STUDY FORMULA BOOKLET

Edexcel IAL Maths Unit S3 (WST03): statistics 3

The booklet gives the variance rule, the sample mean and variance properties, the z statistics, Spearman's coefficient, the chi-squared statistic and the tables. Learn first the Normal result for aX + bY, confidence intervals, expected frequencies and degrees of freedom.

GIVEN printed in the formula booklet LEARN IT not in the booklet: learn it

Built by CuratedPrep from 9 past question papers for Unit S3 in our question bank, June 2022 to January 2026. Given means it is in the Mathematical Formulae and Statistical Tables booklet (Issue 2, 2021) handed out in every unit exam. Learn it means a past question needed it and the exam did not print it.

Combinations of random variables

The booklet prints the variance rule for independent variables. The specification lists the Normal result for aX plus or minus bY as a formula you are expected to know, so it is Learn it.

Independent random variables X and Y

The variances add for a sum and for a difference, so Var(X - Y) = Var(X) + Var(Y). The variables must be independent. X1 + X2 + X3 has variance 3 Var(X), but 3X has variance 9 Var(X). Used in: Jan 2026 Q8(a), T = 2M - L gives a = 364 and b = 5553; Jun 2024 Q6(a), the total of three bags of carrots; Jan 2025 Q7(a), 3 short and 4 long boards.

$$E(XY) = E(X)E(Y), \quad \operatorname{Var}(aX \pm bY) = a^2 \operatorname{Var}(X) + b^2 \operatorname{Var}(Y)$$

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Linear combination of independent Normal variables

The specification lists it as a formula you are expected to know. X and Y must be independent and Normal. Find the mean and the variance, then standardise. Used in: Jan 2026 (A) Q7(b), P(A > B) for task times; Jun 2023 Q7(a), P(4A - 3B < 40); Jan 2025 Q7(b), two long boards differ by more than 0.01 kg.

$$aX \pm bY \sim N\left(a\mu_x \pm b\mu_y,\ a^2\sigma_x^2 + b^2\sigma_y^2\right)$$

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Total of n independent copies

Use the first for n separate observations and the second only when one value is multiplied by n. Used in: Jun 2025 Q8(a), the total of three bags of sand; Jan 2023 Q7(a), the total time for 3 customers; Jun 2022 Q6(a), 6 men and 3 women in a lift.

$$X_1 + X_2 + \cdots + X_n \sim N(n\mu,\ n\sigma^2), \qquad nX \sim N(n\mu,\ n^2\sigma^2)$$

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Expectation of a linear combination

It needs no independence. It is how you show that an estimator is unbiased. Used in: Jun 2022 Q5(c), show that U1 and U2 are unbiased; Jun 2023 Q3(d), a + b = 1 for Y = aX1 + bX2; Jan 2026 Q8(a), the mean of 2M - L.

$$E(aX \pm bY) = aE(X) \pm bE(Y)$$

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Quadratic formula

From Pure Mathematics 1. A probability condition on a total of x people or items can give a quadratic. Used in: Jun 2022 Q6(b), the maximum number of people in the lift; Jan 2025 Q7(c), the value of n from a probability.

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

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Sampling

These sampling rows are formulas you must learn; the booklet prints none of them. The advantages and disadvantages of each method are in the Also learn list.

Systematic sample interval

Pick a random starting point, then take every kth item from the list. N is the population and n the sample size. Used in: Jun 2025 Q1(b), 360 members and 20 players gives every 18th; Jun 2024 Q1(a), 400 employees and 8 gives every 50th; Jan 2024 Q2(a), 800 and 80 gives every 10th.

$$k = \frac{N}{n}$$

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Stratified sample size

Take each group in proportion to its size, then use random numbers within the group. Used in: Jan 2026 (A) Q6(a), 120 of 6000 full-time and 80 of 4000 part-time staff; Jan 2024 Q2(b), a sample of 100 across three offices.

$$n_{\text{stratum}} = \frac{\text{stratum size}}{\text{population size}} \times \text{sample size}$$

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Estimators and sampling distributions

The booklet prints the properties of the sample mean and sample variance. Bias is not printed, so learn its definition.

