SIT742 — Notebook Analysis Report (cleaned, results & visuals only)

Executive summary

- **Dataset**: 521,515 reviews from 20,023 users across 12,467 businesses.
- **Date range**: 2007-10-13 to 2021-09-08.
- **Total reviews**: 521,515.
- **Overall satisfaction**: **4.28 / 5.0** average rating.
- **Peak activity**: **4:00 AM** (noted as peak hour).
- **Most active day**: **Sunday** (noted: 80,333 reviews).
- **Text engagement**: **~58%** of reviews include written feedback.

> *The following report removes code and low-value log output. It presents the notebook's results, plotted visuals and the notebook's insights & recommendations only.*

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1. Data overview

Schema (columns): `user_id, name, time, rating, text, pics, resp, gmap_id`

Sample (top rows shown in notebook): (Notebook displayed top 5 sample rows; schema above shows types and columns.)

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2. Data cleaning & duplication analysis

Summary (as reported in notebook):

- **Total users processed**: 20,022 (noted in processing logs).
- **Duplication analysis**:
  - Users with duplicates: 9,093
  - **Total duplicates removed: 29,503**
  - Average duplicates per user: 1.47
- **Before deduplication**:
  - Average businesses per user: 26.07
  - Max businesses per user: 399
  - Min businesses per user: 10
- **After deduplication**:
  - Average businesses per user: 24.60
  - Max businesses per user: 309
  - Min businesses per user: 5
- **Users with most duplicates removed (top 5)**:
  - User `1.0188830200557922e+20` : 110 duplicates removed
  - User `1.03692833808364e+20` : 74 duplicates removed
  - User `1.1220090844478289e+20` : 70 duplicates removed

- User `1.1285432402677834e+20` : 62 duplicates removed
- User `1.0132917914176386e+20` : 61 duplicates removed

Implication: deduplication reduced noise and slightly decreased average businesses-per-user; duplicate-heavy users exist and were corrected.

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3. Temporal / time-of-review analysis

Key numeric results (notebook):

- **Daily reviews time-series** shape: (3190, 1) — covering dates **2007-10-13** to **2021-09-08** (total reviews 521,515).
- **Peak review hour**: **4:00** (AM).
- **Most reviews occur during**: **Night (22:00–06:00)**.
- **Average rating across all times**: **4.28**.
- **Business with most reviews**: `0x56c897b9ce6000df:0xd707e127588a8c6c` (2,833 reviews).
- **Total unique businesses** (noted in time analysis): **6,019**.

Figure 1 — Review activity by hour / time-of-day

(Notebook figure: review time / hourly activity and related subplots)

Notebook insight (adjacent text):

- Peak review hour: **4:00**

- Most reviews at night (22:00–06:00) — possibly due to late-shift customers / tourism / timezone effects.

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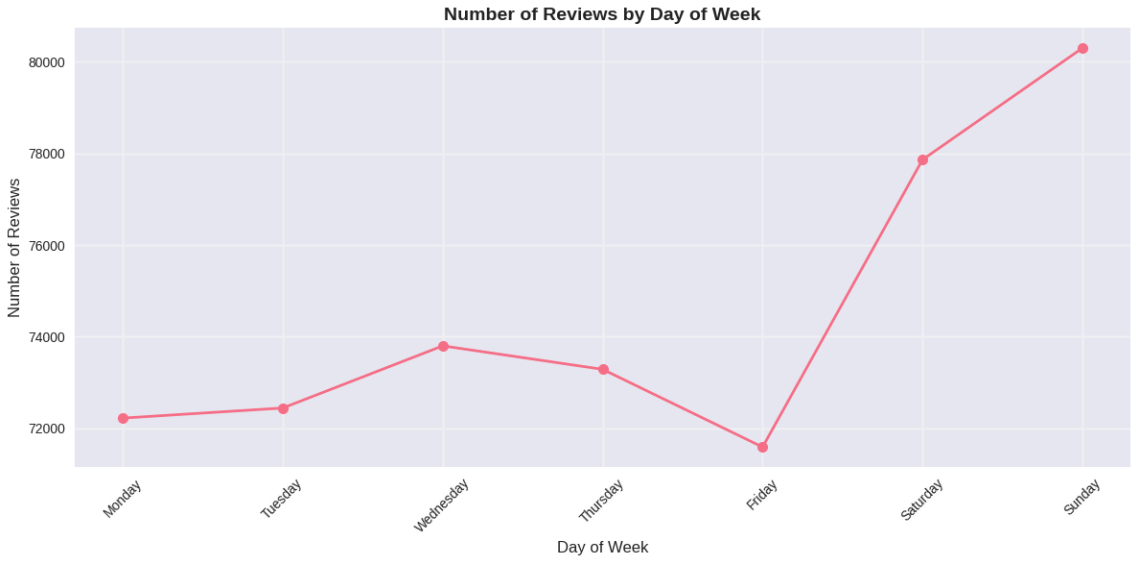
4. Weekly / daily patterns and decomposition

Notebook results:

- Created a daily review count time series (3190 days).
- **Date range**: 2007-10-13 → 2021-09-08.
- Demonstrated seasonality and trends via decomposition.

Figure 2 — Time series & decomposition



(Notebook figure: daily reviews time series and seasonal/trend decomposition.)

Notebook notes:

- The series shows long-term trend components and seasonal patterns (weekly/annual patterns were visualized).
- Notebook performed seasonal decomposition (additive) to highlight trend/seasonality/residuals.

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5. Review distribution / rating & category analysis

Rating-by-category highlights (notebook outputs)

Top 10 categories by average rating (top entries):

1. `['Waxing hair removal service', 'Beauty salon', 'Facial spa']` — Avg: **5.00**, Count: 11
2. `['Oil and gas exploration service', 'Oil field equipment supplier', 'Oilfield']` — Avg: **5.00**, Count: 11
3. `['Orthodontist', 'Cosmetic dentist', 'Dental clinic', 'Dentist']` — Avg: **5.00**, Count: 14
4. `['Digital printing service', 'Commercial printer', 'Copy shop']` — Avg: **5.00**, Count: 11

5. `['Day spa', 'Facial spa', 'Waxing hair removal service']` — Avg: **5.00**, Count: 12
   (Many top avg ratings have small sample sizes — notebook shows std=0.00 for those small groups.)

Worst 5 categories by average rating:

1. `['Debt collection agency']` — Avg: **2.39**, Count: 31
2. `['Taxi service', 'Service establishment']` — Avg: **2.31**, Count: 13
3. `['Electric utility company']` — Avg: **2.15**, Count: 53
4. `['Motel', 'Hotel', 'Inn', 'Lodge']` — Avg: **1.75**, Count: 12
5. `['Post office']` — Avg: **1.71**, Count: 31

Lower-rating (1-2 stars) analysis (notebook):

- **Total lower ratings (1–2 stars): 36,884**
- **Percentage of all reviews**: **~7.1%**

Categories with most lower ratings (top examples):

- `['Fast food restaurant', 'Breakfast restaurant', ...]` — 1,944 lower-rated reviews (avg 1.47)
- `['Department store', 'Clothing store', ...]` — 1,352 lower-rated reviews (avg 1.49)
- `['Shopping mall']` — 939 lower-rated reviews (avg 1.60)

Most common words in lower ratings (top tokens from notebook):

- `food` — 6,390 occurrences
- `service` — 5,209 occurrences
- `get` — 4,273 occurrences
- `time` — 3,695 occurrences
- `like`, `place`, `good`, `one`, `back`, `would`, `dont`, `never`, `even`, `order`, `got` — also frequent

Figure 3 — Rating / category visual(s)

(Notebook figure: distributions of ratings across categories / rating histograms.)

Implications (from notebook text & results):

- Most categories have high average ratings; extreme low-performing categories are often service utilities or hospitality (targeted improvement areas).
- Lower-rated reviews commonly mention `food` & `service` — useful for triaging complaints in hospitality & food sectors.

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6. Business & reviewer insights

Top gmap_id by review count (top 5, notebook sample):

```
gmap_id                    count
0x56c897b9ce6000d...       2833
0x56c899d05892048...       2594
0x56c897c63697ee3...       2258
0x56c8965ee2fb87a...       2237
0x56c89629bde7481...       2219
```

