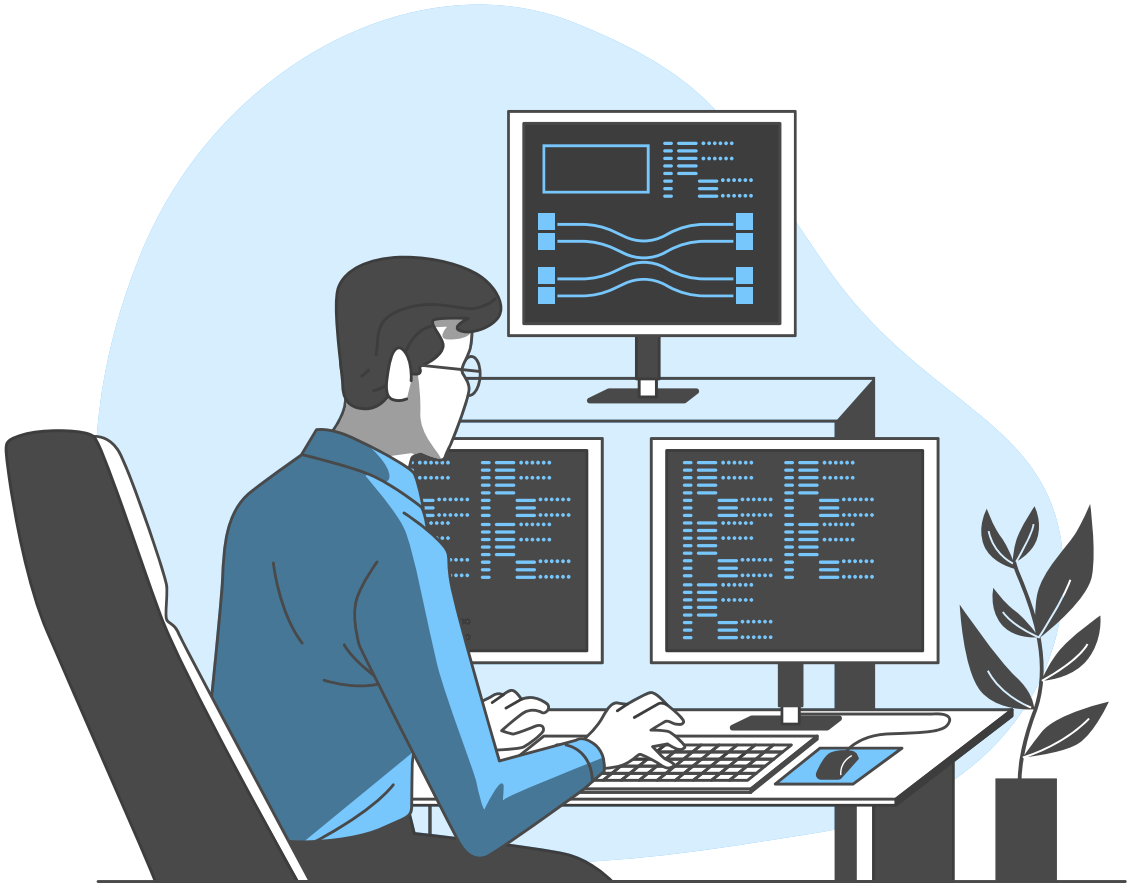
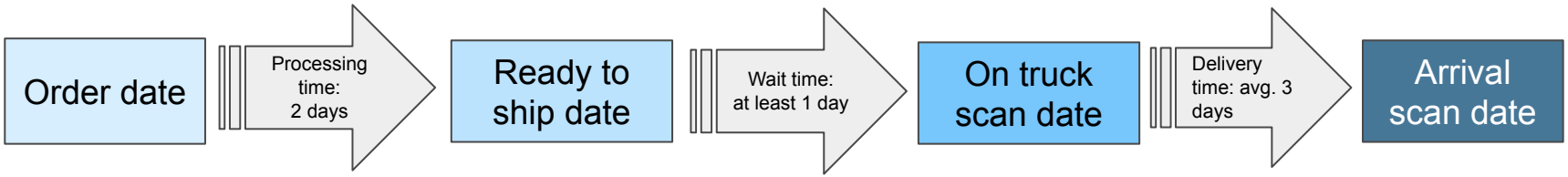


Analyzing a delivery process

Group 5
Adam, André, Kewen, Sasan

Workflow: understanding order & delivery process



Only Mo-Fr

Truck leaving only Mo, We, Fri

Express processing: minimum wait time = 0 days, but no additional trucks

Final delivery only Mo-Fr

Customer scan

Customer scans only available for subgroup of deliveries

Assumption: scan date = arrival date

KPIs

Total time (order until arrival in days)

=

Mean
95% quantile
Distribution

Percentage of orders for which expected time is met

- Normal delivery
- Express delivery

+

Processing time in warehouse (in days)

Mean
95% quantile
Distribution

Percentage of orders for which expected time is met

- Normal delivery
- Express delivery

+

Wait time from “Ready to ship” to “on truck” (in days)

Mean
95% quantile
Distribution

Percentage of orders for which expected time is met

- Normal delivery
- Express delivery

+

Delivery time (in days)

Mean
95% quantile
Distribution

Percentage of orders for which expected time is met

- Normal delivery
- Express delivery

Hypothesis and goal

Hypothesis:

- The delivery process is not fully satisfactory and can be optimized.
- In particular, we do not always meet our expectations with respect to total delivery times and the different steps of the delivery process.

