

DAFTAR PUSTAKA

- Anandar, A. A., Supandi, E. D., & Musthofa, M. W. (2022). Fourier Series Nonparametric Regression Modelling in the Case of Rainfall in West Java Province. *IJID (International Journal on Informatics for Development)*, e-ISSN, 2549-7448.
- Asrini, L. J., & Budiantara, I. N. (2014). Fourier Series Semiparametric Regression Models (Case Study: The Production of Lowland Rice Irrigation In Central Java). *ARPN Journal of engineering and Applied Science*, halaman 1501-1506.
- Astuti, W. T., Hadijati, M., & Irwansyah. (2018). Model Regresi Nonparametrik Deret Fourier pada Pola Data Curah Hujan di Kota Mataram. *Eigen Mathemaics Journal*, Volume 1 No.2, eISSN:2615-3599.
- Bilodeau, M. (1992). Fourier Smoother and Additive Models. *The Canadian Journal of Statistics*, Vol.20,No.3 Pges 257-269.
- Dani, A. T., & Adrianingsih, N. Y. (2021). Pemodelan Regresi Nonparametrik Dengan Estimator Spline Truncated dan Deret Fourier. *Jambura Journal of Mathematics*, Vol.3,No.1, hal.26-36.
- Islamiyati, A., Sahriman, S., & Oktani, S. (2022). Studi Longitudinal Pada Analisis Data Gula Darah Pasien Diabetes melalui Partecipal Component Analysis. *Jambura Journal Of Mathematics*, Vol.4,No.1,pp 41-49.
- Khairunnisa, L. R., Prahutama, A., & Santoso, D. (2020). Pemodelan Regresi Semiparametrik Dengan Pendekatan Deret Fourier (Studi Kasus:Pengaruh Indeks Dow Jones dan BI Rate Terhadap Indeks Harga Saham Gabungan). *Jurnal Gaussian*, Volume.9,Nomor.1,halaman.50-63.
- L.Eubank, R. (1992). *Nonparametric Regression And Spline Smoothing*. New York: Marcel Dekker.
- Malino, C. R., Arsyad, M., & Palloan, P. (2021). Analisis Parameter Curah Hujan Dan Suhu Udara Di Kota Makassar Terkait Fenomena Perubahan Iklim. *Jurnal Sains dan Pendidikan Fisika (JSPF)*, Hal.139-145 eISSN:2548-6373.

- Mardianto, M. F., Gunardi, & Utami, H. (2021). An Analysis about Fourier Series Estimator In Nonparametric Regression For Longitudinal Data. *Mathematics and Statistics*, halaman 501-510.
- Mardianto, M. F., Kartiko, S. H., & Utami, H. (2018). Regression For Trend-Seasonal Longitudinal Data Pattern: Linear and Fourier Series Estimator. *Proceedings of the International Conference on Mathematics and Islam*, pages 350-356.
- Mardianto, M. F., Kartiko, S. H., & Utami, H. (2020). The Fourier Series Estimator to Predict the Number of Dengue and Malaria Sufferers in Indonesia. *International Conference on Mathematics, Computational Science and Statistics* , hal.06002-1-060002-9.
- Mariati, N. P., Budiantara, I. N., & Ratnasari, V. (2020). Combination Estimation of Smoothing Spline and Fourier Series in Nonparametric Regression. *Hindawi Journal of Mathematics*, 10 pages.
- Nisa, H., Kusnandar, D., & Martha, S. (2020). Estimasi Parameter Metode Weighted Least Square Dalam Mengatasi Masalah Heteroskedasitas. *Buletin Ilmiah Math.Stat.dan Terapannya (Bimaster)*, Volume 09,No.1, hal.65-70.
- Nisa, K., & Budiantara, I. N. (2020). Modeling East Java Indonesia Life EXpectancy Using Semiparametrik Regression Mixed Spline Truncated And Fourier Series. *Media Statistika*, hal.149-160.
- Nurjannah, F., Utami, T. W., & Nur, I. M. (2015). Model Regresi Nonparametrik Dengan Pendekatan Deret Fourier Pada Data Curah Hujan Di Kota Semarang. *Statistika*, Vol.3, No.2.
- Octavanny, M. A., Budiantara, I., Kuswanto, H., & Rahmawati, D. P. (2020). Nonparametric Regression Model For Longitudinal Data With Mixed Truncated Spline and Fourier Series. *Hindawi Abstract and Applied Analysis*, 11 pages.
- Putri, A. P., Santoso, R., & Sugito. (2017). ANALISIS REGRESI NONPARAMETRIK KERNEL MENGGUNAKAN METODE JACKKNIFE SAMPEL TERHAPUS-1 DAN SAMPEL TERHAPUS-2 (Studi Kasus: Pemodelan Tingkat Inflasi Terhadap Nilai Tukar Rupiah di Indonesia. *JURNAL GAUSSIAN*, Volume 6, Nomor 1, Halaman 1-10.

