Causal Impact for App Store Analysis

http://google.github.io/CausalImpact/CausalImpact.html

What does it do?

Measures the impact of an event (intervention) on a metric over time

Impact significant or not?

Confidence interval?

Google uses it for measuring the success of ad campaigns

What about correlation analysis?

Correlation analysis

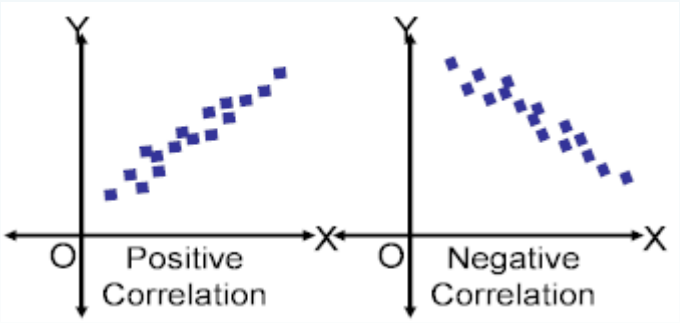
Looks at snapshot of data

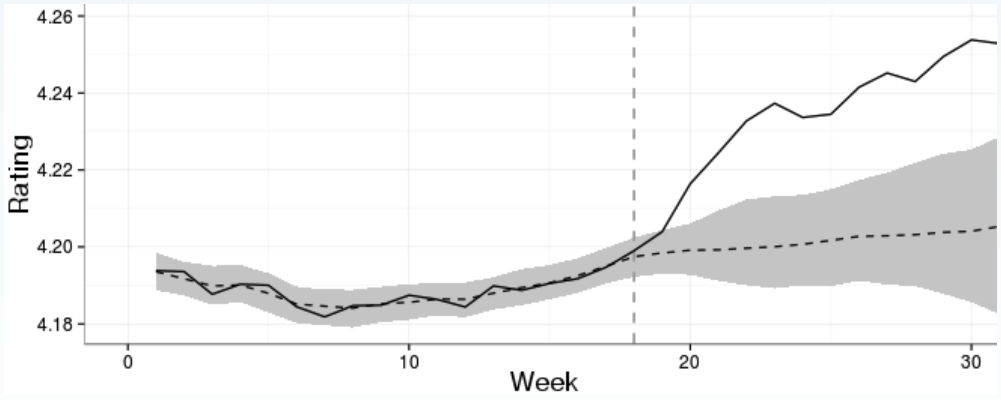
Tells us relationship between vectors (+ve or -ve correlation, or no correlation)

