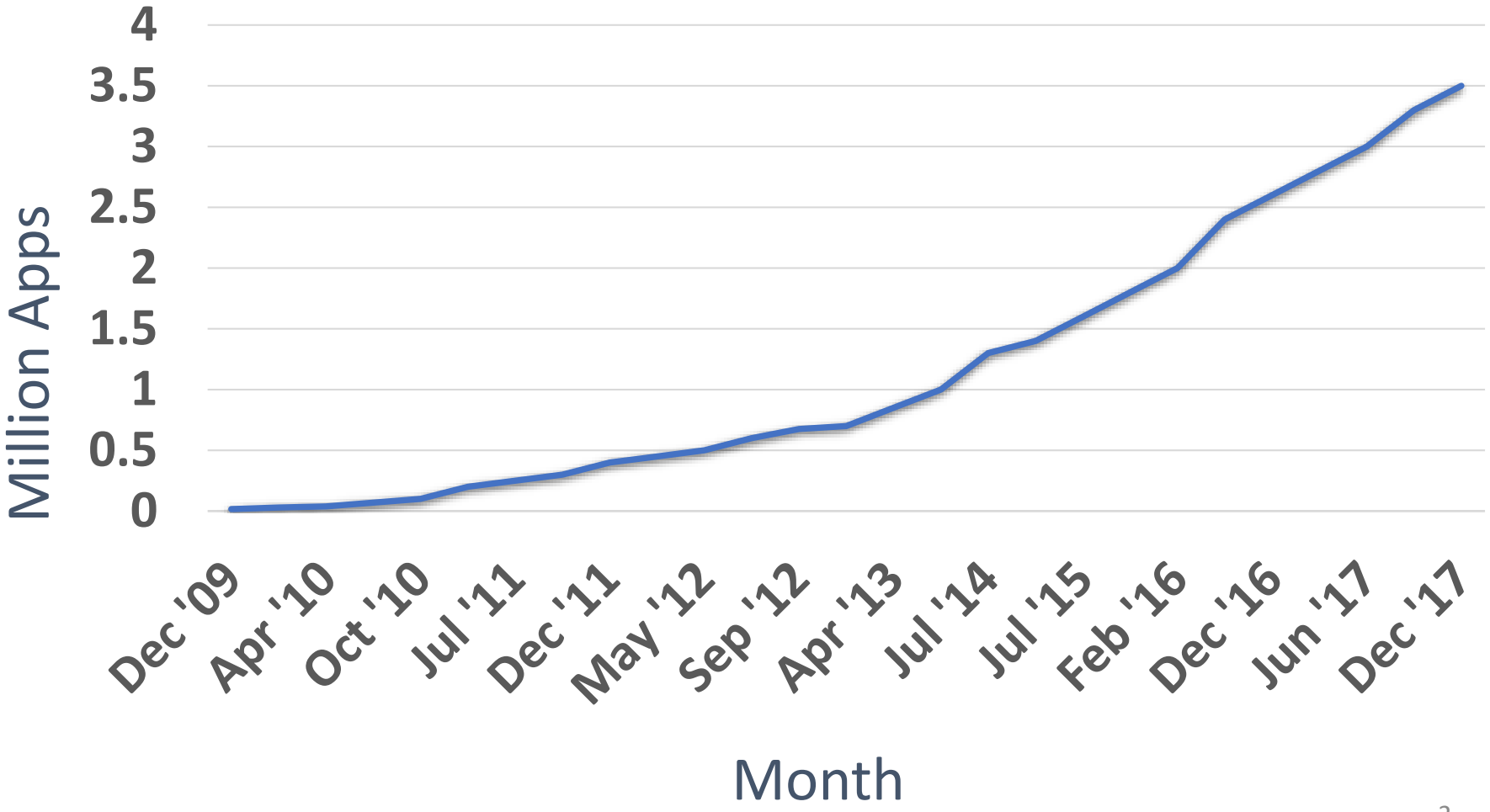
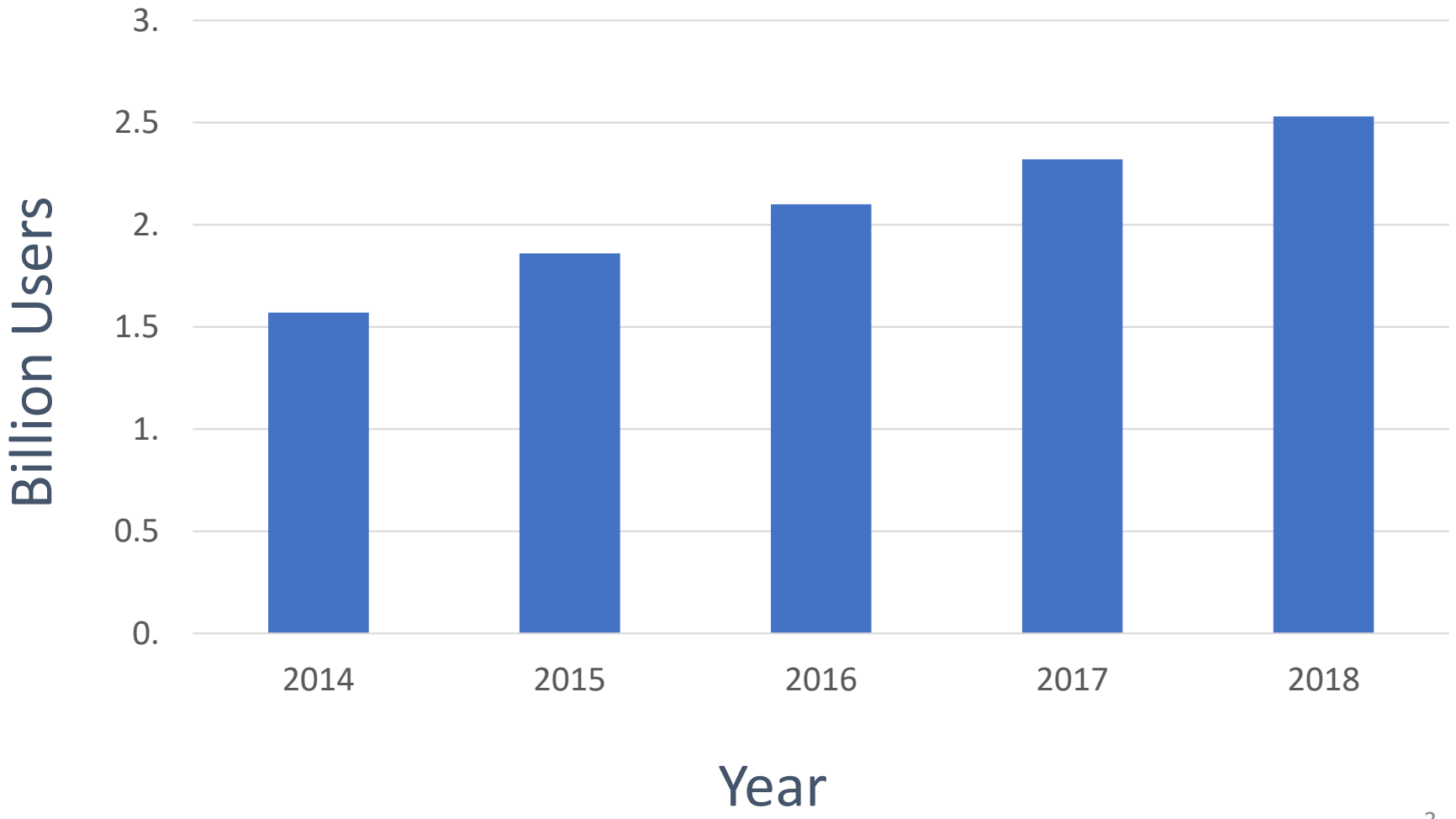
Ehsan Noei
Daniel Alencar da Costa
Ying (Jenny) Zou

Winning the app production rally

The number of mobile apps continues to rise



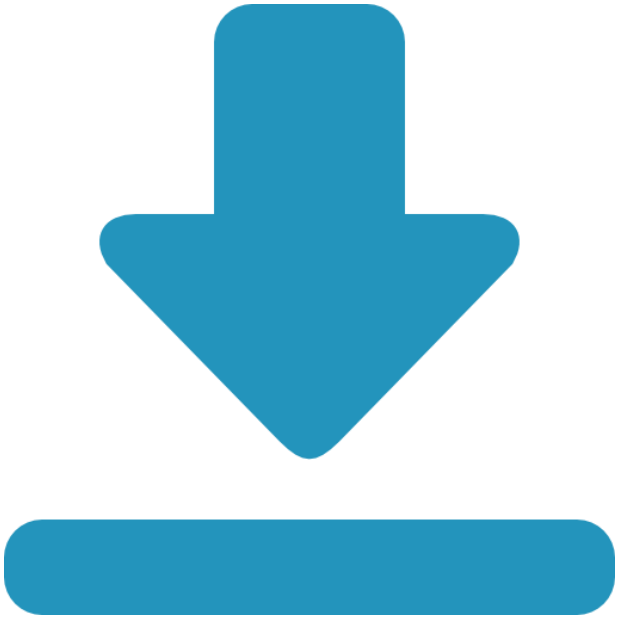
The numbers of smartphone users is raising



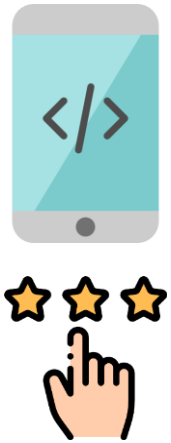
The app markets are becoming more competitive

