Model Evaluation

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AGENDA

- ✓Log-Likelihood
- ✓AIC
- ✓BIC

Log-Likelihood

Log-likelihood is the natural logarithm of the likelihood function, which measures how *likely* it is that the model (with its current parameters) would produce the observed data.

- It evaluates the **fit** of the model.
- A **higher** log-likelihood value means a better fit (given the same number of parameters).

Log-Likelihood

For a model with parameters θ and observed data X, the likelihood $L(\theta|X)$ is:

$$\mathcal{L}(\theta) = P(X|\theta)$$

Then the **log-likelihood** is:

$$\log \mathcal{L}(\theta) = \sum \log P(X_t|\theta)$$

Log-Likelihood

- **Higher Log-Likelihood → Better fit**
- It tells you how likely your data is given the model.
- However**, just using log-likelihood alone is not enough** because it always favors more complex models (more parameters = better fit).

AIC (Akaike Information Criterion)

What is AIC?

AIC is a metric used to compare **different statistical models** on the same dataset. It balances:

- **Goodness of fit** (how well the model fits the data)
- **Model simplicity** (penalizes more parameters to avoid overfitting)

$$\mathrm{AIC} = 2k - 2\log(L)$$

- k = number of parameters in the model
- L = maximum value of the likelihood function

AIC

- **Lower AIC = Better model**

AIC Has No Fixed Range

- **There is no upper or lower bound** — AIC can be **positive, negative, small, or large.**
- Its scale depends on:
  - The dataset size
  - The model complexity
  - The log-likelihood value