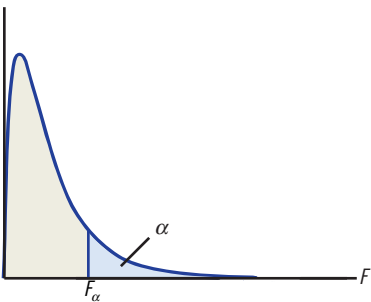
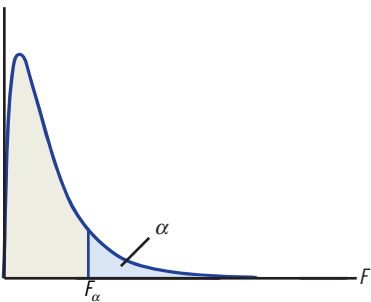


Critical Values of the *F*-Distribution ($\alpha = 0.005$)



| | | Numerator Degrees of Freedom | | | | | | | | |
|--------------------------------|-----|------------------------------|------------|------------|------------|------------|------------|------------|------------|------------|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| Denominator Degrees of Freedom | 1 | 16210.7227 | 19999.5000 | 21614.7414 | 22499.5833 | 23055.7982 | 23437.1111 | 23714.5658 | 23925.4062 | 24091.0041 |
| | 2 | 198.5013 | 199.0000 | 199.1664 | 199.2497 | 199.2997 | 199.3330 | 199.3568 | 199.3746 | 199.3885 |
| | 3 | 55.5520 | 49.7993 | 47.4672 | 46.1946 | 45.3916 | 44.8385 | 44.4341 | 44.1256 | 43.8824 |
| | 4 | 31.3328 | 26.2843 | 24.2591 | 23.1545 | 22.4564 | 21.9746 | 21.6217 | 21.3520 | 21.1391 |
| | 5 | 22.7848 | 18.3138 | 16.5298 | 15.5561 | 14.9396 | 14.5133 | 14.2004 | 13.9610 | 13.7716 |
| | 6 | 18.6350 | 14.5441 | 12.9166 | 12.0275 | 11.4637 | 11.0730 | 10.7859 | 10.5658 | 10.3915 |
| | 7 | 16.2356 | 12.4040 | 10.8824 | 10.0505 | 9.5221 | 9.1553 | 8.8854 | 8.6781 | 8.5138 |
| | 8 | 14.6882 | 11.0424 | 9.5965 | 8.8051 | 8.3018 | 7.9520 | 7.6941 | 7.4959 | 7.3386 |
| | 9 | 13.6136 | 10.1067 | 8.7171 | 7.9559 | 7.4712 | 7.1339 | 6.8849 | 6.6933 | 6.5411 |
| | 10 | 12.8265 | 9.4270 | 8.0807 | 7.3428 | 6.8724 | 6.5446 | 6.3025 | 6.1159 | 5.9676 |
| | 11 | 12.2263 | 8.9122 | 7.6004 | 6.8809 | 6.4217 | 6.1016 | 5.8648 | 5.6821 | 5.5368 |
| | 12 | 11.7542 | 8.5096 | 7.2258 | 6.5211 | 6.0711 | 5.7570 | 5.5245 | 5.3451 | 5.2021 |
| | 13 | 11.3735 | 8.1865 | 6.9258 | 6.2335 | 5.7910 | 5.4819 | 5.2529 | 5.0761 | 4.9351 |
| | 14 | 11.0603 | 7.9216 | 6.6804 | 5.9984 | 5.5623 | 5.2574 | 5.0313 | 4.8566 | 4.7173 |
