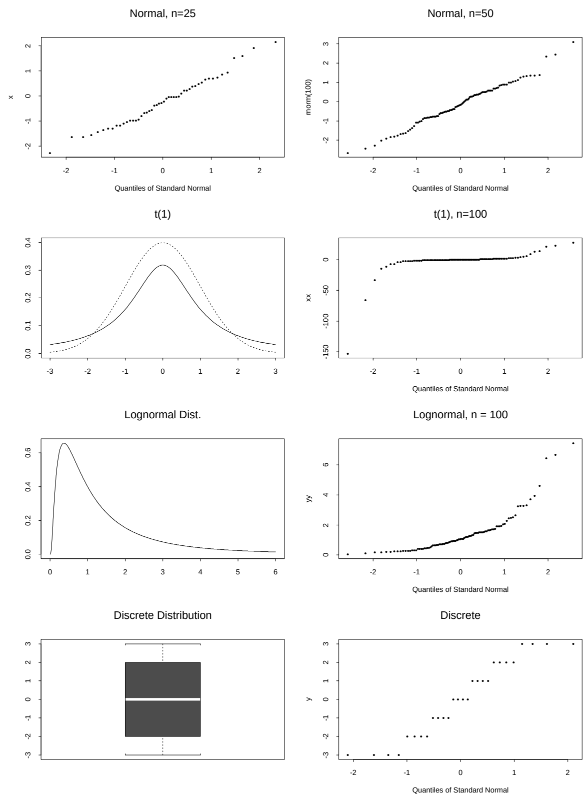


Overview

- Uses of Regression Analysis: Prediction, Variable screening, Model specification (system explanation), Parameter estimation
- Examples of models:
  1. $y_i = \beta_0 + \beta_1 x_i + \varepsilon_i$
  2. $y_i = \beta_0 e^{-\beta_1 x_i} \varepsilon_i$
     $\rightarrow log(y_i) = log(\beta_0) - \beta_1 x_i + log(\varepsilon_i)$
  3. Let $\mu\{Y|X\} = \pi \rightarrow log\frac{\pi}{1-\pi} = \beta_0 + \beta_1 x_i + \varepsilon_i$
  4. $y_i = \frac{V_{max}}{k+x} + \varepsilon_i$ Michaelis-Menten

Presentation of Regression Results

$\hat{Y}$ = 10.32 + -0.0006 X

(0.69) (0.0001)

$\hat{\sigma}$ = 1.93 (14 df)

Why can't we just estimate $\hat{\sigma}$ with $SD(Y)$?

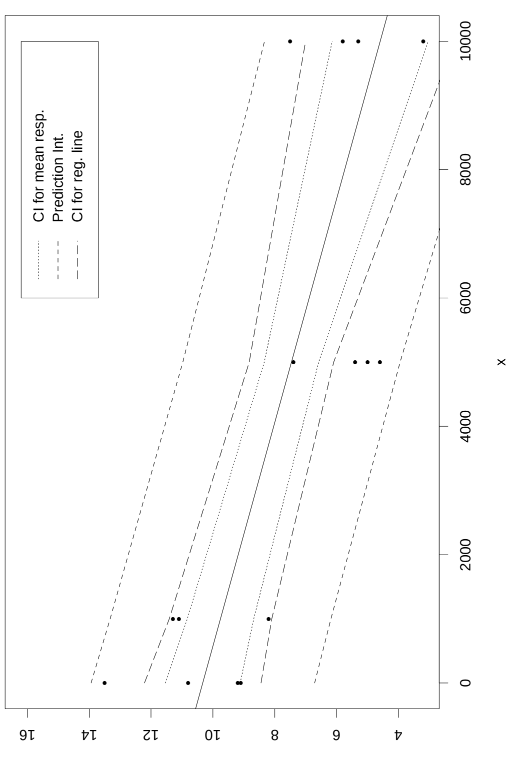

```
Coefficients:
              Value Std. Error  t value Pr(>|t|)
(Intercept) 10.3264     0.6890  14.9876   0.0000
     number -0.0006     0.0001  -4.6740   0.0004

Residual standard error: 1.933 on 14 df
Multiple R-Squared: 0.6094
F-stat: 21.85 on 1 and 14 df, p-val is 0.0003584

          Df Sum of Sq  Mean Sq  F Value     Pr(F)
   Number  1  81.65036 81.65036 21.84666 0.0003584
Residuals 14  52.32401  3.73743
```

Inference

1. Sampling distributions of β_0, β_1.
2. Interpret β_0, β_1 in terms of the problem.
3. Inference about β_1
   - *Is there evidence of a linear association between nematode level and plant height?*
   - *Is plant height dependent on nematode level?*
   - *Are decreased nematode levels associated with increased plant growth?*
4. Inference about β_0.
   - *Estimate the mean plant height when there are no nematodes present.*
   - *When there are 500 nematodes present?*

CI's around predicted values

- CI for *estimated mean response* at a specific value of X. Uncertainty from estimation error.
- Prediction interval for a future response, $x = x_0$. Uncertainty from estimation error *and* sampling error.



Calibration

- For what level of nematodes will the height of any particular plant be 10 cm?
  - Graphical method
  - $SE(\hat{X}) = \frac{SE(Pred\{Y|\hat{X}\})}{|\hat{\beta}_1|}$
- For what level of nematodes will the mean height of plants be 10 cm?
  - Graphical method
  - $SE(\hat{X}) = \frac{SE(\hat{\mu}\{Y|\hat{X}\})}{|\hat{\beta}_1|}$

The Regression Effect

Simultaneous CI's

- CI for β_0 and β_1.
- CI for mean response at k different values of x.
- CI for mean response at *all* values of x in the observed range.

Interpretation after Log Transforms

Lack of Fit F-test