

Passion-Driven Statistics: A data-driven, multidisciplinary curriculum providing access to the data analytics economy through project-based learning



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Introduction

- A central challenge of introductory statistics courses is the development of a curriculum that not only serves diverse students, but also sparks communication, reasoning, and collaboration that crosses disciplines and cultures.
- Inquiry-based projects may be the best way to achieve this by allowing students to, “decompose their topic, identify key components; abstract and formulate different strategies for addressing their research question; connect the original question to the statistical framework; choose and apply methods; reconcile the limitations of the solution; and communicate findings” (Nolan & Temple Lang, 2009).

Course Design

- In our flipped, project-based classroom, the majority of each session is devoted to students actively working on their analyses and thinking about their data.
- In the first week, students develop their own research question after an introduction to a number of large data sets representing different disciplines. The students’ research questions evolve as they continue through the course and apply newly learned statistical techniques.
- All statistical analyses are done within the context of the students’ research question culminating with a poster presentation.

Introduction

- Psychiatric disorders are a potent group of risk factors consistently implicated in the development of nicotine dependence (Rohde et al., 2003; 2004).
- While the association has been well established in the literature, less is known about the ways in which psychiatric disorders may play a role in the emergence of nicotine dependence.
- Most research on psychiatric disorders and heavy smoking e.g. the self medication hypothesis (Khanzian, 1997).
- Alternatively, however, psychiatric disorders may signal a greater sensitivity to nicotine dependence at low levels of smoking (i.e. individuals with psychiatric disorders may develop nicotine dependence symptoms at lower levels of smoking than those without psychiatric disorders).

Research Questions

- Which psychiatric disorders are associated with nicotine dependence or comorbidity?
- Does the association between smoking quantity and nicotine dependence differ for individuals with and without these psychiatric disorders?

Methods

Sample

- Young adults (age 18 to 25) who reported daily smoking in the past year (n=1320) were drawn from the first wave of the National Epidemiologic Study of Alcohol and Related Conditions (NESARC).
- NESARC is a nationally representative sample of non-institutionalized adults in the U.S.

Measures

- Lifetime psychiatric disorders were assessed using the NIAAA Alcohol Use Disorders and Associated Disabilities Interview Schedule – DSM-IV (AUDADIS-IV).
- The tobacco module includes questions on symptom criteria for DSM-IV nicotine dependence.
- Current smoking was evaluated through quantity (“On the days that you smoked in the last year, about how many cigarettes did you usually smoke?”).

Results

Univariate

- Fully 81% of daily smokers met criteria for DSM-IV nicotine dependence.
- A total of 55% of those with psychiatric disorders met criteria for DSM-IV nicotine dependence.

Bivariate

- Chi-Square analysis showed that daily, young adult smokers with a psychiatric disorder were significantly more likely to meet criteria for nicotine dependence (29.5% vs. 24.5% for those without a psychiatric disorder (60.7% vs. 50.1). The most common disorder was alcohol dependence (45% SE 1.9).
- As expected, the number of cigarettes smoked per day was significantly associated with DSM-IV nicotine dependence, OR=1.04 (1.03-1.06).

Multivariate

- Major depression (MDD), specific phobia, alcohol dependence, and antisocial personality disorder (ASPD) were each associated with DSM-IV nicotine dependence after controlling for comorbidity.
- The interaction between number of cigarettes smoked per day and specific phobia, ASPD and MDD was not found to be significant in the presence of nicotine dependence.
- At each level of use, the probability of nicotine dependence is significantly higher among those with the disorder than those without (Figure 1).
- In contrast, the interaction between alcohol dependence and number of cigarettes smoked per day was statistically significant when predicting nicotine dependence (Figure 2).

Discussion

- Individuals with major depression, specific phobia and ASPD may be more sensitive to nicotine dependence across levels of smoking.
- Individuals with alcohol dependence are more sensitive to nicotine dependence at low levels of daily smoking, but not at the highest levels when compared to those without psychiatric disorders.
- Notably, the present findings are based on cross-sectional data and do not reflect the smoking levels at which nicotine dependence emerges among those with and without psychiatric disorders.
- Further research is needed to determine whether sensitivity to nicotine dependence is based on physical and/or psychological differences related to psychiatric disorders.

References

- Rohde, D., et al. (1997). The self-medication hypothesis of substance use disorders: A re-evaluation. *Journal of Abnormal Psychology*, 106, 425-435.
- Rohde, D., et al. (2003). Psychiatric disorders and nicotine dependence: A re-evaluation. *Journal of Abnormal Psychology*, 112, 425-435.
- Rohde, D., et al. (2004). Psychiatric disorders and nicotine dependence: A re-evaluation. *Journal of Abnormal Psychology*, 113, 425-435.

Results

- In previously published work, we have demonstrated that the project-based course enrolls higher rates of under-represented minority (URM) students compared to a traditional introductory statistics course (Dierker et al., 2015).
- Further, because of our focus on programming in the context of data analysis (i.e. R, SAS, Stata, Python, etc.), we have compared enrollment in the project-based course to traditional introductory programming experiences, revealing higher rates of female and URM enrollment compared to both a general introductory programming course and an introductory course representing a gateway to the computer science major (Dierker et al., 2017).



- When compared to a traditional math-statistics course, students completing the project-based course were more likely to report an increase in confidence between the pre- and post-survey with regard to choosing the correct statistical test, managing data and writing code to run statistical analyses. Project-based students were also more likely to show an increase in interest in pursuing advanced course work in statistics (Dierker et al., 2018).
- We also compared experiences of under-represented(URM) and non-underrepresented students in 4 years of the course. While URM students considered the material more difficult than non-URM students, URM students demonstrated similar levels of increased confidence in applied skills and interest in follow-up courses as non-URM students (Dierker et al., 2016).
- URM students were found to be twice as likely as non-URM students to report that their interest in conducting research increased.

Resources

ANOVA

SPSS	UNIANOVA QuantResponseVar BY CategExplanatoryVar.
STATA	oneway QuantResponseVar CategExplanatoryVar, tabulate
SAS	proc anova; class CategExplanatoryVar; model QuantResponseVar = CategExplanatoryVar; means CategExplanatoryVar;
R	myAnovaResults <- aov(QuantResponseVar ~ CategExplanatoryVar, data = myData) summary(myAnovaResults)



- Public website linked in the above QR code.
- Translation code, as shown above, linked at <http://bit.ly/PDSTranslationCode>
- Videos integrating content, demonstrations and interpretation at <http://bit.ly/PDSe-book> (R, SAS, SPSS, Python and Stata).

Discussion

- Traditional classroom settings place the burden of effort on the instructor – thus, class sizes must remain small in order for students to receive adequate support and direction. Many schools and universities lack the staffing to provide such instruction to a large student body and must rely on the large general lecture.
- This program, however, leverages faculty, technology, and peer-to-peer learning to enable larger class sizes without losing individual support and attention.
- The model has been implemented successfully by numerous high schools, colleges, and universities.
- The model has also been adapted to reach a worldwide audience as a Massive Open Online series of courses available through Coursera (for more information see <https://www.coursera.org/specializations/data-analysis>).
- We are always eager to identify new implementation partners.

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REFERENCES:

