

APPENDIX C

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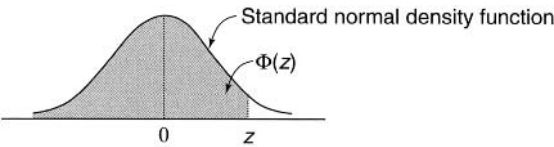
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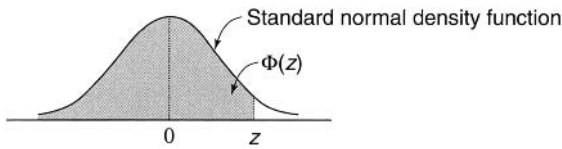
Table C.10. Critical Constants $c_\alpha(m-1, a-1, N-a)$ for Wilks' Λ Statistic for the Test of No Treatment \times Time Interaction

Table C.1 Standard Normal c.d.f. $\Phi(z) = P(Z \leq z)$



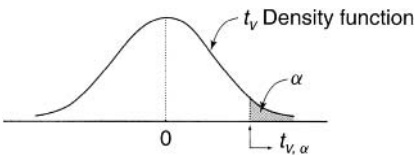
| <i>z</i> | 0.00 | 0.01 | 0.02 | 0.03 | 0.04 | 0.05 | 0.06 | 0.07 | 0.08 | 0.09 |
|----------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| −3.4 | 0.0003 | 0.0003 | 0.0003 | 0.0003 | 0.0003 | 0.0003 | 0.0003 | 0.0003 | 0.0003 | 0.0002 |
| −3.3 | 0.0005 | 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 | 0.0017 | 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 | 0.0352 | 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 | 0.0394 | 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 | 0.0722 | 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 C.1 Standard Normal c.d.f. $\Phi(z) = P(Z \leq z)$ (Continued)



| z | 0.00 | 0.01 | 0.02 | 0.03 | 0.04 | 0.05 | 0.06 | 0.07 | 0.08 | 0.09 |
|-----|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 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 | 0.9278 | 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 |

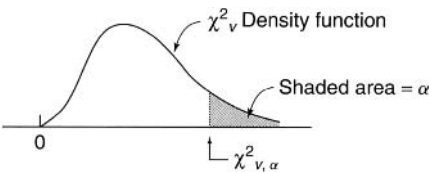
Table C.2 Critical Values $t_{\nu,\alpha}$ for the t -Distribution



| ν | α | | | | | | |
|----------|----------|-------|--------|--------|--------|--------|--------|
| | .10 | .05 | .025 | .01 | .005 | .001 | .0005 |
| 1 | 3.078 | 6.314 | 12.706 | 31.821 | 63.657 | 318.31 | 636.62 |
| 2 | 1.886 | 2.920 | 4.303 | 6.965 | 9.925 | 22.326 | 31.598 |
| 3 | 1.638 | 2.353 | 3.182 | 4.541 | 5.841 | 10.213 | 12.924 |
| 4 | 1.533 | 2.132 | 2.776 | 3.747 | 4.604 | 7.173 | 8.610 |
| 5 | 1.476 | 2.015 | 2.571 | 3.365 | 4.032 | 5.893 | 6.869 |
| 6 | 1.440 | 1.943 | 2.447 | 3.143 | 3.707 | 5.208 | 5.959 |
| 7 | 1.415 | 1.895 | 2.365 | 2.998 | 3.499 | 4.785 | 5.408 |
| 8 | 1.397 | 1.860 | 2.306 | 2.896 | 3.355 | 4.501 | 5.041 |
| 9 | 1.383 | 1.833 | 2.262 | 2.821 | 3.250 | 4.297 | 4.781 |
| 10 | 1.372 | 1.812 | 2.228 | 2.764 | 3.169 | 4.144 | 4.587 |
| 11 | 1.363 | 1.796 | 2.201 | 2.718 | 3.106 | 4.025 | 4.437 |
| 12 | 1.356 | 1.782 | 2.179 | 2.681 | 3.055 | 3.930 | 4.318 |
| 13 | 1.350 | 1.771 | 2.160 | 2.650 | 3.012 | 3.852 | 4.221 |
| 14 | 1.345 | 1.761 | 2.145 | 2.624 | 2.977 | 3.787 | 4.140 |
| 15 | 1.341 | 1.753 | 2.131 | 2.602 | 2.947 | 3.733 | 4.073 |
| 16 | 1.337 | 1.746 | 2.120 | 2.583 | 2.921 | 3.686 | 4.015 |
| 17 | 1.333 | 1.740 | 2.110 | 2.567 | 2.898 | 3.646 | 3.965 |
| 18 | 1.330 | 1.734 | 2.101 | 2.552 | 2.878 | 3.610 | 3.922 |
| 19 | 1.328 | 1.729 | 2.093 | 2.539 | 2.861 | 3.579 | 3.883 |
| 20 | 1.325 | 1.725 | 2.086 | 2.528 | 2.845 | 3.552 | 3.850 |
| 21 | 1.323 | 1.721 | 2.080 | 2.518 | 2.831 | 3.527 | 3.819 |
| 22 | 1.321 | 1.717 | 2.074 | 2.508 | 2.819 | 3.505 | 3.792 |
| 23 | 1.319 | 1.714 | 2.069 | 2.500 | 2.807 | 3.485 | 3.767 |
| 24 | 1.318 | 1.711 | 2.064 | 2.492 | 2.797 | 3.467 | 3.745 |
| 25 | 1.316 | 1.708 | 2.060 | 2.485 | 2.787 | 3.450 | 3.725 |
| 26 | 1.315 | 1.706 | 2.056 | 2.479 | 2.779 | 3.435 | 3.707 |
| 27 | 1.314 | 1.703 | 2.052 | 2.473 | 2.771 | 3.421 | 3.690 |
| 28 | 1.313 | 1.701 | 2.048 | 2.467 | 2.763 | 3.408 | 3.674 |
| 29 | 1.311 | 1.699 | 2.045 | 2.462 | 2.756 | 3.396 | 3.659 |
| 30 | 1.310 | 1.697 | 2.042 | 2.457 | 2.750 | 3.385 | 3.646 |
| 40 | 1.303 | 1.684 | 2.021 | 2.423 | 2.704 | 3.307 | 3.551 |
| 60 | 1.296 | 1.671 | 2.000 | 2.390 | 2.660 | 3.232 | 3.460 |
| 120 | 1.289 | 1.658 | 1.980 | 2.358 | 2.617 | 3.160 | 3.373 |
| ∞ | 1.282 | 1.645 | 1.960 | 2.326 | 2.576 | 3.090 | 3.291 |

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Table C.3 Critical Values $\chi^2_{v,\alpha}$ for Chi-Square Distribution