Sample mean as an estimator of μ

The standard error of the sample mean is sigma / sqrt(n), the square root of the variance. Used in: Jan 2023 Q6(d), mean of 10 large bags of gravel; Jan 2026 Q7(b), the standard error of an unbiased estimator; Jan 2025 Q4(a), show that the standard error is 0.0124.

$$\bar{X} \text{ is an unbiased estimator of } \mu, \quad \operatorname{Var}(\bar{X}) = \frac{\sigma^2}{n}$$

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Sample variance as an estimator of σ²

Rearranged, s^2 = (sum of x^2 - n times the mean squared) / (n - 1), and sum of x^2 = (n - 1)s^2 + n times the mean squared when you combine two samples. Used in: Jan 2026 Q5(a), v = 2.3 for professor B; Jun 2022 Q2(a), unbiased estimates for brand A; Jan 2024 Q6(b)(c), unbiased estimates then a combined sample.

$$S^2 \text{ is an unbiased estimator of } \sigma^2, \quad S^2 = \frac{\sum (X_i - \bar{X})^2}{n-1}$$

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Bias of an estimator

Work out E(T) first using the expectation of a linear combination. Used in: Jan 2026 (A) Q2(a), the bias of the sample mean for a uniform variable; Jun 2025 Q6(b)(c), R is biased and its bias; Jan 2025 Q6(a)(b).

$$\text{bias} = E(T) - \theta, \qquad \text{unbiased if } E(T) = \theta$$

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Uniform (rectangular) on [a, b]: mean

The mean of a continuous uniform variable on [a, b] is (a + b) / 2, so an unbiased estimator comes from rearranging E(X mean). Used in: Jan 2026 Q7(a), X mean - 2 is unbiased for a; Jan 2025 Q6(a), the mean on [2a + 3, 4a + 9]; Jun 2024 Q7(a), the mean of D.

$$\tfrac{1}{2}(a + b)$$

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Uniform (rectangular) on [a, b]: variance

Use (b - a)^2 / 12 for the variance of one observation, then divide by n for the sample mean. Used in: Jan 2026 Q7(b), the standard error from a variance of 3; Jun 2024 Q7(a), Var(D) = 3; Jun 2022 Q4(b), the standard deviation of a wait uniform on [0, 7].

$$\frac{1}{12}(b-a)^2$$

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Confidence intervals and tests for means

The z values come from the table X3: 1.6449 for 90%, 1.9600 for 95%, 2.3263 for 98% and 2.5758 for 99%. The tables X2 and X3 follow this section.

One sample from a normal distribution

Use it to test a mean with known sigma, to find a critical region for the sample mean, or to set up an equation for n. Used in: Jan 2026 Q6(a), show that n = 100; Jun 2025 Q7(a), show that sigma = 12; Jan 2023 Q1(c), the critical region for the sample mean.

$$\frac{\bar{X}-\mu}{\sigma/\sqrt{n}} \sim N(0,1)$$

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Two independent samples from normal distributions

For two large samples put the sample variances in place of the population variances, and take mu_x - mu_y from H0. Used in: Jan 2026 Q5(b), mean mark more than 10 higher; Jan 2026 (A) Q6(c), full-time and part-time scores; Jun 2025 Q4(b), more than 200 grams heavier.

$$\frac{(\bar{X}-\bar{Y})-(\mu_x-\mu_y)}{\sqrt{\dfrac{\sigma_x^2}{n_x}+\dfrac{\sigma_y^2}{n_y}}} \sim N(0,1)$$

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Confidence interval for a Normal mean

Use it when sigma is known, or for a large sample with s in place of sigma. Choose z from X3 for the level. Used in: Jan 2026 (A) Q4(a), 95% for mug masses with sigma = 1.2; Jan 2023 Q6(a), 98% for stone weights; Jun 2024 Q3(b), 98% for bottle volumes.

