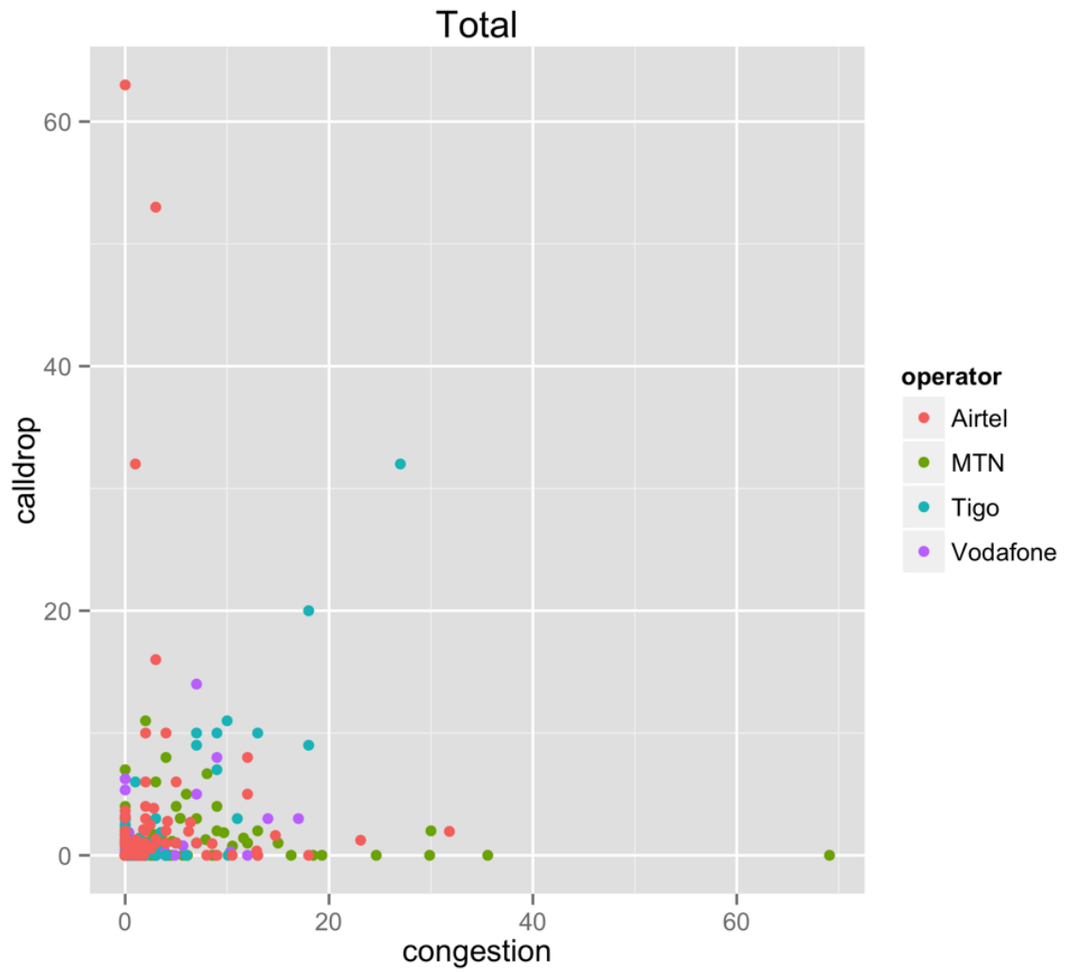

A Network Performance Index in Ghana

By
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A Network Performance Index

- The report is an experience with the Ghana Open Data Initiative (GODI) portal while analyzing selected data
- The author analyzed data published by the NCA on congestion and call drop in various mobile networks
- In particular what relationship, if any exists in the networks between call drops and congestion in the infrastructure
- A national index combining the performance of all the networks is defined in process for call drops and congestion

Background

- September 2011 - Ghana signed the open government partnership

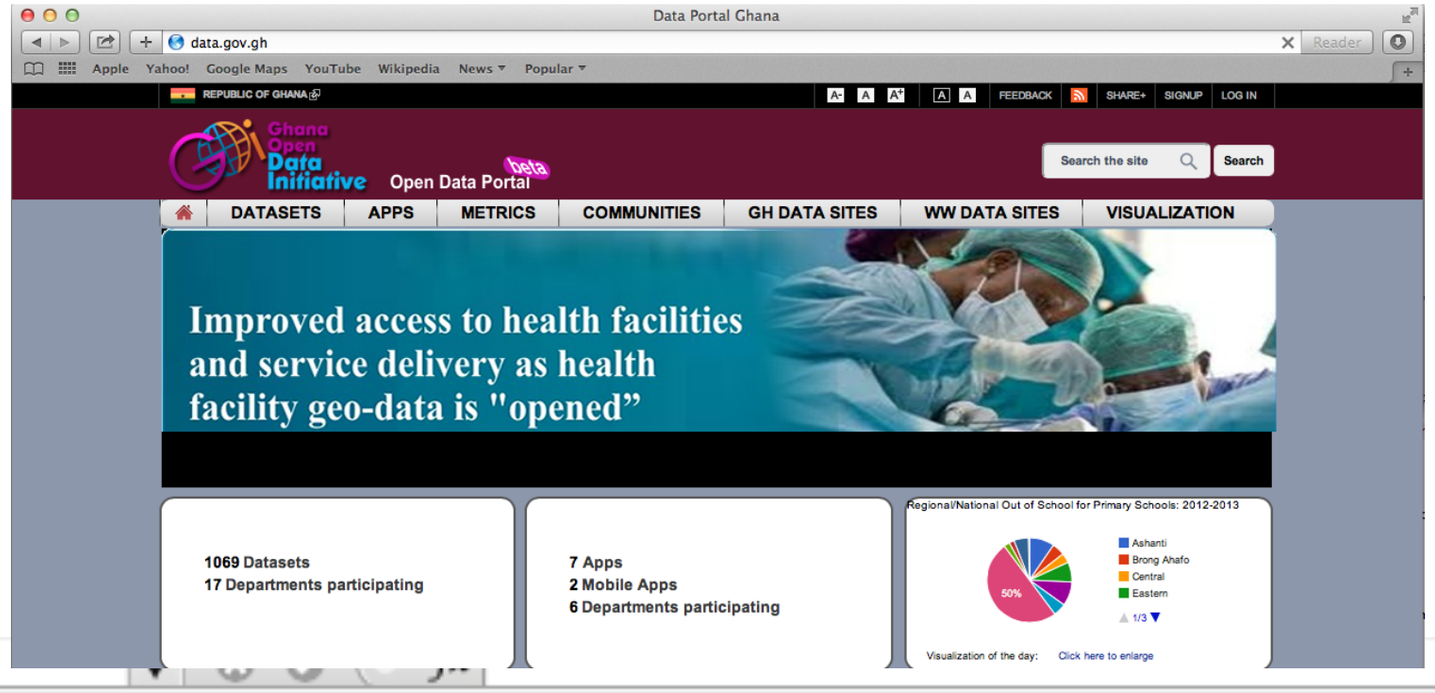
- NITA released its first data set on data.gov.gh portal in 2012

