

**AP Statistics Final Examination
Multiple-Choice Questions Answers in Bold**

Name _____ Date _____ Period _____

Answer Sheet: Multiple-Choice Questions

- | | | | | | | | | | | | |
|-----|----------|----------|----------|----------|----------|-----|----------|----------|----------|----------|----------|
| 1. | A | B | C | D | E | 14. | A | B | C | D | E |
| 2. | A | B | C | D | E | 15. | A | B | C | D | E |
| 3. | A | B | C | D | E | 16. | A | B | C | D | E |
| 4. | A | B | C | D | E | 17. | A | B | C | D | E |
| 5. | A | B | C | D | E | 18. | A | B | C | D | E |
| 6. | A | B | C | D | E | 19. | A | B | C | D | E |
| 7. | A | B | C | D | E | 20. | A | B | C | D | E |
| 8. | A | B | C | D | E | 21. | A | B | C | D | E |
| 9. | A | B | C | D | E | 22. | A | B | C | D | E |
| 10. | A | B | C | D | E | 23. | A | B | C | D | E |
| 11. | A | B | C | D | E | 24. | A | B | C | D | E |
| 12. | A | B | C | D | E | 25. | A | B | C | D | E |
| 13. | A | B | C | D | E | | | | | | |

Formulas

I. Descriptive Statistics

$$\begin{aligned}\bar{x} &= \frac{\sum x_i}{n} \\ s_x &= \sqrt{\frac{1}{n-1} \sum (x_i - \bar{x})^2} \\ s_p &= \sqrt{\frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{(n_1 - 1) + (n_2 - 1)}} \\ \hat{y} &= b_0 + b_1x \\ b_1 &= \frac{\sum (x_i - \bar{x})(y_i - \bar{y})}{\sum (x_i - \bar{x})^2} \\ b_0 &= \bar{y} - b_1\bar{x} \\ r &= \frac{1}{n-1} \sum \left(\frac{x_i - \bar{x}}{s_x} \right) \left(\frac{y_i - \bar{y}}{s_y} \right) \\ b_1 &= r \frac{s_y}{s_x} \\ s_{b_1} &= \frac{\sqrt{\frac{\sum (y_i - \bar{y})^2}{n-2}}}{\sqrt{\sum (x_i - \bar{x})^2}}\end{aligned}$$

II. Probability

$$\begin{aligned}P(A \cup B) &= \frac{P(A \cap B)}{P(B)} \\ P(A|B) &= \frac{P(A \cap B)}{P(B)} \\ E(X) &= \mu_X = \sum x_i p_i \\ \text{Var}(X) &= \sigma_x^2 = \sum (x_i - \mu_X)^2 p_i \\ \text{If } X \text{ has a binomial distribution with parameters } n \text{ and } p, \text{ then:} \\ P(X = k) &= \binom{n}{k} p^k (1-p)^{n-k} \\ \mu_X &= np \\ \sigma_X &= \sqrt{np(1-p)} \\ \mu_{\hat{p}} &= p \\ \sigma_{\hat{p}} &= \sqrt{\frac{p(1-p)}{n}}\end{aligned}$$

If \bar{x} is the mean of a random sample of size n from an infinite population with mean μ and standard deviation σ , the:

$$\begin{aligned}\mu_{\bar{x}} &= \mu \\ \sigma_{\bar{x}} &= \frac{\sigma}{\sqrt{n}}\end{aligned}$$

III. Inferential Statistics

Standardized test statistic: $\frac{\text{statistic} - \text{parameter}}{\text{standard deviation of statistic}}$

Confidence interval:

$$\text{statistic} \pm (\text{critical value}) \cdot (\text{standard deviation of statistic})$$

Single-Sample

| Statistic | Standard Deviation of Statistic |
|-------------------|---------------------------------|
| Sample Mean | $\frac{\sigma}{\sqrt{n}}$ |
| Sample Proportion | $\sqrt{\frac{p(1-p)}{n}}$ |

Two-Sample

| Statistic | Standard Deviation of Statistic |
|----------------------------------|---|
| Difference of sample means | $\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}$ <p>Special case when $\sigma_1 = \sigma_2$</p> $\sigma \sqrt{\frac{1}{n_1} + \frac{1}{n_2}}$ |
| Difference of sample proportions | $\sqrt{\frac{p_1(1-p_1)}{n_1} + \frac{p_2(1-p_2)}{n_2}}$ <p>Special case when $p_1 = p_2 = p$</p> $\sqrt{p(1-p)} \sqrt{\frac{1}{n_1} + \frac{1}{n_2}}$ |

$$\text{Chi - square test statistic} = \sum \frac{(\text{observed} - \text{expected})^2}{\text{expected}}$$

Table entry for z is the area under the standard normal curve left of z .

