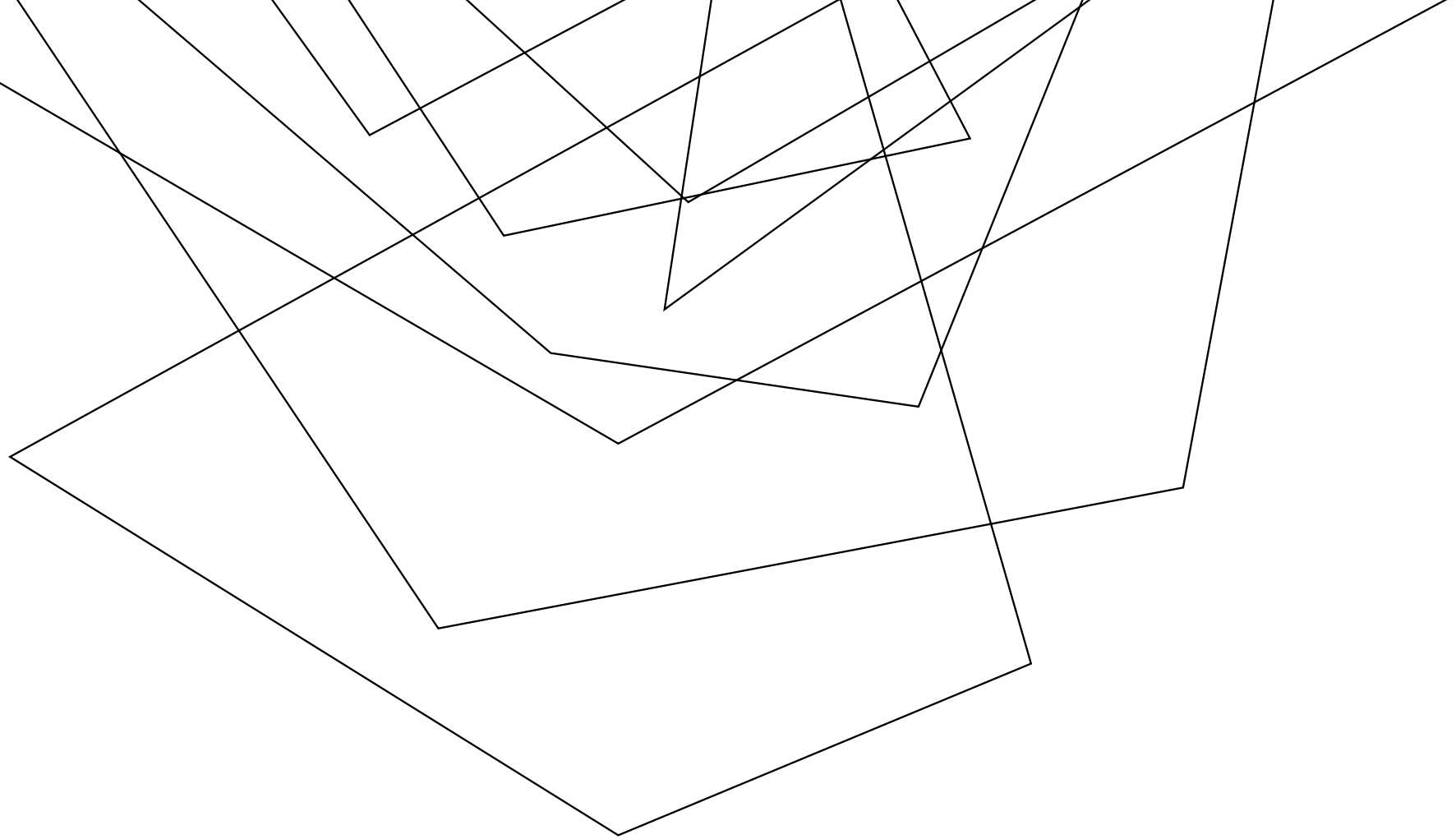


FACEBOOK AD ANALYSIS

Amisha Gadhia

AGENDA

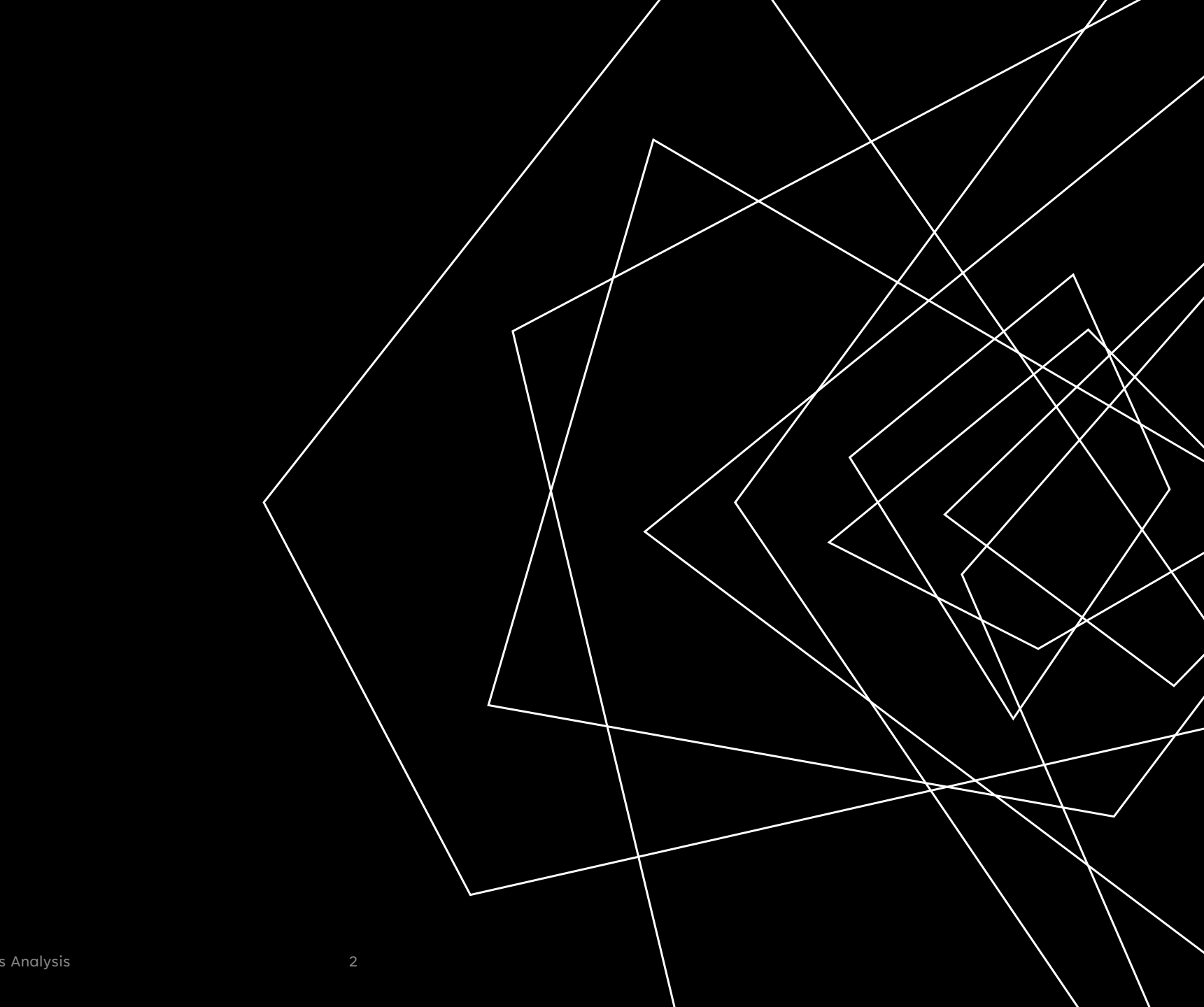
Introduction

Domain knowledge

Data Analysis

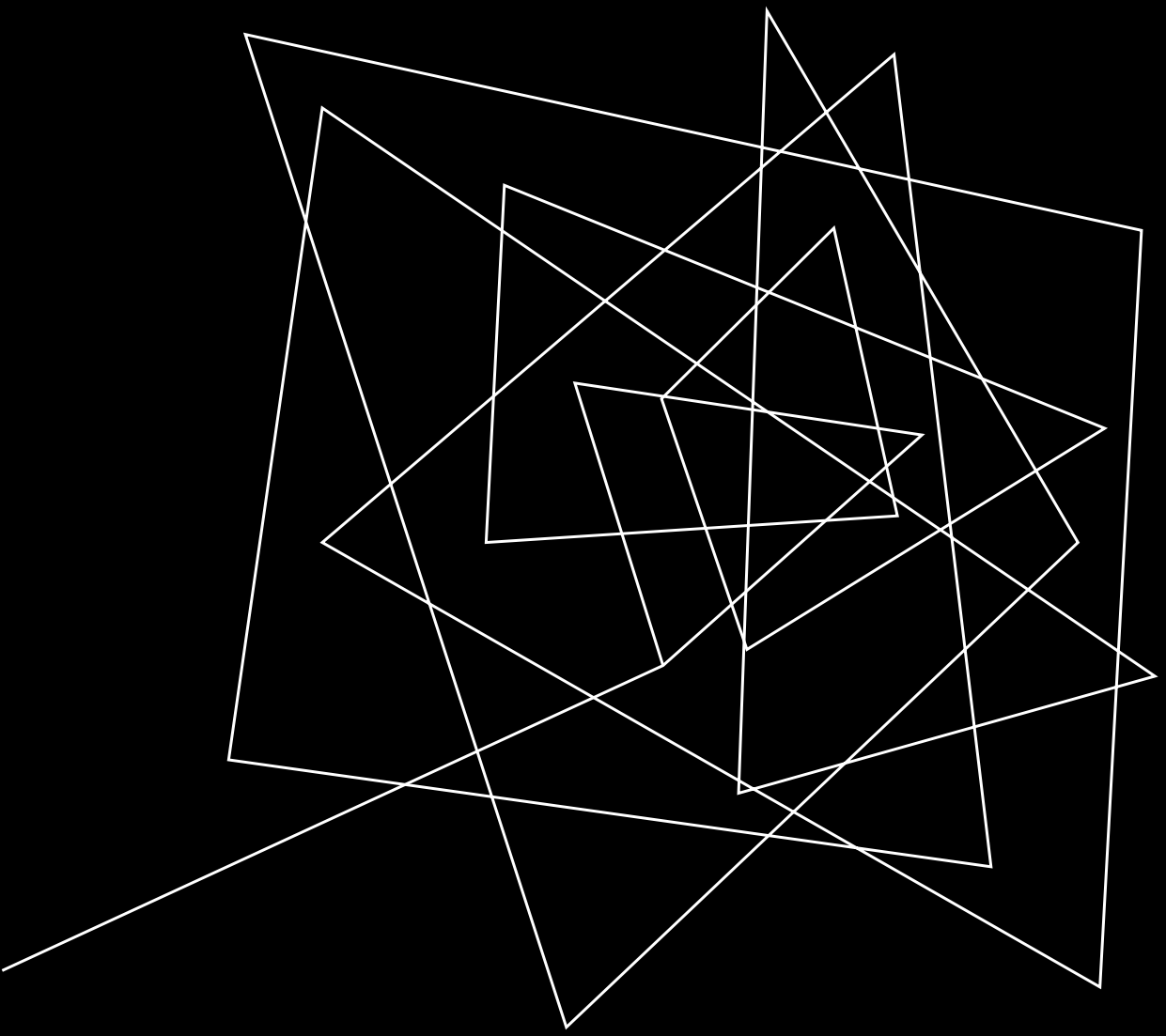
Research Articles

Summary



INTRODUCTION

Digital marketing's evolution from a non-existent field to a money-making powerhouse. The social media advertising market size has grown rapidly. It will grow from $198.78 billion in 2023 to $226.73 billion in 2024 at a compound growth of 14.1%. Facebook advertising is a regular feature in many small businesses’ marketing plans. There are 3.7 million businesses running ad campaigns through Facebook, spending a combined $5.5 billion to reach potential customers using the social media platform.



DOMAIN KNOWLEDGE

Every advertiser submitting their campaigns competes for a specific ad placement in front of their target audience.

Price isn’t the only factor taken into consideration when deciding on an auction winner. To award the ad spot, Facebook determines an ad’s total value—in other words, how much the target audience would like or engage with the ad.

TERMINOLOGIES FOR COSTING OF AN AD

Term	Meaning
CPC	COST PER CLICK – on an average $0.94 per Click
CPM	COST PER MILLE – Cost per 1000 impressions: On an Average $12.07 per 1000 impressions.
CPL	Cost PER LEAD- Research pits the average cost per lead for a Facebook ad at $5.83*
Conversion Rate	On an average the conversion rate is 9.21% for Facebook Ads.
CPC	COST PER CONVERSION - it is typically between $0.25 and $5.00. However, it can be as high as $150 or more for some industries and target audiences.

