



# Faculty of Science

## Department of Statistics and Population Studies

### STA221 Tutorial Test 3

DATE: 14 August 2020

DUE DATE AND TIME: 17 August 2020 10:00AM

TOTAL: 15

Initials and Surname:

Student Number:

### QUESTIONS (15 marks)

Do SAT scores for high school students differ depending on the students' intended field of study? Fifteen students who intended to major in engineering were compared with 15 students who intended to major in language and literature. Given in the accompanying table are the means and standard deviations of the scores on the verbal and mathematics portion of the SAT for the two groups of students:

|                                  | VERBAL          |          | MATH            |          |
|----------------------------------|-----------------|----------|-----------------|----------|
| Engineering ( $n = 15$ )         | $\bar{y} = 446$ | $s = 42$ | $\bar{y} = 548$ | $s = 57$ |
| Language/Literature ( $n = 15$ ) | $\bar{y} = 534$ | $s = 45$ | $\bar{y} = 517$ | $s = 52$ |

The questions follow on page 2. Probability tables are provided at the back of the test.

1. Construct a 95% confidence interval for the difference between the average math scores of students majoring in engineering and those majoring in language/literature. Would you say there is a difference between the average math scores of students majoring in engineering and of those majoring in language/literature? Explain. **(8 marks)**

2. Construct a 95% confidence interval for the standard deviation of math scores of students majoring in engineering. Interpret. **(7 marks)**

Table 4. Normal Curve Areas  
Standard normal probability in right-hand tail  
(for negative values of  $z$ , areas are found by symmetry)

| $z$ | Second decimal place of $z$ |       |       |       |       |       |       |       |       |       |
|-----|-----------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|     | .00                         | .01   | .02   | .03   | .04   | .05   | .06   | .07   | .08   | .09   |
| 0.0 | .5000                       | .4960 | .4920 | .4880 | .4840 | .4801 | .4761 | .4721 | .4681 | .4641 |
| 0.1 | .4602                       | .4562 | .4522 | .4483 | .4443 | .4404 | .4364 | .4325 | .4286 | .4247 |
| 0.2 | .4207                       | .4168 | .4129 | .4090 | .4052 | .4013 | .3974 | .3936 | .3897 | .3859 |
| 0.3 | .3821                       | .3783 | .3745 | .3707 | .3669 | .3632 | .3594 | .3557 | .3520 | .3483 |
| 0.4 | .3446                       | .3409 | .3372 | .3336 | .3300 | .3264 | .3228 | .3192 | .3156 | .3121 |
| 0.5 | .3085                       | .3050 | .3015 | .2981 | .2946 | .2912 | .2877 | .2843 | .2810 | .2776 |
| 0.6 | .2743                       | .2709 | .2676 | .2643 | .2611 | .2578 | .2546 | .2514 | .2483 | .2451 |
| 0.7 | .2420                       | .2389 | .2358 | .2327 | .2296 | .2266 | .2236 | .2206 | .2177 | .2148 |
| 0.8 | .2119                       | .2090 | .2061 | .2033 | .2005 | .1977 | .1949 | .1922 | .1894 | .1867 |
| 0.9 | .1841                       | .1814 | .1788 | .1762 | .1736 | .1711 | .1685 | .1660 | .1635 | .1611 |
| 1.0 | .1587                       | .1562 | .1539 | .1515 | .1492 | .1469 | .1446 | .1423 | .1401 | .1379 |
| 1.1 | .1357                       | .1335 | .1314 | .1292 | .1271 | .1251 | .1230 | .1210 | .1190 | .1170 |
| 1.2 | .1151                       | .1131 | .1112 | .1093 | .1075 | .1056 | .1038 | .1020 | .1003 | .0985 |
| 1.3 | .0968                       | .0951 | .0934 | .0918 | .0901 | .0885 | .0869 | .0853 | .0838 | .0823 |
| 1.4 | .0808                       | .0793 | .0778 | .0764 | .0749 | .0735 | .0722 | .0708 | .0694 | .0681 |
| 1.5 | .0668                       | .0655 | .0643 | .0630 | .0618 | .0606 | .0594 | .0582 | .0571 | .0559 |
| 1.6 | .0548                       | .0537 | .0526 | .0516 | .0505 | .0495 | .0485 | .0475 | .0465 | .0455 |
| 1.7 | .0446                       | .0436 | .0427 | .0418 | .0409 | .0401 | .0392 | .0384 | .0375 | .0367 |
| 1.8 | .0359                       | .0352 | .0344 | .0336 | .0329 | .0322 | .0314 | .0307 | .0301 | .0294 |
| 1.9 | .0287                       | .0281 | .0274 | .0268 | .0262 | .0256 | .0250 | .0244 | .0239 | .0233 |
| 2.0 | .0228                       | .0222 | .0217 | .0212 | .0207 | .0202 | .0197 | .0192 | .0188 | .0183 |
| 2.1 | .0179                       | .0174 | .0170 | .0166 | .0162 | .0158 | .0154 | .0150 | .0146 | .0143 |
| 2.2 | .0139                       | .0136 | .0132 | .0129 | .0125 | .0122 | .0119 | .0116 | .0113 | .0110 |
| 2.3 | .0107                       | .0104 | .0102 | .0099 | .0096 | .0094 | .0091 | .0089 | .0087 | .0084 |
| 2.4 | .0082                       | .0080 | .0078 | .0075 | .0073 | .0071 | .0069 | .0068 | .0066 | .0064 |
| 2.5 | .0062                       | .0060 | .0059 | .0057 | .0055 | .0054 | .0052 | .0051 | .0049 | .0048 |
| 2.6 | .0047                       | .0045 | .0044 | .0043 | .0041 | .0040 | .0039 | .0038 | .0037 | .0036 |
| 2.7 | .0035                       | .0034 | .0033 | .0032 | .0031 | .0030 | .0029 | .0028 | .0027 | .0026 |
| 2.8 | .0026                       | .0025 | .0024 | .0023 | .0023 | .0022 | .0021 | .0021 | .0020 | .0019 |
| 2.9 | .0019                       | .0018 | .0017 | .0017 | .0016 | .0016 | .0015 | .0015 | .0014 | .0014 |
| 3.0 | .00135                      |       |       |       |       |       |       |       |       |       |
| 3.5 | .000233                     |       |       |       |       |       |       |       |       |       |
| 4.0 | .0000317                    |       |       |       |       |       |       |       |       |       |
| 4.5 | .00000340                   |       |       |       |       |       |       |       |       |       |
| 5.0 | .000000287                  |       |       |       |       |       |       |       |       |       |