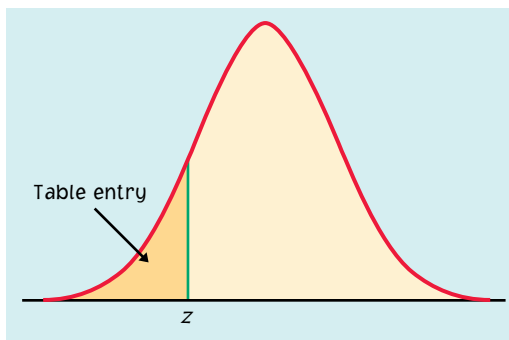


TABLE A Standard normal probabilities

| 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 | .0179 | .0174 | .0170 | .0166 | .0162 | .0158 | .0154 | .0150 | .0146 | .0143 |
| -2.0 | .0228 | .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 p and C is the critical value t^* with probability p lying to its right and probability C lying between $-t^*$ and t^* .

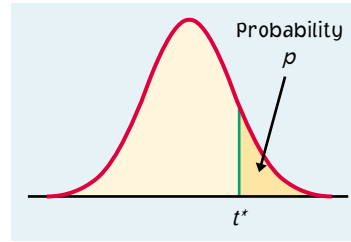


TABLE C t distribution critical values

| df | Upper 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 | 31.82 | 63.66 | 127.3 | 318.3 | 636.6 |
| 2 | 0.816 | 1.061 | 1.386 | 1.886 | 2.920 | 4.303 | 4.849 | 6.965 | 9.925 | 14.09 | 22.33 | 31.60 |
| 3 | 0.765 | 0.978 | 1.250 | 1.638 | 2.353 | 3.182 | 3.482 | 4.541 | 5.841 | 7.453 | 10.21 | 12.92 |
| 4 | 0.741 | 0.941 | 1.190 | 1.533 | 2.132 | 2.776 | 2.999 | 3.747 | 4.604 | 5.598 | 7.173 | 8.610 |
| 5 | 0.727 | 0.920 | 1.156 | 1.476 | 2.015 | 2.571 | 2.757 | 3.365 | 4.032 | 4.773 | 5.893 | 6.869 |
| 6 | 0.718 | 0.906 | 1.134 | 1.440 | 1.943 | 2.447 | 2.612 | 3.143 | 3.707 | 4.317 | 5.208 | 5.959 |
| 7 | 0.711 | 0.896 | 1.119 | 1.415 | 1.895 | 2.365 | 2.517 | 2.998 | 3.499 | 4.029 | 4.785 | 5.408 |
| 8 | 0.706 | 0.889 | 1.108 | 1.397 | 1.860 | 2.306 | 2.449 | 2.896 | 3.355 | 3.833 | 4.501 | 5.041 |
| 9 | 0.703 | 0.883 | 1.100 | 1.383 | 1.833 | 2.262 | 2.398 | 2.821 | 3.250 | 3.690 | 4.297 | 4.781 |
| 10 | 0.700 | 0.879 | 1.093 | 1.372 | 1.812 | 2.228 | 2.359 | 2.764 | 3.169 | 3.581 | 4.144 | 4.587 |
| 11 | 0.697 | 0.876 | 1.088 | 1.363 | 1.796 | 2.201 | 2.328 | 2.718 | 3.106 | 3.497 | 4.025 | 4.437 |
| 12 | 0.695 | 0.873 | 1.083 | 1.356 | 1.782 | 2.179 | 2.303 | 2.681 | 3.055 | 3.428 | 3.930 | 4.318 |
| 13 | 0.694 | 0.870 | 1.079 | 1.350 | 1.771 | 2.160 | 2.282 | 2.650 | 3.012 | 3.372 | 3.852 | 4.221 |
| 14 | 0.692 | 0.868 | 1.076 | 1.345 | 1.761 | 2.145 | 2.264 | 2.624 | 2.977 | 3.326 | 3.787 | 4.140 |
| 15 | 0.691 | 0.866 | 1.074 | 1.341 | 1.753 | 2.131 | 2.249 | 2.602 | 2.947 | 3.286 | 3.733 | 4.073 |
| 16 | 0.690 | 0.865 | 1.071 | 1.337 | 1.746 | 2.120 | 2.235 | 2.583 | 2.921 | 3.252 | 3.686 | 4.015 |
| 17 | 0.689 | 0.863 | 1.069 | 1.333 | 1.740 | 2.110 | 2.224 | 2.567 | 2.898 | 3.222 | 3.646 | 3.965 |
