4 COMMON PROBABILITY DISTRIBUTIONS

1. Approximately 95% of all observations for a normally distributed random variable fall in the interval:
   (A) $\mu \pm \sigma$
   (B) $\mu \pm 3\sigma$
   (C) $\mu \pm 2\sigma$

2. The Cumulative distribution function for a random variable X is given in the following:

X	F(x)
5	0.15
10	0.30
15	0.45
20	0.75
25	1.00

The probability of an outcome greater than 15 is:
   (A) 45%
   (B) 75%
   (C) 55%

3. A normal distribution has a mean of 10 and a standard deviation of 4. Which of the following statements is *most accurate?*
   (A) 81.5% of all the observations will fall between 6 and 18.
   (B) The probability of finding an observation below 2 is 5%.
   (C) The probability of finding an observation at 14 or above is 32%.

4. Which of the following statements regarding the distribution of returns used for asset pricing models is most accurate?
   (A) Lognormal distribution returns are used because this will allow for negative returns on the assets.
   (B) Lognormal distribution returns are used for asset pricing models because they will not result in an asset return of less than -100%.
   (C) Normal distribution returns are used for asset pricing models because they will only allow the asset price to fall to zero.

5. The mean return of a portfolio is 20% and its standard deviation is 40%. The returns are normally distributed. Which of the following statements about this distribution are least accurate? The probability of receiving a return:
   (A) Between 12% and 28% is 0.95
   (B) In excess of 16% is 0.16
   (C) Of less than 12% is 0.025

6. Which of the following statements about the normal probability distribution is most accurate?
   (A) The normal curve is asymmetrical about its mean.
   (B) Five percent of the normal curve probability is more than two standard deviations from the mean.
   (C) Sixty-eight percent of the area under the normal curve falls between the mean and 1 standard deviation above the mean

7. A random variable X is continuous and bounded between zero and five, X:($0 \leq X \leq 5$). The cumulative distribution function (cdf) for X is $F(x) = x / 5$. Calculate $P(2 \leq X \leq 4)$.
   (A) 1.00.
   (B) 0.50.
   (C) 0.40.

8. Segment of the tables of critical values for students'-distribution

Level of Significance for a One-Tailed Test		
df	0.050	0.025
Level of Significance for a Two-Tailed Test		
df	0.10	0.05
28	1.701	2.048
29	1.699	2.045
30	1.697	2.042
40	1.684	2.021

   For a t-distributed test statistic with 30 degrees of freedom, a one-tailed test specifying the parameter greater than some value and a 95% confidence level, the critical value is:
   (A) 1.684.
   (B) 1.697.
   (C) 2.042.

9. A random variable that has a countable number of possible values is best described as a:
   (A) discrete random variable.
   (B) probability distribution.
   (C) continuous random variable.

10. Monte Carlo simulation is necessary to:
    (A) compute continuously compounded returns.
    (B) reduce sampling error.
    (C) approximate solutions to complex problems.

11. For a given stated annual rate of return, compared to the effective rate of return with discrete compounding, the effective rate of return with continuous compounding will be:
    (A) lower.
    (B) higher.
    (C) the same.

12. Given a holding period return of R, the continuously compounded rate of return is:
    (A) $e^R - 1$.
    (B) ln(1 + R).
    (C) ln(1 + R) - 1.

13. In a multivariate normal distribution, a correlation tells the:
    (A) overall relationship between all the variables.
    (B) relationship between the means and variances of the variables.
    (C) strength of the linear relationship between two of the variables.

14. In addition to the usual parameters that describe a normal distribution, to completely describe 10 random variables, a multivariate normal distribution requires knowing the:
    (A) overall correlation.
    (B) 45 correlations.
    (C) 10 correlations.

15. There is an 80% probability of rain on each of the next six days. What is the probability that it will rain on exactly two of those days?
    (A) 0.24327.
    (B) 0.15364.
    (C) 0.01536.

16. A portfolio manager is looking at an investment that has an expected annual return of 10% with a standard deviation of annual returns of 5%. Assuming the returns are approximately normally distributed, the probability that the return will exceed 20% in any given year is closest to:
    (A) 0.0%.
    (B) 2.28%.
    (C) 4.56%.

