



# Question Bank

# Math

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## Sample Statistics and Margin of Error (key)



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Assessment	Test	Domain	Skill	Difficulty
SAT	Math	Problem-Solving and Data Analysis	Inference from sample statistics and margin of error	<div><div></div><div></div><div></div></div>

**ID: 90eed2e5**

A city has 50 city council members. A reporter polled a random sample of 20 city council members and found that 6 of those polled supported a specific bill. Based on the sample, which of the following is the best estimate of the number of city council members in the city who support the bill?

- A. 6
- B. 9
- C. 15
- D. 30

**ID: 90eed2e5 Answer**

Rationale

Choice C is correct. Because a random sample of the city council was polled, the proportion of the sample who supported the bill is expected to be approximately equal to the proportion of the total city council who supports the bill. Since 6 of the 20 polled, or 30%, supported the bill, it can be estimated that  $50 \times 0.3$ , or 15, city council members support the bill.

Choice A is incorrect. This is the number of city council members in the sample who supported the bill. Choice B is incorrect and may result from a computational error. Choice D is incorrect. This is the number of city council members in the sample of city council members who were not polled.

Question Difficulty: Easy



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**ID: e7d9649f**

A random sample of 50 people from a town with a population of 14,878 were asked to name their favorite flavor of ice cream. If 7 people in the sample named chocolate as their favorite ice-cream flavor, about how many people in the town would be expected to name chocolate?

- A. 350
- B. 2,100
- C. 7,500
- D. 10,500

**ID: e7d9649f Answer**

Correct Answer: B

Rationale

Choice B is correct. Let  $x$  be the number of people in the entire town that would be expected to name chocolate. Since the sample of 50 people was selected at random, it is reasonable to expect that the proportion of people who named chocolate as their favorite ice-cream flavor would be the same for both the sample and

the town population. Symbolically, this can be expressed as  $\frac{7}{50} = \frac{x}{14,878}$ . Using cross multiplication,  $7 \times 14,878 = x \times 50$ ; solving for  $x$  yields 2,083. The choice closest to the value of 2,083 is choice B, 2,100.

Choices A, C, and D are incorrect and may be the result of errors when setting up the proportion, solving for the unknown, or incorrectly comparing the choices to the number of people expected to name chocolate, 2,083.

Question Difficulty: Easy



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**ID: f4b3672a**

A certain forest is 253 acres. To estimate the number of trees in the forest, a ranger randomly selects 5 different 1-acre parcels in the forest and determines the number of trees in each parcel. The numbers of trees in the sample acres are 51, 59, 45, 52, and 73. Based on the mean of the sample, which of the following ranges contains the best estimate for the number of trees in the entire forest?

- A. 11,000 to 12,000
- B. 12,500 to 13,500
- C. 13,500 to 14,500
- D. 18,000 to 19,000

**ID: f4b3672a Answer**

Correct Answer: C

Rationale

Choice C is correct. The mean of the 5 samples is  $\frac{51 + 59 + 45 + 52 + 73}{5} = 56$  trees per acre. The best estimate for the total number of trees in the forest is the product of the mean number of trees per acre in the sample and the total number of acres in the forest. This is  $(56)(253) = 14,168$ , which is between 13,500 and 14,500.

Choice A is incorrect and may result from multiplying the minimum number of trees per acre in the sample, 45, by the number of acres, 253. Choice B is incorrect and may result from multiplying the median number of trees per acre in the sample, 52, by the number of acres, 253. Choice D is incorrect and may result from multiplying the maximum number of trees per acre in the sample, 73, by the number of acres, 253.

Question Difficulty: Easy



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**ID: 0108ac2d**

At a large high school, 300 students were selected at random and were asked in a survey about a menu change in the school cafeteria. All 300 students completed the survey. It was estimated that 38% of the students were in support of a menu change, with a margin of error of 5.5%. Which of the following is the best interpretation of the survey results?

- A. The percent of the students at the school who support a menu change is 38%.
- B. The percent of the students at the school who support a menu change is greater than 38%.
- C. Plausible values of the percent of the students at the school who support a menu change are between 32.5% and 43.5%.
- D. Plausible values of the number of the students at the school who support a menu change are between 295 and 305.

