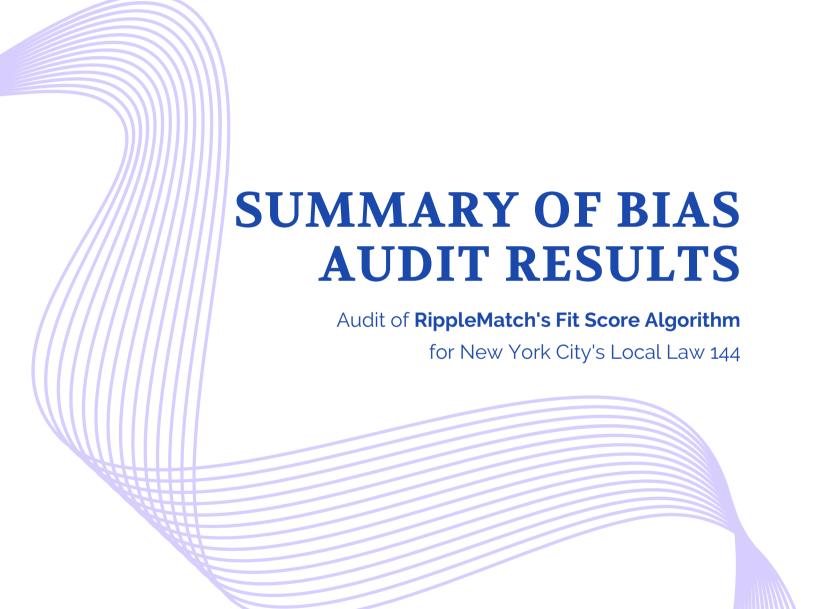
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OFFICIAL DOCUMENT V2.0: 06/22/2023

PREPARED BY BABL AI INC.



Presented toRippleMatch Inc.

Prepared by BABL Al Inc. | 06/22/2023





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Letter from the Lead Auditor

From: Shea Brown

Lead Auditor BABL Al Inc.

sheabrown@babl.ai

To: RippleMatch Inc.

5 West 19th Street

6th Floor

New York, NY 10011

Re: Audit Opinion on RippleMatch's Fit Score Algorithm

06/22/2023

We have independently audited the bias testing assertions and related documentary evidence of RippleMatch (the "Company") as of 06/22/2023, presented to BABL AI in relation to Company's Fit Score Algorithm in accordance with the criteria and audit methodology set forth in this report. The goals of this audit are to:

- 1. **Determine whether the bias testing** methodologies, controls, and procedures performed by Company satisfy the audit criteria (see <u>Findings</u>)
- 2. **Obtain reasonable assurance** as to whether the statements made by the Company, including the summary of bias testing results presented in this report, are free from material misstatement, whether due to fraud or error.

Note that the criteria presented in this report were constructed specifically to address the requirements of a "bias audit" outlined in NYC Local Law No. 144 of 2021. The model was audited as though it were an automated employment decision tool (AEDT) under NYC Local Law No. 144 of 2021, but we do not make any determination whether the model is, in fact, an AEDT under this law.

Company Responsibilities

It is the responsibility of Company representatives to ensure that bias testing and related procedures comply with the criteria outlined in this report. The Company representatives are responsible for ensuring that the documents submitted are fairly presented and free of misrepresentations, providing all resources and personnel needed to ensure an effective and efficient audit process, and providing access to evidential material as requested by the auditors.



BABL AI Responsibilities

It is the responsibility of the lead auditor to express an opinion on the Company's assertions related to the bias testing of the model. In light of the current absence of generally accepted standards for the auditing of algorithms and autonomous systems, our examination was conducted in accordance with the standards and normative references outlined in this report.

Those standards require that we plan and perform audit procedures to obtain reasonable assurance about whether the assertions referred to above 1) satisfy the audit criteria and 2) are free of material misstatement, whether due to error or fraud. Within the scope of our engagement, we performed amongst others the following procedures:

- Inspection of submitted documents and external documentation
- Interviewing Company employees to gain an understanding of the process for determining the disparate impact and risk assessment results
- Observation of selected analytical procedures used in Company's bias testing
- Inspection of the select samples of the bias testing data
- Inquiry of personnel responsible for governance and oversight of the bias testing and risk assessment

We believe that the procedures performed provide a reasonable basis for our opinion.