| | 15 | 10.7980 | 7.7008 | 6.4760 | 5.8029 | 5.3721 | 5.0708 | 4.8473 | 4.6744 | 4.5364 |
| | 16 | 10.5755 | 7.5138 | 6.3034 | 5.6378 | 5.2117 | 4.9134 | 4.6920 | 4.5207 | 4.3838 |
| | 17 | 10.3842 | 7.3536 | 6.1556 | 5.4967 | 5.0746 | 4.7789 | 4.5594 | 4.3894 | 4.2535 |
| | 18 | 10.2181 | 7.2148 | 6.0278 | 5.3746 | 4.9560 | 4.6627 | 4.4448 | 4.2759 | 4.1410 |
| | 19 | 10.0725 | 7.0935 | 5.9161 | 5.2681 | 4.8526 | 4.5614 | 4.3448 | 4.1770 | 4.0428 |
| | 20 | 9.9439 | 6.9865 | 5.8177 | 5.1743 | 4.7616 | 4.4721 | 4.2569 | 4.0900 | 3.9564 |
| | 21 | 9.8295 | 6.8914 | 5.7304 | 5.0911 | 4.6809 | 4.3931 | 4.1789 | 4.0128 | 3.8799 |
| | 22 | 9.7271 | 6.8064 | 5.6524 | 5.0168 | 4.6088 | 4.3225 | 4.1094 | 3.9440 | 3.8116 |
| | 23 | 9.6348 | 6.7300 | 5.5823 | 4.9500 | 4.5441 | 4.2591 | 4.0469 | 3.8822 | 3.7502 |
| | 24 | 9.5513 | 6.6609 | 5.5190 | 4.8898 | 4.4857 | 4.2019 | 3.9905 | 3.8264 | 3.6949 |
| | 25 | 9.4753 | 6.5982 | 5.4615 | 4.8351 | 4.4327 | 4.1500 | 3.9394 | 3.7758 | 3.6447 |
| | 26 | 9.4059 | 6.5410 | 5.4091 | 4.7852 | 4.3844 | 4.1027 | 3.8928 | 3.7297 | 3.5989 |
| | 27 | 9.3423 | 6.4885 | 5.3611 | 4.7396 | 4.3402 | 4.0594 | 3.8501 | 3.6875 | 3.5571 |
| | 28 | 9.2838 | 6.4403 | 5.3170 | 4.6977 | 4.2996 | 4.0197 | 3.8110 | 3.6487 | 3.5186 |
| | 29 | 9.2297 | 6.3958 | 5.2764 | 4.6591 | 4.2622 | 3.9831 | 3.7749 | 3.6131 | 3.4832 |
| | 30 | 9.1797 | 6.3547 | 5.2388 | 4.6234 | 4.2276 | 3.9492 | 3.7416 | 3.5801 | 3.4505 |
| | 40 | 8.8279 | 6.0664 | 4.9758 | 4.3738 | 3.9860 | 3.7129 | 3.5088 | 3.3498 | 3.2220 |
| | 60 | 8.4946 | 5.7950 | 4.7290 | 4.1399 | 3.7599 | 3.4918 | 3.2911 | 3.1344 | 3.0083 |
| | 120 | 8.1788 | 5.5393 | 4.4972 | 3.9207 | 3.5482 | 3.2849 | 3.0874 | 2.9330 | 2.8083 |
| | ∞ | 7.8794 | 5.2983 | 4.2794 | 3.7151 | 3.3499 | 3.0913 | 2.8968 | 2.7444 | 2.6210 |

