

## DAFTAR PUSTAKA

- Anggara, D., Indahwati & A, K., 2015. Generalized Linear Mixed Models Approaches To Modeling Panel Data: Application To Poverty In East Nusa Tenggara. *Iobal Journal of Pure and Applied Mathematics* 11, 11(0973-1768), pp. 2867-2875..
- Asmin, S., 2010. *Pemodelan Nilai Unas IPA dengan Pendekatan Regresi Semiparametrik Spline di SMAN 1 Grati Pasuruan*. Surabaya: Institut Teknologi Sepuluh Nopember .
- Aydin, D. & Yilmaz, E., 2017. Bandwidth Selection Problem for Nonparametrik Regression Model with Right-Censored Data. *Romanian Statistical Review*.
- Berridge, D. M. & Crouchley, R., 2011. *Multivariate Generalized Linear Mixed Models Using R*. New York: CRC Press.
- Budiantara, I. N., 2006. Model *Spline* dengan Knot Optimal. *Jurnal Ilmu Dasar FMIPA Universitas Jember*, Volume 6, pp. 77-85.
- Budiantara, I. N., 2011. *Penelitian Bidang Regresi Spline Menuju Terwujudnya Penelitian Statistika yang Mandiri dan Berkarakter..* Surabaya, Institut Teknologi Sepuluh Nopember.
- Budiantara, I. N., Lestari, B., Islamiyati, A. & Wibowo, W., 2009. Pemilihan Titik Knot Optimal dalam Estimator *Spline Truncated* Terbobot pada Regresi Nonpaametrik Heteroskedastik Data Longitudinal. *Seminar Nasional Statistika IX*, pp. 1-11.
- Cahyati, D. W., 2020. Penerapan Analisis Regresi Multilevel untuk Mengidentifikasi Pengaruh Literasi Keuangan Terhadap Capaian Siswa Bidang Matematika. *Institut Pertanian Bogor*, pp. 1-21.
- Chamidah, N., Budiantara, I. N., Sunaryo, S. & Zain, I., 2012. Designing of child growth chart based on multi-response local polynomial modeling. *Journal of Mathematics and Statistics* , 8(3), pp. 342-347.
- Drapper, N. R. & Smith, H., 1998. *Applied Regression Analysis*. Canada: John Wiley and Sons.

- Eubank, R. L., 1988. *Spline Smoothing and Nonparametrik Regression*. New York: Marcel Dekker Inc.
- Eubank, R. L., 1999. *Nonparametrik regression and spline smoothing*. Second Edition ed. s.l.:CRC press.
- Finch, W. H., Bolin, J. E. & Kelly, K., 2014. *Multilevel Modeling Using R*. New York: Taylor & Francis Group.
- Goldstein, H., 1995. *Multilevel Statistical Models*. London: Arnold Publisher.
- Goldstein, H., 2011. *Multilevel statistical models*. Volume 922.
- Härdle, W., 1990. *Applied nonparametrik regression*. s.l.:Cambridge university press.
- Harlan, J., 2016. *Analisis Multilevel*. Depok: Gunadarma.
- He, L. et al., 2017. *Multi-way multi-level kernel modeling for neuroimaging classification*. s.l., s.n., pp. 356--364.
- Henderson, C. R., 1950. Estimation of genetic parameters (abstract). *Ann. Math. Stat*, Volume 21, p. 309–310.
- Henderson, C. R., 1953. Estimation of variance and covariance components. *Biometrics*, Volume 9, p. 226–252.
- Hidayah, W. A. & Astuti, E. P., 2016. Persepsi Siswa terhadap Ujian Nasional Mata Ujian Matematika. *Pendidikan Matematika*, 19(1).
- Hidayat, A. N., 2016. *Implementasi Ujian Nasional Berbasis Komputer atau Computer Based Test (CBT) di SMA Negeri 1 Wonosari*. Yogyakarta: Universitas Negeri Yogyakarta.
- Hidayati, L., Chamidah, N. & Budiantara, I. N., 2019. *Spline Truncated estimator in multiresponse semiparametric regression model for computer based national exam in West Nusa Tenggara*. s.l., IOP Publishing, p. 052029.
- Howe, L. D. et al., 2016. Linear *spline* multilevel models for summarising childhood growth trajectories: a guide to their application using examples from five birth cohorts. *Statistical methods in medical research*, 25(5), pp. 1854-1874.
- Hox, J. J., 1995. *Applied multilevel analysis*. s.l.:TT-publikaties.