- Renning, F. (10 June 2021). The Role of Fourier Series in Mathematics and Signal Theory. *Springer : International Journal of Research in Undergraduate Mathematics Education*.
- Sahidah, Kuzairi, & Mardianto, M. F. (2022). Estimator Deret Fourier Dalam Regresi Nonparametrik Dengan Penalti Untuk Perencanaan Penjualan Produk Musiman. *Zeta-Math Journal*, Volume 7 No.2 e-ISSN : 2579-5864.
- Sanusi, W. (2016). Analisis Homogenitas Data Curah Hujan Tahunan Kota Makassar. *Jurnal Scientific Phinisi*, Volume 2, hlm.137-142.
- Selatan, B. P. (2019). *Provinsi Sulawesi Selatan Dalam Angka*. Makassar: BPS Provinsi Sulawesi Selatan ISSN 0215-2290.
- Septiani, M., Helmi, & Yudhi. (2019). Penerapan Analisis Fourier Untuk Menentukan Periode Dan Prediksi Suhu Udara. *Buletin Ilmiah Mat.Stat, dan Terapannya (Bimaster)*, Volume 08, No.2, hal.221-228.
- Wening, A. W., Budiantara, I. N., & Zain, I. (2019). Semiparametric Regression Curve Estimation for Longitudinal Data Using Mixed Spline Truncated and Fourier Series Estimator. *Journal of Physics: Confeence Series*, hal 1742-6596.
- Widjajanti, T. (2006). Penerapan Deret Fourier Pada Sistem Pendengaran Manusia. *Natural*, Vol.5 No.2 ISSN 1412-1328.
- Wisisono, I. R., Nurwahidah, A. I., & Andriyana, Y. (2018). Regresi Nonparametrik Dengan Pendekatan Deret Fourier Pada Data Debit Air Sungai Citarum. *Jurnal Matematika "MANTIK"*, ISSN:2527-3159.
- Wu, H., & Zhang, J.-T. (2006). *Nonparametric Regression Methods for Longitudinal Data Analysis*. New Jersey: A John-Wiley and Sons Inc.

LAMPIRAN

Lampiran 1. Data Curah hujan Provinsi Sulawesi Selatan Tahun 2018-2022

| kabupaten/kota | Bulan/Tahun | Y | X1 | X2 | X3 |
|----------------|-------------|------|----|------|----|
| Makassar | Jan-18 | 780 | 7 | 24.4 | 86 |
| Makassar | Feb-18 | 752 | 6 | 26.8 | 86 |
| Makassar | Mar-18 | 602 | 7 | 27.3 | 85 |
| Makassar | Apr-18 | 165 | 6 | 28.4 | 80 |
| Makassar | May-18 | 32 | 6 | 28.7 | 80 |
| Makassar | Jun-18 | 97 | 6 | 27.7 | 82 |
| Makassar | Jul-18 | 45 | 6 | 27.6 | 78 |
| Makassar | Aug-18 | 1 | 7 | 28.1 | 70 |
| Makassar | Sep-18 | 1 | 7 | 28.3 | 73 |
| Makassar | Oct-18 | 12 | 7 | 29.2 | 72 |
| Makassar | Nov-18 | 155 | 6 | 28.8 | 80 |
| Makassar | Dec-18 | 874 | 9 | 27.4 | 85 |
| Makassar | Jan-19 | 577 | 7 | 27.6 | 83 |
| Makassar | Feb-19 | 225 | 7 | 27.9 | 80 |
| Makassar | Mar-19 | 442 | 6 | 27.8 | 82 |
| Makassar | Apr-19 | 384 | 6 | 28.5 | 80 |
| Makassar | May-19 | 59 | 6 | 28.8 | 76 |
| Makassar | Jun-19 | 61 | 7 | 27.8 | 77 |
| Makassar | Jul-19 | 2 | 7 | 27.3 | 71 |
| Makassar | Aug-19 | 0 | 7 | 27.5 | 68 |
| Makassar | Sep-19 | 0 | 7 | 28 | 78 |
| Makassar | Oct-19 | 0 | 7 | 29.4 | 68 |
| Makassar | Nov-19 | 84 | 7 | 29.4 | 74 |
| Makassar | Dec-19 | 280 | 7 | 29 | 79 |
| Makassar | Jan-20 | 573 | 7 | 28.3 | 83 |
| Makassar | Feb-20 | 538 | 7 | 27.8 | 86 |
| Makassar | Mar-20 | 265 | 7 | 28.3 | 80 |
| Makassar | Apr-20 | 120 | 6 | 28.5 | 79 |
| Makassar | May-20 | 175 | 6 | 29 | 78 |
| Makassar | Jun-20 | 73 | 7 | 28.4 | 75 |
| Makassar | Jul-20 | 8 | 6 | 28.2 | 76 |
| Makassar | Aug-20 | 16 | 7 | 28.6 | 70 |
| Makassar | Sep-20 | 23 | 7 | 29.1 | 70 |
| Makassar | Oct-20 | 55 | 7 | 29.3 | 72 |
| Makassar | Nov-20 | 248 | 7 | 28.9 | 77 |
| Makassar | Dec-20 | 942 | 7 | 27 | 86 |
| Makassar | Jan-21 | 1195 | 7 | 26.9 | 87 |
| Makassar | Feb-21 | 434 | 7 | 27.4 | 84 |
| Makassar | Mar-21 | 680 | 7 | 27.5 | 85 |
| Makassar | Apr-21 | 430 | 7 | 28 | 82 |
| Makassar | May-21 | 65 | 6 | 28.5 | 78 |
| Makassar | Jun-21 | 75 | 6 | 28.2 | 78 |

