

Handling Missing Data in ETL			
SECTION A – THEORETICAL QUESTIONS			
QUESTION 1	What are the most common reasons for missing data in ETL pipelines?		
	1) Source system data gaps <ul style="list-style-type: none"> Optional fields left blank by users Data not captured due to application logic Legacy systems with incomplete records 		
ANSWER	4. Incorrect data mapping <ul style="list-style-type: none"> Source column not mapped to target Mapping logic errors 		
	2) extraction failures <ul style="list-style-type: none"> Partial job failures Network or API timeouts File corruption or missing files 		
	5. Filtering during transformation <ul style="list-style-type: none"> WHERE clauses removing records Business rules excluding data 		
	3) Schema or structure changes <ul style="list-style-type: none"> Columns renamed, removed, or added Data type changes 		

QUESTION 2	Why is blindly deleting rows with missing values considered a bad practice in ETL?						
ANSWER	<p>1) Loss of valuable information</p> <p>Missing values don't always mean the entire record is useless.</p> <p>Example:</p> <p>A customer record missing phone number may still have valid name, email, and purchase data</p>						
	<p>2) Data bias and wrong analytics</p> <p>Rows with missing values are often not random.</p>						
	<p>3) Incorrect KPIs and reporting</p> <p>Dropping records reduces counts, totals, and averages.</p>						
	<p>4) Breaks referential integrity</p> <p>Deleting rows can break relationships between tables.</p>						
	<p>5) Hides upstream data issues</p> <p>Blind deletion masks problems in:</p> <table border="1"> <tr> <td>Source systems</td> <td></td> </tr> <tr> <td>ETL logic</td> <td></td> </tr> <tr> <td>Data collection processes</td> <td></td> </tr> </table>	Source systems		ETL logic		Data collection processes	
Source systems							
ETL logic							
Data collection processes							

QUESTION 3	Explain the difference between: Listwise deletion Column deletion
ANSWER	<p>If a row has at least one missing value, the entire row is removed.</p> <p>Checks row by row One null (whole record deleted)</p> <p>If a column has many missing values, the entire column is removed.</p> <p>Evaluate missing % per column Drop columns exceeding threshold (e.g., 60%)</p>
	Listwise deletion removes entire records when any value is missing, while column deletion removes entire attributes when a column contains excessive missing data. Both cause data loss and should be used only after business validation.

QUESTION 4	Why is median imputation preferred over mean imputation for skewed data such as income?
ANSWER	<p>1) Income data is highly skewed</p> <p>Most people earn moderate incomes, while a few earn extremely high amounts</p>
	<p>2) Mean is sensitive to outliers</p> <p>A few very high incomes can dramatically increase the mean.</p>
	<p>3) Median represents the “typical” value</p> <p>The median reflects the middle of the distribution, not the extremes</p>
	<p>4) Prevents distortion of analysis & models</p> <p>Mean imputation: Inflates income values Skews KPIs like average salary Misleads ML models</p>

QUESTION 5	What is forward fill and in what type of dataset is it most useful?																									
ANSWER	If a value is missing at time t, we copy the value from time t-1.																									
	<table border="1"> <thead> <tr> <th>Date</th><th>Stock Price</th><th></th><th>Date</th><th>Stock Price</th></tr> </thead> <tbody> <tr> <td>Jan 1</td><td>100</td><td></td><td>Jan 1</td><td>100</td></tr> <tr> <td>Jan 2</td><td>NULL</td><td>AFTER</td><td>Jan 2</td><td>100</td></tr> <tr> <td>Jan 3</td><td>NULL</td><td></td><td>Jan 3</td><td>100</td></tr> <tr> <td>Jan 4</td><td>105</td><td></td><td>Jan 4</td><td>105</td></tr> </tbody> </table>	Date	Stock Price		Date	Stock Price	Jan 1	100		Jan 1	100	Jan 2	NULL	AFTER	Jan 2	100	Jan 3	NULL		Jan 3	100	Jan 4	105		Jan 4	105
Date	Stock Price		Date	Stock Price																						
Jan 1	100		Jan 1	100																						
Jan 2	NULL	AFTER	Jan 2	100																						
Jan 3	NULL		Jan 3	100																						
Jan 4	105		Jan 4	105																						
	Forward fill is best for time-series or sequential datasets where values change gradually and the previous value is still meaningful.																									
	Data has a clear order (time, sequence)																									
	Values change gradually																									
	Missing values imply "no new value recorded"																									

