Process Echoes in Code

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Git

Git

Commit

Git

Commit

commit hash (sha1)
time/date stamp
committer
files
actual change

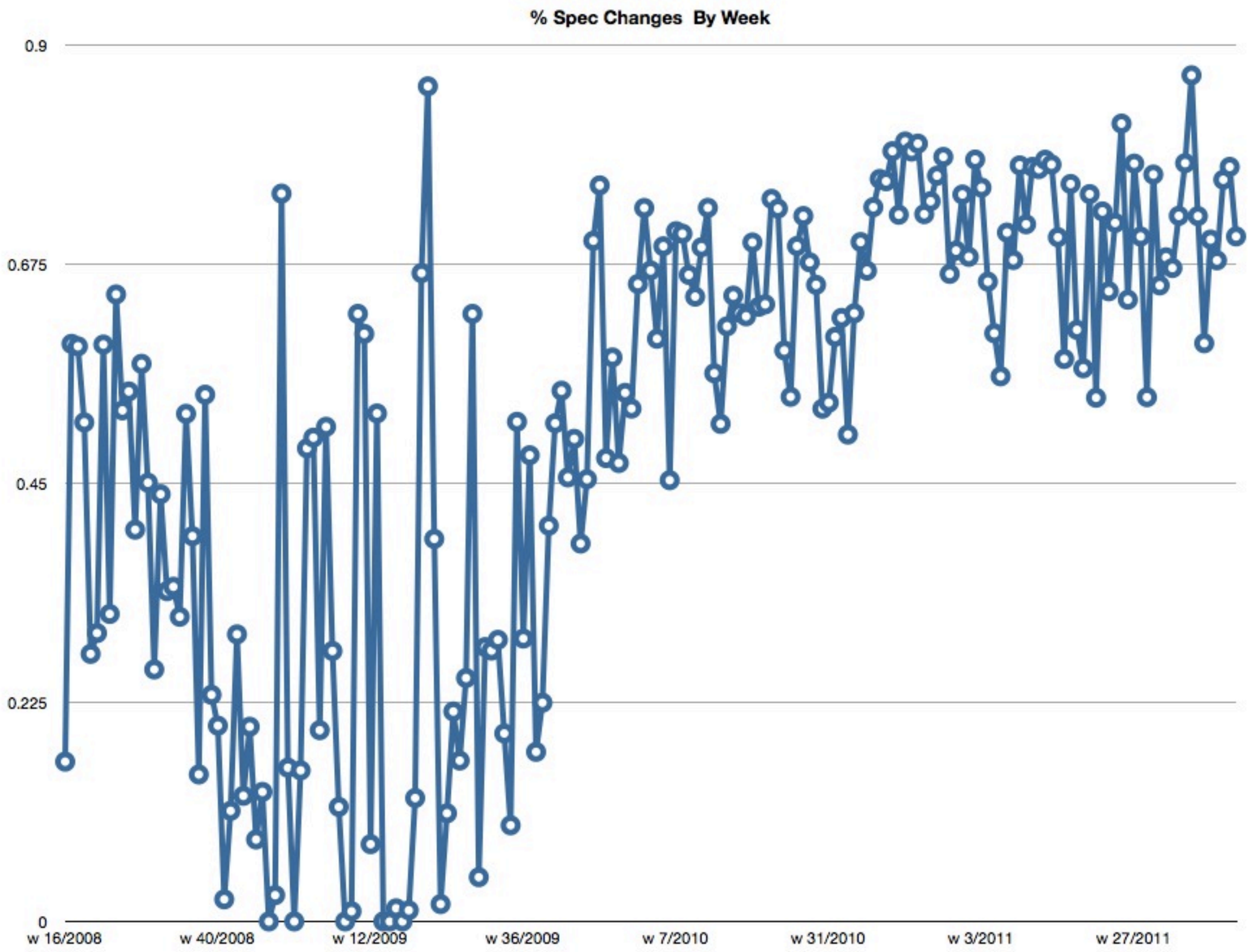
Git

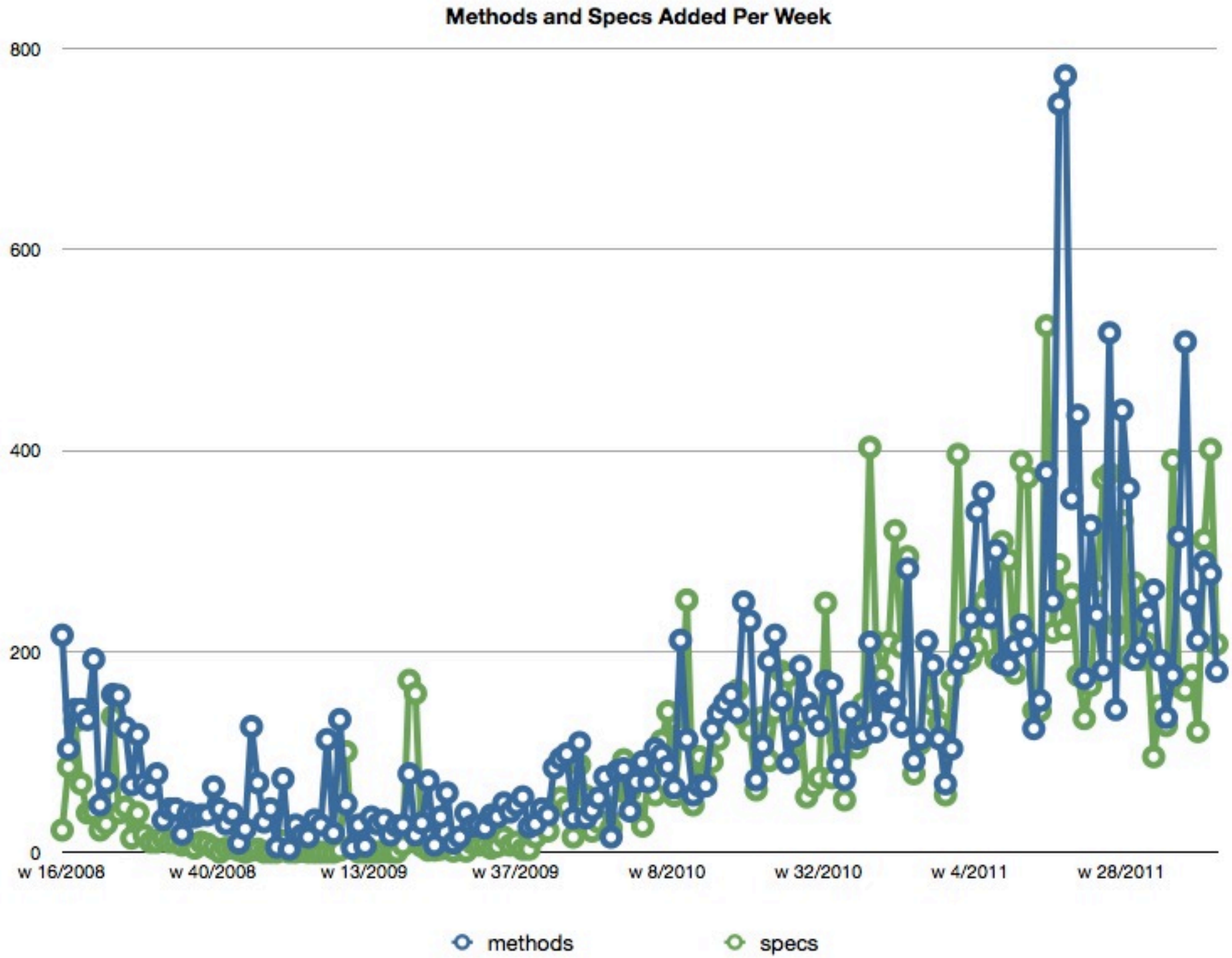
Method Event

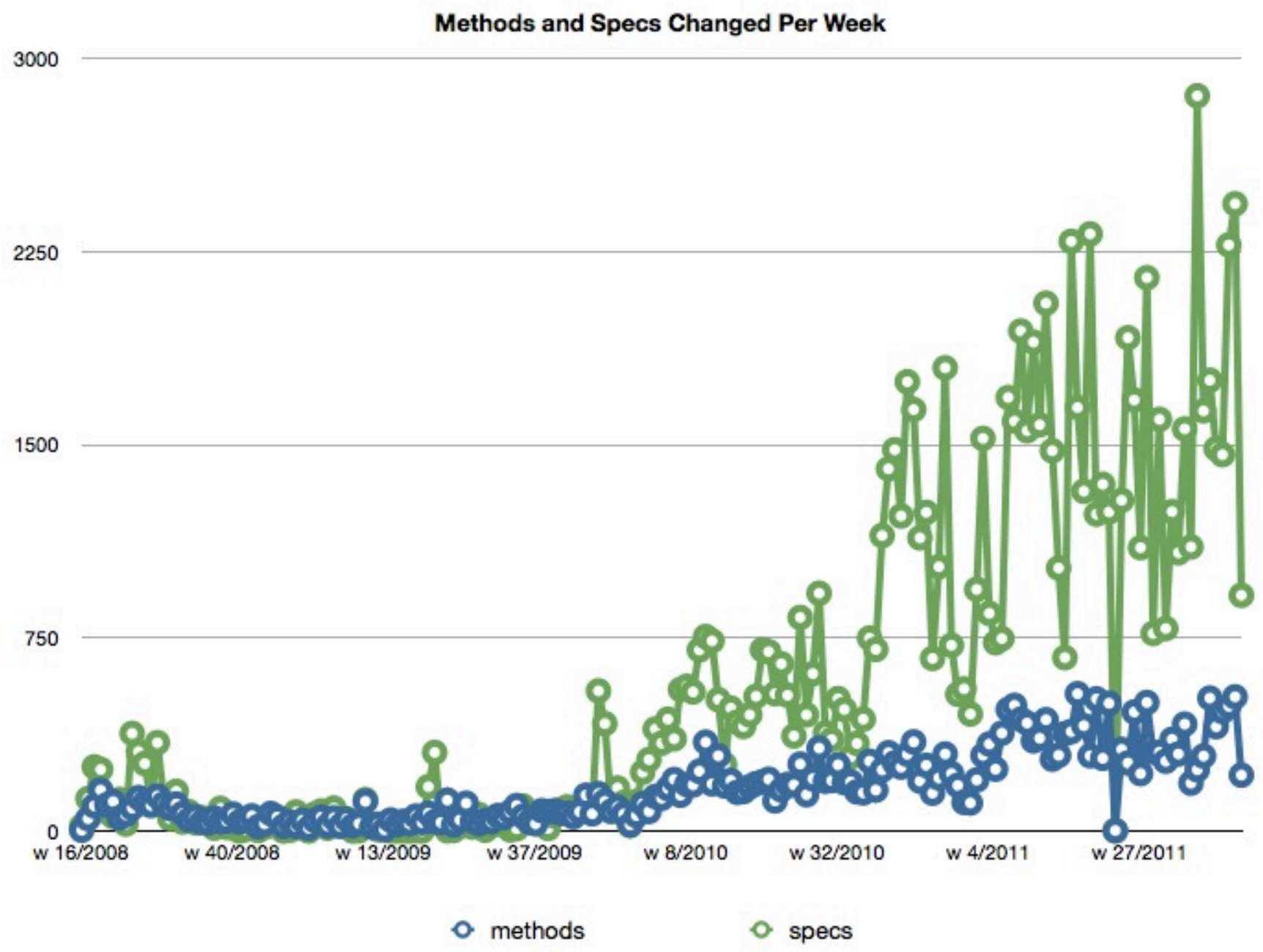
commit hash (sha1)
time/date stamp
committer
method name
method body
add/change/delete

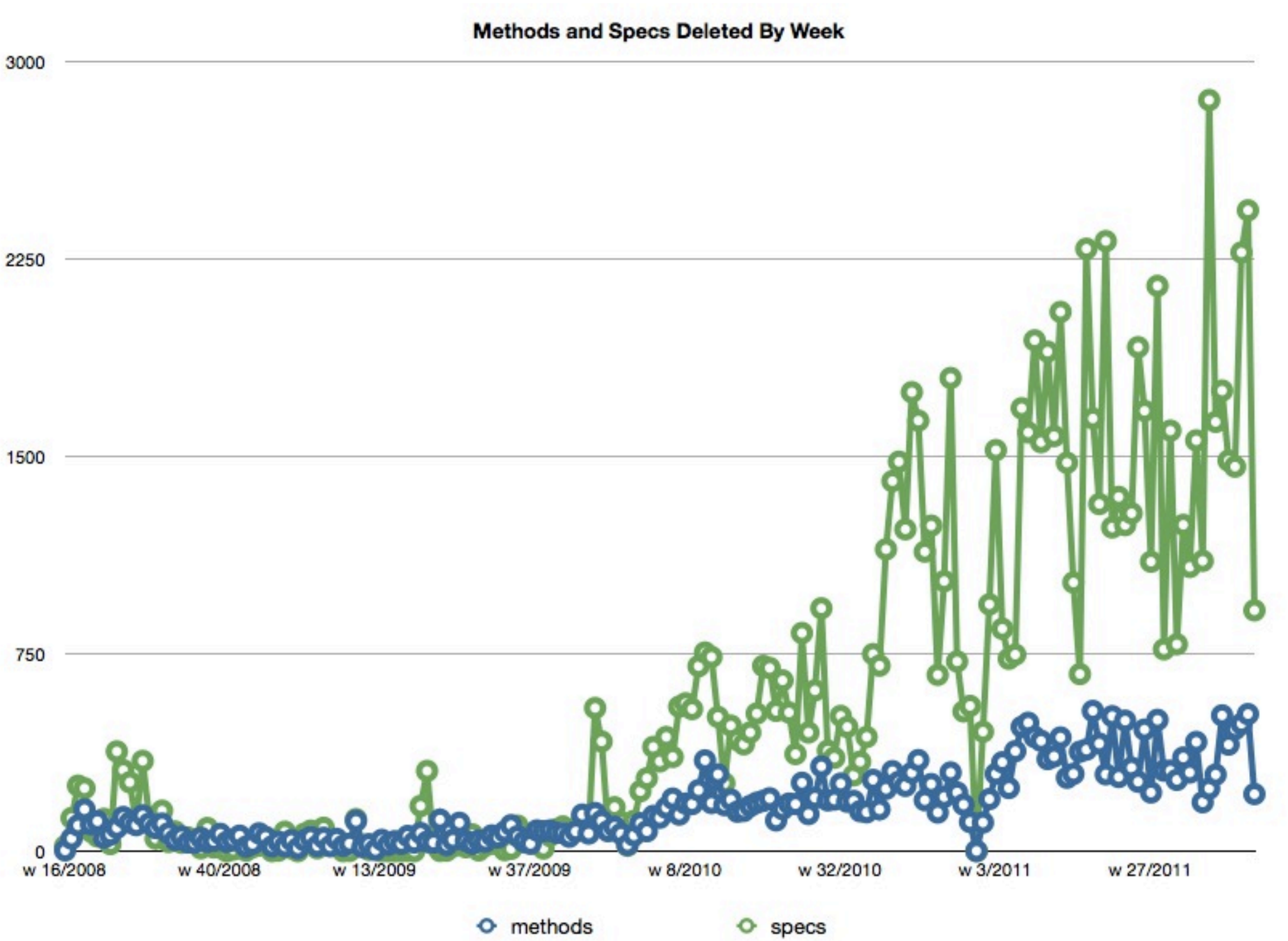
Commit

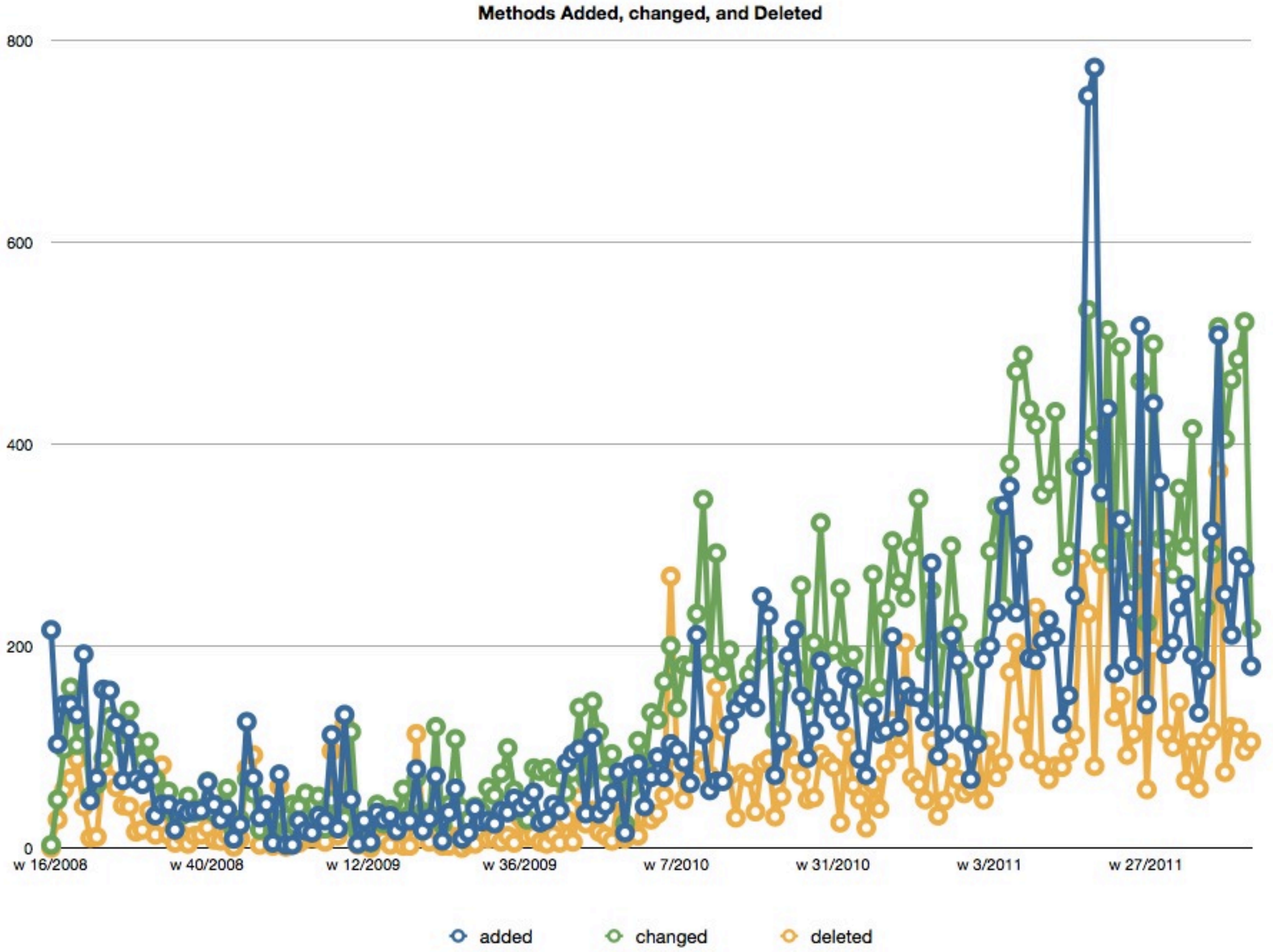
commit hash (sha1)
time/date stamp
committer
files
actual change

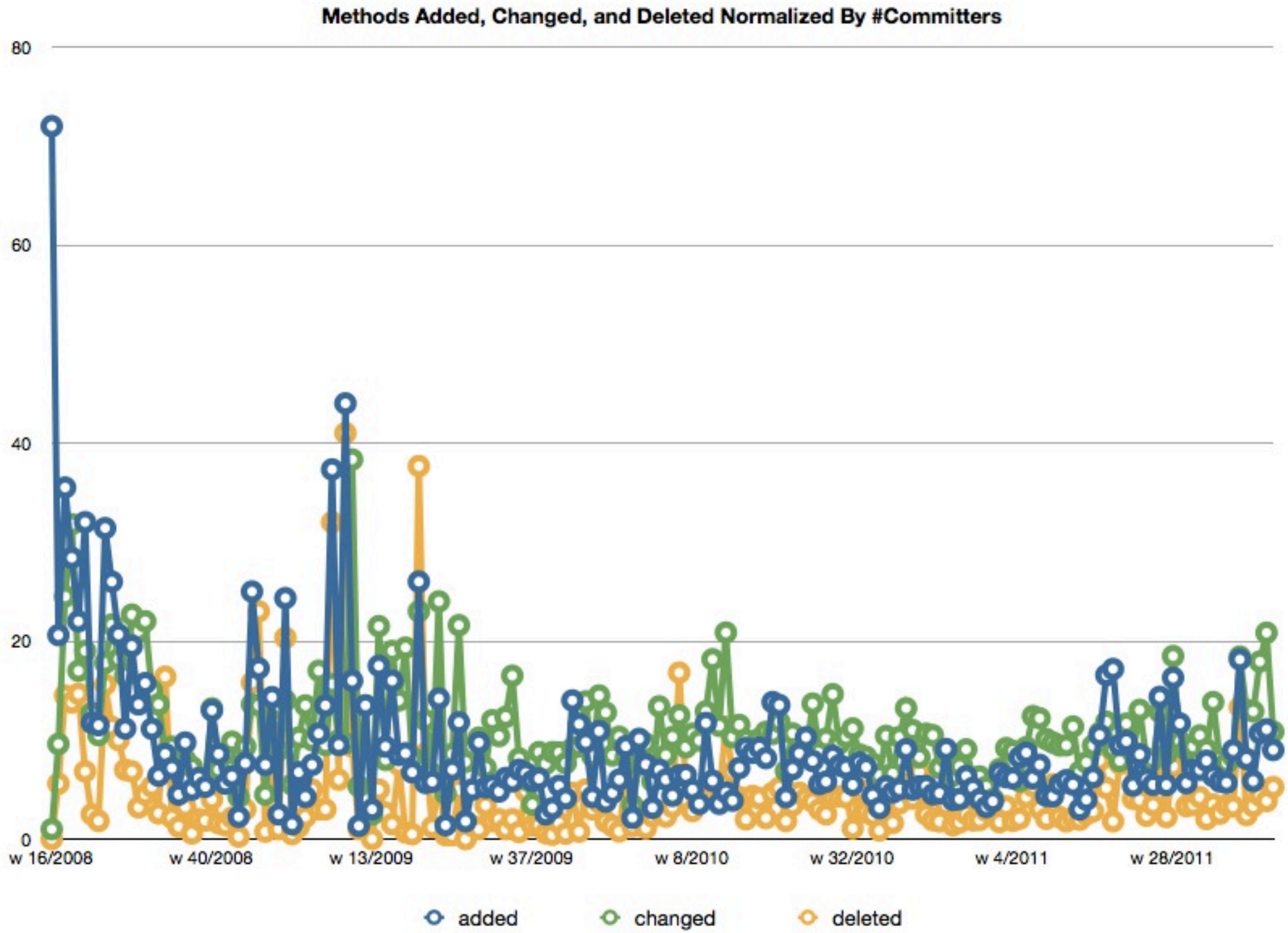

% Spec Changes By Week
0.9
0.675
0.45
0.225
0
w 16/2008
w 40/2008
w 12/2009
w 36/2009
w 7/2010
w 31/2010
w 3/2011
w 27/2011


Methods and Specs Added Per Week
800
600
400
200
0
w 16/2008
w 40/2008
w 13/2009
w 37/2009
w 8/2010
w 32/2010
w 4/2011
w 28/2011
methods
specs


Methods and Specs Changed Per Week
3000
2250
1500
750
0
w 16/2008
w 40/2008
w 13/2009
w 37/2009
w 8/2010
w 32/2010
w 4/2011
w 27/2011
methods
specs


Methods and Specs Deleted By Week
3000
2250
1500
750
0
w 16/2008
w 40/2008
w 13/2009
w 37/2009
w 8/2010
w 32/2010
w 3/2011
w 27/2011
methods
specs


Methods Added, changed, and Deleted
800
600
400
200
0
w 16/2008
w 40/2008
w 12/2009
w 36/2009
w 7/2010
w 31/2010
w 3/2011
w 27/2011
added
changed
deleted


Methods Added, Changed, and Deleted Normalized By #Committers
80
60
40
20
0
w 16/2008
w 40/2008
w 13/2009
w 37/2009
w 8/2010
w 32/2010
w 4/2011
w 28/2011
added
changed
deleted

https://github.com/michaelfeathers/delta-flora

Load a Repository

```
events = read_events('diaspora')
```

Get all of the file names

```
events.map {|e| e.file_name }
```

..if you want to see them :-)

```
ap events.map {|e| e.file_name }
```

Sorted list of file names

```
events.map {|e| e.file_name }.sort.uniq
```

Let's get some class names

```
events.map {|e| e.class_name }.sort.uniq
```

What about committers?

```
events.map {|e| e.committer }.sort.uniq
```

Let's see what time of day jreading commits

```
events.select {|e| e.committer == "jreading" }
      .map {|e| e.date.hour }
      .freq
```

Last commit in the code

```
events.date_sorted.last
```

Highest method complexity over time

```
events.map {|e| e.complexity }.max
```

..to get the name too

```
max_event = events
    .sort {|left,right| left.complexity <=> right.complexity }
    .last

ap max_event.method_name
ap max_event.complexity
```

Number of method events per file

```
events.group_by {|e| e.file_name }
      .map {|name, events| [name, events.count] }
```

Break up your work..

