NSW Dynamic Life Cycle and Welfare Checks Code Companion

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Preface

This is a work-in-progress Matlab package consisting of functions that solve the dynamic life cycle model in Nygård, Sørensen and Wang (2020) (Nygård et al., 2020). The code companion presents solutions to the dynamic life-cycle problem, and methods for evaluating the marginal gains from allocating additional welfare checks. Tested with Matlab 2019a (The MathWorks Inc, 2019).

All functions are parts of a matlab toolbox that can be installed:

> Download and install the Matlab toolbox: PrjOptiSNW.mltbx

The Code Companion can also be accessed via the bookdown site and PDF linked below:

> **bookdown site** and **bookdown pdf**.

This bookdown file is a collection of mlx based vignettes for functions that are available from PrjOptiSNW. Each Vignette file contains various examples for invoking each function.

The package relies on MEconTools, which needs to be installed first. The package does not include allocation functions, only simulation code to generate the value of each welfare check increments for households. Allocation functions rely the R optimal allocation package PrjOptiAlloc.

The site is built using Bookdown (Xie, 2020).

Please contact FanWangEcon for issues or problems.

Chapter 1

Introduction

1.1 Household Problem and Distributions

In Nygaard, Sorensen and Wang (2020), we study the optimal allocation of COVID-19 welfare checks. Congress spent $250 billion sending checks to individuals in March 2020 to provide economic stimulus. Could the same amount of stimulus have been achieved for less money? Using a life-cycle consumption-saving model with heterogeneous consumers, we calculate the consumption responses to cash transfers for, e.g., couples and singles with different levels of income and number of children. We calculate the aggregate consumption response for all feasible allocations of $250 billion and, using a new algorithm that allows for the ranking of an arbitrarily large number of allocations, we find the optimal allocation under alternative constraints. The optimal policy allocates more toward low-income and younger consumers and can achieve the same stimulus effect at almost half the cost.

This Matlab based programming guide, package, and associated vignettes, provide examples and instructions on how the dynamic programming problem in Nygaard, Sorensen and Wang (2020) is solved. The R optimal allocation package PrjOptiAlloc takes inputs from the dynamic programming problems and solves for optimal allocations given varying planner objectives and constraints.

1.1.1 Flat Script and Code Package

There are two broad versions of the code. A number of files are included in the zflat folder, including the operation gateway file main. Files in the zflat folder provides a linear, easier to understand illustration/demonstration of the overall code structure. It is useful to review the overall algorithm design. However, it should not be called to implement the programs. Programs in the folder were written to help test out algorithm ideas.

The rest of the files inside PrjOptiSNW form a matlab package that can be downloaded and installed. Each component of the overall code program is programmed up separately with its own testing vignette and default parameter structure. Various solution algorithms are provided at each step, with the final checks problem relying on efficient and precise solution methods.

1.1.2 Dynamic Programming Solution Structure COVIDless World

First we solve for the optimal consumption/savings problem in the COVID-less world:

- **83**: 2020 age groups, age 18 to 100 age groups
- **65**: grid of savings state-space grid, and exact continuous optimal savings choices using the **FF_VFI_AZ_BISEC_VEC** function from **MEconTools**.
- **6650 shocks**: 1330 productivity shocks for household head and sposue and 5 kids transition count shocks
- **2** permanent education states
- **2** permanent marital states

The state-space has: 2*2*6650*65*83= 143,507,000 elements. The choice-space is is continuous. Two important things two note:

1. The large number of shocks are needed to obtain accurate group-specific marginal propensity effects for small income bins that define the choice-set of the allocation problem.

2. While a choice-grid-based solution algorithm might sufficiently approximate the value function, but its policy function zig-zags. For the welfare checks problem, where welfare checks come in small increments, the zig-zags lead to fluctuating (negative and positive) marginal propensities to consume as resource availability increases for very small amounts of check increments. To deal with this challenge, we rely on the **FF_VFI_AZ_BISEC_VEC** function from **MEconTools** to provides efficient exact savings choices.

Solving this dynamic life-cycle programming problem requires approximately 10 to 20 minutes on a home-pc depending on computer speed. There is no processor requirements. Memory requirement is approximately 20GB. There are two core associated functions vignettes that solves the dynamic programming problem to obtain value/policy and distributions induceds by exogenous processes and the policy function:

- Core dynamic programming code: snwx_vfi_bisec_vec
- Core distribution code: snwx_ds_bisec_vec

Small testing vignettes of alternative solution algorithms for policy/value:

- Small test using matlab minimizer (very slow but identical results as core program): snwx_vfi_test
- Small test using grid-search-based solution algorithm (insufficiently precise for welfare checks): snwx_vfi_test_grid_search
- Small test of core dynamic programming code: snwx_vfi_test_bisec_vec
- Small test of core dynamic programming code with spousal shock: snwx_vfi_test_bisec_vec_spousalshock

Testing vignettes for alternative solution algorithm for distribution:

- Grid serach distributional code (insufficiently precise) :snwx_ds_grid_search
- Core solution distribution code (vectorized for policy/value, looped for dist): snwx_ds_bisec_vec_loop
- Core solution distribution code (vectorized fully): snwx_ds_bisec_vec

1.1.3 Dynamic Programming Solution Structure during COVID Year

During the COVID year, we use the value function from the COVID-less world as the continuation value, and solve for consumption-savings policy/value functions during the COVID year. We solve once for households facing realized COVID surprise unemployment shocks, one more time for households who do not experience COVID unemployment shocks.

We solve for the marginal consumption differences and value given 244 increments of checks ($100) each check. This is done again by using the **FF_VFI_AZ_BISEC_VEC** function from **MEconTools**. While checks could be viewed as an additional state variable, we evaluate the marginal effects of check by solving for the equivalent household-specpfic variation in savings state that has the same effect as a welfare check transfer. The process takes into account the nonlinear tax-schedule that households face as well as return on savings.

Overall:

- 286 million: Solve 143 million state-space points twice under COVID unemployment and COVID employment world
- 70 billion: Solve at the 143 million state-space elements 244 + 1 times for all possible check levels (244 checks + no check value/consumption) to arrive at 70 billion marginal propensity to consume for households with heterogeneities in education level, marital status, children below 18 count (0 to 4), age, savings levels, household head and spouse shocks.

Associated functions vignettes: the core dynamic programming code: snwx_vfi_bisec_vec, has a third input which is the existing future value function. When this is provided, the dynamical programming problems solves for one period given already computed future value, and so the dynamic programming solution solves forward. When it is not provided, solves for value/policy backwards.

- snwx_vfi_unemp_bisec_vec provides the vignette given unemployment shock.
- snwx_a4chk_wrk_bisec_vec computes the marginal impacts of a particular welfare check increment for those without unemployment shock in COVID year.
- snwx_a4chk_unemp_bisec_vec computes the marginal impacts of a particular welfare check increment for those with unemployment shock in COVID year.
- snwx_evuvw20_jaeemk considers probabilities for getting hit with the COVID shock and considers the expected value conditional on age, savings level, shocks, educational status, kids count and marital status in 2020.

1.2 Values of Checks Conditional on 2019 Information

Eligibility for the stimulus checks was tied to each household's income and family size in the year prior to COVID-19. Consistent with this, we focus on the optimal allocation of stimulus checks given household characteristics in 2019.

1.2.1 Expected Outcomes given 2019 Information

In the actual welfare checks allocation policy setting, 2020 realized individual level COVID shocks and other productivity shocks were not used by the IRS to determine allocation eligibility. Instead, the IRS used information available from 2019. Given the persistence of productivity shocks, as well as the correlation between surprised COVID shock and household income and age from 2019, 2019 information are good predicators of household status in 2020.

We compute the expected outcomes from 2019 perspective conditional on household attributes that are observed to the IRS in 2020 given information they gathered in 2019. The planner does not observe the full state-space so we intergrate from 2019 perspective given 2019 to 2020 COVID transition probabilities (conditional on state-space) and kids and shock transitions.

- 82 age groups: Age 18 to 99
- 5 kids groups: Children 0 to 4
- 2 marital groups: Marital Status 0 or 1
- 509 Income Groups: 476 bins below max actual phaseout: solved at \$500 intervals between \$0 and \$238,000, and 33 bins after max actual phaseout: solved at \$5000 interval after \$238,000, where the 33rd final bin is between \$401,130 and Maximum.

Together, these are: 5*2*83*509 = 422,470 groups/bins in 2019. We have (244+1) marginal average consumption gain, and value gain for each of the groups, so from 2019 planner perspective, we have 103.5 million expected MPCs (and expected value changes): 422470*(244+1)=103,505,150.

Each income group is composed of individuals of with different 2019 productivity shocks and savings levels. Given the transition probabilities, policy functions, and covid-less distributions across household types, we can compute the joint distribution of education type, shocks, and savings levels condition on income bins, martial status, kids count and age. This joint distribution is only well approximated when sufficient number of shocks were used when solving for value/policy in the covid-less world and covid-year world.

- snwx_evuvw19_jaeemk provides the expected outcomes conditional on 2019 age, savings levels, shocks, educational status, marital status and kids under 18 count, given the transition probabilities that incorporate the surprise COVID shock. Households do not optimize in 2019 given COVID shock probabilities, the shock is a surprise. But expected value in 2019 given 2019 state-space for consumption and value depends on COVID shock and the non-covid households dynamic consumption/savings choices in 2019.

- snwx_evuvw19_jmky provides the expected value in 2019 given not the full state-space, but the state-space that is potentially known to the IRS in 2019: age, marital status, kids count and 2019 household income. Household income is a function of savings, shock and educational status.
- snwx_evuvw19_jmky_allchecks solves for the marginal incremental effects of a vector of checks for all household types, and stores the results to file. This operation is fully parallelizable.

Given the solution, snwx_evuvw19_jaeemk_mky shows key overall distributional statistics, and distributional statistics by kids, marital and income bins.

1.2.2 Dynamic Programming Timing

Overall time requirements for solving the checks problem on a standard ($1000) dollar desktop with 4 cores:

- 30 minutes to 1 hour: solving the dynamic programming problem 3 times for covid-less world, for covid-world with unemployement shock and without.
- 3 hours: derive the distributions induced by policy functions and shock processes.
- 650 seconds: the time it takes to compute the marginal effects of one check. This step is fully scalable. With a cloud computer with larger memory and cores, the problem over all checks could be solved fully parallelly.

Due to the large state-space, especially the large shock-grid, the memory requirement for storing the various multi-dimensional matrixes is high. Solving the problem requires 20GB of memory.

On a workstation with 12 cores with 190 GB of memory (12 workers same time), the computer is able to fully solve the problem from start to finish for 244 check increments in less than 24 hours. On a computer with 4 to 6 cores and 36 GB of memory, the computer is able to fully solve the problem from start to finish for 244 check increments in about 48 hours.

1.3 The Welfare Check Planning Problem

The planner chooses the amount of stimulus checks for each group, where groups are defined by marital status, number of children, income, and age in 2019.

1.3.1 2019 Information Planning Problem

Given the expected outcomes we computed conditional on 2019 information, we can solve the planning problem. We have a number of different planning problems that we solve given different individual level constraints and what the planner can condition allocations on.

For FEASIBLE allocation, there are **970=5*2*97** types/cells of households:

- 5 children groups
- 2 spousal groups
- 97 income bins: the allocation planner sees approximately $2500 income bins between $0 and $238,800, and 1 bin after $238,800. There are 97 bins

for OPTIMAL G4 (4 age groups 18 to 64) allocation, there are **3880=5*2*97*4** types/cells of households:

- 5 children groups
- 2 spousal groups
- 4 age groups
- 97 income bins

for OPTIMAL G47 (47 age groups) allocation, there are **45590=5*2*97*47** types/cells of households:

- 5 children groups

- 2 spousal groups
- 47 age groups
- 97 income bins

Optimal G4 has a + 1 version where we allocate for a fifth age group of individuals older than 64 years of age. Optimal G47 has a + 35 version where optimal allocation for all age groups are determined.

1.3.2 Allocation Functions

Functions in the AllocateR/alloc_discrete_fun_R folder of the project repository page is responsible for feeding the dynamic programming results into the allocation functions. The functions in this folder call the ffp_snw_process_inputs function to solve the allocation problems and compute REV, and call the ffp_snw_graph_feasible function to generate allocation graphs. These two functions are a part of the PrjOptiAlloc package.

Chapter 2

Parameters

2.1 Model Parameters

This is the example vignette for function: **snw_mp_param** from the **PrjOptiSNW Package.** This function sets and gets different parameters.

2.1.1 Parameters Used for Test Simulation

Rather than solving for all ages between 18 to 100, this solves for age groups, and has limited shocks and asset levels. Used for testing.

```
mp_params = snw_mp_param('default_small', true, 100, 6);
```

```
----------------------------------------
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
CONTAINER NAME: mp_params_preftechpricegov Scalars
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
                                i      idx      value
                                --     ---     -------

    Bequests                     1      1            0
    a0                           2      2        0.258
    a1                           3      3        0.768
    a2                           4      4       1.5286
    a2_covidyr                   5      5          NaN
    a2_covidyr_manna_heaven      6      6       1.5286
    a2_covidyr_tax_fully_pay     7      7       12.718
    bequests_option              8      8            1
    beta                         9      9      0.86389
    cons_allocation_rule        10     10            2
    g_cons                      11     11      0.17576
    g_n                         12     12      0.05101
    gamma                       13     13            2
    jret                        14     14           13
    r                           15     15      0.21665
    theta                       16     16      0.56523
    throw_in_ocean              17     17            1

----------------------------------------
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
CONTAINER NAME: mp_params_intlen Scalars
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
                     i     idx     value
```

	i	idx	value
n_agrid	1	1	25
n_educgrid	2	2	2
n_eta_H_grid	3	3	5
n_eta_S_grid	4	4	1
n_etagrid	5	5	5
n_jgrid	6	6	18
n_kidsgrid	7	7	3
n_marriedgrid	8	8	2

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xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
CONTAINER NAME: mp_params_covid_unemploy ND Array (Matrix etc)
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

	i	idx	ndim	numel	rowN	colN	sum	mean	std	coefv
inc_grid	1	3	2	201	201	1	578.5	2.8781	1.8836	0.654
pi_unemp	2	6	2	240	48	5	9.5319	0.039716	0.019674	0.495

xxx TABLE:inc_grid xxxxxxxxxxxxxxxxxx

	c1
r1	0
r2	0.026667
r3	0.053333
r4	0.08
r5	0.10667
r6	0.13333
r7	0.16
r8	0.18667
r9	0.21333
r10	0.24
r11	0.26667
r12	0.29333
r13	0.32
r14	0.34667
r15	0.37333
r16	0.4
r17	0.42667
r18	0.45333
r19	0.48
r20	0.50667
r21	0.53333
r22	0.56
r23	0.58667
r24	0.61333
r25	0.64
r26	0.66667
r27	0.69333
r28	0.72
r29	0.74667
r30	0.77333
r31	0.8
r32	0.82667
r33	0.85333

r34	0.88
r35	0.90667
r36	0.93333
r37	0.96
r38	0.98667
r39	1.0133
r40	1.04
r41	1.0667
r42	1.0933
r43	1.12
r44	1.1467
r45	1.1733
r46	1.2
r47	1.2267
r48	1.2533
r49	1.28
r50	1.3067
r152	4.06
r153	4.12
r154	4.18
r155	4.24
r156	4.3
r157	4.36
r158	4.42
r159	4.48
r160	4.54
r161	4.6
r162	4.66
r163	4.72
r164	4.78
r165	4.84
r166	4.9
r167	4.96
r168	5.02
r169	5.08
r170	5.14
r171	5.2
r172	5.26
r173	5.32
r174	5.38
r175	5.44
r176	5.5
r177	5.56
r178	5.62
r179	5.68
r180	5.74
r181	5.8
r182	5.86
r183	5.92
r184	5.98
r185	6.04
r186	6.1
r187	6.16
r188	6.22
r189	6.28
r190	6.34
r191	6.4
r192	6.46

r193	6.52
r194	6.58
r195	6.64
r196	6.7
r197	6.76
r198	6.82
r199	6.88
r200	6.94
r201	7

xxx TABLE:pi_unemp xxxxxxxxxxxxxxxxxx

	c1	c2	c3	c4	c5
r1	0.080278	0.051706	0.041502	0.03538	0.025176
r2	0.080278	0.051706	0.041502	0.03538	0.025176
r3	0.080278	0.051706	0.041502	0.03538	0.025176
r4	0.080278	0.051706	0.041502	0.03538	0.025176
r5	0.080278	0.051706	0.041502	0.03538	0.025176
r6	0.080278	0.051706	0.041502	0.03538	0.025176
r7	0.080278	0.051706	0.041502	0.03538	0.025176
r8	0.080278	0.051706	0.041502	0.03538	0.025176
r9	0.080278	0.051706	0.041502	0.03538	0.025176
r10	0.080278	0.051706	0.041502	0.03538	0.025176
r11	0.080278	0.051706	0.041502	0.03538	0.025176
r12	0.080278	0.051706	0.041502	0.03538	0.025176
r13	0.080278	0.051706	0.041502	0.03538	0.025176
r14	0.070703	0.042132	0.031928	0.025805	0.015601
r15	0.070703	0.042132	0.031928	0.025805	0.015601
r16	0.070703	0.042132	0.031928	0.025805	0.015601
r17	0.070703	0.042132	0.031928	0.025805	0.015601
r18	0.070703	0.042132	0.031928	0.025805	0.015601
r19	0.070703	0.042132	0.031928	0.025805	0.015601
r20	0.070703	0.042132	0.031928	0.025805	0.015601
r21	0.070703	0.042132	0.031928	0.025805	0.015601
r22	0.070703	0.042132	0.031928	0.025805	0.015601
r23	0.070703	0.042132	0.031928	0.025805	0.015601
r24	0.067512	0.038941	0.028736	0.022614	0.01241
r25	0.067512	0.038941	0.028736	0.022614	0.01241
r26	0.067512	0.038941	0.028736	0.022614	0.01241
r27	0.067512	0.038941	0.028736	0.022614	0.01241
r28	0.067512	0.038941	0.028736	0.022614	0.01241
r29	0.067512	0.038941	0.028736	0.022614	0.01241
r30	0.067512	0.038941	0.028736	0.022614	0.01241
r31	0.067512	0.038941	0.028736	0.022614	0.01241
r32	0.067512	0.038941	0.028736	0.022614	0.01241
r33	0.067512	0.038941	0.028736	0.022614	0.01241
r34	0.068576	0.040004	0.0298	0.023678	0.013474
r35	0.068576	0.040004	0.0298	0.023678	0.013474
r36	0.068576	0.040004	0.0298	0.023678	0.013474
r37	0.068576	0.040004	0.0298	0.023678	0.013474
r38	0.068576	0.040004	0.0298	0.023678	0.013474
r39	0.068576	0.040004	0.0298	0.023678	0.013474
r40	0.068576	0.040004	0.0298	0.023678	0.013474
r41	0.068576	0.040004	0.0298	0.023678	0.013474
r42	0.068576	0.040004	0.0298	0.023678	0.013474
r43	0.068576	0.040004	0.0298	0.023678	0.013474
r44	0.080278	0.051706	0.041502	0.03538	0.025176

r45	0.080278	0.051706	0.041502	0.03538	0.025176
r46	0.080278	0.051706	0.041502	0.03538	0.025176
r47	0.080278	0.051706	0.041502	0.03538	0.025176
r48	0.080278	0.051706	0.041502	0.03538	0.025176

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xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
CONTAINER NAME: mp_params_covid_unemploy Scalars
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

	i	idx	value
TR	1	1	0.0017225
b	2	2	1
n_incgrid	3	4	201
n_welfchecksgrid	4	5	45
scaleconvertor	5	7	58056
xi	6	8	0.75

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xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
CONTAINER NAME: mp_params_statesgrid ND Array (Matrix etc)
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

	i	idx	ndim	numel	rowN	colN	sum	mean	std
agrid	1	1	2	25	25	1	878.91	35.156	41.372
eta_H_grid	2	2	2	5	5	1	-2.2204e-16	-4.4409e-17	1.4543
eta_S_grid	3	3	2	5	5	1	0	0	0

xxx TABLE:agrid xxxxxxxxxxxxxxxxxx

	c1
r1	0
r2	0.0097656
r3	0.078125
r4	0.26367
r5	0.625
r6	1.2207
r7	2.1094
r8	3.3496
r9	5
r10	7.1191
r11	9.7656
r12	12.998
r13	16.875
r14	21.455
r15	26.797
r16	32.959
r17	40
r18	47.979
r19	56.953
r20	66.982
r21	78.125
r22	90.439
r23	103.98
r24	118.82

r25	135

xxx TABLE:eta_H_grid xxxxxxxxxxxxxxxxxx

	c1
r1	-1.8395
r2	-0.91976
r3	0
r4	0.91976
r5	1.8395

xxx TABLE:eta_S_grid xxxxxxxxxxxxxxxxxx

	c1
r1	0
r2	0
r3	0
r4	0
r5	0

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xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
CONTAINER NAME: mp_params_exotrans ND Array (Matrix etc)
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

	i	idx	ndim	numel	rowN	colN	sum	mean	std
cl_mt_pi_jem_kidseta	1	2	2	1	1	1	0	0	
pi_H_eta	2	3	2	25	5	5	5	0.2	0.3851
pi_eta	3	5	2	25	5	5	5	0.2	0.3851
pi_kids	4	6	5	648	3	216	216	0.33333	0.3561
psi	5	7	2	18	18	1	14.251	0.79171	0.3125

xxx TABLE:cl_mt_pi_jem_kidseta xxxxxxxxxxxxxxxxxx

	c1
r1	0

xxx TABLE:pi_H_eta xxxxxxxxxxxxxxxxxx

	c1	c2	c3	c4	c5
r1	0.925	0.075001	4.8068e-10	0	0
r2	0.0026569	0.96788	0.029459	2.602e-11	0
r3	1.1558e-12	0.0096913	0.98062	0.0096913	1.1559e-12
r4	1.28e-29	2.602e-11	0.029459	0.96788	0.0026569
r5	2.8504e-54	1.8802e-27	4.8068e-10	0.075001	0.925

xxx TABLE:pi_eta xxxxxxxxxxxxxxxxxx

	c1	c2	c3	c4	c5
r1	0.925	0.075001	4.8068e-10	0	0
r2	0.0026569	0.96788	0.029459	2.602e-11	0
r3	1.1558e-12	0.0096913	0.98062	0.0096913	1.1559e-12

r4	1.28e-29	2.602e-11	0.029459	0.96788	0.0026569
r5	2.8504e-54	1.8802e-27	4.8068e-10	0.075001	0.925

xxx TABLE:pi_kids xxxxxxxxxxxxxxxxxx

	c1	c2	c3	c214	c215	c216
r1	0.88584	0.11137	0.0027905	1	0	0
r2	0.051343	0.66234	0.28632	1	0	0
r3	0.0015025	0.063309	0.93519	1	0	0

xxx TABLE:psi xxxxxxxxxxxxxxxxxx

	c1
r1	0.99935
r2	0.99623
r3	0.99635
r4	0.99537
r5	0.99299
r6	0.98956
r7	0.98547
r8	0.98022
r9	0.96914
r10	0.95071
r11	0.92082
r12	0.87772
r13	0.81394
r14	0.70638
r15	0.54032
r16	0.34767
r17	0.18848
r18	0

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xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
CONTAINER NAME: mp_params_exotrans Scalars
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

	i	idx	value
bl_store_shock_trans	1	1	0
pi_S_eta	2	4	1

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xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
CONTAINER NAME: mp_params_typelife ND Array (Matrix etc)
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

	i	idx	ndim	numel	rowN	colN	sum	mean	std	coefvar
SS	1	1	2	36	18	2	3.2218	0.089493	0.12913	1.443
epsilon	2	2	2	36	18	2	39.526	1.0979	0.85451	0.77828

xxx TABLE:SS xxxxxxxxxxxxxxxxxx

	c1	c2

```
    r1          0          0
    r2          0          0
    r3          0          0
    r4          0          0
    r5          0          0
    r6          0          0
    r7          0          0
    r8          0          0
    r9          0          0
    r10         0          0
    r11         0          0
    r12         0          0
    r13   0.24433    0.29263
    r14   0.24433    0.29263
    r15   0.24433    0.29263
    r16   0.24433    0.29263
    r17   0.24433    0.29263
    r18   0.24433    0.29263

xxx TABLE:epsilon xxxxxxxxxxxxxxxxxx
           c1        c2
         ------    ------

    r1        1         1
    r2   1.0778    1.1836
    r3   1.2546    1.6124
    r4    1.397    1.9418
    r5   1.5022    2.1452
    r6   1.5712    2.2394
    r7   1.6064    2.2588
    r8   1.6097    2.2341
    r9   1.5815     2.182
    r10  1.5204    2.1034
    r11  1.4243    1.9846
    r12  1.2917    1.8041
    r13       0         0
    r14       0         0
    r15       0         0
    r16       0         0
    r17       0         0
    r18       0         0

----------------------------------------
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
CONTAINER NAME: mp_params_stat ND Array (Matrix etc)
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
                          i    idx    ndim    numel    rowN    colN     sum       mean        std
                          -    ---    ----    -----    ----    ----    ------    -------    --------

    Pop                   1     1      2       18       18      1      9.8945    0.54969     0.31889
    stat_distr_educ       2     3      2        2        1      2           1        0.5      0.2786
    stat_distr_eta        3     4      2        5        1      5           1        0.2     0.24003
    stat_distr_kids       4     5      3       12        2      6           4    0.33333     0.33166
    stat_distr_married    5     6      2        4        2      2           2        0.5    0.073381

xxx TABLE:Pop xxxxxxxxxxxxxxxxxx
              c1
          --------
```

```
    r1           1
    r2     0.95085
    r3     0.90129
    r4     0.85442
    r5     0.80919
    r6     0.76452
    r7     0.71982
    r8     0.67493
    r9     0.62947
    r10    0.58044
    r11    0.52505
    r12    0.46001
    r13    0.38416
    r14    0.29751
    r15    0.19995
    r16     0.1028
    r17   0.034004
    r18   0.006098

xxx TABLE:stat_distr_educ xxxxxxxxxxxxxxxxxx
           c1       c2
          -----    -----

    r1    0.697    0.303

xxx TABLE:stat_distr_eta xxxxxxxxxxxxxxxxxx
             c1          c2         c3         c4          c5
          ---------    -------    -------    -------    ---------

    r1    0.0069316    0.19567    0.59479    0.19567    0.0069316

xxx TABLE:stat_distr_kids xxxxxxxxxxxxxxxxxx
            c1         c2          c3         c4           c5           c6
          -------    -------    --------    -------    ----------    --------

    r1    0.75801    0.44877      0.1564    0.32041       0.08559     0.23083
    r2    0.97627     0.7604    0.023626     0.2173    0.00010011    0.022305

xxx TABLE:stat_distr_married xxxxxxxxxxxxxxxxxx
            c1        c2
          ------    ------

    r1    0.5635    0.4365
    r2    0.4364    0.5636

----------------------------------------
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
CONTAINER NAME: mp_params_stat String
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
                          i     idx                              string
                         ---    ---    --------------------------------------------------------

    st_old_age_depend    "1"    "2"    "Old-age dependency ratio (ratio of 65+/(18-64))=0.1155"
```

2.1.2 Documentation Run Parameters Docdense

Parameters used for documentation vig. "docdense" uses less shocks than the version of the model used to implement the allocation problems in the Nygaard, Sorensen and Wang (2020).

```
mp_params = snw_mp_param('default_docdense', true, 100, 6);

----------------------------------------
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
CONTAINER NAME: mp_params_preftechpricegov Scalars
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
                                i     idx     value

                                --    ---    -------

    Bequests                     1     1           0
    a0                           2     2       0.258
    a1                           3     3       0.768
    a2                           4     4      1.5286
    a2_covidyr                   5     5         NaN
    a2_covidyr_manna_heaven      6     6      1.5286
    a2_covidyr_tax_fully_pay     7     7      12.718
    bequests_option              8     8           1
    beta                         9     9     0.97116
    cons_allocation_rule        10    10           2
    g_cons                      11    11     0.17576
    g_n                         12    12        0.01
    gamma                       13    13           2
    jret                        14    14          48
    r                           15    15        0.04
    theta                       16    16     0.56523
    throw_in_ocean              17    17           1

----------------------------------------
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
CONTAINER NAME: mp_params_intlen Scalars
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
                     i     idx    value

                     -     ---    -----

    n_agrid          1     1       65
    n_educgrid       2     2        2
    n_eta_H_grid     3     3       81
    n_eta_S_grid     4     4        5
    n_etagrid        5     5      405
    n_jgrid          6     6       83
    n_kidsgrid       7     7        5
    n_marriedgrid    8     8        2

----------------------------------------
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
CONTAINER NAME: mp_params_covid_unemploy ND Array (Matrix etc)
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
                 i    idx    ndim    numel    rowN    colN     sum       mean        std       coefv
                 -    ---    ----    -----    ----    ----    ------   --------   --------    -----

    inc_grid     1     3      2       201      201      1     578.5     2.8781     1.8836    0.654
    pi_unemp     2     6      2       415       83      5    9.5319   0.022968   0.024679     1.07

xxx TABLE:inc_grid xxxxxxxxxxxxxxxxx
```

```
              c1
          --------

    r1           0
    r2    0.026667
    r3    0.053333
    r4        0.08
    r5     0.10667
    r6     0.13333
    r7        0.16
    r8     0.18667
    r9     0.21333
    r10       0.24
    r11    0.26667
    r12    0.29333
    r13       0.32
    r14    0.34667
    r15    0.37333
    r16        0.4
    r17    0.42667
    r18    0.45333
    r19       0.48
    r20    0.50667
    r21    0.53333
    r22       0.56
    r23    0.58667
    r24    0.61333
    r25       0.64
    r26    0.66667
    r27    0.69333
    r28       0.72
    r29    0.74667
    r30    0.77333
    r31        0.8
    r32    0.82667
    r33    0.85333
    r34       0.88
    r35    0.90667
    r36    0.93333
    r37       0.96
    r38    0.98667
    r39     1.0133
    r40       1.04
    r41     1.0667
    r42     1.0933
    r43       1.12
    r44     1.1467
    r45     1.1733
    r46        1.2
    r47     1.2267
    r48     1.2533
    r49       1.28
    r50     1.3067
    r152      4.06
    r153      4.12
    r154      4.18
    r155      4.24
    r156       4.3
```

r157	4.36
r158	4.42
r159	4.48
r160	4.54
r161	4.6
r162	4.66
r163	4.72
r164	4.78
r165	4.84
r166	4.9
r167	4.96
r168	5.02
r169	5.08
r170	5.14
r171	5.2
r172	5.26
r173	5.32
r174	5.38
r175	5.44
r176	5.5
r177	5.56
r178	5.62
r179	5.68
r180	5.74
r181	5.8
r182	5.86
r183	5.92
r184	5.98
r185	6.04
r186	6.1
r187	6.16
r188	6.22
r189	6.28
r190	6.34
r191	6.4
r192	6.46
r193	6.52
r194	6.58
r195	6.64
r196	6.7
r197	6.76
r198	6.82
r199	6.88
r200	6.94
r201	7

xxx TABLE:pi_unemp xxxxxxxxxxxxxxxxxx

	c1	c2	c3	c4	c5
r1	0.080278	0.051706	0.041502	0.03538	0.025176
r2	0.080278	0.051706	0.041502	0.03538	0.025176
r3	0.080278	0.051706	0.041502	0.03538	0.025176
r4	0.080278	0.051706	0.041502	0.03538	0.025176
r5	0.080278	0.051706	0.041502	0.03538	0.025176
r6	0.080278	0.051706	0.041502	0.03538	0.025176
r7	0.080278	0.051706	0.041502	0.03538	0.025176
r8	0.080278	0.051706	0.041502	0.03538	0.025176

r9	0.080278	0.051706	0.041502	0.03538	0.025176
r10	0.080278	0.051706	0.041502	0.03538	0.025176
r11	0.080278	0.051706	0.041502	0.03538	0.025176
r12	0.080278	0.051706	0.041502	0.03538	0.025176
r13	0.080278	0.051706	0.041502	0.03538	0.025176
r14	0.070703	0.042132	0.031928	0.025805	0.015601
r15	0.070703	0.042132	0.031928	0.025805	0.015601
r16	0.070703	0.042132	0.031928	0.025805	0.015601
r17	0.070703	0.042132	0.031928	0.025805	0.015601
r18	0.070703	0.042132	0.031928	0.025805	0.015601
r19	0.070703	0.042132	0.031928	0.025805	0.015601
r20	0.070703	0.042132	0.031928	0.025805	0.015601
r21	0.070703	0.042132	0.031928	0.025805	0.015601
r22	0.070703	0.042132	0.031928	0.025805	0.015601
r23	0.070703	0.042132	0.031928	0.025805	0.015601
r24	0.067512	0.038941	0.028736	0.022614	0.01241
r25	0.067512	0.038941	0.028736	0.022614	0.01241
r26	0.067512	0.038941	0.028736	0.022614	0.01241
r27	0.067512	0.038941	0.028736	0.022614	0.01241
r28	0.067512	0.038941	0.028736	0.022614	0.01241
r29	0.067512	0.038941	0.028736	0.022614	0.01241
r30	0.067512	0.038941	0.028736	0.022614	0.01241
r31	0.067512	0.038941	0.028736	0.022614	0.01241
r32	0.067512	0.038941	0.028736	0.022614	0.01241
r33	0.067512	0.038941	0.028736	0.022614	0.01241
r34	0.068576	0.040004	0.0298	0.023678	0.013474
r35	0.068576	0.040004	0.0298	0.023678	0.013474
r36	0.068576	0.040004	0.0298	0.023678	0.013474
r37	0.068576	0.040004	0.0298	0.023678	0.013474
r38	0.068576	0.040004	0.0298	0.023678	0.013474
r39	0.068576	0.040004	0.0298	0.023678	0.013474
r40	0.068576	0.040004	0.0298	0.023678	0.013474
r41	0.068576	0.040004	0.0298	0.023678	0.013474
r42	0.068576	0.040004	0.0298	0.023678	0.013474
r43	0.068576	0.040004	0.0298	0.023678	0.013474
r44	0.080278	0.051706	0.041502	0.03538	0.025176
r45	0.080278	0.051706	0.041502	0.03538	0.025176
r46	0.080278	0.051706	0.041502	0.03538	0.025176
r47	0.080278	0.051706	0.041502	0.03538	0.025176
r48	0.080278	0.051706	0.041502	0.03538	0.025176
r49	0	0	0	0	0
r50	0	0	0	0	0
r51	0	0	0	0	0
r52	0	0	0	0	0
r53	0	0	0	0	0
r54	0	0	0	0	0
r55	0	0	0	0	0
r56	0	0	0	0	0
r57	0	0	0	0	0
r58	0	0	0	0	0
r59	0	0	0	0	0
r60	0	0	0	0	0
r61	0	0	0	0	0
r62	0	0	0	0	0
r63	0	0	0	0	0
r64	0	0	0	0	0
r65	0	0	0	0	0
r66	0	0	0	0	0

r67	0	0	0	0	0
r68	0	0	0	0	0
r69	0	0	0	0	0
r70	0	0	0	0	0
r71	0	0	0	0	0
r72	0	0	0	0	0
r73	0	0	0	0	0
r74	0	0	0	0	0
r75	0	0	0	0	0
r76	0	0	0	0	0
r77	0	0	0	0	0
r78	0	0	0	0	0
r79	0	0	0	0	0
r80	0	0	0	0	0
r81	0	0	0	0	0
r82	0	0	0	0	0
r83	0	0	0	0	0

----

xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
CONTAINER NAME: mp_params_covid_unemploy Scalars
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

	i	idx	value
TR	1	1	0.0017225
b	2	2	1
n_incgrid	3	4	201
n_welfchecksgrid	4	5	45
scaleconvertor	5	7	58056
xi	6	8	0.75

----

xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
CONTAINER NAME: mp_params_statesgrid ND Array (Matrix etc)
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

	i	idx	ndim	numel	rowN	colN	sum	mean	std
agrid	1	1	2	65	65	1	2228	34.277	39.432
eta_H_grid	2	2	2	405	405	1	1.3234e-13	3.2676e-16	1.5783
eta_S_grid	3	3	2	405	405	1	-1.7764e-14	-4.3861e-17	2.2103

xxx TABLE:agrid xxxxxxxxxxxxxxxxxx

	c1
r1	0
r2	0.00051498
r3	0.0041199
r4	0.013905
r5	0.032959
r6	0.064373
r7	0.11124
r8	0.17664
r9	0.26367
r10	0.37542
r11	0.51498

```
    r12       0.68544
    r13       0.88989
    r14        1.1314
    r15        1.4131
    r16        1.7381
    r17        2.1094
    r18        2.5301
    r19        3.0034
    r20        3.5323
    r21        4.1199
    r22        4.7693
    r23        5.4836
    r24        6.2658
    r25        7.1191
    r26        8.0466
    r27        9.0514
    r28        10.136
    r29        11.305
    r30         12.56
    r31        13.905
    r32        15.342
    r33        16.875
    r34        18.507
    r35        20.241
    r36         22.08
    r37        24.027
    r38        26.085
    r39        28.258
    r40        30.548
    r41        32.959
    r42        35.493
    r43        38.154
    r44        40.945
    r45        43.868
    r46        46.928
    r47        50.126
    r48        53.467
    r49        56.953
    r50        60.587
    r51        64.373
    r52        68.313
    r53        72.411
    r54        76.669
    r55        81.091
    r56         85.68
    r57        90.439
    r58        95.371
    r59        100.48
    r60        105.77
    r61        111.24
    r62        116.89
    r63        122.74
    r64        128.77
    r65           135

xxx TABLE:eta_H_grid xxxxxxxxxxxxxxxxxx
                c1
            ----------
```

r1	-2.6968
r2	-2.6294
r3	-2.562
r4	-2.4945
r5	-2.4271
r6	-2.3597
r7	-2.2923
r8	-2.2249
r9	-2.1574
r10	-2.09
r11	-2.0226
r12	-1.9552
r13	-1.8878
r14	-1.8203
r15	-1.7529
r16	-1.6855
r17	-1.6181
r18	-1.5507
r19	-1.4832
r20	-1.4158
r21	-1.3484
r22	-1.281
r23	-1.2136
r24	-1.1461
r25	-1.0787
r26	-1.0113
r27	-0.94388
r28	-0.87646
r29	-0.80904
r30	-0.74162
r31	-0.6742
r32	-0.60678
r33	-0.53936
r34	-0.47194
r35	-0.40452
r36	-0.3371
r37	-0.26968
r38	-0.20226
r39	-0.13484
r40	-0.06742
r41	2.2204e-16
r42	0.06742
r43	0.13484
r44	0.20226
r45	0.26968
r46	0.3371
r47	0.40452
r48	0.47194
r49	0.53936
r50	0.60678
r356	-0.60678
r357	-0.53936
r358	-0.47194
r359	-0.40452
r360	-0.3371
r361	-0.26968
r362	-0.20226

r363	-0.13484
r364	-0.06742
r365	2.2204e-16
r366	0.06742
r367	0.13484
r368	0.20226
r369	0.26968
r370	0.3371
r371	0.40452
r372	0.47194
r373	0.53936
r374	0.60678
r375	0.6742
r376	0.74162
r377	0.80904
r378	0.87646
r379	0.94388
r380	1.0113
r381	1.0787
r382	1.1461
r383	1.2136
r384	1.281
r385	1.3484
r386	1.4158
r387	1.4832
r388	1.5507
r389	1.6181
r390	1.6855
r391	1.7529
r392	1.8203
r393	1.8878
r394	1.9552
r395	2.0226
r396	2.09
r397	2.1574
r398	2.2249
r399	2.2923
r400	2.3597
r401	2.4271
r402	2.4945
r403	2.562
r404	2.6294
r405	2.6968

xxx TABLE:eta_S_grid xxxxxxxxxxxxxxxxxx

	c1
r1	-3.122
r2	-3.122
r3	-3.122
r4	-3.122
r5	-3.122
r6	-3.122
r7	-3.122
r8	-3.122
r9	-3.122
r10	-3.122

r11	-3.122
r12	-3.122
r13	-3.122
r14	-3.122
r15	-3.122
r16	-3.122
r17	-3.122
r18	-3.122
r19	-3.122
r20	-3.122
r21	-3.122
r22	-3.122
r23	-3.122
r24	-3.122
r25	-3.122
r26	-3.122
r27	-3.122
r28	-3.122
r29	-3.122
r30	-3.122
r31	-3.122
r32	-3.122
r33	-3.122
r34	-3.122
r35	-3.122
r36	-3.122
r37	-3.122
r38	-3.122
r39	-3.122
r40	-3.122
r41	-3.122
r42	-3.122
r43	-3.122
r44	-3.122
r45	-3.122
r46	-3.122
r47	-3.122
r48	-3.122
r49	-3.122
r50	-3.122
r356	3.122
r357	3.122
r358	3.122
r359	3.122
r360	3.122
r361	3.122
r362	3.122
r363	3.122
r364	3.122
r365	3.122
r366	3.122
r367	3.122
r368	3.122
r369	3.122
r370	3.122
r371	3.122
r372	3.122
r373	3.122

r374	3.122
r375	3.122
r376	3.122
r377	3.122
r378	3.122
r379	3.122
r380	3.122
r381	3.122
r382	3.122
r383	3.122
r384	3.122
r385	3.122
r386	3.122
r387	3.122
r388	3.122
r389	3.122
r390	3.122
r391	3.122
r392	3.122
r393	3.122
r394	3.122
r395	3.122
r396	3.122
r397	3.122
r398	3.122
r399	3.122
r400	3.122
r401	3.122
r402	3.122
r403	3.122
r404	3.122
r405	3.122

----
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
CONTAINER NAME: mp_params_exotrans ND Array (Matrix etc)
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

	i	idx	ndim	numel	rowN	colN	sum	mean
cl_mt_pi_jem_kidseta	1	2	2	1	1	1	0	0
pi_H_eta	2	3	2	6561	81	81	81	0.012346
pi_S_eta	3	4	2	25	5	5	5	0.2
pi_eta	4	5	2	1.6403e+05	405	405	405	0.0024691
pi_kids	5	6	5	8300	5	1660	1660	0.2
psi	6	7	2	83	83	1	78.16	0.94169

xxx TABLE:cl_mt_pi_jem_kidseta xxxxxxxxxxxxxxxxxx

	c1
r1	0

xxx TABLE:pi_H_eta xxxxxxxxxxxxxxxxxx

	c1	c2	c3	c79	c80	c81
r1	0.44008	0.19741	0.16603	0	0	0

r2	0.26004	0.18401	0.1972	0	0	0
r3	0.12804	0.13527	0.18471	0	0	0
r4	0.051745	0.078413	0.13644	0	0	0
r5	0.016976	0.035843	0.079479	0	0	0
r6	0.0044863	0.012918	0.036507	0	0	0
r7	0.00094957	0.0036704	0.013221	0	0	0
r8	0.00016032	0.00082204	0.0037748	0	0	0
r9	2.1522e-05	0.0001451	0.00084955	0	0	0
r10	2.2921e-06	2.0182e-05	0.00015069	0	0	0
r11	1.933e-07	2.2115e-06	2.1061e-05	0	0	0
r12	1.2891e-08	1.9089e-07	2.3192e-06	0	0	0
r13	6.7901e-10	1.2976e-08	2.0116e-07	0	0	0
r14	2.8225e-11	6.9453e-10	1.3741e-08	0	0	0
r15	9.2521e-13	2.9264e-11	7.3906e-10	0	0	0
r16	2.3901e-14	9.7051e-13	3.1293e-11	0	0	0
r17	4.8636e-16	2.5328e-14	1.0429e-12	0	0	0
r18	7.7924e-18	5.2007e-16	2.735e-14	0	0	0
r19	9.8265e-20	8.4004e-18	5.6434e-16	0	0	0
r20	9.7502e-22	1.0672e-19	9.1603e-18	0	0	0
r21	7.6101e-24	1.0662e-21	1.1695e-19	0	0	0
r22	4.6713e-26	8.3759e-24	1.1741e-21	0	0	0
r23	2.2546e-28	5.1729e-26	9.269e-24	0	0	0
r24	8.5548e-31	2.5114e-28	5.7527e-26	0	0	0
r25	2.5514e-33	9.583e-31	2.8066e-28	0	0	0
r26	5.9805e-36	2.8738e-33	1.0762e-30	0	0	0
r27	1.1016e-38	6.7725e-36	3.2434e-33	0	0	0
r28	1.5943e-41	1.2541e-38	7.6811e-36	0	0	0
r29	1.8129e-44	1.8245e-41	1.4293e-38	0	0	0
r30	1.6194e-47	2.0853e-44	2.0897e-41	0	0	0
r31	1.1364e-50	1.8723e-47	2.4002e-44	0	0	0
r32	6.2635e-54	1.3205e-50	2.1657e-47	0	0	0
r33	2.7115e-57	7.3149e-54	1.535e-50	0	0	0
r34	9.2192e-61	3.1826e-57	8.5451e-54	0	0	0
r35	2.4617e-64	1.0875e-60	3.7362e-57	0	0	0
r36	5.1617e-68	2.9183e-64	1.283e-60	0	0	0
r37	8.4992e-72	6.1497e-68	3.4599e-64	0	0	0
r38	1.0989e-75	1.0176e-71	7.327e-68	0	0	0
r39	1.1156e-79	1.3223e-75	1.2185e-71	0	0	0
r40	8.8927e-84	1.3491e-79	1.5911e-75	0	0	0
r41	5.5655e-88	1.0807e-83	1.6313e-79	0	0	0
r42	2.7347e-92	6.7971e-88	1.3133e-83	0	0	0
r43	1.055e-96	3.3564e-92	8.3007e-88	0	0	0
r44	3.1951e-101	1.3012e-96	4.1192e-92	0	0	0
r45	7.5967e-106	3.9605e-101	1.6049e-96	0	0	0
r46	1.418e-110	9.4631e-106	4.9088e-101	0	0	0
r47	2.0777e-115	1.7751e-110	1.1787e-105	0	0	0
r48	2.3898e-120	2.6138e-115	2.2219e-110	0	0	0
r49	2.1579e-125	3.0215e-120	3.2881e-115	0	0	0
r50	1.5294e-130	2.7417e-125	3.8196e-120	0	0	0
r51	8.5093e-136	1.9529e-130	3.4831e-125	0	0	0
r52	3.7162e-141	1.0919e-135	2.4933e-130	0	0	0
r53	1.2739e-146	4.7921e-141	1.401e-135	0	0	0
r54	3.4277e-152	1.6509e-146	6.179e-141	0	0	0
r55	7.2393e-158	4.4641e-152	2.1392e-146	0	0	0
r56	1.2001e-163	9.4748e-158	5.8132e-152	0	0	0
r57	1.5615e-169	1.5784e-163	1.2399e-157	0	0	0
r58	1.5947e-175	2.064e-169	2.0759e-163	0	0	0
r59	1.2782e-181	2.1183e-175	2.7279e-169	0	0	0

r60	8.0416e-188	1.7064e-181	2.8135e-175	0	0	0
r61	3.9708e-194	1.0788e-187	2.2776e-181	0	0	0
r62	1.5389e-200	5.3534e-194	1.4472e-187	0	0	0
r63	4.6807e-207	2.085e-200	7.2168e-194	5.5511e-16	0	0
r64	1.1174e-213	6.3733e-207	2.8246e-200	2.7311e-14	5.5511e-16	0
r65	2.0936e-220	1.529e-213	8.677e-207	1.0428e-12	2.5424e-14	4.4409e-16
r66	3.0785e-227	2.8789e-220	2.092e-213	3.1293e-11	9.7056e-13	2.387e-14
r67	3.5527e-234	4.2543e-227	3.9585e-220	7.3906e-10	2.9264e-11	9.2526e-13
r68	3.2178e-241	4.934e-234	5.8786e-227	1.3741e-08	6.9453e-10	2.8225e-11
r69	2.2873e-248	4.491e-241	6.8517e-234	2.0116e-07	1.2976e-08	6.7901e-10
r70	1.276e-255	3.2082e-248	6.2674e-241	2.3192e-06	1.9089e-07	1.2891e-08
r71	5.5866e-263	1.7986e-255	4.4993e-248	2.1061e-05	2.2115e-06	1.933e-07
r72	1.9196e-270	7.9137e-263	2.535e-255	0.00015069	2.0182e-05	2.2921e-06
r73	5.1762e-278	2.7326e-270	1.1209e-262	0.00084955	0.0001451	2.1522e-05
r74	1.0954e-285	7.4052e-278	3.8897e-270	0.0037748	0.00082204	0.00016032
r75	1.8193e-293	1.5749e-285	1.0593e-277	0.013221	0.0036704	0.00094957
r76	2.3712e-301	2.6286e-293	2.264e-285	0.036507	0.012918	0.0044863
r77	2.4254e-309	3.443e-301	3.7975e-293	0.079479	0.035843	0.016976
r78	1.9469e-317	3.5392e-309	4.9987e-301	0.13644	0.078413	0.051745
r79	0	2.8551e-317	5.1639e-309	0.18471	0.13527	0.12804
r80	0	0	4.1864e-317	0.1972	0.18401	0.26004
r81	0	0	0	0.16603	0.19741	0.44008

xxx TABLE:pi_S_eta xxxxxxxxxxxxxxxxxx

	c1	c2	c3	c4	c5
r1	0.012224	0.2144	0.54675	0.2144	0.012224
r2	0.012224	0.2144	0.54675	0.2144	0.012224
r3	0.012224	0.2144	0.54675	0.2144	0.012224
r4	0.012224	0.2144	0.54675	0.2144	0.012224
r5	0.012224	0.2144	0.54675	0.2144	0.012224

xxx TABLE:pi_eta xxxxxxxxxxxxxxxxxx

	c1	c2	c3	c403	c404	c405
r1	0.0053798	0.0024132	0.0020297	0	0	0
r2	0.0031788	0.0022495	0.0024107	0	0	0
r3	0.0015653	0.0016536	0.002258	0	0	0
r4	0.00063256	0.00095856	0.0016679	0	0	0
r5	0.00020753	0.00043816	0.00097159	0	0	0
r6	5.4842e-05	0.00015792	0.00044628	0	0	0
r7	1.1608e-05	4.4868e-05	0.00016162	0	0	0
r8	1.9598e-06	1.0049e-05	4.6145e-05	0	0	0
r9	2.6309e-07	1.7738e-06	1.0385e-05	0	0	0
r10	2.8019e-08	2.4671e-07	1.8421e-06	0	0	0
r11	2.363e-09	2.7035e-08	2.5746e-07	0	0	0
r12	1.5758e-10	2.3335e-09	2.835e-08	0	0	0
r13	8.3005e-12	1.5863e-10	2.459e-09	0	0	0
r14	3.4504e-13	8.4903e-12	1.6797e-10	0	0	0
r15	1.131e-14	3.5774e-13	9.0346e-12	0	0	0
r16	2.9218e-16	1.1864e-14	3.8254e-13	0	0	0
r17	5.9455e-18	3.0962e-16	1.2749e-14	0	0	0
r18	9.5258e-20	6.3575e-18	3.3434e-16	0	0	0
r19	1.2012e-21	1.0269e-19	6.8987e-18	0	0	0
r20	1.1919e-23	1.3046e-21	1.1198e-19	0	0	0
r21	9.303e-26	1.3034e-23	1.4296e-21	0	0	0

r22	5.7105e-28	1.0239e-25	1.4353e-23	0	0	0
r23	2.7561e-30	6.3237e-28	1.1331e-25	0	0	0
r24	1.0458e-32	3.07e-30	7.0324e-28	0	0	0
r25	3.119e-35	1.1715e-32	3.4309e-30	0	0	0
r26	7.3108e-38	3.5131e-35	1.3156e-32	0	0	0
r27	1.3466e-40	8.279e-38	3.9649e-35	0	0	0
r28	1.949e-43	1.533e-40	9.3897e-38	0	0	0
r29	2.2162e-46	2.2303e-43	1.7473e-40	0	0	0
r30	1.9797e-49	2.5492e-46	2.5546e-43	0	0	0
r31	1.3892e-52	2.2888e-49	2.9342e-46	0	0	0
r32	7.6568e-56	1.6142e-52	2.6475e-49	0	0	0
r33	3.3147e-59	8.9421e-56	1.8764e-52	0	0	0
r34	1.127e-62	3.8906e-59	1.0446e-55	0	0	0
r35	3.0092e-66	1.3294e-62	4.5673e-59	0	0	0
r36	6.3099e-70	3.5674e-66	1.5684e-62	0	0	0
r37	1.039e-73	7.5177e-70	4.2295e-66	0	0	0
r38	1.3433e-77	1.244e-73	8.9569e-70	0	0	0
r39	1.3638e-81	1.6164e-77	1.4895e-73	0	0	0
r40	1.0871e-85	1.6492e-81	1.945e-77	0	0	0
r41	6.8035e-90	1.3211e-85	1.9942e-81	0	0	0
r42	3.343e-94	8.3091e-90	1.6054e-85	0	0	0
r43	1.2896e-98	4.1031e-94	1.0147e-89	0	0	0
r44	3.9058e-103	1.5907e-98	5.0355e-94	0	0	0
r45	9.2866e-108	4.8414e-103	1.9619e-98	0	0	0
r46	1.7334e-112	1.1568e-107	6.0007e-103	0	0	0
r47	2.5399e-117	2.1699e-112	1.4409e-107	0	0	0
r48	2.9214e-122	3.1953e-117	2.7162e-112	0	0	0
r49	2.6379e-127	3.6936e-122	4.0195e-117	0	0	0
r50	1.8697e-132	3.3516e-127	4.6693e-122	0	0	0
r356	7.6568e-56	1.6142e-52	2.6475e-49	0	0	0
r357	3.3147e-59	8.9421e-56	1.8764e-52	0	0	0
r358	1.127e-62	3.8906e-59	1.0446e-55	0	0	0
r359	3.0092e-66	1.3294e-62	4.5673e-59	0	0	0
r360	6.3099e-70	3.5674e-66	1.5684e-62	0	0	0
r361	1.039e-73	7.5177e-70	4.2295e-66	0	0	0
r362	1.3433e-77	1.244e-73	8.9569e-70	0	0	0
r363	1.3638e-81	1.6164e-77	1.4895e-73	0	0	0
r364	1.0871e-85	1.6492e-81	1.945e-77	0	0	0
r365	6.8035e-90	1.3211e-85	1.9942e-81	0	0	0
r366	3.343e-94	8.3091e-90	1.6054e-85	0	0	0
r367	1.2896e-98	4.1031e-94	1.0147e-89	0	0	0
r368	3.9058e-103	1.5907e-98	5.0355e-94	0	0	0
r369	9.2866e-108	4.8414e-103	1.9619e-98	0	0	0
r370	1.7334e-112	1.1568e-107	6.0007e-103	0	0	0
r371	2.5399e-117	2.1699e-112	1.4409e-107	0	0	0
r372	2.9214e-122	3.1953e-117	2.7162e-112	0	0	0
r373	2.6379e-127	3.6936e-122	4.0195e-117	0	0	0
r374	1.8697e-132	3.3516e-127	4.6693e-122	0	0	0
r375	1.0402e-137	2.3873e-132	4.2579e-127	0	0	0
r376	4.5428e-143	1.3348e-137	3.0479e-132	0	0	0
r377	1.5573e-148	5.8581e-143	1.7126e-137	0	0	0
r378	4.1902e-154	2.0181e-148	7.5536e-143	0	0	0
r379	8.8497e-160	5.4571e-154	2.6151e-148	0	0	0
r380	1.467e-165	1.1582e-159	7.1063e-154	0	0	0
r381	1.9088e-171	1.9296e-165	1.5158e-159	0	0	0
r382	1.9494e-177	2.5231e-171	2.5377e-165	0	0	0
r383	1.5626e-183	2.5895e-177	3.3347e-171	0	0	0
r384	9.8305e-190	2.0859e-183	3.4394e-177	0	0	0

r385	4.8541e-196	1.3188e-189	2.7843e-183	0	0	0
r386	1.8812e-202	6.5443e-196	1.7691e-189	0	0	0
r387	5.7219e-209	2.5488e-202	8.8221e-196	6.7859e-18	0	0
r388	1.366e-215	7.791e-209	3.453e-202	3.3387e-16	6.7859e-18	0
r389	2.5593e-222	1.8691e-215	1.0607e-208	1.2748e-14	3.108e-16	5.4288e-18
r390	3.7633e-229	3.5193e-222	2.5573e-215	3.8254e-13	1.1865e-14	2.918e-16
r391	4.343e-236	5.2006e-229	4.839e-222	9.0346e-12	3.5774e-13	1.1311e-14
r392	3.9336e-243	6.0316e-236	7.1863e-229	1.6797e-10	8.4903e-12	3.4504e-13
r393	2.7961e-250	5.49e-243	8.3758e-236	2.459e-09	1.5863e-10	8.3005e-12
r394	1.5599e-257	3.9218e-250	7.6616e-243	2.835e-08	2.3335e-09	1.5758e-10
r395	6.8293e-265	2.1987e-257	5.5002e-250	2.5746e-07	2.7035e-08	2.363e-09
r396	2.3466e-272	9.674e-265	3.0989e-257	1.8421e-06	2.4671e-07	2.8019e-08
r397	6.3276e-280	3.3405e-272	1.3702e-264	1.0385e-05	1.7738e-06	2.6309e-07
r398	1.3391e-287	9.0525e-280	4.7549e-272	4.6145e-05	1.0049e-05	1.9598e-06
r399	2.224e-295	1.9252e-287	1.2949e-279	0.00016162	4.4868e-05	1.1608e-05
r400	2.8987e-303	3.2133e-295	2.7676e-287	0.00044628	0.00015792	5.4842e-05
r401	2.9649e-311	4.2089e-303	4.6422e-295	0.00097159	0.00043816	0.00020753
r402	2.38e-319	4.3265e-311	6.1107e-303	0.0016679	0.00095856	0.00063256
r403	0	3.4902e-319	6.3126e-311	0.002258	0.0016536	0.0015653
r404	0	0	5.1176e-319	0.0024107	0.0022495	0.0031788
r405	0	0	0	0.0020297	0.0024132	0.0053798

xxx TABLE:pi_kids xxxxxxxxxxxxxxxxxx

	c1	c2	c3	c1658	c1659	c1660
r1	0.88581	0.11137	0.0027904	0	0	0
r2	0.051118	0.65943	0.28506	0	0	0
r3	0.0012655	0.05332	0.78763	0	0	0
r4	1.808e-05	0.00080512	0.069952	0	0	0
r5	1.8185e-07	8.1047e-06	0.00075722	0	0	0

xxx TABLE:psi xxxxxxxxxxxxxxxxxx

	c1
r1	0.99937
r2	0.99933
r3	0.99929
r4	0.99925
r5	0.99923
r6	0.99923
r7	0.99924
r8	0.99927
r9	0.99928
r10	0.99929
r11	0.99927
r12	0.99924
r13	0.9992
r14	0.99915
r15	0.99909
r16	0.99901
r17	0.99892
r18	0.99882
r19	0.99872
r20	0.9986
r21	0.99848
r22	0.99834

r23	0.9982
r24	0.99806
r25	0.99791
r26	0.99775
r27	0.9976
r28	0.99742
r29	0.99725
r30	0.99706
r31	0.99691
r32	0.99674
r33	0.99657
r34	0.99635
r35	0.99607
r36	0.99574
r37	0.99533
r38	0.99487
r39	0.99436
r40	0.9938
r41	0.99319
r42	0.99253
r43	0.9918
r44	0.99097
r45	0.99005
r46	0.98902
r47	0.98787
r48	0.98659
r49	0.98519
r50	0.98372
r51	0.98217
r52	0.98052
r53	0.97863
r54	0.97651
r55	0.97431
r56	0.9721
r57	0.96973
r58	0.96693
r59	0.96365
r60	0.96005
r61	0.95611
r62	0.95165
r63	0.9465
r64	0.94063
r65	0.93385
r66	0.9261
r67	0.9174
r68	0.90767
r69	0.89701
r70	0.88535
r71	0.87267
r72	0.85894
r73	0.84407
r74	0.82817
r75	0.81104
r76	0.79282
r77	0.77349
r78	0.75398
r79	0.7345
r80	0.71587

```
    r81    0.69772
    r82    0.68139
    r83          0

----------------------------------------
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
CONTAINER NAME: mp_params_exotrans Scalars
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
                            i    idx    value
                            -    ---    -----

    bl_store_shock_trans    1     1       0

----------------------------------------
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
CONTAINER NAME: mp_params_typelife ND Array (Matrix etc)
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
               i    idx    ndim    numel    rowN    colN     sum       mean        std      coefvari
               -    ---    ----    -----    ----    ----    ------    -------    -------    --------

    SS         1     1      2       166      83      2      19.331    0.11645    0.13441     1.1542
    epsilon    2     2      2       166      83      2      159.11    0.95847    0.89457    0.93333

xxx TABLE:SS xxxxxxxxxxxxxxxxxx
             c1         c2
          -------    -------

    r1          0          0
    r2          0          0
    r3          0          0
    r4          0          0
    r5          0          0
    r6          0          0
    r7          0          0
    r8          0          0
    r9          0          0
    r10         0          0
    r11         0          0
    r12         0          0
    r13         0          0
    r14         0          0
    r15         0          0
    r16         0          0
    r17         0          0
    r18         0          0
    r19         0          0
    r20         0          0
    r21         0          0
    r22         0          0
    r23         0          0
    r24         0          0
    r25         0          0
    r26         0          0
    r27         0          0
    r28         0          0
    r29         0          0
    r30         0          0
    r31         0          0
```

```
    r32          0          0
    r33          0          0
    r34          0          0
    r35          0          0
    r36          0          0
    r37          0          0
    r38          0          0
    r39          0          0
    r40          0          0
    r41          0          0
    r42          0          0
    r43          0          0
    r44          0          0
    r45          0          0
    r46          0          0
    r47          0          0
    r48    0.24433    0.29263
    r49    0.24433    0.29263
    r50    0.24433    0.29263
    r51    0.24433    0.29263
    r52    0.24433    0.29263
    r53    0.24433    0.29263
    r54    0.24433    0.29263
    r55    0.24433    0.29263
    r56    0.24433    0.29263
    r57    0.24433    0.29263
    r58    0.24433    0.29263
    r59    0.24433    0.29263
    r60    0.24433    0.29263
    r61    0.24433    0.29263
    r62    0.24433    0.29263
    r63    0.24433    0.29263
    r64    0.24433    0.29263
    r65    0.2443...
```

2.1.3 Parameters Used for Paper Simulations

Full version of parameters used in Nygaard, Sorensen and Wang (2020). This is not printed to save space.

```
% mp_params = snw_mp_param('default_moredense_a65zh266zs5_e2m2', true, 100, 6);
```

2.2 Model Controls

This is the example vignette for function: **snw_mp_control** from the **PrjOptiSNW Package.** This function sets and gets different control parameters.

2.2.1 Test SNW_MP_CONTROLS Defaults

Call the function with defaults.

```
mp_controls = snw_mp_control('default_base', true);
```

```
pos = 35 ; key = options
  fmincon options:

   Options used by current Algorithm ('interior-point'):
   (Other available algorithms: 'active-set', 'sqp', 'sqp-legacy', 'trust-region-reflective')
```

```
   Set properties:
                   Display: 'off'

   Default properties:
                 Algorithm: 'interior-point'
            CheckGradients: 0
       ConstraintTolerance: 1.0000e-06
  FiniteDifferenceStepSize: 'sqrt(eps)'
      FiniteDifferenceType: 'forward'
      HessianApproximation: 'bfgs'
                HessianFcn: []
        HessianMultiplyFcn: []
               HonorBounds: 1
   MaxFunctionEvaluations: 3000
             MaxIterations: 1000
            ObjectiveLimit: -1.0000e+20
       OptimalityTolerance: 1.0000e-06
                 OutputFcn: []
                   PlotFcn: []
              ScaleProblem: 0
 SpecifyConstraintGradient: 0
  SpecifyObjectiveGradient: 0
             StepTolerance: 1.0000e-10
       SubproblemAlgorithm: 'factorization'
                  TypicalX: 'ones(numberOfVariables,1)'
               UseParallel: 0

   Show options not used by current Algorithm ('interior-point')

pos = 36 ; key = options2
  fsolve options:

   Options used by current Algorithm ('trust-region-dogleg'):
   (Other available algorithms: 'levenberg-marquardt', 'trust-region')

   Set properties:
                   Display: 'off'

   Default properties:
                 Algorithm: 'trust-region-dogleg'
            CheckGradients: 0
  FiniteDifferenceStepSize: 'sqrt(eps)'
      FiniteDifferenceType: 'forward'
         FunctionTolerance: 1.0000e-06
    MaxFunctionEvaluations: '100*numberOfVariables'
             MaxIterations: 400
       OptimalityTolerance: 1.0000e-06
                 OutputFcn: []
                   PlotFcn: []
  SpecifyObjectiveGradient: 0
             StepTolerance: 1.0000e-06
                  TypicalX: 'ones(numberOfVariables,1)'
               UseParallel: 0

   Show options not used by current Algorithm ('trust-region-dogleg')

----------------------------------------
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
```

```
CONTAINER NAME: mp_controls Scalars
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
                                             i     idx    value
                                             --    ---    -----

    A_aux                                     1     1       NaN
    Aeq                                       2     2       NaN
    B_aux                                     3     3       NaN
    Beq                                       4     4       NaN
    bl_compute_drv_stats                      5     5         1
    bl_print_a4chk                            6     6         1
    bl_print_a4chk_verbose                    7     7         0
    bl_print_ds                               8     8         1
    bl_print_ds_verbose                       9     9         0
    bl_print_evuvw19_jaeemk                  10    10         1
    bl_print_evuvw19_jaeemk_verbose          11    11         0
    bl_print_evuvw19_jmky                    12    12         1
    bl_print_evuvw19_jmky_allchecks          13    13         1
    bl_print_evuvw19_jmky_allchecks_verbose  14    14         0
    bl_print_evuvw19_jmky_mass               15    15         1
    bl_print_evuvw19_jmky_mass_verbose       16    16         0
    bl_print_evuvw19_jmky_verbose            17    17         0
    bl_print_evuvw20_jaeemk                  18    18         1
    bl_print_evuvw20_jaeemk_verbose          19    19         0
    bl_print_find_tax_rate                   20    20         1
    bl_print_find_tax_rate_verbose           21    21         0
    bl_print_precompute                      22    22         1
    bl_print_precompute_verbose              23    23         0
    bl_print_v_planner                       24    24         1
    bl_print_v_planner_verbose               25    25         0
    bl_print_vfi                             26    26         1
    bl_print_vfi_verbose                     27    27         0
    bl_print_vu_vw                           28    28         1
    bl_print_vu_vw_verbose                   29    29         0
    bl_timer                                 30    30         1
    err                                      31    31         1
    fl_max_trchk_perc_increase               32    32       1.5
    nonlcon                                  33    34       NaN
    tol                                      34    37     0.005

----------------------------------------
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
CONTAINER NAME: mp_controls String
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
                       i     idx        string
                      ---    ----    --------------

    mp_params_name    "1"    "33"    "default_base"
```

Chapter 3

Solving the Dynamic Life Cycle Problem

3.1 Life Cycle Dynamic Programming with Marital Status, Children and Savings

This is the example vignette for function: **snw_vfi_main_bisec_vec** from the **PrjOptiSNW Package.** This function solves for policy function with vectorized bisection. Value function during COVIDless year.

3.1.1 Test SNW_VFI_MAIN_BISECT_VEC Defaults

Call the function with defaults.

```
mp_param = snw_mp_param('default_docdense');
[V_VFI,ap_VFI,cons_VFI] = snw_vfi_main_bisec_vec(mp_param);
```

```
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:83 of 82, time-this-age:4.8333
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:82 of 82, time-this-age:3.5522
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:81 of 82, time-this-age:3.562
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:80 of 82, time-this-age:3.5482
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:79 of 82, time-this-age:3.603
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:78 of 82, time-this-age:3.566
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:77 of 82, time-this-age:3.587
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:76 of 82, time-this-age:3.5763
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:75 of 82, time-this-age:3.5899
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:74 of 82, time-this-age:3.5638
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:73 of 82, time-this-age:3.5816
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:72 of 82, time-this-age:3.5953
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:71 of 82, time-this-age:3.5487
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:70 of 82, time-this-age:3.5608
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:69 of 82, time-this-age:3.5752
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:68 of 82, time-this-age:3.5654
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:67 of 82, time-this-age:3.5772
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:66 of 82, time-this-age:3.559
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:65 of 82, time-this-age:3.5818
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:64 of 82, time-this-age:3.5676
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:63 of 82, time-this-age:3.5591
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:62 of 82, time-this-age:3.5857
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:61 of 82, time-this-age:3.5505
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:60 of 82, time-this-age:3.599
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:59 of 82, time-this-age:3.5761
```

```
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:58 of 82, time-this-age:3.5793
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:57 of 82, time-this-age:3.5776
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:56 of 82, time-this-age:3.543
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:55 of 82, time-this-age:3.6012
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:54 of 82, time-this-age:3.5452
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:53 of 82, time-this-age:3.5613
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:52 of 82, time-this-age:3.5813
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:51 of 82, time-this-age:3.5609
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:50 of 82, time-this-age:3.536
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:49 of 82, time-this-age:3.5886
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:48 of 82, time-this-age:3.566
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:47 of 82, time-this-age:3.7808
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:46 of 82, time-this-age:3.7661
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:45 of 82, time-this-age:3.7932
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:44 of 82, time-this-age:3.8033
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:43 of 82, time-this-age:3.7945
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:42 of 82, time-this-age:3.7732
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:41 of 82, time-this-age:3.9226
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:40 of 82, time-this-age:3.8366
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:39 of 82, time-this-age:3.8564
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:38 of 82, time-this-age:3.8009
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:37 of 82, time-this-age:3.7941
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:36 of 82, time-this-age:4.5804
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:35 of 82, time-this-age:3.8404
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:34 of 82, time-this-age:4.7106
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:33 of 82, time-this-age:3.8021
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:32 of 82, time-this-age:3.8057
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:31 of 82, time-this-age:3.7965
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:30 of 82, time-this-age:3.8032
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:29 of 82, time-this-age:3.7654
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:28 of 82, time-this-age:3.7559
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:27 of 82, time-this-age:3.7947
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:26 of 82, time-this-age:3.7678
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:25 of 82, time-this-age:3.7811
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:24 of 82, time-this-age:3.7676
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:23 of 82, time-this-age:3.7898
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:22 of 82, time-this-age:3.7599
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:21 of 82, time-this-age:3.8708
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:20 of 82, time-this-age:4.153
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:19 of 82, time-this-age:3.8598
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:18 of 82, time-this-age:3.7762
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:17 of 82, time-this-age:3.7936
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:16 of 82, time-this-age:3.8078
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:15 of 82, time-this-age:3.8384
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:14 of 82, time-this-age:3.8247
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:13 of 82, time-this-age:3.8612
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:12 of 82, time-this-age:3.7894
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:11 of 82, time-this-age:3.8057
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:10 of 82, time-this-age:3.7815
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:9 of 82, time-this-age:3.7954
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:8 of 82, time-this-age:3.8034
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:7 of 82, time-this-age:3.82
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:6 of 82, time-this-age:4.665
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:5 of 82, time-this-age:3.8131
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:4 of 82, time-this-age:3.7714
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:3 of 82, time-this-age:3.7764
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:2 of 82, time-this-age:3.8035
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:1 of 82, time-this-age:3.7918
```

```
Completed SNW_VFI_MAIN_BISEC_VEC;SNW_MP_PARAM=default_docdense;SNW_MP_CONTROL=default_base;time=311.
```

3.1.2 Define Parameters

Define the matrix dimensions names and dimension vector values. Policy and Value Functions share the same ND dimensional structure.

```
% Grids:
age_grid = 18:100;
agrid = mp_param('agrid')';
eta_H_grid = mp_param('eta_H_grid')';
eta_S_grid = mp_param('eta_S_grid')';
ar_st_eta_HS_grid = string(cellstr([num2str(eta_H_grid', 'hz=%3.2f;'), num2str(eta_S_grid', 'wz=%3.2
edu_grid = [0,1];
marry_grid = [0,1];
kids_grid = (1:1:mp_param('n_kidsgrid'))';
% NaN(n_jgrid,n_agrid,n_etagrid,n_educgrid,n_marriedgrid,n_kidsgrid);
cl_mp_datasetdesc = {};
cl_mp_datasetdesc{1} = containers.Map({'name', 'labval'}, {'age', age_grid});
cl_mp_datasetdesc{2} = containers.Map({'name', 'labval'}, {'savings', agrid});
cl_mp_datasetdesc{3} = containers.Map({'name', 'labval'}, {'eta', 1:length(eta_H_grid)});
cl_mp_datasetdesc{4} = containers.Map({'name', 'labval'}, {'edu', edu_grid});
cl_mp_datasetdesc{5} = containers.Map({'name', 'labval'}, {'marry', marry_grid});
cl_mp_datasetdesc{6} = containers.Map({'name', 'labval'}, {'kids', kids_grid});
```

3.1.3 Analyze Savings and Shocks

First, analyze Savings Levels and Shocks, Aggregate Over All Others, and do various other calculations.

```
% Generate some Data
mp_support_graph = containers.Map('KeyType', 'char', 'ValueType', 'any');
mp_support_graph('cl_st_xtitle') = {'Savings States, a'};
mp_support_graph('st_legend_loc') = 'eastoutside';
mp_support_graph('bl_graph_logy') = true; % do not log
mp_support_graph('it_legend_select') = 21; % how many shock legends to show
mp_support_graph('cl_colors') = 'jet';
```

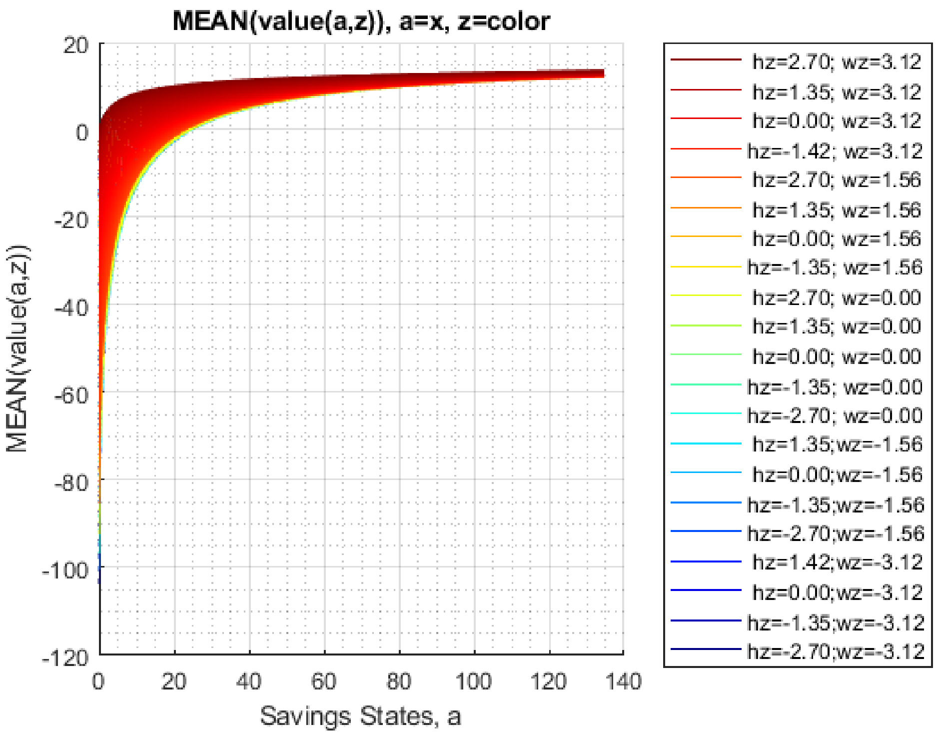
MEAN(VAL(A,Z)), MEAN(AP(A,Z)), MEAN(C(A,Z))

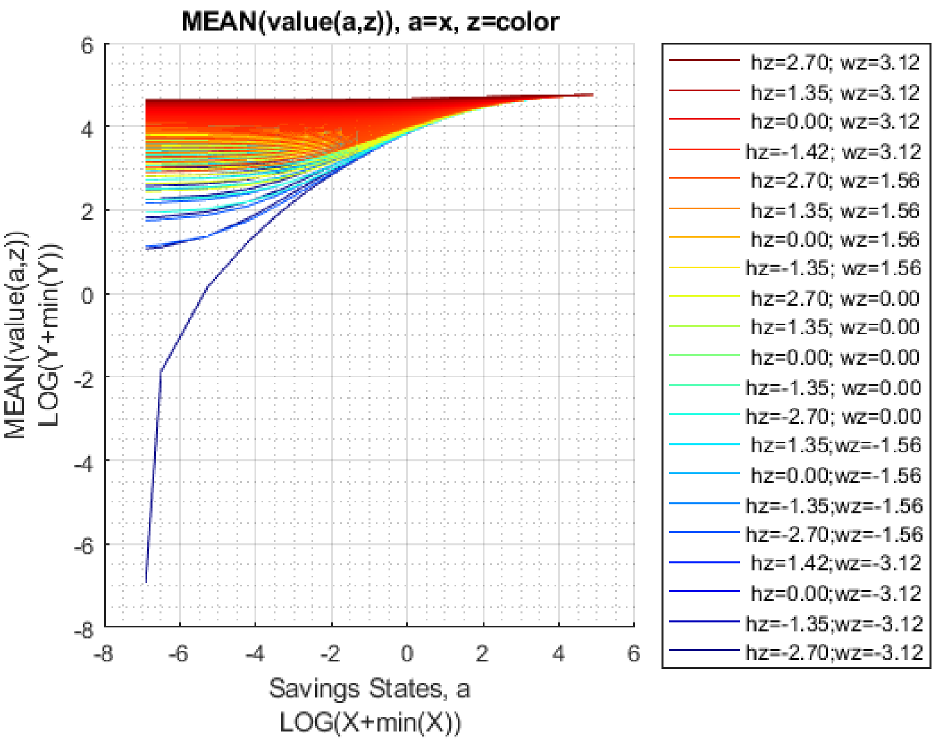
Tabulate value and policies along savings and shocks:

```
% Set
% NaN(n_jgrid,n_agrid,n_etagrid,n_educgrid,n_marriedgrid,n_kidsgrid);
ar_permute = [1,4,5,6,3,2];
% Value Function
tb_az_v = ff_summ_nd_array("MEAN(VAL(A,Z))", V_VFI, true, ["mean"], 4, 1, cl_mp_datasetdesc, ar_perm

xxx  MEAN(VAL(A,Z))  xxxxxxxxxxxxxxxxxxxxxxxxxxx
    group     savings      mean_eta_1    mean_eta_2    mean_eta_3    mean_eta_4    mean_eta_5    mea
    -----    ----------    ----------    ----------    ----------    ----------    ----------    ---

      1               0     -103.74       -100.83       -97.586        -94.14       -90.628       -
```

```
xxx  MEAN(AP(A,Z))  xxxxxxxxxxxxxxxxxxxxxxxxxxx
    group     savings      mean_eta_1    mean_eta_2    mean_eta_3    mean_eta_4    mean_eta_5    mea
    -----    ----------    ----------    ----------    ----------    ----------    ----------    ---

      1              0             0             0             0             0             0
```

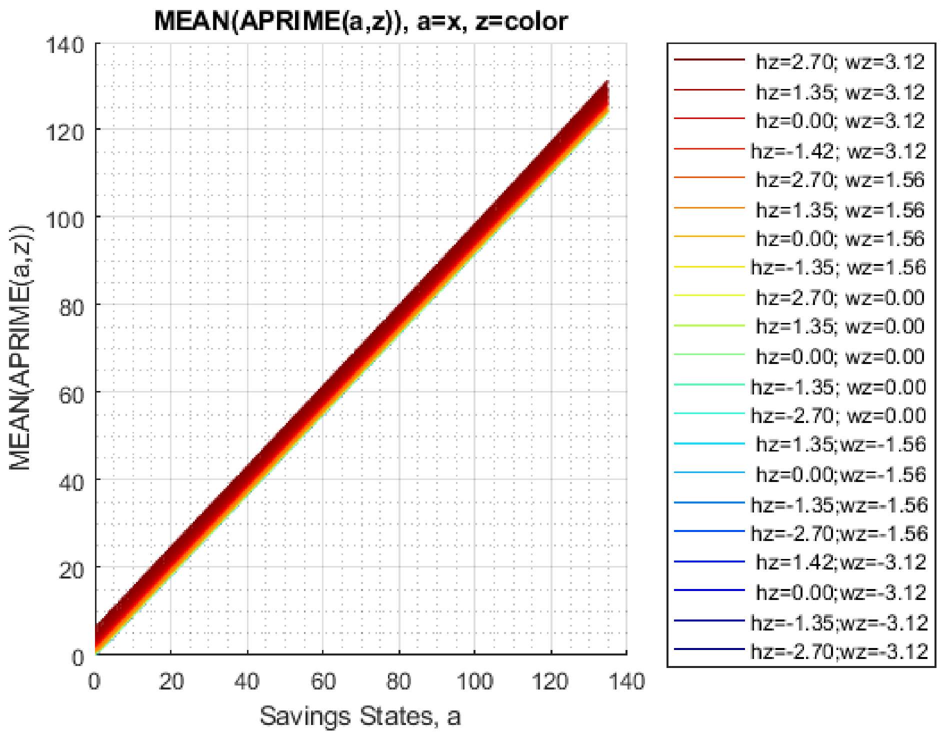
```
mp_support_graph('cl_st_graph_title') = {'MEAN(value(a,z)), a=x, z=color'};
mp_support_graph('cl_st_ytitle') = {'MEAN(value(a,z))'};
ff_graph_grid((tb_az_v{1:end, 3:end})', ar_st_eta_HS_grid, agrid, mp_support_graph);
```

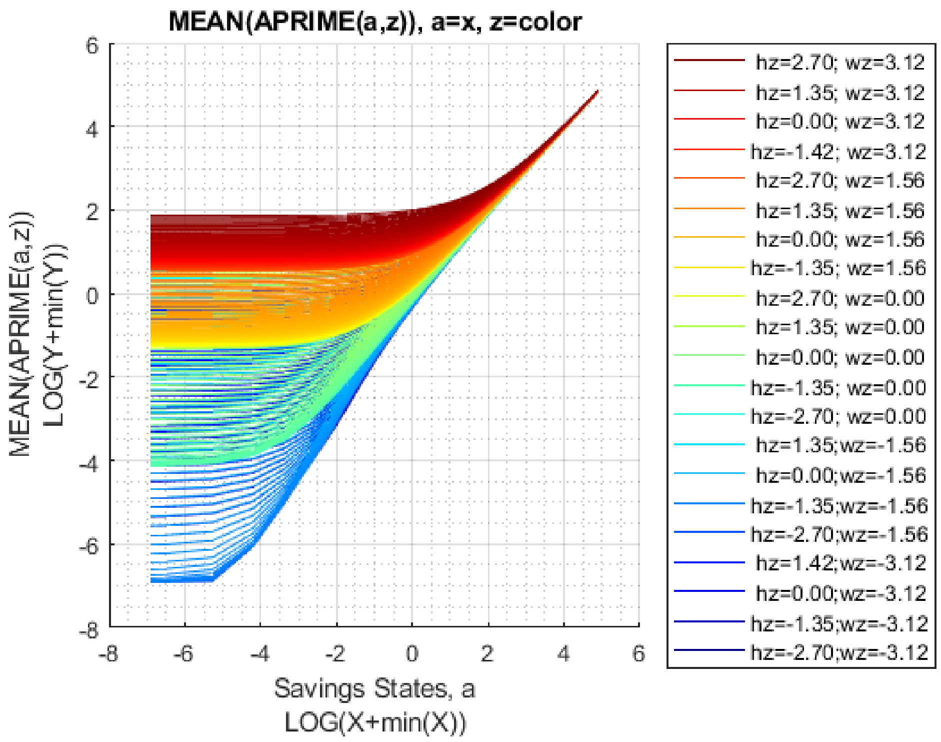




Graph Mean Savings Choices:

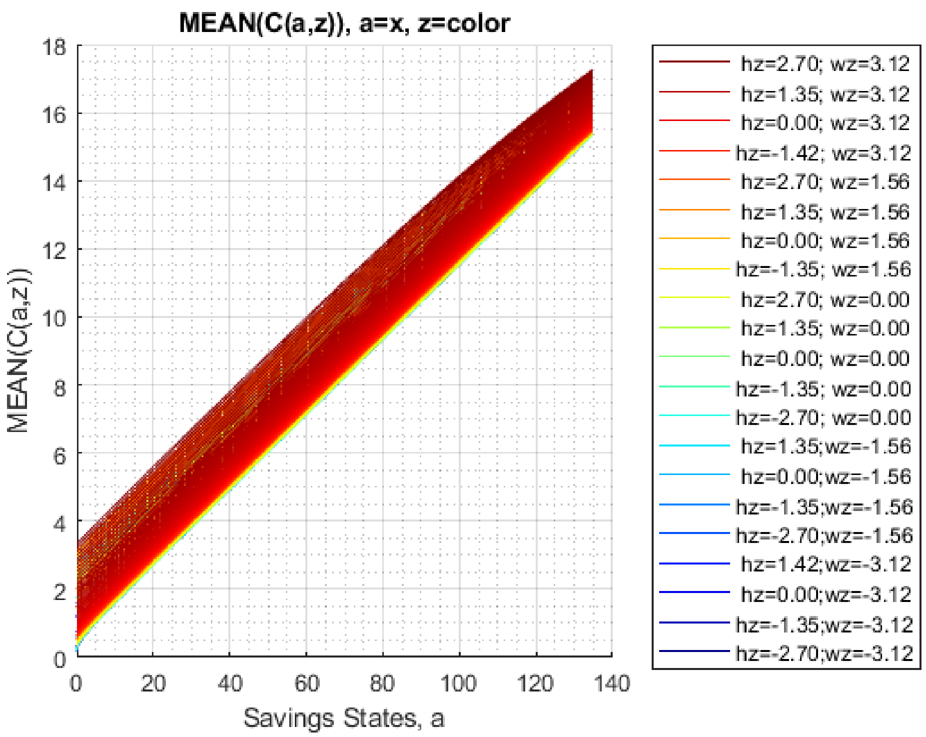
```
mp_support_graph('cl_st_graph_title') = {'MEAN(APRIME(a,z)), a=x, z=color'};
mp_support_graph('cl_st_ytitle') = {'MEAN(APRIME(a,z))'};
ff_graph_grid((tb_az_ap{1:end, 3:end})', ar_st_eta_HS_grid, agrid, mp_support_graph);
```

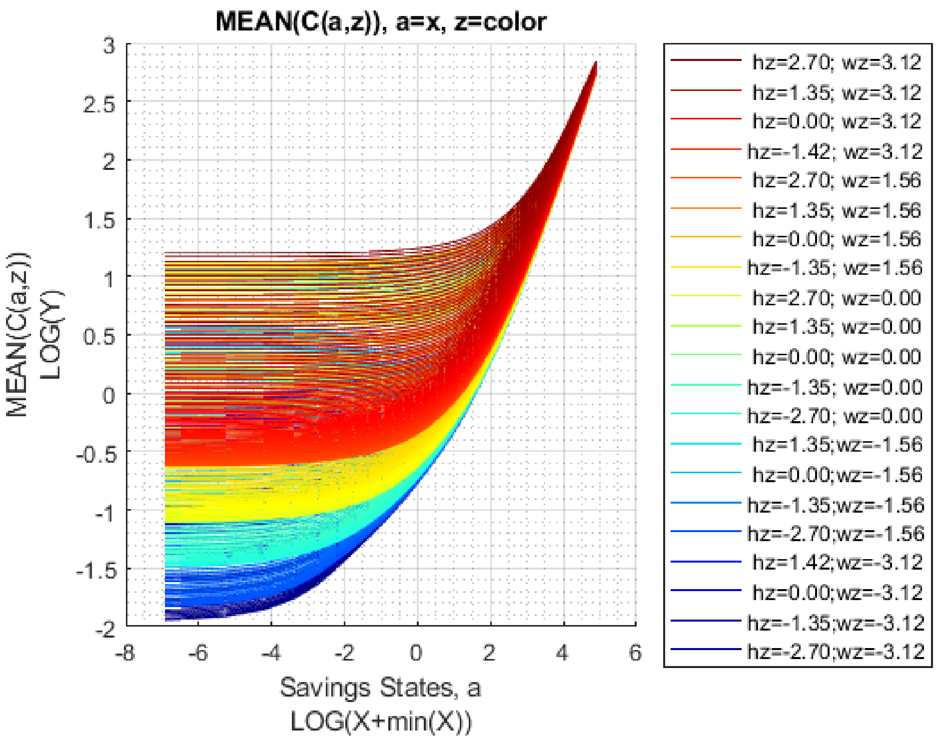




Graph Mean Consumption:

```
mp_support_graph('cl_st_graph_title') = {'MEAN(C(a,z)), a=x, z=color'};
mp_support_graph('cl_st_ytitle') = {'MEAN(C(a,z))'};
ff_graph_grid((tb_az_c{1:end, 3:end})', ar_st_eta_HS_grid, agrid, mp_support_graph);
```





3.1.4 Analyze Kids and Marriage and Age

Aggregating over education, savings, and shocks, what are the differential effects of Marriage and Age.

```
% Generate some Data
mp_support_graph = containers.Map('KeyType', 'char', 'ValueType', 'any');
ar_row_grid = [...
    "k0M0", "K1M0", "K2M0", "K3M0", "K4M0", ...
    "k0M1", "K1M1", "K2M1", "K3M1", "K4M1"];
mp_support_graph('cl_st_xtitle') = {'Age'};
mp_support_graph('st_legend_loc') = 'best';
mp_support_graph('bl_graph_logy') = true; % do not log
mp_support_graph('st_rounding') = '6.2f'; % format shock legend
mp_support_graph('cl_scatter_shapes') = {...
    'o', 'd' ,'s', 'x', '*', ...
    'o', 'd', 's', 'x', '*'};
mp_support_graph('cl_colors') = {...
    'red', 'red', 'red', 'red', 'red'...
    'blue', 'blue', 'blue', 'blue', 'blue'};
```

MEAN(VAL(KM,J)), MEAN(AP(KM,J)), MEAN(C(KM,J))

Tabulate value and policies:

```
% Set
% NaN(n_jgrid,n_agrid,n_etagrid,n_educgrid,n_marriedgrid,n_kidsgrid);
ar_permute = [2,3,4,1,6,5];
% Value Function
tb_az_v = ff_summ_nd_array("MEAN(VAL(KM,J))", V_VFI, true, ["mean"], 3, 1, cl_mp_datasetdesc, ar_per
```

```
xxx  MEAN(VAL(KM,J))  xxxxxxxxxxxxxxxxxxxxxxxxxxx
    group    kids    marry    mean_age_18    mean_age_19    mean_age_20    mean_age_21    mean_age_2
    _____    ____    _____    ___________    ___________    ___________    ___________    __________

      1        1       0        -9.6123         -8.574        -7.5952        -6.6749        -5.8609
      2        2       0        -17.183        -15.851        -14.558        -13.309        -12.171
```

```
      3       3       0       -20.909       -19.563       -18.242       -16.949       -15.768
      4       4       0       -24.758       -23.406        -22.06       -20.727         -19.5
      5       5       0       -27.561       -26.288       -25.009        -23.73       -22.552
      6       1       1        2.1559        3.0013        3.7773        4.4944        5.1268
      7       2       1       -2.4375       -1.4691      -0.55596       0.31118        1.0968
      8       3       1       -4.6483        -3.672       -2.7454       -1.8583       -1.0517
      9       4       1       -7.2434       -6.2806       -5.3574       -4.4633       -3.6454
     10       5       1       -9.2948       -8.3935       -7.5263       -6.6822       -5.9134
```

```
% Aprime Choice
tb_az_ap = ff_summ_nd_array("MEAN(AP(KM,J))", ap_VFI, true, ["mean"], 3, 1, cl_mp_datasetdesc, ar_pe
```

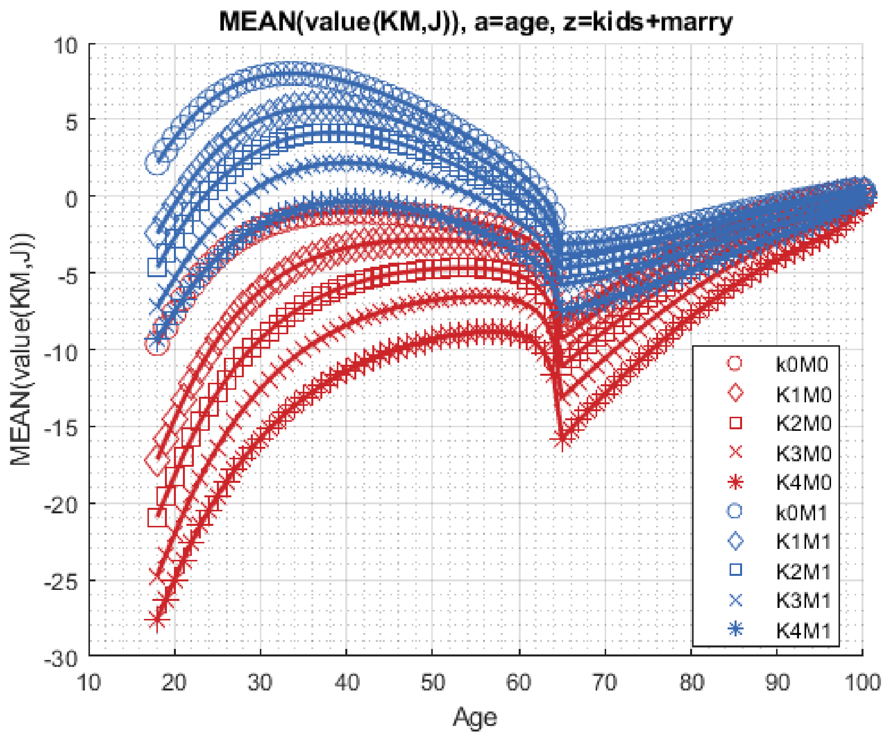
```
xxx  MEAN(AP(KM,J))  xxxxxxxxxxxxxxxxxxxxxxxxxxx
    group    kids    marry    mean_age_18    mean_age_19    mean_age_20    mean_age_21    mean_age_2
    -----    ----    -----    -----------    -----------    -----------    -----------    ----------

      1       1       0         34.494         34.456         34.416         34.452         34.489
      2       2       0           34.3         34.256          34.21         34.238         34.268
      3       3       0         34.146         34.101         34.055         34.082          34.11
      4       4       0         34.053          34.01         33.964         33.991          34.02
      5       5       0          33.97         33.929         33.885         33.915         33.946
      6       1       1         35.208         35.246         35.285         35.413         35.545
      7       2       1         34.951         34.976             35          35.11         35.222
      8       3       1         34.708         34.724         34.739         34.838         34.939
      9       4       1         34.506         34.516         34.523         34.613         34.704
     10       5       1         34.221         34.218         34.212         34.286         34.363
```

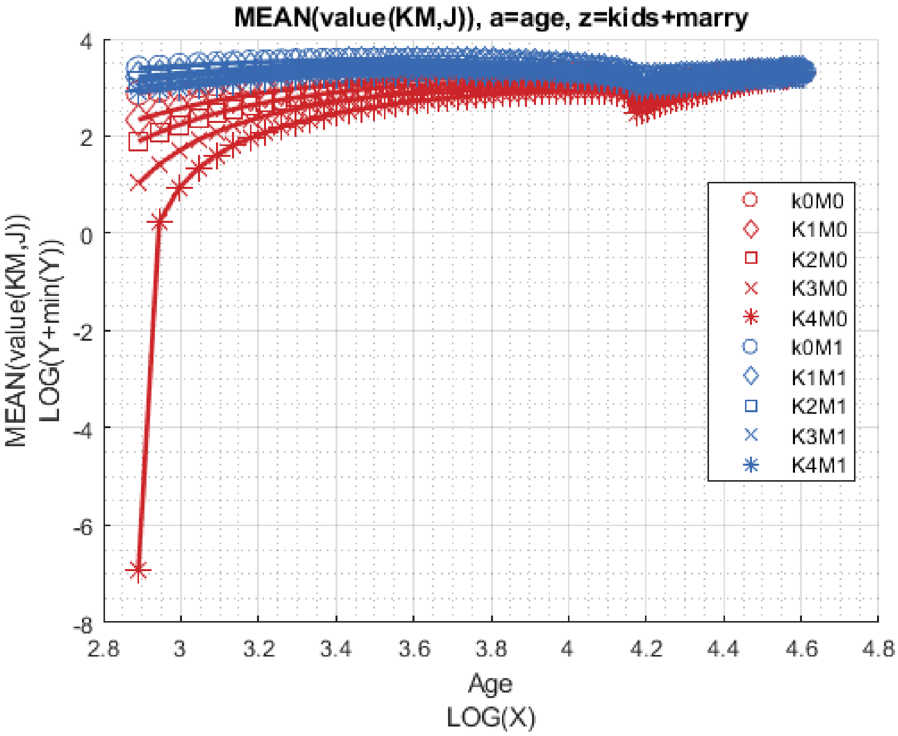
```
% Consumption Choices
tb_az_c = ff_summ_nd_array("MEAN(C(KM,J))", cons_VFI, true, ["mean"], 3, 1, cl_mp_datasetdesc, ar_pe
```

```
xxx  MEAN(C(KM,J))  xxxxxxxxxxxxxxxxxxxxxxxxxxx
    group    kids    marry    mean_age_18    mean_age_19    mean_age_20    mean_age_21    mean_age_2
    -----    ----    -----    -----------    -----------    -----------    -----------    ----------

      1       1       0         2.0632          2.102         2.1418          2.184         2.2244
      2       2       0         2.2579         2.3019          2.348         2.3975         2.4457
      3       3       0         2.4119         2.4563          2.503         2.5537         2.6031
      4       4       0         2.5046         2.5481          2.594         2.6445         2.6938
      5       5       0         2.5877         2.6287         2.6724         2.7207         2.7678
      6       1       1         2.6183         2.6787         2.7402         2.8051         2.8674
      7       2       1          2.681         2.7395         2.8002         2.8656         2.9293
      8       3       1         2.7896         2.8462         2.9054         2.9698         3.0325
      9       4       1         2.8528         2.9056         2.9612         3.0222         3.0816
     10       5       1         2.9174          2.966         3.0172         3.0737         3.1281
```

Graph Mean Values:

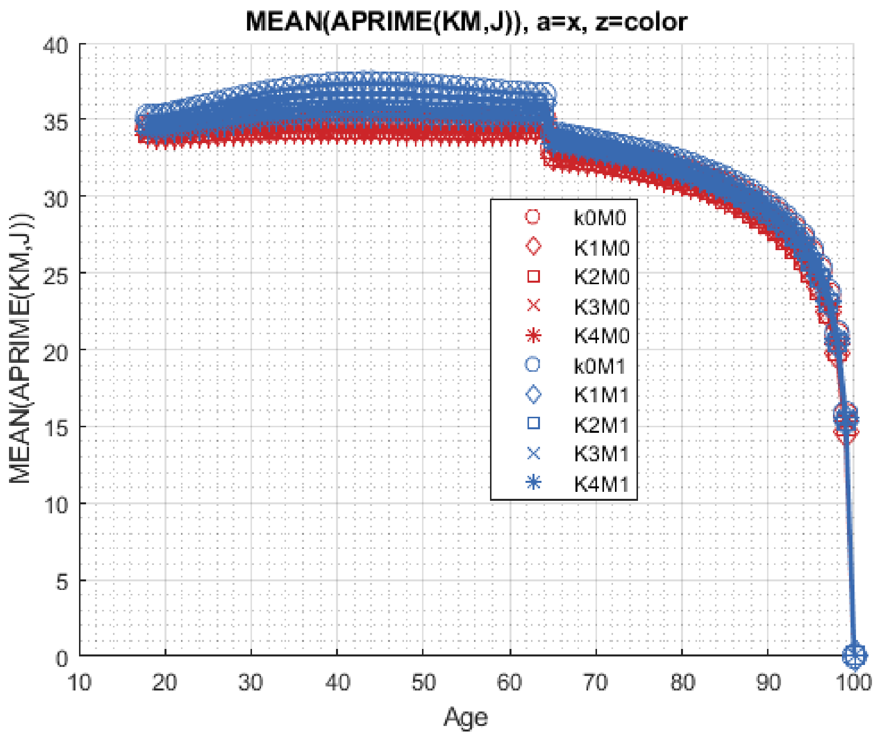
```
mp_support_graph('cl_st_graph_title') = {'MEAN(value(KM,J)), a=age, z=kids+marry'};
mp_support_graph('cl_st_ytitle') = {'MEAN(value(KM,J))'};
ff_graph_grid((tb_az_v{1:end, 4:end}), ar_row_grid, age_grid, mp_support_graph);
```

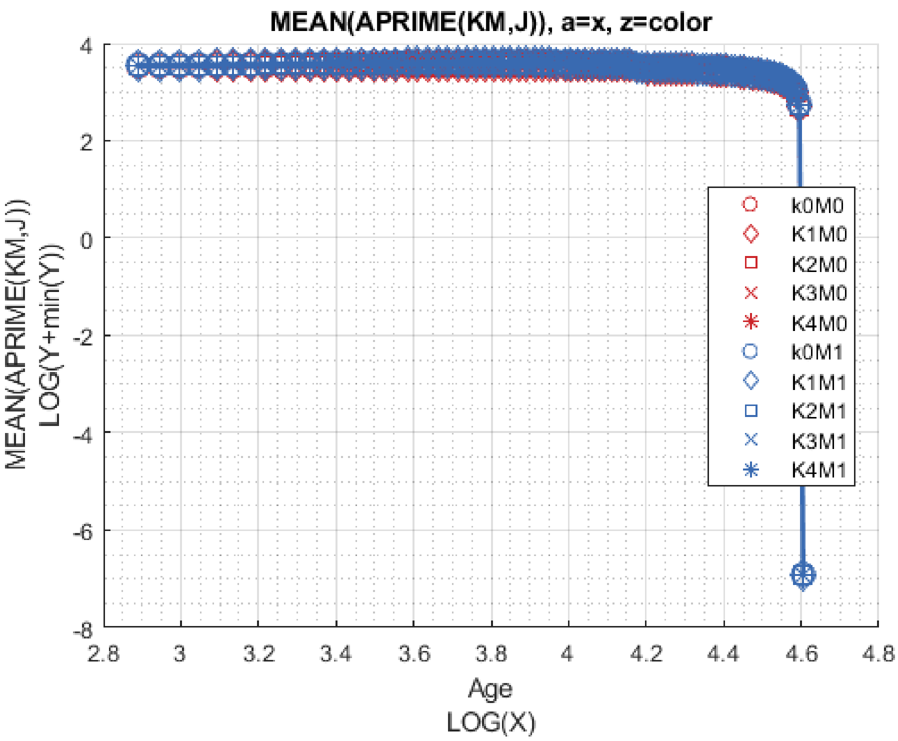




Graph Mean Savings Choices:

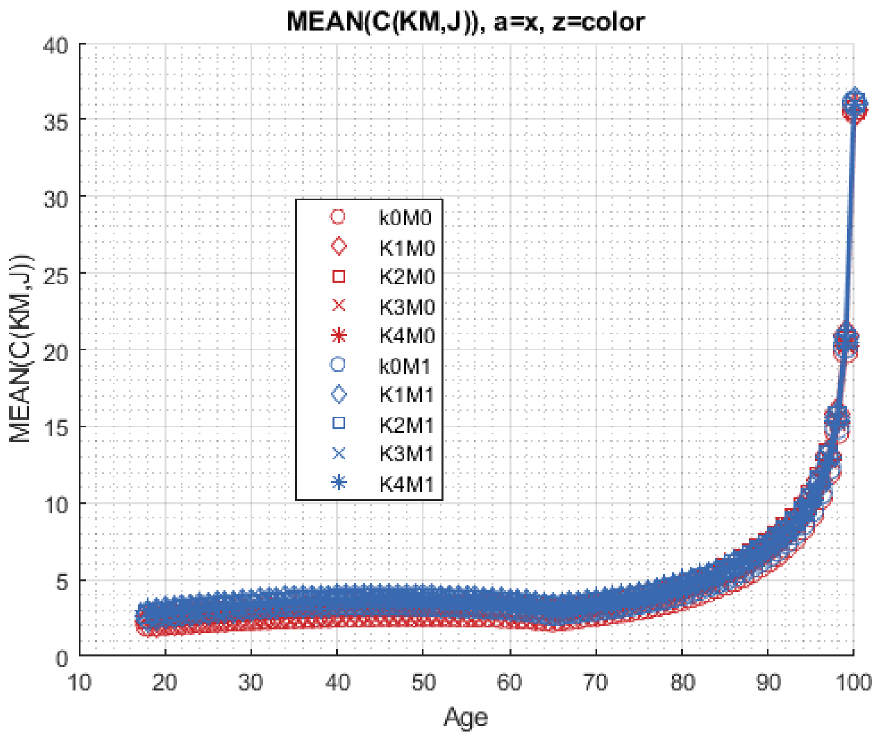
```
mp_support_graph('cl_st_graph_title') = {'MEAN(APRIME(KM,J)), a=x, z=color'};
mp_support_graph('cl_st_ytitle') = {'MEAN(APRIME(KM,J))'};
ff_graph_grid((tb_az_ap{1:end, 4:end}), ar_row_grid, age_grid, mp_support_graph);
```