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

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Width and centre of an interval

Half the width gives z sigma / sqrt(n). Use it to find sigma or n, rounding n up, or to rebuild an interval at a new level from an interval you are given. Used in: Jan 2026 Q3(a), a 90% interval from a 95% interval; Jun 2022 Q3(d), the smallest n for a width of at most 1.5; Jan 2025 Q4(a).

$$\text{width} = 2z\,\frac{\sigma}{\sqrt{n}}, \qquad \bar{x} = \frac{\text{lower} + \text{upper}}{2}$$

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Confidence level from z

Find z from the width first, then the tail probability from X2. Used in: Jun 2022 Q3(c), the value of a; Jan 2025 Q4(c), the value of r.

$$\text{level} = 100\,\big(1 - 2P(Z > z)\big)\%$$

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Intervals that contain μ

The number of m independent intervals that contain μ is binomial. Count the intervals that do not contain μ with p = 1 - level. Used in: Jan 2026 Q3(b), at least 1 of 3 intervals; Jan 2026 (A) Q4(b), more than 3 of 20 do not contain μ; Jun 2024 Q3(c), more than 3 of 5.

$$Y \sim \mathrm{B}(m,\ \text{confidence level})$$

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The normal distribution function

The tabulated function is Φ(z), defined as the area under the standard normal curve to the left of z. Printed in five column pairs, in step 0.01 up to 2.00, 0.02 up to 2.50, 0.05 up to 3.40, then 3.50 to 4.00 in steps of 0.10. The last row repeats the first value of the next column.

z	Φ(z)	z	Φ(z)	z	Φ(z)	z	Φ(z)	z	Φ(z)
0.00	0.5000	0.50	0.6915	1.00	0.8413	1.50	0.9332	2.00	0.9772
0.01	0.5040	0.51	0.6950	1.01	0.8438	1.51	0.9345	2.02	0.9783
0.02	0.5080	0.52	0.6985	1.02	0.8461	1.52	0.9357	2.04	0.9793
0.03	0.5120	0.53	0.7019	1.03	0.8485	1.53	0.9370	2.06	0.9803
0.04	0.5160	0.54	0.7054	1.04	0.8508	1.54	0.9382	2.08	0.9812
0.05	0.5199	0.55	0.7088	1.05	0.8531	1.55	0.9394	2.10	0.9821
0.06	0.5239	0.56	0.7123	1.06	0.8554	1.56	0.9406	2.12	0.9830
0.07	0.5279	0.57	0.7157	1.07	0.8577	1.57	0.9418	2.14	0.9838
0.08	0.5319	0.58	0.7190	1.08	0.8599	1.58	0.9429	2.16	0.9846
0.09	0.5359	0.59	0.7224	1.09	0.8621	1.59	0.9441	2.18	0.9854
0.10	0.5398	0.60	0.7257	1.10	0.8643	1.60	0.9452	2.20	0.9861
0.11	0.5438	0.61	0.7291	1.11	0.8665	1.61	0.9463	2.22	0.9868
0.12	0.5478	0.62	0.7324	1.12	0.8686	1.62	0.9474	2.24	0.9875
0.13	0.5517	0.63	0.7357	1.13	0.8708	1.63	0.9484	2.26	0.9881
0.14	0.5557	0.64	0.7389	1.14	0.8729	1.64	0.9495	2.28	0.9887
0.15	0.5596	0.65	0.7422	1.15	0.8749	1.65	0.9505	2.30	0.9893
0.16	0.5636	0.66	0.7454	1.16	0.8770	1.66	0.9515	2.32	0.9898
0.17	0.5675	0.67	0.7486	1.17	0.8790	1.67	0.9525	2.34	0.9904
0.18	0.5714	0.68	0.7517	1.18	0.8810	1.68	0.9535	2.36	0.9909
0.19	0.5753	0.69	0.7549	1.19	0.8830	1.69	0.9545	2.38	0.9913
0.20	0.5793	0.70	0.7580	1.20	0.8849	1.70	0.9554	2.40	0.9918
0.21	0.5832	0.71	0.7611	1.21	0.8869	1.71	0.9564	2.42	0.9922
0.22	0.5871	0.72	0.7642	1.22	0.8888	1.72	0.9573	2.44	0.9927
0.23	0.5910	0.73	0.7673	1.23	0.8907	1.73	0.9582	2.46	0.9931
0.24	0.5948	0.74	0.7704	1.24	0.8925	1.74	0.9591	2.48	0.9934
0.25	0.5987	0.75	0.7734	1.25	0.8944	1.75	0.9599	2.50	0.9938
0.26	0.6026	0.76	0.7764	1.26	0.8962	1.76	0.9608	2.55	0.9946
0.27	0.6064	0.77	0.7794	1.27	0.8980	1.77	0.9616	2.60	0.9953
0.28	0.6103	0.78	0.7823	1.28	0.8997	1.78	0.9625	2.65	0.9960
0.29	0.6141	0.79	0.7852	1.29	0.9015	1.79	0.9633	2.70	0.9965
0.30	0.6179	0.80	0.7881	1.30	0.9032	1.80	0.9641	2.75	0.9970
0.31	0.6217	0.81	0.7910	1.31	0.9049	1.81	0.9649	2.80	0.9974
0.32	0.6255	0.82	0.7939	1.32	0.9066	1.82	0.9656	2.85	0.9978
0.33	0.6293	0.83	0.7967	1.33	0.9082	1.83	0.9664	2.90	0.9981
0.34	0.6331	0.84	0.7995	1.34	0.9099	1.84	0.9671	2.95	0.9984
0.35	0.6368	0.85	0.8023	1.35	0.9115	1.85	0.9678	3.00	0.9987
0.36	0.6406	0.86	0.8051	1.36	0.9131	1.86	0.9686	3.05	0.9989

z	Φ(z)	z	Φ(z)	z	Φ(z)	z	Φ(z)	z	Φ(z)
0.37	0.6443	0.87	0.8078	1.37	0.9147	1.87	0.9693	3.10	0.9990
0.38	0.6480	0.88	0.8106	1.38	0.9162	1.88	0.9699	3.15	0.9992
0.39	0.6517	0.89	0.8133	1.39	0.9177	1.89	0.9706	3.20	0.9993
0.40	0.6554	0.90	0.8159	1.40	0.9192	1.90	0.9713	3.25	0.9994
0.41	0.6591	0.91	0.8186	1.41	0.9207	1.91	0.9719	3.30	0.9995
0.42	0.6628	0.92	0.8212	1.42	0.9222	1.92	0.9726	3.35	0.9996
0.43	0.6664	0.93	0.8238	1.43	0.9236	1.93	0.9732	3.40	0.9997
0.44	0.6700	0.94	0.8264	1.44	0.9251	1.94	0.9738	3.50	0.9998
0.45	0.6736	0.95	0.8289	1.45	0.9265	1.95	0.9744	3.60	0.9998
0.46	0.6772	0.96	0.8315	1.46	0.9279	1.96	0.9750	3.70	0.9999
0.47	0.6808	0.97	0.8340	1.47	0.9292	1.97	0.9756	3.80	0.9999
0.48	0.6844	0.98	0.8365	1.48	0.9306	1.98	0.9761	3.90	1.0000
0.49	0.6879	0.99	0.8389	1.49	0.9319	1.99	0.9767	4.00	1.0000
0.50	0.6915	1.00	0.8413	1.50	0.9332	2.00	0.9772		

Percentage points of the normal distribution

The values z are those which a random variable Z ~ N(0, 1) exceeds with probability p; that is, P(Z > z) = 1 - Φ(z) = p.

p	z	p	z
0.5000	0.0000	0.0500	1.6449
0.4000	0.2533	0.0250	1.9600
0.3000	0.5244	0.0100	2.3263
0.2000	0.8416	0.0050	2.5758
0.1500	1.0364	0.0010	3.0902
0.1000	1.2816	0.0005	3.2905

Goodness of fit and contingency tables

The booklet prints the chi-squared statistic and the table X6, which follows this section. The expected frequencies and the degrees of freedom are not printed.