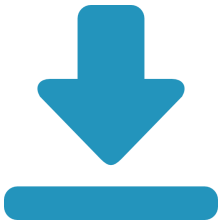
Image Credit: http://pixabay.com/

Prior studies have investigated the success of mobile apps

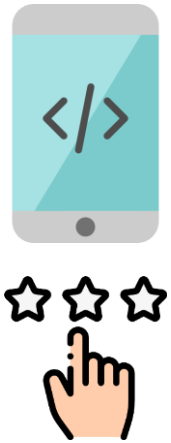


Studied success factors is not as precise as rankings

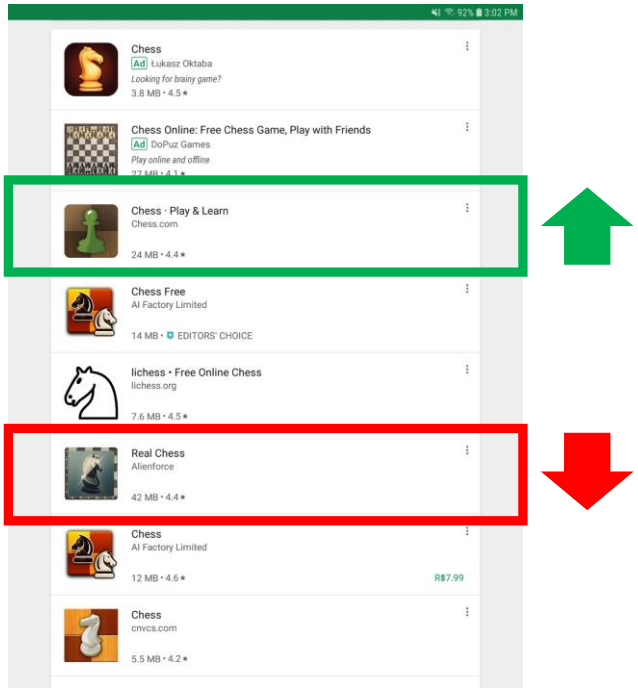




100 Downloads

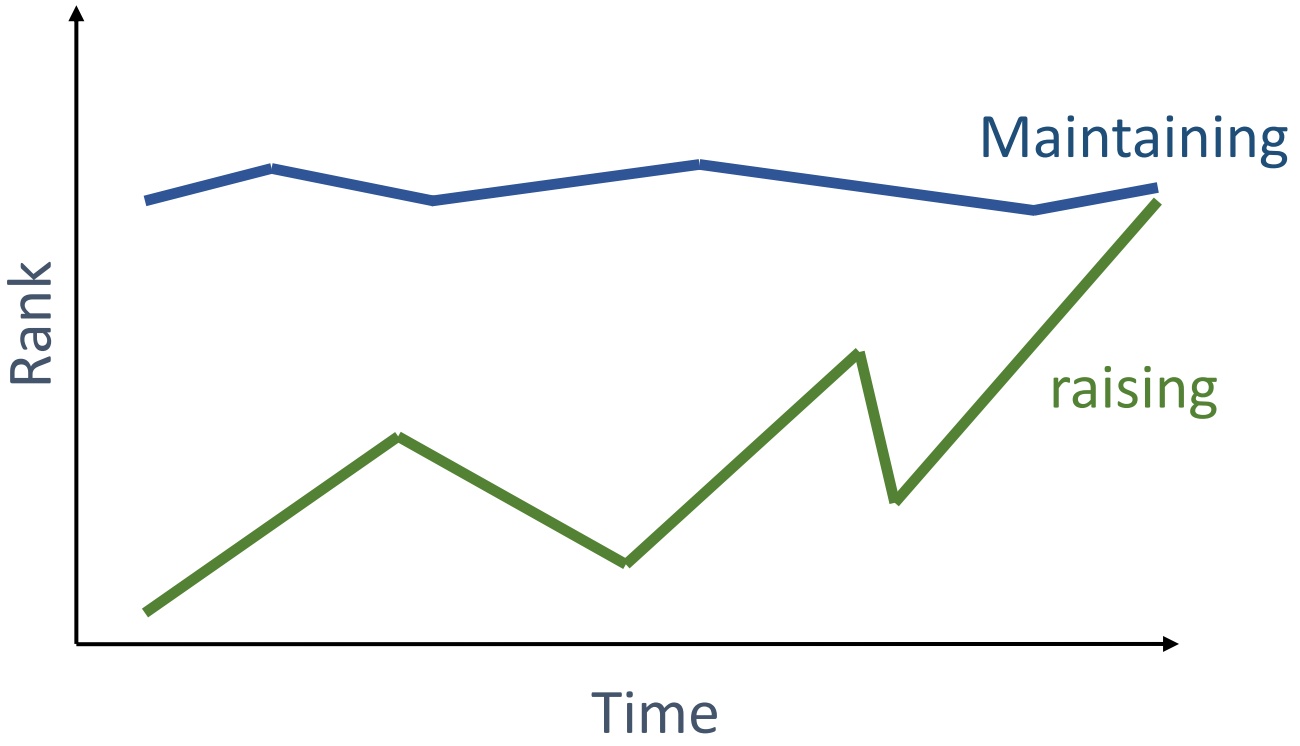


5,000 Downloads



Rank Trend

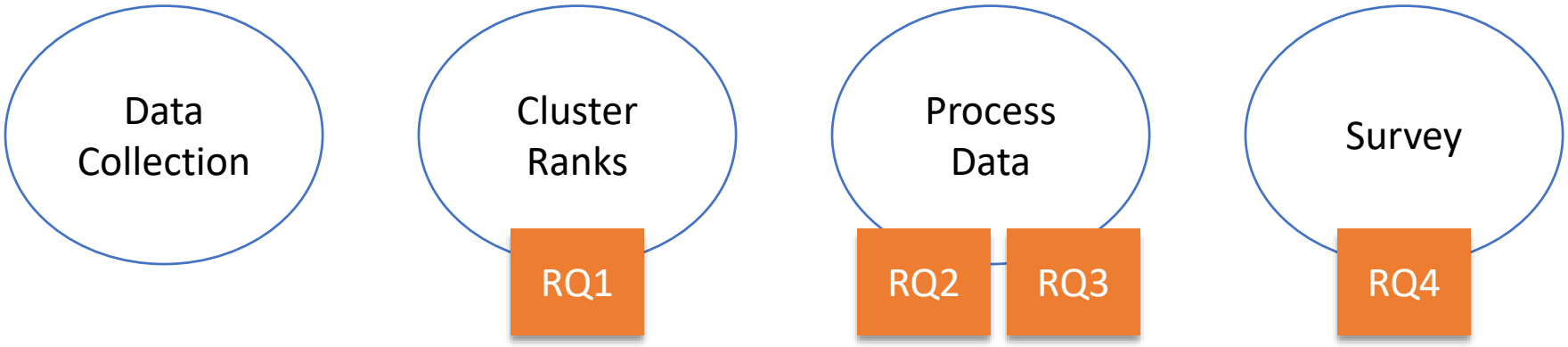
- **Definition.** Rank trend is the evolution of ranks over time.



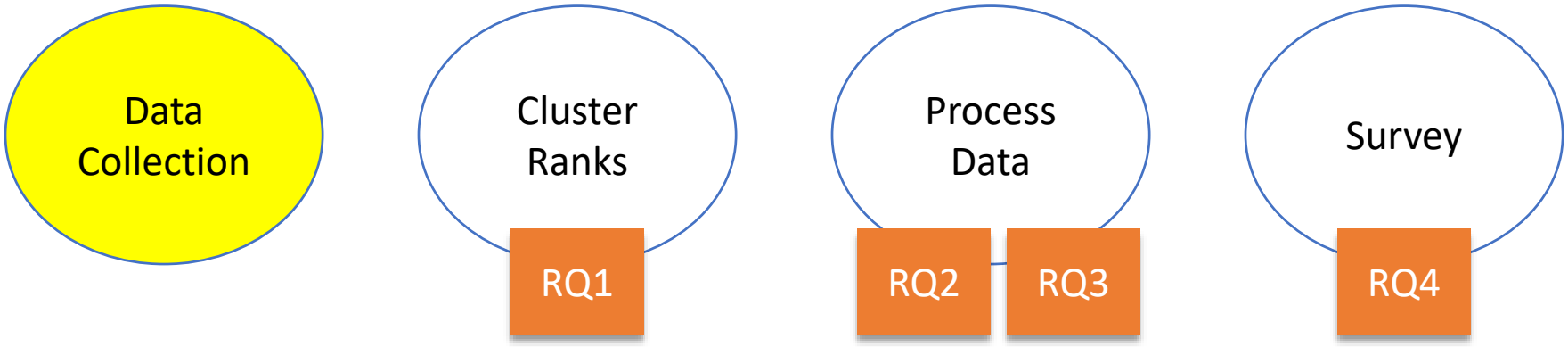
900 apps in 30 top areas containing 4,878,011 reviews

Area	#Versions	#User-reviews	Area	#Versions	#User-reviews
Airline	422	51,408	Health	263	88,306
Bible	339	92,075	Mailbox	339	56,391
Budget	206	18,356	Messaging	525	230,248
Calculator	294	7,316	Movie	279	164,195
Calling	658	210,483	News	690	186,827
Camera	466	55,383	Paint	122	6,674
Chess	186	22,811	Piano	202	27,909
Cloud	546	162,591	Radio	504	238,336
Coupon	348	61,160	Reminder	292	108,461
Dating	916	165,869	Sleep	159	42,713
Dictionary	292	74,073	Spy Phone	162	27,328
Emoji	101	4,105	Talking Pet	235	31,662
Fitness	272	84,436	Translator	206	36,375
GPS	630	151,844	Weather	845	178,968
Grocery List	264	50,944	Weight Loss	278	58,590

