

### Lampiran III Analisis Data Kematian Ikan

#### A. Metode Probit

Metode probit digunakan untuk memperkirakan nilai  $LC_{50}$  dengan keyakinan 95%. Hasil data analisis yang menggunakan program komputer EPA Probit.

##### 1. Influen 1 Limbah Batik

EPA PROBIT ANALYSIS PROGRAM USED FOR CALCULATING LC/EC VALUES Version 1.5					
Influen Limbah batik					
Conc.	Number Exposed	Number Resp.	Observed Proportion Responding	Proportion Responding Adjusted for Controls	Predicted Proportion Responding
0.2000	20	2	0.1000	0.1000	0.0103
0.3900	20	1	0.0500	0.0500	0.0570
0.7800	20	1	0.0500	0.0500	0.2063
1.5600	20	5	0.2500	0.2500	0.4769
3.1300	20	20	1.0000	1.0000	0.7602
Chi - Square for Heterogeneity (calculated)				=	29.166
Chi - Square for Heterogeneity (tabular value at 0.05 level)				=	7.815
*****					
* WARNING *					
* The tabular chi-square value exceeds the calculated *					
* chi-square value for heterogeneity. This is evidence that *					
* the probit model may not be appropriate for these data. *					
* The results reported for this data set may not be valid, *					
* and should be interpreted with appropriate caution. *					
*****					
*****					
* NOTE *					
* Slope not significantly different from zero. *					
* LC/EC fiducial limits cannot be computed. *					
*****					

Mu = 0.216064  
 Sigma = 0.395412

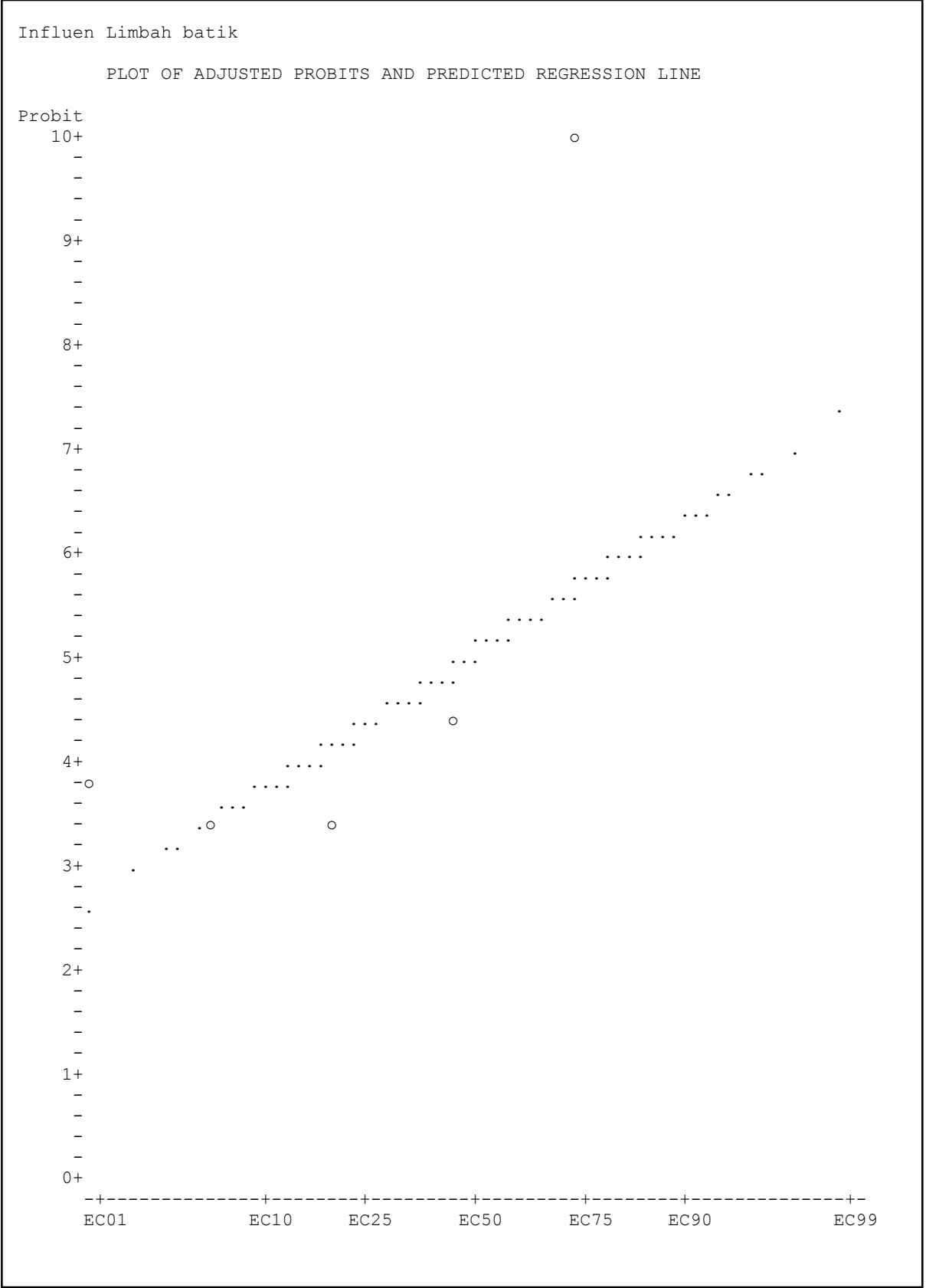
Parameter	Estimate	Std. Err.	95% Confidence Limits	
Intercept	4.453571	0.513831	( 2.818562,	6.088581)
Slope	2.529009	1.487359	( -2.203767,	7.261786)