17. Which of the following is NOT an assumption of the binomial distribution?
    (A) Random variable X is discrete.
    (B) The expected value is a whole number.
    (C) The trials are independent.

18. A normal distribution can be completely described by its:
    (A) mean and mode.
    (B) mean and variance.
    (C) skewness and kurtosis.

19. The number of days a particular stock increases in a given five-day period is uniformly distributed between zero and five inclusive. In a given five-day trading week, what is the probability that the stock will increase exactly three days?
    (A) 0.600.
    (B) 0.167.
    (C) 0.333.

20. With 60 observations, what is the appropriate number of degrees of freedom to use when carrying out a statistical test on the mean of a population?
    (A) 59
    (B) 60.
    (C) 61.

21. The annual rainfall amount in Yucutat, Alaska, is normally distributed with a mean of 150 inches and a standard deviation of 20 inches. The 90% confidence interval for the annual rainfall in Yucutat is *closest to:*
    (A) 117 to 183 inches.
    (B) 137 to 163 inches.
    (C) 110 to 190 inches.

22. Over a period of one year, an investor's portfolio has declined in value from 127,350 to 108,427. What is the continuously compounded rate of return?
    (A) -13.84%.
    (B) -14.86%.
    (C) -16.09%.

23. Possible outcomes for a discrete uniform distribution are the integers 2 to 9 inclusive. What is the probability of an outcome less than 5?
    (A) 37.5%.
    (B) 62.5%.
    (C) 50.0%.

24. A dealer in a casino has rolled a five on a single die three times in a row. What is the probability of her rolling another five on the next roll, assuming it is a fair die?
    (A) 0.001.
    (B) 0.167.
    (C) 0.200.

25. For a binomial random variable with a 40% probability of success on each trial, the expected number of successes in 12 trials is closest to:
    (A) 4.8.
    (B) 5.6.
    (C) 7.2.

26. Standardizing a normally distributed random variable requires the:
    (A) natural logarithm of X.
    (B) mean and the standard deviation.
    (C) mean, variance and skewness.

27. A casual laborer has a 70% probability of finding work on each day that she reports to the day labor marketplace. What is the probability that she will work three days out of five?
    (A) 0.3192
    (B) 0.6045.
    (C) 0.3087.

28. Which statement best describes the properties of Student's t-distribution? The t-distribution is
    (A) symmetrical, and defined by two parameters.
    (B) symmetrical, and defined by a single parameter.
    (C) skewed, and defined by a single parameter.

29. For an F-distribution where both chi-square random variables are based on a sample size of 10, the degrees of freedom in the numerator are:
    (A) 8.
    (B) 19.
    (C) 9.

30. Which of the following statements about probability distributions is least accurate?
    (A) A discrete random variable is a variable that can assume only certain clearly separated values resulting from a count of some set of items.
    (B) The skewness of a normal distribution is zero.
    (C) A binomial probability distribution is an example of a continuous probability distribution.

31. If X follows a continuous uniform distribution over the interval 1 < X < 26, the probability that X is between 5 and 15 is closest to:
    (A) 10%.
    (B) 40%
    (C) 60%

32. A stock increased in value last year. Which will be greater, its continuously compounded or its holding period return?
    (A) Its continuously compounded return.
    (B) Its holding period return.
    (C) Neither, they will be equal.

33. The lower limit of a normal distribution is:
    (A) negative infinity.
    (B) zero.
    (C) negative one.

34. The mean and standard deviation of returns for three portfolios are listed below in percentage terms.
    Portfolio X: Mean 5%, standard deviation 3%.
    Portfolio Y: Mean 14%, standard deviation 20%.
    Portfolio Z: Mean 19%, standard deviation 28%.
    Using Roy's safety-first criteria and a threshold of 4%, select the optimal portfolio.
    (A) Portfolio X.
    (B) Portfolio Z.
    (C) Portfolio Y.

35. A discount brokerage firm states that the time between a customer order for a trade and the execution of the order is uniformly distributed between three minutes and fifteen minutes. If a customer orders a trade at 11:54 A.M., what is the probability that the order is executed after noon?
    (A) 0.250.
    (B) 0.500.
    (C) 0.750.

