MATHEMATICA
Policy Research

The Right Tool for the Job:

A Bayesian Meta-Regression of Employment and Training Studies

Presentation at the OPRE Methods Inquiries Meeting

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Motivation

What is Meta-Regression?

$$Y_i = \alpha + \beta X_i + \varepsilon_i$$

- Y_i: earnings for person i
- X_i: background information about person i

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$$Y_i = \alpha + \beta X_i + \varepsilon_i$$

- Y_i: **estimate in study** i
- X_i: **background information about study** i

Why Meta-Regression?

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Why Meta-Regression?

- Synthesize information rigorously across related studies
  - Overall effect across studies
  - Average effect across outcomes within a study
- Quantify relationships between study features and outcomes
- Weight observations according to their precision

Why Bayesian Meta-Regression?

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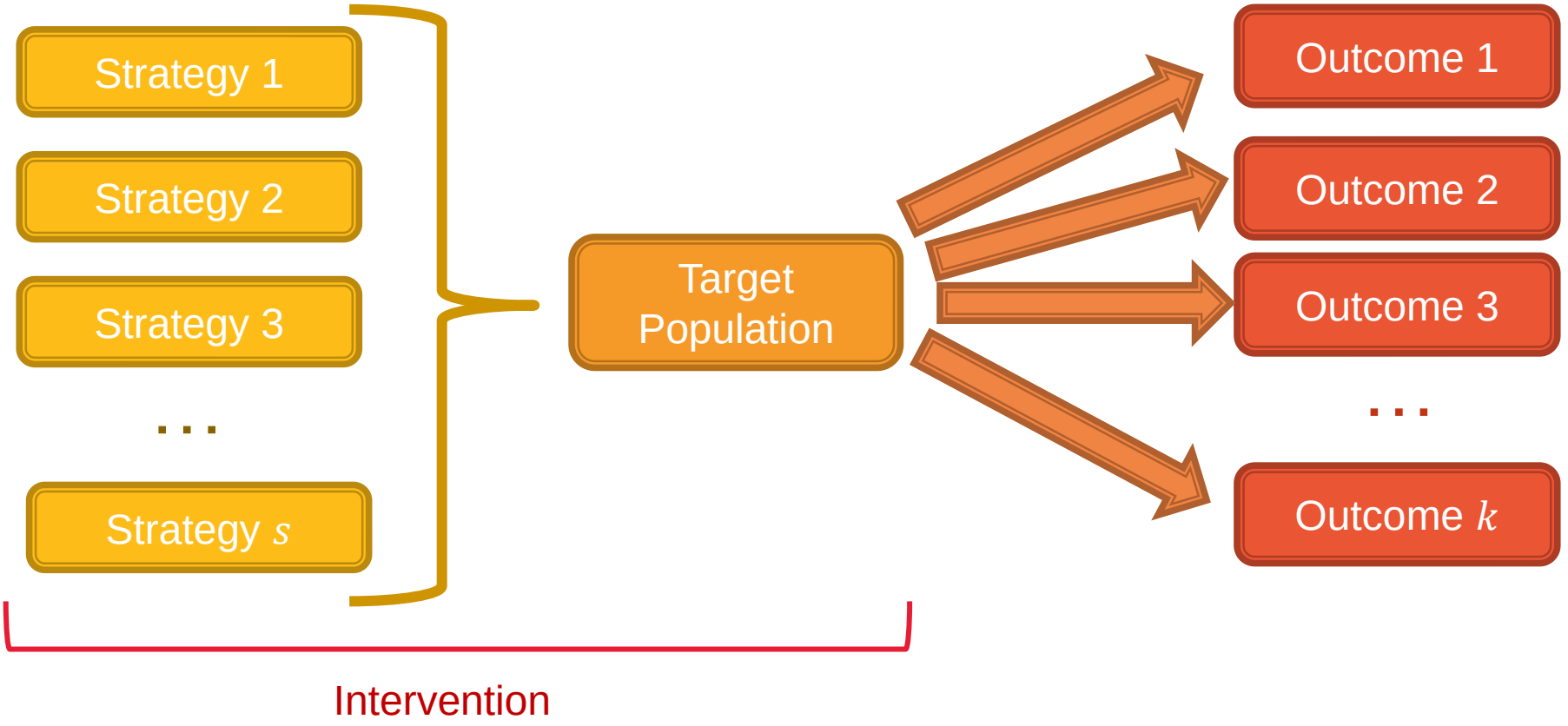
- Describe conclusions probabilistically
  - "There is a 15 percent chance that intervention X improves outcome Y by 5 percent or more."
  - Use plain, intuitive language
  - Focus on practically meaningful thresholds
  - Avoid binary or "bright line" thinking

Example: Employment Strategies Evidence Review (ESER)

Employment Strategies Evidence Review

- Project for the Office of Planning, Research, and Evaluation at the Administration for Children and Families
- Systematic review of literature on employment and training programs and policies for low-income workers
  - Published between 1990 and 2014
  - Conducted in the US, UK, or Canada
- Reviewers rated the quality of each study's causal evidence as *high*, *moderate*, or *low*

An ESER Study



ESER Meta-Regression Research Questions

1. What works?
   - Past interventions
   - Specific employment strategies
2. What works in which domains?
3. What works for which populations?
4. What works for which populations in which domains?

Meta-Regression Implementation

- **Standardize impact estimates using effect sizes**
  - **ESER studies did not provide adequate data to calculate effect sizes for continuous outcomes (e.g. earnings)**
  - **Restricted attention to binary outcomes:**
    - Employment
    - Public assistance receipt
    - Educational attainment
  - **Use the odds ratio effect size metric**
- **Align the sign of favorable/unfavorable impacts across outcomes**
  - **A positive estimate should denote a favorable impact**
  - **Public assistance receipt → independence from public assistance**

Meta-Regression Model: Main Effects

$$y_{ij} = \alpha + a_j + b_{d[i]} + \sum_{s=1}^{S} c_s I_{s[j]} + \sum_{p=1}^{P} g_p I_{p[j]} + \sum_{s=1}^{S}\sum_{d=1}^{D} f_{sd} I_{s[j]} I_{d[i]}$$
$$+ \sum_{p=1}^{P}\sum_{d=1}^{D} h_{pd} I_{p[j]} I_{d[i]} + \sum_{s=1}^{S}\sum_{p=1}^{P} l_{sp} I_{s[j]} I_{p[j]} + \sum_{d=1}^{D}\sum_{s=1}^{S}\sum_{p=1}^{P} m_{dsp} I_{d[i]} I_{s[j]} I_{p[j]}$$
$$+ \varepsilon_{ij}$$

$$\varepsilon_{ij} \sim N(0, \tau^2 + s_{ij}^2)$$

- outcome domain
- employment strategy
- population characteristic

Meta-Regression Model: Interaction Terms

$$y_{ij} = \alpha + a_j + b_{d[i]} + \sum_{s=1}^{S} c_s I_{s[j]} + \sum_{p=1}^{P} g_p I_{p[j]} + \sum_{s=1}^{S}\sum_{d=1}^{D} f_{sd} I_{s[j]} I_{d[i]}$$
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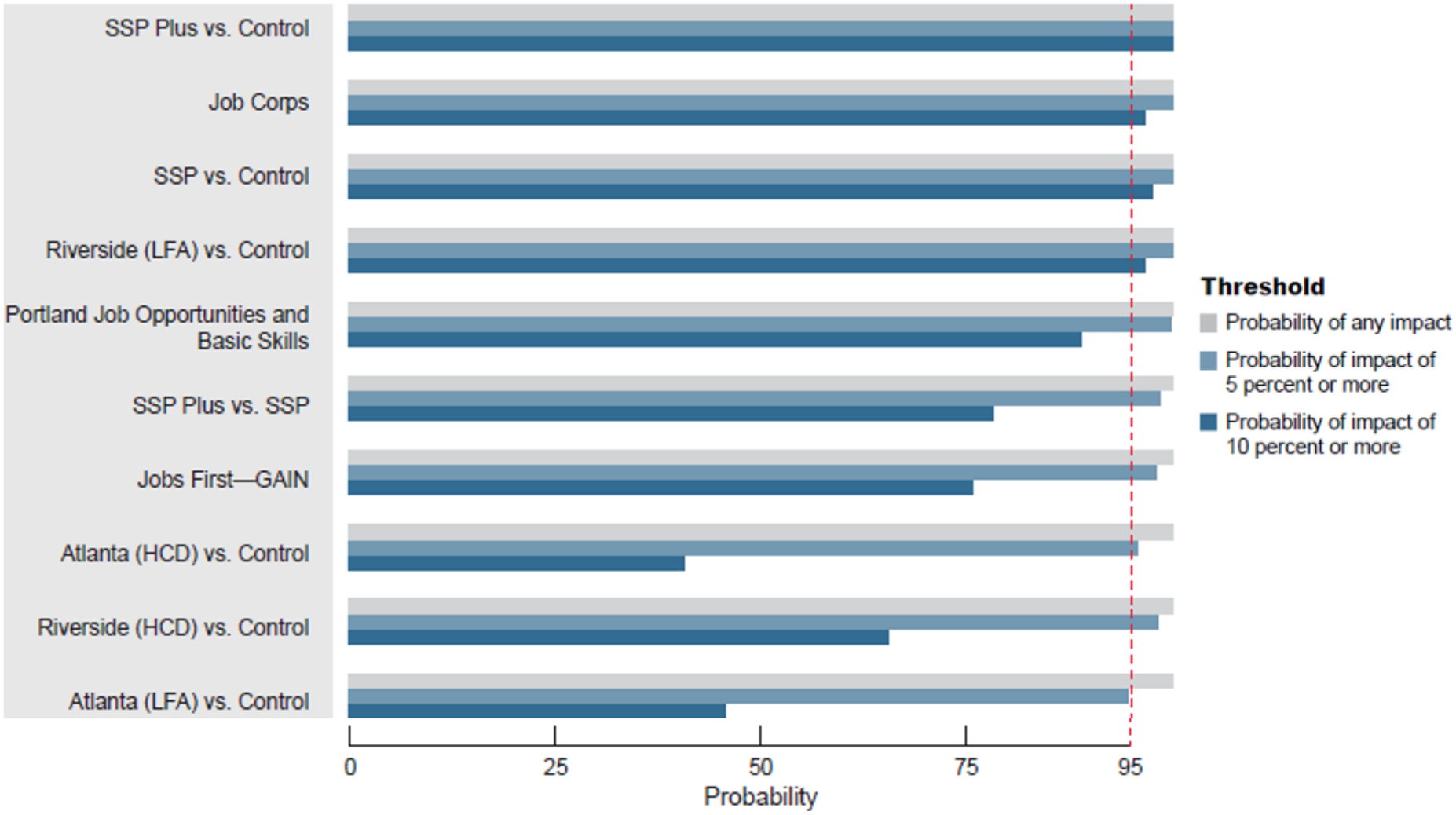
$$+ \varepsilon_{ij}$$

$$\varepsilon_{ij} \sim N(0, \tau^2 + s_{ij}^2)$$

- strategy by domain
- target population by domain
- strategy by target population
- strategy by target population by domain

Results

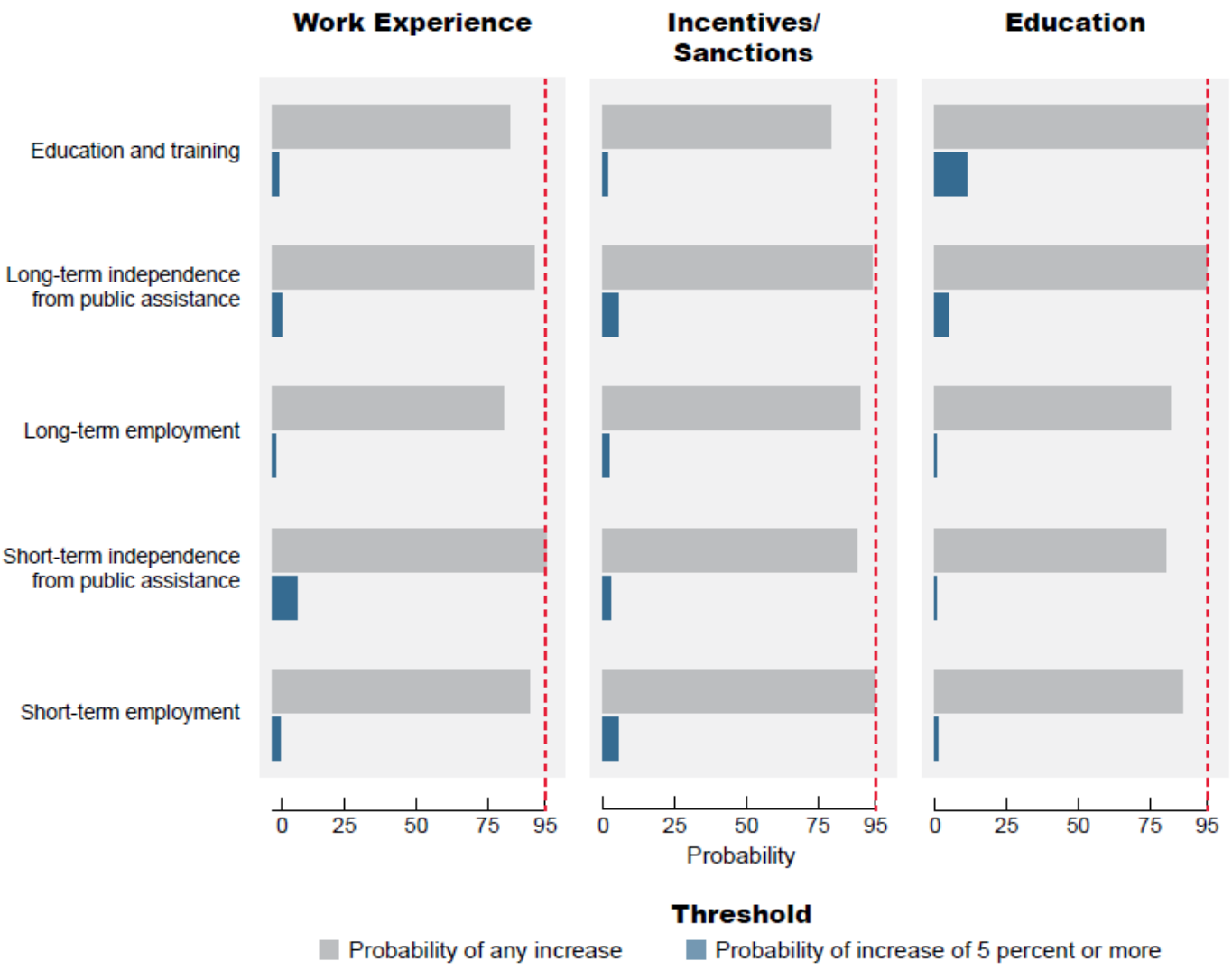
Intervention Impacts



Strategy Impacts

Strategy	Any improvement (%)	Improvement of 5% or more (%)	Improvement of 10% or more (%)
Financial incentives and sanctions	93.02	1.40	0.01
Education	92.77	0.69	0.00
Work experience	92.59	1.20	0.00
Training	92.19	0.73	0.00
Work readiness activities	89.63	0.25	0.00
Job development	88.73	0.41	0.00
Case management	88.33	0.33	0.00
Health services	88.13	0.64	0.00
Employment and retention services	81.59	0.18	0.00
Supportive services	81.05	0.05	0.00

Strategy-by-Domain Impacts



Questions?

For More Information

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https://employmentstrategies.acf.hhs.gov/

Appendix: Meta-Regression Priors

Main Effects	Interaction Terms	Hyperpriors and Variance Components
$\alpha \sim N(0, 10)$	$f_{sd} \sim N(0, \sigma_f^2)$	$\mu_c \sim N(0, 1)$
$a_j \sim N(0, \sigma_a^2)$	$h_{pd} \sim N(0, \sigma_h^2)$	$\mu_g \sim N(0, 1)$
$b_{d[i]} \sim N(0, \sigma_b^2)$	$l_{sp} \sim N(\mu_l, \sigma_l^2)$	$\mu_l \sim N(0, 1)$
$c_s \sim N(\mu_c, \sigma_c^2)$	$m_{dsp} \sim N(0, \sigma_m^2)$	$\tau \sim \text{half}{-}N(0, 2.5)$
$g_p \sim N(\mu_g, \sigma_g^2)$		$\sigma_x \sim \text{half}{-}N(0, \phi^2)$
		$\phi \sim \text{Unif}(0, 5)$