

Table VIII Critical Values of X for the Sign Test

| n | One tail $\alpha = .005$ Two tail $\alpha = .01$ | | One tail $\alpha = .01$ Two tail $\alpha = .02$ | | One tail $\alpha = .025$ Two tail $\alpha = .05$ | | One tail $\alpha = .05$ Two tail $\alpha = .10$ | |
|-----|---|----------------------|--|----------------------|---|----------------------|--|----------------------|
| | Lower critical value | Upper critical value | Lower critical value | Upper critical value | Lower critical value | Upper critical value | Lower critical value | Upper critical value |
| 1 | — | — | — | — | — | — | — | — |
| 2 | — | — | — | — | — | — | — | — |
| 3 | — | — | — | — | — | — | — | — |
| 4 | — | — | — | — | — | — | — | — |
| 5 | — | — | — | — | — | — | 0 | 5 |
| 6 | — | — | — | — | 0 | 6 | 0 | 6 |
| 7 | — | — | 0 | 7 | 0 | 7 | 0 | 7 |
| 8 | 0 | 8 | 0 | 8 | 0 | 8 | 1 | 7 |
| 9 | 0 | 9 | 0 | 9 | 1 | 8 | 1 | 8 |
| 10 | 0 | 10 | 0 | 10 | 1 | 9 | 1 | 9 |
| 11 | 0 | 11 | 1 | 10 | 1 | 10 | 2 | 9 |
| 12 | 1 | 11 | 1 | 11 | 2 | 10 | 2 | 10 |
| 13 | 1 | 12 | 1 | 12 | 2 | 11 | 3 | 10 |
| 14 | 1 | 13 | 2 | 12 | 2 | 12 | 3 | 11 |
| 15 | 2 | 13 | 2 | 13 | 3 | 12 | 3 | 12 |
| 16 | 2 | 14 | 2 | 14 | 3 | 13 | 4 | 12 |
| 17 | 2 | 15 | 3 | 14 | 4 | 13 | 4 | 13 |
| 18 | 3 | 15 | 3 | 15 | 4 | 14 | 5 | 13 |
| 19 | 3 | 16 | 4 | 15 | 4 | 15 | 5 | 14 |
| 20 | 3 | 17 | 4 | 16 | 5 | 15 | 5 | 15 |
| 21 | 4 | 17 | 4 | 17 | 5 | 16 | 6 | 15 |
| 22 | 4 | 18 | 5 | 17 | 5 | 17 | 6 | 16 |
| 23 | 4 | 19 | 5 | 18 | 6 | 17 | 7 | 16 |
| 24 | 5 | 19 | 5 | 19 | 6 | 18 | 7 | 17 |
| 25 | 5 | 20 | 6 | 19 | 7 | 18 | 7 | 18 |

Source: D. B. Owen, *Handbook of Statistical Tables*. © 1962 by Addison-Wesley Publishing Company, Inc. Reprinted by permission of Addison Wesley Longman.

Table IX Critical Values of T for the Wilcoxon Signed-Rank Test

| n | One-tailed $\alpha = .005$ Two-tailed $\alpha = .01$ | One-tailed $\alpha = .01$ Two-tailed $\alpha = .02$ | One-tailed $\alpha = .025$ Two-tailed $\alpha = .05$ | One-tailed $\alpha = .05$ Two-tailed $\alpha = .10$ |
|-----|---|--|---|--|
| 1 | — | — | — | — |
| 2 | — | — | — | — |
| 3 | — | — | — | — |
| 4 | — | — | — | — |
| 5 | — | — | — | 1 |
| 6 | — | — | 1 | 2 |
| 7 | — | 0 | 2 | 4 |
| 8 | 0 | 2 | 4 | 6 |
| 9 | 2 | 3 | 6 | 8 |
| 10 | 3 | 5 | 8 | 11 |
| 11 | 5 | 7 | 11 | 14 |
| 12 | 7 | 10 | 14 | 17 |
| 13 | 10 | 13 | 17 | 21 |
| 14 | 13 | 16 | 21 | 26 |
| 15 | 16 | 20 | 25 | 30 |

Source: *Some Rapid Approximate Statistical Procedures*, 1964. Reprinted with permission of Lederle Pharmaceutical Division of American Cyanamid Company, Philadelphia, PA.

