

Lampiran III Analisis Data Kematian Ugang

A. Metode Probit

Untuk memperkirakan LC50 dan batas atas-batas bawah interval keyakinan 95% dapat digunakan metode probit. Data dapat dianalisis menggunakan program komputer. (USEPA, 2002).

1. Influen IPAL Penyamakan Kulit

EPA PROBIT ANALYSIS PROGRAM USED FOR CALCULATING LC/EC VALUES Version 1.5						
Influen IPAL Industri Penyamakan Kulit						
Conc.	Number Exposed	Number Resp.	Observed Proportion Responding	Proportion Adjusted for Controls	Proportion Responding	Predicted Proportion Responding
1.5600	20	2	0.1000	0.1000	0.1000	0.0806
3.1300	20	6	0.3000	0.3000	0.3000	0.2188
6.2500	20	7	0.3500	0.3500	0.3500	0.4380
12.5000	20	10	0.5000	0.5000	0.5000	0.6793
25.0000	20	20	1.0000	1.0000	1.0000	0.8616
Chi - Square for Heterogeneity (calculated)				=	7.667	
Chi - Square for Heterogeneity (tabular value at 0.05 level)				=	7.815	

Mu = 0.871382

Sigma = 0.484205

Parameter	Estimate	Std. Err.	95% Confidence Limits	
Intercept	3.200386	0.343944	(2.526255,	3.874517)
Slope	2.065242	0.375842	(1.328591,	2.801892)

Theoretical Spontaneous Response Rate = 0.0000

Influen IPAL Industri Penyamakan Kulit

Estimated LC/EC Values and Confidence Limits

Point	Exposure Conc.	95% Confidence Limits	
		Lower	Upper
LC/EC 1.00	0.556	0.132	1.132
LC/EC 5.00	1.188	0.419	2.025
LC/EC 10.00	1.782	0.772	2.784
LC/EC 15.00	2.342	1.158	3.472
LC/EC 50.00	7.437	5.380	10.554
LC/EC 85.00	23.616	15.396	52.093
LC/EC 90.00	31.041	19.131	78.436
LC/EC 95.00	46.543	26.209	144.850
LC/EC 99.00	99.492	46.731	463.259

