

STATISTICS

SECTION II, Part B

Suggested Time—25 minutes

1 Question

Directions: Show all your work. Indicate clearly the methods you use, because you will be scored on the correctness of your methods as well as on the accuracy and completeness of your results and explanations.

To compare success rates for treating allergies at two clinics that specialize in treating allergy sufferers, researchers selected random samples of patient records from the two clinics. The following table summarizes the data.

|                        | Clinic A | Clinic B | Total |
|------------------------|----------|----------|-------|
| Unsuccessful treatment | 51       | 33       | 84    |
| Successful treatment   | 88       | 35       | 123   |
| Total                  | 139      | 68       | 207   |

(a) (i) Complete the following table by recording the relative frequencies of successful and unsuccessful treatments at each clinic.

|                        | Clinic A | Clinic B |
|------------------------|----------|----------|
| Unsuccessful treatment |          |          |
| Successful treatment   |          |          |

(ii) Based on the relative frequency table in part (a-i), which clinic is more successful in treating allergy sufferers? Justify your answer.

GO ON TO THE NEXT PAGE.

Continue your response to QUESTION 6 on this page.

(b) Based on the design of the study, would a statistically significant result allow the researchers to conclude that receiving treatments at the clinic you selected in part (a-ii) causes a higher percentage of successful treatments than at the other clinic? Explain your answer.

A physician who worked at both clinics believed that it was important to separate the patients in the study by severity of the patient's allergy (severe or mild). The physician constructed the following mosaic plot. The values in the mosaic plot represent the number of patients who were either successfully treated or unsuccessfully treated in each allergy severity group within each clinic. For example, the value 78 represents the number of patients successfully treated in the mild group within Clinic A.

CLINIC A

CLINIC B

Based on the mosaic plot, the physician concluded the following:

For mild allergy sufferers, **Clinic B** was more successful in treating allergies.

For severe allergy sufferers, **Clinic B** was more successful in treating allergies.

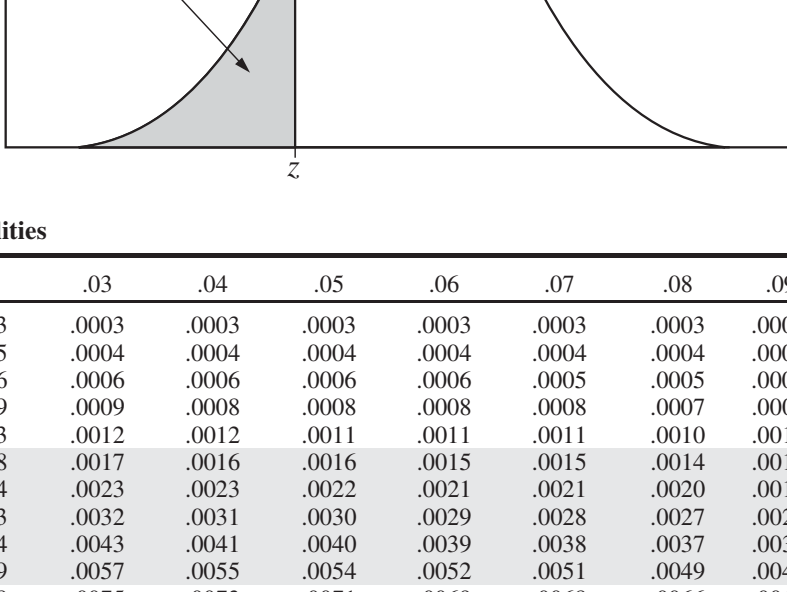
(d) Using your answers from part (c), give a reasonable explanation of why the more successful clinic identified in part (a-ii) is the same as or different from the physician's conclusion that Clinic B is more successful in treating both severe and mild allergies.

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STOP

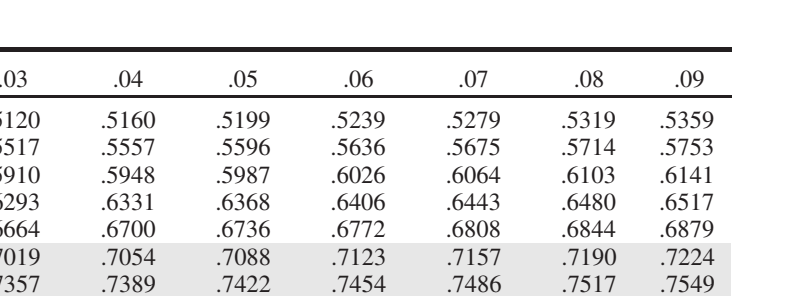
END OF EXAM

Table entry for  $z$  is the probability lying below  $z$ .