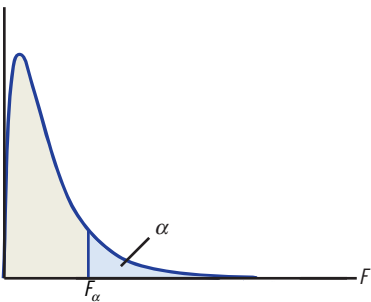
Critical Values of the *F*-Distribution ($\alpha = 0.005$) (continued)



| | | Numerator Degrees of Freedom | | | | | | | | |
|--------------------------------|-----|------------------------------|------------|------------|------------|------------|------------|------------|------------|------------|
| Denominator Degrees of Freedom | | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| | 1 | 24224.4868 | 24334.3581 | 24426.3662 | 24504.5356 | 24571.7673 | 24630.2051 | 24681.4673 | 24726.7982 | 24767.1704 |
| | 2 | 199.3996 | 199.4087 | 199.4163 | 199.4227 | 199.4282 | 199.4329 | 199.4371 | 199.4408 | 199.4440 |
| | 3 | 43.6858 | 43.5236 | 43.3874 | 43.2715 | 43.1716 | 43.0847 | 43.0083 | 42.9407 | 42.8804 |
| | 4 | 20.9667 | 20.8243 | 20.7047 | 20.6027 | 20.5148 | 20.4383 | 20.3710 | 20.3113 | 20.2581 |
| | 5 | 13.6182 | 13.4912 | 13.3845 | 13.2934 | 13.2148 | 13.1463 | 13.0861 | 13.0327 | 12.9850 |
| | 6 | 10.2500 | 10.1329 | 10.0343 | 9.9501 | 9.8774 | 9.8140 | 9.7582 | 9.7086 | 9.6644 |
| | 7 | 8.3803 | 8.2697 | 8.1764 | 8.0967 | 8.0279 | 7.9678 | 7.9148 | 7.8678 | 7.8258 |
| | 8 | 7.2106 | 7.1045 | 7.0149 | 6.9384 | 6.8721 | 6.8143 | 6.7633 | 6.7180 | 6.6775 |
| | 9 | 6.4172 | 6.3142 | 6.2274 | 6.1530 | 6.0887 | 6.0325 | 5.9829 | 5.9388 | 5.8994 |
| | 10 | 5.8467 | 5.7462 | 5.6613 | 5.5887 | 5.5257 | 5.4707 | 5.4221 | 5.3789 | 5.3403 |
| | 11 | 5.4183 | 5.3197 | 5.2363 | 5.1649 | 5.1031 | 5.0489 | 5.0011 | 4.9586 | 4.9205 |
| | 12 | 5.0855 | 4.9884 | 4.9062 | 4.8358 | 4.7748 | 4.7213 | 4.6741 | 4.6321 | 4.5945 |
| | 13 | 4.8199 | 4.7240 | 4.6429 | 4.5733 | 4.5129 | 4.4600 | 4.4132 | 4.3716 | 4.3344 |
| | 14 | 4.6034 | 4.5085 | 4.4281 | 4.3591 | 4.2993 | 4.2468 | 4.2005 | 4.1592 | 4.1221 |
| | 15 | 4.4235 | 4.3295 | 4.2497 | 4.1813 | 4.1219 | 4.0698 | 4.0237 | 3.9827 | 3.9459 |
| | 16 | 4.2719 | 4.1785 | 4.0994 | 4.0314 | 3.9723 | 3.9205 | 3.8747 | 3.8338 | 3.7972 |
| | 17 | 4.1424 | 4.0496 | 3.9709 | 3.9033 | 3.8445 | 3.7929 | 3.7473 | 3.7066 | 3.6701 |
| | 18 | 4.0305 | 3.9382 | 3.8599 | 3.7926 | 3.7341 | 3.6827 | 3.6373 | 3.5967 | 3.5603 |
| | 19 | 3.9329 | 3.8410 | 3.7631 | 3.6961 | 3.6378 | 3.5866 | 3.5412 | 3.5008 | 3.4645 |
| | 20 | 3.8470 | 3.7555 | 3.6779 | 3.6111 | 3.5530 | 3.5020 | 3.4568 | 3.4164 | 3.3802 |
| | 21 | 3.7709 | 3.6798 | 3.6024 | 3.5358 | 3.4779 | 3.4270 | 3.3818 | 3.3416 | 3.3054 |
| | 22 | 3.7030 | 3.6122 | 3.5350 | 3.4686 | 3.4108 | 3.3600 | 3.3150 | 3.2748 | 3.2387 |
| | 23 | 3.6420 | 3.5515 | 3.4745 | 3.4083 | 3.3506 | 3.2999 | 3.2549 | 3.2148 | 3.1787 |
| | 24 | 3.5870 | 3.4967 | 3.4199 | 3.3538 | 3.2962 | 3.2456 | 3.2007 | 3.1606 | 3.1246 |
| | 25 | 3.5371 | 3.4470 | 3.3704 | 3.3044 | 3.2469 | 3.1963 | 3.1515 | 3.1114 | 3.0754 |
| | 26 | 3.4916 | 3.4017 | 3.3252 | 3.2594 | 3.2020 | 3.1515 | 3.1067 | 3.0666 | 3.0306 |
| | 27 | 3.4499 | 3.3602 | 3.2839 | 3.2182 | 3.1608 | 3.1104 | 3.0656 | 3.0256 | 2.9896 |
| | 28 | 3.4117 | 3.3222 | 3.2460 | 3.1803 | 3.1231 | 3.0727 | 3.0279 | 2.9879 | 2.9520 |
| | 29 | 3.3765 | 3.2871 | 3.2110 | 3.1454 | 3.0882 | 3.0379 | 2.9932 | 2.9532 | 2.9173 |
| | 30 | 3.3440 | 3.2547 | 3.1787 | 3.1132 | 3.0560 | 3.0057 | 2.9611 | 2.9211 | 2.8852 |
| | 40 | 3.1167 | 3.0284 | 2.9531 | 2.8880 | 2.8312 | 2.7811 | 2.7365 | 2.6966 | 2.6607 |
| | 60 | 2.9042 | 2.8166 | 2.7419 | 2.6771 | 2.6205 | 2.5705 | 2.5259 | 2.4859 | 2.4498 |
| | 120 | 2.7052 | 2.6183 | 2.5439 | 2.4794 | 2.4228 | 2.3727 | 2.3280 | 2.2878 | 2.2514 |
| | ∞ | 2.5188 | 2.4324 | 2.3583 | 2.2938 | 2.2371 | 2.1868 | 2.1417 | 2.1011 | 2.0642 |

Critical Values of the *F*-Distribution ($\alpha = 0.005$)

