2244 Midterm – Sample Set 1

Question 1.
The incubation periods (in hours) for **8** people who developed food poisoning after consuming contaminated salad are listed below.

43 20 18 19 14 21 36 28

What is the IQR of these data? Use the procedures as described in lecture materials for 2244.

A. 9.0
B. 13.5
C. 18.5
D. 20.5
E. 29.0

Question 2.
Consider the following study designs. Which of the study designs will result in **paired data**?

1. The manufacturer of 'snack pack' (i.e. four crackers wrapped together) Premium Plus crackers is interested in the similarity in mass of crackers within a snack pack. To examine this issue, he weighs two crackers from each snack pack for 60 packs.
2. An ecologist is interested in comparing growth of two species (dinoflagellates and ciliates) in the presence of copepods. To examine this issue, she measures body lengths of a sample of dinoflagellates and a sample of ciliates that live in a single pond with copepods.
3. An ophthalmologist is interested in whether or not spherical refraction is different between left and right eyes. To examine this issue, he measures refraction in both left and right eyes of a sample of people.
4. The 2244 instructors are interested in whether students registered in Biology 2244 perform better than those registered in Statistics 2244. To examine this issue, they record final marks for 100 students from each of Biology 2244 and Statistics 2244.

A. 1, 2, and 3
B. 1 and 3
C. 2 and 4
D. 4 only
E. 1, 2, 3, and 4

Refer to the following information for Questions 3, 4, 5, 6, and 7. Note that these questions are spread across multiple pages.

Acupuncture therapy is widely used to prevent migraine headaches, but does it really work?

Researchers from the Chengdu University of Traditional Chinese Medicine published a paper in the Canadian Medical Association Journal in 2012 reporting the results of their single-blind study on the effectiveness of acupuncture therapy in the prevention of migraine headaches. Individuals from a simple random sample of 239 patients with migraines were randomized to receive one of the following:

- *20 Shaoyang-specific acupuncture treatments **(Acupuncture)*** over a period of four weeks, or
- *20 "sham" acupuncture treatments **(Sham)*** over a period of four weeks. In the sham acupuncture procedure, acupuncture needles were still inserted into the patients' skin, but at nonspecific points (i.e., it was not true acupuncture).

Study participants were monitored for weeks 5 to 7 (the three weeks following their treatments) and asked to report the total number of days they experienced migraines over those three weeks. This experiment was repeated (with the same sampling procedures and study design); the SPSS summaries of the data collected are included below.

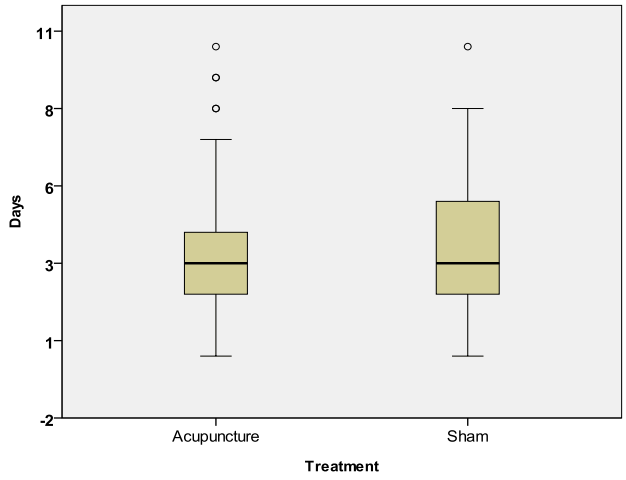
Output 1

Statistics

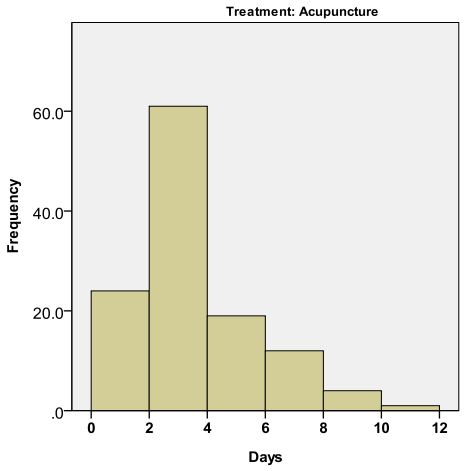
Days

Acup	N	Valid	121
		Missing	0
	Mean		2.98
	Median		3.00
	Std. Deviation		2.092
	Minimum		0
	Maximum		10
	Percentiles	25	2.00
		50	3.00
		75	4.00
Sham	N	Valid	118
		Missing	0
	Mean		3.28
	Median		3.00
	Std. Deviation		2.168
	Minimum		0
	Maximum		10
	Percentiles	25	1.75
		50	3.00
		75	5.00