- Over 800 data sets have since been published at the portal; includes data from NCA

The NCA Data

- The source data was in excel spreadsheet format
- The data covered MTN, Vodafone, Tigo, Airtel and Expresso networks
- The information content was in text format and was on % of call drops and congestion
- Small data set of about 104 records (2010-2012)
- Requirement is not to exceed 1% congestion, 3% call drops

The Data



B110

	A	B	C	D	E	F	G	H
1	Trends in Quality of Services - Call Drop from 2010-2012							
2								
3	Month	City/Town	MTN	Vodafone	Tigo	Airtel	Expresso	Allowable Threshold
4	Feb-10	Cape Coast	2%	0%	10%	32%	0%	3%
5	Feb-10	Elmina	2%	0%	0%	63%	0%	3%
6	Feb-10	Winneba	4%	0%	20%	53%	0%	3%
7	Feb-10	Sekondi Takoradi	0%	1%	0%	0%	0%	3%
8	May-10	Kumasi	4%	5%	11%	10%	1%	3%
9	May-10	Obuasi	11%	0%	2%	16%	3%	3%
10	May-10	Mampong						

A1 Trends in Quality of Services – Conguestion from 2010–2012

	A	B	C	D	E	F	G	H
1	Trends in Quality of Services - Conguestion from 2010-2012							
2								
3	Month	City/Town	MTN	Vodafone	Tigo	Airtel	Expresso	Allowable Threshold
4	Feb-10	Cape Coast	9%	1%	13%	1%	20%	1%
5	Feb-10	Elmina	30%	0%	2%	0%	6%	1%
6	Feb-10	Winneba	0%	0%	18%	3%	21%	1%
7	Feb-10	Sekondi Takoradi	3%	0%	2%	0%	18%	1%
8	May-10	Kumasi	5%	7%	10%	2%	7%	1%
9	May-10	Obuasi	2%	2%	0%	3%	3%	1%
10	May-10	Mampong	7%	0%	0%	0%	21%	1%
11	May-10	Konongo	0%	7%	6%	0%	0%	1%
12	Jun-10	Accra	3%	17%	27%	12%	10%	1%

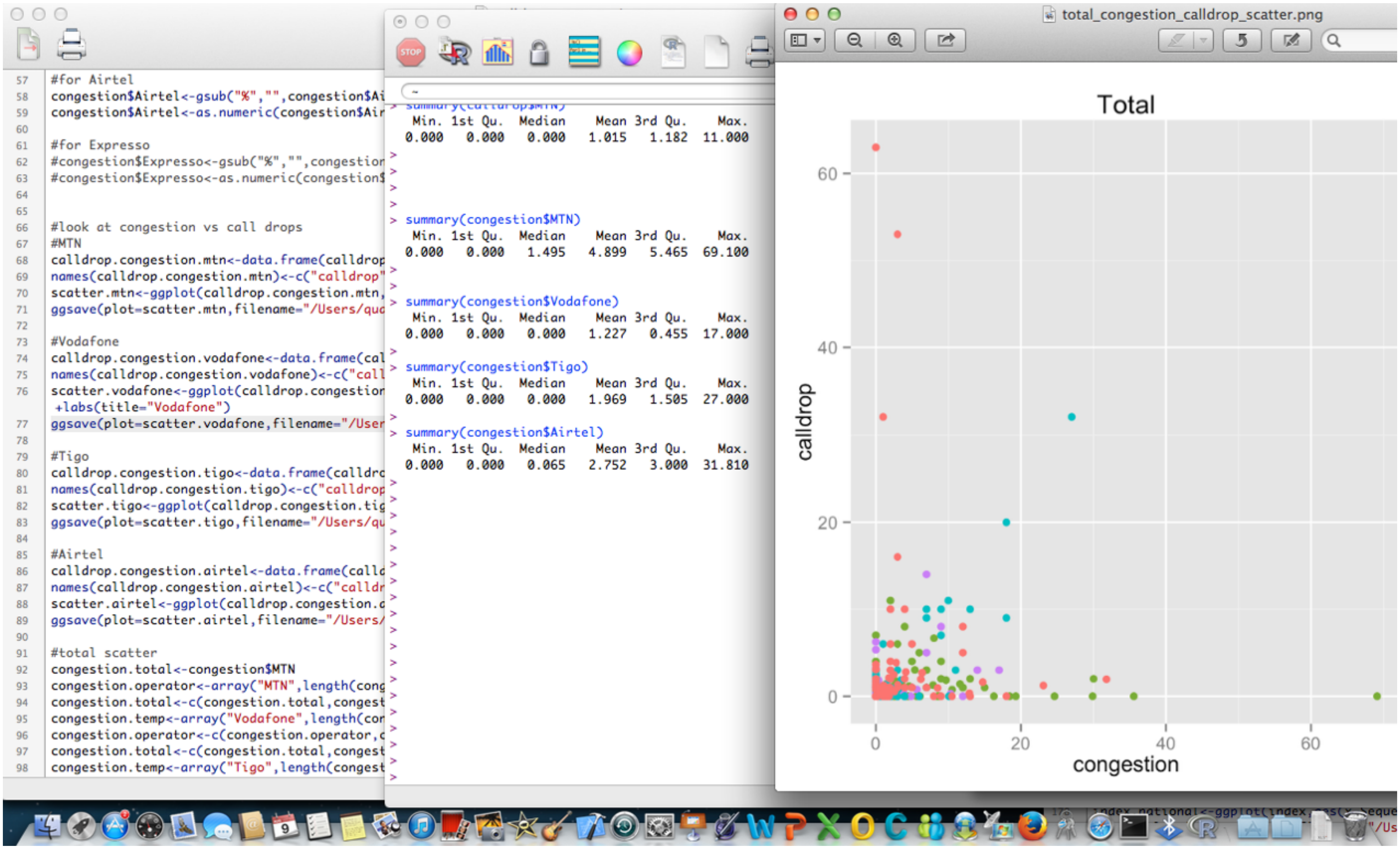
The Analysis Environment and process

- Author is a student of Machine Learning and uses the R programming environment with a console on Mac

