DAFTAR PUSTAKA

Abad, P., Benito, S., & López, C. (2014). A comprehensive review of Value at Risk methodologies. *The Spanish Review of Financial Economics*, *12*(1), 15–32. https://doi.org/10.1016/j.srfe.2013.06.001

Anton, H., & Rorres, C. (2004). *Aljabar Linear Elementer* (Edisi 8). Erlangga.

Ben Alaya, M. A., Zwiers, F. W., & Zhang, X. (2021). On estimating long period wind speed return levels from annual maxima. *Weather and Climate Extremes*, *34*, 100388. https://doi.org/10.1016/j.wace.2021.100388

Bennett, D. A. (2001). How can I deal with missing data in my study? *Australian and New Zealand Journal of Public Health*, *25*(5), 464–469. https://doi.org/10.1111/j.1467-842X.2001.tb00294.x

Bisono, I. (2012). Mengenal Data Ekstrim dan Distribusinya. *Jurnal Teknik Industri*, *13*(2), 81–86. https://doi.org/10.9744/jti.13.2.81-86

BMKG. (2017). *Daftar Istilah Klimatologi*. Balai Besar Meteorologi, Klimatolofi, Dan Geofisika Wilayah III. http://balai3.denpasar.bmkg.go.id/daftar-istilah-musim#:~:text=Curah%20Hujan%20(mm)%20adalah%20ketinggian,tidak%20meresap%20dan%20tidak%20mengalir.

BMKG. (2022). *Probabilistik Curah Hujan 20 mm (tiap 24 jam)*. Informasi Cuaca. https://www.bmkg.go.id/cuaca/probabilistik-curah-hujan.bmkg?mm=20&hour=24&gen=rpmpauaoyir8r42ddc

Bommier, E. (2014). *Peaks-Over-Threshold Modelling of Environmental Data* [Project Report]. Department of Mathematics Uppsala University.

Boudrissa, N., Cheraitia, H., & Halimi, L. (2017). Modelling maximum daily yearly rainfall in northern Algeria using generalized extreme value distributions from 1936 to 2009: Modelling maximum rainfall in northern Algeria. *Meteorological Applications*, *24*(1), 114–119. https://doi.org/10.1002/met.1610

Caires, S. (2016). A Comparative Simulation Study of the Annual Maxima and the Peaks-Over-Threshold Methods. *Journal of Offshore Mechanics and Arctic Engineering*, *138*(5). https://doi.org/10.1115/1.4033563

Casella, G., & Berger, R. L. (2002). *Statistical Inference* (Second edition). Wadsworth Group.

Coles, S. (2001). *An introduction to statistical modeling of extreme values*. Springer.

Coles, S. G., & Dixon, M. J. (1999). *Likelihood-Based Inference for Extreme Value Models*. *2*(1), 5–23.

Davison, A. C., & Smith, R. L. (1990). Models for Exceedances Over High Thresholds. *Journal of the Royal Statistical Society: Series B (Methodological)*, *52*(3), 393–425. https://doi.org/10.1111/j.2517-6161.1990.tb01796.x

Fadholi, A. (2020). Trend Curah Hujan Ekstrem Harian Berdasarkan Data PERSIANN-CCS di Kepulauan Bangka Belitung. *Jurnal Ilmu dan Inovasi Fisika*, *4*(1), 12–22. https://doi.org/10.24198/jiif.v4i1.24731

Fawcett, L., & Walshaw, D. (2007). Improved estimation for temporally clustered extremes. *Environmetrics*, *18*(2), 173–188. https://doi.org/10.1002/env.810

Fisher, R. A., & Tippett, L. H. C. (1928). Limiting forms of the frequency distribution of the largest or smallest member of a sample. *Mathematical Proceedings of the Cambridge Philosophical Society*, *24*(2), 180–190. https://doi.org/10.1017/S0305004100015681

Gilli, M., Maringer, D., & Schumann, E. (2019). Chapter 11-Basic Methods. In *Numerical Methods and Optimization in Finance* (2nd edition, pp. 229–271). Elsevier Inc. https://doi.org/10.1016/B978-0-12-815065-8.00023-6

Gnedenko, B. (1943). Sur La Distribution Limite Du Terme Maximum D'Une Serie Aleatoire. *The Annals of Mathematics*, *44*(3), 423. https://doi.org/10.2307/1968974

Hartono, I. F., & Sutikno. (2020). Analisis Curah Hujan Ekstrem pada Kasus Elevasi Tinggi Air Muka Bendungan Bilibili Sulawesi Selatan dengan Pendekatan Peaks Over Threshold. *JURNAL SAINS DAN SENI ITS*, *9*(2), 193–199.