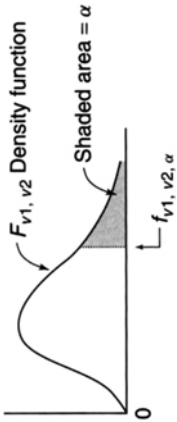


| ν | α | | | | | | | | | |
|-----------------|----------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| | .995 | .99 | .975 | .95 | .90 | .10 | .05 | .025 | .01 | .005 |
| 1 | 0.000 | 0.000 | 0.001 | 0.004 | 0.016 | 2.706 | 3.843 | 5.025 | 6.637 | 7.882 |
| 2 | 0.010 | 0.020 | 0.051 | 0.103 | 0.211 | 4.605 | 5.992 | 7.378 | 9.210 | 10.597 |
| 3 | 0.072 | 0.115 | 0.216 | 0.352 | 0.584 | 6.251 | 7.815 | 9.348 | 11.344 | 12.837 |
| 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 | 15.085 | 16.748 |
| 6 | 0.676 | 0.872 | 1.237 | 1.635 | 2.204 | 10.645 | 12.592 | 14.440 | 16.812 | 18.548 |
| 7 | 0.989 | 1.239 | 1.690 | 2.167 | 2.833 | 12.017 | 14.067 | 16.012 | 18.474 | 20.276 |
| 8 | 1.344 | 1.646 | 2.180 | 2.733 | 3.490 | 13.362 | 15.507 | 17.534 | 20.090 | 21.954 |
| 9 | 1.735 | 2.088 | 2.700 | 3.325 | 4.168 | 14.684 | 16.919 | 19.022 | 21.665 | 23.587 |
| 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 | 5.578 | 17.275 | 19.675 | 21.920 | 24.724 | 26.755 |
| 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 | 7.041 | 19.812 | 22.362 | 24.735 | 27.687 | 29.817 |
| 14 | 4.075 | 4.660 | 5.629 | 6.571 | 7.790 | 21.064 | 23.685 | 26.119 | 29.141 | 31.319 |
| 15 | 4.600 | 5.229 | 6.262 | 7.261 | 8.547 | 22.307 | 24.996 | 27.488 | 30.577 | 32.799 |
| 16 | 5.142 | 5.812 | 6.908 | 7.962 | 9.312 | 23.542 | 26.296 | 28.845 | 32.000 | 34.267 |
| 17 | 5.697 | 6.407 | 7.564 | 8.682 | 10.085 | 24.769 | 27.587 | 30.190 | 33.408 | 35.716 |
| 18 | 6.265 | 7.015 | 8.231 | 9.390 | 10.865 | 25.989 | 28.869 | 31.526 | 34.805 | 37.156 |
| 19 | 6.843 | 7.632 | 8.906 | 10.117 | 11.651 | 27.203 | 30.143 | 32.852 | 36.190 | 38.580 |
| 20 | 7.434 | 8.260 | 9.591 | 10.851 | 12.443 | 28.412 | 31.410 | 34.170 | 37.566 | 39.997 |
| 21 | 8.033 | 8.897 | 10.283 | 11.591 | 13.240 | 29.615 | 32.670 | 35.478 | 38.930 | 41.399 |
| 22 | 8.643 | 9.542 | 10.982 | 12.338 | 14.042 | 30.813 | 33.924 | 36.781 | 40.289 | 42.796 |
| 23 | 9.260 | 10.195 | 11.688 | 13.090 | 14.848 | 32.007 | 35.172 | 38.075 | 41.637 | 44.179 |
| 24 | 9.886 | 10.856 | 12.401 | 13.848 | 15.659 | 33.196 | 36.415 | 39.364 | 42.980 | 45.558 |
| 25 | 10.519 | 11.523 | 13.120 | 14.611 | 16.473 | 34.381 | 37.652 | 40.646 | 44.313 | 46.925 |
| 26 | 11.160 | 12.198 | 13.844 | 15.379 | 17.292 | 35.563 | 38.885 | 41.923 | 45.642 | 48.290 |
| 27 | 11.807 | 12.878 | 14.573 | 16.151 | 18.114 | 36.741 | 40.113 | 43.194 | 46.962 | 49.642 |
| 28 | 12.461 | 13.565 | 15.308 | 16.928 | 18.939 | 37.916 | 41.337 | 44.461 | 48.278 | 50.993 |
| 29 | 13.120 | 14.256 | 16.147 | 17.708 | 19.768 | 39.087 | 42.557 | 45.772 | 49.586 | 52.333 |
| 30 | 13.787 | 14.954 | 16.791 | 18.493 | 20.599 | 40.256 | 43.773 | 46.979 | 50.892 | 53.672 |
| 31 | 14.457 | 15.655 | 17.538 | 19.280 | 21.433 | 41.422 | 44.985 | 48.231 | 52.190 | 55.000 |
| 32 | 15.134 | 16.362 | 18.291 | 20.072 | 22.271 | 42.585 | 46.194 | 49.480 | 53.486 | 56.328 |
| 33 | 15.814 | 17.073 | 19.046 | 20.866 | 23.110 | 43.745 | 47.400 | 50.724 | 54.774 | 57.646 |
| 34 | 16.501 | 17.789 | 19.806 | 21.664 | 23.952 | 44.903 | 48.602 | 51.966 | 56.061 | 58.964 |
| 35 | 17.191 | 18.508 | 20.569 | 22.465 | 24.796 | 46.059 | 49.802 | 53.203 | 57.340 | 60.272 |
| 36 | 17.887 | 19.233 | 21.336 | 23.269 | 25.643 | 47.212 | 50.998 | 54.437 | 58.619 | 61.581 |
| 37 | 18.584 | 19.960 | 22.105 | 24.075 | 26.492 | 48.363 | 52.192 | 55.667 | 59.891 | 62.880 |
| 38 | 19.289 | 20.691 | 22.878 | 24.884 | 27.343 | 49.513 | 53.384 | 56.896 | 61.162 | 64.181 |
| 39 | 19.994 | 21.425 | 23.654 | 25.695 | 28.196 | 50.660 | 54.572 | 58.119 | 62.420 | 65.473 |
| 40 ^a | 20.706 | 22.164 | 24.433 | 26.509 | 29.050 | 51.805 | 55.758 | 59.342 | 63.691 | 66.766 |

^aFor $\nu > 40$, $\chi^2_{\nu,\alpha} \simeq \nu \left(1 - \frac{2}{9\nu} + z_\alpha \sqrt{\frac{2}{9\nu}} \right)^3$.

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Table C.4 Critical Values $f_{v_1, v_2, \alpha}$ for F -Distribution

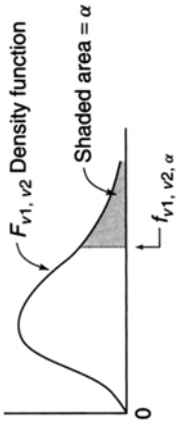


| | | Degrees of freedom for numerator (v_1) | | | | | | | | | | | | | | | | | | | | |
|-----------------|----|--|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|----------|--|--|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 12 | 15 | 20 | 24 | 30 | 40 | 60 | 120 | ∞ | | |
| $\alpha = 0.01$ | 1 | 4052.0 | 4999.5 | 5403.0 | 5625.0 | 5764.0 | 5859.0 | 5928.0 | 5982.0 | 6022.0 | 6056.0 | 6106.0 | 6157.0 | 6209.0 | 6235.0 | 6261.0 | 6287.0 | 6311.0 | 6339.0 | 6366.0 | | |
| | 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 | 99.46 | 99.47 | 99.47 | 99.48 | 99.49 | 99.50 | | |
| | 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 | 26.00 | 26.50 | 26.41 | 26.32 | 26.22 | 26.13 | | |
| | 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 | 13.93 | 13.84 | 13.75 | 13.65 | 13.56 | 13.46 | | |
| | 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 | 9.47 | 9.38 | 9.29 | 9.20 | 9.11 | 9.02 | | |
| | 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 | 7.31 | 7.23 | 7.14 | 7.06 | 6.97 | 6.88 | | |
| | 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 | 6.07 | 5.99 | 5.91 | 5.82 | 5.74 | 5.65 | | |
| | 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 | 5.28 | 5.20 | 5.12 | 5.03 | 4.95 | 4.86 | | |
| | 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 | 4.73 | 4.65 | 4.57 | 4.48 | 4.40 | 4.31 | | |
| | 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 | 4.33 | 4.25 | 4.17 | 4.08 | 4.00 | 3.91 | | |
| | 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 | 4.02 | 3.94 | 3.86 | 3.78 | 3.69 | 3.60 | | |
| | 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 | 3.78 | 3.70 | 3.62 | 3.54 | 3.45 | 3.36 | | |
| | 13 | 9.07 | 6.70 | 5.74 | 5.21 | 4.96 | 4.62 | 4.44 | 4.30 | 4.19 | 4.10 | 3.96 | 3.82 | 3.66 | 3.59 | 3.51 | 3.43 | 3.34 | 3.25 | 3.17 | | |
| | 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 | 3.43 | 3.35 | 3.27 | 3.18 | 3.09 | 3.00 | | |
| | 15 | 8.68 | 6.36 | 5.42 | 4.89 | 4.36 | 4.32 | 4.14 | 4.00 | 3.89 | 3.80 | 3.67 | 3.52 | 3.37 | 3.29 | 3.21 | 3.13 | 3.05 | 2.96 | 2.87 | | |
| | 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 | 3.18 | 3.10 | 3.02 | 2.93 | 2.84 | 2.75 | | |
| | 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 | 3.08 | 3.00 | 2.92 | 2.83 | 2.75 | 2.65 | | |
| | 18 | 8.29 | 6.01 | 5.09 | 1.58 | 4.25 | 4.01 | 3.84 | 3.71 | 3.60 | 3.51 | 3.37 | 3.23 | 3.08 | 3.00 | 2.92 | 2.84 | 2.75 | 2.66 | 2.57 | | |
| | 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 | 2.92 | 2.84 | 2.76 | 2.67 | 2.58 | 2.49 | | |