Causal impact analysis

Looks at time series of data

Tells us how significant an event was





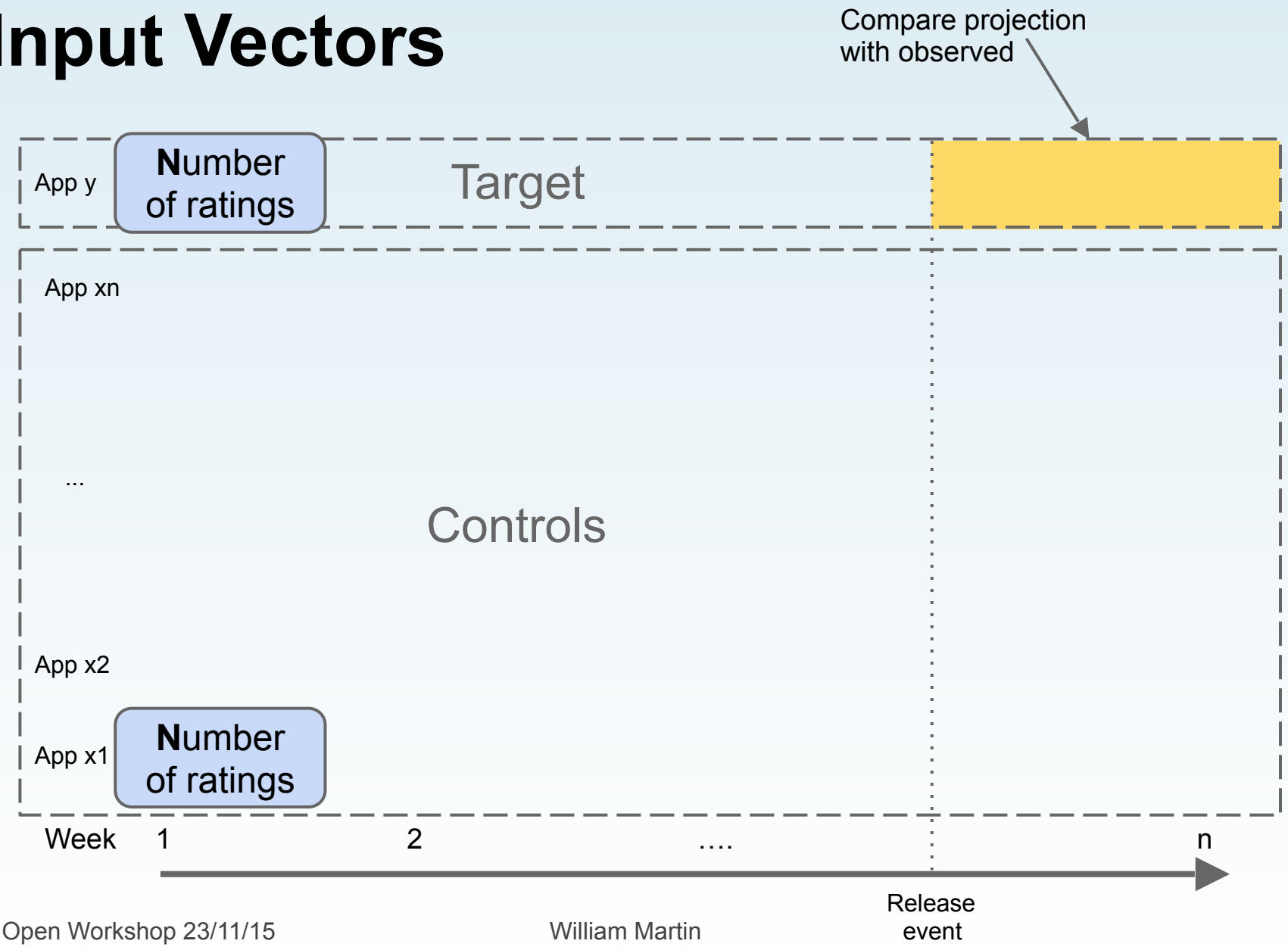
How does it do it?

Trains a predictor (prior time period)

Makes set of predictions (posterior time period)

Compares the observed vector with the predicted vector

Input Vectors



Predictor Model Components

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Local trend

local trend value

$$\mu_{t+1} = \mu_t + \delta_t + \eta_{\mu,t},$$

$$\delta_{t+1} = \delta_t + \eta_{\delta,t},$$

expected increase

noise sampled from Normal distribution

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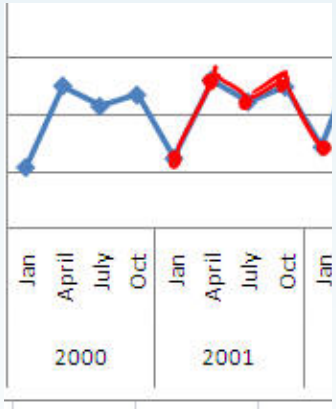
Seasonal variance

Adds seasonal component

Set length and no. seasons



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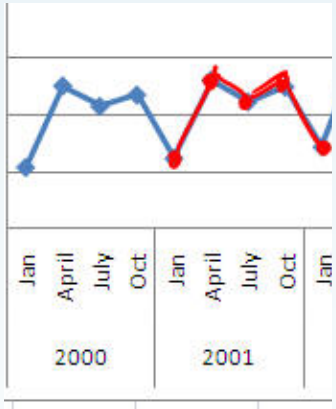