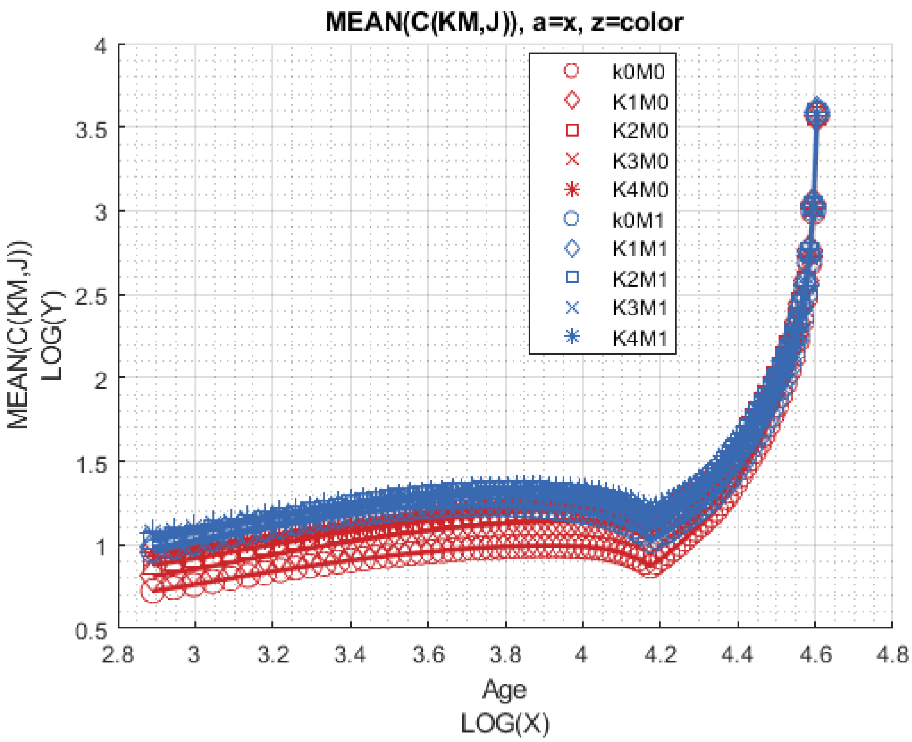




Graph Mean Consumption:

```
mp_support_graph('cl_st_graph_title') = {'MEAN(C(KM,J)), a=x, z=color'};
mp_support_graph('cl_st_ytitle') = {'MEAN(C(KM,J))'};
ff_graph_grid((tb_az_c{1:end, 4:end}), ar_row_grid, age_grid, mp_support_graph);
```





3.1.5 Analyze Education and Marriage and Age

Aggregating over education, savings, and shocks, what are the differential effects of Marriage and Age.

```
% Generate some Data
mp_support_graph = containers.Map('KeyType', 'char', 'ValueType', 'any');
ar_row_grid = ["E0M0", "E1M0", "E0M1", "E1M1"];
mp_support_graph('cl_st_xtitle') = {'Age'};
mp_support_graph('st_legend_loc') = 'best';
mp_support_graph('bl_graph_logy') = true; % do not log
```

```
mp_support_graph('st_rounding') = '6.2f'; % format shock legend
mp_support_graph('cl_scatter_shapes') = {'*', 'p', '*','p' };
mp_support_graph('cl_colors') = {'red', 'red', 'blue', 'blue'};
```

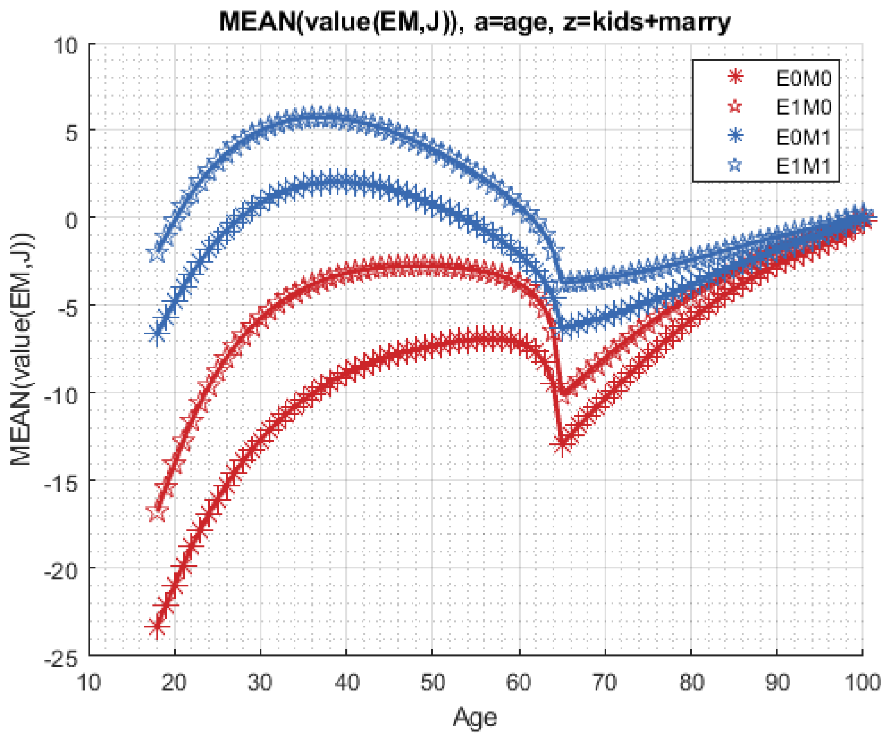
MEAN(VAL(EKM,J)), MEAN(AP(EKM,J)), MEAN(C(EKM,J))

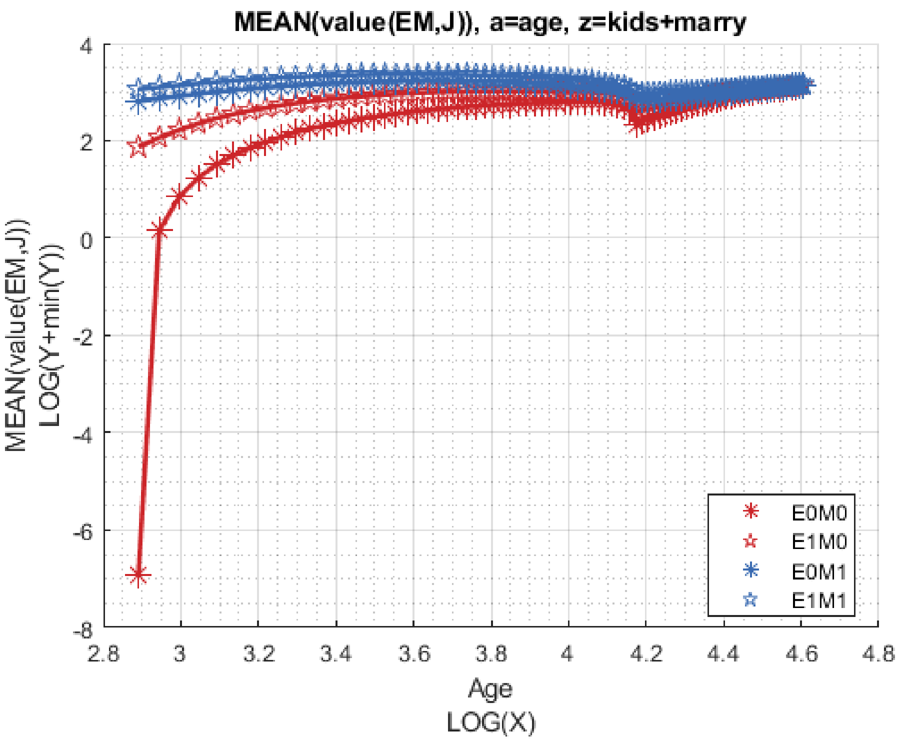
Tabulate value and policies:

```
% Set
% NaN(n_jgrid,n_agrid,n_etagrid,n_educgrid,n_marriedgrid,n_kidsgrid);
ar_permute = [2,3,6,1,4,5];
% Value Function
tb_az_v = ff_summ_nd_array("MEAN(VAL(EKM,J))", V_VFI, true, ["mean"], 3, 1, cl_mp_datasetdesc, ar_pe

xxx  MEAN(VAL(EKM,J))  xxxxxxxxxxxxxxxxxxxxxxxxxxx
    group    edu    marry    mean_age_18    mean_age_19    mean_age_20    mean_age_21    mean_age_22
    -----    ---    -----    -----------    -----------    -----------    -----------    -----------

      1       0       0         -23.27        -22.094        -20.941        -19.811        -18.761
      2       1       0        -16.739        -15.379        -14.045        -12.745         -11.58
      3       0       1        -6.6189        -5.6779        -4.7885        -3.9435        -3.1707
      4       1       1        -1.9684        -1.0477       -0.17465        0.66417         1.4159

% Aprime Choice
tb_az_ap = ff_summ_nd_array("MEAN(AP(EKM,J))", ap_VFI, true, ["mean"], 3, 1, cl_mp_datasetdesc, ar_p

xxx  MEAN(AP(EKM,J))  xxxxxxxxxxxxxxxxxxxxxxxxxxx
    group    edu    marry    mean_age_18    mean_age_19    mean_age_20    mean_age_21    mean_age_22
    -----    ---    -----    -----------    -----------    -----------    -----------    -----------

      1       0       0        34.294         34.261         34.226         34.237         34.247
      2       1       0        34.091          34.04         33.986         34.035         34.087
      3       0       1        34.769         34.789         34.809          34.88         34.951
      4       1       1        34.669         34.683         34.695         34.824         34.958

% Consumption Choices
tb_az_c = ff_summ_nd_array("MEAN(C(EKM,J))", cons_VFI, true, ["mean"], 3, 1, cl_mp_datasetdesc, ar_p

xxx  MEAN(C(EKM,J))  xxxxxxxxxxxxxxxxxxxxxxxxxxx
    group    edu    marry    mean_age_18    mean_age_19    mean_age_20    mean_age_21    mean_age_22
    -----    ---    -----    -----------    -----------    -----------    -----------    -----------

      1       0       0        2.2635         2.2969         2.3317         2.3683         2.4043
      2       1       0        2.4666         2.5178          2.572         2.6319         2.6896
      3       0       1        2.6261         2.6712         2.7175         2.7661         2.8135
      4       1       1        2.9175         2.9832         3.0522         3.1285          3.202
```

Graph Mean Values:

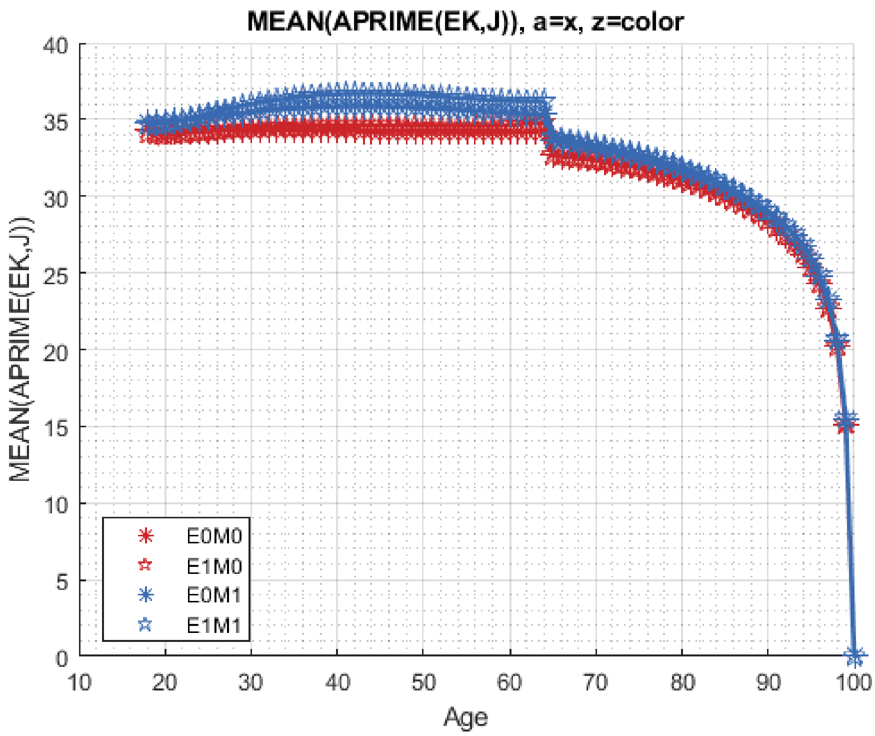
```
mp_support_graph('cl_st_graph_title') = {'MEAN(value(EM,J)), a=age, z=kids+marry'};
mp_support_graph('cl_st_ytitle') = {'MEAN(value(EM,J))'};
ff_graph_grid((tb_az_v{1:end, 4:end}), ar_row_grid, age_grid, mp_support_graph);
```

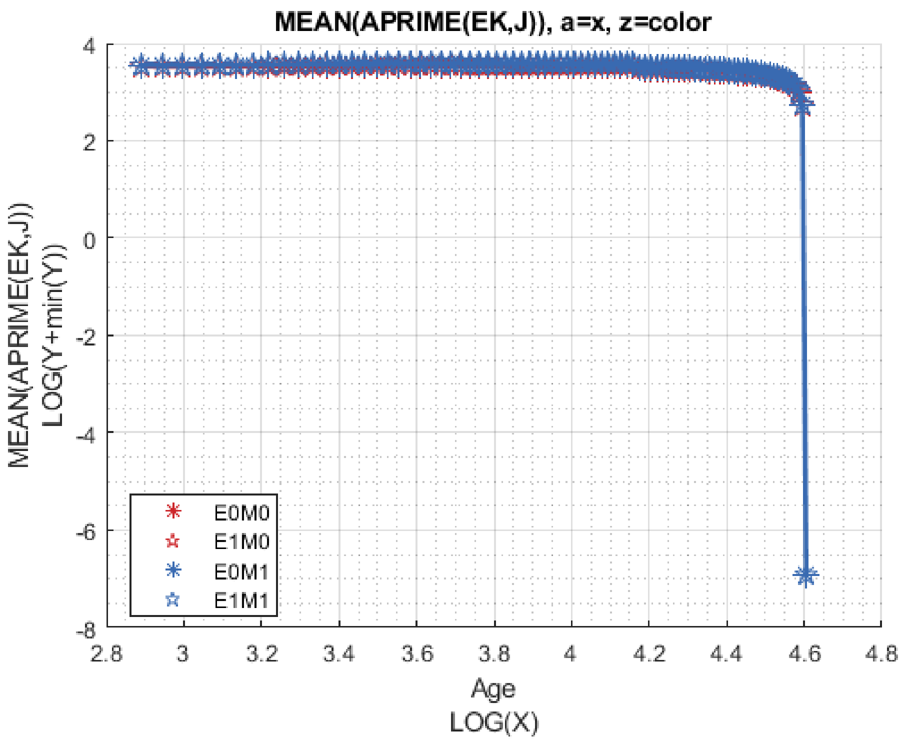




Graph Mean Savings Choices:

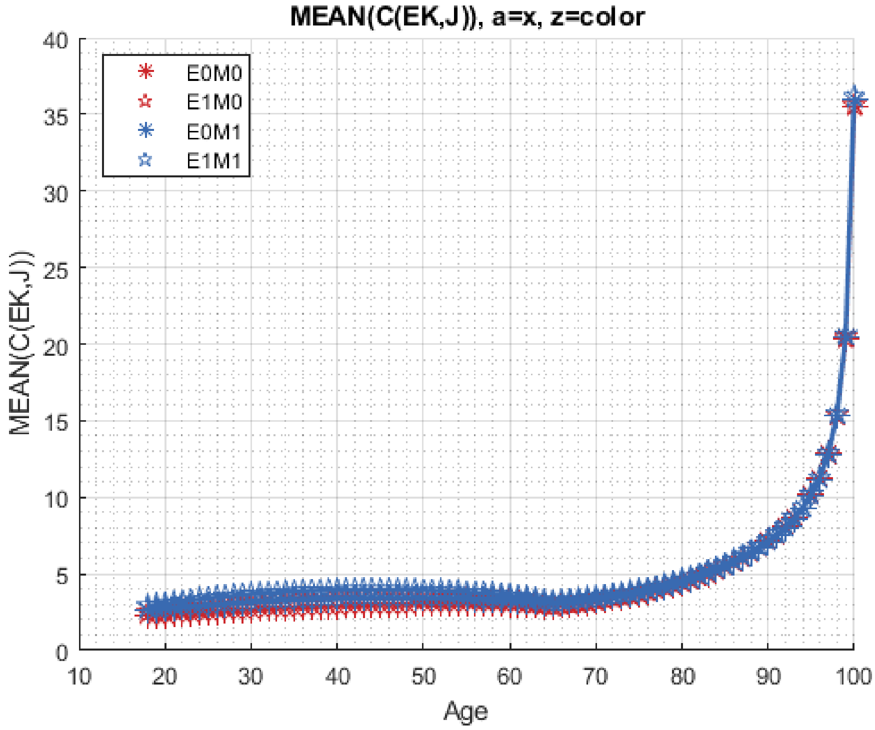
```
mp_support_graph('cl_st_graph_title') = {'MEAN(APRIME(EK,J)), a=x, z=color'};
mp_support_graph('cl_st_ytitle') = {'MEAN(APRIME(EK,J))'};
ff_graph_grid((tb_az_ap{1:end, 4:end}), ar_row_grid, age_grid, mp_support_graph);
```

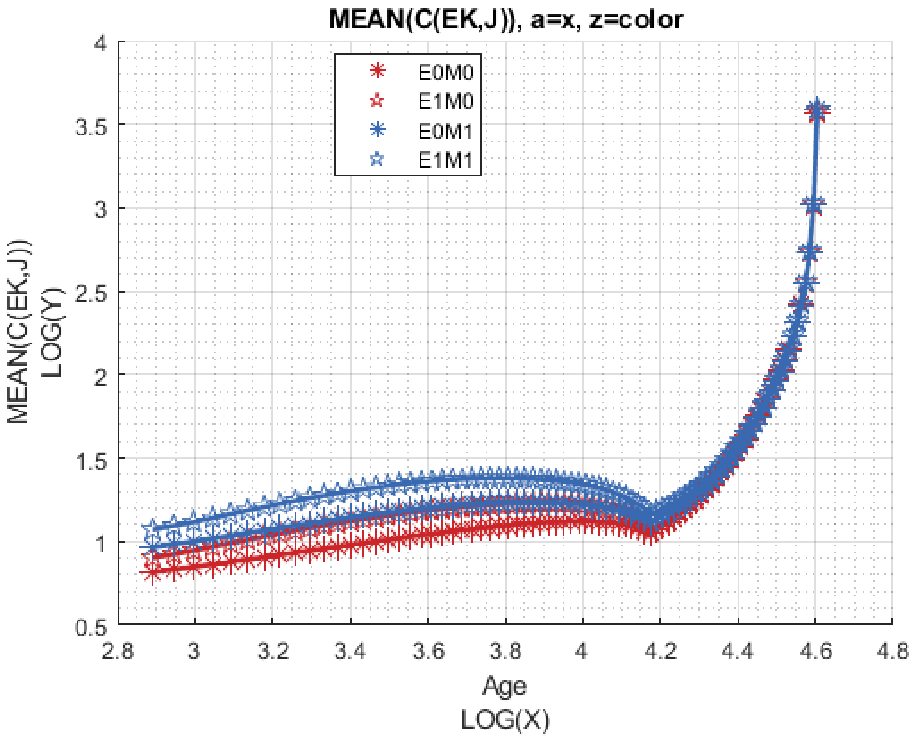




Graph Mean Consumption:

```
mp_support_graph('cl_st_graph_title') = {'MEAN(C(EK,J)), a=x, z=color'};
mp_support_graph('cl_st_ytitle') = {'MEAN(C(EK,J))'};
ff_graph_grid((tb_az_c{1:end, 4:end}), ar_row_grid, age_grid, mp_support_graph);
```


MEAN(C(EK,J)), a=x, z=color
E0M0
E1M0
E0M1
E1M1
MEAN(C(EK,J))
Age


MEAN(C(EK,J)), a=x, z=color
E0M0
E1M0
E0M1
E1M1
MEAN(C(EK,J))
LOG(Y)
Age
LOG(X)

Chapter 4

Alternative Value Function Solution Testing

4.1 Small Test Exact Solution Looped Minimizer

This is the example vignette for function: **snw_vfi_main** from the **PrjOptiSNW Package.** This function solves for policy function fully iteratively using matlab minimizer. Small Solution Analysis.This produces the same result as **snw_vfi_main_bisec_vec,** except slower. The purpose of this function is to confirm that the results from **snw_vfi_main_bisec_vec** is correct.

4.1.1 Test SNW_VFI_MAIN Defaults Small

Call the function with defaults parameters.

```
mp_param = snw_mp_param('default_small');
[V_VFI,ap_VFI,cons_VFI,mp_valpol_more] = snw_vfi_main(mp_param);
```

```
SNW_VFI_MAIN: Finished Age Group:18 of 18
SNW_VFI_MAIN: Finished Age Group:17 of 18
SNW_VFI_MAIN: Finished Age Group:16 of 18
SNW_VFI_MAIN: Finished Age Group:15 of 18
SNW_VFI_MAIN: Finished Age Group:14 of 18
SNW_VFI_MAIN: Finished Age Group:13 of 18
SNW_VFI_MAIN: Finished Age Group:12 of 18
SNW_VFI_MAIN: Finished Age Group:11 of 18
SNW_VFI_MAIN: Finished Age Group:10 of 18
SNW_VFI_MAIN: Finished Age Group:9 of 18
SNW_VFI_MAIN: Finished Age Group:8 of 18
SNW_VFI_MAIN: Finished Age Group:7 of 18
SNW_VFI_MAIN: Finished Age Group:6 of 18
SNW_VFI_MAIN: Finished Age Group:5 of 18
SNW_VFI_MAIN: Finished Age Group:4 of 18
SNW_VFI_MAIN: Finished Age Group:3 of 18
SNW_VFI_MAIN: Finished Age Group:2 of 18
SNW_VFI_MAIN: Finished Age Group:1 of 18
Elapsed time is 375.055636 seconds.
Completed SNW_VFI_MAIN;SNW_MP_PARAM=default_small;SNW_MP_CONTROL=default_base
```

4.1.2 Small Param Results Define Frames

Define the matrix dimensions names and dimension vector values. Policy and Value Functions share the same ND dimensional structure.

```
% Grids:
age_grid = [19, 22:5:97, 100];
agrid = mp_param('agrid')';
eta_H_grid = mp_param('eta_H_grid')';
eta_S_grid = mp_param('eta_S_grid')';
ar_st_eta_HS_grid = string(cellstr([num2str(eta_H_grid', 'hz=%3.2f;'), num2str(eta_S_grid', 'wz=%3.2
edu_grid = [0,1];
marry_grid = [0,1];
kids_grid = (1:1:mp_param('n_kidsgrid'))';
% NaN(n_jgrid,n_agrid,n_etagrid,n_educgrid,n_marriedgrid,n_kidsgrid);
cl_mp_datasetdesc = {};
cl_mp_datasetdesc{1} = containers.Map({'name', 'labval'}, {'age', age_grid});
cl_mp_datasetdesc{2} = containers.Map({'name', 'labval'}, {'savings', agrid});
cl_mp_datasetdesc{3} = containers.Map({'name', 'labval'}, {'eta', 1:length(eta_H_grid)});
cl_mp_datasetdesc{4} = containers.Map({'name', 'labval'}, {'edu', edu_grid});
cl_mp_datasetdesc{5} = containers.Map({'name', 'labval'}, {'marry', marry_grid});
cl_mp_datasetdesc{6} = containers.Map({'name', 'labval'}, {'kids', kids_grid});
```

4.1.3 Analyze Savings and Shocks

First, analyze Savings Levels and Shocks, Aggregate Over All Others, and do various other calculations.

```
% Generate some Data
mp_support_graph = containers.Map('KeyType', 'char', 'ValueType', 'any');
mp_support_graph('cl_st_xtitle') = {'Savings States, a'};
mp_support_graph('st_legend_loc') = 'best';
mp_support_graph('bl_graph_logy') = true; % do not log
```

MEAN(VAL(A,Z)), MEAN(AP(A,Z)), MEAN(C(A,Z))

Tabulate value and policies along savings and shocks:

```
% Set
% NaN(n_jgrid,n_agrid,n_etagrid,n_educgrid,n_marriedgrid,n_kidsgrid);
ar_permute = [1,4,5,6,3,2];
% Value Function
tb_az_v = ff_summ_nd_array("MEAN(VAL(A,Z))", V_VFI, true, ["mean"], 4, 1, cl_mp_datasetdesc, ar_perm
```

```
xxx  MEAN(VAL(A,Z))  xxxxxxxxxxxxxxxxxxxxxxxxxxx
    group     savings     mean_eta_1    mean_eta_2    mean_eta_3    mean_eta_4    mean_eta_5
    -----    ---------    ----------    ----------    ----------    ----------    ----------

      1             0      -17.393       -9.1596       -4.4164       -1.5922      -0.05106
      2     0.0097656      -16.967        -9.023       -4.3405       -1.5316     0.0054257
      3      0.078125      -14.925       -8.2554       -3.9177       -1.2071        0.3028
      4       0.26367      -11.699       -6.8681       -3.1808       -0.6913       0.75178
      5         0.625      -8.2751       -5.1669       -2.2786      -0.13884        1.1911
      6        1.2207      -5.3024       -3.4437       -1.3431       0.38361        1.5638
      7        2.1094      -2.9816       -1.9066      -0.47798       0.86411        1.8672
      8        3.3496      -1.2609      -0.64407       0.28611        1.3001        2.1163
      9             5    -0.012548       0.34403        0.9369        1.6782        2.3266
     10        7.1191       0.8875         1.097        1.4725        1.9981        2.5086
     11        9.7656       1.5392         1.665        1.9037        2.2701        2.6684
     12        12.998       2.0158        2.0932        2.2465        2.5004        2.8071
     13        16.875       2.3684        2.4172        2.5172        2.6933        2.9263
     14        21.455       2.6328        2.6644        2.7307        2.8535        3.0288
     15        26.797       2.8339        2.8549        2.8997         2.986        3.1174
     16        32.959        2.989        3.0032         3.034        3.0954        3.1939
     17            40       3.1102          3.12        3.1416        3.1857        3.2598
     18        47.979       3.2059        3.2128        3.2282        3.2603        3.3164
```

19	56.953	3.2825	3.2875	3.2986	3.3222	3.3649
20	66.982	3.3443	3.348	3.3562	3.3738	3.4064
21	78.125	3.3948	3.3975	3.4036	3.4169	3.4421
22	90.439	3.4364	3.4384	3.443	3.4532	3.4728
23	103.98	3.4709	3.4724	3.476	3.4838	3.4991
24	118.82	3.4998	3.501	3.5037	3.5098	3.5219
25	135	3.5241	3.5251	3.5272	3.5319	3.5416

```
% Aprime Choice
tb_az_ap = ff_summ_nd_array("MEAN(AP(A,Z))", ap_VFI, true, ["mean"], 4, 1, cl_mp_datasetdesc, ar_per
```

xxx MEAN(AP(A,Z)) xxxxxxxxxxxxxxxxxxxxxxxxxxx

group	savings	mean_eta_1	mean_eta_2	mean_eta_3	mean_eta_4	mean_eta_5
1	0	2.7521e-05	0.0021998	0.046507	0.23828	0.88717
2	0.0097656	0.00054713	0.0036592	0.049526	0.24213	0.89277
3	0.078125	0.021674	0.027305	0.079496	0.27478	0.93352
4	0.26367	0.13129	0.14249	0.19452	0.38205	1.0523
5	0.625	0.38725	0.4041	0.44789	0.639	1.3005
6	1.2207	0.83381	0.85545	0.90674	1.0839	1.735
7	2.1094	1.5206	1.5442	1.6064	1.7452	2.3859
8	3.3496	2.477	2.5013	2.5629	2.6789	3.3301
9	5	3.7541	3.7788	3.8405	3.9859	4.5828
10	7.1191	5.416	5.4412	5.5038	5.6835	6.1821
11	9.7656	7.4668	7.4912	7.5553	7.7413	8.177
12	12.998	9.9008	9.9212	9.9832	10.174	10.619
13	16.875	12.918	12.94	12.995	13.186	13.709
14	21.455	16.519	16.538	16.594	16.772	17.365
15	26.797	20.59	20.608	20.657	20.825	21.451
16	32.959	25.295	25.313	25.358	25.513	26.139
17	40	30.657	30.68	30.732	30.877	31.477
18	47.979	36.752	36.772	36.831	36.99	37.553
19	56.953	43.764	43.786	43.839	44.003	44.551
20	66.982	51.595	51.618	51.678	51.84	52.393
21	78.125	59.943	59.966	60.026	60.198	60.755
22	90.439	69.256	69.28	69.342	69.517	70.086
23	103.98	79.744	79.765	79.824	79.998	80.576
24	118.82	91.106	91.13	91.192	91.358	91.933
25	135	103.46	103.48	103.54	103.71	104.28

```
% Consumption Choices
tb_az_c = ff_summ_nd_array("MEAN(C(A,Z))", cons_VFI, true, ["mean"], 4, 1, cl_mp_datasetdesc, ar_per
```

xxx MEAN(C(A,Z)) xxxxxxxxxxxxxxxxxxxxxxxxxxx

group	savings	mean_eta_1	mean_eta_2	mean_eta_3	mean_eta_4	mean_eta_5
1	0	0.3104	0.44	0.69882	1.2297	2.3502
2	0.0097656	0.3214	0.45001	0.70723	1.2373	2.356
3	0.078125	0.3809	0.50664	0.75722	1.2844	2.3949
4	0.26367	0.48992	0.60921	0.85919	1.3936	2.4924
5	0.625	0.65895	0.77122	1.0281	1.5581	2.6654
6	1.2207	0.91142	1.0172	1.2649	1.8076	2.9247
7	2.1094	1.2649	1.3671	1.6019	2.1815	3.3081
8	3.3496	1.7572	1.8573	2.0907	2.6915	3.8066
9	5	2.4045	2.503	2.7347	3.3043	4.4728
10	7.1191	3.2104	3.3074	3.537	4.0708	5.3364

```
    11        9.7656    4.2385    4.3358    4.5627    5.0889    6.4164
    12        12.998    5.5627    5.6635    5.8917    6.4121    7.7296
    13        16.875    7.0504    7.1499    7.3847     7.904    9.1419
    14        21.455    8.7708    8.8721    9.1059    9.6366    10.804
    15        26.797    10.904    11.007    11.246    11.787    12.921
    16        32.959    13.355    13.457      13.7    14.254    15.388
    17            40    16.168    16.266    16.502    17.066    18.225
    18        47.979    19.337    19.437    19.666    20.215    21.411
    19        56.953    22.744    22.843    23.078    23.621    24.831
    20        66.982    26.557    26.654    26.882    27.427    28.632
    21        78.125    31.144    31.241    31.469    32.005    33.205
    22        90.439    36.126    36.222    36.449    36.981    38.169
    23        103.98    41.361     41.46    41.689    42.223    43.402
    24        118.82    47.219    47.315    47.541    48.083    49.265
    25           135    53.648    53.747    53.978    54.513    55.702
```

4.2 Small Test Grid Search Solution

This is the example vignette for function: **snw_vfi_main_grid_search** from the **PrjOptiSNW Package.** This function solves for policy function using grid search. Small Solution Analysis. Small Solution Analysis, husband 5 shocks, wife 1 shocks.

4.2.1 Test SNW_VFI_MAIN_GRID_SEARCH Defaults Small

Call the function with defaults parameters.

```
mp_param = snw_mp_param('default_small');
[V_VFI,ap_VFI,cons_VFI,mp_valpol_more] = snw_vfi_main_grid_search(mp_param);
```

```
SNW_VFI_MAIN_GRID_SEARCH: Finished Age Group:18 of 18
SNW_VFI_MAIN_GRID_SEARCH: Finished Age Group:17 of 18
SNW_VFI_MAIN_GRID_SEARCH: Finished Age Group:16 of 18
SNW_VFI_MAIN_GRID_SEARCH: Finished Age Group:15 of 18
SNW_VFI_MAIN_GRID_SEARCH: Finished Age Group:14 of 18
SNW_VFI_MAIN_GRID_SEARCH: Finished Age Group:13 of 18
SNW_VFI_MAIN_GRID_SEARCH: Finished Age Group:12 of 18
SNW_VFI_MAIN_GRID_SEARCH: Finished Age Group:11 of 18
SNW_VFI_MAIN_GRID_SEARCH: Finished Age Group:10 of 18
SNW_VFI_MAIN_GRID_SEARCH: Finished Age Group:9 of 18
SNW_VFI_MAIN_GRID_SEARCH: Finished Age Group:8 of 18
SNW_VFI_MAIN_GRID_SEARCH: Finished Age Group:7 of 18
SNW_VFI_MAIN_GRID_SEARCH: Finished Age Group:6 of 18
SNW_VFI_MAIN_GRID_SEARCH: Finished Age Group:5 of 18
SNW_VFI_MAIN_GRID_SEARCH: Finished Age Group:4 of 18
SNW_VFI_MAIN_GRID_SEARCH: Finished Age Group:3 of 18
SNW_VFI_MAIN_GRID_SEARCH: Finished Age Group:2 of 18
SNW_VFI_MAIN_GRID_SEARCH: Finished Age Group:1 of 18
Elapsed time is 5.586732 seconds.
Completed SNW_VFI_MAIN_GRID_SEARCH;SNW_MP_PARAM=default_small;SNW_MP_CONTROL=default_base
```

4.2.2 Small Param Results Define Frames

Define the matrix dimensions names and dimension vector values. Policy and Value Functions share the same ND dimensional structure.

```
% Grids:
age_grid = [19, 22:5:97, 100];
agrid = mp_param('agrid')';
eta_H_grid = mp_param('eta_H_grid')';
```

```
eta_S_grid = mp_param('eta_S_grid')';
ar_st_eta_HS_grid = string(cellstr([num2str(eta_H_grid', 'hz=%3.2f;'), num2str(eta_S_grid', 'wz=%3.2
edu_grid = [0,1];
marry_grid = [0,1];
kids_grid = (1:1:mp_param('n_kidsgrid'))';
% NaN(n_jgrid,n_agrid,n_etagrid,n_educgrid,n_marriedgrid,n_kidsgrid);
cl_mp_datasetdesc = {};
cl_mp_datasetdesc{1} = containers.Map({'name', 'labval'}, {'age', age_grid});
cl_mp_datasetdesc{2} = containers.Map({'name', 'labval'}, {'savings', agrid});
cl_mp_datasetdesc{3} = containers.Map({'name', 'labval'}, {'Hshock', eta_H_grid});
cl_mp_datasetdesc{4} = containers.Map({'name', 'labval'}, {'edu', edu_grid});
cl_mp_datasetdesc{5} = containers.Map({'name', 'labval'}, {'marry', marry_grid});
cl_mp_datasetdesc{6} = containers.Map({'name', 'labval'}, {'kids', kids_grid});
```

4.2.3 Analyze Savings and Shocks

First, analyze Savings Levels and Shocks, Aggregate Over All Others, and do various other calculations.

```
% Generate some Data
mp_support_graph = containers.Map('KeyType', 'char', 'ValueType', 'any');
mp_support_graph('cl_st_xtitle') = {'Savings States, a'};
mp_support_graph('st_legend_loc') = 'best';
mp_support_graph('bl_graph_logy') = true; % do not log
```

MEAN(VAL(A,Z)), MEAN(AP(A,Z)), MEAN(C(A,Z))

Tabulate value and policies along savings and shocks:

```
% Set
% NaN(n_jgrid,n_agrid,n_etagrid,n_educgrid,n_marriedgrid,n_kidsgrid);
ar_permute = [1,4,5,6,3,2];
% Value Function
tb_az_v = ff_summ_nd_array("MEAN(VAL(A,Z))", V_VFI, true, ["mean"], 4, 1, cl_mp_datasetdesc, ar_perm
```

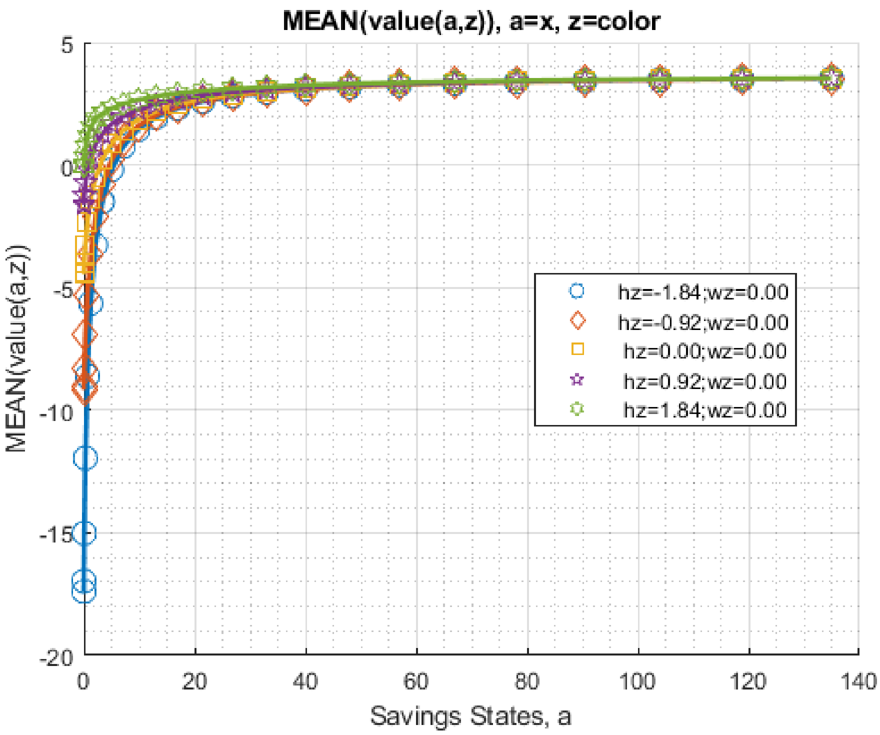
```
xxx  MEAN(VAL(A,Z))  xxxxxxxxxxxxxxxxxxxxxxxxxxx
    group     savings     mean_Hshock__1_8395    mean_Hshock__0_91976    mean_Hshock_0    mean_Hshoc
    -----    ---------    -------------------    --------------------    -------------    ----------

      1              0          -17.394                   -9.166               -4.4582             -1.6
      2      0.0097656          -16.968                  -9.0297                -4.383             -1.5
      3       0.078125          -15.017                  -8.2656               -3.9672             -1.2
      4        0.26367          -11.958                  -6.9235               -3.2427            -0.73
      5          0.625           -8.614                  -5.2917               -2.3144            -0.18
      6         1.2207          -5.6438                  -3.6124               -1.3711             0.33
      7         2.1094          -3.2727                  -2.0767              -0.51202              0.8
      8         3.3496          -1.4899                 -0.79383               0.23904              1.2
      9              5         -0.18672                  0.21807               0.87882              1.6
     10         7.1191          0.75696                  0.99324                1.4131              1.9
     11         9.7656           1.4411                   1.5836                1.8494              2.2
     12         12.998           1.9409                   2.0281                2.1992              2.4
     13         16.875           2.3126                   2.3665                2.4779              2.6
     14         21.455           2.5903                   2.6255                2.6981              2.8
     15         26.797           2.8009                   2.8241                2.8737               2.
     16         32.959           2.9638                   2.9792                3.0129              3.0
     17             40           3.0907                   3.1014                3.1247              3.1
     18         47.979           3.1906                   3.1981                3.2147              3.2
     19         56.953           3.2703                   3.2756                3.2877              3.3
     20         66.982           3.3347                   3.3386                3.3473              3.3
     21         78.125           3.3872                     3.39                3.3965              3.4
     22         90.439           3.4302                   3.4324                3.4373               3.
```

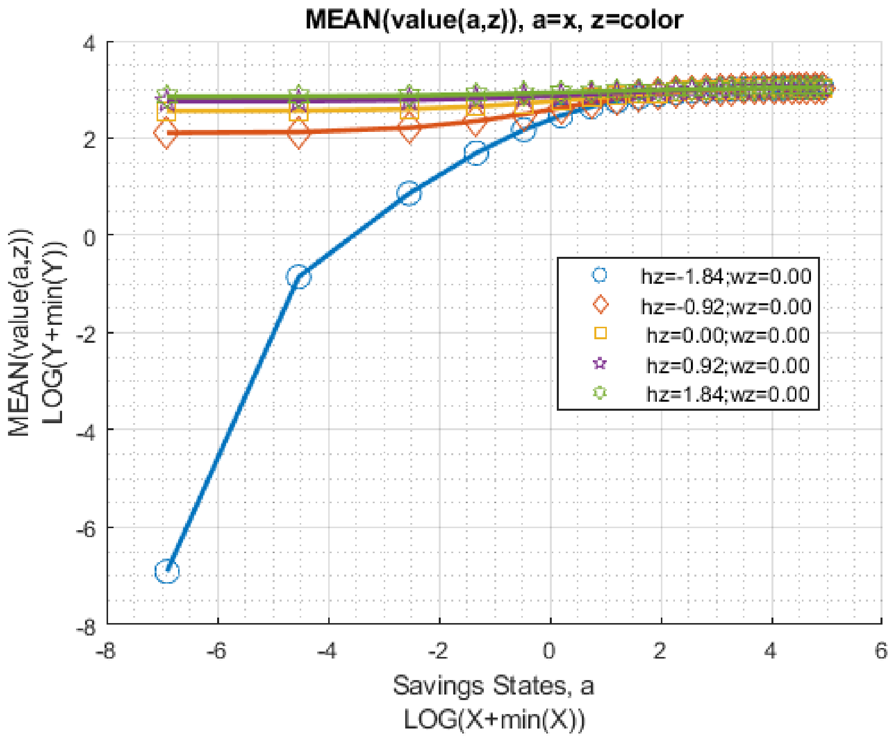
```
    23        103.98          3.4659                  3.4675              3.4712             3.4
    24        118.82          3.4957                   3.497              3.4998             3.5
    25           135          3.5208                  3.5218               3.524              3.

% Aprime Choice
tb_az_ap = ff_summ_nd_array("MEAN(AP(A,Z))", ap_VFI, true, ["mean"], 4, 1, cl_mp_datasetdesc, ar_per

xxx  MEAN(AP(A,Z))  xxxxxxxxxxxxxxxxxxxxxxxxxxx
    group     savings     mean_Hshock__1_8395    mean_Hshock__0_91976    mean_Hshock_0    mean_Hshoc
    -----    ---------    -------------------    --------------------    -------------    ----------

      1            0                   1                 1.1111             1.5694            2.59
      2    0.0097656              1.0463                 1.1852             1.6343            2.60
      3     0.078125              1.7917                 1.9815             2.1806            2.85
      4      0.26367              2.9306                 3.0231             3.2083            3.60
      5        0.625              4.0509                 4.1296             4.2454            4.51
      6       1.2207              5.1296                 5.2176             5.2639            5.38
      7       2.1094              6.1065                 6.1852             6.2361            6.24
      8       3.3496              7.0324                 7.0648             7.1574            7.14
      9            5              7.9259                  7.963              8.037            8.06
     10       7.1191              8.8519                  8.875             8.9306            9.00
     11       9.7656              9.7824                 9.7963             9.8472            9.92
     12       12.998              10.593                 10.625             10.639            10.7
     13       16.875              11.481                 11.491             11.537            11.5
     14       21.455              12.407                 12.407             12.426            12.4
     15       26.797              13.282                 13.296             13.306            13.3
     16       32.959              14.116                  14.12             14.153            14.
     17           40              14.981                 14.981             14.991            15.0
     18       47.979               15.88                  15.88             15.884            15.9
     19       56.953               16.75                 16.769             16.782            16.7
     20       66.982              17.681                 17.685             17.699            17.7
     21       78.125              18.495                   18.5             18.509            18.5
     22       90.439              19.338                 19.338             19.347            19.
     23       103.98               20.25                 20.264             20.269            20.2
     24       118.82              21.097                 21.097              21.13            21.1
     25          135              21.963                 21.968             21.977            21.9

% Consumption Choices
tb_az_c = ff_summ_nd_array("MEAN(C(A,Z))", cons_VFI, true, ["mean"], 4, 1, cl_mp_datasetdesc, ar_per

xxx  MEAN(C(A,Z))  xxxxxxxxxxxxxxxxxxxxxxxxxxx
    group     savings     mean_Hshock__1_8395    mean_Hshock__0_91976    mean_Hshock_0    mean_Hshoc
    -----    ---------    -------------------    --------------------    -------------    ----------

      1            0             0.31042                0.44057            0.71427            1.25
      2    0.0097656              0.3215                 0.4505            0.72262            1.26
      3     0.078125             0.38861                0.50889             0.7788             1.3
      4      0.26367             0.51067                0.62506            0.88538            1.43
      5        0.625               0.686                0.78667             1.0455            1.60
      6       1.2207              0.9128                0.98784             1.2592            1.86
      7       2.1094              1.2523                 1.3082             1.5599            2.26
      8       3.3496              1.7189                 1.8031             1.9833            2.71
      9            5              2.3724                 2.4345             2.6057            3.27
     10       7.1191              3.1536                 3.2269             3.4012             3.9
     11       9.7656              4.0911                  4.176             4.3322            4.83
     12       12.998              5.4598                 5.4763             5.7216            6.16
     13       16.875              6.9683                 7.0533             7.1634            7.64
     14       21.455              8.5994                 8.7201             8.9245            9.35
```

15	26.797	10.632	10.678	10.918	11.3
16	32.959	13.22	13.312	13.401	13.8
17	40	16.041	16.161	16.385	16.7
18	47.979	18.978	19.099	19.35	19.8
19	56.953	22.58	22.534	22.697	23.2
20	66.982	26.096	26.175	26.329	26.8
21	78.125	30.85	30.924	31.108	31.3
22	90.439	35.936	36.056	36.235	36.6
23	103.98	40.993	40.925	41.151	41.7
24	118.82	47.079	47.199	47.025	47.5
25	135	53.5	53.545	53.689	54.1

Graph Mean Values:

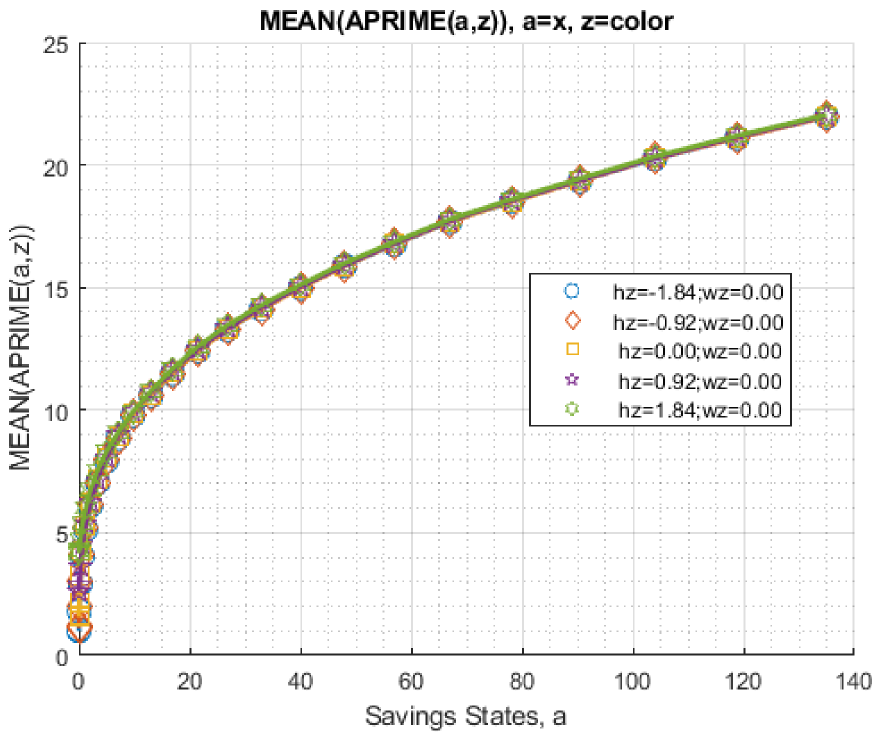
```
mp_support_graph('cl_st_graph_title') = {'MEAN(value(a,z)), a=x, z=color'};
mp_support_graph('cl_st_ytitle') = {'MEAN(value(a,z))'};
ff_graph_grid((tb_az_v{1:end, 3:end})', ar_st_eta_HS_grid, agrid, mp_support_graph);
```

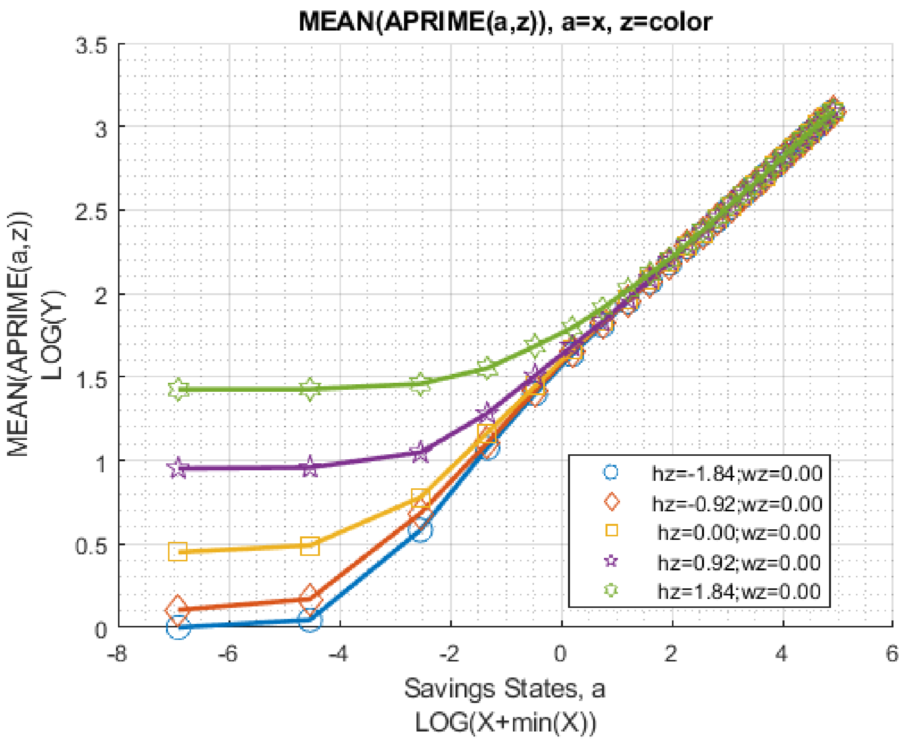




Graph Mean Savings Choices:

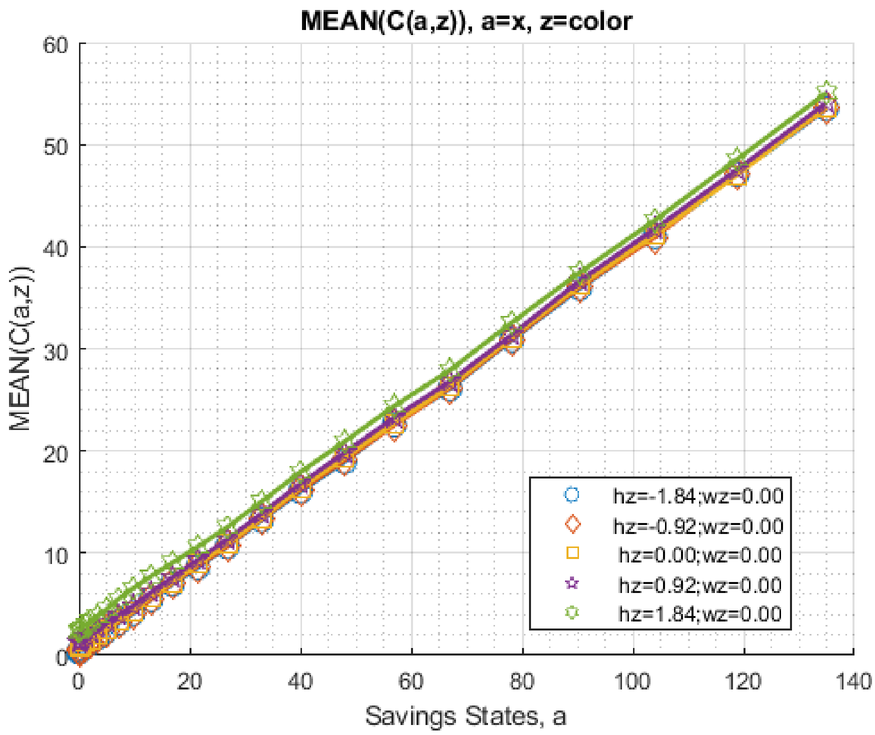
```
mp_support_graph('cl_st_graph_title') = {'MEAN(APRIME(a,z)), a=x, z=color'};
mp_support_graph('cl_st_ytitle') = {'MEAN(APRIME(a,z))'};
ff_graph_grid((tb_az_ap{1:end, 3:end})', ar_st_eta_HS_grid, agrid, mp_support_graph);
```

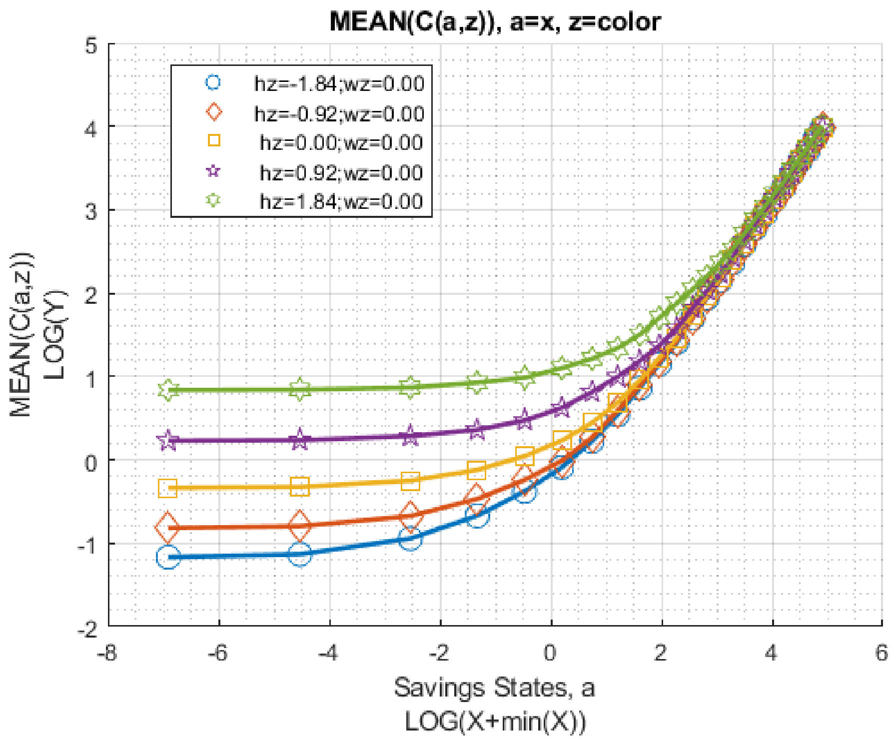




Graph Mean Consumption:

```
mp_support_graph('cl_st_graph_title') = {'MEAN(C(a,z)), a=x, z=color'};
mp_support_graph('cl_st_ytitle') = {'MEAN(C(a,z))'};
ff_graph_grid((tb_az_c{1:end, 3:end})', ar_st_eta_HS_grid, agrid, mp_support_graph);
```





4.2.4 Analyze Kids and Marriage and Age

Aggregating over education, savings, and shocks, what are the differential effects of Marriage and Age.

```
% Generate some Data
mp_support_graph = containers.Map('KeyType', 'char', 'ValueType', 'any');
ar_row_grid = ["k0M0", "K1M0", "K2M0", "k0M1", "K1M1", "K2M1"];
mp_support_graph('cl_st_xtitle') = {'Age'};
mp_support_graph('st_legend_loc') = 'best';
mp_support_graph('bl_graph_logy') = true; % do not log
mp_support_graph('st_rounding') = '6.2f'; % format shock legend
mp_support_graph('cl_scatter_shapes') = { 'o', 'd' ,'s', 'o', 'd', 's'};
mp_support_graph('cl_colors') = {'red', 'red', 'red', 'blue', 'blue', 'blue'};
```

MEAN(VAL(KM,J)), MEAN(AP(KM,J)), MEAN(C(KM,J))

Tabulate value and policies:

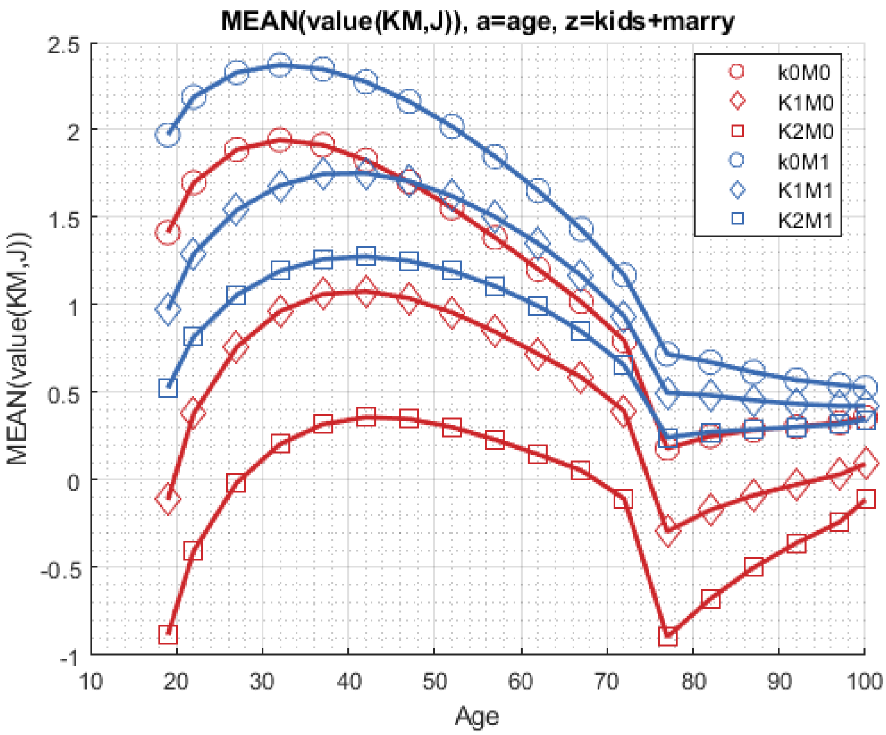
```
% Set
% NaN(n_jgrid,n_agrid,n_etagrid,n_educgrid,n_marriedgrid,n_kidsgrid);
ar_permute = [2,3,4,1,6,5];
% Value Function
tb_az_v = ff_summ_nd_array("MEAN(VAL(KM,J))", V_VFI, true, ["mean"], 3, 1, cl_mp_datasetdesc, ar_per

xxx  MEAN(VAL(KM,J))  xxxxxxxxxxxxxxxxxxxxxxxxxxx
    group     kids     marry     mean_age_19     mean_age_22     mean_age_27     mean_age_32     mean_age_3
    _____     ____     _____     ___________     ___________     ___________     ___________     __________

      1         1        0          1.4134          1.6987          1.8877          1.9428          1.9141
      2         2        0        -0.11224         0.38086         0.75969         0.96426          1.0617
      3         3        0        -0.88391        -0.40356         -0.0148         0.20487         0.31925
      4         1        1          1.9721           2.188          2.3283          2.3713          2.3479
      5         2        1         0.97335          1.2928          1.5422          1.6825          1.7486
      6         3        1         0.52474         0.81914          1.0571          1.1945          1.2619
```

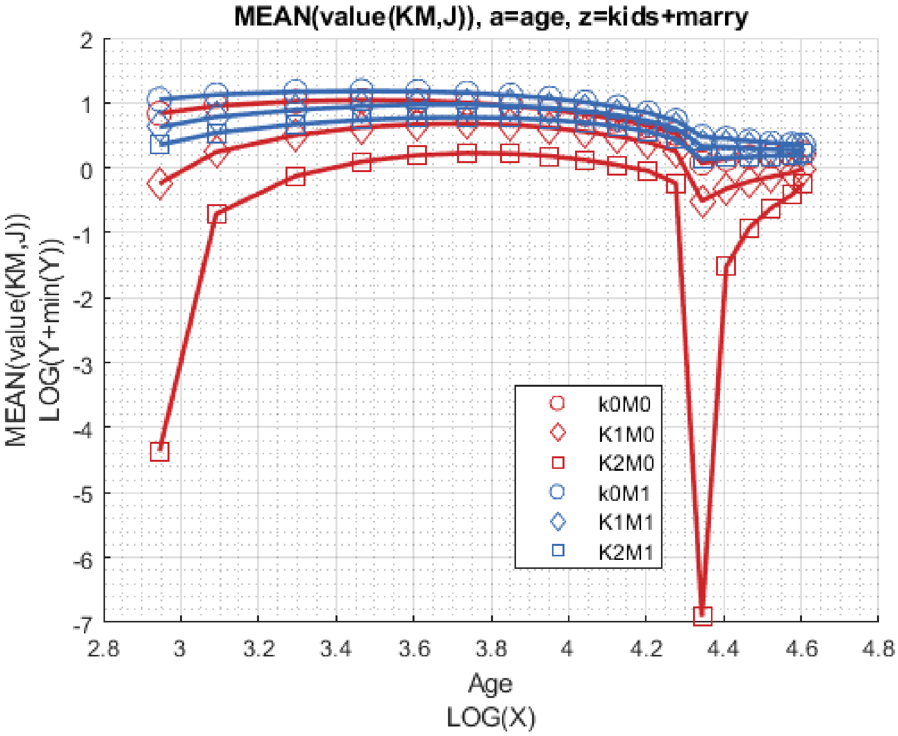
```
% Aprime Choice
```

```
tb_az_ap = ff_summ_nd_array("MEAN(AP(KM,J))", ap_VFI, true, ["mean"], 3, 1, cl_mp_datasetdesc, ar_pe

xxx  MEAN(AP(KM,J))  xxxxxxxxxxxxxxxxxxxxxxxxxxx
    group    kids    marry    mean_age_19    mean_age_22    mean_age_27    mean_age_32    mean_age_3
    _____    ____    _____    ___________    ___________    ___________    ___________    __________

      1        1       0        12.948          12.92         13.052         13.152          13.22
      2        2       0        12.924          12.88         13.004         13.092         13.156
      3        3       0        12.856         12.848         12.972          13.08         13.104
      4        1       1         12.86         12.856         12.972         13.072         13.132
      5        2       1        12.876          12.82         12.956         13.028         13.096
      6        3       1          12.8         12.784         12.912         12.984         13.056

% Consumption Choices
tb_az_c = ff_summ_nd_array("MEAN(C(KM,J))", cons_VFI, true, ["mean"], 3, 1, cl_mp_datasetdesc, ar_pe

xxx  MEAN(C(KM,J))  xxxxxxxxxxxxxxxxxxxxxxxxxxx
    group    kids    marry    mean_age_19    mean_age_22    mean_age_27    mean_age_32    mean_age_3
    _____    ____    _____    ___________    ___________    ___________    ___________    __________

      1        1       0        6.6347         6.7448         6.9773         7.1425         7.2321
      2        2       0        6.6476         6.7581         6.9907         7.1658         7.2726
      3        3       0        6.6714         6.7696         7.0001         7.1702         7.8471
      4        1       1         6.885         7.0096         7.2673         7.4592         7.5807
      5        2       1         6.856          6.987         7.2319         7.4245         7.5495
      6        3       1        6.8708         6.9855         7.2175         7.4148         7.5369
```

Graph Mean Values:

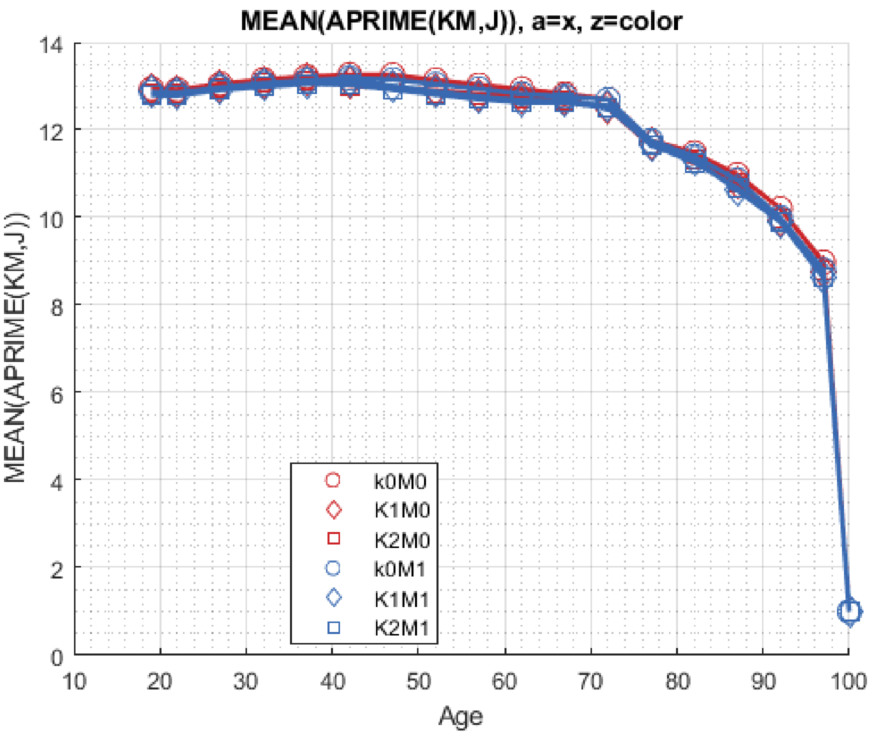
```
mp_support_graph('cl_st_graph_title') = {'MEAN(value(KM,J)), a=age, z=kids+marry'};
mp_support_graph('cl_st_ytitle') = {'MEAN(value(KM,J))'};
ff_graph_grid((tb_az_v{1:end, 4:end}), ar_row_grid, age_grid, mp_support_graph);
```

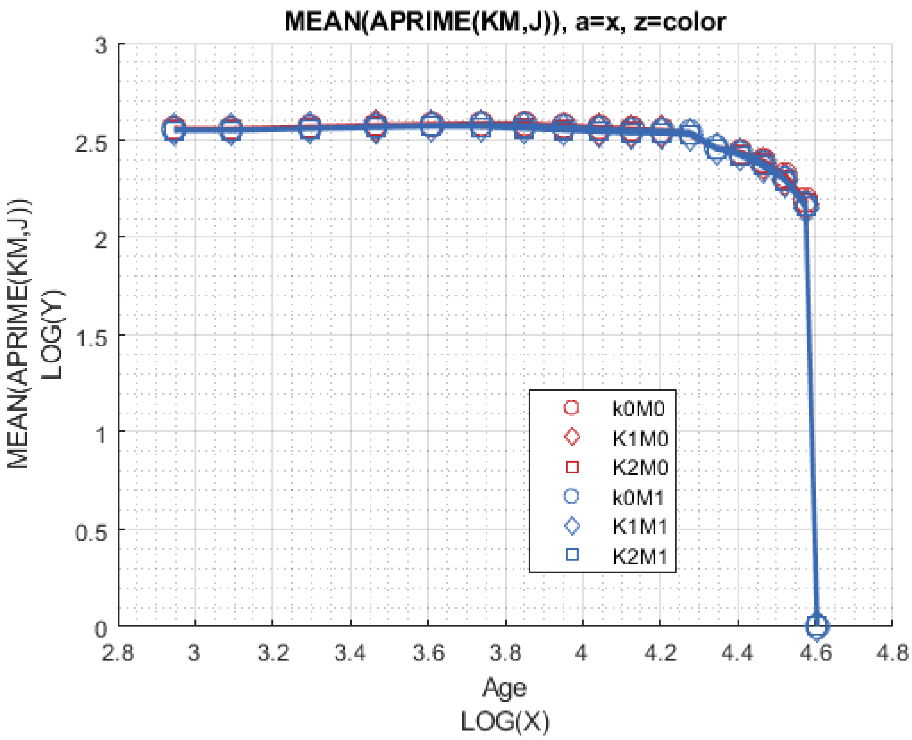




Graph Mean Savings Choices:

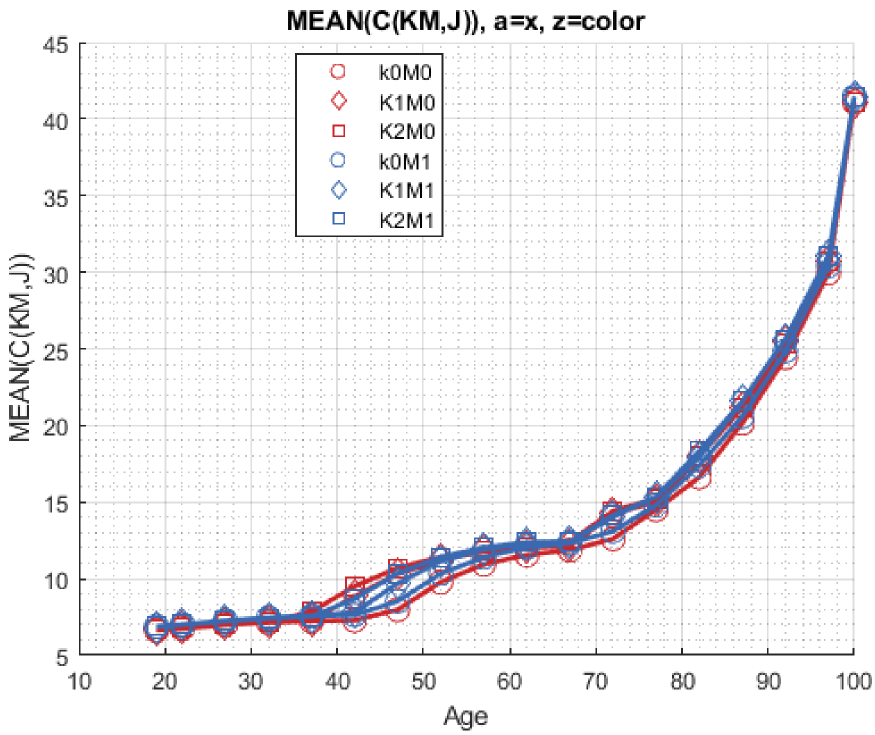
```
mp_support_graph('cl_st_graph_title') = {'MEAN(APRIME(KM,J)), a=x, z=color'};
mp_support_graph('cl_st_ytitle') = {'MEAN(APRIME(KM,J))'};
ff_graph_grid((tb_az_ap{1:end, 4:end}), ar_row_grid, age_grid, mp_support_graph);
```

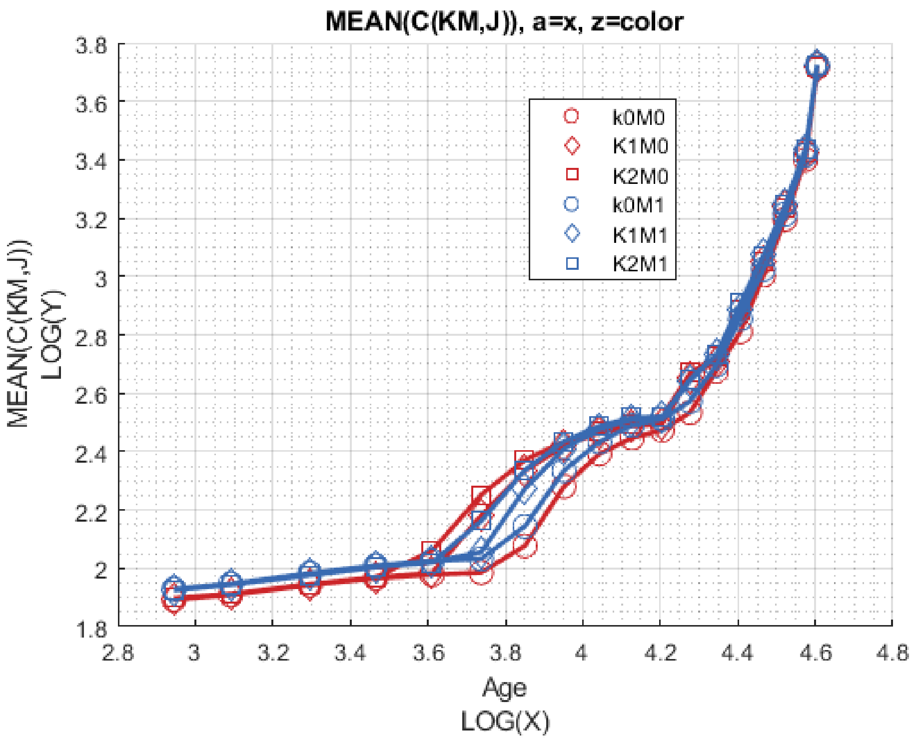




Graph Mean Consumption:

```
mp_support_graph('cl_st_graph_title') = {'MEAN(C(KM,J)), a=x, z=color'};
mp_support_graph('cl_st_ytitle') = {'MEAN(C(KM,J))'};
ff_graph_grid((tb_az_c{1:end, 4:end}), ar_row_grid, age_grid, mp_support_graph);
```





4.2.5 Analyze Education and Marriage and Age

Aggregating over education, savings, and shocks, what are the differential effects of Marriage and Age.

```
% Generate some Data
mp_support_graph = containers.Map('KeyType', 'char', 'ValueType', 'any');
ar_row_grid = ["E0M0", "E1M0", "E0M1", "E1M1"];
mp_support_graph('cl_st_xtitle') = {'Age'};
mp_support_graph('st_legend_loc') = 'best';
mp_support_graph('bl_graph_logy') = true; % do not log
mp_support_graph('st_rounding') = '6.2f'; % format shock legend
mp_support_graph('cl_scatter_shapes') = {'*', 'p', '*','p' };
mp_support_graph('cl_colors') = {'red', 'red', 'blue', 'blue'};
```

MEAN(VAL(EKM,J)), MEAN(AP(EKM,J)), MEAN(C(EKM,J))

Tabulate value and policies:

```
% Set
% NaN(n_jgrid,n_agrid,n_etagrid,n_educgrid,n_marriedgrid,n_kidsgrid);
ar_permute = [2,3,6,1,4,5];
% Value Function
tb_az_v = ff_summ_nd_array("MEAN(VAL(EKM,J))", V_VFI, true, ["mean"], 3, 1, cl_mp_datasetdesc, ar_pe
```

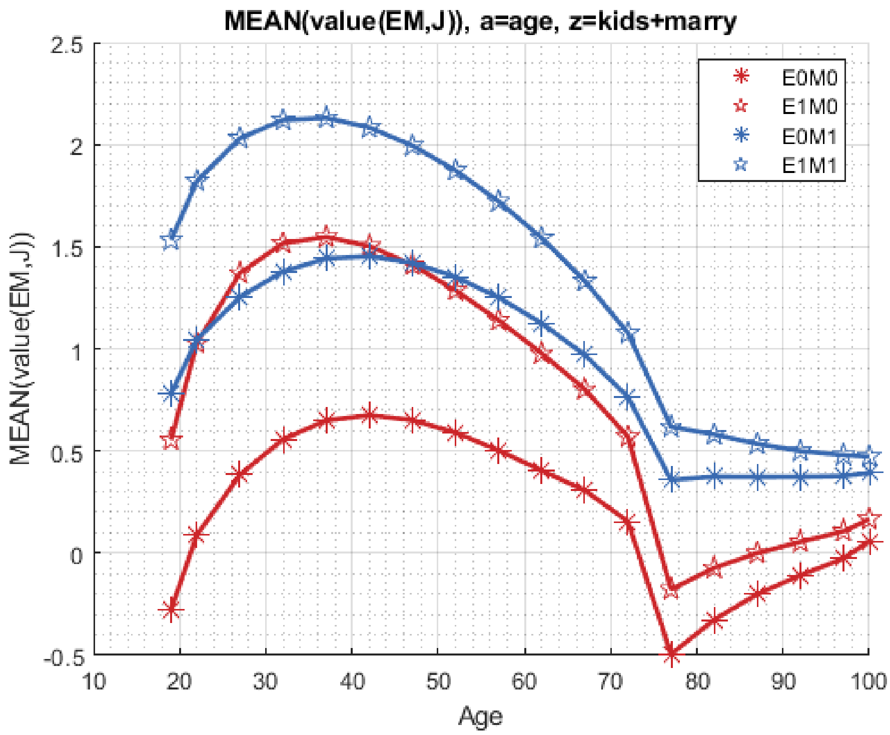
```
xxx  MEAN(VAL(EKM,J))  xxxxxxxxxxxxxxxxxxxxxxxxxxxx
    group    edu    marry    mean_age_19    mean_age_22    mean_age_27    mean_age_32    mean_age_37
    -----    ---    -----    -----------    -----------    -----------    -----------    -----------

      1       0       0       -0.27576         0.0889        0.38392        0.55759         0.6492
      2       1       0        0.55395         1.0284         1.3712         1.5171          1.5475
      3       0       1        0.78157         1.0452          1.254         1.3788          1.4422
      4       1       1         1.5319         1.8215         2.0311           2.12          2.1301
```

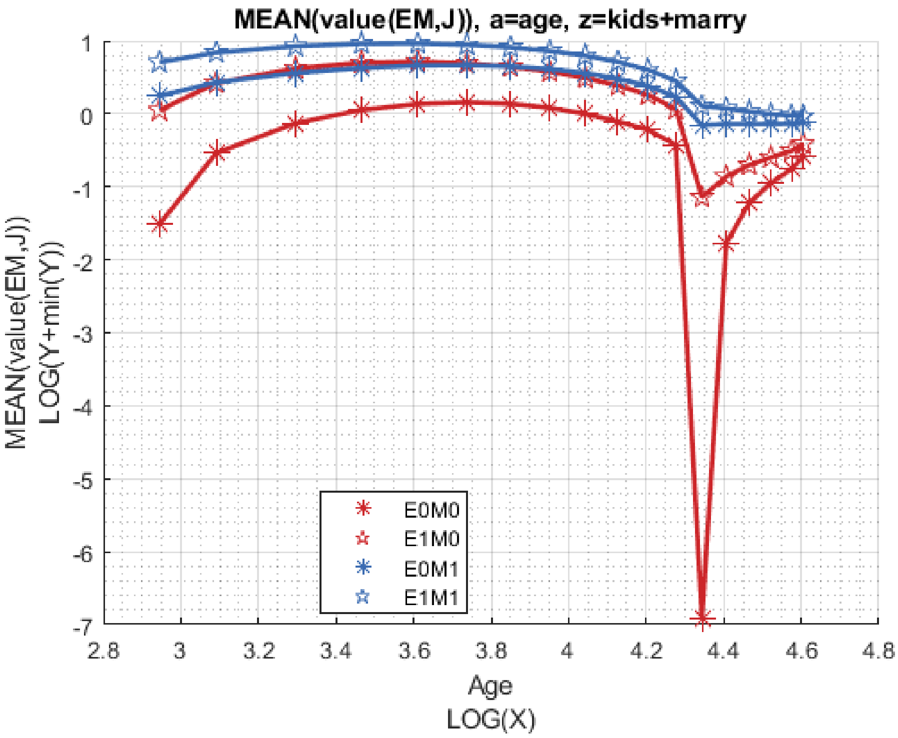
```
% Aprime Choice
tb_az_ap = ff_summ_nd_array("MEAN(AP(EKM,J))", ap_VFI, true, ["mean"], 3, 1, cl_mp_datasetdesc, ar_p
```

```
xxx  MEAN(AP(EKM,J))  xxxxxxxxxxxxxxxxxxxxxxxxxxx
    group     edu     marry     mean_age_19     mean_age_22     mean_age_27     mean_age_32     mean_age_37
    _____     ___     _____     ___________     ___________     ___________     ___________     ___________

      1        0        0         12.989          12.976          13.032          13.091          13.125
      2        1        0         12.829          12.789          12.987          13.125          13.195
      3        0        1         12.933          12.923          12.976          13.021          13.067
      4        1        1         12.757          12.717          12.917          13.035          13.123

% Consumption Choices
tb_az_c = ff_summ_nd_array("MEAN(C(EKM,J))", cons_VFI, true, ["mean"], 3, 1, cl_mp_datasetdesc, ar_p

xxx  MEAN(C(EKM,J))  xxxxxxxxxxxxxxxxxxxxxxxxxxx
    group     edu     marry     mean_age_19     mean_age_22     mean_age_27     mean_age_32     mean_age_37
    _____     ___     _____     ___________     ___________     ___________     ___________     ___________

      1        0        0         6.6262          6.6905          6.8287          6.9345          7.2519
      2        1        0         6.6762          6.8246          7.1501          7.3846          7.6493
      3        0        1         6.8114          6.8929          7.0479          7.1732           7.262
      4        1        1         6.9297          7.0952          7.4299          7.6925          7.8494
```

Graph Mean Values:

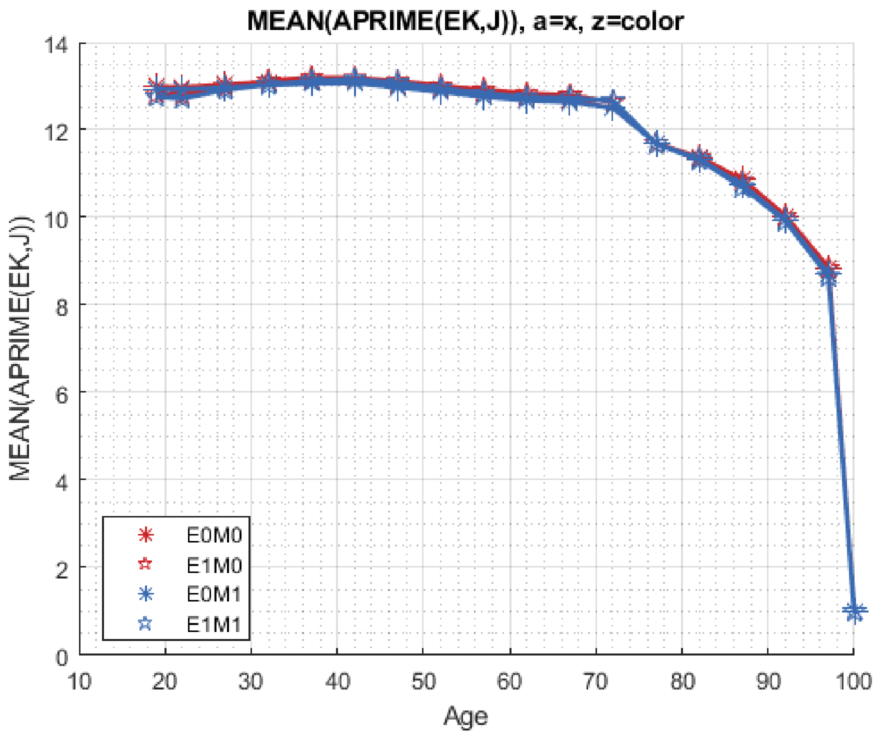
```
mp_support_graph('cl_st_graph_title') = {'MEAN(value(EM,J)), a=age, z=kids+marry'};
mp_support_graph('cl_st_ytitle') = {'MEAN(value(EM,J))'};
ff_graph_grid((tb_az_v{1:end, 4:end}), ar_row_grid, age_grid, mp_support_graph);
```

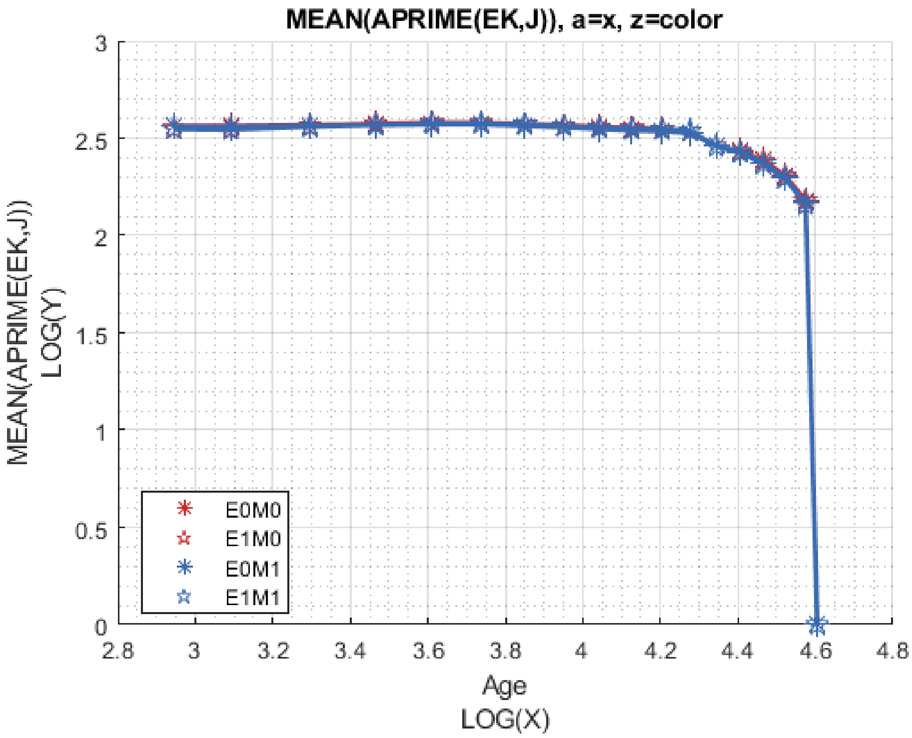




Graph Mean Savings Choices:

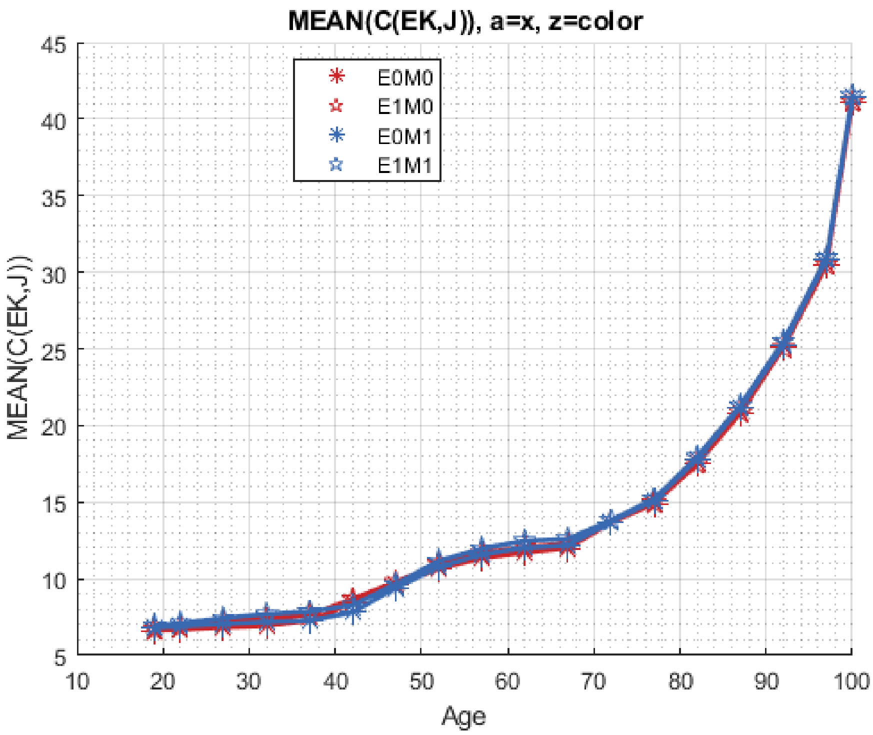
```
mp_support_graph('cl_st_graph_title') = {'MEAN(APRIME(EK,J)), a=x, z=color'};
mp_support_graph('cl_st_ytitle') = {'MEAN(APRIME(EK,J))'};
ff_graph_grid((tb_az_ap{1:end, 4:end}), ar_row_grid, age_grid, mp_support_graph);
```

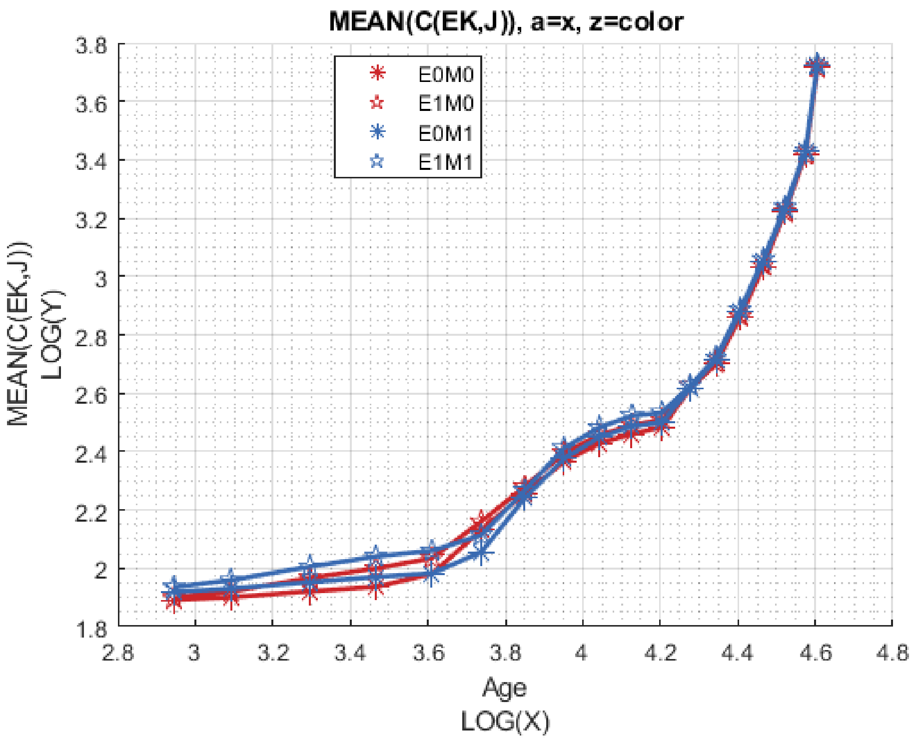




Graph Mean Consumption:

```
mp_support_graph('cl_st_graph_title') = {'MEAN(C(EK,J)), a=x, z=color'};
mp_support_graph('cl_st_ytitle') = {'MEAN(C(EK,J))'};
ff_graph_grid((tb_az_c{1:end, 4:end}), ar_row_grid, age_grid, mp_support_graph);
```





4.3 Small Test Exact Solution Vectorized Bisection

This is the example vignette for function: **snw_vfi_main_bisec_vec** from the **PrjOptiSNW Package.** This function solves for policy function with vectorized bisection. Small Solution Analysis. Small Solution Analysis, husband 5 shocks, wife 1 shocks.