Degrees of freedom for denominator (v_2)

| | | | | | | | | | | | | | | | | | | | |
|-----|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| 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 | 2.86 | 2.78 | 2.69 | 2.61 | 2.52 | 2.42 |
| 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 | 2.80 | 2.72 | 2.64 | 2.55 | 2.46 | 2.36 |
| 22 | 7.95 | 5.72 | 4.81 | 4.31 | 3.99 | 3.76 | 3.59 | 3.45 | 3.35 | 3.26 | 3.12 | 2.98 | 2.83 | 2.75 | 2.67 | 2.58 | 2.50 | 2.40 | 2.31 |
| 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 | 2.70 | 2.62 | 2.54 | 2.45 | 2.35 | 2.26 |
| 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 | 2.66 | 2.58 | 2.49 | 2.40 | 2.31 | 2.21 |
| 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 | 2.62 | 2.54 | 2.45 | 2.36 | 2.27 | 2.17 |
| 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 | 2.58 | 2.50 | 2.42 | 2.33 | 2.23 | 2.13 |
| 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 | 2.55 | 2.47 | 2.38 | 2.29 | 2.20 | 2.10 |
| 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 | 2.52 | 2.44 | 2.35 | 2.26 | 2.17 | 2.06 |
| 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 | 2.49 | 2.41 | 2.33 | 2.23 | 2.14 | 2.03 |
| 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 | 2.47 | 2.39 | 2.30 | 2.21 | 2.11 | 2.01 |
| 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 | 2.29 | 2.20 | 2.11 | 2.02 | 1.92 | 1.80 |
| 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 | 2.12 | 2.03 | 1.94 | 1.84 | 1.73 | 1.60 |
| 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 | 1.95 | 1.86 | 1.76 | 1.66 | 1.53 | 1.38 |
| ∞ | 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 | 1.79 | 1.70 | 1.51 | 1.47 | 1.32 | 1.00 |

Table C.4 Critical Values $f_{v_1, v_2, \alpha}$ for F -Distribution (Continued)

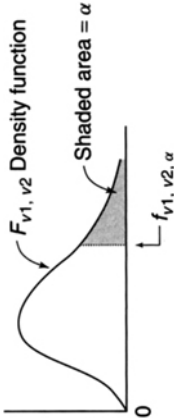


| | | Degrees of freedom for numerator (v_1) | | | | | | | | | | | | | | | | | | | | |
|-----------------|----|--|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|----------|--|--|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 12 | 15 | 20 | 24 | 30 | 40 | 60 | 120 | ∞ | | |
| $\alpha = 0.05$ | 1 | 161.4 | 199.5 | 215.7 | 224.6 | 230.2 | 234.0 | 236.8 | 238.9 | 240.5 | 241.9 | 243.9 | 245.9 | 248.0 | 249.1 | 250.1 | 251.1 | 252.2 | 253.3 | 254.3 | | |
| | 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 | 19.45 | 19.46 | 19.47 | 19.48 | 19.49 | 19.50 | | |
| | 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 | 8.64 | 8.62 | 8.59 | 8.57 | 8.55 | 8.53 | | |
| | 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 | 5.77 | 5.75 | 5.72 | 5.69 | 5.66 | 5.63 | | |
| | 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 | 4.53 | 4.50 | 4.46 | 4.43 | 4.40 | 4.36 | | |
| | 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 | 3.84 | 3.81 | 3.77 | 3.74 | 3.70 | 3.67 | | |
| | 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 | 3.41 | 3.38 | 3.34 | 3.30 | 3.27 | 3.23 | | |
| | 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 | 3.12 | 3.08 | 3.04 | 3.01 | 2.97 | 2.93 | | |
| | 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 | 2.90 | 2.86 | 2.83 | 2.79 | 2.75 | 2.71 | | |
| | 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 | 2.74 | 2.70 | 2.66 | 2.62 | 2.58 | 2.54 | | |
| | 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 | 2.61 | 2.57 | 2.53 | 2.49 | 2.45 | 2.40 | | |
| | 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 | 2.51 | 2.47 | 2.43 | 2.38 | 2.34 | 2.30 | | |
| | 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 | 2.42 | 2.38 | 2.34 | 2.30 | 2.25 | 2.21 | | |
| | 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 | 2.35 | 2.31 | 2.27 | 2.22 | 2.18 | 2.13 | | |
| | 15 | 4.54 | 3.68 | 3.29 | 3.06 | 2.90 | 2.79 | 2.71 | 2.64 | 2.59 | 2.54 | 2.49 | 2.42 | 2.33 | 2.29 | 2.25 | 2.20 | 2.16 | 2.11 | 2.07 | | |
| | 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 | 2.24 | 2.19 | 2.15 | 2.11 | 2.06 | 2.01 | | |
| | 17 | 4.45 | 3.59 | 3.20 | 2.96 | 2.81 | 2.69 | 2.61 | 2.55 | 2.49 | 2.45 | 2.38 | 2.31 | 2.23 | 2.19 | 2.15 | 2.10 | 2.06 | 2.01 | 1.96 | | |
| | 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 | 2.15 | 2.11 | 2.06 | 2.02 | 1.97 | 1.92 | | |
| | 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 | 2.11 | 2.07 | 2.03 | 1.98 | 1.93 | 1.88 | | |

Degrees of freedom for denominator (v_2)

| | | | | | | | | | | | | | | | | | | | |
|-----|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| 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 | 2.08 | 2.04 | 1.99 | 1.95 | 1.90 | 1.84 |
| 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 | 2.05 | 2.01 | 1.96 | 1.92 | 1.87 | 1.81 |
| 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 | 2.03 | 1.98 | 1.94 | 1.89 | 1.84 | 1.78 |
| 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 | 2.01 | 1.96 | 1.91 | 1.86 | 1.81 | 1.76 |
| 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 | 1.98 | 1.94 | 1.89 | 1.84 | 1.79 | 1.73 |
| 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 | 1.96 | 1.92 | 1.87 | 1.82 | 1.77 | 1.71 |
| 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 | 1.95 | 1.90 | 1.81 | 1.80 | 1.75 | 1.69 |
| 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 | 1.93 | 1.88 | 1.84 | 1.79 | 1.73 | 1.67 |
| 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 | 1.91 | 1.87 | 1.82 | 1.77 | 1.71 | 1.65 |
| 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 | 1.90 | 1.85 | 1.91 | 1.75 | 1.70 | 1.64 |
| 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 | 1.89 | 1.84 | 1.79 | 1.74 | 1.68 | 1.62 |
| 40 | 4.09 | 3.23 | 2.84 | 2.61 | 2.45 | 2.34 | 2.25 | 2.18 | 2.12 | 2.08 | 2.00 | 1.92 | 1.84 | 1.79 | 1.74 | 1.69 | 1.64 | 1.59 | 1.51 |
| 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 | 1.70 | 1.65 | 1.59 | 1.53 | 1.47 | 1.39 |
| 120 | 3.92 | 3.07 | 2.68 | 2.45 | 2.29 | 2.17 | 2.09 | 2.02 | 1.96 | 1.91 | 1.81 | 1.75 | 1.66 | 1.61 | 1.55 | 1.55 | 1.43 | 1.35 | 1.25 |
| ∞ | 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 | 1.52 | 1.46 | 1.39 | 1.32 | 1.22 | 1.00 |