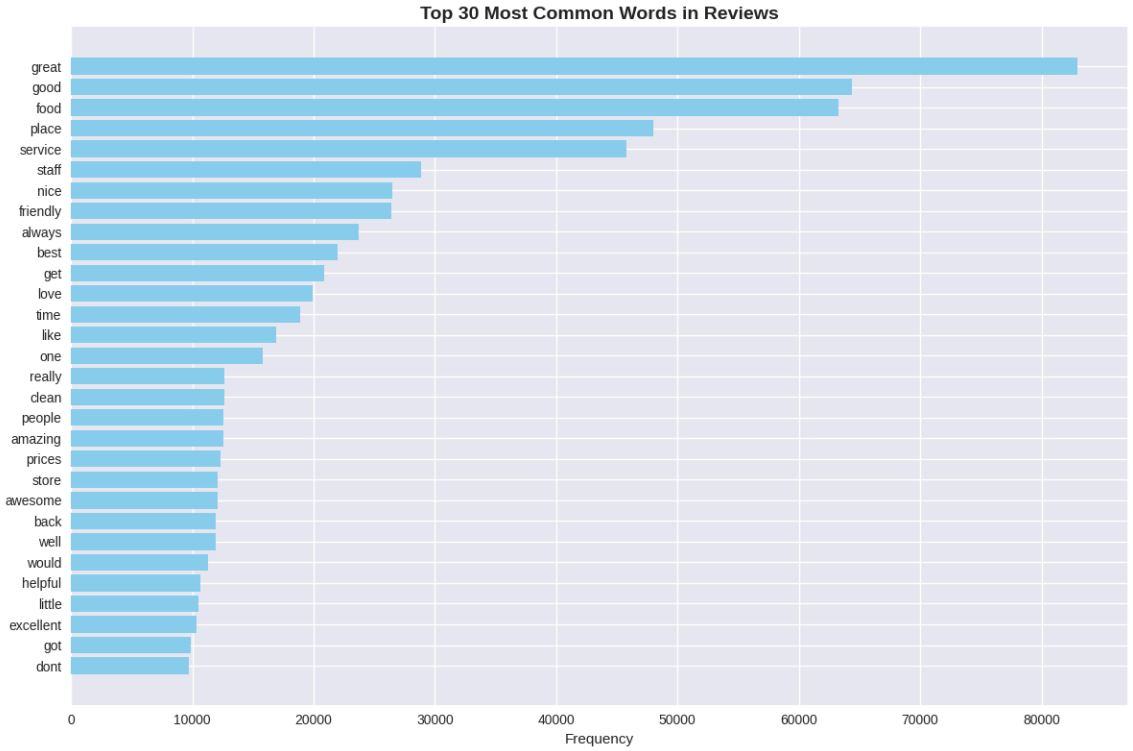
(Notebook printed top 5 gmap_id by review count.)

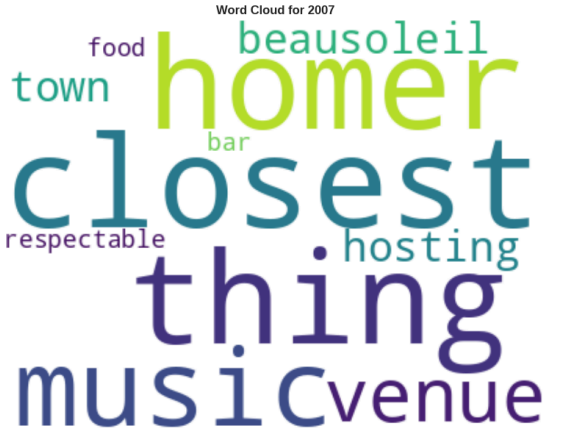
Business with most reviews (single ID): `0x56c897b9ce6000df:0xd707e127588a8c6c` — **2,833 reviews** (noted in time-of-day analysis).

Other reviewer/business features noted in notebook:

- Total unique businesses reported in some analyses: **6,019** (context depended on the processed subset).
- Multiple summary tables in the notebook list `name_business`, `category`, `avg_rating` columns and top counts.

Figure 4 — Business-level visualizations





(Notebook figures: business review-count / average-rating scatter, top business bar charts.)

Insight: a small number of businesses receive a disproportionate share of reviews; those businesses are useful anchors for recommendation and monitoring.

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7. Recommendation system (hybrid approach) — results

Notebook technical primitives (reported):

