Discussion of Semiparametric Bayesian Density Estimation with Disparate Data Sources

Paper by: Finucane, Paciorek, Stevens and Ezzati,
Journal of the American Statistics Association,
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Content represents only the opinion of the author.

Outline of Discussion

(1) Brief review of method

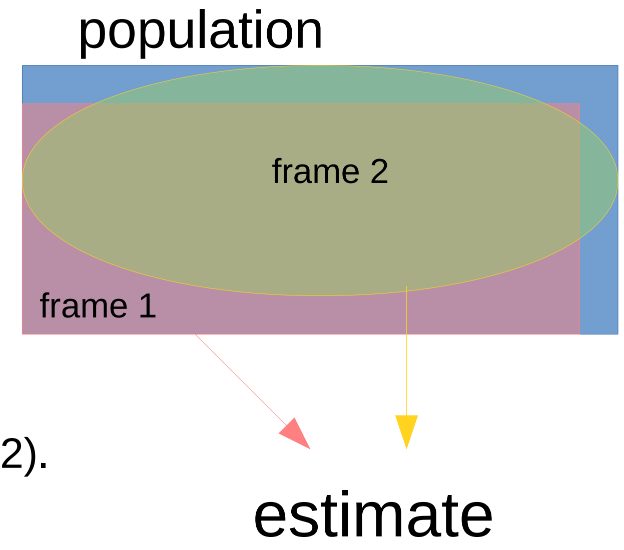
(2) Suggest an application to BLS economic data

A Common Goal

Combine data from several sources to produce a single estimate.

may have

- different sample design
- different frame
- different coverage



Dong, Qi. "Combining Information from Multiple Complex Surveys." (2012).

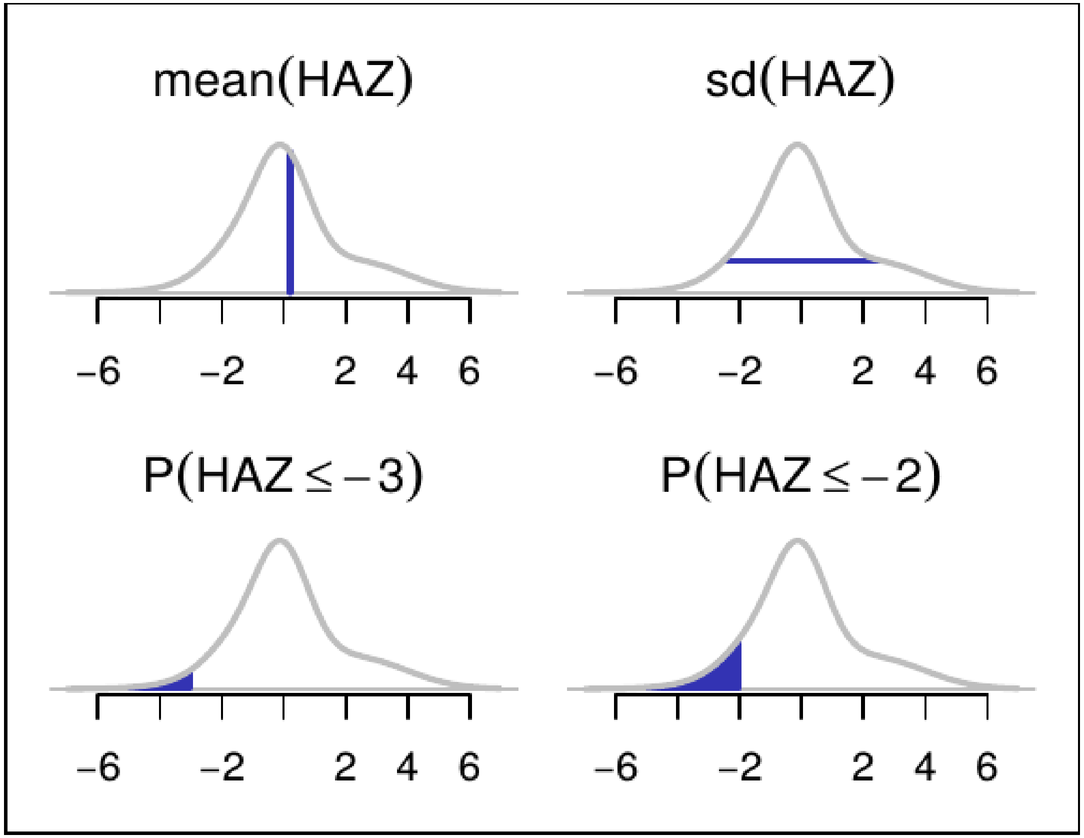
Hentschel, Jesko, et al. "Combining census and survey data to trace the spatial dimensions of poverty: A case study of Ecuador." The World Bank Economic Review 14.1 (2000): 147-165.