Table C.4 Critical Values $f_{v_1, v_2, \alpha}$ for F -Distribution (Continued)



| | | Degrees of freedom for the numerator (v_1) | | | | | | | | | | | | | | | | | | | |
|-----------------|----|--|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|----------|--|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 12 | 15 | 20 | 24 | 30 | 40 | 60 | 120 | ∞ | |
| $\alpha = 0.10$ | 1 | 39.86 | 49.50 | 53.59 | 55.83 | 57.24 | 58.20 | 58.91 | 59.44 | 59.86 | 60.19 | 60.71 | 61.22 | 61.74 | 62.00 | 62.26 | 62.53 | 62.79 | 63.06 | 63.33 | |
| | 2 | 8.53 | 9.00 | 9.16 | 9.24 | 9.29 | 9.33 | 9.35 | 9.37 | 9.38 | 9.39 | 9.41 | 9.42 | 9.44 | 9.45 | 9.46 | 9.47 | 9.47 | 9.48 | 9.49 | |
| | 3 | 5.54 | 5.46 | 5.39 | 5.34 | 5.31 | 5.28 | 5.27 | 5.25 | 5.24 | 5.23 | 5.22 | 5.20 | 5.18 | 5.18 | 5.17 | 5.16 | 5.15 | 5.14 | 5.13 | |
| | 4 | 4.54 | 4.32 | 4.19 | 4.11 | 4.05 | 4.01 | 3.98 | 3.95 | 3.94 | 3.92 | 3.90 | 3.87 | 3.84 | 3.83 | 3.82 | 3.80 | 3.79 | 3.78 | 3.76 | |
| | 5 | 4.06 | 3.78 | 3.62 | 3.52 | 3.45 | 3.40 | 3.37 | 3.34 | 3.32 | 3.30 | 3.27 | 3.24 | 3.21 | 3.19 | 3.17 | 3.16 | 3.14 | 3.12 | 3.10 | |
| | 6 | 3.78 | 3.46 | 3.29 | 3.18 | 3.11 | 3.05 | 3.01 | 2.98 | 2.96 | 2.94 | 2.90 | 2.87 | 2.84 | 2.82 | 2.80 | 2.78 | 2.76 | 2.74 | 2.72 | |
| | 7 | 3.59 | 3.26 | 3.07 | 2.96 | 2.88 | 2.83 | 2.78 | 2.75 | 2.72 | 2.70 | 2.67 | 2.63 | 2.59 | 2.58 | 2.56 | 2.54 | 2.51 | 2.49 | 2.47 | |
| | 8 | 3.46 | 3.11 | 2.92 | 2.81 | 2.73 | 2.67 | 2.62 | 2.59 | 2.56 | 2.54 | 2.50 | 2.46 | 2.42 | 2.40 | 2.38 | 2.36 | 2.34 | 2.32 | 2.29 | |
| | 9 | 3.36 | 3.01 | 2.81 | 2.69 | 2.61 | 2.55 | 2.51 | 2.47 | 2.44 | 2.42 | 2.38 | 2.34 | 2.30 | 2.28 | 2.25 | 2.23 | 2.21 | 2.18 | 2.16 | |
| | 10 | 3.29 | 2.92 | 2.73 | 2.61 | 2.52 | 2.46 | 2.41 | 2.38 | 2.35 | 2.32 | 2.28 | 2.24 | 2.20 | 2.18 | 2.16 | 2.13 | 2.11 | 2.08 | 2.06 | |
| | 11 | 3.23 | 2.86 | 2.66 | 2.54 | 2.45 | 2.39 | 2.34 | 2.30 | 2.27 | 2.25 | 2.21 | 2.17 | 2.12 | 2.10 | 2.08 | 2.05 | 2.03 | 2.00 | 1.97 | |
| | 12 | 3.18 | 2.81 | 2.61 | 2.48 | 2.39 | 2.33 | 2.28 | 2.24 | 2.21 | 2.19 | 2.15 | 2.10 | 2.06 | 2.04 | 2.01 | 1.99 | 1.96 | 1.93 | 1.90 | |
| | 13 | 3.14 | 2.76 | 2.56 | 2.43 | 2.35 | 2.28 | 2.23 | 2.20 | 2.16 | 2.14 | 2.10 | 2.05 | 2.01 | 1.98 | 1.96 | 1.93 | 1.90 | 1.88 | 1.85 | |
| | 14 | 3.10 | 2.73 | 2.52 | 2.39 | 2.31 | 2.24 | 2.19 | 2.15 | 2.12 | 2.10 | 2.05 | 2.01 | 1.96 | 1.94 | 1.91 | 1.89 | 1.86 | 1.83 | 1.80 | |
| | 15 | 3.07 | 2.70 | 2.49 | 2.36 | 2.27 | 2.21 | 2.16 | 2.12 | 2.09 | 2.06 | 2.02 | 1.97 | 1.92 | 1.90 | 1.87 | 1.85 | 1.82 | 1.79 | 1.76 | |
| | 16 | 3.05 | 2.67 | 2.46 | 2.33 | 2.24 | 2.18 | 2.13 | 2.09 | 2.06 | 2.03 | 1.99 | 1.94 | 1.89 | 1.86 | 1.84 | 1.81 | 1.78 | 1.75 | 1.72 | |
| | 17 | 3.03 | 2.64 | 2.44 | 2.31 | 2.22 | 2.15 | 2.10 | 2.06 | 2.03 | 2.00 | 1.96 | 1.91 | 1.86 | 1.84 | 1.81 | 1.78 | 1.75 | 1.72 | 1.69 | |
| | 18 | 3.01 | 2.62 | 2.42 | 2.29 | 2.20 | 2.13 | 2.08 | 2.04 | 2.00 | 1.98 | 1.93 | 1.89 | 1.84 | 1.81 | 1.78 | 1.75 | 1.72 | 1.69 | 1.66 | |
| | 19 | 2.99 | 2.61 | 2.40 | 2.27 | 2.18 | 2.11 | 2.06 | 2.02 | 1.98 | 1.96 | 1.91 | 1.86 | 1.81 | 1.79 | 1.76 | 1.73 | 1.70 | 1.67 | 1.63 | |

Degrees of freedom for denominator (v_2)

| | | | | | | | | | | | | | | | | | | | |
|-----|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| 20 | 2.97 | 2.59 | 2.38 | 2.25 | 2.16 | 2.09 | 2.04 | 2.00 | 1.96 | 1.94 | 1.89 | 1.84 | 1.79 | 1.77 | 1.74 | 1.71 | 1.68 | 1.64 | 1.61 |
| 21 | 2.96 | 2.57 | 2.36 | 2.23 | 2.14 | 2.08 | 2.02 | 1.98 | 1.95 | 1.92 | 1.87 | 1.83 | 1.78 | 1.75 | 1.72 | 1.69 | 1.66 | 1.62 | 1.59 |
| 22 | 2.95 | 2.56 | 2.35 | 2.22 | 2.13 | 2.06 | 2.01 | 1.97 | 1.93 | 1.90 | 1.86 | 1.81 | 1.76 | 1.73 | 1.70 | 1.67 | 1.64 | 1.60 | 1.57 |
| 23 | 2.94 | 2.55 | 2.34 | 2.21 | 2.11 | 2.05 | 1.99 | 1.95 | 1.92 | 1.89 | 1.84 | 1.80 | 1.74 | 1.72 | 1.69 | 1.66 | 1.62 | 1.59 | 1.55 |
| 24 | 2.93 | 2.54 | 2.33 | 2.19 | 2.10 | 2.04 | 1.98 | 1.94 | 1.91 | 1.88 | 1.83 | 1.78 | 1.73 | 1.70 | 1.67 | 1.64 | 1.61 | 1.57 | 1.53 |
| 25 | 2.92 | 2.53 | 2.32 | 2.18 | 2.09 | 2.02 | 1.97 | 1.93 | 1.89 | 1.87 | 1.82 | 1.77 | 1.72 | 1.69 | 1.66 | 1.63 | 1.59 | 1.56 | 1.52 |
| 26 | 2.91 | 2.52 | 2.31 | 2.17 | 2.08 | 2.01 | 1.96 | 1.92 | 1.88 | 1.86 | 1.81 | 1.76 | 1.71 | 1.68 | 1.65 | 1.61 | 1.58 | 1.54 | 1.50 |
| 27 | 2.90 | 2.51 | 2.30 | 2.17 | 2.07 | 2.00 | 1.95 | 1.91 | 1.87 | 1.85 | 1.80 | 1.75 | 1.70 | 1.67 | 1.64 | 1.60 | 1.57 | 1.53 | 1.49 |
| 28 | 2.89 | 2.50 | 2.29 | 2.16 | 2.06 | 2.00 | 1.94 | 1.90 | 1.87 | 1.84 | 1.79 | 1.74 | 1.69 | 1.66 | 1.63 | 1.59 | 1.56 | 1.52 | 1.48 |
| 29 | 2.89 | 2.50 | 2.28 | 2.15 | 2.06 | 1.99 | 1.93 | 1.89 | 1.86 | 1.83 | 1.78 | 1.73 | 1.68 | 1.65 | 1.62 | 1.58 | 1.55 | 1.51 | 1.47 |
| 30 | 2.88 | 2.49 | 2.28 | 2.14 | 2.03 | 1.98 | 1.93 | 1.88 | 1.85 | 1.82 | 1.77 | 1.72 | 1.67 | 1.64 | 1.61 | 1.57 | 1.54 | 1.50 | 1.46 |
| 40 | 2.84 | 2.44 | 2.23 | 2.09 | 2.00 | 1.93 | 1.87 | 1.83 | 1.79 | 1.76 | 1.71 | 1.66 | 1.61 | 1.57 | 1.54 | 1.51 | 1.47 | 1.42 | 1.38 |
| 60 | 2.79 | 2.39 | 2.18 | 2.04 | 1.95 | 1.87 | 1.82 | 1.77 | 1.74 | 1.71 | 1.66 | 1.60 | 1.54 | 1.51 | 1.48 | 1.44 | 1.40 | 1.35 | 1.29 |
| 120 | 2.75 | 2.35 | 2.13 | 1.99 | 1.90 | 1.82 | 1.77 | 1.72 | 1.68 | 1.65 | 1.60 | 1.55 | 1.48 | 1.45 | 1.41 | 1.37 | 1.32 | 1.26 | 1.19 |
| ∞ | 2.71 | 2.30 | 2.08 | 1.94 | 1.85 | 1.77 | 1.72 | 1.67 | 1.63 | 1.60 | 1.55 | 1.49 | 1.42 | 1.38 | 1.34 | 1.30 | 1.24 | 1.17 | 1.00 |

