Statistical Discrimination

Thought experiment: Dining choice on vacation

- Eat at hotel restaurant versus eating outside hotel

Labor “market” imperfect due to scarcity of information about existence and characteristics of workers and jobs

Even if discriminating, may still be maximizing objective due to high cost of acquiring additional information

Skin color or sex used as proxy for unavailable data

- May use previous statistical experience with group during decision-making process
Statistical Discrimination

Kenneth Arrow and Edmund Phelps

Key difference:
- Taste discrimination: Prejudice put ahead of profits
- Statistical discrimination: People can discriminate even if they are not prejudice and intent is to maximize profits

**Statistical Discrimination** (Ladd): discrimination that occurs because person finds it cheaper to use characteristics of an applicant’s group rather than applicant’s own past history
- “rules of thumb” used to weight characteristics of various groups

- Illegal discrimination does **not** have to be uneconomic
  - May not reduce profits

- Does not necessarily lead to discriminatory outcomes on **average**

- May cause members of disadvantaged group to invest less in hard-to-observe human capital
  - May result in different average productivity and wages across groups even if innate ability is the same

- Lack information to accurately match unfamiliar group into correct job → lowers productivity
Aigner and Cain (1977) - “Statistical Theories of Discrimination in Labor Markets.”

- Present several models of statistical discrimination
- Build off the statistical model developed by Phelps (1972)
- **We will only cover the simple model** [pgs 175-180]

---

Aigner and Cain (1977) - Basic Model

- Employer samples from a population of job applicants
- $q$: applicant’s true skill which is **unobserved** by employer
- $\mu$: error term
- $y$: indicator of job applicant’s skill level that is seen by the employer (e.g. performance test score)

$$y = q + \mu$$

- Employer observes $y$ but only interested in $y$ insofar as it provides information about the unobservable $q$
Aigner and Cain (1977) - Model Assumptions

- \( q \sim N(\alpha, \sigma_q^2) \)
  - \( \alpha \) is average group skill level
  - \( \sigma_q^2 \) is the variance of \( q \)

- \( \mu \sim N(0, \sigma_\mu^2) \)
  - \( \sigma_\mu^2 \) is the variance of \( \mu \)

- Group means (\( \alpha' \)s) estimated without bias

Aigner and Cain (1977) - Basic Model II

Main interest of employer: expected value of \( q \) given observed value of \( y \)
- Denote this by \( \hat{q} \)

Assuming a linear relationship,

\[
\hat{q} = E(q|y) = (1 - \gamma)\alpha + \gamma y
\]

where

\[
\gamma = \frac{\sigma_q^2}{\sigma_q^2 + \sigma_\mu^2} = \frac{\text{var}(q)}{\text{var}(q) + \text{var}(\mu)} = \text{‘signal-to-noise’ ratio}
\]
Aigner and Cain (1977) - Basic Model III

- $\gamma$: reliability of the test score ($y$) as a measure of the true score ($q$)
  - $\sigma_{\mu}^2 \downarrow$ then $\gamma \uparrow$ and vice versa

- Since $0 \leq \gamma \leq 1$, $\gamma$ is the weight placed on the observed skill level ($y$)

NOTE: If

$$\sigma_{\mu}^2 = 0$$
$$\gamma = 1$$

then there is no random term ($\mu = 0$) such that $y$ perfectly predicts $q$.