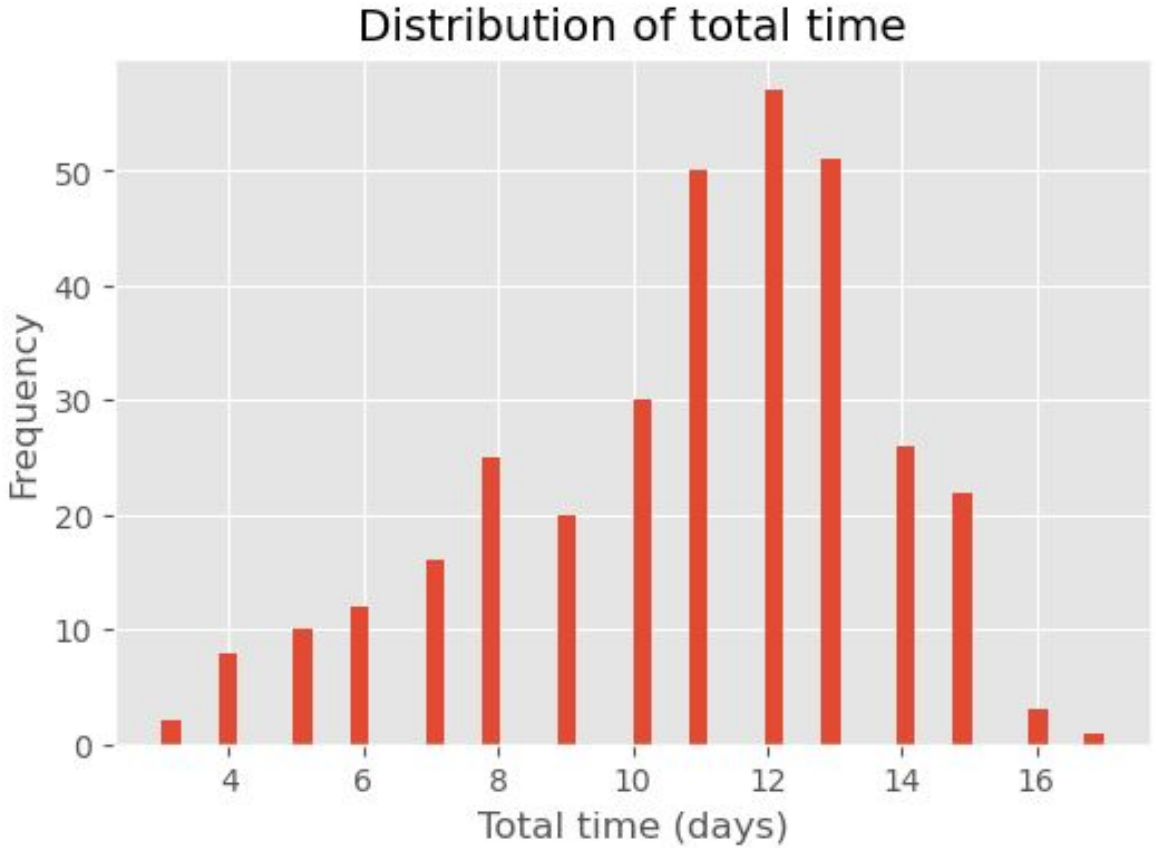
Goals: identify potential for improvement in the delivery process