36. Cumulative z-table

Z	0.00	0.01	0.02	0.03
1.6	0.9452	0.9463	0.9474	0.9484
1.7	0.9554	0.9564	0.9573	0.9582
1.8	0.9641	0.9649	0.9656	0.9664

Monthly sales of hot water heaters are approximately normally distributed with a mean of 21 and a standard deviation of 5. What is the probability of selling 12 hot water heaters or less next month?

(A) 1.80%.
(B) 3.59%.
(C) 96.41%

37. A multivariate distribution:

(A) applies only to binomial distributions.
(B) specifies the probabilities associated with groups of random variables.
(C) gives multiple probabilities for the same outcome.

38. As degrees of freedom increase, the Chi-square and F-distributions most likely become more:

(A) bell shaped.
(B) Negative
(C) Asymmetric.

39. Which one of the following statements about the t-distribution is *most* accurate?

(A) The t-distribution has thinner tails compared to the normal distribution.
(B) The t-distribution is positively skewed.
(C) The t-distribution approaches the standard normal distribution as the degrees of freedom increase

40. Which of the following qualifies as a cumulative distribution function?

(A) F(1) = 0, F(2) = 0.25, F(3) = 0.50, F(4) = 1.
(B) F(1) = 0, F(2) = 0.5, F(3) = 0.5, F(4) = 0.
(C) F(1) = 0.5, F(2) = 0.25, F(3) = 0.25, F(4) = -1

41. The continuously compounded rate of return that will generate a one-year holding period return of -6.5% is closest to:

(A) -5.7 %.
(B) -6.3 %.
(C) -6.7 %.

42. Standard Normal Distribution

$P(Z \leq z) = N(z)$ for $z \geq 0$

Z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.6	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7517	0.7549
0.7	0.7580	0.7611	0.7642	0.7673	0.7704	0.7734	0.7764	0.7794	0.7823	0.7852
0.8	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8078	0.8106	0.8133
0.9	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365	0.8389

John Cupp, CFA, has several hundred clients. The values of the portfolios Cupp manages are approximately normally distributed with a mean of $800,000 and a standard deviation of $250,000. The probability of a randomly selected portfolio being in excess of $1,000,000 is:

(A) 17.36%.
(B) 78.81%.
(C) 21.19%

43. Which of the following distributions can only take on positive values?

(A) Normal distribution.
(B) Student's t-distribution.
(C) F-distribution.

44. A stock portfolio has had a historical average annual return of 12% and a standard deviation of 20%. The returns are normally distributed. The range -27.2 to 51.2% describes a:

(A) 99% confidence interval.
(B) 95% confidence interval.
(C) 68% confidence interval.

45. The probability density function of a continuous uniform distribution is best described by a:

(A) line segment with a 45-degree slope.
(B) line segment with a curvilinear slope.
(C) horizontal line segment.

46. For a Chi-square distribution with a sample size of 10 the degrees of freedom are:

(A) 8.
(B) 9.
(C) 10.

47. Which of the following statements describes a limitation of Monte Carlo simulation?

(A) Outcomes of a simulation can only be as accurate as the inputs to the model
(B) Simulations do not consider possible input values that lie outside historical experience
(C) Variables are assumed to be normally distributed but may actually have non-normal distributions

48. Laura Smith, CFA, is an analyst with the trust department of Bright Star Bank. The department's portfolio managers use a proprietary model to select stocks. Bright Star has been purchased by Mega Bank, which does not plan to use Bright Star's model after completing the purchase. A few weeks before the Bright Star/Mega Bank merger date, Smith downloads the model to her laptop and modifies the model for her own use. Do Smith's actions violate the Standards of Professional Conduct?

(A) No, because Smith modified the model.

(B) Yes, because the model is the property of Mega Bank.

