DAFTAR PUSTAKA

Adryanta, M., & Purhadi. (2019). Analisis metode geographically weighted generalized Poisson regression untuk pemodelan faktor yang mempengaruhi jumlah kematian anak di Provinsi Jawa Timur. Jurnal Sains dan Seni ITS, 8(2), 2337-3520. https://doi.org/10.12962/j27213862.v4i1.8930

Agresti, A. (2007). An introduction to categorical data analysis. Wiley.

Akaike, H. (1978). A Bayesian analysis of the minimum AIC procedure. Annals of the Institute of Statistical Mathematics, 30(1), 9–14. https://www.ism.ac.jp/editsec/aism/pdf/030_1_0009.pdf

Al-Hasani, G., Asaduzzaman, M., & Soliman, A.-H. (2021). Geographically weighted Poisson regression models with different kernels: Application to road traffic accident data. Communications in Statistics: Case Studies, Data Analysis and Applications, 7(1), 24–35. https://doi.org/10.1080/23737484.2020.1869628

AlMuhayfith, F. E., Alzaid, A. A., & Omair, M. A. (2016). On bivariate Poisson regression models. Journal of King Saud University - Science, 28(2), 178–189. https://doi.org/10.1016/j.jksus.2015.09.003

Arkandi, I., & Winahju, W. S. (2015). Analisis faktor risiko kematian ibu dan kematian bayi dengan pendekatan regresi Poisson bivariate di Provinsi Jawa Timur tahun 2013. *Jurnal Sains dan Seni ITS, 4*(2), 2337–3520.

Badan Pusat Statistik. (2023). Statistik Indonesia 2023. Badan Pusat Statistik.

Cahyandari, R. (2014). Penerapan model regresi Poisson dalam analisis data kesehatan. Jurnal Statistik dan Matematika, 3(1), 45-60.

Caraka, R. E., & Yasin, A. M. (2017). Spatial heterogeneity in the analysis of regional development. Journal of Regional Science and Urban Economics, 68, 53-62. https://doi.org/10.1016/j.regsciurbeco.2017.04.002

Cameron, A. C., & Trivedi, P. K. (1998). Regression analysis of count data. Cambridge University Press.

Cressie, N. (2015). Statistics for spatial data. John Wiley & Sons.

Draper, N., & Smith, H. (1992). Analisis regresi terapan. Jakarta: Gramedia Pustaka Utama.

Famoye, F., Wulu, J. T., & Singh, K. P. (2004). On the generalized Poisson regression model with an application to accident data. *Journal of Data Science, 2*(2),

287-295. Retrieved from http://www.jdsonline.com/file_download/53/JDS-167.pdf

Famoye, F. (1993). Restricted generalized Poisson regression model. Communications in Statistics: Theory and Methods, 22(6), 1335-1354. https://doi.org/10.1080/03610929308831089

Fathurahman, M., Purhadi, Sutikno, & Ratnasari, V. (2020). Geographically weighted multivariate logistic regression model and its application. Abstract and Applied Analysis, 2020, 8353481. https://doi.org/10.1155/2020/8353481

Fotheringham, A. S., Brunsdon, C., & Charlton, M. (2002). Geographically weighted regression: The analysis of spatially varying relationships. John Wiley & Sons.

Gollini, I., Lu, B., Charlton, M., Brunsdon, C., & Harris, P. (2015). GWmodel: An R package for exploring spatial heterogeneity using geographically weighted models. Journal of Statistical Software, 63(17), 1–52. https://doi.org/10.18637/jss.v063.i17

Gujarati, D. N., & Porter, D. C. (2010). Basic econometrics (5th ed.). McGraw-Hill Education.

Hilbe, J. M. (2011). *Negative Binomial Regression* (2nd ed.). Cambridge University Press. https://doi.org/10.1017/CBO9780511973420

Hocking, R. R. (1996). Methods and applications of linear models: Regression and the analysis of variance. Wiley.

Hogg, R. V., McKean, J. W., & Craig, A. T. (2013). Introduction to mathematical statistics (7th ed.). Pearson Education, Inc.

Ismail, N., & Jemain, A. A. (2007). Handling overdispersion with negative binomial and generalized Poisson regression models. Statistical Modelling, 7(2), 139-158.