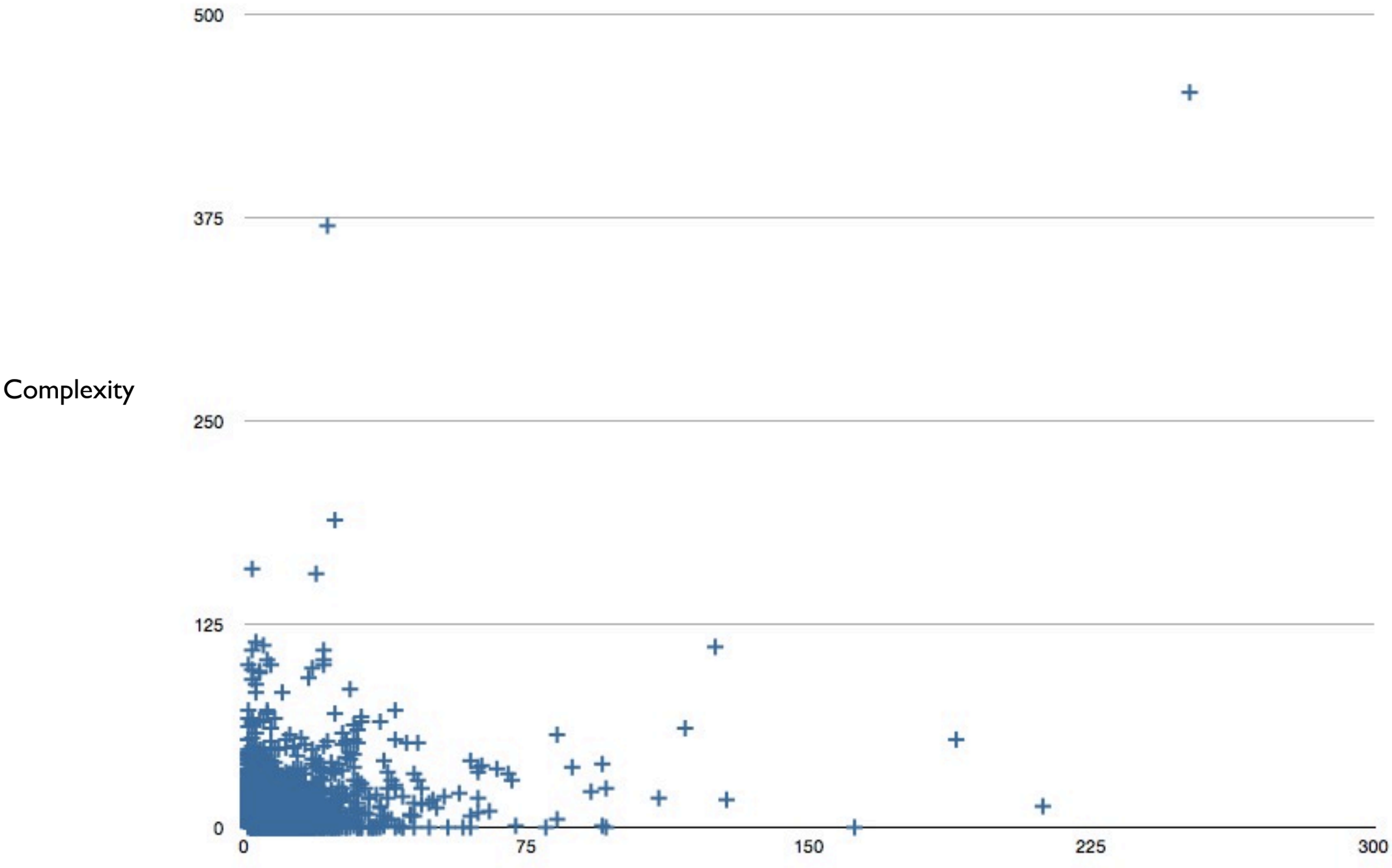
```
method_names = events.map {|e|e.method_name }.sort.uniq

ap method_names

events.date_sorted.select { |e| e.method_name == “initialize” }
                  .last
                  .complexity
```

By class..

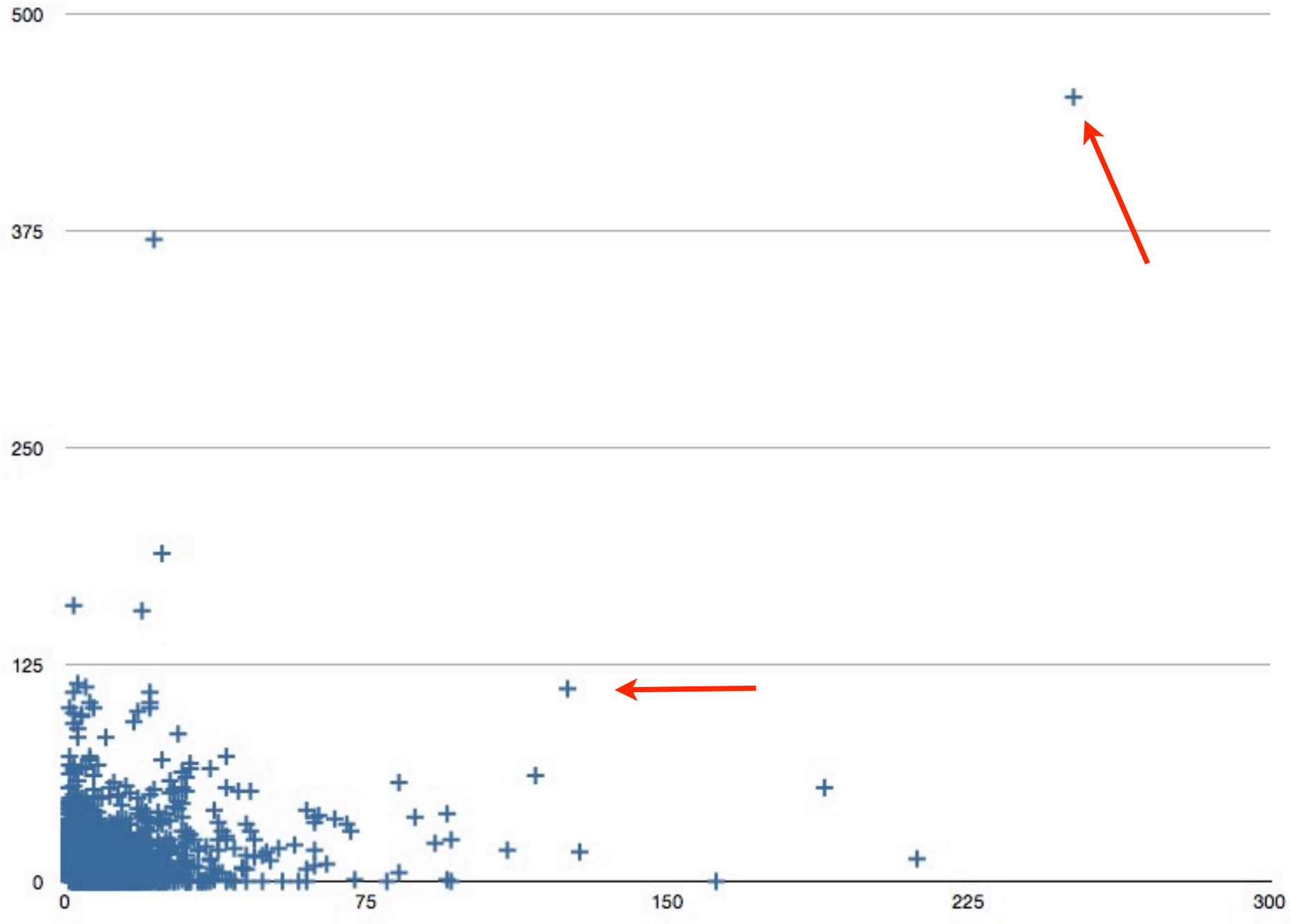
```
class_names = events.map {|e|e.class_name }.sort.uniq
```

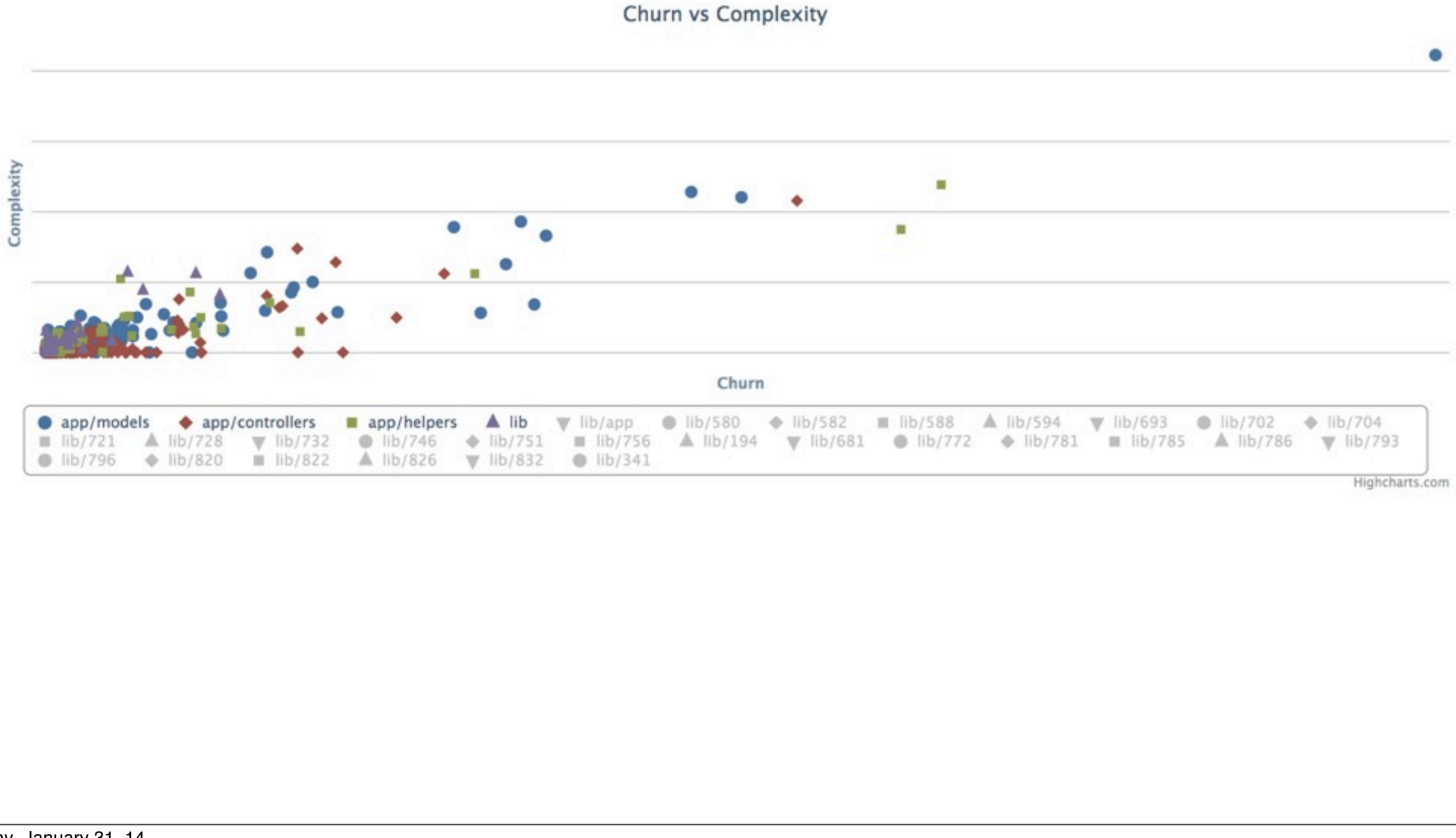
```
events.date_sorted.select { |e| e.class_name == “Router” }
                  .last
                  .complexity
```

Turbulence



Turbulence




Churn vs Complexity
Complexity
Churn
app/models
app/controllers
app/helpers
lib
lib/app
lib/580
lib/582
lib/588
lib/594
lib/693
lib/702
lib/704
lib/721
lib/728
lib/732
lib/746
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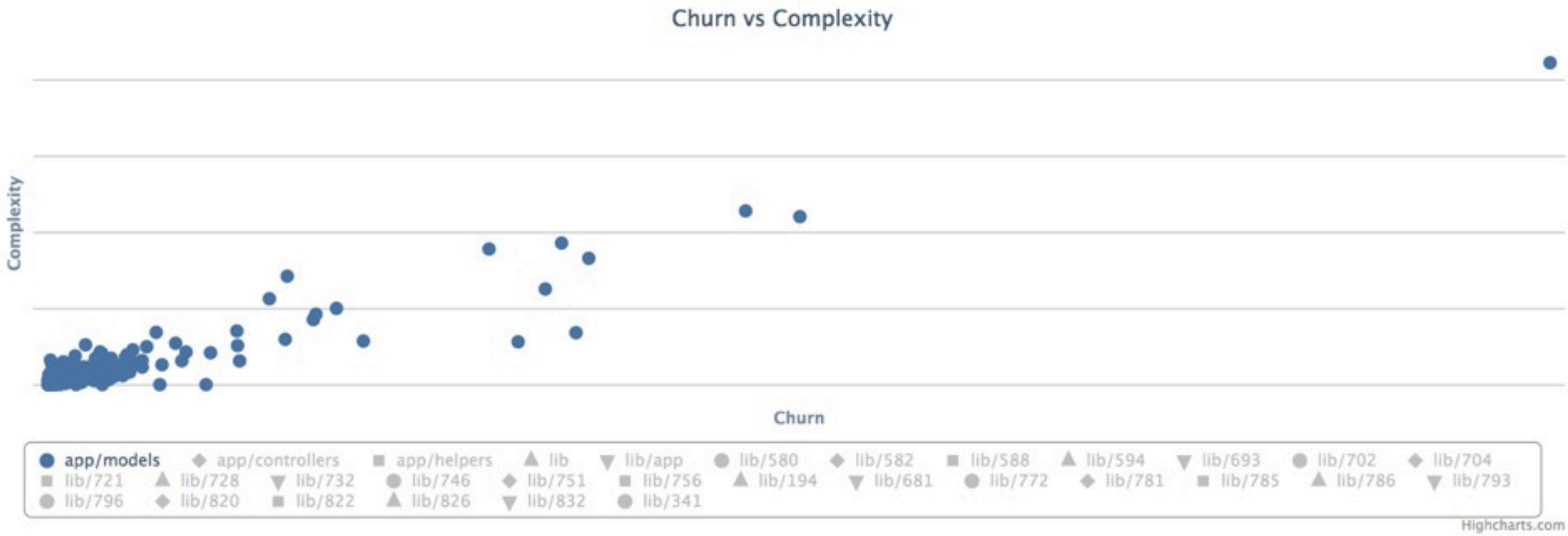
lib/832
lib/341
Highcharts.com


Churn vs Complexity
Complexity
Churn
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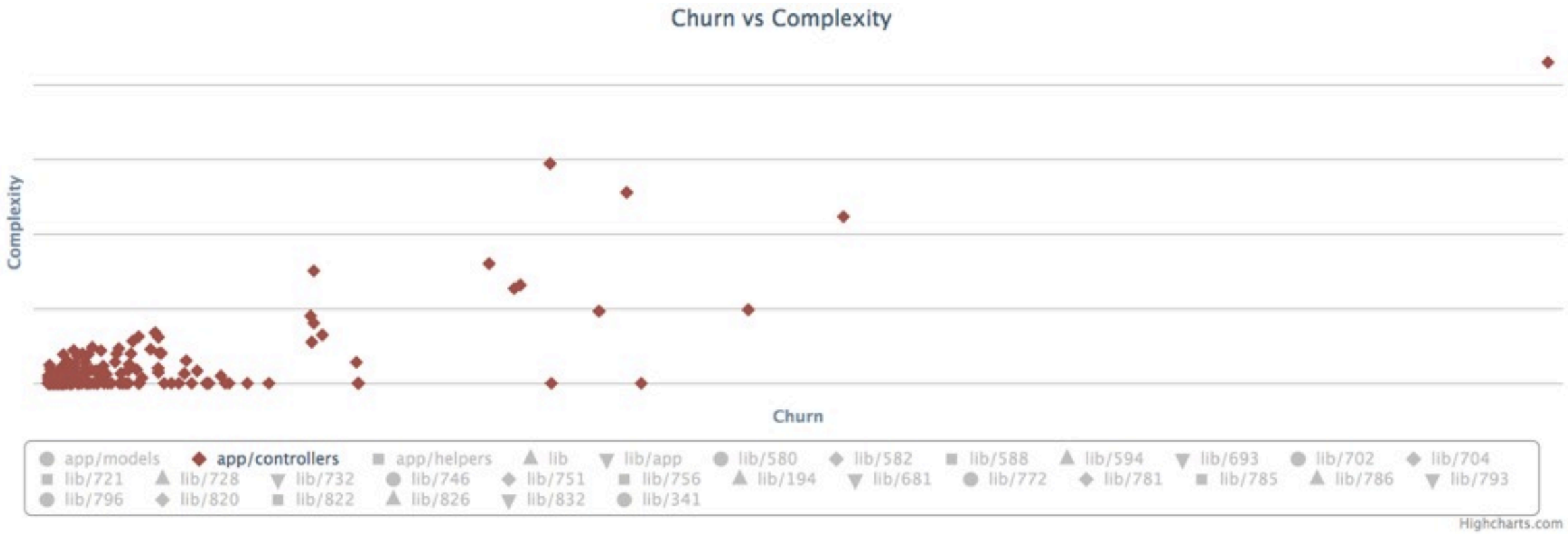
Churn vs Complexity
Complexity
Churn
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lib/772
lib/781
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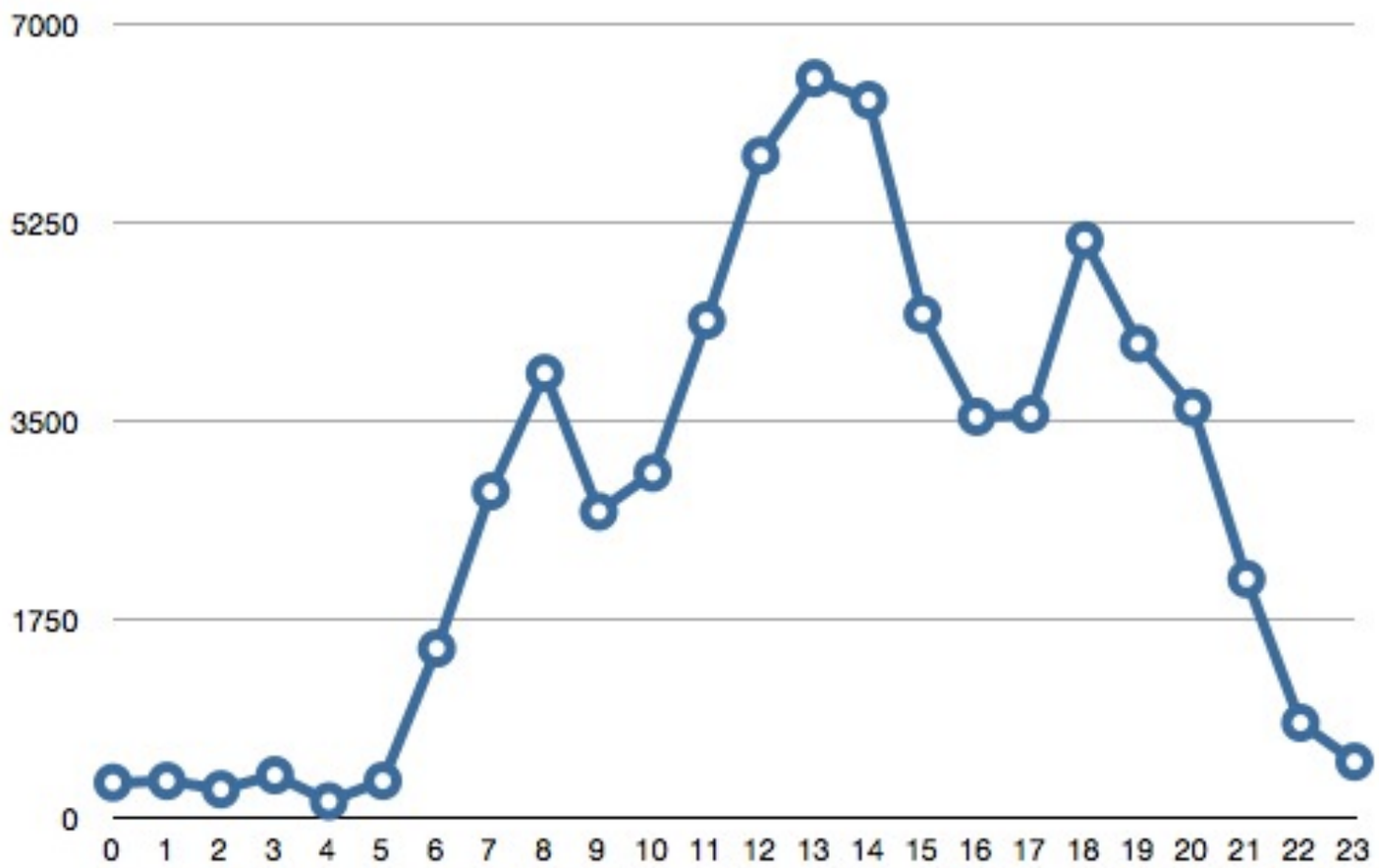
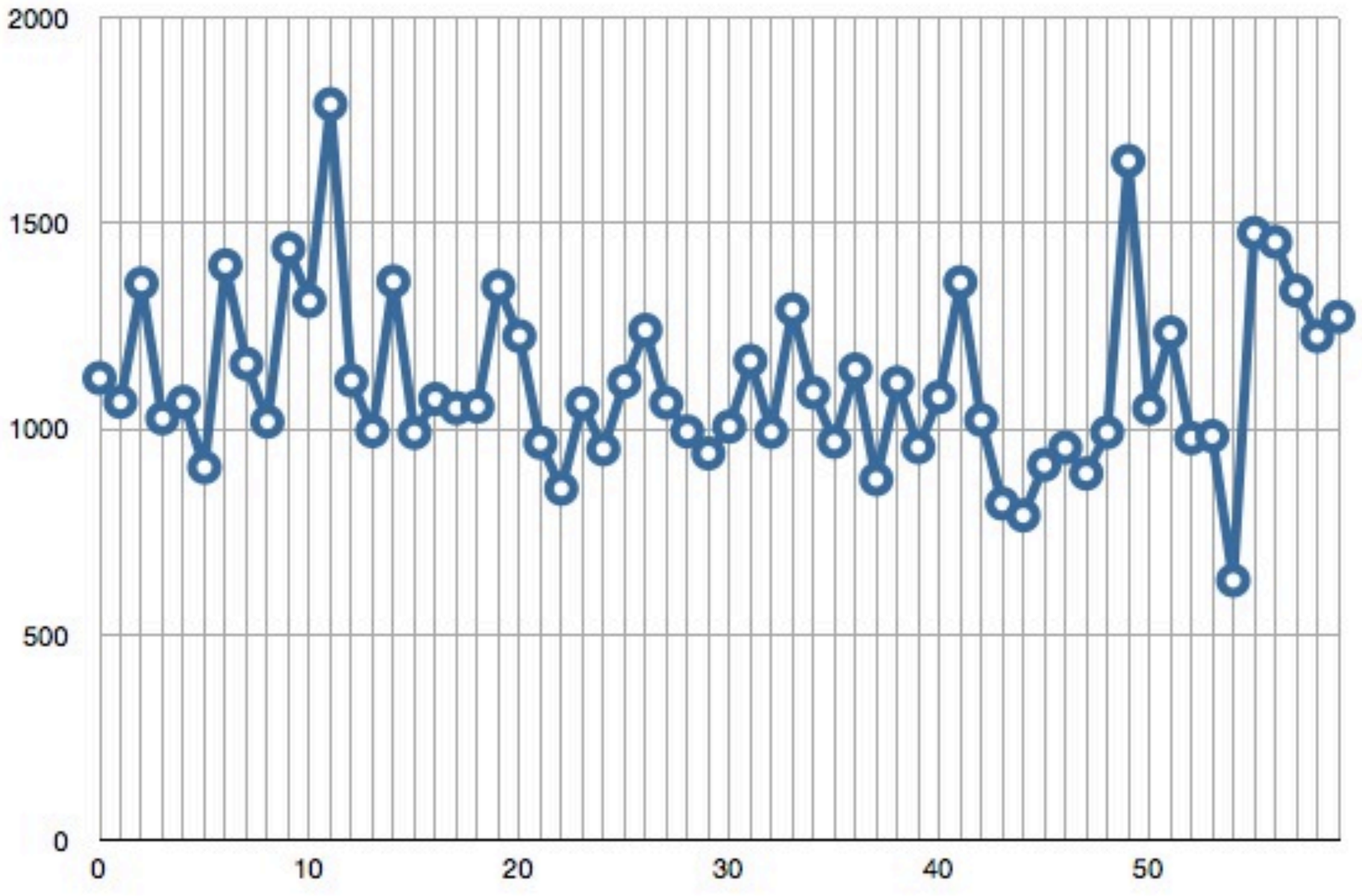
lib/341
Highcharts.com