Aigner and Cain (1977) - Model application

Two types of workers, whites ($W$) and non-whites ($N$)

- Equal average ability

Observed skill levels are noisier predictors for true skill level for non-whites than whites (higher variance on error term) but true skill levels have same variance.

$$\alpha_W = \alpha_N \equiv \bar{\alpha}$$
$$\sigma_{qW}^2 = \sigma_{qN}^2 \equiv \sigma_q^2$$
$$\sigma_{\mu W}^2 < \sigma_{\mu N}^2$$

Thus,

$$\gamma_N = \frac{\sigma_q^2}{\sigma_q^2 + \sigma_{\mu N}^2} < \frac{\sigma_q^2}{\sigma_q^2 + \sigma_{\mu W}^2} = \gamma_W$$
Aigner and Cain (1977) - Model application

\[ \gamma_W > \gamma_N \quad \Rightarrow \quad (1 - \gamma_W) < (1 - \gamma_N) \]

Non-whites:
- More weight on group averages (intercept larger)
- Less weight on test score (slope smaller)

Whites:
- Less weight on group averages (intercept smaller)
- More weight on test score (slope larger)

Aigner and Cain (1977) - Diagram

*Figure 1B.* Predictions of Productivity (q) by Race and Test Score (y), Assuming a Steeper Slope for Whites.
Aigner and Cain (1977) - Model Application

Suppose firm uses estimate of $q$ to set pay or assign jobs

- $y < \alpha \rightarrow$ Firm expects $\hat{q}_N > \hat{q}_W \rightarrow$ Favors N at low $q$
- $y > \alpha \rightarrow$ Firm expects $\hat{q}_N < \hat{q}_W \rightarrow$ Favors W at high $q$
- $y = \alpha \rightarrow$ Expected output equal $\rightarrow$ Equal treatment

Aigner and Cain (1977) - Model Implications

Firms favor W in jobs requiring more ability (wage advantage) since they undervalue $y_N$ at high $q$ values

Favoritism:
- increasing in $\sigma_N^2 - \sigma_W^2$
- decreasing with additional information

Firms undervalue non-white workers at entry (underpay) but non-white workers should experience faster wage growth as employer gains information (Pinkston tests this)
Statistical Discrimination Model Implications

Suppose two jobs available: managerial and laborer

- Managerial: set high minimum level of observed skill level → few N
- Laborers: set low minimum level of observed skill level → high N

N are unable to prove themselves without access to the managerial market

Feedback or self-fulfilling prophecy

- If N are not adequately rewarded for y, they will not invest optimally → expected difference in mean is true in population

Example: Women and tenure

Pinkston (2006) - “A Test of Screening Discrimination with Employer Learning”

Used 2000 data from the NLSY79 to test if employers have less reliable productivity signals at hiring stage for black men compared to white men.

Are black wages...

- initially based more on easily observable characteristics (ex: education)?
- based more on acquired productivity measures for black men? (learning)
Pinkston (2006) - Two types of statistical discrimination

**Screening Discrimination:**
- Employers less able to evaluate ability (productivity) of one group compared to another
  - Typically at time of hiring or labor market entry

**Rational Stereotyping:**
- Employers believe that average productivity differs between groups and use group membership as a signal

---

Pinkston (2006) - Screening Discrimination

Reasons screening discrimination exists:
- Communication differences reduces ability of employer to evaluate groups other than own
- Less interaction with one group compared to another - generalize group characteristics based on previous interactions with members of each group

Important: screening discrimination does not necessarily imply economic discrimination (group averages may be same)
Pinkston (2006) - Model setup

Regress wages on set of characteristics correlated with productivity where some are easy for the employer to observe and others are hard to observe

*Employer learning*: size of coefficients on hard-to-observe variables increase with employee’s experience

- Weight on hard-to-observe variables lower than easy to observe variables during hiring for those with less experience
- Wage more dependent on actual productivity and less dependent on easily observed variables as employer learns more about the worker

Pinkston (2006) - Model Predictions

- Employers observe noisy signal of productivity that has more variance for disadvantaged group

*Screening discrimination*: place more weight on population mean or easily observable characteristics (education) and less on hard to observe individual signals (AFQT score) for disadvantaged group

*Learning*: assume employer collects information at same rate for all workers
  - Effect of learning on wages greater for disadvantaged group
Pinkston (2006) - Key Assumptions

Assumption 1: Signals accumulated by market experience equally reliable for both groups
- **Rationale:** later signals less subjective since come from direct observation of output that depends on true ability
- If later signals less accurate for disadvantaged, learning would not have as big of an impact on earnings

