

HEALTHCARE DATA

ANALYSIS AND

INSIGHTS

By

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1.Project Description:

The healthcare industry generates vast amounts of data daily, providing valuable insights for healthcare providers and policymakers to improve patient care, allocate resources effectively, and manage healthcare costs. This project aims to analyse a comprehensive healthcare dataset comprising medical examinations, hospitalization details, and customer profiles to extract insights into patient health profiles, medical histories, and healthcare costs. By exploring relationships between various health metrics, identifying trends, and visualizing key patterns, we aim to deliver actionable insights to healthcare stakeholders for informed decision-making through rigorous data cleaning, transformation, exploration, and analysis.

2.Data cleaning:

1) Check for the number of missing values marked with '?' in each column of the "Medical Examinations" Table and "Hospitalization Details" Table.

	A	B	C	D	E	F	G	H
1	Customer	BMI	HBA1	Heart Issu	Any Transplar	Cancer histo	NumberOfMajorSurgeri	smoke
61	Id560	23.98	4.9	No	No	No	No major surgery	?
36	Id635	25.175	4.96	No	yes	No	1	?
337								
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Customer Names
Medical Examinations
Hospitalisation Details
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Reformed Format:

	B	C	D	E	F	G	H	I	J
1	BMI	HBA1	Heart Issu	Any Transplar	Cancer histo	NumberOfMajorSurgeri	smoker	Weight status	Diabetes Status
561	23.98	4.9	No	No	No	0	UNKNOWN	NORMALWEIGHT	NORMAL
636	25.175	4.96	No	Yes	No	1	UNKNOWN	OVERWEIGHT	NORMAL
2337									
2338									
2339									
2340									
2341									
2342									
2343									
2344									
2345									
2346									
2347									
2348									
2349									
2350									
2351									
2352									
2353									
2354									

Customer Names Medical Examinations Hospitalisation Details pie chart Donut chart +

2) Fill in the missing values of 'month' with Sep and 'year' with its average rounded to the nearest integer. Determine the most frequently occurring values in the 'smoker', 'Hospital tier' and 'City tier' columns, and fill in the missing values accordingly. If any 'State ID' values are missing, consider filling them with 'Unknown' or using another appropriate strategy.

	A	B	C	D	E	F	G	H	I
1	Customer ID	year	month	date	children	charges	Hospital tier	City tier	State
2	Id2335	1992	Jul	9	0	563.84	tier - 2	tier - 3	R1013
3	Id2334	1992	Nov	30	0	570.62	tier - 2	tier - 1	R1013
4	Id2333	1993	Jun	30	0	600	tier - 2	tier - 1	R1013
5	Id2332	1992	Sep	13	0	604.54	tier - 3	tier - 3	R1013
6	Id2331	1998	Jul	27	0	637.26	tier - 3	tier - 3	R1013
7	Id2330	2001	Nov	20	0	646.14	tier - 3	tier - 3	R1012
8	Id2329	1993	Jun	1	0	650	tier - 3	tier - 3	R1013
9	Id2328	1995	Jul	4	0	650	tier - 3	tier - 3	R1013
10	Id2327	2002	Nov	29	0	668	tier - 3	tier - 2	R1012
11	Id2326	1997	Nov	9	0	670	tier - 3	tier - 3	R1013
12	Id2325	2001	Sep	12	0	687.54	tier - 3	tier - 2	R1013
13	Id2324	1999	Dec	26	0	700	?	tier - 3	R1013
14	Id2323	1999	Dec	14	0	722.99	tier - 3	tier - 1	R1013
15	Id2322	2002	?	19	0	750	tier - 3	tier - 1	R1012
16	Id2321	1993	Aug	9	0	760	tier - 3	tier - 1	R1013
17	Id2320	1996	Oct	22	0	760	tier - 3	tier - 3	R1013
18	Id2319	1993	Jun	28	0	770	tier - 3	tier - 3	R1013
19	Id2318	1996	?	18	0	770.38	tier - 3	?	R1012
20	Id2317	1995	Dec	7	0	773.54	tier - 3	tier - 2	R1013
21	Id2316	2004	Oct	7	0	830.52	tier - 3	tier - 2	R1011

Customer Names Medical Examinations Hospitalisation Details +

Reformed Format:

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Customer ID	year	month1	DOB	month	DATE OF BIRTH	date	AGE	children	charges	Hospital tier	City tier	State ID
2	Id2335	1992	7	9-7-1992	Jul	9-Jul-1992	9	30	0	₹ 563.84	tier - 2	tier - 3	R1013
3	Id2334	1992	11	30-11-1992	Nov	30-Nov-1992	30	30	0	₹ 570.62	tier - 2	tier - 1	R1013
4	Id2333	1993	6	30-6-1993	Jun	30-Jun-1993	30	29	0	₹ 600.00	tier - 2	tier - 1	R1013
5	Id2332	1992	9	13-9-1992	Sep	13-Sep-1992	13	30	0	₹ 604.54	tier - 3	tier - 3	R1013
6	Id2331	1998	7	27-7-1998	Jul	27-Jul-1998	27	24	0	₹ 637.26	tier - 3	tier - 3	R1013
7	Id2330	2001	11	20-11-2001	Nov	20-Nov-2001	20	21	0	₹ 646.14	tier - 3	tier - 3	R1012
8	Id2329	1993	6	1-6-1993	Jun	1-Jun-1993	1	30	0	₹ 650.00	tier - 3	tier - 3	R1013
9	Id2328	1995	7	4-7-1995	Jul	4-Jul-1995	4	27	0	₹ 650.00	tier - 3	tier - 3	R1013
10	Id2327	2002	11	29-11-2002	Nov	29-Nov-2002	29	20	0	₹ 668.00	tier - 3	tier - 2	R1012
11	Id2326	1997	11	9-11-1997	Nov	9-Nov-1997	9	25	0	₹ 670.00	tier - 3	tier - 3	R1013
12	Id2325	2001	9	12-9-2001	Sep	12-Sep-2001	12	21	0	₹ 687.54	tier - 3	tier - 2	R1013
13	Id2324	1999	12	26-12-1999	Dec	26-Dec-1999	26	23	0	₹ 700.00	UNKNOWN	tier - 3	R1013
14	Id2323	1999	12	14-12-1999	Dec	14-Dec-1999	14	23	0	₹ 722.99	tier - 3	tier - 1	R1013
15	Id2322	2002	9	19-9-2002	Sep	19-Sep-2002	19	20	0	₹ 750.00	tier - 3	tier - 1	R1012
16	Id2321	1993	8	9-8-1993	Aug	9-Aug-1993	9	29	0	₹ 760.00	tier - 3	tier - 1	R1013
17	Id2320	1996	10	22-10-1996	Oct	22-Oct-1996	22	26	0	₹ 760.00	tier - 3	tier - 3	R1013
18	Id2319	1993	6	28-6-1993	Jun	28-Jun-1993	28	29	0	₹ 770.00	tier - 3	tier - 3	R1013
19	Id2318	1996	9	18-9-1996	Sep	18-Sep-1996	18	26	0	₹ 770.38	tier - 3	UNKNOWN	R1012
20	Id2317	1995	12	7-12-1995	Dec	7-Dec-1995	7	27	0	₹ 773.54	tier - 3	tier - 2	R1013
21	Id2316	2004	10	7-10-2004	Oct	7-Oct-2004	7	18	0	₹ 830.52	tier - 3	tier - 2	R1011

2. Data Transformation:

1) Split the 'names' column in the "Customer Names" Table into 3 meaningful columns: 'Title', 'First Name', and 'Last Name'

1	Customer ID	name			
2	Id1	Hawks, Ms. Kelly			
3	Id2	Lehner, Mr. Matthew D			
4	Id3	Lu, Mr. Phil			
5	Id4	Osborne, Ms. Kelsey			
6	Id5	Kadala, Ms. Kristyn			
7	Id6	Baker, Mr. Russell B.			
8	Id7	Macpherson, Mr. Scott			
9	Id8	Hallman, Mr. Stephen			
10	Id9	Moran, Mr. Patrick R.			
11	Id10	Benner, Ms. Brooke N.			
12	Id11	Fierro Vargas, Ms. Paola Andrea			
13	Id12	Franz, Mr. David			
14	Id13	Foster, Mr. Wade			
15	Id14	Tenorio, Mr. Franklin			
16	Id15	Rios, Ms. Leilani M.			
17	Id16	Viau-Dupuis, Mr. Philippe			
18	Id17	Cronin, Ms. Jennifer A.			
19	Id18	Noordstar, Ms. Christina M.			
20	Id19	Boudalia, Mr. Said Sr.			

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Customer Names
Medical Examinations
Hospitalisation Details

Reformed Format:

	A	B	C	D
1	Customer ID	First Name	Title	Last Name
2	Id1	Hawks	Ms	Kelly
3	Id2	Lehner	Mr	Matthew D
4	Id3	Lu	Mr	Phil
5	Id4	Osborne	Ms	Kelsey
6	Id5	Kadala	Ms	Kristyn
7	Id6	Baker	Mr	Russell B
8	Id7	Macpherson	Mr	Scott
9	Id8	Hallman	Mr	Stephen
10	Id9	Moran	Mr	Patrick R
11	Id10	Benner	Ms	Brooke N
12	Id11	Fierro Vargas	Ms	Paola Andrea
13	Id12	Franz	Mr	David
14	Id13	Foster	Mr	Wade
15	Id14	Tenorio	Mr	Franklin
16	Id15	Rios	Ms	Leilani M
17	Id16	Viau-Dupuis	Mr	Philippe
18	Id17	Cronin	Ms	Jennifer A
19	Id18	Noordstar	Ms	Christina M
20	Id19	Boudalia	Mr	Said Sr

Customer Names Medical Examinations

2) Convert the "Number of Major Surgeries" column in the "Medical Examinations" Table to numerical data by replacing non-numeric characters with meaningful numerical values.

