IPM of Date Palm Insect Pests and Diseases

Training Course

Statistical Designs and Analysis of IPM data of Date Palm Pests

(Dose - Binary Response Relationship for Probit Analysis, LD50)

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Date: 28 February 2017

Venue: Muscat, Oman

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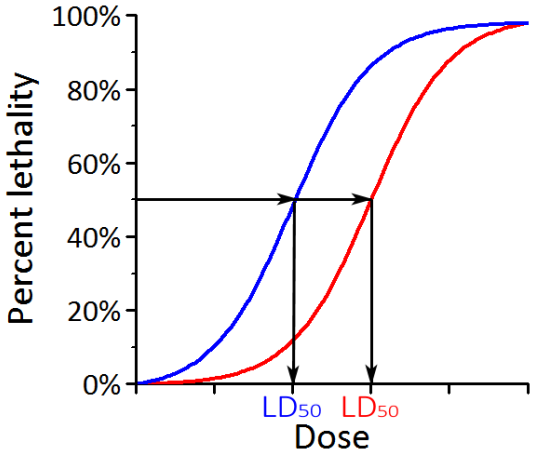
Binomial Response

- Binomial refers to a response variable with only two outcomes.
  - Flipping a coin (heads or tails)

  - The toxicity of pesticides (death or no death)

LD50 and LC50

- The LC50 (Lethal Concentration for liquids) or LD50 (Lethal Dose for solids) at which 50% of population responds are the most widely used outcomes of the modern pesticide response experiments to compare the toxicities of chemicals.



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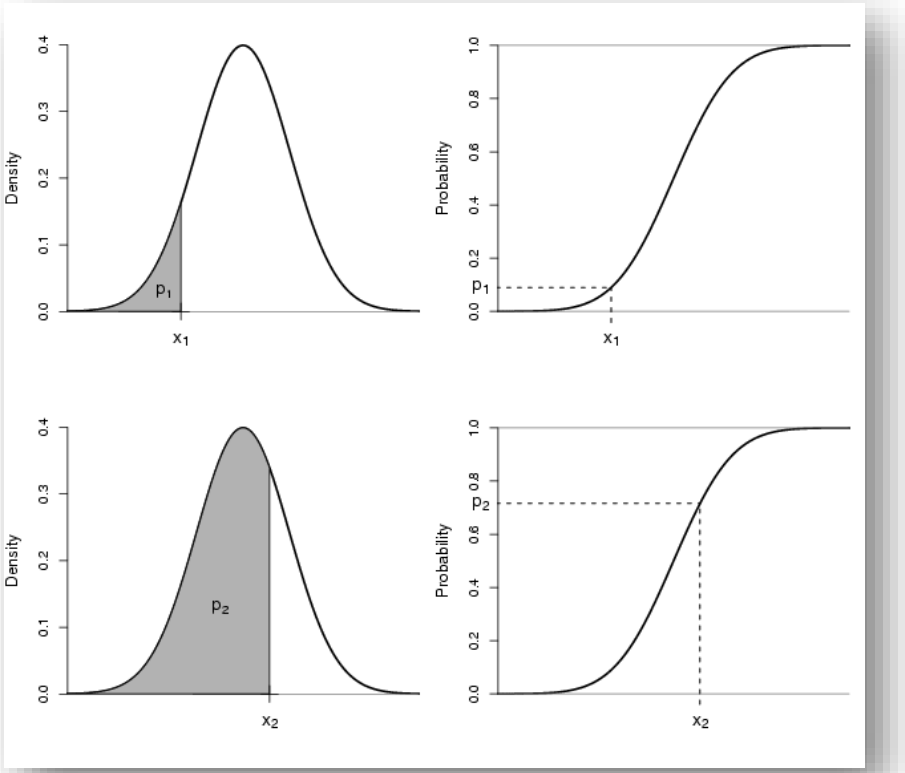
Probit Analysis

It transforms the sigmoid dose-response curve to a straight line(i.e. acts as a transformation from sigmoid to linear) and then runs a regression on the relationship.