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Table C.5 Studentized Range Critical Values $q_{k,v,\alpha}$

| v | k | | | | | | | | |
|-----------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| $\alpha = 0.05$ | | | | | | | | | |
| 5 | 3.635 | 4.602 | 5.218 | 5.673 | 6.033 | 6.330 | 6.582 | 6.802 | 6.995 |
| 10 | 3.151 | 3.877 | 4.327 | 4.654 | 4.912 | 5.124 | 5.305 | 5.461 | 5.599 |
| 15 | 3.014 | 3.674 | 4.076 | 4.367 | 4.595 | 4.782 | 4.940 | 5.077 | 5.198 |
| 20 | 2.950 | 3.578 | 3.958 | 4.232 | 4.445 | 4.620 | 4.768 | 4.986 | 5.008 |
| 30 | 2.888 | 3.486 | 3.845 | 4.102 | 4.302 | 4.464 | 4.602 | 4.720 | 4.824 |
| 40 | 2.858 | 3.442 | 3.791 | 4.039 | 4.232 | 4.389 | 4.521 | 4.635 | 4.735 |
| 60 | 2.829 | 3.399 | 3.737 | 3.977 | 4.163 | 4.314 | 4.441 | 4.550 | 4.646 |
| 120 | 2.800 | 3.356 | 3.685 | 3.917 | 4.096 | 4.241 | 4.363 | 4.468 | 4.560 |
| ∞ | 2.772 | 3.314 | 3.633 | 3.858 | 4.030 | 4.170 | 4.286 | 4.387 | 4.474 |
| $\alpha = 0.10$ | | | | | | | | | |
| 5 | 2.850 | 3.717 | 4.264 | 4.664 | 4.979 | 5.238 | 5.458 | 5.648 | 5.816 |
| 10 | 2.563 | 3.270 | 3.704 | 4.018 | 4.264 | 4.465 | 4.636 | 4.783 | 4.913 |
| 15 | 2.479 | 3.140 | 3.540 | 3.828 | 4.052 | 4.235 | 4.390 | 4.524 | 4.641 |
| 20 | 2.439 | 3.078 | 3.462 | 3.736 | 3.950 | 4.124 | 4.271 | 4.398 | 4.510 |
| 30 | 2.400 | 3.017 | 3.386 | 3.648 | 3.851 | 4.016 | 4.155 | 4.275 | 4.381 |
| 40 | 2.381 | 2.988 | 3.349 | 3.605 | 3.803 | 3.963 | 4.099 | 4.215 | 4.317 |
| 60 | 2.363 | 2.959 | 3.312 | 3.562 | 3.755 | 3.911 | 4.042 | 4.155 | 4.254 |
| 120 | 2.344 | 2.930 | 3.276 | 3.520 | 3.707 | 3.859 | 3.987 | 4.096 | 4.191 |
| ∞ | 2.326 | 2.902 | 3.240 | 3.478 | 3.661 | 3.808 | 3.931 | 4.037 | 4.129 |

Source: Excerpted from H. L. Harter (1960), "Table of range and Studentized range," *Annals of Mathematical Statistics*, **31**, 1122–1147.

Table C.6 One-Sided Multivariate *t* Critical Points $t_{k,\nu,\alpha}$ for Common Correlation, $\rho = 0.5$

| ν | α | k | | | | | | | | |
|----------|----------|--------|-------|-------|-------|-------|-------|-------|-------|-------|
| | | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 5 | .01 | 3.900 | 4.211 | 4.429 | 4.597 | 4.733 | 4.846 | 4.944 | 5.030 | 5.106 |
| | .05 | 2.440 | 2.681 | 2.848 | 2.976 | 3.078 | 3.163 | 3.236 | 3.300 | 3.356 |
| | .10 | 1.873 | 2.094 | 2.245 | 2.359 | 2.451 | 2.527 | 2.592 | 2.649 | 2.699 |
| 10 | .01 | 3.115 | 3.314 | 3.453 | 3.559 | 3.644 | 3.715 | 3.777 | 3.830 | 3.878 |
| | .05 | 2.151 | 2.338 | 2.466 | 2.562 | 2.640 | 2.704 | 2.759 | 2.807 | 2.849 |
| | .10 | 1.713 | 1.899 | 2.024 | 2.119 | 2.194 | 2.256 | 2.309 | 2.355 | 2.396 |
| 15 | .01 | 2.908 | 3.080 | 3.198 | 3.289 | 3.362 | 3.422 | 3.474 | 3.520 | 3.560 |
| | .05 | 2.067 | 2.239 | 2.356 | 2.444 | 2.515 | 2.573 | 2.623 | 2.667 | 2.705 |
| | .10 | 1.665 | 1.840 | 1.959 | 2.047 | 2.118 | 2.176 | 2.225 | 2.268 | 2.306 |
| 20 | .01 | 2.813 | 2.972 | 3.082 | 3.166 | 3.233 | 3.289 | 3.337 | 3.378 | 3.416 |
| | .05 | 2.027 | 2.192 | 2.304 | 2.389 | 2.456 | 2.512 | 2.559 | 2.601 | 2.637 |
| | .10 | 1.642 | 1.813 | 1.927 | 2.013 | 2.081 | 2.137 | 2.185 | 2.227 | 2.263 |
| 25 | .01 | 2.758 | 2.911 | 3.016 | 3.095 | 3.159 | 3.212 | 3.258 | 3.298 | 3.333 |
| | .05 | 2.004 | 2.165 | 2.274 | 2.356 | 2.422 | 2.476 | 2.522 | 2.562 | 2.598 |
| | .10 | 1.629 | 1.796 | 1.909 | 1.993 | 2.060 | 2.115 | 2.162 | 2.202 | 2.238 |
| 30 | .01 | 2.723 | 2.871 | 2.973 | 3.050 | 3.111 | 3.163 | 3.207 | 3.245 | 3.279 |
| | .05 | 1.989 | 2.147 | 2.255 | 2.335 | 2.399 | 2.453 | 2.498 | 2.537 | 2.572 |
| | .10 | 1.620 | 1.786 | 1.897 | 1.980 | 2.046 | 2.100 | 2.146 | 2.186 | 2.222 |
| 35 | .01 | 2.698 | 2.843 | 2.942 | 3.018 | 3.078 | 3.128 | 3.171 | 3.209 | 3.242 |
| | .05 | 1.978 | 2.135 | 2.241 | 2.320 | 2.384 | 2.436 | 2.481 | 2.519 | 2.554 |
| | .10 | 1.614 | 1.778 | 1.888 | 1.971 | 2.036 | 2.090 | 2.135 | 2.175 | 2.210 |
| 40 | .01 | 2.680 | 2.822 | 2.920 | 2.994 | 3.053 | 3.103 | 3.145 | 3.181 | 3.214 |
| | .05 | 1.970 | 2.125 | 2.230 | 2.309 | 2.372 | 2.424 | 2.468 | 2.506 | 2.540 |
| | .10 | 1.609 | 1.772 | 1.882 | 1.964 | 2.028 | 2.082 | 2.127 | 2.167 | 2.201 |
| 50 | .01 | 2.655 | 2.794 | 2.889 | 2.962 | 3.019 | 3.068 | 3.109 | 3.145 | 3.176 |
| | .05 | 1.959 | 2.112 | 2.216 | 2.294 | 2.356 | 2.407 | 2.450 | 2.488 | 2.521 |
| | .10 | 1.603 | 1.764 | 1.873 | 1.954 | 2.018 | 2.071 | 2.116 | 2.155 | 2.189 |
| 100 | .01 | 2.0605 | 2.738 | 2.829 | 2.898 | 2.953 | 2.999 | 3.038 | 3.072 | 3.102 |
| | .05 | 1.938 | 2.087 | 2.188 | 2.263 | 2.324 | 2.373 | 2.415 | 2.452 | 2.484 |
| | .10 | 1.590 | 1.749 | 1.885 | 1.935 | 1.998 | 2.050 | 2.094 | 2.132 | 2.166 |
| 200 | .01 | 2.581 | 2.711 | 2.800 | 2.867 | 2.921 | 2.966 | 3.004 | 3.037 | 3.006 |
| | .05 | 1.927 | 2.074 | 2.174 | 2.249 | 2.308 | 2.357 | 2.398 | 2.434 | 2.466 |
| | .10 | 1.583 | 1.741 | 1.847 | 1.926 | 1.988 | 2.039 | 2.083 | 2.121 | 2.154 |
| ∞ | .01 | 2.558 | 2.685 | 2.772 | 2.837 | 2.889 | 2.933 | 2.970 | 3.002 | 3.031 |
| | .05 | 1.916 | 2.062 | 2.160 | 2.234 | 2.292 | 2.340 | 2.381 | 2.417 | 2.448 |
| | .10 | 1.577 | 1.734 | 1.838 | 1.916 | 1.978 | 2.029 | 2.072 | 2.109 | 2.148 |

