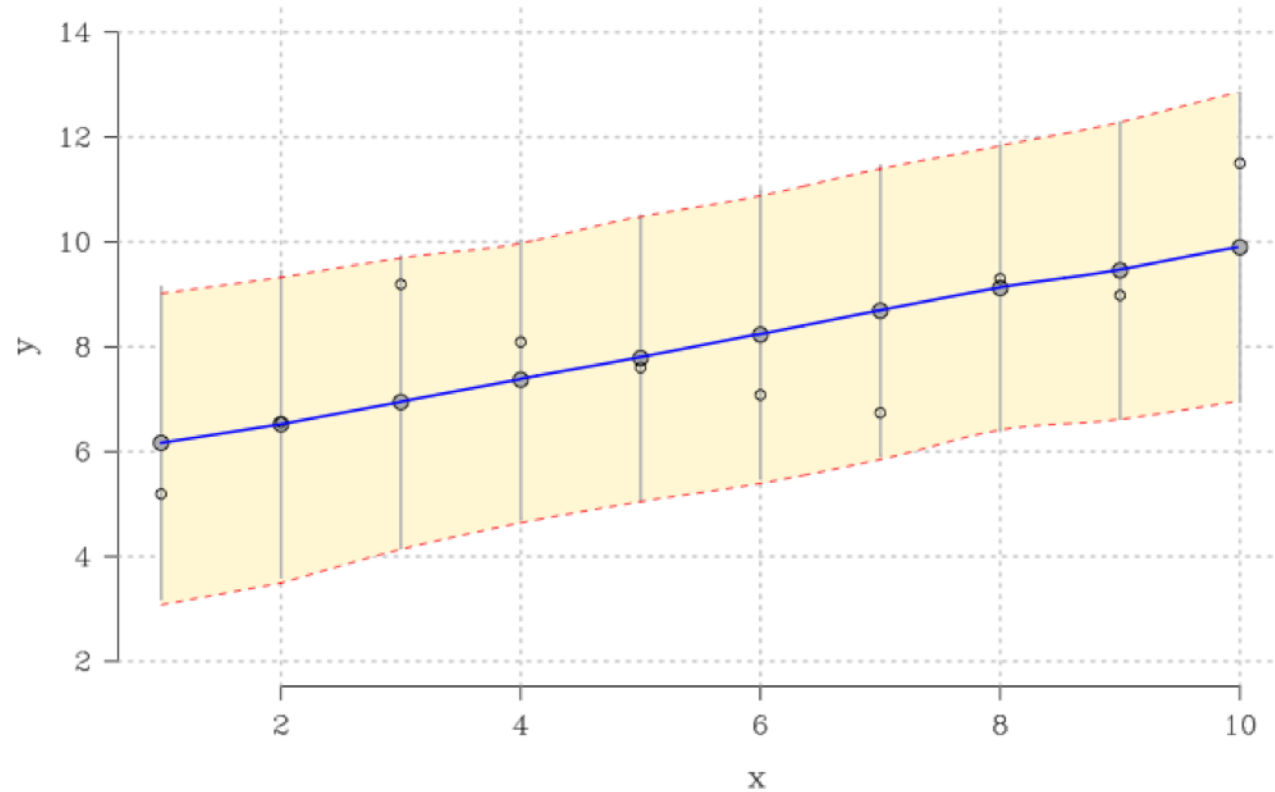# Bayesian Modeling Pipeline
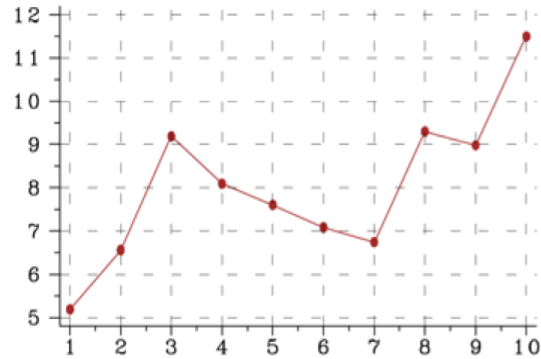
Example 1: Bi-Variate Linear Model
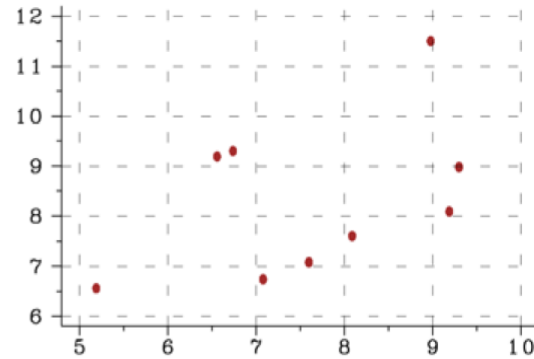
Univariate Stats
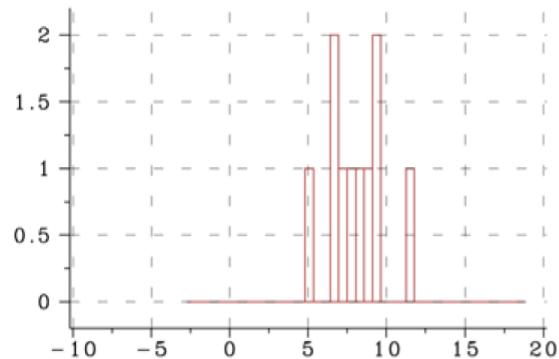
Outcome Variable: Y

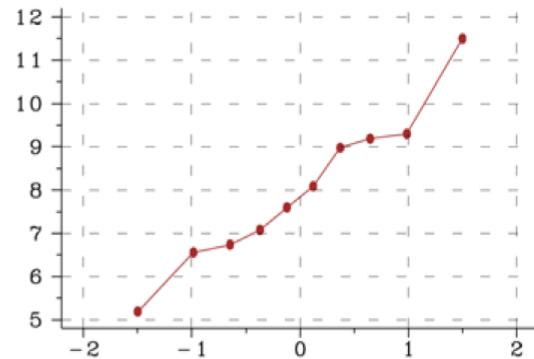| Location Measures		Dispersion Measures	
Midrange:	8.345	Range:	6.310
Mean:	8.023	Standard Deviation:	1.791
Midmean:	7.947	Average Abs. Dev.:	1.389
Median:	7.845	Minimum:	5.190
		Lower Quartile:	6.695
		Lower Hinge:	6.740
		Upper Hinge:	9.190
		Upper Quartile:	9.218
		Maximum:	11.500

Randomness Measures		Distributional Measures	
Autocorrelation Coef:	0.243	St. Third Moment:	0.360
		St. Fourth Moment:	2.686
		St. Wilk-Shapiro:	0.607
		Uniform PPCC:	0.967
		Normal PPCC:	0.981
		Tukey-Lam -.5 PPCC:	0.982
		Cauchy PPCC:	0.969

The Levene Test applied to each quarter of the data indicates no heterogeneity in variances. Grubbs Test shows no outliers.
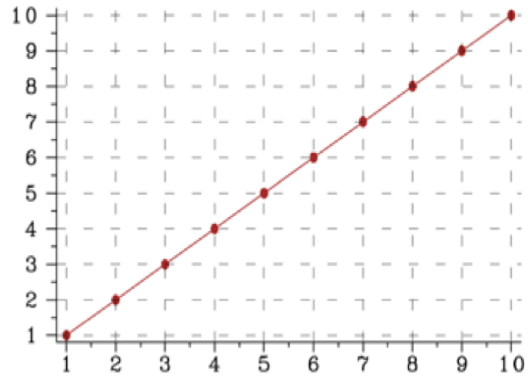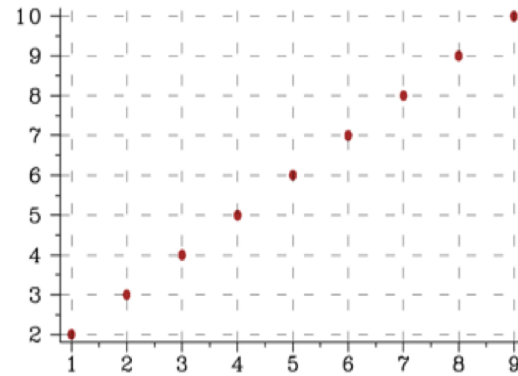Levene Test Statistic: 0.33, p-value 0.8.   Grubbs Test Statistic: 1.94, p-value 0.29

