STUDY FORMULA BOOKLET

Cambridge 9709 Maths Paper 5: probability and statistics 1

MF19 prints the mean, standard deviation, E(X), Var(X), nCr, the binomial and geometric probabilities and the normal tables. Learn first Z = (X - μ)/σ, conditional probability, nPr, frequency density and the continuity correction.

GIVEN printed in the formula list (MF19) LEARN IT not in MF19: learn it

Built by CuratedPrep from 41 past question papers for Paper 5 in our question bank, March 2020 to November 2025. Given means it is in the List of formulae and statistical tables (MF19) given in every paper. Learn it means a past question needed it and the exam did not print it.

Representation of data

MF19 prints the mean and standard deviation formulas for ungrouped and grouped data. Quartiles, frequency density, class midpoints and the coded data formulas are Learn it.

Interquartile range

Q1 and Q3 are the lower and upper quartiles, read from the ordered data or a stem-and-leaf diagram. State both quartile values: the method mark is implied only when both are shown and the IQR is calculated from them. Used in: Nov 2025 paper 55 Q4(b), median and IQR of the Pelicans; Nov 2025 paper 51 Q3(a); Jun 2025 paper 51 Q3(b).

$$\text{IQR} = Q_3 - Q_1$$

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Frequency density

It is the height of a histogram bar. Work out the class widths from the class boundaries, not the printed limits. Used in: Nov 2025 paper 52 Q5(a), histogram of times to the nearest minute; Mar 2024 paper 52 Q3(a); Jun 2024 paper 51 Q3(a).

$$\text{frequency density} = \frac{\text{frequency}}{\text{class width}}$$

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Midpoint of a class

Use boundaries, not the printed limits: for times to the nearest minute, 1 to 10 has boundaries 0.5 and 10.5, so the midpoint is 5.5. The schemes give no marks for upper bounds, lower bounds or class widths used instead of midpoints. Used in: Nov 2025 paper 52 Q5(b), estimate of the mean time; Nov 2023 paper 51 Q4(b); Mar 2020 paper 52 Q7(c).

$$\text{midpoint} = \frac{\text{lower boundary} + \text{upper boundary}}{2}$$

LEARN IT

Ungrouped data: mean

Add the totals when two data sets are combined: mean of all = (sum of x for both sets) / (total number of values). Used in: Jun 2025 paper 51 Q3(c), mean of 50 runners from two teams; Nov 2025 paper 51 Q3(b), mean of 54 employees.

$$\bar{x} = \frac{\Sigma x}{n}$$

GIVEN

Ungrouped data: standard deviation

The variance is the square of the standard deviation, so a given standard deviation squared gives the variance, and with the other totals you can rearrange for an unknown sum of squares. Used in: Nov 2025 paper 51 Q3(b), standard deviation of 54 salaries; Jun 2025 paper 51 Q3(d), finding the sum of y^2 from a combined standard deviation.

$$\sqrt{\frac{\Sigma(x-\bar{x})^2}{n}} = \sqrt{\frac{\Sigma x^2}{n} - \bar{x}^2}$$

GIVEN

Grouped data: mean

x is the class midpoint and f the frequency, so the grouped mean is only an estimate. Used in: Nov 2025 paper 52 Q5(b), mean of 240 times; Nov 2023 paper 51 Q4(b); Jun 2025 paper 52 Q5(c).

$$\bar{x} = \frac{\Sigma x f}{\Sigma f}$$

GIVEN

Grouped data: standard deviation

Use the same midpoints for x, and write the variance before you take the square root. Used in: Jun 2025 paper 52 Q5(c), mean and standard deviation of 300 students' travel times; Nov 2023 paper 51 Q4(b); Mar 2020 paper 52 Q7(c), variance of fish lengths.

$$\sqrt{\frac{\Sigma(x-\bar{x})^2 f}{\Sigma f}} = \sqrt{\frac{\Sigma x^2 f}{\Sigma f} - \bar{x}^2}$$

