Statistical Tables

Making Sense of Social Data

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These are the four statistical tables printed in the appendices of *Making Sense of Social Data*. They are reproduced here so that you can use them without the book to hand.

Every value was computed with R and checked against `qnorm()`, `qt()`, `qchisq()` and `qf()`. If you find a cell that disagrees with software you trust, please report it — that would be a genuine error rather than a rounding convention.

A browsable version of the same four tables is at `https://www.markparadispolitics.com/books/making-sense-of-social-data/online/tables/`.

Appendix A

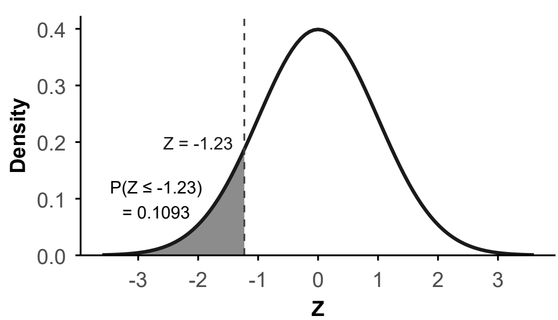
The Standard Normal (Z) Table

This table gives the **cumulative left-tail area** under the standard normal curve $Z \sim N(0, 1)$: the probability that a randomly drawn observation falls *at or below* a specified z-value.

How to use this table: To find the area for a given z-score (e.g., $z = -1.23$):

1. Find the row for the first decimal place ($-\mathbf{1.2}$) in the left-hand column.
2. Find the column for the second decimal place (**.03**) in the header row.
3. The cell at that intersection gives $P(Z \leq -1.23) = \mathbf{0.1093}$.

Note: $z = 0.00$ appears as the last row of the Negative table and the first row of the Positive table. Both give $P(Z \leq 0.00) = 0.5000$; the duplication is intentional to preserve the symmetry of the two tables.



Using the Table for All Probability Types

Let the table value for a given z be $\Phi(z) = P(Z \leq z)$.

Probability type	Rule	R equivalent
Left-tail: $P(Z \leq z)$	Read directly	`pnorm(z)`
Right-tail: $P(Z > z)$	$1 - \Phi(z)$	`pnorm(z, lower=FALSE)`
Middle: $P(a \leq Z \leq b)$	$\Phi(b) - \Phi(a)$	`pnorm(b) - pnorm(a)`
Two-tail: $P(\lvert Z\rvert > z)$	$2\,[1 - \Phi(z)]$	`2*pnorm(z, lower=FALSE)`

Key Critical Values

These four values appear throughout Part III. They are worth memorising.

Use	Two-tailed α	Critical value z^*	Table lookup
One-tail 10%; two-tail 20%	$\alpha = 0.20$	± 1.282	$\Phi(1.28) = 0.8997$
90% confidence interval	$\alpha = 0.10$	± 1.645	$\Phi(1.64) = 0.9495$
95% confidence interval	$\alpha = 0.05$	± 1.960	$\Phi(1.96) = 0.9750$
99% confidence interval	$\alpha = 0.01$	± 2.576	$\Phi(2.58) = 0.9951$

Note: $z^* = 1.645$ lies between table rows 1.64 ($\Phi = 0.9495$) and 1.65 ($\Phi = 0.9505$); the value 1.645 is the conventional midpoint. Similarly, $z^* = 2.576$ lies between 2.57 ($\Phi = 0.9949$) and 2.58 ($\Phi = 0.9951$).

