ESD.86
Models, Data, Inference for Socio-Technical Systems
Massachusetts Institute of Technology
Engineering Systems Division
Problem Set #5
Issued: Monday 2 April, 2007. Due: Monday 9 April, 2007.

1. Parameter Estimation. In the paper Davis, *et al.*, 2007, "A physical probabilistic model to predict failure rates in buried PVC pipelines," *Reliability Engineering and System Safety* **92**:1258-1266, the authors form a Weibull Probability Plot of inherent defect sizes (see their Fig. 4).

a) Use a program of your choice to recreate the plot (Fig. 4 in Davis, *et al.*, 2007). You may use the data table below which we estimated from their Figure.

a x10^4
0.5017
1.8411
1.8411
2.7465
2.7465
3.0354
3.7074
3.7074
6.1125
7.4659

b) Form a least squares fit to the data. Compute your estimate of the parameters reported in the paper including the Weibull distribution parameters (they called them η and α, note that they put η in the exponent rather than α which is unusual) and the expected inherent defect size and standard deviation.

c) The paper reports a regression coefficient of 0.95 and states "which suggests that the Weibull distribution is an appropriate representation of the variation in defect size." Argue in support or against this approach to establishing that the Weibull distribution is "an appropriate representation."

d) Given the same data, estimate the parameters of the Weibull distribution by maximum likelihood estimation (MLE).

e) Given the same data, estimate the parameters of the Weibull distribution by another method of your choice.

f) Comment on the differences among the three estimates formed by regression, MLE, and your chosen approach. Also comment on "goodness of fit."

g) Suggest improvements to the reporting of these results and show how you'd implement them in a revision of the paper.

2. Hypothesis Testing. Gigerenzer, G., 2004, "Mindless Statistics," *Journal of Socio-Economics* **33**:587-606 describes some concerns about misuse of hypothesis testing in social science.

a) Find an example of a journal paper related to your research that uses the "null ritual" or a similar procedure. Provide a full citation for the paper and provide a copy of it. Summarize in a paragraph the investigation, the data analysis, and the key conclusions drawn by the authors.

b) Suggest improvements to the analysis in the paper. If possible, carry out the analysis. Explain how the procedure you suggest would lead to more valid conclusions, greater insights, and/or better communication.