



Oxford Cambridge and RSA

**Wednesday 8 June 2022 – Afternoon**

**Level 3 Certificate Core Maths B (MEI)**

**H869/02 Statistical Problem Solving**

**Formulae and Statistical Tables (ST1)**

**Time allowed: 2 hours**



**INSTRUCTIONS**

- Do **not** send this Booklet for marking. Keep it in the centre or recycle it.

**INFORMATION**

- This document has **8** pages.

## STATISTICS: HYPOTHESIS TESTS

| Description                    | Test statistic                             |
|--------------------------------|--------------------------------------------|
| Spearman rank correlation test | $r_s = 1 - \frac{6\sum d_i^2}{n(n^2 - 1)}$ |
| $\chi^2$ test                  | $X^2 = \sum \frac{(f_o - f_e)^2}{f_e}$     |

# CRITICAL VALUES FOR CORRELATION COEFFICIENTS

Critical values for the product moment correlation coefficient,  $r$

|          | 5%     | 2½%    | 1%     | ½%     | 1-Tail Test | 5%     | 2½%    | 1%     | ½%     |
|----------|--------|--------|--------|--------|-------------|--------|--------|--------|--------|
|          | 10%    | 5%     | 2%     | 1%     |             | 10%    | 5%     | 2%     | 1%     |
| <i>n</i> |        |        |        |        | <i>n</i>    |        |        |        |        |
| 1        | —      | —      | —      | —      | 31          | 0.3009 | 0.3550 | 0.4158 | 0.4556 |
| 2        | —      | —      | —      | —      | 32          | 0.2960 | 0.3494 | 0.4093 | 0.4487 |
| 3        | 0.9877 | 0.9969 | 0.9995 | 0.9999 | 33          | 0.2913 | 0.3440 | 0.4032 | 0.4421 |
| 4        | 0.9000 | 0.9500 | 0.9800 | 0.9900 | 34          | 0.2869 | 0.3388 | 0.3972 | 0.4357 |
| 5        | 0.8054 | 0.8783 | 0.9343 | 0.9587 | 35          | 0.2826 | 0.3338 | 0.3916 | 0.4296 |
| 6        | 0.7293 | 0.8114 | 0.8822 | 0.9172 | 36          | 0.2785 | 0.3291 | 0.3862 | 0.4238 |
| 7        | 0.6694 | 0.7545 | 0.8329 | 0.8745 | 37          | 0.2746 | 0.3246 | 0.3810 | 0.4182 |
| 8        | 0.6215 | 0.7067 | 0.7887 | 0.8343 | 38          | 0.2709 | 0.3202 | 0.3760 | 0.4128 |
| 9        | 0.5822 | 0.6664 | 0.7498 | 0.7977 | 39          | 0.2673 | 0.3160 | 0.3712 | 0.4076 |
| 10       | 0.5494 | 0.6319 | 0.7155 | 0.7646 | 40          | 0.2638 | 0.3120 | 0.3665 | 0.4026 |
| 11       | 0.5214 | 0.6021 | 0.6851 | 0.7348 | 41          | 0.2605 | 0.3081 | 0.3621 | 0.3978 |
| 12       | 0.4973 | 0.5760 | 0.6581 | 0.7079 | 42          | 0.2573 | 0.3044 | 0.3578 | 0.3932 |
| 13       | 0.4762 | 0.5529 | 0.6339 | 0.6835 | 43          | 0.2542 | 0.3008 | 0.3536 | 0.3887 |
| 14       | 0.4575 | 0.5324 | 0.6120 | 0.6614 | 44          | 0.2512 | 0.2973 | 0.3496 | 0.3843 |
| 15       | 0.4409 | 0.5140 | 0.5923 | 0.6411 | 45          | 0.2483 | 0.2940 | 0.3457 | 0.3801 |
| 16       | 0.4259 | 0.4973 | 0.5742 | 0.6226 | 46          | 0.2455 | 0.2907 | 0.3420 | 0.3761 |
| 17       | 0.4124 | 0.4821 | 0.5577 | 0.6055 | 47          | 0.2429 | 0.2876 | 0.3384 | 0.3721 |
| 18       | 0.4000 | 0.4683 | 0.5425 | 0.5897 | 48          | 0.2403 | 0.2845 | 0.3348 | 0.3683 |
| 19       | 0.3887 | 0.4555 | 0.5285 | 0.5751 | 49          | 0.2377 | 0.2816 | 0.3314 | 0.3646 |
| 20       | 0.3783 | 0.4438 | 0.5155 | 0.5614 | 50          | 0.2353 | 0.2787 | 0.3281 | 0.3610 |
| 21       | 0.3687 | 0.4329 | 0.5034 | 0.5487 | 51          | 0.2329 | 0.2759 | 0.3249 | 0.3575 |
| 22       | 0.3598 | 0.4227 | 0.4921 | 0.5368 | 52          | 0.2306 | 0.2732 | 0.3218 | 0.3542 |
| 23       | 0.3515 | 0.4132 | 0.4815 | 0.5256 | 53          | 0.2284 | 0.2706 | 0.3188 | 0.3509 |
| 24       | 0.3438 | 0.4044 | 0.4716 | 0.5151 | 54          | 0.2262 | 0.2681 | 0.3158 | 0.3477 |
| 25       | 0.3365 | 0.3961 | 0.4622 | 0.5052 | 55          | 0.2241 | 0.2656 | 0.3129 | 0.3445 |
| 26       | 0.3297 | 0.3882 | 0.4534 | 0.4958 | 56          | 0.2221 | 0.2632 | 0.3102 | 0.3415 |
| 27       | 0.3233 | 0.3809 | 0.4451 | 0.4869 | 57          | 0.2201 | 0.2609 | 0.3074 | 0.3385 |
| 28       | 0.3172 | 0.3739 | 0.4372 | 0.4785 | 58          | 0.2181 | 0.2586 | 0.3048 | 0.3357 |
| 29       | 0.3115 | 0.3673 | 0.4297 | 0.4705 | 59          | 0.2162 | 0.2564 | 0.3022 | 0.3328 |
| 30       | 0.3061 | 0.3610 | 0.4226 | 0.4629 | 60          | 0.2144 | 0.2542 | 0.2997 | 0.3301 |