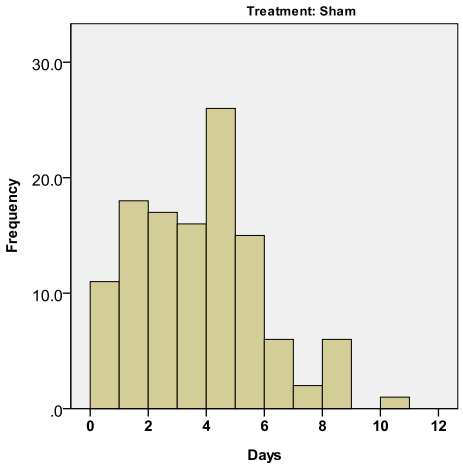
Output 2



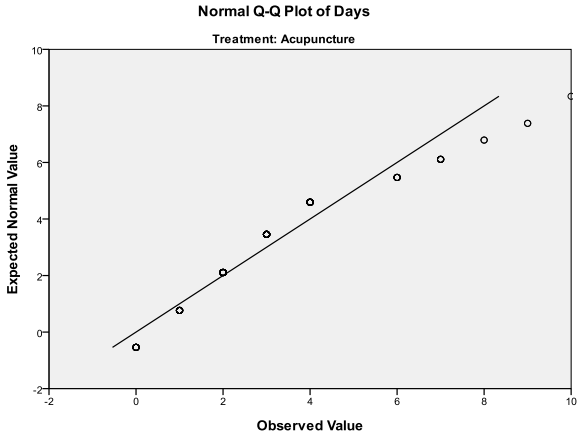
Output 3



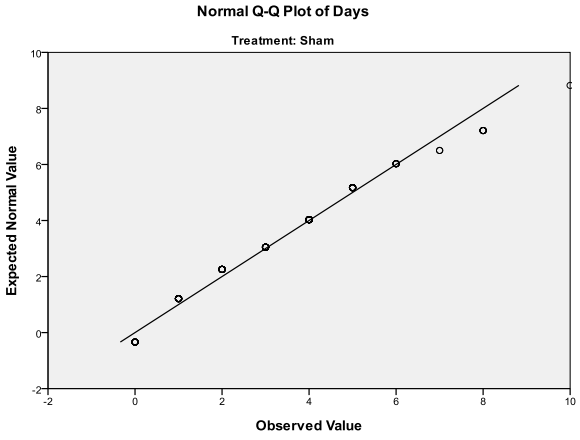
Output 4



Output 5



Output 6



Output 7

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Days	Equal variances assumed	1.843	.176	-1.105	237	.270	-.304	.276	-.847	.238
	Equal variances not assumed			-1.105	236.123	.270	-.304	.276	-.847	.239

Question 3.
Which of the following terms best describes the number **2.092** in the SPSS output table shown in ***Output 1*** above?

A. Statistic
B. Variable
C. Parameter
D. Sampling error
E. Probability

Question 4.
Extensive previous research has indicated that without treatments, migraine sufferers have **1.25** migraines per week (which represents **3.75** migraines over a three week period), on average.

The researchers are interested in assessing the presence of a placebo effect. They conduct a hypothesis test to see if the data suggest that the **sham procedure** eases the frequency of migraines for migraine suffers. Which of the following is the smallest significance level that would result in a decision to reject the null hypothesis?

A. 1.0%
B. 2.5%
C. 5.0%
D. 10.0%

Question 5.
To estimate the difference between mean numbers of migraine headaches, the researchers construct a **90%** confidence interval for $\mu_{sham} - \mu_{acupuncture}$. Compute the margin of error for their interval.

A. 0.276
B. 0.300
C. 0.456
D. 0.543

Question 6.
Which of the following conditions is the **minimum** set of conditions that **must** be reasonable for the researchers' confidence interval referred to in **Question 5** to be valid?