QUESTION 6	Why should flagging missing values be done before imputation in an ETL workflow?						
ANSWER	You don't lose information about "missingness"						
	Once you impute, you can no longer tell which values were originally missing.						
	Missingness itself can be meaningful						
	The fact that a value is missing can carry business or behavioral insight.						
	Better debugging and data audits		Supports different business rules later				
	If reports look off later, flags help answer:		Different teams may want different treatments.				
	Which data was original?						
	Which data was imputed?						
	How much was imputed?		Improves trust and governance				
	Protects downstream analytics & ML models		Clear visibility into data modifications builds stakeholder confidence and meets governance requirements.				
	Imputed values look like real data.						
	Model bias checks						
	Sensitivity analysis						
	Feature engineering using missing indicators						

QUESTION 7	Consider a scenario where income is missing for many customers. How can this missingness itself provide business insights?
ANSWER	<p>1) Income missing may reflect customer behavior</p> <p>High-income or privacy-conscious customers often choose not to disclose income.</p> <p>2) Missingness can indicate trust or engagement levels</p> <p>Customers who skip income fields may:</p> <ul style="list-style-type: none"> Not trust the platform yet Be early-stage users Have low engagement <p>3) Segment-specific patterns</p> <p>Missing income might be concentrated in:</p> <ul style="list-style-type: none"> Certain age groups Specific regions Particular acquisition channels
	<p>4) Risk & eligibility signals</p> <p>In lending or insurance:</p> <p>Missing income can itself be a risk indicator</p>
	<p>5) Strategic ETL takeaway</p> <p>Instead of deleting or blindly imputing:</p> <p>Add <code>income_missing_flag = 1</code></p> <p>Analyze conversion, churn, or revenue by this flag</p>

SECTION B – PRACTICAL QUESTIONS

QUESTION 8

The screenshot shows the MySQL Workbench interface with the script 'pr_skills_DA_Batch.sql' open. The code performs an insert operation into the 'customer' table, adding several rows of data. The 'Result Grid' shows the inserted data:

Customer_id	Name	City	Monthly_Sales	Income	region
102	Angali Rao	Bengluru	12000	65000	south
103	Suresh Iyer	Chennai	15000	72000	South
104	Neha Singh	Delhi	null	null	north
105	Anit Varma	Pune	18000	58000	null
106	Karan shah	Ahmedabad	null	61000	west
107	Pooja Das	Kolkata	14000	null	East
108	Riya Kapoor	Jaipur	16000	69000	North

The 'Action Output' pane shows the execution history:

- 7. 11:07:46 select * from customer
- 8. 11:16:02 insert into customer values (103,'Suresh Iyer','Chennai',15000,72000,'South'),(104,'Neha Singh','Delhi',null,null,'north')
- 9. 11:16:15 select * from customer

Listwise Deletion Remove all rows where Region is missing.

