

Statistics Test

Palm Harbor University High School Invitational February 2003

You may use a graphing calculator with NO qwerty keyboard on this test. The necessary tables and charts are located after question number 30. For all questions, E. NOTA means none of the above answers is correct.

1. What is the sum of the mean, median, and mode of the following set of data?
{1, 1, 2, 4, 8, 9, 10}
A) 7 B) 8 C) 9 D) 10 E) NOTA
2. Inferential statistics is used in finding how many of the following?
I. Median grade on an exam
II. Correlation between GPA and SAT score for a group of students
III. 95% confidence interval for number of chocolate chips in an unopened bag of Chips-Ahoy
IV. Mean number of times one must toss a coin before it comes up heads
A) 1 B) 2 C) 3 D) 4 E) NOTA
3. Which of the following forms of data is qualitative?
A) Final letter grade
B) Grade Point Average
C) Number of questions correct on a test
D) Percent of questions correct on a test
E) NOTA
4. Which of the following would not decrease the margin of error?
A) Decreasing confidence level
B) Decreasing mean
C) Decreasing standard deviation
D) Increasing sample size
E) NOTA
5. In order to determine the mean household income in a small town, a researcher goes to every house number ending with a five. What would be the best description of this sample?
A) Simple Random Sample B) Stratified Random Sample
C) Systematic Sample D) Voluntary Response Sample
E) NOTA

6. In order to become a member of Mensa one must score in the top 2% on a standardized intelligence test. If an I.Q. test has mean 100 and standard deviation 15, what must one score on this test in order to join Mensa? (Round to the nearest I.Q. point.)
- A) 130 B) 131 C) 132 D) 134 E) NOTA
7. In order to survey the study habits of high school students in Pinellas County, the School Board randomly selects 20 students from each high school to complete a survey. What would be the best description of this sample?
- A) Simple Random Sample B) Stratified Random Sample
 C) Systematic Sample D) Voluntary Response Sample
 E) NOTA
8. The "Lucky 13" slot machine has 4 reels and exactly one cherry and one lemon on each reel. It costs you \$1 to play the slot machine. If you get 4 cherries you get \$13, otherwise you get nothing. What is your expected value for playing the slot machine?
- A) $-\$ \frac{3}{16}$ B) $-\$ \frac{1}{16}$ C) \$0 D) $\$ \frac{1}{16}$ E) NOTA
9. Which of the following are experiments?
- I. Counting the number of cars that stop at a stop sign
 II. Administering surveys to learn about drug use among students
 III. Administering surveys to learn how people feel after listening to rap music, classical music, or no music
- A) I, II, III B) II and III C) only II D) only III E) NOTA
10. Given: A and B are two independent random events.
 $P(A)=P(B)$
 $P(A \text{ or } B)=0.8$
 Find: $P(A)$
- A) $\frac{5-2\sqrt{5}}{5}$ B) $\frac{\sqrt{2}}{4}$ C) $\frac{5-\sqrt{5}}{5}$ D) 0.6 E) NOTA
11. Which of the following ensures that casinos will make a profit in the long run because the expected value for each casino game favors the house?
- A) Law of large numbers
 B) Type I Error
 C) Type II Error
 D) Random Sampling
 E) NOTA

Problems 12 and 13 will use the following information.

For a differential equations project, Brandon and Steven were trying to show that the velocity that water comes out under the influence of gravity of a tube with a small hole in the bottom will be linear with respect to time. Their experimental data follows.