Probability Density Function (PDF)



Cumulative Distribution Function (CDF)

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Statistical Details (Skip if you'd like)

$$Pr(x) = \Phi(a + b\,.\,x)$$

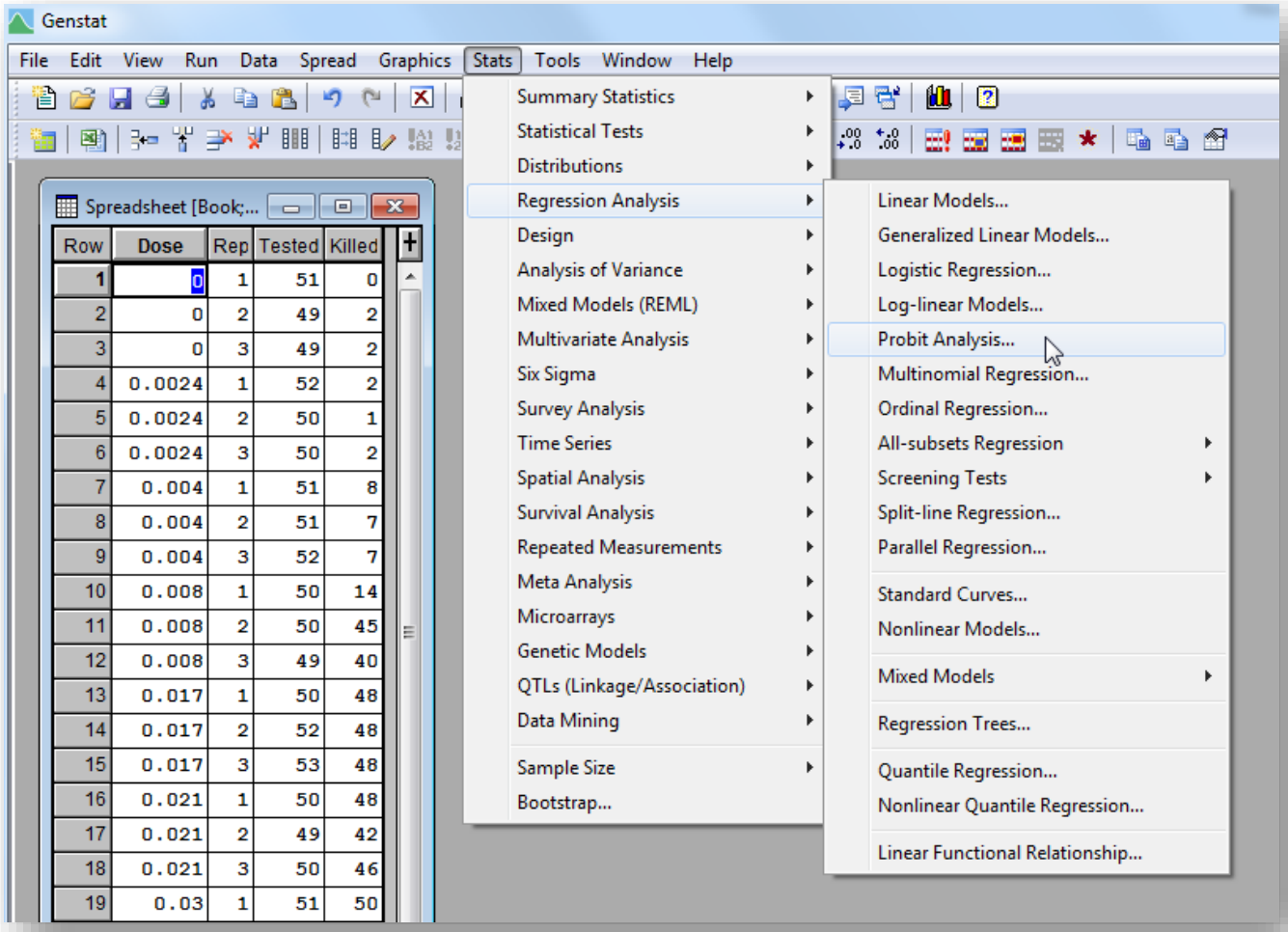
Normal Cumulative Distribution Function (CDF)

$$\Phi(x) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{x} e^{\frac{-t^2}{2}}\, dt$$

GenStat – Probit Analysis, Menu

Treatment: Phosphine, PH3 (mg/l)

Subject: Storage Pests (*Rhizopertha dominica*)