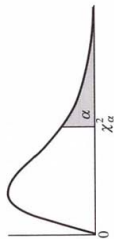
From R. E. Walpole, *Introduction to Statistics* (New York: Macmillan, 1968).

Table 5 Percentage Points of the  $t$  Distributions



| $t_{.100}$ | $t_{.050}$ | $t_{.025}$ | $t_{.010}$ | $t_{.005}$ | df   |
|------------|------------|------------|------------|------------|------|
| 3.078      | 6.314      | 12.706     | 31.821     | 63.657     | 1    |
| 1.886      | 2.920      | 4.303      | 6.965      | 9.925      | 2    |
| 1.638      | 2.353      | 3.182      | 4.541      | 5.841      | 3    |
| 1.533      | 2.132      | 2.776      | 3.747      | 4.604      | 4    |
| 1.476      | 2.015      | 2.571      | 3.365      | 4.032      | 5    |
| 1.440      | 1.943      | 2.447      | 3.143      | 3.707      | 6    |
| 1.415      | 1.895      | 2.365      | 2.998      | 3.499      | 7    |
| 1.397      | 1.860      | 2.306      | 2.896      | 3.355      | 8    |
| 1.383      | 1.833      | 2.262      | 2.821      | 3.250      | 9    |
| 1.372      | 1.812      | 2.228      | 2.764      | 3.169      | 10   |
| 1.363      | 1.796      | 2.201      | 2.718      | 3.106      | 11   |
| 1.356      | 1.782      | 2.179      | 2.681      | 3.055      | 12   |
| 1.350      | 1.771      | 2.160      | 2.650      | 3.012      | 13   |
| 1.345      | 1.761      | 2.145      | 2.624      | 2.977      | 14   |
| 1.341      | 1.753      | 2.131      | 2.602      | 2.947      | 15   |
| 1.337      | 1.746      | 2.120      | 2.583      | 2.921      | 16   |
| 1.333      | 1.740      | 2.110      | 2.567      | 2.898      | 17   |
| 1.330      | 1.734      | 2.101      | 2.552      | 2.878      | 18   |
| 1.328      | 1.729      | 2.093      | 2.539      | 2.861      | 19   |
| 1.325      | 1.725      | 2.086      | 2.528      | 2.845      | 20   |
| 1.323      | 1.721      | 2.080      | 2.518      | 2.831      | 21   |
| 1.321      | 1.717      | 2.074      | 2.508      | 2.819      | 22   |
| 1.319      | 1.714      | 2.069      | 2.500      | 2.807      | 23   |
| 1.318      | 1.711      | 2.064      | 2.492      | 2.797      | 24   |
| 1.316      | 1.708      | 2.060      | 2.485      | 2.787      | 25   |
| 1.315      | 1.706      | 2.056      | 2.479      | 2.779      | 26   |
| 1.314      | 1.703      | 2.052      | 2.473      | 2.771      | 27   |
| 1.313      | 1.701      | 2.048      | 2.467      | 2.763      | 28   |
| 1.311      | 1.699      | 2.045      | 2.462      | 2.756      | 29   |
| 1.282      | 1.645      | 1.960      | 2.326      | 2.576      | inf. |

