

6. T.2 · Discrete mathematics, probability and numerical methods

Starter Quiz ·

GRE Subject Test · GRE Mathematics

Name: _____ Score: _____

1. How many edges does the complete graph K_7 have?

2. Into how many regions do 5 lines in general position divide the plane?

3. A binomial variable has $N = 10$, $p = 0.3$. Its variance is

☐ 0.9

☐ 0.21

☐ 2.1

☐ 3

4. Apply one Newton step to $f(x) = x^2 - 3$ from $x_0 = 2$.

5. Two mutually exclusive events with positive probabilities cannot be independent.

☐ True ☐ False

6. A three-letter code uses A, B, C, D or E in each position. Repetition is allowed. How many codes are possible?

7. Three values are picked independently and uniformly from ten possible values, with replacement. What is the probability of at least one repeated value?

8. On one fair six-sided die roll, let A be “even” and B be “greater than 4”. These events are

☐ both independent and mutually exclusive

☐ neither independent nor mutually exclusive

☐ independent, but not mutually exclusive

☐ mutually exclusive, but not independent

9. For $f(x) = x^3 - 2x + 2$, Newton iteration starts at 0. It alternates between 0 and 1. What does this show?

☐ Every Newton iteration converges after two steps.

☐ The root is 0.

☐ Nonzero derivatives at the iterates do not guarantee convergence.

☐ Newton iteration is undefined at both values.

10. Four independent trials each succeed with probability 0.5. What is the probability of at least one success?

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Answers ·

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1. **21**

Each edge joins a pair of distinct vertices, and K_7 joins every pair: $C(7, 2) = 7 \cdot 6 / 2 = 21$.

2. **16**

The n -th line in general position crosses the earlier $n - 1$ lines and so adds n regions. Starting from 1 region: $1 + (1 + 2 + 3 + 4 + 5) = 1 + 15 = 16$.

3. **2.1**

$10 \times 0.3 \times 0.7$.

4. **1.75**

$x_1 = x_0 - f(x_0)/f'(x_0) = 2 - (4 - 3)/(2 \cdot 2) = 2 - 1/4 = 1.75$, already close to $\sqrt{3} \approx 1.732$.

5. **True**

True. Exclusive means $P(A \cap B) = 0$, but independence needs $P(A \cap B) = P(A)P(B) > 0$.

6. **125**

There are five choices independently for each of three positions: $5^3 = 125$. Dividing by $3!$ would incorrectly merge different ordered codes.

7. **0.28**

The all-distinct probability is $(10 \cdot 9 \cdot 8)/10^3 = 0.72$. Its complement, at least one repeat, has probability $1 - 0.72 = 0.28$.

8. **independent, but not mutually exclusive**

$P(A) = 1/2$, $P(B) = 1/3$ and $P(A \cap B) = P(\{6\}) = 1/6$. The product test holds, but the intersection is not empty.

9. **Nonzero derivatives at the iterates do not guarantee convergence.**

The derivatives are -2 at 0 and 1 at 1 , so both updates are defined. Neither point is a root, and the two-cycle does not converge.

10. **0.9375**

The complement is four failures, with probability $(0.5)^4 = 1/16$. Hence at least one success has probability $15/16 = 0.9375$.