STUDY FORMULA BOOKLET

Cambridge 9709 Maths Paper 6: probability and statistics 2

MF19 prints the Poisson formulas, E(X) and Var(X) for a density function, the unbiased estimates, the sample mean distribution and the normal tables. Learn first the approximations, linear combinations, confidence intervals and test statistic.

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

Built by CuratedPrep from 41 past question papers for Paper 6 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.

The Poisson distribution

MF19 prints the Poisson probability, mean and variance. The rate scaling, sum and approximations are Learn it.

Poisson Po(λ): probability

Use it for the probability of exactly r events; P(X = 0) is e^(-λ). For 'at least' or 'fewer than', add the terms or use 1 minus the complement, with no end errors. Setting two probabilities equal cancels the powers of λ. Used in: Nov 2025 paper 61 Q1(a), probability for Po(3); Jun 2025 paper 62 Q3(b), P(X = n) = P(X = n + 1); Mar 2020 paper 62 Q4(a), accidents in a year.

$$p_r = e^{-\lambda}\frac{\lambda^r}{r!}$$

GIVEN

Poisson Po(λ): mean and variance

The variance of a Poisson variable is its mean, so a Poisson with mean 200 has variance 200 and the normal approximation is N(200, 200). Used in: Nov 2025 paper 62 Q2(a), standard deviation of X + Y with Y ~ Po(4); Jun 2025 paper 62 Q6(b); Nov 2025 paper 61 Q1(c).

$$\mu = \lambda, \quad \sigma^2 = \lambda$$

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Mean number for a different period

Scale the mean to the period in the question before using the Poisson formula: 14.4 per hour becomes 2.4 in 10 minutes. Used in: Nov 2025 paper 65 Q3(a), hits in a 10-minute period; Nov 2021 paper 62 Q5(a), 0.2 errors per page for 10 pages; Mar 2020 paper 62 Q4(a).

$$\lambda = \text{rate} \times \text{length of the period}$$

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Sum of independent Poisson variables

Add the means. The total of 100 values of X and 150 values of Y has mean 100 × 3 + 150 × 2 = 600 and is then approximated by N(600, 600). Used in: Nov 2025 paper 61 Q1(b), P(X + Y) for Po(3) and Po(2); Nov 2021 paper 62 Q5(c), typing and formatting errors; Jun 2025 paper 62 Q6(a).

$$X \sim \text{Po}(\lambda_1),\ Y \sim \text{Po}(\lambda_2) \ \Rightarrow\ X + Y \sim \text{Po}(\lambda_1 + \lambda_2)$$

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Poisson approximation to a binomial Use it when n is large and p is small, then work with λ = np. Used in: Nov 2025 paper 61 Q3(a), 14 500 characters with p = 0.0001; Jun 2025 paper 62 Q6(a), B(700, 0.005); Nov 2025 paper 65 Q4(a), 2430 characters.	$\mathrm{B}(n, p) \approx \mathrm{Po}(np)$	LEARN IT
Conditions for the Poisson approximation State both conditions with the numbers; the Nov 2025 paper 65 Q4(a) scheme calls 'n is large and p is small' insufficient, and other schemes also accept p < 0.1 as the second condition. Used in: Nov 2025 paper 65 Q4(a), justify the approximating distribution; Nov 2025 paper 62 Q4(ab), why Poisson is not suitable for n = 40, p = 0.18; Jun 2022 paper 62 Q3(b).	$n > 50 \quad \text{and} \quad np < 5$	LEARN IT
Normal approximation to a Poisson Mean and variance are both λ, so the standard deviation is the square root of λ. The specification gives the condition as λ large, about 15 or more. Used in: Nov 2025 paper 65 Q4(b), N(123.4, 123.4) for copies sold; Nov 2025 paper 62 Q1(c), 20-week period; Nov 2021 paper 62 Q5(b).	$X \sim \mathrm{Po}(\lambda) \Rightarrow \text{approximately } \mathrm{N}(\lambda, \lambda), \quad \lambda > 15$	LEARN IT
Continuity correction X is the Poisson (or binomial) and Y the normal. Convert the words to whole numbers first: 'more than 50' is at least 51, so use 50.5. The standardising method mark does not need the correction, but the final accuracy mark does. Used in: Nov 2025 paper 65 Q4(b), 130.5 for more than 130; Nov 2025 paper 62 Q1(c), 50.5; Nov 2021 paper 62 Q5(b).	$P(X \geqslant a) \approx P(Y > a - 0.5), \qquad P(X \leqslant a) \approx P(Y < a + 0.5)$	LEARN IT