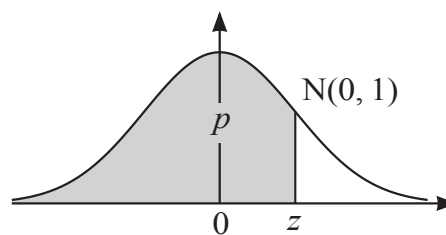
**Critical values for Spearman's rank correlation coefficient,  $r_s$**

|          | 5%     | 2½%    | 1%     | ½%     | <b>1-Tail Test</b> | 5%     | 2½%    | 1%     | ½%     |
|----------|--------|--------|--------|--------|--------------------|--------|--------|--------|--------|
|          | 10%    | 5%     | 2%     | 1%     |                    | 10%    | 5%     | 2%     | 1%     |
| <i>n</i> |        |        |        |        | <i>n</i>           |        |        |        |        |
| 1        | —      | —      | —      | —      | 31                 | 0.3012 | 0.3560 | 0.4185 | 0.4593 |
| 2        | —      | —      | —      | —      | 32                 | 0.2962 | 0.3504 | 0.4117 | 0.4523 |
| 3        | —      | —      | —      | —      | 33                 | 0.2914 | 0.3449 | 0.4054 | 0.4455 |
| 4        | 1.0000 | —      | —      | —      | 34                 | 0.2871 | 0.3396 | 0.3995 | 0.4390 |
| 5        | 0.9000 | 1.0000 | 1.0000 | —      | 35                 | 0.2829 | 0.3347 | 0.3936 | 0.4328 |
| 6        | 0.8286 | 0.8857 | 0.9429 | 1.0000 | 36                 | 0.2788 | 0.3300 | 0.3882 | 0.4268 |
| 7        | 0.7143 | 0.7857 | 0.8929 | 0.9286 | 37                 | 0.2748 | 0.3253 | 0.3829 | 0.4211 |
| 8        | 0.6429 | 0.7381 | 0.8333 | 0.8810 | 38                 | 0.2710 | 0.3209 | 0.3778 | 0.4155 |
| 9        | 0.6000 | 0.7000 | 0.7833 | 0.8333 | 39                 | 0.2674 | 0.3168 | 0.3729 | 0.4103 |
| 10       | 0.5636 | 0.6485 | 0.7455 | 0.7939 | 40                 | 0.2640 | 0.3128 | 0.3681 | 0.4051 |
| 11       | 0.5364 | 0.6182 | 0.7091 | 0.7545 | 41                 | 0.2606 | 0.3087 | 0.3636 | 0.4002 |
| 12       | 0.5035 | 0.5874 | 0.6783 | 0.7273 | 42                 | 0.2574 | 0.3051 | 0.3594 | 0.3955 |
| 13       | 0.4835 | 0.5604 | 0.6484 | 0.7033 | 43                 | 0.2543 | 0.3014 | 0.3550 | 0.3908 |
| 14       | 0.4637 | 0.5385 | 0.6264 | 0.6791 | 44                 | 0.2513 | 0.2978 | 0.3511 | 0.3865 |