MECHANISM OF THE AD VALUATION

We rank ads based on a 'Total Value' for each ad

Click-optimized ad:

Total Value =
(bid for click)
x (estimated click-through rate)
+ relevance/quality factors

Conversion-optimized ad:

Total Value =
(bid for conversion)
x (est. click-through rate) x (est. click-to-conversion rate)
+ relevance/quality factors

THE BEST MARKETING DOESN'T FEEL LIKE MARKETING

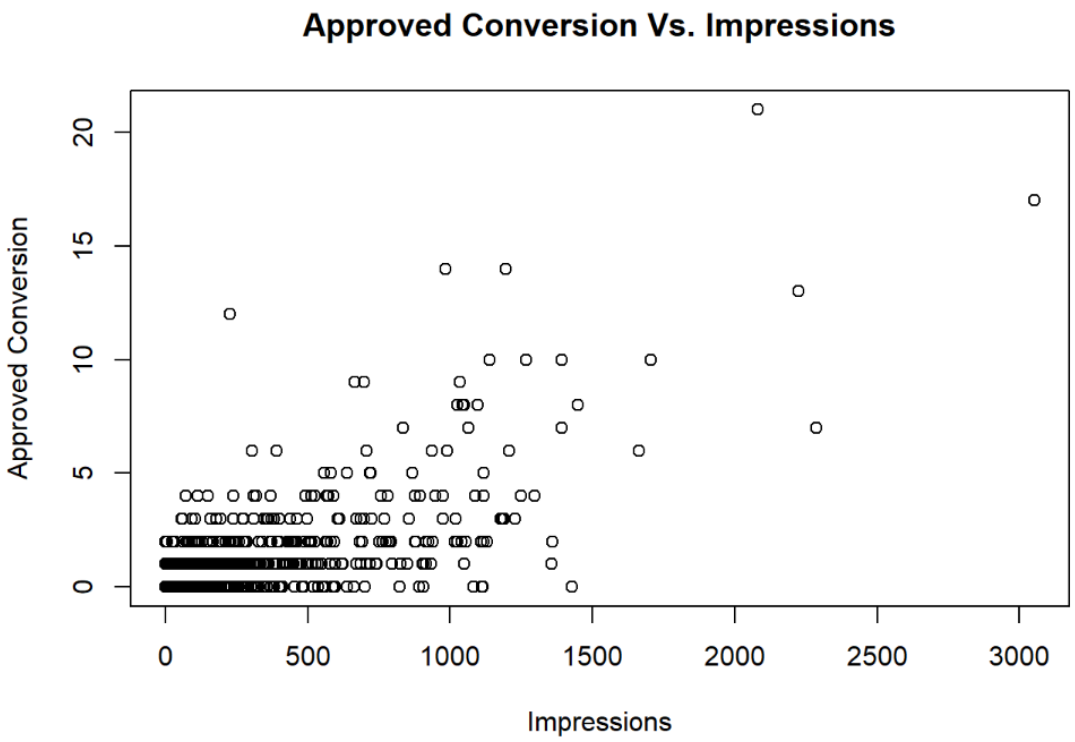
Tom Fishburne

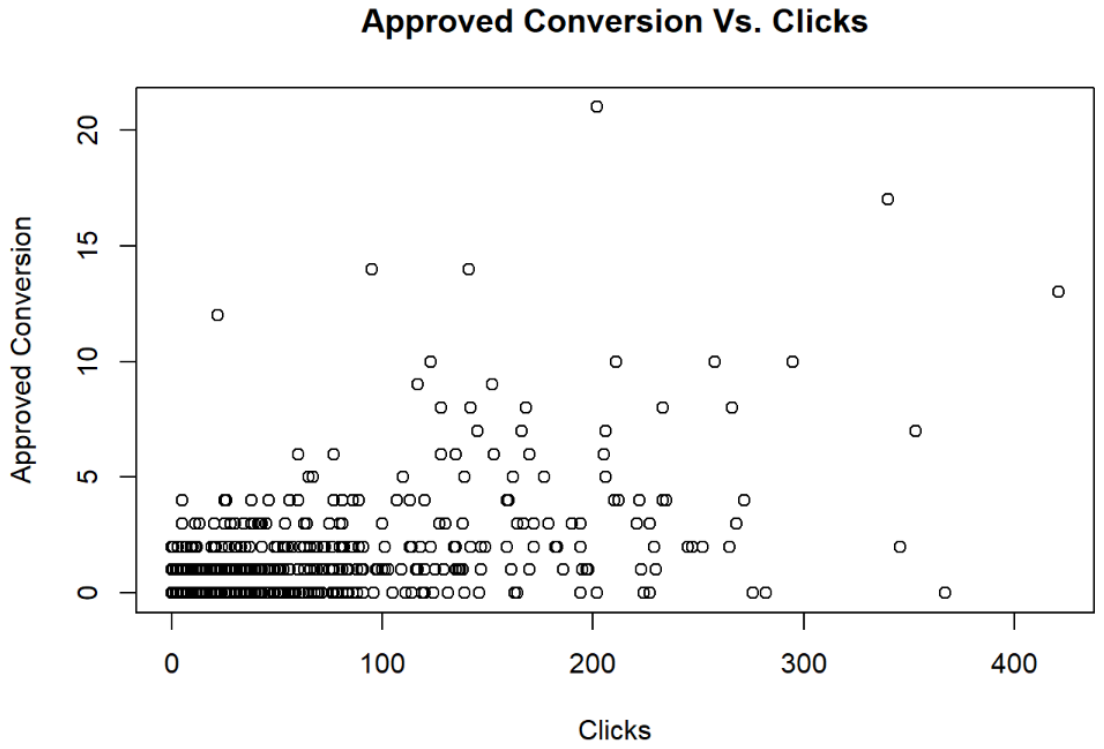
DATA DICTIONARY AND PROCESSING

- Ad_id: Unique ID for each ad.
- Campaign IDs: xyzcampaignid, fbcampaignid.
- Demographic details: Age, gender, interest.
- Ad metrics: Impressions, clicks, spent.
- Conversions: Total_Conversion, Approved_Conversion.

DATA COURTESY: www.Kaggle.com

DATA VIZZ


Approved Conversion Vs. Impressions
Approved Conversion
0
5
10
15
20
0
500
1000
1500
2000
2500
3000
Impressions


Approved Conversion Vs. Clicks
Approved Conversion
0
5
10
15
20
0
100
200
300
400
Clicks

CORRELATION BETWEEN VARIABLES

```r
# Correlation between variables
cor(df[,-c(1,2)])
```

```
##                        interest Impressions     Clicks      Spent
## interest            1.00000000   0.1019733 0.08870606 0.07022597
## Impressions         0.10197326   1.0000000 0.94851414 0.97038617
## Clicks              0.08870606   0.9485141 1.00000000 0.99290634
## Spent               0.07022597   0.9703862 0.99290634 1.00000000
## Total_Conversion    0.12026967   0.8128376 0.69463235 0.72537945
## Approved_Conversion 0.05835320   0.6842485 0.55952579 0.59317782
##                     Total_Conversion Approved_Conversion
## interest                   