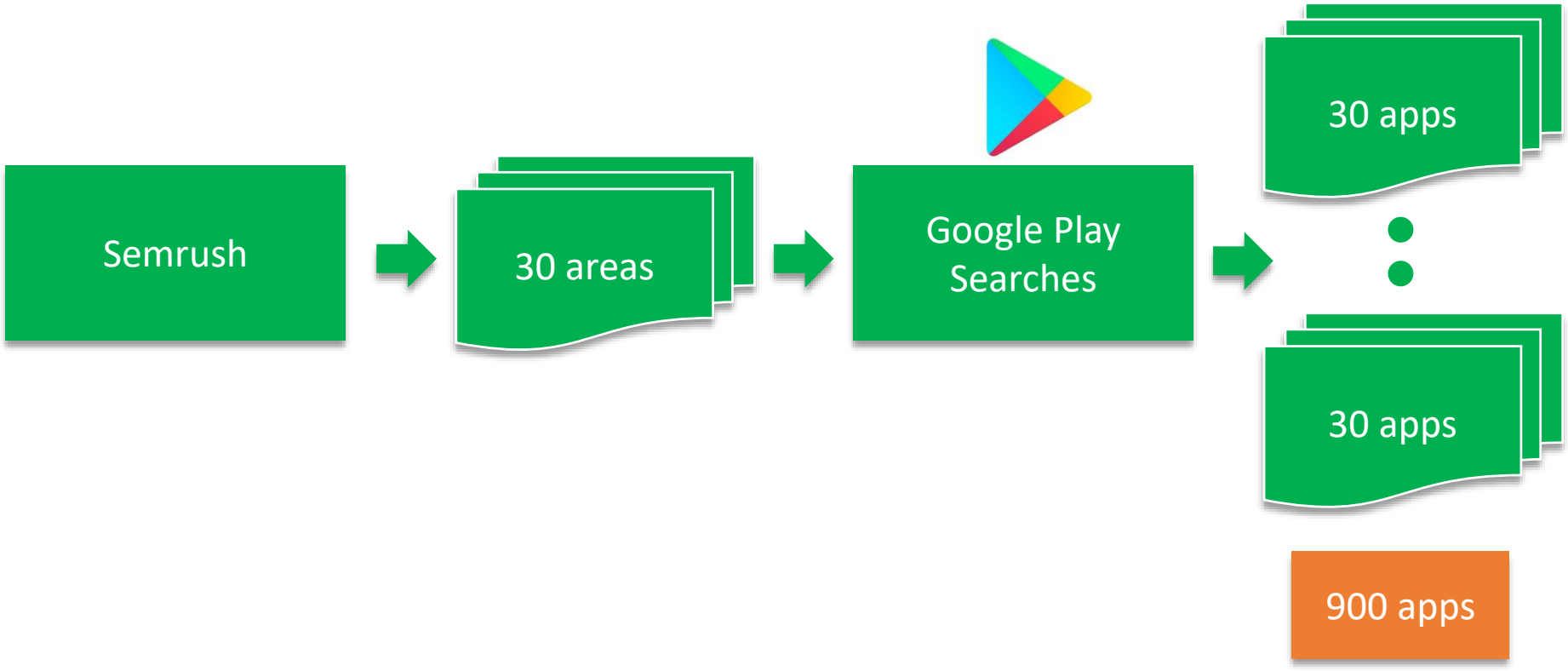
Study Setup


Data Collection
Cluster Ranks
RQ1
Process Data
RQ2
RQ3
Survey
RQ4

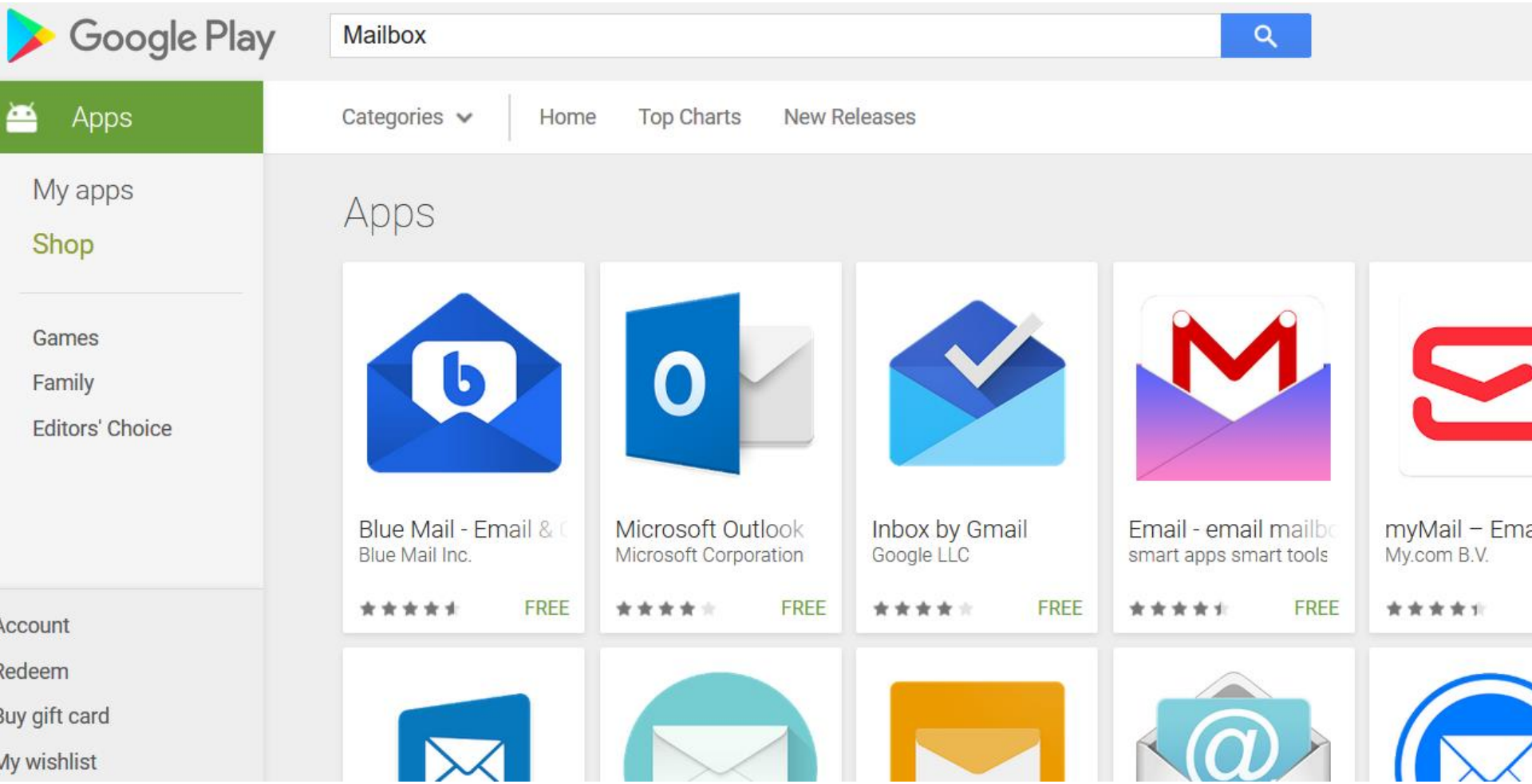
Data Collection



Data Collection



Data Collection



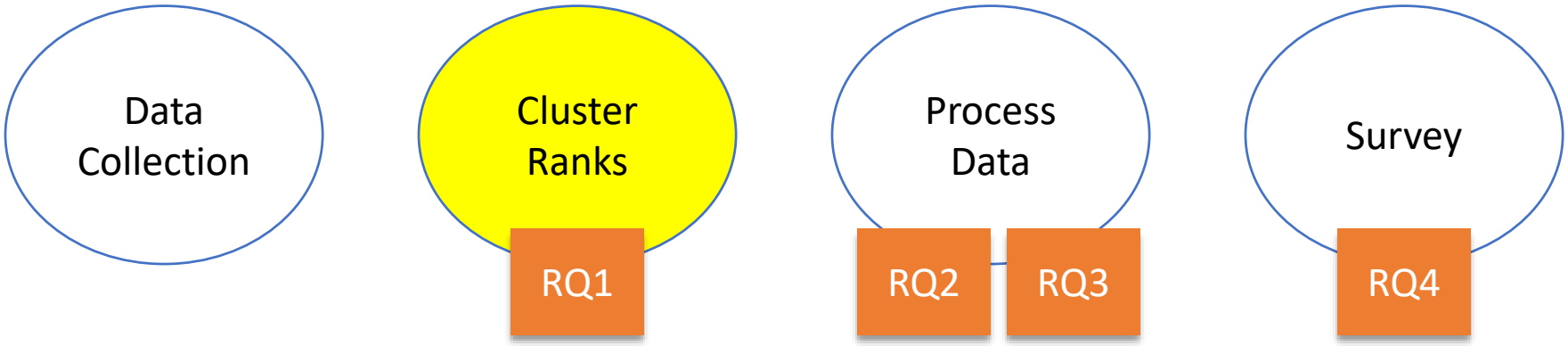
Data Collection

- Data collection process took over 2 years, so that we would not lose any information.

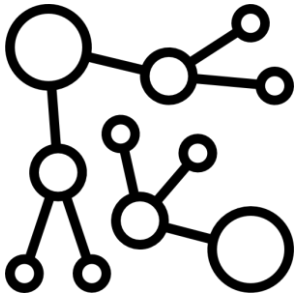
Data Pre-Processing

- ✓Removing Non-English User-reviews
- ✓Filtering Out Uninformative User-reviews
- ✓Correcting Typos and Informal Vocabularies
- ✓Breaking Down App Descriptions and Release Notes
- ✓Resolving Synonyms
- ✓Resolving Negations
- ✓Topic Modeling

RQ1: What are the rank trends of mobile apps?