	A	B	C	D	E	F	G	H
1	Customer ID	BMI	HBA1C	Heart Issues	Any Transplants	Cancer history	NumberOfMajorSurgeries	smoker
2	Id1	47.41	7.47	No	No	No	No major surgery	yes
3	Id2	30.36	5.77	No	No	No	No major surgery	yes
4	Id3	34.485	11.87	yes	No	No		2 yes
5	Id4	38.095	6.05	No	No	No	No major surgery	yes
6	Id5	35.53	5.45	No	No	No	No major surgery	yes
7	Id6	32.8	6.59	No	No	No	No major surgery	yes
8	Id7	36.4	6.07	No	No	No	No major surgery	yes
9	Id8	36.96	7.93	No	No	No		3 yes
10	Id9	41.14	9.58	yes	No	Yes		1 yes
11	Id10	38.06	10.79	No	No	No	No major surgery	yes
12	Id11	37.7	5.96	yes	No	No		2 yes
13	Id12	42.13	11.9	No	No	No	No major surgery	yes
14	Id13	40.92	8.41	No	No	No	No major surgery	yes
15	Id14	40.565	7.02	No	No	No	No major surgery	yes
16	Id15	36.385	7.59	yes	No	No		2 yes
17	Id16	39.9	11.32	No	No	No	No major surgery	yes
18	Id17	33.8	7.67	No	No	No		3 yes
19	Id18	36.765	7.29	yes	No	Yes		1 yes
20	Id19	36.955	4.72	yes	No	No		1 yes
21	Id20	42.9	11.41	No	No	No	No major surgery	yes

Customer Names Medical Examinations Hospitalisation Details +

Reformed Format:

	B	C	D	E	F	G
1	BMI	HBA1C	Heart Issues	Any Transplants	Cancer history	NumberOfMajorSurgeries
2	47.41	7.47	No	No	No	0
3	30.36	5.77	No	No	No	0
4	34.485	11.87	Yes	No	No	2
5	38.095	6.05	No	No	No	0
6	35.53	5.45	No	No	No	0
7	32.8	6.59	No	No	No	0
8	36.4	6.07	No	No	No	0
9	36.96	7.93	No	No	No	3
10	41.14	9.58	Yes	No	Yes	1
11	38.06	10.79	No	No	No	0
12	37.7	5.96	Yes	No	No	2
13	42.13	11.9	No	No	No	0
14	40.92	8.41	No	No	No	0
15	40.565	7.02	No	No	No	0
16	36.385	7.59	Yes	No	No	2
17	39.9	11.32	No	No	No	0
18	33.8	7.67	No	No	No	3
19	36.765	7.29	Yes	No	Yes	1
20	36.955	4.72	Yes	No	No	1
21	42.9	11.41	No	No	No	0

Customer Names **Medical Examinations** Hospitalisation Details pie

3) Create a new column named “Weight Status” that categorizes BMI into different categories as below. Create a new column named “Diabetes Status” and fill it as per the information given below:

BMI	Weight Status
Below 18.5	Underweight
18.5 – 24.9	Normal Weight
25.0 – 29.9	Overweight
30.0 and Above	Obesity

HbA1C	Diabetes Status
Below 5.7	Normal
5.7 – 6.4	Prediabetes
6.5 and Above	Diabetes

	B	C	D	E	F	G	H	I	J
1	BMI	HBA1C	Heart Issues	Any Transplants	Cancer history	NumberOfMajorSurgeries	smoker	Weight status	Diabetes Status
2	47.41	7.47	No	No	No	0	Yes	OBESITY	DIABETES
3	30.36	5.77	No	No	No	0	Yes	OBESITY	PREDIABETES
4	34.485	11.87	Yes	No	No	2	Yes	OBESITY	DIABETES
5	38.095	6.05	No	No	No	0	Yes	OBESITY	PREDIABETES
6	35.53	5.45	No	No	No	0	Yes	OBESITY	NORMAL
7	32.8	6.59	No	No	No	0	Yes	OBESITY	DIABETES
8	36.4	6.07	No	No	No	0	Yes	OBESITY	PREDIABETES
9	36.96	7.93	No	No	No	3	Yes	OBESITY	DIABETES
10	41.14	9.58	Yes	No	Yes	1	Yes	OBESITY	DIABETES
11	38.06	10.79	No	No	No	0	Yes	OBESITY	DIABETES
12	37.7	5.96	Yes	No	No	2	Yes	OBESITY	PREDIABETES
13	42.13	11.9	No	No	No	0	Yes	OBESITY	DIABETES
14	40.92	8.41	No	No	No	0	Yes	OBESITY	DIABETES
15	40.565	7.02	No	No	No	0	Yes	OBESITY	DIABETES
16	36.385	7.59	Yes	No	No	2	Yes	OBESITY	DIABETES
17	39.9	11.32	No	No	No	0	Yes	OBESITY	DIABETES
18	33.8	7.67	No	No	No	3	Yes	OBESITY	DIABETES
19	36.765	7.29	Yes	No	Yes	1	Yes	OBESITY	DIABETES
20	36.955	4.72	Yes	No	No	1	Yes	OBESITY	NORMAL
21	42.9	11.41	No	No	No	0	Yes	OBESITY	DIABETES

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Customer Names
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4) Merge 'year', 'month' and 'date' columns in the "Hospitalization Details" Table into one column named 'Date of Birth' and format it in 'DD-MMM-YYYY' custom format. Calculate the 'Age' of each customer based on their 'Date of Birth' and the date of collection of the dataset, which is 8 th June 2023. (Hint: Use the DATEDIF function. Format 'charges' column as currency (\$))

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Customer ID	year	month1	DOB	month	DATE OF BIRTH	date	AGE	children	charges	Hospital tier	City tier	State ID
2	ld2335	1992	7	9-7-1992	Jul	9-Jul-1992	9	30	0	₹ 563.84	tier - 2	tier - 3	R1013
3	ld2334	1992	11	30-11-1992	Nov	30-Nov-1992	30	30	0	₹ 570.62	tier - 2	tier - 1	R1013
4	ld2333	1993	6	30-6-1993	Jun	30-Jun-1993	30	29	0	₹ 600.00	tier - 2	tier - 1	R1013
5	ld2332	1992	9	13-9-1992	Sep	13-Sep-1992	13	30	0	₹ 604.54	tier - 3	tier - 3	R1013
6	ld2331	1998	7	27-7-1998	Jul	27-Jul-1998	27	24	0	₹ 637.26	tier - 3	tier - 3	R1013
7	ld2330	2001	11	20-11-2001	Nov	20-Nov-2001	20	21	0	₹ 646.14	tier - 3	tier - 3	R1012
8	ld2329	1993	6	1-6-1993	Jun	1-Jun-1993	1	30	0	₹ 650.00	tier - 3	tier - 3	R1013
9	ld2328	1995	7	4-7-1995	Jul	4-Jul-1995	4	27	0	₹ 650.00	tier - 3	tier - 3	R1013
10	ld2327	2002	11	29-11-2002	Nov	29-Nov-2002	29	20	0	₹ 668.00	tier - 3	tier - 2	R1012
11	ld2326	1997	11	9-11-1997	Nov	9-Nov-1997	9	25	0	₹ 670.00	tier - 3	tier - 3	R1013
12	ld2325	2001	9	12-9-2001	Sep	12-Sep-2001	12	21	0	₹ 687.54	tier - 3	tier - 2	R1013
13	ld2324	1999	12	26-12-1999	Dec	26-Dec-1999	26	23	0	₹ 700.00	UNKNOWN	tier - 3	R1013
14	ld2323	1999	12	14-12-1999	Dec	14-Dec-1999	14	23	0	₹ 722.99	tier - 3	tier - 1	R1013
15	ld2322	2002	9	19-9-2002	Sep	19-Sep-2002	19	20	0	₹ 750.00	tier - 3	tier - 1	R1012
16	ld2321	1993	8	9-8-1993	Aug	9-Aug-1993	9	29	0	₹ 760.00	tier - 3	tier - 1	R1013
17	ld2320	1996	10	22-10-1996	Oct	22-Oct-1996	22	26	0	₹ 760.00	tier - 3	tier - 3	R1013
18	ld2319	1993	6	28-6-1993	Jun	28-Jun-1993	28	29	0	₹ 770.00	tier - 3	tier - 3	R1013
19	ld2318	1996	9	18-9-1996	Sep	18-Sep-1996	18	26	0	₹ 770.38	tier - 3	UNKNOWN	R1012
20	ld2317	1995	12	7-12-1995	Dec	7-Dec-1995	7	27	0	₹ 773.54	tier - 3	tier - 2	R1013
21	ld2316	2004	10	7-10-2004	Oct	7-Oct-2004	7	18	0	₹ 830.52	tier - 3	tier - 2	R1011

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3.Data Exploration:

❖ Customer Names Table

➤ Are there any duplicate Customer IDs in the dataset? If yes, how many?

