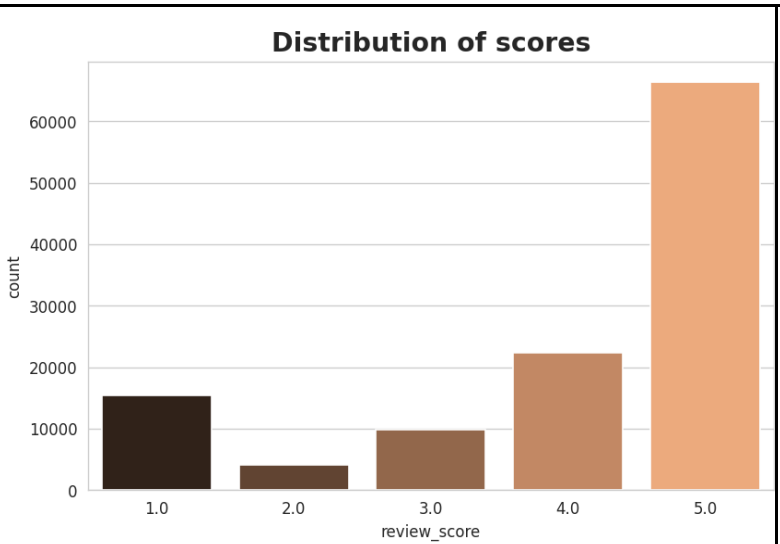
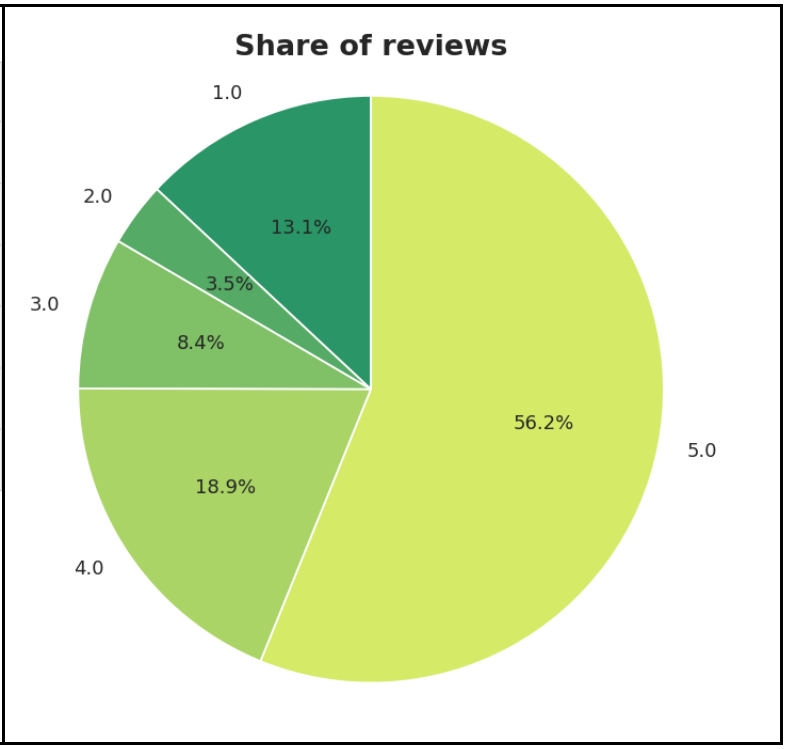
REVIEWS





review_score
5.0 66341
4.0 22319
1.0 15428
3.0 9894
2.0 4162
Name: count, dtype: int64

Summary

Our word cloud analysis of customer reviews highlights key themes related to product delivery, timing, and quality.
The most frequently used words (translated from Portuguese) include:

- produto → product
- entregue → delivered
- chegou → arrived
- prazo → deadline / delivery time
- recebi → received
- não → not
- bom → good
- antes → before / earlier

- compra → purchase
- qualidade → quality

This indicates that many reviews focus on delivery timing issues ("prazo", "chegou antes"), product reception ("recebi", "entregue"), and quality feedback ("bom", "qualidade").