Y
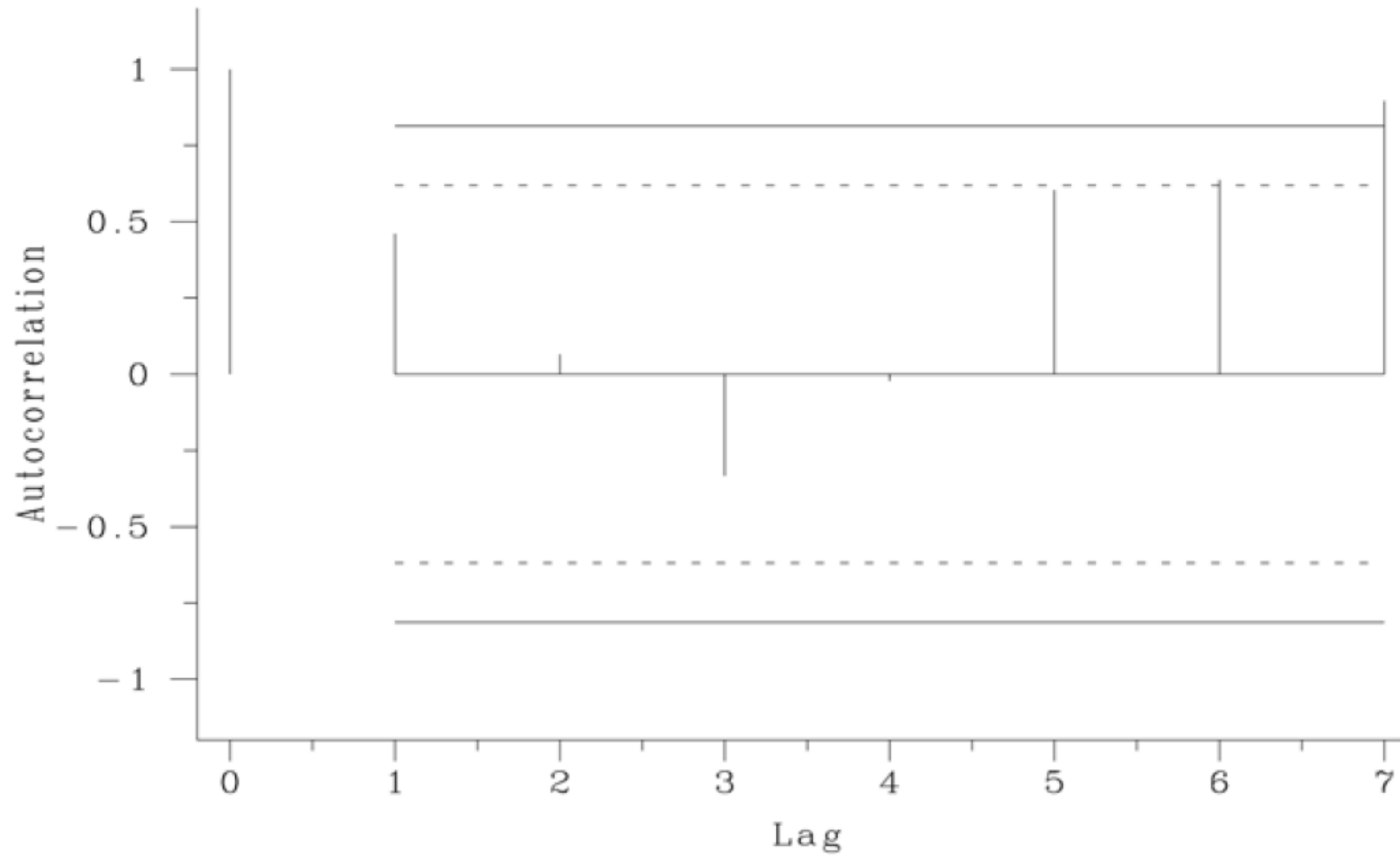
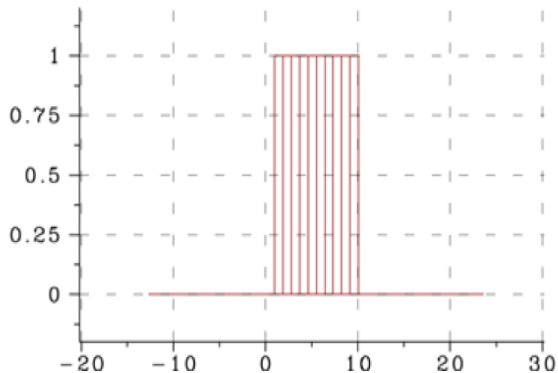Clear support for autocorrelation after checking for drift in location: Coefficient of 0.422, t-value of 2.88
https://www.itl.nist.gov/div898/handbook/eda/section4/eda4232.htm

Explanatory Variable: X

Location Measures		Dispersion Measures	
Midrange:	5.500	Range:	9.000
Mean:	5.500	Standard Deviation:	3.028
Midmean:	5.500	Average Abs. Dev.:	2.500
Median:	5.500	Minimum:	1.000
		Lower Quartile:	2.750
		Lower Hinge:	3.000
		Upper Hinge:	8.000
		Upper Quartile:	8.250
		Maximum:	10.000

Randomness Measures		Distributional Measures	
Autocorrelation Coef:	0.700	St. Third Moment:	0.000
		St. Fourth Moment:	1.776
		St. Wilk–Shapiro:	0.528
		Uniform PPCC:	1.000
		Normal PPCC:	0.994
		Tukey–Lam –.5 PPCC:	0.963
		Cauchy PPCC:	0.926

The Levene Test applied to each quarter of the data indicates no support for heterogenous variances.
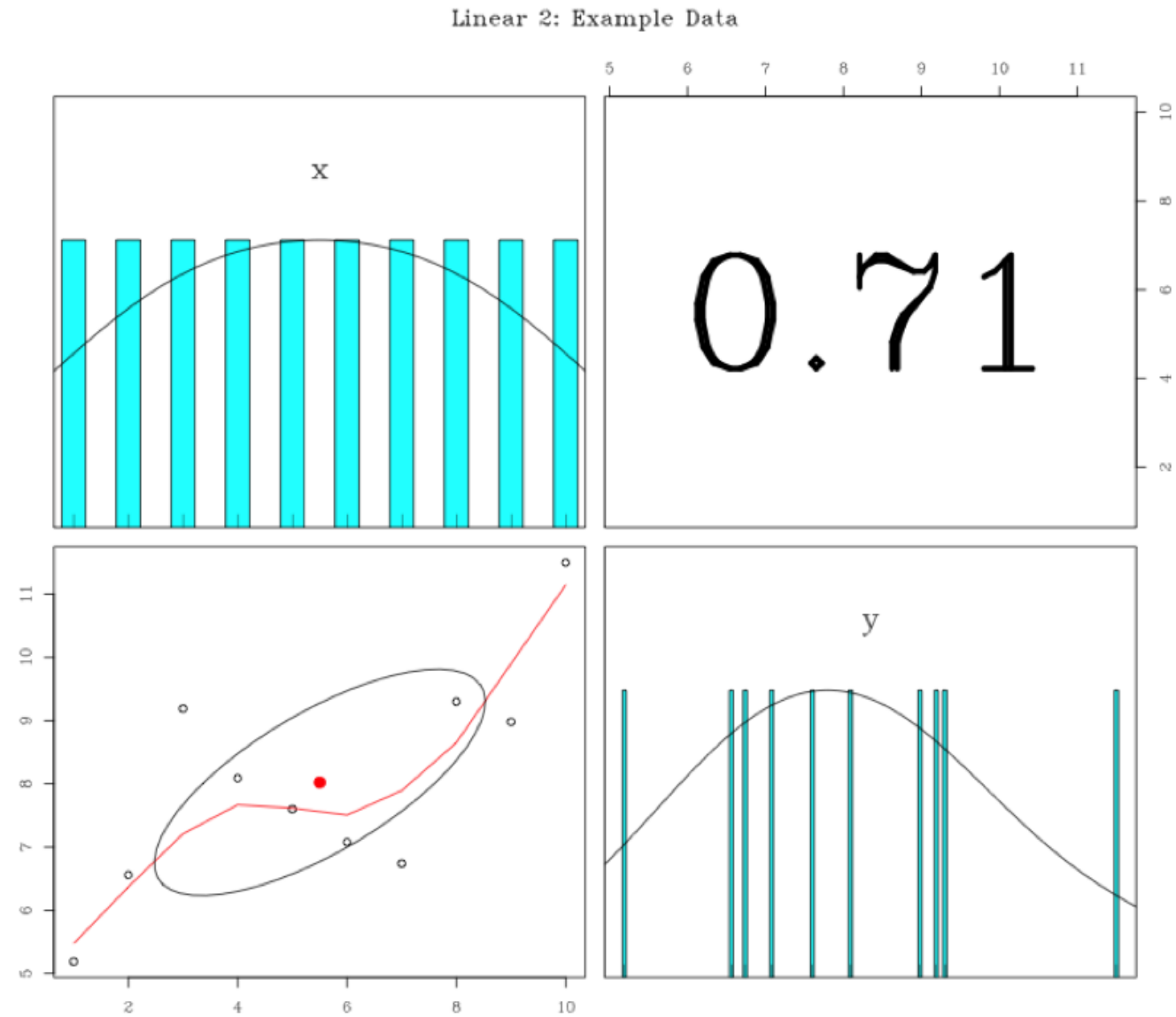Levene Test Statistic: 0.1, p-value 0.95

