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BENFORD ANALYSIS OF ROBO.CASH

*** A FORENSIC AUDITING TOOL FOR P2P INVESTORS***

PREAMBLE

I was always intrigued at Viventor that Atlantis Financiers B.V. offered equal amounts of loan parts with always equal loan duration at those high interest rates. A further indication that something felt wrong were the extensions, applying on the complete set of invoice loans.

I was always intrigued on FastInvest offering identical loan amounts with the same term of the loans.

I always had a bad feeling about this. Are these loans real? Or is someone ticking random numbers on a keyboard?

How do you prove someone is probably “cooking the books”?

I was looking for a scientific, statistic tool which could give some solid mathematical ground to my gut. Preferably there should be some legal acceptance by the courts.

I stumbled on Benfords Law, a forensic auditing tool. For a small summary what it is all about, go to the next page.

In case you want to deepen into the subject:

*As always Wikipedia is a wonderful resource:

https://en.wikipedia.org/wiki/Benford%27s_law

*In case you prefer a Video Clip:

https://youtu.be/BO3WFTw6eqE

https://youtu.be/aggFFcl4yxI

*Benfords Law in courts:

https://www.isaca.org/resources/isaca-journal/past-issues/2011/understanding-and-applying-benfords-law

*For the mathematicians under you:

https://wwwf.imperial.ac.uk/~nadams/classificationgroup/Benfords-Law.pdf

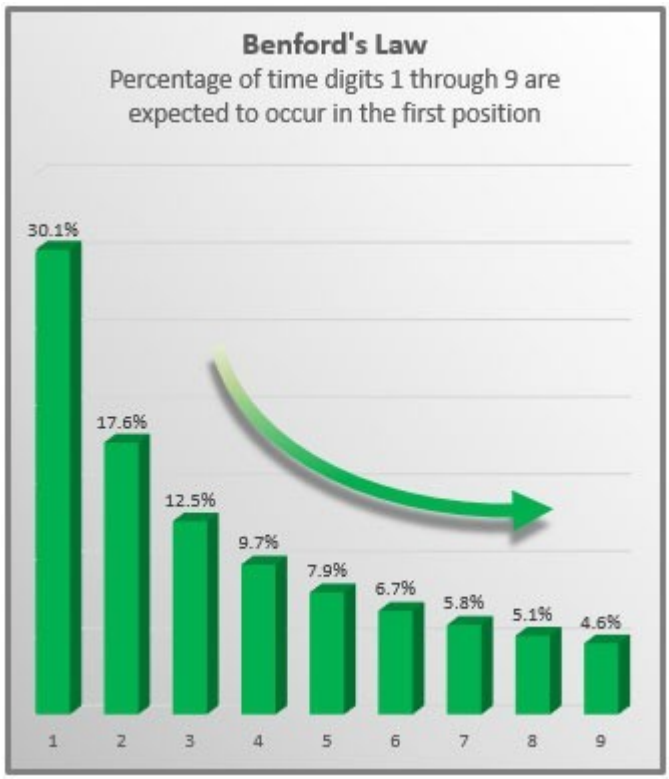
*I have to give some credit to the German pages, where I found the subject initially:

https://p2p-game.com/p2p-scamfraud-erkennung-mit-der-benford-analyse-selbst-gemacht-wie-schlagen-sich-mintos-fastinvest-grupper-finbee#Benford_Analyse_bei_Fastinvest

This is only a tiny selection of what can be found on the www.

#1. THE USE BENFORD'S LAW TO SPOT FRAUD

Briefly explained, Benfords Law maintains that the numeral 1 will be the leading digit in a genuine data set of numbers 30.1% of the time; the numeral 2 will be the leading digit 17.6% of the time; and each subsequent numeral, 3 through 9, will be the leading digit with decreasing frequency. This expected occurrence of leading digits can be illustrated as shown in the chart "Benfords Law."

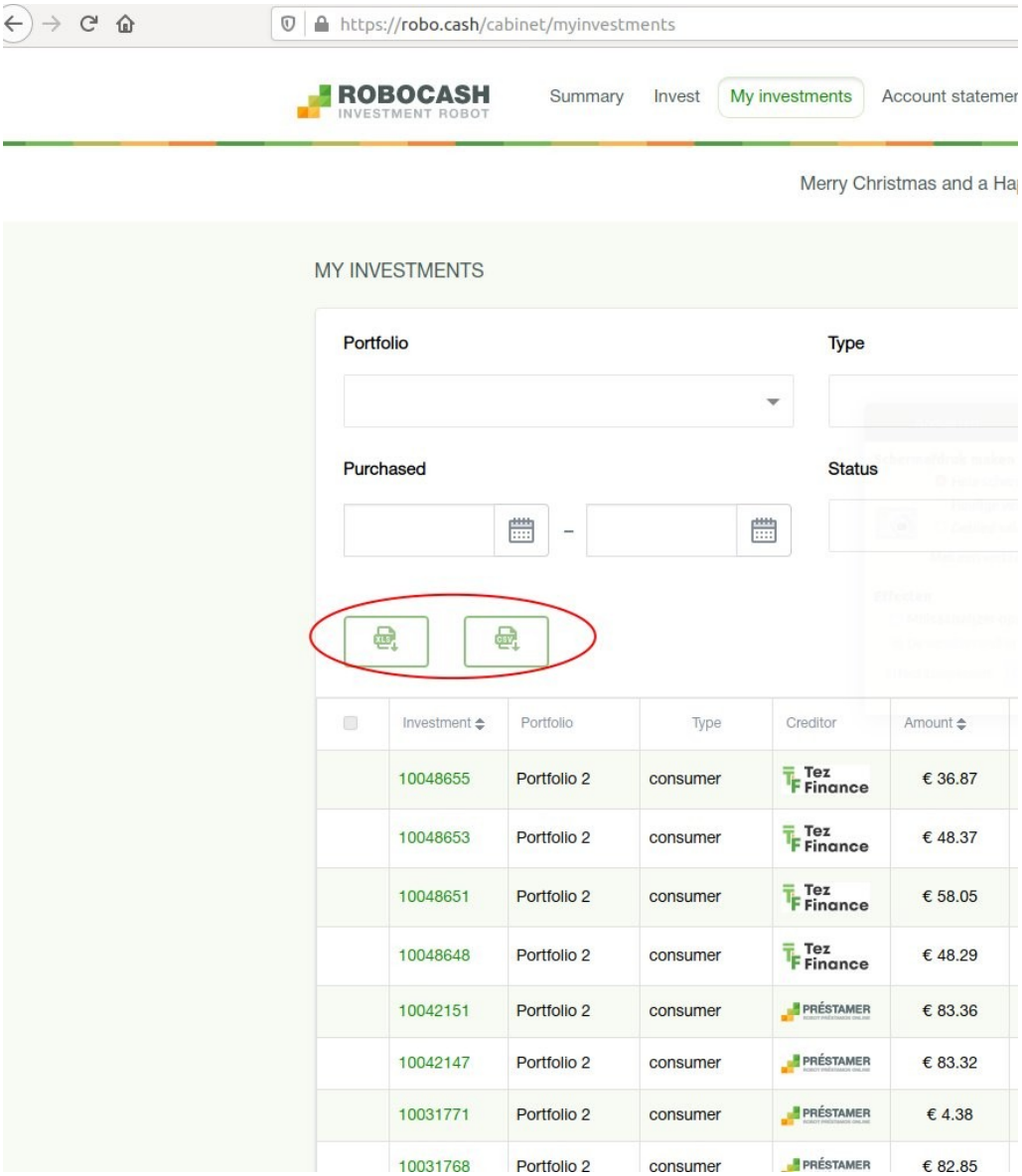


The resulting curve pictured in this green bar chart closely resembles a steep water slide and is sometimes referred to as the Benford curve. Today, armed with any version of Microsoft Excel, Auditors can count the leading digits contained in virtually any data set, chart the findings, and compare the results to Benfords curve to see if that data set obeys the expectations set forth by Benfords Law.

It is all about counting and charting a data set's leading digits are the same for any size data set and can include general ledgers, trial balance reports, income statements, balance sheets, invoice listings, inventory listings, depreciation schedules, investment statements, accounts payable and receivable reports, time sheet data, portfolios, expense reports, and virtually any other group of data containing naturally occurring numbers.

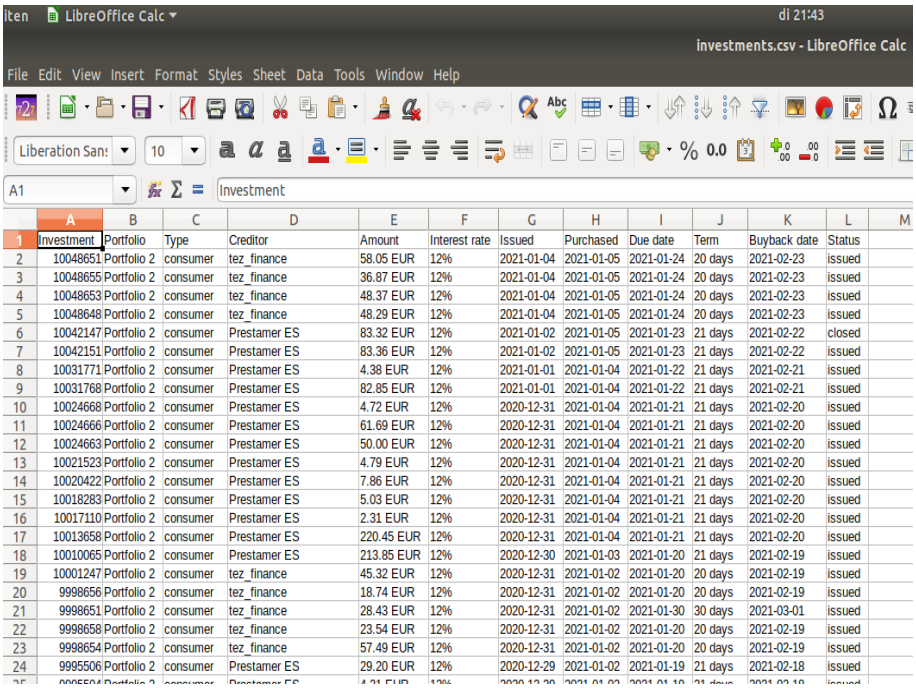
#2. WHERE TO FIND THE ROBO.CASH DATA

On the “My Investments” page there are two buttons (red encircled) to download an XLS or CSV file.
Download the file store it and open it in your spreadsheet program.
The name of the file is “investments.csv” or “investments.xls”.
Depending on the scale of your investments the download may take some time; be patient.



#3. THE ROBO.CASH SPREADSHEET

Unlike the gross of downloaded investment spreadsheets, the Robo.Cash spreadsheet is one of the better kind, neat and tidy.
The column that interests us is in first order the “Amount”.
In second order we are interested in the “Status”, which can be “issued”, “closed” or “late”.
Unfortunately the column E “Amount” comes as text.



	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Investment	Portfolio	Type	Creditor	Amount	Interest rate	Issued	Purchased	Due date	Term	Buyback date	Status	
2	10048651	Portfolio 2	consumer	tez_finance	58.05 EUR	12%	2021-01-04	2021-01-05	2021-01-24	20 days	2021-02-23	issued	
3	10048655	Portfolio 2	consumer	tez_finance	36.87 EUR	12%	2021-01-04	2021-01-05	2021-01-24	20 days	2021-02-23	issued	
4	10048653	Portfolio 2	consumer	tez_finance	48.37 EUR	12%	2021-01-04	2021-01-05	2021-01-24	20 days	2021-02-23	issued	
5	10048648	Portfolio 2	consumer	tez_finance	48.29 EUR	12%	2021-01-04	2021-01-05	2021-01-24	20 days	2021-02-23	issued	
6	10042147	Portfolio 2	consumer	Prestamer ES	83.32 EUR	12%	2021-01-02	2021-01-05	2021-01-23	21 days	2021-02-22	closed	
7	10042151	Portfolio 2	consumer	Prestamer ES	83.36 EUR	12%	2021-01-02	2021-01-05	2021-01-23	21 days	2021-02-22	issued	
8	10031771	Portfolio 2	consumer	Prestamer ES	4.38 EUR	12%	2021-01-01	2021-01-04	2021-01-22	21 days	2021-02-21	issued	
9	10031768	Portfolio 2	consumer	Prestamer ES	82.85 EUR	12%	2021-01-01	2021-01-04	2021-01-22	21 days	2021-02-21	issued	
10	10024668	Portfolio 2	consumer	Prestamer ES	4.72 EUR	12%	2020-12-31	2021-01-04	2021-01-21	21 days	2021-02-20	issued	
11	10024666	Portfolio 2	consumer	Prestamer ES	61.69 EUR	12%	2020-12-31	2021-01-04	2021-01-21	21 days	2021-02-20	issued	
12	10024663	Portfolio 2	consumer	Prestamer ES	50.00 EUR	12%	2020-12-31	2021-01-04	2021-01-21	21 days	2021-02-20	issued	
13	10021523	Portfolio 2	consumer	Prestamer ES	4.79 EUR	12%	2020-12-31	2021-01-04	2021-01-21	21 days	2021-02-20	issued	
14	10020422	Portfolio 2	consumer	Prestamer ES	7.86 EUR	12%	2020-12-31	2021-01-04	2021-01-21	21 days	2021-02-20	issued	
15	10018283	Portfolio 2	consumer	Prestamer ES	5.03 EUR	12%	2020-12-31	2021-01-04	2021-01-21	21 days	2021-02-20	issued	
16	10017110	Portfolio 2	consumer	Prestamer ES	2.31 EUR	12%	2020-12-31	2021-01-04	2021-01-21	21 days	2021-02-20	issued	
17	10013658	Portfolio 2	consumer	Prestamer ES	220.45 EUR	12%	2020-12-31	2021-01-04	2021-01-21	21 days	2021-02-20	issued	
18	10010065	Portfolio 2	consumer	Prestamer ES	213.85 EUR	12%	2020-12-30	2021-01-03	2021-01-20	21 days	2021-02-19	issued	
19	10001247	Portfolio 2	consumer	tez_finance	45.32 EUR	12%	2020-12-31	2021-01-02	2021-01-20	20 days	2021-02-19	issued	
20	9998656	Portfolio 2	consumer	tez_finance	18.74 EUR	12%	2020-12-31	2021-01-02	2021-01-20	20 days	2021-02-19	issued	
21	9998651	Portfolio 2	consumer	tez_finance	28.43 EUR	12%	2020-12-31	2021-01-02	2021-01-30	30 days	2021-03-01	issued	
22	9998658	Portfolio 2	consumer	tez_finance	23.54 EUR	12%	2020-12-31	2021-01-02	2021-01-20	20 days	2021-02-19	issued	
23	9998654	Portfolio 2	consumer	tez_finance	57.49 EUR	12%	2020-12-31	2021-01-02	2021-01-20	20 days	2021-02-19	issued	
24	9995506	Portfolio 2	consumer	Prestamer ES	29.20 EUR	12%	2020-12-29	2021-01-02	2021-01-19	21 days	2021-02-18	issued	

Some basic knowledge and understanding of spreadsheets is assumed now.
-Copy the column E “Amount” into a new spreadsheet.
-Bulk remove the “EUR” by using “find & replace”
-Transform the text amounts to numbers by using “find & replace” by switching ‘.’ and’,’

Robo.cash offers 4 Loan Originators https://robo.cash/loan-originators

#1. TEZ Finance KZT
#2. Prestamer ES
#3. RC Riga Vietnam
#4. RC Riga Singapore

#4.THE EXCEL SPREADSHEET

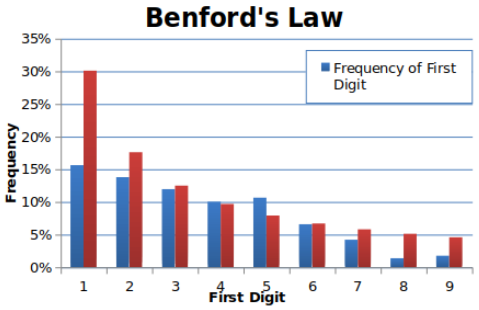
In the www there are a lot of wonderful spreadsheets freely available.
I randomly chose the following at https://investexcel.net/benfords-law-excel/
Download the spreadsheet.
Load the data set.
Be careful, the results may not be what you expected.
Do not forget in loading data sets > 100 to expand the B column conditions.
The magnitude of first data set is 1.305 numbers.
The results are immediate.

Copy data into this column

DATA	FIRST DIGIT
58.05	5
36.87	3
48.37	4
48.29	4
83.32	8
83.36	8
4.38	4
82.85	8
4.72	4
61.69	6
50	5
4.79	4
7.86	7
5.03	5
2.31	2
220.45	2
213.85	2
45.32	4
18.74	1
28.43	2
23.54	2
57.49	5
29.2	2
4.21	4
1	1
21.95	2
40.77	4

ROBOCASH DATA dd 20/01/2020

First Digit	Occurrence Of Digit	Frequency of First Digit	Predicted By Benford
One	204	15.63%	30.10%
Two	180	13.79%	17.61%
Three	156	11.95%	12.49%
Four	131	10.04%	9.69%
Five	139	10.65%	7.92%
Six	86	6.59%	6.69%
Seven	55	4.21%	5.80%
Eight	18	1.38%	5.12%
Nine	23	1.76%	4.58%
Total Number Of Data Points	**1305**		



Digit	1st	2nd	3rd	4th	5th or Greater higher
0		11.97%	10.18%	10.02%	10.00%
1	30.10%	11.39%	10.14%	10.01%	10.00%
2	17.61%	10.88%	10.10%	10.01%	10.00%
3	12.49%	10.43%	10.06%	10.01%	10.00%
4	9.69%	10.03%	10.02%	10.00%	10.00%
5	7.92%	9.67%	9.98%	10.00%	10.00%
6	6.69%	9.34%	9.94%	9.99%	10.00%
7	5.80%	9.04%	9.90%	9.99%	10.00%
8	5.12%	8.76%	9.86%	9.99%	10.00%
9	4.58%	8.50%	9.83%	9.98%	10.00%

#5.A MAN WITH A PLAN

I observed in the first version, using the data of our own two portfolio's, showing anomalies, and decided to ask a limited group of fellow investors for their data.
The response was good; fellow investors were intrigued and had a lot of questions, guidance and observations and comments.

As a result I took 6 anonymised data sets estimated to be representative for the analysis.

We assume the following definitions:
*Investor: Anonymised Data set Name (Every individual Investor will recognize himself)
*Portfolio Amount = the actual active invested amount
*Data set Amount = the Portfolio amount + the Closed Loan amounts
*TEZ Finance KZT Amount = invested amount in this LO excluding closed loans
*Prestamer ES amount = invested amount in this LO excluding closed loans
*RC Riga Vietnam Amount = invested amount in this LO excluding closed loans
*RC Riga Singapore Amount = invested amount in this LO excluding closed loans

The plan:
#1. In **Document ref:210114/V0.2** of 17/01/2020 every participants data were analysed
The results was given as is, without comments.
#2.In this document the combined data set is analysed.
#3.An assessment is made.
#4.A summary of the guidance and observations and comments of the participants in the analysis is added.

Here is an oversight of the data set vital numbers:

SUMMARY OF THE DATASETS

Investor	Portfolio Amount	Dataset Amount	Dataset Lines	TEZ Finance KZT	Prestamer ES	RC Riga Vietnam	RC Riga Singapore	Checksum
GH01	19807.58	73277.55	1710	10560.7	8980.93	0	265.95	19807.58
LI01	14340.16	62841.88	1375	5608.17	7179.85	0	1552.14	14340.16
ME01	3745.97	3956.31	396	152.14	60.77	0	3533.06	3745.97
ME02	5148.33	13037.99	573	1442.33	1918.21	0	1787.79	5148.33
RE01	366.07	11624.79	546	251.84	114.23	0	0	366.07
ST01	12373.17	178891.02	3887	5493.78	6879.39	0	0	12373.17

We assume the following definitions:
*Investor: Anonymised Dataset Name (Every induvidual Investor will recognize himself)
*Portfolio Amount = the active invested amount
*Dataset Amount = the Portfolio amout + the Closed Loan amounts
*TEZ Finance KZT Amount = invested amount in this LO excluding closed loans
*Prestamer ES amount = invested amount in this LO excluding closed loans
*RC Riga Vietnam Amount = invested amount in this LO excluding closed loans
*RC Riga Singapore Amount = invested amount in this LO excluding closed loans

We notice that none of the investors has loan parts of RC Riga Vietnam.

#6.1.RESULTS OF THE TOTAL DATA SET

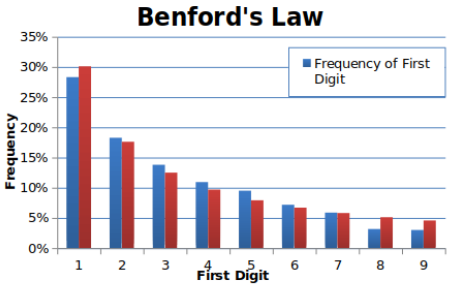
Benford's Law

http://investexcel.net

DATA	FIRST DIGIT
39.14	3
34.13	3
54	5
95	9
145	1
95	9
75	7
37.77	3
12.77	1
33.9	3
33.9	3
16.47	1
28.09	2
28.09	2
22.46	2
22.46	2
8.79	8
56.05	5
65.72	6
17.35	1
16.05	1
22.83	2
7.35	7
32.5	3
7.35	7
25.7	2

ROBOCASH DATA TOTAL OF ALL DATA

First Digit	Occurren Of Digit	Frequency of First Digit	Predicted By Benford
One	2394	28.31%	30.10%
Two	1545	18.27%	17.61%
Three	1166	13.79%	12.49%
Four	924	10.93%	9.69%
Five	803	9.50%	7.92%
Six	607	7.18%	6.69%
Seven	497	5.88%	5.80%
Eight	267	3.16%	5.12%
Nine	253	2.99%	4.58%
Total Number Of Data Points	**8456**		



Digit	1st	2nd	3rd	4th	5th or Greater higher
0		11.97%	10.18%	10.02%	10.00%
1	30.10%	11.39%	10.14%	10.01%	10.00%
2	17.61%	10.88%	10.10%	10.01%	10.00%
3	12.49%	10.43%	10.06%	10.01%	10.00%
4	9.69%	10.03%	10.02%	10.00%	10.00%
5	7.92%	9.67%	9.98%	10.00%	10.00%
6	6.69%	9.34%	9.94%	9.99%	10.00%
7	5.80%	9.04%	9.90%	9.99%	10.00%
8	5.12%	8.76%	9.86%	9.99%	10.00%
9	4.58%	8.50%	9.83%	9.98%	10.00%

#6.2.RESULTS INVESTOR ST01

Benford's Law

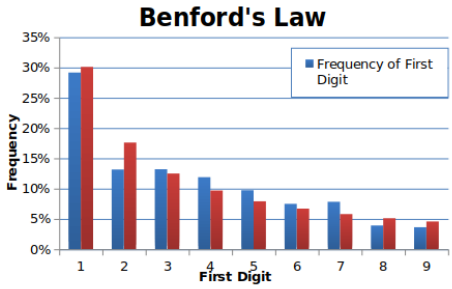
http://investexcel.net

Copy data into this column

DATA	FIRST DIGIT
52.24	5
58.05	5
30.96	3
19.35	1
19.35	1
81.27	8
80.27	8
61.57	6
10.58	1
46.54	4
38.26	3
22.13	2
8.12	8
31.80	3
19.30	1
16.58	1
48.38	4
13.38	1
41.38	4
34.55	3
31.30	3
35.02	3
6.59	6
19.36	1
27.96	2
27.88	2

ROBOCASH DATA INVESTOR ST01-TOTAL

First Digit	Occurren Of Digit	Frequency of First Digit	Predicted By Benford
One	1133	29.16%	30.10%
Two	511	13.15%	17.61%
Three	513	13.20%	12.49%
Four	462	11.89%	9.69%
Five	378	9.73%	7.92%
Six	291	7.49%	6.69%
Seven	304	7.82%	5.80%
Eight	152	3.91%	5.12%
Nine	141	3.63%	4.58%
Total Number Of Data Points	**3885**		



Digit	1st	2nd	3rd	4th	5th or Greater higher
0		11.97%	10.18%	10.02%	10.00%
1	30.10%	11.39%	10.14%	10.01%	10.00%
2	17.61%	10.88%	10.10%	10.01%	10.00%
3	12.49%	10.43%	10.06%	10.01%	10.00%
4	9.69%	10.03%	10.02%	10.00%	10.00%
5	7.92%	9.67%	9.98%	10.00%	10.00%
6	6.69%	9.34%	9.94%	9.99%	10.00%
7	5.80%	9.04%	9.90%	9.99%	10.00%
8	5.12%	8.76%	9.86%	9.99%	10.00%
9	4.58%	8.50%	9.83%	9.98%	10.00%

#6.3. RESULTS INVESTOR GH01

Benford's Law

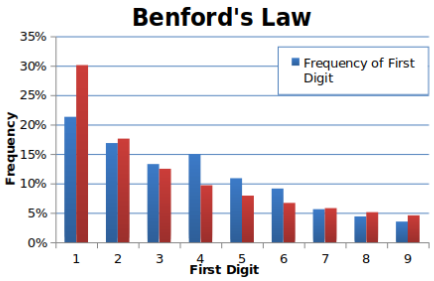
http://investexcel.net

Copy data into this column

DATA	FIRST DIGIT
39.14	3
34.13	3
54	5
95	9
145	1
95	9
75	7
37.77	3
12.77	1
33.9	3
33.9	3
16.47	1
28.09	2
28.09	2
22.46	2
22.46	2
8.79	8
56.05	5
65.72	6
17.35	1
16.05	1
22.83	2
7.35	7
32.5	3
7.35	7
25.7	2

ROBOCASH DATA INVESTOR GH01-TOTAL

First Digit	Occurren Of Digit	Frequency of First Digit	Predicted By Benford
One	364	21.31%	30.10%
Two	288	16.86%	17.61%
Three	227	13.29%	12.49%
Four	256	14.99%	9.69%
Five	186	10.89%	7.92%
Six	156	9.13%	6.69%
Seven	96	5.62%	5.80%
Eight	75	4.39%	5.12%
Nine	60	3.51%	4.58%
Total Number Of Data Points	**1708**		



Digit	1st	2nd	3rd	4th	5th or Greater higher
0		11.97%	10.18%	10.02%	10.00%
1	30.10%	11.39%	10.14%	10.01%	10.00%
2	17.61%	10.88%	10.10%	10.01%	10.00%
3	12.49%	10.43%	10.06%	10.01%	10.00%
4	9.69%	10.03%	10.02%	10.00%	10.00%
5	7.92%	9.67%	9.98%	10.00%	10.00%
6	6.69%	9.34%	9.94%	9.99%	10.00%
7	5.80%	9.04%	9.90%	9.99%	10.00%
8	5.12%	8.76%	9.86%	9.99%	10.00%
9	4.58%	8.50%	9.83%	9.98%	10.00%

#6.4.RESULTS INVESTOR LI01

Benford's Law

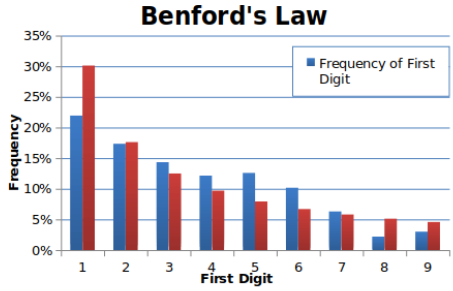
http://investexcel.net

Copy data into this column

DATA	FIRST DIGIT
19.62	1
78.48	7
305	3
185	1
45	4
83.32	8
7.86	7
57.49	5
28.43	2
4.21	4
29.2	2
68.05	6
38.93	3
76.26	7
39.13	3
39.13	3
18.56	1
7.56	7
48.69	4
41.06	4
17.56	1
26.08	2
33.04	3
27.25	2
2.66	2
64.84	6

ROBOCASH DATA INVESTOR LI01-TOTAL

First Digit	Occurren Of Digit	Frequency of First Digit	Predicted By Benford
One	300	21.95%	30.10%
Two	237	17.34%	17.61%
Three	196	14.34%	12.49%
Four	166	12.14%	9.69%
Five	172	12.58%	7.92%
Six	139	10.17%	6.69%
Seven	86	6.29%	5.80%
Eight	30	2.19%	5.12%
Nine	41	3.00%	4.58%
Total Number Of Data Points	**1367**		



Digit	1st	2nd	3rd	4th	5th or Greater higher
0		11.97%	10.18%	10.02%	10.00%
1	30.10%	11.39%	10.14%	10.01%	10.00%
2	17.61%	10.88%	10.10%	10.01%	10.00%
3	12.49%	10.43%	10.06%	10.01%	10.00%
4	9.69%	10.03%	10.02%	10.00%	10.00%
5	7.92%	9.67%	9.98%	10.00%	10.00%
6	6.69%	9.34%	9.94%	9.99%	10.00%
7	5.80%	9.04%	9.90%	9.99%	10.00%
8	5.12%	8.76%	9.86%	9.99%	10.00%
9	4.58%	8.50%	9.83%	9.98%	10.00%

#7.ASSESSMENT

-Foremost what is important for every investor:
The RoboCash platform is genuine. The results obey Benfords Law.

-The auto-invest settings influence the data, more than anticipated.

-The bigger the data set becomes, the more the data seems to obey to Benfords Law.

-There are Restrictions to Benfords Law.

-Benfords Law is an **INDICATOR.** In an audit it serves as circumstantial evidence.

-The interpretation should be assessed with due care.

#8.GUIDANCE, OBSERVATIONS & COMMENTS by investors and the ROBOCASH Platform

-A sidekick observation in manipulating the data sets was: none of the investors has loan parts of RC Riga Vietnam.
The explanation by RoboCash:
Removing a loan originator from the platform is a much less complicated process than adding one, and at the moment we don't discard the possibility that our Vietnamese company will need funding from the platform. This is why we prefer to keep RC Riga Vietnam on the platform until we are 100% sure our business in Vietnam won't need additional funding in the future. On the other hand, the loan originator's presence doesn't affect investors or the AI algorithms in any way.

-Investor ST saw immediately the fact that the data sets had to be large enough:
But if a "settlement" is defined as a village with population between 300 and 999, then Benfords law will not apply.[15][16] https://en.wikipedia.org/wiki/Benford%27s_law

-Loan amount and threshold levels at Loan Originators have a clear impact on the data sets:
Loan Originator SC: Loans amounts are typically concentrated around key credit limit threshold levels. For instance, we have a threshold of say 300 BGN for new customers and everyone that has applied for an amount larger than that (500-600 BGN) will be approved for max of 300 BGN and will likely withdraw 300 BGN from the company. This significantly skews the distribution. In our case we have significant concentration of loans around certain numbers which are entirely influenced by company policy.

-The auto-invest settings of the individual investor may impact the results significantly, especially when the data sets are smaller. One particular investor had the settings of taking always 10 or 20 Euro Loan Parts. This behavior impacted the results.

-Investor ME: Loans could be offered not uniformly for arbitrary amounts, but in graduated scales (possibly distorted by the currency conversion).

-Telegram user C observed:With presenting, cleaning and processing the data, you are in a way also responsible for how they interpret the data, depending on how you present it.
A warning we took to heart.

#9.THANKS

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