Lohr, Sharon L., and J. Michael Brick. "Blending domain estimates from two victimization surveys with possible bias." Canadian Journal of Statistics 40.4 (2012): 679-696.

Lohr, Sharon, and JN K. Rao. "Estimation in multiple-frame surveys." Journal of the American Statistical Association 101.475 (2006): 1019-1030.

Interested in the Entire Distribution

Estimate functionals of the underlying population distribution from several sources of sample data.



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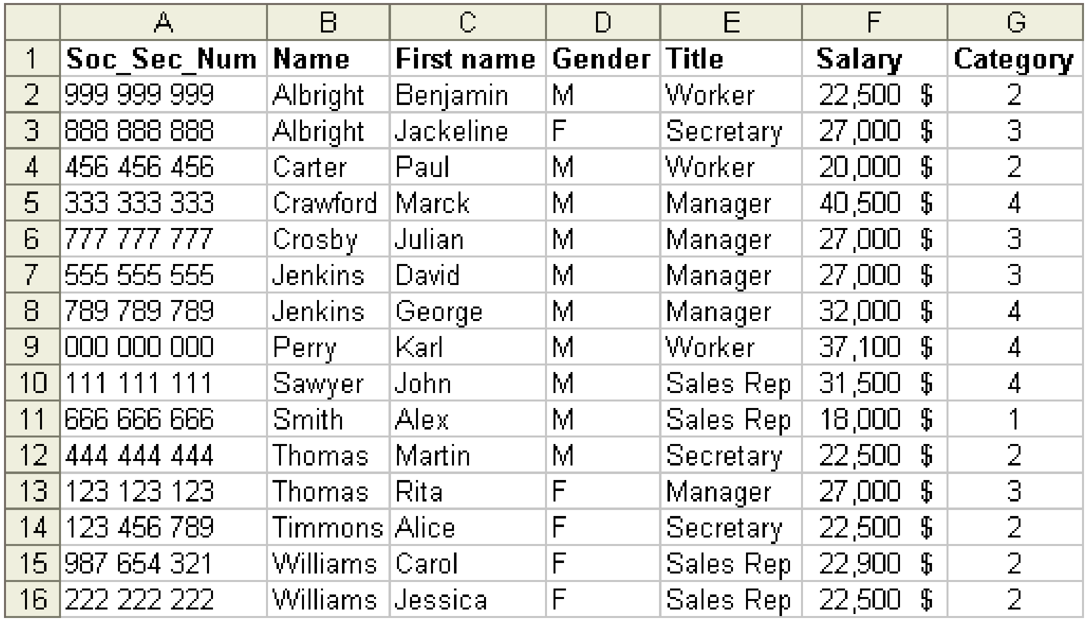
Uses Summary Statistics

