PHP2510

PRE-REQ ASSESSMENT WEEK 0

BACKGROUND

In order to help students determine whether they should enroll in PHP2507/2508 vs PHP2510/2511 (which will include more statistical theory, as well as more advanced coding in R), the following pre-test for PHP2510 has been developed. This is a self-administered voluntary assessment in order to better guide students to the appropriate selection: no specific grade is required to enroll in PHP2510. Instead, students should understand that they will be expected to be comfortable with the material assessed in this test, as 2510/2511 has a pre-requisite of 2 semesters of college mathematics, including one semester of calculus. The answer key follows on page 3.

ASSESSMENT

Please answer the following questions without assistance from any online resources or tools.

1. What is the derivative of $x^3 + 4x^2 + 7$?
2. What information is known when the derivative f'(x) equals 0 at a certain point x = c?
3. How do you represent the area under the curve y = f(x) from x = a to x = b as an integral?
4. In biostatistics, we often use models like: log(y) = a + b*x, where a and b are unknown constants and x and y are variables. What does this mean about the relationship between x and y (not on a log scale)?
5. The sum of the first n natural numbers is equal to n(n+1)/2. Write this in summation notation. Show this holds true for n = 8.
6. Without using a calculator, determine which of the following values is negative: log(20), log(3), log (1), log(0.25). Is the answer the same for $\log_{10}$?
7. Evaluate this expression: 6!/(4! 2!)
8. You are designing an experiment with three phases. You have 6 different potential interventions to test. How many ways can you assign a different intervention to each of the three phases?
9. [calculator required] Variance is defined by the formulae below. Calculate the variance of weight (by hand) in Table 1 below.

$$\mathrm{Var}(X) = \frac{1}{n}\sum_{i=1}^{n}(x_i - \mu)^2 \qquad \mu = \frac{1}{n}\sum_{i=1}^{n} x_i.$$

10. Assume there was another variable in Table 1 that had the same value for all patients. Prove the variance of that new variable is 0.
11. Find the limiting value of each expression as n tends toward infinity:
    a. 1/n
    b. (n + 1) / n
    c. exp(-n)
    d. log(1/n)
12. [stretch] Assume people's birthdays are equally distributed across a 365-day calendar. There are 40 people in the classroom. Create a formula that determines the chance that no one in the classroom shares the same birthday. *Hint: Imagine each person walking into the classroom and having to "avoid" the same birthday(s) as those that already walked in.*

Table 1

Patient	Weight	Height
1	136	5′4
2	204	6′1
3	119	5′5
4	188	5′7
5	240	5′11

ANSWER KEY

1. $3x^2 + 8x$
2. The slope of tangent is 0 (horizontal), which means we are at a local minima, maxima, or inflection point
3. $\int_a^b f(x)\,dx$
4. y = exp(a + b*x)
5. $\sum_{i=1}^{n} i = n(n+1)/2$; 1 + 2 + 3 + 4 + 5 + 6 + 7 + 8 = 36; 8 * 9/2 = 36
6. log(0.25); Yes
7. 15
8. 6 * 5 * 4 = 120
9. mean 177.4; var 1972.64
10. Assume everyone's value is c; μ = ⅕ (c + c + c + c + c) = c; var = ⅕ * ((c-c)^2 + (c-c)^2 + (c-c)^2 + (c-c)^2 + (c-c)^2) = ⅕ (0 + 0 + 0 + 0 + 0) = 0
11. a) 0; b) 1; c) 0; d) -inf
12. 1 * (364/365) * (363/365) * (362 / 365) * … * (326/365) *{note that 326 = 365 - n + 1, where n = 40 in this question}*