

# National Testing Agency

<b>Question Paper Name :</b>	Biostatistics and Mathematical Biology 30 Sep 2020 Shift 1
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## Biostatistics and Mathematical Biology

<b>Group Number :</b>	1
<b>Group Id :</b>	89951468
<b>Group Maximum Duration :</b>	0
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<b>Show Attended Group? :</b>	No
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<b>Break time :</b>	0
<b>Group Marks :</b>	100
<b>Is this Group for Examiner? :</b>	No

## Biostatistics and Mathematical Biology-1

<b>Section Id :</b>	89951476
<b>Section Number :</b>	1
<b>Section type :</b>	Online
<b>Mandatory or Optional :</b>	Mandatory
<b>Number of Questions :</b>	20
<b>Number of Questions to be attempted :</b>	20

**Section Marks :** 20  
**Mark As Answered Required? :** Yes  
**Sub-Section Number :** 1  
**Sub-Section Id :** 89951498  
**Question Shuffling Allowed :** Yes

**Question Number : 1 Question Id : 8995146110 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No Correct Marks : 1 Wrong Marks : 0**

In an experiment where a group of people think they are being exposed to poisonous ivy. Really, they are simply being exposed to a completely harmless substance. But even so they react as you would expect if they actually had the poison applied to their body. All the people's arms reacted with itching, boils and redness. This is an example of:

1. Nocebo effect
2. Placebo effect
3. Availability heuristics
4. Hawthorne effect

**Options :**

89951424189. 1  
89951424190. 2  
89951424191. 3  
89951424192. 4

**Question Number : 2 Question Id : 8995146111 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No Correct Marks : 1 Wrong Marks : 0**

Anti-vaccination camps saying "You don't care about autistic children. As you don't care about autistic children, vaccines are bad". This is an example of:

1. Texas Sharpshooter Fallacy
2. Straw Man Fallacy
3. Anchoring
4. Heuristics

**Options :**

89951424193. 1  
89951424194. 2  
89951424195. 3  
89951424196. 4

**Question Number : 3 Question Id : 8995146112 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No Correct Marks : 1 Wrong Marks : 0**

Which of the following tables can be used to generate histogram?

1. Empirical Frequency Distribution (EFD)
2. 5-point summary
3. Empirical Cumulative Distribution (ECD)
4. None of the above

**Options :**

89951424197. 1  
89951424198. 2  
89951424199. 3  
89951424200. 4

**Question Number : 4 Question Id : 8995146113 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No Correct Marks : 1 Wrong Marks : 0**

Which of the following tests can be performed for measurements of elevation expressed as Above Sea Level (ASL)?

1. Chi square
2. ANOVA
3. Standard Deviation
4. All of the above

**Options :**

89951424201. 1  
89951424202. 2  
89951424203. 3  
89951424204. 4

**Question Number : 5 Question Id : 8995146114 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No Correct Marks : 1 Wrong Marks : 0**

Which among the following can be used for graphical summarization of frequency distribution?

1. Stem and leaf diagram
2. Box and whisker plot
3. Heatmap
4. None of the above

**Options :**

- 89951424205. 1
- 89951424206. 2
- 89951424207. 3
- 89951424208. 4

**Question Number : 6 Question Id : 8995146115 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No Correct Marks : 1 Wrong Marks : 0**

Which among the following graphs can reveal bimodal distribution?

1. Box and whisker plot
2. Contour plot
3. Histogram
4. Spider plot

**Options :**

- 89951424209. 1
- 89951424210. 2
- 89951424211. 3
- 89951424212. 4

**Question Number : 7 Question Id : 8995146116 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No Correct Marks : 1 Wrong Marks : 0**

Which among the following quantifies the precision of determining sample mean with respect to the true population mean?

1. SD
2. CV
3. CD
4. SEM

**Options :**

89951424213. 1

89951424214. 2

89951424215. 3

89951424216. 4

**Question Number : 8 Question Id : 8995146117 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No Correct Marks : 1 Wrong Marks : 0**

To compare scatter of two groups from a non-normal distribution, which of the following error bars is appropriate?

1. Mean $\pm$ SD
2. Mean $\pm$ SEM
3. Mean $\pm$ 95% CI of the mean
4. Median $\pm$  MAD

**Options :**

89951424217. 1

89951424218. 2

89951424219. 3

89951424220. 4

**Question Number : 9 Question Id : 8995146118 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No Correct Marks : 1 Wrong Marks : 0**

Symmetry of the distribution is quantified by which of the following?

