

**HackerRank** 

# **HackerRank Pre-Employment Technical Skills Assessments**

Test Fairness Information

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## Test Fairness Information

In addition to meeting validation requirements, HackerRank wants to ensure that our customers meet all Equal Opportunity Commission (EEOC) guidelines and Office of Federal Contract Compliance Programs (OFCCP) requirements regarding the use of fair and unbiased assessments. The goal of fairness in testing should be approached by making sure that test properties are as barrier-free as possible and fair for all test takers. To this end, HackerRank is committed to helping you recruit and select a diverse workforce.

This document first outlines the process HackerRank employs to ensure that all test items we create are fair and unbiased (Item Fairness and Sensitivity Guidelines). Next we present the results of several studies we have conducted that demonstrate the fairness of our assessments (Adverse Impact Analyses).

### Item Fairness and Sensitivity Guidelines

Tests should provide equal opportunities for all candidates to demonstrate their skills and knowledge. Removing bias – the presence of some characteristic of a test item that results in differential performance for individuals of the same ability but from different ethnic, sex, cultural, or religious groups – is a critical aspect of test development. Recognizing that language influences test responses, any test item development process needs to include a bias review. The challenge for test developers and reviewers is to assure, to the extent possible, that language, symbols, words, phrases and content that can be construed as sexist, racist or otherwise potentially offensive, inappropriate or negative, are eliminated from test items.

While it may be nearly impossible for tests to incorporate the diversity of background, cultural tradition and viewpoints found in the test-taking population, preparing

unbiased tests requires careful development and review. To ensure that any unintended bias is identified and removed from our library of test items, HackerRank conducts a careful Fairness and Sensitivity Review of items by experts including senior item writers/designers, content experts, psychometricians and Industrial/Organizational psychologists.

Following are the types of bias that our experts seek to identify in this review.

### **Offensive Items**

This occurs when an item tends to offend or demean the particular group to which a candidate belongs. This bias can also arise when the test contains language or symbolism that a particular person or group might interpret in an offensive or emotionally charged way. Offensive content in test items can distract, anger, or hurt the candidate.

### **Racial or Ethnic Bias**

This occurs when an item contains language that is not commonly used or may have different connotations among different racial, ethnic, or religious groups. A test item can also be classified as having a racial or ethnic bias when it contains references that different cultures might interpret differently.

### **Gender Bias**

This occurs when an item introduces a stereotypical bias related to gender.

### **Socioeconomic Bias**

This occurs when an item contains connotations or themes that might be unfamiliar to candidates from different social, familial, or economic backgrounds.

### **Stereotypical Bias**

This occurs when an item makes generalizations or assumptions about a person based on his or her membership in a group. Stereotypes could be related to race, gender, religion, or socioeconomic status in society.

## Adverse Impact Analyses

The Uniform Guidelines on Employee Selection Procedures (1978; Uniform Guidelines) jointly adopted by the Civil Service Commission, the Department of Labor, the Department of Justice, and the EEOC establish a common set of standards regarding the use of pre-employment assessments and other selection procedures in the United States. The Uniform Guidelines also provide a framework for assessing test fairness – this framework is known as adverse impact:

*Adverse impact and the “four-fifths rule.” A selection rate for any race, sex, or ethnic group which is less than four-fifths (4/5) (or eighty percent) of the rate for the group with the highest rate will generally be regarded by the Federal enforcement agencies as evidence of adverse impact, while a greater than four-fifths rate will generally not be regarded by Federal enforcement agencies as evidence of adverse impact.*

It is important to note that HackerRank provides skills tests, as opposed to tests of general cognitive abilities, etc., that are typically found to display significant group score differences. Given that these skills assessments are generally administered to a pool of candidates with training or experience in the particular skill, we tend not to find score differences based on gender, ethnicity, etc., in our customers’ candidate pools. Given the careful review described previously, there is really not much room left for cultural bias to creep in when constructing objective skills items for an assessment.