Assumption 2: AFQT scores equally reliable indicators of productivity for black and white men
- If less reliable for black men, would expect less weight on AFQT scores for black men ("false positive")

Assumption 3: Education affects productivity in the same manner for both races

Pinkston (2006) - Data

- 2000 release of NLSY79
- Black and white men only
- At least 8 years of school
- Real hourly wages between $2-$300
- Potential experience less than 20 years
- Actual experience less than potential
Pinkston (2006) - Empirical Evidence

- Strong evidence of learning and screening discrimination
- **Screening**: Coefficient on AFQT falls significantly for black men when include interaction of AFQT and experience (no significant change for white men)
  - When add interaction, AFQT term captures initial (hiring) effect
- **Learning**: Coefficient on interaction of AFQT and experience significantly higher for black men

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>White Men 1</th>
<th>White Men 2</th>
<th>White Men 3</th>
<th>Black Men 1</th>
<th>Black Men 2</th>
<th>Black Men 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade</td>
<td>0.092</td>
<td>0.071</td>
<td>0.050</td>
<td>0.129</td>
<td>0.112</td>
<td>0.139</td>
</tr>
<tr>
<td></td>
<td>(0.010)</td>
<td>(0.010)</td>
<td>(0.011)</td>
<td>(0.015)</td>
<td>(0.016)</td>
<td>(0.018)</td>
</tr>
<tr>
<td>Grade × Pot. Exp./10</td>
<td>-0.006</td>
<td>-0.010</td>
<td>-0.009</td>
<td>-0.077</td>
<td>-0.082</td>
<td>-0.124</td>
</tr>
<tr>
<td></td>
<td>(0.014)</td>
<td>(0.014)</td>
<td>(0.016)</td>
<td>(0.025)</td>
<td>(0.025)</td>
<td>(0.030)</td>
</tr>
<tr>
<td>AFQT Score</td>
<td>—</td>
<td>0.109</td>
<td>0.116</td>
<td>—</td>
<td>0.151</td>
<td>0.018</td>
</tr>
<tr>
<td></td>
<td>—</td>
<td>(0.011)</td>
<td>(0.028)</td>
<td>—</td>
<td>(0.021)</td>
<td>(0.064)</td>
</tr>
<tr>
<td>AFQT Score × Pot. Exp./10</td>
<td>—</td>
<td>—</td>
<td>-0.009</td>
<td>—</td>
<td>—</td>
<td>0.205</td>
</tr>
<tr>
<td></td>
<td>—</td>
<td>—</td>
<td>(0.038)</td>
<td>—</td>
<td>—</td>
<td>(0.078)</td>
</tr>
<tr>
<td>Observations</td>
<td>29,503</td>
<td>29,503</td>
<td>29,503</td>
<td>11,457</td>
<td>11,457</td>
<td>11,457</td>
</tr>
</tbody>
</table>

Pinkston (2006) - Results

Signals employers observe when workers first enter labor market less reliable for black men than white men

- Wages at time of labor-market entry based less on hard-to-observe variables and more on easy to observe variables
- Employer learning has larger impact on wages of black men

Results suggest screening discrimination but **does not** provide evidence suggesting that this difference leads to economic discrimination
Pinkston (2006) - Model Limitations

- AFQT may not be very highly correlated with productivity
- Limited to blacks and whites
- Previous experience may not be equal for all people
  - Depends on previous employer and occupation
- Regional effects not included
- Did not account for employer race
- Company characteristics such as diversity not included
Ladd (1998) - “Evidence on Discrimination in Mortgage Lending”

Discuss the applicability of discrimination models in mortgage lending and review empirical evidence of disparate treatment based on loan denial rates, loan default rates, and geographic redlining.

GROUP 1 PRESENTATION
Readings for Next Section

Occupational Crowding:

- BFW Chapter 5