| | | | | | |
|----------|--------|-----|---|------|----|
| Makassar | Jul-21 | 43 | 6 | 27.8 | 81 |
| Makassar | Aug-21 | 64 | 7 | 28.2 | 75 |
| Makassar | Sep-21 | 115 | 6 | 28.5 | 76 |
| Makassar | Oct-21 | 108 | 7 | 28.6 | 79 |
| Makassar | Nov-21 | 328 | 7 | 28 | 81 |
| Makassar | Dec-21 | 964 | 7 | 27.3 | 84 |
| Makassar | Jan-22 | 765 | 7 | 27 | 84 |
| Makassar | Feb-22 | 660 | 9 | 27.2 | 84 |
| Makassar | Mar-22 | 236 | 7 | 27.8 | 82 |
| Makassar | Apr-22 | 63 | 7 | 28.4 | 79 |
| Makassar | May-22 | 313 | 7 | 28.4 | 79 |
| Makassar | Jun-22 | 105 | 6 | 27.8 | 80 |
| Makassar | Jul-22 | 8 | 7 | 28.2 | 76 |
| Makassar | Aug-22 | 42 | 7 | 28 | 75 |
| Makassar | Sep-22 | 48 | 7 | 28.4 | 74 |
| Makassar | Oct-22 | 390 | 7 | 28.1 | 80 |
| Makassar | Nov-22 | 341 | 7 | 27.6 | 81 |
| Makassar | Dec-22 | 751 | 9 | 27.1 | 82 |
| Maros | Jan-18 | 723 | 6 | 26.6 | 86 |
| Maros | Feb-18 | 600 | 6 | 26.1 | 87 |
| Maros | Mar-18 | 597 | 6 | 26.5 | 85 |
| Maros | Apr-18 | 222 | 6 | 27.2 | 82 |
| Maros | May-18 | 73 | 4 | 27.8 | 81 |
| Maros | Jun-18 | 123 | 4 | 27 | 81 |
| Maros | Jul-18 | 61 | 6 | 26.6 | 77 |
| Maros | Aug-18 | 2 | 6 | 27.3 | 70 |
| Maros | Sep-18 | 0 | 6 | 27.6 | 66 |
| Maros | Oct-18 | 149 | 6 | 27.9 | 70 |
| Maros | Nov-18 | 321 | 4 | 27.6 | 81 |
| Maros | Dec-18 | 844 | 4 | 26.6 | 88 |
| Maros | Jan-19 | 888 | 6 | 26.5 | 87 |
| Maros | Feb-19 | 281 | 6 | 26.9 | 84 |
| Maros | Mar-19 | 227 | 4 | 26.9 | 85 |
| Maros | Apr-19 | 232 | 6 | 27.8 | 83 |
| Maros | May-19 | 17 | 6 | 27.9 | 80 |
| Maros | Jun-19 | 31 | 6 | 27.2 | 79 |
| Maros | Jul-19 | 7 | 6 | 26.4 | 73 |
| Maros | Aug-19 | 1 | 7 | 26.7 | 66 |
| Maros | Sep-19 | 0 | 7 | 27.6 | 64 |
| Maros | Oct-19 | 18 | 7 | 28.7 | 63 |
| Maros | Nov-19 | 84 | 7 | 28.4 | 73 |
| Maros | Dec-19 | 236 | 6 | 27.9 | 81 |
| Maros | Jan-20 | 402 | 6 | 27.3 | 85 |
| Maros | Feb-20 | 587 | 6 | 27 | 87 |