Table A.1 Negative Z-Scores

Z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
–3.4	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0002
–3.3	0.0005	0.0005	0.0005	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0003
–3.2	0.0007	0.0007	0.0006	0.0006	0.0006	0.0006	0.0006	0.0005	0.0005	0.0005
–3.1	0.0010	0.0009	0.0009	0.0009	0.0008	0.0008	0.0008	0.0008	0.0007	0.0007
–3.0	0.0013	0.0013	0.0013	0.0012	0.0012	0.0011	0.0011	0.0011	0.0010	0.0010
–2.9	0.0019	0.0018	0.0018	0.0017	0.0016	0.0016	0.0015	0.0015	0.0014	0.0014
–2.8	0.0026	0.0025	0.0024	0.0023	0.0023	0.0022	0.0021	0.0021	0.0020	0.0019
–2.7	0.0035	0.0034	0.0033	0.0032	0.0031	0.0030	0.0029	0.0028	0.0027	0.0026
–2.6	0.0047	0.0045	0.0044	0.0043	0.0041	0.0040	0.0039	0.0038	0.0037	0.0036
–2.5	0.0062	0.0060	0.0059	0.0057	0.0055	0.0054	0.0052	0.0051	0.0049	0.0048
–2.4	0.0082	0.0080	0.0078	0.0075	0.0073	0.0071	0.0069	0.0068	0.0066	0.0064
–2.3	0.0107	0.0104	0.0102	0.0099	0.0096	0.0094	0.0091	0.0089	0.0087	0.0084
–2.2	0.0139	0.0136	0.0132	0.0129	0.0125	0.0122	0.0119	0.0116	0.0113	0.0110
–2.1	0.0179	0.0174	0.0170	0.0166	0.0162	0.0158	0.0154	0.0150	0.0146	0.0143
–2.0	0.0228	0.0222	0.0217	0.0212	0.0207	0.0202	0.0197	0.0192	0.0188	0.0183
–1.9	0.0287	0.0281	0.0274	0.0268	0.0262	0.0256	0.0250	0.0244	0.0239	0.0233
–1.8	0.0359	0.0351	0.0344	0.0336	0.0329	0.0322	0.0314	0.0307	0.0301	0.0294
–1.7	0.0446	0.0436	0.0427	0.0418	0.0409	0.0401	0.0392	0.0384	0.0375	0.0367
–1.6	0.0548	0.0537	0.0526	0.0516	0.0505	0.0495	0.0485	0.0475	0.0465	0.0455
–1.5	0.0668	0.0655	0.0643	0.0630	0.0618	0.0606	0.0594	0.0582	0.0571	0.0559
–1.4	0.0808	0.0793	0.0778	0.0764	0.0749	0.0735	0.0721	0.0708	0.0694	0.0681
–1.3	0.0968	0.0951	0.0934	0.0918	0.0901	0.0885	0.0869	0.0853	0.0838	0.0823
–1.2	0.1151	0.1131	0.1112	0.1093	0.1075	0.1056	0.1038	0.1020	0.1003	0.0985
–1.1	0.1357	0.1335	0.1314	0.1292	0.1271	0.1251	0.1230	0.1210	0.1190	0.1170
–1.0	0.1587	0.1562	0.1539	0.1515	0.1492	0.1469	0.1446	0.1423	0.1401	0.1379
–0.9	0.1841	0.1814	0.1788	0.1762	0.1736	0.1711	0.1685	0.1660	0.1635	0.1611
–0.8	0.2119	0.2090	0.2061	0.2033	0.2005	0.1977	0.1949	0.1922	0.1894	0.1867
–0.7	0.2420	0.2389	0.2358	0.2327	0.2296	0.2266	0.2236	0.2206	0.2177	0.2148
–0.6	0.2743	0.2709	0.2676	0.2643	0.2611	0.2578	0.2546	0.2514	0.2483	0.2451
–0.5	0.3085	0.3050	0.3015	0.2981	0.2946	0.2912	0.2877	0.2843	0.2810	0.2776
–0.4	0.3446	0.3409	0.3372	0.3336	0.3300	0.3264	0.3228	0.3192	0.3156	0.3121
–0.3	0.3821	0.3783	0.3745	0.3707	0.3669	0.3632	0.3594	0.3557	0.3520	0.3483
–0.2	0.4207	0.4168	0.4129	0.4090	0.4052	0.4013	0.3974	0.3936	0.3897	0.3859
–0.1	0.4602	0.4562	0.4522	0.4483	0.4443	0.4404	0.4364	0.4325	0.4286	0.4247
–0.0	0.5000	0.4960	0.4920	0.4880	0.4840	0.4801	0.4761	0.4721	0.4681	0.4641