0.1202697           0.0583532
## Impressions                0.8128376           0.6842485
## Clicks                     0.6946324           0.5595258
## Spent                      0.7253794           0.5931778
## Total_Conversion           1.0000000           0.8640338
## Approved_Conversion        0.8640338           1.0000000
```

REGRESSION MODELS

```r
# Model-1 : Approved_Conversion ~ Impressions
mod1 <- lm(Approved_Conversion ~ Impressions, data = df)
summary(mod1)
```

```
##
## Call:
## lm(formula = Approved_Conversion ~ Impressions, data = df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -5.6645 -0.4463 -0.2425  0.6678 12.8558
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept) 0.2341098  0.0436790    5.36 1.01e-07 ***
## Impressions 0.0038017  0.0001199   31.69  < 2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.268 on 1141 degrees of freedom
## Multiple R-squared:  0.4682, Adjusted R-squared:  0.4677
## F-statistic:  1005 on 1 and 1141 DF,  p-value: < 2.2e-16
```

```r
# Model-2 : Approved_Conversion ~ Clicks
mod2 <- lm(Approved_Conversion ~ Clicks, data = df)
summary(mod2)
```

```
##
## Call:
## lm(formula = Approved_Conversion ~ Clicks, data = df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -6.6454 -0.4930 -0.3734  0.5668 17.1744
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept) 0.3733681  0.0494222   7.555 8.58e-14 ***
## Clicks      0.0170900  0.0007494  22.804  < 2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.441 on 1141 degrees of freedom
## Multiple R-squared:  0.3131, Adjusted R-squared:  0.3125
## F-statistic:   520 on 1 and 1141 DF,  p-value: < 2.2e-16
```

