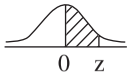
APPENDIX

# Statistical Tables

**TABLE A Normal Distribution**[a] $[P(0 \le Z \le z)$ **where** $Z \sim N(0, 1)]$

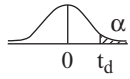



| $z$ | 0.00 | 0.01 | 0.02 | 0.03 | 0.04 | 0.05 | 0.06 | 0.07 | 0.08 | 0.09 |
|---|---|---|---|---|---|---|---|---|---|---|
| 0.0 | 0.00000 | 0.00399 | 0.00798 | 0.01197 | 0.01595 | 0.01994 | 0.02392 | 0.02790 | 0.03188 | 0.03586 |
| 0.1 | 0.03983 | 0.04380 | 0.04776 | 0.05172 | 0.05567 | 0.05962 | 0.06356 | 0.06749 | 0.07142 | 0.07535 |
| 0.2 | 0.07926 | 0.08317 | 0.08706 | 0.09095 | 0.09483 | 0.09871 | 0.10257 | 0.10642 | 0.11026 | 0.11409 |
| 0.3 | 0.11791 | 0.12172 | 0.12552 | 0.12930 | 0.13307 | 0.13683 | 0.14058 | 0.14431 | 0.14803 | 0.15173 |
| 0.4 | 0.15542 | 0.15910 | 0.16276 | 0.16640 | 0.17003 | 0.17364 | 0.17724 | 0.18082 | 0.18439 | 0.18793 |
| 0.5 | 0.19146 | 0.19497 | 0.19847 | 0.20194 | 0.20540 | 0.20884 | 0.21226 | 0.21566 | 0.21904 | 0.22240 |
| 0.6 | 0.22575 | 0.22907 | 0.23237 | 0.23565 | 0.23891 | 0.24215 | 0.24537 | 0.24857 | 0.25175 | 0.25490 |
| 0.7 | 0.25804 | 0.26115 | 0.26424 | 0.26730 | 0.27035 | 0.27337 | 0.27637 | 0.27935 | 0.28230 | 0.28524 |
| 0.8 | 0.28814 | 0.29103 | 0.29389 | 0.29673 | 0.29955 | 0.30234 | 0.30511 | 0.30785 | 0.31057 | 0.31327 |
| 0.9 | 0.31594 | 0.31859 | 0.32121 | 0.32381 | 0.32639 | 0.32894 | 0.33147 | 0.33398 | 0.33646 | 0.33891 |
| 1.0 | 0.34134 | 0.34375 | 0.34614 | 0.34849 | 0.35083 | 0.35314 | 0.35543 | 0.35769 | 0.35993 | 0.36214 |
| 1.1 | 0.36433 | 0.36650 | 0.36864 | 0.37076 | 0.37286 | 0.37493 | 0.37698 | 0.37900 | 0.38100 | 0.38298 |
| 1.2 | 0.38493 | 0.38686 | 0.38877 | 0.39065 | 0.39251 | 0.39435 | 0.39617 | 0.39796 | 0.39973 | 0.40147 |
| 1.3 | 0.40320 | 0.40490 | 0.40658 | 0.40824 | 0.40988 | 0.41149 | 0.41308 | 0.41466 | 0.41621 | 0.41774 |
| 1.4 | 0.41924 | 0.42073 | 0.42220 | 0.42364 | 0.42507 | 0.42647 | 0.42785 | 0.42922 | 0.43056 | 0.43189 |
| 1.5 | 0.43319 | 0.43448 | 0.43574 | 0.43699 | 0.43822 | 0.43943 | 0.44062 | 0.44179 | 0.44295 | 0.44408 |
| 1.6 | 0.44520 | 0.44630 | 0.44738 | 0.44845 | 0.44950 | 0.45053 | 0.45154 | 0.45254 | 0.45352 | 0.45449 |
| 1.7 | 0.45543 | 0.45637 | 0.45728 | 0.45818 | 0.45907 | 0.45994 | 0.46080 | 0.46164 | 0.46246 | 0.46327 |
| 1.8 | 0.46407 | 0.46485 | 0.46562 | 0.46638 | 0.46712 | 0.46784 | 0.46856 | 0.46926 | 0.46995 | 0.47062 |
