# Race and Gender Disparities in Academic Pay

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# Acknowledgements

- Academic Analytics - Data
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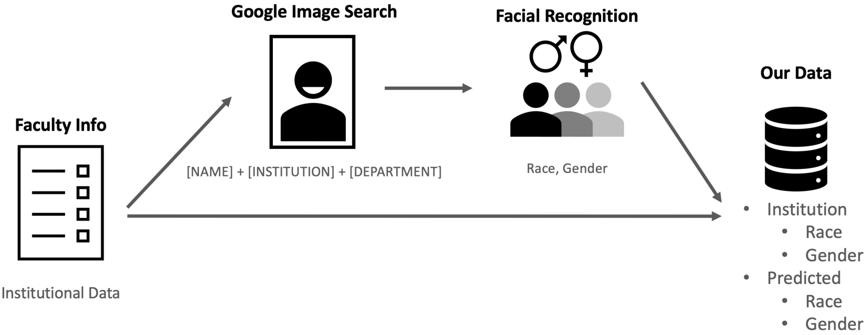
- Research Assistants: Christopher Lindsay, Godwin Mshiu, Melina Raglin, Xiaowen Sun, Yulu Qin

# Part I. Facial Recognition & Validation

# Facial Recognition?

- Rise of Big Data -> abundance in data
- Less utilization in research due to lack of demographic (race, gender) information
- Facial Recognition can efficiently address this shortcoming
- How well do these work? Can we use it for research?

# Framework


Google Image Search
Facial Recognition
Our Data
Faculty Info
[NAME] + [INSTITUTION] + [DEPARTMENT]
Race, Gender
Institutional Data
• Institution
• Race
• Gender
• Predicted
• Race
• Gender

# Algorithm

Computer Vision

- deep learning technique that analyzes multiple layers of an image to associate patterns between its content and a user-generated variable

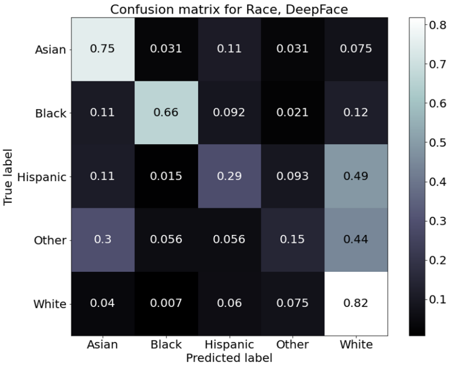
## Two Models

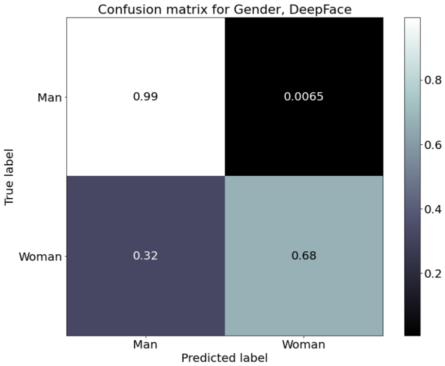
1. Deepface: face recognition and facial attribute analysis model
    - age, gender, emotion, and race (7 category)
2. Fairface: Model that specifically focuses on reducing bias in training data (overrepresentation of Whites, underrepresentation of minorities)
    - age, gender, race (7 category/4category)

# Validation Data

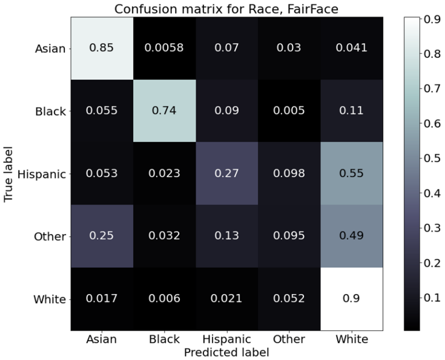
| Race | | | | | | |
|---|---|---|---|---|---|---|
| | **Institution Race** | | **Deepface Race** | | **Fairface Race** | |
| **White** | 3791 | 68.8% | 1823 | 61.2% | 2679 | **68.3%** |
| **Asian** | 966 | 17.5% | 568 | 19.1% | 674 | **17.2%** |
| **Hispanic** | 372 | 6.8% | 258 | 8.7% | 204 | **5.2%** |
| **Black** | 307 | 5.6% | 131 | 4.4% | 175 | **4.5%** |
| **Other** | 74 | 1.3% | 199 | 6.7% | 193 | **4.9%** |
| **Total** | 5510 | 100.0% | 2979 | 100.0% | 3925 | 100.0% |
| **Gender** | | | | | | |
| | **Institution Gender** | | **Deepface Gender** | | **Fairface Gender** | |
| **Man** | 2917 | 62.6% | 2268 | 76.1% | 2474 | **63.4%** |
| **Woman** | 1743 | 37.4% | 711 | 23.9% | 1431 | **36.6%** |
| **Total** | 4660 | 100.0% | 2979 | 100.0% | 3905 | 100.0% |