Independence

Our role as an independent auditor conforms to ForHumanity and Sarbanes-Oxley definitions of Independence. Fees associated with this contract are for the provision of the service to assess compliance. The payment of fees is unrelated to the decision rendered. Our decision is grounded solely in the criteria presented below.

Opinion

In our opinion, based on the procedures performed and the evidence received to obtain assurance, the bias testing and results presented by Company, as of 06/22/2023, is prepared, in all material respects, in accordance with the criteria outlined below.

Sincerely,

Shea Brown, Ph.D.

Lead Auditor, BABL Al Inc.

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System Description

BABL AI was engaged to audit the "RippleMatch Fit Score" algorithm. This algorithm produces a score that predicts the match of a candidate for a particular role using both the hard qualifications set by recruiters and the interests of the candidate. Hard qualifications include attributes such as major, GPA, or skills a candidate listed on their resume.

The Fit Score is computed and assigned to a candidate at the time of their application completion, and is presented to recruiters as a score out of 100 on a candidate's profile. The recruiter for the role determines whether to invite a candidate to an interview for the role using this score in addition to information on the candidate's profile. The interview rates for candidates that belong to various self-declared demographic groups are displayed in the Disparate Impact Quantification results in the Findings section.

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Audit Summary

Background

New York City Local Law No. 144 of 2021 requires yearly "bias audits" for automated employment decision tools (AEDTs) used to substantially assist or replace decisions in hiring or promotion. Specifically, the law states that (1) the bias audit must "assess the [AEDTs'] disparate impact" on certain persons, (2) the audit must be conducted by an "independent auditor ... no more than one year prior to the use", and (3) a "summary of the results of the most recent bias audit ... [must be] made publicly available on the website of the employer or employment agency." The audit outlined in this document has been conducted to satisfy the law's requirement for a bias audit only, and does not include other requirements such as candidate notifications. This report does not make any determination whether the model under this audit is, in fact, an automated employment decision tool as defined under NYC Local Law 144, or not.

Auditor Responsibilities

It is the responsibility of BABL AI auditors to:

- 1. **Obtain reasonable assurance** as to whether the statements made by the auditee are free from material misstatement, whether due to fraud or error,
- 2. **Determine whether the statements** made by the auditee provide sufficient evidence that the audit criteria (see <u>Findings</u>) have been satisfied, and
- 3. Issue an auditor's report that includes an opinion.

As part of an audit in accordance with good auditing practice, BABL AI exercises professional judgment and maintains professional skepticism throughout the audit. Specifically, BABL AI auditors identify and assess the risks of material misstatement in documents provided by the auditee, perform audit procedures responsive to those risks, and obtain audit evidence that is sufficient and appropriate to provide a basis for our opinion, per Public Company Accounting Oversight Board (PCAOB)'s Auditing Standard 1105 on Audit Evidence, where applicable. In addition, this audit report follows International Standard on Assurance Engagements (ISAE) 3000's guidelines on Assurance Report, where applicable.²

BABL AI is also responsible for maintaining auditors' independence and objectivity to ensure the integrity of the opinion and certification provided. BABL AI as an organization, and all

¹ https://pcaobus.org/oversight/standards/auditing-standards/details/AS1105

² https://www.iaasb.org/publications/international-standard-assurance-engagements-isae-3000 -revised-assurance-engagements-other-audits-or-0

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employee and contract auditors, adhere to strict independence as codified by the Sarbanes-Oxley Act of 2002³ and the ForHumanity's Code of Ethics.⁴ In addition, BABL AI Lead Auditors are ForHumanity Certified Auditors under NYC AEDT Bias Audit.⁵ For more details about our methodology and process, see <u>Appendix - Audit Methodology</u>.

Scope & Objective

Audit Section	Audit Objective
Disparate Impact Quantification	To ensure that the auditee has conducted sufficient testing of their model to "assess the tool's disparate impact on persons of any component 1 category," – i.e., race and gender – as the minimal requirement for a bias audit under Local Law 144 of 2021.
Governance	To ensure that effective internal governance exists to own, manage, and monitor risks related to bias and fairness.
Risk Assessment	To ensure that risks of the model that potentially contribute to bias have been rigorously identified, acknowledged, and assessed.