Influen IPAL Industri Penyamakan Kulit

PLOT OF ADJUSTED PROBITS AND PREDICTED
REGRESSION LINE

Probit

10+

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9+

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8+

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7+

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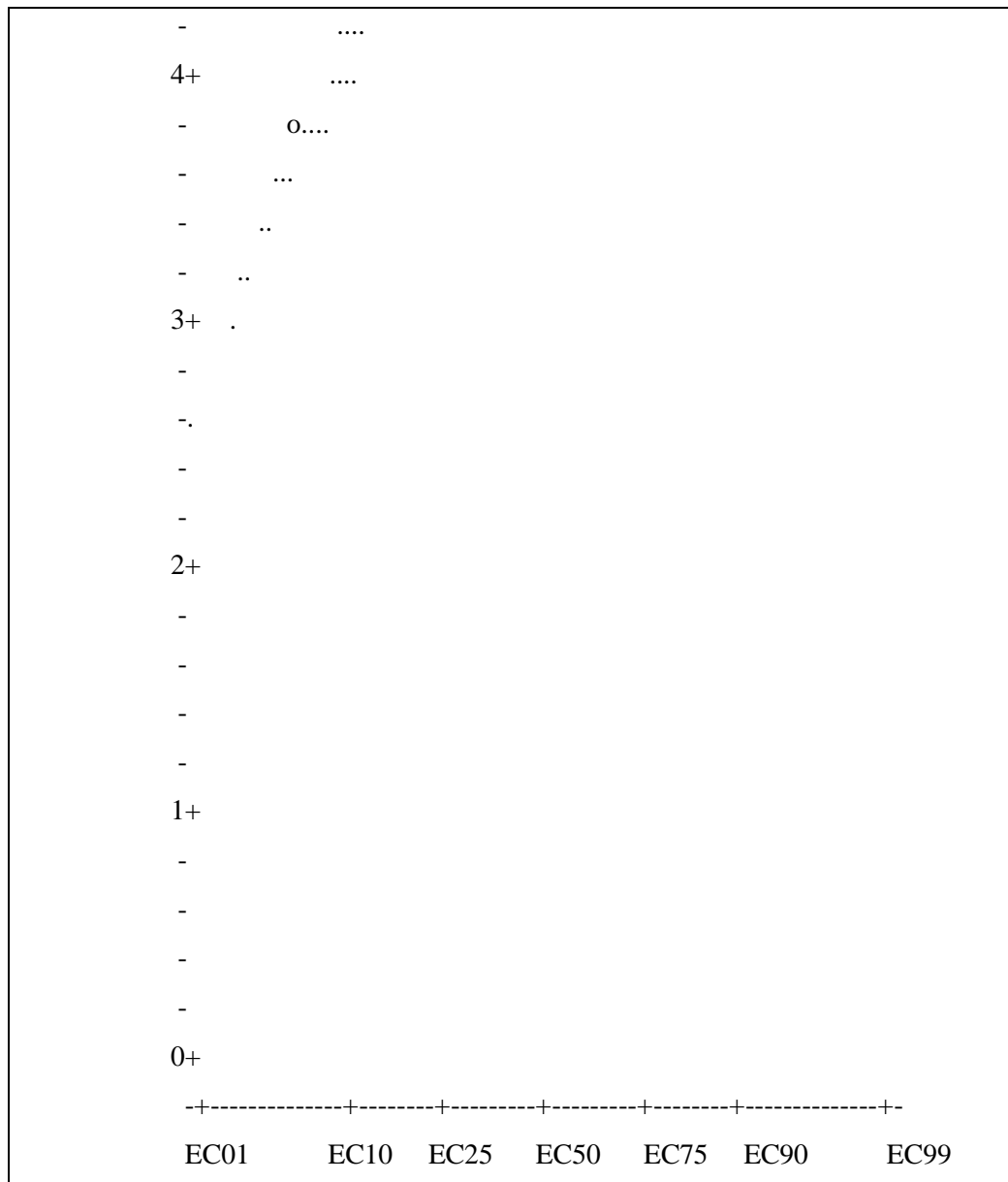
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2. Efluen IPAL Penyamakan Kulit

EPA PROBIT ANALYSIS PROGRAM
 USED FOR CALCULATING LC/EC VALUES
 Version 1.5

Efluen IPAL Industri Penyamakan Kulit

Conc.	Number Exposed	Number Resp.	Observed Proportion Responding	Proportion	
				Responding Adjusted for Controls	Predicted Proportion Responding
6.2500	20	2	0.1000	0.1000	0.0495
12.5000	20	4	0.2000	0.2000	0.1530
25.0000	20	5	0.2500	0.2500	0.3452
50.0000	20	7	0.3500	0.3500	0.5899
100.0000	20	20	1.0000	1.0000	0.8031

Chi - Square for Heterogeneity (calculated) = 11.885

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 = 1.589601

Sigma = 0.481255

Parameter	Estimate	Std. Err.	95% Confidence Limits
Intercept	1.696970	1.185429	(-2.075065, 5.469005)
Slope	2.077899	0.771627	(-0.377416, 4.533215)

Theoretical Spontaneous Response Rate = 0.0000

Efluen IPAL Industri Penyamakan Kulit

Estimated LC/EC Values and Confidence Limits

Point	Exposure Conc.	95% Confidence Limits	
		Lower	Upper
LC/EC 1.00	2.952		
LC/EC 5.00	6.280		
LC/EC 10.00	9.393		
LC/EC 15.00	12.326		
LC/EC 50.00	38.869		
LC/EC 85.00	122.567		
LC/EC 90.00	160.834		