Identify affected rows

Show the dataset after deletion

Mention how many records were lost

ANSWER

1) Identify affected rows

The screenshot shows the MySQL Workbench interface with the script 'pr_skills_DA_Batch.sql' open. The code includes a 'select * from customer where region is null' query. The 'Result Grid' shows one row where the region is null:

Customer_id	Name	City	Monthly_Sales	Income	region
105	Anit Varma	Pune	18000	58000	null

The 'Action Output' pane shows the execution history:

- 11. 11:25:21 select * from customer
- 12. 11:25:57 select * from customer where region is null
- 13. 11:26:57 select * from customer where region is null

2) AFTER THE DELETION RESULT

The screenshot shows the MySQL Workbench interface with the script 'pr_skills_DA_Batch.sql' open. The code includes a 'delete from customer where region is null' query. The 'Result Grid' shows the same data as before, but the row where region is null has been deleted. The 'Action Output' pane shows the execution history:

- 22. 11:33:43 delete from customer where region is null
- 24. 11:34:06 select * from customer

QUESTION 9

Imputation

Handle missing values in Monthly_Sales using:

Forward Fill

Tasks:

Apply forward fill

Explain why forward fill is suitable here.

ANSWER

Customer_ID	Name	City	Monthly_Sales	Income	Region
1	Rahul Mehta	Mumbai	12000	65000	West
2	Neha Singh	Delhi	NaN	NaN	North
3	Anjali Rao	Bengaluru	NaN	NaN	South
4	Amit Verma	Pune	18000	58000	NaN
5	Pooja Das	Kolkata	14000	NaN	East
6	Suresh Iyer	Chennai	15000	72000	South
7	Karan Shah	Ahmedabad	NaN	61000	West
8	Riva Kapoor	Jaipur	16000	69000	North

TECHNIQUE 1 MEAN 15000

AFTER

Customer_ID	Name	City	Monthly_Sales	Income	Region
1	Rahul Mehta	Mumbai	12000	65000	West
2	Neha Singh	Delhi	12000	NaN	North
3	Anjali Rao	Bengaluru	12000	NaN	South
4	Amit Verma	Pune	18000	58000	NaN
5	Pooja Das	Kolkata	14000	NaN	East
6	Suresh Iyer	Chennai	15000	72000	South
7	Karan Shah	Ahmedabad	15000	61000	West
8	Riya Kapoor	Jaipur	16000	69000	North

Explain why forward fill is suitable here

DATA IS A TIME SERIES

PREVIOUS VALUES IS LOGICALLY VALID FOR FORWARD FILL

SALES DATA CHANGE OVER THE TIME

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join* ADVANCE SQL ASIGNMENT FUNCTIONS ASSIGNMENT ETL FUNCTION* SQL File 7* SQL File 8* SQL File 9*  
16 (102,'Anjali Rao','Bengluru',null,null,'south');  
17 * insert into customer  
18 values  
19 (103,'Naren tyer','Chennai',15000,72000,'South'),  
20 (104,'Neha Sigh','Delhi',null,null,'north'),  
21 (105,'Amit Varma','Pune',18000,65000,null),  
22 (106,'Karan shah','Ahmedabad',16000,61000,'west'),  
23 (107,'Pooja Das','Kolkata',16000,null,'East'),  
24 (108,'Riya Kapoor','Jaipur',16000,69000,'North');  
25 * select* from customer;  
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QUESTION 10**Flagging Missing Data**

Create a flag column for missing Income

Tasks:

Create Income_Missing_Flag (0 = present, 1 = missing)

Show updated dataset

Count how many customers have missing income

ANSWER**AFTER CHANGING THE MISSING INCOME****FLAGGING MISSING DATA**

Customer_ID	Name	City	Monthly_Sales	Income	MISSING INCOME	Region
1	Rahul Mehta	Mumbai	12000	65000	0	West
2	Neha Singh	Delhi	NaN	NaN	1	North
3	Anjali Rao	Bengaluru	NaN	NaN	1	South
4	Amit Verma	Pune	18000	58000	0	NaN
5	Pooja Das	Kolkata	14000	NaN	1	East
6	Suresh Iyer	Chennai	15000	72000	0	South
7	Karan Shah	Ahmedabad	NaN	61000	0	West
8	Riya Kapoor	Jaipur	16000	69000	0	North

COUNT HOW MANY CUSTOMERS HAVE MISSING INCOME =3

TOTAL NUMBERS OF MISSING DATA = '3'