

The usefulness of GRE scores

Many US physics departments are considering dropping the use of Graduate Record Examinations (GREs) in making admissions decisions (see, for example, the commentary by Alexander Rudolph, *PHYSICS TODAY*, June 2019, page 10). They are concerned that the exams contribute to the profession's nonrepresentative demographics. The American Physical Society (APS) Panel on Public Affairs is looking at adopting a similar position. Those decisions may be influenced by a widely publicized *Science Advances* paper entitled "Typical physics Ph.D. admissions criteria limit access to underrepresented groups but fail to predict doctoral completion," by Casey Miller and coauthors.¹

Although that paper uses data provided by many physics departments, I found some serious statistical flaws in its analysis. Contrary to its conclusions, proper statistical analysis of even the incomplete published features of the data indicates that an equal-weight sum of the quantitative and physics GREs is somewhat better than undergraduate grade point average at predicting who will graduate.²

I believe the key issues raised include the need for more transparency and statistical literacy in handling data, but the effects of graduate admissions policies themselves are also important. Systematic uncertainties in estimating the effects of using GREs in admissions decisions would remain even after a proper analysis of more complete data,² as is typical for any attempt to estimate causal parameters from observational data.³ Therefore, it may be worth trying a more robust way to get information on those effects.

Given the fairly large number of physics departments that are uncertain about what the GRE's role in the admissions process should be, APS could ask for departments to volunteer in a randomized controlled trial. Some departments would be assigned to GRE-aware admissions and others to GRE-blind ad-

missions. Ideally, the assignments would be switched after a year. Beyond graduation rates, various other outcomes of interest could be tracked. Departments could participate in long-term follow-up even if they committed to only two years of randomized admissions policy. Incremental costs above the already labor-intensive selection procedures should be small, perhaps even negative, if one counts the time saved in decision making.

Although the information obtained might be inconclusive, at least the setup

A model of efficient competition in admissions: The more desirable programs attract students who are more likely to succeed.

could be a model for approaching policy issues scientifically and honestly. That's important when we consider that our credibility on the really big issues—climate, for example—has been challenged by people who wrongly claim we are just pushing political positions disguised as science.

References

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Alexander Rudolph's commentary correctly notes that achieving greater diversity in physics requires revamping admissions criteria: You only get what you select for. However, the recommendation against using Graduate Record Examination (GRE) scores draws heavily on

a study by Casey Miller and coauthors.¹ That study has three major problems:

- The study measured performance with a binary variable: completion. Eliminating gradations of performance obscures relationships that may be present in more granular data. A large meta-analysis examined student performance with fine-grained measures—for example, research productivity, faculty ratings of student work—and found significant predictive power in GRE scores.²

- The work by Miller and coauthors included program rank as an explanatory variable, despite its being strongly correlated with GRE scores. When two or more such variables are strongly correlated, a regression routine cannot easily determine which variable should get the larger coefficient; different coefficient choices could fit the data similarly well. Consequently, coefficient estimates will have large uncertainties.³ Thus the estimated coefficient of GRE score will almost certainly have a magnitude comparable to the estimate's uncertainty.

- The predictive power of program ranking actually fits a model of efficient competition in admissions: The more desirable programs attract students who are more likely to succeed. Moreover, a student who is weak by one measure can gain admission by demonstrating strength in another measure. Such cases may camouflage correlations between student performance and other explanatory variables.⁴ Of course, there are other plausible explanations for the predictive power of program ranking, but nothing in the cited work enables readers to choose among explanations.

Admissions criteria are ultimately about values, and it is wholly appropriate to include diversity of backgrounds among them. However, if performance is also valued, then valid predictors of performance should also be included. The Miller study does not demonstrate that GRE scores lack predictive power, and it should not be cited uncritically.

References

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Adjunct educators in a profit-driven arena

To the Issues and Events story about contract lecturers (PHYSICS TODAY, November 2018, page 22), I would like to add a significant concern that we have seen arise with instructors and adjuncts over about the past two decades. During that time the numbers of private and public community colleges and universities have skyrocketed while funding has declined. Those facts, combined with the profit motive and less stringent admissions practices at the freshman level, have led to many displeased academics, particularly in the hard sciences.

Nowadays a significant number of students entering these institutions are not well prepared to succeed in hard-science courses. In search of profits, institutions of learning have loosened entrance requirements. As a result, some admitted students have no motivation to continue in science but either need to take these courses for a career in other fields or are bent on receiving high grades without doing the necessary work.

As test and exam dates draw near, some students realize that they cannot make the high grades, and they complain to the dean or department chair, who rarely offers the teacher an opportunity to make a defense. If the teacher is present, then the students are less likely to embellish their performance or tell lies or denigrate the teachers. Student complaints often get lodged without rebuttal or evidence and become part of the teacher's record. And even if the com-

plaints are true, institutions should have a protocol established for instructors to be able to improve their performance or correct the record. That rarely happens. Now instructors, realizing that they could be fired, may jack up grades in the hope of calming the complaints. One has to think twice to fail a student who might file a complaint.

Often the result is that the complaining students receive better grades than their work deserves and teachers—even research leaders with broad teaching experience—may lose their positions. Their loss leads to a decline in academic standards. In the past decade or so, maybe as a result of this, many failures of high-tech manufacturing products, services, and air travel, some of which have been life threatening, have been in the news.

Colleges and universities must change their policies regarding admissions standards and quality of education, particularly in the hard sciences. Having school administrators require that an instructor be present when a complaint is lodged will minimize students' opportunity to present only their side of the situation, and supporting the professors once they are hired should also help maintain ethical standards. Administrators could also encourage the complainers to first try to settle with their teachers before they lodge an administrative grievance.

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Notes on superconducting hydrides

In their article "The quest for room-temperature superconductivity in hydrides" (PHYSICS TODAY, May 2019, page 52), Warren Pickett and Mikhail Erements commented that "in the late 1960s William McMillan of Bell Labs extended the [Bardeen-Cooper-Schrieffer] analysis to moderately strong coupling," which is measured by the electron-phonon coupling constant, λ . According to Pickett and Erements, the McMillan "equation for T_c was extrapolated beyond

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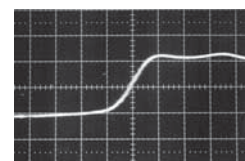
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