

MAPPING RESEARCH PRODUCTIVITY OF BIOINFORMATICS SCHOLARLY COMMUNICATION DURING 2010 TO 2019: A SCIENTOMETRIC STUDY

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ABSTRACT--The present paper explains the Mapping Research Productivity of Bioinformatics scholarly Communication during 2010 to 2019: A Scientometric Study. The data analyzed the Scopus Database and searching key word of Bioinformatics. The study reveals the year wise publications, analyze the Relative Growth Rate and Doubling Time, Top ten Prolific Authors, Top Ten Rank Subject Area, Document Type, Source Title, Country wise publications and keyword search. The result analyzed the year wise publications in year 2019 more number of publications 15394 (16.32%), Among the 10 year's period of Research Growth trend has research increase from 0.63 in 2011 and 0.18 in 2019 and doubling time during increased from 1.09 to 4.21 in 2018. Author "Chen, G" contributed 109 publications (15.08%) is more numbers, Top Ten Rank Subject Area an Agricultural and Biological Sciences (10.63%) secured as a first position, majority an "Articles" (61.42%) contributed in the Bioinformatics research.

Keywords--Scientometric Study, Bioinformatics and Scopus Database

I. INTRODUCTION

Scientometrics term introduced by Nalimov and Mulchenko (1969) is the application of these quantitative methods which are dealing with the analysis of science viewed as an information process".Scientometrics is a discipline which analyses scientific publications and citations appended to the papers to gain an understanding of the structure of science, growth of science at global level, performance of a country in a particular domain, performance of institutions, departments/divisions, and scientific eminence of an individual scientist. (Sagar et al 2009).

Bioinformatics means Biology related subjects of Physiology, Biotechnology and allied subjects to relate in the science disciplines of analysis of molecular and genomic related study, Gene, development of database and management systems etc

1.1. Mapping of Science

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A map of science can be defined as “the visualization of the topology of relationships between elements or aspects of science.” It can be useful for three purposes: retrieving information, the dynamics of science, and informing science-policy decisions about the funding of resources and rewards.

The scientometric analysis focuses on revealing the internal structure of intellectual domains, which is, mapping the components of disciplines, specialties on the basis of evidence from the literatures under study. This can be achieved by mapping subject terms, documents, authors’ *œuvres*, or journals. The basic data are co-occurrence counts.

II. REVIEW OF LITERATURE:

Velmurugan (2019) published an article “Mapping of Nephrology Research Performance of Global Scientists in Science Citation Index Expanded.” The data collected from the Web of Science citation database during the period 2006 -2015. This study analyzed the total of 23, 335 publications and average number of publications published was 2333.5 and the highest numbers of publications (3357) in 2015. It is conclude the study the broad features of literature on global warming focusing on year wise growth of publications, most prolific authors, highly productive institutes, highly productive countries, language wise distributions of publications, high productive subject areas and most preferred journals for publications by scientists in the Nephrology Research.

Murugan (2019) published on article an ‘Eye Disease’ Research Output during 2009-2018: Scientometric Study the recent years as using scientometric analysis for determining scientific trends in journal collaboration and growth. The present study has collected the data were PubMed database using the Keyword search an Eye disease from 2009 to 2018. It is found that the total number of 165,083 records are eye diseases during 2009 to 2018. The most of the accurate records is found in 2015, 19264(11.66%), the Female, 42466 (61.23%) is more, an article types publication of rare eye diseases are naturally majority of the case reports and Classical Articles are same category (49.27%), totally 9,717 documents are exposed in the journal category, In 2014, 5350 (12.04%) are top most level of Species - Human and majority of the records are scientifically derived from an AIDS 28469 (97.38%).

The present study has in common an eye disease. It is more number of records are found in more number of females, year reasonable an article type’s publication of eye diseases are majority of the case reports and Classical Articles are in the study

Sab et al. (2017) carried out a study on “Mapping of Indian Biomedicine Research: A Scientometric Analysis of Research Output During 2012 – 2016.” It is based on the global level of the study shows the total publication output, its growth rate, quality of papers published and rank of India. It analyzed the patterns of international collaborative research output and the major partner institutions of India.

The publication data on biomedicine has been retrieved by using Web of Science database. The study as a result of total number of 2712 publications and insignificant growth in Biomedicine literature published from India. The high quality research in India is grossly inadequate and requires strategic planning, investment and resource support, need to improve the existing biomedical education system.

III. OBJECTIVES OF THE STUDY:

The following objectives of the study are below:

- To carry out the year wise distribution of Bio Informatics Research Publications
- To analyze the Relative Growth Rate and Doubling Time.
- To measure the Block wise Productivity
- To identify the top ten Prolific Authors wise Publications
- To reveals the Top Ten Rank Subject Area wise publications
- To analyzed the distribution of Document Type wise Publications
- To investigate the distribution of Source Title wise Publications
- To identify the Country wise and
- To analyzed the Keywords.

IV. DATA SOURCE:

The present study data have collected from the Scopus Database and using the keyword search for Bioinformatics of during the period 2010 to 2018 up to 10 years.

4.1. Analysis of Data:

Table.1. Year Wise Distribution of the Bio Informatics Research Publications

S.No	Year	No.of Publications	Percentage	Cumulative	Cumulative Percentage
1	2010	8160	8.65	8160	8.65
2	2011	7227	7.66	15387	16.31
3	2012	6576	6.97	21963	23.28
4	2013	6790	7.20	28753	30.48
5	2014	8406	8.91	37159	39.39
6	2015	9456	10.02	46615	49.41
7	2016	9106	9.65	55721	59.06
8	2017	11240	11.91	66961	70.97
9	2018	11993	12.71	78954	83.68
10	2019	15394	16.32	94348	100.00
Total		94348	100.00		

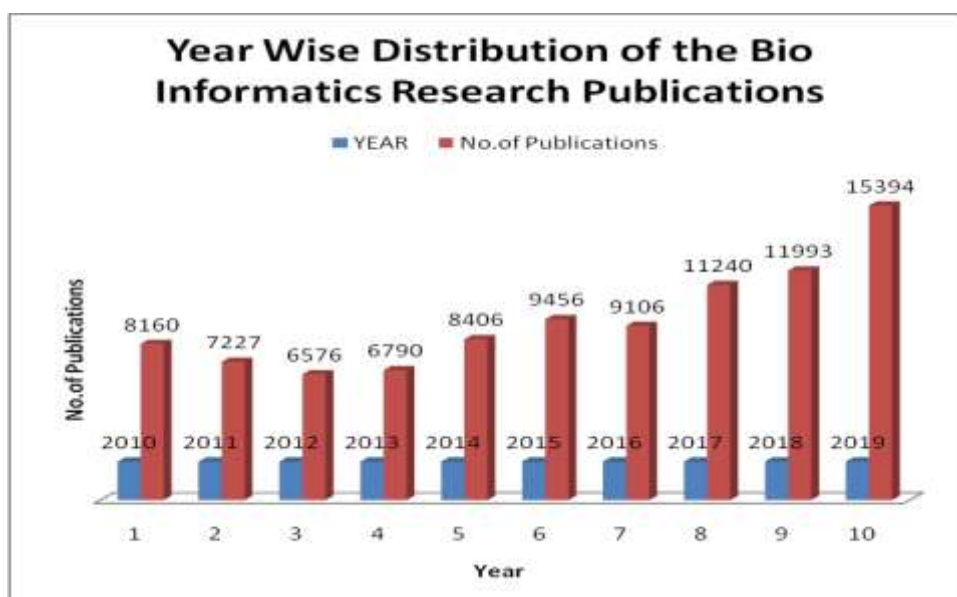


Figure.1

Table one reveals the Year Wise Distribution of the Bio Informatics Research Publications during the year 2010 - 2019. The Mapping Research Productivity of Bioinformatics of the scholarly Communication is among the ten years found in totally 94,348 publications. In 2010, 8160 publications (8.65%) followed by year 2011, 7227 (7.66%), in 2012, 6576 (6.97%), in 2013, 6790 (7.20%), in 2014, 8406 (8.91%), in 2015, 9456 (10.02%), in 2016, 9106 (9.65%), in 2017, 11240 (11.91%), in 2018, 11993 (12.71%), in 2019, 15394 (16.32%). The study reveals the Mapping Research Productivity of Bioinformatics of the scholarly Communication in year 2019 more number of publications 15394 (16.32%) and followed by the year 2015 (12.71%) and lowest number of published in year 2012 (6.97%) and represents the figure.1.

V. RELATIVE GROWTH RATE:

The relative Growth rate and Doubling Time model was developed by Mahapatra and applied to examined the relative Growth Rate of research publications. The relative Growth rate is increased in the number of publications or pages per unit of time and can be calculated from the following equations.

$$= R(1-2) \quad W2_W1/T2-T1$$

Where, $R(1-2)$ is mean Relative Growth Rate over the specified period

$W1 = \text{Log } W1$: (Natural log of initial number of publications/pages)

$W2 = \text{Log } W2$: (Natural log of final number of publications/pages)

$T2-T1$ = The Unit difference between the Initial time and Final time

The relative Growth rate for both publications and pages can be calculated separately.

Therefore,

$R_{(a)}$ = Relative growth rate per unit of time (Year)

$R_{(p)}$ = Relative growth rate per unit of pages, per unit of time

VI. DOUBLING TIME:

From the calculation, it is found that there is a direct equivalence existing between the relative Growth rates and Doubling time. If the number of publications/pages of a subject doubles during the given period, then the difference between the logarithm of the numbers at the beginning and at the end of the period must be the logarithms of the number two. If one uses a natural logarithm, this difference has a value of 0.693. The corresponding doubling time for publications and pages can be calculated by using the following table.

Table.2.Relative Growth and Doubling Time Year wise Bio Informatics Publications

Years	Publication	Cumulative	w1	w2	R(a)	Mean(a)1-2	Doubling Time	Mean pt (a)1-2
2010	8160	8160		9.01	-	0.30	-	1.66
2011	7227	15387	9.01	9.64	0.63		1.09	
2012	6576	21963	9.64	10.00	0.36		1.95	
2013	6790	28753	10.00	10.27	0.27		2.57	
2014	8406	37159	10.27	10.52	0.26		2.70	
2015	9456	46615	10.52	10.75	0.23	0.19	3.06	3.76
2016	9106	55721	10.75	10.93	0.18		3.88	
2017	11240	66961	10.93	11.11	0.18		3.77	
2018	11993	78954	11.11	11.28	0.16		4.21	
2019	15394	94348	11.28	11.45	0.18		3.89	
Total	94348					0.24		2.71

Tables two reveal the Relative Growth and Doubling Time Year wise Bio Informatics Publications. Totally 94348 publications, in 10 years of this period have research increase from 0.63 in 2011 and 0.18 and 2016. 2018 and 2019 are lowest growth rate. The present study period indicate the highest Doubling Time in 2018 has 4.21 and lowest Doubling Time in year 2011 has 1.09.

Table.3. Block wise Bioinformatics scholarly Communication Productivity

Blocks	Total No. of Publications	Percentage
2010-2014	37159	39.39
2015-2019	57189	60.61
Total	94348	100.00
Average Per Publication Block $94348/2 = 47174$		

In table 3 shows the Research productivity Bioinformatics scholarly Communication during the period 2010- 2019 totally 94348 records are found and with in average publications is 47174. It can be observed year 2010 – 2014 has normal growth and compared to 2015 – 2019 has increased and growth period in publications

over the study period. The study conclude the gradually increase the growth trend of the Bioinformatics publications.

Table.4. Distribution of Top Ten Prolific Authors wise Publications

Sl.No	Author Name	No.of publications	Percentage	Cumulative	Cumulative Percentage
1	Chen, G.	109	15.08	109	15.08
2	Wang, J.	78	10.79	187	25.86
3	Cannataro, M.	76	10.51	263	36.38
4	Martens, L.	75	10.37	338	46.75
5	Pérez-Jiménez, M.J.	69	9.54	407	56.29
6	Gasser, R.B.	66	9.13	473	65.42
7	Guzzi, P.H.	65	8.99	538	74.41
8	Shehu, A.	63	8.71	601	83.13
9	Wu, F.X.	63	8.71	664	91.84
10	Romero, E.	59	8.16	723	100.00
Total		723	100.00		

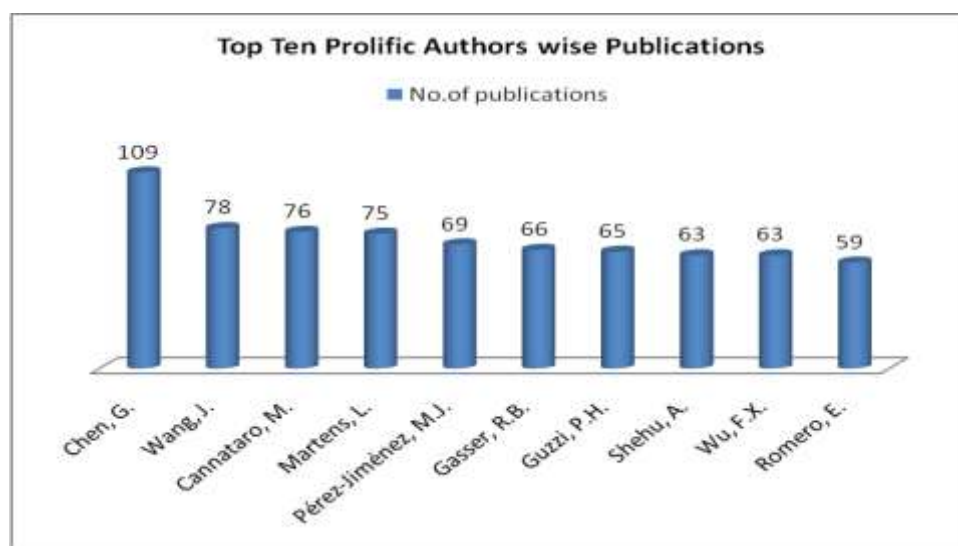


Figure.2

Table 4 shows that the distribution of top ten Prolific Authors wise Publications. Out of 723, Author “Chen, G” contributed 109 publications (15.08%) followed by “Wang, J” 78 publications (10.79%), “Cannataro, M” 76 publications (10.51%), “Martens, L” 75 (10.37%), “Pérez-Jiménez, M.J” , 69 (9.54%), “Gasser, R.B”, 66 (9.13%), “Guzzi, P.H”65 (8.99%), “Shehu, A”, “Wu, F.X” 36 (8.71%) and author “Romero, E” 59 (8.16%).The author Chen, G” contributed 109 publications (15.08%) with first position and followed by Wang, J” 78 publications (10.79%) and figure two represents the distribution of top ten Prolific Authors wise Publications.

Table. 5. Top Ten Rank Subject Area wise publications

S.No	Subject Area	No.of Publications	Percentage	Rank
1	Agricultural and Biological Sciences	9201	10.63	1
2	Arts and Humanities	148	0.17	2
3	Biochemistry, Genetics and Molecular Biology	41694	48.17	3
4	Business, Management and Accounting	357	0.41	4
5	Chemical Engineering	3763	4.35	5
6	Chemistry	5582	6.45	6
7	Computer Science	24558	28.37	7
8	Decision Sciences	846	0.98	8
9	Dentistry	162	0.19	9
10	Earth and Planetary Sciences	244	0.28	10
Total		86555	100.00	

It is evident from the table 5 shows that the Top Ten Rank Subject Area wise publications. Totally 86555 publications, the maximum number of publications found an Agricultural and Biological Sciences with 9201 (10.63%) occupy in the first position followed by Arts and Humanities, 148 (0.17%) as a second rank, Biochemistry, Genetics and Molecular Biology with 41694 publications (48.17%) are more publications occupied in third rank, Business, Management and Accounting, 357 (0.41%) in fourth rank, fifth rank of Chemical Engineering with 3763 (4.35%), Chemistry as a sixth ranked with 5582 publications (6.45%), Computer Science followed by a seventh ranked, 24558 (28.37%), Decision Sciences as a eight ranked with 846 (0.98%), Dentistry with 162 publications (0.19%) secured as a ninth position and Earth and Planetary Sciences got it tenth ranked .244(0.28%) of the Bioinformatics research Publication trend.

Table. 6. Distribution of Document Type wise Publications

Sl.No	Document Type	No.of Records	Percentage
1	Article	57947	61.42
2	Conference Paper	23195	24.58
3	Review	5439	5.76
4	Editorial	2759	2.92
5	Book Chapter	2431	2.58
6	Note	686	0.73
7	Short Survey	372	0.39
8	Letter	362	0.38

9	Book	357	0.38
10	Erratum	318	0.34
11	Conference Review	289	0.31
12	Data Paper	51	0.05
13	Retracted	24	0.03
14	Undefined	118	0.13
Total		94348	100.00

Table 6 denotes the Distribution of Document Type wise Publications. Out of 94,348, Most of the articles with 57,947 records (61.42%) followed by Conference Paper, 23195 (24.58%), Review , 5439 (5.76%), Editorial, 2759 (2.92%), Book Chapter, 2431 (2.58%), Note, 686 (0.73%), Short Survey, 372 (0.39%), Letter, 362 (0.38%), Book, 357 (0.38%), Erratum, (318 (0.34%), Conference Review, 289 (.31%), Data Paper, 51 (0.05%), Retracted, 24 (0.03%) and undefined , 118 (0.13%).

Table. 7. Distribution of Source Title wise Publications

S.No	Source title	No. of Records	Percentage	Cumulative	Cumulative Percentage
1	Lecture Notes In Computer Science Including Subseries Lecture Notes In Artificial Intelligence And Lecture Notes In Bioinformatics	5097	28.98	5097	28.98
2	PLOS One	2317	13.18	7414	42.16
3	2010 4th International Conference On Bioinformatics And Biomedical Engineering Icbbe 2010	2018	11.48	9432	53.64
4	Bioinformatics	1591	9.05	11023	62.68
5	5th International Conference On Bioinformatics And Biomedical Engineering Icbbe 2011	1432	8.14	12455	70.83
6	BMC Bioinformatics	1262	7.18	13717	78.00
7	Frontiers In Microbiology	1155	6.57	14872	84.57
8	Methods In Molecular Biology	996	5.66	15868	90.24
9	International Journal Of Molecular Sciences	937	5.33	16805	95.56

10	BMC Genomics	780	4.44	17585	100.00
Total		17585	100.00		

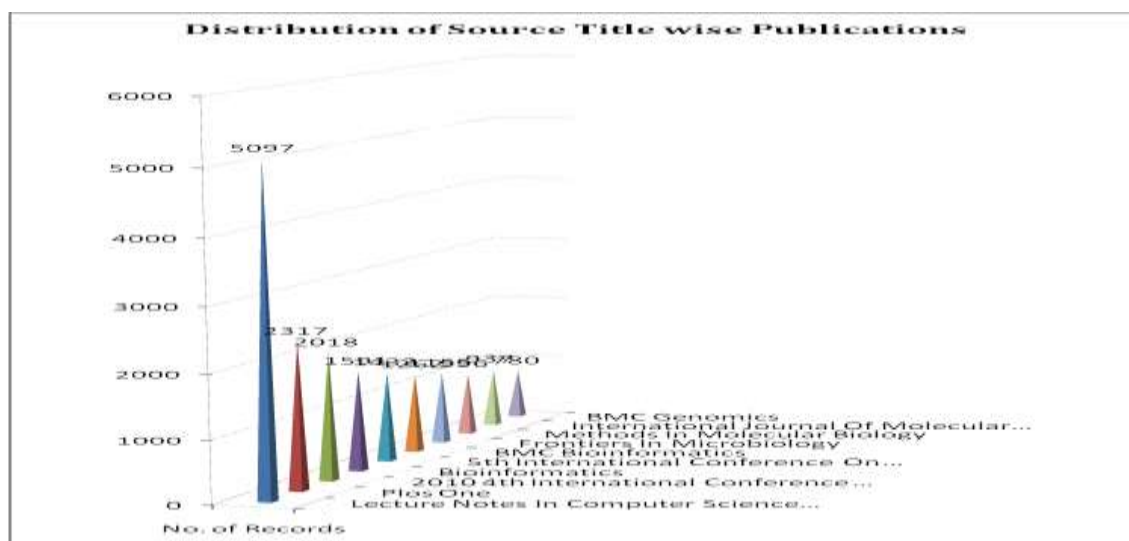


Figure.3

Table 7 explores the distribution of Source Title wise Publications. Totally 17585, the source title of Lecture Notes in Computer Science Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics with 5097 records are found(28.98%) followed by PLOS One, 2317 (13.18%), 2010 4th International Conference On Bioinformatics And Biomedical Engineering Icbbe 2010, 2018 (11.48%), Bioinformatics, 1591 (9.05%), 5th International Conference On Bioinformatics And Biomedical Engineering Icbbe 2011, 1432 (8.14%), BMC Bioinformatics, 1262 (7.18%), Frontiers In Microbiology, 1155 (6.57%), Methods In Molecular Biology, 996 (5.66%), International Journal Of Molecular Sciences, 937 (5.33%) and BMC Genomics, 780 (4.44%).

Table.8. Country wise Distribution of the Publications

S.No	Country	No of Records	Percentage	Cumulative	Percentage
1	China	28445	32.69	28445	32.69
2	United States America	24888	28.60	53333	61.29
3	United Kingdom	6195	7.12	59528	68.40
4	Germany	5569	6.40	65097	74.80
5	India	4644	5.34	69741	80.14
6	Italy	3970	4.56	73711	84.70
7	Canada	3653	4.20	77364	88.90
8	France	3602	4.14	80966	93.04
9	Spain	3122	3.59	84088	96.63
10	Australia	2936	3.37	87024	100.00
Total		87024	100.00		

The country wise distribution of the Publications explained the table seven. Out of 87024, China contributed more publications 28445 (32.69%) followed by United States America, 24888 (28.60%), United Kingdom, 6195 (7.12%), Germany, 5569 (6.40%), India, 4644 (5.34%), Italy, 3970 (4.56%), Canada, 3653 (4.20%), France, 3602 (4.14%), Spain, 3122 (3.59%) and Australia, 2936, (3.37%).

Table.9. Keywords wise Publications

S.No	Keywords	No. of Records	Percentage
1	Bioinformatics	72310	20.36
2	Article	41694	11.74
3	Human	32475	9.15
4	Humans	24163	6.80
5	Nonhuman	23146	6.52
6	Controlled Study	22909	6.45
7	Genetics	21413	6.03
8	Priority Journal	20682	5.82
9	Metabolism	16563	4.66
10	Unclassified Drug	15949	4.49
11	Gene Expression	14702	4.14
12	Computational Biology	13591	3.83
13	Animals	12649	3.56
14	Biology	11794	3.32
15	Female	11072	3.12
Total		355112	100.00

In table nine shows that the Keywords wise Publications. Out of 3,55,112, the keyword of “Bioinformatics” with 72310 (20.36%) followed by Article, 41,694 (11.74%), Human, 32475 (9.15%), Humans, 24163 (6.80%), Nonhuman, 23146, (6.52%), Controlled Study, 22909 (6.45%), Genetics, 21413 (6.03%), Priority Journal, 20682 (5.82%), Metabolism, 16563 (4.66%), Unclassified Drug, 15949 (4.49%), Gene Expression. 14702 (4.14%), Computational Biology, 13591(3.83%), Animals, 12649 (3.56%), Biology, 11794 (3.32%) and Female, 11072 (3.12%).

VII. FINDING OF THE STUDY

- Most of the Bioinformatics Research output in 2019, 15394 publications (16.32%) and .
- The Relative and Growth Rate of Bioinformatics publications on 10 years of this period have research increase the year 2019 (0.18 and the mean relative growth rate of 0.24.
- The analyzed the top ten Prolific Authors wise Publications. Author “Chen, G” contributed 109 publications (15.08%) is top most level and followed by other authors are respectively in order.
- The finding of the study, Top Ten Rank Subject Area wise publications the more number of publications found an Agricultural and Biological Sciences with 9201 (10.63%) secured as a first position.

- The Document Type wise contributed in most of the publications are the articles (61.42%)
- The Source Title wise Publications of Lecture Notes in Computer Science Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics with 5097 records (28.98%)
- The Country wise publications are found in the more number of papers contributed by China (32.69%) followed by United States America (28.60%), United Kingdom (7.12%) is respectively in the order.
- The Keyword search term of “Bioinformatics” (20.36%) is more in the research.

VIII. CONCLUSION

Today has advances of the bioinformatics field, with the computerized programming and software developments using the biological, engineering and multilevel interdisciplinary of science field using the Bioinformatics research. The study examined the Mapping Research Productivity of Bioinformatics scholarly Communication during 2010 to 2019. Scientometric study has using the statistical and mathematical calculation of techniques and analyzed the study. This study found that the 94348 publications are Bioinformatics research output among the ten year periods. The growth of Bioinformatics is year by year increase and suddenly decreasing the some years after growth is increase trend. Majority of the publications are article (61.42%) and more number of publications contributed by China, United States America, United Kingdom and India has fifth place of Bioinformatics research in country level.

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