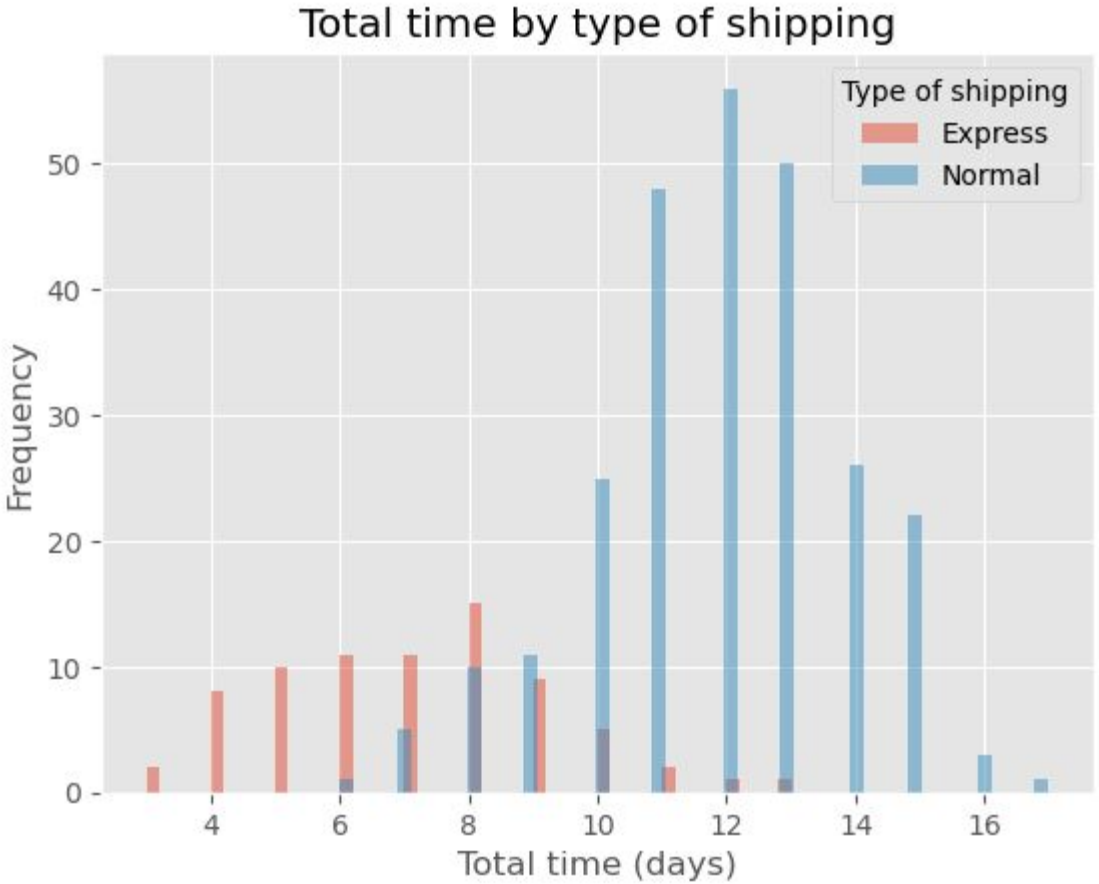
Table of contents

01
Total metrics

Metrics overview for: Total time (in days)

	Overall	Normal delivery	Express delivery
count	333	258	75
mean	**10.83**	**11.93**	**7.05**
std	2.86	1.96	2.16
min	3.00	6.00	3.00
25%	9.00	11.00	5.00
50%	11.00	12.00	7.00
75%	13.00	13.00	8.00
95%	**15.00**	**15.00**	**10.30**
max	17.00	17.00	13.00


Distribution of total time
Frequency
0
10
20
30
40
50
4
6
8
10
12
14
16
Total time (days)