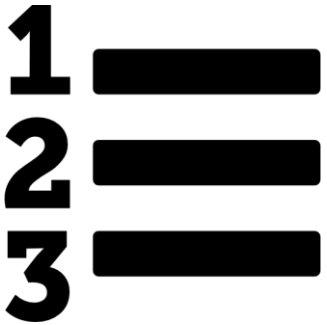


Time Series Clustering



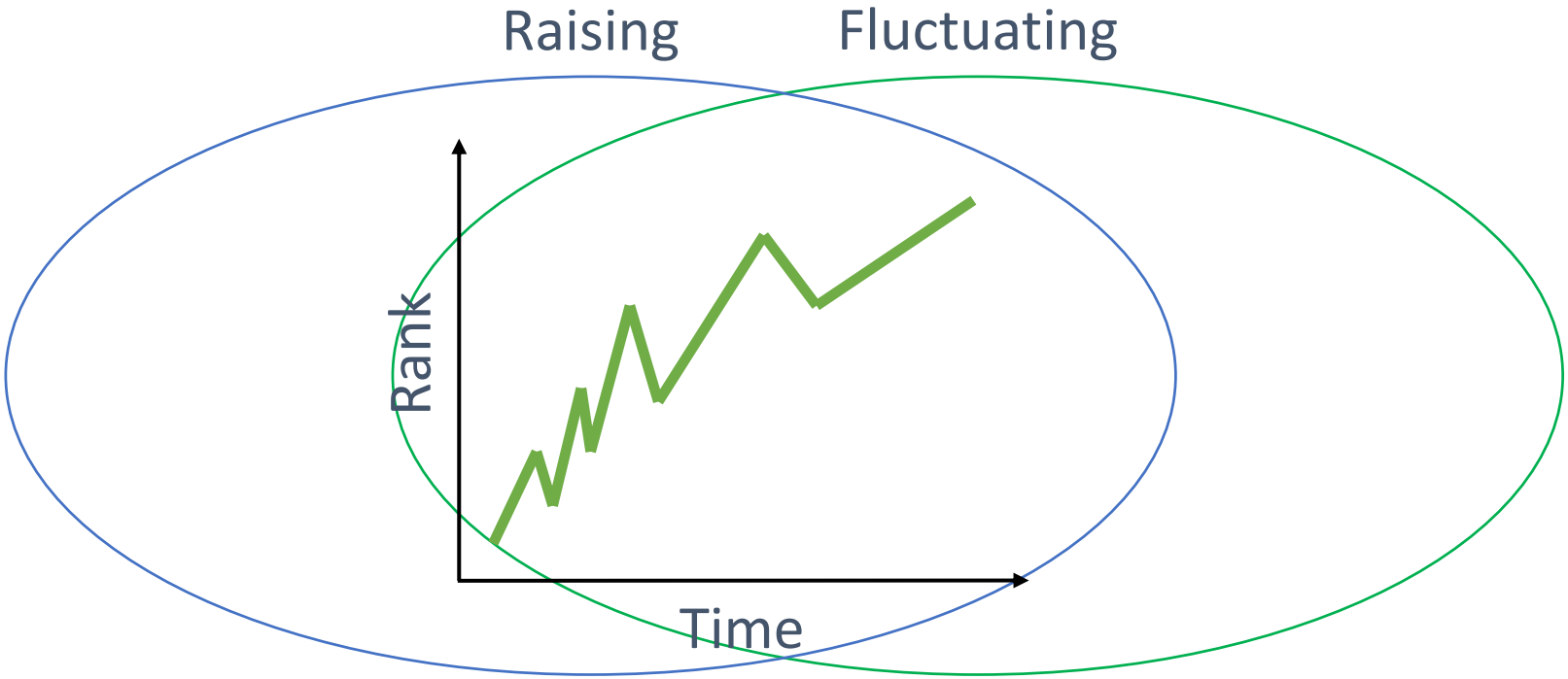
Clustering algorithm

Distance measurement method

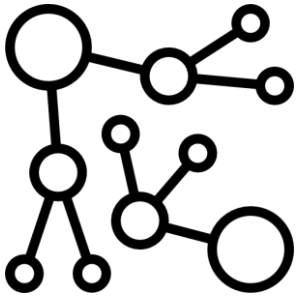


Number of clusters

Clustering Algorithm: Fuzzy

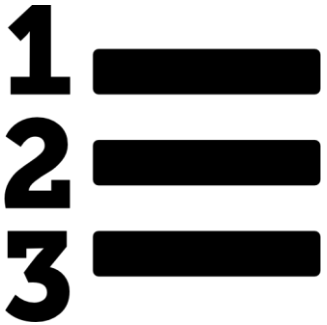


Time Series Clustering



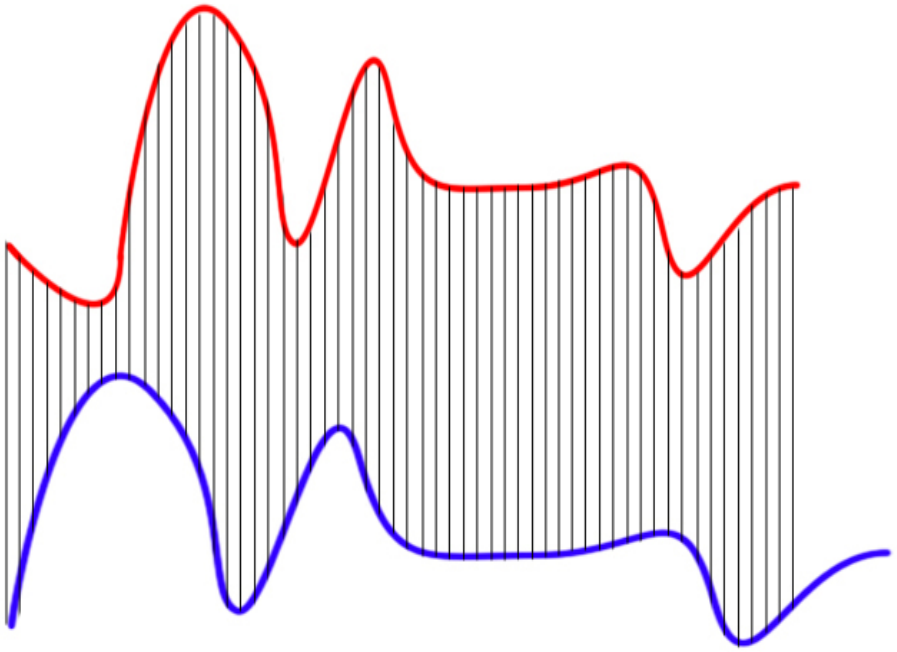
Clustering algorithm

Distance measurement method

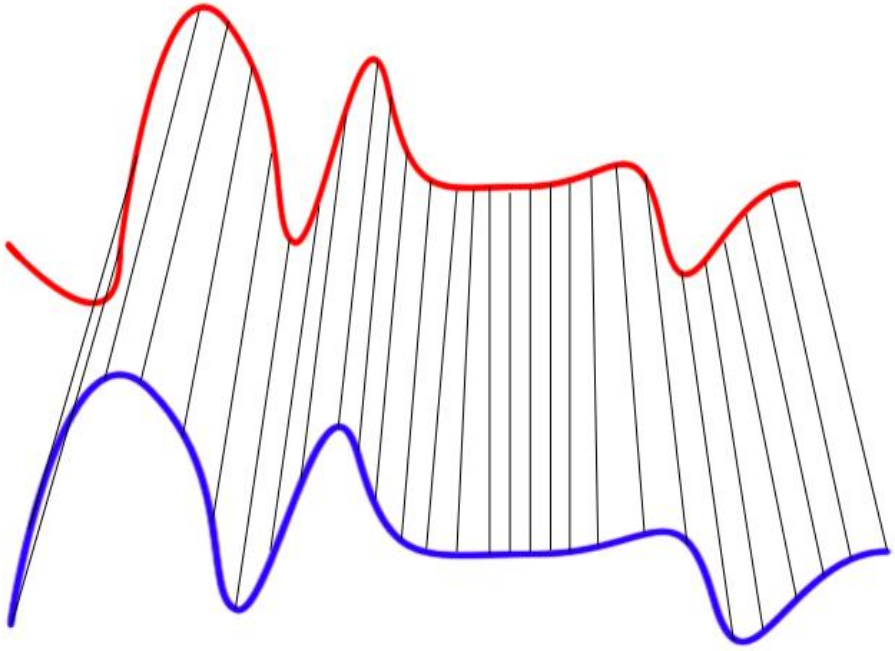


Number of clusters

Distance Measurement Method:
Dynamic Time Warping

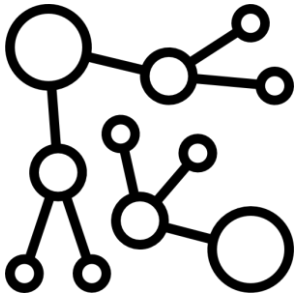


Euclidean Distance



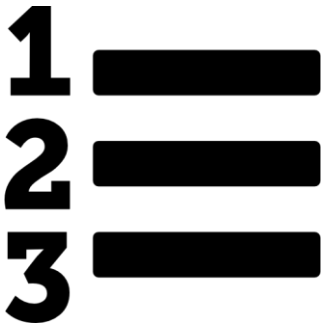
DTW Distance

Time Series Clustering



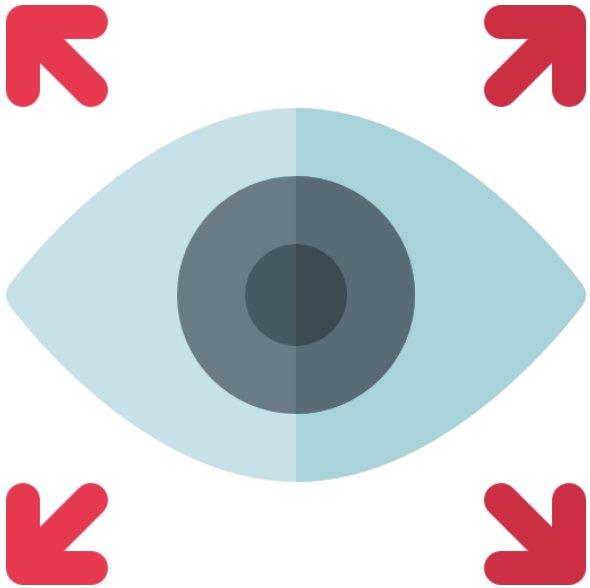
Clustering algorithm

Distance measurement method

