CAMBRIDGE SYSTEMATICS

Think Forward

SERPM 8 Model Status and Next Steps

presented to

RTTAC-MS

presented by

Cambridge Systematics, Inc.

Jay Evans, Marty Milkovits

July 17, 2019

Model status

- Latest model version released for use - January 30, 2019
- Developer version enhancements completed
  - **Fixes**: TNC repositioning trip mechanism
  - **Enhancements:** Default to utilize all threads in Cube Catalog
  - **Reports**: SE Data; PopSyn; TNC & C/AV summaries
  - **Utilities**: seed skim generation; free-flow network; voyager.exe check; PopSyn checker, site impact preparation
  - **Catalog**: scenario key defaults; key names
  - **Inputs**: highway network updated with D6 feedback and removed unused fields
- Pending enhancements
  - Update JPPF (to utilize all processors on Windows 10 systems)
- Bi-weekly maintenance calls
  - Next call Monday August 5, 3 - 3:45pm

Documentation status

- Materials for approval
  - Online documentation: https://sites.google.com/site/serpm8reference/
  - Development and validation tech report
  - Tutorial videos
    - Installation, configuration, scenario creation, running the model,
    - Reviewing assignment results,
    - Model reports (in production)
  - Executive summary
- Approved materials to be uploaded to FSUTMS (with attachments)

We are requesting a motion today to approve the documentation

Calibration status

- Model validated and ready to use
- Additional revisions will continue during update phase
  - Network corrections
  - Traffic count corrections
- Additional checks where base year model results differ from observations
  - Selected aggregate summaries
  - Links where base year modeled volumes differ from counts

Model Sensitivity Testing

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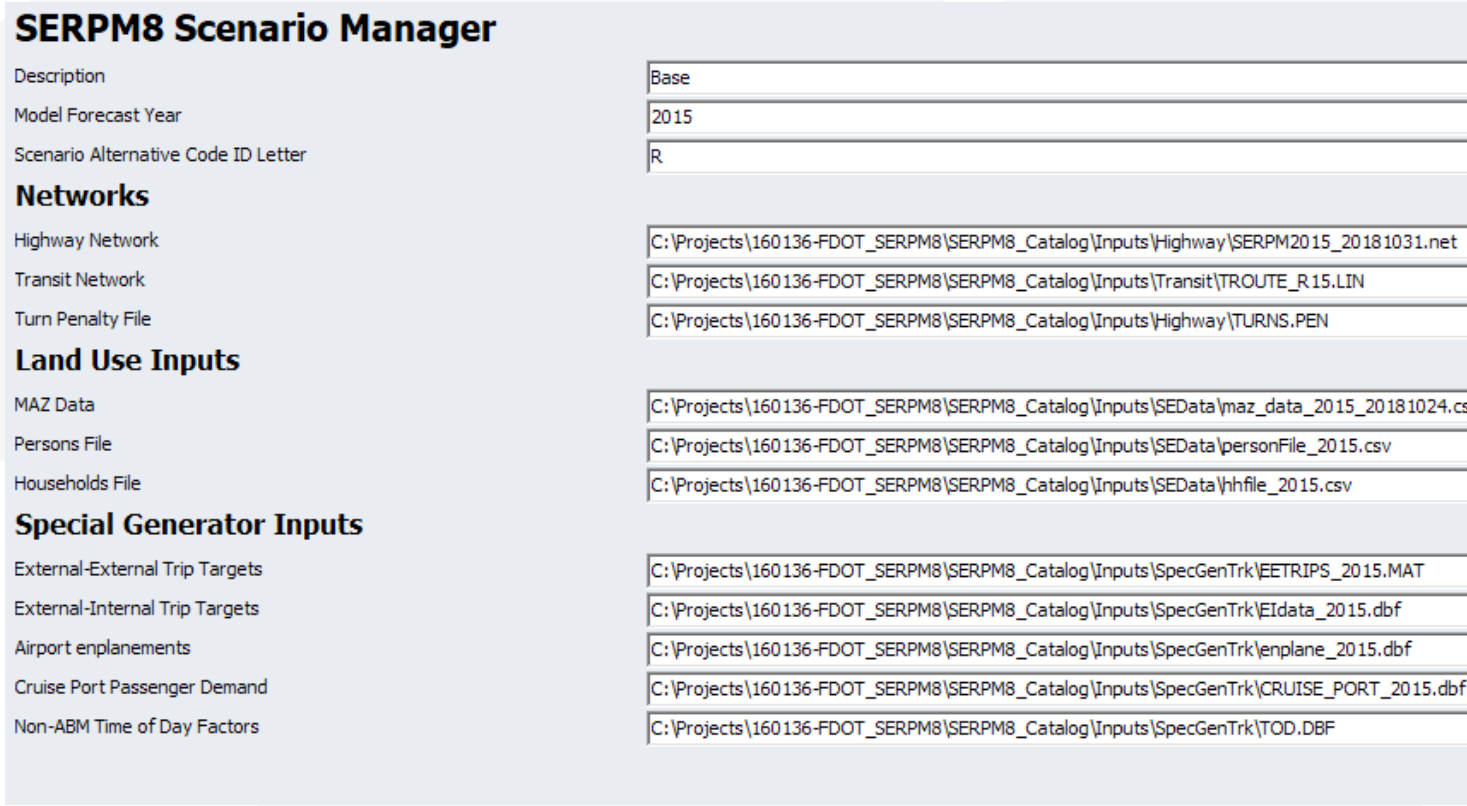
Motivation

- Developing guidance for application
- Scenario specification decisions:
  - Input data
  - Model steps to run (PopSyn, Assignment-Only)
  - Model setup

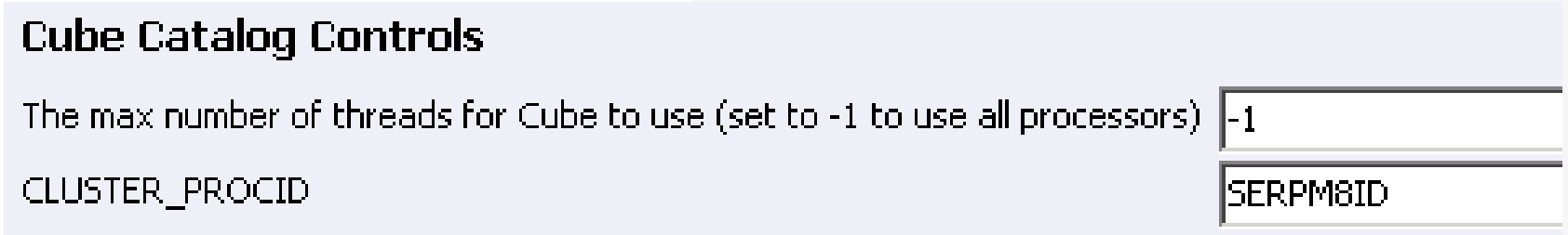


Variables tested

- Number of Cube Cluster threads (10, 15, 20) – base 2015 scenario
- Seed skims (base 2015, free-flow, forecast 2045) – base 2015 scenarios
- Shadow pricing – base 2015, E+C 2045, XCF 2045, RTP scenarios

Cluster threads

- 6 threads are necessary for transit path building
- Highway assignment and trip table processing will use as many as available
- Multi-threaded results are not consistent
  - Different number of threads
  - Different processors



Cluster threads (aggregate checks)

VMT

Facility Type	20 Tread Baseline	10 Threads	15 Threads
Freeways	24,041,873	-0.14%	-0.14%
Uninterrupted Roadways	4,448,838	-0.16%	-0.15%
High Speed Arterials	52,674,314	-0.08%	-0.01%
Low Speed Collectors	10,994,630	-0.10%	0.07%
Ramps	4,831,878	-0.02%	-0.05%
HOV Lanes	2,819,527	0.41%	0.27%
Toll Roads	16,808,520	-0.04%	0.10%
All Groups	116,619,581	-0.08%	-0.01%

Operator	20 Thread Baseline	10 Threads	15 Threads
Tri-Rail	16,684	-0.1%	-0.4%
MDT	332,492	-0.3%	-0.2%
BCT	119,213	0.5%	-0.1%
Palm Tran	41,676	-0.5%	0.4%
Total Transit Boardings	510,065	-0.1%	-0.1%
Total Transit Linked Trips	359,464	0.1%	0.0%
Boardings / Linked Trip	1.42	-0.2%	-0.1%

Cluster threads (link-level checks)

- Exclude links with zero volume in either scenario (parallel paths)
- Large percentage differences associated with low baseline volumes
- Low RMSE
- Links with substantial relative volume difference:
  - 5 with 50% lane capacity change (low speed collectors and ramps)
  - 14 with 25% lane capacity change (low speed collectors and ramps)

Percent RMSE (compared to 20 thread)

County	Facility Type	Daily		AM Peak		PM Peak	
		10thr	15thr	10thr	15thr	10thr	15thr
Palm Beach	Freeways	1%	1%	1%	1%	1%	1%
Palm Beach	Uninterrupted Roadways	1%	1%	3%	2%	2%	1%
Palm Beach	High Speed Arterials	1%	1%	3%	3%	2%	2%
Palm Beach	Low Speed Collectors	3%	3%	5%	7%	4%	3%
Palm Beach	Ramps	1%	1%	2%	2%	2%	2%
Palm Beach	HOV Lanes	2%	3%	4%	4%	2%	3%
Palm Beach	Toll Roads	0%	0%	1%	1%	1%	1%
Broward	Freeways	0%	0%	1%	1%	0%	1%
Broward	Uninterrupted Roadways	1%	1%	2%	2%	1%	2%
Broward	High Speed Arterials	1%	1%	3%	3%	2%	1%
Broward	Low Speed Collectors	3%	3%	6%	7%	4%	3%
Broward	Ramps	1%	1%	3%	4%	3%	3%
Broward	HOV Lanes	1%	1%	1%	1%	1%	1%
Broward	Toll Roads	0%	1%	1%	1%	1%	1%
Miami-Dade	Freeways	0%	1%	1%	1%	1%	1%
Miami-Dade	Uninterrupted Roadways	1%	1%	2%	4%	1%	1%
Miami-Dade	High Speed Arterials	1%	1%	3%	3%	2%	1%
Miami-Dade	Low Speed Collectors	3%	3%	6%	6%	4%	3%
Miami-Dade	Ramps	2%	2%	4%	5%	3%	3%
Miami-Dade	HOV Lanes	2%	1%	4%	4%	2%	2%
Miami-Dade	Toll Roads	1%	1%	1%	3%	1%	1%

Cluster threads (transit route-level checks)

Mode	10 Threads compared to 20 Thread Baseline RMSE	PRMSE
TriRail	82	1.3%
TriRail Shuttles	14	11.2%
I-95/595 Express Buses	19	9.2%
Metrorail	77	0.4%
Metromover	166	2.6%
Local Bus	27	3.2%

Operator	10 Threads compared to 20 Thread Baseline RMSE	PRMSE
Regional	22	5.6%
Palm Beach	17	3.1%
Broward	32	3.6%
Miami-Dade	36	2.8%

Thread sensitivity test implications

- Use maximum threads to reduce run time
- Use caution when basing conclusions on relatively small link-level percentage changes

Seed skims and network

- “Warm” start with loaded network can save 2 iterations from speed feedback loops
- Impact of seed network is mitigated through speed feedback loops, but different starting point produces different results

Run Controls

Starting Feedback Loop	1
Maximum speed feedback iterations	6
Loaded network to seed transit skims	D:\Models\SERPM_Release\Inputs\Highway\seed_net_skm2045\AVGLOAD_MSA.net
AM Seed Skim	D:\Models\SERPM_Release\Inputs\Highway\seed_net_skm2045\X_AMHSKIMS.mat
PM Seed Skims	D:\Models\SERPM_Release\Inputs\Highway\seed_net_skm2045\X_PMHSKIMS.mat
Off-Peak Seed Skims	D:\Models\SERPM_Release\Inputs\Highway\seed_net_skm2045\X_OFHSKIMS.mat

Seed network (aggregate checks)

VMT

Facility Type	2015 Seed	Free Flow	2045 Seed
Freeways	24,041,873	0.04%	0.18%
Uninterrupted Roadways	4,448,838	-0.42%	0.12%
High Speed Arterials	52,674,314	-0.02%	0.15%
Low Speed Collectors	10,994,630	-0.23%	0.17%
Ramps	4,831,878	-0.03%	0.20%
HOV Lanes	2,819,527	-0.14%	0.49%
Toll Roads	16,808,520	0.03%	0.46%
All Groups	116,619,581	-0.04%	0.21%

Operator	2015 Seed	Free Flow	2045 Seed
Tri-Rail	16,684	-1.5%	3.0%
MDT	332,492	-0.2%	0.6%
BCT	119,213	0.5%	1.1%
Palm Tran	41,676	0.2%	0.9%
Total Transit Boardings	510,065	-0.1%	0.8%
Total Transit Linked Trips	359,464	-0.1%	0.8%
Boardings / Linked Trip	1.42	0.0%	0.0%

Seed network (link-level checks)

- Exclude links with zero volume in either scenario (parallel paths)
- Large percentage differences associated with low baseline volumes
- Low RMSE
- Links with substantial relative volume difference:
  - 4 with 50% lane capacity change (high speed arterials, low speed collectors and ramps)
  - 28 with 25% lane capacity change (high speed arterials, low speed collectors and ramps)

Percent RMSE (compared to 2015 seed)

		Daily		AM Peak		PM Peak	
County	**Facility Type**	**freeflow**	**forecast**	**freeflow**	**forecast**	**freeflow**	**forecast**
Palm Beach	Freeways	1%	1%	1%	1%	1%	1%
Palm Beach	Uninterrupted Roadways	2%	1%	2%	4%	3%	2%
Palm Beach	High Speed Arterials	2%	2%	3%	4%	2%	2%
Palm Beach	Low Speed Collectors	4%	3%	8%	8%	6%	6%
Palm Beach	Ramps	2%	2%	3%	3%	3%	3%
Palm Beach	HOV Lanes	3%	2%	5%	5%	3%	2%
Palm Beach	Toll Roads	1%	1%	1%	3%	1%	1%
Broward	Freeways	0%	1%	1%	1%	1%	1%
Broward	Uninterrupted Roadways	1%	1%	3%	3%	1%	3%
Broward	High Speed Arterials	1%	1%	3%	3%	2%	2%
Broward	Low Speed Collectors	3%	3%	7%	7%	5%	5%
Broward	Ramps	2%	2%	4%	4%	3%	3%
Broward	HOV Lanes	0%	1%	1%	1%	1%	2%
Broward	Toll Roads	1%	1%	1%	2%	1%	1%
Miami-Dade	Freeways	1%	1%	1%	1%	1%	1%
Miami-Dade	Uninterrupted Roadways	1%	1%	3%	4%	2%	2%
Miami-Dade	High Speed Arterials	2%	2%	3%	3%	2%	2%
Miami-Dade	Low Speed Collectors	3%	3%	6%	7%	4%	4%
Miami-Dade	Ramps	3%	2%	5%	5%	3%	3%
Miami-Dade	HOV Lanes	2%	3%	1%	4%	5%	7%
Miami-Dade	Toll Roads	1%	1%	2%	2%	1%	1%

Seed network (transit route-level checks)

	Free Flow		Forecast	
Mode	RMSE	PRMSE	RMSE	PRMSE
TriRail	77	1.2%	259	4.0%
TriRail Shuttles	17	13.5%	26	20.6%
I-95/595 Express Buses	22	10.6%	24	11.6%
Metrorail	130	0.6%	390	1.9%
Metromover	104	1.6%	112	1.7%
Local Bus	42	5.0%	46	5.5%

	Free Flow		Forecast	
Operator	RMSE	PRMSE	RMSE	PRMSE
Regional	26	6.6%	56	14.2%
Palm Beach	25	4.7%	39	7.2%
Broward	49	5.6%	47	5.4%
Miami-Dade	46	3.6%	69	5.4%

Seed network sensitivity test implications

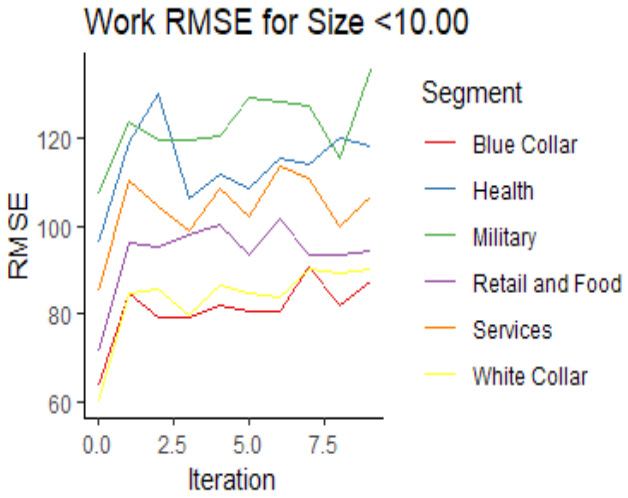
- Use closest seed network to reduce run time
- Where appropriate, use consistent seed networks across scenarios
- Use caution when basing conclusions on relatively small link-level percentage changes

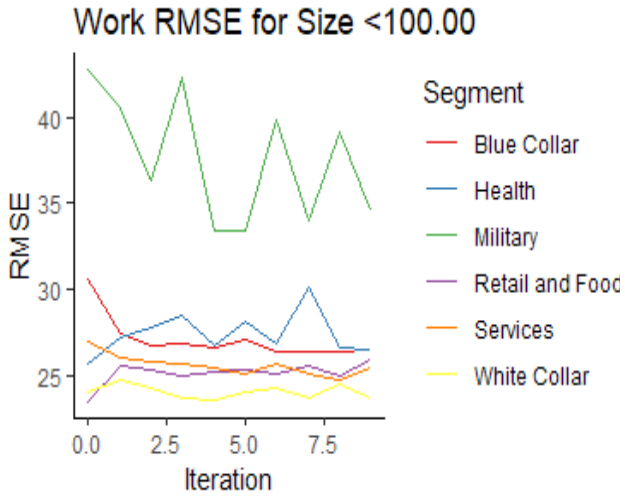
Shadow pricing

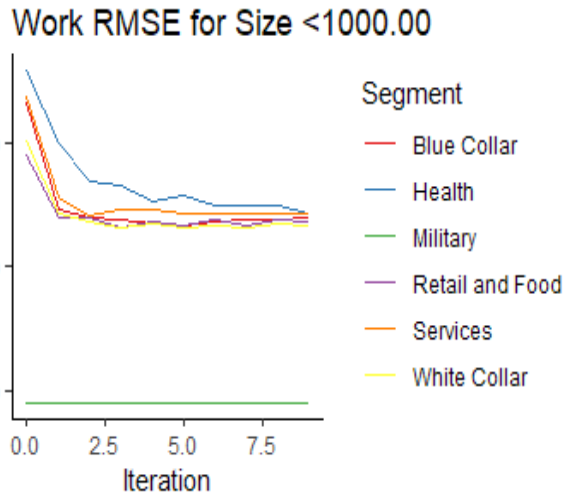
- Shadow pricing promotes consistency between work and school locations and jobs and enrollment
- Shadow prices are produced through CT-RAMP operation
- Changes in land use and/or network conditions may require update to the shadow price

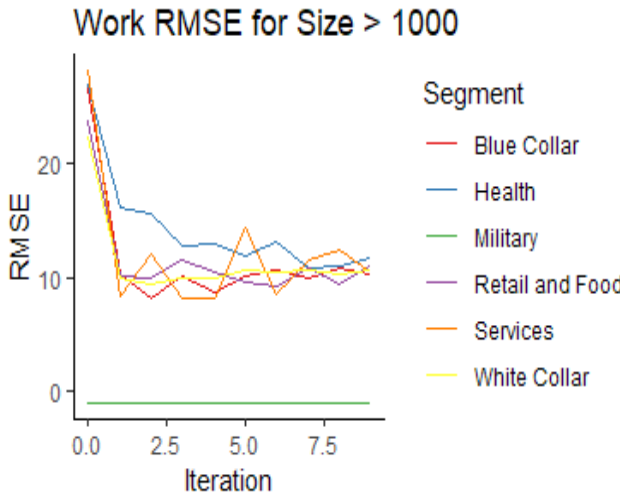
```
UsualWorkLocationChoice.ShadowPrice.Input.File = /uec/ShadowPricingOutput2045RTN_work_0.csv
UsualSchoolLocationChoice.ShadowPrice.Input.File = /uec/ShadowPricingOutput2045RTN_school_0.csv
uwsl.ShadowPricing.Work.MaximumIterations = 1
uwsl.ShadowPricing.School.MaximumIterations = 1
uwsl.ShadowPricing.OutputFile = /../_abm/ShadowPricingOutput.csv
```

2015

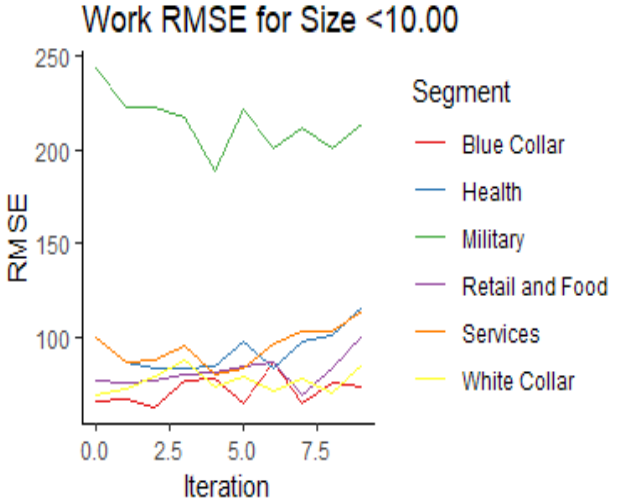


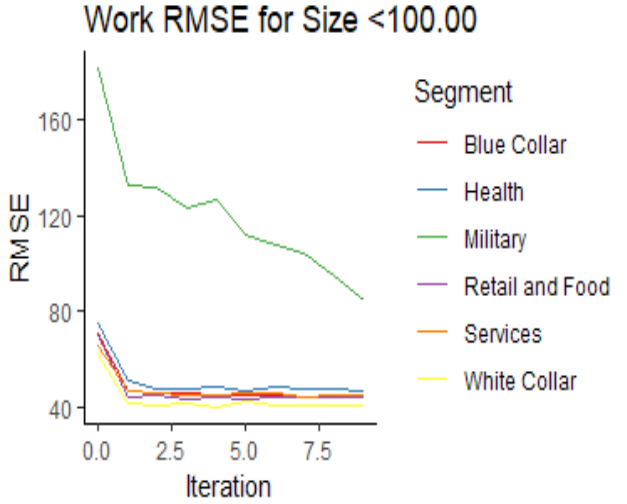


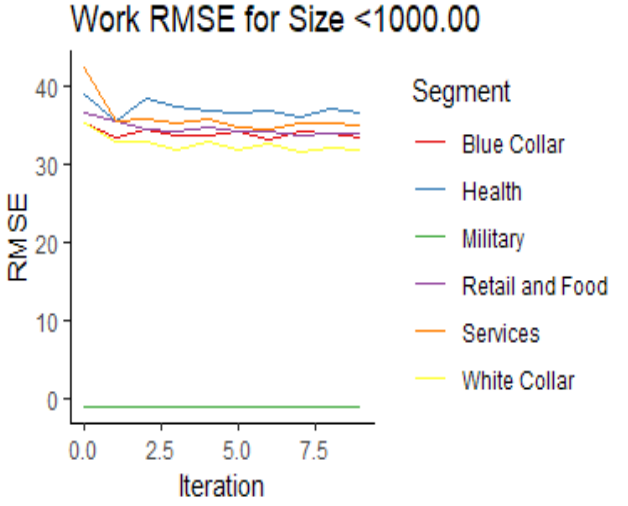


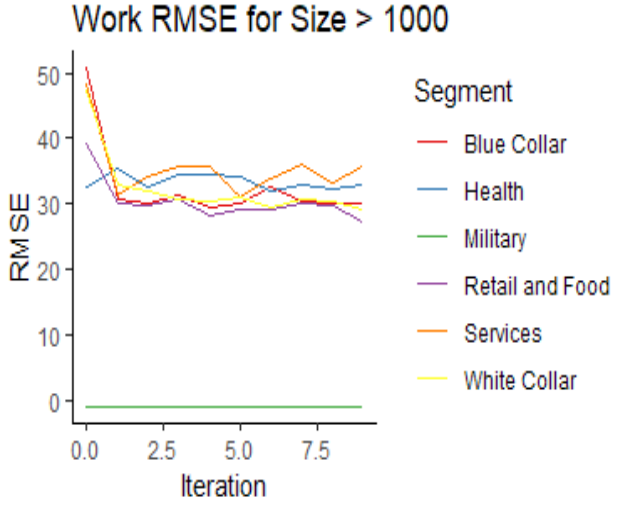


2045









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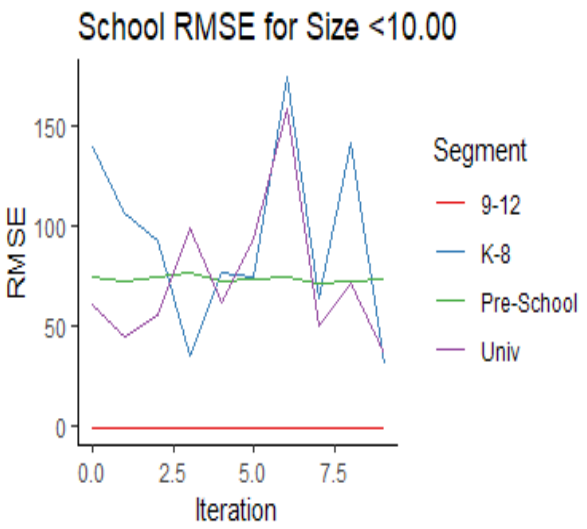
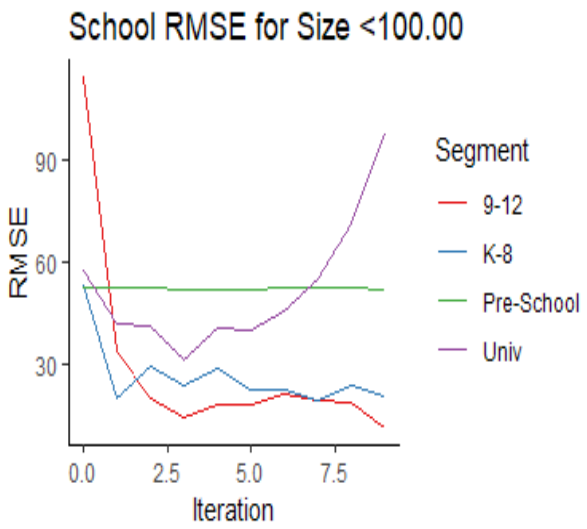
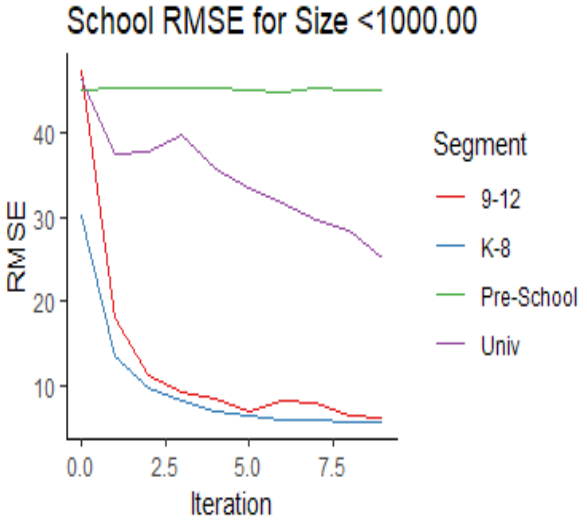
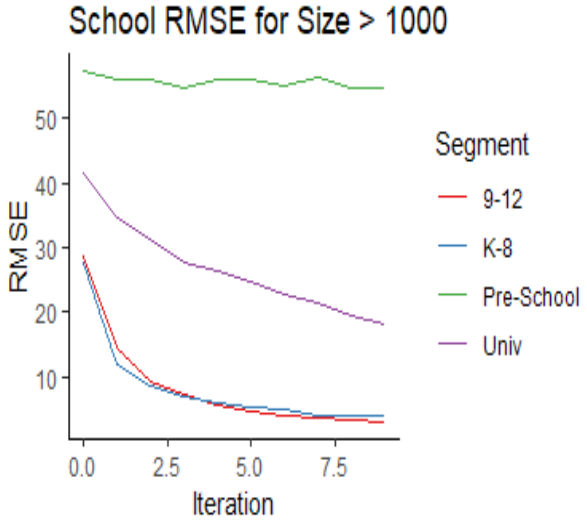
2015

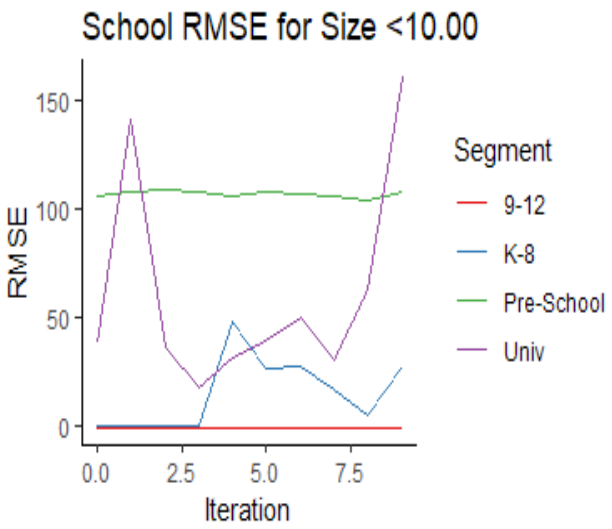


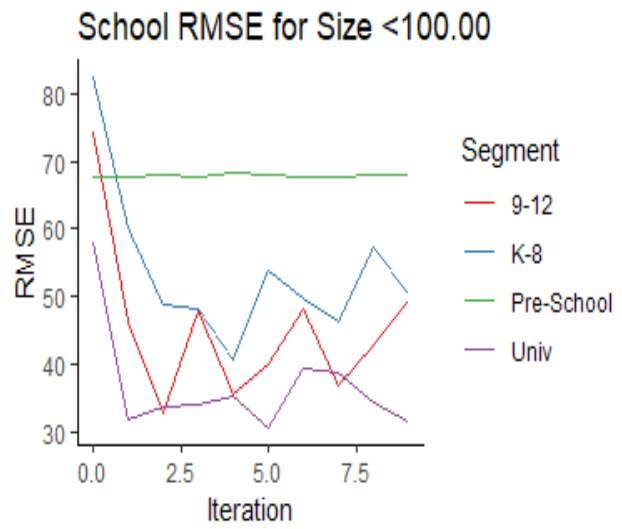


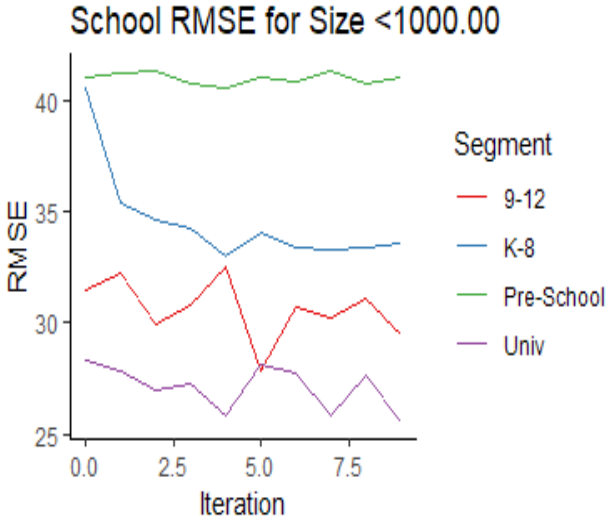


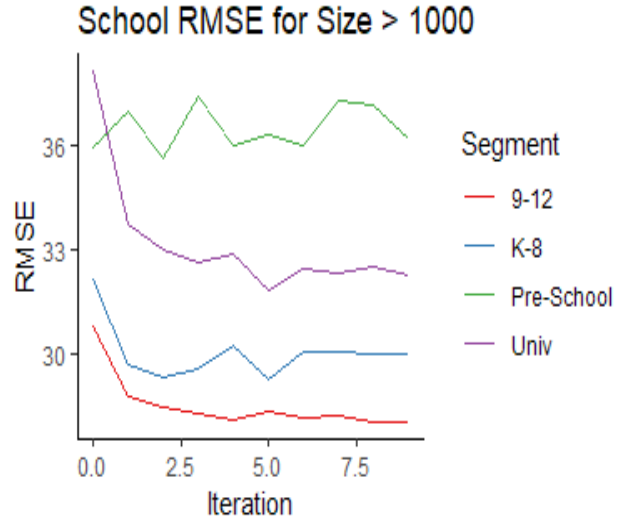


2045









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Shadow pricing convergence

- Inconsistent trend of improvement beyond initial iterations
- Large variations for segments with sparse targets (e.g. Military, University)

Next steps

- Test impact of shadow prices on scenarios in same forecast year - RTP Scenarios
- Test variation due to change in shadow price
- If necessary, develop a model process to identify need and produce updated shadow prices

Application Testing Lessons Learned/ Addressing Known Issues

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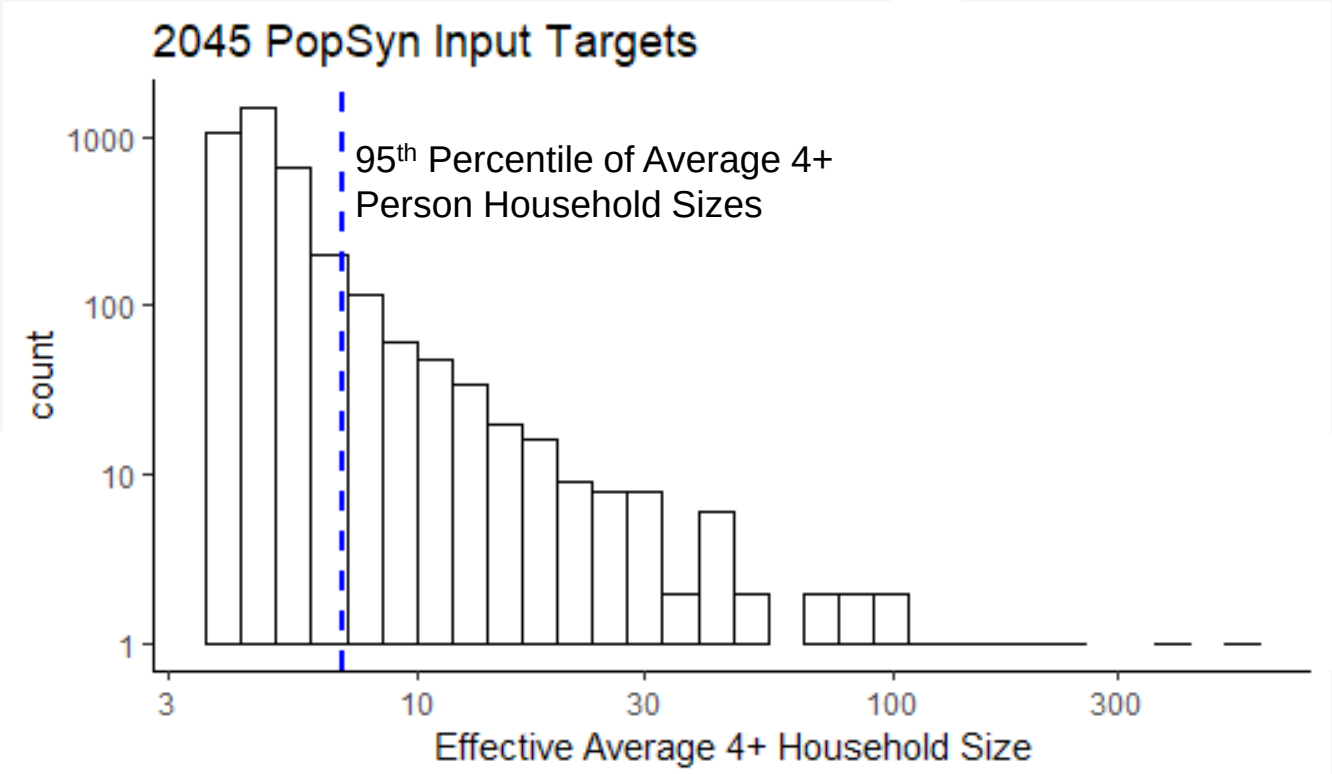
Addressing Known Issues

- Calibration updates (discussed previously)
- Network updates
  - D6 feedback applied to 2045 network
  - D4 feedback applied to 2015 and 2045 networks
- SE data updates
  - Zones flagged by enhanced checking utility corrected
  - Households by size (average size of 4+ person households)
  - Workers by population
- SE data Corrections
  - Override with TAD (or SD) distributions

Enhanced PopSyn checks

- 4+ Person Households
  - Average 4+ person household size?
- Worker Households
  - Percentage of children and seniors who are workers?

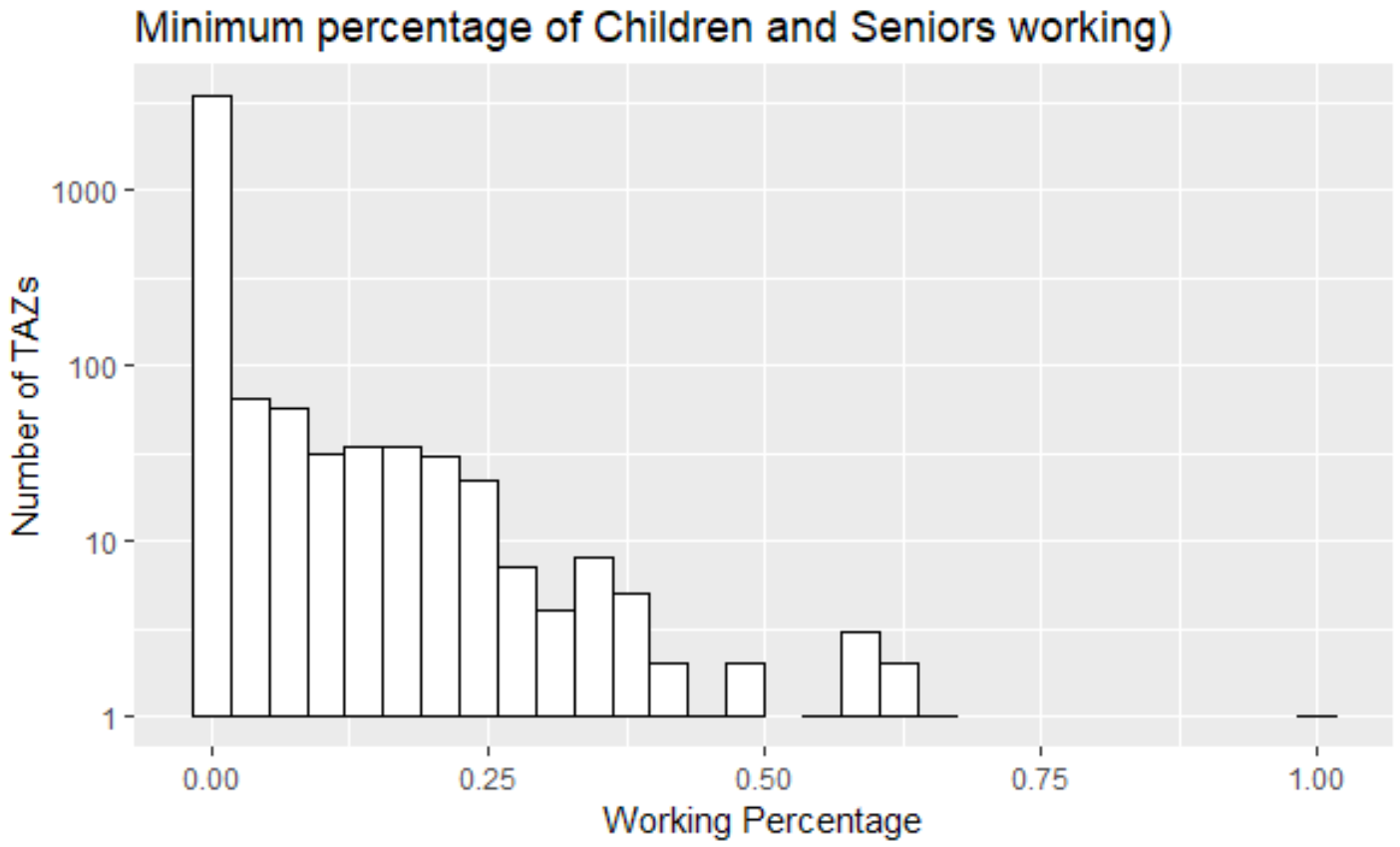
4+ person households



Example zone with 4+ average size = 165

	INPUT	OUTPUT
TOTAL_HOUSEHOLDS	198	274
PERSONS	776	567
HHSIZE_1	117	102
HHSIZE_2	70	115
HHSIZE_3	8	25
HHSIZE_4PLUS	3	32

Workers



Zones with > 50% Senior/Children Working

MIN WORKERS	CHILDREN	ADULTS	SENIORS	% working children / seniors
159	60	120	12	54.2%
765	198	556	128	64.1%
210	62	162	21	57.8%
1	0	0	1	100.0%
15	3	8	8	63.6%
25	5	14	14	57.9%
16	1	6	15	62.5%
11	0	7	7	57.1%

Recommended resolution

- HH Size: if average 4+ size > 7 (95th percentile)
  - Population will be less than target
  - Apply TAD distribution of HH Sizes
  - Recheck and apply SD distribution
- Workers: High percentages will lead to
  - More 16-17 year old children
  - More 65+ workers
  - More part time workers
  - Flag zones with > 50% of children + seniors working

Model Enhancements

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Next steps: model enhancements

- Windowed area model
- PopSyn input utility [new checks discussed in RTP section]
- Determination of traveler characteristics
- Computational efficiencies

Enhancement milestones

- Initial test results (August)
  - Initial results on WAM testing
  - Initial results on Computational Efficiency testing
  - Draft traveler characteristics excel report
- Complete testing (September/October)
  - Complete WAM geographic sampling tests
  - Complete Computational Efficiency tests and recommendations
  - Sample traveler characteristics results
- Complete utilities (November)
  - PopSyn utility complete
  - Traveler characteristics process complete
- Updated catalog (December/January)
  - Updated catalog with enhancements incorporated