BAISED RESULTS

```
# Multilinear model
mod4 <- lm(Approved_Conversion ~ Impressions + Clicks, data = df)
summary(mod4)
```

```
##
## Call:
## lm(formula = Approved_Conversion ~ Impressions + Clicks, data = df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -4.7316 -0.4351 -0.2704  0.6423 10.3954
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)  0.2660397  0.0403477   6.594 6.55e-11 ***
## Impressions  0.0085029  0.0003493  24.344  < 2e-16 ***
## Clicks      -0.0272472  0.0019201 -14.190  < 2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.169 on 1140 degrees of freedom
## Multiple R-squared:  0.548,  Adjusted R-squared:  0.5472
## F-statistic: 691.1 on 2 and 1140 DF,  p-value: < 2.2e-16
```

VIF TEST

```
vif(mod5)
```

```
##      Impressions           Clicks Total_Conversion
##        18.345219        12.028234         3.556444
```

```
(vif(mod6))
```

```
##      Impressions Total_Conversion
##         2.947287         2.947287
```

POISSON REGRESSION MODEL

```
mod1_1 <- glm(Approved_Conversion ~ Impressions, df, family = poisson)
summary(mod1_1)
```

```
##
## Call:
## glm(formula = Approved_Conversion ~ Impressions, family = poisson,
##     data = df)
##
## Coefficients:
##               Estimate Std. Error z value Pr(>|z|)
## (Intercept) -5.349e-01  3.776e-02  -14.17   <2e-16 ***
## Impressions  1.474e-03  3.848e-05   38.31   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for poisson family taken to be 1)
##
##     Null deviance: 2199.3  on 1142  degrees of freedom
## Residual deviance: 1382.9  on 1141  degrees of freedom
## AIC: 2741.8
##
## Number of Fisher Scoring iterations: 5
```

```
mod2_1 <- glm(Approved_Conversion ~ Clicks, df, family = poisson)
summary(mod2_1)
```

```
##
## Call:
## glm(formula = Approved_Conversion ~ Clicks, family = poisson,
##     data = df)
##
## Coefficients:
##               Estimate Std. Error z value Pr(>|z|)
## (Intercept) -0.5378170  0.0395466  -13.60   <2e-16 ***
## Clicks       0.0085331  0.0002746   31.08   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for poisson family taken to be 1)
##
##     Null deviance: 2199.3  on 1142  degrees of freedom
## Residual deviance: 1542.6  on 1141  degrees of freedom
## AIC: 2901.5
##
## Number of Fisher Scoring iterations: 5
```