Hasan, H., Salam, N., & Adam, M. B. (2013). *Modelling Extreme Temperature in Malaysia Using Generalized Extreme Value Distribution*. *7*(6), 7.

Hermawan, E. (2015). *Indeks Monsun Asia-Australia dan Aplikasinya*. LIPI Press.

Horn, R. A., & Johnson, C. R. (2012). *Matrix analysis* (2nd ed). Cambridge University Press.

Hosking, J. R. M., & Wallis, J. R. (1987). Parameter and Quantile Estimation for the Generalized Pareto Distribution. *Technometrics*, *29*(3), 339–349. https://doi.org/10.1080/00401706.1987.10488243

Iliopoulou, T., Koutsoyiannis, D., & Montanari, A. (2018). Characterizing and Modeling Seasonality in Extreme Rainfall. *Water Resources Research*, *54*(9), 6242–6258. https://doi.org/10.1029/2018WR023360

Indarto, Susanto, B., & Diniarti, E. M. (2011). *Analisis Kecenderungan Data Hujan di Jawa Timur Menggunakan Metode Mann-Kendal & Rank-Sum Test*. *25*(1), 19–28.

Jenkinson, A. F. (1955). The frequency distribution of the annual maximum (or minimum) values of meteorological elements. *Quarterly Journal of the*

Royal Meteorological Society, *81*(348), 158–171. https://doi.org/10.1002/qj.49708134804

Kahal Musakkal, N. F., Chin, S. N., Ghazali, K., & Gabda, D. (2017). A penalized likelihood approach to model the annual maximum flow with small sample sizes. *Malaysian Journal of Fundamental and Applied Sciences*, *13*(4), 563–566. https://doi.org/10.11113/mjfas.v0n0.620

Kotz, S., & Nadarajah, S. (2000). *Extreme value distributions: Theory and applications*. Imperial College Press ; Distributed by World Scientific.

Leon, S. J. (2001). *Aljabar linear dan aplikasinya* (Ed. Ke-5). Erlangga.

Loo, Y. Y., Billa, L., & Singh, A. (2015). Effect of climate change on seasonal monsoon in Asia and its impact on the variability of monsoon rainfall in Southeast Asia. *Geoscience Frontiers*, *6*(6), 817–823. https://doi.org/10.1016/j.gsf.2014.02.009

Martins, A. L. A., Liska, G. R., Beijo, L. A., Menezes, F. S. de, & Cirillo, M. Â. (2020). Generalized Pareto distribution applied to the analysis of maximum rainfall events in Uruguaiana, RS, Brazil. *SN Applied Sciences*, *2*(9), 1479. https://doi.org/10.1007/s42452-020-03199-8

Maulidani, S., Ihsan, N., & Sulistiawaty. (2015). ANALISIS POLA DAN INTENSITAS CURAH HUJAN BERDASAKAN DATA OBSERVASI DAN SATELIT TROPICAL RAINFALL MEASURING MISSIONS (TRMM) 3B42 V7 DI MAKASSAR. *Jurnal Sains Dan Pendidikan Fisika*, *11*(1), 98–103. https://doi.org/10.35580/jspf.v11i1.1472

Musara, K., Nadarajah, S., & Wiegand, M. (2022). Statistical modeling of annual highest monthly rainfall in Zimbabwe. *Scientific Reports*, *12*(1), 7698. https://doi.org/10.1038/s41598-022-11839-9

Musliadi, Chaerul, M., & Gusty, S. (2021). Study on Flood Simulation of Tallo Watershed, Makassar City, South Sulawesi Province. *Journal of Physics: Conference Series*, *1899*(1), 012063. https://doi.org/10.1088/1742-6596/1899/1/012063

Pickands, J. (1975). Statistical Inference Using Extreme Order Statistic. *The Annals of Statistics*, *3*(1), 119–131. https://doi.org/10.1214/aos/1176343003

Rahayu, A. (2013). Identification of Climate Change with Generalized Extreme Value (GEV) Distribution Approach. *Journal of Physics: Conference Series*, *423*, 012026. https://doi.org/10.1088/1742-6596/423/1/012026

Rahman, A. S., Rahman, A., Zaman, M. A., Haddad, K., Ahsan, A., & Imteaz, M. (2013). A study on selection of probability distributions for at-site flood frequency analysis in Australia. *Natural Hazards*, *69*(3), 1803–1813. https://doi.org/10.1007/s11069-013-0775-y

Salleh, N. H. M., & Hasan, H. (2018). GENERALIZED PARETO DISTRIBUTION FOR EXTREME TEMPERATURES IN PENINSULAR MALAYSIA. *Sci.Int.(Lahore)*, *30*(1), 63–67.