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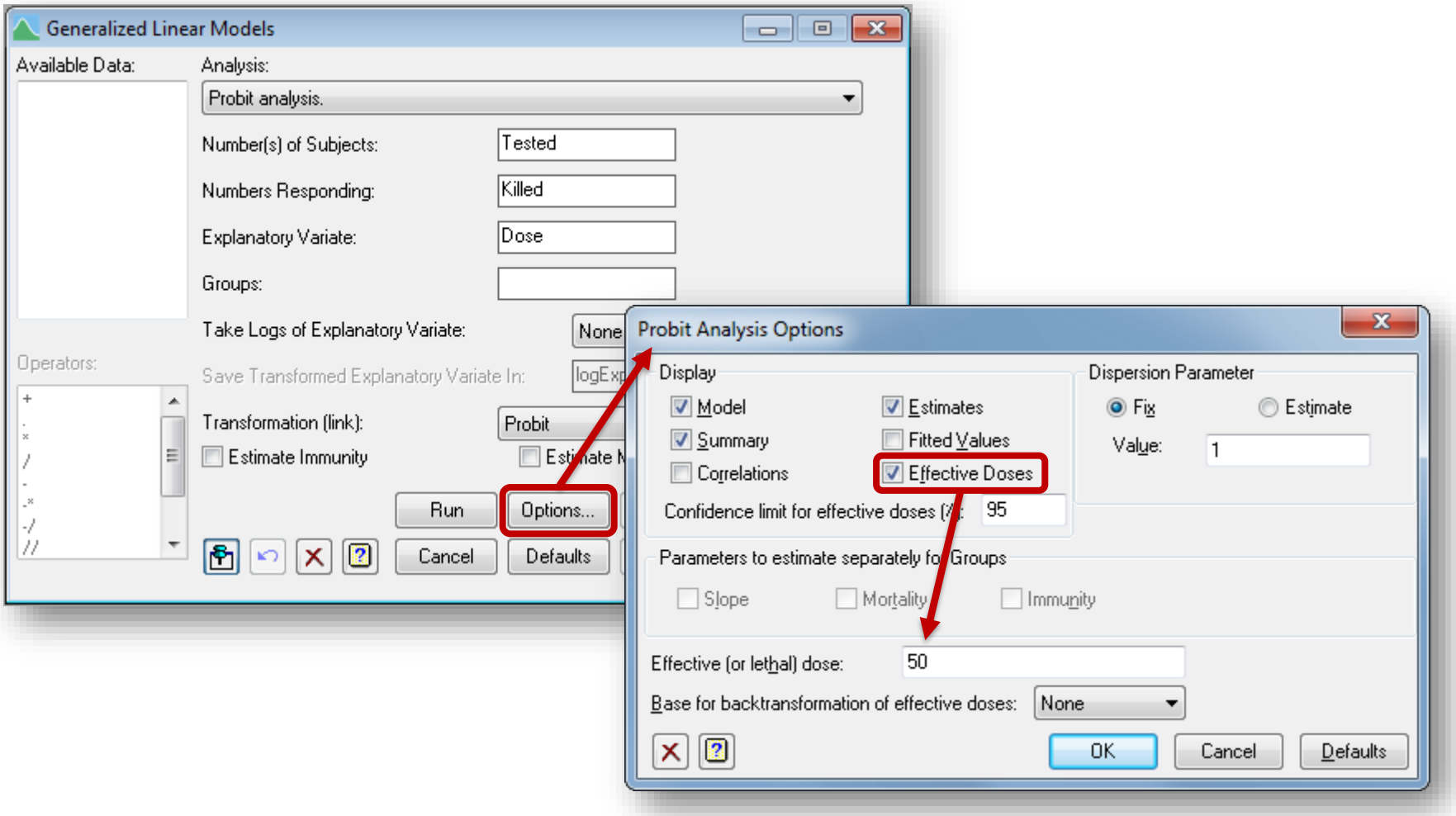
GenStat – Probit Analysis, Options



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GenStat – Probit Analysis, Outputs

```
61  "Probit analysis."
62  PROBITANALYSIS [PRINT=model,summary,estimates,effectivedose; TRANSFORMATION=probit;\
63   DISP=1; LD=!(50); CIPROBABILITY=0.95] Killed; DOSE=Dose; NBINOMIAL=Tested
```

Regression analysis

Response variate:	Killed
Binomial totals:	Tested
Distribution:	Binomial
Link function:	Probit
Fitted terms:	Constant, Dose

Summary of analysis

Source	d.f.	deviance	mean deviance	deviance ratio
Regression	1	752.9	752.879	752.88
Residual	19	166.8	8.781	
Total	20	919.7	45.986	

Dispersion parameter is fixed at 1.00.

Estimates of parameters

Parameter	estimate	s.e.	t(*)
Constant	-1.4575	0.0808	-18.03
Dose	148.62	7.56	19.66

Message: s.e.s are based on dispersion parameter with value 1.