GIVEN

Mean from coded data

MF19 does not print the coded form. The question gives the totals of (x - k) and (x - k)^2 for a constant k; add k back to get the mean of x. Used in: Jun 2025 paper 53 Q1(a), find k from a mean of 124.0; Nov 2021 paper 51 Q2(a).

$$\bar{x} = k + \frac{\Sigma(x-k)}{n}$$

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Variance from coded data

This is the variance formula of S17.1 applied to x - k. The constant k does not change the variance, so do not add it back; take the square root for the standard deviation. Used in: Jun 2025 paper 53 Q1(b), standard deviation of 40 values; Nov 2021 paper 51 Q2(b).

$$\text{variance} = \frac{\Sigma(x-k)^2}{n} - \left(\frac{\Sigma(x-k)}{n}\right)^2$$

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Permutations and combinations

MF19 prints the binomial coefficient, which is nCr. The other counting formulas are Learn it.

Arrangements of different items

n different items in a line can be arranged in n factorial ways, n x (n - 1) x ... x 1. If one item has a fixed place, arrange the other n - 1 items in (n - 1) factorial ways. Used in: Nov 2025 paper 55 Q5(b), arrangements of 8 athletes in a row; Jun 2025 paper 53 Q7(a); Nov 2021 paper 51 Q5(a), Raman at the centre of a line.

$$n!$$

LEARN IT

Arrangements with repeated items

p, q and r count the identical items, so SEYCHELLES has two Ss, three Es and two Ls and gives 10 factorial divided by (2 factorial x 3 factorial x 2 factorial). Used in: Nov 2025 paper 51 Q7(a), arrangements of SEYCHELLES; Jun 2025 paper 52 Q6(b); Mar 2020 paper 52 Q4(a).

$$\frac{n!}{p!\,q!\,r!}$$

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Combinations (nCr)

Choose r items from n when the order does not matter. For several types, multiply a combination for each type, then add the cases that fit the condition. Used in: Nov 2025 paper 55 Q5(a), teams of 6 athletes from sprinters, hurdlers and throwers; Nov 2025 paper 51 Q7(d); Mar 2020 paper 52 Q1.

$$\binom{n}{r} = \frac{n!}{r!\,(n-r)!}$$

GIVEN

Permutations

Choose and order r of n items: use it to place two or three particular items in the slots of a line. Used in: Nov 2025 paper 55 Q5(b), hurdlers placed in slots among the other athletes; Jun 2025 paper 52 Q6(b); Nov 2021 paper 51 Q5(b).

$${}^{n}P_{r} = \frac{n!}{(n-r)!}$$

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Dividing into groups

Choose the first group, then the second from those left, and so on. This applies when the groups can be told apart, such as different towns or the back and front rows. Used in: Jun 2025 paper 53 Q7(c), 7 men and 4 women into groups of 6, 3 and 2; Jun 2025 paper 55 Q6(b); Nov 2021 paper 51 Q5(c).

$${}^{n}C_{a} \times {}^{n-a}C_{b} \times {}^{n-a-b}C_{c}$$

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Probability by counting

Count the favourable cases and the total the same way. For a selection without replacement of k items from a of one kind and b of another, P(x of the first kind) = (aCx x bC(k - x)) / (a+bCk). Used in: Nov 2025 paper 51 Q7(d), 5 letters chosen from SEYCHELLES include all three Es; Jun 2025 paper 51 Q6(a); Jun 2025 paper 55 Q6(a).

$$P = \frac{\text{number of favourable selections or arrangements}}{\text{total number}}$$

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Probability

MF19 prints none of these, so every row in this section is Learn it.

