

Statistics ~ Business Statistics

TEST 2: Probability & Estimation

(Revised Summer, 2011)

1. What is the difference between **theoretical** and **empirical** (or experimental) probability?

2. What is the **LAW OF LARGE NUMBERS** in probability?

_____ 3. If an event is **impossible**, what is its probability?

_____ 4. If an event is **certain**, what is its probability?

_____ 5. Suppose there is a $\frac{4}{5}$ probability that an event will happen. What is the probability that the event will **not** happen?

YES or NO: Can these numbers be the probability of something?

_____ 6. $\frac{4}{3}$ _____ 9. 47%

_____ 7. .15 _____ 10. $-\frac{1}{4}$

_____ 8. $\frac{17}{24}$ _____ 11. 2.45

12. Fill in the blanks: The **EMPIRICAL RULE** says that in a normal distribution

_____ percent of the data is within one standard deviation either side of the mean,

_____ percent of the data is within two standard deviations either side of the mean,

and _____ percent of the data is within three standard deviations either side of the mean.

Use this information for the following problems: A couch potato has 2 bags of Cheetos, 4 bags of Fritos, 3 bags of Ruffles, and 1 bag of Mr. Salty pretzels.

_____ 13. If he reaches for a snack at random, what is the probability he will pick Ruffles?

_____ 14. If he reaches for a snack at random, what is the probability he will pick Cheetos?

_____ 15. If he reaches for a snack at random, what is the probability he will pick either Fritos or Ruffles?

_____ 16. Suppose he picks a snack, puts it back because he doesn't like it, and then picks at random again. What is the probability he will get Mr. Salty pretzels both times?

_____ 17. Suppose he picks a snack, eats it, and then picks another snack. What is the probability he will get Fritos the first time and Cheetos the second time?

USE THIS INFORMATION FOR THE PROBLEMS BELOW:

When Algona's Brad Nelson (who took this class in Spring, 2001) played professional baseball for the Class A Beloit Snappers in 2002, the team roster had 2 men from the Midwest (both of whom were from Iowa), 2 men from the Northeast, 12 men from the Southeast, 4 men from the Southwest, and 8 men from other countries.

Before each minor league game, a player from each team is randomly chosen to take a drug test.

- _____ 18. What is the probability that the player selected at a Snappers game was from the Southeast?
- _____ 19. What is the probability the player selected at a Snappers game was **not** from another country?
- _____ 20. Suppose the team plays a double-header. If the same players could be randomly selected before each game, what is the probability the player selected for both the first and the second games was from the Midwest.

Use this information for the following problems: A new drug has some bad side effects. It causes diarrhea in 12% of the people who take it, it causes vomiting in 6% of the people who take it. BOTH diarrhea and vomiting occur in 3% of the people who take the drug.

- _____ 21. What percent of people who take the drug will experience either diarrhea or vomiting?
- _____ 22. What percent of people who take the drug will have no side effects—neither diarrhea nor vomiting?

Use the fundamental counting principal to find the number of possible outcomes.

- _____ 23. There are 100 U.S. Senators and 438 members of the House of Representatives. ABC randomly chooses one senator **and** one representative to interview on *World News Tonight*. How many ways could they make their selection?
- _____ 24. In some states motorcycle license plates have the format with two letters followed by three numbers, such as *AB 123*. How many possible license plates are there in this format?
- _____ 25. You take a 6-question multiple choice quiz, where each question could be answered "A", "B", "C", or "D". How many ways could you fill out your test form?

- _____26. If you draw a card from a standard deck of 52 cards, what is the probability the card is an ace?
- _____27. If you draw a card from a standard deck of 52 cards, what is the probability the card is a spade (♠)?
- _____28. If you draw a card from a standard deck of 52 cards, what is the probability it is the ace of spades?
- _____29. If you draw a card from a standard deck of 52 cards, what is the probability the card is an ace **or** a spade?
- _____30. If you draw two cards from a standard deck of 52 cards (**without** replacement), what is the probability both cards are clubs (♣)?
- _____31. If you draw a card from a standard deck of 52 cards, replace the card and re-shuffle, and then draw another card, what is the probability the first card is a spade (♠) and the second card is a king?

Would each of these problems involve **combinations** or **permutations**?

Write “**C**” or “**P**”. Do **not** actually solve the problems.

- _____32. A company has plants in eight different cities. The C.E.O. wants to take a business trip to inspect four of those facilities. In how many different orders could he plan his trip?
- _____33. A hotel is hiring housekeepers. Nine people apply for the job, and five of them will be hired. How many ways can they hire these employees?
- _____34. A waitress has seven tables. She must select three of these to take a special survey. How many ways could she do this?
- _____35. There are 100 people entered in a raffle. Three names will be drawn—one to win \$1000, one to win \$500, and one to win \$100. How many ways could the names be selected?