Linear combinations of random variables

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

Linear function of one variable The constant b changes the mean but not the variance, and the multiplier a is squared in the variance. Used in: Nov 2021 paper 62 Q1(b), price P = 11M + 0.50; Jun 2025 paper 61 Q4(a), cost at $0.40 per minute; Nov 2025 paper 65 Q5(b), price per kg.	$\mathrm{E}(aX + b) = a\mathrm{E}(X) + b, \qquad \mathrm{Var}(aX + b) = a^2\mathrm{Var}(X)$	LEARN IT
Mean of a combination It holds whether or not X and Y are independent. For a difference such as L - 3S, use a = 1 and b = -3. Used in: Nov 2025 paper 61 Q6(b), large bag against 3 small bags; Mar 2020 paper 62 Q6(b), L - 2S; Nov 2025 paper 62 Q2(b).	$\mathrm{E}(aX + bY) = a\mathrm{E}(X) + b\mathrm{E}(Y)$	LEARN IT
Variance of a combination The variances add even for a difference, because a minus sign is squared: Var(X - Y) = Var(X) + Var(Y). Used in: Nov 2025 paper 62 Q2(b), standard deviation of 5X - Y; Jun 2025 paper 62 Q1(b), difference between two students' times; Mar 2020 paper 62 Q6(b).	$\mathrm{Var}(aX + bY) = a^2\mathrm{Var}(X) + b^2\mathrm{Var}(Y) \quad (X, Y \text{ independent})$	LEARN IT

Sum of n independent observations

This is different from n times one value, where the variance is n^2 sigma^2. Say that the observations are independent. Used in: Jun 2025 paper 61 Q4(b), total paid by 35 people; Jun 2025 paper 63 Q5, n men on a footbridge.

$$\mathrm{E}(X_1 + \cdots + X_n) = n\mu, \qquad \mathrm{Var}(X_1 + \cdots + X_n) = n\sigma^2$$

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Combination of independent normal variables

In N(mean, variance) the second number is the variance, so N(2.5, 0.05) has standard deviation sqrt(0.05). Work out the mean and variance of the combination, then standardise. Used in: Nov 2025 paper 61 Q6(a), total mass of a large and a small bag; Nov 2025 paper 65 Q5(a); Mar 2020 paper 62 Q6(a).

$$X \sim \mathrm{N}(\mu_1, \sigma_1^2),\ Y \sim \mathrm{N}(\mu_2, \sigma_2^2) \ \Rightarrow\ aX + bY \sim \mathrm{N}\left(a\mu_1 + b\mu_2,\ a^2\sigma_1^2 + b^2\sigma_2^2\right)$$

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Standardising

Use the standard deviation, the square root of the variance. For P(difference > 12) with a difference that can be either way, double the one-sided probability. Used in: Jun 2025 paper 62 Q1(b), probability the difference exceeds 12 minutes; Nov 2025 paper 61 Q6(b); Jun 2025 paper 63 Q5.

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

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Continuous random variables

MF19 prints E(X), Var(X) and the integration rules. The total area, probabilities and the median from a density function are Learn it.

Total area under a density function

Use it to find an unknown constant such as k, then keep that value for later parts. Used in: Jun 2025 paper 62 Q7(a), show that k = 3/a^3; Nov 2025 paper 62 Q5(a); Nov 2021 paper 62 Q7(a).

$$\int f(x)\,\mathrm{d}x = 1 \quad \text{(over the whole domain)}$$

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Probability from a density function

Integrate between the limits; an upper tail P(X > c) runs from c to the top of the domain. Used in: Nov 2025 paper 61 Q7(a), time longer than 4.5 minutes; Jun 2025 paper 61 Q7(a); Mar 2020 paper 62 Q5(a), bottle containing more than 305 ml.

$$P(a < X < b) = \int_a^b f(x)\,\mathrm{d}x$$

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Median of a continuous variable

m is the median; start the integral at the lower end of the domain. For a symmetrical density function the median is at the line of symmetry. Used in: Jun 2025 paper 62 Q7(c), median of X; Nov 2023 paper 62 Q5(c); Nov 2025 paper 62 Q5(b), P(X <= m) = 0.5.