X
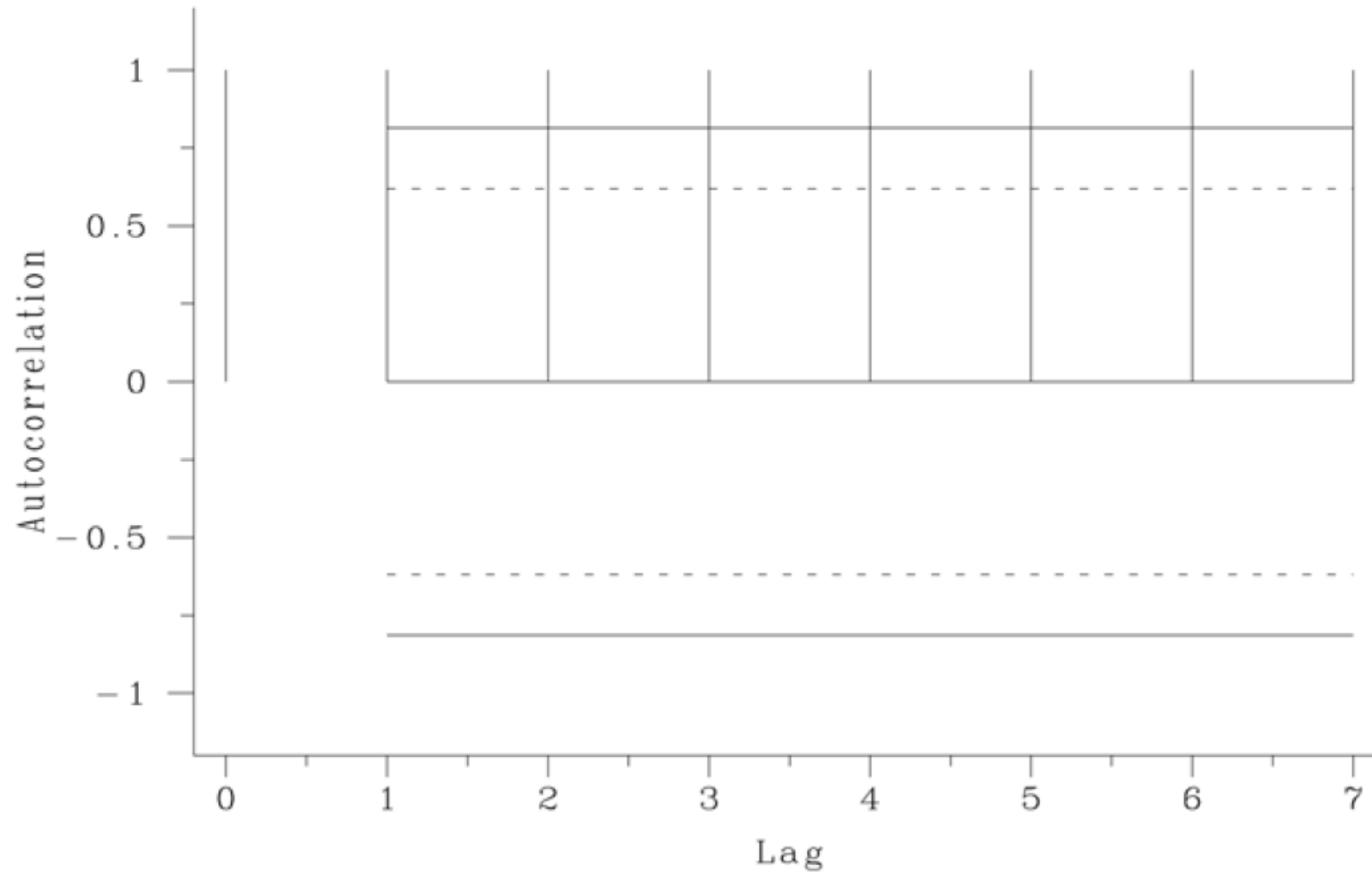
Clear support for autocorrelation after checking for drift in location: Coefficient of 1, t-value of 999
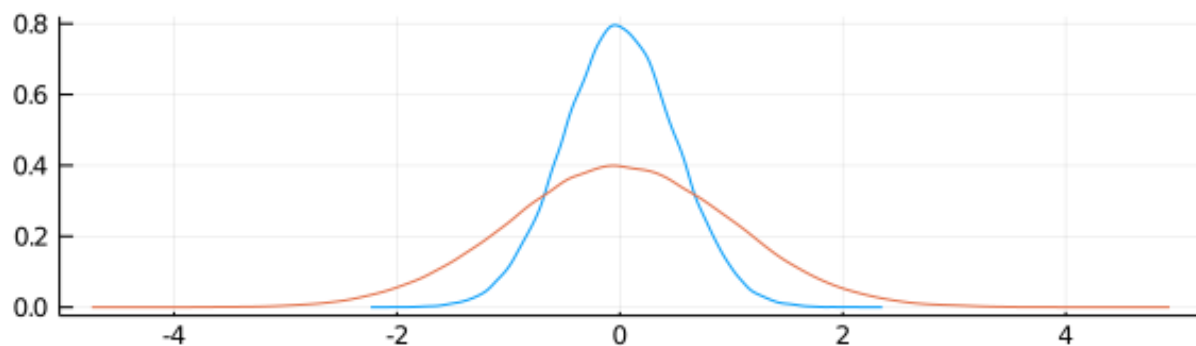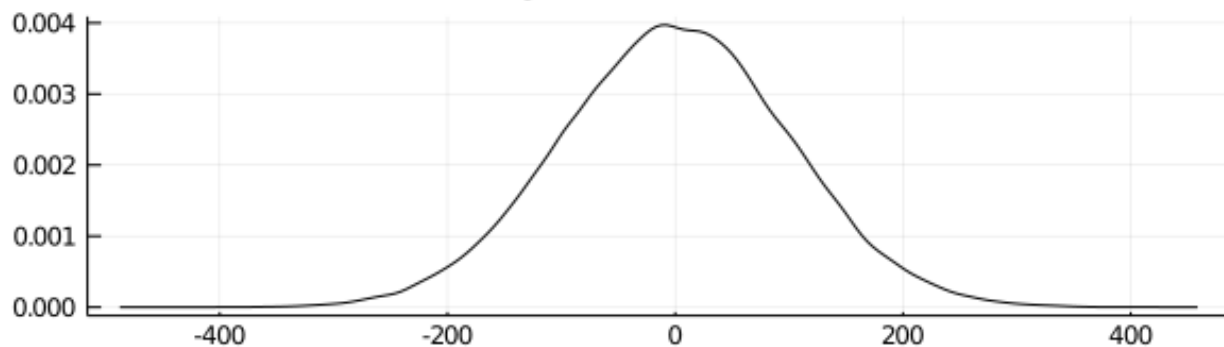https://www.itl.nist.gov/div898/handbook/eda/section4/eda4232.htm

Pearson Correlations

Model

Prior Predicative Checks
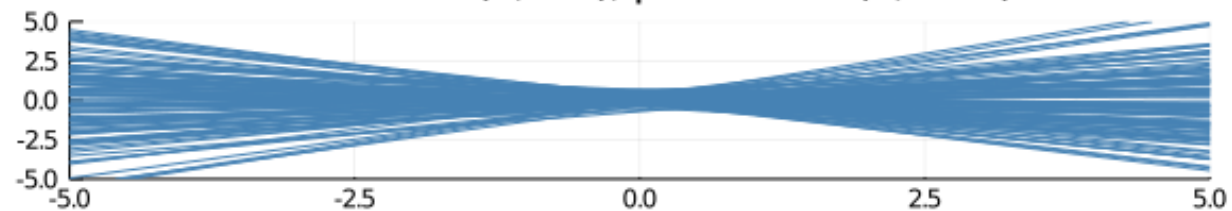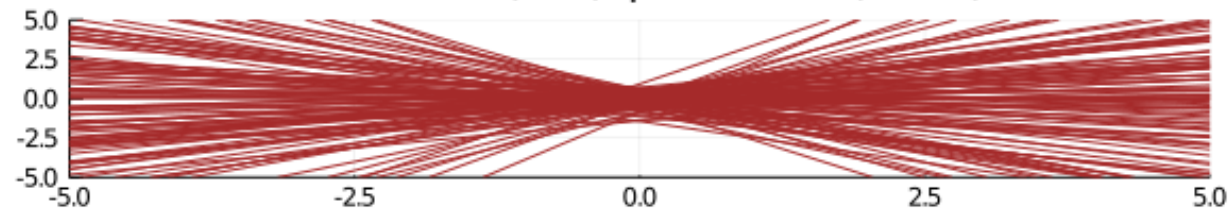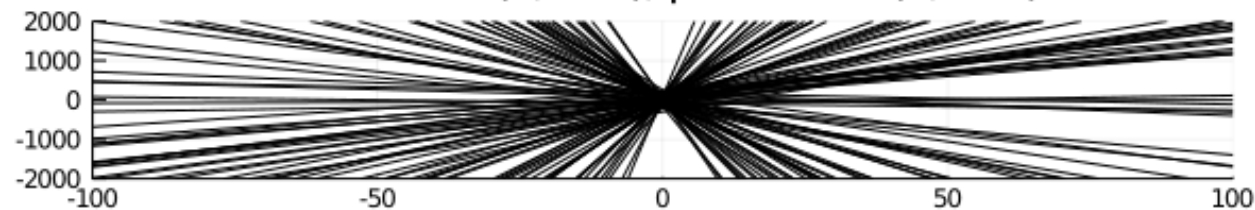
Mathematical Description