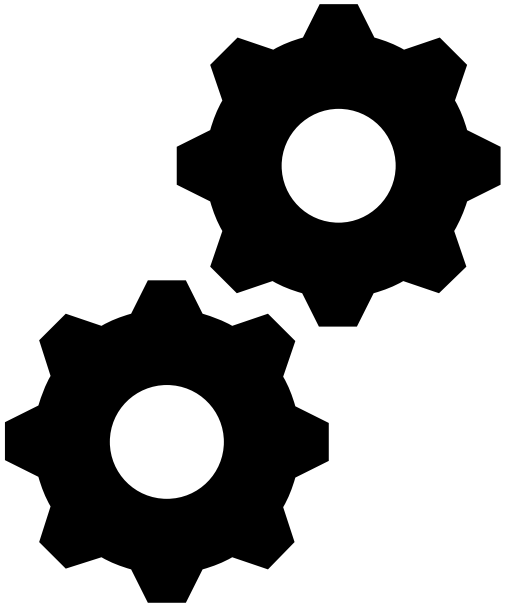


Number of clusters

Number of Clusters: 13

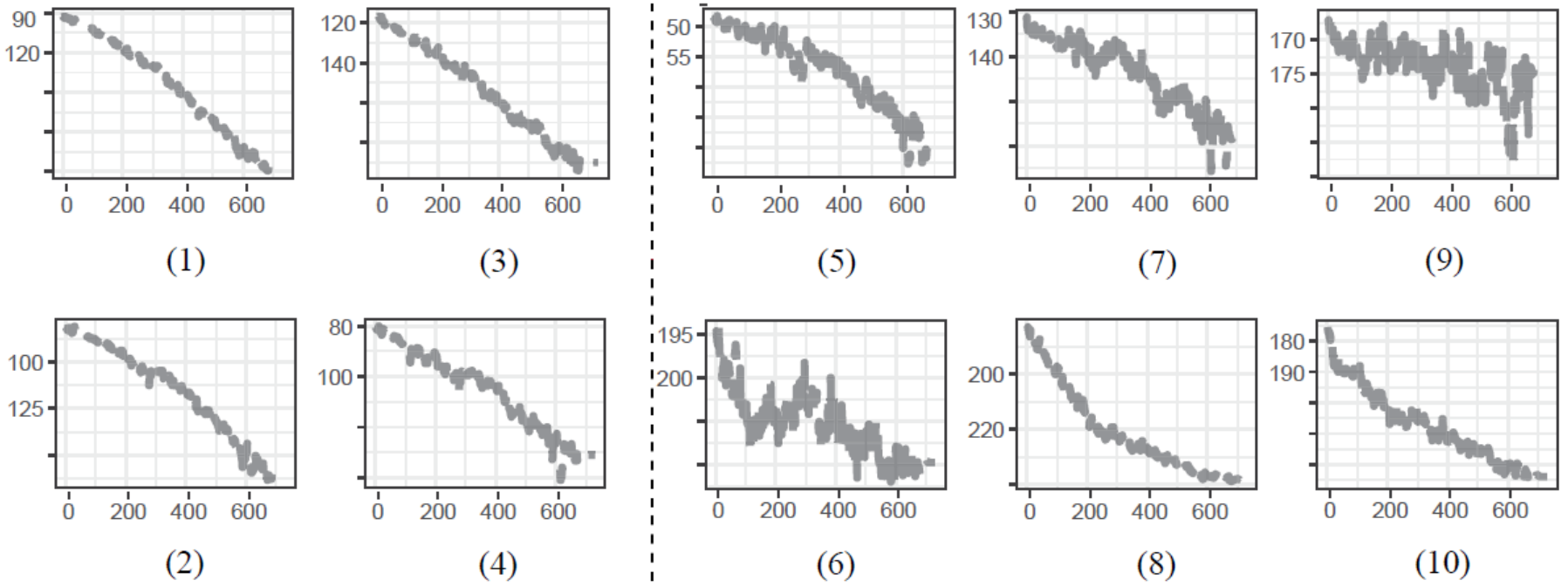


Visual Inspection

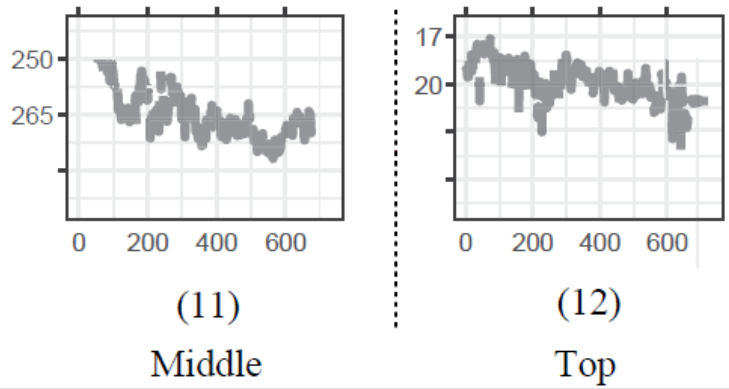


Gap Statistic

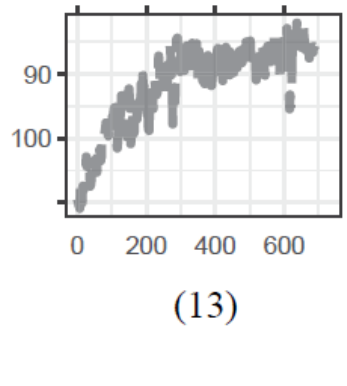
Falling

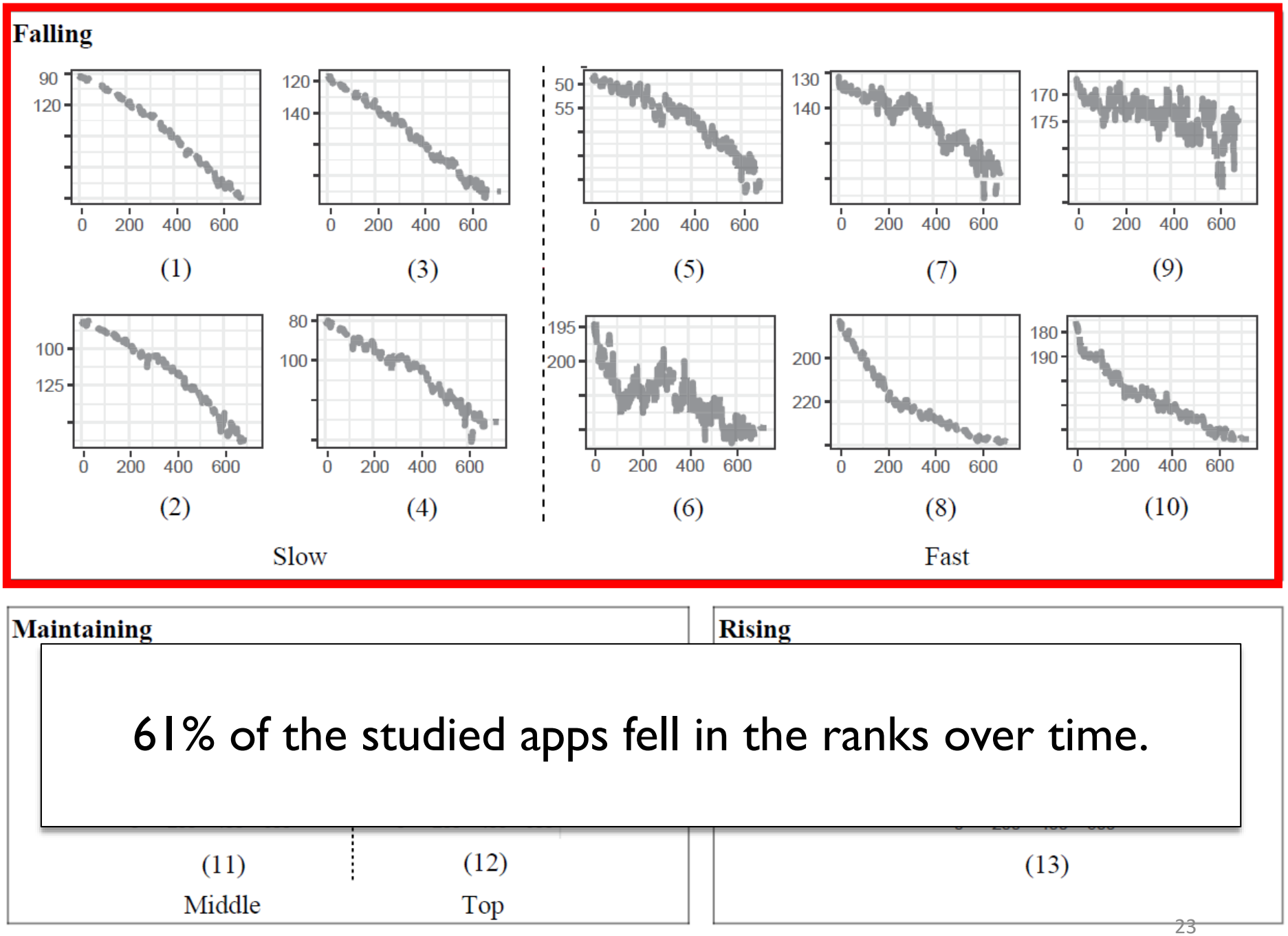


Maintaining

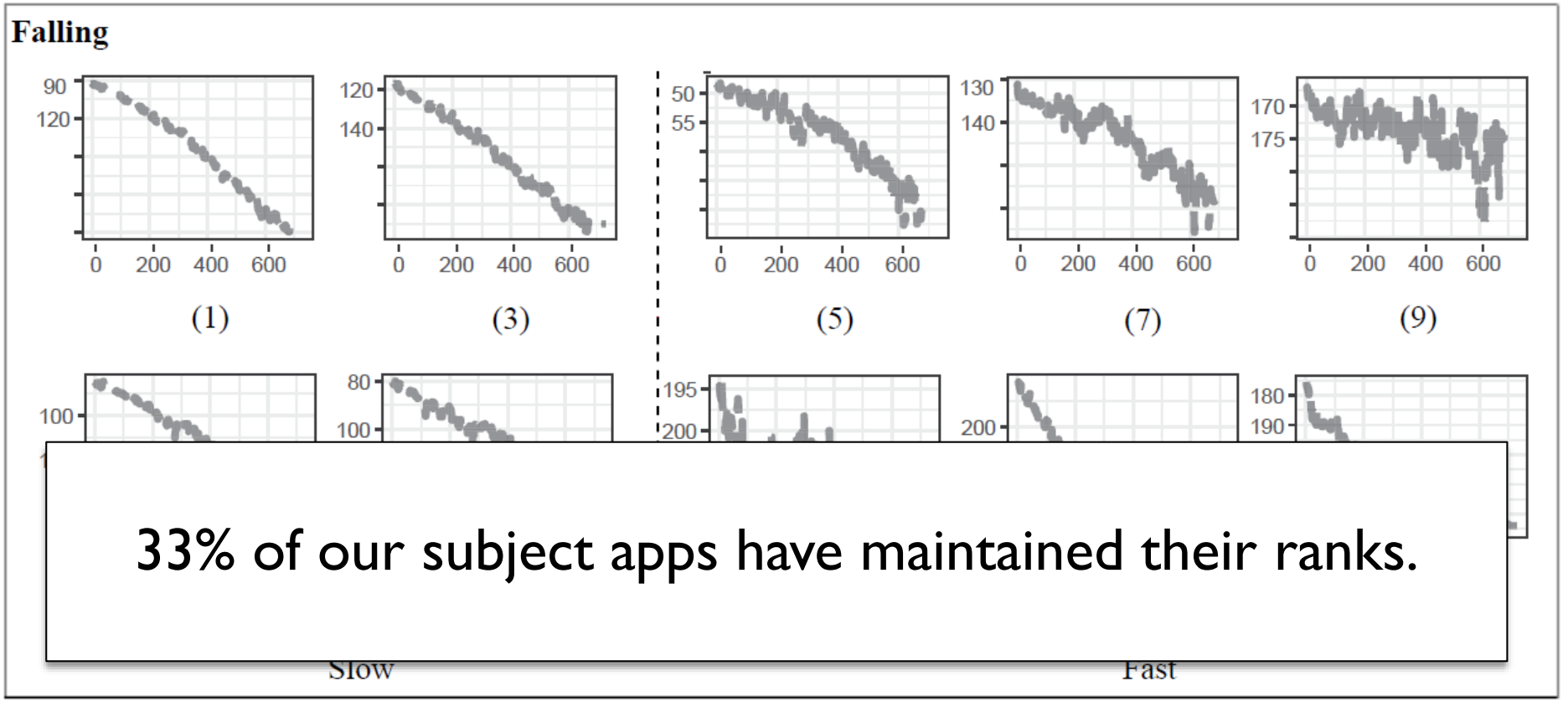


Rising

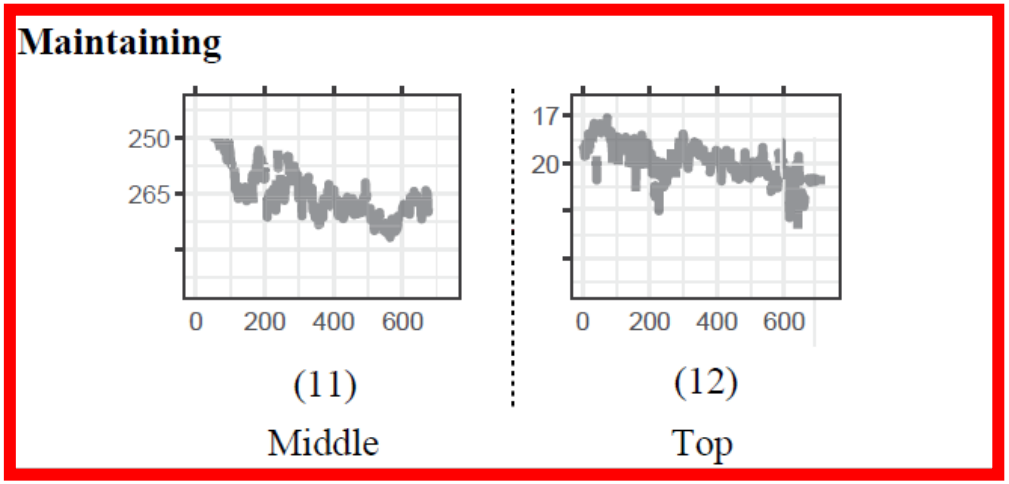


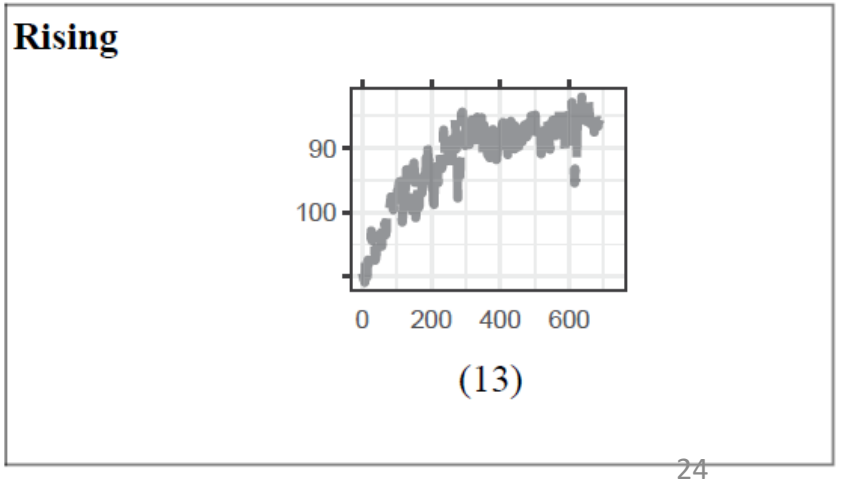


61% of the studied apps fell in the ranks over time.

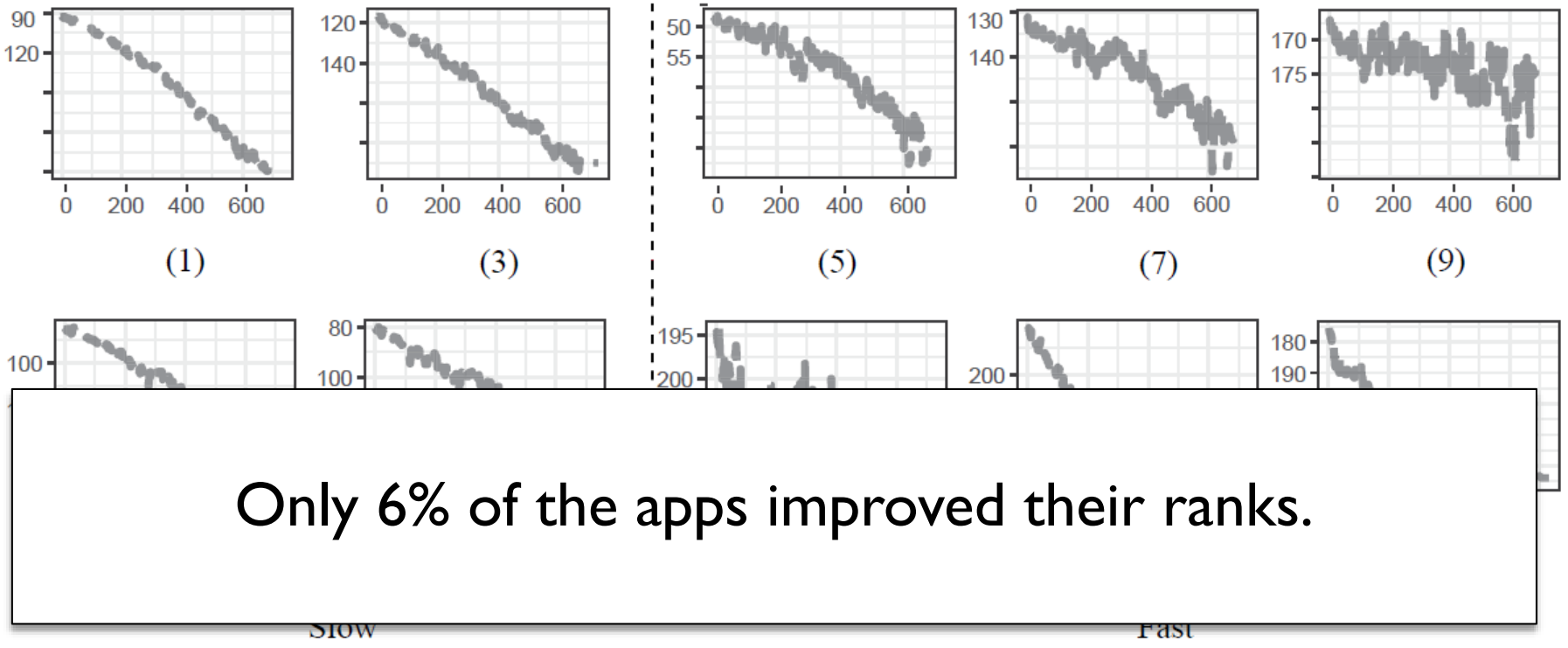


33% of our subject apps have maintained their ranks.



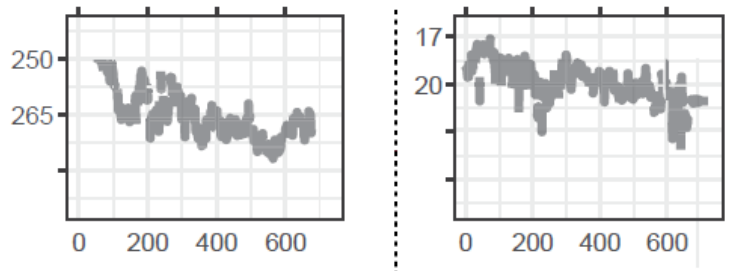


Falling

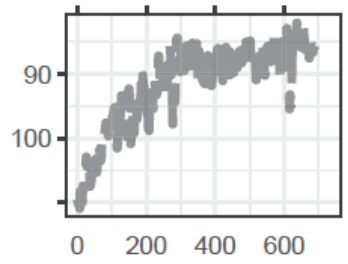


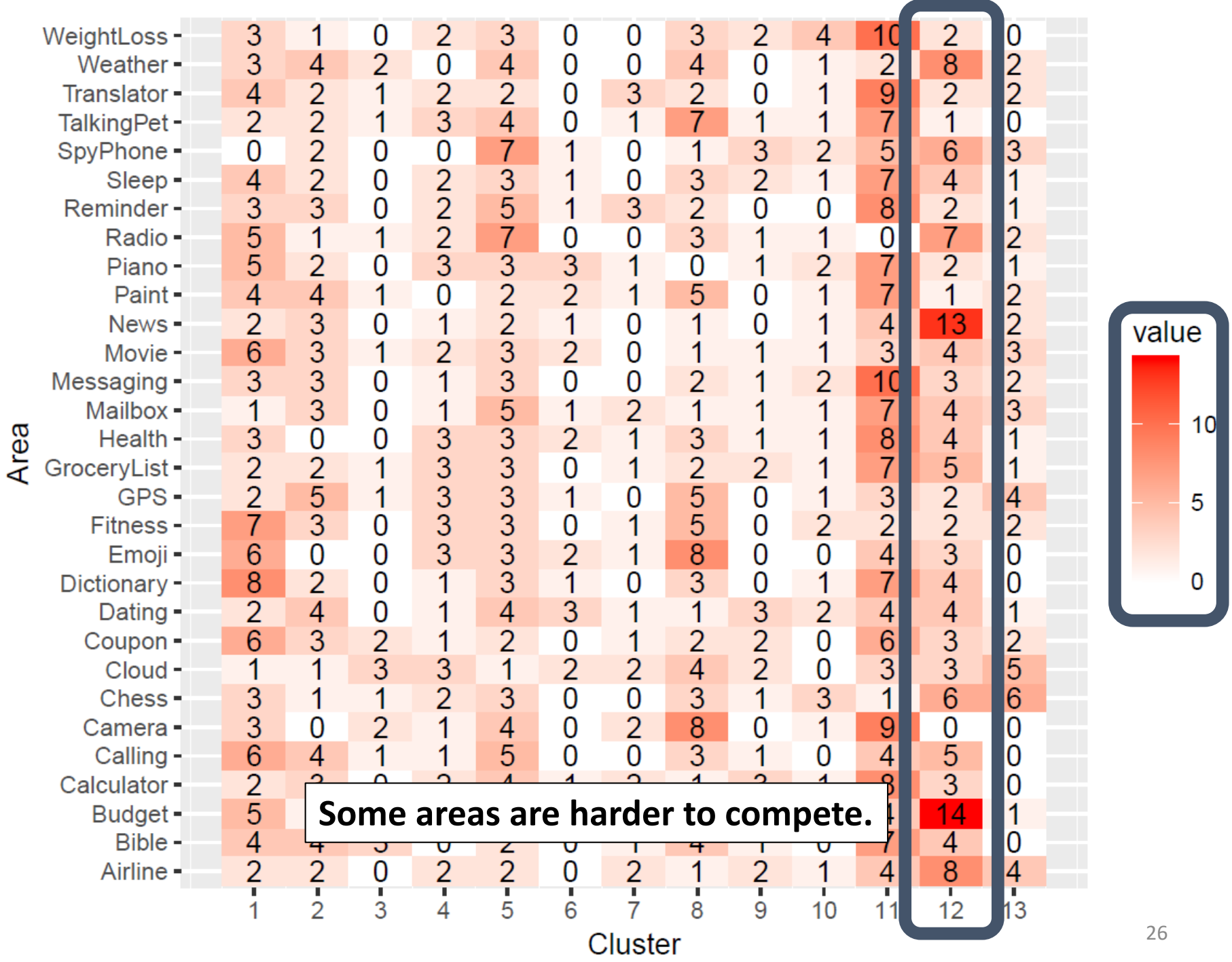
Only 6% of the apps improved their ranks.

