**The CHI-SQUARE Distribution**

**Probability**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ***df*** | ***.05*** | ***.02*** | ***.01*** | ***.001*** |
| *1* | 3.841 | 5.412 | 6.635 | 10.827 |
| *2* | 5.991 | 7.824 | 9.210 | 13.815 |
| *3* | 7.815 | 9.837 | 11.345 | 16.266 |
| *4* | 9.488 | 11.668 | 13.277 | 18.467 |
| *5* | 11.070 | 13.388 | 15.086 | 20.515 |
| *6* | 12.592 | 15.033 | 16.812 | 22.457 |
| *7* | 14.067 | 16.622 | 18.475 | 24.322 |
| *8* | 15.507 | 18.168 | 20.090 | 26.125 |
| *9* | 16.919 | 19.679 | 21.666 | 27.877 |
| *10* | 18.307 | 21.161 | 23.209 | 29.588 |
| *11* | 19.675 | 22.618 | 24.725 | 31.264 |
| *12* | 21.026 | 24.054 | 26.217 | 32.909 |
| *13* | 22.362 | 25.472 | 27.688 | 34.528 |
| *14* | 23.685 | 26.873 | 29.141 | 36.123 |
| *15* | 24.996 | 28.259 | 30.578 | 37.697 |
| *16* | 26.296 | 29.633 | 32.000 | 39.252 |
| *17* | 27.587 | 30.995 | 33.409 | 40.790 |
| *18* | 28.869 | 32.346 | 34.805 | 42.312 |
| *19* | 30.144 | 33.687 | 36.191 | 43.820 |
| *20* | 31.410 | 35.020 | 37.566 | 45.315 |
| *21* | 32.671 | 36.343 | 38.932 | 46.797 |
| *22* | 33.924 | 37.659 | 40.289 | 48.268 |
| *23* | 35.172 | 38.968 | 41.638 | 49.728 |
| *24* | 36.415 | 40.270 | 42.980 | 51.179 |
| *25* | 37.652 | 41.566 | 44.314 | 52.620 |
| *26* | 38.885 | 42.856 | 45.642 | 54.052 |
| *27* | 40.113 | 44.140 | 46.963 | 55.476 |
| *28* | 41.337 | 45.419 | 48.278 | 56.893 |
| *29* | 42.557 | 46.693 | 49.588 | 58.302 |
| *30* | 43.773 | 47.962 | 50.892 | 59.703 |

**The *t* DISTRIBUTION**

|  |  |
| --- | --- |
|  | **Level of Significance for One-Tailed Test** |
| .10 | .05 | .025 | .01 | .005 | .0005 |
| **Level of Significance for Two-Tailed Test** |
| .20 | .10 | .05 | .02 | .01 | .001 |
| **1** | 3.078 | 6.314 | 12.706 | 31.821 | 63.657 | 636.619 |
| **2** | 1.886 | 2.920 | 4.303 | 6.965 | 9.925 | 31.598 |
| **3** | 1.638 | 2.353 | 3.182 | 4.451 | 5.841 | 12.941 |
| **4** | 1.533 | 2.132 | 2.776 | 3.747 | 4.604 | 8.610 |
| **5** | 1.476 | 2.015 | 2.571 | 3.365 | 4.032 | 6.859 |
| **6** | 1.440 | 1.943 | 2.447 | 3.143 | 3.707 | 5.959 |
| **7** | 1.415 | 1.895 | 2.365 | 2.998 | 3.499 | 5.405 |