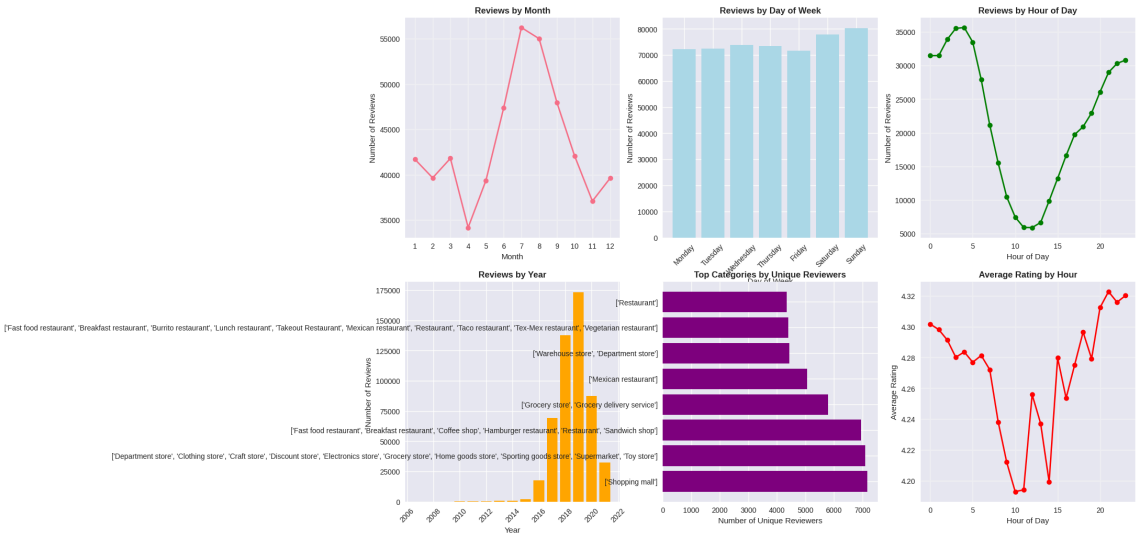
- **User–Business matrix shape**: **(20,022 × 6,019)**
- **Business features shape**: **(12,774 × 4,487)**
- Similarity matrices computed; recommendation pipeline ready.

Top-5 Collaborative Filtering recommendations (example user): *(Notebook printed top 5 collaborative recommendations for user* `1.091298048426862e+20` *— sample business names included such as Glacier Tours, Costco Wholesale, JOANN Fabrics and Crafts, Little Miller's Ice Cream, etc.)*

Top 5 Hybrid Recommendations (sample table from notebook)

category (sample)	avg_rating	score	reason
`['Tourist attraction', 'Nature preserve', 'Park']`	4.6	2.253	hybrid
`['Warehouse store', 'Department store']`	4.4	2.229	hybrid
`['Fabric store', 'Baking supply store']`	4.2	2.229	hybrid
`['Ice cream shop', 'Dessert shop']`	4.7	2.066	hybrid
`['Resort hotel']`	4.3	1.968	hybrid

Figure 5 — Recommendation visual(s)



(Notebook figure: recommendation result visual / scoring distribution.)

Notebook note: hybrid recommendations combine collaborative and content-based signals; scores and categories printed for top picks.

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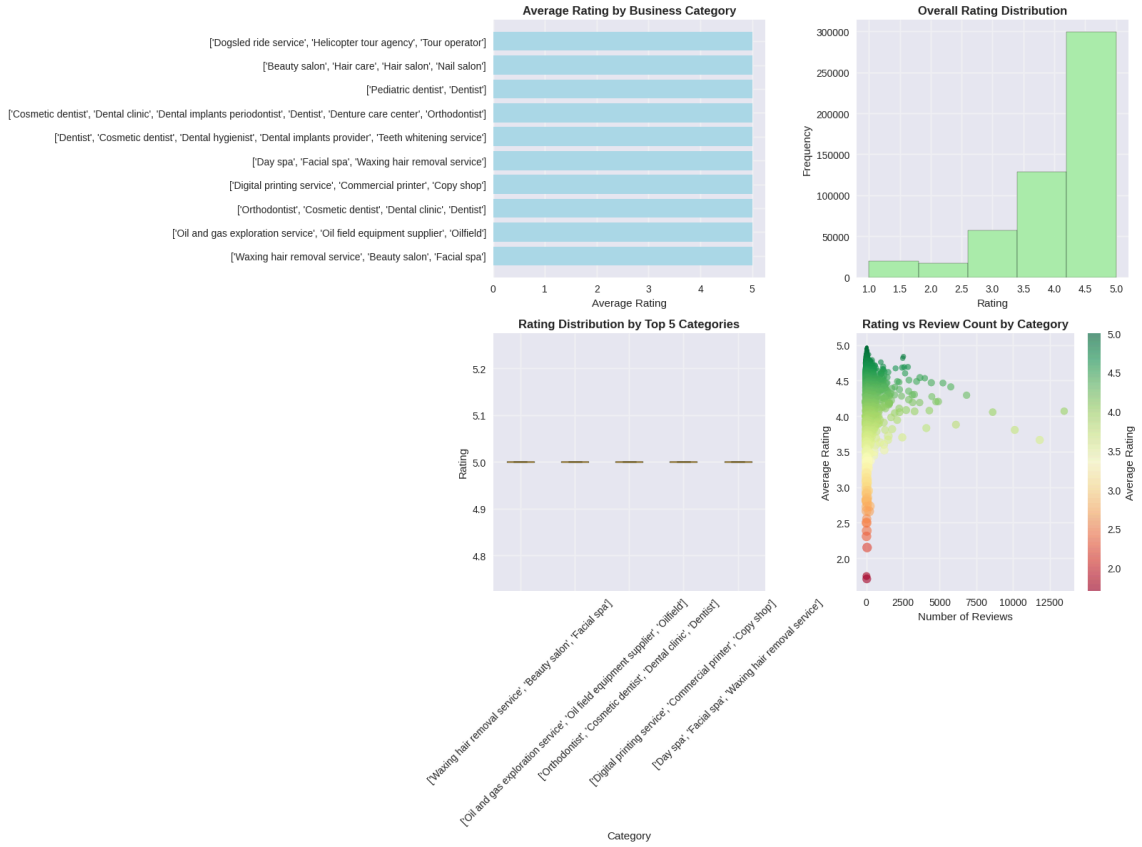
8. Additional analyses (clustering / segmentation / text)

