Australian Journal of Basic and Applied Sciences

2020 February; 14(2): pages 1-12
DOI: 10.22587/ajbas.2020.14.2.1

Original paper AENSI Publications

Test membership in quartet Tago galaxy groups

Sabry A. Mohamed[1,2]

[1]National Research Institute of Astronomy and Geophysics, 11421, Helwan, Cairo, Egypt
[2]Department of Physics, College of Science, Majmaah University, Al-Majmaah, 11952, Saudi Arabia

Correspondence Author: Sabry A. Mohamed, National Research Institute of Astronomy and Geophysics, 11421, Helwan, Cairo, Egypt
Department of Physics, College of Science, Majmaah University, Al-Majmaah, 11952, Saudi Arabia
E-mail:- sa.mohamed@mu.edu.sa, sabryali@nriag.sci.eg,

Received date: 15 September 2019, Accepted date: 12 December 2019, Online date: 31 December 2019

Abstract

Groups of galaxies are small number of galaxies in a diameter less than 2 Mpc. It's providing good laboratories for studying the interaction between individual galaxies and their environment. Because most selection criteria depend on the separation distance between a center of the group and the individual, the projection effect is very serious problems that found in the definition of groups which causes many errors in identifying the members within each group. The aim of this paper is to determine the reality membership in each group by applying specific selection criteria depends on astrophysical properties and applying cluster analysis method too. The data sample consists of 7872 quartet groups with total number of 31488 galaxies taken from final release of the two-degree field galaxy redshift survey (2dFGRS). The results showed that 821 groups of galaxies have one member have different astrophysical parameters vary from other members in the same group and should be discarded from the catalog. The common astrophysical properties such as centroid coordinates, mean redshift, group's radial velocity, group's distance and group's combined magnitude in these groups will be changed after excluding these discordant members.

Keywords: Galaxies, Galaxy Groups, cluster Analysis, statistics

INTRODUCTION

Galaxies are not randomly scattered in the universe, but they tend to gather in groups, either huge groups (clusters), large groups (loose groups) or small groups (compact groups). Nearly half of the galaxies in the universe belongs in groups (Humason et al. 1956, de Vaucoulaurs 1965, Holmberg 1969, Materne 1979, Tully 1987a).

Groups of the galaxy are essential for understanding the development of galaxy clustering and evolution of galaxies. They provide an excellent laboratory for studying the interaction between group's members and their environments (Dressler 1980; McGlyne and Ostriker 1980; Geller and Postman 1983; Mezzetti et la 1983).

Groups usually selected based on close values of redshift and enhanced frequencies of galaxies relative to that of the background. There are many different catalogues and studies of groups of galaxies. The earliest studies, identification of group members was based on qualitative criteria (deVaucouleurs1965, Sandage and Tamman 1975). Several catalogues with different selection criteria and techniques were published (Shakhbazian 1973, de Vaucouleurs 1975, Turner and Gott 1976a,b, Rose 1977, Karachentsev et al., 1979, Huchra and Geller 1982, Hickson 1982,1993, Huchra et al. 1983, Tully 1987a,b, Hickson et al. 1992, Prandoni et al., 1994, Barton et al. 1996, Allam et al.,2000, Focardi, P. and Kelm 2002, de Carvalho et al., 2005, Tago et al. 2006, Deng X et al.,2008, Wang et al. 2008, McConnachie et al. 2009, Diaz et al. 2012, Tempel et al., 2012, Sohn et al., 2015, Kafleet al 2017, Yu Heng et al., 2018, Grokhovskaya, A. and Dodonov, S. N.2019, Zarattini, S.; Aguerri et al., 2019)

There are many problems in groups of galaxies catalogue because most of selection criteria depends on the separation distance between members and the center of the group and the radii of the members too. The projection effect is the very serious problems that found in the definition of groups of galaxies. This problem may be caused by the uncertainty in determining the radii of galaxies (R) and distance determination (D). The uncertainties in observational parameters such as velocity (V), Distance and Hubble constant cause severe problems in the Radii of the groups and the individuals too which makes a relative uncertainty in the radii of galaxies and the main selection criteria too (separation distance between centre and individuals).

Citation: Sabry A. Mohamed et al., 2020.Test membership in quartet Tago galaxy groups. Australian Journal of Basic and Applied Sciences, 14(2): 1-12.
DOI: 10.22587/ajbas.2020.14.2.1

Galaxies in the same group are supposed to have similar astrophysical properties that connect them. Some galaxies that lie in the same group might be mistakenly identified as members of the group. This can be added to the fact that one cannot assume if these groups are true physical groups or just projection (Sulentic, 1983; Mendes 1995).

This paper aims to determine the physical and real groups of galaxies by using cluster analysis method which used to identify the real members in each group by applying some specific astrophysical criteria.

The paper is organized as follows. In section 2, data used and Method to test the membership in each group are described. Results and conclusions are given in section 3 and 4, respectively.

2- The Data and Method

Tago et al., (2006) presented a cluster and groups of galaxies catalogue by applying the friends-of-friends (FOF) algorithm in the final release of the Two Degree Field Galaxy Redshift Survey (2dFGRS). They used a magnitude limited sample when they study the changes in group sizes and mean galaxy number densities within groups when shifting nearby observed groups to larger distances. The final sample contains 10750 groups in the Northern part and 14465 groups in the Southern part of the 2dF survey with membership $N_{gal} \geq 2$.

Galaxies in the same groups have nearly similar astrophysical properties that connect them. So the cluster analysis method(Unweight pair Group Method using arithmetic Average –UPGMA) is an excellent choice to test the reality of membership in the group by computing the similarity level between any two galaxies within each group.

Unweight pair Group Method using arithmetic Average (UPGMA) is well known as a clustering technique uses to measure the similarity and dissimilarity between two objects and clusters (Sokal and Michener 1958, William and Edelsbuner 1984, Murtagh 1984, Romesburg 1984).

The method depends on studying the similarity between these astrophysical parameters. If these attributes are similar or nearly equal, according to the philosophy of the technique, then it may form a group, and this group is real. The astrophysical properties of each galaxy like magnitude and colour index can be used as the attributes in this method.

The method depends on computing the average Euclidean distance coefficient e_{jk} which is defined as the square root of the sum of the squares of the differences of the values of the n attributes (parameters) expressed as eq (1),

$$e_{jk} = \sqrt{\frac{\sum_{i=1}^{n} (X_{ij} - X_{ik})^2}{N}} \qquad (1)$$

Where X is the galaxy parameters, N is the number of the total calculated Euclidean coefficients in the group. I , j and k is the arrays takes the number of galaxies in each group. The combined euclidean coefficients are written by (eq.2)

$$e_{i(j,k)} = \frac{(e_{ij} + e_{ik})}{2} \qquad (2)$$

This means that to compute e_{jk} for two objects J and K, we use the data in the j[th]and k[th] columns of the original data matrix. Adding a third attribute, the Euclidian distance coefficient is given by just adding a third term, i.e.

In all the equations (1) and (2), X_{ij} stands for the value of the i[th] attribute measured on the j[th] object and X_{ik} is the value of the i[th] attribute measured for the k[th] object, Romesburg (1984).

Sabry et al. (2009) criteria were used along with the method on the groups of galaxies to test the physical reality of each member in all quartet groups of galaxies in Tago et al (2006) catalogue.

The criteria stated that,

1. Galaxies of coefficients smaller by any value than $e_{av} - \sigma$ are given the name Twin (T). The twin property is here of a relative sense because it depends on the attributes of the groups.
2. Galaxies of coefficients of the order $e_{ij} < e_{av}$ given the name pair (P).
3. Coefficients ranging between $e_{av} \leq e_{ij} \leq e_{av} + \sigma$ are given the named member (M)
4. If the coefficients are $e_{ij} > e_{av} + \sigma$, it is called attribute discordant galaxy (AD).
5. To decide the triplet character or attribute discordant, the Combined Euclidean Distance Coefficient (CEC) is to be determined.

Where e_{av} is the average euclidian coefficients and σ is the standard deviation in the same group.

Citation: Sabry A. Mohamed et al., 2020.Test membership in quartet Tago galaxy groups. Australian Journal of Basic and Applied Sciences, 14(2): 1-12.
DOI: 10.22587/ajbas.2020.14.2.1

RESULTS AND DISCUSSION

Unweighted pair group method and astrophysical criteria from Sabry et al., (2009) are used in all quartet galaxy groups (7872 quartets with the total number of 31488 galaxies) taken from Tago catalogue (Tago et al., 2006). The astrophysical Euclidean separation coefficients were computed by using the magnitude in b-band and the Color index (bj-br) of each two members within the group as attributes.

From Tago et al., (2006) catalogue, the group ID. No. 67 used as a sample of the computational method and results.

The magnitude in b band and colour index (bj-br) used to get the data matrix as astrophysical attributes. Table (1) shows the input data for every member of the group ID—no. 67.

Table 1: The attributes of 4 galaxy members Tago Group ID No.67

Object	Galaxy1	Galaxy2	Galaxy3	Galaxy4
Magnitude (B)	-18.198	-19.344	-17.924	-18.514
color index (bj-br)	0.816	0.911	0.848	0.973

Applying UPGAMA method, we get the resemblance matrix coefficients to measure the degree of similarity between each pair of galaxies. Its value is computed by entering for a given pair of objects, the values from their columns in the data matrix listed in table 2.

Table 2: Resemblance Matrix of Tago Groups ID No.67

Galaxy No.	1	2	3
1			
2	1.1499		
3	0.27586	1.4214	
4	0.35285	0.83231	0.6031

This matrix enables the determination of similarity or dissimilarity between individual galaxies that may form a group. If the attributes are close to each other, we may expect to cluster. If the attributes are very close or nearly equal, we can expect compact clustering in its real sense. The astrophysical euclidean coefficients is the best choice for the distance metric because inter-point distances between the samples can be computed directly, it measures how big the similarity or dissimilarity between the attributes of objects regardless of the number.

Table 3 shows the results of applying the method on the group ID No.67 as a sample where:

Column (1) : the number of galaxy pair, column (2): the b magnitude of the first galaxy, column :3 the b magnitude of the second, column (4) : the colour index (bj-br) of the first galaxy, column (5): the colour index (bj-br) of the second galaxy, column (6) : the calculated Astrophysical euclidean coefficient, column (7) is the average astrophysical euclidean coefficient, column (8): the standard deviation, column (9): the classification of each two galaxies (T, P, M, AD) according to the value of the similarity. Column (10): the comments about the type of the result.

Table 3: the input attributes of each member and the euclidean coefficients

Galaxies	$(B)_i$	$(B)_j$	$(B_j - B_r)_i$	$(B_j - B_r)_j$	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$	type	Notice
G_{12}	-18.198	-19.344	0.816	0.911	1.1499	0.77258	0.41202	M	
G_{13}	-18.198	-17.924	0.816	0.848	0.27586			T	G_{13} make a twin.
G_{14}	-18.198	-18.514	0.816	0.973	0.35285			T	G_{14} make a twin
G_{23}	-19.344	-17.924	0.911	0.848	1.4214			AD	G_{34} make a pair.
G_{24}	-19.344	-18.514	0.911	0.973	0.83231			M	Galaxy 2 is AD (attribute discordant)
G_{34}	-17.924	-18.514	0.848	0.973	0.6031			P	

Table (3) shows that galaxies 1 and 3 share a large value of similarity than with the other two galaxies. Galaxies 2 with 3 has the largest value of dissimilarity in the group. After that, we look to the value of all galaxy ID No. 2 euclidean coefficients with other galaxies. We can notice that galaxy 2 make a source of disturbance in the group.

The last step to be assured that the galaxies appeared as AD (galaxies that show a large value of dissimilarity) are both members of the group is to apply the combined Euclidean coefficient and find the galaxy no. 2 is the AD galaxies and should exclude from the groups and recalculated all the groups' astrophysical parameters again such as group's coordinates, magnitude, centroid and distance.

The final results from quartet galaxies in Tago groups show that most of the members in the groups are real members while some groups have one attribute discordant galaxies. The final results show that 821 Groups have one galaxy that has attribute discordant and should be discarded from its group (table 4).

Citation: Sabry A. Mohamed et al., 2020.Test membership in quartet Tago galaxy groups. Australian Journal of Basic and Applied Sciences, 14(2): 1-12.
DOI: 10.22587/ajbas.2020.14.2.1

Table 4: shows the result of applying the method on Tago groups which have four galaxy members only. Columns: (1,6,11) are the Group ID,columns (2,7,12) are the Galaxy ID, columns (3,8,12) are the galaxy Right ascension 2000, columns (4,9,13) are the galaxy declination 2000.

Table 4: The list of attribute discordant galaxy (821 AD galaxies) which should be excluded from catalogue

Group ID	Galaxy ID	$\alpha_{2000}(\deg)$	$\delta_{2000}(\deg)$		Group ID	Galaxy ID	$\alpha_{2000}(\deg)$	$\alpha_{2000}(\deg)$
67	512	150.8909	-3.233		2331	17356	48.5781	-32.4492
74	563	150.767	-4.2131		2338	17389	48.3924	-33.3229
112	809	150.037	-3.9402		2357	17568	46.9997	-33.1873
207	1520	152.2898	-5.6775		2358	17569	46.9879	-33.4966
222	2785	151.8945	-6.5233		2455	18330	330.7896	-32.5407
236	2790	151.7201	-6.4482		2457	18364	330.5169	-33.7271
299	2200	150.27	-5.0779		2469	19456	329.2822	-34.5802
300	2167	150.3723	-5.2696		2569	19211	330.9957	-35.5138
315	2272	149.9882	-5.3782		2586	19401	329.6163	-34.8325
395	2861	158.0496	-3.1499		2604	19565	328.7082	-34.6716
424	3180	157.3829	-3.0004		2624	19662	333.5899	-37.0086
510	3792	155.9719	-5.1907		2670	20034	328.9097	-36.997
511	3834	155.8636	-5.7443		2686	20164	338.9198	-33.2012
564	4302	155.0524	-3.1259		2763	20690	334.6776	-33.0172
567	4324	155.023	-5.5147		2769	20721	334.4097	-33.0869
571	4554	154.700	-5.7866		2777	20789	333.908	-33.2465
684	5275	163.0866	-4.3544		2786	20852	339.4748	-34.2179
738	5648	162.3808	-5.4296		2789	20885	339.2895	-34.4429
788	5988	161.8147	-4.8183		2820	21140	337.9039	-34.1148
790	6005	161.7792	-2.8392		2878	21522	335.7426	-35.0179
899	6810	160.1518	-3.443		2880	21578	335.4389	-33.9545
926	6943	159.9535	-2.9692		2883	21601	335.2672	-34.5973
955	7170	159.4205	-2.8192		2887	21646	335.1633	-34.9448
971	7270	159.1726	-3.4604		2889	21634	335.1956	-34.2095
996	7485	158.5731	-5.0406		2903	21767	334.7686	-34.2743
1001	7490	158.5737	-3.0279		2907	21754	334.814	-35.644
1012	7550	158.4067	-6.0935		2920	21858	334.4191	-35.4482
1061	7853	167.9092	-4.1307		2925	21864	334.4218	-34.6791
1068	7922	167.7908	-3.4865		2935	21956	334.0586	-34.1694
1100	8142	167.3812	-4.796		2991	22389	334.4928	-35.7441
1103	8163	167.3383	-4.4818		3083	23110	342.2844	-33.7304
1138	8350	166.995	-5.5458		3106	23290	341.08	-32.8787
1205	8790	166.2913	-4.8693		3125	23429	340.2629	-33.7571
1232	9034	165.8144	-5.6206		3160	23670	344.6271	-34.4825
1251	9135	165.5494	-4.4988		3163	23699	344.5238	-35.1584
1330	9807	163.8756	-5.6203		3186	23864	343.821	-34.6899
1341	9889	163.7682	-5.6629		3207	24028	343.0461	-34.566
1353	9940	163.7045	-6.059		3316	24731	340.7884	-34.6363
1443	10646	172.4308	-4.1614		3333	24825	340.4653	-35.6238
1444	10633	172.4565	-3.7309		3351	24944	339.9214	-35.639
1463	10763	172.1942	-3.0854		3416	25461	350.3181	-32.7911
1466	10813	172.0879	-4.7496		3434	25540	349.8427	-32.757
1495	10993	171.7882	-4.8102		3505	26063	346.9688	-33.1439
1501	11022	171.7385	-6.0856		3507	26117	346.7843	-33.81
1572	11587	170.6127	-5.1952		3553	26411	345.7168	-33.3897
1594	11739	170.3081	-4.5257		3598	26748	350.198	-34.7119
1603	11784	170.2354	-4.5091		3636	27070	348.0654	-35.3531
1624	12036	169.8243	-4.8463		3639	27107	347.8625	-34.512
1649	12192	169.5488	-4.2674		3655	27209	347.1522	-35.1084
1659	12260	169.419	-4.9232		3665	27259	346.7965	-34.4383
1663	12262	169.4202	-4.4609		3680	27359	346.1214	-34.4696
1741	12923	168.3364	-5.3744		3740	27814	355.607	-33.1134
1764	13125	177.9857	-4.6396		3867	28568	352.3715	-32.4278

Citation: Sabry A. Mohamed et al., 2020.Test membership in quartet Tago galaxy groups. Australian Journal of Basic and Applied Sciences, 14(2): 1-12.
DOI: 10.22587/ajbas.2020.14.2.1

1863	13796	176.5796	-2.8041		3931	29072	356.1334	-34.6068
1946	14383	175.4528	-4.9967		3981	29350	355.232	-35.5248
1950	14403	175.4167	-4.2726		4020	29655	353.8734	-35.0466
1967	14510	175.2769	-5.0947		4058	29911	352.8008	-35.5192
2039	15101	174.1514	-5.5644		4076	30096	352.2819	-35.0425
2044	15129	174.1167	-5.7148		4179	30789	0.9554	-28.0668
2051	15184	174.0201	-4.8596		4227	31127	359.8735	-28.4118
2093	15426	173.6078	-3.2709		4232	31198	359.501	-27.5294
2101	15582	173.3423	-3.7951		4233	31221	359.3342	-27.5497
2129	15664	173.2342	-3.9565		4255	31338	358.8499	-27.2625
2163	15901	182.4433	-4.1047		4277	82437	358.35	-27.2212
2171	16940	182.0772	-4.5264		4294	31651	357.8583	-28.3656
2175	16000	181.9936	-3.7696		4319	31891	2.9198	-30.1188
2210	16214	181.0163	-4.452		4346	32067	2.3781	-30.5073
2217	16271	180.8308	-3.9296		4391	32371	0.7733	-30.3992
2218	16283	180.7945	-2.8759		4393	32367	0.8009	-30.4968
2255	16569	179.1793	-4.1227		4487	32947	358.0641	-29.5999
2346	17203	180.878	-5.1989		4593	33686	359.9732	-31.8607
2400	17586	187.2755	-4.1157		4596	33731	359.8186	-31.1486
2408	17636	187.1206	-3.5129		4651	34115	358.4139	-31.0749
2472	18078	185.2917	-4.3994		4660	34140	358.3354	-31.5987
2514	18485	183.781	-3.9982		4704	34434	8.7032	-28.1414
2522	18546	183.6175	-4.0939		4735	34643	7.5497	-28.715
2583	18944	193.028	-4.3992		4764	34853	6.2678	-27.4078
2642	19313	191.7972	-4.0367		4771	34885	6.1381	-28.4091
2659	19426	191.3559	-3.6207		4823	35253	4.3063	-28.4714
2687	19640	190.6279	-3.9903		4833	35364	3.7972	-28.0257
2713	19737	190.3494	-4.0686		4870	35520	8.8625	-29.2853
2730	61446	189.9346	-2.7596		4880	35622	8.424	-29.1002
2736	19873	189.8959	-2.8832		4970	36176	6.5792	-29.4758
2747	20872	189.6423	-4.5791		4974	36204	6.4503	-29.5037
2775	20185	188.9086	-3.7682		4988	36315	5.888	-29.3201
2793	20254	188.6886	-3.2345		5048	36674	4.0361	-30.5504
2802	20313	188.5036	-4.4704		5055	36739	3.7797	-29.2112
2804	20334	188.4409	-4.0342		5082	36907	8.4996	-31.8388
2854	20698	191.6037	-4.8209		5156	37404	5.3517	-30.8166
2875	20826	190.2536	-4.7335		5166	37492	4.9829	-31.0329
2885	20897	189.3744	-4.5076		5244	38055	14.3242	-27.6439
2937	21274	196.9869	-4.0177		5256	38165	13.8588	-28.1058
2994	21658	195.7855	-2.8556		5277	38324	13.1889	-27.6022
3049	22139	194.695	-4.2095		5299	38473	12.5953	-28.6334
3051	22146	194.6702	-3.8266		5374	38996	10.6054	-28.1296
3101	22479	193.522	-3.5914		5387	39042	10.5023	-28.0262
3123	22626	198.029	-5.92		5390	39040	10.5201	-27.3109
3134	22687	197.8085	-4.7		5400	39127	10.311	-28.2937
3137	22726	197.6832	-4.6577		5406	39142	10.2758	-28.6373
3176	23042	194.9733	-4.9743		5416	39210	10.0962	-27.9769
3260	23641	201.8419	-2.8039		5468	39532	14.9388	-30.2766
3281	23839	201.1465	-3.7309		5499	39714	14.2344	-29.7658
3301	23933	200.9288	-3.3709		5537	39953	13.5632	-29.4181
3319	24094	200.4	-4.032		5555	40037	13.1063	-30.2716
3353	24313	199.0492	-4.3295		5636	40567	10.7942	-29.921
3428	24923	201.0554	-5.7878		5640	40573	10.7774	-29.1459
3493	25517	206.5815	-3.3807		5655	40750	10.1417	-30.7559
3522	25757	205.9024	-5.2486		5663	40759	10.1147	-30.6679
3540	25851	205.6335	-3.828		5681	40947	9.5233	-29.0809
3674	26919	211.9846	-4.1653		5687	40972	9.4473	-30.4811
3697	27090	211.3544	-4.6454		5701	41046	14.916	-31.1577
3705	27186	210.9495	-4.3586		5730	41266	13.9654	-31.6665

Citation: Sabry A. Mohamed et al., 2020.Test membership in quartet Tago galaxy groups. Australian Journal of Basic and Applied Sciences, 14(2): 1-12.
DOI: 10.22587/ajbas.2020.14.2.1

3710	72826	210.7164	-2.6614		5743	41345	13.5652	-31.3634
3722	27347	210.3365	-3.743		5761	41505	12.4649	-31.5222
3767	27669	208.9726	-2.7705		5785	41726	10.2192	-31.4654
3769	27686	208.8758	-4.2556		5801	46528	20.7308	-27.9929
3785	27815	218.1255	-3.6743		5909	42599	17.1982	-28.5809
3870	28483	214.8198	-3.7751		5961	42947	15.124	-28.4451
3880	28540	214.6343	-3.8153		5994	43139	20.17	-30.4229
3896	28699	213.8329	-4.2252		6011	43278	19.6214	-29.0473
3970	29281	221.7112	-6.0416		6039	43539	18.6819	-29.8396
4001	29498	221.1202	-5.189		6058	43636	18.2994	-29.5654
4116	30314	153.1253	1.9599		6061	43665	18.2049	-30.0095
4157	30595	152.6273	-1.9051		6067	43702	18.0626	-29.1134
4216	31081	151.9597	2.1151		6074	44961	18.0447	-30.8948
4226	31115	151.8882	0.7863		6094	43917	17.3672	-29.7052
4253	31311	151.522	-1.2985		6134	44217	15.9839	-29.6364
4264	31388	151.3938	0.0897		6143	44275	15.7334	-29.6363
4319	31817	150.6513	0.8476		6191	44583	20.2629	-32.1103
4348	32045	150.2898	-0.0797		6195	44639	19.8191	-31.0051
4370	32262	149.9509	1.095		6222	44813	18.7665	-31.7841
4386	32327	149.8589	-0.2539		6227	44880	18.4487	-32.0286
4390	32321	149.8674	0.9099		6238	44933	18.1997	-31.5027
4437	32692	149.2732	-2.5502		6304	45467	15.3311	-30.9036
4472	32954	149.0079	0.7697		6309	45486	15.2544	-31.8602
4477	32889	149.0692	-0.5552		6334	45639	25.9807	-27.3405
4485	32898	149.0608	0.103		6363	45847	24.612	-27.9306
4500	33086	148.7912	-0.0212		6484	46684	25.777	-30.3528
4518	33197	148.5639	1.6978		6528	47096	23.4274	-30.3928
4547	33456	158.0329	0.9736		6585	47508	21.5858	-29.6168
4564	33549	157.883	0.2855		6639	47943	24.8765	-31.0635
4583	33606	157.78	-1.3142		6671	48140	23.6253	-31.7194
4609	33855	157.3859	0.602		6708	48424	22.4953	-32.0708
4645	34099	156.9212	1.8916		6726	48572	21.6366	-31.5352
4723	34624	156.1881	1.2573		6750	48784	32.1022	-27.5534
4831	35475	155.1159	-1.9714		6766	48853	32.0233	-29.2432
4857	35698	154.8691	1.0625		6777	48930	31.8838	-28.6211
4859	35715	154.8397	-0.6472		6832	49247	31.4072	-31.5949
4887	35854	154.6518	-0.1783		6918	49911	30.1986	-28.4025
4911	36133	154.3522	0.5004		6991	50391	29.3544	-29.9969
4924	36301	154.1204	-1.3404		7020	50574	29.0005	-31.0955
4950	36439	153.9505	-0.3226		7027	50614	28.9559	-28.0037
4952	36428	153.9689	1.2771		7066	50972	28.2227	-30.8797
4962	36559	153.8019	0.9614		7101	51228	27.7705	-28.9974
4986	36749	153.567	0.3067		7113	51400	27.4965	-28.9498
5060	37304	162.879	-1.1462		7119	51412	27.447	-30.1333
5073	37352	162.7847	0.9076		7154	51653	27.0999	-29.0019
5089	37537	162.555	1.0008		7161	51695	27.0621	-28.337
5129	37795	162.2678	-1.7586		7180	51937	26.634	-28.5245
5137	37914	162.1132	1.9017		7239	52269	36.3323	-27.5612
5198	38226	161.6948	1.8752		7255	52382	35.8682	-28.9153
5218	38439	161.4571	1.7231		7316	52851	34.0026	-27.8941
5226	38493	161.3769	-1.6958		7331	52945	33.5827	-27.5819
5230	38473	161.4102	-0.4216		7341	53073	33.0778	-27.4335
5245	38622	161.2295	0.9487		7365	53224	32.3788	-28.3725
5306	39106	160.7799	-1.4944		7369	53233	32.3627	-27.637
5326	39249	160.6579	0.8706		7383	53343	37.3495	-29.2108
5345	39310	160.6023	-0.7271		7403	53520	36.3995	-30.3831
5388	39580	160.3714	0.4193		7411	53586	36.2147	-30.6914
5414	39751	160.1842	0.8436		7420	53714	35.5862	-29.35
5420	39730	160.2116	1.874		7435	53808	35.1425	-29.2946

Citation: Sabry A. Mohamed et al., 2020.Test membership in quartet Tago galaxy groups. Australian Journal of Basic and Applied Sciences, 14(2): 1-12.
DOI: 10.22587/ajbas.2020.14.2.1

5425	39857	160.0433	0.2884		7454	53935	34.4707	-29.2167
5455	40023	159.8668	0.6118		7499	55114	33.4031	-30.9072
5470	40049	159.8475	1.0225		7528	54444	32.4337	-29.6336
5530	40463	159.3736	0.9455		7533	54468	32.2858	-30.3481
5531	40510	159.3091	-2.1178		7565	54722	36.2582	-31.3189
5533	40490	159.3285	-0.453		7574	54825	35.481	-31.5953
5575	40717	159.0331	-0.5822		7593	54936	34.6228	-31.0884
5590	40834	158.8599	1.4504		7627	55255	32.5321	-31.5681
5611	41061	158.5377	-0.4301		7654	55451	42.6958	-27.3247
5646	41259	158.3042	2.072		7762	56236	39.0501	-28.3902
5701	41544	167.734	0.7727		7785	56374	38.2709	-27.4789
5729	41742	167.1895	2.0446		7792	57164	37.9666	-29.0112
5759	41935	166.6288	1.6945		7795	59696	43.6639	-29.6054
5773	42021	166.3751	0.8615		7836	56854	40.6918	-29.6365
5815	42343	165.0079	1.7761		7842	56869	40.6296	-29.1873
5894	43038	167.3555	-0.098		7881	57134	38.1543	-30.4773
5911	43049	167.3103	-0.2402		7952	57811	49.206	-28.936
5984	43558	165.3902	-1.0981		7958	57921	49.0097	-28.9567
5987	43593	165.1947	-0.3971		7974	57974	48.8857	-27.3608
6015	43807	164.1635	-0.0545		7980	57986	48.9292	-31.4535
6031	43886	163.7663	-1.0964		7995	58147	48.6181	-30.2592
6033	43885	163.7528	-0.7656		8031	58421	48.0615	-30.8533
6070	44091	167.9675	-2.7617		8037	58444	47.9759	-27.3921
6085	44235	167.3154	-1.5568		8093	58781	47.1302	-31.7308
6092	44351	166.8335	-2.5468		8104	58960	46.6535	-29.8403
6195	44962	173.101	1.2568		8132	59182	45.9969	-31.0763
6223	45101	172.8715	1.1971		8134	59164	46.0424	-31.2265
6277	45654	172.1139	1.0825		8181	59658	43.8745	-28.9746
6292	45588	172.2182	2.143		8185	59717	55.0384	-28.5261
6369	46090	171.5261	-1.8341		8199	59866	53.7859	-28.6501
6399	46279	171.2575	1.0112		8229	60040	52.7505	-28.3918
6443	46560	170.8616	0.418		8259	60252	51.9183	-28.396
6466	46747	170.679	-2.2669		8331	60818	49.9054	-27.4969
6493	47012	170.4315	-1.1987		8357	60885	49.6778	-27.5542
6608	47784	169.5187	0.0159		8366	60949	49.4625	-27.4849
6631	47941	169.3192	1.8276		8370	60995	54.7003	-29.1564
6705	48412	168.7575	0.2267		8385	61136	53.9576	-29.5894
6731	48603	168.5149	-1.2654		8386	61163	53.9152	-30.6222
6754	48847	168.2344	0.7256		8426	61392	53.2445	-29.8763
6765	48918	178.096	-2.1825		8427	61384	53.2718	-29.4702
6859	49596	177.0593	-1.9837		8438	61445	53.1353	-30.7812
6905	49978	176.4839	-1.3494		8443	61502	53.0038	-30.1104
6933	50174	176.239	-2.5047		8447	61475	53.0598	-29.4089
6942	50262	176.1083	-1.9573		8476	61737	51.955	-30.5256
6964	50441	175.8373	0.0284		8492	61853	51.3438	-29.9106
6980	50530	175.6992	-1.8987		8532	62190	49.6387	-30.3129
6983	50580	175.6289	-2.2516		8538	62229	49.4736	-30.2789
7003	50713	175.3589	-2.4969		8589	62606	52.3864	-31.7627
7051	51087	174.7782	-2.3083		8620	62869	50.3045	-31.3587
7073	51253	174.4399	0.9904		8626	62930	49.9639	-31.7797
7083	51348	174.2468	-1.8748		8788	64131	330.8439	-29.3521
7095	51444	174.0571	-0.8979		8902	64935	327.2791	-30.601
7112	51543	173.8719	0.9524		8907	64987	327.1538	-30.8804
7142	51824	173.3615	0.2454		8937	65168	326.593	-29.3229
7167	52024	182.9341	1.3045		8955	65376	325.7962	-30.0123
7193	52276	181.8269	1.1034		9002	65765	329.175	-31.7679
7215	52401	181.3483	1.8288		9003	65768	329.1442	-31.6312
7268	52788	180.1699	2.1403		9038	66031	327.4754	-32.2464
7269	52792	180.1698	1.2756		9049	66108	327.101	-31.6287

Citation: Sabry A. Mohamed et al., 2020.Test membership in quartet Tago galaxy groups. Australian Journal of Basic and Applied Sciences, 14(2): 1-12.
DOI: 10.22587/ajbas.2020.14.2.1

7276	52848	179.9775	0.6166		9051	66099	327.1335	-31.1879
7283	52914	179.6928	1.7124		9088	66377	337.0531	-28.5683
7285	52936	179.6455	1.0881		9139	66745	334.9847	-28.7861
7323	53216	178.491	1.7289		9213	67315	332.6084	-27.3213
7351	53412	182.6342	-0.1636		9237	67469	332.0005	-28.3055
7383	53612	181.816	-0.518		9240	67508	331.883	-28.4396
7403	53727	181.3153	0.0069		9241	67521	331.8214	-28.0917
7466	54079	180.0699	0.405		9251	67565	331.6762	-28.4067
7507	54345	179.4382	0.1136		9255	67617	331.4836	-27.4378
7512	54358	179.4246	-1.3962		9260	67653	337.0356	-30.2831
7537	54494	179.0653	-0.2057		9279	67865	336.2749	-29.3076
7622	55076	180.7853	-1.9991		9295	68025	335.6873	-29.8906
7674	55485	178.4867	-1.8685		9301	68081	335.3657	-29.4145
7737	55964	185.9046	1.3085		9343	68354	333.9216	-29.8315
7782	56237	184.6354	1.924		9358	68451	333.4983	-30.1883
7892	57027	185.442	0.3096		9369	68540	333.1576	-30.1731
7901	57112	185.0282	-1.134		9499	69526	333.9281	-31.8367
8005	57831	186.2859	-2.3475		9533	69773	332.2061	-31.2058
8065	58295	192.6849	1.2294		9560	69930	342.5225	-27.9874
8077	58360	192.2071	2.0151		9573	69995	342.1965	-28.5685
8078	58366	192.1581	1.8709		9610	70276	340.4682	-28.139
8099	58551	191.2314	1.8983		9612	70322	340.2182	-27.904
8110	58642	191.0405	1.0756		9657	70699	342.6449	-29.0365
8159	58845	190.0508	0.6954		9712	71055	341.0413	-29.0452
8170	58915	189.668	1.7994		9825	71853	341.3092	-31.5789
8282	59786	191.2145	0.3888		9918	73747	347.9012	-28.9981
8287	59800	191.195	-0.973		9949	72719	347.0809	-28.3261
8296	59907	190.8536	0.6104		9960	72793	346.7555	-28.0956
8336	60179	189.7734	0.2827		9964	72838	346.588	-28.0539
8354	60267	189.4157	-0.8227		9997	74128	345.5673	-29.0039
8427	60786	192.3438	-2.3581		10027	73268	344.156	-27.3555
8430	60796	192.3101	-1.3593		10069	73543	348.5487	-30.6197
8431	60820	192.259	-1.3881		10073	73578	348.4412	-30.8373
8476	61202	191.0072	-2.026		10085	73650	348.2072	-29.2854
8511	61450	189.8852	-1.6204		10098	73727	347.9623	-29.1602
8526	61549	189.48	-1.5418		10119	73853	347.5487	-30.6772
8564	61784	188.2974	-1.3907		10232	74729	347.3602	-32.1499
8579	61895	198.0367	-0.2391		10271	74974	346.1184	-31.9832
8582	61967	197.9609	0.6869		10272	74987	346.0474	-31.6646
8670	62527	197.2858	-2.6827		10275	75008	345.9606	-31.4548
8693	62740	196.9892	-1.9675		10286	75122	345.4888	-31.4292
8694	62723	197.0126	-0.0609		10356	75626	354.1022	-27.983
8716	62960	196.5837	-1.5923		10361	75651	353.9797	-28.8245
8717	62885	196.7295	-1.0271		10435	76225	350.1597	-28.1019
8729	62976	196.5514	-0.8502		10443	76269	349.9438	-27.9725
8778	63274	196.0558	1.2355		10482	76604	354.262	-30.5578
8797	63443	195.7512	-0.4815		10534	77017	352.5771	-29.225
8854	63903	195.1064	-2.5444		10570	77296	351.4806	-30.8068
8897	64274	194.5348	1.8624		10665	78009	353.6798	-32.0564
8938	64558	193.9809	-1.7158		10676	78092	353.1914	-31.7763
8953	64672	193.7669	-2.3073		10682	78136	352.9077	-31.2132
8960	64717	193.706	-1.6314		10735	78483	350.8975	-31.5221
8983	64998	193.2835	-2.2395		10745	78550	350.458	-30.974
9084	65631	201.1591	1.9813		10750	78605	350.1093	-31.0946
9123	65870	200.2667	1.3055		10751	78606	350.0835	-32.0488
9130	65900	200.1959	0.7931		10827	79142	357.3152	-30.2486
9182	66315	198.4051	0.5907		10830	79197	357.221	-31.2844
9197	68073	202.4598	-1.4294		10859	79381	356.8902	-29.3267
9201	66502	202.4998	0.3055		10885	79588	356.6195	-29.2622

Citation: Sabry A. Mohamed et al., 2020.Test membership in quartet Tago galaxy groups. Australian Journal of Basic and Applied Sciences, 14(2): 1-12.
DOI: 10.22587/ajbas.2020.14.2.1

9252	68370	201.2518	-1.3979		10936	79953	356.0685	-27.6509
9373	67671	198.7789	-1.3853		10942	79991	355.982	-29.0841
9384	67818	203.1048	-2.1606		10990	80287	355.4605	-32.1948
9462	68472	200.754	-1.8042		11025	80600	355.0645	-28.4333
9494	68695	199.8375	-1.6232		11080	81052	2.2039	-25.7484
9501	68754	199.4678	-1.6701		11136	81401	358.8735	-25.7356
9547	69023	208.1245	0.8524		11317	82664	7.7634	-25.6454
9557	69103	207.7698	1.6865		11320	82680	7.5624	-25.1891
9605	69443	205.6859	1.4385		11339	82841	5.4936	-25.327
9610	69514	205.4568	2.1858		11355	82918	4.9683	-25.3679
9667	69873	203.2115	1.8527		11362	82969	4.4341	-25.7519
9740	70495	205.2505	-0.716		11375	83056	3.5511	-25.4016
9783	70750	203.9115	-0.9202		11380	83077	8.757	-26.4531
9785	71449	203.8354	-1.4401		11386	83113	8.4382	-26.1346
9793	70810	203.5768	-0.9845		11393	83171	8.1164	-26.0914
9830	71069	206.4828	-1.9133		11394	83180	8.0877	-26.5511
9857	71307	204.8313	-1.7793		11397	83216	7.8877	-26.2145
9885	71518	203.4617	-1.9321		11402	83236	7.7951	-26.6879
9886	71542	203.3823	-2.3206		11420	83323	7.1334	-26.5746
9896	71589	213.1147	0.1065		11461	83677	4.3105	-27.1161
9911	71722	212.9035	0.4399		11473	83804	3.7947	-26.3537
9926	71786	212.8021	0.9429		11478	83811	3.7885	-26.2719
9944	72002	212.4342	-0.4485		11534	84329	13.8338	-25.9739
9953	72016	212.4137	-0.8876		11537	84346	13.8069	-26.5834
9995	72366	211.6942	-1.4783		11571	84587	12.3201	-26.2194
10036	72550	211.2434	-0.4529		11586	84736	11.207	-25.8988
10037	72544	211.2618	-0.2515		11590	84747	11.1739	-26.2304
10065	72725	210.9243	0.0873		11591	84774	11.079	-26.6236
10103	73114	210.0551	-0.9628		11595	84784	11.0305	-26.1203
10137	73368	209.5739	-1.3058		11648	85164	9.5217	-26.8776
10172	73633	209.1165	-2.3052		11681	85349	19.1848	-25.5181
10241	74210	217.428	0.6226		11689	85397	18.703	-25.8699
10294	77552	218.198	0.2858		11690	85400	18.6849	-25.5653
10342	74964	216.2808	-1.1282		11744	85908	18.5328	-26.3796
10351	75032	215.9443	-0.6639		11776	86144	16.4311	-26.0678
10387	75290	214.4909	0.3389		11779	86188	16.1162	-26.923
10424	75565	213.6886	-0.1022		11791	86283	15.4235	-25.9925
10446	75744	213.2156	-1.0435		11796	86312	15.2014	-26.3213
10449	75747	213.164	-0.4394		11800	86351	15.0017	-26.174
10497	76095	215.8596	-2.1877		11816	86459	14.4365	-26.3062
10541	76390	213.7484	-2.5569		11842	86636	23.3588	-25.7204
10588	76779	222.1568	-0.7773		11881	86925	20.5445	-25.8792
10615	77006	220.6112	-0.2519		11890	86973	20.1115	-25.7153
10634	77164	219.8397	-0.8126		11918	87244	23.7575	-26.9452
10650	77288	219.3185	0.1773		11939	87372	23.2822	-26.1968
10652	77305	219.2422	-0.3089		11991	87837	20.6665	-26.2675
10713	77794	220.1062	-1.884		12013	87974	19.8872	-26.7099
23	141	2.9217	-33.0313		12080	88592	28.427	-26.5713
80	535	0.6643	-33.4403		12082	88582	28.4744	-26.548
110	739	359.4255	-32.8383		12106	88712	27.7497	-26.3224
119	791	359.2613	-32.7049		12137	88998	25.8675	-26.5803
123	860	359.0045	-33.817		12152	89124	35.506	-25.7771
178	1278	3.3399	-34.7573		12162	89207	34.1028	-25.22
203	1431	2.6929	-34.7695		12163	89240	33.6435	-25.7445
279	1959	0.4598	-35.4783		12164	89241	33.6348	-25.7962
308	2179	359.7663	-34.4295		12172	89286	32.8448	-25.4815
364	2639	358.3109	-34.0534		12196	89450	35.945	-26.8362
389	2822	8.723	-33.372		12236	89789	33.4486	-27.0765
402	2904	8.1162	-32.6818		12270	90058	31.7593	-26.8216

Citation: Sabry A. Mohamed et al., 2020.Test membership in quartet Tago galaxy groups. Australian Journal of Basic and Applied Sciences, 14(2): 1-12.
DOI: 10.22587/ajbas.2020.14.2.1

418	3037	7.191	-32.4058		12286	90174	31.1913	-27.0617
482	3607	5.1955	-32.9274		12300	90264	41.76	-24.8049
531	3919	3.8812	-33.4696		12392	90971	39.5875	-26.9899
541	4057	8.568	-34.3036		12423	91185	38.6678	-26.2293
549	4115	8.1997	-34.8465		12451	91401	37.6886	-25.6423
554	4147	7.8974	-34.6212		12456	91416	37.5822	-26.4229
563	4257	7.2589	-35.0784		12471	91519	37.1487	-26.2831
606	4577	6.0025	-33.8982		12499	91734	47.1382	-23.7987
628	4779	5.0387	-34.013		12566	92261	43.2027	-25.0855
639	4751	5.129	-33.9412		12590	92422	42.7266	-25.4293
643	4766	5.0612	-34.9444		12597	92464	42.5887	-25.4975
700	5247	15.423	-33.6757		12600	92492	42.4486	-25.8519
717	5307	15.0715	-32.4304		12622	92634	47.1907	-26.9265
747	41291	13.8341	-32.2027		12625	92688	46.7715	-27.2031
816	6005	11.1131	-32.4302		12640	92839	45.6239	-27.2324
822	6059	10.7967	-33.3016		12741	93596	52.008	-26.4397
872	6397	14.588	-34.2672		12755	93683	51.6362	-26.6184
882	6458	14.3404	-34.2254		12875	94529	48.7951	-27.2189
883	6718	14.5769	-35.9293		12887	94613	48.5269	-25.5556
884	6480	14.2571	-34.4377		12899	94685	48.282	-26.6987
891	6517	14.0665	-35.254		12913	94743	48.1187	-26.1195
906	6651	12.1245	-34.1204		12936	94995	47.4791	-25.8264
959	7009	20.6624	-33.0382		12961	95183	332.6702	-23.4621
963	7034	20.6256	-33.5773		12965	95204	332.3868	-23.529
1124	8340	19.3621	-34.3481		12988	95386	330.3149	-23.8319
1141	8699	18.9967	-35.9173		13047	95860	332.4841	-24.5979
1205	8921	26.4121	-32.3194		13056	95926	332.1626	-24.6374
1211	8983	26.0149	-33.4304		13078	96092	331.1366	-25.2711
1250	9316	24.3991	-33.9237		13101	96275	330.2008	-24.1147
1262	9440	23.8914	-32.9646		13102	96290	330.153	-24.8547
1266	9488	23.741	-33.1077		13126	96469	329.2363	-25.3508
1330	9873	22.6111	-33.6651		13151	96724	332.7154	-26.1439
1437	10770	21.6167	-34.0607		13213	97172	329.7624	-26.9203
1482	11006	32.6762	-33.8571		13353	98153	336.6345	-24.4412
1498	11085	32.3945	-33.4638		13374	98279	336.0934	-24.8796
1515	11220	31.4622	-32.5321		13376	98303	335.922	-24.4781
1527	11276	31.1482	-33.0229		13427	98576	334.7241	-24.2435
1533	11353	30.7538	-32.5627		13519	99265	336.1731	-26.172
1544	11452	30.3487	-33.7807		13522	99315	335.9266	-26.6129
1547	11466	30.3085	-33.493		13587	99835	333.7699	-25.8055
1560	11536	30.0928	-32.7785		13658	100298	343.6202	-25.2628
1601	11846	28.8666	-33.0991		13676	100423	343.2635	-25.4746
1623	12014	28.2179	-33.6829		13691	100519	342.8612	-24.683
1713	12604	31.4086	-34.5978		13732	100850	340.671	-24.916
1720	12684	31.0927	-35.7426		13745	100958	340.0637	-24.6434
1737	12793	30.6576	-34.316		13801	101437	343.4221	-26.1327
1796	16240	39.6295	-33.4183		13810	101477	343.1592	-26.2323
1801	13301	39.229	-33.1178		13815	101509	343.0482	-27.0457
1831	13471	38.49	-33.6627		13825	101622	342.2292	-26.0479
1838	13524	38.3172	-33.8431		13826	101652	341.886	-26.4087
1842	13511	38.3597	-33.577		13866	102002	349.644	-26.7663
1875	13802	37.3444	-33.8706		13882	102150	349.3107	-23.5245
1882	13945	36.5477	-33.1937		13891	102181	349.3149	-27.0531
1912	14141	35.2677	-33.2489		13942	102540	348.4363	-24.4368
1965	14505	38.7858	-34.6405		14019	103125	346.9203	-25.5387
1989	14672	37.7449	-34.1986		14085	103547	345.741	-25.9229
2000	14772	37.1521	-34.3536		14153	104092	354.6512	-25.4939
2111	15573	43.8279	-32.4134		14157	104121	353.964	-25.5123
2115	15621	43.5524	-33.7191		14160	104155	353.5358	-25.5379

Citation: Sabry A. Mohamed et al., 2020.Test membership in quartet Tago galaxy groups. Australian Journal of Basic and Applied Sciences, 14(2): 1-12.
DOI: 10.22587/ajbas.2020.14.2.1

2176	16107	40.4999	-32.3882		14172	104289	352.0489	-25.0427
2186	16194	39.9507	-33.4296		14194	104389	351.584	-25.2946
2200	16285	44.6449	-34.0389		14272	104974	353.4513	-26.5606
2214	16423	43.31	-34.705		14302	105185	352.1812	-26.2331
2254	16691	41.8567	-35.4274		14322	105328	351.4556	-27.1301
2290	16952	40.5476	-34.6561		14423	106054	356.9381	-26.0596
2304	17079	50.9575	-33.3938		14434	106158	356.4015	-27.0347
2325	17335	48.663	-32.946		14458	106251	356.045	-26.4609
2328	58131	48.7014	-32.2913					

CONCLUSION

In this paper, the UPGAMA method as a cluster analysis technique used to test the membership in quartet Tago groups of galaxies. The complete sample has7872 quartet groups with a total number of 31488 galaxies. The euclidean separation coefficients between each pair's astrophysical parameters within the same group are computed and apply specific criteria to identify the relation between every galaxy pair. The astrophysical parameters b-magnitude and colour index are used as attributes to test the similarity or dissimilarity between each pair.

The final results show that there are 821 Groups have one galaxy differ in some astrophysical parameters from the other members in the same group and should be discarded from the groups. The group's data which have AD galaxy in the catalogue will be changes when the AD list discarded from their groups because the standard astrophysical parameters in the group depend on all members data such as centroid coordinates, mean redshift, group's radial velocity, group's distance and group's combined magnitude.

REFERENCES

Allam, S. and Tucker, D.; (2000): Compact Groups of Galaxies in the Las Campanas Redshift Survey. AN. 321: 101-114

Barton, E., Geller, M. J., Ramella, M., Marzke, R., and da Costa L., 1996, Compact group selection from redshift surveys, AJ, 112:871

de Vaucouleurs, G. 1965, in stars and stellar systems, Vol.9.ed. A. Sandage, M Sandage and J. Kristian (Chicago university press)

de Vaucouleurs .G. 1975., Supergalactic studies. I -Supergalactic distribution of the nearest galaxies, ApJ. 202:319

de Carvalho, R. R.; Gonçalves, T. S.; Iovino, A.; Kohl-Moreira, J. L.; Gal, R. R.; Djorgovski, S. G., (2005). A Catalog of Distant Compact Groups Using the Digitized Second Palomar Observatory Sky Survey.AJ. 130(2):425:444

Deng X.-F., He J.-Z., Ma X.-S., Jiang P., and Tang X.-X.(2008). Compact groups of galaxies (CGs) from the SDSS Data Release 6. Central Eur. J. Phys. 6(2): 185-193

Diaz-Gimenez, E., Mamon, G. A., Pacheco, M., Mendes de Oliveira, C. and Alonso, M. V. 2012, Compact groups of galaxies selected by stellar mass: the 2MASS compact group catalogue, MNRAS, 426, 1:296

Dressler, A., 1980,Galaxy morphology in rich clusters: implications for the formation and evolution of galaxies. ApJ. 236: 351-365

Focardi, P., and Kelm, B., 2002, Compact groups in the UZC galaxy sample, A&A, 301: 35

Geller, M. J. and Postman, M.; 1983, First-ranked galaxies in groups, ApJ, 274:31-38.

Grokhovskaya, A. A.andDodonov, S. N., 2019, Large Scale Distribution of Galaxies in The Field HS 47.5-22. I. Data Analysis Technique**,** AstBu.74:379G

Hickson, P. 1982, Systematic properties of compact groups of galaxies, ApJ, 255: 382

Hickson, P., Mendes de Oliveira, C., Huchra, J. P., and Palumbo, G. 1992, Dynamical properties of compact groups of galaxies ApJ., 399: 353

Hickson, P., 1993, Atlas of Compact Groups of Galaxies (Special Issue); 1993, Ap L & C, 29:1H

Holmberg, E., 1969, A study of physical groups of galaxies, ArkivförAstronomi, 5, 305:343

Huchra, J..P., and Geller, M.. J., 1982, Groups of galaxies. I – Nearby groups. ApJ, 257: 423

Huchra, J..P., Davis, M., Latham,, D.W, and Tonry, J., 1983 A survey of galaxy redshifts. IV - The data.,ApJS, 52, 89

Humason, M.L., Mayall.N.U., and Sandage, A. R., 1956, Redshifts and magnitudes of extragalactic Nebulae, AJ.61, 97.

Karachentsev, V.E, Karachentsev, I. D. and Scherbanovsky A. (1979):Isolated triplet of galaxies.Astrofizik.Issledovanija. 11: 3-39

Kafle, Prajwal R., Robotham, Aaron, Lagos, Claudia, Driver, Simon P.,2017, Galaxy group dynamics using the GAMA survey and predictions from semi-analytics and cosmological simulation, AAS.,229:105

Materne, J., The structure of nearby groups of galaxies: quantitative membership probabilities.1979, A&A, 74,235

McConnachie, Alan W., Brasseur, Crystal M., Ellison, Sara L., Patton, David R , 2009, Compact groups in theory and practice - III. Compact groups of galaxies in the Sixth Data Release of the Sloan Digital Sky Survey, MNRAS. 395: 255

McGlynn, T. A.; Ostriker, J. P., 1980, Galactic cannibalism. IV. The evidence-correlations between dynamical time scales and Bautz-Morgan type. ApJ, 241:915-924

Mendes de Oliveira C., 1995. The nature of discordant redshift galaxies in compact groups.MNRAS, 273:139–145.

Citation: Sabry A. Mohamed et al., 2020.Test membership in quartet Tago galaxy groups. Australian Journal of Basic and Applied Sciences, 14(2): 1-12. DOI: 10.22587/ajbas.2020.14.2.1

Mezzetti, M.; Giuricin, G.; Malagnini, M. L.; and Mardirossian, F.,1983, Galaxy groups - Correlations between luminosities, velocity dispersions, and virial radii, A&A., 125:368-370.

Murtagh F. (1984). Complexities of Hierarchic Clustering Algorithms: the state of the art. Computational Statistics Quarterly 1: 101–113

Prandoni, I., Iovino, A., and MacGillivray, H. T., 1994, Automated search for compact groups of galaxies in the southern sky. AJ.107 :1235.

Romesburg, H. Charles, 1984, Cluster Analysis for Researchers, Lifetime learning publications, U.S.A

Rose, J. A., 1977, A survey of compact groups of galaxies, ApJ. 211:311.

Sabry A. Mohamed, Issa A.Issa., A.I.Osman., A.Bakry, and M. Beahary, 2009, Investigation in Groups of Galaxies, PhD. Azharuniv.

Sandage, A.; and Tammann, G. A.; 1975, Steps toward the Hubble constant. V. The Hubble constant from nearby galaxies and the regularity of the local velocity field., ApJ, 196:313-328.

Shakhbazian, R. K.,Compact groups of compact galaxies, 1973, AstrophyZika, 9, 495

Sohn, Jubee; Hwang, Ho Seong; Geller, Margaret J.; Diaferio, Antonaldo; Rines, Kenneth J.; Lee, MyungGyoon; and Lee, Gwang-Ho, 2015, Compact Groups of Galaxies with Complete Spectroscopic Redshifts in the Local Universe, JKAS.48:381-398

Sokal R and Michener C. , 1958. "A statistical method for evaluating systematic relationships".University of Kansas Science Bulletin 38: 1409–1438

Sulentic, J.W., 1983, on the density of galaxy quartets and the statistical likelihood of discordant redshift groups, ApJ, 270: 417, 21

Tago, E.; Einasto, J.; Saar, E.; Einasto, M.; Suhhonenko, I.; Jõeveer, M.; Vennik, J.; Heinämäki, P.; Tucker, D. L., 2006, Clusters and groups of galaxies in the 2dF galaxy redshift survey: A new catalogue., Astron.Nach. 327, No.4:365

Tempel , E., Tago, E. and Liivamagi L.J. ,2012. Groups and clusters of galaxies in the SDSS DR8.Value-added catalogues. A&A. 540: A106-9P

Tully, R. B., 1987a, nearby groups of galaxies. II - an all-sky survey within 3000 kilometers per second.,ApJ, 321: 280

Tully, R. B., 1987b, Nearby galaxies catalog, Cambridge: Cambridge Univ. Press

Turner, E. L., and Gott, J., R.,1976a, Groups of galaxies. I. A catalogue. ApJS., 32:409.

Turner, E. L., and Gott, J., R.,1976b, Groups of Galaxies. II. The Luminosity Function. ApJ.209:6.

Wang, Yu; Yang, Xiaohu; Mo, H. J.; van den Bosch, Frank C, Weinmann, Simone M.; Chu, Yaoquan,

The Clustering of SDSS Galaxy Groups: Mass and Color Dependence. 2008, ApJ, 68:,919

William H. E and Edelsbrunner. Herbert (1984-12-01). "Efficient algorithms for agglomerative hierarchical clustering methods". Journal of Classification1 (1): 7–24.

Yu, Heng; Diaferio, Antonaldo; Serra, Ana Laura and Baldi, Marco, 2018, Blooming Trees: Substructures and Surrounding Groups of Galaxy Clusters, ApJ., 860: 118Y

Zarattini, S.; Aguerri, J. A. L.; Biviano, A.; Girardi, M.; Corsini, E. M and D'Onghia, E,2019, Fossil group origins. X. Velocity segregation in fossil systems, A&A.631:16Z