**AP STATISTICS**

**A Review of Probability**

**A. Normal Calculations**

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| AP test frequency: Very high  Key to recognizing: Problem will state that the random variable follows a normal distribution  (1) Calculating and interpreting a standardized score.  (2) Calculating a percentage from a given data point  (3) Calculating a data point from a given percentage |

**Sample Multiple Choice Exercises**

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| **1.** | A distribution of scores is approximately normal with a mean of 78 and a standard deviation of 8.6. Which of the following equations can be used to find the score *x* above which 33 percent of the scores fall? | | | |
|  | **(A)** |  | **(D)** |  |
|  | **(B)** |  | **(E)** |  |
|  | **(C)** |  |  |  |

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| **2.** | The caffeine content of 8-ounce cans of a certain cola drink is approximately normally distributed with a mean of 33 milligrams (mg). A randomly selected 8-ounce can containing 35 mg of caffeine is 1.2 standard deviations above the mean. Approximately what percent of 8-ounce cans of the cola have a caffeine content greater than 35 mg? | | | |
|  | **(A)** | 1% | **(D)** | 16% |
|  | **(B)** | 8% | **(E)** | 88% |
|  | **(C)** | 12% |  |  |

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| **3.** | The height of 3-year-old boys is approximately normally distributed. Duncan and Shane are 3-year-old boys. Duncan is 32.0 inches tall and is at the 32nd percentile of the distribution. Shane is 34.0 inches tall and is at the 62nd percentile of the distribution. Which of the following is closest to the mean of the height distribution? | | | |
|  | **(A)** | 32.50 inches | **(D)** | 33.21 inches |
|  | **(B)** | 32.79 inches | **(E)** | 36.53 inches |
|  | **(C)** | 33.00 inches |  |  |

**A. Normal Calculations (continued)**

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| **4.** | The heights of adult women are approximately normally distributed about a mean of 65 inches with a standard deviation of 2 inches. If Rachael is at the 99th percentile for adult women, then her height, in inches, is closest to | | | |
|  | **(A)** | 60 | **(D)** | 70 |
|  | **(B)** | 62 | **(E)** | 74 |
|  | **(C)** | 68 |  |  |

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| **5.** | Gina’s doctor told her that the standardized score (*z*-score) for her systolic blood pressure, as compared to the blood pressure of other women her age, is 1.50. Which of the following is the best interpretation of this standardized score? | |
|  | **(A)** | Gina’s systolic blood pressure is 150. |
|  | **(B)** | Gina’s systolic blood pressure is 1.50 standard deviations above the average systolic blood pressure of women her age. |
|  | **(C)** | Gina’s systolic blood pressure is 1.50 above the average systolic blood pressure of women her age. |
|  | **(D)** | Gina’s systolic blood pressure is 1.50 times the average blood pressure for women her age. |
|  | **(E)** | Only 1.5% of women Gina’s age have a higher systolic blood pressure than she does. |

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| **6.** | At a college, the scores on the chemistry final exam are approximately normally distributed with a mean of 75 and a standard deviation of 12. The scores on the calculus final exam are also approximately normally distributed with a mean of 80 and a standard deviation of 8. A student scored 81 on the chemistry final and 84 on the calculus final. Relative to the students in each respective class, in which subject did this student do better? | |
|  | **(A)** | The student did better in chemistry. |
|  | **(B)** | The student did better in calculus. |
|  | **(C)** | The student did equally well in each course. |
|  | **(D)** | There is no basis for comparison, since the subjects are different from each other and are in different departments. |
|  | **(E)** | There is not enough information for comparison, because the number of students in each class is not known. |

**A. Normal Calculations (continued)**

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| **7.** | The distribution of weights of loaves of bread from a certain bakery follows an approximate normal distribution. Based on a very large sample, it was found that 10 percent of the loaves weighed less than 15.34 ounces, and 20 percent of the loaves weighed more than 16.31 ounces. What are the mean and standard deviation of the weights of the loaves of bread? | | | |
|  | **(A)** | μ = 15.82, σ = 0.48 | **(D)** | μ = 15.93, σ = 0.46 |
|  | **(B)** | μ = 15.82, σ = 0.69 | **(E)** | μ = 16.00, σ = 0.50 |
|  | **(C)** | μ = 15.87, σ = 0.50 |  |  |