individual unit data



	A	B	C	D	E	F	G
1	**Soc_Sec_Num**	**Name**	**First name**	**Gender**	**Title**	**Salary**	**Category**
2	999 999 999	Albright	Benjamin	M	Worker	22,500 $	2
3	888 888 888	Albright	Jackeline	F	Secretary	27,000 $	3
4	456 456 456	Carter	Paul	M	Worker	20,000 $	2
5	333 333 333	Crawford	Marck	M	Manager	40,500 $	4
6	777 777 777	Crosby	Julian	M	Manager	27,000 $	3
7	555 555 555	Jenkins	David	M	Manager	27,000 $	3
8	789 789 789	Jenkins	George	M	Manager	32,000 $	4
9	000 000 000	Perry	Karl	M	Worker	37,100 $	4
10	111 111 111	Sawyer	John	M	Sales Rep	31,500 $	4
11	666 666 666	Smith	Alex	M	Sales Rep	18,000 $	1
12	444 444 444	Thomas	Martin	M	Secretary	22,500 $	2
13	123 123 123	Thomas	Rita	F	Manager	27,000 $	3
14	123 456 789	Timmons	Alice	F	Secretary	22,500 $	2
15	987 654 321	Williams	Carol	F	Sales Rep	22,900 $	2
16	222 222 222	Williams	Jessica	F	Sales Rep	22,500 $	2

summary statistics

mean salary

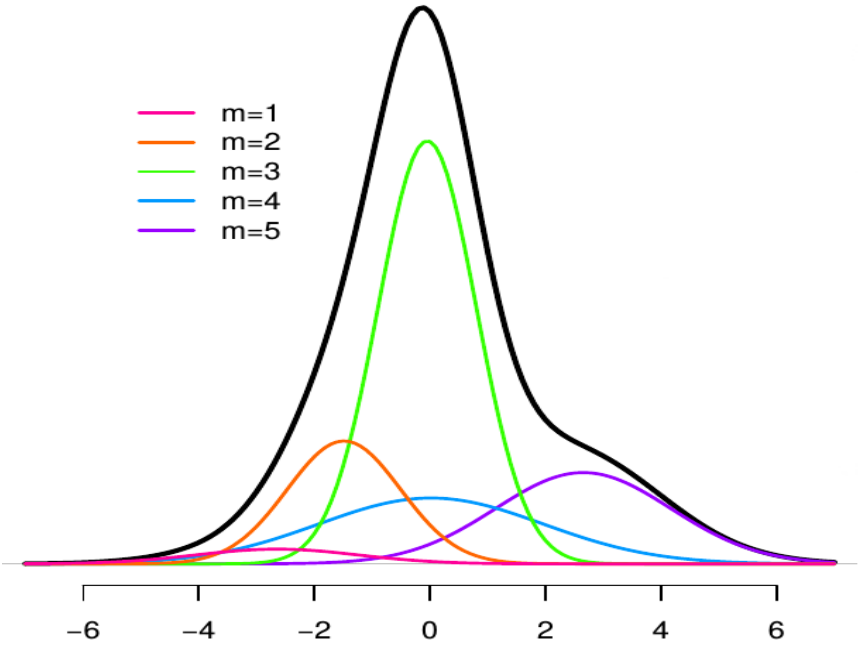
median salary

salary of top 1%

$f(y)$ estimate

Simple Likelihood

$$f_i(y) = \sum w_{mi} \, \mathcal{N}(\mu_m, \sigma_m^2)$$



Finucane, Paciorek, Stevens, and Ezzati; *JASA*, in press

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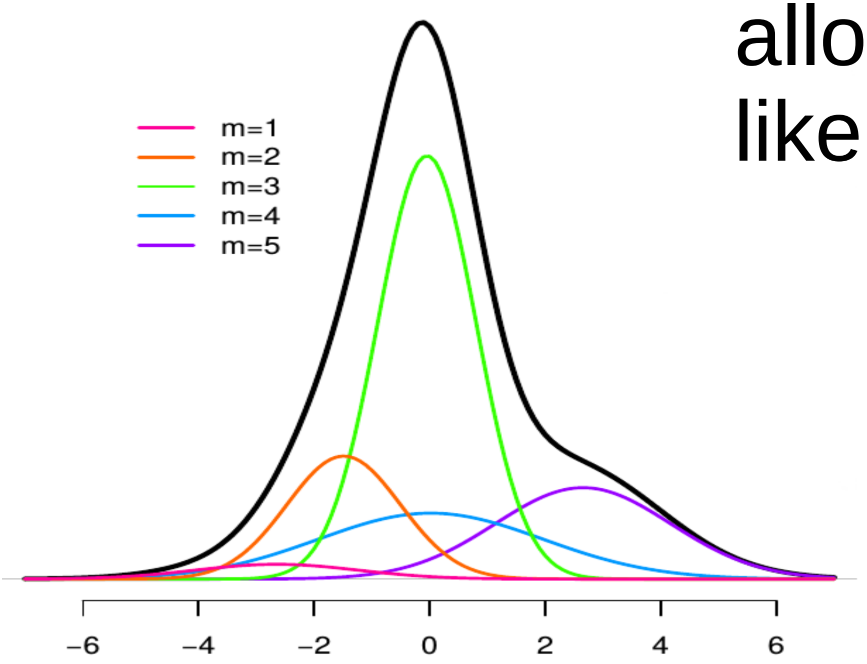