4.3.1 Test SNW_VFI_MAIN Defaults Small

Call the function with defaults parameters.

```
mp_param = snw_mp_param('default_small');
[V_VFI,ap_VFI,cons_VFI,mp_valpol_more] = snw_vfi_main_bisec_vec(mp_param);

SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:18 of 17, time-this-age:0.019266
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:17 of 17, time-this-age:0.020088
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:16 of 17, time-this-age:0.019484
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:15 of 17, time-this-age:0.020422
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:14 of 17, time-this-age:0.018799
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:13 of 17, time-this-age:0.019274
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:12 of 17, time-this-age:0.019728
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:11 of 17, time-this-age:0.020101
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:10 of 17, time-this-age:0.019674
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:9 of 17, time-this-age:0.019648
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:8 of 17, time-this-age:0.019126
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:7 of 17, time-this-age:0.018838
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:6 of 17, time-this-age:0.01893
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:5 of 17, time-this-age:0.018729
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:4 of 17, time-this-age:0.018653
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:3 of 17, time-this-age:0.018577
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:2 of 17, time-this-age:0.018797
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:1 of 17, time-this-age:0.019341
Completed SNW_VFI_MAIN_BISEC_VEC;SNW_MP_PARAM=default_small;SNW_MP_CONTROL=default_base;time=0.35835
```

4.3.2 Small Param Results Define Frames

Define the matrix dimensions names and dimension vector values. Policy and Value Functions share the same ND dimensional structure.

```
% Grids:
age_grid = [19, 22:5:97, 100];
agrid = mp_param('agrid')';
eta_H_grid = mp_param('eta_H_grid')';
eta_S_grid = mp_param('eta_S_grid')';
ar_st_eta_HS_grid = string(cellstr([num2str(eta_H_grid', 'hz=%3.2f;'), num2str(eta_S_grid', 'wz=%3.2
edu_grid = [0,1];
marry_grid = [0,1];
kids_grid = (1:1:mp_param('n_kidsgrid'))';
% NaN(n_jgrid,n_agrid,n_etagrid,n_educgrid,n_marriedgrid,n_kidsgrid);
cl_mp_datasetdesc = {};
cl_mp_datasetdesc{1} = containers.Map({'name', 'labval'}, {'age', age_grid});
cl_mp_datasetdesc{2} = containers.Map({'name', 'labval'}, {'savings', agrid});
cl_mp_datasetdesc{3} = containers.Map({'name', 'labval'}, {'Hshock', eta_H_grid});
cl_mp_datasetdesc{4} = containers.Map({'name', 'labval'}, {'edu', edu_grid});
cl_mp_datasetdesc{5} = containers.Map({'name', 'labval'}, {'marry', marry_grid});
cl_mp_datasetdesc{6} = containers.Map({'name', 'labval'}, {'kids', kids_grid});
```

4.3.3 Analyze Savings and Shocks

First, analyze Savings Levels and Shocks, Aggregate Over All Others, and do various other calculations.

```
% Generate some Data
mp_support_graph = containers.Map('KeyType', 'char', 'ValueType', 'any');
mp_support_graph('cl_st_xtitle') = {'Savings States, a'};
mp_support_graph('st_legend_loc') = 'best';
mp_support_graph('bl_graph_logy') = true; % do not log
```

MEAN(VAL(A,Z)), MEAN(AP(A,Z)), MEAN(C(A,Z))

Tabulate value and policies along savings and shocks:

```
% Set
% NaN(n_jgrid,n_agrid,n_etagrid,n_educgrid,n_marriedgrid,n_kidsgrid);
ar_permute = [1,4,5,6,3,2];
% Value Function
tb_az_v = ff_summ_nd_array("MEAN(VAL(A,Z))", V_VFI, true, ["mean"], 4, 1, cl_mp_datasetdesc, ar_perm
```

```
xxx  MEAN(VAL(A,Z))  xxxxxxxxxxxxxxxxxxxxxxxxxxx
    group     savings      mean_Hshock__1_8395    mean_Hshock__0_91976    mean_Hshock_0    mean_Hshoc
    _____    _________    ___________________    ____________________    _____________    __________

      1              0          -17.393                  -9.1596              -4.4164            -1.5
      2      0.0097656          -16.967                   -9.023              -4.3405            -1.5
      3       0.078125          -14.925                  -8.2554              -3.9177            -1.2
      4        0.26367          -11.699                  -6.8681              -3.1808            -0.6
      5          0.625          -8.2751                  -5.1669              -2.2785           -0.13
      6         1.2207          -5.3024                  -3.4437              -1.3431            0.38
      7         2.1094          -2.9816                  -1.9066             -0.47797            0.86
      8         3.3496          -1.2609                 -0.64407              0.28612             1.3
      9              5        -0.012543                  0.34403               0.9369             1.6
     10         7.1191          0.88751                    1.097               1.4725             1.9
     11         9.7656           1.5392                    1.665               1.9037             2.2
     12         12.998           2.0158                   2.0932               2.2465             2.5
     13         16.875           2.3684                   2.4172               2.5172             2.6
     14         21.455           2.6328                   2.6644               2.7307             2.8
```

15	26.797	2.8339	2.8549	2.8997	2.
16	32.959	2.989	3.0032	3.034	3.0
17	40	3.1102	3.12	3.1416	3.1
18	47.979	3.2059	3.2128	3.2282	3.2
19	56.953	3.2825	3.2875	3.2986	3.3
20	66.982	3.3443	3.348	3.3562	3.3
21	78.125	3.3948	3.3975	3.4036	3.4
22	90.439	3.4364	3.4384	3.443	3.4
23	103.98	3.4709	3.4724	3.476	3.4
24	118.82	3.4998	3.501	3.5037	3.5
25	135	3.5241	3.5251	3.5272	3.5

```
% Aprime Choice
tb_az_ap = ff_summ_nd_array("MEAN(AP(A,Z))", ap_VFI, true, ["mean"], 4, 1, cl_mp_datasetdesc, ar_per
```

xxx MEAN(AP(A,Z)) xxxxxxxxxxxxxxxxxxxxxxxxxxx

group	savings	mean_Hshock__1_8395	mean_Hshock__0_91976	mean_Hshock_0	mean_Hshoc
1	0	2.7511e-05	0.0021997	0.046353	0.23
2	0.0097656	0.00054711	0.0036547	0.049525	0.24
3	0.078125	0.021674	0.027305	0.079481	0.27
4	0.26367	0.13129	0.14249	0.19451	0.38
5	0.625	0.38703	0.404	0.44756	0.63
6	1.2207	0.83381	0.85545	0.90672	1.0
7	2.1094	1.5206	1.5442	1.6064	1.7
8	3.3496	2.477	2.5013	2.5629	2.6
9	5	3.7541	3.7788	3.8405	3.9
10	7.1191	5.416	5.4412	5.5038	5.6
11	9.7656	7.4668	7.4912	7.5553	7.7
12	12.998	9.9008	9.9211	9.9832	10.
13	16.875	12.918	12.94	12.995	13.
14	21.455	16.519	16.538	16.594	16.
15	26.797	20.59	20.608	20.657	20.
16	32.959	25.295	25.313	25.358	25.
17	40	30.657	30.68	30.732	30.
18	47.979	36.751	36.772	36.831	36
19	56.953	43.764	43.786	43.839	44.
20	66.982	51.594	51.617	51.677	51
21	78.125	59.942	59.965	60.024	60.
22	90.439	69.254	69.278	69.34	69.
23	103.98	79.741	79.762	79.821	79.
24	118.82	91.103	91.126	91.188	91.
25	135	103.46	103.48	103.53	103

```
% Consumption Choices
tb_az_c = ff_summ_nd_array("MEAN(C(A,Z))", cons_VFI, true, ["mean"], 4, 1, cl_mp_datasetdesc, ar_per
```

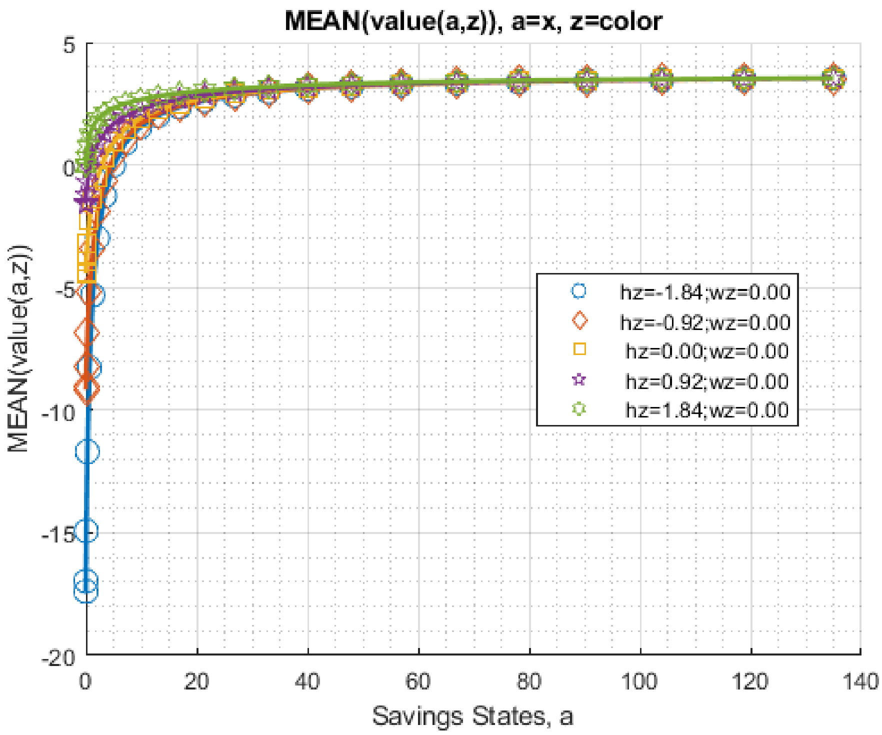
xxx MEAN(C(A,Z)) xxxxxxxxxxxxxxxxxxxxxxxxxxxx

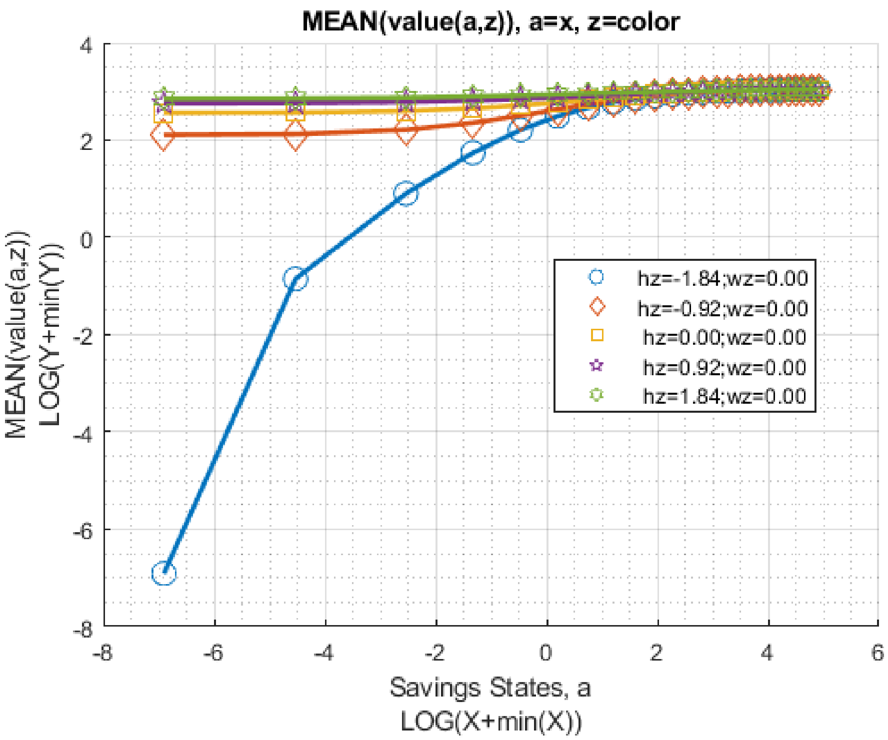
group	savings	mean_Hshock__1_8395	mean_Hshock__0_91976	mean_Hshock_0	mean_Hshoc
1	0	0.3104	0.44	0.69897	1.22
2	0.0097656	0.3214	0.45001	0.70723	1.23
3	0.078125	0.3809	0.50664	0.75724	1.28
4	0.26367	0.48992	0.60921	0.8592	1.39
5	0.625	0.65917	0.77131	1.0284	1.55
6	1.2207	0.91141	1.0172	1.2649	1.80

7	2.1094	1.2649	1.3671	1.6019	2.18
8	3.3496	1.7572	1.8573	2.0907	2.69
9	5	2.4045	2.503	2.7347	3.30
10	7.1191	3.2104	3.3074	3.537	4.07
11	9.7656	4.2385	4.3358	4.5627	5.08
12	12.998	5.5627	5.6635	5.8917	6.41
13	16.875	7.0504	7.1499	7.3847	7.90
14	21.455	8.7708	8.8721	9.1059	9.63
15	26.797	10.904	11.007	11.247	11.7
16	32.959	13.355	13.457	13.7	14.2
17	40	16.168	16.266	16.502	17.0
18	47.979	19.337	19.437	19.666	20.2
19	56.953	22.744	22.843	23.078	23.6
20	66.982	26.557	26.654	26.883	27.4
21	78.125	31.145	31.242	31.47	32.0
22	90.439	36.128	36.224	36.451	36.9
23	103.98	41.364	41.464	41.692	42.2
24	118.82	47.222	47.319	47.545	48.0
25	135	53.652	53.751	53.983	54.5

Graph Mean Values:

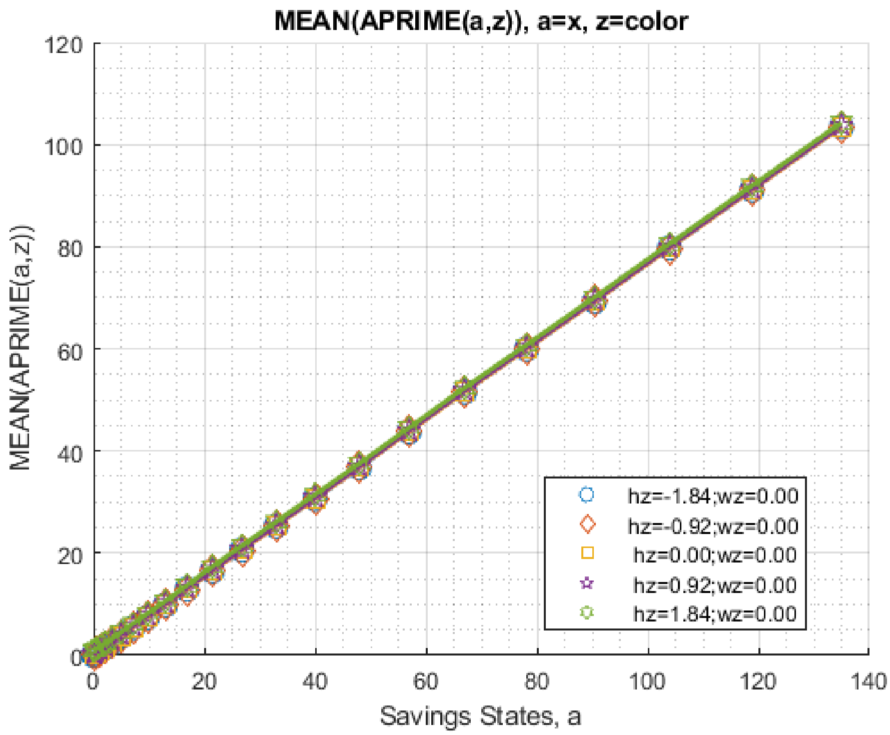
```
mp_support_graph('cl_st_graph_title') = {'MEAN(value(a,z)), a=x, z=color'};
mp_support_graph('cl_st_ytitle') = {'MEAN(value(a,z))'};
ff_graph_grid((tb_az_v{1:end, 3:end})', ar_st_eta_HS_grid, agrid, mp_support_graph);
```

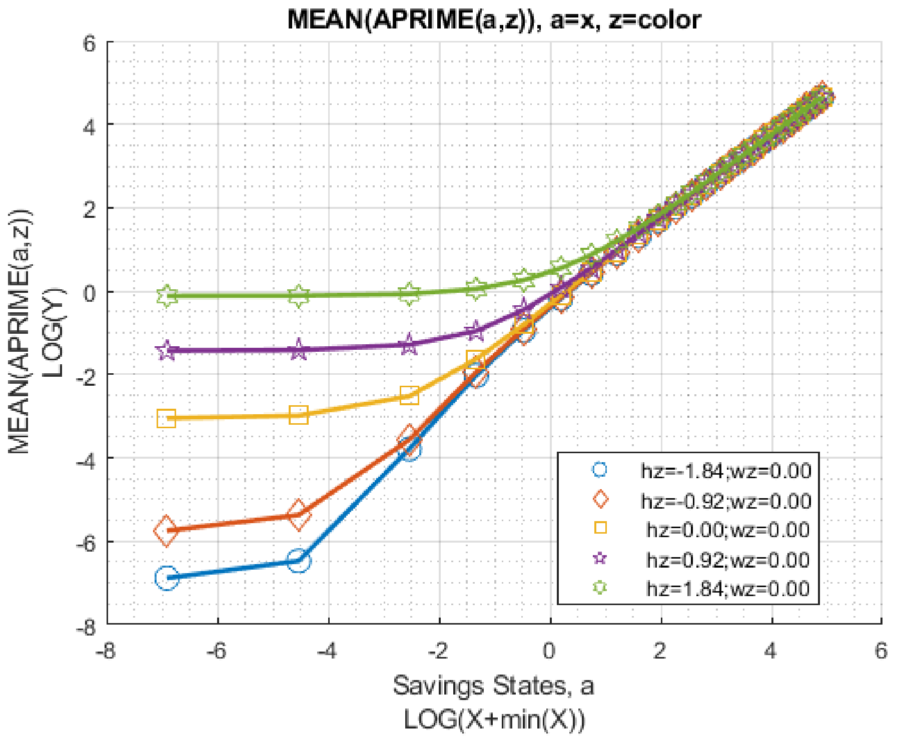




Graph Mean Savings Choices:

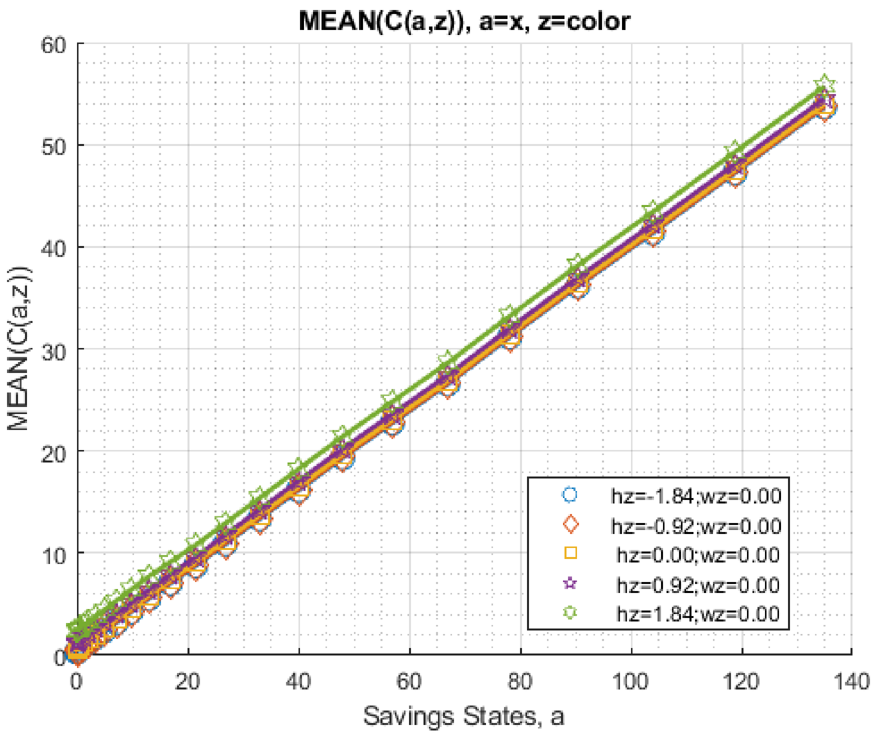
```
mp_support_graph('cl_st_graph_title') = {'MEAN(APRIME(a,z)), a=x, z=color'};
mp_support_graph('cl_st_ytitle') = {'MEAN(APRIME(a,z))'};
ff_graph_grid((tb_az_ap{1:end, 3:end})', ar_st_eta_HS_grid, agrid, mp_support_graph);
```

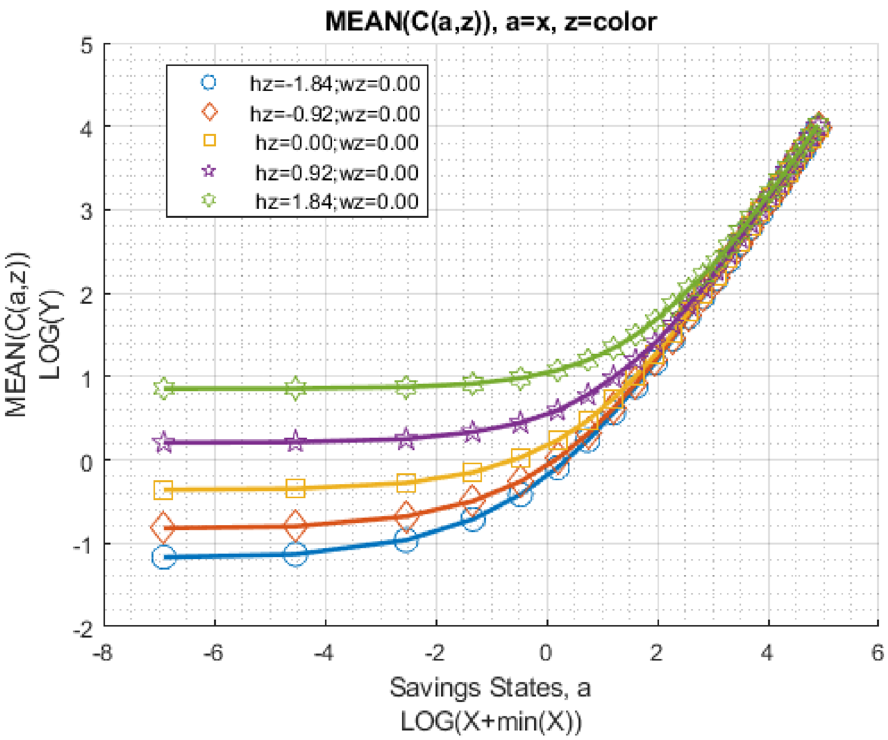




Graph Mean Consumption:

```
mp_support_graph('cl_st_graph_title') = {'MEAN(C(a,z)), a=x, z=color'};
mp_support_graph('cl_st_ytitle') = {'MEAN(C(a,z))'};
ff_graph_grid((tb_az_c{1:end, 3:end})', ar_st_eta_HS_grid, agrid, mp_support_graph);
```





4.3.4 Analyze Kids and Marriage and Age

Aggregating over education, savings, and shocks, what are the differential effects of Marriage and Age.

```
% Generate some Data
mp_support_graph = containers.Map('KeyType', 'char', 'ValueType', 'any');
ar_row_grid = ["k0M0", "K1M0", "K2M0", "k0M1", "K1M1", "K2M1"];
mp_support_graph('cl_st_xtitle') = {'Age'};
mp_support_graph('st_legend_loc') = 'best';
mp_support_graph('bl_graph_logy') = true; % do not log
mp_support_graph('st_rounding') = '6.2f'; % format shock legend
mp_support_graph('cl_scatter_shapes') = { 'o', 'd' ,'s', 'o', 'd', 's'};
mp_support_graph('cl_colors') = {'red', 'red', 'red', 'blue', 'blue', 'blue'};
```

MEAN(VAL(KM,J)), MEAN(AP(KM,J)), MEAN(C(KM,J))

Tabulate value and policies:

```
% Set
% NaN(n_jgrid,n_agrid,n_etagrid,n_educgrid,n_marriedgrid,n_kidsgrid);
ar_permute = [2,3,4,1,6,5];
% Value Function
tb_az_v = ff_summ_nd_array("MEAN(VAL(KM,J))", V_VFI, true, ["mean"], 3, 1, cl_mp_datasetdesc, ar_per
```

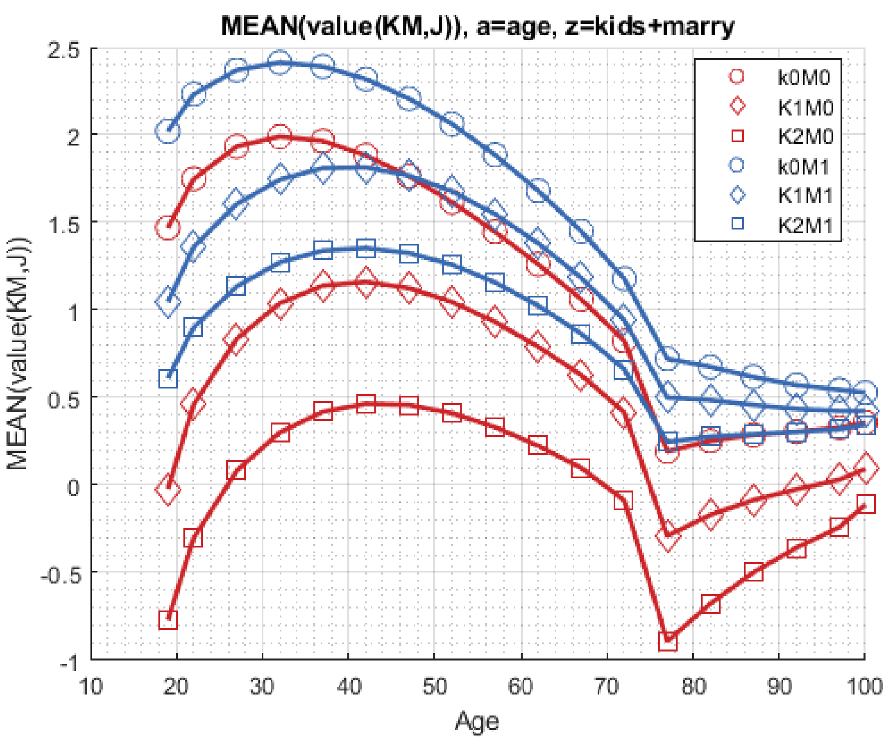
```
xxx  MEAN(VAL(KM,J))  xxxxxxxxxxxxxxxxxxxxxxxxxxx
    group     kids     marry     mean_age_19     mean_age_22     mean_age_27     mean_age_32     mean_age_3
    _____     ____     _____     ___________     ___________     ___________     ___________     __________

      1         1        0           1.4699          1.7485          1.9344          1.9907          1.9652
      2         2        0        -0.020723         0.46111         0.83504          1.0389          1.1397
      3         3        0         -0.77111        -0.30145        0.081934         0.30157         0.41928
      4         1        1           2.0205          2.2326          2.3705          2.4138          2.3913
      5         2        1           1.0463          1.3598          1.6057           1.745          1.8111
      6         3        1          0.61068         0.90045          1.1354          1.2721          1.3395
```

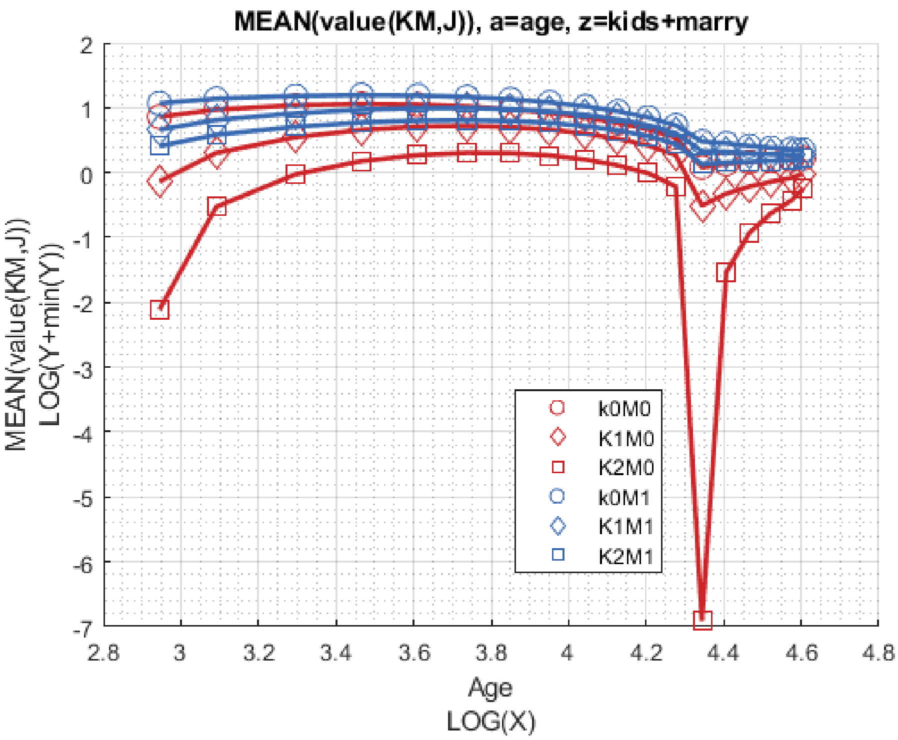
```
% Aprime Choice
```

```
tb_az_ap = ff_summ_nd_array("MEAN(AP(KM,J))", ap_VFI, true, ["mean"], 3, 1, cl_mp_datasetdesc, ar_pe

xxx  MEAN(AP(KM,J))  xxxxxxxxxxxxxxxxxxxxxxxxxxx
    group    kids    marry    mean_age_19    mean_age_22    mean_age_27    mean_age_32    mean_age_3
    _____    ____    _____    ___________    ___________    ___________    ___________    __________

      1        1       0        34.929         34.724         34.662          34.55         34.357
      2        2       0          34.6         34.331         34.195          33.99         33.687
      3        3       0        34.185         33.965         33.873           33.7         33.421
      4        1       1        34.819         34.614         34.562         34.453         34.262
      5        2       1        34.667         34.448          34.36         34.201         33.945
      6        3       1          34.3         34.115         34.061         33.932           33.7

% Consumption Choices
tb_az_c = ff_summ_nd_array("MEAN(C(KM,J))", cons_VFI, true, ["mean"], 3, 1, cl_mp_datasetdesc, ar_pe

xxx  MEAN(C(KM,J))  xxxxxxxxxxxxxxxxxxxxxxxxxxx
    group    kids    marry    mean_age_19    mean_age_22    mean_age_27    mean_age_32    mean_age_3
    _____    ____    _____    ___________    ___________    ___________    ___________    __________

      1        1       0        6.8551         7.1756          7.502         7.8205         8.1483
      2        2       0        7.1843         7.5683         7.9695         8.3802         8.8184
      3        3       0        7.5997          7.934         8.2911         8.6703         9.0841
      4        1       1        7.1871         7.5271         7.8696          8.209         8.5573
      5        2       1        7.3044         7.6564         8.0306         8.4165          8.826
      6        3       1        7.6479         7.9629         8.3009         8.6543         9.0382
```

Graph Mean Values:

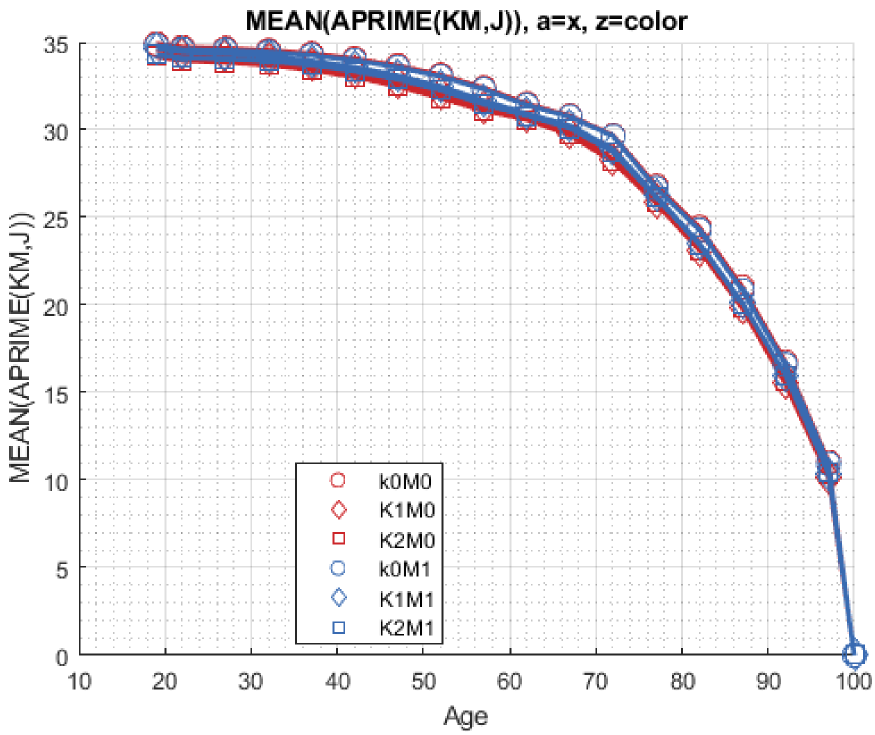
```
mp_support_graph('cl_st_graph_title') = {'MEAN(value(KM,J)), a=age, z=kids+marry'};
mp_support_graph('cl_st_ytitle') = {'MEAN(value(KM,J))'};
ff_graph_grid((tb_az_v{1:end, 4:end}), ar_row_grid, age_grid, mp_support_graph);
```

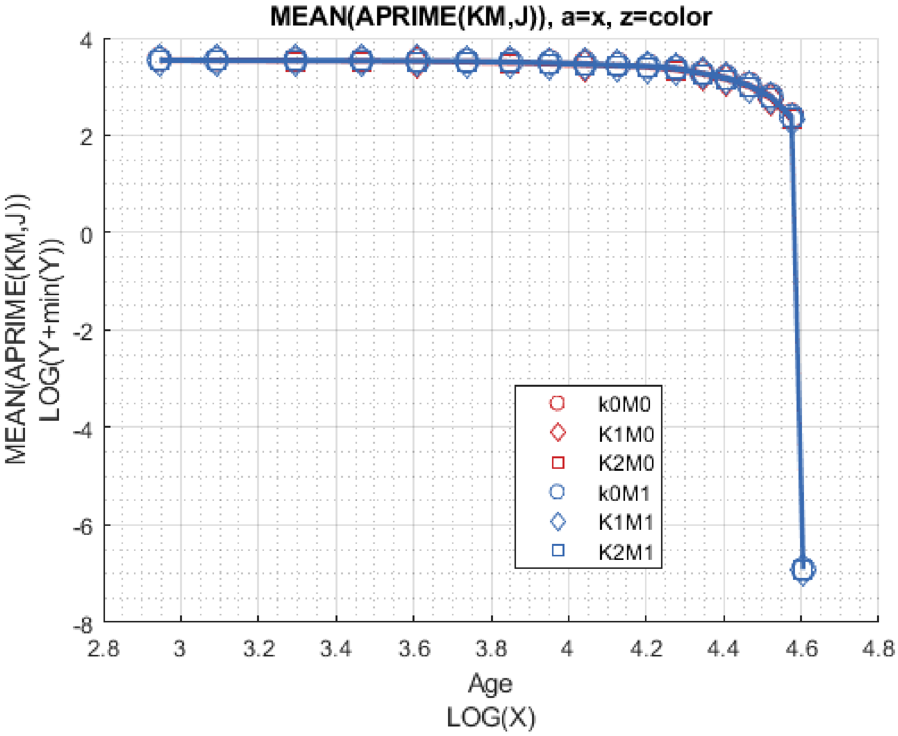




Graph Mean Savings Choices:

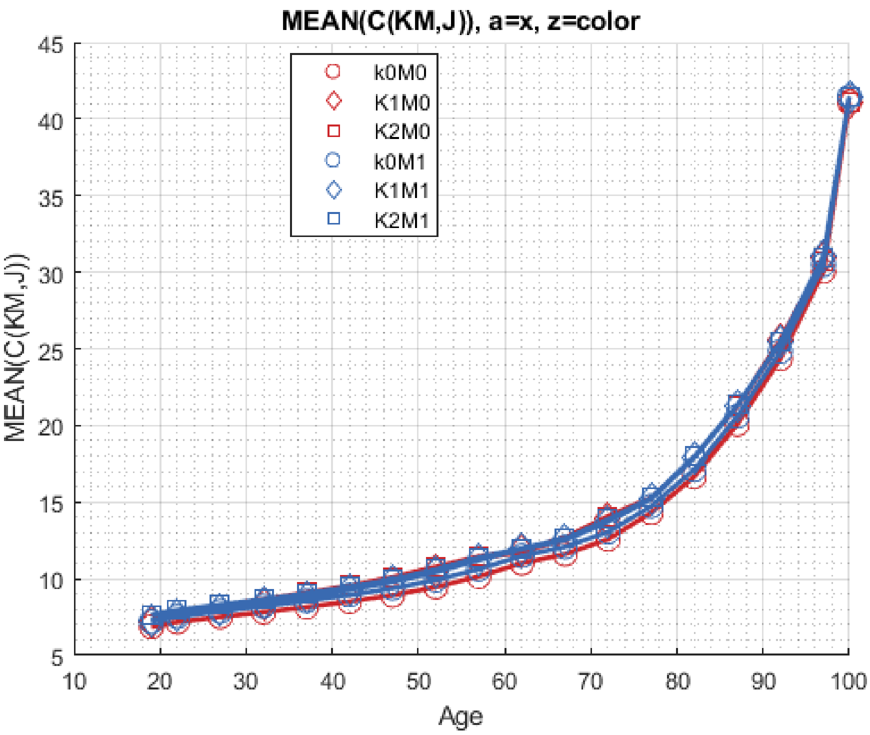
```
mp_support_graph('cl_st_graph_title') = {'MEAN(APRIME(KM,J)), a=x, z=color'};
mp_support_graph('cl_st_ytitle') = {'MEAN(APRIME(KM,J))'};
ff_graph_grid((tb_az_ap{1:end, 4:end}), ar_row_grid, age_grid, mp_support_graph);
```

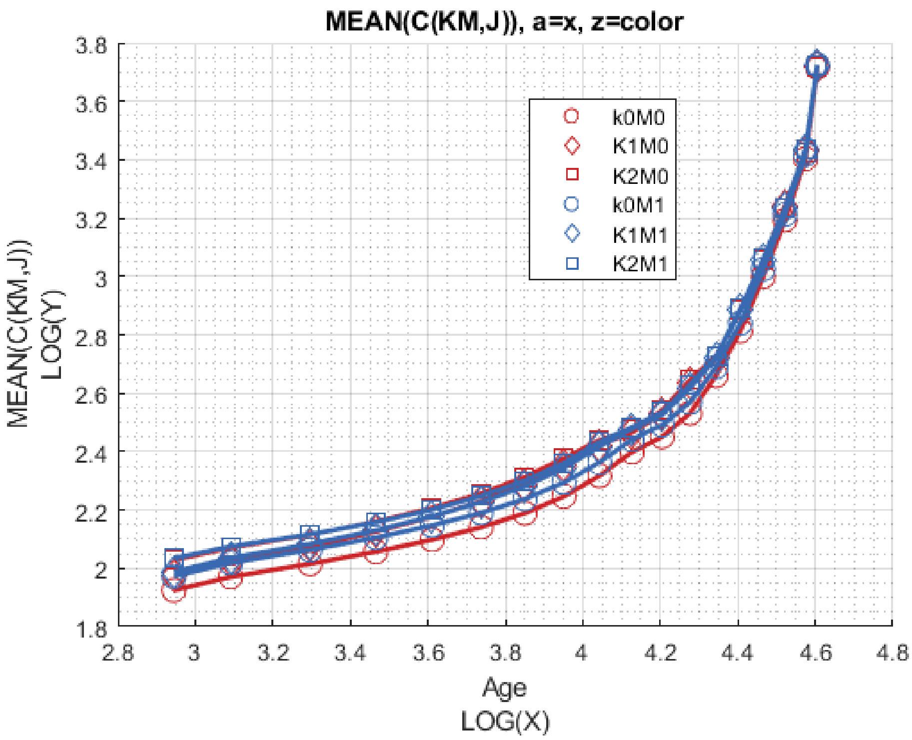




Graph Mean Consumption:

```
mp_support_graph('cl_st_graph_title') = {'MEAN(C(KM,J)), a=x, z=color'};
mp_support_graph('cl_st_ytitle') = {'MEAN(C(KM,J))'};
ff_graph_grid((tb_az_c{1:end, 4:end}), ar_row_grid, age_grid, mp_support_graph);
```





4.3.5 Analyze Education and Marriage and Age

Aggregating over education, savings, and shocks, what are the differential effects of Marriage and Age.

```
% Generate some Data
mp_support_graph = containers.Map('KeyType', 'char', 'ValueType', 'any');
ar_row_grid = ["E0M0", "E1M0", "E0M1", "E1M1"];
mp_support_graph('cl_st_xtitle') = {'Age'};
mp_support_graph('st_legend_loc') = 'best';
mp_support_graph('bl_graph_logy') = true; % do not log
mp_support_graph('st_rounding') = '6.2f'; % format shock legend
mp_support_graph('cl_scatter_shapes') = {'*', 'p', '*','p' };
mp_support_graph('cl_colors') = {'red', 'red', 'blue', 'blue'};
```

MEAN(VAL(EKM,J)), MEAN(AP(EKM,J)), MEAN(C(EKM,J))

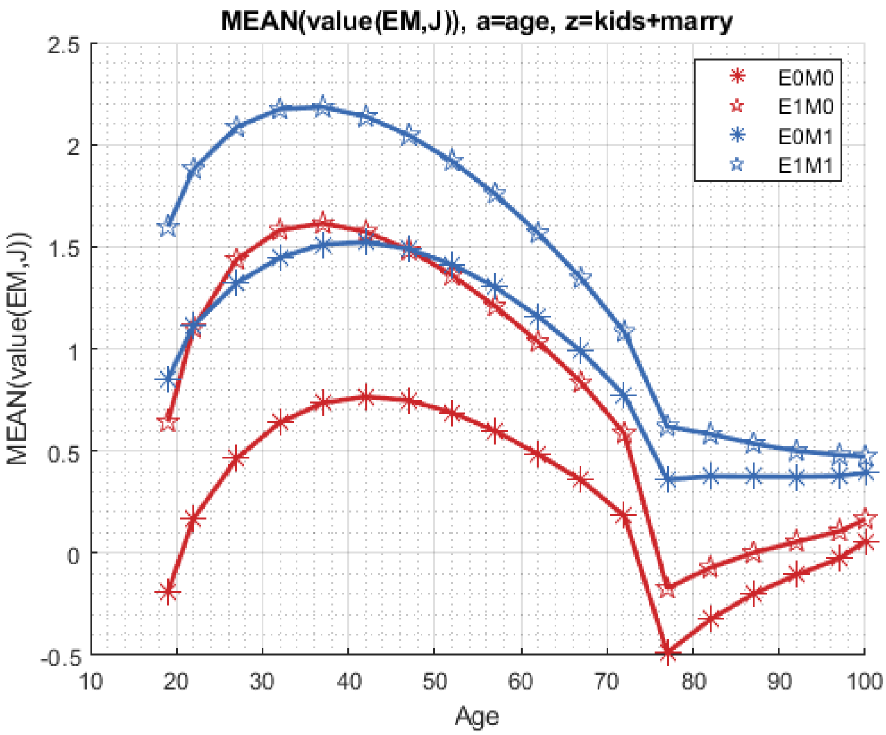
Tabulate value and policies:

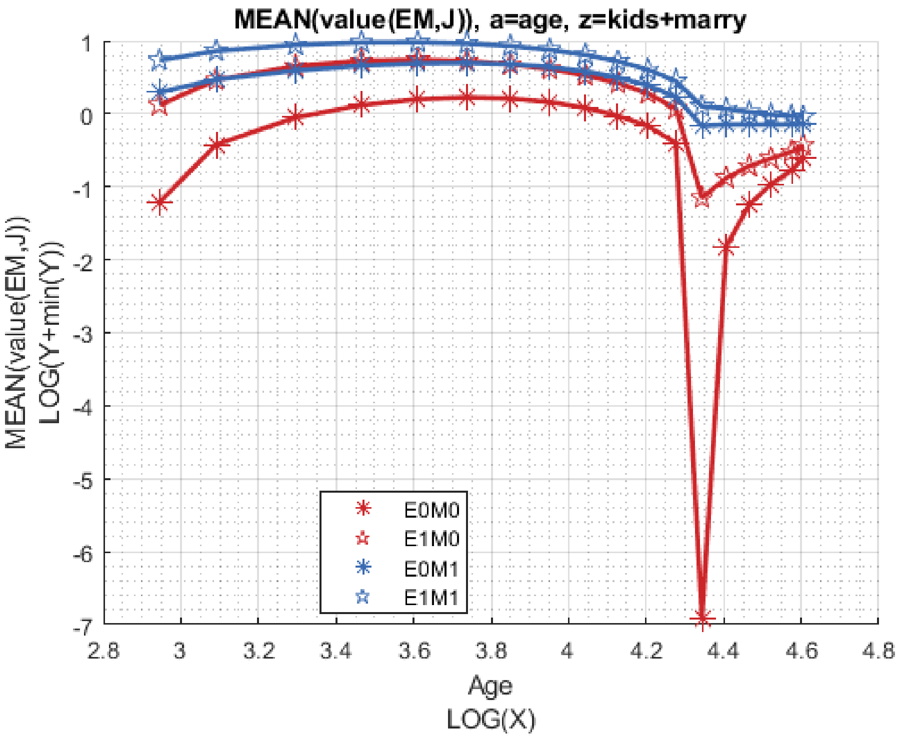
```
% Set
% NaN(n_jgrid,n_agrid,n_etagrid,n_educgrid,n_marriedgrid,n_kidsgrid);
ar_permute = [2,3,6,1,4,5];
% Value Function
tb_az_v = ff_summ_nd_array("MEAN(VAL(EKM,J))", V_VFI, true, ["mean"], 3, 1, cl_mp_datasetdesc, ar_pe

xxx  MEAN(VAL(EKM,J))  xxxxxxxxxxxxxxxxxxxxxxxxxxx
    group     edu     marry     mean_age_19     mean_age_22     mean_age_27     mean_age_32     mean_age_37
    -----     ---     -----     -----------     -----------     -----------     -----------     -----------

      1        0        0        -0.19018         0.16944         0.46325         0.63924         0.73534
      2        1        0         0.64221          1.1027          1.4377          1.5815          1.6141
      3        0        1         0.85396          1.1146          1.3219          1.4469          1.5109
      4        1        1          1.5977          1.8806          2.0859          2.1737          2.1837

% Aprime Choice
tb_az_ap = ff_summ_nd_array("MEAN(AP(EKM,J))", ap_VFI, true, ["mean"], 3, 1, cl_mp_datasetdesc, ar_p
```

```
xxx  MEAN(AP(EKM,J))  xxxxxxxxxxxxxxxxxxxxxxxxxxx
    group     edu     marry     mean_age_19     mean_age_22     mean_age_27     mean_age_32     mean_age_37
    -----     ---     -----     -----------     -----------     -----------     -----------     -----------

      1        0        0          34.68          34.441          34.268          34.044          33.748
      2        1        0         34.463          34.238          34.218          34.116          33.895
      3        0        1         34.723          34.511          34.368          34.173          33.909
      4        1        1         34.468          34.274          34.287          34.218          34.029

% Consumption Choices
tb_az_c = ff_summ_nd_array("MEAN(C(EKM,J))", cons_VFI, true, ["mean"], 3, 1, cl_mp_datasetdesc, ar_p

xxx  MEAN(C(EKM,J))  xxxxxxxxxxxxxxxxxxxxxxxxxxx
    group     edu     marry     mean_age_19     mean_age_22     mean_age_27     mean_age_32     mean_age_37
    -----     ---     -----     -----------     -----------     -----------     -----------     -----------

      1        0        0         7.1043          7.4114          7.7391          8.0887          8.4765
      2        1        0         7.3218          7.7071          8.1025           8.492          8.8907
      3        0        1         7.2329          7.5281          7.8428          8.1801          8.5525
      4        1        1         7.5267          7.9028          8.2913          8.6732          9.0619
```

Graph Mean Values:

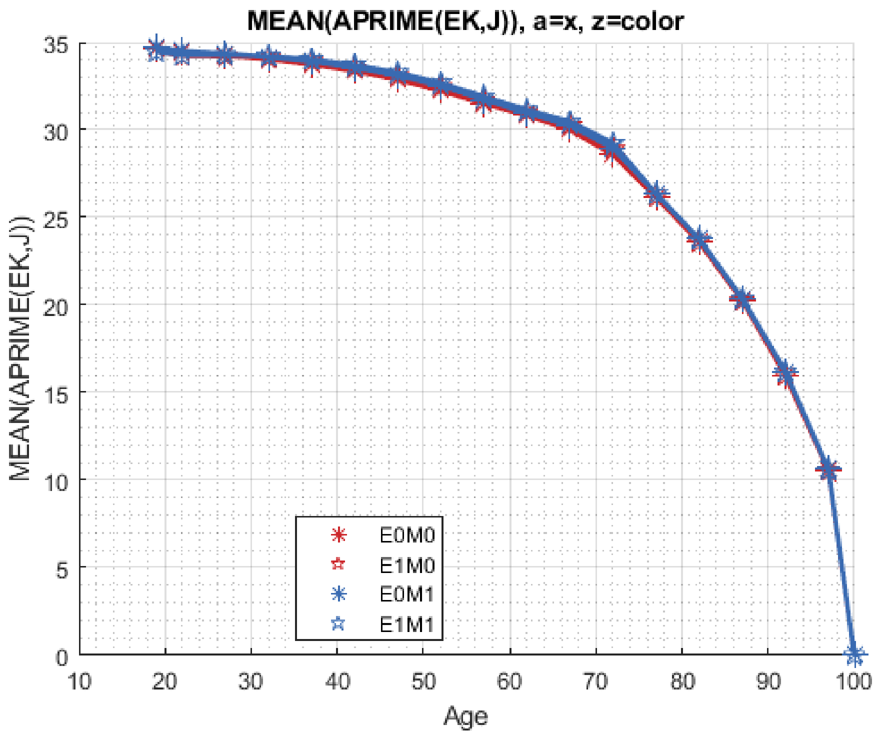
```
mp_support_graph('cl_st_graph_title') = {'MEAN(value(EM,J)), a=age, z=kids+marry'};
mp_support_graph('cl_st_ytitle') = {'MEAN(value(EM,J))'};
ff_graph_grid((tb_az_v{1:end, 4:end}), ar_row_grid, age_grid, mp_support_graph);
```

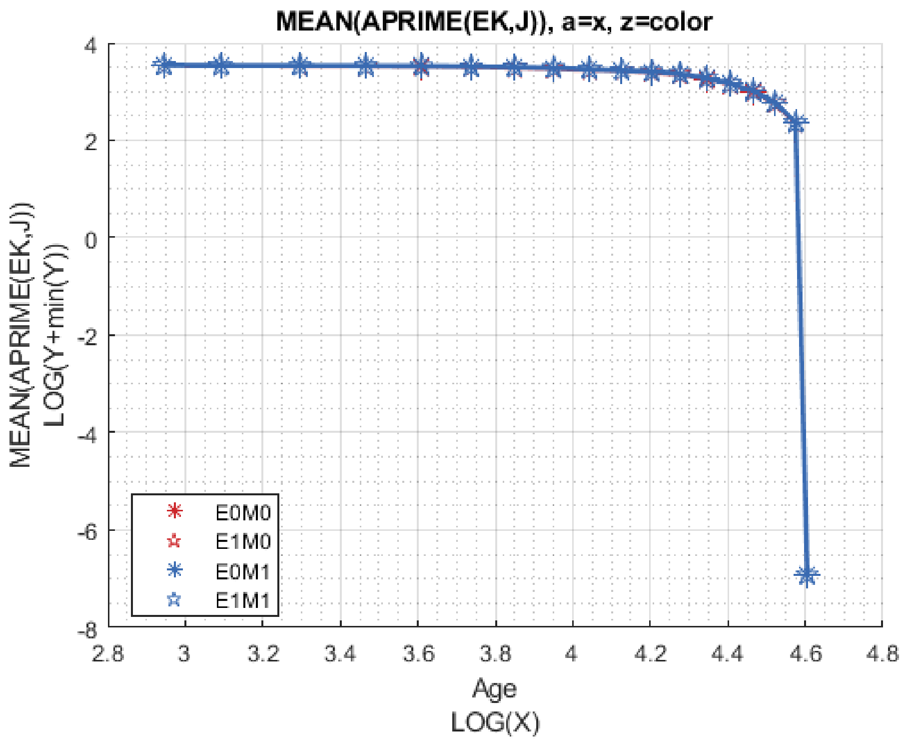




Graph Mean Savings Choices:

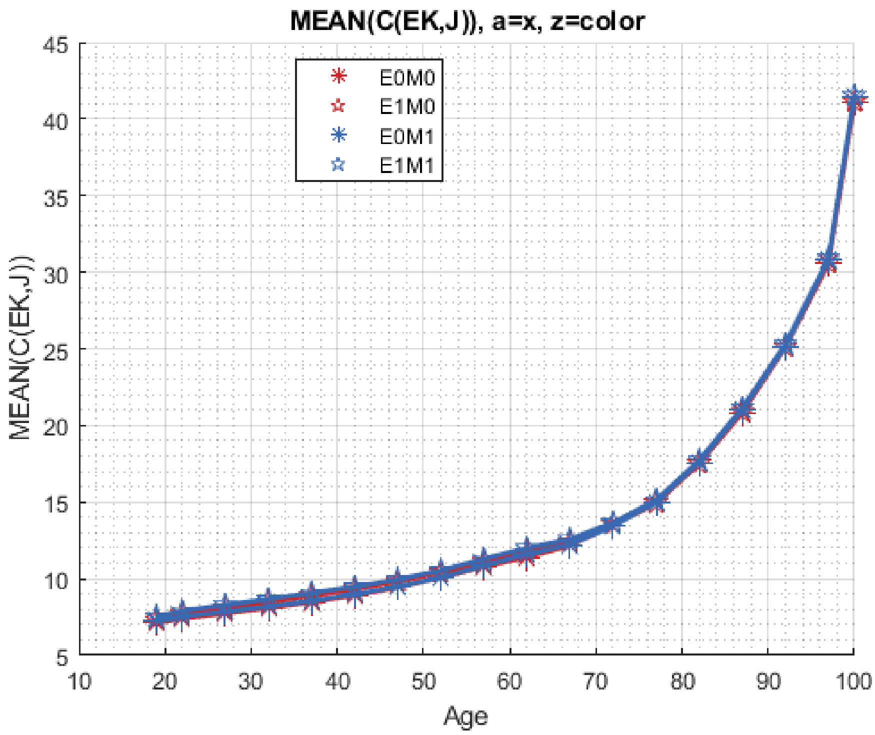
```
mp_support_graph('cl_st_graph_title') = {'MEAN(APRIME(EK,J)), a=x, z=color'};
mp_support_graph('cl_st_ytitle') = {'MEAN(APRIME(EK,J))'};
ff_graph_grid((tb_az_ap{1:end, 4:end}), ar_row_grid, age_grid, mp_support_graph);
```

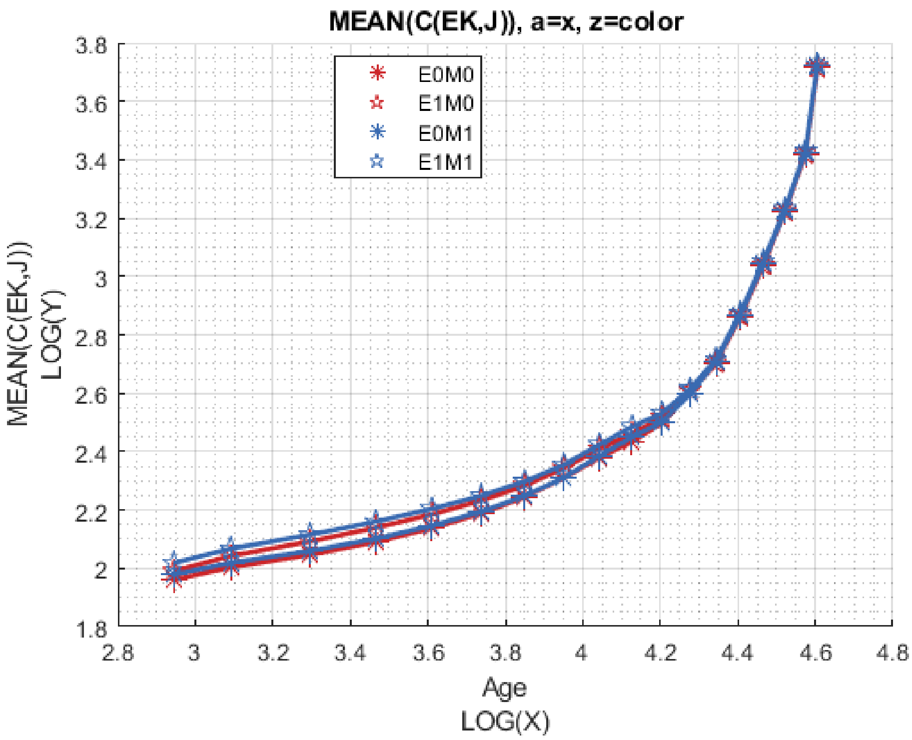




Graph Mean Consumption:

```
mp_support_graph('cl_st_graph_title') = {'MEAN(C(EK,J)), a=x, z=color'};
mp_support_graph('cl_st_ytitle') = {'MEAN(C(EK,J))'};
ff_graph_grid((tb_az_c{1:end, 4:end}), ar_row_grid, age_grid, mp_support_graph);
```





4.4 Small Test Exact Solution Spousal Shocks

This is the example vignette for function: **snw_vfi_main_bisec_vec** from the **PrjOptiSNW Package.** This function solves for policy function with vectorized bisection. Small Solution Analysis, husband 5 shocks, wife 3 shocks.

4.4.1 Test SNW_VFI_MAIN Defaults Small

Call the function with default parameters.

```
mp_param = snw_mp_param('default_small53');
[V_VFI,ap_VFI,cons_VFI,mp_valpol_more] = snw_vfi_main_bisec_vec(mp_param);

SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:18 of 17, time-this-age:0.058874
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:17 of 17, time-this-age:0.059673
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:16 of 17, time-this-age:0.059922
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:15 of 17, time-this-age:0.062184
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:14 of 17, time-this-age:0.057978
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:13 of 17, time-this-age:0.059396
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:12 of 17, time-this-age:0.061417
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:11 of 17, time-this-age:0.058985
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:10 of 17, time-this-age:0.05982
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:9 of 17, time-this-age:0.07028
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:8 of 17, time-this-age:0.06746
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:7 of 17, time-this-age:0.059236
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:6 of 17, time-this-age:0.069577
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:5 of 17, time-this-age:0.068207
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:4 of 17, time-this-age:0.060701
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:3 of 17, time-this-age:0.059637
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:2 of 17, time-this-age:0.062462
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:1 of 17, time-this-age:0.0598
Completed SNW_VFI_MAIN_BISEC_VEC;SNW_MP_PARAM=default_small53;SNW_MP_CONTROL=default_base;time=1.153
```

4.4.2 Small Param Results Define Frames

Define the matrix dimensions names and dimension vector values. Policy and Value Functions share the same ND dimensional structure.

```
% Grids:
age_grid = [19, 22:5:97, 100];
agrid = mp_param('agrid')';
eta_H_grid = mp_param('eta_H_grid')';
eta_S_grid = mp_param('eta_S_grid')';
ar_st_eta_HS_grid = string(cellstr([num2str(eta_H_grid', 'hz=%3.2f;'), num2str(eta_S_grid', 'wz=%3.2
edu_grid = [0,1];
marry_grid = [0,1];
kids_grid = (1:1:mp_param('n_kidsgrid'))';
% NaN(n_jgrid,n_agrid,n_etagrid,n_educgrid,n_marriedgrid,n_kidsgrid);
cl_mp_datasetdesc = {};
cl_mp_datasetdesc{1} = containers.Map({'name', 'labval'}, {'age', age_grid});
cl_mp_datasetdesc{2} = containers.Map({'name', 'labval'}, {'savings', agrid});
cl_mp_datasetdesc{3} = containers.Map({'name', 'labval'}, {'eta', 1:length(eta_H_grid)});
cl_mp_datasetdesc{4} = containers.Map({'name', 'labval'}, {'edu', edu_grid});
cl_mp_datasetdesc{5} = containers.Map({'name', 'labval'}, {'marry', marry_grid});
cl_mp_datasetdesc{6} = containers.Map({'name', 'labval'}, {'kids', kids_grid});
```

4.4.3 Analyze Savings and Shocks

First, analyze Savings Levels and Shocks, Aggregate Over All Others, and do various other calculations.

```
% Generate some Data
mp_support_graph = containers.Map('KeyType', 'char', 'ValueType', 'any');
mp_support_graph('cl_st_xtitle') = {'Savings States, a'};
mp_support_graph('st_legend_loc') = 'best';
mp_support_graph('bl_graph_logy') = true; % do not log
mp_support_graph('it_legend_select') = 9; % how many shock legends to show
mp_support_graph('cl_colors') = 'jet';
```

MEAN(VAL(A,Z)), MEAN(AP(A,Z)), MEAN(C(A,Z))

Tabulate value and policies along savings and shocks:

```
% Set
% NaN(n_jgrid,n_agrid,n_etagrid,n_educgrid,n_marriedgrid,n_kidsgrid);
ar_permute = [1,4,5,6,3,2];
% Value Function
tb_az_v = ff_summ_nd_array("MEAN(VAL(A,Z))", V_VFI, true, ["mean"], 4, 1, cl_mp_datasetdesc, ar_perm
```

```
xxx  MEAN(VAL(A,Z))  xxxxxxxxxxxxxxxxxxxxxxxxxxx
    group     savings      mean_eta_1     mean_eta_2     mean_eta_3     mean_eta_4     mean_eta_5     mean
    -----    ---------     ----------     ----------     ----------     ----------     ----------     ----

      1              0       -20.307        -10.285        -5.0527        -2.1772        -0.66137       -17
      2      0.0097656       -19.558        -10.063        -4.9312        -2.0759        -0.5645          -
      3       0.078125       -16.259        -8.8768        -4.2806        -1.5512        -0.069704      -14
      4        0.26367       -12.127         -7.062         -3.289        -0.8157         0.59457       -11
      5          0.625       -8.3166         -5.145        -2.2609        -0.1528          1.1414       -7.
      6         1.2207       -5.2004        -3.3395        -1.2735          0.417          1.5609       -4.
      7         2.1094       -2.8448        -1.7849       -0.39262        0.91448          1.8837       -2.
      8         3.3496       -1.1351       -0.53317          0.368         1.3497          2.1394       -1.
      9              5      0.088433        0.43451         1.0071         1.7212          2.3505        0.
     10         7.1191       0.96365         1.1669         1.5292         2.0348          2.5311       0.9
     11         9.7656        1.5949         1.7173          1.948         2.3007          2.6878        1.
     12         12.998        2.0558         2.1316         2.2803         2.5253          2.8229          2
```

```
    13       16.875       2.397       2.4453       2.5427       2.7131         2.939     2.
    14       21.455      2.6533       2.6848       2.7497        2.869        3.0391     2.
    15       26.797      2.8488       2.8698       2.9139        2.998        3.1258     2.
    16       32.959      2.9999       3.0142       3.0447       3.1047        3.2007     3.
    17           40      3.1182       3.1282       3.1496       3.1929        3.2653     3.
    18       47.979      3.2119        3.219       3.2343       3.2659        3.3208     3.
    19       56.953       3.287       3.2921       3.3033       3.3266        3.3685     3.
    20       66.982      3.3477       3.3515       3.3597       3.3772        3.4093     3.
    21       78.125      3.3974       3.4002       3.4064       3.4196        3.4444     3.
    22       90.439      3.4384       3.4405       3.4452       3.4553        3.4746     3.
    23       103.98      3.4724       3.4741       3.4776       3.4854        3.5006     3.
    24       118.82       3.501       3.5022        3.505       3.5111        3.5231     3.
    25          135      3.5251       3.5261       3.5282        3.533        3.5426     3.
```

```
% Aprime Choice
tb_az_ap = ff_summ_nd_array("MEAN(AP(A,Z))", ap_VFI, true, ["mean"], 4, 1, cl_mp_datasetdesc, ar_per
```

```
xxx  MEAN(AP(A,Z))  xxxxxxxxxxxxxxxxxxxxxxxxxxx
    group     savings      mean_eta_1     mean_eta_2     mean_eta_3     mean_eta_4     mean_eta_5     mean
    -----    ---------     ----------     ----------     ----------     ----------     ----------     ----

      1             0     2.7511e-05     0.0015443       0.029727        0.16652        0.75086     0.00
      2     0.0097656     0.00054711     0.0027834       0.031634        0.16984        0.75642     0.00
      3      0.078125       0.015731      0.018652       0.049638        0.19667        0.79532      0.0
      4       0.26367       0.093357        0.0908        0.12387         0.2854         0.9063       0.
      5         0.625        0.31381       0.31997        0.35088        0.51766         1.1457       0.
      6        1.2207        0.74541        0.7447        0.78537        0.95128         1.5671       0.
      7        2.1094         1.4161        1.4196         1.4616         1.6183         2.2194        1
      8        3.3496         2.3637        2.3696         2.4109         2.5645         3.1433        2
      9             5         3.6292        3.6363          3.678         3.8404         4.3795        3
     10        7.1191         5.2766        5.2846          5.326         5.4907         5.9774        5
     11        9.7656         7.3022        7.3101         7.3505         7.5158         7.9941        7
     12        12.998         9.7443        9.7504         9.7888         9.9552         10.482
     13        16.875         12.756        12.762         12.797         12.958         13.553        1
     14        21.455         16.326         16.33         16.365         16.512         17.127        1
     15        26.797          20.39        20.392         20.419         20.557         21.172        2
     16        32.959         25.075        25.082         25.112         25.235         25.829        2
     17            40         30.452         30.46         30.499         30.623         31.182
     18        47.979         36.549        36.557         36.599         36.745         37.265        3
     19        56.953          43.56        43.567         43.602         43.748          44.27        4
     20        66.982         51.366        51.375         51.418         51.556         52.091        5
     21        78.125         59.653        59.661         59.707         59.864         60.396        5
     22        90.439         69.009        69.015         69.057         69.216         69.764        6
     23        103.98         79.499        79.505         79.547         79.696          80.26        7
     24        118.82         90.869        90.876         90.918         91.063         91.614        9
     25           135         103.22        103.22         103.26         103.41         103.95
```

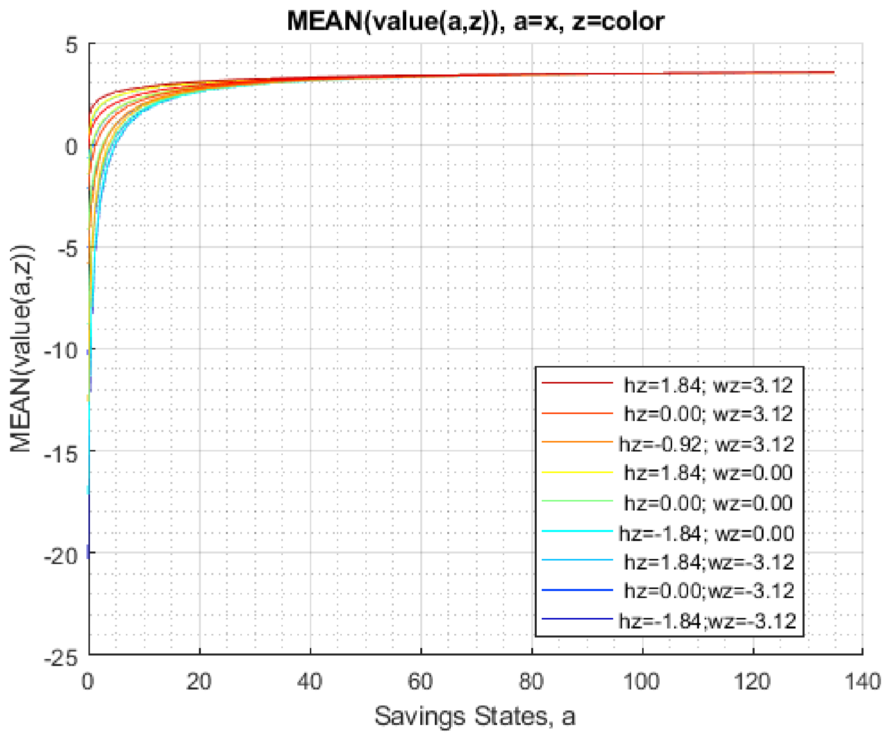
```
% Consumption Choices
tb_az_c = ff_summ_nd_array("MEAN(C(A,Z))", cons_VFI, true, ["mean"], 4, 1, cl_mp_datasetdesc, ar_per
```

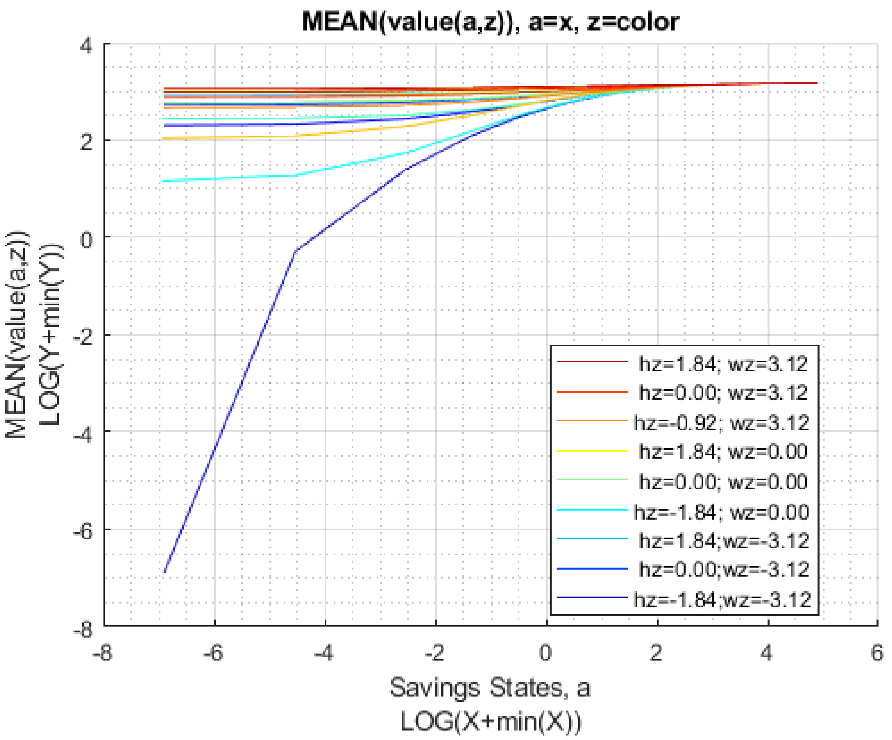
```
xxx  MEAN(C(A,Z))  xxxxxxxxxxxxxxxxxxxxxxxxxxx
    group     savings      mean_eta_1     mean_eta_2     mean_eta_3     mean_eta_4     mean_eta_5     mean
    -----    ---------     ----------     ----------     ----------     ----------     ----------     ----

      1             0       0.17596         0.2993         0.5664         1.1423         2.3148      0.3
      2     0.0097656       0.18702        0.30957        0.57594         1.1504         2.3206      0.3
      3      0.078125       0.25285        0.37423        0.63806         1.2035         2.3616      0.3
      4       0.26367       0.39479        0.52047        0.78122         1.3316         2.4672      0.4
```

5	0.625	0.60083	0.71594	0.97718	1.5213	2.6493	0.6
6	1.2207	0.87005	0.9899	1.2392	1.7827	2.9223	0.9
7	2.1094	1.2414	1.355	1.6005	2.1515	3.305	1.
8	3.3496	1.7441	1.8535	2.0975	2.6496	3.8243	1.
9	5	2.4043	2.5112	2.7528	3.2942	4.5075	2.
10	7.1191	3.2256	3.3306	3.571	4.1085	5.3729	3.
11	9.7656	4.2795	4.3841	4.6243	5.1596	6.4314	4.
12	12.998	5.596	5.7019	5.9433	6.4763	7.6989	5.
13	16.875	7.0899	7.1954	7.4401	7.977	9.1305	7.
14	21.455	8.8406	8.9481	9.1919	9.7431	10.875	8.
15	26.797	10.982	11.091	11.342	11.901	13.033	11
16	32.959	13.452	13.557	13.805	14.378	15.531	13
17	40	16.251	16.354	16.593	17.165	18.352	16
18	47.979	19.418	19.521	19.756	20.307	21.532	19
19	56.953	22.826	22.93	23.172	23.723	24.945	22
20	66.982	26.663	26.765	27	27.557	28.767	26
21	78.125	31.312	31.414	31.646	32.184	33.397	3
22	90.439	36.251	36.355	36.591	37.128	38.324	36
23	103.98	41.485	41.589	41.825	42.372	43.552	41
24	118.82	47.334	47.438	47.674	48.224	49.417	4
25	135	53.768	53.874	54.112	54.659	55.86	53

Graph Mean Values:

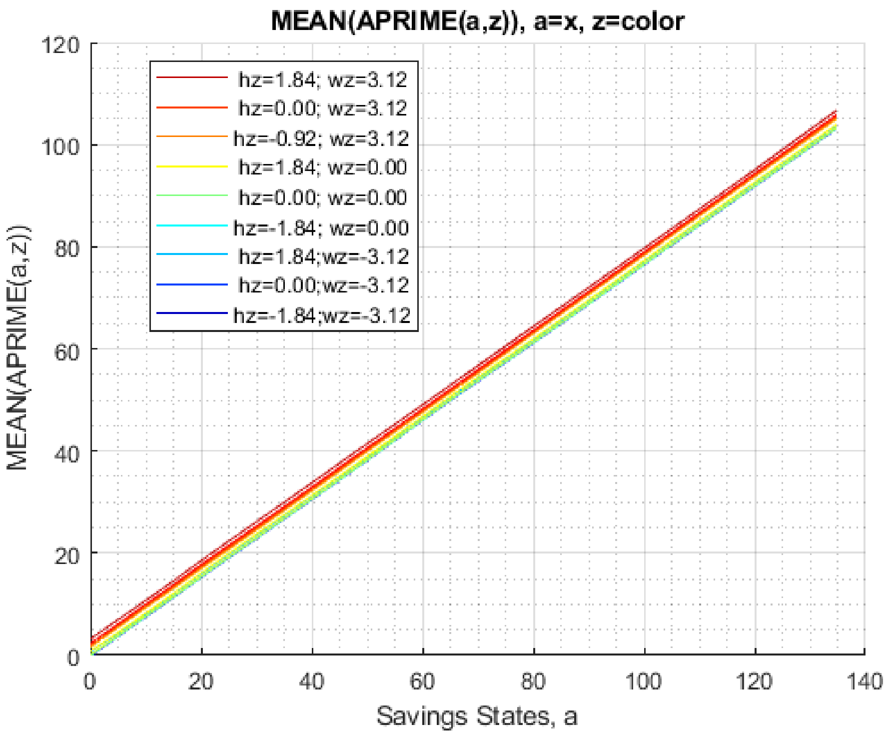
```
mp_support_graph('cl_st_graph_title') = {'MEAN(value(a,z)), a=x, z=color'};
mp_support_graph('cl_st_ytitle') = {'MEAN(value(a,z))'};
ff_graph_grid((tb_az_v{1:end, 3:end})', ar_st_eta_HS_grid, agrid, mp_support_graph);
```

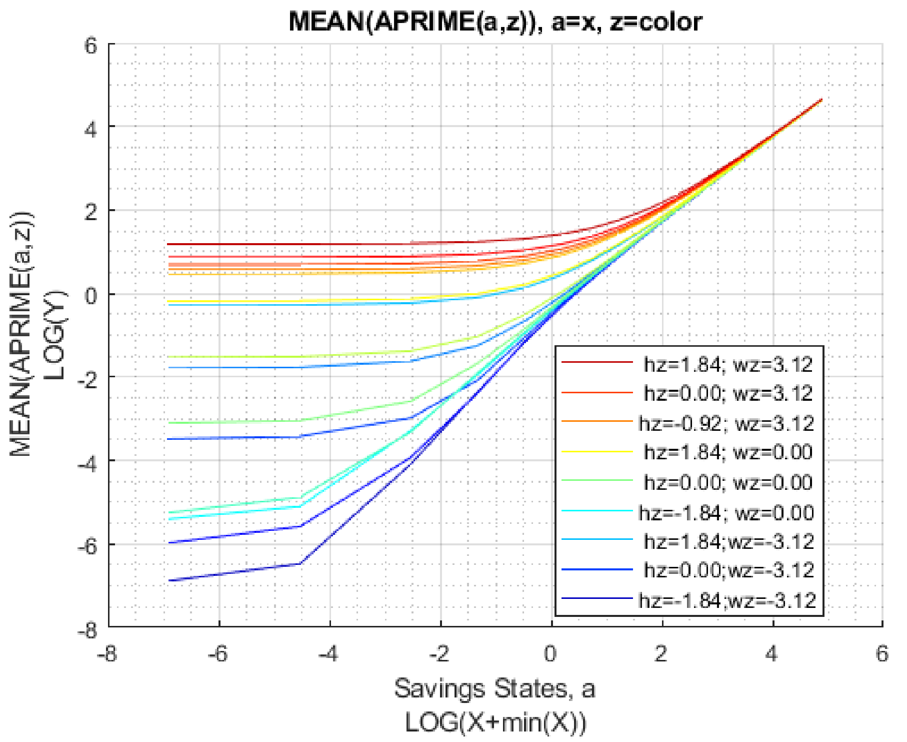




Graph Mean Savings Choices:

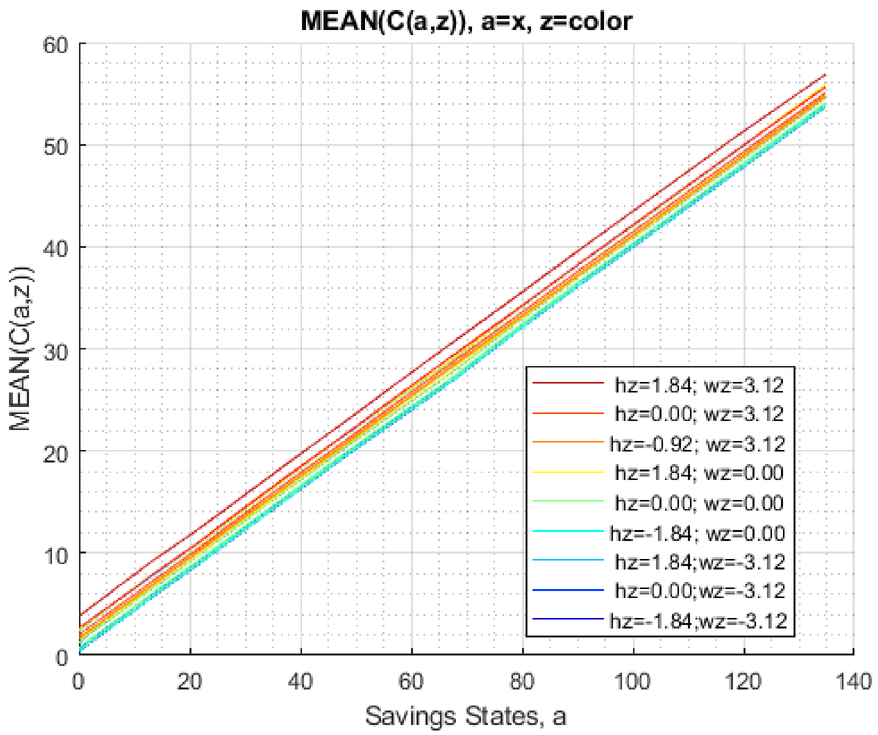
```
mp_support_graph('cl_st_graph_title') = {'MEAN(APRIME(a,z)), a=x, z=color'};
mp_support_graph('cl_st_ytitle') = {'MEAN(APRIME(a,z))'};
ff_graph_grid((tb_az_ap{1:end, 3:end})', ar_st_eta_HS_grid, agrid, mp_support_graph);
```

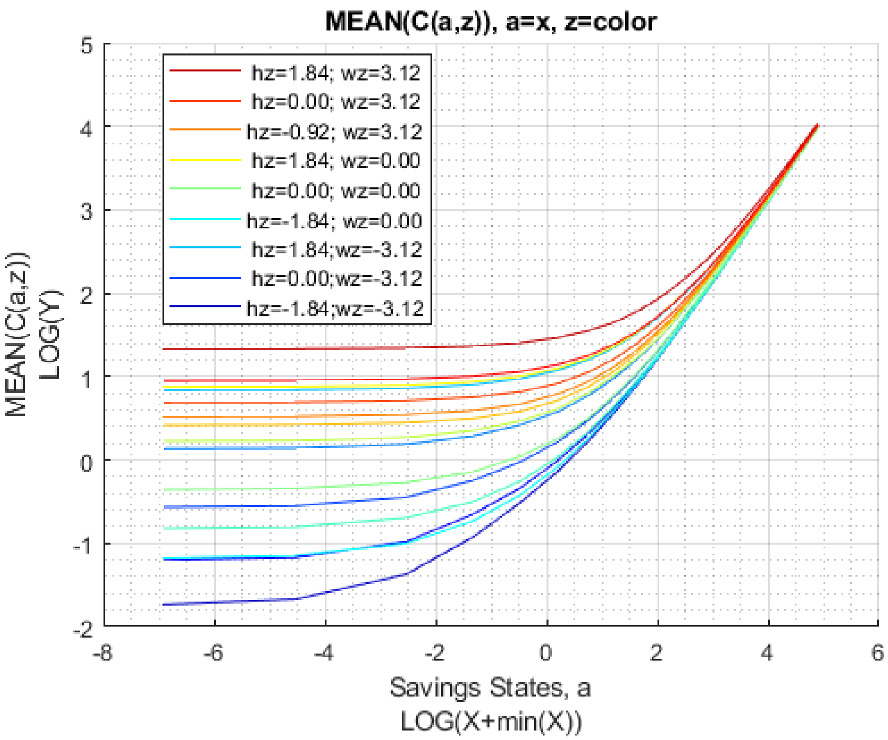




Graph Mean Consumption:

```
mp_support_graph('cl_st_graph_title') = {'MEAN(C(a,z)), a=x, z=color'};
mp_support_graph('cl_st_ytitle') = {'MEAN(C(a,z))'};
ff_graph_grid((tb_az_c{1:end, 3:end})', ar_st_eta_HS_grid, agrid, mp_support_graph);
```





4.4.4 Analyze Kids and Marriage and Age

Aggregating over education, savings, and shocks, what are the differential effects of Marriage and Age.

```
% Generate some Data
mp_support_graph = containers.Map('KeyType', 'char', 'ValueType', 'any');
ar_row_grid = ["k0M0", "K1M0", "K2M0", "k0M1", "K1M1", "K2M1"];
mp_support_graph('cl_st_xtitle') = {'Age'};
mp_support_graph('st_legend_loc') = 'best';
mp_support_graph('bl_graph_logy') = true; % do not log
mp_support_graph('st_rounding') = '6.2f'; % format shock legend
mp_support_graph('cl_scatter_shapes') = { 'o', 'd' ,'s', 'o', 'd', 's'};
mp_support_graph('cl_colors') = {'red', 'red', 'red', 'blue', 'blue', 'blue'};
```

MEAN(VAL(KM,J)), MEAN(AP(KM,J)), MEAN(C(KM,J))

Tabulate value and policies:

```
% Set
% NaN(n_jgrid,n_agrid,n_etagrid,n_educgrid,n_marriedgrid,n_kidsgrid);
ar_permute = [2,3,4,1,6,5];
% Value Function
tb_az_v = ff_summ_nd_array("MEAN(VAL(KM,J))", V_VFI, true, ["mean"], 3, 1, cl_mp_datasetdesc, ar_per
```

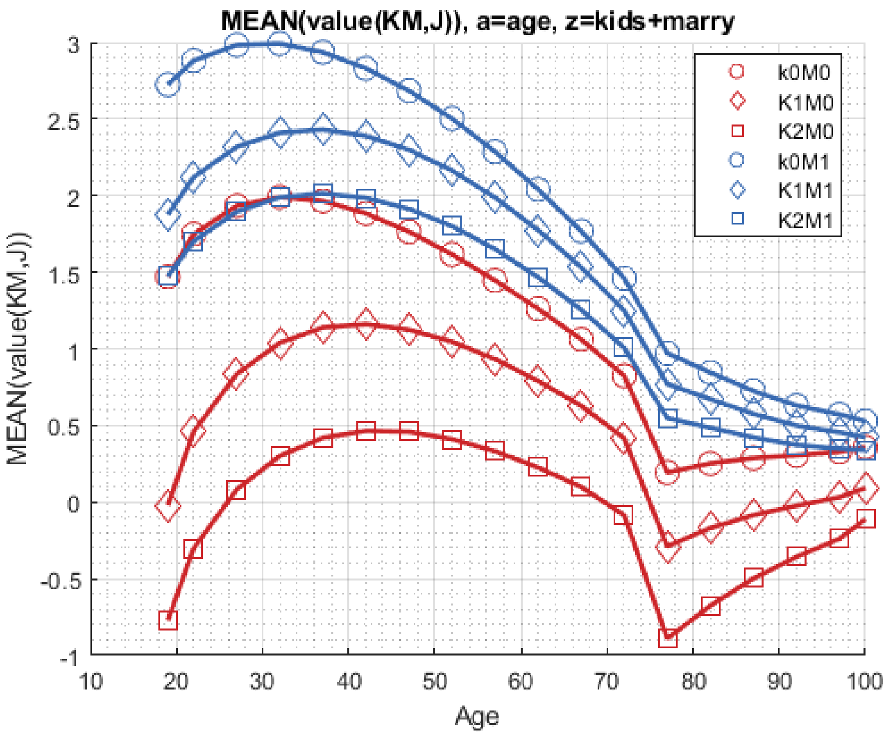
```
xxx  MEAN(VAL(KM,J))  xxxxxxxxxxxxxxxxxxxxxxxxxxx
    group    kids    marry    mean_age_19    mean_age_22    mean_age_27    mean_age_32    mean_age_3
    -----    ----    -----    -----------    -----------    -----------    -----------    ----------

      1        1       0          1.4699         1.7485         1.9344         1.9907         1.9652
      2        2       0       -0.020723        0.46111        0.83504         1.0389         1.1397
      3        3       0        -0.77111       -0.30145       0.081934        0.30157        0.41928
      4        1       1          2.7247         2.8812         2.9832         2.9923         2.9362
      5        2       1          1.8762         2.1212         2.3182         2.4103         2.4302
      6        3       1          1.4732         1.7023         1.8951         1.9893         2.0142
```

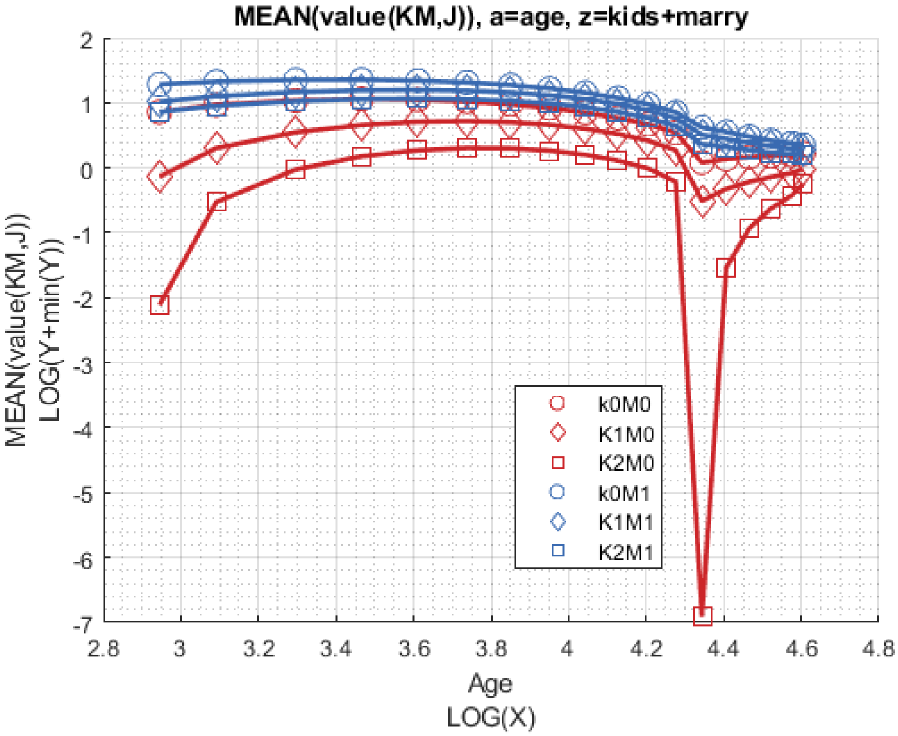
```
% Aprime Choice
```

```
tb_az_ap = ff_summ_nd_array("MEAN(AP(KM,J))", ap_VFI, true, ["mean"], 3, 1, cl_mp_datasetdesc, ar_pe

xxx  MEAN(AP(KM,J))  xxxxxxxxxxxxxxxxxxxxxxxxxxx
    group    kids    marry    mean_age_19    mean_age_22    mean_age_27    mean_age_32    mean_age_3
    -----    ----    -----    -----------    -----------    -----------    -----------    ----------

      1       1        0        34.929         34.724         34.662          34.55         34.357
      2       2        0          34.6         34.331         34.195          33.99         33.687
      3       3        0        34.185         33.965         33.873           33.7         33.421
      4       1        1        35.711         35.608         35.696         35.722         35.654
      5       2        1        35.365         35.243          35.28         35.238         35.095
      6       3        1          34.9         34.807         34.856         34.829         34.694

% Consumption Choices
tb_az_c = ff_summ_nd_array("MEAN(C(KM,J))", cons_VFI, true, ["mean"], 3, 1, cl_mp_datasetdesc, ar_pe

xxx  MEAN(C(KM,J))  xxxxxxxxxxxxxxxxxxxxxxxxxxx
    group    kids    marry    mean_age_19    mean_age_22    mean_age_27    mean_age_32    mean_age_3
    -----    ----    -----    -----------    -----------    -----------    -----------    ----------

      1       1        0        6.8551         7.1756          7.502         7.8205         8.1483
      2       2        0        7.1843         7.5683         7.9695         8.3802         8.8184
      3       3        0        7.5997          7.934         8.2911         8.6703         9.0841
      4       1        1        7.8017         8.1851         8.5662         8.9367         9.3167
      5       2        1        7.8815         8.2584         8.6593         9.0691         9.4965
      6       3        1        8.1632         8.4941         8.8603         9.2345         9.6357
```

Graph Mean Values:

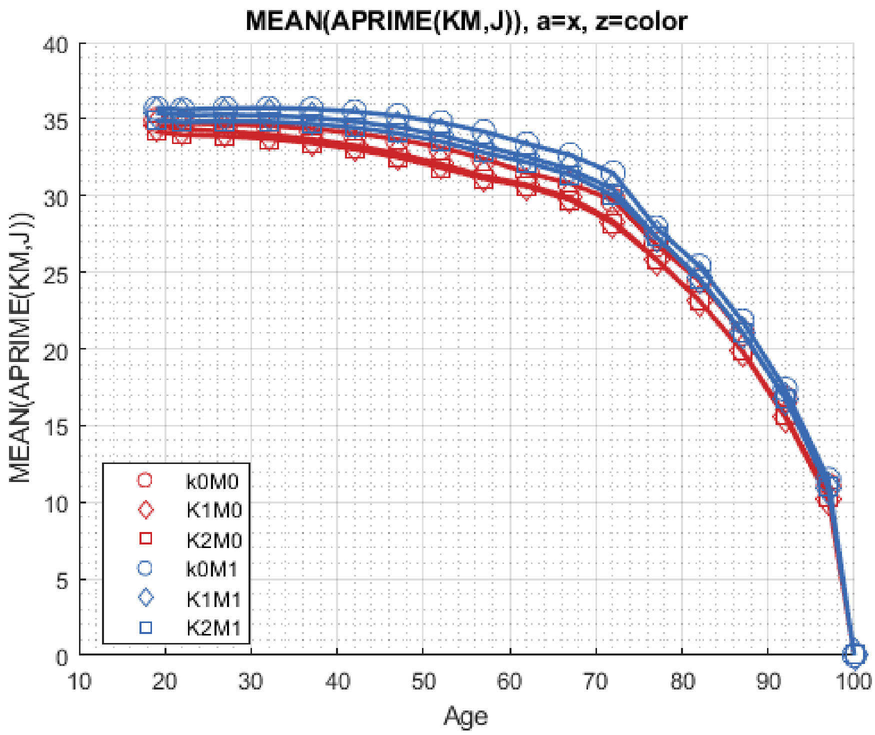
```
mp_support_graph('cl_st_graph_title') = {'MEAN(value(KM,J)), a=age, z=kids+marry'};
mp_support_graph('cl_st_ytitle') = {'MEAN(value(KM,J))'};
ff_graph_grid((tb_az_v{1:end, 4:end}), ar_row_grid, age_grid, mp_support_graph);
```

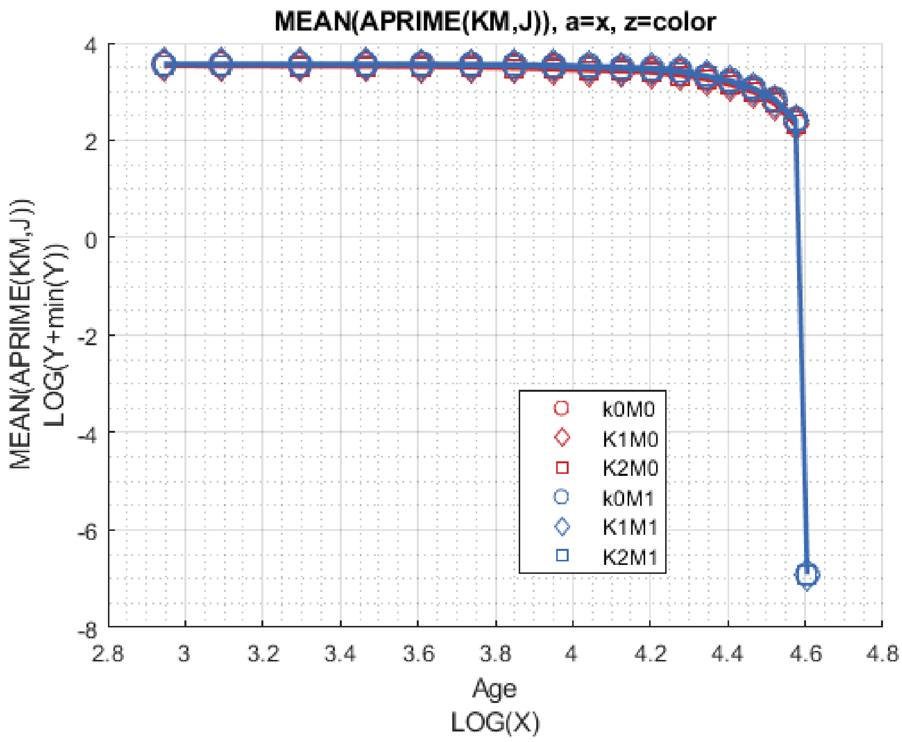




Graph Mean Savings Choices:

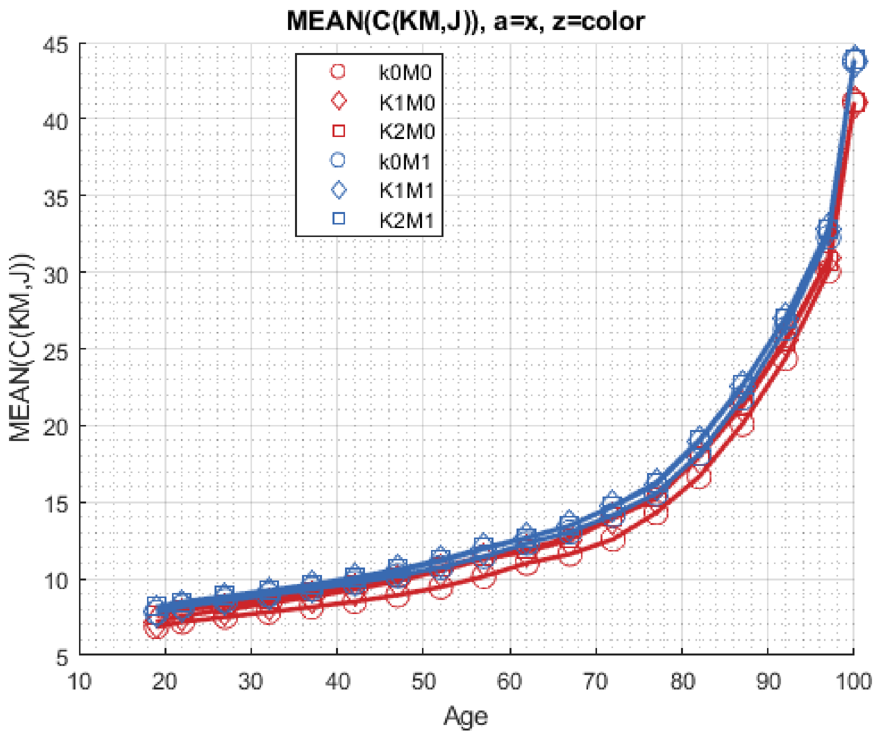
```
mp_support_graph('cl_st_graph_title') = {'MEAN(APRIME(KM,J)), a=x, z=color'};
mp_support_graph('cl_st_ytitle') = {'MEAN(APRIME(KM,J))'};
ff_graph_grid((tb_az_ap{1:end, 4:end}), ar_row_grid, age_grid, mp_support_graph);
```

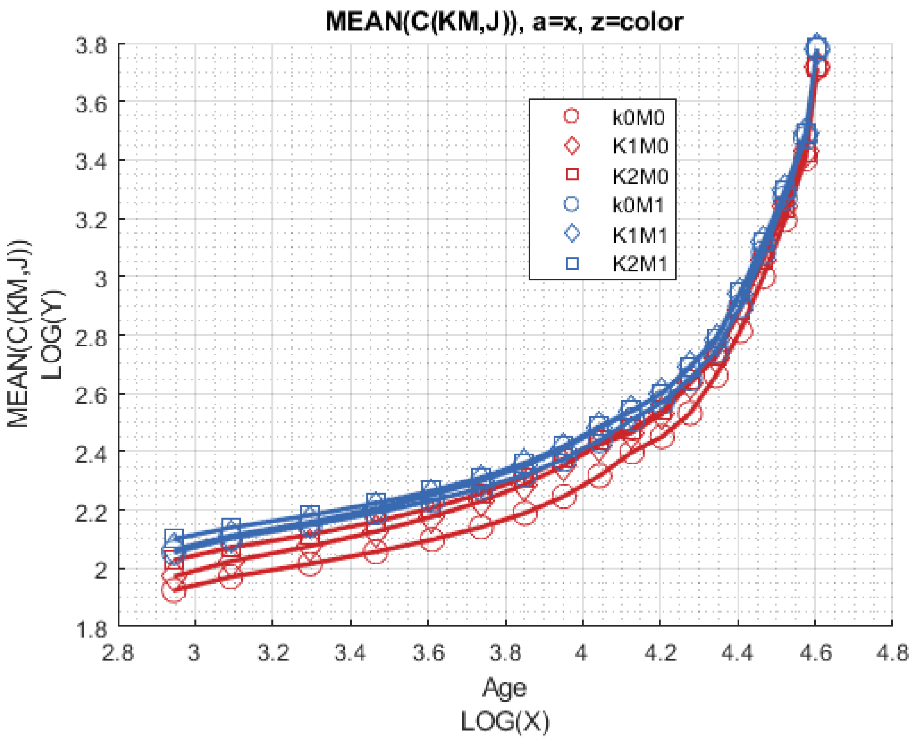




Graph Mean Consumption:

```
mp_support_graph('cl_st_graph_title') = {'MEAN(C(KM,J)), a=x, z=color'};
mp_support_graph('cl_st_ytitle') = {'MEAN(C(KM,J))'};
ff_graph_grid((tb_az_c{1:end, 4:end}), ar_row_grid, age_grid, mp_support_graph);
```





4.4.5 Analyze Education and Marriage and Age

Aggregating over education, savings, and shocks, what are the differential effects of Marriage and Age.

```
% Generate some Data
mp_support_graph = containers.Map('KeyType', 'char', 'ValueType', 'any');
ar_row_grid = ["E0M0", "E1M0", "E0M1", "E1M1"];
mp_support_graph('cl_st_xtitle') = {'Age'};
mp_support_graph('st_legend_loc') = 'best';
mp_support_graph('bl_graph_logy') = true; % do not log
mp_support_graph('st_rounding') = '6.2f'; % format shock legend
mp_support_graph('cl_scatter_shapes') = {'*', 'p', '*','p' };
mp_support_graph('cl_colors') = {'red', 'red', 'blue', 'blue'};
```

MEAN(VAL(EKM,J)), MEAN(AP(EKM,J)), MEAN(C(EKM,J))

Tabulate value and policies:

```
% Set
% NaN(n_jgrid,n_agrid,n_etagrid,n_educgrid,n_marriedgrid,n_kidsgrid);
ar_permute = [2,3,6,1,4,5];
% Value Function
tb_az_v = ff_summ_nd_array("MEAN(VAL(EKM,J))", V_VFI, true, ["mean"], 3, 1, cl_mp_datasetdesc, ar_pe
```

```
xxx  MEAN(VAL(EKM,J))  xxxxxxxxxxxxxxxxxxxxxxxxxxxx
```

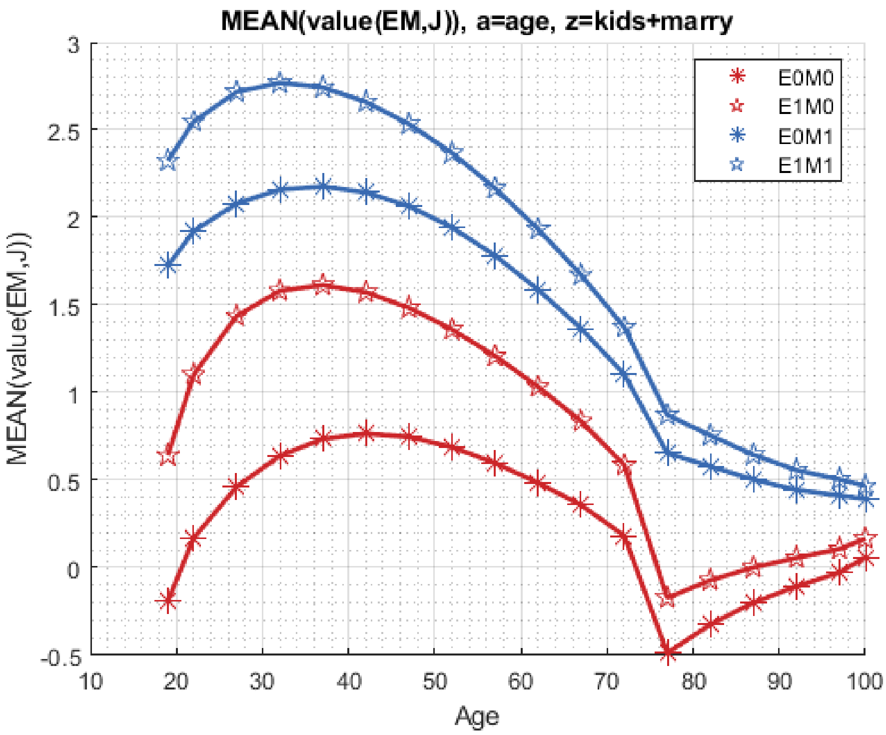
group	edu	marry	mean_age_19	mean_age_22	mean_age_27	mean_age_32	mean_age_37
1	0	0	-0.19018	0.16944	0.46325	0.63924	0.73534
2	1	0	0.64221	1.1027	1.4377	1.5815	1.6141
3	0	1	1.7253	1.9221	2.0804	2.1589	2.1772
4	1	1	2.3242	2.5478	2.7173	2.769	2.7432

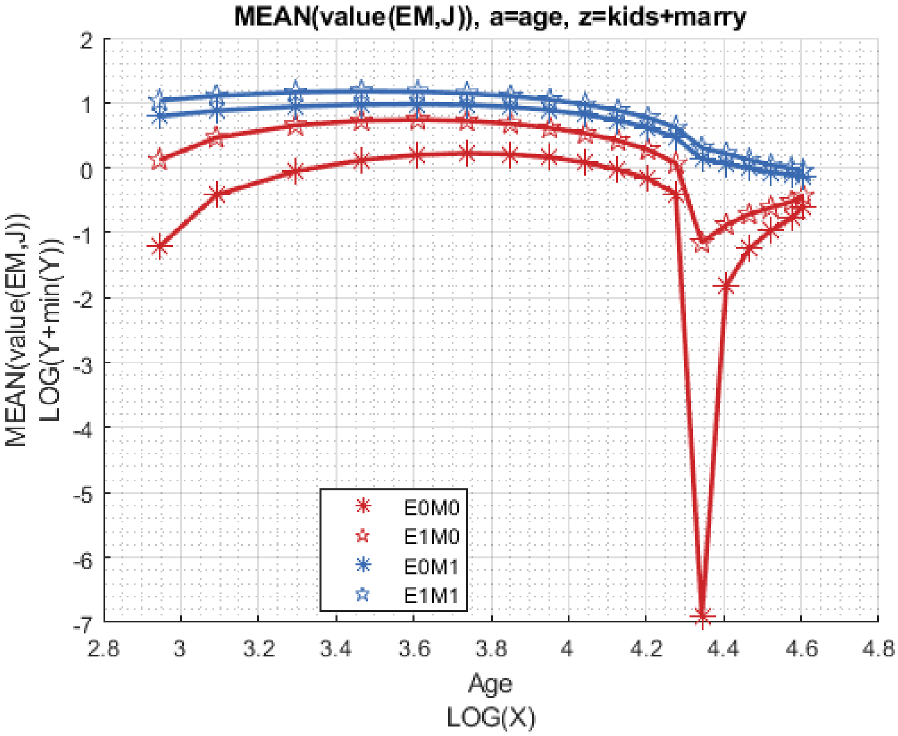
```
% Aprime Choice
tb_az_ap = ff_summ_nd_array("MEAN(AP(EKM,J))", ap_VFI, true, ["mean"], 3, 1, cl_mp_datasetdesc, ar_p
```

```
xxx  MEAN(AP(EKM,J))  xxxxxxxxxxxxxxxxxxxxxxxxxxx
    group    edu    marry    mean_age_19    mean_age_22    mean_age_27    mean_age_32    mean_age_37
    -----    ---    -----    -----------    -----------    -----------    -----------    -----------

      1       0       0          34.68         34.441         34.268         34.044         33.748
      2       1       0         34.463         34.238         34.218         34.116         33.895
      3       0       1         35.361         35.231         35.189         35.094         34.928
      4       1       1          35.29         35.207         35.366         35.432         35.368

% Consumption Choices
tb_az_c = ff_summ_nd_array("MEAN(C(EKM,J))", cons_VFI, true, ["mean"], 3, 1, cl_mp_datasetdesc, ar_p

xxx  MEAN(C(EKM,J))  xxxxxxxxxxxxxxxxxxxxxxxxxxx
    group    edu    marry    mean_age_19    mean_age_22    mean_age_27    mean_age_32    mean_age_37
    -----    ---    -----    -----------    -----------    -----------    -----------    -----------

      1       0       0         7.1043         7.4114         7.7391         8.0887         8.4765
      2       1       0         7.3218         7.7071         8.1025          8.492         8.8907
      3       0       1          7.761         8.0772         8.4119         8.7662         9.1545
      4       1       1         8.1365         8.5478         8.9787          9.394         9.8115
```

Graph Mean Values:

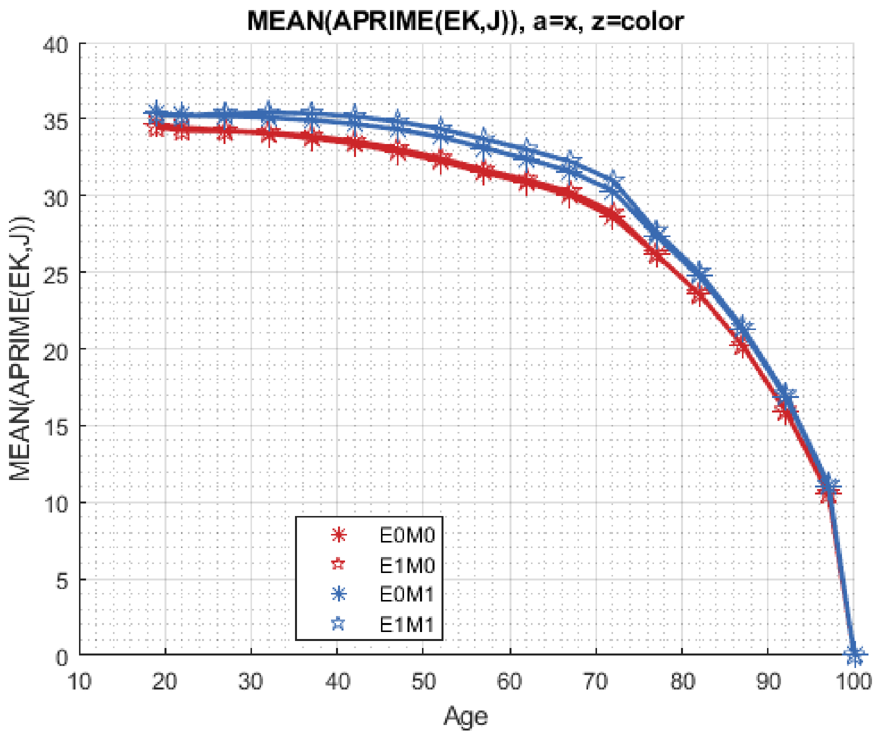
```
mp_support_graph('cl_st_graph_title') = {'MEAN(value(EM,J)), a=age, z=kids+marry'};
mp_support_graph('cl_st_ytitle') = {'MEAN(value(EM,J))'};
ff_graph_grid((tb_az_v{1:end, 4:end}), ar_row_grid, age_grid, mp_support_graph);
```

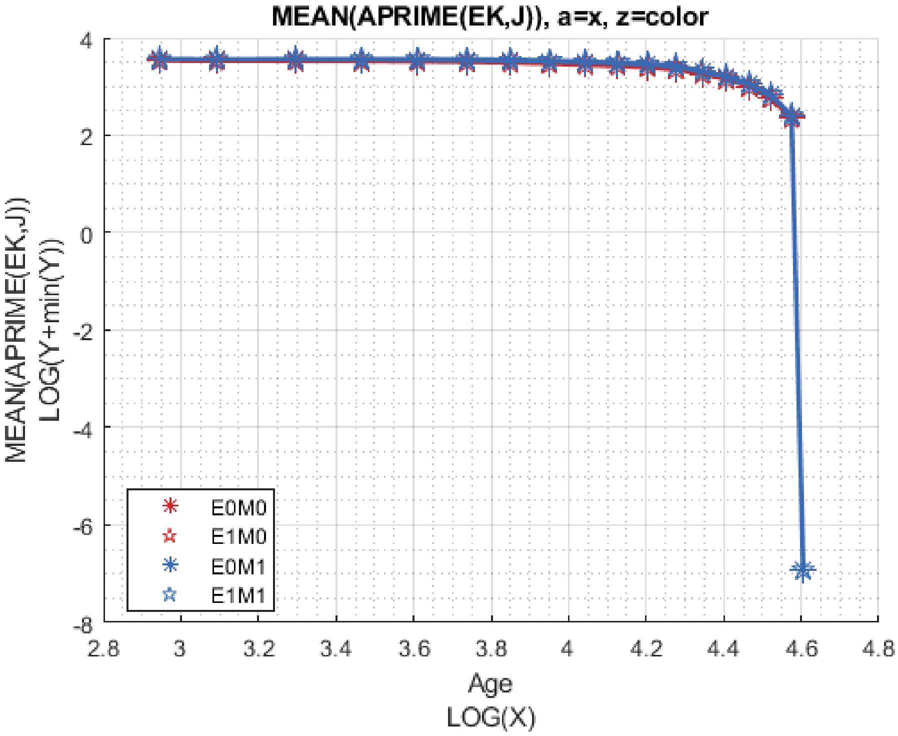




Graph Mean Savings Choices:

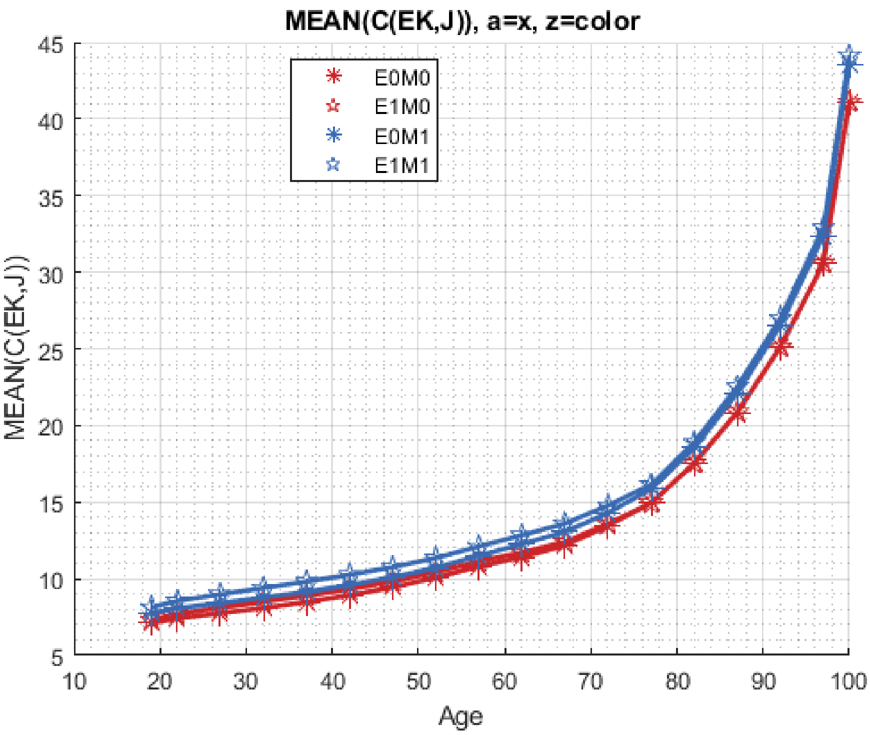
```
mp_support_graph('cl_st_graph_title') = {'MEAN(APRIME(EK,J)), a=x, z=color'};
mp_support_graph('cl_st_ytitle') = {'MEAN(APRIME(EK,J))'};
ff_graph_grid((tb_az_ap{1:end, 4:end}), ar_row_grid, age_grid, mp_support_graph);
```

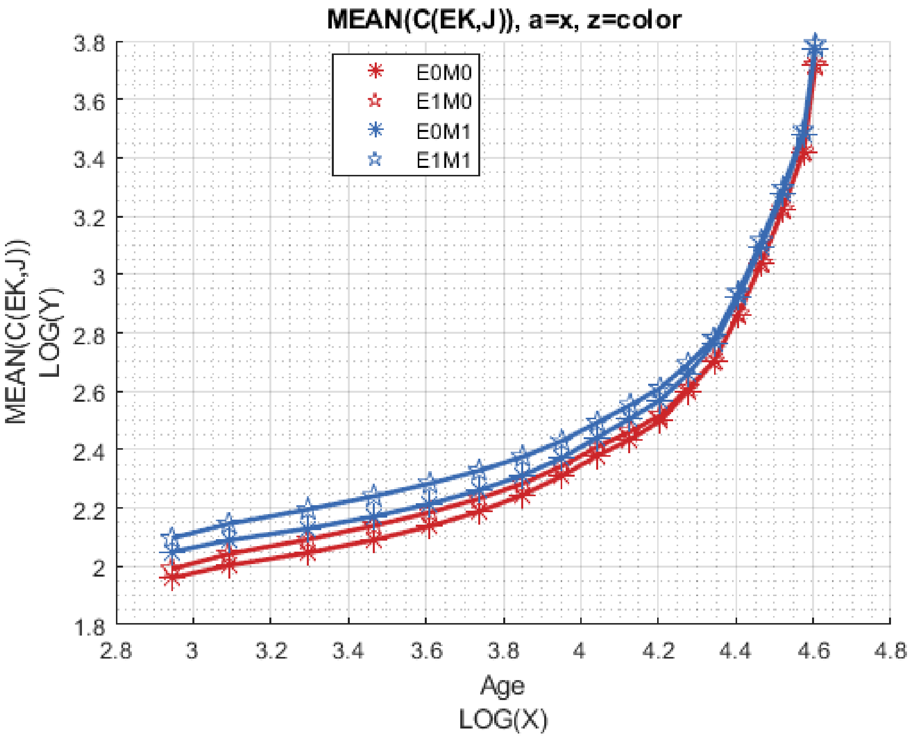




Graph Mean Consumption:

```
mp_support_graph('cl_st_graph_title') = {'MEAN(C(EK,J)), a=x, z=color'};
mp_support_graph('cl_st_ytitle') = {'MEAN(C(EK,J))'};
ff_graph_grid((tb_az_c{1:end, 4:end}), ar_row_grid, age_grid, mp_support_graph);
```




MEAN(C(EK,J)), a=x, z=color
E0M0
E1M0
E0M1
E1M1
MEAN(C(EK,J))
LOG(Y)
Age
LOG(X)
3.8
3.6
3.4
3.2
3
2.8
2.6
2.4
2.2
2
1.8
2.8
3
3.2
3.4
3.6
3.8
4
4.2
4.4
4.6
4.8

Chapter 5

Solution with Unemployment

5.1 Life Cycle Dynamic Programming under Unemployment Shock

This is the example vignette for function: **snw_vfi_main_bisec_vec** from the **PrjOptiSNW Package.** This function solves for policy function using Exact Vectorized Solution. Value in 2020 with surprise COVID unemployment Shock, with non-covid year Value as the continuation function. The file focuses on the change in value function, asset choice, and consumption choice given a one period unemployment shock (that does not reappear in the future again).

5.1.1 Test SNW_VFI_UNEMP

Solve the Regular Value and Also the Unemployment Value.