| 1.9 | 0.47128 | 0.47193 | 0.47257 | 0.47320 | 0.47381 | 0.47441 | 0.47500 | 0.47558 | 0.47615 | 0.47670 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 2.0 | 0.47725 | 0.47778 | 0.47831 | 0.47882 | 0.47932 | 0.47982 | 0.48030 | 0.48077 | 0.48124 | 0.48169 |
| 2.1 | 0.48214 | 0.48257 | 0.48300 | 0.48341 | 0.48382 | 0.48422 | 0.48461 | 0.48500 | 0.48537 | 0.48574 |
| 2.2 | 0.48610 | 0.48645 | 0.48679 | 0.48713 | 0.48745 | 0.48778 | 0.48809 | 0.48840 | 0.48870 | 0.48899 |
| 2.3 | 0.48928 | 0.48956 | 0.48983 | 0.49010 | 0.49036 | 0.49061 | 0.49086 | 0.49111 | 0.49134 | 0.49158 |
| 2.4 | 0.49180 | 0.49202 | 0.49224 | 0.49245 | 0.49266 | 0.49286 | 0.49305 | 0.49324 | 0.49343 | 0.49361 |
| 2.5 | 0.49379 | 0.49396 | 0.49413 | 0.49430 | 0.49446 | 0.49461 | 0.49477 | 0.49492 | 0.49506 | 0.49520 |
| 2.6 | 0.49534 | 0.49547 | 0.49560 | 0.49573 | 0.49585 | 0.49598 | 0.49609 | 0.49621 | 0.49632 | 0.49643 |
| 2.7 | 0.49653 | 0.49664 | 0.49674 | 0.49683 | 0.49693 | 0.49702 | 0.49711 | 0.49720 | 0.49728 | 0.49736 |
| 2.8 | 0.49744 | 0.49752 | 0.49760 | 0.49767 | 0.49774 | 0.49781 | 0.49788 | 0.49795 | 0.49801 | 0.49807 |
| 2.9 | 0.49813 | 0.49819 | 0.49825 | 0.49831 | 0.49836 | 0.49841 | 0.49846 | 0.49851 | 0.49856 | 0.49861 |
| 3.0 | 0.49865 | 0.49869 | 0.49874 | 0.49878 | 0.49882 | 0.49886 | 0.49889 | 0.49893 | 0.49896 | 0.49900 |
| 3.1 | 0.49903 | 0.49906 | 0.49910 | 0.49913 | 0.49916 | 0.49918 | 0.49921 | 0.49924 | 0.49926 | 0.49929 |
| 3.2 | 0.49931 | 0.49934 | 0.49936 | 0.49938 | 0.49940 | 0.49942 | 0.49944 | 0.49946 | 0.49948 | 0.49950 |
| 3.3 | 0.49952 | 0.49953 | 0.49955 | 0.49957 | 0.49958 | 0.49960 | 0.49961 | 0.49962 | 0.49964 | 0.49965 |
| 3.4 | 0.49966 | 0.49968 | 0.49969 | 0.49970 | 0.49971 | 0.49972 | 0.49973 | 0.49974 | 0.49975 | 0.49976 |
| 3.5 | 0.49977 | 0.49978 | 0.49978 | 0.49979 | 0.49980 | 0.49981 | 0.49981 | 0.49982 | 0.49983 | 0.49983 |
| 3.6 | 0.49984 | 0.49985 | 0.49985 | 0.49986 | 0.49986 | 0.49987 | 0.49987 | 0.49988 | 0.49988 | 0.49989 |
| 3.7 | 0.49989 | 0.49990 | 0.49990 | 0.49990 | 0.49991 | 0.49991 | 0.49992 | 0.49992 | 0.49992 | 0.49992 |
| 3.8 | 0.49993 | 0.49993 | 0.49993 | 0.49994 | 0.49994 | 0.49994 | 0.49994 | 0.49995 | 0.49995 | 0.49995 |
| 3.9 | 0.49995 | 0.49995 | 0.49996 | 0.49996 | 0.49996 | 0.49996 | 0.49996 | 0.49996 | 0.49997 | 0.49997 |

[a] These values were generated using MINITAB.

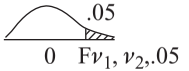
**TABLE B *t* Distribution**[a]




| d.f. ($\nu$)/$\alpha$ | 0.40 | 0.25 | 0.10 | 0.05 | 0.025 | 0.01 | 0.005 | 0.0025 | 0.001 | 0.0005 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.325 | 1.000 | 3.078 | 6.314 | 12.706 | 31.820 | 63.655 | 127.315 | 318.275 | 636.438 |
| 2 | 0.289 | 0.816 | 1.886 | 2.920 | 4.303 | 6.965 | 9.925 | 14.089 | 22.327 | 31.596 |
| 3 | 0.277 | 0.765 | 1.638 | 2.353 | 3.182 | 4.541 | 5.841 | 7.453 | 10.214 | 12.923 |
| 4 | 0.271 | 0.741 | 1.533 | 2.132 | 2.776 | 3.747 | 4.604 | 5.597 | 7.173 | 8.610 |
| 5 | 0.267 | 0.727 | 1.476 | 2.015 | 2.571 | 3.365 | 4.032 | 4.773 | 5.893 | 6.869 |
| 6 | 0.265 | 0.718 | 1.440 | 1.943 | 2.447 | 3.143 | 3.707 | 4.317 | 5.208 | 5.959 |
| 7 | 0.263 | 0.711 | 1.415 | 1.895 | 2.365 | 2.998 | 3.499 | 4.029 | 4.785 | 5.408 |
| 8 | 0.262 | 0.706 | 1.397 | 1.860 | 2.306 | 2.896 | 3.355 | 3.833 | 4.501 | 5.041 |
| 9 | 0.261 | 0.703 | 1.383 | 1.833 | 2.262 | 2.821 | 3.250 | 3.690 | 4.297 | 4.781 |
| 10 | 0.260 | 0.700 | 1.372 | 1.812 | 2.228 | 2.764 | 3.169 | 3.581 | 4.144 | 4.587 |
| 11 | 0.260 | 0.697 | 1.363 | 1.796 | 2.201 | 2.718 | 3.106 | 3.497 | 4.025 | 4.437 |
| 12 | 0.259 | 0.695 | 1.356 | 1.782 | 2.179 | 2.681 | 3.055 | 3.428 | 3.930 | 4.318 |
| 13 | 0.259 | 0.694 | 1.350 | 1.771 | 2.160 | 2.650 | 3.012 | 3.372 | 3.852 | 4.221 |
| 14 | 0.258 | 0.692 | 1.345 | 1.761 | 2.145 | 2.624 | 2.977 | 3.326 | 3.787 | 4.140 |
| 15 | 0.258 | 0.691 | 1.341 | 1.753 | 2.131 | 2.602 | 2.947 | 3.286 | 3.733 | 4.073 |
| 16 | 0.258 | 0.690 | 1.337 | 1.746 | 2.120 | 2.583 | 2.921 | 3.252 | 3.686 | 4.015 |
| 17 | 0.257 | 0.689 | 1.333 | 1.740 | 2.110 | 2.567 | 2.898 | 3.222 | 3.646 | 3.965 |
| 18 | 0.257 | 0.688 | 1.330 | 1.734 | 2.101 | 2.552 | 2.878 | 3.197 | 3.610 | 3.922 |
| 19 | 0.257 | 0.688 | 1.328 | 1.729 | 2.093 | 2.539 | 2.861 | 3.174 | 3.579 | 3.883 |
| 20 | 0.257 | 0.687 | 1.325 | 1.725 | 2.086 | 2.528 | 2.845 | 3.153 | 3.552 | 3.849 |
| 21 | 0.257 | 0.686 | 1.323 | 1.721 | 2.080 | 2.518 | 2.831 | 3.135 | 3.527 | 3.819 |
| 22 | 0.256 | 0.686 | 1.321 | 1.717 | 2.074 | 2.508 | 2.819 | 3.119 | 3.505 | 3.792 |
| 23 | 0.256 | 0.685 | 1.319 | 1.714 | 2.069 | 2.500 | 2.807 | 3.104 | 3.485 | 3.768 |
| 24 | 0.256 | 0.685 | 1.318 | 1.711 | 2.064 | 2.492 | 2.797 | 3.091 | 3.467 | 3.745 |
| 25 | 0.256 | 0.684 | 1.316 | 1.708 | 2.060 | 2.485 | 2.787 | 3.078 | 3.450 | 3.725 |
| 26 | 0.256 | 0.684 | 1.315 | 1.706 | 2.056 | 2.479 | 2.779 | 3.067 | 3.435 | 3.707 |
| 27 | 0.256 | 0.684 | 1.314 | 1.703 | 2.052 | 2.473 | 2.771 | 3.057 | 3.421 | 3.690 |
| 28 | 0.256 | 0.683 | 1.313 | 1.701 | 2.048 | 2.467 | 2.763 | 3.047 | 3.408 | 3.674 |
| 29 | 0.256 | 0.683 | 1.311 | 1.699 | 2.045 | 2.462 | 2.756 | 3.038 | 3.396 | 3.659 |
| 30 | 0.256 | 0.683 | 1.310 | 1.697 | 2.042 | 2.457 | 2.750 | 3.030 | 3.385 | 3.646 |
| 40 | 0.255 | 0.681 | 1.303 | 1.684 | 2.021 | 2.423 | 2.704 | 2.971 | 3.307 | 3.551 |
| 60 | 0.254 | 0.679 | 1.296 | 1.671 | 2.000 | 2.390 | 2.660 | 2.915 | 3.232 | 3.460 |
| 100 | 0.254 | 0.677 | 1.290 | 1.660 | 1.984 | 2.364 | 2.626 | 2.871 | 3.174 | 3.391 |
| Infinity | 0.253 | 0.674 | 1.282 | 1.645 | 1.960 | 2.326 | 2.576 | 2.807 | 3.090 | 3.290 |

[a] These values were generated using MINITAB.

**TABLE C** ***F* Distribution**[a,b]




| $\nu_1$ | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | $a.\ F_{\nu_1,\nu_2},\ .05$ | | | | | | | | |
| $\nu_2$ | 1 | 161.44 | 199.50 | 215.69 | 224.57 | 230.16 | 233.98 | 236.78 | 238.89 | 240.55 | 241.89 | 242.97 | 243.91 | 244.67 | 245.35 | 245.97 |
| | 2 | 18.51 | 19.00 | 19.16 | 19.25 | 19.30 | 19.33 | 19.35 | 19.37 | 19.39 | 19.40 | 19.40 | 19.41 | 19.42 | 19.42 | 19.43 |
| | 3 | 10.13 | 9.55 | 9.28 | 9.12 | 9.01 | 8.94 | 8.89 | 8.85 | 8.81 | 8.79 | 8.76 | 8.74 | 8.73 | 8.71 | 8.70 |
| | 4 | 7.71 | 6.94 | 6.59 | 6.39 | 6.26 | 6.16 | 6.09 | 6.04 | 6.00 | 5.96 | 5.94 | 5.91 | 5.89 | 5.87 | 5.86 |
| | 5 | 6.61 | 5.79 | 5.41 | 5.19 | 5.05 | 4.95 | 4.88 | 4.82 | 4.77 | 4.74 | 4.70 | 4.68 | 4.66 | 4.64 | 4.62 |
| | 6 | 5.99 | 5.14 | 4.76 | 4.53 | 4.39 | 4.28 | 4.21 | 4.15 | 4.10 | 4.06 | 4.03 | 4.00 | 3.98 | 3.96 | 3.94 |
| | 7 | 5.59 | 4.74 | 4.35 | 4.12 | 3.97 | 3.87 | 3.79 | 3.73 | 3.68 | 3.64 | 3.60 | 3.57 | 3.55 | 3.53 | 3.51 |
| | 8 | 5.32 | 4.46 | 4.07 | 3.84 | 3.69 | 3.58 | 3.50 | 3.44 | 3.39 | 3.35 | 3.31 | 3.28 | 3.26 | 3.24 | 3.22 |
| | 9 | 5.12 | 4.26 | 3.86 | 3.63 | 3.48 | 3.37 | 3.29 | 3.23 | 3.18 | 3.14 | 3.10 | 3.07 | 3.05 | 3.03 | 3.01 |
| | 10 | 4.96 | 4.10 | 3.71 | 3.48 | 3.33 | 3.22 | 3.14 | 3.07 | 3.02 | 2.98 | 2.94 | 2.91 | 2.89 | 2.86 | 2.85 |
| | 11 | 4.84 | 3.98 | 3.59 | 3.36 | 3.20 | 3.09 | 3.01 | 2.95 | 2.90 | 2.85 | 2.82 | 2.79 | 2.76 | 2.74 | 2.72 |
| | 12 | 4.75 | 3.89 | 3.49 | 3.26 | 3.11 | 3.00 | 2.91 | 2.85 | 2.80 | 2.75 | 2.72 | 2.69 | 2.66 | 2.64 | 2.62 |
| | 13 | 4.67 | 3.81 | 3.41 | 3.18 | 3.03 | 2.92 | 2.83 | 2.77 | 2.71 | 2.67 | 2.63 | 2.60 | 2.58 | 2.55 | 2.53 |
| | 14 | 4.60 | 3.74 | 3.34 | 3.11 | 2.96 | 2.85 | 2.76 | 2.70 | 2.65 | 2.60 | 2.57 | 2.53 | 2.51 | 2.48 | 2.46 |
| | 15 | 4.54 | 3.68 | 3.29 | 3.06 | 2.90 | 2.79 | 2.71 | 2.64 | 2.59 | 2.54 | 2.51 | 2.48 | 2.45 | 2.42 | 2.40 |
| | 16 | 4.49 | 3.63 | 3.24 | 3.01 | 2.85 | 2.74 | 2.66 | 2.59 | 2.54 | 2.49 | 2.46 | 2.42 | 2.40 | 2.37 | 2.35 |
| | 17 | 4.45 | 3.59 | 3.20 | 2.96 | 2.81 | 2.70 | 2.61 | 2.55 | 2.49 | 2.45 | 2.41 | 2.38 | 2.35 | 2.33 | 2.31 |
| | 18 | 4.41 | 3.55 | 3.16 | 2.93 | 2.77 | 2.66 | 2.58 | 2.51 | 2.46 | 2.41 | 2.37 | 2.34 | 2.31 | 2.29 | 2.27 |
| | 19 | 4.38 | 3.52 | 3.13 | 2.90 | 2.74 | 2.63 | 2.54 | 2.48 | 2.42 | 2.38 | 2.34 | 2.31 | 2.28 | 2.26 | 2.23 |
| | 20 | 4.35 | 3.49 | 3.10 | 2.87 | 2.71 | 2.60 | 2.51 | 2.45 | 2.39 | 2.35 | 2.31 | 2.28 | 2.25 | 2.22 | 2.20 |
| | 21 | 4.32 | 3.47 | 3.07 | 2.84 | 2.68 | 2.57 | 2.49 | 2.42 | 2.37 | 2.32 | 2.28 | 2.25 | 2.22 | 2.20 | 2.18 |
| | 22 | 4.30 | 3.44 | 3.05 | 2.82 | 2.66 | 2.55 | 2.46 | 2.40 | 2.34 | 2.30 | 2.26 | 2.23 | 2.20 | 2.17 | 2.15 |
| | 23 | 4.28 | 3.42 | 3.03 | 2.80 | 2.64 | 2.53 | 2.44 | 2.37 | 2.32 | 2.27 | 2.24 | 2.20 | 2.18 | 2.15 | 2.13 |
| | 24 | 4.26 | 3.40 | 3.01 | 2.78 | 2.62 | 2.51 | 2.42 | 2.36 | 2.30 | 2.25 | 2.22 | 2.18 | 2.15 | 2.13 | 2.11 |

**TABLE C** ***F*** **Distribution** (*Continued*)

| $\nu_1$ | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 25 | 4.24 | 3.39 | 2.99 | 2.76 | 2.60 | 2.49 | 2.40 | 2.34 | 2.28 | 2.24 | 2.20 | 2.16 | 2.14 | 2.11 | 2.09 |
| | 26 | 4.23 | 3.37 | 2.98 | 2.74 | 2.59 | 2.47 | 2.39 | 2.32 | 2.27 | 2.22 | 2.18 | 2.15 | 2.12 | 2.09 | 2.07 |
| | 27 | 4.21 | 3.35 | 2.96 | 2.73 | 2.57 | 2.46 | 2.37 | 2.31 | 2.25 | 2.20 | 2.17 | 2.13 | 2.10 | 2.08 | 2.06 |
| | 28 | 4.20 | 3.34 | 2.95 | 2.71 | 2.56 | 2.45 | 2.36 | 2.29 | 2.24 | 2.19 | 2.15 | 2.12 | 2.09 | 2.06 | 2.04 |
| | 29 | 4.18 | 3.33 | 2.93 | 2.70 | 2.55 | 2.43 | 2.35 | 2.28 | 2.22 | 2.18 | 2.14 | 2.10 | 2.08 | 2.05 | 2.03 |
| | 30 | 4.17 | 3.32 | 2.92 | 2.69 | 2.53 | 2.42 | 2.33 | 2.27 | 2.21 | 2.16 | 2.13 | 2.09 | 2.06 | 2.04 | 2.01 |
| | 40 | 4.08 | 3.23 | 2.84 | 2.61 | 2.45 | 2.34 | 2.25 | 2.18 | 2.12 | 2.08 | 2.04 | 2.00 | 1.97 | 1.95 | 1.92 |
| | | | | | | | | *b*. $F_{\nu_1,\nu_2}$, .0.01 | | | | | | | | |
| $\nu_2$ | 1 | 4052.45 | 4999.42 | 5402.96 | 5624.03 | 5763.93 | 5858.82 | 5928.73 | 5981.06 | 6021.73 | 6055.29 | 6083.22 | 6106.00 | 6125.37 | 6142.48 | 6157.06 |
| | 2 | 98.51 | 99.00 | 99.17 | 99.25 | 99.30 | 99.33 | 99.35 | 99.38 | 99.39 | 99.40 | 99.41 | 99.41 | 99.42 | 99.42 | 99.43 |
| | 3 | 34.12 | 30.82 | 29.46 | 28.71 | 28.24 | 27.91 | 27.67 | 27.49 | 27.35 | 27.23 | 27.13 | 27.05 | 26.98 | 26.92 | 26.87 |
| | 4 | 21.20 | 18.00 | 16.69 | 15.98 | 15.52 | 15.21 | 14.98 | 14.80 | 14.66 | 14.55 | 14.45 | 14.37 | 14.31 | 14.25 | 14.20 |
| | 5 | 16.26 | 13.27 | 12.06 | 11.39 | 10.97 | 10.67 | 10.46 | 10.29 | 10.16 | 10.05 | 9.96 | 9.89 | 9.82 | 9.77 | 9.72 |
| | 6 | 13.74 | 10.92 | 9.78 | 9.15 | 8.75 | 8.47 | 8.26 | 8.10 | 7.98 | 7.87 | 7.79 | 7.72 | 7.66 | 7.60 | 7.56 |
| | 7 | 12.25 | 9.55 | 8.45 | 7.85 | 7.46 | 7.19 | 6.99 | 6.84 | 6.72 | 6.62 | 6.54 | 6.47 | 6.41 | 6.36 | 6.31 |
| | 8 | 11.26 | 8.65 | 7.59 | 7.01 | 6.63 | 6.37 | 6.18 | 6.03 | 5.91 | 5.81 | 5.73 | 5.67 | 5.61 | 5.56 | 5.52 |
| | 9 | 10.56 | 8.02 | 6.99 | 6.42 | 6.06 | 5.80 | 5.61 | 5.47 | 5.35 | 5.26 | 5.18 | 5.11 | 5.05 | 5.01 | 4.96 |
| | 10 | 10.04 | 7.56 | 6.55 | 5.99 | 5.64 | 5.39 | 5.20 | 5.06 | 4.94 | 4.85 | 4.77 | 4.71 | 4.65 | 4.60 | 4.56 |
| | 11 | 9.65 | 7.21 | 6.22 | 5.67 | 5.32 | 5.07 | 4.89 | 4.74 | 4.63 | 4.54 | 4.46 | 4.40 | 4.34 | 4.29 | 4.25 |
| | 12 | 9.33 | 6.93 | 5.95 | 5.41 | 5.06 | 4.82 | 4.64 | 4.50 | 4.39 | 4.30 | 4.22 | 4.16 | 4.10 | 4.05 | 4.01 |
| | 13 | 9.07 | 6.70 | 5.74 | 5.21 | 4.86 | 4.62 | 4.44 | 4.30 | 4.19 | 4.10 | 4.02 | 3.96 | 3.91 | 3.86 | 3.82 |
| | 14 | 8.86 | 6.51 | 5.56 | 5.04 | 4.69 | 4.46 | 4.28 | 4.14 | 4.03 | 3.94 | 3.86 | 3.80 | 3.75 | 3.70 | 3.66 |
| | 15 | 8.68 | 6.36 | 5.42 | 4.89 | 4.56 | 4.32 | 4.14 | 4.00 | 3.89 | 3.80 | 3.73 | 3.67 | 3.61 | 3.56 | 3.52 |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 16 | 8.53 | 6.23 | 5.29 | 4.77 | 4.44 | 4.20 | 4.03 | 3.89 | 3.78 | 3.69 | 3.62 | 3.55 | 3.50 | 3.45 | 3.41 |
| 17 | 8.40 | 6.11 | 5.18 | 4.67 | 4.34 | 4.10 | 3.93 | 3.79 | 3.68 | 3.59 | 3.52 | 3.46 | 3.40 | 3.35 | 3.31 |
| 18 | 8.29 | 6.01 | 5.09 | 4.58 | 4.25 | 4.01 | 3.84 | 3.71 | 3.60 | 3.51 | 3.43 | 3.37 | 3.32 | 3.27 | 3.23 |
| 19 | 8.18 | 5.93 | 5.01 | 4.50 | 4.17 | 3.94 | 3.77 | 3.63 | 3.52 | 3.43 | 3.36 | 3.30 | 3.24 | 3.19 | 3.15 |
| 20 | 8.10 | 5.85 | 4.94 | 4.43 | 4.10 | 3.87 | 3.70 | 3.56 | 3.46 | 3.37 | 3.29 | 3.23 | 3.18 | 3.13 | 3.09 |
| 21 | 8.02 | 5.78 | 4.87 | 4.37 | 4.04 | 3.81 | 3.64 | 3.51 | 3.40 | 3.31 | 3.24 | 3.17 | 3.12 | 3.07 | 3.03 |
| 22 | 7.95 | 5.72 | 4.82 | 4.31 | 3.99 | 3.76 | 3.59 | 3.45 | 3.35 | 3.26 | 3.18 | 3.12 | 3.07 | 3.02 | 2.98 |
| 23 | 7.88 | 5.66 | 4.76 | 4.26 | 3.94 | 3.71 | 3.54 | 3.41 | 3.30 | 3.21 | 3.14 | 3.07 | 3.02 | 2.97 | 2.93 |
| 24 | 7.82 | 5.61 | 4.72 | 4.22 | 3.90 | 3.67 | 3.50 | 3.36 | 3.26 | 3.17 | 3.09 | 3.03 | 2.98 | 2.93 | 2.89 |
| 25 | 7.77 | 5.57 | 4.68 | 4.18 | 3.85 | 3.63 | 3.46 | 3.32 | 3.22 | 3.13 | 3.06 | 2.99 | 2.94 | 2.89 | 2.85 |
| 26 | 7.72 | 5.53 | 4.64 | 4.14 | 3.82 | 3.59 | 3.42 | 3.29 | 3.18 | 3.09 | 3.02 | 2.96 | 2.90 | 2.86 | 2.81 |
| 27 | 7.68 | 5.49 | 4.60 | 4.11 | 3.78 | 3.56 | 3.39 | 3.26 | 3.15 | 3.06 | 2.99 | 2.93 | 2.87 | 2.82 | 2.78 |
| 28 | 7.64 | 5.45 | 4.57 | 4.07 | 3.75 | 3.53 | 3.36 | 3.23 | 3.12 | 3.03 | 2.96 | 2.90 | 2.84 | 2.79 | 2.75 |
| 29 | 7.60 | 5.42 | 4.54 | 4.04 | 3.73 | 3.50 | 3.33 | 3.20 | 3.09 | 3.00 | 2.93 | 2.87 | 2.81 | 2.77 | 2.73 |
| 30 | 7.56 | 5.39 | 4.51 | 4.02 | 3.70 | 3.47 | 3.30 | 3.17 | 3.07 | 2.98 | 2.91 | 2.84 | 2.79 | 2.74 | 2.70 |
| 40 | 7.31 | 5.18 | 4.31 | 3.83 | 3.51 | 3.29 | 3.12 | 2.99 | 2.89 | 2.80 | 2.73 | 2.66 | 2.61 | 2.56 | 2.52 |

