

DAFTAR PUSTAKA

- Gibbons, J. D. & Chakraborti, S. (2003). *Nonparametric Statistical Inference (4th ed)*. New York: Marcel Dekker
- Imam, A., Usman, M., & Chiawa, M. A. (2014). On Consistency and Limitation of paired t-test, Sign and Wilcoxon Sign Rank Test. *Journal of Mathematics Volume 10, Issue 1 Ver. IV, PP 01-06*
- Ainun. (2022). *Performa Bagan Kendali Nonparametrik Exponentially Weighted Moving Average Sign Pada Produksi Pakan Ternak* [Skripsi]. Universitas Hasanuddin.
- Damayanti, K., Fajri, M., & Adriana, N. (2022). Pengendalian Kualitas Di Mabel PT. Jaya Abadi Dengan Menggunakan Metode *Seven Tools*. *Bulletin of Applied Industrial Engineering*, 3(1).
- Harris, T., & Hardin, J. W. (2013). Exact Wilcoxon signed-rank and Wilcoxon Mann–Whitney ranksum tests. *The Stata Journal (2013) 13, Number 2*, pp. 337–343.
- Wilcox, R. R. (2003). *Applying Contemporary Statistical Techniques*. PP 557-608. Los Angeles:
- Riffenburgh, R. H. (2006). Statistics in medicine (2th Ed). *Basic of Rank*, 16(1), 281-303.
- Raza, M. A., Nawaz, T., Aslam, M., Bhatti, S. H., & Sherwani, R. A. K. (2020). A new nonparametric double exponentially weighted moving average control chart. *Quality and Reliability Engineering International*, 36(1), 68–87.
- Abbasi, S. A. (2010). On sensitivity of EWMA control chart for monitoring process dispersion. *WCE 2010 - World Congress on Engineering 2010*, 3, 2027–2032.
- Montgomery, D. C. (2009). Introduction To Statistical Quality Control. In *Plastics and rubber international*, 10(1), 419-428.
- Putri, k. i. k. (2011). Bagan Kendali Exponentially Weighted Moving Average Untuk Mean Proses. *Universitas Indonesia : Skripsi*.
- Sibuea, N. A. (2019). Pendugaan Parameter Distribusi Binomial Dengan Menggunakan Pemrograman Bahasa R. *Universitas Sumatera Utara: Skripsi*.
- Sujarweni, V.M., Endrayanto, P. (2012). *Statistika untuk Penelitian*. Yogyakarta:

Graha Ilmu.

- Amin, R. W., Reynolds, M. R., & Bakir, S. (2014). Nonparametric quality control charts based on the sign statistic. *Communications in Statistics - Theory and Methods*, 24(6), 1597–1623.
- Nuraviva, D. A., & Achmad, A. I. (2011). Diagram Kendali Exponentially Weighted Moving Average Sign. *Prosiding Statistika*, 4(1), 1–9.
- Park, H.-I. (2013). A Note on the Median Control Chart. *Communications for Statistical Applications and Methods*, 20(2), 107–113.
- Ronald, L. I. (1974). Use of a t-Statistic as an Approximation to the Exact Distribution of the Wilcoxon Signed Ranks Test Statistic. *Western Michigan University*
- Gibbons, J. D. & Chakraborti, S. (2010). *Nonparametric Statistical Inference* (5th ed). Boca Raton: CRC Press

LAMPIRAN

Lampiran 1. Data Pengamatan Kandungan Lemak (%) dalam Produk Pakan Ternak pada Bulan Desember 2021 hingga Januari 2022