Use either combinations or permutations to compute.

Your answers should be numbers.

- _____36. There are 27 women entered in the Miss Iowa pageant. Seven finalists will be selected, but the names will not be read in any particular order. How many ways could the finalists be chosen?

- _____ 37. Suppose that a cable system carried 60 different commercial channels. Advertisers agree to pay a premium rate for the five top-rated cable channels. In how many different orders could those top five channels be listed?

For its grand opening, a store is running a contest. Each customer gets a card, and each card gets a certain percentage discount off the regular price:

Probability	Discount (%)
$\frac{1}{2500}$	100
$\frac{5}{2500}$	75
$\frac{25}{2500}$	50
$\frac{50}{2500}$	25
$\frac{2419}{2500}$	10

- _____ 38. Use the idea of **expected value** to find the average percentage discount each customer can expect to receive at the grand opening described above.

Now do this expected value problems.

- _____ 39. 1,000 tickets are sold for a raffle. One tickets will win a trip to Las Vegas worth \$1600, 3 will win TV sets worth \$275 each, and 20 will each win a gift certificate for \$25. What is the **expected value** of the raffle? (Assume that all 1000 tickets are eligible for every prize.)

Use the binomial probability formula $({}_nC_r)(p^r)(q^{n-r})$ for the problems below.

In intramural basketball, each time someone shoots a basket, there is a 13% chance they will actually score. During one minute of play, 9 different shots are taken. What is the probability exactly 2 of the shots are good?

Give the value of each of these variables:

_____ 40 p _____ 41 q _____ 42 n _____ 43 r

- _____ 44. Answer the question.

In a scratch-off lottery game, 1 in 5 tickets is a winner. If someone buys 10 tickets, what is the probability 3 of them are winners?

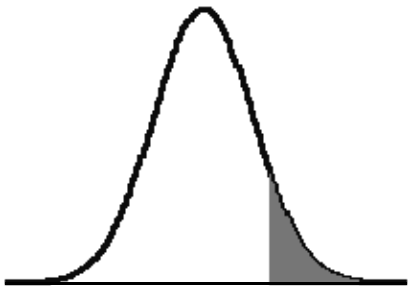
Give the value of each of these variables:

_____ 45. p _____ 46. q _____ 47. n _____ 48. r

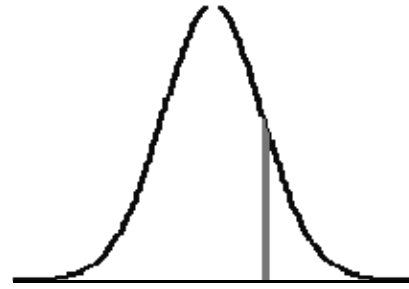
_____ 49. Answer the question.

What is the probability that a score is in each of these areas under the normal curve?