LC/EC 95.00 240.557

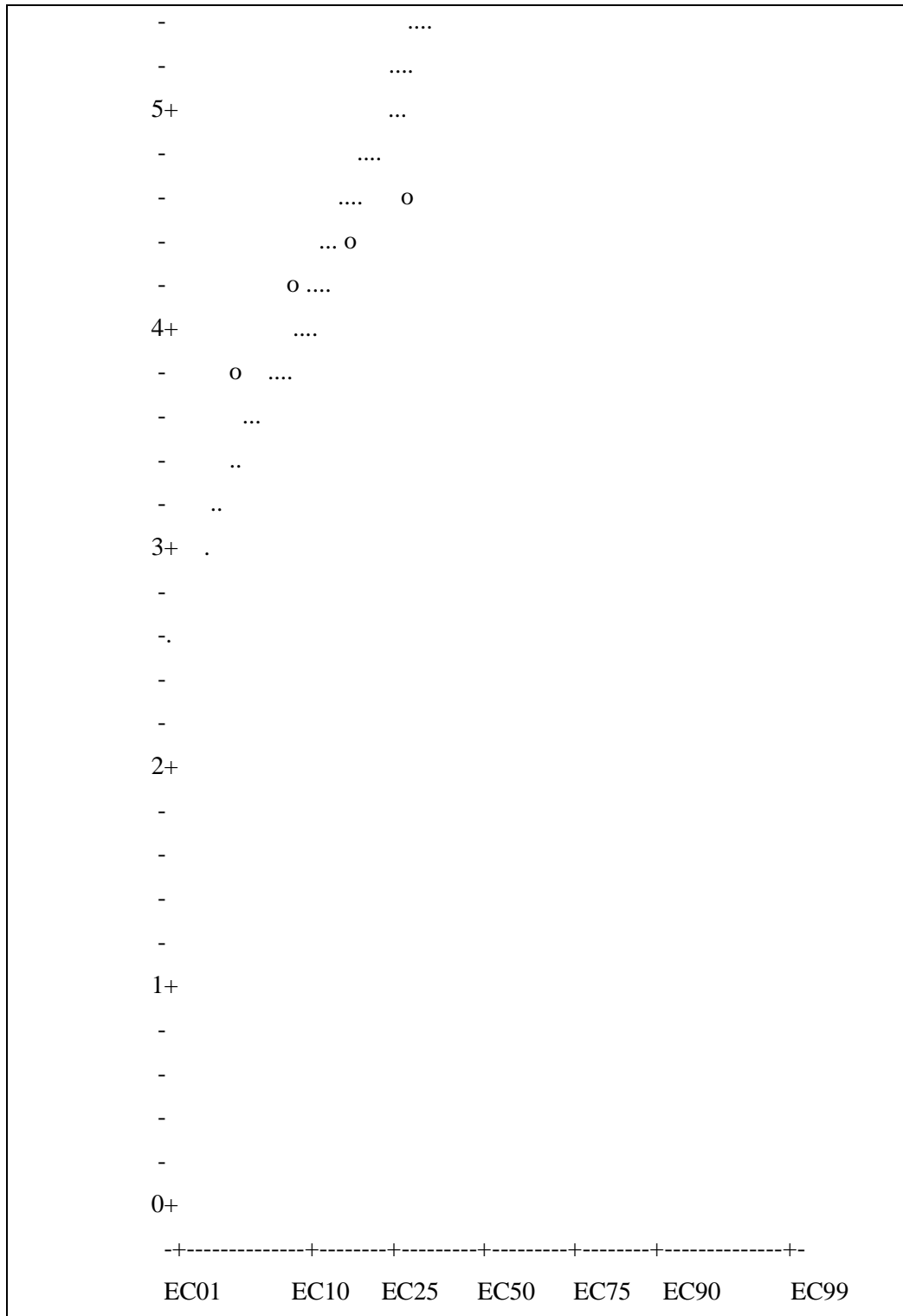
LC/EC 99.00 511.852

Efluen IPAL Industri Penyamakan Kulit

PLOT OF ADJUSTED PROBITS AND PREDICTED
REGRESSION LINE

Probit

10+	o
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9+	
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8+	
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-	.
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7+	.
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-	..
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6+
-
-	...



Metode Probit dapat dihitung dengan menggunakan regresi least square (tanpa program komputer).