Out of Scope

- 1. The audit did not ensure the sufficient testing of the tool's disparate impact on any other protected class beyond race/ethnicity and gender
- 2. The audit did not certify that the model is "bias-free"
- 3. The audit is not intended for compliance purposes for any legislation other than the NYC AEDT law

³ https://www.govinfo.gov/content/pkg/PLAW-107publ204/pdf/PLAW-107publ204.pdf

⁴ https://forhumanity.center/code-of-ethics/

⁵ https://forhumanity.center/nyc-bias-audit/

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Conclusions

Our opinions for the bias audit of **Fit Score Algorithm** by **RippleMatch** are as follows:

Audit Section	Opinion
Disparate impact quantification	PASS
Governance	PASS
Risk assessment	PASS
Overall	PASS

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Findings

Note: The information disclosed under each criterion is not documentary evidence.

Disparate Impact Quantification

Audit Criteria	Opinion
 Q.A. Components: The model to be tested for disparate impact shall be defined. Q.A.1. Where the model comprises more than one automated component, evidence shall show appropriate definition of the model. 	PASS

Components or combinations of components that were tested: N/A

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Q.B. Testing dataset: The dataset on which disparate impact was quantified shall be defined and characterized.

- Q.B.1. Evidence shall show justification for why the selected dataset was appropriate for disparate impact testing.
- Q.B.2. Where test data as defined in § 5-300 was used, evidence shall show
 - a. justification for not using historical data,
 - b. that historical data is not sufficient to perform a statistically significant disparate impact testing, and
 - c. the methodology by which test data was collected
- Q.B.3. Where disparate impact testing was not completed by BABL, evidence shall show
 - a. that the most recent testing was conducted less than one year prior to the start date of this audit, or after a major update to the model, unless the update was more than one year prior to the start date of this audit, in which case, evidence shall show
 - b. justification for why such testing was still appropriate.
- Q.B.4. Evidence shall show that the data used in the testing was within one year of the start date of the disparate impact testing.

PASS

Testing conducted by: RippleMatch **Date of last testing:** Nov 2022

Time span of data: Nov 1, 2021 to Oct 31, 2022

From RippleMatch: The dataset contains "applications submitted between November 1, 2021 and October 31, 2022" as historical data from RippleMatch as an employer and from RippleMatch's customers. Their demographic information was "directly supplied by candidates ... when they complete their profile" on the platform.

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Q.C. Disparate-impact quantifiable PCVs: PCVs that can be quantified using the testing dataset shall be defined.

- Q.C.1. Evidence shall identify PCVs that were quantifiable in regard to disparate impact.
- Q.C.2. Evidence shall show that the PCVs that can be quantified include at the least: race, and gender.
- Q.C.3. Evidence shall disclose the method by which PCV data was collected.
- Q.C.4. Evidence shall identify and disclose PCVs that were not quantified in regard to disparate impact.
- Q.C.5. Where PCV data was inferred, evidence shall
 - a. identify the method by which PCV data was inferred, and
 - b. show justification for why the selected method of PCV inference was appropriate.

PASS

PCVs for which disparate impact was quantified:

- 1. Gender
- 2. Race/ethnicity

PCVs for which disparate impact was not quantified:

Note: Italicized are indicated as PCVs for potential future quantification

- 1. Age
- 2. Immigration or citizenship status
- 3. Color
- 4. Disability status
- 5. Marital status and partnership status
- 6. National origin
- 7. Pregnancy and lactation accommodations
- 8. Religion/creed
- 9. Sexual orientation
- 10. Veteran or Active Military Service Member status
- 11. Socioeconomic status

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Q.D. Positive vs. negative outcome: Where the selection rate method was used, positive and negative outcomes of the model shall be clearly defined.

- Q.D.1. Evidence shall show justification for why the selected definition of positive outcome was appropriate.
- Q.D.2. Where thresholding is used, evidence shall show justification for why the level/levels of threshold to determine positive vs. negative outcomes was/were appropriate.
- Q.D.3. Evidence shall identify and disclose
 - a. all user-configurable settings,
 - b. whether each setting affects positive outcomes, and for all settings that affect outcomes,
 - c. their extents of user configurability,
 - d. their default values, and
 - e. justification for why such default values were appropriate.
- Q.D.4. Evidence shall disclose the user-configurable settings and combinations of settings on which disparate impact was tested.

PASS

Positive outcome: getting an interview for a candidate who completed an application

User-configurable settings that can affect fit score: weights for a subset of modules that is configurable by recruiters during creation of a posting for a role:

- 1. Schools
- 2. GPA
- 3. Varsity athletics
- 4. SAT/ACT score
- 5. Majors
- 6. Internships
- 7. Leadership

The weights for these modules are presented to users as a 5-point Likert scale ranging from "Not At All Important" to "Extremely Important." The default weight value for all of these modules is "Not So Important".