Source: Excerpted from R. E. Bechhofer and C. W. Dunnett (1988), "Percentage points of multivariate *t*-distribution," *Selected Tables in Mathematical Statistics*, **11**, Providence, RI: American Mathematical Society.

Table C.7 Two-Sided Multivariate t Critical Points $|t|_{k,\nu,\alpha}$ for Common Correlation, $\rho = 0.5$

| ν | α | k | | | | | | | | |
|----------|----------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| | | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 5 | .01 | 4.627 | 4.975 | 5.219 | 5.406 | 5.557 | 5.683 | 5.792 | 5.887 | 5.971 |
| | .05 | 3.030 | 3.293 | 3.476 | 3.615 | 3.727 | 3.821 | 3.900 | 3.970 | 4.032 |
| | .10 | 2.433 | 2.669 | 2.832 | 2.956 | 3.055 | 3.137 | 3.207 | 3.268 | 3.322 |
| 10 | .01 | 3.531 | 3.739 | 3.883 | 3.994 | 4.084 | 4.159 | 4.223 | 4.279 | 4.329 |
| | .05 | 2.568 | 2.759 | 2.890 | 2.990 | 3.070 | 3.137 | 3.194 | 3.244 | 3.288 |
| | .10 | 2.149 | 2.335 | 2.463 | 2.559 | 2.636 | 2.700 | 2.755 | 2.802 | 2.844 |
| 15 | .01 | 3.253 | 3.426 | 3.547 | 3.639 | 3.713 | 3.776 | 3.829 | 3.875 | 3.917 |
| | .05 | 2.439 | 2.610 | 2.727 | 2.816 | 2.887 | 2.946 | 2.997 | 3.041 | 3.080 |
| | .10 | 2.066 | 2.238 | 2.355 | 2.443 | 2.514 | 2.572 | 2.622 | 2.665 | 2.703 |
| 20 | .01 | 3.127 | 3.285 | 3.395 | 3.479 | 3.547 | 3.603 | 3.651 | 3.694 | 3.731 |
| | .05 | 2.379 | 2.540 | 2.651 | 2.735 | 2.802 | 2.857 | 2.905 | 2.946 | 2.983 |
| | .10 | 2.027 | 2.192 | 2.304 | 2.388 | 2.455 | 2.511 | 2.559 | 2.600 | 2.636 |
| 25 | .01 | 3.055 | 3.205 | 3.309 | 3.388 | 3.452 | 3.505 | 3.551 | 3.591 | 3.626 |
| | .05 | 2.344 | 2.500 | 2.607 | 2.688 | 2.752 | 2.806 | 2.852 | 2.891 | 2.927 |
| | .10 | 2.004 | 2.165 | 2.274 | 2.356 | 2.421 | 2.476 | 2.522 | 2.562 | 2.597 |
| 30 | .01 | 3.009 | 3.154 | 3.254 | 3.330 | 3.391 | 3.442 | 3.486 | 3.524 | 3.558 |
| | .05 | 2.321 | 2.474 | 2.578 | 2.657 | 2.720 | 2.772 | 2.817 | 2.856 | 2.890 |
| | .10 | 1.989 | 2.147 | 2.254 | 2.335 | 2.399 | 2.452 | 2.498 | 2.537 | 2.572 |
| 35 | .01 | 2.976 | 3.118 | 3.215 | 3.289 | 3.349 | 3.398 | 3.441 | 3.478 | 3.511 |
| | .05 | 2.305 | 2.455 | 2.558 | 2.635 | 2.697 | 2.748 | 2.792 | 2.830 | 2.864 |
| | .10 | 1.978 | 2.135 | 2.240 | 2.320 | 2.383 | 2.436 | 2.480 | 2.519 | 2.553 |
| 40 | .01 | 2.952 | 3.091 | 3.186 | 3.259 | 3.317 | 3.366 | 3.408 | 3.444 | 3.476 |
| | .05 | 2.293 | 2.441 | 2.543 | 2.619 | 2.680 | 2.731 | 2.774 | 2.812 | 2.845 |
| | .10 | 1.970 | 2.125 | 2.230 | 2.309 | 2.372 | 2.424 | 2.468 | 2.506 | 2.540 |
| 50 | .01 | 2.920 | 3.054 | 3.147 | 3.218 | 3.274 | 3.321 | 3.362 | 3.397 | 3.428 |
| | .05 | 2.276 | 2.422 | 2.522 | 2.597 | 2.657 | 2.707 | 2.749 | 2.786 | 2.819 |
| | .10 | 1.959 | 2.112 | 2.216 | 2.294 | 2.355 | 2.407 | 2.450 | 2.488 | 2.521 |
| 100 | .01 | 2.856 | 2.983 | 3.071 | 3.137 | 3.191 | 3.235 | 3.273 | 3.306 | 3.335 |
| | .05 | 2.244 | 2.385 | 2.481 | 2.554 | 2.611 | 2.659 | 2.700 | 2.735 | 2.767 |
| | .10 | 1.938 | 2.087 | 2.188 | 2.263 | 2.323 | 2.373 | 2.415 | 2.452 | 2.484 |
| 200 | .01 | 2.825 | 2.949 | 3.034 | 3.098 | 3.150 | 3.193 | 3.230 | 3.262 | 3.291 |
| | .05 | 2.228 | 2.367 | 2.461 | 2.532 | 2.589 | 2.636 | 2.676 | 2.711 | 2.741 |
| | .10 | 1.927 | 2.074 | 2.174 | 2.249 | 2.308 | 2.357 | 2.398 | 2.434 | 2.466 |
| ∞ | .01 | 2.794 | 2.915 | 2.998 | 3.060 | 3.110 | 3.152 | 3.188 | 3.219 | 3.246 |
| | .05 | 2.212 | 2.349 | 2.442 | 2.511 | 2.567 | 2.613 | 2.652 | 2.686 | 2.716 |
| | .10 | 1.916 | 2.062 | 2.160 | 2.234 | 2.292 | 2.340 | 2.381 | 2.417 | 2.488 |

Source: Excerpted from R. E. Bechhofer and C. W. Dunnett (1988), "Percentage points of multivariate t -distribution," *Selected Tables in Mathematical Statistics*, **11**, (Providence, RI: American Mathematical Society.)

