Expectation and Moments – Quiz

Probability & Statistics

Question 1

The expected value E[X] represents:

A. The most likely outcome
B. The probability-weighted average
C. The maximum value
D. The variance

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Answer: B

Expected value is the probability-weighted average of all possible values. It represents the long-run average if the experiment is repeated many times.

Question 2

If $E[X] = 5$ and $E[Y] = 3$, what is $E[X + Y]$?

A. 15

B. 8

C. 2

D. Cannot determine without knowing dependence

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B. 8
C. 2
D. Cannot determine without knowing dependence

Answer: B
$E[X + Y] = E[X] + E[Y] = 5 + 3 = 8$. This linearity holds even when X and Y are dependent!

Question 3

For $E[aX + b]$, the result is:

A. $aE[X]$

B. $E[X] + b$

C. $aE[X] + b$

D. $a + bE[X]$

Question 3

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B. $E[X] + b$

C. $aE[X] + b$

D. $a + bE[X]$

Answer: C

Linearity of expectation: $E[aX + b] = aE[X] + b$. Constants scale and shift the expected value.

Question 4

If X and Y are independent, then E[XY] equals:

A. E[X] + E[Y]
B. E[X] x E[Y]
C. E[X] - E[Y]
D. E[X^2] x E[Y^2]

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If X and Y are independent, then E[XY] equals:

A. E[X] + E[Y]
B. E[X] x E[Y]
C. E[X] - E[Y]
D. E[X^2] x E[Y^2]

Answer: B
For independent random variables, E[XY] = E[X] x E[Y]. This only holds for independent variables.

Question 5

Variance measures:

A. The center of the distribution
B. The spread or dispersion around the mean
C. The probability of success
D. The correlation between variables

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Answer: B
Variance Var(X) = E[(X - E[X])^2] measures how spread out the values are around the mean.

Question 6

The formula Var(X) = E[X^2] - (E[X])^2 is called:

A. The difference formula
B. The computational formula for variance
C. The central limit theorem
D. Bayes theorem

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Answer: B
This computational formula is equivalent to E[(X - mu)^2] but is often easier to calculate.

Question 7

If Var(X) = 16, what is the standard deviation?

A. 4

B. 256

C. 8

D. 2

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B. 256

C. 8

D. 2

Answer: A

Standard deviation = sqrt(Variance) = sqrt(16) = 4.

Question 8

Var(aX + b) equals:

A. a × Var(X) + b
B. a^2 × Var(X)
C. (a + b)^2 × Var(X)
D. Var(X)

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Var(aX + b) equals:

A. a x Var(X) + b
B. a^2 x Var(X)
C. (a + b)^2 x Var(X)
D. Var(X)

Answer: B
Adding a constant doesn't change variance. Multiplying by a scales variance by a^2: Var(aX + b) = a^2 Var(X).

Question 9

Covariance Cov(X, Y) ¿ 0 indicates:

A. X and Y move in opposite directions
B. X and Y tend to move in the same direction
C. X and Y are independent
D. Variance of X equals variance of Y

Question 9

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A. X and Y move in opposite directions
B. X and Y tend to move in the same direction
C. X and Y are independent
D. Variance of X equals variance of Y

Answer: B
Positive covariance means when X is above its mean, Y tends to be above its mean too - they move together.

Question 10

The correlation coefficient is bounded by:

A. 0 and 1
B. -1 and $+1$
C. 0 and infinity
D. -infinity and $+$infinity

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A. 0 and 1

B. -1 and +1

C. 0 and infinity

D. -infinity and +infinity

Answer: B

Correlation rho = Cov(X,Y)/(sigma_X x sigma_Y) is always between -1 and +1.

Question 11

If rho = +1, the relationship between X and Y is:

A. No relationship
B. Perfect positive linear relationship
C. Perfect negative linear relationship
D. Nonlinear relationship

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D. Nonlinear relationship

Answer: B

rho = +1 means Y = a + bX for some positive b. All points lie exactly on an upward-sloping line.

Question 12

Var(X + Y) = Var(X) + Var(Y) only when:

A. X and Y have the same mean

B. X and Y are independent (or Cov(X,Y) = 0)

C. X and Y are normally distributed

D. Always true

Question 12

$Var(X + Y) = Var(X) + Var(Y)$ only when:

A. X and Y have the same mean
B. X and Y are independent (or $Cov(X,Y) = 0$)
C. X and Y are normally distributed
D. Always true

Answer: B
In general, $Var(X + Y) = Var(X) + Var(Y) + 2Cov(X,Y)$. The simple sum only holds when $Cov(X,Y) = 0$.

Question 13

For portfolio diversification, we want assets with:

A. High positive correlation

B. Low or negative correlation

C. The same expected return

D. Identical variances

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Answer: B
Low or negative correlation reduces portfolio variance. When assets move in opposite directions, losses in one are offset by gains in another.

Question 14

The third central moment measures:

A. Mean
B. Variance
C. Skewness
D. Kurtosis

Question 14

The third central moment measures:

A. Mean
B. Variance
C. Skewness
D. Kurtosis

Answer: C
The first moment is mean, second is variance, third is skewness (asymmetry), fourth is kurtosis (tail weight).

Question 15

Positive skewness indicates:

A. Symmetric distribution
B. Long right tail
C. Long left tail
D. Fat tails

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A. Symmetric distribution
B. Long right tail
C. Long left tail
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Answer: B
Positive skewness means the right tail is longer - there are more extreme high values than extreme low values.

Question 16

High kurtosis (relative to normal) indicates:

A. Thin tails
B. Fat tails (more extreme values)
C. Perfect symmetry
D. Zero variance

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C. Perfect symmetry
D. Zero variance

Answer: B
High kurtosis means fat tails - extreme events (both high and low) occur more frequently than in a normal distribution.

Question 17

The covariance between X and itself, Cov(X, X), equals:

A. 0
B. 1
C. Var(X)
D. E[X]

Question 17

The covariance between X and itself, Cov(X, X), equals:

A. 0

B. 1

C. Var(X)

D. E[X]

Answer: C
Cov(X, X) = E[X x X] - E[X] x E[X] = E[X^2] - (E[X])^2 = Var(X).

Question 18

If Cov(X, Y) = 0, then X and Y are:

A. Always independent
B. Uncorrelated (but not necessarily independent)
C. Always dependent
D. Perfectly correlated

Question 18

If Cov(X, Y) = 0, then X and Y are:

A. Always independent
B. Uncorrelated (but not necessarily independent)
C. Always dependent
D. Perfectly correlated

Answer: B
Zero covariance means no LINEAR relationship, but X and Y could still be related nonlinearly. Independence implies zero correlation, but not vice versa.

Question 19

For a two-asset portfolio with weights w1 and w2, the portfolio variance depends on:

A. Only the individual variances

B. Individual variances and the covariance between assets

C. Only the expected returns

D. Only the covariance

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Answer: B

Portfolio variance = w1ˆ2 Var(X1) + w2ˆ2 Var(X2) + 2 w1 w2 Cov(X1, X2). Both variances and covariance matter.

Question 20

If Var(X) = 0, then:

A. X is normally distributed

B. X is a constant (non-random)

C. E[X] = 0

D. X has infinite mean

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If Var(X) = 0, then:

A. X is normally distributed

B. X is a constant (non-random)

C. $E[X] = 0$

D. X has infinite mean

Answer: B

If $Var(X) = 0$, there is no spread - X takes the same value with probability 1. X is essentially a constant.