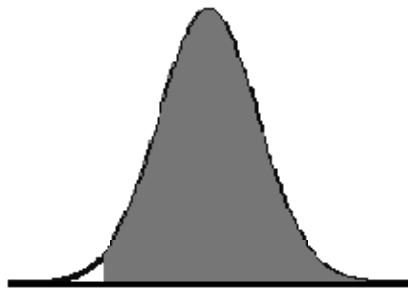
_____ 50. $z > 1.83$



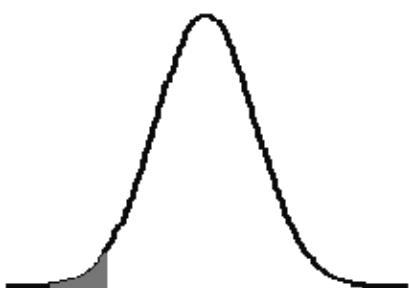
_____ 51. $1.59 < z < 1.70$



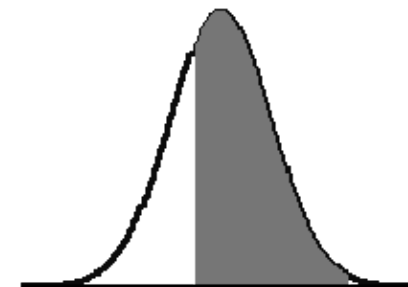
_____ 52. $z > -2.01$



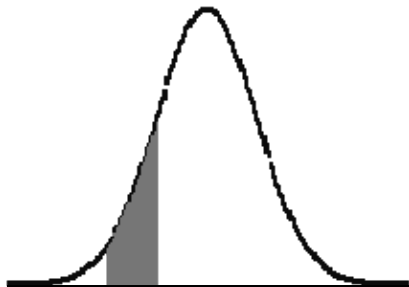
_____ 53. $z < -2.05$

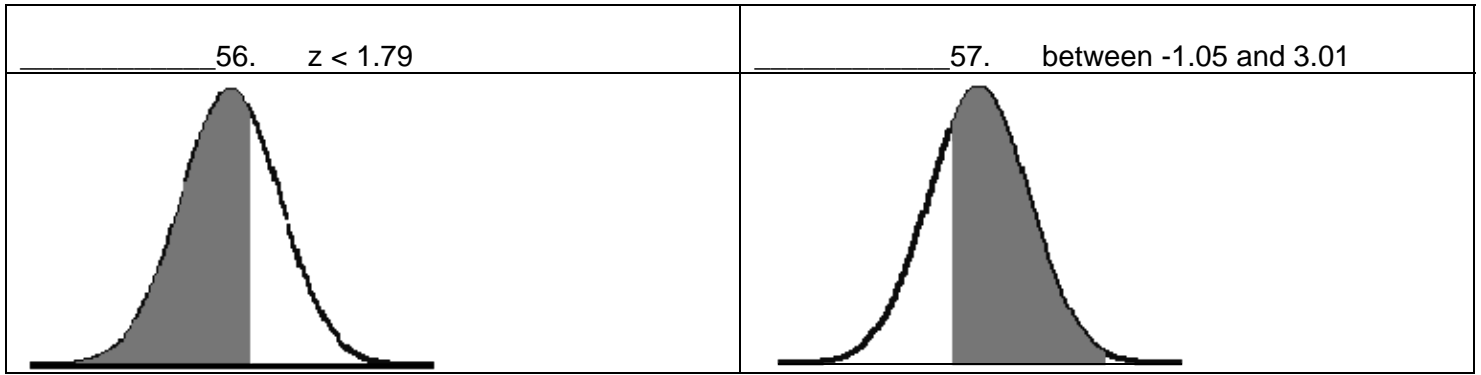


_____ 54. between -1.03 and 2.34



_____ 55. between -2.34 and -1.60

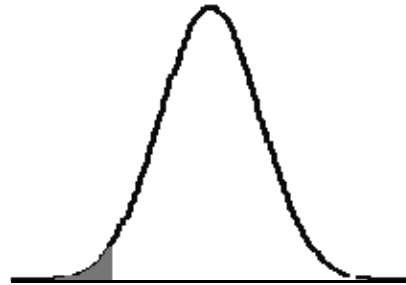




Use this information for the following problems: According to Hospitality Franchise Systems, the average Super 8 motel has 55 guest rooms. The standard deviation is 11 rooms.

_____ 48. Use the z-score formula to find the z-score associated with 35 rooms at a Super 8 motel.

_____ 59. Use the z-table to find out what percent of Super 8 motels have less than 35 guest rooms.

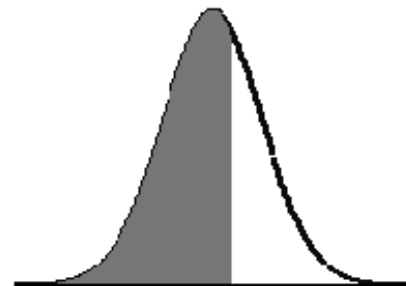


Find the z-score associated with these percentages of the normal curve.

_____ 60. Find z so that 15% of the normal curve is more than z .



_____ 61. Find z so that 67% of the normal curve is less than z .



Here are the test scores for several students in a class:

Student	Score	Student	Score
Allison	87	Kevin	39
Bart	84	LaNorra	38
Cyndi	84	Manuel	36
Danielle	70	Nancy	28
Edward	63	Ophelia	23
Frieda	62	Pauline	21
Gerald	58	Quenton	20
Hesperia	55	Rex	9
Ivan	55	Sonny	7
Janette	42	Therese	4

The mean of this data is 44.25, and the standard deviation is 26.13.

Use this information to find the following:

- _____ 62. Is Janette's z-score positive or negative?
- _____ 63. Is Bart's z-score positive or negative?
- _____ 64. What is Rex's z-score?
- _____ 65. What is Danielle's z-score?
- _____ 66. A student has a z-score of approximately -0.928 . Which student is this?
- _____ 67. A student has a z-score of approximately 1.636 . Which student is this?

Complete the following:

The Central Limit Theorem says that in a (68) _____, which is the distribution of the means of every possible sample of a given size, the mean is (69) _____ ($<$, $>$, $=$) the mean of the whole population and the standard deviation is (70) _____ ($<$. $>$. $=$) the standard deviation of the whole population. This is why there is a very low chance of choosing a sample that will badly represent the population.

