# Likelihood and Log Likelihood

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## 1 Background

The likelihood is the probability that a given set of parameters would give rise to a given data set.

Formally, the likelihood is a product of probabilities.

$$\mathcal{L}(\beta) = \prod p(\beta | x, y) \tag{1}$$

## 2 Maximum Likelihood Estimation

Maximum Likelihood Estimation is essentially the process of finding the *combination* of parameters (e.g. $\beta$) which maximizes the likelihood of producing the data.

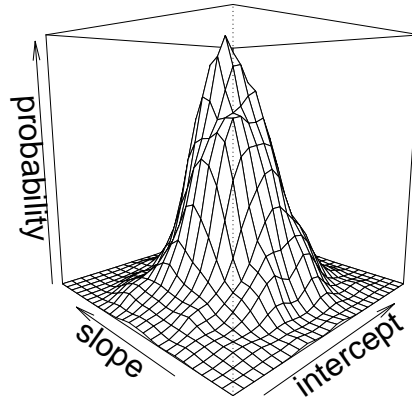**Joint Likelihood of Two Parameters**



Figure 1: Joint Likelihood of Two Parameters

# 3 An Empirical Example

# 4 Log-Likelihood

Because probabilities are by definition $< 1$, the likelihood $\mathcal{L}$ tends to be a very small number. For a variety of reasons, it is often easier to work with the logarithm of the likelihood: $\ln \mathcal{L}$.

# 5 Visualizing the Likelihood and Log-Likelihood

# 6 Conclusion

Higher values of the *log-likelihood*, closer to 0, represent models with a better fit.

## Line With Intercept And Slope Most Likely To Produce Da



Lines Less Likely To Produce Data in Grey

Figure 2: An Empirical Example

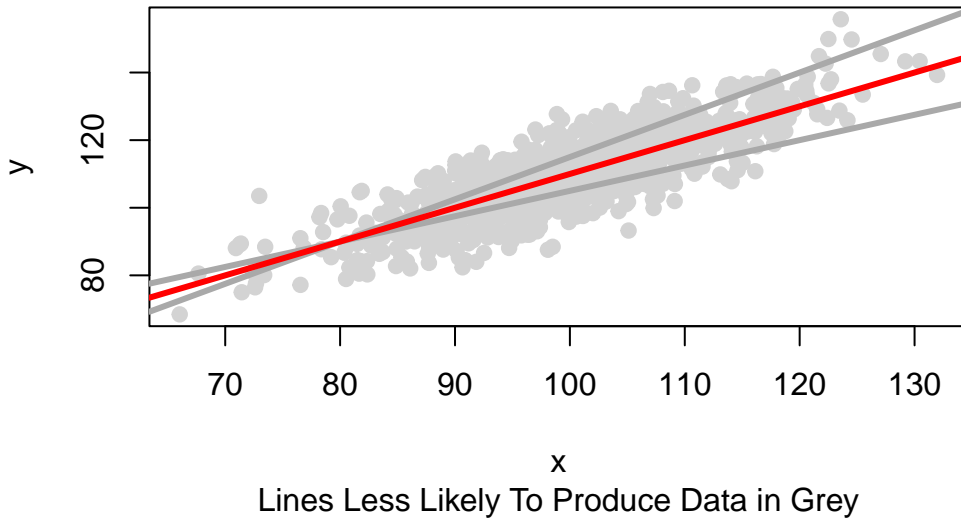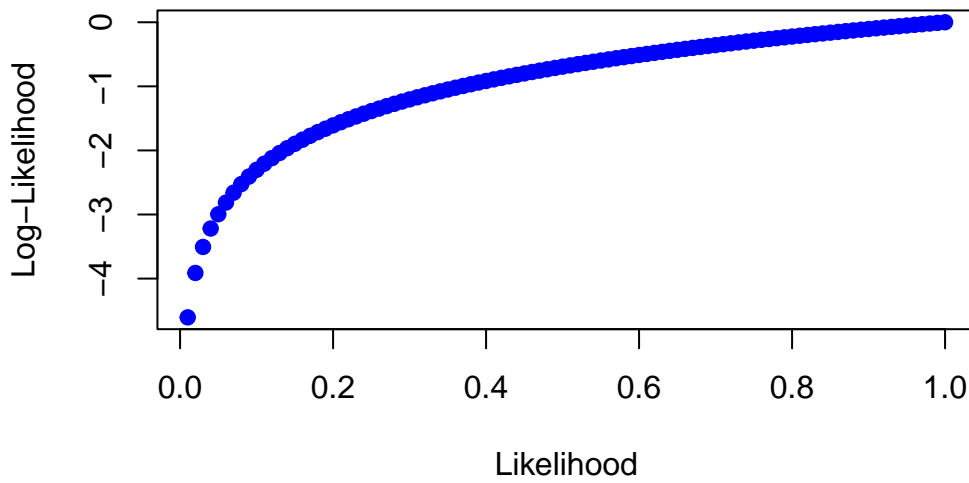## Simulated Likelihood and Log−Likelihood



Figure 3: Likelihood and Log-Likelihood