

Self-Assessment Quiz: Mathematical Induction (Lecture 10)

Ungraded Quiz – For Practice and Understanding

Self-Assessment Quiz: Mathematical Induction (MCQs)

Instructions: Choose the correct option. This quiz is ungraded.

1. The Principle of Mathematical Induction requires which two steps?
 - (a) Basis Step and Contradiction Step
 - (b) Basis Step and Inductive Step
 - (c) Inductive Step and Verification Step
 - (d) Hypothesis Step and Proof Step
2. In the Basis Step of induction, we typically verify:
 - (a) $P(k)$ is true for some arbitrary k
 - (b) $P(n)$ is true for all integers
 - (c) $P(1)$ (or $P(0)$) is true
 - (d) $P(n+1)$ is true
3. In the Inductive Step, we assume $P(k)$ is true. This assumption is called:
 - (a) Inductive lemma
 - (b) Inductive hypothesis
 - (c) Inductive result
 - (d) Proof structure
4. What must be shown in the Inductive Step?
 - (a) $P(k)$ implies $P(k+1)$
 - (b) $P(k+1)$ implies $P(k)$
 - (c) $P(k+2)$ implies $P(k)$
 - (d) $P(n)$ is true for all even integers only
5. Which of the following is an example of a statement often proven using induction?
 - (a) Proving irrationality of $\sqrt{2}$
 - (b) Proving the sum $1 + 2 + \cdots + n = \frac{n(n+1)}{2}$
 - (c) Solving differential equations
 - (d) Computing limits of sequences
6. Strong induction differs from weak induction because:

- (a) It does not require a basis step
 - (b) The inductive step assumes $P(1), P(2), \dots, P(k)$
 - (c) It only works for even numbers
 - (d) It cannot be used for sequences
7. Structural induction is mainly used on:
- (a) Real numbers
 - (b) Geometric sequences
 - (c) Recursively-defined structures
 - (d) Trigonometric identities
8. For the statement $1 + 3 + 5 + \dots + (2n - 1) = n^2$, the expression $2n - 1$ represents:
- (a) The n th even number
 - (b) The n th odd number
 - (c) The n th prime number
 - (d) The n th triangular number
9. To prove $2 + 2^2 + 2^3 + \dots + 2^n = 2^{n+1} - 1$, the inductive step adds which term?
- (a) 2^n
 - (b) 2^{n+1}
 - (c) $n + 1$
 - (d) $2n$
10. In induction proofs involving sums, which common technique is used in the inductive step?
- (a) Multiplying both sides by zero
 - (b) Adding the next term to both sides
 - (c) Integrating both sides
 - (d) Taking the derivative of both sides
11. Which type of induction is most helpful for proving statements about algorithms defined recursively?
- (a) Weak induction
 - (b) Strong induction
 - (c) Structural induction
 - (d) None of the above
12. The statement “If $P(k)$ is true, then $P(k+1)$ is true” establishes:
- (a) A recursive definition
 - (b) Logical equivalence

- (c) A chain of implications proving the statement for all n
 - (d) A contradiction
13. Which of the following best describes the idea behind mathematical induction?
- (a) Proof by contradiction
 - (b) Proving the truth for infinitely many cases using two steps
 - (c) Guessing patterns from examples
 - (d) Numerical experimentation
14. When proving statements involving factorials such as $n! > 2^n$, which method is most commonly used?
- (a) Structural induction
 - (b) Weak induction
 - (c) Strong induction
 - (d) Algebraic manipulation only
15. Which of the following is **not** usually required for an induction proof?
- (a) Basis step
 - (b) Inductive hypothesis
 - (c) Inductive step
 - (d) Counterexample

Answer Key (Self-Assessment Quiz)

- 1. (b)
- 2. (c)
- 3. (b)
- 4. (a)
- 5. (b)
- 6. (b)
- 7. (c)
- 8. (b)
- 9. (a)
- 10. (b)
- 11. (c)

12. (c)

13. (b)

14. (c)

15. (d)