LAMPIRAN

Lampiran 1 Contoh Proses Perhitungan K-Means Dengan Inisialisasi Centroid

Untuk mempermudah perhitungan pada bagian ini hanya digunakan simulasi beberapa variable dan data klastering secara acak seperti terlampir.

Tabel 1. Data Awal Pengelompokan Nilai

No	Kategori				
	IPK	Ekonomi	Prodi	Jenis SMA	Kota Asal
1	3	3	1	2	7
2	2	2	4	1	3
3	3	4	2	2	5
4	4	4	3	3	3
5	3	3	4	2	1
6	4	1	2	1	5
7	3	4	3	3	2
8	2	1	2	3	2
9	1	3	1	1	1
10	4	4	1	2	3
11	3	2	1	1	9
12	3	1	3	1	7

Adapun proses perhitungan secara manual menggunakan algoritma klaster dinamis dengan inisialisasi centoid (mean based):

a) Proses Inisialisasi Awal Kluster (Mean Based)

1) Inisialisasi dimulai dari proses perhitungan *euclidean distance* pada setiap data $(x, 0)$ menggunakan persamaan:

$$d = \sum_{i=1}^{k} \sum_{x_\lambda \epsilon classi}^{n} \sqrt{\sum_{j=1}^{q} (x_{\lambda,j} - x_{i,j})^2}$$

Adapun hasil perhitungan manual nilai euclidean berdasarkan rumus yaitu:

Euclidean (1,0) = $\sqrt{(3-0)^2 + (3-0)^2 + (1-0)^2 + (2-0)^2 + (7-0)^2}$ = 8,485281374

Euclidean (2,0) = $\sqrt{(2-0)^2 + (2-0)^2 + (4-0)^2 + (1-0)^2 + (3-0)^2}$ =5,830951895

Euclidean (3,0) = $\sqrt{(3-0)^2 + (4-0)^2 + (2-0)^2 + (2-0)^2 + (5-0)^2}$ = 7,615773106

Euclidean (4,0) = $\sqrt{(4-0)^2 + (4-0)^2 + (3-0)^2 + (3-0)^2 + (3-0)^2}$ = 7,681145748

Euclidean (5,0) = $\sqrt{(3-0)^2 + (3-0)^2 + (4-0)^2 + (2-0)^2 + (1-0)^2}$ =6,244997998

Euclidean (6,0) = $\sqrt{(4-0)^2 + (1-0)^2 + (1-0)^2 + (1-0)^2 + (5-0)^2}$ = 6,8556546

Euclidean (7,0) = $\sqrt{(3-0)^2 + (4-0)^2 + (3-0)^2 + (3-0)^2 + (2-0)^2}$ = 6,8556546

Euclidean (8,0) = $\sqrt{(2-0)^2 + (1-0)^2 + (2-0)^2 + (3-0)^2 + (2-0)^2}$ = 4,69041576

Euclidean (9,0) = $\sqrt{(1-0)^2 + (3-0)^2 + (1-0)^2 + (1-0)^2 + (1-0)^2}$ = 3,605551275

Euclidean (10,0) = $\sqrt{(4-0)^2 + (4-0)^2 + (1-0)^2 + (2-0)^2 + (3-0)^2}$ = 6,782329983

Euclidean (11,0) = $\sqrt{(2-0)^2 + (2-0)^2 + (1-0)^2 + (1-0)^2 + (9-0)^2}$ = 9,797958971

Euclidean (12,0) = $\sqrt{(3-0)^2 + (1-0)^2 + (3-0)^2 + (1-0)^2 + (7-0)^2}$ = 8,306623863

2) Proses berikutnya dilakukan pengurutan data berdasarkan jarak pusat klaster yang dihasilkan pada setiap data. Pengurutan data dilakukan dari nilai eucledean terkecil. Hasil pengurutan dapat dilihat pada tabel 7.
3) Dalam hal ini jumlah klaster telah ditentukan sejumlah 3. Sehingga selanjutnya data yang sudah diurutkan dibagi kedalam 3 klaster. Setiap data yang terlibat dimasukan kedalam salah satu klaster yang tersedia dan memperoleh hasil sebagai berikut.

Tabel 7. Hasil perhitungan nilai Euclidean dan pengelompokan data awal

No	Variabel					Euclidean	Klaster
	IPK	Ekonomi	Prodi	Jenis SMA	Kota Asal		
9	1	3	1	1	1	3,61	1
8	2	1	2	3	2	4,69	1
2	2	2	4	1	3	5,83	1
5	3	3	4	2	1	6,24	1
10	4	4	1	2	3	6,78	2
6	4	1	2	1	5	6,86	2
7	3	4	3	3	2	6,86	2
3	3	4	2	2	5	7,62	2
4	4	4	3	3	3	7,68	3
12	3	1	3	1	7	8,31	3
1	3	3	1	2	7	8,49	3
11	3	2	1	1	9	9,80	3

4) Hitung titik pusat klaster (*centroid*) baru dengan mencari rata-rata disetiap klaster menggunakan persamaan $c_i = \sum_{j=1}^{n(s_i)} m_{ij} \ \epsilon \ s_i$.
Perhitungan dilakukan berdasarkan rata-rata perklaster (seperti terlihat pada tabel warna orange diatas). Hasilnya adalah sebagai berikut.

Centroid Klaster 1 C1 (IPK) = $\frac{(1+2+2+3)}{4}$ = 2

Centroid Klaster 1 C2 (Ekonomi) = $\frac{(3+1+2+3)}{4}$ = 2,25

Centroid Klaster 1 C3 (Prodi) = $\frac{(1+2+4+4)}{4}$ = 2,75

Centroid Klaster 1 C4 (Jenis SMA) = $\frac{(1+3+1+2)}{4}$ = 1,75

Centroid Klaster 1 C5 (Kota Asal) = $\frac{(1+2+3+1)}{4}$ = 1,75

Centroid Klaster 1 C1 (IPK) = $\frac{(4+4+3+3)}{4}$ = 3,5

Centroid Klaster 2 C2 (Ekonomi) = $\frac{(4+1+4+4)}{4}$ = 3,25

Centroid Klaster 2 C3 (Prodi) = $\frac{(1+2+3+2)}{4}$ = 2

Centroid Klaster 2 C4 (Jenis SMA) = $\frac{(2+1+3+2)}{4}$ = 2

Centroid Klaster 2 C5 (Kota Asal) = $\frac{(3+5+2+5)}{4}$ = 3,75

Centroid Klaster 3 C1 (IPK) = $\frac{(4+3+3+3)}{4}$ = 3,25

Centroid Klaster 3 C2 (Ekonomi) = $\frac{(4+1+3+2)}{4}$ = 2,5

Centroid Klaster 3 C3 (Prodi) = $\frac{(1+2+3+2)}{4}$ = 2

Centroid Klaster 3 C4 (Jenis SMA) = $\frac{(3+1+2+2)}{4}$ = 1,75

Centroid Klaster 3 C5 (Kota Asal) = $\frac{(3+7+7+9)}{4}$ = 6,5

Setelah perhitungan centroid awal selesai dilakukan maka proses inisialisasi cluster dengan metode *mean based* telah selesai dilakukan. Nilai hasil rata-rata centoid akan digunakan untuk inisialisasi awal pada metode k-mean.

b) Perhitungan Dengan Algoritma K-Means

Adapun proses yang terjadi pada algoritma *k-means* ini yaitu.

1) Algoritma *k-means* pada rencana penelitian ini diawali dari perhitungan *lister n* data dengan titik pusat lister (*centroid*) yang dihasilkan pada tahap inisialisasi awal sebelumnya (*mean based)*. Perhitungan *euclidean* menggunakan persamaan

$$d = \sum_{i=1}^{k} \sum_{x_\lambda \epsilon classi}^{n} \sqrt{\sum_{j=1}^{q} (x_{\lambda,j} - x_{i,j})^2}$$

Dengan penentuan centroid awal pusat cluster (berdasarkan hasil perhitungan mean):

C1	C2	C3	C4	C5
2	2,25	2,75	1,75	1,75
3,5	3,25	2	2	3,75
3,25	2,5	2	1,75	6,5

Maka perhitungan nilai ecludian k-mean sesuai rumus didapatkan hasil sebagai berikut:

Berdasarkan centroid awal kluster 1:

Euclidean (1,1) = $\sqrt{(3-2)^2 + (3-2{,}5)^2 + (1-2{,}75)^2 + (2-1{,}75)^2 + (7-1{,}75)^2} = 5{,}68$

Euclidean (1,2) = $\sqrt{(2-2)^2 + (2-2{,}5)^2 + (4-2{,}75)^2 + (1-1{,}75)^2 + (3-1{,}75)^2} = 1{,}94$

Euclidean (1,3) = $\sqrt{(3-2)^2 + (4-2{,}5)^2 + (2-2{,}75)^2 + (2-1{,}75)^2 + (5-1{,}75)^2} = 3{,}91$

Euclidean (1,4) = $\sqrt{(4-2)^2 + (4-2{,}5)^2 + (3-2{,}75)^2 + (3-1{,}75)^2 + (3-1{,}75)^2} = 3{,}20$

Euclidean (1,5) = $\sqrt{(3-2)^2 + (3-2{,}5)^2 + (4-2{,}75)^2 + (2-1{,}75)^2 + (1-1{,}75)^2} = 1{,}94$

Euclidean (1,6) = $\sqrt{(4-2)^2 + (1-2{,}5)^2 + (2-2{,}75)^2 + (1-1{,}75)^2 + (5-1{,}75)^2} = 4{,}15$

Euclidean (1,7) = $\sqrt{(3-2)^2 + (4-2{,}5)^2 + (3-2{,}75)^2 + (3-1{,}75)^2 + (2-1{,}75)^2} = 2{,}40$

Euclidean (1,8) = $\sqrt{(2-2)^2 + (1-2{,}5)^2 + (2-2{,}75)^2 + (3-1{,}75)^2 + (2-1{,}75)^2} = 1{,}94$

Euclidean (1,9) = $\sqrt{(1-2)^2 + (3-2{,}5)^2 + (1-2{,}75)^2 + (1-1{,}75)^2 + (1-1{,}75)^2} = 2{,}40$

Euclidean (1,10) = $\sqrt{(4-2)^2 + (4-2{,}5)^2 + (1-2{,}75)^2 + (2-1{,}75)^2 + (3-1{,}75)^2} = 3{,}43$

Euclidean (1,11) = $\sqrt{(3-2)^2 + (2-2{,}5)^2 + (1-2{,}75)^2 + (1-1{,}75)^2 + (9-1{,}75)^2} = 7{,}57$

Euclidean (1,12) = $\sqrt{(3-2)^2 + (1-2{,}5)^2 + (3-2{,}75)^2 + (1-1{,}75)^2 + (7-1{,}75)^2} = 5{,}55$

Karena pada penelitian digunakan 3 kluster, lanjutkan hitung nilai *Euclidean* untuk mencari nilai pada kluster 2 dan kluster 3. Hasil Euclidean dapat dilihat pada tabel 8.

2) Kelompokan setiap data ke dalam klaster dengan jarak pusat klaster yang paling kecil.

Tabel 8. Hasil pengelompokan dan nilai euclidean data (x,y)

No	Klaster 1	Klaster 2	Klaster 3	Klaster
1	5,68	3,45	1,27	1
2	1,94	3,06	4,32	1
3	3,91	1,54	2,15	1
4	3,20	1,84	4,20	1
5	1,94	3,45	5,88	2
6	4,15	2,81	2,37	2
7	2,40	2,42	5,01	2
8	1,94	3,37	5,06	2
9	2,40	3,98	6,09	3
10	3,43	1,54	4,02	3
11	7,57	5,60	2,85	3
12	5,55	4,23	2,03	3

3) Setelah semua data sudah masuk ke salah satu klaster, maka pusat cluster baru dapat dibentuk dengan cara menghitung nilai rata-rata kriteria dari masing-masing kelompok cluster yang sama.
Untuk mencari pusat kluster dapat menggunakan persamaan $c_i = \sum_{j=1}^{n(s_i)} m_{ij} \ \epsilon \ s_i$.
Gunakan data pada tabel 6 untuk menghitung pusat kluster, hasil centroid masing-masing variable sebagai berikut.

Centroid Klaster 1 C1 (IPK) = $\frac{(3+2+3+4)}{4}$ = 3

Centroid Klaster 1 C2 (Ekonomi) = $\frac{(3+2+4+4)}{4}$ = 3,25

Centroid Klaster 1 C3 (Prodi) = $\frac{(1+4+2+3)}{4}$ = 2,5

Centroid Klaster 1 C4 (Jenis SMA) = $\frac{(2+1+2+3)}{4}$ = 2

Centroid Klaster 1 C5 (Kota Asal) = $\frac{(7+3+5+3)}{4}$ = 4,5

Centroid Klaster 2 C1 (IPK) = $\frac{(3+4+3+2)}{4}$ = 3

Centroid Klaster 2 C2 (Ekonomi) = $\frac{(3+1+4+1)}{4}$ = 2,25

Centroid Klaster 2 C3 (Prodi) = $\frac{(4+2+3+2)}{4}$ = 2,75

Centroid Klaster 2 C4 (Jenis SMA) = $\frac{(2+1+3+3)}{4}$ = 2,25

Centroid Klaster 2 C5 (Kota Asal) = $\frac{(1+5+2+2)}{4}$ = 2,5

Centroid Klaster 3 C1 (IPK) = $\frac{(1+4+3+3)}{4}$ = 2,75

Centroid Klaster 3 C2 (Ekonomi) = $\frac{(3+4+2+1)}{4}$ = 2,5

Centroid Klaster 3 C3 (Prodi) = $\frac{(1+1+1+3)}{4}$ = 1,5

Centroid Klaster 3 C4 (Jenis SMA) = $\frac{(1+2+1+1)}{4}$ = 1,25

Centroid Klaster 3 C5 (Kota Asal) = $\frac{(1+3+9+7)}{4}$ = 5

Secara ringkas maka diperoleh pusat kluster baru seperti pada tabel berikut.

Centroid Baru	IPK	Ekonomi	Prodi	Jenis SMA	Kota Asal
A	3	3,25	2,5	2	4,5

B	3	2,25	2,75	2,25	2,5
C	2,75	2,5	1,5	1,25	5

4) Setelah pusat cluster baru terbentuk, maka perhitungan dilanjutkan untuk enghitung jarak data ke pusat cluster yang baru dan sekaligus penentuan kelompok kluster.

No	Klaster 1	Klaster 2	Klaster 3	Klaster
1	2,93	4,89	2,26	1
2	2,84	2,11	3,34	1
3	1,03	3,15	1,77	1
4	2,25	2,22	3,62	1
5	3,82	2,11	4,81	2
6	2,75	3,31	2,03	2
7	2,84	1,98	4,08	2
8	3,68	1,98	3,89	2
9	4,42	3,38	4,43	3
10	2,46	2,73	2,94	3
11	5,01	6,85	4,08	3
12	3,54	4,84	2,94	3

Hasil iterasi pada k-means clustering akan berhenti apabila data terakhir titik pusat sama/ tidak ada perubahan hasil jarak pusat. Karena pada kasus ini nilai centoid/ pengelompokan berbeda, maka lakukan penghitungan kembali nilai klaster sesuai langkah 1. Pada penulisan ini, perhitungan berhenti pada iterasi ke 3 karena sudah tidak mengalami perubahan kelompok cluster. Data akhir dapat dilihat pada tabel 9.

Tabel 9. Hasil akhir iterasi

No	Klaster 1	Klaster 2	Klaster 3	Hasil Klaster
1	2,93	4,89	2,26	3
2	2,84	2,11	3,34	2
3	1,03	3,15	1,77	1
4	2,25	2,22	3,62	1
5	3,82	2,11	4,81	2
6	2,75	3,31	2,03	3
7	2,84	1,98	4,08	2
8	3,68	1,98	3,89	2
9	4,42	3,38	4,43	2
10	2,46	2,73	2,94	1
11	5,01	6,85	4,08	3
12	3,54	4,84	2,94	3

Tabel 10. Nilai centoid akhir

Rata-rata / centroid				
IPK	**Ekonomi**	**Prodi**	**Jenis SMA**	**Kota Asal**
3	3,25	2,5	2	4,5
3	2,25	2,75	2,25	2,5
2,75	2,5	1,5	1,25	5

c) Analisa Cluster Variance

Berdasarkan data diatas, nilai anggota cluster tidak berubah maka selanjutnya dilakukan proses hitung intra dan inter cluster. Adapun rumus yang diterapkan yaitu:

$$inter = min\{||mk - mkk||\} \; \forall \; k = 1,2,\dots,k-1 \; dan \; k = k+1,\dots,K$$

$$\text{Intra} = \sqrt{\frac{1}{n-1}\sum_{i=1}^{n}(Xi - Xm)^2}$$

Untuk mencari nilai cluster variance dilakukan dengan beberapa tahap yaitu:

1) Mencari Nilai M berdasarkan rata-rata nilai hasil klaster akhir

$$M1 = \frac{c1 + c2 + c3}{jumlah\ klaster} = \frac{2{,}93 + 4{,}89 + 2{,}26}{3} = 3{,}36$$

$$M2 = \frac{c1 + c2 + c3}{jumlah\ klaster} = \frac{2{,}83 + 2{,}11 + 3{,}34}{3} = 2{,}76$$

$$M3 = \frac{c1 + c2 + c3}{jumlah\ klaster} = \frac{1{,}03 + 3{,}15 + 1{,}77}{3} = 1{,}98$$

$$M4 = \frac{c1 + c2 + c3}{jumlah\ klaster} = \frac{2{,}25 + 2{,}22 + 3{,}62}{3} = 2{,}70$$

$$M5 = \frac{c1 + c2 + c3}{jumlah\ klaster} = \frac{3{,}82 + 2{,}11 + 4{,}81}{3} = 3{,}58$$

$$M6 = \frac{c1 + c2 + c3}{jumlah\ klaster} = \frac{2{,}75 + 3{,}31 + 2{,}03}{3} = 2{,}70$$

$$M7 = \frac{c1 + c2 + c3}{jumlah\ klaster} = \frac{2{,}84 + 1{,}98 + 4{,}08}{3} = 2{,}97$$

$$M8 = \frac{c1 + c2 + c3}{jumlah\ klaster} = \frac{3{,}68 + 1{,}98 + 4{,}08}{3} = 3{,}19$$

$$M9 = \frac{c1 + c2 + c3}{jumlah\ klaster} = \frac{4{,}42 + 3{,}38 + 4{,}43}{3} = 4{,}08$$

$$M10 = \frac{c1 + c2 + c3}{jumlah\ klaster} = \frac{2{,}46 + 2{,}73 + 2{,}94}{3} = 2{,}71$$

$$M12 = \frac{c1 + c2 + c3}{jumlah\ klaster} = \frac{5{,}01 + 6{,}85 + 4{,}08}{3} = 5{,}31$$

$$M12 = \frac{c1 + c2 + c3}{jumlah\ klaster} = \frac{3{,}54 + 4{,}84 + 2{,}94}{3} = 3{,}77$$

2) Menghitung nilai rata-rata per kluster:

$$M\_C1 = \frac{M1 + M2 + M3 + M4}{jumlah\ anggota\ klaster} = \frac{3{,}36 + 2{,}76 + 1{,}98 + 2{,}70}{4} = 2{,}70$$

$$M\_C2 = \frac{M5 + M6 + M7 + M8}{jumlah\ anggota\ klaster} = \frac{3{,}58 + 2{,}70 + 2{,}97 + 3{,}19}{4} = 3{,}11$$

$$M\_C3 = \frac{M9 + M10 + M11 + M12}{jumlah\ anggota\ klaster} = \frac{4{,}08 + 2{,}71 + 5{,}31 + 3{,}77}{4} = 3{,}97$$

3) Menghitung nilai variance cluster
4) Menghitung varian minimum
5) Menghitung varian between (vb)
6) Menghitung nilai variance

$$V = \frac{Vw}{Vb}\ x\ 100\%$$

7) Membandingkan nilai intra baru dan intra lama

Jika nilai intra klaster baru lebih kecil dari intra klaster lama dan nilai inter klaster baru lebih besar dari inter klaster lama, maka jumlah klaster ditambahkan 1 dan kembali ke proses awal yaitu inisialisasi klaster. Jika tidak maka proses *cluster* akan berhenti pada k=k.

Tabel 11. Perhitungan hasil nilai cluster varian

No	m	_x	vc	vck	Varian Minimum (Vm)	Total nilai rata-rata kluster (Vx)	Varian Between (Vb)	Varian Maksimum (Vm)	Variance (V)
1	3,36	2,70	0,44	0,56	**0,67**	3,26	0,84	**0,65**	**1,03**
2	2,76		0,00						
3	1,98		0,51						
4	2,70		0,00						
5	3,58	3,11	0,22	0,37					
6	2,70		0,17						
7	2,97		0,02						
8	3,19		0,01						
9	4,08	3,97	0,01	1,07					
10	2,71		1,59						
11	5,31		1,80						
12	3,77		0,04						

Lampiran 2 Perbandingan Hasil Pengujian Dengan Nilai Sum of Square Error Minimum (SSE)

Uji Coba	K-means Tradisional				K-means Dinamis				K-means Dinamis Inisialisasi Centroid			
	K = 2	**K = 3**	**K = 4**	**K = 5**	**K = 2**	**K = 3**	**K = 4**	**K = 5**	**K = 2**	**K = 3**	**K = 4**	**K = 5**
1	2,17130	2,16010	2,16148	2,16588	2,17743	2,16307	2,16459	2,16186	2,15593	2,15258	2,15265	2,15152
2	2,18006	2,15962	2,16691	2,16681	2,17311	2,15495	2,16495	2,15319	2,15593	2,15258	2,15265	2,15152
3	2,18917	2,16989	2,15853	2,15273	2,15676	2,15797	2,17248	2,15562	2,15593	2,15258	2,15265	2,15152
4	2,18157	2,15772	2,15457	2,16191	2,17353	2,15495	2,16495	2,15319	2,15593	2,15258	2,15265	2,15152
5	2,19064	2,17748	2,16627	2,16980	2,15714	2,15619	2,15924	2,15336	2,15593	2,15258	2,15265	2,15152
6	2,15507	2,17093	2,16010	2,15670	2,19080	2,16577	2,15373	2,15533	2,15593	2,15258	2,15265	2,15152
7	2,16123	2,17158	2,17029	2,16508	2,15945	2,15711	2,15807	2,15595	2,15593	2,15258	2,15265	2,15152
8	2,16629	2,16698	2,16605	2,17124	2,17800	2,15394	2,15644	2,16591	2,15593	2,15258	2,15265	2,15152
9	2,15698	2,15843	2,19166	2,15379	2,19303	2,16208	2,15239	2,15940	2,15593	2,15258	2,15265	2,15152
10	2,16527	2,16397	2,16825	2,16192	2,16625	2,16042	2,19582	2,15766	2,15593	2,15258	2,15265	2,15152
Rerata	2,17176	2,16567	2,16641	2,16259	2,17255	2,15864	2,16427	2,15715	2,15593	2,15258	2,15265	2,15152
Min	2,15507	2,15772	2,15457	2,15273	2,15676	2,15394	2,15239	2,15319	2,15593	2,15258	2,15265	2,15152
Nilai min	**2,15273**				**2,15239**				**2,15152**			

Lampiran 3 Perbandingan Hasil Pengujian Dengan Nilai *Davies Bouldin Index (DBI)*

Uji Coba	K-means Tradisional				K-means Dinamis*				K-means Dinamis Inisialisasi Centroid			
	K = 2	K = 3	K = 4	K = 5	K = 2	K = 3	K = 4	K = 5	K = 2	K = 3	K = 4	K = 5
1	0,38354	0,29409	0,09147	0,14286	0,38354	0,29266	0,17807	0,05973	0,38354	0,22470	0,17412	0,16824
2	0,38156	0,29266	0,09085	0,07859	0,38354	0,22713	0,17269	0,08268	0,38354	0,22470	0,17412	0,16824
3	0,38354	0,22470	0,09085	0,16596	0,38156	0,26596	0,09147	0,08100	0,38354	0,22470	0,17412	0,16824
4	0,22346	0,22470	0,29266	0,14032	0,38156	0,22713	0,17269	0,08268	0,38354	0,22470	0,17412	0,16824
5	0,22346	0,22713	0,22346	0,22470	0,38354	0,22713	0,17412	0,13279	0,38354	0,22470	0,17412	0,16824
6	0,29266	0,22346	0,29409	0,22470	0,38156	0,22713	0,17807	0,16973	0,38354	0,22470	0,17412	0,16824
7	0,22470	0,14032	0,29266	0,26596	0,38354	0,14032	0,17230	0,08100	0,38354	0,22470	0,17412	0,16824
8	0,14682	0,14682	0,14682	0,29266	0,38354	0,22346	0,07239	0,05944	0,38354	0,22470	0,17412	0,16824
9	0,22346	0,29409	0,29266	0,22470	0,38156	0,26596	0,07239	0,16702	0,38354	0,22470	0,17412	0,16824
10	0,29266	0,29266	0,14032	0,14032	0,38354	0,14682	0,17823	0,16256	0,38354	0,22470	0,17412	0,16824
Rerata	0,27759	0,23606	0,19558	0,19008	0,38275	0,22437	0,14624	0,10786	0,38354	0,22470	0,17412	0,16824
Min	0,14682	0,14032	0,09085	0,07859	0,38156	0,14032	0,07239	0,05944	0,38354	0,22470	0,17412	0,16824
Nilai min	**0,07859**				**0,05944**				**0,16824**			

Lampiran 4 Perbandingan Hasil Pengujian Dengan Nilai Purity Coeficient (PC)

Uji Coba	K-means Tradisional				K-means Dinamis				K-means Dinamis Inisialisasi Centroid			
	K = 2	K = 3	K = 4	K = 5	K = 2	K = 3	K = 4	K = 5	K = 2	K = 3	K = 4	K = 5
1	0,36786	0,56438	0,80086	0,96035	0,35388	0,61014	0,82277	0,96163	0,38984	0,58483	0,77964	0,97471
2	0,42086	0,58796	0,69174	0,72139	0,36954	0,60592	0,72252	0,94656	0,38984	0,58483	0,77964	0,97471
3	0,34480	0,54356	0,74528	0,90144	0,38878	0,54119	0,83633	0,93907	0,38984	0,58483	0,77964	0,97471
4	0,53512	0,57013	0,58617	0,56499	0,41297	0,60592	0,72252	0,94656	0,38984	0,58483	0,77964	0,97471
5	0,49478	0,63217	0,53458	0,55604	0,38460	0,60020	0,81413	0,96188	0,38984	0,58483	0,77964	0,97471
6	0,59412	0,54724	0,56438	0,59069	0,42941	0,63183	0,76465	0,94841	0,38984	0,58483	0,77964	0,97471
7	0,56422	0,55501	0,57241	0,51654	0,38492	0,55953	0,80787	0,93813	0,38984	0,58483	0,77964	0,97471
8	0,58986	0,60399	0,59413	0,63001	0,35312	0,56578	0,78863	0,97077	0,38984	0,58483	0,77964	0,97471
9	0,53728	0,58846	0,65965	0,58631	0,44393	0,52258	0,75576	0,94920	0,38984	0,58483	0,77964	0,97471
10	0,62548	0,62187	0,55668	0,53875	0,38733	0,58420	0,73000	0,94545	0,38984	0,58483	0,77964	0,97471
Rerata	0,50744	0,58148	0,63059	0,65665	0,39085	0,58273	0,77652	0,95077	0,38984	0,58483	0,77964	0,97471
Maks	0,62548	0,63217	0,80086	0,96035	0,44393	0,63183	0,83633	0,97077	0,38984	0,58483	0,77964	0,97471
Nilai maks	**0,96035**				**0,97077**				**0,97471**			

Lampiran 5 Perbandingan Hasil Pengujian Dengan Nilai Variance

Uji Coba	K-means Dinamis				K-means Dinamis Inisialisasi Centroid			
	K = 2	K = 3	K = 4	K = 5	K = 2	K = 3	K = 4	K = 5
1	0,54241	0,40553	0,29021	0,25928	0,54241	0,40442	0,29021	0,25928
2	0,54241	0,40553	0,29033	0,26053	0,54241	0,40442	0,29021	0,25928
3	0,53961	0,38416	0,29021	0,26053	0,54241	0,40442	0,29021	0,25928
4	0,53961	0,40553	0,29033	0,26053	0,54241	0,40442	0,29021	0,25928
5	0,54241	0,40553	0,29021	0,25978	0,54241	0,40442	0,29021	0,25928
6	0,53961	0,40553	0,29021	0,25978	0,54241	0,40442	0,29021	0,25928
7	0,54241	0,38416	0,29021	0,26053	0,54241	0,40442	0,29021	0,25928
8	0,54241	0,38416	0,29021	0,25978	0,54241	0,40442	0,29021	0,25928
9	0,53961	0,38416	0,29021	0,26053	0,54241	0,40442	0,29021	0,25928
10	0,54241	0,40553	0,29033	0,26053	0,54241	0,40442	0,29021	0,25928
Rerata	0,54129	0,39698	0,29025	0,26018	0,54241	0,40442	0,29021	0,25928
Min	0,53961	0,38416	0,29021	0,25928	0,54241	0,40442	0,29021	0,25928
Nilai min	**0,2592820**				**0,2592816**			

Lampiran 6 Source Code Implementasi Algoritma

a. Implementasi algoritma inisialisasi k-means berbasis *centroid*

```
public function centroid_initial($data,$k){
        $n= floor(count($data)/$k);
        foreach($data as $i=> $row){
            $temp=0;
            foreach($row as $l=> $row3){
                if(is_numeric($l)){
                    $temp=$temp + pow(($row3['f_score']-0),2);
                }
            }
            $row['euclidean']=sqrt($temp);
            $data_new[$i]=$row;
            $euclidean[$i]=$row['euclidean'];
        }
        asort($euclidean);
        $x=1;
        $cluster=array();
        foreach($euclidean as $i=>$row){
            foreach($data_new[$i] as $j=>$row2){
                if(is_numeric($j)){
                    $temp_cluster[$x][$j]=(isset($temp_cluster[$x][$j]))
                        ?$temp_cluster[$x][$j]:0;
                    $temp_cluster[$x][$j]+=$row2['f_score'];
                    $temp_cluster[$x]['arr'][$i][$j]=$row2['f_score'];
                    $cluster[$x][$j]['f_score']=$temp_cluster[$x][$j]/(count($temp_cluster[$x]['arr'
                    ]));
                }
            }
            $c[$x]=(isset($c[$x]))?$c[$x]:0;
            $c[$x]+=1;
            if($c[$x]==$n && count($cluster)<$k){
                $x++;
            }
            $data_new2[]=$data_new[$i];
        }
        return $cluster;}
```

b. Implementasi Algoritma K-means Dinamis

```
Public function euclidean_distance($data,$cluster,$iterasi=1){
        $euclidean=array();
        $data_new=array();
        $lanjut=false;
        $clus=array();
        foreach($data as $i=> $row){//baris
            foreach($cluster as $j=> $row2){//cluster
                $temp=0;
                foreach($row as $l=> $row3){//variable
                    if(is_numeric($l)){
                      $temp=$temp+pow(($row3['f_score']-$cluster[$j][$l]['f_score']),2);
                    }
                }
            $euclidean[$i][$j]=sqrt($temp);
```

```
            }
            $cluster_fix=array_keys($euclidean[$i], min($euclidean[$i]))[0];
            if(isset($row['f_cluster']['f_score'])){
                if($row['f_cluster']['f_score']!=$cluster_fix){
                    $lanjut=true;
                }
            }else{
                $lanjut=true;
            }
            $row['f_cluster']['f_score']= $cluster_fix;
            $data[$i]=$row;
            $member_cluster[$row['f_cluster']['f_score']][]=$i;
        }
        $iterasi=(isset($iterasi))? $iterasi+1:1;
        if($lanjut==true){
            $cluster=$this->setCentroid($data,$cluster);
            $data=$this->euclidean_distance($data,$cluster,$iterasi +1);
            $iterasi=$data['iterasi'];
        }else{
            $data['data']=$data;
            $data['centroid']=$cluster;
            $data['member_cluster']=$member_cluster;
            $data['iterasi']=$iterasi;
        }
        return $data;
}
private function setCentroid($data,$cluster){
        $tamp=array();
        foreach($cluster as $i=> $row){//cluster
                $nc[$i]=0;
                foreach($data as $j=> $row2){//baris
                        if(isset($row2['f_cluster'])){
                                if($row2['f_cluster']['f_score']==$i){
                                        $nc[$i]++;
                                        foreach($row2 as $l=>$row3){
                                            if(is_numeric($l)){
                                                $temp=(isset($tamp[$i][$l]))?$tamp[$i][$l]:0;
                                                $tamp[$i][$l]=$temp+$row3['f_score'];
                                            }
                                        }
                                }
                        }
                }
        }
        $cent=array();
        foreach($cluster as $i=> $row){
                foreach($row2 as $j=>$row3){
                        if(is_numeric($j)){
                                if($nc[$i]>0){
                                        $cent[$i][$j]['f_score']=$tamp[$i][$j]/$nc[$i];
                                }
                        }
                }
        }
        return $cent;
}
```

c. Implementasi Algoritma Pengujian *Cluster Variance*

```
public function variance_within_cluster_average($data){
        $this->benchmark->mark('start');
        foreach($data as $i=>$row){
            $tmp=0;
            $n=0;
            foreach($row as $j=>$row2){
              if(is_numeric($j)){
                    $tmp+=$row2['f_score'];
                    $n++;
              }
            }
            $c=$row['f_cluster']['f_score'];
            $v_temp[$c]['x'][]=$tmp/$n;
            $v_temp[$c]['n']=(isset($v_temp[$c]['n']))?$v_temp[$c]['n']:0;
            $v_temp[$c]['m']=(isset($v_temp[$c]['m']))?$v_temp[$c]['m']:0;
            $v_temp[$c]['n']+=1;
            $v_temp[$c]['m']+=$tmp/$n;
            $v_temp[$c]['_x']=$v_temp[$c]['m']/$v_temp[$c]['n'];
        }
        foreach($v_temp as $k=>$row){
            foreach($row['x'] as $l=>$row2){
                    $vc[$k]=(isset($vc[$k]))?$vc[$k]:0;
                    $vc[$k]+=pow($row2-$row['_x'],2);
            }
            $n_c=($row['n']>1)?$row['n']-1:$row['n'];
            $vc[$k]=($vc[$k] >0)?sqrt($vc[$k]/$n_c):0;
            $vw=(isset($vw))?$vw:0;
            $vw+=$vc[$k];
            $_x=(isset($_x))?$_x:0;
            $_x+=$row['_x'];
        }
        $vw=$vw/count($vc);
        $_x=$_x/count($vc);
        $vb=0;
        foreach($v_temp as $k=>$row){
            $vb+=pow($row['_x']-$_x,2);
            $nc[$k]=$row['n'];
        }
        $vb=sqrt($vb/(count($v_temp)-1));
        $v=$vw/$vb;
        $data_new['vc']=$vc;
        $data_new['nc']=$nc;
        $data_new['vw']=$vw;
        $data_new['vb']=$vb;
        $data_new['v']=$v;
        $prev=(isset($vc[count($vc)-1]))?$vc[count($vc)-1]:0;
        $prev_x=(isset($v_temp[count($v_temp)-]))
        $v_temp[count($v_temp)-1]['_x']:0;
        $ri=($vc[count($vc)]+$prev)/abs($v_temp[count($vc)]['_x']
        $prev_x);
        $dbi=$ri/count($vc);
        $data_new['dbi']=$dbi;
        $this->benchmark->mark('end');
        $data_new['time']=$this->benchmark->elapsed_time('start', 'end');
        return $data_new; }
```

Lampiran 7 Data Awal Perhitungan Klastering

No Responden	IPK	Nilai UN	Rerata Rapor
1	3.86	88.00	79.60
2	3.93	82.00	86.07
3	3.41	64.00	81.60
4	3.67	50.41	81.73
5	3.77	74.00	77.60
6	3.68	43.50	83.53
7	3.30	54.50	81.20
8	3.30	52.34	81.27
9	3.14	56.00	74.60
10	3.57	78.00	76.53
11	3.88	82.02	90.87
12	3.65	50.62	78.60
13	3.85	52.00	81.87
14	3.95	64.38	83.40
15	3.81	51.75	81.87
16	3.59	34.50	77.93
17	3.82	80.05	80.33
18	3.72	26.95	79.67
19	3.79	27.00	78.33
20	3.58	50.00	82.67
21	3.77	64.25	79.73
22	3.35	66.00	76.27
23	3.93	59.50	80.53
24	3.10	53.78	81.07
25	3.46	66.87	80.27
26	3.51	48.12	78.40
27	3.94	56.75	78.20
28	3.24	85.40	74.67
29	3.12	53.78	81.67
30	3.41	83.00	81.80
31	3.44	60.75	82.53
32	3.45	56.80	85.20
33	3.74	50.87	79.20
34	3.71	50.41	80.87
35	3.62	50.41	79.33
36	3.59	80.86	79.80
37	3.82	62.75	82.73
38	3.96	68.55	76.33
39	3.72	53.25	81.13
40	3.91	61.12	83.00
41	3.83	61.25	84.27
42	3.91	98.89	84.53
43	3.73	56.00	83.93
44	3.86	66.00	78.13
45	3.90	54.75	82.53
46	3.64	44.00	85.53
47	3.68	54.57	76.25
95	3.68	51.25	80.80
96	3.80	70.50	80.73
97	3.45	53.38	81.93

No Responden	IPK	Nilai UN	Rerata Rapor
48	3.68	54.41	76.80
49	3.73	50.41	80.47
50	3.79	58.12	82.07
51	3.79	50.41	76.47
52	3.86	75.50	79.87
53	3.64	40.86	86.20
54	3.56	31.40	83.70
55	3.36	50.50	82.33
56	3.66	85.00	85.60
57	3.40	52.15	84.95
58	3.26	78.25	92.48
59	3.36	82.60	81.73
60	3.58	57.13	82.20
61	3.80	23.05	80.20
62	3.85	81.63	87.47
63	3.66	76.00	88.00
64	3.42	50.91	85.40
65	3.80	71.38	84.80
66	3.54	47.25	82.07
67	3.90	63.25	85.87
68	3.54	43.00	80.73
69	3.40	93.68	84.07
70	3.93	69.38	83.37
71	3.63	59.75	79.87
72	3.49	51.50	81.33
73	3.60	51.50	81.73
74	3.40	93.20	79.87
75	3.48	73.64	84.61
76	3.92	74.00	89.47
77	3.84	77.13	87.07
78	3.63	85.00	80.73
79	3.87	55.01	89.87
80	3.55	53.78	84.45
81	3.77	71.25	85.47
82	3.74	52.23	83.47
83	3.77	55.50	83.53
84	3.80	65.38	80.90
85	3.28	49.62	82.07
86	3.74	63.75	82.13
87	3.89	69.10	85.43
88	3.70	58.88	80.73
89	3.78	52.88	83.00
90	3.74	72.80	87.87
91	3.62	48.25	78.38
92	3.52	52.00	80.60
93	3.50	57.00	81.47
94	3.51	50.41	82.15
146	3.96	69.88	80.93
147	3.63	53.00	83.93
148	3.56	48.25	82.67

No Responden	IPK	Nilai UN	Rerata Rapor
98	3.88	71.63	86.53
99	3.59	58.50	81.27
100	3.60	40.33	83.69
101	3.54	49.60	80.87
102	3.80	67.25	85.47
103	3.75	93.68	85.67
104	3.66	52.37	84.25
105	3.78	62.75	84.33
106	3.74	64.38	82.33
107	3.50	51.12	79.47
108	3.60	53.78	82.75
109	3.73	74.88	88.60
110	3.57	56.50	84.87
111	3.69	63.13	86.80
112	3.89	73.75	83.67
113	3.67	90.00	84.93
114	3.66	68.37	85.00
115	3.52	83.87	82.33
116	3.85	65.60	87.80
117	3.61	50.41	84.40
118	3.70	55.12	84.00
119	3.76	70.25	81.65
120	3.70	50.41	83.47
121	3.66	83.00	83.27
122	3.64	60.63	82.73
123	3.72	54.37	83.73
124	3.61	53.75	81.89
125	3.80	63.86	85.73
126	3.90	78.75	85.70
127	3.81	85.00	87.07
128	3.67	73.50	85.37
129	3.84	56.25	84.73
130	3.78	73.12	83.13
131	3.52	49.97	86.17
132	3.60	59.88	84.20
133	3.88	62.88	84.07
134	3.69	72.50	81.20
135	3.62	44.87	81.27
136	3.66	75.50	86.73
137	3.59	75.00	83.93
138	3.63	68.25	83.53
139	3.53	41.00	78.40
140	3.86	50.41	81.43
141	3.64	55.00	83.20
142	3.78	40.62	81.62
143	3.90	72.75	81.05
144	3.89	67.38	84.50
145	3.57	49.00	74.00
197	3.77	63.13	83.78
198	3.45	64.00	81.62
199	3.83	62.37	88.07
200	3.64	78.00	84.62
201	3.71	54.40	83.72

No Responden	IPK	Nilai UN	Rerata Rapor
149	3.93	62.75	83.53
150	3.97	68.50	89.26
151	3.86	53.25	82.72
152	3.96	57.50	82.22
153	3.88	53.75	85.53
154	3.63	49.88	91.33
155	3.44	54.67	75.87
156	3.83	57.13	83.08
157	3.87	43.37	79.73
158	3.82	51.75	81.53
159	3.73	24.30	86.11
160	3.67	86.30	85.93
161	3.82	85.49	85.53
162	3.64	23.95	81.20
163	3.60	57.88	81.47
164	3.69	90.00	83.27
165	3.77	62.60	84.67
166	3.47	18.05	80.07
167	3.77	80.63	86.40
168	3.43	54.37	84.53
169	3.28	44.63	82.54
170	3.62	57.88	78.28
171	3.70	85.20	86.59
172	3.60	93.68	79.60
173	3.05	60.00	83.67
174	3.40	85.20	77.73
175	3.55	50.13	79.60
176	3.67	62.25	82.80
177	3.62	53.78	84.40
178	3.27	69.25	84.47
179	3.46	24.00	77.40
180	3.33	49.12	78.60
181	3.61	67.75	79.67
182	3.68	64.75	84.53
183	3.63	62.00	79.53
184	3.69	69.88	81.90
185	3.82	75.00	84.33
186	3.70	59.75	82.47
187	3.52	64.88	83.07
188	3.71	63.25	86.41
189	3.70	66.00	84.53
190	3.67	74.75	86.60
191	3.74	50.50	85.69
192	3.73	63.25	80.47
193	3.86	75.75	82.27
194	3.87	68.63	86.67
195	3.73	56.88	82.33
196	3.26	43.75	78.35
248	3.48	56.13	82.53
249	3.68	61.38	85.20
250	3.83	80.25	85.67
251	3.55	60.75	84.33
252	3.43	44.95	81.80

No Responden	IPK	Nilai UN	Rerata Rapor
202	3.50	58.38	86.40
203	3.71	63.25	81.83
204	3.47	60.90	85.60
205	3.23	66.37	79.13
206	3.71	63.00	87.25
207	3.89	63.88	86.55
208	3.72	67.50	83.67
209	3.43	63.75	83.07
210	3.37	65.00	78.53
211	3.21	51.25	77.60
212	3.55	51.63	88.73
213	3.71	74.18	79.48
214	3.68	70.00	77.73
215	3.41	58.00	81.67
216	3.65	32.80	82.27
217	3.87	71.75	86.07
218	3.49	62.13	80.65
219	3.48	50.75	80.20
220	3.64	64.13	84.00
221	3.33	50.25	93.07
222	3.66	28.85	87.88
223	3.69	47.37	82.25
224	3.61	70.60	83.67
225	3.79	59.50	82.07
226	3.31	50.75	83.33
227	3.82	69.25	83.93
228	3.90	90.05	86.73
229	3.91	79.25	91.07
230	3.44	56.00	80.53
231	3.56	58.70	85.75
232	3.56	58.73	88.27
233	3.59	50.41	83.60
234	3.62	61.75	83.27
235	3.52	69.27	87.00
236	3.34	85.07	77.43
237	3.38	47.44	81.40
238	3.54	45.37	87.47
239	3.71	53.78	85.73
240	3.70	68.50	86.20
241	3.42	57.13	82.47
242	3.47	52.59	81.25
243	3.64	88.63	83.67
244	3.49	50.41	82.73
245	3.18	61.75	83.40
246	3.55	75.10	88.52
247	3.67	70.50	84.93
299	3.61	85.25	82.00
300	3.85	76.50	84.40
301	3.86	80.85	85.20
302	3.76	74.50	85.87
303	3.51	55.12	77.73
304	3.55	78.13	86.67
305	3.41	66.25	81.93

No Responden	IPK	Nilai UN	Rerata Rapor
253	3.55	50.68	79.87
254	3.51	68.50	78.27
255	3.80	71.38	87.52
256	3.56	50.68	84.93
257	3.71	67.87	88.00
258	3.60	50.41	82.20
259	3.78	50.41	78.02
260	3.33	35.43	82.20
261	3.53	62.50	87.90
262	3.75	73.50	83.00
263	3.64	57.12	84.67
264	3.64	50.68	85.80
265	3.44	95.55	80.90
266	3.22	57.58	83.27
267	3.54	58.60	83.33
268	3.46	53.89	84.20
269	3.07	58.50	80.07
270	3.34	58.06	81.20
271	3.70	50.68	83.27
272	3.73	80.13	89.73
273	3.47	70.04	82.73
274	3.22	53.50	82.93
275	3.28	54.37	85.00
276	3.44	56.25	83.73
277	3.34	53.94	87.80
278	3.32	36.75	83.73
279	3.62	63.40	84.67
280	3.64	55.75	82.13
281	3.29	46.85	74.00
282	3.86	84.00	80.60
283	3.79	77.50	84.33
284	3.92	50.68	84.87
285	3.91	54.62	81.60
286	3.91	75.04	82.65
287	3.88	62.99	82.67
288	3.90	80.00	80.07
289	3.84	42.88	79.67
290	3.74	58.75	79.11
291	2.78	93.63	81.17
292	3.37	73.00	84.02
293	3.79	82.50	87.67
294	3.75	61.88	81.80
295	3.60	68.12	83.44
296	3.20	48.75	77.53
297	3.56	75.45	80.80
298	3.61	81.25	83.80
350	2.75	65.75	83.27
351	2.92	78.63	87.00
352	3.53	75.75	86.40
353	3.54	65.75	88.53
354	3.43	93.62	80.40
355	3.65	60.12	84.73
356	3.41	59.75	91.73

No Responden	IPK	Nilai UN	Rerata Rapor
306	3.46	71.63	82.00
307	3.71	58.38	81.77
308	3.55	68.75	83.20
309	3.90	86.50	84.78
310	3.71	78.00	87.40
311	3.54	67.13	89.07
312	2.99	58.12	85.33
313	2.62	55.38	84.00
314	2.97	70.25	86.00
315	2.40	50.87	86.40
316	2.98	65.25	86.00
317	3.06	71.10	87.47
318	2.66	39.88	81.57
319	3.23	79.62	95.13
320	3.01	60.50	85.07
321	2.80	57.38	83.87
322	3.42	76.88	84.60
323	3.00	49.62	85.20
324	3.50	78.88	84.13
325	3.26	71.37	80.57
326	3.54	86.63	89.93
327	3.09	77.00	88.73
328	3.80	95.00	87.93
329	3.59	61.88	85.47
330	3.02	60.88	89.20
331	2.85	84.50	88.40
332	2.48	63.40	80.40
333	3.26	60.00	84.13
334	3.55	70.88	86.17
335	2.79	70.38	85.80
336	2.64	66.80	79.58
337	2.86	73.25	86.27
338	2.71	70.00	84.20
339	3.28	74.88	82.87
340	2.81	56.88	84.13
341	3.76	77.50	88.12
342	2.76	54.88	83.13
343	3.64	88.80	90.20
344	3.12	88.25	86.33
345	2.46	83.00	82.33
346	2.75	68.00	83.27
347	2.71	65.62	79.47
348	3.50	75.75	85.87
349	2.90	77.75	82.50
401	3.35	49.96	84.93
402	3.51	52.25	80.53
403	3.21	55.25	83.47
404	3.35	47.13	80.42
405	3.95	63.88	86.13
406	3.78	82.75	86.87
407	3.21	53.78	84.12
408	3.46	85.00	82.60
409	3.57	66.50	83.13

No Responden	IPK	Nilai UN	Rerata Rapor
357	3.50	65.13	85.27
358	3.74	68.88	83.27
359	3.60	69.00	86.20
360	3.51	50.41	88.13
361	3.46	63.50	83.67
362	3.43	76.34	83.40
363	3.59	60.75	85.33
364	3.34	69.13	80.93
365	3.37	79.00	82.80
366	3.71	68.50	84.37
367	3.21	82.37	86.70
368	3.42	80.00	86.47
369	3.51	64.12	80.40
370	3.54	74.88	82.93
371	2.70	47.00	79.60
372	3.30	85.00	84.60
373	3.43	66.37	85.33
374	3.39	80.99	84.13
375	2.79	44.60	76.47
376	3.69	71.00	83.87
377	3.49	68.88	83.05
378	3.40	78.80	81.13
379	3.68	32.30	89.87
380	3.46	53.93	89.80
381	3.32	63.50	84.07
382	3.18	75.77	80.80
383	3.43	70.00	82.30
384	3.57	85.00	81.67
385	3.68	65.38	84.40
386	3.67	77.90	85.13
387	3.48	25.80	83.47
388	3.41	79.80	80.80
389	3.16	80.50	80.40
390	3.77	87.50	89.00
391	3.71	67.80	85.27
392	3.16	25.70	82.82
393	3.42	51.50	82.07
394	3.58	63.25	79.07
395	3.32	50.13	78.07
396	3.24	47.10	81.30
397	3.28	64.00	82.60
398	3.60	71.38	81.38
399	3.37	77.50	81.17
400	3.50	77.37	82.00
452	3.42	55.13	80.00
453	3.55	48.50	81.67
454	3.79	63.75	80.87
455	3.83	70.62	84.13
456	3.62	83.00	80.80
457	3.75	53.37	80.33
458	3.81	63.25	87.69
459	3.75	46.00	84.40
460	3.79	84.00	78.20

No Responden	IPK	Nilai UN	Rerata Rapor
410	3.43	70.00	81.93
411	3.50	58.63	81.73
412	3.67	58.00	81.53
413	3.48	51.25	83.93
414	3.52	66.63	81.63
415	3.55	50.12	78.87
416	3.62	55.25	81.00
417	3.53	58.88	84.67
418	3.73	55.50	83.40
419	3.47	65.50	81.47
420	3.30	57.66	78.80
421	3.86	64.12	85.27
422	3.48	41.63	81.00
423	3.36	91.85	85.13
424	3.89	76.00	83.33
425	3.14	93.68	77.73
426	3.67	60.00	84.80
427	3.73	50.50	83.20
428	3.30	45.30	80.53
429	3.38	45.00	81.00
430	3.75	78.62	83.47
431	3.32	51.38	85.47
432	3.75	73.50	79.73
433	3.96	65.50	81.05
434	3.66	32.25	89.80
435	3.70	94.89	77.20
436	2.15	88.50	82.20
437	3.88	48.25	83.40
438	3.84	65.62	83.13
439	3.89	38.12	79.15
440	3.56	49.38	89.33
441	3.66	50.50	80.60
442	3.88	46.85	77.67
443	3.54	48.00	79.60
444	3.84	74.00	81.40
445	3.64	84.00	79.53
446	3.68	48.12	82.96
447	3.68	63.12	81.00
448	3.80	61.75	82.45
449	3.61	60.07	79.70
450	3.51	36.75	80.13
451	3.42	66.80	89.00
503	3.82	69.20	86.37
504	3.61	78.20	76.38
505	3.65	54.00	83.00
506	3.74	60.13	82.38
507	3.17	54.05	81.80
508	3.40	68.56	79.73
509	3.10	58.90	84.11
510	3.64	76.10	86.98
511	3.30	82.00	85.34
512	3.75	53.95	78.47
513	3.59	53.95	83.40

No Responden	IPK	Nilai UN	Rerata Rapor
461	3.87	65.25	84.85
462	3.63	51.63	80.53
463	3.96	52.20	85.42
464	3.70	63.75	78.00
465	3.74	50.42	83.13
466	3.66	83.76	82.53
467	3.78	32.25	87.33
468	3.78	83.50	81.93
469	3.63	50.41	78.33
470	3.74	57.25	83.64
471	3.75	66.95	78.82
472	3.71	39.25	75.40
473	3.85	73.64	82.34
474	3.64	49.87	79.67
475	3.88	68.00	86.53
476	3.53	83.98	83.60
477	3.73	57.27	78.88
478	3.64	51.63	80.20
479	3.62	20.60	81.87
480	3.66	49.25	73.47
481	3.96	66.38	83.80
482	3.82	53.60	78.52
483	3.62	89.63	88.67
484	3.92	64.07	87.39
485	3.87	58.38	79.84
486	3.78	54.58	77.08
487	3.68	53.63	79.13
488	3.78	57.33	74.84
489	3.75	66.68	82.45
490	3.87	78.60	85.00
491	3.70	53.95	82.95
492	3.81	52.52	84.90
493	3.74	52.37	77.50
494	3.71	46.83	81.93
495	3.65	48.50	77.84
496	3.95	69.00	84.48
497	3.77	78.00	90.59
498	3.80	56.77	80.00
499	3.44	76.32	83.80
500	3.27	65.38	85.27
501	2.56	19.85	77.93
502	3.38	61.67	78.00
554	3.60	90.87	79.33
555	3.71	59.12	85.80
556	3.75	62.87	82.73
557	3.91	58.62	84.93
558	3.32	61.00	79.80
559	3.86	66.80	85.68
560	3.78	84.77	83.62
561	3.56	47.16	79.53
562	3.65	51.25	80.17
563	3.50	44.25	78.00
564	3.50	78.75	79.10

No Responden	IPK	Nilai UN	Rerata Rapor
514	3.73	85.42	85.07
515	3.34	53.23	85.39
516	3.74	82.00	82.63
517	3.89	64.00	86.20
518	3.20	52.37	85.23
519	2.33	55.20	86.34
520	3.39	60.00	80.16
521	3.82	78.50	88.40
522	3.33	65.11	76.52
523	3.68	53.94	78.58
524	3.35	12.85	83.20
525	3.30	91.00	93.23
526	3.72	64.72	77.55
527	3.26	52.00	81.87
528	3.49	75.00	77.35
529	3.32	67.10	82.32
530	3.67	72.83	83.77
531	3.23	59.65	76.19
532	3.42	82.80	76.07
533	3.89	79.90	88.02
534	3.93	73.67	88.29
535	3.65	58.37	84.02
536	3.83	66.72	85.59
537	3.73	26.40	82.38
538	3.59	53.52	78.05
539	3.51	61.75	76.75
540	3.50	41.25	77.80
541	3.38	56.38	82.53
542	3.80	64.35	86.07
543	3.68	72.50	79.98
544	3.45	43.45	86.27
545	3.67	61.20	76.82
546	3.67	70.25	86.27
547	3.64	65.17	79.55
548	3.67	74.90	85.85
549	3.71	78.75	87.15
550	3.65	65.70	83.90
551	3.83	59.40	84.53
552	3.79	58.00	81.10
553	3.62	85.02	82.93
605	3.56	47.63	80.73
606	3.58	68.25	81.00
607	3.51	56.38	79.40
608	3.68	63.25	80.07
609	3.50	61.13	80.07
610	3.64	48.75	81.98
611	3.83	60.63	83.20
612	3.81	62.50	80.80
613	3.19	49.75	83.13
614	3.60	60.50	83.13
615	3.70	61.13	75.80
616	3.52	62.13	81.80
617	3.64	46.50	83.27

No Responden	IPK	Nilai UN	Rerata Rapor
565	3.68	74.38	85.25
566	3.66	63.25	82.20
567	3.41	41.00	78.13
568	3.84	53.95	77.23
569	3.96	71.50	85.20
570	3.64	40.12	81.40
571	3.62	70.00	82.60
572	3.49	79.50	79.87
573	3.43	71.10	74.83
574	3.80	69.60	81.00
575	3.54	45.41	83.27
576	3.53	44.25	79.00
577	3.95	85.50	89.93
578	3.56	38.13	83.73
579	3.68	87.50	79.75
580	3.74	64.88	81.93
581	3.49	46.38	81.87
582	3.67	67.50	78.67
583	3.76	60.63	83.47
584	3.64	59.00	78.60
585	3.72	67.18	81.98
586	3.66	71.40	82.73
587	3.71	55.50	82.73
588	3.75	62.38	83.78
589	3.75	65.53	84.32
590	3.54	57.00	76.20
591	3.76	53.13	79.27
592	3.60	56.25	76.47
593	3.76	61.88	79.73
594	3.59	57.50	75.60
595	3.67	59.75	77.47
596	3.65	47.25	75.20
597	3.65	60.58	77.63
598	3.34	19.10	74.53
599	3.82	51.13	86.35
600	3.74	62.13	83.20
601	3.80	61.63	85.67
602	3.86	77.48	88.96
603	3.70	56.25	82.20
604	3.77	60.63	79.27
656	3.48	48.52	84.67
657	3.79	56.13	79.87
658	3.83	74.83	85.08
659	3.57	47.87	77.00
660	3.75	35.40	85.27
661	3.71	69.33	83.00
662	3.61	52.38	85.47
663	3.34	65.13	83.43
664	3.83	80.75	85.53
665	3.35	58.00	82.47
666	3.41	61.25	84.33
667	3.94	81.17	88.02
668	3.55	73.64	85.39

No Responden	IPK	Nilai UN	Rerata Rapor
618	3.64	67.00	86.35
619	3.76	57.63	81.60
620	3.68	56.50	79.27
621	3.89	71.13	85.76
622	3.65	52.87	82.87
623	3.67	49.38	84.13
624	3.75	56.75	82.67
625	3.73	50.25	81.41
626	3.59	19.25	80.06
627	3.73	67.37	81.93
628	3.46	41.05	80.99
629	3.78	64.13	87.31
630	3.50	55.37	80.93
631	3.66	72.37	82.05
632	3.30	72.00	75.60
633	3.77	52.63	82.40
634	3.47	39.00	80.42
635	3.61	58.28	83.96
636	3.65	71.75	84.15
637	3.41	57.75	81.13
638	3.68	58.50	84.08
639	3.64	57.00	83.67
640	3.79	71.60	86.13
641	3.59	70.50	81.60
642	3.38	62.38	80.80
643	3.33	51.37	81.87
644	3.74	55.35	81.48
645	3.62	95.33	80.43
646	3.62	57.25	81.40
647	3.43	61.00	81.67
648	3.64	61.43	81.66
649	3.66	68.12	84.87
650	3.55	45.59	75.60
651	3.50	56.88	80.60
652	3.65	49.80	82.80
653	3.69	60.62	84.63
654	3.47	49.87	79.33
655	3.59	61.37	81.27
707	3.68	68.38	86.11
708	3.34	48.58	81.47
709	3.27	89.15	75.80
710	3.66	72.38	87.73
711	3.67	73.38	87.73
712	3.38	61.00	80.13
713	3.52	45.41	84.20
714	3.30	44.88	80.13
715	3.60	59.55	85.06
716	3.11	64.13	81.13
717	3.34	49.63	79.27
718	3.72	75.75	89.47
719	3.29	71.60	83.53
720	3.35	62.05	80.60
721	3.87	73.50	85.00

No Responden	IPK	Nilai UN	Rerata Rapor
669	3.70	55.38	78.87
670	3.52	65.25	81.73
671	3.83	66.13	80.70
672	3.58	38.75	81.80
673	3.78	85.00	82.07
674	3.52	67.85	85.83
675	3.52	45.50	79.27
676	2.89	54.13	77.53
677	3.80	73.00	85.53
678	3.55	71.62	80.73
679	3.30	24.00	79.07
680	3.78	68.63	86.80
681	3.79	71.75	87.07
682	3.47	58.25	81.87
683	3.33	61.88	82.00
684	3.45	55.50	87.03
685	3.55	61.63	84.40
686	3.76	68.00	87.63
687	3.28	98.00	84.74
688	3.76	71.13	83.00
689	3.47	56.38	86.67
690	3.50	53.95	86.93
691	3.47	59.62	81.40
692	3.84	79.75	89.20
693	3.77	80.00	87.05
694	3.73	72.50	85.58
695	3.54	84.50	84.07
696	3.42	56.75	77.80
697	3.62	63.25	85.21
698	3.59	51.00	80.40
699	3.68	75.62	85.53
700	3.43	71.25	83.93
701	3.39	64.25	79.40
702	3.13	60.00	81.20
703	3.65	80.00	84.42
704	3.70	77.25	87.02
705	3.61	63.68	86.00
706	3.32	50.63	81.60
737	3.74	68.00	80.47
738	3.69	69.85	87.05
739	3.63	74.83	84.04
740	3.52	70.63	81.93
741	3.37	61.62	80.59
742	3.30	90.00	80.49
743	3.52	80.50	84.67
744	3.75	72.63	86.49
745	3.22	45.87	83.33
746	3.29	59.50	80.95
747	3.67	82.00	87.40
748	3.63	60.12	79.93
749	3.32	68.75	82.47
750	3.81	80.75	84.13
751	3.81	71.88	87.73

No Responden	IPK	Nilai UN	Rerata Rapor
722	3.36	60.00	81.20
723	3.45	77.50	83.13
724	3.85	71.13	83.73
725	3.70	75.25	83.83
726	3.50	54.75	79.40
727	3.66	62.70	84.73
728	3.42	63.75	84.23
729	3.60	76.95	84.30
730	3.79	75.00	84.89
731	3.44	70.00	83.08
732	3.55	49.63	77.53
733	3.56	70.58	83.33
734	3.45	77.13	84.70
735	3.46	73.64	84.84
736	3.64	88.50	87.19

No Responden	IPK	Nilai UN	Rerata Rapor
752	3.67	43.63	78.20
753	3.49	84.00	82.73
754	3.69	80.00	87.47
755	3.41	57.00	79.18
756	3.60	50.88	86.00
757	3.53	70.02	78.23
758	3.25	53.17	77.53
759	3.32	58.63	85.98
760	3.84	78.63	85.47
761	3.47	73.38	85.33
762	3.54	63.65	86.47
763	3.28	44.94	80.40
764	3.53	59.00	81.80
765	3.71	79.13	85.00