- The data from the portal is saved in csv format and loaded in R; then cleaned; the text entries are converted to dates and numbers

- One provider, Expresso, had > 10 % missing data and was excluded in the analysis

The R Environment



Analysis Approach

- Study congestion and call drop separately using suitable techniques for analyzing a single variable: statistics, time series, histograms, density plots

- Employ Principal Component Analysis (PCA) to derive an index about the mean for a combined index of four operators for congestion and call drops

- Use techniques suitable to find relationship among multiple variables to study congestion and call drops: scatterplots, curve fitting for each operator and for combined set of operators

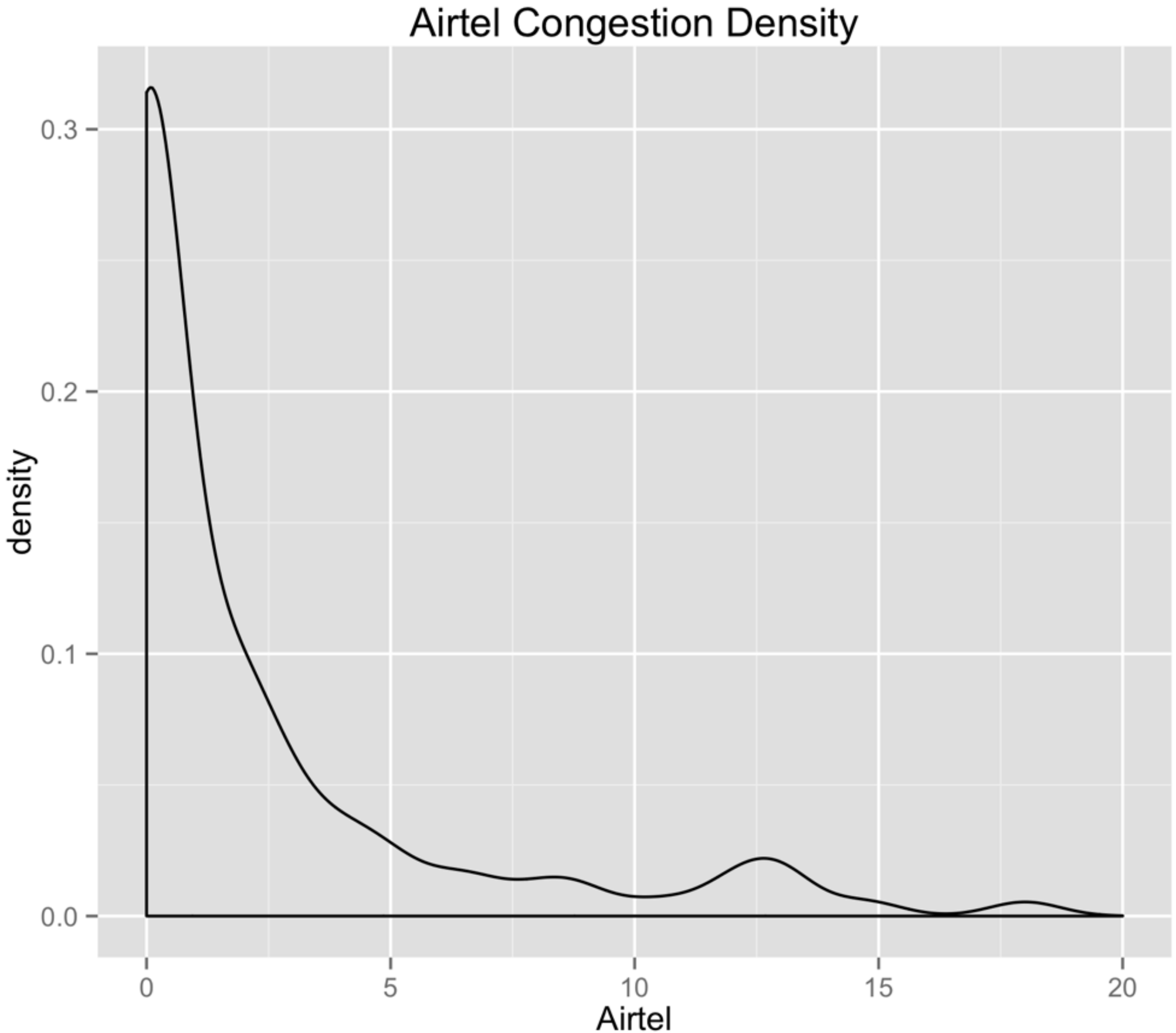
Congestion Statistics

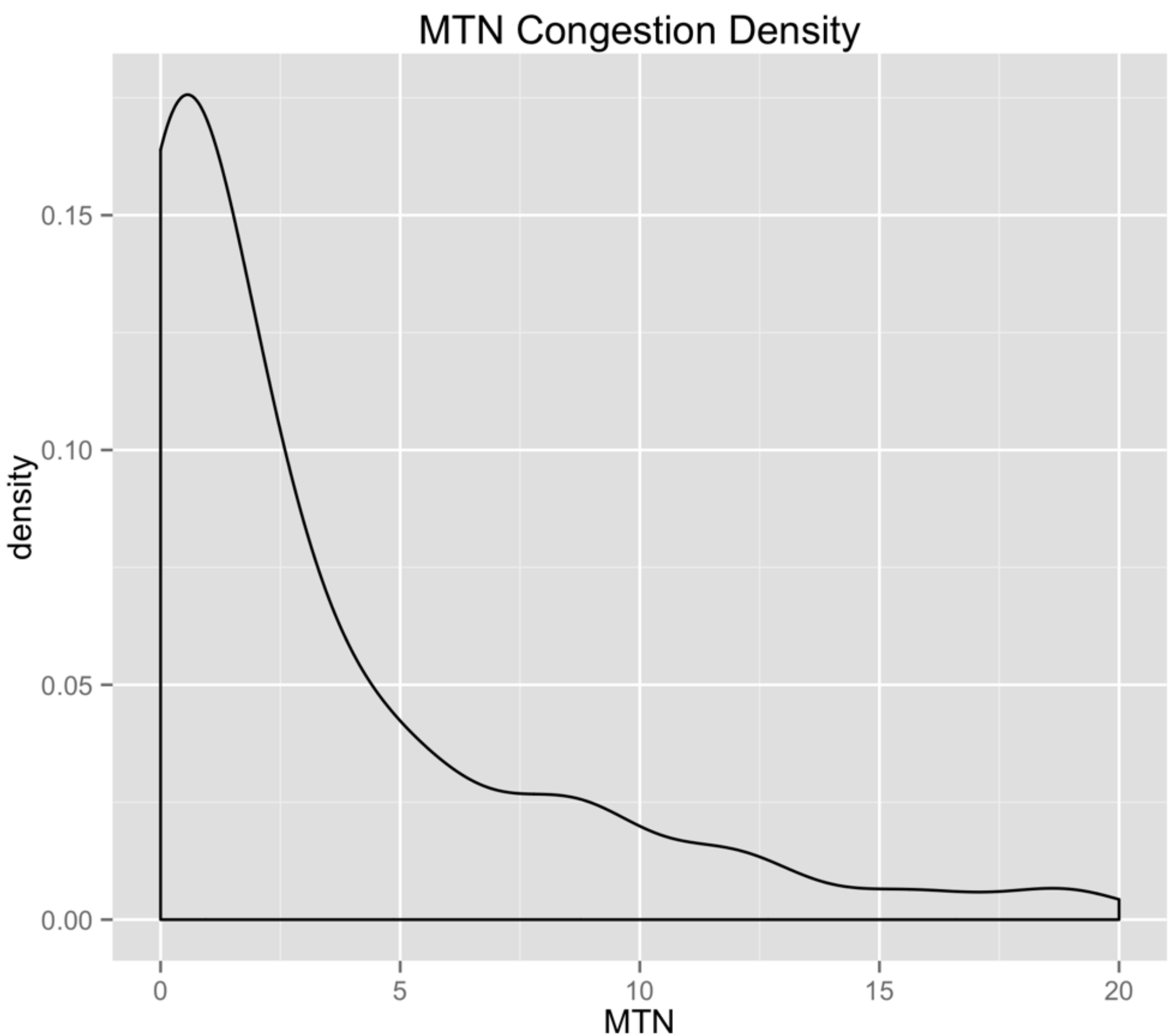
```
>
>
> summary(congestion$MTN)
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
  0.000   0.000   1.495   4.899   5.465  69.100
>
>
> summary(congestion$Vodafone)
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
  0.000   0.000   0.000   1.227   0.455  17.000
>
> summary(congestion$Tigo)
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.     NA's
  0.000   0.000   0.000   1.969   1.505  27.000        1
>
> summary(congestion$Airtel)
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
  0.000   0.000   0.065   2.752   3.000  31.810
>
>
>
```