Effective doses

LD	estimate	s.e.	lower 95%	upper 95%
50.00	0.009807	0.0003636	0.009114	0.01053

X 1000 (i.e. mg/l → mcg/l)

Estimates of parameters

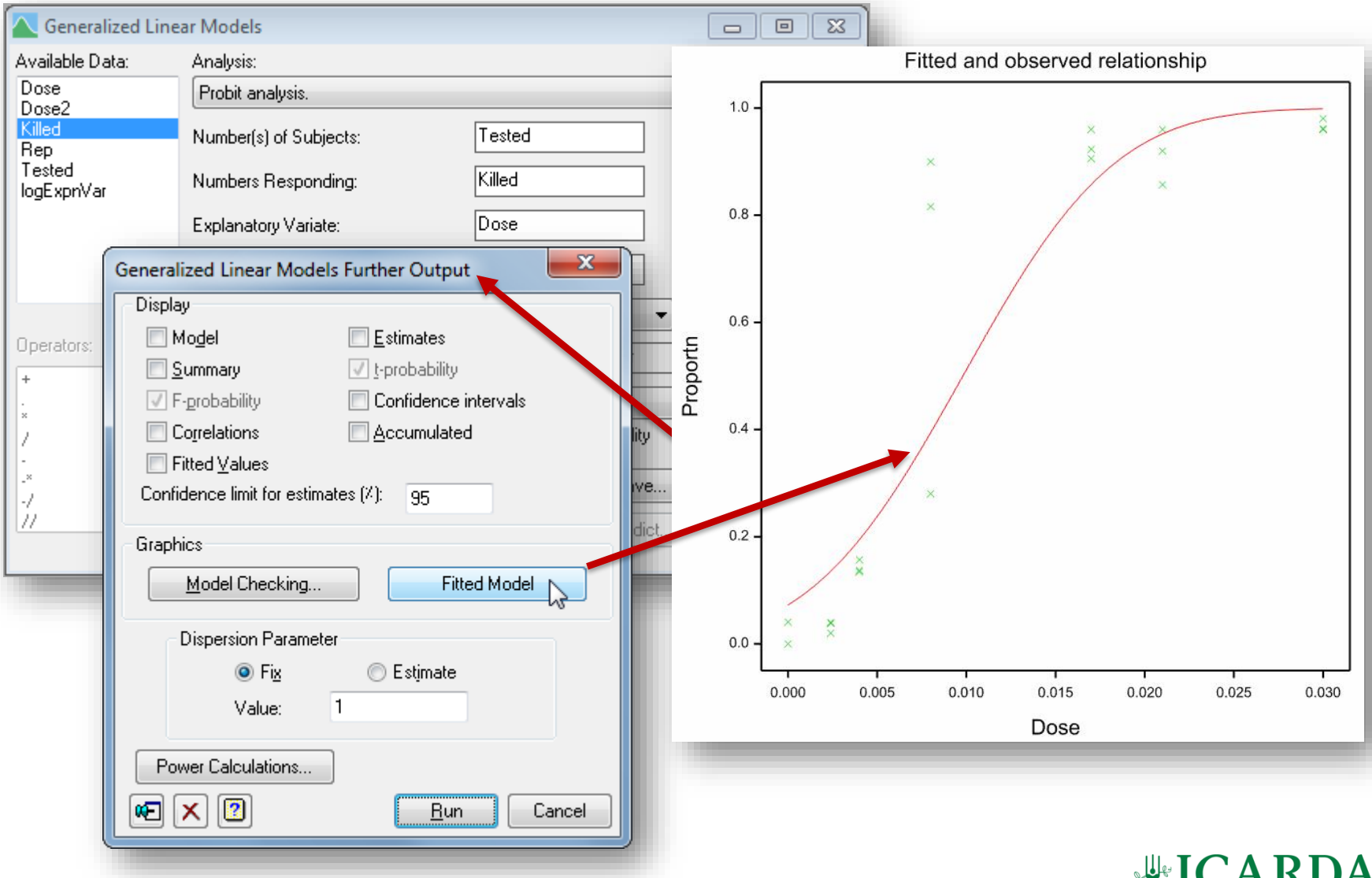
Parameter	estimate	s.e.	t(*)
Constant	-1.4575	0.0808	-18.03
Dose	0.14862	0.00756	19.66

Message: s.e.s are based on dispersion parameter with value 1.