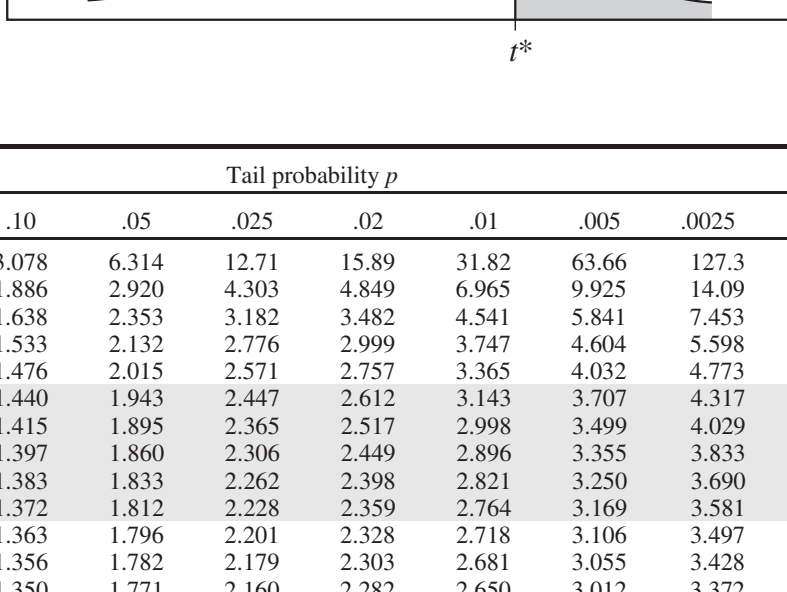
| $z$  | .00   | .01   | .02   | .03   | .04   | .05   | .06   | .07   | .08   | .09   |
|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| -3.4 | .0003 | .0003 | .0003 | .0003 | .0003 | .0003 | .0003 | .0003 | .0003 | .0002 |
| -3.3 | .0005 | .0005 | .0005 | .0004 | .0004 | .0004 | .0004 | .0004 | .0004 | .0003 |
| -3.2 | .0007 | .0007 | .0006 | .0006 | .0006 | .0006 | .0006 | .0005 | .0005 | .0005 |
| -3.1 | .0010 | .0009 | .0009 | .0009 | .0008 | .0008 | .0008 | .0008 | .0007 | .0007 |
| -3.0 | .0013 | .0013 | .0013 | .0012 | .0012 | .0011 | .0011 | .0011 | .0010 | .0010 |
| -2.9 | .0019 | .0018 | .0018 | .0017 | .0016 | .0016 | .0015 | .0015 | .0014 | .0014 |
| -2.8 | .0026 | .0025 | .0024 | .0023 | .0023 | .0022 | .0021 | .0021 | .0020 | .0019 |
| -2.7 | .0035 | .0034 | .0033 | .0032 | .0031 | .0030 | .0029 | .0028 | .0027 | .0026 |
| -2.6 | .0047 | .0045 | .0044 | .0043 | .0041 | .0040 | .0039 | .0038 | .0037 | .0036 |
| -2.5 | .0062 | .0060 | .0059 | .0057 | .0055 | .0054 | .0052 | .0051 | .0049 | .0048 |
| -2.4 | .0082 | .0080 | .0078 | .0075 | .0073 | .0071 | .0069 | .0068 | .0066 | .0064 |
| -2.3 | .0107 | .0104 | .0102 | .0099 | .0096 | .0094 | .0091 | .0089 | .0087 | .0084 |
| -2.2 | .0139 | .0136 | .0132 | .0129 | .0125 | .0122 | .0119 | .0116 | .0113 | .0110 |
| -2.1 | .0178 | .0174 | .0170 | .0166 | .0162 | .0158 | .0154 | .0150 | .0146 | .0143 |
| -2.0 | .0229 | .0222 | .0217 | .0212 | .0207 | .0202 | .0197 | .0192 | .0188 | .0183 |
| -1.9 | .0287 | .0281 | .0274 | .0268 | .0262 | .0256 | .0250 | .0244 | .0239 | .0233 |