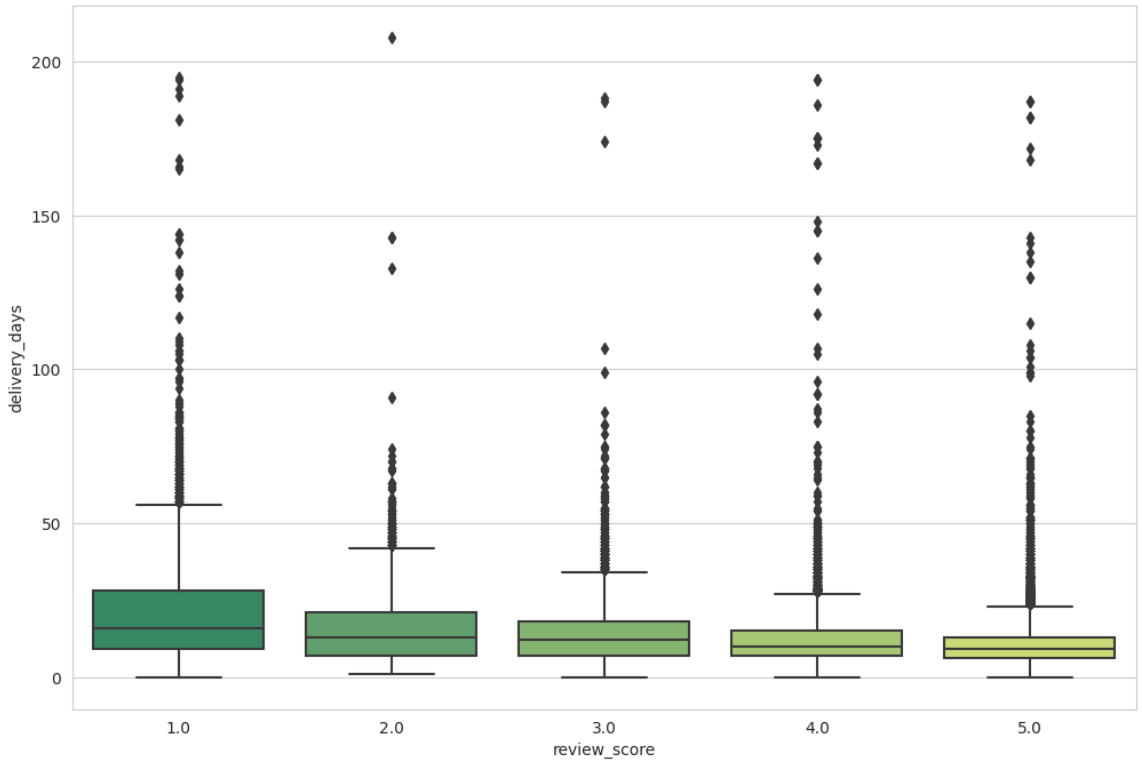
Negative sentiment is also visible through words like "não" (not) and "ainda" (still, as in "still not received").

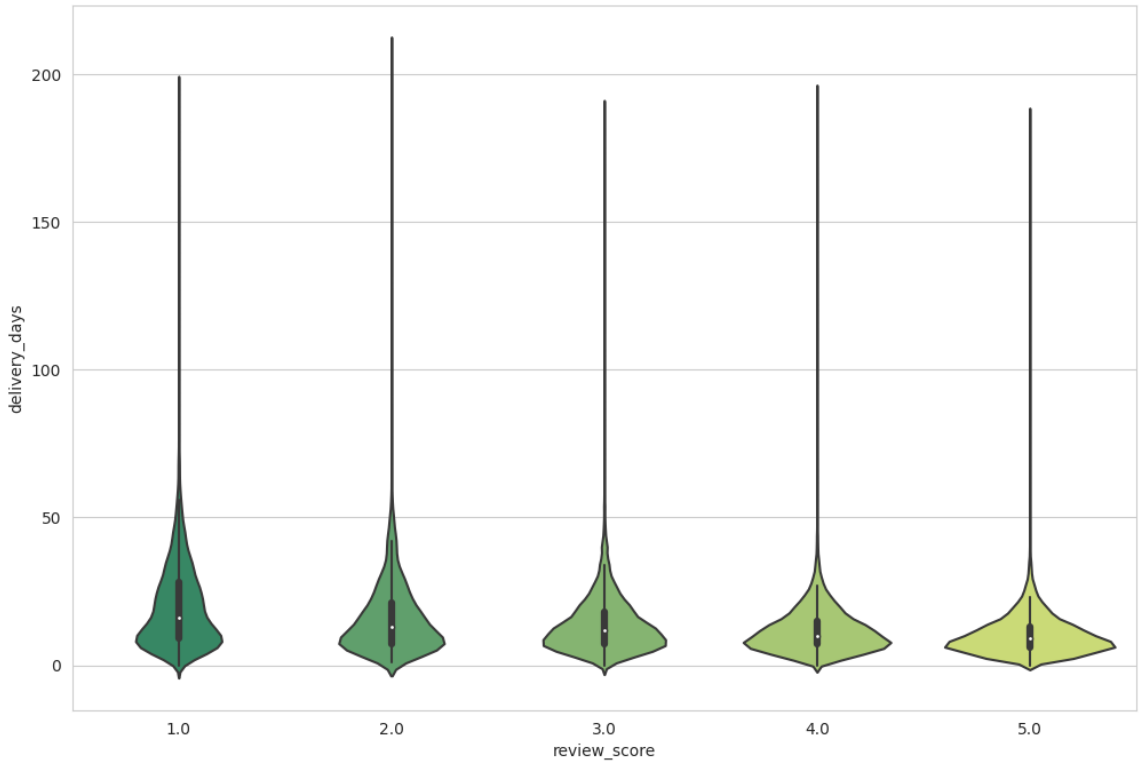
Furthermore, our analysis of missing review comments reveals that negative reviews (1-2 stars) are more likely to contain written feedback, while higher ratings (4-5 stars) often lack text comments.

This suggests that dissatisfied customers tend to provide detailed feedback, whereas satisfied customers typically leave only a rating.

These insights highlight areas for improvement, particularly in delivery reliability and customer satisfaction.