Table X Critical Values of T for the Wilcoxon Rank Sum Test

a. One-tailed $\alpha = .025$; Two-tailed $\alpha = .05$

| $n_1 \backslash n_2$ | 3 | | 4 | | 5 | | 6 | | 7 | | 8 | | 9 | | 10 | |
|----------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| | T_L | T_U | T_L | T_U | T_L | T_U | T_L | T_U | T_L | T_U | T_L | T_U | T_L | T_U | T_L | T_U |
| 3 | 5 | 16 | 6 | 18 | 6 | 21 | 7 | 23 | 7 | 26 | 8 | 28 | 8 | 31 | 9 | 33 |
| 4 | 6 | 18 | 11 | 25 | 12 | 28 | 12 | 32 | 13 | 35 | 14 | 38 | 15 | 41 | 16 | 44 |
| 5 | 6 | 21 | 12 | 28 | 18 | 37 | 19 | 41 | 20 | 45 | 21 | 49 | 22 | 53 | 24 | 56 |
| 6 | 7 | 23 | 12 | 32 | 19 | 41 | 26 | 52 | 28 | 56 | 29 | 61 | 31 | 65 | 32 | 70 |
| 7 | 7 | 26 | 13 | 35 | 20 | 45 | 28 | 56 | 37 | 68 | 39 | 73 | 41 | 78 | 43 | 83 |
| 8 | 8 | 28 | 14 | 38 | 21 | 49 | 29 | 61 | 39 | 73 | 49 | 87 | 51 | 93 | 54 | 98 |
| 9 | 8 | 31 | 15 | 41 | 22 | 53 | 31 | 65 | 41 | 78 | 51 | 93 | 63 | 108 | 66 | 114 |
| 10 | 9 | 33 | 16 | 44 | 24 | 56 | 32 | 70 | 43 | 83 | 54 | 98 | 66 | 114 | 79 | 131 |

b. One-tailed $\alpha = .05$; Two-tailed $\alpha = .10$

| $n_1 \backslash n_2$ | 3 | | 4 | | 5 | | 6 | | 7 | | 8 | | 9 | | 10 | |
|----------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| | T_L | T_U | T_L | T_U | T_L | T_U | T_L | T_U | T_L | T_U | T_L | T_U | T_L | T_U | T_L | T_U |
| 3 | 6 | 15 | 7 | 17 | 7 | 20 | 8 | 22 | 9 | 24 | 9 | 27 | 10 | 29 | 11 | 31 |
| 4 | 7 | 17 | 12 | 24 | 13 | 27 | 14 | 30 | 15 | 33 | 16 | 36 | 17 | 39 | 18 | 42 |
| 5 | 7 | 20 | 13 | 27 | 19 | 36 | 20 | 40 | 22 | 43 | 24 | 46 | 25 | 50 | 26 | 54 |
| 6 | 8 | 22 | 14 | 30 | 20 | 40 | 28 | 50 | 30 | 54 | 32 | 58 | 33 | 63 | 35 | 67 |
| 7 | 9 | 24 | 15 | 33 | 22 | 43 | 30 | 54 | 39 | 66 | 41 | 71 | 43 | 76 | 46 | 80 |
| 8 | 9 | 27 | 16 | 36 | 24 | 46 | 32 | 58 | 41 | 71 | 52 | 84 | 54 | 90 | 57 | 95 |
| 9 | 10 | 29 | 17 | 39 | 25 | 50 | 33 | 63 | 43 | 76 | 54 | 90 | 66 | 105 | 69 | 111 |
| 10 | 11 | 31 | 18 | 42 | 26 | 54 | 35 | 67 | 46 | 80 | 57 | 95 | 69 | 111 | 83 | 127 |

Source: *Some Rapid Approximate Statistical Procedures*, 1964. Reprinted with the permission of Lederle Pharmaceutical Division of American Cyanamid Company, Philadelphia, PA.