**ID: 0108ac2d Answer**

Correct Answer: C

Rationale

Choice C is correct. It's given that an estimated 38% of sampled students at the school were in support of a menu change, with a margin of error of 5.5%. It follows that the percent of the students at the school who support a menu change is 38% plus or minus 5.5%. The lower bound of this estimation is  $38 - 5.5$ , or 32.5%. The upper bound of this estimation is  $38 + 5.5$ , or 43.5%. Therefore, plausible values of the percent of the students at the school who support a menu change are between 32.5% and 43.5%.

Choice A is incorrect. This is the percent of the sampled students at the school who support a menu change. Choices B and D are incorrect and may result from misinterpreting the margin of error.

Question Difficulty: Easy



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**ID: 6a305cd0**

In a study, the data from a random sample of a population had a mean of 37, with an associated margin of error of 3. Which of the following is the most appropriate conclusion that can be made about the population mean?

- A. It is less than 37.
- B. It is greater than 37.
- C. It is between 34 and 40.
- D. It is less than 34 or greater than 40.

**ID: 6a305cd0 Answer**

Correct Answer: C

Rationale

Choice C is correct. It's given that the mean of the data from a random sample of a population is 37, with an associated margin of error of 3. The most appropriate conclusion that can be made is that the mean of the entire population will fall between 37, plus or minus 3. Therefore, the population mean is between  $37 - 3 = 34$  and  $37 + 3 = 40$ .

Choice A is incorrect. While it's an appropriate conclusion that the population mean is as low as  $37 - 3$ , or 34, it isn't appropriate to conclude that the population mean is less than 34. Choice B is incorrect. While it's an appropriate conclusion that the population mean is as high as  $37 + 3$ , or 40, it isn't appropriate to conclude that the population mean is greater than 40. Choice D is incorrect. It isn't an appropriate conclusion that the population mean is less than 34 or greater than 40.

Question Difficulty: Easy



Assessment	Test	Domain	Skill	Difficulty
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**ID: 53d97af5**

A study was done on the weights of different types of fish in a pond. A random sample of fish were caught and marked in order to ensure that none were weighed more than once. The sample contained 150 largemouth bass, of which 30% weighed more than 2 pounds. Which of the following conclusions is best supported by the sample data?

- A. The majority of all fish in the pond weigh less than 2 pounds.
- B. The average weight of all fish in the pond is approximately 2 pounds.
- C. Approximately 30% of all fish in the pond weigh more than 2 pounds.
- D. Approximately 30% of all largemouth bass in the pond weigh more than 2 pounds.

**ID: 53d97af5 Answer**

Correct Answer: D

Rationale

Choice D is correct. The sample of 150 largemouth bass was selected at random from all the largemouth bass in the pond, and since 30% of the fish in the sample weighed more than 2 pounds, it can be concluded that approximately 30% of all largemouth bass in the pond weigh more than 2 pounds.

Choices A, B, and C are incorrect. Since the sample contained 150 largemouth bass, of which 30% weighed more than 2 pounds, this result can be generalized only to largemouth bass in the pond, not to all fish in the pond.

Question Difficulty: Medium



Assessment	Test	Domain	Skill	Difficulty
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**ID: f8f79e11**

A park ranger asked a random sample of visitors how far they hiked during their visit. Based on the responses, the estimated mean was found to be 4.5 miles, with an associated margin of error of 0.5 miles. Which of the following is the best conclusion from these data?

- A. It is likely that all visitors hiked between 4 and 5 miles.
- B. It is likely that most visitors hiked exactly 4.5 miles.
- C. It is not possible that any visitor hiked less than 3 miles.
- D. It is plausible that the mean distance hiked for all visitors is between 4 and 5 miles.

**ID: f8f79e11 Answer**

Correct Answer: D

Rationale

Choice D is correct. The given estimated mean has an associated margin of error because from sample data, the population mean can't be determined precisely. Rather, from the sample mean, an interval can be determined within which it's plausible that the population's mean is likely to lie. Since the estimated mean is 4.5 miles with an associated margin of error of 0.5 miles, it follows that between  $4.5 - 0.5$  miles and  $4.5 + 0.5$  miles, or between 4 and 5 miles, is plausibly the mean distance hiked for all visitors.