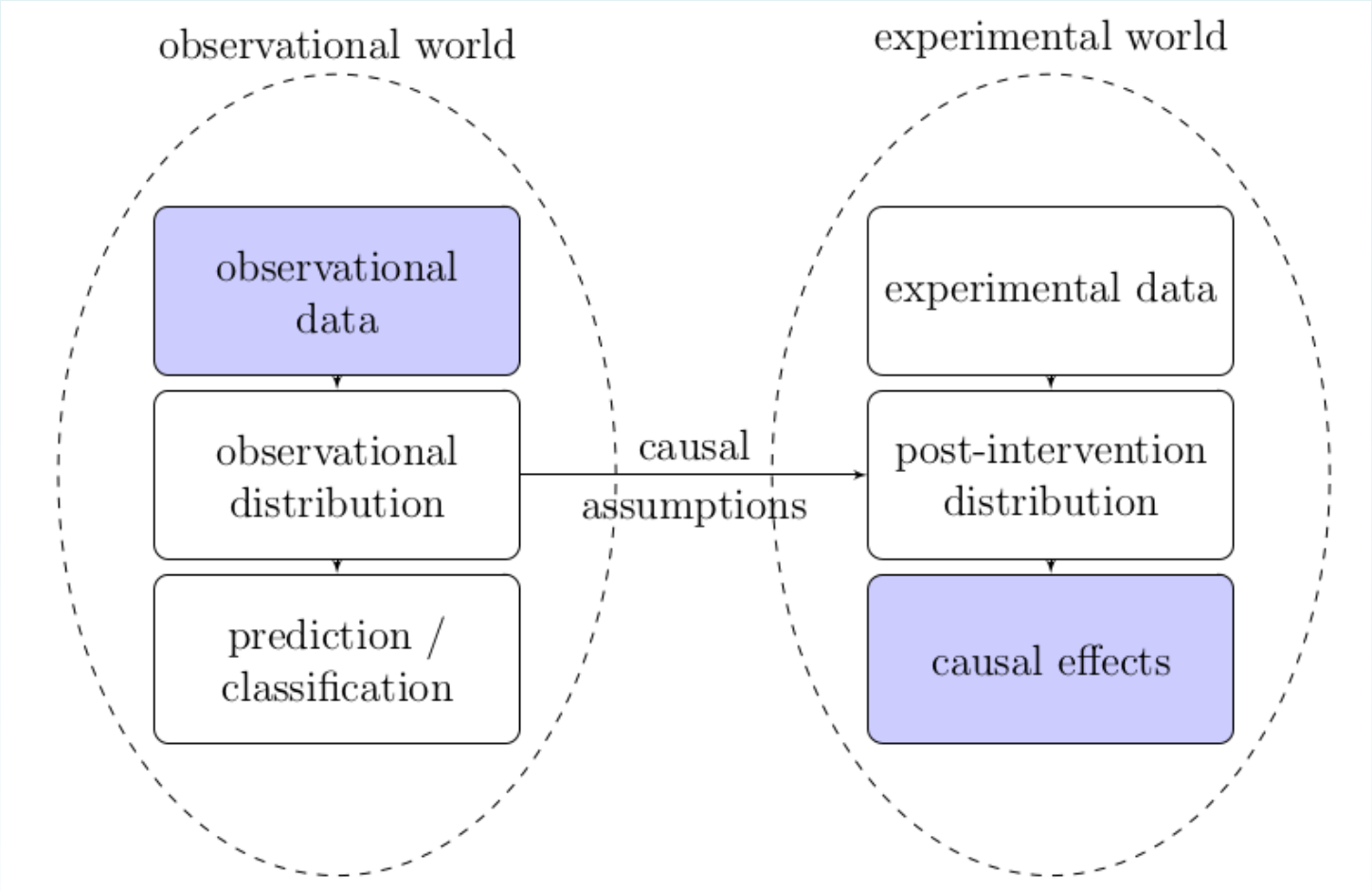
Control variance

Spike and slab prior

zero coefficients

small (equal) coefficients

What does it do?



Maathuis, Marloes H., and Preetam Nandy. "A review of some recent advances in causal inference." arXiv preprint arXiv:1506.07669 (2015).