Commits By Hour



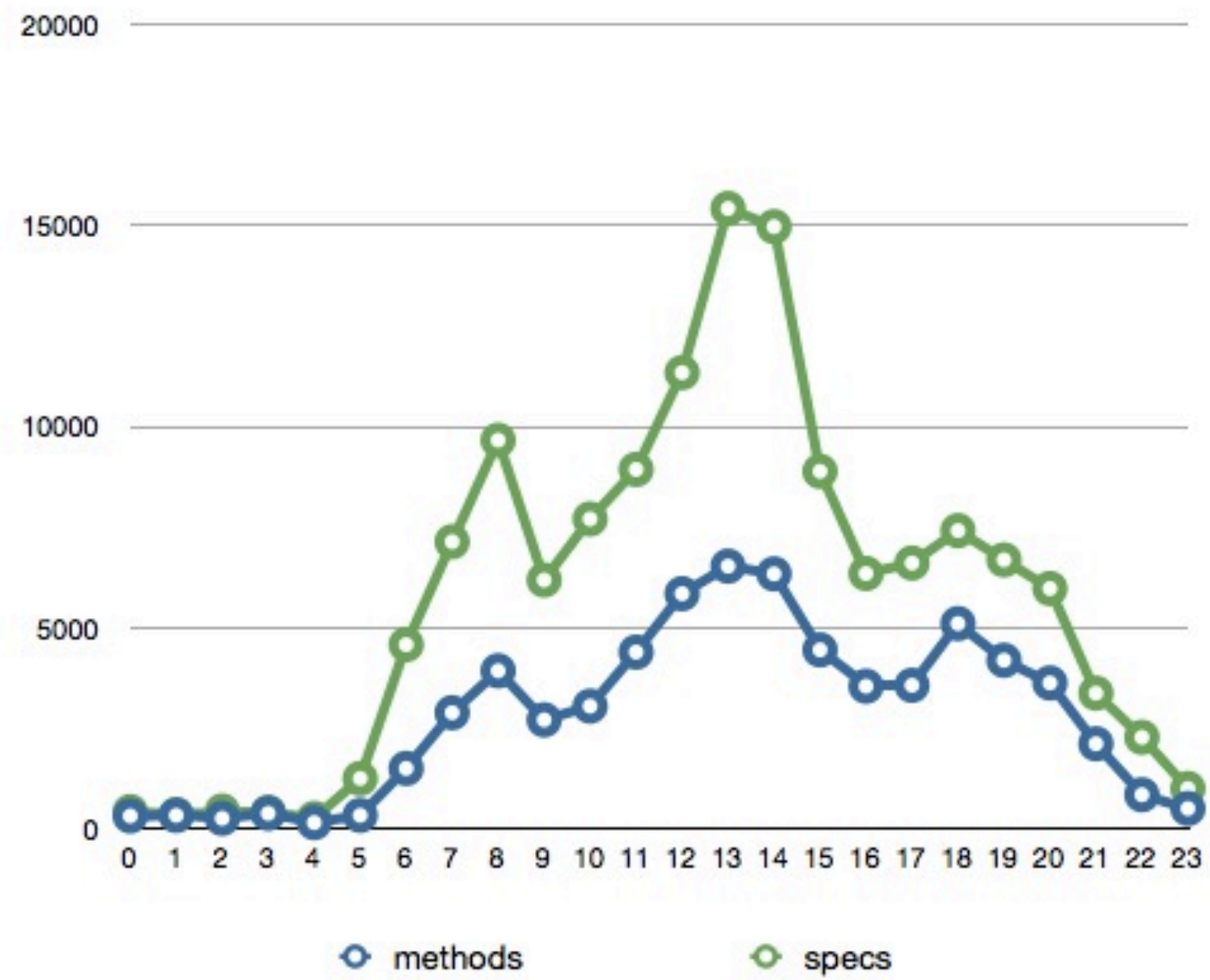
chart(['hour','commits'],method_events(events).freq_by {|e| e.date.hour })

Commits By Minute

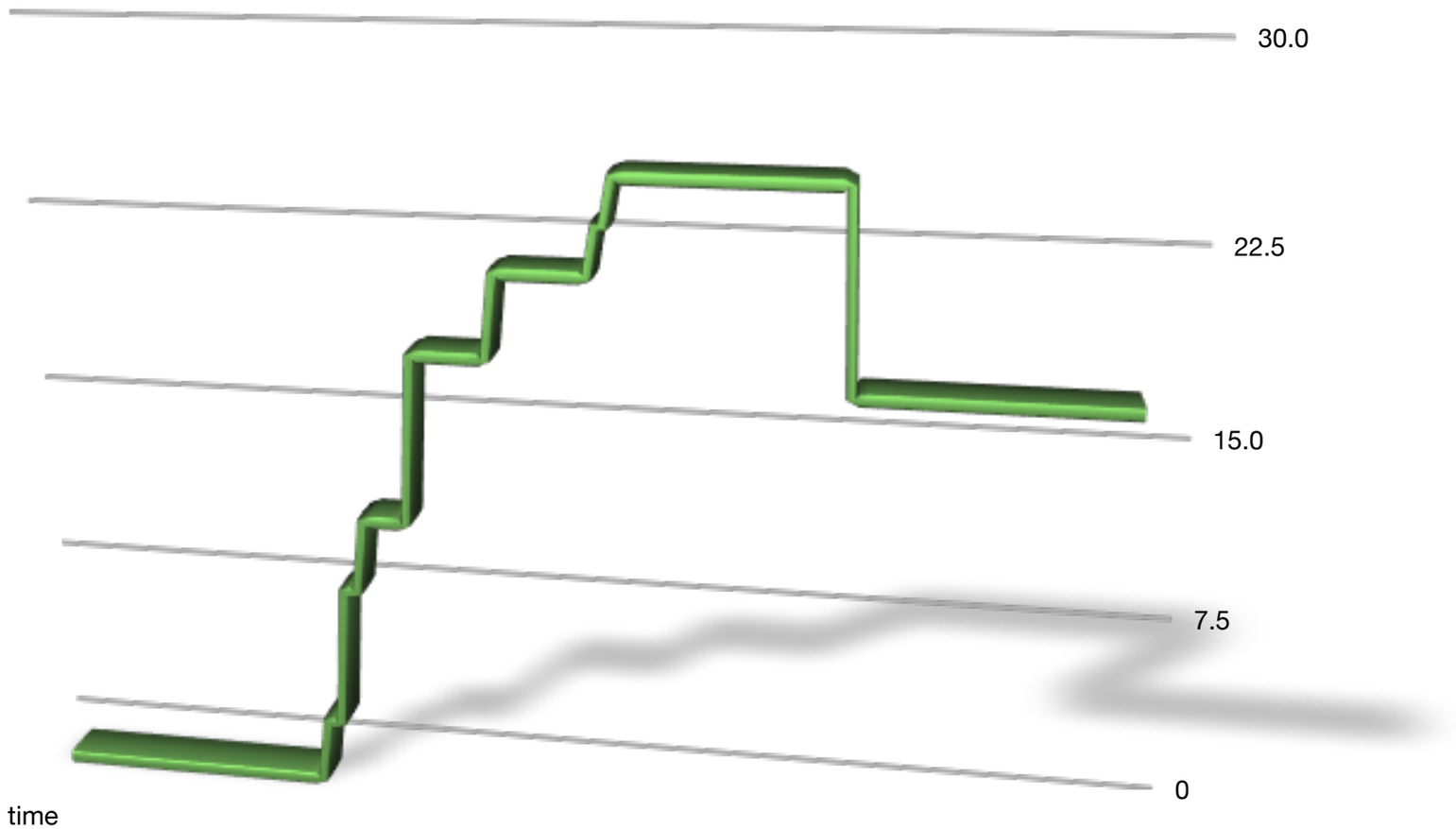



```
chart(['hour','commits'],method_events(events).freq_by {|e| e.date.min })
```

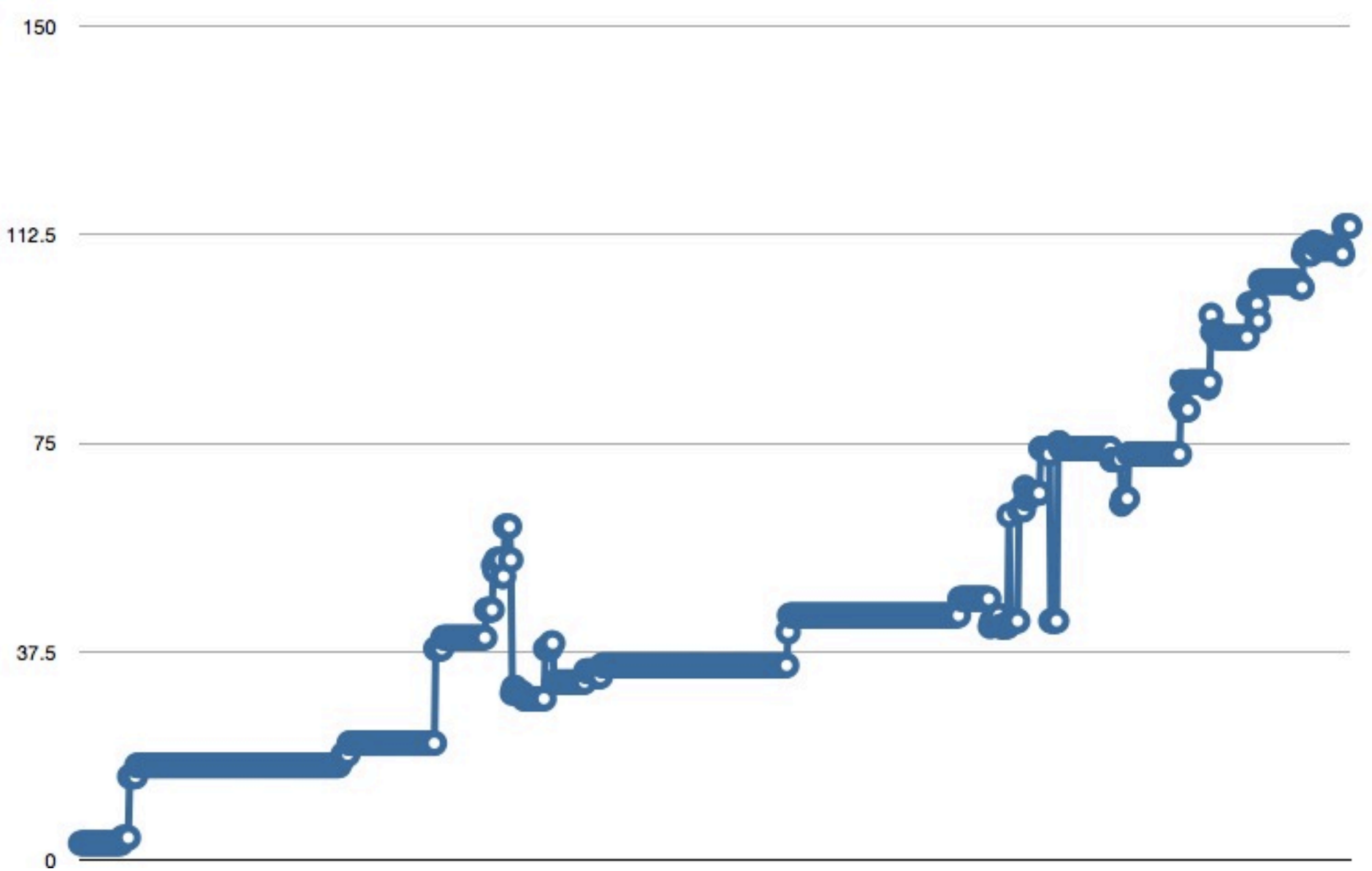
Method and Spec Changes Per Hour of Day

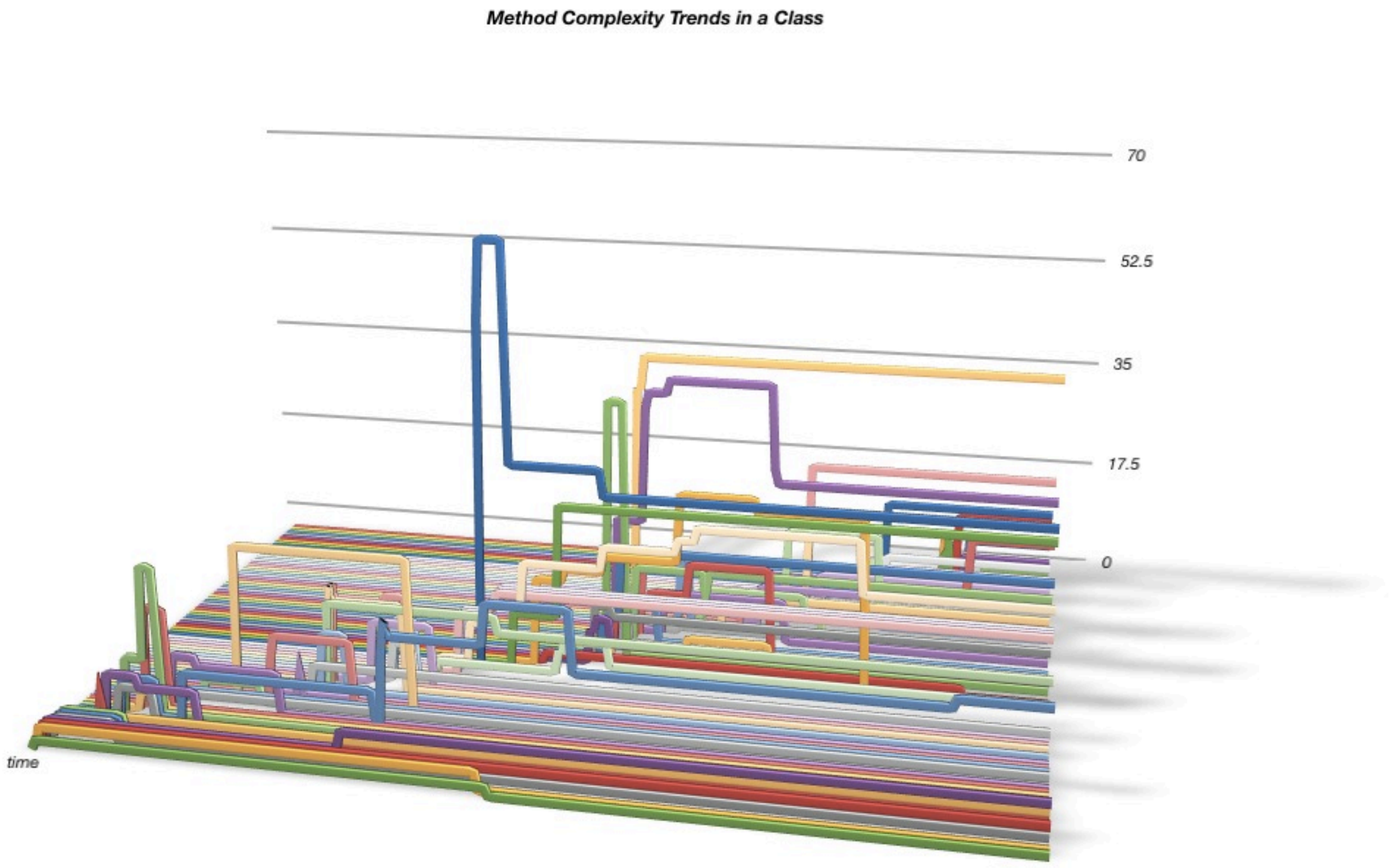


A Method Lifeline



Router::confirmation




Method Complexity Trends in a Class
70
52.5
35
17.5
0
time

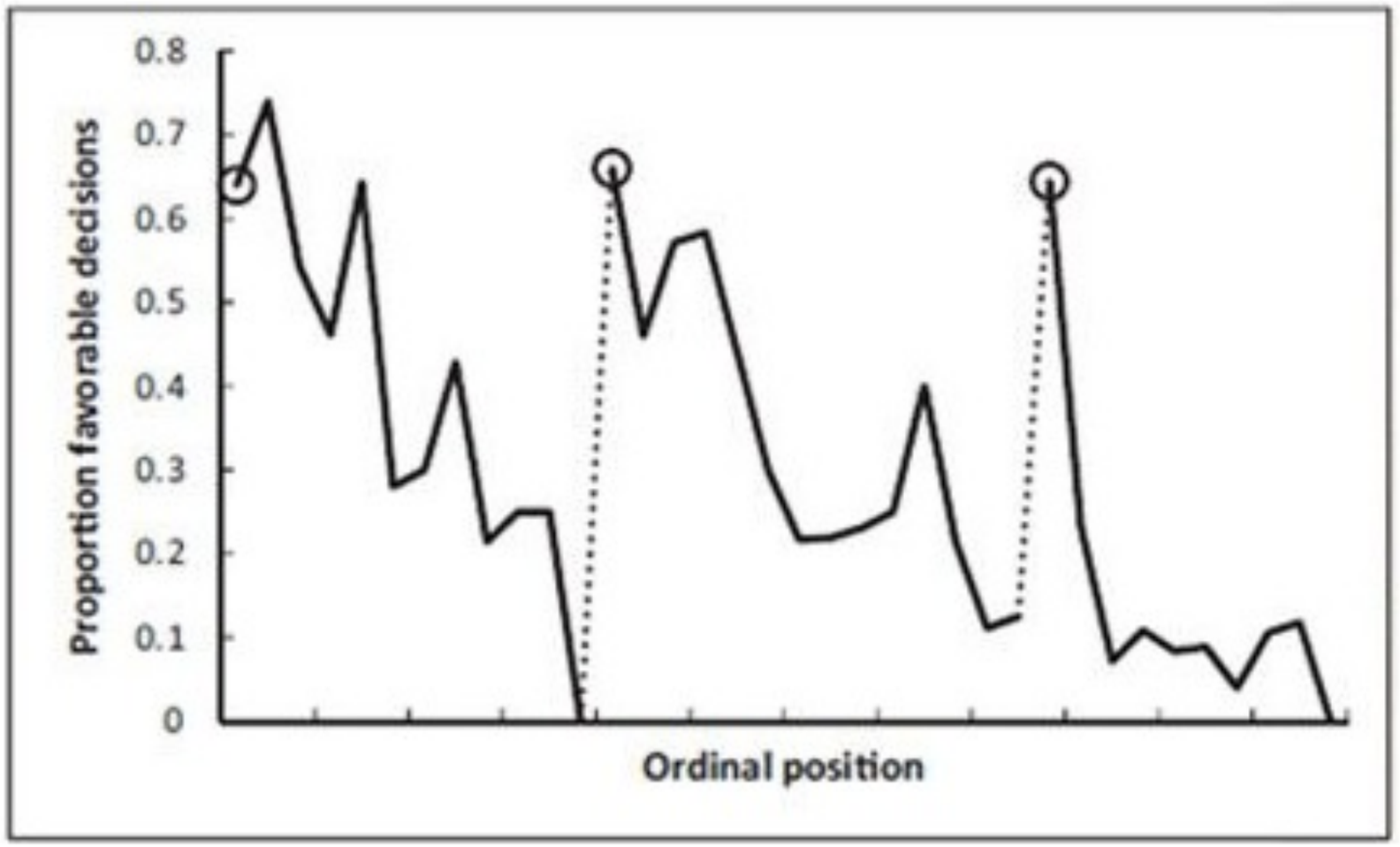
If you want parole, have your case heard right after lunch

By Kate Shaw | Last updated 4 days ago

Between the courtroom antics of lawyers, witnesses, and jurors, reason doesn't always prevail in our legal system. But judges are trained to be impartial, consistent, and rational, and make deliberate decisions based on the case in front of them, right? Actually no, according to a new study in *PNAS*, which shows that judges are subject to the same whims and lapses in judgment as the rest of us.