DELIVERY VS REVIEW


200
150
100
50
0
delivery_days
1.0
2.0
3.0
4.0
5.0
review_score

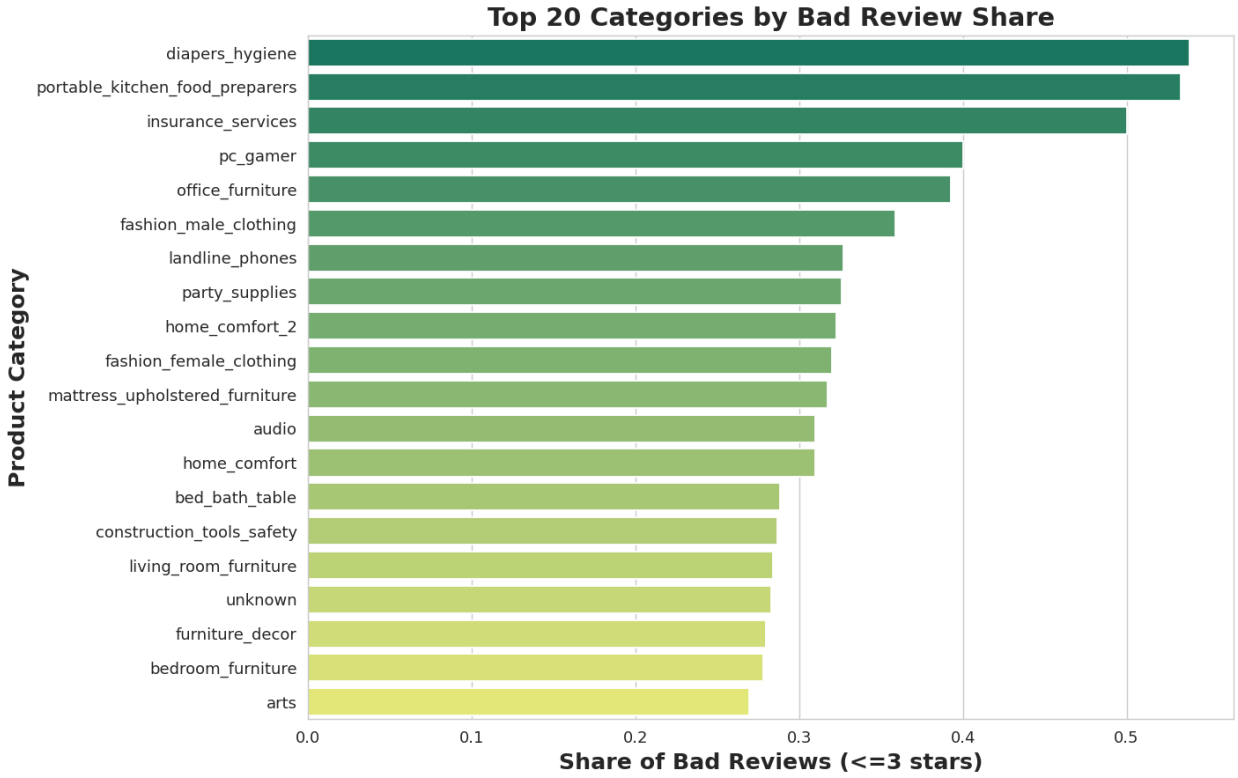

200
150
100
50
0
delivery_days
1.0
2.0
3.0
4.0
5.0
review_score

```
orders.groupby('review_score')['delivery_days'].median()
```

```
review_score
1.0    16.0
2.0    13.0
3.0    12.0
4.0    10.0
5.0     9.0
Name: delivery_days, dtype: float64
```