Ji, S., Wang, Y., & Wang, Y. (2021). Geographically weighted Poisson regression under linear model of coregionalization assistance: Application to a bicycle crash study. Accident Analysis and Prevention, 159, 106230. https://doi.org/10.1016/j.aap.2021.106230

Karlis, D., & Ntzoufras, I. (2005). Bivariate Poisson and diagonal inflated bivariate Poisson regression models in R. Journal of Statistical Software, 14(10), 1–36. https://doi.org/10.18637/jss.v014.i10

Kawamura, K. (1973). The Structure of Bivariate Poisson Distribution. *Kodai Math. Sem. Rep.*, *25*(2), 246–256. https://doi.org/10.2996/kmj/1138846776

Kocherlakota, S. K., & Kocherlakota, K. S. (2007). Modeling with Poisson distributions: Applications in biostatistics. Springer.

Kementerian Kesehatan Republik Indonesia. (2022). Profil kesehatan Indonesia 2021. Jakarta: Kemenkes RI.

Kementerian Kesehatan Republik Indonesia. (2023). Komisi Penanggulangan AIDS: Struktur dan fungsi. Jakarta: Kemenkes RI.

Kementerian Kesehatan Republik Indonesia. (2023). Laporan tahunan penanggulangan HIV dan AIDS. Jakarta: Kemenkes RI.

Kementerian Kesehatan Republik Indonesia. (2023). Program nasional pencegahan dan pengendalian HIV, AIDS, dan penyakit infeksi menular seksual (PIMS). Jakarta: Pusat Pencegahan dan Pengendalian Penyakit Menular (P2PM), Kemenkes RI.

Kementerian Kesehatan Republik Indonesia. (2023). Rencana aksi nasional (RAN) HIV AIDS dan PIMS 2020-2023. Jakarta: Kemenkes RI.

McCullagh, P., & Nelder, J. A. (1989). Generalized linear models (2nd ed.). Chapman and Hall/CRC.

Nyoman, S. (1990). Epidemiologi AIDS: Standarisasi diagnosik dan penatalaksanaan beberapa penyakit menular seksual. Fakultas Kedokteran Universitas Sumatera Utara.

Nuchaila, R. (2020). Negative binomial regression model for HIV/AIDS cases in East Java using local linear estimator. Jurnal Epidemiologi dan Biostatistik, 18(2), 153-165.

Riemann, J. F. (2018). Geographically weighted Poisson regression for modelling count data: A case study of road traffic accidents in Germany. *European Journal of Transport and Infrastructure Research, 18(1), 45-62. https://doi.org/10.18757/ejtir.2018.18.1.4052

Ryan, T. A. (2009). Modern regression methods. Wiley.

Simanjuntak, M. (2017). Pemodelan bivariate generalized Poisson regression dan aplikasinya. Institut Teknologi Sepuluh Nopember.

Sinharay, S. (2010). An Overview of Statistics in Education. In *International Encyclopedia of Education* (3rd ed., pp. 1–11). Elsevier. https://doi.org/10.1016/B978-0-08-044894-7.01719-X

Soermartojo, G., Kurniawan, A., & Putra, F. S. (2018). Spatial kernel density estimation for geographical data. Journal of Spatial Statistics, 32, 52-68. https://doi.org/10.1016/j.spasta.2018.04.004

Tantri, E. (2017). Modeling HIV and tuberculosis cases in East Java using bivariate Poisson regression. Jurnal Statistika dan Komputasi, 12(3), 235-245.

Thahar, A., & Sirait, S. (2023). Factors affecting new HIV/AIDS cases in East Java using generalized weighted negative binomial regression (GWNBR) method. Jurnal Kesehatan Masyarakat, 25(1), 78-92.

Thola, M. (2015). Geographically weighted bivariate Poisson regression untuk pemodelan kasus kusta di Jawa Timur. Institut Teknologi Sepuluh Nopember.