- Hox, J. J., 2010. *Multilevel Analysis. Techniques and Applications*. 2. ed ed. New York: Routledge (Quantitative methodology series).
- Hox, J. J. & Maas, C. J., 2002. *Sample sizes for multilevel modeling*. s.l.:s.n.
- Hox, J. J., Moerbeek, M. & Schoot, R. v. d., 2017. *Multilevel Analysis Techniques and Application Third Edition*. New York: Routledge.
- Islamiyati, A. & Chamidah, N., 2018. *Estimation of covariance matrix on bi-response longitudinal data analysis with penalized spline regression*. s.l., IOP Publishing, p. 012093.
- Islamiyati, A. et al., 2020. Use of Two Smoothing Parameters in Penalized *Spline* Estimator for Bi-Variate Prediktor Non-Parametric Regression Model. *Journal of Sciences, Islamic Republic of Iran*, Volume 31, pp. 175-183.
- Kemendikbud, 2013. *Indikator Pendidikan di Indonesia*, Jakarta: Pusat Data dan Statistik Pendidikan, Kemdikbud.
- Kuswanto, H., Islamiyati, A. & and Ilyas, N., 2022. Multilevel Nonparametrik Regression Model with *Truncated Linear Spline* Estimator on Students' National Examination Scores. *International Journal of Academic and Applied Research (IJAAR)*.
- Laili, M., 2016. *Estimasi Parameter Model Linier Hierarki Dengan Pendekatan Generalized Least Square (Studi Kasus: Lingkar Perut pada Data Riskesdas dan Susenas Tahun 2013)*. Surabaya: (Doctoral dissertation, Institut Teknologi Sepuluh Nopember).
- Lee, Y. & Nelder, J. A., 2001. Hierarchical Generalised Linear Models: A Synthesis of Generalised Linear Models, Random-Effect Models and Structured Dispersions. *Biometrika Trust*, pp. 987-1006.
- Lestari, B., Budiantara, N., Sunaryo, S. & Mashuri, M., 2010. *Spline* estimator in multi-response nonparametrik regression model. *Jurnal Ilmu Dasar* , 11(1), pp. 17-22.
- Macdonald-Wallis, C., Lawlor, D. A., Palmer, T. & Tilling, K., 2012. Multivariate multilevel *spline* models for parallel growth processes: application to weight and mean arterial pressure in pregnancy. *Statistics in medicine*, 31(26), pp. 3147-3164.

