Research
Project Title: Designing a Model for Predicting Fatigue Cracking in Asphalt Pavement

Affiliates: Dr. Eshan Dave, Dr. Rasool Nemati

Synopsis: I used JMP Pro12 software to analyze the relationships between ten components of asphalt pavement mixtures. Statistically significant factors were identified using $R^2$ ($>1$), Chi Square (<0.0001), p value (< 0.05), and RMSE ($>0$).

Results: I accurately predicted the entire damage characteristic curve of an asphalt pavement mixture using the generalized regression: $C = e^{at}$. The components that were statistically significant were % RAP, NMAS, % Air Void Content, PG temperature extremes, % Asphalt Content, and % RAS.

Takeaways
The purpose of data is to inform.
I had been asking students in my class to look at arbitrary data to make calculations that meant nothing.
We want to prepare students for careers in an increasingly data-driven world, to become informed consumers and voters. To do so, data must have real meaning to them. An instructional change needed to be made immediately.

Classroom Impact
7th Grade: data acquisition and analysis
• Develop a research question
• Survey two school subpopulations
• Analyze the results using measures of center & variability
• Draw a conclusion that compares the two populations
• Create a poster with your conclusion and analysis

8th Grade: data acquisition and bivariate regression
• UNH lab; damage testing of asphalt & concrete pavements
• Create & Test Chocolate Asphalt Cookie (pavement design)
• Measuring thickness, time, and terminating load
• Choose two variables to analyze
• Characterize the bivariate relationship qualitatively and write a linear equation to model
• Use analysis as evidence to argue your conclusion

Classroom Impact
7th & 8th Grade: Social Studies
Not-So-Civil Figures
• Choose & pre-search a historical figure from the time period
• Introduce that person’s story through perspective taking
• Serve as the resident “expert” for that person during history Time Traveler's Journal
• Narrate the life of an original character; their perspective & societal role through historical events & themes
• Students seek additional historical information to embellish their character's persona and experience
• Perspective-taking makes the information more personal

Acknowledgements
Thank you to the UNH Leitzel Center for these authentic inquiry experiences in engineering and to Rye Junior High School for their support of ingenuity in education.

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2016 & 2017

Research
Project Title: Comparative Life Cycle Assessment of Traditional and Solar Water Heating in 5 U.S. Cities

Affiliates: Dr. Weiwei Mo, Mingcheng Ren

Synopsis: I used SimaPro and Excel to calculate and compare CED, GWP and Cost/Benefit of a Thermosyphon Solar Hybrid system versus a Traditional 100% Natural Gas System.

<table>
<thead>
<tr>
<th>Cities Studied</th>
<th>Avg. Household Size</th>
<th>Period of Frost</th>
<th>Transportation Distance to Market</th>
<th>Consumer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boston</td>
<td>3000 sq ft</td>
<td>150 days</td>
<td>100 miles</td>
<td></td>
</tr>
<tr>
<td>Atlanta</td>
<td>1500 sq ft</td>
<td>100 days</td>
<td>50 miles</td>
<td></td>
</tr>
<tr>
<td>Chicago</td>
<td>2000 sq ft</td>
<td>200 days</td>
<td>120 miles</td>
<td></td>
</tr>
<tr>
<td>Phoenix</td>
<td>2500 sq ft</td>
<td>250 days</td>
<td>150 miles</td>
<td></td>
</tr>
<tr>
<td>Los Angeles</td>
<td>3500 sq ft</td>
<td>300 days</td>
<td>200 miles</td>
<td></td>
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</tbody>
</table>

Results: Only in Phoenix was the cost of the solar hybrid system lower than the traditional system. In all other cities, the costs were comparable.

Takeaways
Personal data is memorable data.
People remember data figures that relate to them or personally impact them in some way. Further, still, people are naturally skeptical of figures presented to them. They must be convinced that the conclusions are valid and important.

Valuable data exists, waiting to be sought.
The study of history is part of the social sciences. We should be incorporating inquiry into the way students learn history. Let students seek knowledge.

Classroom Impact
7th Grade Math & Social-Emotional Learning
Identify a problem in your community.
• Analyze the data to form a conclusion.
• Determine elements of your analysis that can be used as evidence to support your conclusion.
• Write a letter to a local governing agency, stating the change you’d like to make and using your data analysis as evidence to argue your position.

Formative Assessment
• More intentional use of content-specific pre-assessments.
• More frequent formative assessments during instruction.
• More frequent use of standardized benchmark tests.

Acknowledgements
Thank you to the UNH Leitzel Center for these authentic inquiry experiences in engineering and to Rye Junior High School for their support of ingenuity in education.

NSF Award # ENG-1711701
2018

Research
Project Title: Recommendations & Barriers to Uniform New England Quality Assurance of Asphalt Pavement Projects

Affiliates: Dr. Jo Sias Daniel, Dr. Eshan Dave

Synopsis: A uniform QA practice would simplify certification, allow shared resources, and streamline operations.

<table>
<thead>
<tr>
<th>Primary Stages of Quality Assurance</th>
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<tbody>
<tr>
<td>What?</td>
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<tr>
<td>Who?</td>
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<tr>
<td>When?</td>
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</tbody>
</table>

Results: Some Best Practices, Priority Attributes to Test, and Potential Barriers to Change were identified in existing practices. New England states and P.I.s began the conversation and identified next steps for further inquiry & discussion.

Takeaways
Performance is personal.
There is a human element to all data. Investigators must be sensitive in their data acquisition and communication of their findings. People doing their best can take recommendations for change as criticism or censure.

Formative assessment is essential.
It is simpler to recover a fault that is caught early, rather than at the end of a task. Quality must be checked regularly.