[a] These values were generated using MINITAB.

[b] $\nu_2$ = degrees of freedom for the denominator; $\nu_1$ = degrees of freedom for the numerator.

**TABLE D Analysis of Means Constants**[a]

| | Number of Means, $k$ | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| d.f.[b]($v$) | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| | | | | | | | | | $a.\ h_{0.05}$ | | | | | | | | | |
| 3 | 4.18 | | | | | | | | | | | | | | | | | |
| 4 | 3.56 | 3.89 | | | | | | | | | | | | | | | | |
| 5 | 3.25 | 3.53 | 3.72 | | | | | | | | | | | | | | | |
| 6 | 3.07 | 3.31 | 3.49 | 3.62 | | | | | | | | | | | | | | |
| 7 | 2.94 | 3.17 | 3.33 | 3.45 | 3.56 | | | | | | | | | | | | | |
| 8 | 2.86 | 3.07 | 3.21 | 3.33 | 3.43 | 3.51 | | | | | | | | | | | | |
| 9 | 2.79 | 2.99 | 3.13 | 3.24 | 3.33 | 3.41 | 3.48 | | | | | | | | | | | |
| 10 | 2.74 | 2.93 | 3.07 | 3.17 | 3.26 | 3.33 | 3.40 | 3.45 | | | | | | | | | | |
| 11 | 2.70 | 2.88 | 3.01 | 3.12 | 3.20 | 3.27 | 3.33 | 3.39 | 3.44 | | | | | | | | | |
| 12 | 2.67 | 2.85 | 2.97 | 3.07 | 3.15 | 3.22 | 3.28 | 3.33 | 3.38 | 3.42 | | | | | | | | |
| 13 | 2.64 | 2.81 | 2.94 | 3.03 | 3.11 | 3.18 | 3.24 | 3.29 | 3.34 | 3.38 | 3.42 | | | | | | | |
| 14 | 2.62 | 2.79 | 2.91 | 3.00 | 3.08 | 3.14 | 3.20 | 3.25 | 3.30 | 3.34 | 3.37 | 3.41 | | | | | | |
| 15 | 2.60 | 2.76 | 2.88 | 2.97 | 3.05 | 3.11 | 3.17 | 3.22 | 3.26 | 3.30 | 3.34 | 3.37 | 3.40 | | | | | |
| 16 | 2.58 | 2.74 | 2.86 | 2.95 | 3.02 | 3.09 | 3.14 | 3.19 | 3.23 | 3.27 | 3.31 | 3.34 | 3.37 | 3.40 | | | | |
| 17 | 2.57 | 2.73 | 2.84 | 2.93 | 3.00 | 3.06 | 3.12 | 3.16 | 3.21 | 3.25 | 3.28 | 3.31 | 3.34 | 3.37 | 3.40 | | | |
| 18 | 2.55 | 2.71 | 2.82 | 2.91 | 2.98 | 3.04 | 3.10 | 3.14 | 3.18 | 3.22 | 3.26 | 3.29 | 3.32 | 3.35 | 3.37 | 3.40 | | |
| 19 | 2.54 | 2.70 | 2.81 | 2.89 | 2.96 | 3.02 | 3.08 | 3.12 | 3.16 | 3.20 | 3.24 | 3.27 | 3.30 | 3.32 | 3.35 | 3.37 | 3.40 | |
| 20 | 2.53 | 2.68 | 2.79 | 2.88 | 2.95 | 3.01 | 3.06 | 3.11 | 3.15 | 3.18 | 3.22 | 3.25 | 3.28 | 3.30 | 3.33 | 3.35 | 3.37 | 3.40 |
| 24 | 2.50 | 2.65 | 2.75 | 2.83 | 2.90 | 2.96 | 3.01 | 3.05 | 3.09 | 3.13 | 3.16 | 3.19 | 3.22 | 3.24 | 3.27 | 3.29 | 3.31 | 3.33 |
| 30 | 2.47 | 2.61 | 2.71 | 2.79 | 2.85 | 2.91 | 2.96 | 3.00 | 3.04 | 3.07 | 3.10 | 3.13 | 3.16 | 3.18 | 3.20 | 3.22 | 3.25 | 3.27 |
| 40 | 2.43 | 2.57 | 2.67 | 2.75 | 2.81 | 2.86 | 2.91 | 2.95 | 2.98 | 3.01 | 3.04 | 3.07 | 3.10 | 3.12 | 3.14 | 3.16 | 3.18 | 3.20 |
| 60 | 2.40 | 2.54 | 2.63 | 2.70 | 2.76 | 2.81 | 2.86 | 2.90 | 2.93 | 2.96 | 2.99 | 3.02 | 3.04 | 3.06 | 3.08 | 3.10 | 3.12 | 3.14 |
| 120 | 2.37 | 2.50 | 2.59 | 2.66 | 2.72 | 2.77 | 2.81 | 2.84 | 2.88 | 2.91 | 2.93 | 2.96 | 2.98 | 3.00 | 3.02 | 3.04 | 3.06 | 3.08 |
| Infinity | 2.34 | 2.47 | 2.56 | 2.62 | 2.68 | 2.72 | 2.76 | 2.80 | 2.83 | 2.86 | 2.88 | 2.90 | 2.93 | 2.95 | 2.97 | 2.98 | 3.00 | 3.02 |

(*cont.*)