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| **8.** | The weights of ripened peaches grown in the southeastern United States follow an approximately normal distribution with a mean of 6.2 ounces and a standard deviation of 0.8 ounces. Find the interquartile range (IQR) of the weights of these peaches. | | | |
|  | **(A)** | 0.5 ounces | **(D)** | 2.5 ounces |
|  | **(B)** | 1.1 ounces | **(E)** | 4.8 ounces |
|  | **(C)** | 1.6 ounces |  |  |

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| **9.** | The distribution of the diameters of a particular variety of oranges is approximately normal with a standard deviation of 0.3 inch. How does the diameter at the 67th percentile compare with the mean diameter? | | | |
|  | **(A)** | 0.201 inch below the mean | **(D)** | 0.201 inch above the mean |
|  | **(B)** | 0.132 inch below the mean | **(E)** | 0.440 inch above the mean |
|  | **(C)** | 0.132 inch above the mean |  |  |

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| **10.** | Let *X* represent a random variable whose distribution is normal, with a mean of 100 and a standard deviation of 10. Which of the following is equivalent to *P*(*X* > 115)? | | | |
|  | **(A)** | *P*(*X* < 115) | **(D)** | *P*(85 < *X* < 115) |
|  | **(B)** | *P*(*X* < 115) | **(E)** | 1 – *P*(*X* < 85) |
|  | **(C)** | *P*(*X* < 85) |  |  |

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| **11.** | One of the values in a normal distribution is 43 and its *z*-score is 1.65. If the mean of the distribution is 40, what is the standard deviation of the distribution? | | | |
|  | **(A)** | 3 | **(D)** | 1.82 |
|  | **(B)** | -1.82 | **(E)** | 0.55 |
|  | **(C)** | -0.55 |  |  |

**B. Standard Probability Calculations**

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| AP test frequency: High  Key to recognizing: “What is the probability that…?”  (1) Multiplying probabilities of independent events  An event has a certain probability and then is repeated a number of times  (2) Conditional probabilities  *“Given* or *If* something occurs, what is the probability that…”  (3) Checking for independence  (a) By comparing: Does *P*(A|B) = *P*(A) ??  (b) By checking the multiplication rule: Does *P*(A) x *P*(B) = *P*(A and B) ?? |

**Sample Multiple Choice Exercises**

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| **1.** | The distribution of colors of candies in a bag is as follows:   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | Color | Brown | Red | Yellow | Green | Orange | | Proportion | 0.3 | 0.2 | 0.2 | 0.2 | 0.1 |   If two candies are randomly drawn from the bag with replacement, what is the probability that they are the same color? | | | |
|  | **(A)** | 0.09 | **(D)** | 0.75 |
|  | **(B)** | 0.22 | **(E)** | 0.78 |
|  | **(C)** | 0.25 |  |  |

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| **2.** | All bags entering a research facility are screened. Ninety-seven percent of the bags that contain forbidden material trigger an alarm. Fifteen percent of the bags that do not contain forbidden material also trigger the alarm. If 1 out of every 1,000 bags entering the building contains forbidden material, what is the probability that a bag that triggers the alarm will actually contain forbidden material? | | | |
|  | **(A)** | 0.00097 | **(D)** | 0.14550 |
|  | **(B)** | 0.00640 | **(E)** | 0.97000 |
|  | **(C)** | 0.03000 |  |  |

**B. Standard Probability Calculations (continued)**

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| **3.** | A survey of 57 students was conducted to determine whether or not they held jobs outside of school. The two-way table below shows the number of students by employment status (job, no job) and class (juniors, seniors). Which of the following best describes the relationship between employment status and class?   |  |  |  |  | | --- | --- | --- | --- | |  | Job | No job | Total | | Juniors | 13 | 5 | 18 | | Seniors | 13 | 26 | 39 | | Total | 26 | 31 | 57 | | |
|  | **(A)** | There appears to be no association, since the same number of juniors and seniors have jobs. |
|  | **(B)** | There appears to be no association, since close to half of the students have jobs. |
|  | **(C)** | There appears to be an association, since there are more seniors than juniors in the survey. |
|  | **(D)** | There appears to be an association, since the proportion of juniors having jobs is much larger than the proportion of seniors having jobs. |
|  | **(E)** | A measure of association cannot be determined from these data. |