| 18 | 0.688 | 0.862 | 1.067 | 1.330 | 1.734 | 2.101 | 2.214 | 2.552 | 2.878 | 3.197 | 3.611 | 3.922 |
| 19 | 0.688 | 0.861 | 1.066 | 1.328 | 1.729 | 2.093 | 2.205 | 2.539 | 2.861 | 3.174 | 3.579 | 3.883 |
| 20 | 0.687 | 0.860 | 1.064 | 1.325 | 1.725 | 2.086 | 2.197 | 2.528 | 2.845 | 3.153 | 3.552 | 3.850 |
| 21 | 0.686 | 0.859 | 1.063 | 1.323 | 1.721 | 2.080 | 2.189 | 2.518 | 2.831 | 3.135 | 3.527 | 3.819 |
| 22 | 0.686 | 0.858 | 1.061 | 1.321 | 1.717 | 2.074 | 2.183 | 2.508 | 2.819 | 3.119 | 3.505 | 3.792 |
| 23 | 0.685 | 0.858 | 1.060 | 1.319 | 1.714 | 2.069 | 2.177 | 2.500 | 2.807 | 3.104 | 3.485 | 3.768 |
| 24 | 0.685 | 0.857 | 1.059 | 1.318 | 1.711 | 2.064 | 2.172 | 2.492 | 2.797 | 3.091 | 3.467 | 3.745 |
| 25 | 0.684 | 0.856 | 1.058 | 1.316 | 1.708 | 2.060 | 2.167 | 2.485 | 2.787 | 3.078 | 3.450 | 3.725 |
| 26 | 0.684 | 0.856 | 1.058 | 1.315 | 1.706 | 2.056 | 2.162 | 2.479 | 2.779 | 3.067 | 3.435 | 3.707 |
| 27 | 0.684 | 0.855 | 1.057 | 1.314 | 1.703 | 2.052 | 2.158 | 2.473 | 2.771 | 3.057 | 3.421 | 3.690 |
| 28 | 0.683 | 0.855 | 1.056 | 1.313 | 1.701 | 2.048 | 2.154 | 2.467 | 2.763 | 3.047 | 3.408 | 3.674 |
| 29 | 0.683 | 0.854 | 1.055 | 1.311 | 1.699 | 2.045 | 2.150 | 2.462 | 2.756 | 3.038 | 3.396 | 3.659 |
| 30 | 0.683 | 0.854 | 1.055 | 1.310 | 1.697 | 2.042 | 2.147 | 2.457 | 2.750 | 3.030 | 3.385 | 3.646 |
| 40 | 0.681 | 0.851 | 1.050 | 1.303 | 1.684 | 2.021 | 2.123 | 2.423 | 2.704 | 2.971 | 3.307 | 3.551 |
| 50 | 0.679 | 0.849 | 1.047 | 1.299 | 1.676 | 2.009 | 2.109 | 2.403 | 2.678 | 2.937 | 3.261 | 3.496 |
| 60 | 0.679 | 0.848 | 1.045 | 1.296 | 1.671 | 2.000 | 2.099 | 2.390 | 2.660 | 2.915 | 3.232 | 3.460 |
| 80 | 0.678 | 0.846 | 1.043 | 1.292 | 1.664 | 1.990 | 2.088 | 2.374 | 2.639 | 2.887 | 3.195 | 3.416 |
| 100 | 0.677 | 0.845 | 1.042 | 1.290 | 1.660 | 1.984 | 2.081 | 2.364 | 2.626 | 2.871 | 3.174 | 3.390 |
| 1000 | 0.675 | 0.842 | 1.037 | 1.282 | 1.646 | 1.962 | 2.056 | 2.330 | 2.581 | 2.813 | 3.098 | 3.300 |
| z^* | 0.674 | 0.841 | 1.036 | 1.282 | 1.645 | 1.960 | 2.054 | 2.326 | 2.576 | 2.807 | 3.091 | 3.291 |
| | 50% | 60% | 70% | 80% | 90% | 95% | 96% | 98% | 99% | 99.5% | 99.8% | 99.9% |
| | Confidence level C | | | | | | | | | | | |

Table entry for p is the critical value x^* with probability p lying to its right.