| -1.8 | .0359 | .0351 | .0344 | .0336 | .0329 | .0322 | .0314 | .0307 | .0301 | .0294 |
| -1.7 | .0446 | .0436 | .0427 | .0418 | .0409 | .0401 | .0392 | .0384 | .0375 | .0367 |
| -1.6 | .0548 | .0537 | .0526 | .0516 | .0505 | .0495 | .0485 | .0475 | .0465 | .0455 |
| -1.5 | .0668 | .0655 | .0643 | .0630 | .0618 | .0606 | .0594 | .0582 | .0571 | .0559 |
| -1.4 | .0808 | .0793 | .0778 | .0764 | .0749 | .0735 | .0721 | .0708 | .0694 | .0681 |
| -1.3 | .0968 | .0951 | .0934 | .0918 | .0901 | .0885 | .0869 | .0853 | .0838 | .0823 |
| -1.2 | .1151 | .1131 | .1112 | .1093 | .1075 | .1056 | .1038 | .1020 | .1003 | .0985 |
| -1.1 | .1357 | .1335 | .1314 | .1292 | .1271 | .1251 | .1230 | .1210 | .1190 | .1170 |
| -1.0 | .1587 | .1562 | .1539 | .1515 | .1492 | .1469 | .1446 | .1423 | .1401 | .1379 |
| -0.9 | .1841 | .1814 | .1788 | .1762 | .1736 | .1711 | .1685 | .1660 | .1635 | .1611 |
| -0.8 | .2119 | .2090 | .2061 | .2033 | .2005 | .1977 | .1949 | .1922 | .1894 | .1867 |
| -0.7 | .2420 | .2389 | .2358 | .2327 | .2296 | .2266 | .2236 | .2206 | .2177 | .2148 |
| -0.6 | .2743 | .2709 | .2676 | .2643 | .2611 | .2578 | .2546 | .2514 | .2483 | .2451 |
| -0.5 | .3085 | .3050 | .3015 | .2981 | .2946 | .2912 | .2877 | .2843 | .2810 | .2776 |
| -0.4 | .3446 | .3409 | .3372 | .3336 | .3300 | .3264 | .3228 | .3192 | .3156 | .3121 |
| -0.3 | .3821 | .3783 | .3745 | .3707 | .3669 | .3632 | .3594 | .3557 | .3520 | .3483 |
| -0.2 | .4207 | .4168 | .4129 | .4090 | .4052 | .4013 | .3974 | .3936 | .3897 | .3859 |
| -0.1 | .4602 | .4562 | .4522 | .4483 | .4443 | .4404 | .4364 | .4325 | .4286 | .4247 |
| -0.0 | .5000 | .4960 | .4920 | .4880 | .4840 | .4801 | .4761 | .4721 | .4681 | .4641 |

