

# National Testing Agency

**Question Paper Name:** Biostatistics and Mathematical Biology 09th November 2019 Shift 1  
**Subject Name:** Biostatistics and Mathematical Biology  
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**Duration:** 180  
**Total Marks:** 100  
**Display Marks:** Yes

## Biostatistics and Mathematical Biology

**Group Number :** 1  
**Group Id :** 709597247  
**Group Maximum Duration :** 0  
**Group Minimum Duration :** 120  
**Revisit allowed for view? :** No  
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**Break time:** 0  
**Group Marks:** 100

## Biostatistics and Mathematical Biology-1

**Section Id :** 709597320  
**Section Number :** 1  
**Section type :** Online  
**Mandatory or Optional:** Mandatory  
**Number of Questions:** 20  
**Number of Questions to be attempted:** 20  
**Section Marks:** 20  
**Display Number Panel:** Yes  
**Group All Questions:** No

**Sub-Section Number:** 1  
**Sub-Section Id:** 709597415  
**Question Shuffling Allowed :** No

**Question Number : 1 Question Id : 70959722399 Question Type : MCQ Option Shuffling : No Display Question Number : Yes**  
**Single Line Question Option : No Option Orientation : Vertical**  
**Correct Marks : 1 Wrong Marks : 0**

A study analyzed cases of cat injuries associated with falling from buildings. They found that among cases reported at veterinary hospitals, injuries were higher when falling from lower floors of buildings comparing with that from higher floors of buildings. Authors concluded that cats were more likely to be injured from lower floors than from higher floors. This conclusion is an example of which of the following biases?

- a. Cherry-picking
- b. Positivity bias
- c. Publication bias
- d. Survivorship bias
- e. Hyperbolic discounting

**Question Number : 2 Question Id : 70959722400 Question Type : MCQ Option Shuffling : No Display Question Number : Yes**  
**Single Line Question Option : No Option Orientation : Vertical**

**Correct Marks : 1 Wrong Marks : 0**

Thomas Kuhn is best known for:

- a. Pseudoscience
- b. A-priori reasoning
- c. Statistical corroboration
- d. Logical induction
- e. Paradigm shift

**Question Number : 3 Question Id : 70959722401 Question Type : MCQ Option Shuffling : No Display Question Number : Yes**  
**Single Line Question Option : No Option Orientation : Vertical**

**Correct Marks : 1 Wrong Marks : 0**

Which of the following tests can be performed for temperature expressed in °C?

- a. Chi square
- b. ANOVA
- c. Standard Deviation
- d. Average
- e. All of the above

**Question Number : 4 Question Id : 70959722402 Question Type : MCQ Option Shuffling : No Display Question Number : Yes**  
**Single Line Question Option : No Option Orientation : Vertical**

**Correct Marks : 1 Wrong Marks : 0**

Time is an example of:

- a. Dependent variable
- b. Independent variable
- c. Discrete variable
- d. Qualitative variable
- e. None of the above

**Question Number : 5 Question Id : 70959722403 Question Type : MCQ Option Shuffling : No Display Question Number : Yes**  
**Single Line Question Option : No Option Orientation : Vertical**

**Correct Marks : 1 Wrong Marks : 0**

Which among the following visualizes data based on percentiles?

- a. Box and whisker plot
- b. Histogram
- c. Bubble chart
- d. Spider plot
- e. Contour plot

**Question Number : 6 Question Id : 70959722404 Question Type : MCQ Option Shuffling : No Display Question Number : Yes**  
**Single Line Question Option : No Option Orientation : Vertical**

**Correct Marks : 1 Wrong Marks : 0**

Which of among the following is oftentimes used to track project progress?

- a. 3 D doughnut plots
- b. Surface plots
- c. Dynamite plunger plot
- d. Phylogenetic tree
- e. Grantt chart

**Question Number : 7 Question Id : 70959722405 Question Type : MCQ Option Shuffling : No Display Question Number : Yes**  
**Single Line Question Option : No Option Orientation : Vertical**

**Correct Marks : 1 Wrong Marks : 0**

If observations are divided by a constant, what will happen to the Standard Deviation?

