CMS Data Exercise Recommendations

1. Based on different types of nurses.

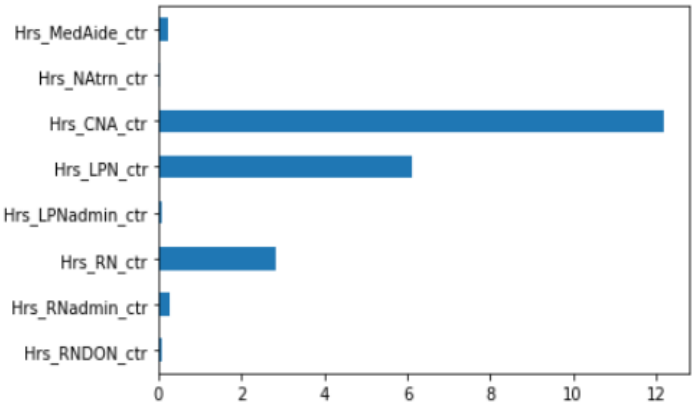

Fig. 1 Average Hours of Each Type Nurse

```
final_data[ctr_Hrs_col].sum()
```

```
Hrs_RNDON_ctr        127992.47
Hrs_RNadmin_ctr      332805.07
Hrs_RN_ctr          3726398.89
Hrs_LPNadmin_ctr      89971.57
Hrs_LPN_ctr         8114992.20
Hrs_CNA_ctr        16144404.91
Hrs_NAtrn_ctr         69033.67
Hrs_MedAide_ctr      284975.42
dtype: float64
```

```
final_data[ctr_Hrs_col].mean()
```

```
Hrs_RNDON_ctr        0.096575
Hrs_RNadmin_ctr      0.251112
Hrs_RN_ctr           2.811691
Hrs_LPNadmin_ctr     0.067887
Hrs_LPN_ctr          6.123030
Hrs_CNA_ctr         12.181487
Hrs_NAtrn_ctr        0.052088
Hrs_MedAide_ctr      0.215023
dtype: float64
```

Tab. 1 Total Hours Worked by Each Contract Basis Nurse

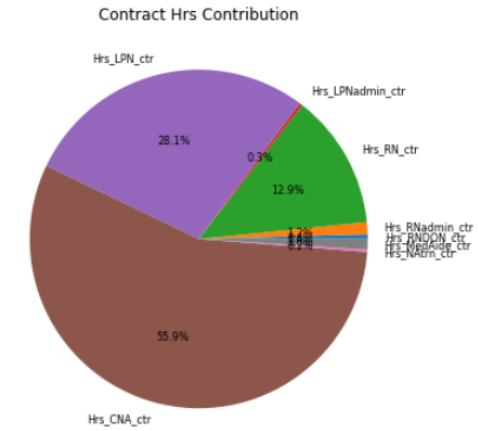

Fig. 2 Percentages of Average Hours of Each Type Nurse

Fig. 1 shows a horizontal bar graph showing the number of hours for various contract-based healthcare roles. It provides a visual comparison of how different roles in healthcare are distributed in terms of hours worked. From Fig. 1, we can see that **Certified Nursing Assistants (CNA)** have the highest number of hours, after that **Licensed Practical Nurse (LPN)** and Registered Nurse (RN) are high in demand. while most administrative roles have significantly fewer hours.

Fig. 2 shows that **CNAs** have the highest demand in terms of contract hours, at **55.9%** of the Total, followed by **LPNs** and **RNs** with **28.1%** & **12.9%** respectively. The administrative roles and specialized RN roles each have a smaller percentage of the total contract hours.

From Tab. 1 we can conclude that total hours worked by **CNAs** are **16144404 Hrs** approx. And by **LPNs** & **RNs** is **8114992 Hrs**, **3726398 Hrs** respectively.

2. Demand for Nurses based on Ownership Type

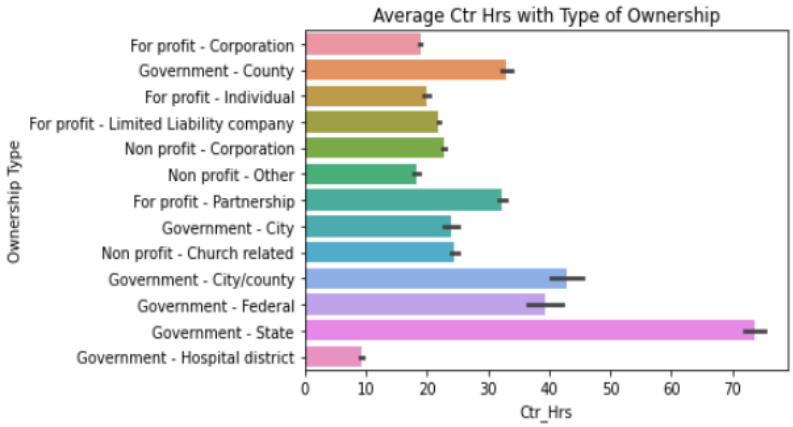

Fig. 3 Average Contract Hours Based on Ownership

```
final_data.groupby("Ownership Type")["Ctr_Hrs"].mean()
```

```
Ownership Type
For profit - Corporation                  18.930770
For profit - Individual                   19.933876
For profit - Limited Liability company    21.946939
For profit - Partnership                  32.316137
Government - City                         23.939168
Government - City/county                  42.926062
Government - County                       33.061404
Government - Federal                      39.364168
Government - Hospital district             9.369158
Government - State                        73.690279
Non profit - Church related               24.535706
Non profit - Corporation                  22.809058
Non profit - Other                        18.388724
Name: Ctr_Hrs, dtype: float64
```

Tab. 2 Average Contract Hours Based on Ownership

In Figure 3 and Table 2, we observe a significant demand for nurses on a contract basis, particularly within **government-owned institutions.** The data clearly shows that nurses working in government-owned facilities, whether at the state, city/county, or federal level, have notably higher average hours per day. Specifically, **government-state** facilities show an average of **73.69** hours per day, while **government-city/county** and **government-federal** facilities follow closely with **42.92** and **39.36** hours, respectively.

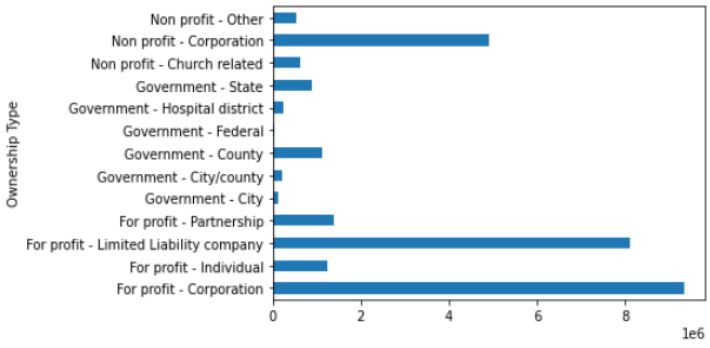

Fig. 4 Average Contract Hours Based on Ownership

```
final_data.groupby("Ownership Type")["Ctr_Hrs"].sum()
```

```
Ownership Type
For profit - Corporation                  9357687.98
For profit - Individual                   1238950.18
For profit - Limited Liability company    8122496.26
For profit - Partnership                  1379220.43
Government - City                          121994.00
Government - City/county                   218751.21
Government - County                       1122203.24
Government - Federal                        50149.95
Government - Hospital district             234463.17
Government - State                         898579.26
Non profit - Church related                629635.28
Non profit - Corporation                  4917153.86
Non profit - Other                         537153.01
Name: Ctr_Hrs, dtype: float64
```

Tab. 3 Average Contract Hours Based on Ownership

From Figure 4 and Table 3, we can observe that the demand for nurses on a contract basis is notably higher in both for-profit and non-profit corporations. Specifically, the highest demand is seen in **Profit corporations**, followed closely by **profit limited liability companies (LLCs)** and **non-profit corporations.** In the second quarter of 2024, **for-profit corporations** recorded a total of **9,357,687** hours, **for-profit LLCs** had **8,122,496** hours, and **non-profit corporations** reached **4,917,153** hours approx.

This indicates that the healthcare sector, particularly within these organizational structures, is experiencing a growing need for contract nurses. This reliance on contract nurses in for-profit and non-profit corporations speaks to the evolving landscape of healthcare staffing and the increasing role of temporary nursing services in meeting sector-wide needs.

3. State Base Contract Nursing Demand

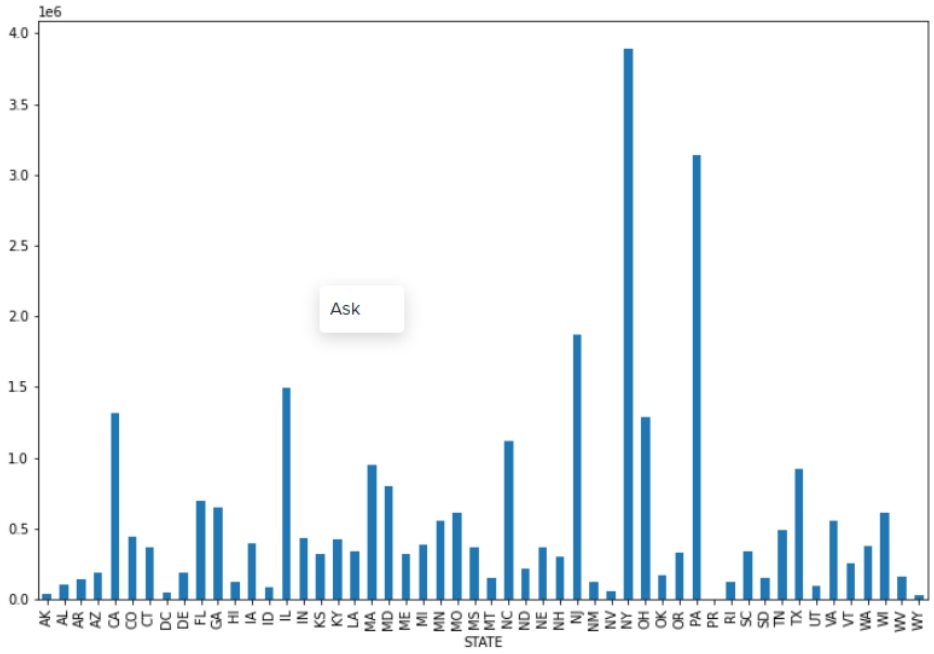

Fig. 5 Total Contract Hours Based on State

STATE	
AK	0.123400
AL	0.361904
AR	0.473804
AZ	0.641602
CA	4.562856
CO	1.526648
CT	1.255415
DC	0.149903
DE	0.642627
FL	2.412379
GA	2.260725
HI	0.408368
IA	1.376673
ID	0.278572
IL	5.157767
IN	1.483526
KS	1.096222
KY	1.476180
LA	1.165056
MA	3.301452
MD	2.755804
ME	1.100361
MI	1.346900
MN	1.925487
MO	2.104803
MS	1.280043
MT	0.534849
NC	3.871724
ND	0.758352
NE	1.262220
NH	1.056748
NJ	6.489045
NM	0.426236
NV	0.192496
NY	13.469751
OH	4.470607
OK	0.592739
OR	1.136224
PA	10.869316
PR	0.003273
RI	0.433105
SC	1.170958
SD	0.523891
TN	1.702732
TX	3.176801
UT	0.311649
VA	1.906903
VT	0.871599
WA	1.293599
WI	2.124649
WV	0.569518
WY	0.112540

Name: Ctr_Hrs, dtype: float64

Tab. 4 Percentage of Contract Hours Base on State

From Figure 5 and Table 4, we can conclude that **New York** State leads the charge in demand for contract-based nurses, accounting for nearly **14%** of the total contract nurse hours in the U.S. This highlights New York's significant reliance on temporary nursing staff to meet the healthcare needs of its vast and diverse population, as well as the demands on its healthcare system.

Following New York, **Pennsylvania** shows strong demand, with contract nurses contributing almost **11%** of the total contract nurse hours nationwide. This indicates a substantial need for flexible, skilled nurses to support healthcare facilities across the state.

New Jersey takes the third position, with contract nurses contributing around **7%** of the total contract nurse hours in the second quarter of 2024. The demand for contract nursing in New Jersey further underscores the vital role that temporary staffing plays in maintaining healthcare quality and efficiency in densely populated regions.

Together, these three states New York, Pennsylvania, and New Jersey represent a significant portion of the U.S. contract nursing workforce, which denotes high-demand areas in the country.

4. Region Base Contract Nurse's Demand

Figure 6 highlights the regions in the U.S. with the highest demand for contract nurses across different nursing roles CNA, LPN, and RN during the second quarter of 2024.

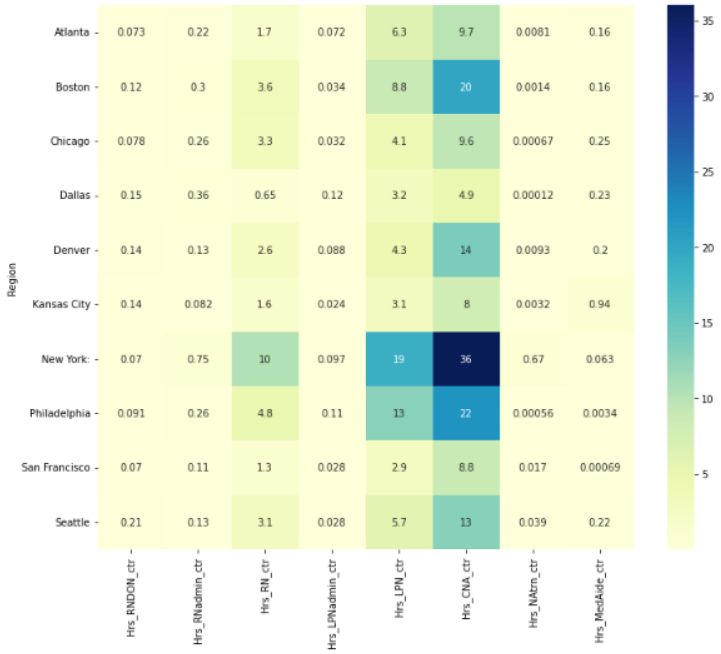

Fig. 6 Average Contract Hours Based on Region

New York stands out as the most demanding region, with **CNA** nurses working an average of **36** hours per day per nursing home, followed by **LPN** nurses at **19** hours and **RN** nurses at **10** hours. This indicates a strong reliance on contract nurses to support the state's busy healthcare facilities.

Philadelphia follows closely, with **CNA** nurses in demand for **22** hours per day, **LPN** nurses for **13** hours, and **RN** nurses for **4.8** hours per day per nursing home. This suggests that Philadelphia's healthcare system also heavily depends on temporary nursing staff to maintain operations.

Boston ranks third, with contract **CNA** nurses working **20** hours per day, **LPN** nurses at **8.8** hours, and **RN** nurses at **3.6** hours per day per nursing home. While slightly lower than New York and Philadelphia, these numbers still reflect a significant need for contract nurses in the region.

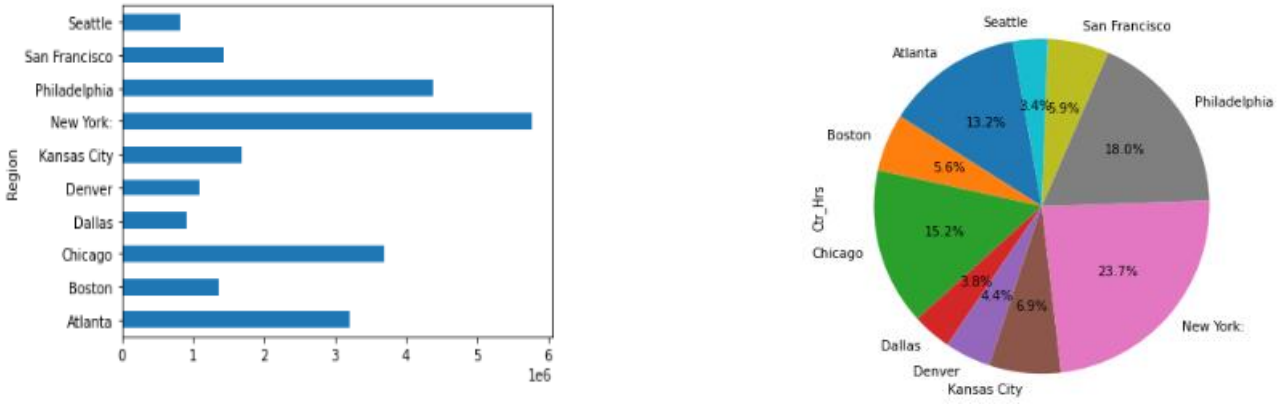

Fig. 7 Percentage Contract Hours Based on Region

Figure 7 highlights the top three regions with the highest demand for contract nurses. **New York** leads with nearly **24%** of total contract nurse working hours, reflecting its immense healthcare needs. **Philadelphia** follows, accounting for **18%**, while **Chicago** ranks third with **15%**. These numbers indicate a strong reliance on contract nurses in these metropolitan areas, driven by large populations, high patient volumes, and the need for flexible staffing. Together, these regions stand out as the most demanding for contract nurses, emphasizing their crucial role in maintaining healthcare efficiency and quality.

5. Top Fifty Nursing Homes

0	ISABELLA GERIATRIC CENTER INC	820.533297	New York:
1	PLEASANT ACRES REHABILITATION AND NURSING CENTER	804.793846	Philadelphia
2	QUEENS BOULEVARD EXTENDED CARE FACILITY	733.686813	New York:
3	BRIGHTON REHABILITATION AND WELLNESS CENTER	671.206813	Philadelphia
4	THE PLAZA REHAB AND NURSING CENTER	669.915714	New York:
5	WORKMENS CIRCLE MULTICARE CENTER	667.622418	New York:
6	MICHIGAN VETERAN HOMES AT GRAND RAPIDS	626.086923	Chicago
7	CORAL REEF SUBACUTE CARE CENTER LLC	610.297143	NaN
8	RICHMOND CTR FOR REHAB AND SPECIALTY HEALTHCARE	596.722527	New York:
9	BETH ABRAHAM CENTER FOR REHABILITATION AND NUR...	587.733187	New York:
10	DEPTFORD CENTER FOR REHABILITATION AND HEALTHCARE	567.994505	New York:
11	WILLOW POINT REHABILITATION AND NURSING CENTER	566.346154	New York:
12	PLEASANT RIDGE MANOR EAST/WEST	536.395604	Philadelphia
13	FRANKLIN CENTER FOR REHABILITATION AND NURSING	528.120879	New York:
14	PREFERRED CARE AT CUMBERLAND	508.868242	New York:
15	COMPLETE CARE AT CEDAR GROVE	487.400220	New York:
16	HAMMONTON CENTER FOR REHABILITATION AND HEALTH...	481.538462	New York:
17	MENORAH HOME & HOSPITAL FOR AGED & INFIRM	478.150220	New York:
18	JOHN J KANE REGIONAL CENTER-SC	471.807692	Philadelphia
19	ST PATRICKS HOME	467.815934	New York:
20	MERRIMACK COUNTY NURSING HOME	451.865385	Boston
21	JOHN J KANE REGIONAL CENTER-GL	447.903846	Philadelphia
22	EMBASSY MANOR AT EDISON NURSING AND REHABILITA...	434.949341	New York:
23	SPLIT ROCK REHABILITION AND HEALTH CARE CENTER	433.978022	New York:
24	SUN HARBOR HEALTHCARE	427.928352	NaN
25	ST JOSEPH'S REHABILITATION AND RESIDENCE	427.670659	Boston
26	OZANAM HALL OF QUEENS NURSING HOME INC	425.334835	New York:
27	LINDEN CENTER FOR NURSING AND REHABILITATION	410.079670	New York:
28	ROSEMONT AT STONE MOUNTAIN	405.247582	NaN
29	INDIANA VETERANS HOME	400.037473	Chicago
30	NEW YORK CENTER FOR REHABILITATION & NURSING	397.370769	New York:
31	ROOSEVELT CARE CENTER AT OLD BRIDGE	393.211978	New York:
32	CLIFFSIDE REHAB & RESIDENTIAL HEALTH CARE CENTER	389.329670	New York:
33	ROCKINGHAM COUNTY NURSING HOME	387.340330	Boston
34	FORT TRYON CENTER FOR REHABILITATION AND NURSING	387.060440	New York:
35	PROVIDENCE MOUNT ST VINCENT	386.519341	Seattle
36	HUDSON HILL CENTER FOR REHABILITATION & NURSING	378.763736	New York:
37	JOHN J KANE REGIONAL CENTER-MC	374.371099	Philadelphia
38	PINNACLE MULTICARE NURSING AND REHAB CENTER	372.079011	New York:
39	CHESTNUT HILL LODGE HEALTH AND REHAB CTR	357.868813	Philadelphia
40	IMMACULATEMARYCENTER FOR REHABILITATION&HEALTH...	356.546484	Philadelphia
41	PREMIER WASHINGTON REHABILITATION AND NURSING CTR	350.791099	Philadelphia
42	QUEENS NASSAU REHABILITATION AND NURSING CENTER	346.446703	New York:
43	MARTINE CENTER FOR REHABILITATION AND NURSING	339.758242	New York:
44	GOLDEN SONORA CARE CENTER	334.517582	NaN
45	WAYNE CENTER FOR NURSING & REHABILITATION	333.974066	New York:
46	MORRIS VIEW HEALTHCARE CENTER	332.802088	New York:
47	CUMMING OPERATING COMPANY LLC	330.220440	NaN
48	SULLIVAN COUNTY ADULT CARE CENTER	327.056154	New York:
49	DOWNTOWN BROOKLYN NURSING & REHABILITATION CENTER	325.707143	New York:

Tab. 5 Top 50 Nursing Homes

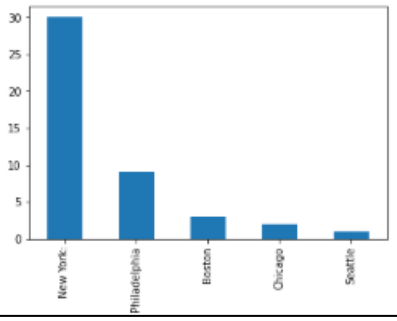

Fig. 8 Region wise top 50 Nursing Homes

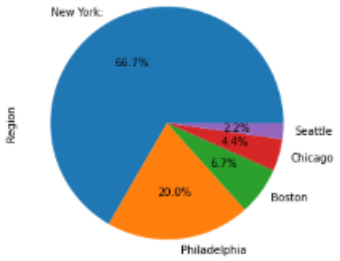

Fig. 9 Region wise top 50 Nursing Homes

The list of the **top fifty nursing homes** based on contract nurses' daily working hours showcases the regions with the highest demand for temporary nursing staff. The daily working hours per nursing home range from **820 to 320 hours**, for top fifty nursing homes. highlighting the significant reliance on contract nurses in these facilities.

Notably, **more than 30 of these top nursing homes are located in the New York region**, reinforcing its status as the most demanding area for contract nursing services. **Philadelphia follows, with 10 nursing homes making the list**, further emphasizing its strong need for flexible staffing solutions.

This distribution underscores the growing dependence on contract nurses in major metropolitan areas, where healthcare demands are high, and facilities require adaptable workforce solutions to ensure seamless patient care.

SQL Exercise

1. **Write a query to return the customer_name, product_name, and total_amount for each sale in the last 30 days.**

```
select c.customer_name, p.product_name, s.total_amount
from sales s
join Customers c on s.customer_id = c.customer_id
join Products p on s.product_id = p.product_id
where s.sale_date >= curdate() - inerval 30 day;
```

2. **Write a query to find the total revenue generated by each product category in the last year. The output should include the product category and the total revenue for that category.**

```
select p.category, sum(s.total_amount) as 'total_revenue'
from sales s
join products p on s.product_id = p.product_id
where sale_date >= curdate() - interval 1 year
group by p.category;
```

3. **Write a query to return all customers who made purchases in 2023 and are located in the "West" region.**

```
select distinct c.customer_id,  c.customer_name, c.sales_region
from sales s
join customers c on s.customer_id = c.customer_id
where c.sales_region = "West"
and s.sale_date between "2023-01-01" and "2023-12-31";
```

4. **Write a query to display the total number of sales, total quantity sold, and total revenue for each customer. The result should include the customer_name, total sales, total quantity, and total revenue.**

```
select c.customer_name, count(s.sales_id) as "total_sales",
sum(s.quantity) as "total_quantity", sum(s.total_amount) as "total_revenue"
from sales s
join customers c on s.customer_id = c.customer_id
group by c.customer_id;
```

5. **Write a query to find the top 3 customers (by total revenue) in the year 2023.**

```
select c.customer_name, sum(s.total_amount) as "total_revenue"
from sales s
join customers c on s.customer_id = c.customer_id
where s.sale_date between "2023-01-01" and "2023-12-31"
group by c.customer_id
order by total_revenue desc
limit 3;
```

6. **Write a query to rank products by their total sales quantity in 2023. The result should include the product_name, total quantity sold, and rank.**

```
select p.product_name,
    sum(s.quantity) as "total_quantity_sold",
    rank() over (order by sum(s.quantity ) desc) as "rank"
from sales s
join products p on s.product_id = p.product_id
where year(s.sale_date) = 2023
group by p.product_id;
```

7. **Write a query that categorizes customers into "New" (if they signed up in the last 6 months) or "Existing" based on their sign_up_date. Include the customer_name, region, and category in the result.**

```
select customer_name, sales_region,
   case
       when sign_up_date >= curdate() - interval 6 month then "New"
       else "Existing"
    end as "category"
from customers;
```

8. **Write a query to return the month and year along with the total sales for each month for the last 12 months.**

```
select date_format(sale_date, "%m") as "month",
date_format(sale_date, "%y") as "year",  sum(total_amount) as "total_sales"
from sales
where sale_date >= curdate() - interval 12 month
group by month;
```

9. **Write a query to return the product categories that generated more than $50,000 in revenue during the last 6 months.**

```
select p.category, sum(s.total_amount) as "total_revenue"
from sales s
join products p on s.product_id = p.product_id
where s.sale_date >= curdate() - interval 6 month
group by p.category
having total_revenue > 50000;
```

10. **Write a query to check for any sales where the total_amount doesn't match the expected value (i.e., quantity * price).**

```
select s.sales_id,
        s.quantity,
        p.price,
        s.total_amount,
        s.quantity * p.price as "Exp_revenue"
from sales s
join products p on s.product_id = p.product_id
where s.total_amount <> (s.quantity * p.price);
```