Time	Velocity
13.30 s	0 in/s
11.87 s	26.2 in/s
10.37 s	52.4 in/s
6.65 s	91.7 in/s
4.04 s	131.0 in/s
0 s	189.9 in/s

12. What is the correlation for their experimental data?
(Round to three significant digits.)
- A) -0.998 B) -0.996 C) 0.996 D) 0.998 E) NOTA
13. In the previous problem, what proportion of the variability in velocity can be explained by the variability in time? (Round to three significant digits.)
- A) -0.998 B) -0.996 C) 0.996 D) 0.998 E) NOTA
14. A factory is supposed to produce ball bearings with a mean diameter of 10 millimeters and standard deviation of 0.5 millimeters. To insure quality, an inspector randomly selects 25 ball bearings and finds the mean diameter to be 10.1 millimeters. He performs a statistical test to see if the mean diameter is out of specifications. What is the p-value? (Round to three significant digits.)
- A) 0.0357 B) 0.0455 C) 0.211 D) 0.317 E) NOTA
15. What is the area under a probability density function?
- A) 0 B) 0.5
C) 1 D) Not enough information E) NOTA
16. Warren is running for S.G.A. President at a large school and wants to know his chance of winning. He randomly surveys 100 students and finds that 59 will vote for him. What is the 95% confidence interval for the percent of students that will vote for Warren? (Round to the nearest percent.)
- A) 49% - 69% B) 52% - 66% C) 54% - 64% D) 57% - 61% E) NOTA

Problems 17 and 18 will use the following information.

Steven is trying to find a prime number larger than anyone has ever seen before. It takes his computer approximately 12 days and 6 hours to determine whether a number is a Mersenne prime or not. The probability that each number he tests is prime is approximately $\frac{1}{120000}$.

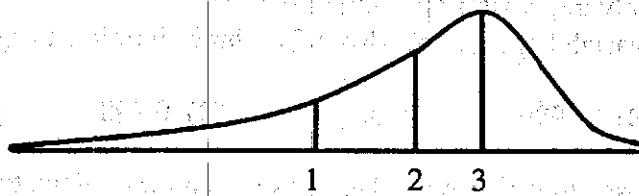
17. What is the probability he will find at least one Mersenne prime if his computer runs nonstop for one year? (Round to four significant digits.)

- A) 0.000008331 B) 0.0002416
 C) 0.0002417 D) 0.0002500 E) NOTA

18. If Steven's computer checks numbers until it finds a new Mersenne prime and then stops, what is the expected number of days his computer must run?

- A) 1,440,000 B) 1,470,000 C) 1,500,000 D) 1,525,000 E) NOTA

19. Which of the following correctly identifies the mean, median, and mode (in that order) for the given distribution?



- A) 1, 3, 2 B) 2, 1, 3 C) 3, 1, 2 D) 3, 2, 1 E) NOTA

20. Suppose the average SAT score for both the verbal and math sections is 500 with a standard deviation of 100. If a student's verbal and math scores are independent, what percentile is a combined score of 1200? (Round to the nearest percent.)

- A) 84% B) 92% C) 97% D) 99% E) NOTA

21. What is the interquartile range of the following set of data?
 {1, 1, 2, 4, 8, 9, 10}

- A) 7 B) 8 C) 9 D) 10 E) NOTA

22. You are trying to find a 99% confidence interval for the mean mass of a pea. The standard deviation of the mass of a pea is believed to be approximately 0.15 g. If you want the margin of error to be less than 0.05 g, how many peas do you need to sample?