Settings on which disparate impact was tested: a wide set of permutations and combinations of user settings for a variety of jobs in a variety of industries

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Q.E. Selection rate or scoring rate: A metric corresponding to selection rate or scoring rate shall be defined.	
 Q.E.1. Where the selection rate method was used, evidence shall show that the selection rate of a group was defined as the ratio of positive outcome to all outcomes for that group. Q.E.2. Where the scoring rate method was used, evidence shall show that the scoring rate of a group was defined as the rate at which that group receives a score from the AEDT above the median score of the sample 	PASS

Method of quantifying disparate impact: selection rate method

 Q.F. Favored, disfavored groups: Favored and disfavored groups shall be defined, for all PCVs. Q.F.1. Evidence shall show that favored and disfavored groups were defined according to selection rates or 	
scoring rates ordered by PCV.	
Q.F.2. Evidence shall show that the groups pertaining to	
race and ethnicity satisfy <u>§ 60-3.4 B in the EEO</u>	
<u>guidelines</u> .	
Q.F.3. Where the groups pertaining to race and ethnicity do	
not satisfy EEO guidelines, evidence shall show	PASS
justification for why EEO grouping was not used, and the	
appropriateness of any substituted groupings.	
Q.F.4. Evidence shall show that the groups pertaining to gender contain at least "Male" and "Female".	
Q.F.5. Evidence shall show intersectional groups containing	
all permutations of gender and race/ethnicity group combinations.	
Q.F.6. Where race/ethnicities and genders are not known	
for a sample of candidates assessed by the AEDT,	
evidence shall disclose its sample size.	

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Q.G. Impact ratio: Impact ratios shall be disclosed for all disfavored groups, for all PCVs. Q.G.1. Where an impact ratio for a disfavored group is below 0.8, evidence shall show justification for why the disfavored group is disadvantaged. Q.G.2. Evidence shall show results of uncertainty analysis (e.g., standard error for the mean) or error propagation of impact ratios in the form of errors or error bars. Q.G.3. Where PCV data was inferred, evidence shall show **PASS** that systematic errors due to PCV inference were properly propagated in impact ratio calculations. Q.G.4. Where a gender, race/ethnicity, or intersectional group was excluded from impact ratio calculation due to its size being below 2% of the total sample size of each analysis, evidence shall show a. justification for the exclusion of such group b. the sample size of such group, and c. the selection rate or scoring rate of such group

Non-intersectional, Gender, sorted by Impact ratio

	N applications	Selection rate	Impact ratio
Female	58,598	0.416	1.000
Male	112,130	0.365	0.876

Non-intersectional, Race/ethnicity, sorted by Impact ratio

	N applications	Selection rate	Impact ratio ⁶
Hispanic or Latino	19,913	0.405	1.000
Two or more races	12,051	0.404	0.999
Black or African American	27,851	0.402	0.993
Asian	62,427	0.372	0.920
White	47,509	0.371	0.918

⁶ N/A refers to the demographic group representing less than 2% of the total N applications in the table

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Native Hawaiian or Pacific Islander	393	0.344	N/A
Native American or Alaskan Native	620	0.297	N/A

Intersectionals, sorted by Impact ratio

		N applications	Selection rate	Impact ratio ⁷
Black or African American	Female	9,588	0.430	1.000
Two or more races	Female	3,795	0.422	0.981
Asian	Female	23,399	0.419	0.975
Hispanic or Latino	Female	5,529	0.413	0.960
Native Hawaiian or Pacific Islander	Female	155	0.413	N/A
White	Female	15,951	0.406	0.945
Hispanic or Latino	Male	14.375	0.406	0.944
Two or more races	Male	8,256	0.396	0.921
Black or African American	Male	18,263	0.387	0.900
White	Male	31,558	0.354	0.823
Asian	Male	39,028	0.344	0.800
Native American or Alaskan Native	Male	439	0.319	N/A
Native Hawaiian or Pacific Islander	Male	238	0.298	N/A
Native American or Alaskan Native	Female	181	0.243	N/A

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 $^{^{7}\,\}text{N/A}$ refers to the demographic group representing less than 2% of the total N applications in the table

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Note: Data on these applications was not included in the calculations above:

- 1. The model was used to assess 5,791 applications with an unknown gender category,
- 2. The model was used to assess 16,520 applications with an unknown race/ethnicity category, and
- 3. The model was used to assess 3,412 applications with an unknown gender and unknown race/ethnicity category.