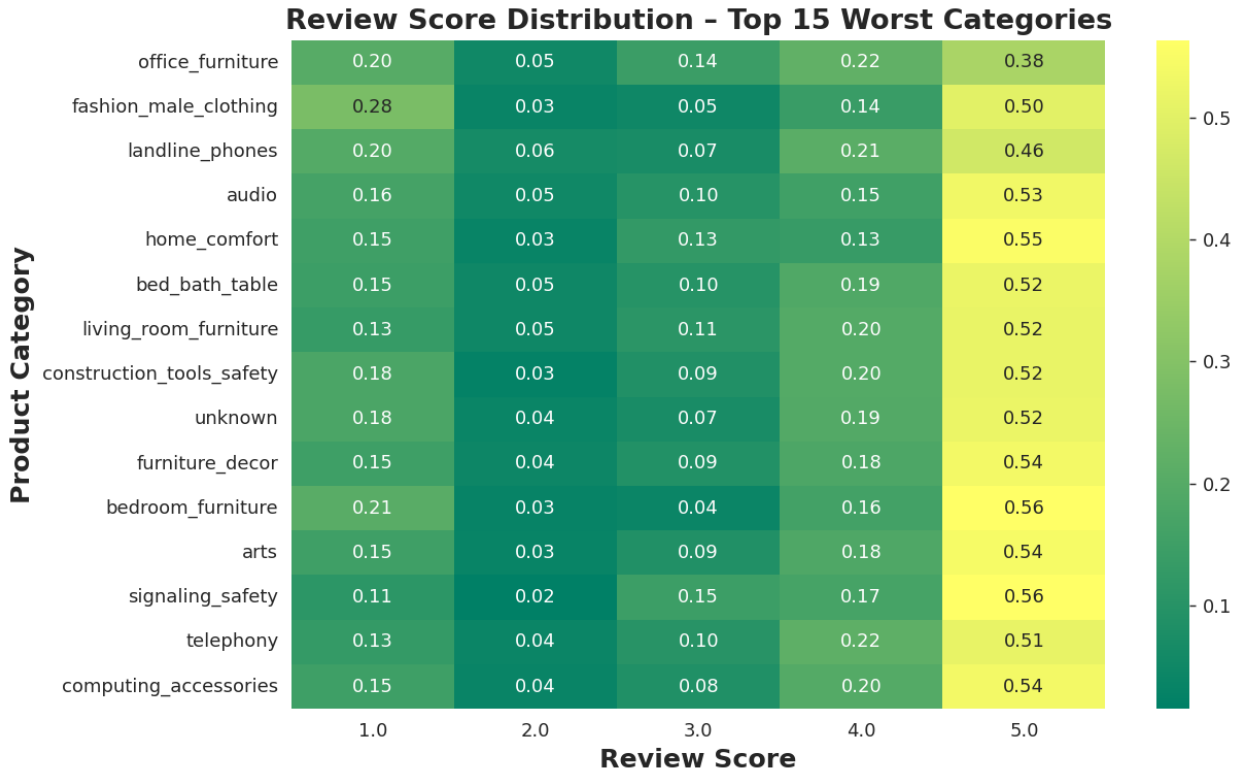
Delivery time has a clear impact on customer satisfaction.
Orders with lower review scores tend to have significantly longer delivery times.
The median delivery duration drops consistently from 16 days (score 1) to 9 days (score 5), indicating that faster delivery strongly correlates with higher customer ratings.

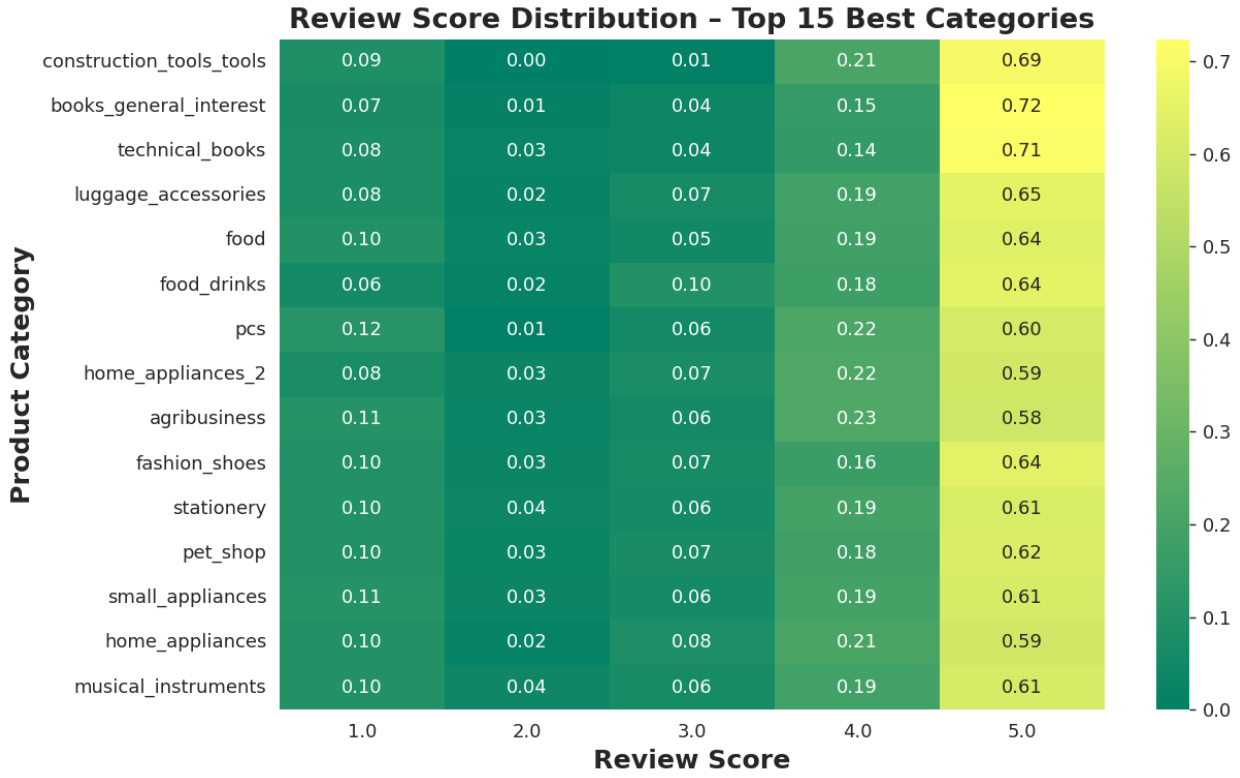
DELIVERY VS REVIEW VS PRODUCT



product_category_english
diapers_hygiene 0.538462
portable_kitchen_food_preparers 0.533333

```
insurance_services                0.500000
pc_gamer                          0.400000
office_furniture                  0.392617
                                      ...
fashion_children_clothing         0.125000
books_general_interest            0.123894
flowers                           0.121212
construction_tools_tools          0.095238
cds_dvds_music                    0.071429
Name: bad_score, Length: 74, dtype: float64
```