| **8** | 1.397 | 1.860 | 2.306 | 2.896 | 3.355 | 5.041 |
| **9** | 1.383 | 1.833 | 2.262 | 2.821 | 3.250 | 4.781 |
| **10** | 1.372 | 1.812 | 2.228 | 2.764 | 3.169 | 4.587 |
| **11** | 1.363 | 1.796 | 2.201 | 2.718 | 3.106 | 4.437 |
| **12** | 1.356 | 1.782 | 2.179 | 2.681 | 3.055 | 4.318 |
| **13** | 1.350 | 1.771 | 2.160 | 2.650 | 3.012 | 4.221 |
| **14** | 1.345 | 1.761 | 2.145 | 2.624 | 2.977 | 4.140 |
| **15** | 1.341 | 1.753 | 2.131 | 2.602 | 2.947 | 4.073 |
| **16** | 1.337 | 1.746 | 2.120 | 2.583 | 2.921 | 4.015 |
| **17** | 1.333 | 1.740 | 2.110 | 2.567 | 2.898 | 3.965 |
| **18** | 1.330 | 1.734 | 2.101 | 2.552 | 2.878 | 3.922 |
| **19** | 1.328 | 1.729 | 2.093 | 2.539 | 2.861 | 3.883 |
| **20** | 1.325 | 1.725 | 2.086 | 2.528 | 2.845 | 3.850 |
| **21** | 1.323 | 1.721 | 2.080 | 2.518 | 2.831 | 3.819 |
| **22** | 1.321 | 1.717 | 2.074 | 2.508 | 2.819 | 3.792 |
| **23** | 1.319 | 1.714 | 2.069 | 2.500 | 2.807 | 3.767 |
| **24** | 1.318 | 1.711 | 2.064 | 2.492 | 2.797 | 3.745 |
| **25** | 1.316 | 1.708 | 2.060 | 2.485 | 2.787 | 3.725 |
| **26** | 1.315 | 1.706 | 2.056 | 2.479 | 2.779 | 3.707 |
| **27** | 1.314 | 1.703 | 2.052 | 2.473 | 2.771 | 3.690 |
| **28** | 1.313 | 1.701 | 2.048 | 2.467 | 2.763 | 3.674 |
| **29** | 1.311 | 1.699 | 2.045 | 2.462 | 2.756 | 3.659 |
| **30** | 1.310 | 1.697 | 2.042 | 2.457 | 2.750 | 3.346 |
| **40** | 1.303 | 1.684 | 2.021 | 2.423 | 2.704 | 3.551 |
| **60** | 1.296 | 1.671 | 2.000 | 2.390 | 2.660 | 3.460 |
| **120** | 1.289 | 1.658 | 1.980 | 2.358 | 2.617 | 3.373 |
| **∞** | 1.282 | 1.645 | 1.960 | 2.326 | 2.576 | 3.291 |

**The F DISTRIBUTION**

**p = .05**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **N1 /N2** | **1** | **2** | **3** | **4** | **5** | **6** | **8** | **12** | **24** | **∞** |
| **1** | 161.4 | 199.5 | 215.7 | 224.6 | 230.2 | 234.0 | 238.9 | 243.9 | 249.0 | 254.3 |
| **2** | 18.51 | 19.00 | 19.16 | 19.25 | 19.30 | 19.33 | 19.37 | 19.41 | 19.45 | 19.50 |
| **3** | 10.13 | 9.55 | 9.28 | 9.12 | 9.01 | 8.94 | 8.84 | 8.74 | 8.64 | 8.53 |
| **4** | 7.71 | 6.94 | 6.59 | 6.39 | 6.26 | 6.16 | 6.04 | 5.91 | 5.77 | 5.63 |
