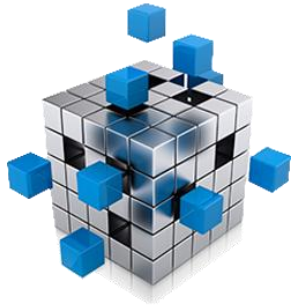
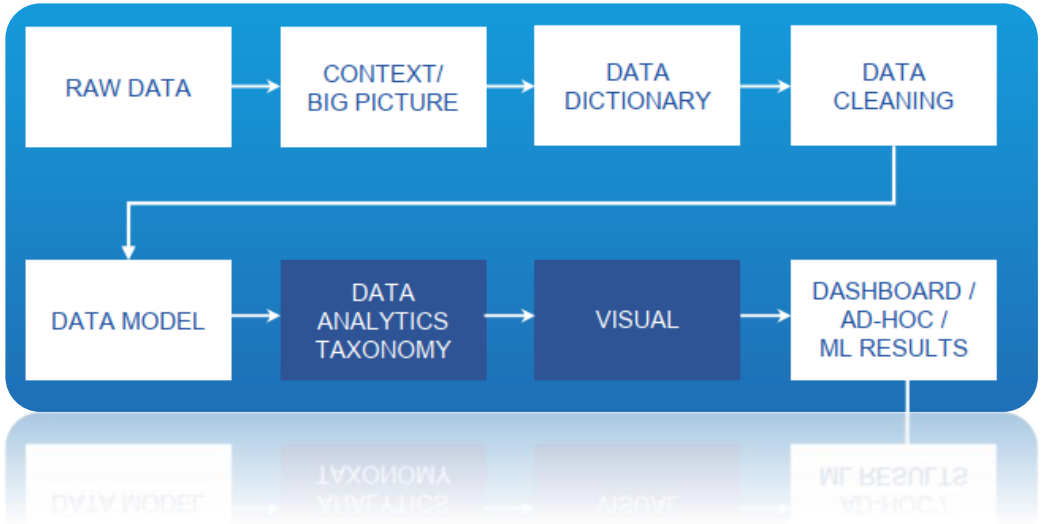
Risk & Uncertainty Modelling

Analyze demand trends and forecastBooking, GMV & Spending for GrabFood Vietnam

Phuoc Ngoc Nguyen (Patrick)





AGENDA

I. Business Questions & Data Understanding

II. Project Plan for GrabFood Performance

III. Grabfood Demand Trend Analysis

IV. Forecasting next 6 weeks performance

I. Business Questions & Data Understanding

About Grabfood

- Grabfood is SBU of Grab Holdings Inc which is known as Grab.
- Grab began to grow their business and added the GrabFood service in 2018.
- GrabFood entered the Vietnamese market in in June of 2018 in Ho Chi Minh City and on October 2 in Hanoi.

I. Business Questions & Data Understanding

week	account	active_mex	booking	completed	gmv	grossbilling	mex_spend	grab_spend
2020-09-14	A1	1,759	438,985	381,949	4,538,171	220,516	54,468	374,568
2020-09-14	A2	1,176	393,392	354,934	3,583,448	187,806	69,091	315,987
2020-09-14	A3	18,896	988,044	878,425	8,661,127	588,076	185,433	737,147
2020-09-14	A4	560	37,204	30,882	397,346	8,314	676	14,129
2020-09-21	A1	1,771	420,341	350,038	4,119,369	197,731	72,783	260,398
2020-09-21	A2	1,196	379,266	329,964	3,290,777	174,484	65,498	255,994
2020-09-21	A3	19,202	950,124	812,845	7,901,299	539,090	176,357	589,879
2020-09-21	A4	591	37,698	30,232	389,858	8,429	635	14,506
2020-09-28	A1	1,775	391,980	349,254	4,208,916	204,460	65,291	252,371
2020-09-28	A2	1,220	355,698	321,090	3,287,323	173,575	65,215	247,560
2020-09-28	A3	19,390	915,597	816,834	8,050,719	549,152	179,932	588,732
2020-09-28	A4	685	39,485	32,663	423,392	8,904	524	14,761
2020-10-05	A1	1,774	488,151	381,412	4,351,328	212,199	104,079	280,414
2020-10-05	A2	1,226	383,193	305,928	3,199,683	168,617	58,388	244,130
2020-10-05	A3	20,124	1,018,546	812,117	8,039,923	549,175	172,467	600,591
2020-10-05	A4	733	43,780	30,827	400,147	8,393	234	12,622
2020-10-12	A1	1,784	443,151	336,271	4,045,914	195,870	75,462	268,531
2020-10-12	A2	1,247	373,062	290,601	3,032,869	160,736	59,104	214,683
2020-10-12	A3	20,845	1,063,813	810,039	7,994,375	546,857	172,230	581,277

Definition	
Week	Refers to the Monday of the week.
Account	Segment of Merchants.
Active Mex	The number of Merchants active during the week.
Booking	The number of orders users booked.
Completed	The number of orders successfully delivered to users.
GMV	Gross Merchandise Value, the total value of merchandise sold over a given period.
Gross Billing	The revenue collected by Grab based on GMV.
Mex Spend	The amount of promotion spending by Merchants.
Grab Spend	The amount of promotion spending by Grab.

Business Questions:

1. **Describe the demand trend and what happened last week? What were the potential reasons impacted the last week result?**
   - Overview GMV contribution by cateogy
   - Spending Allocation by category
   - Booking order by category
   - Correaltion of spending, active merchant vs booking order
   - Regression Analysis (Correlation Checked >> Multiple Linear Regression)

2. **Build a GMV & Spending forcast for the next 6 weeks**

II. Project Structuring

1 Data Understanding & Cleaning

- Load the dataset into **R**.
- Handle **missing values** if any.
- Convert the **Week** column into a date format.
- Check the **data types** of all variables.