Complement

Use it for 'at least one' by finding P(none) and subtracting from 1. Used in: Nov 2025 paper 55 Q3(c), at least one disc is red; Jun 2025 paper 53 Q2(a), at least 1 of 3 students studies Drama; Nov 2025 paper 51 Q5(a).

$$P(A') = 1 - P(A)$$

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Independent events

Multiply the probabilities of separate trials that do not affect each other. For different results in any order, count the orders: 6 orders (3 factorial) for three different directions. Used in: Jun 2025 paper 52 Q4(a), three vehicles go in different directions; Nov 2025 paper 53 Q1(a); Nov 2025 paper 52 Q6(a), 10 people none with a weekend birthday.

$$P(A \cap B) = P(A) \times P(B)$$

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Test for independence

Work out P(A), P(B) and P(A and B) separately, compare P(A and B) with P(A) x P(B), and state the conclusion; the schemes need all three values and the conclusion. Used in: Nov 2024 paper 52 Q1(c), events X and N; Jun 2023 paper 53 Q5(a), two dice; Mar 2023 paper 52 Q5.

$$P(A \cap B) = P(A)\,P(B) \;\Leftrightarrow\; A \text{ and } B \text{ independent}$$

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Dependent events (without replacement)

On a tree diagram the second set of branches depends on the first choice, so the probabilities on them change. Multiply along a route and add the routes that give the event. Used in: Nov 2025 paper 55 Q3(b), two discs from bag X without replacement; Jun 2025 paper 52 Q3(a); Nov 2025 paper 51 Q4(ab).

$$P(A \cap B) = P(A) \times P(B \mid A)$$

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Conditional probability

P(B) is the total of all the routes through the tree that give B, not just one branch. For 'at least one' in the condition, use 1 - P(none). Used in: Nov 2025 paper 55 Q3(c), discs from bag X given at least one red; Jun 2025 paper 53 Q5(c); Jun 2025 paper 52 Q3(b).

$$P(A \mid B) = \frac{P(A \cap B)}{P(B)}$$

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Discrete random variables

MF19 prints E(X), Var(X), the binomial formulas and the geometric probability. The tail and 'rth success' results are Learn it.

Probabilities add to 1

Use it to find an unknown such as k or p in a distribution table, and check a table adds to 1. Used in: Nov 2025 paper 51 Q1(a), probabilities kx^2 for x = -2, 1, 2, 3; Nov 2025 paper 55 Q2(a), spinner with probabilities p, 0.4, 2p, p.

$$\Sigma p = 1$$

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Expectation of a discrete random variable

Multiply each value by its probability and add. Use the full distribution table, with probabilities that add to 1. Used in: Nov 2025 paper 51 Q1(b), find E(X); Jun 2025 paper 55 Q1(b); Nov 2025 paper 52 Q2(b), E(X) before Var(X).

$$\mathrm{E}(X) = \Sigma xp$$

GIVEN

Variance of a discrete random variable

Square the values, multiply by the probabilities, add, then subtract the square of E(X). Used in: Nov 2025 paper 55 Q2(a), variance of a spinner score; Nov 2025 paper 53 Q4(b); Nov 2025 paper 52 Q2(b).

$$\mathrm{Var}(X) = \Sigma x^2 p - \{\mathrm{E}(X)\}^2$$

GIVEN

Binomial B(n, p): probability

n is a fixed number of independent trials, each with probability p of success, and r is the number of successes. Used in: Nov 2025 paper 55 Q2(b), spinner spun 10 times; Jun 2025 paper 52 Q7(c); Mar 2020 paper 52 Q5(a).

$$p_r = \binom{n}{r} p^r (1-p)^{n-r}$$

GIVEN

Binomial B(n, p): mean and variance

These are also the mean and variance used when a binomial is approximated by a normal distribution. Used in: Nov 2025 paper 51 Q5(b), mean 15 and variance 13.5 for 150 days; Nov 2025 paper 52 Q6(c); Jun 2025 paper 52 Q2.

$$\mu = np, \quad \sigma^2 = np(1-p)$$

GIVEN

Geometric Geo(p): probability

Use it when the question counts trials up to the first success: r - 1 failures, then a success. Used in: Nov 2025 paper 52 Q1(a), first head on the 5th throw; Nov 2025 paper 51 Q2(a); Nov 2021 paper 51 Q1(a).