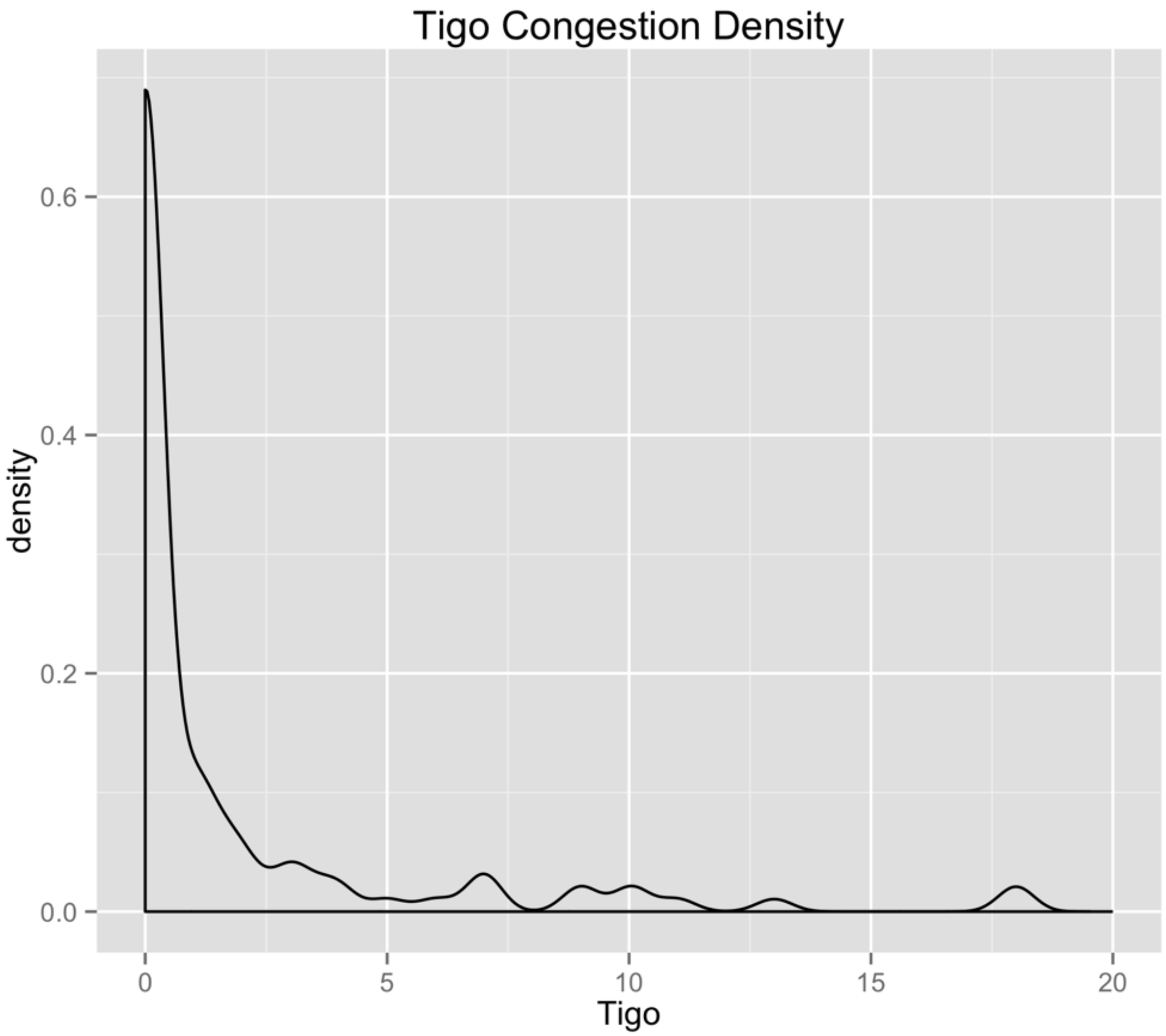
Fail

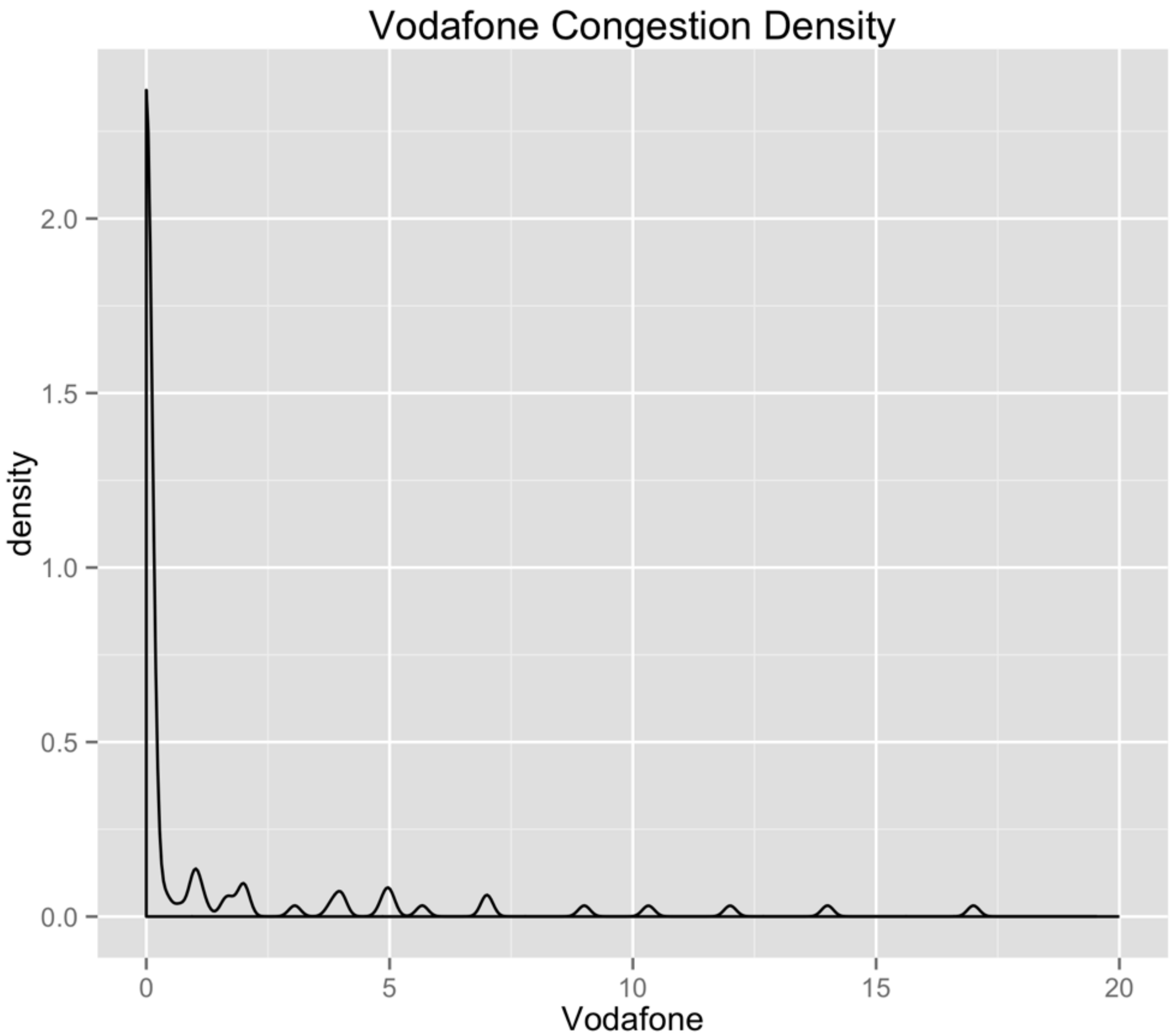
Pass

Congestion Density plots


Airtel Congestion Density
density
0.3
0.2
0.1
0.0
0
5
10
15
20
Airtel


MTN Congestion Density
density
0.15
0.10
0.05
0.00
0
5
10
15
20
MTN


Tigo Congestion Density