(C) No, because Mega Bank has discontinued use of the model

49. Which of the following portfolios provides the optimal "safety first" return if the minimum acceptable return is 9%?

Portfolio	Expected Return (%)	Standard Deviation (%)
1	13	5
2	11	3
3	9	2

(A) 1

(B) 2

(C) 3

50. A cumulative distribution function for a random variable X is given as follows:

X	F(x)
5	0.14
10	0.25
15	0.86
20	1.00

The probability of an outcome less than or equal to 10 is:

(A) 39%.

(B) 25%.

(C) 14%.

51. Which of the following statements about a normal distribution is least accurate?

(A) Kurtosis is equal to 3.

(B) Approximately 34% of the observations fall within plus or minus one standard deviation of the mean.

(C) The distribution is completely described by its mean and variance.

52. A grant writer for a local school district is trying to justify an application for funding an after-school program for low-income families. Census information for the school district shows an average household income of $26,200 with a standard deviation of $8,960. Assuming that the household income is normally distributed, what is the percentage of households in the school district with incomes of less than $12,000?

(A) 5.71%.

(B) 9.92%.

(C) 15.87%.

53. A stock that pays no dividend is currently priced at €42.00. One year ago the stock was €44.23. The continuously compounded rate of return is closest to:
    (A) +5.17%.
    (B) -5.04%.
    (C) -5.17%.

54. A probability distribution is least likely to:
    (A) the probability that the distribution is realistic.
    (B) have only non-negative probabilities.
    (C) contain all the possible outcomes

55. Which of the following random variables would be most likely to follow a discrete uniform distribution?
    (A) The number of heads on the flip of two coins.
    (B) The outcome of a roll of a standard, six-sided die where X equals the number facing up on the die
    (C) The outcome of the roll of two standard, six-sided dice where X is the sum of the numbers facing up

56. In a normal distribution, the:
    (A) median equals the mode.
    (B) kurtosis is 4.
    (C) skew is positive.

57. If a stock decreases from $90 to $80, the continuously compounded rate of return for the period is:
    (A) -0.1250.
    (B) -0.1000.
    (C) -0.1178.

58. Cumulative Z-Table

Z	0.04	0.05
1.8	0.9671	0.9678
1.9	0.9738	0.9744
2.0	0.9793	0.9798
2.1	0.9838	0.9842

The owner of a bowling alley determined that the average weight for a bowling ball is 12 pounds with a standard deviation of 1.5 pounds. A ball denoted "heavy" should be one of the top 2% based on weight. Assuming the weights of bowling balls are normally distributed, at what weight (in pounds) should the "heavy" designation be used?

(A) 15.08 pounds.
(B) 14.00 pounds.
(C) 14.22 pounds.

59. A food retailer has determined that the mean household income of her customers is $47,500 with a standard deviation of $12,500. She is trying to justify carrying a line of luxury food items that would appeal to households with incomes greater than $60,000. Based on her information and assuming that household incomes are normally distributed, what percentage of households in her customer base has incomes of $60,000 or more?
(A) 15.87%
(B) 2.50%
(C) 5.00%

60. An investor is considering investing in one of the following three portfolios:

Statistical Measures	Portfolio X	Portfolio Y	Portfolio Z
Expected annual return	12%	17%	22%
Standard deviation of return	14%	20%	25%

If the investor's minimum acceptable return is 5%, the optimal portfolio using Roy's safety-first criterion is:
(A) Portfolio Z.
(B) Portfolio Y.
(C) Portfolio X.

61. The mean and standard deviation of returns on three portfolios are listed below in percentage terms:
- **Portfolio X:** Mean 5%, standard deviation 3%.
- **Portfolio Y:** Mean 14%, standard deviation 20%.
- **Portfolio Z:** Mean 19%, standard deviation 28%.

Using Roy's safety first criteria and a threshold of 3%, which of these is the optimal portfolio?
(A) Portfolio X.
(B) Portfolio Y.
(C) Portfolio Z.

62. A stated interest rate of 9% compounded continuously results in an effective annual rate closest to:
(A) 9.20%
(B) 9.67 %.
(C) 9.42%.

63. Which of the following portfolios provides the best "safety first" ratio if the minimum acceptable return is 6%?

Portfolio	Expected Returns %	Standard Deviation %
1	13	5
2	11	3
3	9	2

(A) 1
(B) 2
(C) 3

64. Multivariate distributions can describe:
(A) continuous random variables only.
(B) either discrete or continuous random variables.
(C) discrete random variables only.