$$Yi \sim N(\hat{y}, \boldsymbol{\sigma})$$

$$\hat{Y}i = \boldsymbol{\alpha} + \boldsymbol{\beta}\mathbf{X}i$$

Prior Distributions

$$\boldsymbol{\alpha} \sim N(0, 100)$$

$$\boldsymbol{\beta} \sim N(0, 100)$$
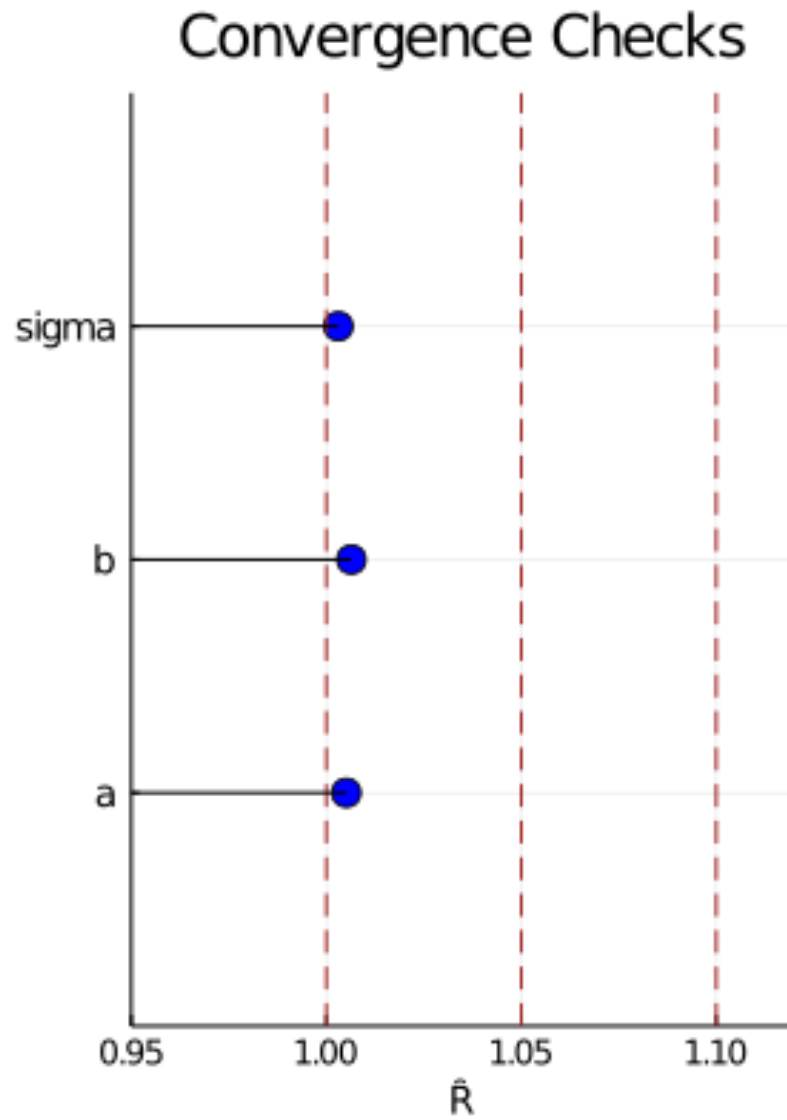
$$\boldsymbol{\sigma} \sim \text{Half-Cauchy}(0, 2)$$