Choices A, B, and C are incorrect. Based on the estimated mean, no determination can be made about the number of miles hiked for all visitors to the park.

Question Difficulty: Medium



Assessment	Test	Domain	Skill	Difficulty
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ID: e03f3477

A sample consisting of **720** adults who own televisions was selected at random for a study. Based on the sample, it is estimated that **32%** of all adults who own televisions use their televisions to watch nature shows, with an associated margin of error of **3.41%**. Which of the following is the most plausible conclusion about all adults who own televisions?

- A. More than **35.41%** of all adults who own televisions use their televisions to watch nature shows.
- B. Between **28.59%** and **35.41%** of all adults who own televisions use their televisions to watch nature shows.
- C. Since the sample included adults who own televisions and not just those who use their televisions to watch nature shows, no conclusion can be made.
- D. Since the sample did not include all the people who watch nature shows, no conclusion can be made.

ID: e03f3477 Answer

Correct Answer: B

Rationale

Choice B is correct. It's given that based on a sample selected at random, it's estimated that **32%** of all adults who own televisions use their televisions to watch nature shows, with an associated margin of error of **3.41%**. Subtracting the margin of error from the estimate and adding the margin of error to the estimate gives an interval of plausible values for the true percentage of adults who own televisions who use their televisions to watch nature shows. This means it's plausible that between **32% - 3.41%**, or **28.59%**, and **32% + 3.41%**, or **35.41%**, of all adults who own televisions use their televisions to watch nature shows. Therefore, of the given choices, the most plausible conclusion is that between **28.59%** and **35.41%** of all adults who own televisions use their televisions to watch nature shows.

Choice A is incorrect and may result from conceptual errors.

Choice C is incorrect. To make a plausible conclusion about all adults who own televisions, the sample must be selected at random from all adults who own televisions, not just those who use their televisions to watch nature shows.

Choice D is incorrect. Since the sample was selected at random from all adults who own televisions, a plausible conclusion can be made about all adults who own televisions.

Question Difficulty: Medium



Assessment	Test	Domain	Skill	Difficulty
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**ID: fc46af57**

A bag containing 10,000 beads of assorted colors is purchased from a craft store. To estimate the percent of red beads in the bag, a sample of beads is selected at random. The percent of red beads in the bag was estimated to be 15%, with an associated margin of error of 2%. If  $r$  is the actual number of red beads in the bag, which of the following is most plausible?

- A.  $r > 1,700$
- B.  $1,300 < r < 1,700$
- C.  $200 < r < 1,500$
- D.  $r < 1,300$

**ID: fc46af57 Answer**

Correct Answer: B

Rationale

Choice B is correct. It was estimated that 15% of the beads in the bag are red. Since the bag contains 10,000 beads, it follows that there are an estimated  $10,000 \times 0.15 = 1,500$  red beads. It's given that the margin of error is 2%, or  $10,000 \times 0.02 = 200$  beads. If the estimate is too high, there could plausibly be  $1,500 - 200 = 1,300$  red beads. If the estimate is too low, there could plausibly be  $1,500 + 200 = 1,700$  red beads. Therefore, the most plausible statement of the actual number of red beads in the bag is  $1,300 < r < 1,700$ .

Choices A and D are incorrect and may result from misinterpreting the margin of error. It's unlikely that more than 1,700 beads or fewer than 1,300 beads in the bag are red. Choice C is incorrect because 200 is the margin of error for the number of red beads, not the lower bound of the range of red beads.

Question Difficulty: Medium



Assessment	Test	Domain	Skill	Difficulty
SAT	Math	Problem-Solving and Data Analysis	Inference from sample statistics and margin of error	■ ■ □

**ID: 89f8d08a**

A store manager reviewed the receipts from 80 customers who were selected at random from all the customers who made purchases last Thursday. Of those selected, 20 receipts showed that the customer had purchased fruit. If 1,500 customers made purchases last Thursday, which of the following is the most appropriate conclusion?

- A. Exactly 75 customers must have purchased fruit last Thursday.
- B. Exactly 375 customers must have purchased fruit last Thursday.
- C. The best estimate for the number of customers who purchased fruit last Thursday is 75.
- D. The best estimate for the number of customers who purchased fruit last Thursday is 375.