The authors examined over 1,000 parole decisions made by eight judges in Israel over a 10-month period. In each parole request, a prisoner appeared in front of a judge, and the judge could either accept or deny the request. The judges heard between 14 and 35 of these cases per day, separated into three distinct sessions. The first session ran from the beginning of the day until a mid-morning snack break, the second lasted from the snack break until a late lunch, and the third lasted from lunch until the end of the day.

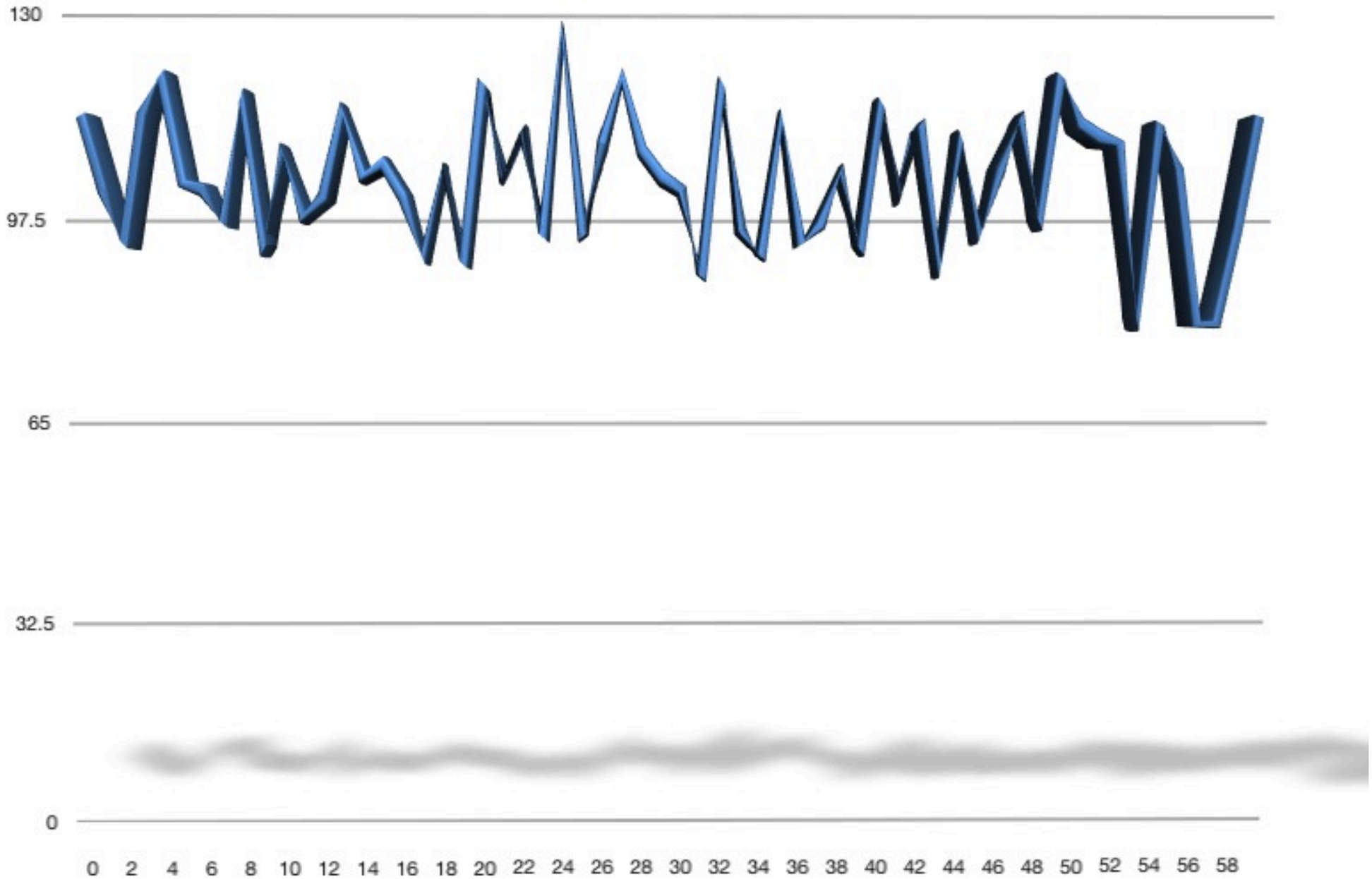
Overall, judges were much more likely to accept prisoners' requests for parole at the beginning of the day than the at end. Moreover, a prisoner's chances of receiving parole more than doubled if his case was heard at the beginning of one of the three sessions, rather than later on in the session. More specifically, it was the number of rulings that a judge made, rather than the time elapsed in a session, that significantly affected later decisions. Every single judge in the sample followed this pattern.



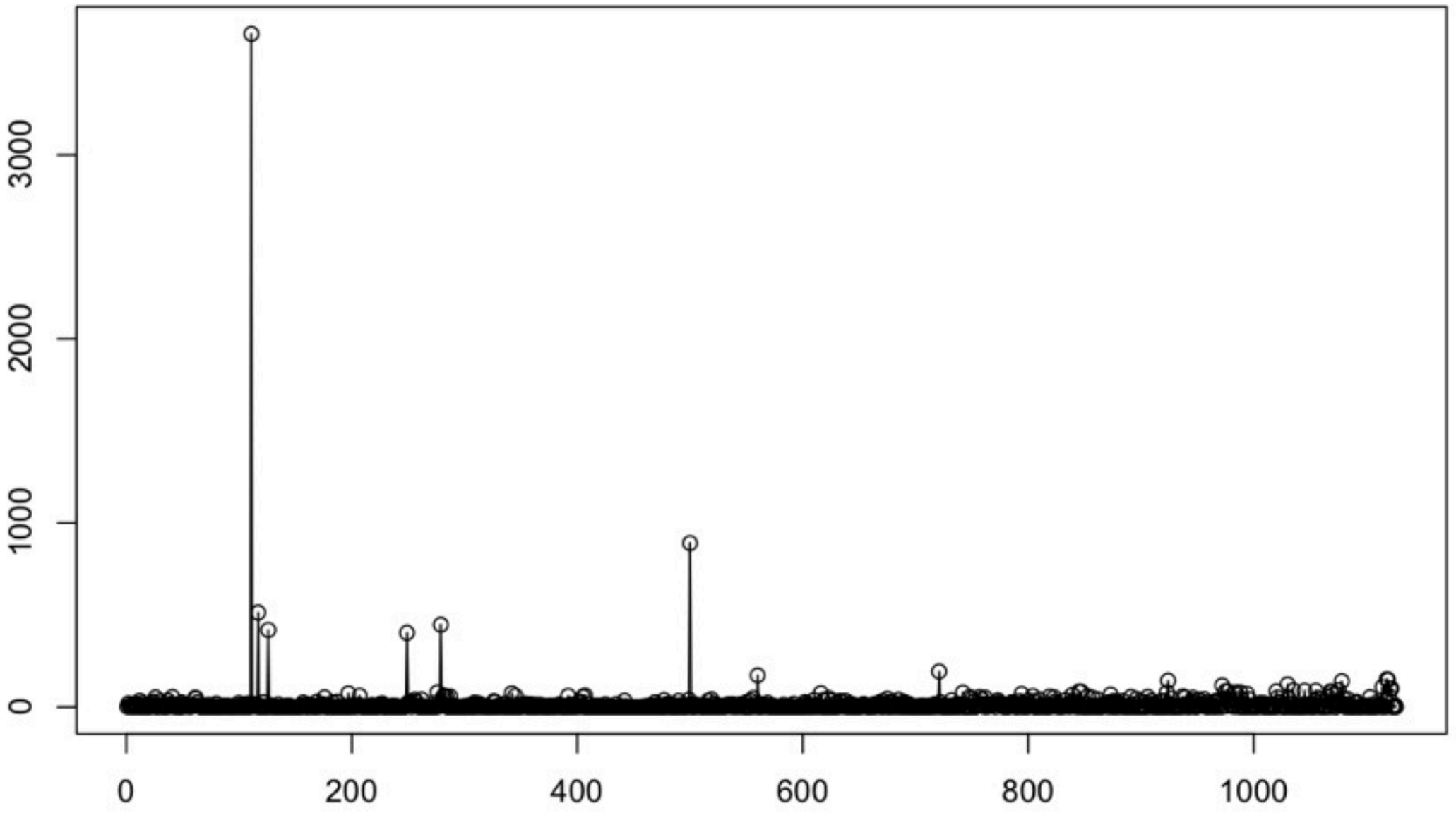
Each judge took two breaks. One at mid-morning beginning as early as 9:45 a.m. or as late as 10:30 a.m., and a lunch break that began between 12:45 p.m. and 2:10 p.m.

http://www.physorg.com/news/2011-04-early-lunch.html

"You're always surprised when you find effects where you don't want to find them," Jonathan Levav of Columbia University said in a telephone interview. "If you're a social scientist it gets you excited. But, as an ordinary citizen, you don't want to find this."

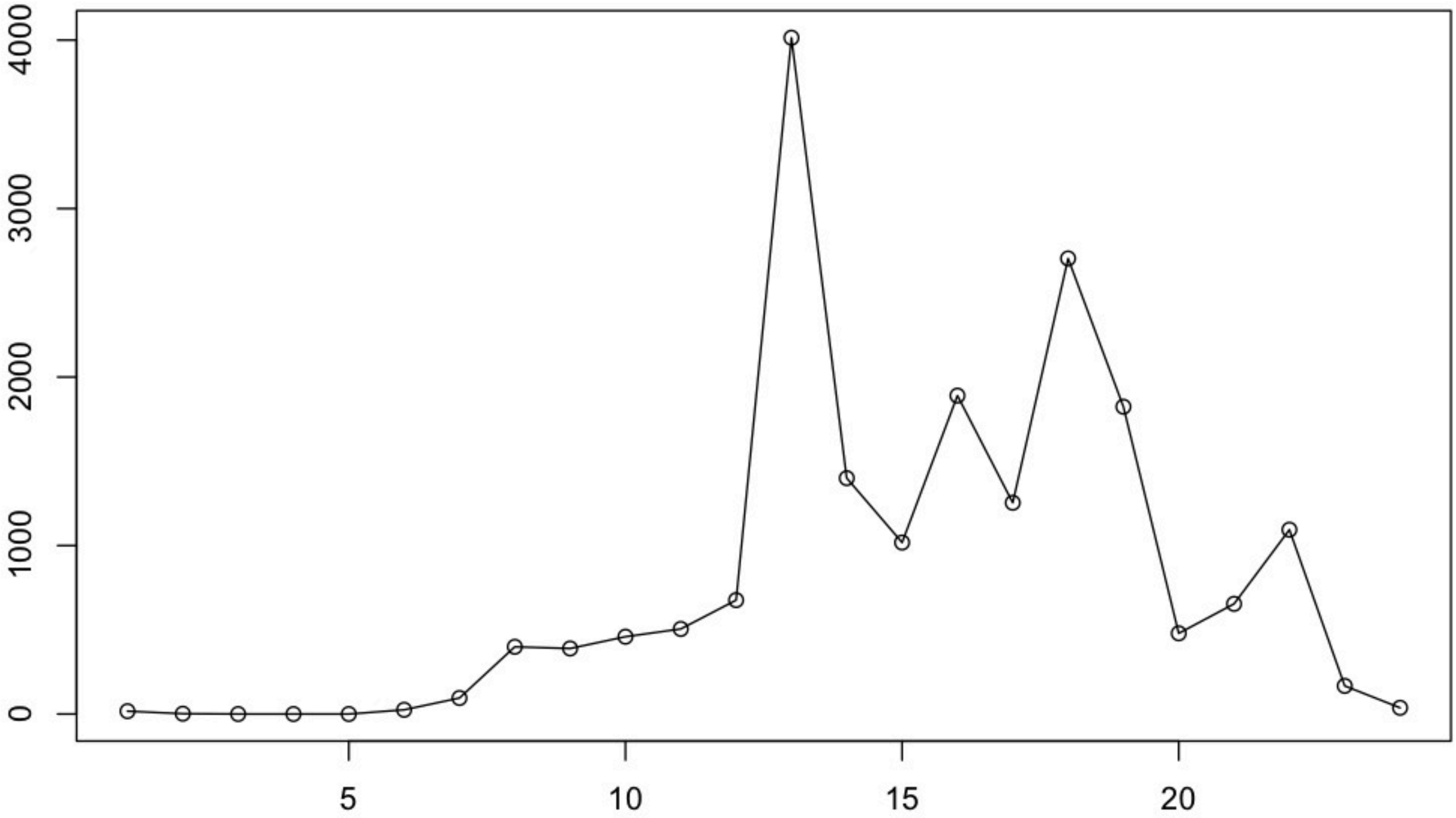

130
97.5
65
32.5
0
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58

Added Complexity Over Time

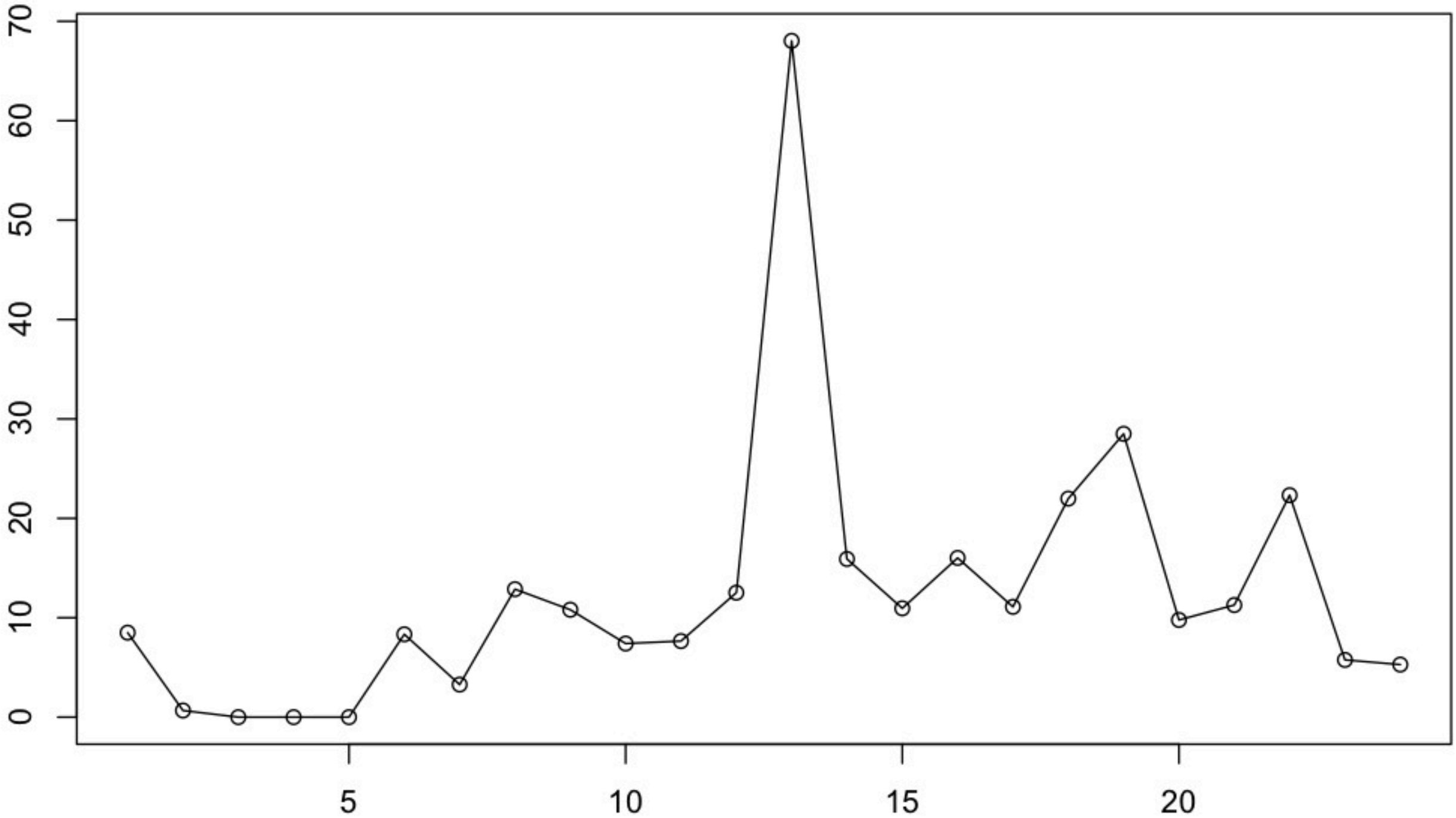


repo.commits.map {|c,_| repo.commit(c).added_complexity.to_i }

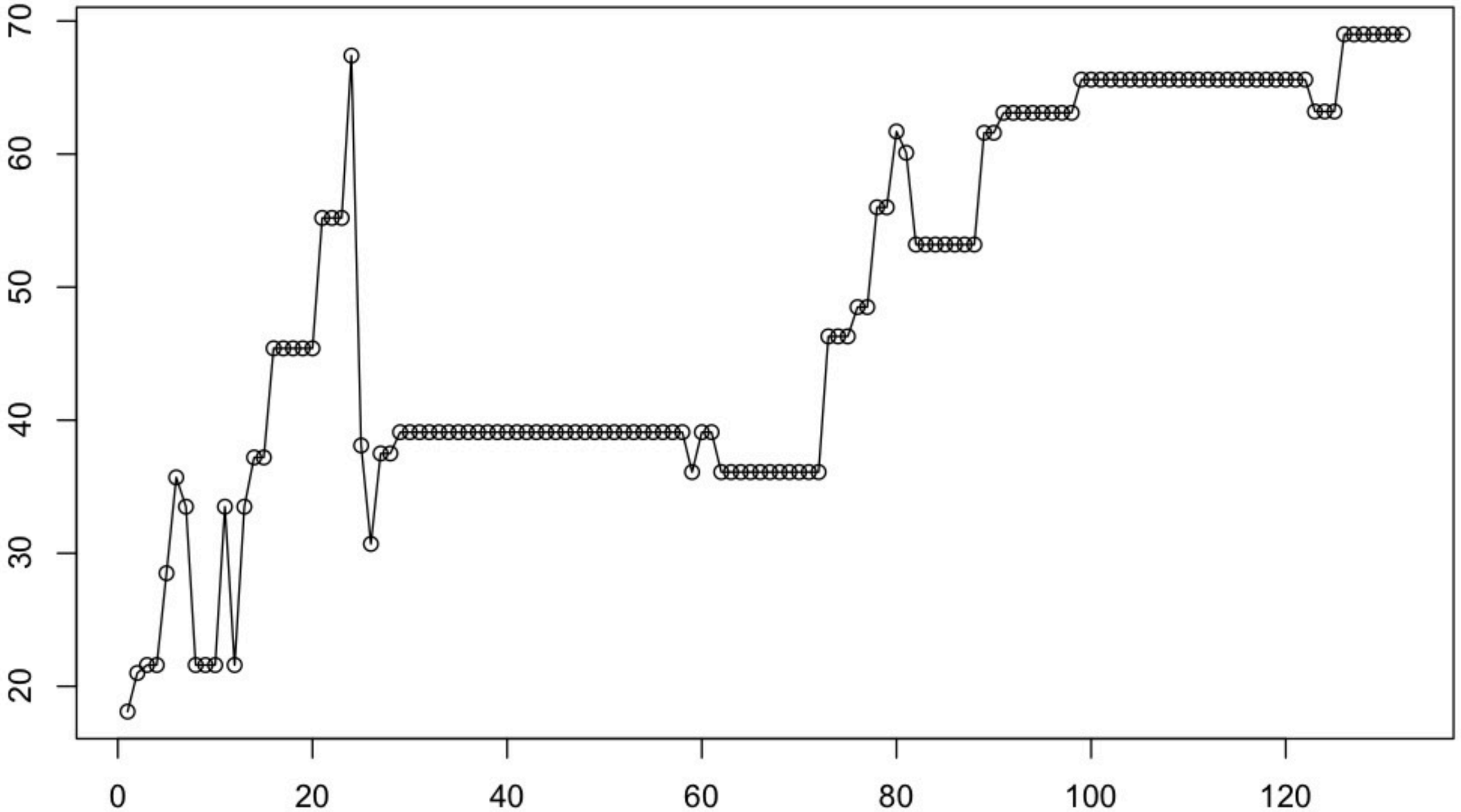
Amount of Complexity Added by Hour of Day



Normalized by Commits

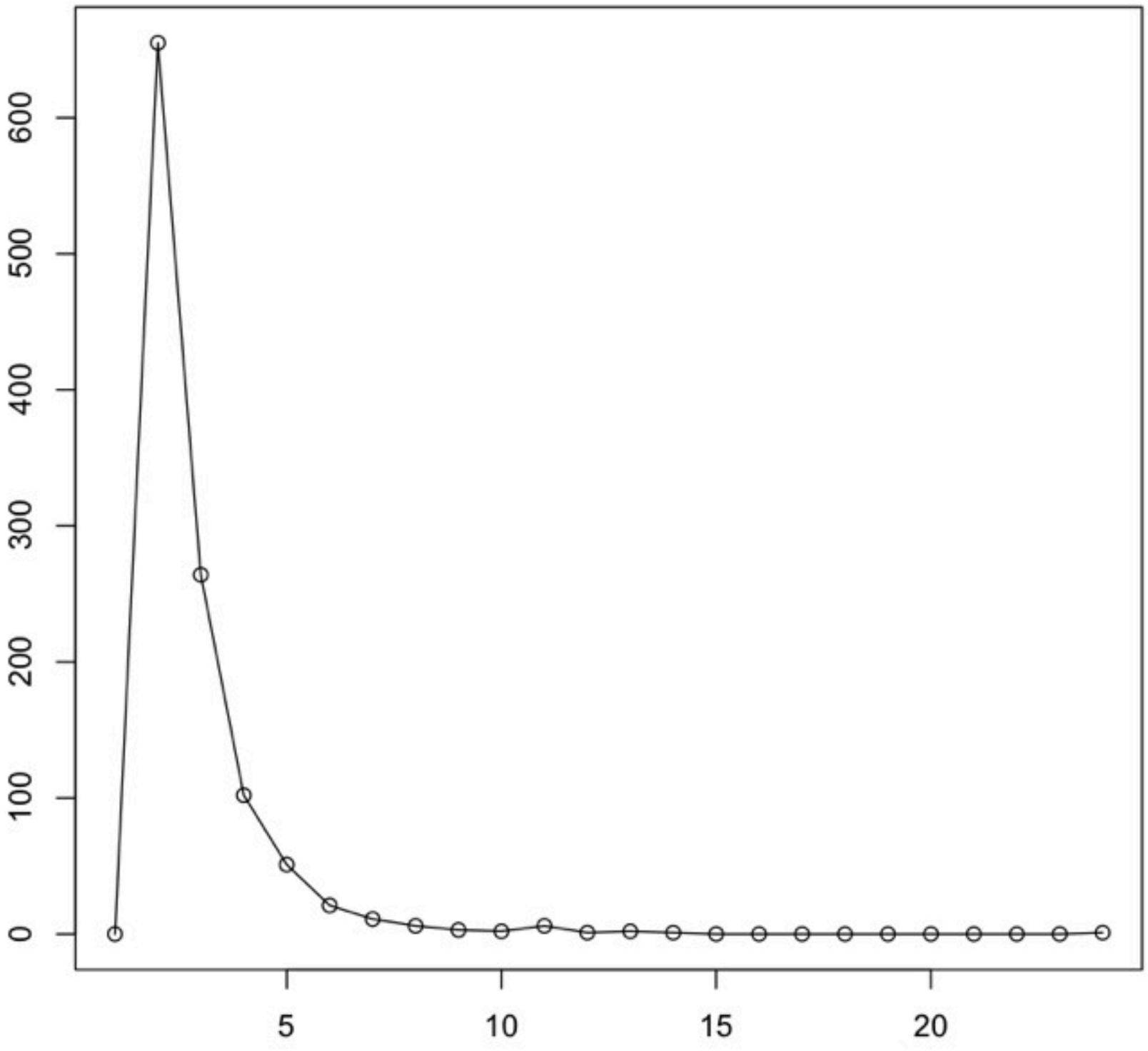


A Lifeline



repo.methods.select {|m| m.full_name == "FeelingsController#create" }.first.life_line