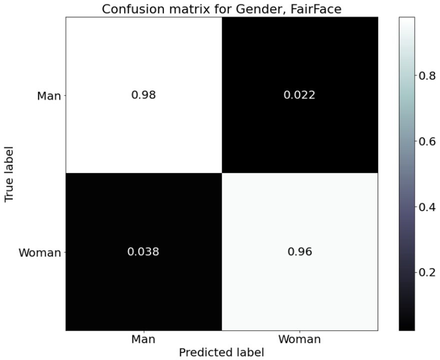
# Validation Results - Deepface



# Validation Results - Fairface



# Validation Results - Summary

**Race**

| Model | Race | Precision | Recall | F1 |
|---|---|---|---|---|
| DeepFace | Asian | 76.41% | 75.35% | 75.87% |
| | Black | 70.99% | 65.96% | 68.38% |
| | Hispanic | 22.87% | 28.92% | 25.54% |
| | Other | 4.02% | 14.81% | 6.32% |
| | White | 89.91% | 81.79% | 85.65% |
| Fairface | Asian | 87.24% | 85.34% | 86.28% |
| | Black | 84.00% | 73.87% | 78.61% |
| | Hispanic | 35.78% | 27.44% | 31.06% |
| | Other | 3.11% | 9.52% | 4.69% |
| | White | 91.43% | 90.44% | 90.93% |

**Gender**

| Model | Race | Precision | Recall | F1 |
|---|---|---|---|---|
| DeepFace | Men | 85.87% | 99.35% | 92.12% |
| | Women | 98.13% | 67.52% | 80.00% |
| Fairface | Men | 97.97% | 97.77% | 97.87% |
| | Women | 95.81% | 96.17% | 95.99% |

# Conclusion

- Fairface predicts Asians, Blacks, and Whites better than Hispanics and 'Others'
- Accuracy for gender is over 95% when using Fairface (DeepFace ~86%)
- Fairface performs better than Deepface on both race and gender

# Q&A

Please ask any questions you may have!

# Part II. Race & Gender Disparities in Academic Pay

The New York Times

# *5 Professors Sue Rutgers, Saying It Shortchanges Women on Pay*

The five women say they are paid tens of thousands of dollars less than men with similar qualifications. The university says it is “committed to pay equity.”

npr

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EDUCATION

# Princeton University Agrees To Nearly $1 Million In Back Pay To Female Professors

October 13, 2020 · 12:42 PM ET

BRAKKTON BOOKER

# Literature

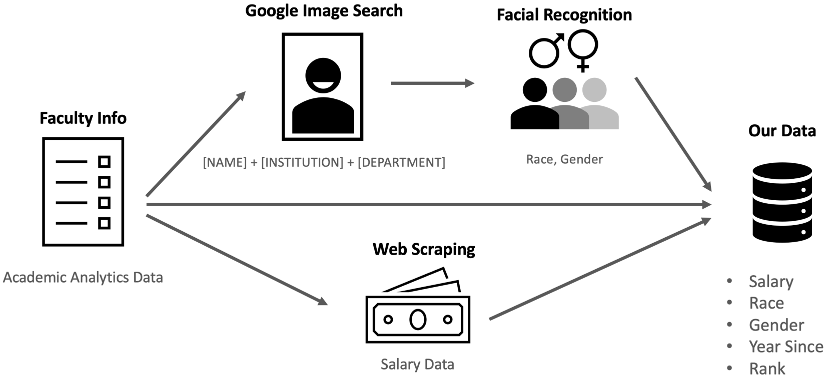
- Existing literature on gender and racial pay gap focus on **allocative, valuative, and within-job discrimination** (Peterson and Morgan 1995; Dwyer 2013; Glenn 1992; Pager, Bonikowski, and Western 2009)
- Literature on **Academic wage** also focus on race and gender (Chen and Crown 2019; Renzulli et al. 2013; Toutkoushian, Bellas, and Moore 2007)
- But most of these studies require **restricted data**, **nationally representative sample**, or are **limited to certain institutions**
- To overcome this limitation, we extract race & gender using **computational methods** to examine inequality in faculty pay