Table A.2 Positive Z-Scores

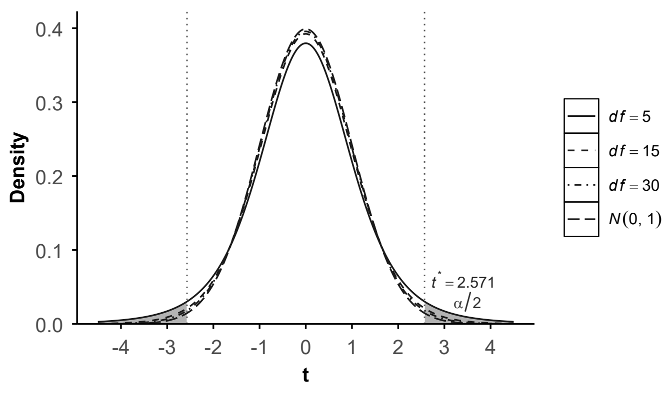
Z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0	0.5000	0.5040	0.5080	0.5120	0.5160	0.5199	0.5239	0.5279	0.5319	0.5359
0.1	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753
0.2	0.5793	0.5832	0.5871	0.5910	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141
0.3	0.6179	0.6217	0.6255	0.6293	0.6331	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
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
3.0	0.9987	0.9987	0.9987	0.9988	0.9988	0.9989	0.9989	0.9989	0.9990	0.9990
3.1	0.9990	0.9991	0.9991	0.9991	0.9992	0.9992	0.9992	0.9992	0.9993	0.9993
3.2	0.9993	0.9993	0.9994	0.9994	0.9994	0.9994	0.9994	0.9995	0.9995	0.9995
3.3	0.9995	0.9995	0.9995	0.9996	0.9996	0.9996	0.9996	0.9996	0.9996	0.9997
3.4	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9998

Appendix B

The *t*-Distribution Table

This table gives the **critical value** t^* for the t-distribution with a given number of degrees of freedom (df). t^* is the positive value that cuts off the specified area in the tail(s) of the distribution: $P(T > t^*) = \alpha/2$ for a two-tailed test, or $P(T > t^*) = \alpha$ for a one-tailed test.

Important: The t-distribution is symmetric about zero, so the left-tail critical value is $-t^*$. For a two-tailed test you reject H_0 when the test statistic t satisfies $|t| > t^*$, i.e., when $t < -t^*$ or $t > t^*$.



The figure shows t-distributions at selected df values alongside the standard normal $N(0, 1)$. As df increases, the t-curve approaches the normal curve and the critical values converge to the z^* values in Appendix A. The shaded tails on the $df = 5$ curve illustrate the two-tailed $\alpha = .05$ critical region ($t^* = 2.571$).

How to use this table:

1. Determine the degrees of freedom (df) for your test using the formulas below.

2. Decide whether your test is **one-tailed** or **two-tailed**, and choose your significance level (α).

3. Find the row for your df and the column for your α. The cell value is t^*.

4. If your df falls between two tabled rows, use the row with the *smaller* df (the more conservative critical value). For $df > 120$, use the z^* values in the ∞ row, or consult Appendix A directly.

Degrees of freedom formulas:

- **One-sample t-test or paired t-test:** $df = n - 1$
- **Independent-samples t-test (equal variances assumed):** $df = n_1 + n_2 - 2$
- **Independent-samples t-test (Welch; unequal variances):** df is estimated from the sample data using the Welch–Satterthwaite formula and is often non-integer. Round *down* to the nearest integer and use that row in this table; rounding down yields a slightly larger critical value, which is the conservative choice.
- **Linear regression — slope:** $df = n - 2$

Using t^* in Practice

Let t^* be the critical value from the table and t be the test statistic computed from your data.

Confidence interval	$\bar{x} \pm t^* \cdot SE$, where $SE = s/\sqrt{n}$. Use the **two-tailed** column for your chosen confidence level (e.g., $\alpha = .05$ for a 95% confidence interval).
Hypothesis test	Reject H_0 if $\lvert t \rvert > t^*$ (two-tailed), or if $t > t^*$ (right-tailed), or if $t < -t^*$ (left-tailed). Use the column matching your chosen α and the directionality of H_1.

Key Critical Values for Large Samples

As $df \to \infty$ the t-distribution converges to the standard normal. The bottom row of this table (∞) gives the limiting z^* values, which match the key critical values in Appendix A. For most purposes, $t^* \approx z^*$ once $df \geq 120$.

Two-tailed α	.20	.10	.05	.01
Confidence level	80%	90%	95%	99%
z^* (limiting value)	1.282	1.645	1.960	2.576

Note: The $\alpha = .05$ two-tailed column ($t^* \approx 1.96$ for large df) is the most commonly used threshold in social science research.