1. patients undergoing sham treatments are independent from patients undergoing acupuncture treatments
2. sampling distribution of sample mean number of migraine headaches is at least approximately normal for each of the sham and acupuncture groups
3. both the sham treatments and the acupuncture treatments groups are simple random samples
4. number of migraine headaches are approximately normal for each of the sham and acupuncture groups

A. 1, 2, and 3
B. 1 and 3
C. 2 and 4
D. 4 only
E. 1, 2, 3, and 4

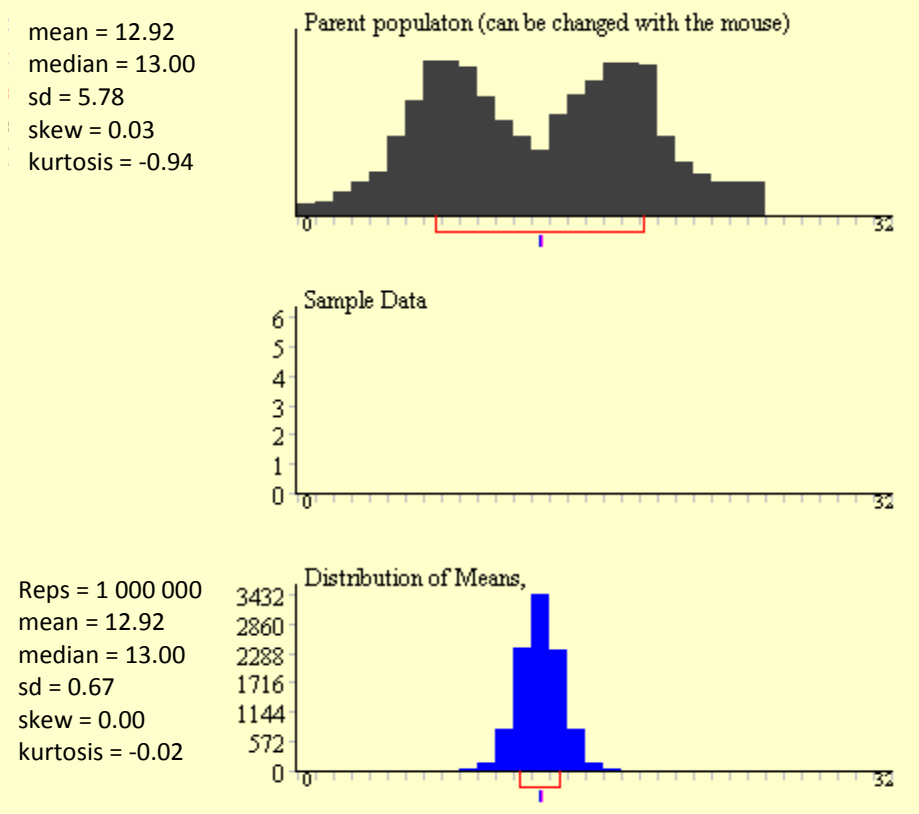
Question 7.
The researchers assess the effectiveness of the acupuncture treatments by conducting the appropriate hypothesis test based on their data. They used a significance level of **15%**. What conclusion would they make?

A. Reject H_0.
B. Fail to reject H_0.
C. Not enough information for a valid answer.

Question 8.

In Lab 3, we worked with an applet investigating distributions. A screenshot of a particular simulation using the applet from lab is shown below. What sample size was most likely used to generate these data?

A. 25
B. 50
C. 75
D. 100 or more
E. Not enough information for a valid answer.



Refer to the following information for Questions 9 and 10

A local wireless provider is interested in current usage patterns of potential customers to develop appealing promotional deals. They surveyed a simple random sample (SRS) of **16** potential customers to estimate the mean number of daytime minutes used on their cell phones. Using these data, they first confirmed necessary conditions were satisfied, and then computed the **90%** confidence interval for the mean daytime minutes to be (**22.5** minutes/day, **30.5** minutes/day).

Question 9.
Which of the following statements is a correct interpretation of their confidence interval for μ, the population mean daytime minutes?

1. There is a 90% chance that the population mean daytime minutes is between 22.5 and 30.5 minutes/day.
2. About 9 out of 10 of this wireless provider's potential customers use between 22.5 and 30.5 daytime minutes/day.
3. 90% of all possible SRSs of potential customers will have sample means between 22.5 and 30.5 daytime minutes/day.
4. About 9 times out of 10, SRSs of potential customers will result in intervals that capture the population mean daytime minutes/day.