Shaharudin, S. M., Ahmad, N., Mohamed, N. S., & Mahdin, H. (2020). Fitting statistical distribution of extreme rainfall data for the purpose of simulation. *Indonesian Journal of Electrical Engineering and Computer Science*, *18*(3), 1367. https://doi.org/10.11591/ijeecs.v18.i3.pp1367-1374

Siregar, S. (2015). *Statistika Terapan untuk Perguruan Tinggi*. Prenada Media Grup.

Sunusi, N., Herdiani, E. T., & Nirwan. (2017). Modeling of Extreme Rainfall Recurrence Time by Using Point Process Models. *Journal of Environmental Science and Technology*, *10*(6), 320–324. https://doi.org/10.3923/jest.2017.320.324

Supari, Sudibyakto, Ettema, J., & Aldrian, E. (2012). Spatiotemporal Characteristics of Extreme Rainfall Events Over Java Island, Indonesia. *The Indonesian Journal of Geography*, *44*(1), 62–68. http://dx.doi.org/10.22146/indo.j.geog,2391

Susan, M. (2015). Modelling Oil Price Risk. *American Journal of Theoretical and Applied Statistics*, *4*(6), 539. https://doi.org/10.11648/j.ajtas.20150406.25

Teixeira, R., Nogal, M., & O'Connor, A. (2018). On the suitability of the generalized Pareto to model extreme waves. *Journal of Hydraulic Research*, *56*(6), 755–770. https://doi.org/10.1080/00221686.2017.1402829

Tiro, M. A., Sukarna, & Aswi. (2008). *Pengantar Teori Peluang*. Andira Publisher.

Trenberth, K. (2011). Changes in precipitation with climate change. *Climate Research*, *47*(1), 123–138. https://doi.org/10.3354/cr00953

Tukidin. (2010). Karakter Curah Hujan di Indonesia. *Jurnal Geografi Universitas Negeri Semarang*, *7*(2), 136–145. https://doi.org/10.15294/jg.v7i2.84

Varberg, D., Purcell, E. J., & Rigdon, S. E. (2007). *Calculus* (9th edition). Pearson Prentice Hall.

Zalina, M. D., Desa, M. N. M., Nguyen, V.-T.-A., & Kassim, A. H. M. (2002). Selecting a probability distribution for extreme rainfall series in Malaysia. *Water Science and Technology*, *45*(2), 63–68. https://doi.org/10.2166/wst.2002.0028

LAMPIRAN

Lampiran 1. Kejadian curah hujan ekstrem periode 1980 – 2022 di kota Makassar berdasarkan metode BM

Blok	**Tahun**	**Bulan**	**Tanggal**	**Curah hujan**
1	1980	Januari	18	163
2	1981	Februari	7	87
3	1982	Februari	6	95
4	1983	Desember	29	151
5	1984	Maret	8	209
6	1985	Maret	5	125
7	1986	Januari	12	178
8	1987	Desember	22	175
9	1988	Februari	11	235
10	1989	Januari	28	124
11	1990	Desember	24	158
12	1991	Januari	27	110
13	1992	Januari	11	135
14	1993	Desember	24	160
15	1994	Maret	12	90
16	1995	Februari	28	385
17	1996	Desember	21	153
18	1997	Februari	18	109
19	1998	Juli	23	106
20	1999	Februari	4	222
21	2000	Februari	25	197
22	2001	Januari	10	270
23	2002	Januari	3	148
24	2003	Desember	25	128
25	2004	Maret	5	139
26	2005	Desember	20	208
27	2006	Maret	29	139
28	2007	Desember	18	129
29	2008	Februari	3	157
30	2009	Februari	1	128
31	2010	September	18	106
32	2011	Februari	5	129
33	2012	Januari	30	103
34	2013	April	19	144
35	2014	Desember	7	123.6
36	2015	Desember	18	136.1
37	2016	Oktober	10	139.3
38	2017	Desember	22	162.5
39	2018	Desember	23	141.6
40	2019	Januari	22	197
41	2020	Desember	22	144.2
42	2021	Desember	7	243.3
43	2022	Februari	21	166.3