Two-tailed α	.20	.10	.05	.02	.01
One-tailed α	**.10**	**.05**	**.025**	**.01**	**.005**
Confidence level	*80%*	*90%*	*95%*	*98%*	*99%*
1	3.078	6.314	12.706	31.821	63.657
2	1.886	2.920	4.303	6.965	9.925
3	1.638	2.353	3.182	4.541	5.841
4	1.533	2.132	2.776	3.747	4.604
5	1.476	2.015	2.571	3.365	4.032
6	1.440	1.943	2.447	3.143	3.707
7	1.415	1.895	2.365	2.998	3.499
8	1.397	1.860	2.306	2.896	3.355
9	1.383	1.833	2.262	2.821	3.250
10	1.372	1.812	2.228	2.764	3.169
11	1.363	1.796	2.201	2.718	3.106
12	1.356	1.782	2.179	2.681	3.055
13	1.350	1.771	2.160	2.650	3.012
14	1.345	1.761	2.145	2.624	2.977
15	1.341	1.753	2.131	2.602	2.947
16	1.337	1.746	2.120	2.583	2.921
17	1.333	1.740	2.110	2.567	2.898
18	1.330	1.734	2.101	2.552	2.878
19	1.328	1.729	2.093	2.539	2.861
20	1.325	1.725	2.086	2.528	2.845
21	1.323	1.721	2.080	2.518	2.831
22	1.321	1.717	2.074	2.508	2.819
23	1.319	1.714	2.069	2.500	2.807
24	1.318	1.711	2.064	2.492	2.797
25	1.316	1.708	2.060	2.485	2.787
26	1.315	1.706	2.056	2.479	2.779
27	1.314	1.703	2.052	2.473	2.771
28	1.313	1.701	2.048	2.467	2.763
29	1.311	1.699	2.045	2.462	2.756
30	1.310	1.697	2.042	2.457	2.750
40	1.303	1.684	2.021	2.423	2.704
50	1.299	1.676	2.009	2.403	2.678
60	1.296	1.671	2.000	2.390	2.660
80	1.292	1.664	1.990	2.374	2.639
100	1.290	1.660	1.984	2.364	2.626
120	1.289	1.658	1.980	2.358	2.617
∞ (z^*)	1.282	1.645	1.960	2.326	2.576

The ∞ row gives the limiting z^* values as $df \to \infty$, matching Appendix A. Computed with `qt()` in R.

Appendix C

The χ^2 (Chi-Square) Distribution Table

This table gives the **right-tail critical value** χ^2_{crit} for the chi-square distribution with a given number of degrees of freedom (df). χ^2_{crit} is the value that cuts off the specified area in the *right* tail:

$$P\left(\chi^2 > \chi^2_{\text{crit}}\right) = \alpha$$

The chi-square test is always right-tailed: large values of χ^2 indicate departure from the null hypothesis, so only the right tail is used for the rejection region.

Degrees of freedom formulas:

- **Test for association (two-way contingency table):**

$$df = (\text{rows} - 1) \times (\text{columns} - 1)$$

- **Goodness-of-fit test:**

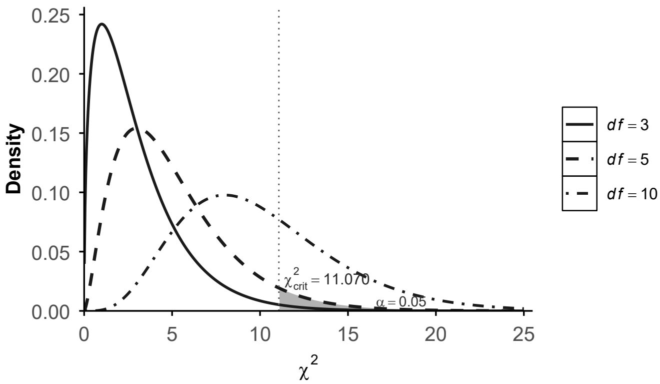
$$df = k - 1$$

  where k is the number of categories.

How to use this table:

1. Determine df using the appropriate formula above.
2. Choose your significance level (α). The conventional threshold in social science is $\alpha = .05$.
3. Find the row for your df and the column for your α. The cell value is χ^2_{crit}.

4. If your df falls between two tabled rows, use the row with the *smaller df* (the more conservative critical value). For $df > 50$, the chi-square distribution is well approximated by the normal; see the note at the end of this appendix.



The figure shows chi-square distributions at selected df values. Unlike the normal and t-distributions, the chi-square distribution is *right-skewed* and defined only for positive values. As df increases the distribution shifts right and becomes more symmetric. The shaded right tail on the $df = 5$ curve illustrates the $\alpha = .05$ critical region ($\chi^2_{\text{crit}} = 11.070$).