Effective doses

LD	estimate	s.e.	lower 95%	upper 95%
50.00	9.807	0.3636	9.114	10.53

GenStat – Probit Analysis, Further Output



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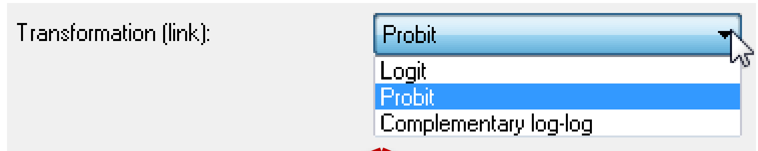
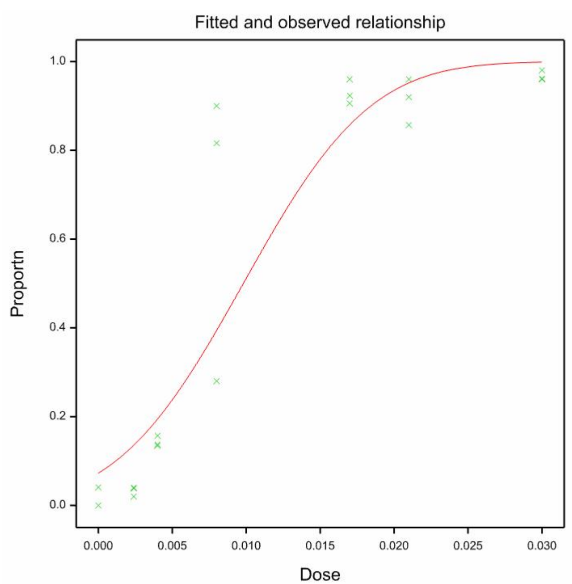
GenStat – Transformation Link

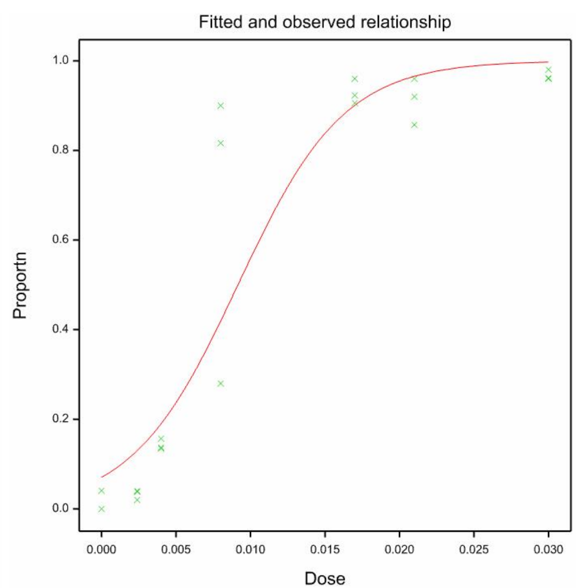


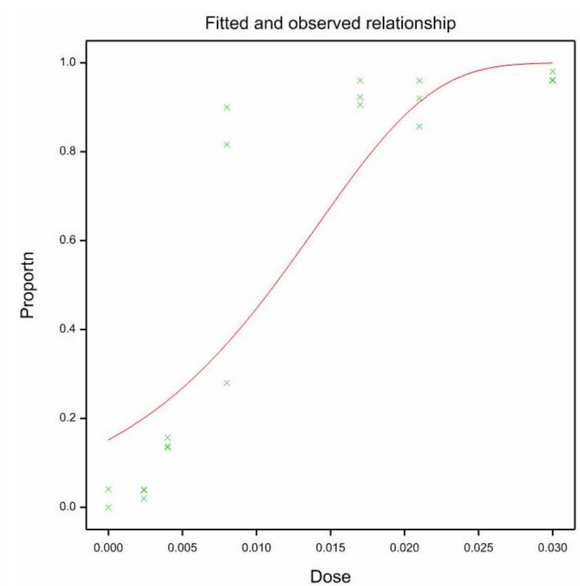
Probit
CDF(P%)

Logit
log(P% / (100 - P%))

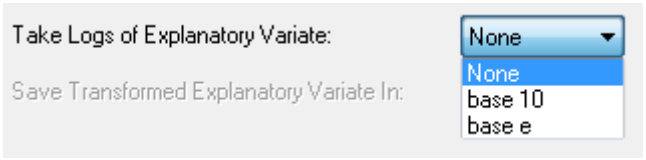
C Log-Log
log(-log(100-P%))