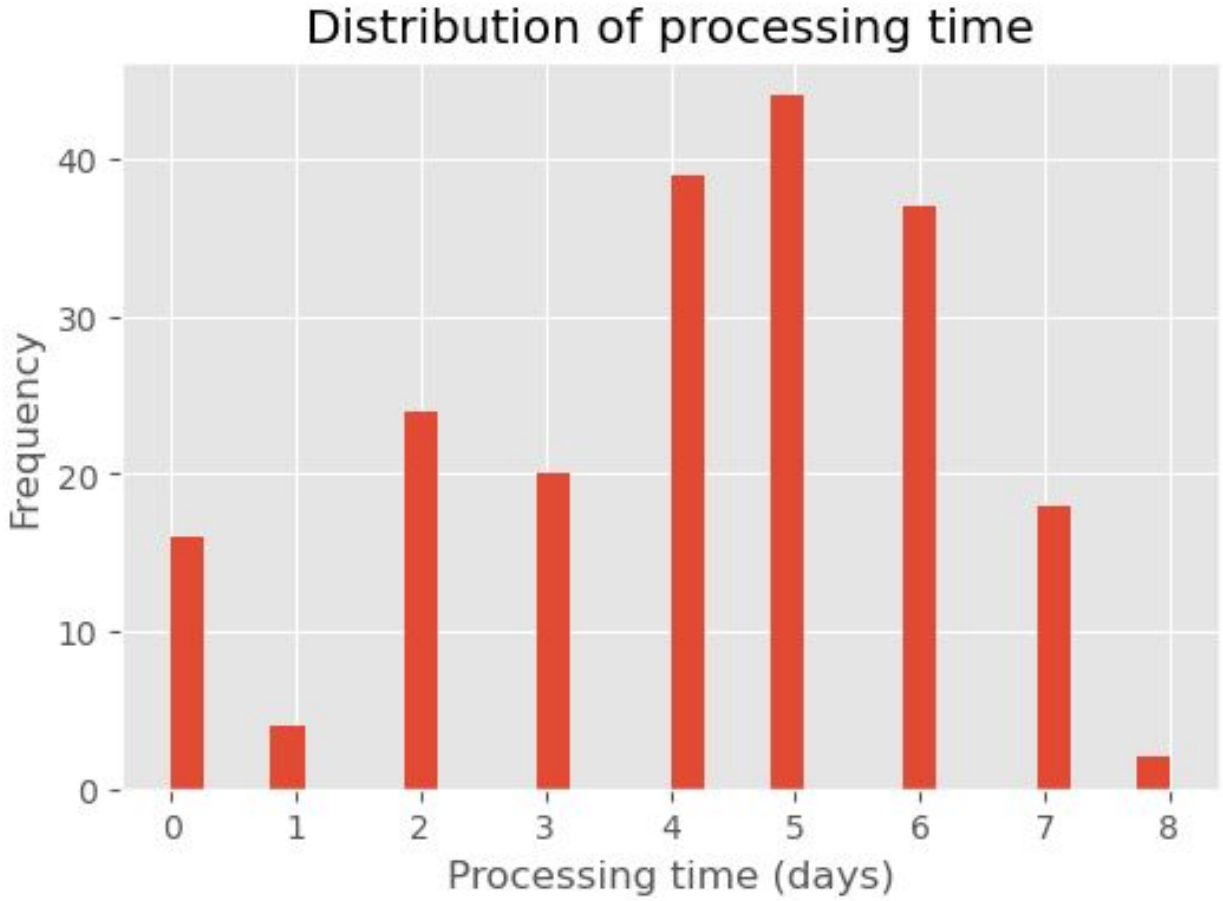

Total time by type of shipping
Type of shipping
Express
Normal
Frequency
0
10
20
30
40
50
4
6
8
10
12
14
16
Total time (days)

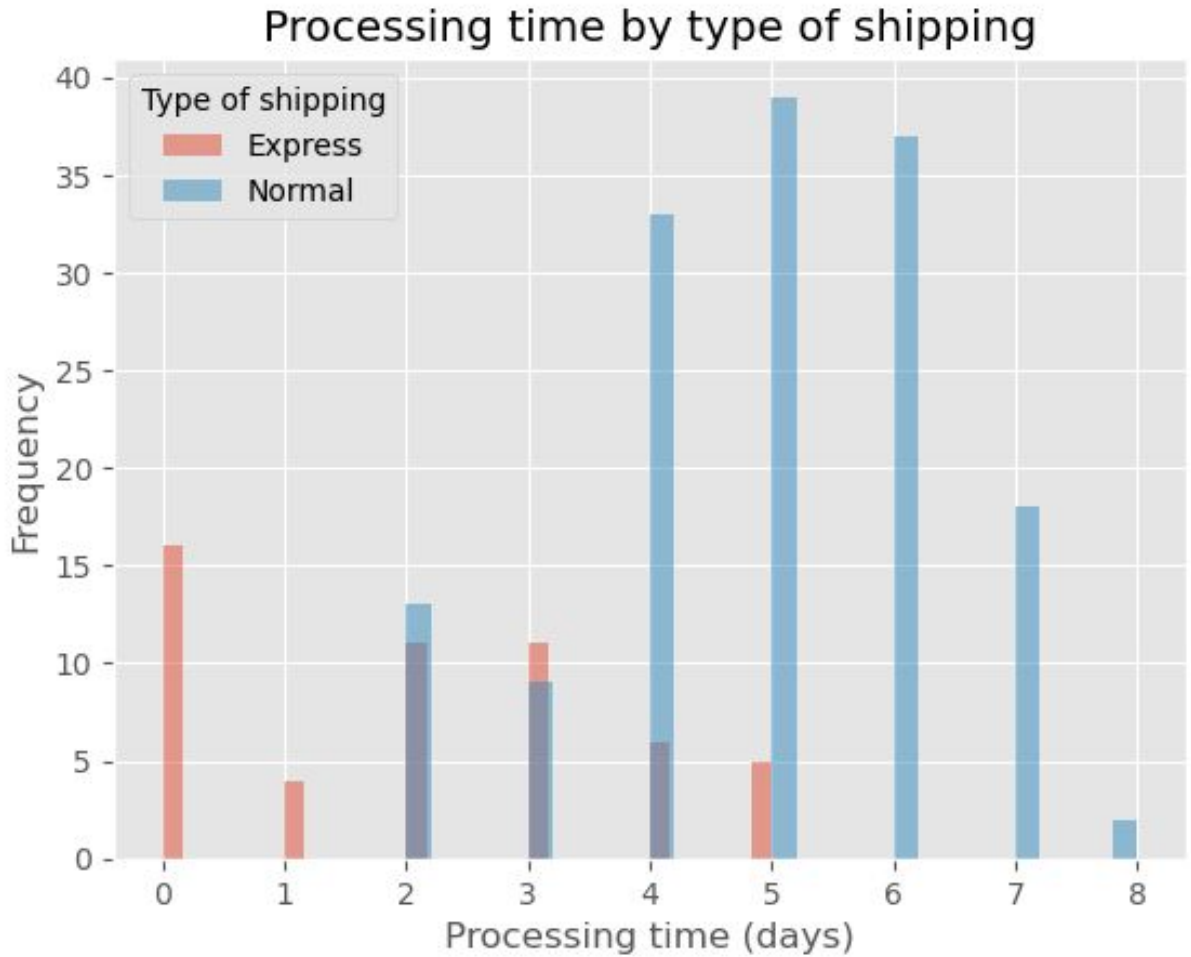
Total time should not exceed the sum of the expected time spans, i.e.:
4 + 3 + 5 = 12 days

