

The following exam consists of 40 questions, each worth 2.5 points. You will have 75 minutes to complete the test. This means that you have, on average, about 1 minute, 50 seconds per question.

1. Record your answer to each question on the scantron sheet provided. You are welcome to write on this exam, but your scantron will record your graded answer.
2. Read carefully, and check your answers. Don't let yourself write nonsense.
3. Keep your eyes on your own paper. If you believe that someone sitting near you is cheating, raise your hand and quietly inform me or the instructor of this. I'll keep an eye peeled, and your anonymity will be respected.
4. If any question seems unclear or ambiguous to you, do your best to answer the question and write down your comments, and I will look into it when I grade the test.
5. Be sure you correctly record your student number on your scantron, and blacken in the corresponding digits. **Failure to do so will cost you 10 points on this exam!**

Pledge: On my honor as a JMU student, I pledge that I have neither given nor received unauthorized assistance on this examination.

Signature \_\_\_\_\_

1. Which of the following statement about the standard error of the mean is NOT true?
  - a). It is never larger than the standard deviation of the population.
  - b). It decreases as the sample size increases and the population standard deviation keeps constant.
  - c). It increases as the sample size increases and the population standard deviation keeps constant.
  - d). It increases as the population standard deviation increases and the sample size keeps constant.
  
2. The Central Limit Theorem is important in statistics because
  - a). for a large  $n$ , it says the sampling distribution of the sample mean is approximately normal, regardless of the shape of the population.
  - b). for a large  $n$ , it says the population is approximately normal.
  - c). for any population, it says the sampling distribution of the sample mean is approximately normal, regardless of the sample size.
  - d). for any sized sample, it says the sampling distribution of the sample mean is approximately normal.
  
3. Which of the following statements about the sampling distribution of the sample mean is incorrect?
  - a). The sampling distribution of the sample mean is approximately normal whenever the sample size is sufficiently large ( $n \geq 30$ ).
  - b). The standard deviation of the sampling distribution of the sample mean is equal to the population standard deviation.
  - c). The sampling distribution of the sample mean is generated by repeatedly taking samples of size  $n$  and computing the sample means.
  - d). The mean of the sampling distribution of the sample mean is equal to the population mean.
  
4. Why is the Central Limit Theorem so important to the study of sampling distributions?
  - a). It allows us to disregard the size of the sample selected when the population is not normal.
  - b). It allows us to disregard the shape of the population when the sample size  $n$  is large.
  - c). It allows us to disregard the shape of the sampling distribution when the size of the population is large.
  - d). It allows us to disregard the size of the population from which we draw samples.
  
5. The dollar amount of gasoline purchased per car at Sheeze Gas station has a population mean of \$25 and a population standard deviation of \$6. What is the probability that the sample mean dollar amount of gasoline purchased for a sample of 4 cars to be between \$19 and \$31?
  - a). The probability is 68.26% because the sample mean amount is  $\pm 1$  standard deviation away from the population mean.
  - b). The probability is 95.45% because the sample mean amount is  $\pm 2$  standard deviations away from the population mean.
  - c). The probability is 86.64% because the sample mean amount is  $\pm 1.5$  standard deviations away from the population mean.
  - d). The probability is neither 68.26%, nor 86.64%, and nor 95.45%.

**The following problem is associated with the questions 6 to 9:**

Procter and Gamble is in the process to evaluate the performance of a recent advertisement to sale its Pantene Proof products in Harrisonburg. A survey was conducted. On the basis of this survey, the following events were identified:

- SA = individual recalls seeing the advertisement
- NSA = individual recalls not seeing the advertisement
- P = individual purchased the product
- NP = individual not purchased the product

Among the 100 people returned this survey, 40 people recalled seeing the advertisement, 20 people purchased the product, and 12 people recalled seeing the advertisement and purchased the product. (Hint: you may want to create a contingency table for the problem before answer the questions)

Given a contingency table below.

Event	Purch	NotP	Row Sum

SeeAd	12	28	0	40
NotSA	8	52	0	60
Col Sum	20	80	0	100

Once you have this contingency table, you should see the answers are straight forward.

6. What is the probability of an individual's purchasing the product given that the individual recalls seeing the advertisement?
  - a). 0.200
  - b). 0.300
  - c). 0.600
  - d). 0.080
  
7. What is the probability of an individual's purchasing the product given that the individual don't recall seeing the advertisement?
  - a). 0.200
  - b). 0.080
  - c). 0.400
  - d). 0.133
  
8. Does seeing the advertisement increase the probability that an individual will purchase the product? As a decision maker, would you recommend continuing the advertisement (assuming that the cost is reasonable)?
  - a). The probability of an individual's purchasing the product given that the individual recalls seeing the advertisement is the same as the probability of an individual's purchasing the product given that the individual don't recall seeing the advertisement. Therefore, the advertisement would not make any difference.
  - b). The probability of an individual's purchasing the product given that the individual recalls seeing the advertisement is smaller than the probability of an individual's purchasing the product given that the individual don't recall seeing the advertisement. Therefore, the advertisement should not continue.
  - c). The probability of an individual's purchasing the product given that the individual recalls seeing the advertisement is greater than the probability of an individual's purchasing the product given that the individual don't recall seeing the advertisement. Therefore, the advertisement should continue.
  - d). The probability of an individual's purchasing the product given that the individual recalls seeing the advertisement is smaller than the probability of an individual's purchasing the product given that the individual don't recall seeing the advertisement. Therefore, the advertisement should continue.
  
9. What is the probability of an individual's purchasing the product or the individual recalls seeing the advertisement?
  - a). 0.600
  - b). 0.300
  - c). 0.480
  - d). 0.120

**The following problem is associated with the questions 10 to 15:**

Suppose a random variable Z has a standardized normal distribution with a mean of 0 and a standard deviation of 1.

