LAMPIRAN A

UJI KENORMALAN DATA

UJI KESERAGAMAN DATA

UJI KECUKUPAN DATA

UJI WILCOXON TWO SAMPLE RANK TEST

UJI ANOVA

UJI KESAMAAN RATA-RATA

LAMPIRAN B

BAGAN ANALISA

LAMPIRAN C

TABEL UJI χ^2

TABEL UJI PERINGKAT BERTANDA WILCOXON

TABEL UJI F

TABEL FAKTOR PENYESUAIAN WESTINGHOUSE

TABEL MTM-1

UJI KENORMALAN DATA

UJI KESERAGAMAN DATA

UJI KECUKUPAN DATA

REACH

Distance Moved Inches	Time TMU A	B	C or D	E	Hand in Motion A	B	Case & Description
3/4 or less	2	2	2	2	1.6	1.6	A. Reach to object in fixed location or to object in other hand or on which other hand rest
1	2.5	2.5	3.6	2.4	2.3	2.3	
2	4	4	5.9	3.8	3.5	2.7	
3	5.3	5.3	7.3	5.3	4.5	3.6	
4	6.1	6.4	8.4	6.8	4.9	4.3	B. Reach to single object in location which may vary slightly from cycle to cycle
5	6.5	7.8	9.4	7.4	5.3	5	
6	7	8.6	10.1	8	5.7	5.7	
7	7.4	9.3	10.8	8.7	6.1	6.5	
8	7.9	10.1	11.5	9.3	6.5	7.2	C. Reach to objectjumbled with other objects in a group so that search & select occur
9	8.3	10.8	12.2	9.9	6.9	7.9	
10	8.7	11.5	12.9	10.5	7.3	8.6	
12	9.6	12.9	14.2	11.8	8.1	10.1	
14	10.5	14.4	15.6	13	8.9	11.5	D. Reach to a very small object or where accurate grasp is required
16	11.4	15.8	17	14.2	9.7	12.9	
18	12.3	17.2	18.4	15.5	10.5	14.4	
20	13.1	18.6	19.8	16.7	11.3	15.8	
22	14	20.1	21.2	18	12.1	17.3	E. Reach to indefinite location to get hand in position for body balance or next motion or out of way
24	14.9	21.5	22.5	19.2	12.9	18.8	
26	15.8	22.9	23.9	20.4	13.7	20.2	
28	16.7	24.4	25.3	21.7	14.5	21.7	
30	17.5	25.8	26.7	22.9	15.3	23.2	
Additional	0.4	0.7	0.7	0.6			TMU per inch over 30 inches

Lampiran C : Tabel MTM-1 ; REACH

Sumber : Yudiantyo, Wawan, *Petunjuk Praktis Penggunaan MTM-1,2,3 (Methods Time Measurement)*, 2003

GRASP

Type of Grasp	Case	Time TMU	Description	
Pick-up	1a	2	Any size object by itself, easily grasped	
	1b	3.5	Object very small or lying close againt a flat surface	
	1c1	7.3	Diameter larger than 1/2"	Interference with Grasp on bottom & one side of nearly cylindrical object
	1c2	8.7	Diameter 1/4" to 1/2"	
	1c3	10.8	Diameter less than 1/4"	
Regrasp	2	5.6	Change grasp without relinguishing control	
Transfer	3	5.6	Control transferred from one hand to the other	
Select	4a	7.3	Larger than 1"X1"X1"	Object jumbled with other object so that search and select occur
	4b	9.1	1/4"X1/4"X1/8" to 1"X1"X1"	
	4c	12.9	Smaller than 1/4"X1/4"X1/8"	
Contact	5	0	Contact, Sliding or Hook Grasp	

Lampiran C : Tabel MTM-1 ; GRASP

Sumber : Yudiantyo, Wawan, *Petunjuk Praktis Penggunaan MTM-1,2,3 (Methods Time Measurement)*, 2003

RELEASE

Case	Time TMU	Description
1	2	Normal release performanced by opening fingers as independent motion
2	0	Contact Release

Lampiran C : Tabel MTM-1 ; RELEASE

Sumber : Yudiantyo, Wawan, *Petunjuk Praktis Penggunaan MTM-1,2,3 (Methods Time Measurement)*, 2003

POSITION

	Class of Fit	Symetry	Easy to Handle	Difficult to Handle
1. Loose	No pressure required	S	5.6	11.2
		SS	9.1	14.7
		NS	10.4	16
2. Close	Light pressure required	S	16.2	21.8
		SS	19.7	15.3
		NS	21	26.6
3. Exact	Heavy pressure required	S	43	48.6
		SS	46.5	52.1
		NS	47.8	53.4
Supplementary rule for surface aligment				
P1SE per aligmnet : > 1/16 <= 1/4"		P2SE per aligment : <=1/16"		

Distance moved aligment to engage - 1" or less

Lampiran C : Tabel MTM-1 ; POSITION

Sumber : Yudiantyo, Wawan, *Petunjuk Praktis Penggunaan MTM-1,2,3 (Methods Time Measurement)*, 2003

DISENGAGE

Class of Fit	Height of Record	Easy to Handle	Difficult to Handle
1 - Loose-Very slight effort, blends with subsequent move	Up to 1"	4	5.7
2 - Close-Normal effort, slight recoil	Over 1" to 5"	7.5	11.8
3 - Tight-Considerable effort, hand recoils markedly	Over 5" to 12"	22.9	34.7

Lampiran C : Tabel MTM-1 ; DISENGAGE

Sumber : Yudiantyo, Wawan, *Petunjuk Praktis Penggunaan MTM-1,2,3 (Methods Time Measurement)*, 2003

TURN

Weight	Time TMU for degree turned										
	30	**45**	**60**	**75**	**90**	**105**	**120**	**135**	**150**	**165**	**180**
Small - 0 to 2 pounds	2.80	4	4.1	4.8	5.4	6.1	6.8	7.4	8.1	8.7	9.4
Medium-2.1to 10 pounds	4.4	5.5	6.5	7.5	8.5	9.6	10.6	11.6	12.7	13.7	14.8
Large-10.1 to 35 pounds	8.4	10.5	12.3	14.4	16.2	18.3	20.4	22.2	24.3	26.1	28.2

Lampiran C : Tabel MTM-1 ; TURN

Sumber : Yudiantyo, Wawan, *Petunjuk Praktis Penggunaan MTM-1,2,3 (Methods Time Measurement)*, 2003

BAGAN ANALISA

Bagian :						**No :**
Operasi :Memasang pipa pada soket berbentuk lurus (I)						**Lembar ke 1 dari 1**
Keterangan Tangan Kiri	**No**	**LH**	**TMU**	**RH**	**No**	**Keterangan Tangan Kanan**
1. Mengarahkan pipa 1 pada I(a)						
Menjangkau soket I		R12B	12.9	R10B		Menjangkau pipa 1
Memegang soket I		G1A	2	G1A		Memegang pipa 1
Membawa soket I		M12B	13.4	M10B		Membawa pipa 1
			43	P2SE		Mengarahkan pipa 1 pada I(a)
2. Memutar pipa 1 pada I(a) (3x)						
			5.4	T90S		Memutar pipa 1 pada I(a)
			5.6	G2		Pemegangan kembali
3. Mengarahkan pipa 2 pada I(b)						
			5.4	T90S		Memutar pipa 1 pada I(a)
			2	RL1		Melepaskan tangan
Membalikkan tangan (soket I)		T180S	9.4			
			12.9	R12B		Menjangkau pipa 2
			2	G1A		Memegang pipa 2
			43	P2SE		Mengarahkan pipa 2 pada I(b)
4. Memutar pipa 2 pada I(b) (3x)						
			5.4	T90S		Memutar pipa 2 pada I(b)
			5.6	G2		Pemegangan kembali
5. Meletakkan pipa ke area simpan & tangan kembali						
			5.4	T90S		Memutar pipa 2 pada I(b)
			2	RL1		Melepaskan tangan
			7.9	R8A		Tangan kembali ke posisi semula
Membawa pipa ke area simpan		M8B	10.6			
Melepaskan pipa		RL1	2			
Tangan kembali ke posisi semula		R8A	7.9			

No	**Keterangan Elemen Gerakan**	**TMU**	**Faktor Konversi 0.00001 (jam)**	**Kelonggaran 0%**	**Waktu (jam)**	**Jumlah ulang per siklus**	**Total Waktu (detik)**
1	Mengarahkan pipa 1 pada I(a)	71.3	0.000713	0	0.000713	1	2.5668
2	Memutar pipa 1 pada I(a)	11	0.00011	0	0.00011	3	1.188
3	Mengarahkan pipa 2 pada I(b)	74.7	0.000747	0	0.000747	1	2.6892
4	Memutar pipa 2 pada I(b)	11	0.00011	0	0.00011	3	1.188
5	Meletakkan pipa (area simpan) & tangan kembali	35.8	0.000358	0	0.000358	1	1.2888
						Total	**8.9208**

1. Melepaskan mur pada baut yang terpasang di pipa menggunakan tangan

Darat

Interval kelas	Batas Kelas	Oi	Z1	Z2	P(Z1)	P(Z2)	P(Z2-Z1)	Ei	Eig	Oig	$(Oig - Eig)^2/Eig$
< 4.07	< 4.065	0	-9.27	-1.97	0.00	0.02	0.02	0.60	9.30	7	0.5688
4.07 - 4.47	4.065 - 4.475	6	-1.97	-1.23	0.02	0.11	0.09	2.70			
4.48 - 4.88	4.475 - 4.885	1	-1.23	-0.50	0.11	0.31	0.20	6.00			
4.89 - 5.29	4.885 - 5.295	8	-0.50	0.24	0.31	0.59	0.28	8.40	8.40	8	0.0190
5.3 - 5.70	5.295 - 5.705	13	0.24	0.97	0.59	0.83	0.24	7.20	12.00	15	0.7482
5.71 - 6.11	5.705 - 6.115	1	0.97	1.70	0.83	0.96	0.12	3.60			
6.12 - 6.52	6.115 - 6.525	1	1.70	2.43	0.96	0.99	0.04	1.20			
> 6.53	> 6.525	0	2.43	3.17	1.00	1.00	0.00	0.00			
		30									1.3361

$$K = 3.3\log n + 1$$
$$= 3.3\log(30) + 1$$
$$= 5.87 \approx 6$$

$$C = \frac{x\,maks - x\,min}{k}$$
$$= \frac{6.48 - 4.07}{6} = 0.41$$

$$Z_1 = \frac{batas\ bawah - \bar{x}}{S_{\bar{x}}}$$
$$= \frac{0 - 5.16}{0.56}$$
$$= -9.27$$

$$Z_2 = \frac{batas\ atas - \bar{x}}{S_{\bar{x}}}$$
$$= \frac{4.065 - 5.16}{0.56}$$
$$= -1.97$$

$$ei = P(Z2 - Z1) \cdot \sum oi$$
$$= 0.02 \cdot 30$$
$$= 0.60$$

$$\chi^2 = \sum \frac{(oig - eig)^2}{eig}$$
$$= 1.34$$

$$v = k - 1$$
$$= 6 - 1$$
$$= 5$$

$$\alpha = 0{,}05$$
$$\chi^2(\alpha, v) = \chi^2(0{,}05; 5)$$
$$= 11.07$$

$\chi^2 < \chi^2(\alpha, v)$ maka data diatas mengikuti distribusi normal

Air Tawar

Interval kelas	Batas Kelas	Oi	Z1	Z2	P(Z1)	P(Z2)	P(Z2-Z1)	Ei	Eig	Oig	$(Oig - Eig)^2/Eig$
< 10.17	< 10.165	0	-19.34	-1.19	0.00	0.12	0.12	3.60	8.40	12	1.5429
10.17 - 10.50	10.17 - 10.505	12	-1.19	-0.58	0.12	0.28	0.16	4.80			
10.51 - 10.84	10.51 - 10.845	6	-0.58	0.03	0.28	0.51	0.23	6.90	6.88	6	0.1119
10.85 - 11.18	10.85 - 11.185	1	0.03	0.63	0.51	0.74	0.23	6.90	6.77	1	4.9140
11.19 - 11.52	11.19 - 11.525	8	0.64	1.24	0.74	0.89	0.16	4.80	8.10	11	1.0383
11.53 - 11.86	11.53 - 11.865	2	1.24	1.85	0.89	0.97	0.07	2.10			
11.87 - 12.20	11.87 - 12.205	0	1.85	2.46	0.97	0.99	0.03	0.90			
> 12.21	> 12.205	1	2.46	3.06	0.99	1.00	0.01	0.30			
		30									7.6070

$$K = 3.3\log n + 1$$
$$= 3.3\log(30) + 1$$
$$= 5.87 \approx 6$$

$$C = \frac{x\,maks - x\,min}{k}$$
$$= \frac{12.23 - 10.17}{6} = 0.34$$

$$Z_1 = \frac{batas\ bawah - \bar{x}}{S_{\bar{x}}}$$
$$= \frac{0 - 10.83}{0.56}$$
$$= -19.34$$

$$Z_2 = \frac{batas\ atas - \bar{x}}{S_{\bar{x}}}$$
$$= \frac{10.165 - 10.83}{0.56}$$
$$= -1.19$$

$$ei = P(Z2 - Z1) \cdot \sum oi$$
$$= 0.12 \cdot 30$$
$$= 3.60$$

$$\chi^2 = \sum \frac{(oig - eig)^2}{eig}$$
$$= 7.61$$

$$v = k - 1$$
$$= 6 - 1$$
$$= 5$$

$$\alpha = 0{,}05$$
$$\chi^2(\alpha, v) = \chi^2(0{,}05; 5)$$
$$= 11.07$$

$\chi^2 < \chi^2(\alpha, v)$ maka data diatas mengikuti distribusi normal

2. Melepaskan baut pada mur yang terpasang di pipa menggunakan obeng

Darat

Interval kelas	Batas Kelas	Oi	Z1	Z2	P(Z1)	P(Z2)	P(Z2-Z1)	Ei	Eig	Oig	$(Oig - Eig)^2/Eig$
< 6.19	< 6.185	0	-8.80	-1.52	0.00	0.06	0.06	1.80	5.10	5	0.0020
6.19 - 6.68	6.185 - 6.685	5	-1.52	-0.94	0.06	0.17	0.11	3.30			
6.69 - 7.18	6.685 - 7.185	4	-0.94	-0.35	0.17	0.36	0.19	5.70	5.70	4	0.5070
7.19 - 7.68	7.185 - 7.685	12	-0.35	0.24	0.36	0.60	0.23	6.90	6.90	12	3.7696
7.69 - 8.18	7.685 - 8.185	1	0.24	0.83	0.60	0.80	0.20	6.00	6.00	1	4.1667
8.19 - 8.68	8.185 - 8.685	3	0.83	1.42	0.80	0.92	0.13	3.90	5.70	8	0.9281
8.69 - 9.18	8.685 - 9.185	4	1.42	2.01	0.92	0.98	0.06	1.80			
> 9.19	> 9.185	1	2.01	2.59	1.00	1.00	0.00	0.00			
		30									9.3733

$$K = 3.3\log n + 1$$
$$= 3.3\log(30) + 1$$
$$= 5.87 \approx 6$$

$$C = \frac{x\,maks - x\,min}{k}$$
$$= \frac{9.21 - 6.19}{6} = 0.50$$

$$Z_1 = \frac{batas\ bawah - \bar{x}}{S_{\bar{x}}}$$
$$= \frac{0 - 7.48}{0.85}$$
$$= -8.80$$

$$Z_2 = \frac{batas\ atas - \bar{x}}{S_{\bar{x}}}$$
$$= \frac{6.185 - 7.48}{0.85}$$
$$= -1.52$$

$$ei = P(Z2 - Z1) \cdot \sum oi$$
$$= 0.06 \cdot 30$$
$$= 1.80$$

$$\chi^2 = \sum \frac{(oig - eig)^2}{eig}$$
$$= 9.37$$

$$v = k - 1$$
$$= 6 - 1$$
$$= 5$$

$$\alpha = 0{,}05$$
$$\chi^2(\alpha, v) = \chi^2(0{,}05; 5)$$
$$= 11.07$$

$\chi^2 < \chi^2(\alpha, v)$ maka data diatas mengikuti distribusi normal

Air Tawar

Interval kelas	Batas Kelas	Oi	Z1	Z2	P(Z1)	P(Z2)	P(Z2-Z1)	Ei	Eig	Oig	$(Oig - Eig)^2/Eig$
< 11.88	< 11.875	0	-18.59	-1.38	0.00	0.08	0.08	2.40	7.80	9	0.1846
11.88 - 12.39	11.875 - 12.395	9	-1.38	-0.63	0.08	0.26	0.18	5.40			
12.40 - 12.91	12.395 - 12.915	10	-0.63	0.12	0.26	0.55	0.28	8.40	8.40	10	0.3048
12.92 - 13.43	12.915 - 13.435	5	0.12	0.88	0.55	0.81	0.26	7.80	7.80	5	1.0051
13.44 - 13.95	13.435 - 13.955	4	0.88	1.63	0.81	0.95	0.14	4.20	5.70	6	0.0158
13.96 - 14.47	13.955 - 14.475	1	1.63	2.38	0.95	0.99	0.04	1.20			
14.48 - 14.99	14.475 - 14.995	1	2.38	3.14	0.99	1.00	0.01	0.30			
> 15.00	> 14.995	0	3.14	3.89	1.00	1.00	0.00	0.00			
		30									1.5103

$$K = 3.3\log n + 1 = 3.3\log(30) + 1 = 5.87 \approx 6$$

$$C = \frac{x\,maks - x\,min}{k} = \frac{14.97 - 11.88}{6} = 0.52$$

$$Z_1 = \frac{batas\ bawah - \bar{x}}{S_{\bar{x}}} = \frac{0 - 12.83}{0.69} = -18.59$$

$$Z_2 = \frac{batas\ atas - \bar{x}}{S_{\bar{x}}} = \frac{11.875 - 12.83}{0.69} = -1.38$$

$$ei = P(Z2 - Z1) \cdot \sum oi = 0.08 \cdot 30 = 2.40$$

$$\chi^2 = \sum \frac{(oig - eig)^2}{eig} = 1.51$$

$$v = k - 1 = 6 - 1 = 5$$

$$\alpha = 0{,}05$$

$$\chi^2(\alpha, v) = \chi^2(0{,}05; 5) = 11.07$$

$\chi^2 < \chi^2(\alpha, v)$ maka data diatas mengikuti distribusi normal

3. Memasukkan mur pada baut

Darat

Interval kelas	Batas Kelas	Oi	Z1	Z2	P(Z1)	P(Z2)	P(Z2-Z1)	Ei	Eig	Oig	$(Oig - Eig)^2/Eig$
<4.68	< 4.675	0	-14.47	-1.49	0.00	0.07	0.07	2.10	5.40	7	0.4741
4.68 - 4.88	4.675 - 4.885	7	-1.49	-0.90	0.07	0.18	0.11	3.30			
4.89 - 5.09	4.885 - 5.095	5	-0.90	-0.32	0.18	0.37	0.19	5.70	5.70	5	0.0860
5.1 - 5.3	5.095 - 5.305	6	-0.32	0.26	0.37	0.60	0.23	6.90	6.90	6	0.1174
5.31 - 5.51	5.305 - 5.515	7	0.26	0.85	0.60	0.80	0.20	6.00	6.00	7	0.1667
5.52 - 5.72	5.515 - 5.725	1	0.85	1.43	0.80	0.92	0.12	3.60	5.10	5	0.0020
5.73 - 5.93	5.725 - 5.935	4	1.43	2.01	0.92	0.98	0.05	1.50			
> 5.94	> 5.935	0	2.01	2.60	1.00	1.00	0.00	0.00			
		30									0.8461

$$K = 3.3\log n + 1$$
$$= 3.3\log(30) + 1$$
$$= 5.87 \approx 6$$

$$C = \frac{x\,maks - x\,min}{k}$$
$$= \frac{5.91 - 4.68}{6} = 0.21$$

$$Z_1 = \frac{batas\ bawah - \bar{x}}{S_{\bar{x}}}$$
$$= \frac{0 - 5.21}{0.36}$$
$$= -14.47$$

$$Z_2 = \frac{batas\ atas - \bar{x}}{S_{\bar{x}}}$$
$$= \frac{4.675 - 5.21}{0.36}$$
$$= -1.49$$

$$ei = P(Z2 - Z1) \cdot \sum oi$$
$$= 0.07\ .\ 30$$
$$= 2.10$$

$$\chi^2 = \sum \frac{(oig - eig)^2}{eig}$$
$$= 0.85$$

$$v = k - 1$$
$$= 6 - 1$$
$$= 5$$

$$\alpha = 0{,}05$$
$$\chi^2(\alpha, v) = \chi^2(0{,}05; 5)$$
$$= 11.07$$

$\chi^2 < \chi^2(\alpha, v)$ maka data diatas mengikuti distribusi normal

Air Tawar

Interval kelas	Batas Kelas	Oi	Z1	Z2	P(Z1)	P(Z2)	P(Z2-Z1)	Ei	Eig	Oig	$(Oig - Eig)^2/Eig$
< 7.57	< 7.565	0	-16.25	-2.50	0.00	0.01	0.01	0.30	10.20	9	0.1412
7.57 - 7.94	7.565 - 7.945	1	-2.50	-1.81	0.01	0.04	0.03	0.90			
7.95 - 8.32	7.945 - 8.325	4	-1.81	-1.12	0.04	0.13	0.10	3.00			
8.33 - 8.70	8.325 - 8.705	4	-1.12	-0.43	0.13	0.33	0.20	6.00			
8.71 - 9.08	8.705 - 9.085	8	-0.43	0.26	0.33	0.60	0.27	8.10	8.10	8	0.0012
9.09 - 9.46	9.085 - 9.465	7	0.26	0.95	0.60	0.83	0.23	6.90	10.50	13	0.5952
9.47 - 9.84	9.465 - 9.845	5	0.95	1.65	0.83	0.95	0.12	3.60			
> 9.85	> 9.845	1	1.65	2.34	0.95	0.99	0.04	0.00			
		30									0.7376

$$K = 3.3\log n + 1$$
$$= 3.3\log(30) + 1$$
$$= 5.87 \approx 6$$

$$C = \frac{x\,maks - x\,min}{k}$$
$$= \frac{9.57 - 7.57}{6} = 0.38$$

$$Z_1 = \frac{batas\ bawah - \bar{x}}{S_{\bar{x}}}$$
$$= \frac{0 - 8.94}{0.55}$$
$$= -16.25$$

$$Z_2 = \frac{batas\ atas - \bar{x}}{S_{\bar{x}}}$$
$$= \frac{7.565 - 8.94}{0.55}$$
$$= -2.50$$

$$ei = P(Z2 - Z1) \cdot \sum oi$$
$$= 0.01 . 30$$
$$= 0.30$$

$$\chi^2 = \sum \frac{(oig - eig)^2}{eig}$$
$$= 0.74$$

$$v = k - 1$$
$$= 6 - 1$$
$$= 5$$

$$\alpha = 0{,}05$$
$$\chi^2(\alpha, v) = \chi^2(0{,}05; 5)$$
$$= 11.07$$

$\chi^2 < \chi^2(\alpha, v)$ maka data diatas mengikuti distribusi normal

4. Memasang pipa pada soket berbentuk L

Darat

Interval kelas	Batas Kelas	Oi	Z1	Z2	P(Z1)	P(Z2)	P(Z2-Z1)	Ei	Eig	Oig	$(Oig - Eig)^2/Eig$
<7.11	< 7.105	0	-9.55	-1.28	0.00	0.10	0.10	3.00	8.10	11	1.0383
7.11 - 7.67	7.105 - 7.675	11	-1.28	-0.62	0.10	0.27	0.17	5.10			
7.68 - 8.24	7.675 - 8.245	5	-0.62	0.04	0.27	0.52	0.25	7.50	7.50	5	0.8333
8.25 - 8.81	8.245 - 8.815	8	0.04	0.70	0.52	0.76	0.24	7.20	7.20	8	0.0889
8.82 - 9.38	8.815 - 9.385	4	0.70	1.37	0.76	0.91	0.15	4.50	6.90	6	0.1174
9.39 - 9.95	9.385 - 9.955	1	1.37	2.03	0.91	0.98	0.06	1.80			
9.96 - 10.49	9.955 - 10.495	0	2.03	2.66	0.98	1.00	0.02	0.60			
> 10.50	> 10.495	1	2.69	3.35	1.00	1.00	0.00	0.00			
		30									2.0779

$$K = 3.3\log n + 1$$
$$= 3.3\log(30) + 1$$
$$= 5.87 \approx 6$$

$$C = \frac{x\,maks - x\,min}{k}$$
$$= \frac{10.55 - 7.11}{6} = 0.57$$

$$Z_1 = \frac{batas\ bawah - \bar{x}}{S_{\bar{x}}}$$
$$= \frac{0 - 8.21}{0.86}$$
$$= -9.55$$

$$Z_2 = \frac{batas\ atas - \bar{x}}{S_{\bar{x}}}$$
$$= \frac{7.105 - 8.21}{0.86}$$
$$= -1.2$$

$$ei = P(Z2 - Z1) \cdot \sum oi$$
$$= 0.10 \cdot 30$$
$$= 3.00$$

$$\chi^2 = \sum \frac{(oig - eig)^2}{eig}$$
$$= 2.08$$

$$v = k - 1$$
$$= 6 - 1$$
$$= 5$$

$$\alpha = 0{,}05$$
$$\chi^2(\alpha, v) = \chi^2(0{,}05; 5)$$
$$= 11.07$$

$\chi^2 < \chi^2(\alpha, v)$ maka data diatas mengikuti distribusi normal

Air Tawar

Interval kelas	Batas Kelas	Oi	Z1	Z2	P(Z1)	P(Z2)	P(Z2-Z1)	Ei	Eig	Oig	$(Oig - Eig)^2/Eig$
< 12.17	< 12.165	0	-19.00	-2.34	0.00	0.01	0.01	0.30	10.80	9	0.3000
12.17 - 12.64	12.165 - 12.645	2	-2.34	-1.68	0.01	0.05	0.04	1.20			
12.65 - 13.12	12.645 - 13.125	2	-1.68	-1.02	0.05	0.15	0.11	3.30			
13.13 - 13.60	13.125 - 13.605	5	-1.02	-0.36	0.15	0.36	0.20	6.00			
13.61 - 14.08	13.605 - 14.085	8	-0.36	0.29	0.36	0.62	0.26	7.80	7.80	8	0.0051
14.09 - 14.56	14.085 - 14.565	8	0.29	0.95	0.62	0.83	0.21	6.30	9.90	13	0.9707
14.57 - 15.04	14.565 - 15.045	5	0.95	1.61	0.83	0.95	0.12	3.60			
> 15.05	> 15.045	0	1.61	2.27	0.95	0.99	0.04	0.00			
		30									1.2758

$$K = 3.3\log n + 1$$
$$= 3.3\log(30) + 1$$
$$= 5.87 \approx 6$$

$$C = \frac{x\,maks - x\,min}{k}$$
$$= \frac{15.03 - 12.17}{6} = 0.48$$

$$Z_1 = \frac{batas\ bawah - \bar{x}}{S_{\bar{x}}}$$
$$= \frac{0 - 13.87}{0.73}$$
$$= -19.00$$

$$Z_2 = \frac{batas\ atas - \bar{x}}{S_{\bar{x}}}$$
$$= \frac{12.165 - 13.87}{0.73}$$
$$= -2.34$$

$$ei = P(Z2 - Z1) \cdot \sum oi$$
$$= 0.01 \cdot 30$$
$$= 0.30$$

$$\chi^2 = \sum \frac{(oig - eig)^2}{eig}$$
$$= 1.28$$

$$v = k - 1$$
$$= 6 - 1$$
$$= 5$$

$$\alpha = 0{,}05$$
$$\chi^2(\alpha, v) = \chi^2(0{,}05; 5)$$
$$= 11.07$$

$\chi^2 < \chi^2(\alpha, v)$ maka data diatas mengikuti distribusi normal

5. Memasang pipa pada soket berbentuk T

Darat

Interval kelas	Batas Kelas	Oi	Z1	Z2	P(Z1)	P(Z2)	P(Z2-Z1)	Ei	Eig	Oig	$(Oig - Eig)^2/Eig$
<15.05	< 15.045	0	-19.74	-1.17	0.00	0.12	0.12	3.60	8.70	12	1.2517
15.05 - 15.54	15.05 - 15.55	12	-1.17	-0.55	0.12	0.29	0.17	5.10			
15.55 - 16.04	15.55 - 16.05	8	-0.55	0.07	0.29	0.53	0.24	7.20	7.20	8	0.0889
16.05 - 16.54	16.05 - 16.55	3	0.07	0.69	0.53	0.75	0.23	6.90	6.90	3	2.2043
16.55 - 17.04	16.55 - 17.05	4	0.69	1.30	0.75	0.90	0.15	4.50	7.20	7	0.0056
17.05 - 17.54	17.05 - 17.55	0	1.30	1.92	0.90	0.97	0.07	2.10			
17.55 - 18.04	17.55 - 18.045	3	1.92	2.54	0.97	0.99	0.02	0.60			
> 18.05	>18.045	0	2.54	3.15	1.00	1.00	0.00	0.00			
		30									3.5505

$$K = 3.3\log n + 1 = 3.3\log(30) + 1 = 5.87 \approx 6$$

$$C = \frac{x\,maks - x\,min}{k} = \frac{18.04 - 15.05}{6} = 0.50$$

$$Z_1 = \frac{batas\ bawah - \bar{x}}{S_{\bar{x}}} = \frac{0 - 15.99}{0.81} = -19.74$$

$$Z_2 = \frac{batas\ atas - \bar{x}}{S_{\bar{x}}} = \frac{15.045 - 15.99}{0.81} = -1.17$$

$$ei = P(Z2 - Z1) \cdot \sum oi = 0.12 \cdot 30 = 3.60$$

$$\chi^2 = \sum \frac{(oig - eig)^2}{eig} = 3.55$$

$$v = k - 1 = 6 - 1 = 5$$

$$\alpha = 0{,}05$$

$$\chi^2(\alpha, v) = \chi^2(0{,}05; 5) = 11.07$$

$\chi^2 < \chi^2(\alpha, v)$ maka data diatas mengikuti distribusi normal

Air Tawar

Interval kelas	Batas Kelas	Oi	Z1	Z2	P(Z1)	P(Z2)	P(Z2-Z1)	Ei	Eig	Oig	$(Oig - Eig)^2/Eig$
<25.21	< 25.205	0	-38.46	-2.45	0.00	0.01	0.01	0.30	10.20	7	1.0039
25.21 - 25.67	25.205 - 25.675	3	-2.45	-1.78	0.01	0.04	0.03	0.90			
25.68 - 26.14	25.675 - 26.145	0	-1.78	-1.11	0.04	0.13	0.10	3.00			
26.15 - 26.61	26.145 - 26.615	4	-1.11	-0.44	0.13	0.33	0.20	6.00			
26.62 - 27.08	26.615 - 27.085	7	-0.44	0.24	0.33	0.59	0.26	7.80	7.80	7	0.0821
27.09 - 27.55	27.085 - 27.555	12	0.24	0.91	0.59	0.82	0.22	6.60	6.60	12	4.4182
27.56 - 28.02	27.555 - 28.025	4	0.91	1.58	0.82	0.94	0.12	3.60	5.10	4	0.2373
>28.03	> 28.025	0	1.58	2.25	0.94	0.99	0.05	1.50			
		30									5.7414

$$K = 3.3\log n + 1$$
$$= 3.3\log(30) + 1$$
$$= 5.87 \approx 6$$

$$C = \frac{x\,maks - x\,min}{k}$$
$$= \frac{28.04 - 25.21}{6} = 0.47$$

$$Z_1 = \frac{batas\ bawah - \bar{x}}{S_{\bar{x}}}$$
$$= \frac{0 - 26.92}{0.70}$$
$$= -38.46$$

$$Z_2 = \frac{batas\ atas - \bar{x}}{S_{\bar{x}}}$$
$$= \frac{25.205 - 26.92}{0.70}$$
$$= -2.45$$

$$ei = P(Z2 - Z1) \cdot \sum oi$$
$$= 0.01 \cdot 30$$
$$= 0.30$$

$$\chi^2 = \sum \frac{(oig - eig)^2}{eig}$$
$$= 5.74$$

$$v = k - 1$$
$$= 6 - 1$$
$$= 5$$

$$\alpha = 0{,}05$$
$$\chi^2(\alpha, v) = \chi^2(0{,}05; 5)$$
$$= 11.07$$

$\chi^2 < \chi^2(\alpha, v)$ maka data diatas mengikuti distribusi normal

6. Memasang pipa berbentuk C

Darat

Interval kelas	Batas Kelas	Oi	Z1	Z2	P(Z1)	P(Z2)	P(Z2-Z1)	Ei	Eig	Oig	$(Oig - Eig)^2/Eig$
<23.70	<23.695	0	-34.64	-1.73	0.00	0.04	0.04	1.20	5.10	4	0.2373
23.70 - 24.13	23.695 - 24.135	4	-2.56	-1.12	0.01	0.13	0.13	3.90			
24.14 - 24.57	24.135 - 24.575	6	-1.12	-0.51	0.13	0.31	0.17	5.10	5.10	6	0.1588
24.58 - 25.01	24.575 - 25.015	8	-0.51	0.10	0.31	0.54	0.24	7.20	7.20	8	0.0889
25.02 - 25.45	25.015 - 25.455	4	0.10	0.72	0.54	0.76	0.22	6.60	6.60	4	1.0242
25.46 - 25.89	25.455 - 25.895	3	0.72	1.33	0.76	0.91	0.14	4.20	6.90	8	0.1754
25.90 - 26.33	25.895 - 26.335	5	1.33	1.94	0.91	0.97	0.07	2.10			
> 26.34	>26.335	0	1.94	2.55	0.97	0.99	0.02	0.60			
		30									1.6846

$$K = 3.3\log n + 1$$
$$= 3.3\log(30) + 1$$
$$= 5.87 \approx 6$$

$$C = \frac{x\,maks - x\,min}{k}$$
$$= \frac{26.31 - 23.70}{6} = 0.44$$

$$Z_1 = \frac{\text{batas bawah} - \bar{x}}{S_{\bar{x}}}$$
$$= \frac{0 - 24.94}{0.72}$$
$$= -34.64$$

$$Z_2 = \frac{\text{batas atas} - \bar{x}}{S_{\bar{x}}}$$
$$= \frac{23.695 - 24.94}{0.72}$$
$$= -1.73$$

$$ei = P(Z2 - Z1) \cdot \sum oi$$
$$= 0.04 * 30$$
$$= 1.20$$

$$\chi^2 = \sum \frac{(oig - eig)^2}{eig}$$
$$= 1.68$$

$$v = k - 1$$
$$= 6 - 1$$
$$= 5$$

$$\alpha = 0{,}05$$
$$\chi^2(\alpha, v) = \chi^2(0{,}05; 5)$$
$$= 11.07$$

$\chi^2 < \chi^2(\alpha, v)$ maka data diatas mengikuti distribusi normal

Air Tawar

Interval kelas	Batas Kelas	Oi	Z1	Z2	P(Z1)	P(Z2)	P(Z2-Z1)	Ei	Eig	Oig	$(Oig - Eig)^2/Eig$
<28.53	< 28.525	0	-57.75	-1.81	0.00	0.03	0.03	0.90	7.20	9	0.4500
28.53 - 28.81	28.525 - 28.815	6	-1.81	-1.25	0.03	0.11	0.07	2.10			
28.82 - 29.10	28.815 - 29.105	3	-1.25	-0.68	0.11	0.25	0.14	4.20			
29.11 - 29.39	29.105 - 29.395	3	-0.68	-0.11	0.25	0.46	0.21	6.30	6.30	3	1.7286
29.40 - 29.68	29.395 - 29.685	5	-0.11	0.46	0.46	0.68	0.22	6.60	6.60	5	0.3879
29.69 - 29.97	29.685 - 29.975	7	0.46	1.03	0.68	0.85	0.17	5.10	9.30	13	1.4720
29.98 - 30.26	29.975 - 30.265	5	1.03	1.60	0.85	0.94	0.10	3.00			
>30.27	>30.265	1	1.60	2.17	0.94	0.98	0.04	1.20			
		30									4.0385

$$K = 3.3\log n + 1$$
$$= 3.3\log(30) + 1$$
$$= 5.87 \approx 6$$

$$C = \frac{x\,maks - x\,min}{k}$$
$$= \frac{30.29 - 28.53}{6} = 0.29$$

$$Z_1 = \frac{\text{batas bawah} - \bar{x}}{S_{\bar{x}}}$$
$$= \frac{0 - 29.45}{0.51}$$
$$= -57.75$$

$$Z_2 = \frac{\text{batas atas} - \bar{x}}{S_{\bar{x}}}$$
$$= \frac{28.525 - 29.45}{0.51}$$
$$= -1.81$$

$$ei = P(Z2 - Z1) \cdot \sum oi$$
$$= 0.03 * 30$$
$$= 0.90$$

$$\chi^2 = \sum \frac{(oig - eig)^2}{eig}$$
$$= 4.04$$

$$v = k - 1$$
$$= 6 - 1$$
$$= 5$$

$$\alpha = 0{,}05$$
$$\chi^2(\alpha, v) = \chi^2(0{,}05;5)$$
$$= 11.07$$

$\chi^2 < \chi^2(\alpha, v)$ maka data diatas mengikuti distribusi normal

7. Memasukkan baut panjang pada pipa U

Darat

Interval kelas	Batas Kelas	Oi	Z1	Z2	P(Z1)	P(Z2)	P(Z2-Z1)	Ei	Eig	Oig	$(Oig - Eig)^2/Eig$
<14.55	<14.545	0	-34.64	-1.73	0.00	0.04	0.04	1.20	5.10	4	0.2373
14.55 - 14.83	14.545 - 14.835	10	-2.56	-1.12	0.01	0.13	0.13	3.90			
14.84 - 15.12	14.835 - 15.125	8	-1.12	-0.51	0.13	0.31	0.17	5.10	5.10	6	0.1588
15.13 - 15.41	15.125 - 15.415	3	-0.51	0.10	0.31	0.54	0.24	7.20	7.20	8	0.0889
15.42 - 15.70	15.415 - 15.705	4	0.10	0.72	0.54	0.76	0.22	6.60	6.60	4	1.0242
15.71 - 15.99	15.705 - 15.995	4	0.72	1.33	0.76	0.91	0.14	4.20	6.90	8	0.1754
16.00 - 16.28	15.995 - 16.285	0	1.33	1.94	0.91	0.97	0.07	2.10			
>16.29	>16.285	1	1.94	2.55	0.97	0.99	0.02	0.60			
16.29		30									1.6846

$$K = 3.3\log n + 1$$
$$= 3.3\log(30) + 1$$
$$= 5.87 \approx 6$$

$$C = \frac{x\,maks - x\,min}{k}$$
$$= \frac{16.31 - 14.55}{6} = 0.29$$

$$Z_1 = \frac{batas\ bawah - \bar{x}}{S_{\bar{x}}}$$
$$= \frac{0 - 24.94}{0.72}$$
$$= -34.64$$

$$Z_2 = \frac{batas\ atas - \bar{x}}{S_{\bar{x}}}$$
$$= \frac{23.695 - 24.94}{0.72}$$
$$= -1.73$$

$$ei = P(Z2 - Z1) \cdot \sum oi$$
$$= 0.04 * 30$$
$$= 1.20$$

$$\chi^2 = \sum \frac{(oig - eig)^2}{eig}$$
$$= 1.68$$

$$v = k - 1$$
$$= 6 - 1$$
$$= 5$$

$$\alpha = 0{,}05$$
$$\chi^2(\alpha, v) = \chi^2(0{,}05; 5)$$
$$= 11.07$$

$\chi^2 < \chi^2(\alpha, v)$ maka data diatas mengikuti distribusi normal

Air Tawar

Interval kelas	Batas Kelas	Oi	Z1	Z2	P(Z1)	P(Z2)	P(Z2-Z1)	Ei	Eig	Oig	$(Oig - Eig)^2/Eig$
<19.23	< 19.225	0	-34.00	-1.42	0.00	0.08	0.08	2.40	6.60	9	0.8727
19.23 - 19.60	19.225 - 19.605	9	-1.42	-0.77	0.08	0.22	0.14	4.20			
19.61 - 19.98	19.605 - 19.985	7	-0.77	-0.13	0.22	0.45	0.23	6.90	6.90	7	0.0014
19.99 - 20.36	19.985 - 20.365	5	-0.13	0.52	0.45	0.70	0.25	7.50	7.50	5	0.8333
20.37 - 20.74	20.365 - 20.745	5	0.52	1.16	0.70	0.88	0.18	5.40	9.30	9	0.0097
20.75 - 21.12	20.745 - 21.125	3	1.16	1.81	0.88	0.96	0.09	2.70			
21.13 - 21.50	21.125 - 21.505	1	1.81	2.45	0.96	0.99	0.03	0.90			
>21.51	>21.505	0	2.45	3.09	0.99	1.00	0.01	0.30			
		30									1.7172

$$K = 3.3\log n + 1$$
$$= 3.3\log(30) + 1$$
$$= 5.87 \approx 6$$

$$C = \frac{x\,maks - x\,min}{k}$$
$$= \frac{21.48 - 19.23}{6} = 0.38$$

$$Z_1 = \frac{batas\ bawah - \bar{x}}{S_{\bar{x}}}$$
$$= \frac{0 - 20.06}{0.59}$$
$$= -34$$

$$Z_2 = \frac{batas\ atas - \bar{x}}{S_{\bar{x}}}$$
$$= \frac{19.225 - 20.06}{0.59}$$
$$= -1.42$$

$$ei = P(Z2 - Z1) \cdot \sum oi$$
$$= 0.08 * 30$$
$$= 2.40$$

$$\chi^2 = \sum \frac{(oig - eig)^2}{eig}$$
$$= 1.72$$

$$v = k - 1$$
$$= 6 - 1$$
$$= 5$$

$$\alpha = 0{,}05$$
$$\chi^2(\alpha, v) = \chi^2(0{,}05; 5)$$
$$= 11.07$$

$\chi^2 < \chi^2(\alpha, v)$ maka data diatas mengikuti distribusi normal

8. Memasang pipa pada soket berbentuk lurus (I)

Darat

Interval kelas	Batas Kelas	Oi	Z1	Z2	P(Z1)	P(Z2)	P(Z2-Z1)	Ei	Eig	Oig	$(Oig - Eig)^2/Eig$
<10.76	< 10.755	0	-25.23	-2.82	0.00	0.00	0.00	0.00	6.90	3	2.2043
10.76 - 11.09	10.755 - 11.095	3	-2.82	-2.11	0.00	0.02	0.01	0.30			
11.10 - 11.43	11.095 - 11.435	0	-2.11	-1.41	0.02	0.08	0.06	1.80			
11.44 - 11.77	11.435 - 11.775	0	-1.41	-0.70	0.08	0.24	0.16	4.80			
11.78 - 12.11	11.775 - 12.115	11	-0.70	0.01	0.24	0.50	0.26	7.80	7.80	11	1.3128
12.12 - 12.45	12.115 - 12.455	12	0.01	0.72	0.50	0.76	0.26	7.80	7.80	12	2.2615
12.46 - 12.79	12.455 - 12.795	3	0.72	1.43	0.76	0.92	0.16	4.80	6.60	4	1.0242
> 12.80	>12.795	1	1.43	2.14	0.92	0.98	0.06	1.80			
		30									6.8029

$$K = 3.3\log n + 1$$
$$= 3.3\log(30) + 1$$
$$= 5.87 \approx 6$$

$$C = \frac{x\,maks - x\,min}{k}$$
$$= \frac{12.80 - 10.76}{6} = 0.34$$

$$Z_1 = \frac{batas\ bawah - \bar{x}}{S_{\bar{x}}}$$
$$= \frac{0 - 12.11}{0.48}$$
$$= -25.23$$

$$Z_2 = \frac{batas\ atas - \bar{x}}{S_{\bar{x}}}$$
$$= \frac{10.755 - 12.11}{0.48}$$
$$= -2.82$$

$$ei = P(Z2 - Z1) \cdot \sum oi$$
$$= 0 \,.\, 30$$
$$= 0$$

$$\chi^2 = \sum \frac{(oig - eig)^2}{eig}$$
$$= 6.80$$

$$v = k - 1$$
$$= 6 - 1$$
$$= 5$$

$$\alpha = 0{,}05$$
$$\chi^2(\alpha, v) = \chi^2(0{,}05; 5)$$
$$= 11.07$$

$\chi^2 < \chi^2(\alpha, v)$ maka data diatas mengikuti distribusi normal

Air Tawar

Interval kelas	Batas Kelas	Oi	Z1	Z2	P(Z1)	P(Z2)	P(Z2-Z1)	Ei	Eig	Oig	$(Oig - Eig)^2/Eig$
<17.43	< 17.425	0	-56.72	-2.27	0.00	0.01	0.01	0.30	7.80	7	0.0821
17.43 - 17.68	17.425 - 17.685	1	-2.27	-1.45	0.01	0.07	0.06	1.80			
17.69 - 17.94	17.685 - 17.945	6	-1.45	-0.64	0.07	0.26	0.19	5.70			
17.95 - 18.20	17.945 - 18.205	10	-0.64	0.17	0.26	0.57	0.31	9.30	9.30	10	0.0527
18.21 - 18.46	18.205 - 18.465	9	0.17	0.98	0.57	0.84	0.27	8.10	8.10	9	0.1000
18.47 - 18.72	18.465 - 18.725	3	0.98	1.80	0.84	0.96	0.13	3.90	5.10	4	0.2373
18.73 - 18.98	18.725 - 18.985	0	1.80	2.61	0.96	1.00	0.04	1.20			
>18.99	>18.985	1	2.61	3.42	1.00	1.00	0.00	0.00			
		30									0.4720

$$K = 3.3\log n + 1 = 3.3\log(30) + 1 = 5.87 \approx 6$$

$$C = \frac{x\,maks - x\,min}{k} = \frac{19.01 - 17.43}{6} = 0.26$$

$$Z_1 = \frac{\text{batas bawah} - \bar{x}}{S_{\bar{x}}} = \frac{0 - 18.15}{0.32} = -56.72$$

$$Z_2 = \frac{\text{batas atas} - \bar{x}}{S_{\bar{x}}} = \frac{17.425 - 18.15}{0.32} = -2.27$$

$$ei = P(Z2 - Z1) \cdot \sum oi = 0.01 \cdot 30 = 0.30$$

$$\chi^2 = \sum \frac{(oig - eig)^2}{eig} = 0.47$$

$$v = k - 1 = 6 - 1 = 5$$

$$\alpha = 0{,}05$$

$$\chi^2(\alpha, v) = \chi^2(0{,}05; 5) = 11.07$$

$\chi^2 < \chi^2(\alpha, v)$ maka data diatas mengikuti distribusi normal

1. Melepaskan mur pada baut yang terpasang di pipa menggunakan tangan

Darat

Sub grup ke-	1	2	3	4	5	Rata-rata
1	6.48	5.31	5.11	5.85	4.28	5.41
2	5.61	4.87	5.12	5.28	4.14	5.00
3	5.70	5.67	5.17	5.33	4.11	5.20
4	5.48	5.44	5.24	5.41	4.07	5.13
5	5.30	5.25	5.32	5.44	4.41	5.14
6	5.40	5.41	5.18	5.17	4.32	5.10
					$\bar{\bar{x}}$	5.16
					$S_{\bar{x}}$	0.56

Contoh perhitungan :

$$\bar{\bar{x}} = \frac{\sum xi}{k} = \frac{154.87}{30} = 5.16$$

$$\sigma = \sqrt{\frac{\sum (xi - \bar{\bar{x}})^2}{N-1}} = 0.56$$

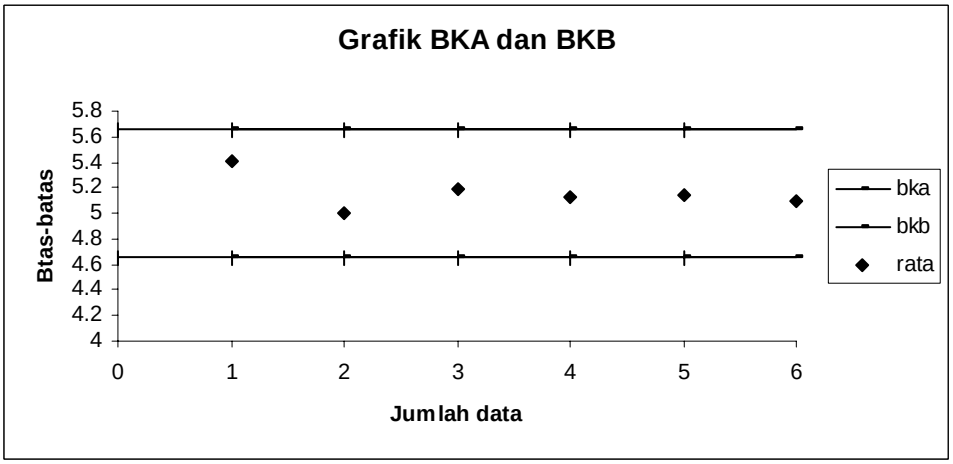
$$\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}} = \frac{0.56}{\sqrt{5}} = 0.25$$

Tingkat ketelitian 5% dan kepercayaan 95%

$$BKA = \bar{\bar{x}} + c\sigma_{\bar{x}}$$
$$= 5.16 + 2(0.25)$$
$$= 5.66$$

$$BKB = \bar{\bar{x}} - c\sigma_{\bar{x}}$$
$$= 5.16 - 2(0.25)$$
$$= 4.66$$

Karena semua nilai rata-ratanya berada diantara kedua batas kontrol maka data seragam.



Air Tawar

Sub grup ke-	1	2	3	4	5	Rata-rata
1	10.69	11.24	10.57	11.39	10.72	10.92
2	10.89	10.35	11.31	10.27	10.39	10.64
3	11.31	10.3	10.42	11.44	10.52	10.80
4	11.23	10.21	11.71	10.38	10.77	10.86
5	11.42	10.17	12.23	11.72	10.24	11.16
6	11.37	10.52	10.44	10.34	10.31	10.60
					$\bar{\bar{x}}$	10.83
					$S_{\bar{x}}$	0.56

Contoh perhitungan :

$$\bar{\bar{x}} = \frac{\sum xi}{k} = \frac{324.87}{30} = 10.83$$

$$\sigma = \sqrt{\frac{\sum (xi - \bar{\bar{x}})^2}{N-1}} = 0.56$$

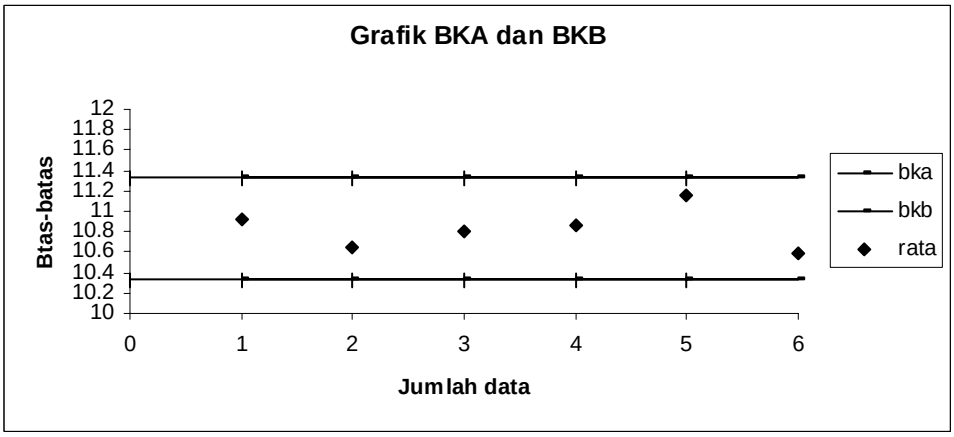
$$\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}} = \frac{0.56}{\sqrt{5}} = 0.25$$

Tingkat ketelitian 5% dan kepercayaan 95%

$$BKA = \bar{\bar{x}} + c\sigma_{\bar{x}}$$
$$= 10.83 + 2(0.25)$$
$$= 11.33$$

$$BKB = \bar{\bar{x}} - c\sigma_{\bar{x}}$$
$$= 10.83 - 2(0.25)$$
$$= 10.33$$

Karena semua nilai rata-ratanya berada diantara kedua batas kontrol maka data seragam.



2. Melepaskan baut pada mur yang terpasang di pipa menggunakan obeng

Darat

Sub grup ke-	1	2	3	4	5	Rata-rata
1	8.43	8.32	7.17	7.21	6.32	7.49
2	9.21	7.24	6.33	7.32	7.83	7.59
3	8.92	7.31	7.41	7.45	6.45	7.51
4	6.88	8.90	7.32	7.41	7.34	7.57
5	8.71	8.73	7.24	7.33	6.19	7.64
6	8.19	7.24	7.16	6.24	6.73	7.11
					$\bar{\bar{x}}$	7.48
					$S_{\bar{x}}$	0.85

Contoh perhitungan :

$$\bar{\bar{x}} = \frac{\sum xi}{k} = \frac{224.53}{30} = 7.48$$

$$\sigma = \sqrt{\frac{\sum (xi - \bar{\bar{x}})^2}{N-1}} = 0.85$$

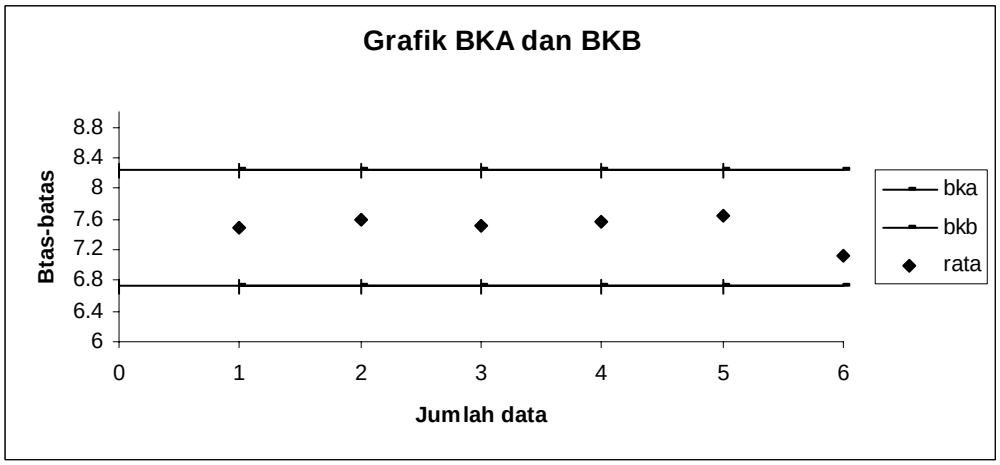
$$\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}} = \frac{0.85}{\sqrt{5}} = 0.38$$

Tingkat ketelitian 5% dan kepercayaan 95%

$$BKA = \bar{\bar{x}} + c\,\sigma_{\bar{x}}$$
$$= 7.48 + 2(0.38)$$
$$= 8.24$$

$$BKB = \bar{\bar{x}} - c\,\sigma_{\bar{x}}$$
$$= 7.48 - 2(0.38)$$
$$= 6.72$$

Karena semua nilai rata-ratanya berada diantara kedua batas kontrol maka data seragam.



Air Tawar

Sub grup ke-	1	2	3	4	5	Rata-rata
1	14.97	12.17	12.91	12.59	13.04	13.14
2	14.03	12.24	11.98	11.88	13.40	12.71
3	13.44	12.56	13.50	12.65	13.25	13.08
4	12.10	12.63	12.39	12.21	13.48	12.56
5	12.97	13.81	12.88	12.89	12.07	12.92
6	12.83	12.66	12.30	13.01	12.13	12.59
					$\bar{\bar{x}}$	12.83
					$S_{\bar{x}}$	0.69

Contoh perhitungan :

$$\bar{\bar{x}} = \frac{\sum xi}{k} = \frac{384.97}{30} = 12.83$$

$$\sigma = \sqrt{\frac{\sum (xi - \bar{\bar{x}})^2}{N-1}} = 0.69$$

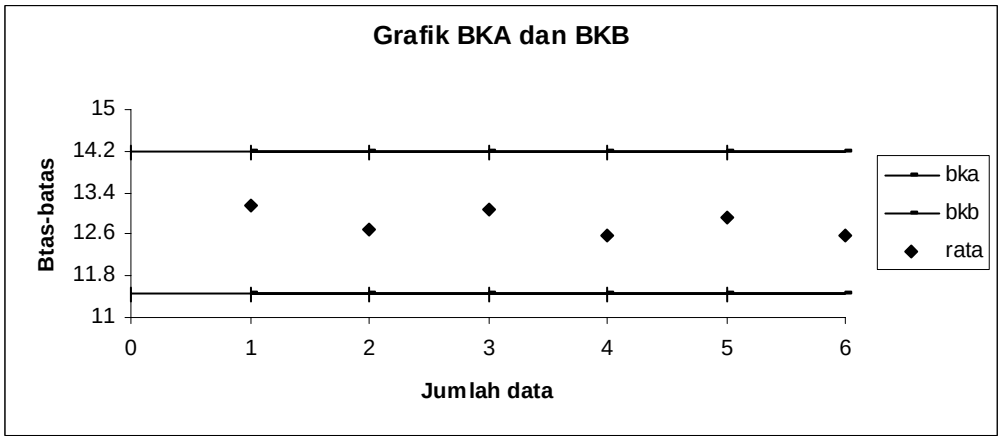
$$\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}} = \frac{0.69}{\sqrt{5}} = 0.31$$

Tingkat ketelitian 5% dan kepercayaan 95%

$$BKA = \bar{\bar{x}} + c\sigma_{\bar{x}}$$
$$= 12.83 + 2(0.69)$$
$$= 14.21$$

$$BKB = \bar{\bar{x}} - c\sigma_{\bar{x}}$$
$$= 12.83 - 2(0.69)$$
$$= 11.45$$

Karena semua nilai rata-ratanya berada diantara kedua batas kontrol maka data seragam.



3. Memasukkan mur pada baut

Darat

Sub grup ke-	1	2	3	4	5	Rata-rata
1	5.48	4.98	5.83	5.24	5.31	5.37
2	4.91	4.99	5.86	5.39	5.29	5.29
3	4.80	5.47	4.80	5.68	4.75	5.10
4	5.03	5.36	5.79	4.87	4.91	5.19
5	5.10	5.11	4.87	4.73	5.44	5.05
6	5.15	5.91	5.43	4.68	5.25	5.28
					$\bar{\bar{x}}$	5.21
					$S_{\bar{x}}$	0.36

Contoh perhitungan :

$$\bar{\bar{x}} = \frac{\sum xi}{k} = \frac{156.41}{30} = 5.21$$

$$\sigma = \sqrt{\frac{\sum (xi - \bar{\bar{x}})^2}{N-1}} = 0.36$$

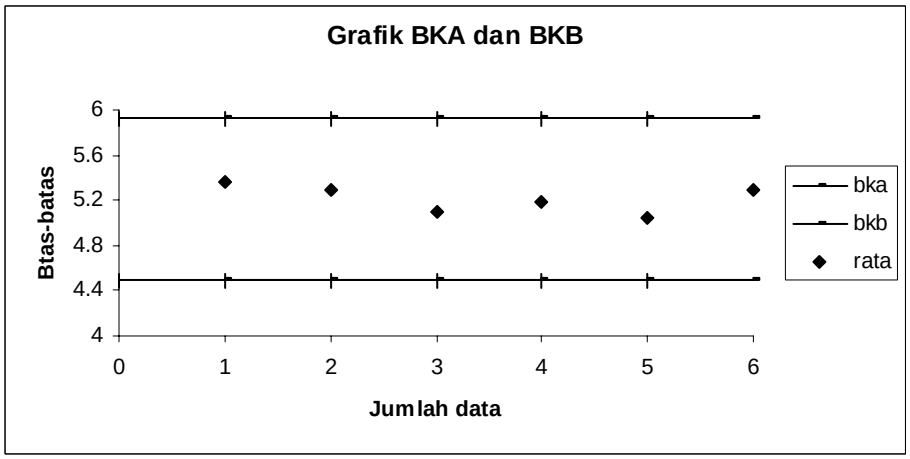
$$\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}} = \frac{0.36}{\sqrt{5}} = 0.16$$

Tingkat ketelitian 5% dan kepercayaan 95%

$$BKA = \bar{\bar{x}} + c\sigma_{\bar{x}}$$
$$= 5.21 + 2(0.36)$$
$$= 5.93$$

$$BKB = \bar{\bar{x}} - c\sigma_{\bar{x}}$$
$$= 5.21 - 2(0.36)$$
$$= 4.49$$

Karena semua nilai rata-ratanya berada diantara kedua batas kontrol maka data seragam.



Air Tawar

Sub grup ke-	1	2	3	4	5	Rata-rata
1	8.97	8.53	9.59	8.92	9.40	9.08
2	9.24	9.50	9.45	8.89	9.55	9.33
3	8.42	8.64	8.98	8.78	8.12	8.59
4	7.57	8.29	9.47	9.26	8.68	8.65
5	9.01	9.31	9.87	9.10	8.01	9.06
6	8.90	9.56	9.10	9.05	8.03	8.93
					$\bar{\bar{x}}$	8.94
					$S_{\bar{x}}$	0.55

Contoh perhitungan :

$$\bar{\bar{x}} = \frac{\sum xi}{k} = \frac{268.19}{30} = 8.94$$

$$\sigma = \sqrt{\frac{\sum (xi - \bar{\bar{x}})^2}{N-1}} = 0.55$$

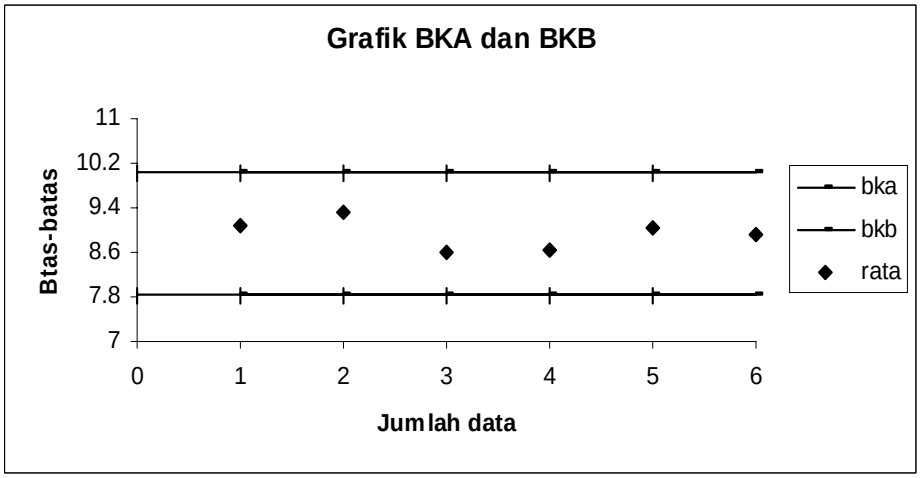
$$\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}} = \frac{0.55}{\sqrt{5}} = 0.25$$

Tingkat ketelitian 5% dan kepercayaan 95%

$$BKA = \bar{\bar{x}} + c\sigma_{\bar{x}}$$
$$= 8.94 + 2(0.55)$$
$$= 10.04$$

$$BKB = \bar{\bar{x}} - c\sigma_{\bar{x}}$$
$$= 8.94 - 2(0.55)$$
$$= 7.84$$

Karena semua nilai rata-ratanya berada diantara kedua batas kontrol maka data seragam.



4. Memasang pipa pada soket berbentuk L

Darat

Sub grup ke-	1	2	3	4	5	Rata-rata
1	8.03	8.32	7.44	8.51	8.32	8.12
2	8.59	8.42	7.23	8.66	9.19	8.42
3	7.90	7.21	8.12	7.21	9.27	7.94
4	10.55	7.32	8.21	7.61	9.11	8.56
5	7.26	7.11	8.32	7.51	9.31	7.90
6	8.19	7.46	8.76	7.42	9.81	8.33
					$\bar{\bar{x}}$	8.21
					$S_{\bar{x}}$	0.86

Contoh perhitungan :

$$\bar{\bar{x}} = \frac{\sum xi}{k} = \frac{246.37}{30} = 8.21$$

$$\sigma = \sqrt{\frac{\sum (xi - \bar{\bar{x}})^2}{N-1}} = 0.86$$

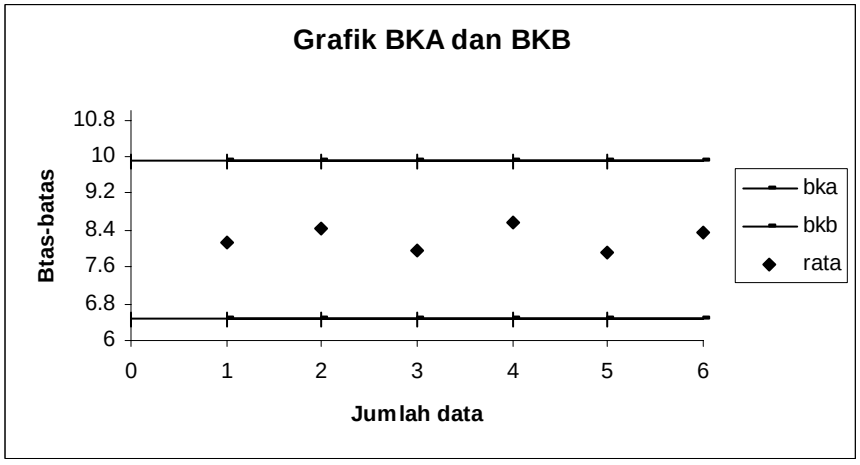
$$\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}} = \frac{0.86}{\sqrt{5}} = 0.38$$

Tingkat ketelitian 5% dan kepercayaan 95%

$$BKA = \bar{\bar{x}} + c\sigma_{\bar{x}}$$
$$= 8.21 + 2(0.86)$$
$$= 9.93$$

$$BKB = \bar{\bar{x}} - c\sigma_{\bar{x}}$$
$$= 8.21 - 2(0.86)$$
$$= 6.49$$

Karena semua nilai rata-ratanya berada diantara kedua batas kontrol maka data seragam.



Air Tawar

Sub grup ke-	1	2	3	4	5	Rata-rata
1	15.03	13.77	14.37	12.91	13.32	13.88
2	13.44	13.67	14.41	13.78	13.42	13.74
3	13.30	13.82	14.55	13.42	14.72	13.96
4	14.15	14.21	14.52	13.63	14.34	14.17
5	14.91	12.19	13.77	14.71	12.17	13.55
6	13.98	14.33	13.87	14.68	12.83	13.94
					$\bar{\bar{x}}$	13.87
					$S_{\bar{x}}$	0.73

Contoh perhitungan :

$$\bar{\bar{x}} = \frac{\sum xi}{k} = \frac{416.22}{30} = 13.87$$

$$\sigma = \sqrt{\frac{\sum (xi - \bar{\bar{x}})^2}{N-1}} = 0.73$$

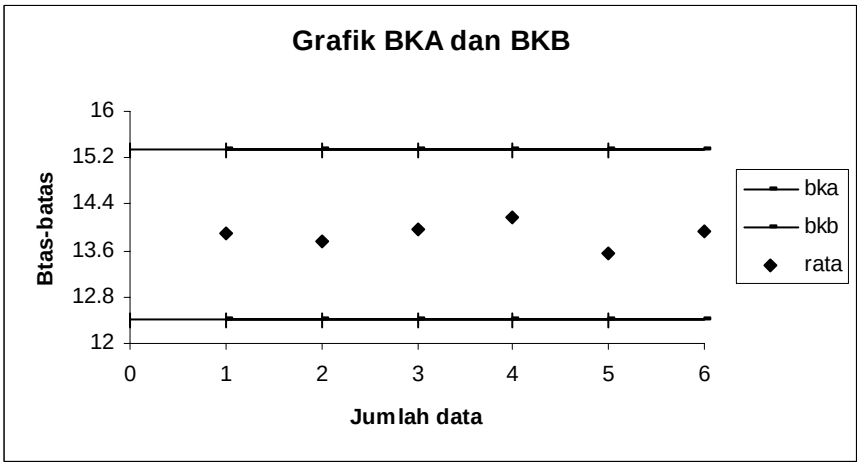
$$\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}} = \frac{0.73}{\sqrt{5}} = 0.33$$

Tingkat ketelitian 5% dan kepercayaan 95%

$$BKA = \bar{\bar{x}} + c\sigma_{\bar{x}}$$
$$= 13.87 + 2(0.73)$$
$$= 15.33$$

$$BKB = \bar{\bar{x}} - c\sigma_{\bar{x}}$$
$$= 13.87 - 2(0.73)$$
$$= 12.41$$

Karena semua nilai rata-ratanya berada diantara kedua batas kontrol maka data seragam.



5. Memasang pipa pada soket berbentuk T (darat)

Darat

Sub grup ke-	1	2	3	4	5	Rata-rata
1	18.04	15.45	15.24	15.41	15.25	15.88
2	17.84	16.13	15.44	15.70	15.96	16.21
3	15.21	16.58	15.53	15.84	16.95	16.02
4	16.21	15.37	16.73	15.62	15.76	15.94
5	15.11	17.60	16.75	16.01	15.83	16.26
6	15.30	15.05	15.38	15.98	16.51	15.64
					$\bar{\bar{x}}$	15.99
					$S_{\bar{x}}$	0.81

Contoh perhitungan :

$$\bar{\bar{x}} = \frac{\sum xi}{k} = \frac{479.78}{30} = 15.99$$

$$\sigma = \sqrt{\frac{\sum (xi - \bar{\bar{x}})^2}{N-1}} = 0.81$$

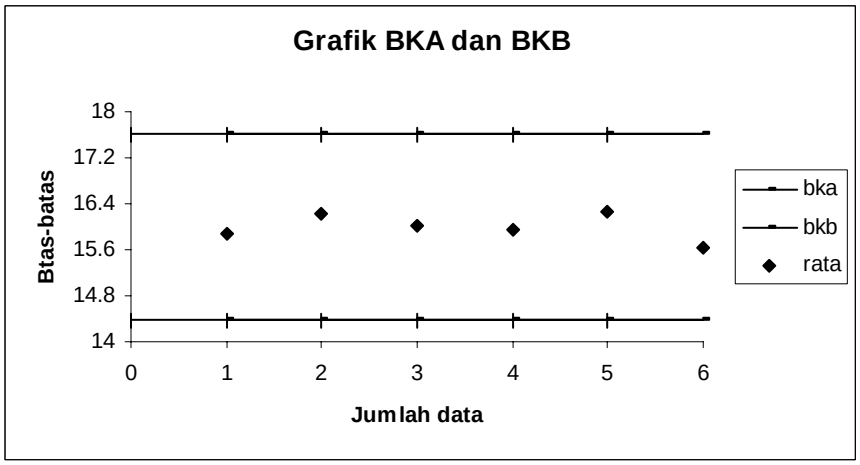
$$\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}} = \frac{0.81}{\sqrt{5}} = 0.36$$

Tingkat ketelitian 5% dan kepercayaan 95%

$$BKA = \bar{\bar{x}} + c\sigma_{\bar{x}}$$
$$= 15.99 + 2(0.81)$$
$$= 17.61$$

$$BKB = \bar{\bar{x}} - c\sigma_{\bar{x}}$$
$$= 15.99 - 2(0.81)$$
$$= 14.37$$

Karena semua nilai rata-ratanya berada diantara kedua batas kontrol maka data seragam.



Air Tawar

Sub grup ke-	1	2	3	4	5	Rata-rata
1	28.04	26.68	26.77	26.24	26.53	26.85
2	27.15	26.72	25.42	26.62	27.39	26.66
3	26.78	27.51	27.34	27.34	27.62	27.32
4	27.31	26.32	27.30	27.14	27.35	27.08
5	25.42	25.21	27.67	26.72	27.82	26.57
6	27.37	27.11	26.43	26.77	27.45	27.03
					$\bar{\bar{x}}$	26.92
					$S_{\bar{x}}$	0.70

Contoh perhitungan :

$$\bar{\bar{x}} = \frac{\sum xi}{k} = \frac{807.54}{30} = 26.92$$

$$\sigma = \sqrt{\frac{\sum (xi - \bar{\bar{x}})^2}{N-1}} = 0.70$$

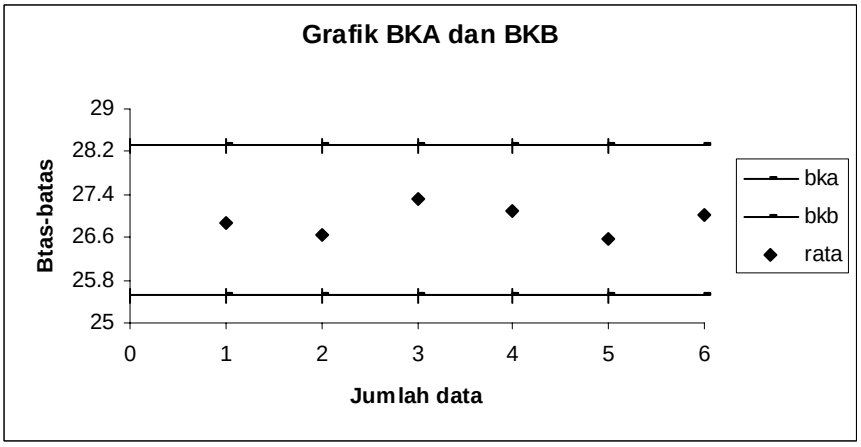
$$\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}} = \frac{0.70}{\sqrt{5}} = 0.31$$

Tingkat ketelitian 5% dan kepercayaan 95%

$$BKA = \bar{\bar{x}} + c\sigma_{\bar{x}}$$
$$= 26.92 + 2(0.70)$$
$$= 28.32$$

$$BKB = \bar{\bar{x}} - c\sigma_{\bar{x}}$$
$$= 26.92 - 2(0.70)$$
$$= 25.52$$

Karena semua nilai rata-ratanya berada diantara kedua batas kontrol maka data seragam.



6. Memasang pipa berbentuk C

Darat

Sub grup ke-	1	2	3	4	5	Rata-rata
1	26.31	26.01	23.85	24.74	24.80	25.14
2	26.04	25.70	24.75	25.79	24.76	25.41
3	25.25	24.43	24.32	23.98	25.43	24.68
4	24.82	26.02	25.30	24.85	24.34	25.07
5	24.25	24.56	25.01	24.51	23.70	24.41
6	23.98	24.75	26.03	25.03	24.79	24.92
					$\bar{\bar{x}}$	24.94
					$S_{\bar{x}}$	0.72

Contoh perhitungan :

$$\bar{\bar{x}} = \frac{\sum xi}{k} = \frac{748.10}{30} = 24.94$$

$$\sigma = \sqrt{\frac{\sum (xi - \bar{\bar{x}})^2}{N-1}} = 0.72$$

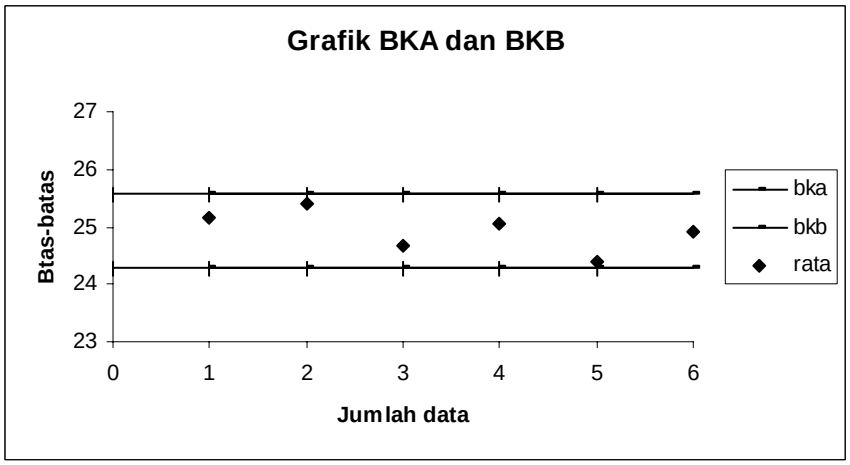
$$\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}} = \frac{0.72}{\sqrt{5}} = 0.32$$

Tingkat ketelitian 5% dan kepercayaan 95%

$$BKA = \bar{\bar{x}} + c\sigma_{\bar{x}}$$
$$= 24.94 + 2(0.32)$$
$$= 25.58$$

$$BKB = \bar{\bar{x}} - c\sigma_{\bar{x}}$$
$$= 24.94 - 2(0.32)$$
$$= 24.3$$

Karena semua nilai rata-ratanya berada diantara kedua batas kontrol maka data seragam.



Air Tawar

Sub grup ke-	1	2	3	4	5	Rata-rata
1	29.35	28.97	29.87	28.93	29.58	29.34
2	29.89	28.75	28.69	28.88	29.35	29.11
3	28.53	29.35	29.73	28.74	28.80	29.03
4	29.41	30.29	29.41	30.01	29.81	29.79
5	29.77	29.54	30.10	30.03	28.75	29.64
6	30.03	30.18	29.35	29.71	29.56	29.77
					$\bar{\bar{x}}$	29.45
					$S_{\bar{x}}$	0.51

Contoh perhitungan :

$$\bar{\bar{x}} = \frac{\sum xi}{k} = \frac{883.36}{30} = 29.45$$

$$\sigma = \sqrt{\frac{\sum (xi - \bar{\bar{x}})^2}{N-1}} = 0.51$$

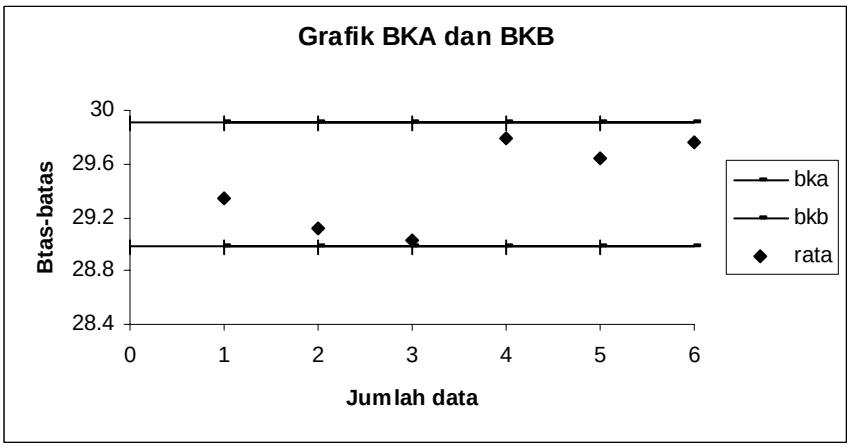
$$\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}} = \frac{0.51}{\sqrt{5}} = 0.23$$

Tingkat ketelitian 5% dan kepercayaan 95%

$$BKA = \bar{\bar{x}} + c\sigma_{\bar{x}}$$
$$= 29.45 + 2(0.23)$$
$$= 29.91$$

$$BKB = \bar{\bar{x}} - c\sigma_{\bar{x}}$$
$$= 29.45 - 2(0.23)$$
$$= 28.99$$

Karena semua nilai rata-ratanya berada diantara kedua batas kontrol maka data seragam.



7. Memasukkan baut panjang pada pipa U

Darat

Sub grup ke-	1	2	3	4	5	Rata-rata
1	14.67	14.75	15.09	15.93	14.74	15.04
2	14.86	14.89	14.69	15.90	14.88	15.04
3	14.55	15.29	14.74	14.64	15.44	14.93
4	15.30	15.01	15.87	15.51	15.83	15.50
5	15.03	15.23	14.92	15.45	14.85	15.10
6	16.31	15.66	14.58	15.10	14.70	15.27
					$\bar{\bar{x}}$	15.15
					$S_{\bar{x}}$	0.48

Contoh perhitungan :

$$\bar{\bar{x}} = \frac{\sum xi}{k} = \frac{454.41}{30} = 15.15$$

$$\sigma = \sqrt{\frac{\sum (xi - \bar{\bar{x}})^2}{N-1}} = 0.48$$

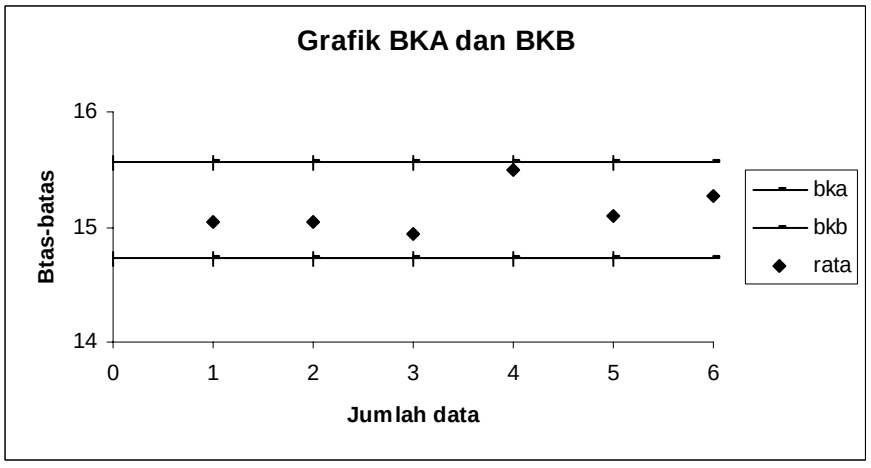
$$\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}} = \frac{0.48}{\sqrt{5}} = 0.21$$

Tingkat ketelitian 5% dan kepercayaan 95%

$$BKA = \bar{\bar{x}} + c\sigma_{\bar{x}}$$
$$= 15.15 + 2(0.21)$$
$$= 15.57$$

$$BKB = \bar{\bar{x}} - c\sigma_{\bar{x}}$$
$$= 15.15 - 2(0.21)$$
$$= 14.73$$

Karena semua nilai rata-ratanya berada diantara kedua batas kontrol maka data seragam.



Air Tawar

Sub grup ke-	1	2	3	4	5	Rata-rata
1	21.48	19.70	20.15	20.24	19.60	20.23
2	20.68	19.73	19.62	19.73	20.78	20.11
3	19.59	21.09	19.23	20.22	19.82	19.99
4	20.35	20.73	20.59	19.39	19.83	20.18
5	20.40	20.07	19.51	19.34	19.66	19.80
6	19.56	19.59	21.06	19.53	20.40	20.03
					$\bar{\bar{x}}$	20.06
					$S_{\bar{x}}$	0.59

Contoh perhitungan :

$$\bar{\bar{x}} = \frac{\sum xi}{k} = \frac{601.67}{30} = 20.06$$

$$\sigma = \sqrt{\frac{\sum (xi - \bar{\bar{x}})^2}{N-1}} = 0.59$$

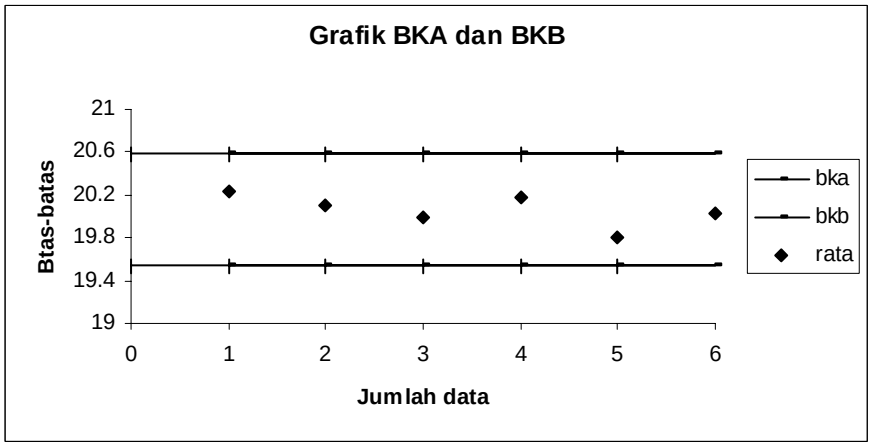
$$\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}} = \frac{0.59}{\sqrt{5}} = 0.26$$

Tingkat ketelitian 5% dan kepercayaan 95%

$$BKA = \bar{\bar{x}} + c\sigma_{\bar{x}}$$
$$= 20.06 + 2(0.26)$$
$$= 20.58$$

$$BKB = \bar{\bar{x}} - c\sigma_{\bar{x}}$$
$$= 20.06 - 2(0.26)$$
$$= 19.54$$

Karena semua nilai rata-ratanya berada diantara kedua batas kontrol maka data seragam.



8. Memasang pipa pada soket berbentuk lurus (I)

Darat

Sub grup ke-	1	2	3	4	5	Rata-rata
1	12.80	12.25	11.05	12.29	12.07	12.09
2	10.76	12.20	12.73	12.11	12.67	12.09
3	12.13	12.37	12.39	12.35	11.78	12.20
4	11.95	11.88	12.30	12.42	11.99	12.11
5	12.06	11.98	12.33	12.09	12.75	12.24
6	12.01	10.98	12.25	11.90	12.40	11.91
					$\bar{\bar{x}}$	12.11
					$S_{\bar{x}}$	0.48

Contoh perhitungan :

$$\bar{\bar{x}} = \frac{\sum xi}{k} = \frac{363.24}{30} = 12.11$$

$$\sigma = \sqrt{\frac{\sum (xi - \bar{\bar{x}})^2}{N-1}} = 0.48$$

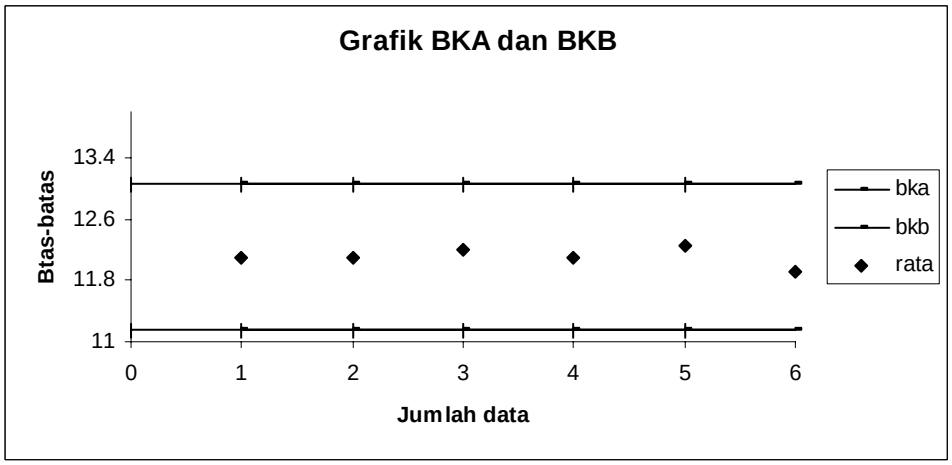
$$\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}} = \frac{0.48}{\sqrt{5}} = 0.21$$

Tingkat ketelitian 5% dan kepercayaan 95%

$$BKA = \bar{\bar{x}} + c\sigma_{\bar{x}}$$
$$= 12.11 + 2(0.48)$$
$$= 13.07$$

$$BKB = \bar{\bar{x}} - c\sigma_{\bar{x}}$$
$$= 12.11 - 2(0.48)$$
$$= 11.15$$

Karena semua nilai rata-ratanya berada diantara kedua batas kontrol maka data seragam.



Air Tawar

Sub grup ke-	1	2	3	4	5	Rata-rata
1	18.24	18.30	18.52	18.42	18.21	18.34
2	18.13	18.45	18.30	18.24	17.83	18.19
3	17.88	18.13	17.43	17.69	18.28	17.88
4	17.98	19.01	17.85	17.71	18.10	18.13
5	18.11	18.42	18.53	17.95	18.15	18.23
6	18.09	17.77	18.50	17.97	18.17	18.10
					$\bar{\bar{x}}$	18.15
					$S_{\bar{x}}$	0.32

Contoh perhitungan :

$$\bar{\bar{x}} = \frac{\sum xi}{k} = \frac{544.36}{30} = 18.14$$

$$\sigma = \sqrt{\frac{\sum (xi - \bar{\bar{x}})^2}{N-1}} = 0.32$$

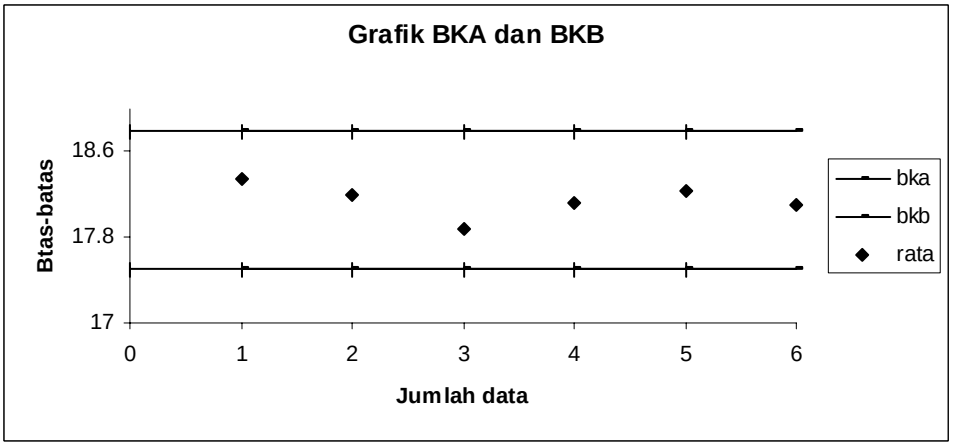
$$\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}} = \frac{0.32}{\sqrt{5}} = 0.14$$

Tingkat ketelitian 5% dan kepercayaan 95%

$$BKA = \bar{\bar{x}} + c\sigma_{\bar{x}}$$
$$= 18.15 + 2(0.32)$$
$$= 18.79$$

$$BKB = \bar{\bar{x}} - c\sigma_{\bar{x}}$$
$$= 18.15 - 2(0.32)$$
$$= 17.51$$

Karena semua nilai rata-ratanya berada diantara kedua batas kontrol maka data seragam.



1. Melepaskan mur pada baut yang terpasang di pipa menggunakan tangan

Darat ***Air Tawar***

Tingkat ketelitian 5% dan kepercayaan 95%

$$N' = \left[\frac{c/\alpha \sqrt{N\sum xi^2 - (\sum xi)^2}}{\sum xi}\right]^2$$

$$= \left[\frac{2/0{,}05\sqrt{30*(808.49) - (154.87)^2}}{154.87}\right]^2$$

$$= \left[\frac{657.24}{154.87}\right]^2$$

$$= 18.01$$

$$\approx 18$$

$$N' = \left[\frac{c/\alpha \sqrt{N\sum xi^2 - (\sum xi)^2}}{\sum xi}\right]^2$$

$$= \left[\frac{2/0{,}05\sqrt{30*(3527.18) - (324.87)^2}}{324.87}\right]^2$$

$$= \left[\frac{663.18}{324.87}\right]^2$$

$$= 4.17$$

$$\approx 4$$

Karena N' < N maka data mencukupi

2. Melepaskan baut pada mur yang terpasang di pipa menggunakan obeng

Darat ***Air Tawar***

Tingkat ketelitian 5% dan kepercayaan 95%

$$N' = \left[\frac{c/\alpha \sqrt{N\sum xi^2 - (\sum xi)^2}}{\sum xi}\right]^2$$

$$= \left[\frac{2/0{,}05\sqrt{30*(1701.28) - (224.53)^2}}{224.53}\right]^2$$

$$= \left[\frac{999.74}{224.53}\right]^2$$

$$= 19.83$$

$$\approx 20$$

$$N' = \left[\frac{c/\alpha \sqrt{N\sum xi^2 - (\sum xi)^2}}{\sum xi}\right]^2$$

$$= \left[\frac{2/0{,}05\sqrt{30*(4953.997) - (384.97)^2}}{384.97}\right]^2$$

$$= \left[\frac{817.81}{384.97}\right]^2$$

$$= 4.51$$

$$\approx 5$$

Karena N' < N maka data mencukupi

3. Memasukkan mur pada baut

Darat ***Air Tawar***

Tingkat ketelitian 5% dan kepercayaan 95%

$$N' = \left[\frac{c/\alpha \sqrt{N\sum xi^2 - (\sum xi)^2}}{\sum xi}\right]^2$$

$$= \left[\frac{2/_{0,05}\sqrt{30*(819.27) - (156.41)^2}}{156.41}\right]^2$$

$$= \left[\frac{427.11}{156.41}\right]^2$$

$$= 7.46$$

$$\approx 7$$

$$N' = \left[\frac{c/\alpha \sqrt{N\sum xi^2 - (\sum xi)^2}}{\sum xi}\right]^2$$

$$= \left[\frac{2/_{0,05}\sqrt{30*(2406.33) - (268.19)^2}}{268.19}\right]^2$$

$$= \left[\frac{649.95}{268.19}\right]^2$$

$$= 5.87$$

$$\approx 6$$

Karena N' < N maka data mencukupi

4. Memasang pipa pada soket berbentuk L

Darat ***Air Tawar***

Tingkat ketelitian 5% dan kepercayaan 95%

$$N' = \left[\frac{c/\alpha \sqrt{N\sum xi^2 - (\sum xi)^2}}{\sum xi}\right]^2$$

$$= \left[\frac{2/_{0,05}\sqrt{30*(2044.86) - (246.37)^2}}{246.37}\right]^2$$

$$= \left[\frac{1017.94}{246.37}\right]^2$$

$$= 17.07$$

$$\approx 17$$

$$N' = \left[\frac{c/\alpha \sqrt{N\sum xi^2 - (\sum xi)^2}}{\sum xi}\right]^2$$

$$= \left[\frac{2/_{0,05}\sqrt{30*(5790.27) - (416.22)^2}}{416.22}\right]^2$$

$$= \left[\frac{866.27}{416.22}\right]^2$$

$$= 4.33$$

$$\approx 4$$

Karena N' < N maka data mencukupi

5. Memasang pipa pada soket berbentuk T (darat)

Darat

Tingkat ketelitian 5% dan kepercayaan 95%

$$N' = \left[\frac{c/\alpha \sqrt{N\sum xi^2 - (\sum xi)^2}}{\sum xi}\right]^2$$

$$= \left[\frac{2/_{0,05}\sqrt{30*(7691.99) - (479.78)^2}}{479.78}\right]^2$$

$$= \left[\frac{955.70}{479.78}\right]^2$$

$$= 3.96$$

$$\approx 4$$

Air Tawar

$$N' = \left[\frac{c/\alpha \sqrt{N\sum xi^2 - (\sum xi)^2}}{\sum xi}\right]^2$$

$$= \left[\frac{2/_{0,05}\sqrt{30*(21751.43) - (807.54)^2}}{807.54}\right]^2$$

$$= \left[\frac{821.75}{807.54}\right]^2$$

$$= 1.04$$

$$\approx 1$$

Karena N' < N maka data mencukupi

6. Memasang pipa berbentuk C

Darat

Tingkat ketelitian 5% dan kepercayaan 95%

$$N' = \left[\frac{c/\alpha \sqrt{N\sum xi^2 - (\sum xi)^2}}{\sum xi}\right]^2$$

$$= \left[\frac{2/_{0,05}\sqrt{30*(18670.07) - (748.10)^2}}{748.10}\right]^2$$

$$= \left[\frac{847.10}{748.10}\right]^2$$

$$= 1.28$$

$$\approx 1$$

Air Tawar

$$N' = \left[\frac{c/\alpha \sqrt{N\sum xi^2 - (\sum xi)^2}}{\sum xi}\right]^2$$

$$= \left[\frac{2/_{0,05}\sqrt{30*(26018.46) - (883.36)^2}}{883.36}\right]^2$$

$$= \left[\frac{605.19}{883.36}\right]^2$$

$$= 0.47$$

$$\approx 1$$

Karena N' < N maka data mencukupi

7. Memasukkan baut panjang pada pipa U

Darat ***Air Tawar***

Tingkat ketelitian 5% dan kepercayaan 95%

$$N' = \left[\frac{c/\alpha \sqrt{N\sum xi^2 - (\sum xi)^2}}{\sum xi}\right]^2$$

$$= \left[\frac{2/_{0,05}\sqrt{30*(6889.55) - (454.41)^2}}{454.41}\right]^2$$

$$= \left[\frac{562.92}{454.41}\right]^2$$

$$= 1.53$$

$$\approx 2$$

$$N' = \left[\frac{c/\alpha \sqrt{N\sum xi^2 - (\sum xi)^2}}{\sum xi}\right]^2$$

$$= \left[\frac{2/_{0,05}\sqrt{30*(12076.9383) - (601.67)^2}}{601.67}\right]^2$$

$$= \left[\frac{694.45}{601.67}\right]^2$$

$$= 1.33$$

$$\approx 1$$

Karena N' < N maka data mencukupi

8. Memasang pipa pada soket berbentuk lurus (I) (darat)

Darat ***Air Tawar***

Tingkat ketelitian 5% dan kepercayaan 95%

$$N' = \left[\frac{c/\alpha \sqrt{N\sum xi^2 - (\sum xi)^2}}{\sum xi}\right]^2$$

$$= \left[\frac{2/_{0,05}\sqrt{30*(4404.74) - (363.24)^2}}{363.24}\right]^2$$

$$= \left[\frac{564.13}{363.24}\right]^2$$

$$= 2.41$$

$$\approx 2$$

$$N' = \left[\frac{c/\alpha \sqrt{N\sum xi^2 - (\sum xi)^2}}{\sum xi}\right]^2$$

$$= \left[\frac{2/_{0,05}\sqrt{30*(9880.50) - (544.36)^2}}{544.36}\right]^2$$

$$= \left[\frac{373.50}{544.36}\right]^2$$

$$= 0.47$$

$$\approx 1$$

Karena N' < N maka data mencukupi

Uji Wilcoxon (Two Sample Rank Test) untuk index ϕ

1. Ho : $\mu_1 = \mu_2$

   Hi : $\mu_1 \neq \mu_2$

2. $\alpha = 0.05$

Metoda / Pekerjaan	1	2	3	4	5	6	7
Jam henti (air tawar)	12.45	14.76	10.28	15.96	30.96	33.82	23.07
Jam henti (darat)	5.94	8.61	6.00	9.44	18.39	28.68	17.46
di	6.52	6.15	4.28	6.51	12.56	5.14	5.61
Rank	5	3	1	4	7	2	6

Karena Hi : $\mu_1 \neq \mu_2$ maka W = min (W_+;W_-)

$W_+ = 5 + 3 + 1 + 4 + 7 + 2 + 6 = 28$

$W_- = 0$

W = min (W_+;W_-) = 0

$W\alpha = 4$

Wilayah kritis = $W < W\alpha$

Keputusan : Tolak Ho

Kesimpulan : Nilai tengah pengukuran dengan metoda langsung di air tidak sama dengan pengukuran dengan metoda langsung di darat

Uji Wilcoxon (Two Sample Rank Test) untuk index β

1. Ho : $\mu_1 = \mu_2$

   Hi : $\mu_1 \neq \mu_2$

2. $\alpha = 0.05$

Metoda / Pekerjaan	1	2	3	4	5	6	7
Jam henti (darat)	5.94	8.61	6.00	9.44	18.39	28.68	17.46
MTM-1	4.44	5.23	3.89	8.78	12.65	17.16	10.23
di	1.50	3.38	2.10	0.67	5.74	11.52	7.23
Rank	2	4	3	1	5	7	6

Karena Hi : $\mu_1 \neq \mu_2$ maka W = min (W_+;W_-)

$W_+ = 2 + 4 + 3 + 1 + 5 + 7 + 6 = 28$

$W_- = 0$

$W = \min (W_+;W_-) = 0$

$W\alpha = 4$

Wilayah kritis = $W < W\alpha$

Keputusan : Tolak Ho

Kesimpulan : Nilai tengah pengukuran dengan metoda langsung di darat tidak sama dengan pengukuran dengan metoda MTM-1

Uji Wilcoxon (Two Sample Rank Test) untuk index γ

1. Ho : $\mu_1 = \mu_2$

   Hi : $\mu_1 \neq \mu_2$

2. $\alpha = 0.05$

Metoda / Pekerjaan	1	2	3	4	5	6	7
Jam henti (air tawar)	12.45	14.76	10.28	15.96	30.96	33.82	23.07
MTM-1	4.44	5.23	3.89	8.78	12.65	17.16	10.23
di	8.01	9.53	6.39	7.18	18.30	16.66	12.84
Rank	3	4	1	2	7	6	5

Karena Hi : $\mu_1 \neq \mu_2$ maka $W = \min (W_+;W_-)$

$W_+ = 3 + 4 + 1 + 2 + 7 + 6 + 5 = 28$

$W_- = 0$

$W = \min (W_+;W_-) = 0$

$W\alpha = 4$

Wilayah kritis = $W < W\alpha$

Keputusan : Tolak Ho

Kesimpulan : Nilai tengah pengukuran dengan metoda langsung di air tidak sama dengan pengukuran dengan metoda MTM-1

Uji Anova Klasifikasi 2 arah

Pekerjaan	Rasio Index Perbandingan			Total
	φ	β	γ	
1	0.48	1.34	2.81	4.62
2	0.58	1.65	2.82	5.05
3	0.58	1.54	2.64	4.77
4	0.59	1.08	1.82	3.49
5	0.59	1.45	2.45	4.49
6	0.85	1.67	1.97	4.49
7	0.76	1.71	2.26	4.72
Total	4.43	10.43	16.76	**31.62**

Struktur Hipotesis

a. Ho: $\alpha_1 = \alpha_2 = ... = \alpha_7 = 0$ (pengaruh baris adalah nol)

Hi : sekurang-kurangnya satu α_i tidak sama dengan nol

b. Ho: $\beta_1 = \beta_2 = ... = \beta 3 = 0$ (pengaruh kolom adalah nol)

Hi : sekurang-kurangnya satu β_j tidak sama dengan nol

$\alpha = 0.05$

Statistik uji : Uji Anova Klasifikasi 2 arah

$$JKT = SST = \sum_{i=1}^{r}\sum_{j=1}^{c} X_{ij}^2 - \frac{T^2}{rc}$$

$$= (0.48^2+0.58^2+.....+2.26^2) - \frac{(0.48+0.58+.....+2.26)^2}{7*3}$$

$$= 12.20$$

$V_T = rc - 1 = (7*3) - 1 = 20$

$$JKB = SSB = \frac{\sum_{i=1}^{r} T_i^2}{c} - \frac{T^2}{rc}$$

$$= \left(\frac{4.62^2+5.05^2+....+4.72^2}{3}\right) - \frac{(0.48+0.58+.....+2.26)^2}{7*3}$$

$$= 0.49$$

$V_B = r - 1 = 7 - 1 = 6$

$$JKK = SSR = \frac{\sum_{j=1}^{c} Tj^2}{r} - \frac{T^2}{rc}$$

$$= \left(\frac{4.43^2 + 10.43^2 + 16.76^2}{7}\right) - \frac{(0.48 + 0.58 + ... + 2.26)^2}{7*3}$$

$$= 10.85$$

$V_R = c - 1 = 3 - 1 = 2$

JKG = SSE = JKT – JKB – JKK

= 12.20 – 0.49 – 10.85

= 0.86

$V_E = (r - 1)(c - 1)$

= 6 * 2 = 12

Tabel Anova

Sumber Variansi	SS	V	MS	f hitung
Nilai tengah baris	0.49	6	$S_1^2 = \frac{JKB}{r-1} = \frac{0.49}{6} = 0.08$	$f_1 = \frac{S_1^2}{S_3^2} = \frac{0.08}{0.07} = 1.14$
Nilai tengah kolom	10.85	2	$S_2^2 = \frac{JKK}{c-1} = \frac{10.85}{2} = 5.43$	$f_2 = \frac{S_2^2}{S_3^2} = \frac{5.43}{0.07} = 77.57$
Galat	0.86	12	$S_3^2 = \frac{JKG}{(r-1)(c-1)} = \frac{0.86}{12} = 0.07$	
Total	12.20	20		

Wilayah kritis

(1) $F_1 < F\,\alpha(v1, v2) = F_1 < F_{0.05(6.12)}$

= 1.14 < 3

Keputusan : Terima Ho

Kesimpulan : pengaruh baris adalah nol pada $\alpha = 0.05$

(2) $F_2 > F\,\alpha(v1, v2) = F_2 > F_{0.05(2.12)}$

= 77.57 > 3.89

Keputusan : Tolak Ho

Kesimpulan : sekurang-kurangnya satu β_j tidak sama dengan nol pada $\alpha = 0.05$

UJI KESAMAAN RATA_RATA

Uji Kesamaan Rata-rata index ϕ

Pekerjaan	Waktu Normal (jam henti)		Rasio Index
	darat	air tawar	Perbandingan
1	5.94	12.45	0.48
2	8.61	14.76	0.58
3	6.00	10.28	0.58
4	9.44	15.96	0.59
5	18.39	30.96	0.59
6	28.68	33.82	0.85
7	17.46	23.07	0.76
		Total	4.43
		Rata-rata	0.63

Ho : $\mu_1 = \mu_2 = ... = \mu_7$ (rasio index perbandingan ketujuh jenis pekerjaan sama)

Hi : paling sedikit satu tanda sama dengan tidak berlaku

$\alpha = 0.05$

$\overline{X} = \frac{4.43}{7} = 0.63$

$$\chi^2 = \frac{(0.48-0.63)^2}{0.63} + \frac{(0.58-0.63)^2}{0.63} + ... + \frac{(0.76-0.63)^2}{0.63}$$

$= 0.15$

$\chi^2_{(1-\alpha)(k-1)} = \chi^2_{0.95(6)} = 12.6$

$\chi^2_{0.95(6)} > \chi^2$

Keputusan : Terima Ho

Kesimpulan : rasio index perbandingan ketujuh jenis pekerjaan sama pada $\alpha = 0.05$

Uji Kesamaan Rata-rata index β

Pekerjaan	Waktu Normal		Rasio Index
	darat (jam henti)	MTM-1	Perbandingan
1	5.94	4.44	1.34
2	8.61	5.23	1.65
3	6.00	3.89	1.54
4	9.44	8.78	1.08
5	18.39	12.65	1.45
6	28.68	17.16	1.67
7	17.46	10.23	1.71
		Total	10.43
		Rata-rata	1.49

Ho : $\mu_1 = \mu_2 = ... = \mu_7$ (rasio index perbandingan ketujuh jenis pekerjaan sama)

Hi : paling sedikit satu tanda sama dengan tidak berlaku

$\alpha = 0.05$

$\overline{X} = \frac{10.43}{7} = 1.49$

$$\chi^2 = \frac{(1.34-1.49)^2}{1.49} + \frac{(1.65-1.49)^2}{1.49} + ... + \frac{(1.71-1.49)^2}{1.49}$$

$= 0.20$

$\chi^2_{(1-\alpha)(k-1)} = \chi^2_{0.95(6)} = 12.6$

$\chi^2_{0.95(6)} > \chi^2$

Keputusan : Terima Ho

Kesimpulan : rasio index perbandingan ketujuh jenis pekerjaan sama pada $\alpha = 0.05$

Uji Kesamaan Rata-rata index γ

Pekerjaan	Waktu Normal		Rasio Index
	air tawar (jam henti)	MTM-1	Perbandingan
1	12.45	4.44	2.81
2	14.76	5.23	2.82
3	10.28	3.89	2.64
4	15.96	8.78	1.82
5	30.96	12.65	2.45
6	33.82	17.16	1.97
7	23.07	10.23	2.26
		Total	16.76
		Rata-rata	2.39

Ho : $\mu_1 = \mu_2 = ... = \mu_7$ (rasio index perbandingan ketujuh jenis pekerjaan sama)

Hi : paling sedikit satu tanda sama dengan tidak berlaku

$\alpha = 0.05$

$\overline{X} = \frac{16.76}{7} = 2.39$

$$\chi^2 = \frac{(2.81-2.39)^2}{2.39} + \frac{(2.82-2.39)^2}{2.39} + ... + \frac{(2.26-2.39)^2}{2.39}$$

$= 0.40$

$\chi^2_{(1-\alpha)(k-1)} = \chi^2_{0.95(6)} = 12.6$

$\chi^2_{0.95(6)} > \chi^2$

Keputusan : Terima Ho

Kesimpulan : rasio index perbandingan ketujuh jenis pekerjaan sama pada $\alpha = 0.05$

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