02
Processing

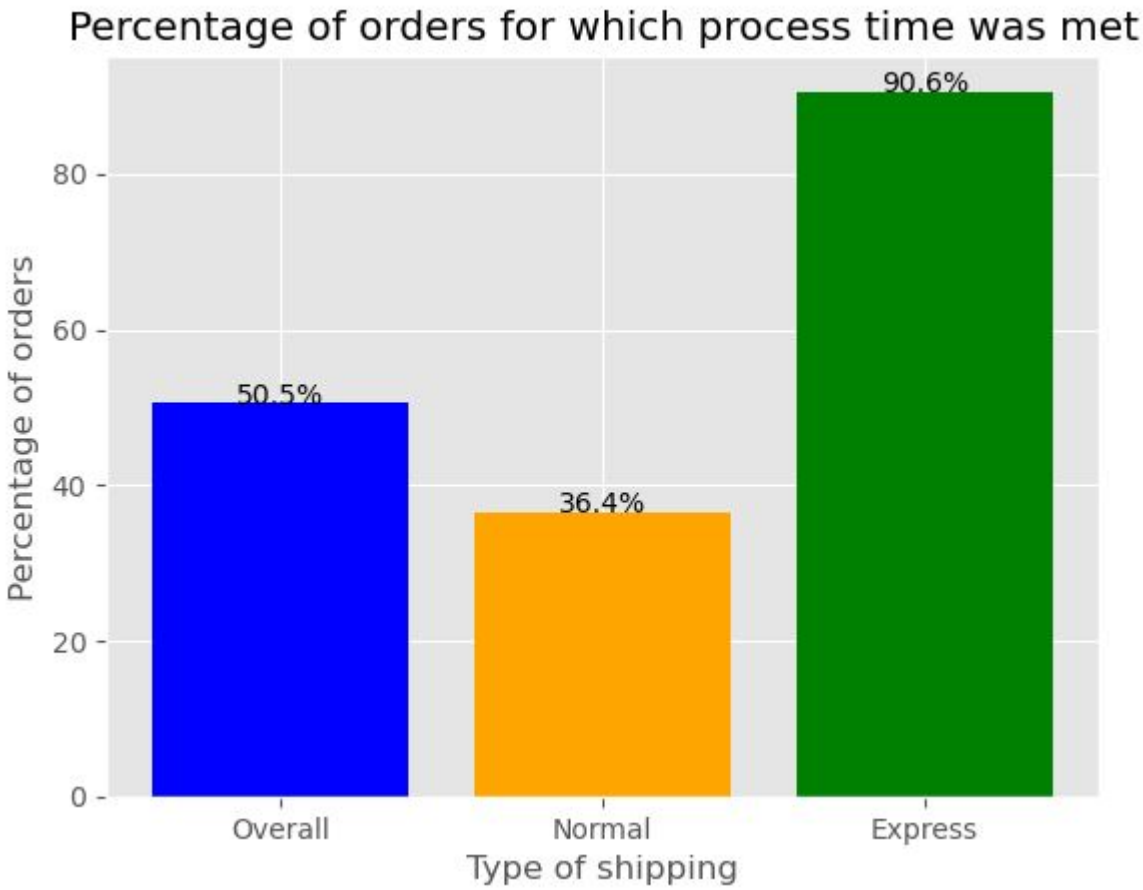
Metrics overview for: Processing time (in days)

	Overall	Normal delivery	Express delivery
count	204	151	53
mean	**4.18**	**4.93**	**2.04**
std	1.97	1.44	1.69
min	0.00	2.00	0.00
25%	3.00	4.00	0.00
50%	4.00	5.00	2.00
75%	6.00	6.00	3.00
95%	**7.00**	**7.00**	**5.00**
max	8.00	8.00	5.00


Distribution of processing time
Frequency
0
10
20
30
40
0
1
2
3
4
5
6
7
8
Processing time (days)


Processing time by type of shipping
Type of shipping
Express
Normal
Frequency
Processing time (days)
0
5
10
15
20
25
30
35
40
0
1
2
3
4
5
6
7
8