| | | | | | |
|-------------|--------|-----|---|------|----|
| Maros | Mar-20 | 314 | 6 | 27.3 | 84 |
| Maros | Apr-20 | 220 | 6 | 27.4 | 84 |
| Maros | May-20 | 264 | 6 | 27.8 | 84 |
| Maros | Jun-20 | 57 | 6 | 27.3 | 82 |
| Maros | Jul-20 | 19 | 6 | 27.1 | 79 |
| Maros | Aug-20 | 11 | 7 | 27.8 | 72 |
| Maros | Sep-20 | 35 | 7 | 28.2 | 74 |
| Maros | Oct-20 | 236 | 7 | 28.1 | 78 |
| Maros | Nov-20 | 435 | 6 | 27.6 | 84 |
| Maros | Dec-20 | 939 | 6 | 26.4 | 89 |
| Maros | Jan-21 | 828 | 6 | 26.2 | 90 |
| Maros | Feb-21 | 501 | 6 | 26.4 | 88 |
| Maros | Mar-21 | 624 | 7 | 26.6 | 87 |
| Maros | Apr-21 | 286 | 7 | 26.9 | 84 |
| Maros | May-21 | 132 | 6 | 27.6 | 83 |
| Maros | Jun-21 | 167 | 7 | 27.2 | 83 |
| Maros | Jul-21 | 79 | 7 | 26.7 | 82 |
| Maros | Aug-21 | 133 | 7 | 27.4 | 78 |
| Maros | Sep-21 | 133 | 7 | 27.7 | 77 |
| Maros | Oct-21 | 364 | 7 | 27.7 | 81 |
| Maros | Nov-21 | 464 | 7 | 27.1 | 83 |
| Maros | Dec-21 | 643 | 6 | 26.4 | 86 |
| Maros | Jan-22 | 654 | 7 | 26.2 | 85 |
| Maros | Feb-22 | 789 | 6 | 26.1 | 86 |
| Maros | Mar-22 | 362 | 4 | 26.7 | 83 |
| Maros | Apr-22 | 93 | 4 | 27 | 81 |
| Maros | May-22 | 374 | 4 | 27.2 | 83 |
| Maros | Jun-22 | 310 | 4 | 26.6 | 83 |
| Maros | Jul-22 | 41 | 4 | 26.9 | 78 |
| Maros | Aug-22 | 59 | 4 | 26.9 | 74 |
| Maros | Sep-22 | 134 | 4 | 27.2 | 78 |
| Maros | Oct-22 | 445 | 5 | 26.8 | 84 |
| Maros | Nov-22 | 721 | 9 | 26.7 | 84 |
| Maros | Dec-22 | 982 | 6 | 26 | 86 |
| Tana Toraja | Jan-18 | 190 | 4 | 22.9 | 80 |
| Tana Toraja | Feb-18 | 241 | 4 | 22.5 | 82 |
| Tana Toraja | Mar-18 | 317 | 4 | 22.5 | 85 |
| Tana Toraja | Apr-18 | 253 | 4 | 22.9 | 84 |
| Tana Toraja | May-18 | 168 | 4 | 22.8 | 86 |
| Tana Toraja | Jun-18 | 312 | 4 | 22.2 | 88 |
| Tana Toraja | Jul-18 | 87 | 4 | 22 | 85 |
| Tana Toraja | Aug-18 | 144 | 6 | 22.1 | 83 |
| Tana Toraja | Sep-18 | 23 | 6 | 21.6 | 79 |
| Tana Toraja | Oct-18 | 40 | 6 | 23 | 78 |

| | | | | | |
|-------------|--------|-----|---|------|----|
| Tana Toraja | Nov-18 | 231 | 4 | 23.2 | 82 |
| Tana Toraja | Dec-18 | 346 | 4 | 22.8 | 85 |
| Tana Toraja | Jan-19 | 181 | 4 | 23.1 | 83 |
| Tana Toraja | Feb-19 | 310 | 4 | 22.5 | 87 |
| Tana Toraja | Mar-19 | 310 | 4 | 22.6 | 85 |
| Tana Toraja | Apr-19 | 398 | 4 | 23 | 88 |
| Tana Toraja | May-19 | 132 | 4 | 23 | 86 |
| Tana Toraja | Jun-19 | 231 | 4 | 22.2 | 88 |
| Tana Toraja | Jul-19 | 16 | 4 | 21.1 | 85 |
| Tana Toraja | Aug-19 | 17 | 6 | 21.5 | 81 |
| Tana Toraja | Sep-19 | 9 | 6 | 22.2 | 76 |
| Tana Toraja | Oct-19 | 55 | 4 | 22.9 | 76 |
| Tana Toraja | Nov-19 | 129 | 4 | 23 | 79 |
| Tana Toraja | Dec-19 | 206 | 4 | 23.1 | 85 |
| Tana Toraja | Jan-20 | 320 | 4 | 23.2 | 87 |
| Tana Toraja | Feb-20 | 486 | 4 | 23 | 90 |
| Tana Toraja | Mar-20 | 447 | 4 | 23.3 | 87 |
| Tana Toraja | Apr-20 | 670 | 2 | 23 | 88 |
| Tana Toraja | May-20 | 370 | 4 | 23.6 | 87 |
| Tana Toraja | Jun-20 | 220 | 4 | 22.1 | 86 |
| Tana Toraja | Jul-20 | 162 | 4 | 21.6 | 90 |
| Tana Toraja | Aug-20 | 106 | 4 | 22.1 | 86 |
| Tana Toraja | Sep-20 | 125 | 4 | 22.5 | 86 |
| Tana Toraja | Oct-20 | 452 | 4 | 22.8 | 85 |
| Tana Toraja | Nov-20 | 245 | 4 | 23 | 85 |
| Tana Toraja | Dec-20 | 134 | 2 | 23.1 | 83 |
| Tana Toraja | Jan-21 | 404 | 2 | 22.7 | 88 |
| Tana Toraja | Feb-21 | 235 | 4 | 22.5 | 86 |
| Tana Toraja | Mar-21 | 503 | 4 | 22.6 | 87 |
| Tana Toraja | Apr-21 | 262 | 6 | 22.8 | 85 |
| Tana Toraja | May-21 | 247 | 4 | 23 | 88 |
| Tana Toraja | Jun-21 | 73 | 6 | 22.5 | 87 |
| Tana Toraja | Jul-21 | 150 | 6 | 22.1 | 90 |
| Tana Toraja | Aug-21 | 162 | 5 | 22.3 | 92 |
| Tana Toraja | Sep-21 | 221 | 6 | 22.3 | 92 |
| Tana Toraja | Oct-21 | 203 | 6 | 23.3 | 89 |
| Tana Toraja | Nov-21 | 629 | 5 | 22.9 | 91 |
| Tana Toraja | Dec-21 | 109 | 6 | 22.9 | 90 |
| Tana Toraja | Jan-22 | 206 | 6 | 22.5 | 90 |
| Tana Toraja | Feb-22 | 255 | 6 | 22.5 | 91 |
| Tana Toraja | Mar-22 | 273 | 6 | 22.9 | 90 |
| Tana Toraja | Apr-22 | 395 | 5 | 22.6 | 91 |
| Tana Toraja | May-22 | 281 | 4 | 23.2 | 90 |
| Tana Toraja | Jun-22 | 159 | 6 | 22.6 | 91 |