Maintaining

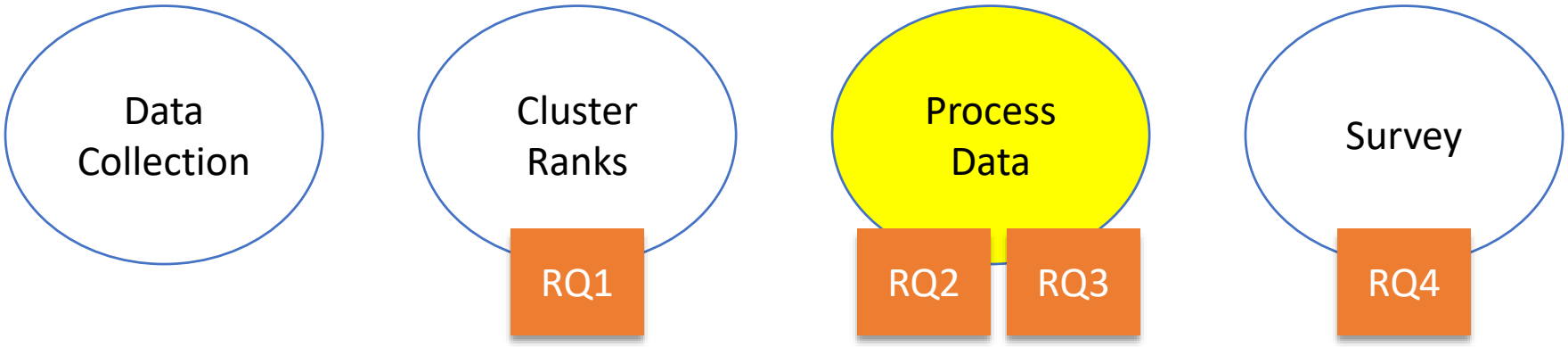


Rising




Area
WeightLoss 3 1 0 2 3 0 0 3 2 4 10 2 0
Weather 3 4 2 0 4 0 0 4 0 1 2 8 2
Translator 4 2 1 2 2 0 3 2 0 1 9 2 2
TalkingPet 2 2 1 3 4 0 1 7 1 1 7 1 0
SpyPhone 0 2 0 0 7 1 0 1 3 2 5 6 3
Sleep 4 2 0 2 3 1 0 3 2 1 7 4 1
Reminder 3 3 0 2 5 1 3 2 0 0 8 2 1
Radio 5 1 1 2 7 0 0 3 1 1 0 7 2
Piano 5 2 0 3 3 3 1 0 1 2 7 2 1
Paint 4 4 1 0 2 2 1 5 0 1 7 1 2
News 2 3 0 1 2 1 0 1 0 1 4 13 2
Movie 6 3 1 2 3 2 0 1 1 1 3 4 3
Messaging 3 3 0 1 3 0 0 2 1 2 10 3 2
Mailbox 1 3 0 1 5 1 2 1 1 1 7 4 3
Health 3 0 0 3 3 2 1 3 1 1 8 4 1
GroceryList 2 2 1 3 3 0 1 2 2 1 7 5 1
GPS 2 5 1 3 3 1 0 5 0 1 3 2 4
Fitness 7 3 0 3 3 0 1 5 0 2 2 2 2
Emoji 6 0 0 3 3 2 1 8 0 0 4 3 0
Dictionary 8 2 0 1 3 1 0 3 0 1 7 4 0
Dating 2 4 0 1 4 3 1 1 3 2 4 4 1
Coupon 6 3 2 1 2 0 1 2 2 0 6 3 2
Cloud 1 1 3 3 1 2 2 4 2 0 3 3 5
Chess 3 1 1 2 3 0 0 3 1 3 1 6 6
Camera 3 0 2 1 4 0 2 8 0 1 9 0 0
Calling 6 4 1 1 5 0 0 3 1 0 4 5 0
Calculator 2 3 0
Budget 5 14 1
Bible 4 4 0
Airline 2 2 0 2 2 0 2 1 2 1 4 8 4
1 2 3 4 5 6 7 8 9 10 11 12 13
Cluster
Some areas are harder to compete.
value
10
5
0

Study Setup

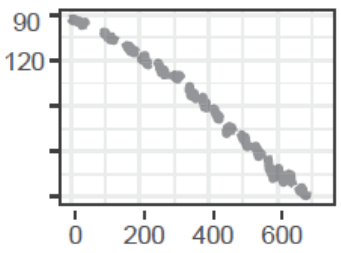

Data Collection
Cluster Ranks
RQ1
Process Data
RQ2
RQ3
Survey
RQ4

RQ2: Which variables can improve the rank trends?

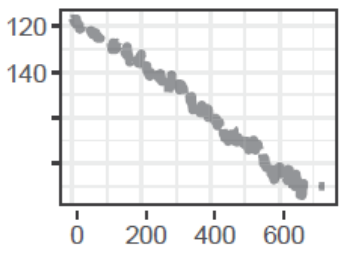
- Optimistic
  - Maintained ranks on Top
  - Rising ranks

- Pessimistic
  - Maintained ranks in the Middle
  - Falling ranks

Falling



(1)



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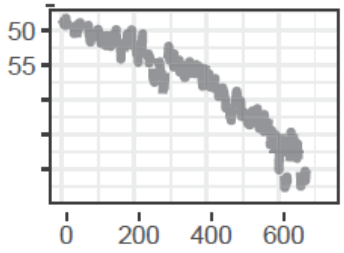

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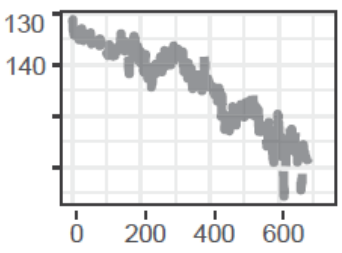

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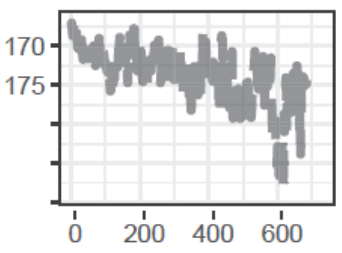

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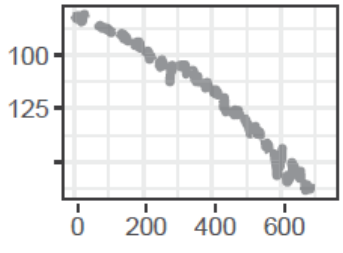

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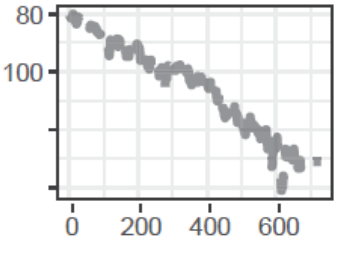

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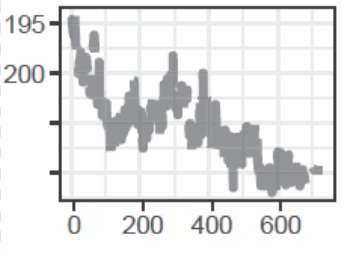

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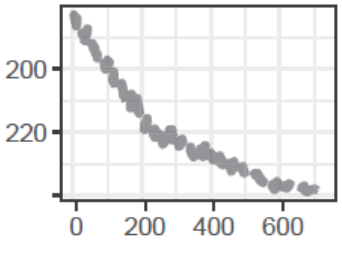

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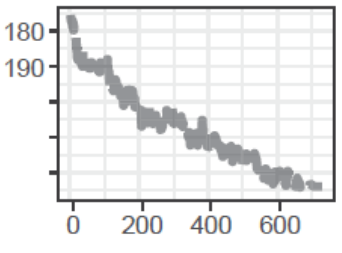
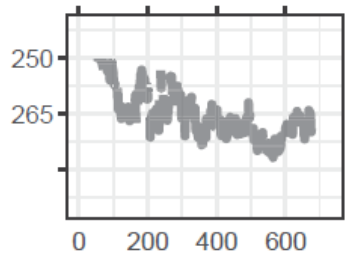


(10)

Slow

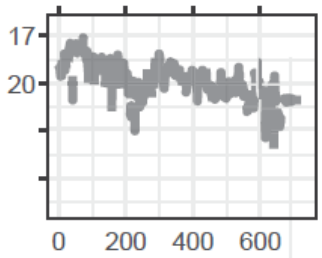
Optimistic Trends

Maintaining



(11)

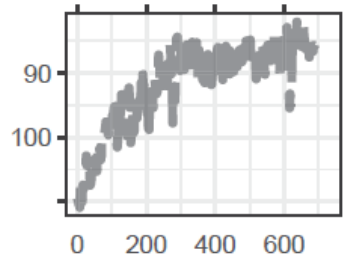
Middle



(12)

Top

Rising



(13)

Independent Variables

#pictures

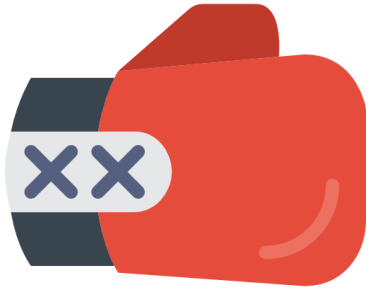
#releases

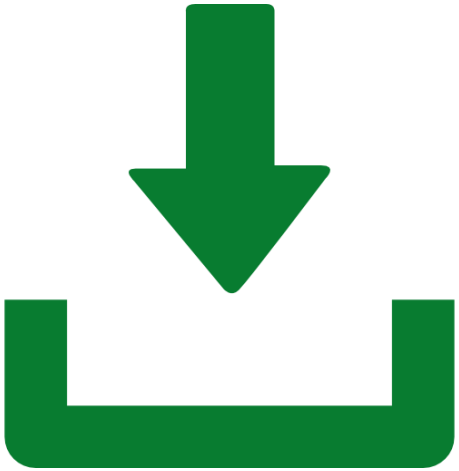
#reviews

Launch D.

Correlation Analysis

Correlated!





reviews

downloads

Logistic Regression Model

- Pessimistic/Optimistic ~ Independent Variable

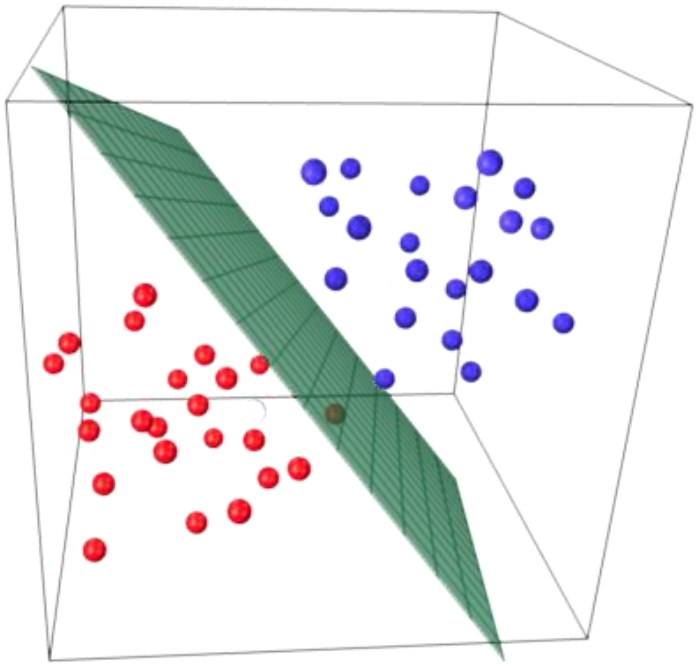
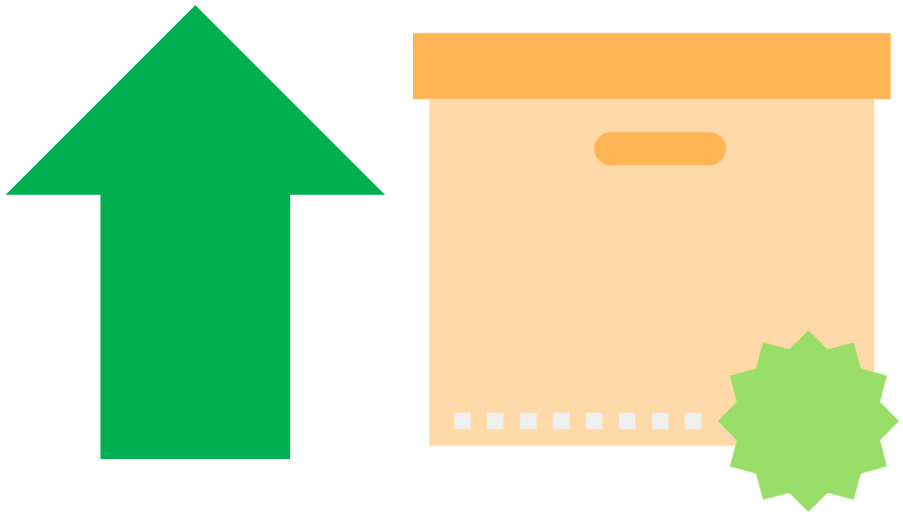