# Our Research

**Are there disparities in Academic pay by Race and Gender?**

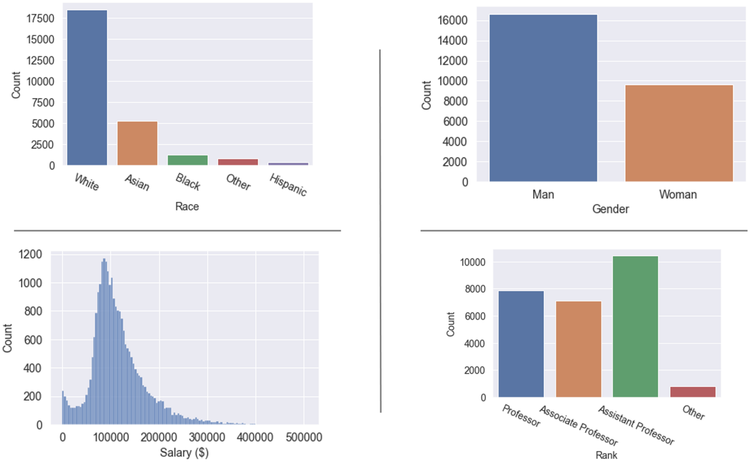
- 119 universities and colleges in the US
- 12 subject areas
- 25,586 faculty members
- 2018 Salary

# Data Processing Method




- Salary
- Race
- Gender
- Year Since Degree
- Rank
- Field of Study
- Institution

# Data


17500
15000
12500
10000
7500
5000
2500
0
Count
White
Asian
Black
Other
Hispanic
Race
16000
14000
12000
10000
8000
6000
4000
2000
0
Count
Man
Woman
Gender
1200
1000
800
600
400
200
0
Count
0
100000
200000
300000
400000
500000
Salary ($)
10000
8000
6000
4000
2000
0
Count
Professor
Associate Professor
Assistant Professor
Other
Rank

# Method

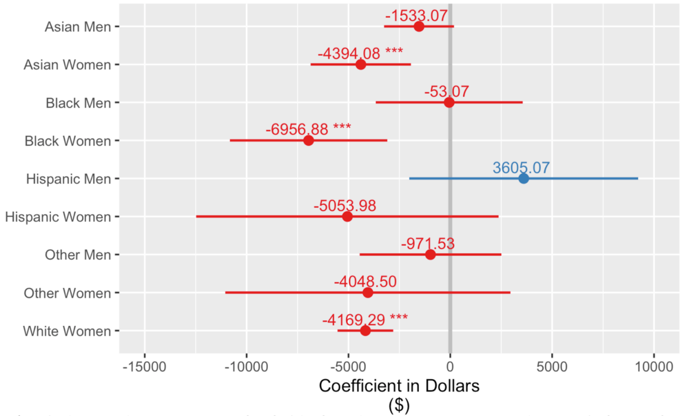
- Linear Mixed-Effects Model
- Random Intercepts
  - Field of Study
  - Institution
- Intersectional Analysis (by race and gender)

# Linear Mixed-Effects Model

| | Total Salary for 2018 | | | | |
|---|---|---|---|---|---|
| | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 |
| Asian | $-9{,}912^{***}$ | $-10{,}319^{***}$ | $-9{,}303^{***}$ | $-1{,}157$ | $-1{,}411$ |
| Black | $-7{,}409^{***}$ | $-7{,}049^{***}$ | $-6{,}781^{***}$ | $-1{,}331$ | $-1{,}295$ |
| Hispanic | $-2{,}417$ | $-2{,}539$ | $-2{,}216$ | $1{,}987$ | $1{,}962$ |
| Other | $-6{,}423^{***}$ | $-8{,}294^{***}$ | $-7{,}738^{***}$ | $-749$ | $-833$ |
| Woman | | $\mathbf{-11{,}485}^{***}$ | $\mathbf{-10{,}948}^{***}$ | $\mathbf{-4{,}116}^{***}$ | $\mathbf{-4{,}204}^{***}$ |
| Year since Degree | | | $-170^{***}$ | | $95^{***}$ |
| Associate Professor | | | | $-32{,}602^{***}$ | $-33{,}552^{***}$ |
| Assistant Professor | | | | $-50{,}860^{***}$ | $-52{,}575^{***}$ |
| Other | | | | $-83{,}268^{***}$ | $-81{,}667^{***}$ |
| Constant | $113{,}874^{***}$ | $118{,}581^{***}$ | $457{,}258^{***}$ | $145{,}151^{***}$ | $-43{,}213$ |

$^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$
Base categories for race, gender, and rank are white, man, and professor.

# Intersectional Salary Gap Compared to White Men




***Includes random intercepts for field of study and institution, and controls for professorial rank.***

# Conclusion

- There is a significant **gender gap ($4,204)** for female faculty, after controlling for rank, and year since terminal degree
- Racial differences are no longer significant once we control for professorial rank
- Intersectional analysis results show that Asian, Black and White Women are being paid significantly less than White men

# Q&A

Please ask any questions you may have!

# Part III: DCiFR

# DCiFR

DCiFR (Demographic Characteristics in Facial Recognition) is a user-friendly GUI developed by our team

- allows you to run complex deep learning models without any programming skills
- simply choose the picture you want to analyze and get results
- Main author: Melina Raglin

# Demo

https://github.com/mlraglin/DCiFR

# Q&A

Please ask any questions you may have!

# Thank you

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