| | | | | | |
|-------------|--------|-----|---|------|----|
| Tana Toraja | Jul-22 | 165 | 5 | 22.2 | 92 |
| Tana Toraja | Aug-22 | 248 | 7 | 22.2 | 91 |
| Tana Toraja | Sep-22 | 104 | 6 | 22.5 | 90 |
| Tana Toraja | Oct-22 | 231 | 6 | 23 | 91 |
| Tana Toraja | Nov-22 | 343 | 5 | 22.6 | 91 |
| Tana Toraja | Dec-22 | 352 | 6 | 22.5 | 90 |

Keterangan :

Y = Curah Hujan

X1 = Suhu

X2 = Temperatur

X3 = Kelembaban

Lampiran 2. Berikut merupakan nilai hasil estimasi regresi nonparametrik deret Fourier dengan tiga titik osilasi.

| Y | \hat{Y} | Error |
|------|-----------|----------|
| 780 | 926.5356 | -146.536 |
| 752 | 431.5154 | 320.4846 |
| 602 | 459.3464 | 142.6536 |
| 165 | 148.0297 | 16.97032 |
| 32 | 185.1892 | -153.189 |
| 97 | 259.233 | -162.233 |
| 45 | 107.058 | -62.058 |
| 1 | -17.8186 | 18.81862 |
| 1 | 17.62028 | -16.6203 |
| 12 | 127.8377 | -115.838 |
| 155 | 201.7317 | -46.7317 |
| 874 | 750.3082 | 123.6918 |
| 577 | 398.2032 | 178.7968 |
| 225 | 255.8292 | -30.8292 |
| 442 | 249.0483 | 192.9517 |
| 384 | 157.6417 | 226.3583 |
| 59 | 116.755 | -57.755 |
| 61 | 180.1051 | -119.105 |
| 2 | 34.8251 | -32.8251 |
| 0 | -30.8204 | 30.82035 |
| 0 | 174.4803 | -174.48 |
| 0 | 78.98824 | -78.9882 |
| 84 | 244.5469 | -160.547 |
| 280 | 298.5435 | -18.5435 |
| 573 | 358.63 | 214.37 |
| 538 | 429.741 | 108.259 |
| 265 | 246.0642 | 18.93578 |
| 120 | 115.3832 | 4.616759 |
| 175 | 162.2225 | 12.77752 |
| 73 | 132.954 | -59.9541 |
| 8 | 54.34137 | -46.3414 |
| 16 | 12.06706 | 3.932938 |
| 23 | 95.52813 | -72.5281 |
| 55 | 143.7192 | -88.7192 |
| 248 | 238.6129 | 9.38711 |
| 942 | 508.1812 | 433.8188 |
| 1195 | 600.7522 | 594.2478 |
| 434 | 405.9509 | 28.04913 |
| 680 | 440.0834 | 239.9166 |
| 430 | 337.3093 | 92.69071 |

