Student Voices

Persistent Controversy in Statistical Approaches in Wildlife Sciences: A Perspective of Students

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ABSTRACT The controversy over the use of null hypothesis statistical testing (NHST) has persisted for decades, yet NHST remains the most widely used statistical approach in wildlife sciences and ecology. A disconnect exists between those opposing NHST and many wildlife scientists and ecologists who conduct and publish research. This disconnect causes confusion and frustration on the part of students. We, as students, offer our perspective on how this issue may be addressed. Our objective is to encourage academic institutions and advisors of undergraduate and graduate students to introduce students to various statistical approaches so we can make well-informed decisions on the appropriate use of statistical tools in wildlife and ecological research projects. We propose an academic course that introduces students to various statistical approaches (e.g., Bayesian, frequentist, Fisherian, information theory) to build a foundation for critical thinking in applying statistics. We encourage academic advisors to become familiar with the statistical approaches available to wildlife scientists and ecologists and thus decrease bias towards one approach. Null hypothesis statistical testing is likely to persist as the most common statistical analysis tool in wildlife science until academic institutions and student advisors change their approach and emphasize a wider range of statistical methods. (JOURNAL OF WILDLIFE MANAGEMENT 71(7):2142–2144; 2007)

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For decades, researchers have argued against the use of null hypothesis statistical testing (NHST) in various scientific disciplines (e.g., Yates 1951, Cherry 1998, Fidler et al. 2004), yet reviews of the literature indicate that NHST remains the most widely used statistical approach to research in wildlife science and ecology (Anderson et al. 2000, Fidler et al. 2006, Stephens et al. 2007). An obvious disconnect exists between those opposed to using NHST and many wildlife scientists and ecologists who conduct and publish research. This disconnect causes confusion and frustration for researchers (particularly students) when choosing a method to analyze data.

We, as students, arrive in academia ready and eager to learn the various tools and methods for rigorous and meaningful research. Instead, limited options in statistics courses and inconsistencies in the literature confront us. Although varying opinions in the literature allow for healthy debate and discussion, they can also result in misunderstanding and uncertainty. We do not wish to immerse ourselves in the ongoing debate regarding the use of NHST (see Johnson 1999, Guthery et al. 2001, Robinson and Wainer 2002, Fidler et al. 2004, Gigerenzer 2004); instead, we offer our perspective on how to address this issue. Our perspective is an amalgam of thought from a diverse undergraduate background (viz., universities in CT, IN, NJ, OH, PA, RI, TX, USA; Tamaulipas, México; and Tucumán, Argentina) and varying lengths of time as graduate students.

Our objective is to point out the overemphasis of NHST in education and encourage academic institutions to create an introductory statistics course that surveys a variety of statistical approaches (e.g., Bayesian, frequentist, Fisherian, etc.). We also encourage professors serving as undergraduate and graduate student advisors to maintain familiarity with standard statistical methods along with new changes and techniques. First we make suggestions to academic institutions and student advisors on how to better inform students of the available approaches. We then offer 3 suggestions to students that we feel apply to the argument regarding NHST.

ACADEMIC INSTITUTIONS

The unifying theme that we hope to convey is the need for academic institutions to improve awareness of available statistical approaches. Many universities require students to enroll in an introductory statistics class, yet the course covers a limited range of topics and often focuses exclusively on NHST. Although it is important for academic institutions to introduce the basics of statistical analysis, such courses are typically not sufficient for students who plan to conduct scientific research. Therefore, we propose integrating a different statistical course into the wildlife sciences and ecology curriculum that surveys various statistical ap-

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proaches and the respective assumptions, strengths, and weaknesses of each approach. Colleges should offer the course to upper level undergraduates who intend to pursue wildlife and ecological research and should require the course for new graduate students. The course should enable students to make informed decisions about which statistics courses to pursue in their educational career and build a foundation for critical thinking in applying statistics. The introduction of statistical tools is crucial; we must know what tools exist to better understand and explore their uses. We do not ask for, nor advocate, the development of a cookbook of statistical methods. We simply believe that if educators expose students of wildlife sciences and ecology to a variety of statistical methods, they will equip students to select suitable methods for their research. We stress that it is not incorrect to teach NHST or use the method when appropriate (Robinson and Wainer 2002, Mogie 2004). However, the overwhelming emphasis on NHST in the statistics classroom risks creating the assumption that it is the only method available.

STUDENT ADVISORS

Professors involved in advising undergraduate and graduate students in wildlife sciences and ecology should have a strong foundation in various statistical approaches and should stay apprised of new statistical methods. We are not asking that the advisors be statistical gurus, but we do ask that they remain current on statistical methods to provide sufficient guidance in the statistical approaches available to wildlife and ecology students. Advisors should require students to focus on the biological significance of the results, regardless of the statistical method employed. Advisors should also encourage their students to entertain new approaches and could make these approaches accessible through assigned readings, lab group discussions, workshop attendance, and other means. We understand that the majority of our education at the graduate level must be self-directed, but that does not absolve the professors from their duties of teaching and guiding.

Some advisors believe the most important aspects of research are the research question and the study design. While we agree with that notion, we realize that appropriate questions and designs do not release us from the burden of statistics and the need for knowledge about statistical tools. In fact, designing a study includes planning analyses, which often involves statistical methods.

STUDENTS

We have 3 suggestions to help students navigate statistical analysis decisions. First, do not ignore or reject a statistical tool simply because researchers misuse it (Guthery et al. 2001). Although there are numerous examples in the literature in which authors misuse NHST (and other statistical approaches), there are situations where NHST is the correct tool for the job (Nickerson 2000, Robinson and Wainer 2002, Eberhardt 2003). Second, although the diversity of statistical tools may be daunting, do not become distraught deciding which statistical tool to use. More than one will often suffice. The key is to understand the strengths, weaknesses, and purposes of various statistical approaches. Finally, we encourage taking an active role in increasing your awareness of the multitude of statistical approaches available and realize that introductory statistical courses examine only one facet of a much larger discipline.

Wildlife scientists and ecologists must be careful not to use inappropriate or uninformative statistical tests that detract from interesting biological questions. Statistical analyses are altogether irrelevant if the underlying questions are not biologically meaningful (Johnson 1999).

CONCLUSION

The use of NHST gains momentum in universities where educators teach NHST to the exclusion of other statistical methods. Students are often caught in the middle, working towards contributing to the published literature, yet uncertain or unaware of statistical analysis options. Professors, journal editors, and agencies continually pressure authors to use more advanced statistical tests (i.e., beyond descriptive statistics) in their analyses. As students, we use the methods taught to us, which is primarily NHST. Changes in the roles of academic programs and advisors may help break this cycle.

We realize that some academic programs may have implemented similar plans and maintain a strong, diverse statistical component in their wildlife-related departments. Based on our diverse undergraduate backgrounds, however, we believe that such programs are rare and our suggestions may yet be of worth to some institutions.

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