1. Skewness
2. Kurtosis
3. ROUT method
4. Grubb's test

**Options :**

89951424221. 1  
89951424222. 2  
89951424223. 3  
89951424224. 4

**Question Number : 10 Question Id : 8995146119 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No Correct Marks : 1 Wrong Marks : 0**

If the Grubb's test detect one outlier in the dataset:

1. Outlier should be removed before further analysis
2. Outlier should be checked for possible reasons for extraordinary value
3. Before proceeding for outlier removal, ROUT Method test should be conducted
4. None of the above

**Options :**

89951424225. 1  
89951424226. 2  
89951424227. 3  
89951424228. 4

**Question Number : 11 Question Id : 8995146120 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No Correct Marks : 1 Wrong Marks : 0**

When the null hypothesis is true, decision of statistical test is to reject the null hypothesis to conclude statistical significance. This type of error is called:

1. Type I error
2. Type II error
3. Type III error
4. None of the above

**Options :**

89951424229. 1  
89951424230. 2  
89951424231. 3  
89951424232. 4

**Question Number : 12 Question Id : 8995146121 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No Correct Marks : 1 Wrong Marks : 0**

Changing objectives of PhD thesis after results are known is an example of:

1. Stargazing
2. P Hacking
3. HARK
4. None of the above

**Options :**

- 89951424233. 1
- 89951424234. 2
- 89951424235. 3
- 89951424236. 4

**Question Number : 13 Question Id : 8995146122 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No Correct Marks : 1 Wrong Marks : 0**

Fraction of False Negatives out of all cases where null hypothesis is false

1. Significance level
2. Beta
3. Prior probability
4. Statistical Power

**Options :**

- 89951424237. 1
- 89951424238. 2
- 89951424239. 3
- 89951424240. 4

**Question Number : 14 Question Id : 8995146123 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No Correct Marks : 1 Wrong Marks : 0**

Which of the following tests compare sample group means to infer whether infinite population group means are significantly different or not?

1. One-way ANOVA
2. Two-way ANOVA
3. Type-II ANOVA
4. Multivariate ANOVA

**Options :**

- 89951424241. 1
- 89951424242. 2
- 89951424243. 3
- 89951424244. 4

**Question Number : 15 Question Id : 8995146124 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No Correct Marks : 1 Wrong Marks : 0**

To indicate the risk of contracting a disease which among the following measure is used?

1. Sensitivity
2. Specificity
3. Disease incidence
4. Disease prevalence

**Options :**

- 89951424245. 1
- 89951424246. 2
- 89951424247. 3
- 89951424248. 4

**Question Number : 16 Question Id : 8995146125 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No Correct Marks : 1 Wrong Marks : 0**

Odds of 3:7 in probability is:

1. 1.0
2. 0.3
3. 0.7
4. 0.21



**Options :**

- 89951424249. 1
- 89951424250. 2
- 89951424251. 3
- 89951424252. 4

**Question Number : 17 Question Id : 8995146126 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No Correct Marks : 1 Wrong Marks : 0**

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

- 1. Correlation is nonexistent
- 2. As X increases Y decreases linearly
- 3. As X increases Y increases linearly
- 4. None of the above

**Options :**

- 89951424253. 1
- 89951424254. 2
- 89951424255. 3
- 89951424256. 4

**Question Number : 18 Question Id : 8995146127 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No Correct Marks : 1 Wrong Marks : 0**

Out of 5 candidate brown algal species, 3 are being selected for anticancer drug screening.

How many ways there 3 species can be selected if order is not important?

- 1. 10
- 2. 60
- 3. 125
- 4. 15

**Options :**

- 89951424257. 1
- 89951424258. 2
- 89951424259. 3
- 89951424260. 4

**Question Number : 19 Question Id : 8995146128 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No Correct Marks : 1 Wrong Marks : 0**

Two cards are chosen at random without replacement from a pack of 52 playing cards. What is the probability that the first card is an Ace and second is a King?

1.  $4/52 \times 3/51$
2.  $4/52 \times 4/51$
3.  $4/51$
4.  $4/51 \times 3/52$

**Options :**

89951424261. 1  
89951424262. 2  
89951424263. 3  
89951424264. 4

**Question Number : 20 Question Id : 8995146129 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No Correct Marks : 1 Wrong Marks : 0**

Monty Hall problem is related with:

1. Bayesian inference
2. Frequentist view of probability
3. Laplace's classical view of probability
4. Impact bias

**Options :**

89951424265. 1  
89951424266. 2  
89951424267. 3  
89951424268. 4

## **Biostatistics and Mathematical Biology-2**

**Section Id :**

89951477

<b>Section Number :</b>	2
<b>Section type :</b>	Offline
<b>Mandatory or Optional :</b>	Mandatory
<b>Number of Questions :</b>	7
<b>Number of Questions to be attempted :</b>	5
<b>Section Marks :</b>	30
<b>Mark As Answered Required? :</b>	Yes
<b>Sub-Section Number :</b>	1
<b>Sub-Section Id :</b>	89951499
<b>Question Shuffling Allowed :</b>	No

**Question Number : 21 Question Id : 8995146130 Question Type : SUBJECTIVE**

**Correct Marks : 6**

In a study involving people from Punjab ( $n=4000$ ), mean fasting blood sugar was found to be 80. Sample variance was 16. Calculate Coefficient of variation

**Question Number : 22 Question Id : 8995146131 Question Type : SUBJECTIVE**

**Correct Marks : 6**

Following number of pyrenoids were observed in 3 distinct algal cells: {9,6,4}. Calculate geometric mean (GM)