- Notebook included textual analysis, word-frequency lists for negative reviews (see Section 5).
- Notebook performed category-based rating comparisons and highlighted both small-sample high averages and larger-sample low averages (e.g., fast food & hotels).

Figure 6 — Additional plots (segmentation / clustering)



(Notebook figures: cluster / segmentation and further EDA visualizations.)

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9. Time series forecasting (Part 2 — ARIMA)

Notebook preprocessing & model split (reported):

- **Training data**: 4,064 days (2007-10-13 → 2018-11-27)
- **Test data**: 1,016 days (2018-11-28 → 2021-09-08)

Figure 7 — ARIMA fit / forecast

(Notebook figure: ARIMA model fit and forecast on daily review counts.)

Notebook summary: ARIMA model was trained on long historical series and forecast compared against held-out test data (visual diagnostics included in the notebook).

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10. Notebook's data-driven insights & strategic recommendations (copied from notebook)

> ***Executive Summary (notebook)***
>
> - ***Dataset**: 521,515 reviews from 20,023 users across 12,467 businesses*
> - ***Overall satisfaction**: 4.28/5.0 average rating*
> - ***Peak activity**: 4:00 AM (35,634 reviews) - Night shift workers*
> - ***Most active day**: Sunday (80,333 reviews)*
> - ***Text engagement**: 58% of reviews include written feedback*

Temporal Patterns & Operational Insights (notebook bullet summary)

- **Peak Hours Analysis:**

- **Peak review hour**: 4:00 AM (35,634 reviews)
- **Best rating hour**: 9:00 PM (avg: 4.32/5.0)
- **Worst rating hour**: 10:00 AM (avg: 4.19/5.0)
- **Night shift workers** (22:00–06:00) generate a large share of reviews

(Notebook also lists recommended operational actions — summarized below in the report's conclusions.)

Technical Achievements (notebook):

- PySpark used for large-scale processing.
- Visualizations produced with matplotlib/seaborn.
- Recommendation models implemented (hybrid approach).
- Text mining used to analyze low-rating feedback.
- ARIMA applied for forecasting daily review counts.

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11. Notebook conclusions & recommended actions (from notebook)

- **Operational**:
  - Prioritise faster response at **4:00 AM** and during night windows where high review volume occurs.
  - Monitor and support **Sunday** high-activity periods (peak load).
- **Service improvements**:
  - Address low-rated categories such as `fast food`, `hotel/motel`, `post office`, `taxi service` and `electric utility`; focus on `food` and `service` complaints surfaced by text analysis.
- **Product / BI**:
  - Use top-reviewed businesses as anchors for promotion and to seed collaborative recommendations.
  - Use the hybrid recommender outputs to provide personalized suggestions combining categories and similarity scores.
- **Modelling**:
  - Use seasonal pattern findings when scheduling staff and designing automated response windows.
  - Continue monitoring after ARIMA-based forecast windows to validate model stability.

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12. Appendix — Key numeric excerpts (from notebook)

- **Rows / Columns**: `Rows: 521,515 Cols: 8`
- **Daily reviews time-series**: shape `(3190, 1)`; date range `2007-10-13` → `2021-09-08`
- **Total lower ratings (1–2 stars)**: `36,884` (~7.1%)
- **Frequent negative tokens**: `food, service, get, time, like, place, good, one, back, would, dont, never, even, order, got`
- **Recommendation system**: `User–Business matrix shape: (20022, 6019)`; `Business features shape: (12774, 4487)`