$$\int_{\text{lower limit}}^{m} f(x)\,\mathrm{d}x = \tfrac{1}{2}$$

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Expectation of a continuous random variable

Integrate x f(x) over the domain. Use it to find an unknown constant when E(X) is given, as well as to find E(X). Used in: Jun 2025 paper 62 Q7(b), find a given E(X); Nov 2025 paper 65 Q6(bc), find a from E(X); Nov 2024 paper 61 Q4(b), show that E(X) involves a log.

$$\mathrm{E}(X) = \int x\,\mathrm{f}(x)\,dx$$

GIVEN

Variance of a continuous random variable Integrate x^2 f(x), then subtract the square of E(X). Used in: Mar 2024 paper 62 Q6(c), find Var(X).	$$\mathrm{Var}(X) = \int x^2 \, \mathrm{f}(x) \, dx - \{\mathrm{E}(X)\}^2$$	GIVEN
Power of x Integrate each power of x: add 1 to the power and divide by the new power. A density function with brackets is expanded first. Used in: Nov 2025 paper 61 Q7(a); Nov 2025 paper 62 Q5(a); Jun 2025 paper 62 Q7(a).	$$\int x^n \, dx = \frac{x^{n+1}}{n+1} \quad (n \neq -1)$$	GIVEN
One over x A term in 1/x integrates to ln of x, which appears when x f(x) contains a 1/x term. Used in: Nov 2024 paper 61 Q4(b), show that E(X) involves ln; Nov 2023 paper 62 Q5(a), show that b = 2a.	$$\int \frac{1}{x} \, dx = \ln \lvert x \rvert$$	GIVEN
cos x Integrating a density function that contains cos x gives sin x. Used in: Jun 2025 paper 61 Q7(a), show a probability for a density function with cos x.	$$\int \cos x \, dx = \sin x$$	GIVEN
Integration by parts Use it for E(X) when f(x) contains cos x, because x cos x needs integration by parts. Used in: Jun 2025 paper 61 Q7(b), show that E(X) takes a given value.	$$\int u \frac{dv}{dx} \, dx = uv - \int v \frac{du}{dx} \, dx$$	GIVEN

Sampling and estimation

MF19 prints the unbiased estimates and the distribution of a sample mean and of a sample proportion. Confidence intervals are Learn it.

Unbiased estimate of the mean The unbiased estimate of the population mean is the sample mean. Used in: Nov 2021 paper 62 Q1(a), estimates from 40 blocks of cheese; Mar 2020 paper 62 Q3(a); Jun 2025 paper 61 Q3(a).	$$\bar{x} = \frac{\Sigma x}{n}$$	GIVEN
Unbiased estimate of the variance Divide by n - 1, not n: the schemes give no marks for the biased variance. The second form needs only the totals of x and x^2, and rearranging it gives the sum of x^2 from a known estimate. Used in: Nov 2021 paper 62 Q1(a); Jun 2025 paper 62 Q2, find the sum of h^2; Mar 2020 paper 62 Q3(a).	$$s^2 = \frac{\Sigma (x - \bar{x})^2}{n-1} = \frac{1}{n-1}\left(\Sigma x^2 - \frac{(\Sigma x)^2}{n}\right)$$	GIVEN
Central Limit Theorem The mean of a sample of n values has mean μ and variance sigma^2/n, so standardise with sigma divided by the square root of n. It is normal if the population is normal, or approximately normal for a large sample. Used in: Nov 2025 paper 61 Q2, test on 60 packets of tea; Jun 2025 paper 61 Q2(ab), sample of 100 values from a binomial; Jun 2025 paper 63 Q2(b).	$$\bar{X} \sim \mathrm{N}\left(\mu, \frac{\sigma^2}{n}\right)$$	GIVEN

Confidence interval for a mean

Use the population standard deviation if it is known; if not, use the square root of the unbiased variance for a large sample. The answer must be an interval. Used in: Nov 2025 paper 65 Q1(ab), 96% interval from 80 lectures; Jun 2025 paper 65 Q2(ab); Nov 2025 paper 62 Q3(a).

$$\bar{x} \pm z \frac{\sigma}{\sqrt{n}}$$

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Width of a confidence interval