Using χ^2_{crit} in Practice

Let χ^2_{calc} be the test statistic computed from your data and χ^2_{crit} be the value from this table.

Decision rule	Reject H_0 if $\chi^2_{\text{calc}} > \chi^2_{\text{crit}}$.
Direction	The chi-square test is always one-directional (right-tailed). There is no two-tailed version: small values of χ^2 are consistent with H_0, not evidence against it.
Assumptions	Every cell must have an observed frequency > 0; empty cells invalidate the test. Expected cell frequencies should also generally be ≥ 5. When either condition is violated, interpret results cautiously or consider an alternative procedure (e.g., collapsing categories or using Fisher's exact test for 2 × 2 tables).

Key Critical Values

The most frequently encountered critical values in social science research. The $df = 1$ value (3.841) appears in every 2×2 contingency table analysis and is worth memorising.

α	**.10**	**.05**	**.01**	**.001**
$df = 1$	2.706	**3.841**	6.635	10.828
$df = 2$	4.605	**5.991**	9.210	13.816
$df = 3$	6.251	**7.815**	11.345	16.266
$df = 4$	7.779	**9.488**	13.277	18.467

Note: For large df (beyond this table), the quantity $\sqrt{2\chi^2} - \sqrt{2\,df - 1}$ is approximately standard normal. Alternatively, use the z^* values in Appendix A as a rough upper bound.

	Significance Level (α)				
df	**.10**	**.05**	**.025**	**.01**	**.001**
1	2.706	3.841	5.024	6.635	10.828
2	4.605	5.991	7.378	9.210	13.816
3	6.251	7.815	9.348	11.345	16.266
4	7.779	9.488	11.143	13.277	18.467
5	9.236	11.070	12.833	15.086	20.515
6	10.645	12.592	14.449	16.812	22.458
7	12.017	14.067	16.013	18.475	24.322
8	13.362	15.507	17.535	20.090	26.124
9	14.684	16.919	19.023	21.666	27.877
10	15.987	18.307	20.483	23.209	29.588
11	17.275	19.675	21.920	24.725	31.264
12	18.549	21.026	23.337	26.217	32.909
13	19.812	22.362	24.736	27.688	34.528
14	21.064	23.685	26.119	29.141	36.123
15	22.307	24.996	27.488	30.578	37.697
16	23.542	26.296	28.845	32.000	39.252
17	24.769	27.587	30.191	33.409	40.790
18	25.989	28.869	31.526	34.805	42.312
19	27.204	30.144	32.852	36.191	43.820
20	28.412	31.410	34.170	37.566	45.315
21	29.615	32.671	35.479	38.932	46.797
22	30.813	33.924	36.781	40.289	48.268
23	32.007	35.172	38.076	41.638	49.728
24	33.196	36.415	39.364	42.980	51.179
25	34.382	37.652	40.646	44.314	52.620
26	35.563	38.885	41.923	45.642	54.052
27	36.741	40.113	43.195	46.963	55.476
28	37.916	41.337	44.461	48.278	56.892
29	39.087	42.557	45.722	49.588	58.301
30	40.256	43.773	46.979	50.892	59.703
40	51.805	55.758	59.342	63.691	73.402
50	63.167	67.505	71.420	76.154	86.661

Values give $P(\chi^2 > \chi^2_{crit}) = \alpha$ for the right-tail critical region. For $df > 50$, the approximation $\sqrt{2\chi^2} - \sqrt{2\,df - 1} \approx N(0,1)$ may be used; consult Appendix A for the corresponding z^* value. Values were computed using `qchisq()` *in R.*

Appendix D

The F-Distribution Table

This table gives the **right-tail critical value** F_{crit} for the F-distribution with numerator degrees of freedom df_1 and denominator degrees of freedom df_2:

$$P(F > F_{\text{crit}}) = \alpha$$

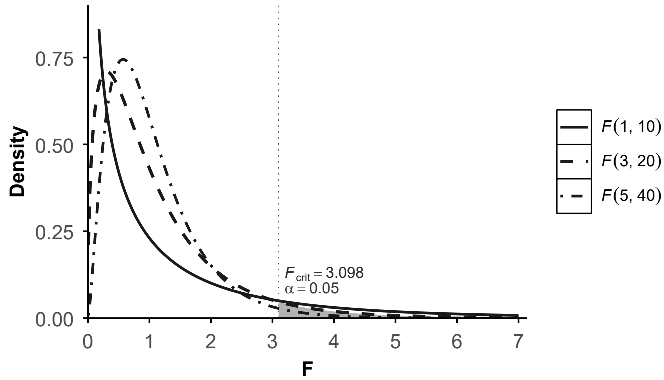
The F-test is always right-tailed. Large values of F indicate more variance between groups than within groups (in ANOVA) or a better-fitting model than expected by chance (in regression), so only the right tail defines the rejection region.