Table entry for  $z$  is the probability lying below  $z$ .



| $z$ | .00   | .01   | .02   | .03   | .04   | .05   | .06   | .07   | .08   | .09   |
|-----|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 0.0 | .5000 | .5040 | .5080 | .5120 | .5160 | .5199 | .5239 | .5279 | .5319 | .5359 |
| 0.1 | .5398 | .5438 | .5478 | .5517 | .5557 | .5596 | .5636 | .5675 | .5714 | .5753 |
| 0.2 | .5793 | .5832 | .5871 | .5910 | .5948 | .5987 | .6026 | .6064 | .6103 | .6141 |
| 0.3 | .6179 | .6217 | .6255 | .6293 | .6331 | .6368 | .6406 | .6443 | .6480 | .6517 |
| 0.4 | .6554 | .6591 | .6628 | .6664 | .6701 | .6736 | .6772 | .6808 | .6844 | .6879 |
| 0.5 | .6915 | .6950 | .6985 | .7019 | .7054 | .7088 | .7125 | .7157 | .7190 | .7224 |
| 0.6 | .7257 | .7291 | .7324 | .7357 | .7389 | .7422 | .7454 | .7486 | .7517 | .7549 |
| 0.7 | .7580 | .7611 | .7642 | .7673 | .7704 | .7734 | .7764 | .7794 | .7823 | .7852 |
| 0.8 | .7881 | .7910 | .7939 | .7967 | .7995 | .8023 | .8051 | .8078 | .8106 | .8133 |
| 0.9 | .8159 | .8186 | .8212 | .8238 | .8264 | .8289 | .8315 | .8340 | .8365 | .8389 |
| 1.0 | .8413 | .8438 | .8461 | .8485 | .8508 | .8531 | .8554 | .8577 | .8599 | .8621 |
| 1.1 | .8643 | .8665 | .8686 | .8708 | .8729 | .8749 | .8770 | .8790 | .8810 | .8830 |
| 1.2 | .8849 | .8869 | .8888 | .8907 | .8925 | .8944 | .8962 | .8980 | .8997 | .9015 |
| 1.3 | .9032 | .9049 | .9066 | .9082 | .9099 | .9115 | .9131 | .9147 | .9162 | .9177 |
| 1.4 | .9192 | .9207 | .9222 | .9236 | .9251 | .9265 | .9279 | .9292 | .9306 | .9319 |
| 1.5 | .9332 | .9345 | .9357 | .9370 | .9382 | .9394 | .9406 | .9418 | .9429 | .9441 |
| 1.6 | .9452 | .9463 | .9474 | .9484 | .9495 | .9505 | .9515 | .9525 | .9535 | .9545 |
| 1.7 | .9554 | .9564 | .9573 | .9582 | .9591 | .9599 | .9608 | .9617 | .9625 | .9633 |
| 1.8 | .9641 | .9649 | .9656 | .9664 | .9671 | .9678 | .9686 | .9693 | .9699 | .9706 |
| 1.9 | .9713 | .9719 | .9726 | .9732 | .9738 | .9744 | .9750 | .9756 | .9761 | .9767 |
| 2.0 | .9772 | .9778 | .9783 | .9788 | .9793 | .9798 | .9803 | .9808 | .9812 | .9817 |
| 2.1 | .9821 | .9826 | .9830 | .9834 | .9838 | .9842 | .9846 | .9850 | .9854 | .9857 |
| 2.2 | .9861 | .9864 | .9868 | .9871 | .9875 | .9878 | .9881 | .9884 | .9887 | .9890 |
| 2.3 | .9893 | .9896 | .9898 | .9901 | .9904 | .9906 | .9909 | .9911 | .9913 | .9916 |
| 2.4 | .9918 | .9920 | .9922 | .9925 | .9927 | .9929 | .9931 | .9932 | .9934 | .9936 |
| 2.5 | .9938 | .9940 | .9941 | .9943 | .9945 | .9946 | .9948 | .9949 | .9951 | .9952 |
| 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 |
| 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 | .9995 | .9996 | .9996 | .9996 | .9996 | .9996 | .9996 | .9997 |
| 3.4 | .9997 | .9997 | .9997 | .9997 | .9997 | .9997 | .9997 | .9997 | .9997 | .9998 |

Table entry for  $p$  and  $C$  is the point  $t^*$  with probability  $p$  lying above it and probability  $C$  lying between  $-t^*$  and  $t^*$ .