2 Exploratory Data Analysis (EDA)

- Summary statistics (`summary()`, `mean()`, `sd()`, `quantile()`)
- Visualize demand trends:
  - `ggplot2` for **time series analysis** of **Bookings & GMV**.
  - **Correlation analysis** between **GMV, Bookings, and Promotions (Mex Spend & Grab Spend)**.

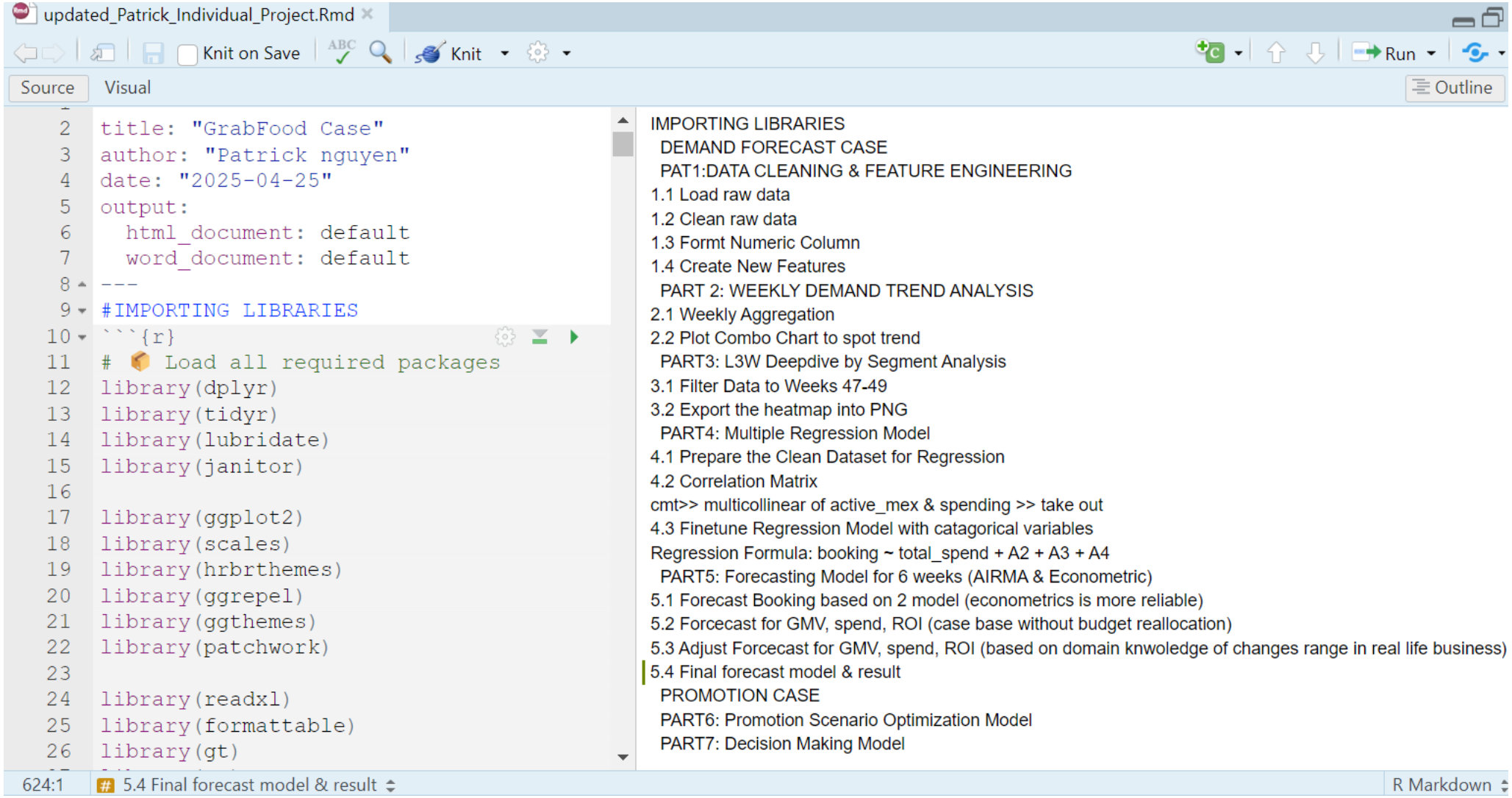
3 Analyzing Last Week's Performance

- Compare last week's GMV, Completed Orders, and Spending with previous weeks.
- Identify **potential causes** of changes (seasonality, promotions, external factors).

4 Building a 4-Week Forecast

- Use Time Series Models:
  - **Simple Moving Average (SMA)** for trend smoothing.
  - **Exponential Smoothing (ETS)** for forecasting.
  - **ARIMA (AutoRegressive Integrated Moving Average)** for advanced forecasting.
- Forecast **GMV & Spending (Mex Spend + Grab Spend)**.

II. Project Code Structuring in Rstudio, R Markdown



Data after cleaning

	week	account	active_mex	booking	completed	gmv	grossbilling	mex_spend	grab_spend
1	2020-09-14	A1	1759	438985	381949	4538171	220516	54468	374568
2	2020-09-14	A2	1176	393392	354934	3583448	187806	69091	315987
3	2020-09-14	A3	18896	988044	878425	8661127	588076	185433	737147
4	2020-09-14	A4	560	37204	30882	397346	8314	676	14129
5	2020-09-21	A1	1771	420341	350038	4119369	197731	72783	260398
6	2020-09-21	A2	1196	379266	329964	3290777	174484	65498	255994
7	2020-09-21	A3	19202	950124	812845	7901299	539090	176357	589879
8	2020-09-21	A4	591	37698	30232	389858	8429	635	14506
9	2020-09-28	A1	1775	391980	349254	4208916	204460	65291	252371
10	2020-09-28	A2	1220	355698	321090	3287323	173575	65215	247560
11	2020-09-28	A3	19390	915597	816834	8050719	549152	179932	588732
12	2020-09-28	A4	685	39485	32663	423392	8904	524	14761
13	2020-10-05	A1	1774	488151	381412	4351328	212199	104079	280414
14	2020-10-05	A2	1226	383193	305928	3199683	168617	58388	244130
15	2020-10-05	A3	20124	1018546	812117	8039923	549175	172467	600591
16	2020-10-05	A4	733	43780	30827	400147	8393	234	12622
17	2020-10-12	A1	1784	443151	336271	4045914	195870	75462	268531
18	2020-10-12	A2	1247	373062	290601	3032869	160736	59104	214683
19	2020-10-12	A3	20845	1063813	810039	7994375	546857	172230	581277
20	2020-10-12	A4	744	45974	33943	430408	9003	133	14014

Showing 1 to 20 of 48 entries, 9 total columns

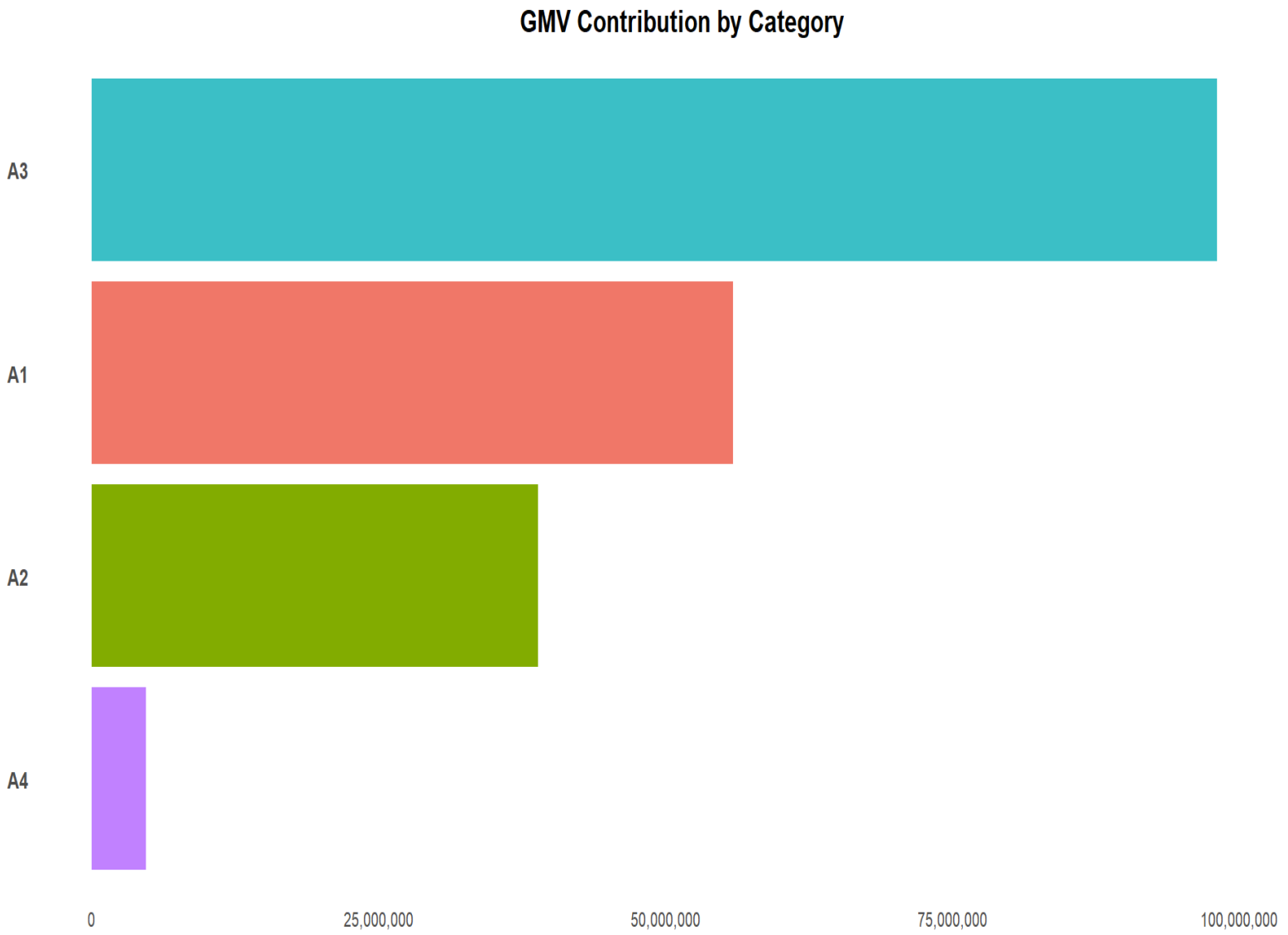
Demand summary using pivot in R >>

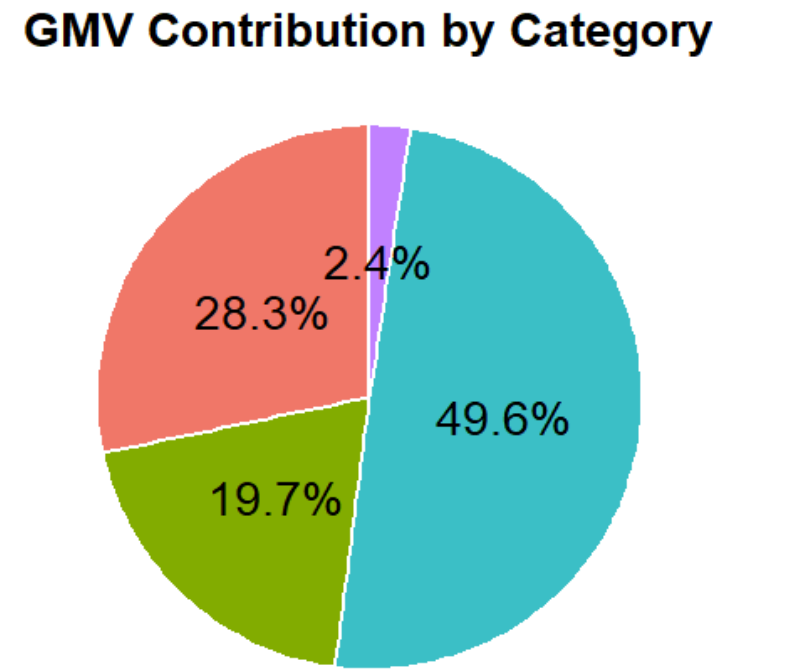
	month	week_in_year	total_spent	total_booking	ROI
1	Sep	37	1751499	1857625	9.81
2	Sep	38	1436050	1787429	10.93
3	Sep	39	1414386	1702760	11.29
4	Oct	40	1472925	1933670	10.86
5	Oct	41	1385434	1926000	11.19
6	Oct	42	1553758	1679411	11.04
7	Oct	43	1509718	1657728	10.69
8	Nov	44	1503587	1634483	10.66
9	Nov	45	1537401	1610411	10.58
10	Nov	46	1594337	1666134	10.64

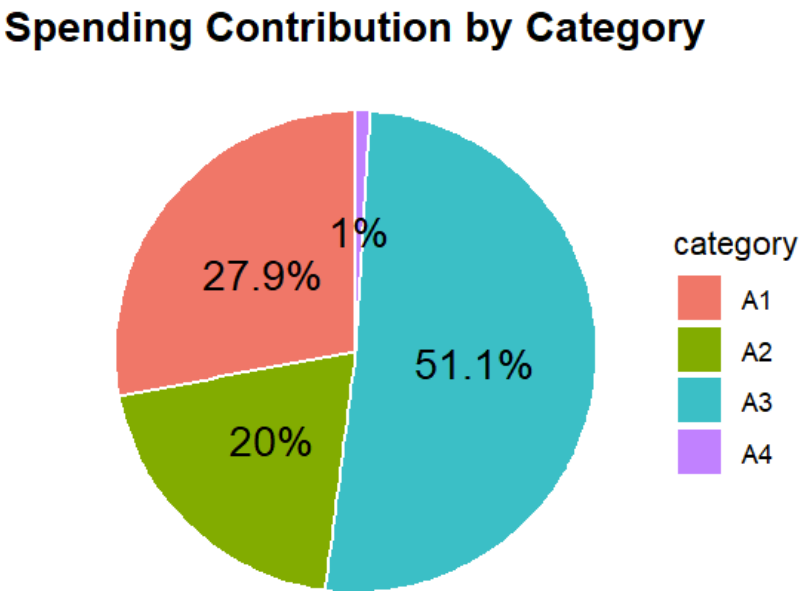
Showing 1 to 11 of 12 entries, 5 total columns

```r
# 📊 Pivot Table: Grouped by Month & Week in Year
demand_summary <- grabfood %>%
  group_by(month, week_in_year) %>%
  summarise(
    total_spent = sum(total_spent, na.rm = TRUE),
    total_booking = sum(booking, na.rm = TRUE),
    ROI = round(sum(gmv, na.rm = TRUE) / sum(total_spent, na.rm = TRUE), 2)  # Round to 2 decima
  ) %>%
  mutate(month = as.character(month)) %>%  # Convert month to character for sorting
  arrange(match(month, month.name), week_in_year)  # Correct sorting order
```