Causal Assumptions

External events that are not accounted for by variances do not apply

Meaning external events must do one of the following:

- Happen globally
- Happen in the prior time period

Causal Assumptions

The control data vectors are unaffected by the event (release)

- Non-releasing apps = control set

The relationship between the target and control data vectors is unchanged in the series

- Control set must not contain app or derivatives

Input Metrics

Number of ratings

Number of ratings / week

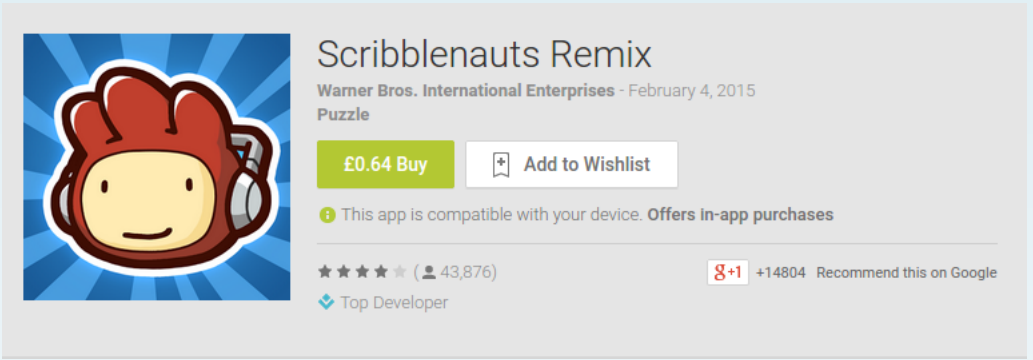
Obtain: p-value for each metric, for each release

rank of **D**ownloads

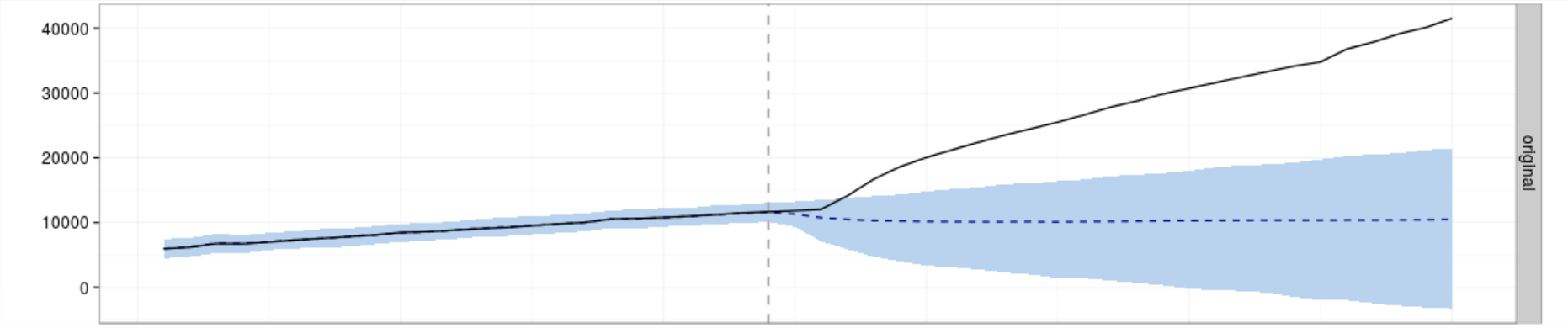
Rating

Results - Scribblenauts Remix

Posterior tail-area probability p: 0.00111



The blue region indicates prediction with 95% confidence interval



Apps often have rapid / agile release cycles

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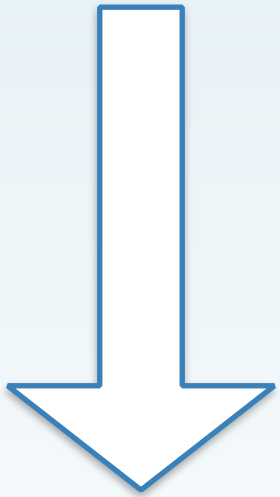

Do releases correlate with good performance?