| df | Tail probability $p$ |       |       |       |       |       |       |       |       |       |       |       |
|----|----------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|    | .25                  | .20   | .15   | .10   | .05   | .025  | .02   | .01   | .005  | .0025 | .001  | .0005 |
| 1  | 1.000                | 1.376 | 1.963 | 3.078 | 6.314 | 12.71 | 15.89 | 6.63  | 63.66 | 127.3 | 318.3 | 636.6 |
| 2  | 1.86                 | 2.07  | 2.33  | 2.77  | 3.84  | 5.02  | 5.41  | 6.96  | 9.21  | 10.60 | 11.98 | 13.82 |
| 3  | 2.37                 | 2.77  | 3.22  | 3.79  | 4.61  | 5.99  | 7.38  | 8.84  | 11.34 | 12.84 | 14.32 | 15.20 |
| 4  | 2.77                 | 3.00  | 3.34  | 3.94  | 5.19  | 6.58  | 7.94  | 9.49  | 11.14 | 12.73 | 14.27 | 15.14 |
| 5  | 3.36                 | 3.58  | 3.92  | 4.55  | 5.79  | 7.17  | 8.54  | 10.13 | 11.75 | 13.28 | 14.86 | 15.09 |
| 6  | 3.84                 | 4.05  | 4.35  | 4.95  | 6.16  | 7.53  | 8.91  | 10.59 | 12.19 | 13.78 | 15.33 | 15.46 |
| 7  | 4.35                 | 4.55  | 4.84  | 5.42  | 6.63  | 8.01  | 9.39  | 11.03 | 12.59 | 14.16 | 15.71 | 15.84 |
| 8  | 4.84                 | 5.03  | 5.31  | 5.89  | 7.17  | 8.55  | 9.93  | 11.59 | 13.12 | 14.69 | 16.25 | 16.39 |
| 9  | 5.32                 | 5.51  | 5.79  | 6.37  | 7.63  | 9.00  | 10.39 | 12.02 | 13.58 | 15.15 | 16.72 | 16.86 |
| 10 | 5.79                 | 5.98  | 6.25  | 6.83  | 8.09  | 9.49  | 10.88 | 12.53 | 14.11 | 15.68 | 17.25 | 17.37 |
| 11 | 6.25                 | 6.43  | 6.70  | 7.28  | 8.54  | 9.93  | 11.33 | 12.92 | 14.51 | 16.08 | 17.67 | 17.79 |
| 12 | 6.68                 | 6.86  | 7.13  | 7.71  | 8.97  | 10.37 | 11.78 | 13.36 | 14.94 | 16.51 | 18.03 | 18.15 |
| 13 | 7.11                 | 7.29  | 7.56  | 8.13  | 9.35  | 10.75 | 12.16 | 13.75 | 15.32 | 16.90 | 18.47 | 18.59 |
| 14 | 7.53                 | 7.71  | 7.98  | 8.55  | 9.77  | 11.17 | 12.57 | 14.16 | 15.73 | 17.30 | 18.87 | 18.99 |
| 15 | 7.95                 | 8.13  | 8.40  | 8.97  | 10.19 | 11.59 | 12.99 | 14.57 | 16.14 | 17.71 | 19.28 | 19.40 |
| 16 | 8.37                 | 8.55  | 8.82  | 9.39  | 10.61 | 12.00 | 13.40 | 14.97 | 16.54 | 18.11 | 19.68 | 19.80 |
| 17 | 8.78                 | 8.96  | 9.23  | 9.80  | 11.00 | 12.40 | 13.80 | 15.37 | 16.94 | 18.51 | 20.09 | 20.21 |
| 18 | 9.18                 | 9.36  | 9.63  | 10.20 | 11.40 | 12.80 | 14.20 | 15.77 | 17.34 | 18.91 | 20.49 | 20.61 |
| 19 | 9.58                 | 9.76  | 10.03 | 10.59 | 11.80 | 13.20 | 14.60 | 16.17 | 17.74 | 19.31 | 20.89 | 21.01 |
| 20 | 9.98                 | 10.16 | 10.43 | 10.99 | 12.20 | 13.60 | 15.00 | 16.57 | 18.15 | 19.71 | 21.29 | 21.41 |
| 21 | 10.37                | 10.55 | 10.82 | 11.38 | 12.60 | 14.00 | 15.40 | 16.97 | 18.54 | 20.10 | 21.69 | 21.81 |
| 22 | 10.75                | 10.93 | 11.20 | 11.76 | 13.00 | 14.40 | 15.80 | 17.35 | 18.91 | 20.49 | 22.08 | 22.20 |
| 23 | 11.13                | 11.31 | 11.58 | 12.14 | 13.40 | 14.80 | 16.20 | 17.71 | 19.28 | 20.89 | 22.47 | 22.59 |
| 24 | 11.51                | 11.69 | 11.96 | 12.52 | 13.80 | 15.20 | 16.60 | 18.17 | 19.67 | 21.27 | 22.86 | 22.98 |
| 25 | 11.89                | 12.07 | 12.34 | 12.90 | 14.20 | 15.60 | 17.00 | 18.54 | 20.07 | 21.66 | 23.25 | 23.37 |
| 26 | 12.27                | 12.45 | 12.72 | 13.28 | 14.60 | 16.00 | 17.40 | 18.91 | 20.46 | 22.05 | 23.64 | 23.76 |
| 27 | 12.65                | 12.83 | 13.10 | 13.66 | 15.00 | 16.40 | 17.80 | 19.28 | 20.85 | 22.44 | 24.03 | 24.15 |
| 28 | 13.03                | 13.21 | 13.48 | 14.04 | 15.40 | 16.80 | 18.20 | 19.67 | 21.23 | 22.83 | 24.42 | 24.54 |
| 29 | 13.41                | 13.59 | 13.86 | 14.42 | 15.80 | 17.20 | 18.60 | 20.06 | 21.62 | 23.22 | 24.81 | 24.93 |
| 30 | 13.79                | 13.97 | 14.24 | 14.80 | 16.20 | 17.60 | 19.00 | 20.45 | 2     |       |       |       |