| | | |
|-----|----------|----------|
| 65 | 83.27236 | -18.2724 |
| 75 | 64.94878 | 10.05122 |
| 43 | 226.5165 | -183.517 |
| 64 | 124.2425 | -60.2425 |
| 115 | 72.66495 | 42.33505 |
| 108 | 232.1932 | -124.193 |
| 328 | 314.7775 | 13.22248 |
| 964 | 415.2539 | 548.7461 |
| 765 | 443.0861 | 321.9139 |
| 660 | 724.3849 | -64.3849 |
| 236 | 353.2585 | -117.259 |
| 63 | 209.9814 | -146.981 |
| 313 | 209.9814 | 103.0186 |
| 105 | 160.5886 | -55.5886 |
| 8 | 158.5516 | -150.552 |
| 42 | 129.5638 | -87.5638 |
| 48 | 90.83433 | -42.8343 |
| 390 | 244.5659 | 145.4341 |
| 341 | 351.5654 | -10.5654 |
| 751 | 721.9852 | 29.01485 |
| 723 | 477.6543 | 245.3457 |
| 600 | 795.2036 | -195.204 |
| 597 | 489.491 | 107.509 |
| 222 | 308.5224 | -86.5224 |
| 73 | 258.0589 | -185.059 |
| 123 | 336.4992 | -213.499 |
| 61 | 228.0183 | -167.018 |
| 2 | -51.1879 | 53.18792 |
| 0 | -241.807 | 241.8067 |
| 149 | -110.766 | 259.7656 |
| 321 | 278.8976 | 42.10242 |
| 844 | 608.6436 | 235.3564 |
| 888 | 590.9794 | 297.0206 |
| 281 | 350.9611 | -69.9611 |
| 227 | 426.5959 | -199.596 |
| 232 | 273.1544 | -41.1544 |
| 17 | 151.619 | -134.619 |
| 31 | 177.8043 | -146.804 |
| 7 | 157.3782 | -150.378 |
| 1 | -32.3174 | 33.31737 |
| 0 | -163.033 | 163.0334 |
| 18 | -193.264 | 211.2639 |
| 84 | 23.79593 | 60.20407 |
| 236 | 217.5469 | 18.45306 |

| | | |
|-----|----------|----------|
| 402 | 355.1362 | 46.86376 |
| 587 | 484.4569 | 102.5431 |
| 314 | 311.0437 | 2.956259 |
| 220 | 301.7407 | -81.7407 |
| 264 | 260.4357 | 3.564293 |
| 57 | 299.6563 | -242.656 |
| 19 | 186.792 | -167.792 |
| 11 | 18.25555 | -7.25555 |
| 35 | 82.12273 | -47.1227 |
| 236 | 170.1966 | 65.80335 |
| 435 | 281.2744 | 153.7256 |
| 939 | 689.6441 | 249.3559 |
| 828 | 770.9404 | 57.0596 |
| 501 | 650.2113 | -149.211 |
| 624 | 662.3503 | -38.3503 |
| 286 | 455.1712 | -169.171 |
| 132 | 293.993 | -161.993 |
| 167 | 436.8387 | -269.839 |
| 79 | 479.3763 | -400.376 |
| 133 | 231.7345 | -98.7345 |
| 133 | 190.2897 | -57.2897 |
| 364 | 340.9114 | 23.08863 |
| 464 | 445.8264 | 18.17363 |
| 643 | 550.7643 | 92.2357 |
| 654 | 736.783 | -82.783 |
| 789 | 714.7178 | 74.28219 |
| 362 | 430.8146 | -68.8146 |
| 93 | 336.4992 | -243.499 |
| 374 | 364.1709 | 9.829135 |
| 310 | 456.8202 | -146.82 |
| 41 | 208.287 | -167.287 |
| 59 | 121.2508 | -62.2508 |
| 134 | 177.2358 | -43.2358 |
| 445 | 483.1011 | -38.1011 |
| 721 | 791.0286 | -70.0286 |
| 982 | 780.4744 | 201.5256 |
| 190 | 83.73285 | 106.2671 |
| 241 | 103.6162 | 137.3838 |
| 317 | 159.0961 | 157.9039 |
| 253 | 183.5799 | 69.42006 |
| 168 | 232.0937 | -64.0937 |
| 312 | 236.4752 | 75.52485 |
| 87 | 101.3955 | -14.3955 |
| 144 | 44.04999 | 99.95001 |