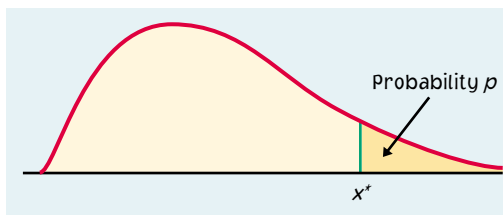


TABLE E Chi-square distribution critical values

| df | p | | | | | | | | | | | |
|-----|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| | .25 | .20 | .15 | .10 | .05 | .025 | .02 | .01 | .005 | .0025 | .001 | .0005 |
| 1 | 1.32 | 1.64 | 2.07 | 2.71 | 3.84 | 5.02 | 5.41 | 6.63 | 7.88 | 9.14 | 10.83 | 12.12 |
| 2 | 2.77 | 3.22 | 3.79 | 4.61 | 5.99 | 7.38 | 7.82 | 9.21 | 10.60 | 11.98 | 13.82 | 15.20 |
| 3 | 4.11 | 4.64 | 5.32 | 6.25 | 7.81 | 9.35 | 9.84 | 11.34 | 12.84 | 14.32 | 16.27 | 17.73 |
| 4 | 5.39 | 5.99 | 6.74 | 7.78 | 9.49 | 11.14 | 11.67 | 13.28 | 14.86 | 16.42 | 18.47 | 20.00 |
| 5 | 6.63 | 7.29 | 8.12 | 9.24 | 11.07 | 12.83 | 13.39 | 15.09 | 16.75 | 18.39 | 20.51 | 22.11 |
| 6 | 7.84 | 8.56 | 9.45 | 10.64 | 12.59 | 14.45 | 15.03 | 16.81 | 18.55 | 20.25 | 22.46 | 24.10 |
| 7 | 9.04 | 9.80 | 10.75 | 12.02 | 14.07 | 16.01 | 16.62 | 18.48 | 20.28 | 22.04 | 24.32 | 26.02 |
| 8 | 10.22 | 11.03 | 12.03 | 13.36 | 15.51 | 17.53 | 18.17 | 20.09 | 21.95 | 23.77 | 26.12 | 27.87 |
| 9 | 11.39 | 12.24 | 13.29 | 14.68 | 16.92 | 19.02 | 19.68 | 21.67 | 23.59 | 25.46 | 27.88 | 29.67 |
| 10 | 12.55 | 13.44 | 14.53 | 15.99 | 18.31 | 20.48 | 21.16 | 23.21 | 25.19 | 27.11 | 29.59 | 31.42 |
| 11 | 13.70 | 14.63 | 15.77 | 17.28 | 19.68 | 21.92 | 22.62 | 24.72 | 26.76 | 28.73 | 31.26 | 33.14 |
| 12 | 14.85 | 15.81 | 16.99 | 18.55 | 21.03 | 23.34 | 24.05 | 26.22 | 28.30 | 30.32 | 32.91 | 34.82 |
| 13 | 15.98 | 16.98 | 18.20 | 19.81 | 22.36 | 24.74 | 25.47 | 27.69 | 29.82 | 31.88 | 34.53 | 36.48 |
| 14 | 17.12 | 18.15 | 19.41 | 21.06 | 23.68 | 26.12 | 26.87 | 29.14 | 31.32 | 33.43 | 36.12 | 38.11 |
| 15 | 18.25 | 19.31 | 20.60 | 22.31 | 25.00 | 27.49 | 28.26 | 30.58 | 32.80 | 34.95 | 37.70 | 39.72 |
| 16 | 19.37 | 20.47 | 21.79 | 23.54 | 26.30 | 28.85 | 29.63 | 32.00 | 34.27 | 36.46 | 39.25 | 41.31 |
| 17 | 20.49 | 21.61 | 22.98 | 24.77 | 27.59 | 30.19 | 31.00 | 33.41 | 35.72 | 37.95 | 40.79 | 42.88 |
| 18 | 21.60 | 22.76 | 24.16 | 25.99 | 28.87 | 31.53 | 32.35 | 34.81 | 37.16 | 39.42 | 42.31 | 44.43 |
| 19 | 22.72 | 23.90 | 25.33 | 27.20 | 30.14 | 32.85 | 33.69 | 36.19 | 38.58 | 40.88 | 43.82 | 45.97 |
| 20 | 23.83 | 25.04 | 26.50 | 28.41 | 31.41 | 34.17 | 35.02 | 37.57 | 40.00 | 42.34 | 45.31 | 47.50 |
| 21 | 24.93 | 26.17 | 27.66 | 29.62 | 32.67 | 35.48 | 36.34 | 38.93 | 41.40 | 43.78 | 46.80 | 49.01 |
| 22 | 26.04 | 27.30 | 28.82 | 30.81 | 33.92 | 36.78 | 37.66 | 40.29 | 42.80 | 45.20 | 48.27 | 50.51 |
| 23 | 27.14 | 28.43 | 29.98 | 32.01 | 35.17 | 38.08 | 38.97 | 41.64 | 44.18 | 46.62 | 49.73 | 52.00 |
| 24 | 28.24 | 29.55 | 31.13 | 33.20 | 36.42 | 39.36 | 40.27 | 42.98 | 45.56 | 48.03 | 51.18 | 53.48 |
| 25 | 29.34 | 30.68 | 32.28 | 34.38 | 37.65 | 40.65 | 41.57 | 44.31 | 46.93 | 49.44 | 52.62 | 54.95 |
| 26 | 30.43 | 31.79 | 33.43 | 35.56 | 38.89 | 41.92 | 42.86 | 45.64 | 48.29 | 50.83 | 54.05 | 56.41 |
| 27 | 31.53 | 32.91 | 34.57 | 36.74 | 40.11 | 43.19 | 44.14 | 46.96 | 49.64 | 52.22 | 55.48 | 57.86 |
| 28 | 32.62 | 34.03 | 35.71 | 37.92 | 41.34 | 44.46 | 45.42 | 48.28 | 50.99 | 53.59 | 56.89 | 59.30 |
| 29 | 33.71 | 35.14 | 36.85 | 39.09 | 42.56 | 45.72 | 46.69 | 49.59 | 52.34 | 54.97 | 58.30 | 60.73 |
| 30 | 34.80 | 36.25 | 37.99 | 40.26 | 43.77 | 46.98 | 47.96 | 50.89 | 53.67 | 56.33 | 59.70 | 62.16 |
| 40 | 45.62 | 47.27 | 49.24 | 51.81 | 55.76 | 59.34 | 60.44 | 63.69 | 66.77 | 69.70 | 73.40 | 76.09 |
| 50 | 56.33 | 58.16 | 60.35 | 63.17 | 67.50 | 71.42 | 72.61 | 76.15 | 79.49 | 82.66 | 86.66 | 89.56 |
| 60 | 66.98 | 68.97 | 71.34 | 74.40 | 79.08 | 83.30 | 84.58 | 88.38 | 91.95 | 95.34 | 99.61 | 102.7 |
| 80 | 88.13 | 90.41 | 93.11 | 96.58 | 101.9 | 106.6 | 108.1 | 112.3 | 116.3 | 120.1 | 124.8 | 128.3 |
| 100 | 109.1 | 111.7 | 114.7 | 118.5 | 124.3 | 129.6 | 131.1 | 135.8 | 140.2 | 144.3 | 149.4 | 153.2 |

