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# Bayes theorem and probability distribution of a random variable

Formulas and units, JEE Main. Status: Reviewed on 2026-11-20.

| Result | Formula | Units or note |
|---|---|---|
| **Total probability** | P(A) = sum of P(Ej) P(A \| Ej) Valid when: events E1..En mutually exclusive, exhaustive, with P(Ej) > 0 | pure number |
| **Bayes theorem** | P(Ei \| A) = P(Ei) P(A \| Ei)/sum of P(Ej) P(A \| Ej) Valid when: same partition E1..En; P(A) > 0 | pure number |
| **Two-cause form** | P(E1 \| A) = a1 l1/(a1 l1 + a2 l2), a = prior, l = likelihood Valid when: only two causes E1, E2 that are exclusive and exhaustive | pure number |
| **Distribution condition** | 0 <= p_i <= 1 and sum of p_i = 1 Valid when: for any discrete probability distribution | pure number |
| **Mean (expectation)** | E(X) = sum of x_i p_i Valid when: discrete random variable with finite values x_i | same as X |
| **Variance** | Var(X) = E(X^2) - (E(X))^2, E(X^2) = sum of x_i^2 p_i Valid when: discrete random variable; Var(X) divides by total probability 1 | unit of X squared |
| **Linear change** | E(aX + b) = a E(X) + b; Var(aX + b) = a^2 Var(X) Valid when: a and b are constants; holds for any random variable | as X |
| **Expected gain** | E(G) = sum of g_i p_i; fair game if E(G) = 0 Valid when: discrete gains g_i; expectation is the long-run average per play | rupees per game |
| **Larger of two dice** | P(X = k) = (2k - 1)/36; E(X) = 161/36 Valid when: max of two fair dice thrown together, X = larger number | pure number |

Full lesson with worked examples:
https://www.engineeringrise.in/learn/learn/jee-main/mathematics/statistics-and-probability/bayes-theorem-and-probability-distributio

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