| 15       | 0.4464 | 0.5214 | 0.6036 | 0.6536 | 45                 | 0.2484 | 0.2945 | 0.3470 | 0.3822 |
| 16       | 0.4294 | 0.5029 | 0.5824 | 0.6353 | 46                 | 0.2456 | 0.2913 | 0.3433 | 0.3781 |
| 17       | 0.4142 | 0.4877 | 0.5662 | 0.6176 | 47                 | 0.2429 | 0.2880 | 0.3396 | 0.3741 |
| 18       | 0.4014 | 0.4716 | 0.5501 | 0.5996 | 48                 | 0.2403 | 0.2850 | 0.3361 | 0.3702 |
| 19       | 0.3912 | 0.4596 | 0.5351 | 0.5842 | 49                 | 0.2378 | 0.2820 | 0.3326 | 0.3664 |
| 20       | 0.3805 | 0.4466 | 0.5218 | 0.5699 | 50                 | 0.2353 | 0.2791 | 0.3293 | 0.3628 |
| 21       | 0.3701 | 0.4364 | 0.5091 | 0.5558 | 51                 | 0.2329 | 0.2764 | 0.3260 | 0.3592 |
| 22       | 0.3608 | 0.4252 | 0.4975 | 0.5438 | 52                 | 0.2307 | 0.2736 | 0.3228 | 0.3558 |
| 23       | 0.3528 | 0.4160 | 0.4862 | 0.5316 | 53                 | 0.2284 | 0.2710 | 0.3198 | 0.3524 |
| 24       | 0.3443 | 0.4070 | 0.4757 | 0.5209 | 54                 | 0.2262 | 0.2685 | 0.3168 | 0.3492 |
| 25       | 0.3369 | 0.3977 | 0.4662 | 0.5108 | 55                 | 0.2242 | 0.2659 | 0.3139 | 0.3460 |
| 26       | 0.3306 | 0.3901 | 0.4571 | 0.5009 | 56                 | 0.2221 | 0.2636 | 0.3111 | 0.3429 |
| 27       | 0.3242 | 0.3828 | 0.4487 | 0.4915 | 57                 | 0.2201 | 0.2612 | 0.3083 | 0.3400 |
| 28       | 0.3180 | 0.3755 | 0.4401 | 0.4828 | 58                 | 0.2181 | 0.2589 | 0.3057 | 0.3370 |
| 29       | 0.3118 | 0.3685 | 0.4325 | 0.4749 | 59                 | 0.2162 | 0.2567 | 0.3030 | 0.3342 |
| 30       | 0.3063 | 0.3624 | 0.4251 | 0.4670 | 60                 | 0.2144 | 0.2545 | 0.3005 | 0.3314 |

# THE NORMAL DISTRIBUTION AND ITS INVERSE

## The Normal distribution: values of $\Phi(z) = p$

The table gives the probability,  $p$ , of a random variable distributed as  $N(0, 1)$  being less than  $z$ .



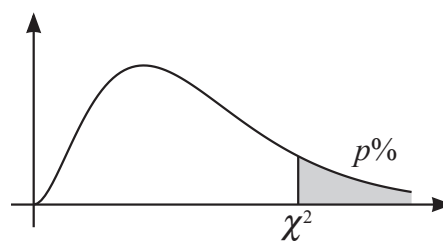
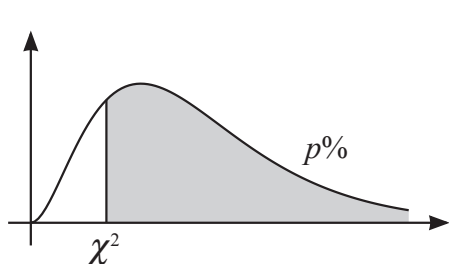
(add)