HackerRank has conducted several studies to ensure a lack of adverse impact on protected classes of individuals from the use of our library of questions and associated tests. The assessments used for these analyses are presented as representative of how our questions, and tests constructed from them, function in general. It is not our intention to imply that these are specific tests for similar roles in other organizations, as they may have different requirements. Rather, these studies are presented as examples. While these studies are based on particular populations and results of similar studies will vary based on a company’s unique applicant pool and set of questions, the results do

provide strong evidence that our questions, and assessments built from them, are fair and unbiased.

### Study 1 (Gender): Online Travel Industry – North American SDE Interns

**Company:** An American online travel shopping company for consumer and small business travel. Its websites are primarily travel fare aggregators and travel metasearch engines.

**Location:** Based in Seattle, WA

**Number of Employees:** Approximately 25,000

In this study, a three-question coding assessment was administered to 1,137 candidates for software development engineer (SDE) interns across North America. The sample provided gender information and included 620 males and 517 females.

The coding assessment consisted of 2 coding problems and 6 multiple choice questions.

Skills and/or Language Assessed: >NET, Algorithms, Application Development, Arrays, Binary Trees, C#, Data Structures, Dynamic Programming, Graphs, Hashing, Implementation, Java, Linked Lists, Problem Solving, Recursion, Stacks, Strings, Sets, and Trees.

Candidates from over 60 public and private colleges and universities throughout North America completed the assessment and were required to achieve a score of 70% correct to pass the assessment. Following is the information obtained for this sample:

| Status  | # Passed | % Passed | # Failed | % Failed | AI Ratio   |
|---------|----------|----------|----------|----------|------------|
| Male    | 389      | 62.7%    | 231      | 37.3%    | na         |
| Female  | 267      | 51.6%    | 250      | 48.4%    | <b>.82</b> |
| Overall | 656      | 57.7%    | 481      | 42.3%    |            |

When comparing the passing rates of males and females in this sample, we derive an Adverse Impact ratio of 82%. This value is above the 80% guideline established by the EEOC and indicates a lack of adverse impact against females.

## Study 2 (Gender): Software Development Industry – SD Interns and Graduates

**Company:** An American multinational software company that provides server, application and desktop virtualization, networking, software as a service (SaaS), and cloud computing technologies. This company's products are used by over 400,000 clients worldwide, including 99% of the Fortune 100, and 98% of the Fortune 500.

**Location:** Based in Florida and California

**Number of Employees:** Approximately 8,200

In this study, a three-question coding assessment was administered to 3,925 candidates for software developer (SD) interns and recent graduates globally. The sample provided gender information and included 2,798 males and 1127 females. Candidates were required to achieve a score of approximately 70% correct to pass the assessment, however passing scores varied somewhat by region. Following is the information obtained for this sample:

| Status  | # Passed | % Passed | # Failed | % Failed | AI Ratio   |
|---------|----------|----------|----------|----------|------------|
| Male    | 695      | 24.8%    | 2103     | 75.2%    | na         |
| Female  | 239      | 21.2%    | 888      | 78.8%    | <b>.85</b> |
| Overall | 934      | 23.8%    | 2,991    | 76.2%    |            |

When comparing the passing rates of males and females in this sample, we arrive at an Adverse Impact ratio of 85%. This value is above the 80% guideline established by the EEOC and indicates a lack of Adverse Impact against females.

### Study 3 (Gender & Ethnicity): Virtual Career Fair

**Setting:** A university coding contest where candidates demonstrated their skills and sent employment applications to sponsoring companies throughout the U.S. A total of 72,000 applications were submitted.

In this study, data from three coding challenges presented to candidates at HackerRank's Virtual Career Fair were examined. Sixty (60) minutes was allotted to complete the following three-question assessment.

Brief Description of Question 1: The challenge expects candidates to analyze an entire sequence of circular left shifts to determine how many shifts result in a string that begins and ends with the same character.

Skills and/or Language Assessed: Candidates must be able to traverse strings and perform comparisons. Generally, count the number of consecutive like characters and subtract 1 to find how many rotations will have the same beginning and ending characters. A special case that must be handled is when the string begins and ends with the same character. Solutions can be in C, Clojure, C++, C#, Haskell, Java, JavaScript (Node.js), Julia, Kotlin, Lua, Objective C, Perl, PHP, PyPy, Python, R, Ruby or Scala.