**ID: 89f8d08a Answer**

Correct Answer: D

Rationale

Choice D is correct. It's given that the manager took a random selection of the receipts of 80 customers from a total of 1,500. It's also given that of those 80 receipts, 20 showed that the customer had purchased fruit. This means that an appropriate estimate of the fraction of customers who purchased fruit is  $\frac{20}{80}$ , or  $\frac{1}{4}$ .

Multiplying this fraction by the total number of customers yields  $\left(\frac{1}{4}\right)(1,500) = 375$ . Therefore, the best estimate for the number of customers who purchased fruit is 375.

Choices A and B are incorrect because an exact number of customers can't be known from taking a random selection. Additionally, choice A may also be the result of a calculation error. Choice C is incorrect and may result from a calculation error.

Question Difficulty: Medium



Assessment	Test	Domain	Skill	Difficulty
SAT	Math	Problem-Solving and Data Analysis	Inference from sample statistics and margin of error	■ ■ □

**ID: 9ee22c16**

A random sample of 400 town voters were asked if they plan to vote for Candidate A or Candidate B for mayor. The results were sorted by gender and are shown in the table below.

	Plan to vote for Candidate A	Plan to vote for Candidate B
Female	202	20
Male	34	144

The town has a total of 6,000 voters. Based on the table, what is the best estimate of the number of voters who plan to vote for Candidate A?

**ID: 9ee22c16 Answer**

Rationale

The correct answer is 3,540. According to the table, of 400 voters randomly sampled, the total number of men and women who plan to vote for Candidate A is  $202 + 34 = 236$ . The best estimate of the total number of voters in the town who plan to vote for Candidate A is the fraction of voters in the sample who plan to vote for

Candidate A,  $\frac{236}{400}$ , multiplied by the total voter population of 6000. Therefore, the answer is

$$\left(\frac{236}{400}\right)(6,000) = 3,540$$

Question Difficulty: Medium



Assessment	Test	Domain	Skill	Difficulty
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ID: 85939da5

Texting behavior	Talks on cell phone daily	Does not talk on cell phone daily	Total
Light	110	146	256
Medium	139	164	303
Heavy	166	74	240
Total	415	384	799

In a study of cell phone use, 799 randomly selected US teens were asked how often they talked on a cell phone and about their texting behavior. The data are summarized in the table above. Based on the data from the study, an estimate of the percent of US teens who are heavy texters is 30% and the associated margin of error is 3%. Which of the following is a correct statement based on the given margin of error?

- A. Approximately 3% of the teens in the study who are classified as heavy texters are not really heavy texters.
- B. It is not possible that the percent of all US teens who are heavy texters is less than 27%.
- C. The percent of all US teens who are heavy texters is 33%.
- D. It is doubtful that the percent of all US teens who are heavy texters is 35%.

ID: 85939da5 Answer

Correct Answer: D

Rationale

Choice D is correct. The given margin of error of 3% indicates that the actual percent of all US teens who are heavy texters is likely within 3% of the estimate of 30%, or between 27% and 33%. Therefore, it is unlikely, or doubtful, that the percent of all US teens who are heavy texters would be 35%.

Choice A is incorrect. The margin of error doesn't provide any information about the accuracy of reporting in the study. Choice B is incorrect. Based on the estimate and given margin of error, it is unlikely that the percent of all US teens who are heavy texters would be less than 27%, but it is possible. Choice C is incorrect. While the percent of all US teens who are heavy texters is likely between 27% and 33%, any value within this interval is equally likely. We can't be certain that the value is exactly 33%.

Question Difficulty: Hard





Assessment	Test	Domain	Skill	Difficulty
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ID: c7e73ece

Views on Nuclear  
Energy Use

Response	Frequency
Strongly favor	56
Somewhat favor	214
Somewhat oppose	104
Strongly oppose	37

A researcher interviewed 411 randomly selected US residents and asked about their views on the use of nuclear energy. The table above summarizes the responses of the interviewees. If the population of the United States was 300 million when the survey was given, based on the sample data for the 411 US residents, what is the best estimate, in millions, of the difference between the number of US residents who somewhat favor or strongly favor the use of nuclear energy and the number of those who somewhat oppose or strongly oppose it? (Round your answer to the nearest whole number.)