Data

$$\mathbf{X} = [1, 2, 3, 4, 5, 6, 7, 8, 9, 10]$$
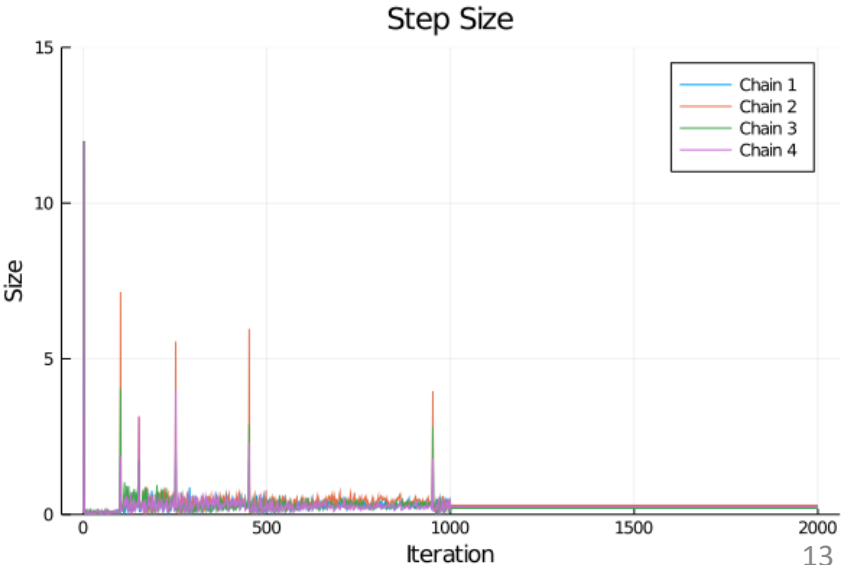
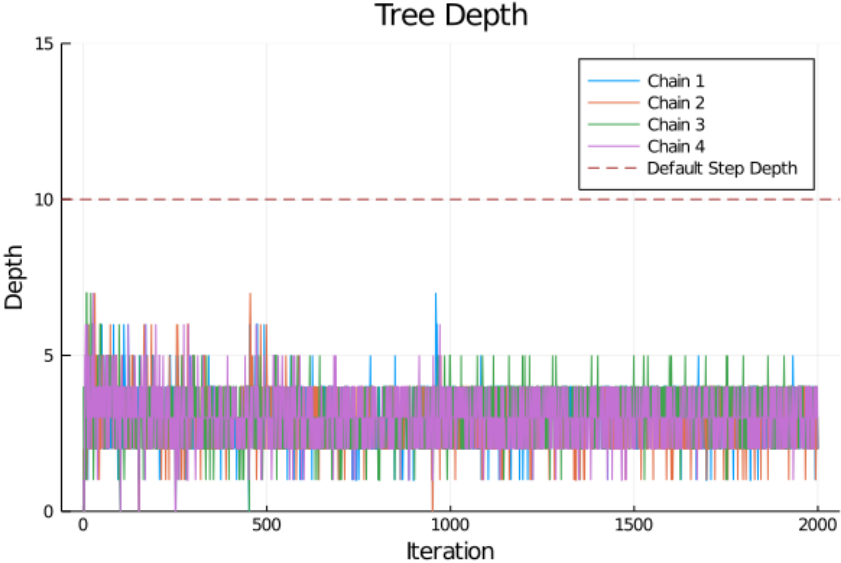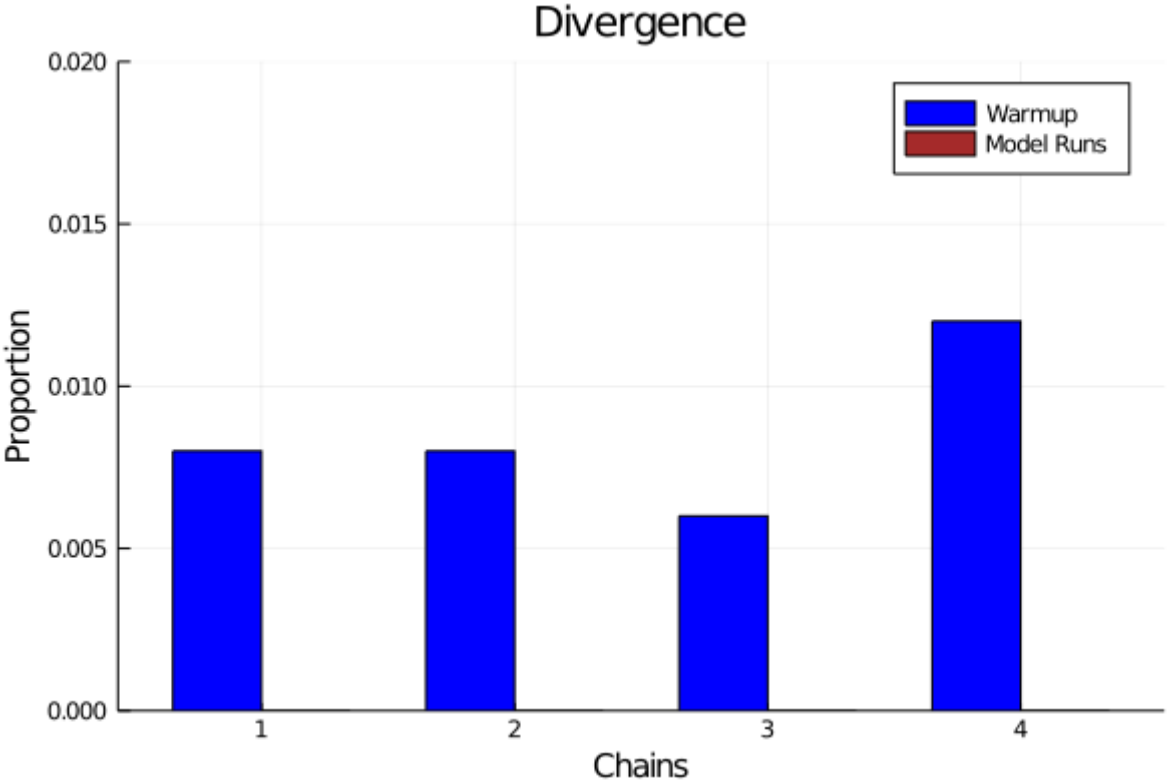$$Y = [5.19, 6.56, 9.19, 8.09, 7.6, 7.08, 6.74, 9.3, 8.98, 11.5]$$
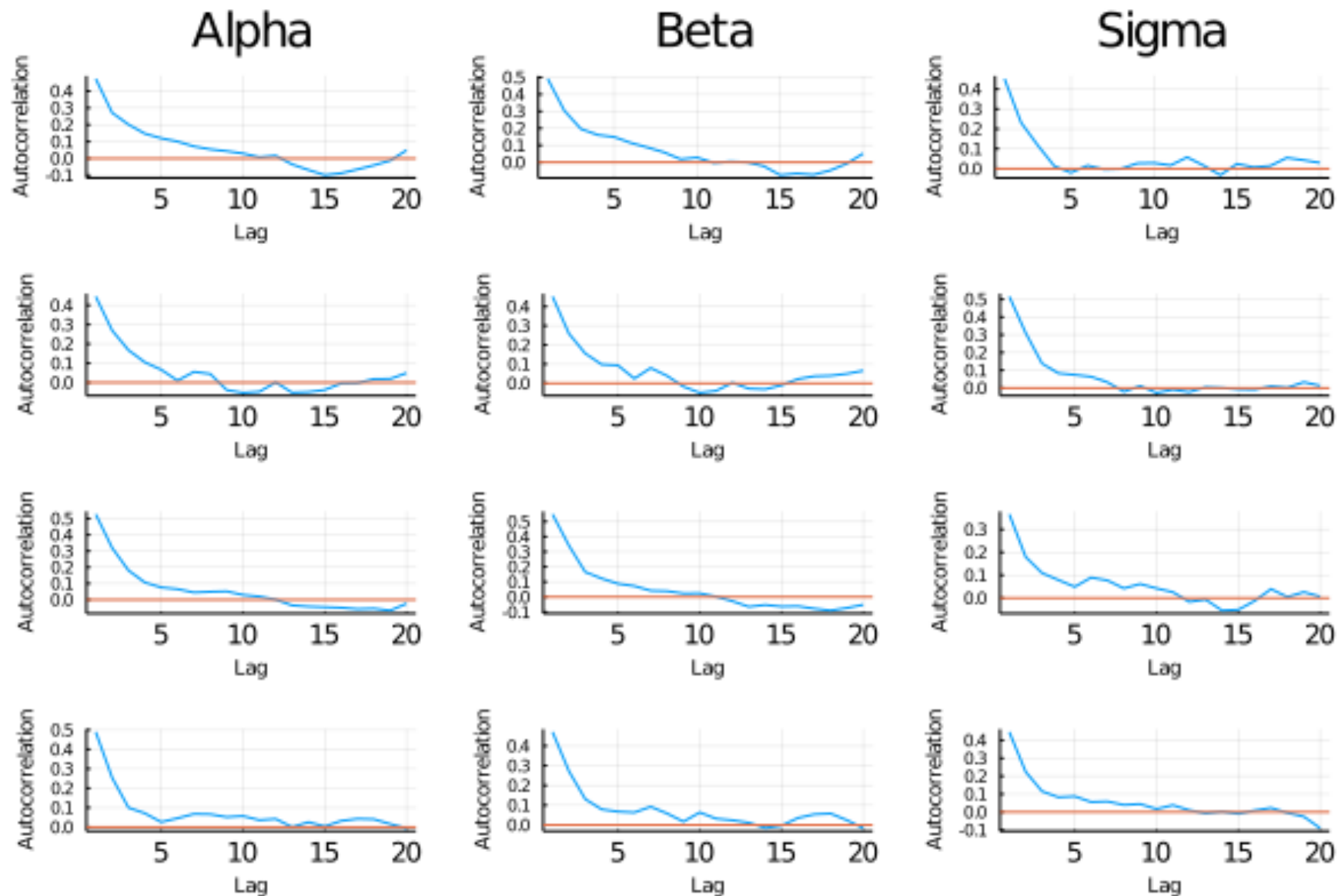