POISSON MULTIPLE REGRESSION MODEL

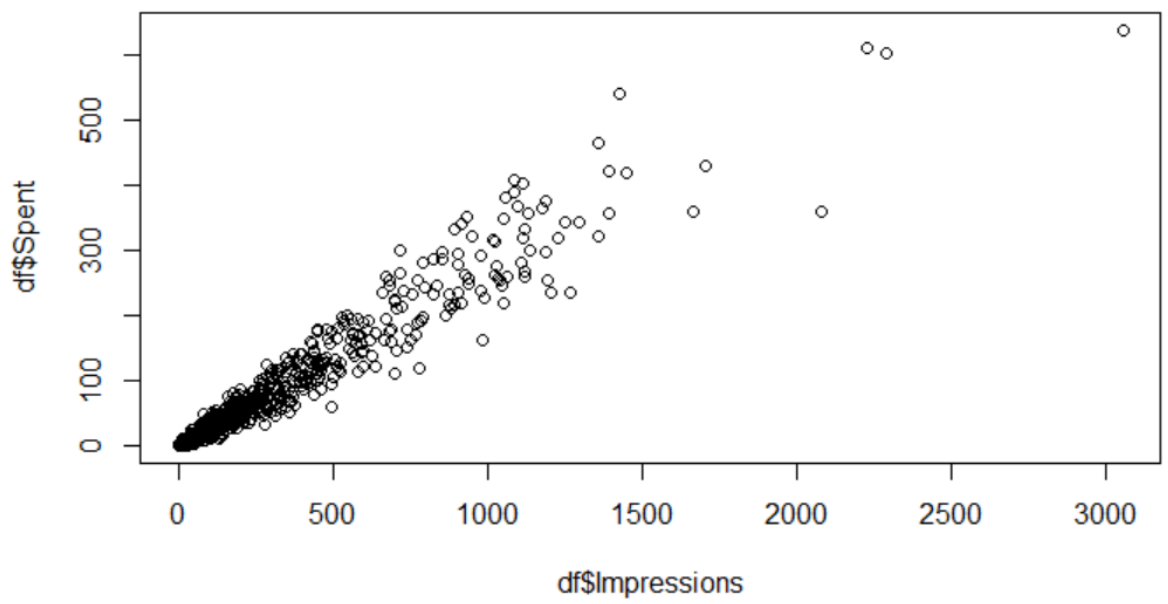
```
mod3_1 <- glm(Approved_Conversion ~ Clicks + Impressions, df, family = poisson)
summary(mod3_1)
```

```
##
## Call:
## glm(formula = Approved_Conversion ~ Clicks + Impressions, family = poisson,
##     data = df)
##
## Coefficients:
##               Estimate Std. Error z value Pr(>|z|)
## (Intercept) -0.5367098  0.0393924 -13.625   <2e-16 ***
## Clicks       0.0001214  0.0007500   0.162    0.871
## Impressions  0.0014582  0.0001068  13.653   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for poisson family taken to be 1)
##
##     Null deviance: 2199.3  on 1142  degrees of freedom
## Residual deviance: 1382.9  on 1140  degrees of freedom
## AIC: 2743.8
##
## Number of Fisher Scoring iterations: 5
```

RECAP

1. Correlation between the variables
2. Causal effect between the independent variables
3. Detecting biased results
4. Reliability of regression models

SPENDING ANALYSIS




```
Call:
lm(formula = Spent ~ Impressions, data = df)

Residuals:
     Min       1Q   Median       3Q      Max
-201.900   -4.153   -1.220    1.849  155.524

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept) 1.009289   0.723611   1.395    0.163
Impressions 0.269645   0.001987 135.695   <2e-16 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 21 on 1141 degrees of freedom
Multiple R-squared:  0.9416,    Adjusted R-squared:  0.9416
F-statistic: 1.841e+04 on 1 and 1141 DF,  p-value: < 2.2e-16
```

SPENDING ANALYSIS

```
mod10 <- lm(Spent ~ Approved_Conversion + Impressions + Clicks, df)
summary(mod10)
```

```
##
## Call:
## lm(formula = Spent ~ Approved_Conversion + Impressions + Clicks,
##     data = df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -37.243  -1.068   0.044   1.053  60.162
##
## Coefficients:
##                      Estimate Std. Error t value Pr(>|t|)
## (Intercept)         -0.103050   0.235007  -0.438    0.661
## Approved_Conversion -0.680407   0.169310  -4.019 6.24e-05 ***
## Impressions          0.085004   0.002462  34.533  < 2e-16 ***
## Clicks               1.085138   0.011907  91.138  < 2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 6.684 on 1139 degrees of freedom
## Multiple R-squared:  0.9941, Adjusted R-squared:  0.9941
## F-statistic: 6.397e+04 on 3 and 1139 DF,  p-value: < 2.2e-16
```

- Nastišin's paper explores CPC and CTR dynamics on Facebook and Instagram across industries and regions.
- It emphasizes their importance in budget planning and highlights differing CTRs. Importantly, it notes a trend where increased conversions lead to decreased ad spending.
- This finding aligns with my regression model's negative correlation between 'Approved_Conversion' and 'Spent', reinforcing its theoretical basis.

AREAS OF FOCUS

Casual Effects

Relationship between impressions and clicks.

Factors affecting impressions and clicks.

Limitation of the dataset.

Unreliable and biased regression results.