Response from RippleMatch: "RippleMatch is always identifying and measuring the risk of bias on our platform, and actively working to mitigate it. One of the ways RippleMatch does this is through the ongoing research of our Algorithm Risk Committee – which was responsible for producing this report and proposed remediation. Native Hawaiian and Pacific Islander candidates represented only 0.2% of applications considered in scope of the audit, and Native American and Alaskan Native candidates represented only 0.4% of applications in scope of the audit. Due to this smaller proportional representation in the candidate pool, the risk committee has concluded that the first step of remediation to improve the impact ratio for these groups is to work to increase representation of candidates from those backgrounds on the platform – and then to continue to frequently and proactively monitor and improve the experiences of all candidates on the platform."

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Q.H. Statistical significance : Where the selection rate method was used, statistical significance calculation shall satisfy <u>UGESP</u> <u>guidelines</u> .	
Q.H.1. Evidence shall show that statistical significance was calculated using the Two Independent-Sample Binomial Z-Test for sample sizes of 30 or more, and using the Fisher's Exact Test for sample sizes of fewer than 30.	PASS

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Governance

Audit Criteria	Opinion
G.A. Accountable party for disparate impact risks: The auditee shall have a party who is accountable for risks related to disparate impact.	
G.A.1. Evidence should show that the accountable party is a committee, but may also show that the accountable party is a single individual. G.A.2. Evidence shall clearly show that risks related to disparate impact are owned and managed by the accountable party.	PASS

Accountable party: RippleMatch Algorithm Risk Committee Charter Contact information: Reid Wade, reid.wade@ripplematch.com
Role in the auditee organization: Governance group/committee

G.B. Defined duties of the accountable party: Duties of the party accountable for disparate impact risks shall be clearly defined.	
 G.B.1. Evidence shall show that such duties pertain to the ownership, management, and monitoring of disparate impact risks. G.B.2. Evidence shall show that the accountable party has influence over product changes per effective challenge in <u>Federal Guidance on Model Risk Management</u>. 	PASS

G.C. Documentation pertaining to duties carried out: The auditee shall provide evidence that the defined duties of the party accountable for disparate impact risks are carried out.	PASS
G.C.1. Evidence shall show that the defined duties were carried out prior to the start date of this audit.	

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Risk Assessment

Audit Criteria	Opinion
R.A. Completion: The auditee shall have completed a risk assessment of the model.	
R.A.1. Evidence shall show that a risk assessment or an equivalent analysis was completed less than one year prior to the issuance date of this audit.	PASS

Evidence of Risk Assessment completion: Risk assessment document, and verbal testimony from select Algorithmic Risk Committee members

R.B. Identification of risks: Risk assessment shall show identification of relevant risks related to bias.	
 R.B.1. Evidence shall show identification of risks related to various biases along all stages of the AI life cycle as listed in NIST Standard for Identifying and Managing Bias in Artificial Intelligence. R.B.2. Evidence shall show awareness of the parties potentially affected by the decisions made along all stages of the AI life cycle. 	PASS

R.C. Evaluation of risks: Risk assessment shall demonstrate appropriate evaluation of relevant risks.	
 R.C.1. Evidence shall show that the identified risks are assessed from the perspectives of multiple affected external and internal stakeholders, with justifications for the extent of and mechanism by which such risks affect these stakeholders. R.C.2. Evidence shall show that the identified risks are assessed in a sufficiently rigorous manner, using a quantitative and/or qualitative evaluation scheme, and along multiple dimensions, such as but not limited to likelihood of harm and severity of harm. R.C.3. Evidence shall show justification for the provided evaluation of risks. 	PASS

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Appendix

Audit Methodology

The Process Audit

The BABL AI audit framework is the *Process Audit*, defined as "an impartial verification and evaluation process conducted by an independent auditor to determine whether sufficient evidence exists to warrant the judgment that AI risks have been prevented, detected, mitigated, or otherwise managed." A process audit is modeled after the financial auditing practice as a *cooperative third-party* audit, and is distinguished from other commonly used forms of assessment of algorithms, such as first- or second-party assessments, and assurance. The audit framework contains three phases:

- Scoping The auditor conducts a preliminary survey of the auditee's algorithm to gain a full understanding to contextualize documentary evidence
- 2. **Evaluation & Verification** The auditee submits documentation containing evidence demonstrating satisfaction of the audit criteria which the auditors evaluate and verify.
- 3. **Certification** If the auditee is determined to pass the audit criteria, the auditor drafts the auditor's report and certifies the auditee's algorithm.