$$p_r = p(1-p)^{r-1}$$

GIVEN

Geometric: tail probabilities

(1 - p)^n is the probability that the first n trials are all failures. 'After the 6th throw' means more than 6; 'before the 8th' means at most 7. Used in: Nov 2025 paper 53 Q4(c), first 4 before the 8th spin; Nov 2025 paper 52 Q1(b); Nov 2021 paper 51 Q1(b).

$$P(X > n) = (1-p)^n, \qquad P(X \leqslant n) = 1 - (1-p)^n$$

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The rth success on the nth trial

The nth trial is a success and exactly r - 1 successes came in the first n - 1 trials. Used in: Jun 2025 paper 51 Q2(c), second A on the 6th roll; Jun 2025 paper 52 Q4(c); Nov 2025 paper 51 Q2(b), third 6 on the 7th throw.

$$\binom{n-1}{r-1} p^r (1-p)^{n-r}$$

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The normal distribution

MF19 prints the normal distribution function table, its ADD columns and the critical values table, but not the standardising formula.

Standardising

Divide by the standard deviation, not the variance: the schemes withhold the mark for sigma^2 or the square root of sigma. Show the substitution in full. Used in: Nov 2025 paper 55 Q6(a), probability a runner took more than 55.1 s; Nov 2025 paper 53 Q7(a); Nov 2025 paper 51 Q6(a).

$$Z = \frac{X - \mu}{\sigma}$$

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Upper tail and negative z

The table gives P(Z <= z), so for 'more than' subtract from 1. A negative z uses the symmetry. Used in: Nov 2025 paper 55 Q6(a), 1 - Φ(1.375); Nov 2025 paper 53 Q7(a); Nov 2025 paper 51 Q6(b), values above 114.0 g.

$$P(Z > z) = 1 - \Phi(z), \qquad \Phi(-z) = 1 - \Phi(z)$$

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Probability between two values

Standardise both ends, look up both and subtract. Used in: Nov 2025 paper 51 Q6(a), bars between 148 g and 160 g; Jun 2025 paper 52 Q7(a), wingspans between 72.4 and 76.3 cm.

$$P(a < X < b) = \Phi(z_b) - \Phi(z_a)$$

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Within a distance of the mean

Use it when the question asks for a value within a given distance of the mean, because the two ends are symmetric. Used in: Nov 2025 paper 52 Q3(a), heights within 5 cm of the mean; Jun 2025 paper 51 Q4(a); Mar 2020 paper 52 Q3(b).

$$P(-z < Z < z) = 2\Phi(z) - 1$$

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Expected number

Multiply the probability by the number in the group, then give one whole number with no sign of rounding (the Nov 2025 paper 51 Q6(a) scheme asks for one integer). Used in: Nov 2025 paper 51 Q6(a), 350 chocolate bars; Jun 2025 paper 52 Q7(a), 120 kestrels; Nov 2021 paper 51 Q7(a).

$$\text{expected number} = n \times P$$

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Unknown mean or standard deviation

Find z from the table for the probability given, using P(Z < z) for the area below x; the schemes call z = 1.282 a critical value. Put the z value in the equation, not the probability. Two unknowns need two equations solved together. Used in: Nov 2025 paper 51 Q6(b), mean and standard deviation from 8% above and 20% below; Jun 2025 paper 51 Q1; Mar 2020 paper 52 Q3(a).

$$\frac{x-\mu}{\sigma}=z$$

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Normal approximation to a binomial

The second number is the variance, so standardise with its square root. Used in: Nov 2025 paper 52 Q6(c), 392 people and a birthday on a Friday; Nov 2025 paper 51 Q5(b); Jun 2025 paper 52 Q2.

$$X \sim \mathrm{B}(n,p) \;\Rightarrow\; \text{approximately } \mathrm{N}\left(np,\; np(1-p)\right)$$

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Conditions for the approximation

State both values and that each is greater than 5. Used in: Nov 2022 paper 52 Q6(bc), justify the approximation with np = 72 and nq = 8; Jun 2021 paper 51 Q6(bc).