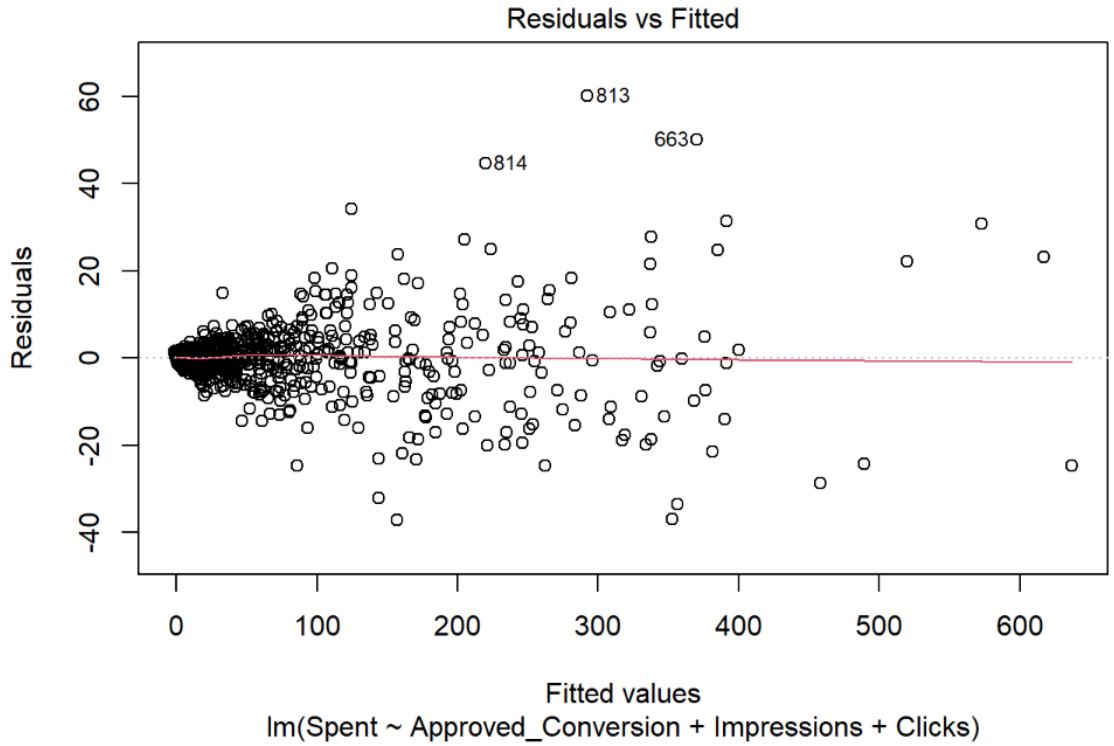
Analyzing Spending on Ads

99% R Square with three independent variables affecting Amount Spent on Ads

Reliability of regression model and unbiased results.

Un-usual coefficients' in the model.

RESIDUALS VS FITTED



- The residual plot displays a straight line, indicating a robust linear relationship between independent variables (Approved_Conversion, Impressions, Clicks) and the dependent variable (Spent).
- The high R-squared value of 0.9941 demonstrates that the model effectively explains 99.41% of the variability in Spent, confirming its reliability and strong explanatory power for the dataset.

HYPOTHESIS TEST

The hypothesis test rejects the null hypothesis, indicating a significant relationship between Spent, Approved_Conversion, Impressions, and Clicks. High goodness of fit statistics, including R-squared and adjusted R-squared values of 0.9941, confirm the model's strong explanatory power and suitability for the data.

GENERAL CONCLUSIONS AND SUGGESTIONS FOR IMPROVEMENT

While the analysis provides valuable insights into the relationship between advertising metrics and expenditure on Facebook, further research could explore additional factors that may influence advertising performance, such as ad content, targeting strategies, and audience demographics.

Additionally, incorporating data from other advertising platforms or conducting comparative analyses across multiple platforms could provide a more comprehensive understanding of digital advertising dynamics and enable more robust decision-making processes.

APPLICABILITY AND DECISION IMPROVEMENT

The conclusions and prescriptions derived from the analysis apply to businesses and organizations engaged in digital marketing activities, particularly those utilizing Facebook advertising.

By implementing the insights gained from the analysis, advertisers and marketers can make more informed decisions regarding budget allocation and campaign optimization, leading to improved effectiveness and efficiency in achieving advertising objectives.

SUMMARY

This research project explored Facebook ads analysis via multiple linear regression, aiming to reveal factors impacting ad performance. By analyzing conversions, impressions, clicks, and ad spending, it aimed to elucidate digital marketing dynamics using a Kaggle-sourced dataset. The findings, highlighted in the final model summary, demonstrate a strong linear relationship between independent variables and ad spending, with an R-squared value of 0.9941 indicating the model's high explanatory power. This study contributes valuable insights for advertisers to optimize digital ad strategies effectively.

THANK YOU

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