VALUE OF ACCREDITATION FOR COMPUTING PROGRAMS VS. ENGINEERING PROGRAMS

Caitlin McOsker, College of Engineering and Computing, Georgia Southern University, C.O.B.A. Dr, Statesboro, GA 30458, 762-231-9621, clang@caitlinlang.org, cm11625@georgiasouthern.edu

ABSTRACT

This paper looks to investigate the value of ABET accreditation for students of computing programs as compared to engineering programs. This is done by comparing the number of job ads that indicate a preference or requirement for ABET accreditation for the two categories. Job ads are scraped from popular job posting website Monster.com using relevant search terms, then analyzed using a t-test to determine if there is a difference between the two groups.

LITERATURE REVIEW

The first part of this review gives a brief overview of the ABET organization and outlines the accreditation process. This is to understand the process programs go through to achieve ABET accreditation, as well as some historical background. Then, we explore the costs and perceived return on investment for the students in ABET accredited programs.

About Accreditation and ABET

Academic accreditation as provided by private organizations is one of the cornerstones of American higher education [5]. Going to not only an accredited institution, but attending a separately accredited program, is an important requirement for some students. Accreditation reflects the accountability of a program, providing them with a sense of assurance that their degree will be worthwhile after graduation [11]. This is often emphasized in STEM career paths that begin at the university level.

ABET, Inc., formerly the Accreditation Board for Engineering and Technology, is a non-profit, non-governmental organization founded in 1932 that acts as the United States main accreditation body for STEM programs, particularly in the engineering and computing disciplines. According to their website ABET.org, ABET accreditation seeks to assure that post-secondary programs that receive ABET accreditation meet “quality standards of the profession for which that program prepares graduates.” These “standards” are implemented with the help of ABET affiliated member societies, and since ABET covers such a wide range of disciplines, these requirements vary between sectors and have separate committees [1].

Since the 1990’s, ABET has had a hand in accrediting computing programs in the United States, as well as internationally. In 2001, ABET merged with CSAB, the Computing Sciences Accreditation Board, and formed their Computing Accreditation Commission [9]. The CAC generates and approves criteria for the four programs they cover: computer science, cybersecurity, information technology, and information systems.

The road to program accreditation is an involved 18 month process every few years. Aside from the time commitment, there is a monetary value to each step of this process [1] [5]. While many institutions see accreditation as a necessary part of higher education, it is not well understood how important accreditation in general is for programs like computer science and information technology. Constantly changing industry standards, resource cost, and changing program goals have muddied the waters on whether ABET accreditation is worthwhile for this particular field [8]. Programs make this investment with the hope that accreditation will offer a return on investment for its students, but there are serious financial and time commitments from faculty and staff to stay accredited.

Investigating Accreditation and Its Value

Because students of computing do not have the same level of licensure requirements as engineering [11], this raises several questions. Is accreditation important for computing disciplines; specifically, within the programs covered by the CAC, how important is accreditation for information technology students? Where is the intersection between the goals of ABET and the programs seeking accreditation, and is this intersection great enough to warrant the time and costs? Is there an industry requirement for information technology graduates to have attended an accredited university, or has this become an expensive self-imposed check-mark for IT programs?

There are a variety of reasons that programs seek accreditation [5]. In a paper from 2018 titled "The Value of ABET Accreditation to Computing Programs," the authors say that accreditation "projects both the image and reality of a commitment to continuous improvement, a commitment to adequate resources, and a commitment to deliver a curriculum that includes foundational and advanced topics..." [11]. This statement is supported by the general criteria laid out in the "Criteria for Accrediting Computing Programs" published by ABET in 2018, which include requirements to regularly evaluate if criteria are being reached, and to apply that information towards "continuous improvement of the program." The 2019-2020 standards also require that facilities are adequate for student use and that the curriculum "prepare[s] students for a career, further study, and lifelong professional development in the computing discipline associated with the program" [2]. According to Fisher, some departments might have internal pressure from the college or university to seek out accreditation. For less established programs, they may see accreditation as necessary to be able to compete.