Section I

Questions 1–25

Directions: The questions or incomplete statements that follow are each followed by five suggested answers or completions. Choose the response that best answers the question or completes the statement.

1. Suppose there is a correlation of $r = 0.9$ between number of hours per day students study and GPAs. Which of the following is a reasonable conclusion?
 - (A) 90% of students who study receive high grades.
 - (B) 90% of students who receive high grades study a lot.
 - (C) 90% of the variation in GPAs can be explained by variation in number of study hours.
 - (D) 10% of the variation in GPAs cannot be explained by variation in number of study hours per day.
 - (E) 81% of the variation in GPAs can be explained by variation in number of study hours per day.

2. A pet food manufacturer runs an experiment to determine whether three brands of dog food are equally preferred by dogs. In the experiment, 150 dogs are individually presented with three dishes of food, each containing a different brand, and their choices are noted. Tabulations show that 62 dogs go to brand A, 43 to brand B, and 45 to brand C. Is there sufficient evidence to say that dogs have preferences among the brands? Test at the 10% significance level.
 - (A) No, with $\chi^2 = 2.09$, there is not sufficient evidence even at the 25% significance level.
 - (B) No, with $\chi^2 = 4.36$, there is not sufficient evidence at the 10% level.
 - (C) No, with $\chi^2 = 19.0$, there is not sufficient evidence even at the 0.1% level.
 - (D) Yes, with $\chi^2 = 4.36$, there is sufficient evidence at the 10% level.
 - (E) Yes, with $\chi^2 = 19.0$, there is sufficient evidence even at the 0.1% level.