- A) 34 B) 35 C) 59 D) 60 E) NOTA

23. Which of the following is not a measure of the variability of a set of data?
- A) Interquartile Range B) Variance
C) Range D) Standard Deviation E) NOTA
24. An investigative journalist is conducting an experiment to determine whether a new drug actually causes chronic migraine sufferers to experience less pain. They place an ad asking for appropriate volunteers for the study. The researchers randomly divide the participants into two groups. Research assistants, with no knowledge of the experimental design, administer the drug to one group and a placebo to the other. The assistants then interview the participants to determine their level of pain relief. The experiment concluded that the drug fails to alleviate pain at a statistically significant level. Which of the following may have produced inaccurate results in this experiment?
- A) Correlation does not imply causation
B) Failure to make the experiment double-blind
C) Placebo Effect
D) Voluntary Response Error
E) NOTA
25. Damien is taking a 30 question multiple-choice Mu Alpha Theta test. Without looking at the test, he randomly bubbles in answers for all 30 questions on the test. What is the probability he gets a positive score on the test? (Four points are awarded for correct answers. One point is deducted for incorrect answers. Round to the nearest percent.)
- A) 24% B) 39% C) 43% D) 57% E) NOTA
26. Which of the following is not a requirement for a geometric setting?
- A) Each observation is either a success or failure.
B) The observations are all independent.
C) The probability of a success is the same for each observation.
D) There are a fixed number of observations.
E) NOTA
27. A researcher is studying whether girls are more extroverted than boys. The researcher administers a test of introversion/extroversion to 100 boys and 100 girls. The mean score for boys was 60 with a standard deviation of 10. The mean score for girls was 62 with a standard deviation of 6. If the alternative hypothesis is that girls will have a higher score, what is the significance test's p-value? (Round to 2 significant digits.)
- A) 0.044 B) 0.059 C) 0.088 D) 0.118 E) NOTA

Problems 28 and 29 will use the following information.

For a psychological experiment, Keith asks his participants to select one of five colors. The control group simply selects a color while the experimental group reads a sad story before selecting a color. The experimental data follows. Keith expects the experimental group to behave in a similar manner to the control group. A chi-square goodness of fit test is performed in order to test the hypothesis that reading the story affects color selection.

Color	Control Group	Experimental Group
Blue	22	30
Red	18	11
Green	23	27
Black	13	16
Yellow	24	16

28. What is the chi-square statistic for this test? (Round to three significant digits.)
- A) 9.69 B) 11.7 C) 202 D) 262 E) NOTA
29. What is the p-value for this test? (Round to two significant digits.)
- A) 0.019 B) 0.046 C) 0.059 D) 0.085 E) NOTA
30. As the degrees of freedom increases, which set of curves approaches the standard normal curve and the mean of which set of curves increases? (in that order)
- A) chi-square distribution, chi-square distribution
 B) chi-square distribution, t-distribution
 C) t-distribution, chi-square distribution
 D) t-distribution, t-distribution
 E) NOTA

