Joint Distributions – Quiz

Probability & Statistics

Question 1

A joint distribution describes:

A. A single random variable
B. The relationship between two or more random variables
C. Only continuous variables
D. The sample size

Question 1

A joint distribution describes:

A. A single random variable
B. The relationship between two or more random variables
C. Only continuous variables
D. The sample size

Answer: B
Joint distributions describe the probability of combinations of values for two or more random variables together.

Question 2

The joint PMF p(x, y) represents:

A. P(X ¡= x and Y ¡= y)
B. P(X = x or Y = y)
C. P(X = x and Y = y)
D. P(X = x) + P(Y = y)

Question 2

The joint PMF p(x, y) represents:

A. P(X ¡= x and Y ¡= y)
B. P(X = x or Y = y)
C. P(X = x and Y = y)
D. P(X = x) + P(Y = y)

Answer: C
The joint PMF gives the probability that X equals x AND Y equals y simultaneously.

Question 3

For a valid joint PMF, what must be true?

A. All probabilities are negative
B. The sum over all (x, y) pairs equals 1
C. Only diagonal entries are non-zero
D. Each row must sum to the same value

Question 3

For a valid joint PMF, what must be true?

A. All probabilities are negative
B. The sum over all (x, y) pairs equals 1
C. Only diagonal entries are non-zero
D. Each row must sum to the same value

Answer: B
A valid joint PMF requires all probabilities to be non-negative and the sum over all pairs (x, y) must equal 1.

Question 4

The marginal distribution of X is obtained by:

A. Multiplying joint probabilities
B. Summing joint probabilities over all values of Y
C. Dividing joint by conditional probabilities
D. Taking the square root of joint probabilities

Question 4

The marginal distribution of X is obtained by:

A. Multiplying joint probabilities
B. Summing joint probabilities over all values of Y
C. Dividing joint by conditional probabilities
D. Taking the square root of joint probabilities

Answer: B
The marginal distribution of X is found by summing p(x, y) over all values of y: p_X(x) = sum over y of p(x, y).

Question 5

The conditional distribution of Y given X = x is:

A. p(x, y) / p_X(x)
B. p(x, y) × p_X(x)
C. p_X(x) / p(x, y)
D. p_X(x) + p_Y(y)

Question 5

The conditional distribution of Y given X = x is:

A. p(x, y) / p_X(x)
B. p(x, y) x p_X(x)
C. p_X(x) / p(x, y)
D. p_X(x) + p_Y(y)

Answer: A
The conditional distribution p(y—x) = p(x, y) / p_X(x), where p_X(x) is the marginal probability of X = x.

Question 6

Two random variables X and Y are independent if:

A. P(X = x) = P(Y = y) for all x, y
B. p(x, y) = p_X(x) x p_Y(y) for all x, y
C. Cov(X, Y) ¿ 0
D. They have the same distribution

Question 6

Two random variables X and Y are independent if:

A. P(X = x) = P(Y = y) for all x, y
B. p(x, y) = p_X(x) x p_Y(y) for all x, y
C. Cov(X, Y) ¿ 0
D. They have the same distribution

Answer: B
Independence means the joint distribution factors into the product of the marginals: p(x, y) = p_X(x) x p_Y(y).

Question 7

If X and Y are independent, then p(y—x) equals:

A. p(x—y)
B. p_X(x)
C. p_Y(y)
D. p(x, y)

Question 7

If X and Y are independent, then p(y—x) equals:

A. p(x—y)
B. p_X(x)
C. p_Y(y)
D. p(x, y)

Answer: C
If X and Y are independent, knowing X tells us nothing about Y, so p(y—x) = p_Y(y).

Question 8

In the bivariate normal distribution, the parameter rho represents:

A. The mean of X
B. The variance of Y
C. The correlation between X and Y
D. The sum of means

Question 8

In the bivariate normal distribution, the parameter rho represents:

A. The mean of X
B. The variance of Y
C. The correlation between X and Y
D. The sum of means

Answer: C
In bivariate normal, rho is the correlation coefficient measuring the linear relationship between X and Y, ranging from -1 to +1.

Question 9

For bivariate normal, if rho = 0, then X and Y are:

A. Perfectly correlated
B. Independent
C. Negatively correlated
D. Cannot be determined

Question 9

For bivariate normal, if rho = 0, then X and Y are:

A. Perfectly correlated
B. Independent
C. Negatively correlated
D. Cannot be determined

Answer: B
For bivariate normal (unlike other distributions), zero correlation implies independence.