Set the width equal to the value given and solve for z, sigma or n. A higher confidence level or a smaller sample gives a wider interval. Used in: Mar 2020 paper 62 Q2, find the confidence level from a width of 1.25 cm; Nov 2025 paper 61 Q4(a), width ratio 1.414; Jun 2025 paper 63 Q3(ab), wider or narrower.

$$\text{width} = 2z \frac{\sigma}{\sqrt{n}}$$

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Confidence interval for a proportion

p-hat is the sample proportion, the number found divided by n; this uses the approximate distribution of a sample proportion printed in MF19 (S20.3), with p-hat in place of p. Used in: Jun 2025 paper 61 Q6(c), 5 of 40 students; Nov 2021 paper 62 Q3(a), 35 reds in 140 spins; Jun 2025 paper 62 Q4, width 0.1066.

$$\hat{p} \pm z \sqrt{\frac{\hat{p}(1-\hat{p})}{n}}$$

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z value for a confidence level

For a c% interval, look up the z that leaves (100 - c)/2 % in each tail: 90% gives 1.645, 95% gives 1.960 and 99% gives 2.576. The schemes accept z = 2.054 or 2.055 for 96%. Used in: Nov 2025 paper 65 Q1(ab); Nov 2021 paper 62 Q3(a); Mar 2020 paper 62 Q2, confidence level from z = 1.953.

$$\Phi(z) = \frac{1}{2}\left(1 + \frac{c}{100}\right)$$

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All of several confidence intervals contain the value

Independent c% intervals each contain the true value with probability c/100; for exactly some of them, use a binomial or add the cases. Used in: Nov 2025 paper 62 Q3(c), largest r with probability over 0.5; Nov 2021 paper 62 Q3(b), exactly two of three intervals.

$$P = \left(\frac{c}{100}\right)^r$$

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Hypothesis tests

MF19 prints the binomial probability and the distribution of a sample mean. The test statistic and the error probabilities are Learn it.

Test statistic for a mean

This is the standardised form of the sample mean distribution in MF19 (S20.2), with mu_0 from H0. Use the population standard deviation, or the square root of the unbiased variance for a large sample, and divide by the square root of n. Used in: Nov 2025 paper 62 Q6(a), mean weekly profit; Nov 2025 paper 61 Q2; Nov 2021 paper 62 Q4(bc), fireworks at the 1% level.

$$z = \frac{\bar{x} - \mu_0}{\sigma / \sqrt{n}}$$

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Critical value of the sample mean

Rearrange the test statistic to find the boundary of the rejection region, using the z from the table for the significance level. Used in: Nov 2025 paper 62 Q6(c), critical value a before the Type II error; Jun 2025 paper 62 Q5, smallest possible sample mean.

$$\bar{x}_c = \mu_0 \pm z\,\frac{\sigma}{\sqrt{n}}$$

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Binomial B(n, p): probability

For a test on a proportion with a small sample, X ~ B(n, p0) under H0. Add the tail probabilities and compare the tail probability with the significance level, with no end errors. Used in: Jun 2025 paper 62 Q8(a), 2 sixes in 30 throws; Nov 2025 paper 61 Q5(a), 40 households; Nov 2021 paper 62 Q6(b), rejection region.

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

GIVEN

Probability of a Type I error

Use the null value of the parameter and add the probabilities of every value in the rejection region. For a region found at the stated significance level it is no more than that level. Used in: Nov 2025 paper 61 Q5(a), find the probability of a Type I error; Jun 2025 paper 62 Q8(b); Nov 2021 paper 62 Q6(c).

$$P(\text{Type I}) = P(\text{reject } H_0 \mid H_0 \text{ true})$$

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Probability of a Type II error (small sample)

Use the true value of the parameter given, not the null value, and add the probabilities of the values outside the rejection region. Used in: Jun 2025 paper 62 Q8(c), true p = 0.02; Nov 2021 paper 62 Q6(d), a 0 once in 40 digits; Mar 2020 paper 62 Q7(c).

$$P(\text{Type II}) = P(\text{do not reject } H_0 \mid \text{true parameter})$$

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Probability of a Type II error (test on a mean)

Find the critical value of the sample mean first, then standardise it with the true mean and take the tail on the acceptance side. Used in: Nov 2025 paper 62 Q6(c), true mean $718.

$$P(\text{Type II}) = P(\bar{X} \text{ in the acceptance region} \mid \mu_{\text{true}})$$

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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

z	0	1	2	3	4	5	6	7	8	9
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
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

z	1	2	3	4	5	6	7	8	9
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
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

Conditions for a Poisson model

Events occur singly, at random and independently of each other, at a constant average rate; give one in the context of the question. Used in: Nov 2025 paper 65 Q4(b); Nov 2025 paper 62 Q1(a).