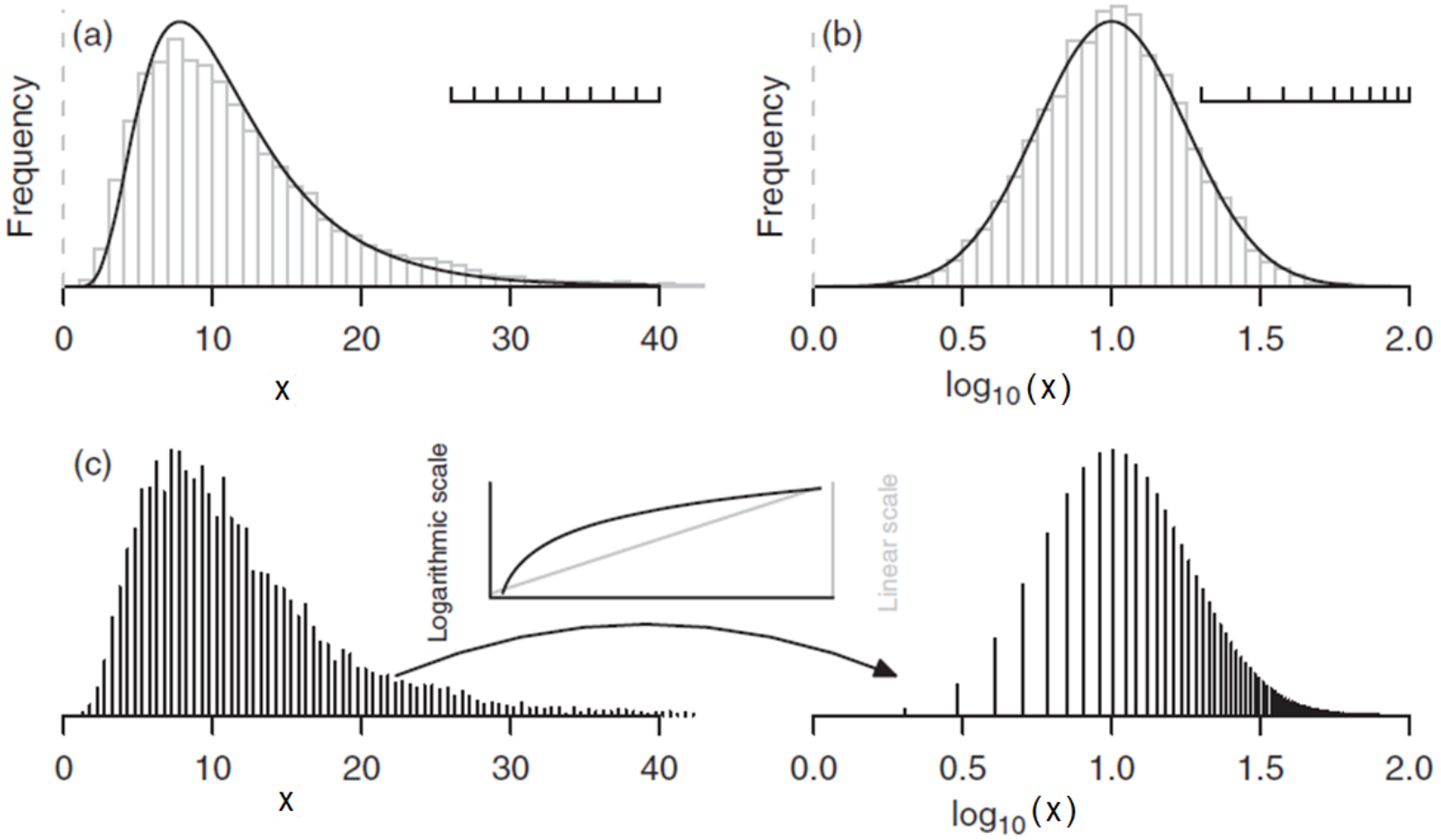






GenStat - Take Logs of Explanatory Variate





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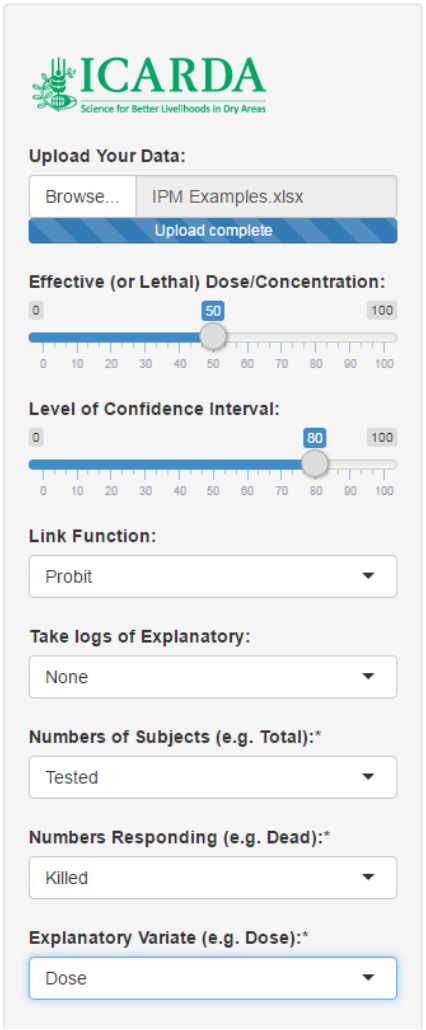
BioComputing Online – LD50, Input Data