Lampiran 2. Kejadian curah hujan ekstrem periode 1980 – 2022 di kota Makassar berdasarkan metode POT dengan *threshold* 100 mm/hari

No	Tahun	Bulan	Curah hujan	No	Tahun	Bulan	Curah hujan
1	1980	Januari	163	**51**	1998	Juli	106
2	1980	Desember	128	**52**	1999	Januari	158
3	1980	Desember	102	**53**	1999	Januari	161
4	1983	November	136	**54**	1999	Januari	184
5	1983	November	118	**55**	1999	Februari	222
6	1983	Desember	151	**56**	1999	Februari	107
7	1984	Januari	146	**57**	1999	Maret	114
8	1984	Februari	112	**58**	1999	April	114
9	1984	Februari	136	**59**	1999	Desember	156
10	1984	Maret	209	**60**	1999	Desember	120
11	1984	Maret	123	**61**	2000	Januari	109
12	1984	Desember	103	**62**	2000	Januari	131
13	1984	Desember	102	**63**	2000	Februari	175
14	1985	Maret	125	**64**	2000	Februari	197
15	1985	November	113	**65**	2001	Januari	270
16	1986	Januari	178	**66**	2001	Februari	235
17	1986	Januari	125	**67**	2001	Maret	120
18	1986	Maret	138	**68**	2001	Maret	169
19	1987	Desember	102	**69**	2001	Juni	148
20	1987	Desember	143	**70**	2001	Desember	168
21	1987	Desember	111	**71**	2002	Januari	105
22	1987	Desember	121	**72**	2002	Januari	148
23	1987	Desember	175	**73**	2002	Maret	114
24	1988	Januari	119	**74**	2002	Desember	147
25	1988	Februari	166	**75**	2003	Januari	102
26	1988	Februari	235	**76**	2003	Februari	110
27	1988	Februari	109	**77**	2003	Desember	116
28	1989	Januari	124	**78**	2003	Desember	128
29	1990	Mei	114	**79**	2004	Februari	109
30	1990	Desember	158	**80**	2004	Februari	112
31	1991	Januari	110	**81**	2004	Maret	139
32	1992	Januari	135	**82**	2004	Maret	102
33	1992	Maret	106	**83**	2005	Desember	208
34	1993	Januari	130	**84**	2006	Februari	107
35	1993	April	144	**85**	2006	Maret	139
36	1993	Desember	160	**86**	2006	Desember	125
37	1993	Desember	143	**87**	2007	Februari	108
38	1995	Januari	113	**88**	2007	Desember	129
39	1995	Februari	385	**89**	2008	Februari	157
40	1995	April	103	**90**	2009	Februari	128
41	1995	Mei	121	**91**	2009	Februari	103
42	1996	Januari	148	**92**	2010	Januari	103
43	1996	Februari	131	**93**	2010	September	106
44	1996	Desember	139	**94**	2011	Januari	113
45	1996	Desember	106	**95**	2011	Februari	129
46	1996	Desember	101	**96**	2011	Desember	104
47	1996	Desember	109	**97**	2011	Desember	114
48	1996	Desember	153	**98**	2011	Desember	116
49	1997	Januari	104	**99**	2011	Desember	101
50	1997	Februari	109	**100**	2012	Januari	103

Lanjutan

No	Tahun	Bulan	Curah hujan
101	2013	Januari	126
102	2013	Maret	105
103	2013	April	144
104	2013	April	107
105	2013	November	137.4
106	2013	Desember	109
107	2014	Februari	106
108	2014	Desember	123.6
109	2014	Desember	106.4
110	2014	Desember	107.7
111	2015	Januari	104.8
112	2015	Februari	121.7
113	2015	Desember	136.1
114	2015	Desember	102
115	2016	Januari	124.4
116	2016	Oktober	139.3
117	2016	Oktober	106
118	2017	Desember	159.5
119	2017	Desember	112.3
120	2017	Desember	162.5
121	2018	Januari	134.2
122	2018	Januari	120.1
123	2018	Desember	141.6
124	2018	Desember	117.4
125	2019	Januari	110.2
126	2019	Januari	197
127	2020	Februari	106.2
128	2020	Maret	116.1
129	2020	Desember	101.3
130	2020	Desember	144.2
131	2021	Januari	110
132	2021	Maret	208.7
133	2021	Maret	106.3
134	2021	April	115.8
135	2021	November	113.5
136	2021	November	104
137	2021	Desember	243.3
138	2022	Januari	134.5
139	2022	Februari	166.3
140	2022	Februari	158.4
141	2022	Maret	109.6
142	2022	Mei	128.4
143	2022	November	136.1
144	2022	Desember	121
145	2022	Desember	108.4
146	2022	Desember	138.4