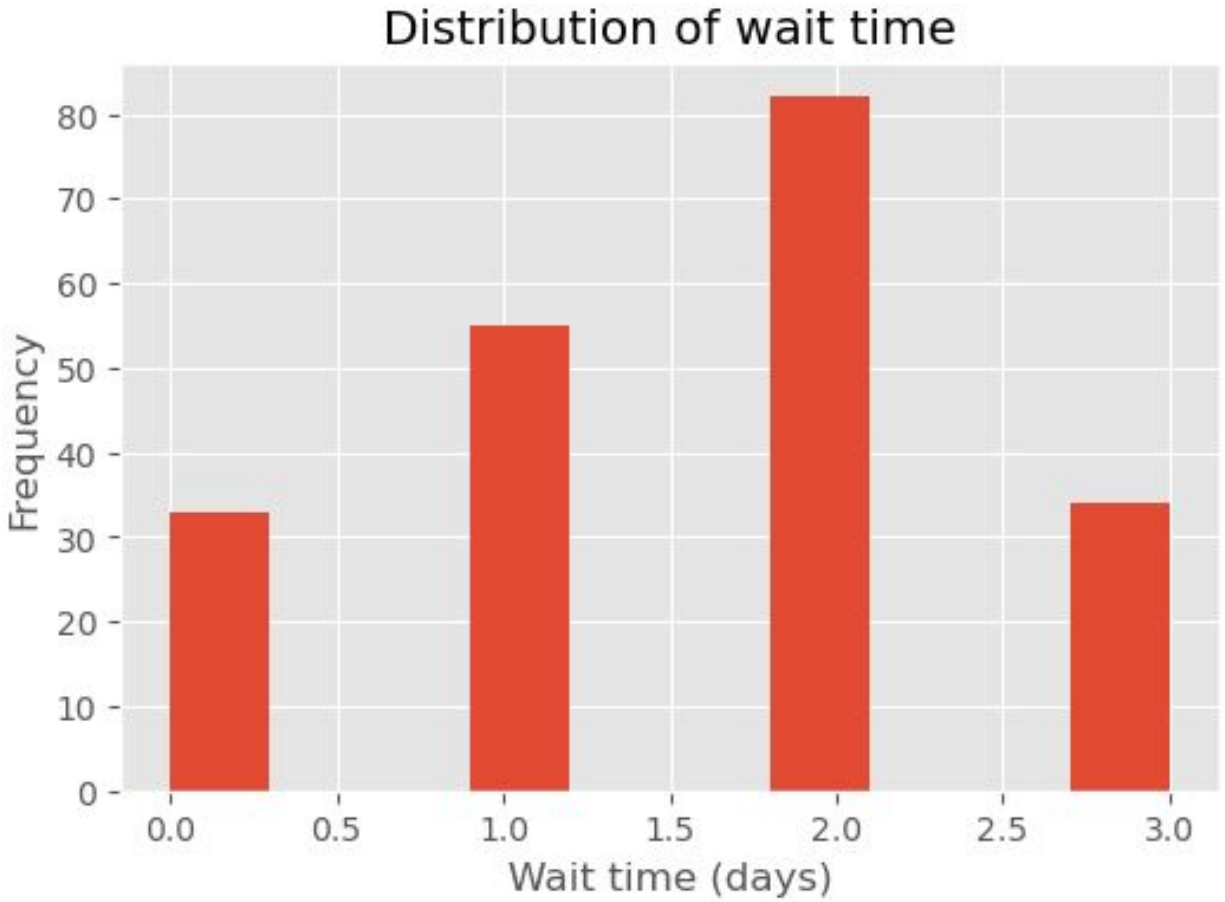
Processing time should not exceed 2 days (+ weekend) = 4 days.