- Mardianto, M. F. F., Tjahjono, E. & Rifada, M., 2019. Statistical modelling for prediction of rice production in Indonesia using semiparametric regression based on three forms of fourier series estimator. *ARPN J. Eng. Appl. Sci*, Volume 14, pp. 2763-70.
- Otok, B. W., 2009. Konsistensi dan Asimtotik Normalitas Model Multivariate Adaptive Regression *Spline* (Mars) Respon Biner Consistency and Asymptotic Normality of Maximum Likelihood Estimator in MARS Binary Response Model. *Jurnal Ilmu Dasar*, 10(2), pp. 133-140..
- Pendidikan, P. P., 2015. *Panduan Pemanfaatan Hasil UN Tahun Pelajaran 2015/2015*, Jakarta: Badan Penelitian dan Pengembangan, Kementerian Pendidikan dan Kebudayaan.
- Rencher, A. & Schaalje, G., 2007. *Linear Models in Statistics*. 2nd Edition ed. New Jersey: John Willey and Sons Inc.
- Ringdal, 1992. Methods for Multilevel Analysis. *Acta Sociologica*, Volume 35, pp. 235-243.
- Rodriguez, G., 2001. *Smoothing and non-parametric regression*. s.l.:Working paper.
- Safitri, K. A., Notodiputro, K. A. & Kurnia, A., 2015. *Modelling The Average Scores Of National Examination In West Java*. Yogyakarta, Yogyakarta State University.
- Sailan, M., 2016. Persepsi Siswa Tentang Pelaksanaan Ujian Nasional Berbasis Komputer Di Smk Komputer Mutiara Ilmu Makassar. *Jurnal Tomalebbi*, Volume 4, pp. 25-32.
- Searle, S. R., 1970. Large sample variances of maximum likelihood estimators of variance components using unbalanced data. *Biometrics*, pp. pp.505-524.
- Searle, S. R., Casella, G. & McCulloch, C. E., 2006. *Variance Component*. Canada: John Wiley & Sons, Inc.
- Thompson, R., 2008. *Estimation of quantitative genetic parameters*. s.l., Proceedings of the Royal Society B: Biological Sciences, pp. 679-686.
- Verbyla, A. P., 1990. A conditional derivation of residual maximum likelihood. *Australian Journal of Statistics*, 32(2), pp. 227-230.

- Wahba, G., 1990. *Spline models for observational data*. s.l.:Society for industrial and applied mathematics.
- Wang, J. & Lijian, Y., 2009. Polynomial *spline* confidence bands for regression curves. *Statistica Sinica*, pp. 325-342.
- West, B. T. & Welch, K. B., 2007. *Linear Mixed Models, A Practical Guide Using Statistical Software..* Chapel Hill: Wiley InterScience.
- Wulandari, I., Istri, D. A. M. & Budiantara, I. N., 2014. Analisis Faktor-Faktor yang Mempengaruhi Persentase Penduduk Miskin dan Pengeluaran Perkapita Makanan di Jawa Timur menggunakan Regresi Nonparametrik Birespon *Spline*. *Jurnal Sains dan Seni ITS*, Volume 3, pp. D30-D35.
- Zulvia, P., 2017. Pemodelan Multilevel dan Analisis Data Panel pada Penelitian Pendidikan. *IPB e-Journal*, pp. 1-29.

# LAMPIRAN

## Lampiran A. Data Pendidikan SMP Sulawesi Selatan Tahun 2019

Klp.	No.	Nama Sekolah (SMP)	Level-1				Level-2	
			Y	X1	X2	X3	Z1	Z2
			Nilai UN	Peserta UN	PD	Guru	APK	APM
1	1	SMPN 10 MAKASSAR	47.70	280	870	39	85.24	70.47
	2	SMP ABDI PEMBANGUNAN	41.25	58	155	8		
	3	SMP ANAK INDONESIA	41.86	15	84	1		
	∴	∴	∴	∴	∴	∴		
	191	MUHAMMADIYAH 2 MAKASSAR	43.03	105	275	16		
2	1	SMP MUHAMMADIYAH PALOPO	48.67	30	125	10	101.63	82.4
	2	SMP NEGERI 5 PALOPO	48.08	138	467	32		
	3	SMP NEGERI 8 PALOPO	49.08	235	830	47		
	∴	∴	∴	∴	∴	∴		
	23	TERPADU WAHDAH ISLAMIYAH	42.66	7	91	13		
3	1	NEGERI 12 PAREPARE	43.22	78	249	27	88.07	70.47
	2	NEGERI 2 PAREPARE	55.27	314	1.017	64		
	3	NEGERI 6 PAREPARE	44.41	81	245	27		
	∴	∴	∴	∴	∴	∴		
	22	AL BADAR BILALANG PAREPARE	46.22	9	42	2		
4	1	SMPN 1 TURIKALE	45.71	347	888	56	80.58	66.44
	2	SMP ISLAM TERPADU AL ISHLAH	50.21	136	546	19		
	3	SMP MUHAMMADIYAH MAROS	45.04	29	46	9		
	∴	∴	∴	∴	∴	∴		
	71	SMP ISLAM AL WASI	41.63	44	108	4		
5	1	SMP NEGERI 1 BUNGORO	48.80	287	874	84	90.04	72.27
	2	SMP NEGERI 2 BUNGORO	55.70	75	249	26		
	3	SMP NEGERI 3 BUNGORO	53.87	109	335	35		
	∴	∴	∴	∴	∴	∴		
	89	SMP NEGERI 2 MANDALLE	52.31	43	134	16		
6	1	SMP NEGERI 1 SUNGGUMINASA	53.22	493	1.09	72	77.61	65.51
	2	SMP NEGERI 2 SUNGGUMINASA	46.29	440	1.331	66		
	3	SMP NEGERI 3 SUNGGUMINASA	46.73	309	1.026	61		
	∴	∴	∴	∴	∴	∴		
	109	SMP NEGERI 4 SATAP PARIGI	60.59	14	42	8		
7	1	4 POLOMBANGKENG UTARA	51.94	10	64	12	90.01	72.84

