Experiment 1: Strongly clustered data, two dimensions: Let d = 2, q = 3, ~µ0 = h0, 0i, ~µ1 = h6, 0i, ~µ2 = h3, 3 √ 3i, σ = 1.

Best clustering found

KMeans terminates with final clustering Cluster 0 : [4, 5, 9, 12, 15, 17, 21, 23, 25, 28, 29, 32, 33, 39, 42, 45, 48, 53, 54] . Center= [0.30562677282926914, 0.18089174189877535] Cluster 1 : [0, 1, 2, 6, 8, 10, 11, 14, 16, 18, 19, 24, 37, 41, 43, 47, 4 9, 51, 52, 58] . Center= [2.9265855838303776, 5.412865360549857] Cluster 2 : [3, 7, 13, 20, 22, 26, 27, 30, 31, 34, 35, 36, 38, 40, 44, 4 6, 50, 55, 56, 57, 59] . Center= [5.7066271174945244, -0.23146495980785944]

Cost= 116.1039993185675

Average number of iterations: 3.8

Starvation occured 0 times.

Experiment 2: Weakly clustered data, two dimensions: Let d = 2, q = 3, ~µ0 = h0, 0i, ~µ1 = h2, 0i, ~µ2 = h1, √ 3i, σ = 2.

Best clustering found KMeans terminates with final clustering Cluster 0 : [0, 1, 3, 7, 12, 13, 17, 18, 23, 25, 28, 29, 30, 31, 33, 36, 38, 40, 44, 45, 48, 49, 55, 56, 58, 59] . Center= [-0.5448076913176523, -1.6 18996582379296] Cluster 1 : [4, 5, 8, 11, 14, 15, 19, 20, 21, 22, 24, 26, 32, 34, 35, 37, 46, 50, 51, 54, 57] . Center= [4.9481923827925485, 1.5417134015192555] Cluster 2 : [2, 6, 9, 10, 16, 27, 39, 41, 42, 43, 47, 52, 53] . Center= [-1.324128506241414, 4.08386607325103]

Cost= 415.97523100302806

Average number of iterations: 6.1

Starvation occured 0 times.

Experiment 3: Unclustered data, two dimensions: Let d = 2, q = 1, ~µ0 = h0, 0i, σ = 2.

Best clustering found

KMeans terminates with final clustering Cluster 0 : [0, 1, 2, 3, 7, 12, 13, 17, 18, 23, 28, 29, 30, 31, 33, 36, 3 8, 40, 44, 49, 55, 56, 58, 59] . Center= [-1.2482549200366158, -1.4598129023 73302] Cluster 1 : [4, 5, 8, 14, 15, 19, 20, 21, 22, 24, 26, 32, 34, 35, 37, 46, 48, 50, 51, 54] . Center= [2.7911479978865605, 0.6327370473272003] Cluster 2 : [6, 9, 10, 11, 16, 25, 27, 39, 41, 42, 43, 45, 47, 52, 53, 5

7] . Center= [-1.0943288888346863, 1.7626027565229738]

Cost= 186.1513370315143

Average number of iterations: 8.4

Starvation occured 0 times.

Experiment 4: Very strongly clustered data, one hundred dimensions: 2 Let d = 100, q = 3, ~µ0 = h0, 0, . . . 0i, ~µ1 = h60, 0, . . . 0i, ~µ2 = h30, 30√ 3, . . . 0i, σ = 1.

Best clustering found KMeans terminates with final clustering

Cluster 0 : [4, 9, 10, 14, 15, 24, 25, 27, 29, 33, 36, 37, 39, 43, 44, 4 5, 49, 51, 57, 59] . Center. [-0.02771997803300356, .0.04408670531481113,

0.6061499436113246, 0.2094828521299311, 0.04264744313419164, 0.8432700915328 81126, .0.27728542350935903, .0.1496880357411653, -0.2771986323455279, 0.011 255718809708071, 0.3021380631653229, 0.18456812795788638, 0.0159100319291010 5, 0.14830534661890765, 0.1730347280332923, 0.013496418012055719, -0.2500476 983350755, 0.1494423730588969, 0.17769208652669916, 0.21470488847568042, 0.1 5665363302463758, 0.01679792811728541, 0.007503767695033009, 0.0348359135379 83695, .0.04143813438569994, .0.019012247912241174, 0.030653857559215215, 0. 01704807538505563, .0.1552673446442095, 0.2126866201983396, 0.00936609015796 9954, -0.31260388414968426, 0.08533538104309923, -0.25972821187382067, 0.254 747036760873, 0.01802934932184701, 0.03518277601825271, 0.03711499068122501 4, .0.01776075436094312, -8.07779389379571745, .0.25942939473919413, -0.2654 4743693298695, -0.27264138509592084, -0.0807234551625882379, 0.0785306123676 6411, -0.022253673872367322, -0.16082775133991573, -0.12102383400121797, -0. 04859487859533934, .0.44751753836604796, 0.18423858346837343, 0.313925528717 9066, -0.4472611524787665, 0.18976082284198764, -0.5691246898982734, 0.01937 867554282798, 0.2903498100431109, -0.025211593495734465, 0.1101626726786179, .0.15812787773843281, .0.1973080242700347, .0.08794463620852602, .0.22510068 590620663, .0.21200354536213184, 0.38808061917998825, .0.19368556305362855, 0.15661951130625518, 0.24950590735376638, -0.18601828096551065, -0.276137913 2708334, 0.202685227987299, 0.13571949834492275, 0.09391S96728439319, -0.342 57559507187607, 0.13079989459166858, -0.38607698426871945, 0.083380797156003 45, -0.06298142435998536, 0.11434878255698408, 0.02370468539198189, -8.28242 939182280274, -0.05558036234662687, -0.08383369726163171, 0.0868074627777308 7, -0.0755325243466872, 0.07305073064892768, -0.08574958872674493, -0.312639 6988484387, 0.23190746479423546, 0.1556101039310986, -0.34444563477914103. 0.3901343641024325, -0.06526069359487967, 0.4101206707234513, -0.19864655305 570414, 0.036635360683023144, 0.3415719128527193, -0.15177604893384095, -0.0 7755953802273606, 0.14392961044149452] Cluster 1 : [0, 2, 7, 8, 11, 12, 16, 17, 22, 26, 32, 35, 38, 42, 47, 48, 50, 54, 55, 56] . Center. [29.75390896897536, 361.62364210567796, -0.0401655 4750497103, .0.1878935589915768, 0.08701186105693928, 0.43915839918605004, -0.2293680524227116, 0.23870503691207148, -0.32312284715473716, -8.0871468374 6233721, 0.1970543143855378, 0.32857069036078207, 0.02201106588075078, 0.521 6408829656678, 0.025615090156592784, -0.14490582304698468, 0.1596943119062154 52, 0.20508903089821828, -0.005496444809624701, 0.5543282910295302, -0.20389 044964614672, -0.2768878554727703, 0.24056753472737186, 0.3932188058483815. 0.3271343993892317, .0.017825279120537236, 0.18848708267624015, 0.2416210745 1291487, -0.12835348892896412, 0.15180295330919452, .0.35656867366124484, 0. 22700599121363205, .0.810133643012004378, 0.011515855072479876, .0.113557530 04705293, 0.41121877780750404, 0.4440895354350122, 0.14363796130515177, -0.0 9355734932733466, 0.13812171786070054, .0.3512692974191513, .0.10030177448143143, -0.3376077425716328, .0.407170027074368, -0.14196812849864576, 0.21634 703514155987, 0.014552851218415219, 0.1398714520250557, 0.81732325914352673, 0.0063217963968410265, -8.29873605560879657, 0.14573933857577548, 0.03198416 509243924, .0.2665906299447803, -0.0816008535497265, 0.4484842428074609, 0.4 832283315975527, 0.07331145508942143, 0.2707744080564971, 0.0747466200623815 6, -0.2017502113724161, -0.44789767450424334, 0.05667482578644842, 0.0303472 7919062461, 0.13421896961012747, 0.07104903613296733, -0.11307393696266776, 0.14606353576892536, -0.11132482517484835, .0.10960068410973094, 0.116936863 90896127, .0.37835478253592114, -0.11930989134907792, 0.5054825975641951, 0. 036587653909194794, 0.18211828675194147, 0.2093524171469079, 0.1361943587658 3866, 0.07333985694867586, 0.41596377153910036, 0.37912815744007355, -0.3012 629803393393, -0.15870735708489336, -0.17703654091643378, -0.129279732402411 47, 0.2389133190250008, 0.3610676935696759, -0.026464649265504004, 0.0341693 02396434266, 0.07379777980745772, 0.19134398721726072, 0.18642333020551116, 0.3955417007391215, -0.18057066986402953, 0.375194275062949, 0.1615750213224 3357, -0.2552917999848816, -0.0441080508539443, -0.004680382549004281, -0.56 86746505834620 Cluster 2 : [1, 3, 5, 6, 13, 18, 19, 20, 21, 23, 28, 30, 31, 34, 40, 41, 46, 52, 53, 58J . Center. [59.79901055907174, 0.3560856989971192, 0.17035648 155169295, 0.2967919438819311, -0.14006137165822255, -0.009891281171649105, -0.12786543979854312, 0.2688248620784884, -0.05001618949851362, -0.067989922 24786005, -0.3062398349165646, 0.32555767453002177, -0.29404271838623425, -0.14464712553748715, 0.22135679061905034, 0.11914414420415183, 0.08492186411 497182, -8.40909605905990815, .0.0316262164573511, 0.20792479489765095, 0.42 336347382942596, .0.15318071356186333, 0.015517212294069521, 0.1539128220902 5836, -0.05298107407445166, -0.15578027219867863, -0.022341168684933344, -0. 5456977455889913, 0.02343449129085092, 0.07065757076757549, -0.2548351440101 5015, .0.12693668738178573, -0.3694494681032686, 0.06512688690421548, 0.1329 9082880010057, .0.05737547967882217, -0.07235292403220016, 0.41160218345170 4, -0.5821059865904991, 0.2525587760289471, 0.1558977152986779, -0.090200754 0092955, -0.03179792572435326, -0.10833401488894065, -0.41643728820075143, 0.22631762277422246, -0.004174342841554218, -8.038847854323993194, -0329717 41991098196, -0.1660527897313263, 0.16179032055059853, 0.21000756094671097, -0.37519864062603536, -0.18625650641645303, -0.07236918663118184, 0.12907164 26724562, 0.10358716452587569, -0.15830782275651717, 0.48205949630636474, -0.16648394865225465, -0.4559040056581466, 0.05523354548199041, -0.1688324490 6135153, 0.00791416919539839, 0.0023368452128636221, 0.05526228691582395, 0. 55468554256394, .0.08124946010158089, .0.19688928813671716, .0.1238161427461 0833, -0.02691172216908979, .0.16902872862866813, .0.12139773693116004, .0.1 1163715047025627, -0.2624401147565549, 0.82485342448404851, 8.55884922170712 13, -0.6380581024470282, 0.19825777295913088, 0.31233923440741007, 0.1142598 3748722648, -0.14029279368353836, 0.3369974413864341, -0.02494691807036838, -0.1491656127012821, -0.03635634942673006, 0.2543811483672675, 0.10129151747 10931, 0.0026162810394722846, 0.10940610885673308, .0.028675620023344717, 0. 02334689414637613, -0.19935948583776666, 0.6656495026060189, 0.0338106670666 2019, -0.018884114716439304, -0.02537820986273883, -0.2814467862969511, 0.14 23560251702392, -0.16874864523098998]

Cost. 5853.538754344347

Average number of iterations. 2.1

Starvation occured 6 times.

Experiment 5: Strongly clustered data, one hundred dimensions: Let d = 100, q = 3, ~µ0 = h0, 0, . . . 0i, ~µ1 = h6, 0, . . . 0i, ~µ2 = h3, 3 √ 3, . . . 0i, σ = 1.

Best clustering found KMeans terminates with final clustering

Cluster 0 : [0, 2, 7, 8, 11, 12, 16, 17, 22, 26, 32, 3S, 38, 42, 47, 4 8, 54, 55, 56] . Center. [2.7096549267383416, 5.118888107955937, -0.033392

74284217344, -0.1763214899261937, 0.06905978303898756, 0.5893572367629023, -0.281951710743725, 0.17694054175187596, -0.30730211606240837, -0.00068643 77571979055, 8.20260318496675667, 0.27919279468567276, 0.08423348280835357 3, 0.4335265884680189, -0.0466556884386826, -0.2249449504284335, 0.0994103 8519159816, 0.22364780889096822, -0.015552391251709614, 0.638998194098311 4, -0.2669125880689563, -0.28947648151320715, 0.21531875491413502, 0.41802 61522311667, 0.32582773218698013, -0.015677093862122654, 0.193930984633710 58, 0.2063730911365307, 0.15817200269614243, 0.1144896870425226, -0.33331 301630044824, 0.30966232377204594, 0.014417418479274913, -0.06108002914803 917, -0.1638673223312076, 0.4233398687924761, 0.39865138863014715, 0.12349 416511833616, -0.028725379133493927, 0.20833868978256536, -0.3086233155102 456, -0.06161544203049373, -0.4217145784471068, -0.4266878848659056, -0.13 614778237540245, 0.17052350249835777, -0.044725146254143054, 0.09497819986 468771, 0.0698621096152779, -0.006466505262732286, -0.2938893544423553, 0. 08426492140248543, -0.002040884472844223, -0.36124708782499276, -0.0342615 25657563845, 0.47266795002075856, 0.5433900925225167, 0.16596591555697932, 0.37686159929146573, 0.06166478949748874, .0.16527256755743422, 0.5101216 14823918, 0.07005225837091743, .0.010274755819308742, 0.17908476613428295, 0.019528232345308146, -0.13279982412955268, 0.19163539405219188, -0.098336 59118919859, -0.04860279511056607, 0.10149485602612444, -0.335138865252072 87, -0.14267161953714001, 0.4994848053282413, 0.03287487173673032, 0.23023 86125361315, 0.18804287236737918, 0.096215498856784, 0.051911725126628824, 0.4142597664299447, 0.3710054836575168, -0.27587603829745655, -0.274713660 6751319, -0.08781395807764637, -0.17094907047234265, 0.17652856155207713, 0.2902276245440463, 5.4762825273993028-05, 0.12209343908345778, 0.06254966 033297396, 0.1473360387278841, 0.29680608656824883, 0.45513748508643037, -0.21861142797151803, 0.38478916216947134, 0.2166212773444018, 0.259167271 871201, 0.04135303867434514, .0.019246373425451442, .0.5998122360266159] Cluster 1 [1, 3, 5, 6, 13, 18, 19, 20, 21, 23, 28, 30, 31, 34, 40, 4 1, 46, 50, 52, 53, 58] . Center. [5.694045131091127, 0.5039823517176205, 0.15420384737789208, 0.26324171459070317, -0.11300600427459186, -0.1244021 494384345, -0.08512320668068188, 0.31565369935835974, -0.0773352632323455, -0.14712823222938975, -0.28729385357090065, 0.37037639042849024, -0.262908 0582683994, -0.03319666820613075, 0.27742360456418247, 0.0885186895849323 7, 0.1430210640429601, -0.39664042534105687, -0.02228370415985873, 0.14781 40966988431, 0.4505142693797979, -0.1476818205686541, 0.04907802843144104, 0.14286360316098243, 0.032745733583667676, 0.15115458300018986, .0.01722 7163248303128, .0.47631534062455294, 0.04318514754592579, 0.10828125846321 293, -0.2799585258913992, -0.18486657500152126, -0.3745520558767468, 0.128 25597111174528, 0.1667688142549475, -0.046028168784924245, -0.006649721710 312107, 0.4170673218042252, -0.541308786420014, 0.18357975111639102, 0.093 16244534691417, -0.12568367482108372, 0.029736363075014663, -0.10490528699114131, -0.40863335565977604, 0.26730221956413563, 0.05034990220028278, 0. 010280301313913522, -0.3607259378113088, -0.1462741079379882, 0.1354753825 3527575, 0.2625668801810717, -0.32502441455656583, -0.10444038374046682, -0.11563961029354543, 0.11478222186685369, 0.06723324593051198, -0.23110855 947259626, 0.37601465241520887, -0.14316083677284513, -0.4768050265247622 5, 0.08757276672425626, -0.17019739878788062, 0.04573568229939649, -0.0319 7591714816922, 0.10262809744833191, 0.5407347033565212, -0.111656713030702 71, -0.20456604922078747, -0.1783277823817157, -0.006090449033282623, -0.2 1809675159535238, -0.10016151401882374, -0.07682392187418129, -0.244841513 330718, -0.01119521016508088, 0.5614865810523989, -0.5650175881858421, 0.2 1167856289286602, 0.3188154550838695, 0.13422170043110387, -0.170927178705 04176, 0.4183505351837296, -0.11291447506003628, -0.11051783633806506, 0.0 3319508202266424, 0.32355485582866617, 0.0712141366872179, -0.075431603517 50323, 0.11788734414082429, 0.021618219335643923, 0.021718516297191327, -0.22495085326738476, 0.659771132680887, 0.041385941017687056, -0.060094577 96894042, -0.03282009673331382, -0.34746687989668884, 0.1485330451194417, -0.15962063960873094] Cluster 2 : [4, 9, 10, 14, 15, 24, 25, 27, 29, 33, 36, 37, 39, 43, 44, 45, 49, 51, 57, 59] . Center= [-0.02771997803300356, -0.04408670531481113, -0.6061499436113246, 0.2094828521299311, 0.04264744313419164, 0.0432700915 32081126, -0.27728542350935903, -0.1496800357411653, -0.2771906323455279, 0.011255718809708071, 0.3021380631653229, 0.18456812795788638, 0.015970031 92910105, 0.14830534661890765, 0.1730347280332923, 0.013496418012055719, -0.2500476983350755, 0.1494423730588969, 0.17769208652669916, 0.21470488847 568042, 0.15665363302463758, 0.01679792811728541, 0.007503767695033009, 0. 034835913537983695, -0.04343813438569994, -0.019012247912241174, 0.0306538 57559215215, 0.01704807538505563, -0.1552673446442095, 0.2126866201983396, 0.009366090157969954, -0.31260388414968426, 0.08533538104309923, -0.259728 21187382067, 0.254747036760073, 0.01802934932184701, 0.03518277601825271, 0.037114990681225014, -0.01776075436094312, -0.07779389379571745, -0.25942 939473919413, -0.26544743693298695, -0.27264138509592084, -0.0007234551625 882379, 0.07853061236766411, -0.022253673872367322, -0.16082775133991573, -0.12102383400121797, -0.04859487859533934, -0.44751753836604796, 0.184238 58346837343, 0.3139255287179066, -0.4472611524787665, 0.18976082284198764, -0.5691246898982734, 0.01937867554282798, 0.2903498100431109, -0.025211593 495734465, 0.1101626726786179, -0.15812787773843281, -0.1973080242700347, -0.08794463620852602, -0.22510068590620663, -0.21200354536213184, 0.380080 61917998825, -0.19368556305362855, 0.15661951130625518, 0.2495059073537663 8, -0.18601828096551065, -0.2761379132708334, 0.202685227987299, 0.1357194 9834492275, 0.09391596728439319, -0.34257559507187607, 0.1307998945916685 8, -0.38607698426871945, 0.08338079715600345, -0.06298142435998536, 0.1143 4878255698408, 0.02370460539198189, -0.28242939182280274, -0.0555803623466 2687, -0.08383369726163171, 0.08680746277773087, -0.0755325243466872, 0.07 305073064892768, -0.08574958872674493, -0.3126396988484387, 0.232907464794 23546, 0.1556101039310986, -0.34444563477914103, 0.3901343641024325, -0.06 526069359487967, 0.4101206707234513, -0.19864655305570414, 0.0366353606830 23144, 0.3415719128527193, -0.15177604893384095, -0.07755953802273606, 0.1 4392961044149452]

Cost= 5853.1060985691565

Average number of iterations: 5.6

Starvation occured 0 times.

Experiment 6: Weakly clustered data, one hundred dimensions: Let d = 100, q = 3, ~µ0 = h0, 0 . . . 0i, ~µ1 = h2, 0, . . . 0i, ~µ2 = h1, √ 3 . . . 0i, σ = 2.

Best clustering found KMeans terminates with final clustering

Cluster 0 : (4, 5, 6, 10, 14, 16, 18, 20, 24, 33, 39, 41, 44, 45, 46, 5 0, 54, 57, 58] . Center= (0.5941468542082708, 0.23642618307319996, -1.0289

89716970469, 0.7434685299240775, -0.37417011544063056, -0.2305233814157025 8, -0.5734080206375362, 0.4004466154253553, -0.4412509304079379, 0.3342185 4886290464, -0.11768549209706251, 0.2642442116207325, -0.5014545209325556, 0.6335282053954167, 0.7384587027053572, -0.7218598166431043, 0.48811392962 09066, -0.630823126671635, -0.03490937479638408, -0.28528023303375055, 0.5 738291718914803, 0.17819808478749838, -0.6076550916981165, 0.2694856957091 303, 0.08312673917284844, -0.14983448759679024, 0.7266059986228113, 0.4522 6113382532895, -0.11727222140058617, 0.37343892175180093, -0.0545297788140 0414, -0.8205204683929487, -0.9415918933389498, 0.40437666408955847, 0.827 5396465234598, -0.45915716748973684, 0.45813156813684897, 1.55908312898743 1, -0.45944986431600813, 0.07650334845837876, -0.08834031167758238, -0.5224 168182691016, -0.16805625334634303, 0.2162306921120755, 0.1951799700373961 8, -0.21766666994960543, -0.2068593318955597, -0.32199699931420617, -0.284 7522175720044, -1.8073002314272363, -0.19190359495192472, 1.23280994644420 46, -0.6513737909581957, -0.35532779668074516, -0.8888353817187247, 0.0253 39256100880572, -0.22227478506079373, -0.11890454407315958, 0.622812939637 1759, 0.15362778502338945, -0.8562823103920514, 0.013489504552304004, -0.6 700373554639546, -0.8384414644812918, 0.08237756719429946, -0.307695654241 4473, 0.6065672713477318, 0.5153451387243445, -0.121722376899481, -0.36945 96585847086, 0.2805545135401543, 0.6985575987968627, 0.726661479517075, -0.04589072525316267, 0.17998305078231897, -0.5683107221081686, 0.250426057 34668344, -0.5963648940727047, 0.581578791673072, -0.11363072246573798, 0. 3986436289684633, 0.03197838945131425, 0.24484029670159385, -0.84148205442 86523, 0.3837375865671596, 8.5613998591467123, 0.239045178363852, -0.16311 854651766622, 0.38161115354883696, 0.3950672677721836, -1.009437865192118 8, 0.550965603067456, -0.046526719335934726, 1.8974666256990715, -0.536106 2911097951, -0.02601447354932108, 1.2269540816556586, -0.0086485022735034 8, -0.43166634828317957, 0.7921765774838299] Cluster 1 : (0, 1, 2, 3, 12, 13, 15, 17, 19, 23, 25, 26, 28, 30, 32, 3 5, 36, 40, 42, 48, 49, 51, 56] . Center- (2.681400344122668, 1.27420636205 72284, 0.28954598002894, -0.16785316812231751, -0.24150972344242452, 0.166 4572846029819, -1.108695828146248, 0.29344588237031305, -0.142400104073133 64, 0.1804189352173417, 0.291525025995333, 0.7583280611919845, -0.66754468 25079138, 0.27728694511061375, 0.018557819070976957, 0.8190573875566468, -0.14264430493774083, 0.1351671713864099, -0.09744147547816465, 0.879423166 8275089, 0.07302783020975938, -0.2743243654961313, 0.5874543119154877, 0.8 004034439668642, 0.2884503611388837, -0.2738712956129808, 0.22147140701126 358, -0.7772329980500361, -0.7010274409999084, 0.3768809300605821, -8.7205 585338330678, 0.14472068293925196, 0.4190550490332152, -0.416585215554036 7, -0.7150626570759159, 1.3390105113252664, -0.13364200580672226, 0.552113 134597327, -0.917256005952597, 0.32314585730801526, -0.8810973528350401, -0.3522802041903278, -0.6698183073383859, -0.9472790956475583, -0.3011005102810242, 8.9897113959787368, -0.32520819094801506, 0.07137279278601467, 0. 4190437559716979, -0.045533377936511535, 0.09059812414349203, 0.4479071421 640733, -0.08569934835755856, 0.1822904879933564, .0.3888790294939481, 0.5 805039084293127, 0.8887874728213824, 0.14810474943635182, 0.88808387569413 77, -0.32652029977086455, -0.32460459500888744, -0.6287018169588058, 0.115 24454766516401, 0.9848913187289858, 0.669559133022717, 0.4689564157694666, 0.45249993168967995, 0.1510734437565389, -0.4920067633451094, -0.583118017 1292347, .0.16996543952787296, .0.18619300497600713, -0.7453987637586511, 0.5881965478581, -0.3129695364580357, -0.5071368574323276, 1.1101804095788 872, -0.22570045581588694, -0.26537384906180145, 0.21083250375913423, -0.3 6493639550136275, -0.6991765736276562, -0.25301648980935676, 0.48563233563 21452, -1.0283508394108758, 0.140537257366844, 0.5393163448179855, -0.2563 8075522970005, 0.23842121356887702, 0.09779739731510809, 0.165027063293240 27, 0.6375843477398315, 0.43963586182749276, 0.05294667987694026, 0.533715 7933182421, 0.8887437900413396, -0.832725965731166, .0.432342646525394, 0. 11848480404713976, -0.7228888793509057] Cluster 2 : (7, 8, 9, 11, 21, 22, 27, 29, 31, 34, 37, 38, 43, 47, 52, 5 3, 55, 591 . Center. (0.4470547475436501, 0.3843118944043564, -0.341506294 48948966, 0.13722057105929167, 0.6804373963257823, 1.0807175046049469, 0.6 118888783473521, -0.020208136534620526, -0.7974564826954584, -0.9030571985 785342, 0.18050280318463158, 0.6158707936521136, 0.813261042908071, 0.1442 9602899036104, 0.13015106457350878, .0.31186587948972117, -0.1450430141970 641, 0.37190045893121787, 0.4737338370843345, 1.348439475929056, 0.1368151 0708633787, .0.7559516022914099, 0.47652989760372055, -0.01393365392480053 9, 0.058602293704709055, 0.08006572745440504, -0.6126314151706441, -0.1220 9702306506948, 0.44135275879534025, 0.09123804812926564, -0.35781094582835 32, 0.208897776619428, -0.19544051984504696, .0.3013953031024322, 0.649466 7360736197, -0.39990831556416534, 0.5914467686553802, -1.033554229387582, 0.2938595482666776, 0.2016414258313146, 0.20842588681629393, -0.0116463540 81004858, -0.3934995696284936, -0.1650035464039706, -0.8876722148620163, -0.1006253342628805, 0.2995636654987664, 0.20424218338252006, .1.0370709233 329305, -0.2279982876868886, 0.19189585473295956, -0.38546422903321403, - 0.9595465600036077, -0.44249475789349234, -0.1717610706794829, 0.540241482 284382, 1.0482067382180478, -0.308641185897737, 0.12558267153264918, -0.30 0198292989264, -0.5812900038539175, -0.2789171892040226, -0.18945817831822 362, -0.7595442435925821, 0.206634648214722, -0.4241527629057624, 0.110942 67176841963, -0.03852486229547271, -0.34113416961418835, 0.002736572334164 2076, 0.5715046744980535, -1.4142619875266051, -0.14078127690051337, -0.58 92112633357612, -0.0013045153642721433, 0.8498800288716424, 0.209502940583 32872, -0.3373201805833449, 0.5828587769569276, 1.5216744774404793, 8.5143 14015017246, -0.24510964782883646, 0.2747593949934044, 0.01175419256901124 8, 0.12233002131438155, -0.1597025685187227, 0.23565754492672694, .0.02869 4637310845966, -0.1081432166836885, 0.21094119321625565, 0.450780348638707 3, -0.06314460656249937, -0.22170868346614256, -0.08120329926857552, 0.351 3828804289523, .0.7096545267751677, .0.09574190107981863, -0.4991685016727 126, 0.43784190601311934, -1.2313698978911254]

Cost. 22953.691294377

Average number of iterations: 3.8

Starvation occured 0 times.

Experiment 7: Unclustered data, one hundred dimensions: Let d = 100, q = 1, ~µ0 = h0, 0, . . . 0i, σ = 2.

Best clustering found KNeans terminates with final clustering Cluster

0 (3, 4, 8, 10, 13, 17, 19, 22, 30, 32, 35, 44, 46, 51, 53, 54, 58) . Center. (-0.860908883558661, 1.0671546376625192, 1.0392888212065987, 0.41990642629619807, 0.467619139440961, 0.4402424728103347, -0.4840186853845 161, 0.2830569444403694, -0.6000352526150053, -0.2561582908662861, 0.6705917 878348813, 0.48684865609563027, -0.358338816552863, 0.4160896386241412, 0.73 65646050148125, -0.41175806488699096, -0.16407782870603316, 0.62279934127920 06, 0.4936339648294434, 0.1298153751366764, -0.01280792071344727, -0.5727331 575947394, 0.28196846082301974, 1.0488787944356863, 0.9284955289943099, 0.79 58496792068946, 0.2776538078291231, 0.40881575339952825, -0.595204305340828, 0.033944340483494206, -1.042911820759251, -0.8876918081430148, -0.0735421043 3876578, 0.37882038750524744, -0.6609699152515021, 0.45779912510728465, -0.4 0048626727634895, 1.0098579581539904, .1.0490649375698875, 0.331464307173193 64, 0.42590600953470154, 0.401238955667439, -0.18370373876775792, -0.6324024 58585107, 0.3409719287053639, 0.8308498301182307, 0.14833567139424586, 0.492 04699658784806, 0.014356461358182844, -0.45919149338542364, -0.2166014130048 681, -0.19821853855762625, .0.29557921430041845, -0.9958269227496844, 0.1851 1582313938627, 0.5467077798203323, -0.009971003932574211, -0.219640967604257 3, -0.6936039123868372, 0.19464941148284556, -0.2958448624891896, -0.9742652 772844456, -0.17582611882789004, -0.30660603522094076, 0.5054564371288249, -0.3525620506874482, 0.005759789830519911, -0.8422583510178129, 0.55940897315 71223, -0.5887913909991416, 0.05742257398449543, -0.3840093319696986, .0.229 17878803735364, 0.5974351288682662, -0.5486305974451852, 0.02199498032148686 7, 0.31188454917706876, -0.18234601742816553, 0.33979172068250874, -0.119657 91978465073, -0.3377955943732758, -0.844369346786715, 0.11217743989673663, -1.0472853560777824, .0.7249459411881671, -0.4001317936157486, 0.292409672857 5563, -1.0913625474220985, 0.725817933900381, 0.5216615034309376, 0.06057565 482101463, 0.7123842750204838, 2.0224988590188402, 0.8989748215252049, -0.07 726466675470023, 0.03156367782946677, -0.23000254701844633, 0.32243895279405 7, -0.4997893298649497, -0.03725562525262055] Cluster 1 [0, 6, 15, 16, 18, 20, 25, 27, 28, 29, 31, 33, 38, 40, 42, 4 7, 48, 56, 59] . Center- C-0.6148124774364699, -0.008881709597867377, -1.639 229646187353, 0.023637283363748023, -0.7595003001683569, 0.6417595142379533, 0.37446668640925757, 1.0720678212005434, -0.4550565371837755, 0.467380155364 0201, -0.10854662191004674, 1.0749011801350925, -0.5807095954994344, 0.15863 368447524287, 0.03489284628378351, 0.808187429364598, 0.18122102724038422, -0.6241469904097731, 0.3000197958067128, 0.7911228313986695, -0.1256375617275 2083, -0.7626715137898202, 0.8060949831199359, 0.38591772245671263, -0.49335 0227616241, -0.25283400646870546, 0.20003072547925194, -0.5134927624100375, -0.31732844409669125, 0.0018590666355822534, -0.9211459854310536, 0.33674673 30125333, -0.5434772684326582, -0.9828625737399568, 0.3370087908113872, 0.34 862584782851513, 0.24246790806463855, 0.45071217972182004, 0.231486718510558 77, 0.8324721808182072, -1.0816075782119552, -0.04568132672158655, -0.033256 90773531463, .0.2522255875326804, .0.8521567091084181, 0.16596270439712763, -0.537223019325689, -0.15649498981055543, 0.030590781213458578, -0.3912440350873126, 0.2697280572260439, 1.072727392210254, 0.28044337592726426, 0.50793 79455933024, -0.6485946727359115, 0.6106195477337264, 0.743190622558925, 0.5 667112030635442, 1.4056883958400825, -0.838886315664219, -0.860588081296228, 0.25310117569790114, 0.5986388346043805, -0.5985704812528513, 0.611675559055 6706, 1.162359476310496, 0.5087892819205024, 1.3441413412656027, 0.72467531 99549264, 0.6340981103718369, 0.10120822681944724, -0.12032014142194948, -0. 20902201548015695, 0.2036868766494979, -0.022759604451656104, -0.24956378047 62873, 0.8155123148589513, -1.1411227566562927, -0.37531166776880787, 0.7896 168978855698, 1.308854667891597, 0.07579029680902524, 0.3780541112635171, 0. 32005013023627704, 0.5966790024616282, 0.9673167426456754, 0.284525714616775 95, -0.9514105032927042, 0.11661969400454888, -0.45571056462298304, -0.15687 710958025447, 0.48562794639090096, 0.002459011581122407, 0.4642601558463533, 0.3034384426323484, 0.18021138554903599, 0.5728265867078551, -0.116644905973 04865, 0.13789954784417577, 1.265860200528028] Cluster 2 : (1, 2, 5, 7, 9, 11, 12, 14, 21, 23, 24, 26, 34, 36, 37, 39, 4 1, 43, 45, 49, 50, 52, 55, 57] . Center= (0.3052029871814322, -0.49572644184 56428, -0.23170446106402384, 0.21448882707770156, 0.25270406808421594, -0.03 233601776823012, -1.0111377508109867, -0.4661359220133677, -0.2986047191251 8, 0.4283655684670451, 0.06748220298042713, 0.20201292240646396, 0.2867823 9053469295, 0.4551833458433381, 0.15128758282140486, -0.36859485366998307, -0.03630437649511268, -0.03797425783635162, -0.3528906880016311, 0.9100051584 25677, 0.7354131088861741, 0.32068320018430124, -0.3985719968587976, -0.0785 2810720913622, 0.11907658204035491, -0.6845962663695869, 0.0270294856325000 76, 0.36144371456842067, 0.239177497389096, 0.6997295715295383, 0.465906898 981679, 0.007966233269983256, -0.008067722037809168, 0.20462597989937314, 0. 6583556230993334, 0.01951790260231354, 0.7699229911380163, -0.08487130357538 274, -0.4625461385068174, -0.3723500272368758, -0.20341238543539483, -1.0079 631523168366, 0.9136265554022257, 0.21274883024867233, 0.366689062008356 7, 0.01922079724244797, 0.06948171811022585, 0.25797514948329514, -0.63603 52938606918, -0.3770853839987545, 0.018712702924789198, 0.40728299304585597, -1.3301084425002254, -0.135217325845747, -0.8228108089431049, 0.110899115709 30623, 0.8806457285436565, 0.4767472856436737, 0.8167937529697443, 0.109799 65622164793, 0.5340813935449727, 0.31128180140232115, 0.9114760918605619, 0.40147741097903394, 0.818785929451308792, -0.7827601995169292, 0.5901804955 288632, 0.05635440850419996, -0.6462673848171052, -0.9341916689644334, 0.367 0531134075375, -0.3188466325951977, 0.08315797195517528, -0.4989855735924366 7, 0.2482104162884148, -0.11651723990662478, 0.5527719217529613, 0.091141997 96255755, 0.6996799556081804, 0.7129903345855385, 0.44530706089228184, -0.2 904659249490624, -0.22132454627729117, 0.29649411376959117, -0.5488306176911 389, -0.0230195670380071, 0.45045904633794764, 1.1298937351259613, -0.156956 54721612787, 0.5559506197217631, -0.22167548988922567, 0.11077999505822693, 0.5080142071292749, 0.4876860504836847, 0.16510435365707862, 0.133852160126 16985, -0.1890660086638211, -0.9316018511416875, 0.5633814250284765, 0.03937 2584350365]

Cost= 22863.74719111

Average number of iterations: 2.8

Starvation occured 0 times.