$$np>5 \quad \text{and} \quad n(1-p)>5$$

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Continuity correction

X is the binomial and Y the normal. Turn the words into whole-number limits first: 'more than 65' is at least 66, so use 65.5; 'fewer than 22' is at most 21, so use 21.5. The correction goes on the value, not on the mean. Used in: Nov 2025 paper 52 Q6(c), 65.5; Nov 2025 paper 51 Q5(b), 21.5; Jun 2025 paper 52 Q2, 120.5.

$$P(X \leqslant a) \approx P(Y < a+0.5), \qquad P(X \geqslant a) \approx P(Y > a-0.5)$$

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The normal distribution function

If Z has a normal distribution with mean 0 and variance 1, the table gives Phi(z) = P(Z <= z). Read the row for z to one decimal place and the column for the second decimal place. For negative values of z, use Phi(-z) = 1 - Phi(z).

z	0	1	2	3	4	5	6	7	8	9
0.0	0.5000	0.5040	0.5080	0.5120	0.5160	0.5199	0.5239	0.5279	0.5319	0.5359
0.1	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753
0.2	0.5793	0.5832	0.5871	0.5910	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141
0.3	0.6179	0.6217	0.6255	0.6293	0.6331	0.6368	0.6406	0.6443	0.6480	0.6517
0.4	0.6554	0.6591	0.6628	0.6664	0.6700	0.6736	0.6772	0.6808	0.6844	0.6879
0.5	0.6915	0.6950	0.6985	0.7019	0.7054	0.7088	0.7123	0.7157	0.7190	0.7224
0.6	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7517	0.7549
0.7	0.7580	0.7611	0.7642	0.7673	0.7704	0.7734	0.7764	0.7794	0.7823	0.7852
0.8	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8078	0.8106	0.8133
0.9	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365	0.8389
1.0	0.8413	0.8438	0.8461	0.8485	0.8508	0.8531	0.8554	0.8577	0.8599	0.8621
1.1	0.8643	0.8665	0.8686	0.8708	0.8729	0.8749	0.8770	0.8790	0.8810	0.8830
1.2	0.8849	0.8869	0.8888	0.8907	0.8925	0.8944	0.8962	0.8980	0.8997	0.9015
1.3	0.9032	0.9049	0.9066	0.9082	0.9099	0.9115	0.9131	0.9147	0.9162	0.9177
1.4	0.9192	0.9207	0.9222	0.9236	0.9251	0.9265	0.9279	0.9292	0.9306	0.9319
1.5	0.9332	0.9345	0.9357	0.9370	0.9382	0.9394	0.9406	0.9418	0.9429	0.9441

z	0	1	2	3	4	5	6	7	8	9
1.6	0.9452	0.9463	0.9474	0.9484	0.9495	0.9505	0.9515	0.9525	0.9535	0.9545
1.7	0.9554	0.9564	0.9573	0.9582	0.9591	0.9599	0.9608	0.9616	0.9625	0.9633
1.8	0.9641	0.9649	0.9656	0.9664	0.9671	0.9678	0.9686	0.9693	0.9699	0.9706
1.9	0.9713	0.9719	0.9726	0.9732	0.9738	0.9744	0.9750	0.9756	0.9761	0.9767
2.0	0.9772	0.9778	0.9783	0.9788	0.9793	0.9798	0.9803	0.9808	0.9812	0.9817
2.1	0.9821	0.9826	0.9830	0.9834	0.9838	0.9842	0.9846	0.9850	0.9854	0.9857
2.2	0.9861	0.9864	0.9868	0.9871	0.9875	0.9878	0.9881	0.9884	0.9887	0.9890
2.3	0.9893	0.9896	0.9898	0.9901	0.9904	0.9906	0.9909	0.9911	0.9913	0.9916
2.4	0.9918	0.9920	0.9922	0.9925	0.9927	0.9929	0.9931	0.9932	0.9934	0.9936
2.5	0.9938	0.9940	0.9941	0.9943	0.9945	0.9946	0.9948	0.9949	0.9951	0.9952
2.6	0.9953	0.9955	0.9956	0.9957	0.9959	0.9960	0.9961	0.9962	0.9963	0.9964
2.7	0.9965	0.9966	0.9967	0.9968	0.9969	0.9970	0.9971	0.9972	0.9973	0.9974
2.8	0.9974	0.9975	0.9976	0.9977	0.9977	0.9978	0.9979	0.9979	0.9980	0.9981
2.9	0.9981	0.9982	0.9982	0.9983	0.9984	0.9984	0.9985	0.9985	0.9986	0.9986