From "Table of Percentage Points of the  $t$ -Distribution," Computed by Maxine Merrington, *Biometrika*, Vol. 32 (1941), p. 300.

Table 6 Percentage Points of the  $\chi^2$  Distributions

| df  | $\chi^2_{0.995}$ | $\chi^2_{0.990}$ | $\chi^2_{0.975}$ | $\chi^2_{0.950}$ | $\chi^2_{0.900}$ |
|-----|------------------|------------------|------------------|------------------|------------------|
| 1   | 0.0000393        | 0.0001571        | 0.0009821        | 0.0039321        | 0.0157908        |
| 2   | 0.0100251        | 0.0201007        | 0.0506356        | 0.102587         | 0.210720         |
| 3   | 0.0717212        | 0.114832         | 0.215795         | 0.351846         | 0.584375         |
| 4   | 0.206990         | 0.297110         | 0.484419         | 0.710721         | 1.063623         |
| 5   | 0.411740         | 0.554300         | 0.831211         | 1.145476         | 1.61031          |
| 6   | 0.675727         | 0.872085         | 1.237347         | 1.63539          | 2.20413          |
| 7   | 0.989265         | 1.239043         | 1.68987          | 2.16735          | 2.83311          |
| 8   | 1.344419         | 1.646482         | 2.17973          | 2.73264          | 3.48954          |
| 9   | 1.734926         | 2.087912         | 2.70039          | 3.32511          | 4.16816          |
| 10  | 2.15585          | 2.55821          | 3.24697          | 3.94030          | 4.86518          |
| 11  | 2.60321          | 3.05347          | 3.81575          | 4.57481          | 5.57779          |
| 12  | 3.07382          | 3.57056          | 4.40379          | 5.22603          | 6.30380          |
| 13  | 3.56503          | 4.10691          | 5.00874          | 5.89186          | 7.04150          |
| 14  | 4.07468          | 4.66043          | 5.62872          | 6.57063          | 7.78953          |
| 15  | 4.60094          | 5.22935          | 6.26214          | 7.26094          | 8.54675          |
| 16  | 5.14224          | 5.81221          | 6.90766          | 7.96164          | 9.31223          |
| 17  | 5.69724          | 6.40776          | 7.56418          | 8.67176          | 10.0852          |
| 18  | 6.26481          | 7.01491          | 8.23075          | 9.39046          | 10.8649          |
| 19  | 6.84398          | 7.63273          | 8.90655          | 10.1170          | 11.6509          |
| 20  | 7.43386          | 8.26040          | 9.59083          | 10.8508          | 12.4426          |
| 21  | 8.03366          | 8.89720          | 10.28293         | 11.5913          | 13.2396          |
| 22  | 8.64272          | 9.54249          | 10.9823          | 12.3380          | 14.0415          |
| 23  | 9.26042          | 10.19567         | 11.6885          | 13.0905          | 14.8479          |
| 24  | 9.88623          | 10.8564          | 12.4011          | 13.8484          | 15.6587          |
| 25  | 10.5197          | 11.5240          | 13.1197          | 14.6114          | 16.4734          |
| 26  | 11.1603          | 12.1981          | 13.8439          | 15.3791          | 17.2919          |
| 27  | 11.8076          | 12.8786          | 14.5733          | 16.1513          | 18.1138          |
| 28  | 12.4613          | 13.5648          | 15.3079          | 16.9279          | 18.9392          |
| 29  | 13.1211          | 14.2565          | 16.0471          | 17.7083          | 19.7677          |
| 30  | 13.7867          | 14.9535          | 16.7908          | 18.4926          | 20.5992          |
| 40  | 20.7065          | 22.1643          | 24.4331          | 26.5093          | 29.0505          |
| 50  | 27.9907          | 29.7067          | 32.3574          | 34.7642          | 37.6886          |
| 60  | 35.5346          | 37.4848          | 40.4817          | 43.1879          | 46.4589          |
| 70  | 43.2752          | 45.4418          | 48.7576          | 51.7393          | 55.3290          |
| 80  | 51.1720          | 53.5400          | 57.1532          | 60.3915          | 64.2778          |
| 90  | 59.1963          | 61.7541          | 65.6466          | 69.1260          | 73.2912          |
| 100 | 67.3276          | 70.0648          | 74.2219          | 77.9295          | 82.3581          |