Theoretical Spontaneous Response Rate = 0.0000

Influen Limbah batik

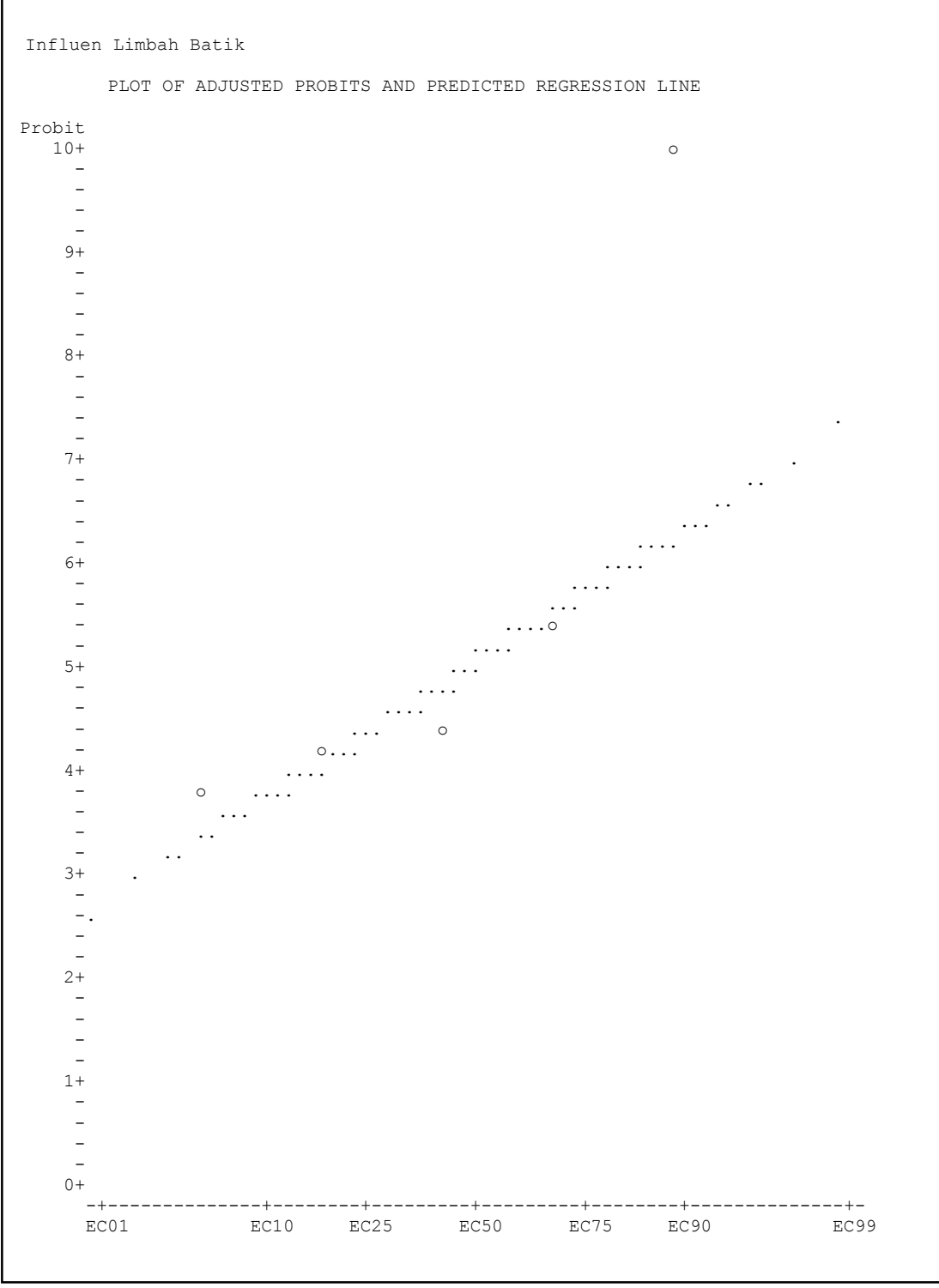
Estimated LC/EC Values and Confidence Limits