| **5** | 6.61 | 5.79 | 5.41 | 5.19 | 5.05 | 4.95 | 4.82 | 4.68 | 4.53 | 4.36 |
| **6** | 5.99 | 5.14 | 4.76 | 4.53 | 4.39 | 4.28 | 4.15 | 4.00 | 3.84 | 3.67 |
| **7** | 5.59 | 4.74 | 4.35 | 4.12 | 3.97 | 3.87 | 3.73 | 3.57 | 3.41 | 3.23 |
| **8** | 5.32 | 4.46 | 4.07 | 3.84 | 3.69 | 3.58 | 3.44 | 3.28 | 3.12 | 2.93 |
| **9** | 5.12 | 4.26 | 3.86 | 3.63 | 3.48 | 3.37 | 3.23 | 3.07 | 2.90 | 2.71 |
| **10** | 4.96 | 4.10 | 3.71 | 3.48 | 3.33 | 3.22 | 3.07 | 2.91 | 2.74 | 2.54 |
| **11** | 4.84 | 3.98 | 3.59 | 3.36 | 3.20 | 3.09 | 2.95 | 2.79 | 2.61 | 2.40 |
| **12** | 4.75 | 3.88 | 3.49 | 3.26 | 3.11 | 3.00 | 2.85 | 2.69 | 2.50 | 2.30 |
| **13** | 4.67 | 3.80 | 3.41 | 3.18 | 3.02 | 2.92 | 2.77 | 2.60 | 2.42 | 2.21 |
| **14** | 4.60 | 3.74 | 3.34 | 3.11 | 2.96 | 2.85 | 2.70 | 2.53 | 2.35 | 2.13 |
| **15** | 4.54 | 3.68 | 3.29 | 3.06 | 2.90 | 2.79 | 2.64 | 2.48 | 2.29 | 2.07 |
| **16** | 4.49 | 3.63 | 3.24 | 3.01 | 2.85 | 2.74 | 2.59 | 2.42 | 2.24 | 2.01 |
| **17** | 4.45 | 3.59 | 3.20 | 2.96 | 2.81 | 2.70 | 2.55 | 2.38 | 2.19 | 1.96 |
| **18** | 4.41 | 3.55 | 3.16 | 2.93 | 2.77 | 2.66 | 2.51 | 2.34 | 2.15 | 1.92 |
| **19** | 4.38 | 3.52 | 3.13 | 2.90 | 2.74 | 2.63 | 2.48 | 2.31 | 2.11 | 1.88 |
| **20** | 4.35 | 3.49 | 3.10 | 2.87 | 2.71 | 2.60 | 2.45 | 2.28 | 2.08 | 1.84 |
| **21** | 4.32 | 3.47 | 3.07 | 2.84 | 2.68 | 2.57 | 2.42 | 2.25 | 2.05 | 1.81 |
| **22** | 4.30 | 3.44 | 3.05 | 2.82 | 2.66 | 2.55 | 2.40 | 2.23 | 2.03 | 1.78 |
| **23** | 4.28 | 3.42 | 3.03 | 2.80 | 2.64 | 2.53 | 2.38 | 2.20 | 2.00 | 1.76 |
| **24** | 4.26 | 3.40 | 3.01 | 2.78 | 2.62 | 2.51 | 2.36 | 2.18 | 1.98 | 1.73 |
| **25** | 4.24 | 3.38 | 2.99 | 2.76 | 2.60 | 2.49 | 2.34 | 2.16 | 1.96 | 1.71 |
| **26** | 4.22 | 3.37 | 2.98 | 2.74 | 2.59 | 2.47 | 2.32 | 2.15 | 1.95 | 1.69 |
| **27** | 4.21 | 3.35 | 2.96 | 2.73 | 2.57 | 2.46 | 2.30 | 2.13 | 1.93 | 1.67 |
| **28** | 4.20 | 3.34 | 2.95 | 2.71 | 2.56 | 2.44 | 2.29 | 2.12 | 1.91 | 1.65 |
| **29** | 4.18 | 3.33 | 2.93 | 2.70 | 2.54 | 2.43 | 2.28 | 2.10 | 1.90 | 1.64 |
| **30** | 4.17 | 3.32 | 2.92 | 2.69 | 2.53 | 2.42 | 2.27 | 2.09 | 1.89 | 1.62 |
