

Table of selected values

Most statistical textbooks list *t* distribution tables. Nowadays, the better way to a fully precise critical *t* value or a cumulative probability is the statistical function implemented in spreadsheets (Office Excel, OpenOffice Calc, etc.), or an interactive calculating web page. The relevant spreadsheet functions are TDIST and TINV, while online calculating pages save troubles like positions of parameters or names of functions. For example, a Mediawiki page supported by R extension can easily give the interactive result (http://mars.wiwi.hu-berlin.de/mediawiki/slides/index.php/Comparison_of_noncentral_and_central_distributions) of critical values or cumulative probability, even for noncentral t-distribution.

The following table lists a few selected values for t-distributions with *ν* degrees of freedom for a range of *one-sided* or *two-sided* critical regions. For an example of how to read this table, take the fourth row, which begins with 4; that means *ν*, the number of degrees of freedom, is 4 (and if we are dealing, as above, with *n* values with a fixed sum, *n* = 5). Take the fifth entry, in the column headed 95% for *one-sided* (90% for *two-sided*). The value of that entry is "2.132". Then the probability that *T* is less than 2.132 is 95% or $\Pr(-\infty < T < 2.132) = 0.95$; or mean that $\Pr(-2.132 < T < 2.132) = 0.9$.

This can be calculated by the symmetry of the distribution,

$$\Pr(T < -2.132) = 1 - \Pr(T > -2.132) = 1 - 0.95 = 0.05,$$

and so

$$\Pr(-2.132 < T < 2.132) = 1 - 2(0.05) = 0.9.$$

Note that the last row also gives critical points: a *t*-distribution with infinitely-many degrees of freedom is a normal distribution. (See Related distributions above).

The first column is the number of degrees of freedom.

<i>One Sided</i>	75%	80%	85%	90%	95%	97.5%	99%	99.5%	99.75%	99.9%	99.95%
<i>Two Sided</i>	50%	60%	70%	80%	90%	95%	98%	99%	99.5%	99.8%	99.9%
1	1.000	1.376	1.963	3.078	6.314	12.71	31.82	63.66	127.3	318.3	636.6
2	0.816	1.061	1.386	1.886	2.920	4.303	6.965	9.925	14.09	22.33	31.60
3	0.765	0.978	1.250	1.638	2.353	3.182	4.541	5.841	7.453	10.21	12.92
4	0.741	0.941	1.190	1.533	2.132	2.776	3.747	4.604	5.598	7.173	8.610
5	0.727	0.920	1.156	1.476	2.015	2.571	3.365	4.032	4.773	5.893	6.869
6	0.718	0.906	1.134	1.440	1.943	2.447	3.143	3.707	4.317	5.208	5.959
7	0.711	0.896	1.119	1.415	1.895	2.365	2.998	3.499	4.029	4.785	5.408
8	0.706	0.889	1.108	1.397	1.860	2.306	2.896	3.355	3.833	4.501	5.041
9	0.703	0.883	1.100	1.383	1.833	2.262	2.821	3.250	3.690	4.297	4.781
10	0.700	0.879	1.093	1.372	1.812	2.228	2.764	3.169	3.581	4.144	4.587
11	0.697	0.876	1.088	1.363	1.796	2.201	2.718	3.106	3.497	4.025	4.437
12	0.695	0.873	1.083	1.356	1.782	2.179	2.681	3.055	3.428	3.930	4.318
13	0.694	0.870	1.079	1.350	1.771	2.160	2.650	3.012	3.372	3.852	4.221
14	0.692	0.868	1.076	1.345	1.761	2.145	2.624	2.977	3.326	3.787	4.140

15	0.691	0.866	1.074	1.341	1.753	2.131	2.602	2.947	3.286	3.733	4.073
16	0.690	0.865	1.071	1.337	1.746	2.120	2.583	2.921	3.252	3.686	4.015
17	0.689	0.863	1.069	1.333	1.740	2.110	2.567	2.898	3.222	3.646	3.965
18	0.688	0.862	1.067	1.330	1.734	2.101	2.552	2.878	3.197	3.610	3.922
19	0.688	0.861	1.066	1.328	1.729	2.093	2.539	2.861	3.174	3.579	3.883
20	0.687	0.860	1.064	1.325	1.725	2.086	2.528	2.845	3.153	3.552	3.850
21	0.686	0.859	1.063	1.323	1.721	2.080	2.518	2.831	3.135	3.527	3.819
22	0.686	0.858	1.061	1.321	1.717	2.074	2.508	2.819	3.119	3.505	3.792
23	0.685	0.858	1.060	1.319	1.714	2.069	2.500	2.807	3.104	3.485	3.767
24	0.685	0.857	1.059	1.318	1.711	2.064	2.492	2.797	3.091	3.467	3.745
25	0.684	0.856	1.058	1.316	1.708	2.060	2.485	2.787	3.078	3.450	3.725
26	0.684	0.856	1.058	1.315	1.706	2.056	2.479	2.779	3.067	3.435	3.707
27	0.684	0.855	1.057	1.314	1.703	2.052	2.473	2.771	3.057	3.421	3.690
28	0.683	0.855	1.056	1.313	1.701	2.048	2.467	2.763	3.047	3.408	3.674
29	0.683	0.854	1.055	1.311	1.699	2.045	2.462	2.756	3.038	3.396	3.659
30	0.683	0.854	1.055	1.310	1.697	2.042	2.457	2.750	3.030	3.385	3.646
40	0.681	0.851	1.050	1.303	1.684	2.021	2.423	2.704	2.971	3.307	3.551
50	0.679	0.849	1.047	1.299	1.676	2.009	2.403	2.678	2.937	3.261	3.496
60	0.679	0.848	1.045	1.296	1.671	2.000	2.390	2.660	2.915	3.232	3.460
80	0.678	0.846	1.043	1.292	1.664	1.990	2.374	2.639	2.887	3.195	3.416
100	0.677	0.845	1.042	1.290	1.660	1.984	2.364	2.626	2.871	3.174	3.390
120	0.677	0.845	1.041	1.289	1.658	1.980	2.358	2.617	2.860	3.160	3.373
∞	0.674	0.842	1.036	1.282	1.645	1.960	2.326	2.576	2.807	3.090	3.291