65. An investment has an expected return of 10% with a standard deviation of 5%. If the returns are normally distributed, the probability of losing money is closest to:
(A) 16.0%
(B) 5.0%.
(C) 2.5%.

66. For a certain class of junk bonds, the probability of default in a given year is 0.2. Whether one bond defaults is independent of whether another bond defaults. For a portfolio of five of these junk bonds, what is the probability that zero or one bond of the five defaults in the year ahead?
(A) 0.7373.
(B) 0.4096.
(C) 0.0819.

67. Assume 30% of the CFA candidates have a degree in economics. A random sample of three CFA candidates is selected. What is the probability that none of them has a degree in economics?
(A) 0.027.
(B) 0.343.
(C) 0.900.

68. A client will move his investment account unless the portfolio manager earns at least a 10% rate of return on his account. The rate of return for the portfolio that the portfolio manager has chosen has a normal probability distribution with an expected return of 19% and a standard deviation of 4.5%. What is the probability that the portfolio manager will keep this account?
(A) 0.750.
(B) 0.950.
(C) 0.977.

69. Which of the following is least likely a probability distribution?
    (A) Flip a coin: P(H) = P(T) = 0.5.
    (B) Roll an irregular die: p(1) = p(2) = p(3) = p(4) = 0.2 and p(5) = p(6) = 0.1.
    (C) Zeta Corp.: P(dividend increases) = 0.60, P(dividend decreases) = 0.30.

70. A normal distribution is completely described by its:
    (A) mean, mode, and skewness.
    (B) variance and mean.
    (C) median and mode.

71. A stock portfolio's returns are normally distributed. It has had a mean annual return of 25% with a standard deviation of 40%. The probability of a return between -41% and 91% is closest to:
    (A) 65%.
    (B) 90%.
    (C) 95%.

72. A random variable follows a continuous uniform distribution over 27 to 89. What is the probability of an outcome between 34 and 38?
    (A) 0.0546.
    (B) 0.0645.
    (C) 0.0719.

73. Which of the following is least likely to be an example of a discrete random variable?
    (A) The number of days of sunshine in the month of May 2006 in a particular city.
    (B) Quoted stock prices on the NASDAQ.
    (C) The rate of return on a real estate investment.

74. If X has a normal distribution with $\mu = 100$ and $\sigma = 5$, then there is approximately a 90% probability that:
    (A) $P(90.2 < X < 109.8)$.
    (B) $P(91.8 < X < 108.3)$.
    (C) $P(93.4 < X < 106.7)$.

75. A multivariate normal distribution that includes three random variables can be completely described by the means and variances of each of the random variables and the:
    (A) correlation coefficient of the three random variables.
    (B) correlations between each pair of random variables.
    (C) conditional probabilities among the three random variables.

76. The t-distribution is appropriate for constructing confidence intervals based on small samples from a population with:
(A) unknown variance and a normal distribution.
(B) known variance and a non-normal distribution.
(C) unknown variance and a non-normal distribution.

77. Three portfolios with normally distributed returns are available to an investor who wants to minimize the probability that the portfolio return will be less than 5%. The risk and return characteristics of these portfolios are shown in the following table:

Portfolio	Expected return	Standard deviation
Epps	6%	4%
Flake	7%	9%
Grant	10%	15%

Based on Roy's safety-first criterion, which portfolio should the investor select?
(A) Epps.
(B) Flake.
(C) Grant.

78. An investment has a mean return of 15% and a standard deviation of returns equal to 10%. If returns are normally distributed, which of the following statements is least accurate? The probability of obtaining a return:
(A) greater than 35% is 0.025.
(B) between 5% and 25% is 0.68.
(C) greater than 25% is 0.32.

79. One of the major limitations of Monte Carlo simulation is that it:
(A) cannot provide the insight that analytic methods can.
(B) does not lend itself to performing "what if' scenarios.
(C) requires that variables be modeled using the normal distribution.

