

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 $1 + 2 + \dots + n = \frac{n(n+1)}{2}$
 - (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 nth even number
 - (b) The nth odd number
 - (c) The nth prime number
 - (d) The nth 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)