First, solve for value without unemployment issue (use the vectorized code that was previously tested):

```
mp_params = snw_mp_param('default_docdense');
mp_controls = snw_mp_control('default_test');
[V_VFI_ss,ap_VFI_ss,cons_VFI_ss,mp_valpol_more_ss] = ...
    snw_vfi_main_bisec_vec(mp_params, mp_controls);
```

```
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:83 of 82, time-this-age:7.0273
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:82 of 82, time-this-age:5.7228
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:81 of 82, time-this-age:5.7083
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:80 of 82, time-this-age:5.7427
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:79 of 82, time-this-age:5.6962
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:78 of 82, time-this-age:5.7223
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:77 of 82, time-this-age:5.7035
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:76 of 82, time-this-age:5.8126
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:75 of 82, time-this-age:5.7166
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:74 of 82, time-this-age:5.6915
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:73 of 82, time-this-age:5.6971
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:72 of 82, time-this-age:5.7128
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:71 of 82, time-this-age:5.6819
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:70 of 82, time-this-age:5.7212
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:69 of 82, time-this-age:5.6814
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:68 of 82, time-this-age:5.6867
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:67 of 82, time-this-age:5.6787
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:66 of 82, time-this-age:5.7367
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:65 of 82, time-this-age:5.7251
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:64 of 82, time-this-age:5.7155
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:63 of 82, time-this-age:5.6715
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:62 of 82, time-this-age:6.3362
```

```
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:61 of 82, time-this-age:5.6611
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:60 of 82, time-this-age:5.6816
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:59 of 82, time-this-age:5.6858
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:58 of 82, time-this-age:5.6664
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:57 of 82, time-this-age:5.7059
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:56 of 82, time-this-age:5.6912
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:55 of 82, time-this-age:5.7074
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:54 of 82, time-this-age:5.7189
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:53 of 82, time-this-age:5.8154
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:52 of 82, time-this-age:6.2071
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:51 of 82, time-this-age:5.7038
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:50 of 82, time-this-age:5.7383
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:49 of 82, time-this-age:5.7201
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:48 of 82, time-this-age:5.7148
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:47 of 82, time-this-age:5.8791
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:46 of 82, time-this-age:5.8699
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:45 of 82, time-this-age:5.9276
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:44 of 82, time-this-age:5.8993
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:43 of 82, time-this-age:5.9322
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:42 of 82, time-this-age:5.8956
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:41 of 82, time-this-age:5.892
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:40 of 82, time-this-age:5.941
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:39 of 82, time-this-age:5.9249
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:38 of 82, time-this-age:5.9262
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:37 of 82, time-this-age:5.9554
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:36 of 82, time-this-age:5.9082
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:35 of 82, time-this-age:5.8864
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:34 of 82, time-this-age:5.846
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:33 of 82, time-this-age:5.9126
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:32 of 82, time-this-age:5.918
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:31 of 82, time-this-age:5.873
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:30 of 82, time-this-age:5.9253
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:29 of 82, time-this-age:5.8694
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:28 of 82, time-this-age:5.9057
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:27 of 82, time-this-age:5.9302
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:26 of 82, time-this-age:5.9329
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:25 of 82, time-this-age:6.1905
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:24 of 82, time-this-age:5.9237
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:23 of 82, time-this-age:5.9634
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:22 of 82, time-this-age:5.8632
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:21 of 82, time-this-age:6.2308
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:20 of 82, time-this-age:5.9032
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:19 of 82, time-this-age:5.916
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:18 of 82, time-this-age:5.9014
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:17 of 82, time-this-age:5.852
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:16 of 82, time-this-age:5.8767
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:15 of 82, time-this-age:5.9424
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:14 of 82, time-this-age:5.8916
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:13 of 82, time-this-age:5.9423
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:12 of 82, time-this-age:5.8851
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:11 of 82, time-this-age:5.8739
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:10 of 82, time-this-age:5.8917
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:9 of 82, time-this-age:5.9436
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:8 of 82, time-this-age:5.9345
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:7 of 82, time-this-age:5.9111
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:6 of 82, time-this-age:5.9251
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:5 of 82, time-this-age:5.9407
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:4 of 82, time-this-age:5.9242
```

```
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:3 of 82, time-this-age:5.9242
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:2 of 82, time-this-age:5.8728
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:1 of 82, time-this-age:5.9204
Completed SNW_VFI_MAIN_BISEC_VEC;SNW_MP_PARAM=default_docdense;SNW_MP_CONTROL=default_test;time=486.
----------------------------------------
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
CONTAINER NAME: mp_outcomes ND Array (Matrix etc)
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
                i    idx    ndim     numel      rowN      colN           sum        mean       std
                -    ---    ----    --------    ----    ---------    -----------    -------    -----

    V_VFI       1     1      6      4.37e+07     83     5.265e+05    -1.5339e+08    -3.5101    26.11
    ap_VFI      2     2      6      4.37e+07     83     5.265e+05     1.4159e+09     32.402    36.79
    cons_VFI    3     3      6      4.37e+07     83     5.265e+05     2.1402e+08     4.8975    8.329

xxx TABLE:V_VFI xxxxxxxxxxxxxxxxxx
             c1         c2         c3         c4         c5       c526496    c526497    c526498    c
           -------    -------    -------    -------    -------    -------    -------    -------    -

    r1     -346.51    -346.12    -343.63    -337.86    -328.51     21.702     21.852     22.003
    r2     -334.38    -333.99    -331.51    -325.83    -316.83     21.724     21.869     22.015
    r3     -322.45    -322.06     -319.6    -314.14     -305.6     21.745     21.885     22.027
    r4     -310.63    -310.27    -307.99    -302.88    -294.87     21.767     21.903     22.041
    r5     -299.94     -299.6    -297.46    -292.67    -285.12     21.775     21.907     22.042
    r79    -9.9437    -9.9325    -9.8557    -9.6597    -9.3232     2.5394     2.5501     2.5602
    r80    -8.9023    -8.8911    -8.8143    -8.6183    -8.2818     2.3039     2.3121     2.3198
    r81    -7.6363    -7.6251    -7.5484    -7.3524    -7.0159     2.0068     2.0124     2.0176
    r82    -5.9673    -5.9561    -5.8793    -5.6833    -5.3468     1.5958     1.5989     1.6018
    r83    -3.5892     -3.578    -3.5012    -3.3052    -2.9687    0.97904    0.98004    0.98097    0

xxx TABLE:ap_VFI xxxxxxxxxxxxxxxxxx
           c1    c2        c3            c4           c5        c526496    c526497    c526498    c5264
           --    --    ----------    ---------    ---------    -------    -------    -------    -----

    r1     0     0      0.0005656    0.0075134    0.022901     114.75     120.41     126.27     132.3
    r2     0     0     0.00051498    0.0065334    0.021549     114.86     120.53     126.41     132.5
    r3     0     0     0.00051498    0.0049294    0.019875     114.97     120.65     126.56      132.
    r4     0     0     0.00051498    0.0047937    0.019672     115.73     121.42     127.34     133.5
    r5     0     0     0.00048517    0.0046683    0.019484      116.5     122.21     128.15     134.3
    r79    0     0              0            0           0     81.091      85.68     90.335     94.37
    r80    0     0              0            0           0     76.669     80.563     84.304      88.0
    r81    0     0              0            0           0     68.313     71.534     74.475     77.83
    r82    0     0              0            0           0     50.126     53.467     56.953     58.74
    r83    0     0              0            0           0          0          0          0

xxx TABLE:cons_VFI xxxxxxxxxxxxxxxxxx
              c1          c2          c3          c4          c5        c526496    c526497    c526498
           --------    --------    --------    --------    --------    -------    -------    -------

    r1     0.036717    0.037251    0.040426     0.04363    0.048012    9.6491       9.817     9.9649
    r2     0.036717    0.037251    0.040477     0.04461    0.049364    9.8118      9.9685     10.101
    r3     0.036717    0.037251    0.040477    0.046214    0.051039    9.9779       10.12     10.234
    r4     0.038144    0.038678    0.041903    0.047776    0.052666    10.131      10.258     10.354
    r5     0.039534    0.040068    0.043323     0.04929    0.054241    10.272      10.384     10.463
    r79      0.2179     0.21844     0.22216     0.23228     0.25197    35.858      37.092     38.455
    r80      0.2179     0.21844     0.22216     0.23228     0.25197    40.253      42.183     44.459
    r81      0.2179     0.21844     0.22216     0.23228     0.25197    48.587       51.19     54.266
    r82      0.2179     0.21844     0.22216     0.23228     0.25197    66.755      69.238      71.77
```

```
    r83      0.2179      0.21844      0.22216      0.23228      0.25197     116.87      122.69      128.71
```

Second, solve for the unemployment value, use the exact-bisec result code, call the snw_vfi_main_bisec_vec.m function with a third input of existing value. xi is the share of income lost during covid year given surprise covid shock, b is the share of income loss that is covered by unemployment insurance. xi=0.5 and b=0 means will lose 50 percent of income given COVID shocks, and the loss will not be covered at all by unemployment insurance.

```
mp_params('xi') = 0.5;
mp_params('b') = 0;
mp_params('a2_covidyr') = mp_params('a2_covidyr_manna_heaven');
[V_VFI_unemp,ap_VFI_unemp,cons_VFI_unemp,mp_valpol_more_unemp] = ...
    snw_vfi_main_bisec_vec(mp_params, mp_controls, V_VFI_ss);
```

```
SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock: Age 1 of 82, time-this-age:5.8952
SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock: Age 2 of 82, time-this-age:5.8156
SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock: Age 3 of 82, time-this-age:5.8749
SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock: Age 4 of 82, time-this-age:6.0917
SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock: Age 5 of 82, time-this-age:5.8328
SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock: Age 6 of 82, time-this-age:5.8616
SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock: Age 7 of 82, time-this-age:5.8821
SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock: Age 8 of 82, time-this-age:5.8446
SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock: Age 9 of 82, time-this-age:5.8487
SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock: Age 10 of 82, time-this-age:5.8319
SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock: Age 11 of 82, time-this-age:5.8572
SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock: Age 12 of 82, time-this-age:5.884
SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock: Age 13 of 82, time-this-age:5.84
SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock: Age 14 of 82, time-this-age:5.8824
SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock: Age 15 of 82, time-this-age:5.8512
SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock: Age 16 of 82, time-this-age:5.8691
SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock: Age 17 of 82, time-this-age:5.8793
SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock: Age 18 of 82, time-this-age:5.8426
SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock: Age 19 of 82, time-this-age:5.8459
SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock: Age 20 of 82, time-this-age:5.8282
SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock: Age 21 of 82, time-this-age:5.833
SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock: Age 22 of 82, time-this-age:5.825
SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock: Age 23 of 82, time-this-age:5.8161
SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock: Age 24 of 82, time-this-age:5.816
SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock: Age 25 of 82, time-this-age:5.8359
SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock: Age 26 of 82, time-this-age:5.865
SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock: Age 27 of 82, time-this-age:5.8444
SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock: Age 28 of 82, time-this-age:5.8535
SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock: Age 29 of 82, time-this-age:5.8373
SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock: Age 30 of 82, time-this-age:5.839
SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock: Age 31 of 82, time-this-age:7.5134
SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock: Age 32 of 82, time-this-age:5.8543
SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock: Age 33 of 82, time-this-age:5.9343
SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock: Age 34 of 82, time-this-age:5.8427
SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock: Age 35 of 82, time-this-age:5.8876
SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock: Age 36 of 82, time-this-age:5.866
SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock: Age 37 of 82, time-this-age:5.8107
SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock: Age 38 of 82, time-this-age:6.3797
SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock: Age 39 of 82, time-this-age:5.8577
SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock: Age 40 of 82, time-this-age:5.8751
SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock: Age 41 of 82, time-this-age:7.5158
SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock: Age 42 of 82, time-this-age:5.8538
SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock: Age 43 of 82, time-this-age:5.8376
SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock: Age 44 of 82, time-this-age:5.8281
SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock: Age 45 of 82, time-this-age:5.8513
```

```
SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock: Age 46 of 82, time-this-age:5.7947
SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock: Age 47 of 82, time-this-age:5.8408
SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock: Age 48 of 82, time-this-age:6.7877
SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock: Age 49 of 82, time-this-age:5.5985
SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock: Age 50 of 82, time-this-age:5.5925
SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock: Age 51 of 82, time-this-age:5.634
SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock: Age 52 of 82, time-this-age:5.6392
SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock: Age 53 of 82, time-this-age:5.6292
SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock: Age 54 of 82, time-this-age:5.7258
SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock: Age 55 of 82, time-this-age:5.6309
SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock: Age 56 of 82, time-this-age:5.6201
SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock: Age 57 of 82, time-this-age:5.664
SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock: Age 58 of 82, time-this-age:5.6269
SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock: Age 59 of 82, time-this-age:5.6471
SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock: Age 60 of 82, time-this-age:5.6017
SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock: Age 61 of 82, time-this-age:5.6667
SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock: Age 62 of 82, time-this-age:5.6161
SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock: Age 63 of 82, time-this-age:5.6465
SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock: Age 64 of 82, time-this-age:5.7106
SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock: Age 65 of 82, time-this-age:5.6156
SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock: Age 66 of 82, time-this-age:5.5758
SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock: Age 67 of 82, time-this-age:5.6609
SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock: Age 68 of 82, time-this-age:5.6021
SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock: Age 69 of 82, time-this-age:5.6702
SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock: Age 70 of 82, time-this-age:5.6106
SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock: Age 71 of 82, time-this-age:5.6488
SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock: Age 72 of 82, time-this-age:5.6466
SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock: Age 73 of 82, time-this-age:5.6387
SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock: Age 74 of 82, time-this-age:5.6332
SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock: Age 75 of 82, time-this-age:5.6365
SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock: Age 76 of 82, time-this-age:5.6274
SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock: Age 77 of 82, time-this-age:5.6614
SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock: Age 78 of 82, time-this-age:5.6463
SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock: Age 79 of 82, time-this-age:5.6609
SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock: Age 80 of 82, time-this-age:5.6158
SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock: Age 81 of 82, time-this-age:5.6678
SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock: Age 82 of 82, time-this-age:5.6513
SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock: Age 83 of 82, time-this-age:6.9657
Completed SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock;SNW_MP_PARAM=default_docdense;SNW_MP_CONTROL=d
----------------------------------------
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
CONTAINER NAME: mp_outcomes ND Array (Matrix etc)
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
                i    idx    ndim     numel      rowN      colN          sum         mean       std
                -    ---    ----    --------    ----    ---------    -----------    -------    -----

    V_VFI       1     1      6      4.37e+07     83     5.265e+05    -1.7805e+08    -4.0743    27.11
    ap_VFI      2     2      6      4.37e+07     83     5.265e+05     1.3789e+09     31.553    36.67
    cons_VFI    3     3      6      4.37e+07     83     5.265e+05     2.1097e+08     4.8277    8.328

xxx TABLE:V_VFI xxxxxxxxxxxxxxxxxx
             c1         c2         c3         c4         c5       c526496    c526497    c526498    c
           -------    -------    -------    -------    -------    -------    -------    -------    -

    r1     -372.97    -371.47    -362.94    -349.52    -336.96     21.573     21.728     21.882
    r2     -360.84    -359.34    -350.81    -337.39    -324.98     21.595     21.745     21.894
    r3     -348.91    -347.41    -338.88    -325.46    -313.34     21.617     21.762     21.906
    r4     -336.09     -334.7    -326.73    -314.01    -302.44     21.633     21.772     21.913
```

```
    r5     -324.48    -323.18    -315.72    -303.62    -292.54     21.634      21.77     21.907
    r79    -9.9437    -9.9325    -9.8557    -9.6597    -9.3232     2.5374     2.5482     2.5584
    r80    -8.9023    -8.8911    -8.8143    -8.6183    -8.2818     2.3024     2.3107     2.3185
    r81    -7.6363    -7.6251    -7.5484    -7.3524    -7.0159     2.0057     2.0114     2.0168
    r82    -5.9673    -5.9561    -5.8793    -5.6833    -5.3468     1.5952     1.5984     1.6014
    r83    -3.5892     -3.578    -3.5012    -3.3052    -2.9687    0.97886    0.97987    0.98082    0

xxx TABLE:ap_VFI xxxxxxxxxxxxxxxxxx
           c1     c2     c3     c4        c5         c526496    c526497    c526498    c526499    c526500
           --     --     --     --    ---------      -------    -------    -------    -------    -------

    r1     0      0      0      0     0.0092181      110.06     115.71     121.55     127.62     133.93
    r2     0      0      0      0      0.008238      110.03     115.68     121.54     127.62     133.95
    r3     0      0      0      0     0.0066341      109.99     115.65     121.53     127.63     133.97
    r4     0      0      0      0     0.0058019      110.28     115.95     121.84     127.96     134.33
    r5     0      0      0      0      0.004998      110.58     116.27     122.17     128.31     134.69
    r79    0      0      0      0             0      81.091     85.229     89.297     93.341     97.382
    r80    0      0      0      0             0      75.865     79.539      83.28     87.016     90.669
    r81    0      0      0      0             0      67.781     70.521     73.462     76.819     81.091
    r82    0      0      0      0             0      50.126     53.467     56.108     57.742     60.587
    r83    0      0      0      0             0           0          0          0          0          0

xxx TABLE:cons_VFI xxxxxxxxxxxxxxxxxx
              c1          c2          c3          c4          c5        c526496    c526497    c526498
           --------    --------    --------    --------    --------     -------    -------    -------

    r1     0.018623    0.019158    0.022901    0.033062     0.04363     9.4708     9.6491      9.817
    r2     0.018623    0.019158    0.022901    0.033062     0.04461     9.6414     9.8118     9.9685
    r3     0.018623    0.019158    0.022901    0.033062    0.046214     9.8179     9.9779      10.12
    r4     0.019354    0.019888    0.023632    0.033792    0.047776     9.9825     10.131     10.258
    r5     0.020066    0.020601    0.024344    0.034504     0.04929     10.135     10.272     10.384
    r79      0.2179     0.21844     0.22216     0.23228     0.25197      34.82     36.506     38.455
    r80      0.2179     0.21844     0.22216     0.23228     0.25197     40.033     42.183     44.459
    r81      0.2179     0.21844     0.22216     0.23228     0.25197     48.106      51.19     54.266
    r82      0.2179     0.21844     0.22216     0.23228     0.25197     65.751     68.234     71.611
    r83      0.2179     0.21844     0.22216     0.23228     0.25197     115.87     121.69     127.71
```

Difference Between Value and Choices In Unemployment and Future Periods

```
V_VFI_unemp_drop = V_VFI_ss - V_VFI_unemp;
ap_VFI_unemp_drop = ap_VFI_ss - ap_VFI_unemp;
cons_VFI_unemp_drop = cons_VFI_ss - cons_VFI_unemp;
```

5.1.2 Define Parameter Frames

Define the matrix dimensions names and dimension vector values. Policy and Value Functions share the same ND dimensional structure.

```
% Grids:
age_grid = 18:100;
agrid = mp_params('agrid')';
eta_H_grid = mp_params('eta_H_grid')';
eta_S_grid = mp_params('eta_S_grid')';
ar_st_eta_HS_grid = string(cellstr([num2str(eta_H_grid', 'hz=%3.2f;'), num2str(eta_S_grid', 'wz=%3.2
edu_grid = [0,1];
marry_grid = [0,1];
kids_grid = (1:1:mp_params('n_kidsgrid'))';
% NaN(n_jgrid,n_agrid,n_etagrid,n_educgrid,n_marriedgrid,n_kidsgrid);
cl_mp_datasetdesc = {};
cl_mp_datasetdesc{1} = containers.Map({'name', 'labval'}, {'age', age_grid});
```

```
cl_mp_datasetdesc{2} = containers.Map({'name', 'labval'}, {'savings', agrid});
cl_mp_datasetdesc{3} = containers.Map({'name', 'labval'}, {'eta', 1:length(eta_H_grid)});
cl_mp_datasetdesc{4} = containers.Map({'name', 'labval'}, {'edu', edu_grid});
cl_mp_datasetdesc{5} = containers.Map({'name', 'labval'}, {'marry', marry_grid});
cl_mp_datasetdesc{6} = containers.Map({'name', 'labval'}, {'kids', kids_grid});
```

5.1.3 Analyze Savings and Shocks

First, analyze Savings Levels and Shocks, Aggregate Over All Others, and do various other calculations.

```
% Generate some Data
mp_support_graph = containers.Map('KeyType', 'char', 'ValueType', 'any');
mp_support_graph('cl_st_xtitle') = {'Savings States, a'};
mp_support_graph('st_legend_loc') = 'eastoutside';
mp_support_graph('bl_graph_logy') = true; % do not log
mp_support_graph('it_legend_select') = 15; % how many shock legends to show
mp_support_graph('cl_colors') = 'jet';
```

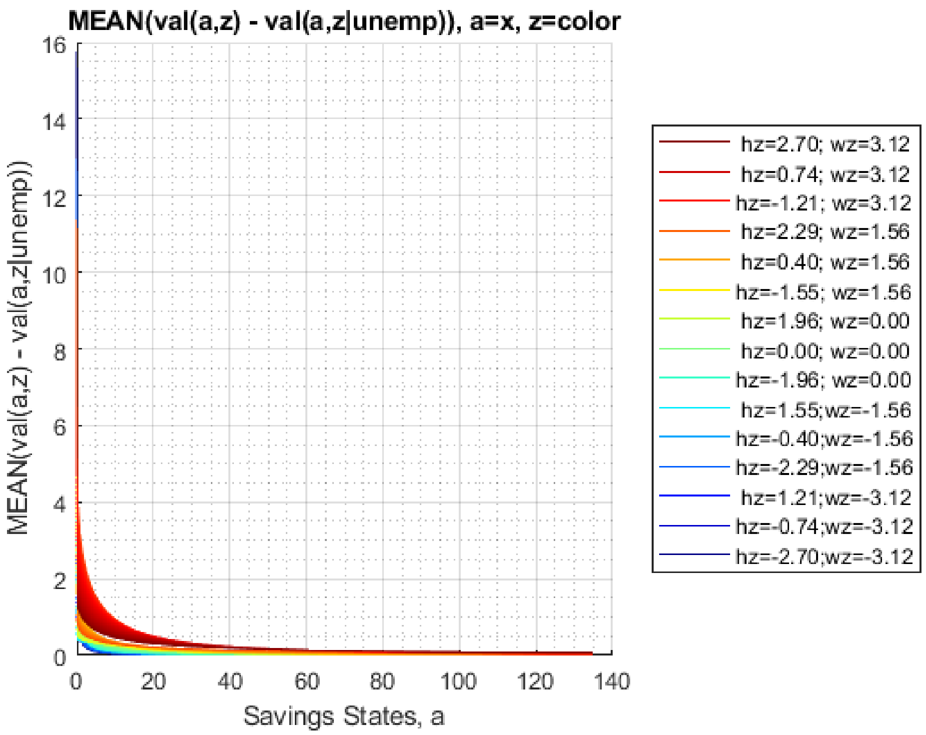
MEAN(VAL(A,Z) - VAL(A,Z|unemp)), MEAN(AP(A,Z) - AP(A,Z|unemp)), MEAN(C(A,Z) - C(A,Z|unemp))

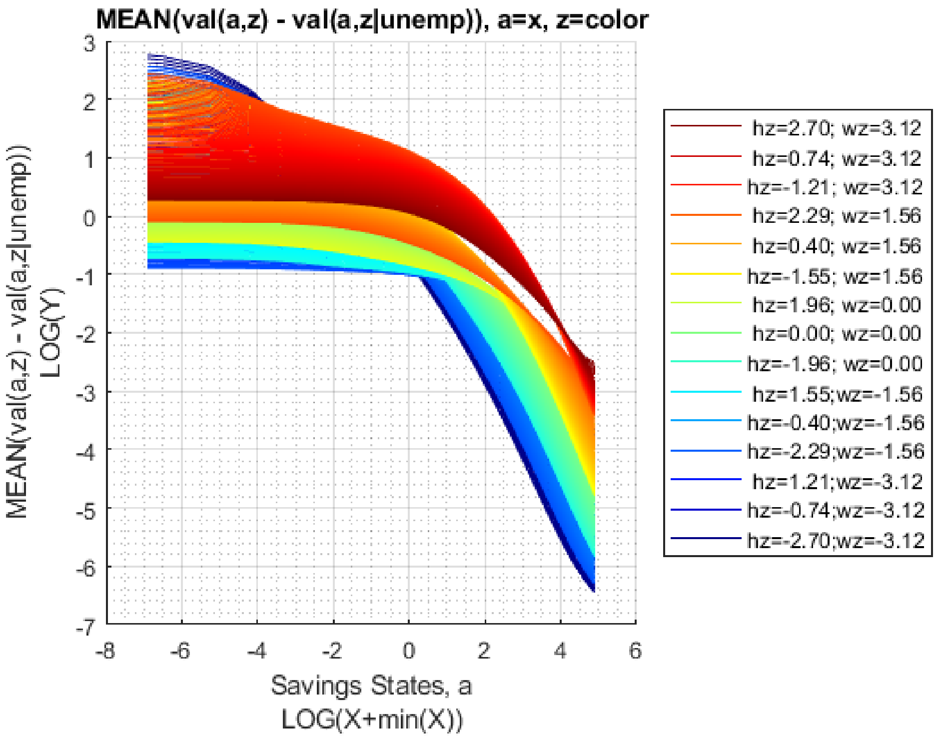
Tabulate value and policies along savings and shocks:

```
% Set
% NaN(n_jgrid,n_agrid,n_etagrid,n_educgrid,n_marriedgrid,n_kidsgrid);
ar_permute = [1,4,5,6,3,2];
% Value Function
tb_az_v = ff_summ_nd_array("MEAN(v(A,Z) - v(A,Z|unemp))", V_VFI_unemp_drop, true, ["mean"], 4, 1, cl

xxx  MEAN(v(A,Z) - v(A,Z|unemp))  xxxxxxxxxxxxxxxxxxxxxxxxxxx
    group     savings      mean_eta_1    mean_eta_2    mean_eta_3    mean_eta_4    mean_eta_5    mea
    -----    ----------    ----------    ----------    ----------    ----------    ----------    ---

      1              0       15.753        14.805        13.912        13.072        12.281
```

1	0	0.019317	0.020449	0.021654	0.022935	0.024299

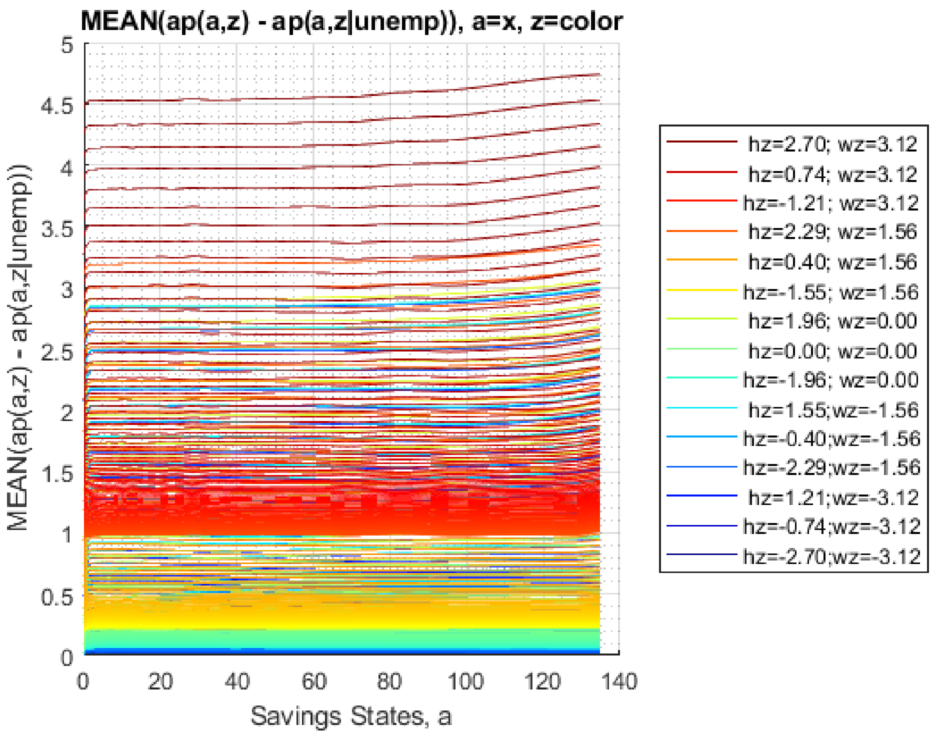
```
mp_support_graph('cl_st_graph_title') = {'MEAN(val(a,z) - val(a,z|unemp)), a=x, z=color'};
mp_support_graph('cl_st_ytitle') = {'MEAN(val(a,z) - val(a,z|unemp))'};
ff_graph_grid((tb_az_v{1:end, 3:end})', ar_st_eta_HS_grid, agrid, mp_support_graph);
```

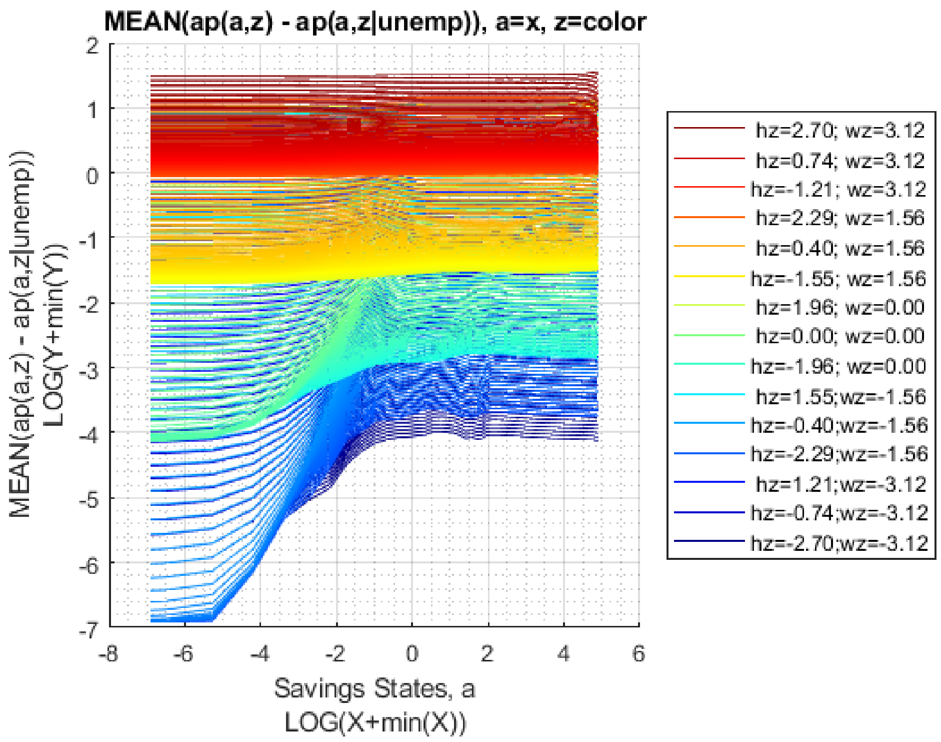




Graph Mean Savings Choices Change:

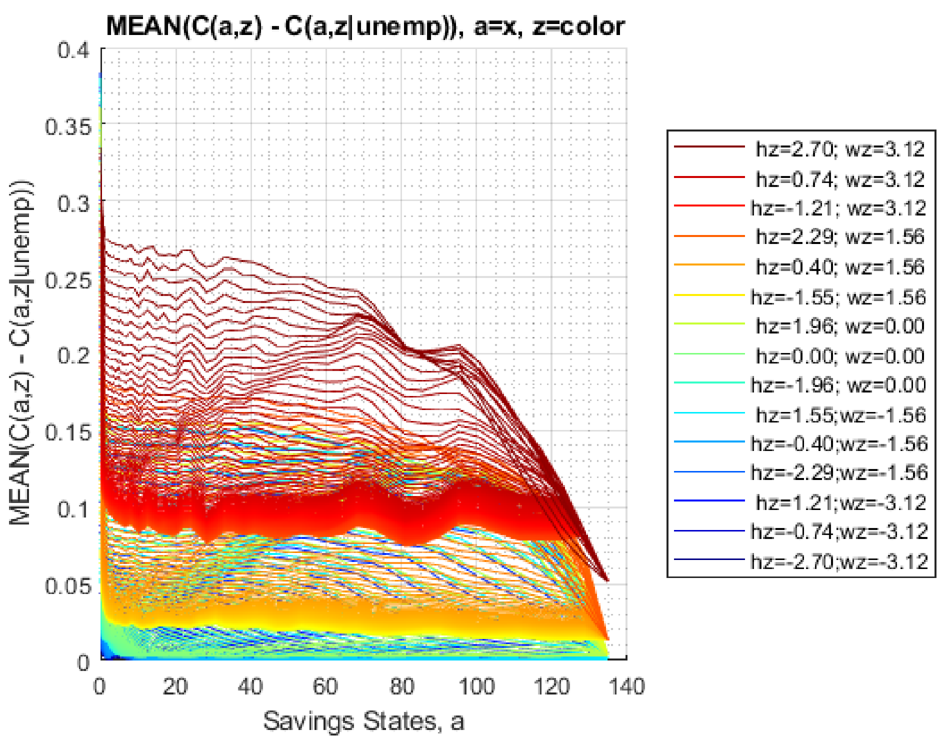
```
mp_support_graph('cl_st_graph_title') = {'MEAN(ap(a,z) - ap(a,z|unemp)), a=x, z=color'};
mp_support_graph('cl_st_ytitle') = {'MEAN(ap(a,z) - ap(a,z|unemp))'};
ff_graph_grid((tb_az_ap{1:end, 3:end})', ar_st_eta_HS_grid, agrid, mp_support_graph);
```

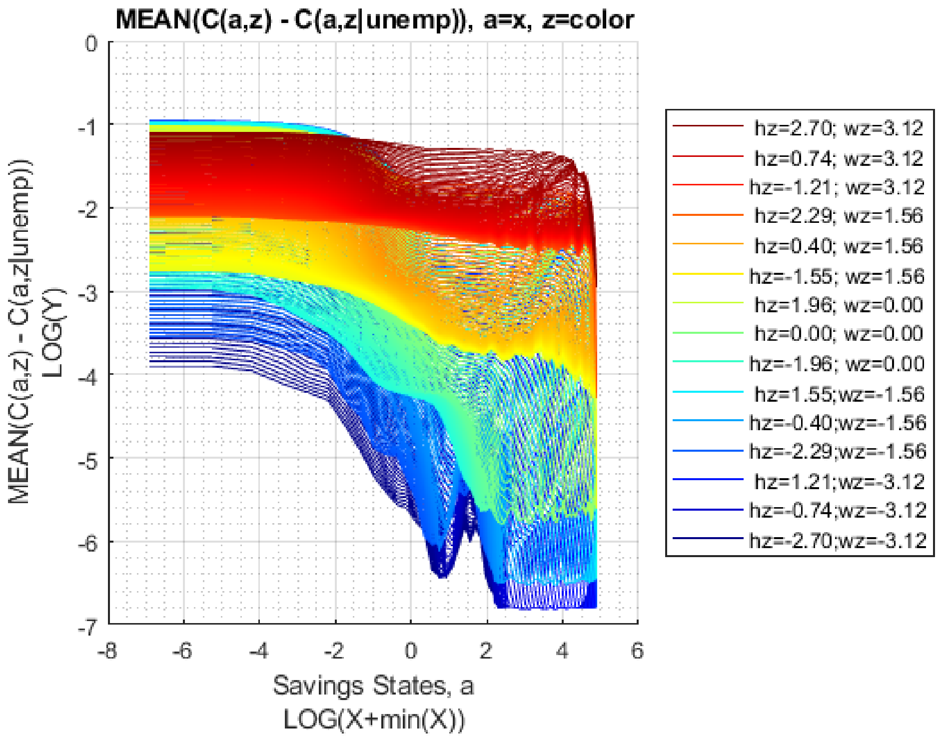




Graph Mean Consumption Change:

```
mp_support_graph('cl_st_graph_title') = {'MEAN(C(a,z) - C(a,z|unemp)), a=x, z=color'};
mp_support_graph('cl_st_ytitle') = {'MEAN(C(a,z) - C(a,z|unemp))'};
ff_graph_grid((tb_az_c{1:end, 3:end})', ar_st_eta_HS_grid, agrid, mp_support_graph);
```





5.1.4 Analyze Kids and Marriage and Age

Aggregating over education, savings, and shocks, what are the differential effects of Marriage and Age.

```
% Generate some Data
mp_support_graph = containers.Map('KeyType', 'char', 'ValueType', 'any');
ar_row_grid = [...
    "k0M0", "K1M0", "K2M0", "K3M0", "K4M0", ...
    "k0M1", "K1M1", "K2M1", "K3M1", "K4M1"];
mp_support_graph('cl_st_xtitle') = {'Age'};
mp_support_graph('st_legend_loc') = 'best';
mp_support_graph('bl_graph_logy') = true; % do not log
mp_support_graph('st_rounding') = '6.2f'; % format shock legend
mp_support_graph('cl_scatter_shapes') = {...
    'o', 'd' ,'s', 'x', '*', ...
    'o', 'd', 's', 'x', '*'};
mp_support_graph('cl_colors') = {...
    'red', 'red', 'red', 'red', 'red'...
    'blue', 'blue', 'blue', 'blue', 'blue'};
```

MEAN(V(KM,J) - V(KM,J | unemp)), MEAN(ap(KM,J) - ap(KM,J | unemp)), MEAN(c(KM,J) - c(KM,J | unemp))

Tabulate value and policies:

```
% Set
% NaN(n_jgrid,n_agrid,n_etagrid,n_educgrid,n_marriedgrid,n_kidsgrid);
ar_permute = [2,3,4,1,6,5];
% Value Function
tb_az_v = ff_summ_nd_array("MEAN(V(KM,J) - V(KM,J | unemp))", V_VFI_unemp_drop, true, ["mean"], 3, 1

xxx  MEAN(V(KM,J) - V(KM,J | unemp))  xxxxxxxxxxxxxxxxxxxxxxxxxxxx
    group    kids    marry    mean_age_18    mean_age_19    mean_age_20    mean_age_21    mean_age_2
    _____    ____    _____    ___________    ___________    ___________    ___________    __________

      1        1       0        0.61637        0.59885        0.58106        0.56498        0.55117
```

```
     2       2       0       0.82734       0.80489       0.78136       0.75704       0.73572
     3       3       0       0.96755       0.94502       0.92045       0.89136       0.86587
     4       4       0        1.0948        1.0713         1.045        1.0118        0.9827
     5       5       0        1.2011        1.1779         1.151        1.1149        1.0833
     6       1       1       0.76784       0.74924       0.73091       0.71544       0.70238
     7       2       1       0.93021       0.90698       0.88323       0.86203       0.84347
     8       3       1        1.0185        0.9941       0.96877       0.94495       0.92408
     9       4       1        1.1171        1.0915        1.0645        1.0382        1.0151
    10       5       1        1.1585        1.1346        1.1083        1.0807        1.0569
```

```
% Aprime Choice
tb_az_ap = ff_summ_nd_array("MEAN(ap(KM,J) - ap(KM,J | unemp))", ap_VFI_unemp_drop, true, ["mean"],
```

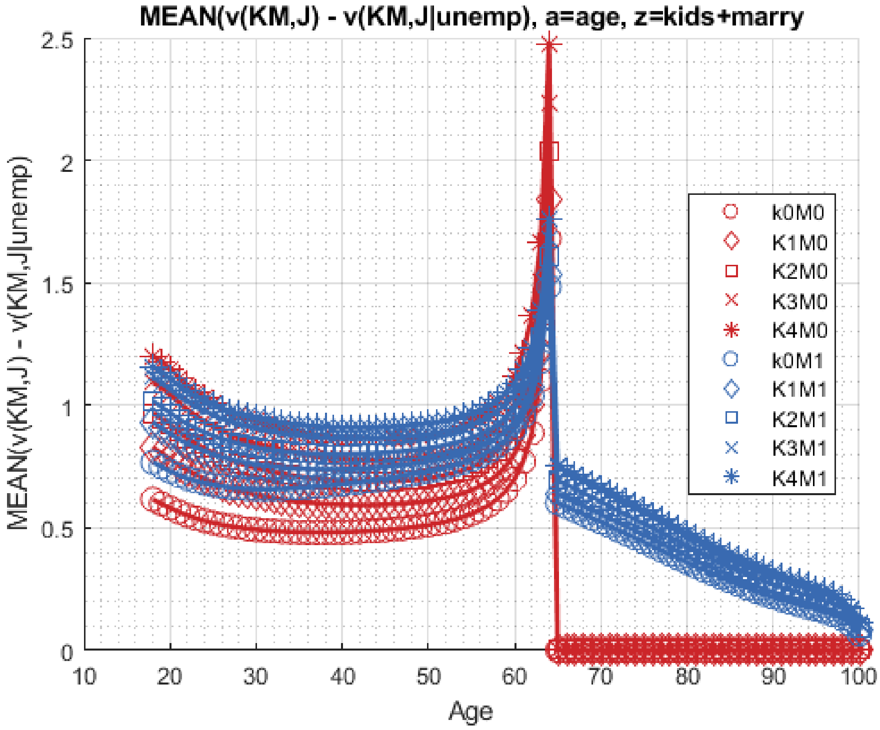
```
xxx  MEAN(ap(KM,J) - ap(KM,J | unemp))  xxxxxxxxxxxxxxxxxxxxxxxxxx
    group    kids    marry    mean_age_18    mean_age_19    mean_age_20    mean_age_21    mean_age_2
    _____    ____    _____    ___________    ___________    ___________    ___________    __________

      1       1        0        0.54429        0.54157        0.53838        0.57688        0.61527
      2       2        0        0.53828        0.53451        0.53011        0.56791        0.60562
      3       3        0        0.53173        0.52734        0.52253        0.55991        0.59734
      4       4        0         0.5276          0.523        0.51797        0.55513        0.59235
      5       5        0        0.52354        0.51894        0.51381        0.55085        0.58805
      6       1        1         1.1323         1.1757         1.2198         1.3119         1.4048
      7       2        1         1.0396         1.0753         1.1115         1.1942         1.2777
      8       3        1        0.97097          1.002         1.0331         1.1097          1.187
      9       4        1        0.89591        0.92257        0.94909         1.0212         1.0937
     10       5        1        0.78017        0.79798        0.81575        0.87811        0.94079
```

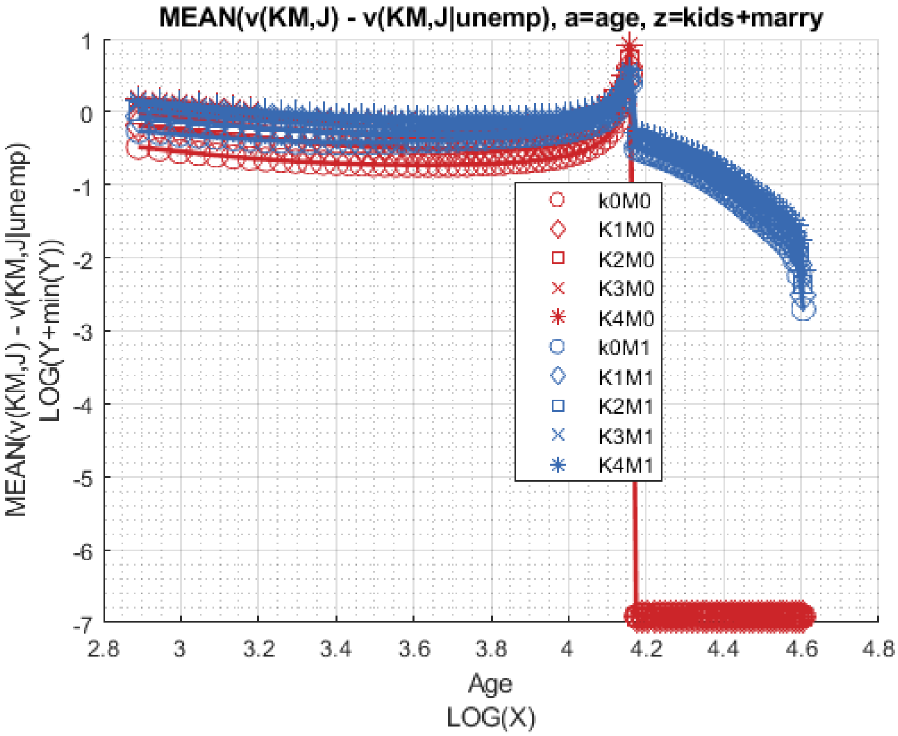
```
% Consumption Choices
tb_az_c = ff_summ_nd_array("MEAN(c(KM,J) - c(KM,J | unemp))", cons_VFI_unemp_drop, true, ["mean"], 3
```

```
xxx  MEAN(c(KM,J) - c(KM,J | unemp))  xxxxxxxxxxxxxxxxxxxxxxxxxx
    group    kids    marry    mean_age_18    mean_age_19    mean_age_20    mean_age_21    mean_age_2
    _____    ____    _____    ___________    ___________    ___________    ___________    __________

      1       1        0       0.050084       0.052801       0.055995       0.056344       0.056497
      2       2        0       0.056094       0.059866       0.064267       0.065317        0.06615
      3       3        0       0.062643       0.067034       0.071841       0.073312       0.074434
      4       4        0        0.06677       0.071371       0.076406       0.078097       0.079421
      5       5        0        0.07083       0.075431       0.080561       0.082377       0.083719
      6       1        1       0.091654        0.09722         0.1029        0.10693        0.11041
      7       2        1       0.087426       0.093165       0.099035        0.10362        0.10765
      8       3        1       0.089332       0.094467        0.10022        0.10478        0.10884
      9       4        1       0.095488       0.099656        0.10451        0.10733        0.10981
     10       5        1         0.1018        0.10631        0.11124        0.11381        0.11605
```

Graph Mean Values Change:

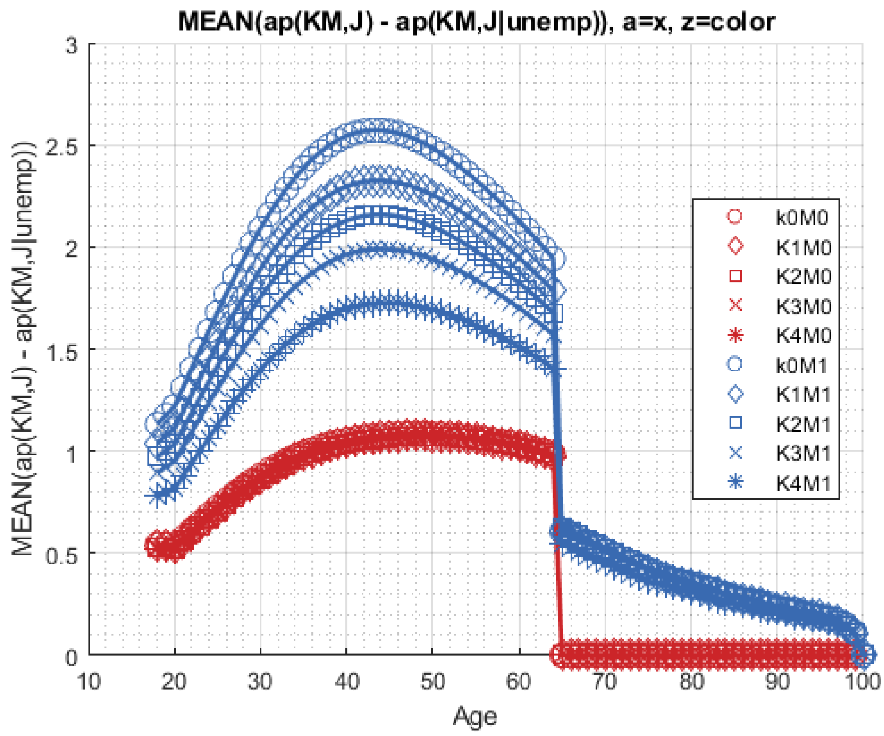
```
mp_support_graph('cl_st_graph_title') = {'MEAN(v(KM,J) - v(KM,J|unemp), a=age, z=kids+marry'};
mp_support_graph('cl_st_ytitle') = {'MEAN(v(KM,J) - v(KM,J|unemp)'};
ff_graph_grid((tb_az_v{1:end, 4:end}), ar_row_grid, age_grid, mp_support_graph);
```

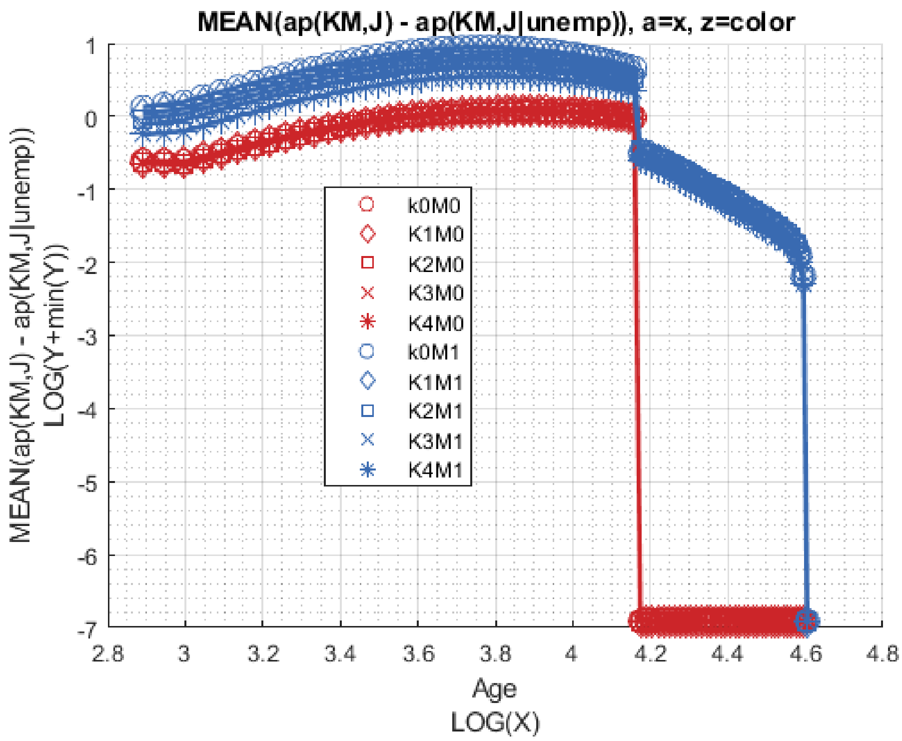




Graph Mean Savings Choices Change:

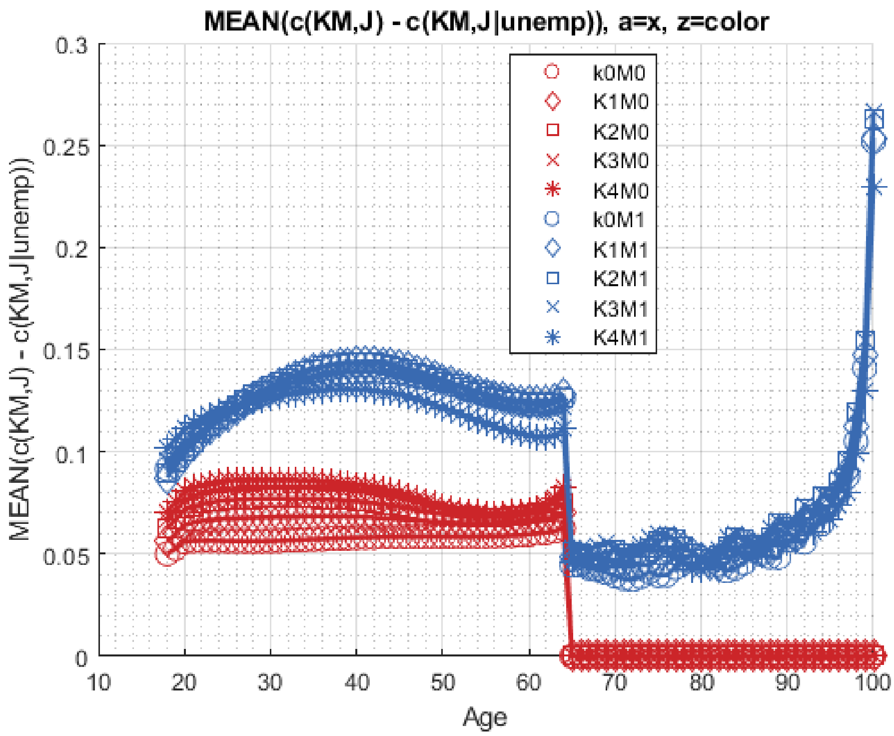
```
mp_support_graph('cl_st_graph_title') = {'MEAN(ap(KM,J) - ap(KM,J|unemp)), a=x, z=color'};
mp_support_graph('cl_st_ytitle') = {'MEAN(ap(KM,J) - ap(KM,J|unemp))'};
ff_graph_grid((tb_az_ap{1:end, 4:end}), ar_row_grid, age_grid, mp_support_graph);
```

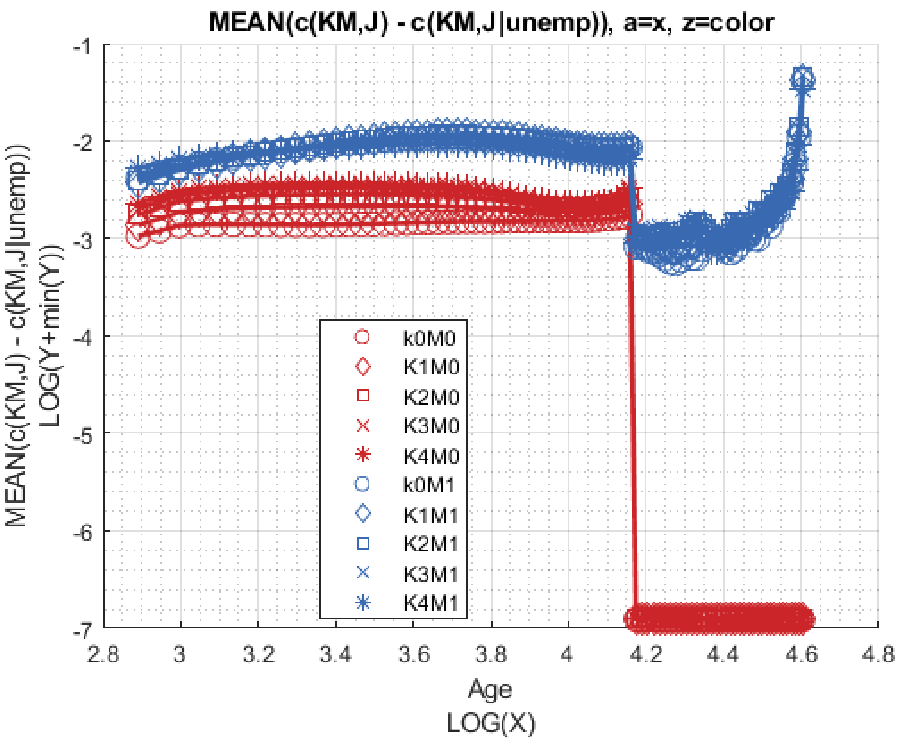




Graph Mean Consumption Change:

```
mp_support_graph('cl_st_graph_title') = {'MEAN(c(KM,J) - c(KM,J|unemp)), a=x, z=color'};
mp_support_graph('cl_st_ytitle') = {'MEAN(c(KM,J) - c(KM,J|unemp))'};
ff_graph_grid((tb_az_c{1:end, 4:end}), ar_row_grid, age_grid, mp_support_graph);
```





5.1.5 Analyze Education and Marriage and Age

Aggregating over education, savings, and shocks, what are the differential effects of Marriage and Age.

```
% Generate some Data
mp_support_graph = containers.Map('KeyType', 'char', 'ValueType', 'any');
ar_row_grid = ["E0M0", "E1M0", "E0M1", "E1M1"];
mp_support_graph('cl_st_xtitle') = {'Age'};
mp_support_graph('st_legend_loc') = 'best';
mp_support_graph('bl_graph_logy') = true; % do not log
```

```
mp_support_graph('st_rounding') = '6.2f'; % format shock legend
mp_support_graph('cl_scatter_shapes') = {'*', 'p', '*','p' };
mp_support_graph('cl_colors') = {'red', 'red', 'blue', 'blue'};
```

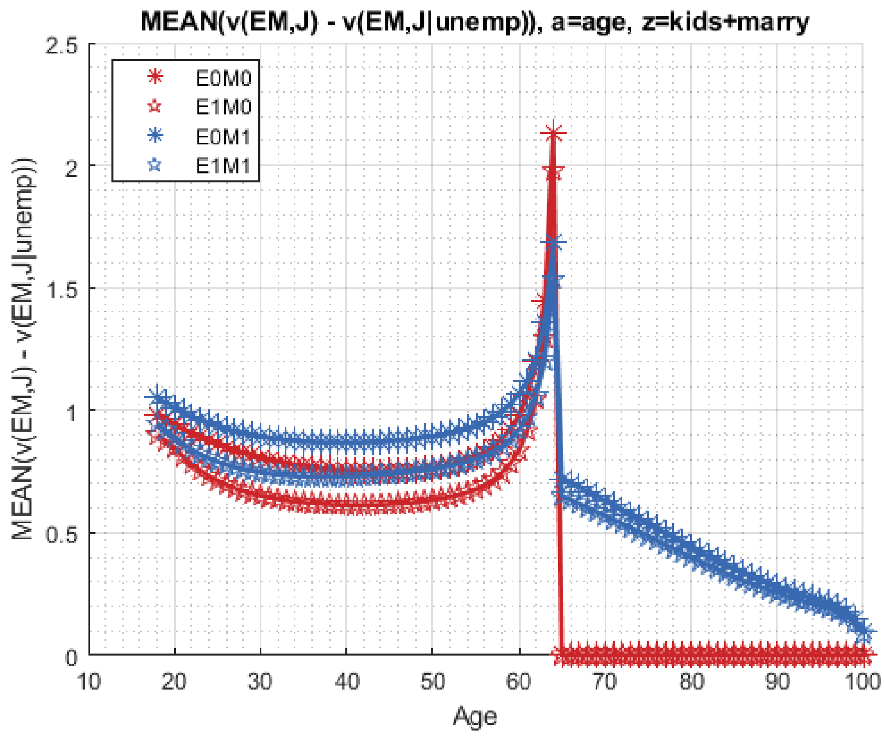
MEAN(v(EKM,J) - v(EKM,J|unemp)), MEAN(ap(EM,J) - ap(EM,J|unemp)), MEAN(c(EM,J) - c(EM,J|unemp))

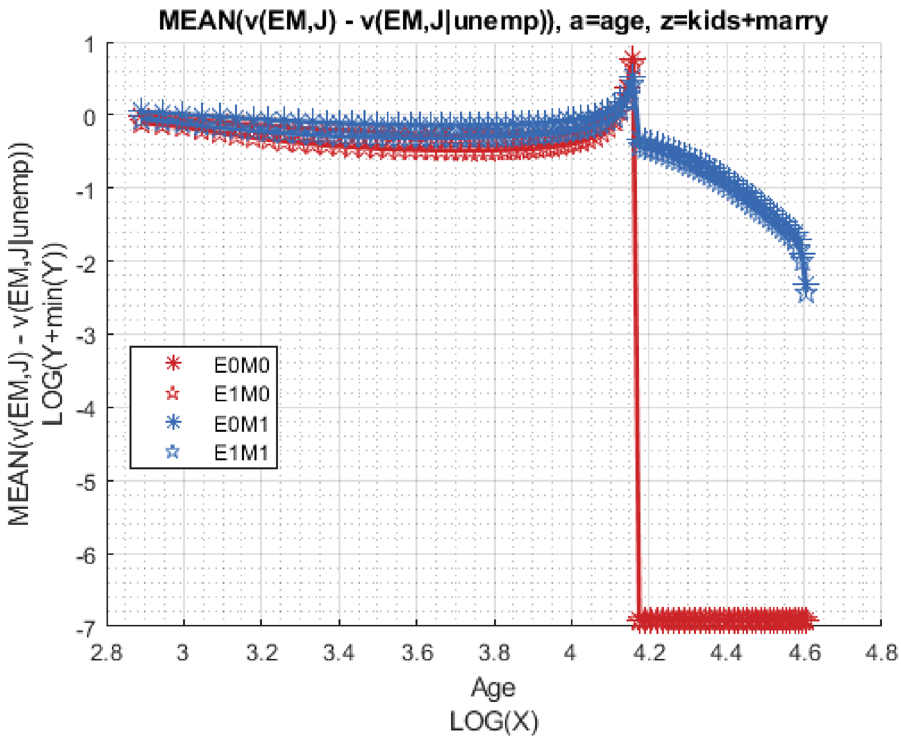
Tabulate value and policies:

```
% Set
% NaN(n_jgrid,n_agrid,n_etagrid,n_educgrid,n_marriedgrid,n_kidsgrid);
ar_permute = [2,3,6,1,4,5];
% Value Function
tb_az_v = ff_summ_nd_array("MEAN(v(EM,J) - v(EM,J|unemp))", V_VFI_unemp_drop, true, ["mean"], 3, 1,

xxx  MEAN(v(EM,J) - v(EM,J|unemp))  xxxxxxxxxxxxxxxxxxxxxxxxxxx
    group    edu    marry    mean_age_18    mean_age_19    mean_age_20    mean_age_21    mean_age_22
    -----    ---    -----    -----------    -----------    -----------    -----------    -----------

      1       0       0        0.98303        0.96405        0.94385        0.92458        0.90689
      2       1       0        0.89982        0.87513        0.84768        0.81144        0.78062
      3       0       1         1.0503         1.0306         1.0104        0.99222        0.97585
      4       1       1        0.94657        0.91993        0.89191        0.86431        0.84092

% Aprime Choice
tb_az_ap = ff_summ_nd_array("MEAN(ap(EM,J) - ap(EM,J|unemp))", ap_VFI_unemp_drop, true, ["mean"], 3,

xxx  MEAN(ap(EM,J) - ap(EM,J|unemp))  xxxxxxxxxxxxxxxxxxxxxxxxxxx
    group    edu    marry    mean_age_18    mean_age_19    mean_age_20    mean_age_21    mean_age_22
    -----    ---    -----    -----------    -----------    -----------    -----------    -----------

      1       0       0        0.54395        0.54191        0.53951        0.56214        0.58423
      2       1       0        0.52222        0.51623        0.50961        0.56213        0.61523
      3       0       1        0.93033        0.95904        0.98801         1.0446         1.1011
      4       1       1        0.99726         1.0304         1.0637         1.1614         1.2605

% Consumption Choices
tb_az_c = ff_summ_nd_array("MEAN(c(EM,J) - c(EM,J|unemp))", cons_VFI_unemp_drop, true, ["mean"], 3,

xxx  MEAN(c(EM,J) - c(EM,J|unemp))  xxxxxxxxxxxxxxxxxxxxxxxxxxx
    group    edu    marry    mean_age_18    mean_age_19    mean_age_20    mean_age_21    mean_age_22
    -----    ---    -----    -----------    -----------    -----------    -----------    -----------

      1       0       0        0.05042       0.052463       0.054861       0.055684       0.056488
      2       1       0       0.072148       0.078138       0.084767       0.086495         0.0876
      3       0       1       0.079245       0.082789       0.086633       0.089336       0.091941
      4       1       1        0.10704        0.11354        0.12053        0.12525        0.12917
```

Graph Mean Values Change:

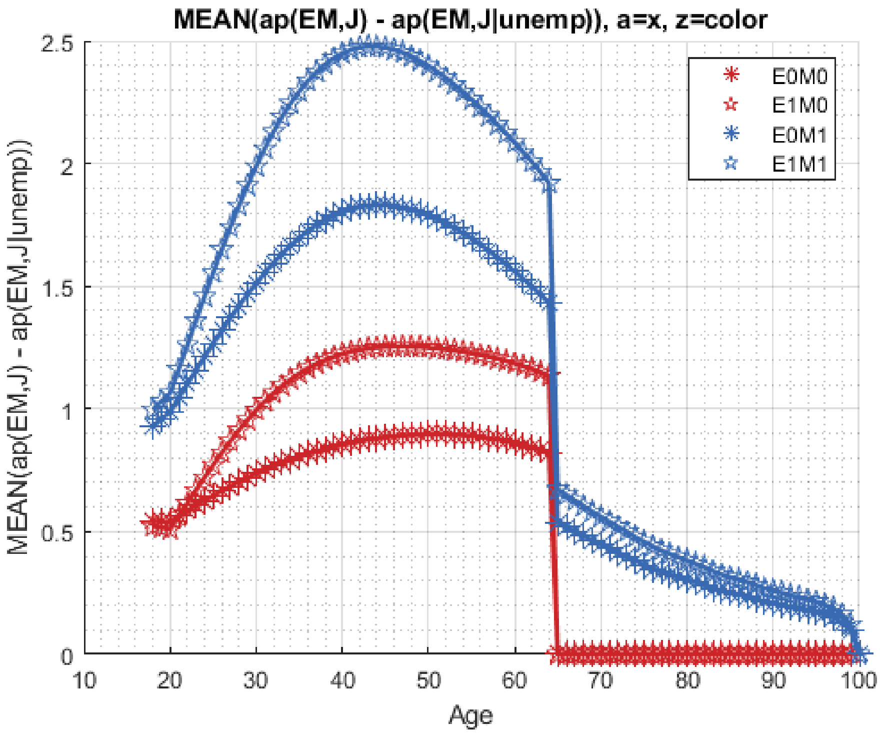
```
mp_support_graph('cl_st_graph_title') = {'MEAN(v(EM,J) - v(EM,J|unemp)), a=age, z=kids+marry'};
mp_support_graph('cl_st_ytitle') = {'MEAN(v(EM,J) - v(EM,J|unemp))'};
ff_graph_grid((tb_az_v{1:end, 4:end}), ar_row_grid, age_grid, mp_support_graph);
```

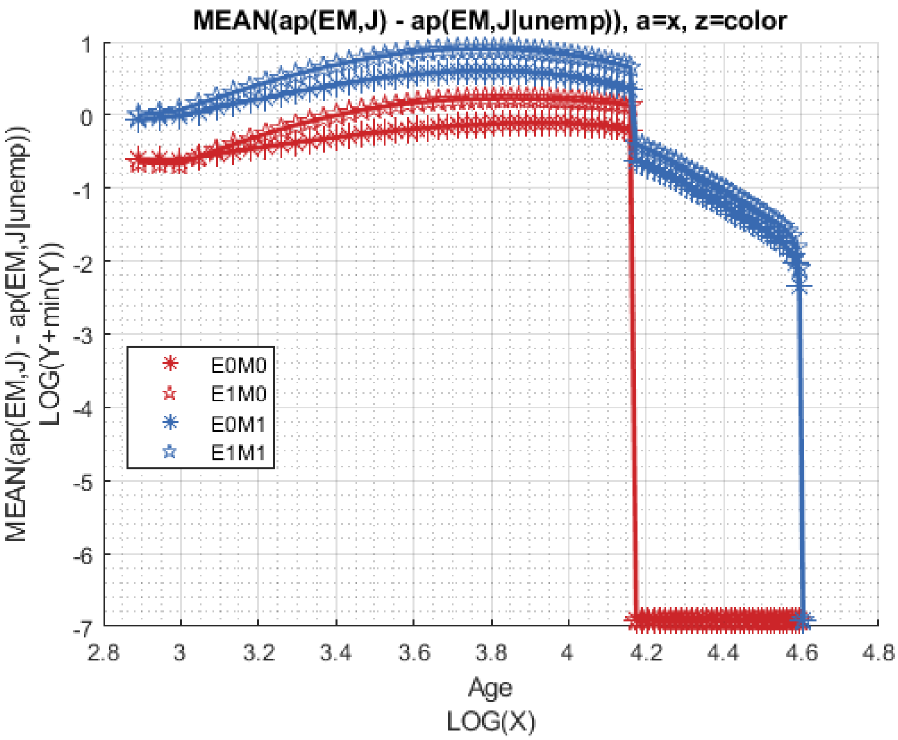




Graph Mean Savings Choices Change:

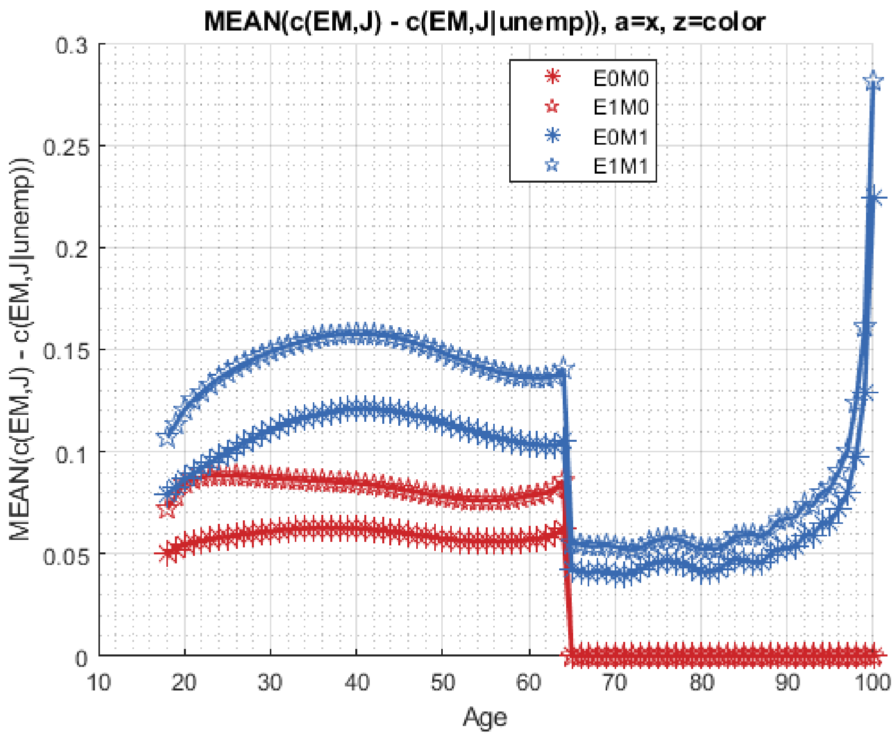
```
mp_support_graph('cl_st_graph_title') = {'MEAN(ap(EM,J) - ap(EM,J|unemp)), a=x, z=color'};
mp_support_graph('cl_st_ytitle') = {'MEAN(ap(EM,J) - ap(EM,J|unemp))'};
ff_graph_grid((tb_az_ap{1:end, 4:end}), ar_row_grid, age_grid, mp_support_graph);
```

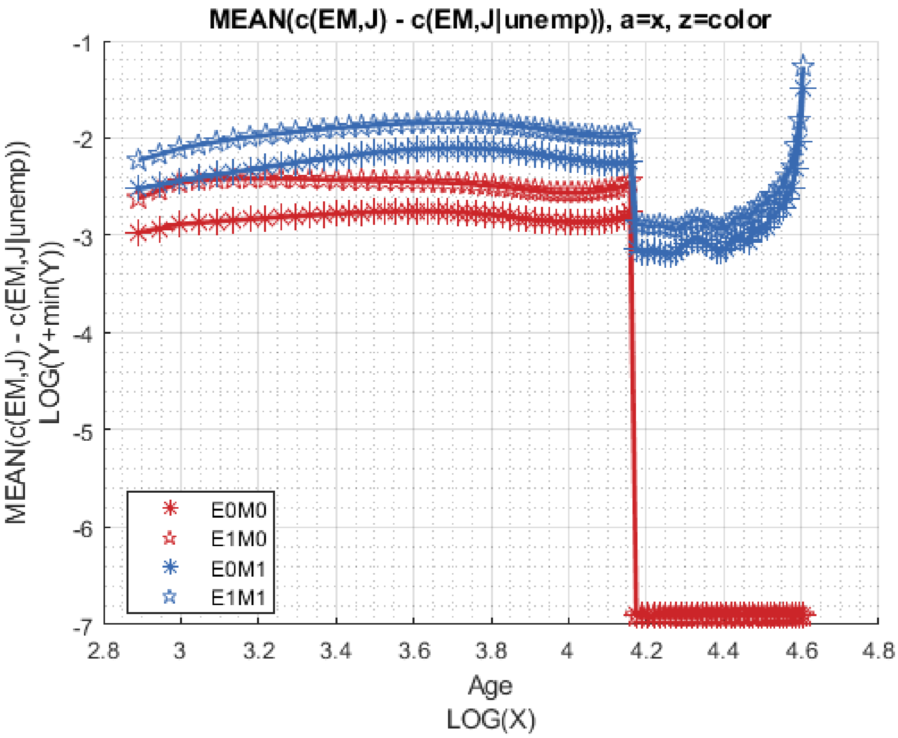




Graph Mean Consumption Change:

```
mp_support_graph('cl_st_graph_title') = {'MEAN(c(EM,J) - c(EM,J|unemp)), a=x, z=color'};
mp_support_graph('cl_st_ytitle') = {'MEAN(c(EM,J) - c(EM,J|unemp))'};
ff_graph_grid((tb_az_c{1:end, 4:end}), ar_row_grid, age_grid, mp_support_graph);
```


MEAN(c(EM,J) - c(EM,J|unemp)), a=x, z=color
MEAN(c(EM,J) - c(EM,J|unemp))
Age
E0M0
E1M0
E0M1
E1M1


MEAN(c(EM,J) - c(EM,J|unemp)), a=x, z=color
MEAN(c(EM,J) - c(EM,J|unemp))
LOG(Y+min(Y))
Age
LOG(X)
E0M0
E1M0
E0M1
E1M1

Chapter 6

Household Life Cycle Distribution

6.1 Distribution Exact Savings Choices

This is the example vignette for function: **snw_ds_main** from the **PrjOptiSNW Package.** This function solves for vfi and gets distribution induced by policy functions and exogenous distributions. Looped to get distribution, but uses bisect vec for VFI.

6.1.1 Test SNW_DS_MAIN Defaults

Call the function with testing defaults.

```
mp_params = snw_mp_param('default_docdense');
mp_controls = snw_mp_control('default_test');
mp_controls('bl_print_vfi') = false;
mp_controls('bl_print_ds') = false;
mp_controls('bl_print_ds_verbose') = false;
[Phi_true,Phi_adj,A_agg,Y_inc_agg,it,mp_dsvfi_results] = snw_ds_main(mp_params, mp_controls);
```

```
Completed SNW_VFI_MAIN_BISEC_VEC;SNW_MP_PARAM=default_docdense;SNW_MP_CONTROL=default_test;time=496.
----------------------------------------
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
CONTAINER NAME: mp_outcomes ND Array (Matrix etc)
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
                i    idx    ndim     numel      rowN      colN          sum         mean       std
                -    ---    ----    --------    ----    ---------    -----------    -------    -----

    V_VFI       1     1      6      4.37e+07     83     5.265e+05    -1.5339e+08    -3.5101    26.11
    ap_VFI      2     2      6      4.37e+07     83     5.265e+05     1.4159e+09     32.402    36.79
    cons_VFI    3     3      6      4.37e+07     83     5.265e+05     2.1402e+08     4.8975    8.329

xxx TABLE:V_VFI xxxxxxxxxxxxxxxxxx
             c1         c2         c3         c4         c5       c526496    c526497    c526498    c
           -------    -------    -------    -------    -------    -------    -------    -------    -

    r1     -346.51    -346.12    -343.63    -337.86    -328.51     21.702     21.852     22.003
    r2     -334.38    -333.99    -331.51    -325.83    -316.83     21.724     21.869     22.015
    r3     -322.45    -322.06     -319.6    -314.14     -305.6     21.745     21.885     22.027
    r4     -310.63    -310.27    -307.99    -302.88    -294.87     21.767     21.903     22.041
    r5     -299.94     -299.6    -297.46    -292.67    -285.12     21.775     21.907     22.042
    r79    -9.9437    -9.9325    -9.8557    -9.6597    -9.3232     2.5394     2.5501     2.5602
    r80    -8.9023    -8.8911    -8.8143    -8.6183    -8.2818     2.3039     2.3121     2.3198
    r81    -7.6363    -7.6251    -7.5484    -7.3524    -7.0159     2.0068     2.0124     2.0176
    r82    -5.9673    -5.9561    -5.8793    -5.6833    -5.3468     1.5958     1.5989     1.6018
```

```
    r83    -3.5892     -3.578    -3.5012    -3.3052    -2.9687    0.97904    0.98004    0.98097    0

xxx TABLE:ap_VFI xxxxxxxxxxxxxxxxxx
           c1    c2        c3           c4           c5       c526496    c526497    c526498    c5264
           --    --    ----------    ---------    --------    -------    -------    -------    -----

    r1     0     0      0.0005656    0.0075134    0.022901    114.75     120.41     126.27     132.3
    r2     0     0     0.00051498    0.0065334    0.021549    114.86     120.53     126.41     132.5
    r3     0     0     0.00051498    0.0049294    0.019875    114.97     120.65     126.56      132.
    r4     0     0     0.00051498    0.0047937    0.019672    115.73     121.42     127.34     133.5
    r5     0     0     0.00048517    0.0046683    0.019484     116.5     122.21     128.15     134.3
    r79    0     0              0            0           0    81.091      85.68     90.335     94.37
    r80    0     0              0            0           0    76.669     80.563     84.304      88.0
    r81    0     0              0            0           0    68.313     71.534     74.475     77.83
    r82    0     0              0            0           0    50.126     53.467     56.953     58.74
    r83    0     0              0            0           0         0          0          0

xxx TABLE:cons_VFI xxxxxxxxxxxxxxxxxx
              c1          c2          c3          c4          c5       c526496    c526497    c526498
           --------    --------    --------    --------    --------    -------    -------    -------

    r1     0.036717    0.037251    0.040426     0.04363    0.048012    9.6491      9.817     9.9649
    r2     0.036717    0.037251    0.040477     0.04461    0.049364    9.8118     9.9685     10.101
    r3     0.036717    0.037251    0.040477    0.046214    0.051039    9.9779      10.12     10.234
    r4     0.038144    0.038678    0.041903    0.047776    0.052666    10.131     10.258     10.354
    r5     0.039534    0.040068    0.043323     0.04929    0.054241    10.272     10.384     10.463
    r79      0.2179     0.21844     0.22216     0.23228     0.25197    35.858     37.092     38.455
    r80      0.2179     0.21844     0.22216     0.23228     0.25197    40.253     42.183     44.459
    r81      0.2179     0.21844     0.22216     0.23228     0.25197    48.587      51.19     54.266
    r82      0.2179     0.21844     0.22216     0.23228     0.25197    66.755     69.238      71.77
    r83      0.2179     0.21844     0.22216     0.23228     0.25197    116.87     122.69     128.71

Completed SNW_DS_MAIN;SNW_MP_PARAM=default_docdense;SNW_MP_CONTROL=default_test;time=1498.3692
```

```
% [Phi_true,Phi_adj] = snw_ds_main(mp_params, mp_controls);
Phi_true = Phi_true/sum(Phi_true(:));
```

6.1.2 Show All Info in mp_dsvfi_results More Dense

```
mp_cl_mt_xyz_of_s = mp_dsvfi_results('mp_cl_mt_xyz_of_s');
disp(mp_cl_mt_xyz_of_s('tb_outcomes'))
```

```
                         mean      unweighted_sum       sd        coefofvar       gini        min
                       --------    --------------    -------    ---------    --------    --------    -

    a_ss                 4.2486              2228     6.7963       1.5996     0.68054           0
    ap_ss                4.3473        5.3198e+08      6.834        1.572     0.68147           0
    cons_ss              1.0676        5.0976e+07    0.69454      0.65055      0.3385    0.036717
    v_ss                -15.745       -2.1145e+07      21.68      -1.3769    -0.67203     -586.22
    n_ss                 2.3554                21     1.4375      0.61029      0.3128           1
    y_all                 1.415        8.3532e+07     1.4926       1.0548     0.47801           0
    y_head_inc           1.1087        1.9253e+06     1.0092      0.91029     0.41889    0.038108
    y_head_earn         0.88655             19732    0.92804       1.0468     0.53121           0
    y_spouse_inc        0.35849        4.8273e+05    0.95494       2.6638     0.85255           0
    yshr_interest       0.12214        3.8429e+06    0.16806       1.3759     0.66002           0    0
    yshr_wage           0.77513        8.8876e+06    0.33759      0.43553      0.2056           0
    yshr_SS             0.10273             30336    0.23637       2.3009     0.91226           0
    yshr_tax            0.17862        2.8339e+06    0.03519      0.19701     0.11226    0.036506
```

```
    yshr_nttxss       0.075896       2.8036e+06       0.25563       3.3681        1.3974    -0.89184
```

6.1.3 More Dense Param Results Define Frames

Define the matrix dimensions names and dimension vector values. Probability mass matrixes, Policy and Value Functions share the same ND dimensional structure.

```
% Grids:
age_grid = 18:100;
agrid = mp_params('agrid')';
eta_H_grid = mp_params('eta_H_grid')';
eta_S_grid = mp_params('eta_S_grid')';
ar_st_eta_HS_grid = string(cellstr([num2str(eta_H_grid', 'hz=%3.2f;'), num2str(eta_S_grid', 'wz=%3.2
edu_grid = [0,1];
marry_grid = [0,1];
kids_grid = (1:1:mp_params('n_kidsgrid'))';
% NaN(n_jgrid,n_agrid,n_etagrid,n_educgrid,n_marriedgrid,n_kidsgrid);
cl_mp_datasetdesc = {};
cl_mp_datasetdesc{1} = containers.Map({'name', 'labval'}, {'age', age_grid});
cl_mp_datasetdesc{2} = containers.Map({'name', 'labval'}, {'savings', agrid});
cl_mp_datasetdesc{3} = containers.Map({'name', 'labval'}, {'eta', 1:length(eta_H_grid)});
cl_mp_datasetdesc{4} = containers.Map({'name', 'labval'}, {'edu', edu_grid});
cl_mp_datasetdesc{5} = containers.Map({'name', 'labval'}, {'marry', marry_grid});
cl_mp_datasetdesc{6} = containers.Map({'name', 'labval'}, {'kids', kids_grid});
```

6.1.4 Analyze Probability Mass Along Age Dimensions

Where are the mass at? Analyze mass given state space components.

```
% Get the Joint distribution over all states
% Define Graph Inputs
mp_support_graph = containers.Map('KeyType', 'char', 'ValueType', 'any');
mp_support_graph('st_legend_loc') = 'best';
mp_support_graph('bl_graph_logy') = false; % do not log
```

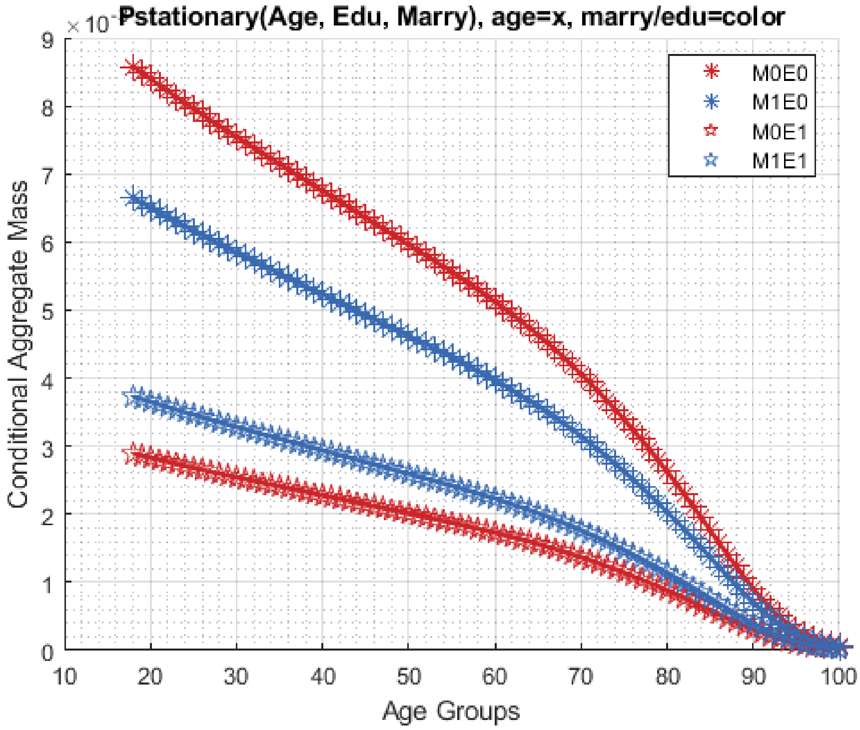
Exogenous Permanent States Mass: Life Cycle, Edu and Marraige

Tabulate value and policies along savings and shocks:

```
% NaN(n_jgrid,n_agrid,n_etagrid,n_educgrid,n_marriedgrid,n_kidsgrid);
ar_permute = [2,3,6,1,5,4];
% Value Function
tb_prob_aem = ff_summ_nd_array("P(Age, EDU, MARRY))", Phi_true, true, ["sum"], 3, 1, cl_mp_datasetde
```

```
xxx  P(Age, EDU, MARRY))  xxxxxxxxxxxxxxxxxxxxxxxxxxx
    group    marry    edu    sum_age_18    sum_age_19    sum_age_20    sum_age_21    sum_age_22    s
    -----    -----    ---    ----------    ----------    ----------    ----------    ----------    -

      1        0       0     0.0085768     0.0084866     0.0083969     0.0083078     0.0082194     0
      2        1       0     0.0066438     0.0065739     0.0065044     0.0064354     0.0063669
      3        0       1     0.0028875     0.0028571      0.002827      0.002797     0.0027672     0
      4        1       1     0.0037292     0.0036899     0.0036509     0.0036122     0.0035738     0
```

```
mp_support_graph('cl_st_graph_title') = {'Pstationary(Age, Edu, Marry), age=x, marry/edu=color'};
mp_support_graph('cl_st_ytitle') = {'Conditional Aggregate Mass'};
ar_row_grid = ["M0E0", "M1E0", "M0E1", "M1E1"];
mp_support_graph('cl_st_xtitle') = {'Age Groups'};
mp_support_graph('cl_scatter_shapes') = {'*', '*', 'p', 'p' };
mp_support_graph('cl_colors') = {'red', 'blue', 'red', 'blue'};
ff_graph_grid((tb_prob_aem{1:end, 4:end}), ar_row_grid, age_grid, mp_support_graph);
```



Kids and Marry By Age Mass

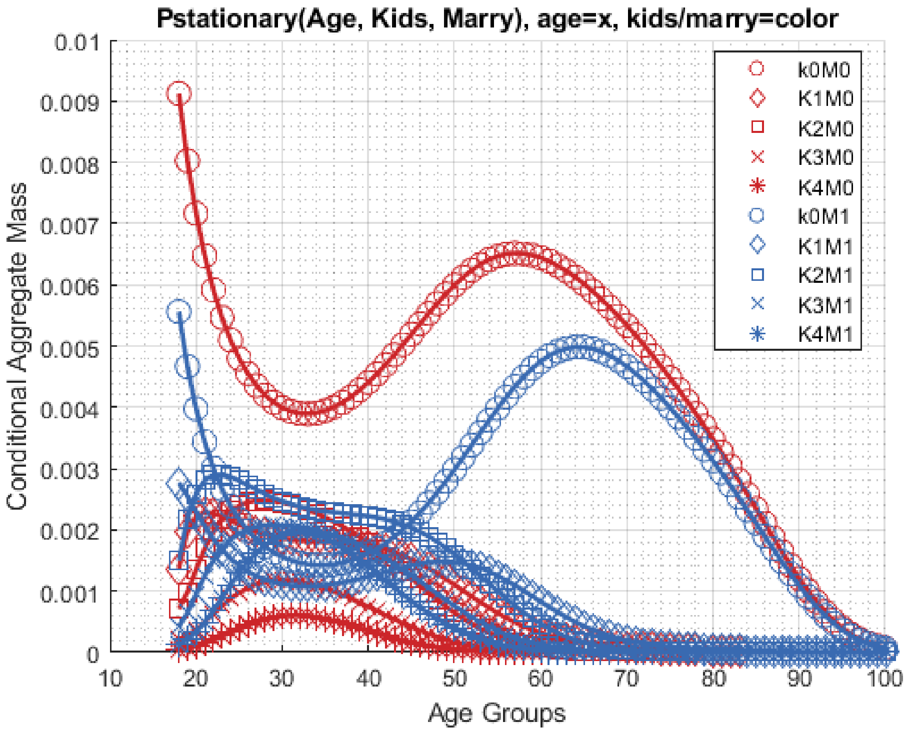
```
% NaN(n_jgrid,n_agrid,n_etagrid,n_educgrid,n_marriedgrid,n_kidsgrid);
ar_permute = [2,3,4,1,6,5];
% Value Function
tb_prob_amarrykids = ff_summ_nd_array("P(Age, Kids, Marry))", Phi_true, true, ["sum"], 3, 1, cl_mp_d
```

```
xxx  P(Age, Kids, Marry))  xxxxxxxxxxxxxxxxxxxxxxxxxxx
```

group	kids	marry	sum_age_18	sum_age_19	sum_age_20	sum_age_21	sum_age_22
1	1	0	0.0091249	0.0080278	0.0071652	0.0064765	0.0059205
2	2	0	0.0013699	0.0019743	0.0022187	0.0022858	0.0022687
3	3	0	0.00071266	0.00098425	0.0013537	0.0016929	0.0019639
4	4	0	0.00020622	0.00027865	0.00037326	0.00049476	0.00062818
5	5	0	5.0761e-05	7.8715e-05	0.000113	0.00015485	0.00020534
6	1	1	0.0055624	0.0046679	0.0039774	0.0034368	0.0030088
7	2	1	0.0027682	0.0025539	0.0023005	0.0020611	0.0018525
8	3	1	0.0014982	0.0021823	0.0025943	0.0028096	0.002896
9	4	1	0.00041197	0.00064648	0.00095224	0.0012491	0.0015009
10	5	1	0.00013221	0.0002132	0.00033097	0.00049097	0.00068255

```
mp_support_graph('cl_st_graph_title') = {'Pstationary(Age, Kids, Marry), age=x, kids/marry=color'};
mp_support_graph('cl_st_ytitle') = {'Conditional Aggregate Mass'};
ar_row_grid = [...
    "k0M0", "K1M0", "K2M0", "K3M0", "K4M0", ...
    "k0M1", "K1M1", "K2M1", "K3M1", "K4M1"];
mp_support_graph('cl_scatter_shapes') = {...
    'o', 'd' ,'s', 'x', '*', ...
    'o', 'd', 's', 'x', '*'};
mp_support_graph('cl_colors') = {...
    'red', 'red', 'red', 'red', 'red'...
    'blue', 'blue', 'blue', 'blue', 'blue'};
mp_support_graph('cl_st_xtitle') = {'Age Groups'};
```

```
ff_graph_grid((tb_prob_amarrykids{1:end, 4:end}), ar_row_grid, age_grid, mp_support_graph);
```



6.1.5 Analyze Probability Mass Asset and Shock Dimensions

Where are the mass at?

```
% Define Graph Inputs
mp_support_graph = containers.Map('KeyType', 'char', 'ValueType', 'any');
mp_support_graph('st_legend_loc') = 'best';
mp_support_graph('bl_graph_logy') = false; % do not log
```

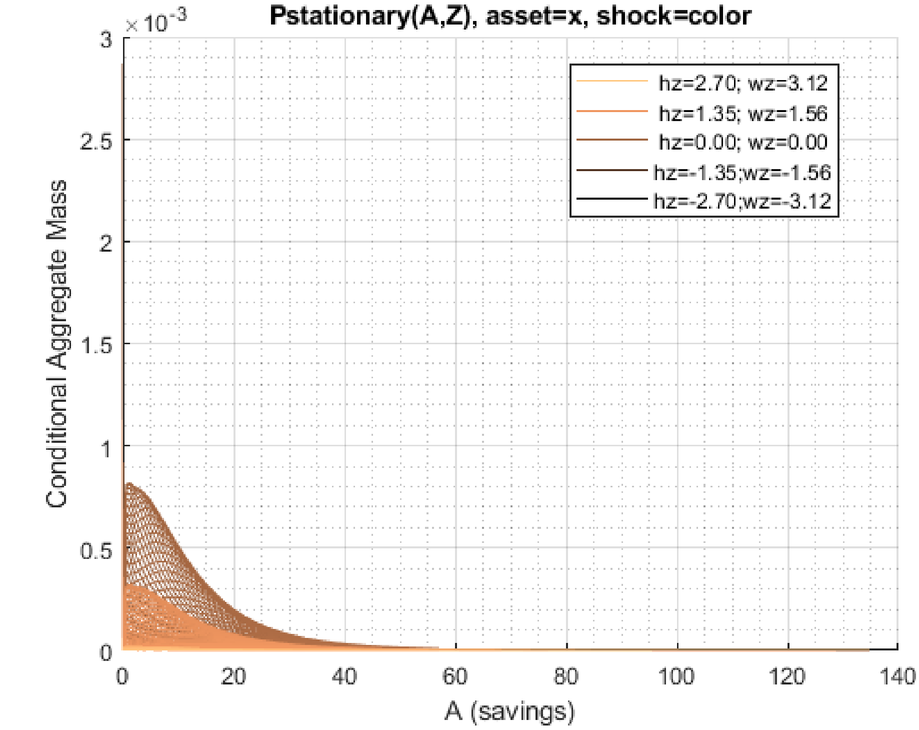
Asset and Shock Mass

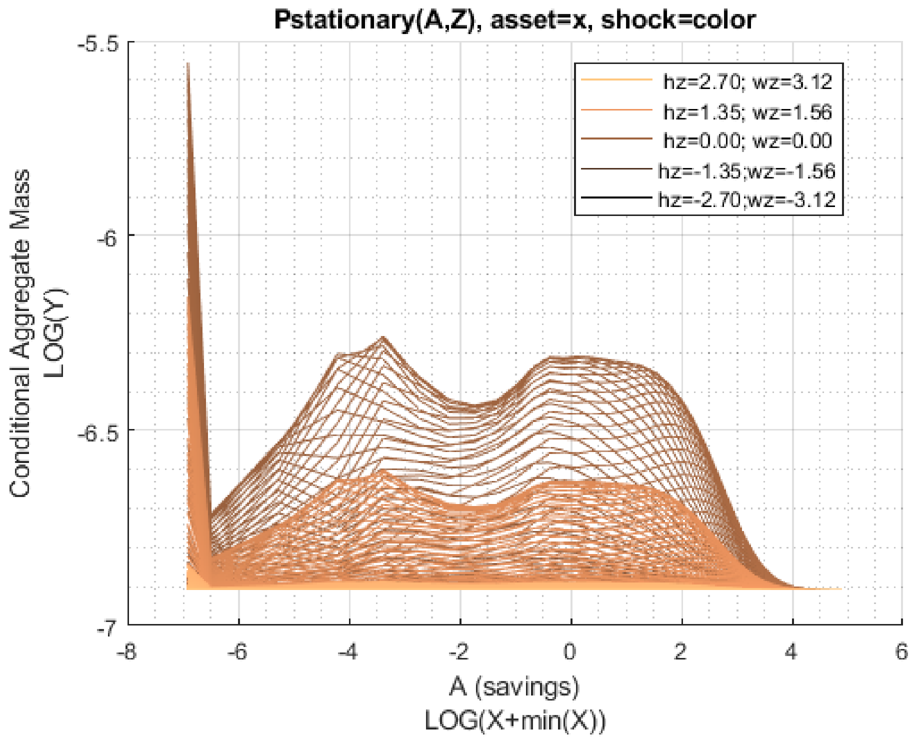
```
% NaN(n_jgrid,n_agrid,n_etagrid,n_educgrid,n_marriedgrid,n_kidsgrid);
ar_permute = [1,4,5,6,3,2];
% Value Function
tb_prob_az = ff_summ_nd_array("P(A,Z))", Phi_true, true, ["sum"], 4, 1, cl_mp_datasetdesc, ar_permut
```

```
xxx  P(A,Z))  xxxxxxxxxxxxxxxxxxxxxxxxxxx
    group     savings       sum_eta_1     sum_eta_2     sum_eta_3     sum_eta_4     sum_eta_5     sum
    _____    __________    __________    __________    __________    __________    __________    ___

      1               0    1.6824e-07    1.4406e-07    2.1911e-07    3.1913e-07    4.5491e-07    6.4
      2      0.00051498    3.4279e-10    3.2632e-10    5.6501e-10    1.0203e-09    1.9975e-09    4.1
      3       0.0041199    7.1369e-10    6.2373e-10    9.7246e-10    1.4702e-09    2.2039e-09    3.2
      4        0.013905     1.573e-09    1.3633e-09    2.1044e-09    3.1331e-09    4.6025e-09    6.7
      5        0.032959     5.494e-09    4.7235e-09      7.23e-09    1.0641e-08    1.5401e-08     2.
      6        0.064373    6.5788e-09    5.6779e-09     8.702e-09    1.2804e-08    1.8492e-08    2.6
```

```
mp_support_graph('cl_st_graph_title') = {'Pstationary(A,Z), asset=x, shock=color'};
mp_support_graph('cl_st_ytitle') = {'Conditional Aggregate Mass'};
mp_support_graph('cl_st_xtitle') = {'A (savings)'};
mp_support_graph('st_rowvar_name') = 'z=';
mp_support_graph('it_legend_select') = 5;
mp_support_graph('st_rounding') = '6.2f';
```

```
mp_support_graph('bl_graph_logy') = true;
mp_support_graph('cl_colors') = 'copper';
ff_graph_grid((tb_prob_az{1:end, 3:end})', ar_st_eta_HS_grid, agrid, mp_support_graph);% Consumption
```





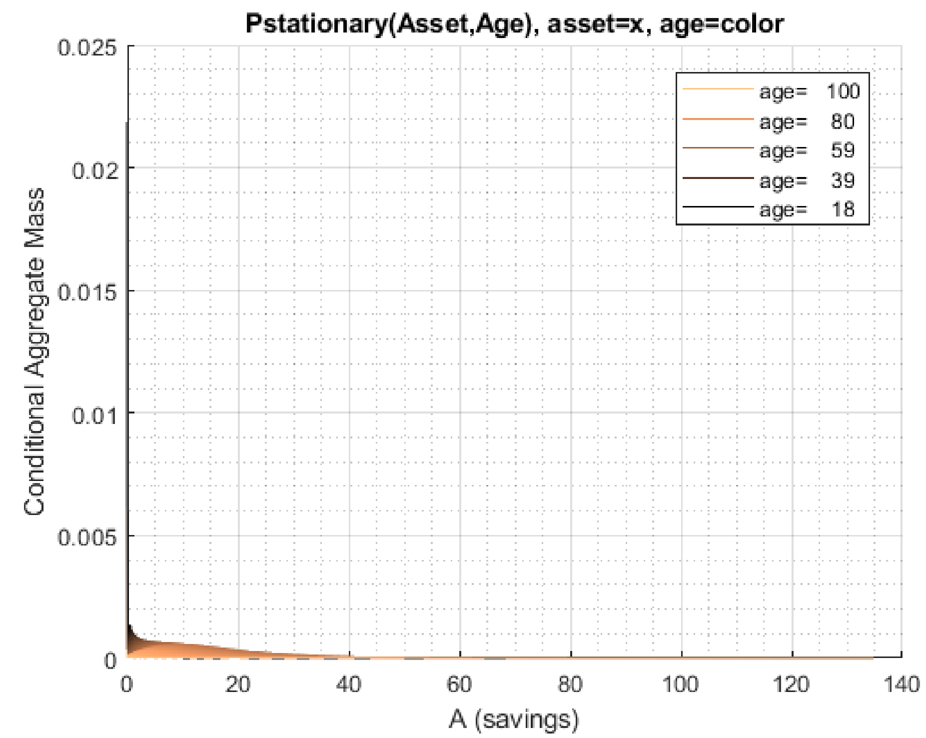
Asset Mass by Age

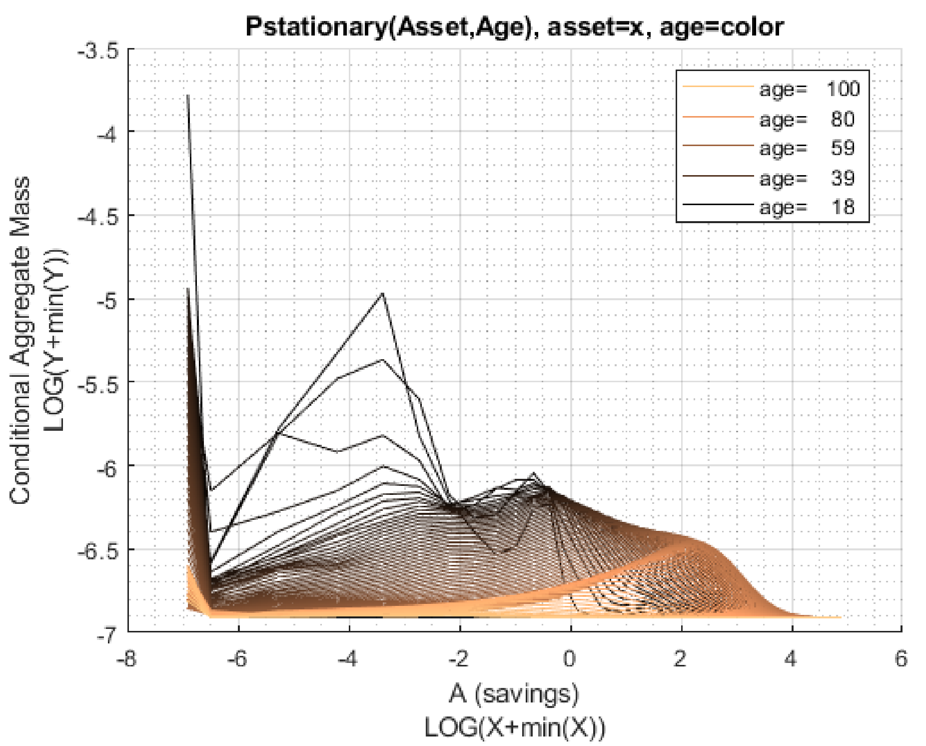
```
% NaN(n_jgrid,n_agrid,n_etagrid,n_educgrid,n_marriedgrid,n_kidsgrid);
ar_permute = [3,4,5,6,1,2];
% Value Function
tb_prob_aage = ff_summ_nd_array("P(A,Z))", Phi_true, true, ["sum"], 4, 1, cl_mp_datasetdesc, ar_perm
```

```
xxx  P(A,Z))  xxxxxxxxxxxxxxxxxxxxxxxxxxx
    group     savings      sum_age_18    sum_age_19    sum_age_20    sum_age_21    sum_age_22    sum
    -----    ----------    ----------    ----------    ----------    ----------    ----------    ---

      1               0      0.021837     0.0023507     0.0017993     0.0039371     0.0058435     0.
      2      0.00051498             0    0.00039608    0.00037932     0.0011301    0.00066626     0.0
      3       0.0041199             0     0.0020816     0.0019888      0.002009    0.00088325     0.0
      4        0.013905             0     0.0038656     0.0031682      0.001688     0.0011334     0.0
      5        0.032959             0     0.0059678     0.0036757     0.0019686     0.0014691     0.
      6        0.064373             0      0.001968     0.0026857     0.0015598     0.0012805     0.
      7         0.11124             0     0.0010155     0.0010772    0.00089495    0.00094737     0.0
      8         0.17664             0    0.00066497    0.00081578     0.0009608     0.0010548     0.
      9         0.26367             0    0.00045021    0.00085579     0.0011593     0.0011712     0.
     10         0.37542             0    0.00053095     0.0011218     0.0012745     0.0011467     0.
     11         0.51498             0    0.00090691     0.0013663     0.0012758     0.0012278      0
     12         0.68544             0    0.00097523      0.001111     0.0010957     0.0011325     0.
     13         0.88989             0    0.00023441    0.00050314    0.00074645     0.0009432     0.
     14          1.1314             0    4.5279e-05    0.00027467    0.00049029    0.00060869     0.0
     15          1.4131             0    1.7339e-05    0.00019476    0.00030104    0.00040391     0.0
     16          1.7381             0    8.1464e-06    6.6555e-05    0.00014925    0.00025602     0.0
     17          2.1094             0    6.1188e-06    3.5994e-05    9.5417e-05      0.000162     0.0
     18          2.5301             0    1.3448e-05    3.7101e-05    7.3464e-05    0.00012006     0.0
     19          3.0034             0    2.2537e-05    4.8195e-05    7.7883e-05    0.00011025     0.0
     20          3.5323             0    2.9909e-05    5.5599e-05    8.0928e-05    0.00010452     0.0
     21          4.1199             0    3.0433e-05     5.458e-05    7.2693e-05    9.1664e-05     0.0
     22          4.7693             0    2.0391e-05    3.7793e-05    5.5429e-05    7.2296e-05     8.9
     23          5.4836             0    5.1199e-06    1.8361e-05     3.277e-05    4.8259e-05     6.4
     24          6.2658             0    7.2528e-07    5.2955e-06    1.4093e-05    2.6887e-05     4.
     25          7.1191             0    1.0524e-07    1.2817e-06    4.9228e-06    1.2149e-05     2.2
     26          8.0466             0    1.7628e-08    5.0295e-07    2.0294e-06    5.2782e-06     1.1
     27          9.0514             0    3.0056e-09    3.0395e-07    1.0911e-06    2.7755e-06     5.7
     28          10.136             0    1.1825e-10    1.6421e-07    5.5086e-07    1.5801e-06     3.2
     29          11.305             0             0    4.8037e-08    2.2122e-07    8.0726e-07     1.8
     30           12.56             0             0    9.2865e-09    6.9448e-08    3.1086e-07     1.0
     31          13.905             0             0     1.789e-09     2.077e-08    9.8086e-08     4.7
     32          15.342             0             0    4.0984e-10    6.2012e-09    3.4485e-08     1.8
     33          16.875             0             0    9.8855e-11    1.6718e-09    1.2956e-08     6.
     34          18.507             0             0    2.1171e-11    4.7002e-10    4.2475e-09     2.1
     35          20.241             0             0    8.4937e-13    1.3772e-10    1.2013e-09     8.
     36           22.08             0             0             0    2.9206e-11     3.623e-10     2.7
     37          24.027             0             0             0    3.6378e-12    1.1269e-10     8.3
     38          26.085             0             0             0    7.7367e-13    2.3608e-11     2.7
     39          28.258             0             0             0    1.7753e-13    3.9993e-12     8.0
     40          30.548             0             0             0    8.3602e-15    1.0518e-12     1.7
     41          32.959             0             0             0             0    1.9415e-13     3.6
     42          35.493             0             0             0             0    1.4615e-14     9.1
     43          38.154             0             0             0             0    2.3455e-15     1.4
     44          40.945             0             0             0             0    2.9499e-16     1.7
     45          43.868             0             0             0             0    6.0398e-18     3.2
     46          46.928             0             0             0             0             0     3.3
     47          50.126             0             0             0             0            ...
```

```
mp_support_graph('cl_st_graph_title') = {'Pstationary(Asset,Age), asset=x, age=color'};
mp_support_graph('cl_st_ytitle') = {'Conditional Aggregate Mass'};
mp_support_graph('cl_st_xtitle') = {'A (savings)'};
mp_support_graph('st_rowvar_name') = 'age=';
mp_support_graph('it_legend_select') = 5;
mp_support_graph('st_rounding') = '6.0f';
```

```
mp_support_graph('bl_graph_logy') = true;
mp_support_graph('cl_colors') = 'copper';
ff_graph_grid((tb_prob_aage{1:end, 3:end})', age_grid, agrid, mp_support_graph);% Consumption Choice
```