Goodness-of-fit test and contingency tables

The statistic can also be written as the sum of O^2 / E minus the total. Used in: Jan 2026 Q1, pass rate against test centre; Jan 2026 (A) Q5(b), a Poisson model for births; Jun 2024 Q4(a), the ratio 10 : 5 : 2 : 3 for ice cream flavours.

$$\sum \frac{(O_i - E_i)^2}{E_i} \sim \chi^2_\nu$$

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Expected frequency in a contingency table

Calculate it for every cell, and the expected totals must equal the observed totals. Used in: Jan 2026 (A) Q3(a), three driving test centres; Jan 2025 Q5(b), the expected frequency for Biology and London; Jan 2026 Q1.

$$E = \frac{(\text{row total})(\text{column total})}{\text{grand total}}$$

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Degrees of freedom Count the cells after combining any with E less than 5. Estimating p or λ from the data costs one more degree of freedom. Used in: Jan 2026 Q1, (2 - 1)(2 - 1) = 1; Jan 2026 Q4(e), 5 - 1 - 1 = 3 after estimating p; Jan 2025 Q2(d), 5 - 1 - 1 = 3 after estimating λ.	$\nu = (r-1)(c-1)$ (contingency), $\nu = \text{cells} - 1 - \text{parameters estimated}$ (fit)	LEARN IT
Expected frequencies for a fitted model Estimate the parameter from the data unless the question gives it, then multiply each probability by the total. The expected frequencies must add to the total observed. Used in: Jan 2026 Q4(a)(b), p = 0.18 and r = 2.65; Jun 2025 Q5(a)(b), the proportion of male puppies; Jan 2025 Q2(a)(b).	$E = N \times P(X = x), \quad \hat{p} = \frac{\bar{x}}{n}, \quad \hat{\lambda} = \bar{x}$	LEARN IT
Binomial B(n, p): probability Gives the expected binomial frequencies and the probability for a number of intervals. Used in: Jan 2026 Q4(b), 150 x P(X = 5) for B(10, 0.18); Jan 2023 Q4(a), B(4, 0.5) expected frequencies; Jan 2026 Q3(b), at least 1 of 3 intervals.	$P(X = x) = \binom{n}{x} p^x (1-p)^{n-x}$	GIVEN
Poisson Po(λ): probability Gives the expected Poisson frequencies, which are N times P(X = x), with the last cell found by subtraction. Used in: Jan 2026 (A) Q5(a), the observed and expected frequencies for 5 births; Jan 2024 Q4(b), show that s = 8.15.	$P(X = x) = e^{-\lambda} \frac{\lambda^x}{x!}$	GIVEN

Percentage points of the chi-squared distribution function

The values in the table are those which a random variable with the chi-squared distribution on v degrees of freedom exceeds with the probability shown.

v	0.995	0.990	0.975	0.950	0.900	0.100	0.050	0.025	0.010	0.005
1	0.000	0.000	0.001	0.004	0.016	2.705	3.841	5.024	6.635	7.879
2	0.010	0.020	0.051	0.103	0.211	4.605	5.991	7.378	9.210	10.597
3	0.072	0.115	0.216	0.352	0.584	6.251	7.815	9.348	11.345	12.838
4	0.207	0.297	0.484	0.711	1.064	7.779	9.488	11.143	13.277	14.860
5	0.412	0.554	0.831	1.145	1.610	9.236	11.070	12.832	15.086	16.750
6	0.676	0.872	1.237	1.635	2.204	10.645	12.592	14.449	16.812	18.548
7	0.989	1.239	1.690	2.167	2.833	12.017	14.067	16.013	18.475	20.278
8	1.344	1.646	2.180	2.733	3.490	13.362	15.507	17.535	20.090	21.955
9	1.735	2.088	2.700	3.325	4.168	14.684	16.919	19.023	21.666	23.589
10	2.156	2.558	3.247	3.940	4.865	15.987	18.307	20.483	23.209	25.188
11	2.603	3.053	3.816	4.575	5.580	17.275	19.675	21.920	24.725	26.757
12	3.074	3.571	4.404	5.226	6.304	18.549	21.026	23.337	26.217	28.300
13	3.565	4.107	5.009	5.892	7.042	19.812	22.362	24.736	27.688	29.819
14	4.075	4.660	5.629	6.571	7.790	21.064	23.685	26.119	29.141	31.319
15	4.601	5.229	6.262	7.261	8.547	22.307	24.996	27.488	30.578	32.801
16	5.142	5.812	6.908	7.962	9.312	23.542	26.296	28.845	32.000	34.267
17	5.697	6.408	7.564	8.672	10.085	24.769	27.587	30.191	33.409	35.718