Do releases affect performance?

Dataset

July 2014 - July 2015

Recorded apps that are consistently (every week) in the most popular free or paid lists:

Google Play	apps: **307**	releases: **1,570**
Windows Phone	apps: **726**	releases: **1,617**

Metrics

Developer controlled factors:

P - price

RT - release text

Performance metrics:

R - rating

D - download rank

N - number of ratings

NW - number of ratings in last week

Do app metrics change over time?

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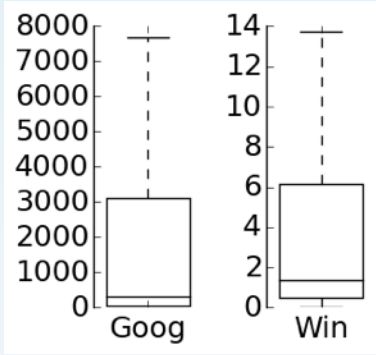
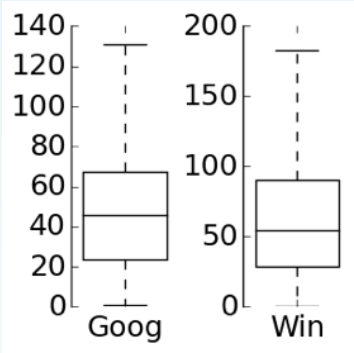
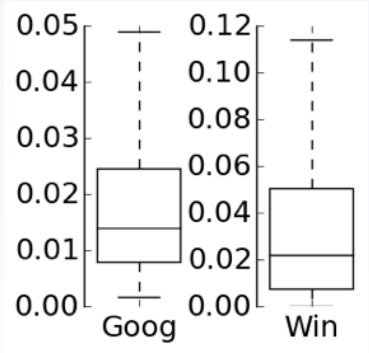
D, N and NW have a high standard deviation over 12 months

D, N and NW are likely to change







R has very small standard deviation

So rating is very stable, unlikely to change

Do release statistics have a correlation with app performance?

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No strong correlations are observed

number of releases

Method	R	ΔR	D	ΔD	N	ΔN
Spearman	-	-	-	-	-	0.13
Pearson	-	-	-	-	-	-

Google

Method	R	ΔR	D	ΔD	N	ΔN
Spearman	0.20	-	-0.17	-	0.32	0.42
Pearson	0.16	-	-0.16	-0.09	0.27	0.34

Windows

release interval

Method	R	ΔR	D	ΔD	N	ΔN
Spearman	-	-	-	-	-0.15	-0.19
Pearson	-	-	0.16	-	-	-

Google

Method	R	ΔR	D	ΔD	N	ΔN
Spearman	-	-	0.12	0.13	-	-
Pearson	-	-	0.13	-	-	-

Windows

Do releases impact app performance?