Lampiran 3. Tabel nilai kritis uji Kolmogorov-Smirnov

Critical Values of One-Sample Kolmogorov-Smirnov Test Statistic D

	Alpha				
n	0.20	0.10	0.05	0.02	0.01
1	0.900	0.950	0.975	0.990	0.995
2	0.684	0.776	0.842	0.900	0.929
3	0.565	0.636	0.708	0.785	0.829
4	0.493	0.656	0.624	0.689	0.734
5	0.447	0.509	0.563	0.627	0.669
6	0.410	0.468	0.519	0.577	0.617
7	0.381	0.436	0.483	0.538	0.576
8	0.358	0.410	0.454	0.507	0.542
9	0.339	0.387	0.430	0.480	0.513
10	0.323	0.369	0.409	0.457	0.489
11	0.308	0.352	0.391	0.437	0.468
12	0.296	0.338	0.375	0.419	0.449
13	0.285	0.325	0.361	0.404	0.432
14	0.275	0.314	0.349	0.390	0.418
15	0.266	0.304	0.338	0.377	0.404
16	0.258	0.295	0.327	0.366	0.392
17	0.250	0.286	0.318	0.355	0.381
18	0.244	0.279	0.309	0.346	0.371
19	0.237	0.271	0.301	0.337	0.361
20	0.232	0.265	0.294	0.329	0.352

	Alpha				
n	0.20	0.10	0.05	0.02	0.01
21	0.226	0.259	0.287	0.321	0.344
22	0.221	0.253	0.281	0.314	0.337
23	0.216	0.247	0.275	0.307	0.330
24	0.212	0.242	0.269	0.301	0.323
25	0.208	0.238	0.264	0.295	0.317
26	0.204	0.233	0.259	0.290	0.311
27	0.200	0.229	0.254	0.284	0.305
28	0.197	0.225	0.250	0.279	0.300
29	0.193	0.221	0.246	0.275	0.295
30	0.190	0.218	0.242	0.270	0.290
31	0.187	0.214	0.238	0.266	0.285
32	0.184	0.211	0.234	0.262	0.281
33	0.182	0.208	0.231	0.258	0.277
34	0.179	0.205	0.227	0.254	0.273
35	0.177	0.202	0.224	0.251	0.269
36	0.174	0.199	0.221	0.247	0.265
37	0.172	0.196	0.218	0.244	0.262
38	0.170	0.194	0.215	0.241	0.258
39	0.168	0.191	0.213	0.238	0.255
40	0.165	0.189	0.210	0.235	0.252
$n > 40$ approx.	$\frac{1.07}{\sqrt{n}}$	$\frac{1.22}{\sqrt{n}}$	$\frac{1.36}{\sqrt{n}}$	$\frac{1.52}{\sqrt{n}}$	$\frac{1.63}{\sqrt{n}}$