allows easy calculation of likelihood for summary statistics

$$P(y_{\text{summary}}|\theta)$$

Finucane, Paciorek, Stevens, and Ezzati; *JASA*, in press

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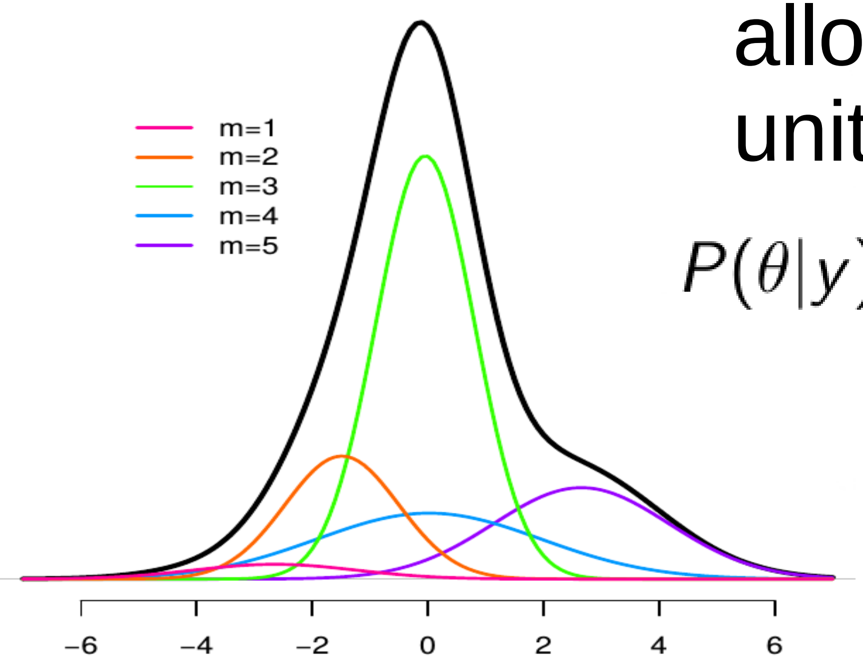

allows combining with individual unit data

$$P(\theta|y) \propto P(y_{\text{individual}}|\theta)\ P(y_{\text{summary}}|\theta)\ P(\theta)$$

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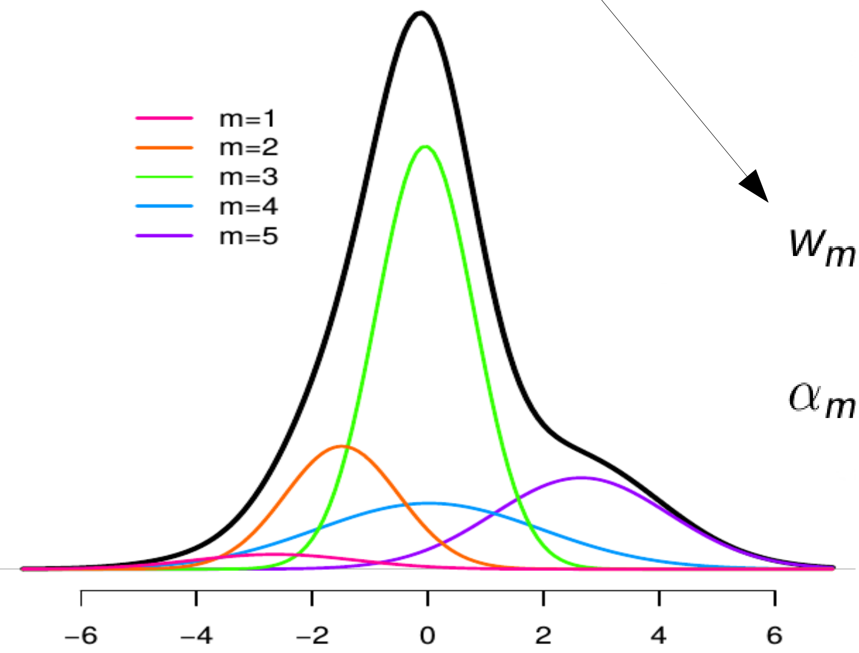
Complicated Weights

$$f_i(y) = \sum w_{mi}\, \mathcal{N}(\mu_m, \sigma^2_m)$$



$$w_{mi} = \Phi(\alpha_{mi}) \prod_{u=1}^{m-1} (1 - \Phi(\alpha_{ui}))$$

$$\alpha_{mi} \sim \mathcal{N}(a^c_{mj[i]} + b^c_{mj[i]} t_i + u_{mj[i],t_i} + X_i \beta_m + e_{mi}, \tau^2_{mi})$$

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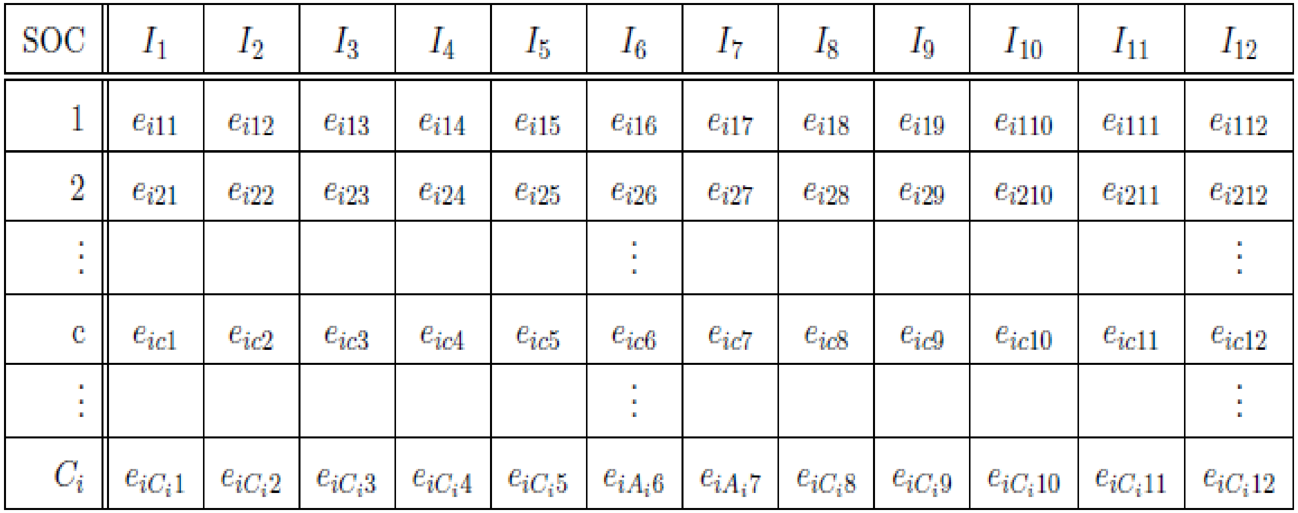
Potential Application
BLS Occupational Wage Data

Occupational Employment Statistics Survey (OES)

- Semi-annual establishment survey (May and Nov)
- PPS Stratified Sample of establishments
- Sample size of about 179,000 establishments
- Measures employment and wages by occupation
- 78% response rate

OES publishes employment and wage rate estimates for 800 occupations by industry and area.

OES Data Comes as Cell Counts



SOC	I_1	I_2	I_3	I_4	I_5	I_6	I_7	I_8	I_9	I_{10}	I_{11}	I_{12}
1	e_{i11}	e_{i12}	e_{i13}	e_{i14}	e_{i15}	e_{i16}	e_{i17}	e_{i18}	e_{i19}	e_{i110}	e_{i111}	e_{i112}
2	e_{i21}	e_{i22}	e_{i23}	e_{i24}	e_{i25}	e_{i26}	e_{i27}	e_{i28}	e_{i29}	e_{i210}	e_{i211}	e_{i212}
$\vdots$						$\vdots$						$\vdots$
c	e_{ic1}	e_{ic2}	e_{ic3}	e_{ic4}	e_{ic5}	e_{ic6}	e_{ic7}	e_{ic8}	e_{ic9}	e_{ic10}	e_{ic11}	e_{ic12}
$\vdots$						$\vdots$						$\vdots$
C_i	e_{iC_i1}	e_{iC_i2}	e_{iC_i3}	e_{iC_i4}	e_{iC_i5}	e_{iA_i6}	e_{iA_i7}	e_{iC_i8}	e_{iC_i9}	e_{iC_i10}	e_{iC_i11}	e_{iC_i12}

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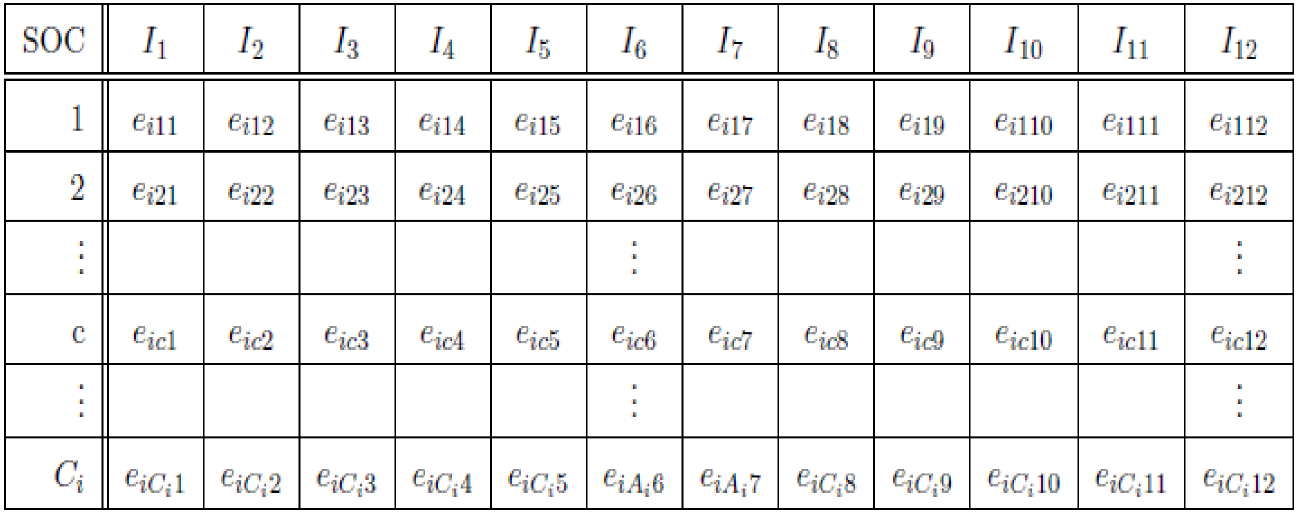

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Some establishments voluntarily provide **full salary data** for every employee.

QCEW Data

We also have quarterly administrative payroll records for almost every establishment through the Unemployment Insurance records.

Contains: location; industry; total number of employees; total wages paid.

We can compute an approximate average wage

total quarterly payroll of establishment divided by total employment

AVEWAGE = WAGE/EMPL

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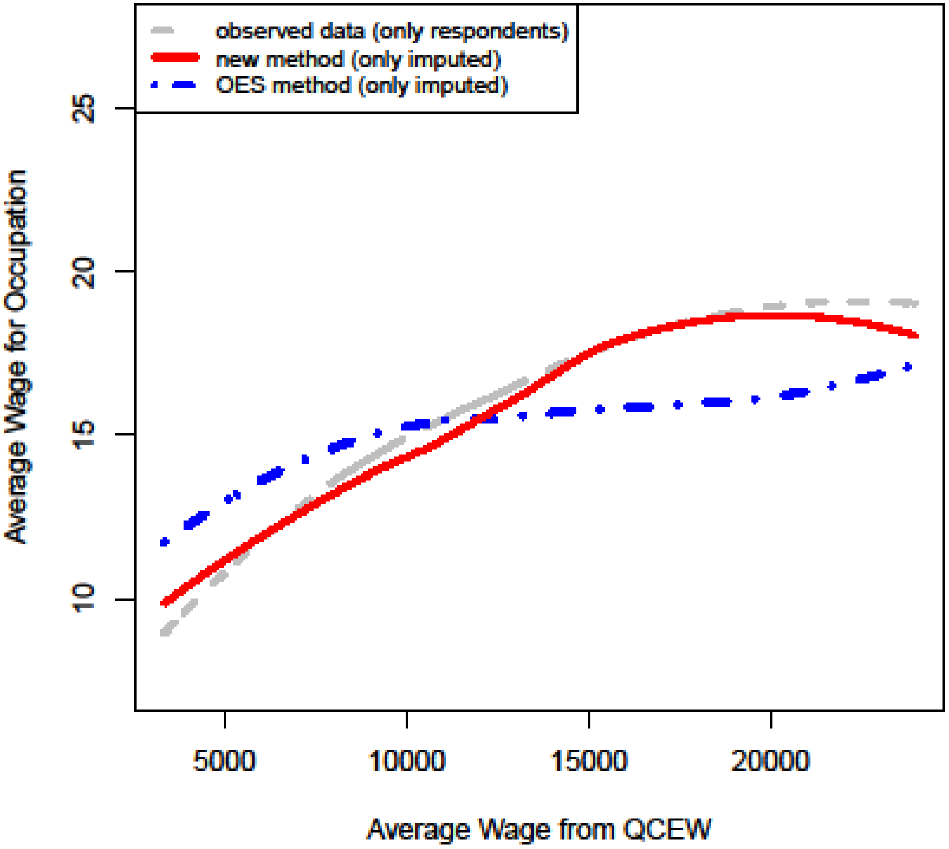
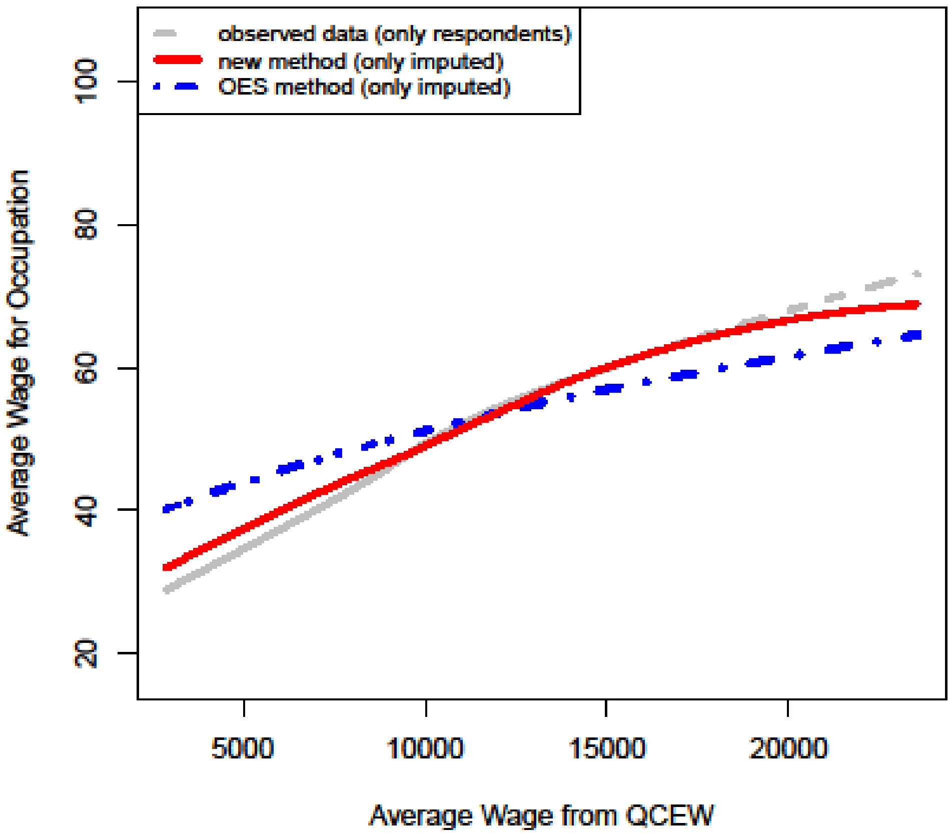
This does not include occupational information or hours worked.

Customer Service Rep



Horton, Toth and Phipps (2014), *Annals of Applied Statistics*, 8, 956-973

Managers



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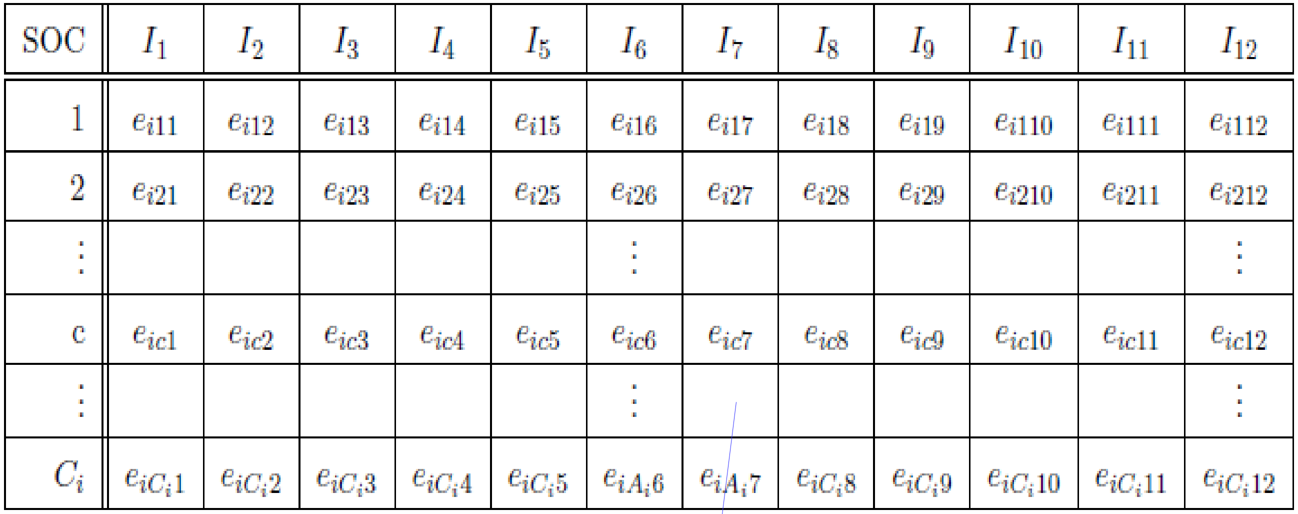
Estimation with Disparate Data Sources



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$\vdots$						$\vdots$						$\vdots$
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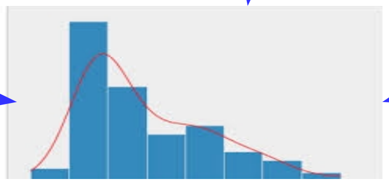
AVEWAGE

Full data from volunteers



Can we estimate underlying distribution?

Thank You

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