The number at the beginning of each row in the table above is ν which has been defined above as $n - 1$. The percentage along the top is $100\%(1 - \alpha)$. The numbers in the main body of the table are $t_{\alpha, \nu}$. If a quantity T is distributed as a Student's t distribution with ν degrees of freedom, then there is a probability $1 - \alpha$ that T will be less than $t_{\alpha, \nu}$. (Calculated as for a one-tailed or one-sided test as opposed to a two-tailed test.)

For example, given a sample with a sample variance 2 and sample mean of 10, taken from a sample set of 11 (10 degrees of freedom), using the formula

$$\bar{X}_n \pm A \frac{S_n}{\sqrt{n}}.$$

We can determine that at 90% confidence, we have a true mean lying below

$$10 + 1.37218 \frac{\sqrt{2}}{\sqrt{11}} = 10.58510.$$

(In other words, on average, 90% of the times that an upper threshold is calculated by this method, this upper threshold exceeds the true mean.) And, still at 90% confidence, we have a true mean lying over

$$10 - 1.37218 \frac{\sqrt{2}}{\sqrt{11}} = 9.41490.$$

(In other words, on average, 90% of the times that a lower threshold is calculated by this method, this lower threshold lies below the true mean.) So that at 80% confidence (calculated from $1 - 2 \times (1 - 90\%) = 80\%$), we have a true mean lying within the interval

$$\left(10 - 1.37218 \frac{\sqrt{2}}{\sqrt{11}}, 10 + 1.37218 \frac{\sqrt{2}}{\sqrt{11}} \right) = (9.41490, 10.58510).$$

This is generally expressed in interval notation, e.g., for this case, at 80% confidence the true mean is within the interval [9.41490, 10.58510].

(In other words, on average, 80% of the times that upper and lower thresholds are calculated by this method, the true mean is both below the upper threshold and above the lower threshold. This is not the same thing as saying that there is an 80% probability that the true mean lies between a particular pair of upper and lower thresholds that have been calculated by this method—see confidence interval and prosecutor's fallacy.)

For information on the inverse cumulative distribution function see Quantile function.

See also

- Chi-squared distribution
- F-distribution
- Gamma distribution
- Hotelling's T-squared distribution
- Multivariate Student distribution
- Student's t-statistic
- Wilks' lambda distribution
- Wishart distribution

Notes

1. [^] Hurst, Simon, The Characteristic Function of the Student-t Distribution (<http://www.maths.anu.edu.au/research.reports/srr/95/044/>) , Financial Mathematics Research Report No. FMRR006-95, Statistics Research Report No. SRR044-95
2. [^] ^a ^b ^c Johnson, N.L., Kotz, S., Balakrishnan, N. (1995) *Continuous Univariate Distributions, Volume 2*, 2nd Edition. Wiley, ISBN 0-471-58494-0 (Chapter 28)
3. [^] Helmert, F. R. (1875). "Über die Bestimmung des wahrscheinlichen Fehlers aus einer endlichen Anzahl wahrer Beobachtungsfehler". *Z. Math. Phys.*, 20, 300-3.
4. [^] Helmert, F. R. (1876a). "Über die Wahrscheinlichkeit der Potenzsummen der Beobachtungsfehler und über einige damit in Zusammenhang stehende Fragen". *Z. Math. Phys.*, 21, 192-218.
5. [^] Helmert, F. R. (1876b). "Die Genauigkeit der Formel von Peters zur Berechnung des wahrscheinlichen Beobachtungsfehlers director Beobachtungen gleicher Genauigkeit", *Astron. Nachr.*, 88, 113-32.
6. [^] Lüroth, J (1876). "Vergleichung von zwei Werten des wahrscheinlichen Fehlers". *Astron. Nachr.* **87** (14): 209–20. Bibcode 1876AN.....87..209L (<http://adsabs.harvard.edu/abs/1876AN.....87..209L>) . doi:10.1002/asna.18760871402 (<http://dx.doi.org/10.1002%2Fasna.18760871402>) .
7. [^] Pfanzagl, J.; Sheynin, O. (1996). "A forerunner of the t-distribution (Studies in the history of probability and statistics XLIV)" (<http://biomet.oxfordjournals.org/cgi/content/abstract/83/4/891>) . *Biometrika* **83** (4): 891–898. doi:10.1093/biomet/83.4.891 (<http://dx.doi.org/10.1093%2Fbiomet%2F83.4.891>) . MR1766040 (<http://www.ams.org/mathscinet-getitem?mr=1766040>) . <http://biomet.oxfordjournals.org/cgi/content/abstract/83/4/891>.
8. [^] Sheynin, O (1995). "Helmert's work in the theory of errors". *Arch. Hist. Ex. Sci.* **49**: 73–104. doi:10.1007/BF00374700 (<http://dx.doi.org/10.1007%2FBF00374700>) .
9. [^] Student [William Sealy Gosset] (March 1908). "The probable error of a mean" (<http://www.york.ac.uk/depts/maths/histstat/student.pdf>) . *Biometrika* **6** (1): 1–25. doi:10.1093/biomet/6.1.1 (<http://dx.doi.org>