Parameter Inspection
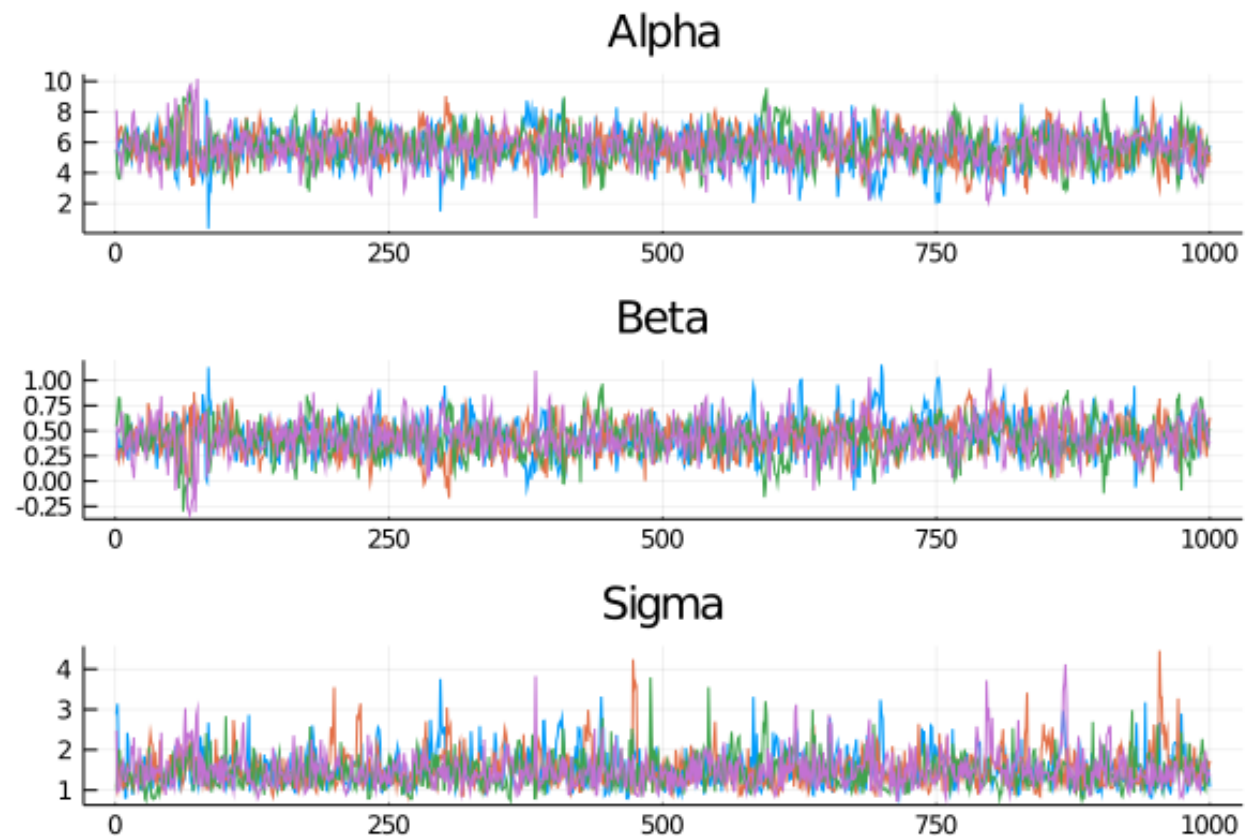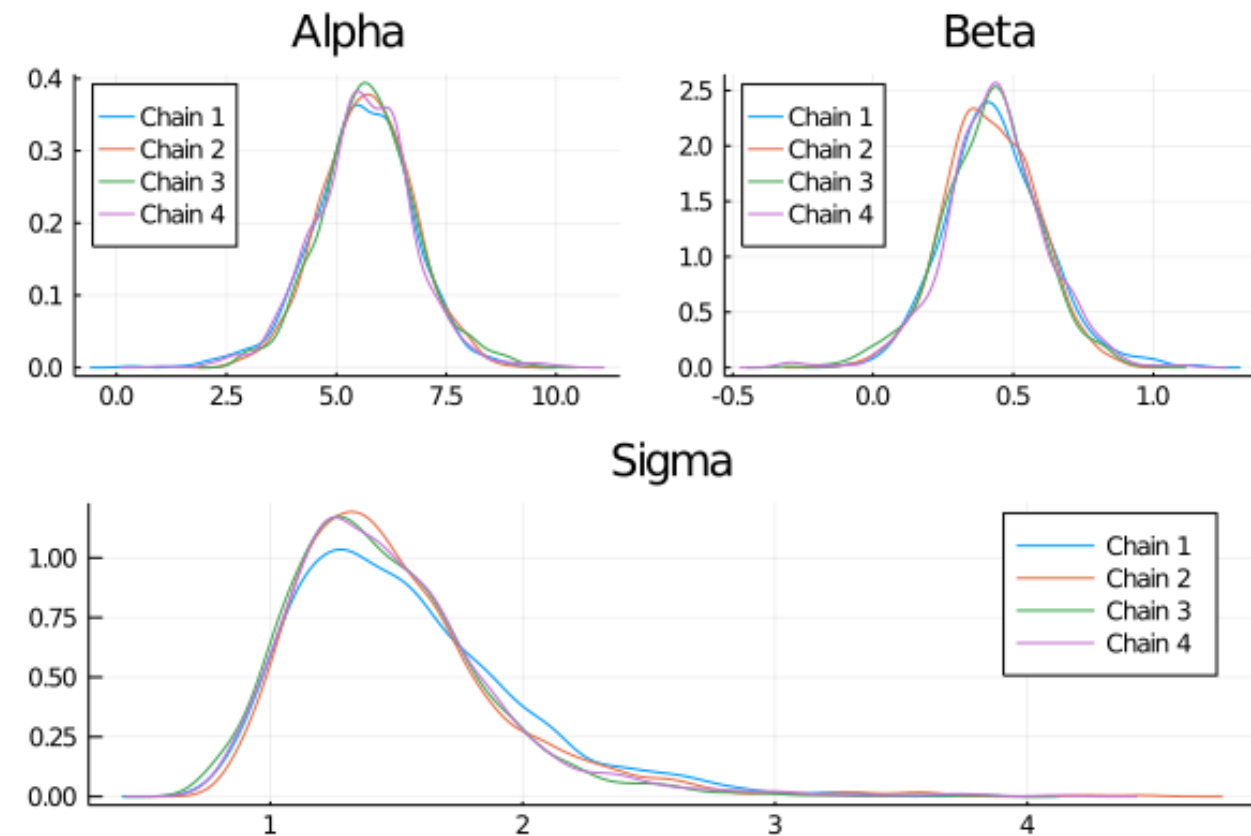
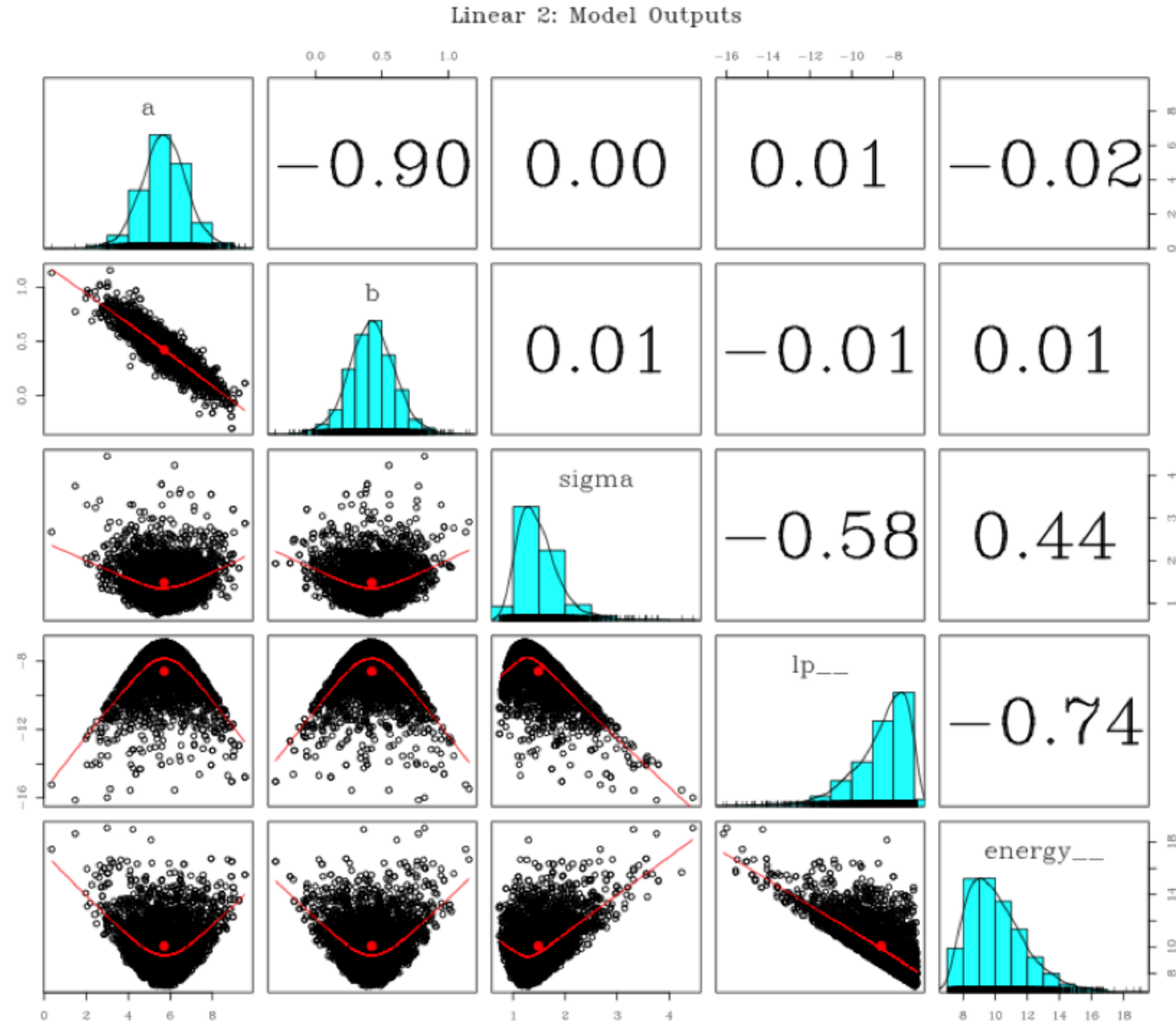# Model Diagnostics: R̂ & Effective Sample Size
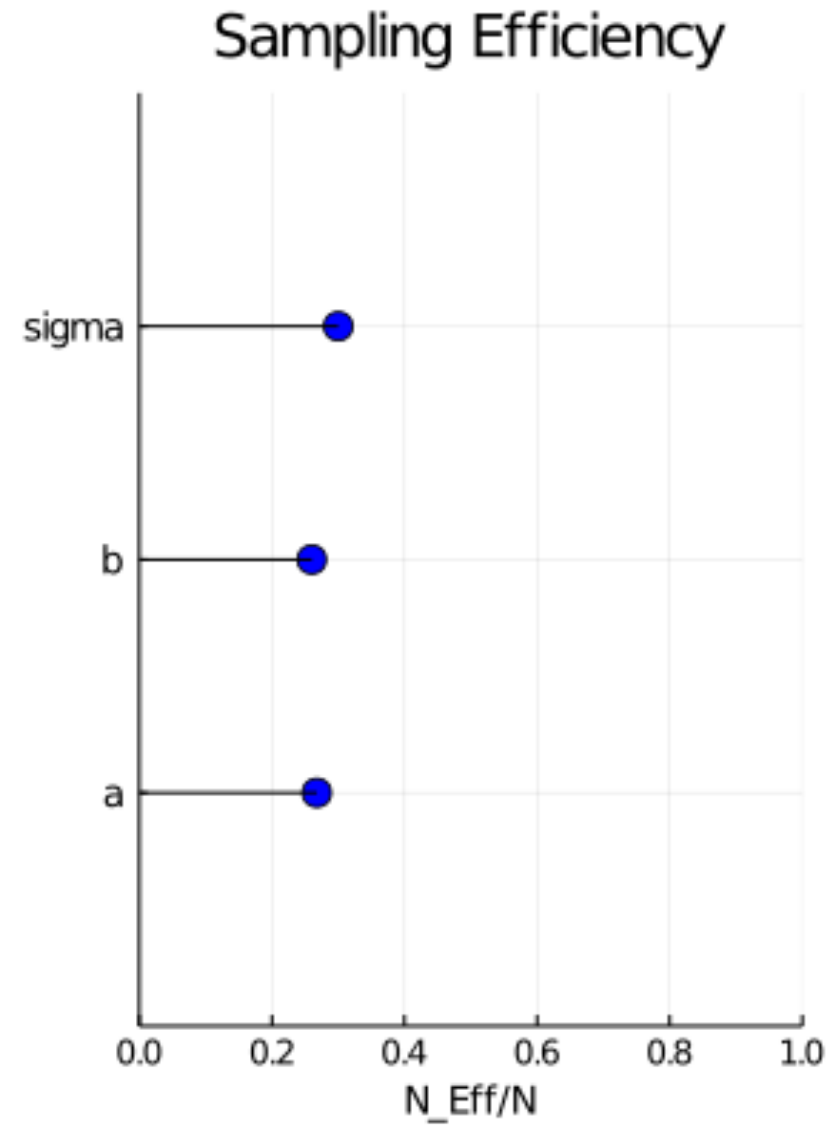
Model Diagnostics: Divergence, Tree Depth, & Step Size

