

MA329 Statistical linear models 21-22

Assignment 1 (Due date: Sept 29, 6pm. The solution will be posted at 6pm of Oct 9. For late submission, each day costs 10 percent)

1. (20 marks)

- Define a simple linear regression model and derive MLE (maximum likelihood estimation) for all the unknown parameters
- Comments on the difference between MLE and LSE (least square estimation)

2. (50 marks, Except scatterplot, don't use R outcome directly) Two processes for hydraulic drilling of rock are dry drilling and wet drilling. In a dry hole, compressed air is forced down the drill rods to flush the cuttings and drive the hammer; in a wet hole, water is forced down. An experiment was conducted to determine whether the time y (in minutes) it takes to dry drill a distance of 5 feet in rock increases with depth x (in feet). [Data can also be found in the file: DRILLROCK.csv]

x	0	25	50	75	100	125	150	175	200	225	250	275	300	325	350	375	395
y	4.9	7.41	6.19	5.57	5.17	6.89	7.05	7.11	6.19	8.28	4.84	8.29	8.91	8.54	11.79	12.12	11.02

- Construct and comment a scatterplot of the data.
- Find the least squares line from the data and plot it on your scatterplot.
- What is your regression model? State the necessary assumptions.
- Test the hypothesis that the depth of the rock provides no information for the prediction of the time required to drill a distance of 5 feet when a linear model is used (use $\alpha = 0.05$). State the null and alternative hypotheses. Draw the appropriate test conclusions.
- Find a 95% confidence interval for β_1 (the slope of the linear regression model). Interpret your results.
- Find the coefficient of determination for the linear regression model. Interpret your result.
- What is the regression prediction equation? Find a prediction for the **mean** amount of time to drill a distance of 5 feet when depth is 6 feet and its 95% interval.
- Find a 95% interval for the amount of time for a **single** drill (5 feet) when depth is 6 feet.
- Give the ANOVA table and interpret the result using the F test.