	2	1 POLOMBANGKENG UTARA	51.63	255	834	63		
	3	2 POLOMBANGKENG UTARA	42.12	130	407	31		
	:	:	:	:	:	:		
	43	SMP NEGERI 1 SANROBONE	45.93	112	320	36		
8	1	SMP AL AMANAH JENEPONTO	34.34	19	33	3	70.96	72.84
	2	SMP NEGERI 1 BINAMU	42.47	251	182	23		
	3	SMP NEGERI 2 BINAMU	40.97	130	51	19		
	:	:	:	:	:	:		
	75	SMP NEGERI 2 BATANG	44.07	35	38	4		
9	1	SMP NEGERI 1 BARRU	48.75	281	783	54	84.07	60.09
	2	SMP NEGERI 2 BARRU	45.72	133	371	35		
	3	SMP NEGERI 3 BARRU	44.11	116	276	25		
	:	:	:	:	:	:		
	38	SMP MUHAMMADIYAH TAKKALASI	37.46	10	32	5		
10	1	SMP NEGERI 1 WATAMPONE	55.80	304	962	55	69.58	53.16
	2	SMP NEGERI 2 WATAMPONE	49.08	170	478	41		
	3	SMP NEGERI 4 WATAMPONE	54.49	325	833	55		
	:	:	:	:	:	:		
	123	SMPN SATAP 5 TELLU LIMPOE	50.99	16	99	6		
11	1	SMP NEGERI 1 SENKANG	51.13	288	790	50	67.45	53.46
	2	SMP NEGERI 2 SENKANG	45.86	193	640	47		
	3	SMP NEGERI 3 SENKANG	47.36	78	288	27		
	:	:	:	:	:	:		
	74	WAHDAH I ANABANUA	50.68	91	152	8		
12	1	SMP NEGERI 1 WATANSOPPENG	61.49	199	554	56	68.4	51.36
	2	SMP NEGERI 2 WATANSOPPENG	52.03	136	390	40		
	3	SMP NEGERI 3 WATANSOPPENG	49.56	133	310	37		
	:	:	:	:	:	:		
	38	SMP SATAP Negeri LabaE	49.24	15	47	8		
13	1	SMP NEGERI 1 BANTAENG	52.19	191	556	37	72.4	50.53
	2	SMP NEGERI 2 BANTAENG	51.89	163	442	38		
	3	SMP NEGERI 3 BANTAENG	57.13	34	178	13		
	:	:	:	:	:	:		



