

## **Comparative analysis of Select Search Engines: An Experiment With Forecasting of Result Fluctuation Using Simple Keyword “Catchwork”**

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**Abstract:-** This paper presents an experiment with forecasting of result fluctuation in four major search engines- Google, Bing, Yahoo, and Baidu using simple keyword “Catchwork” in the field of Library and Information Science. The forecasting of search engines was carried out by time series analysis collecting 100 days of sampling and latter by method of trend projecting 50 days of forecast data was generated which was taken into evaluation. The evaluation reveals that Google shows huge negative secular trend while Bing also shows downward negative secular trend. Yahoo! shows a straight or neutral secular trend, while Baidu remarkable shows a positive secular trend producing a consistent growth in the database of Baidu in terms of results towards the simple term “Catchwork”.

**Keywords:-** Search engine, Result, Fluctuation, Catchwork, Counter, Index, Terms, Keywords.

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### **I. INTRODUCTION**

Web has procured it's vogue as an important source of information in last two decades. The major activity performed on Web is searching information for one's research purposes<sup>1,2</sup>, which can be accessed using various search engines<sup>3</sup>. However the results yielded for a number of queries rank in several thousand or even in millions due to the availability of infinite amount of information. However many studies show that only first few results are browsed by the users<sup>4,5,6,7</sup>, which determines the success of a search engine therefore result ranking holds utmost importance in this regard. Result ranking was merely based on term frequency and the inverse document frequency in case of classical IR system<sup>8</sup>. Various parameters are taken into account in Web search results ranking as number of links pointing to a given web page<sup>9,10</sup>, the anchor text of the links pointing to the web page, the placement of the search terms in the document (terms occurring in title or header may get a higher weight), the distance between the search terms, popularity of the page (in terms of the number of times it is visited), the text appearing in metatags<sup>11</sup>, subject specific authority of the web page<sup>12,13</sup>, recently in search index and exactness of the hits<sup>14</sup>. There is always an ongoing competition between search engines and Web page authors for users and high ranking respectively, which is why the algorithm ranking are kept a secret by the search engine companies as Google states<sup>10</sup>, "Due to the nature of our business and our interest in protecting the integrity of our search results, this is the only information we make available to the public about our ranking system". Apart from this search engines keep on updating and upgrading their algorithm so to improve their ranking of results. Nowadays search engine optimization industries are present which design and redesign Web pages in order to enhance their rankings within a specific search engine (e.g., search engine optimization Inc., [www.seoine.com/](http://www.seoine.com/)). Therefore in the crux it can be concluded that the First ten results retrieved for a query have major chances of being visited by the users. In addition to the examination of changes overtime for the top ten results related to a query of the largest search engine, which at the times of first data collection were Google, yahoo and Tacoma (MSN search came out if beta on Feb 1<sup>st</sup> 2005 in the midst of data collection for the second round<sup>15</sup>. However various transformations between the user's "visceral need" (a fuzzy view of the information problem in user's mind) and the "compromised need" (the way the query is phrased taking into account the limitations of the search tool at hand)<sup>16</sup>. Above all the fluctuation of a result related to a query can only be judged by the user while some researchers claim that it is impractical due to the presence of a large number of documents related to a query and all of them can't be viewed by the user, hence for checking fluctuation a panel of judges is required<sup>17,18</sup>.

### **II. PROBLEM**

In the beginning of the internet, it was easy to fine information using variety of software that was usually command driven rather than using a graphical interface. With the proliferation of information, systems

such as Archie, Gopher and Veronica became increasingly unable to cope with huge information. The advent of many types of search engines provided solution for literature search using Boolean operators, Proximity searching, Wild cards, Truncation etc. Many search engines developed new versions and techniques to achieve some kind of sophistication but all have not helped to forward the case of access and searching from scholar's perspective. Besides keeping in view different ways of indexing the internet, search engines operate in different ways and retrieve documents in different orders. Further, it does not sift information from scholar's point of view i.e., it retrieves information on a particular topic from different aspects like marketing, advertisement, news and entertainment mixed with some research papers. The academic community attempts to look purely for scholarly information on his topic of interest to have output/ retrieval best in terms of comprehensiveness and devoid of fluctuations etc.

The present investigation attempts to evaluate the performance of the select search engines in terms of result fluctuation captured in two phases to check the consistency of search engines.

### Objectives

The following objectives are laid down for the study:

- To select search engines.
- To select search term for the study.
- To collect data for 100 days.
- To compare trending by forecasting of time series analysis.

### III. METHOD

As certified by International Standard Organization there are 230 search engines<sup>19</sup> available for searching the web. These search engines are of various types like general search engine, robotic search engine, Meta search engine, directories and specialized search engines. Most users prefer robotic search engines as they allow the users to compose their own queries rather than simply follow pre specified search paths or hierarchy as in case of directories. Moreover, robotic search engines locate data in a similar way i.e., by the use of crawlers or worms. This distinguishing feature differentiates them from web directories like Yahoo! Where collections of links to retrieve URL's are created and maintained by subject experts or by means of some automated indexing process. However some of these services also include a robot driven search engine facility. But this is not their primary purposes. This due to this feature Yahoo! Was included for the study.

Meta search engine e.g., Dogpile etc don't have their own database. These access the database of many robotic search engines simultaneously. Thus these were excluded for the study.

Still hundreds of robotic general search engines navigate the web, in order to limit the scope of study after preliminary study, following criteria was laid down for selection of general search engines:-

- a) Availability of automated indexing
- b) Global coverage to data.
- c) Quick response time.
- d) Availability of result counter.

Following two general search engines were selected for the study for meeting all the criteria and being comprehensive in nature.

- a) Google.
- b) Baidu.

Since the study relates to the field of Library and Information Science but there is no specialized search engine in the subject so another specialized search engine which relates to the subject area i.e., Bing was taken for study. Thus the search engines undertaken for evaluation of study are:-

- a) Google (General)
- b) Bing (Specific)
- c) Yahoo! (Directory)
- d) Baidu (Country Specific General Search engine)

### IV. SELECTION OF TERMS

Selection of terms is not directly possible in development and multidimensional field like Library and Information Science. Therefore, classification schemes like DDC (18<sup>th</sup>) and DDC (22<sup>nd</sup>) were consulted to understand Broad/Narrow structure of Library and Information Science. It helped to get five terms/Fields i.e.,

Information System.

- a) Digital Library.
- b) Library Automation.
- c) Library Services.
- d) Librarianship.

These terms were then browsed in “LC list of subject Headings” which provided many other related terms (RT) and Narrow terms (NT). Further NT and RT attached to each other preferred or standard terms were also browsed which retrieve a large number of Library and Information Science terms. At first instance 140 Library and Information Science related terms were identified.

Some terms occurred more than once and duplication removed. It reduced the number to 100. Later terms were divided into three broad groups under:

- a) Application. b) Transformation. c) Inter-relation.

“Application” denotes utility of Library and Information science in various fields and about 50 terms came under this group. “Transformation” refers to a method of developing or manufacturing library services into practical market and 30 terms fall under this group. “Inter-relation” means transformation/dependence of one subject onto another and 20 terms came under this group.

Further each category is sub-divided into groups.

“Application” into four i.e., “Reference service”, “Informatics”, “Information Retrieval” & “Information Sources”. “Transformation” into two i.e., “Digitization” & “Consortia”. “Inter-relation” into two i.e., “Library Network” & “Information System”.

The terms in each group were arranged alphabetically and each term was given a tag. Later 19% of the terms were selected from each group using “Systematic Sampling” (i.e., first item selected randomly and next item after specific intervals). It further reduced the number to 19. Finally the selected terms were classified into three groups under “Simple”, “Compound” & “Complex Terms” (**Table:-1.0**). This was done in order to investigate how search engines control and handle simple and phrased terms.

“Simple Terms” containing a single word were submitted to the search engine in the natural form i.e., without punctuating marks. “Compound Terms” consisting of two words were submitted to the search engines in the form of phrases as suggested by respective search engines and “Complex Terms” composed of more than two words or phrases, were sent to the search engine with suitable Boolean operator “AND” & “OR” between the terms to perform special searches. From the simple terms the 1<sup>st</sup> term “*Catchwork*” was taken for the study.

S. No	Simple terms	Compound Terms	Complex Terms
1	Catchwork	Bibliometric Classification	Digital Library Open Source Software
2	Citation	Citation Analysis	Health Information System
3	Dublincore	Comparative Librarianship	Library Information System
4	Indexing	Digital Preservation	Library Information Network
5	Manuscript	Electronic Repositories	Multimedia Information Retrieval
6	Plagiarism	Library Automation	
7	Reprints	Semantic web	

Table 1.0: Keywords

## V. FLUCTUATION

The amount of information on the web keeps on changing as documents are added, removed or modified. These quantitative and qualitative changes are expressed as fluctuations. The quantitative changes are expressed as “Result Fluctuations” and the qualitative changes are expressed as “Document” and “Indexing Fluctuations”. A fluctuation may show decrease or increase in number of documents. However, growth in size of the database is a continuous and usual routine of the search engines. Thus increase and decrease is taken into account here.

A “Result Fluctuation” appears when a search engine show increase/decrease in total number of results for a query that is searched at two different intervals of time. In other words the total number of results retrieved for a query in second observation may be less as retrieved in the first observation. Thus result fluctuation appears when there is increase/decrease in the number of results for a query tested over time i.e., the number of results in succeeding observation may be more or less than the results of the preceding observation.

### Forecasting of Result Fluctuation: A time series analysis using Trend Projection Method

A forecast is an estimate of a future event achieved by systematically combining and casting forward in predetermined way from the data about the past. It is simply a statement about the future prediction. Forecasts are possible only when a history of data exists. The study collected 100 days of data samples from four search engine out of seven as result-counter was available with Google, Bing, Yahoo and Baidu. The data collection was carried on 15<sup>th</sup> May, 2016 and ended on 18<sup>th</sup> of August, 2016 collecting 100 samples for keyword “*Catchwork*” in four search engines **Table:-1.1**.

For forecasting process few points were taken into consideration as:

- 1) Fluctuation of search results and sustainability
- 2) 100 days of data sampling were taken into consideration (**Table:- 1.1**).

- 3) As the data is seasonal, Trend Projection Method was taken into consideration.
- 4) Total results were taken from result search counter of search engine.
- 5) A forecast of 50 days was generated (Table-1.2).
- 6) The results were evaluated on a scattered graph with regression line

Table 1.1:- Time series data for forecasting of Select Search engines for the keyword “Catchwork”

Days (t)	Google			Bing			Yahoo!			Baidu		
	Result (Y <sub>t</sub> )	Multiplication of Days and Results (tY <sub>t</sub> )	Square of Days (t) <sup>2</sup>	Result (Y <sub>t</sub> )	Multiplication of Days and Results (te <sub>avg</sub> )	Square of Days (t) <sup>2</sup>	Result (Y <sub>t</sub> )	Multiplication of Days and Results (tY <sub>t</sub> )	Square of Days (t) <sup>2</sup>	Result (Y <sub>t</sub> )	Multiplication of Days and Results (tY <sub>t</sub> )	Square of Days (t) <sup>2</sup>
1	31500	31500	1	10700	10700	1	6940	6940	1	390000	390000	1
2	31400	62800	4	10300	20600	4	6880	13760	4	390000	780000	4
3	31600	94800	9	10300	30900	9	7050	21150	9	390000	1170000	9
4	31500	126000	16	10400	41600	16	7000	28000	16	390000	1560000	16
5	31500	157500	25	11500	57500	25	6920	34600	25	390000	1950000	25
6	31700	190200	36	11600	69600	36	6910	41460	36	400000	2400000	36
7	31800	222600	49	11300	79100	49	6940	48580	49	400000	2800000	49
8	31900	255200	64	11300	90400	64	6980	55840	64	400000	3200000	64
9	31800	286200	81	11200	100800	81	6800	61200	81	400000	3600000	81
10	32200	322000	100	11200	112000	100	6840	68400	100	389000	3890000	100
11	32100	353100	121	11200	123200	121	6850	75350	121	393000	4323000	121
12	32300	387600	144	10000	120000	144	6800	81600	144	393000	4716000	144
13	32300	419900	169	10000	130000	169	6780	88140	169	393000	5109000	169
14	32600	456400	196	8070	112980	196	6900	96600	196	379000	5306800	196
15	32600	489000	225	7490	112350	225	6920	103800	225	501000	7515000	225
16	34300	548800	256	6700	107200	256	6940	111040	256	375000	6000000	256
17	34300	583100	289	6700	113900	289	6940	117980	289	375000	6375000	289
18	34500	621000	324	7580	136440	324	6930	124740	324	375000	6750000	324
19	34500	655500	361	7380	140220	361	7010	133190	361	375000	7125000	361
20	34300	686000	400	6700	134000	400	6940	138800	400	375000	7500000	400
21	34700	728700	441	8310	174510	441	7070	148470	441	392000	8232000	441
22	35600	783200	484	8310	182820	484	7040	154880	484	392000	8624000	484
23	32300	742900	529	10000	230000	529	6780	155940	529	393000	9039000	529
24	32600	782400	576	8070	193680	576	6900	165600	576	379000	9096000	576
25	37600	940000	625	8550	213750	625	7060	176500	625	388000	9700000	625
26	39800	1034800	676	9020	234520	676	7010	182260	676	388000	10088800	676
27	39600	1069200	729	9020	243540	729	7050	190350	729	388000	10476000	729
28	41300	1156400	784	9260	259280	784	6990	195720	784	389000	10892000	784
29	41500	1203500	841	9270	268830	841	7010	203290	841	389000	11281000	841
30	42500	1275000	900	9370	281100	900	6940	208200	900	389000	11670000	900
31	43700	1354700	961	9540	295740	961	7100	220100	961	407000	12617000	961
32	39800	1273600	1024	9020	288640	1024	7010	224320	1024	388000	12416000	1024
33	39600	1306800	1089	9020	297660	1089	7050	232650	1089	388000	12804000	1089

34	41300	1404200	1156	9260	314840	1156	6990	237660	1156	389000	13226000	1156
35	52900	1851500	1225	8570	299950	1225	7180	251300	1225	418000	14630000	1225
36	52600	1893600	1296	8720	313920	1296	6940	249840	1296	418000	15048000	1296
37	52200	1931400	1369	8720	322640	1369	6890	254930	1369	418000	15466000	1369
38	52400	1991200	1444	8430	320340	1444	6860	260680	1444	409000	15542000	1444
39	52600	2051400	1521	8440	329160	1521	6980	272220	1521	409000	15951000	1521
40	52700	2108000	1600	8560	342400	1600	7040	281600	1600	409000	16360000	1600
41	52900	2168900	1681	8570	351370	1681	7180	294380	1681	418000	17138000	1681
42	52600	2209200	1764	8720	366240	1764	6940	291480	1764	418000	17556000	1764
43	52200	2244600	1849	8720	374960	1849	6890	296270	1849	418000	17974000	1849
44	42200	1856800	1936	8610	378840	1936	7140	314160	1936	398000	17512000	1936
45	37200	1674000	2025	8940	402300	2025	7000	315000	2025	398000	17910000	2025
46	36200	1665200	2116	8990	413540	2116	6960	320160	2116	395000	18170000	2116
47	37200	1748400	2209	8940	420180	2209	7000	329000	2209	398000	18706000	2209
48	35700	1713600	2304	8820	423360	2304	7090	340320	2304	395000	18960000	2304
49	35400	1734600	2401	8750	428750	2401	7210	353290	2401	395000	19355000	2401
50	34900	1745000	2500	8590	429500	2500	7310	365500	2500	394000	19700000	2500
51	34400	1754400	2601	8590	438090	2601	7110	362610	2601	394000	20094000	2601
52	34600	1799200	2704	8570	445640	2704	7050	366600	2704	396000	20592000	2704
53	34400	1823200	2809	8590	455270	2809	7110	376830	2809	394000	20882000	2809
54	39000	1782000	2916	7970	430380	2916	6960	375840	2916	396000	21384000	2916
55	32500	1787500	3025	7970	438350	3025	6870	377850	3025	398000	21890000	3025
56	32200	1803200	3136	8030	449680	3136	6880	385280	3136	398000	22288000	3136
57	31800	1812600	3249	8030	457710	3249	6880	392160	3249	398000	22686000	3249
58	31500	1827000	3364	7960	461680	3364	6920	401360	3364	401000	23258000	3364
59	31100	1834900	3481	8300	489700	3481	6930	408870	3481	401000	23659000	3481
60	31200	1872000	3600	8300	498000	3600	6930	415800	3600	410000	24600000	3600
61	31000	1891000	3721	8260	503860	3721	6900	420900	3721	410000	25010000	3721
62	30900	1915800	3844	8080	500960	3844	6880	426560	3844	410000	25420000	3844
63	30900	1946700	3969	8120	511560	3969	7020	442260	3969	408000	25704000	3969
64	30900	1977600	4096	8210	525440	4096	7140	456960	4096	408000	26112000	4096
65	31000	2015000	4225	7880	512200	4225	8060	523900	4225	413000	26845000	4225
66	31000	2046000	4356	7650	504900	4356	8030	529980	4356	413000	27258000	4356
67	30800	2063600	4489	7650	512550	4489	8030	538010	4489	413000	27671000	4489
68	30500	2074000	4624	7700	523600	4624	8150	554200	4624	412000	28016000	4624
69	30600	2111400	4761	7700	531300	4761	8150	562350	4761	412000	28428000	4761
70	30800	2156000	4900	7700	539000	4900	7760	532000	4900	412000	28840000	4900
71	30700	2179700	5041	7350	521850	5041	7760	550960	5041	409000	29039000	5041
72	30700	2210400	5184	7620	548640	5184	6930	498960	5184	409000	29448000	5184
73	30600	2233800	5329	7420	541660	5329	7430	542390	5329	404000	29492000	5329

74	30800	2279200	5476	7430	549820	5476	6810	503940	5476	404000	29896000	5476
75	30700	2302500	5625	7000	525000	5625	7040	528000	5625	404000	30300000	5625
76	30700	2333200	5776	7200	547200	5776	7180	545680	5776	388000	29488000	5776
77	31100	2394700	5929	7200	554400	5929	7180	552860	5929	388000	29876000	5929
78	31100	2425800	6084	7050	549900	6084	7180	560040	6084	401000	31278000	6084
79	31100	2456900	6241	7110	561690	6241	6830	539570	6241	407000	32153000	6241
80	31100	2488000	6400	7050	564000	6400	7180	574400	6400	401000	32080000	6400
81	31100	2519100	6561	6960	563760	6561	6710	543510	6561	407000	32967000	6561
82	30600	2509200	6724	7320	600240	6724	6740	552680	6724	407000	33374000	6724
83	31100	2581300	6889	7050	585150	6889	7180	595940	6889	401000	33283000	6889
84	31100	2612400	7056	6960	584640	7056	6710	563640	7056	407000	34188000	7056
85	30100	2558500	7225	7680	652800	7225	6660	566100	7225	436000	37060000	7225
86	29900	2571400	7396	7790	669940	7396	6660	572760	7396	436000	37496000	7396
87	29900	2601300	7569	7990	695130	7569	8010	696870	7569	429000	37323000	7569
88	29800	2622400	7744	8090	711920	7744	6730	592240	7744	429000	37752000	7744
89	29800	2652200	7921	8160	726240	7921	8290	737810	7921	429000	38181000	7921
90	29900	2691000	8100	8250	742500	8100	7060	635400	8100	416000	37440000	8100
91	29800	2711800	8281	8250	750750	8281	7050	641550	8281	416000	37856000	8281
92	29500	2714000	8464	7990	735080	8464	6960	640320	8464	416000	38272000	8464
93	29400	2734200	8649	8040	747720	8649	6850	637050	8649	402000	37386000	8649
94	29500	2773000	8836	7990	751060	8836	6960	654240	8836	416000	39104000	8836
95	29400	2793000	9025	8000	760000	9025	6780	644100	9025	402000	38190000	9025
96	29500	2832000	9216	7840	752640	9216	6700	643200	9216	403000	38688000	9216
97	29500	2861500	9409	7900	766300	9409	6700	649900	9409	403000	39091000	9409
98	29500	2891000	9604	7900	774200	9604	6680	654640	9604	402000	39396000	9604
99	29600	2930400	9801	8000	792000	9801	6690	662310	9801	402000	39798000	9801
100	29700	2970000	10000	7740	774000	10000	6750	675000	10000	403000	40300000	10000
$\Sigma t$	$\Sigma(Y_t)$	$\Sigma tY_t$	$\Sigma(t)^2$	$\Sigma(Y_t)$	$\Sigma tY_t$	$\Sigma(t)^2$	$\Sigma(Y_t)$	$\Sigma tY_t$	$\Sigma(t)^2$	$\Sigma(Y_t)$	$\Sigma tY_t$	$\Sigma(t)^2$
5050	3466900	168319000	338350	846320	40569950	338350	705030	35754820	338350	40214000	2049430000	338350

### Trend Projections:

This time-series forecasting method fits a trend line to a series of historical data points and then projects the line into the future for medium- to long range forecasts. The research has described the trend component with a line visually to a set of points on a graph. The graph, however, is subject to slightly different interpretations. There are three types of trend projection viz.,

- 1) Positive Secular Trend or Upward Secular Trend:- it describes the data into an upward or raising trend line.
- 2) Negative Secular Trend or Downward Secular Trend:- it describes the data into a lowering trend line
- 3) Neutral Secular Trend or Straight Secular Trend:- no changes the data is consistent.

For the study 400 samples were taken into account to generate 200 results of projected data which are described in graphs.

The formula derived for the study is:-

$$t_t = b_0 + b_1 t$$

$b_0$  and  $b_1$  can be derived as:

$$b_0 = \bar{y} - b_1 \bar{t}$$

$$b_1 = \frac{n \Sigma t y_t - \Sigma t \Sigma y_t}{n \Sigma t^2 - (\Sigma t)^2}$$

Where

$t$  = days

$y_t$  = Result of the search query

The projected result **Table 1.2**, shows a vast fluctuation both in terms of positive Secular trend and negative secular trend. The estimate is given by a trending line.

**Table 1.2:- Projected data using trend projection method for 50 days for the keyword “Catchwork”**

Days	Google	Bing	Yahoo!	Baidu
1	30572	7149	7142	413427
2	30258	7117	7145	413851
3	29920	7078	7147	414276
4	29564	7040	7152	414703
5	29182	7007	7157	415130
6	28776	7000	7160	415558
7	28348	7002	7162	416229
8	27895	7001	7165	416928
9	27416	7006	7169	417659
10	26905	7014	7169	418421
11	26372	7027	7169	418924
12	25804	7047	7169	419538
13	25207	7040	7167	420164
14	24574	7036	7164	420803

15	23911	6979	7164	421049
16	23208	6902	7164	424884
17	22516	6796	7164	425289
18	21785	6681	7164	425662
19	21020	6586	7164	425999
20	20213	6478	7165	426298
21	19355	6341	7165	426555
22	18463	6247	7168	427333
23	17551	6148	7170	428126
24	16478	6103	7164	428970
25	15350	5991	7161	429342
26	14335	5891	7162	430000
27	13348	5802	7162	430655
28	12310	5711	7164	431308
29	11287	5627	7163	431993
30	10230	5540	7162	432677
31	9166	5455	7159	433358
32	8108	5375	7161	434745
33	6855	5274	7159	435449
34	5534	5169	7159	436146
35	4221	5070	7157	436877
36	3333	4941	7162	438816
37	2427	4811	7157	440889
38	1497	4676	7149	443105
39	567	4523	7139	445081
40	-361	4363	7133	447174
41	-1289	4200	7129	449392
42	-2212	4029	7131	452153
43	-3149	3858	7122	455103
44	-4107	3678	7110	458256
45	-5541	3485	7108	460680
46	-7270	3298	7099	463226
47	-9135	3105	7088	465756
48	-11050	2902	7077	468553
49	-13139	2683	7069	471346
50	-15356	2450	7067	474275

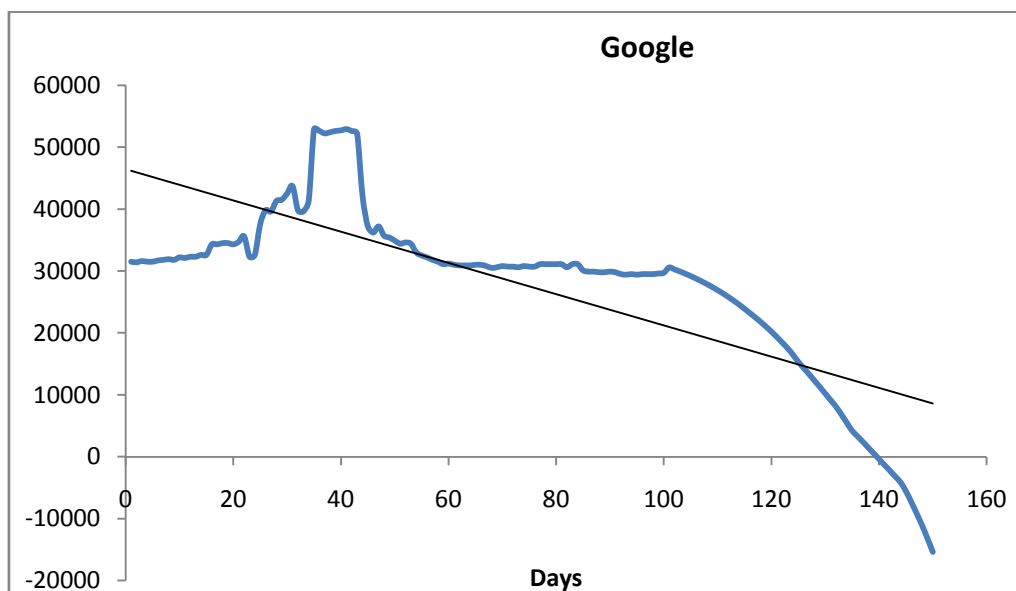


Fig 1.3:- Negative Secular Trend of Google for the keyword “Catchwork”

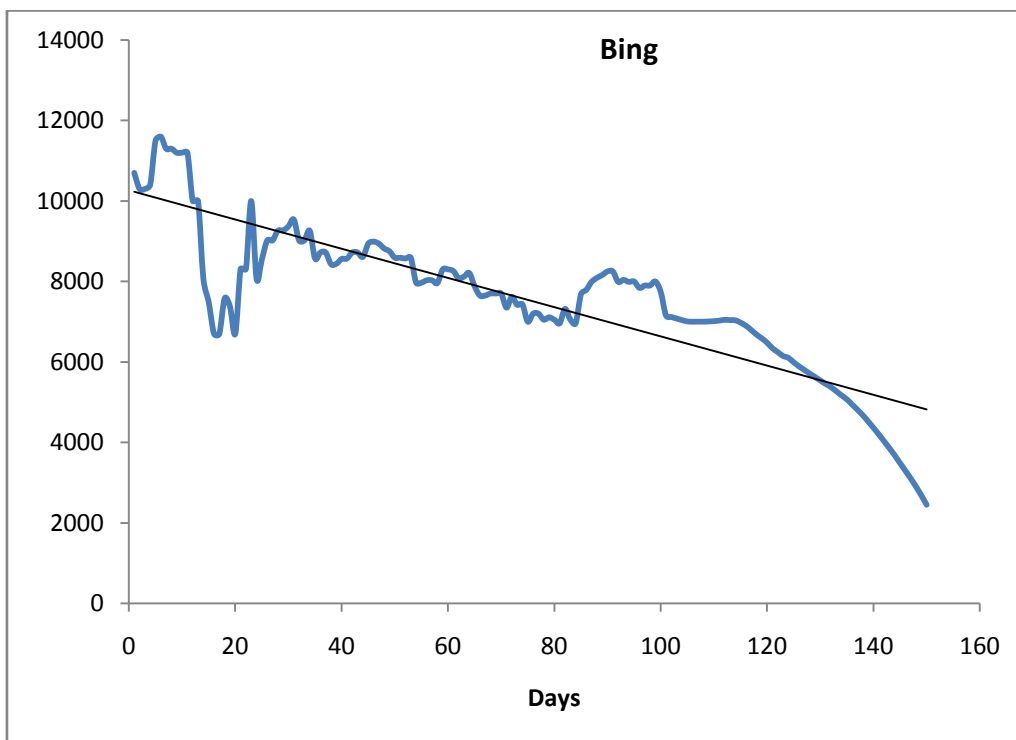


Fig 1.4:- Negative Secular Trend of Bing for the keyword "Catchwork"

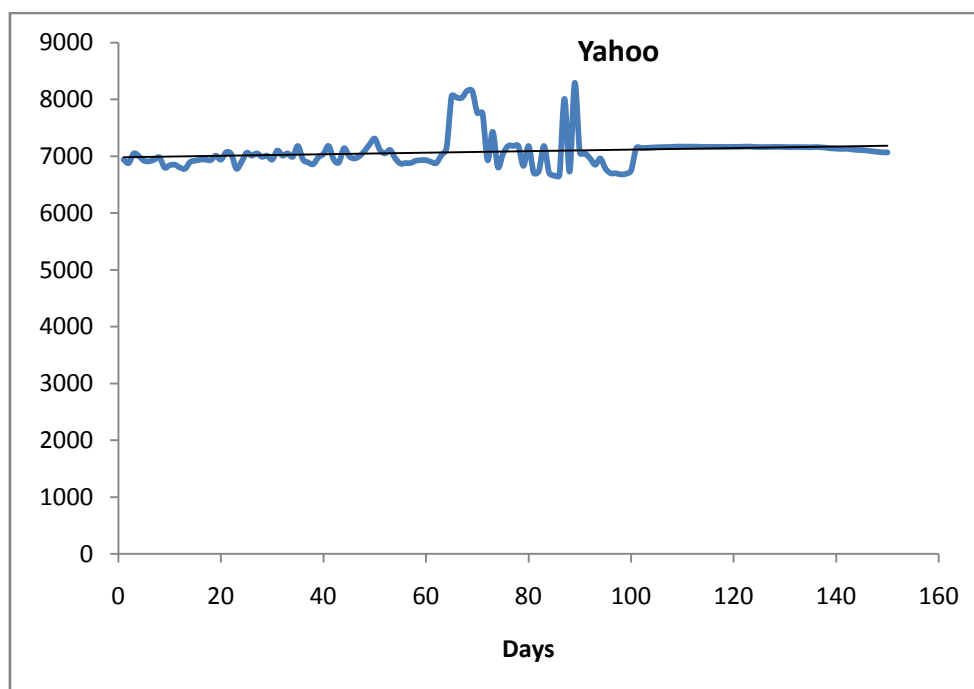
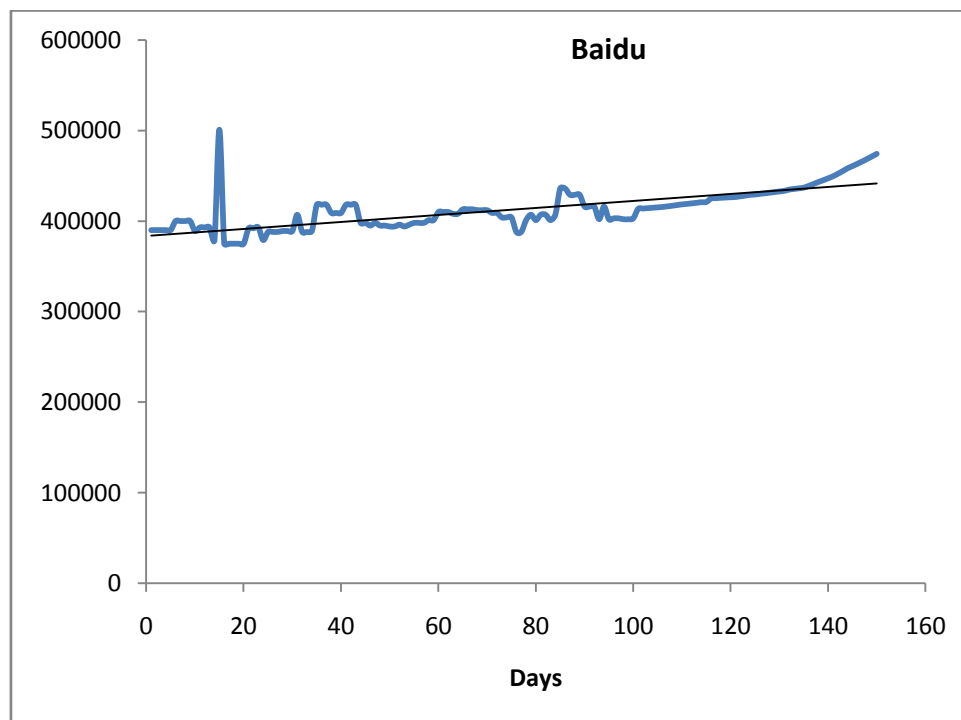


Fig 1.5:- Straight Secular Trend of Yahoo! for the keyword "Catchwork"





**Fig 1.6:- Positive Secular Trend of Baidu for the keyword “Catchwork”**

The trending of the search engines reveal that Google shows huge negative secular trend while Bing also shows negative secular trend. Yahoo! Shows a straight or neutral secular trend, Baidu remarkable shows a positive secular trend. The data forecasted show a consistent growth in the database of Baidu in terms of result fluctuation. Google drops down showing down secular trending resulting loss in database.

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