Review Score Distribution – Top 15 Worst Categories
Product Category
office_furniture 0.20 0.05 0.14 0.22 0.38
fashion_male_clothing 0.28 0.03 0.05 0.14 0.50
landline_phones 0.20 0.06 0.07 0.21 0.46
audio 0.16 0.05 0.10 0.15 0.53
home_comfort 0.15 0.03 0.13 0.13 0.55
bed_bath_table 0.15 0.05 0.10 0.19 0.52
living_room_furniture 0.13 0.05 0.11 0.20 0.52
construction_tools_safety 0.18 0.03 0.09 0.20 0.52
unknown 0.18 0.04 0.07 0.19 0.52
furniture_decor 0.15 0.04 0.09 0.18 0.54
bedroom_furniture 0.21 0.03 0.04 0.16 0.56
arts 0.15 0.03 0.09 0.18 0.54
signaling_safety 0.11 0.02 0.15 0.17 0.56
telephony 0.13 0.04 0.10 0.22 0.51
computing_accessories 0.15 0.04 0.08 0.20 0.54
1.0 2.0 3.0 4.0 5.0
Review Score
0.5 0.4 0.3 0.2 0.1


Review Score Distribution – Top 15 Best Categories
Product Category
construction_tools_tools 0.09 0.00 0.01 0.21 0.69
books_general_interest 0.07 0.01 0.04 0.15 0.72
technical_books 0.08 0.03 0.04 0.14 0.71
luggage_accessories 0.08 0.02 0.07 0.19 0.65
food 0.10 0.03 0.05 0.19 0.64
food_drinks 0.06 0.02 0.10 0.18 0.64
pcs 0.12 0.01 0.06 0.22 0.60
home_appliances_2 0.08 0.03 0.07 0.22 0.59
agribusiness 0.11 0.03 0.06 0.23 0.58
fashion_shoes 0.10 0.03 0.07 0.16 0.64
stationery 0.10 0.04 0.06 0.19 0.61
pet_shop 0.10 0.03 0.07 0.18 0.62
small_appliances 0.11 0.03 0.06 0.19 0.61
home_appliances 0.10 0.02 0.08 0.21 0.59
musical_instruments 0.10 0.04 0.06 0.19 0.61
1.0 2.0 3.0 4.0 5.0
Review Score
0.7 0.6 0.5 0.4 0.3 0.2 0.1 0.0

Summary

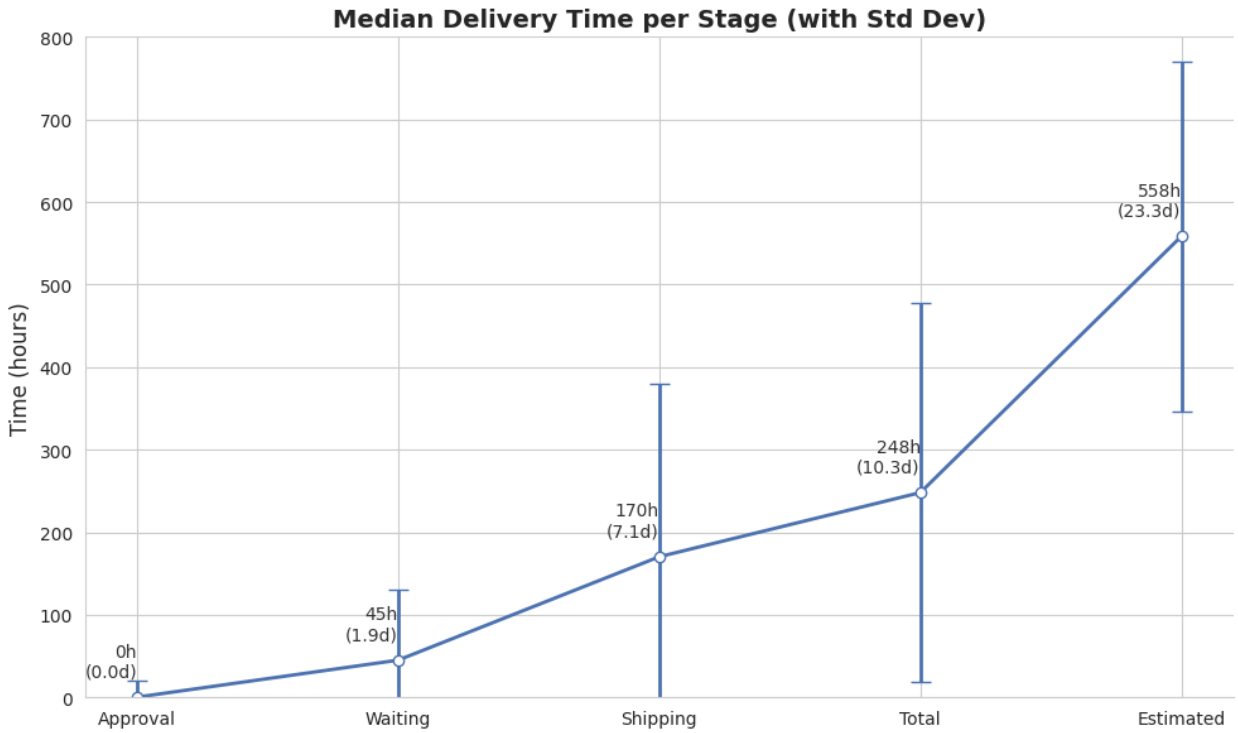
We analyzed how product review scores vary across categories, with a focus on the share of negative feedback (scores ≤ 3). To ensure statistical relevance, only categories with more than 100 orders were included. We visualized the distribution of ratings for the 15 best and worst-performing categories.