3. The American Medical Association (AMA) wishes to determine the percentage of obstetricians who are considering leaving the profession because of the rapidly increasing number of lawsuits against obstetricians. How large a sample should be taken to find the answer to within $\pm 3\%$ at the 95% confidence level?
 - (A) 6
 - (B) 33
 - (C) 534
 - (D) 752
 - (E) 1068

4. Which of the following are true statements?
- I. If there is sufficient evidence to reject a null hypothesis at the 10% level, then there is sufficient evidence to reject it at the 5% level.
 - II. Whether to use a one- or two-sided test is typically decided after the data are gathered.
 - III. If a hypothesis test is conducted at the 1% level, there is a 1% chance of rejecting the null hypothesis.
- (A) I only
(B) II only
(C) III only
(D) I, II, and III
(E) None are true.
5. A manufacturer claims that a particular automobile model will get 50 miles per gallon on the highway. The researchers at a consumer-oriented magazine believe that this claim is high and plan a test with a simple random sample of 30 cars. Assuming the standard deviation between individual cars is 2.3 miles per gallon, what should the researchers conclude if the sample mean is 49 miles per gallon?
- (A) There is not sufficient evidence to reject the manufacturer's claim; 49 miles per gallon is too close to the claimed 50 miles per gallon.
(B) The manufacturer's claim should not be rejected because the P -value of .0087 is too small.
(C) The manufacturer's claim should be rejected because the sample mean is less than the claimed mean.
(D) The P -value of .0087 is sufficient evidence to reject the manufacturer's claim.
(E) The P -value of .0087 is sufficient evidence to prove that the manufacturer's claim is false.
6. A historian believes that the average height of soldiers in World War II was greater than that of soldiers in World War I. She examines a random sample of records of 100 men in each war and notes standard deviations of 2.5 and 2.3 inches in World War I and World War II, respectively. If the average height from the sample of World War II soldiers is 1 inch greater than from the sample of World War I soldiers, what conclusion is justified from a two-sample hypothesis test where

$$H_0 : \mu_1 - \mu_2 = 0 \quad \text{and} \quad H_a : \mu_1 - \mu_2 < 0?$$

- (A) The observed difference in average height is significant.
(B) The observed difference in average height is not significant.
(C) A conclusion is not possible without knowing the mean height in each sample.
(D) A conclusion is not possible without knowing both the sample means and the two original population sizes.
(E) A two-sample hypothesis test should not be used in this example.

7. Which of the following statements about the correlation coefficient are true?
- I. The correlation coefficient and the slope of the regression line may have opposite signs.
 - II. A correlation of 1 indicates a perfect cause-and-effect relationship between the variables.
 - III. Correlations of $+.87$ and $-.87$ indicate the same degree of clustering around the regression line.
- (A) I only
 - (B) II only
 - (C) III only**
 - (D) I and II
 - (E) I, II, and III
8. A soft drink dispenser can be adjusted to deliver any fixed number of ounces of soft drink. If the machine is operating with a standard deviation in delivery equal to 0.3 ounces, what should be the mean setting so that a 12-ounce cup will overflow less than 1% of the time? Assume a normal distribution for ounces delivered.
- (A) 11.23 ounces
 - (B) 11.30 ounces**
 - (C) 11.70 ounces
 - (D) 12.70 ounces
 - (E) 12.77 ounces
9. The death rate from a particular form of cancer is 23% during the first year. When treated with an experimental drug, only 15 out of 84 patients die during the initial year. Is this strong evidence to claim that the new medication reduces the mortality rate?
- (A) Yes, because the P -value is .0459.
 - (B) Yes, because the P -value is .1314.
 - (C) No, because the P -value is only .0459.
 - (D) No, because the P -value is above .10.**
 - (E) An answer cannot be given without first knowing if a placebo was also used and what the results were.

10. Consider the following back-to-back stemplot:

| | | |
|-------|---|-------|
| | 0 | 348 |
| | 1 | 01256 |
| 843 | 2 | 29 |
| 65210 | 3 | 2557 |
| 92 | 4 | |
| 7552 | 5 | 6 |
| | 6 | 1458 |
| 6 | 7 | 09 |
| 8541 | 8 | |
| 90 | 9 | |

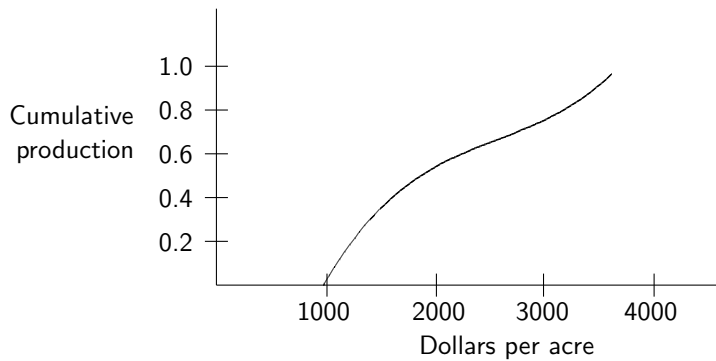
Which of the following are true statements?