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| **4.** | Joe and Sam plan to visit a bookstore. Based on their previous visits to this bookstore, the probability distribution of the number of books when will buy are given below.   |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | | # of books Joe will buy | 0 | 1 | 2 |  | # of books Sam will buy | 0 | 1 | 2 | | probability | 0.50 | 0.25 | 0.25 |  | probability | 0.25 | 0.50 | 0.25 |   Assuming that Joe and Sam make their decisions independently, what is the probability that they will purchase no books on this visit to the bookstore? | | | |
|  | **(A)** | 0.0625 | **(D)** | 0.2500 |
|  | **(B)** | 0.1250 | **(E)** | 0.7500 |
|  | **(C)** | 0.1875 |  |  |

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| **5.** | A fair coin is to be flipped 5 times. The first 4 flips land “heads” up. What is the probability of “heads” on the next (5th) flip of this coin? | | | |
|  | **(A)** | 1 | **(D)** |  |
|  | **(B)** |  | **(E)** | 0 |
|  | **(C)** |  |  |  |

**B. Standard Probability Calculations (continued)**

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| **6.** | Lynn is planning to fly from New York to Los Angeles and will take the Airtight Airlines flight that leaves at 8 A.M. The Web site she used to make the reservation states that the probability that the flight will arrive in Los Angeles on time is 0.70. Of the following, which is the most reasonable explanation for how that probability could have been estimated? | |
|  | **(A)** | By using an extended weather forecast for the date of her flight, which showed a 30% chance of bad weather. |
|  | **(B)** | By making assumptions about how airplanes work, and factoring all of those assumptions into an equation to arrive at the probability. |
|  | **(C)** | From the fact that, of all airline flights arriving in California, 70% arrive on time. |
|  | **(D)** | From the fact that, of all airline flights in the United States, 70% arrive on time. |
|  | **(E)** | From the fact that, on all previous days this particular flight had been scheduled, it had arrived on time 70% of those days. |

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| **7.** | An experiment has three mutually exclusive outcomes, A, B, and C. If *P*(A) = 0.12, *P*(B) = 0.61, and *P*(C) = 0.27, which of the following must be true?  I. A and C are independent  II. *P*(A and B) = 0  III. *P*(B or C) = *P*(B) + *P*(C) | | | |
|  | **(A)** | I only | **(D)** | II and III only |
|  | **(B)** | I and II only | **(E)** | I,II, and III |
|  | **(C)** | I and III only |  |  |

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| **8.** | Given *P*(A) = 0.4, *P*(B) = 0.3, and *P*(B|A) = 0.2, what are *P*(A and B) and *P*(A or B)? | | | |
|  | **(A)** | *P*(A and B) = 0.12, *P*(A or B) = 0.58 | **(D)** | *P*(A and B) = 0.08, *P*(A or B) = 0.58 |
|  | **(B)** | *P*(A and B) = 0.08, *P*(A or B) = 0.62 | **(E)** | *P*(A and B) = 0.08, *P*(A or B) = 0.70 |
|  | **(C)** | *P*(A and B) = 0.12, *P*(A or B) = 0.62 |  |  |

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| **9.** | At a local college, 90% of the students take English, 80% of those who don’t take English take an art course, while only 50% of those who do take English also take an art course. What is the probability that a student takes an art course? | | | |
|  | **(A)** | 0.80 | **(D)** | 0.45 |
|  | **(B)** | 0.53 | **(E)** | 0.10 |
|  | **(C)** | 0.50 |  |  |

**B. Standard Probability Calculations (continued)**

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| **10.** | At a local college, 90% of the students take English, 80% of those who don’t take English take an art course, while only 50% of those who do take English also take an art course. What is the probability that a student who takes an art course does not take English? | | | |
|  | **(A)** | 0.08 | **(D)** | 0.80 |
|  | **(B)** | 0.10 | **(E)** | 0.85 |
|  | **(C)** | 0.15 |  |  |

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| **11.** | You own an unusual die. Three faces are marked with the letter “X,” two faces with the letter “Y,” and one face with the letter “Z.” What is the probability that at least one of the first two rolls is a “Y?” | | | |
|  | **(A)** | 1/6 | **(D)** | 1/3 |
|  | **(B)** | 2/3 | **(E)** | 2/9 |
|  | **(C)** | 5/9 |  |  |