A. 1, 2, and 3
B. 1 and 3
C. 2 and 4
D. 4 only
E. 1, 2, 3, and 4

Question 10.
The wireless provider currently includes 30 daytime minutes (per day) in some of their service plans. If mean daytime usage of potential customers is less than **30** minutes/day, the company will consider lowering the number of minutes allowed per day. Using a **5%** significance level, the company uses their survey data to test whether the population mean daytime minutes is less than **30** minutes/day. Which of the following options is the P-value for this test?

A. $P < 0.05$
B. $P = 0.05$
C. $0.05 < P < 0.10$
D. $P = 0.10$
E. $P > 0.10$

Question 11.

You plan to construct a **92%** confidence interval to estimate a population mean (μ) based on a simple random sample of **48** individuals. Holding everything else constant, which of the following will make a critical value, $t_{\alpha/2}$, **larger**?

1. Cutting the sample size in half
2. Using a more conservative value for df
3. Adjusting the confidence level from 92% to 99%
4. Doubling the sample standard deviation (*s*)

A. 1, 2, and 3
B. 1 and 3
C. 2 and 4
D. 4 only
E. 1, 2, 3, and 4

Refer to the following information for Questions 12, 13, 14, and 15. Note that these questions are spread across multiple pages.

In a previous term, a lab was conducted to evaluate 2244 students' confidence in their recall skills, testing the claim that the majority of 2244 students are overly optimistic about their recall skills. The hypotheses associated with this claim are:

H_0: $p = 0.5$
H_a: $p > 0.5$

where *p* refers to individuals who predict a higher score than they actually achieve on the recall activity. A simple random sample of the instructors and TAs for 2244 repeated the study, under the same hypotheses. The data from their study are presented below as the results of the SPSS 'binomial test.'

Instructors and TAs

Binomial Test

		Category	N	Observed Prop.	Test Prop.	Exact Sig. (2-tailed)
Differences (Binned)	Group 1	Predicted <= Actual	8	.33	.50	.152
	Group 2	Predicted > Actual	16	.67		
	Total		24	1.00		

Question 12.

Conduct the binomial test for the hypotheses outlined above for 2244 instructors and TAs. What does the test suggest about confidence in recall skills? Use a significance level of **0.10**.

A. 2244 Instructors and TAs are not overly optimistic about their recall skills.
B. 2244 Instructors and TAs are overly optimistic about their recall skills.
C. Not enough information for a valid answer.

Question 13.
What is the P-value (rounded to two decimal places) for the appropriate approximate z-test for p, as covered in lecture and the textbook, for these data and the hypotheses described above?

A. 0.04
B. 0.05
C. 0.08
D. 0.10
E. Not enough information for a valid answer.

Question 14.
A new simple random sample of 2244 *students* went through the recall activity. The results of their study are presented below.

Students

Binomial Test

		Category	N	Observed Prop.	Test Prop.	Exact Sig. (2-tailed)
Differences (Binned)	Group 1	Predicted <= Actual	28	.41	.50	.148
	Group 2	Predicted > Actual	41	.59		
	Total		69	1.00		

Conduct the appropriate hypothesis test at significance level of **0.10** to evaluate whether the rate of optimism in 2244 students differs from that of 2244 instructors and TAs. Which of the following is the correct conclusion?

A. Reject H_0.
B. Fail to reject H_0
C. Not enough information for a valid answer.

Question 15.
Compute a **75%** confidence interval for the proportion of 2244 ***Instructors and TAs*** (not the students from **Question 14**) who underestimated their recall abilities. Note that there were no instructors and TAs who had a predicted score exactly equal to their actual score.

A. (0.22, 0.44)
B. (0.26, 0.40)
C. (0.56, 0.78)
D. (0.60, 0.74)
E. Not enough information for a valid answer.

Question 16.
Blood pressure has an optimal value, where a difference between systolic pressure (mmHg) and diastolic pressure (mmHg) of **40** mmHg is considered ideal. Smaller differences or larger differences are indicative of abnormal blood pressure.

A group of physicians are working on a new medication, aimed at keeping blood pressure 'normal' (or 'ideal'). They collected a simple random sample of patients with a history of abnormal blood pressure, and prescribed the drug. After two months on the drug, each patients' systolic and diastolic pressures were measured.

The SPSS output shown below summarizes the data collected in this study. Compute the P-value for the appropriate hypothesis test.