(continued)



| | | Numerator Degrees of Freedom | | | | | | |
|--------------------------------|----------|------------------------------|------------|------------|------------|------------|------------|------------|
| | | 19 | 20 | 24 | 30 | 40 | 60 | 120 |
| Denominator Degrees of Freedom | 1 | 24803.3549 | 24835.9709 | 24939.5653 | 25043.6277 | 25148.1532 | 25253.1369 | 25358.5734 |
| | 2 | 199.4470 | 199.4496 | 199.4579 | 199.4663 | 199.4746 | 199.4829 | 199.4912 |
| | 3 | 42.8263 | 42.7775 | 42.6222 | 42.4658 | 42.3082 | 42.1494 | 41.9895 |
| | 4 | 20.2104 | 20.1673 | 20.0300 | 19.8915 | 19.7518 | 19.6107 | 19.4684 |
| | 5 | 12.9422 | 12.9035 | 12.7802 | 12.6556 | 12.5297 | 12.4024 | 12.2737 |
| | 6 | 9.6247 | 9.5888 | 9.4742 | 9.3582 | 9.2408 | 9.1219 | 9.0015 |
| | 7 | 7.7881 | 7.7540 | 7.6450 | 7.5345 | 7.4224 | 7.3088 | 7.1933 |
| | 8 | 6.6411 | 6.6082 | 6.5029 | 6.3961 | 6.2875 | 6.1772 | 6.0649 |
| | 9 | 5.8639 | 5.8318 | 5.7292 | 5.6248 | 5.5186 | 5.4104 | 5.3001 |
| | 10 | 5.3055 | 5.2740 | 5.1732 | 5.0706 | 4.9659 | 4.8592 | 4.7501 |
| | 11 | 4.8863 | 4.8552 | 4.7557 | 4.6543 | 4.5508 | 4.4450 | 4.3367 |
| | 12 | 4.5606 | 4.5299 | 4.4314 | 4.3309 | 4.2282 | 4.1229 | 4.0149 |
| | 13 | 4.3008 | 4.2703 | 4.1726 | 4.0727 | 3.9704 | 3.8655 | 3.7577 |
| | 14 | 4.0888 | 4.0585 | 3.9614 | 3.8619 | 3.7600 | 3.6552 | 3.5473 |
| | 15 | 3.9127 | 3.8826 | 3.7859 | 3.6867 | 3.5850 | 3.4803 | 3.3722 |
| | 16 | 3.7641 | 3.7342 | 3.6378 | 3.5389 | 3.4372 | 3.3324 | 3.2240 |
| | 17 | 3.6372 | 3.6073 | 3.5112 | 3.4124 | 3.3108 | 3.2058 | 3.0971 |
| | 18 | 3.5275 | 3.4977 | 3.4017 | 3.3030 | 3.2014 | 3.0962 | 2.9871 |
| | 19 | 3.4318 | 3.4020 | 3.3062 | 3.2075 | 3.1058 | 3.0004 | 2.8908 |
| | 20 | 3.3475 | 3.3178 | 3.2220 | 3.1234 | 3.0215 | 2.9159 | 2.8058 |
| | 21 | 3.2728 | 3.2431 | 3.1474 | 3.0488 | 2.9467 | 2.8408 | 2.7302 |
| | 22 | 3.2060 | 3.1764 | 3.0807 | 2.9821 | 2.8799 | 2.7736 | 2.6625 |
| | 23 | 3.1461 | 3.1165 | 3.0208 | 2.9221 | 2.8197 | 2.7132 | 2.6015 |
| | 24 | 3.0920 | 3.0624 | 2.9667 | 2.8679 | 2.7654 | 2.6585 | 2.5463 |
| | 25 | 3.0429 | 3.0133 | 2.9176 | 2.8187 | 2.7160 | 2.6088 | 2.4961 |
| | 26 | 2.9981 | 2.9685 | 2.8728 | 2.7738 | 2.6709 | 2.5633 | 2.4501 |
| | 27 | 2.9571 | 2.9275 | 2.8318 | 2.7327 | 2.6296 | 2.5217 | 2.4079 |
| | 28 | 2.9194 | 2.8899 | 2.7941 | 2.6949 | 2.5916 | 2.4834 | 2.3690 |
| | 29 | 2.8847 | 2.8551 | 2.7594 | 2.6600 | 2.5565 | 2.4479 | 2.3331 |
| | 30 | 2.8526 | 2.8230 | 2.7272 | 2.6278 | 2.5241 | 2.4151 | 2.2998 |
| | 40 | 2.6281 | 2.5984 | 2.5020 | 2.4015 | 2.2958 | 2.1838 | 2.0636 |
| | 60 | 2.4171 | 2.3872 | 2.2898 | 2.1874 | 2.0789 | 1.9622 | 1.8341 |
| | 120 | 2.2183 | 2.1881 | 2.0890 | 1.9840 | 1.8709 | 1.7469 | 1.6055 |
| | ∞ | 2.0306 | 1.9998 | 1.8983 | 1.7891 | 1.6691 | 1.5325 | 1.3637 |