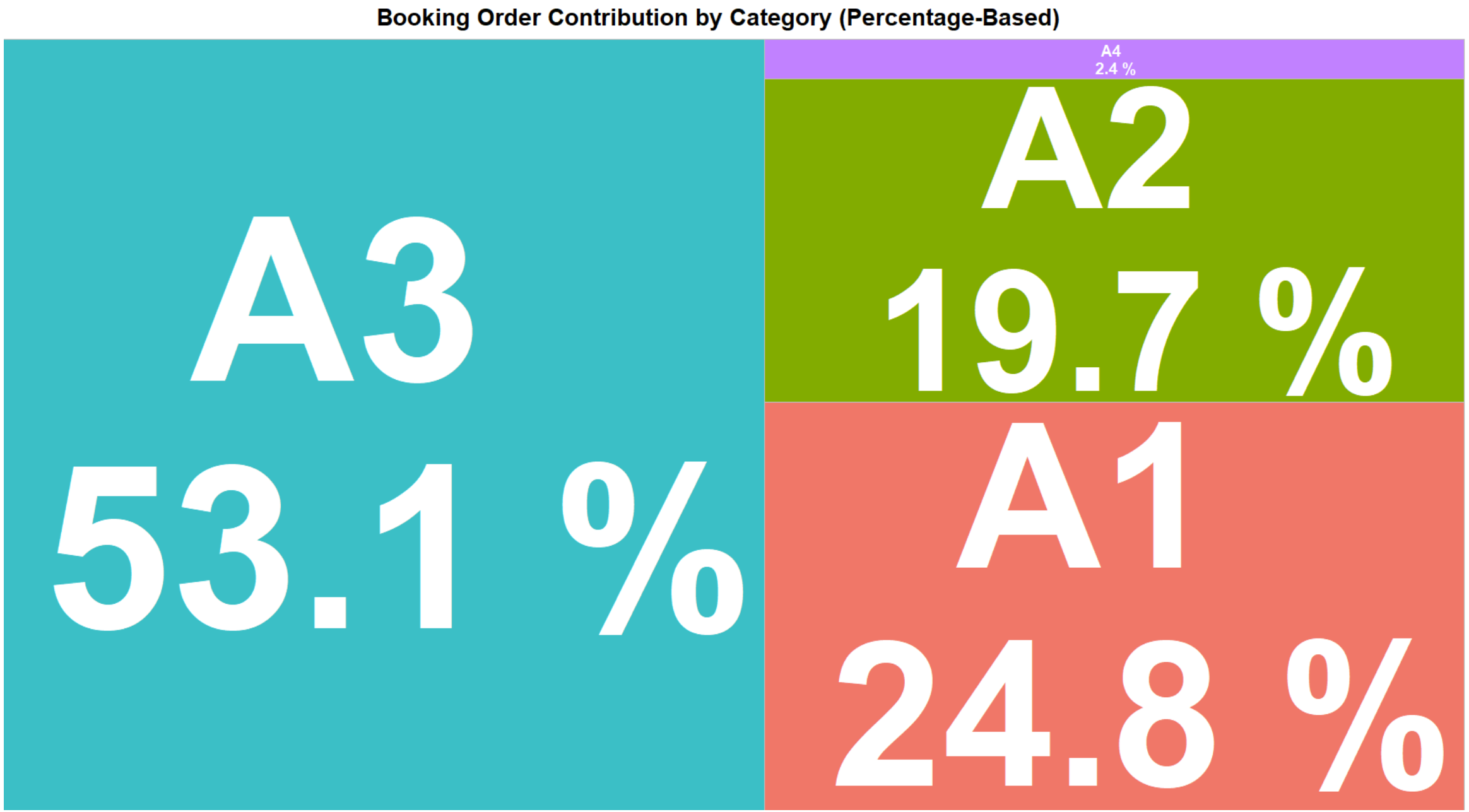
Demand summary using pivot in R >>

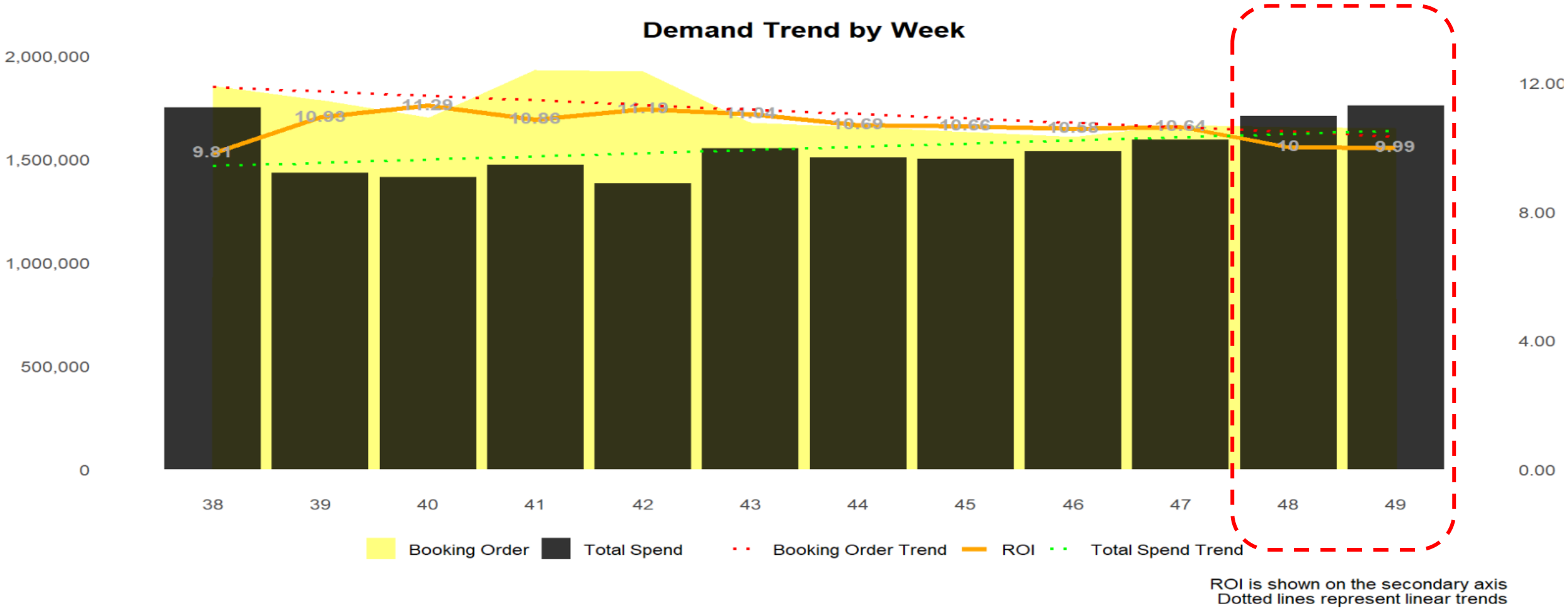




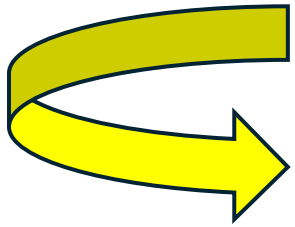


I. Business Questions & Data Understanding

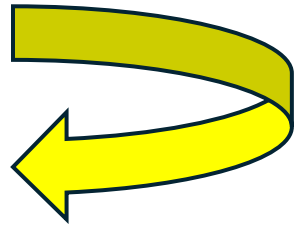


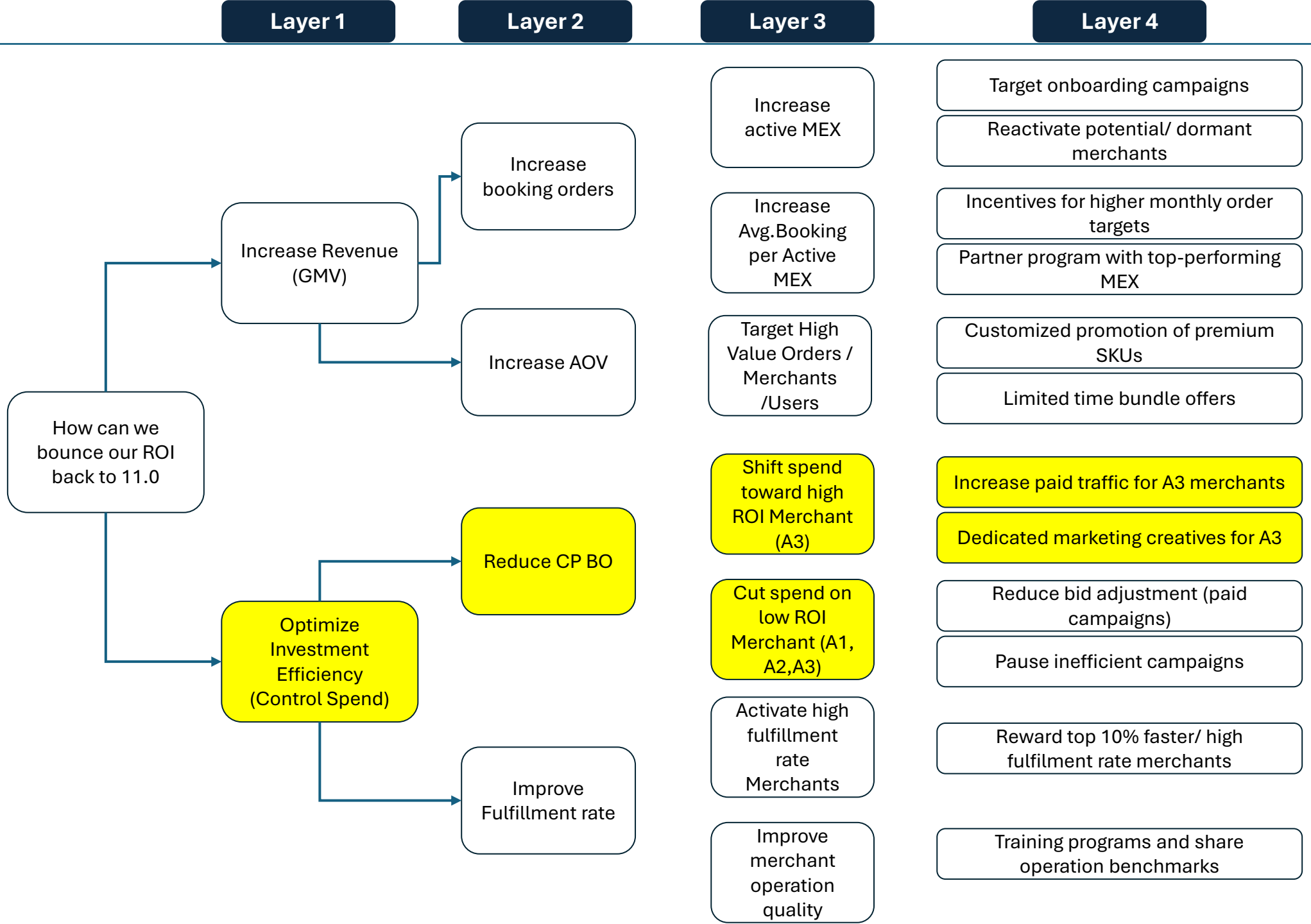

Demand Trend by Week
2,000,000
1,500,000
1,000,000
500,000
0
12.00
8.00
4.00
0.00
9.81
10.93
11.29
10.86
11.19
11.04
10.69
10.66
10.58
10.64
10
9.99
38
39
40
41
42
43
44
45
46
47
48
49
Booking Order
Total Spend
Booking Order Trend
ROI
Total Spend Trend
ROI is shown on the secondary axis
Dotted lines represent linear trends

egory	Time	active_mex	total_spend	booking	avg_booking_per_mex	pct_change_active_mex	pct_change_spent	pct_change_booking	pct_change_avg_demand_mex
A1	47	1,819.00	488,764.00	447,750.00	246.15	0.0	0.0	0.0	0.0
A1	48	1,809.00	543,562.00	438,005.00	242.13	-0.5	11.2	-2.2	-1.6