| **40** | 4.08 | 3.23 | 2.84 | 2.61 | 2.45 | 2.34 | 2.18 | 2.00 | 1.79 | 1.51 |
| **60** | 4.00 | 3.15 | 2.76 | 2.52 | 2.37 | 2.25 | 2.10 | 1.92 | 1.70 | 1.39 |
| **120** | 3.92 | 3.07 | 2.68 | 2.45 | 2.29 | 2.17 | 2.02 | 1.83 | 1.61 | 1.25 |
| **∞** | 3.84 | 2.99 | 2.60 | 2.37 | 2.21 | 2.10 | 1.94 | 1.75 | 1.52 | 1.00 |

**The F DISTRIBUTION**

**p = .01**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **N1 /N2** | **1** | **2** | **3** | **4** | **5** | **6** | **8** | **12** | **24** | **∞** |
| **1** | 4052 | 4999 | 5403 | 5625 | 5764 | 5859 | 5982 | 6106 | 6234 | 6336 |
| **2** | 98.50 | 99.00 | 99.17 | 99.25 | 99.30 | 99.33 | 99.37 | 99.42 | 99.46 | 99.50 |
| **3** | 34.12 | 30.82 | 29.46 | 28.71 | 28.24 | 27.91 | 27.49 | 27.05 | 26.46 | 26.12 |
| **4** | 21.20 | 18.00 | 16.69 | 15.98 | 15.52 | 15.21 | 14.80 | 14.37 | 13.93 | 13.46 |
| **5** | 16.26 | 13.27 | 12.06 | 11.39 | 10.97 | 10.67 | 10.29 | 9.89 | 9.47 | 9.02 |
| **6** | 13.74 | 10.92 | 9.78 | 9.15 | 8.75 | 8.47 | 8.10 | 7.72 | 7.31 | 6.88 |
| **7** | 12.25 | 9.55 | 8.45 | 7.85 | 7.46 | 7.19 | 6.84 | 6.47 | 6.07 | 5.65 |
| **8** | 11.26 | 8.65 | 7.59 | 7.01 | 6.63 | 6.37 | 6.03 | 5.67 | 5.28 | 4.86 |
| **9** | 10.56 | 8.02 | 6.99 | 6.42 | 6.06 | 5.80 | 5.47 | 5.11 | 4.73 | 4.31 |
| **10** | 10.04 | 7.56 | 6.55 | 5.99 | 5.64 | 5.39 | 5.06 | 4.71 | 4.33 | 3.91 |
| **11** | 9.65 | 7.20 | 6.22 | 5.67 | 5.32 | 5.07 | 4.74 | 4.40 | 4.02 | 3.60 |
| **12** | 9.33 | 6.93 | 5.95 | 5.41 | 5.06 | 4.82 | 4.50 | 4.16 | 3.78 | 3.36 |
| **13** | 9.07 | 6.70 | 5.74 | 5.20 | 4.86 | 4.62 | 4.30 | 3.96 | 3.59 | 3.16 |
| **14** | 8.86 | 6.51 | 5.56 | 5.03 | 4.69 | 4.46 | 4.14 | 3.80 | 3.43 | 3.00 |
| **15** | 8.68 | 6.36 | 5.42 | 4.89 | 4.56 | 4.32 | 4.00 | 3.67 | 3.29 | 2.87 |
| **16** | 8.53 | 6.23 | 5.29 | 4.77 | 4.44 | 4.20 | 3.89 | 3.55 | 3.18 | 2.75 |
| **17** | 8.40 | 6.11 | 5.18 | 4.67 | 4.34 | 4.10 | 3.79 | 3.45 | 3.08 | 2.65 |
| **18** | 8.28 | 6.01 | 5.09 | 4.58 | 4.25 | 4.01 | 3.71 | 3.37 | 3.00 | 2.57 |
| **19** | 8.18 | 5.93 | 5.01 | 4.50 | 4.17 | 3.94 | 3.63 | 3.30 | 2.92 | 2.49 |
| **20** | 8.10 | 5.85 | 4.94 | 4.43 | 4.10 | 3.87 | 3.56 | 3.23 | 2.86 | 2.42 |