	37	SMP NEGERI 3 SINOA SATAP BATU TIROA	46.75	7	39	6		
14	1	SMP NEGERI 4 BULUKUMBA	44.69	193	543	40	77.48	58.91
	2	SMP NEGERI 48 BULUKUMBA	76.51	27	91	12		
	3	SMP NEGERI 5 BULUKUMBA	69.42	109	260	29		
	:	:	:	:	:	:		
	63	SATAP 7 BULUKUMBA	67.78	16	20	13		
15	1	UPTD SMP NEGERI 12 SINJAI	48.57	92	324	25	72.06	55.28
	2	UPTD SMP NEGERI 14 SINJAI	45.57	82	232	25		
	3	UPTD SMP NEGERI 23 SINJAI	47.29	118	323	31		
	:	:	:	:	:	:		
	43	UPTD SMPN 32 SINJAI	44.69	36	78	11		
16	1	12 KEPULAUAN SELAYAR	54.46	26	68	14	99.77	65.8
	2	27 KEPULAUAN SELAYAR	54.46	26	90	14		
	3	34 KEPULAUAN SELAYAR	69.08	48	128	15		
	:	:	:	:	:	:		
	52	47 SATAP KEPULAUAN SELAYAR	60.65	16	66	8		
17	1	UPT SMP NEGERI 10 LEMBANG	43.19	16	50	10	84.02	67.37
	2	UPT SMP NEGERI 1 LEMBANG	42.92	185	521	41		
	3	UPT SMP NEGERI 2 LEMBANG	44.08	101	283	24		
	:	:	:	:	:	:		
	56	NEGERI 2 MATTIRO SOMPE	45.40	132	358	26		
18	1	SMP Negeri 1 Pangsid	59.15	228	769	49	69.69	57.26
	2	SMP NEGERI 2 PANGSID	47.30	108	306	38		
	3	SMP NEGERI 3 PANGSID	43.09	95	301	33		
	:	:	:	:	:	:		
	48	SMP NEGERI 3 PANCA RIJANG	45.37	84	189	18		
19	1	SMP NEGERI 1 ENREKANG	51.14	272	688	51	68.37	51.98
	2	SMP NEGERI 2 ENREKANG	46.80	114	297	32		
	3	SMP NEGERI 4 ENREKANG	49.58	64	255	19		
	:	:	:	:	:	:		
	45	SMP NEGERI 5 ALLA	44.61	74	204	23		
20	1	SMP NEGERI 1 Ponrang Selatan	42.97	41	88	14	82.78	65.73
	2	SMP NEGERI 3 BUA PONRANG	41.09	147	389	38		

	3	NEGERI SATAP PACCERAKANG	40.55	55	160	17		
	:	:	:	:	:	:		
	78	SMPN 1 KUMILA SATU ATAP	68.16	15	42	7		
21	1	SMP NEGERI 1 MAKALE	57.22	309	907	46	89.94	66.7
	2	SMP NEGERI 5 MAKALE	46.35	69	194	17		
	3	SMP KATOLIK MAKALE	49.85	105	322	14		
	:	:	:	:	:	:		
	82	Satap 4 Bonggakaradeng	40.94	56	131	8		
22	1	NEGERI 1 MASAMBA	46.60	243	661	43	80.19	61.75
	2	NEGERI 2 MASAMBA	44.32	165	413	36		
	3	NEGERI 3 SATAP MASAMBA	40.59	13	47	7		
	:	:	:	:	:	:		
	73	NEGERI 3 SATAP RAMPI	57.48	12	25	10		
23	1	SMP 1 RANTEPAO	48.36	465	1.188	64	99.54	72.27
	2	SMP 2 RANTEPAO	50.35	321	1.191	57		
	3	SMP 3 RANTEPAO SATAP	46.23	28	115	8		
	:	:	:	:	:	:		
	77	SMP NEGERI 2 BANGKELEKILA	44.34	108	300	20		
24	1	SMP NEGERI 1 MALILI	49.54	172	529	29	90.28	70.49
	2	SMP NEGERI 2 MALILI	52.73	179	444	30		
	3	SMP NEGERI 3 MALILI	48.75	166	444	31		
	:	:	:	:	:	:		
	40	SMP NEGERI 1 KALAENA	46.53	249	550	33		