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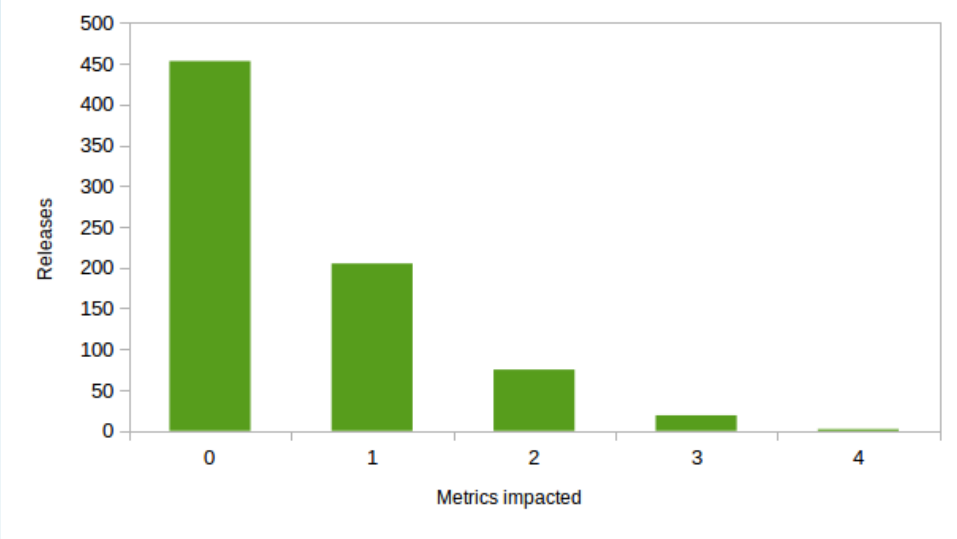
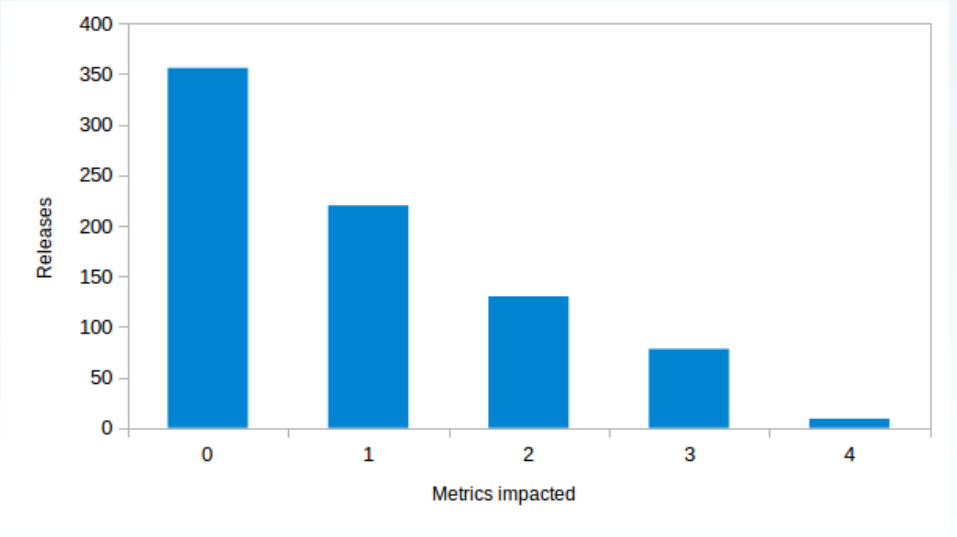
40% of releases impact performance in Google apps



55% of releases impact performance in Windows apps



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- size
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(new, feature) better than (bug, fix)

Releases that mention (new, feature) are more likely to be impactful, and to positively affect Rating compared with releases that mention (bug, fix)

What characterises impactful releases?

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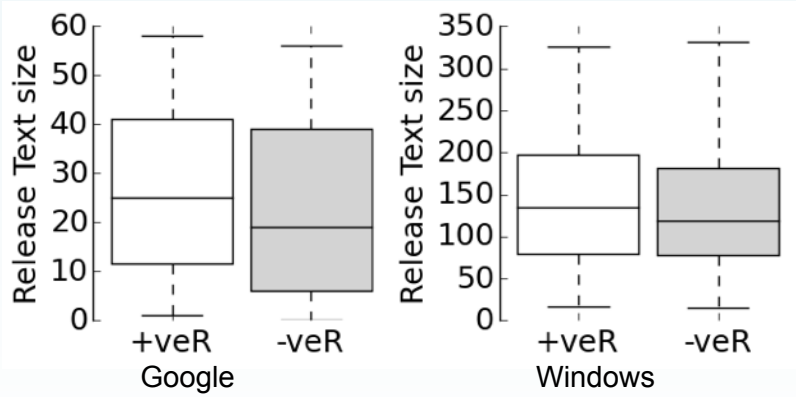
Day - day of release