No duplicates were found in the analysis.

- How many customers are included in the dataset?

There are 2335 customers included in the dataset.

❖ Medical Examination Table:

- How many customers have a history of cancer?
- How many obese customers have heart issues?
- What is the total number of major surgeries performed on customers?
- Calculate the percentage of customers who have undergone any transplants.
- Find the average HBA1C value of customers who are smokers.

CANCER HISTORY		391
OBESITY		1221
NO:OF MAJOR SURGERIES		
	1	965
	2	274
	3	22
TOTAL NO OF SURGERIES		1261
ANY TRANSPLANTS		144
		6%
SMOKERS		488
		21%

❖ Hospitalization details Table:

- Calculate all the Summary statistics for the 'charges' column.
- Find the average hospitalization charges for customers who are more than 50 years old
- Compare the total charges across different hospital tiers.
- Calculate the average charges for people who have more than 2 children.

- Find the integer average number of children of customers who are less than 40 years old

SUMMARY STATISTICS	
MEAN	₹ 13,559.07
MEDIAN	₹ 9,634.54
MODE	650
STD.DEV	11920.11383
MINI	₹ 563.84
MAXI	₹ 63,770.43
SUM	₹ 3,17,68,896.02
COUNT	2343
>50 YEARS	17856.79086
>2 CHILDREN	14217.5205
<40 YEARS	10477.41655

4.Data Analysis:

- Create a new sheet named "Healthcare", combine all three tables into one, using Customer ID as the common column, utilizing VLOOKUP.
- Retain the following necessary columns: Customer ID, First Name, BMI, HBA1C, Heart Issues, Any Transplants, Cancer history, Number of Major Surgeries, smoker, Weight Status, Diabetes Status, Date of Birth, charges, Hospital tier, City tier, State ID, Age.