6.1.6 Probability Statistics A, C and V Conditional on Ages

Where are the mass at?

```
ap_ss = mp_dsvfi_results('ap_ss');
c_ss = mp_dsvfi_results('cons_ss');
```

```
v_ss = mp_dsvfi_results('v_ss');
n_ss = mp_dsvfi_results('n_ss');

y_head_inc = mp_dsvfi_results('y_head_inc_ss');
y_spouse_inc = mp_dsvfi_results('y_spouse_inc_ss');

yshr_wage = mp_dsvfi_results('yshr_wage_ss');
yshr_SS = mp_dsvfi_results('yshr_SS_ss');
yshr_nttxss = mp_dsvfi_results('yshr_nttxss_ss');

for it_ctr=1:size(ap_ss, 1)
    if (ismember(it_ctr, round(linspace(1, size(ap_ss, 1), 3))))
        display(['age =' num2str(age_grid(it_ctr))]);

        % construct input data
        Phi_true_age = Phi_true(it_ctr, :, :, : ,: ,:);
        ap_ss_age = ap_ss(it_ctr, :, :, : ,: ,:);
        c_ss_age = c_ss(it_ctr, :, :, : ,: ,:);
        v_ss_age = v_ss(it_ctr, :, :, : ,: ,:);
        n_ss_age = n_ss(it_ctr, :, :, : ,: ,:);

        y_head_inc_age = y_head_inc(it_ctr, :, :, : ,: ,:);
        y_spouse_inc_age = y_spouse_inc(it_ctr, :, :, : ,: ,:);
        yshr_wage_age = yshr_wage(it_ctr, :, :, : ,: ,:);
        yshr_SS_age = yshr_SS(it_ctr, :, :, : ,: ,:);
        yshr_nttxss_age = yshr_nttxss(it_ctr, :, :, : ,: ,:);

        mp_cl_ar_xyz_of_s = containers.Map('KeyType','char', 'ValueType','any');
        mp_cl_ar_xyz_of_s('ap_ss') = {ap_ss_age(:), zeros(1)};
        mp_cl_ar_xyz_of_s('c_ss') = {c_ss_age(:), zeros(1)};
        mp_cl_ar_xyz_of_s('v_ss') = {v_ss_age(:), zeros(1)};
        mp_cl_ar_xyz_of_s('n_ss') = {n_ss_age(:), zeros(1)};
        mp_cl_ar_xyz_of_s('y_head_inc') = {y_head_inc_age(:), zeros(1)};
        mp_cl_ar_xyz_of_s('y_spouse') = {y_spouse_inc_age(:), zeros(1)};
        mp_cl_ar_xyz_of_s('yshr_wage') = {yshr_wage_age(:), zeros(1)};
        mp_cl_ar_xyz_of_s('yshr_SS') = {yshr_SS_age(:), zeros(1)};
        mp_cl_ar_xyz_of_s('yshr_nttxss') = {yshr_nttxss_age(:), zeros(1)};
        mp_cl_ar_xyz_of_s('ar_st_y_name') = ["ap_ss", "c_ss", "v_ss", "n_ss",...
            "y_head_inc", "y_spouse", "yshr_wage", "yshr_SS", "yshr_nttxss"];

        % controls
        mp_support = containers.Map('KeyType','char', 'ValueType','any');
        mp_support('ar_fl_percentiles') = [0.01 10 25 50 75 90 99.99];
        mp_support('bl_display_final') = true;
        mp_support('bl_display_detail') = false;
        mp_support('bl_display_drvm2outcomes') = false;
        mp_support('bl_display_drvstats') = false;
        mp_support('bl_display_drvm2covcor') = false;

        % Call Function
        mp_cl_mt_xyz_of_s = ff_simu_stats(Phi_true_age(:)/sum(Phi_true_age,'all'), mp_cl_ar_xyz_of_s
    end
end

age =18
xxx tb_outcomes: all stats xxx
    OriginalVariableNames       ap_ss          c_ss          v_ss           n_ss        y_head_inc
    _____________________    __________    __________    ___________    ___________    __________
```

```
    {'mean'                 }      0.13166       0.63405         -31.11         1.9854        0.71265
    {'unweighted_sum'       }   1.0934e+07    8.5358e+05    -2.1835e+06             21          15541
    {'sd'                   }      0.34823       0.37905         29.813         1.0848        0.54567
    {'coefofvar'            }        2.645       0.59783       -0.95831        0.54639        0.76569
    {'gini'                 }      0.77092       0.31105       -0.47974          0.268        0.36259
    {'min'                  }            0      0.036717        -586.22              1       0.038108
    {'max'                  }       145.07        10.212          24.63              6         13.784
    {'pYis0'                }      0.10805             0              0              0              0
    {'pYls0'                }            0             0        0.93414              0              0
    {'pYgr0'                }      0.89195             1       0.065859              1              1
    {'pYisMINY'             }      0.10805    1.3288e-05     5.8837e-08        0.41786     2.5312e-05
    {'pYisMAXY'             }            0             0              0      0.0060544              0
    {'p0_01'                }            0      0.047727        -322.58              1       0.046651
    {'p10'                  }            0       0.24819        -67.491              1        0.23528
    {'p25'                  }     0.012186       0.36957        -41.871              1        0.35258
    {'p50'                  }     0.032959       0.55272        -24.354              2        0.56523
    {'p75'                  }      0.07477       0.80089         -11.18              3        0.90612
    {'p90'                  }      0.47812        1.1198        -2.6906              4         1.3579
    {'p99_99'               }       5.4504        3.6593         17.393              6         6.8484
    {'fl_cov_ap_ss'         }      0.12126      0.055072         2.4507       0.026881           0.05
    {'fl_cor_ap_ss'         }            1       0.41721        0.23606       0.071158        0.26313
    {'fl_cov_c_ss'          }     0.055072       0.14368         8.0391        0.07643        0.18689
    {'fl_cor_c_ss'          }      0.41721             1        0.71138        0.18587        0.90355
    {'fl_cov_v_ss'          }       2.4507        8.0391          888.8        0.38384         10.004
    {'fl_cor_v_ss'          }      0.23606       0.71138              1       0.011868        0.61498
    {'fl_cov_n_ss'          }     0.026881       0.07643        0.38384         1.1768     1.1384e-17
    {'fl_cor_n_ss'          }     0.071158       0.18587       0.011868              1     1.9231e-17
    {'fl_cov_y_head_inc'    }         0.05       0.18689         10.004     1.1384e-17        0.29776
    {'fl_cor_y_head_inc'    }      0.26313       0.90355        0.61498     1.9231e-17              1
    {'fl_cov_y_spouse'      }      0.18249      0.071644         3.4658        0.13323       0.010455
    {'fl_cor_y_spouse'      }      0.92021       0.33189        0.20413        0.21565       0.033645
    {'fl_cov_yshr_wage'     }   1.2236e-32    7.3426e-32    -4.4373e-30    -3.4513e-31     1.4096e-31
    {'fl_cor_yshr_wage'     }   1.0549e-16    5.8159e-16    -4.4688e-16    -9.5519e-16     7.7559e-16
    {'fl_cov_yshr_SS'       }            0             0              0              0              0
    {'fl_cor_yshr_SS'       }          NaN           NaN            NaN            NaN            NaN
    {'fl_cov_yshr_nttxss'}       0.0057457      0.011176        0.85848       0.007516        0.01319
    {'fl_cor_yshr_nttxss'}         0.48632       0.86907        0.84874        0.20421        0.71249
    {'fracByP0_01'          }            0    7.1684e-06      0.0013012        0.21046      7.788e-06
    {'fracByP10'            }            0      0.030643        0.32088        0.21046       0.027495
    {'fracByP25'            }    0.0067356       0.10365        0.58193        0.21046       0.092606
    {'fracByP50'            }      0.04689       0.29058        0.83099        0.53024        0.26377
    {'fracByP75'            }      0.13162       0.54875        0.97426        0.77109         0.5245
    {'fracByP90'            }      0.35822       0.76944         1.0077        0.92834        0.74403
    {'fracByP99_99'         }      0.99575       0.99938         1.0001              1        0.99912

age =59
xxx tb_outcomes: all stats xxx
    OriginalVariableNames       ap_ss          c_ss           v_ss          n_ss       y_head_inc
    ______________________    __________    __________    ___________    _________    __________

    {'mean'                 }       9.4506        1.2067        -9.9431       1.7239         1.6033
    {'unweighted_sum'       }   1.1247e+07    1.0819e+06    -3.4419e+05           21          45380
    {'sd'                   }       9.4598       0.76797         14.834      0.90777         1.2742
    {'coefofvar'            }        1.001       0.63643        -1.4919      0.52659        0.79474
    {'gini'                 }      0.48835       0.32979       -0.78368      0.23461        0.38321
    {'min'                  }            0       0.05663        -208.18            1       0.059541
    {'max'                  }       158.43        12.311         14.965            6          23.47
```

```
    {'pYis0'              }     0.0059691             0             0            0             0
    {'pYls0'              }             0             0       0.73383            0             0
    {'pYgr0'              }       0.99403             1       0.26617            1             1
    {'pYisMINY'           }     0.0059691    9.8324e-06    2.9687e-09      0.48835    9.8989e-06
    {'pYisMAXY'           }    9.0457e-09    3.8325e-11    5.2662e-07    0.0036816    1.4683e-06
    {'p0_01'              }             0       0.07838          -101            1       0.08341
    {'p10'                }        1.0833       0.41297        -30.14            1       0.49019
    {'p25'                }        3.0034       0.65765        -16.23            1        0.7717
    {'p50'                }        6.7818        1.0568        -6.363            2        1.2612
    {'p75'                }        12.812        1.5534       0.45344            2        2.0256
    {'p90'                }          20.8        2.1542        4.9139            3        3.0996
    {'p99_99'             }        112.23        8.4857        13.926            6        15.937
    {'fl_cov_ap_ss'       }        89.487        6.8831        97.649       0.8159        10.409
    {'fl_cor_ap_ss'       }             1       0.94746       0.69588     0.095013       0.86354
    {'fl_cov_c_ss'        }        6.8831       0.58977        8.5503      0.23192       0.85197
    {'fl_cor_c_ss'        }       0.94746             1       0.75055      0.33267       0.87063
    {'fl_cov_v_ss'        }        97.649        8.5503        220.04       2.4373        12.623
    {'fl_cor_v_ss'        }       0.69588       0.75055             1        0.181       0.66782
    {'fl_cov_n_ss'        }        0.8159       0.23192        2.4373      0.82404      0.055267
    {'fl_cor_n_ss'        }      0.095013       0.33267         0.181            1       0.04778
    {'fl_cov_y_head_inc' }        10.409       0.85197        12.623     0.055267        1.6237
    {'fl_cor_y_head_inc' }       0.86354       0.87063       0.66782      0.04778             1
    {'fl_cov_y_spouse'    }        2.2143       0.24542        3.4887      0.27625         0.116
    {'fl_cor_y_spouse'    }        0.2103       0.28712       0.21131      0.27342       0.08179
    {'fl_cov_yshr_wage'   }      -0.54196     -0.036396      -0.86915    0.0011758     -0.038212
    {'fl_cor_yshr_wage'   }      -0.56735      -0.46933      -0.58024     0.012827      -0.29697
    {'fl_cov_yshr_SS'     }             0             0             0            0             0
    {'fl_cor_yshr_SS'     }           NaN           NaN           NaN          NaN           NaN
    {'fl_cov_yshr_nttxss'}       0.19452      0.017952       0.42036    0.0075501      0.027003
    {'fl_cor_yshr_nttxss'}       0.67266        0.7647       0.92699      0.27208       0.69323
    {'fracByP0_01'        }             0    6.8812e-06     0.0011212      0.28329    5.8341e-06
    {'fracByP10'          }      0.004897      0.026408       0.43931      0.28329      0.022426
    {'fracByP25'          }      0.037048      0.092569       0.77208      0.28329      0.081818
    {'fracByP50'          }       0.16368       0.27051        1.0414      0.72028       0.23952
    {'fracByP75'          }       0.41532       0.53706        1.1137      0.72028       0.48823
    {'fracByP90'          }       0.67288       0.76168         1.075      0.85389       0.72007
    {'fracByP99_99'       }       0.99866       0.99926        1.0001            1       0.99889

age =100
xxx tb_outcomes: all stats xxx
    OriginalVariableNames    ap_ss       c_ss          v_ss          n_ss        y_head_inc      y_s
    _____________________    _____    __________    __________    __________    ___________    ____

    {'mean'               }      0       0.34868       -3.0033        1.4797         0.2604      0
    {'unweighted_sum'     }      0    1.2188e+05        458.94            21         213.14
    {'sd'                 }      0       0.23392         1.043       0.50567        0.02289      0
    {'coefofvar'          }    NaN       0.67088      -0.34728       0.34173       0.087904
    {'gini'               }    NaN         0.275      -0.17693       0.12034       0.041151
    {'min'                }      0        0.2179       -10.065             1        0.24433
    {'max'                }      0        141.66       0.99282             6         5.6926
    {'pYis0'              }      1             0             0             0              0      0
    {'pYls0'              }      0             0       0.99285             0              0
    {'pYgr0'              }      0             1     0.0071501             1              1      0
    {'pYisMINY'           }      1       0.36483    1.5455e-10        0.5232        0.52813      0
    {'pYisMAXY'           }      1             0             0    4.2206e-08              0   1.03
    {'p0_01'              }      0        0.2179       -6.3349             1        0.24433
    {'p10'                }      0        0.2179       -3.6603             1        0.24433
    {'p25'                }      0        0.2179       -3.5892             1        0.24433
```

```
    {'p50'                }       0      0.25824     -3.5892           1      0.24433
    {'p75'                }       0      0.36458     -2.8095           2      0.29263     0
    {'p90'                }       0       0.6134     -1.3055           2      0.29279     0
    {'p99_99'             }       0       2.8989     0.51215           4      0.33789
    {'fl_cov_ap_ss'       }       0            0           0           0            0
    {'fl_cor_ap_ss'       }     NaN          NaN         NaN         NaN          NaN
    {'fl_cov_c_ss'        }       0     0.054721     0.19746    0.059476    0.0015551     0
    {'fl_cor_c_ss'        }     NaN            1     0.80934     0.50281      0.29042     0
    {'fl_cov_v_ss'        }       0      0.19746      1.0878     0.16711      0.01031
    {'fl_cor_v_ss'        }     NaN      0.80934           1     0.31686      0.43183     0
    {'fl_cov_n_ss'        }       0     0.059476     0.16711      0.2557    0.0019105
    {'fl_cor_n_ss'        }     NaN      0.50281     0.31686           1      0.16506
    {'fl_cov_y_head_inc'  }       0    0.0015551     0.01031   0.0019105   0.00052397  0.00
    {'fl_cor_y_head_inc'  }     NaN      0.29042     0.43183     0.16506            1     0
    {'fl_cov_y_spouse'    }       0      0.05178      0.1649      0.0533   0.00067518    0.
    {'fl_cor_y_spouse'    }     NaN      0.89356     0.63823      0.4255      0.11907
    {'fl_cov_yshr_wage'   }       0     0.039513     0.15927    0.083913   0.00067571    0.
    {'fl_cor_yshr_wage'   }     NaN       0.7643     0.69097     0.75087      0.13357     0
    {'fl_cov_yshr_SS'     }       0    -0.040547    -0.16461   -0.085285  -0.00072523   -0.
    {'fl_cor_yshr_SS'     }     NaN     -0.77966    -0.70991    -0.75864     -0.14251    -0
    {'fl_cov_yshr_nttxss'}        0     0.044511     0.18091    0.091879   0.00087698    0.
    {'fl_cor_yshr_nttxss'}      NaN      0.78763     0.71798     0.75212      0.15859     0
    {'fracByP0_01'        }     NaN      0.22799  0.00053042     0.35357      0.49553
    {'fracByP10'          }     NaN      0.22799     0.22059     0.35357      0.49553
    {'fracByP25'          }     NaN      0.22799      0.6552     0.35357      0.49553
    {'fracByP50'          }     NaN      0.35394      0.6552     0.35357      0.49553
    {'fracByP75'          }     NaN      0.55083     0.87677     0.99419      0.88359     0
    {'fracByP90'          }     NaN       0.7612     0.97549     0.99419      0.89158     0
    {'fracByP99_99'       }     NaN      0.99927           1     0.99999      0.99991
```

6.2 Distribution Exact Savings Choices Vectorized

This is the example vignette for function: **snw_ds_main_vec** from the **PrjOptiSNW Package.** This function solves for vfi and gets distribution induced by policy functions and exogenous distributions. Vectorized vfi and distribution methods.

6.2.1 Test SNW_DS_MAIN_VEC

Call the function with testing defaults.

```
mp_params = snw_mp_param('default_docdense');
mp_controls = snw_mp_control('default_test');
mp_controls('bl_print_vfi') = false;
mp_controls('bl_print_ds') = true;
mp_controls('bl_print_ds_verbose') = false;
[Phi_true,Phi_adj,A_agg,Y_inc_agg,it,mp_dsvfi_results] = snw_ds_main_vec(mp_params, mp_controls);
```

```
Completed SNW_VFI_MAIN_BISEC_VEC;SNW_MP_PARAM=default_docdense;SNW_MP_CONTROL=default_test;time=495.
----------------------------------------
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
CONTAINER NAME: mp_outcomes ND Array (Matrix etc)
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
                i    idx    ndim      numel      rowN      colN          sum          mean       std
                _    ___    ____    ________     ____    _________    ___________    _______    _____

    V_VFI       1     1      6      4.37e+07      83     5.265e+05    -1.5339e+08    -3.5101    26.11
    ap_VFI      2     2      6      4.37e+07      83     5.265e+05     1.4159e+09     32.402    36.79
    cons_VFI    3     3      6      4.37e+07      83     5.265e+05     2.1402e+08     4.8975    8.329
```

xxx TABLE:V_VFI xxxxxxxxxxxxxxxxxx

	c1	c2	c3	c4	c5	c526496	c526497	c526498	c
r1	-346.51	-346.12	-343.63	-337.86	-328.51	21.702	21.852	22.003	
r2	-334.38	-333.99	-331.51	-325.83	-316.83	21.724	21.869	22.015	
r3	-322.45	-322.06	-319.6	-314.14	-305.6	21.745	21.885	22.027	
r4	-310.63	-310.27	-307.99	-302.88	-294.87	21.767	21.903	22.041	
r5	-299.94	-299.6	-297.46	-292.67	-285.12	21.775	21.907	22.042	
r79	-9.9437	-9.9325	-9.8557	-9.6597	-9.3232	2.5394	2.5501	2.5602	
r80	-8.9023	-8.8911	-8.8143	-8.6183	-8.2818	2.3039	2.3121	2.3198	
r81	-7.6363	-7.6251	-7.5484	-7.3524	-7.0159	2.0068	2.0124	2.0176	
r82	-5.9673	-5.9561	-5.8793	-5.6833	-5.3468	1.5958	1.5989	1.6018	
r83	-3.5892	-3.578	-3.5012	-3.3052	-2.9687	0.97904	0.98004	0.98097	0

xxx TABLE:ap_VFI xxxxxxxxxxxxxxxxxx

	c1	c2	c3	c4	c5	c526496	c526497	c526498	c5264
r1	0	0	0.0005656	0.0075134	0.022901	114.75	120.41	126.27	132.3
r2	0	0	0.00051498	0.0065334	0.021549	114.86	120.53	126.41	132.5
r3	0	0	0.00051498	0.0049294	0.019875	114.97	120.65	126.56	132.
r4	0	0	0.00051498	0.0047937	0.019672	115.73	121.42	127.34	133.5
r5	0	0	0.00048517	0.0046683	0.019484	116.5	122.21	128.15	134.3
r79	0	0	0	0	0	81.091	85.68	90.335	94.37
r80	0	0	0	0	0	76.669	80.563	84.304	88.0
r81	0	0	0	0	0	68.313	71.534	74.475	77.83
r82	0	0	0	0	0	50.126	53.467	56.953	58.74
r83	0	0	0	0	0	0	0	0	

xxx TABLE:cons_VFI xxxxxxxxxxxxxxxxxx

	c1	c2	c3	c4	c5	c526496	c526497	c526498
r1	0.036717	0.037251	0.040426	0.04363	0.048012	9.6491	9.817	9.9649
r2	0.036717	0.037251	0.040477	0.04461	0.049364	9.8118	9.9685	10.101
r3	0.036717	0.037251	0.040477	0.046214	0.051039	9.9779	10.12	10.234
r4	0.038144	0.038678	0.041903	0.047776	0.052666	10.131	10.258	10.354
r5	0.039534	0.040068	0.043323	0.04929	0.054241	10.272	10.384	10.463
r79	0.2179	0.21844	0.22216	0.23228	0.25197	35.858	37.092	38.455
r80	0.2179	0.21844	0.22216	0.23228	0.25197	40.253	42.183	44.459
r81	0.2179	0.21844	0.22216	0.23228	0.25197	48.587	51.19	54.266
r82	0.2179	0.21844	0.22216	0.23228	0.25197	66.755	69.238	71.77
r83	0.2179	0.21844	0.22216	0.23228	0.25197	116.87	122.69	128.71

```
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:1 of 82, time-this-age:0.38533
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:2 of 82, time-this-age:4.8535
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:3 of 82, time-this-age:5.4245
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:4 of 82, time-this-age:5.9426
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:5 of 82, time-this-age:6.1288
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:6 of 82, time-this-age:6.5704
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:7 of 82, time-this-age:6.8969
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:8 of 82, time-this-age:6.9897
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:9 of 82, time-this-age:7.1947
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:10 of 82, time-this-age:8.6388
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:11 of 82, time-this-age:9.0845
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:12 of 82, time-this-age:10.3717
```

```
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:13 of 82, time-this-age:10.517
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:14 of 82, time-this-age:10.7579
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:15 of 82, time-this-age:10.8217
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:16 of 82, time-this-age:10.8223
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:17 of 82, time-this-age:10.7043
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:18 of 82, time-this-age:10.7417
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:19 of 82, time-this-age:10.8037
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:20 of 82, time-this-age:10.818
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:21 of 82, time-this-age:10.7822
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:22 of 82, time-this-age:11.9326
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:23 of 82, time-this-age:11.9625
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:24 of 82, time-this-age:11.8969
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:25 of 82, time-this-age:11.7013
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:26 of 82, time-this-age:11.9384
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:27 of 82, time-this-age:12.7336
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:28 of 82, time-this-age:12.6447
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:29 of 82, time-this-age:12.7296
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:30 of 82, time-this-age:12.7955
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:31 of 82, time-this-age:12.6745
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:32 of 82, time-this-age:12.822
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:33 of 82, time-this-age:12.4306
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:34 of 82, time-this-age:12.5625
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:35 of 82, time-this-age:12.4247
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:36 of 82, time-this-age:12.2152
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:37 of 82, time-this-age:12.4463
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:38 of 82, time-this-age:12.409
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:39 of 82, time-this-age:12.2658
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:40 of 82, time-this-age:12.2869
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:41 of 82, time-this-age:12.1216
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:42 of 82, time-this-age:12.1159
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:43 of 82, time-this-age:12.0175
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:44 of 82, time-this-age:11.8754
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:45 of 82, time-this-age:11.8576
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:46 of 82, time-this-age:11.6876
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:47 of 82, time-this-age:11.4529
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:48 of 82, time-this-age:11.2909
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:49 of 82, time-this-age:13.2073
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:50 of 82, time-this-age:14.38
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:51 of 82, time-this-age:14.2335
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:52 of 82, time-this-age:14.3025
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:53 of 82, time-this-age:14.4099
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:54 of 82, time-this-age:14.6607
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:55 of 82, time-this-age:14.3725
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:56 of 82, time-this-age:13.0721
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:57 of 82, time-this-age:14.2288
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:58 of 82, time-this-age:11.5969
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:59 of 82, time-this-age:11.2636
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:60 of 82, time-this-age:11.4644
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:61 of 82, time-this-age:11.153
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:62 of 82, time-this-age:9.8175
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:63 of 82, time-this-age:9.4858
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:64 of 82, time-this-age:8.2039
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:65 of 82, time-this-age:7.8046
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:66 of 82, time-this-age:8.0482
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:67 of 82, time-this-age:7.7332
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:68 of 82, time-this-age:7.8717
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:69 of 82, time-this-age:7.7449
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:70 of 82, time-this-age:7.6917
```

```
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:71 of 82, time-this-age:7.4818
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:72 of 82, time-this-age:7.5373
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:73 of 82, time-this-age:7.477
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:74 of 82, time-this-age:7.0533
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:75 of 82, time-this-age:7.0132
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:76 of 82, time-this-age:6.8244
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:77 of 82, time-this-age:6.5596
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:78 of 82, time-this-age:6.3739
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:79 of 82, time-this-age:6.145
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:80 of 82, time-this-age:5.9883
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:81 of 82, time-this-age:5.6745
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:82 of 82, time-this-age:5.4529
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:1 of 82, time-this-age:0.32995
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:2 of 82, time-this-age:0.046363
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:3 of 82, time-this-age:0.0452
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:4 of 82, time-this-age:0.04461
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:5 of 82, time-this-age:0.046124
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:6 of 82, time-this-age:0.044917
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:7 of 82, time-this-age:0.044963
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:8 of 82, time-this-age:0.045331
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:9 of 82, time-this-age:0.044994
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:10 of 82, time-this-age:0.045092
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:11 of 82, time-this-age:0.045782
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:12 of 82, time-this-age:0.045744
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:13 of 82, time-this-age:0.044755
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:14 of 82, time-this-age:0.045424
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:15 of 82, time-this-age:0.04489
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:16 of 82, time-this-age:0.045122
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:17 of 82, time-this-age:0.044855
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:18 of 82, time-this-age:0.044743
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:19 of 82, time-this-age:0.04457
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:20 of 82, time-this-age:0.042135
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:21 of 82, time-this-age:0.042964
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:22 of 82, time-this-age:0.042523
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:23 of 82, time-this-age:0.041992
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:24 of 82, time-this-age:0.042772
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:25 of 82, time-this-age:0.042253
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:26 of 82, time-this-age:0.042336
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:27 of 82, time-this-age:0.042502
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:28 of 82, time-this-age:0.042069
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:29 of 82, time-this-age:0.042066
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:30 of 82, time-this-age:0.042307
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:31 of 82, time-this-age:0.042301
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:32 of 82, time-this-age:0.042422
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:33 of 82, time-this-age:0.04251
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:34 of 82, time-this-age:0.043235
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:35 of 82, time-this-age:0.041973
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:36 of 82, time-this-age:0.042507
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:37 of 82, time-this-age:0.04212
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:38 of 82, time-this-age:0.041928
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:39 of 82, time-this-age:0.042805
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:40 of 82, time-this-age:0.042282
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:41 of 82, time-this-age:0.042023
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:42 of 82, time-this-age:0.041985
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:43 of 82, time-this-age:0.042461
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:44 of 82, time-this-age:0.042176
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:45 of 82, time-this-age:0.041744
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:46 of 82, time-this-age:0.042401
```

```
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:47 of 82, time-this-age:0.041823
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:48 of 82, time-this-age:0.042776
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:49 of 82, time-this-age:0.042345
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:50 of 82, time-this-age:0.041778
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:51 of 82, time-this-age:0.04279
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:52 of 82, time-this-age:0.042188
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:53 of 82, time-this-age:0.042106
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:54 of 82, time-this-age:0.041468
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:55 of 82, time-this-age:0.04238
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:56 of 82, time-this-age:0.042431
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:57 of 82, time-this-age:0.042291
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:58 of 82, time-this-age:0.042408
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:59 of 82, time-this-age:0.042301
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:60 of 82, time-this-age:0.041831
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:61 of 82, time-this-age:0.041465
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:62 of 82, time-this-age:0.043668
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:63 of 82, time-this-age:0.042077
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:64 of 82, time-this-age:0.041524
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:65 of 82, time-this-age:0.043254
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:66 of 82, time-this-age:0.042202
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:67 of 82, time-this-age:0.041436
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:68 of 82, time-this-age:0.041208
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:69 of 82, time-this-age:0.041526
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:70 of 82, time-this-age:0.042328
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:71 of 82, time-this-age:0.041618
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:72 of 82, time-this-age:0.041941
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:73 of 82, time-this-age:0.04211
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:74 of 82, time-this-age:0.041632
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:75 of 82, time-this-age:0.041663
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:76 of 82, time-this-age:0.042221
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:77 of 82, time-this-age:0.042
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:78 of 82, time-this-age:0.041732
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:79 of 82, time-this-age:0.042972
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:80 of 82, time-this-age:0.04279
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:81 of 82, time-this-age:0.042028
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:82 of 82, time-this-age:0.042981
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:83 of 82, time-this-age:0.041914
SNW_DS_MAIN: Share of population with assets equal to upper bound on asset grid:6.6266e-06
SNW_DS_MAIN: Accidental bequests are thrown in the ocean
SNW_DS_MAIN_VEC: Number of a2-adjustments (for taxation) used to balance the government budget= 0
SNW_DS_MAIN_VEC: Old and updated value of a2=1.5286      1.5286
SNW_DS_MAIN_VEC: Aggregates: Cons., Gov. cons., Save, Assets, Income, Bequests 48.88966      11.3883
SNW_DS_MAIN_VEC: Resource constraint: C_t+A_{t+1}+G_t=A_t+Y_t 259.3534      259.3526
Completed SNW_DS_MAIN_VEC;SNW_MP_PARAM=default_docdense;SNW_MP_CONTROL=default_test;time=869.5447
xxx tb_outcomes: all stats xxx
     OriginalVariableNames        a_ss         ap_ss        cons_ss        n_ss         y_all
    ________________________    __________    __________    __________    _________    __________

    {'mean'              }         4.2486        4.3473        1.0676        2.3554        1.4672
    {'unweighted_sum'    }           2228    5.3198e+08    5.0976e+07            21    8.3563e+07
    {'sd'                }         6.7963         6.834       0.69454        1.4375        1.4636
    {'coefofvar'         }         1.5996         1.572       0.65055       0.61029       0.99755
    {'gini'              }        0.68054       0.68147        0.3385        0.3128       0.44353
    {'min'               }              0             0      0.036717             1      0.038108
    {'max'               }            135         163.7        141.66             6        50.873
    {'pYis0'             }         0.1223       0.10225             0             0             0
    {'pYls0'             }              0             0             0             0             0
    {'pYgr0'             }         0.8777       0.89775             1             1             1
```

{'pYisMINY' }	0.1223	0.10225	8.6094e-07	0.36005	8.6094e-07
{'pYisMAXY' }	6.6266e-06	2.2031e-12	0	0.041101	2.2031e-12
{'p0_01' }	0	0	0.066316	1	0.069931
{'p0_1' }	0	0	0.10404	1	0.11208
{'p1' }	0	0	0.185	1	0.20291
{'p5' }	0	0	0.27653	1	0.28
{'p10' }	0	0	0.35932	1	0.35446
{'p20' }	0.064373	0.070044	0.49736	1	0.50155
{'p25' }	0.11124	0.18238	0.56384	1	0.5774
{'p30' }	0.26367	0.37542	0.63117	1	0.65517
{'p40' }	0.68544	0.85525	0.77036	2	0.8305
{'p50' }	1.4131	1.5959	0.92038	2	1.0329
{'p60' }	2.5301	2.7681	1.086	2	1.2828
{'p70' }	4.1199	4.5042	1.2802	3	1.6166
{'p75' }	5.4836	5.7337	1.3961	3	1.8353
{'p80' }	7.1191	7.2583	1.5324	4	2.1144
{'p90' }	12.56	12.145	1.9406	5	3.0534
{'p95' }	16.875	17.551	2.3509	5	4.0423
{'p99' }	30.548	31.57	3.4062	6	6.9038
{'p99_9' }	56.953	57.547	5.2994	6	14.807
{'p99_99' }	90.439	90.439	7.5689	6	21.018
{'fl_cov_a_ss' }	46.189	46.181	3.4533	-1.4145	4.552
{'fl_cor_a_ss' }	1	0.99429	0.73158	-0.14479	0.45762
{'fl_cov_ap_ss' }	46.181	46.704	3.5562	-1.3778	5.3963
{'fl_cor_ap_ss' }	0.99429	1	0.74922	-0.14025	0.53951
{'fl_cov_cons_ss' }	3.4533	3.5562	0.48239	0.23887	0.77192
{'fl_cor_cons_ss' }	0.73158	0.74922	1	0.23926	0.75937
{'fl_cov_n_ss' }	-1.4145	-1.3778	0.23887	2.0664	0.36008
{'fl_cor_n_ss' }	-0.14479	-0.14025	0.23926	1	0.17115
{'fl_cov_y_all' }	4.552	5.3963	0.77192	0.36008	2.1421
{'fl_cor_y_all' }	0.45762	0.53951	0.75937	0.17115	1
{'fl_cov_y_head_inc' }	3.9111	4.1925	0.5697	0.092861	1.1244
{'fl_cor_y_head_inc' }	0.57021	0.60786	0.81274	0.064008	0.7612
{'fl_cov_y_head_earn' }	1.9006	2.2089	0.43359	0.19345	0.97967
{'fl_cor_y_head_earn' }	0.30133	0.34828	0.67268	0.14501	0.72126
{'fl_cov_y_spouse_inc' }	0.64085	1.2037	0.20222	0.26722	1.0177
{'fl_cor_y_spouse_inc' }	0.098743	0.18445	0.3049	0.19466	0.72817
{'fl_cov_yshr_interest'}	0.77027	0.72501	0.038411	-0.066855	-0.0092638
{'fl_cor_yshr_interest'}	0.67438	0.63125	0.32907	-0.27673	-0.037662
{'fl_cov_yshr_wage' }	-0.77963	-0.69253	-0.0045925	0.17059	0.10778
{'fl_cor_yshr_wage' }	-0.3398	-0.30018	-0.019587	0.35152	0.21813
{'fl_cov_yshr_SS' }	0.0093601	-0.032478	-0.033818	-0.10373	-0.098514
{'fl_cor_yshr_SS' }	0.0058267	-0.020106	-0.206	-0.3053	-0.28477
{'fl_cov_yshr_tax' }	0.099405	0.11025	0.018741	0.01336	0.038806
{'fl_cor_yshr_tax' }	0.41564	0.45846	0.76677	0.26411	0.75345
{'fl_cov_yshr_nttxss' }	0.090044	0.14273	0.052559	0.11709	0.13732
{'fl_cor_yshr_nttxss' }	0.05183	0.081703	0.29603	0.31865	0.36703
{'fracByP0_01' }	0	0	5.4315e-06	0.15286	4.2545e-06
{'fracByP0_1' }	0	0	8.2399e-05	0.15286	6.3218e-05
{'fracByP1' }	0	0	0.0013761	0.15286	0.0010863
{'fracByP5' }	0	0	0.01022	0.15286	0.007951
{'fracByP10' }	0	0	0.025187	0.15286	0.018765
{'fracByP20' }	0.00074359	0.00061895	0.065443	0.15286	0.04804
{'fracByP25' }	0.0014042	0.0020497	0.090297	0.15286	0.066483
{'fracByP30' }	0.0041483	0.0051966	0.11827	0.15286	0.08755
{'fracByP40' }	0.01665	0.018812	0.18387	0.40183	0.13814
{'fracByP50' }	0.045047	0.046332	0.26291	0.40183	0.20163
{'fracByP60' }	0.094899	0.095657	0.35672	0.40183	0.27993

```
    {'fracByP70'        }     0.17353     0.17824     0.46729     0.56321     0.37814
    {'fracByP75'        }     0.24359     0.23689     0.52992     0.56321     0.43683
    {'fracByP80'        }     0.32643     0.31096     0.59841     0.75407     0.50391
    {'fracByP90'        }     0.56332      0.5274     0.75898      0.8953     0.67588
    {'fracByP95'        }     0.69729     0.69468     0.85836      0.8953     0.79474
    {'fracByP99'        }     0.90278     0.90216     0.96058           1     0.93117
    {'fracByP99_9'      }     0.98493     0.98362     0.99414           1     0.98801
    {'fracByP99_99'     }     0.99793     0.99759     0.99921           1     0.99841
```

```
% [Phi_true,Phi_adj] = snw_ds_main(mp_params, mp_controls);
Phi_true = Phi_true/sum(Phi_true(:));
```

6.2.2 Show All Info in mp_dsvfi_results

```
mp_cl_mt_xyz_of_s = mp_dsvfi_results('mp_cl_mt_xyz_of_s');
disp(mp_cl_mt_xyz_of_s('tb_outcomes'))
```

```
                          mean      unweighted_sum     sd       coefofvar     gini        min        

                        --------    --------------   -------    ---------    -------    --------    --

    a_ss                  4.2486             2228     6.7963       1.5996    0.68054           0    
    ap_ss                 4.3473       5.3198e+08      6.834        1.572    0.68147           0    
    cons_ss               1.0676       5.0976e+07    0.69454      0.65055     0.3385    0.036717    1
    n_ss                  2.3554               21     1.4375      0.61029     0.3128           1    
    y_all                 1.4672       8.3563e+07     1.4636      0.99755    0.44353    0.038108    5
    y_head_inc            1.1087       1.9253e+06     1.0092      0.91029    0.41889    0.038108    2
    y_head_earn          0.88655            19732    0.92804       1.0468    0.53121           0    1
    y_spouse_inc         0.35849       4.8273e+05    0.95494       2.6638    0.85255           0    2
    yshr_interest        0.12214       3.8429e+06    0.16806       1.3759    0.66002           0    0.
    yshr_wage            0.77513       8.8876e+06    0.33759      0.43553     0.2056           0    
    yshr_SS              0.10273            30336    0.23637       2.3009    0.91226           0    
    yshr_tax             0.17862       2.8339e+06    0.03519      0.19701    0.11226    0.036506    0
    yshr_nttxss         0.075896       2.8036e+06    0.25563       3.3681     1.3974    -0.89184    0
```

6.3 Distribution Grid Search

This is the example vignette for function: **snw_ds_main_grid_search** from the **PrjOptiSNW Package.** This function solves for vfi and gets distribution induced by policy functions and exogenous distributions. Grid Search for VFI and Grid Search also for Distribution. The results are illustrative of the differences between using grid search and exact solution. The grid search solution here is not fully vectorized but loops over the state-space.

6.3.1 Test SNW_DS_MAIN_GRID_SEARCH Defaults More Dense

Rather than solving for "docdense", this solves for "moredense", which has fewer shocks, in order to save time given the relatively slow speed of this algorithm.

```
mp_params = snw_mp_param('default_moredense');
mp_controls = snw_mp_control('default_test');
mp_controls('bl_print_vfi') = false;
mp_controls('bl_print_ds') = false;
mp_controls('bl_print_ds_verbose') = false;
[Phi_true,Phi_adj,A_agg,Y_inc_agg,it,mp_dsvfi_results] = snw_ds_main_grid_search(mp_params, mp_contr
```

```
Elapsed time is 11762.574665 seconds.
Completed SNW_VFI_MAIN_GRID_SEARCH;SNW_MP_PARAM=default_moredense;SNW_MP_CONTROL=default_test
Elapsed time is 12505.621399 seconds.
Completed SNW_DS_MAIN;SNW_MP_PARAM=;default_moredense;SNW_MP_CONTROL=;default_test
```

```
Phi_true = Phi_true/sum(Phi_true(:));
```

6.3.2 Show All Info in mp_dsvfi_results More Dense

```
mp_cl_mt_xyz_of_s = mp_dsvfi_results('mp_cl_mt_xyz_of_s');
disp(mp_cl_mt_xyz_of_s('tb_outcomes'))
```

```
                      mean      unweighted_sum       sd        coefofvar      gini        min
                    --------    --------------    --------    ---------    -------    --------    -

    a_ss             4.1966         5130.2         8.2211        1.959     0.74586           0
    ap_ss            33.417          11476         25.564        0.765     0.44091           1
    cons_ss          1.1837        1.59e+07        1.0186      0.86052     0.40734    0.035637
    v_ss            -19.282      -9.477e+06         35.18      -1.8245     -0.7793     -867.32
    n_ss             2.3554             21         1.4375      0.61029      0.3128           1
    y_all            1.6288       2.398e+07        1.8953       1.1636     0.49934    0.038108
    y_head_inc       1.2693      5.6172e+05         1.541       1.2141     0.50187    0.038108
    y_head_earn      1.0492         2628.2         1.4242       1.3574     0.60462           0
    y_spouse_inc    0.35948          55577        0.96095       2.6732     0.85293           0
    yshr_interest   0.10937      1.0949e+06        0.1698       1.5525       0.711           0    0
    yshr_wage       0.78519      2.3994e+06       0.34085      0.43409     0.19417           0
    yshr_SS         0.10544          70381        0.24571       2.3303     0.91374           0
    yshr_tax        0.17729      7.7889e+05      0.040058      0.22594     0.12851    0.036506
    yshr_nttxss    0.071855      7.0851e+05       0.26576       3.6986      1.5402    -0.89184
```

6.3.3 More Dense Param Results Define Frames

Define the matrix dimensions names and dimension vector values. Probability mass matrixes, Policy and Value Functions share the same ND dimensional structure.

```
% Grids:
age_grid = 18:100;
agrid = mp_params('agrid')';
eta_H_grid = mp_params('eta_H_grid')';
eta_S_grid = mp_params('eta_S_grid')';
ar_st_eta_HS_grid = string(cellstr([num2str(eta_H_grid', 'hz=%3.2f;'), num2str(eta_S_grid', 'wz=%3.2
edu_grid = [0,1];
marry_grid = [0,1];
kids_grid = (1:1:mp_params('n_kidsgrid'))';
% NaN(n_jgrid,n_agrid,n_etagrid,n_educgrid,n_marriedgrid,n_kidsgrid);
cl_mp_datasetdesc = {};
cl_mp_datasetdesc{1} = containers.Map({'name', 'labval'}, {'age', age_grid});
cl_mp_datasetdesc{2} = containers.Map({'name', 'labval'}, {'savings', agrid});
cl_mp_datasetdesc{3} = containers.Map({'name', 'labval'}, {'eta', 1:length(eta_H_grid)});
cl_mp_datasetdesc{4} = containers.Map({'name', 'labval'}, {'edu', edu_grid});
cl_mp_datasetdesc{5} = containers.Map({'name', 'labval'}, {'marry', marry_grid});
cl_mp_datasetdesc{6} = containers.Map({'name', 'labval'}, {'kids', kids_grid});
```

6.3.4 Analyze Probability Mass Along Age Dimensions

Where are the mass at? Analyze mass given state space components.

```
% Get the Joint distribution over all states
% Define Graph Inputs
mp_support_graph = containers.Map('KeyType', 'char', 'ValueType', 'any');
mp_support_graph('st_legend_loc') = 'best';
mp_support_graph('bl_graph_logy') = false; % do not log
```

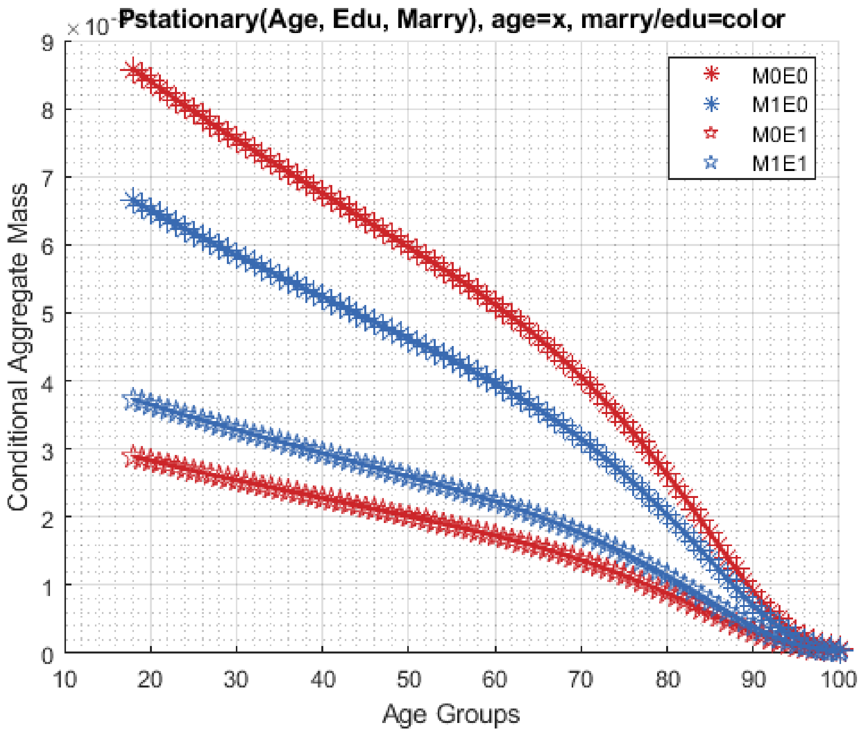
Exogenous Permanent States Mass: Life Cycle, Edu and Marraige

Tabulate value and policies along savings and shocks:

```
% NaN(n_jgrid,n_agrid,n_etagrid,n_educgrid,n_marriedgrid,n_kidsgrid);
ar_permute = [2,3,6,1,5,4];
% Value Function
tb_prob_aem = ff_summ_nd_array("P(Age, EDU, MARRY))", Phi_true, true, ["sum"], 3, 1, cl_mp_datasetde
```

```
xxx  P(Age, EDU, MARRY))  xxxxxxxxxxxxxxxxxxxxxxxxxxx
    group    marry    edu    sum_age_18    sum_age_19    sum_age_20    sum_age_21    sum_age_22    s
    -----    -----    ---    ----------    ----------    ----------    ----------    ----------    -

      1        0       0     0.0085768     0.0084866     0.0083969     0.0083078     0.0082194     0
      2        1       0     0.0066438     0.0065739     0.0065044     0.0064354     0.0063669
      3        0       1     0.0028875     0.0028571      0.002827      0.002797     0.0027672     0
      4        1       1     0.0037292     0.0036899     0.0036509     0.0036122     0.0035738     0
```

```
mp_support_graph('cl_st_graph_title') = {'Pstationary(Age, Edu, Marry), age=x, marry/edu=color'};
mp_support_graph('cl_st_ytitle') = {'Conditional Aggregate Mass'};
ar_row_grid = ["M0E0", "M1E0", "M0E1", "M1E1"];
mp_support_graph('cl_st_xtitle') = {'Age Groups'};
mp_support_graph('cl_scatter_shapes') = {'*', '*', 'p', 'p' };
mp_support_graph('cl_colors') = {'red', 'blue', 'red', 'blue'};
ff_graph_grid((tb_prob_aem{1:end, 4:end}), ar_row_grid, age_grid, mp_support_graph);
```



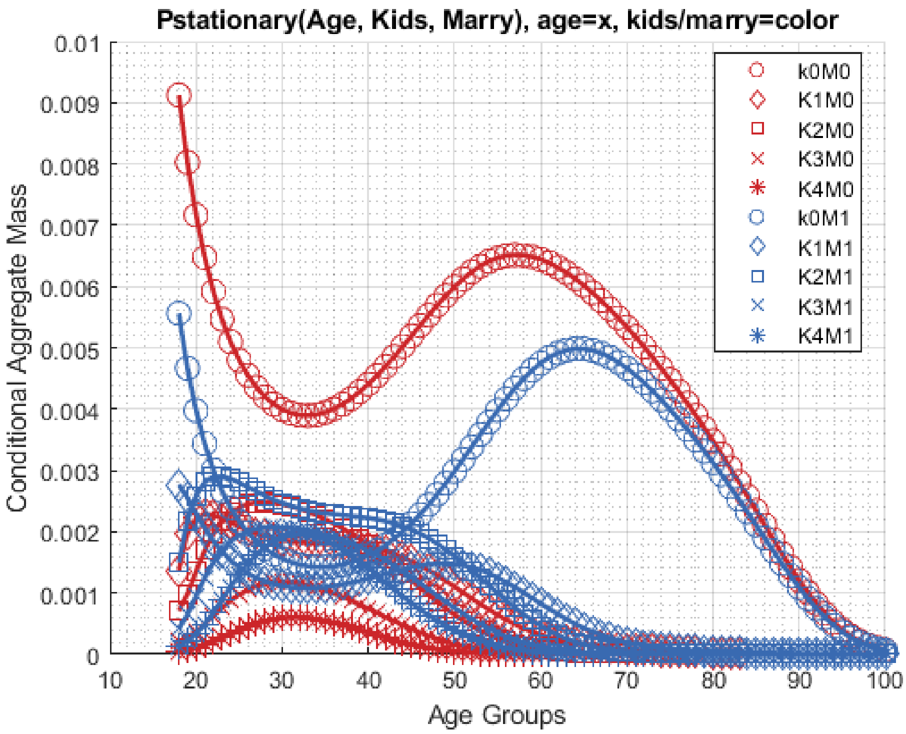
Kids and Marry By Age Mass

```
% NaN(n_jgrid,n_agrid,n_etagrid,n_educgrid,n_marriedgrid,n_kidsgrid);
ar_permute = [2,3,4,1,6,5];
% Value Function
tb_prob_amarrykids = ff_summ_nd_array("P(Age, Kids, Marry))", Phi_true, true, ["sum"], 3, 1, cl_mp_d
```

```
xxx  P(Age, Kids, Marry))  xxxxxxxxxxxxxxxxxxxxxxxxxxx
    group    kids    marry    sum_age_18    sum_age_19    sum_age_20    sum_age_21    sum_age_22
    -----    ----    -----    ----------    ----------    ----------    ----------    ----------
```

```
 1      1      0     0.0091249    0.0080278    0.0071652    0.0064765    0.0059205
 2      2      0     0.0013699    0.0019743    0.0022187    0.0022858    0.0022687
 3      3      0    0.00071266   0.00098425    0.0013537    0.0016929    0.0019639
 4      4      0    0.00020622   0.00027865   0.00037326   0.00049476   0.00062818
 5      5      0    5.0761e-05   7.8715e-05     0.000113   0.00015485   0.00020534
 6      1      1     0.0055624    0.0046679    0.0039774    0.0034368    0.0030088
 7      2      1     0.0027682    0.0025539    0.0023005    0.0020611    0.0018525
 8      3      1     0.0014982    0.0021823    0.0025943    0.0028096     0.002896
 9      4      1    0.00041197   0.00064648   0.00095224    0.0012491    0.0015009
10      5      1    0.00013221    0.0002132   0.00033097   0.00049097   0.00068255
```

```
mp_support_graph('cl_st_graph_title') = {'Pstationary(Age, Kids, Marry), age=x, kids/marry=color'};
mp_support_graph('cl_st_ytitle') = {'Conditional Aggregate Mass'};
ar_row_grid = [...
    "k0M0", "K1M0", "K2M0", "K3M0", "K4M0", ...
    "k0M1", "K1M1", "K2M1", "K3M1", "K4M1"];
mp_support_graph('cl_scatter_shapes') = {...
    'o', 'd' ,'s', 'x', '*', ...
    'o', 'd', 's', 'x', '*'};
mp_support_graph('cl_colors') = {...
    'red', 'red', 'red', 'red', 'red'...
    'blue', 'blue', 'blue', 'blue', 'blue'};
mp_support_graph('cl_st_xtitle') = {'Age Groups'};
ff_graph_grid((tb_prob_amarrykids{1:end, 4:end}), ar_row_grid, age_grid, mp_support_graph);
```



6.3.5 Analyze Probability Mass Asset and Shock Dimensions

Where are the mass at?

```
% Define Graph Inputs
mp_support_graph = containers.Map('KeyType', 'char', 'ValueType', 'any');
mp_support_graph('st_legend_loc') = 'best';
mp_support_graph('bl_graph_logy') = false; % do not log
```

Asset and Shock Mass

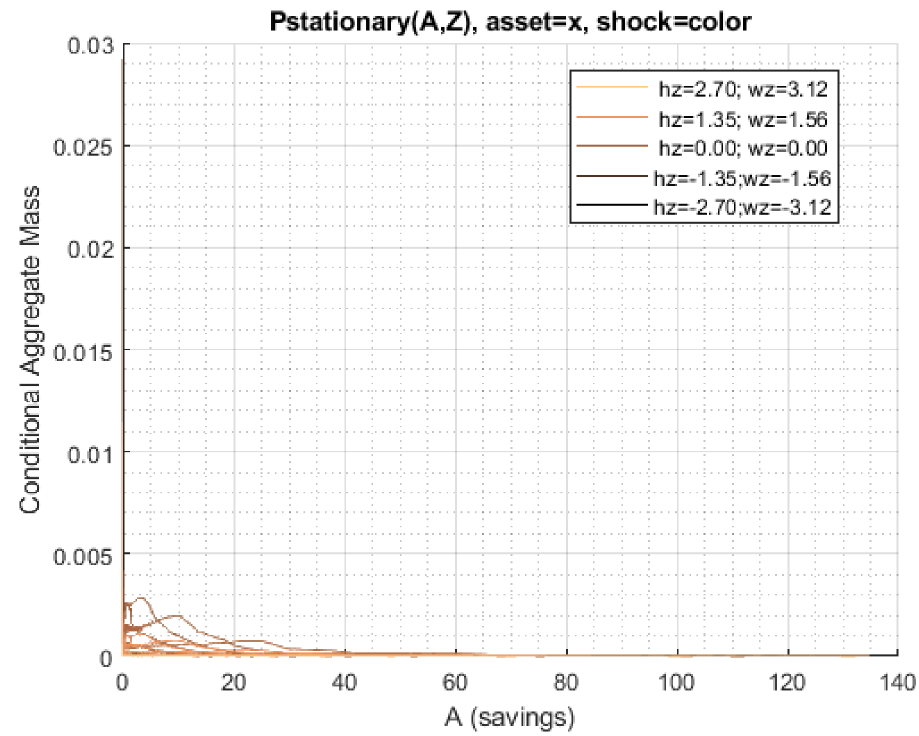
```
% NaN(n_jgrid,n_agrid,n_etagrid,n_educgrid,n_marriedgrid,n_kidsgrid);
ar_permute = [1,4,5,6,3,2];
% Value Function
tb_prob_az = ff_summ_nd_array("P(A,Z))", Phi_true, true, ["sum"], 4, 1, cl_mp_datasetdesc, ar_permut
```

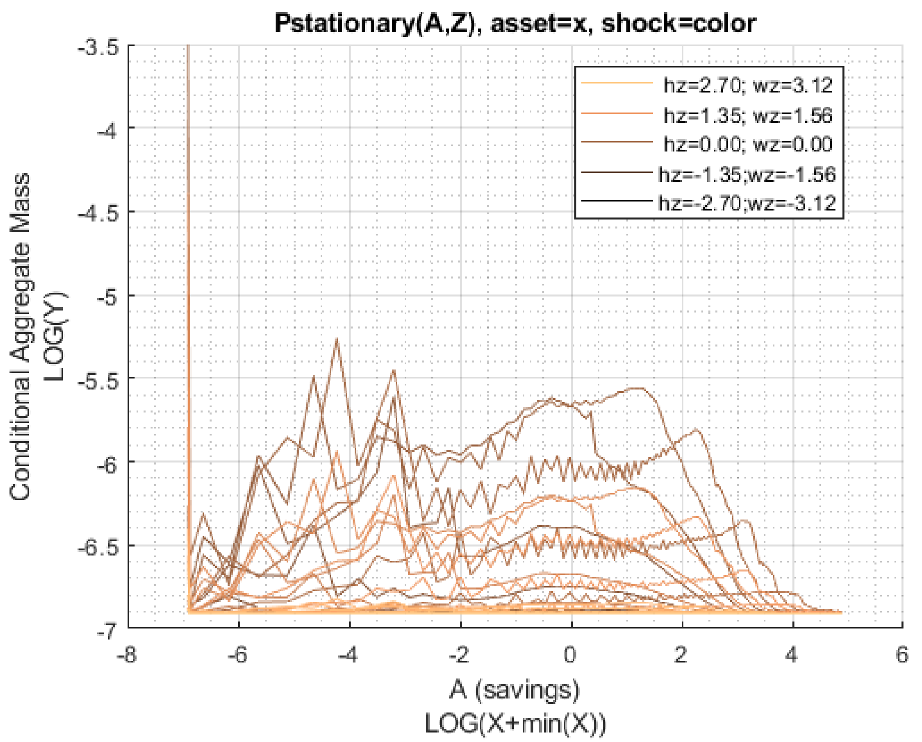
xxx P(A,Z)) xxxxxxxxxxxxxxxxxxxxxxxxxxx

group	savings	sum_eta_1	sum_eta_2	sum_eta_3	sum_eta_4	sum_eta_5	sum_et
1	0	1.7781e-05	0.00011464	0.00040781	0.00065248	0.00059124	0.0003
2	4e-05	2.8722e-07	1.1649e-06	3.9632e-06	1.1727e-06	9.1594e-06	8.6911
3	0.00032	8.5865e-07	2.0949e-06	1.3074e-05	9.3326e-06	1.8355e-05	2.7109
4	0.00108	2.4439e-06	7.4985e-06	7.825e-06	5.1658e-06	4.2511e-06	9.0564
5	0.00256	7.4917e-07	5.7803e-06	3.1919e-05	3.5332e-05	2.8844e-05	5.4161
6	0.005	1.6199e-07	5.684e-06	1.1553e-05	2.0567e-05	4.1715e-05	9.3727
7	0.00864	2.9061e-07	1.562e-05	1.4073e-05	7.0288e-05	3.462e-05	1.6548
8	0.01372	9.5464e-08	2.3479e-06	1.7752e-05	2.4581e-05	9.4236e-05	2.0967
9	0.02048	1.4979e-07	5.1146e-06	2.195e-05	2.7505e-05	3.1649e-05	2.1267
10	0.02916	2.2894e-07	2.3319e-06	2.9711e-05	4.1965e-05	4.8965e-05	4.931
11	0.04	3.76e-07	3.6133e-06	5.9345e-05	4.0368e-05	4.4556e-05	7.3962
12	0.05324	2.756e-07	2.2346e-06	1.4966e-05	3.6227e-05	2.4755e-05	3.695
13	0.06912	3.3888e-07	2.6932e-06	1.5812e-05	3.8986e-05	3.8211e-05	1.648
14	0.08788	3.0263e-07	2.2683e-06	1.6049e-05	3.5262e-05	2.667e-05	2.515
15	0.10976	2.6825e-07	2.1043e-06	2.4986e-05	3.6843e-05	3.4559e-05	1.5405
16	0.135	2.768e-07	1.8377e-06	9.0408e-06	3.5423e-05	3.2867e-05	2.4479
17	0.16384	2.8181e-07	1.9353e-06	9.257e-06	3.8786e-05	3.6177e-05	1.9607
18	0.19652	3.067e-07	2.0467e-06	9.1227e-06	3.8618e-05	3.0376e-05	2.7065
19	0.23328	3.3018e-07	2.1755e-06	1.0247e-05	4.2533e-05	4.2068e-05	1.8014
20	0.27436	3.6009e-07	2.3328e-06	1.0941e-05	4.3919e-05	3.3639e-05	2.5977
21	0.32	4.1186e-07	2.5895e-06	1.1659e-05	4.7371e-05	4.4252e-05	2.4973
22	0.37044	4.4759e-07	2.8965e-06	1.2583e-05	4.8243e-05	4.0516e-05	2.8508
23	0.42592	4.7723e-07	3.3135e-06	1.3374e-05	5.3569e-05	4.9866e-05	2.3551
24	0.48668	5.296e-07	3.4623e-06	1.4309e-05	5.3859e-05	5.1087e-05	3.5022
25	0.55296	5.459e-07	3.6382e-06	1.5329e-05	5.7267e-05	5.3924e-05	2.6534
26	0.625	5.615e-07	3.878e-06	1.5435e-05	5.7034e-05	5.5588e-05	3.3803
27	0.70304	5.616e-07	3.8405e-06	1.5148e-05	5.8804e-05	5.7189e-05	3.0223
28	0.78732	5.8141e-07	3.7688e-06	1.5044e-05	5.7591e-05	5.4784e-05	3.5161
29	0.87808	5.8397e-07	3.8463e-06	1.504e-05	5.6538e-05	5.6164e-05	2.6669
30	0.97556	5.7697e-07	3.9047e-06	1.4901e-05	5.5173e-05	5.4358e-05	3.4721
31	1.08	5.7655e-07	3.8874e-06	1.5177e-05	5.445e-05	5.7049e-05	2.7157
32	1.1916	5.6606e-07	3.778e-06	1.4865e-05	5.185e-05	5.5565e-05	3.2554
33	1.3107	5.5291e-07	3.7261e-06	1.43e-05	4.9523e-05	5.7531e-05	2.8096
34	1.4375	5.3074e-07	3.574e-06	1.3682e-05	5.2445e-05	5.5479e-05	3.1707
35	1.5722	5.0996e-07	3.497e-06	1.3373e-05	3.5566e-05	5.7462e-05	2.7077
36	1.715	5.0049e-07	3.3282e-06	1.3028e-05	3.4521e-05	5.6522e-05	3.2615
37	1.8662	4.7974e-07	3.329e-06	1.2601e-05	3.3434e-05	5.8509e-05	2.6878
38	2.0261	4.596e-07	3.1609e-06	1.2343e-05	3.178e-05	5.9485e-05	3.2101
39	2.1949	4.4954e-07	3.105e-06	1.2095e-05	3.1287e-05	5.9761e-05	2.7128
40	2.3728	4.1729e-07	3.0323e-06	1.186e-05	3.0175e-05	6.1927e-05	3.2379
41	2.56	3.9929e-07	2.924e-06	1.1544e-05	2.9921e-05	6.1827e-05	2.7425
42	2.7568	3.8414e-07	2.7951e-06	1.1251e-05	2.6814e-05	6.3135e-05	3.2763
43	2.9635	3.616e-07	2.7007e-06	1.0868e-05	2.5813e-05	6.3482e-05	2.7626
44	3.1803	3.3481e-07	2.5593e-06	1.0429e-05	2.5595e-05	6.3992e-05	3.3047
45	3.4074	3.131e-07	2.4198e-06	9.99e-06	2.4766e-05	6.3343e-05	2.858
46	3.645	2.9457e-07	2.2754e-06	9.6582e-06	2.4476e-05	6.3967e-05	3.3608
47	3.8934	2.7703e-07	2.1293e-06	9.1931e-06	2.3981e-05	6.2378e-05	3.2136
48	4.1529	2.515e-07	2.018e-06	8.6923e-06	2.3738e-05	6.0398e-05	3.4717
49	4.4237	2.3412e-07	1.8599e-06	8.0926e-06	2.2417e-05	5.8532e-05	3.3219

50	4.706	2.1348e-07	1.7011e-06	7.6231e-06	2.1465e-05	5.6363e-05	3.5656
51	5	1.9593e-07	1.5641e-06	7.1764e-06	2.0854e-05	5.2743e-05	3.4502
52	5.306	1.7768e-07	1.4581e-06	6.7963e-06	2.007e-05	4.821e-05	3.7676
53	5.6243	1.5982e-07	1.3264e-06	6.2348e-06	1.9171e-05	4.3737e-05	3.5788
54	5.9551	1.4334e-07	1.204e-06	5.8483e-06	1.8296e-05	4.106e-05	3.8181
55	6.2986	1.3188e-07	1.1011e-06	5.4121e-06	1.7322e-05	3.901e-05	3.7324
56	6.655	1.1797e-07	9.977e-07	4.9804e-06	1.6132e-05	3.7093e-05	4.0152
57	7.0246	1.0623e-07	9.1605e-07	4.7007e-06	1.5537e-05	3.4804e-05	4.0289
58	7.4077	9.4398e-08	8.3453e-07	4.3022e-06	1.4566e-05	3.2665e-05	4.1753
59	7.8045	8.2422e-08	7.5244e-07	3.9469e-06	1.3777e-05	3.0198e-05	4.183
60	8.2152	7.1784e-08	6.6939e-07	3.6212e-06	1.3091e-05	2.7445e-05	4.309
61	8.64	6.1804e-08	5.8987e-07	3.2784e-06	1.2179e-05	2.5843e-05	4.2847
62	9.0792	5.3502e-08	5.1823e-07	2.9635e-06	1.1462e-05	2.4729e-05	4.4278
63	9.5331	4.5477e-08	4.5311e-07	2.6656e-06	1.0485e-05	2.3755e-05	4.4697
64	10.002	3.8449e-08	3.8904e-07	2.358e-06	9.5066e-06	2.227e-05	4.4247
65	10.486	3.2576e-08	3.3716e-07	2.0726e-06	8.8323e-06	2.1148e-05	4.3231
66	10.985	2.7144e-08	2.8859e-07	1.805e-06	8.1101e-06	1.9267e-05	4.0181
67	11.5	2.234e-08	2.4458e-07	1.5627e-06	7.3458e-06	1.7795e-05	3.8372
68	12.031	1.8426e-08	2.0804e-07	1.3548e-06	6.7189e-06	1.6482e-05	3.5562
69	12.577	1.5109e-08	1.7304e-07	1.1665e-06	6.035e-06	1.5039e-05	3.3252
70	13.14	1.2136e-08	1.4416e-07	9.8771e-07	5.3216e-06	1.3797e-05	2.8982
71	13.72	9.7439e-09	1.1717e-07	8.4655e-07	4.7591e-06	1.2593e-05	2.5621
72	14.316	7.6519e-09	9.5696e-08	7.1116e-07	4.1025e-06	1.1341e-05	2.5829
73	14.93	6.0255e-09	7.71e-08	5.9381e-07	3.5724e-06	1.0484e-05	2.4658
74	15.561	4.7503e-09	6.2213e-08	4.9108e-07	3.1215e-06	9.5178e-06	2.3245
75	16.209	3.7139e-09	4.928e-08	4.0026e-07	2.6199e-06	8.2935e-06	2.1991
76	16.875	2.945e-09	3.8866e-08	3.2717e-07	2.258e-06	7.5498e-06	1.9996
77	17.559	2.3042e-09	3.075e-08	2.6267e-07	1.8986e-06	6.5071e-06	1.9146
78	18.261	1.7888e-09	2.4653e-08	2.1261e-07	1.6083e-06	5.7887e-06	1.8096
79	18.982	1.3465e-09	1.9495e-08	1.7008e-07	1.3129e-06	5.0003e-06	1.5323
80	19.722	9.9583e-10	1.5366e-08	1.3569e-07	1.0922e-06	4.3544e-06	1.2912
81	20.48	7.1218e-10	1.1848e-08	1.0869e-07	9.0647e-07	3.715e-06	1.1136
82	21.258	5.1489e-10	8.9408e-09	8.6675e-08	7.3075e-07	3.2426e-06	1.018
83	22.055	3.7141e-10	6.6969e-09	6.8391e-08	5.9709e-07	2.8121e-06	9.0229
84	22.871	2.7136e-10	4.8427e-09	5.3798e-08	4.7428e-07	2.4448e-06	8.136
85	23.708	1.9274e-10	3.4542e-09	4.184e-08	3.8443e-07	2.0544e-06	7.4782
86	24.565	1.3871e-10	2.4987e-09	3.1083e-08	3.0722e-07	1.6959e-06	6.7652
87	25.442	9.9269e-11	1.8401e-09	2.3394e-08	2.4072e-07	1.4171e-06	6.0563
88	26.34	7.0282e-11	1.338e-09	1.7154e-08	1.9419e-07	1.1731e-06	5.8143

```
mp_support_graph('cl_st_graph_title') = {'Pstationary(A,Z), asset=x, shock=color'};
mp_support_graph('cl_st_ytitle') = {'Conditional Aggregate Mass'};
mp_support_graph('cl_st_xtitle') = {'A (savings)'};
mp_support_graph('st_rowvar_name') = 'z=';
mp_support_graph('it_legend_select') = 5;
mp_support_graph('st_rounding') = '6.2f';
mp_support_graph('bl_graph_logy') = true;
mp_support_graph('cl_colors') = 'copper';
ff_graph_grid((tb_prob_az{1:end, 3:end})', ar_st_eta_HS_grid, agrid, mp_support_graph);% Consumption
```





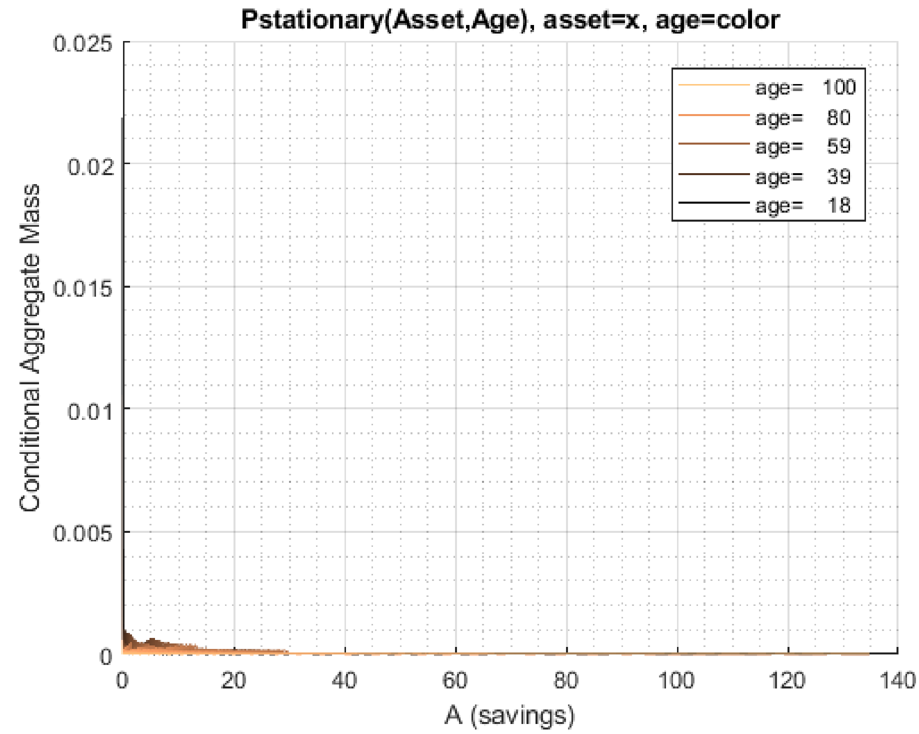
Asset Mass by Age

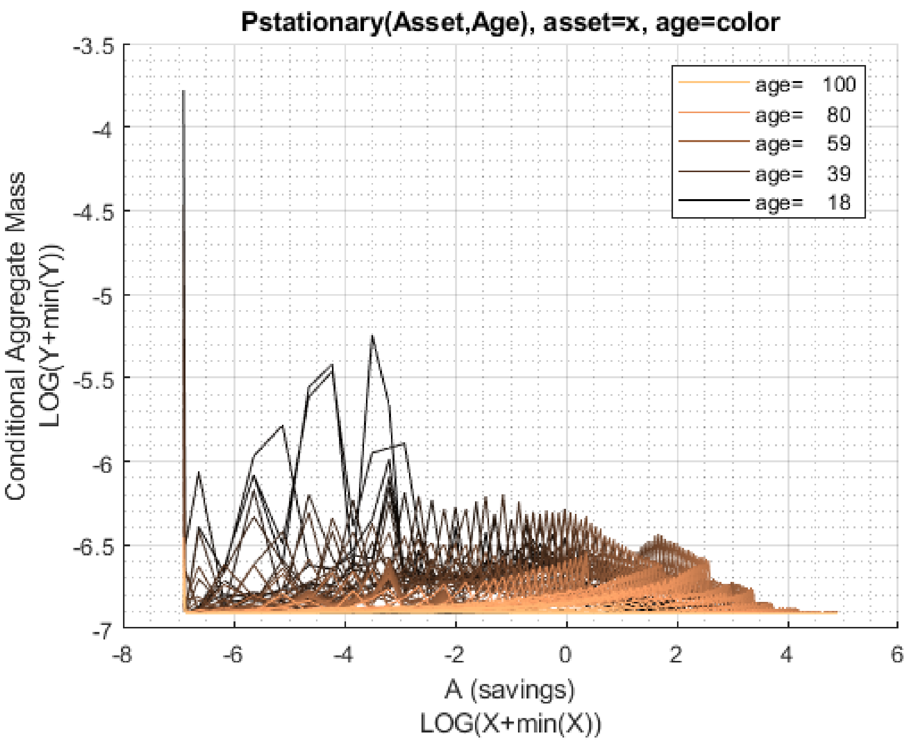
```
% NaN(n_jgrid,n_agrid,n_etagrid,n_educgrid,n_marriedgrid,n_kidsgrid);
ar_permute = [3,4,5,6,1,2];
% Value Function
tb_prob_aage = ff_summ_nd_array("P(A,Z))", Phi_true, true, ["sum"], 4, 1, cl_mp_datasetdesc, ar_perm
```

```
xxx  P(A,Z))  xxxxxxxxxxxxxxxxxxxxxxxxxxx
    group    savings    sum_age_18    sum_age_19    sum_age_20    sum_age_21    sum_age_22    sum_ag
    -----    -------    ----------    ----------    ----------    ----------    ----------    ------
```

1	0	0.021837	0.002388	0.0018389	0.006441	0.0087965	0.01
2	4e-05	0	2.3862e-06	2.8257e-06	1.5227e-05	0.0005064	7.0852
3	0.00032	0	3.749e-05	3.8393e-05	0.00067452	0.0013201	3.5849
4	0.00108	0	0.00031485	0.0003134	0.00027518	6.9704e-05	0.0001
5	0.00256	0	0.0012853	0.0012851	0.0015569	8.2105e-05	0.0001
6	0.005	0	0.00034215	0.00051426	0.0020794	0.00015795	0.0001
7	0.00864	0	0.0028722	0.0026464	0.00033471	0.00033022	0.0001
8	0.01372	0	0.003431	0.003249	0.00029554	0.00030632	0.0001
9	0.02048	0	0.00028503	0.00067599	0.00046576	0.00041506	0.0003
10	0.02916	0	0.004274	0.0016076	0.00075151	0.00038657	0.0003
11	0.04	0	0.0024741	0.0016863	0.0015147	0.0012561	0.001
12	0.05324	0	0.00012193	0.0017565	0.00025806	0.00022971	0.0002
13	0.06912	0	0.00044563	0.00062939	0.00029172	0.00029386	0.0002
14	0.08788	0	2.7692e-05	0.00011258	0.00016217	0.00018796	0.0002
15	0.10976	0	6.2377e-05	8.9179e-06	7.302e-05	0.00017801	0.0001
16	0.135	0	0.00067668	0.00016485	0.00010669	0.000221	0.0002
17	0.16384	0	5.8231e-06	5.1096e-05	0.00019395	0.00024128	0.000
18	0.19652	0	3.2338e-05	4.7486e-05	0.00021219	0.000234	0.0002
19	0.23328	0	2.7827e-05	0.00062962	0.00032249	0.00035572	0.0002
20	0.27436	0	3.3098e-06	0.00012226	0.00073141	0.00035073	0.0003
21	0.32	0	4.0326e-05	0.00029658	0.00038943	0.00026142	0.0003
22	0.37044	0	0.00023294	0.00034328	0.00045557	0.00074931	0.0003
23	0.42592	0	0.00029162	0.00046139	0.0003154	0.00034178	0.0003
24	0.48668	0	0.0002901	0.00049107	0.00051926	0.00039455	0.0006
25	0.55296	0	0.00034886	0.00054566	0.00036044	0.00041009	0.0004
26	0.625	0	0.00050916	0.00043446	0.00028992	0.00033921	0.0003
27	0.70304	0	0.00039586	0.00037772	0.00035949	0.00035245	0.0003
28	0.78732	0	0.00020681	0.00035133	0.00037856	0.00031646	0.0003
29	0.87808	0	1.4297e-05	5.5411e-05	0.00015549	0.0003353	0.0002
30	0.97556	0	1.5592e-05	6.2891e-05	0.00029115	0.00021838	0.0002
31	1.08	0	2.009e-06	8.4112e-05	0.000141	0.00019198	0.0002
32	1.1916	0	2.1045e-05	0.00010104	0.00015492	0.00012578	0.0001
33	1.3107	0	1.4435e-06	6.9531e-05	5.1206e-05	0.0002098	0.0001
34	1.4375	0	5.1689e-07	4.651e-05	7.8499e-05	7.7448e-05	0.0001
35	1.5722	0	4.7793e-07	4.9348e-06	2.019e-05	8.9748e-05	0.0001
36	1.715	0	2.3446e-06	4.4093e-06	2.1355e-05	4.3825e-05	0.0001
37	1.8662	0	2.6545e-07	5.0217e-06	2.7683e-05	3.388e-05	5.2151
38	2.0261	0	5.4286e-07	3.5584e-06	1.9841e-05	3.2561e-05	4.6305
39	2.1949	0	1.5332e-06	2.2585e-05	9.5902e-06	3.1168e-05	4.1488
40	2.3728	0	4.1159e-06	1.2545e-05	1.5104e-05	1.9972e-05	4.8064
41	2.56	0	4.9992e-06	9.9133e-06	2.4176e-05	2.6663e-05	3.4515
42	2.7568	0	7.7981e-06	1.537e-05	2.0404e-05	3.8764e-05	3.1904
43	2.9635	0	1.0694e-05	1.9867e-05	2.6641e-05	3.3667e-05	4.0931
44	3.1803	0	1.3309e-05	1.8778e-05	4.551e-05	3.4837e-05	4.3432
45	3.4074	0	1.3226e-05	2.3e-05	3.5495e-05	3.4352e-05	4.101
46	3.645	0	3.533e-06	2.5708e-05	3.2758e-05	4.0617e-05	3.8932
47	3.8934	0	1.8503e-05	2.4946e-05	2.607e-05	3.9121e-05	3.9913

```
mp_support_graph('cl_st_graph_title') = {'Pstationary(Asset,Age), asset=x, age=color'};
mp_support_graph('cl_st_ytitle') = {'Conditional Aggregate Mass'};
mp_support_graph('cl_st_xtitle') = {'A (savings)'};
mp_support_graph('st_rowvar_name') = 'age=';
mp_support_graph('it_legend_select') = 5;
mp_support_graph('st_rounding') = '6.0f';
mp_support_graph('bl_graph_logy') = true;
mp_support_graph('cl_colors') = 'copper';
ff_graph_grid((tb_prob_aage{1:end, 3:end})', age_grid, agrid, mp_support_graph);% Consumption Choice
```





6.3.6 Probability Statistics A, C and V Conditional on Ages

Where are the mass at?

```
ap_ss = mp_dsvfi_results('ap_ss');
c_ss = mp_dsvfi_results('cons_ss');
v_ss = mp_dsvfi_results('v_ss');
n_ss = mp_dsvfi_results('n_ss');

y_head_inc = mp_dsvfi_results('y_head_inc_ss');
```

```
y_spouse_inc = mp_dsvfi_results('y_spouse_inc_ss');

yshr_wage = mp_dsvfi_results('yshr_wage_ss');
yshr_SS = mp_dsvfi_results('yshr_SS_ss');
yshr_nttxss = mp_dsvfi_results('yshr_nttxss_ss');

for it_ctr=1:size(ap_ss, 1)
    if (ismember(it_ctr, round(linspace(1, size(ap_ss, 1), 3))))
        display(['age =' num2str(age_grid(it_ctr))]);

        % construct input data
        Phi_true_age = Phi_true(it_ctr, :, :, : ,: ,:);
        ap_ss_age = ap_ss(it_ctr, :, :, : ,: ,:);
        c_ss_age = c_ss(it_ctr, :, :, : ,: ,:);
        v_ss_age = v_ss(it_ctr, :, :, : ,: ,:);
        n_ss_age = n_ss(it_ctr, :, :, : ,: ,:);

        y_head_inc_age = y_head_inc(it_ctr, :, :, : ,: ,:);
        y_spouse_inc_age = y_spouse_inc(it_ctr, :, :, : ,: ,:);
        yshr_wage_age = yshr_wage(it_ctr, :, :, : ,: ,:);
        yshr_SS_age = yshr_SS(it_ctr, :, :, : ,: ,:);
        yshr_nttxss_age = yshr_nttxss(it_ctr, :, :, : ,: ,:);

        mp_cl_ar_xyz_of_s = containers.Map('KeyType','char', 'ValueType','any');
        mp_cl_ar_xyz_of_s('ap_ss') = {ap_ss_age(:), zeros(1)};
        mp_cl_ar_xyz_of_s('c_ss') = {c_ss_age(:), zeros(1)};
        mp_cl_ar_xyz_of_s('v_ss') = {v_ss_age(:), zeros(1)};
        mp_cl_ar_xyz_of_s('n_ss') = {n_ss_age(:), zeros(1)};
        mp_cl_ar_xyz_of_s('y_head_inc') = {y_head_inc_age(:), zeros(1)};
        mp_cl_ar_xyz_of_s('y_spouse') = {y_spouse_inc_age(:), zeros(1)};
        mp_cl_ar_xyz_of_s('yshr_wage') = {yshr_wage_age(:), zeros(1)};
        mp_cl_ar_xyz_of_s('yshr_SS') = {yshr_SS_age(:), zeros(1)};
        mp_cl_ar_xyz_of_s('yshr_nttxss') = {yshr_nttxss_age(:), zeros(1)};
        mp_cl_ar_xyz_of_s('ar_st_y_name') = ["ap_ss", "c_ss", "v_ss", "n_ss",...
            "y_head_inc", "y_spouse", "yshr_wage", "yshr_SS", "yshr_nttxss"];

        % controls
        mp_support = containers.Map('KeyType','char', 'ValueType','any');
        mp_support('ar_fl_percentiles') = [0.01 10 25 50 75 90 99.99];
        mp_support('bl_display_final') = true;
        mp_support('bl_display_detail') = false;
        mp_support('bl_display_drvm2outcomes') = false;
        mp_support('bl_display_drvstats') = false;
        mp_support('bl_display_drvm2covcor') = false;

        % Call Function
        mp_cl_mt_xyz_of_s = ff_simu_stats(Phi_true_age(:)/sum(Phi_true_age,'all'), mp_cl_ar_xyz_of_s
    end
end

age =18
xxx tb_outcomes: all stats xxx
    OriginalVariableNames        ap_ss         c_ss          v_ss          n_ss        y_head_inc
    _____________________    ___________    ___________    ___________    ___________    __________

    {'mean'              }         10.116        0.75737        -37.312         1.9854        0.8434
    {'unweighted_sum'    }          11476     2.4434e+05    -7.8101e+05             21        4422.
    {'sd'                }         6.9537        0.67774         55.469         1.0848        0.9050
```

```
    {'coefofvar'          }       0.68742        0.89486        -1.4866        0.54639         1.073
    {'gini'               }       0.32034        0.41117       -0.64451          0.268         0.4135
    {'min'                }             1       0.035637        -867.32              1        0.03810
    {'max'                }           151         18.059         25.519              6         13.78
    {'pYis0'              }             0              0              0              0
    {'pYls0'              }             0              0         0.8166              0
    {'pYgr0'              }             1              1         0.1834              1
    {'pYisMINY'           }       0.11052      0.0014188     7.8342e-06        0.41786       0.003370
    {'pYisMAXY'           }             0              0              0      0.0060544
    {'p0_01'              }             1       0.035637        -745.16              1        0.03810
    {'p10'                }             1        0.24578        -86.259              1         0.1467
    {'p25'                }             7         0.3161         -50.56              1         0.2880
    {'p50'                }             9        0.51551        -25.263              2         0.5652
    {'p75'                }            11        0.88958        -5.3994              3          1.109
    {'p90'                }            23         1.5797         6.1229              4          2.176
    {'p99_99'             }            52         6.8857         23.695              6          8.383
    {'fl_cov_ap_ss'       }        48.354         1.9167         115.84        0.29345          1.774
    {'fl_cor_ap_ss'       }             1         0.4067        0.30034       0.038901         0.2819
    {'fl_cov_c_ss'        }        1.9167        0.45934         20.257       0.067217         0.5982
    {'fl_cor_c_ss'        }        0.4067              1        0.53884       0.091423          0.975
    {'fl_cov_v_ss'        }        115.84         20.257         3076.8         2.8057          24.48
    {'fl_cor_v_ss'        }       0.30034        0.53884              1       0.046626         0.4877
    {'fl_cov_n_ss'        }       0.29345       0.067217         2.8057         1.1768    -4.9873e-1
    {'fl_cor_n_ss'        }      0.038901       0.091423       0.046626              1    -5.0797e-1
    {'fl_cov_y_head_inc' }        1.7747        0.59824         24.488    -4.9873e-18         0.8191
    {'fl_cor_y_head_inc' }       0.28199         0.9753        0.48778    -5.0797e-18
    {'fl_cov_y_spouse'   }        3.1074       0.081697         4.9077        0.13364        0.02175
    {'fl_cor_y_spouse'   }       0.77947        0.21026        0.15433        0.21488         0.0419
    {'fl_cov_yshr_wage'  }   -9.6296e-31    -3.1682e-32     5.4234e-31      3.667e-31     3.5697e-3
    {'fl_cor_yshr_wage'  }   -1.5592e-16    -5.2631e-17     1.1008e-17     3.8058e-16     4.4408e-1
    {'fl_cov_yshr_SS'    }             0              0              0              0
    {'fl_cor_yshr_SS'    }           NaN            NaN            NaN            NaN             Na
    {'fl_cov_yshr_nttxss'}       0.16611       0.021334         1.8502      0.0077776        0.02521
    {'fl_cor_yshr_nttxss'}       0.58487        0.77071        0.81669        0.17554         0.6822
    {'fracByP0_01'       }      0.010925     6.6761e-05      0.0030622        0.21046      0.0001522
    {'fracByP10'         }      0.010925       0.050401        0.44077        0.21046        0.01922
    {'fracByP25'         }         0.148       0.072459        0.71224        0.21046        0.09634
    {'fracByP50'         }       0.28531        0.21889        0.94749        0.53024         0.2966
    {'fracByP75'         }       0.60536        0.47077         1.0368        0.77109         0.5936
    {'fracByP90'         }         0.758        0.70215         1.0326        0.92834         0.8450
    {'fracByP99_99'      }       0.99975        0.99993              1              1

age =59
xxx tb_outcomes: all stats xxx
    OriginalVariableNames       ap_ss         c_ss          v_ss          n_ss       y_head_inc
    ______________________    __________    __________    __________    __________    __________

    {'mean'              }        54.878        1.2923       -12.279        1.7239        1.8459
    {'unweighted_sum'    }         11476    2.7092e+05        -80406            21         13268
    {'sd'                }        23.415        1.0959        19.332       0.90777        2.0412
    {'coefofvar'         }       0.42667       0.84801       -1.5745       0.52659        1.1058
    {'gini'              }       0.23612        0.3991      -0.81005       0.23461       0.48077
    {'min'               }             1      0.055882       -229.42             1      0.059541
    {'max'               }           151         32.48        14.764             6         23.47
    {'pYis0'             }             0             0             0             0             0
    {'pYls0'             }             0             0       0.73941             0             0
    {'pYgr0'             }             1             1       0.26059             1             1
    {'pYisMINY'          }     0.0042169    2.9508e-05    3.9539e-07       0.48835    9.9253e-05
```

```
    {'pYisMAXY'          }    4.8703e-06    2.3072e-08            0     0.0036816    1.9995e-06
    {'p0_01'             }             1       0.05663      -132.27             1      0.059554
    {'p10'               }            26       0.31762      -39.004             1       0.38493
    {'p25'               }            40       0.59646      -18.282             1       0.63825
    {'p50'               }            54        1.0652      -7.1081             2        1.1351
    {'p75'               }            70        1.6718      0.46981             2        2.1332
    {'p90'               }            85        2.4861       6.4893             3        4.1604
    {'p99_99'            }           146        15.179       14.695             6        22.847
    {'fl_cov_ap_ss'      }        548.26        22.158       403.41        3.0428        38.333
    {'fl_cor_ap_ss'      }             1       0.86352       0.8912       0.14315       0.80205
    {'fl_cov_c_ss'       }        22.158         1.201       13.858       0.23973        2.0792
    {'fl_cor_c_ss'       }       0.86352             1       0.6541       0.24098       0.92951
    {'fl_cov_v_ss'       }        403.41        13.858       373.74        3.5819        22.934
    {'fl_cor_v_ss'       }        0.8912        0.6541            1       0.20411       0.58118
    {'fl_cov_n_ss'       }        3.0428       0.23973       3.5819       0.82404      0.062213
    {'fl_cor_n_ss'       }       0.14315       0.24098      0.20411             1      0.033576
    {'fl_cov_y_head_inc' }        38.333        2.0792       22.934      0.062213        4.1664
    {'fl_cor_y_head_inc' }       0.80205       0.92951      0.58118      0.033576             1
    {'fl_cov_y_spouse'   }        6.1095       0.27813       4.5119        0.2771       0.17233
    {'fl_cor_y_spouse'   }       0.23287       0.22651       0.2083       0.27244       0.07535
    {'fl_cov_yshr_wage'  }       -1.3956     -0.043321      -1.0776    -0.0071751     -0.056896
    {'fl_cor_yshr_wage'  }      -0.66407      -0.44044     -0.62107     -0.088065      -0.31056
    {'fl_cov_yshr_SS'    }             0             0            0             0             0
    {'fl_cor_yshr_SS'    }           NaN           NaN          NaN           NaN           NaN
    {'fl_cov_yshr_nttxss'}       0.77952      0.028412      0.68735     0.0085362      0.047811
    {'fl_cor_yshr_nttxss'}       0.88801       0.69155      0.94837       0.25083       0.62479
    {'fracByP0_01'       }    7.6842e-05     5.431e-06     0.001404       0.28329    4.1671e-06
    {'fracByP10'         }      0.027337      0.019346      0.47531       0.28329      0.013211
    {'fracByP25'         }       0.11727      0.077024      0.79795       0.28329      0.054199
    {'fracByP50'         }       0.33388       0.22863       1.0581       0.72028       0.18178
    {'fracByP75'         }       0.62869       0.48302        1.117       0.72028       0.41537
    {'fracByP90'         }       0.83409       0.72082       1.0748       0.85389       0.64728
    {'fracByP99_99'      }        0.9998       0.99882            1             1       0.99936

age =100
xxx tb_outcomes: all stats xxx
    OriginalVariableNames        ap_ss          c_ss          v_ss          n_ss       y_head_inc
    _____________________     ___________    __________    ___________    __________    ___________

    {'mean'              }              1       0.35551       -2.9555        1.4797        0.26067
    {'unweighted_sum'    }              1     2.807e+05          1215            21          491.5
    {'sd'                }     1.7875e-14       0.23928        1.0697       0.50567       0.023035
    {'coefofvar'         }     1.7875e-14       0.67307      -0.36194       0.34173       0.088367
    {'gini'              }              0       0.28119      -0.18783       0.12034       0.041657
    {'min'               }              1        0.2179       -10.065             1        0.24433
    {'max'               }              1        141.66       0.99282             6         5.6926
    {'pYis0'             }              0             0             0             0              0
    {'pYls0'             }              0             0       0.99182             0              0
    {'pYgr0'             }              1             1     0.0081757             1              1
    {'pYisMINY'          }              1       0.35002    1.5074e-10        0.5232        0.50379
    {'pYisMAXY'          }              1             0             0    4.2206e-08              0
    {'p0_01'             }              1        0.2179       -6.3349             1        0.24433
    {'p10'               }              1        0.2179       -3.6603             1        0.24433
    {'p25'               }              1        0.2179       -3.5892             1        0.24433
    {'p50'               }              1       0.25824       -3.5892             1        0.24433
    {'p75'               }              1       0.37165       -2.5873             2        0.29263
    {'p90'               }              1        0.6134       -1.2288             2        0.29283
    {'p99_99'            }              1        2.9509       0.52075             4         0.3403
```

{'fl_cov_ap_ss' }	3.195e-28	6.5284e-30	-2.443e-29	3.5367e-29	2.9775e-31
{'fl_cor_ap_ss' }	1	1.5264e-15	-1.2777e-15	3.9129e-15	7.2317e-16
{'fl_cov_c_ss' }	6.5284e-30	0.057256	0.20779	0.059046	0.0016896
{'fl_cor_c_ss' }	1.5264e-15	1	0.81181	0.488	0.30655
{'fl_cov_v_ss' }	-2.443e-29	0.20779	1.1443	0.15982	0.010842
{'fl_cor_v_ss' }	-1.2777e-15	0.81181	1	0.29547	0.44002
{'fl_cov_n_ss' }	3.5367e-29	0.059046	0.15982	0.2557	0.0018939
{'fl_cor_n_ss' }	3.9129e-15	0.488	0.29547	1	0.1626
{'fl_cov_y_head_inc' }	2.9775e-31	0.0016896	0.010842	0.0018939	0.00053059
{'fl_cor_y_head_inc' }	7.2317e-16	0.30655	0.44002	0.1626	1
{'fl_cov_y_spouse' }	6.9736e-31	0.051708	0.16183	0.0533	0.00067244
{'fl_cor_y_spouse' }	1.5749e-16	0.87235	0.61072	0.4255	0.11785
{'fl_cov_yshr_wage' }	1.4253e-30	0.039337	0.15536	0.083876	0.00066872
{'fl_cor_yshr_wage' }	3.6093e-16	0.74409	0.65738	0.75078	0.1314
{'fl_cov_yshr_SS' }	1.2113e-29	-0.040637	-0.16221	-0.085115	-0.00073196
{'fl_cor_yshr_SS' }	3.0517e-15	-0.76482	-0.68289	-0.75803	-0.1431
{'fl_cov_yshr_nttxss'}	-1.3389e-29	0.044612	0.17828	0.091702	0.00088432
{'fl_cor_yshr_nttxss'}	-3.1042e-15	0.77263	0.69067	0.75153	0.1591
{'fracByP0_01' }	1	0.21454	0.00051608	0.35357	0.47222
{'fracByP10' }	1	0.21454	0.21323	0.35357	0.47222
{'fracByP25' }	1	0.21454	0.64329	0.35357	0.47222
{'fracByP50' }	1	0.32886	0.64329	0.35357	0.47222
{'fracByP75' }	1	0.54497	0.88331	0.99419	0.87831
{'fracByP90' }	1	0.75075	0.97695	0.99419	0.88528
{'fracByP99_99' }	1	0.99925	1	0.99999	0.99987

Chapter 7

Value of Each Check

7.1 2020 V and C without Unemployment

This is the example vignette for function: **snw_a4chk_wrk_bisec_vec** from the **PrjOptiSNW Package.** This function solves for the V(states, check) for individuals working. Dense solution. Bisection, most time for the test here taken to genereate the income matrixes. But these can be generated out of the check loops.