**Table C.8 Studentized Maximum Critical Values $M_{k,v,\alpha}$
(One-sided Multivariate t Critical Values $t_{k,v,\rho,\alpha}$ with $\rho = 0$)**

| ν | α | k | | | | | | | | |
|----------|----------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| | | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 5 | .01 | 3.997 | 4.387 | 4.671 | 4.896 | 5.081 | 5.239 | 5.376 | 5.497 | 5.606 |
| | .05 | 2.532 | 2.840 | 3.062 | 3.234 | 2.376 | 3.495 | 3.599 | 3.690 | 3.772 |
| | .10 | 1.969 | 2.256 | 2.459 | 2.616 | 2.744 | 2.851 | 2.944 | 3.026 | 3.098 |
| 10 | .01 | 3.161 | 3.394 | 3.560 | 3.690 | 3.796 | 3.886 | 3.963 | 4.032 | 4.094 |
| | .05 | 2.211 | 2.439 | 2.598 | 2.720 | 2.820 | 2.903 | 2.976 | 3.039 | 3.096 |
| | .10 | 1.787 | 2.018 | 2.178 | 2.300 | 2.398 | 2.481 | 2.552 | 2.614 | 2.670 |
| 15 | .01 | 2.942 | 3.138 | 3.276 | 3.382 | 3.469 | 3.542 | 3.606 | 3.662 | 3.712 |
| | .05 | 2.120 | 2.326 | 2.467 | 2.576 | 2.663 | 2.737 | 2.800 | 2.856 | 2.905 |
| | .10 | 1.732 | 1.947 | 2.095 | 2.207 | 2.297 | 2.372 | 2.436 | 2.492 | 2.542 |
| 20 | .01 | 2.842 | 3.021 | 3.147 | 3.243 | 3.322 | 3.388 | 3.444 | 3.494 | 3.539 |
| | .05 | 2.076 | 2.271 | 2.405 | 2.507 | 2.590 | 2.659 | 2.718 | 2.770 | 2.816 |
| | .10 | 1.706 | 1.914 | 2.055 | 2.162 | 2.248 | 2.320 | 2.381 | 2.434 | 2.481 |
| 25 | .01 | 2.785 | 2.955 | 3.073 | 3.164 | 3.238 | 3.299 | 3.353 | 3.400 | 3.441 |
| | .05 | 2.051 | 2.239 | 2.369 | 2.468 | 2.547 | 2.613 | 2.670 | 2.720 | 2.764 |
| | .10 | 1.691 | 1.894 | 2.032 | 2.136 | 2.220 | 2.289 | 2.348 | 2.400 | 2.446 |
| 30 | .01 | 2.748 | 2.912 | 3.026 | 3.113 | 3.184 | 3.243 | 3.294 | 3.338 | 3.378 |
| | .05 | 2.034 | 2.219 | 2.346 | 2.442 | 2.519 | 2.584 | 2.639 | 2.687 | 2.730 |
| | .10 | 1.681 | 1.881 | 2.017 | 2.119 | 2.201 | 2.269 | 2.327 | 2.378 | 2.422 |
| 35 | .01 | 2.722 | 2.881 | 2.992 | 3.077 | 3.146 | 3.203 | 3.253 | 3.296 | 3.334 |
| | .05 | 2.022 | 2.204 | 2.329 | 2.424 | 2.499 | 2.563 | 2.617 | 2.664 | 2.706 |
| | .10 | 1.674 | 1.872 | 2.006 | 2.107 | 2.188 | 2.255 | 2.312 | 2.362 | 2.406 |
| 40 | .01 | 2.703 | 2.859 | 2.968 | 3.051 | 3.118 | 3.174 | 3.222 | 3.264 | 3.302 |
| | .05 | 2.014 | 2.194 | 2.317 | 2.410 | 2.485 | 2.547 | 2.600 | 2.647 | 2.688 |
| | .10 | 1.668 | 1.865 | 1.998 | 2.098 | 2.178 | 2.244 | 2.301 | 2.350 | 2.393 |
| 50 | .01 | 2.676 | 2.829 | 2.934 | 3.015 | 3.080 | 3.134 | 3.180 | 3.221 | 3.258 |
| | .05 | 2.001 | 2.179 | 2.300 | 2.391 | 2.465 | 2.526 | 2.578 | 2.623 | 2.663 |
| | .10 | 1.661 | 1.855 | 1.987 | 2.085 | 2.164 | 2.229 | 2.285 | 2.333 | 2.376 |
| 100 | .01 | 2.625 | 2.769 | 2.869 | 2.944 | 3.005 | 3.056 | 3.100 | 3.138 | 3.171 |
| | .05 | 1.978 | 2.150 | 2.267 | 2.355 | 2.425 | 2.483 | 2.533 | 2.577 | 2.615 |
| | .10 | 1.647 | 1.837 | 1.965 | 2.061 | 2.137 | 2.200 | 2.254 | 2.301 | 2.342 |
| 200 | .01 | 2.600 | 2.740 | 2.837 | 2.910 | 2.969 | 3.018 | 3.060 | 3.097 | 3.130 |
| | .05 | 1.966 | 2.135 | 2.250 | 2.337 | 2.405 | 2.463 | 2.511 | 2.554 | 2.591 |
| | .10 | 1.639 | 1.827 | 1.954 | 2.049 | 2.124 | 2.186 | 2.239 | 2.285 | 2.325 |
| ∞ | .01 | 2.575 | 2.712 | 2.806 | 2.877 | 2.934 | 2.981 | 3.022 | 3.057 | 3.089 |
| | .05 | 1.955 | 2.121 | 2.234 | 2.319 | 2.386 | 2.442 | 2.490 | 2.531 | 2.568 |
| | .10 | 1.632 | 1.818 | 1.943 | 2.036 | 2.111 | 2.172 | 2.224 | 2.269 | 2.309 |

Source: Excerpted from R. E. Bechhofer and C. W. Dunnett (1988), "Tables of percentage points of multivariate student t distributions," *Selected Tables in Mathematical Statistics*, **11**, 1–371.

**Table C.9 Studentized Maximum Modulus Critical Values $|M|_{k,v,\alpha}$
(Two-Sided Multivariate t Critical Values $|t|_{k,v,\rho,\alpha}$ for $\rho = 0$)**