The most problematic areas — in terms of customer dissatisfaction — include **office furniture, men's clothing, and landline phones**. Meanwhile, customers consistently rated **tools, books, and luggage** highly.

These results provide a strong foundation for further analysis, especially regarding delivery and payment factors that may be driving these differences in satisfaction.

ORDER DELAYS

	mean	median	std
approval_time	0 days 09:49:23	0 days 00:20:26	0 days 19:46:32
waiting_time	2 days 21:44:50	1 days 21:07:54	3 days 12:53:49
shipping_time	9 days 09:04:38	7 days 02:20:44	8 days 17:53:23
total_time	12 days 16:38:51	10 days 08:03:15	9 days 13:37:01
estimated_time	23 days 20:42:37	23 days 06:29:45	8 days 19:55:42



Delivery Time Breakdown: What the Numbers Reveal
The timeline of order fulfillment in Brazilian e-commerce reveals clear bottlenecks and areas of stability — with some surprises along the way.

⏱️ Approval Time appears as "0h (0.0d)" on the graph, but it's important to highlight that the true median is approximately 20 minutes. This tells us that most orders are instantly or automatically approved, with little to no manual intervention. This is a strength in the process and reflects the efficiency of front-end systems.

⏳ Waiting Time (time from approval to handoff to logistics) sits at 45h (1.9 days) median. However, the standard deviation is high (≈ 90 hours), which signals inconsistencies in seller responsiveness or warehouse logistics. Some sellers ship quickly; others delay for days. This variance can erode customer trust.

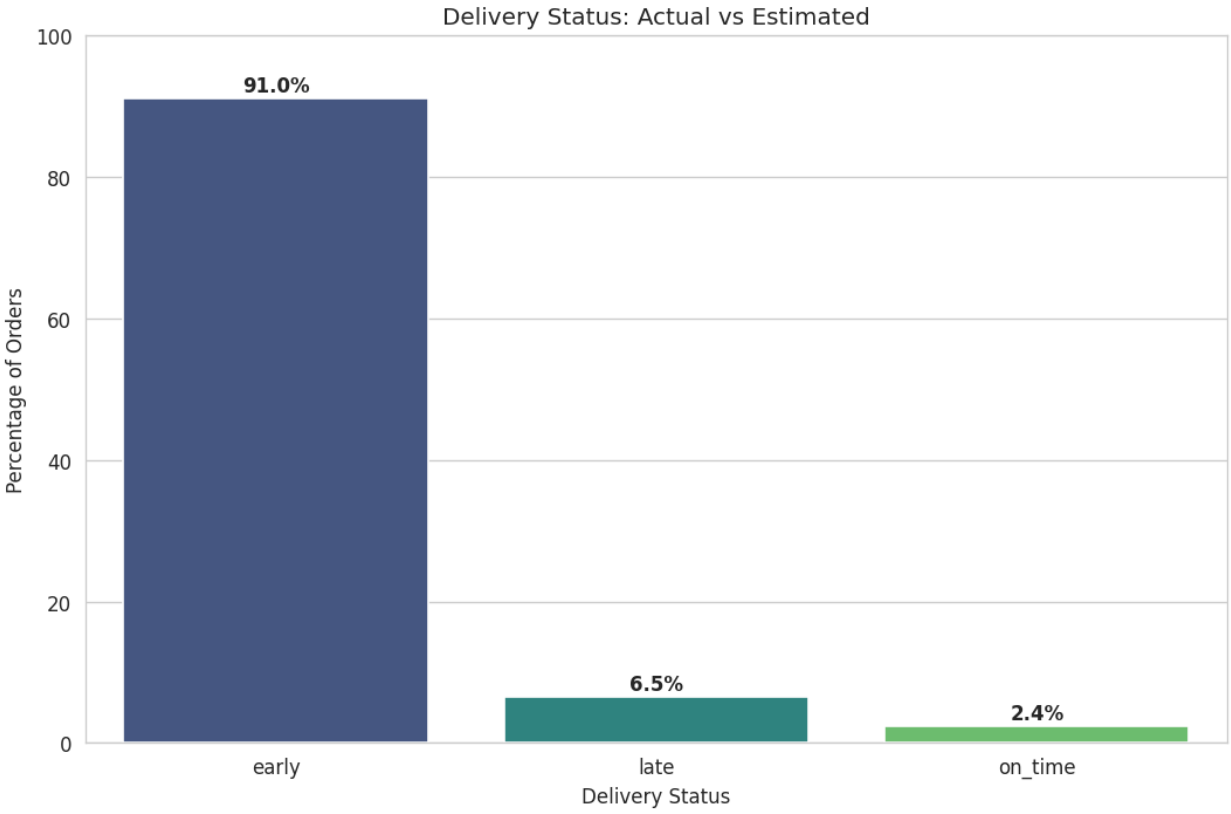
🚚 Shipping Time is the most dominant stage, with a median of 170h (7.1 days) and a wide spread (≈ 190h std dev). Delivery across Brazil faces obvious challenges: regional remoteness, infrastructure, and varying courier efficiency. This step is the most promising target for optimization, as it contributes the most to delays and user dissatisfaction.