Triyanto. (2017). Geographically Weighted Multivariate Poisson Regression. Surabaya: ITS

United Nations Development Programme (UNDP). (2020). Sustainable development goals: Goal 3 - Good health and well-being. Retrieved from https://www.undp.org/content/undp/en/home/sustainable-development-goals/goal-3-good-health-and-well-being.html

UNAIDS. (2022). Global AIDS update 2022. Retrieved from https://www.unaids.org/en/resources/documents/2022/global-aids-update-2022

Vernic, R. (1997). Generalized Poisson distribution: Theory and applications. Journal of Statistical Planning and Inference, 58(2), 239-254. https://doi.org/10.1016/S0378-3758(96)00086-0

Walpole, R. E., Myers, R. H., Myers, S. L., & Ye, K. (2011). Probability & statistics for engineers and scientists (9th ed.). Pearson.

Wardani, D. K. (2016). Penerapan bivariate generalized Poisson regression (BGPR): Studi kasus jumlah kematian bayi dan kematian ibu di Provinsi Jawa Timur tahun 2013. Exact Papers in Compilation, 1(1), 21-26.

Wibisono, Y. (2009). Metode statistika (Edisi 2). Yogyakarta: UGM Press.

World Bank. (2022). HIV/AIDS in Southeast Asia: Challenges and opportunities. Retrieved from https://www.worldbank.org/en/topic/health/publication/hivaids-in-southeast-asia

World Health Organization (WHO). (2021). Global HIV/AIDS overview. Retrieved from https://www.who.int/news-room/fact-sheets/detail/hiv-aids

Yuan, G., Wei, Z., & Lu, X. (2011). A BFGS trust-region method for nonlinear equations. Computing, 92(4), 317-333. https://doi.org/10.1007/s00607-011-0146-z

Zamani, H., Faroughi, P., & Ismail, N. (2016). Bivariate generalized Poisson regression model: Applications on health care data. Empirical Economics, 51(4), 1607–1621. https://doi.org/10.1007/s00181-015-1051-7

LAMPIRAN

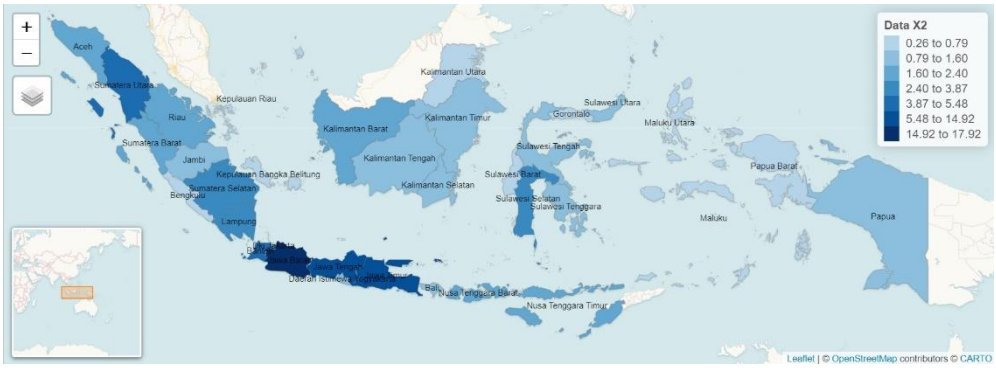
Lampiran 1. Data Penelitian

Provinsi	Y_1	Y_2
Aceh	269	33
Sumatera Utara	2.777	403
Sumatera Barat	526	109
Riau	766	223
Jambi	182	21
Sumatera Selatan	844	563
Bengkulu	179	81
Lampung	721	159
Kepulauan Bangka Belitung	279	35
Kepulauan Riau	926	167
DKI Jakarta	5.744	89
Jawa Barat	8.680	510
Jawa Tengah	5.897	1.484
DI Yogyakarta	902	107
Jawa Timur	7.424	666
Banten	2.404	434
Bali	1.826	851
Nusa Tenggara Barat	618	396
Nusa Tenggara Timur	556	178
Kalimantan Barat	931	229
Kalimantan Tengah	385	75
Kalimantan Selatan	621	162
Kalimantan Timur	1.312	232
Kalimantan Utara	173	64
Sulawesi Utara	656	177
Sulawesi Tengah	455	127
Sulawesi Selatan	1.476	464
Sulawesi Tenggara	524	116
Gorontalo	143	19
Sulawesi Barat	38	12
Maluku	487	33
Maluku Utara	413	123
Papua Barat	797	141
Papua	3.206	858

