A Standardized Approach for Developing Probabilistic Exposure Factor Distributions

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http://eetd.lbl.gov/ied/era/

Overview

- **Distributions for probabilistic risk assessment** and the need for a “standardized approach”
- **Exploring and communicating the critical attributes of an input distribution**
- **Balancing flexibility with consistency and transparency in the distribution development process**

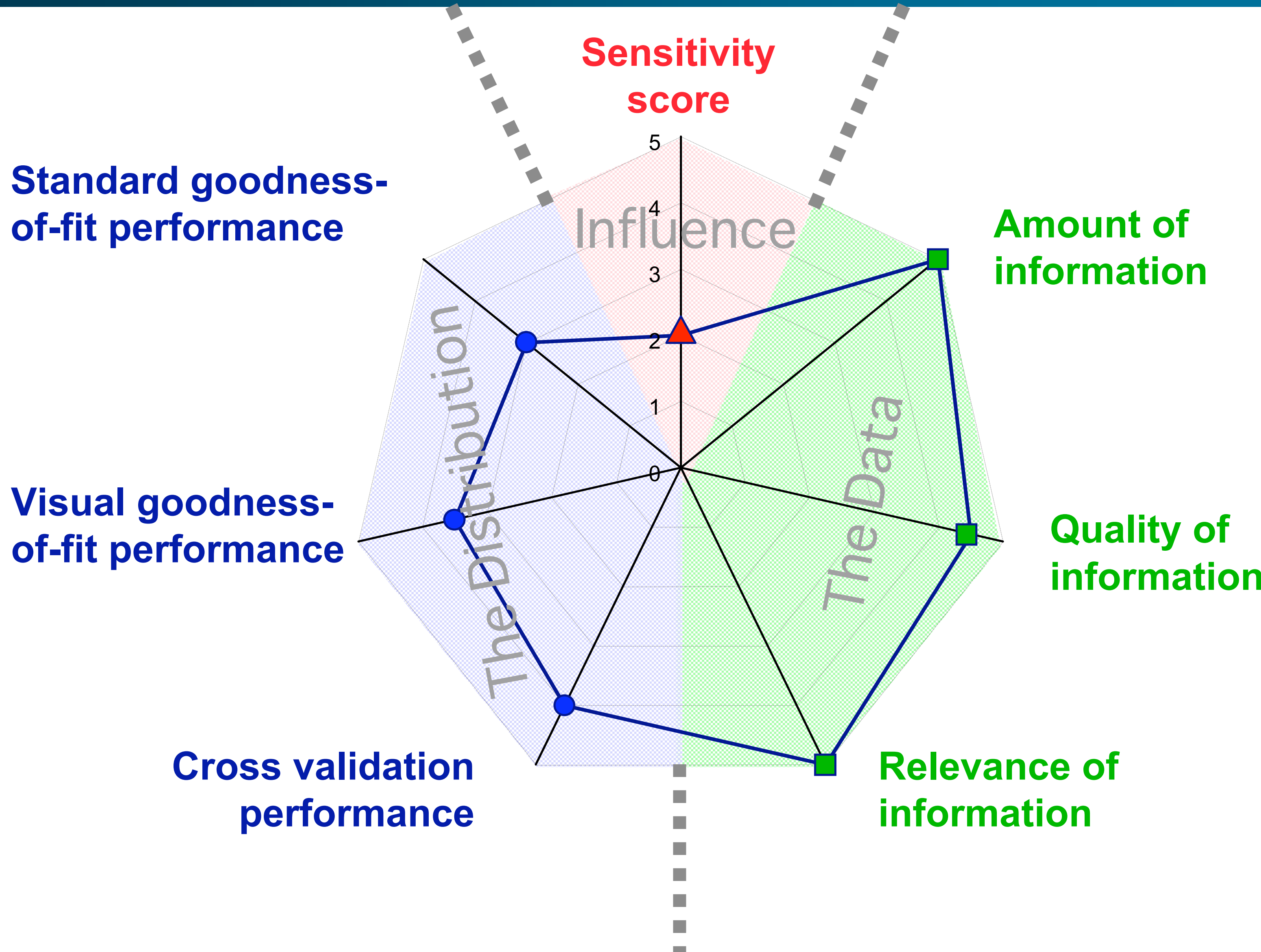
Why a Standardized Approach

- Probabilistic risk assessments are increasingly used in Europe and America
- Regulatory decision makers need to understand and judge the adequacy of Probabilistic Risk Assessments (PRA)
- The adequacy of a PRA depends on the adequacy of the input distributions
  - The 7 critical attributes of a distribution

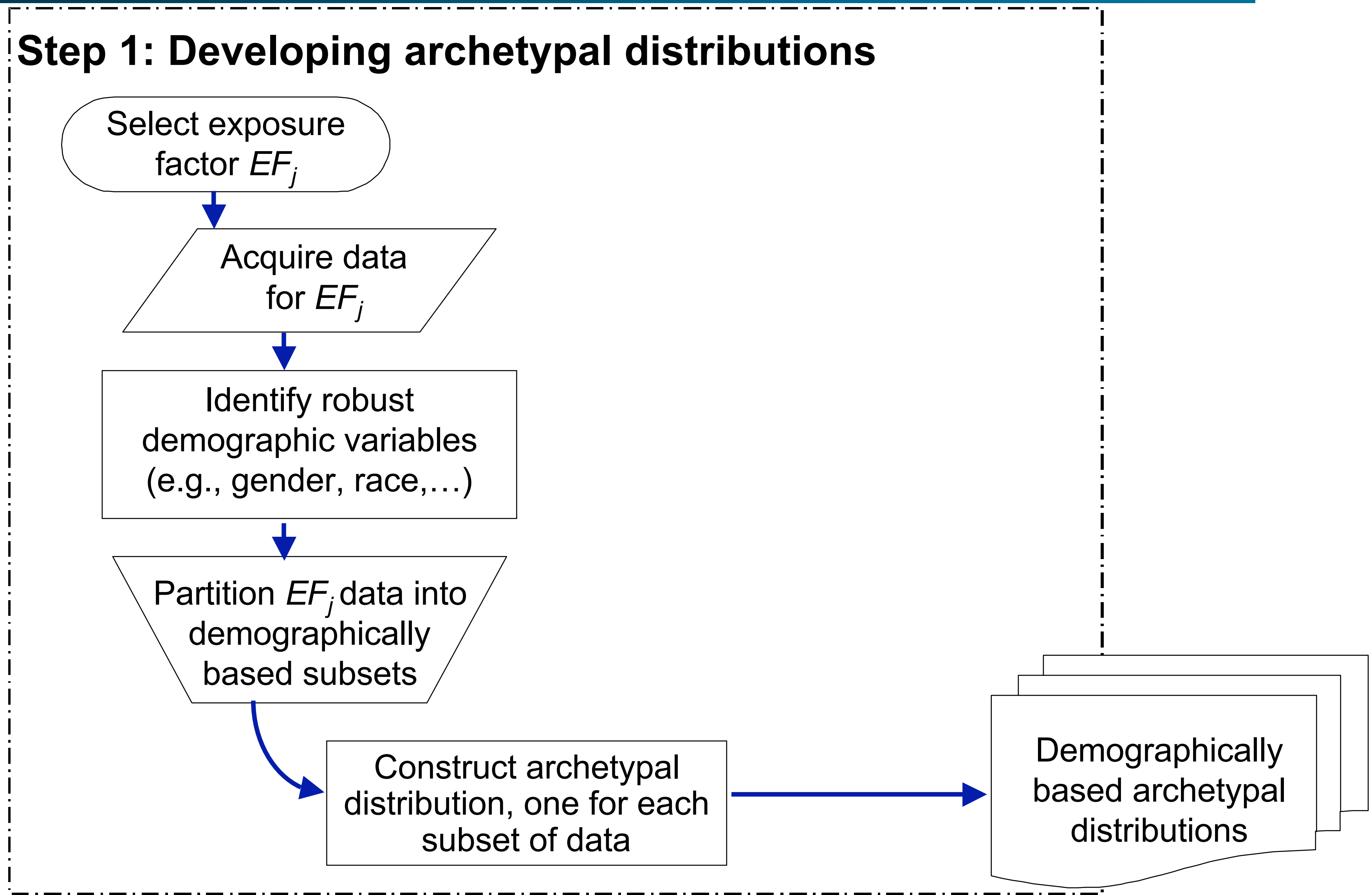
Critical attributes of a distribution

- Three information categories defining the **task-specific adequacy** of a distribution:
  - The level of **influence** that the input has on the PRA model outcome
    (i.e., sensitivity analysis)
  - The original **data** or information used to develop the input distribution
  - The ability of the **distribution** to "simulate" the original and new data

Communicating the critical attributes



A standard approach: Step 1



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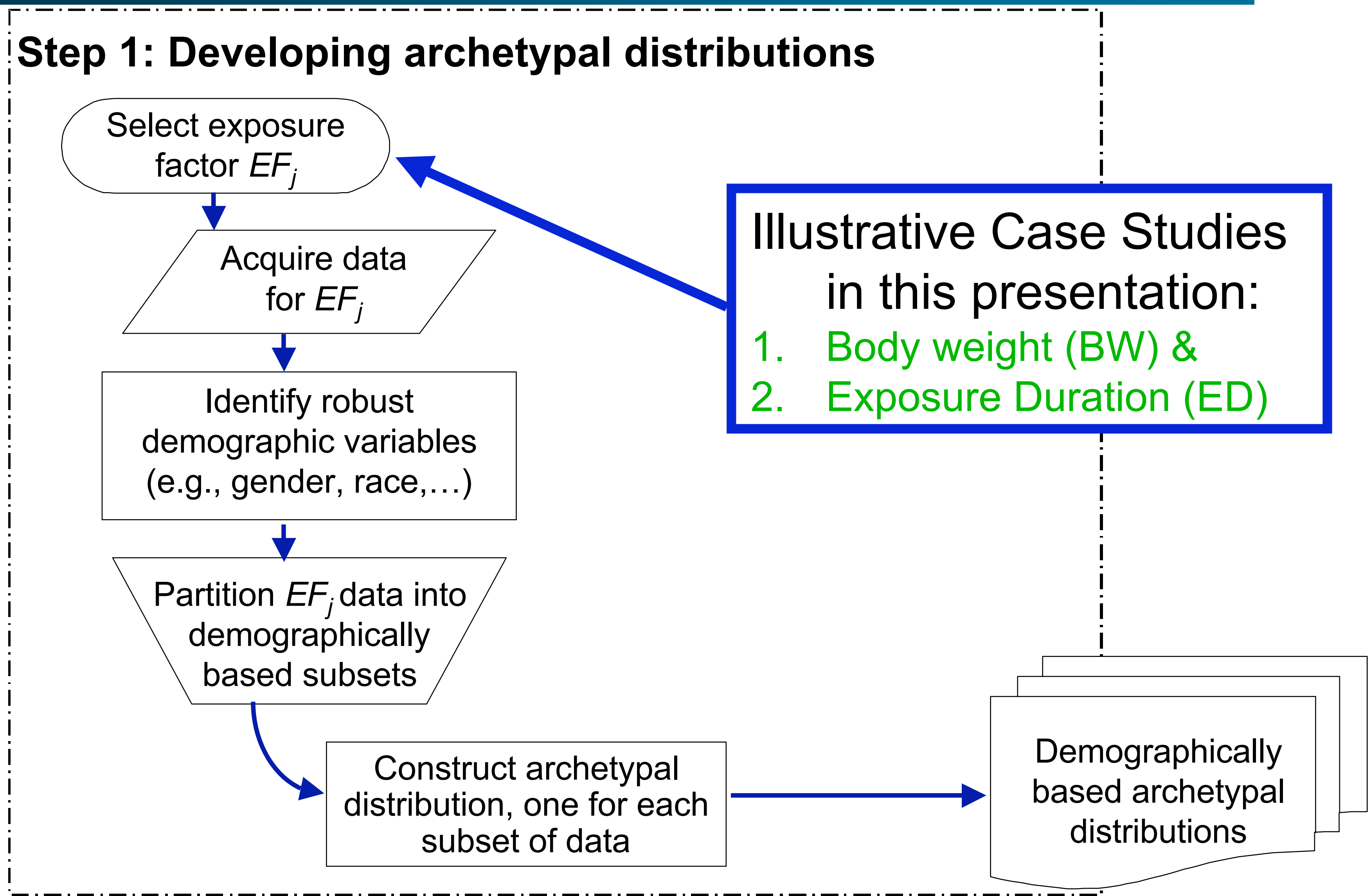

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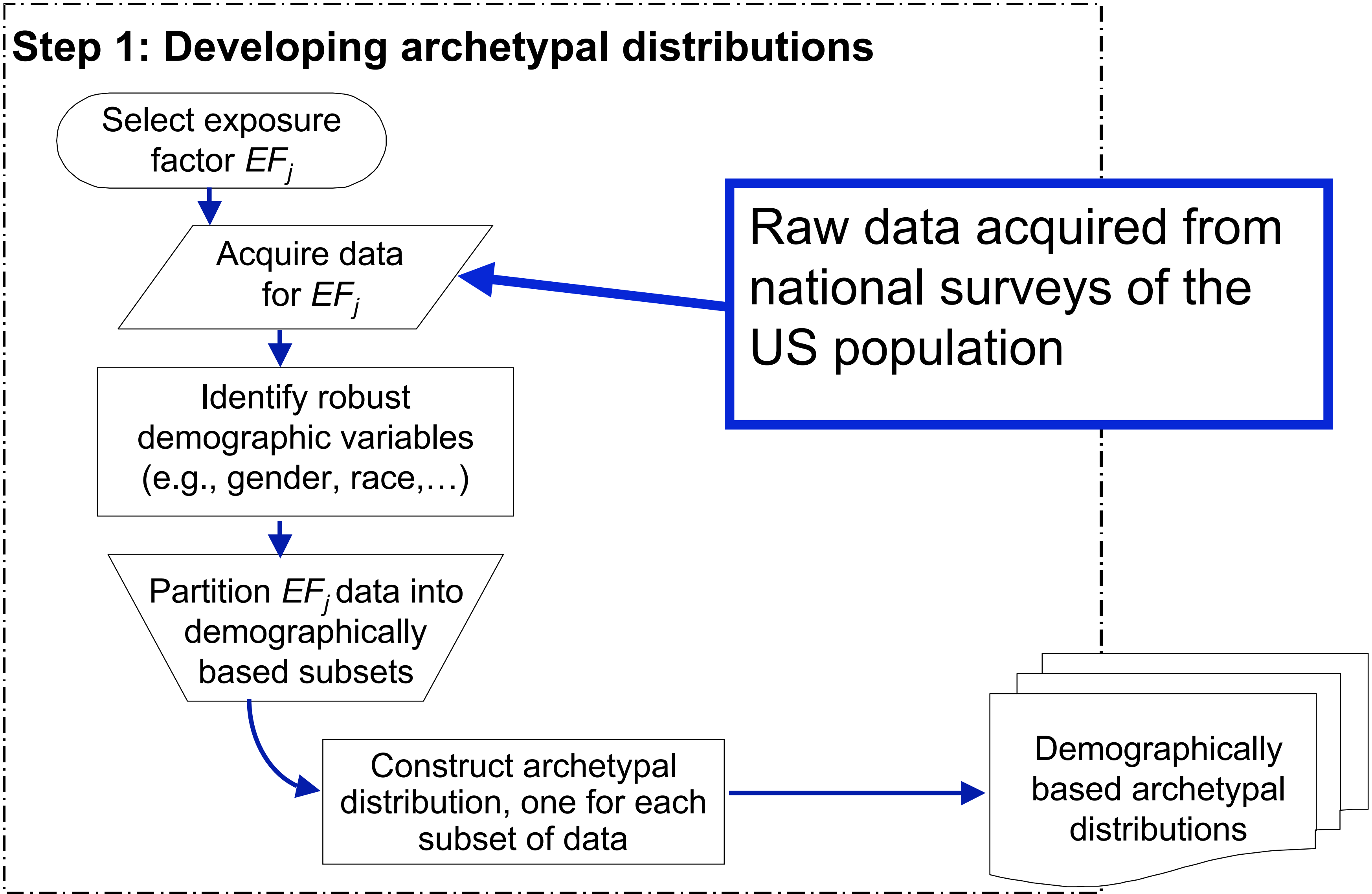

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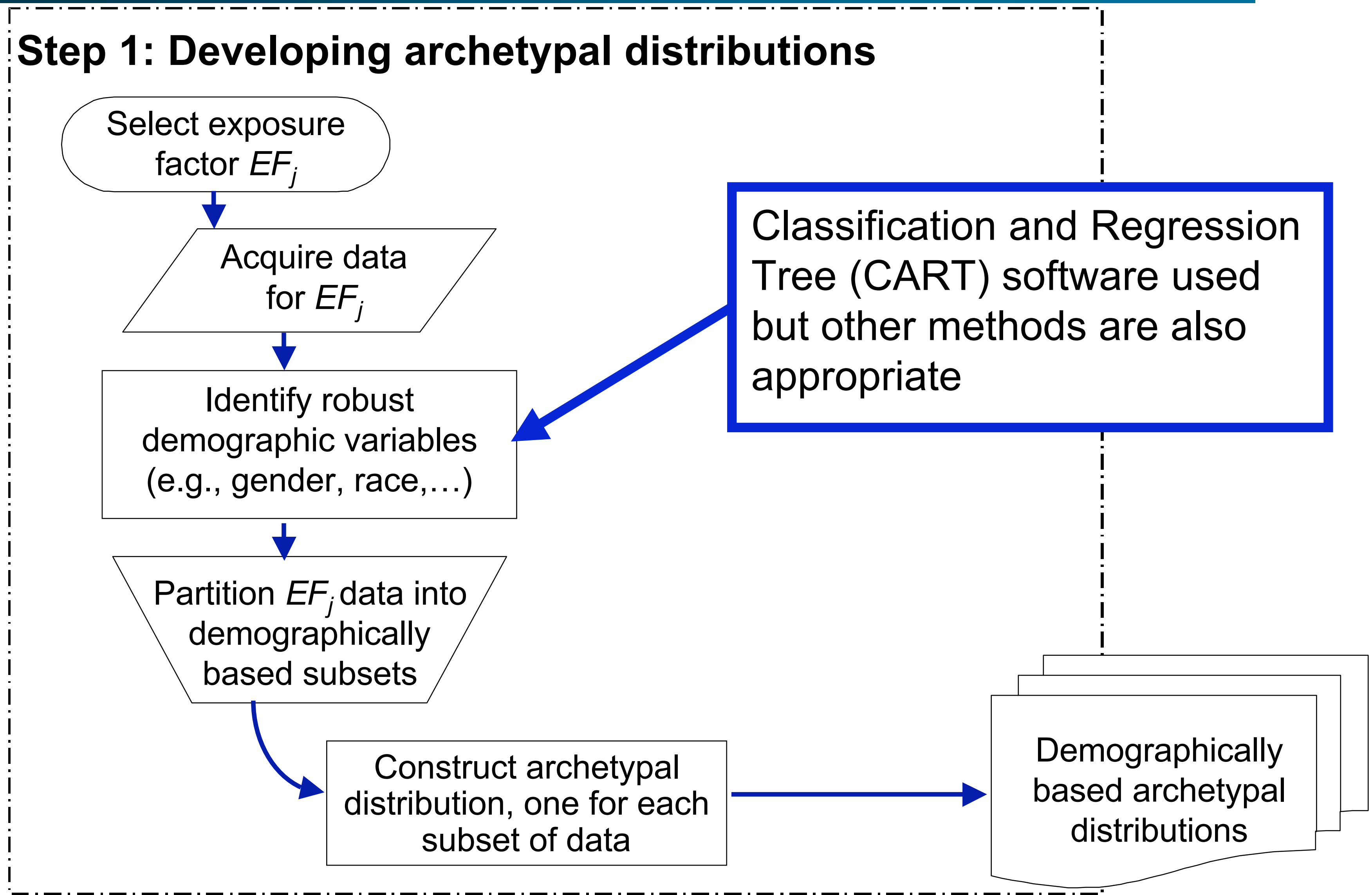

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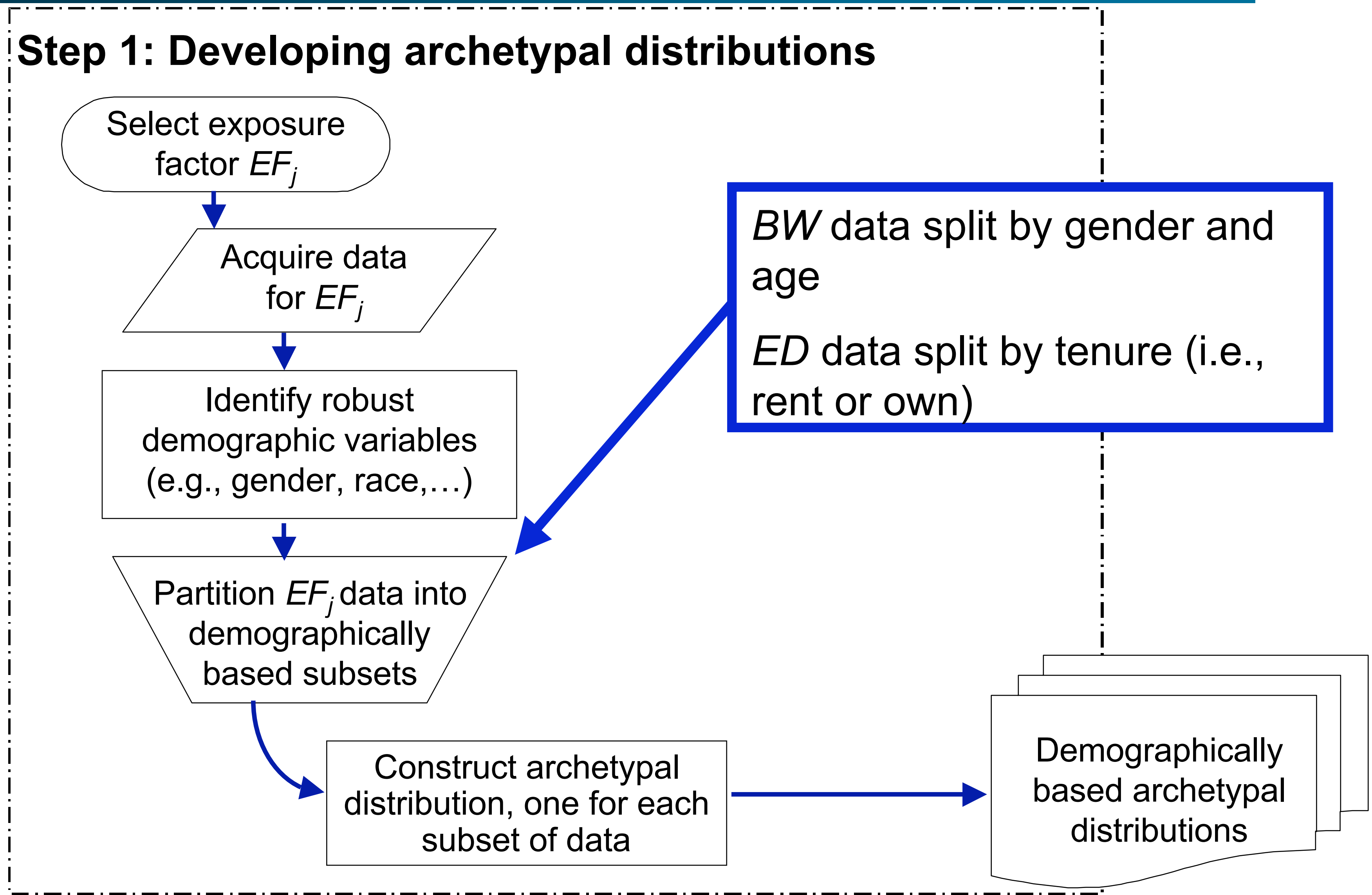

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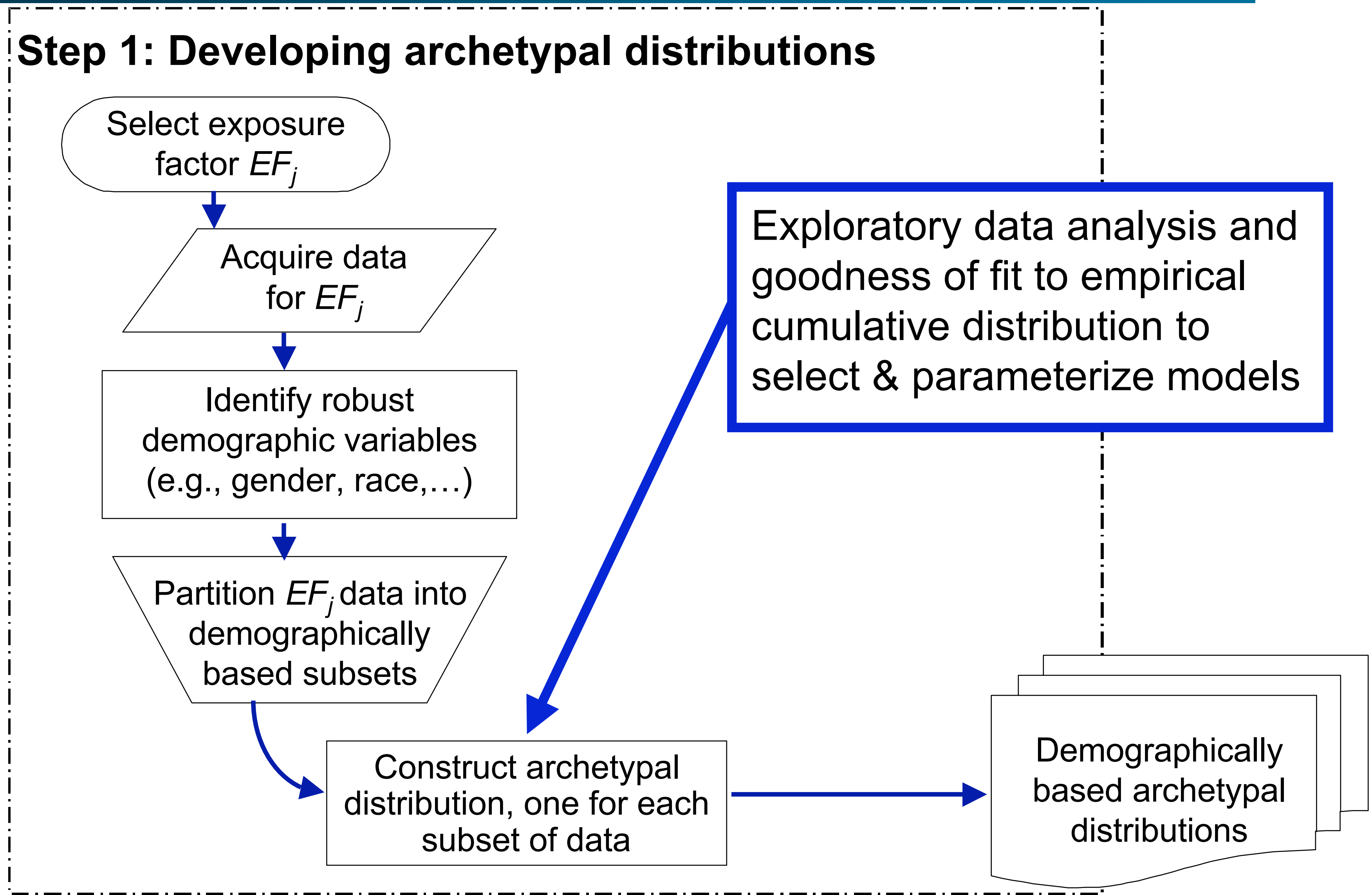

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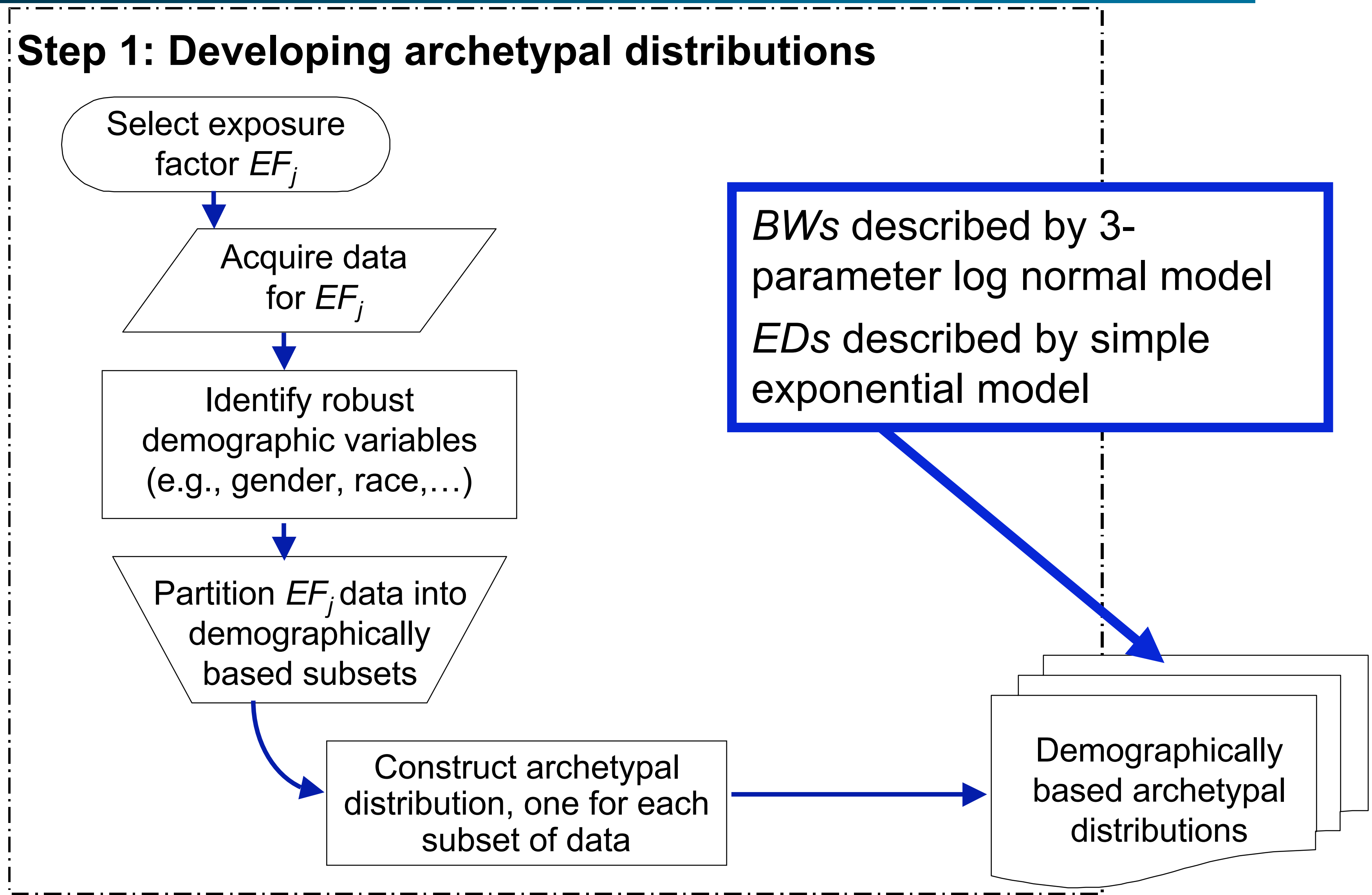
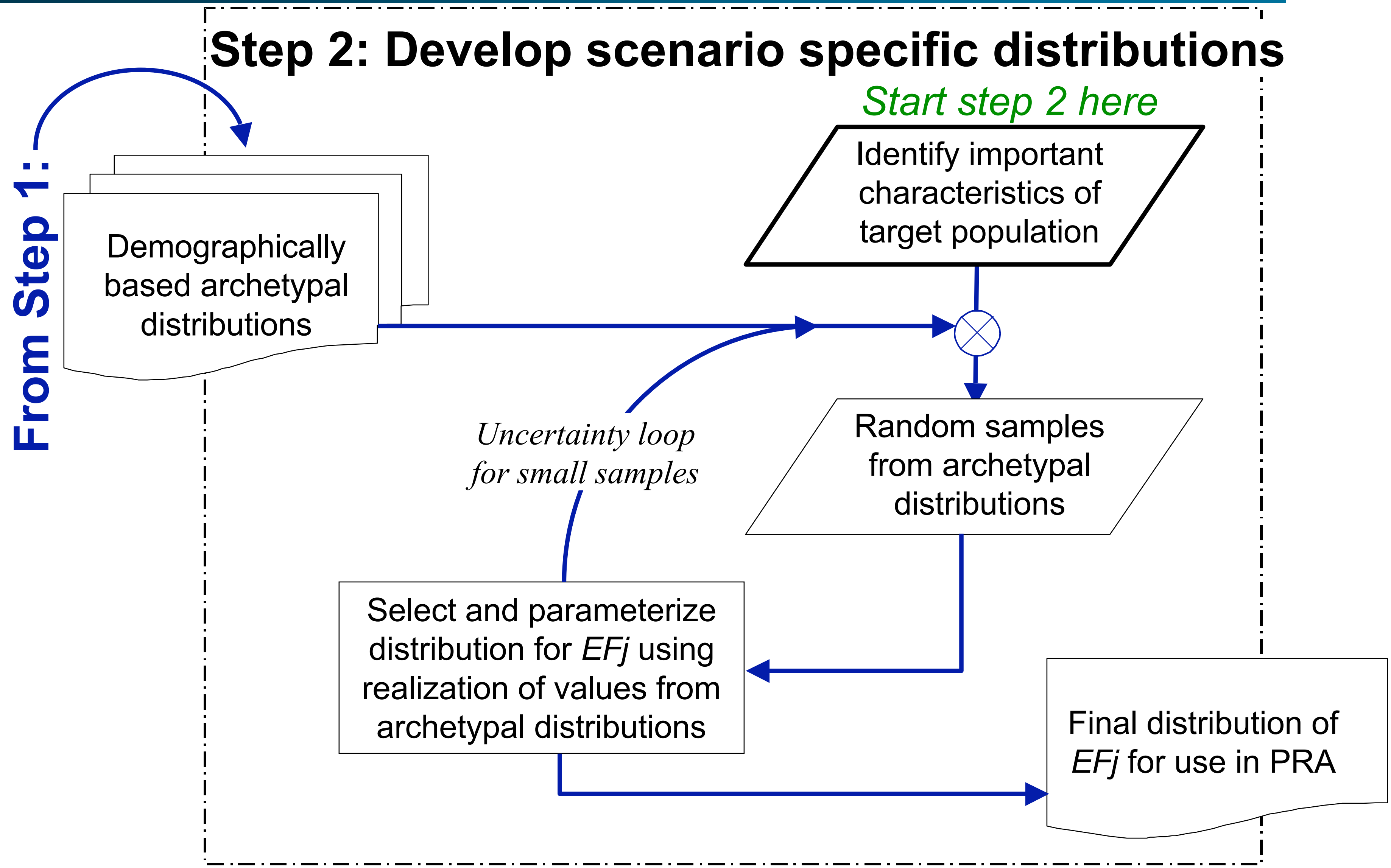
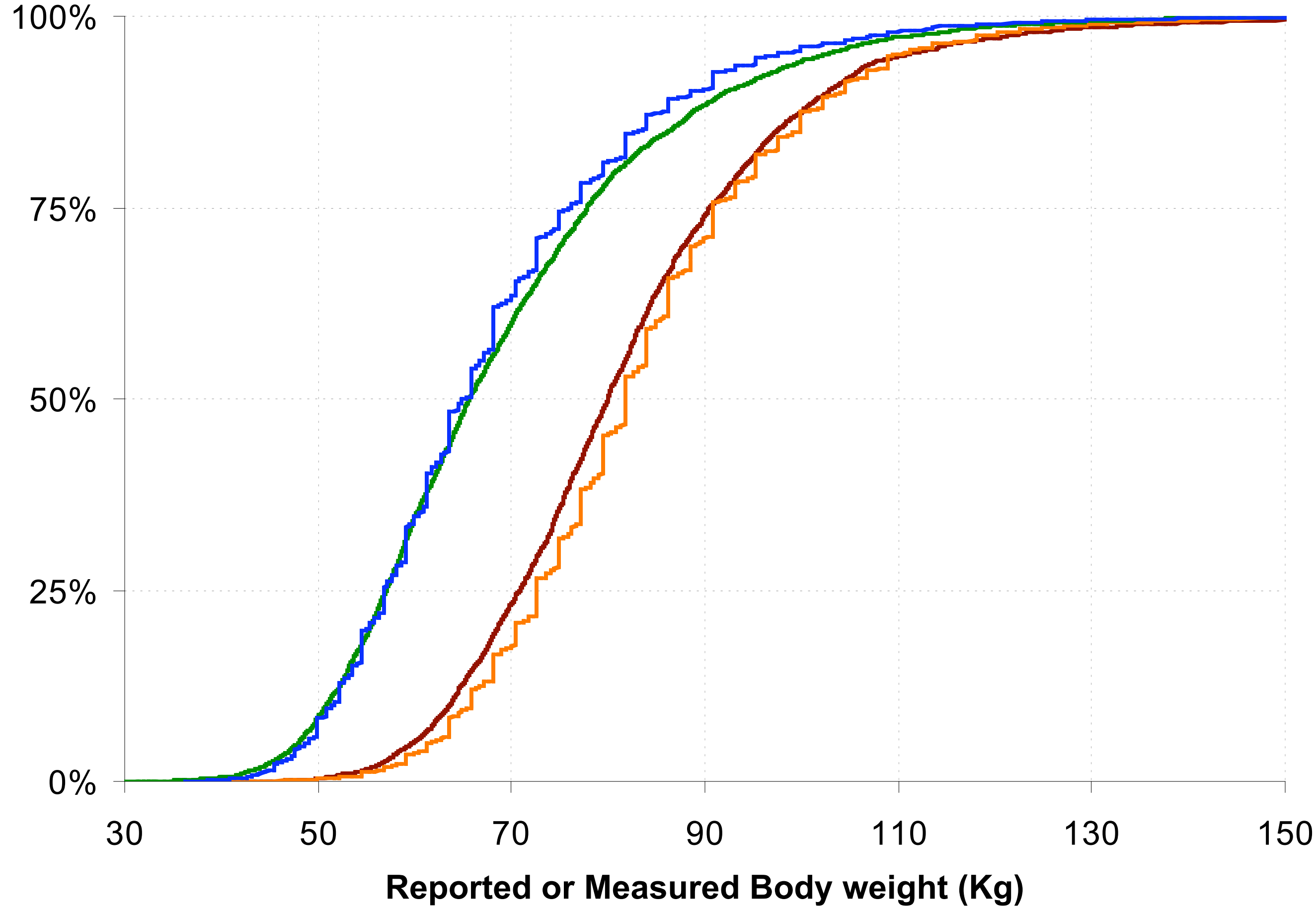


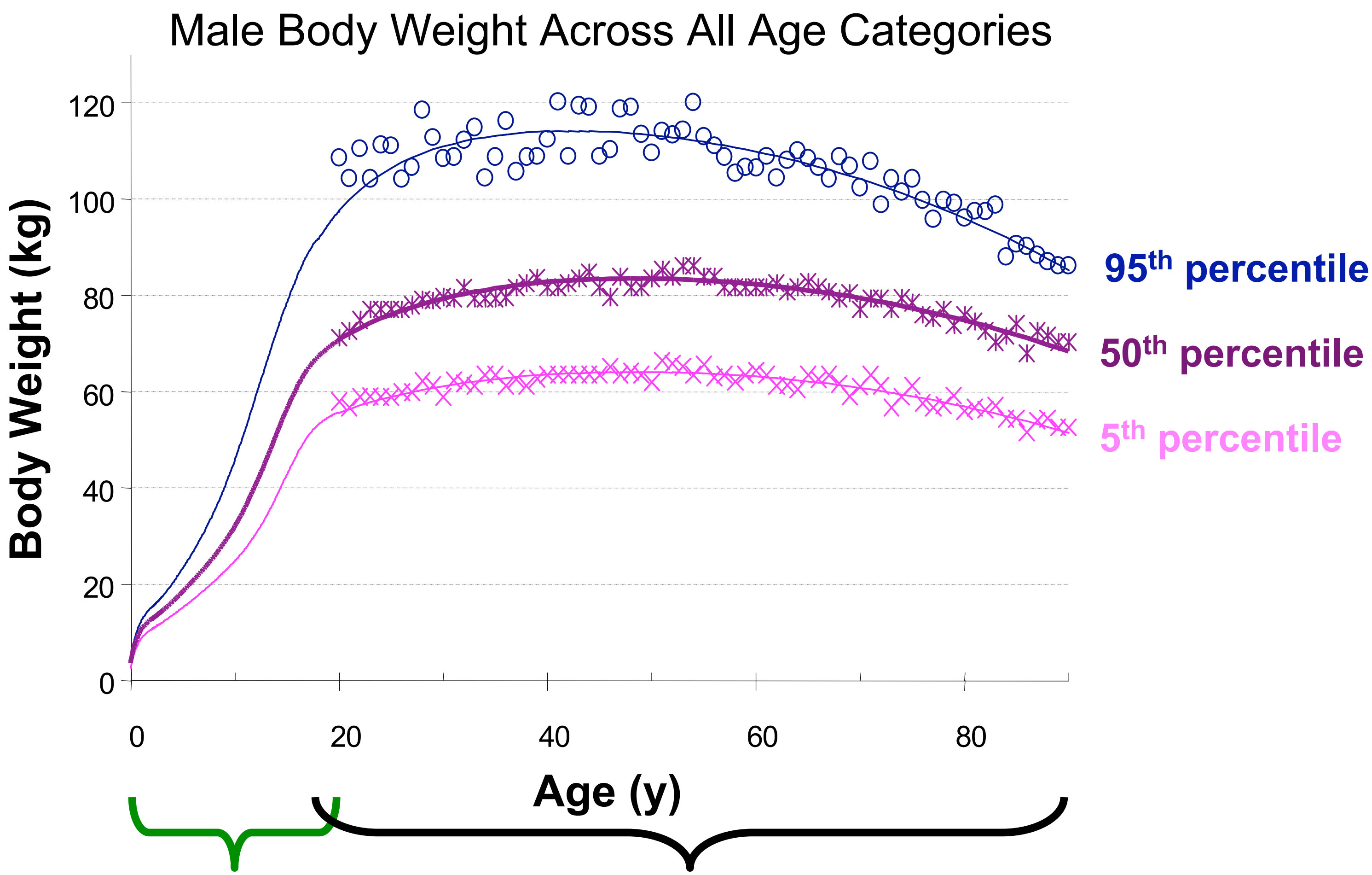
A standard approach: Step 2



BW and Gender



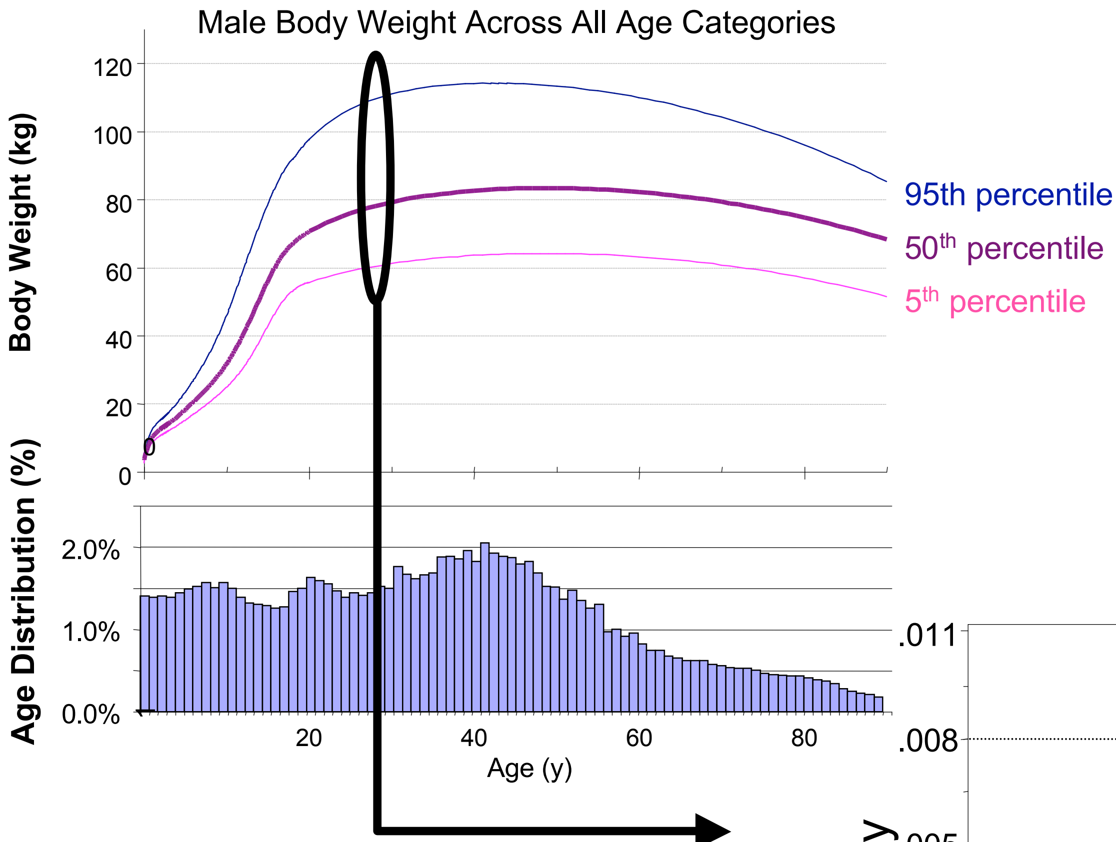
BW and Age



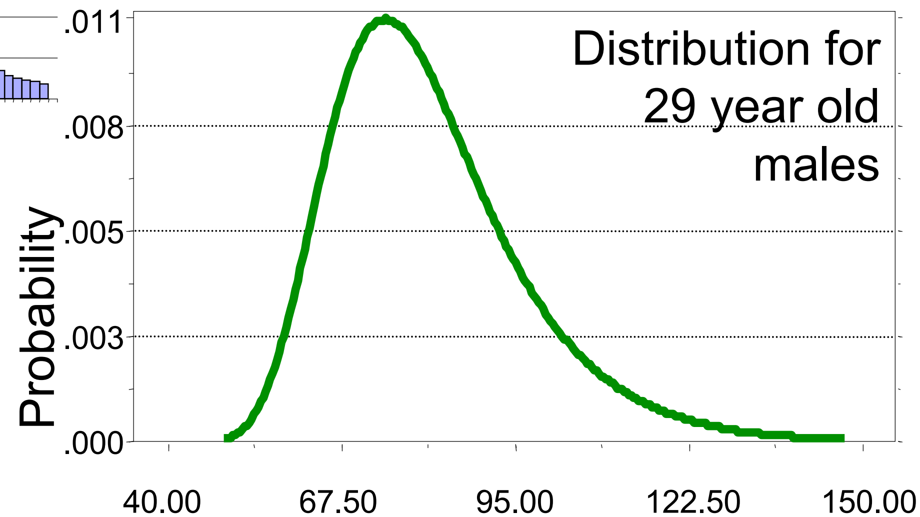
Growth curves, U.S. Center for Disease Control (2000)

Adult Weight-for-Age data and curves constructed from U.S. National Data

Constructing *BW* archetypes



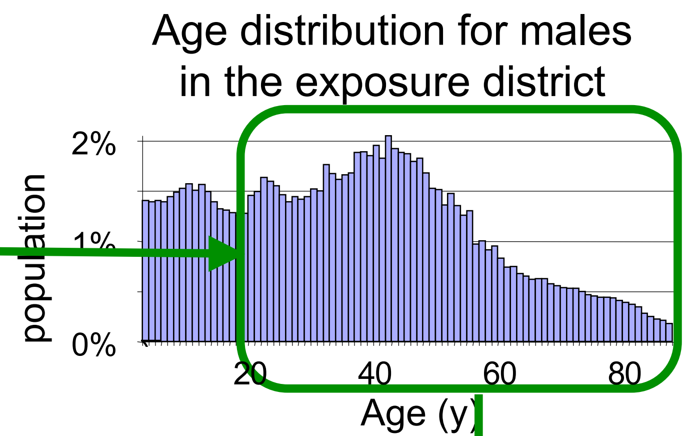
3-parameter Log Normal PDF typical across all age/gender categories



Construct distributions by sampling from each age/gender categories

The site specific *BW* distribution

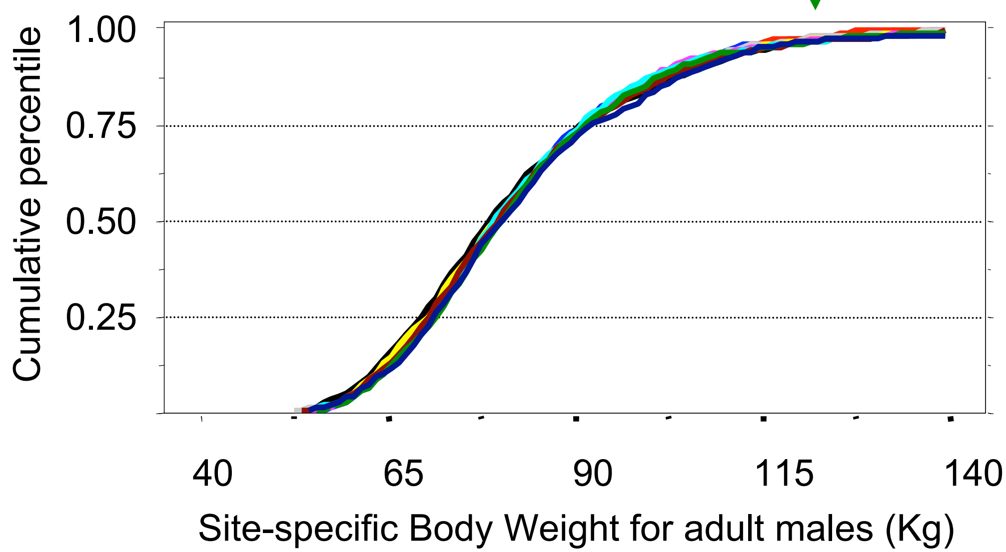
- Adult males in exposure district based on census data, *n* = 3895 adult males
- Appropriate number of *BWs* sampled from each archetypal distribution
- Sampled values combined to construct single distribution for site specific *BW*
- Repeat the process to characterize **uncertainty** and **variability**



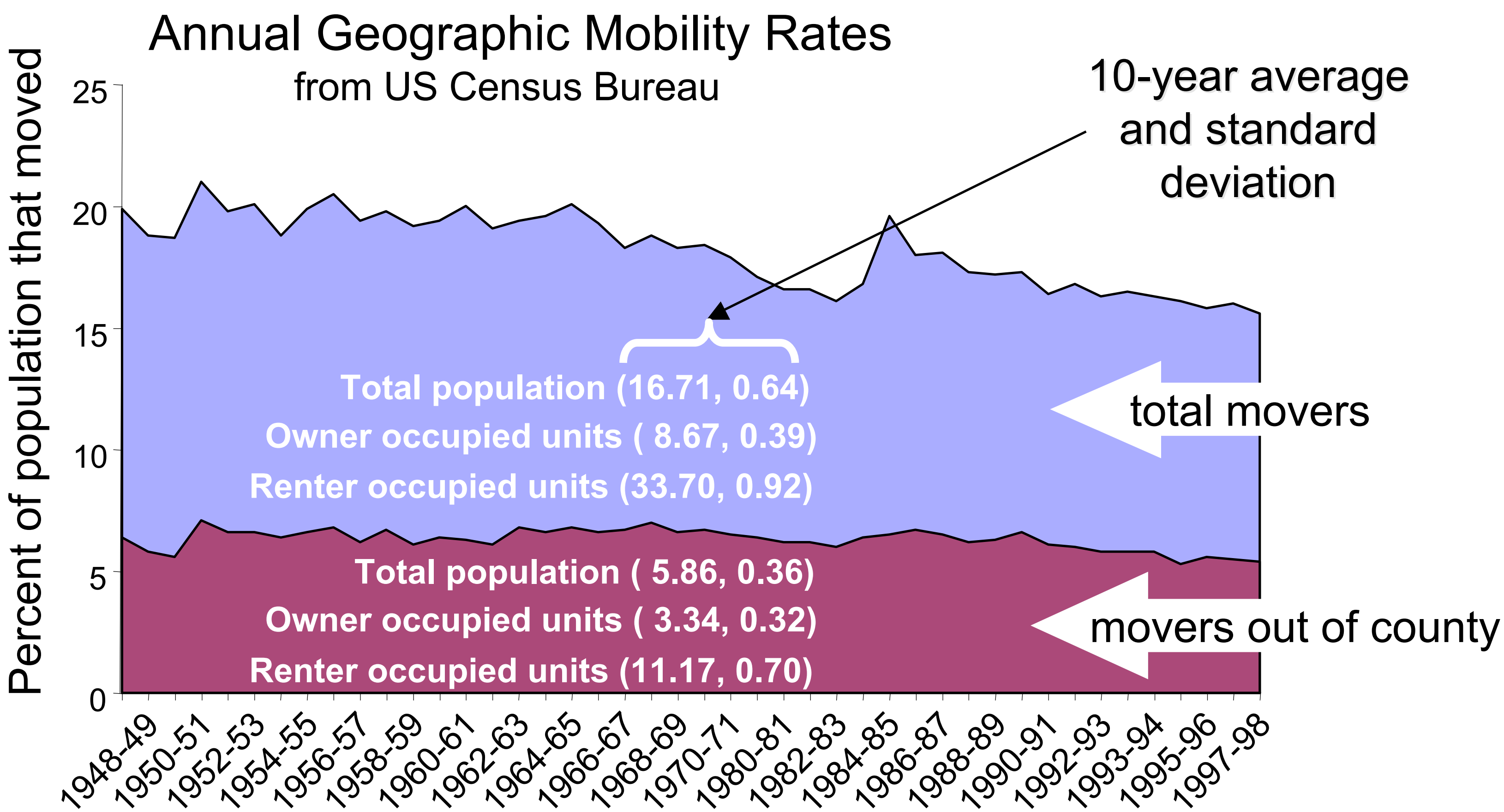
Extreme value distribution

mode = 75.4 ± 0.35

scale = 13.1 ± 0.23



Tenure and the *ED* archetype

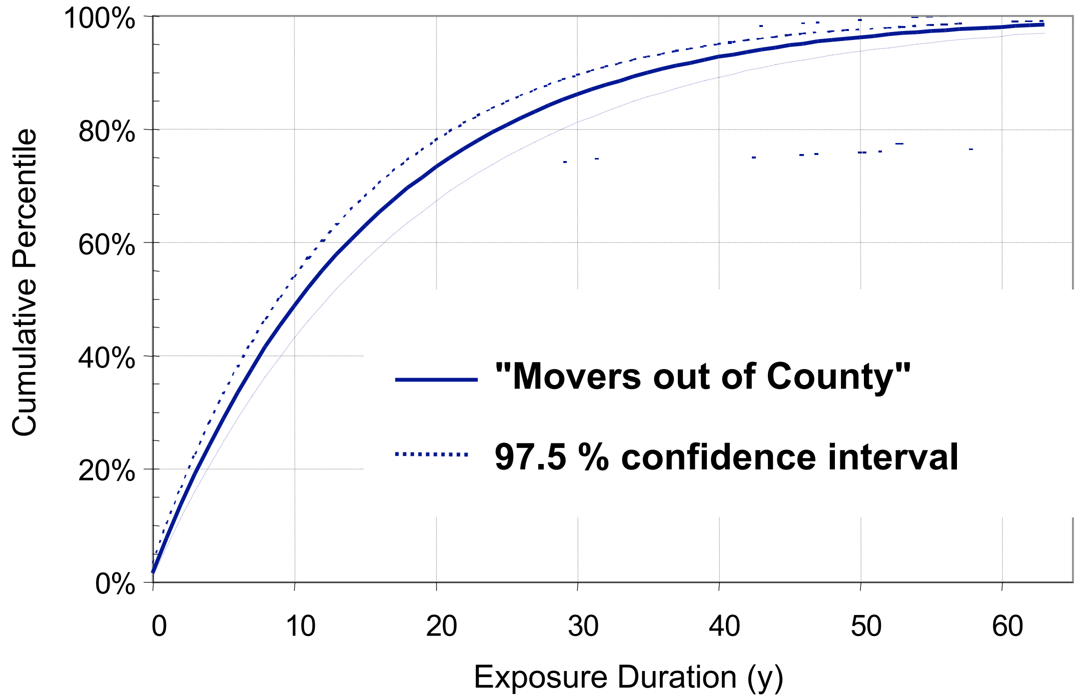


Likelihood of move for a given household estimated from exponential model using tenure-based moving rates

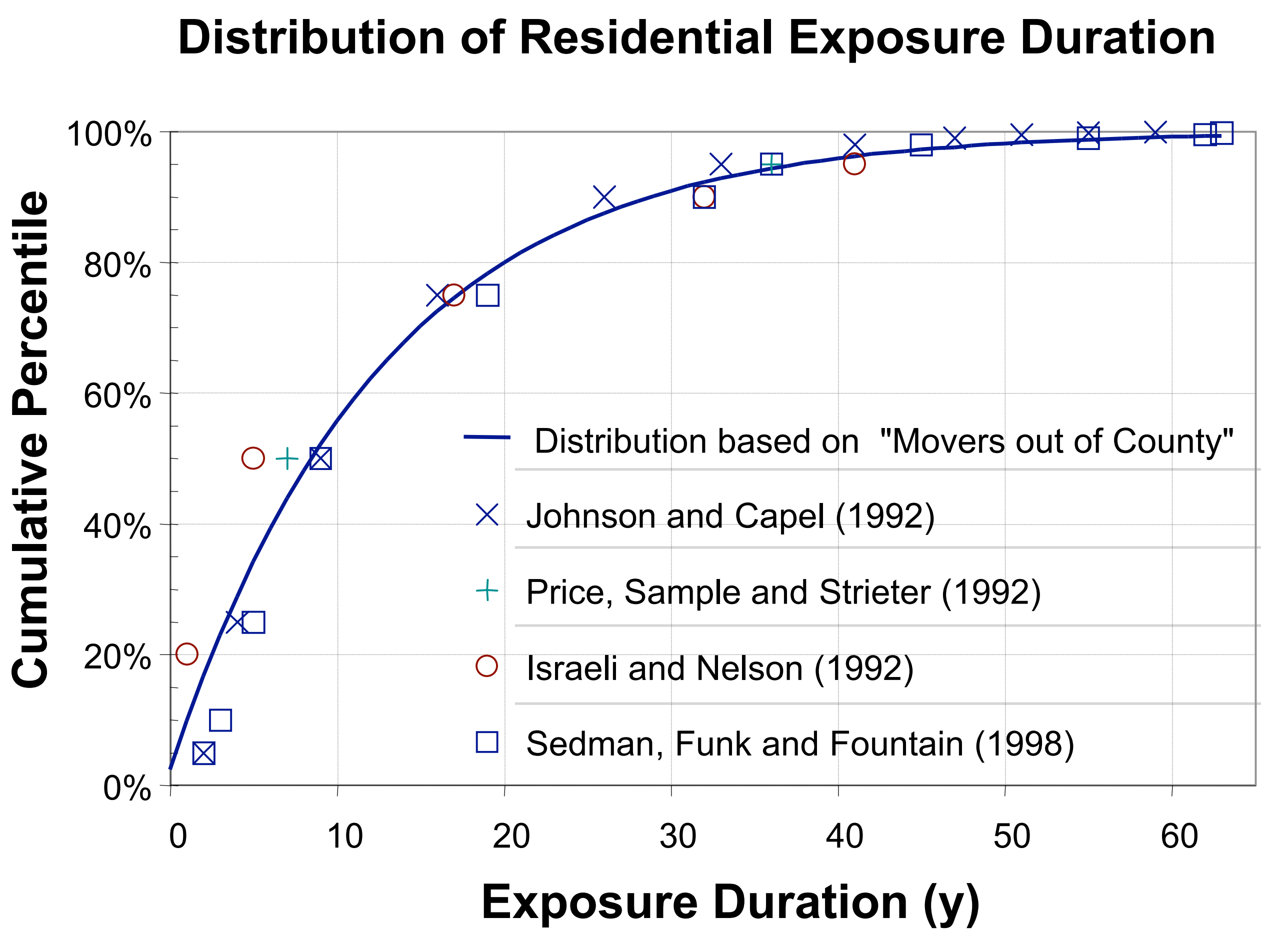
The site specific *ED* distribution

- **Total occupied housing units = 1490** (renter = 362; owner = 1128)
- **Ten year average annual geographic mobility rates and exponential model for each occupied home in district**
  (renter = 11.2 ± 0.7; owner = 3.3 ± 0.32)
- **Simulate total occupied housing units for 85 years**
- **Repeat process several times to estimate uncertainty**

median = 9 to 13 y
95% ucl = 40 to 54 y



Comparison to other *ED* models



	mobility	mortality	current occupancy	tax records	demographics
Distribution based on "Movers out of County"	X				
Johnson and Capel (1992)	X	X	X		
Price, Sample and Strieter (1992)	X	X			X
Israeli and Nelson (1992)	X		X		
Sedman, Funk and Fountain (1998)				X	

Summary remarks

- Adequacy of a PRA is related to adequacy of inputs (among other things)
  - —Seven-points of an adequate distribution
- Archetypal distributions provide consistency and flexibility
- Archetypal distributions provide a focus point for developing consensus and identifying data gaps

Summary remarks

- Variability, uncertainty and demographics
  - —Relating “archetypal distributions” to specific population requires knowledge about the population and the area of the exposure district
- Many exposure factors lack sufficient data for this approach (i.e., soil ingestion) or require site specific information (i.e., exposure concentrations)