Statistics

		Systolic (mmHg)	Diastolic (mmHg)	Systolic - Diastolic
N	Valid	58	58	58
	Missing	0	0	0
Mean		118.81	82.14	36.67
Median		118.00	80.00	38.00
Std. Deviation		15.889	9.664	11.967
Minimum		90	60	17
Maximum		155	106	57
Percentiles	25	107.75	76.75	24.75
	50	118.00	80.00	38.00
	75	130.00	89.00	47.00

A. $0.01 < P < 0.025$
B. $0.02 < P < 0.05$
C. $0.05 < P < 0.10$
D. $0.10 < P < 0.20$
E. Not enough information for a valid answer.

Question 17.
Profs White and Waugh are having a friendly competition between their curling teams, who play in different leagues. White claims that her team has a higher winning record than Waugh; in a simple random sample of the **40** games that White's team has played, **35%** were recorded wins. Waugh thinks that the whole dispute is simply ridiculous because her team has won **40%** of a simple random sample of **20** games played.

The Dean of the Faculty of Science has stepped in to settle this dispute once and for all; she calculated an **86%** confidence interval of **(-0.2468, 0.1468)** for the difference in the proportion of wins between White and Waugh.

What is the estimated standard deviation of the difference in the proportion of wins between White and Waugh?

A. 0.018
B. 0.132
C. 0.133
D. 0.137
E. Not enough information for a valid answer.

Refer to the following information for Questions 18, 19, and 20.

In its advertising campaign, Mercedes Benz reports the mean fuel efficiency of its entire production line of 2009 Coupes to be **6.8** L/km, with standard deviation of **0.8** L/km.

Car and Driver magazine periodically tests advertising claims such as this to ensure consumers are receiving appropriate information. The magazine researchers obtain a simple random sample of sixty-three (**63**) Mercedes Benz 2009 Coupes for their test. They drive each car in their sample around the city and record their fuel efficiencies. The mean fuel efficiency of their sample was **5.4** L/km.

Question 18.
Assume Mercedes Benz's claims for fuel efficiency are true. What proportion of mean fuel efficiencies (for samples of n = 63) would fall within **0.2187** L/km of the reported mean fuel efficiency of all 2009 Coupes?

A. 0.950
B. 0.970
C. 0.985
D. 0.993
E. Not enough information for a valid answer.

Question 19.
For Car and Driver's sample, what is the probability that they obtain a sample mean greater than **6.85** L/km? Assume Mercedes Benz's claims for fuel efficiency are true.

A. 0.3085
B. 0.4761
C. 0.5239
D. 0.5915
E. Not enough information for a valid answer.

Question 20.
Mercedes Benz wants to advertise that **90%** of their 2009 Coupes have a fuel efficiency of a particular value or better. They would make a claim that looks like the following:

"90% of our 2009 Coupes have a fuel efficiency of _____ *L/km* or better*."*

What value of fuel efficiency should they advertise?

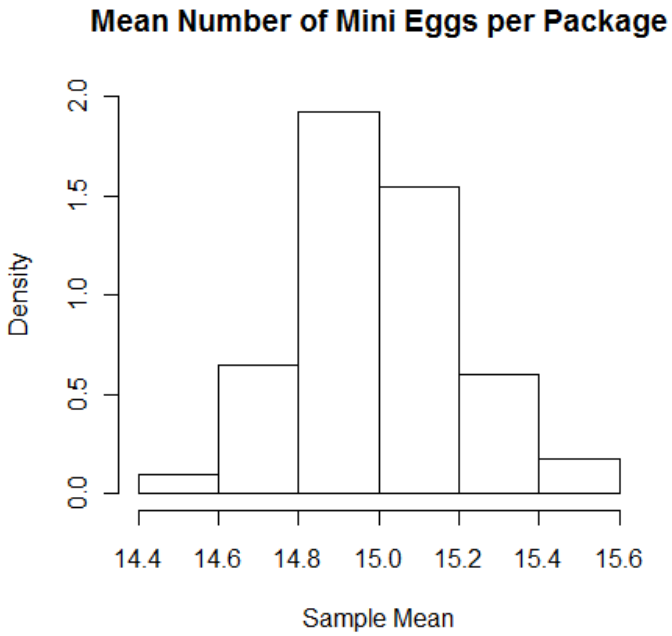
A. 5.78
B. 6.67
C. 6.93
D. 7.82
E. Not enough information for a valid answer.

Refer to the following information for Questions 21 and 22. Note that these questions are spread across multiple pages.