At least or fewer than for a Poisson

Use P(X >= k) = 1 - P(X <= k - 1), and write out every term of the Poisson probability with no end errors. Used in: Nov 2025 paper 65 Q3(a); Nov 2025 paper 65 Q4(a); Mar 2020 paper 62 Q1.

No events in a period

P(X = 0) = e^(-λ), so a condition such as 'no accidents in n days with probability more than 0.95' becomes e^(-λ) > 0.95; take natural logs and solve for n. Used in: Mar 2020 paper 62 Q4(b).

Straight-line density function

The area of a triangle, one half x base x height, equals 1; this gives a relationship between the constants. Used in: Nov 2025 paper 65 Q6(a).

Symmetrical density function

The median is at the line of symmetry. Used in: Nov 2025 paper 61 Q7(bc); Mar 2020 paper 62 Q5(c).

Random sampling

Every member of the population must have a chance of selection; number the members and use random numbers, and a method that reaches only some of the population is unsatisfactory. Used in: Nov 2021 paper 62 Q2(a); Nov 2021 paper 62 Q2(b); Jun 2025 paper 62 Q1(a).

When the Central Limit Theorem is needed

It is needed when the population is not normal, as for a binomial, and the sample is large; it is not needed when the population is normal. Used in: Jun 2025 paper 61 Q2(ab); Jun 2025 paper 63 Q2(b); Nov 2025 paper 62 Q3(b).

Hypotheses

Write H0 and H1 in terms of the population parameter, such as the population mean or the proportion p, with p defined, not just 'mean'. Used in: Nov 2025 paper 65 Q2(b); Nov 2025 paper 61 Q2; Jun 2025 paper 61 Q6(a).

One-tailed or two-tailed

Use a two-tailed test when the claim is 'different from' and a one-tailed test for 'less than' or 'more than'. Used in: Nov 2025 paper 65 Q2(a); Nov 2025 paper 62 Q6(a).

Conclusion of a test

Compare the test statistic with the critical value (or the probability with the significance level), then say 'insufficient evidence that ...' or 'sufficient evidence that ...' in the context, never definite. Used in: Nov 2025 paper 65 Q2(c); Nov 2025 paper 62 Q6(a); Nov 2025 paper 61 Q2.

A necessary assumption

For a test on a mean with a known sigma, assume the standard deviation is unchanged; for a total of independent values, assume independence. Used in: Nov 2025 paper 62 Q6(a); Jun 2025 paper 62 Q5; Jun 2025 paper 63 Q5.

Rejection region and the errors

A Type I error is rejecting H0 when it is true and a Type II error is not rejecting it when it is false; if H0 is rejected a Type II error is impossible, and if it is not rejected a Type I error is impossible. Used in: Nov 2025 paper 61 Q5(c); Nov 2025 paper 65 Q3(b); Nov 2025 paper 61 Q5(b).

Using the booklet in the exam

- State both conditions for a Poisson approximation to a binomial, n > 50 and np < 5, with the numbers; the Nov 2025 paper 65 Q4(a) scheme calls 'n large and p small' insufficient.
- In N(mean, variance) the second number is the variance. Take its square root before standardising, and add variances, never standard deviations, for a combination.
- For an unbiased variance divide by n - 1. The Nov 2021 paper 62 Q1(a) scheme gives M0 A0 for the biased variance, and a biased value costs the accuracy marks in tests and intervals.
- In a test, write the hypotheses in terms of the population parameter, show the test statistic with sigma over the square root of n, compare it with the critical value from the normal table, and conclude in context without being definite.
- For a Type II error use the true parameter value given in the question, and for a test on a mean find the critical value of the sample mean first.
- Know the critical values from the table of normal critical values: 1.645 for a one-tailed 5% test, 1.960 for a two-tailed 5% test and 2.326 for a one-tailed 1% test; a 96% interval needs z = 2.054 from the normal distribution function table.

Built by CuratedPrep from the Cambridge International AS and A Level Mathematics 9709 Paper 6 (9709 Paper 6) 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.