CLASS 12 MATHEMATICS — FORMULA SHEET

Chapter 13 : Probability (NCERT)

13.1 Conditional Probability

Concept	Formula
Conditional probability	$P(A\|B) = P(A \cap B) \div P(B)$, $P(B) \neq 0$
Multiplication theorem	$P(A \cap B) = P(B)\, P(A\|B) = P(A)\, P(B\|A)$
For three events	$P(A \cap B \cap C) = P(A)\, P(B\|A)\, P(C\|A \cap B)$
Range	$0 \leq P(A\|B) \leq 1$
P(S|B)	= 1
Complement	$P(A'\|B) = 1 - P(A\|B)$

13.2 Independent Events

Concept	Condition
Independent events	$P(A \cap B) = P(A) \times P(B)$
Then P(A|B)	= P(A) (B does not affect A)
Three independent events	$P(A \cap B \cap C) = P(A)P(B)P(C)$
Independent vs mutually exclusive	Different ideas — don't confuse them
Mutually exclusive	$P(A \cap B) = 0$ (cannot occur together)
If A, B independent	A & B', A' & B, A' & B' are also independent

13.3 Total Probability & Bayes' Theorem

Concept	Formula
Total probability theorem	$P(A) = \Sigma\, P(E_i)\, P(A\|E_i)$
Partition condition	$E_1, E_2, \ldots$ are mutually exclusive & exhaustive
Bayes' theorem	$P(E_i\|A) = [P(E_i)P(A\|E_i)] \div [\Sigma\, P(E_j)P(A\|E_j)]$
Prior probability	$P(E_i)$ — before the event A is known
Posterior probability	$P(E_i\|A)$ — revised after A occurs
Use of Bayes	Find the cause given the observed effect

13.4 Random Variable & Probability Distribution

Concept	Formula
Random variable (X)	Real-valued function on the sample space
Probability distribution	Lists X values with their probabilities p_i
Condition	$\Sigma\, p_i = 1$ (all probabilities sum to 1)
Mean (expectation)	$E(X) = \mu = \Sigma\, x_i\, p_i$

Concept	Formula
Variance	$\text{Var}(X) = \Sigma x_i^2 p_i - \mu^2$
Standard deviation	$\sigma = \sqrt{(\text{Var}(X))}$

13.5 Bernoulli Trials & Binomial Distribution

Concept	Formula
Bernoulli trial	Trial with two outcomes: success / failure
Conditions	Fixed n trials, independent, constant p
Binomial probability	$P(X = r) = {}^nC_r\, p^r\, q^{(n-r)}$
q (failure)	$q = 1 - p$
Mean of binomial	$\mu = n\, p$
Variance of binomial	$\sigma^2 = n\, p\, q$
Standard deviation	$\sigma = \sqrt{(n\, p\, q)}$
Note	Mean > variance (since $q < 1$)

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Conditional	$P(A\|B) = P(A \cap B)/P(B)$. Multiplication: $P(A \cap B) = P(A)P(B\|A)$.
Independent	$P(A \cap B) = P(A)P(B)$. Independent ≠ mutually exclusive!
Mutually exclusive	$P(A \cap B) = 0$ (can't both happen) — opposite idea to independence.
Total probability	$P(A) = \Sigma P(E_i)P(A\|E_i)$ over a partition of the sample space.
Bayes' theorem	Reverses the condition: find P(cause|effect) from P(effect|cause).
Distribution check	All probabilities must sum to 1 ($\Sigma p_i = 1$).
Mean & variance	$E(X) = \Sigma x_i p_i$; $\text{Var}(X) = \Sigma x_i^2 p_i - \mu^2$.
Binomial	$P(X=r) = {}^nC_r\, p^r q^{(n-r)}$; mean = np, variance = npq.