- a. No Change
- b. SD gets multiplied by the same constant
- c. SD gets divided with the same constant
- d. SD gets subtracted with the same constant
- e. None of the above

**Question Number : 8 Question Id : 70959722406 Question Type : MCQ Option Shuffling : No Display Question Number : Yes**  
**Single Line Question Option : No Option Orientation : Vertical**

**Correct Marks : 1 Wrong Marks : 0**

Which among the following quantifies the scatter of individual data points?

- a. SD
- b. CV
- c. SEM
- d. 95% Confidence Interval of the mean
- e. None of the above

**Question Number : 9 Question Id : 70959722407 Question Type : MCQ Option Shuffling : No Display Question Number : Yes**  
**Single Line Question Option : No Option Orientation : Vertical**

**Correct Marks : 1 Wrong Marks : 0**

If two error bars on two different group means plotted as mean  $\pm$  95% CI of the mean do not overlaps, it means:

- a. Difference between two group means is significant
- b. Difference between two group means is not significant
- c. Difference between two group means is zero
- d. No valid conclusion
- e. Difference between two group means is within 95% Confidence Limits of the true population mean

**Question Number : 10 Question Id : 70959722408 Question Type : MCQ Option Shuffling : No Display Question Number : Yes**  
**Single Line Question Option : No Option Orientation : Vertical**

**Correct Marks : 1 Wrong Marks : 0**

If excess Kurtosis is 2.7, which of the below conclusions are valid?

- a. Distribution is mesokurtic
- b. Distribution is platykurtic
- c. Distribution is leptokurtic
- d. Distribution is symmetrical
- e. None of the above

**Question Number : 11 Question Id : 70959722409 Question Type : MCQ Option Shuffling : No Display Question Number : Yes**  
**Single Line Question Option : No Option Orientation : Vertical**

**Correct Marks : 1 Wrong Marks : 0**

Rejecting the true null hypothesis is called:

- a. Type I error
- b. Type II error
- c. Type III error
- d. False Positive
- e. None of the above

Question Number : 12 Question Id : 70959722410 Question Type : MCQ Option Shuffling : No Display Question Number : Yes  
Single Line Question Option : No Option Orientation : Vertical

Correct Marks : 1 Wrong Marks : 0

It is recommended to use low  $\alpha$  (like 0.01) in situations when which of the following errors are tolerated?

- a. Type S error
- b. False Negative
- c. Errors in particle physics
- d. Low alpha should never be used
- e. False Positive

Question Number : 13 Question Id : 70959722411 Question Type : MCQ Option Shuffling : No Display Question Number : Yes  
Single Line Question Option : No Option Orientation : Vertical

Correct Marks : 1 Wrong Marks : 0

A high statistical power is obtained when:

- a. Sample Size is small
- b. When Standard Deviation is small
- c. When looking for small effect
- d. When prior probability is large
- e. None of the above

Question Number : 14 Question Id : 70959722412 Question Type : MCQ Option Shuffling : No Display Question Number : Yes  
Single Line Question Option : No Option Orientation : Vertical

Correct Marks : 1 Wrong Marks : 0

While performing t-test, if the t-critical found in the table is lesser than the obtained t-ratio at 95% Confidence Level, then:

- a.  $P < 0.05$
- b.  $P > 0.05$
- c.  $P < 0.01$
- d.  $P > 0.01$
- e. No valid conclusions can be inferred

Question Number : 15 Question Id : 70959722413 Question Type : MCQ Option Shuffling : No Display Question Number : Yes  
Single Line Question Option : No Option Orientation : Vertical

Correct Marks : 1 Wrong Marks : 0

Specificity is related with

- a. Type I errors
- b. Type II errors
- c. Type III errors
- d. Death
- e. Health

Question Number : 16 Question Id : 70959722414 Question Type : MCQ Option Shuffling : No Display Question Number : Yes  
Single Line Question Option : No Option Orientation : Vertical

Correct Marks : 1 Wrong Marks : 0

High sensitivity means

- a. High false negatives
- b. Low false negatives
- c. High false positives
- d. Low false positives
- e. None of the above

Question Number : 17 Question Id : 70959722415 Question Type : MCQ Option Shuffling : No Display Question Number : Yes  
Single Line Question Option : No Option Orientation : Vertical

Correct Marks : 1 Wrong Marks : 0

Which of the following methods can be used to fit the data into Dose-response model of pharmacology?