Point	Exposure Conc.	95% Confidence Limits	
		Lower	Upper
LC/EC 1.00	0.198		
LC/EC 5.00	0.368		
LC/EC 10.00	0.512		
LC/EC 15.00	0.640		
LC/EC 50.00	1.645		
LC/EC 85.00	4.225		
LC/EC 90.00	5.282		
LC/EC 95.00	7.353		
LC/EC 99.00	13.674		



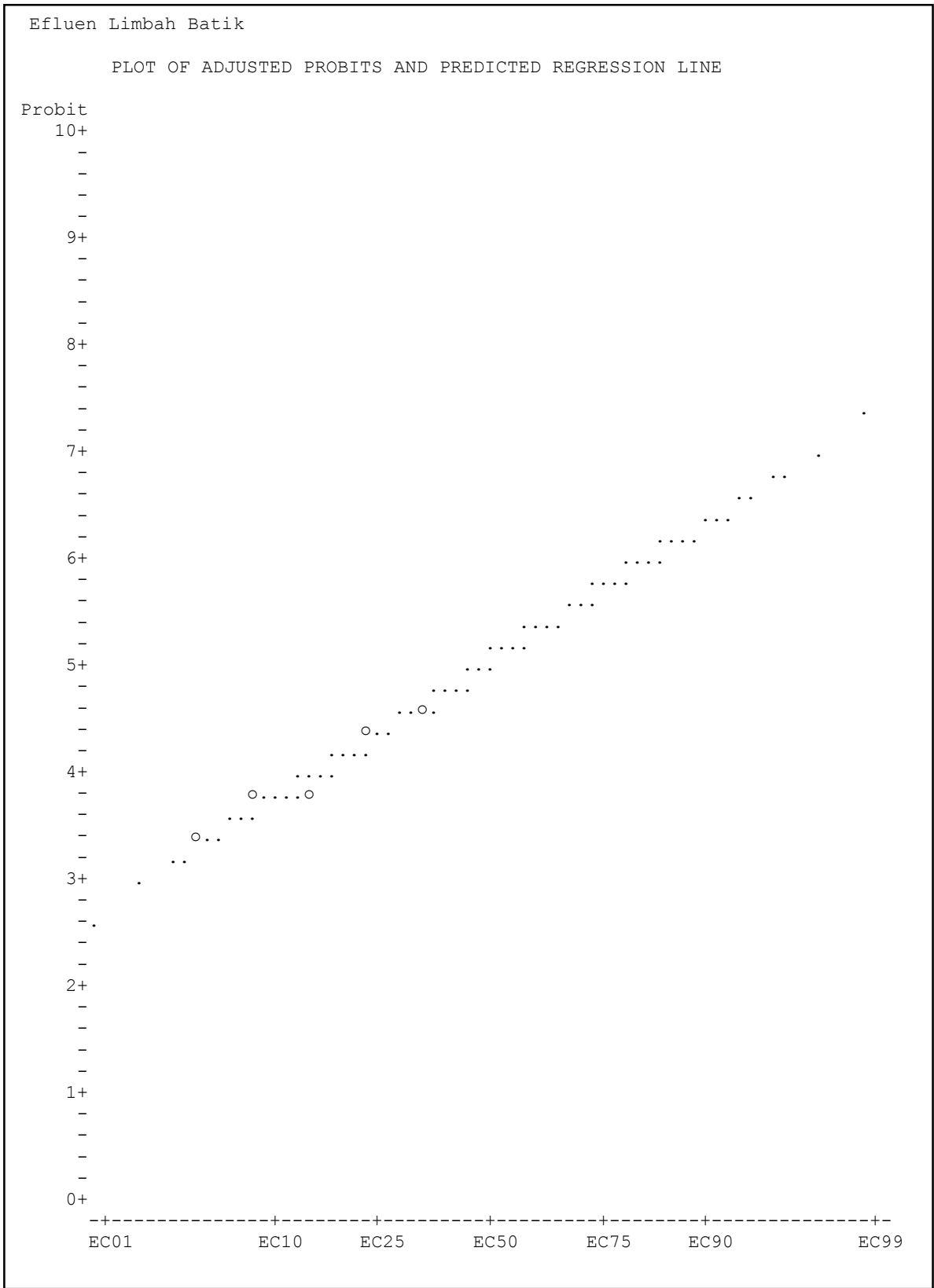
## 2. Influen 2 Limbah Batik

EPA PROBIT ANALYSIS PROGRAM USED FOR CALCULATING LC/EC VALUES Version 1.5					
Influen Limbah Batik					
Conc.	Number Exposed	Number Resp.	Observed Proportion Responding	Proportion Responding Adjusted for Controls	Predicted Proportion Responding
0.2000	20	2	0.1000	0.1000	0.0504
0.3900	20	4	0.2000	0.2000	0.1789
0.7800	20	6	0.3000	0.3000	0.4323
1.5600	20	13	0.6500	0.6500	0.7185
3.1300	20	20	1.0000	1.0000	0.9084
Chi - Square for Heterogeneity (calculated)				=	4.997
Chi - Square for Heterogeneity (tabular value at 0.05 level)				=	7.815
Mu	=	-0.039361			
Sigma	=	0.401923			
Parameter	Estimate	Std. Err.	95% Confidence Limits		
Intercept	5.097931	0.152958	(	4.798133,	5.397728)
Slope	2.488038	0.417837	(	1.669077,	3.306999)
Theoretical Spontaneous Response Rate = 0.0000					
Influen Limbah Batik					
Estimated LC/EC Values and Confidence Limits					
Point	Exposure Conc.	95% Confidence Limits			
		Lower	Upper		
LC/EC 1.00	0.106	0.036	0.188		
LC/EC 5.00	0.199	0.090	0.308		
LC/EC 10.00	0.279	0.147	0.404		
LC/EC 15.00	0.350	0.202	0.487		
LC/EC 50.00	0.913	0.689	1.230		
LC/EC 85.00	2.383	1.678	4.337		
LC/EC 90.00	2.991	2.021	5.993		
LC/EC 95.00	4.186	2.643	9.739		
LC/EC 99.00	7.864	4.325	24.488		