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| **12.** | You roll two dice. What is the probability that the sum is six given that one die shows a 4? | | | |
|  | **(A)** | 2/12 | **(D)** | 2/11 |
|  | **(B)** | 2/36 | **(E)** | 12/36 |
|  | **(C)** | 11/36 |  |  |

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| **13.** | Of the registered voters in a particular district, 42% are Democrats, 38% are Republicans, and 20% are unaffiliated. The new healthcare reform bill is favored by only 19% of the Republican voters in this district. What percentage of voters in this district are Republicans that do NOT favor the healthcare reform bill? | | | |
|  | **(A)** | 19% | **(D)** | 81% |
|  | **(B)** | 31% | **(E)** | 93% |
|  | **(C)** | 38% |  |  |

**C. Random Variables**

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| AP test frequency: High  Key to recognizing: A small list of discrete outcomes with the probability of each outcome.  (1) Basic addition rule (disjoint)  Just add up the probabilities that you are interested in!  (2) Calculate the expected value (a very common test question)  “What is the average…” or “What is the expected value…”. Use Σ(x\*p)  (3) Calculate the standard deviation  (4) Rules for combining random variables   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | |  | *X, Y* | *aX* | *X* + *c* | *aX* + *bY* | *aX* – *bY* | | Mean |  |  |  |  |  | | Standard Deviation |  |  |  | if independent | | |

**Sample Multiple Choice Exercises**

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| **1.** | A box contains 10 tags, numbered 1 through 10, with a different number on each tag. A second box contains 8 tags, numbered 20 through 27, with a different number on each tag. One tag is drawn at random from each box. What is the expected value of the sum of the numbers on the two selected tags? | | | |
|  | **(A)** | 13.5 | **(D)** | 27.0 |
|  | **(B)** | 14.5 | **(E)** | 29.0 |
|  | **(C)** | 15.0 |  |  |

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| **2.** | Let X be a random variable whose values are the number of dots that appear on the uppermost face when a fair die is rolled. The possible values of X are 1, 2, 3, 4, 5, and 6. The mean of X is  and the variance of X is . Let Y be the random variable whose value is the difference (first minus second) between the number of dots that appear on the uppermost face for the first and second rolls of a fair die that is rolled twice. What is the standard deviation of Y? | | | |
|  | **(A)** |  | **(D)** |  |
|  | **(B)** |  | **(E)** |  |
|  | **(C)** |  |  |  |

**C. Random Variables (continued)**

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| **3.** | Students in a large psychology class measured the time, in seconds, it took each of them to perform a certain task. The times were later converted to minutes. If a student had a standardized score of *z* = 1.72 before the conversion, what is the standardized score for the student after the conversion? | | | |
|  | **(A)** | *z* = 0.26 | **(D)** | *z* = 1.98 |
|  | **(B)** | *z* = 1.03 | **(E)** | The standardized score cannot be determined. |
|  | **(C)** | *z* = 1.72 |  |  |

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| **4.** | A random variable *X* has a mean of 120 and a standard deviation of 15. A random variable *Y* has a mean of 100 and a standard deviation of 9. If X and Y are independent, approximately what is the standard deviation of *X* – *Y*. | | | |
|  | **(A)** | 24.0 | **(D)** | 6.0 |
|  | **(B)** | 17.5 | **(E)** | 4.9 |
|  | **(C)** | 12.0 |  |  |

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| **5.** | Each value in a sample has been transformed by multiplying by 3 and then adding 10. If the original sample had a variance of 4, what is the variance of the transformed sample? | | | |
|  | **(A)** | 4 | **(D)** | 22 |
|  | **(B)** | 12 | **(E)** | 36 |
|  | **(C)** | 16 |  |  |

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| **6.** | A company ships gift baskets that contain apples and pears. The distribution of weight for the apples, the pears, and the baskets are each approximately normal. The mean and standard deviation for each distribution is shown in the table below. The weights of the items are assumed to be independent.   |  |  |  |  | | --- | --- | --- | --- | | Item | Apple | Pear | Basket | | Mean | 4.72 ounces | 5.41 ounces | 13.25 ounces | | Standard deviation | 0.20 ounce | 0.18 ounce | 1.88 ounces |   Let the random variable *W* represent the total weight of 4 apples, 6 pears, and 1 basket. Which of the following is closest to the standard deviation of *W*? | | | |
|  | **(A)** | 1.90 ounces | **(D)** | 3.76 ounces |
|  | **(B)** | 1.97 ounces | **(E)** | 3.83 ounces |
|  | **(C)** | 2.26 ounces |  |  |