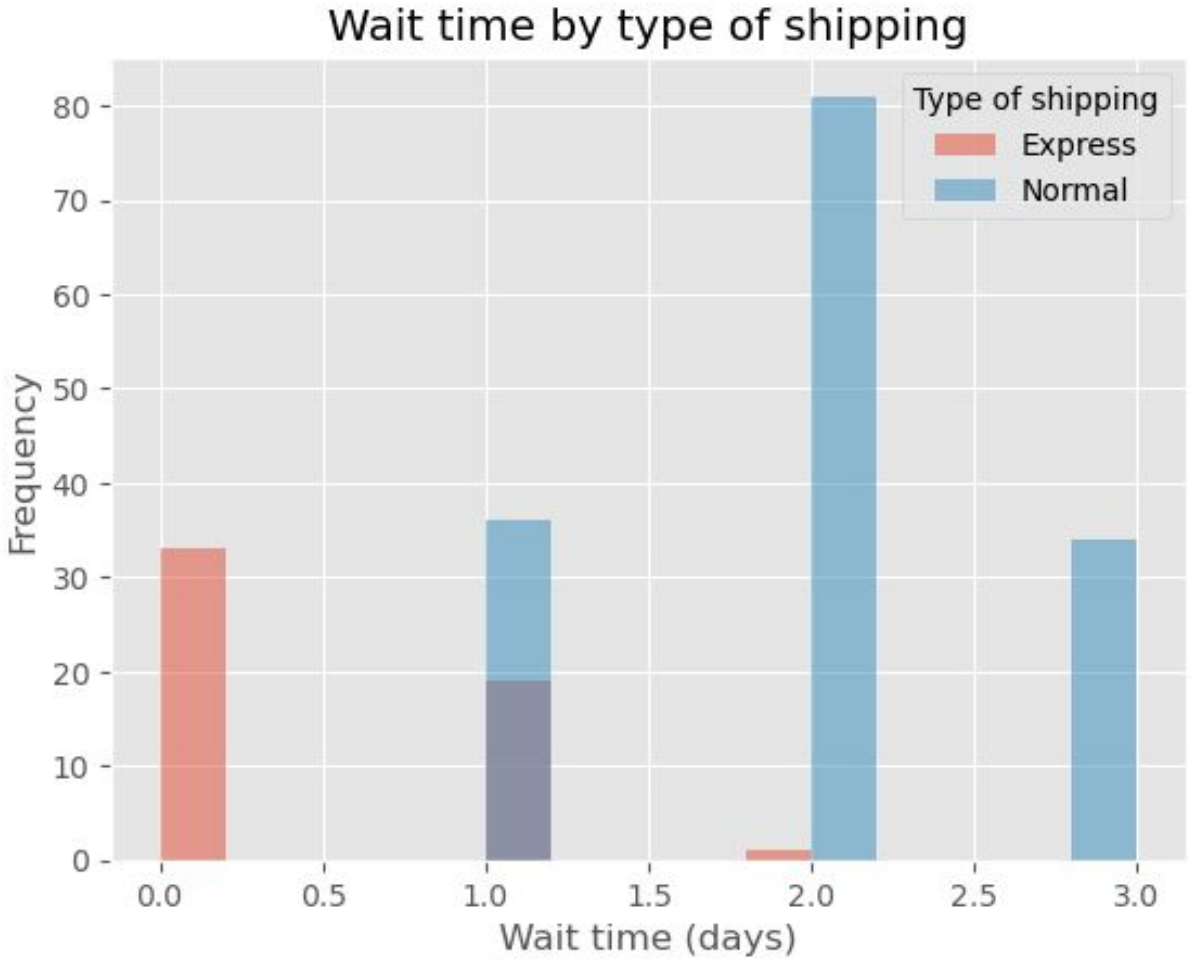


03
Ready to ship

Metrics overview for: Wait time (in days)

	Overall	Normal delivery	Express delivery
count	204	151	53
mean	**1.57**	**1.99**	**0.40**
std	0.95	0.68	0.53
min	0.00	1.00	0.00
25%	1.00	2.00	0.00
50%	2.00	2.00	0.00
75%	2.00	2.00	1.00
95%	**3.00**	**3.00**	**1.00**
max	3.00	3.00	2.00


Distribution of wait time
Frequency
0
10
20
30
40
50
60
70
80
0.0
0.5
1.0
1.5
2.0
2.5
3.0
Wait time (days)


Wait time by type of shipping
Type of shipping
Express
Normal
Frequency
80
70
60
50
40
30
20
10
0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
Wait time (days)

Wait time should not exceed 3 days (Friday to Monday).

04
Delivery

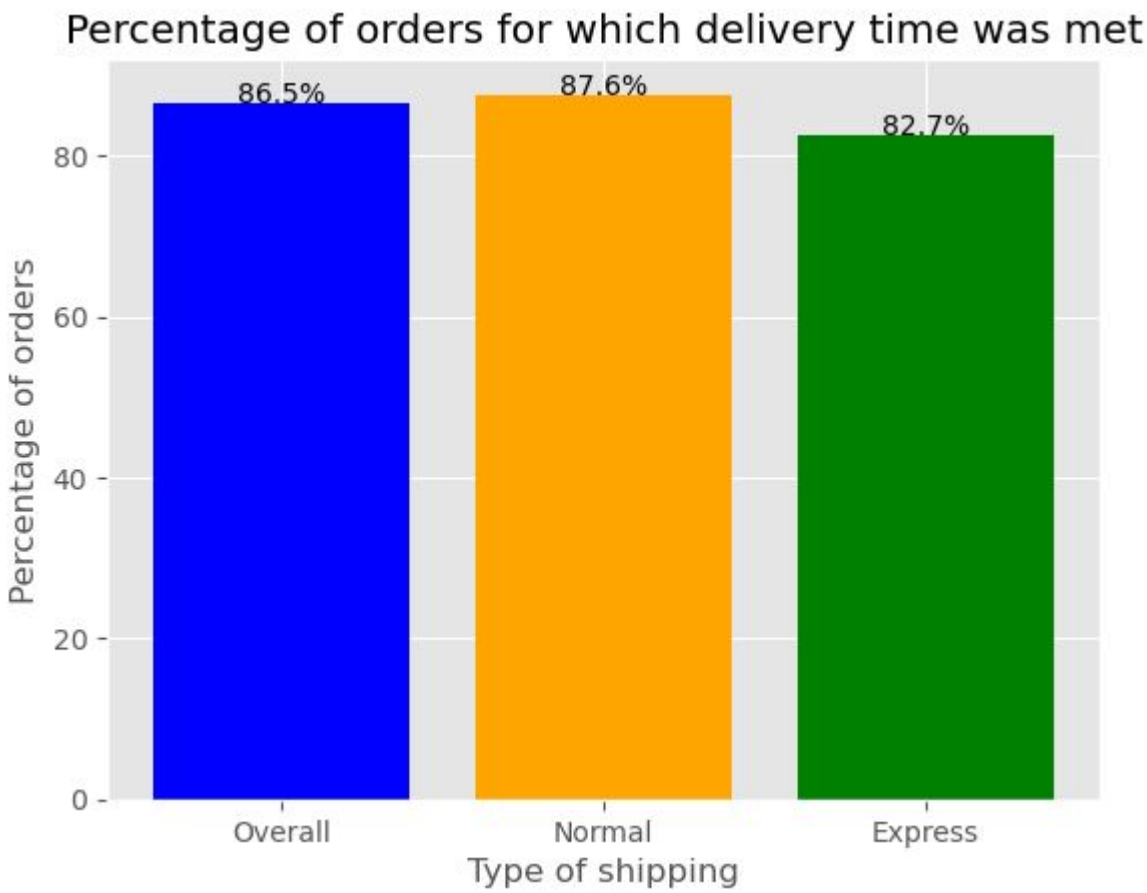
Metrics overview for: Delivery time (in days)

	Overall	Normal delivery	Express delivery
count	333	258	75
mean	**4.60**	**4.64**	**4.48**
std	1.20	1.16	1.34
min	1.00	1.00	2.00
25%	4.00	4.00	3.00
50%	5.00	5.00	5.00
75%	5.00	5.00	5.00
95%	**7.00**	**6.00**	**7.00**
max	7.00	7.00	7.00


Distribution of delivery time
Frequency
0
25
50
75
100
125
150
175
1
2
3
4
5
6
7
Delivery time (days)


Delivery time by type of shipping
Type of shipping
Express
Normal
Frequency
0
20
40
60
80
100
120
140
1
2
3
4
5
6
7
Delivery time (days)

Delivery time should not exceed 3 days (+ weekend) = 5 days.