Lampiran 4. Uji Kolmogorov-Smirnov pada data ekstrem berdasarkan metode BM

ch	freq	fkum	CDF sampel	CDF GEV	selisih	$\|selisih\|$	D_{hitung}
87	1	1	0.023255814	0.013351717	0.009904	0.009904097	0.06811517
90	1	2	0.046511628	0.020742849	0.025769	0.025768778	
95	1	3	0.069767442	0.038757043	0.03101	0.031010399	
103	1	4	0.093023256	0.084191004	0.008832	0.008832252	
106	2	6	0.139534884	0.10645597	0.033079	0.033078913	
109	1	7	0.162790698	0.131280084	0.031511	0.031510614	
110	1	8	0.186046512	0.140072362	0.045974	0.045974149	
123.6	1	9	0.209302326	0.277417492	-0.06812	0.068115167	
124	1	10	0.23255814	0.281758832	-0.0492	0.049200693	
125	1	11	0.255813953	0.292639579	-0.03683	0.036825625	
128	2	13	0.302325581	0.325408659	-0.02308	0.023083078	
129	2	15	0.348837209	0.336335086	0.012502	0.012502123	
135	1	16	0.372093023	0.401205799	-0.02911	0.029112776	
136.1	1	17	0.395348837	0.412876476	-0.01753	0.017527639	
139	2	19	0.441860465	0.443167859	-0.00131	0.001307394	
139.3	1	20	0.465116279	0.446257634	0.018859	0.018858645	
141.6	1	21	0.488372093	0.46964238	0.01873	0.018729713	
144	1	22	0.511627907	0.493426937	0.018201	0.01820097	
144.2	1	23	0.534883721	0.495378767	0.039505	0.039504954	
148	1	24	0.558139535	0.531526011	0.026614	0.026613524	
151	1	25	0.581395349	0.558744834	0.022651	0.022650515	
153	1	26	0.604651163	0.576217585	0.028434	0.028433578	
157	1	27	0.627906977	0.609513035	0.018394	0.018393942	
158	1	28	0.651162791	0.617490907	0.033672	0.033671883	
160	1	29	0.674418605	0.633031906	0.041387	0.041386698	
162.5	1	30	0.697674419	0.65168529	0.045989	0.045989129	
163	1	31	0.720930233	0.65531377	0.065616	0.065616463	
166.3	1	32	0.744186047	0.678419778	0.065766	0.065766268	
175	1	33	0.76744186	0.732607539	0.034834	0.034834322	
178	1	34	0.790697674	0.749166966	0.041531	0.041530708	
197	2	36	0.837209302	0.832551813	0.004657	0.004657489	
208	1	37	0.860465116	0.867067797	-0.0066	0.006602681	
209	1	38	0.88372093	0.869805542	0.013915	0.013915388	
222	1	39	0.906976744	0.900354889	0.006622	0.006621855	
235	1	40	0.930232558	0.923247295	0.006985	0.006985263	
243.3	1	41	0.953488372	0.934795796	0.018693	0.018692576	
270	1	42	0.976744186	0.960648328	0.016096	0.016095858	
385	1	43	1	0.993900808	0.006099	0.006099192	

Keterangan:

Selisih = CDF sampel – CDF GEV

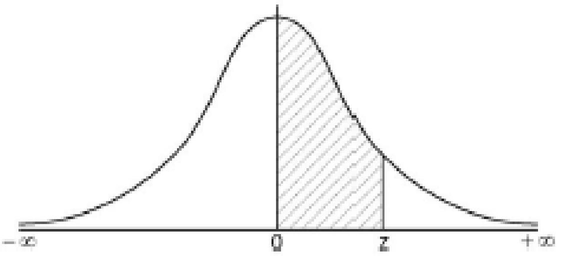
$D_{hitung} = maks|selisih|$

Lampiran 5. Uji Kolmogorov-Smirnov pada data ekstrem berdasarkan metode POT

ch	freq	fkum	CDF sampel	CDF GP	selisih	$\lvert selisih \rvert$	D_{hitung}
101	1	1	0.00685	0.03216	-0.02531	0.0253147	0.0429126
101	1	2	0.0137	0.03216	-0.01847	0.01846538	
101.3	1	3	0.02055	0.04159	-0.02104	0.02104187	
102	1	4	0.0274	0.06319	-0.0358	0.03579549	
102	1	5	0.03425	0.06319	-0.02895	0.02894617	
102	1	6	0.0411	0.06319	-0.0221	0.02209686	
102	1	7	0.04795	0.06319	-0.01525	0.01524754	
102	1	8	0.05479	0.06319	-0.0084	0.00839823	
102	1	9	0.06164	0.06319	-0.00155	0.00154891	
103	1	10	0.06849	0.09313	-0.02464	0.02463665	
103	1	11	0.07534	0.09313	-0.01779	0.01778734	
103	1	12	0.08219	0.09313	-0.01094	0.01093802	
103	1	13	0.08904	0.09313	-0.00409	0.00408871	
103	1	14	0.09589	0.09313	0.002761	0.00276061	
104	1	15	0.10274	0.12202	-0.01928	0.01927725	
104	1	16	0.10959	0.12202	-0.01243	0.01242794	
104	1	17	0.11644	0.12202	-0.00558	0.00557862	
104.8	1	18	0.12329	0.1444	-0.02111	0.02111012	
105	1	19	0.13014	0.14989	-0.01976	0.01975735	
105	1	20	0.13699	0.14989	-0.01291	0.01290804	
106	1	21	0.14384	0.1768	-0.03296	0.03296469	
106	1	22	0.15068	0.1768	-0.02612	0.02611537	
106	1	23	0.15753	0.1768	-0.01927	0.01926606	
106	1	24	0.16438	0.1768	-0.01242	0.01241674	
106	1	25	0.17123	0.1768	-0.00557	0.00556743	
106	1	26	0.17808	0.1768	0.001282	0.00128189	
106.2	1	27	0.18493	0.18207	0.002863	0.00286331	
106.3	1	28	0.19178	0.18469	0.007093	0.00709261	
106.4	1	29	0.19863	0.1873	0.011331	0.01133114	
107	1	30	0.20548	0.20277	0.002708	0.00270775	
107	1	31	0.21233	0.20277	0.009557	0.00955707	
107	1	32	0.21918	0.20277	0.016406	0.01640638	
107.7	1	33	0.22603	0.22041	0.005613	0.00561281	
108	1	34	0.23288	0.22784	0.005033	0.00503285	
⋮	⋮	⋮	⋮	⋮	⋮	⋮	
243.3	1	144	0.9863	0.97853	0.007767	0.00776749	
270	1	145	0.99315	0.98793	0.005216	0.00521571	
385	1	146	1	0.99861	0.001395	0.00139456	