10. What is the probability that Z is between -2.5 and +2.5?
  - a). 0.9876
  - b). 0.4876
  - c). 0.0124
  - d). 0.9938
  
11. What is the probability that Z is greater than -1.5?
  - a). 0.5668
  - b). 0.4332
  - c). 0.0668
  - d). 0.9332
  
12. Which one(s) of the following statements about the random variable Z is correct?
  - I. 3 of every 4 observations would fall between  $\pm 1$  standard deviations around the mean.
  - II. 9 of every 10 observations would fall between  $\pm 1.645$  standard deviations around the mean.
  - III. 99 of every 100 observations would fall between  $\pm 2.576$  standard deviations around the mean.
  - a). II and III only
  - b). I and II only
  - c). I and III only
  - d). I, II and III



20. What is the number of minutes  $X$  such that a randomly selected JMU student has a probability 0.40 to find a parking spot between the mean 15 minutes and  $X$  minutes?  
 a). 1.2816                      b). 21.4078                      c). 13.7333                      d). 16.2667
21. What is the Excel function to find the number of minutes  $X$  such that a randomly selected JMU student has a probability 0.40 to find a parking spot between the mean 15 minutes and  $X$  minutes?  
 a). =NORMINV(0.40,15,5)                      b). =NORMINV(0.5-0.40,15,5)  
 c). =NORMDIST(0.40,15,5)                      d). =NORMINV(0.5+0.40,15,5)
22. What is the number of minutes  $X$  such that a randomly selected JMU student has a probability 0.85 to spend between  $15 - X$  minutes and  $15 + X$  minutes to find a parking spot?  
 a). 1.44                      b). 5.18                      c). 7.80                      d). 7.20
23. What is the Excel functions to find the number of minutes  $Y=15-X$  and  $Z=15+X$  such that a randomly selected JMU student has a probability 0.85 to spend between  $Y=15-X$  and  $Z=15+X$  minutes to find a parking spot? (where  $X$  is a positive number)  
 I. =NORMINV(0.85,15,5)  
 II. =NORMINV(1-0.85,15,5)  
 III. =NORMINV(0.5-0.85/2,15,5)  
 IV. =NORMINV(0.5+0.85/2,15,5)  
 a). III and IV only                      b). II and III only                      c). I and II only                      d). II and IV only
24. Suppose a random sample of 16 students is taken. What is the standard error of the mean number of minutes to find a parking spot?  
 a). 5.0000                      b). 0.3125                      c). 1.5625                      d). 1.2500

**The following problem is associated with the questions 25 to 32:**

Suppose that the length of time it takes a JMU student to find a parking spot follows a normal distribution with a mean of 15 minutes and a standard deviation of 5 minutes. A random sample of 4 students is taken and the standard deviation of the mean is thus 2.5 minutes.

25. What is the probability that the sample mean length of time to find a parking spot is less than 10 minutes?  
 a). 0.0228                      b). 0.1587                      c). 0.9772                      d). 0.4772
26. What is the Excel function to compute the probability that the sample mean length of time to find a parking spot is greater than 10 minutes?  
 a). =1-NORMDIST(10,15,2.5,TRUE)                      b). =1-NORMDIST(10,15,5,TRUE)  
 c). =NORMDIST(10,15,2.5,TRUE)                      d). =NORMDIST(10,15,5,TRUE)



- II. It is binomial distributed because a person in the sample either skips or has breakfast.
- III.  $\sigma_{p_s}$  decreases when the sample proportion  $p_s$  is constant and the sample size increases.
- IV.  $\sigma_{p_s}$  increases when the sample size  $n$  is constant and the sample proportion  $p_s$  increases.

- a). I and II only                      b). II and IV only                      c). I and III only                      d). III and IV only

35. What is the probability that the sample proportion  $p_s$  will be between 0.20 and 0.30?

- a). 0.9788                      b). 0.4894                      c). 0.0212                      d). 0.5106

36. What is the Excel function to computer the probability that the sample proportion  $p_s$  will be between 0.22 and 0.28?

- a). =NORMDIST(0.22,0.25,0.0217,TRUE)-NORMDIST(0.28,0.25,0.0217,TRUE)
- b). =NORMINV(0.28,0.25,0.0217,TRUE)-NORMINV(0.22,0.25,0.0217,TRUE)
- c). =NORMSDIST(0.28,0.25,0.0217,TRUE)-NORMSDIST(0.22,0.25,0.0217,TRUE)
- d). =NORMDIST(0.28,0.25,0.0217,TRUE)-NORMDIST(0.22,0.25,0.0217,TRUE)

37. What is the probability that the sample proportion  $p_s$  will be greater than 0.265?

- a). 0.6900                      b). 0.2447                      c). 0.7553                      d). 0.7447

38. What are the limits  $p_x$  and  $p_y$  of the sample proportions such that 90% of all sample proportions will be between these two limits?

- a). 0.2222 and 0.2778                      b). 0.2143 and 0.2857
- c). 0.2222 and 0.2614                      d). -1.645 and +1.645

39. What is the sample proportion  $p_z$  such that there is a 0.25 probability that a sample proportion  $p_s$  is less than  $p_z$ ?

- a). -0.6745                      b). 0.2646                      c). 0.2354                      d). 0.225

40. Which statement is correct about the sample mean  $\bar{x}$  as a point estimator for the population mean?

- I. The expected value of the sample mean equals to the population mean.
  - II. The standard deviation of the sample mean is smaller than the sample standard deviation of the sample median.
  - III. The sample mean tends to become closer to the population mean as the sample size increases.
- a). I and II only                      b). I and III only                      c). II and III only                      d). I, II and III