7.1.1 Test SNW_A4CHK_WRK_BISEC_VEC Defaults Dense

Call the function with default parameters. Solve first for non-covid value and policy. Then depending on 2020 taxes, solve for 2020 policy and value.

```
mp_params = snw_mp_param('default_docdense');
mp_controls = snw_mp_control('default_test');
mp_controls('bl_print_vfi') = false;
mp_controls('bl_timer') = true;
[V_ss,~,cons_ss,~] = snw_vfi_main_bisec_vec(mp_params, mp_controls);
```

```
Completed SNW_VFI_MAIN_BISEC_VEC;SNW_MP_PARAM=default_docdense;SNW_MP_CONTROL=default_test;time=490.
----------------------------------------
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
CONTAINER NAME: mp_outcomes ND Array (Matrix etc)
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
                i    idx    ndim     numel      rowN      colN          sum          mean       std
                -    ---    ----    --------    ----    ----------   -----------    -------    -----

    V_VFI       1     1      6      4.37e+07     83     5.265e+05    -1.5339e+08    -3.5101    26.11
    ap_VFI      2     2      6      4.37e+07     83     5.265e+05     1.4159e+09     32.402    36.79
    cons_VFI    3     3      6      4.37e+07     83     5.265e+05     2.1402e+08     4.8975    8.329

xxx TABLE:V_VFI xxxxxxxxxxxxxxxxxx
             c1          c2          c3          c4          c5        c526496     c526497     c526498     c
           -------     -------     -------     -------     -------     -------     -------     -------     -

    r1     -346.51     -346.12     -343.63     -337.86     -328.51      21.702      21.852      22.003
    r2     -334.38     -333.99     -331.51     -325.83     -316.83      21.724      21.869      22.015
    r3     -322.45     -322.06      -319.6     -314.14      -305.6      21.745      21.885      22.027
    r4     -310.63     -310.27     -307.99     -302.88     -294.87      21.767      21.903      22.041
    r5     -299.94      -299.6     -297.46     -292.67     -285.12      21.775      21.907      22.042
    r79    -9.9437     -9.9325     -9.8557     -9.6597     -9.3232      2.5394      2.5501      2.5602
    r80    -8.9023     -8.8911     -8.8143     -8.6183     -8.2818      2.3039      2.3121      2.3198
    r81    -7.6363     -7.6251     -7.5484     -7.3524     -7.0159      2.0068      2.0124      2.0176
```

```
    r82    -5.9673    -5.9561    -5.8793    -5.6833    -5.3468     1.5958     1.5989     1.6018
    r83    -3.5892     -3.578    -3.5012    -3.3052    -2.9687    0.97904    0.98004    0.98097    0

xxx TABLE:ap_VFI xxxxxxxxxxxxxxxxxx
           c1    c2        c3           c4           c5       c526496    c526497    c526498    c5264
           --    --    ----------    ---------    --------    -------    -------    -------    -----

    r1     0     0      0.0005656    0.0075134    0.022901    114.75     120.41     126.27     132.3
    r2     0     0     0.00051498    0.0065334    0.021549    114.86     120.53     126.41     132.5
    r3     0     0     0.00051498    0.0049294    0.019875    114.97     120.65     126.56      132.
    r4     0     0     0.00051498    0.0047937    0.019672    115.73     121.42     127.34     133.5
    r5     0     0     0.00048517    0.0046683    0.019484     116.5     122.21     128.15     134.3
    r79    0     0              0            0           0    81.091      85.68     90.335     94.37
    r80    0     0              0            0           0    76.669     80.563     84.304      88.0
    r81    0     0              0            0           0    68.313     71.534     74.475     77.83
    r82    0     0              0            0           0    50.126     53.467     56.953     58.74
    r83    0     0              0            0           0         0          0          0

xxx TABLE:cons_VFI xxxxxxxxxxxxxxxxxx
              c1          c2          c3          c4          c5       c526496    c526497    c526498
           --------    --------    --------    --------    --------    -------    -------    -------

    r1     0.036717    0.037251    0.040426     0.04363    0.048012    9.6491       9.817     9.9649
    r2     0.036717    0.037251    0.040477     0.04461    0.049364    9.8118      9.9685     10.101
    r3     0.036717    0.037251    0.040477    0.046214    0.051039    9.9779       10.12     10.234
    r4     0.038144    0.038678    0.041903    0.047776    0.052666    10.131      10.258     10.354
    r5     0.039534    0.040068    0.043323     0.04929    0.054241    10.272      10.384     10.463
    r79      0.2179     0.21844     0.22216     0.23228     0.25197    35.858      37.092     38.455
    r80      0.2179     0.21844     0.22216     0.23228     0.25197    40.253      42.183     44.459
    r81      0.2179     0.21844     0.22216     0.23228     0.25197    48.587       51.19     54.266
    r82      0.2179     0.21844     0.22216     0.23228     0.25197    66.755      69.238      71.77
    r83      0.2179     0.21844     0.22216     0.23228     0.25197    116.87      122.69     128.71
```

```
welf_checks = 2; % 2 checks is $200 dollar of welfare checks
xi=1; % xi=0 full income loss from covid shock, xi=1, no covid income losses
b=1; % when xi=1, b does not matter, no income losses
TR = 100/58056;
mp_params('TR') = TR;
mp_params('xi') = xi;
mp_params('b') = b;
% if = mp_params('a2_covidyr_manna_heaven'), V_emp_2020 same as V_ss if b=1
% or xi=1.
% if = mp_params('a2_covidyr_tax_fully_pay'), V_emp_2020 differ due to 2020
% tax differences
mp_params('a2_covidyr') = mp_params('a2_covidyr_manna_heaven');
% mp_params('a2_covidyr') = mp_params('a2_covidyr_tax_fully_pay');
[V_emp_2020,~,cons_emp_2020,~] = snw_vfi_main_bisec_vec(mp_params, mp_controls, V_ss);
```

```
Completed SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock;SNW_MP_PARAM=default_docdense;SNW_MP_CONTROL=d
----------------------------------------
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
CONTAINER NAME: mp_outcomes ND Array (Matrix etc)
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
                i     idx    ndim     numel      rowN      colN          sum          mean       std
                -     ---    ----    --------    ----    ---------    -----------    -------    -----

    V_VFI       1      1      6      4.37e+07     83     5.265e+05    -1.5339e+08    -3.5101    26.11
    ap_VFI      2      2      6      4.37e+07     83     5.265e+05     1.4159e+09     32.402    36.79
```

```
    cons_VFI    3     3      6      4.37e+07     83     5.265e+05     2.1402e+08     4.8975    8.329

xxx TABLE:V_VFI xxxxxxxxxxxxxxxxxx
              c1         c2         c3         c4         c5       c526496    c526497    c526498    c
           -------    -------    -------    -------    -------    -------    -------    -------    -

    r1     -346.51    -346.12    -343.63    -337.86    -328.51     21.702     21.852     22.003
    r2     -334.38    -333.99    -331.51    -325.83    -316.83     21.724     21.869     22.015
    r3     -322.45    -322.06     -319.6    -314.14     -305.6     21.745     21.885     22.027
    r4     -310.63    -310.27    -307.99    -302.88    -294.87     21.767     21.903     22.041
    r5     -299.94     -299.6    -297.46    -292.67    -285.12     21.775     21.907     22.042
    r79    -9.9437    -9.9325    -9.8557    -9.6597    -9.3232     2.5394     2.5501     2.5602
    r80    -8.9023    -8.8911    -8.8143    -8.6183    -8.2818     2.3039     2.3121     2.3198
    r81    -7.6363    -7.6251    -7.5484    -7.3524    -7.0159     2.0068     2.0124     2.0176
    r82    -5.9673    -5.9561    -5.8793    -5.6833    -5.3468     1.5958     1.5989     1.6018
    r83    -3.5892     -3.578    -3.5012    -3.3052    -2.9687    0.97904    0.98004    0.98097    0

xxx TABLE:ap_VFI xxxxxxxxxxxxxxxxxx
           c1    c2        c3             c4            c5       c526496    c526497    c526498    c5264
           --    --    ----------    ---------    --------    -------    -------    -------    -----

    r1     0     0      0.0005656    0.0075134    0.022901     114.75     120.41     126.27     132.3
    r2     0     0     0.00051498    0.0065334    0.021549     114.86     120.53     126.41     132.5
    r3     0     0     0.00051498    0.0049294    0.019875     114.97     120.65     126.56      132.
    r4     0     0     0.00051498    0.0047937    0.019672     115.73     121.42     127.34     133.5
    r5     0     0     0.00048517    0.0046683    0.019484      116.5     122.21     128.15     134.3
    r79    0     0              0            0           0     81.091      85.68     90.335     94.37
    r80    0     0              0            0           0     76.669     80.563     84.304      88.0
    r81    0     0              0            0           0     68.313     71.534     74.475     77.83
    r82    0     0              0            0           0     50.126     53.467     56.953     58.74
    r83    0     0              0            0           0          0          0          0

xxx TABLE:cons_VFI xxxxxxxxxxxxxxxxxx
               c1          c2          c3          c4          c5       c526496    c526497    c526498
           --------    --------    --------    --------    --------    -------    -------    -------

    r1     0.036717    0.037251    0.040426     0.04363    0.048012     9.6491      9.817     9.9649
    r2     0.036717    0.037251    0.040477     0.04461    0.049364     9.8118     9.9685     10.101
    r3     0.036717    0.037251    0.040477    0.046214    0.051039     9.9779      10.12     10.234
    r4     0.038144    0.038678    0.041903    0.047776    0.052666     10.131     10.258     10.354
    r5     0.039534    0.040068    0.043323     0.04929    0.054241     10.272     10.384     10.463
    r79      0.2179     0.21844     0.22216     0.23228     0.25197     35.858     37.092     38.455
    r80      0.2179     0.21844     0.22216     0.23228     0.25197     40.253     42.183     44.459
    r81      0.2179     0.21844     0.22216     0.23228     0.25197     48.587      51.19     54.266
    r82      0.2179     0.21844     0.22216     0.23228     0.25197     66.755     69.238      71.77
    r83      0.2179     0.21844     0.22216     0.23228     0.25197     116.87     122.69     128.71
```

```
[V_W_2020, C_W_2020] = snw_a4chk_wrk_bisec_vec(welf_checks, V_emp_2020, cons_emp_2020, mp_params, mp
```

```
Completed SNW_A4CHK_WRK_BISEC_VEC;welf_checks=2;TR=0.0017225;SNW_MP_PARAM=default_docdense;SNW_MP_CO
----------------------------------------
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
CONTAINER NAME: mp_container_map ND Array (Matrix etc)
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
                      i    idx    ndim      numel      rowN       colN            sum           mean
                      -    ---    ----    --------    ----    ---------    -----------    ----------

    C_W               1     1      6      4.37e+07     83     5.265e+05     2.1404e+08        4.8981
```

```
    C_W_minus_C_ss    2    2    6    4.37e+07    83    5.265e+05         23044    0.00052732
    V_W               3    3    6    4.37e+07    83    5.265e+05    -1.5281e+08       -3.4969
    V_W_minus_V_ss    4    4    6    4.37e+07    83    5.265e+05     5.7996e+05      0.013271
    mn_MPC            5    5    6    4.37e+07    83    5.265e+05     6.6891e+06       0.15307
```

```
mn_V_W_gain_check = V_W_2020 - V_emp_2020;
mn_MPC_W_gain_share_check = (C_W_2020 - cons_emp_2020)./(welf_checks*mp_params('TR'));
```

7.1.2 Dense Param Results Define Frames

Define the matrix dimensions names and dimension vector values. Policy and Value Functions share the same ND dimensional structure.

```
% Grids:
age_grid = 18:100;
agrid = mp_params('agrid')';
eta_H_grid = mp_params('eta_H_grid')';
eta_S_grid = mp_params('eta_S_grid')';
ar_st_eta_HS_grid = string(cellstr([num2str(eta_H_grid', 'hz=%3.2f;'), num2str(eta_S_grid', 'wz=%3.2
edu_grid = [0,1];
marry_grid = [0,1];
kids_grid = (1:1:mp_params('n_kidsgrid'))';
% NaN(n_jgrid,n_agrid,n_etagrid,n_educgrid,n_marriedgrid,n_kidsgrid);
cl_mp_datasetdesc = {};
cl_mp_datasetdesc{1} = containers.Map({'name', 'labval'}, {'age', age_grid});
cl_mp_datasetdesc{2} = containers.Map({'name', 'labval'}, {'savings', agrid});
cl_mp_datasetdesc{3} = containers.Map({'name', 'labval'}, {'eta', 1:length(eta_H_grid)});
cl_mp_datasetdesc{4} = containers.Map({'name', 'labval'}, {'edu', edu_grid});
cl_mp_datasetdesc{5} = containers.Map({'name', 'labval'}, {'marry', marry_grid});
cl_mp_datasetdesc{6} = containers.Map({'name', 'labval'}, {'kids', kids_grid});
```

7.1.3 Analyze Difference in V and C with Check

The difference between V and V with Check, marginal utility gain given the check.

```
% Generate some Data
mp_support_graph = containers.Map('KeyType', 'char', 'ValueType', 'any');
mp_support_graph('cl_st_xtitle') = {'Savings States, a'};
mp_support_graph('st_legend_loc') = 'eastoutside';
mp_support_graph('bl_graph_logy') = true; % do not log
mp_support_graph('it_legend_select') = 21; % how many shock legends to show
mp_support_graph('cl_colors') = 'jet';
```

MEAN(MN_V_GAIN_CHECK(A,Z))

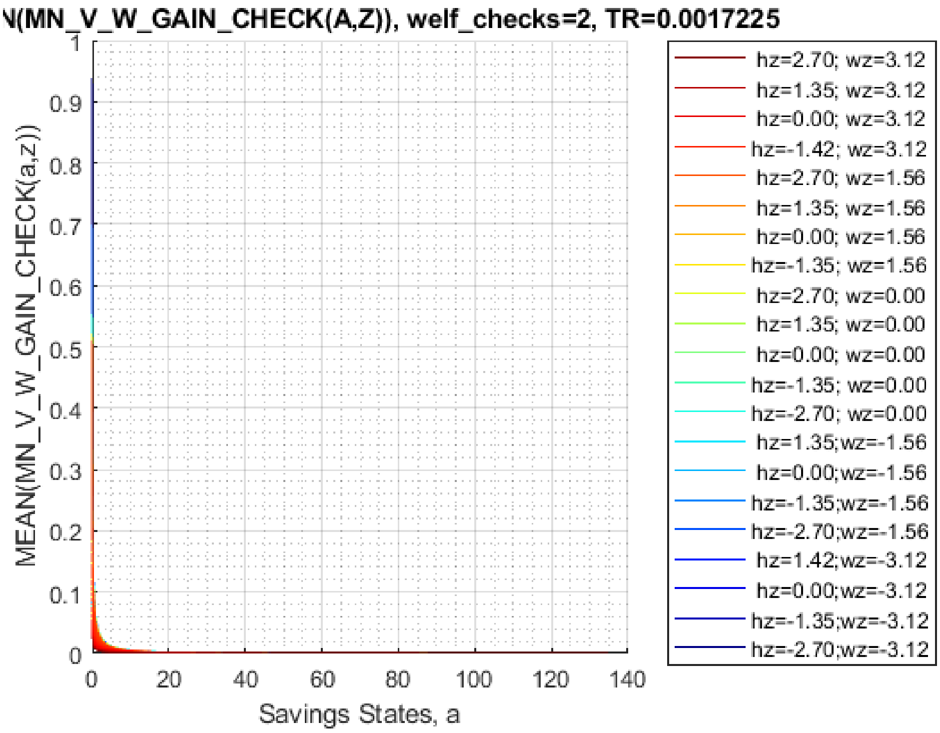
Tabulate value and policies along savings and shocks:

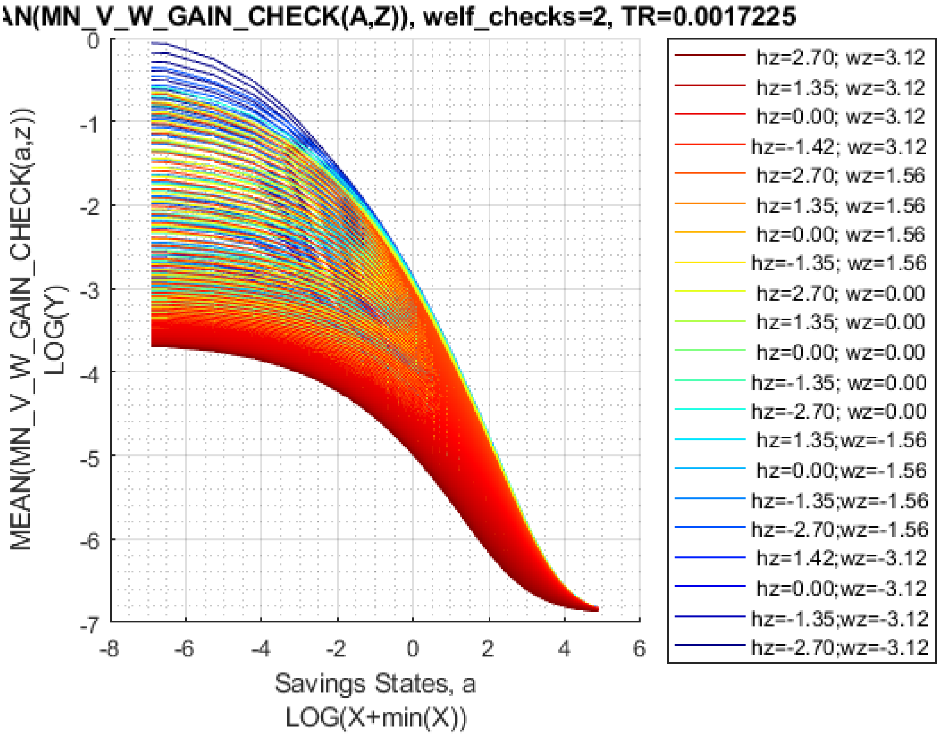
```
% Set
ar_permute = [1,4,5,6,3,2];
% Value Function
st_title = ['MEAN(MN_V_W_GAIN_CHECK(A,Z)), welf_checks=' num2str(welf_checks) ', TR=' num2str(mp_par
tb_az_v = ff_summ_nd_array(st_title, mn_V_W_gain_check, true, ["mean"], 4, 1, cl_mp_datasetdesc, ar_
```

```
xxx  MEAN(MN_V_W_GAIN_CHECK(A,Z)), welf_checks=2, TR=0.0017225  xxxxxxxxxxxxxxxxxxxxxxxxxxxx
    group     savings      mean_eta_1    mean_eta_2    mean_eta_3    mean_eta_4    mean_eta_5    mea
    -----    ----------    ----------    ----------    ----------    ----------    ----------    ---

      1               0      0.93933        0.8402       0.75179       0.67285       0.60245
```

5	0.032959	0.4333	0.40626	0.37812	0.35006	0.32301

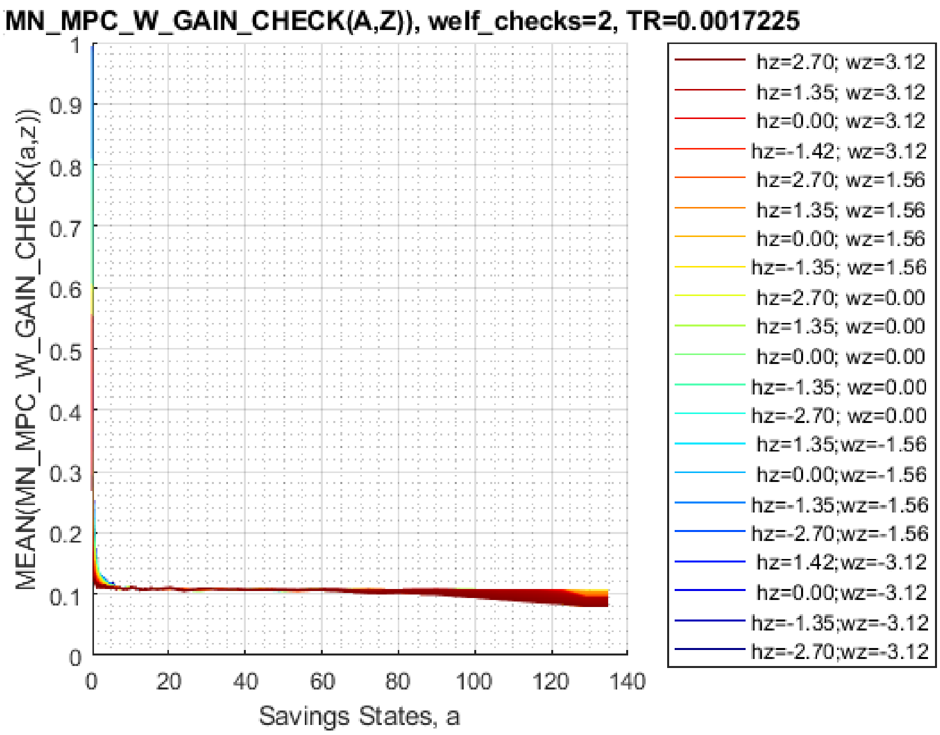
```
st_title = ['MEAN(MN\_V\_W\_GAIN\_CHECK(A,Z)), welf\_checks=' num2str(welf_checks) ', TR=' num2str(m
mp_support_graph('cl_st_graph_title') = {st_title};
mp_support_graph('cl_st_ytitle') = {'MEAN(MN\_V\_W\_GAIN\_CHECK(a,z))'};
ff_graph_grid((tb_az_v{1:end, 3:end})', ar_st_eta_HS_grid, agrid, mp_support_graph);
```

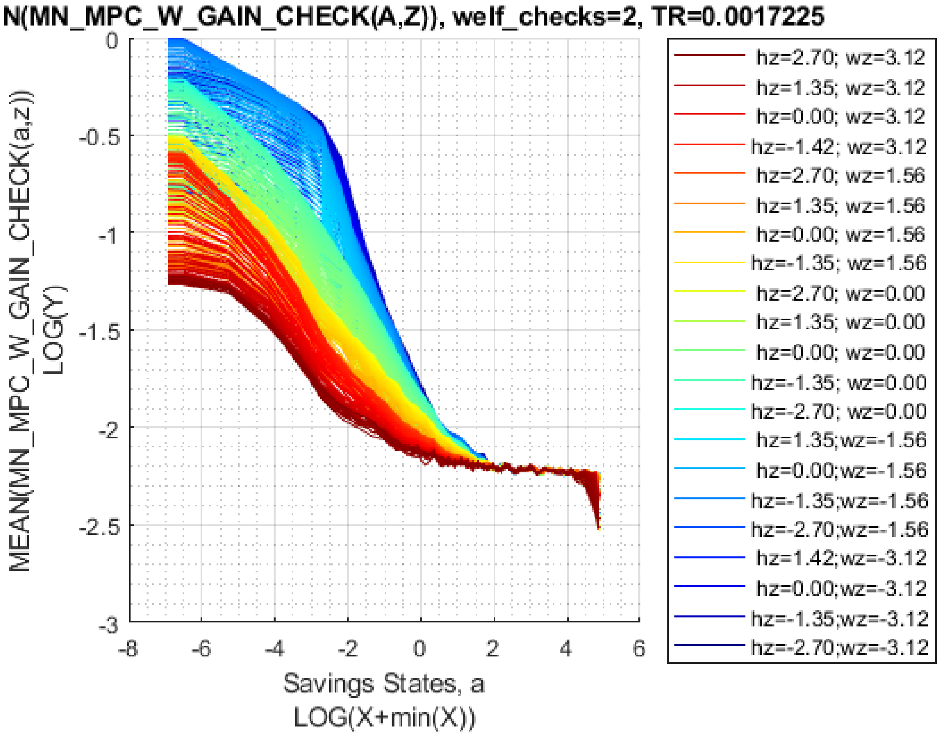




Graph Mean Consumption (***MPC: Share of Check Consumed***):

```
st_title = ['MEAN(MN\_MPC\_W\_GAIN\_CHECK(A,Z)), welf\_checks=' num2str(welf_checks) ', TR=' num2str
mp_support_graph('cl_st_graph_title') = {st_title};
mp_support_graph('cl_st_ytitle') = {'MEAN(MN\_MPC\_W\_GAIN\_CHECK(a,z))'};
ff_graph_grid((tb_az_c{1:end, 3:end})', ar_st_eta_HS_grid, agrid, mp_support_graph);
```





7.1.4 Analyze Kids and Marriage and Age

Aggregating over education, savings, and shocks, what are the differential effects of Marriage and Age.

```
% Generate some Data
mp_support_graph = containers.Map('KeyType', 'char', 'ValueType', 'any');
ar_row_grid = [...
    "k0M0", "K1M0", "K2M0", "K3M0", "K4M0", ...
    "k0M1", "K1M1", "K2M1", "K3M1", "K4M1"];
mp_support_graph('cl_st_xtitle') = {'Age'};
mp_support_graph('st_legend_loc') = 'best';
mp_support_graph('bl_graph_logy') = true; % do not log
mp_support_graph('st_rounding') = '6.2f'; % format shock legend
mp_support_graph('cl_scatter_shapes') = {...
    'o', 'd' ,'s', 'x', '*', ...
    'o', 'd', 's', 'x', '*'};
mp_support_graph('cl_colors') = {...
    'red', 'red', 'red', 'red', 'red'...
    'blue', 'blue', 'blue', 'blue', 'blue'};
```

MEAN(VAL(KM,J)), MEAN(AP(KM,J)), MEAN(C(KM,J))

Tabulate value and policies:

```
% Set
% NaN(n_jgrid,n_agrid,n_etagrid,n_educgrid,n_marriedgrid,n_kidsgrid);
ar_permute = [2,3,4,1,6,5];
% Value Function
st_title = ['MEAN(MN_V_W_GAIN_CHECK(KM,J)), welf_checks=' num2str(welf_checks) ', TR=' num2str(mp_pa
tb_az_v = ff_summ_nd_array(st_title, mn_V_W_gain_check, true, ["mean"], 3, 1, cl_mp_datasetdesc, ar_

xxx  MEAN(MN_V_W_GAIN_CHECK(KM,J)), welf_checks=2, TR=0.0017225  xxxxxxxxxxxxxxxxxxxxxxxxxxx
    group    kids    marry    mean_age_18    mean_age_19    mean_age_20    mean_age_21    mean_age_2
    _____    ____    _____    ___________    ___________    ___________    ___________    __________

      1        1       0       0.031034       0.029745       0.028239       0.025902        0.02395
```

2	2	0	0.042182	0.040477	0.0384	0.035121	0.032371
3	3	0	0.048861	0.047196	0.045053	0.041229	0.038024
4	4	0	0.055272	0.053518	0.051182	0.046853	0.043227
5	5	0	0.060434	0.0587	0.056288	0.051575	0.047632
6	1	1	0.0088974	0.0084565	0.0080356	0.007287	0.0066592
7	2	1	0.011887	0.011299	0.010733	0.0097237	0.0088734
8	3	1	0.014254	0.013578	0.01292	0.011706	0.010686
9	4	1	0.017048	0.016271	0.015496	0.014054	0.012839
10	5	1	0.020638	0.019777	0.018893	0.017162	0.015705

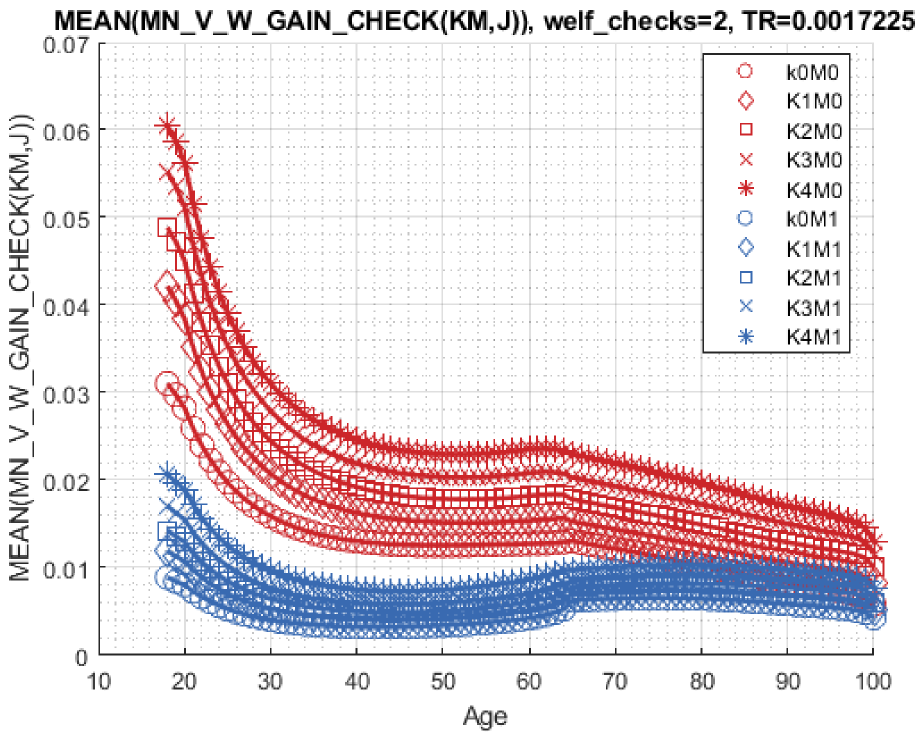
```
% Consumption Function
st_title = ['MEAN(MN_MPC_W_GAIN_CHECK(KM,J)), welf_checks=' num2str(welf_checks) ', TR=' num2str(mp_
tb_az_c = ff_summ_nd_array(st_title, mn_MPC_W_gain_share_check, true, ["mean"], 3, 1, cl_mp_datasetd
```

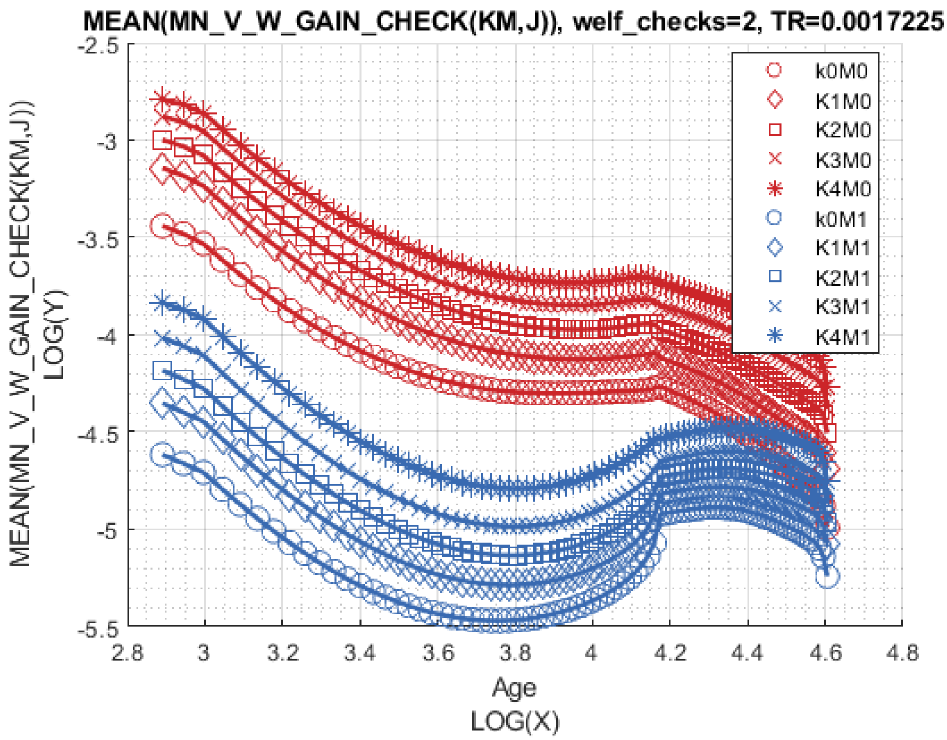
```
xxx  MEAN(MN_MPC_W_GAIN_CHECK(KM,J)), welf_checks=2, TR=0.0017225  xxxxxxxxxxxxxxxxxxxxxxxxxxx
```

group	kids	marry	mean_age_18	mean_age_19	mean_age_20	mean_age_21	mean_age_2
1	1	0	0.050486	0.055015	0.066697	0.065256	0.063327
2	2	0	0.057524	0.062751	0.075955	0.074114	0.073156
3	3	0	0.065349	0.07164	0.08726	0.084785	0.083817
4	4	0	0.069224	0.077159	0.092501	0.089833	0.087737
5	5	0	0.07472	0.082465	0.097494	0.094842	0.091941
6	1	1	0.08249	0.085999	0.088435	0.087541	0.086694
7	2	1	0.084681	0.087712	0.09101	0.089941	0.088666
8	3	1	0.08783	0.092431	0.09692	0.095481	0.094512
9	4	1	0.090426	0.093954	0.098752	0.097968	0.096993
10	5	1	0.095109	0.099933	0.1075	0.10332	0.10194

Graph Mean Values:

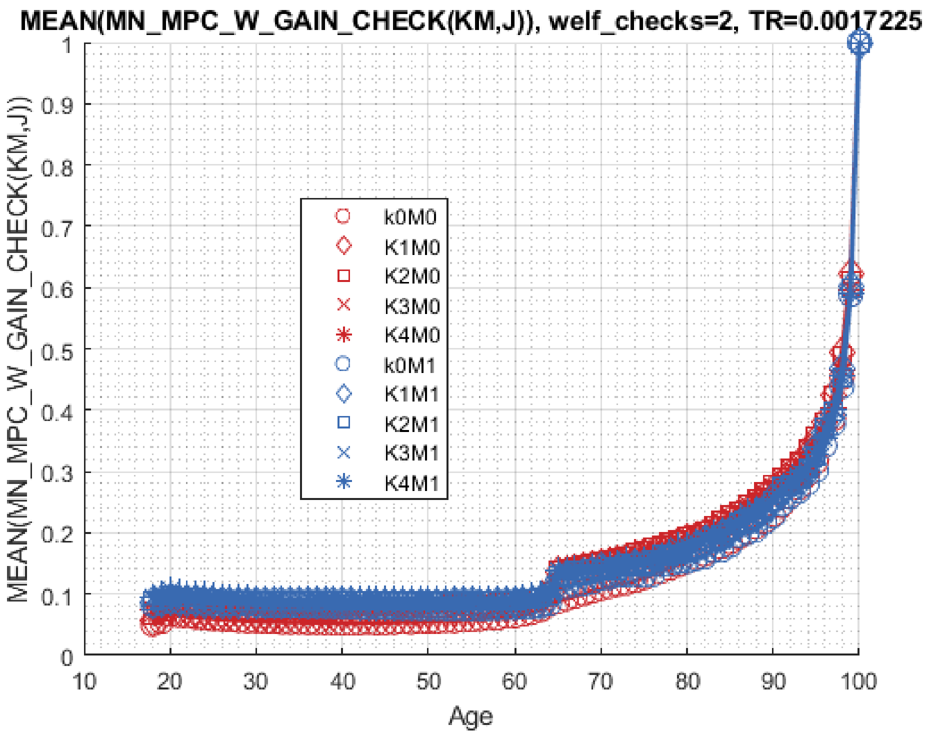
```
st_title = ['MEAN(MN\_V\_W\_GAIN\_CHECK(KM,J)), welf\_checks=' num2str(welf_checks) ', TR=' num2str(
mp_support_graph('cl_st_graph_title') = {st_title};
mp_support_graph('cl_st_ytitle') = {'MEAN(MN\_V\_W\_GAIN\_CHECK(KM,J))'};
ff_graph_grid((tb_az_v{1:end, 4:end}), ar_row_grid, age_grid, mp_support_graph);
```

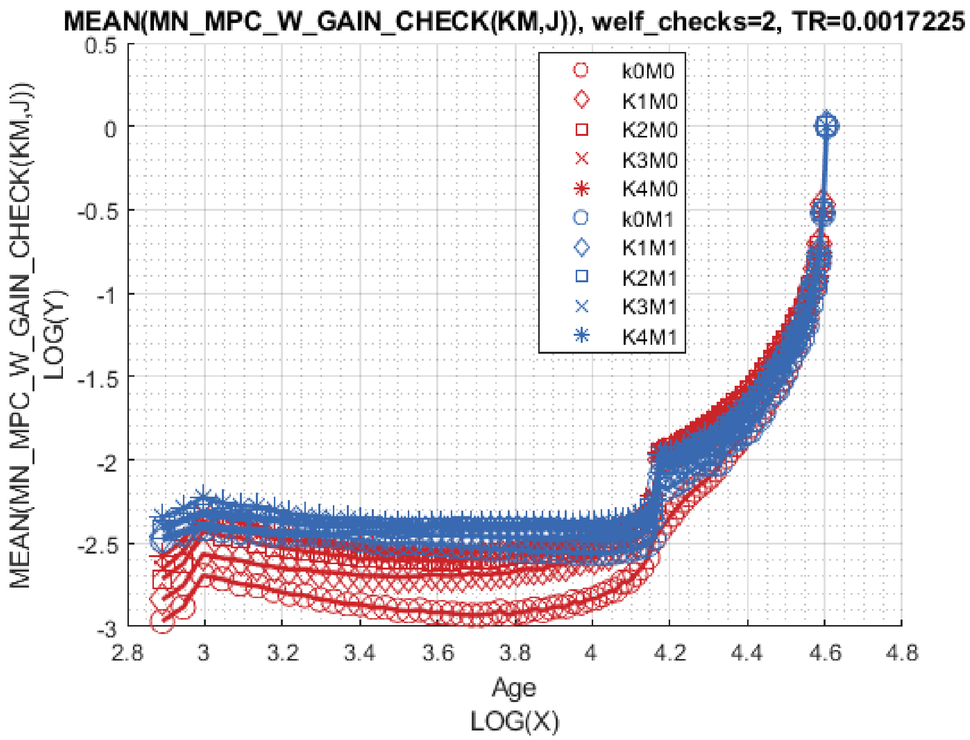




Graph Mean Consumption (***MPC: Share of Check Consumed***):

```
st_title = ['MEAN(MN\_MPC\_W\_GAIN\_CHECK(KM,J)), welf\_checks=' num2str(welf_checks) ', TR=' num2st
mp_support_graph('cl_st_graph_title') = {st_title};
mp_support_graph('cl_st_ytitle') = {'MEAN(MN\_MPC\_W\_GAIN\_CHECK(KM,J))'};
ff_graph_grid((tb_az_c{1:end, 4:end}), ar_row_grid, age_grid, mp_support_graph);
```





7.1.5 Analyze Education and Marriage

Aggregating over education, savings, and shocks, what are the differential effects of Marriage and Age.

```
% Generate some Data
mp_support_graph = containers.Map('KeyType', 'char', 'ValueType', 'any');
ar_row_grid = ["E0M0", "E1M0", "E0M1", "E1M1"];
mp_support_graph('cl_st_xtitle') = {'Age'};
mp_support_graph('st_legend_loc') = 'best';
mp_support_graph('bl_graph_logy') = true; % do not log
mp_support_graph('st_rounding') = '6.2f'; % format shock legend
mp_support_graph('cl_scatter_shapes') = {'*', 'p', '*','p' };
mp_support_graph('cl_colors') = {'red', 'red', 'blue', 'blue'};
```

MEAN(VAL(EM,J)), MEAN(AP(EM,J)), MEAN(C(EM,J))

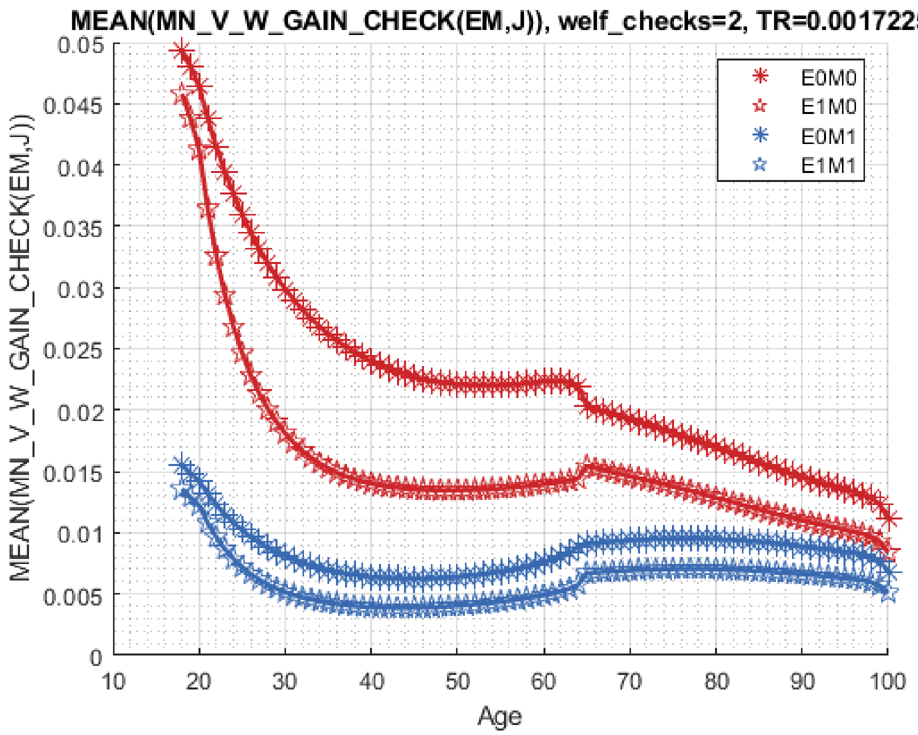
Tabulate value and policies:

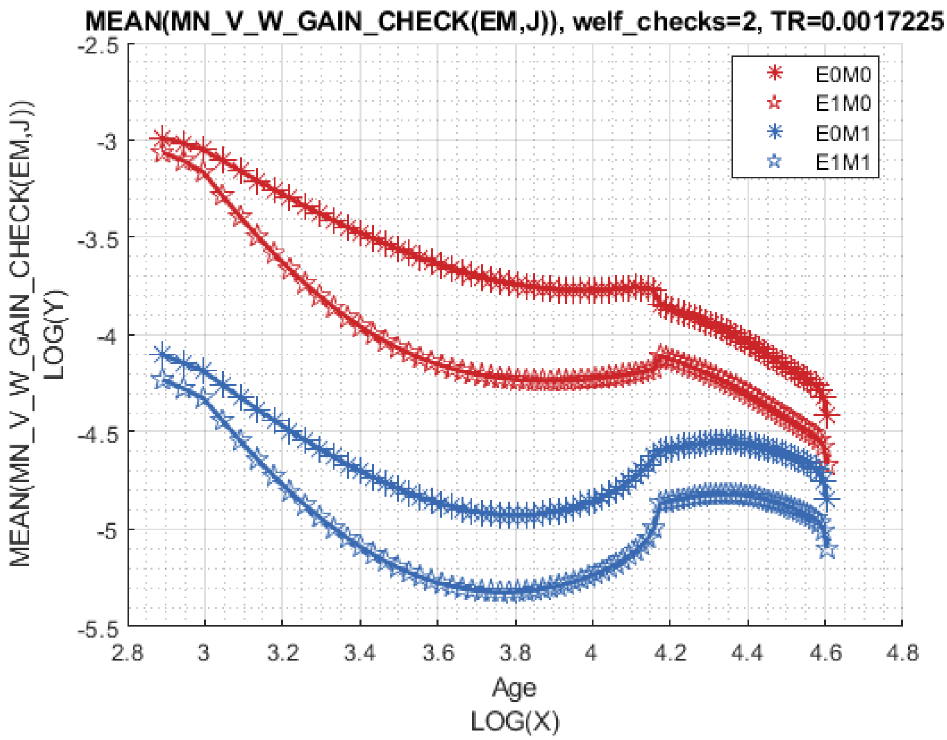
```
% Set
% NaN(n_jgrid,n_agrid,n_etagrid,n_educgrid,n_marriedgrid,n_kidsgrid);
ar_permute = [2,3,6,1,4,5];
% Value Function
st_title = ['MEAN(MN_V_W_GAIN_CHECK(EM,J)), welf_checks=' num2str(welf_checks) ', TR=' num2str(mp_pa
tb_az_v = ff_summ_nd_array(st_title, mn_V_W_gain_check, true, ["mean"], 3, 1, cl_mp_datasetdesc, ar_

xxx  MEAN(MN_V_W_GAIN_CHECK(EM,J)), welf_checks=2, TR=0.0017225  xxxxxxxxxxxxxxxxxxxxxxxxxxx
    group    edu    marry    mean_age_18    mean_age_19    mean_age_20    mean_age_21    mean_age_22
    _____    ___    _____    ___________    ___________    ___________    ___________    ___________

      1       0       0       0.049345       0.048033         0.0464        0.04381       0.041506
      2       1       0       0.045768       0.043821       0.041264       0.036462       0.032576
      3       0       1       0.015526       0.014854       0.014197       0.013177        0.01228
      4       1       1       0.013563       0.012899       0.012234       0.010796      0.0096246

% Consumption
st_title = ['MEAN(MN_MPC_W_GAIN_CHECK(EM,J)), welf_checks=' num2str(welf_checks) ', TR=' num2str(mp_
```

```
tb_az_c = ff_summ_nd_array(st_title, mn_MPC_W_gain_share_check, true, ["mean"], 3, 1, cl_mp_datasetd

xxx  MEAN(MN_MPC_W_GAIN_CHECK(EM,J)), welf_checks=2, TR=0.0017225  xxxxxxxxxxxxxxxxxxxxxxxxxxx
    group    edu    marry    mean_age_18    mean_age_19    mean_age_20    mean_age_21    mean_age_22
    _____    ___    _____    ___________    ___________    ___________    ___________    ___________

      1       0       0        0.056783       0.060466       0.069707       0.069219       0.069323
      2       1       0        0.070138       0.079146       0.098256       0.094312       0.090668
      3       0       1         0.08145       0.084246       0.086686       0.086881       0.086662
      4       1       1        0.094765       0.099766        0.10636        0.10282        0.10086
```

Graph Mean Values:

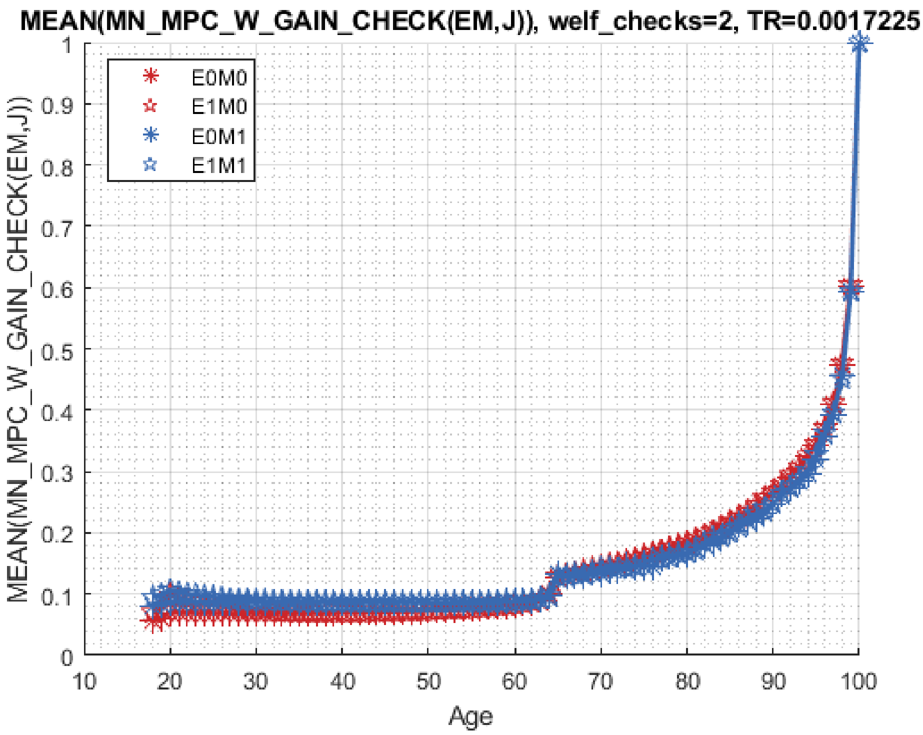
```
st_title = ['MEAN(MN\_V\_W\_GAIN\_CHECK(EM,J)), welf\_checks=' num2str(welf_checks) ', TR=' num2str(
mp_support_graph('cl_st_graph_title') = {st_title};
mp_support_graph('cl_st_ytitle') = {'MEAN(MN\_V\_W\_GAIN\_CHECK(EM,J))'};
ff_graph_grid((tb_az_v{1:end, 4:end}), ar_row_grid, age_grid, mp_support_graph);
```

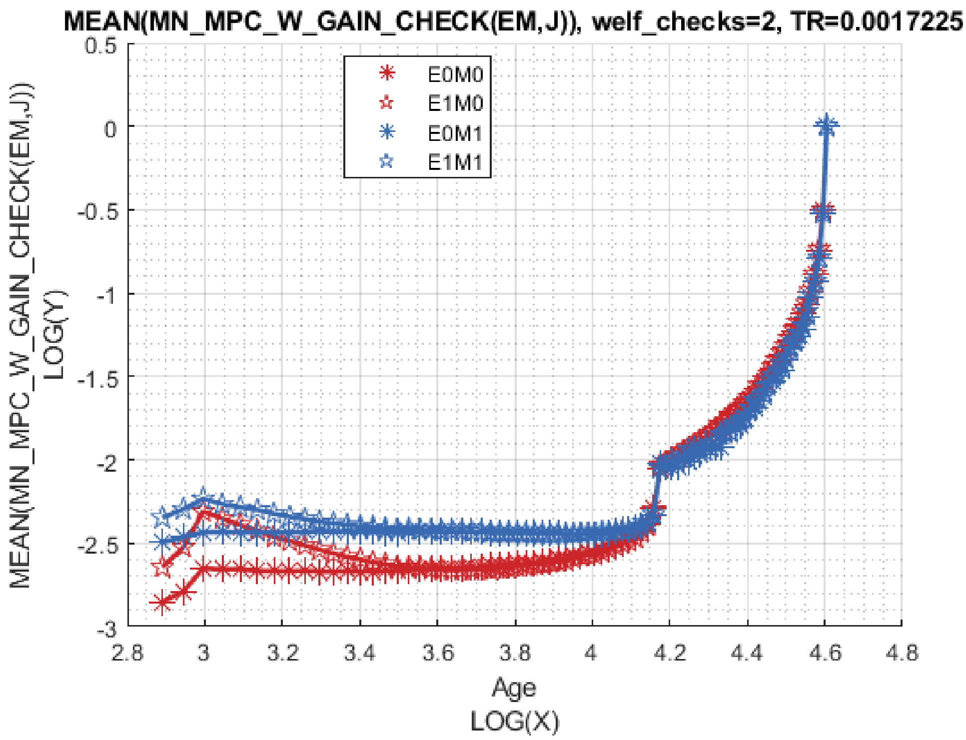




Graph Mean Consumption (***MPC: Share of Check Consumed***):

```
st_title = ['MEAN(MN\_MPC\_W\_GAIN\_CHECK(EM,J)), welf\_checks=' num2str(welf_checks) ', TR=' num2st
mp_support_graph('cl_st_graph_title') = {st_title};
mp_support_graph('cl_st_ytitle') = {'MEAN(MN\_MPC\_W\_GAIN\_CHECK(EM,J))'};
ff_graph_grid((tb_az_c{1:end, 4:end}), ar_row_grid, age_grid, mp_support_graph);
```





7.2 2020 V and C with Unemployment

This is the example vignette for function: **snw_a4chk_unemp_bisec_vec** from the **PrjOptiSNW Package.** This function solves for the V(states, check) for individuals working. Dense solution. Bisection, most time for the test here taken to genereate the income matrixes. But these can be generated out of the check loops.

7.2.1 Test SNW_A4CHK_UNEMP_BISEC_VEC Defaults

Solve for Value/Policy in non-COVID years, then solve for covid year value/policy given covid shocks. COVID lasts one period.

```
mp_params = snw_mp_param('default_docdense', false, 'tauchen', true);
mp_controls = snw_mp_control('default_test');
mp_controls('bl_print_vfi') = false;
mp_controls('bl_timer') = true;
[V_ss,~,cons_ss,~] = snw_vfi_main_bisec_vec(mp_params, mp_controls);
```

```
Completed SNW_VFI_MAIN_BISEC_VEC;SNW_MP_PARAM=default_docdense;SNW_MP_CONTROL=default_test;time=494.
----------------------------------------
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
CONTAINER NAME: mp_outcomes ND Array (Matrix etc)
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
                i    idx    ndim     numel      rowN      colN          sum          mean      std
                -    ---    ----    --------    ----    ---------    -----------    -------    -----

    V_VFI       1     1      6      4.37e+07     83     5.265e+05    -1.5339e+08    -3.5101    26.11
    ap_VFI      2     2      6      4.37e+07     83     5.265e+05     1.4159e+09     32.402    36.79
    cons_VFI    3     3      6      4.37e+07     83     5.265e+05     2.1402e+08     4.8975    8.329

xxx TABLE:V_VFI xxxxxxxxxxxxxxxxxx
            c1         c2         c3         c4         c5       c526496    c526497    c526498    c
         -------    -------    -------    -------    -------    -------    -------    -------    -
```

```
    r1     -346.51    -346.12    -343.63    -337.86    -328.51      21.702     21.852     22.003
    r2     -334.38    -333.99    -331.51    -325.83    -316.83      21.724     21.869     22.015
    r3     -322.45    -322.06     -319.6    -314.14     -305.6      21.745     21.885     22.027
    r4     -310.63    -310.27    -307.99    -302.88    -294.87      21.767     21.903     22.041
    r5     -299.94     -299.6    -297.46    -292.67    -285.12      21.775     21.907     22.042
    r79    -9.9437    -9.9325    -9.8557    -9.6597    -9.3232      2.5394     2.5501     2.5602
    r80    -8.9023    -8.8911    -8.8143    -8.6183    -8.2818      2.3039     2.3121     2.3198
    r81    -7.6363    -7.6251    -7.5484    -7.3524    -7.0159      2.0068     2.0124     2.0176
    r82    -5.9673    -5.9561    -5.8793    -5.6833    -5.3468      1.5958     1.5989     1.6018
    r83    -3.5892     -3.578    -3.5012    -3.3052    -2.9687     0.97904    0.98004    0.98097    0

xxx TABLE:ap_VFI xxxxxxxxxxxxxxxxxx
          c1    c2        c3           c4           c5       c526496    c526497    c526498    c5264
          --    --    ----------    ---------    --------    -------    -------    -------    -----

    r1     0     0     0.0005656    0.0075134    0.022901     114.75     120.41     126.27     132.3
    r2     0     0    0.00051498    0.0065334    0.021549     114.86     120.53     126.41     132.5
    r3     0     0    0.00051498    0.0049294    0.019875     114.97     120.65     126.56      132.
    r4     0     0    0.00051498    0.0047937    0.019672     115.73     121.42     127.34     133.5
    r5     0     0    0.00048517    0.0046683    0.019484      116.5     122.21     128.15     134.3
    r79    0     0             0            0           0     81.091      85.68     90.335     94.37
    r80    0     0             0            0           0     76.669     80.563     84.304      88.0
    r81    0     0             0            0           0     68.313     71.534     74.475     77.83
    r82    0     0             0            0           0     50.126     53.467     56.953     58.74
    r83    0     0             0            0           0          0          0          0

xxx TABLE:cons_VFI xxxxxxxxxxxxxxxxxx
              c1          c2          c3          c4          c5       c526496    c526497    c526498
          --------    --------    --------    --------    --------    -------    -------    -------

    r1    0.036717    0.037251    0.040426     0.04363    0.048012     9.6491      9.817     9.9649
    r2    0.036717    0.037251    0.040477     0.04461    0.049364     9.8118     9.9685     10.101
    r3    0.036717    0.037251    0.040477    0.046214    0.051039     9.9779      10.12     10.234
    r4    0.038144    0.038678    0.041903    0.047776    0.052666     10.131     10.258     10.354
    r5    0.039534    0.040068    0.043323     0.04929    0.054241     10.272     10.384     10.463
    r79     0.2179     0.21844     0.22216     0.23228     0.25197     35.858     37.092     38.455
    r80     0.2179     0.21844     0.22216     0.23228     0.25197     40.253     42.183     44.459
    r81     0.2179     0.21844     0.22216     0.23228     0.25197     48.587      51.19     54.266
    r82     0.2179     0.21844     0.22216     0.23228     0.25197     66.755     69.238      71.77
    r83     0.2179     0.21844     0.22216     0.23228     0.25197     116.87     122.69     128.71
```

```
welf_checks = 2; % 2 checks is $200 dollar of welfare checks
xi=0.5; % xi=0 full income loss from covid shock, xi=1, no covid income losses
b=0; % b=0 means no UI benefits compensating COVID, b=1 if full income replacement
TR = 100/58056;
mp_params('TR') = TR;
mp_params('xi') = xi;
mp_params('b') = b;
mp_params('a2_covidyr') = mp_params('a2_covidyr_manna_heaven');
% mp_params('a2_covidyr') = mp_params('a2_covidyr_tax_fully_pay');
[V_unemp_2020,~,cons_unemp_2020,~] = snw_vfi_main_bisec_vec(mp_params, mp_controls, V_ss);
```

```
Completed SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock;SNW_MP_PARAM=default_docdense;SNW_MP_CONTROL=d
----------------------------------------
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
CONTAINER NAME: mp_outcomes ND Array (Matrix etc)
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
               i    idx    ndim     numel      rowN      colN           sum         mean       std
```

V_VFI	1	1	6	4.37e+07	83	5.265e+05	-1.7805e+08	-4.0743	27.11
ap_VFI	2	2	6	4.37e+07	83	5.265e+05	1.3789e+09	31.553	36.67
cons_VFI	3	3	6	4.37e+07	83	5.265e+05	2.1097e+08	4.8277	8.328

xxx TABLE:V_VFI xxxxxxxxxxxxxxxxxx

	c1	c2	c3	c4	c5	c526496	c526497	c526498	c
r1	-372.97	-371.47	-362.94	-349.52	-336.96	21.573	21.728	21.882	
r2	-360.84	-359.34	-350.81	-337.39	-324.98	21.595	21.745	21.894	
r3	-348.91	-347.41	-338.88	-325.46	-313.34	21.617	21.762	21.906	
r4	-336.09	-334.7	-326.73	-314.01	-302.44	21.633	21.772	21.913	
r5	-324.48	-323.18	-315.72	-303.62	-292.54	21.634	21.77	21.907	
r79	-9.9437	-9.9325	-9.8557	-9.6597	-9.3232	2.5374	2.5482	2.5584	
r80	-8.9023	-8.8911	-8.8143	-8.6183	-8.2818	2.3024	2.3107	2.3185	
r81	-7.6363	-7.6251	-7.5484	-7.3524	-7.0159	2.0057	2.0114	2.0168	
r82	-5.9673	-5.9561	-5.8793	-5.6833	-5.3468	1.5952	1.5984	1.6014	
r83	-3.5892	-3.578	-3.5012	-3.3052	-2.9687	0.97886	0.97987	0.98082	0

xxx TABLE:ap_VFI xxxxxxxxxxxxxxxxxx

	c1	c2	c3	c4	c5	c526496	c526497	c526498	c526499	c526500
r1	0	0	0	0	0.0092181	110.06	115.71	121.55	127.62	133.93
r2	0	0	0	0	0.008238	110.03	115.68	121.54	127.62	133.95
r3	0	0	0	0	0.0066341	109.99	115.65	121.53	127.63	133.97
r4	0	0	0	0	0.0058019	110.28	115.95	121.84	127.96	134.33
r5	0	0	0	0	0.004998	110.58	116.27	122.17	128.31	134.69
r79	0	0	0	0	0	81.091	85.229	89.297	93.341	97.382
r80	0	0	0	0	0	75.865	79.539	83.28	87.016	90.669
r81	0	0	0	0	0	67.781	70.521	73.462	76.819	81.091
r82	0	0	0	0	0	50.126	53.467	56.108	57.742	60.587
r83	0	0	0	0	0	0	0	0	0	0

xxx TABLE:cons_VFI xxxxxxxxxxxxxxxxxx

	c1	c2	c3	c4	c5	c526496	c526497	c526498
r1	0.018623	0.019158	0.022901	0.033062	0.04363	9.4708	9.6491	9.817
r2	0.018623	0.019158	0.022901	0.033062	0.04461	9.6414	9.8118	9.9685
r3	0.018623	0.019158	0.022901	0.033062	0.046214	9.8179	9.9779	10.12
r4	0.019354	0.019888	0.023632	0.033792	0.047776	9.9825	10.131	10.258
r5	0.020066	0.020601	0.024344	0.034504	0.04929	10.135	10.272	10.384
r79	0.2179	0.21844	0.22216	0.23228	0.25197	34.82	36.506	38.455
r80	0.2179	0.21844	0.22216	0.23228	0.25197	40.033	42.183	44.459
r81	0.2179	0.21844	0.22216	0.23228	0.25197	48.106	51.19	54.266
r82	0.2179	0.21844	0.22216	0.23228	0.25197	65.751	68.234	71.611
r83	0.2179	0.21844	0.22216	0.23228	0.25197	115.87	121.69	127.71

```
[V_U_2020, C_U_2020] = snw_a4chk_unemp_bisec_vec(welf_checks, V_unemp_2020, cons_unemp_2020, mp_para

Completed SNW_A4CHK_UNEMP_BISEC_VEC;welf_checks=2;TR=0.0017225;xi=0.5;b=0;SNW_MP_PARAM=default_docde
----------------------------------------
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
CONTAINER NAME: mp_container_map ND Array (Matrix etc)
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
```

```
                         i    idx    ndim     numel      rowN      colN          sum          mean
                         -    ---    ----    --------    ----    ---------    -----------    -------

    C_U                  1     1      6      4.37e+07     83     5.265e+05       2.11e+08      4.828
    C_U_minus_C_unemp    2     2      6      4.37e+07     83     5.265e+05          28536    0.00065
    V_U                  3     3      6      4.37e+07     83     5.265e+05    -1.7705e+08     -4.051
    V_U_minus_V_unemp    4     4      6      4.37e+07     83     5.265e+05     9.9227e+05    0.02270
    mn_MPC_unemp         5     5      6      4.37e+07     83     5.265e+05     8.2833e+06     0.1895
```

```
mn_V_U_gain_check = V_U_2020 - V_unemp_2020;
mn_MPC_U_gain_share_check = (C_U_2020 - cons_unemp_2020)./(welf_checks*mp_params('TR'));
```

7.2.2 Dense Param Results Define Frames

Define the matrix dimensions names and dimension vector values. Policy and Value Functions share the same ND dimensional structure.

```
% Grids:
age_grid = 18:100;
agrid = mp_params('agrid')';
eta_H_grid = mp_params('eta_H_grid')';
eta_S_grid = mp_params('eta_S_grid')';
ar_st_eta_HS_grid = string(cellstr([num2str(eta_H_grid', 'hz=%3.2f;'), num2str(eta_S_grid', 'wz=%3.2
edu_grid = [0,1];
marry_grid = [0,1];
kids_grid = (1:1:mp_params('n_kidsgrid'))';
% NaN(n_jgrid,n_agrid,n_etagrid,n_educgrid,n_marriedgrid,n_kidsgrid);
cl_mp_datasetdesc = {};
cl_mp_datasetdesc{1} = containers.Map({'name', 'labval'}, {'age', age_grid});
cl_mp_datasetdesc{2} = containers.Map({'name', 'labval'}, {'savings', agrid});
cl_mp_datasetdesc{3} = containers.Map({'name', 'labval'}, {'eta', 1:length(eta_H_grid)});
cl_mp_datasetdesc{4} = containers.Map({'name', 'labval'}, {'edu', edu_grid});
cl_mp_datasetdesc{5} = containers.Map({'name', 'labval'}, {'marry', marry_grid});
cl_mp_datasetdesc{6} = containers.Map({'name', 'labval'}, {'kids', kids_grid});
```

7.2.3 Analyze Difference in V and C with Check

The difference between V and V with Check, marginal utility gain given the check.

```
% Generate some Data
mp_support_graph = containers.Map('KeyType', 'char', 'ValueType', 'any');
mp_support_graph('cl_st_xtitle') = {'Savings States, a'};
mp_support_graph('st_legend_loc') = 'eastoutside';
mp_support_graph('bl_graph_logy') = true; % do not log
mp_support_graph('it_legend_select') = 21; % how many shock legends to show
mp_support_graph('cl_colors') = 'jet';
```

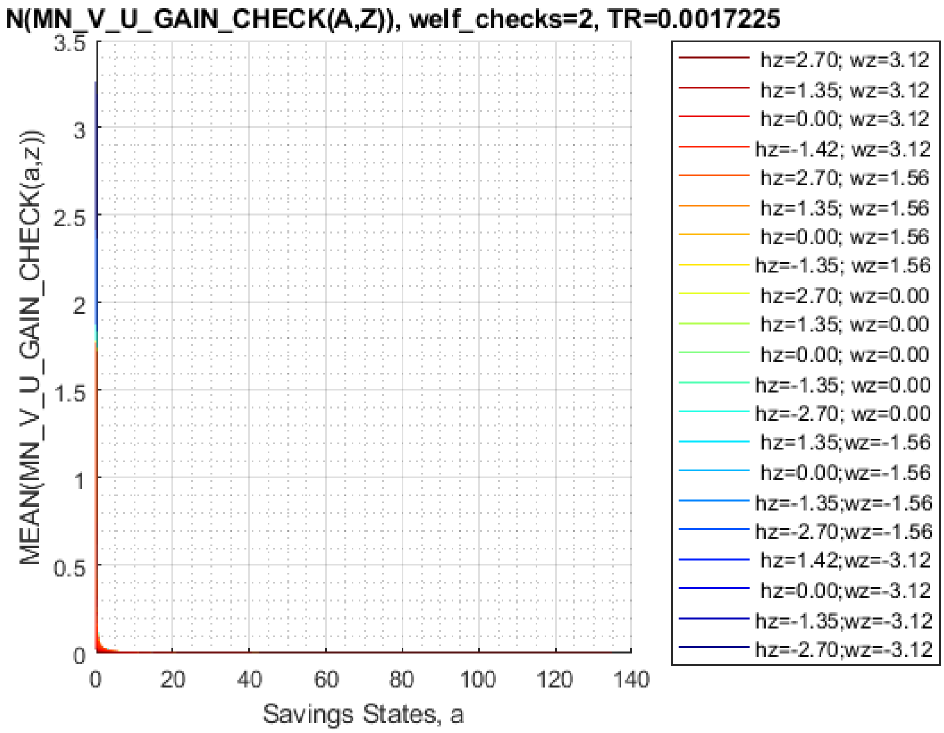
MEAN(MN_V_GAIN_CHECK(A,Z))

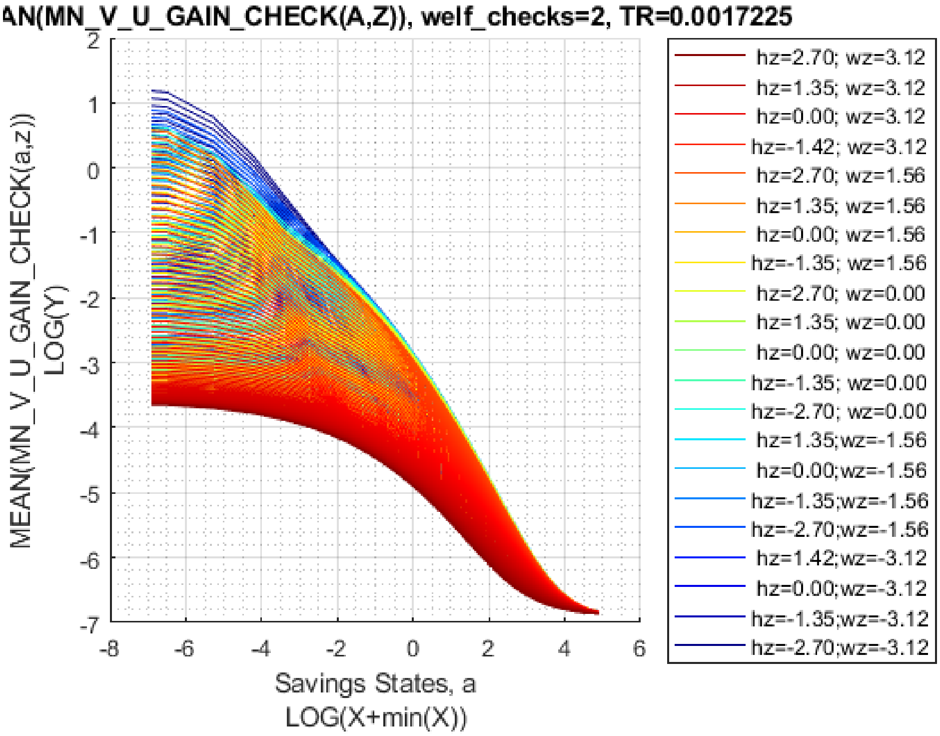
Tabulate value and policies along savings and shocks:

```
% Set
ar_permute = [1,4,5,6,3,2];
% Value Function
st_title = ['MEAN(MN_V_U_GAIN_CHECK(A,Z)), welf_checks=' num2str(welf_checks) ', TR=' num2str(mp_par
tb_az_v = ff_summ_nd_array(st_title, mn_V_U_gain_check, true, ["mean"], 4, 1, cl_mp_datasetdesc, ar_

xxx  MEAN(MN_V_U_GAIN_CHECK(A,Z)), welf_checks=2, TR=0.0017225  xxxxxxxxxxxxxxxxxxxxxxxxxxx
    group     savings      mean_eta_1    mean_eta_2    mean_eta_3    mean_eta_4    mean_eta_5    mea
    -----    ----------    ----------    ----------    ----------    ----------    ----------    ---
```

```
    1              0       3.2686       2.9159       2.6002        2.318       2.0659
```

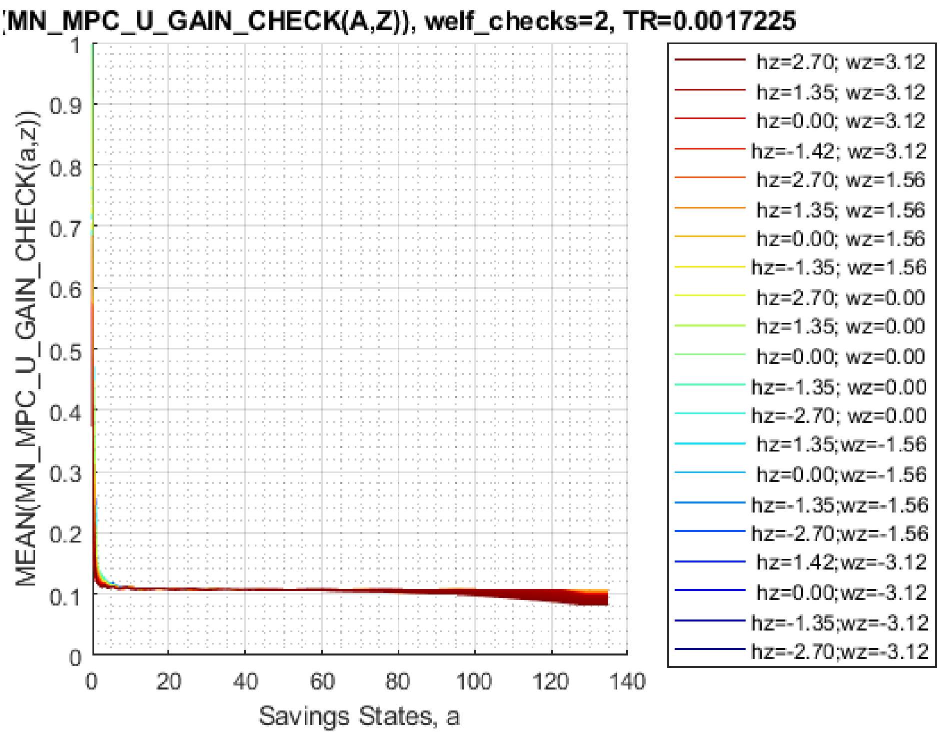
```
st_title = ['MEAN(MN\_V\_U\_GAIN\_CHECK(A,Z)), welf\_checks=' num2str(welf_checks) ', TR=' num2str(m
mp_support_graph('cl_st_graph_title') = {st_title};
mp_support_graph('cl_st_ytitle') = {'MEAN(MN\_V\_U\_GAIN\_CHECK(a,z))'};
ff_graph_grid((tb_az_v{1:end, 3:end})', ar_st_eta_HS_grid, agrid, mp_support_graph);
```

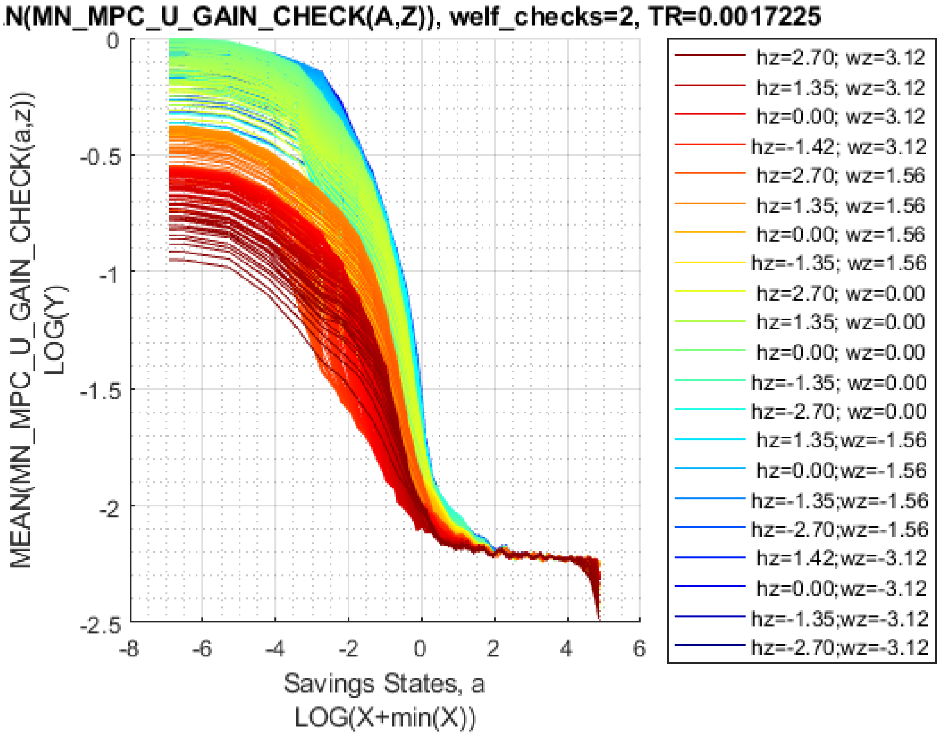




Graph Mean Consumption (***MPC: Share of Check Consumed***):

```
st_title = ['MEAN(MN\_MPC\_U\_GAIN\_CHECK(A,Z)), welf\_checks=' num2str(welf_checks) ', TR=' num2str
mp_support_graph('cl_st_graph_title') = {st_title};
mp_support_graph('cl_st_ytitle') = {'MEAN(MN\_MPC\_U\_GAIN\_CHECK(a,z))'};
ff_graph_grid((tb_az_c{1:end, 3:end})', ar_st_eta_HS_grid, agrid, mp_support_graph);
```





7.2.4 Analyze Kids and Marriage and Age

Aggregating over education, savings, and shocks, what are the differential effects of Marriage and Age.

```
% Generate some Data
mp_support_graph = containers.Map('KeyType', 'char', 'ValueType', 'any');
ar_row_grid = [...
    "k0M0", "K1M0", "K2M0", "K3M0", "K4M0", ...
    "k0M1", "K1M1", "K2M1", "K3M1", "K4M1"];
mp_support_graph('cl_st_xtitle') = {'Age'};
mp_support_graph('st_legend_loc') = 'best';
mp_support_graph('bl_graph_logy') = true; % do not log
mp_support_graph('st_rounding') = '6.2f'; % format shock legend
mp_support_graph('cl_scatter_shapes') = {...
    'o', 'd' ,'s', 'x', '*', ...
    'o', 'd', 's', 'x', '*'};
mp_support_graph('cl_colors') = {...
    'red', 'red', 'red', 'red', 'red'...
    'blue', 'blue', 'blue', 'blue', 'blue'};
```

MEAN(VAL(KM,J)), MEAN(AP(KM,J)), MEAN(C(KM,J))

Tabulate value and policies:

```
% Set
% NaN(n_jgrid,n_agrid,n_etagrid,n_educgrid,n_marriedgrid,n_kidsgrid);
ar_permute = [2,3,4,1,6,5];
% Value Function
st_title = ['MEAN(MN_V_U_GAIN_CHECK(KM,J)), welf_checks=' num2str(welf_checks) ', TR=' num2str(mp_pa
tb_az_v = ff_summ_nd_array(st_title, mn_V_U_gain_check, true, ["mean"], 3, 1, cl_mp_datasetdesc, ar_

xxx  MEAN(MN_V_U_GAIN_CHECK(KM,J)), welf_checks=2, TR=0.0017225  xxxxxxxxxxxxxxxxxxxxxxxxxxx
    group    kids    marry    mean_age_18    mean_age_19    mean_age_20    mean_age_21    mean_age_2
    _____    ____    _____    ___________    ___________    ___________    ___________    __________

      1        1       0        0.05876       0.057807       0.056772       0.051707       0.047488
```

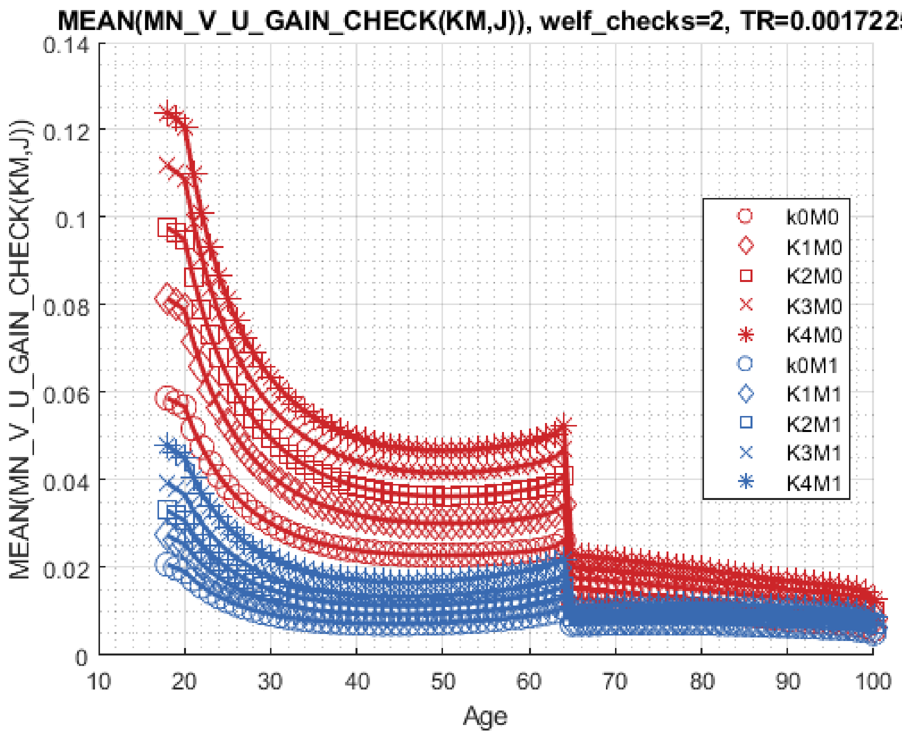
```
      2       2      0     0.081525     0.080267     0.078856     0.071726     0.065777
      3       3      0     0.097699      0.09639     0.094869       0.0863     0.079154
      4       4      0      0.11184      0.11044      0.10878     0.098969     0.090785
      5       5      0      0.12393      0.12252       0.1208      0.10994      0.10089
      6       1      1     0.020733     0.019926     0.019164      0.01732     0.015771
      7       2      1      0.02739      0.02635     0.025367     0.022922     0.020867
      8       3      1     0.033087     0.031892     0.030749      0.02779     0.025312
      9       4      1     0.039391     0.038018      0.03669     0.033174     0.030229
     10       5      1     0.047955     0.046442     0.044963     0.040683     0.037108
```

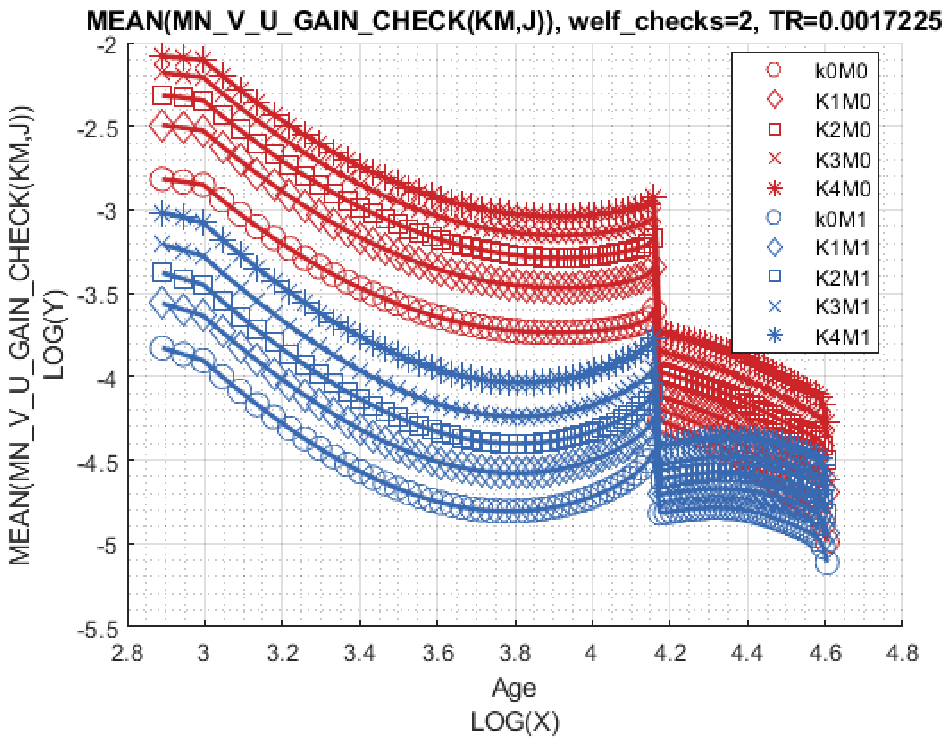
```
% Consumption Function
st_title = ['MEAN(MN_MPC_U_GAIN_CHECK(KM,J)), welf_checks=' num2str(welf_checks) ', TR=' num2str(mp_
tb_az_c = ff_summ_nd_array(st_title, mn_MPC_U_gain_share_check, true, ["mean"], 3, 1, cl_mp_datasetd
```

```
xxx  MEAN(MN_MPC_U_GAIN_CHECK(KM,J)), welf_checks=2, TR=0.0017225  xxxxxxxxxxxxxxxxxxxxxxxxxxx
    group    kids    marry    mean_age_18    mean_age_19    mean_age_20    mean_age_21    mean_age_2
    _____    ____    _____    ___________    ___________    ___________    ___________    __________

      1       1      0      0.13845      0.14295      0.14757      0.14693      0.14633
      2       2      0      0.15131      0.15536      0.15963      0.16001      0.16023
      3       3      0       0.1601      0.16368      0.16762      0.16817      0.16857
      4       4      0      0.16455      0.16795      0.17175      0.17234      0.17279
      5       5      0      0.16853      0.17166      0.17526      0.17576      0.17614
      6       1      1      0.13988      0.14409      0.14573      0.14586      0.14644
      7       2      1       0.1441      0.14787      0.14961      0.15012      0.15078
      8       3      1      0.15004      0.15388      0.15527      0.15614      0.15695
      9       4      1      0.15447      0.15723      0.15901      0.15929      0.16005
     10       5      1      0.16131      0.16321      0.16694      0.16691      0.16454
```

Graph Mean Values:

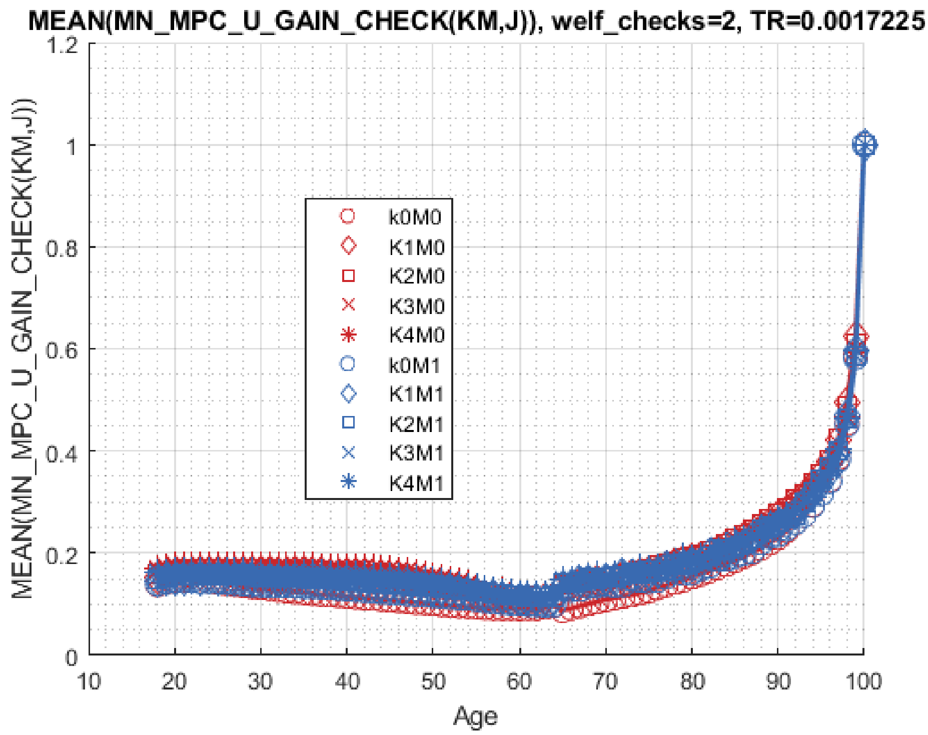
```
st_title = ['MEAN(MN\_V\_U\_GAIN\_CHECK(KM,J)), welf\_checks=' num2str(welf_checks) ', TR=' num2str(
mp_support_graph('cl_st_graph_title') = {st_title};
mp_support_graph('cl_st_ytitle') = {'MEAN(MN\_V\_U\_GAIN\_CHECK(KM,J))'};
ff_graph_grid((tb_az_v{1:end, 4:end}), ar_row_grid, age_grid, mp_support_graph);
```

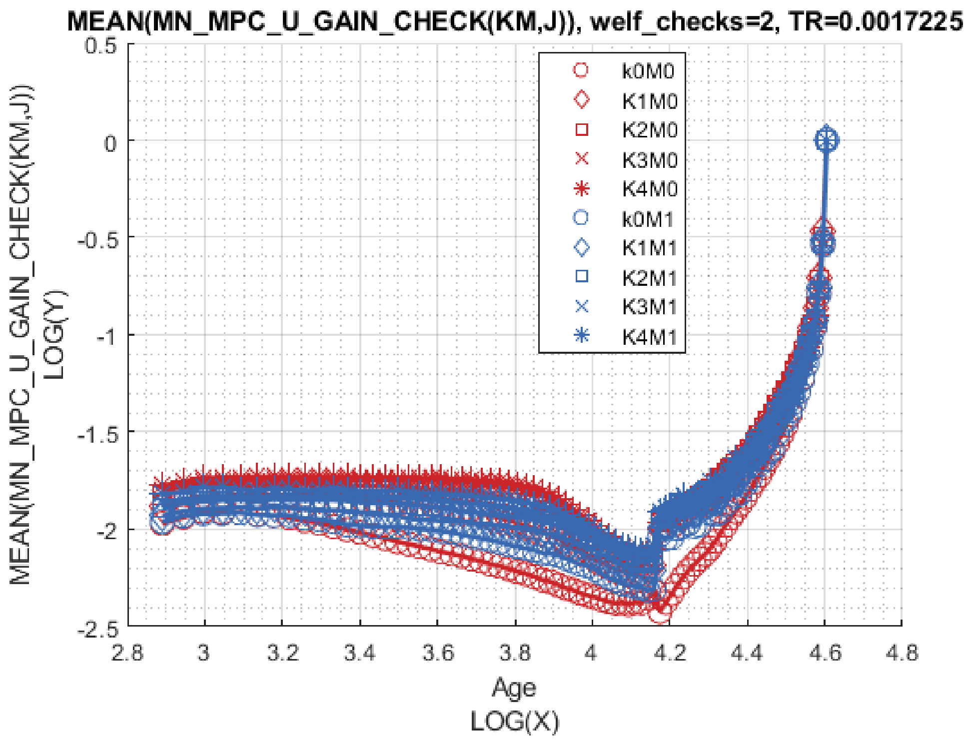




Graph Mean Consumption (***MPC: Share of Check Consumed***):

```
st_title = ['MEAN(MN\_MPC\_U\_GAIN\_CHECK(KM,J)), welf\_checks=' num2str(welf_checks) ', TR=' num2st
mp_support_graph('cl_st_graph_title') = {st_title};
mp_support_graph('cl_st_ytitle') = {'MEAN(MN\_MPC\_U\_GAIN\_CHECK(KM,J))'};
ff_graph_grid((tb_az_c{1:end, 4:end}), ar_row_grid, age_grid, mp_support_graph);
```





7.2.5 Analyze Education and Marriage

Aggregating over education, savings, and shocks, what are the differential effects of Marriage and Age.

```
% Generate some Data
mp_support_graph = containers.Map('KeyType', 'char', 'ValueType', 'any');
ar_row_grid = ["E0M0", "E1M0", "E0M1", "E1M1"];
mp_support_graph('cl_st_xtitle') = {'Age'};
mp_support_graph('st_legend_loc') = 'best';
mp_support_graph('bl_graph_logy') = true; % do not log
mp_support_graph('st_rounding') = '6.2f'; % format shock legend
mp_support_graph('cl_scatter_shapes') = {'*', 'p', '*','p' };
mp_support_graph('cl_colors') = {'red', 'red', 'blue', 'blue'};
```

MEAN(VAL(EM,J)), MEAN(AP(EM,J)), MEAN(C(EM,J))

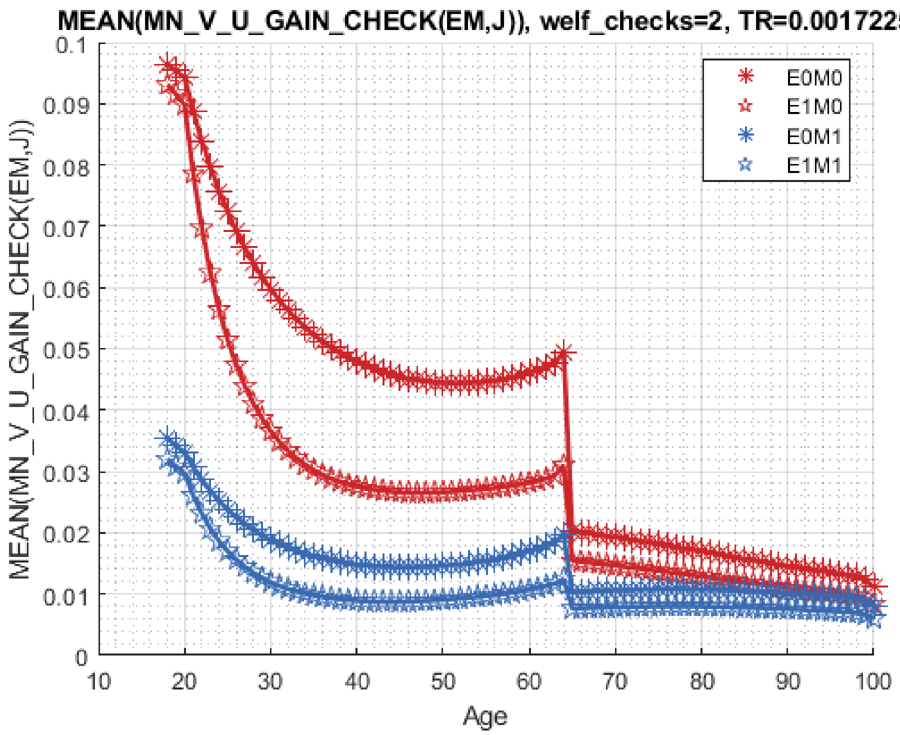
Tabulate value and policies:

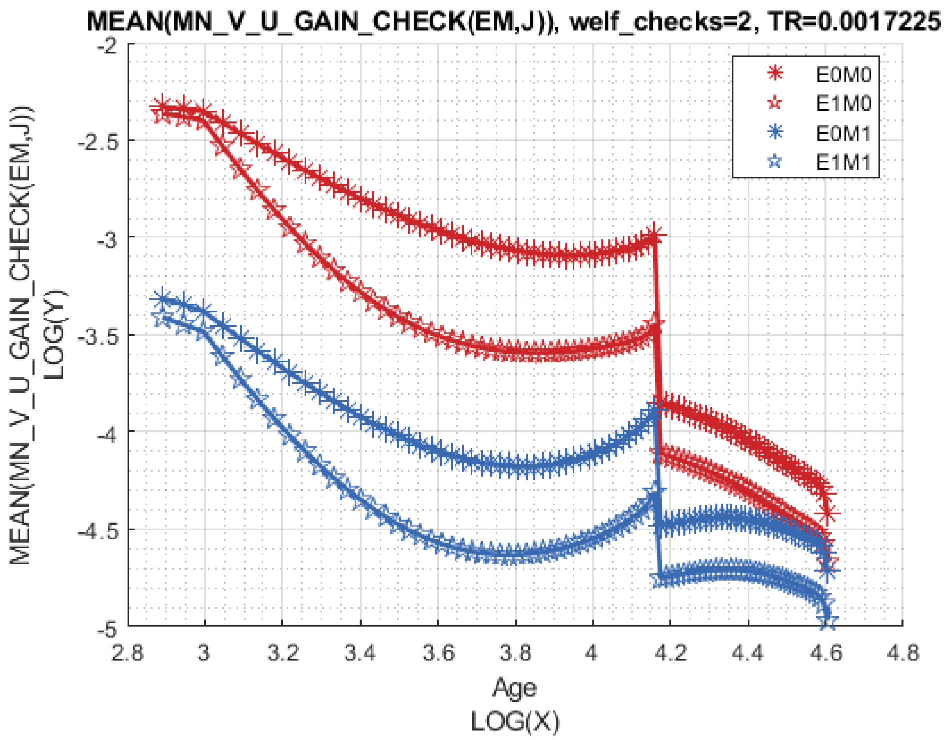
```
% Set
% NaN(n_jgrid,n_agrid,n_etagrid,n_educgrid,n_marriedgrid,n_kidsgrid);
ar_permute = [2,3,6,1,4,5];
% Value Function
st_title = ['MEAN(MN_V_U_GAIN_CHECK(EM,J)), welf_checks=' num2str(welf_checks) ', TR=' num2str(mp_pa
tb_az_v = ff_summ_nd_array(st_title, mn_V_U_gain_check, true, ["mean"], 3, 1, cl_mp_datasetdesc, ar_

xxx  MEAN(MN_V_U_GAIN_CHECK(EM,J)), welf_checks=2, TR=0.0017225  xxxxxxxxxxxxxxxxxxxxxxxxxxxxx
    group    edu    marry    mean_age_18    mean_age_19    mean_age_20    mean_age_21    mean_age_22
    _____    ___    _____    ___________    ___________    ___________    ___________    ___________

      1       0       0       0.096397       0.095384       0.094239       0.088786       0.083945
      2       1       0       0.093102       0.091587       0.089794       0.078671       0.069692
      3       0       1       0.035401       0.034205       0.033063       0.030696       0.028627
      4       1       1       0.032021       0.030846       0.029711        0.02606       0.023088

% Consumption
st_title = ['MEAN(MN_MPC_U_GAIN_CHECK(EM,J)), welf_checks=' num2str(welf_checks) ', TR=' num2str(mp_
```

```
tb_az_c = ff_summ_nd_array(st_title, mn_MPC_U_gain_share_check, true, ["mean"], 3, 1, cl_mp_datasetd

xxx  MEAN(MN_MPC_U_GAIN_CHECK(EM,J)), welf_checks=2, TR=0.0017225  xxxxxxxxxxxxxxxxxxxxxxxxxxx
    group    edu    marry    mean_age_18    mean_age_19    mean_age_20    mean_age_21    mean_age_22
    _____    ___    _____    ___________    ___________    ___________    ___________    ___________

      1       0       0        0.14718        0.15045        0.15381        0.15404        0.15431
      2       1       0          0.166         0.1702        0.17493        0.17525        0.17532
      3       0       1        0.14287        0.14583        0.14746        0.14781        0.14772
      4       1       1        0.15705        0.16068        0.16316        0.16351        0.16378
```

Graph Mean Values:

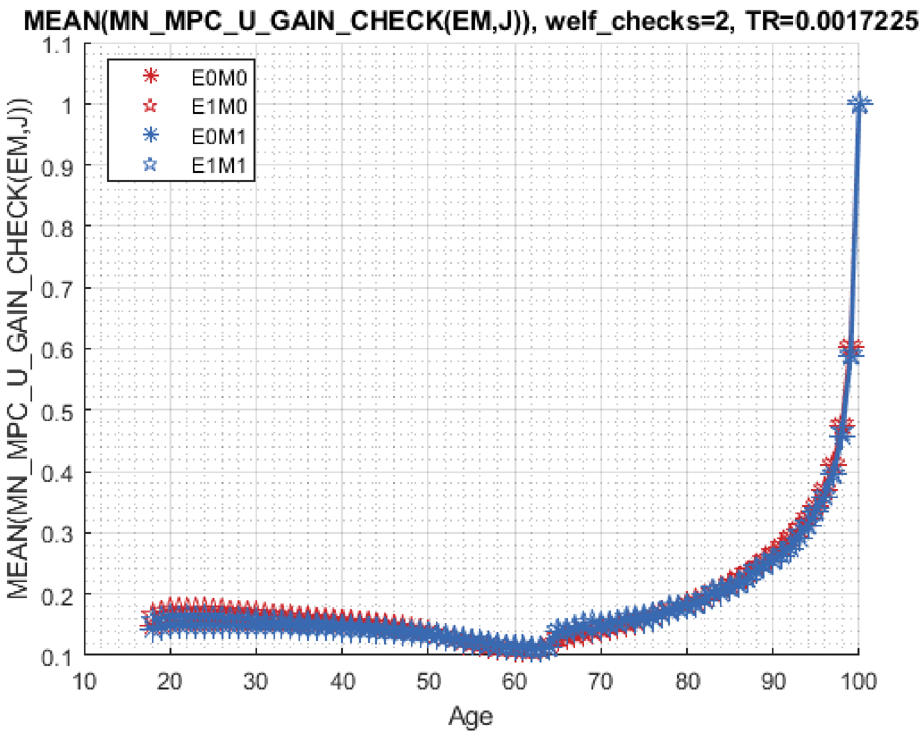
```
st_title = ['MEAN(MN\_V\_U\_GAIN\_CHECK(EM,J)), welf\_checks=' num2str(welf_checks) ', TR=' num2str(
mp_support_graph('cl_st_graph_title') = {st_title};
mp_support_graph('cl_st_ytitle') = {'MEAN(MN\_V\_U\_GAIN\_CHECK(EM,J))'};
ff_graph_grid((tb_az_v{1:end, 4:end}), ar_row_grid, age_grid, mp_support_graph);
```

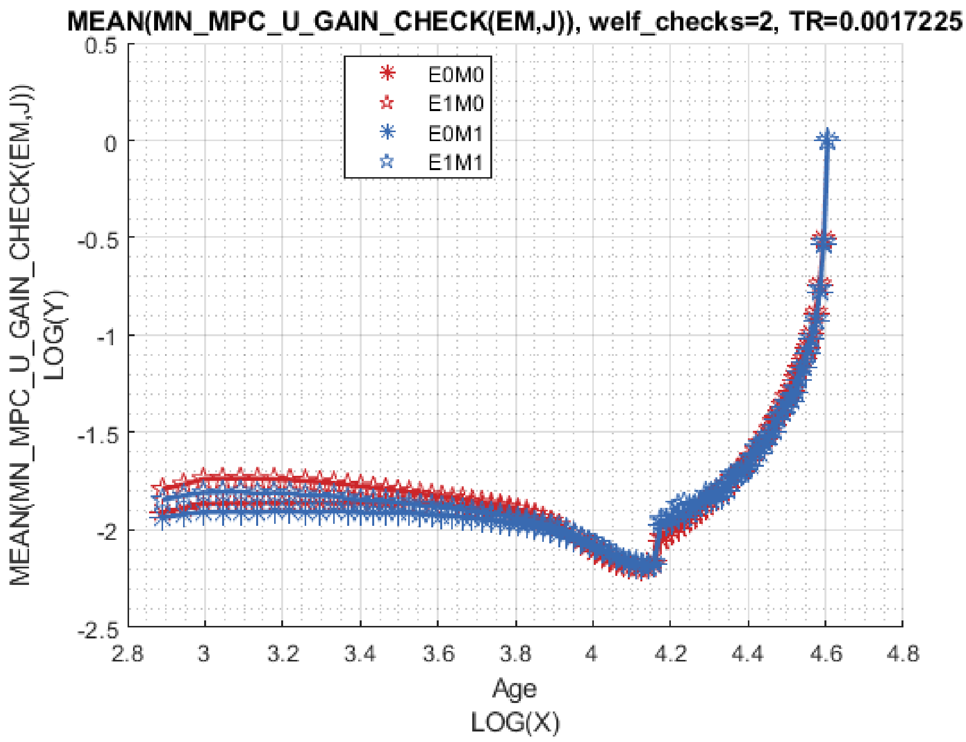




Graph Mean Consumption (***MPC: Share of Check Consumed***):

```
st_title = ['MEAN(MN\_MPC\_U\_GAIN\_CHECK(EM,J)), welf\_checks=' num2str(welf_checks) ', TR=' num2st
mp_support_graph('cl_st_graph_title') = {st_title};
mp_support_graph('cl_st_ytitle') = {'MEAN(MN\_MPC\_U\_GAIN\_CHECK(EM,J))'};
ff_graph_grid((tb_az_c{1:end, 4:end}), ar_row_grid, age_grid, mp_support_graph);
```




MEAN(MN_MPC_U_GAIN_CHECK(EM,J)), welf_checks=2, TR=0.0017225
E0M0
E1M0
E0M1
E1M1
MEAN(MN_MPC_U_GAIN_CHECK(EM,J))
LOG(Y)
Age
LOG(X)
0.5
0
-0.5
-1
-1.5
-2
-2.5
2.8
3
3.2
3.4
3.6
3.8
4
4.2
4.4
4.6
4.8

Chapter 8

2020 Outcomes Full State Space with Savings, Shocks and Education

8.1 2020 Full States EV and EC of One Check

This is the example vignette for function: **snw_evuvw20_jaeemk** from the **PrjOptiSNW Package.** 2020 integrated over VU and VW. Average C or V given unemployment probabilities.