ID: c7e73ece Answer

Rationale

The correct answer is 94. Of those interviewed,  $56 + 214 = 270$  “strongly favor” or “somewhat favor” the use of nuclear energy, and  $104 + 37 = 141$  interviewees “somewhat oppose” or “strongly oppose” the use of nuclear energy. The difference between the sizes of the two surveyed groups is  $270 - 141 = 129$ . The proportion of this difference among the entire group of interviewees is  $\frac{129}{411}$ . Because the sample of interviewees was selected at random from US residents, it is reasonable to assume that the proportion of this difference is the same among all US residents as in the sample. Therefore, the best estimate, in millions, of the difference between the number of US residents who somewhat favor or strongly favor the use of nuclear energy and the number of those who somewhat oppose or strongly oppose it is  $\frac{129}{411} \times 300$ , which to the nearest million is 94.

Question Difficulty: Hard



Assessment	Test	Domain	Skill	Difficulty
SAT	Math	Problem-Solving and Data Analysis	Inference from sample statistics and margin of error	■ ■ ■

ID: 308084c5

Sample	Percent in favor	Margin of error
A	52%	4.2%
B	48%	1.6%

The results of two random samples of votes for a proposition are shown above. The samples were selected from the same population, and the margins of error were calculated using the same method. Which of the following is the most appropriate reason that the margin of error for sample A is greater than the margin of error for sample B?

- A. Sample A had a smaller number of votes that could not be recorded.
- B. Sample A had a higher percent of favorable responses.
- C. Sample A had a larger sample size.
- D. Sample A had a smaller sample size.

ID: 308084c5 Answer

Correct Answer: D

Rationale

Choice D is correct. Sample size is an appropriate reason for the margin of error to change. In general, a smaller sample size increases the margin of error because the sample may be less representative of the whole population.

Choice A is incorrect. The margin of error will depend on the size of the sample of recorded votes, not the number of votes that could not be recorded. In any case, the smaller number of votes that could not be recorded for sample A would tend to decrease, not increase, the comparative size of the margin of error. Choice B is incorrect. Since the percent in favor for sample A is the same distance from 50% as the percent in favor for sample B, the percent of favorable responses doesn't affect the comparative size of the margin of error for the two samples. Choice C is incorrect. If sample A had a larger margin of error than sample B, then sample A would tend to be less representative of the population. Therefore, sample A is not likely to have a larger sample size.

Question Difficulty: Hard



Assessment	Test	Domain	Skill	Difficulty
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**ID: 9ba3e283**

In State X, Mr. Camp's eighth-grade class consisting of 26 students was surveyed and 34.6 percent of the students reported that they had at least two siblings. The average eighth-grade class size in the state is 26. If the students in Mr. Camp's class are representative of students in the state's eighth-grade classes and there are 1,800 eighth-grade classes in the state, which of the following best estimates the number of eighth-grade students in the state who have fewer than two siblings?

- A. 16,200
- B. 23,400
- C. 30,600
- D. 46,800

**ID: 9ba3e283 Answer**

Correct Answer: C

Rationale

Choice C is correct. It is given that 34.6% of 26 students in Mr. Camp's class reported that they had at least two siblings. Since 34.6% of 26 is 8.996, there must have been 9 students in the class who reported having at least two siblings and 17 students who reported that they had fewer than two siblings. It is also given that the average eighth-grade class size in the state is 26 and that Mr. Camp's class is representative of all eighth-grade classes in the state. This means that in each eighth-grade class in the state there are about 17 students who have fewer than two siblings. Therefore, the best estimate of the number of eighth-grade students in the state who have fewer than two siblings is  $17 \times (\text{number of eighth-grade classes in the state})$ , or  $17 \times 1,800 = 30,600$ .

Choice A is incorrect because 16,200 is the best estimate for the number of eighth-grade students in the state who have at least, not fewer than, two siblings. Choice B is incorrect because 23,400 is half of the estimated total number of eighth-grade students in the state; however, since the students in Mr. Camp's class are representative of students in the eighth-grade classes in the state and more than half of the students in Mr. Camp's class have fewer than two siblings, more than half of the students in each eighth-grade class in the state have fewer than two siblings, too. Choice D is incorrect because 46,800 is the estimated total number of eighth-grade students in the state.

Question Difficulty: Hard