Class 12 Maths Chapter 13: Probability - Notes, Important Questions and MCQs (2026-27)

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These Class 12 Maths Chapter 13 notes cover “Probability” from the NCERT Mathematics Part II textbook (2026-27): conditional probability and its properties, the multiplication theorem, independent events, the theorem of total probability, Bayes’ theorem, random variables, probability distributions and the mean of a random variable – with formula tables, solved examples, Q&A, 10 MCQs and a free PDF.

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Chapter Overview

Conditional probability P(E|F) is the probability of event E given that F has already occurred: $P(E|F) = P(E \cap F)/P(F)$, $P(F) \neq 0$. It leads to the multiplication theorem $P(E \cap F) = P(F)\, P(E|F)$.

Events are independent if the occurrence of one does not affect the other: $P(E \cap F) = P(E)\, P(F)$. Bayes’ theorem reverses conditional probabilities to find the probability of a cause given an observed outcome, and random variables let us summarise outcomes with distributions and their mean.

Important Topics and Concepts

Conditional Probability

- $P(E|F) = P(E \cap F)/P(F)$, $P(F) \neq 0$.
- $P(S|F) = P(F|F) = 1$.
- $P((A \cup B)|F) = P(A|F) + P(B|F) - P((A \cap B)|F)$.
- $P(E'|F) = 1 - P(E|F)$.

Multiplication Theorem and Independence

- $P(E \cap F) = P(E)\, P(F|E) = P(F)\, P(E|F)$.
- For three events: $P(E \cap F \cap G) = P(E)\, P(F|E)\, P(G|E \cap F)$.
- Independent events: $P(E \cap F) = P(E)\, P(F)$.
- If E and F are independent, so are E and F′, E′ and F, E′ and F′.
- Independent ≠ mutually exclusive (for events with non-zero probability).

Total Probability and Bayes' Theorem

- Partition: $E_1, E_2, \ldots, E_n$ pairwise disjoint, exhaustive, with non-zero probabilities.
- Total probability: $P(A) = \Sigma\, P(E_i)\, P(A|E_i)$.
- Bayes': $P(E_i|A) = P(E_i)\, P(A|E_i) / \Sigma\, P(E_j)\, P(A|E_j)$.
- $P(E_i)$ are prior probabilities; $P(E_i|A)$ are posterior probabilities.

Random Variables and Distributions

- Random variable: real-valued function on the sample space.
- Probability distribution: values x_i with probabilities p_i, $p_i \geq 0$ and $\Sigma p_i = 1$.
- Example: number of heads in two coin tosses: 0, 1, 2 with probabilities 1/4, 1/2, 1/4.

Mean of a Random Variable

- Mean (expectation) $E(X) = \mu = \Sigma\, x_i\, p_i$.
- For number of heads in two tosses: $E(X) = 0(1/4) + 1(1/2) + 2(1/4) = 1$.
- Mean of score on a fair die = 3.5.

Bayes' Theorem – Worked Example

Board-pattern practice.

- Bag I has 3 red and 4 black balls; Bag II has 5 red and 6 black balls. A bag is chosen at random and a ball drawn is red. Find the probability it came from Bag II.
- $P(E_1) = P(E_2) = 1/2$; $P(R|E_1) = 3/7$; $P(R|E_2) = 5/11$.
- $P(E_2|R) = (1/2)(5/11) / [(1/2)(3/7) + (1/2)(5/11)]$.
- $= (5/11) / (3/7 + 5/11) = (5/11) / (68/77) = 35/68$.

Key Probability Formulas

Concept	Formula
Conditional	$P(E\|F) = P(E \cap F)/P(F)$
Multiplication	$P(E \cap F) = P(F)\, P(E\|F)$
Independent	$P(E \cap F) = P(E)\, P(F)$
Total probability	$P(A) = \Sigma\, P(E_i)\, P(A\|E_i)$
Bayes'	$P(E_i\|A) = P(E_i)P(A\|E_i)/\Sigma\, P(E_j)P(A\|E_j)$

Concept	Formula
Mean	$E(X) = \Sigma x_i p_i$

Important Definitions and Terms

Term	Meaning
Conditional probability	Probability of E given F
Independent events	Occurrence of one does not affect other
Mutually exclusive	Cannot occur together
Partition	Disjoint exhaustive events
Prior probability	Probability before evidence
Posterior probability	Probability after evidence
Bayes' theorem	Finding probability of a cause
Random variable	Function from sample space to reals
Probability distribution	Values with their probabilities
Expectation	Mean value $\Sigma x_i p_i$

Short Answer Questions

Q1. Define conditional probability.

$P(E|F) = P(E \cap F)/P(F)$, $P(F) \neq 0$.

Q2. If $P(A) = 0.4$, $P(B) = 0.5$ and A, B independent, find $P(A \cap B)$.

0.2.

Q3. What is $P(E'|F)$?

1 – $P(E|F)$.

Q4. State the multiplication theorem.

$P(E \cap F) = P(E)\, P(F|E)$.