Statistics—Business Statistics

FORMULAS

COMPOUND PROBABILITY

- $P(A') = 1 - P(A)$
- $P(A \text{ and } B) = P(A) \cdot P(B | A)$
- $P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$

BINOMIAL DISTRIBUTION

- $P(r/n) = ({}_n C_r)(p^r)(q^{n-r})$
- $q = 1 - p$

STANDARD SCORES

- $z = \frac{\bar{X} - \bar{X}}{s}$ or $z = \frac{X - \mu}{\sigma}$

ANSWERS

1. Theoretical probability is what math says the answer should be; empirical probability is the actual distribution, based on your experience
2. If you repeat an experiment a large number of times, the empirical probability will approach the theoretical probability
3. 0
4. 1
5. $\frac{1}{5}$ or .2
6. No (not between 0 and 1)
7. Yes
8. Yes
9. Yes (since 47% is the same as .47)
10. No
11. No (if it were a % it would be yes, but it's not.)
12. 68%, 95%, 99.7%
13. $\frac{3}{10} = .3 = 30\%$ (all forms are correct answers)
14. $\frac{2}{10} = \frac{1}{5} = .2 = 20\%$
15. $\frac{7}{10} = .7 = 70\%$
16. $\frac{1}{10} * \frac{1}{10} = \frac{1}{100} = .01 = 1\%$
17. $\frac{4}{10} * \frac{2}{9} = \frac{8}{90} = \frac{4}{45} = .0888... = 8.9\%$
18. $\frac{12}{28} = \frac{3}{7} = .428571 = 42.9\%$ (all forms are correct answers)
19. 8 were from other countries, so 20 weren't
 $\rightarrow \frac{20}{28} = \frac{5}{7} = .714285 = 71.4\%$
20. $\frac{2}{28} * \frac{2}{28} = \frac{4}{784} = \frac{1}{196} = .0051020408 = 0.5\%$
21. $12 + 6 - 3 = 15\%$
22. $100 - 15 = 85\%$
23. $100 * 438 = 43,800$
24. $26 * 26 * 10 * 10 = 676,000$
25. 4^6 or $4 * 4 * 4 * 4 * 4 * 4 = 4096$
26. $\frac{4}{52}$ or $\frac{1}{13}$ or appx. .0769
27. $\frac{13}{15}$ or $\frac{1}{4}$ or .25
28. $\frac{1}{52}$ or appx. .0192
29. $\frac{16}{52}$ or $\frac{4}{13}$ or appx. .3077
30. $\frac{13}{52} * \frac{12}{51} = \frac{156}{2652}$ or $\frac{1}{17}$ or appx. .0588
31. $\frac{13}{52} * \frac{4}{52} = \frac{52}{2704}$ or $\frac{1}{52}$ or appx. .0192
32. P ("order" is key word)
33. C (they're applying for the same job)
34. C (order doesn't matter)
35. P (different prizes)
36. $27 nCr 7 = 888,030$
37. $60 nPr 5 = 655,381,440$
38. $\frac{1}{2500} * 100 + \frac{5}{2500} * 75 + \frac{25}{2500} * 50 + \frac{50}{2500} * 25 + \frac{2419}{2500} * 10 = 10.866$ or about 11%.
39. $\frac{1}{1000} * 1600 + \frac{3}{1000} * 275 + \frac{20}{1000} * 25 = 2.925$ or appx. \$2.93
40. .13
41. $1 - .13 = .87$
42. 9
43. 2
44. $9nC2 * .13^2 * .87^7 = .2205218172$ (note—this answer has been corrected)
45. $\frac{1}{5}$ or .2
46. $\frac{4}{5}$ or .8
47. 10
48. 3
49. $10nC3 * .2^3 * .8^7 = .201326592$
50. .0336
51. .9778
52. $1 - .1515 - .0096 = .8389$
53. .9633
54. $.0559 - .0446 = .0113$
55. .0202
56. $.0548 - .0096 = .0452$
57. $1 - .1469 - .0013 = .8518$
58. $(35-55)/11 = -1.82$

- 59. .0344
- 60. .1492 is closest number in the table → This goes with $z = 1.04$
- 61. .6700 exactly is in the table → This goes with $z = 0.44$
- 62. Janette's z-score is negative, because it's below the mean of 44.25
- 63. Bart's z-score is positive, because it's above the mean.
- 64. $z = (9 - 44.25) / 26.13 = -1.349$
- 65. $z = (70 - 44.25) / 26.13 = .985$
- 66. Quenton → $-.928 * 26.13 + 44.25 \approx 20$
- 67. Allison → $1.636 * 26.13 + 44.25 \approx 87$
- 68. sampling distribution
- 69. =
- 70. <