HILDA Standard Errors

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Outline

- Hilda survey design
- Methods
- Design issues
- Preliminary results
- Improvements/Additions
- Benchmarking
- Final points

HILDA Survey Design

- Australia was stratified via major statistical region
  - Census Collection Districts (CCD's) were systematically selected (via serpentine ordering)
  - probability of selection proportional to the number of dwellings in each CCD
- Dwellings were selected systematically from within CCD's
- Households were randomly selected within dwellings
- All individuals were selected in each household.

SRS?

- HILDA has a complex survey design with unequal weights
- Cluster selection causes groups of similar households to appear in the data
- People are clustered within households
- SRS formulas ignore clustering and the systematic selection

Methods of Complex SE Calculation

- Method categories:
  - Linearisation techniques
  - Resampling
- HILDA user manual recommends only two:
  - Taylor Series Linearisation
  - Delete a group Jackknife

Delete-a-group Jackknife

- The Jack-knife is a method for producing replicate weights for the sample
- 30 replicates provided for all weights on the dataset.
- Takes into account the complex design of the survey and the way it has evolved from wave 1
- Simple formula for the variance using the replicate weights

$$Var(\hat{x}) = \left(\frac{R-1}{R} \right) \sum_{r=1}^{R} \left(\hat{x}^{(r)} - \hat{x} \right)^2$$

Delete-a-group Jackknife – Replicates

- Aim to mirror the overall sample design within each replicate group
- Ordered CCD's systematically allocated to a replicate group
  - CCD 1 to 30 allocated to replicate group 1 to 30 then repeated
- Allocated group of CCD's dropped from each replicate
  - Replicate group size 29/30 of main sample
- Replicate group undergoes weighting process
  - units in dropped CCD's receive zero weight

Taylor Series Linearisation

- Use Taylor's Theorem to create a linear approximation to a non-linear statistic
- Calculate the variance of the linear approximation
- Benefits
  - Well developed theory
  - Can be applied in general sample designs
  - Software readily available
- Accuracy of linear approximation a concern

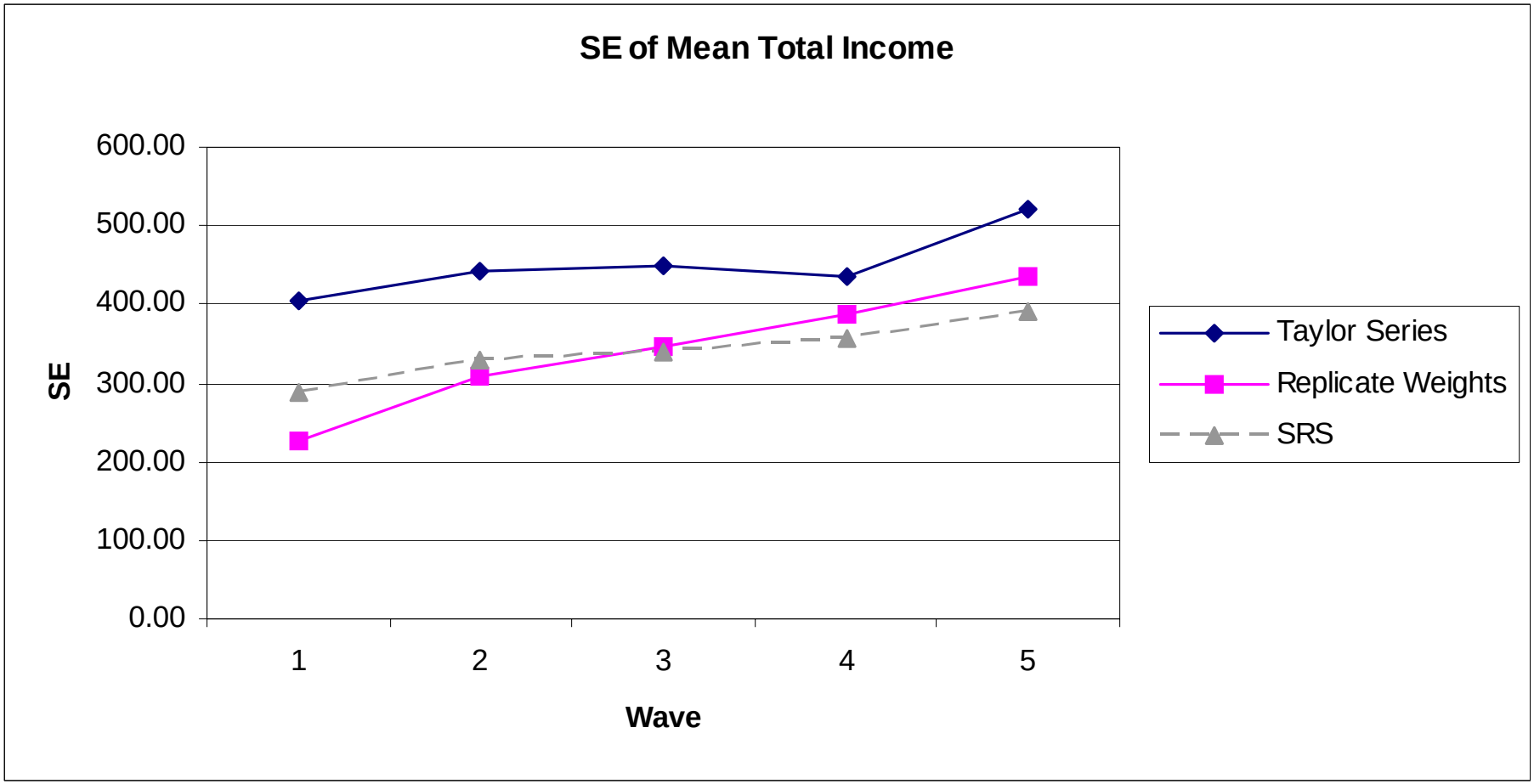
Sample Design Issues

- Taylor Series
  - Software packages assume a stratified cluster design
  - Doesn’t take into account benchmarking effects or systematic selection
- Replicate groups don’t correctly reflect the sample design
  - Cluster size needs to be taken into account
  - Systematic selection skips

Sample Design Issues

- As the survey progresses over time:
  - Systematic design less apparent
  - Sample dispersion/un-clustering
  - Unlikely to reduce to a random ordering of units
  - Approximation or replicate weights still more suitable than SRS

Preliminary Results



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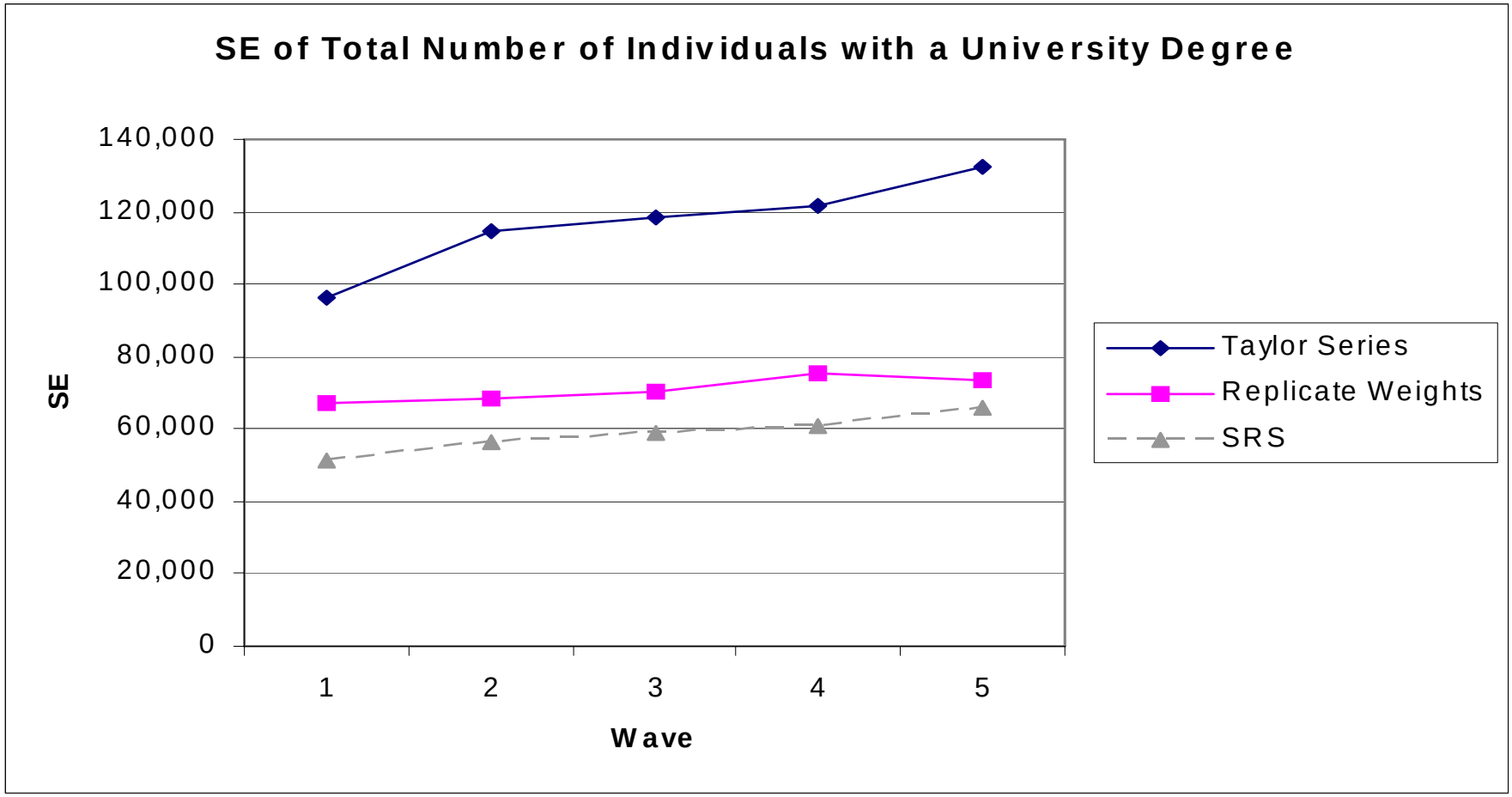

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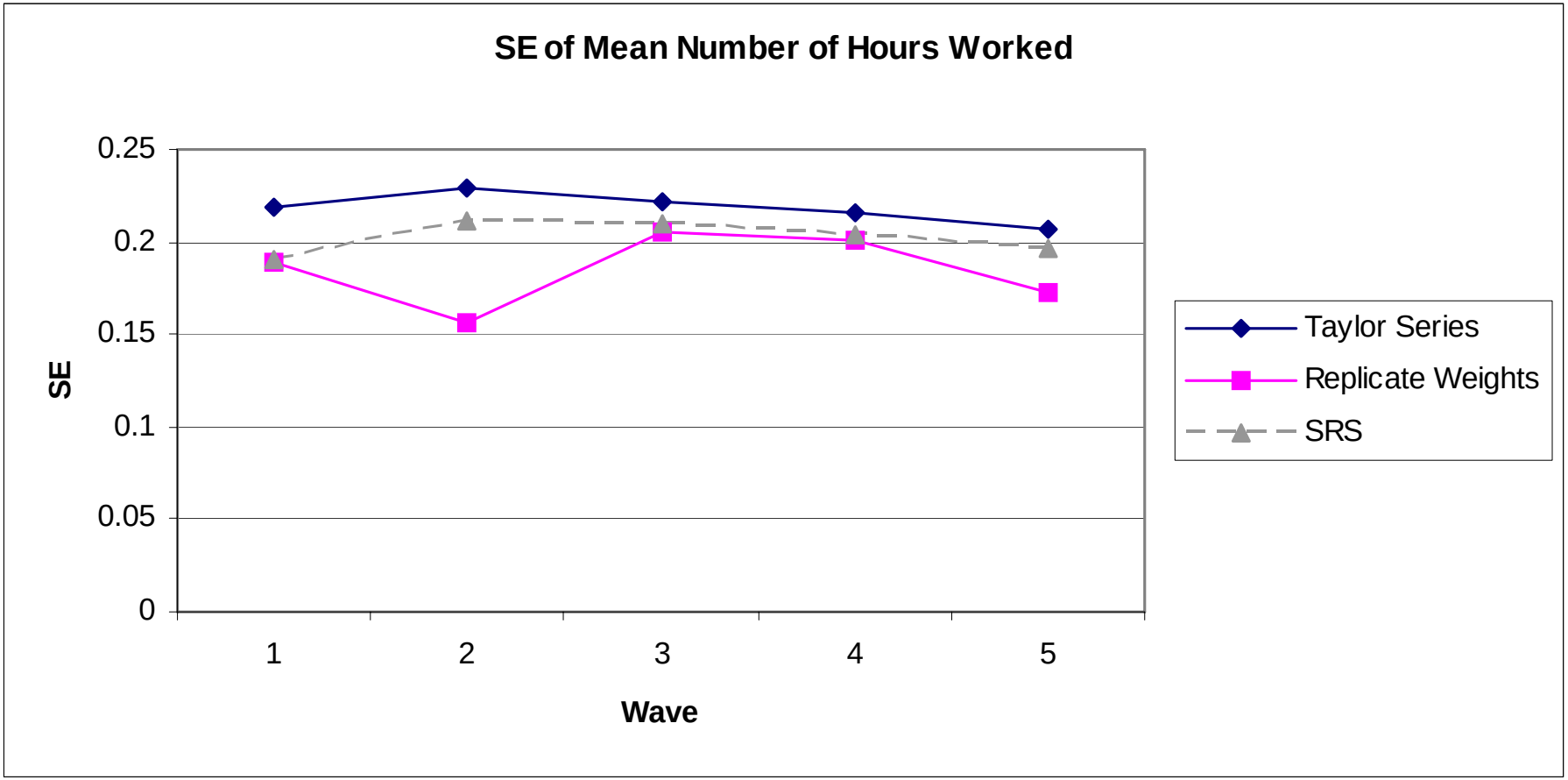


Observations

- Large difference between methods
- What is correct?
- Increase in estimates over waves
  - Attrition
  - Un-clustering
  - New sample members

Updated Taylor Series estimates

- Taylor approximation method only using a broad stratification variable
- Choose finer level stratum boundaries
  - Closer approximation to the systematic selection
- Incorporate the original ordering of the clusters

Updated Taylor Series estimates

Revised Stratum Variable					
	W 1	*W 2*	*W 3*	*W 4*	*W 5*
Average Income					
Major statistical Region	405	442	450	436	521
CD order strata	385	413	428	423	493
Average Hours					
Major statistical Region	0.2186	0.2299	0.2219	0.2164	0.2064
CD order strata	0.2188	0.2335	0.2215	0.2131	0.1995
Education Count					
Major statistical Region	96,326	114,547	118,612	121,871	132,278
CD order strata	85,054	89,868	91,915	93,347	102,099

Updated Replicate Estimates W1 (1)

- Introduced the replicate weight creation at the start of the weighting process
- Small change in results

Replicate Weights Comparison - Wave 1

	Existing Replicates	*Adjusted Replicates*
Average Income	226	214
Average Hours	0.1884	0.1975
Education Count	66,937	70,123

Replicate Group Formation

- Updated to take into account the size of each cluster
- Random start point with systematic selection of clusters for each replicate
  - Random number has a very large impact on results
  - Larger number of replicate improves consistency across runs

Updated Replicate Estimates W1 (2)

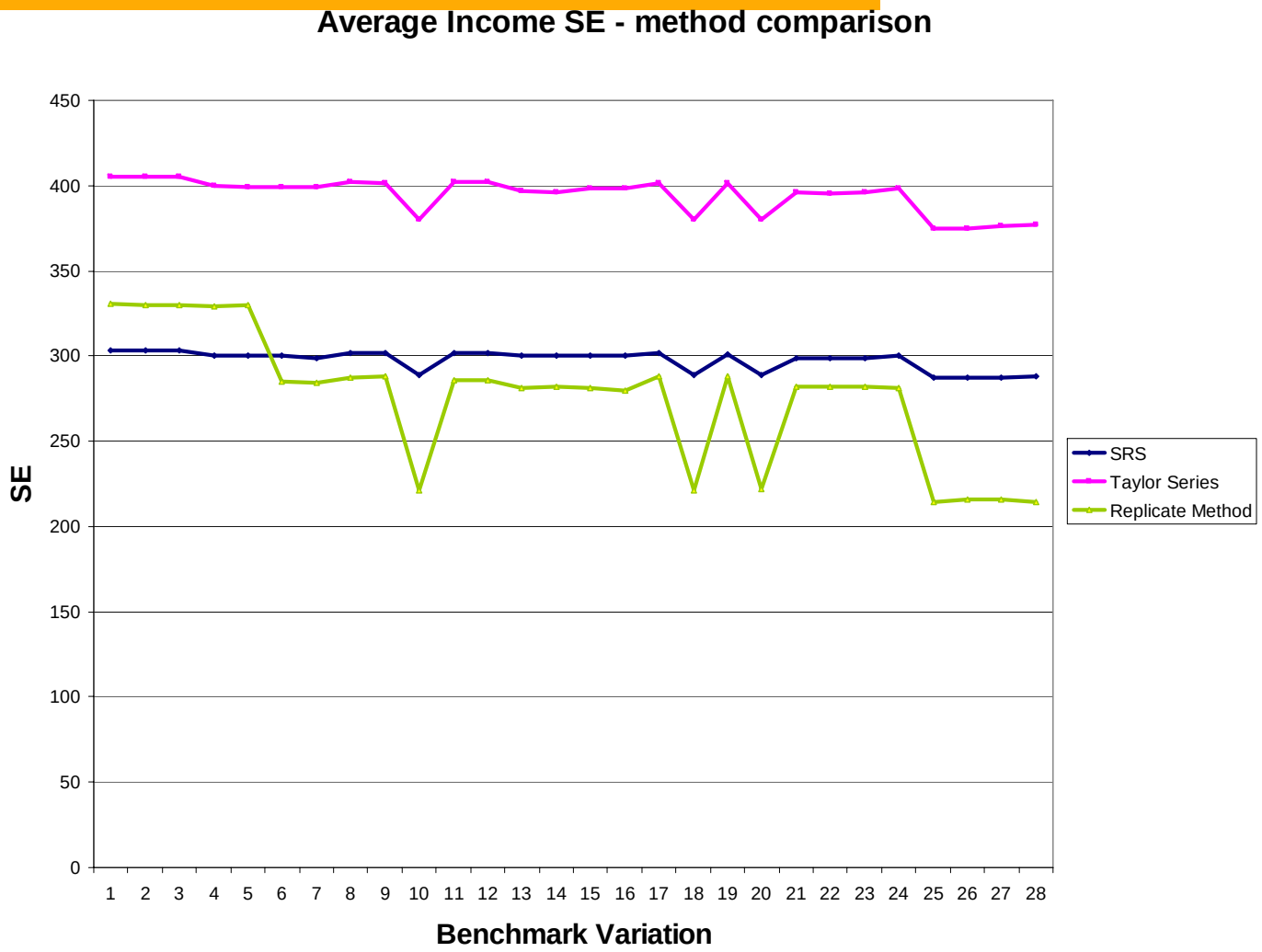
Mean Income SE			Original Replicates
Replicates	*Mean*	*Std Deviation*	
30	276	49	214
100	276	23	
Mean Hours worked SE			
Replicates	*Mean*	*Std Deviation*	
30	0.185	0.021	0.198
100	0.180	0.013	
Education Count SE			
Replicates	*Mean*	*Std Deviation*	
30	65,400	6,519	70,123
100	65,096	8,136	

HILDA Benchmarking

- Benchmarking reduces estimates of SE via replicate weights for related variables
- Incorporate the error of survey benchmarks?

HILDA survey Benchmark source	
Estimated Residential Population	*Labour Force Survey*
Number of Adults	Labour Force Status
Number of Children	Social Marital Status
Broad State Group	Occupation
State	
Capital City	
Sex	
Age Group	

Effect of benchmarking on estimates



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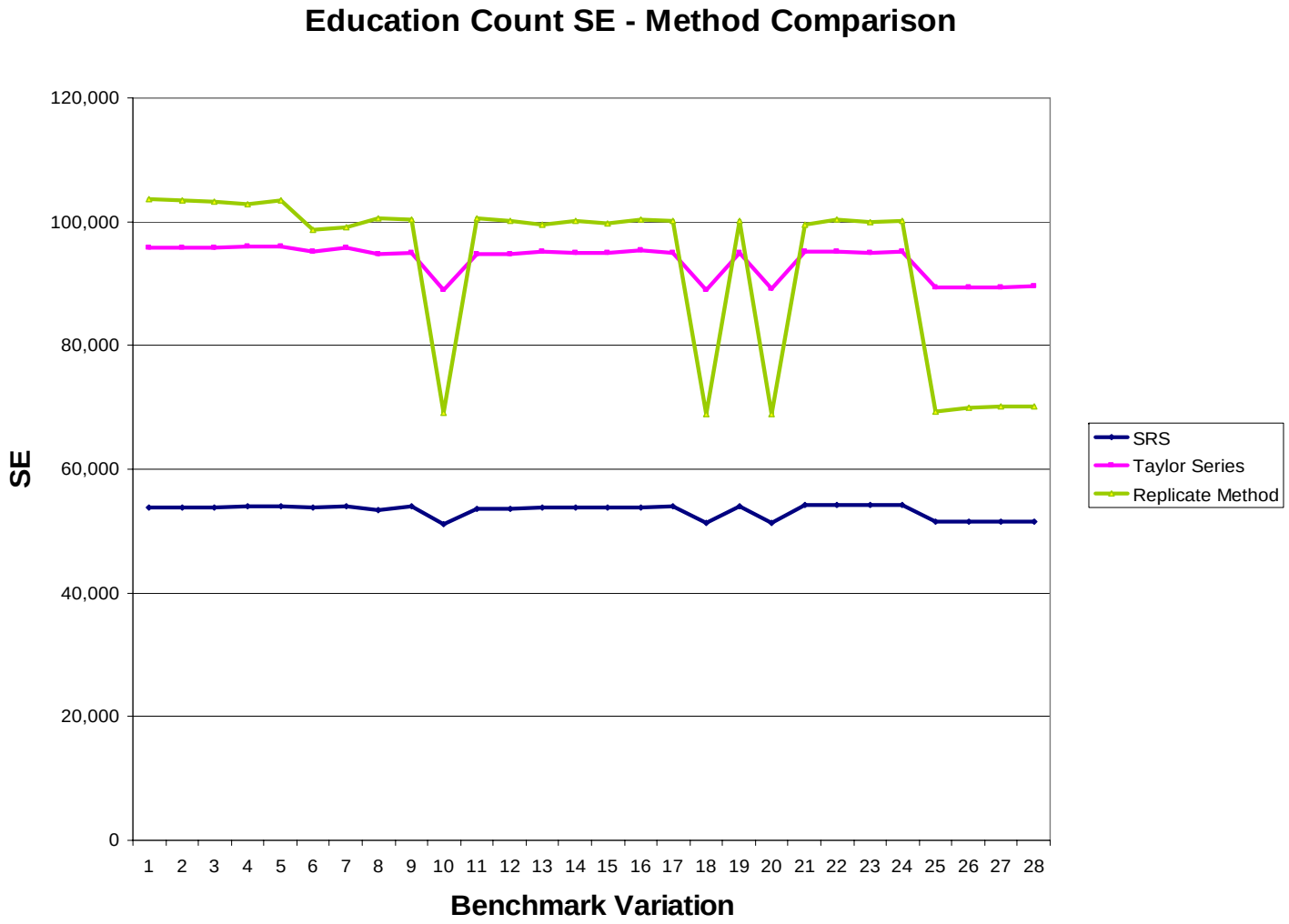

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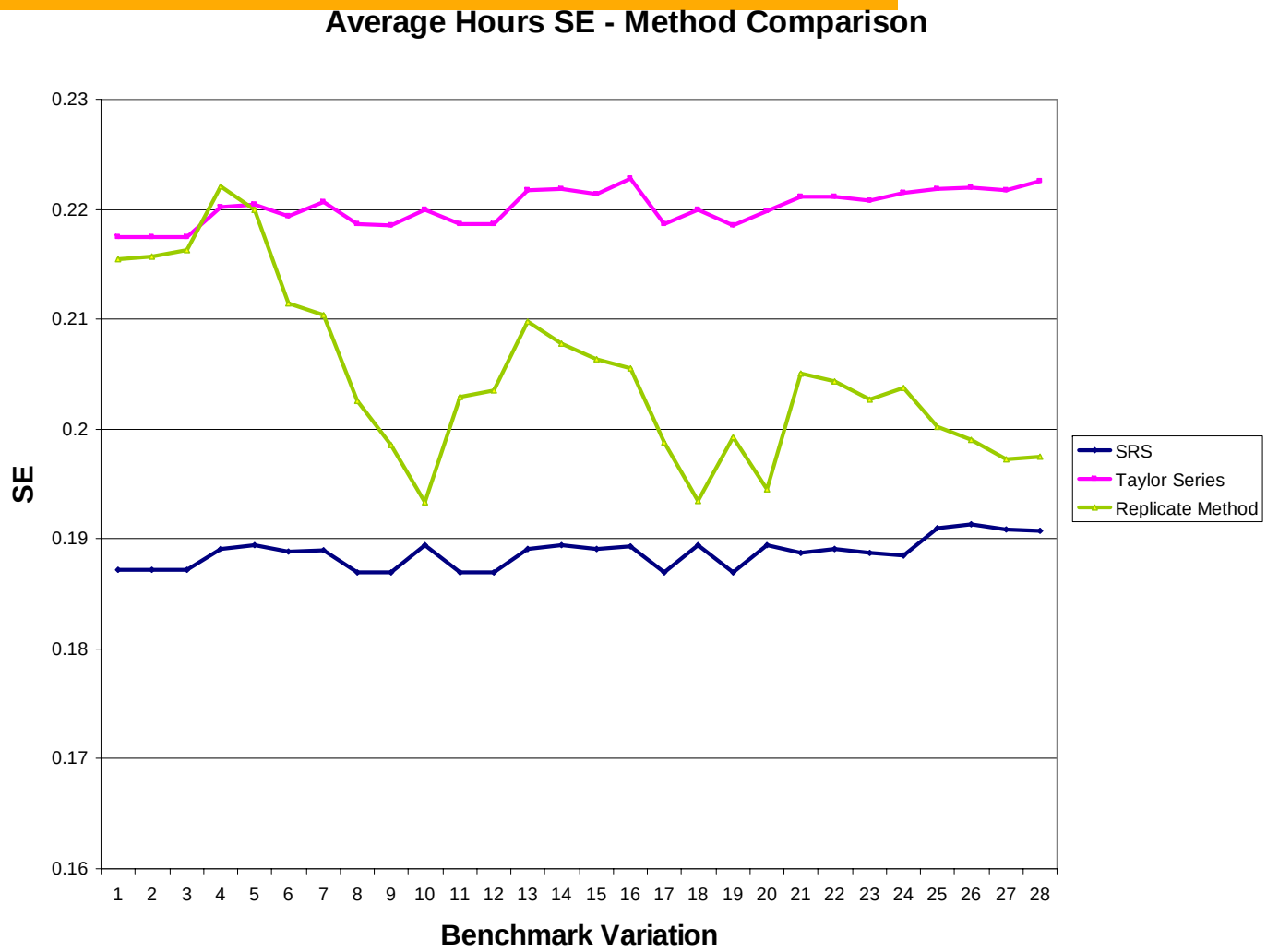

Observations

- Large drop in the replicate estimate:
  - As more benchmarks are added
  - When the labour force survey benchmarks are introduced
- Incorporate error into external benchmarks from the Labour force survey due to their impact on estimates
- Overall should we benchmark to less?

Potential changes to HILDA Release 6

- Provide the updated stratification variable for the Taylor Series method
- Replicate weights
  - Update the replicate group selection process
  - Implement from the start of the weighting process
  - Add error to the LFS benchmarks
  - Provide more replicates?

Future work

- More investigation:
  - Sample design effect
  - Current recommended methods
- Alternative methods
  - Group Bootstrap
- Discussion paper to go on the website
  - http://www.melbourneinstitute.com/hilda/