| | | |
|-----|----------|----------|
| 23 | -104.508 | 127.5075 |
| 40 | -6.21692 | 46.21692 |
| 231 | 219.9037 | 11.0963 |
| 346 | 211.0911 | 134.9089 |
| 181 | 227.9406 | -46.9406 |
| 310 | 260.5845 | 49.41549 |
| 310 | 176.3744 | 133.6256 |
| 398 | 364.0839 | 33.91609 |
| 132 | 264.6369 | -132.637 |
| 231 | 236.4752 | -5.47515 |
| 16 | 163.7262 | -147.726 |
| 17 | 12.9074 | 4.092597 |
| 9 | -144.433 | 153.4331 |
| 55 | -1.24386 | 56.24386 |
| 129 | 57.43633 | 71.56367 |
| 206 | 259.3145 | -53.3145 |
| 320 | 376.872 | -56.872 |
| 486 | 382.0019 | 103.9981 |
| 447 | 394.2934 | 52.70658 |
| 670 | 315.1622 | 354.8378 |
| 370 | 466.9132 | -96.9132 |
| 220 | 127.9688 | 92.03121 |
| 162 | 251.6005 | -89.6005 |
| 106 | 127.9688 | -21.9688 |
| 125 | 180.0987 | -55.0987 |
| 452 | 211.0911 | 240.9089 |
| 245 | 243.6343 | 1.365657 |
| 134 | 179.0189 | -45.0189 |
| 404 | 265.4176 | 138.5824 |
| 235 | 180.0987 | 54.9013 |
| 503 | 277.8628 | 225.1372 |
| 262 | 179.5487 | 82.45132 |
| 247 | 364.0839 | -117.084 |
| 73 | 229.0421 | -156.042 |
| 150 | 213.7914 | -63.7914 |
| 162 | 408.3956 | -246.396 |
| 221 | 291.7148 | -70.7148 |
| 203 | 421.1451 | -218.145 |
| 629 | 493.2539 | 135.7461 |
| 109 | 334.4977 | -225.498 |
| 206 | 265.9213 | -59.9213 |
| 255 | 307.9968 | -52.9968 |
| 273 | 334.4977 | -61.4977 |
| 395 | 441.9559 | -46.9559 |

| | | |
|-----|----------|----------|
| 281 | 413.7512 | -132.751 |
| 159 | 325.2752 | -166.275 |
| 165 | 396.2578 | -231.258 |
| 248 | 369.1365 | -121.137 |
| 104 | 265.9213 | -161.921 |
| 231 | 392.5351 | -161.535 |
| 343 | 441.9559 | -98.9559 |
| 352 | 265.9213 | 86.07868 |

Lampiran 3. Syntaks Regresi Nonparametrik Deret Fourier

```

#Deret Fourier
#penentuan nilai k osilasi
datauji
Y=as.matrix(datauji[,3])
X1=as.matrix(datauji[,4])
X2=as.matrix(datauji[,5])
X3=as.matrix(datauji[,6])
deretfourier<-function(Y, X1, X2, X3,K)
{
  N=length(Y)
  a<-(3*(K+1))+1
  C<-matrix(0, N, a)
  hasil<-matrix(0, K, 2)
  for (k in 1:K)
  {
    for(i in 1:N)
    {
      for(j in 1:k)
      {
        C[i,1]=1
        C[i,2]<-X1[i]
        C[i,2+j]=cos(j*X1[i])
        C[i,3+k]<-X2[i]
        C[i,3+k+j]<-cos(j*X2[i])
        C[i,4+(2*k)+j]<-cos(j*X3[i])
      }
    }
  }
  library(pracma)
  I<-diag(1,N,N)
  A<- C %**% pinv(t(C) %**% C) %**% t(C)
  Atot=A
  Ytop<-Atot %**% Y
  df<-sum(diag(Atot))
  W<-(1/N)*I
  atas<-t(Y-Ytop) %**% W %**% (Y-Ytop)
  bawah<-((1-df)/N)^2
  GCV<-atas/bawah
}

```

```
    hasil[k,1]<-k
    hasil[k,2]<-GCV
  }
  print(hasil)
  GCV2<-min(hasil[,2])
  s<-1
  repeat{
    if(hasil[s,2]==GCV2)
    {
      kopt<-hasil[s,1]
      GCVopt<-GCV2
      break
    }
    else s<-s+1
  }
  cat("nilai k optimal adalah \t",kopt,"\n")
  print(C)
}
Model_df = deretfourier(Y, x1, x2, x3, k<-c(3))
write.csv(Model_df,file="D:/Tknot.csv")
```


Lampiran 4. Estimasi Model

```

#program estimasi model
estimasi<-function(Y, x1, x2, x3, koptimal)
{
  N<-length(Y)
  X<-matrix(0, N, 2)
  k<-koptimal
  a<-(3*(k+1))+1
  C<-matrix(0, N, a)
  hasil<-matrix(0, k, 2)
  error<-rep(0, N)
  cat("=====  

  = =====")
  cat("\nx\ty\t\tytopi\t\terror")
  cat("\n=====  

  = =====")
  for(i in 1:N)
  {
    for(j in 1:k)
    {
      C[i,1]=1
      C[i,2]<-x1[i]
      C[i,2+j]=cos(j*x1[i])
      C[i,3+k]<-x2[i]
      C[i,3+k+j]<-cos(j*x2[i])
      C[i,4+(2*k)]<-x3[i]
      C[i,4+(2*k)+j]<-cos(j*x3[i])
    }
  }
  library(pracma)
  I<-diag(1, N, N)
  A<-C%%pinv(t(C)%%C)%%t(C)
  Atot<-A
  ytop<-Atot%%Y
  alfa<-rep(0,a)
  alfa<-pinv(t(C)%%C)%%t(C)%%Y
  error<-Y-ytop
  MSE<-sum((error)^2)/N
  for(i in 1:N)
  {
    cat("\n", "\t", Y[i], "\t", ytop[i], "\t", error[i], "\n")
  }
}