Sampel Produk Pakan Ternak (i)	Pengamatan Kandungan Lemak (%) dalam setiap sampel produk pakan ternak (j)									
	X ₁	X ₂	X ₃	X ₄	X ₅	X ₆	X ₇	X ₈	X ₉	X ₁₀
1	5.8	5.7	5.9	5.3	6	5.9	5.5	5.8	5.2	5
2	5.1	4.7	5.2	5	5.8	5.7	4.9	5	5.2	5.5
3	5.7	5.5	5.9	6.1	5.8	5.5	5.2	4.9	5.3	5.8
4	5.6	5.7	5.6	5.5	6.4	5.8	6.2	5.9	5.2	5.5
5	6.7	6.3	6	5.8	5.7	5.3	5	5.5	5.3	5.9
6	6.5	6	5.9	5.5	5.6	5.8	5.2	5.7	5.9	6.4
7	6	5.9	5.8	6.1	6.3	5.8	5.7	5.8	5.9	6.5
8	5.9	6.1	5.8	5.7	5.7	5.6	5.7	5.4	5.4	5.7
9	5.7	6.1	5.9	5.5	6.5	5.6	6	5.7	5.8	6
10	5.5	5.7	6.2	5.9	5.8	5.5	6.2	5.8	5.7	5.1
11	5.7	6.2	5.9	5.7	5.4	5.8	5.9	5.7	5.9	5.5
12	5.2	5.5	5.3	5.8	5.5	5.2	5.9	6	5.7	5.1
13	5.7	6	5.5	5.8	5.9	5.5	6.5	5	5.5	5.8
14	5.7	5.6	5.4	5.8	5.9	6	6.4	5.5	5.3	4.7
15	5.1	5.5	5.8	5.3	5.2	5.8	6	6.1	5.8	5.5
16	5.1	5.8	5.9	5.8	5.9	5.1	5.9	5.8	5.9	5.8
17	6.3	5.8	5.9	5.8	6.2	5.9	6.2	6.3	6.1	5.9
18	5.7	6.1	6.4	5.9	6.4	6.7	6.8	6.5	6.3	6.2
19	6	5.8	5.9	5.8	6.1	5.9	5.8	5.9	5.8	6
20	5.8	5.6	5.8	5.9	5.9	5.8	5.7	5.8	5.2	6.2
21	5.5	5.4	4.9	5.6	5.8	5.3	5.9	5.5	5.6	5.7
22	5.7	5.8	5.5	5.7	5.6	5.9	5.6	5.9	5.7	5.8
23	5.5	5.7	5.5	5.9	5.6	5.5	5.6	5.5	5.6	5.9
24	5.4	5.7	5.5	5.5	5.9	5.7	5.7	5.9	5.6	5.9
25	5.9	6.5	6.4	6	6.3	5.9	6.5	6.8	6.4	6
26	6	5.9	6.3	6.4	6.7	6.5	6.4	6	6.5	6.6
27	5.8	5.5	5.6	4.9	5.5	5.8	4.7	5.9	5.8	5.5
28	5.7	5.9	6.3	6.2	6	5.9	5.9	5.7	5.9	6
29	5.7	5.8	6.1	5.7	5.8	6.1	6.4	6.3	6.2	6.4
30	5.5	5.2	5.3	5.1	5.3	5.5	5.4	5.9	5.4	5.8

Sumber: Divisi *Quality Control* (QC) PT. Japfa Comfeed Indonesia, Tbk Unit Makassar.

Lampiran 2. Uji Normalitas Kolmogorov-Smirnov

Data Kandungan Lemak (%) dalam produk pakan ternak	Frek (F_i)	F_{kum}	F_s	F_t	$ F_t - F_s $
4.7	3	3	0.01	0.00276	0.00724
4.8	1	4	0.013333	0.005943	0.00739
4.9	4	8	0.026667	0.012035	0.014632
5	4	12	0.04	0.02294	0.01706
5.1	7	19	0.063333	0.041195	0.022139
5.2	11	30	0.1	0.069774	0.030226
5.3	9	39	0.13	0.111618	0.018382
5.4	8	47	0.156667	0.168916	0.012249
5.5	35	82	0.273333	0.242292	0.031041
5.6	16	98	0.326667	0.330172	0.003506
5.7	35	133	0.443333	0.428605	0.014728
5.8	46	179	0.596667	0.531716	0.064951
5.9	48	227	0.756667	0.63273	0.123936
6	18	245	0.816667	0.725281	0.091385
6.1	10	255	0.85	0.804585	0.045415
6.2	10	265	0.883333	0.868136	0.015197
6.3	9	274	0.913333	0.915765	0.002431
6.4	11	285	0.95	0.949148	0.000852
6.5	9	294	0.98	0.97103	0.00897
6.6	1	295	0.983333	0.984445	0.001112
6.7	3	298	0.993333	0.992136	0.001197
6.8	2	300	1	0.99626	0.00374