A1	49	1,828.00	561,742.00	420,510.00	230.04	1.1	3.3	-4.0	-5.0
A1	Subtotal	5,456.00	1,594,068.00	1,306,265.00	239.42	NA	NA	NA	NA
A2	47	1,313.00	309,783.00	318,473.00	242.55	0.0	0.0	0.0	0.0
A2	48	1,329.00	330,201.00	319,314.00	240.27	1.2	6.6	0.3	-0.9
A2	49	1,337.00	338,823.00	324,266.00	242.53	0.6	2.6	1.6	0.9
A2	Subtotal	3,979.00	978,807.00	962,053.00	241.78	NA	NA	NA	NA
A3	47	21,557.00	781,054.00	863,045.00	40.04	0.0	0.0	0.0	0.0
A3	48	21,797.00	818,961.00	865,377.00	39.70	1.1	4.9	0.3	-0.8
A3	49	21,670.00	845,023.00	872,666.00	40.27	-0.6	3.2	0.8	1.4
A3	Subtotal	65,024.00	2,445,038.00	2,601,088.00	40.00	NA	NA	NA	NA
A4	47	640.00	14,736.00	36,866.00	57.60	0.0	0.0	0.0	0.0
A4	48	603.00	16,489.00	35,462.00	58.81	-5.8	11.9	-3.8	2.1
A4	49	583.00	13,615.00	33,161.00	56.88	-3.3	-17.4	-6.5	-3.3
A4	Subtotal	1,826.00	44,840.00	105,489.00	57.77	NA	NA	NA	NA