**C. Random Variables (continued)**

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| **7.** | Erica travels through two intersections with traffic lights as she drives to the market. The traffic lights operate independently. The probability that both lights will be red when she reaches them is 0.22. The probability that the first light will be red and the second light will not be red is 0.33. What is the probability that the second light will be red when she reaches it? | | | |
|  | **(A)** | 0.40 | **(D)** | 0.55 |
|  | **(B)** | 0.45 | **(E)** | 0.60 |
|  | **(C)** | 0.50 |  |  |

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| **8.** | In a certain game, a fair die is rolled and a player gains 20 points if the die shows a “6.” If the die does not show a “6,” the player loses 3 points. If the die were to be rolled 100 times, what would be the expected gain or loss for the player? | | | |
|  | **(A)** | A gain of about 1,700 points | **(D)** | A loss of about 250 points |
|  | **(B)** | A gain of about 583 points | **(E)** | A loss of about 300 points |
|  | **(C)** | A gain of about 83 points |  |  |

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| **9.** | A magazine has 1,620,000 subscribers, of whom 640,000 are women and 980,000 are men. Thirty percent of the women read the advertisements in the magazine and 50 percent of the men read the advertisements in the magazine. A random sample of 100 subscribers is selected. What is the expected number of subscribers in the sample who read the advertisements? | | | |
|  | **(A)** | 30 | **(D)** | 50 |
|  | **(B)** | 40 | **(E)** | 80 |
|  | **(C)** | 42 |  |  |

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| **10.** | The number of sweatshirts a vendor sells daily has the following probability distribution.   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | Number of sweatshirts (*x*) | 0 | 1 | 2 | 3 | 4 | 5 | | *P*(*x*) | 0.3 | 0.2 | 0.3 | 0.1 | 0.08 | 0.02 |   If each sweatshirt sells for $25, what is the expected daily total dollar amount taken in by the vendor from the sale of sweatshirts? | | | |
|  | **(A)** | $5.00 | **(D)** | $38.00 |
|  | **(B)** | $7.60 | **(E)** | $75.00 |
|  | **(C)** | $35.50 |  |  |

**D. Binomial/Geometric Random Variables**

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| AP test frequency: Moderate/High  Key to recognizing: The questions will NOT use the word binomial. Look for success or failure with a fixed number of trials and counting the number of times you succeed or fail.  (1) Binomial Random Variable: The number of successes in n independent Bernoulli trials.  (i) Basic pdf and cdf calculations.  Know how to do on calculator and write out with formula.  (ii) Calculate the mean and standard deviation of a binominal random variable.  See the formula sheet.  (2)Geometric: The number of trials until (and including) the first success.  Know the basic calculation. *P*(*X* = *k*) = (1 – *p*)(*k*-1) ⋅*p* |

**Sample Multiple Choice Exercises**

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| **1.** | A popular computer card game keeps track of the number of games played and the number of games won on that computer. The cards are shuffled before each game, so the outcome of the game is independent from one game to the next and is based on the skill of the player. Let X represent the number of games that have been won out of 100 games. Under which of the following situations would X be a binomial random variable? | |
|  | **(A)** | All games were played by the same player whose skill improved over the course of the 100 games. |
|  | **(B)** | A group of 5 players of different skill levels played 20 games in a row. |
|  | **(C)** | A group of players of different skill levels were each allowed to play until they had lost 3 games and this resulted in 100 games played. |
|  | **(D)** | Two players of equal skill level each played 50 games and their skill level did not change from game-to-game. |
|  | **(E)** | Two players of equal skill level each played 50 games. Their skill level improved from game-to-game. |

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| **2.** | A blind taste test will be conducted with 9 volunteers to determine whether people can taste a difference between bottled water and tap water. Each participant will taste the water from two different glasses and then identify which glass he or she thinks contains the tap water. Assuming that people cannot taste a difference between bottled water and tap water, what is the probability that at least 8 of the 9 participants will correctly identify the tap water? | | | |
|  | **(A)** | 0.0020 | **(D)** | 0.9805 |
|  | **(B)** | 0.0195 | **(E)** | 0.9980 |
|  | **(C)** | 0.8889 |  |  |