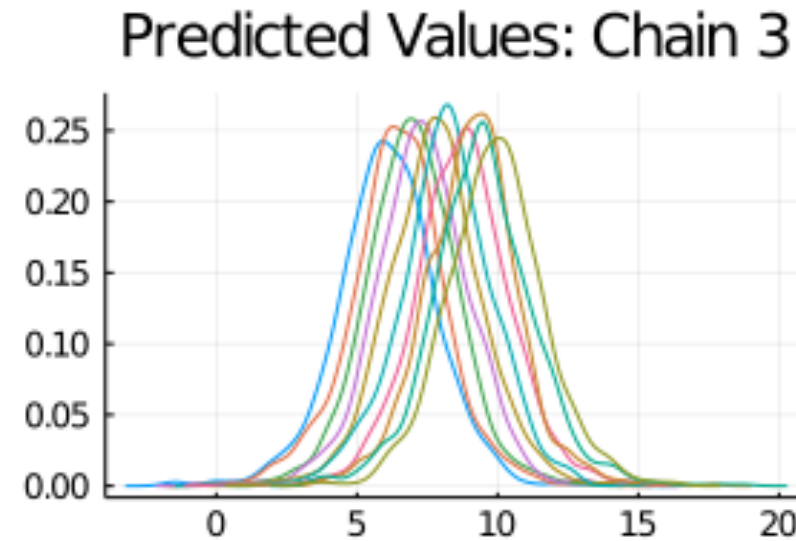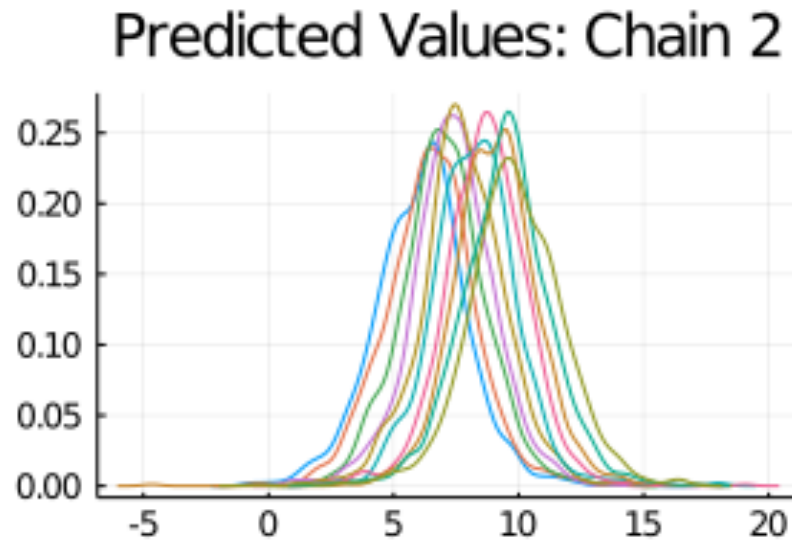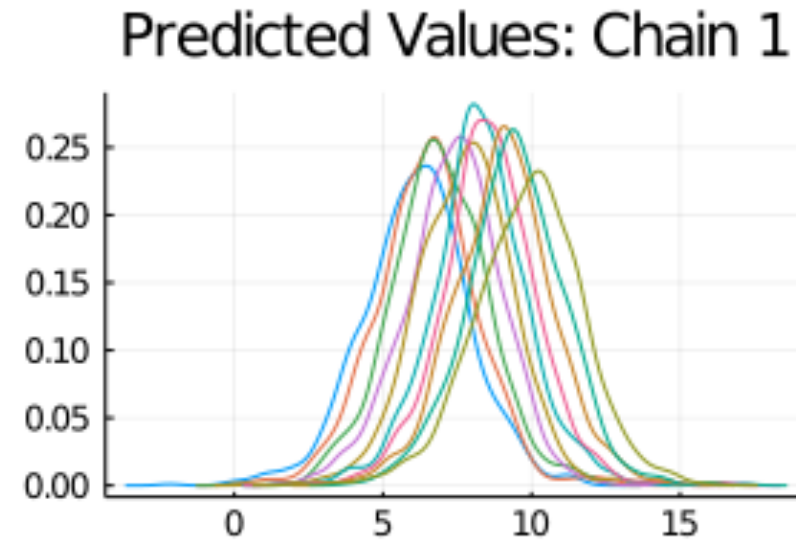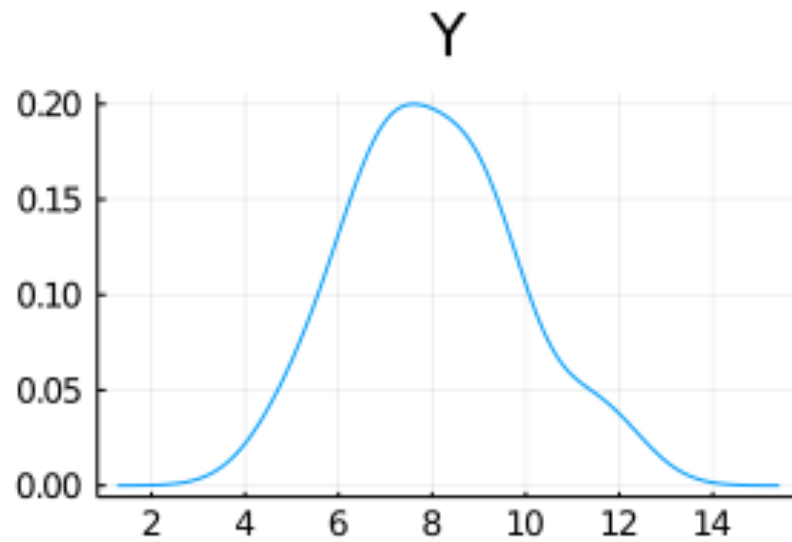# Model Diagnostics: MCMC Sample Autocorrelation
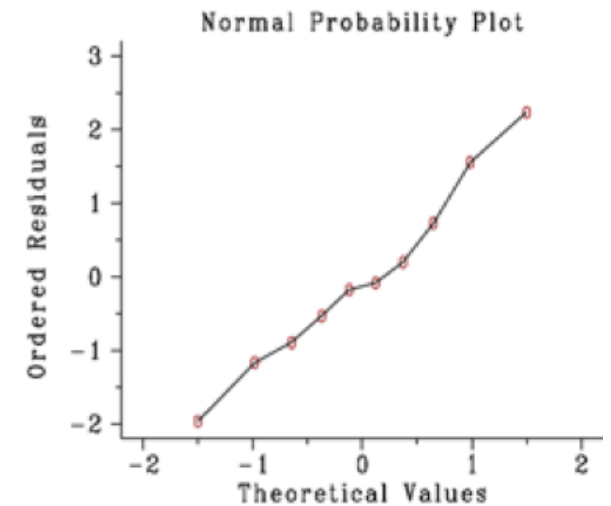
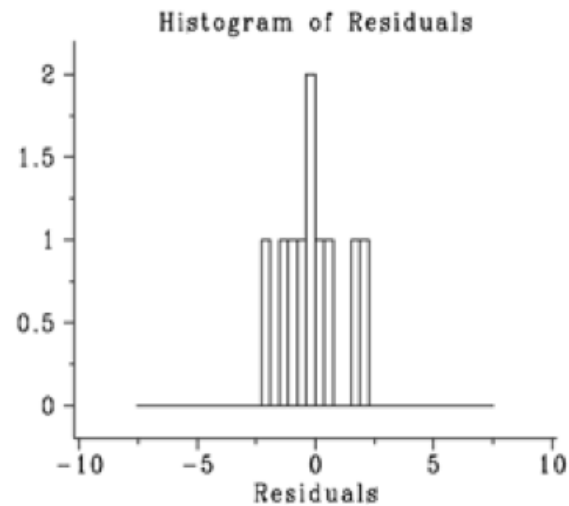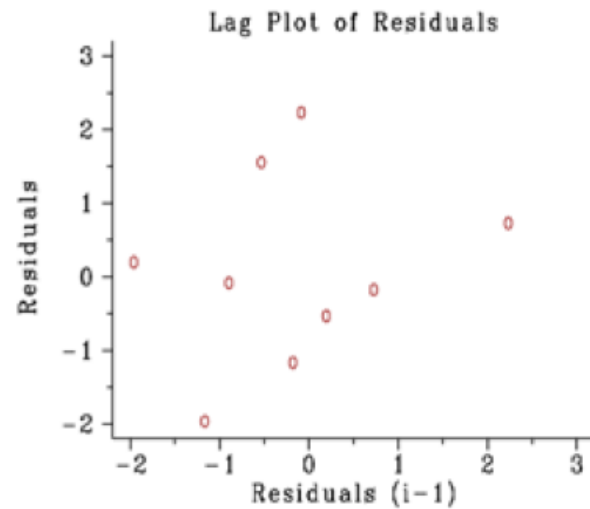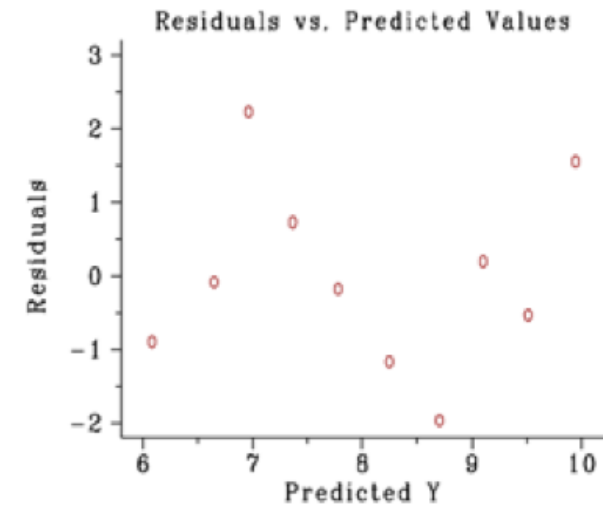# Model Diagnostics: Univariate & Bi-Variate Marginal Distributions
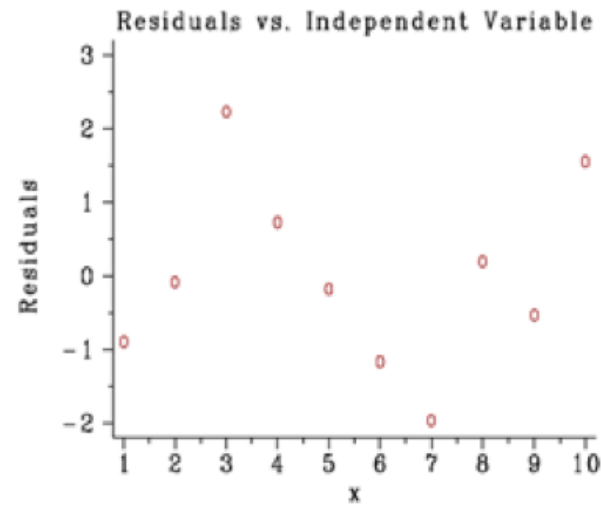