Brief Description of Question 2: The challenge is to determine how many boxes are greater than 2 times the size of another box. This gives the number of boxes to reduce the initial count by.

Skills and/or Language Assessed: Candidates must be able to traverse an array and perform comparisons. The algorithm is to sort the array and create two index pointers. One points to the highest index, and the other points to the middle index. Traverse the array using the two pointers to determine how many boxes at the higher index are 2 times the size of the lower index box. A special case is when there are no boxes that will fit inside another box. This question has code environments for C, Clojure, COBOL, C++, C#, D, Elixir, Erlang, Fortran, F#, Go, Groovy, Haskell, Java, JavaScript (Node.js), Julia, Kotlin, Lua, Objective C,

OCaml, Pascal, Perl, PHP, PyPy, Python , R, Racket, Ruby, Rust, Common Lisp, Scala, Smalltalk, Swift and VB.NET.

Brief Description of Question 3: The challenge is to determine the maximum number of elements that can be equalized by adding some number at most, cumulatively. For example, if there are teams of sizes [3, 2, 1] and 3 new hires are possible, hire all three to have 3 groups of 3 (3 + 0, 2+1, 1+2). Note that new teams cannot be formed. If in this example, 7 new hires are available, the answer is 3 groups of 3, leaving 4 new hires unused.

Skills and/or Language Assessed: Candidates must be able to traverse an array and perform comparisons. The algorithm is to sort the array in reverse. Traverse the array checking the count at the current value plus needed new hires for higher index values. Do this until new hires are exhausted or the end of the array is reached. Maintain a maximum of this result. This question has code environments for C, Clojure, C++, C#, Erlang, Go, Java, JavaScript (Node.js), Julia, Kotlin, Lua, Objective C, Perl, PHP, PyPy, Python , R, Ruby, Scala and Swift.

Demographic data was voluntarily provided by a number of the career fair participants. Overall, 2,066 candidates identified as male and 795 identified as female. In addition, 2,585 candidates provided ethnicity information. Information from individuals who provided demographic data was included in the following analyses.

| Status  | # Passed | % Passed | # Failed | % Failed | AI Ratio   |
|---------|----------|----------|----------|----------|------------|
| Male    | 2066     | 84.3%    | 386      | 15.7%    | na         |
| Female  | 795      | 79.2%    | 209      | 20.8%    | <b>.94</b> |
| Overall | 2,861    | 82.8%    | 595      | 17.2%    |            |

When comparing the passing rates of males and females in this sample, we arrive at an Adverse Impact ratio of 94%. This value is above the 80% guideline established by the EEOC and indicates a lack of adverse impact against females.

| Status           | # Passed | % Passed | # Failed | % Failed | AI Ratio    |
|------------------|----------|----------|----------|----------|-------------|
| White            | 268      | 78.4%    | 74       | 21.6%    | na          |
| Asian            | 2132     | 86.6%    | 329      | 13.4%    | <b>1.10</b> |
| Other Minorities | 185      | 67.0%    | 91       | 32.9%    | <b>.85</b>  |
| Overall          | 2,585    | 84.0%    | 494      | 16.0%    |             |

For this analysis, Adverse Impact ratios were computed for all ethnic groups that comprise a minimum of 10% of the total sample. Ethnicities that comprise less than 10% of the sample were aggregated into a single group labeled 'Other Minorities.' This aggregate group had the following composition: American Indian (n=4, .1%), Black (n=100, 3.2%), Hispanic (n=128, 4.2%), Middle Eastern (n=37, 1.2%) and Hawaiian or Pacific Islander (n=7, .2%). When comparing the passing rates of ethnic groups in this sample, we find that all obtained values are above the 80% guideline established by the EEOC which indicates a lack of adverse impact against individuals of various ethnicities.

## Conclusions

While the information and data presented in this report do provide evidence of the fairness and lack of adverse impact resulting from the use of HackerRank's assessments, it is important, and often mandatory, for an employer to track the effects of the testing program on its candidates. For these organizations, we recommend ongoing monitoring of the assessment program including this type of study. Please contact us at [Validation@HackerRank.com](mailto:Validation@HackerRank.com) if you would like us to guide you through this process or to conduct these analyses for your organization.