**Question Number : 23 Question Id : 8995146132 Question Type : SUBJECTIVE**

**Correct Marks : 6**

Briefly contrast following terms an example each:

- Falsification Vs. Paradigm shift
- Regression vs. Correlation
- Parametric vs. Nonparametric tests

**Question Number : 24 Question Id : 8995146133 Question Type : SUBJECTIVE**

**Correct Marks : 6**

Briefly explain the following tests with its practical utility:

- a) Wilcoxon signed-rank test
- b) Non-linear regression
- c) Tukey's Honestly Signified Differences

**Question Number : 25 Question Id : 8995146134 Question Type : SUBJECTIVE**

**Correct Marks : 6**

In a study conducted at Bharati station, East Antarctica, the average weight of 1200 emperor penguins was  $30 \pm 4$  kg (mean  $\pm$  standard deviation). Calculate Coefficient of Dispersion.

**Question Number : 26 Question Id : 8995146135 Question Type : SUBJECTIVE**

**Correct Marks : 6**

Age of six randomly selected cyclists at Bathinda, Punjab were: {18, 29, 41, 93, 79, 65}. Calculate MAD (Median Absolute Deviation)

**Question Number : 27 Question Id : 8995146136 Question Type : SUBJECTIVE**

**Correct Marks : 6**

Following is the data from a Randomized Controlled Trial to see whether Vitamin C treatment is effective in preventing common cold:

	Cold-Yes	Cold-No
Vitamin C	10	140
Placebo	20	110

Calculate the following:

- a) Relative Risk
- b) Attributable Risk
- c) Number Needed to Treat

## Biostatistics and Mathematical Biology-3

Section Id :	89951478
Section Number :	3
Section type :	Offline
Mandatory or Optional :	Mandatory
Number of Questions :	7
Number of Questions to be attempted :	5
Section Marks :	50
Mark As Answered Required? :	Yes
Sub-Section Number :	1
Sub-Section Id :	899514100
Question Shuffling Allowed :	No

**Question Number : 28 Question Id : 8995146137 Question Type : SUBJECTIVE**

**Correct Marks : 10**

- If alcoholics are fairly rare in population (5%) but 10% in population have liver disease and among the people with liver disease, 6% are alcoholics. If a patient has liver disease, what is the chance that he or she is alcoholic? (6 marks)
- If 49% of population have dominant individuals with homozygous genotype, what is the probability of having recessive phenotype? (4 marks)

**Question Number : 29 Question Id : 8995146138 Question Type : SUBJECTIVE**

**Correct Marks : 10**

Following is the result (F<sub>2</sub> phenotypes) from Dihybrid cross in the dog breed Golden Retriever:

Black: 168, Brown: 51 and Golden: 3

Canine breeder suspect the result is because of 'recessive epistasis' phenomenon in which she expects a ratio of 9:3:4 (Black:Brown:Golden)

Are obtained results significantly different from the expected results at 95% Confidence level? Perform **appropriate test** (8 marks) and **interpret the results** (2 marks).

**Question Number : 30 Question Id : 8995146139 Question Type : SUBJECTIVE**

**Correct Marks : 10**

Following data is from Denmark:

Average daily cycle commute (in km per day, SD= 5.62):	Life Expectancy (in years, SD= 2.43)
0	83
3	84
6	87
9	88
12	89
15	92

Is there any correlation between these two variables? Perform appropriate test (8 marks) and infer the results (2 marks).

**Question Number : 31 Question Id : 8995146140 Question Type : SUBJECTIVE**

**Correct Marks : 10**

Heights of neem trees at two locations are as under:

Location 1:{ 6, 5, 6, 8, 9, 7, 8}

Location 2:{4, 3, 4, 3, 5, 2, 5}

Plot mean  $\pm$  95% CI for both of these locations in column scatter plot (8 marks). Are differences in group means statistically significant? (2 marks)

**Question Number : 32 Question Id : 8995146141 Question Type : SUBJECTIVE**

**Correct Marks : 10**

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

Heights of neem trees at two locations are as under:

Location 1:{ 6, 5, 6, 8, 9, 7, 8}

Location 2:{4, 3, 4, 3, 5, 2, 5}

**Question Number : 33 Question Id : 8995146142 Question Type : SUBJECTIVE**

**Correct Marks : 10**

Plot **Box and Whisker diagram** for both of these two groups

Heights of neem trees at two locations are as under

Location 1: { 6, 5, 6, 8, 9, 7, 8 }

Location 2: { 4, 3, 4, 3, 5, 2, 5 }

**Question Number : 34 Question Id : 8995146143 Question Type : SUBJECTIVE**

**Correct Marks : 10**

Inspect the following summary of age of onset of a particular disease:

{ 77, 44, 97, 84, 61, 60, 63, 58, 86, 99, 55, 77, 63, 57, 74, 54, 47, 59, 83, 68, 31, 76, 43, 27, 36, 25, 63, 34, 13, 14, 40, 65 }

Construct a **stem and leaf diagram** (7 marks) and **infer the pattern** (3 marks)