- a. Polynomial regression
- b. Simple linear regression
- c. Proportional Hazards Regression
- d. Multiple regression
- e. Nonlinear regression

Question Number : 18 Question Id : 70959722416 Question Type : MCQ Option Shuffling : No Display Question Number : Yes  
Single Line Question Option : No Option Orientation : Vertical

Correct Marks : 1 Wrong Marks : 0

If Pearson's correlation coefficient  $r$  is 1, it means:

- a. Correlation is nonexistent
- b. As  $X$  increases  $Y$  decreases linearly as  $r$  is positive
- c. As  $X$  increases  $Y$  increases linearly
- d. Perfect correlation
- e. None of the above

Question Number : 19 Question Id : 70959722417 Question Type : MCQ Option Shuffling : No Display Question Number : Yes  
Single Line Question Option : No Option Orientation : Vertical

Correct Marks : 1 Wrong Marks : 0

How many ways 5' end of CRISPR-Cas9 sequence be modified? Assume 5' end has gRNA (Guide RNA) has a length of 22 nucleotides, that can be modified to target genomic region for genome editing. Clue: Order matters and repetitions are allowed.

- a.  $4^{22}$
- b.  $22^4$
- c.  $22! / 18!$
- d.  $22! / 18! \times 4!$
- e.  $22 \times 4 = 88$

Question Number : 20 Question Id : 70959722418 Question Type : MCQ Option Shuffling : No Display Question Number : Yes  
Single Line Question Option : No Option Orientation : Vertical

Correct Marks : 1 Wrong Marks : 0

Which among the following is Bayes Theorem?

- a.  $P(M \text{ AND } D)/P(D)$
- b.  $P(D) \times P(M)$
- c.  $P(D) + P(M)$
- d.  $P(D|M) \times P(D)/P(M)$
- e. None of the above

## Biostatistics and Mathematical Biology-2

Section Id :	709597321
Section Number :	2
Section type :	Offline
Mandatory or Optional:	Mandatory
Number of Questions:	10
Number of Questions to be attempted:	10
Section Marks:	30
Display Number Panel:	Yes
Group All Questions:	No

Sub-Section Number:	1
Sub-Section Id:	709597416
Question Shuffling Allowed :	No

**Question Number : 21 Question Id : 70959722419 Question Type : SUBJECTIVE Display Question Number : Yes Correct Marks : 3**

In a study involving people from Kerala ( $n=3000$ ), mean fasting blood sugar was found to be 80. Sample variance was 49. Calculate Coefficient of variation

**Question Number : 22 Question Id : 70959722420 Question Type : SUBJECTIVE Display Question Number : Yes Correct Marks : 3**

Following number of pyrenoids were observed in 3 distinct algal cells: {8,2,4}. Calculate geometric mean (GM)

**Question Number : 23 Question Id : 70959722421 Question Type : SUBJECTIVE Display Question Number : Yes Correct Marks : 3**

In a study conducted at Maitri station, East Antarctica, the average weight of 1200 Adélie penguins was  $10 \pm 7$  kg (mean  $\pm$  standard deviation). Calculate Coefficient of Dispersion.

**Question Number : 24 Question Id : 70959722422 Question Type : SUBJECTIVE Display Question Number : Yes Correct Marks : 3**

In Car Nicobar island, over a period of 1 year there had been 100 deaths. What is the mean death per day with its 95% CI?