density
0.6
0.4
0.2
0.0
0
5
10
15
20
Tigo


Vodafone Congestion Density
density
2.0
1.5
1.0
0.5
0.0
0
5
10
15
20
Vodafone

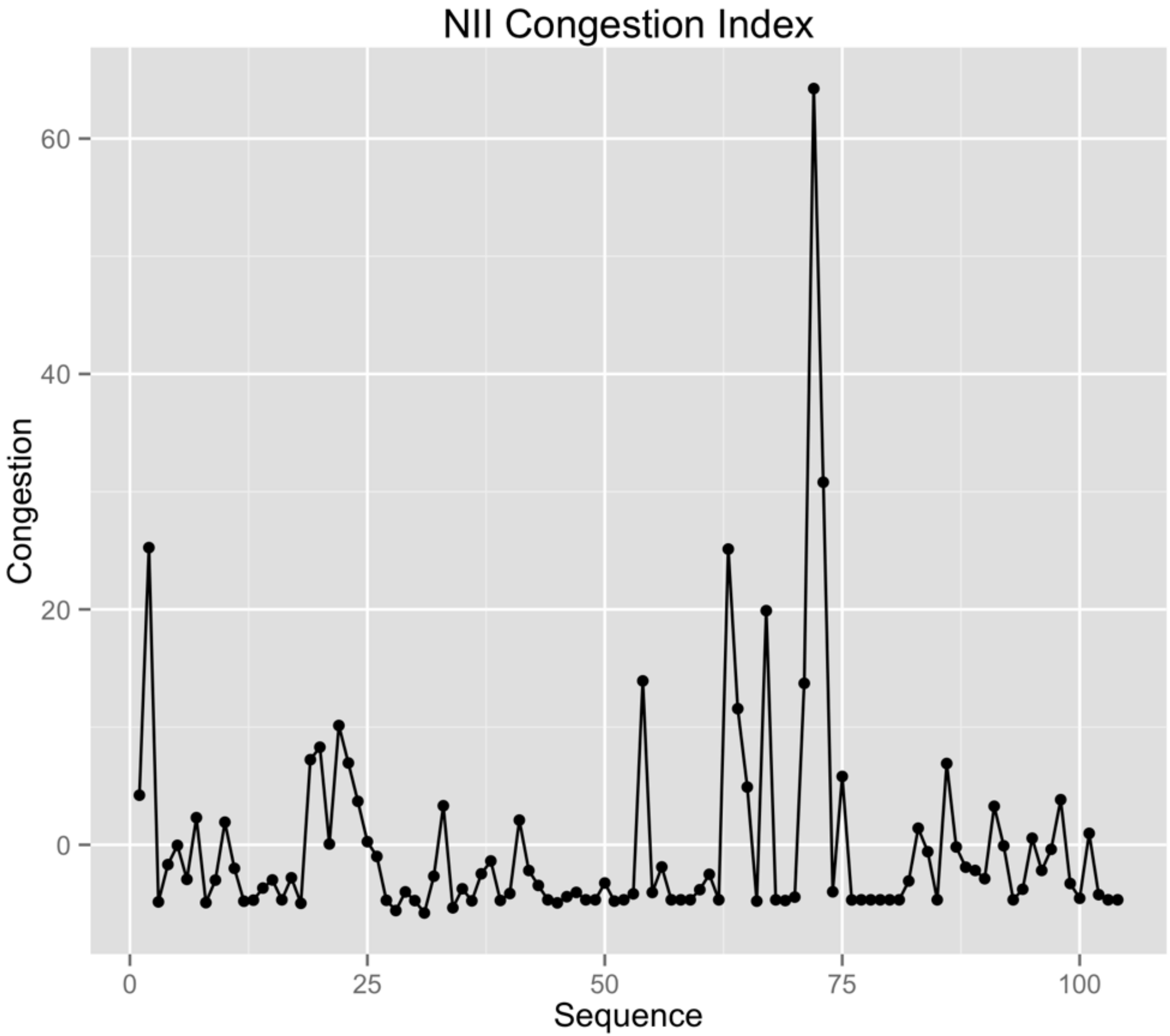
Congestion Density plots

- Vodafone and Tigo are skewed to 0-1%
- MTN has a tail at 20%
- Airtel is tails at < 14%

