Exam 3 Practice Questions Part I

1. A standard error calculated in a single sample is indicative of ________ of the sampling distribution.

   A. the standard error

   B. the standard deviation

   C. the interquartile range

   D. the mean absolute deviation

   E. the index of qualitative variation

B

2. When a correlation is equal to zero, it is reasonable to say the variables are:

   A. independent

   B. disjunct

   C. divisive

   D. inversely correlated

   E. positively correlated

A

3. Small sample confidence intervals for continuous variables are based on the:

   A. normal or z-distribution

   B. chi square distribution

   C. central limit theorem

   D. t-distribution

   E. Gauss/Yule theorem

D

4. Which of the following types of estimates communicates uncertainty to a scientific audience?

   A. point estimates

   B. marginal estimates

   C. joint estimates

   D. pooled estimates

   E. interval estimates

E

5. Suppose we have a random sample of 72 adolescents currently incarcerated in a particular state. The average age at the time each of these people was first arrested is 14.2 and the standard deviation is 1.3. What is the standard error of the mean?

   A. 0.081
   B. 0.024
   C. 0.153
   D. 0.287
   E. 0.302

$$\text{Std. error} = S/\sqrt{N} = 1.3/\sqrt{72}$$
$$= 1.3/8.485$$
$$= 0.153$$

6. The local police department conducts a study to estimate the fraction of adults in the city who feel unsafe walking in their neighborhood at night. A local research firm collects a random sample of 547 survey responses; 283 of the respondents reported feeling unsafe while the remaining 264 said they had no safety concerns. Based on this information, what is the estimated proportion of people who feel unsafe?

   A. 0.624
   B. 0.517
   C. 0.385
   D. 0.452
   E. 0.583

$$p(\text{unsafe}) = \frac{\text{number of people who say they feel unsafe}}{\text{number of people}} = \frac{283}{547} = 0.517$$

7. Consider a random sample of 385 people being released from prison. Among these 385 people we learn that 207 of them have at least one prior arrest. What is the lower bound of the 90% confidence interval for the proportion of people released from prison having at least one prior arrest?

   A. 0.579
   B. 0.412
   C. 0.381
   D. 0.497
   E. 0.641

1. $p(\text{at least one prior arrest}) = \frac{207}{385} = 0.538 = \theta$
2. $\text{std. dev.} = \sqrt{\theta(1-\theta)} = \sqrt{0.538 \times 0.462}$
   $= \sqrt{0.249} = 0.499$
3. $\text{Std. error} = sd/\sqrt{N} = 0.499/\sqrt{385}$
   $= 0.499/19.621$
   $= 0.025$
4. 90% CI corresponds to $\alpha = 0.10$ (2-tailed)
5. Z-distribution (large sample proportion) = 1.645
6. $LB = 0.538 - 1.645(0.025)$
   $= 0.538 - 0.041$
   $= 0.497$

$N=8$

8. The local juvenile court has been keeping track of the hours of community service that a random sample of $\boxed{\text{8 kids}}$ have contributed. Based on these records we obtain the following data points: 14, 21, 27, 35, 18, 25, 21, 18. Estimate the upper bound of the 95% confidence interval for the average number of hours of community service.

 A. 30.452
 B. 27.852
 C. 25.017
 D. 33.365

data points	devs	devs^2
14	−8.375	70.141
21	−1.375	1.891
27	4.625	21.391
35	12.625	159.391
18	−4.375	19.141
25	2.625	6.891
21	−1.375	1.891
18	−4.375	19.141
$\Sigma \rightarrow$	0	299.878

$$\text{Mean} = \frac{\text{Sum of scores}}{\text{\# of scores}} = 179/8 = 22.375$$

$$sd = \sqrt{\frac{1}{N-1}\sum_i (x_i-\bar{x})^2} = \sqrt{\frac{1}{8-1}\,299.878} = \sqrt{\frac{1}{7}\,299.878} = \sqrt{42.883} = 6.549$$