Q5. What are prior probabilities?

Probabilities of hypotheses before observing the event.

Q6. Write the condition for a probability distribution.

$p_i \geq 0$ and $\Sigma p_i = 1$.

Q7. Find the mean of the score on a fair die.

3.5.

Q8. Are mutually exclusive events independent?

No, unless one has zero probability.

Long Answer Questions

Q1. State and prove Bayes' theorem.

Let $E_1, \ldots, E_n$ partition S and A be an event.

$P(E_i|A) = P(A \cap E_i)/P(A)$.

$P(A \cap E_i) = P(E_i)\ P(A|E_i)$.

$P(A) = \Sigma\ P(E_j)\ P(A|E_j)$ (total probability).

Hence $P(E_i|A) = P(E_i)P(A|E_i)/\Sigma\ P(E_j)P(A|E_j)$.

Q2. Find the probability distribution and mean of the number of heads in three tosses of a coin.

X = 0, 1, 2, 3.

P = 1/8, 3/8, 3/8, 1/8.

$\Sigma p = 1$ – valid.

E(X) = 0 + 3/8 + 6/8 + 3/8.

= 12/8 = 1.5.

Q3. A die is thrown twice. Find the probability that the sum is 8 given that the first throw shows an even number.

F: first even – 18 outcomes; P(F) = 1/2.

E ∩ F: (2,6), (4,4), (6,2) – 3 outcomes.

P(E ∩ F) = 3/36 = 1/12.

P(E|F) = (1/12)/(1/2).

= 1/6.

MCQs with Answers

1. P(E|F) =(a) P(E)P(F) (b) P(E ∩ F)/P(F) (c) P(E ∪ F) (d) P(F)/P(E)Answer: (b) P(E ∩ F)/P(F)

2. Independent events satisfy(a) P(E ∩ F) = 0 (b) P(E ∩ F) = P(E)P(F) (c) P(E) = P(F) (d) P(E ∪ F) = 1Answer: (b) P(E ∩ F) = P(E)P(F)

3. Sum of probabilities in a distribution(a) 0 (b) 1 (c) any (d) 2Answer: (b) 1

4. Mean of number of heads in 2 tosses(a) 0.5 (b) 1 (c) 1.5 (d) 2Answer: (b) 1

5. P(S|F) =(a) 0 (b) 1 (c) P(F) (d) P(S)Answer: (b) 1

6. Posterior probability is found by(a) addition theorem (b) Bayes' theorem (c) binomial theorem (d) meanAnswer: (b) Bayes' theorem

7. If A, B independent, A and B′ are(a) dependent (b) independent (c) mutually exclusive (d) exhaustiveAnswer: (b) independent

8. P(A) = 0.3, P(B) = 0.4 independent; P(A ∩ B)(a) 0.7 (b) 0.12 (c) 0.1 (d) 0.34Answer: (b) 0.12

9. Random variable is a function from(a) R to S (b) S to R (c) S to S (d) R to RAnswer: (b) S to R

10. Mean of score on a fair die(a) 3 (b) 3.5 (c) 4 (d) 6Answer: (b) 3.5

Quick Revision Points

- Conditional probability and properties.
- Multiplication theorem.
- Independent events.
- Total probability.
- Bayes' theorem.
- Random variable, distribution, mean.

Chapter Summary

Conditional probability $P(E|F) = P(E \cap F)/P(F)$ measures the chance of E once F has occurred, leading to the multiplication theorem. Independent events satisfy $P(E \cap F) = P(E)P(F)$.

The theorem of total probability and Bayes' theorem relate prior and posterior probabilities over a partition. A random variable assigns numbers to outcomes; its probability distribution has non-negative probabilities summing to 1, and its mean is $\Sigma\, x_i\, p_i$.

Exam Tips and PYQ Pattern

- Define events clearly before calculating.
- Draw a tree diagram for Bayes' problems.
- Check $\Sigma p = 1$ in distributions.
- Do not confuse independent with mutually exclusive.
- Simplify fractions at the end.

Frequently Asked Questions

Is this chapter in the 2026-27 CBSE syllabus?

Yes. It is part of the NCERT Class 12 Mathematics Part II textbook, prescribed in the CBSE 2026-27 syllabus.

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Yes. Use the free PDF link at the top of this page – no signup needed.

What is Bayes' theorem?

It gives the probability of a cause E_i given an observed event A: $P(E_i|A) = P(E_i)P(A|E_i)/\Sigma\, P(E_j)P(A|E_j)$.

What is the difference between independent and mutually exclusive events?

Independent events do not affect each other's probability; mutually exclusive events cannot occur together.

Conclusion

Probability closes the Class 12 Maths syllabus. Practise the Bayes' problems here and save the free PDF.

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Freshness Note: These notes follow the NCERT Class 12 Maths textbook, Mathematics Part II (NCERT reprint 2026-27, rationalised syllabus), and the CBSE syllabus for the 2026-27 session. Last checked on 26 November 2026.