http://geoagro.icarda.org/bss/shinyapps/ld50



Input Data | Analysis Output | Graphics Output | Help

Input Data

Show 25 entries Search:

Dose	Rep	Tested	Killed
0	1	51	0
0	2	49	2
0	3	49	2
2.4	1	52	2
2.4	2	50	1
2.4	3	50	2
4	1	51	8
4	2	51	7
4	3	52	7
8	1	50	14
8	2	50	45
8	3	49	40
17	1	50	48
17	2	52	48
17	3	53	48
21	1	50	48
21	2	49	42

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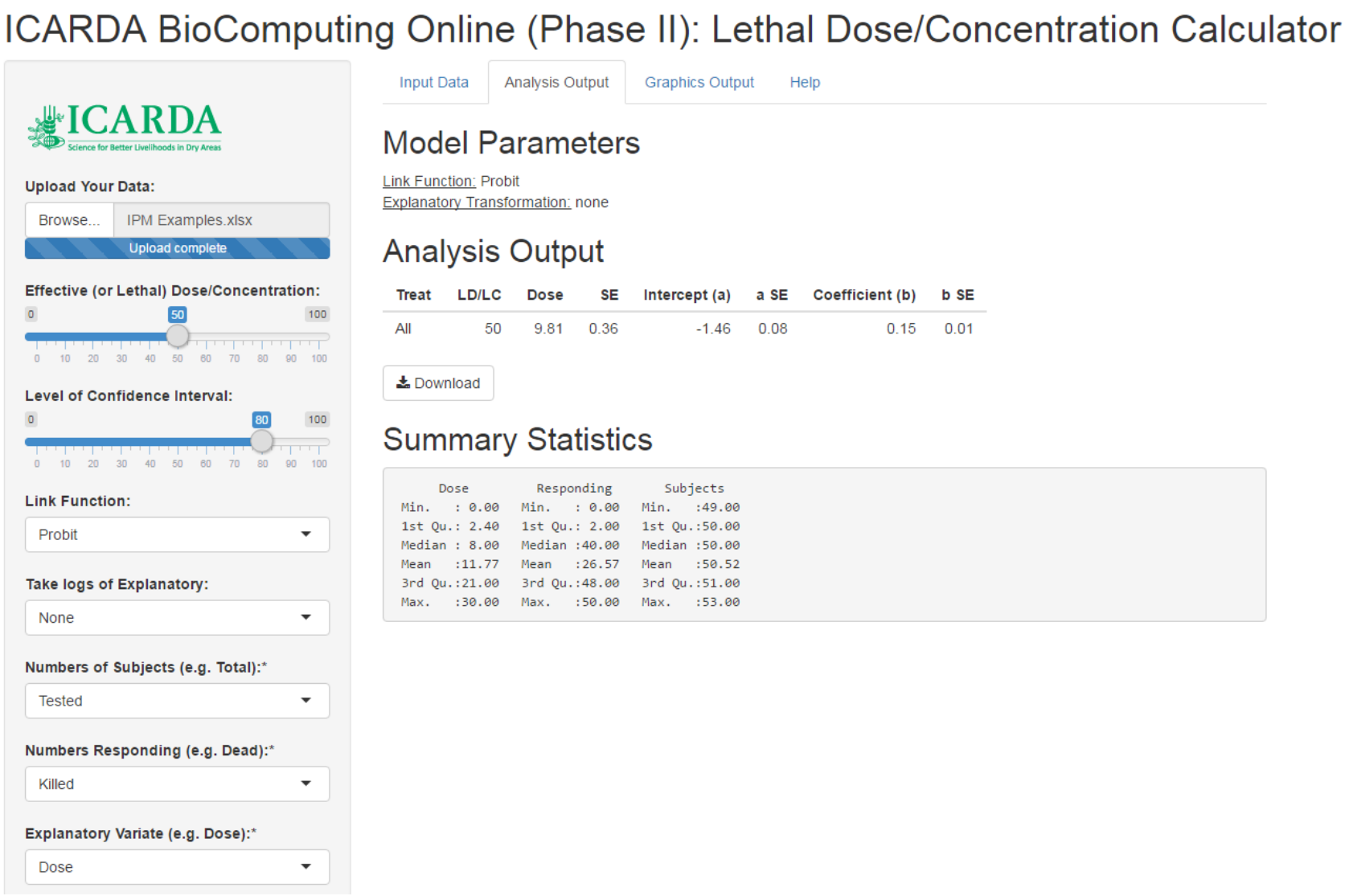
BioComputing Online – LD50, Analysis Output