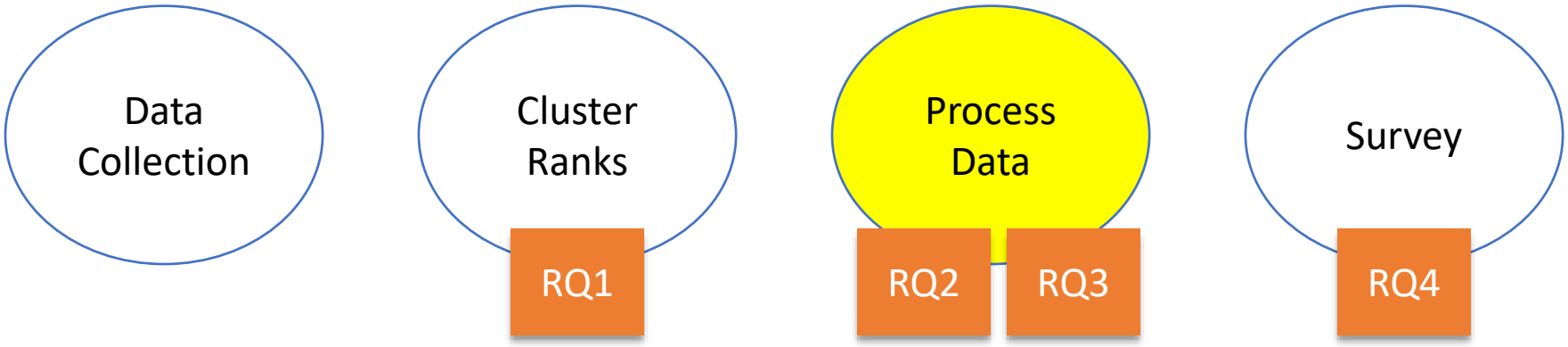
Image Credit: https://codesachin.wordpress.com/2015/08/16/logistic-regression-for-dummies/

Newcomers should be hopeful, since apps that were lunched later are associated with optimistic rank trends.

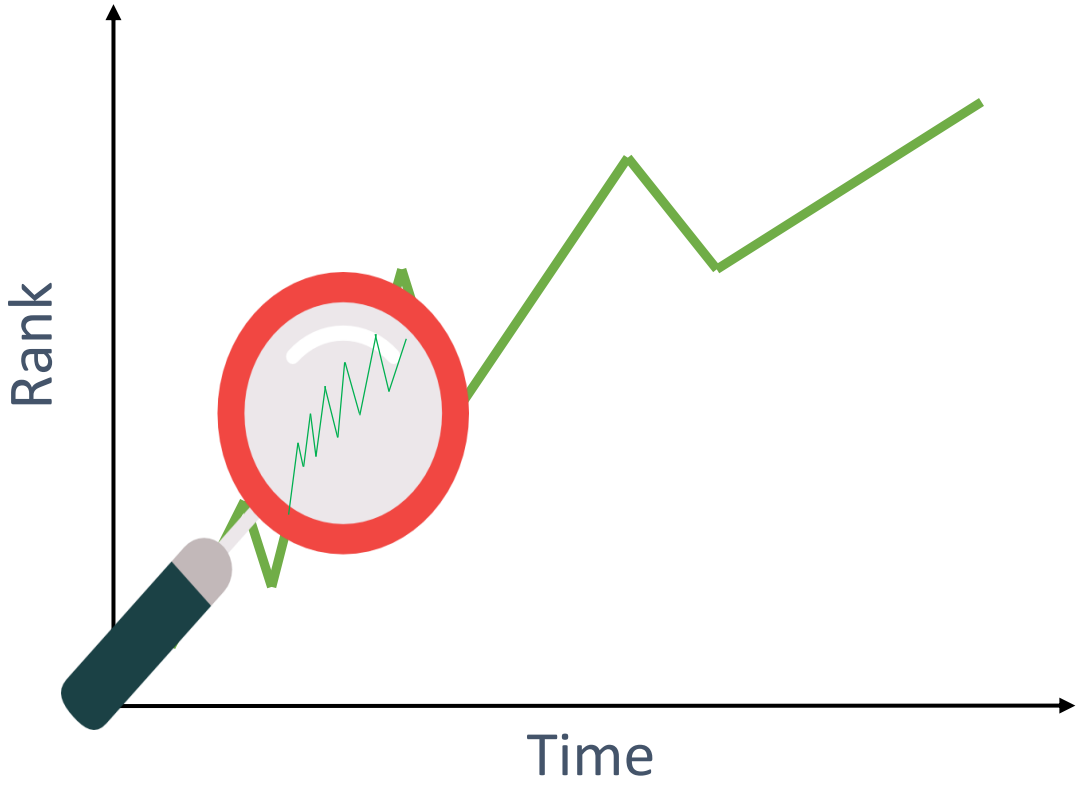
More releases are encouraged.



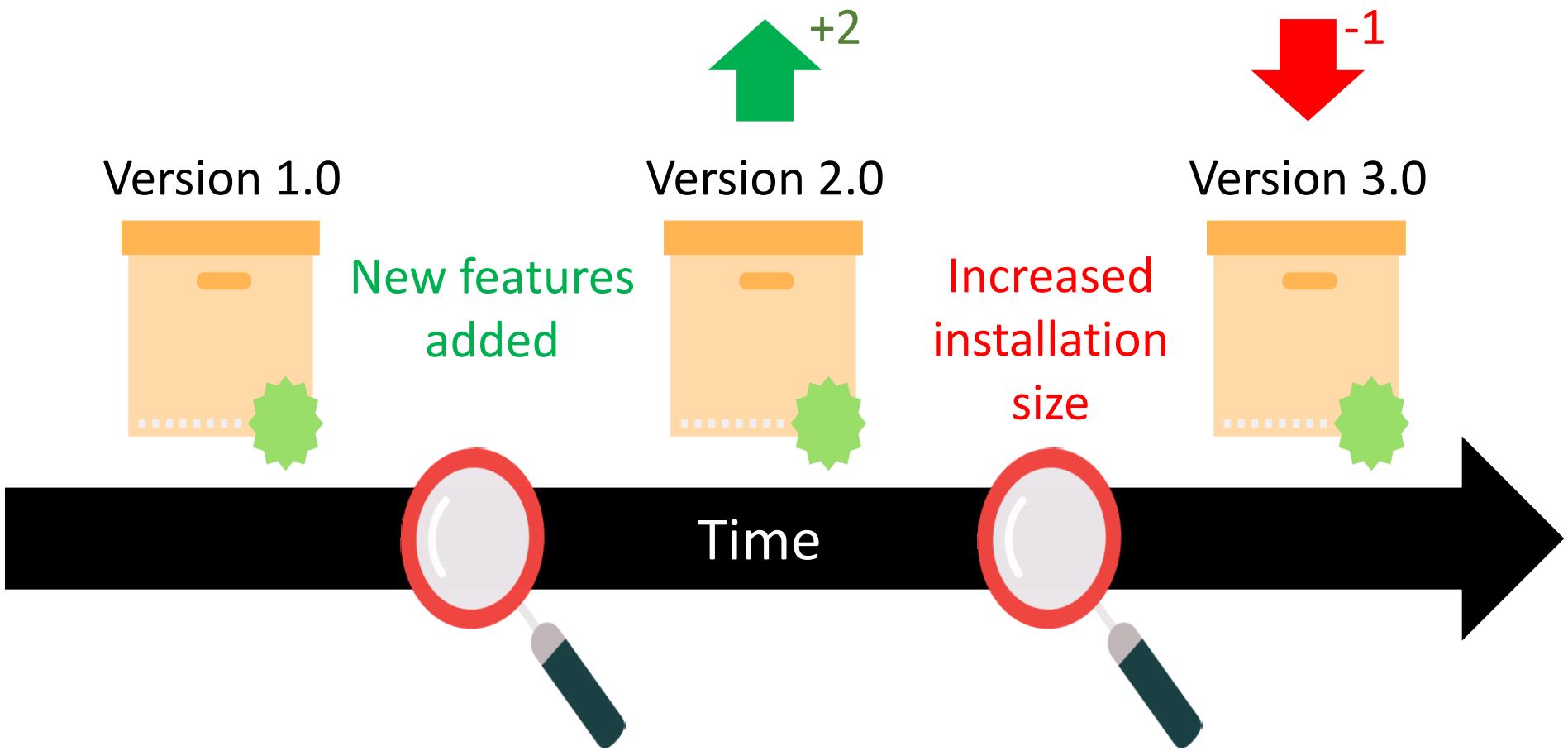
Study Setup


Data Collection
Cluster Ranks
RQ1
Process Data
RQ2
RQ3
Survey
RQ4

RQ3: What variables share a significant relationship with the changes in the ranks overtime?



Example


+2
-1
Version 1.0
Version 2.0
Version 3.0
New features added
Increased installation size
Time

Mixed Effects Model

Goodness of Fit

Marginal R^2

0.02

Conditional R^2

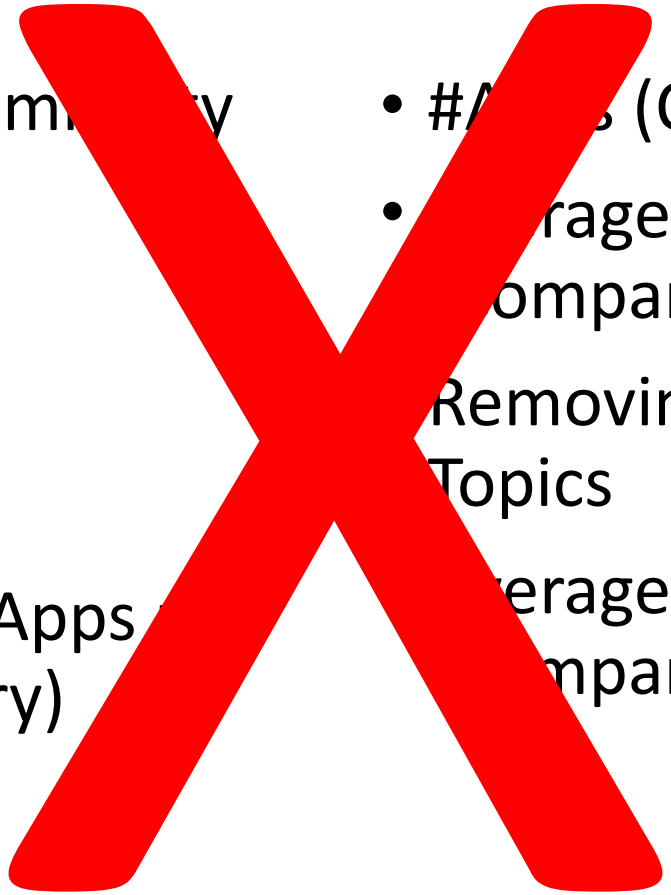
0.68

Statistically Significant Metrics

- Description Similarity
- Average Price (Category)
- #Pictures
- Name Size
- Ratio of Paid Apps per Total (Category)
- #Apps (Category)
- Average Star-Rating (Company)
- Removing Previous Topics
- Average Price (Company)

Statistically Significant Metrics

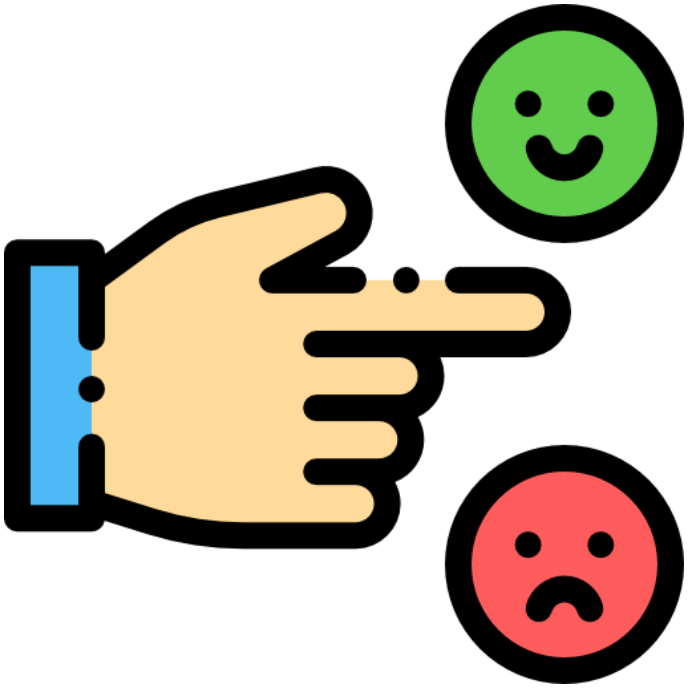
- Description Sim[illegible]ty
- Average Price (Category)
- #Pictures
- Name Size
- Ratio of Paid Apps [illegible] Total (Category)
- #A[illegible]s (Category)
- [illegible]rage Star-Rating [illegible]ompany)
- Removing Previous [illegible]Topics
- [illegible]erage Price [illegible]mpany)



Common-wisdom does not hold.