**Question Number : 25 Question Id : 70959722423 Question Type : SUBJECTIVE Display Question Number : Yes Correct Marks : 3**

Age of six randomly selected cyclists from Berlin, Germany were: {15,39,8,89,32,28}. Calculate MAD (Median Absolute Deviation)

**Question Number : 26 Question Id : 70959722424 Question Type : SUBJECTIVE Display Question Number : Yes Correct Marks : 3**

Briefly explain "Placebo effect" with an example

**Question Number : 27 Question Id : 70959722425 Question Type : SUBJECTIVE Display Question Number : Yes Correct Marks : 3**

Following is the data from a Randomized Controlled Trial to see whether Hepatitis C Vaccine for adults is effective in preventing Hepatitis C infection:

	Hepatitis C infection in 5 years	No Hepatitis C infection in 5 years
Vaccinated	2	540
Placebo	8	350

Calculate the following:

- Relative Risk
- Attributable Risk
- Number Needed to Treat

**Question Number : 28 Question Id : 70959722426 Question Type : SUBJECTIVE Display Question Number : Yes Correct Marks : 3**

Match the following tests with its uses/analogous tests: (Note: Answer should only contain letters with matching numbers, like a:6)

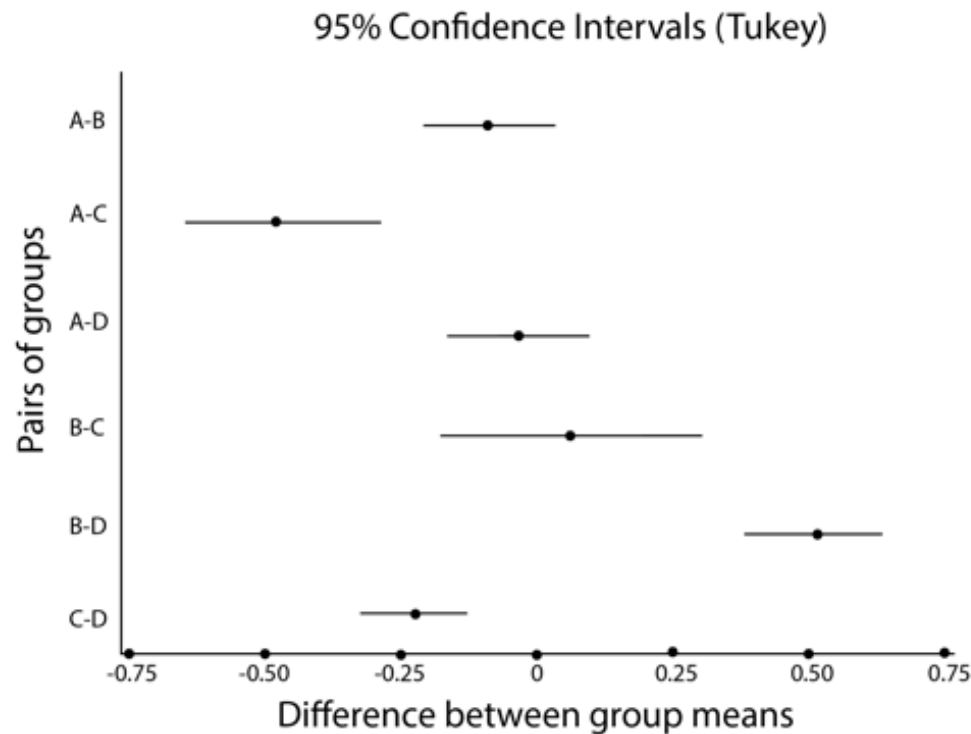
Test	Uses/Analogous tests
a) Multiple Regression	1) Analogous to paired t-test for three or more groups
b) ROUT Method	2) Analogous to independent t-test
c) D'Agostino-Pearson omnibus K2 test	3) To detect outliers
d) Fisher's Exact test	4) To correct influences of confounding factors on the main outcome variable
e) Mann-Whitney U Test	5) Normality test
f) Repeated Measures one way ANOVA	6) To analyze 2x2 contingency table for dependency

**Question Number : 29 Question Id : 70959722427 Question Type : SUBJECTIVE Display Question Number : Yes Correct Marks : 3**

Briefly explain the following: a) Statistical Confounding b) Prosecutor's fallacy c) P-Hacking

**Question Number : 30 Question Id : 70959722428 Question Type : SUBJECTIVE Display Question Number : Yes Correct Marks : 3**

After one-way ANOVA involving four groups (A,B,C and D), investigator performed Tukey’s HSD post-hoc test. The result is given below; following graph presents 95% Confidence Intervals of differences between each pair of group means (total 6 pairs). Solid dot represent difference between group means, while error bars represent its 95% CI. Differences between which of the group means are statistically significant?