8.1.1 Test SNW_EVUVW20_JAEEMK Defaults

Call the function with defaults.

```
clear all;
st_solu_type = 'bisec_vec';

% Solve the VFI Problem and get Value Function
mp_params = snw_mp_param('default_docdense');
mp_controls = snw_mp_control('default_test');

% set Unemployment Related Variables
xi=0.5; % Proportional reduction in income due to unemployment (xi=0 refers to 0 labor income; xi=1
b=0; % Unemployment insurance replacement rate (b=0 refers to no UI benefits; b=1 refers to 100 perc
TR=100/58056; % Value of a welfare check (can receive multiple checks). TO DO: Update with alternati

mp_params('xi') = xi;
mp_params('b') = b;
mp_params('TR') = TR;

% Solve for Unemployment Values
mp_controls('bl_print_vfi') = false;
mp_controls('bl_print_ds') = false;
mp_controls('bl_print_ds_verbose') = false;
mp_controls('bl_print_precompute') = false;
mp_controls('bl_print_precompute_verbose') = false;
mp_controls('bl_print_a4chk') = false;
mp_controls('bl_print_a4chk_verbose') = false;
mp_controls('bl_print_evuvw20_jaeemk') = false;
mp_controls('bl_print_evuvw20_jaeemk_verbose') = false;
```

Solve the model:

```
%% A. Solve VFI
% 2. Solve VFI and Distributon
% Solve the Model to get V working and unemployed
```

```
% solved with calibrated regular a2
[V_ss,ap_ss,cons_ss,mp_valpol_more_ss] = snw_vfi_main_bisec_vec(mp_params, mp_controls);

Completed SNW_VFI_MAIN_BISEC_VEC;SNW_MP_PARAM=default_docdense;SNW_MP_CONTROL=default_test;time=517.
----------------------------------------
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
CONTAINER NAME: mp_outcomes ND Array (Matrix etc)
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
                i    idx    ndim     numel      rowN      colN          sum         mean       std
                -    ---    ----    --------    ----    ---------    -----------    -------    -----

    V_VFI       1     1      6      4.37e+07     83     5.265e+05    -1.5339e+08    -3.5101    26.11
    ap_VFI      2     2      6      4.37e+07     83     5.265e+05     1.4159e+09     32.402    36.79
    cons_VFI    3     3      6      4.37e+07     83     5.265e+05     2.1402e+08     4.8975    8.329

xxx TABLE:V_VFI xxxxxxxxxxxxxxxxxx
              c1         c2         c3         c4         c5       c526496    c526497    c526498    c
           -------    -------    -------    -------    -------    -------    -------    -------    -

    r1     -346.51    -346.12    -343.63    -337.86    -328.51     21.702     21.852     22.003
    r2     -334.38    -333.99    -331.51    -325.83    -316.83     21.724     21.869     22.015
    r3     -322.45    -322.06     -319.6    -314.14     -305.6     21.745     21.885     22.027
    r4     -310.63    -310.27    -307.99    -302.88    -294.87     21.767     21.903     22.041
    r5     -299.94     -299.6    -297.46    -292.67    -285.12     21.775     21.907     22.042
    r79    -9.9437    -9.9325    -9.8557    -9.6597    -9.3232     2.5394     2.5501     2.5602
    r80    -8.9023    -8.8911    -8.8143    -8.6183    -8.2818     2.3039     2.3121     2.3198
    r81    -7.6363    -7.6251    -7.5484    -7.3524    -7.0159     2.0068     2.0124     2.0176
    r82    -5.9673    -5.9561    -5.8793    -5.6833    -5.3468     1.5958     1.5989     1.6018
    r83    -3.5892     -3.578    -3.5012    -3.3052    -2.9687    0.97904    0.98004    0.98097    0

xxx TABLE:ap_VFI xxxxxxxxxxxxxxxxxx
           c1    c2        c3            c4           c5       c526496    c526497    c526498    c5264
           --    --    ----------    ---------    ---------    -------    -------    -------    -----

    r1     0     0      0.0005656    0.0075134    0.022901     114.75     120.41     126.27     132.3
    r2     0     0     0.00051498    0.0065334    0.021549     114.86     120.53     126.41     132.5
    r3     0     0     0.00051498    0.0049294    0.019875     114.97     120.65     126.56      132.
    r4     0     0     0.00051498    0.0047937    0.019672     115.73     121.42     127.34     133.5
    r5     0     0     0.00048517    0.0046683    0.019484      116.5     122.21     128.15     134.3
    r79    0     0              0            0           0     81.091      85.68     90.335     94.37
    r80    0     0              0            0           0     76.669     80.563     84.304      88.0
    r81    0     0              0            0           0     68.313     71.534     74.475     77.83
    r82    0     0              0            0           0     50.126     53.467     56.953     58.74
    r83    0     0              0            0           0          0          0          0

xxx TABLE:cons_VFI xxxxxxxxxxxxxxxxxx
              c1          c2          c3          c4          c5       c526496    c526497    c526498
           --------    --------    --------    --------    --------    -------    -------    -------

    r1     0.036717    0.037251    0.040426     0.04363    0.048012    9.6491      9.817     9.9649
    r2     0.036717    0.037251    0.040477     0.04461    0.049364    9.8118     9.9685     10.101
    r3     0.036717    0.037251    0.040477    0.046214    0.051039    9.9779      10.12     10.234
    r4     0.038144    0.038678    0.041903    0.047776    0.052666    10.131     10.258     10.354
    r5     0.039534    0.040068    0.043323     0.04929    0.054241    10.272     10.384     10.463
    r79      0.2179     0.21844     0.22216     0.23228     0.25197    35.858     37.092     38.455
    r80      0.2179     0.21844     0.22216     0.23228     0.25197    40.253     42.183     44.459
    r81      0.2179     0.21844     0.22216     0.23228     0.25197    48.587      51.19     54.266
    r82      0.2179     0.21844     0.22216     0.23228     0.25197    66.755     69.238      71.77
```

```
    r83      0.2179     0.21844     0.22216     0.23228     0.25197    116.87     122.69     128.71

% COVID year tax
mp_params('a2_covidyr') = mp_params('a2_covidyr_manna_heaven');
% 2020 V and C same as V_SS and cons_ss if tax the same
if (mp_params('a2_covidyr') == mp_params('a2'))
    % mana from heaven
    V_ss_2020 = V_ss;
    cons_ss_2020 = cons_ss;
else
    % change xi and b to for people without unemployment shock
    % solving for employed but 2020 tax results
    % a2_covidyr > a2, we increased tax in 2020 to pay for covid and other
    % costs resolve for both employed and unemployed
    xi = mp_params('xi');
    b = mp_params('b');
    mp_params('xi') = 1;
    mp_params('b') = 0;
    [V_ss_2020,~,cons_ss_2020,~] = snw_vfi_main_bisec_vec(mp_params, mp_controls, V_ss);
    mp_params('xi') = xi;
    mp_params('b') = b;
end

% Solve unemployment, with three input parameters, auto will use a2_covidyr
% as tax, similar for employed call above
[V_unemp_2020,~,cons_unemp_2020] = snw_vfi_main_bisec_vec(mp_params, mp_controls, V_ss);

Completed SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock;SNW_MP_PARAM=default_docdense;SNW_MP_CONTROL=d
----------------------------------------
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
CONTAINER NAME: mp_outcomes ND Array (Matrix etc)
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
                i    idx    ndim     numel      rowN      colN          sum         mean       std
                -    ---    ----    --------    ----    ---------    -----------    -------    -----

    V_VFI       1     1      6      4.37e+07     83     5.265e+05    -1.7805e+08    -4.0743    27.11
    ap_VFI      2     2      6      4.37e+07     83     5.265e+05     1.3789e+09     31.553    36.67
    cons_VFI    3     3      6      4.37e+07     83     5.265e+05     2.1097e+08     4.8277    8.328

xxx TABLE:V_VFI xxxxxxxxxxxxxxxxxx
             c1         c2         c3         c4         c5       c526496    c526497    c526498    c
           -------    -------    -------    -------    -------    -------    -------    -------    -

    r1     -372.97    -371.47    -362.94    -349.52    -336.96     21.573     21.728     21.882
    r2     -360.84    -359.34    -350.81    -337.39    -324.98     21.595     21.745     21.894
    r3     -348.91    -347.41    -338.88    -325.46    -313.34     21.617     21.762     21.906
    r4     -336.09     -334.7    -326.73    -314.01    -302.44     21.633     21.772     21.913
    r5     -324.48    -323.18    -315.72    -303.62    -292.54     21.634      21.77     21.907
    r79    -9.9437    -9.9325    -9.8557    -9.6597    -9.3232     2.5374     2.5482     2.5584
    r80    -8.9023    -8.8911    -8.8143    -8.6183    -8.2818     2.3024     2.3107     2.3185
    r81    -7.6363    -7.6251    -7.5484    -7.3524    -7.0159     2.0057     2.0114     2.0168
    r82    -5.9673    -5.9561    -5.8793    -5.6833    -5.3468     1.5952     1.5984     1.6014
    r83    -3.5892     -3.578    -3.5012    -3.3052    -2.9687    0.97886    0.97987    0.98082    0

xxx TABLE:ap_VFI xxxxxxxxxxxxxxxxxx
             c1    c2    c3    c4       c5        c526496    c526497    c526498    c526499    c526500
             --    --    --    --    ---------    -------    -------    -------    -------    -------
```

```
    r1     0     0     0     0    0.0092181    110.06     115.71     121.55     127.62     133.93
    r2     0     0     0     0     0.008238    110.03     115.68     121.54     127.62     133.95
    r3     0     0     0     0    0.0066341    109.99     115.65     121.53     127.63     133.97
    r4     0     0     0     0    0.0058019    110.28     115.95     121.84     127.96     134.33
    r5     0     0     0     0     0.004998    110.58     116.27     122.17     128.31     134.69
    r79    0     0     0     0            0    81.091     85.229     89.297     93.341     97.382
    r80    0     0     0     0            0    75.865     79.539      83.28     87.016     90.669
    r81    0     0     0     0            0    67.781     70.521     73.462     76.819     81.091
    r82    0     0     0     0            0    50.126     53.467     56.108     57.742     60.587
    r83    0     0     0     0            0         0          0          0          0          0

xxx TABLE:cons_VFI xxxxxxxxxxxxxxxxxx
              c1          c2          c3          c4          c5       c526496    c526497    c526498
           --------    --------    --------    --------    --------    -------    -------    -------

    r1     0.018623    0.019158    0.022901    0.033062     0.04363     9.4708     9.6491      9.817
    r2     0.018623    0.019158    0.022901    0.033062     0.04461     9.6414     9.8118     9.9685
    r3     0.018623    0.019158    0.022901    0.033062    0.046214     9.8179     9.9779      10.12
    r4     0.019354    0.019888    0.023632    0.033792    0.047776     9.9825     10.131     10.258
    r5     0.020066    0.020601    0.024344    0.034504     0.04929     10.135     10.272     10.384
    r79      0.2179     0.21844     0.22216     0.23228     0.25197      34.82     36.506     38.455
    r80      0.2179     0.21844     0.22216     0.23228     0.25197     40.033     42.183     44.459
    r81      0.2179     0.21844     0.22216     0.23228     0.25197     48.106      51.19     54.266
    r82      0.2179     0.21844     0.22216     0.23228     0.25197     65.751     68.234     71.611
    r83      0.2179     0.21844     0.22216     0.23228     0.25197     115.87     121.69     127.71
```

```
%% B. Solve Dist
[Phi_true] = snw_ds_main_vec(mp_params, mp_controls, ap_ss, cons_ss);
```

```
Completed SNW_DS_MAIN_VEC;SNW_MP_PARAM=default_docdense;SNW_MP_CONTROL=default_test;time=876.6781
```

Previous code

```
% % Solve the Model to get V working and unemployed
% [V_ss,ap_ss,cons_ss,mp_valpol_more_ss] = snw_vfi_main_bisec_vec(mp_params, mp_controls);
% % Solve unemployment
% [V_unemp,~,cons_unemp,~] = snw_vfi_main_bisec_vec(mp_params, mp_controls, V_ss);
% [Phi_true] = snw_ds_main(mp_params, mp_controls, ap_ss, cons_ss, mp_valpol_more_ss);
```

8.1.2 Precompute

```
inc_VFI = mp_valpol_more_ss('inc_VFI');
spouse_inc_VFI = mp_valpol_more_ss('spouse_inc_VFI');
total_inc_VFI = inc_VFI + spouse_inc_VFI;
% Get Matrixes
cl_st_precompute_list = {'a', ...
    'inc', 'inc_unemp', 'spouse_inc', 'spouse_inc_unemp', 'ref_earn_wageind_grid'};
mp_controls('bl_print_precompute_verbose') = false;
[mp_precompute_res] = snw_hh_precompute(mp_params, mp_controls, cl_st_precompute_list, ap_ss, Phi_tr
```

```
Wage quintile cutoffs=0.4645     0.71528      1.0335      1.5632
Completed SNW_HH_PRECOMPUTE;SNW_MP_PARAM=default_docdense;SNW_MP_CONTROL=default_test;time cost=318.
```

8.1.3 Solve for 2020 Evuvw With 0 and 2 Checks

```
% Call Function
welf_checks = 0;
[ev20_jaeemk_check0, ec20_jaeemk_check0] = snw_evuvw20_jaeemk(...
    welf_checks, st_solu_type, mp_params, mp_controls, ...
```

```
    V_ss_2020, cons_ss_2020, V_unemp_2020, cons_unemp_2020, mp_precompute_res);
```

```
Completed SNW_A4CHK_WRK_BISEC_VEC;welf_checks=0;TR=0.0017225;SNW_MP_PARAM=default_docdense;SNW_MP_CO
Completed SNW_A4CHK_UNEMP_BISEC_VEC;welf_checks=0;TR=0.0017225;xi=0.5;b=0;SNW_MP_PARAM=default_docde
Completed SNW_EVUVW20_JAEEMK;SNW_MP_PARAM=default_docdense;SNW_MP_CONTROL=default_test;timeEUEC=8.07
```

```
% Call Function
welf_checks = 2;
[ev20_jaeemk_check2, ec20_jaeemk_check2] = snw_evuvw20_jaeemk(...
    welf_checks, st_solu_type, mp_params, mp_controls, ...
    V_ss_2020, cons_ss_2020, V_unemp_2020, cons_unemp_2020, mp_precompute_res);
```

```
Completed SNW_A4CHK_WRK_BISEC_VEC;welf_checks=2;TR=0.0017225;SNW_MP_PARAM=default_docdense;SNW_MP_CO
Completed SNW_A4CHK_UNEMP_BISEC_VEC;welf_checks=2;TR=0.0017225;xi=0.5;b=0;SNW_MP_PARAM=default_docde
Completed SNW_EVUVW20_JAEEMK;SNW_MP_PARAM=default_docdense;SNW_MP_CONTROL=default_test;timeEUEC=7.84
```

Differences between Checks in Expected Value and Expected Consumption

```
mn_V_U_gain_check = ev20_jaeemk_check2 - ev20_jaeemk_check0;
mn_MPC_U_gain_share_check = (ec20_jaeemk_check2 - ec20_jaeemk_check0)./(welf_checks*mp_params('TR'))
```

8.1.4 Param Results Define Frames

Define the matrix dimensions names and dimension vector values. Policy and Value Functions share the same ND dimensional structure.

```
% Grids:
age_grid = 18:100;
agrid = mp_params('agrid')';
eta_H_grid = mp_params('eta_H_grid')';
eta_S_grid = mp_params('eta_S_grid')';
ar_st_eta_HS_grid = string(cellstr([num2str(eta_H_grid', 'hz=%3.2f;'), num2str(eta_S_grid', 'wz=%3.2
edu_grid = [0,1];
marry_grid = [0,1];
kids_grid = (1:1:mp_params('n_kidsgrid'))';
% NaN(n_jgrid,n_agrid,n_etagrid,n_educgrid,n_marriedgrid,n_kidsgrid);
cl_mp_datasetdesc = {};
cl_mp_datasetdesc{1} = containers.Map({'name', 'labval'}, {'age', age_grid});
cl_mp_datasetdesc{2} = containers.Map({'name', 'labval'}, {'savings', agrid});
cl_mp_datasetdesc{3} = containers.Map({'name', 'labval'}, {'eta', 1:length(eta_H_grid)});
cl_mp_datasetdesc{4} = containers.Map({'name', 'labval'}, {'edu', edu_grid});
cl_mp_datasetdesc{5} = containers.Map({'name', 'labval'}, {'marry', marry_grid});
cl_mp_datasetdesc{6} = containers.Map({'name', 'labval'}, {'kids', kids_grid});
```

8.1.5 Analyze Difference in V and C with Check

The difference between V and V with Check, marginal utility gain given the check.

```
% Generate some Data
mp_support_graph = containers.Map('KeyType', 'char', 'ValueType', 'any');
mp_support_graph('cl_st_xtitle') = {'Savings States, a'};
mp_support_graph('st_legend_loc') = 'eastoutside';
mp_support_graph('bl_graph_logy') = true; % do not log
mp_support_graph('it_legend_select') = 21; % how many shock legends to show
mp_support_graph('cl_colors') = 'jet';
```

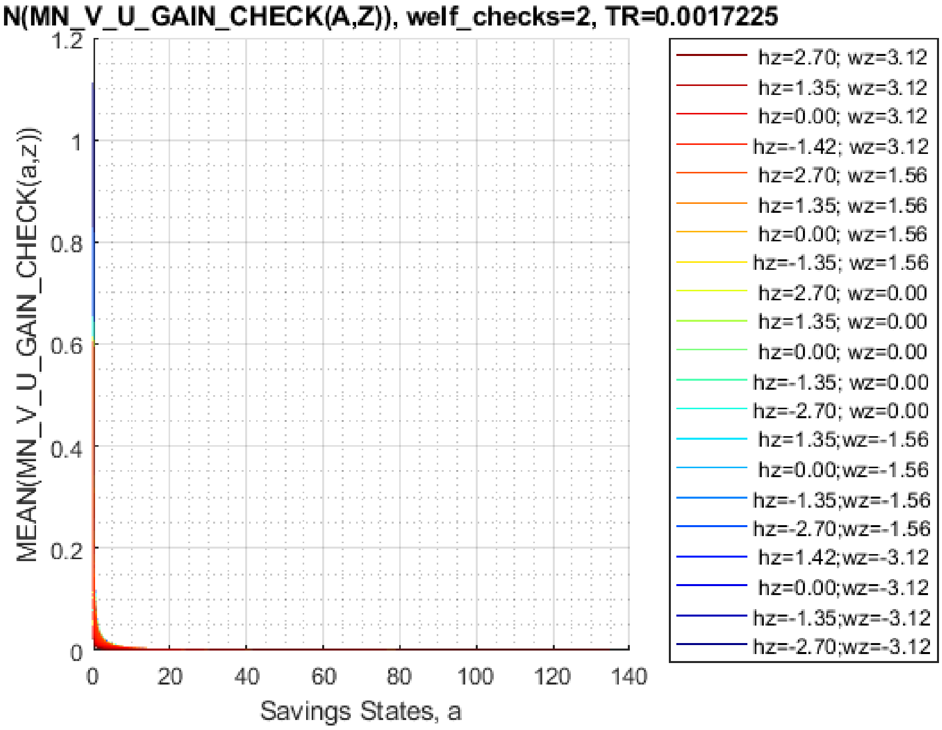
MEAN(MN_V_GAIN_CHECK(A,Z))

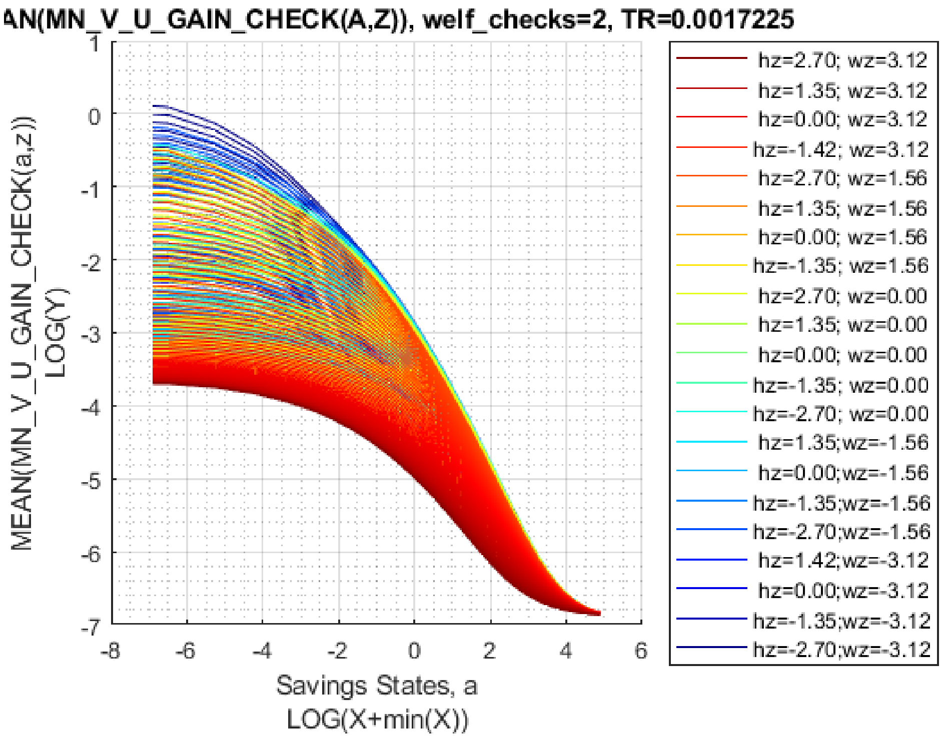
Tabulate value and policies along savings and shocks:

```
% Set
ar_permute = [1,4,5,6,3,2];
```

```
% Value Function
st_title = ['MEAN(MN_V_U_GAIN_CHECK(A,Z)), welf_checks=' num2str(welf_checks) ', TR=' num2str(mp_par
tb_az_v = ff_summ_nd_array(st_title, mn_V_U_gain_check, true, ["mean"], 4, 1, cl_mp_datasetdesc, ar_

xxx  MEAN(MN_V_U_GAIN_CHECK(A,Z)), welf_checks=2, TR=0.0017225  xxxxxxxxxxxxxxxxxxxxxxxxxxx
    group     savings      mean_eta_1    mean_eta_2    mean_eta_3    mean_eta_4    mean_eta_5    mea
    -----    ----------    ----------    ----------    ----------    ----------    ----------    ---

      1             0        1.1134       0.99534       0.88994       0.79581       0.71183
```

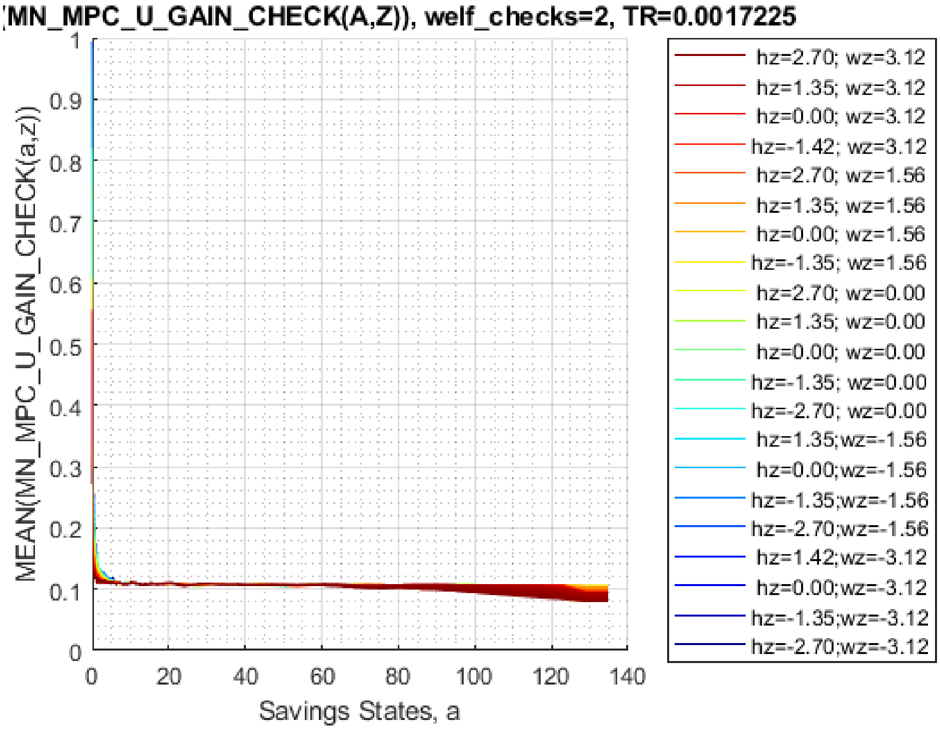
```
st_title = ['MEAN(MN\_V\_U\_GAIN\_CHECK(A,Z)), welf\_checks=' num2str(welf_checks) ', TR=' num2str(m
mp_support_graph('cl_st_graph_title') = {st_title};
mp_support_graph('cl_st_ytitle') = {'MEAN(MN\_V\_U\_GAIN\_CHECK(a,z))'};
ff_graph_grid((tb_az_v{1:end, 3:end})', ar_st_eta_HS_grid, agrid, mp_support_graph);
```

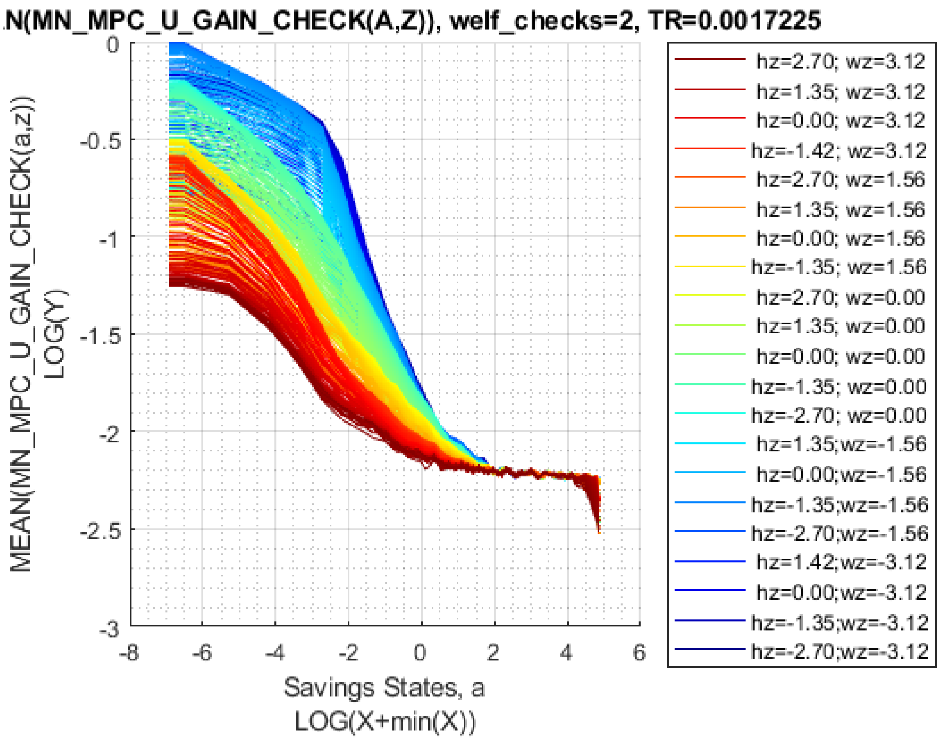




Graph Mean Consumption (MPC: Share of Check Consumed):

```
st_title = ['MEAN(MN\_MPC\_U\_GAIN\_CHECK(A,Z)), welf\_checks=' num2str(welf_checks) ', TR=' num2str
mp_support_graph('cl_st_graph_title') = {st_title};
mp_support_graph('cl_st_ytitle') = {'MEAN(MN\_MPC\_U\_GAIN\_CHECK(a,z))'};
ff_graph_grid((tb_az_c{1:end, 3:end})', ar_st_eta_HS_grid, agrid, mp_support_graph);
```





8.1.6 Analyze Marginal Value and MPC over Y(a,eta), Conditional On Kids, Marry, Age, Education

Income is generated by savings and shocks, what are the income levels generated by all the shock and savings points conditional on kids, marital status, age and educational levels. Plot on the Y axis MPC, and plot on the X axis income levels, use colors to first distinguish between different a levels, then use colors to distinguish between different eta levles.

Set Up date, Select Age 38, unmarried, no kids, lower education:

```
% NaN(n_jgrid,n_agrid,n_etagrid,n_educgrid,n_marriedgrid,n_kidsgrid);
% 38 year old, unmarried, no kids, lower educated
% Only Household Head Shock Matters so select up to 'n_eta_H_grid'
mn_total_inc_jemk = total_inc_VFI(20,:,1:mp_params('n_eta_H_grid'),1,1,1);
mn_V_W_gain_check_use = ev20_jaeemk_check2 - ev20_jaeemk_check0;
mn_C_W_gain_check_use = ec20_jaeemk_check2 - ec20_jaeemk_check0;
```

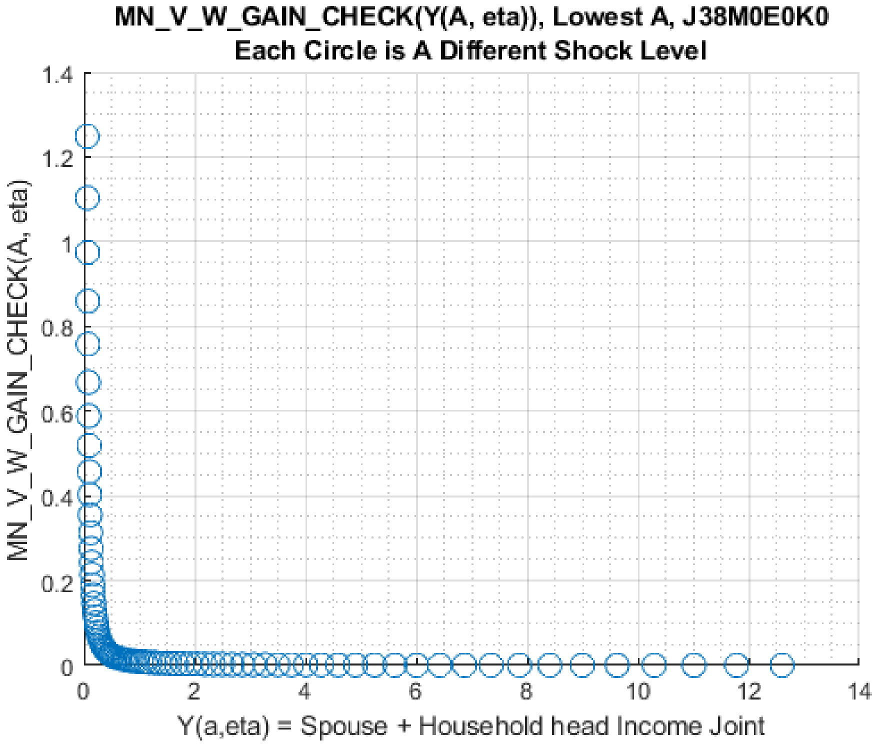
Select Age, Education, Marital, Kids Count:s

```
% Selections
it_age = 21; % +18
it_marital = 1; % 1 = unmarried
it_kids = 1; % 1 = kids is zero
it_educ = 1; % 1 = lower education
% Select: NaN(n_jgrid,n_agrid,n_etagrid,n_educgrid,n_marriedgrid,n_kidsgrid);
mn_C_W_gain_check_jemk = mn_C_W_gain_check_use(it_age, :, 1:mp_params('n_eta_H_grid'), it_educ, it_m
mn_V_W_gain_check_jemk = mn_V_W_gain_check_use(it_age, :, 1:mp_params('n_eta_H_grid'), it_educ, it_m
% Reshape, so shock is the first dim, a is the second
mt_total_inc_jemk = permute(mn_total_inc_jemk,[3,2,1]);
mt_C_W_gain_check_jemk = permute(mn_C_W_gain_check_jemk,[3,2,1]);
mt_C_W_gain_check_jemk(mt_C_W_gain_check_jemk<=1e-10) = 1e-10;
mt_V_W_gain_check_jemk = permute(mn_V_W_gain_check_jemk,[3,2,1]);
mt_V_W_gain_check_jemk(mt_V_W_gain_check_jemk<=1e-10) = 1e-10;
% Generate meshed a and shock grid
[mt_eta_H, mt_a] = ndgrid(eta_H_grid(1:mp_params('n_eta_H_grid')), agrid);
```

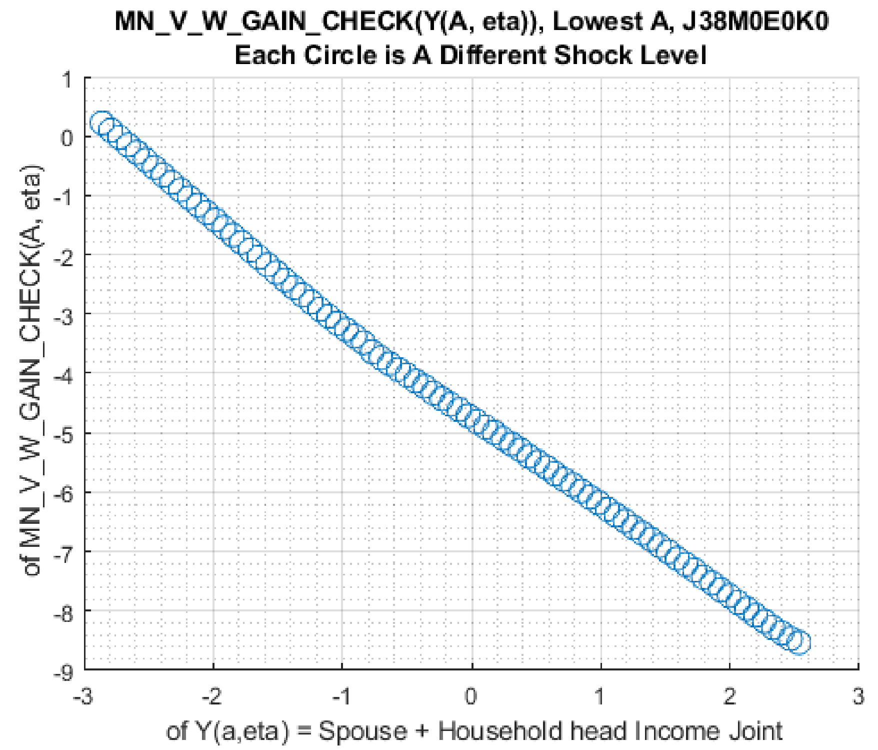
8.1.7 Marginal Value Gains, Color as Shock, Conditional on Age, Marital, Kids, and Education

How do shocks and a impact marginal value. First plot one asset level, variation comes only from increasingly higher shocks:

```
figure();
it_a = 1;
scatter((mt_total_inc_jemk(:,it_a)), (mt_V_W_gain_check_jemk(:,it_a)), 100);
title({'MN\_V\_W\_GAIN\_CHECK(Y(A, eta)), Lowest A, J38M0E0K0', ...
    'Each Circle is A Different Shock Level'});
xlabel('Y(a,eta) = Spouse + Household head Income Joint');
ylabel('MN\_V\_W\_GAIN\_CHECK(A, eta)');
grid on;
grid minor;
```

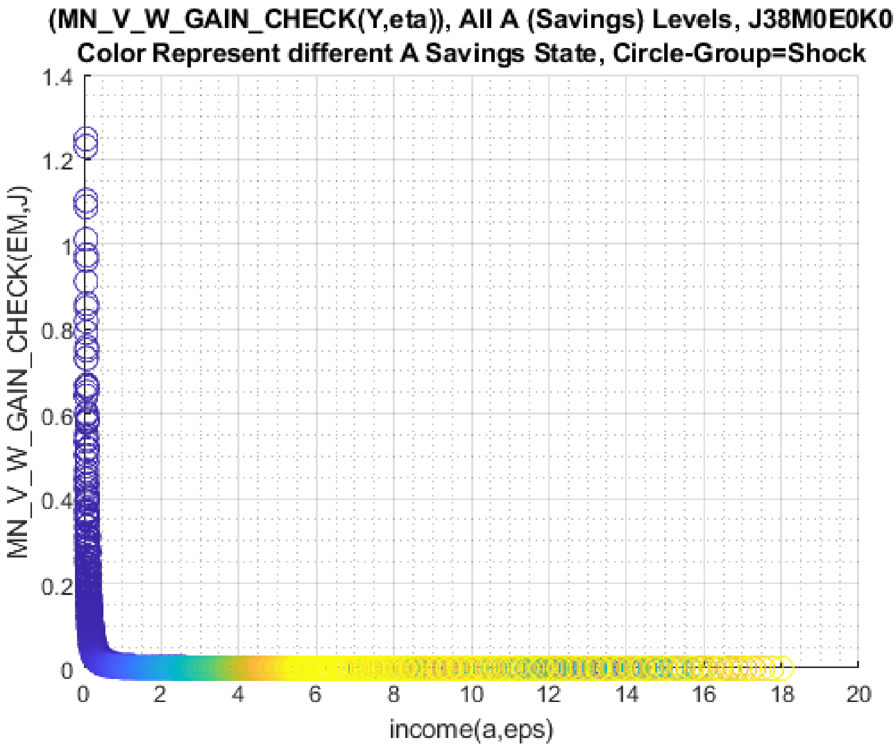



```
figure();
it_shock = 1;
scatter(log(mt_total_inc_jemk(:,it_a)), log(mt_V_W_gain_check_jemk(:,it_a)), 100);
title({'MN\_V\_W\_GAIN\_CHECK(Y(A, eta)), Lowest A, J38M0E0K0', ...
    'Each Circle is A Different Shock Level'});
xlabel(' of Y(a,eta) = Spouse + Household head Income Joint');
ylabel(' of MN\_V\_W\_GAIN\_CHECK(A, eta)');
grid on;
grid minor;
```

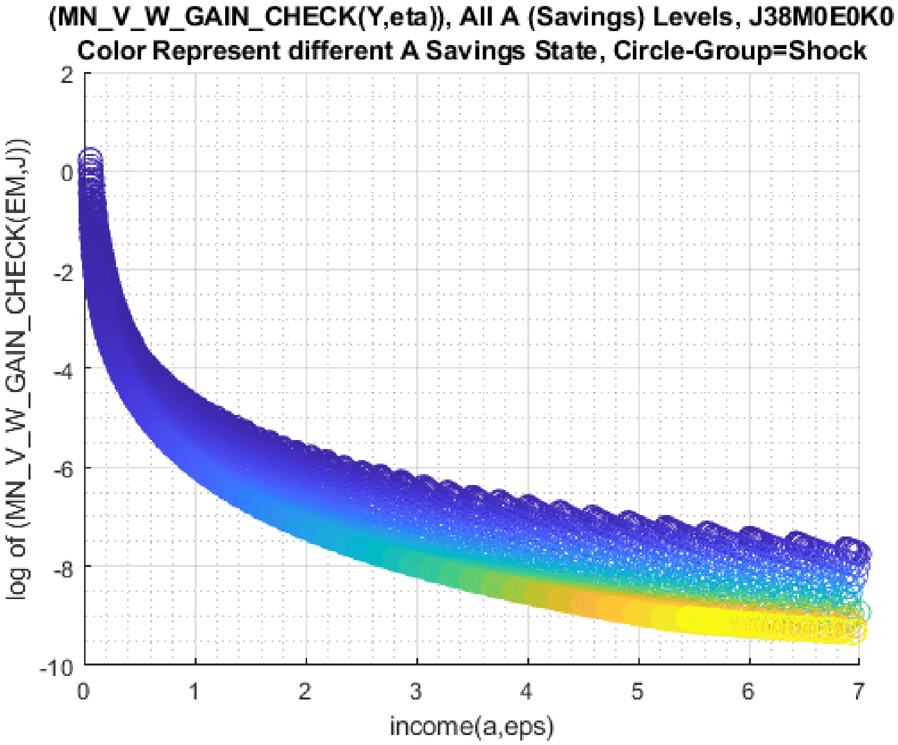


Plot all asset levels:

```
figure();
scatter((mt_total_inc_jemk(:)), (mt_V_W_gain_check_jemk(:)), 100, mt_a(:));
title({'(MN\_V\_W\_GAIN\_CHECK(Y,eta)), All A (Savings) Levels, J38M0E0K0', ...
    'Color Represent different A Savings State, Circle-Group=Shock'});
xlabel('income(a,eps)');
ylabel('MN\_V\_W\_GAIN\_CHECK(EM,J)');
grid on;
grid minor;
```



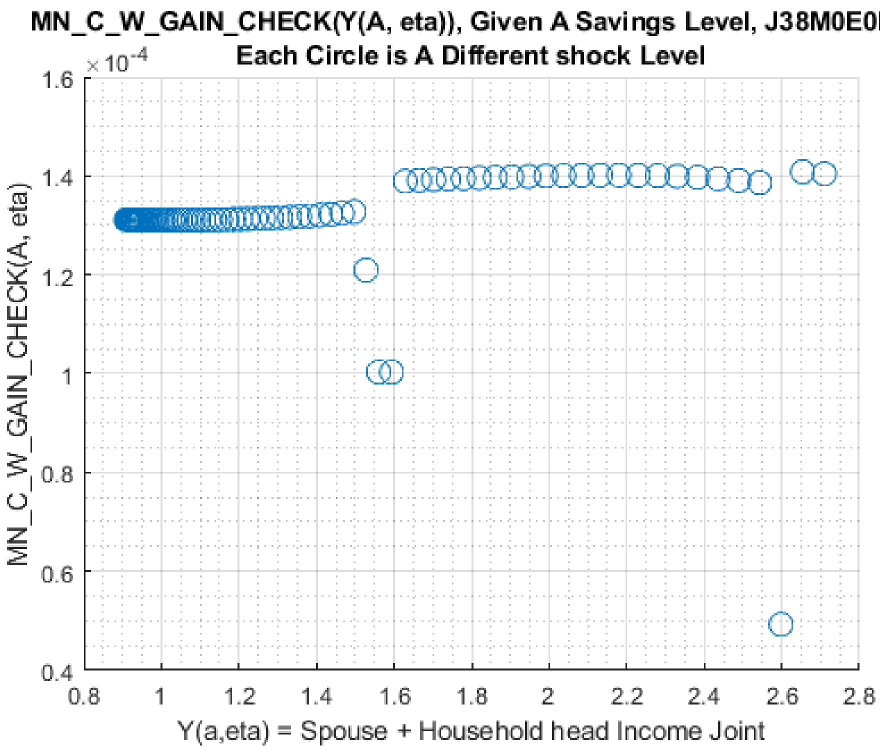

```
figure();
scatter((mt_total_inc_jemk(:)), log(mt_V_W_gain_check_jemk(:)), 100, mt_a(:));
title({'(MN\_V\_W\_GAIN\_CHECK(Y,eta)), All A (Savings) Levels, J38M0E0K0', ...
    'Color Represent different A Savings State, Circle-Group=Shock'});
xlabel('income(a,eps)');
ylabel('log of (MN\_V\_W\_GAIN\_CHECK(EM,J))');
xlim([0,7]);
grid on;
grid minor;
```



8.1.8 Marginal Consumption Gains, Color as Shock, Conditional on Age, Marital, Kids, and Education

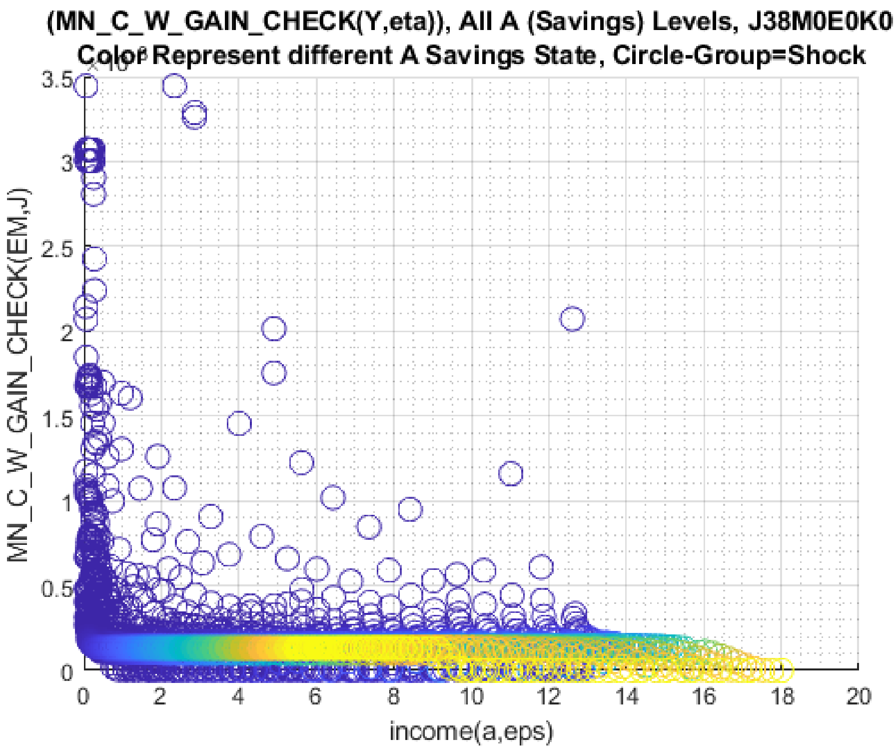
How do shocks and a impact marginal value. First plot one asset level, variation comes only from increasingly higher shocks:

```
figure();
it_a = 50;
scatter(log(mt_total_inc_jemk(:,it_a)), mt_C_W_gain_check_jemk(:,it_a), 100);
title({'MN\_C\_W\_GAIN\_CHECK(Y(A, eta)), Given A Savings Level, J38M0E0K0', ...
    'Each Circle is A Different shock Level'});
xlabel('Y(a,eta) = Spouse + Household head Income Joint');
ylabel('MN\_C\_W\_GAIN\_CHECK(A, eta)');
grid on;
grid minor;
```

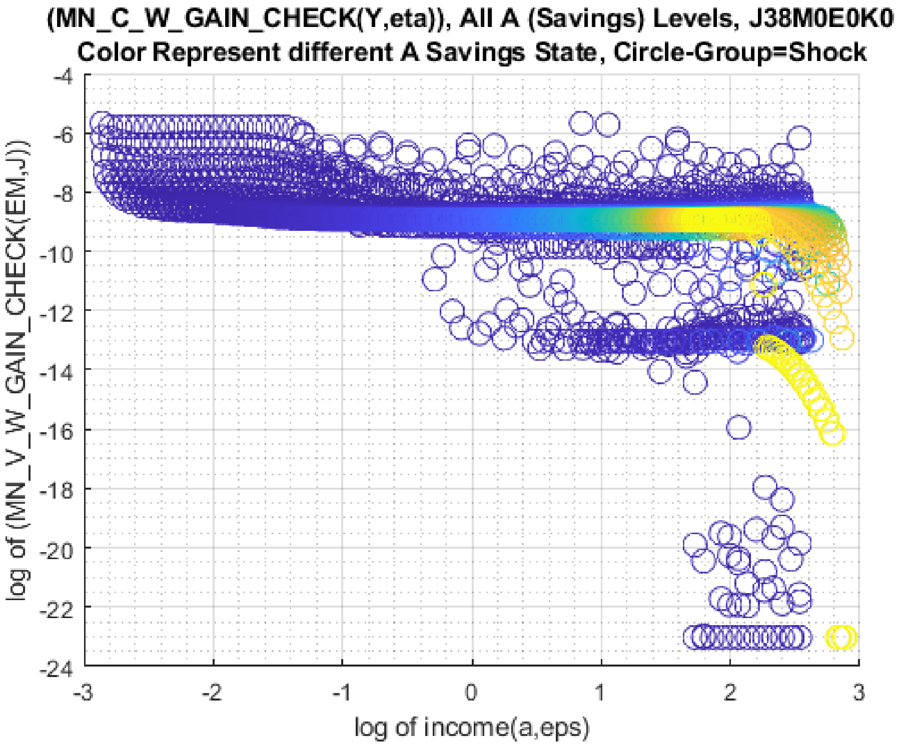


Plot all asset levels:

```
figure();
scatter((mt_total_inc_jemk(:)), (mt_C_W_gain_check_jemk(:)), 100, mt_a(:));
title({'(MN\_C\_W\_GAIN\_CHECK(Y,eta)), All A (Savings) Levels, J38M0E0K0', ...
    'Color Represent different A Savings State, Circle-Group=Shock'});
xlabel('income(a,eps)');
ylabel('MN\_C\_W\_GAIN\_CHECK(EM,J)');
grid on;
grid minor;
```



```
figure();
scatter(log(mt_total_inc_jemk(:)), log(mt_C_W_gain_check_jemk(:)), 100, mt_a(:));
title({'(MN\_C\_W\_GAIN\_CHECK(Y,eta)), All A (Savings) Levels, J38M0E0K0', ...
    'Color Represent different A Savings State, Circle-Group=Shock'});
xlabel('log of income(a,eps)');
ylabel('log of (MN\_V\_W\_GAIN\_CHECK(EM,J))');
grid on;
grid minor;
```



8.1.9 Analyze Kids and Marriage and Age

Aggregating over education, savings, and shocks, what are the differential effects of Marriage and Age.

```
% Generate some Data
mp_support_graph = containers.Map('KeyType', 'char', 'ValueType', 'any');
ar_row_grid = [...
    "k0M0", "K1M0", "K2M0", "K3M0", "K4M0", ...
    "k0M1", "K1M1", "K2M1", "K3M1", "K4M1"];
mp_support_graph('cl_st_xtitle') = {'Age'};
mp_support_graph('st_legend_loc') = 'best';
mp_support_graph('bl_graph_logy') = true; % do not log
mp_support_graph('st_rounding') = '6.2f'; % format shock legend
mp_support_graph('cl_scatter_shapes') = {...
    'o', 'd' ,'s', 'x', '*', ...
    'o', 'd', 's', 'x', '*'};
mp_support_graph('cl_colors') = {...
    'red', 'red', 'red', 'red', 'red'...
    'blue', 'blue', 'blue', 'blue', 'blue'};
```

MEAN(VAL(KM,J)), MEAN(AP(KM,J)), MEAN(C(KM,J))

Tabulate value and policies:

```
% Set
% NaN(n_jgrid,n_agrid,n_etagrid,n_educgrid,n_marriedgrid,n_kidsgrid);
ar_permute = [2,3,4,1,6,5];
```

```
% Value Function
st_title = ['MEAN(MN_V_U_GAIN_CHECK(KM,J)), welf_checks=' num2str(welf_checks) ', TR=' num2str(mp_pa
tb_az_v = ff_summ_nd_array(st_title, mn_V_U_gain_check, true, ["mean"], 3, 1, cl_mp_datasetdesc, ar_
```

xxx MEAN(MN_V_U_GAIN_CHECK(KM,J)), welf_checks=2, TR=0.0017225 xxxxxxxxxxxxxxxxxxxxxxxxxxx

group	kids	marry	mean_age_18	mean_age_19	mean_age_20	mean_age_21	mean_age_2
1	1	0	0.033245	0.031982	0.030513	0.027957	0.025823
2	2	0	0.045318	0.043648	0.041624	0.038035	0.035028
3	3	0	0.052753	0.051115	0.049022	0.044815	0.041294
4	4	0	0.059779	0.058053	0.055771	0.051	0.047008
5	5	0	0.065493	0.063784	0.061427	0.056219	0.051865
6	1	1	0.0098334	0.0093632	0.008915	0.008078	0.0073763
7	2	1	0.013114	0.012489	0.01189	0.010765	0.0098179
8	3	1	0.015745	0.015027	0.01433	0.012975	0.011838
9	4	1	0.018816	0.017992	0.017173	0.015564	0.014209
10	5	1	0.022802	0.021889	0.020957	0.019021	0.017394

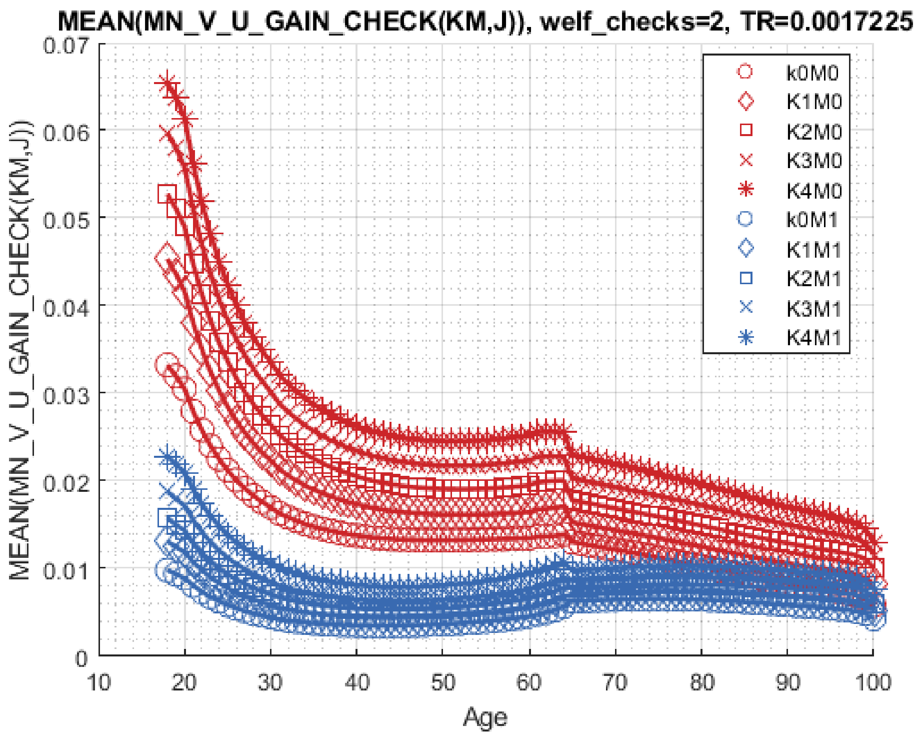
```
% Consumption Function
st_title = ['MEAN(MN_MPC_U_GAIN_CHECK(KM,J)), welf_checks=' num2str(welf_checks) ', TR=' num2str(mp_
tb_az_c = ff_summ_nd_array(st_title, mn_MPC_U_gain_share_check, true, ["mean"], 3, 1, cl_mp_datasetd
```

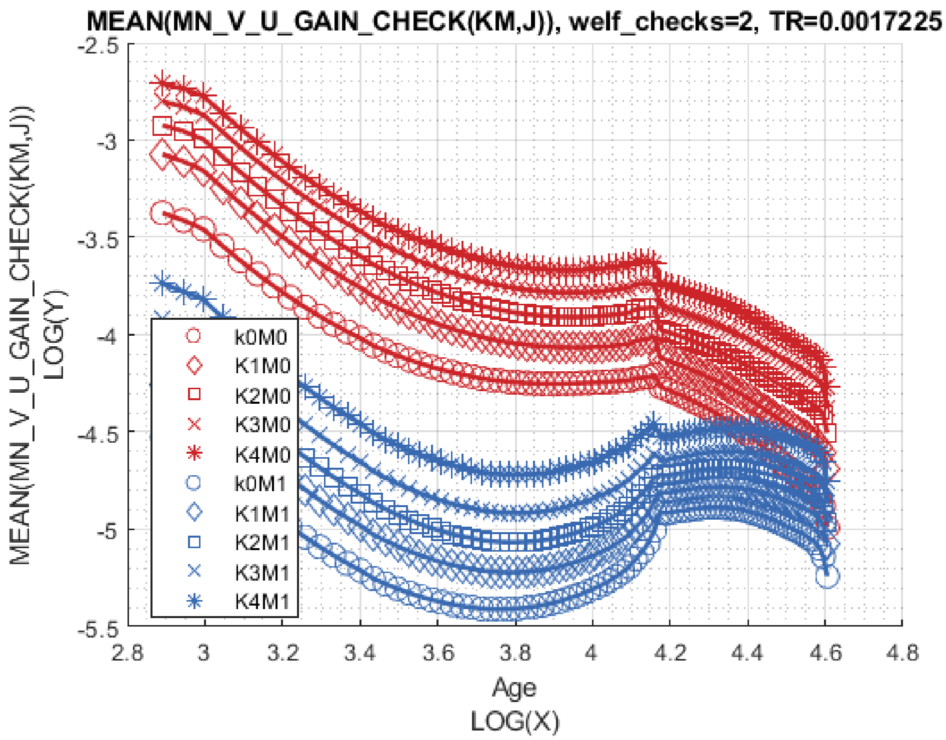
xxx MEAN(MN_MPC_U_GAIN_CHECK(KM,J)), welf_checks=2, TR=0.0017225 xxxxxxxxxxxxxxxxxxxxxxxxxxx

group	kids	marry	mean_age_18	mean_age_19	mean_age_20	mean_age_21	mean_age_2
1	1	0	0.054527	0.058931	0.069975	0.068541	0.066643
2	2	0	0.061679	0.066745	0.079243	0.077437	0.076495
3	3	0	0.069419	0.075436	0.090313	0.087902	0.086963
4	4	0	0.073241	0.080862	0.095495	0.092897	0.09086
5	5	0	0.078577	0.086033	0.10041	0.09783	0.095009
6	1	1	0.084627	0.088189	0.090609	0.089711	0.088925
7	2	1	0.086884	0.08995	0.093211	0.092146	0.090954
8	3	1	0.090166	0.09473	0.099076	0.097712	0.096798
9	4	1	0.092841	0.096367	0.10103	0.10024	0.099267
10	5	1	0.097558	0.10223	0.1097	0.10567	0.10418

Graph Mean Values:

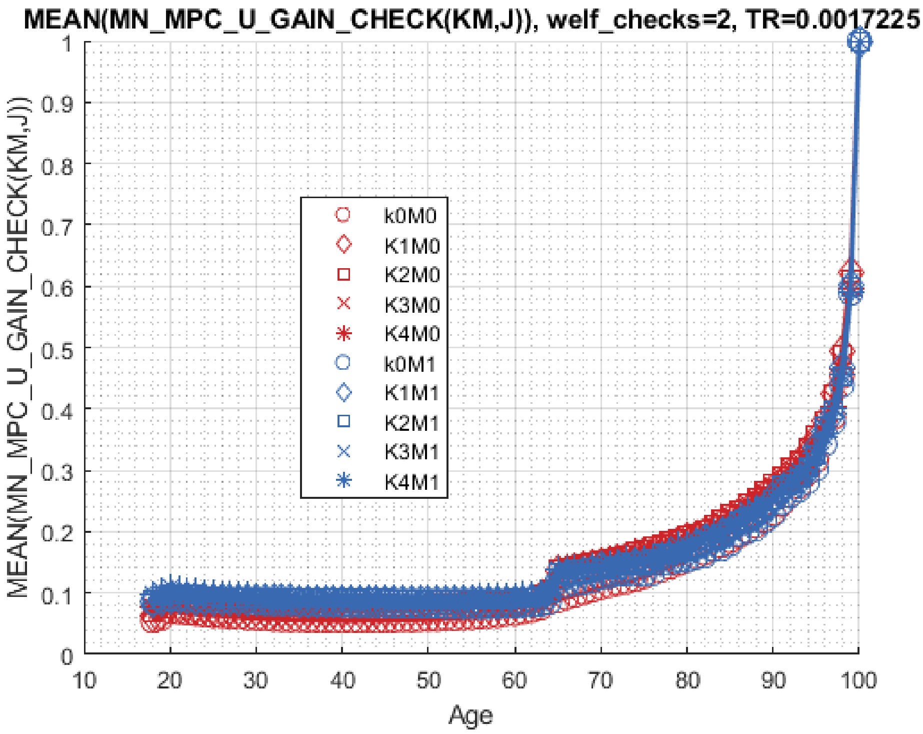
```
st_title = ['MEAN(MN\_V\_U\_GAIN\_CHECK(KM,J)), welf\_checks=' num2str(welf_checks) ', TR=' num2str(
mp_support_graph('cl_st_graph_title') = {st_title};
mp_support_graph('cl_st_ytitle') = {'MEAN(MN\_V\_U\_GAIN\_CHECK(KM,J))'};
ff_graph_grid((tb_az_v{1:end, 4:end}), ar_row_grid, age_grid, mp_support_graph);
```

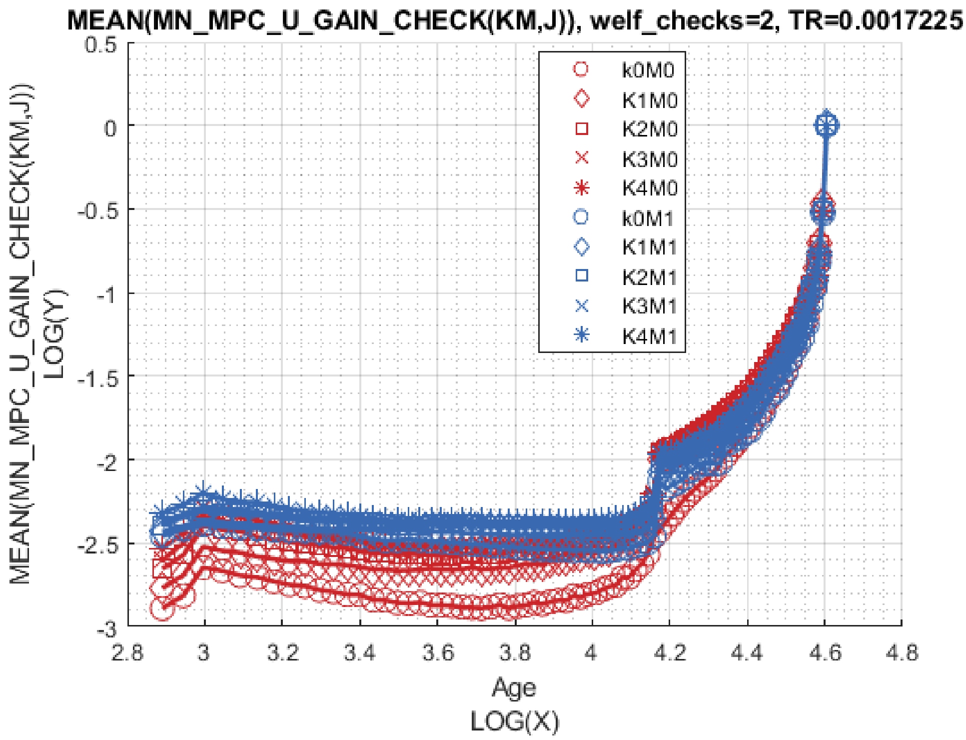




Graph Mean Consumption (***MPC: Share of Check Consumed***):

```
st_title = ['MEAN(MN\_MPC\_U\_GAIN\_CHECK(KM,J)), welf\_checks=' num2str(welf_checks) ', TR=' num2st
mp_support_graph('cl_st_graph_title') = {st_title};
mp_support_graph('cl_st_ytitle') = {'MEAN(MN\_MPC\_U\_GAIN\_CHECK(KM,J))'};
ff_graph_grid((tb_az_c{1:end, 4:end}), ar_row_grid, age_grid, mp_support_graph);
```





8.1.10 Analyze Education and Marriage

Aggregating over education, savings, and shocks, what are the differential effects of Marriage and Age.

```
% Generate some Data
mp_support_graph = containers.Map('KeyType', 'char', 'ValueType', 'any');
ar_row_grid = ["E0M0", "E1M0", "E0M1", "E1M1"];
mp_support_graph('cl_st_xtitle') = {'Age'};
mp_support_graph('st_legend_loc') = 'best';
mp_support_graph('bl_graph_logy') = true; % do not log
```

```
mp_support_graph('st_rounding') = '6.2f'; % format shock legend
mp_support_graph('cl_scatter_shapes') = {'*', 'p', '*','p' };
mp_support_graph('cl_colors') = {'red', 'red', 'blue', 'blue'};
```

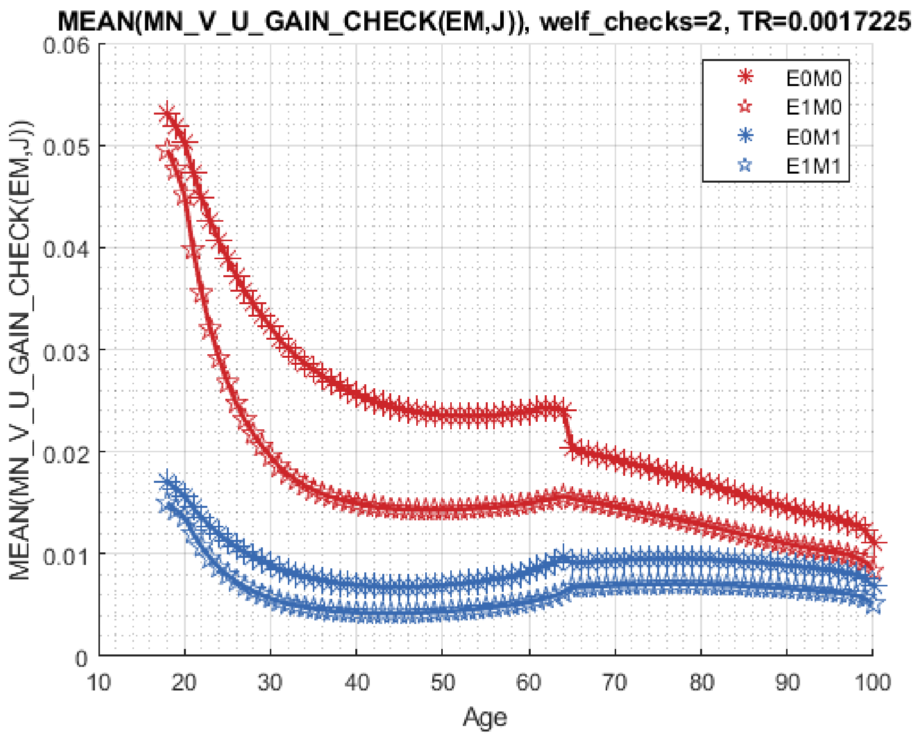
MEAN(VAL(EM,J)), MEAN(AP(EM,J)), MEAN(C(EM,J))

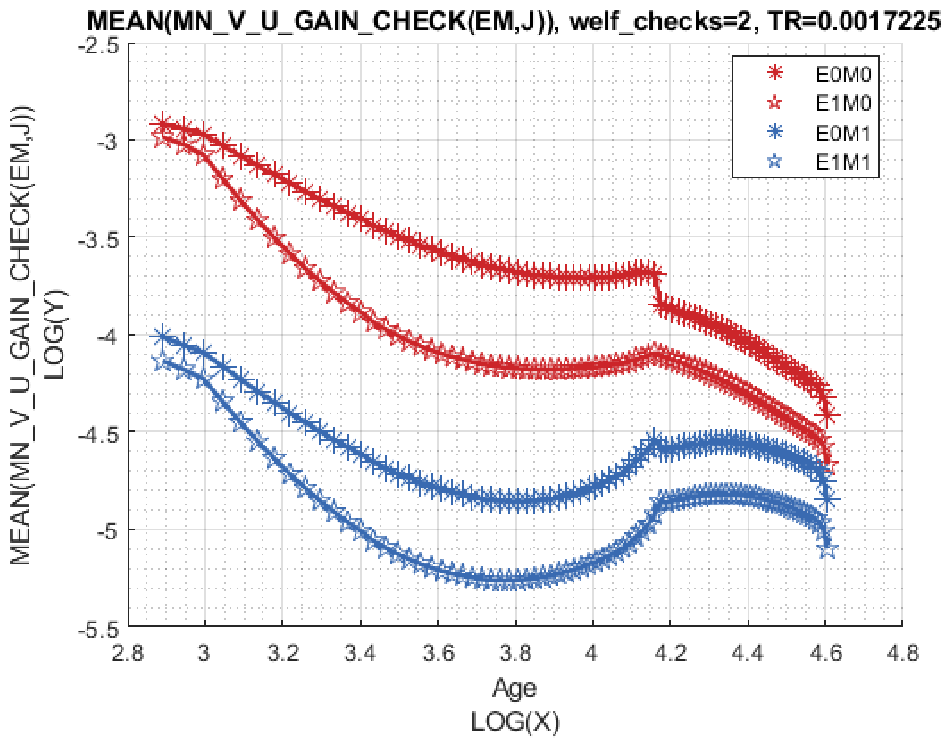
Tabulate value and policies:

```
% Set
% NaN(n_jgrid,n_agrid,n_etagrid,n_educgrid,n_marriedgrid,n_kidsgrid);
ar_permute = [2,3,6,1,4,5];
% Value Function
st_title = ['MEAN(MN_V_U_GAIN_CHECK(EM,J)), welf_checks=' num2str(welf_checks) ', TR=' num2str(mp_pa
tb_az_v = ff_summ_nd_array(st_title, mn_V_U_gain_check, true, ["mean"], 3, 1, cl_mp_datasetdesc, ar_

xxx  MEAN(MN_V_U_GAIN_CHECK(EM,J)), welf_checks=2, TR=0.0017225  xxxxxxxxxxxxxxxxxxxxxxxxxxx
    group    edu    marry    mean_age_18    mean_age_19    mean_age_20    mean_age_21    mean_age_22
    -----    ---    -----    -----------    -----------    -----------    -----------    -----------

      1       0       0       0.053096       0.051807       0.050213       0.047392       0.044883
      2       1       0       0.049539       0.047626        0.04513       0.039818       0.035524
      3       0       1         0.0171       0.016386        0.01569       0.014562        0.01357
      4       1       1       0.015024       0.014318       0.013616       0.011999       0.010684

% Consumption
st_title = ['MEAN(MN_MPC_U_GAIN_CHECK(EM,J)), welf_checks=' num2str(welf_checks) ', TR=' num2str(mp_
tb_az_c = ff_summ_nd_array(st_title, mn_MPC_U_gain_share_check, true, ["mean"], 3, 1, cl_mp_datasetd

xxx  MEAN(MN_MPC_U_GAIN_CHECK(EM,J)), welf_checks=2, TR=0.0017225  xxxxxxxxxxxxxxxxxxxxxxxxxxx
    group    edu    marry    mean_age_18    mean_age_19    mean_age_20    mean_age_21    mean_age_22
    -----    ---    -----    -----------    -----------    -----------    -----------    -----------

      1       0       0        0.06081       0.064362       0.073095       0.072607       0.072694
      2       1       0       0.074167       0.082841        0.10108       0.097236       0.093694
      3       0       1       0.083761       0.086559       0.088972       0.089128       0.088901
      4       1       1       0.097069        0.10202        0.10848        0.10507        0.10315
```

Graph Mean Values:

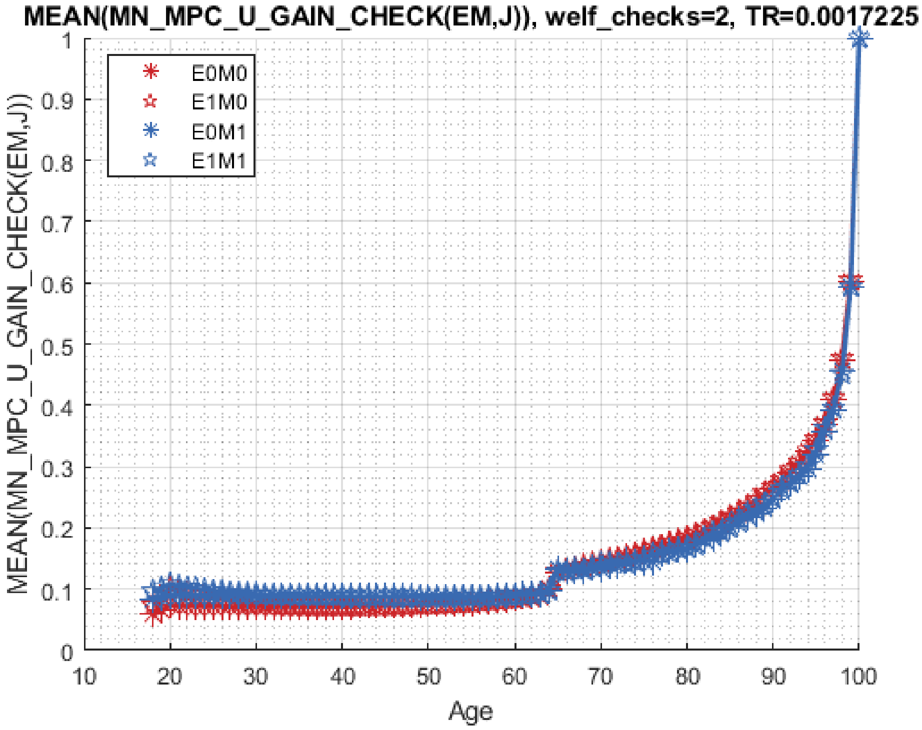
```
st_title = ['MEAN(MN\_V\_U\_GAIN\_CHECK(EM,J)), welf\_checks=' num2str(welf_checks) ', TR=' num2str(
mp_support_graph('cl_st_graph_title') = {st_title};
mp_support_graph('cl_st_ytitle') = {'MEAN(MN\_V\_U\_GAIN\_CHECK(EM,J))'};
ff_graph_grid((tb_az_v{1:end, 4:end}), ar_row_grid, age_grid, mp_support_graph);
```

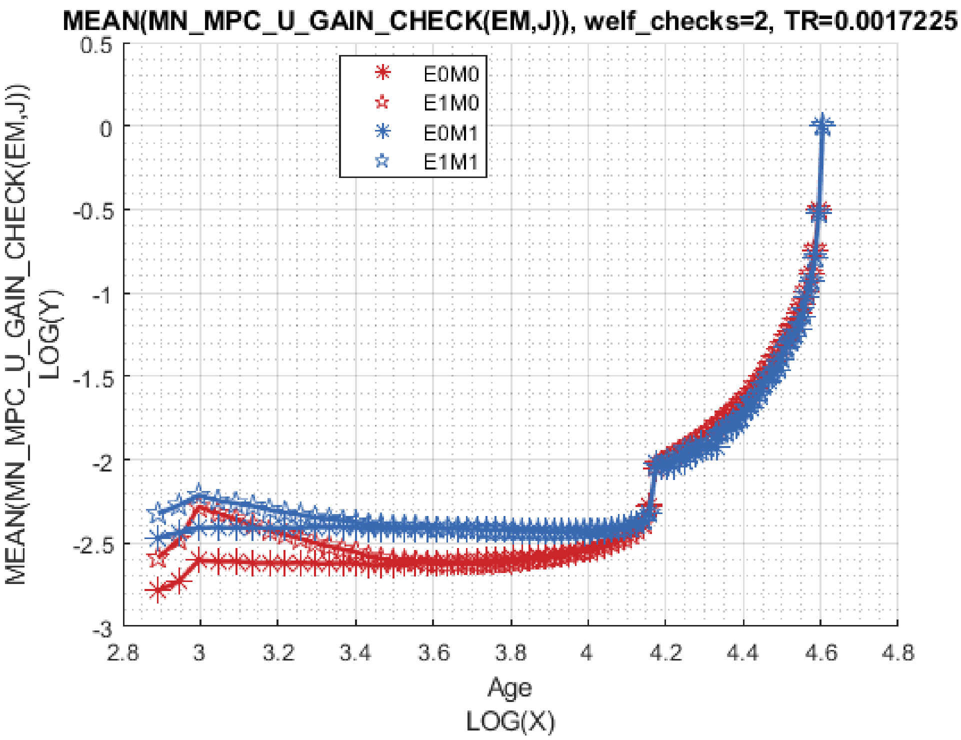




Graph Mean Consumption (***MPC: Share of Check Consumed***):

```
st_title = ['MEAN(MN\_MPC\_U\_GAIN\_CHECK(EM,J)), welf\_checks=' num2str(welf_checks) ', TR=' num2st
mp_support_graph('cl_st_graph_title') = {st_title};
mp_support_graph('cl_st_ytitle') = {'MEAN(MN\_MPC\_U\_GAIN\_CHECK(EM,J))'};
ff_graph_grid((tb_az_c{1:end, 4:end}), ar_row_grid, age_grid, mp_support_graph);
```





8.2 2019 Full States EV and EC of One Check

This is the example vignette for function: **snw_evuvw19_jaeemk** from the **PrjOptiSNW Package.** 2019 integrated over VU and VW, given optimal savings choices, unemployment shocks and various expectations.

8.2.1 Test SNW_EVUVW19_JAEEMK Defaults

Call the function with defaults.

```
clear all;
st_solu_type = 'bisec_vec';

% Solve the VFI Problem and get Value Function
mp_params = snw_mp_param('default_docdense');
mp_controls = snw_mp_control('default_test');

% set Unemployment Related Variables
mp_params('a2_covidyr') = mp_params('a2_covidyr_manna_heaven');
% mp_params('a2_covidyr') = mp_params('a2_covidyr_tax_fully_pay');

% Solve for Unemployment Values
mp_controls('bl_print_vfi') = false;
mp_controls('bl_print_vfi_verbose') = true;
mp_controls('bl_print_ds') = false;
mp_controls('bl_print_ds_verbose') = false;
mp_controls('bl_print_precompute') = false;
mp_controls('bl_print_precompute_verbose') = false;
mp_controls('bl_print_a4chk') = false;
mp_controls('bl_print_a4chk_verbose') = false;
mp_controls('bl_print_evuvw20_jaeemk') = false;
mp_controls('bl_print_evuvw20_jaeemk_verbose') = false;

% Solve the Model to get V working and unemployed
[V_ss,ap_ss,cons_ss,mp_valpol_more_ss] = snw_vfi_main_bisec_vec(mp_params, mp_controls);
```

```
Completed SNW_VFI_MAIN_BISEC_VEC;SNW_MP_PARAM=default_docdense;SNW_MP_CONTROL=default_test;time=527.
----------------------------------------
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
CONTAINER NAME: mp_outcomes ND Array (Matrix etc)
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
                i    idx    ndim     numel      rowN      colN          sum         mean       std
                -    ---    ----    --------    ----    ---------    -----------    -------    -----

    V_VFI       1     1      6      4.37e+07     83     5.265e+05    -1.5339e+08    -3.5101    26.11
    ap_VFI      2     2      6      4.37e+07     83     5.265e+05     1.4159e+09     32.402    36.79
    cons_VFI    3     3      6      4.37e+07     83     5.265e+05     2.1402e+08     4.8975    8.329

xxx TABLE:V_VFI xxxxxxxxxxxxxxxxxx
             c1         c2         c3         c4         c5       c526496    c526497    c526498    c
           -------    -------    -------    -------    -------    -------    -------    -------    -

    r1     -346.51    -346.12    -343.63    -337.86    -328.51     21.702     21.852     22.003
    r2     -334.38    -333.99    -331.51    -325.83    -316.83     21.724     21.869     22.015
    r3     -322.45    -322.06     -319.6    -314.14     -305.6     21.745     21.885     22.027
    r4     -310.63    -310.27    -307.99    -302.88    -294.87     21.767     21.903     22.041
    r5     -299.94     -299.6    -297.46    -292.67    -285.12     21.775     21.907     22.042
    r79    -9.9437    -9.9325    -9.8557    -9.6597    -9.3232     2.5394     2.5501     2.5602
    r80    -8.9023    -8.8911    -8.8143    -8.6183    -8.2818     2.3039     2.3121     2.3198
    r81    -7.6363    -7.6251    -7.5484    -7.3524    -7.0159     2.0068     2.0124     2.0176
    r82    -5.9673    -5.9561    -5.8793    -5.6833    -5.3468     1.5958     1.5989     1.6018
    r83    -3.5892     -3.578    -3.5012    -3.3052    -2.9687    0.97904    0.98004    0.98097    0

xxx TABLE:ap_VFI xxxxxxxxxxxxxxxxxx
           c1    c2        c3            c4            c5        c526496    c526497    c526498    c5264
           --    --    ----------    ---------    ---------    -------    -------    -------    -----

    r1     0     0     0.0005656     0.0075134     0.022901     114.75     120.41     126.27     132.3
```

```
    r2     0     0    0.00051498    0.0065334    0.021549    114.86     120.53     126.41     132.5
    r3     0     0    0.00051498    0.0049294    0.019875    114.97     120.65     126.56     132.
    r4     0     0    0.00051498    0.0047937    0.019672    115.73     121.42     127.34     133.5
    r5     0     0    0.00048517    0.0046683    0.019484     116.5     122.21     128.15     134.3
    r79    0     0             0            0           0    81.091      85.68     90.335     94.37
    r80    0     0             0            0           0    76.669     80.563     84.304     88.0
    r81    0     0             0            0           0    68.313     71.534     74.475     77.83
    r82    0     0             0            0           0    50.126     53.467     56.953     58.74
    r83    0     0             0            0           0         0          0          0

xxx TABLE:cons_VFI xxxxxxxxxxxxxxxxxx
              c1          c2          c3          c4          c5       c526496    c526497    c526498
           --------    --------    --------    --------    --------    -------    -------    -------

    r1     0.036717    0.037251    0.040426     0.04363    0.048012    9.6491      9.817     9.9649
    r2     0.036717    0.037251    0.040477     0.04461    0.049364    9.8118     9.9685     10.101
    r3     0.036717    0.037251    0.040477    0.046214    0.051039    9.9779      10.12     10.234
    r4     0.038144    0.038678    0.041903    0.047776    0.052666    10.131     10.258     10.354
    r5     0.039534    0.040068    0.043323     0.04929    0.054241    10.272     10.384     10.463
    r79      0.2179     0.21844     0.22216     0.23228     0.25197    35.858     37.092     38.455
    r80      0.2179     0.21844     0.22216     0.23228     0.25197    40.253     42.183     44.459
    r81      0.2179     0.21844     0.22216     0.23228     0.25197    48.587      51.19     54.266
    r82      0.2179     0.21844     0.22216     0.23228     0.25197    66.755     69.238      71.77
    r83      0.2179     0.21844     0.22216     0.23228     0.25197    116.87     122.69     128.71
```

```
inc_VFI = mp_valpol_more_ss('inc_VFI');
spouse_inc_VFI = mp_valpol_more_ss('spouse_inc_VFI');
total_inc_VFI = inc_VFI + spouse_inc_VFI;
% Solve employment, same as 2020, except with possible change in tax
mp_params('xi') = 1;
mp_params('b') = 0;
[V_emp_2020,~,cons_emp_2020,~] = snw_vfi_main_bisec_vec(mp_params, mp_controls, V_ss);
```

```
Completed SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock;SNW_MP_PARAM=default_docdense;SNW_MP_CONTROL=d
----------------------------------------
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
CONTAINER NAME: mp_outcomes ND Array (Matrix etc)
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
                i     idx    ndim     numel      rowN      colN          sum          mean       std
                -     ---    ----    --------    ----    ---------    -----------    -------    -----

    V_VFI       1      1      6      4.37e+07     83     5.265e+05    -1.5339e+08    -3.5101    26.11
    ap_VFI      2      2      6      4.37e+07     83     5.265e+05     1.4159e+09     32.402    36.79
    cons_VFI    3      3      6      4.37e+07     83     5.265e+05     2.1402e+08     4.8975    8.329

xxx TABLE:V_VFI xxxxxxxxxxxxxxxxxx
             c1         c2         c3         c4         c5       c526496    c526497    c526498    c
           -------    -------    -------    -------    -------    -------    -------    -------    -

    r1     -346.51    -346.12    -343.63    -337.86    -328.51     21.702     21.852     22.003
    r2     -334.38    -333.99    -331.51    -325.83    -316.83     21.724     21.869     22.015
    r3     -322.45    -322.06     -319.6    -314.14     -305.6     21.745     21.885     22.027
    r4     -310.63    -310.27    -307.99    -302.88    -294.87     21.767     21.903     22.041
    r5     -299.94     -299.6    -297.46    -292.67    -285.12     21.775     21.907     22.042
    r79    -9.9437    -9.9325    -9.8557    -9.6597    -9.3232     2.5394     2.5501     2.5602
    r80    -8.9023    -8.8911    -8.8143    -8.6183    -8.2818     2.3039     2.3121     2.3198
    r81    -7.6363    -7.6251    -7.5484    -7.3524    -7.0159     2.0068     2.0124     2.0176
    r82    -5.9673    -5.9561    -5.8793    -5.6833    -5.3468     1.5958     1.5989     1.6018
```

```
    r83    -3.5892     -3.578    -3.5012    -3.3052    -2.9687    0.97904    0.98004    0.98097    0

xxx TABLE:ap_VFI xxxxxxxxxxxxxxxxxx
           c1    c2        c3           c4            c5        c526496    c526497    c526498    c5264
           --    --    ----------    ---------    --------    -------    -------    -------    -----

    r1     0     0      0.0005656    0.0075134    0.022901    114.75     120.41     126.27     132.3
    r2     0     0     0.00051498    0.0065334    0.021549    114.86     120.53     126.41     132.5
    r3     0     0     0.00051498    0.0049294    0.019875    114.97     120.65     126.56      132.
    r4     0     0     0.00051498    0.0047937    0.019672    115.73     121.42     127.34     133.5
    r5     0     0     0.00048517    0.0046683    0.019484     116.5     122.21     128.15     134.3
    r79    0     0              0            0           0    81.091      85.68     90.335     94.37
    r80    0     0              0            0           0    76.669     80.563     84.304      88.0
    r81    0     0              0            0           0    68.313     71.534     74.475     77.83
    r82    0     0              0            0           0    50.126     53.467     56.953     58.74
    r83    0     0              0            0           0         0          0          0

xxx TABLE:cons_VFI xxxxxxxxxxxxxxxxxx
              c1          c2          c3          c4          c5        c526496    c526497    c526498
           --------    --------    --------    --------    --------    -------    -------    -------

    r1     0.036717    0.037251    0.040426     0.04363    0.048012    9.6491      9.817     9.9649
    r2     0.036717    0.037251    0.040477     0.04461    0.049364    9.8118     9.9685     10.101
    r3     0.036717    0.037251    0.040477    0.046214    0.051039    9.9779      10.12     10.234
    r4     0.038144    0.038678    0.041903    0.047776    0.052666    10.131     10.258     10.354
    r5     0.039534    0.040068    0.043323     0.04929    0.054241    10.272     10.384     10.463
    r79      0.2179     0.21844     0.22216     0.23228     0.25197    35.858     37.092     38.455
    r80      0.2179     0.21844     0.22216     0.23228     0.25197    40.253     42.183     44.459
    r81      0.2179     0.21844     0.22216     0.23228     0.25197    48.587      51.19     54.266
    r82      0.2179     0.21844     0.22216     0.23228     0.25197    66.755     69.238      71.77
    r83      0.2179     0.21844     0.22216     0.23228     0.25197    116.87     122.69     128.71

% Solve unemployment, different income than under ss due to income losses
mp_params('xi') = 0.50;
mp_params('b') = 0.50;
[V_unemp_2020,~,cons_unemp_2020,~] = snw_vfi_main_bisec_vec(mp_params, mp_controls, V_ss);

Completed SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock;SNW_MP_PARAM=default_docdense;SNW_MP_CONTROL=d
----------------------------------------
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
CONTAINER NAME: mp_outcomes ND Array (Matrix etc)
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
                 i    idx    ndim     numel      rowN      colN           sum          mean       std
                 -    ---    ----    --------    ----    ---------    -----------    -------    -----

    V_VFI        1     1      6      4.37e+07     83     5.265e+05    -1.6419e+08    -3.7572    26.50
    ap_VFI       2     2      6      4.37e+07     83     5.265e+05     1.3972e+09     31.974    36.73
    cons_VFI     3     3      6      4.37e+07     83     5.265e+05     2.1267e+08     4.8667    8.327

xxx TABLE:V_VFI xxxxxxxxxxxxxxxxxx
             c1         c2         c3         c4         c5       c526496    c526497    c526498    c
           -------    -------    -------    -------    -------    -------    -------    -------    -

    r1     -355.34    -354.66    -350.52    -342.92     -332.4     21.638     21.791     21.943
    r2     -343.21    -342.53    -338.39     -330.8    -320.53      21.66     21.807     21.955
    r3     -331.28     -330.6    -326.46    -318.91    -309.12     21.682     21.824     21.967
    r4     -319.13     -318.5    -314.65    -307.53    -298.32       21.7     21.838     21.977
    r5     -308.13    -307.54    -303.94    -297.21    -288.52     21.705     21.839     21.975
```

```
    r79    -9.9437    -9.9325    -9.8557    -9.6597    -9.3232     2.5384     2.5492     2.5593
    r80    -8.9023    -8.8911    -8.8143    -8.6183    -8.2818     2.3032     2.3114     2.3191
    r81    -7.6363    -7.6251    -7.5484    -7.3524    -7.0159     2.0063     2.0119     2.0172
    r82    -5.9673    -5.9561    -5.8793    -5.6833    -5.3468     1.5955     1.5987     1.6016
    r83    -3.5892     -3.578    -3.5012    -3.3052    -2.9687    0.97895    0.97995    0.98089    0

xxx TABLE:ap_VFI xxxxxxxxxxxxxxxxxx
           c1    c2    c3        c4            c5       c526496    c526497    c526498    c526499    c
           --    --    --    ----------    --------    -------    -------    -------    -------    -

    r1     0     0     0      0.0017295    0.013921    112.32     117.97     123.84     129.95     1
    r2     0     0     0      0.0014073    0.013905    112.36     118.03     123.91     130.03     1
    r3     0     0     0     0.00051498    0.013905     112.4     118.08     123.99     130.13     1
    r4     0     0     0     0.00051498    0.013905    112.93     118.63     124.55     130.71     1
    r5     0     0     0     0.00051498    0.013905    113.47     119.18     125.12      131.3     1
    r79    0     0     0              0           0    81.091      85.68     89.816      93.86     9
    r80    0     0     0              0           0    76.378     80.051     83.793     87.528     9
    r81    0     0     0              0           0    68.288     71.027     73.968     77.326     8
    r82    0     0     0              0           0    50.126     53.467      56.61     58.244     6
    r83    0     0     0              0           0         0          0          0          0

xxx TABLE:cons_VFI xxxxxxxxxxxxxxxxxx
              c1          c2          c3          c4          c5       c526496    c526497    c526498
           --------    --------    --------    --------    --------    -------    -------    -------

    r1     0.027723    0.028258    0.031999    0.040426    0.048012    9.6491      9.817     9.9649
    r2     0.027723    0.028258    0.031999    0.040748    0.048028    9.8118     9.9685     10.101
    r3     0.027723    0.028258    0.031999    0.041641    0.048028    9.9779      10.12     10.234
    r4     0.028805    0.029339    0.033081    0.042722    0.049108    10.131     10.258     10.354
    r5     0.029859    0.030394    0.034135    0.043775    0.050161    10.272     10.384     10.463
    r79      0.2179     0.21844     0.22216     0.23228     0.25197    35.339     36.573     38.455
    r80      0.2179     0.21844     0.22216     0.23228     0.25197    40.033     42.183     44.459
    r81      0.2179     0.21844     0.22216     0.23228     0.25197    48.106      51.19     54.266
    r82      0.2179     0.21844     0.22216     0.23228     0.25197    66.254     68.736     71.611
    r83      0.2179     0.21844     0.22216     0.23228     0.25197    116.37     122.19     128.21
```

```
[Phi_true] = snw_ds_main(mp_params, mp_controls, ap_ss, cons_emp_2020, mp_valpol_more_ss);
```

```
Completed SNW_DS_MAIN;SNW_MP_PARAM=default_docdense;SNW_MP_CONTROL=default_test;time=1500.619
```

```
% Get Matrixes
cl_st_precompute_list = {'a', ...
    'inc', 'inc_unemp', 'spouse_inc', 'spouse_inc_unemp', 'ref_earn_wageind_grid',...
    'ap_idx_lower_ss', 'ap_idx_higher_ss', 'ap_idx_lower_weight_ss'};
mp_controls('bl_print_precompute_verbose') = false;
[mp_precompute_res] = snw_hh_precompute(mp_params, mp_controls, cl_st_precompute_list, ap_ss, Phi_tr
```

```
Wage quintile cutoffs=0.4645     0.71528      1.0335      1.5632
Completed SNW_HH_PRECOMPUTE;SNW_MP_PARAM=default_docdense;SNW_MP_CONTROL=default_test;time cost=428.
```

8.2.2 Solve for 2019 Evuvw With 0 and 2 Checks

```
% Call Function
welf_checks = 0;
[ev19_jaeemk_check0, ec19_jaeemk_check0, ev20_jaeemk_check0, ec20_jaeemk_check0] = snw_evuvw19_jaeem
    welf_checks, st_solu_type, mp_params, mp_controls, ...
    V_emp_2020, cons_emp_2020, V_unemp_2020, cons_unemp_2020, mp_precompute_res);
```

```
Completed SNW_A4CHK_WRK_BISEC_VEC;welf_checks=0;TR=0.0017225;SNW_MP_PARAM=default_docdense;SNW_MP_CO
Completed SNW_A4CHK_UNEMP_BISEC_VEC;welf_checks=0;TR=0.0017225;xi=0.5;b=0.5;SNW_MP_PARAM=default_doc
Completed SNW_EVUVW20_JAEEMK;SNW_MP_PARAM=default_docdense;SNW_MP_CONTROL=default_test;timeEUEC=7.92
Completed SNW_EVUVW19_JAEEMK;SNW_MP_PARAM=default_docdense;SNW_MP_CONTROL=default_test;time=4834.357
----------------------------------------
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
CONTAINER NAME: mp_outcomes ND Array (Matrix etc)
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
                   i    idx    ndim      numel       rowN      colN          sum         mean
                   -    ---    ----    ----------    ----    ---------    -----------    -------

    ec19_jaeemk    1     1      6     4.3173e+07      82     5.265e+05     1.8059e+08      4.183
    ec20_jaeemk    2     2      6       4.37e+07      83     5.265e+05     2.1399e+08     4.8969
    ev19_jaeemk    3     3      6     4.3173e+07      82     5.265e+05    -1.4054e+08    -3.2554
    ev20_jaeemk    4     4      6       4.37e+07      83     5.265e+05    -1.5388e+08    -3.5212

xxx TABLE:ec19_jaeemk xxxxxxxxxxxxxxxxxx
              c1          c2          c3          c4          c5       c526496    c526497    c526498
           --------    --------    --------    --------    --------    -------    -------    -------

    r1     0.039253    0.039253    0.039822    0.044086    0.049231    9.6484     9.8085     9.9488
    r2     0.039253    0.039253    0.039788    0.044409    0.050518    9.7796     9.9379     10.073
    r3     0.040776    0.040776    0.041311     0.04504     0.05173     9.994     10.125     10.224
    r4     0.042261    0.042261    0.042795    0.046467    0.053274    10.173     10.282     10.354
    r5     0.043702    0.043702    0.044205    0.047871    0.054769    10.328     10.416     10.467
    r78      0.2179      0.2179      0.2179      0.2179     0.21844    27.794     28.962     29.988
    r79      0.2179      0.2179      0.2179      0.2179      0.2179    30.071     31.673      33.01
    r80      0.2179      0.2179      0.2179      0.2179      0.2179      33.5     35.375     37.367
    r81      0.2179      0.2179      0.2179      0.2179      0.2179    40.296     41.727     43.475
    r82      0.2179      0.2179      0.2179      0.2179      0.2179    52.118     55.559      59.15

xxx TABLE:ec20_jaeemk xxxxxxxxxxxxxxxxxx
              c1          c2          c3          c4          c5       c526496    c526497    c526498
           --------    --------    --------    --------    --------    -------    -------    -------

    r1     0.035995    0.036529     0.03975    0.043373    0.048012    9.6491      9.817     9.9649
    r2     0.035995    0.036529    0.039796      0.0443    0.049257    9.8118     9.9685     10.101
    r3     0.035995    0.036529    0.039796    0.045847    0.050797    9.9779      10.12     10.234
    r4     0.037394    0.037928    0.041195     0.04737     0.05238    10.131     10.258     10.354
    r5     0.038757    0.039291    0.042585    0.048848    0.053914    10.272     10.384     10.463
    r79      0.2179     0.21844     0.22216     0.23228     0.25197    35.858     37.092     38.455
    r80      0.2179     0.21844     0.22216     0.23228     0.25197    40.253     42.183     44.459
    r81      0.2179     0.21844     0.22216     0.23228     0.25197    48.587      51.19     54.266
    r82      0.2179     0.21844     0.22216     0.23228     0.25197    66.755     69.238      71.77
    r83      0.2179     0.21844     0.22216     0.23228     0.25197    116.87     122.69     128.71

xxx TABLE:ev19_jaeemk xxxxxxxxxxxxxxxxxx
             c1         c2         c3         c4         c5       c526496    c526497    c526498    c
           -------    -------    -------    -------    -------    -------    -------    -------    -

    r1     -330.68    -330.68    -330.27    -326.02     -318.4     21.591     21.741     21.892
    r2     -318.19    -318.19    -317.82    -314.17    -306.96      21.61     21.755     21.902
    r3     -305.88    -305.88    -305.54    -302.95    -296.09     21.628     21.769     21.913
    r4     -294.75    -294.75    -294.43    -292.07    -285.66     21.648     21.785     21.925
    r5     -284.65    -284.65    -284.37    -282.21    -276.18     21.653     21.787     21.924
    r78      -9.95      -9.95      -9.95      -9.95    -9.9388     2.4886      2.501     2.5125
    r79    -8.9084    -8.9084    -8.9084    -8.9084    -8.9084     2.2539     2.2657     2.2765
    r80    -7.6422    -7.6422    -7.6422    -7.6422    -7.6422     1.9631     1.9708     1.9776
```

```
    r81    -5.9728    -5.9728    -5.9728    -5.9728    -5.9728     1.5603     1.5647     1.5684
    r82    -3.5937    -3.5937    -3.5937    -3.5937    -3.5937    0.95581    0.95855    0.96107    0

xxx TABLE:ev20_jaeemk xxxxxxxxxxxxxxxxxx
             c1         c2         c3         c4         c5       c526496    c526497    c526498    c
           -------    -------    -------    -------    -------    -------    -------    -------    -

    r1     -347.22     -346.8    -344.19    -338.27    -328.82     21.701     21.851     22.001
    r2     -335.09    -334.67    -332.06    -326.23    -317.13     21.722     21.867     22.013
    r3     -323.16    -322.74    -320.15    -314.53    -305.89     21.743     21.884     22.026
    r4     -311.32    -310.93    -308.52    -303.26    -295.15     21.765     21.902      22.04
    r5     -300.59    -300.24    -297.98    -293.04     -285.4     21.773     21.906     22.041
    r79    -9.9437    -9.9325    -9.8557    -9.6597    -9.3232     2.5394     2.5501     2.5602
    r80    -8.9023    -8.8911    -8.8143    -8.6183    -8.2818     2.3039     2.3121     2.3198
    r81    -7.6363    -7.6251    -7.5484    -7.3524    -7.0159     2.0068     2.0124     2.0176
    r82    -5.9673    -5.9561    -5.8793    -5.6833    -5.3468     1.5958     1.5989     1.6018
    r83    -3.5892     -3.578    -3.5012    -3.3052    -2.9687    0.97904    0.98004    0.98097    0

% Call Function
welf_checks = 2;
[ev19_jaeemk_check2, ec19_jaeemk_check2, ev20_jaeemk_check2, ec20_jaeemk_check2] = snw_evuvw19_jaeem
    welf_checks, st_solu_type, mp_params, mp_controls, ...
    V_emp_2020, cons_emp_2020, V_unemp_2020, cons_unemp_2020, mp_precompute_res);

Completed SNW_A4CHK_WRK_BISEC_VEC;welf_checks=2;TR=0.0017225;SNW_MP_PARAM=default_docdense;SNW_MP_CO
Completed SNW_A4CHK_UNEMP_BISEC_VEC;welf_checks=2;TR=0.0017225;xi=0.5;b=0.5;SNW_MP_PARAM=default_doc
Completed SNW_EVUVW20_JAEEMK;SNW_MP_PARAM=default_docdense;SNW_MP_CONTROL=default_test;timeEUEC=7.86
Completed SNW_EVUVW19_JAEEMK;SNW_MP_PARAM=default_docdense;SNW_MP_CONTROL=default_test;time=4826.021
----------------------------------------
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
CONTAINER NAME: mp_outcomes ND Array (Matrix etc)
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
                    i    idx    ndim      numel       rowN      colN          sum          mean
                    -    ---    ----    ----------    ----    ---------    -----------    -------

    ec19_jaeemk     1     1      6      4.3173e+07     82     5.265e+05     1.8061e+08     4.1835
    ec20_jaeemk     2     2      6        4.37e+07     83     5.265e+05     2.1401e+08     4.8974
    ev19_jaeemk     3     3      6      4.3173e+07     82     5.265e+05       -1.4e+08    -3.2427
    ev20_jaeemk     4     4      6        4.37e+07     83     5.265e+05    -1.5329e+08    -3.5078

xxx TABLE:ec19_jaeemk xxxxxxxxxxxxxxxxxx
              c1          c2          c3          c4          c5        c526496    c526497    c526498
           --------    --------    --------    --------    --------    -------    -------    -------

    r1     0.041965    0.041965     0.04239    0.045342    0.049961     9.6485     9.8086     9.9489
    r2      0.04233     0.04233    0.042797    0.046025    0.051275     9.7797     9.9379     10.073
    r3     0.043853    0.043853     0.04432    0.046854    0.052519     9.9941     10.125     10.224
    r4     0.045349    0.045349    0.045817    0.048322    0.054074     10.173     10.282     10.354
    r5     0.046815    0.046815    0.047261    0.049758     0.05558     10.328     10.416     10.467
    r78     0.22135     0.22135     0.22135     0.22135     0.22188     27.795     28.962     29.988
    r79     0.22135     0.22135     0.22135     0.22135     0.22135     30.073     31.674     33.011
    r80     0.22135     0.22135     0.22135     0.22135     0.22135     33.501     35.377     37.368
    r81     0.22135     0.22135     0.22135     0.22135     0.22135     40.297     41.729     43.477
    r82     0.22135     0.22135     0.22135     0.22135     0.22135     52.121     55.563     59.153

xxx TABLE:ec20_jaeemk xxxxxxxxxxxxxxxxxx
              c1          c2          c3          c4          c5        c526496    c526497    c526498
           --------    --------    --------    --------    --------    -------    -------    -------
```

```
    r1     0.039035    0.039495    0.040979    0.044181    0.048566    9.6492     9.8171      9.965
    r2     0.039071    0.039538    0.041324    0.045164    0.049841    9.8119     9.9686     10.101
    r3     0.039071    0.039538    0.041849     0.04671    0.051404     9.978      10.12     10.234
    r4      0.04047    0.040937     0.04329    0.048243    0.052999    10.131     10.258     10.354
    r5     0.041855    0.042325     0.04471     0.04973    0.054543    10.272     10.384     10.463
    r79     0.22135     0.22188     0.22561     0.23572     0.25394    35.858     37.093     38.456
    r80     0.22135     0.22188     0.22561     0.23572     0.25394    40.254     42.184      44.46
    r81     0.22135     0.22188     0.22561     0.23572     0.25402    48.589     51.192     54.268
    r82     0.22135     0.22188     0.22561     0.23572     0.25436    66.757      69.24     71.772
    r83     0.22135     0.22188     0.22561     0.23572     0.25541    116.87     122.69     128.71

xxx TABLE:ev19_jaeemk xxxxxxxxxxxxxxxxxx
              c1         c2         c3         c4         c5       c526496    c526497    c526498    c
           -------    -------    -------    -------    -------    -------    -------    -------    -

    r1     -328.44    -328.44    -328.07     -324.3    -317.04     21.591     21.741     21.892
    r2     -315.98    -315.98    -315.64    -312.48    -305.65      21.61     21.755     21.903
    r3     -303.83    -303.83    -303.52    -301.32    -294.84     21.628     21.769     21.913
    r4     -292.84    -292.84    -292.55    -290.54    -284.48     21.648     21.785     21.925
    r5     -282.87    -282.87    -282.61    -280.77    -275.07     21.653     21.787     21.924
    r78    -9.8787    -9.8787    -9.8787    -9.8787    -9.8678     2.4886      2.501     2.5125
    r79    -8.8371    -8.8371    -8.8371    -8.8371    -8.8371     2.2539     2.2657     2.2765
    r80    -7.5709    -7.5709    -7.5709    -7.5709    -7.5709     1.9631     1.9708     1.9776
    r81    -5.9015    -5.9015    -5.9015    -5.9015    -5.9015     1.5603     1.5647     1.5684
    r82    -3.5225    -3.5225    -3.5225    -3.5225    -3.5225    0.95582    0.95855    0.96107    0

xxx TABLE:ev20_jaeemk xxxxxxxxxxxxxxxxxx
              c1         c2         c3         c4         c5       c526496    c526497    c526498    c
           -------    -------    -------    -------    -------    -------    -------    -------    -

    r1     -344.77    -344.39    -342.18    -336.62    -327.49     21.701     21.851     22.001
    r2     -332.64    -332.26    -330.08    -324.65    -315.86     21.722     21.868     22.014
    r3     -320.73    -320.36    -318.24    -313.02    -304.68     21.743     21.884     22.026
    r4     -309.06    -308.71    -306.74    -301.84    -294.01     21.765     21.902      22.04
    r5     -298.48    -298.16    -296.31    -291.71    -284.33     21.773     21.906     22.041
    r79    -9.8725    -9.8615    -9.7889    -9.6008    -9.2728     2.5394     2.5501     2.5602
    r80    -8.8311    -8.8201    -8.7475    -8.5594    -8.2319     2.3039     2.3121     2.3198
    r81    -7.5651    -7.5542    -7.4816    -7.2935    -6.9665     2.0068     2.0124     2.0176
    r82    -5.8961    -5.8851    -5.8126    -5.6245    -5.2979     1.5958     1.5989     1.6018
    r83     -3.518     -3.507    -3.4345    -3.2464    -2.9207    0.97904    0.98004    0.98097    0
```

Differences between Checks in Expected Value and Expected Consumption

```
mn_V_U_gain_check = ev19_jaeemk_check2 - ev19_jaeemk_check0;
mn_MPC_U_gain_share_check = (ec19_jaeemk_check2 - ec19_jaeemk_check0)./(welf_checks*mp_params('TR'))
```

8.2.3 Param Results Define Frames

Define the matrix dimensions names and dimension vector values. Policy and Value Functions share the same ND dimensional structure.

```
% Grids:
age_grid = 18:99;
agrid = mp_params('agrid')';
eta_H_grid = mp_params('eta_H_grid')';
eta_S_grid = mp_params('eta_S_grid')';
ar_st_eta_HS_grid = string(cellstr([num2str(eta_H_grid', 'hz=%3.2f;'), num2str(eta_S_grid', 'wz=%3.2
edu_grid = [0,1];
marry_grid = [0,1];
```

```
kids_grid = (1:1:mp_params('n_kidsgrid'))';
% NaN(n_jgrid,n_agrid,n_etagrid,n_educgrid,n_marriedgrid,n_kidsgrid);
cl_mp_datasetdesc = {};
cl_mp_datasetdesc{1} = containers.Map({'name', 'labval'}, {'age', age_grid});
cl_mp_datasetdesc{2} = containers.Map({'name', 'labval'}, {'savings', agrid});
cl_mp_datasetdesc{3} = containers.Map({'name', 'labval'}, {'eta', 1:length(eta_H_grid)});
cl_mp_datasetdesc{4} = containers.Map({'name', 'labval'}, {'edu', edu_grid});
cl_mp_datasetdesc{5} = containers.Map({'name', 'labval'}, {'marry', marry_grid});
cl_mp_datasetdesc{6} = containers.Map({'name', 'labval'}, {'kids', kids_grid});
```

8.2.4 Analyze Difference in V and C with Check

The difference between V and V with Check, marginal utility gain given the check.

```
% Generate some Data
mp_support_graph = containers.Map('KeyType', 'char', 'ValueType', 'any');
mp_support_graph('cl_st_xtitle') = {'Savings States, a'};
mp_support_graph('st_legend_loc') = 'eastoutside';
mp_support_graph('bl_graph_logy') = true; % do not log
mp_support_graph('it_legend_select') = 21; % how many shock legends to show
mp_support_graph('cl_colors') = 'jet';
```

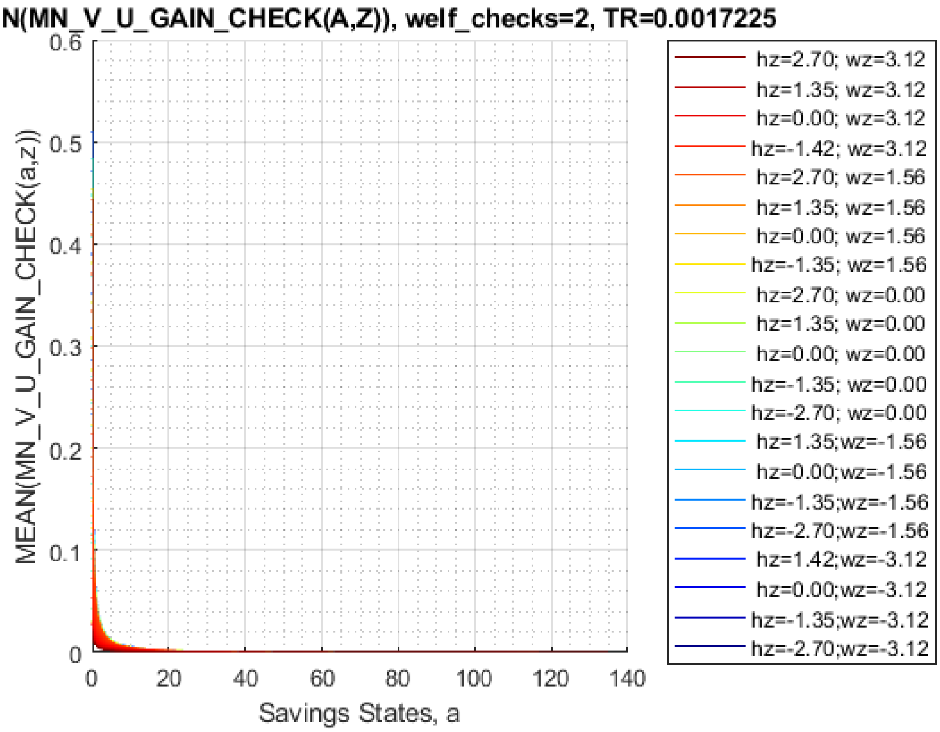
MEAN(MN_V_GAIN_CHECK(A,Z))

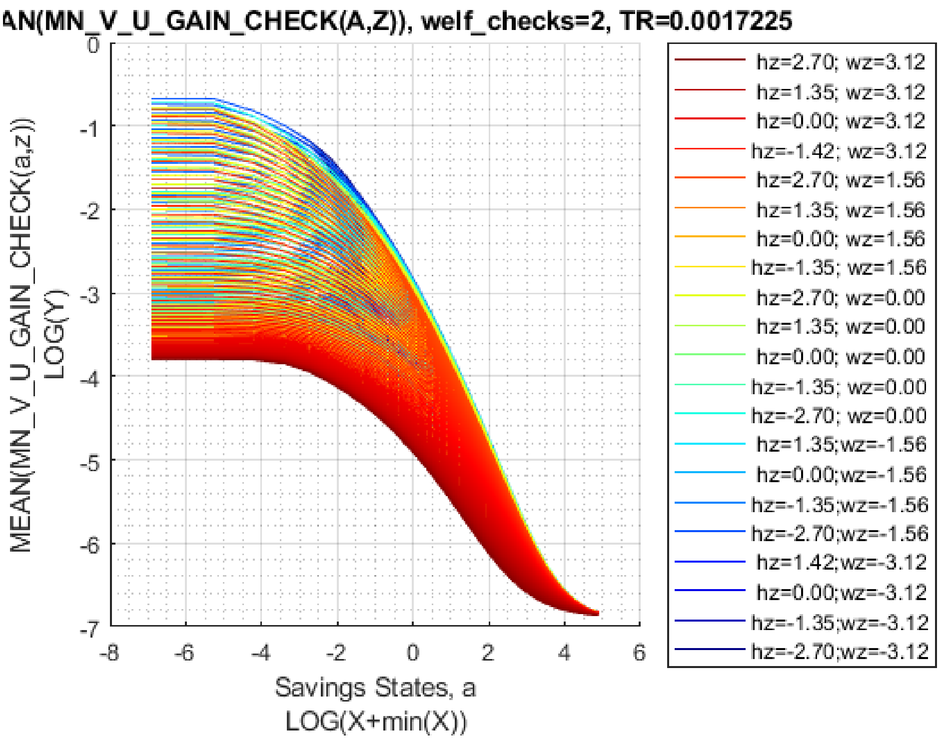
Tabulate value and policies along savings and shocks:

```
% Set
ar_permute = [1,4,5,6,3,2];
% Value Function
st_title = ['MEAN(MN_V_U_GAIN_CHECK(A,Z)), welf_checks=' num2str(welf_checks) ', TR=' num2str(mp_par
tb_az_v = ff_summ_nd_array(st_title, mn_V_U_gain_check, true, ["mean"], 4, 1, cl_mp_datasetdesc, ar_

xxx  MEAN(MN_V_U_GAIN_CHECK(A,Z)), welf_checks=2, TR=0.0017225  xxxxxxxxxxxxxxxxxxxxxxxxxxxx
    group     savings      mean_eta_1     mean_eta_2     mean_eta_3     mean_eta_4     mean_eta_5     mea
    -----    ----------    ----------     ----------     ----------     ----------     ----------     ---

      1              0       0.51002        0.47311        0.43235        0.39151        0.35308
```

```
st_title = ['MEAN(MN\_V\_U\_GAIN\_CHECK(A,Z)), welf\_checks=' num2str(welf_checks) ', TR=' num2str(m
```

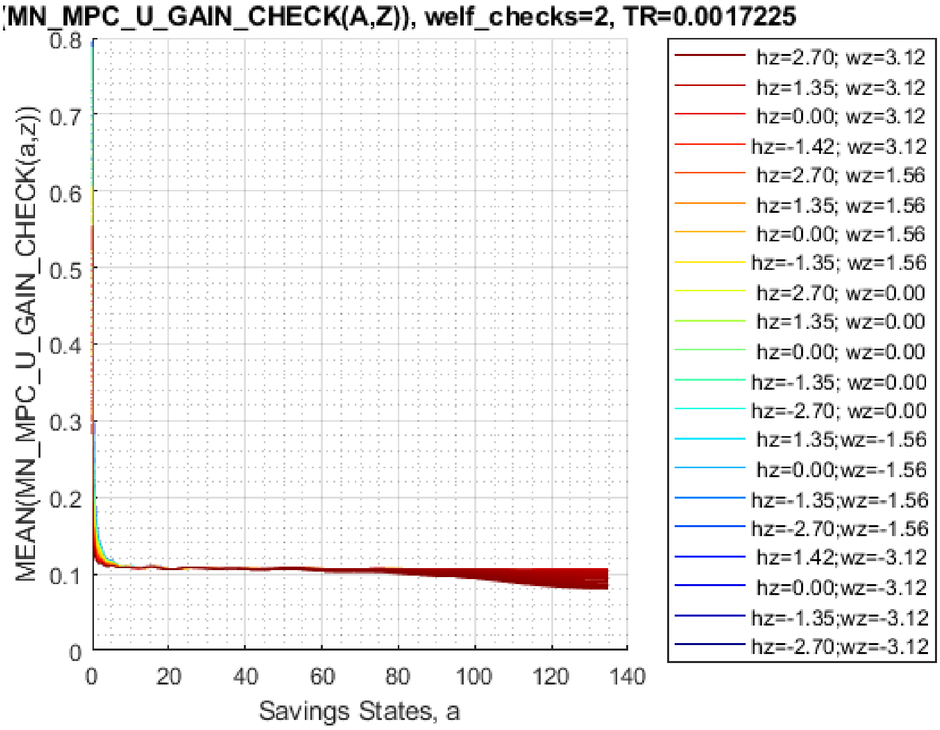
```
mp_support_graph('cl_st_graph_title') = {st_title};
mp_support_graph('cl_st_ytitle') = {'MEAN(MN\_V\_U\_GAIN\_CHECK(a,z))'};
ff_graph_grid((tb_az_v{1:end, 3:end})', ar_st_eta_HS_grid, agrid, mp_support_graph);
```

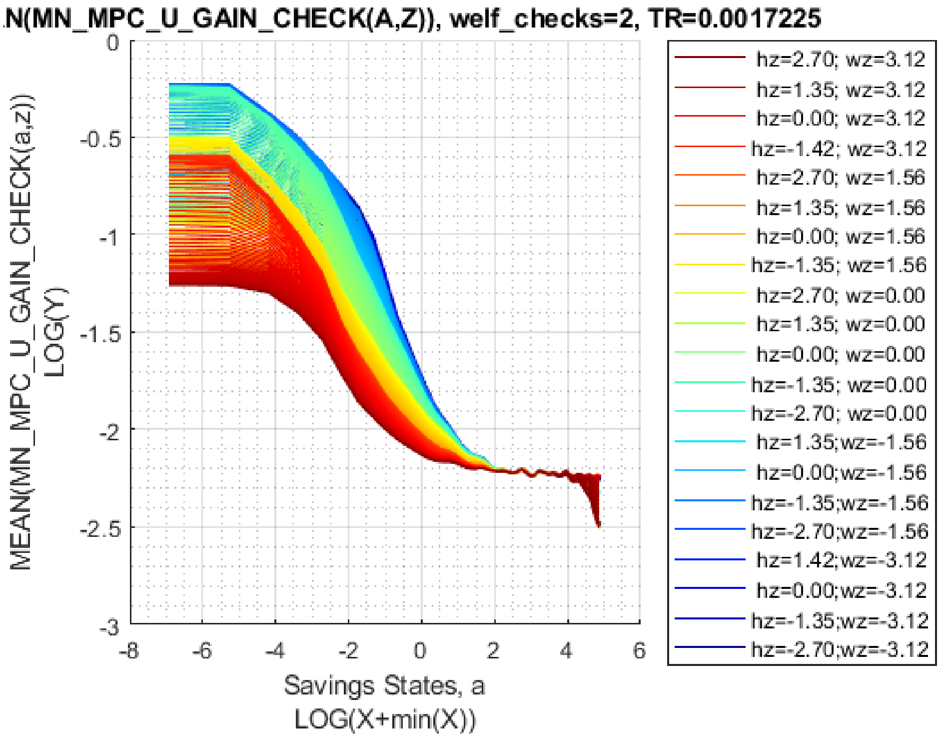




Graph Mean Consumption (***MPC: Share of Check Consumed***):

```
st_title = ['MEAN(MN\_MPC\_U\_GAIN\_CHECK(A,Z)), welf\_checks=' num2str(welf_checks) ', TR=' num2str
mp_support_graph('cl_st_graph_title') = {st_title};
mp_support_graph('cl_st_ytitle') = {'MEAN(MN\_MPC\_U\_GAIN\_CHECK(a,z))'};
ff_graph_grid((tb_az_c{1:end, 3:end})', ar_st_eta_HS_grid, agrid, mp_support_graph);
```





8.2.5 Analyze Marginal Value and MPC over Y(a,eta), Conditional On Kids, Marry, Age, Education

Income is generated by savings and shocks, what are the income levels generated by all the shock and savings points conditional on kids, marital status, age and educational levels. Plot on the Y axis MPC, and plot on the X axis income levels, use colors to first distinguish between different a levels, then use colors to distinguish between different eta levles.