Question 10

The contours of a bivariate normal distribution form:

A. Circles when rho $= 0$
B. Rectangles
C. Triangles
D. Irregular shapes

Question 10

The contours of a bivariate normal distribution form:

A. Circles when rho $= 0$
B. Rectangles
C. Triangles
D. Irregular shapes

Answer: A
When rho $= 0$ and the variances are equal, contours are circles. Non-zero correlation tilts the ellipse.

Question 11

In finance, joint distributions are important for:

A. Modeling single asset returns only
B. Understanding how multiple assets move together
C. Calculating simple interest
D. Determining tax rates

Question 11

In finance, joint distributions are important for:

A. Modeling single asset returns only
B. Understanding how multiple assets move together
C. Calculating simple interest
D. Determining tax rates

Answer: B
Joint distributions capture how multiple asset returns move together, which is crucial for portfolio diversification and risk management.

Question 12

A copula describes:

A. Only marginal distributions
B. The dependence structure between variables, separate from their marginals
C. Only normal distributions
D. Time series patterns

Question 12

A copula describes:

A. Only marginal distributions
B. The dependence structure between variables, separate from their marginals
C. Only normal distributions
D. Time series patterns

Answer: B
A copula separates the dependence structure from the marginal distributions, allowing flexible modeling of joint behavior.

Question 13

If Corr(X, Y) = +0.9, what can we conclude?

A. X and Y are independent
B. X and Y have a strong positive linear relationship
C. X and Y are negatively related
D. X causes Y

Question 13

If Corr(X, Y) = +0.9, what can we conclude?

A. X and Y are independent

B. X and Y have a strong positive linear relationship

C. X and Y are negatively related

D. X causes Y

Answer: B

A correlation of $+0.9$ indicates a strong positive linear relationship: as X increases, Y tends to increase. Correlation does not imply causation.

Question 14

The marginal of a joint distribution is found at the:

A. Center of the table
B. Row totals or column totals (margins)
C. Diagonal entries
D. Corners of the table

Question 14

The marginal of a joint distribution is found at the:

A. Center of the table
B. Row totals or column totals (margins)
C. Diagonal entries
D. Corners of the table

Answer: B
The name 'marginal' comes from finding these distributions by summing across rows or columns, with totals appearing in the margins.

Question 15

For continuous joint distributions, probability is found as:

A. The height of the joint PDF
B. The volume under the joint PDF surface
C. The sum of PDF values
D. The product of individual CDFs

Question 15

For continuous joint distributions, probability is found as:

A. The height of the joint PDF
B. The volume under the joint PDF surface
C. The sum of PDF values
D. The product of individual CDFs

Answer: B
For continuous variables, probability is the volume under the joint PDF surface over a specified region.

Question 16

The conditional distribution of Y given X = x tells us:

A. The probability of X
B. How Y is distributed once we know X's value
C. The joint probability of X and Y
D. Whether X and Y are independent

Question 16

The conditional distribution of Y given X = x tells us:

A. The probability of X
B. How Y is distributed once we know X's value
C. The joint probability of X and Y
D. Whether X and Y are independent

Answer: B
The conditional distribution describes the distribution of Y after we observe or fix the value of X.

Question 17

For bivariate normal, conditional distributions are:

A. Uniform
B. Exponential
C. Normal
D. Unknown

Question 17

For bivariate normal, conditional distributions are:

A. Uniform
B. Exponential
C. Normal
D. Unknown

Answer: C
A key property of bivariate normal: if you condition on one variable, the other is still normally distributed (with updated mean and variance).

Question 18

If the correlation rho = -1 in bivariate normal:

A. X and Y are independent
B. X and Y have a perfect negative linear relationship
C. X and Y are unrelated
D. Both X and Y equal zero

Question 18

If the correlation rho = -1 in bivariate normal:

A. X and Y are independent
B. X and Y have a perfect negative linear relationship
C. X and Y are unrelated
D. Both X and Y equal zero

Answer: B
rho = -1 means perfect negative correlation: Y = a - bX for some positive b. Points lie exactly on a line with negative slope.

Question 19

Why is independence rarely exact for financial assets?

A. Financial data is always normal
B. Common factors (market, interest rates) affect multiple assets
C. Returns are always positive
D. Variance is constant

Question 19

Why is independence rarely exact for financial assets?

A. Financial data is always normal
B. Common factors (market, interest rates) affect multiple assets
C. Returns are always positive
D. Variance is constant

Answer: B
Financial assets are typically affected by common factors like market movements, economic conditions, and interest rates, creating dependence.

Question 20

The bivariate normal has how many parameters?

A. 2
B. 3
C. 5
D. 7

Question 20

The bivariate normal has how many parameters?

A. 2
B. 3
C. 5
D. 7

Answer: C
Bivariate normal has 5 parameters: two means (mu_X, mu_Y), two standard deviations (sigma_X, sigma_Y), and one correlation (rho).