars
   D. It cannot show frequencies
8. If two datasets have the same mean but different spreads, the measure distinguishing them is:
   A. Median
   B. Mode
   C. Standard deviation
   D. Range

9. The median is preferred to the mean when:
   A. Data are symmetrically distributed
   B. There are extreme outliers
   C. All values are equal
   D. Data are nominal
10. The range is limited as a measure of dispersion because it:
   A. Ignores all but two extreme values
   B. Considers all data equally
   C. Remains stable despite outliers
   D. Reflects the entire distribution
11. The variance of a dataset is obtained by:
   A. Adding deviations from the mean
   B. Squaring deviations and finding their average
   C. Dividing standard deviation by mean
   D. Multiplying range by median
12. A positive skew in a dataset indicates that:
   A. Most values lie below the mean
   B. The mean equals the median
   C. Distribution is symmetrical
   D. Outliers are clustered on the left
13. The coefficient of variation (CV) is used to:
   A. Compare relative variability between datasets with different means
   B. Describe correlation strength
   C. Measure frequency distribution
   D. Estimate sample size
14. In a rehabilitation center, which graphical display best compares pre- and post-therapy pain scores for each patient?
   A. Pie chart
   B. Bar graph
   C. Line graph
   D. Histogram
15. If a sample of 40 patients has a mean BMI of 26 kg/m² and standard deviation of 2, the variance is:
   A. 2
   B. 4
   C. 24
   D. 52
16. The normal distribution is critical in biostatistics because:
   A. It describes symmetrical patterns of most biological variables
   B. It only applies to small samples
   C. It excludes variability
   D. It guarantees significance
17. In a normally distributed sample, approximately 95% of values fall within:
   A. ±1 SD
   B. ±2 SD

C. ±3 SD
D. ±4 SD

18. If the mean heart rate is 80 bpm and SD is 10, the Z-score for a value of 90 bpm is:
    A. 0.5
    B. 1.0
    C. 2.0
    D. 3.0
19. A physiotherapist collecting data from only 10 athletes should recognize that:
    A. The sample mean perfectly represents the population
    B. Smaller samples increase sampling error
    C. Probability laws are unaffected by sample size
    D. Larger samples increase error
20. The probability of drawing an ace from a deck of 52 cards is:
    A. 1/13
    B. 1/26
    C. 4/13
    D. 1/4
21. If the probability of injury is 0.3, the probability of no injury is:
    A. 0.3
    B. 0.5
    C. 0.7
    D. 1.3
22. The binomial distribution applies when:
    A. There are two mutually exclusive outcomes
    B. Data are continuous
    C. Outcomes have unequal probability
    D. More than two outcomes exist
23. The standard error of the mean (SEM) primarily measures:
    A. Variation of the population mean
    B. Precision of the sample mean estimate
    C. Skewness of the distribution
    D. Variance among variables
24. In a 95% confidence interval, the wider interval indicates:
    A. More precise estimate
    B. Less confidence
    C. Greater uncertainty in estimate
    D. Smaller sample size
25. In hypothesis testing, the alternative hypothesis (H_1) proposes that:
    A. No difference exists
    B. Observed difference is due to chance
    C. A genuine effect or difference exists
    D. Results are not significant
26. A Type II error occurs when a researcher:
    A. Rejects a true null hypothesis
    B. Fails to reject a false null hypothesis

C. Accepts the alternative hypothesis correctly
D. Misinterprets a p-value

27. The p-value represents:
    A. The probability that results occurred by chance
    B. The effect size of treatment
    C. The confidence level
    D. The mean difference
28. The Chi-square test is used to analyze:
    A. Relationship between two categorical variables
    B. Difference between two means
    C. Correlation between continuous variables
    D. Trends in time-series data
29. A physiotherapy researcher tests whether exercise type affects flexibility improvement. The most appropriate test is:
    A. Chi-square
    B. t-test
    C. ANOVA
    D. Pearson correlation
30. A statistically significant result ($p < 0.05$) means that:
    A. The observed effect is unlikely due to chance
    B. The effect size is clinically large
    C. The hypothesis is true
    D. Sample size was adequate

SECTION B: SHORT ANSWER QUESTIONS (20 marks)

Answer ALL questions. (Each 5 marks). Show all steps and calculations.

1. The following represents the pain scores (0–10 scale) for eight patients undergoing two types of therapy:
   Therapy A: 6, 7, 8, 5
   Therapy B: 7, 9, 6, 8
   (a) Compute the mean and standard deviation for each therapy group.
   (b) Interpret which therapy demonstrates greater consistency in pain reduction.
2. A physiotherapist is analyzing the ages (in years) of 10 stroke patients:
   45, 50, 48, 47, 52, 46, 49, 51, 44, 50.
   (a) Organize the data into a frequency distribution table using class intervals of 2 years.
   (b) Draw or describe the shape of the histogram that would represent the data.
3. The table below shows the number of physiotherapy sessions attended by two patient groups in a clinical study:

Group	Mean	SD	n
Control	12	2.0	10
Intervention	15	2.5	10

(a) Compute the t-value to determine if there is a significant difference.
(b) Comment on whether this difference is significant at $\alpha = 0.05$ (critical $t \approx 2.10$).

4. A study examined the relationship between exercise duration (minutes per session) and weight reduction (kg) in 6 participants:
   Duration (X): 30, 45, 60, 75, 90, 105
   Weight loss (Y): 1, 2, 2, 3, 3, 4
   (a) Compute the Pearson correlation coefficient (r).
   (b) Interpret the relationship in terms of clinical relevance.

SECTION C: LONG ANSWER QUESTIONS (20 marks)

Answer ONE (1) question only. Show all steps and calculations.

1. A physiotherapist measured the grip strength (kg) of 10 elderly clients before an exercise program: 22, 24, 21, 23, 26, 25, 24, 22, 28, 23
   (a) Compute the mean, variance, and standard deviation. (10 marks)
   (b) Interpret the findings: what do the results suggest about functional variability among participants? (5 marks)
   (c) If another group of similar patients had a mean of 30 kg (SD = 3), use a Z-test to determine if the difference between groups is statistically significant at $\alpha = 0.05$. (5 marks)
2. A physiotherapist tests the effectiveness of a new ultrasound therapy on reducing inflammation size (in cm^2). The pre- and post-treatment results from 8 patients are as follows:

Patient	pre	post
1	10	8
2	12	10
3	11	9
4	9	8
5	13	11
6	10	9
7	12	11
8	11	10

   (a) Compute the mean difference and standard deviation of the differences. (10 marks)
   (b) Conduct a paired t-test to determine if the reduction is significant at $\alpha = 0.05$ (critical $t \approx 2.36$). (5 marks)
   (c) Interpret the clinical implication of your results for physiotherapy decision-making. (5 marks)