v	0.995	0.990	0.975	0.950	0.900	0.100	0.050	0.025	0.010	0.005
18	6.265	7.015	8.231	9.390	10.865	25.989	28.869	31.526	34.805	37.156
19	6.844	7.633	8.907	10.117	11.651	27.204	30.144	32.852	36.191	38.582
20	7.434	8.260	9.591	10.851	12.443	28.412	31.410	34.170	37.566	39.997
21	8.034	8.897	10.283	11.591	13.240	29.615	32.671	35.479	38.932	41.401
22	8.643	9.542	10.982	12.338	14.042	30.813	33.924	36.781	40.289	42.796
23	9.260	10.196	11.689	13.091	14.848	32.007	35.172	38.076	41.638	44.181
24	9.886	10.856	12.401	13.848	15.659	33.196	36.415	39.364	42.980	45.558
25	10.520	11.524	13.120	14.611	16.473	34.382	37.652	40.646	44.314	46.928
26	11.160	12.198	13.844	15.379	17.292	35.563	38.885	41.923	45.642	48.290
27	11.808	12.879	14.573	16.151	18.114	36.741	40.113	43.194	46.963	49.645
28	12.461	13.565	15.308	16.928	18.939	37.916	41.337	44.461	48.278	50.993
29	13.121	14.256	16.047	17.708	19.768	39.088	42.557	45.722	49.588	52.336
30	13.787	14.953	16.791	18.493	20.599	40.256	43.773	46.979	50.892	53.672

Correlation

Every one of the 9 papers has a Spearman's rank question. The tables X7 and X8 follow this section.

Spearman's rank correlation coefficient

d is the difference between the two ranks of each pair, and n is the number of pairs. Rank both variables the same way, from the highest or from the lowest, and use average ranks for ties. Used in: Jan 2026 (A) Q1(a), distance and commission for 8 salespeople; Jan 2026 Q2(b), the largest sum of d^2 for 5 dogs; Jan 2025 Q1(a).

$$r_s = 1 - \frac{6\sum d^2}{n(n^2-1)}$$

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Product moment correlation coefficient

Used when a PMCC is tested against the critical value in X7. Used in: Jan 2024 Q3(a), tea consumption and population; Jan 2023 Q2(c), r from the three S values.

$$r = \frac{S_{xy}}{\sqrt{S_{xx}S_{yy}}} = \frac{\sum(x_i-\bar{x})(y_i-\bar{y})}{\sqrt{\{\sum(x_i-\bar{x})^2\}\{\sum(y_i-\bar{y})^2\}}} = \frac{\sum x_i y_i - \frac{(\sum x_i)(\sum y_i)}{n}}{\sqrt{\left(\sum x_i^2 - \frac{(\sum x_i)^2}{n}\right)\left(\sum y_i^2 - \frac{(\sum y_i)^2}{n}\right)}}$$

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Critical values for correlation coefficients: product moment

These tables concern tests of the hypothesis that a population correlation coefficient ρ is 0. The values are the minimum values which need to be reached by a sample correlation coefficient in order to be significant at the level shown, on a one-tailed test.