Total (n)	300
Rata-rata (μ)	5.769333
SD (σ)	0.385341
D_{hitung}	0.123936
$D(0.05;300)$	0.077942
Hasil	$D_{hitung} = 0.12393 > D_{(0.05;300)} = 0.0779$

Lampiran 3. Output Hasil Perhitungan M_{ij} dan S_i Dengan Mean

Sampe l (i)	M_{ij}										S_i
	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	
1	1	1	1	0	1	1	0	1	0	0	6
2	0	0	0	0	1	1	0	0	0	1	3
3	1	0	1	1	1	0	0	0	0	1	5
4	0	0	0	0	1	1	1	1	0	0	4
5	1	1	1	1	0	0	0	0	0	1	5
6	1	1	1	0	0	0	0	0	1	1	5
7	1	0	0	1	1	0	0	0	0	1	4
8	1	1	1	0	0	0	0	0	0	0	3
9	0	1	1	0	1	0	1	0	0	1	5
10	0	0	1	1	1	0	1	1	0	0	5
11	0	1	1	0	0	1	1	0	1	0	5
12	0	0	0	1	0	0	1	1	1	0	4
13	0	1	0	1	1	0	1	0	0	1	5
14	1	0	0	1	1	1	1	0	0	0	5
15	0	0	1	0	0	1	1	1	1	0	5
16	0	1	1	1	1	0	1	1	1	1	8
17	1	0	0	0	1	0	1	1	1	0	5
18	0	0	1	0	1	1	1	1	0	0	5
19	1	0	0	0	1	0	0	0	0	1	3
20	1	0	1	1	1	1	0	1	0	1	7
21	0	0	0	1	1	0	1	0	1	1	5
22	0	1	0	0	0	1	0	1	0	1	4
23	0	1	0	1	0	0	0	0	0	1	3
24	0	1	0	0	1	1	1	1	0	1	6
25	0	1	1	0	1	0	1	1	1	0	6
26	0	0	0	1	1	1	1	0	1	1	6
27	1	0	1	0	0	1	0	1	1	0	5
28	0	0	1	1	1	0	0	0	0	1	4
29	0	0	1	0	0	1	1	1	1	1	6
30	1	0	0	0	0	1	0	1	0	1	4

Lampiran 4. Output Hasil Perhitungan M_{ij} dan S_i Dengan Median

Sampe l (i)	M_{ij}										S_i
	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	
1	1	0	1	0	1	1	0	1	0	0	5
2	0	0	1	0	1	1	0	0	1	1	5
3	1	0	1	1	1	0	0	0	0	1	5
4	0	1	0	0	1	1	1	1	0	0	5
5	1	1	1	1	0	0	0	0	0	1	5
6	1	1	1	0	0	0	0	0	1	1	5
7	1	0	0	1	1	0	0	0	0	1	4
8	1	1	1	0	0	0	0	0	0	0	3
9	0	1	1	0	1	0	1	0	0	1	5
10	0	0	1	1	1	0	1	1	0	0	5
11	0	1	1	0	0	1	1	0	1	0	5
12	0	0	0	1	0	0	1	1	1	0	4
13	0	1	0	1	1	0	1	0	0	1	5
14	1	0	0	1	1	1	1	0	0	0	5
15	0	0	1	0	0	1	1	1	1	0	5
16	0	0	1	0	1	0	1	0	1	0	4
17	1	0	0	0	1	0	1	1	1	0	5
18	0	0	1	0	1	1	1	1	0	0	5
19	1	0	0	0	1	0	0	0	0	1	3
20	0	0	0	1	1	0	0	0	0	1	3
21	0	0	0	1	1	0	1	0	1	1	5
22	0	1	0	0	0	1	0	1	0	1	4
23	0	1	0	1	0	0	0	0	0	1	3
24	0	0	0	0	1	0	0	1	0	1	3
25	0	1	1	0	0	0	1	1	1	0	5
26	0	0	0	0	1	1	0	0	1	1	4
27	1	0	1	0	0	1	0	1	1	0	5
28	0	0	1	1	1	0	0	0	0	1	4
29	0	0	0	0	0	0	1	1	1	1	4
30	1	0	0	0	0	1	0	1	0	1	4