$$\text{Std. error} = sd/\sqrt{N} = 6.549/\sqrt{8} = 6.549/2.828 = 2.316$$

t-distribution w 8-1 df = 7df
multiplier for $\alpha = 0.05$ (2-tailed) $= 2.365$
(Table 133/p.536)

$$UCL = 22.375 + 2.365(2.316) = 22.375 + 5.477 = 27.852$$

9. We survey a random sample of American youth and each of the people who participate are asked whether they've been arrested by the police within the past 12 months. Our sample is comprised of 2,422 people with a total of 2087 participants and 335 nonparticipants. Among the participants, 272 report that they had been arrested while the remaining 1,815 said they had not been arrested. What is the lower bound of the partial identification interval for the arrest rate of the entire sample?

   A. 0.112
   B. 0.095
   C. 0.138
   D. 0.130
   E. 0.159

$p(A) = p(obs)\,p(A|obs) + p(miss)\,p(A|miss)$

$= 0.862 \times 0.130 = 0.112$

$p(obs) = 2087/2422 = 0.862$ $\quad p(miss) = 1 - p(obs) = 0.138$

$p(A|obs) = 272/2087 = 0.130$ $\quad$ Note: $p(A|miss) = \emptyset$

10. Historically, the local court has monitored the waiting time between initial booking at the police department and the first appearance in bond court. Over time, the average waiting time has been estimated at $\boxed{\text{18 hours}}$. We now consider a random sample of 7 recent arrestees who each had the following waiting times (in hours): 22, 23, 27, 19, 25, 21, 17. The clerk of court has asked us to test the hypothesis that the recent arrestees have an average waiting time that is equal to the historical average (the alternative to our hypothesis is that the recent arrestees have a *longer* average waiting time so this is a directional or one-tailed test). After consulting with a statistician, we choose to use a $p < .01$ significance level for our one-tailed test. What do we conclude?

   A. reject the hypothesis
   B. fail to reject the hypothesis

Since $3.096 < 3.143$ we fail to reject

Sample mean $= \dfrac{\text{Sum of scores}}{\#\text{ of scores}} = \dfrac{154}{7} = 22$

data	$X-\bar{X}$	$(X-\bar{X})^2$
22	0	0
23	1	1
27	5	25
19	−3	9
25	3	9
21	−1	1
17	−5	25
Sums →	0	70

Std. error $= sd/\sqrt{N} = \dfrac{3.419}{\sqrt{7}} = \dfrac{3.419}{2.646} = 1.292$

$sd = \sqrt{\dfrac{1}{7-1}\sum_i (x-\bar{x})^2} = \sqrt{\dfrac{1}{6}\,70} = \sqrt{0.167(70)} = \sqrt{11.69} = 3.419$

t-dist w/ $7-1=6$ df, $\alpha = 0.01$ (1-tailed) $\Big\} \rightarrow t = 3.143$ critical

test statistic $= \dfrac{\bar{X} - \mu}{sd/\sqrt{N}} = \dfrac{22-18}{1.292} = 4/1.292 = 3.096$

11. Consider the following contingency table examining the effect of a drug treatment program (randomly assigned to treatment = 1 and randomly assigned to control = 0) on substance use relapse rates (no relapse = 0, relapse = 1).

	$R = 0$	$R = 1$	Total
$T = 0$	322	165	487
$T = 1$	373	119	492
Total	695	284	979

Based on the information in this table, estimate Yule's Q for this table.

A. -0.108

B. -0.143

C. -0.233

D. -0.314

E. -0.181

$$Q = (AD - BC)/(AD + BC) = \frac{322 \times 119 - 165 \times 373}{322 \times 119 + 165 \cdot 373}$$

$$= \frac{38318 - 61545}{38318 + 61545} = \frac{-23227}{99863} = -0.233$$

12. Reconsidering the contingency table in problem 11, estimate a 90% confidence interval for Yule's Q. Does the 90% confidence interval you estimated include the number zero?

