

Your name: \_\_\_\_\_

**Quiz rules:**

- (a) This quiz is closed book, but you are allowed a two-sided sheet of paper of notes and a calculator.
- (b) Each question is worth 6 points.
- (c) A normal table is provided on the last page.
- (d) You have 50 minutes to complete this quiz.
- (e) If you fail to show your work and/or explain how you arrived at your answer then no points will be awarded.
- (f) You do not need to solve all the problems to do well. Try your best.

1. The Olympic committee is concerned about the rate of banned equipment use. To assess the rate at which banned equipment is used the committee conducts a simple random sample of 400 out of the 50,000 registered Olympic athletes. They asked "Have you knowingly used banned equipment during competition in the last 365 days?"
  - (a) True or false, and explain briefly: The sample size (which is less than 1% of the total population) is too small to produce an estimate of the percentage with any reasonable confidence of athletes in the population who had knowingly used banned equipment in the last 365 days.
  - (b) Noting that the statute of limitations for using banned equipment is limited to the prior 365 days (i.e., an athlete cannot be held responsible for actions taken more than 365 days ago), a statistician recommends that the survey's question be changed to: "Excluding competitions in the last 365 days, have you ever knowingly used banned equipment during competition?" Explain how this might reduce at least one kind of bias.

- (c) The statistician also recommends implementing a system where each athlete rolls a die in private before answering the question. If a 1 or 2 come up then they must answer “no,” if a 3 or 4 come up they must answer “yes,” and if a 5 or 6 come up they must answer truthfully. The interviewer does not see the outcome of the die. There are two types of bias that this technique has the potential to reduce (i) name the two types of bias (ii) uses 2-3 sentences to say how this technique may reduce these types of bias.

2. On January 9, 2014 in West Virginia it was discovered that 4-methylcyclohexane methanol (MCHM) was discovered leaking from a storage tank owned by Freedom Industries into the Elk River and from there into the water supply for Charleston, WV. To get an estimate of the contamination of the water in the area, 10 locations (e.g., streams, drinking wells, ground water) were randomly selected and tested each day for a week. Thus there were 70 tests. Across the tests there was an average level of contamination of 1.1ppb and a standard deviation of 0.2ppb. A local news organization wants to discuss the amount of error in the estimate of the average contamination level so they calculate a standard error of

$$\frac{0.2 \text{ ppb}}{\sqrt{70}} \cong 0.0239 \text{ ppb}$$

Explain the assumptions in the above calculation and take a stance on whether they are justified.

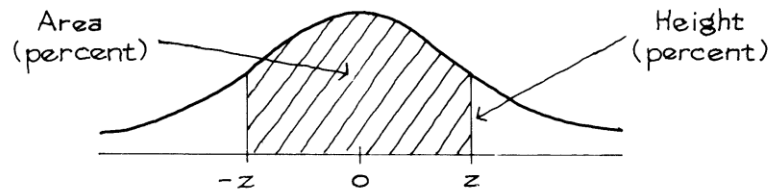
- (b) The researchers take 16 measurements of the hips of each of the 225 subjects for a total of 3600 measurements. The average measurement is 2.5 across these 3600 measurements. Can you attach a margin of error to this estimate? If so, calculate it; otherwise, explain why not.

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- (b) Suppose 235 of the 1000 people surveyed answer “yes” in this particular sample. True or false, and explain briefly: : there is about a 95% chance that 23.5% is within 2.7% of the percentage of all Americans who view Chris Christie less favorably.

6. A small town with 4,000 households plans to ban household pets in public parks. Rolf Barkley, a dog owner, would like to make a case against this ordinance by citing the average number of pets per household. A recent census of all 4,000 households was taken, but Rolf does not remember the average; he only remembers the SD, which was 2.0. Because he does not have time to survey all 4,000 households, he decides to take a simple random sample of 200 households, in which there was an average of 1.4 pets per household with an SD of 2.5.
- (a) Rolf would like to attach an uncertainty to this estimate of 1.4. Is this possible? If so, do it; otherwise, explain why not.

- (b) Is it possible to construct a 90% confidence interval for this estimate? If so, do it; otherwise, explain why not.



A NORMAL TABLE

$z$	<i>Height</i>	<i>Area</i>	$z$	<i>Height</i>	<i>Area</i>	$z$	<i>Height</i>	<i>Area</i>
0.00	39.89	0	1.50	12.95	86.64	3.00	0.443	99.730
0.05	39.84	3.99	1.55	12.00	87.89	3.05	0.381	99.771
0.10	39.69	7.97	1.60	11.09	89.04	3.10	0.327	99.806
0.15	39.45	11.92	1.65	10.23	90.11	3.15	0.279	99.837
0.20	39.10	15.85	1.70	9.40	91.09	3.20	0.238	99.863
0.25	38.67	19.74	1.75	8.63	91.99	3.25	0.203	99.885
0.30	38.14	23.58	1.80	7.90	92.81	3.30	0.172	99.903
0.35	37.52	27.37	1.85	7.21	93.57	3.35	0.146	99.919
0.40	36.83	31.08	1.90	6.56	94.26	3.40	0.123	99.933
0.45	36.05	34.73	1.95	5.96	94.88	3.45	0.104	99.944
0.50	35.21	38.29	2.00	5.40	95.45	3.50	0.087	99.953
0.55	34.29	41.77	2.05	4.88	95.96	3.55	0.073	99.961
0.60	33.32	45.15	2.10	4.40	96.43	3.60	0.061	99.968
0.65	32.30	48.43	2.15	3.96	96.84	3.65	0.051	99.974
0.70	31.23	51.61	2.20	3.55	97.22	3.70	0.042	99.978
0.75	30.11	54.67	2.25	3.17	97.56	3.75	0.035	99.982
0.80	28.97	57.63	2.30	2.83	97.86	3.80	0.029	99.986
0.85	27.80	60.47	2.35	2.52	98.12	3.85	0.024	99.988
0.90	26.61	63.19	2.40	2.24	98.36	3.90	0.020	99.990
0.95	25.41	65.79	2.45	1.98	98.57	3.95	0.016	99.992
1.00	24.20	68.27	2.50	1.75	98.76	4.00	0.013	99.9937
1.05	22.99	70.63	2.55	1.54	98.92	4.05	0.011	99.9949
1.10	21.79	72.87	2.60	1.36	99.07	4.10	0.009	99.9959
1.15	20.59	74.99	2.65	1.19	99.20	4.15	0.007	99.9967
1.20	19.42	76.99	2.70	1.04	99.31	4.20	0.006	99.9973
1.25	18.26	78.87	2.75	0.91	99.40	4.25	0.005	99.9979
1.30	17.14	80.64	2.80	0.79	99.49	4.30	0.004	99.9983
1.35	16.04	82.30	2.85	0.69	99.56	4.35	0.003	99.9986
1.40	14.97	83.85	2.90	0.60	99.63	4.40	0.002	99.9989
1.45	13.94	85.29	2.95	0.51	99.68	4.45	0.002	99.9991