(new, feature) better than (bug, fix)

more descriptive release text

Releases with longer release text are more likely to positively impact Rating



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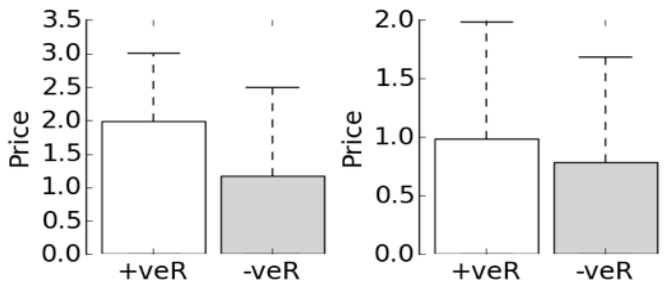
(new, feature) better than (bug, fix)

more descriptive release text

higher prices

Releases with higher prices are more likely to positively impact Rating



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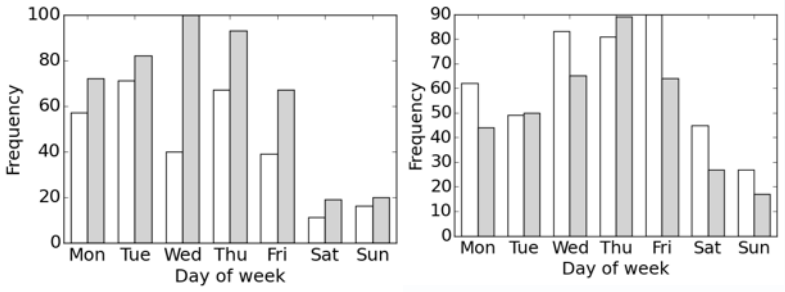
Saturday to Tuesday



Google Windows

Releases from Saturday to Tuesday are more likely to be impactful

Conclusions

Causal Impact Analysis can point to significant changes

We look at groups of significant releases to minimise risk of external factors

Useful developer guidelines found that apply to multiple platforms

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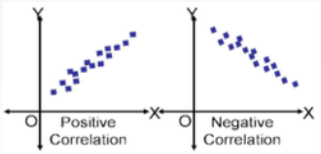

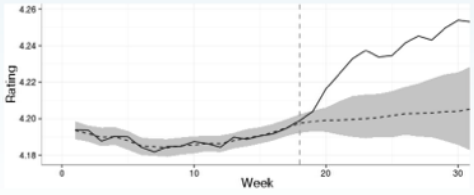

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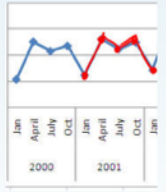

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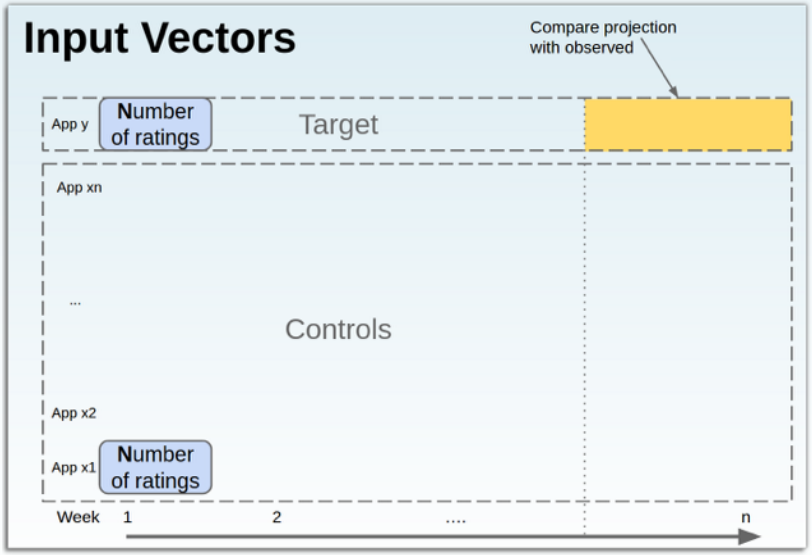

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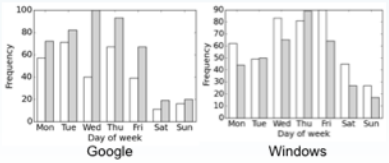
Day - day of release — Saturday to Tuesday



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