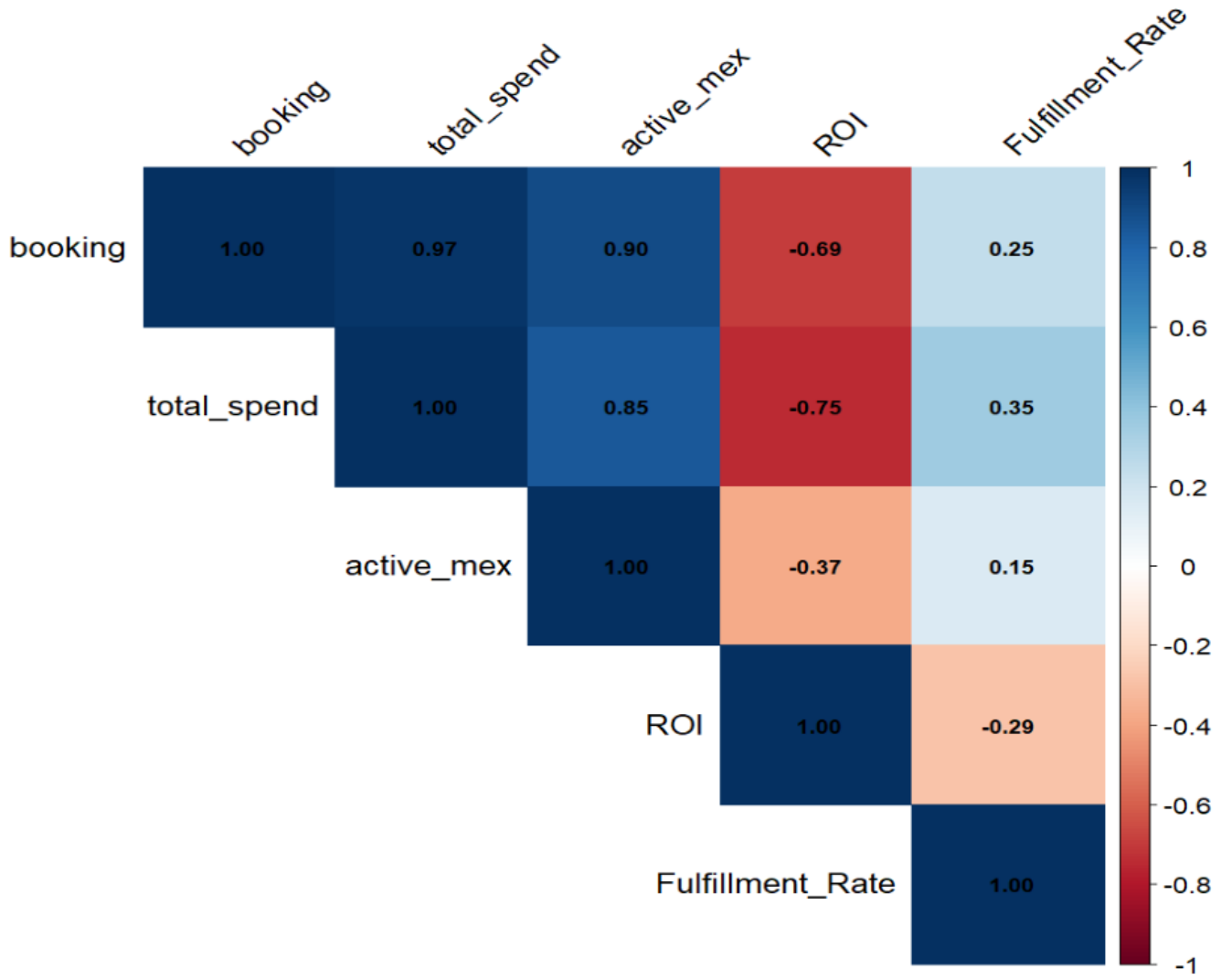


Merchant Cat	% Change spent	Change spent	Booking
A1	11%	54,798	Decrease
A2	7%	20,418	Maintain
A3	4%	37,907	Slight Increase
A4	12%	1,753	Slight Decrease




Layer 1
Layer 2
Layer 3
Layer 4
How can we bounce our ROI back to 11.0
Increase Revenue (GMV)
Increase booking orders
Increase AOV
Optimize Investment Efficiency (Control Spend)
Reduce CP BO
Improve Fulfillment rate
Increase active MEX
Increase Avg.Booking per Active MEX
Target High Value Orders / Merchants /Users
Shift spend toward high ROI Merchant (A3)
Cut spend on low ROI Merchant (A1, A2,A3)
Activate high fulfillment rate Merchants
Improve merchant operation quality
Target onboarding campaigns
Reactivate potential/ dormant merchants
Incentives for higher monthly order targets
Partner program with top-performing MEX
Customized promotion of premium SKUs
Limited time bundle offers
Increase paid traffic for A3 merchants
Dedicated marketing creatives for A3
Reduce bid adjustment (paid campaigns)
Pause inefficient campaigns
Reward top 10% faster/ high fulfilment rate merchants
Training programs and share operation benchmarks

III. Validation step: Correlation Matrix



Validation. Finetune regression model with categorical variable

```
lm(formula = booking ~ total_spend + A2 + A3 + A4, data = df_model)

Residuals:
   Min     1Q Median     3Q    Max
-11708  -2594   -247   4129   8801

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept)  4.915e+05  5.467e+04   8.990 4.30e-05 ***
total_spend -1.054e-01  1.026e-01  -1.028 0.338052
A2          -1.364e+05  2.191e+04  -6.223 0.000436 ***
A3           4.615e+05  2.973e+04  15.522 1.11e-06 ***
A4          -4.547e+05  5.332e+04  -8.529 6.04e-05 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 7539 on 7 degrees of freedom
Multiple R-squared:  0.9996,    Adjusted R-squared:  0.9994
F-statistic:  4723 on 4 and 7 DF,  p-value: 4.4e-12
```