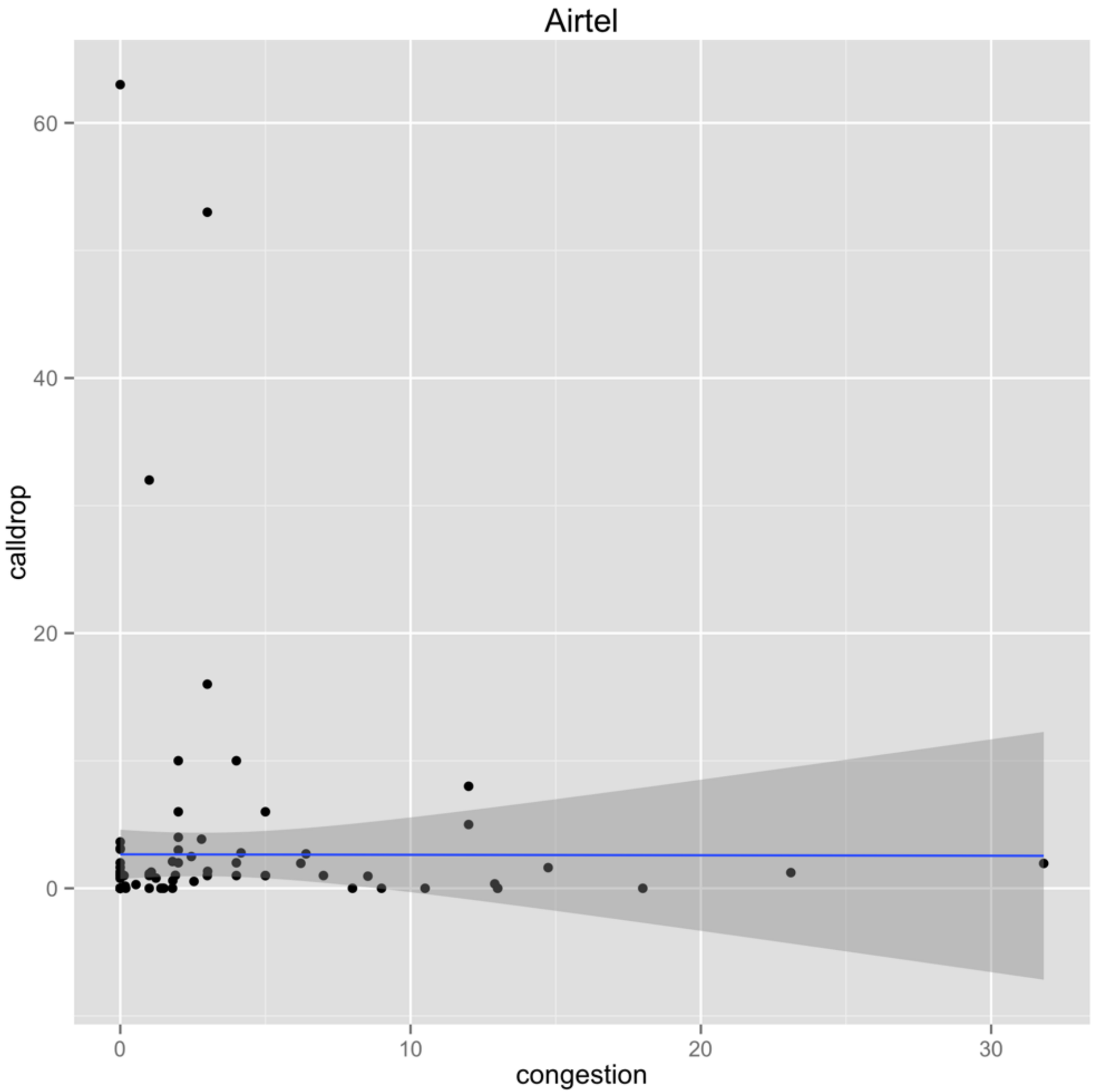
Congestion Index

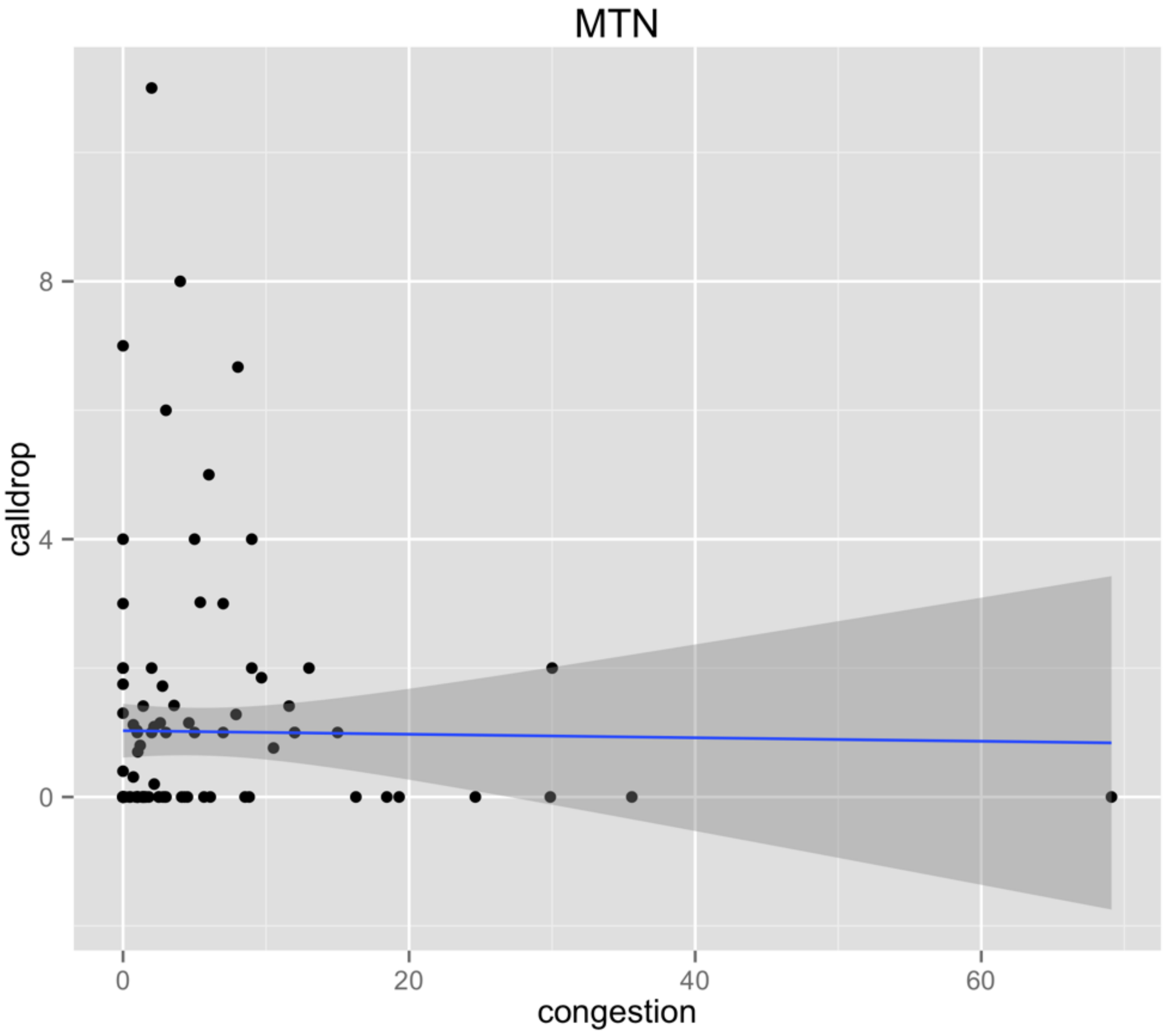
- Use PCA to combine the four variables to create a national index on congestion about the mean of the data

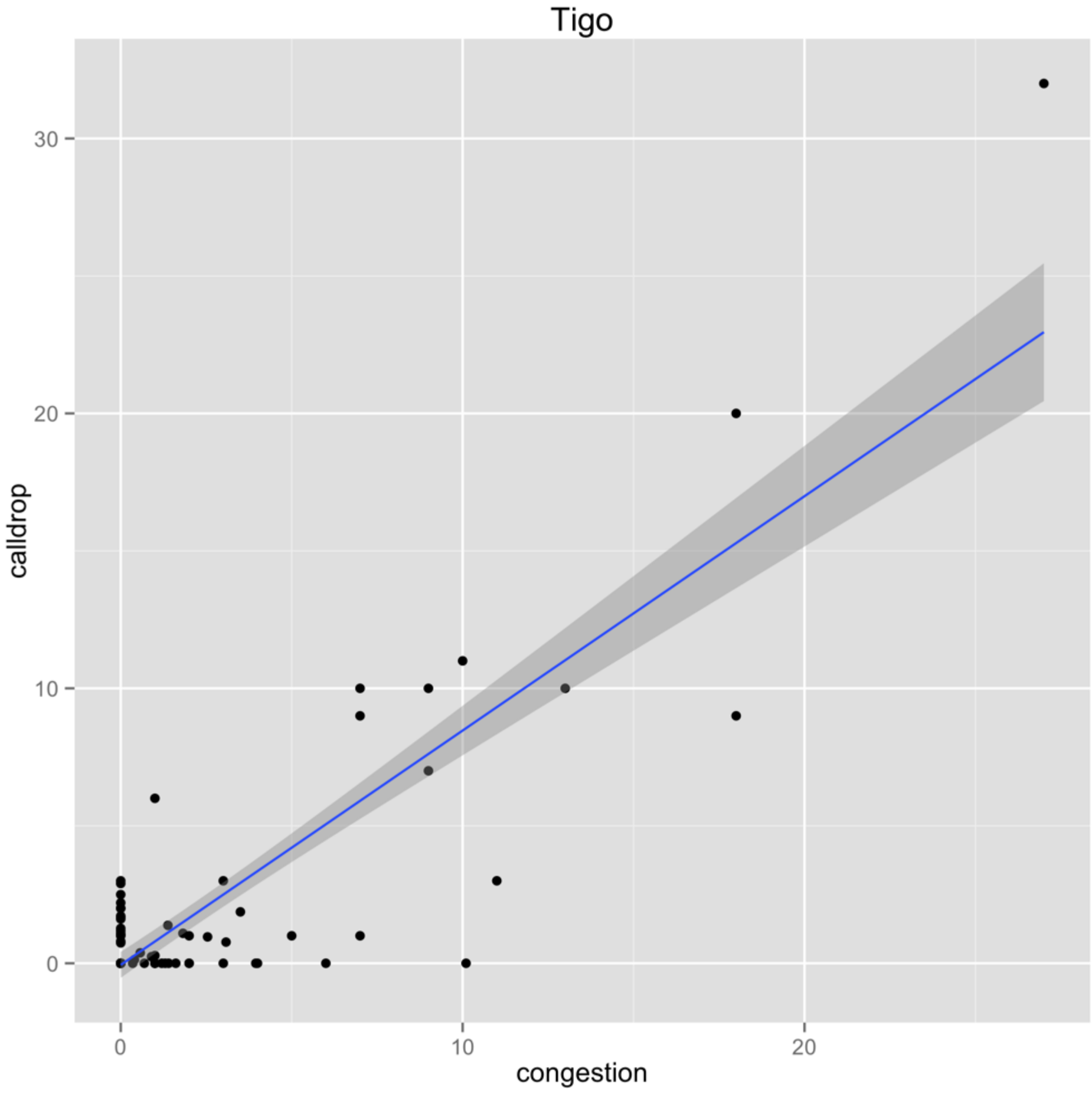
- In practice one studies the density of the principal component loadings looking to see all positive or all negative

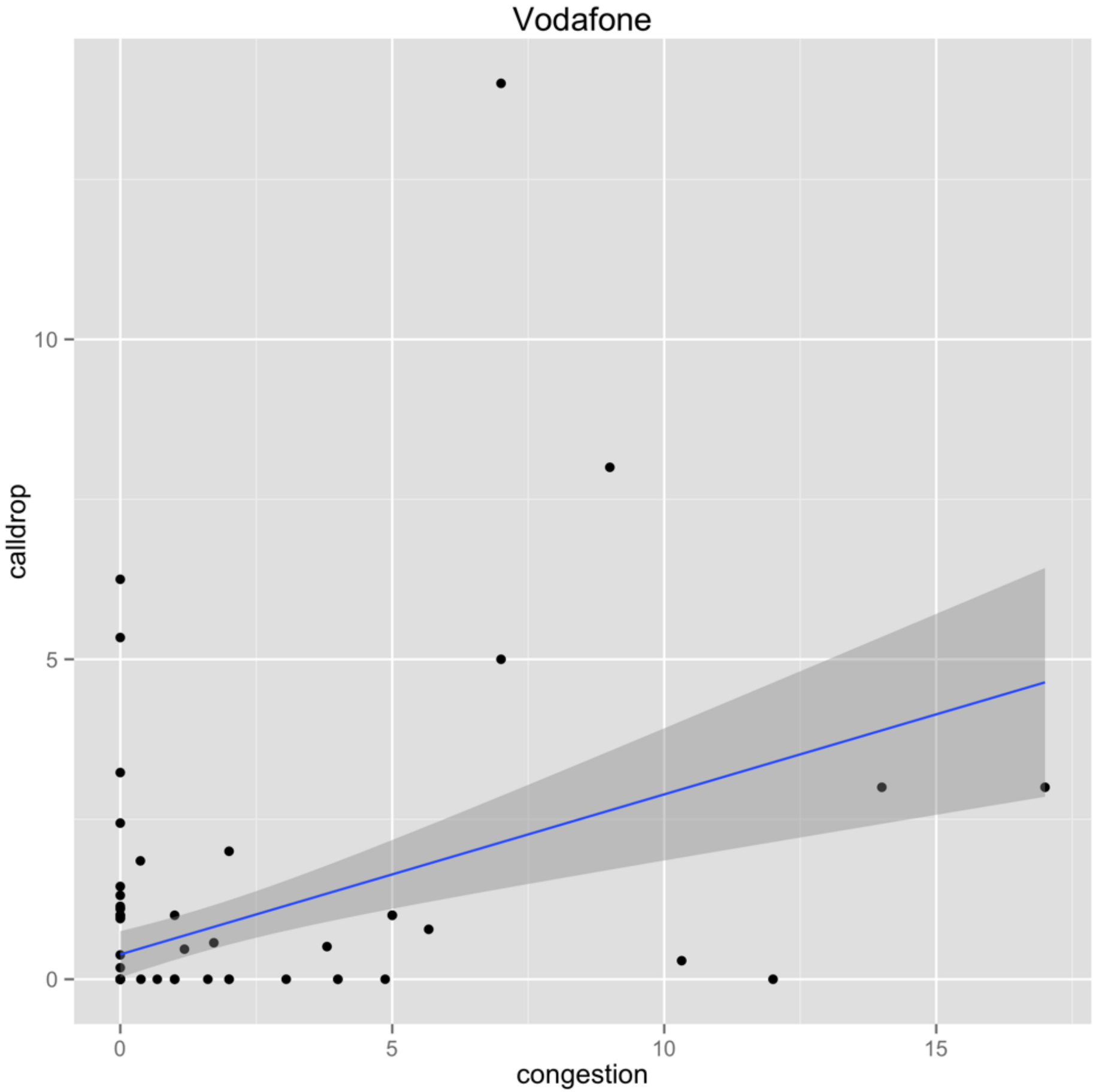

NII Congestion Index
60
40
20
0
Congestion
0
25
50
75
100
Sequence

Congestion and Call drops


Airtel
60
40
20
0
call drop
0
10
20
30
congestion


MTN
8
4
0
dropcall
0
20
40
60
congestion


Tigo
calldrop
congestion
0
10
20
30
0
10
20


Vodafone
10
5
0
drop
0
5
10
15
congestion

- Tigo and Vodafone show a relationship between call drops and congestion

- MTN and Airtel on the other hand show no meaningful relationship

Conclusion

- NCA to release larger volume of data for analysis and to be more complete
- NCA to define more precisely the performance criteria for limits
- The 1% congestion limit proved difficult for providers while 3% call drops was easily met by all providers

Conclusion(2)

- More current data would be enhance the study
- Make regulations on the definition and calculation of limits to better govern the mobile telecommunication sector
- GODI as a platform for evidence based analysis and reporting has been successful
- An independent scientist, without permission, has analyzed the performance of the national network