

## STA 3180 Statistical Modelling: Simulation

1. Given a set of data points, simulate a linear regression model and calculate the coefficient of determination ( $R^2$ ).

Solution: Use the least squares method to fit a linear regression model to the data points. Calculate the sum of squared errors (SSE) and the total sum of squares (TSS). The coefficient of determination ( $R^2$ ) is then calculated as  $1 - (SSE/TSS)$ .

2. Simulate a Poisson distribution and calculate the mean and variance.

Solution: Generate a random sample from a Poisson distribution with a given mean and variance. Calculate the mean and variance of the sample using the formulas  $\mu = \lambda$  and  $\sigma^2 = \lambda$ .

3. Simulate a binomial distribution and calculate the probability of success.

Solution: Generate a random sample from a binomial distribution with a given number of trials and probability of success. Calculate the probability of success by counting the number of successes in the sample and dividing it by the total number of trials.

4. Simulate a normal distribution and calculate the probability of a given value.

Solution: Generate a random sample from a normal distribution with a given mean and standard deviation. Calculate the probability of a given value by finding the area under the normal curve between the given value and negative infinity.

5. Simulate a chi-squared distribution and calculate the degrees of freedom.

Solution: Generate a random sample from a chi-squared distribution with a given number of degrees of freedom. Calculate the degrees of freedom by counting the number of independent variables in the sample.

6. Simulate a t-distribution and calculate the critical value.

Solution: Generate a random sample from a t-distribution with a given number of degrees of freedom. Calculate the critical value by finding the value of the t-distribution at the desired confidence level.