*Note: Answers should only include respective group pair labels. For example, A-B, A-D and C-D.*

### Biostatistics and Mathematical Biology-3

Section Id :	709597322
Section Number :	3
Section type :	Offline
Mandatory or Optional:	Mandatory
Number of Questions:	7
Number of Questions to be attempted:	5
Section Marks:	50
Display Number Panel:	Yes
Group All Questions:	No

Sub-Section Number:	1
Sub-Section Id:	709597417
Question Shuffling Allowed :	No

**Question Number : 31   Question Id : 70959722429   Question Type : SUBJECTIVE   Display Question Number : Yes**  
**Correct Marks : 10**

Inspect the following summary of age of onset of diabetes mellitus:

{58,67,85,75,45,12,49,28,62,66,33,91,54,58,42,53,54,40,32,35,76,94,75,61,20,62,83,82,109,78,67,61}

- Construct a stem and leaf diagram (5 marks) and infer the pattern
- If the mean is 59.59 and Standard deviation is 22.43, calculate Standard Error of the mean



Question Number : 32 Question Id : 70959722430 Question Type : SUBJECTIVE Display Question Number : Yes  
Correct Marks : 10

Heights of mango trees at two locations are as under:

Location A:{ 7,4,3,8,4,7,5}

Location B:{6,8,7,6,8,5,9}

- a. Plot mean  $\pm$  95% CI for both of these locations in column scatter plot . Are differences in group means statistically significant?

Question Number : 33 Question Id : 70959722431 Question Type : SUBJECTIVE Display Question Number : Yes  
Correct Marks : 10

Heights of mango trees at two locations are as under:

Location A:{ 7,4,3,8,4,7,5}

Location B:{6,8,7,6,8,5,9}

Plot Box and Whisker diagram for both of these two groups

Question Number : 34 Question Id : 70959722432 Question Type : SUBJECTIVE Display Question Number : Yes  
Correct Marks : 10

Perform appropriate t-Test for the following data and infer the results at 95% Confidence

Level:

Location A:{ 7,4,3,8,4,7,5}

Location B:{6,8,7,6,8,5,9}

Question Number : 35 Question Id : 70959722433 Question Type : SUBJECTIVE Display Question Number : Yes  
Correct Marks : 10

Following data is from Denmark:

Average daily cycle commute (in km per day, SD= 5.61):	Life Expectancy (in years, SD= 2.40)
0	80
3	82
6	84
9	85
12	86
15	86

Is there any correlation between these two variables? Perform appropriate test and infer the results .

Question Number : 36 Question Id : 70959722434 Question Type : SUBJECTIVE Display Question Number : Yes  
Correct Marks : 10

Following is the result (F2 phenotypes) from Dihybrid cross in the vegetable summer squash (*Cucurbita pepo*):

White: 168, Yellow: 53 and Green: 19

Plant breeder suspect the result is because of 'dominant epistasis' phenomenon in which she expects a ratio of 12:3:1 (White:Yellow:Green)

Are obtained results significantly different from the expected results at 95% Confidence level? Perform appropriate test and interpret the results.

Question Number : 37 Question Id : 70959722435 Question Type : SUBJECTIVE Display Question Number : Yes  
Correct Marks : 10

- a. Breast cancer is fairly rare in population (1%), 96% of women who have breast cancer test positive on mammograms, and overall 8% of population tests positive in mammogram. If patient test positive in mammogram, what is the probability that she has breast cancer?
- b. If 9% of population have recessive phenotype, what is the probability of having a heterozygous individual?