Table XI Critical Values for the Spearman Rho Rank Correlation Coefficient Test

| <i>n</i> | One-tailed α | | | |
|----------|---------------------|-------|-------|-------|
| | .05 | .025 | .01 | .005 |
| | Two-tailed α | | | |
| | .10 | .05 | .02 | .01 |
| 5 | ±.900 | — | — | — |
| 6 | ±.829 | ±.886 | ±.943 | — |
| 7 | ±.714 | ±.786 | ±.893 | ±.929 |
| 8 | ±.643 | ±.738 | ±.833 | ±.881 |
| 9 | ±.600 | ±.700 | ±.783 | ±.833 |
| 10 | ±.564 | ±.648 | ±.745 | ±.794 |
| 11 | ±.536 | ±.618 | ±.709 | ±.755 |
| 12 | ±.503 | ±.587 | ±.678 | ±.727 |
| 13 | ±.475 | ±.566 | ±.672 | ±.744 |
| 14 | ±.456 | ±.544 | ±.645 | ±.714 |
| 15 | ±.440 | ±.524 | ±.622 | ±.688 |
| 16 | ±.425 | ±.506 | ±.601 | ±.665 |
| 17 | ±.411 | ±.490 | ±.582 | ±.644 |
| 18 | ±.399 | ±.475 | ±.564 | ±.625 |
| 19 | ±.388 | ±.462 | ±.548 | ±.607 |
| 20 | ±.377 | ±.450 | ±.534 | ±.591 |
| 21 | ±.368 | ±.438 | ±.520 | ±.576 |
| 22 | ±.359 | ±.428 | ±.508 | ±.562 |
| 23 | ±.351 | ±.418 | ±.496 | ±.549 |
| 24 | ±.343 | ±.409 | ±.485 | ±.537 |
| 25 | ±.336 | ±.400 | ±.475 | ±.526 |
| 26 | ±.329 | ±.392 | ±.465 | ±.515 |
| 27 | ±.323 | ±.384 | ±.456 | ±.505 |
| 28 | ±.317 | ±.377 | ±.448 | ±.496 |
| 29 | ±.311 | ±.370 | ±.440 | ±.487 |
| 30 | ±.305 | ±.364 | ±.432 | ±.478 |

Table XII Critical Values for a Two-Tailed Runs Test with $\alpha = .05$

| $n_1 \backslash n_2$ | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|----------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|----------|
| 2 | — | — | — | — | — | — | — | 2 6 | 2 6 | 2 6 | 2 6 |
| 3 | — | 2 8 | 2 8 | 2 8 | 2 8 | 2 8 | 2 8 | 2 8 | 2 8 | 2 8 | 3 8 |
| 4 | 2 9 | 2 9 | 2 10 | 3 10 | 3 10 | 3 10 | 3 10 | 3 10 | 3 10 | 3 10 | 3 10 |
| 5 | 2 10 | 3 10 | 3 11 | 3 11 | 3 12 | 3 12 | 4 12 | 4 12 | 4 12 | 4 12 | 4 12 |
| 6 | 3 10 | 3 11 | 3 12 | 3 12 | 4 13 | 4 13 | 4 13 | 4 13 | 5 14 | 5 14 | 5 14 |
| 7 | 3 11 | 3 12 | 3 13 | 4 13 | 4 14 | 5 14 | 5 14 | 5 14 | 5 15 | 5 15 | 6 15 |
| 8 | 3 11 | 3 12 | 4 13 | 4 14 | 5 14 | 5 15 | 5 15 | 6 16 | 6 16 | 6 16 | 6 16 |
| 9 | 3 12 | 4 13 | 4 14 | 5 14 | 5 15 | 5 16 | 6 16 | 6 16 | 6 17 | 7 17 | 7 18 |
| 10 | 3 12 | 4 13 | 5 14 | 5 15 | 5 16 | 6 16 | 6 17 | 7 17 | 7 18 | 7 18 | 7 18 |
| 11 | 4 12 | 4 13 | 5 14 | 5 15 | 6 16 | 6 17 | 7 17 | 7 18 | 7 19 | 8 19 | 8 19 |
| 12 | 4 12 | 4 13 | 5 14 | 6 16 | 6 16 | 7 17 | 7 18 | 7 19 | 8 19 | 8 20 | 8 20 |
| 13 | 4 12 | 5 14 | 5 15 | 6 16 | 6 17 | 7 18 | 7 19 | 8 19 | 8 20 | 9 20 | 9 21 |
| 14 | 4 12 | 5 14 | 5 15 | 6 16 | 7 17 | 7 18 | 8 19 | 8 20 | 9 20 | 9 21 | 9 22 |
| 15 | 4 12 | 5 14 | 6 15 | 6 16 | 7 18 | 7 18 | 8 19 | 8 20 | 9 21 | 9 22 | 10 22 |

Source: Frieda S. Swed and C. Eisenhart, "Tables for Testing Randomness of Grouping in a Sequence of Alternatives," *The Annals of Statistics* 14(1943). Reprinted with permission of the Institute of Mathematical Statistics.