Degrees of freedom formulas:

- **One-way ANOVA** (Chapter **??**):
  - $df_1 = k - 1$ (numerator; k = number of groups)
  - $df_2 = N - k$ (denominator; N = total sample size)
- **Simple linear regression** (Chapter **??**):
  - $df_1 = 1$ (one predictor)
  - $df_2 = N - 2$ (denominator)

How to use this table:

1. Determine df_1 (columns) and df_2 (rows) using the appropriate formula above.
2. Select the table for your significance level ($\alpha = .05$ or $\alpha = .01$).
3. Find the cell at the intersection of your df_1 column and df_2 row. That value is F_{crit}.
4. If your df_1 or df_2 falls between two tabled values, use the column or row with the *smaller* degrees of freedom (the more conservative critical value).



The figure shows F-distributions at selected (df_1, df_2) combinations. Like the chi-square distribution, the F-distribution is right-skewed and defined only for positive values. The shape depends on both df_1 and df_2; the distribution becomes more symmetric as both increase. The shaded tail on the $F(3, 20)$ curve illustrates the $\alpha = .05$ critical region ($F_{\text{crit}} = 3.10$).

Using F_{crit} in Practice

Let F_{calc} be the test statistic from your analysis and F_{crit} be the value from this table.

Decision rule	Reject H_0 if $F_{\text{calc}} > F_{\text{crit}}$.
Direction	The F-test is always right-tailed. An F ratio near 1.0 is consistent with H_0; values well above 1.0 are evidence against it.
Relationship to t	When $df_1 = 1$, $F = t^2$. The F_{crit} value in the $df_1 = 1$ column equals the square of the corresponding t^* from Appendix B.

Key Critical Values ($\alpha = .05$)

The most frequently encountered values in introductory ANOVA and regression. Note that $F(1, \infty) = 3.84 \approx (1.96)^2 = (z^*)^2$, confirming the $F = t^2$ relationship for large samples.

	df_1 **(numerator)**			
df_2	**1**	**2**	**3**	**4**
10	4.96	4.10	3.71	3.48
20	4.35	3.49	3.10	2.87
30	4.17	3.32	2.92	2.69
60	4.00	3.15	2.76	2.53
∞	3.84	3.00	2.60	2.37

Table F.1 Critical Values of the F-Distribution, $\alpha = .05$

df_2	df_1 — **Numerator Degrees of Freedom**												
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**12**	**15**	**20**
1	161.45	199.50	215.71	224.58	230.16	233.99	236.77	238.88	240.54	241.88	243.91	245.95	248.01
2	18.51	19.00	19.16	19.25	19.30	19.33	19.35	19.37	19.38	19.40	19.41	19.43	19.45
3	10.13	9.55	9.28	9.12	9.01	8.94	8.89	8.85	8.81	8.79	8.74	8.70	8.66
4	7.71	6.94	6.59	6.39	6.26	6.16	6.09	6.04	6.00	5.96	5.91	5.86	5.80
5	6.61	5.79	5.41	5.19	5.05	4.95	4.88	4.82	4.77	4.74	4.68	4.62	4.56
6	5.99	5.14	4.76	4.53	4.39	4.28	4.21	4.15	4.10	4.06	4.00	3.94	3.87
7	5.59	4.74	4.35	4.12	3.97	3.87	3.79	3.73	3.68	3.64	3.57	3.51	3.44
8	5.32	4.46	4.07	3.84	3.69	3.58	3.50	3.44	3.39	3.35	3.28	3.22	3.15
9	5.12	4.26	3.86	3.63	3.48	3.37	3.29	3.23	3.18	3.14	3.07	3.01	2.94
10	4.96	4.10	3.71	3.48	3.33	3.22	3.14	3.07	3.02	2.98	2.91	2.85	2.77
11	4.84	3.98	3.59	3.36	3.20	3.09	3.01	2.95	2.90	2.85	2.79	2.72	2.65
12	4.75	3.89	3.49	3.26	3.11	3.00	2.91	2.85	2.80	2.75	2.69	2.62	2.54
13	4.67	3.81	3.41	3.18	3.03	2.92	2.83	2.77	2.71	2.67	2.60	2.53	2.46
14	4.60	3.74	3.34	3.11	2.96	2.85	2.76	2.70	2.65	2.60	2.53	2.46	2.39
15	4.54	3.68	3.29	3.06	2.90	2.79	2.71	2.64	2.59	2.54	2.48	2.40	2.33
16	4.49	3.63	3.24	3.01	2.85	2.74	2.66	2.59	2.54	2.49	2.42	2.35	2.28
17	4.45	3.59	3.20	2.96	2.81	2.70	2.61	2.55	2.49	2.45	2.38	2.31	2.23
18	4.41	3.55	3.16	2.93	2.77	2.66	2.58	2.51	2.46	2.41	2.34	2.27	2.19
19	4.38	3.52	3.13	2.90	2.74	2.63	2.54	2.48	2.42	2.38	2.31	2.23	2.16
20	4.35	3.49	3.10	2.87	2.71	2.60	2.51	2.45	2.39	2.35	2.28	2.20	2.12