Lampiran 5. Output Bagan Kendali Wilcoxon Sign Dengan Mean

Sampel (i)	SR_i	T_i	UCL	CL	LCL	KETERANGAN
1	6	8	8	5	2	Terkendali
2	3	6.5	8	5	2	Terkendali
3	5	7.5	8	5	2	Terkendali
4	4	7	8	5	2	Terkendali
5	5	7.5	8	5	2	Terkendali
6	5	7.5	8	5	2	Terkendali
7	4	7	8	5	2	Terkendali
8	3	6.5	8	5	2	Terkendali
9	5	7.5	8	5	2	Terkendali
10	5	7.5	8	5	2	Terkendali
11	5	7.5	8	5	2	Terkendali
12	4	7	8	5	2	Terkendali
13	5	7.5	8	5	2	Terkendali
14	5	7.5	8	5	2	Terkendali
15	5	7.5	8	5	2	Terkendali
16	8	9	8	5	2	Tidak terkendali
17	5	7.5	8	5	2	Terkendali
18	5	7.5	8	5	2	Terkendali
19	3	6.5	8	5	2	Terkendali
20	7	8.5	8	5	2	Tidak terkendali
21	5	7.5	8	5	2	Terkendali
22	4	7	8	5	2	Terkendali
23	3	6.5	8	5	2	Terkendali
24	6	8	8	5	2	Terkendali
25	6	8	8	5	2	Terkendali
26	6	8	8	5	2	Terkendali
27	5	7.5	8	5	2	Terkendali
28	4	7	8	5	2	Terkendali
29	6	8	8	5	2	Terkendali
30	4	7	8	5	2	Terkendali

Lampiran 6. Output Bagan Kendali Wilcoxon Sign Dengan Median

Sampel (i)	SR_i	T_i	UCL	CL	LCL	KETERANGAN
1	5	7.5	8	5	2	Terkendali
2	5	7.5	8	5	2	Terkendali
3	5	7.5	8	5	2	Terkendali
4	5	7.5	8	5	2	Terkendali
5	5	7.5	8	5	2	Terkendali
6	5	7.5	8	5	2	Terkendali
7	4	7	8	5	2	Terkendali
8	3	6.5	8	5	2	Terkendali
9	5	7.5	8	5	2	Terkendali
10	5	7.5	8	5	2	Terkendali
11	5	7.5	8	5	2	Terkendali
12	4	7	8	5	2	Terkendali
13	5	7.5	8	5	2	Terkendali
14	5	7.5	8	5	2	Terkendali
15	5	7.5	8	5	2	Terkendali
16	4	7	8	5	2	Terkendali
17	5	7.5	8	5	2	Terkendali
18	5	7.5	8	5	2	Terkendali
19	3	6.5	8	5	2	Terkendali
20	3	6.5	8	5	2	Terkendali
21	5	7.5	8	5	2	Terkendali
22	4	7	8	5	2	Terkendali
23	3	6.5	8	5	2	Terkendali
24	3	6.5	8	5	2	Terkendali
25	5	7.5	8	5	2	Terkendali
26	4	7	8	5	2	Terkendali
27	5	7.5	8	5	2	Terkendali
28	4	7	8	5	2	Terkendali
29	4	7	8	5	2	Terkendali
30	4	7	8	5	2	Terkendali