| $z$ | .00   | .01   | .02   | .03   | .04   | .05   | .06   | .07   | .08   | .09   | 1                            | 2 | 3  | 4  | 5  | 6  | 7  | 8  | 9  |
|-----|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------------------------------|---|----|----|----|----|----|----|----|
| 0.0 | .5000 | .5040 | .5080 | .5120 | .5160 | .5199 | .5239 | .5279 | .5319 | .5359 | 4                            | 8 | 12 | 16 | 20 | 24 | 28 | 32 | 36 |
| 0.1 | .5398 | .5438 | .5478 | .5517 | .5557 | .5596 | .5636 | .5675 | .5714 | .5753 | 4                            | 8 | 12 | 16 | 20 | 24 | 28 | 32 | 35 |
| 0.2 | .5793 | .5832 | .5871 | .5910 | .5948 | .5987 | .6026 | .6064 | .6103 | .6141 | 4                            | 8 | 12 | 15 | 19 | 23 | 27 | 31 | 35 |
| 0.3 | .6179 | .6217 | .6255 | .6293 | .6331 | .6368 | .6406 | .6443 | .6480 | .6517 | 4                            | 8 | 11 | 15 | 19 | 23 | 26 | 30 | 34 |
| 0.4 | .6554 | .6591 | .6628 | .6664 | .6700 | .6736 | .6772 | .6808 | .6844 | .6879 | 4                            | 7 | 11 | 14 | 18 | 22 | 25 | 29 | 32 |
| 0.5 | .6915 | .6950 | .6985 | .7019 | .7054 | .7088 | .7123 | .7157 | .7190 | .7224 | 3                            | 7 | 10 | 14 | 17 | 21 | 24 | 27 | 31 |
| 0.6 | .7257 | .7291 | .7324 | .7357 | .7389 | .7422 | .7454 | .7486 | .7517 | .7549 | 3                            | 6 | 10 | 13 | 16 | 19 | 23 | 26 | 29 |
| 0.7 | .7580 | .7611 | .7642 | .7673 | .7704 | .7734 | .7764 | .7794 | .7823 | .7852 | 3                            | 6 | 9  | 12 | 15 | 18 | 21 | 24 | 27 |
| 0.8 | .7881 | .7910 | .7939 | .7967 | .7995 | .8023 | .8051 | .8078 | .8106 | .8133 | 3                            | 6 | 8  | 11 | 14 | 17 | 19 | 22 | 25 |
| 0.9 | .8159 | .8186 | .8212 | .8238 | .8264 | .8289 | .8315 | .8340 | .8365 | .8389 | 3                            | 5 | 8  | 10 | 13 | 15 | 18 | 20 | 23 |
| 1.0 | .8413 | .8438 | .8461 | .8485 | .8508 | .8531 | .8554 | .8577 | .8599 | .8621 | 2                            | 5 | 7  | 9  | 12 | 14 | 16 | 18 | 21 |
| 1.1 | .8643 | .8665 | .8686 | .8708 | .8729 | .8749 | .8770 | .8790 | .8810 | .8830 | 2                            | 4 | 6  | 8  | 10 | 12 | 14 | 16 | 19 |
| 1.2 | .8849 | .8869 | .8888 | .8907 | .8925 | .8944 | .8962 | .8980 | .8997 | .9015 | 2                            | 4 | 6  | 7  | 9  | 11 | 13 | 15 | 16 |
| 1.3 | .9032 | .9049 | .9066 | .9082 | .9099 | .9115 | .9131 | .9147 | .9162 | .9177 | 2                            | 3 | 5  | 6  | 8  | 10 | 11 | 13 | 14 |
| 1.4 | .9192 | .9207 | .9222 | .9236 | .9251 | .9265 | .9279 | .9292 | .9306 | .9319 | 1                            | 3 | 4  | 6  | 7  | 8  | 10 | 11 | 13 |
| 1.5 | .9332 | .9345 | .9357 | .9370 | .9382 | .9394 | .9406 | .9418 | .9429 | .9441 | 1                            | 2 | 4  | 5  | 6  | 7  | 8  | 10 | 11 |
| 1.6 | .9452 | .9463 | .9474 | .9484 | .9495 | .9505 | .9515 | .9525 | .9535 | .9545 | 1                            | 2 | 3  | 4  | 5  | 6  | 7  | 8  | 9  |