Table F.1 Critical Values of the F-Distribution, $\alpha = .05$

df_2	df_1 — **Numerator Degrees of Freedom** 1	2	3	4	5	6	7	8	9	10	12	15	20
21	4.32	3.47	3.07	2.84	2.68	2.57	2.49	2.42	2.37	2.32	2.25	2.18	2.10
22	4.30	3.44	3.05	2.82	2.66	2.55	2.46	2.40	2.34	2.30	2.23	2.15	2.07
23	4.28	3.42	3.03	2.80	2.64	2.53	2.44	2.37	2.32	2.27	2.20	2.13	2.05
24	4.26	3.40	3.01	2.78	2.62	2.51	2.42	2.36	2.30	2.25	2.18	2.11	2.03
25	4.24	3.39	2.99	2.76	2.60	2.49	2.40	2.34	2.28	2.24	2.16	2.09	2.01
26	4.23	3.37	2.98	2.74	2.59	2.47	2.39	2.32	2.27	2.22	2.15	2.07	1.99
27	4.21	3.35	2.96	2.73	2.57	2.46	2.37	2.31	2.25	2.20	2.13	2.06	1.97
28	4.20	3.34	2.95	2.71	2.56	2.45	2.36	2.29	2.24	2.19	2.12	2.04	1.96
29	4.18	3.33	2.93	2.70	2.55	2.43	2.35	2.28	2.22	2.18	2.10	2.03	1.94
30	4.17	3.32	2.92	2.69	2.53	2.42	2.33	2.27	2.21	2.16	2.09	2.01	1.93
40	4.08	3.23	2.84	2.61	2.45	2.34	2.25	2.18	2.12	2.08	2.00	1.92	1.84
60	4.00	3.15	2.76	2.53	2.37	2.25	2.17	2.10	2.04	1.99	1.92	1.84	1.75
120	3.92	3.07	2.68	2.45	2.29	2.18	2.09	2.02	1.96	1.91	1.83	1.75	1.66
∞	3.84	3.00	2.60	2.37	2.21	2.10	2.01	1.94	1.88	1.83	1.75	1.67	1.57

Values give $P(F > F_{crit}) = .05$. df_1 = numerator (columns); df_2 = denominator (rows). For df values between tabled entries, use the smaller df (conservative). Values computed using `qf()` in R.