**D. Binomial/Geometric Random Variables (continued)**

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| **3.** | Circuit boards are assembled by selecting 4 computer chips at random from a large batch of chips. In this batch of chips, 90 percent of the chips are acceptable. Let X denote the number of acceptable chips out of a sample of 4 chips from this batch. What is the least probable value of X? | | | |
|  | **(A)** | 0 | **(D)** | 3 |
|  | **(B)** | 1 | **(E)** | 4 |
|  | **(C)** | 2 |  |  |

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| **4.** | In a carnival game, a person can win a prize by guessing which one of 5 identical boxes contains the prize. After each guess, if the prize has been won, a new prize is randomly placed in one of the 5 boxes. If the prize has not been won, then the prize is again randomly placed in one of the 5 boxes. If a person make 4 guesses, what is the probability that the person wins a prize exactly two times | | | |
|  | **(A)** |  | **(D)** | (0.2)2(0.8)2 |
|  | **(B)** |  | **(E)** | 6(0.2)2(0.8)2 |
|  | **(C)** | 2(0.2)(0.8) |  |  |

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| --- | --- | --- | --- | --- |
| **5.** | Suppose that 10% of all U.S. school-aged children suffer from Attention-Deficit Hyperactivity Disorder (ADHD). What is the probability that in a random sample of ten U.S. school-aged children, exactly one of them suffers from ADHD? | | | |
|  | **(A)** | 0 | **(D)** |  |
|  | **(B)** | 0.10 | **(E)** |  |
|  | **(C)** | 1 |  |  |

**E. Simulating Probability Events**

|  |
| --- |
| AP test frequency: Low  Key to recognizing: Random digit table is written out and usually a simulation will be asked for directly. You may have to calculate the probability of a success or it may be given to you  (1) Binomial random variable: Fixed number of trials  (2)Geometric**:** Keep going until you get the desired number of successes  (3)Other |

**Sample Multiple Choice Exercises**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **1.** | A fair coin is flipped 10 times and the number of heads is counted. This procedure of 10 coin flips is repeated 100 times and the results are placed in a frequency table. Which of the frequency tables below is most likely to contain results from these 100 trials? | | | | | | |
|  | **(A)** | |  |  | | --- | --- | | Number of heads | Frequency | | 0 | 19 | | 1 | 12 | | 2 | 9 | | 3 | 6 | | 4 | 2 | | 5 | 1 | | 6 | 3 | | 7 | 5 | | 8 | 8 | | 9 | 14 | | 10 | 21 | | **(C)** | |  |  | | --- | --- | | Number of heads | Frequency | | 0 | 9 | | 1 | 9 | | 2 | 9 | | 3 | 9 | | 4 | 9 | | 5 | 10 | | 6 | 9 | | 7 | 9 | | 8 | 9 | | 9 | 9 | | 10 | 9 | |  | **(E)** | |  |  | | --- | --- | | Number of heads | Frequency | | 0 | 0 | | 1 | 0 | | 2 | 6 | | 3 | 9 | | 4 | 22 | | 5 | 24 | | 6 | 18 | | 7 | 12 | | 8 | 7 | | 9 | 2 | | 10 | 0 | |
|  | **(B)** | |  |  | | --- | --- | | Number of heads | Frequency | | 0 | 7 | | 1 | 10 | | 2 | 6 | | 3 | 11 | | 4 | 8 | | 5 | 10 | | 6 | 9 | | 7 | 12 | | 8 | 7 | | 9 | 11 | | 10 | 9 | | **(D)** | |  |  | | --- | --- | | Number of heads | Frequency | | 0 | 0 | | 1 | 0 | | 2 | 0 | | 3 | 2 | | 4 | 24 | | 5 | 51 | | 6 | 22 | | 7 | 1 | | 8 | 0 | | 9 | 0 | | 10 | 0 | |  |  |  |