| 1.7 | .9554 | .9564 | .9573 | .9582 | .9591 | .9599 | .9608 | .9616 | .9625 | .9633 | 1                            | 2 | 3  | 3  | 4  | 5  | 6  | 7  | 8  |
| 1.8 | .9641 | .9649 | .9656 | .9664 | .9671 | .9678 | .9686 | .9693 | .9699 | .9706 | 1                            | 1 | 2  | 3  | 4  | 4  | 5  | 6  | 6  |
| 1.9 | .9713 | .9719 | .9726 | .9732 | .9738 | .9744 | .9750 | .9756 | .9761 | .9767 | 1                            | 1 | 2  | 2  | 3  | 4  | 4  | 5  | 5  |
| 2.0 | .9772 | .9778 | .9783 | .9788 | .9793 | .9798 | .9803 | .9808 | .9812 | .9817 | 0                            | 1 | 1  | 2  | 2  | 3  | 3  | 4  | 4  |
| 2.1 | .9821 | .9826 | .9830 | .9834 | .9838 | .9842 | .9846 | .9850 | .9854 | .9857 | 0                            | 1 | 1  | 2  | 2  | 2  | 3  | 3  | 4  |
| 2.2 | .9861 | .9864 | .9868 | .9871 | .9875 | .9878 | .9881 | .9884 | .9887 | .9890 | 0                            | 1 | 1  | 1  | 2  | 2  | 2  | 3  | 3  |
| 2.3 | .9893 | .9896 | .9898 | .9901 | .9904 | .9906 | .9909 | .9911 | .9913 | .9916 | 0                            | 1 | 1  | 1  | 1  | 2  | 2  | 2  | 2  |
| 2.4 | .9918 | .9920 | .9922 | .9925 | .9927 | .9929 | .9931 | .9932 | .9934 | .9936 | 0                            | 0 | 1  | 1  | 1  | 1  | 1  | 2  | 2  |
| 2.5 | .9938 | .9940 | .9941 | .9943 | .9945 | .9946 | .9948 | .9949 | .9951 | .9952 | differences<br>untrustworthy |   |    |    |    |    |    |    |    |
| 2.6 | .9953 | .9955 | .9956 | .9957 | .9959 | .9960 | .9961 | .9962 | .9963 | .9964 |                              |   |    |    |    |    |    |    |    |
| 2.7 | .9965 | .9966 | .9967 | .9968 | .9969 | .9970 | .9971 | .9972 | .9973 | .9974 |                              |   |    |    |    |    |    |    |    |
| 2.8 | .9974 | .9975 | .9976 | .9977 | .9977 | .9978 | .9979 | .9979 | .9980 | .9981 |                              |   |    |    |    |    |    |    |    |
| 2.9 | .9981 | .9982 | .9982 | .9983 | .9984 | .9984 | .9985 | .9985 | .9986 | .9986 |                              |   |    |    |    |    |    |    |    |
| 3.0 | .9987 | .9987 | .9987 | .9988 | .9988 | .9989 | .9989 | .9989 | .9990 | .9990 | differences<br>untrustworthy |   |    |    |    |    |    |    |    |
| 3.1 | .9990 | .9991 | .9991 | .9991 | .9992 | .9992 | .9992 | .9992 | .9993 | .9993 |                              |   |    |    |    |    |    |    |    |
| 3.2 | .9993 | .9993 | .9994 | .9994 | .9994 | .9994 | .9994 | .9995 | .9995 | .9995 |                              |   |    |    |    |    |    |    |    |
| 3.3 | .9995 | .9995 | .9996 | .9996 | .9996 | .9996 | .9996 | .9996 | .9996 | .9997 |                              |   |    |    |    |    |    |    |    |
| 3.4 | .9997 | .9997 | .9997 | .9997 | .9997 | .9997 | .9997 | .9997 | .9997 | .9998 |                              |   |    |    |    |    |    |    |    |

**The Inverse Normal function: values of  $\Phi^{-1}(p) = z$**

| $p$ | .000  | .001  | .002  | .003  | .004  | .005  | .006  | .007  | .008  | .009  |
|-----|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| .50 | .0000 | .0025 | .0050 | .0075 | .0100 | .0125 | .0150 | .0175 | .0201 | .0226 |
| .51 | .0251 | .0276 | .0301 | .0326 | .0351 | .0376 | .0401 | .0426 | .0451 | .0476 |
| .52 | .0502 | .0527 | .0552 | .0577 | .0602 | .0627 | .0652 | .0677 | .0702 | .0728 |
| .53 | .0753 | .0778 | .0803 | .0828 | .0853 | .0878 | .0904 | .0929 | .0954 | .0979 |
| .54 | .1004 | .1030 | .1055 | .1080 | .1105 | .1130 | .1156 | .1181 | .1206 | .1231 |
| .55 | .1257 | .1282 | .1307 | .1332 | .1358 | .1383 | .1408 | .1434 | .1459 | .1484 |
| .56 | .1510 | .1535 | .1560 | .1586 | .1611 | .1637 | .1662 | .1687 | .1713 | .1738 |
| .57 | .1764 | .1789 | .1815 | .1840 | .1866 | .1891 | .1917 | .1942 | .1968 | .1993 |
| .58 | .2019 | .2045 | .2070 | .2096 | .2121 | .2147 | .2173 | .2198 | .2224 | .2250 |
| .59 | .2275 | .2301 | .2327 | .2353 | .2378 | .2404 | .2430 | .2456 | .2482 | .2508 |
| .60 | .2533 | .2559 | .2585 | .2611 | .2637 | .2663 | .2689 | .2715 | .2741 | .2767 |
| .61 | .2793 | .2819 | .2845 | .2871 | .2898 | .2924 | .2950 | .2976 | .3002 | .3029 |
| .62 | .3055 | .3081 | .3107 | .3134 | .3160 | .3186 | .3213 | .3239 | .3266 | .3292 |
| .63 | .3319 | .3345 | .3372 | .3398 | .3425 | .3451 | .3478 | .3505 | .3531 | .3558 |
| .64 | .3585 | .3611 | .3638 | .3665 | .3692 | .3719 | .3745 | .3772 | .3799 | .3826 |
| .65 | .3853 | .3880 | .3907 | .3934 | .3961 | .3989 | .4016 | .4043 | .4070 | .4097 |
| .66 | .4125 | .4152 | .4179 | .4207 | .4234 | .4261 | .4289 | .4316 | .4344 | .4372 |
| .67 | .4399 | .4427 | .4454 | .4482 | .4510 | .4538 | .4565 | .4593 | .4621 | .4649 |
| .68 | .4677 | .4705 | .4733 | .4761 | .4789 | .4817 | .4845 | .4874 | .4902 | .4930 |
| .69 | .4959 | .4987 | .5015 | .5044 | .5072 | .5101 | .5129 | .5158 | .5187 | .5215 |
| .70 | .5244 | .5273 | .5302 | .5330 | .5359 | .5388 | .5417 | .5446 | .5476 | .5505 |
| .71 | .5534 | .5563 | .5592 | .5622 | .5651 | .5681 | .5710 | .5740 | .5769 | .5799 |
| .72 | .5828 | .5858 | .5888 | .5918 | .5948 | .5978 | .6008 | .6038 | .6068 | .6098 |
| .73 | .6128 | .6158 | .6189 | .6219 | .6250 | .6280 | .6311 | .6341 | .6372 | .6403 |
| .74 | .6433 | .6464 | .6495 | .6526 | .6557 | .6588 | .6620 | .6651 | .6682 | .6713 |
| .75 | .6745 | .6776 | .6808 | .6840 | .6871 | .6903 | .6935 | .6967 | .6999 | .7031 |
| .76 | .7063 | .7095 | .7128 | .7160 | .7192 | .7225 | .7257 | .7290 | .7323 | .7356 |
| .77 | .7388 | .7421 | .7454 | .7488 | .7521 | .7554 | .7588 | .7621 | .7655 | .7688 |
| .78 | .7722 | .7756 | .7790 | .7824 | .7858 | .7892 | .7926 | .7961 | .7995 | .8030 |
| .79 | .8064 | .8099 | .8134 | .8169 | .8204 | .8239 | .8274 | .8310 | .8345 | .8381 |
| .80 | .8416 | .8452 | .8488 | .8524 | .8560 | .8596 | .8633 | .8669 | .8705 | .8742 |
| .81 | .8779 | .8816 | .8853 | .8890 | .8927 | .8965 | .9002 | .9040 | .9078 | .9116 |
| .82 | .9154 | .9192 | .9230 | .9269 | .9307 | .9346 | .9385 | .9424 | .9463 | .9502 |
| .83 | .9542 | .9581 | .9621 | .9661 | .9701 | .9741 | .9782 | .9822 | .9863 | .9904 |
| .84 | .9945 | .9986 | 1.003 | 1.007 | 1.011 | 1.015 | 1.019 | 1.024 | 1.028 | 1.032 |
| .85 | 1.036 | 1.041 | 1.045 | 1.049 | 1.054 | 1.058 | 1.063 | 1.067 | 1.071 | 1.076 |
| .86 | 1.080 | 1.085 | 1.089 | 1.094 | 1.099 | 1.103 | 1.108 | 1.112 | 1.117 | 1.122 |
| .87 | 1.126 | 1.131 | 1.136 | 1.141 | 1.146 | 1.150 | 1.155 | 1.160 | 1.165 | 1.170 |
| .88 | 1.175 | 1.180 | 1.185 | 1.190 | 1.195 | 1.200 | 1.206 | 1.211 | 1.216 | 1.221 |
| .89 | 1.227 | 1.232 | 1.237 | 1.243 | 1.248 | 1.254 | 1.259 | 1.265 | 1.270 | 1.276 |
| .90 | 1.282 | 1.287 | 1.293 | 1.299 | 1.305 | 1.311 | 1.317 | 1.323 | 1.329 | 1.335 |
| .91 | 1.341 | 1.347 | 1.353 | 1.360 | 1.366 | 1.372 | 1.379 | 1.385 | 1.392 | 1.398 |
| .92 | 1.405 | 1.412 | 1.419 | 1.426 | 1.433 | 1.440 | 1.447 | 1.454 | 1.461 | 1.468 |
| .93 | 1.476 | 1.483 | 1.491 | 1.499 | 1.506 | 1.514 | 1.522 | 1.530 | 1.538 | 1.546 |
| .94 | 1.555 | 1.563 | 1.572 | 1.581 | 1.589 | 1.598 | 1.607 | 1.616 | 1.626 | 1.635 |
| .95 | 1.645 | 1.655 | 1.665 | 1.675 | 1.685 | 1.695 | 1.706 | 1.717 | 1.728 | 1.739 |
| .96 | 1.751 | 1.762 | 1.774 | 1.787 | 1.799 | 1.812 | 1.825 | 1.838 | 1.852 | 1.866 |
| .97 | 1.881 | 1.896 | 1.911 | 1.927 | 1.943 | 1.960 | 1.977 | 1.995 | 2.014 | 2.034 |
| .98 | 2.054 | 2.075 | 2.097 | 2.120 | 2.144 | 2.170 | 2.197 | 2.226 | 2.257 | 2.290 |
| .99 | 2.326 | 2.366 | 2.409 | 2.457 | 2.512 | 2.576 | 2.652 | 2.748 | 2.878 | 3.090 |

# PERCENTAGE POINTS OF THE $\chi^2$ DISTRIBUTION



| $p\%$   | 99    | 97.5  | 95    | 90    |  | 10    | 5     | 2.5   | 1     | 0.5   |
|---------|-------|-------|-------|-------|--|-------|-------|-------|-------|-------|
| $v = 1$ | .0001 | .0010 | .0039 | .0158 |  | 2.706 | 3.841 | 5.024 | 6.635 | 7.879 |
| 2       | .0201 | .0506 | 0.103 | 0.211 |  | 4.605 | 5.991 | 7.378 | 9.210 | 10.60 |
| 3       | 0.115 | 0.216 | 0.352 | 0.584 |  | 6.251 | 7.815 | 9.348 | 11.34 | 12.84 |
| 4       | 0.297 | 0.484 | 0.711 | 1.064 |  | 7.779 | 9.488 | 11.14 | 13.28 | 14.86 |
| 5       | 0.554 | 0.831 | 1.145 | 1.610 |  | 9.236 | 11.07 | 12.83 | 15.09 | 16.75 |
| 6       | 0.872 | 1.237 | 1.635 | 2.204 |  | 10.64 | 12.59 | 14.45 | 16.81 | 18.55 |
| 7       | 1.239 | 1.690 | 2.167 | 2.833 |  | 12.02 | 14.07 | 16.01 | 18.48 | 20.28 |
| 8       | 1.646 | 2.180 | 2.733 | 3.490 |  | 13.36 | 15.51 | 17.53 | 20.09 | 21.95 |
| 9       | 2.088 | 2.700 | 3.325 | 4.168 |  | 14.68 | 16.92 | 19.02 | 21.67 | 23.59 |
| 10      | 2.558 | 3.247 | 3.940 | 4.865 |  | 15.99 | 18.31 | 20.48 | 23.21 | 25.19 |
| 11      | 3.053 | 3.816 | 4.575 | 5.578 |  | 17.28 | 19.68 | 21.92 | 24.72 | 26.76 |
| 12      | 3.571 | 4.404 | 5.226 | 6.304 |  | 18.55 | 21.03 | 23.34 | 26.22 | 28.30 |
| 13      | 4.107 | 5.009 | 5.892 | 7.042 |  | 19.81 | 22.36 | 24.74 | 27.69 | 29.82 |
| 14      | 4.660 | 5.629 | 6.571 | 7.790 |  | 21.06 | 23.68 | 26.12 | 29.14 | 31.32 |
| 15      | 5.229 | 6.262 | 7.261 | 8.547 |  | 22.31 | 25.00 | 27.49 | 30.58 | 32.80 |
| 16      | 5.812 | 6.908 | 7.962 | 9.312 |  | 23.54 | 26.30 | 28.85 | 32.00 | 34.27 |
| 17      | 6.408 | 7.564 | 8.672 | 10.09 |  | 24.77 | 27.59 | 30.19 | 33.41 | 35.72 |
| 18      | 7.015 | 8.231 | 9.390 | 10.86 |  | 25.99 | 28.87 | 31.53 | 34.81 | 37.16 |
| 19      | 7.633 | 8.907 | 10.12 | 11.65 |  | 27.20 | 30.14 | 32.85 | 36.19 | 38.58 |
| 20      | 8.260 | 9.591 | 10.85 | 12.44 |  | 28.41 | 31.41 | 34.17 | 37.57 | 40.00 |
| 21      | 8.897 | 10.28 | 11.59 | 13.24 |  | 29.62 | 32.67 | 35.48 | 38.93 | 41.40 |
| 22      | 9.542 | 10.98 | 12.34 | 14.04 |  | 30.81 | 33.92 | 36.78 | 40.29 | 42.80 |
| 23      | 10.20 | 11.69 | 13.09 | 14.85 |  | 32.01 | 35.17 | 38.08 | 41.64 | 44.18 |
| 24      | 10.86 | 12.40 | 13.85 | 15.66 |  | 33.20 | 36.42 | 39.36 | 42.98 | 45.56 |
| 25      | 11.52 | 13.12 | 14.61 | 16.47 |  | 34.38 | 37.65 | 40.65 | 44.31 | 46.93 |
| 26      | 12.20 | 13.84 | 15.38 | 17.29 |  | 35.56 | 38.89 | 41.92 | 45.64 | 48.29 |
| 27      | 12.88 | 14.57 | 16.15 | 18.11 |  | 36.74 | 40.11 | 43.19 | 46.96 | 49.64 |
| 28      | 13.56 | 15.31 | 16.93 | 18.94 |  | 37.92 | 41.34 | 44.46 | 48.28 | 50.99 |
| 29      | 14.26 | 16.05 | 17.71 | 19.77 |  | 39.09 | 42.56 | 45.72 | 49.59 | 52.34 |
| 30      | 14.95 | 16.79 | 18.49 | 20.60 |  | 40.26 | 43.77 | 46.98 | 50.89 | 53.67 |
| 35      | 18.51 | 20.57 | 22.47 | 24.80 |  | 46.06 | 49.80 | 53.20 | 57.34 | 60.27 |
| 40      | 22.16 | 24.43 | 26.51 | 29.05 |  | 51.81 | 55.76 | 59.34 | 63.69 | 66.77 |
| 50      | 29.71 | 32.36 | 34.76 | 37.69 |  | 63.17 | 67.50 | 71.42 | 76.15 | 79.49 |
| 100     | 70.06 | 74.22 | 77.93 | 82.36 |  | 118.5 | 124.3 | 129.6 | 135.8 | 140.2 |

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