1. Influen IPAL Pnyamakan Kulit

Tabel III. 1 Konsentrasi dan Nilai Probit Air Limbah Influen IPAL Penyamakan Kulit

No	Konsentrasi Air Limbah Penyamakan Kulit (%)	Jumlah Populasi (ekor)	Kematian (ekor)	Kematian (%)	Log Konsentrasi Air Limbah Penyamakan Kulit (X)	Nilai Probit (Y)
	(1)	(2)	(3)	(4)	(5)	(6)
1	1,56	20	2	10	0,193	3,72
2	3,13	20	6	30	0,496	4,48
3	6,25	20	7	35	0,796	4,61
4	12,5	20	10	50	1,097	5,00
5	25	20	20	100	1,398	8,09

Tabel III. 2 Persamaan Linear Influen Air Limbah Penyamakan Kulit Metode Probit

No	Konsentrasi Air Limbah Penyamakan Kulit (%)	Log Konsentrasi Air Limbah Penyamakan Kulit (X)	Nilai Probit (Y)	XY	X ²
1.	1,56	0,193	3,72	0,71842	0,037
2.	3,13	0,496	4,48	2,22004	0,246
3.	6,25	0,796	4,61	3,66901	0,633
4.	12,5	1,097	5,00	5,48455	1,203
5.	25	1,398	8,09	11,30933	1,954
Total		3,9794	25,90	23,4014	4,074

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

$$= \frac{(25,90)(4,074) - (3,9794)(23,4014)}{5(4,074) - (3,9794)^2}$$

$$= 2,7331$$

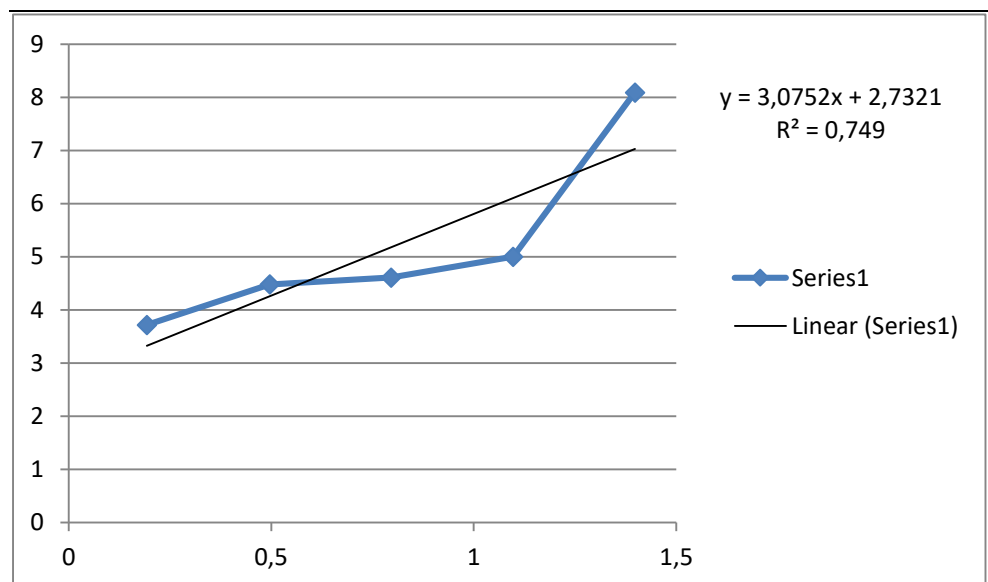
$$b = \frac{n(\sum xy) - (\sum x)(\sum y)}{n(\sum x^2) - (\sum x)^2}$$

$$= \frac{5(23,4014) - (3,9794)(25,90)}{5(4,074) - (3,9794)^2}$$

$$= 3,0744$$

$$Y = bX + a$$

$$= 3,0744X + 2,7331$$



Gambar III. 1 Hubungan Konsentrasi Respon Influen IPAL Penyamakan Kulit

$$Y = bX + a$$

$$Y = 3,0744 X + 2,7331$$

Y untuk 50% kematian populasi adalah 5

$$5 = 3,0744 X + 2,7331$$

$$X = \frac{5 - 2,7331}{3,0744}$$

$$= 0,7373$$

$$LC_{50} = 10^{0,7373}$$

$$= 5,461$$

$$\begin{aligned}
 TUa &= 100/ LC_{50} \\
 &= 100/ 5,461 \\
 &= 18,312 \text{ (High Acute Toxicity)}
 \end{aligned}$$