Table 6 (Continued)

| $\chi^2_{0.100}$ | $\chi^2_{0.050}$ | $\chi^2_{0.025}$ | $\chi^2_{0.010}$ | $\chi^2_{0.005}$ | df  |
|------------------|------------------|------------------|------------------|------------------|-----|
| 2.70554          | 3.84146          | 5.02389          | 6.63490          | 7.87944          | 1   |
| 4.60517          | 5.99147          | 7.37776          | 9.21034          | 10.5966          | 2   |
| 6.25139          | 7.81473          | 9.34840          | 11.3449          | 12.8381          | 3   |
| 7.77944          | 9.48773          | 11.1433          | 13.2767          | 14.8602          | 4   |
| 9.23635          | 11.0705          | 12.8325          | 15.0863          | 16.7496          | 5   |
| 10.6446          | 12.5916          | 14.4494          | 16.8119          | 18.5476          | 6   |
| 12.0170          | 14.0671          | 16.0128          | 18.4753          | 20.2777          | 7   |
| 13.3616          | 15.5073          | 17.5346          | 20.0902          | 21.9550          | 8   |
| 14.6837          | 16.9190          | 19.0228          | 21.6660          | 23.5893          | 9   |
| 15.9871          | 18.3070          | 20.4831          | 23.2093          | 25.1882          | 10  |
| 17.2750          | 19.6751          | 21.9200          | 24.7250          | 26.7569          | 11  |
| 18.5494          | 21.0261          | 23.3367          | 26.2170          | 28.2995          | 12  |
| 19.8119          | 22.3621          | 24.7356          | 27.6883          | 29.8194          | 13  |
| 21.0642          | 23.6848          | 26.1190          | 29.1413          | 31.3193          | 14  |
| 22.3072          | 24.9958          | 27.4884          | 30.5779          | 32.8013          | 15  |
| 23.5418          | 26.2962          | 28.8454          | 31.9999          | 34.2672          | 16  |
| 24.7690          | 27.5871          | 30.1910          | 33.4087          | 35.7185          | 17  |
| 25.9894          | 28.8693          | 31.5264          | 34.8053          | 37.1564          | 18  |
| 27.2036          | 30.1435          | 32.8523          | 36.1908          | 38.5822          | 19  |
| 28.4120          | 31.4104          | 34.1696          | 37.5662          | 39.9968          | 20  |
| 29.6151          | 32.6705          | 35.4789          | 38.9321          | 41.4010          | 21  |
| 30.8133          | 33.9244          | 36.7807          | 40.2894          | 42.7956          | 22  |
| 32.0069          | 35.1725          | 38.0757          | 41.6384          | 44.1813          | 23  |
| 33.1963          | 36.4151          | 39.3641          | 42.9798          | 45.5585          | 24  |
| 34.3816          | 37.6525          | 40.6465          | 44.3141          | 46.9278          | 25  |
| 35.5631          | 38.8852          | 41.9232          | 45.6417          | 48.2899          | 26  |
| 36.7412          | 40.1133          | 43.1944          | 46.9630          | 49.6449          | 27  |
| 37.9159          | 41.3372          | 44.4607          | 48.2782          | 50.9933          | 28  |
| 39.0875          | 42.5569          | 45.7222          | 49.5879          | 52.3356          | 29  |
| 40.2560          | 43.7729          | 46.9792          | 50.8922          | 53.6720          | 30  |
| 51.8050          | 55.7585          | 59.3417          | 63.6907          | 66.7659          | 40  |
| 63.1671          | 67.5048          | 71.4202          | 76.1539          | 79.4900          | 50  |
| 74.3970          | 79.0819          | 83.2976          | 88.3794          | 91.9517          | 60  |
| 85.5271          | 90.5312          | 95.0231          | 100.425          | 104.215          | 70  |
| 96.5782          | 101.879          | 106.629          | 112.329          | 116.321          | 80  |
| 107.565          | 113.145          | 118.136          | 124.116          | 128.299          | 90  |
| 118.498          | 124.342          | 129.561          | 135.807          | 140.169          | 100 |

From "Tables of the Percentage Points of the  $\chi^2$ -Distribution," *Biometrika*, Vol. 32 (1941), pp. 188-189, by Catherine M. Thompson.