*b.* $h_{0.01}$

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | 7.51 | | | | | | | | | | | | | | | | | |
| 4 | 5.74 | 6.21 | | | | | | | | | | | | | | | | |
| 5 | 4.93 | 5.29 | 5.55 | | | | | | | | | | | | | | | |
| 6 | 4.48 | 4.77 | 4.98 | 5.16 | | | | | | | | | | | | | | |
| 7 | 4.18 | 4.44 | 4.63 | 4.78 | 4.90 | | | | | | | | | | | | | |
| 8 | 3.98 | 4.21 | 4.38 | 4.52 | 4.63 | 4.72 | | | | | | | | | | | | |
| 9 | 3.84 | 4.05 | 4.20 | 4.33 | 4.43 | 4.51 | 4.59 | | | | | | | | | | | |
| 10 | 3.73 | 3.92 | 4.07 | 4.18 | 4.28 | 4.36 | 4.43 | 4.49 | | | | | | | | | | |
| 11 | 3.64 | 3.82 | 3.96 | 4.07 | 4.16 | 4.23 | 4.30 | 4.36 | 4.41 | | | | | | | | | |
| 12 | 3.57 | 3.74 | 3.87 | 3.98 | 4.06 | 4.13 | 4.20 | 4.25 | 4.31 | 4.35 | | | | | | | | |
| 13 | 3.51 | 3.68 | 3.80 | 3.90 | 3.98 | 4.05 | 4.11 | 4.17 | 4.22 | 4.26 | 4.30 | | | | | | | |
| 14 | 3.46 | 3.63 | 3.74 | 3.84 | 3.92 | 3.98 | 4.04 | 4.09 | 4.14 | 4.18 | 4.22 | 4.26 | | | | | | |
| 15 | 3.42 | 3.58 | 3.69 | 3.79 | 3.86 | 3.92 | 3.98 | 4.03 | 4.08 | 4.12 | 4.16 | 4.19 | 4.22 | | | | | |
| 16 | 3.38 | 3.54 | 3.65 | 3.74 | 3.81 | 3.87 | 3.93 | 3.98 | 4.02 | 4.06 | 4.10 | 4.14 | 4.17 | 4.20 | | | | |
| 17 | 3.35 | 3.50 | 3.61 | 3.70 | 3.77 | 3.83 | 3.89 | 3.93 | 3.98 | 4.02 | 4.05 | 4.09 | 4.12 | 4.14 | 4.17 | | | |
| 18 | 3.33 | 3.47 | 3.58 | 3.66 | 3.73 | 3.79 | 3.85 | 3.89 | 3.94 | 3.97 | 4.01 | 4.04 | 4.07 | 4.10 | 4.12 | 4.15 | | |
| 19 | 3.30 | 3.45 | 3.55 | 3.63 | 3.70 | 3.76 | 3.81 | 3.86 | 3.90 | 3.94 | 3.97 | 4.00 | 4.03 | 4.06 | 4.08 | 4.11 | 4.13 | |
| 20 | 3.28 | 3.42 | 3.53 | 3.61 | 3.67 | 3.73 | 3.78 | 3.83 | 3.87 | 3.90 | 3.94 | 3.97 | 4.00 | 4.02 | 4.05 | 4.07 | 4.09 | 4.12 |
| 24 | 3.21 | 3.35 | 3.45 | 3.52 | 3.58 | 3.64 | 3.69 | 3.73 | 3.77 | 3.80 | 3.83 | 3.86 | 3.89 | 3.91 | 3.94 | 3.96 | 3.98 | 4.00 |
| 30 | 3.15 | 3.28 | 3.37 | 3.44 | 3.50 | 3.55 | 3.59 | 3.63 | 3.67 | 3.70 | 3.73 | 3.76 | 3.78 | 3.81 | 3.83 | 3.85 | 3.87 | 3.89 |
| 40 | 3.09 | 3.21 | 3.29 | 3.36 | 3.42 | 3.46 | 3.50 | 3.54 | 3.58 | 3.60 | 3.63 | 3.66 | 3.68 | 3.70 | 3.72 | 3.74 | 3.76 | 3.78 |
| 60 | 3.03 | 3.14 | 3.22 | 3.29 | 3.34 | 3.38 | 3.42 | 3.46 | 3.49 | 3.51 | 3.54 | 3.56 | 3.59 | 3.61 | 3.63 | 3.64 | 3.66 | 3.68 |
| 120 | 2.97 | 3.07 | 3.15 | 3.21 | 3.26 | 3.30 | 3.34 | 3.37 | 3.40 | 3.42 | 3.45 | 3.47 | 3.49 | 3.51 | 3.55 | 3.55 | 3.56 | 3.58 |
| Infinity | 2.91 | 3.01 | 3.08 | 3.14 | 3.18 | 3.22 | 3.26 | 3.29 | 3.32 | 3.34 | 3.36 | 3.38 | 3.40 | 3.42 | 3.44 | 3.45 | 3.47 | 3.48 |

[a] From Tables 2 and 3 of L. S. Nelson, Exact critical values for use with the analysis of means. *Journal of Quality Technology*, **15**(1), January 1983. Reprinted with permission from *Journal of Quality Technology* © 1983 American Society for Quality.

[b] Degrees of freedom for $s$.