Table F.2 Critical Values of the F-Distribution, $\alpha = .01$

df_2	df_1 — **Numerator Degrees of Freedom** 1	2	3	4	5	6	7	8	9	10	12	15	20
1	4,052.18	4,999.50	5,403.35	5,624.58	5,763.65	5,858.99	5,928.36	5,981.07	6,022.47	6,055.85	6,106.32	6,157.28	6,208.73
2	98.50	99.00	99.17	99.25	99.30	99.33	99.36	99.37	99.39	99.40	99.42	99.43	99.45
3	34.12	30.82	29.46	28.71	28.24	27.91	27.67	27.49	27.35	27.23	27.05	26.87	26.69
4	21.20	18.00	16.69	15.98	15.52	15.21	14.98	14.80	14.66	14.55	14.37	14.20	14.02
5	16.26	13.27	12.06	11.39	10.97	10.67	10.46	10.29	10.16	10.05	9.89	9.72	9.55
6	13.75	10.92	9.78	9.15	8.75	8.47	8.26	8.10	7.98	7.87	7.72	7.56	7.40
7	12.25	9.55	8.45	7.85	7.46	7.19	6.99	6.84	6.72	6.62	6.47	6.31	6.16
8	11.26	8.65	7.59	7.01	6.63	6.37	6.18	6.03	5.91	5.81	5.67	5.52	5.36
9	10.56	8.02	6.99	6.42	6.06	5.80	5.61	5.47	5.35	5.26	5.11	4.96	4.81
10	10.04	7.56	6.55	5.99	5.64	5.39	5.20	5.06	4.94	4.85	4.71	4.56	4.41
11	9.65	7.21	6.22	5.67	5.32	5.07	4.89	4.74	4.63	4.54	4.40	4.25	4.10
12	9.33	6.93	5.95	5.41	5.06	4.82	4.64	4.50	4.39	4.30	4.16	4.01	3.86
13	9.07	6.70	5.74	5.21	4.86	4.62	4.44	4.30	4.19	4.10	3.96	3.82	3.66
14	8.86	6.51	5.56	5.04	4.69	4.46	4.28	4.14	4.03	3.94	3.80	3.66	3.51
15	8.68	6.36	5.42	4.89	4.56	4.32	4.14	4.00	3.89	3.80	3.67	3.52	3.37
16	8.53	6.23	5.29	4.77	4.44	4.20	4.03	3.89	3.78	3.69	3.55	3.41	3.26
17	8.40	6.11	5.18	4.67	4.34	4.10	3.93	3.79	3.68	3.59	3.46	3.31	3.16
18	8.29	6.01	5.09	4.58	4.25	4.01	3.84	3.71	3.60	3.51	3.37	3.23	3.08
19	8.18	5.93	5.01	4.50	4.17	3.94	3.77	3.63	3.52	3.43	3.30	3.15	3.00
20	8.10	5.85	4.94	4.43	4.10	3.87	3.70	3.56	3.46	3.37	3.23	3.09	2.94

Table F.2 Critical Values of the F-Distribution, $\alpha = .01$

df_2	df_1 — **Numerator Degrees of Freedom**												
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**12**	**15**	**20**
21	8.02	5.78	4.87	4.37	4.04	3.81	3.64	3.51	3.40	3.31	3.17	3.03	2.88
22	7.95	5.72	4.82	4.31	3.99	3.76	3.59	3.45	3.35	3.26	3.12	2.98	2.83
23	7.88	5.66	4.76	4.26	3.94	3.71	3.54	3.41	3.30	3.21	3.07	2.93	2.78
24	7.82	5.61	4.72	4.22	3.90	3.67	3.50	3.36	3.26	3.17	3.03	2.89	2.74
25	7.77	5.57	4.68	4.18	3.85	3.63	3.46	3.32	3.22	3.13	2.99	2.85	2.70
26	7.72	5.53	4.64	4.14	3.82	3.59	3.42	3.29	3.18	3.09	2.96	2.81	2.66
27	7.68	5.49	4.60	4.11	3.78	3.56	3.39	3.26	3.15	3.06	2.93	2.78	2.63
28	7.64	5.45	4.57	4.07	3.75	3.53	3.36	3.23	3.12	3.03	2.90	2.75	2.60
29	7.60	5.42	4.54	4.04	3.73	3.50	3.33	3.20	3.09	3.00	2.87	2.73	2.57
30	7.56	5.39	4.51	4.02	3.70	3.47	3.30	3.17	3.07	2.98	2.84	2.70	2.55
40	7.31	5.18	4.31	3.83	3.51	3.29	3.12	2.99	2.89	2.80	2.66	2.52	2.37
60	7.08	4.98	4.13	3.65	3.34	3.12	2.95	2.82	2.72	2.63	2.50	2.35	2.20
120	6.85	4.79	3.95	3.48	3.17	2.96	2.79	2.66	2.56	2.47	2.34	2.19	2.03
∞	6.63	4.61	3.78	3.32	3.02	2.80	2.64	2.51	2.41	2.32	2.18	2.04	1.88

Values give $P(F > F_{crit}) = .01$. df_1 = numerator (columns); df_2 = denominator (rows). For df values between tabled entries, use the smaller df (conservative). Values computed using `qf()` in R.