### 3. Efluen Limbah Batik

EPA PROBIT ANALYSIS PROGRAM USED FOR CALCULATING LC/EC VALUES Version 1.5					
Efluen Limbah Batik					
Conc.	Number Exposed	Number Resp.	Observed Proportion Responding	Proportion Responding Adjusted for Controls	Predicted Proportion Responding
6.2500	20	1	0.0500	0.0500	0.0458
10.5000	20	2	0.1000	0.1000	0.0881
17.6400	20	2	0.1000	0.1000	0.1544
29.6000	20	6	0.3000	0.3000	0.2470
50.0000	20	7	0.3500	0.3500	0.3647
Chi - Square for Heterogeneity (calculated)				=	0.817
Chi - Square for Heterogeneity (tabular value at 0.05 level)				=	7.815
Mu	=	1.932000			
Sigma	=	0.673518			
Parameter	Estimate	Std. Err.	95% Confidence Limits		
Intercept	2.131480	0.719315	(	0.721623,	3.541338)
Slope	1.484741	0.518446	(	0.468588,	2.500895)
Theoretical Spontaneous Response Rate = 0.0000					
Efluen Limbah Batik					
Estimated LC/EC Values and Confidence Limits					
Point	Exposure Conc.	95% Confidence Limits			
		Lower	Upper		
LC/EC 1.00	2.318	0.015	6.275		
LC/EC 5.00	6.670	0.415	12.434		
LC/EC 10.00	11.717	2.260	19.001		
LC/EC 15.00	17.138	6.419	27.971		
LC/EC 50.00	85.507	44.363	1711.238		
LC/EC 85.00	426.612	122.617	261784.516		
LC/EC 90.00	623.994	154.619	868064.313		
LC/EC 95.00	1096.148	217.537	5138743.000		
LC/EC 99.00	3153.585	410.957	144948224.000		



Nilai  $LC_{50}$  dapat dihitung dengan menggunakan metode probit tanpa menggunakan program komputer, yaitu dengan menggunakan least square.

a) Influen Limbah Batik

Tabel III.1 Konsentrasi dan Nilai Probit Influen1 Limbah Batik

NO	Konsentrasi Limbah (%)	Jumlah Populasi (ekor)	Kematian (ekor)	Kematian (%)	Log Konsentrasi Limbah (X)	Nilai Probit (Y)
	(1)	(2)	(3)	(4)	(5)	(6)
1	0.2	20	2	10	-0.699	3.72
2	0.39	20	1	5	-0.409	3.36
3	0.78	20	1	5	-0.108	3.36
4	1.56	20	5	25	0.193	4.33
5	3.13	20	20	100	0.496	8.09

Tabel III.2 Persamaan Linear Influen1 Limbah Batik Metode Probit

No	Konsentrasi Limbah	Log Konsentrasi Limbah (X)	Nilai Probit (Y)	X.Y	X <sup>2</sup>
	(1)	(2)	(3)	(4)	(5)
1	0.2	-0.699	3.72	-2.6002	0.4886
2	0.39	-0.409	3.36	-1.3740	0.1672
3	0.78	-0.108	3.36	-0.3626	0.0116
4	1.56	0.193	4.33	0.8362	0.0373
5	3.13	0.496	8.09	4.0090	0.2456
Total		-0.527	22.860	0.508	0.950

$$\begin{aligned}
 a &= \frac{(\sum y)(\sum x^2) - (\sum x)(\sum xy)}{n(\sum x^2) - (\sum x)^2} \\
 &= \frac{(22,86)(0,950) - (-0,527)(0,508)}{5(0,950) - (-0,527)^2} \\
 &= 4,9195
 \end{aligned}$$