Lampiran 6. Tabel distribusi normal baku

Luas di bawah kurva normal baku dari 0 ke z



z	0	1	2	3	4	5	6	7	8	9
0.0	0.0000	0.0040	0.0080	0.0120	0.0160	0.0199	0.0239	0.0279	0.0319	0.0359
0.1	0.0398	0.0438	0.0478	0.0517	0.0557	0.0596	0.0636	0.0675	0.0714	0.0753
0.2	0.0793	0.0832	0.0871	0.0910	0.0948	0.0987	0.1026	0.1064	0.1103	0.1141
0.3	0.1179	0.1217	0.1255	0.1293	0.1331	0.1368	0.1406	0.1443	0.1480	0.1517
0.4	0.1554	0.1591	0.1628	0.1664	0.1700	0.1736	0.1772	0.1808	0.1844	0.1879
0.5	0.1915	0.1950	0.1985	0.2019	0.2054	0.2088	0.2123	0.2157	0.2190	0.2224
0.6	0.2257	0.2291	0.2324	0.2357	0.2389	0.2422	0.2454	0.2486	0.2517	0.2549
0.7	0.2580	0.2611	0.2642	0.2673	0.2704	0.2734	0.2764	0.2794	0.2823	0.2852
0.8	0.2881	0.2910	0.2939	0.2967	0.2995	0.3023	0.3051	0.3078	0.3106	0.3133
0.9	0.3159	0.3186	0.3212	0.3238	0.3264	0.3289	0.3315	0.3340	0.3365	0.3389
1.0	0.3413	0.3438	0.3461	0.3485	0.3508	0.3531	0.3554	0.3577	0.3599	0.3621
1.1	0.3643	0.3665	0.3686	0.3708	0.3729	0.3749	0.3770	0.3790	0.3810	0.3830
1.2	0.3849	0.3869	0.3888	0.3907	0.3925	0.3944	0.3962	0.3980	0.3997	0.4015
1.3	0.4032	0.4049	0.4066	0.4082	0.4099	0.4115	0.4131	0.4147	0.4162	0.4177
1.4	0.4192	0.4207	0.4222	0.4236	0.4251	0.4265	0.4279	0.4292	0.4306	0.4319
1.5	0.4332	0.4345	0.4357	0.4370	0.4382	0.4394	0.4406	0.4418	0.4429	0.4441
1.6	0.4452	0.4463	0.4474	0.4484	0.4495	0.4505	0.4515	0.4525	0.4535	0.4545
1.7	0.4554	0.4564	0.4573	0.4582	0.4591	0.4599	0.4608	0.4616	0.4625	0.4633
1.8	0.4641	0.4649	0.4656	0.4664	0.4671	0.4678	0.4686	0.4693	0.4699	0.4706
1.9	0.4713	0.4719	0.4726	0.4732	0.4738	0.4744	0.4750	0.4756	0.4761	0.4767
2.0	0.4772	0.4778	0.4783	0.4788	0.4793	0.4798	0.4803	0.4808	0.4812	0.4817
2.1	0.4821	0.4826	0.4830	0.4834	0.4838	0.4842	0.4846	0.4850	0.4854	0.4857
2.2	0.4861	0.4864	0.4868	0.4871	0.4875	0.4878	0.4881	0.4884	0.4887	0.4890
2.3	0.4893	0.4896	0.4898	0.4901	0.4904	0.4906	0.4909	0.4911	0.4913	0.4916
2.4	0.4918	0.4920	0.4922	0.4925	0.4927	0.4929	0.4931	0.4932	0.4934	0.4936
2.5	0.4938	0.4940	0.4941	0.4943	0.4945	0.4946	0.4948	0.4949	0.4951	0.4952
2.6	0.4953	0.4955	0.4956	0.4957	0.4959	0.4960	0.4961	0.4962	0.4963	0.4964
2.7	0.4965	0.4966	0.4967	0.4968	0.4969	0.4970	0.4971	0.4972	0.4973	0.4974
2.8	0.4974	0.4975	0.4976	0.4977	0.4977	0.4978	0.4979	0.4979	0.4980	0.4981
2.9	0.4981	0.4982	0.4982	0.4983	0.4984	0.4984	0.4985	0.4985	0.4986	0.4986
3.0	0.4987	0.4987	0.4987	0.4988	0.4988	0.4989	0.4989	0.4989	0.4990	0.4990
3.1	0.4990	0.4991	0.4991	0.4991	0.4992	0.4992	0.4992	0.4992	0.4993	0.4993
3.2	0.4993	0.4993	0.4994	0.4994	0.4994	0.4994	0.4994	0.4995	0.4995	0.4995
3.3	0.4995	0.4995	0.4995	0.4996	0.4996	0.4996	0.4996	0.4996	0.4996	0.4997
3.4	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4998
3.5	0.4998	0.4998	0.4998	0.4998	0.4998	0.4998	0.4998	0.4998	0.4998	0.4998
3.6	0.4998	0.4998	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999
3.7	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999
3.8	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999
3.9	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000