2. Efluen IPAL Penyamakan Kulit

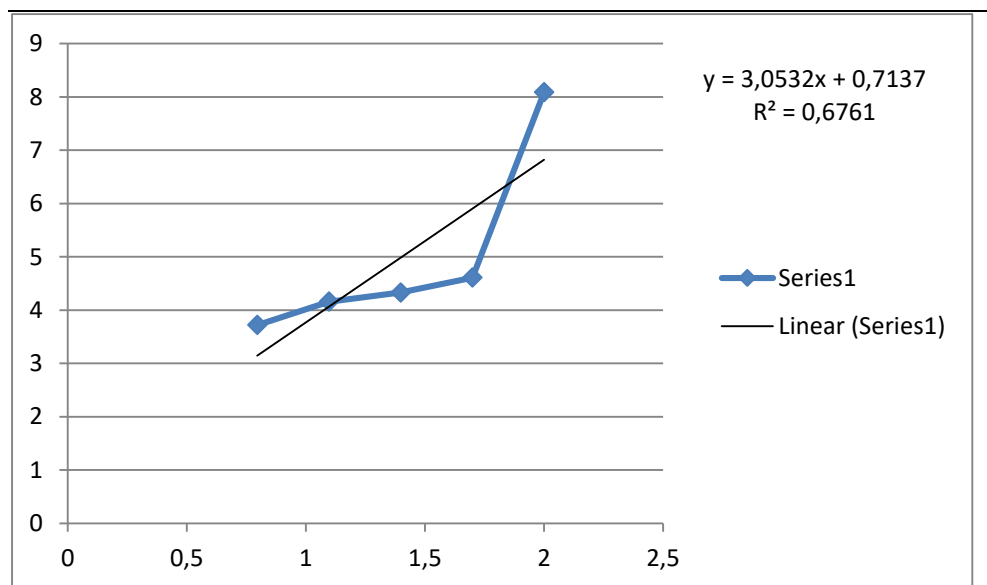
Tabel III. 3 Konsentrasi dan Nilai Probit Air Limbah Efluen IPAL Penyamakan Kulit

No	Konsentrasi Air Limbah Penyamakan Kulit (%)	Jumlah Populasi (ekor)	Kematian (ekor)	Kematian (%)	Log Konsentrasi Air Limbah Penyamakan Kulit (X)	Nilai Probit (Y)
	(1)	(2)	(3)	(4)	(5)	(6)
1	6,25	20	2	10	0,796	3,72
2	12,5	20	4	20	1,097	4,16
3	25	20	5	25	1,398	4,33
4	50	20	7	35	1,699	4,61
5	100	20	20	100	2,000	8,09

Tabel III. 4 Persamaan Linear Influen Air Limbah Penyamakan Kulit Metode Probit

No	Konsentrasi Air Limbah Penyamakan Kulit (%)	Log Konsentrasi Air Limbah Penyamakan Kulit (X)	Nilai Probit (Y)	XY	X ²
1.	6,25	0,796	3,72	2,96067	0,633
2.	12,5	1,097	4,16	4,56315	1,203
3.	25	1,398	4,33	6,05308	1,954
4.	50	1,699	4,61	7,83225	2,886
5.	100	2,000	8,09	16,18000	4,000
Total		6,9897	24,91	37,5892	10,677

$$\begin{aligned}
 a &= \frac{(\sum y)(\sum x^2) - (\sum x)(\sum xy)}{n(\sum x^2) - (\sum x)^2} \\
 &= \frac{(24,91)(10,677) - (6,9897)(37,5892)}{5(10,677) - (6,9897)^2} \\
 &= 0,712469 \\
 b &= \frac{n(\sum xy) - (\sum x)(\sum y)}{n(\sum x^2) - (\sum x)^2} \\
 &= \frac{5(37,5892) - (6,9897)(24,91)}{5(10,677) - (6,9897)^2} \\
 &= 3,054159 \\
 Y &= bX + a \\
 &= 3,054159X + 0,712469
 \end{aligned}$$