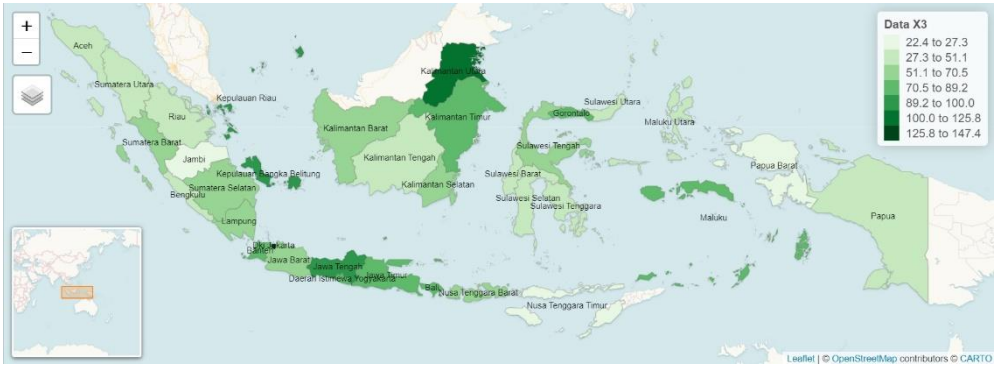
Provinsi	X_1	X_2	X_3	X_4	X_5	X_6
Aceh	14,75	1,96	39,2	0,00	3,4	49,94
Sumatera Utara	8,33	5,48	43,6	1,20	3,9	42,74
Sumatera Barat	6,04	2,05	56,8	0,00	5,3	39,34
Riau	6,84	2,4	51,1	0,40	7,4	35,27
Jambi	7,70	1,32	27,3	0,00	1,7	49,06
Sumatera Selatan	11,95	3,14	70,5	2,00	1,2	38,12
Bengkulu	14,34	0,75	49,2	2,50	2,9	46,92
Lampung	11,44	3,33	57,6	0,60	1,2	44,14
Kepulauan Bangka Belitung	4,61	0,54	99,4	0,00	2,3	37,22
Kepulauan Riau	6,03	0,79	100,0	0,00	4,3	33,33
DKI Jakarta	4,61	3,87	147,4	5,60	9	38,30
Jawa Barat	7,98	17,92	66,5	1,60	1,3	27,85
Jawa Tengah	10,98	13,43	98,6	0,40	3,8	27,39
DI Yogyakarta	11,49	1,36	82,7	0,00	15,1	31,39
Jawa Timur	10,49	14,92	80,4	1,10	1,60	31,38
Banten	6,24	4,44	89,2	1,40	1,1	33,61
Bali	4,53	1,6	80,8	0,50	3,8	20,46
Nusa Tenggara Barat	13,82	1,98	63,0	0,50	0,5	43,49
Nusa Tenggara Timur	20,23	1,98	22,4	1,70	0,4	60,88
Kalimantan Barat	6,81	2,01	61,0	0,90	0,6	47,96
Kalimantan Tengah	5,22	0,99	48,0	0,00	0,7	51,01
Kalimantan Selatan	4,61	1,52	62,1	0,60	1,1	38,71
Kalimantan Timur	6,44	1,4	87,3	0,00	3,7	34,55
Kalimantan Utara	6,86	0,26	125,8	3,10	2,3	44,08
Sulawesi Utara	7,34	0,96	44,7	0,60	0,4	39,33
Sulawesi Tengah	12,30	1,11	56,5	0,00	0,3	56,38
Sulawesi Selatan	8,66	3,35	42,6	0,90	1,1	45,58
Sulawesi Tenggara	11,27	0,98	41,3	0,00	0,7	66,06
Gorontalo	15,51	0,43	81,2	0,00	0,5	50,00
Sulawesi Barat	11,92	0,53	42,9	0,00	1	54,55
Maluku	16,23	0,68	76,1	0,00	0,5	70,80
Maluku Utara	6,37	0,48	46,1	0,80	0,1	62,75
Papua Barat	21,43	0,43	25,0	0,00	0,6	69,60
Papua	26,80	1,6	44,0	0,00	0,4	72,27