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BioComputing Online – LD50, Graphics Output

ICARDA BioComputing Online (Phase II): Lethal Dose/Concentration Calculator

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Upload Your Data:

Browse... IPM Examples.xlsx

Upload complete

Effective (or Lethal) Dose/Concentration:

0 50 100

0 10 20 30 40 50 60 70 80 90 100

Level of Confidence Interval:

0 80 100

0 10 20 30 40 50 60 70 80 90 100

Link Function:

Probit

Take logs of Explanatory:

None

Numbers of Subjects (e.g. Total):*

Tested

Numbers Responding (e.g. Dead):*

Killed

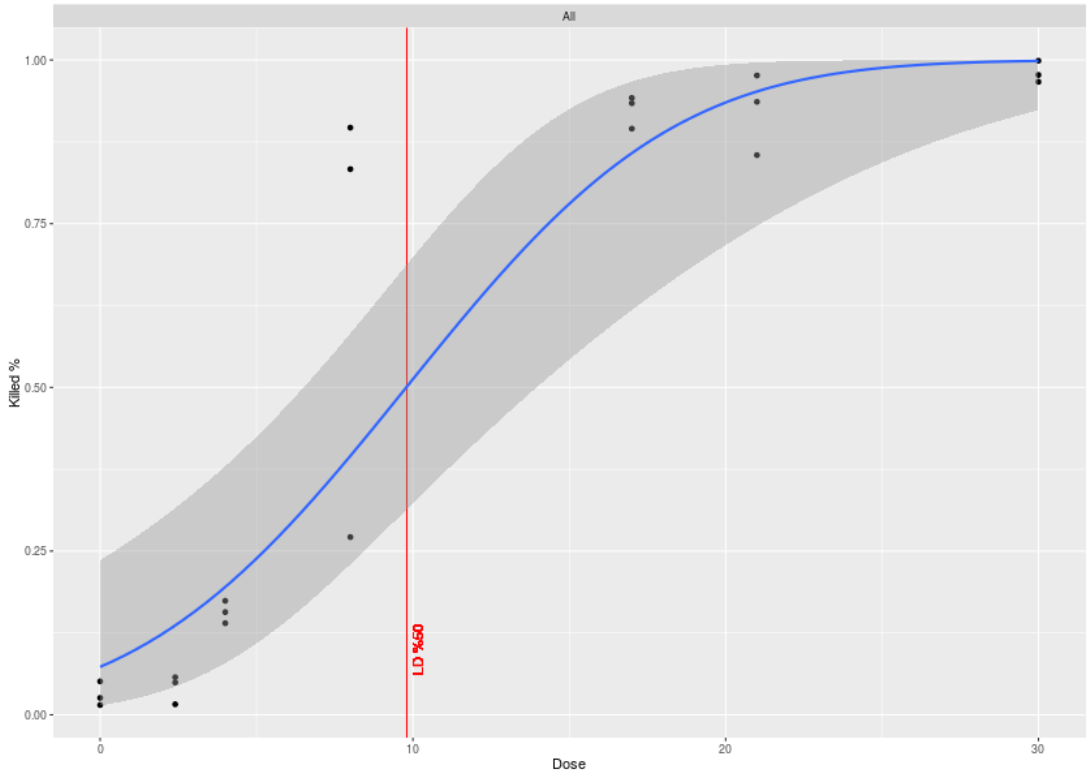
Explanatory Variate (e.g. Dose):*

Dose

Input Data | Analysis Output | Graphics Output | Help

Graphics Output

Download High Resolution Graph



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Thank You

Questions?

Japanese attitude for work:

If one can do it, I can do it. If no one can do it, I must do it.

Middle Eastern attitude for work:

Wallahi... if one can do it, let him do it.
If no one can do it, ya-habibi how can I do it?

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