Gambar III. 2 Hubungan Konsentrasi Respon Efluen IPAL Penyamakan Kulit

$$\begin{aligned}
 Y &= 3,054159X + 0,712469 \\
 5 &= 3,054159X + 0,712469 \\
 X &= \frac{5 - 0,712469}{3,054159} \\
 &= 1,403834
 \end{aligned}$$

$$LC_{50} = 10^{1,403834}$$

$$= 25,3416$$

$$TUa = 100 / LC_{50}$$

$$= 100 / 25,3416$$

$$= 3,946 \text{ (Significant Acute Toxicity)}$$

B. Metode Spearman-Kärber

Tabel III. 1 Penyesuaian % Kematian Udang

No	Konsentrasi Air Limbah Penyamakan Kulit (xi)	Log Konsentrasi Air Limbah Penyamakan Kulit $\text{Log}_{10}(xi)$	Populasi Hewan Uji Terpapar (ni)	Kematian Hewan Uji (ri)	% Kematian (pi)	% Kematian yang disesuaikan (p'i)
	(1)	(2)	(3)	(4)	(5)	(6)
1.	6,25	0,79588	20	2	0,10	0,10
2.	12,5	1,09691	20	4	0,20	0,20
3.	25	1,39794	20	5	0,25	0,25
4.	50	1,69897	20	7	0,35	0,35
5.	100	2	20	20	1,00	1,00

a. Log 10 untuk LC50 diperkirakan menggunakan persamaan berikut:

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

Tabel III. 2 Perhitungan LC50

No	p'_i	x'_i	$(P'_{i+1} - p'_i)$	$x'_i + x'_{i+1}$	$\frac{(3) \times (4)}{2}$
	(1)	(2)	(3)	(4)	(5)
1	0,10	0,79588			
2	0,20	1,09691	0,10	0,94640	0,09464
3	0,25	1,39794	0,05	1,24743	0,06237
5	0,35	1,69897	0,10	1,54846	0,15485
6	1,00	2	0,65	1,84949	1,20217
				m	1,51402

b. Variasi estimasi dihitung sebagai berikut :

$$V_m = \sum_{i=2}^{k-1} \frac{p'_i(1-p'_i)(x_{i+1}-x_{i-1})^2}{4(n_i-1)}$$

Tabel III. 3 Perhitungan Batas Atas dan Batas Bawah LC50

No	p'_i	x'_i	$p'_i(1-p'_i)$	$(x_{i+1} - x_{i-1})^2$	$\frac{4(n_i - 1)}{(5)}$	$\frac{(3) \times (4)}{(5)}$
	(1)	(2)	(3)	(4)	(5)	(6)
1	0,10	0,79588	0,09	0,09062	76	0,000107
2	0,20	1,09691	0,16	0,09062	76	0,000191
3	0,25	1,39794	0,19	0,09062	76	0,000224
4	0,35	1,69897	0,23	0,09062	76	0,000271
5	1,00	2	0		76	0
					V_m	0,000793

c. Interval keyakinan 95%

$$I = m \pm 2,0 \sqrt{V_m}$$

$$= 1,51402 \pm 2,0 \sqrt{0,000793}$$

$$LC_{50} = 10^{1,51402}$$

$$= 32,660 \%$$

Batas atas interval kepercayaan 95%

$$LC_{50+} = 10^{1,51440}$$

$$= 32,6889 \%$$

Batas bawah interval kepercayaan 95%

$$LC_{50-} = 10^{1,51364}$$

$$= 32,6317 \%$$

$$LC_{50} = 32,660 \%$$

$$TU_a = 100/LC_{50}$$

$$= 100/32,660$$

$$= 3,06 \text{ (Significant Acute Toxicity)}$$