Lampiran 2. Peta variabel prediktor

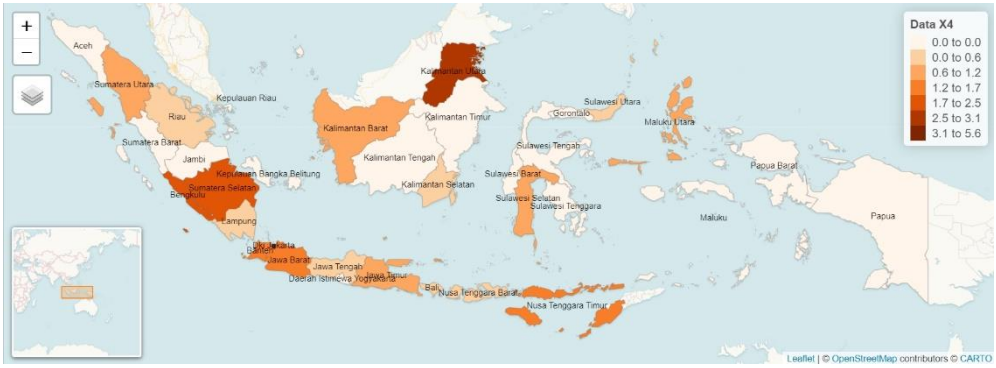
(a) Persentase penduduk miskin



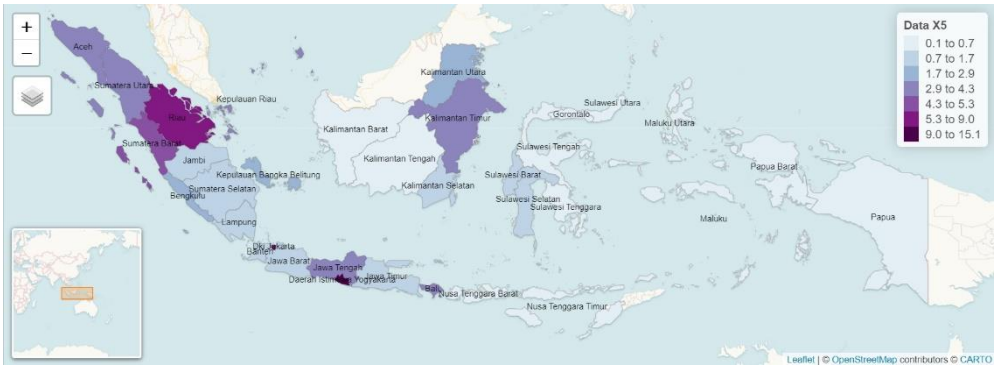
(b) Persentase penduduk



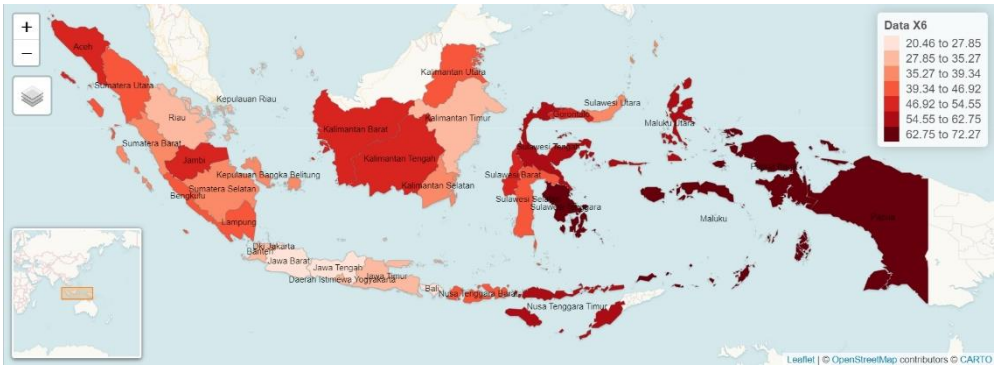
(c) Persentase orang dengan risiko terinfeksi HIV mendapatkan pelayanan deteksi dini HIV sesuai standar



(d) Persentase kasus baru AIDS pada pengguna NAPZA suntikan (IDU)



(e) Persentase pasangan usia produktif yang menggunakan kondom



(f) Persentase jumlah fasilitas kesehatan tempat pelayanan dan pengobatan HIV AIDS