The normal distribution function: ADD columns

The booklet prints these nine ADD columns beside the table above. For the third decimal place of z, add the number in the matching column (1 to 9) to the fourth decimal place of Phi(z). Use the same row for z.

z	1	2	3	4	5	6	7	8	9
0.0	4	8	12	16	20	24	28	32	36
0.1	4	8	12	16	20	24	28	32	36
0.2	4	8	12	15	19	23	27	31	35
0.3	4	7	11	15	19	22	26	30	34
0.4	4	7	11	14	18	22	25	29	32
0.5	3	7	10	14	17	20	24	27	31
0.6	3	7	10	13	16	19	23	26	29
0.7	3	6	9	12	15	18	21	24	27
0.8	3	5	8	11	14	16	19	22	25
0.9	3	5	8	10	13	15	18	20	23
1.0	2	5	7	9	12	14	16	19	21
1.1	2	4	6	8	10	12	14	16	18
1.2	2	4	6	7	9	11	13	15	17
1.3	2	3	5	6	8	10	11	13	14
1.4	1	3	4	6	7	8	10	11	13
1.5	1	2	4	5	6	7	8	10	11
1.6	1	2	3	4	5	6	7	8	9
1.7	1	2	3	4	4	5	6	7	8
1.8	1	1	2	3	4	4	5	6	6
1.9	1	1	2	2	3	4	4	5	5
2.0	0	1	1	2	2	3	3	4	4
2.1	0	1	1	2	2	2	3	3	4
2.2	0	1	1	1	2	2	2	3	3

z	1	2	3	4	5	6	7	8	9
2.3	0	1	1	1	1	2	2	2	2
2.4	0	0	1	1	1	1	1	2	2
2.5	0	0	0	1	1	1	1	1	1
2.6	0	0	0	0	1	1	1	1	1
2.7	0	0	0	0	0	1	1	1	1
2.8	0	0	0	0	0	0	0	1	1
2.9	0	0	0	0	0	0	0	0	0

Critical values for the normal distribution

If Z has a normal distribution with mean 0 and variance 1, the table gives the value z such that P(Z <= z) = p.

p	0.75	0.90	0.95	0.975	0.99	0.995	0.9975	0.999	0.9995
z	0.674	1.282	1.645	1.960	2.326	2.576	2.807	3.090	3.291

Also learn these

Median and quartiles from ordered data
Put the data in order, then take the middle value for the median and the middle of each half for the quartiles; label Q1, Q2 and Q3. Used in: Nov 2025 paper 51 Q3(a); Nov 2025 paper 55 Q4(b); Jun 2025 paper 51 Q3(b).

Back-to-back stem-and-leaf diagram
Keep the first named group on the left with its leaves in order outwards from the stem, give both groups the same stems, and add a key with both groups and the units. Used in: Nov 2025 paper 55 Q4(a); Jun 2025 paper 51 Q3(a); Nov 2025 paper 53 Q6(a).

Box-and-whisker plot
Plot the smallest value, Q1, median, Q3 and largest value on one linear scale, with whiskers to the end values and not through the box, and label each group and the units. Used in: Nov 2025 paper 55 Q4(c); Nov 2025 paper 53 Q6(c); Jun 2025 paper 55 Q5(b).

Cumulative frequency graph
Plot the cumulative frequency at the upper class boundary of each class, join with a smooth curve starting at zero at the beginning of the first class, and read medians, quartiles and 'more than k' values across from the frequency to the graph and down. Used in: Jun 2025 paper 52 Q5(ab); Jun 2025 paper 53 Q4(a); Mar 2020 paper 52 Q7(ab).

Class boundaries
Data recorded to the nearest minute have boundaries 0.5 below and above the printed limits, and histogram bars run from boundary to boundary with no gaps. Used in: Nov 2025 paper 52 Q5(a); Mar 2020 paper 52 Q7(ab).

Comparing two sets of data
Compare one measure of average (median or mean) and one of spread (IQR, range or standard deviation), in the context of the question; a bare comparison of two numbers is not enough. Used in: Nov 2025 paper 55 Q4(d); Nov 2025 paper 53 Q6(d); Jun 2025 paper 55 Q5(c).

Items that must be together
Treat the items as one block, arrange the block with the others, then multiply by the arrangements inside the block. Used in: Nov 2025 paper 52 Q7(a); Jun 2025 paper 51 Q2(a); Jun 2025 paper 53 Q7(b).

Items that must not be together
Subtract the arrangements with the items together from the total, or arrange the other items first and place the two in the gaps. Used in: Nov 2025 paper 55 Q5(b); Jun 2025 paper 53 Q7(a); Nov 2021 paper 51 Q5(b).

A fixed gap between two items
Fix the pattern (for example S C _ S) in each possible position and arrange the rest, remembering the two orders when the two ends are different. Used in: Nov 2025 paper 51 Q7(b); Jun 2025 paper 52 Q6(b); Nov 2025 paper 53 Q3(b).

Selections with at least or at most
List each case that fits (for example 3 sprinters, 2 hurdlers, 1 thrower), find a product of combinations for each, and add them. Used in: Nov 2025 paper 55 Q5(a); Jun 2025 paper 51 Q5(a); Nov 2025 paper 53 Q2.

Binomial or geometric
Use binomial when there are a fixed number of independent trials with the same probability p and you count the successes; use geometric when you repeat until the first success and count the trials. Used in: Nov 2025 paper 52 Q1(a); Nov 2025 paper 55 Q2(b).

At least or fewer than for a binomial
Use P(X >= r) = 1 - P(X <= r - 1) when that leaves fewer terms to add. Used in: Nov 2025 paper 51 Q5(a); Nov 2025 paper 55 Q2(b); Jun 2025 paper 52 Q7(c).

Normal probability then binomial
A probability found from the normal distribution can become the p of a binomial: find the normal probability first, then use B(n, p) or its normal approximation for a sample. Used in: Jun 2025 paper 51 Q4(b); Jun 2025 paper 51 Q4(c).

Using the booklet in the exam

- Standardise with the standard deviation: the schemes give no mark for sigma^2 or the square root of sigma in Z = (X - μ)/sigma (Nov 2025 paper 51 Q6(a) scheme).

- For a normal approximation to a binomial, write the mean np and the variance np(1 - p), use a continuity correction of 0.5 on the value, and state np > 5 and nq > 5 when the question asks you to justify it.
- For a z value that matches a probability such as 0.90, use the critical values table (z = 1.282); for any other probability read the normal distribution function table backwards, using the ADD columns for the third decimal place.
- In a counting question list the cases (for example 4 sprinters, 1 hurdler, 1 thrower) and write a product of combinations for each, so that the method marks show (Nov 2025 paper 55 Q5(a) scheme).
- Write the geometric formula p(1 - p)^(r - 1) before using it, and turn 'after the 6th' into $P(X > 6) = (1 - p)^6$ and 'before the 8th' into $1 - (1 - p)^7$.
- Show your quartiles, class midpoints and the totals you substitute in the variance formula: most method marks in data questions are for the formula with correct values substituted.

Built by CuratedPrep from the Cambridge International AS and A Level Mathematics 9709 Paper 5 (9709 Paper 5) papers March 2020 to November 2025 in our question bank (41 question papers). Given rows are copied from our checked copy of the List of formulae and statistical tables (MF19). Updated 17 November 2026. Always practise with the version of the official booklet your exam uses. More free sheets and topic worksheets at curatedprep.com.