While the reasons for choosing to seek accreditation can be many, it is hard to determine if having or not having gone to an accredited university has direct effects on graduate's job prospects. In his paper, Oudshoorn says that accreditation for computing is important because it has set the benchmark in other areas; in fact, he says that "accreditation criteria for engineering is recognized as so valuable that... applicant's resumes will not even be considered if their degree is from a non-accredited institution." This suggests that, because the CAC sets criteria of similar "structure and content" as the EAC (Engineering Accreditation Commission), the same value should be placed on accreditation in computing. However, they do not address whether this same pressure can be found in the computing disciplines within the United States [11].

Similarly, in Fisher's study of a 38-member industrial advisory board (IAB) supports this idea. 40% of California employers said accreditation affects the offered salary of job applicants. However, his survey also concluded that employers are "mixed on the question of there being a difference between employees with or without an accredited degree" [7].

Overall, while there are a variety of reasons why programs seek accreditation, it is unclear whether having that status is necessary within industry, or whether lack of ABET accreditation directly affects computing graduate's job prospects.

Mining Job Ads

In the age of information, there has become a growing need to acquire data sets from the greatest collection of information: the Worldwide Web. This has caused a rise of web scraping to acquire and store data to analyze for many reasons, from analyzing current business environments to studying economic trends. Web scraping techniques follow the same structure: the input is the HTML of a website, and the output is structured data (i.e. CSV files, spreadsheets, database tables) [13]. One popular method for automating web scraping is through extraction and parsing using Python scripts. Four Python libraries commonly used for extraction and cleaning are Beautiful Soup, requests, pandas and nltk, although there are others.

Within the realm of text scraping, the nature of online job ads makes them an opportune source of data [10] [13]. It is consistent in supplying the following information:

- Company
- Job title
- Expected skills
- Location [13].

The organization of online job search engines is also convenient for text scraping, as the jobs are presented in a list that can be easily extracted. Because of these factors, using online job ads from job search websites has been used to study the relevance, desired skills, and types of jobs currently on the market [4] [12].

There are some biases within job ad data that must be considered, however. Job ads do not represent every job, and they are not accurately represented for every sector [4]. STEM and college graduate jobs are generally overrepresented, while blue-collar work is often under. This is because these employers target the demographics that are more likely to seek out jobs online.

However, for jobs within STEM, this can lead to an abundance of information about what skills are currently in demand. In a 2018 study about the demand for ICT and statistician employment, text scraping was used to acquire 1,007 job ads based on certain criteria relevant to their study [10]. A similar text scraping method was used to analyze information technology employers in Northern Russia, in which Python was used to gather the data [12].

METHODOLOGY

First, we will present the hypothesis and the reasoning behind it. Then, outline the steps taken to acquire the data and clean it. Finally, we will describe how we analyzed the data.

Hypothesis

The hypothesis is that more job ads targeting engineers require ABET accreditation than job ads for computing disciplines. This hypothesis is based on previous studies [7] [8] [11]. To test this hypothesis, we conducted a hypothesis test based on the sample proportions of job ads from Monster.com containing specific keywords.

Data Acquisition

A Python script was written to scrape job ads from Monster.com, which utilized the BeautifulSoup, requests, and pandas libraries. The script found the job description data and the relevant information about each job listing, such as company, location, position name, the url for the posting, and the name of the search. Then it looped through all the URLs in the URL list. Within each page's 'soup,' we used the find_all(), find(), and compile() BeautifulSoup methods to find all of the links to job postings in the page. Then it looped through this list of record URLs. In this for loop, if statements were used to remove ads, copies, and job ads with the same company and job title across different locations. Then, the descriptions were tokenized and cleaned.

Initially, we ran this script using job descriptions from the Bureau of Labor Statistics' for "computer and information technology positions" [6]. The occupations searched were

- Computer Network Architect,
- Computer Programmer,
- Computer Support Specialist,
- Computer Systems Analyst,
- Database Administrator,
- Information Security Analyst,
- Network and Computer Systems Administrator,
- Software Developer, and
- Web Developer.