Lampiran 3. *Output* pengujian distribusi *Bivariate Generalized Poisson*

```
> # UJI DISTRIBUSI BIVARIATE GENERALIZED POISSON
>
> # Menghitung panjang data
> n = length(y1)
>
> # Menghitung rata-rata dan variansi dari y1 dan y2
> y1bar = mean(y1)
> y2bar = mean(y2)
> vary1 = var(y1)
> vary2 = var(y2)
>
> # Menghitung kovariansi antara y1 dan y2
> covy1y2 = cov(y1, y2)
>
> # Menghitung Z1 dan Z2
> Z1 = vary1 - y1bar
> Z2 = vary2 - y2bar
> Z = matrix(c(Z1, Z2), ncol = 1, nrow = 2)
>
> # Menghitung miu1, miu2, dan miu12
> miu1 = vary1^2
> miu2 = vary2^2
> miu12 = covy1y2^2
>
> # Membentuk matriks V1 dan V2
> V1 = matrix(c(miu1, miu12, miu12, miu2), ncol = 2, nrow = 2)
> V2 = (2/n1) * V1
>
> # Menghitung invers dari V2
> V = solve(V2)
>
> # Menghitung nilai statistik T
> T = round(t(Z) %*% V %*% Z, 4)
> csq = qchisq(0.95, 2)
>
> # Menampilkan hasil T
> cbind(T, csq)
     T      csq
[1,] 1.4506 5.991465
```

Lampiran 4. *Output* pengujian korelasi variabel respons

```
> # UJI KORELASI ANTAR VARIABEL RESPON
> alpha  <- 0.05
> kor    <- cor.test(y1, y2, method = "pearson")
>
> # Hitung derajat bebas dan t-tabel
> db1    <- n - 2
> ttabel <- qt(1 - alpha / 2, db1)
>
> # Perbandingan koefisien korelasi dengan t-tabel
> ujikor <- cbind(kor$statistic, ttabel)
> print(ujikor)  # harus abs(kor$statistic) > ttabel
             ttabel
t 4.376834 2.036933
> print(kor)     # output full

       Pearson's product-moment correlation

data:  y1 and y2
t = 4.3768, df = 32, p-value = 0.0001202
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval:
 0.3452115 0.7872040
sample estimates:
      cor
0.6119401

> ttabel
[1] 2.036933
```

Lampiran 5. *Output* pendeteksian overdispersi

```
> # UJI OVERDISPERSI
> # Hitung parameter dispersi
> Dy1     <- 2 * sum(ifelse(y1 == 0, 0, y1 * log(y1 / mean(y1)) - (y1 -
mean(y1))))
> Dy2     <- 2 * sum(ifelse(y2 == 0, 0, y2 * log(y2 / mean(y2)) - (y2 -
mean(y2))))
>
> # Hitung derajat bebas dan p-value
> x <- as.matrix(cbind(rep(1, n), x1, x2, x3, x4, x5, x6))
> p <- ncol(x)
> dbdev   <- n - p - 1
> phitopi <- cbind(Dy1 / dbdev, Dy2 / dbdev)
> print(phitopi)  # Nilai harus > 1
         [,1]     [,2]
[1,] 2675.985 355.1754
```

Lampiran 6. *Output* pengujian multikolinearitas

```
> # UJI ASUMSI MULTIKOLINEARITAS
> # Matriks Korelasi Antar Variabel Prediktor
> cor_matrix <- cor(data[,3:8])
>
> # Menampilkan Matriks Korelasi
> print(cor_matrix)
            X1          X2         X3         X4         X5         X6
X1  1.00000000 -0.08706071  0.0205858  0.1780792 -0.4605749  0.1935729
X2 -0.08706071  1.00000000 -0.2463302 -0.4226893  0.6544282 -0.1880531
X3  0.02058580 -0.24633020  1.0000000  0.4033566 -0.4690074  0.1904519
X4  0.17807918 -0.42268934  0.4033566  1.0000000 -0.5237098  0.4938532
X5 -0.46057486  0.65442822 -0.4690074 -0.5237098  1.0000000 -0.2003710
X6  0.19357289 -0.18805313  0.1904519  0.4938532 -0.2003710  1.0000000
>
> # Fit Poisson models
> modely1 <- glm(y1 ~ x1 + x2 + x3 + x4 + x5 + x6, family = quasipoisson,
data = data)
> modely2 <- glm(y2 ~ x1 + x2 + x3 + x4 + x5 + x6, family = quasipoisson,
data = data)
>
> # Hitung VIF
> library(car)
> vif <- cbind(vif(modely1), vif(modely2))
> print(vif)  # Should be all values < 10
       [,1]     [,2]
x1 2.080151 2.080151
x2 1.618159 1.618159
x3 1.856189 1.856189
x4 1.391639 1.391639
x5 1.497171 1.497171
x6 3.513887 3.513887
```