```

```

}
cat("\n=====
= =====\n")
cat("\n MSE=",MSE,"\n")
Q<-0
for(i in 1:N)
{
  q<-(ytop[i]-mean(Y))^2
  Q<-Q+q
}
F<-0
for(i in 1:N)
{
  f<-(Y[i]-mean(Y))^2
  F<-F+f
}
R<-Q/F
cat("Nilai koefisien Determinasi =")
print(R)
print(alfa)
}
estimasi(Y, x1, x2, x3, k<-c(3))
dx<-estimasi(Y, x1, x2, x3, koptimal = 3)
write.csv(dx,file="D:/estimasi.csv")

```

Lampiran 5. Uji serentak dan uji parsial

```

#Uji serentak dan uji parsial
library(readr)
alpha = 0.05
data=datauji
  knot= read_csv("D:/Tknot.csv", col_types = cols(...1 =
col_skip()))
  mdata=as.matrix(datauji[3:6])
  knot=as.matrix(knot)
  ybar=mean(mdata[,1])
  p=nrow(mdata)
  q=ncol(mdata)
  satu=rep(1,p)
  n1=ncol(knot)
  mx=cbind(satu, mdata[,2], knot[,3], knot[,6], knot[,9], mdata[,3],
          knot[,4], knot[,7], knot[,10], mdata[,3], knot[,5],
          knot[,8],
          knot[,11])
  mx=as.matrix(mx)
  library(pracma)
  B=(pinv(t(mx)%*%mx))%*%t(mx)%*%mdata[,1]
  cat("=====", "\n")
  cat("Estimasi Parameter", "\n")
  cat("=====", "\n")
  print (B)
  n1=nrow(B)
  yhat=mx%*%B
  res=mdata[,1]-yhat
  SSE=sum((mdata[,1]-yhat)^2)
  SSR=sum((yhat-ybar)^2)
  SST=SSR+SSE
  MSE=SSE/(p-n1)
  MSR=SSR/(n1-1)
  Rsq=(SSR/(SSR+SSE))*100
#uji F (uji serentak)
Fhit=MSR/MSE
pvalue=pf(Fhit, (n1-1), (p-n1), lower.tail=FALSE)
if (pvalue<=alpha)
{

```

```

cat("-----", "\n")
cat("Kesimpulan hasil uji serentak", "\n")
cat("-----", "\n")
cat("Tolak Ho yakni minimal terdapat 1 prediktor yang
signifikan", "\n")
cat("", "\n")
} else {
cat("-----", "\n")
cat("Kesimpulan hasil uji serentak", "\n")
cat("-----", "\n")
cat("Gagal Tolak Ho yakni semua prediktor tidak berpengaruh
signifikan", "\n")
cat("", "\n")
}

#uji t (uji individu)
thit=rep(NA,n1)
pval=rep(NA,n1)
SE=sqrt(diag(MSE*(pinv(t(mx)%*%mx))))
cat("-----", "\n")
cat("Kesimpulan hasil uji individu", "\n")
cat("-----", "\n")
thit=rep(NA,n1)
pval=rep(NA,n1)
for (i in 1:n1)
{
thit[i]=B[i,1]/SE[i]
pval[i]=2*(pt(abs(thit[i]),(p-n1),lower.tail=FALSE))
if (pval[i]<=alpha)
cat("Tolak Ho yakni prediktor signifikan dengan
pvalue",pval[i], "\n")
else
cat("Gagal tolak Ho yakni prediktor tidak signifikan dengan
pvalue",pval[i], "\n")
}
thit=as.matrix(thit)
cat("=====", "\n")
cat("nilai t hitung", "\n")
cat("=====", "\n")
print (thit)

```

```

cat("Analysis of Variance","\n")
cat("=====", "\n")
cat("Sumber      df      SS      MS      Fhit","\n")
cat("Regresi    ",(n1-1)," ",SSR," ",MSR,"",Fhit,"\n")
cat("Error      ",p-n1," ",SSE,"",MSE,"\n")
cat("Total      ",p-1," ",SST,"\n")
cat("=====", "\n")
cat("s=",sqrt(MSE)," Rsq=",Rsq,"\n")
cat("pvalue(F)=",pvalue,"\n")
write.csv(res,file="D:/output residual.csv")
# write.csv(pval,file="D:/output pvalue.csv")
# write.csv(mx,file="D:/output mx.csv")
write.csv(yhat,file="D:/output yhat.csv")

```

Lampiran 6. Riwayat Hidup

A. Data Pribadi

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B. Riwayat Pendidikan

- SD Negeri 66 Balangriri (2005-2011)
- MTSN 410 Tanete (2011-2014)
- SMA Negeri 2 Bulukumba (2014-2017)
- S1 di Universitas Negeri Makassar Jurusan Statistika Program Studi Statistika (2017-2021)
- S2 di Universitas Hasanuddin Departemen Statistika Program Studi Magister Statistika (2022-2023)