**E. Simulating Probability Events (continued)**

|  |  |  |
| --- | --- | --- |
| **2.** | Suppose that 30 percent of the subscribers to a cable television service watch the shopping channel at least once a week. You are to design a simulation to estimate the probability that none of five randomly selected subsribers watches the shopping channel at least once a week. Which of the following assignments of the digits 0 through 9 would be appropriate for modeling an individual subscriber’s behavior in this simulation? | |
|  | **(A)** | Assign “0, 1, 2” as watching the shopping channel at least once a week and “3, 4, 5, 6, 7, 8, and 9” as not watching. |
|  | **(B)** | Assign “0, 1, 2, 3” as watching the shopping channel at least once a week and “4, 5, 6, 7, 8, and 9” as not watching. |
|  | **(C)** | Assign “0” as watching the shopping channel at least once a week and “1, 2, 3, 4, and 5” as not watching. Ignore digits “6, 7, 8, and 9.” |
|  | **(D)** | Assign “0” as watching the shopping channel at least once a week and “1, 2, 3, 4, 5, 6, 7, 8, and 9” as not watching. |
|  | **(E)** | Assign “3” as watching the shopping channel at least once a week and “0, 1, 2, 4, 5, 6, 7, 8, and 9” as not watching. |

|  |  |  |
| --- | --- | --- |
| **3.** | Julie generates a sample of 20 random integers between 0 and 9 inclusive. She records the number of 6’s in the sample. She repeats this process 99 more times, recording the number of 6’s in each sample. What kind of distribution has she simulated? | |
|  | **(A)** | The sampling distribution of the sample proportion with *n* = 20 and *p* = 0.6 |
|  | **(B)** | The sampling distribution of the sample proportion with *n* = 100 and *p* = 0.1 |
|  | **(C)** | The binomial distribution with *n* = 20 and *p* = 0.1 |
|  | **(D)** | The binomial distribution with *n* = 100 and *p* = 0.1 |
|  | **(E)** | The binomial distribution with *n* = 20 and *p* = 0.6 |

**F. Sampling Distributions**

|  |
| --- |
| AP test frequency: Moderate  Key to recognizing: The exercise asks about the probability of a sample mean or a sample proportion  (1)Means**. Use the Central Limit Theorem. Be prepared to check the conditions.**  (2)Proportions**.** You need to know this to do a 1 and 2 proportion z-test and z-intervals, but you probably won’t get any questions directly about this. |

**Sample Multiple Choice Exercises**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **1.** | Employees at a large company can earn monthly bonuses. The distribution of monthly bonuses earned by all employees last year has a mean of 2.3 and a standard deviation of 1.3. Let *z* represent the standard normal distribution. If  represents the mean number of monthly bonuses earned last year for a random sample of 40 employees, which of the following calculations will give the approximate probability that  is less than 2? | | | |
|  | **(A)** |  | **(D)** |  |
|  | **(B)** |  | **(E)** |  |
|  | **(C)** |  |  |  |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **2.** | A summer resort rents rowboats to customers but does not allow more than four people to a boat. Each boat is designed to hold no more than 800 pounds. Suppose the distribution of adult males who rent boats, including their clothes and gear, is normal with a mean of 190 pounds and standard deviation of 10 pounds. If the weights of individual passengers are independent, what is the probability that a group of four adult male passengers will exceed the acceptable weight limit of 800 pounds? | | | |
|  | **(A)** | 0.023 | **(D)** | 0.317 |
|  | **(B)** | 0.046 | **(E)** | 0.977 |
|  | **(C)** | 0.159 |  |  |

**F. Sampling Distributions (continued)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **3.** | According to government data, 22 percent of children in the United States under the age of 6 years live in households with incomes that are classified at a particular income level. A sample random sample of 300 children in the United States under the age of 6 years was selected for a study of learning in early childhood. If the government data are correct, which of the following best approximates the probability that at least 27 percent of the children in the sample live in households that are classified at the particular income level? | | | |
|  | **(A)** |  | **(D)** |  |
|  | **(B)** |  | **(E)** |  |
|  | **(C)** |  |  |  |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **4.** | Suppose that public opinion in a large city is 65 percent in favor of increasing taxes to support the public school system and 35 percent against such an increase. If a random sample of 500 people from this city are interviewed, what is the approximate probability that more than 200 of these people will be against increasing taxes? | | | |
|  | **(A)** |  | **(D)** |  |
|  | **(B)** |  | **(E)** |  |
|  | **(C)** |  |  |  |