- I. The distributions have the same mean.
 - II. The distributions have the same range.
 - III. The distributions have the same standard deviation.
- (A) II only
(B) I and II
(C) I and III
(D) II and III
(E) I, II, and III

11. A plumbing contractor obtains 60% of her boiler circulators from a company whose defect rate is 0.005, and the rest from a company whose defect rate is 0.010. What proportion of the circulators can be expected to be defective? If a circulator is defective, what is the probability that it came from the first company?

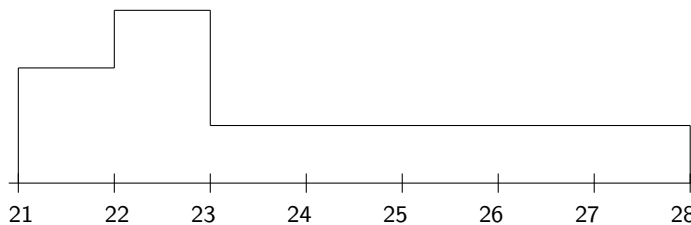
- (A) .0070, .429
(B) .0070, .600
(C) .0075, .500
(D) .0075, .600
(E) .0150, .571

12. The graph below shows cumulative proportions plotted against land values (in dollars per acre) for farms on sale in a rural community.



- What is the median land value?
- (A) \$2000
(B) \$2250
(C) \$2500
(D) \$2750
(E) \$3000
13. A teacher believes that giving her students a practice quiz every week will motivate them to study harder, leading to a greater overall understanding of the course material. She tries this technique for a year, and everyone in the class achieved a grade of a least C. Is this an experiment or an observational study?
- (A) An experiment, but with no reasonable conclusion possible about cause and effect
(B) An experiment, thus making cause and effect a reasonable conclusion
(C) An observational study, because there was no use of a control group
(D) An observational study, but a poorly designed one because randomization was not used
(E) An observational study, and thus a reasonable conclusion of association but not of cause and effect
14. In a simple random survey of 89 teachers of high school AP Statistics, 73 said that it was the most satisfying, most enjoyable course they had ever taught. Establish a 98% confidence interval estimate of the proportion of all high school AP Statistics teachers who feel this way.
- (A) $.820 \pm .004$
(B) $.820 \pm .041$
(C) $.820 \pm .084$
(D) $.820 \pm .095$
(E) $.820 \pm .223$

15. To survey the opinions of the students at your high school, a researcher plans to select every twenty-fifth student entering the school in the morning. Assuming there are no absences, will this result in a simple random sample of students attending your school?
- (A) Yes, because every students has the same chance of being selected.
 (B) Yes, but only if there is a single entrance to the school.
 (C) Yes, because the 24 out of every 25 students who are not selected will form a control group.
 (D) Yes, because this is an example of systematic sampling, which is a special case of simple random sampling.
 (E) No, because not every sample of the intended size has an equal chance of being selected.
16. Following is a histogram of ages of people applying for a particular high-school teaching position.



- Which of the following statements are true?
- I. The median age is between 24 and 25.
 II. The mean age is between 22 and 23.
 III. The mean age is greater than the median age.
- (A) I only
 (B) II only
 (C) III only
 (D) All are true
 (E) None is true
17. Suppose 4% of the population have a certain disease. A laboratory blood test gives a positive reading for 95% of people who have the disease and for 5% of people who do not have the disease. What is the probability of testing positive? If a person tests positive, what is the probability the person has the disease?
- (A) .086, .442
 (B) .086, .500
 (C) .086, .914
 (D) .500, .950
 (E) .914, .950

18. A reading specialist in a large public school system believes that the more time students spend reading, the better they will do in school. She plans a middle school experiment in which an SRS of 30 eighth graders will be assigned four extra hours of reading per week, and SRS of 30 seventh graders will be assigned two extra hours of reading per week, and an SRS of 30 sixth graders with no extra assigned reading will be a control group. After one school year, the mean GPAs from each group will be compared. Is this a good experimental design?
- (A) Yes
 - (B) No, because while this design may point out an association between reading and GPA, it cannot establish a cause-and-effect relationship.
 - (C) No, because without blinding, there is a strong chance of a placebo effect.
 - (D) No, because any conclusion would be flawed because of blocking bias.
 - (E) No, because grade level is a lurking variable which may well be confounded with the variables under consideration.
19. To determine the mean cost of groceries in a certain city, an identical grocery basket of food is purchased at each store in a random sample of ten stores. If the average cost is \$47.52 with a standard deviation of \$1.59, find a 98% confidence interval estimate for the cost of these groceries in the city.
- (A) $\$47.52 \pm \0.45
 - (B) $\$47.52 \pm \1.17
 - (C) $\$47.52 \pm \1.39
 - (D) $\$47.52 \pm \1.42
 - (E) $\$47.52 \pm \4.49
20. Suppose we have a random variable X where $P(X = k) = \binom{15}{k} (.29)^k (.71)^{15-k}$ for $k = 0, 1, \dots, 15$. What is the mean of X ?
- (A) 0.29
 - (B) 0.71
 - (C) 4.35
 - (D) 10.65
 - (E) None of the above

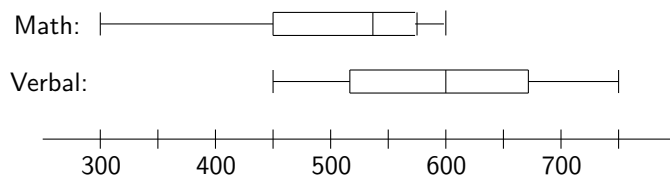
21. A study was conducted to determine the effectiveness of varying amounts of vitamin C in reducing the number of common colds. A survey of 450 people provided the following information:

| | Daily amount of vitamin C taken | | |
|-------------------|---------------------------------|--------|---------|
| | None | 500 mg | 1000 mg |
| No colds | 57 | 26 | 17 |
| At least one cold | 223 | 84 | 43 |

Is there evidence of a relationship between catching a cold and taking vitamin C?

- (A) The data prove that vitamin C reduces the number of common colds.
 - (B) The data prove that vitamin C has no effect on the number of common colds.
 - (C) There is sufficient evidence at the 1% significance level of a relationship between taking vitamin C and catching fewer colds.
 - (D) There is sufficient evidence at the 10% significance level, but not at the 1% significance level, of a relationship between taking vitamin C and catching fewer colds.
 - (E) There is not sufficient evidence at the 10% level of a relationship between taking vitamin C and catching fewer colds.
22. Both over-the-counter niacin and the prescription drug Lipitor are known to lower blood cholesterol levels. In one double-blind study Lipitor outperformed niacin. The 95% confidence interval estimate of the difference in mean cholesterol level lowering was (18, 41). Which of the following is a reasonable conclusion?
- (A) Niacin lowers cholesterol an average of 18 points, while Lipitor lowers cholesterol an average of 41 points.
 - (B) There is a .95 probability that Lipitor will outperform niacin in lowering the cholesterol level of any given individual.
 - (C) There is a .95 probability that Lipitor will outperform niacin by at least 23 points in lowering the cholesterol level of any given individual.
 - (D) We should be 95% confident that Lipitor will outperform niacin as a cholesterol-lowering drug.
 - (E) None of the above.

23. The boxplots below summarize the distribution of SAT verbal and math scores among students at an upstate New York high school.



Which of the following statements are true?

- I. The range of the math scores equals the range of the verbal scores.
 - II. The highest math score equals the median verbal score.
 - III. The verbal scores appear to be roughly symmetric, while the math scores appear to be skewed to the right.
- (A) I only
(B) III only
(C) I and II
(D) II and III
(E) I, II, and III
24. A survey is conducted to determine the percentage of students at state universities who change their major at least once. In an SRS of 100 students 78% indicated that they graduated with a major different from the one with which they entered college. Determine a 95% confidence interval for the percentage of students who change their major.
- (A) 68.2% to 87.8%
(B) 68.5% to 87.5%
(C) 69.9% to 86.1%
(D) 71.2% to 84.8%
(E) 73.9% to 82.1%

25. An *Archaeopteryx* is an extinct animal having feathers like a bird but also having very prominent teeth. Five fossilized specimen of this creature have been found with the lengths of the femur (a leg bone) plotted against the lengths of the humerus (a bone in the upper arm):

| | | | | | |
|---------|----|----|----|----|----|
| Femur | 38 | 56 | 59 | 64 | 74 |
| Humerus | 41 | 63 | 70 | 71 | 76 |

Archeologists have long felt that there should be a positive linear correlation between the lengths of the femur and the lengths of the humerus in these extinct creatures. What do the above data suggest?

- (A) A positive correlation is likely because lengths of bones in any animal are always positively correlated.
- (B) A positive correlation is likely because the above test yields a P -value of .0039.
- (C) A positive correlation is likely because the above test yields a P -value of .0078.
- (D) There is no significant positive correlation at the 1% level of significance as the P -value is .039.
- (E) There is no significant positive correlation at the 5% level of significance as the P -value is .078.

End of Multiple-Choice Questions