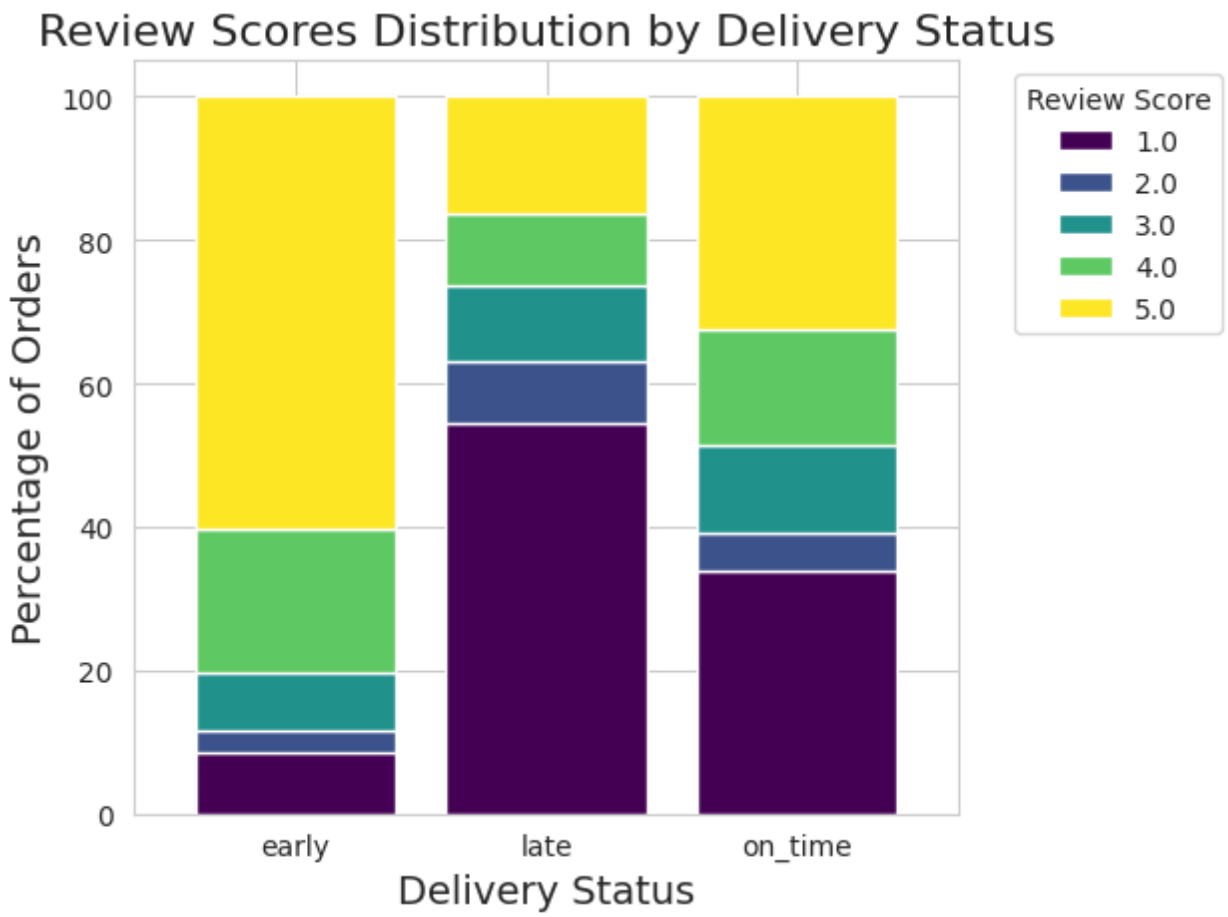
📦 Total Time — from approval to delivery — clocks in at 248h (10.3 days) median. This is the actual customer experience, and although it's within reasonable bounds, there's room for improvement when compared to global standards.

🗓️ Estimated Delivery Time is set very conservatively at 558h (23.3 days). That's more than double the actual delivery time — which suggests either:

the platform is underpromising to overdeliver, or
its forecasting model lacks precision and skews to the safer side.
Either way, this inflated estimate could confuse or deter customers who expect tighter windows.

🧠 Takeaways:
Approval is frictionless — a clear operational strength.
Shipping is the weak link — it eats up the most time and has the widest spread.
Forecasting is overly cautious — possibly damaging trust or affecting conversion.
Improving delivery times and providing more accurate estimates could reduce customer anxiety and churn — especially in competitive segments.