| **21** | 8.02 | 5.78 | 4.87 | 4.37 | 4.04 | 3.81 | 3.51 | 3.17 | 2.80 | 2.36 |
| **22** | 7.94 | 5.72 | 4.82 | 4.31 | 3.99 | 3.76 | 3.45 | 3.12 | 2.75 | 2.31 |
| **23** | 7.88 | 5.66 | 4.76 | 4.26 | 3.94 | 3.71 | 3.41 | 3.07 | 2.70 | 2.26 |
| **24** | 7.82 | 5.61 | 4.72 | 4.22 | 3.90 | 3.67 | 3.36 | 3.03 | 2.66 | 2.21 |
| **25** | 7.77 | 5.57 | 4.68 | 4.18 | 3.86 | 3.63 | 3.32 | 2.99 | 2.62 | 2.17 |
| **26** | 7.72 | 5.53 | 4.64 | 4.14 | 3.82 | 3.59 | 3.29 | 2.96 | 2.58 | 2.13 |
| **27** | 7.68 | 5.49 | 4.60 | 4.11 | 3.78 | 3.56 | 3.26 | 2.93 | 2.55 | 2.10 |
| **28** | 7.64 | 5.45 | 4.57 | 4.07 | 3.75 | 3.53 | 3.23 | 2.90 | 2.52 | 2.06 |
| **29** | 7.60 | 5.42 | 4.54 | 4.04 | 3.73 | 3.50 | 3.20 | 2.87 | 2.49 | 2.03 |
| **30** | 7.56 | 5.39 | 4.51 | 4.02 | 3.70 | 3.47 | 3.17 | 2.84 | 2.47 | 2.01 |
| **40** | 7.31 | 5.18 | 4.31 | 3.83 | 3.51 | 3.29 | 2.99 | 2.66 | 2.29 | 1.80 |
| **60** | 7.08 | 4.98 | 4.13 | 3.65 | 3.34 | 3.12 | 2.82 | 2.50 | 2.12 | 1.60 |
| **120** | 6.85 | 4.79 | 3.95 | 3.48 | 3.17 | 2.96 | 2.66 | 2.34 | 1.95 | 1.38 |
| **∞** | 6.64 | 4.60 | 3.78 | 3.32 | 3.02 | 2.80 | 2.51 | 2.18 | 1.79 | 1.00 |

**The F DISTRIBUTION**

**p = .001**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **N1 /N2** | **1** | **2** | **3** | **4** | **5** | **6** | **8** | **12** | **24** | **∞** |
| **1** | 405284 | 500000 | 540379 | 562500 | 576405 | 585937 | 598144 | 610667 | 623497 | 636619 |
| **2** | 998.5 | 999.0 | 999.2 | 999.2 | 999.3 | 999.3 | 999.4 | 999.4 | 999.5 | 999.5 |
| **3** | 167.0 | 148.5 | 141.1 | 137.1 | 134.6 | 132.8 | 130.6 | 128.3 | 125.9 | 123.5 |
| **4** | 74.14 | 61.25 | 56.18 | 53.44 | 51.71 | 50.53 | 49.00 | 47.41 | 45.77 | 44.05 |
| **5** | 47.18 | 37.12 | 33.20 | 31.09 | 29.75 | 28.84 | 27.64 | 26.42 | 25.14 | 23.78 |
| **6** | 35.51 | 27.00 | 23.70 | 21.92 | 20.81 | 20.03 | 19.03 | 17.99 | 16.89 | 15.75 |
| **7** | 29.25 | 21.69 | 18.77 | 17.19 | 16.21 | 15.52 | 14.63 | 13.71 | 12.73 | 11.69 |
| **8** | 25.42 | 18.49 | 15.83 | 14.39 | 13.49 | 12.86 | 12.04 | 11.19 | 10.30 | 9.34 |