$$b = \frac{n(\sum xy) - (\sum x)(\sum y)}{n(\sum x^2) - (\sum x)^2}$$

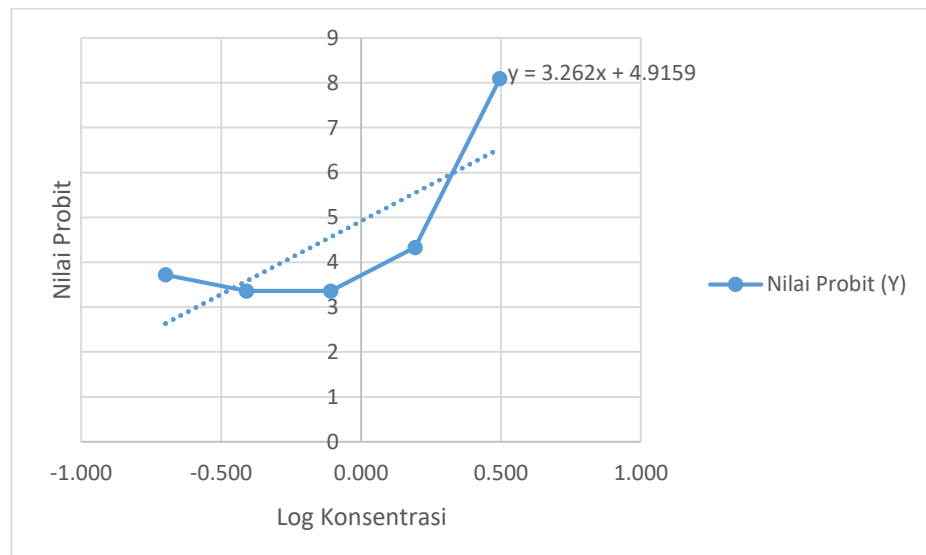


$$= \frac{5(0,508) - (-0,527)(22,86)}{5(\sum 0,950) - (-0,527)^2}$$

$$= 3,262$$

$$Y = bX + a$$

$$= 3,262X + 4,9195$$



Gambar III.1 Grafik Hubungan Konsentrasi Respon Influen Limbah Batik

$$Y = bX + a$$

$$= 3,262X + 4,9195$$

Y untuk 50% kematian populasi adalah 5

$$5 = 3,262X + 4,9195$$

$$X = \frac{5 - 4,9195}{3,262}$$

$$= 0,02578$$

$$LC_{50} = 10^{0,02578}$$

$$= 1,0612$$

$$\begin{aligned}
 TUa &= 100/LC_{50} \\
 &= 100/1,0612 \\
 &= 94,236 \text{ (High Acute Toxicity)}
 \end{aligned}$$

## b) Efluen Limbah Batik

Tabel III.3 Konsentrasi dan Nilai Probit Efluen Limbah Batik

NO	Konsentrasi Limbah (%)	Jumlah Populasi (ekor)	Kematian (ekor)	Kematian (%)	Log Konsentrasi Lindi (X)	Nilai Probit (Y)
	(1)	(2)	(3)	(4)	(5)	(6)
1	6.25	20	1	5	0.796	3.36
2	10.5	20	2	10	1.021	3.72
3	17.64	20	2	10	1.246	3.72
4	29.6	20	6	30	1.471	4.48
5	50	20	7	35	1.699	4.61

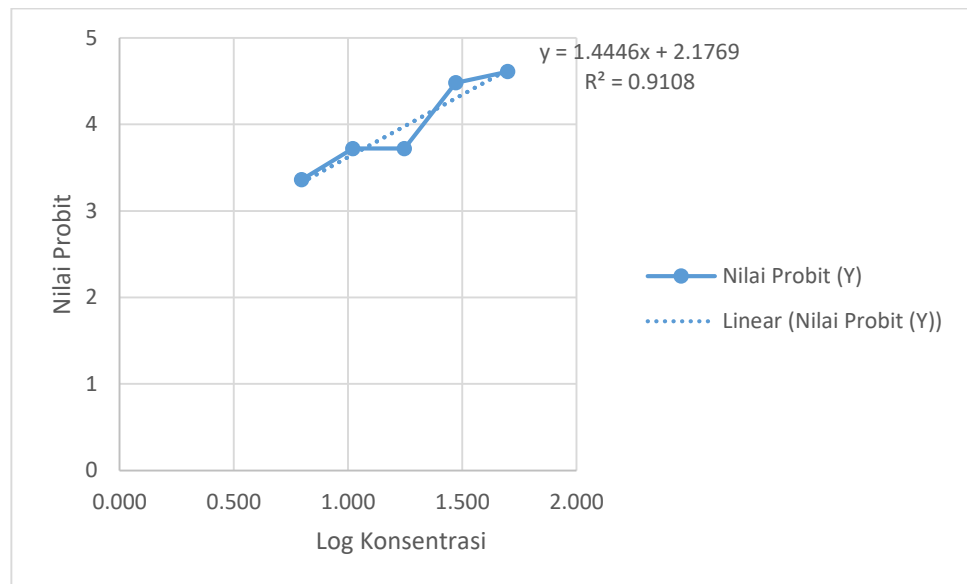
Tabel III.4 Persamaan Linear Efluen Limbah Batik Metode Probit