Lampiran 7. Output Hasil Perhitungan Rank (R_i) dan S_i Dengan Mean

Sampe l (i)	R_i										S_i
	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	
1	4	1	6	7	8	5	2	3	9	10	6
2	3	9	1	4	10	8	7	5	2	6	3
3	3	1	7	9	4	2	8	10	6	5	5
4	3	1	4	6	10	2	8	5	9	7	4
5	10	8	4	1	2	6	9	5	7	3	5
6	9	4	1	7	6	2	10	5	3	8	5
7	1	2	5	4	9	6	8	7	3	10	4
8	7	10	5	1	2	6	3	8	9	4	3
9	5	7	1	9	10	8	3	6	2	4	5
10	6	1	8	5	3	7	9	4	2	10	5
11	2	10	5	3	9	1	6	4	7	8	5
12	6	1	4	5	2	7	8	10	3	9	4
13	1	8	5	2	4	6	10	9	7	3	5
14	2	1	5	4	6	8	9	3	7	10	5
15	10	1	3	6	8	4	7	9	5	2	5
16	9	1	5	2	6	10	7	3	8	4	8
17	9	7	2	8	5	3	6	10	1	4	5
18	10	5	2	7	3	8	9	6	1	4	5
19	4	5	1	6	10	2	7	3	8	9	3
20	1	8	2	6	7	3	5	4	10	9	7
21	1	5	10	3	8	7	9	2	4	6	5
22	1	4	10	2	6	8	7	9	3	5	4
23	5	4	6	9	1	7	2	8	3	10	3
24	10	1	5	6	7	2	3	8	4	9	6
25	8	4	2	6	1	9	5	10	3	7	6
26	7	10	1	2	9	4	3	8	5	6	6
27	5	1	4	9	2	6	10	8	7	3	5
28	7	1	10	8	2	3	4	9	5	6	4
29	7	4	1	8	5	2	9	6	3	10	6
30	3	7	5	8	6	4	1	10	2	9	4

Lampiran 8. Output Hasil Perhitungan Rank (R_i) dan S_i Dengan Median

Sampe l (i)	R_i										S_i
	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	
1	1	2	4	8	6	5	7	3	9	10	5
2	1	8	2	4	10	9	6	5	3	7	5
3	1	2	6	9	4	3	8	10	7	5	5
4	1	2	3	6	10	4	9	7	8	5	5
5	10	8	4	1	2	6	9	5	7	3	5
6	10	5	1	7	6	2	9	4	3	8	5
7	6	2	3	7	9	4	8	5	1	10	4
8	7	10	5	1	3	6	2	9	8	4	3
9	5	8	1	9	10	7	3	6	2	4	5
10	6	3	8	5	4	7	9	2	1	10	5
11	2	10	6	4	9	3	7	1	5	8	5
12	5	2	4	7	1	6	8	10	3	9	4
13	1	5	7	2	4	8	9	10	6	3	5
14	1	2	6	3	5	8	9	4	7	10	5
15	10	1	2	6	9	4	7	8	3	5	5
16	10	1	5	3	8	9	7	4	6	2	4
17	10	5	2	6	8	4	7	9	3	1	5
18	10	6	1	8	3	7	9	5	2	4	5
19	9	6	1	7	10	3	8	2	4	5	3
20	4	8	1	5	7	3	6	2	10	9	3
21	2	5	10	3	8	7	9	1	4	6	5
22	1	4	10	2	6	9	7	8	3	5	4
23	4	5	8	9	2	7	3	6	1	10	3
24	10	2	7	8	5	3	1	6	4	9	3
25	10	5	3	6	2	8	4	9	1	7	5
26	9	10	4	2	7	5	1	8	3	6	4
27	7	4	1	9	3	6	10	8	5	2	5
28	7	1	10	9	6	3	4	8	2	5	4
29	9	5	2	10	8	1	6	4	3	7	4
30	6	7	4	8	5	3	2	10	1	9	4