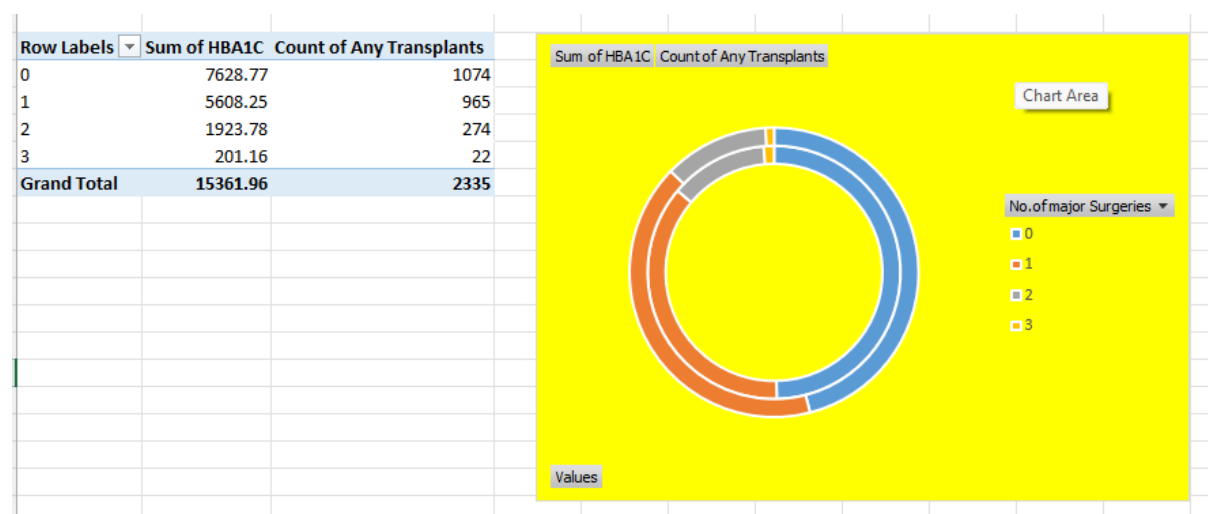
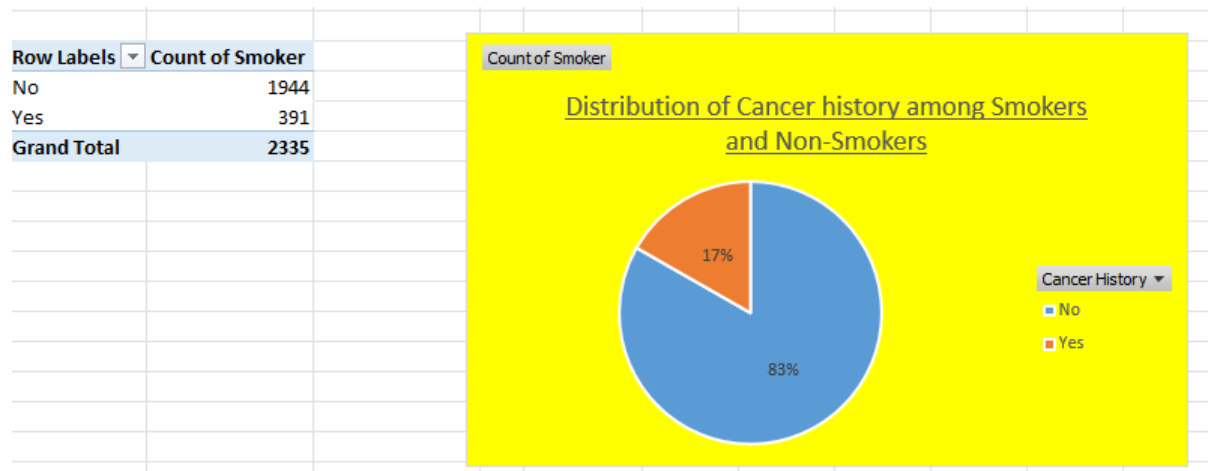
	BMI	HbA1C	Heart Issues	Any Transplants	Cancer History	No.of major Surgeries	Smoker	Weight Status	Diabetes Status	Date of Birth
1										
2	47.41	7.47	No	No	No	0	Yes	OBESITY	DIABETES	12-10-1968
3	30.36	5.77	No	No	No	0	Yes	OBESITY	PREDIABETES	8-6-1977
4	34.485	11.87	Yes	No	No	2	Yes	OBESITY	DIABETES	11-9-1970
5	38.095	6.05	No	No	No	0	Yes	OBESITY	PREDIABETES	6-6-1991
6	35.53	5.45	No	No	No	0	Yes	OBESITY	NORMAL	19-6-1989
7	32.8	6.59	No	No	No	0	Yes	OBESITY	DIABETES	4-8-1962
8	36.4	6.07	No	No	No	0	Yes	OBESITY	PREDIABETES	27-10-1994
9	36.96	7.93	No	No	No	3	Yes	OBESITY	DIABETES	27-6-1958
10	41.14	9.58	Yes	No	Yes	1	Yes	OBESITY	DIABETES	4-9-1963
11	38.06	10.79	No	No	No	0	Yes	OBESITY	DIABETES	29-12-1978
12	37.7	5.96	Yes	No	No	2	Yes	OBESITY	PREDIABETES	22-7-1959
13	42.13	11.9	No	No	No	0	Yes	OBESITY	DIABETES	27-10-1965
14	40.92	8.41	No	No	No	0	Yes	OBESITY	DIABETES	11-10-1962
15	40.565	7.02	No	No	No	0	Yes	OBESITY	DIABETES	1-12-1968
16	36.385	7.59	Yes	No	No	2	Yes	OBESITY	DIABETES	21-12-1961
17	39.9	11.32	No	No	No	0	Yes	OBESITY	DIABETES	27-8-1962
18	33.8	7.67	No	No	No	3	Yes	OBESITY	DIABETES	16-11-1958
19	36.765	7.29	Yes	No	Yes	1	Yes	OBESITY	DIABETES	5-8-1963
20	36.955	4.72	Yes	No	No	1	Yes	OBESITY	NORMAL	7-11-1964

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Charges	Hospital Tier	City Tier	State ID	Age
63770.43	tier - 1	tier - 3	R1013	54
62592.87	tier - 2	tier - 3	R1013	46
60021.4	tier - 1	tier - 1	R1012	52
58571.07	tier - 1	tier - 3	R1024	32
55135.4	tier - 1	tier - 2	R1012	33
52590.83	tier - 1	tier - 3	R1011	60
51194.56	tier - 1	tier - 3	R1011	28
49577.66	tier - 2	tier - 2	R1013	64
48970.25	tier - 1	tier - 2	R1013	59
48885.14	tier - 1	tier - 2	R1013	44
48824.45	tier - 2	tier - 1	R1011	63
48675.52	tier - 1	tier - 2	R1013	57
48673.56	tier - 1	tier - 2	R1013	60
48549.18	tier - 1	tier - 3	R1016	54
48517.56	tier - 1	tier - 3	R1024	61
48173.36	tier - 1	tier - 3	R1011	60
47928.03	tier - 2	tier - 3	R1011	64
47896.79	tier - 1	tier - 3	R1024	59
47496.49	tier - 1	tier - 3	R1012	58

Analysis using Pie/Donut Chart:

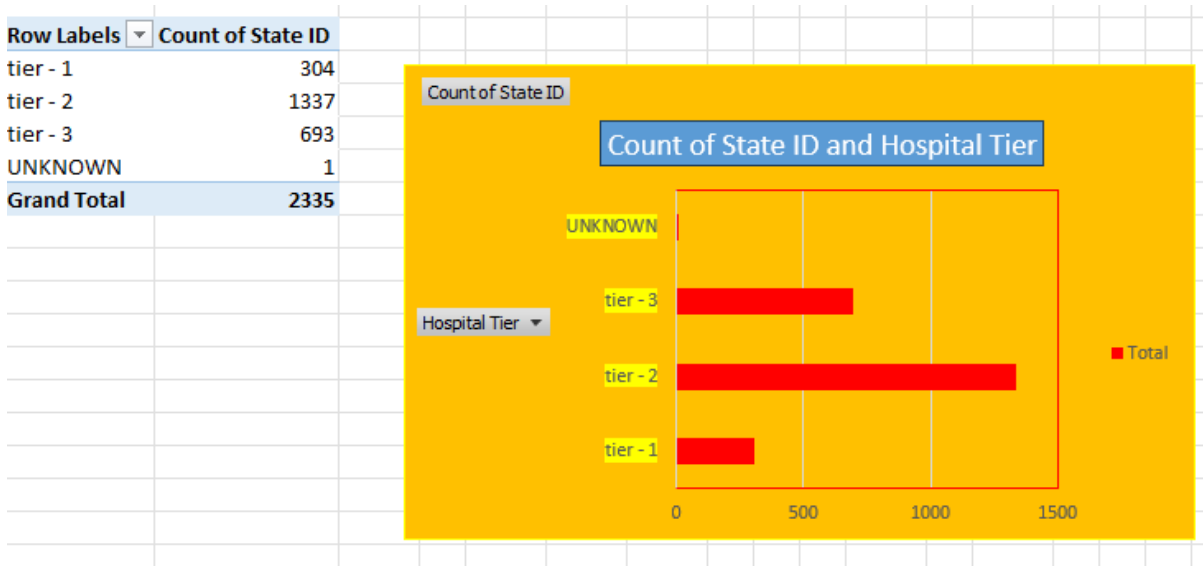
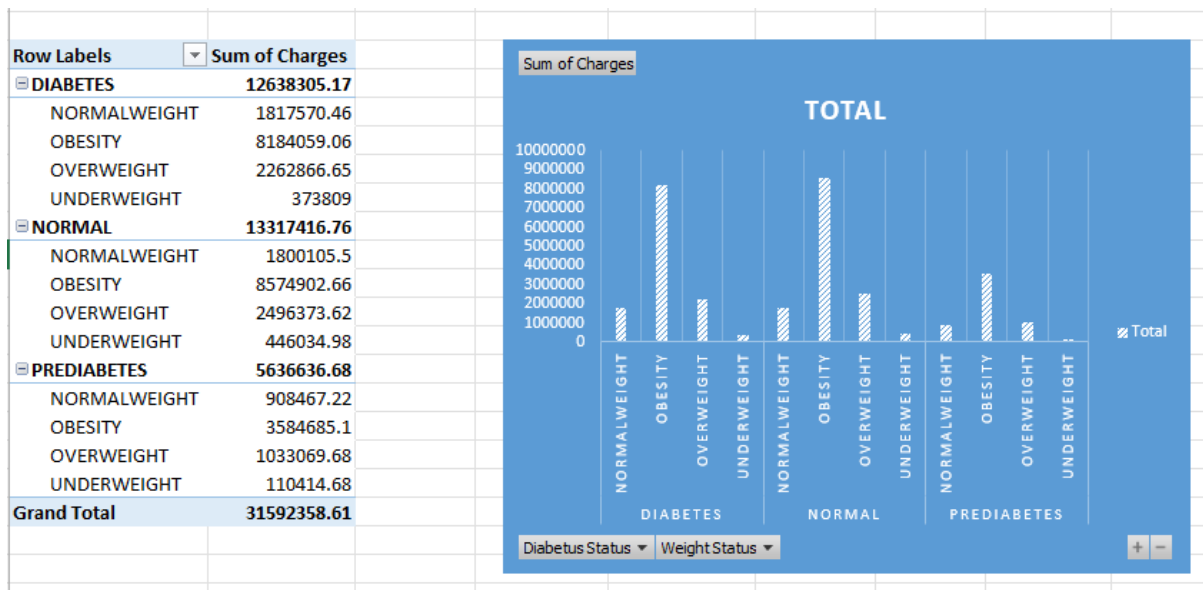
- What is the distribution of cancer history among smokers and non-smokers?
- How does the total number of major surgeries and average HbA1C differ between patients with and without a history of transplants?



Analysis using Column/Bar Chart:

➤ How do healthcare charges vary based on different weight statuses and diabetes statuses?

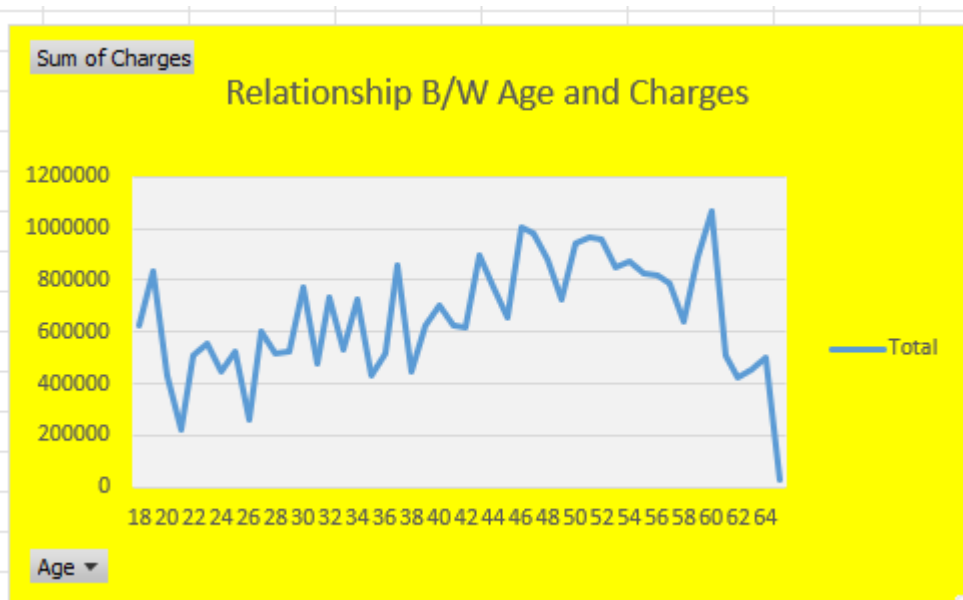
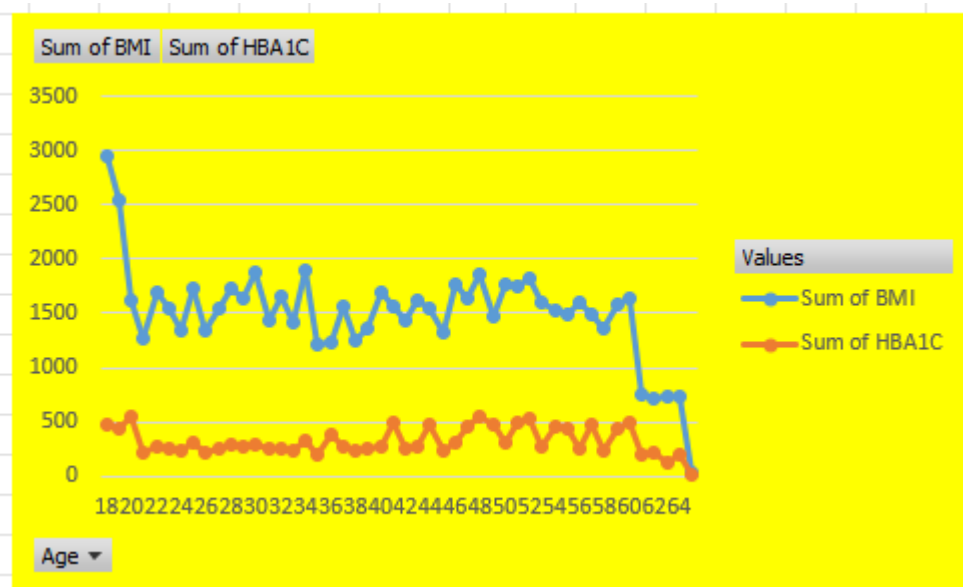
➤ Can you compare the average charges for each hospital tier within different states?



Analysis using Line/Scatter Plot:

➤ Is there any correlation between age and both BMI and HbA1C in the dataset?

➤ Explore the relationship between age and healthcare charges



6.Final Thoughts:

- In summary, a comprehensive conclusion for a data analysis in a research study involves a strategic synthesis of key findings, their implications, and their contribution to the broader field of study.
- Healthcare data analytics helps managers in making predictions regarding resource availability, treatment facilities, checkups, etc. This has promoted strategic decision-making and also boosted the trust and faith of patients in medical treatments.
- We hope it helps you in your decision-making as healthcare data analytics professional.