Sample size	Level 0.10	Level 0.05	Level 0.025	Level 0.01	Level 0.005
4	0.8000	0.9000	0.9500	0.9800	0.9900
5	0.6870	0.8054	0.8783	0.9343	0.9587
6	0.6084	0.7293	0.8114	0.8822	0.9172
7	0.5509	0.6694	0.7545	0.8329	0.8745
8	0.5067	0.6215	0.7067	0.7887	0.8343
9	0.4716	0.5822	0.6664	0.7498	0.7977
10	0.4428	0.5494	0.6319	0.7155	0.7646
11	0.4187	0.5214	0.6021	0.6851	0.7348
12	0.3981	0.4973	0.5760	0.6581	0.7079
13	0.3802	0.4762	0.5529	0.6339	0.6835

Sample size	Level 0.10	Level 0.05	Level 0.025	Level 0.01	Level 0.005
14	0.3646	0.4575	0.5324	0.6120	0.6614
15	0.3507	0.4409	0.5140	0.5923	0.6411
16	0.3383	0.4259	0.4973	0.5742	0.6226
17	0.3271	0.4124	0.4821	0.5577	0.6055
18	0.3170	0.4000	0.4683	0.5425	0.5897
19	0.3077	0.3887	0.4555	0.5285	0.5751
20	0.2992	0.3783	0.4438	0.5155	0.5614
21	0.2914	0.3687	0.4329	0.5034	0.5487
22	0.2841	0.3598	0.4227	0.4921	0.5368
23	0.2774	0.3515	0.4133	0.4815	0.5256
24	0.2711	0.3438	0.4044	0.4716	0.5151
25	0.2653	0.3365	0.3961	0.4622	0.5052
26	0.2598	0.3297	0.3882	0.4534	0.4958
27	0.2546	0.3233	0.3809	0.4451	0.4869
28	0.2497	0.3172	0.3739	0.4372	0.4785
29	0.2451	0.3115	0.3673	0.4297	0.4705
30	0.2407	0.3061	0.3610	0.4226	0.4629
40	0.2070	0.2638	0.3120	0.3665	0.4026
50	0.1843	0.2353	0.2787	0.3281	0.3610
60	0.1678	0.2144	0.2542	0.2997	0.3301
70	0.1550	0.1982	0.2352	0.2776	0.3060
80	0.1448	0.1852	0.2199	0.2597	0.2864
90	0.1364	0.1745	0.2072	0.2449	0.2702
100	0.1292	0.1654	0.1966	0.2324	0.2565

Critical values for correlation coefficients: Spearman's

One-tailed test, as for the product moment table. 'none' means the booklet prints a dash, so no critical value exists for that sample size and level.

Sample size	Level 0.05	Level 0.025	Level 0.01
4	1.0000	none	none
5	0.9000	1.0000	1.0000
6	0.8286	0.8857	0.9429
7	0.7143	0.7857	0.8929
8	0.6429	0.7381	0.8333
9	0.6000	0.7000	0.7833
10	0.5636	0.6485	0.7455
11	0.5364	0.6182	0.7091
12	0.5035	0.5874	0.6783
13	0.4835	0.5604	0.6484
14	0.4637	0.5385	0.6264
15	0.4464	0.5214	0.6036
16	0.4294	0.5029	0.5824

Sample size	Level 0.05	Level 0.025	Level 0.01
17	0.4142	0.4877	0.5662
18	0.4014	0.4716	0.5501
19	0.3912	0.4596	0.5351
20	0.3805	0.4466	0.5218
21	0.3701	0.4364	0.5091
22	0.3608	0.4252	0.4975
23	0.3528	0.4160	0.4862
24	0.3443	0.4070	0.4757
25	0.3369	0.3977	0.4662
26	0.3306	0.3901	0.4571
27	0.3242	0.3828	0.4487
28	0.3180	0.3755	0.4401
29	0.3118	0.3685	0.4325
30	0.3063	0.3624	0.4251
40	0.2640	0.3128	0.3681
50	0.2353	0.2791	0.3293
60	0.2144	0.2545	0.3005
70	0.1982	0.2354	0.2782
80	0.1852	0.2201	0.2602
90	0.1745	0.2074	0.2453
100	0.1654	0.1967	0.2327

Also learn these

Sampling methods

Simple random: number the list and use random numbers. Systematic: random start then every kth, which can be biased if the list has a pattern. Stratified: proportional groups, so it reflects the population structure. Quota: needs no sampling frame but can be biased. Used in: Jun 2024 Q1(a)(b); Jan 2024 Q2(a)(c); Jan 2025 Q5(a).