Lampiran 7. Kode program untuk estimasi parameter

Parameter distribusi GEV:

```
> library(extRemes)
> bm_gev <- fevd(ekstrem_bm$rainfall, ekstrem_bm,
+               type="GEV",
+               method = "MLE",
+               optim.args = list(method="BFGS"))
> print(bm_gev)

fevd(x = ekstrem_bm$rainfall, data = ekstrem_bm, type = "GEV",
    method = "MLE", optim.args = list(method = "BFGS"))

[1] "Estimation Method used: MLE"


 Negative Log-Likelihood Value:  222.8667


 Estimated parameters:
   location        scale       shape
131.8988507  33.9691418   0.1406644

 Standard Error Estimates:
 location      scale     shape
5.8464151 4.4842428 0.1177287

 Estimated parameter covariance matrix.
           location       scale       shape
location 34.1805692 13.47790075 -0.21700313
scale    13.4779007 20.10843389 -0.06308899
shape    -0.2170031 -0.06308899  0.01386005

 AIC = 451.7334

 BIC = 457.017

> ci(bm_gev, type="parameter")
fevd(x = ekstrem_bm$rainfall, data = ekstrem_bm, type = "GEV",
    method = "MLE", optim.args = list(method = "BFGS"))

[1] "Normal Approx."

         95% lower CI    Estimate 95% upper CI
location  120.4400877 131.8988507  143.3576137
scale      25.1801873  33.9691418   42.7580963
shape      -0.0900796   0.1406644    0.3714084

> bm_gev$results$hessian
            location       scale      shape
location  0.04364430 -0.02750194  0.5581425
scale    -0.02750194  0.06778090 -0.1220616
shape     0.55814252 -0.12206155 80.3329202
```

Parameter distribusi GP:

```
> pot_gpd <- fevd(ch_mks_clean$rainfall, ch_mks_clean,
+                threshold = 100,
+                type="GP",
+                method = "MLE",
+                optim.args = list(method="BFGS"))
> print(pot_gpd)

fevd(x = ch_mks_clean$rainfall, data = ch_mks_clean, threshold =
100,
    type = "GP", method = "MLE", optim.args = list(method = "BFGS"))

[1] "Estimation Method used: MLE"


 Negative Log-Likelihood Value:  659.7292


 Estimated parameters:
     scale      shape
30.5374678  0.1009668

 Standard Error Estimates:
     scale      shape
3.67888639 0.08783821

 Estimated parameter covariance matrix.
           scale       shape
scale 13.5342051 -0.21235869
shape -0.2123587  0.00771555

 AIC = 1323.458

 BIC = 1329.426

> ci(pot_gpd, type="parameter")
fevd(x = ch_mks_clean$rainfall, data = ch_mks_clean, threshold =
100,
    type = "GP", method = "MLE", optim.args = list(method = "BFGS"))

[1] "Normal Approx."

      95% lower CI   Estimate 95% upper CI
scale  23.32698292 30.5374678   37.7479526
shape  -0.07119293  0.1009668    0.2731265

> pot_gpd$results$hessian
          scale      shape
scale 0.1300499   3.579405
shape 3.5794046 228.121807
```