Evaluation & Verification

The procedure for all BABL AI auditors in conducting a process audit follows the guidelines set forth in the Public Company Accounting Oversight Board (PCAOB)'s Auditing Standard 1105 on Audit Evidence, where applicable. Specifically, the auditors:

- 1. **Obtain audit claims and statements** from the auditee's submitted documentation which either support or contradict the criteria and sub-criteria,
- 2. **Evaluate the claims and statements** in regard to satisfying the criteria and sub-criteria, based on the *sufficiency* and *appropriateness* of the evidence, and
- 3. **Verify that the claims and statements** made by the auditee are free from material misstatement, whether due to fraud or error.⁹

⁸ Carrier, R., & Brown, S. (2021). Taxonomy: Al Audit, Assurance & Assessment. For Humanity. https://forhumanity.center/blog/taxonomy-ai-audit-assurance-assessment/

⁹ "Reasonable assurance" is a high level of assurance but is not a guarantee that an audit conducted in accordance with good auditing practice always detects a material misstatement when it exists. Misstatements can arise from fraud or error and are considered material if, individually or in aggregate, they could reasonably be expected to influence the decisions of stakeholders taken based on these statements.

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In addition, evaluation and verification of claims and statements may involve requesting additional supporting documentary evidence, and/or interviewing those responsible for the governance of the algorithm, other relevant employees of the auditee organization, or other third parties referenced in the submitted documentation.

At the end, the auditors reach an audit opinion based on:

- 1. The sufficiency and appropriateness of the audit evidence, and
- 2. The risk of material misstatement of the audit evidence.

Terminologies & Definitions

Term	Abbrev	Definition
automated employment decision tool	AEDT	"any computational process, derived from machine learning, statistical modeling, data analytics, or artificial intelligence, that issues simplified output, including a score, classification, or recommendation, that is used to substantially assist or replace discretionary decision making for making employment decisions that impact natural persons." – see § 20-870 of the Code and § 5-300 of the adopted rule for full definition
disfavored group		any gender or race/ethnicity group not having the highest selection rate or average score
disparate impact or adverse impact		"a selection rate for any race, sex, or ethnic group which is less than four-fifths (1/6) (or 80%) of the rate for the group with the highest rate will <i>generally</i> be regarded by the Federal enforcement agencies as evidence of adverse impact" – see § 60-3.4.D of UGESP (1978) for full definition
error propagation		calculation or computation of a variable's uncertainty that is dependent on another variable's uncertainty
favored group		the gender or race/ethnicity group having the higher selection rate or average score compared to the other groups
impact ratio		"either (1) the selection rate for a category divided by the selection rate of the most selected category or (2) the scoring rate for a category divided by the scoring rate for the highest scoring category." – see

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Term	Abbrev	Definition
		§ 5-300 of the <u>adopted rule</u> for full definition
scoring rate		"the rate at which individuals in a category receive a score above the sample's median score, where the score has been calculated by an AEDT"
justification		a compelling reason that illuminates the issue and carries normative force, as opposed to solely explanatory power
positive outcome		the basis for selection rate, the favorable outcome for a candidate from the use of the model, such as being selected to move forward in the hiring process or assigned a classification by an model
protected category variables	PCV	defined per jurisdiction, equivalent to protected class, including but not limited to: race/ethnicity, age, gender, religion, ability or disability, sexual orientation, color, nation of origin, socioeconomic class
risk assessment		an assessment of the risk that the use of the algorithm negatively impacts the rights and interests of stakeholders, with a corresponding identification of situations of the context and/or features of the algorithm which give rise or contribute to these negative impacts ¹⁰
selection rate		"the rate at which individuals in a category are either selected to move forward in the hiring process or assigned a classification by an AEDT" – see § 5-300 of the adopted rule for full definition
testing dataset		the dataset used to test for or quantify disparate impact
uncertainty analysis		calculation or computation to quantify the uncertainty of a variable, outputting errors or error bars

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¹⁰ Hasan, A., Brown, S., Davidovic, J., Lange, B., & Regan, M. (2022). Algorithmic Bias and Risk Assessments: Lessons from Practice. Digital Society, 1(1). https://doi.org/10.1007/s44206-022-00017-z