Number of Files Touched Per Commit



repo.events.group_by(&:commit).map { |sha, events| events.map(&:file_name).uniq.count }.freq

The Trending View

Methods Ascending

```
def methods_ascending_last_n events, n
  methods_by(method_events(events)) do |es|
    es.count >= n && \
      es.map(&:method_length).last(n).each_cons(2).all? {|l,r| l < r }
  end.keys
end
```

Trending Methods

```
def trending_methods events
  method_events(events).select {|e| e.status == :changed } \
                       .group_by {|e| month_from_date(e.date) } \
                       .to_a \
                       .last[1] \
                       .freq_by(&:method_name)
                       .sort_by {|_,count| -count } \
                       .take(10)
end
```

Static Views

Classes By Closure Date

[["DummiesController", 2008-04-21 13:03:08 -0700],
["Core::ActiveRecord::AttributeDefaults::ClassMethods", 2008-04-22 16:02:54 -0700],
["Legacy::Database", 2008-04-24 15:37:51 -0700],
["Core::ActiveRecord::AttributeDelegation::ClassMethods", 2008-04-24 20:46:58 -0700],
["Core::ActiveRecord::SkipValidationForHasOnes", 2008-04-29 21:54:32 -0700]]

Classes By Closure Date

```
def classes_by_closure events
  class_names = method_events(events).map(&:class_name).uniq
  classes = Hash[class_names.zip([Time.now] * class_names.length)]
  method_events(events).each {|e| classes[e.class_name] = e.date }
  classes.to_a.sort_by {|_,date| date }
end
```

Temporal Correlation of Class Changes

[[["App", "Inventory"], 277],
[["Inventory", "Object"], 216],
[["Admin", "Inventory"], 195],
[["Inventory", "User"], 188],
[["Inventory", "Users"], 171],
[["Inventory", "Deals"], 167],
[["App", "Object"], 159],
[["App", "InventoryController"], 152],
[["Inventory", "Order"], 149],
[["User", "Users"], 149],
[["App", "User"], 143],
[["Inventory", "InventoryController"], 143],
[["Api", "Inventory"], 141],
[["Admin", "App"], 136],
[["Campaign", "Orders"], 134]]

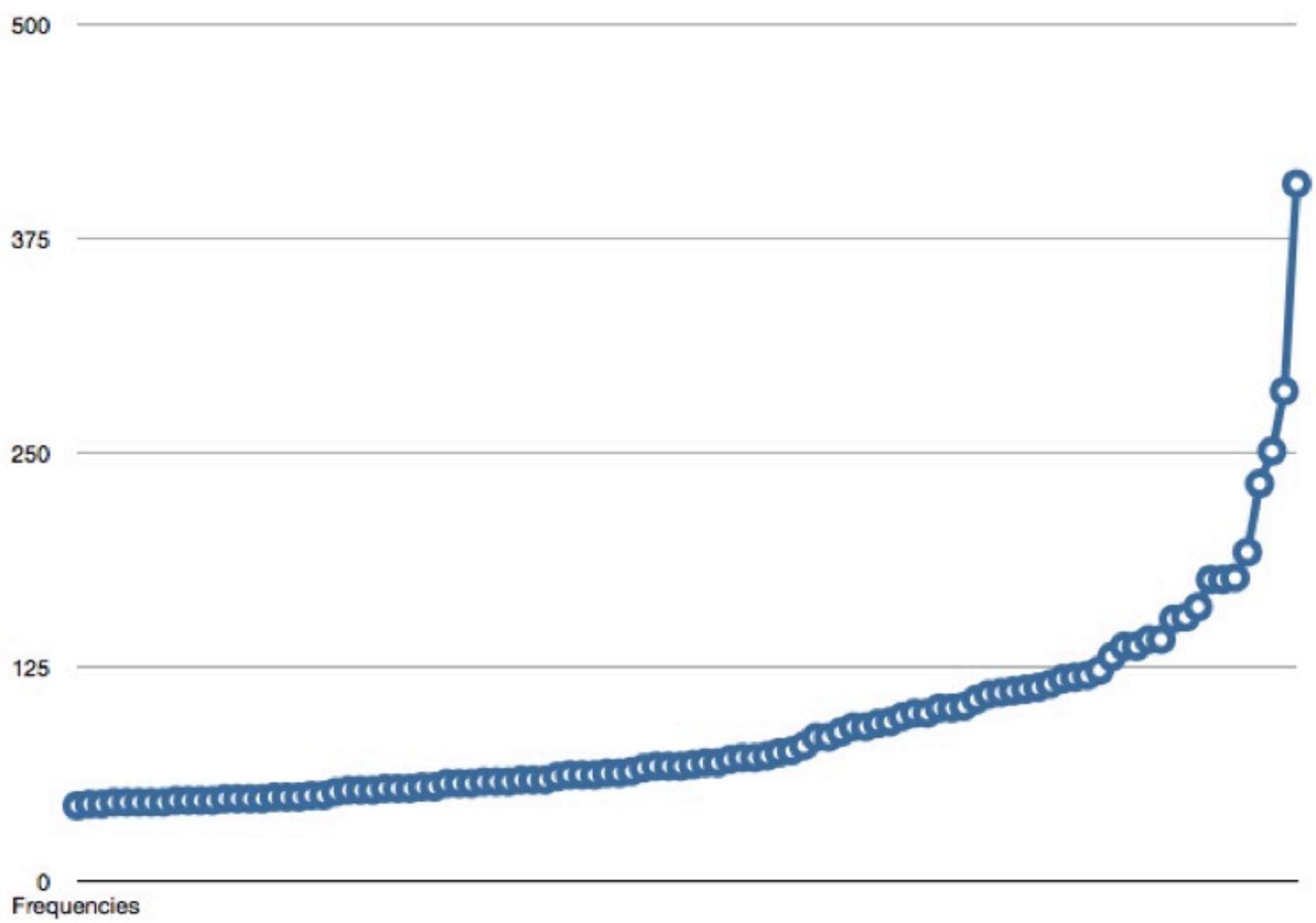
Temporal Correlation of Class Changes

```
def temporal_correlation_of_classes events
  events.group_by {|e| [e.day,e.committer]} \
        .values \
        .map {|e| e.map(&:class_name).uniq.combination(2).to_a } \
        .flatten(1) \
        .pairs \
        .freq_by {|e| e } \
        .sort_by {|p| p[1] }
end
```

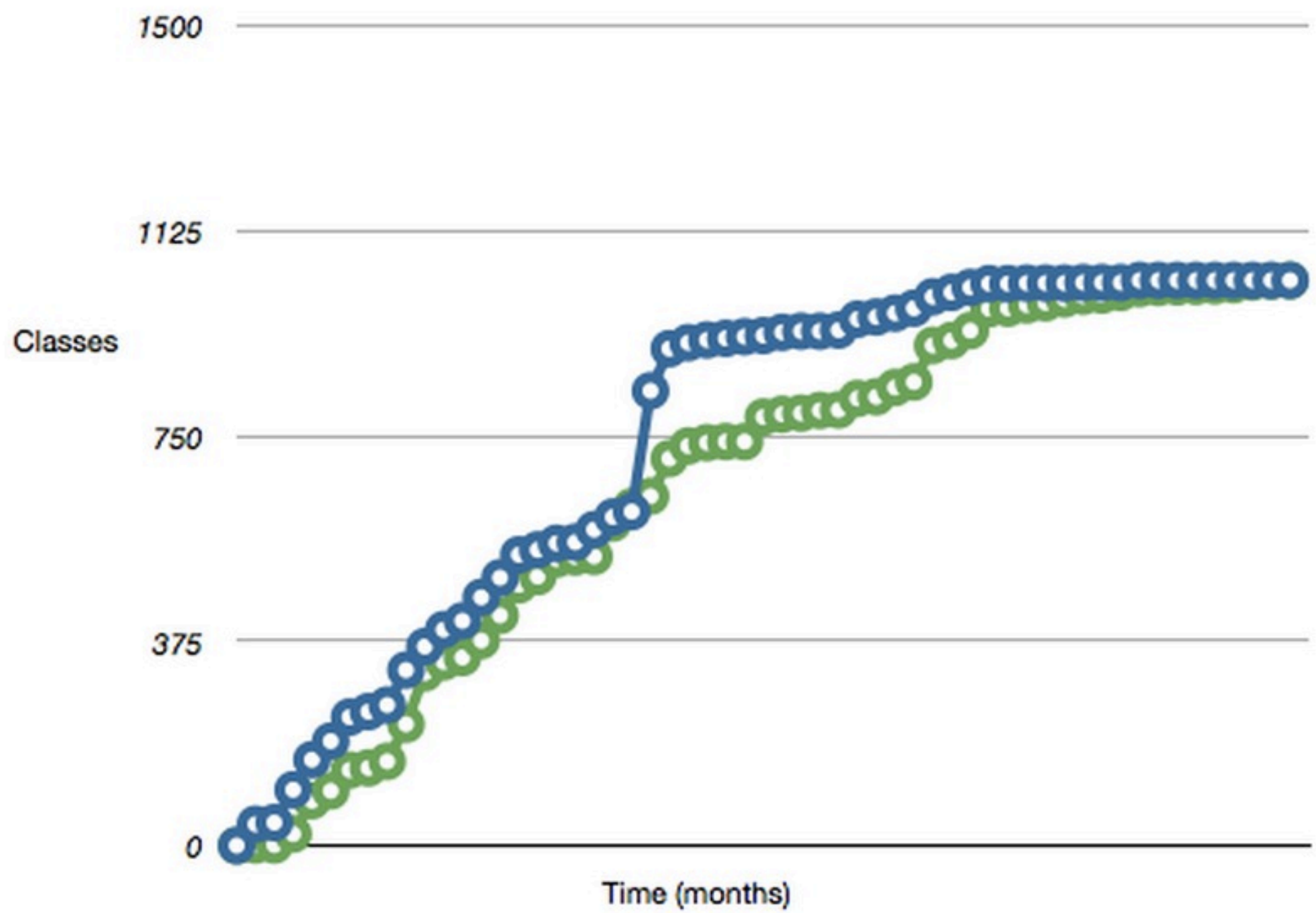
Temporal Correlation of Class Changes

```
events.group_by {|e| [e.day,e.committer]}.values
  .map {|e| e.map(&:class_name).uniq.combination(2).to_a }
  .flatten(1).norm_pairs.freq_by {|e| e }.sort_by {|p| p[1] }
```

When you examine these sorts of frequencies, they typically have that power law-ish shape:



Active Set of Classes



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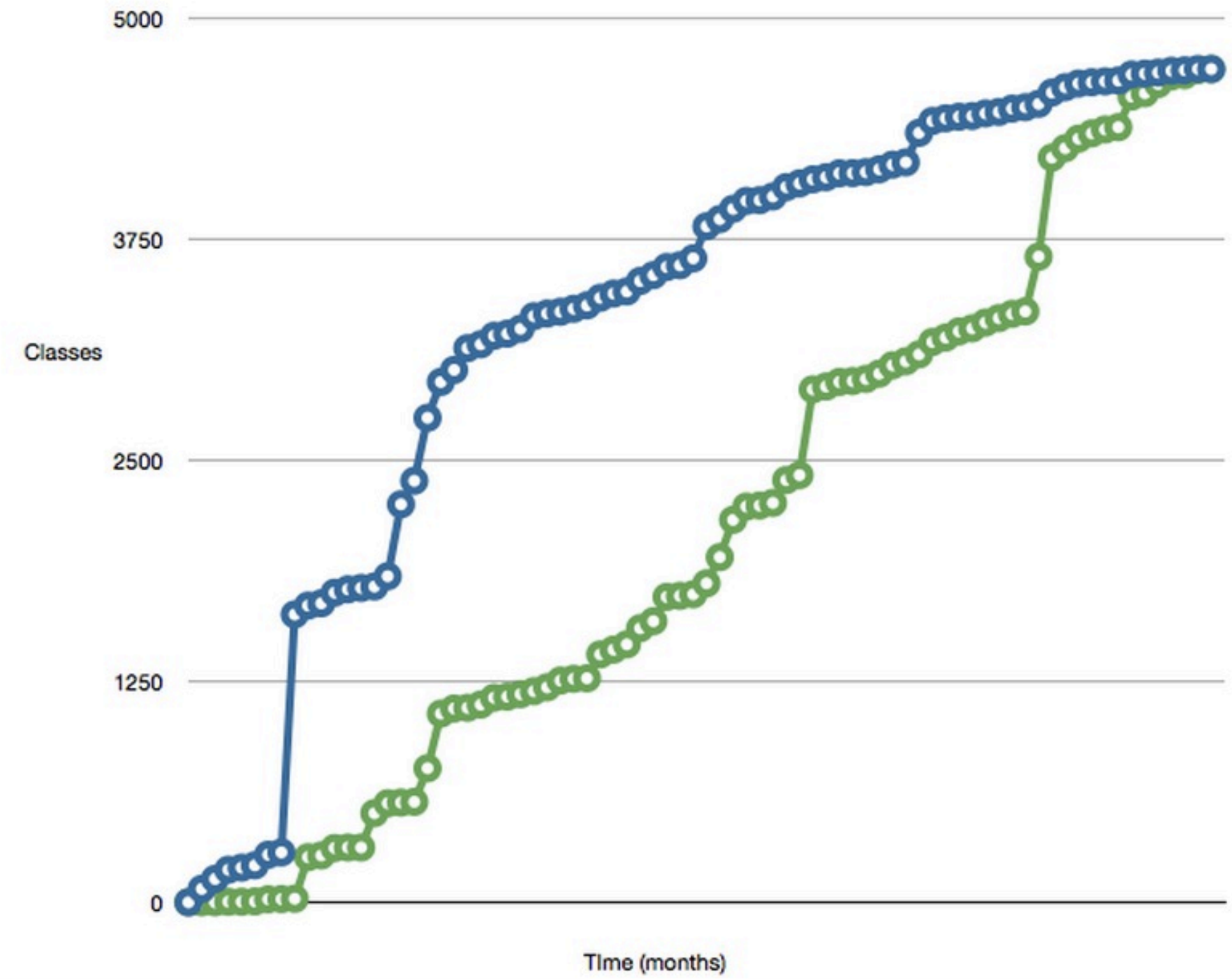


Enki - A Rails Blogging Platform

5 Unique Committers ["Xavier", "Jason", "Zach", "Pedro", "Gaelian"]

637 method events

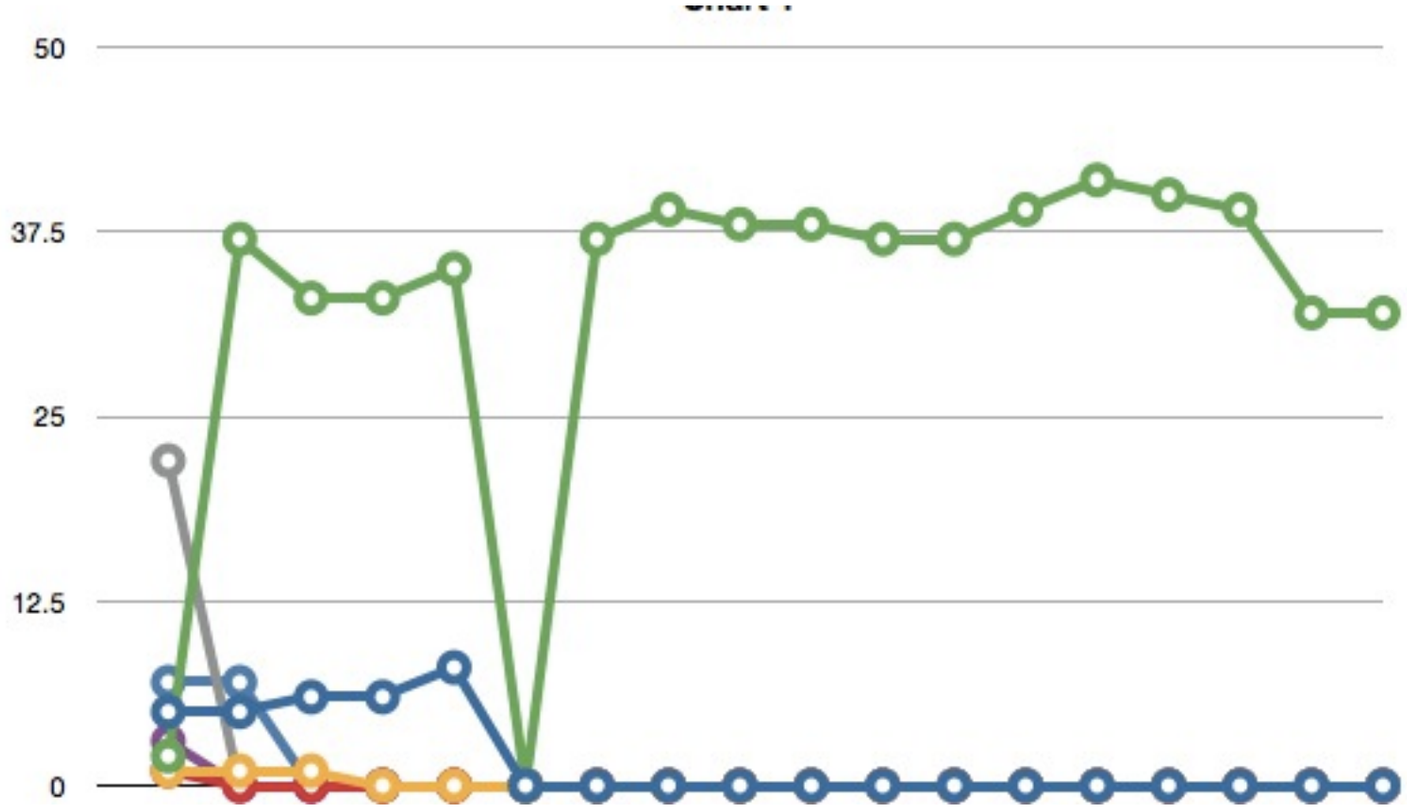
Spec to method ratios by committer:

[0.09245283018867924, "Xavier"],
[0.05084745762711865, "Jason"],
[0.0, "Zach"],
[0.6666666666666666, "Pedro"],
[0.0, "Gaelian"]]

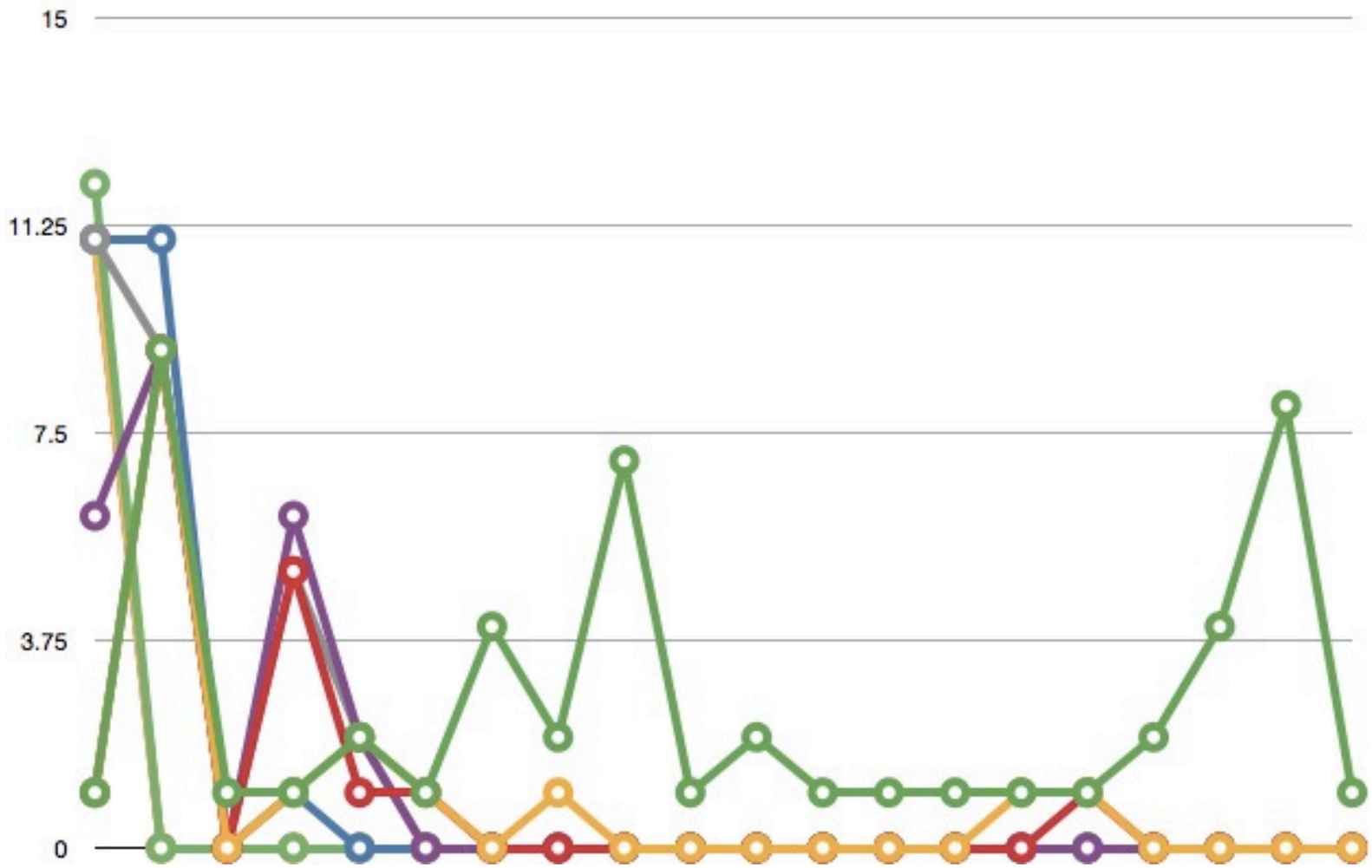
Number of Method Modifications:

Zach => 6
Xavier=> 167
Jason => 10
Pedro => 1

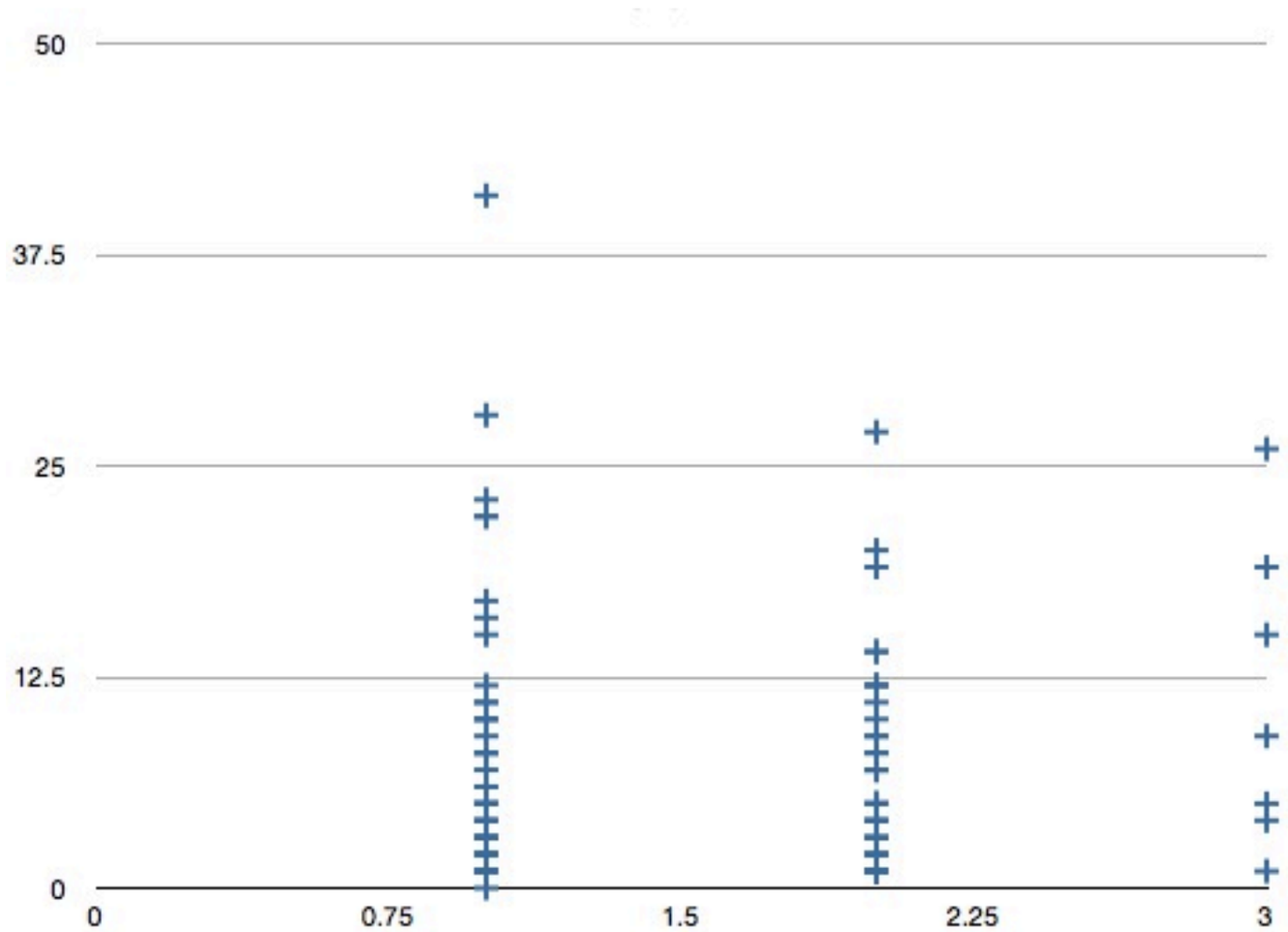
Enki - CommentController Class



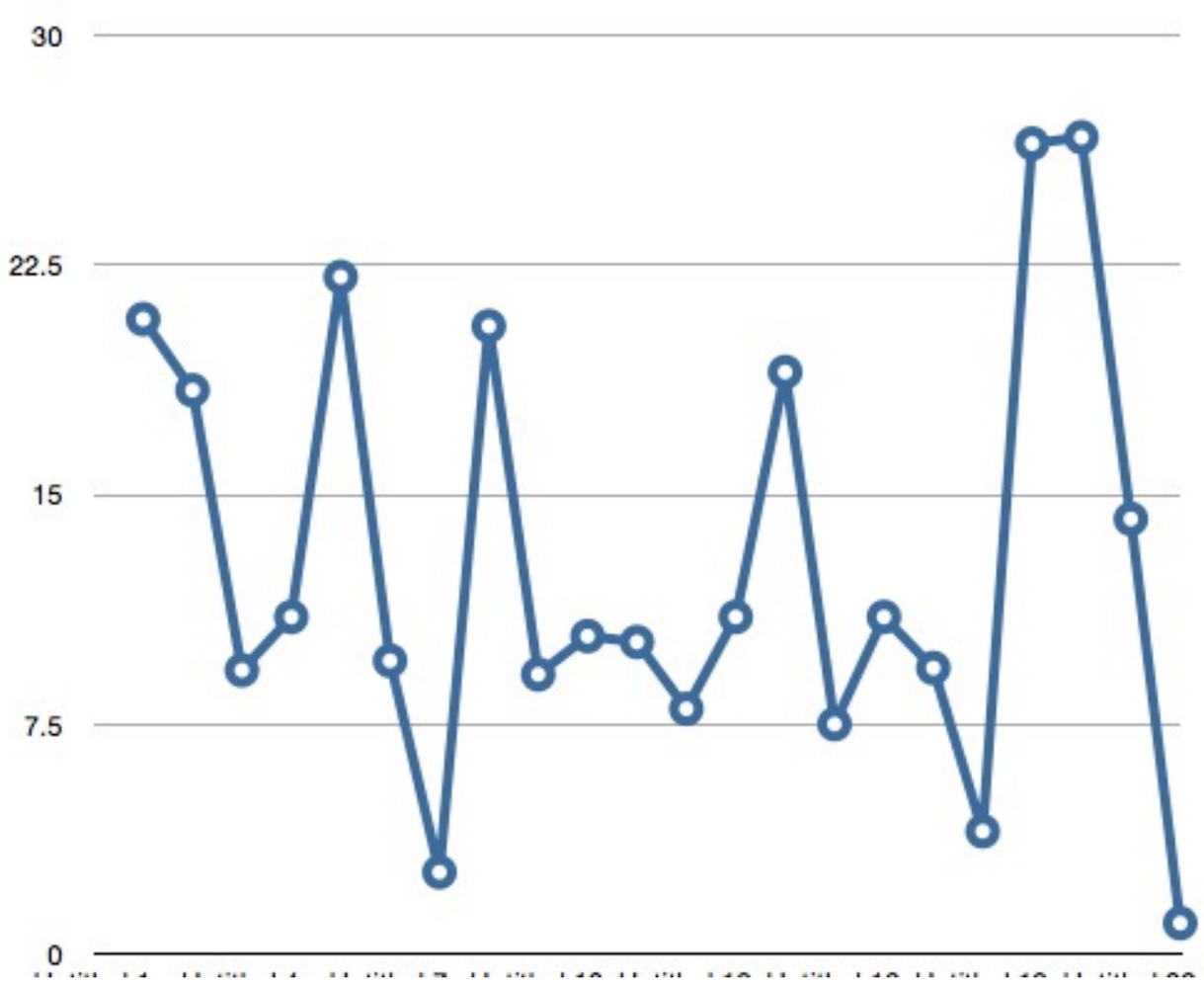
Enki - Post Class



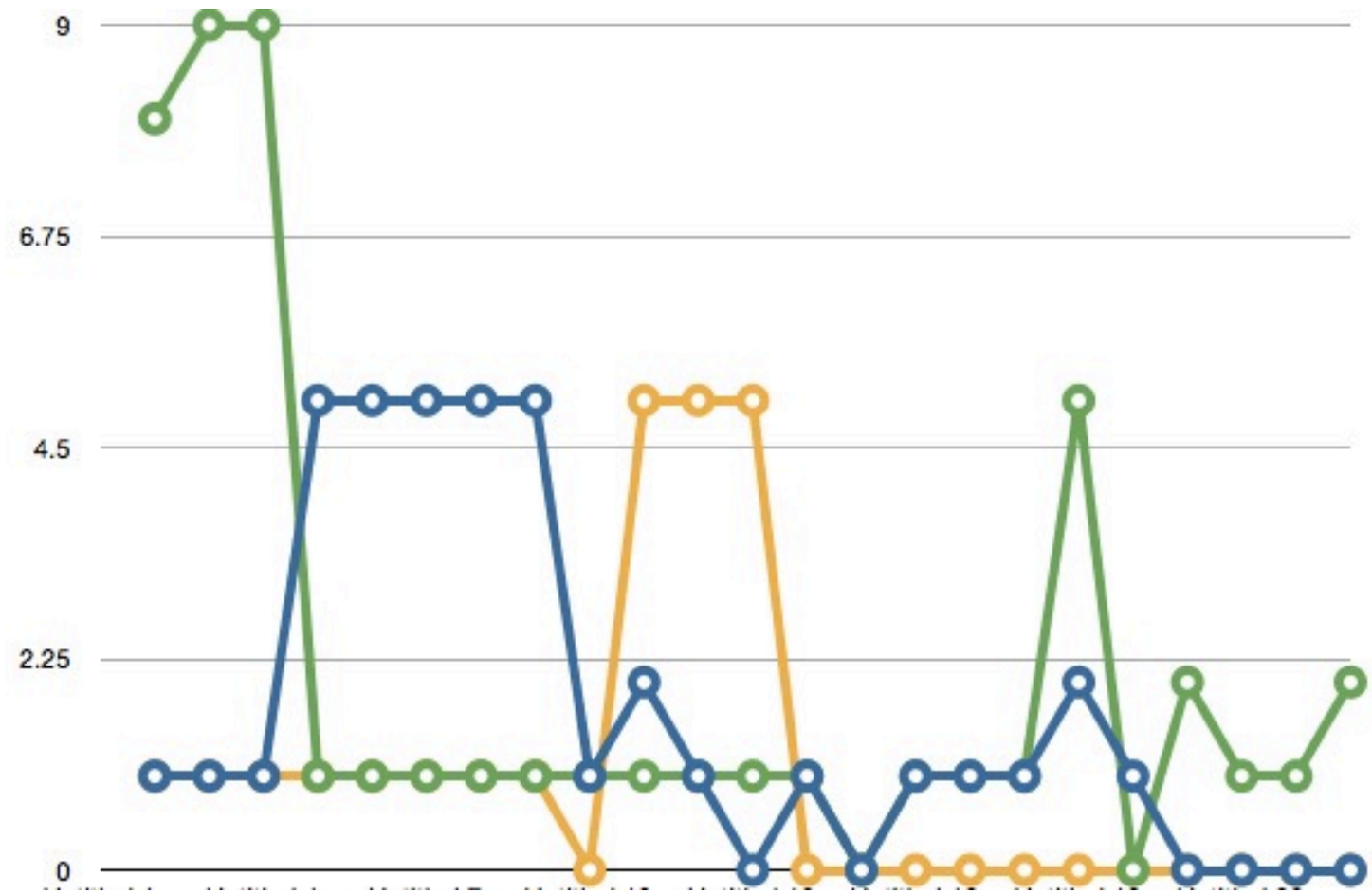
Enki - Ownership Effect



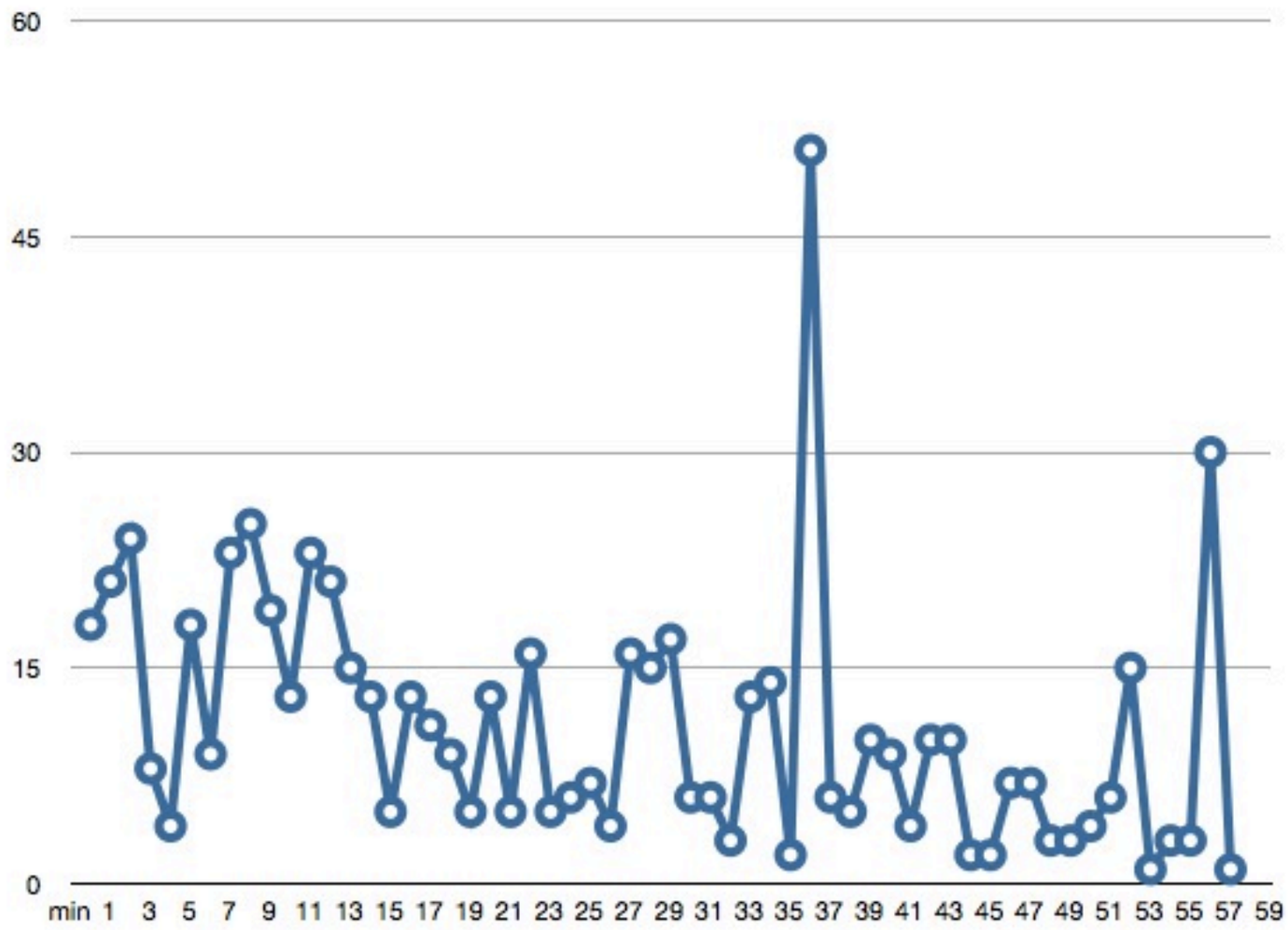
Enki - Average Lines Per Commit By Month



Enki - Spec Lifelines



Enki - Hour Profile



MercuryApp

5 Unique Committers ["Sarah", "coreyhaines", "Cory", "Spencer", "sarah"]

7788 method events

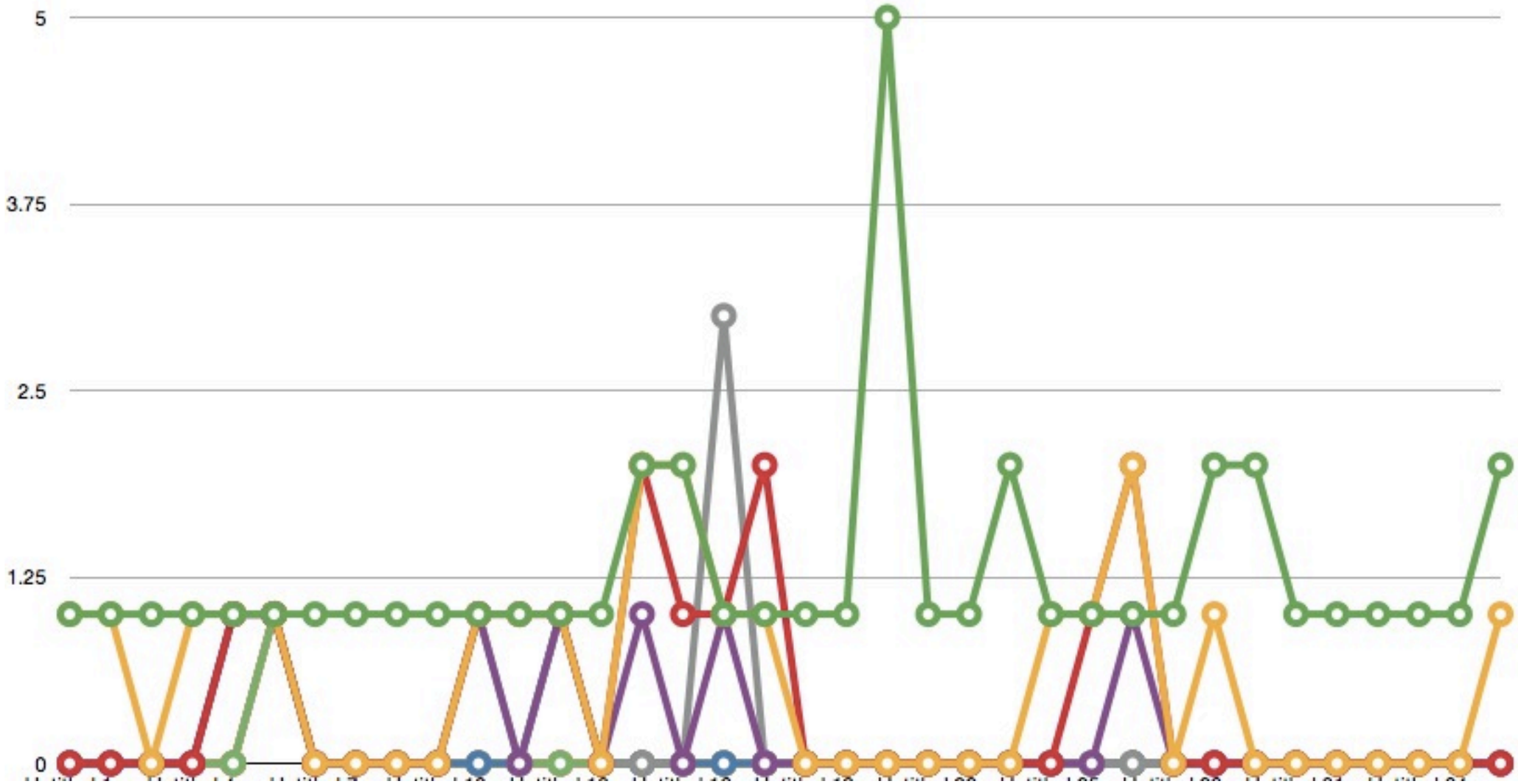
Spec to method ratios by committer:

[0.40381791483113066, "Sarah"],
[0.5220038748962081, "coreyhaines"],
[0.0, "Cory"],
[0.0, "Spencer"],
[0.517106200997861 8, "sarah"]

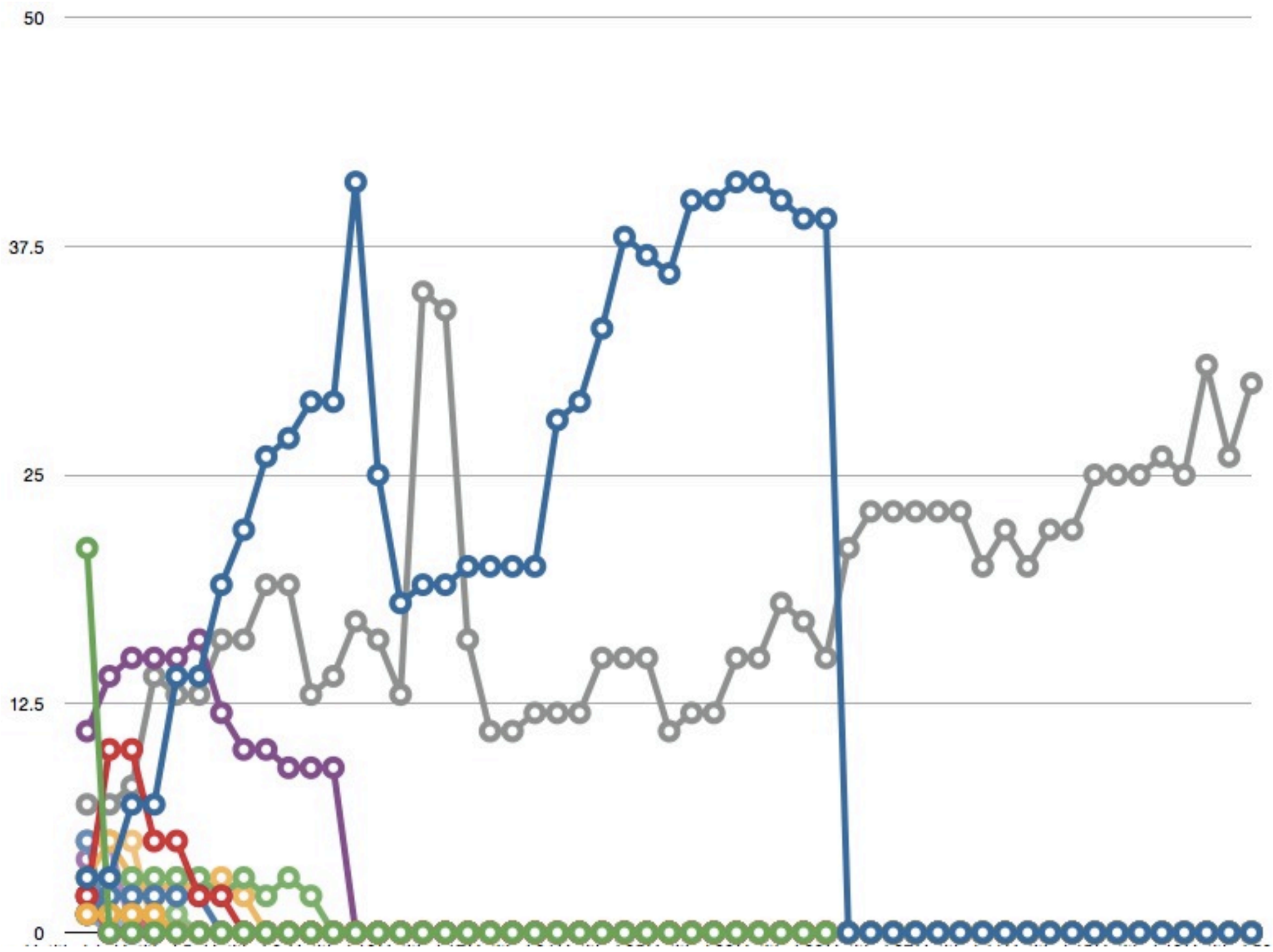
Number of Method Modifications:

Cory => 629
Sarah=> 739
Spencer => 2

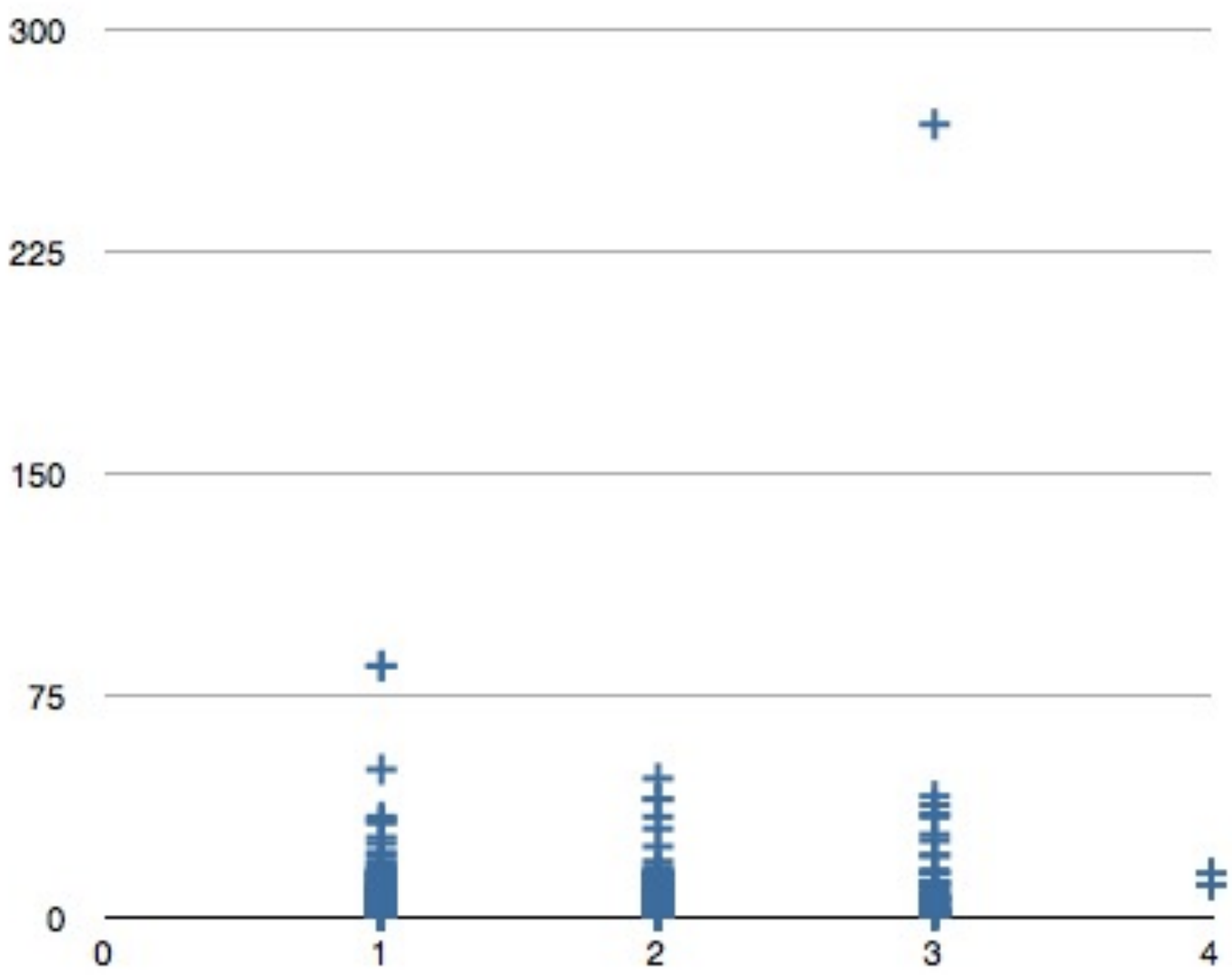
MercuryApp - User Class



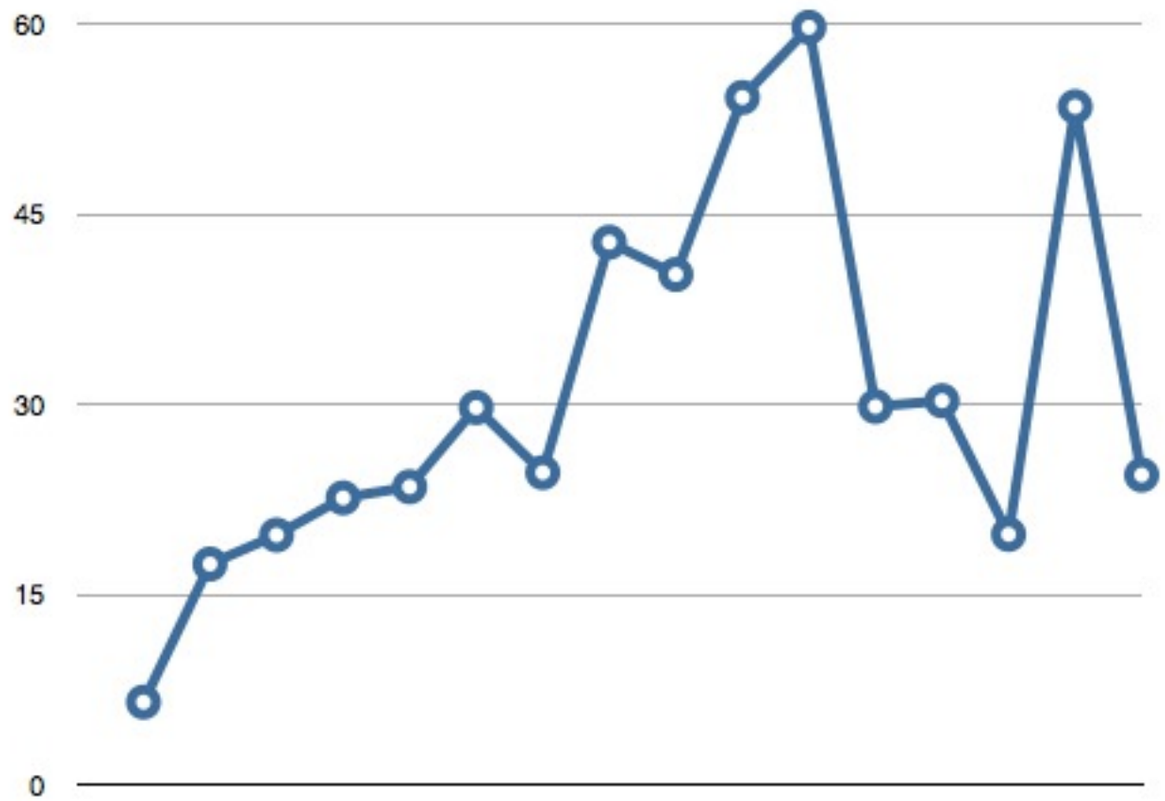
MercuryApp - FeelingsController Class



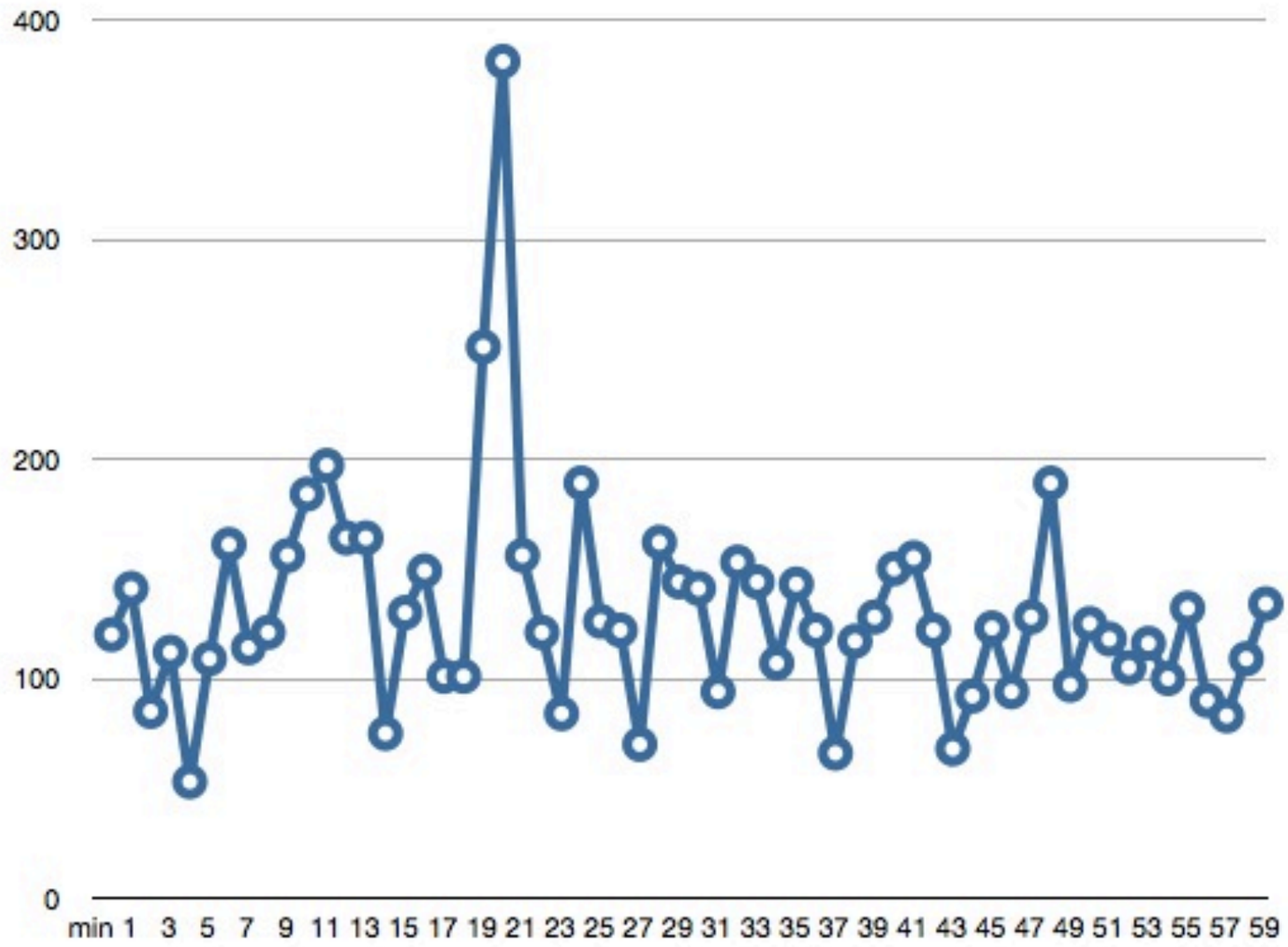
MercuryApp - Ownership Effect

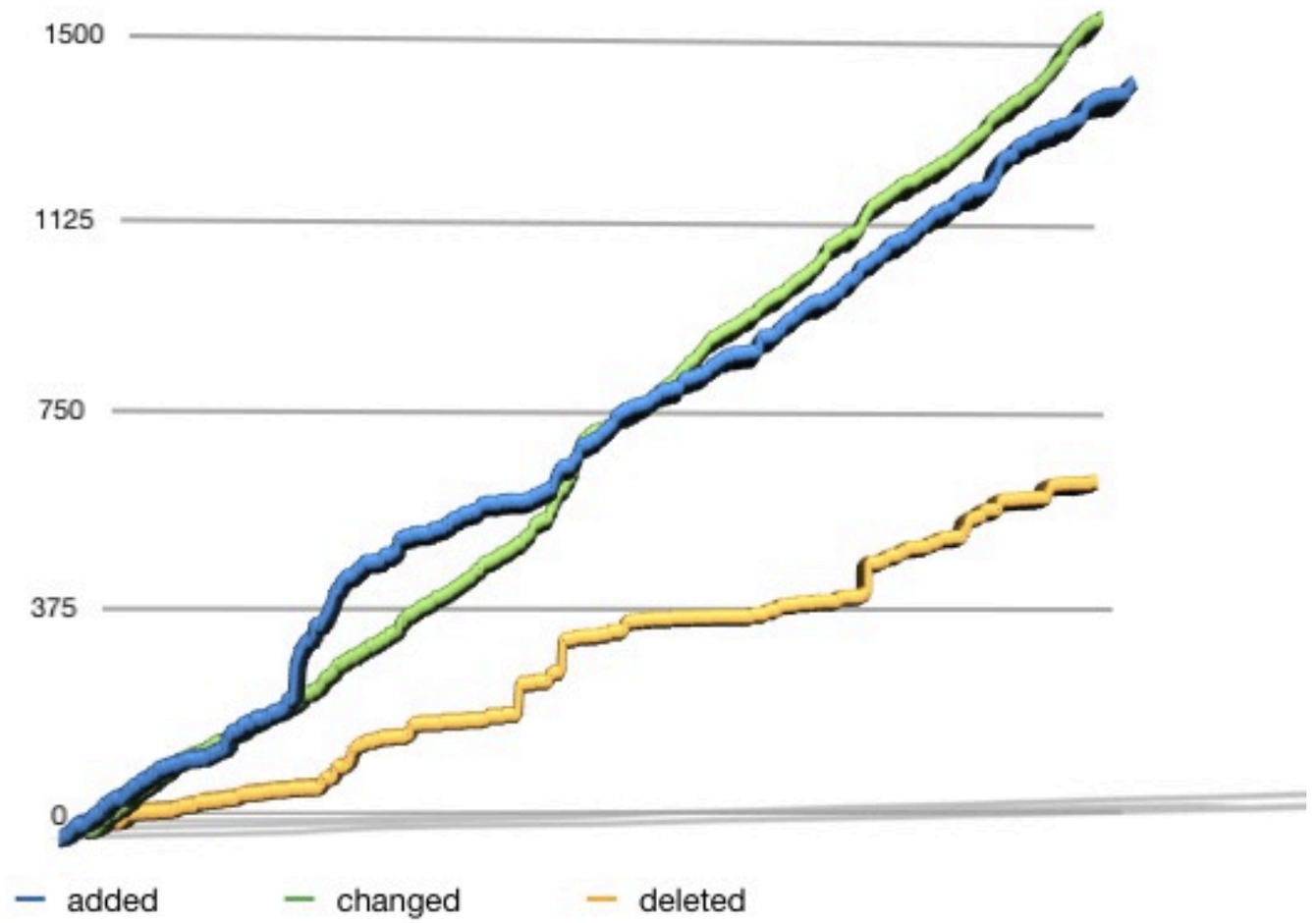


MercuryApp - Average Lines Per Commit By Month

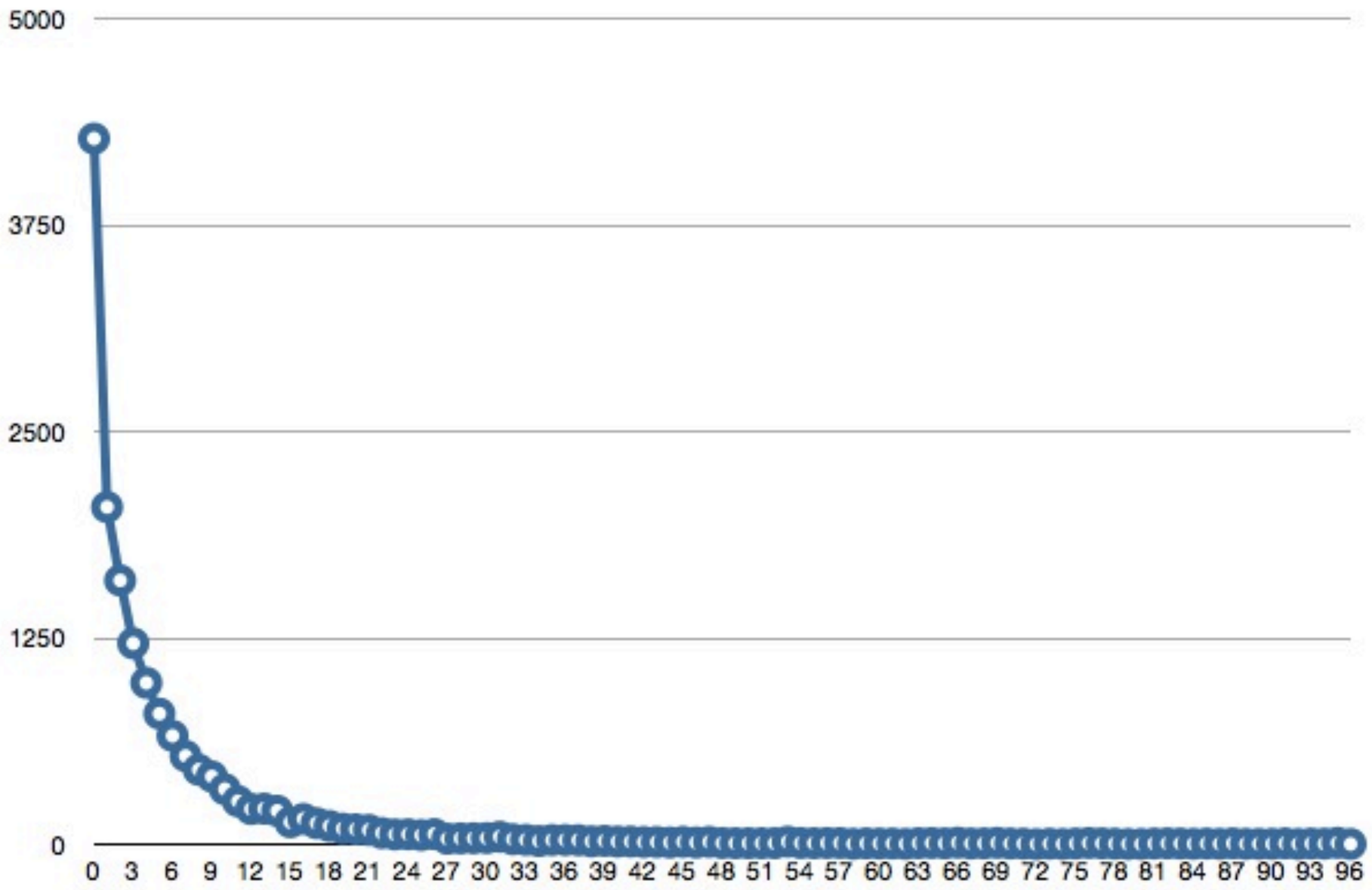


MercuryApp - Hour Profile

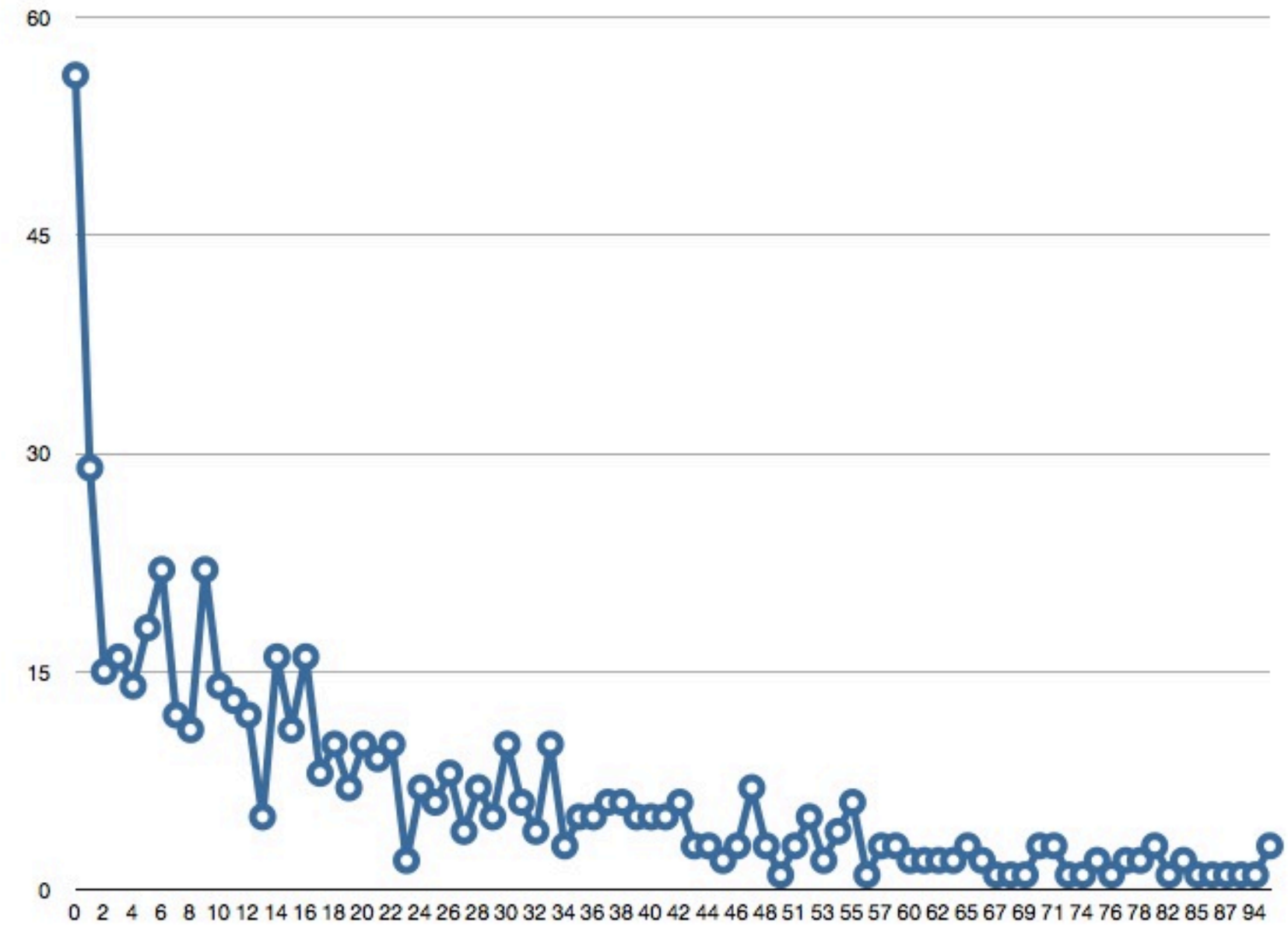



1500
1125
750
375
0
added
changed
deleted

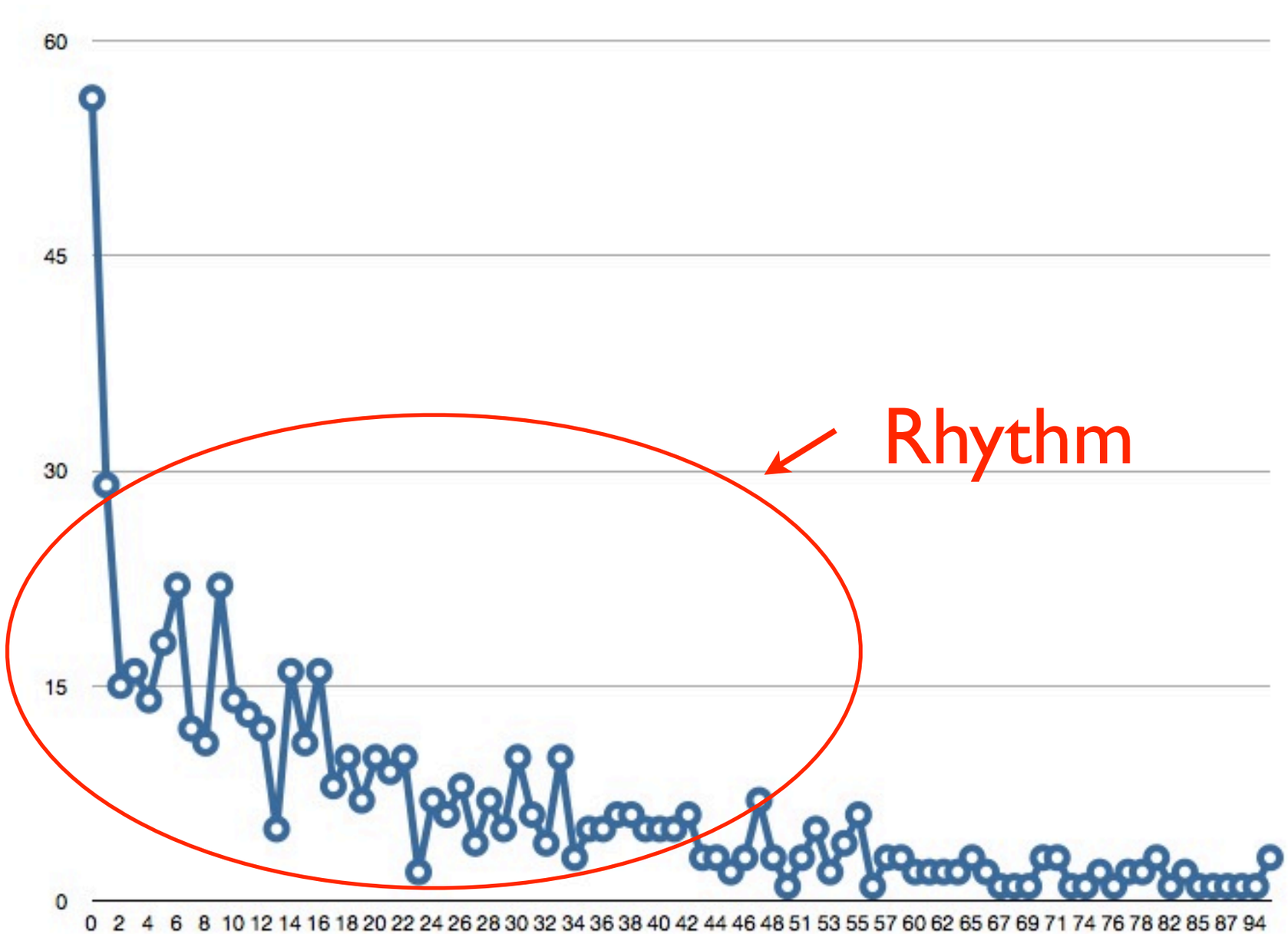
Frequency of Inter-commit Intervals



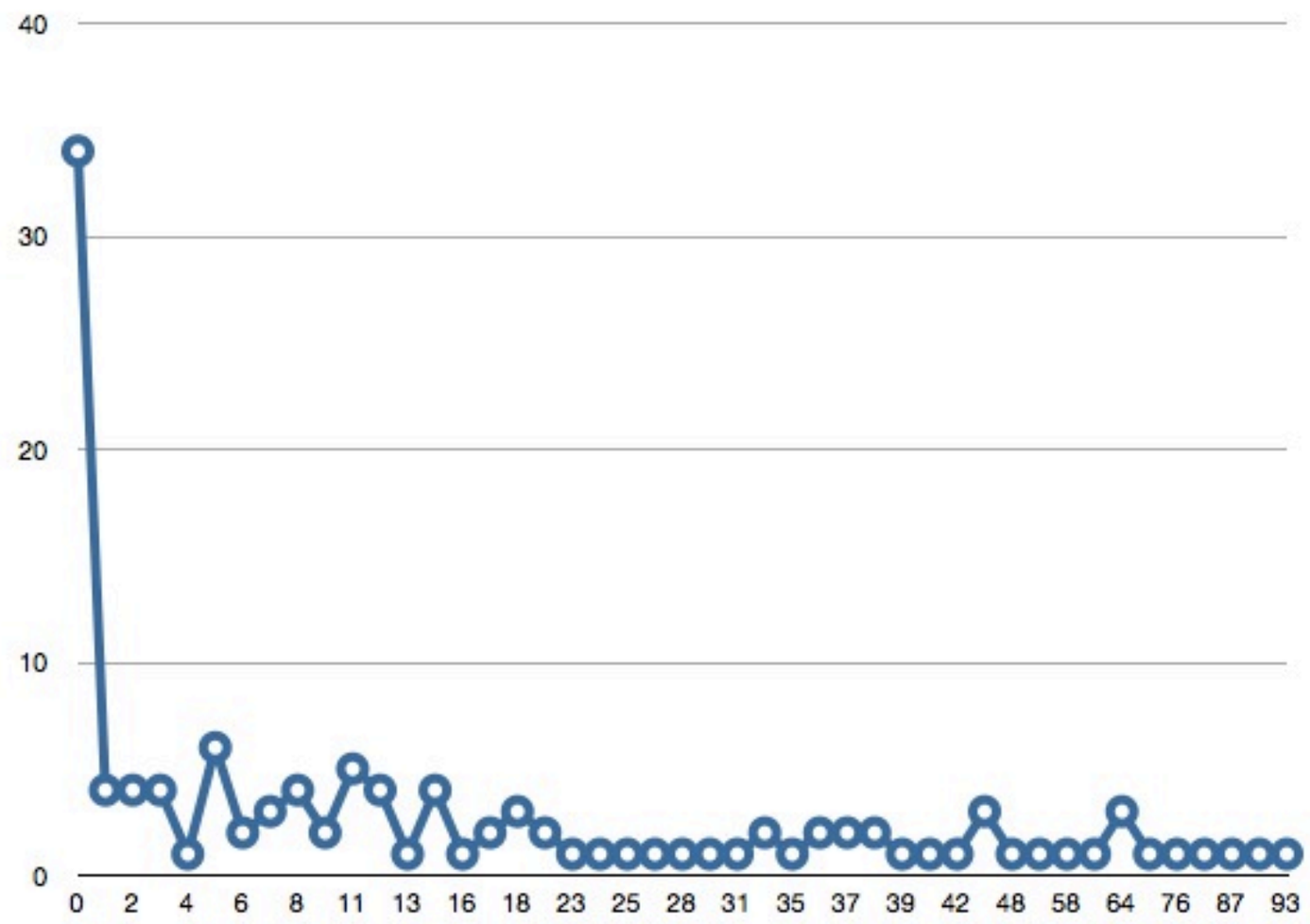
Frequency of Inter-commit Intervals



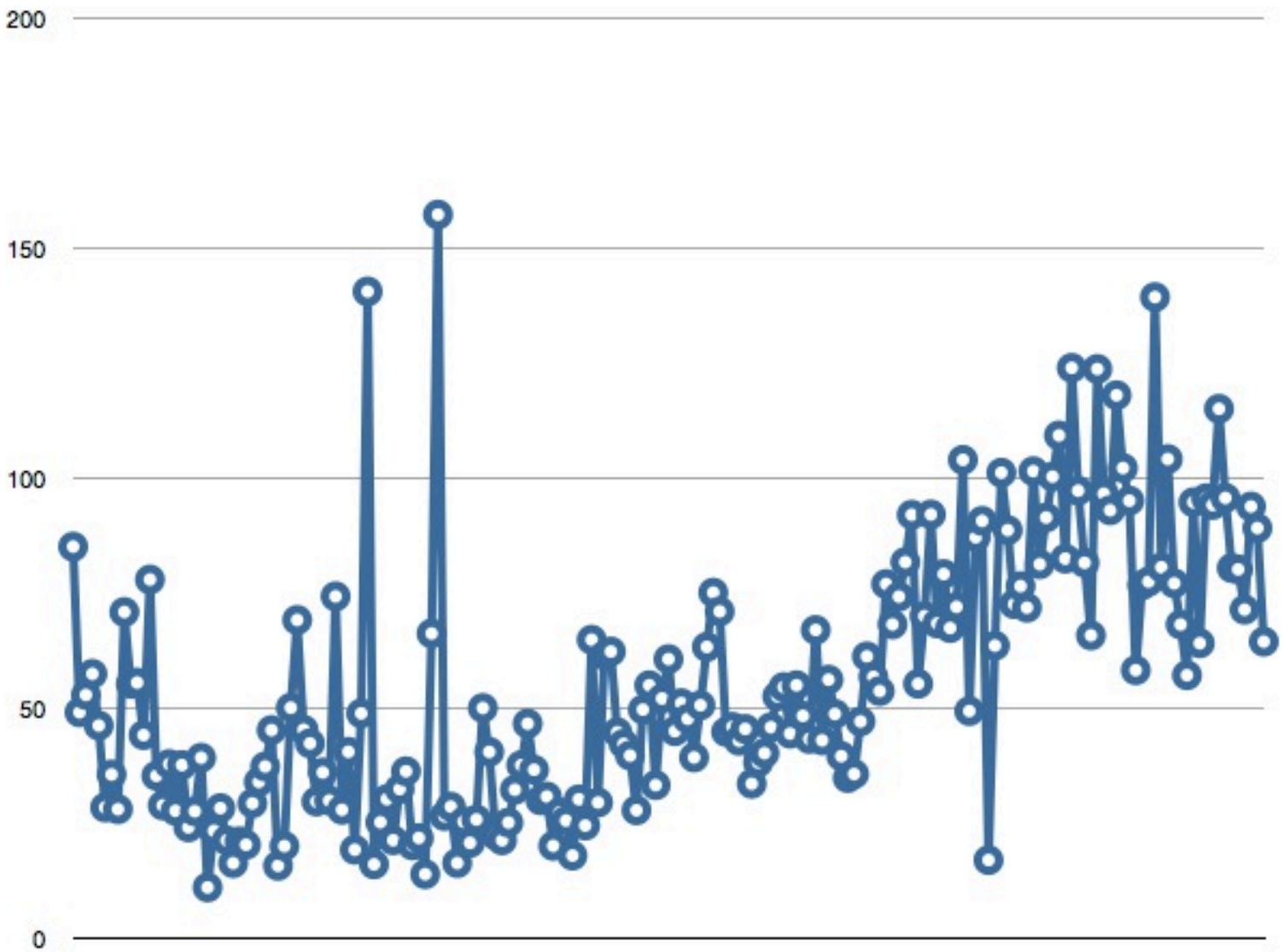
Frequency of Inter-commit Intervals



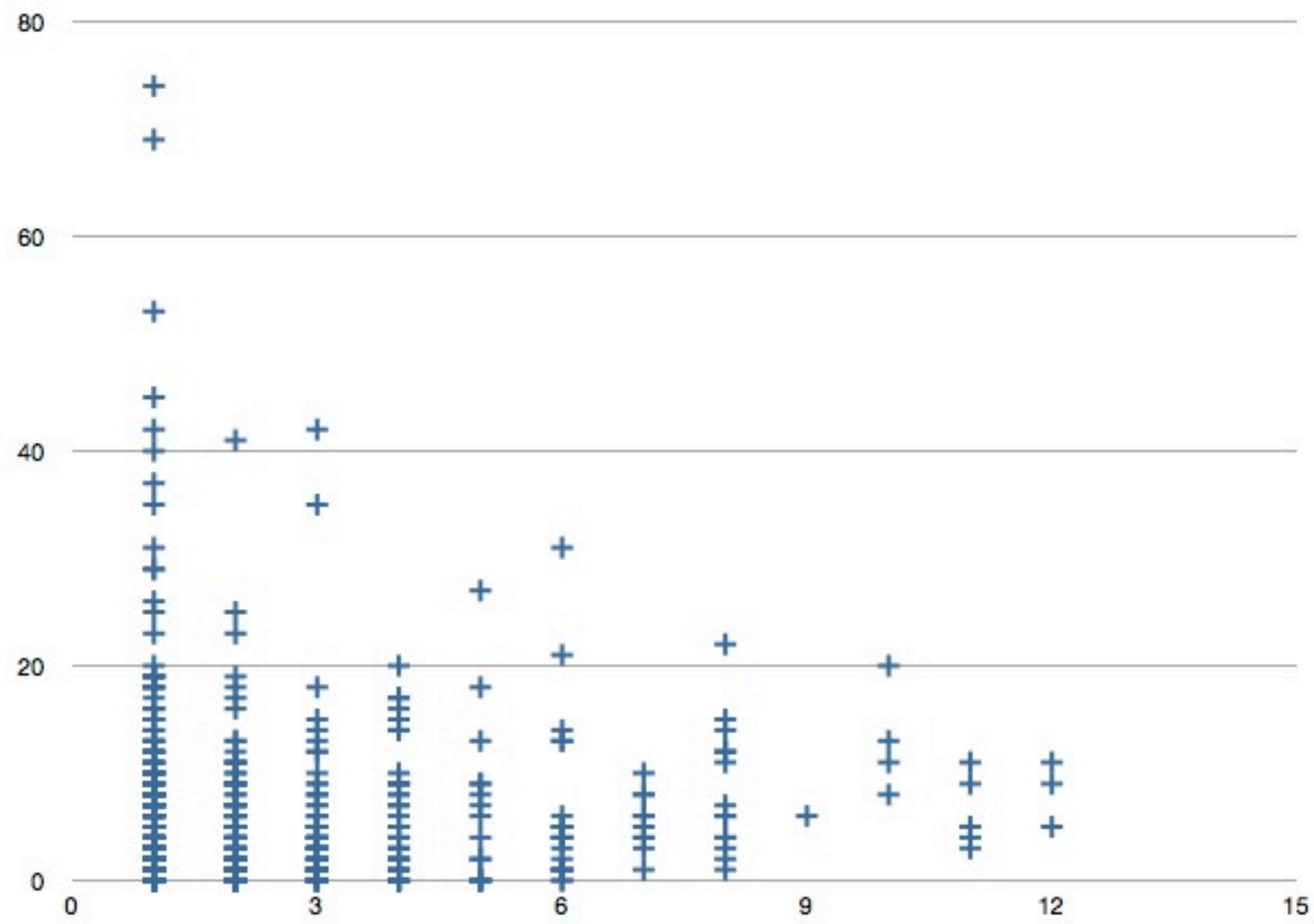
Frequency of Inter-commit Intervals



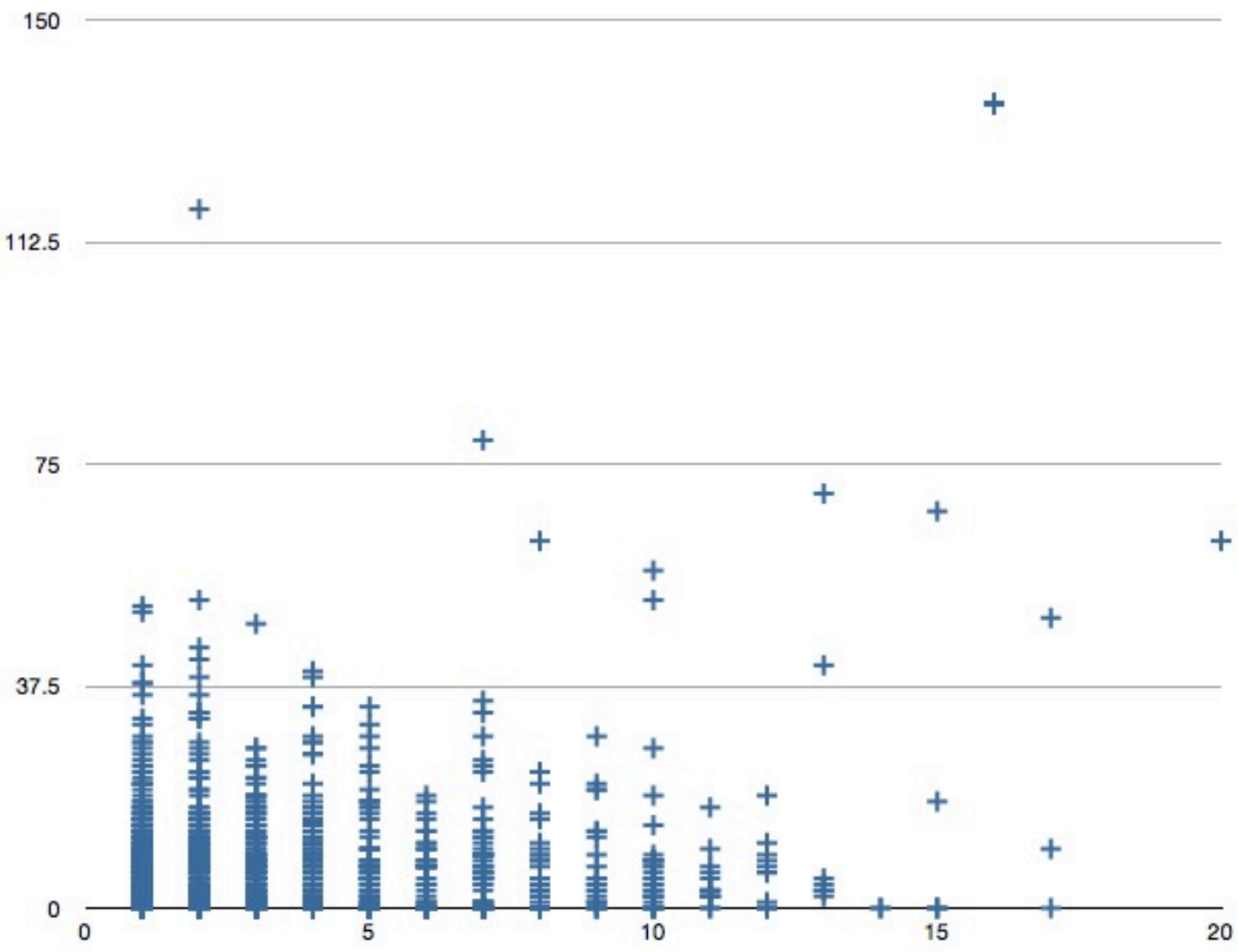