05

Understanding the results

Understanding the results

- On average, we deliver within a total of 11 days (normal: 12 days, express: 7 days).
- For 95% of the orders, we do not exceed 15 days (normal: 15 days, express: 10 days).
- Express delivery is generally much faster than normal delivery with respect to total time, processing time, and wait time.
- We exceed the expected total time for 30.9% of the orders (normal: 39.5%, express: 1.3%).
- In 63.6% of the orders with normal delivery, we exceed our expected processing time in the warehouse.
- Therefore, there is room for improvement of the delivery process, especially with respect to the processing time in case of normal deliveries.

Technical documentation

Metrics overview for time (in days)

```python
# Create ship mode variable with two categories "Express" vs. "Normal" delivery:

category_names = {
    'First Class':'Express',
    'Second Class':'Normal',
    'Standard Class':'Normal'
}

df['ship_mode2'] = df['ship_mode'].map(category_names)
df[['ship_mode','ship_mode2']]
```

✓ 0.0s

```python
# Describe main variables in dataframe:
df[['process_days','wait_days','delivery_days','total_days']].describe(percentiles=[0.25, 0.5, 0.75, 0.95])
```

✓ 0.0s

```python
# Describe main variables for normal deliveries:
df[['ship_mode2', 'process_days','wait_days','delivery_days','total_days']].query('ship_mode2 == "Normal"').describe(percentiles=[0.25, 0.5, 0.75, 0.95])
```

✓ 0.0s

```python
# Describe main variables for express deliveries:
df[['ship_mode2', 'process_days','wait_days','delivery_days','total_days']].query('ship_mode2 == "Express"').describe(percentiles=[0.25, 0.5, 0.75, 0.95])
```

✓ 0.0s

Distribution of total time

```python
# Histogram for total days
# ---

# Create dataframe without NaN values in total days:
df4 = df.copy()
df4.dropna(subset=['total_days'], inplace=True)

# Use predefined style ggplot:
plt.style.use('ggplot')

# Set figure size:
plt.figure(figsize=(6, 4))

# Create histogram by specifying x-value:
plt.hist(x = df4['total_days'], align="mid", bins=50)

# Axis labels:
plt.xlabel("Total time (days)")
plt.ylabel("Frequency")

# Set title
plt.title("Distribution of total time")

# Show graphic
plt.show()
```

Total time by type of shipping

```python
# Histogram grouped by type of shipping

fig, ax = plt.subplots()
df.groupby('ship_mode2')['total_days'].plot(kind='hist',align='mid', alpha=0.5, legend=True, ax=ax, bins=50)

# Customize the plot
ax.set_title('Total time by type of shipping')
ax.set_xlabel('Total time (days)')
ax.set_ylabel('Frequency')
ax.legend(title='Type of shipping')

# Show the plot
plt.show()
```

✓ 0.1s

Percentage of orders for which total time was met

Total time should not exceed the sum of the expected time spans, i.e.:
4 + 3 + 5 = 12 days

```
# Create variable assessing whether expected total time was met;
# total time should not exceed the sum of the expected time spans, i.e.:
# 4 + 3 + 5 = 12 days.
# ---

def total_met(row):
    if row['total_days'] <= 12:
        return 1
    if row['total_days'] > 12:
        return 0

df4['total_met'] = df4.apply(total_met, axis=1)

df4[['total_days', 'total_met']].sample(10)
```

✓ 0.0s

Percentage of orders for which total time was met

Total time should not exceed the sum of the expected time spans, i.e.:
4 + 3 + 5 = 12 days

```python
# Create variables for percentage of orders for which total time was met:

# Total:
total_met_overall = df4["total_met"].mean() * 100

# Normal delivery:
total_met_normal = df4.query('ship_mode2 == "Normal"')["total_met"].mean() * 100

# Express delivery:
total_met_express = df4.query('ship_mode2 == "Express"')["total_met"].mean() * 100


# Show bar chart:

# Data
values = [total_met_overall, total_met_normal, total_met_express]
labels = ['Overall', 'Normal', 'Express']

plt.bar(labels, values, color=['blue', 'orange', 'green'])

# Adding percentages above the bars
for i, value in enumerate(values):
    plt.text(i, value, f'{value:.1f}%', ha='center')

# Adding labels and title
plt.xlabel('Type of shipping')
plt.ylabel('Percentage of orders')
plt.title('Percentage of orders for which total time was met')

# Show the plot
plt.show()
```