- **Category A3 is the most significant positive driver** of booking orders, with an estimated uplift of **+461,500 bookings** compared to baseline (A1).
- **Category A2 and A4 show strong negative impacts** on bookings, reducing performance by **-136,400** and **-454,700 bookings** respectively
- **Total Spend itself is not statistically significant** — suggesting that **where we allocate budget** (category selection) **matters more than simply increasing spend**
- The model explains **99.9% of booking variance**, indicating a **very strong and reliable fit** for strategic forecasting
- **Actionable Strategy:** Reallocate investment toward **Category A3** to drive maximum booking growth, while **optimizing or limiting spending** on Categories A2 and A4

r.squared <dbl>	adj.r.squared <dbl>	sigma <dbl>	statistic <dbl>	p.value <dbl>	df <dbl>	logLik <dbl>	AIC <dbl>	BIC <dbl>	deviance <dbl>	df.residual <int>	nobs <int>
0.9996296	0.9994179	7539.354	4722.82	4.4e-12	4	-120.928	253.856	256.7654	397893014	7	12

1 row

term <chr>	estimate <dbl>	std.error <dbl>	statistic <dbl>	p.value <dbl>
(Intercept)	4.914518e+05	5.466511e+04	8.990228	4.295947e-05
total_spend	-1.054474e-01	1.025518e-01	-1.028235	3.380521e-01
A2	-1.363632e+05	2.191441e+04	-6.222536	4.356006e-04
A3	4.615185e+05	2.973372e+04	15.521721	1.112980e-06
A4	-4.547127e+05	5.331530e+04	-8.528748	6.043923e-05

- **5. Forecast by GPT (no real-world scenario added)**

week <int>	AOV <dbl>	CPBO <dbl>	fulfillment_rate <dbl>	total_spend <dbl>	booking <dbl>	GMV <dbl>	completed_orders <dbl>	ROI <dbl>
1	12.0	0.90	0.92	1400000	806000	9672000	741520	6.908571
2	12.2	0.92	0.92	1400000	806000	9833200	741520	7.023714
3	12.3	0.93	0.91	1400000	806000	9913800	733460	7.081286
4	12.4	0.94	0.91	1400000	806000	9994400	733460	7.138857
5	12.5	0.95	0.91	1400000	806000	10075000	733460	7.196429
6	12.6	0.96	0.90	1400000	806000	10155600	725400	7.254000

Historical (46-49)

Week	% Allocation	Spend	GMV	ROI	AOV	Completed Order	Booking Order	CP CO	CP BO	Fullfillment rate
46	23%	1,537,401	16,266,414	10.58	10.71	1,519,410	1,610,411	1.01	0.95	94%
47	24%	1,594,337	16,961,174	10.64	10.86	1,561,173	1,666,134	1.02	0.96	94%
48	26%	1,709,213	17,095,598	10.00	10.69	1,599,773	1,658,158	1.07	1.03	96%
49	27%	1,759,203	17,575,245	9.99	11.14	1,578,025	1,650,603	1.11	1.07	96%
Total	**100%**	**6,600,154**	**67,898,431**	**10.29**	**10.85**	**6,258,381**	**6,585,306**	**1.05**	**1.00**	**95%**

	Historical				% Change			New		
Week	% Allocation	AOV	CP BO	Fullfillment rate	AOV	CP BO	Fullfillment rate	AOV	CP BO	Fullfillment rate
50	23%	10.71	0.95	94%	**10%**	**-15%**	**0%**	11.78	0.81	94%
51	24%	10.86	0.96	94%	**12%**	**-10%**	**-2%**	12.17	0.86	92%
52	26%	10.69	1.03	96%	**18%**	**-10%**	**-5%**	12.61	0.93	92%
1	27%	11.14	1.07	96%	**15%**	**-5%**	**-5%**	12.81	1.01	91%

Category	New Plan
A1	**Cut 10%**
A2	**Cut 3%**
A3	**Boost 15%**
A4	**Cut 10%**

- **6. Forecast by GPT with key metrics updated**

week <int>	total_spend <dbl>	AOV <dbl>	CPBO <dbl>	fulfillment_rate <dbl>	booking <dbl>	completed_orders <dbl>	GMV <dbl>	ROI <dbl>	Scenario <chr>
50	1537401	12.0	0.90	0.92	1708223	1571565	18858780	12.27	Baseline Fix
51	1594337	12.2	0.92	0.92	1732975	1594337	19450911	12.20	Baseline Fix
52	1709213	12.3	0.93	0.91	1837863	1672455	20571196	12.04	Baseline Fix
53	1759203	12.4	0.94	0.91	1871493	1703059	21117932	12.00	Baseline Fix
54	1650039	12.5	0.95	0.91	1736883	1580564	19757050	11.97	Baseline Fix
55	1650039	12.6	0.96	0.90	1718790	1546911	19491079	11.81	Baseline Fix

rows

week <int>	total_spend <dbl>	AOV <dbl>	CPBO <dbl>	fulfillment_rate <dbl>	booking <dbl>	completed_orders <dbl>	GMV <dbl>	ROI <dbl>	Scenario <chr>
50	1537401	12.0	0.90	0.92	1759470	1618712	19424544	12.63	Optimized Reallocation
51	1594337	12.2	0.92	0.92	1784964	1642167	20034437	12.57	Optimized Reallocation
52	1709213	12.3	0.93	0.91	1892999	1722629	21188337	12.40	Optimized Reallocation
53	1759203	12.4	0.94	0.91	1927638	1754151	21751472	12.36	Optimized Reallocation
54	1650039	12.5	0.95	0.91	1788989	1627980	20349750	12.33	Optimized Reallocation
55	1650039	12.6	0.96	0.90	1770354	1593319	20075819	12.17	Optimized Reallocation

References

- Data Source: Grab Holdings Limited in Vietnam (Marketplace Strategy team)
- Ggplot doc: https://ggplot2.tidyverse.org/
- Corrplot doc: https://www.rdocumentation.org/packages/corrplot/versions/0.95
- R doc: https://www.r-project.org/other-docs.html

Thank You!