Average Lines of Code Per Commit By Week



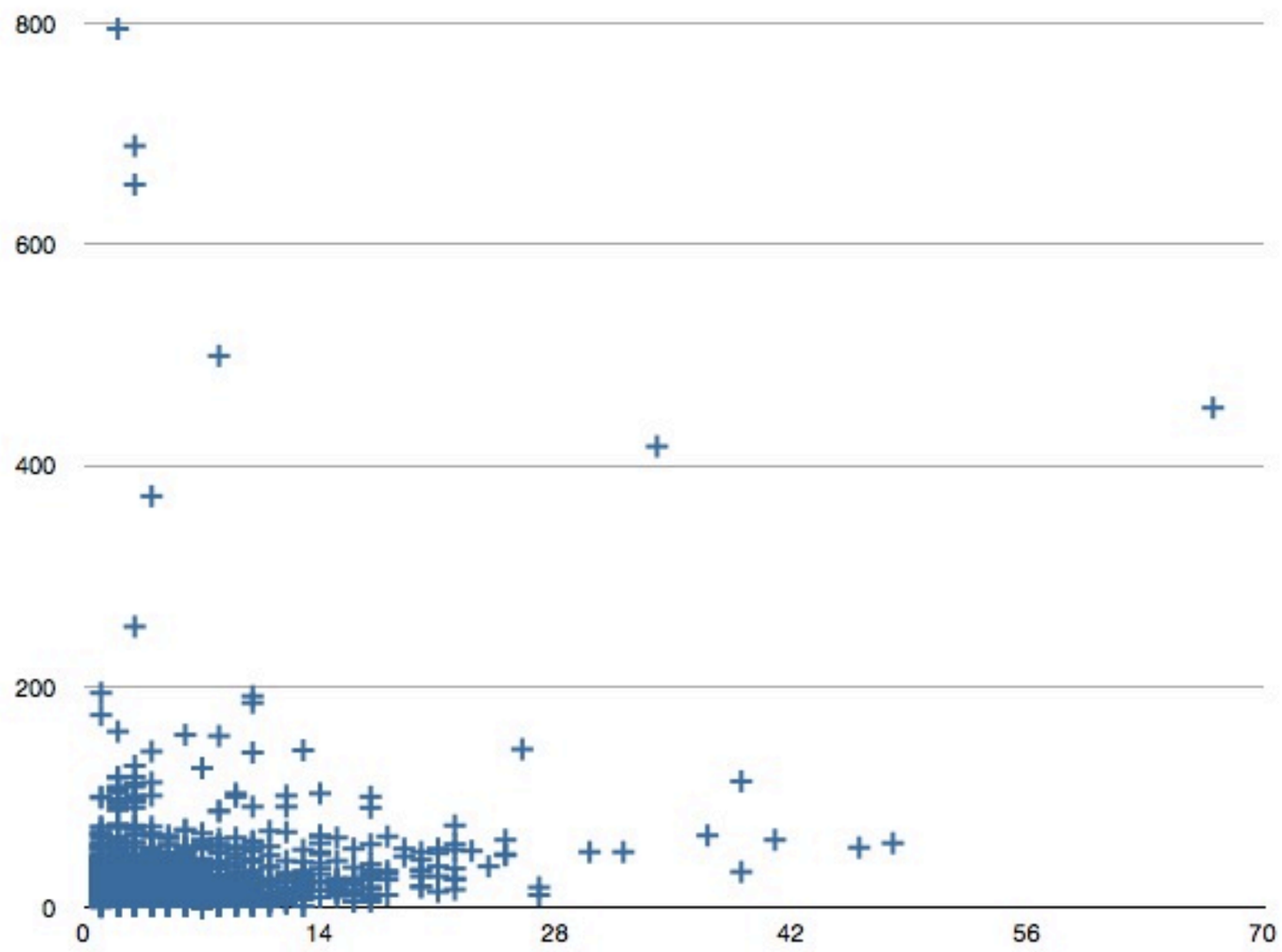
Complexity Tolerance (Developer A)



Complexity Tolerance (Developer B)



Ownership Effect (all methods)



Code Mining Issues

The Commit Problem

The Social Environment Problem

Blame

Dangerous Knowledge

Best Practice may be ‘Per Product Analysis’

Things to Look For

Things to Look For

- Relationship between the presence of tests and refactoring

Things to Look For

- Reasons behind high churn in classes and methods (beyond the runaways)

Things to Look For

- Identification Patterns for Good Programming Episodes

Future Work

- Automated commits for full picture of development

Future Work

- Analysis of changes for developer improvement

Future Work

- Catalog of norms for good development

Future Work

- Integration with bug fix data