Delivery Status: Actual vs Estimated
Percentage of Orders
100
80
60
40
20
0
91.0%
6.5%
2.4%
early
late
on_time
Delivery Status


Review Scores Distribution by Delivery Status
Percentage of Orders
100
80
60
40
20
0
early
late
on_time
Delivery Status
Review Score
1.0
2.0
3.0
4.0
5.0

```
orders[orders['delivery_status'] == 'late']['review_score'].mean()
```

```
2.2511919357035826
```

```
orders[orders['delivery_status'] == 'early']['review_score'].mean()
```

```
4.208795945933001
```

```
orders[orders['delivery_status'] == 'late']['review_score'].value_counts(normalize=True)
```

```
review_score
1.0    0.544476
5.0    0.163602
3.0    0.105708
4.0    0.099578
2.0    0.086637
Name: proportion, dtype: float64
```

```
orders[orders['delivery_status'] == 'early']['review_score'].value_counts(normalize=True)
```

```
review_score
5.0    0.604527
4.0    0.198814
1.0    0.084501
3.0    0.082087
2.0    0.030070
```

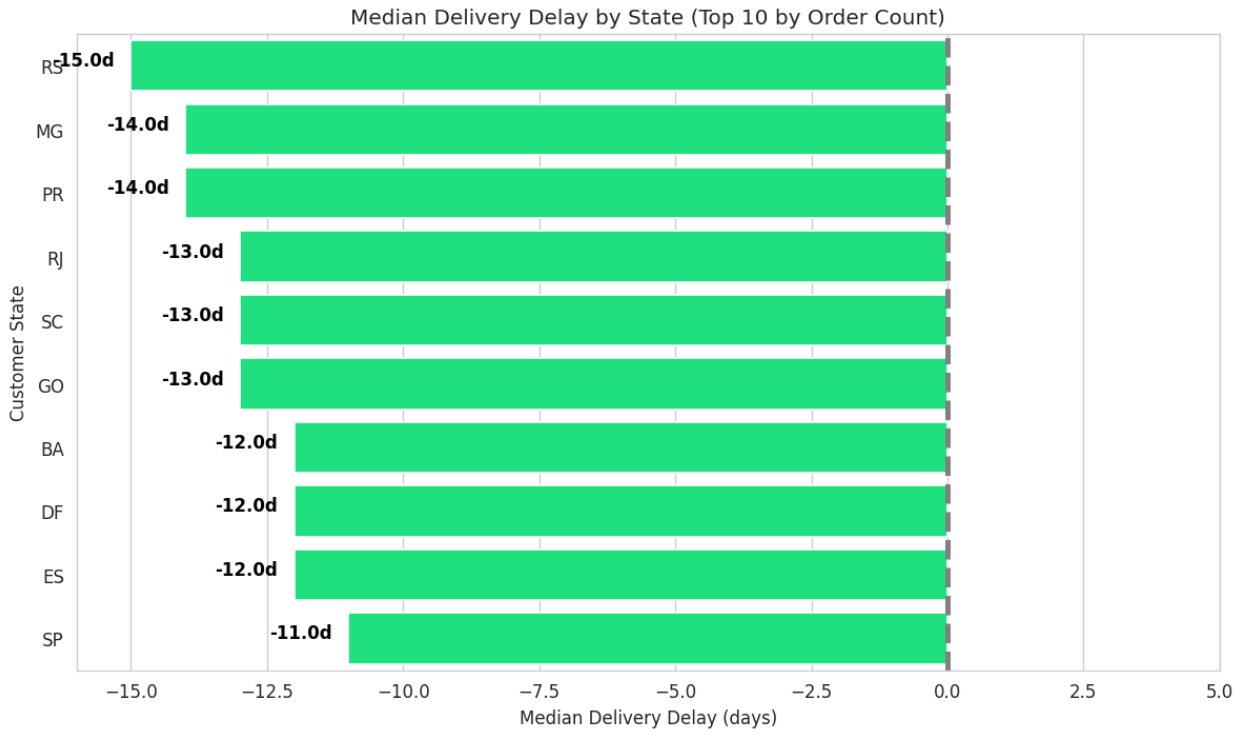
"In 54% of cases, when the delivery was late, customers gave a 1-star rating. In contrast, with early deliveries, only 8.5% of customers gave a 1-star rating."

```
early = orders[orders['delivery_status'] == 'early']['review_score'].dropna()
late = orders[orders['delivery_status'] == 'late']['review_score'].dropna()

stat, p = mannwhitneyu(early, late, alternative='two-sided')
print(f"U-statistic: {stat:.2f}, p-value: {p:.10f}")
```

```
U-statistic: 619408468.50, p-value: 0.0000000000
```

Statistical test confirms the obvious: the difference in review scores between early and late deliveries is highly significant (Mann-Whitney U, p < 1e-10). The effect of delivery timing on customer satisfaction is not only visible — it's statistically indisputable!



Across all states, deliveries tend to arrive ahead of the estimated date.

Among the 10 states with the highest order volume, the median delivery delay is negative — meaning early delivery is the norm. The fastest deliveries are seen in São Paulo (SP), Minas Gerais (MG), and Rio de Janeiro (RJ), all showing median delivery times 2–3 days earlier than expected.

This suggests that the estimated delivery dates may be overly conservative, and there may be room for more accurate (and competitive) estimations.