No	Konsentrasi Limbah	Log Konsentrasi Limbah (X)	Nilai Probit (Y)	X.Y	X <sup>2</sup>
	(1)	(2)	(3)	(4)	(5)
1	6.25	0.796	3.36	2.6742	0.6334
2	10.5	1.021	3.72	3.7988	1.0428
3	17.64	1.246	3.72	4.6370	1.5538
4	29.6	1.471	4.48	6.5914	2.1647
5	50	1.699	4.61	7.8323	2.8865
Total		6.234	19.890	25.534	8.281

$$\begin{aligned}
 a &= \frac{(\sum y)(\sum x^2) - (\sum x)(\sum xy)}{n(\sum x^2) - (\sum x)^2} \\
 &= \frac{(19,890)(8,281) - (6,234)(25,534)}{5(8,281) - (6,234)^2} \\
 &= 2,1769
 \end{aligned}$$

$$\begin{aligned}
 b &= \frac{n(\sum xy) - (\sum x)(\sum y)}{n(\sum x^2) - (\sum x)^2} \\
 &= \frac{5(25,534) - (8,281)(19,890)}{5(\sum 8,281) - (6,234)^2} \\
 &= 1,4446
 \end{aligned}$$

$$\begin{aligned}
 Y &= bX + a \\
 &= 1,4446X + 2,1769
 \end{aligned}$$



Gambar III.2 Grafik Hubungan Konsentrasi Respon Efluen Limbah Batik

$$\begin{aligned}
 Y &= bX + a \\
 &= 1,4446X + 2,1769 \\
 5 &= 1,4446X + 2,1769 \\
 X &= \frac{5 - 2,1769}{1,4446} \\
 &= 1,954
 \end{aligned}$$

$$LC_{50} = 10^{1,954}$$

$$= 90,000182$$

$$TUa = 100/90,000182$$

$$= 1,1111089 \text{ (Significant acute toxicit)}$$

## B. Metode Speraman-Karber

Metode Spearman-Karber digunakan untuk memperbaiki data sehingga data kematian ikan dapat disesuaikan dengan konsentrasi dibawahnya.

Tabel III.5 Penyesuaian % Kematian Ikan pada Uji Toksisitas Influen Limbah Batik

NO	Konsentrasi (mL)	Ln Konsentrasi (xi)	Populasi hewan uji (ni)	Kematian (ri)	% Kematian (pi)	% Kematian diperbaiki (p'i)
	(1)	(2)	(3)	(4)	(5)	(6)
1	0.20	-1.634756	20	2	0.1	0.066667
2	0.39	-0.941609	20	1	0.05	0.066667
3	0.78	-0.248461	20	1	0.05	0.066667
4	1.56	0.4446858	20	5	0.25	0.25
5	3.13	1.1394343	20	20	1	1

- a. Karena nilai pi pada konsentrasi 0,39 dan 0,78 lebih kecil daripada nilai pi pada konsentrasi 0,2, maka nilai pada pi perlu diperbaiki atau disesuaikan.

$$p'i_1 = p'i_2 = \frac{pi_2 + pi_1 + pi_3}{3}$$

$$p'i_1 = p'i_2 = \frac{0,05 + 0,1}{3}$$

$$= 0,0667$$

- b. Log 10 untuk  $LC_{50}$  menggunakan persamaan:

$$m = \sum_{i=1}^{k-1} \frac{(p'_{i+1} - p'_i)(x_i + x_{i+1})}{2}$$

Tabel III.6 Perhitungan LC<sub>50</sub>

NO	p'i	x'i	Rf = (p'i+1 - p'i)	Mi= (x'i)+(x'i+1)	m= $\frac{(3)x(4)}{2}$
	(1)	(2)	(3)	(4)	(5)
1	0.066667	-1.63476			
2	0.066667	-0.94161	0	-2.57636426	0
3	0.066667	-0.24846	0	-1.190069899	0
4	0.25	0.444686	0.183	0.196224462	0.0179872
5	1	1.139434	0.75	1.584120104	0.594045
				m	0.6120323

$$\begin{aligned} LC_{50} &= 10^{0,6120323} \\ &= 1,84 \end{aligned}$$

$$\begin{aligned} TUa &= 100/LC_{50} \\ &= 54,22 \end{aligned}$$