Lampiran 9. Output Bagan Kendali Wilcoxon Sign Rank Dengan Mean

Sampel (i)	SR_i	R^+	UCL	CL	LCL	KETERANGAN
1	6	27	56.93	27.50	-1.93	Terkendali
2	3	24	56.93	27.50	-1.93	Terkendali
3	5	28	56.93	27.50	-1.93	Terkendali
4	4	25	56.93	27.50	-1.93	Terkendali
5	5	26	56.93	27.50	-1.93	Terkendali
6	5	25	56.93	27.50	-1.93	Terkendali
7	4	24	56.93	27.50	-1.93	Terkendali
8	3	22	56.93	27.50	-1.93	Terkendali
9	5	25	56.93	27.50	-1.93	Terkendali
10	5	29	56.93	27.50	-1.93	Terkendali
11	5	29	56.93	27.50	-1.93	Terkendali
12	4	26	56.93	27.50	-1.93	Terkendali
13	5	27	56.93	27.50	-1.93	Terkendali
14	5	29	56.93	27.50	-1.93	Terkendali
15	5	28	56.93	27.50	-1.93	Terkendali
16	8	36	56.93	27.50	-1.93	Terkendali
17	5	31	56.93	27.50	-1.93	Terkendali
18	5	28	56.93	27.50	-1.93	Terkendali
19	3	23	56.93	27.50	-1.93	Terkendali
20	7	32	56.93	27.50	-1.93	Terkendali
21	5	30	56.93	27.50	-1.93	Terkendali
22	4	26	56.93	27.50	-1.93	Terkendali
23	3	23	56.93	27.50	-1.93	Terkendali
24	6	30	56.93	27.50	-1.93	Terkendali
25	6	25	56.93	27.50	-1.93	Terkendali
26	6	29	56.93	27.50	-1.93	Terkendali
27	5	30	56.93	27.50	-1.93	Terkendali
28	4	26	56.93	27.50	-1.93	Terkendali
29	6	31	56.93	27.50	-1.93	Terkendali
30	4	26	56.93	27.50	-1.93	Terkendali

Lampiran 10. Output Bagan Kendali Wilcoxon Sign Rank Dengan Median

Sampel (i)	SR_i	R^+	UCL	CL	LCL	KETERANGAN
1	5	19	56.93	27.50	-1.93	Terkendali
2	5	31	56.93	27.50	-1.93	Terkendali
3	5	25	56.93	27.50	-1.93	Terkendali
4	5	32	56.93	27.50	-1.93	Terkendali
5	5	26	56.93	27.50	-1.93	Terkendali
6	5	27	56.93	27.50	-1.93	Terkendali
7	4	32	56.93	27.50	-1.93	Terkendali
8	3	22	56.93	27.50	-1.93	Terkendali
9	5	26	56.93	27.50	-1.93	Terkendali
10	5	28	56.93	27.50	-1.93	Terkendali
11	5	31	56.93	27.50	-1.93	Terkendali
12	4	28	56.93	27.50	-1.93	Terkendali
13	5	23	56.93	27.50	-1.93	Terkendali
14	5	26	56.93	27.50	-1.93	Terkendali
15	5	24	56.93	27.50	-1.93	Terkendali
16	4	26	56.93	27.50	-1.93	Terkendali
17	5	37	56.93	27.50	-1.93	Terkendali
18	5	25	56.93	27.50	-1.93	Terkendali
19	3	24	56.93	27.50	-1.93	Terkendali
20	3	21	56.93	27.50	-1.93	Terkendali
21	5	30	56.93	27.50	-1.93	Terkendali
22	4	26	56.93	27.50	-1.93	Terkendali
23	3	24	56.93	27.50	-1.93	Terkendali
24	3	20	56.93	27.50	-1.93	Terkendali
25	5	22	56.93	27.50	-1.93	Terkendali
26	4	21	56.93	27.50	-1.93	Terkendali
27	5	27	56.93	27.50	-1.93	Terkendali
28	4	30	56.93	27.50	-1.93	Terkendali
29	4	20	56.93	27.50	-1.93	Terkendali
30	4	28	56.93	27.50	-1.93	Terkendali