| **9** | 22.86 | 16.39 | 13.90 | 12.56 | 11.71 | 11.13 | 10.37 | 9.57 | 8.72 | 7.81 |
| **10** | 21.04 | 14.91 | 12.55 | 11.28 | 10.48 | 9.92 | 9.20 | 8.45 | 7.64 | 6.76 |
| **11** | 19.69 | 13.81 | 11.56 | 10.35 | 9.58 | 9.05 | 8.35 | 7.63 | 6.85 | 6.00 |
| **12** | 18.64 | 12.97 | 10.80 | 9.63 | 8.89 | 8.38 | 7.71 | 7.0 | 6.25 | 5.42 |
| **13** | 17.81 | 12.31 | 10.21 | 9.07 | 8.35 | 7.86 | 7.21 | 6.52 | 5.78 | 4.97 |
| **14** | 17.14 | 11.78 | 9.73 | 8.62 | 7.92 | 7.43 | 6.80 | 6.13 | 5.41 | 4.60 |
| **15** | 16.59 | 11.34 | 9.34 | 8.25 | 7.57 | 7.09 | 6.47 | 5.81 | 5.10 | 4.31 |
| **16** | 16.12 | 10.97 | 9.00 | 7.94 | 7.27 | 6.81 | 6.19 | 5.55 | 4.85 | 4.06 |
| **17** | 15.72 | 10.66 | 8.73 | 7.68 | 7.02 | 6.56 | 5.96 | 5.32 | 4.63 | 3.85 |
| **18** | 15.38 | 10.39 | 8.49 | 7.46 | 6.81 | 6.35 | 5.76 | 5.13 | 4.45 | 3.67 |
| **19** | 15.08 | 10.16 | 8.28 | 7.26 | 6.62 | 6.18 | 5.59 | 4.97 | 4.29 | 3.52 |
| **20** | 14.82 | 9.95 | 8.10 | 7.10 | 6.46 | 6.02 | 5.44 | 4.82 | 4.15 | 3.38 |
| **21** | 14.59 | 9.77 | 7.94 | 6.95 | 6.32 | 5.88 | 5.31 | 4.70 | 4.03 | 3.26 |
| **22** | 14.38 | 9.61 | 7.80 | 6.81 | 6.19 | 5.76 | 5.19 | 4.58 | 3.92 | 3.15 |
| **23** | 14.19 | 9.47 | 7.67 | 6.69 | 6.08 | 5.65 | 5.09 | 4.48 | 3.82 | 3.05 |
| **24** | 14.03 | 9.34 | 7.55 | 6.59 | 5.98 | 5.55 | 4.99 | 4.39 | 3.74 | 2.97 |
| **25** | 13.88 | 9.22 | 7.45 | 6.49 | 5.88 | 5.46 | 4.91 | 4.31 | 3.66 | 2.89 |
| **26** | 13.74 | 9.12 | 7.36 | 6.41 | 5.80 | 5.38 | 4.83 | 4.24 | 3.59 | 2.82 |
| **27** | 13.61 | 9.02 | 7.27 | 6.33 | 5.73 | 5.31 | 4.76 | 4.17 | 3.52 | 2.75 |
| **28** | 13.50 | 8.93 | 7.19 | 6.25 | 5.66 | 5.24 | 4.69 | 4.11 | 3.46 | 2.70 |
| **29** | 13.39 | 8.85 | 7.12 | 6.19 | 5.59 | 5.18 | 4.64 | 4.05 | 3.41 | 2.64 |
| **30** | 13.29 | 8.77 | 7.05 | 6.12 | 5.53 | 5.12 | 4.58 | 4.00 | 3.36 | 2.59 |
| **40** | 12.61 | 8.25 | 6.60 | 5.70 | 5.13 | 4.73 | 4.21 | 3.64 | 3.01 | 2.23 |
| **60** | 11.97 | 7.76 | 6.17 | 5.31 | 4.76 | 4.37 | 3.87 | 3.31 | 2.69 | 1.90 |
| **120** | 11.38 | 7.32 | 5.79 | 4.95 | 4.42 | 4.04 | 3.55 | 3.02 | 2.40 | 1.54 |
| **∞** | 10.83 | 6.91 | 5.42 | 4.62 | 4.10 | 3.74 | 3.27 | 2.74 | 2.13 | 1.00 |