**F. Sampling Distributions (continued)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **5.** | The population {2, 3, 5, 7} has mean μ = 4.25 and standard deviation σ = 1.92. When sampling with replacement, there are 16 different possible ordered samples of size 2 that can be selected from this population. The distribution of the 16 samples has its own mean and its own standard deviation . Which of the following statements is true? | | | |
|  | **(A)** |  | **(D)** |  |
|  | **(B)** |  | **(E)** |  |
|  | **(C)** |  |  |  |

|  |  |  |
| --- | --- | --- |
| **6.** | An urn contains exactly three balls numbered 1, 2, and 3, respectively. Random samples of two balls are drawn from the urn with replacement. The average  , where *X*1 and *X*2 are the numbers on the selected balls, is recorded after each drawing. Which of the following describes the sampling distribution of ? | |
|  | **(A)** | |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | |  | 1 | 1.5 | 2 | 2.5 | 3 | | Probability |  |  |  |  |  | |
|  | **(B)** | |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | |  | 1 | 1.5 | 2 | 2.5 | 3 | | Probability |  |  |  |  |  | |
|  | **(C)** | |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | |  | 1 | 1.5 | 2 | 2.5 | 3 | | Probability | 0 | 0 | 1 | 0 | 0 | |
|  | **(D)** | |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | |  | 1 | 1.5 | 2 | 2.5 | 3 | | Probability |  |  |  |  |  | |
|  | **(E)** | The sampling distribution cannot be determined from the given information. |

**F. Sampling Distributions (continued)**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **7.** | A game of chance is played in which *X*, the number of points scored in each game, has the distribution shown below. Which of the following is true for the sampling distribution of the sum, *Y*, of the scores when the game is played twice?   |  |  |  |  | | --- | --- | --- | --- | | *x* | 0 | 1 | 2 | | *P*(*x*) | 0.3 | 0.4 | 0.3 | | |
|  | **(A)** | *Y* takes on values 0, 1, 2 with respective probabilities 0.3, 0.4, 0.3. |
|  | **(B)** | *Y* takes on values 0, 2, 4 according to a binomial distribution with mean equal to 2. |
|  | **(C)** | *Y* takes on values 0, 2, 4 with respective probabilities 0.3, 0.4, 0.3. |
|  | **(D)** | *Y* takes on values 0, 1, 2, 3, 4 according to a binomial distribution with mean equal to 2. |
|  | **(E)** | *Y* takes on values 0, 1, 2, 3, 4 with respective probabilities 0.09, 0.24, 0.34, 0.24, 0.09. |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **8.** | In a large population, 55% of the people get a physical examination at least once every two years. A SRS of 100 people are interviewed and the sample proportion of people who reported getting a physical examination at least once every two years is computed. The mean and standard deviation of the sampling distribution of the sample proportion are | | | |
|  | **(A)** | 0.55, 04.97 | **(D)** | 0.55, 0.0497 |
|  | **(B)** | 0.55, 0.002 | **(E)** | The mean and standard deviation cannot be determined. |
|  | **(C)** | 0.55, 2 |  |  |

**Answers**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Set A** | | **Set B** | | **Set C** | | **Set D** | | **Set E** | | **Set F** | |
| **1.** | D | **1.** | B | **1.** | E | **1.** | D | **1.** | E | **1.** | D |
| **2.** | C | **2.** | B | **2.** | C | **2.** | B | **2.** | A | **2.** | A |
| **3.** | D | **3.** | D | **3.** | C | **3.** | A | **3.** | C | **3.** | B |
| **4.** | D | **4.** | B | **4.** | B | **4.** | E |  |  | **4.** | E |
| **5.** | B | **5.** | B | **5.** | E | **5.** | E |  |  | **5.** | C |
| **6.** | C | **6.** | E | **6.** | B |  |  |  |  | **6.** | B |
| **7.** | D | **7.** | D | **7.** | A |  |  |  |  | **7.** | E |
| **8.** | B | **8.** | B | **8.** | C |  |  |  |  | **8.** | D |
| **9.** | E | **9.** | B | **9.** | C |  |  |  |  |  |  |
| **10.** | C | **10.** | C | **10.** | D |  |  |  |  |  |  |
| **11.** | D | **11.** | C |  |  |  |  |  |  |  |  |
|  |  | **12.** | D |  |  |  |  |  |  |  |  |
|  |  | **13.** | B |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |