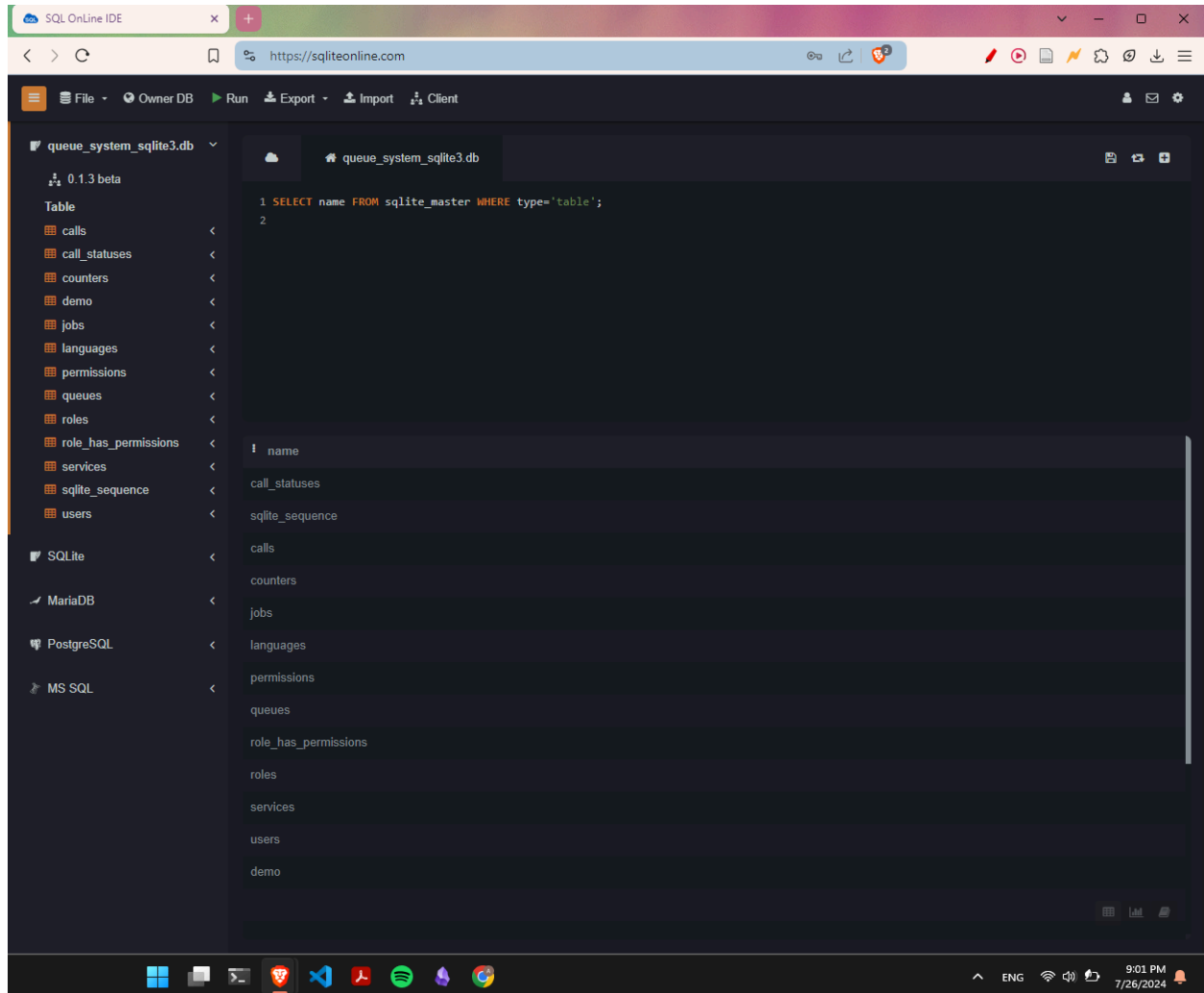


Sample Data -> Restore

Screenshot is in the file named tables.png



Tables Definition and their Relation

Tables

1. queues

- **id** (bigint(20) unsigned) - Primary Key, auto_increment
- **service_id** (bigint(20) unsigned) - Foreign Key referencing **services(id)**
- **number** (int(11)) - Queue number
- **called** (tinyint(1)) - Indicator if the queue has been called

- `reference_no` (varchar(191)) - Reference number for the queue
- `letter` (varchar(191)) - Letter associated with the queue
- `name` (varchar(191)) - Name of the person in the queue
- `email` (varchar(191)) - Email of the person in the queue
- `phone` (varchar(191)) - Phone number of the person in the queue
- `position` (int(11)) - Position in the queue
- `created_at` (timestamp) - Timestamp when the queue was created
- `updated_at` (timestamp) - Timestamp when the queue was last updated

2. **users**

- `id` (int(11)) - Primary Key, auto_increment
- `name` (varchar(191)) - Name of the user
- `email` (varchar(191)) - Email address of the user, unique
- `email_verified_at` (timestamp) - Timestamp when the user's email was verified
- `password` (varchar(191)) - Hashed password of the user
- `remember_token` (varchar(100)) - Token for authentication using the functionalities like *remember me*
- `created_at` (timestamp) - Timestamp when the user was created
- `updated_at` (timestamp) - Timestamp when the user was last updated
- `image` (varchar(191)) - Path or URL to the user's profile image

3. **call_statuses**

- `id` (int(11)) - Primary Key, auto_increment
- `name` (varchar(191)) - Name of the call status
- `created_at` (timestamp) - Timestamp when the call status was created
- `updated_at` (timestamp) - Timestamp when the call status was last updated

4. **calls**

- `id` (int(11)) - Primary Key, auto_increment
- `queue_id` (int(11)) - Foreign Key referencing `queues(id)`
- `service_id` (int(11)) - Foreign Key referencing `services(id)`
- `counter_id` (int(11)) - Foreign Key referencing `counters(id)`
- `user_id` (int(11)) - Foreign Key referencing `users(id)`
- `token_letter` (varchar(191)) - Letter associated with the call token
- `token_number` (int(11)) - Number associated with the call token
- `called_date` (date) - Date when the call was made
- `started_at` (datetime) - Datetime when the call started, default current timestamp
- `ended_at` (datetime) - Datetime when the call ended
- `waiting_time` (time) - Time spent waiting
- `served_time` (time) - Time spent being served
- `turn_around_time` (time) - Total time from initial waiting to the end of the call
- `created_at` (timestamp) - Timestamp when the call record was created

- `updated_at` (timestamp) - Timestamp when the call record was last updated
 - `call_status_id` (int(11)) - Foreign Key referencing `call_statuses(id)`
5. **counters**
- `id` (int(11)) - Primary Key, auto_increment
 - `name` (varchar(191)) - Name of the counter
 - `status` (int(11)) - Status of the counter
 - `created_at` (timestamp) - Timestamp when the counter was created
 - `updated_at` (timestamp) - Timestamp when the counter was last updated

Relations

1. **calls & queues:**
 - Linked by `queue_id` in the `calls` table referencing `queues(id)`.
2. **calls & services:**
 - Linked by `service_id` in the `calls` table referencing `services(id)`.
3. **calls & counters:**
 - Linked by `counter_id` in the `calls` table referencing `counters(id)`.
4. **calls & users:**
 - Linked by `user_id` in the `calls` table referencing `users(id)`.
5. **calls & call_statuses:**
 - Linked by `call_status_id` in the `calls` table referencing `call_statuses(id)`.
6. **queues & services:**
 - Linked by `service_id` in the `queues` table referencing `services(id)`.

Query Building

3. The sql query is in the file `counter_summary.sql` and the screenshot is in the picture with the same name.

The screenshot shows the SQL Online IDE interface. The query editor contains the following SQL code:

```

7
8 FROM
9   counters c
10  LEFT JOIN
11    calls ca
12  ON
13    c.id = ca.counter_id
14  LEFT JOIN
15    call_statuses cs ON ca.call_status_id = cs.id
16 WHERE
17   ca.called_date = '2024-02-14'
18 GROUP BY
19   c.id ;

```

The results table displays the following data:

counter_id	called	serving	served	no_show
1	37	0	27	10
2	12	0	12	0
3	32	0	24	8
5	21	0	15	6
6	37	0	30	7
7	7	0	7	0
8	26	0	22	4
10	7	0	7	0

4. The sql query is in the file service_summary.sql and the screenshot is in the picture with the same name.

The screenshot shows the SQL Online IDE interface. The query editor contains the following SQL code:

```

3  COUNT(s.id) AS visitor,
4  COUNT(q.id) AS queued,
5  COUNT(ca.id) AS called,
6  SUM(CASE WHEN cs.name = 'serving' THEN 1 ELSE 0 END) AS serving,
7  SUM(CASE WHEN cs.name = 'served' THEN 1 ELSE 0 END) AS served,
8  SUM(CASE WHEN cs.name = 'noshow' THEN 1 ELSE 0 END) AS no_show
9 FROM services s
10 LEFT JOIN calls ca ON s.id = ca.service_id
11 LEFT JOIN queues q ON s.id = q.service_id AND q.id = ca.queue_id
12 LEFT JOIN call_statuses cs ON ca.call_status_id = cs.id
13 WHERE ca.called_date = '2024-02-14'
14 GROUP BY s.id ;

```

The results table displays the following data:

service_id	letter	visitor	queued	called	serving	served	no_show
1	W	87	87	87	0	65	22
2	NR	79	79	79	0	68	11
3	T	13	13	13	0	11	2

5. The sql query is in the file service_x_counter_summary.sql and the screenshot is in the picture with the same name.

SQL Online IDE interface showing a query in the 'queue_system_sqlite3.db' database. The query is as follows:

```

5 COUNT(q.id) AS queued,
6 COUNT(ca.id) AS called,
7 SUM(CASE WHEN cs.name = 'serving' THEN 1 ELSE 0 END) AS serving,
8 SUM(CASE WHEN cs.name = 'served' THEN 1 ELSE 0 END) AS served,
9 SUM(CASE WHEN cs.name = 'no_show' THEN 1 ELSE 0 END) AS no_show
10 FROM services s
11 LEFT JOIN calls ca ON s.id = ca.service_id
12 LEFT JOIN counters c ON ca.counter_id = c.id
13 LEFT JOIN queues q ON s.id = q.service_id AND q.id = ca.queue_id
14 LEFT JOIN call_statuses cs ON ca.call_status_id = cs.id
15 WHERE ca.called_date = '2024-02-14'
16 GROUP BY c.id, s.id
17 ORDER BY s.id;

```

service_id	letter	counter_id	visitor	queued	called	serving	served	no_show
1	W	1	35	35	35	0	26	9
1	W	2	4	4	4	0	4	0
1	W	3	15	15	15	0	9	6
1	W	5	19	19	19	0	13	6
1	W	6	10	10	10	0	10	0
1	W	8	4	4	4	0	3	1
2	NR	1	2	2	2	0	1	1
2	NR	2	8	8	8	0	8	0
2	NR	3	4	4	4	0	4	0
2	NR	5	2	2	2	0	2	0
2	NR	6	27	27	27	0	20	7
2	NR	7	7	7	7	0	7	0
2	NR	8	22	22	22	0	19	3
2	NR	10	7	7	7	0	7	0

6. The sql query is in the file agent_summary.sql and the screenshot is in the picture with the same name.

SQL Online IDE interface showing a query in the 'queue_system_sqlite3.db' database. The query is as follows:

```

13 calls ca ON u.id = ca.user_id
14 LEFT JOIN
15 services s ON ca.service_id = s.id
16 LEFT JOIN
17 queues q ON s.id = q.service_id AND q.id = ca.queue_id
18 LEFT JOIN
19 call_statuses cs ON ca.call_status_id = cs.id
20 WHERE
21 ca.called_date = '2024-02-14'
22 GROUP BY
23 u.id, u.name, s.id, s.letter
24 ORDER BY
25 u.name, s.letter;

```

name	letter	visitor	queued	called	serving	served	no_show
Ajaya Limbu	NR	7	7	7	0	7	0
Bishnu Pd Marasini	NR	27	27	27	0	20	7
Bishnu Pd Marasini	W	10	10	10	0	10	0
Chhiring Ghale	NR	4	4	4	0	4	0
Chhiring Ghale	T	13	13	13	0	11	2
Chhiring Ghale	W	15	15	15	0	9	6
Lokendra Sunar	NR	22	22	22	0	19	3
Lokendra Sunar	W	4	4	4	0	3	1
Mahima Kalikote	W	35	35	35	0	26	9
Rahul khadka	NR	9	9	9	0	8	1
Sagar Magar	NR	2	2	2	0	2	0
Sagar Magar	W	19	19	19	0	13	6
Suyog Tamang	NR	8	8	8	0	8	0
Suyog Tamang	W	4	4	4	0	4	0

EDA

The query used to create the dataset for eda is in the file named data_extraction.sql and the extracted data is in counter_service.csv file.

Data Preprocessing:

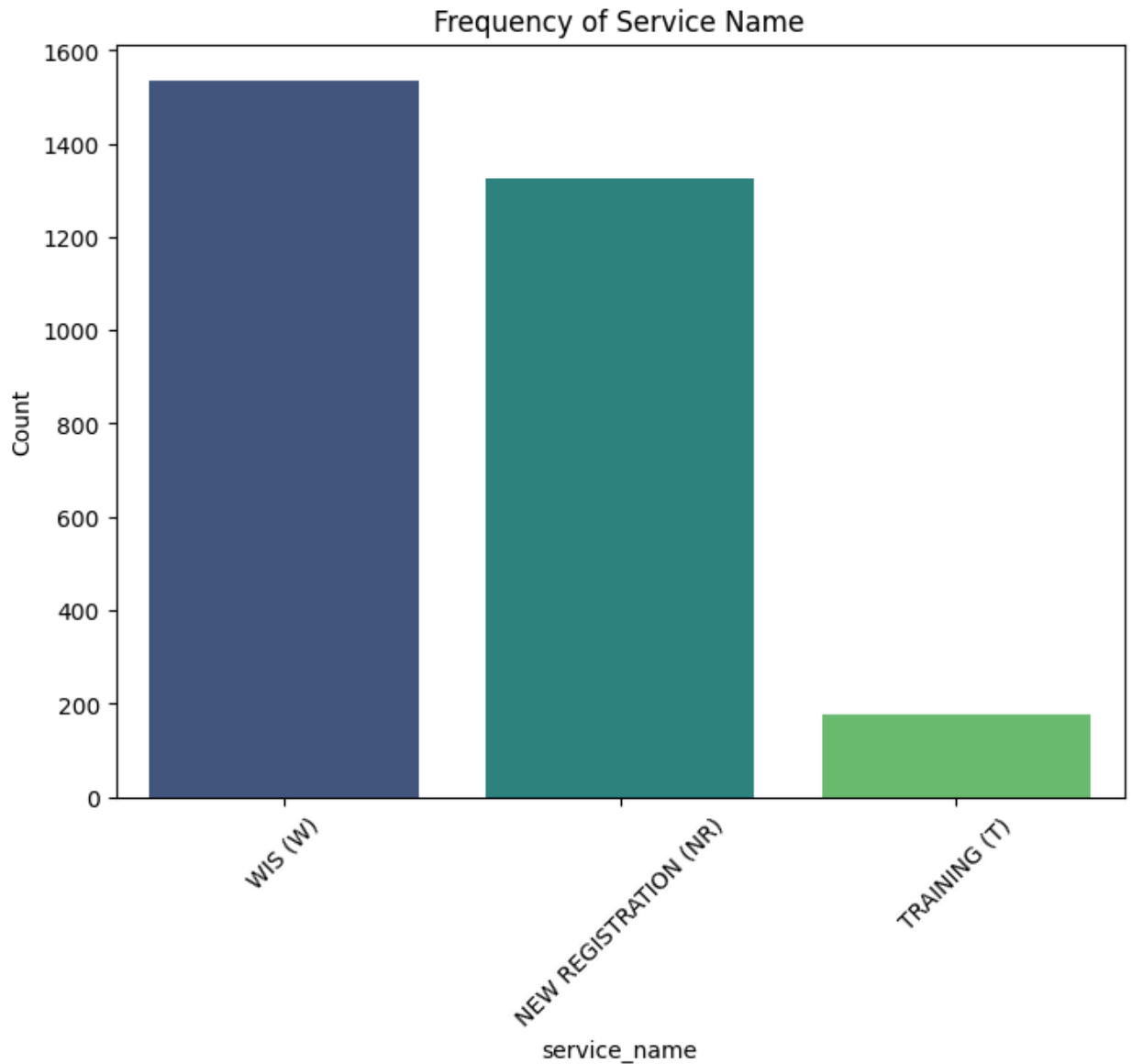
1. Called_date, started_date, ended_date are converted to pandas datetime formats
2. Waiting time, served time and turn around time are converted to seconds from HH:MM:SS format
3. Null values for each column are counted and imputed with suitable values.
 - a. Following columns have null values:
 - i. ended_at 19
 1. Filled with started time + global average served time
 - ii. served_time 617
 1. Filled with global average served time
 - iii. turn_around_time 617
 1. Filled with global average turn around time
 - iv. call status 19
 1. Filled with unknown status(seemed like a good idea to me)
4. Removed outliers from continuous data columns ['waiting_time_seconds', 'served_time_seconds', 'turn_around_time_seconds'] by dropping any columns with values less than lower bound or greater than the upper bound
 - a. lower_bound = $Q1 - 1.5 * IQR$
 - b. upper_bound = $Q3 + 1.5 * IQR$

Descriptive Statistics

1. Mean Values:
 - a. waiting_time_seconds 3891.881423
 - b. served_time_seconds 621.896529
 - c. turn_around_time_seconds 4467.004533
2. Median Values:
 - a. waiting_time_seconds 3562.500000
 - b. served_time_seconds 721.000000
 - c. turn_around_time_seconds 4872.068688
3. Standard Deviation Values:
 - a. waiting_time_seconds 2579.068876
 - b. served_time_seconds 310.403761
 - c. turn_around_time_seconds 2305.367558

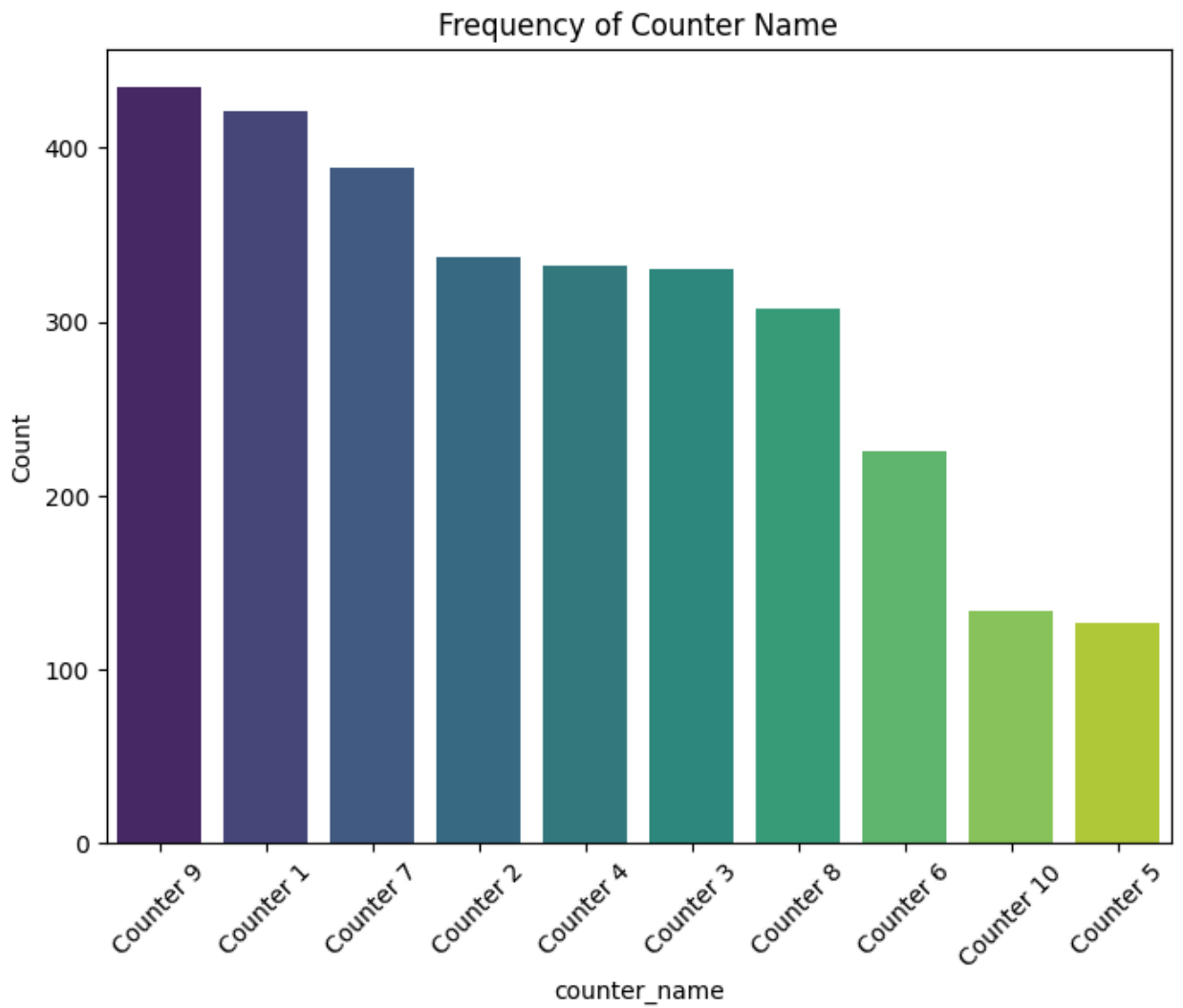
Visualizations, Correlations and Insights

1. Frequency of service names: Clearly, W service is sought the most by the users while people rarely call for T service.

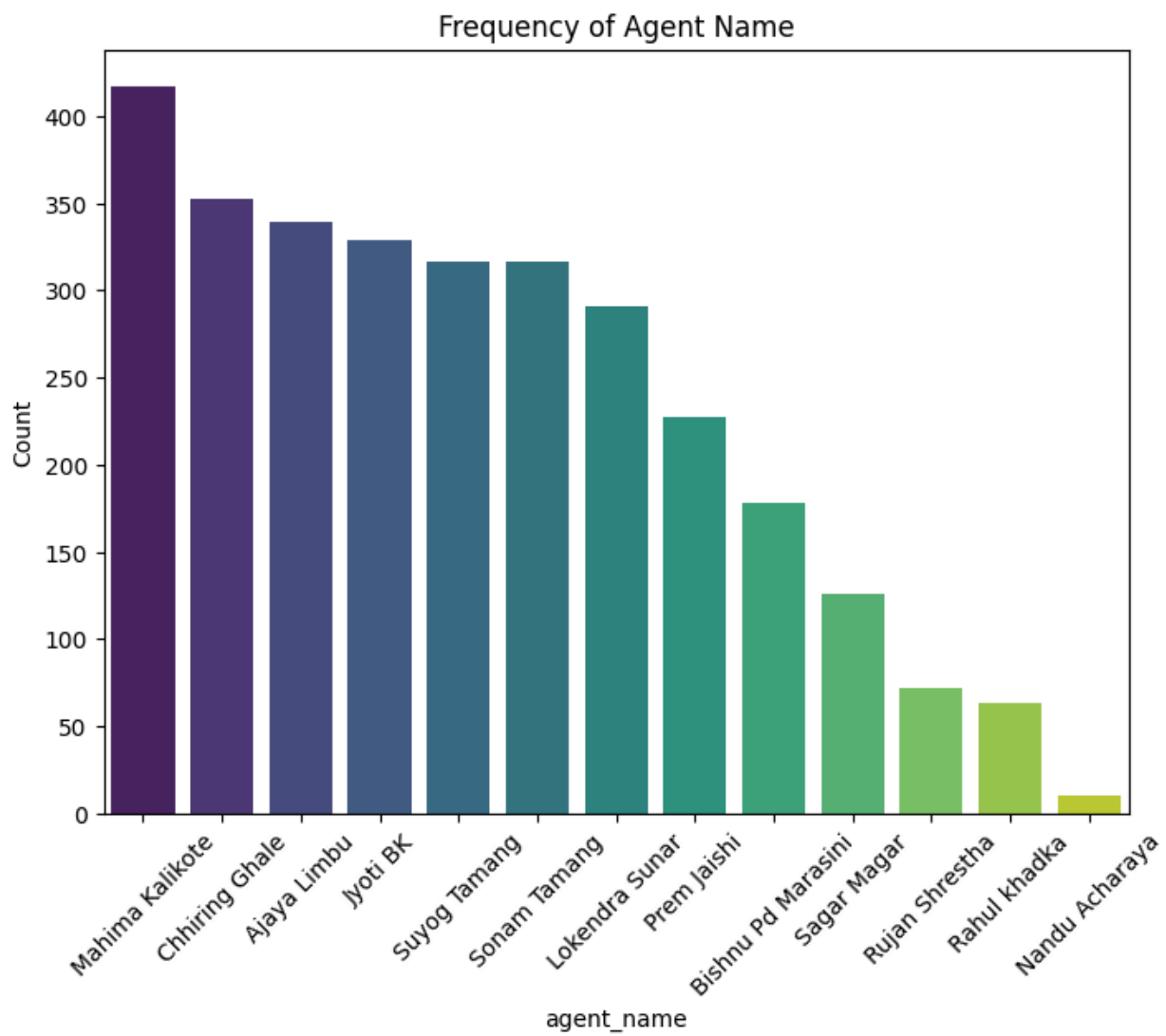


2. Frequency of counter name: Calls are not evenly distributed among the counters.
Counter 9 got almost 500 calls while counter 5 got only 100 calls in the period of January

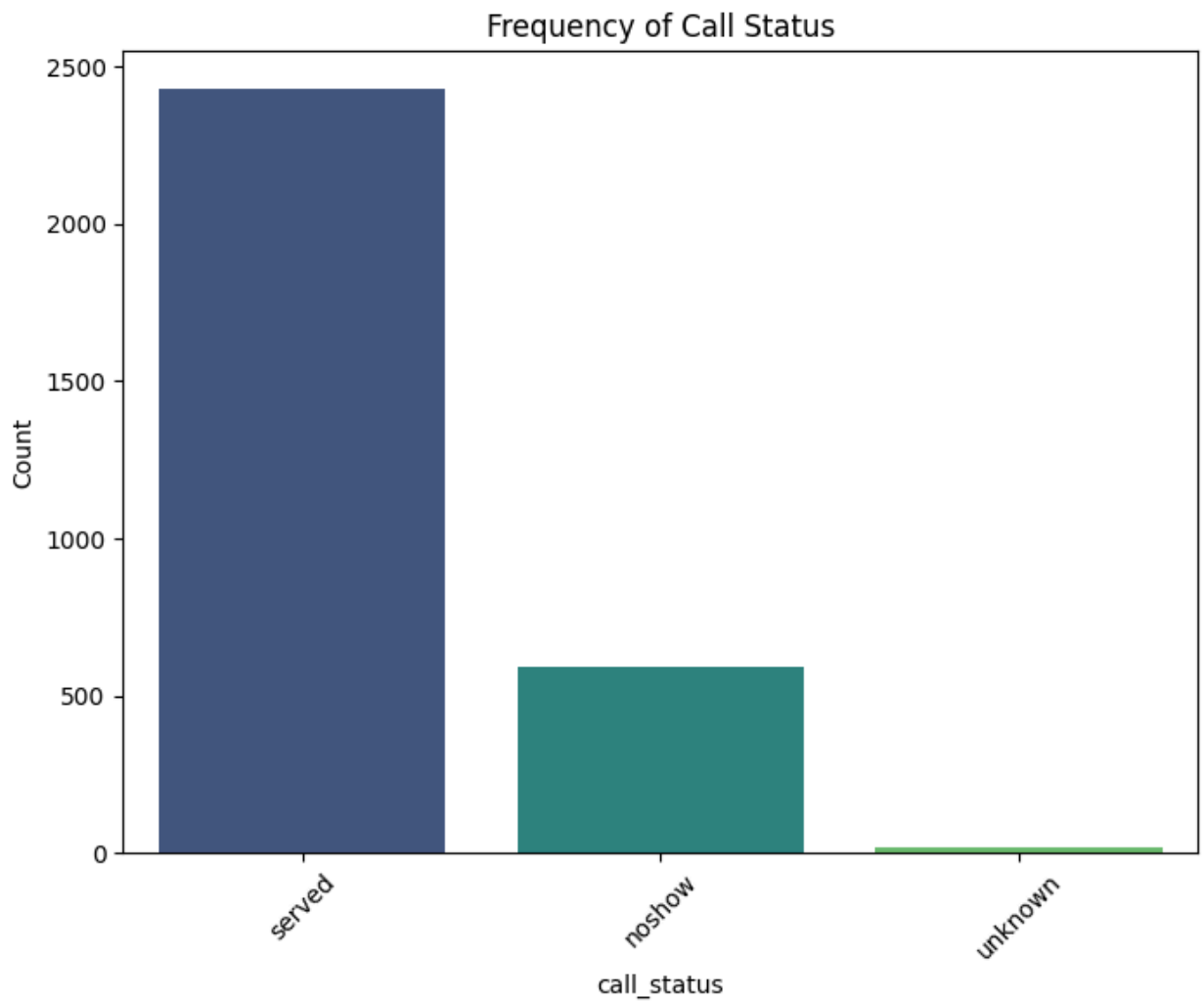
25 to february 17 of 2024.



3. Frequency of agent name: Some users like Mahima make significantly more calls than the others like Nandu.

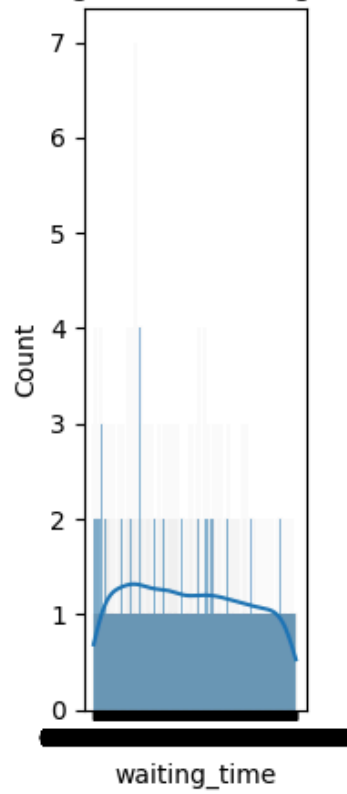


4. Frequency of call status: More than 80% of the calls are served but about 20% people couldn't be contacted. 20 calls have unknown status.

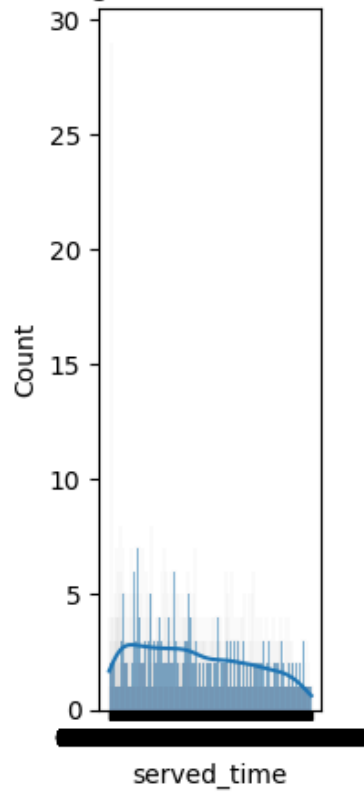


5. Histograms

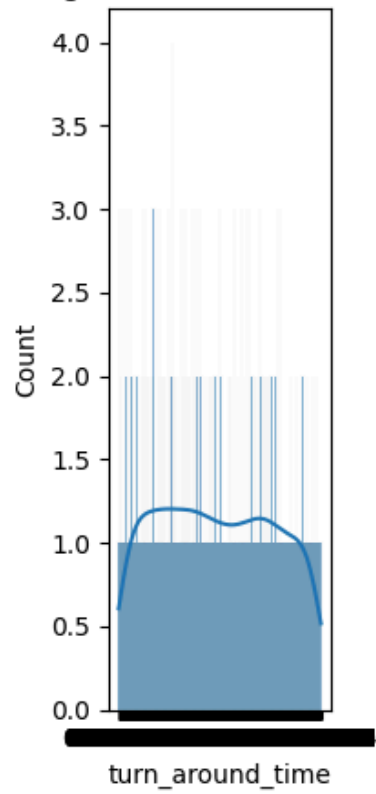
Histogram of Waiting Time



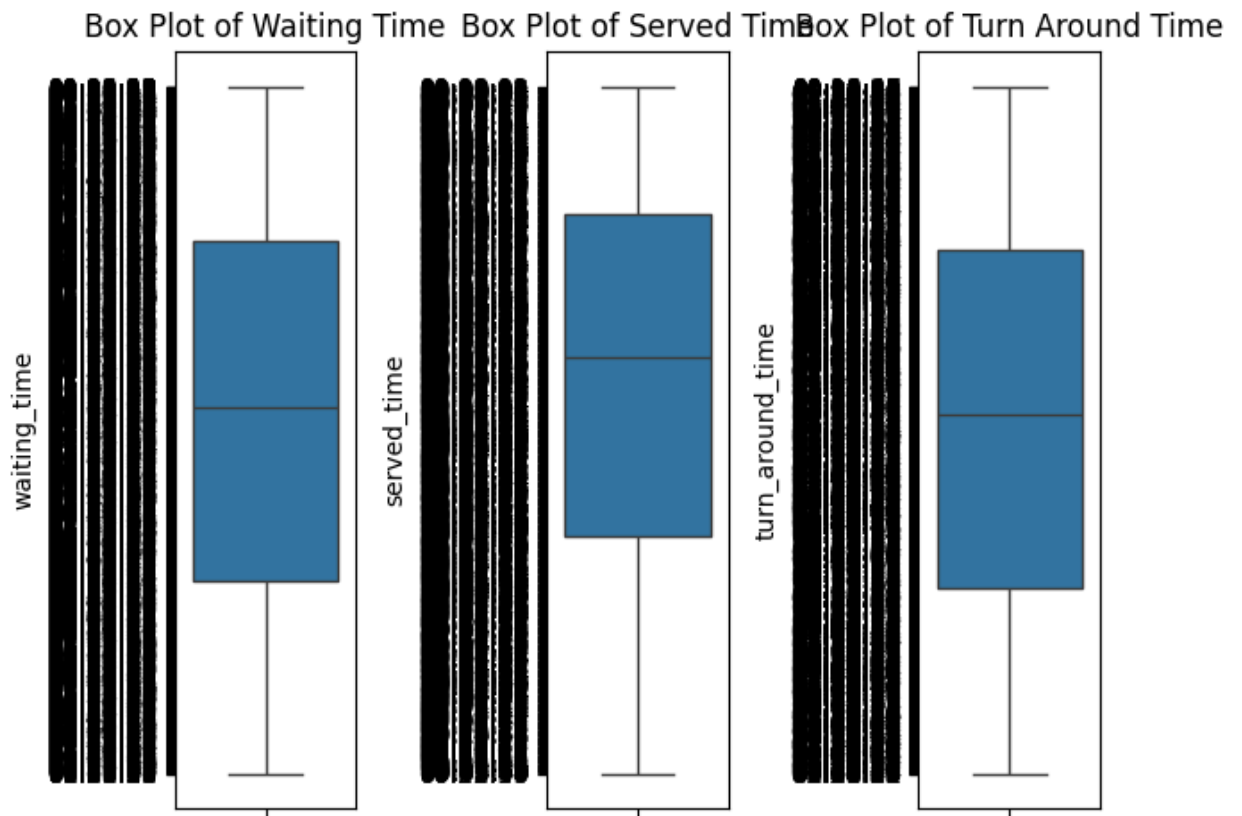
Histogram of Served Time



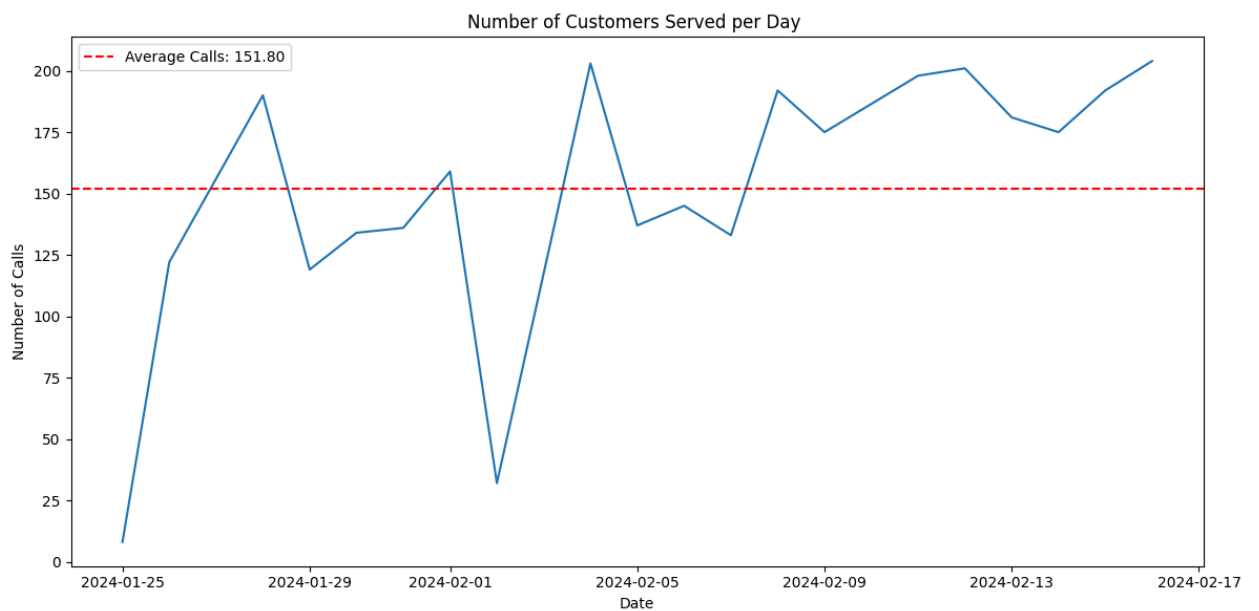
Histogram of Turn Around Time



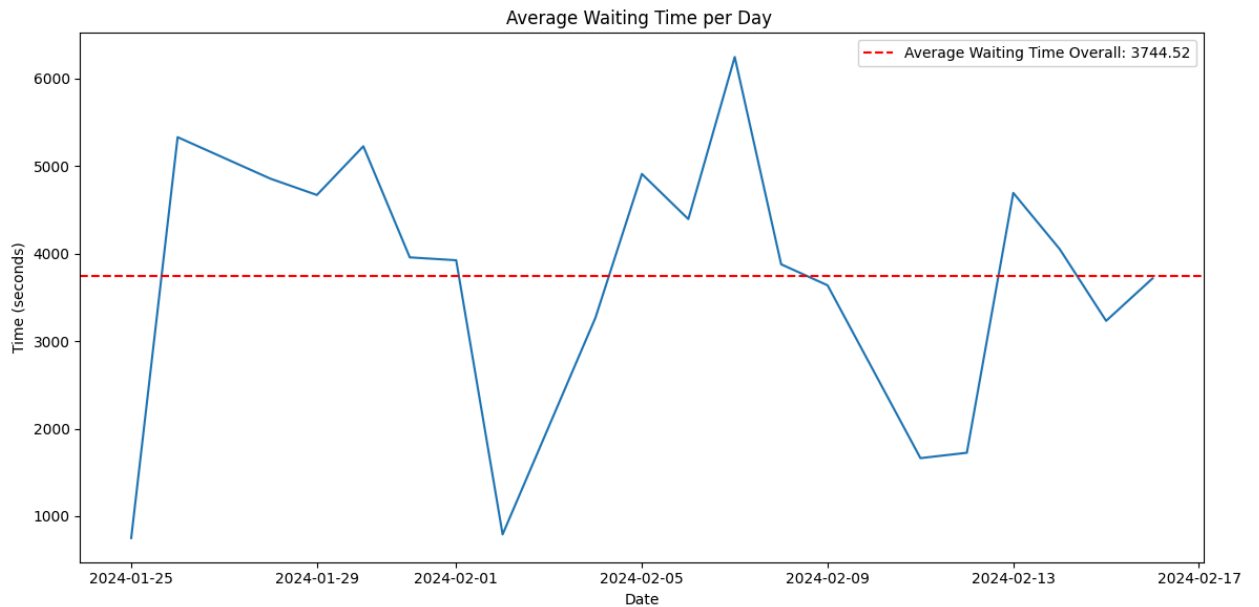
6. Box Plots: times are almost symmetrically distributed.



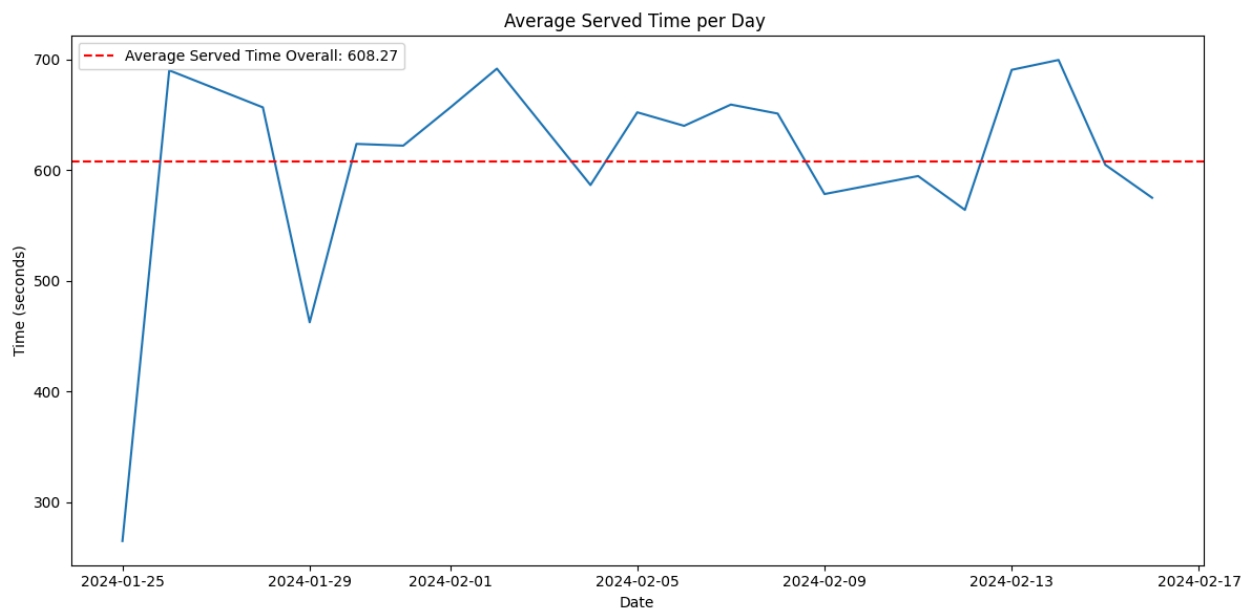
7. Number of customers served per day: There is no significant trend but the number of calls seem to be increasing with some exceptions. Jan 25 and Feb 2 have a very low number of calls. On an average 151 calls are made each day.



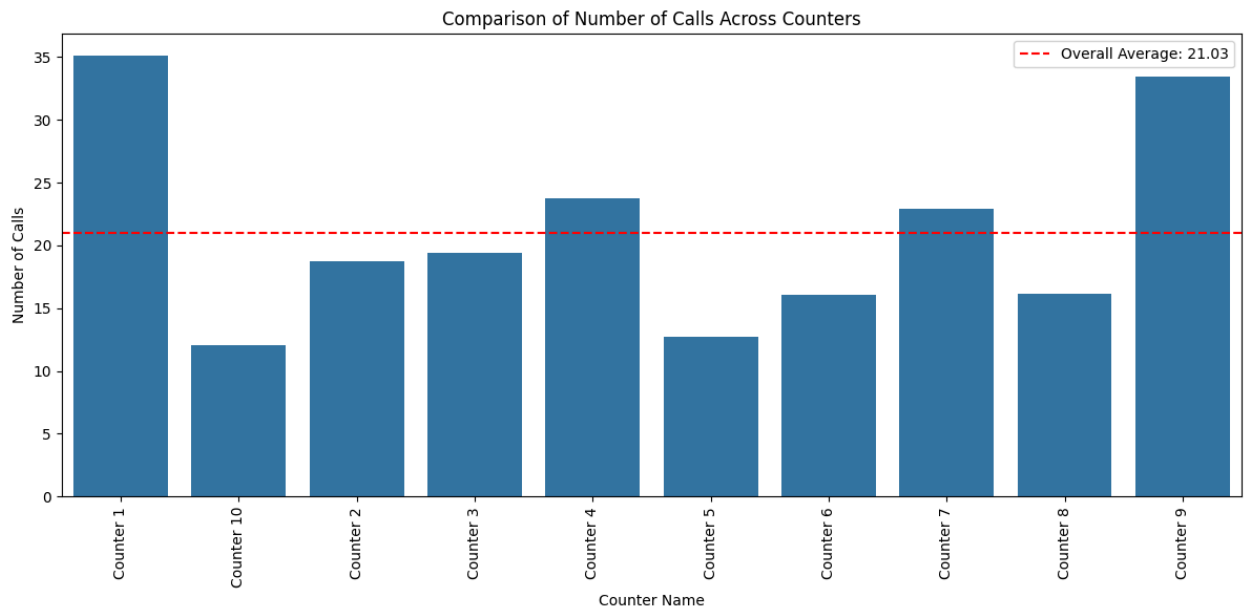
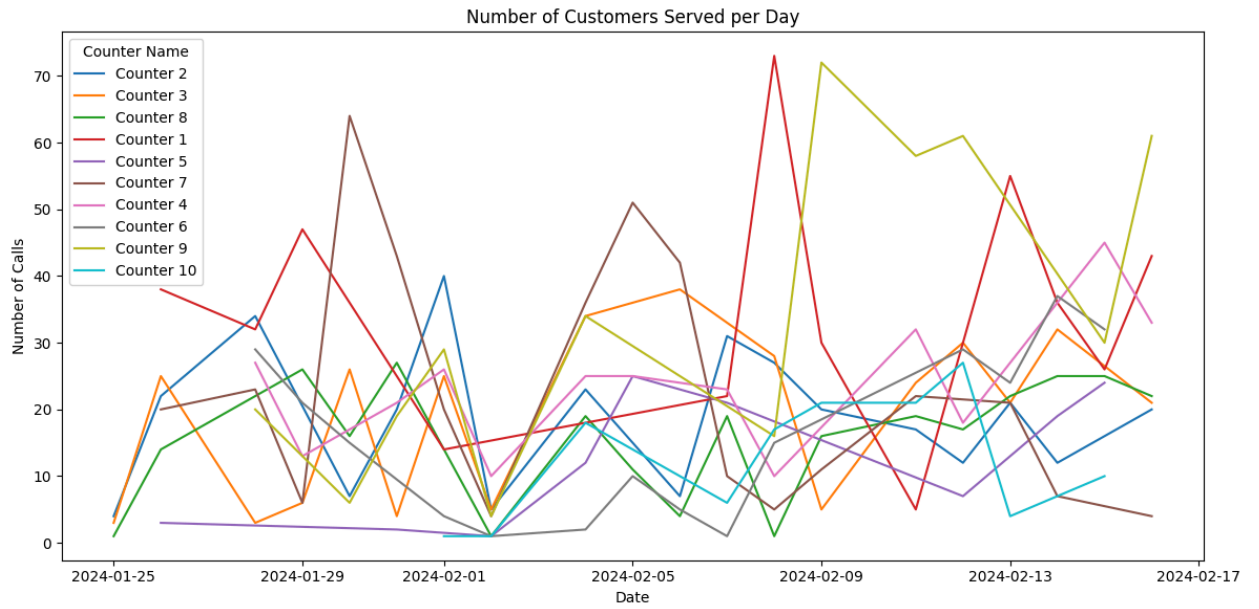
8. Average waiting time per day: Waiting time is very low on days with low frequency of calls. On average waiting time is 3744 sec or 62.4 minutes.



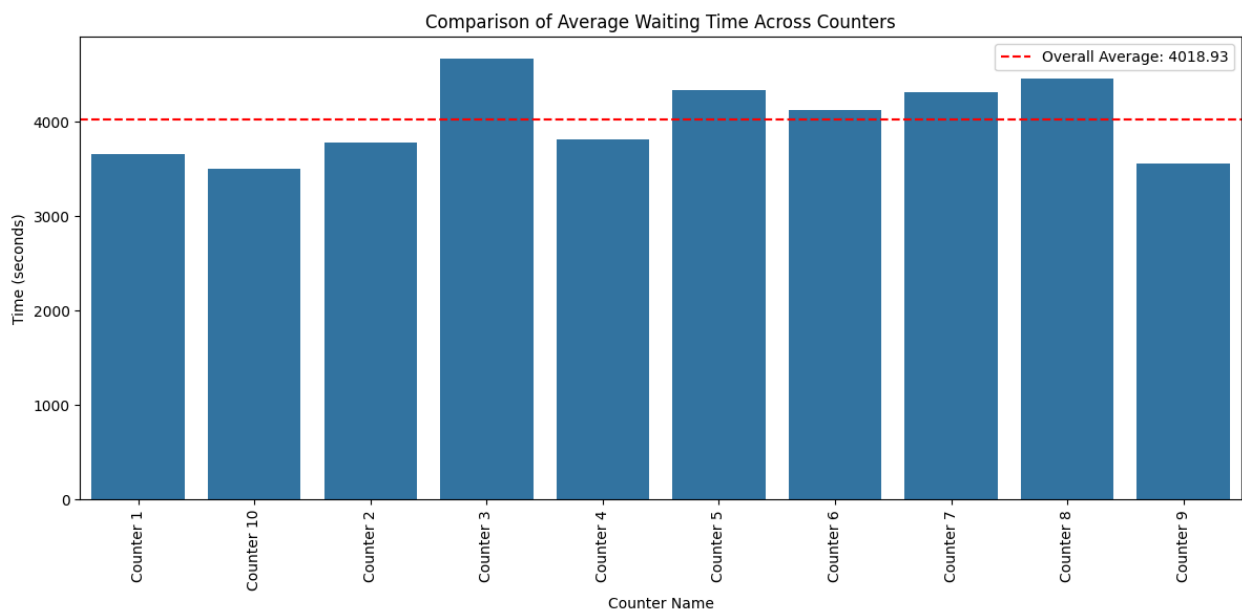
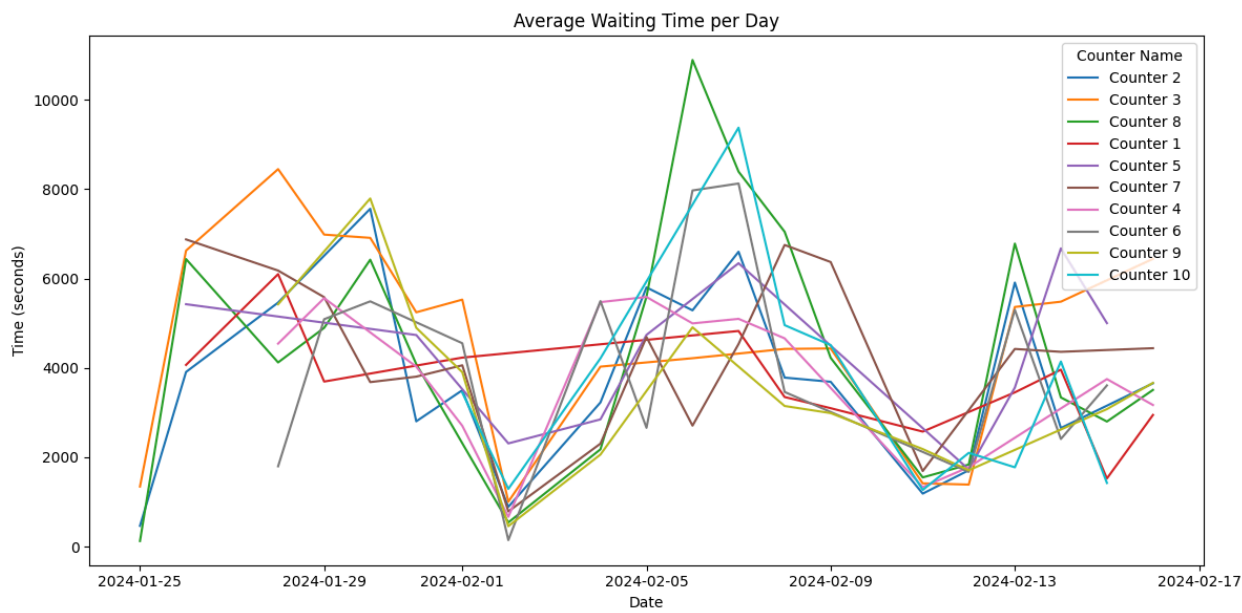
9. Average served time per day: On an average served time is about 10 minutes.



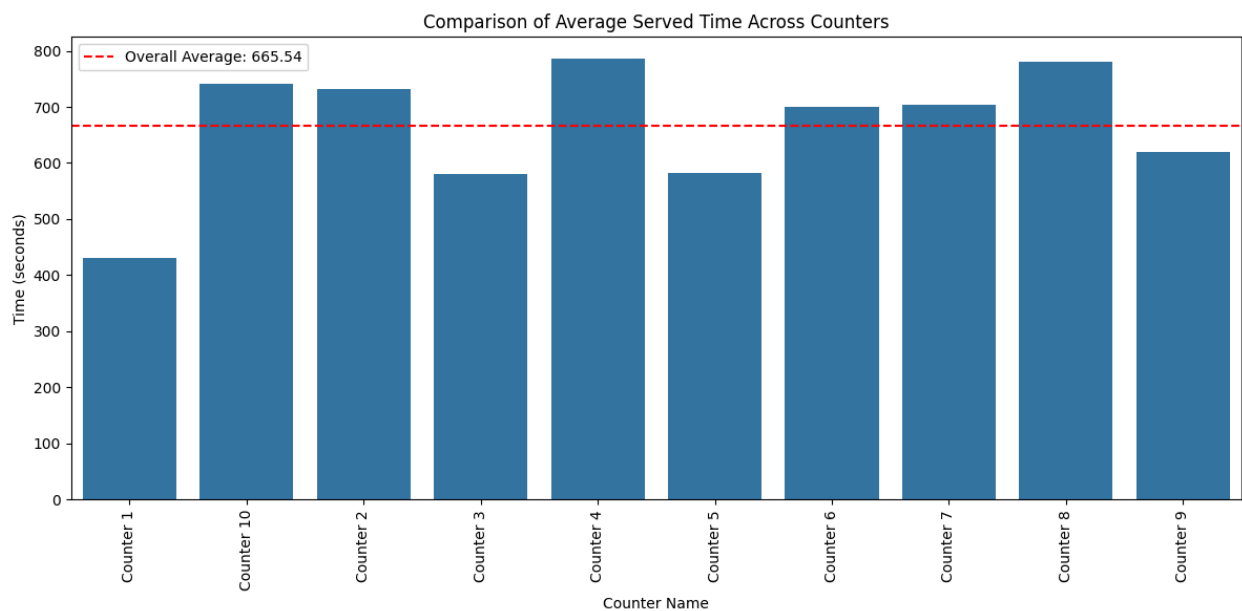
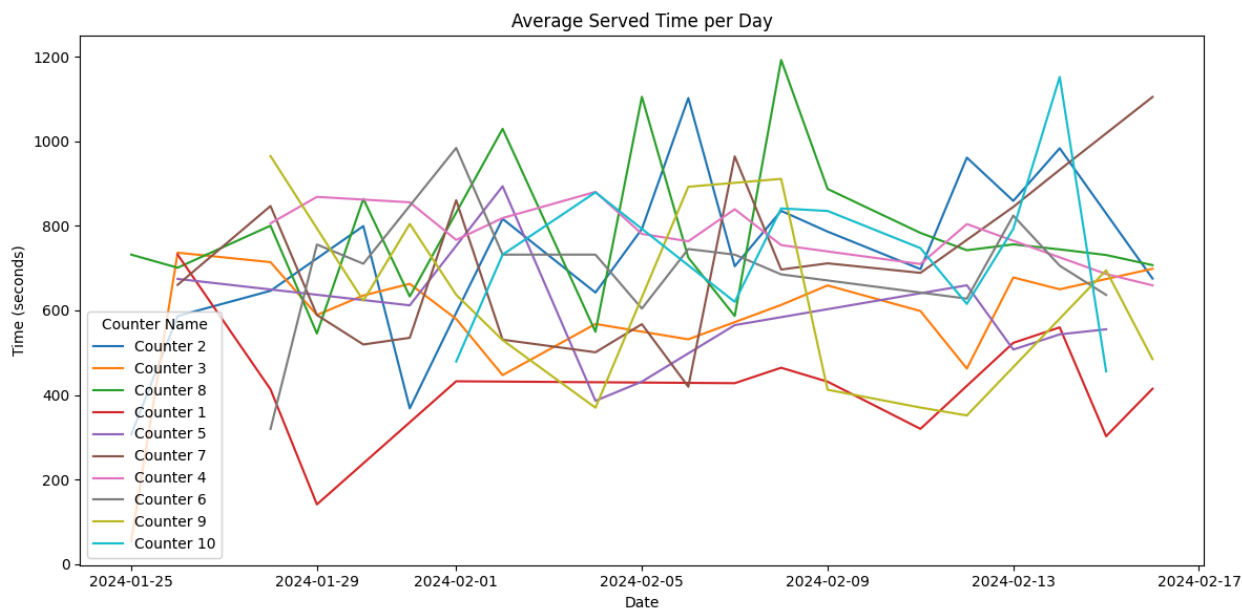
10. Counterwise calls per day: Some counters get higher calls than the others and the counters with higher average calls also have higher calls per day.



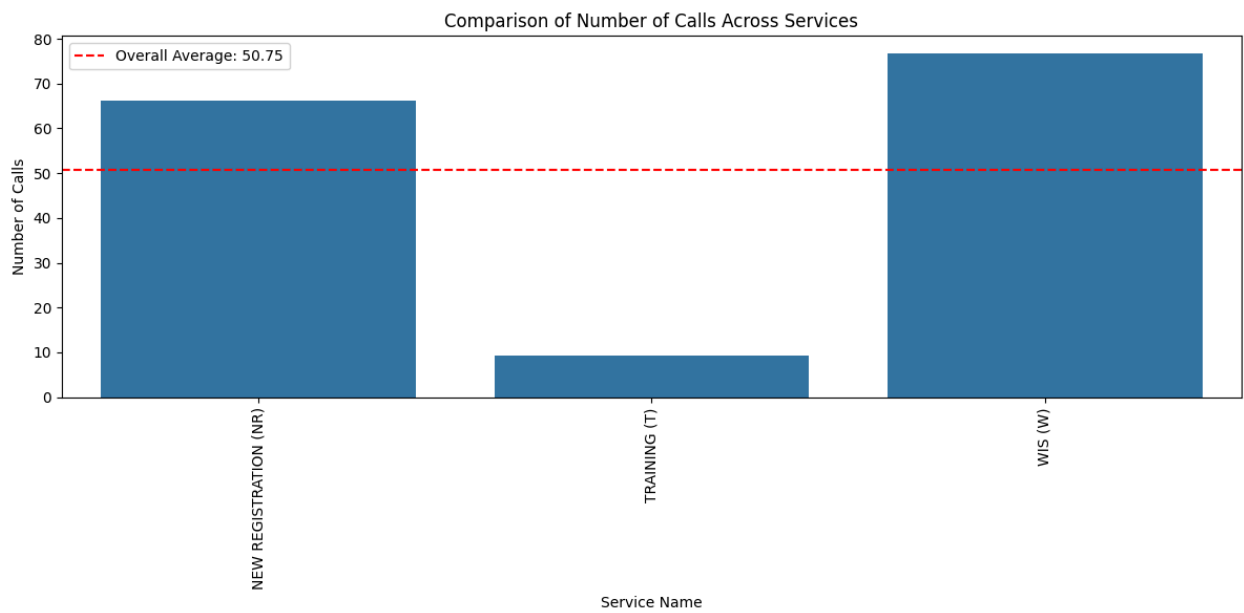
11. Counterwise waiting time per day



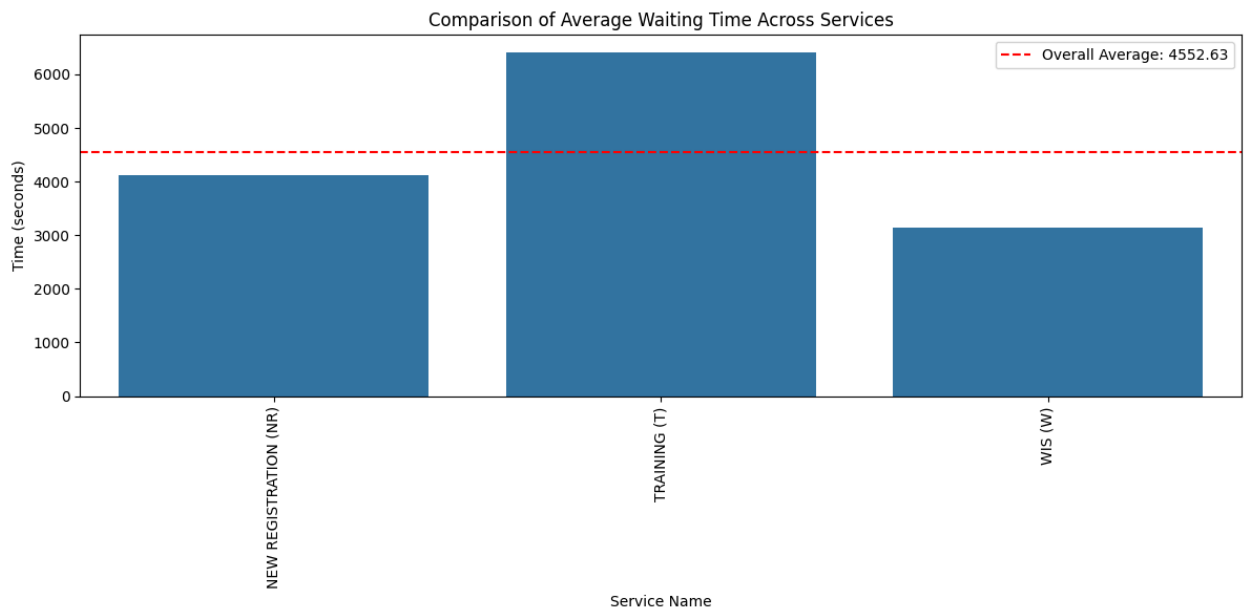
12. Counterwise served time per day



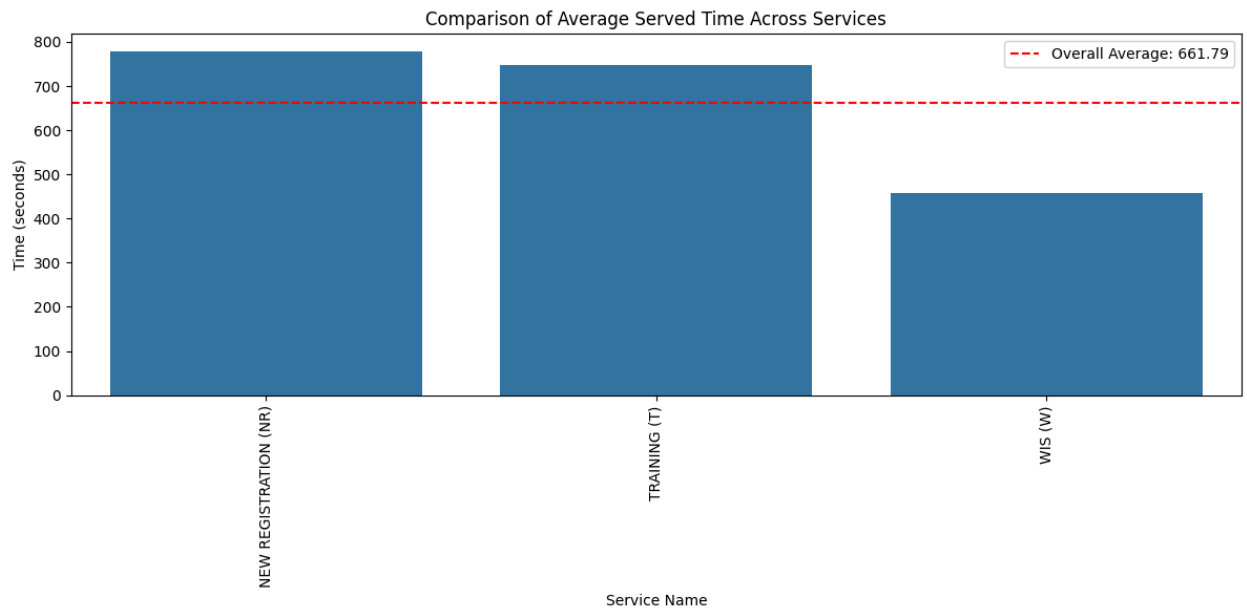
13. Servicewise calls per day: T service calls are fewer per day as well.



14. Servicewise waiting time per day



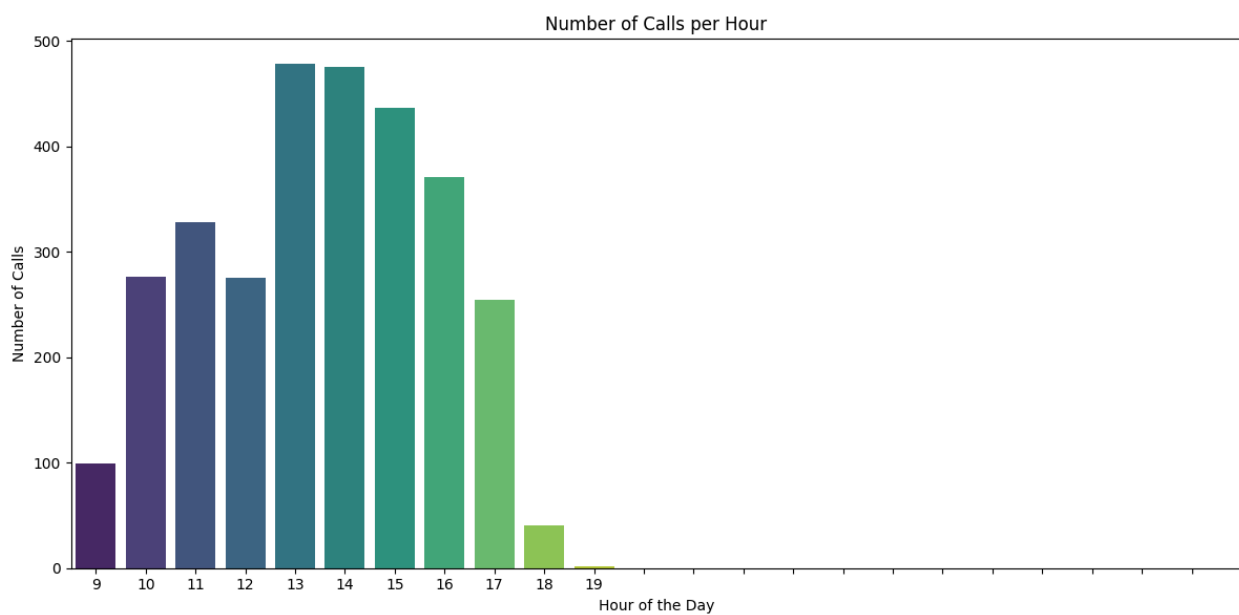
15. Servicewise served time per day



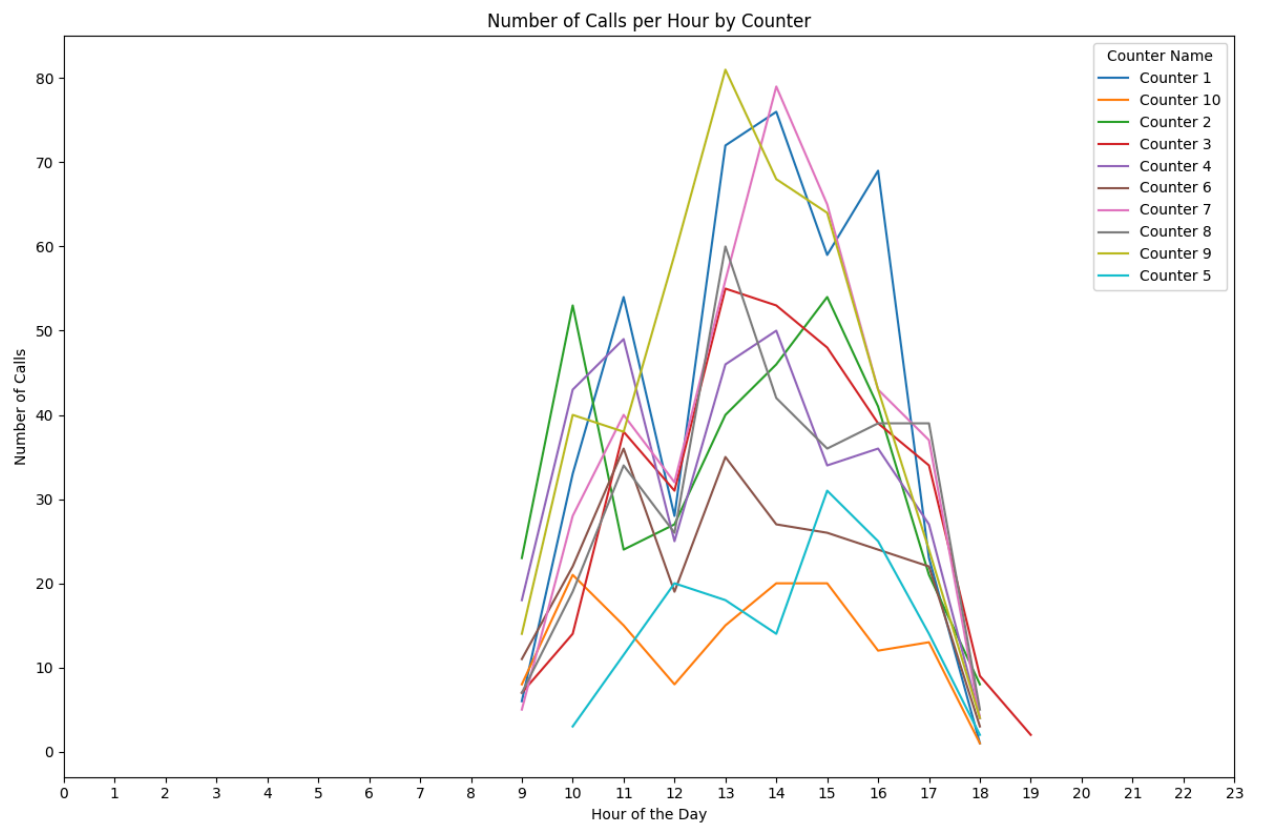
16. Correlation among ['service_id', 'counter_id', 'user_id', 'waiting_time_seconds', 'served_time_seconds', 'turn_around_time_seconds', 'call_status_numeric']
- High correlation between service type and served time indicates the type of service significantly affects the time taken to serve.
 - Strong positive correlation between waiting time and turnaround time suggests that higher waiting times lead to longer turnaround times.
 - Moderate correlation between service type and waiting time means that certain services have longer waiting periods.
 - High correlation between user and served time implies that some users consistently require more service time.
 - Positive correlation between served time and turnaround time indicates that longer served times result in longer turnaround times.
 - Positive correlation between waiting time and served time shows that longer waiting times often lead to longer served times.
 - Very low correlation between call status and other factors suggests it is independent of service and time variables.



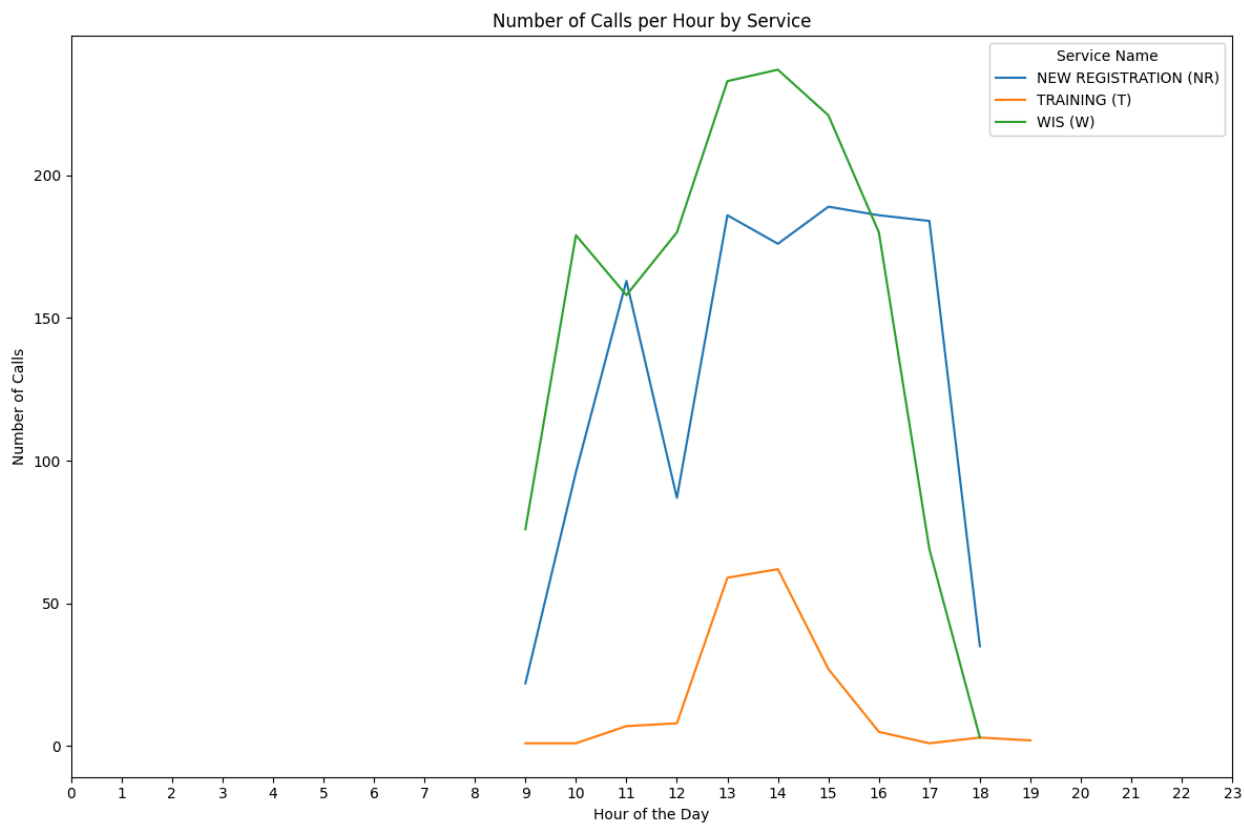
17. Calls per hour: 1pm to 3pm are peak hours.



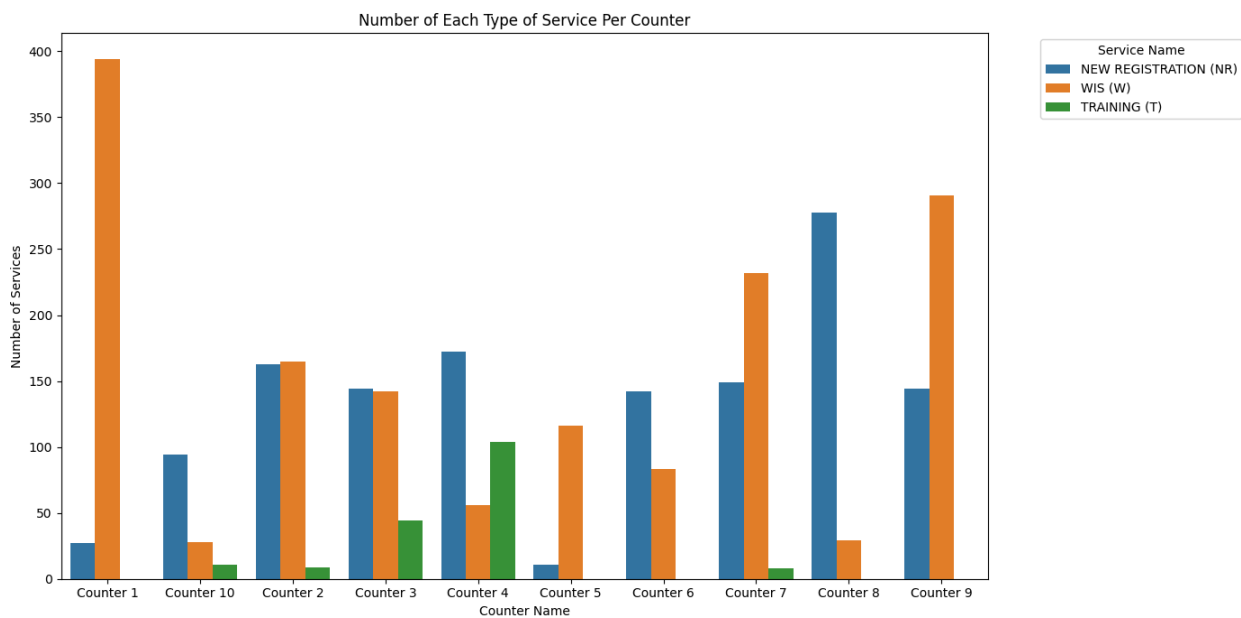
18. Calls per hour grouped by counter: most calls are made by counters 9,1 and 7 during peak hours.



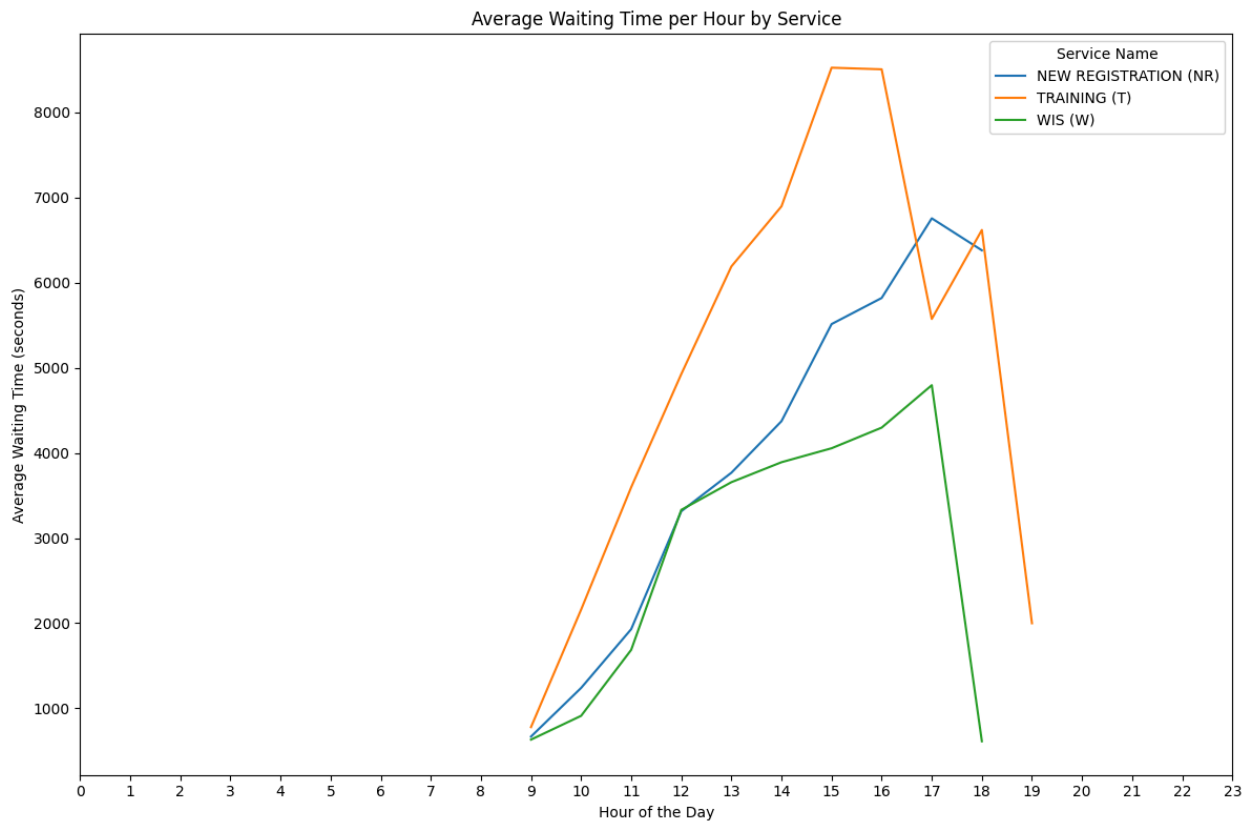
19. Calls per hour by service



20. Number of service calls made by each counter



21. Waiting time is significantly higher during peak hours



Insights

- Calls are unevenly distributed among counters.
- 20% of calls are no shows.
- January 25 and February 2 have very low call volumes.
- On average, 151 calls are made each day.
- Average waiting time is 62.4 minutes; lower on days with fewer calls.
- Longer wait times for training services due to limited counters (mainly 3 and 4) handling these calls.
- W services have shorter waiting and served periods.
- Counters 9 and 1 handle more calls, while counters 10 and 5 underperform.
- 45% of calls are made between 1 pm and 3 pm.

Recommendations

- Balance calls and services across all counters.
- Provide T services at all counters to reduce wait times.
- Add more staff during peak hours to handle higher call volume.
- Investigate and enhance the performance of counters 10 and 5.