Cadbury Mini Eggs are flying off the shelves. Each 39-gram package contains about 15 candies, on average. There is variability in the process used to make the candies (i.e., they are not all the same size and weight) as well as in the process of filling the packages (i.e. specific packages may contain fewer or more than 15 candies).

Cadbury makes a set number of 39-gram packages per day. They monitor their product and have been collecting data on the number of Mini Eggs for simple random samples of sixty (**60**) of the 39-gram packages produced each day for the last year.

The density histogram to the right summarizes their distribution of sample mean numbers of Mini Eggs per Package. The means were divided into six classes to make the graph. When interpreting the graph, note that none of the sample means recorded were exactly equal to any of the class endpoints.



Question 21.

Which of the following may describe the distribution of the number of Mini Eggs in 39-gram packages of Cadbury Mini Eggs?

1. Left Skewed
2. Symmetric
3. Right skewed
4. Normal

A. 1, 2, and 3
B. 1 and 3
C. 2 and 4
D. 4 only
E. 1, 2, 3, and 4

Question 22.
We take a new simple random sample of sixty (**60**) 39-gram packages of Mini Eggs and compute a sample mean number of Mini Eggs per package of **14.6**. What is the approximate P-value for the test with the hypotheses shown below? Assume any necessary conditions are met.

H_0: $\mu = 15$
H_a: $\mu \neq 15$

A. 0.04
B. 0.06
C. 0.20
D. 0.30
E. Not enough information for a valid answer.

Question 23.
Owners of comic book stores have to pay careful attention to their sales to make sure they buy the right number of copies of a particular comic book (so they don't buy too many or too few). The owner of a comic book store thinks she sells, on average, **25** copies of the 'Betty and Veronica' comic book each month. Looking back over her career as owner, she takes a simple random sample of **51** months, and determines the number of copies of 'Betty and Veronica' sold in each month. For this sample, she calculates a mean number of copies sold per month of **28** copies (and standard deviation of **4** copies sold per month).

Assume that the true mean number of copies sold per month really is **25** copies. Which of the following sample mean number of copies sold per month would result in a type I error, if the significance level for the appropriate two-tailed hypothesis test is **0.05**?

1. 24
2. 25
3. 26
4. 27

A. 1, 2, and 3
B. 1 and 3
C. 2 and 4
D. 4 only
E. 1, 2, 3, and 4

Refer to the following information for Questions 24 to 25.

In Lab 3, shoe sizes and foot sizes (both measured on right feet in UK Adult Shoe size units) were recorded for each study participant to assess whether 2244 students wear shoes that fit. Appropriately fitting shoes were defined as those that were within a half-size of foot size. At this time of year, many people are wearing boots and other footwear appropriate for winter conditions, which results in a looser fit than other styles of footwear.

This study was repeated on a separate simple random sample of twelve (**12**) 2244 students to investigate this further. Eight (**8**) study participants had right shoes that were too big (i.e. their right shoes were more than **0.5** UK Adult Shoe size units larger than their foot size in the same units) and the sample mean difference between shoe and foot sizes was **0.75** UK Adult Shoe Size units.

Question 24.
Assume that the necessary assumptions look reasonable for these data. Which of the following inference procedures would be most appropriate to investigate whether the typical difference between shoe and foot sizes of 2244 students exceeds **0.5** UK Adult Shoe sizes?

1. Paired t test for μ
2. Two sample t test for $\mu_1 - \mu_2$
3. One sample t test for μ
4. Approximate Z test for p

A. 1, 2, and 3
B. 1 and 3
C. 2 and 4
D. 4 only
E. 1, 2, 3, and 4

Question 25.
A claim is made that **75%** of 2244 students wear right shoes that are too big at this time of year. SPSS was used to generate appropriate probabilities of having different numbers of successes assuming this claim is true (see screenshot of the SPSS Data View window to the right).

NumBig	BinomP	CBinomP
0	.00000	.00000
1	.00000	.00000
2	.00004	.00004
3	.00035	.00039
4	.00239	.00278
5	.01147	.01425
6	.04015	.05440
7	.10324	.15764
8	.19358	.35122
9	.25810	.60932
10	.23229	.84162
11	.12671	.96832
12	.03168	1.00000

Assume the claim is true. Compute the probability that, in another simple random sample of twelve (**12**) 2244 students, we would observe at least as many study participants with right shoes too big for their right feet as we observed in our sample of **12** students.

A. 0.19358
B. 0.35122
C. 0.64878
D. 0.84236
