ISSN NO. 2320-5407

Journal homepage: http://www.journalijar.com
Journal DOI: 10.21474/IJAR01

INTERNATIONAL JOURNAL OF ADVANCED RESEARCH

RESEARCH ARTICLE

The Physical Reality Of McConnachie compact groups of galaxies -1.

Sabry A. Mohamed[1,2].

1. National Research Institute of astronomy and Geophysics, Helwan, Cairo, Egypt.
2. Physics Dept., College of Science and Humanities, Hawtat sudair, Majmaah University, Saudi Arabia.

Manuscript Info

Manuscript History:

Received: 15 March 2016
Final Accepted: 16 April 2016
Published Online: May 2016

Key words:
galaxies, catalog, groups, cluster, statistics.

Corresponding Author

Sabry A. Mohamed.

Abstract

In this paper the tree clustering technique (The Astrophysical Euclidean Separation Coefficients) is used to test the reality of compact groups of galaxies in McConnachie et al. (2009) catalog. The method applied on the first 100 groups only.
The result will reveal the membership of each galaxy and how it relates to its group.
The tables of groups and their members are included.

Introduction:-

Groups of galaxies defined as a small number of galaxies from 3 to some tens of galaxies. The most galaxies in the universe tend to belong in a groups (Holmberg 1950, Humason et al 1956; de Vaucoulaurs 1965; de Vaucoulaurs 1975 ; Materne 1979; Huchra and Geller 1982; Geller and Huchra 1983; Tully 1987).

Groups of galaxies usually selected on the basis of close values of redshift and enhanced frequencies of galaxies relative to that of the background.

A galaxy group is called Compact Group of Galaxies (hereafter CGGs), when the mean projected separation among the member galaxies is comparable to the diameters of the galaxies themselves and the group is sufficiently isolated.

There are many different groups of galaxy catalogues differ from each other by various selection criteria of members in the groups (e.g., Shakhbazian 1957; de Vaucoulaurs 1975, Turner and Gott 1976a,b, Rose 1977, Karanchentsev et al.1979, Hickson 1982, Garcia 1995, Barton et al.1996, Allam et al 2000, Focardi et al. 2002, Iovenio et el. 2003, Lee et al. 2004, de Carvalho et al. 2005, Deng et al. 2007, Wang, Yu, et. al. 2008, McConnachie et al 2009, Diaz-Gimenez et al. 2012 , Sohn et al 2015).

Because of most of these catalogs defined by using criteria depends on compactness (high surface density) and isolation of possible members from field galaxies which means most of criteria depends on mainly on redshift observations, so many problems in these catalogs can be found such as discordant members and uncertainties in determining the radii of galaxies due to uncertainties of distance determination.

The paper is organized as follows: section 2 describes the data used and method while section 3 describes the results obtained and discussion.

Data and Method:-

The Data:-

McConnachie et al. (2009) introduced the largest catalogue of the compact groups of galaxies selected from the Sixth Data Release of the Sloan Digital Sky Survey (SDSS DR6) by using the following criteria from Hickson (1982):

$$n \geq 4 \text{ with } m \geq m_B + 3$$
$$R_N \geq 3R_G$$
$$\mu_G \leq 26$$

where n is the number of members, m_B is the estimated magnitude of the brightest group member, R_G is the radius of the smallest circle containing the group members, R_N is the distance from the center of this circle to the nearest nonmember satisfying the same magnitude condition and μ_G is the mean surface brightness contained by the circle.

They identify 2297 CGGs down to a limiting magnitude of r =18 and 74791 CGGs down to a limiting magnitude of r=21

The Method:-

Cluster analysis techniques assesses the similarity between galaxies by measuring the astrophysical euclidean separation coefficients .in the attribute space. Galaxies that are similar will lie close to one another, whereas dissimilar galaxies lie from each other in the galaxy attribute space. The choice of the distance metric to express similarity between galaxies in a data set depends on the type of measured variables (attributes) used (magnitudes, color indices,……..).The technique depends on studying together some attributes of objects which seems to form a group or catalogued as group. If these attributes are similar or nearly equal, according to the philosophy of the technique then it may form a cluster. The main core of the method depends on a matrix in which columns stands for objects while its rows are concerned with the attributes of these objects.

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 clustering. 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.

$$e_{jk} = \sqrt{\sum_{i=1}^{3} (X_{ij} - X_{ik})^2} \qquad \textbf{(1)}$$

This means that to compute e_{jk} for two galaxies j and k Adding a third attribute, the euclidean distance coefficient is given by just adding a third term, i.e. A generalization of n attribute can take the form

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

Equation (2) gives the square root of the sum of the squares of the differences of the values of the n attributes.

The average Euclidean distance coefficient e_{jk} is defined as the average of the squares of the differences, expressed as,

$$e_{jk} = \sqrt{\sum_{i=1}^{n} \left[\frac{(X_{ij} - X_{ik})^2}{n}\right]} \qquad \textbf{(3)}$$

by using the Unweighted Pair Group Method using Arithmetic Average (UPGMA) (Romesburg 1984). its starts with galaxies as being individual clusters and merges galaxies with similar attributes by averaging similarities of each two galaxies and forms a tree-like structure in a bottom-up way which can be cut off at any level.

With the following criteria used by Sabry et al. (2009) and Sabry et al. (2012), one can define the separation between each two galaxies:

1. If $e_{jk} < e_{av} - \sigma$

The galaxies are regarded as a Twin (T)

2. If $e_{jk} < e_{av}$

The galaxies are regarded as a Pair (P)

3. If $e_{av} \leq e_{jk} \leq e_{av} + \sigma$

The galaxies are regarded as a Member (M)

4. If $e_{jk} > e_{av} + \sigma$

The galaxies have a discordant attribute and are regarded as an Attribute Discordant (AD).
when Some members appeared attribute discordant in any groups and some groups contained sub groups too , the combined coefficient applied to inspect the reality of the results

$$e_{m(jk)} = \frac{1}{2}\left(e_{mj} + e_{mk}\right)$$

Where m, j and k are galaxy members of the same group.

Results:-

By Appling the UPGAMA method in the first 100 groups from the catalog of McConnachie et al. (2009) and calculated the astrophysical euclidean separation coefficients of each two members in the same group using the total magnitude of the group in the r band and the g-r color index we get the results shows in table as follows:
Column (1) : the number of the group and the Euclidean coefficient, column (2): the total magnitude of the first object in the r band, column (3): the total magnitude of the second object in the r band, column (4) : the g-r color index of the first object, column (5) : the g-r color index of the second object, 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 every two galaxies regarding each other and column (10) is the comments.

Group No 1

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	15.01	15.29	0.86	0.82	0.282843	1.307739	0.729946	T	G_{12} make a twin.
G_{13}	15.01	16.23	0.86	1.07	1.237942			P	G_{13} make a pair.
G_{14}	15.01	17.29	0.86	0.97	2.282652			AD	G_{23} make a pair.
G_{23}	15.29	16.23	0.82	1.07	0.972677			P	G_{34} make a pair
G_{24}	15.29	17.29	0.82	0.97	2.005617			M	
G_{34}	16.23	17.29	1.07	0.97	1.064707			P	

Group no.2

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	14.81	15.07	1.08	0.87	0.334215	1.561362	1.167964	T	G_{12} make a twin
G_{13}	14.81	15.52	1.08	1.12	0.711126			P	G_{13} make a pair
G_{14}	14.81	17.71	1.08	0.68	2.927456			AD	G_{23} make a pair.
G_{23}	15.07	15.52	0.87	1.12	0.514782			P	Galaxy 4 may be
G_{24}	15.07	17.71	0.87	0.68	2.646828			M	attribute discordant
G_{34}	15.52	17.71	1.12	0.68	2.233764			M	

Group no.3

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	16.42	16.69	0.85	1.03	0.324500	0.290208	0.119227	M	G_{23} make a pair
G_{13}	16.42	16.77	0.85	0.81	0.352278			M	G_{34} make a twin
G_{14}	16.42	16.86	0.85	0.79	0.444072			AD	.
G_{23}	16.69	16.77	1.03	0.81	0.234094			P	
G_{24}	16.69	16.86	1.03	0.79	0.294109			M	
G_{34}	16.77	16.86	0.81	0.79	0.092195			T	

Group no.4

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	15.82	17.2	0.99	1.09	1.383618	1.087443	0.726844	M	G_{23} make a pair
G_{13}	15.82	17.57	0.99	0.84	1.756417			M	G_{24} make a pair
G_{14}	15.82	17.83	0.99	0.95	2.010398			AD	G_{34} make a twin
G_{23}	17.2	17.57	1.09	0.84	0.446542			P	.
G_{24}	17.2	17.83	1.09	0.95	0.645368			P	
G_{34}	17.57	17.83	0.84	0.95	0.282312			T	

Group no.5

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	14.53	16.16	0.97	1.07	1.633065	1.294891	0.845535	M	G_{23} make a twin
G_{13}	14.53	16.33	0.97	1.05	1.801777			M	G_{24} make a pair
G_{14}	14.53	17.04	0.97	0.84	2.513364			AD	G_{34} make a pair
G_{23}	16.16	16.33	1.07	1.05	0.171172			T	.
G_{24}	16.16	17.04	1.07	0.84	0.909560			P	
G_{34}	16.33	17.04	1.05	0.84	0.740405			P	

Group no.6

	(r mag)i	(r mag)j	(g-r)i	(g-r)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	16.84	16.95	1.36	0.46	0.906697	0.803965	0.254810	M	G_{23} make a twin
G_{13}	16.84	17.22	1.36	0.83	0.652150			P	G_{13} make a pair
G_{14}	16.84	17.87	1.36	0.93	1.116154			AD	G_{34} make a pair
G_{23}	16.95	17.22	0.46	0.83	0.458039			T	
G_{24}	16.95	17.87	0.46	0.93	1.033102			M	
G_{34}	17.22	17.87	0.83	0.93	0.657647			P	

Group no.7

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	15.77	16.77	1.22	1.18	1.000800	1.000727	0.449862	M	G_{23} make a twin
G_{13}	15.77	17.01	1.22	1.59	1.294025			M	G_{24} make a pair
G_{14}	15.77	17.48	1.22	0.98	1.726760			AD	G_{34} make a pair
G_{23}	16.77	17.01	1.18	1.59	0.475079			T	
G_{24}	16.77	17.48	1.18	0.98	0.737631			P	
G_{34}	17.01	17.48	1.59	0.98	0.770065			P	

Group no.8

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	14.89	15.74	0.81	0.96	0.863134	0.951944	0.509101	P	G_{12} make a pair
G_{13}	14.89	16.24	0.81	0.88	1.351814			M	G_{23} make a pair
G_{14}	14.89	16.61	0.81	1.00	1.730462			AD	G_{24} make a pair
G_{23}	15.74	16.24	0.96	0.88	0.506360			P	G_{34} make a pair
G_{24}	15.74	16.61	0.96	1.00	0.870919			P	
G_{34}	16.24	16.61	0.88	1.00	0.388973			T	

Group no.9

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	14.95	15.02	0.56	0.48	0.106301	1.666445	0.927703	T	G_{12} make a twin
G_{13}	14.95	16.64	0.56	0.47	1.692395			M	G_{23} make a pair
G_{14}	14.95	17.34	0.56	1.64	2.622689			AD	. Galaxy 4 may be
G_{23}	15.02	16.64	0.48	0.47	1.620031			P	attribute discordant
G_{24}	15.02	17.34	0.48	1.64	2.593839			M	
G_{34}	16.64	17.34	0.47	1.64	1.363415			P	

Group no.10

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	16.01	16.97	0.98	1.09	0.966282	0.986142	0.526089	P	G_{12} make a pair
G_{13}	16.01	17.32	0.98	1.09	1.314610			M	G_{23} make a twin
G_{14}	16.01	17.82	0.98	0.81	1.817966			AD	G_{24} make a pair
G_{23}	16.97	17.32	1.09	1.09	0.350000			T	G_{34} make a pair.
G_{24}	16.97	17.82	1.09	0.81	0.894930			P	
G_{34}	17.32	17.82	1.09	0.81	0.573062			P	

Group no.11

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	16.48	16.76	0.95	1.11	0.322490	0.519121	0.236549	P	G_{12} make a pair
G_{13}	16.48	16.87	0.95	0.84	0.405216			P	G_{23} make a pair
G_{14}	16.48	17.26	0.95	0.56	0.872067			AD	G_{13} make a pair
G_{23}	16.76	16.87	1.11	0.84	0.291548			P	G_{34} make a pair
G_{24}	16.76	17.26	1.11	0.56	0.743303			M	
G_{34}	16.87	17.26	0.84	0.56	0.480104			P	

Group no.12

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	15.36	15.95	0.92	0.85	0.594138	1.399809	0.745213	T	G_{12} make a twin
G_{13}	15.36	17.23	0.92	0.91	1.870027			M	G_{23} make a pair
G_{14}	15.36	17.73	0.92	0.86	2.370759			AD	G_{34} make a twin.
G_{23}	15.95	17.23	0.85	0.91	1.281405			P	The groups have 2
G_{24}	15.95	17.73	0.85	0.86	1.780028			M	subgroups
G_{34}	17.23	17.73	0.91	0.86	0.502494			T	

Group no.13

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	16.14	16.8	1.04	1.08	0.661211	1.003816	0.484834	P	G_{12} make a pair
G_{13}	16.14	17.07	1.04	0.76	0.971236			P	G_{13} make a pair
G_{14}	16.14	17.97	1.04	1.12	1.831748			AD	G_{23} make a twin
G_{23}	16.8	17.07	1.08	0.76	0.418688			T	G_{34} make a pair
G_{24}	16.8	17.97	1.08	1.12	1.170684			M	.
G_{34}	17.07	17.97	0.76	1.12	0.969330			P	

Group no.14

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	15.01	15.66	0.88	0.81	0.653758	1.804171	0.959052	T	G_{12} make a twin
G_{13}	15.01	17.49	0.88	0.84	2.480323			M	G_{34} make a twin
G_{14}	15.01	17.89	0.88	1.35	2.918099			AD	. This group contains 2
G_{23}	15.66	17.49	0.81	0.84	1.830246			M	sub groups (1 and 2) and
G_{24}	15.66	17.89	0.81	1.35	2.294450			M	(3 and 4).
G_{34}	17.49	17.89	0.84	1.35	0.648151			T	

Group no.15

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	15.62	16.4	0.93	1.03	0.786384	1.399357	0.545437	T	G_{12} make a twin
G_{13}	15.62	17.43	0.93	0.53	1.853672			M	G_{23} make a pair
G_{14}	15.62	17.77	0.93	1.44	2.209661			AD	G_{34} make a pair
G_{23}	16.4	17.43	1.03	0.53	1.144945			P	
G_{24}	16.4	17.77	1.03	1.44	1.430035			M	
G_{34}	17.43	17.77	0.53	1.44	0.971442			P	

Group no.16

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	15.04	17.21	0.87	0.84	2.170207	1.504204	1.175757	M	G_{23} make a pair
G_{13}	15.04	17.68	0.87	0.75	2.642726			M	G_{24} make a pair
G_{14}	15.04	17.88	0.87	0.85	2.840070			AD	G_{34} make a twin
G_{23}	17.21	17.68	0.84	0.75	0.478539			P	
G_{24}	17.21	17.88	0.84	0.85	0.670075			P	
G_{34}	17.68	17.88	0.75	0.85	0.223607			T	

Group no.17

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	15.72	17.36	0.96	0.84	1.644384	1.176878	0.724533	M	G_{23} make a pair
G_{13}	15.72	17.46	0.96	1.42	1.799778			M	G_{24} make a twin
G_{14}	15.72	17.75	0.96	0.89	2.031207			AD	G_{34} make a pair
G_{23}	17.36	17.46	0.84	1.42	0.588558			P	Galaxy 1 may be
G_{24}	17.36	17.75	0.84	0.89	0.393192			T	attribute discordant.
G_{34}	17.46	17.75	1.42	0.89	0.604152			P	

Group no.18

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	14.99	15.11	1.03	0.92	0.162788	1.891046	1.159273	T	G_{12} make a twin
G_{13}	14.99	17.3	1.03	0.98	2.310541			M	G_{34} make a pair
G_{14}	14.99	17.97	1.03	0.57	3.015294			M	This group contains 2
G_{23}	15.11	17.3	0.92	0.98	2.190822			M	sub groups (1 and 2) and
G_{24}	15.11	17.97	0.92	0.57	2.881336			M	(3 and 4).
G_{34}	17.3	17.97	0.98	0.57	0.785493			P	

Group no.19

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	15.35	15.97	0.82	0.84	0.620322	1.533156	0.698184	T	G_{12} make a twin.
G_{13}	15.35	16.8	0.82	1.51	1.605802			M	G_{23} make a pair
G_{14}	15.35	17.95	0.82	0.85	2.600173			AD	G_{34} make a pair
G_{23}	15.97	16.8	0.84	1.51	1.066677			P	
G_{24}	15.97	17.95	0.84	0.85	1.980025			M	
G_{34}	16.8	17.95	1.51	0.85	1.325934			P	

Group no.20

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	16.41	16.57	1.05	1.25	0.256125	0.628978	0.312321	T	G_{12} make a twin.
G_{13}	16.41	17.18	1.05	1.05	0.770000			M	G_{34} make a twin.
G_{14}	16.41	17.41	1.05	1.16	1.006032			AD	This group contains 2
G_{23}	16.57	17.18	1.25	1.05	0.641950			M	sub groups (1 and 2) and
G_{24}	16.57	17.41	1.25	1.16	0.844808			M	(3 and 4).
G_{34}	17.18	17.41	1.05	1.16	0.254951			T	

Group no.21

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	15.39	15.96	0.86	0.9	0.571402	1.158938	0.579841	T	G_{12} make a twin.
G_{13}	15.39	17.1	0.86	1.35	1.778820			AD	G_{34} make a twin
G_{14}	15.39	17.16	0.86	0.95	1.772287			AD	This group contains 2
G_{23}	15.96	17.1	0.9	1.35	1.225602			M	sub groups (1 and 2) and
G_{24}	15.96	17.16	0.9	0.95	1.201041			M	(3 and 4).
G_{34}	17.1	17.16	1.35	0.95	0.404475			T	

Group no.22

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	15.55	15.96	0.87	0.97	0.422019	1.280201	0.712126	T	G_{12} make a twin.
G_{13}	15.55	16.67	0.87	1.03	1.131371			P	G_{13} make a pair
G_{14}	15.55	17.86	0.87	0.86	2.310022			AD	G_{23} make a pair.
G_{23}	15.96	16.67	0.97	1.03	0.712531			P	G_{34} make a pair.
G_{24}	15.96	17.86	0.97	0.86	1.903182			M	
G_{34}	16.67	17.86	1.03	0.86	1.202082			P	

Group no.23

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	15.14	15.75	0.88	0.96	0.615224	0.893821	0.515325	P	G_{12} make a pair.
G_{13}	15.14	16.44	0.88	0.92	1.300615			M	G_{23} make a pair.
G_{14}	15.14	16.46	0.88	0.97	1.323065			M	G_{24} make a pair.
G_{15}	15.14	16.93	0.88	1.29	1.836355			AD	G_{34} make a twin.
G_{23}	15.75	16.44	0.96	0.92	0.691158			P	G_{35} make a pair.
G_{24}	15.75	16.46	0.96	0.97	0.710070			P	G_{45} make a pair.
G_{25}	15.75	16.93	0.96	1.29	1.225275			AD	
G_{34}	16.44	16.46	0.92	0.97	0.053852			T	
G_{35}	16.44	16.93	0.92	1.29	0.614003			P	
G_{45}	16.46	16.93	0.97	1.29	0.568595			P	

Group no.24

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	14.66	16.62	0.5	0.67	1.967359	1.401497	1.011210	M	G_{23} make a twin
G_{13}	14.66	16.82	0.5	0.55	2.160579			M	. G_{24} make a pair. G_{34}
G_{14}	14.66	17.38	0.5	0.57	2.720901			AD	make a pair.
G_{23}	16.62	16.82	0.67	0.55	0.233238			T	Galaxy 1 may be an
G_{24}	16.62	17.38	0.67	0.57	0.766551			P	attribute discordant.
G_{34}	16.82	17.38	0.55	0.57	0.560357			P	

GROUP NO.25

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	16.52	16.61	0.88	0.89	0.090554	0.946447	0.685527	T	G_{12} make a twin.
G_{13}	16.52	17.94	0.88	0.81	1.421724			M	G_{34} make a twin.
G_{14}	16.52	17.96	0.88	0.78	1.443468			M	This group contains 2
G_{23}	16.61	17.94	0.89	0.81	1.332404			M	sub groups (1 and 2) and
G_{24}	16.61	17.96	0.89	0.78	1.354474			M	(3 and 4).
G_{34}	17.94	17.96	0.81	0.78	0.036056			T	

Group no.26

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	16.74	17.14	1.03	1.14	0.414849	0.459318	0.222378	P	G_{12} make a pair.
G_{13}	16.74	17.44	1.03	1.06	0.700643			AD	G_{23} make a pair.
G_{14}	16.74	17.47	1.03	0.89	0.743303			AD	G_{24} make a pair
G_{23}	17.14	17.44	1.14	1.06	0.310483			P	G_{34} make a twin.
G_{24}	17.14	17.47	1.14	0.89	0.414005			P	
G_{34}	17.44	17.47	1.06	0.89	0.172627			T	

Group no.27

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	15.39	16.42	0.85	0.9	1.031213	1.179282	0.735997	P	G_{12} make a pair.
G_{13}	15.39	16.46	0.85	0.9	1.071168			P	G_{13} make a pair.
G_{14}	15.39	17.71	0.85	1.16	2.340620			AD	G_{23} make a twin.
G_{23}	16.42	16.46	0.9	0.9	0.040000			T	Galaxy 4 might be an
G_{24}	16.42	17.71	0.9	1.16	1.315941			M	attribute discordant.
G_{34}	16.46	17.71	0.9	1.16	1.276754			M	

Group no.28

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	15.97	16.46	0.68	0.9	0.537122	1.143231	0.454563	T	G_{12} make a twin.
G_{13}	15.97	17.32	0.68	0.51	1.360662			M	G_{23} make a pair.
G_{14}	15.97	17.7	0.68	1.3	1.837743			AD	G_{34} make a pair.
G_{23}	16.46	17.32	0.9	0.51	0.944299			P	
G_{24}	16.46	17.7	0.9	1.3	1.302920			M	
G_{34}	17.32	17.7	0.51	1.3	0.876641			P	

Group no.29

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	14.97	15.64	0.83	0.79	0.671193	1.361391	0.783133	P	G_{12} make a pair.
G_{13}	14.97	16.01	0.83	1.08	1.069626			P	G_{13} make a pair.
G_{14}	14.97	17.52	0.83	0.86	2.550176			AD	G_{23} make a twin.
G_{23}	15.64	16.01	0.79	1.08	0.470106			T	Galaxy 4 may be an
G_{24}	15.64	17.52	0.79	0.86	1.881303			M	attribute discordant.
G_{34}	16.01	17.52	1.08	0.86	1.525942			M	

Group no.30

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	16.77	17.23	1.31	1.21	0.470744	0.633208	0.298189	P	G_{12} make a pair.
G_{13}	16.77	17.71	1.31	1.56	0.972677			AD	G_{23} make a pair.
G_{14}	16.77	17.76	1.31	1.34	0.990454			AD	G_{24} make a pair.
G_{23}	17.23	17.71	1.21	1.56	0.594054			P	G_{34} make a twin.
G_{24}	17.23	17.76	1.21	1.34	0.545711			P	
G_{34}	17.71	17.76	1.56	1.34	0.225610			T	

Group no.31

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	16.07	16.49	1.03	1.13	0.431741	0.545737	0.298003	P	G_{12} make a pair.
G_{13}	16.07	16.89	1.03	1.09	0.822192			M	G_{23} make a pair.
G_{14}	16.07	17.02	1.03	1.06	0.950474			AD	G_{24} make a pair.
G_{23}	16.49	16.89	1.13	1.09	0.401995			P	G_{34} make a twin.
G_{24}	16.49	17.02	1.13	1.06	0.534603			P	
G_{34}	16.89	17.02	1.09	1.06	0.133417			T	

Group no.32

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	17.02	17.12	1.87	0.25	1.623083	1.092900	0.476406	AD	G_{13} make a twin.
G_{13}	17.02	17.38	1.87	1.83	0.362215			T	G_{14} make a pair.
G_{14}	17.02	17.75	1.87	1.06	1.090413			P	G_{24} make a pair.
G_{23}	17.12	17.38	0.25	1.83	1.601250			AD	G_{34} make a pair.
G_{24}	17.12	17.75	0.25	1.06	1.026158			P	
G_{34}	17.38	17.75	1.83	1.06	0.854283			P	

Group no.33

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	15.75	16.98	1.08	1.05	1.230366	0.958768	0.608092	M	G_{23} make a pair.
G_{13}	15.75	17.35	1.08	1.45	1.642224			AD	G_{24} make a pair.
G_{14}	15.75	17.36	1.08	1.11	1.610279			AD	G_{34} make a twin.
G_{23}	16.98	17.35	1.05	1.45	0.544885			P	Galaxy 1 may be an
G_{24}	16.98	17.36	1.05	1.11	0.384708			P	attribute discordant.
G_{34}	17.35	17.36	1.45	1.11	0.340147			T	

Group no.34

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	16.55	16.83	0.93	0.98	0.284429	0.320141	0.169563	P	G_{12} make a pair.
G_{13}	16.55	17.04	0.93	0.85	0.496488			AD	G_{23} make a pair.
G_{14}	16.55	17.09	0.93	0.92	0.540093			AD	G_{24} make a pair.
G_{23}	16.83	17.04	0.98	0.85	0.246982			P	G_{34} make a twin.
G_{24}	16.83	17.09	0.98	0.92	0.266833			P	
G_{34}	17.04	17.09	0.85	0.92	0.086023			T	

Group no.35

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
e12	15.52	15.75	0.88	0.9	0.230868	1.280668	0.787816	T	G_{12} make a twin.
e13	15.52	17.08	0.88	0.85	1.560288			M	G_{34} make a twin.
e14	15.52	17.55	0.88	0.76	2.033544			M	G35 make a pair.
e15	15.52	17.81	0.88	0.88	2.290000			AD	G45 make a pair.
e23	15.75	17.08	0.9	0.85	1.330940			M	This groups contains 2
e24	15.75	17.55	0.9	0.76	1.805436			M	sub groups (1 and 2) and
e25	15.75	17.81	0.9	0.88	2.060097			AD	(3, 4 and 5).
e34	17.08	17.55	0.85	0.76	0.478539			T	
e35	17.08	17.81	0.85	0.88	0.730616			P	
e45	17.55	17.81	0.76	0.88	0.286356			P	

Group no.36

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	15.08	15.84	0.7	0.86	0.776660	1.715543	0.918724	T	G_{12} make a twin.
G_{13}	15.08	17.44	0.7	0.75	2.360530			M	G_{23} make a pair.
G_{14}	15.08	17.96	0.7	0.91	2.887646			AD	G_{34} make a twin.
G_{23}	15.84	17.44	0.86	0.75	1.603777			P	
G_{24}	15.84	17.96	0.86	0.91	2.120590			M	
G_{34}	17.44	17.96	0.75	0.91	0.544059			T	

Group no.37

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	15.19	15.37	0.92	0.83	0.201246	0.545111	0.247357	T	G_{12} make a twin.
G_{13}	15.19	15.8	0.92	0.91	0.610082			M	G_{23} make a pair.
G_{14}	15.19	16.02	0.92	0.56	0.904710			AD	G_{34} make a pair.
G_{23}	15.37	15.8	0.83	0.91	0.437379			P	
G_{24}	15.37	16.02	0.83	0.56	0.703847			M	
G_{34}	15.8	16.02	0.91	0.56	0.413401			P	

Group no.38

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	16.14	17.27	1.11	1.24	1.137453	0.759566	0.580596	M	G_{23} make a pair.
G_{13}	16.14	17.45	1.11	1.04	1.311869			M	G_{24} make a pair.
G_{14}	16.14	17.52	1.11	0.98	1.386110			AD	G_{34} make a twin.
G_{23}	17.27	17.45	1.24	1.04	0.269072			P	Galaxy 1 may be an
G_{24}	17.27	17.52	1.24	0.98	0.360694			P	attribute discordant.
G_{34}	17.45	17.52	1.04	0.98	0.092195			T	

Group no.39

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	16.99	17.21	1.08	0.98	0.241661	0.428620	0.272327	P	G_{12} make a pair.
G_{13}	16.99	17.28	1.08	1.02	0.296142			P	G_{13} make a pair.
G_{14}	16.99	17.8	1.08	0.91	0.827647			AD	G_{23} make a twin. Galaxy 4 may be an attribute discordant.
G_{23}	17.21	17.28	0.98	1.02	0.080623			T	
G_{24}	17.21	17.8	0.98	0.91	0.594138			M	
G_{34}	17.28	17.8	1.02	0.91	0.531507			M	

Group no.40

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	16.34	16.68	0.63	1.34	0.787210	1.125524	0.591925	P	G_{12} make a pair.
G_{13}	16.34	17.91	0.63	1.18	1.663550			M	G_{34} make a twin.
G_{14}	16.34	17.94	0.63	1.07	1.659397			M	This group contains 2 sub groups (1 and 2) and (3 and 4).
G_{23}	16.68	17.91	1.34	1.18	1.240363			M	
G_{24}	16.68	17.94	1.34	1.07	1.288604			M	
G_{34}	17.91	17.94	1.18	1.07	0.114018			T	

Group no.41

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	16.69	16.9	0.92	0.67	0.326497	0.768380	0.377242	T	G_{12} make a twin.
G_{13}	16.69	17.56	0.92	0.7	0.897385			M	G_{23} make a pair.
G_{14}	16.69	17.95	0.92	0.67	1.284562			AD	G_{34} make a pair.
G_{23}	16.9	17.56	0.67	0.7	0.660681			P	
G_{24}	16.9	17.95	0.67	0.67	1.050000			M	
G_{34}	17.56	17.95	0.7	0.67	0.391152			P	

Group no.42

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	14.51	14.85	0.88	0.89	0.340147	1.178184	0.854195	P	G_{12} make a pair.
G_{13}	14.51	16.4	0.88	0.88	1.890000			M	G_{34} make a twin. G35 make a pair. G45 make a pair. This group contains 2 sub groups (1 and 2) and (3, 4 and 5).
G_{14}	14.51	16.56	0.88	0.89	2.050024			AD	
G_{15}	14.51	16.56	0.88	0.77	2.052949			AD	
G_{23}	14.85	16.4	0.89	0.88	1.550032			M	
G_{24}	14.85	16.56	0.89	0.89	1.710000			M	
G_{25}	14.85	16.56	0.89	0.77	1.714205			AD	
G_{34}	16.4	16.56	0.88	0.89	0.160312			T	
G_{35}	16.4	16.56	0.88	0.77	0.194165			P	
G_{45}	16.56	16.56	0.89	0.77	0.120000			P	

Group no.43

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	16.1	16.35	1.11	1.07	0.253180	0.762092	0.438427	T	G_{12} make a twin.
G_{13}	16.1	17.14	1.11	1.1	1.040048			M	G_{34} make a twin. G35 make a pair. G45 make a pair. This group contains 2 sub groups (1 and 2) and (3, 4 and 5).
G_{14}	16.1	17.26	1.11	0.95	1.170982			M	
G_{15}	16.1	17.49	1.11	1.21	1.393592			AD	
G_{23}	16.35	17.14	1.07	1.1	0.790569			M	
G_{24}	16.35	17.26	1.07	0.95	0.917878			M	
G_{25}	16.35	17.49	1.07	1.21	1.148564			AD	
G_{34}	17.14	17.26	1.1	0.95	0.192094			T	
G_{35}	17.14	17.49	1.1	1.21	0.366879			P	
G_{45}	17.26	17.49	0.95	1.21	0.347131			P	

Group no.44

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	15.99	16.29	0.76	0.91	0.335410	0.751588	0.298023	T	G_{12} make a twin.
G_{13}	15.99	16.83	0.76	1.25	0.972471			M	G_{23} make a pair.
G_{14}	15.99	17.14	0.76	0.79	1.150391			AD	G_{34} make a pair.
G_{23}	16.29	16.83	0.91	1.25	0.638122			P	
G_{24}	16.29	17.14	0.91	0.79	0.858429			M	
G_{34}	16.83	17.14	1.25	0.79	0.554707			P	

Group no.45

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	14.91	16.57	0.79	0.85	1.661084	1.593662	0.850383	M	G_{23} make a pair.
G_{13}	14.91	17.33	0.79	0.33	2.463331			AD	G_{24} make a pair.
G_{14}	14.91	17.65	0.79	0.94	2.744103			AD	G_{34} make a twin.
G_{23}	16.57	17.33	0.85	0.33	0.920869			P	Galaxy 1 may be an
G_{24}	16.57	17.65	0.85	0.94	1.083744			P	attribute discordant.
G_{34}	17.33	17.65	0.33	0.94	0.688840			T	

Group no.46

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	15.72	16.43	1.24	0.96	0.763217	3.053883	2.603242	P	G_{12} make a pair.
G_{13}	15.72	17.01	1.24	1.49	1.314002			P	G_{13} make a pair.
G_{14}	15.72	17.02	1.24	7.42	6.315251			AD	G_{15} make a pair.
G_{15}	15.72	17.21	1.24	2	1.672633			P	G_{23} make a pair.
G_{23}	16.43	17.01	0.96	1.49	0.785684			P	G_{25} make a pair.
G_{24}	16.43	17.02	0.96	7.42	6.486887			AD	G35 make a pair.
G_{25}	16.43	17.21	0.96	2	1.300000			P	Galaxy 4 is an attribute
G_{34}	17.01	17.02	1.49	7.42	5.930008			AD	discordant.
G_{35}	17.01	17.21	1.49	2	0.547814			P	
G_{45}	17.02	17.21	7.42	2	5.423329			AD	

Group no.47

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	14.7	14.98	0.79	0.84	0.284429	1.481704	1.357949	P	G_{12} make a pair. G_{13}
G_{13}	14.7	15.07	0.79	0.85	0.374833			P	make a pair. G_{23} make a
G_{14}	14.7	17.63	0.79	0.82	2.930154			AD	pair. Galaxy 4 may be an
G_{23}	14.98	15.07	0.84	0.85	0.090554			T	attribute discordant.
G_{24}	14.98	17.63	0.84	0.82	2.650075			M	
G_{34}	15.07	17.63	0.85	0.82	2.560176			M	

Group no.48

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	16.29	17.33	0.55	0.91	1.100545	0.704618	0.592331	M	G_{23} make a pair.
G_{13}	16.29	17.56	0.55	0.83	1.300500			AD	G_{24} make a pair.
G_{14}	16.29	17.56	0.55	0.87	1.309695			AD	G_{34} make a twin.
G_{23}	17.33	17.56	0.91	0.83	0.243516			P	Galaxy 1 may be an
G_{24}	17.33	17.56	0.91	0.87	0.233452			P	attribute discordant.
G_{34}	17.56	17.56	0.83	0.87	0.040000			T	

Group no.49

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	16.62	17.25	0.58	0.95	0.730616	0.594546	0.315020	M	G_{23} make a twin.
G_{13}	16.62	17.27	0.58	0.77	0.677200			M	G_{24} make a pair.
G_{14}	16.62	17.69	0.58	0.82	1.096586			AD	G_{34} make a pair.
G_{23}	17.25	17.27	0.95	0.77	0.181108			T	Galaxy 1 might be an
G_{24}	17.25	17.69	0.95	0.82	0.458803			P	attribute discordant.
G_{34}	17.27	17.69	0.77	0.82	0.422966			P	

Group no.50

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	15.78	15.9	1.14	0.48	0.670820	0.646827	0.207504	M	G_{13} make a pair. G_{23} make a pair. G_{24} make a pair. G_{34} make a pair.
G_{13}	15.78	16.2	1.14	0.86	0.504777			P	
G_{14}	15.78	16.5	1.14	0.38	1.046900			AD	
G_{23}	15.9	16.2	0.48	0.86	0.484149			P	
G_{24}	15.9	16.5	0.48	0.38	0.608276			P	
G_{34}	16.2	16.5	0.86	0.38	0.566039			P	

Group no.51

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	16.44	16.88	0.52	0.96	0.622254	0.520980	0.246487	M	G_{23} make a twin. G_{24} make a pair. G_{34} make a pair. Galaxy 1 might be an attribute discordant.
G_{13}	16.44	17.01	0.52	0.76	0.618466			M	
G_{14}	16.44	17.3	0.52	0.8	0.904434			AD	
G_{23}	16.88	17.01	0.96	0.76	0.238537			T	
G_{24}	16.88	17.3	0.96	0.8	0.449444			P	
G_{34}	17.01	17.3	0.76	0.8	0.292746			P	

Group no.52

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	15.52	16.45	0.86	0.98	0.937710	1.177950	0.602495	P	G_{12} make a pair. G_{23} make a pair. G_{34} make a twin.
G_{13}	15.52	17.13	0.86	0.95	1.612514			M	
G_{14}	15.52	17.64	0.86	0.85	2.120024			AD	
G_{23}	16.45	17.13	0.98	0.95	0.680661			P	
G_{24}	16.45	17.64	0.98	0.85	1.197080			M	
G_{34}	17.13	17.64	0.95	0.85	0.519711			T	

Group no.53

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	17.71	17.74	1.15	0.68	0.470956	0.335662	0.163454	M	G_{14} make a pair. G_{23} make a twin. This group contains 2 sub groups (1 and 4) and (2 and 3).
G_{13}	17.71	17.74	1.15	0.73	0.421070			M	
G_{14}	17.71	17.93	1.15	1.08	0.230868			P	
G_{23}	17.74	17.74	0.68	0.73	0.050000			T	
G_{24}	17.74	17.93	0.68	1.08	0.442832			M	
G_{34}	17.74	17.93	0.73	1.08	0.398246			M	

Group no.54

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	16.59	16.76	0.93	1.57	0.662193	0.473315	0.166515	AD	G_{13} make a pair. G_{23} make a pair. G_{34} make a twin.
G_{13}	16.59	16.94	0.93	1.18	0.430116			P	
G_{14}	16.59	17.13	0.93	1.2	0.603738			M	
G_{23}	16.76	16.94	1.57	1.18	0.429535			P	
G_{24}	16.76	17.13	1.57	1.2	0.523259			M	
G_{34}	16.94	17.13	1.18	1.2	0.191050			T	

Group no.55

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	17.47	17.69	0.91	0.85	0.228035	0.348987	0.116917	T	G_{12} make a twin. G_{23} make a twin. G_{24} make a pair.
G_{13}	17.47	17.87	0.91	0.98	0.406079			M	
G_{14}	17.47	17.9	0.91	0.6	0.530094			AD	
G_{23}	17.69	17.87	0.85	0.98	0.222036			T	
G_{24}	17.69	17.9	0.85	0.6	0.326497			P	
G_{34}	17.87	17.9	0.98	0.6	0.381182			M	

Group no.56

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	15.15	17.73	0.94	0.95	2.580019	1.418445	1.373549	M	G_{23} make a pair.
G_{13}	15.15	17.84	0.94	1.09	2.694179			M	G_{24} make a pair.
G_{14}	15.15	17.89	0.94	0.94	2.740000			M	G_{34} make a pair.
G_{23}	17.73	17.84	0.95	1.09	0.178045			P	
G_{24}	17.73	17.89	0.95	0.94	0.160312			P	
G_{34}	17.84	17.89	1.09	0.94	0.158114			P	

Group no.57

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	16.47	16.77	0.97	0.91	0.305941	1.019139	0.439552	T	G_{12} make a twin.
G_{13}	16.47	17.62	0.97	1.06	1.153516			M	G_{23} make a pair.
G_{14}	16.47	17.67	0.97	1.94	1.543017			AD	G_{34} make a pair.
G_{23}	16.77	17.62	0.91	1.06	0.863134			P	
G_{24}	16.77	17.67	0.91	1.94	1.367808			M	
G_{34}	17.62	17.67	1.06	1.94	0.881419			P	

Group no.58

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	15.63	15.83	1.06	0.99	0.211896	1.344141	0.888897	T	G_{12} make a twin.
G_{13}	15.63	16.34	1.06	1.05	0.710070			P	G_{13} make a pair.
G_{14}	15.63	17.9	1.06	0.98	2.271409			AD	G_{23} make a pair.
G_{15}	15.63	17.95	1.06	0.98	2.321379			AD	G45 make a pair.
G_{23}	15.83	16.34	0.99	1.05	0.513517			P	This group contains 2 sub groups (1, 2 and 3) and (4 and 5).
G_{24}	15.83	17.9	0.99	0.98	2.070024			M	
G_{25}	15.83	17.95	0.99	0.98	2.120024			AD	
G_{34}	16.34	17.9	1.05	0.98	1.561570			M	
G_{35}	16.34	17.95	1.05	0.98	1.611521			AD	
G_{45}	17.9	17.95	0.98	0.98	0.050000			P	

Group no.59

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	16.59	16.83	0.99	1.02	0.241868	0.839743	0.406543	T	G_{12} make a twin.
G_{13}	16.59	17.75	0.99	1.01	1.160172			M	G_{34} make a pair.
G_{14}	16.59	17.76	0.99	0.57	1.243101			M	This group contains 2 sub groups (1 and 2) and (3 and 4).
G_{23}	16.83	17.75	1.02	1.01	0.920054			M	
G_{24}	16.83	17.76	1.02	0.57	1.033151			M	
G_{34}	17.75	17.76	1.01	0.57	0.440114			P	

Group no.60

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	16.88	17.18	1.27	1.12	0.335410	0.592952	0.316065	P	G_{12} make a pair.
G_{13}	16.88	17.66	1.27	1.14	0.790759			M	G_{23} make a pair.
G_{14}	16.88	17.77	1.27	0.98	0.936056			AD	G_{34} make a twin. G35 make a pair. G45 make a pair.
G_{15}	16.88	17.92	1.27	0.81	1.137190			AD	
G_{23}	17.18	17.66	1.12	1.14	0.480416			P	
G_{24}	17.18	17.77	1.12	0.98	0.606383			M	
G_{25}	17.18	17.92	1.12	0.81	0.802309			AD	
G_{34}	17.66	17.77	1.14	0.98	0.194165			T	
G_{35}	17.66	17.92	1.14	0.81	0.420119			P	
G_{45}	17.77	17.92	0.98	0.81	0.226716			P	

Group no.61

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	15.02	16.85	0.86	0.92	1.830983	1.391773	0.939458	M	G_{23} make a twin.
G_{13}	15.02	17.11	0.86	0.8	2.090861			M	G_{24} make a pair.
G_{14}	15.02	17.68	0.86	1.07	2.668277			AD	G_{34} make a pair.
G_{23}	16.85	17.11	0.92	0.8	0.286356			T	Galaxy 1 may be an
G_{24}	16.85	17.68	0.92	1.07	0.843445			P	attribute discordant.
G_{34}	17.11	17.68	0.8	1.07	0.630714			P	

Group no.62

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	14.5	15.96	0.6	0.84	1.479595	1.638974	0.852817	P	G_{12} make a pair. G_{23}
G_{13}	14.5	16.6	0.6	1.35	2.229910			M	make a pair. G_{24} make a
G_{14}	14.5	17.37	0.6	1.45	2.993226			AD	pair. G_{34} make a twin.
G_{23}	15.96	16.6	0.84	1.35	0.818352			P	
G_{24}	15.96	17.37	0.84	1.45	1.536294			P	
G_{34}	16.6	17.37	1.35	1.45	0.776466			T	

Group no.63

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	15.11	17.7	0.95	0.94	2.590019	1.414371	1.370440	M	G_{23} make a pair.
G_{13}	15.11	17.78	0.95	0.82	2.673163			M	G_{24} make a pair.
G_{14}	15.11	17.83	0.95	0.73	2.728883			M	G_{34} make a pair.
G_{23}	17.7	17.78	0.94	0.82	0.144222			P	
G_{24}	17.7	17.83	0.94	0.73	0.246982			P	
G_{34}	17.78	17.83	0.82	0.73	0.102956			P	

Group no.64

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	15.78	16.81	1.01	1.04	1.030437	0.845625	0.536770	M	G_{23} make a twin.
G_{13}	15.78	16.95	1.01	1.06	1.171068			M	G_{24} make a pair.
G_{14}	15.78	17.41	1.01	0.91	1.633065			AD	G_{34} make a pair.
G_{23}	16.81	16.95	1.04	1.06	0.141421			T	Galaxy 1 may be an
G_{24}	16.81	17.41	1.04	0.91	0.613922			P	attribute discordant.
G_{34}	16.95	17.41	1.06	0.91	0.483839			P	

Group no.65

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	16.24	16.67	0.9	1.44	0.690290	0.697574	0.239768	P	G_{12} make a pair.
G_{13}	16.24	16.93	0.9	1.01	0.698713			M	G_{23} make a pair.
G_{14}	16.24	17.31	0.9	0.91	1.070047			AD	G_{34} make a twin.
G_{23}	16.67	16.93	1.44	1.01	0.502494			P	
G_{24}	16.67	17.31	1.44	0.91	0.830963			M	
G_{34}	16.93	17.31	1.01	0.91	0.392938			T	

Group no.66

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	15.25	16.43	0.73	0.76	1.180381	1.189306	0.643663	P	G_{12} make a pair.
G_{13}	15.25	16.99	0.73	0.57	1.747341			M	G_{23} make a pair.
G_{14}	15.25	17.38	0.73	0.91	2.137592			AD	G_{34} make a twin.
G_{23}	16.43	16.99	0.76	0.57	0.591354			P	
G_{24}	16.43	17.38	0.76	0.91	0.961769			P	
G_{34}	16.99	17.38	0.57	0.91	0.517397			T	

Group no.67

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	15.03	16.63	1.13	0.9	1.616447	1.475781	0.936679	M	G_{23} make a pair.
G_{13}	15.03	17.46	1.13	0.96	2.435939			AD	G_{24} make a pair.
G_{14}	15.03	17.68	1.13	0.99	2.653696			AD	G_{25} make a pair.
G_{15}	15.03	17.93	1.13	0.32	3.010997			AD	G_{34} make a twin. G35 make a pair. G45 make a pair.
G_{23}	16.63	17.46	0.9	0.96	0.832166			P	
G_{24}	16.63	17.68	0.9	0.99	1.053850			P	
G_{25}	16.63	17.93	0.9	0.32	1.423517			P	
G_{34}	17.46	17.68	0.96	0.99	0.222036			T	Galaxy 1 may be an attribute discordant.
G_{35}	17.46	17.93	0.96	0.32	0.794040			P	
G_{45}	17.68	17.93	0.99	0.32	0.715122			P	

Group no.68

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	15.03	15.33	0.84	0.77	0.308058	1.336248	0.894008	T	G_{12} make a twin.
G_{13}	15.03	15.89	0.84	0.77	0.862844			P	G_{13} make a pair.
G_{14}	15.03	17.51	0.84	0.7	2.483948			AD	G_{23} make a pair.
G_{23}	15.33	15.89	0.77	0.77	0.560000			P	
G_{24}	15.33	17.51	0.77	0.7	2.181124			M	Galaxy 4 may be an attribute discordant.
G_{34}	15.89	17.51	0.77	0.7	1.621512			M	

Group no.69

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	15.33	16.15	0.92	0.85	0.822982	1.103525	0.592975	P	G_{12} make a pair.
G_{13}	15.33	16.97	0.92	0.76	1.647786			M	G_{23} make a pair.
G_{14}	15.33	17.25	0.92	0.88	1.920417			AD	G_{24} make a pair.
G_{23}	16.15	16.97	0.85	0.76	0.824924			P	G_{34} make a twin.
G_{24}	16.15	17.25	0.85	0.88	1.100409			P	
G_{34}	16.97	17.25	0.76	0.88	0.304631			T	

Group no.70

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	15.75	16.37	0.95	0.98	0.620725	0.566682	0.328613	M	G_{23} make a twin.
G_{13}	15.75	16.57	0.95	0.96	0.820061			M	G_{24} make a pair
G_{14}	15.75	16.79	0.95	0.82	1.048094			AD	G_{34} make a pair.
G_{23}	16.37	16.57	0.98	0.96	0.200998			T	Galaxy 1 might be an attribute discordant.
G_{24}	16.37	16.79	0.98	0.82	0.449444			P	
G_{34}	16.57	16.79	0.96	0.82	0.260768			P	

Group no.71

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	15.77	16.25	1.11	0.85	0.545894	1.328655	0.723651	T	G_{12} make a twin.
G_{13}	15.77	17.58	1.11	1.02	1.812236			M	G_{34} make a twin.
G_{14}	15.77	17.95	1.11	0.92	2.188264			AD	This group contains 2 sub groups (1 and 2) and (3 and 4).
G_{23}	16.25	17.58	0.85	1.02	1.340821			M	
G_{24}	16.25	17.95	0.85	0.92	1.701441			M	
G_{34}	17.58	17.95	1.02	0.92	0.383275			T	

Group no.72

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	16.3	16.86	0.93	0.71	0.601664	0.522126	0.279217	M	G_{23} make a twin.
G_{13}	16.3	16.98	0.93	0.88	0.681836			M	G_{24} make a pair.
G_{14}	16.3	17.25	0.93	0.86	0.952575			AD	G_{34} make a pair.
G_{23}	16.86	16.98	0.71	0.88	0.208087			T	Galaxy 1 might be an attribute discordant.
G_{24}	16.86	17.25	0.71	0.86	0.417852			P	
G_{34}	16.98	17.25	0.88	0.86	0.270740			P	

Group no.73

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	14.83	16.94	0.71	0.32	2.145740	2.030176	0.848083	M	G_{23} make a pair.
G_{13}	14.83	17.56	0.71	1.96	3.002566			AD	G_{24} make a twin.
G_{14}	14.83	17.8	0.71	0.57	2.973298			AD	G_{34} make a pair.
G_{23}	16.94	17.56	0.32	1.96	1.753283			P	Galaxy 1 is an attribute
G_{24}	16.94	17.8	0.32	0.57	0.895600			T	discordant.
G_{34}	17.56	17.8	1.96	0.57	1.410567			P	

Group no.74

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	15.01	16.67	0.94	1.19	1.678720	1.203459	0.899512	M	G_{23} make a pair.
G_{13}	15.01	17.11	0.94	0.91	2.100214			M	G_{24} make a pair.
G_{14}	15.01	17.21	0.94	0.89	2.200568			AD	G_{34} make a twin.
G_{23}	16.67	17.11	1.19	0.91	0.521536			P	Galaxy 1 may be an
G_{24}	16.67	17.21	1.19	0.89	0.617738			P	attribute discordant.
G_{34}	17.11	17.21	0.91	0.89	0.101980			T	

Group no.75

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	16.86	16.87	0.86	0.66	0.200250	0.556685	0.404725	P	G_{12} make a pair.
G_{13}	16.86	16.96	0.86	0.91	0.111803			T	G_{13} make a twin.
G_{14}	16.86	17.79	0.86	1.01	0.942019			M	G_{23} make a pair.
G_{23}	16.87	16.96	0.66	0.91	0.265707			P	Galaxy 4 may be an
G_{24}	16.87	17.79	0.66	1.01	0.984327			AD	attribute discordant.
G_{34}	16.96	17.79	0.91	1.01	0.836002			M	

Group no.76

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	15.37	15.7	0.85	0.87	0.330606	1.147047	0.655316	T	G_{12} make a twin.
G_{13}	15.37	16.89	0.85	0.73	1.524729			M	G_{34} make a twin.
G_{14}	15.37	17.26	0.85	0.74	1.893198			AD	This group contains 2
G_{23}	15.7	16.89	0.87	0.73	1.198207			M	sub groups (1 and 2) and
G_{24}	15.7	17.26	0.87	0.74	1.565407			M	(3 and 4).
G_{34}	16.89	17.26	0.73	0.74	0.370135			T	

Group no.77

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	15.51	16.46	0.85	0.86	0.950053	1.243430	0.624114	P	G_{12} make a pair.
G_{13}	15.51	17.08	0.85	0.84	1.570032			M	G_{23} make a pair.
G_{14}	15.51	17.79	0.85	0.84	2.280022			AD	G_{34} make a pair
G_{23}	16.46	17.08	0.86	0.84	0.620322			P	
G_{24}	16.46	17.79	0.86	0.84	1.330150			M	
G_{34}	17.08	17.79	0.84	0.84	0.710000			P	

Group no.78

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	15.05	16.71	0.85	0.64	1.673230	1.501127	0.940735	M	G_{23} make a pair.
G_{13}	15.05	17.42	0.85	0.37	2.418119			M	G_{24} make a pair.
G_{14}	15.05	17.76	0.85	0.5	2.732508			AD	G_{34} make a twin.
G_{23}	16.71	17.42	0.64	0.37	0.759605			P	Galaxy 1 might be an
G_{24}	16.71	17.76	0.64	0.5	1.059292			P	attribute discordant.
G_{34}	17.42	17.76	0.37	0.5	0.364005			T	

Group no.79

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	15.77	16.11	1.08	0.95	0.364005	1.224299	0.663213	T	G_{12} make a twin.
G_{13}	15.77	16.9	1.08	0.78	1.169145			P	G_{13} make a pair.
G_{14}	15.77	17.92	1.08	0.8	2.168156			AD	G_{23} make a pair.
G_{23}	16.11	16.9	0.95	0.78	0.808084			P	G_{34} make a pair.
G_{24}	16.11	17.92	0.95	0.8	1.816205			M	
G_{34}	16.9	17.92	0.78	0.8	1.020196			P	

Group no.80

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	14.92	16.17	0.82	1.02	1.265899	1.088179	0.651367	M	G_{23} make a twin.
G_{13}	14.92	16.25	0.82	0.87	1.330940			M	G_{24} make a pair.
G_{14}	14.92	17.03	0.82	0.88	2.110853			AD	G_{34} make a pair.
G_{23}	16.17	16.25	1.02	0.87	0.170000			T	Galaxy 1 might be an
G_{24}	16.17	17.03	1.02	0.88	0.871321			P	attribute discordant.
G_{34}	16.25	17.03	0.87	0.88	0.780064			P	

group no.81

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	16.02	16.15	0.8	1.01	0.246982	1.183613	0.655769	T	G_{12} make a twin.
G_{13}	16.02	17.34	0.8	0.78	1.320152			M	G_{34} make a pair.
G_{14}	16.02	17.94	0.8	0.86	1.920937			AD	This group contains 2
G_{23}	16.15	17.34	1.01	0.78	1.212023			M	sub groups (1 and 2) and
G_{24}	16.15	17.94	1.01	0.86	1.796274			M	(3 and 4).
G_{34}	17.34	17.94	0.78	0.86	0.605310			P	

Group no.82

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	15.69	16.73	0.96	0.87	1.043887	1.266453	0.775471	P	G_{12} make a pair.
G_{13}	15.69	17.78	0.96	0.89	2.091172			AD	G_{23} make a pair.
G_{14}	15.69	17.87	0.96	0.91	2.180573			AD	G_{24} make a pair. G_{34}
G_{23}	16.73	17.78	0.87	0.89	1.050190			P	make a pair.
G_{24}	16.73	17.87	0.87	0.91	1.140702			P	
G_{34}	17.78	17.87	0.89	0.91	0.092195			T	

Group no.83

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	17.15	17.47	1.04	1.12	0.329848	0.492820	0.259682	P	G_{12} make a pair.
G_{13}	17.15	17.87	1.04	1.14	0.726911			M	G_{23} make a pair.
G_{14}	17.15	17.97	1.04	1.24	0.844038			AD	G_{34} make a twin.
G_{23}	17.47	17.87	1.12	1.14	0.400500			P	
G_{24}	17.47	17.97	1.12	1.24	0.514198			M	
G_{34}	17.87	17.97	1.14	1.24	0.141421			T	

Group no.84

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	16.5	16.63	0.84	0.93	0.158114	0.857877	0.496149	T	G_{12} make a twin.
G_{13}	16.5	17.35	0.84	1.16	0.908240			M	G_{23} make a pair.
G_{14}	16.5	17.89	0.84	0.93	1.392911			AD	G_{34} make a pair. G35
G_{15}	16.5	17.95	0.84	1.03	1.462395			AD	make a pair. G45 make a
G_{23}	16.63	17.35	0.93	1.16	0.755844			P	pair.
G_{24}	16.63	17.89	0.93	0.93	1.260000			M	
G_{25}	16.63	17.95	0.93	1.03	1.323782			AD	
G_{34}	17.35	17.89	1.16	0.93	0.586941			P	
G_{35}	17.35	17.95	1.16	1.03	0.613922			P	
G_{45}	17.89	17.95	0.93	1.03	0.116619			P	

Group no.85

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	16.39	17.12	1.05	1.22	0.749533	0.797417	0.427448	P	G_{12} make a pair.
G_{13}	16.39	17.39	1.05	1.23	1.016071			M	G_{23} make a twin.
G_{14}	16.39	17.88	1.05	1.2	1.497531			AD	G_{24} make a pair
G_{23}	17.12	17.39	1.22	1.23	0.270185			T	. G_{34} make a pair.
G_{24}	17.12	17.88	1.22	1.2	0.760263			P	
G_{34}	17.39	17.88	1.23	1.2	0.490918			P	

Group no.86

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	16.12	16.71	0.93	0.83	0.598415	0.817242	0.402863	P	G_{12} make a pair.
G_{13}	16.12	17.09	0.93	0.92	0.970052			M	G_{23} make a twin.
G_{14}	16.12	17.62	0.93	0.92	1.500033			AD	G_{34} make a pair.
G_{23}	16.71	17.09	0.83	0.92	0.390512			T	
G_{24}	16.71	17.62	0.83	0.92	0.914440			M	
G_{34}	17.09	17.62	0.92	0.92	0.530000			P	

Group no.87

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	15.58	17.31	0.88	0.66	1.743932	1.288769	0.904550	M	G_{23} make a pair.
G_{13}	15.58	17.67	0.88	0.83	2.090598			M	G_{24} make a pair.
G_{14}	15.58	17.99	0.88	0.96	2.411327			AD	G_{34} make a twin.
G_{23}	17.31	17.67	0.66	0.83	0.398121			P	Galaxy 1 may be an
G_{24}	17.31	17.99	0.66	0.96	0.743236			P	attribute discordant.
G_{34}	17.67	17.99	0.83	0.96	0.345398			T	

Group no.88

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	16.09	17.02	1.00	0.98	0.930215	0.867969	0.502888	M	G_{23} make a twin.
G_{13}	16.09	17.23	1.00	0.92	1.142804			M	G_{24} make a pair.
G_{14}	16.09	17.75	1.00	1.00	1.660000			AD	G_{34} make a pair.
G_{23}	17.02	17.23	0.98	0.92	0.218403			T	Galaxy 1 may be an
G_{24}	17.02	17.75	0.98	1.00	0.730274			P	attribute discordant.
G_{34}	17.23	17.75	0.92	1.00	0.526118			P	

Group no.89

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	17.32	17.59	1.16	0.91	0.367967	0.419555	0.116999	P	G_{12} make a pair.
G_{13}	17.32	17.73	1.16	1.25	0.419762			M	G_{23} make a pair.
G_{14}	17.32	17.95	1.16	0.99	0.652534			AD	G_{24} make a pair.
G_{23}	17.59	17.73	0.91	1.25	0.367696			P	G_{34} make a pair.
G_{24}	17.59	17.95	0.91	0.99	0.368782			P	
G_{34}	17.73	17.95	1.25	0.99	0.340588			P	

Group no.90

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	16.41	16.9	1.24	0.83	0.638905	0.809536	0.443218	P	G_{12} make a pair.
G_{13}	16.41	17.03	1.24	0.95	0.684471			P	G_{13} make a pair.
G_{14}	16.41	17.88	1.24	0.85	1.520855			AD	G_{23} make a twin.
G_{23}	16.9	17.03	0.83	0.95	0.176918			T	Galaxy 4 might be an
G_{24}	16.9	17.88	0.83	0.85	0.980204			M	attribute discordant.
G_{34}	17.03	17.88	0.95	0.85	0.855862			M	

Group no.91

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	15.62	17.05	0.9	0.79	1.434225	1.001256	0.724820	M	G_{23} make a twin.
G_{13}	15.62	17.11	0.9	0.89	1.490034			M	G_{24} make a pair.
G_{14}	15.62	17.58	0.9	0.87	1.960230			AD	G_{34} make a pair.
G_{23}	17.05	17.11	0.79	0.89	0.116619			T	Galaxy 1 may be an
G_{24}	17.05	17.58	0.79	0.87	0.536004			P	attribute discordant.
G_{34}	17.11	17.58	0.89	0.87	0.470425			P	

Group no.92

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	15.72	16.21	0.93	1.12	0.525547	1.254882	0.629799	T	G_{12} make a twin.
G_{13}	15.72	17.06	0.93	1.04	1.344507			M	G_{23} make a pair.
G_{14}	15.72	17.93	0.93	1.01	2.211447			AD	G_{34} make a pair.
G_{23}	16.21	17.06	1.12	1.04	0.853756			P	
G_{24}	16.21	17.93	1.12	1.01	1.723514			M	
G_{34}	17.06	17.93	1.04	1.01	0.870517			P	

Group no.93

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	15.45	17.57	0.82	1.19	2.152046	1.274370	1.153906	M	G_{23} make a pair.
G_{13}	15.45	17.77	0.82	1.3	2.369135			M	G_{24} make a pair.
G_{14}	15.45	17.87	0.82	1.19	2.448122			AD	G_{34} make a pair.
G_{23}	17.57	17.77	1.19	1.3	0.228254			P	Galaxy 1 may be an
G_{24}	17.57	17.87	1.19	1.19	0.300000			P	attribute discordant.
G_{34}	17.77	17.87	1.3	1.19	0.148661			P	

Group no.94

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	15.62	16.16	1.01	1.01	0.540000	1.190908	0.615910	T	G_{12} make a twin.
G_{13}	15.62	17.19	1.01	1.1	1.572578			M	G_{23} make a pair.
G_{14}	15.62	17.65	1.01	0.97	2.030394			AD	G_{34} make a twin.
G_{23}	16.16	17.19	1.01	1.1	1.033925			P	
G_{24}	16.16	17.65	1.01	0.97	1.490537			M	
G_{34}	17.19	17.65	1.1	0.97	0.478017			T	

Group no.95

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	15.22	15.72	0.6	0.85	0.559017	1.536595	0.837705	T	G_{12} make a twin.
G_{13}	15.22	16.55	0.6	0.74	1.337348			P	G_{13} make a pair.
G_{14}	15.22	17.95	0.6	0.34	2.742353			AD	G_{23} make a pair.
G_{23}	15.72	16.55	0.85	0.74	0.837257			P	G_{34} make a pair.
G_{24}	15.72	17.95	0.85	0.34	2.287575			M	
G_{34}	16.55	17.95	0.74	0.34	1.456022			P	

Group no.96

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	15.26	16.5	0.96	1.01	1.241008	1.063700	0.646940	M	G_{23} make a twin.
G_{13}	15.26	16.58	0.96	0.88	1.322422			M	G_{24} make a pair.
G_{14}	15.26	17.33	0.96	0.86	2.072414			AD	G_{34} make a pair.
G_{23}	16.5	16.58	1.01	0.88	0.152643			T	Galaxy 1 might be an
G_{24}	16.5	17.33	1.01	0.86	0.843445			P	attribute discordant.
G_{34}	16.58	17.33	0.88	0.86	0.750267			P	

Group no.97

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	16.65	17.04	0.88	0.92	0.392046	0.591280	0.382552	P	G_{12} make a pair.
G_{13}	16.65	17.09	0.88	0.91	0.441022			P	G_{13} make a pair.
G_{14}	16.65	17.81	0.88	0.82	1.161551			AD	G_{23} make a twin.
G_{23}	17.04	17.09	0.92	0.91	0.050990			T	Galaxy 4 might be an
G_{24}	17.04	17.81	0.92	0.82	0.776466			M	attribute discordant.
G_{34}	17.09	17.81	0.91	0.82	0.725603			M	

Group no.98

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	16.55	16.72	0.75	0.23	0.547083	1.092236	0.477248	T	G_{12} make a twin.
G_{13}	16.55	17.61	0.75	0.95	1.078703			P	G_{13} make a pair.
G_{14}	16.55	17.94	0.75	1.4	1.534471			M	G_{34} make a twin.
G_{23}	16.72	17.61	0.23	0.95	1.144771			M	
G_{24}	16.72	17.94	0.23	1.4	1.690355			AD	
G_{34}	17.61	17.94	0.95	1.4	0.558032			T	

Group no.99

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	16.54	17.59	1.07	0.99	1.053043	0.716890	0.569055	M	G_{23} make a pair.
G_{13}	16.54	17.81	1.07	1.08	1.270039			M	G_{24} make a pair.
G_{14}	16.54	17.89	1.07	1.06	1.350037			AD	G_{34} make a twin.
G_{23}	17.59	17.81	0.99	1.08	0.237697			P	Galaxy 1 may be an
G_{24}	17.59	17.89	0.99	1.06	0.308058			P	attribute discordant.
G_{34}	17.81	17.89	1.08	1.06	0.082462			T	

Group no.100

	(r mag)i	(r mag)j	(g-r mag)i	(g-r mag)j	e_{ij}	$\mathbf{e}_{av}$	$\boldsymbol{\sigma}$		Comments
G_{12}	17.02	17.25	0.42	0.8	0.444185	0.344793	0.106777	M	G_{23} make a twin.
G_{13}	17.02	17.37	0.42	0.66	0.424382			M	G_{34} make a pair.
G_{14}	17.02	17.39	0.42	0.42	0.370000			M	
G_{23}	17.25	17.37	0.8	0.66	0.184391			T	
G_{24}	17.25	17.39	0.8	0.42	0.404969			M	
G_{34}	17.37	17.39	0.66	0.42	0.240832			P	

References

1. Allam, S. S and Tucker, D. L. 2000, AN, 321, 2, 101
2. Barton , E., Geller, M. J., Ramella, M., Marzke, R., and da Costa L., 1996, AJ, 112,871
3. deCarvalho, R. R. et al. 2005, AJ, 130,425
4. de Vaucouleurs, G. 1965, in stars and stellar systems, Vol.9
5. de Vaucouleurs .G. 1975. ApJ. 202,319
6. Deng X.-F., He J.-Z., Ma X.-S., Jiang P., Tang X.-X., 2008, Central Eur. J. Phys., 6(2), 185
7. Diaz-Gimenez, E., Mamon, G. A., Pacheco, M., Mendes de Oliveira, C. and Alonso, M. V. 2012, MNRAS, 426, 1, 296
8. Focardi, P. and Kelm, B. 2002, A&A 301, 35
9. Garcia, A. M. 1995, A&A, 297, 1, 56
10. Hickson, P. 1982, ApJ, 255, 382
11. Hickson, P., Mendes de Oliveira, C., Huchra, J. P., and Palumbo, G. 1992, ApJ., 399, 353
12. Huchra, J..P., and Geller, M.. J., 1982, ApJ, 257, 423
13. Huchra, J..P., Davis, M., Latham,, D.W, and Tonry, J., 1983, ApJS, 52, 89
14. Holmberg, E., 1950, Medd. Lunds Obs. Ser. 2, 128, 1.
15. Humason, M.L., Mayall.N.U., and Sandage, A. R., 1956, AJ., 61, 97.
16. Iovino, A. 2003, AJ, 125, 1660
17. Karachentsev, V.E, Karachentsev, I. D., and Scherbanovsky, A.L., 1979, IZv. Space.Astrophys. Obs.., 11,3

18. Lee, B. C., Allam, S., Tucker, D. L, Annis, J., Johnston, D., Scranton, R.,Acebo, Yamina,
19. Bahcall, Neta A., and 14 coauthors,2004, AJ, 127,1811L
20. Materne, J., 1979, A&A, 74,235
21. McConnachie, Alan W., Brasseur, Crystal M., Ellison, Sara L.; Patton, David R 2009, MNRAS. 395, 255
22. Prandoni, I., Iovino, A. and MacGillivray, H. T. 1994, AJ, 107, 4, 1235
23. Rose, J. A., 1977, ApJ., 211, 311.
24. Romesburg, H.Charles, 1984, Cluster Analysis for Researchers, Lifetime learning publications, U.S.A
25. Sabry A. Mohamed, Issa A.Issa., A.I.Osman., A.Bakry, and M. Beahary, 2009,
26. Investigation in Groups of Galaxies, PhD. Azhar univ.
27. Sabry, M.A., Issa,I.A., Abdelrahman, H. and Shaker, A.A. 2012, NRIAG-JAG, 1, 81.
28. Shakhbazian, R. K. 1957, Astron. Tsirk., 177, 11
29. Shakhbazyan, R. K. 1973, Ap, 9, 4, 296-304
30. Sohn, Jubee; Hwang, Ho Seong; Geller, Margaret J.; Diaferio, Antonaldo;
31. Rines, Kenneth J.; Lee, Myung Gyoon; Lee, Gwang-Ho , 2015, 2015JKAS...48..381S
32. Tully, R. B., 1987, ApJ, 321, 280
33. Tully, R. B., 1987, Nearby galaxies catalog, Cambridge, Cambridge Univ. Press
34. Turner, E. L., and Gott, J., R.,1976a, ApJS, 32, 409.
35. Turner, E. L., and Gott, J., R.,1976b, ApJ, 209, 6.
36. Wang, Yu; Yang, Xiaohu; Mo, H. J.; van den Bosch, Frank C, Weinmann, Simone M.; Chu, Yaoquan, 2008, ApJ, 687,919