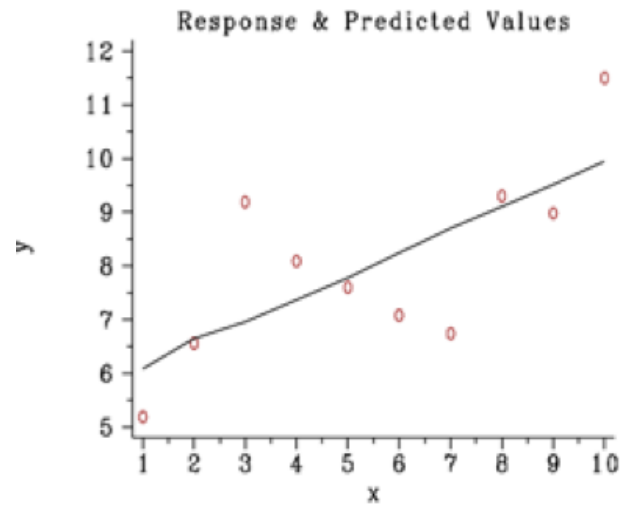Linear 2: Model Outputs

Model Assessment

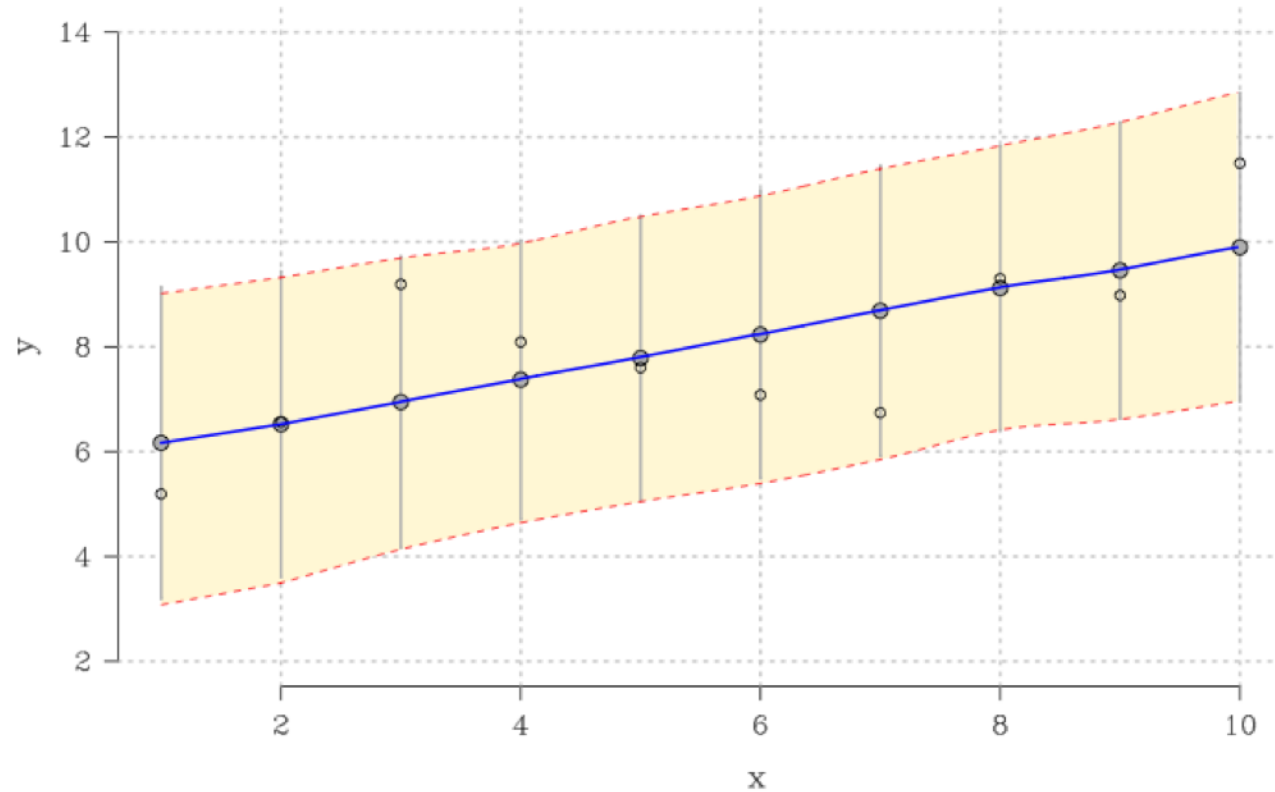# Posterior Predicative Checks

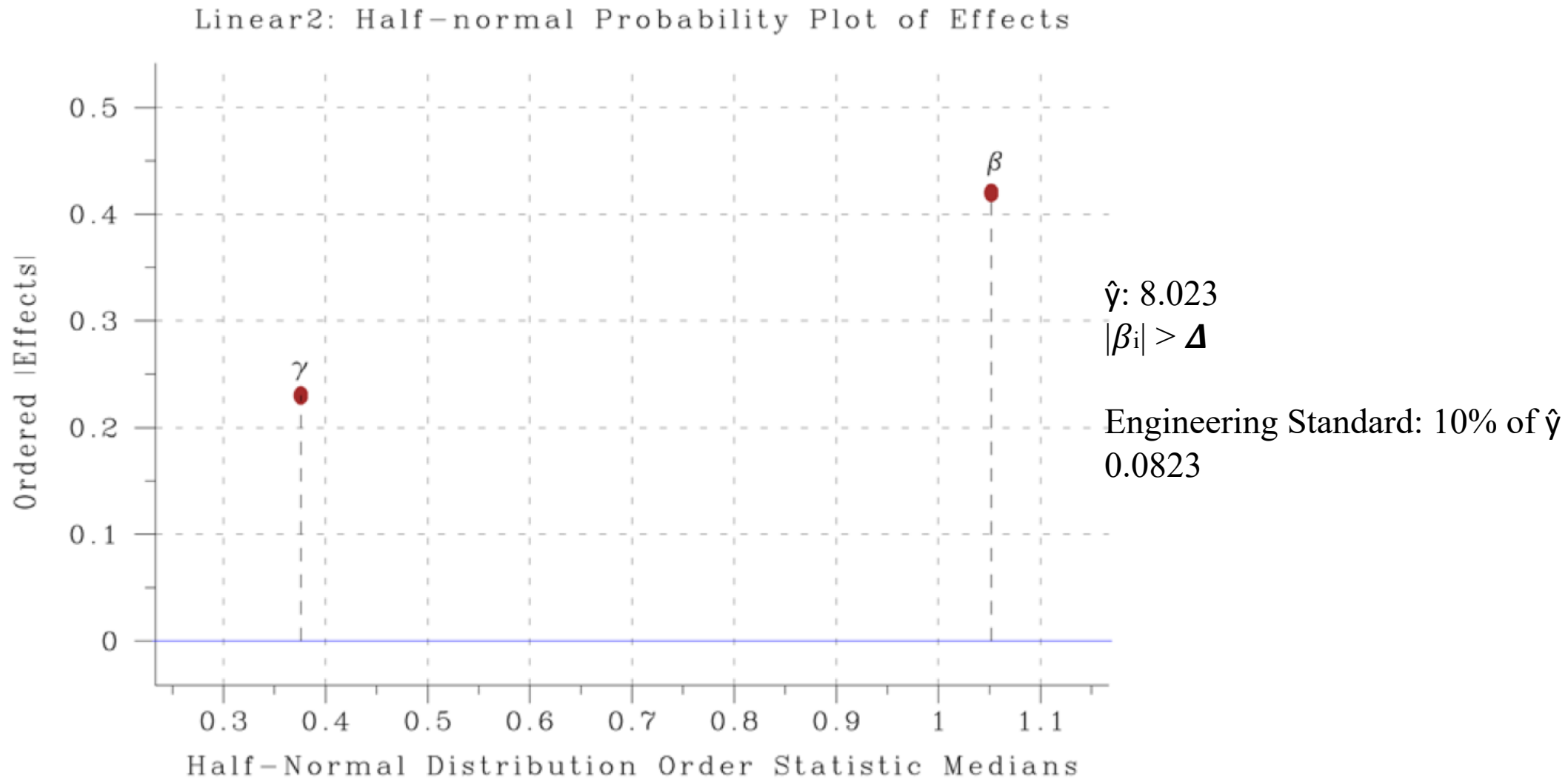# Posterior Predicative Checks

Residual SD: 1.26

Credible Interval

The credible interval does not span 0, indicating a statistically significant effect.

Thinking about Practical Significance

Linear2: Half−normal Probability Plot of Effects

$\hat{y}$: 8.023
$|\beta_i| > \Delta$

Engineering Standard: 10% of $\hat{y}$
0.0823

γ included for demonstration purposes.

Comparing Simple and More Complex Models