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

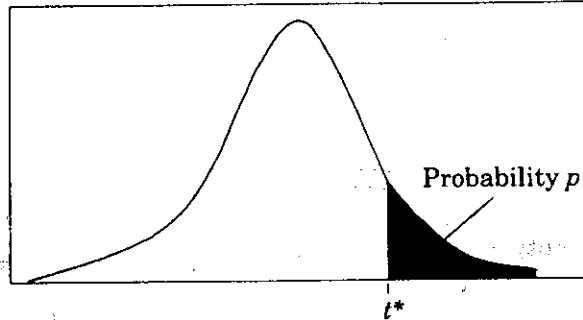


Table C t distribution critical values

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	31.82	63.66	127.3	318.3	636.6
2	.816	1.061	1.386	1.886	2.920	4.303	4.849	6.965	9.925	14.09	22.33	31.60
3	.765	.978	1.250	1.638	2.353	3.182	3.482	4.541	5.841	7.453	10.21	12.92
4	.741	.941	1.190	1.533	2.132	2.776	2.999	3.747	4.604	5.598	7.173	8.610
5	.727	.920	1.156	1.476	2.015	2.571	2.757	3.365	4.032	4.773	5.893	6.869
6	.718	.906	1.134	1.440	1.943	2.447	2.612	3.143	3.707	4.317	5.208	5.959
7	.711	.896	1.119	1.415	1.895	2.365	2.517	2.998	3.499	4.029	4.785	5.408
8	.706	.889	1.108	1.397	1.860	2.306	2.449	2.896	3.355	3.833	4.501	5.041
9	.703	.883	1.100	1.383	1.833	2.262	2.398	2.821	3.250	3.690	4.297	4.781
10	.700	.879	1.093	1.372	1.812	2.228	2.359	2.764	3.169	3.581	4.144	4.587
11	.697	.876	1.088	1.363	1.796	2.201	2.328	2.718	3.106	3.497	4.025	4.437
12	.695	.873	1.083	1.356	1.782	2.179	2.303	2.681	3.055	3.428	3.930	4.318
13	.694	.870	1.079	1.350	1.771	2.160	2.282	2.650	3.012	3.372	3.852	4.221
14	.692	.868	1.076	1.345	1.761	2.145	2.264	2.624	2.977	3.326	3.787	4.140
15	.691	.866	1.074	1.341	1.753	2.131	2.249	2.602	2.947	3.286	3.733	4.073
16	.690	.865	1.071	1.337	1.746	2.120	2.235	2.583	2.921	3.252	3.686	4.015
17	.689	.863	1.069	1.333	1.740	2.110	2.224	2.567	2.898	3.222	3.646	3.965
18	.688	.862	1.067	1.330	1.734	2.101	2.214	2.552	2.878	3.197	3.611	3.922
19	.688	.861	1.066	1.328	1.729	2.093	2.205	2.539	2.861	3.174	3.579	3.883
20	.687	.860	1.064	1.325	1.725	2.086	2.197	2.528	2.845	3.153	3.552	3.850
21	.686	.859	1.063	1.323	1.721	2.080	2.189	2.518	2.831	3.135	3.527	3.819
22	.686	.858	1.061	1.321	1.717	2.074	2.183	2.508	2.819	3.119	3.505	3.792
23	.685	.858	1.060	1.319	1.714	2.069	2.177	2.500	2.807	3.104	3.485	3.768
24	.685	.857	1.059	1.318	1.711	2.064	2.172	2.492	2.797	3.091	3.467	3.745
25	.684	.856	1.058	1.316	1.708	2.060	2.167	2.485	2.787	3.078	3.450	3.725
26	.684	.856	1.058	1.315	1.706	2.056	2.162	2.479	2.779	3.067	3.435	3.707
27	.684	.855	1.057	1.314	1.703	2.052	2.158	2.473	2.771	3.057	3.421	3.690
28	.683	.855	1.056	1.313	1.701	2.048	2.154	2.467	2.763	3.047	3.408	3.674
29	.683	.854	1.055	1.311	1.699	2.045	2.150	2.462	2.756	3.038	3.396	3.659
30	.683	.854	1.055	1.310	1.697	2.042	2.147	2.457	2.750	3.030	3.385	3.646
40	.681	.851	1.050	1.303	1.684	2.021	2.123	2.423	2.704	2.971	3.307	3.551
50	.679	.849	1.047	1.299	1.676	2.009	2.109	2.403	2.678	2.937	3.261	3.496
60	.679	.848	1.045	1.296	1.671	2.000	2.099	2.390	2.660	2.915	3.232	3.460
80	.678	.846	1.043	1.292	1.664	1.990	2.088	2.374	2.639	2.887	3.195	3.416
100	.677	.845	1.042	1.290	1.660	1.984	2.081	2.364	2.626	2.871	3.174	3.390
1000	.675	.842	1.037	1.282	1.646	1.962	2.056	2.330	2.581	2.813	3.098	3.300
∞	.674	.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 point (χ^2) with probability p lying above it.

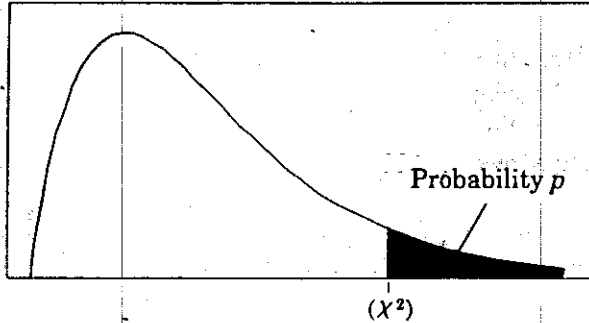


Table E χ^2 critical values

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