The second set of data was based on the Bureau of Labor Statistics's job descriptions for

- Civil Engineer,
- Computer Hardware Engineer,
- Electrical and Electronics Engineer,
- Industrial Engineer, and
- Mechanical Engineer [3].

Data Analysis

Next was to analyze the job ads for related terms. The script looped through and checked the descriptions for three terms: ABET, accreditation, and accredited. These counts were then recorded as 1 or 0. Then a hypothesis test was conducted to compare the proportion of ads from each category that mentioned our keywords. We assume that

$$H_0: p_c - p_e = 0,\ \alpha = 0.05 \quad \textbf{[1]}$$

where p_c is the population of computing ads, p_e is the population of engineering ads, and α is the statistical significance, meaning that the populations of job ads with keywords is the same for both computing and engineering. The alternative hypothesis is stated as

$$H_a: | p_c - p_e | > 0, \quad \textbf{[2]}$$

indicating that the populations are not the same, and if $p_c - p_e < 0$, then our keywords are more prevalent in engineering job ads.

To test this, a t-test of the proportions of the samples was done, using n_c as the sample of computing ads and n_e as the sample of engineering ads. The following equation was used to calculate the z-score of the proportions:

$$z = \frac{(\hat{\rho}_c - \hat{\rho}_e) - 0}{SE}, \quad \textbf{[3]}$$

where the standard deviation is

$$SE = \sqrt{\hat{\rho}\,(1 - \hat{\rho}\,)\left(\frac{1}{n_1} + \frac{1}{n_2}\right)} \quad \textbf{[4]}$$

and the sample proportion is

$$\hat{\rho} = \frac{s_c + s_e}{n_c + n_e}. \quad \textbf{[5]}$$

Finally, the *p-values* of the three tests were evaluated, with a statistical significance of $\alpha = 0.05$.

RESULTS

Below are the results of the data scraping methods outlined above:

Table 1: Keyword counts

Keywords	**Computing**	**Engineering**
"abet"	$s_1 = 4$	$s_2 = 110$
"accredited"	$s_1 = 365$	$s_2 = 715$
"accreditation"	$s_1 = 212$	$s_2 = 57$
Number of Ads Analyzed	$n_c = 7652$	$n_e = 4682$

Table 2 outlines the results of the t-test calculations for each keyword.

Table 2: Z-score calculations

Keywords	$\hat{\rho}_c = \frac{s_c}{n_c}$	$\hat{\rho}_e = \frac{s_e}{n_e}$	$\hat{\rho}$	*SE*	*z*	*p-value*
abet	0.00052	0.02349	0.00924	0.00178	-12.9377	0
accredited	0.0477	0.15271	0.08756	0.00524	-20.0231	0
accreditation	0.02771	0.01217	0.02181	0.00271	5.73075	4.99928E-09

Therefore, we reject the null hypothesis because the *p-values*, the probability that the observed results are accurate, for all three search terms is less than the stated statistical significance of 0.05.

DISCUSSION

This test compared how employers value ABET accreditation for two different fields, computing and engineering. The purpose was to look for differences in value for students in these different fields, with the assumption that most STEM students seek out degrees with the intention of getting a job in their field. The results suggest that engineering employers require accreditation more often than their computing counterparts.

As part of the larger picture, this raises the question if ABET accreditation is as important as other job requirements for computing disciplines.

LIMITATIONS

The job postings analyzed in this paper were scraped in a very limited time frame. Both datasets were pulled in November and December of 2019 and show a snapshot of only that time of year, as well as only those days. Observing if these requirements could change over time could yield more insight.

Other requirements were not taken into consideration when analyzing the ads. This includes whether a bachelor's degree was required, as well as any pertinent certifications.

Finally, from a logistical perspective, the number of ads that could be scraped at any one time was limited by the amount of requests the website would allow at one time.

CONCLUSION

The results of the test demonstrate that there is evidence that ABET accreditation is a requirement in more engineering jobs than computing jobs. In the larger picture, it is suggested that, for computing disciplines, it may not be as worthwhile to the student that seeks post-graduate employment to prioritize accreditation. These results were limited by the short time frame and a narrow analysis that ignored other important factors in the ads themselves.

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