80. Consider a random variable X that follows a continuous uniform distribution: $7 \leq X \leq 20$. Which of the following statements is least accurate?
(A) F (21) = 0.00.
(B) F(10) = 0.23.
(C) $F(12 \leq X \leq 16) = 0.307$.

81. Bill Phillips is developing a Monte Carlo simulation to value a complex and thinly traded security. Phillips wants to model one input variable to have negative skewness and a second input variable to have positive excess kurtosis. In a Monte Carlo simulation, Phillips can appropriately use:
(A) both of these variables.
(B) only one of these variables.
(C) neither of these variables.

82. Standard Normal Distribution

$P(Z \leq z) = N(z)$ for $z \geq 0$

z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.5	0.6915	0.6950	0.6985	0.7019	0.7054	0.7088	0.7123	0.7157	0.7190	0.7224
0.6	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7517	0.7549
0.7	0.7580	0.7611	0.7642	0.7673	0.7704	0.7734	0.7764	0.7794	0.7823	0.7852
0.8	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8078	0.8106	0.8133
0.9	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365	0.8389
1.0	0.8413	0.8438	0.8461	0.8485	0.8508	0.8531	0.8554	0.8577	0.8599	0.8621
1.1	0.8643	0.8665	0.8686	0.8708	0.8729	0.8749	0.8770	0.8790	0.8810	0.8830
1.2	0.8849	0.8869	0.8888	0.8907	0.8925	0.8944	0.8962	0.8980	0.8997	0.9015
1.3	0.9032	0.9049	0.9066	0.9082	0.9099	0.9115	0.9131	0.9147	0.9162	0.9177
1.4	0.9192	0.9207	0.9222	0.9236	0.9251	0.9265	0.9279	0.9292	0.9306	0.9319

Given a normally distributed population with a mean income of $40,000 and standard deviation of $7,500, what percentage of the population makes between $30,000 and $35,000?

(A) 15.96.
(B) 13.34.
(C) 41.67.

83. The average amount of snow that falls during January in Frostbite Falls is normally distributed with a mean of 35 inches and a standard deviation of 5 inches. The probability that the snowfall amount in January of next year will be between 40 inches and 26.75 inches is closest to:

(A) 68%.
(B) 79%.
(C) 87%.

84. Which of the following statements about probability distributions is least accurate?

(A) A probability distribution includes a listing of all the possible outcomes of an experiment.
(B) In a binomial distribution each observation has only two possible outcomes that are mutually exclusive.
(C) A probability distribution is, by definition, normally distributed.

85. A lognormal distribution is least likely to be:

(A) used to model stock prices.
(B) negatively skewed.
(C) bounded below by zero.

86. If a random variable x is lognormally distributed then ln x is:

(A) abnormally distributed.
(B) defined as e^x.
(C) normally distributed.

87. Which of the following statements about a normal distribution is least accurate?
(A) The mean and variance completely define a normal distribution.
(B) Approximately 68% of the observations lie within +/- 1 standard deviation of the mean.
(C) A normal distribution has excess kurtosis of three.

88. Which of the following would least likely be categorized as a multivariate distribution?
(A) The days a stock traded and the days it did not trade.
(B) The returns of the stocks in the DJIA.
(C) The return of a stock and the return of the DJIA.

89. If random variable Y follows a lognormal distribution then the natural log of Y must be:
(A) denoted as e^x.
(B) lognormally distributed.
(C) normally distributed.

90. The probability that a normally distributed random variable will be more than two standard deviations above its mean is:
(A) 0.9772.
(B) 0.0228.
(C) 0.4772.

91. Which of the following distributions is most likely a discrete distribution?
(A) A univariate distribution.
(B) A normal distribution.
(C) A binomial distribution.

92. A multivariate distribution is best defined as describing the behavior of:
(A) a random variable with more than two possible outcomes.
(B) two or more dependent random variables.
(C) two or more independent random variables.

93. A group of investors wants to be sure to always earn at least a 5% rate of return on their investments. They are looking at an investment that has a normally distributed probability distribution with an expected rate of return of 10% and a standard deviation of 5%. The probability of meeting or exceeding the investors' desired return in any given year is closest to:
(A) 98%.
(B) 84%.
(C) 34%.