Lampiran 7. *Output* estimasi parameter dan uji signifikansi parameter model regresi *Bivariate Generalized Poisson* dengan algoritma BFGS

```
> # ESTIMASI PARAMETER MODEL BGPR-BFGS
> FULL_BGPR_BFGS(data, alfa0, maxit, epsilon, print.info=TRUE)
-------------------------------------------
Hasil Uji Parsial BGPR-BFGS
-------------------------------------------
           Koefisien Std.Error    Z.Value P.Value
lambda0    0.0624    0.0057  10.9474  0.0000
b10       -3.4143    0.4429  -7.7090  0.0000
b11        0.9971    0.4429   2.2513  0.0244
b12        2.7027    0.0336  80.4375  0.0000
b13        0.8921    0.0765  11.6614  0.0000
b14        0.9745    0.0000   0.0000  0.0000
b15        0.6914    0.0089  77.6854  0.0000
b16        0.0258    0.4429   0.0583  0.9535
b20       -0.8186    0.8803  -0.9299  0.3524
b21        3.5287    0.8803   4.0085  0.0001
b22        0.4242    0.0668   6.3503  0.0000
b23        0.1444    0.1521   0.9494  0.3424
b24       -0.4663    0.0000   0.0000  0.0000
b25       -1.4631    0.0176 -83.1307  0.0000
b26       -4.1916    0.8803  -4.7616  0.0000
a1         0.0601    0.2523   0.2382  0.8117
a2         0.1011    0.8814   0.1147  0.9087
a0         0.0806    0.0000   0.0000  0.0000
-------------------------------------------
Informasi Iterasi & Hasil Uji Serentak BGPR-BFGS
-------------------------------------------
                      Values
Number of Iteration   8
Converged/Not         Konvergen
ln.H1                 313.06024
ln.H0                 98.70383
G^2                   428.71282
P.Value of F          0
AIC BGPR              -614.120488111957
```

Lampiran 8. *Output* estimasi parameter dan uji signifikansi parameter model regresi *Bivariate Generalized Poisson* dengan algoritma Nelder-Mead

```
> # ESTIMASI PARAMETER MODEL BGPR-NELDER-MEAD
> FULL_BGPR_NM(data, alfa0, maxit, epsilon, print.info=TRUE)
-------------------------------------------
Hasil Uji Parsial BGPR BGPR-NM
-------------------------------------------
        Koefisien Std.Error  Z.Value P.Value
lambda0    0.0327    0.0057   5.7368  0.0000
b10       -3.4106    0.4429  -7.7006  0.0000
b11        0.9979    0.4429   2.2531  0.0243
b12        2.7032    0.0336  80.4524  0.0000
b13        0.8933    0.0765  11.6771  0.0000
b14        0.9749    0.0000   0.0000  0.0000
b15        0.6919    0.0089  77.7416  0.0000
b16        0.0276    0.4429   0.0623  0.9503
b20       -0.7964    0.8803  -0.9047  0.3656
b21        3.5349    0.8803   4.0156  0.0001
b22        0.4255    0.0668   6.3698  0.0000
b23        0.1487    0.1521   0.9776  0.3283
b24       -0.4654    0.0000   0.0000  0.0000
b25       -1.4615    0.0176 -83.0398  0.0000
b26       -4.1736    0.8803  -4.7411  0.0000
a1         0.0601    0.2523   0.2382  0.8117
a2         0.1011    0.8814   0.1147  0.9087
a0         0.0806    0.0000   0.0000  0.0000


-------------------------------------------
Informasi Iterasi & Hasil Uji Serentak BGPR-NM
-------------------------------------------
                      Values
Number of Iteration   19
Converged/Not         Konvergen
ln.H1                 295.50046
ln.H0                 118.5537
G^2                   353.89352
P.Value of F          0
AIC BGPR              -579.000926581467
```