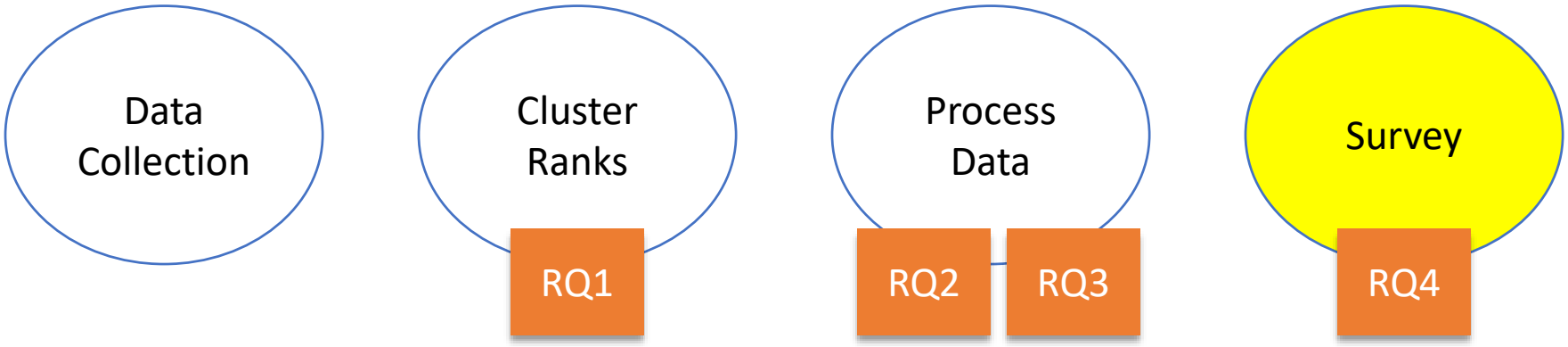
Earth was once believed
to be flat

User reviews' sentiment score have a strong association with the ranks.



Developers should not wait too long to publish an update.

Study Setup


Data Collection
Cluster Ranks
RQ1
Process Data
RQ2
RQ3
Survey
RQ4

"I wish I could have read this paper earlier!"

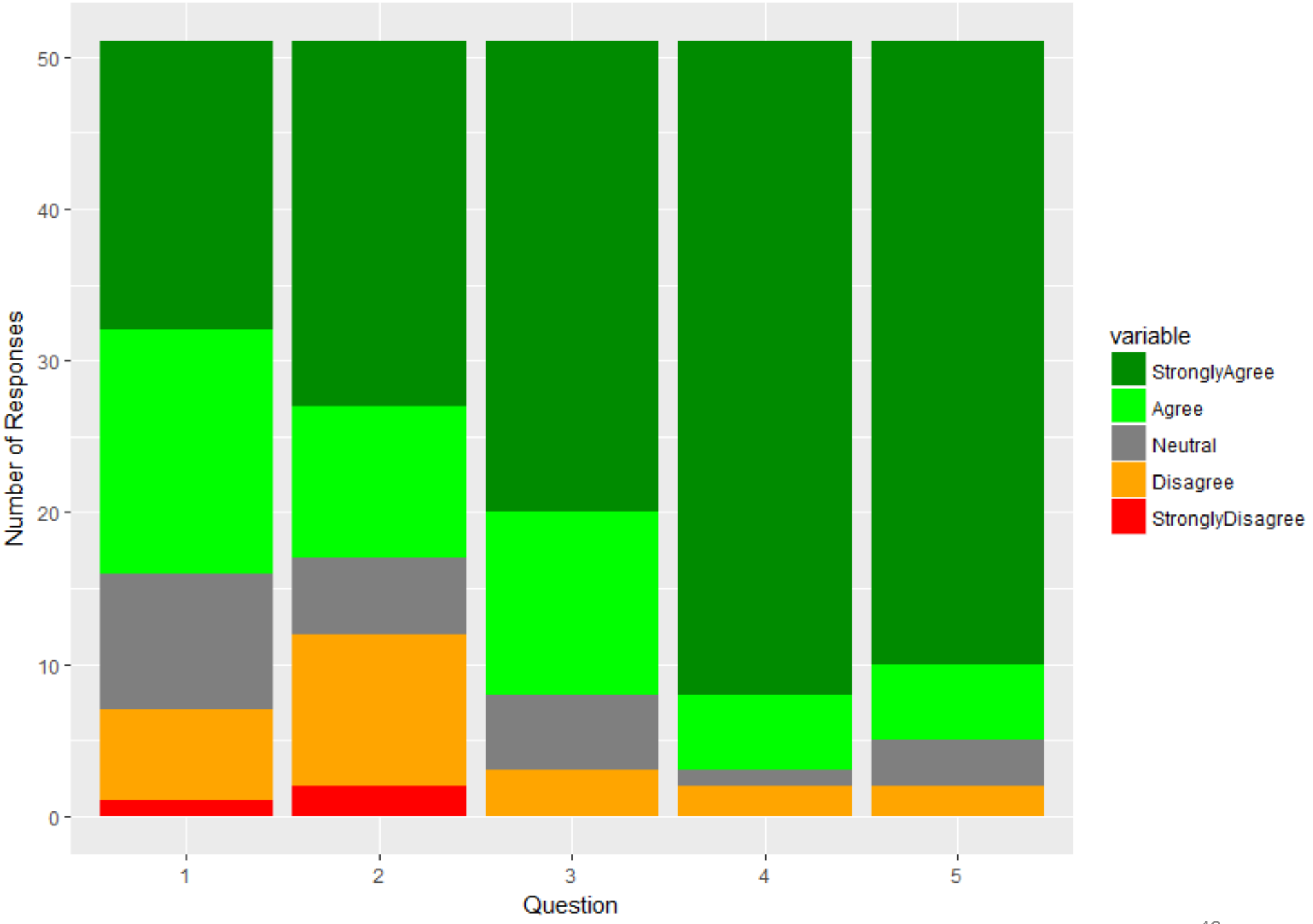
"It is a very informative paper. It would definitely help app developers."

"I confirm your findings and hope developers could better plan for their future according to your work."

Image Credit: https://www.facebook.com/celebsg4llery/

Survey of 51 App Developers

1. Do you think that the studied areas are the top areas of mobile apps?
2. Are the considered variables reasonable and sufficient for explaining ranks and rank trends?
3. Do you think the findings of RQ1 are useful and practical for the industry?
4. Do you think the findings of RQ2 are useful and practical for the industry?
5. Do you think the findings of RQ3 are useful and practical for the industry?

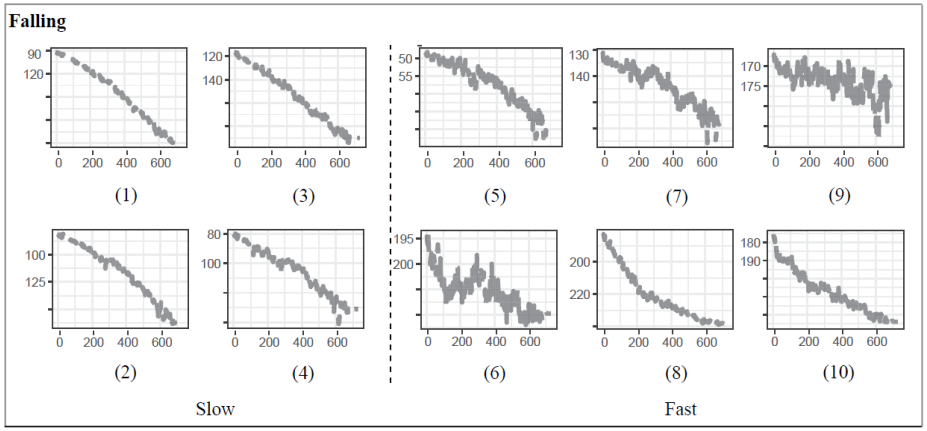

Number of Responses
50
40
30
20
10
0
1
2
3
4
5
Question
variable
StronglyAgree
Agree
Neutral
Disagree
StronglyDisagree

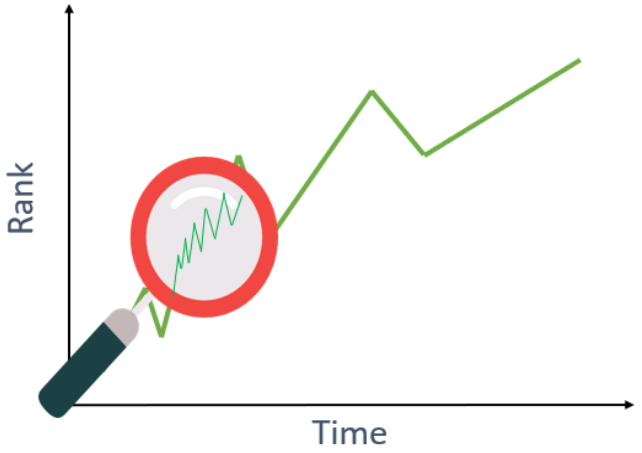
GGR-044

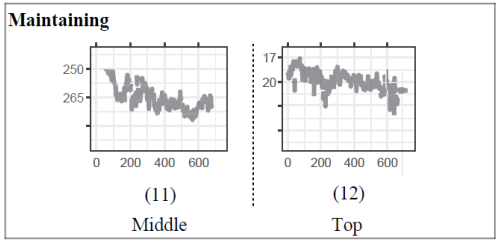
M EV 8842E

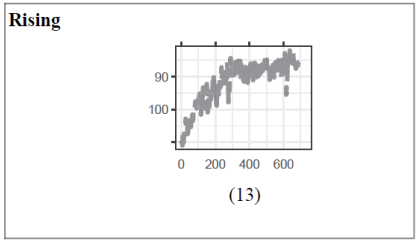
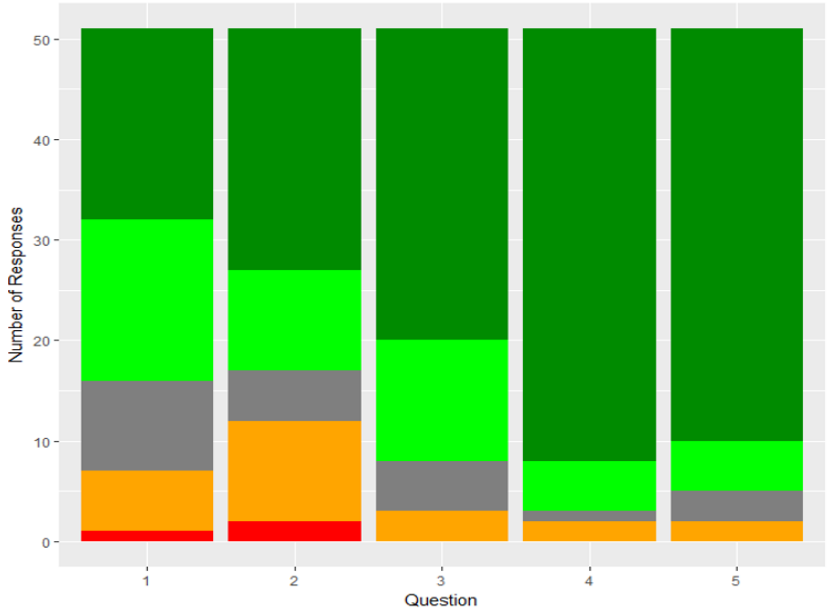
Implications For New Developers

- Developers should carefully select the area in which they intend to work.
- Never is late
  - as in the past two years, many apps have achieved higher ranks in the Google Play Store.
- Investing time and money on the user-reviews
  - Own app
  - Competitors
- Developers should not be distracted by the variables that sound critical but are not much important.





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