**Lampiran B. Daftar riwayat hidup*****CURRICULUM VITAE*****A. Data Pribadi**

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7. Bidang/Ketertarikan : Data Scientist dan Machine Learning

**B. Riwayat Pendidikan**

1. Tamat SMA tahun 2014 di SMAN 2 Watampone
2. Sarjana (S1) tahun 2019 di Universitas Departemen Statistika Program Studi Statistika
3. Magister (S2) tahun 2022 di Universitas Departemen Statistika Program Studi Statistika

**C. Pekerjaan dan Riwayat Pekerjaan**

1. Konsultan Statistik, Unit Konsultasi Statistika Universitas Hasanuddin
2. Research Assistant, Penelitian kesehatan dasar (RISKESDAS) 2013 dan 2018 di Indonesia Departemen Statistika Universitas Hasanuddin
3. Konsultan Statistik, Swan Statistics
4. Koordinator survey dan olah data, Survei Indeks Kepuasan Masyarakat Indeks Politica Indonesia

**D. Karya ilmiah yang telah dipublikasikan**

1. Kuswanto, H., Islamiyati, A. and Ilyas, N., 2022. Multilevel Nonparametrik Regression Model with Truncated Linear Spline Estimator on Students' National Examination Scores. *International Journal of Academic and Applied Research (IJAAR)*.
2. Kuswanto, H., Sunusi, N., Siswanto, S. and Nirwan, N., 2021. Application of Resampling and Boosting Methods Using the C5. 0 Algorithm: Case Study Indonesia Family Survey Data. In *Proceedings of The International Conference on Data Science and Official Statistics (Vol. 2021, No. 1, pp. 233-246)*.

3. Ilyas, N., Sunusi, N., Kalondeng, A. and Kuswanto, H., 2022. Circulation analysis and forecasting of fuel sales using the backpropagation artificial neural network method. *J. Math. Comput. Sci.*, 12, pp.Article-ID.
4. Thamrin, S.A., Arsyad, D.S., Kuswanto, H., Lawi, A. and Arundhana, A.I., 2022. Obesity Risk-Factor Variation Based on Island Clusters: A Secondary Analysis of Indonesian Basic Health Research 2018. *Nutrients*, 14(5), p.971.
5. Thamrin, S.A., Arsyad, D.S., Kuswanto, H., Lawi, A. and Nasir, S., 2021. Predicting obesity in adults using machine learning techniques: An analysis of Indonesian basic health research 2018. *Frontiers in nutrition*, p.252.
6. Thamrin, S.A., Sidik, D., Kuswanto, H., Lawi, A. and Ansariadi, A., 2021. Exploration of Obesity Status of Indonesia Basic Health Research 2013 With Synthetic Minority Over-Sampling Techniques: Eksplorasi Status Obesitas Riset Kesehatan Dasar 2013 Indonesia dengan Teknik Synthetic Minority Over-Sampling. *Indonesian Journal of Statistics and Its Applications*, 5(1), pp.75-91.
7. Syahrir, N.H.A., Sumarheni, S., Amir, S.B.H. and Kuswanto, H., 2021. Target prediction of compounds on jamu formula using nearest profile method. *Jurnal Matematika, Statistika dan Komputasi*, 17(2), pp.293-303.
8. Ente, D.R., Thamrin, S.A., Arifin, S., Kuswanto, H. and Andreza, A., 2020. Klasifikasi Faktor-Faktor Penyebab Penyakit Diabetes Melitus Di Rumah Sakit Unhas Menggunakan Algoritma C4. 5. *Indonesian Journal of Statistics and Its Applications*, 4(1), pp.80-88.