| ν | α | k | | | | | | | | |
|----------|----------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| | | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 5 | .01 | 4.700 | 5.106 | 5.397 | 5.625 | 5.812 | 5.969 | 6.106 | 6.226 | 6.334 |
| | .05 | 3.091 | 3.399 | 3.619 | 3.789 | 3.928 | 4.044 | 4.145 | 4.233 | 4.312 |
| | .10 | 2.491 | 2.769 | 2.965 | 3.116 | 3.239 | 3.341 | 3.430 | 3.507 | 3.576 |
| 10 | .01 | 3.567 | 3.801 | 3.968 | 4.098 | 4.205 | 4.295 | 4.373 | 4.441 | 4.503 |
| | .05 | 2.609 | 2.829 | 2.983 | 3.103 | 3.199 | 3.281 | 3.351 | 3.412 | 3.467 |
| | .10 | 2.193 | 2.410 | 2.562 | 2.678 | 2.771 | 2.850 | 2.918 | 2.977 | 3.029 |
| 15 | .01 | 3.279 | 3.472 | 3.608 | 3.714 | 3.800 | 3.872 | 3.935 | 3.990 | 4.040 |
| | .05 | 2.474 | 2.669 | 2.805 | 2.909 | 2.994 | 3.065 | 3.126 | 3.180 | 3.227 |
| | .10 | 2.107 | 2.305 | 2.443 | 2.548 | 2.633 | 2.704 | 2.765 | 2.818 | 2.865 |
| 20 | .01 | 3.149 | 3.323 | 3.446 | 3.540 | 3.617 | 3.682 | 3.738 | 3.787 | 3.831 |
| | .05 | 2.411 | 2.594 | 2.721 | 2.819 | 2.897 | 2.963 | 3.020 | 3.070 | 3.114 |
| | .10 | 2.065 | 2.255 | 2.386 | 2.486 | 2.567 | 2.634 | 2.691 | 2.742 | 2.786 |
| 25 | .01 | 3.075 | 3.239 | 3.354 | 3.442 | 3.514 | 3.574 | 3.626 | 3.672 | 3.713 |
| | .05 | 2.374 | 2.551 | 2.673 | 2.766 | 2.841 | 2.904 | 2.959 | 3.006 | 3.048 |
| | .10 | 2.041 | 2.226 | 2.353 | 2.450 | 2.528 | 2.592 | 2.648 | 2.697 | 2.740 |
| 30 | .01 | 3.027 | 3.185 | 3.295 | 3.379 | 3.447 | 3.505 | 3.554 | 3.598 | 3.637 |
| | .05 | 2.350 | 2.522 | 2.641 | 2.732 | 2.805 | 2.866 | 2.918 | 2.964 | 3.005 |
| | .10 | 2.025 | 2.207 | 2.331 | 2.426 | 2.502 | 2.565 | 2.620 | 2.667 | 2.709 |
| 35 | .01 | 2.994 | 3.147 | 3.253 | 3.335 | 3.401 | 3.457 | 3.504 | 3.546 | 3.584 |
| | .05 | 2.333 | 2.502 | 2.619 | 2.708 | 2.779 | 2.839 | 2.890 | 2.935 | 2.975 |
| | .10 | 2.014 | 2.193 | 2.316 | 2.409 | 2.484 | 2.546 | 2.599 | 2.646 | 2.687 |
| 40 | .01 | 2.969 | 3.119 | 3.223 | 3.303 | 3.367 | 3.421 | 3.468 | 3.508 | 3.545 |
| | .05 | 2.321 | 2.488 | 2.602 | 2.690 | 2.760 | 2.819 | 2.869 | 2.913 | 2.952 |
| | .10 | 2.006 | 2.183 | 2.305 | 2.397 | 2.470 | 2.532 | 2.584 | 2.630 | 2.671 |
| 50 | .01 | 2.935 | 3.080 | 3.181 | 3.258 | 3.320 | 3.372 | 3.417 | 3.456 | 3.491 |
| | .05 | 2.304 | 2.467 | 2.580 | 2.665 | 2.734 | 2.791 | 2.840 | 2.883 | 2.921 |
| | .10 | 1.994 | 2.169 | 2.289 | 2.379 | 2.452 | 2.512 | 2.564 | 2.609 | 2.648 |
| 100 | .01 | 2.869 | 3.006 | 3.100 | 3.172 | 3.229 | 3.278 | 3.319 | 3.356 | 3.388 |
| | .05 | 2.270 | 2.427 | 2.535 | 2.616 | 2.682 | 2.736 | 2.783 | 2.823 | 2.859 |
| | .10 | 1.971 | 2.141 | 2.257 | 2.345 | 2.414 | 2.473 | 2.522 | 2.565 | 2.604 |
| 200 | .01 | 2.838 | 2.970 | 3.061 | 3.130 | 3.186 | 3.232 | 3.272 | 3.307 | 3.338 |
| | .05 | 2.253 | 2.407 | 2.513 | 2.592 | 2.656 | 2.709 | 2.755 | 2.794 | 2.829 |
| | .10 | 1.960 | 2.128 | 2.242 | 2.328 | 2.396 | 2.453 | 2.502 | 2.544 | 2.582 |
| ∞ | .01 | 2.806 | 2.934 | 3.022 | 3.089 | 3.143 | 3.188 | 3.226 | 3.260 | 3.289 |
| | .05 | 2.236 | 2.388 | 2.491 | 2.569 | 2.631 | 2.683 | 2.727 | 2.766 | 2.800 |
| | .10 | 1.949 | 2.114 | 2.226 | 2.311 | 2.378 | 2.434 | 2.481 | 2.523 | 2.560 |

Source: Excerpted from R. E. Bechhofer and C. W. Dunnett (1988), "Tables of percentage points of multivariate student t distributions," *Selected Tables in Mathematical Statistics*, **11**, 1–371.

Table C.10 Critical Constants $c_\alpha(m-1, a-1, N-a)$ for Wilks' Λ Statistic for the Test of No Treatment-Time Interaction ($\alpha = 0.05$)

| $N-a$ | $m=4$ | | | | | | $m=5$ | | | | | | $m=6$ | | | | | |
|-------|-------|-------|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|--------|--------|--------|
| | a | | | | | | a | | | | | | a | | | | | |
| | 3 | 4 | 5 | 6 | 6 | 6 | 3 | 4 | 5 | 6 | 6 | 6 | 3 | 4 | 5 | 6 | 6 | 6 |
| 10 | 0.243 | 0.164 | 0.0864 | 0.117 | 0.117 | 0.117 | 0.155 | 0.091 | 0.057 | 0.038 | 0.038 | 0.038 | 0.092 | 0.046 | 0.026 | 0.015 | 0.015 | 0.015 |
| 15 | 0.405 | 0.309 | 0.243 | 0.195 | 0.195 | 0.195 | 0.314 | 0.219 | 0.159 | 0.119 | 0.119 | 0.119 | 0.239 | 0.152 | 0.102 | 0.0703 | 0.0703 | 0.0703 |
| 20 | 0.515 | 0.419 | 0.348 | 0.293 | 0.293 | 0.293 | 0.431 | 0.329 | 0.257 | 0.205 | 0.205 | 0.205 | 0.359 | 0.256 | 0.188 | 0.142 | 0.142 | 0.142 |
| 25 | 0.591 | 0.500 | 0.430 | 0.374 | 0.374 | 0.374 | 0.516 | 0.415 | 0.340 | 0.283 | 0.283 | 0.283 | 0.449 | 0.343 | 0.268 | 0.213 | 0.213 | 0.213 |
| 30 | 0.648 | 0.563 | 0.495 | 0.439 | 0.439 | 0.439 | 0.580 | 0.483 | 0.409 | 0.349 | 0.349 | 0.349 | 0.519 | 0.415 | 0.337 | 0.277 | 0.277 | 0.277 |
| 40 | 0.724 | 0.651 | 0.591 | 0.539 | 0.539 | 0.539 | 0.668 | 0.583 | 0.513 | 0.455 | 0.455 | 0.455 | 0.617 | 0.522 | 0.446 | 0.384 | 0.384 | 0.384 |
| 60 | 0.808 | 0.752 | 0.704 | 0.661 | 0.661 | 0.661 | 0.767 | 0.700 | 0.643 | 0.592 | 0.592 | 0.592 | 0.729 | 0.652 | 0.587 | 0.531 | 0.531 | 0.531 |
| 80 | 0.853 | 0.808 | 0.769 | 0.733 | 0.733 | 0.733 | 0.821 | 0.766 | 0.718 | 0.675 | 0.675 | 0.675 | 0.791 | 0.727 | 0.672 | 0.623 | 0.623 | 0.623 |
| 100 | 0.881 | 0.844 | 0.810 | 0.780 | 0.780 | 0.780 | 0.854 | 0.809 | 0.768 | 0.730 | 0.730 | 0.730 | 0.830 | 0.776 | 0.728 | 0.685 | 0.685 | 0.685 |

For $a = 2$, use $F = \left(\frac{N-m}{m-1}\right) \left(\frac{1-\Lambda}{\Lambda}\right) \sim F_{m-1, N-m}$.
For $m = 2$, use $F = \left(\frac{N-a}{a-1}\right) \left(\frac{1-\Lambda}{\Lambda}\right) \sim F_{a-1, N-a}$.
For $m = 3$, use $F = \left(\frac{N-a-1}{a-1}\right) \left(\frac{1-\sqrt{\Lambda}}{\sqrt{\Lambda}}\right) \sim F_{2(a-1), 2(N-a-1)}$.

Source: Adapted from Timm (1975), Table IX. Reprinted by permission of Dr. Neil H. Timm.