LABORATORY EARTHQUAKE ANALYSIS

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[2] *Add Los Alamos, USGS and or Kaggle here?*

Abstract. Earthquakes cause death and destruction. The technologies used in the laboratory to simulate and collect earthquake data have improved over time. In this study we predict the time remaining until *laboratory* earthquakes occur more accurately(hopefully) than a 2017 Los Alamos National Laboratory study[1]. We analyze data patterns using geophysical subject matter expertise, statistical methods and the latest technology available. We design a statistical algorithm to model the patterns and predict the time remaining until a laboratory earthquake will occur for given test data. We compare predicted versus actual time remaining to determine our accuracy. Our results prove that our model predicted impending laboratory earthquakes with *TBD accuracy, null hypothesis, statistical results with pvalue or confidence interval and relevent scores*. The evidence of this experiment suggests *depends on final results*

1   INTRODUCTION

In August 2017 LANL conducted an experiment[1] which predicted the remaining time until *laboratory* earthquakes occur with 90% accuracy. Subsequently there have been improvements in the technology used to collect and measure laboratory seismic signal data*(additional facts to be added?)*. There have also been improvements in computing power including the software and hardware required for GPU computing. LANL is now providing data collected by more advanced technology to the public via a Kaggle competition.

> "For this challenge we selected an experiment that exhibits a very aperiodic and more realistic behavior compared to the data we studied in our early work, with earthquakes occurring very irregularly.[2]"

The results of this experiment are potentially applicable to the field of real world earthquakes. Other potential applications include avalanche prediction or failure of machine parts.

> "If this challenge is solved and the physics are ultimately shown to scale from the laboratory to the field, researchers will have the potential to improve earthquake hazard assessments that could save lives and billions of dollars in infrastructure.[2]"

Given seismic signal data with considerably more a-periodic laboratory earthquake failures and modern computing hardware; we improve on the Los Alamos study[1] to determine when laboratory earthquakes will occur.

2 TUTORIAL MATERIAL

Paper should be tutorial in nature Audience is data scientists of varying levels of knowledge. Keep newer students in mind

3 DATA

Must have section that defines data Use tables and figures to illustrate data attributes

4 METHODS AND EXPERIMENTS

Define algorithms, methods and eperiments DO NOT give play by play of everything we did Dont put code in paper; if anything put in appendix. Put versions of software but no one cares about how to use technology; just state what we did.

5 RESULTS

Results of experiments Use tables and graphs Use tables and graphs Use tables and graphs Don't forget explanations

6 ANALYSIS

Analyze results. These are NOT conclusions.

7 ETHICS

If people believe us and we are wrong; bad things can happen. If people believe us and we are right; good and bad things can happen.

8 CONCLUSION

Draw conclusionS (plural, more than one conclusion- minimum of 3) This is NOT a summary section.

References

1. Bertrand Rouet-Leduc, Claudia Hulbert, N.L.K.B.C.J.H.P.A.J.: Machine learning predicts laboratory earthquakes
2. Kaggle, R.: Lanl earthquake prediction
3. Hunter, J.D.: Matplotlib: A 2d graphics environment. Computing In Science & Engineering **9**(3) (2007) 90–95