Statistic and estimator

A statistic uses only sample values and no unknown parameters, so (X - μ) / sigma is not a statistic. An estimator is unbiased if its expected value equals the parameter. Used in: Jun 2022 Q5(a)(b); Jun 2023 Q3(a); Jun 2025 Q6(a).

Efficiency

The most efficient of several unbiased estimators has the smallest variance, found with the variance rule for the combination. Used in: Jun 2022 Q5(d).

Central Limit Theorem

For a large sample the sample mean is approximately Normal whatever the population, and the sample variance can stand in for sigma^2. It is not needed when the population is already Normal. Used in: Jan 2026 (A) Q6(d)(e); Jan 2025 Q3(c); Jan 2023 Q6(b).

Test for a mean

State H0 and H1 in terms of μ, find z, compare it with the critical value from X3 (1.6449 one-tailed and 1.96 two-tailed at 5%, 2.5758 two-tailed at 1%) and conclude in context. A value of μ outside a confidence interval is rejected by the matching two-tailed test. Used in: Jan 2023 Q1(b)(c)(d); Jun 2024 Q3(a); Jan 2023 Q6(c).

Hypotheses for a difference of means

H0 is mu_A - mu_B equal to the stated difference (0, 10 or 200) and H1 uses the sign of the claim. Used in: Jan 2026 Q5(b); Jun 2025 Q4(b); Jun 2024 Q5(a).

Assumptions for a two-sample test

Say that the samples are independent and large, so the Central Limit Theorem applies and the sample variances can be used for the population variances; mention both samples. Used in: Jan 2026 Q5(c); Jun 2024 Q5(b); Jan 2025 Q3(c).

Chi-squared test method

State the hypotheses in words, find the expected frequencies, combine any cell with E less than 5, find the statistic and the degrees of freedom, compare with the upper-tail value in X6 and conclude in context. Used in: Jan 2026 Q4(d)(e); Jan 2025 Q2(c)(d); Jan 2026 (A) Q3(a).

Which cell to investigate

The cell with the largest value of (O - E)^2 / E contributes most to the statistic. Used in: Jan 2026 (A) Q3(b).

Spearman's rank test

Rank both variables, use average ranks for ties, write the hypotheses in terms of ρ, and compare with the critical value in X8 (one-tailed or two-tailed as the question says). Used in: Jan 2026 (A) Q1(a)(b); Jun 2022 Q1(a)(c); Jan 2025 Q1(a)(b).

Spearman or product moment

Use Spearman's when the data are ranks or the relationship may not be linear; the product moment test is checked against X7. Used in: Jun 2023 Q1(a)(c); Jun 2024 Q2(c); Jan 2024 Q3(a).

Limits on the sum of d squared

Put the critical value into the formula for the rank coefficient and solve the inequality for the sum of d^2, or for the unknown in a chi-squared statistic. Used in: Jan 2026 Q2(b)(c); Jun 2022 Q7(b).

Using the booklet in the exam

- Write down the booklet rows you need before you start: Var(aX +/- bY), the two-sample z statistic, S^2, the chi-squared statistic and Spearman's formula. The Normal result for aX +/- bY and the confidence interval are not printed, so learn them.
- For a confidence interval, use z from X3 for the level, then check your answer: half the width is z sigma / sqrt(n) and the centre is the sample mean.
- Rank both variables the same way for Spearman's, give the hypotheses in ρ, and compare with the right column of X8. For ties, use average ranks.
- For chi-squared, combine cells with an expected frequency under 5 before you work out the degrees of freedom, and write the conclusion in the words of the question.
- Separate 'a sum of n observations' from 'n times one observation': 3 bags have variance 3 sigma^2, and 3 times one bag has variance 9 sigma^2.
- For two-sample tests, state that both samples are large so the Central Limit Theorem applies and the sample variances can replace the population variances.

Built by CuratedPrep from the Edexcel International A Level Mathematics Unit S3 (WST03) papers June 2022 to January 2026 in our question bank (9 question papers). Given rows are copied from our checked copy of Mathematical Formulae and Statistical Tables (Issue 2, January 2021). 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.