A. yes

B. no

C. not enough information to tell

CI Formula

$$Q \pm z\sqrt{\frac{(1-Q^2)^2(1/A + 1/B + 1/C + 1/D)}{4}}$$

Precision of CI = 90%

z-multiplier for $\alpha = 0.10$ (2-tailed)

$= 1.645$

$Q = -0.233$ / $Q^2 = 0.054$

$$LB = -0.233 - 1.645\sqrt{\frac{(1-0.054)^2(1/322 + 1/165 + 1/373 + 1/119)}{4}}$$

$$= -0.233 - 1.645\sqrt{\frac{0.946^2(0.003 + 0.006 + 0.003 + 0.008)}{4}}$$

$$= -0.233 - 1.645\sqrt{\frac{0.895 \times 0.020}{4}} = -0.233 - 1.645\sqrt{0.018/4}$$

$$= -0.233 - 1.645\sqrt{0.005}$$

$$= -0.233 - 1.645(0.071)$$

$$= -0.233 - 0.117$$

$$= -0.350$$

$$UB = -0.233 + 1.645(0.071)$$

$$= -0.233 + 0.117$$

$$= -0.116$$

$CI = [-0.350, -0.116]$

Table B.3 The t Distribution

	Level of Significance for a One-Tailed Test					
	.10	.05	.025	.01	.005	.0005
	Level of Significance for a Two-Tailed Test					
df	.20	.10	.05	.02	.01	.001
1	3.078	6.314	12.706	31.821	63.657	636.619
2	1.886	2.920	4.303	6.965	9.925	31.598
3	1.638	2.353	3.182	4.541	5.841	12.941
4	1.533	2.132	2.776	3.747	4.604	8.610
5	1.476	2.015	2.571	3.365	4.032	6.859
6	1.440	1.943	2.447	3.143	3.707	5.959
7	1.415	1.895	2.365	2.998	3.499	5.405
8	1.397	1.860	2.306	2.896	3.355	5.041
9	1.383	1.833	2.262	2.821	3.250	4.781
10	1.372	1.812	2.228	2.764	3.169	4.587
11	1.363	1.796	2.201	2.718	3.106	4.437
12	1.356	1.782	2.179	2.681	3.055	4.318
13	1.350	1.771	2.160	2.650	3.012	4.221
14	1.345	1.761	2.145	2.624	2.977	4.140
15	1.341	1.753	2.131	2.602	2.947	4.073
16	1.337	1.746	2.120	2.583	2.921	4.015
17	1.333	1.740	2.110	2.567	2.898	3.965
18	1.330	1.734	2.101	2.552	2.878	3.922
19	1.328	1.729	2.093	2.539	2.861	3.883
20	1.325	1.725	2.086	2.528	2.845	3.850
21	1.323	1.721	2.080	2.518	2.831	3.819
22	1.321	1.717	2.074	2.508	2.819	3.792
23	1.319	1.714	2.069	2.500	2.807	3.767
24	1.318	1.711	2.064	2.492	2.797	3.745
25	1.316	1.708	2.060	2.485	2.787	3.725
26	1.315	1.706	2.056	2.479	2.779	3.707
27	1.314	1.703	2.052	2.473	2.771	3.690
28	1.313	1.701	2.048	2.467	2.763	3.674
29	1.311	1.699	2.045	2.462	2.756	3.659
30	1.310	1.697	2.042	2.457	2.750	3.646
40	1.303	1.684	2.021	2.423	2.704	3.551
60	1.206	1.671	2.000	2.390	2.660	3.460
120	1.289	1.658	1.980	2.358	2.617	3.373
∞	1.282	1.645	1.960	2.326	2.576	3.291

Source: TABLE B-3 is adapted with permission from Table III of Fisher and Yates, *Statistical Tables for Biological, Agricultural and Medical Research* (6th ed.). Published by Longman Group UK Ltd., 1974.