Set Up date, Select Age 37vn

, unmarried, no kids, lower education:

```
% NaN(n_jgrid,n_agrid,n_etagrid,n_educgrid,n_marriedgrid,n_kidsgrid);
% 38 year old, unmarried, no kids, lower educated
% Only Household Head Shock Matters so select up to 'n_eta_H_grid'
mn_total_inc_jemk = total_inc_VFI(19,:,1:mp_params('n_eta_H_grid'),1,1,1);
mn_V_W_gain_check_use = ev19_jaeemk_check2 - ev19_jaeemk_check0;
mn_C_W_gain_check_use = ec19_jaeemk_check2 - ec19_jaeemk_check0;
```

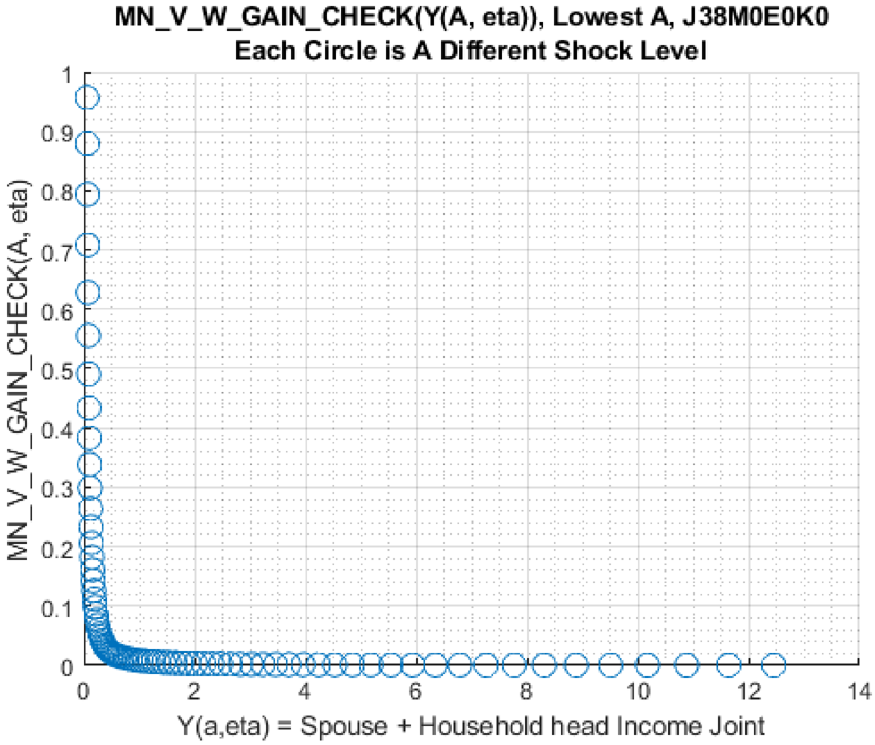
Select Age, Education, Marital, Kids Count:s

```
% Selections
it_age = 21; % +18
it_marital = 1; % 1 = unmarried
it_kids = 1; % 1 = kids is zero
it_educ = 1; % 1 = lower education
% Select: NaN(n_jgrid,n_agrid,n_etagrid,n_educgrid,n_marriedgrid,n_kidsgrid);
mn_C_W_gain_check_jemk = mn_C_W_gain_check_use(it_age, :, 1:mp_params('n_eta_H_grid'), it_educ, it_m
mn_V_W_gain_check_jemk = mn_V_W_gain_check_use(it_age, :, 1:mp_params('n_eta_H_grid'), it_educ, it_m
% Reshape, so shock is the first dim, a is the second
mt_total_inc_jemk = permute(mn_total_inc_jemk,[3,2,1]);
mt_C_W_gain_check_jemk = permute(mn_C_W_gain_check_jemk,[3,2,1]);
mt_C_W_gain_check_jemk(mt_C_W_gain_check_jemk<=1e-10) = 1e-10;
mt_V_W_gain_check_jemk = permute(mn_V_W_gain_check_jemk,[3,2,1]);
mt_V_W_gain_check_jemk(mt_V_W_gain_check_jemk<=1e-10) = 1e-10;
% Generate meshed a and shock grid
[mt_eta_H, mt_a] = ndgrid(eta_H_grid(1:mp_params('n_eta_H_grid')), agrid);
```

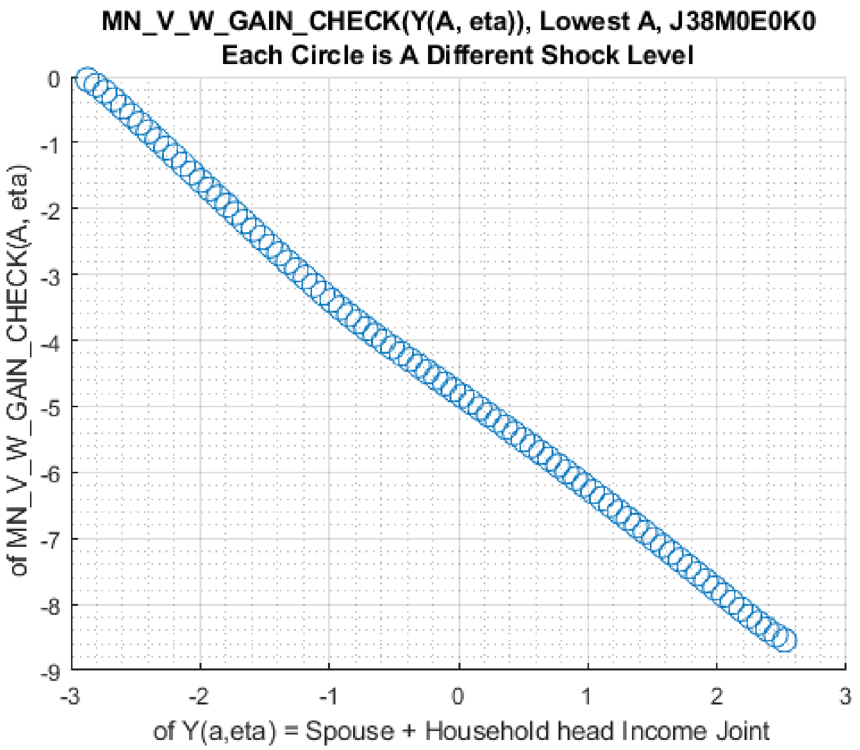
8.2.6 Marginal Value Gains, Color as Shock, Conditional on Age, Marital, Kids, and Education

How do shocks and a impact marginal value. First plot one asset level, variation comes only from increasingly higher shocks:

```
figure();
it_a = 1;
scatter((mt_total_inc_jemk(:,it_a)), (mt_V_W_gain_check_jemk(:,it_a)), 100);
title({'MN\_V\_W\_GAIN\_CHECK(Y(A, eta)), Lowest A, J38M0E0K0', ...
    'Each Circle is A Different Shock Level'});
xlabel('Y(a,eta) = Spouse + Household head Income Joint');
ylabel('MN\_V\_W\_GAIN\_CHECK(A, eta)');
grid on;
grid minor;
```

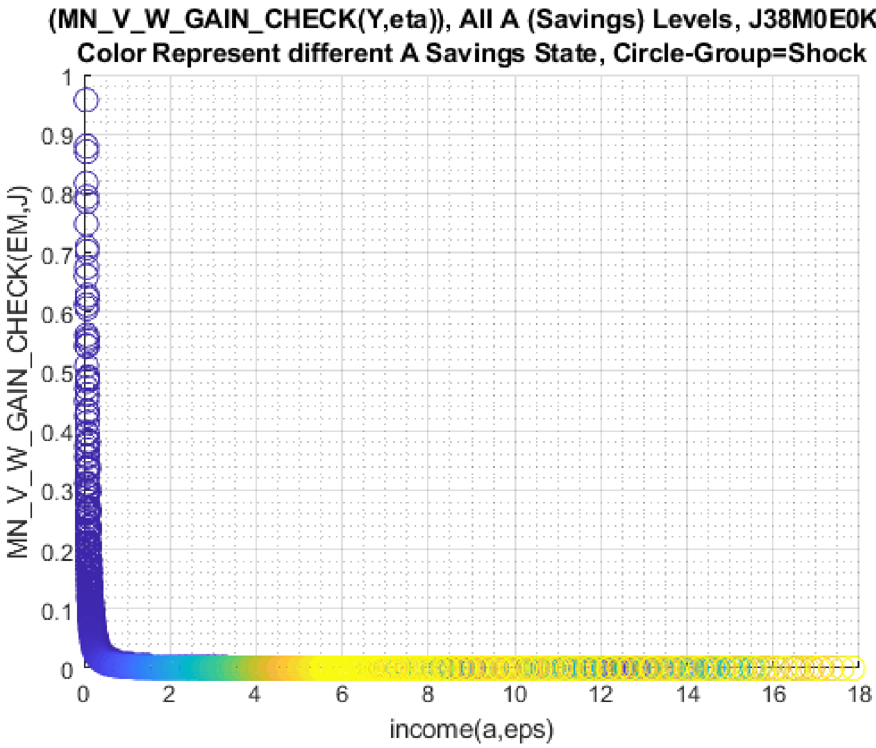



```
figure();
it_shock = 1;
scatter(log(mt_total_inc_jemk(:,it_a)), log(mt_V_W_gain_check_jemk(:,it_a)), 100);
title({'MN\_V\_W\_GAIN\_CHECK(Y(A, eta)), Lowest A, J38M0E0K0', ...
    'Each Circle is A Different Shock Level'});
xlabel(' of Y(a,eta) = Spouse + Household head Income Joint');
ylabel(' of MN\_V\_W\_GAIN\_CHECK(A, eta)');
grid on;
grid minor;
```

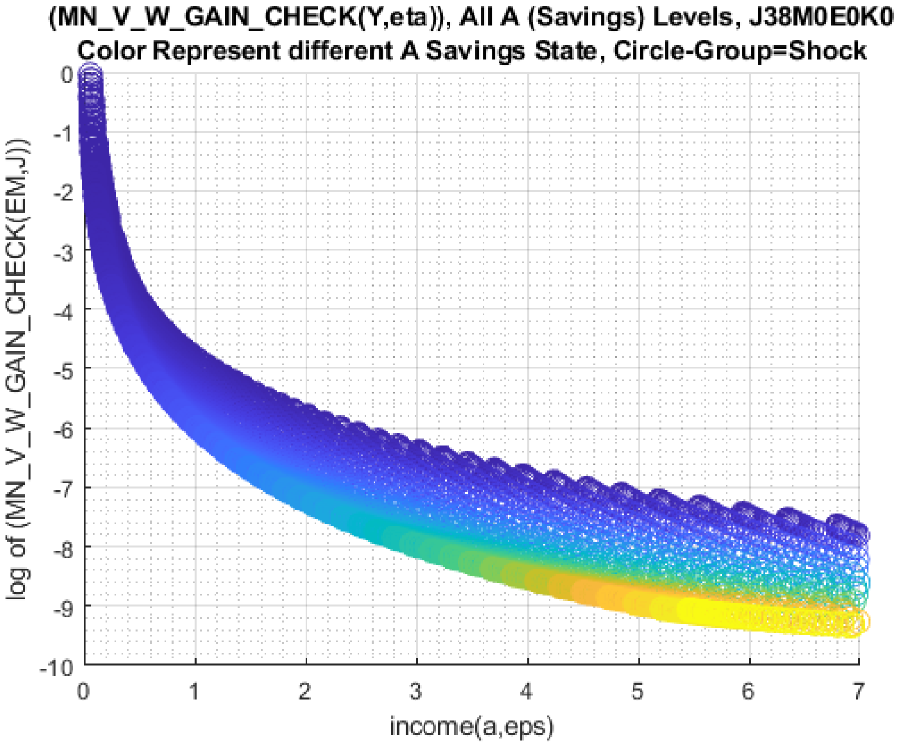


Plot all asset levels:

```
figure();
scatter((mt_total_inc_jemk(:)), (mt_V_W_gain_check_jemk(:)), 100, mt_a(:));
title({'(MN\_V\_W\_GAIN\_CHECK(Y,eta)), All A (Savings) Levels, J38M0E0K0', ...
    'Color Represent different A Savings State, Circle-Group=Shock'});
xlabel('income(a,eps)');
ylabel('MN\_V\_W\_GAIN\_CHECK(EM,J)');
grid on;
grid minor;
```



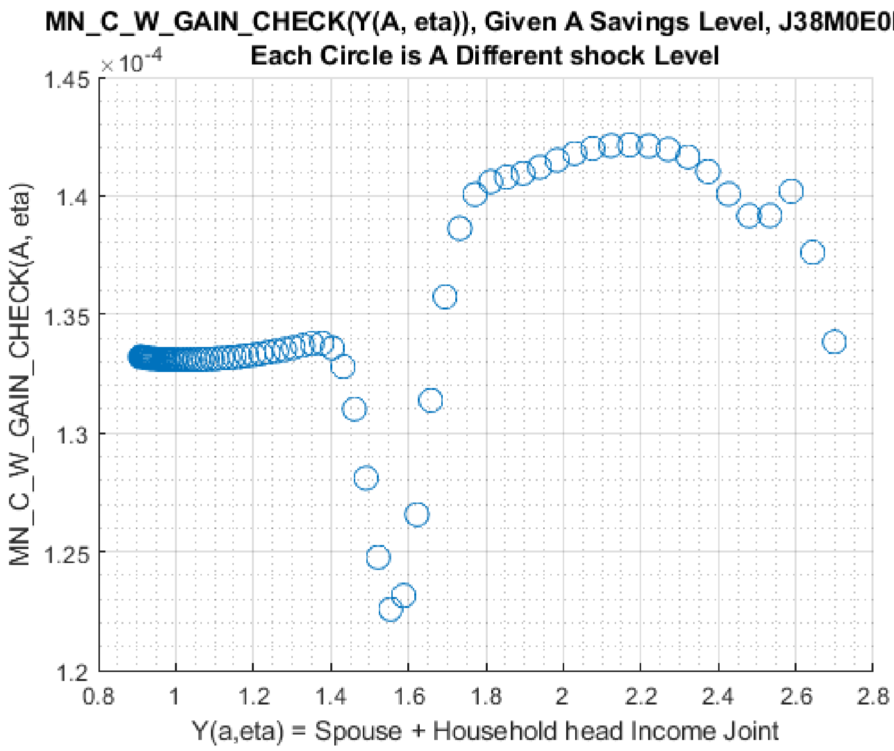

```
figure();
scatter((mt_total_inc_jemk(:)), log(mt_V_W_gain_check_jemk(:)), 100, mt_a(:));
title({'(MN\_V\_W\_GAIN\_CHECK(Y,eta)), All A (Savings) Levels, J38M0E0K0', ...
    'Color Represent different A Savings State, Circle-Group=Shock'});
xlabel('income(a,eps)');
ylabel('log of (MN\_V\_W\_GAIN\_CHECK(EM,J))');
xlim([0,7]);
grid on;
grid minor;
```



8.2.7 Marginal Consumption Gains, Color as Shock, Conditional on Age, Marital, Kids, and Education

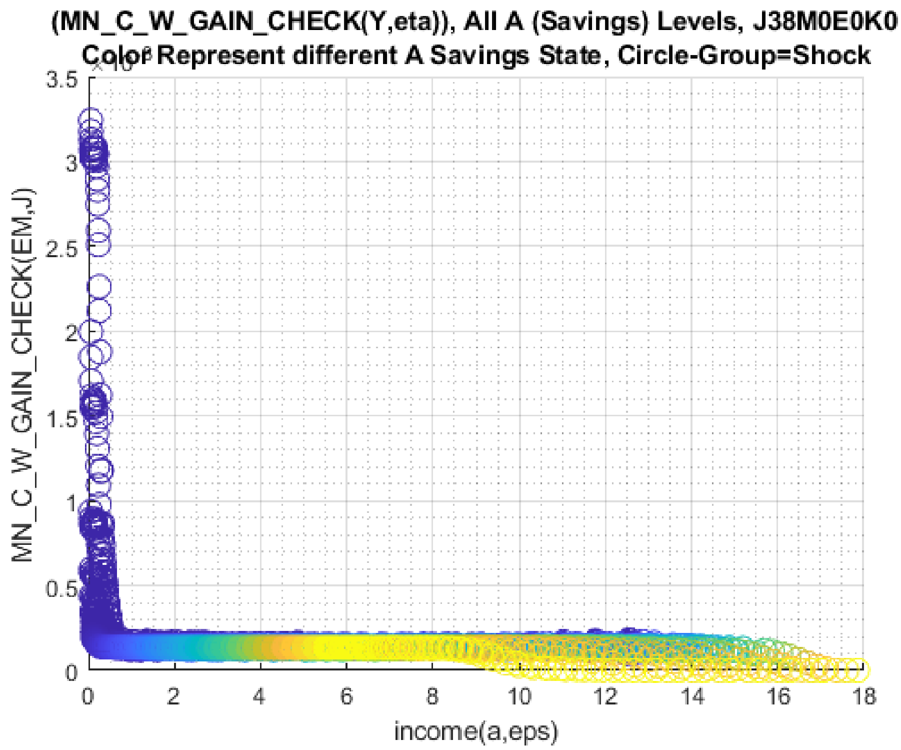
How do shocks and a impact marginal value. First plot one asset level, variation comes only from increasingly higher shocks:

```
figure();
it_a = 50;
scatter(log(mt_total_inc_jemk(:,it_a)), mt_C_W_gain_check_jemk(:,it_a), 100);
title({'MN\_C\_W\_GAIN\_CHECK(Y(A, eta)), Given A Savings Level, J38M0E0K0', ...
    'Each Circle is A Different shock Level'});
xlabel('Y(a,eta) = Spouse + Household head Income Joint');
ylabel('MN\_C\_W\_GAIN\_CHECK(A, eta)');
grid on;
grid minor;
```

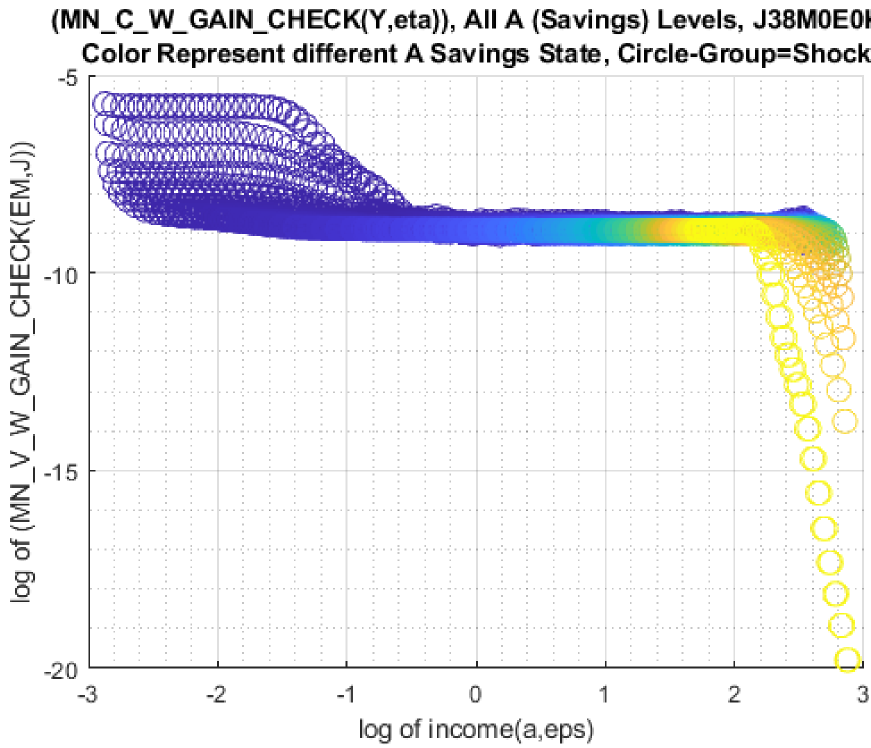


Plot all asset levels:

```
figure();
scatter((mt_total_inc_jemk(:)), (mt_C_W_gain_check_jemk(:)), 100, mt_a(:));
title({'(MN\_C\_W\_GAIN\_CHECK(Y,eta)), All A (Savings) Levels, J38M0E0K0', ...
    'Color Represent different A Savings State, Circle-Group=Shock'});
xlabel('income(a,eps)');
ylabel('MN\_C\_W\_GAIN\_CHECK(EM,J)');
grid on;
grid minor;
```



```
figure();
scatter(log(mt_total_inc_jemk(:)), log(mt_C_W_gain_check_jemk(:)), 100, mt_a(:));
title({'(MN\_C\_W\_GAIN\_CHECK(Y,eta)), All A (Savings) Levels, J38M0E0K0', ...
    'Color Represent different A Savings State, Circle-Group=Shock'});
xlabel('log of income(a,eps)');
ylabel('log of (MN\_V\_W\_GAIN\_CHECK(EM,J))');
grid on;
grid minor;
```



8.2.8 Analyze Kids and Marriage and Age

Aggregating over education, savings, and shocks, what are the differential effects of Marriage and Age.

```
% Generate some Data
mp_support_graph = containers.Map('KeyType', 'char', 'ValueType', 'any');
ar_row_grid = [...
    "k0M0", "K1M0", "K2M0", "K3M0", "K4M0", ...
    "k0M1", "K1M1", "K2M1", "K3M1", "K4M1"];
mp_support_graph('cl_st_xtitle') = {'Age'};
mp_support_graph('st_legend_loc') = 'best';
mp_support_graph('bl_graph_logy') = true; % do not log
mp_support_graph('st_rounding') = '6.2f'; % format shock legend
mp_support_graph('cl_scatter_shapes') = {...
    'o', 'd' ,'s', 'x', '*', ...
    'o', 'd', 's', 'x', '*'};
mp_support_graph('cl_colors') = {...
    'red', 'red', 'red', 'red', 'red'...
    'blue', 'blue', 'blue', 'blue', 'blue'};
```

MEAN(VAL(KM,J)), MEAN(AP(KM,J)), MEAN(C(KM,J))

Tabulate value and policies:

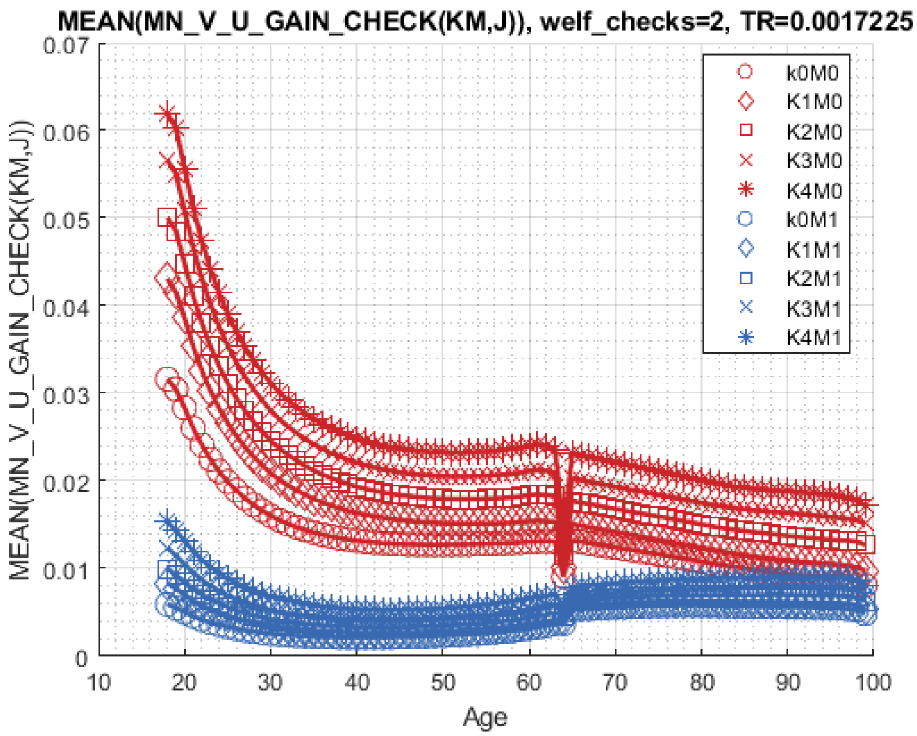
```
% Set
% NaN(n_jgrid,n_agrid,n_etagrid,n_educgrid,n_marriedgrid,n_kidsgrid);
ar_permute = [2,3,4,1,6,5];
```

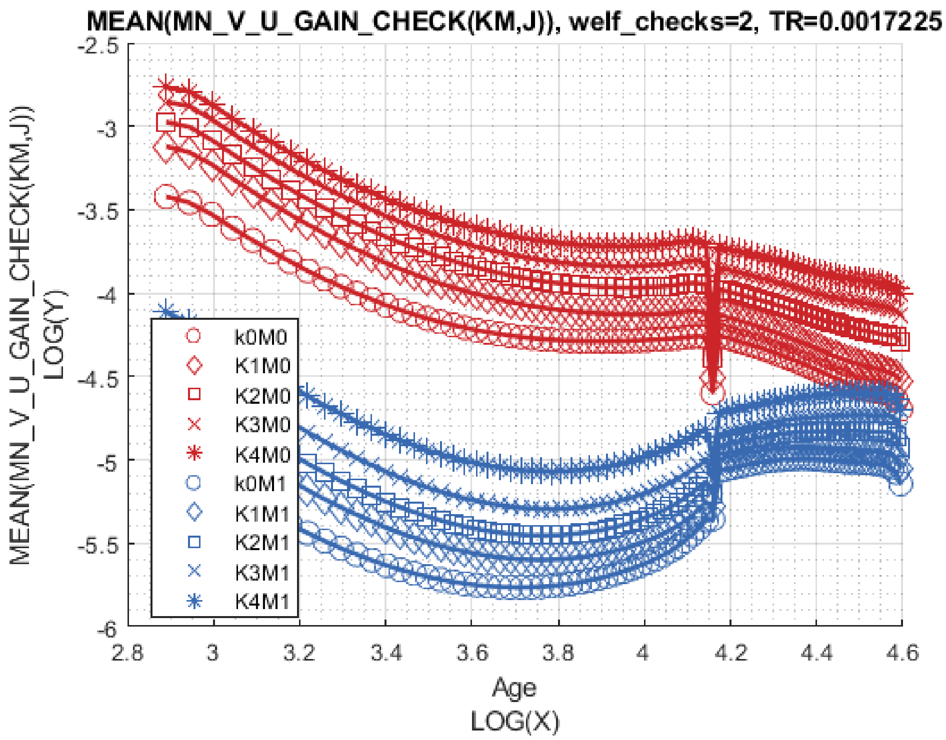
```
% Value Function
st_title = ['MEAN(MN_V_U_GAIN_CHECK(KM,J)), welf_checks=' num2str(welf_checks) ', TR=' num2str(mp_pa
tb_az_v = ff_summ_nd_array(st_title, mn_V_U_gain_check, true, ["mean"], 3, 1, cl_mp_datasetdesc, ar_

xxx  MEAN(MN_V_U_GAIN_CHECK(KM,J)), welf_checks=2, TR=0.0017225  xxxxxxxxxxxxxxxxxxxxxxxxxxx
    group    kids    marry    mean_age_18    mean_age_19    mean_age_20    mean_age_21    mean_age_2
    _____    ____    _____    ___________    ___________    ___________    ___________    __________

      1        1       0        0.031641       0.030484        0.02834       0.026038        0.02411
      2        2       0        0.043088       0.041562       0.038594       0.035346       0.032616
      3        3       0        0.050052       0.048552        0.04484       0.041129       0.038009
      4        4       0        0.056653       0.055085       0.050837       0.046658       0.043144
      5        5       0        0.061929        0.06035       0.055674       0.051173        0.04739
      6        1       1       0.0059451      0.0055031      0.0050109      0.0045637      0.0041817
      7        2       1       0.0083276      0.0077158      0.0070125      0.0063646      0.0058204
      8        3       1       0.0099952      0.0092796      0.0084495      0.0076771      0.0070251
      9        4       1        0.012363         0.0115       0.010491      0.0095402      0.0087368
     10        5       1        0.015311       0.014353       0.013136       0.011989       0.011016
```

```
% Consumption Function
st_title = ['MEAN(MN_MPC_U_GAIN_CHECK(KM,J)), welf_checks=' num2str(welf_checks) ', TR=' num2str(mp_
tb_az_c = ff_summ_nd_array(st_title, mn_MPC_U_gain_share_check, true, ["mean"], 3, 1, cl_mp_datasetd

xxx  MEAN(MN_MPC_U_GAIN_CHECK(KM,J)), welf_checks=2, TR=0.0017225  xxxxxxxxxxxxxxxxxxxxxxxxxxx
    group    kids    marry    mean_age_18    mean_age_19    mean_age_20    mean_age_21    mean_age_2
    _____    ____    _____    ___________    ___________    ___________    ___________    __________

      1        1       0       0.056223       0.069417       0.075469       0.073238       0.071407
      2        2       0       0.065756       0.079137       0.086795       0.084309       0.082576
      3        3       0       0.074976         0.0915       0.097876       0.095212       0.092901
      4        4       0       0.080849       0.097766        0.10385        0.10096       0.098266
      5        5       0       0.086722        0.10427         0.1095        0.10587        0.10288
      6        1       1       0.076254       0.076512       0.076532       0.075066       0.074001
      7        2       1       0.078384        0.08099          0.082       0.080237       0.078625
      8        3       1       0.081685       0.086418       0.087477       0.086713       0.086059
      9        4       1       0.084587       0.091629       0.092233       0.091036       0.089321
     10        5       1       0.094144        0.10366        0.10288        0.10024       0.099154
```

Graph Mean Values:

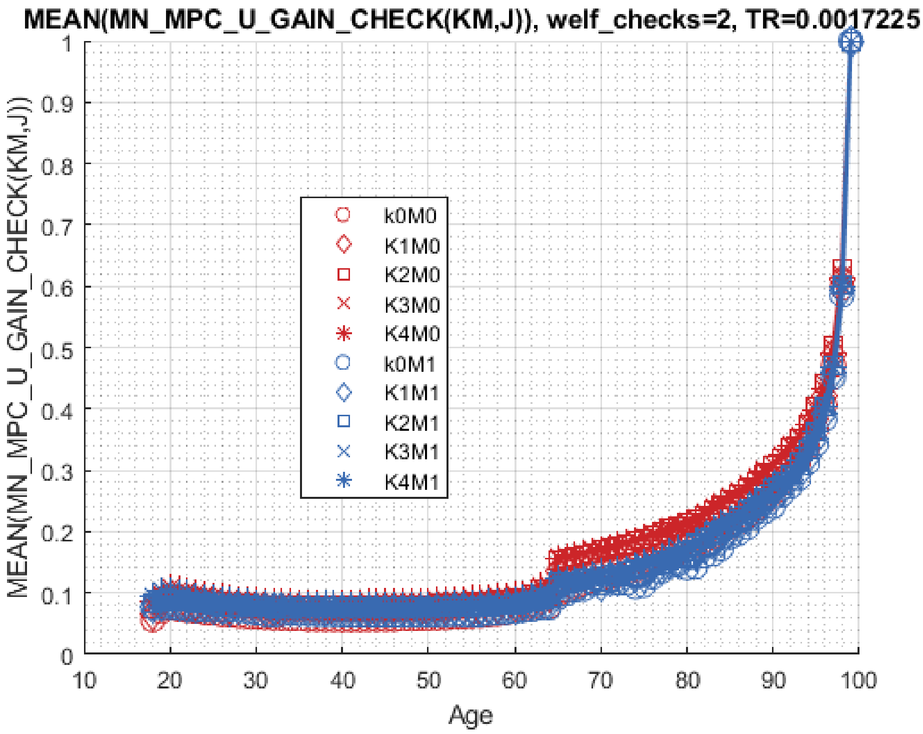
```
st_title = ['MEAN(MN\_V\_U\_GAIN\_CHECK(KM,J)), welf\_checks=' num2str(welf_checks) ', TR=' num2str(
mp_support_graph('cl_st_graph_title') = {st_title};
mp_support_graph('cl_st_ytitle') = {'MEAN(MN\_V\_U\_GAIN\_CHECK(KM,J))'};
ff_graph_grid((tb_az_v{1:end, 4:end}), ar_row_grid, age_grid, mp_support_graph);
```

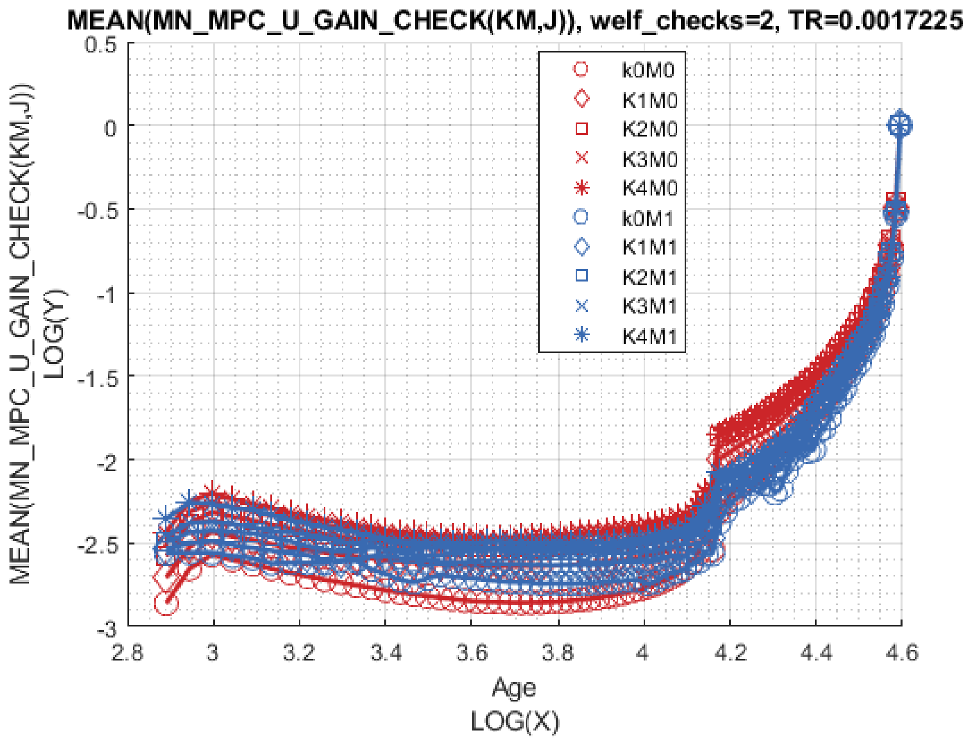




Graph Mean Consumption (***MPC: Share of Check Consumed***):

```
st_title = ['MEAN(MN\_MPC\_U\_GAIN\_CHECK(KM,J)), welf\_checks=' num2str(welf_checks) ', TR=' num2st
mp_support_graph('cl_st_graph_title') = {st_title};
mp_support_graph('cl_st_ytitle') = {'MEAN(MN\_MPC\_U\_GAIN\_CHECK(KM,J))'};
ff_graph_grid((tb_az_c{1:end, 4:end}), ar_row_grid, age_grid, mp_support_graph);
```





8.2.9 Analyze Education and Marriage

Aggregating over education, savings, and shocks, what are the differential effects of Marriage and Age.

```
% Generate some Data
mp_support_graph = containers.Map('KeyType', 'char', 'ValueType', 'any');
ar_row_grid = ["E0M0", "E1M0", "E0M1", "E1M1"];
mp_support_graph('cl_st_xtitle') = {'Age'};
mp_support_graph('st_legend_loc') = 'best';
mp_support_graph('bl_graph_logy') = true; % do not log
```

```
mp_support_graph('st_rounding') = '6.2f'; % format shock legend
mp_support_graph('cl_scatter_shapes') = {'*', 'p', '*','p' };
mp_support_graph('cl_colors') = {'red', 'red', 'blue', 'blue'};
```

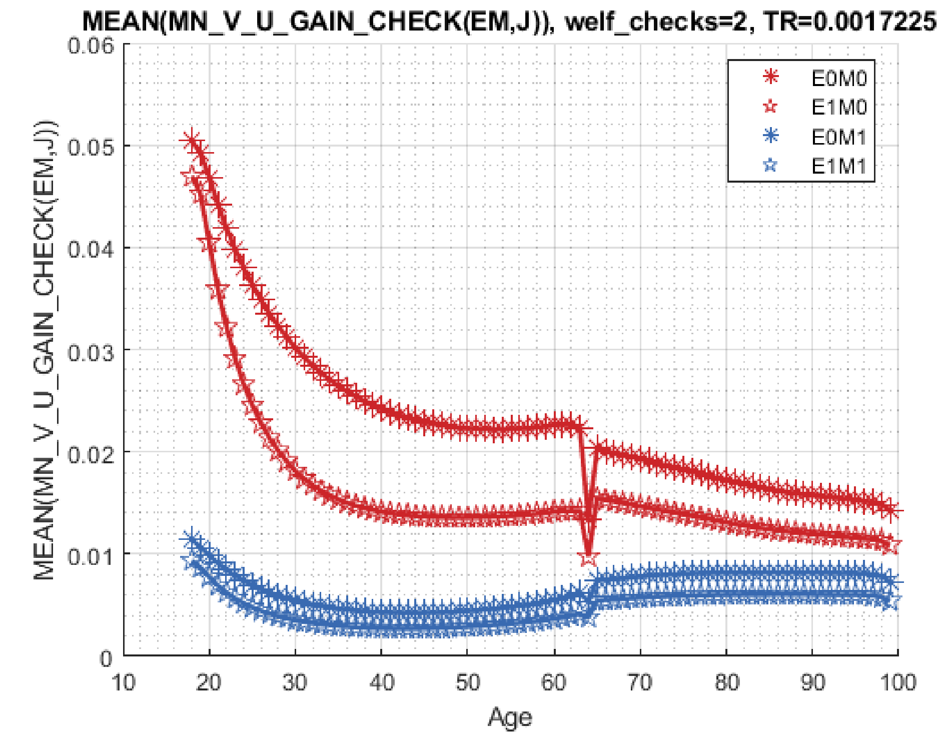
MEAN(VAL(EM,J)), MEAN(AP(EM,J)), MEAN(C(EM,J))

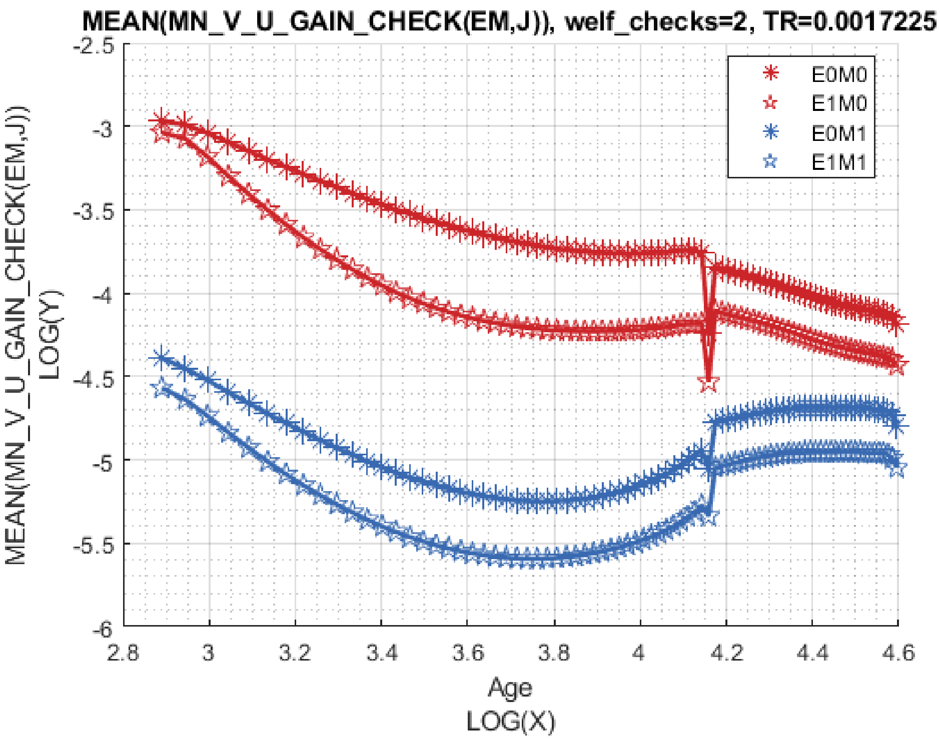
Tabulate value and policies:

```
% Set
% NaN(n_jgrid,n_agrid,n_etagrid,n_educgrid,n_marriedgrid,n_kidsgrid);
ar_permute = [2,3,6,1,4,5];
% Value Function
st_title = ['MEAN(MN_V_U_GAIN_CHECK(EM,J)), welf_checks=' num2str(welf_checks) ', TR=' num2str(mp_pa
tb_az_v = ff_summ_nd_array(st_title, mn_V_U_gain_check, true, ["mean"], 3, 1, cl_mp_datasetdesc, ar_

xxx  MEAN(MN_V_U_GAIN_CHECK(EM,J)), welf_checks=2, TR=0.0017225  xxxxxxxxxxxxxxxxxxxxxxxxxxx
    group    edu    marry    mean_age_18    mean_age_19    mean_age_20    mean_age_21    mean_age_22
    -----    ---    -----    -----------    -----------    -----------    -----------    -----------

      1       0       0       0.050402       0.049194       0.046825        0.04423       0.041921
      2       1       0       0.046943       0.045218       0.040488       0.035907       0.032187
      3       0       1       0.011395       0.010664      0.0098666      0.0091158      0.0084651
      4       1       1       0.009382      0.0086772      0.0077734      0.0069379      0.0062467

% Consumption
st_title = ['MEAN(MN_MPC_U_GAIN_CHECK(EM,J)), welf_checks=' num2str(welf_checks) ', TR=' num2str(mp_
tb_az_c = ff_summ_nd_array(st_title, mn_MPC_U_gain_share_check, true, ["mean"], 3, 1, cl_mp_datasetd

xxx  MEAN(MN_MPC_U_GAIN_CHECK(EM,J)), welf_checks=2, TR=0.0017225  xxxxxxxxxxxxxxxxxxxxxxxxxxx
    group    edu    marry    mean_age_18    mean_age_19    mean_age_20    mean_age_21    mean_age_22
    -----    ---    -----    -----------    -----------    -----------    -----------    -----------

      1       0       0       0.063628       0.073179       0.078161       0.077574       0.077065
      2       1       0       0.082182        0.10366        0.11123        0.10627        0.10215
      3       0       1       0.075603       0.077333       0.078368       0.078269       0.078227
      4       1       1       0.090419       0.098351       0.098081        0.09505       0.092637
```

Graph Mean Values:

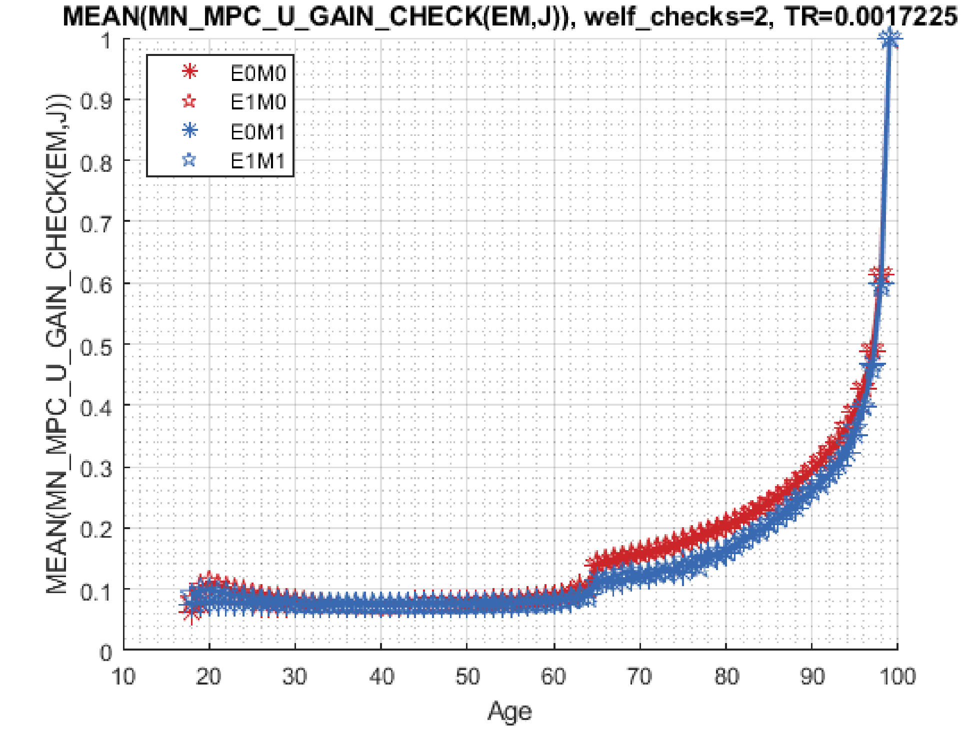
```
st_title = ['MEAN(MN\_V\_U\_GAIN\_CHECK(EM,J)), welf\_checks=' num2str(welf_checks) ', TR=' num2str(
mp_support_graph('cl_st_graph_title') = {st_title};
mp_support_graph('cl_st_ytitle') = {'MEAN(MN\_V\_U\_GAIN\_CHECK(EM,J))'};
ff_graph_grid((tb_az_v{1:end, 4:end}), ar_row_grid, age_grid, mp_support_graph);
```

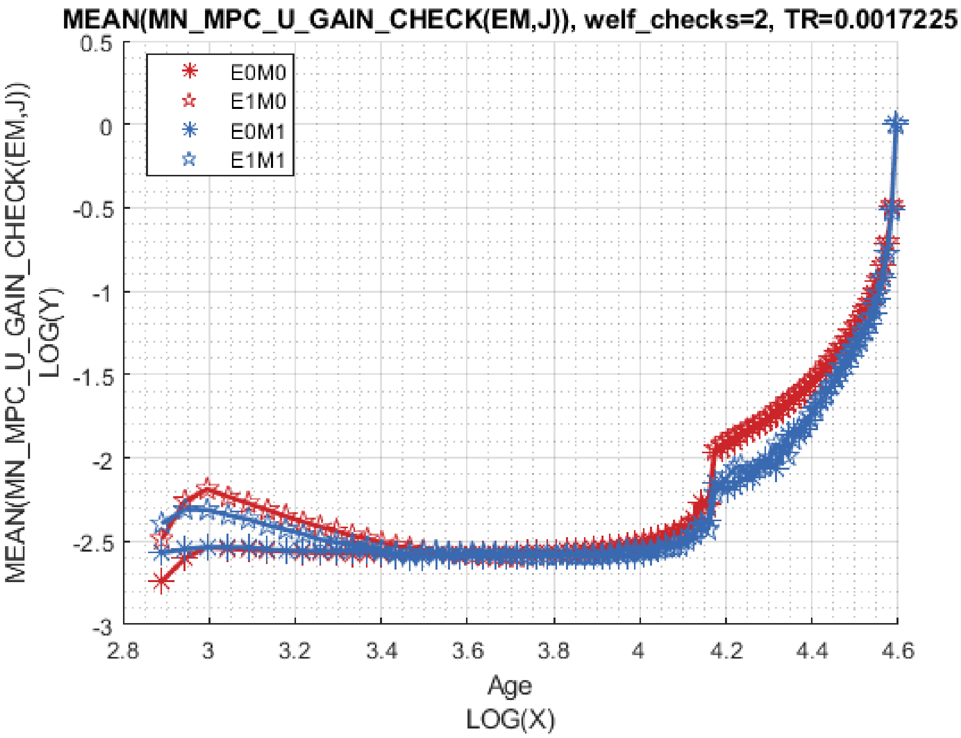




Graph Mean Consumption (***MPC: Share of Check Consumed***):

```
st_title = ['MEAN(MN\_MPC\_U\_GAIN\_CHECK(EM,J)), welf\_checks=' num2str(welf_checks) ', TR=' num2st
mp_support_graph('cl_st_graph_title') = {st_title};
mp_support_graph('cl_st_ytitle') = {'MEAN(MN\_MPC\_U\_GAIN\_CHECK(EM,J))'};
ff_graph_grid((tb_az_c{1:end, 4:end}), ar_row_grid, age_grid, mp_support_graph);
```


MEAN(MN_MPC_U_GAIN_CHECK(EM,J)), welf_checks=2, TR=0.0017225
E0M0
E1M0
E0M1
E1M1
MEAN(MN_MPC_U_GAIN_CHECK(EM,J))
Age


MEAN(MN_MPC_U_GAIN_CHECK(EM,J)), welf_checks=2, TR=0.0017225
E0M0
E1M0
E0M1
E1M1
MEAN(MN_MPC_U_GAIN_CHECK(EM,J))
LOG(Y)
Age
LOG(X)

Chapter 9

2019 Expectations Given Income, Age, Kids and Marital Status

9.1 2019 Age, Income, Kids, Marry EV and EC of One Check

This is the example vignette for function: **snw_evuvw19_jmky** from the **PrjOptiSNW Package.** 2019 integrated over VU and VW

9.1.1 Test SNW_EVUVW19_JMKY Defaults Dense

Set Parameters

Call the function with defaults.

```
clear all;
st_solu_type = 'bisec_vec';

% Solve the VFI Problem and get Value Function
% mp_params = snw_mp_param('default_tiny');
% mp_params = snw_mp_param('default_dense');
mp_params = snw_mp_param('default_docdense');
mp_controls = snw_mp_control('default_test');

% set Unemployment Related Variables
xi=0.5; % Proportional reduction in income due to unemployment (xi=0 refers to 0 labor income; xi=1
b=0; % Unemployment insurance replacement rate (b=0 refers to no UI benefits; b=1 refers to 100 perc
TR=100/58056; % Value of a welfare check (can receive multiple checks). TO DO: Update with alternati

mp_params('xi') = xi;
mp_params('b') = b;
mp_params('TR') = TR;

% Check Numbers
% n_incgrid=201; % Number of income groups
% n_incgrid_aux=round(0.75*n_incgrid);
% inc_grid1=linspace(0,4,n_incgrid_aux)'; % 4 refers to 4*58056=232224 dollars in 2012USD
% inc_grid=[inc_grid1;linspace(4+((7-4)/(n_incgrid-n_incgrid_aux)),7,n_incgrid-n_incgrid_aux)']; % 7
n_incgrid=201; % Number of income groups
inc_grid=linspace(0,7,n_incgrid)';
mp_params('n_incgrid') = n_incgrid;
mp_params('inc_grid') = inc_grid;

% Solve for Unemployment Values
```

```
mp_controls('bl_print_vfi') = false;
mp_controls('bl_print_vfi_verbose') = false;
mp_controls('bl_print_ds') = false;
mp_controls('bl_print_ds_verbose') = false;
mp_controls('bl_print_precompute') = false;
mp_controls('bl_print_precompute_verbose') = false;
mp_controls('bl_print_a4chk') = false;
mp_controls('bl_print_a4chk_verbose') = false;
mp_controls('bl_print_evuvw20_jaeemk') = false;
mp_controls('bl_print_evuvw20_jaeemk_verbose') = false;
mp_controls('bl_print_evuvw19_jaeemk') = false;
mp_controls('bl_print_evuvw19_jaeemk_verbose') = false;
mp_controls('bl_print_evuvw19_jmky') = false;
```

9.1.2 Solve VFI and Distributon

```
% Solve the Model to get V working and unemployed
[V_ss,ap_ss,cons_ss,mp_valpol_more_ss] = snw_vfi_main_bisec_vec(mp_params, mp_controls);
```

```
Completed SNW_VFI_MAIN_BISEC_VEC;SNW_MP_PARAM=default_docdense;SNW_MP_CONTROL=default_test;time=493.
```

```
inc_VFI = mp_valpol_more_ss('inc_VFI');
spouse_inc_VFI = mp_valpol_more_ss('spouse_inc_VFI');
total_inc_VFI = inc_VFI + spouse_inc_VFI;

% COVID year tax
mp_params('a2_covidyr') = mp_params('a2_covidyr_manna_heaven');
% 2020 V and C same as V_SS and cons_ss if tax the same
if (mp_params('a2_covidyr') == mp_params('a2'))
    % mana from heaven
    V_ss_2020 = V_ss;
    cons_ss_2020 = cons_ss;
else
    % change xi and b to for people without unemployment shock
    % solving for employed but 2020 tax results
    % a2_covidyr > a2, we increased tax in 2020 to pay for covid and other
    % costs resolve for both employed and unemployed
    xi = mp_params('xi');
    b = mp_params('b');
    mp_params('xi') = 1;
    mp_params('b') = 0;
    [V_ss_2020,~,cons_ss_2020,~] = snw_vfi_main_bisec_vec(mp_params, mp_controls, V_ss);
    mp_params('xi') = xi;
    mp_params('b') = b;
end
% Solve unemployment
[V_unemp_2020,~,cons_unemp_2020] = snw_vfi_main_bisec_vec(mp_params, mp_controls, V_ss);
```

```
Completed SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock;SNW_MP_PARAM=default_docdense;SNW_MP_CONTROL=d
```

```
[Phi_true] = snw_ds_main(mp_params, mp_controls, ap_ss, cons_ss, mp_valpol_more_ss);
```

```
Completed SNW_DS_MAIN;SNW_MP_PARAM=default_docdense;SNW_MP_CONTROL=default_test;time=1493.0859
```

```
% Get Matrixes
cl_st_precompute_list = {'a', ...
    'inc', 'inc_unemp', 'spouse_inc', 'spouse_inc_unemp', 'ref_earn_wageind_grid', ...
    'ap_idx_lower_ss', 'ap_idx_higher_ss', 'ap_idx_lower_weight_ss', ...
```

```
    'inc_tot_ygroup_grid'};
mp_controls('bl_print_precompute_verbose') = false;
```

9.1.3 Pre-Compute Matrixes and YMKY Mass

```
% Pre-compute
[mp_precompute_res] = snw_hh_precompute(mp_params, mp_controls, cl_st_precompute_list, ap_ss, Phi_tr

Wage quintile cutoffs=0.4645     0.71528      1.0335      1.5632
Completed SNW_HH_PRECOMPUTE;SNW_MP_PARAM=default_docdense;SNW_MP_CONTROL=default_test;time cost=457.

inc_tot_ygroup_grid = mp_precompute_res('inc_tot_ygroup_grid');
% YMKY Mass
[Phi_true_jmky] = snw_evuvw19_jmky_mass(mp_params, mp_controls, Phi_true, inc_tot_ygroup_grid);

SNW_EVUVW19_JMKY_MASS Start
Completed SNW_EVUVW19_JMKY_MASS;SNW_MP_PARAM=default_docdense;SNW_MP_CONTROL=default_test;time=11.30
----------------------------------------
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
CONTAINER NAME: mp_outcomes ND Array (Matrix etc)
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
                     i    idx    ndim      numel       rowN      colN         sum          mean
                     -    ---    ----    ----------    ----    ---------    ------    ----------

    Phi_true         1     1      6        4.37e+07     83     5.265e+05    45.793    1.0479e-06
    Phi_true_jmky    2     2      4      1.6482e+05     82          2010    45.787     0.0002778
```

9.1.4 Solve for 2019 Evuvw With 0 and 2 Checks

Zero checks:

```
% Solve ev 19 JAEEMK
welf_checks = 0;
[ev19_jaeemk_check0, ec19_jaeemk_check0, ev20_jaeemk_check0, ec20_jaeemk_check0] = ...
    snw_evuvw19_jaeemk(...
    welf_checks, st_solu_type, mp_params, mp_controls, ...
    V_ss_2020, cons_ss_2020, V_unemp_2020, cons_unemp_2020, mp_precompute_res);

Completed SNW_A4CHK_WRK_BISEC_VEC;welf_checks=0;TR=0.0017225;SNW_MP_PARAM=default_docdense;SNW_MP_CO
Completed SNW_A4CHK_UNEMP_BISEC_VEC;welf_checks=0;TR=0.0017225;xi=0.5;b=0;SNW_MP_PARAM=default_docde
Completed SNW_EVUVW20_JAEEMK;SNW_MP_PARAM=default_docdense;SNW_MP_CONTROL=default_test;timeEUEC=8.40
Completed SNW_EVUVW19_JAEEMK;SNW_MP_PARAM=default_docdense;SNW_MP_CONTROL=default_test;time=4628.523

% Solve ev 19 JMKY
[ev19_jmky_check0, ec19_jmky_check0] = snw_evuvw19_jmky(...
    mp_params, mp_controls, ...
    ev19_jaeemk_check0, ec19_jaeemk_check0, ...
    Phi_true, Phi_true_jmky, inc_tot_ygroup_grid);

Completed SNW_EVUVW19_JMKY;SNW_MP_PARAM=default_docdense;SNW_MP_CONTROL=default_test;time=20.5467
----------------------------------------
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
CONTAINER NAME: mp_outcomes ND Array (Matrix etc)
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
                     i    idx    ndim      numel       rowN      colN          sum            mean
                     -    ---    ----    ----------    ----    ---------    -----------    ---------

    Phi_true         1     1      6        4.37e+07     83     5.265e+05         45.793    1.0479e-0
    Phi_true_jmky    2     2      4      1.6482e+05     82          2010         45.787     0.000277
```

```
    ec19_jaeemk      3     3      6      4.3173e+07     82     5.265e+05     1.8057e+08         4.182
    ec19_jmky        4     4      4      1.6482e+05     82          2010     3.4269e+05         2.079
    ev19_jaeemk      5     5      6      4.3173e+07     82     5.265e+05    -1.4106e+08        -3.267
    ev19_jmky        6     6      4      1.6482e+05     82          2010    -4.0603e+05        -2.463
```

Two checks:

```
% Solve ev 19 JAEEMK
welf_checks = 1;
[ev19_jaeemk_check2, ec19_jaeemk_check2, ev20_jaeemk_check2, ec20_jaeemk_check2] = ...
    snw_evuvw19_jaeemk(...
    welf_checks, st_solu_type, mp_params, mp_controls, ...
    V_ss_2020, cons_ss_2020, V_unemp_2020, cons_unemp_2020, mp_precompute_res);

Completed SNW_A4CHK_WRK_BISEC_VEC;welf_checks=1;TR=0.0017225;SNW_MP_PARAM=default_docdense;SNW_MP_CO
Completed SNW_A4CHK_UNEMP_BISEC_VEC;welf_checks=1;TR=0.0017225;xi=0.5;b=0;SNW_MP_PARAM=default_docde
Completed SNW_EVUVW20_JAEEMK;SNW_MP_PARAM=default_docdense;SNW_MP_CONTROL=default_test;timeEUEC=7.59
Completed SNW_EVUVW19_JAEEMK;SNW_MP_PARAM=default_docdense;SNW_MP_CONTROL=default_test;time=4634.111

% Solve ev 19 JMKY
[ev19_jmky_check2, ec19_jmky_check2] = snw_evuvw19_jmky(...
    mp_params, mp_controls, ...
    ev19_jaeemk_check2, ec19_jaeemk_check2, ...
    Phi_true, Phi_true_jmky, inc_tot_ygroup_grid);

Completed SNW_EVUVW19_JMKY;SNW_MP_PARAM=default_docdense;SNW_MP_CONTROL=default_test;time=20.4065
----------------------------------------
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
CONTAINER NAME: mp_outcomes ND Array (Matrix etc)
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
                     i    idx    ndim      numel       rowN      colN          sum          mean
                     -    ---    ----    ----------    ----    ---------    -----------    ---------

    Phi_true         1     1      6        4.37e+07     83     5.265e+05         45.793    1.0479e-0
    Phi_true_jmky    2     2      4      1.6482e+05     82          2010         45.787     0.000277
    ec19_jaeemk      3     3      6      4.3173e+07     82     5.265e+05     1.8058e+08         4.182
    ec19_jmky        4     4      4      1.6482e+05     82          2010     3.4272e+05         2.079
    ev19_jaeemk      5     5      6      4.3173e+07     82     5.265e+05    -1.4077e+08        -3.260
    ev19_jmky        6     6      4      1.6482e+05     82          2010    -4.0525e+05        -2.458
```

Differences between Checks in Expected Value and Expected Consumption

```
mn_V_U_gain_check = ev19_jmky_check2 - ev19_jmky_check0;
mn_MPC_U_gain_share_check = (ec19_jmky_check2 - ec19_jmky_check0)./(welf_checks*mp_params('TR'));
```

9.1.5 Dense Param Results Define Frames

Define the matrix dimensions names and dimension vector values. Policy and Value Functions share the same ND dimensional structure.

```
% Grids:
age_grid = 18:99;
marry_grid = [0,1];
kids_grid = (1:1:mp_params('n_kidsgrid'))';
inc_grid = mp_params('inc_grid');
cl_mp_datasetdesc = {};
cl_mp_datasetdesc{1} = containers.Map({'name', 'labval'}, {'age', age_grid});
cl_mp_datasetdesc{2} = containers.Map({'name', 'labval'}, {'marry', marry_grid});
cl_mp_datasetdesc{3} = containers.Map({'name', 'labval'}, {'kids', kids_grid});
cl_mp_datasetdesc{4} = containers.Map({'name', 'labval'}, {'ylower', inc_grid});
```

9.1.6 Analyze Marginal Value and MPC over Y(a,eta), Conditional On Kids, Marry, Age, Education

Income is generated by savings and shocks, what are the income levels generated by all the shock and savings points conditional on kids, marital status, age and educational levels. Plot on the Y axis MPC, and plot on the X axis income levels, use colors to first distinguish between different a levels, then use colors to distinguish between different eta levles.

Set Up date, Select Age 37, unmarried, no kids, lower education:

```
% NaN(n_jgrid,n_agrid,n_etagrid,n_educgrid,n_marriedgrid,n_kidsgrid);
% 38 year old, unmarried, no kids, lower educated
% Only Household Head Shock Matters so select up to 'n_eta_H_grid'
mn_V_W_gain_check_use = ev19_jmky_check2 - ev19_jmky_check0;
mn_C_W_gain_check_use = ec19_jmky_check2 - ec19_jmky_check0;
```

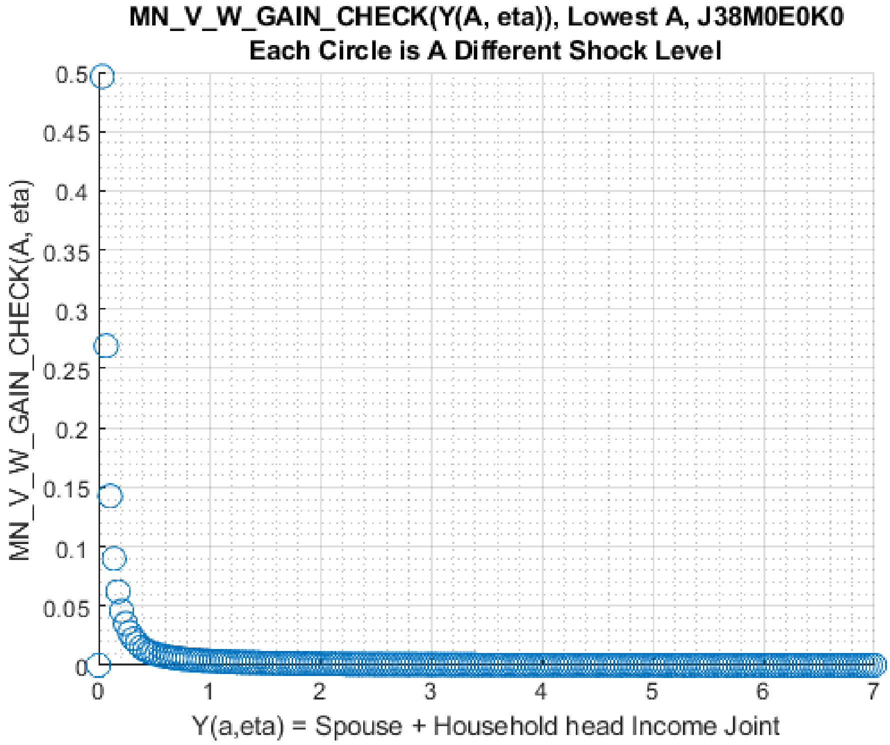
Select Age, Education, Marital, Kids Count:s

```
% Selections
it_age = 21; % +18
it_marital = 1; % 1 = unmarried
it_kids = 1; % 1 = kids is zero
% Select: NaN(n_jgrid-1,n_marriedgrid,n_kidsgrid,n_incgrid);
mn_C_W_gain_check_jemk = mn_C_W_gain_check_use(it_age, it_marital, it_kids, :);
mn_V_W_gain_check_jemk = mn_V_W_gain_check_use(it_age, it_marital, it_kids, :);
% Reshape, so shock is the first dim, a is the second
ar_C_W_gain_check_jemk = mn_C_W_gain_check_jemk(:);
ar_V_W_gain_check_jemk = mn_V_W_gain_check_jemk(:);
```

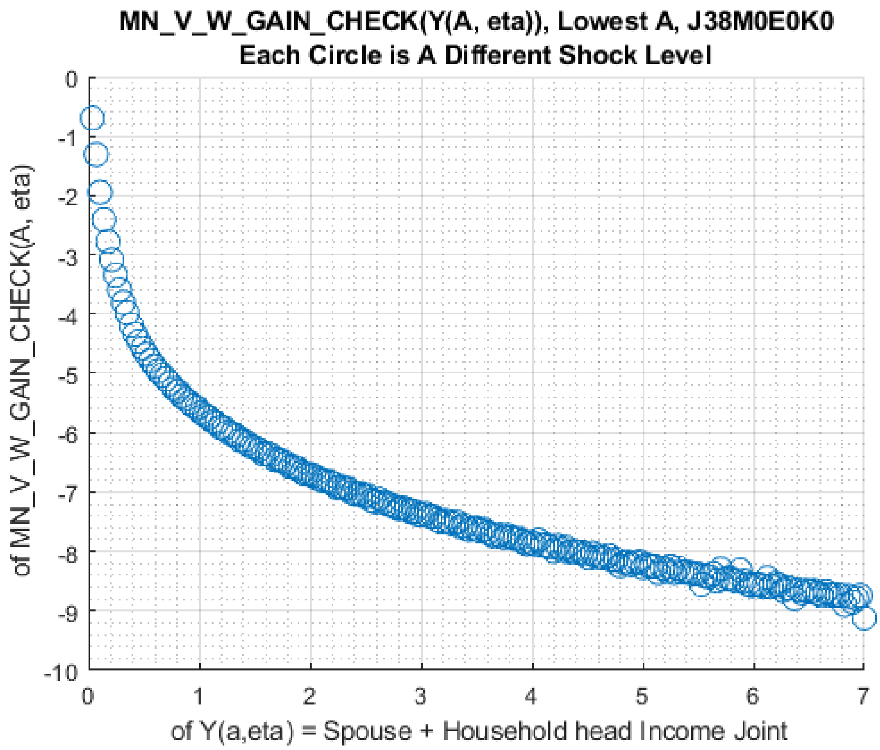
Marginal Value Gains, Color as Shock, Conditional on Age, Marital, Kids, and Education

How do shocks and a impact marginal value. First plot one asset level, variation comes only from increasingly higher shocks:

```
figure();
scatter(inc_grid, ar_V_W_gain_check_jemk, 100);
title({'MN\_V\_W\_GAIN\_CHECK(Y(A, eta)), Lowest A, J38M0E0K0', ...
    'Each Circle is A Different Shock Level'});
xlabel('Y(a,eta) = Spouse + Household head Income Joint');
ylabel('MN\_V\_W\_GAIN\_CHECK(A, eta)');
grid on;
grid minor;
```



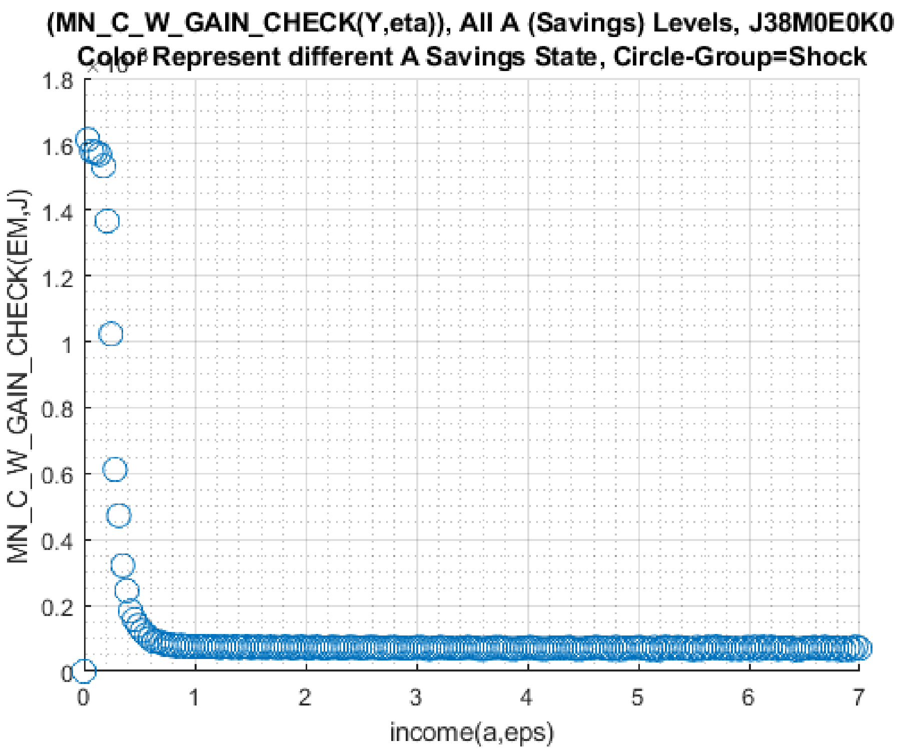

```
figure();
it_shock = 1;
scatter((inc_grid), log(ar_V_W_gain_check_jemk), 100);
title({'MN\_V\_W\_GAIN\_CHECK(Y(A, eta)), Lowest A, J38M0E0K0', ...
    'Each Circle is A Different Shock Level'});
xlabel(' of Y(a,eta) = Spouse + Household head Income Joint');
ylabel(' of MN\_V\_W\_GAIN\_CHECK(A, eta)');
grid on;
grid minor;
```



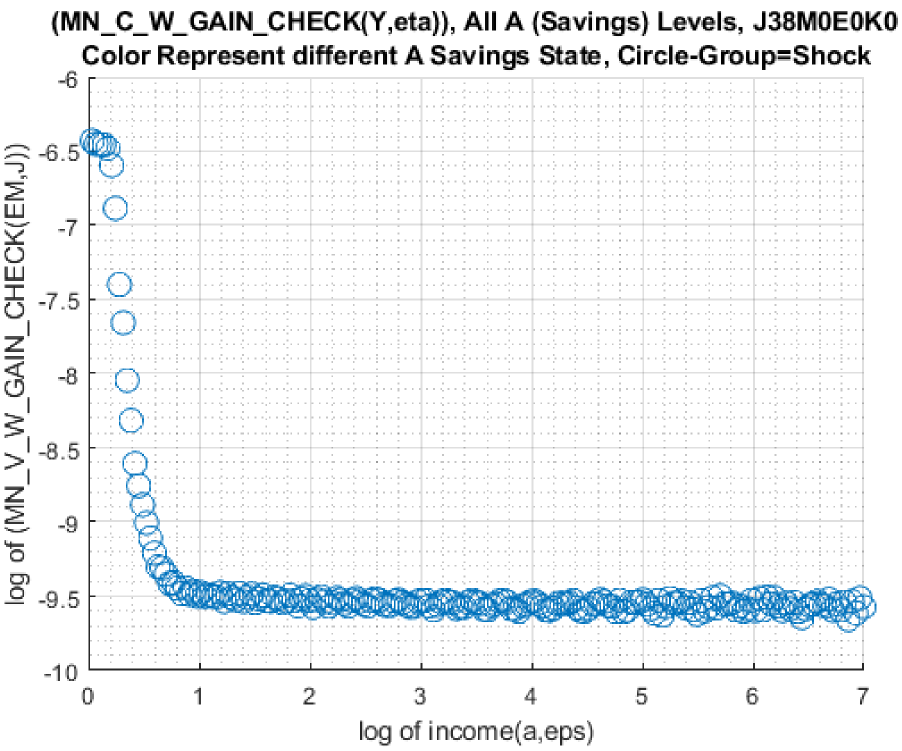
Marginal Consumption Gains, Color as Shock, Conditional on Age, Marital, Kids, and Education

Plot all asset levels:

```
figure();
scatter(inc_grid, ar_C_W_gain_check_jemk, 100);
title({'(MN\_C\_W\_GAIN\_CHECK(Y,eta)), All A (Savings) Levels, J38M0E0K0', ...
    'Color Represent different A Savings State, Circle-Group=Shock'});
xlabel('income(a,eps)');
ylabel('MN\_C\_W\_GAIN\_CHECK(EM,J)');
grid on;
grid minor;
```




```
figure();
scatter((inc_grid), log(ar_C_W_gain_check_jemk), 100);
title({'(MN\_C\_W\_GAIN\_CHECK(Y,eta)), All A (Savings) Levels, J38M0E0K0', ...
    'Color Represent different A Savings State, Circle-Group=Shock'});
xlabel('log of income(a,eps)');
ylabel('log of (MN\_V\_W\_GAIN\_CHECK(EM,J))');
grid on;
grid minor;
```



9.2 2019 Age, Income, Kids, Marry EV and EC All Checks

This is the example vignette for function: **snw_evuvw19_jmky_allchecks** from the **PrjOptiSNW Package.** 2019 integrated over VU and VW

9.2.1 Test SNW_EVUVW19_JMKY_ALLCHECKS Parameters

Save a result that is low in memory cost so that it can be loaded quickly for various allocation tests. Turn off Various Printing Controls. Call function with wide income bins to reduce memory storage and retrievel costs

```
clear all;
% Start mp contorls
mp_controls = snw_mp_control('default_test');
% Solve for Unemployment Values
mp_controls('bl_timer') = true;
mp_controls('bl_print_vfi') = false;
mp_controls('bl_print_vfi_verbose') = false;
mp_controls('bl_print_ds') = false;
mp_controls('bl_print_ds_verbose') = true;
mp_controls('bl_print_precompute') = false;
mp_controls('bl_print_precompute_verbose') = false;
mp_controls('bl_print_a4chk') = false;
mp_controls('bl_print_a4chk_verbose') = false;
mp_controls('bl_print_evuvw20_jaeemk') = false;
mp_controls('bl_print_evuvw20_jaeemk_verbose') = false;
mp_controls('bl_print_evuvw19_jaeemk') = false;
mp_controls('bl_print_evuvw19_jaeemk_verbose') = false;
mp_controls('bl_print_evuvw19_jmky') = false;
mp_controls('bl_print_evuvw19_jmky_verbose') = false;
```

Dense default, and unemployment parameters:

```
% default dense load
```

```
% mp_params = snw_mp_param('default_dense');
mp_params = snw_mp_param('default_docdense');
% Unemployment
xi=0.5; % Proportional reduction in income due to unemployment (xi=0 refers to 0 labor income; xi=1
b=0; % Unemployment insurance replacement rate (b=0 refers to no UI benefits; b=1 refers to 100 perc
TR=100/58056; % Value of a wezlfare check (can receive multiple checks). TO DO: Update with alternat
mp_params('xi') = xi;
mp_params('b') = b;
mp_params('TR') = TR;
% Check Count: 89 checks to allow for both the first and the second round
n_welfchecksgrid = 3;
mp_params('n_welfchecksgrid') = n_welfchecksgrid;
mp_params('a2_covidyr') = mp_params('a2_covidyr_manna_heaven');
```

Income bins:

```
% Income Grid
% 4 refers to 4*58056=232224 dollars in 2012USD
% max 7 refers to 7*58056=406392 dollars in 2012USD
% all phase out = (4400/5)*100 + 150000 = 238000
% if 500 dollar interval, need 476 inc groups before 238000
% if have 85 percent of points betwen 238000,
fl_max_phaseout = 238000;
fl_multiple = 58056;
it_bin_dollar_before_phaseout = 5000;
it_bin_dollar_after_phaseout = 25000;
fl_thres = fl_max_phaseout/fl_multiple;
inc_grid1 = linspace(0,fl_thres,(fl_max_phaseout)/it_bin_dollar_before_phaseout);
inc_grid2 = linspace(fl_thres, 7, (7*fl_multiple-fl_max_phaseout)/it_bin_dollar_after_phaseout);
inc_grid=sort(unique([inc_grid1 inc_grid2]'));
mp_params('n_incgrid') = length(inc_grid);
mp_params('inc_grid') = inc_grid;
```

9.2.2 SNW_EVUVW19_JMKY_ALLCHECKS Low Storage Invoke

The simulation here (dense) requires less than 10 GB of memory with 8 workers (8 threads needed), simulating over 88 checks takes with 8 workers

```
st_solu_type = 'bisec_vec';
bl_parfor = false;
it_workers = 1;
bl_export = false;
bl_load_mat = false;
snm_suffix = ['_test_ybin' num2str(it_bin_dollar_before_phaseout)];
[ev19_jmky_allchecks, ec19_jmky_allchecks, output] = ...
    snw_evuvw19_jmky_allchecks(mp_params, mp_controls, st_solu_type, ...
    bl_parfor, it_workers, ...
    bl_export, bl_load_mat, snm_suffix);

Completed SNW_VFI_MAIN_BISEC_VEC;SNW_MP_PARAM=default_docdense;SNW_MP_CONTROL=default_test;time=331.
Completed SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock;SNW_MP_PARAM=default_docdense;SNW_MP_CONTROL=d
Completed SNW_DS_MAIN_VEC;SNW_MP_PARAM=default_docdense;SNW_MP_CONTROL=default_test;time=916.1458
Wage quintile cutoffs=0.4645     0.71528      1.0335      1.5632
Completed SNW_HH_PRECOMPUTE;SNW_MP_PARAM=default_docdense;SNW_MP_CONTROL=default_test;time cost=361.
SNW_EVUVW19_JMKY_MASS Start
Completed SNW_EVUVW19_JMKY_MASS;SNW_MP_PARAM=default_docdense;SNW_MP_CONTROL=default_test;time=5.503
----------------------------------------
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
CONTAINER NAME: mp_outcomes ND Array (Matrix etc)
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
```

```
                    i    idx    ndim     numel      rowN      colN        sum        mean       --
                    -    ---    ----    --------    ----    ---------    ------    ----------   --

    Phi_true        1     1      6      4.37e+07     83     5.265e+05    45.793    1.0479e-06   1.
    Phi_true_jmky   2     2      4         42640     82           520    45.787     0.0010738   0.

SNW_EVUVW19_JMKY_ALLCHECKS Start
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
Completed SNW_A4CHK_WRK_BISEC_VEC;welf_checks=0;TR=0.0017225;SNW_MP_PARAM=default_docdense;SNW_MP_CO
Completed SNW_A4CHK_UNEMP_BISEC_VEC;welf_checks=0;TR=0.0017225;xi=0.5;b=0;SNW_MP_PARAM=default_docde
Completed SNW_EVUVW20_JAEEMK;SNW_MP_PARAM=default_docdense;SNW_MP_CONTROL=default_test;timeEUEC=8.73
Completed SNW_EVUVW19_JAEEMK_FOC;SNW_MP_PARAM=default_docdense;SNW_MP_CONTROL=default_test;time=14.7
Completed SNW_EVUVW19_JMKY;SNW_MP_PARAM=default_docdense;SNW_MP_CONTROL=default_test;time=11.4225
SNW_EVUVW19_JMKY_ALLCHECKS: Finished Check 0 of 2, time=188.6232
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
Completed SNW_A4CHK_WRK_BISEC_VEC;welf_checks=1;TR=0.0017225;SNW_MP_PARAM=default_docdense;SNW_MP_CO
Completed SNW_A4CHK_UNEMP_BISEC_VEC;welf_checks=1;TR=0.0017225;xi=0.5;b=0;SNW_MP_PARAM=default_docde
Completed SNW_EVUVW20_JAEEMK;SNW_MP_PARAM=default_docdense;SNW_MP_CONTROL=default_test;timeEUEC=8.38
Completed SNW_EVUVW19_JAEEMK_FOC;SNW_MP_PARAM=default_docdense;SNW_MP_CONTROL=default_test;time=14.8
Completed SNW_EVUVW19_JMKY;SNW_MP_PARAM=default_docdense;SNW_MP_CONTROL=default_test;time=11.4378
SNW_EVUVW19_JMKY_ALLCHECKS: Finished Check 1 of 2, time=189.5593
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
Completed SNW_A4CHK_WRK_BISEC_VEC;welf_checks=2;TR=0.0017225;SNW_MP_PARAM=default_docdense;SNW_MP_CO
Completed SNW_A4CHK_UNEMP_BISEC_VEC;welf_checks=2;TR=0.0017225;xi=0.5;b=0;SNW_MP_PARAM=default_docde
Completed SNW_EVUVW20_JAEEMK;SNW_MP_PARAM=default_docdense;SNW_MP_CONTROL=default_test;timeEUEC=8.12
Completed SNW_EVUVW19_JAEEMK_FOC;SNW_MP_PARAM=default_docdense;SNW_MP_CONTROL=default_test;time=14.8
Completed SNW_EVUVW19_JMKY;SNW_MP_PARAM=default_docdense;SNW_MP_CONTROL=default_test;time=10.9041
SNW_EVUVW19_JMKY_ALLCHECKS: Finished Check 2 of 2, time=188.6191
Completed SNW_EVUVW19_JMKY_ALLCHECKS;SNW_MP_PARAM=default_docdense;SNW_MP_CONTROL=default_test;time=
----------------------------------------
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
CONTAINER NAME: mp_outcomes ND Array (Matrix etc)
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
                                   i    idx    ndim      numel         rowN        colN        sum
                                   -    ---    ----    ----------    ----------    -----    --------

    Output                         1     1      2      1.0307e+06    1.1452e+05      9       6.804e
    ec19_jmky_allchecks            2     2      5      1.2792e+05             3    42640    2.6964e
    ec19_jmky_allchecks_posmass    3     3      2      1.1452e+05    1.1452e+05      1      2.6964e
    ev19_jmky_allchecks            4     4      5      1.2792e+05             3    42640   -8.4257e
    ev19_jmky_allchecks_posmass    5     5      2      1.1452e+05    1.1452e+05      1     -8.4257e

xxx TABLE:Output xxxxxxxxxxxxxxxxxx
              c1    c2    c3    c4        c6           c7          c8          c9
              --    --    --    --    ----------    --------    -------    --------

    r1        18    0     0     0     2.9349e-05    -0.57722    -204.67    0.069778
    r2        18    0     0     1     2.9349e-05    -0.57722    -204.21     0.07068
    r3        18    0     0     2     2.9349e-05    -0.57722    -203.76     0.07159
    r4        19    0     0     0     2.5821e-05     0.42278    -196.02     0.07008
    r5        19    0     0     1     2.5821e-05     0.42278    -195.57    0.071671
    r114518   87    1     4     1      1.897e-42      4.2413     3.8911      14.055
    r114519   87    1     4     2      1.897e-42      4.2413     3.8911      14.055
    r114520   88    1     4     0     1.5306e-60      4.2556     3.7289      15.409
    r114521   88    1     4     1     1.5306e-60      4.2556     3.7289      15.409
    r114522   88    1     4     2     1.5306e-60      4.2556     3.7289      15.409

xxx TABLE:ec19_jmky_allchecks xxxxxxxxxxxxxxxxxx
```

	c1	c2	c3	c4	c42637	c42638	c42639	c42640
	--------	--------	--------	--------	------	------	------	------
r1	0.069778	0.07008	0.073462	0.07559	0	0	0	0
r2	0.07068	0.071671	0.075078	0.077198	0	0	0	0
r3	0.07159	0.073241	0.076648	0.078753	0	0	0	0

xxx TABLE:ec19_jmky_allchecks_posmass xxxxxxxxxxxxxxxxxx

	c1
	--------
r1	0.069778
r2	0.07068
r3	0.07159
r4	0.07008
r5	0.071671
r114518	14.055
r114519	14.055
r114520	15.409
r114521	15.409
r114522	15.409

xxx TABLE:ev19_jmky_allchecks xxxxxxxxxxxxxxxxxx

	c1	c2	c3	c4	c42637	c42638	c42639	c42640
	-------	-------	-------	-------	------	------	------	------
r1	-204.67	-196.02	-187.61	-184.45	0	0	0	0
r2	-204.21	-195.57	-187.2	-184.07	0	0	0	0
r3	-203.76	-195.13	-186.8	-183.69	0	0	0	0

xxx TABLE:ev19_jmky_allchecks_posmass xxxxxxxxxxxxxxxxxx

	c1
	-------
r1	-204.67
r2	-204.21
r3	-203.76
r4	-196.02
r5	-195.57
r114518	3.8911
r114519	3.8911
r114520	3.7289
r114521	3.7289
r114522	3.7289

Chapter 10

Taxes

10.1 Compute for Equilibrium Tax

Taking advantage of **snw_calibrate_beta_norm_gdp** from the **PrjOptiSNW Package**, this function solves for equilibrium tax rate.

10.1.1 Parameter Controls

```
clear all;
mp_params = snw_mp_param('default_docdense');
xi=0; % Proportional reduction in income due to unemployment (xi=0 refers to 0 labor income; xi=1 re
b=1; % Unemployment insurance replacement rate (b=0 refers to no UI benefits; b=1 refers to 100 perc
mp_params('xi') = xi;
mp_params('b') = b;
mp_controls = snw_mp_control('default_test');
```

Parameters for COVID related Costs:

```
% Average check per household, given COVID actual policy payment schedule
% And given distribution. The number is from averaging over the actual
% allocations given distribution.
Covid_checks_per_capita = 18.7255856*100/58056;
% Covid_checks_per_capita = 0;
% which tax parameter to change a2 is the deafult, a0 shifts max tax rate
bl_adjust_a0 = false;
bl_load_existing = false;
```

Graph Controls etc:

```
mp_controls('bl_timer') = true;
mp_controls('bl_print_vfi') = false;
mp_controls('bl_print_vfi_verbose') = false;
mp_controls('bl_print_ds') = false;
mp_controls('bl_print_ds_verbose') = false;
mp_controls('bl_print_find_tax_rate') = true;
mp_controls('bl_print_find_tax_rate_verbose') = true;
```

10.1.2 Solve for New Tax Rate

Solve for Equilibrium Tax rate that clears government costs and income. In the extreme bounding exercise, we assume the government will pay COVID costs all in one year. This is to test whether an extreme tax scenario will lead to changes in allocation results.

Given the checks that the government hands out and the taxes imposed, individual resources post-tax are different in 2020. Households' savings decisions in 2020 vary with taxes and checks. However, the policy function post 2020 shifts back to thte previous non-COVID world's policy function because the COVID shock is an one period surprise shock.

```
a2 = snw_find_tax_rate(mp_params, mp_controls, Covid_checks_per_capita, bl_adjust_a0, bl_load_existi
```

```
Completed SNW_VFI_MAIN_BISEC_VEC;SNW_MP_PARAM=default_docdense;SNW_MP_CONTROL=default_test;time=319.
Completed SNW_DS_MAIN_VEC;SNW_MP_PARAM=default_docdense;SNW_MP_CONTROL=default_test;time=919.8561
Wage quintile cutoffs=0.4645     0.71528      1.0335      1.5632
Y_inc_agg=64.7962
A_agg=194.5563
Y_inc_agg_per_capita_1=1.415
A_per_capita=4.2486
Gov_cons_per_capita=0.24869
Covid_checks_share_of_GDP=0.022795
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SNW_FIND_TAX_RATE: Aggregation, Finished Age Group:2 of 83, time-this-age:0.30409
SNW_FIND_TAX_RATE: Aggregation, Finished Age Group:3 of 83, time-this-age:0.30899
SNW_FIND_TAX_RATE: Aggregation, Finished Age Group:4 of 83, time-this-age:0.30567
SNW_FIND_TAX_RATE: Aggregation, Finished Age Group:5 of 83, time-this-age:0.30909
SNW_FIND_TAX_RATE: Aggregation, Finished Age Group:6 of 83, time-this-age:0.30687
SNW_FIND_TAX_RATE: Aggregation, Finished Age Group:7 of 83, time-this-age:0.3075
SNW_FIND_TAX_RATE: Aggregation, Finished Age Group:8 of 83, time-this-age:0.32568
SNW_FIND_TAX_RATE: Aggregation, Finished Age Group:9 of 83, time-this-age:0.30706
SNW_FIND_TAX_RATE: Aggregation, Finished Age Group:10 of 83, time-this-age:0.30656
SNW_FIND_TAX_RATE: Aggregation, Finished Age Group:11 of 83, time-this-age:0.30787
SNW_FIND_TAX_RATE: Aggregation, Finished Age Group:12 of 83, time-this-age:0.30388
SNW_FIND_TAX_RATE: Aggregation, Finished Age Group:13 of 83, time-this-age:0.30705
SNW_FIND_TAX_RATE: Aggregation, Finished Age Group:14 of 83, time-this-age:0.30526
SNW_FIND_TAX_RATE: Aggregation, Finished Age Group:15 of 83, time-this-age:0.30613
SNW_FIND_TAX_RATE: Aggregation, Finished Age Group:16 of 83, time-this-age:0.30936
SNW_FIND_TAX_RATE: Aggregation, Finished Age Group:17 of 83, time-this-age:0.30467
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SNW_FIND_TAX_RATE tax a2 or a0 adjustments;a2=11.6315;a0=0.258;err=0.0027222
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SNW_FIND_TAX_RATE tax a2 or a0 adjustments;a2=11.6775;a0=0.258;err=0.0026002
SNW_FIND_TAX_RATE tax a2 or a0 adjustments;a2=11.6998;a0=0.258;err=0.0025415
SNW_FIND_TAX_RATE tax a2 or a0 adjustments;a2=11.7217;a0=0.258;err=0.0024842
SNW_FIND_TAX_RATE tax a2 or a0 adjustments;a2=11.7431;a0=0.258;err=0.0024283
SNW_FIND_TAX_RATE tax a2 or a0 adjustments;a2=11.764;a0=0.258;err=0.0023738
SNW_FIND_TAX_RATE tax a2 or a0 adjustments;a2=11.7846;a0=0.258;err=0.0023207
SNW_FIND_TAX_RATE tax a2 or a0 adjustments;a2=11.8046;a0=0.258;err=0.0022688
SNW_FIND_TAX_RATE tax a2 or a0 adjustments;a2=11.8243;a0=0.258;err=0.0022182
SNW_FIND_TAX_RATE tax a2 or a0 adjustments;a2=11.8436;a0=0.258;err=0.0021688
SNW_FIND_TAX_RATE tax a2 or a0 adjustments;a2=11.8625;a0=0.258;err=0.0021206
SNW_FIND_TAX_RATE tax a2 or a0 adjustments;a2=11.8809;a0=0.258;err=0.0020735
SNW_FIND_TAX_RATE tax a2 or a0 adjustments;a2=11.899;a0=0.258;err=0.0020276
SNW_FIND_TAX_RATE tax a2 or a0 adjustments;a2=11.9168;a0=0.258;err=0.0019828
SNW_FIND_TAX_RATE tax a2 or a0 adjustments;a2=11.9341;a0=0.258;err=0.001939
SNW_FIND_TAX_RATE tax a2 or a0 adjustments;a2=11.9511;a0=0.258;err=0.0018963
SNW_FIND_TAX_RATE tax a2 or a0 adjustments;a2=11.9678;a0=0.258;err=0.0018546
SNW_FIND_TAX_RATE tax a2 or a0 adjustments;a2=11.9841;a0=0.258;err=0.0018138
SNW_FIND_TAX_RATE tax a2 or a0 adjustments;a2=12.0001;a0=0.258;err=0.0017741
SNW_FIND_TAX_RATE tax a2 or a0 adjustments;a2=12.0157;a0=0.258;err=0.0017352
SNW_FIND_TAX_RATE tax a2 or a0 adjustments;a2=12.031;a0=0.258;err=0.0016973
SNW_FIND_TAX_RATE tax a2 or a0 adjustments;a2=12.046;a0=0.258;err=0.0016602
SNW_FIND_TAX_RATE tax a2 or a0 adjustments;a2=12.0607;a0=0.258;err=0.001624
SNW_FIND_TAX_RATE tax a2 or a0 adjustments;a2=12.0751;a0=0.258;err=0.0015887
SNW_FIND_TAX_RATE tax a2 or a0 adjustments;a2=12.0892;a0=0.258;err=0.0015542
SNW_FIND_TAX_RATE tax a2 or a0 adjustments;a2=12.103;a0=0.258;err=0.0015204
SNW_FIND_TAX_RATE tax a2 or a0 adjustments;a2=12.1165;a0=0.258;err=0.0014875
SNW_FIND_TAX_RATE tax a2 or a0 adjustments;a2=12.1298;a0=0.258;err=0.0014552
SNW_FIND_TAX_RATE tax a2 or a0 adjustments;a2=12.1427;a0=0.258;err=0.0014238
```

```
SNW_FIND_TAX_RATE tax a2 or a0 adjustments;a2=12.1554;a0=0.258;err=0.001393
SNW_FIND_TAX_RATE tax a2 or a0 adjustments;a2=12.1679;a0=0.258;err=0.001363
SNW_FIND_TAX_RATE tax a2 or a0 adjustments;a2=12.1801;a0=0.258;err=0.0013336
SNW_FIND_TAX_RATE tax a2 or a0 adjustments;a2=12.192;a0=0.258;err=0.0013049
SNW_FIND_TAX_RATE tax a2 or a0 adjustments;a2=12.2037;a0=0.258;err=0.0012768
SNW_FIND_TAX_RATE tax a2 or a0 adjustments;a2=12.2151;a0=0.258;err=0.0012494
SNW_FIND_TAX_RATE tax a2 or a0 adjustments;a2=12.2263;a0=0.258;err=0.0012226
SNW_FIND_TAX_RATE tax a2 or a0 adjustments;a2=12.2373;a0=0.258;err=0.0011964
SNW_FIND_TAX_RATE tax a2 or a0 adjustments;a2=12.2481;a0=0.258;err=0.0011708
SNW_FIND_TAX_RATE tax a2 or a0 adjustments;a2=12.2586;a0=0.258;err=0.0011457
SNW_FIND_TAX_RATE tax a2 or a0 adjustments;a2=12.2689;a0=0.258;err=0.0011213
SNW_FIND_TAX_RATE tax a2 or a0 adjustments;a2=12.279;a0=0.258;err=0.0010973
SNW_FIND_TAX_RATE tax a2 or a0 adjustments;a2=12.2889;a0=0.258;err=0.0010739
SNW_FIND_TAX_RATE tax a2 or a0 adjustments;a2=12.2986;a0=0.258;err=0.001051
SNW_FIND_TAX_RATE tax a2 or a0 adjustments;a2=12.3081;a0=0.258;err=0.0010287
SNW_FIND_TAX_RATE tax a2 or a0 adjustments;a2=12.3174;a0=0.258;err=0.0010068
SNW_FIND_TAX_RATE tax a2 or a0 adjustments;a2=12.3265;a0=0.258;err=0.0009854
SNW_FIND_TAX_RATE tax a2 or a0 adjustments;a2=12.3355;a0=0.258;err=0.00096448
SNW_FIND_TAX_RATE tax a2 or a0 adjustments;a2=12.3442;a0=0.258;err=0.00094402
SNW_FIND_TAX_RATE tax a2 or a0 adjustments;a2=12.3528;a0=0.258;err=0.00092401
SNW_FIND_TAX_RATE tax a2 or a0 adjustments;a2=12.3612;a0=0.258;err=0.00090444
SNW_FIND_TAX_RATE tax a2 or a0 adjustments;a2=12.3694;a0=0.258;err=0.0008853
SNW_FIND_TAX_RATE tax a2 or a0 adjustments;a2=12.3774;a0=0.258;err=0.00086657
SNW_FIND_TAX_RATE tax a2 or a0 adjustments;a2=12.3853;a0=0.258;err=0.00084826
SNW_FIND_TAX_RATE tax a2 or a0 adjustments;a2=12.393;a0=0.258;err=0.00083035
```

Chapter 11

Calibration

11.1 Model Calibration

Taking advantage of **snw_calibrate_beta_norm_gdp** from the **PrjOptiSNW Package**, this function calibrates the discount factor and also solves for the normalizing constant.

11.1.1 Calibrate Parameter Controls for SNW Functions

Set up controls for shock process and tiny/small/dense/densemore

```
clear all;
bl_print_mp_params = false;
% st_shock_method = 'rouwenhorst';
st_shock_method = 'tauchen';
% st_param_group = 'default_tiny';
% st_param_group = 'default_small';
% st_param_group = 'default_base';
% st_param_group = 'default_dense';
% st_param_group = 'default_moredense';
st_param_group = 'default_docdense';
mp_params = snw_mp_param(st_param_group, bl_print_mp_params, st_shock_method);
Pop = mp_params('Pop');
```

Set up print defaults

```
mp_controls = snw_mp_control('default_test');
mp_controls('bl_timer') = true;
mp_controls('bl_print_vfi') = false;
mp_controls('bl_print_vfi_verbose') = false;
mp_controls('bl_print_ds') = false;
mp_controls('bl_print_ds_verbose') = false;
```

11.1.2 Calibrate Routine

Test this for 3 iterations

```
%% Calibration
err=1;
tol=0.005;
it_counter = 1;
while err>tol && it_counter <= 10
    disp('');
    it=1;

    while it>0
```

```
        % Solve optimization problem and get the distribution
        tm_start_a2 = tic;
        a2_old = mp_params('a2');
        [Phi_true,~,A_agg,Y_inc_agg,it,mp_dsvfi_results, a2] = snw_ds_main(mp_params, mp_controls);
        mp_params('a2') = a2;
        tm_end_a2 = toc(tm_start_a2);
        disp(['a2_old:' num2str(a2_old) ', a2_new:' num2str(a2) ', tm_end_a2:' num2str(tm_end_a2)])
    end

    % Get Stats
    mp_cl_mt_xyz_of_s = mp_dsvfi_results('mp_cl_mt_xyz_of_s');
    tb_outcomes = mp_cl_mt_xyz_of_s('tb_outcomes');
    A_agg_alt = tb_outcomes{'a_ss', 'mean'}*sum(Pop);
    Aprime_agg_alt = tb_outcomes{'ap_ss', 'mean'}*sum(Pop);
    Y_inc_agg_alt = tb_outcomes{'y_all', 'mean'}*sum(Pop);
    Y_inc_median = tb_outcomes{'y_all', 'p50'};

    % Comparison
    name='Median household income (target=1.0)=';
    name2=[name,num2str(Y_inc_median)];
    disp(name2);
    name='Aggregate wealth to aggregate income (target=3.0)=';
    name2=[name,num2str(A_agg/Y_inc_agg)];
    disp(name2);

    err1=abs(Y_inc_median-1.0); % Target: Median household income (normalized to 1 in the model)
    err2=abs((A_agg/Y_inc_agg)-3.0); % Target: Annual capital/income ratio of 3

    err=max(err1,err2);

    % Beta and Theta
    theta = mp_params('theta');
    beta = mp_params('beta');
    param_update=[theta;beta];

    if err>tol

        theta=theta*((1.0/Y_inc_median)^0.2); % Normalize theta such that median household income eq
        beta=beta*((3.0/(A_agg/Y_inc_agg))^0.025); % Calibrate beta such that annual capital/income

    end
    mp_params('theta') = theta;
    mp_params('beta') = beta;

    param_update=[param_update(1,1),theta;param_update(2,1),beta];

    it_counter = it_counter + 1;
    name='Old/updated theta:';
    st_theta=[name, num2str(param_update(1,:))];
    name='Old/updated beta:';
    st_beta=[name,num2str(param_update(2,:))];
    disp(['counter=' num2str(it_counter) ...
        ';beta=' num2str(beta) ...
        ';theta=' num2str(theta)]);
end

Completed SNW_VFI_MAIN_BISEC_VEC;SNW_MP_PARAM=default_docdense;SNW_MP_CONTROL=default_test;time=568.
```

```
Completed SNW_DS_MAIN;SNW_MP_PARAM=default_docdense;SNW_MP_CONTROL=default_test;time=2318.9782
a2_old:1.5286, a2_new:1.5286, tm_end_a2:3102.469
Median household income (target=1.0)=0.99853
Aggregate wealth to aggregate income (target=3.0)=3.0026
counter=2;beta=0.97116;theta=0.56523
```

Chapter 12

Summary Statistics

12.1 2019 Full States MPC and Distributional Statistics by Marital, Kids, and Income Groups.

In the file here, we consider marital, kids and income groups, and summarize various statistics for each bin.

12.1.1 Test SNW_EVUVW19_JAEEMK Defaults Dense

VFI and Distribution

Call the function with defaults.

```
clear all;
st_solu_type = 'bisec_vec';
bl_save_csv = false;

% Solve the VFI Problem and get Value Function
% mp_params = snw_mp_param('default_dense');
% mp_params = snw_mp_param('default_docdense');
mp_params = snw_mp_param('default_moredense_a65zh133zs5_e2m2');
mp_controls = snw_mp_control('default_test');

% set Unemployment Related Variables
xi=0.5; % Proportional reduction in income due to unemployment (xi=0 refers to 0 labor income; xi=1
b=1; % Unemployment insurance replacement rate (b=0 refers to no UI benefits; b=1 refers to 100 perc
TR=100/58056; % Value of a welfare check (can receive multiple checks). TO DO: Update with alternati

mp_params('xi') = xi;
mp_params('b') = b;
mp_params('TR') = TR;

% Solve for Unemployment Values
mp_controls('bl_print_vfi') = false;
mp_controls('bl_print_vfi_verbose') = false;
mp_controls('bl_print_ds') = true;
mp_controls('bl_print_ds_verbose') = true;
mp_controls('bl_print_precompute') = false;
mp_controls('bl_print_precompute_verbose') = false;
mp_controls('bl_print_a4chk') = false;
mp_controls('bl_print_a4chk_verbose') = false;
mp_controls('bl_print_evuvw20_jaeemk') = false;
mp_controls('bl_print_evuvw20_jaeemk_verbose') = false;
```

```
mp_controls('bl_print_evuvw19_jaeemk') = false;
mp_controls('bl_print_evuvw19_jaeemk_verbose') = false;

% Solve the Model to get V working and unemployed
[V_ss,ap_ss,cons_ss,mp_valpol_more_ss] = snw_vfi_main_bisec_vec(mp_params, mp_controls);

Completed SNW_VFI_MAIN_BISEC_VEC;SNW_MP_PARAM=default_moredense_a65zh133zs5_e2m2;SNW_MP_CONTROL=defa

inc_VFI = mp_valpol_more_ss('inc_VFI');
spouse_inc_VFI = mp_valpol_more_ss('spouse_inc_VFI');
total_inc_VFI = inc_VFI + spouse_inc_VFI;
% tax during covid year
mp_params('a2_covidyr') = mp_params('a2_covidyr_manna_heaven');
% Solve unemployment
[V_unemp,~,cons_unemp,~] = snw_vfi_main_bisec_vec(mp_params, mp_controls, V_ss);

Completed SNW_VFI_MAIN_BISEC_VEC 1 Period Unemp Shock;SNW_MP_PARAM=default_moredense_a65zh133zs5_e2m

[Phi_true, Phi_adj, A_agg, Y_inc_agg, ~, mp_dsvfi_results] = snw_ds_main_vec(mp_params, mp_controls,

SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:1 of 82, time-this-age:1.074
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:2 of 82, time-this-age:20.5148
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:3 of 82, time-this-age:23.4908
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:4 of 82, time-this-age:28.525
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:5 of 82, time-this-age:33.2054
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:6 of 82, time-this-age:35.3197
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:7 of 82, time-this-age:37.5611
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:8 of 82, time-this-age:40.226
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:9 of 82, time-this-age:44.3653
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:10 of 82, time-this-age:48.3751
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:11 of 82, time-this-age:49.4182
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:12 of 82, time-this-age:50.6325
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:13 of 82, time-this-age:51.0802
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:14 of 82, time-this-age:52.1717
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:15 of 82, time-this-age:53.2068
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:16 of 82, time-this-age:53.6567
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:17 of 82, time-this-age:53.8811
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:18 of 82, time-this-age:55.0892
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:19 of 82, time-this-age:55.6717
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:20 of 82, time-this-age:56.2143
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:21 of 82, time-this-age:56.5704
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:22 of 82, time-this-age:57.0081
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:23 of 82, time-this-age:57.1682
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:24 of 82, time-this-age:57.3671
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:25 of 82, time-this-age:57.5453
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:26 of 82, time-this-age:57.8356
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:27 of 82, time-this-age:58.0491
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:28 of 82, time-this-age:57.9265
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:29 of 82, time-this-age:57.6332
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:30 of 82, time-this-age:58.1269
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:31 of 82, time-this-age:57.7606
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:32 of 82, time-this-age:57.5816
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:33 of 82, time-this-age:57.3361
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:34 of 82, time-this-age:57.7288
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:35 of 82, time-this-age:56.9154
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:36 of 82, time-this-age:57.2866
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:37 of 82, time-this-age:57.1634
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:38 of 82, time-this-age:57.0388
```

```
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:39 of 82, time-this-age:56.6859
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:40 of 82, time-this-age:56.7277
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:41 of 82, time-this-age:56.9976
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:42 of 82, time-this-age:56.6711
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:43 of 82, time-this-age:56.7355
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:44 of 82, time-this-age:56.6671
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:45 of 82, time-this-age:56.1114
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:46 of 82, time-this-age:55.9357
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:47 of 82, time-this-age:55.9514
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:48 of 82, time-this-age:55.4533
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:49 of 82, time-this-age:58.5505
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:50 of 82, time-this-age:59.402
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:51 of 82, time-this-age:59.5814
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:52 of 82, time-this-age:59.4987
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:53 of 82, time-this-age:59.3449
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:54 of 82, time-this-age:59.6498
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:55 of 82, time-this-age:59.3396
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:56 of 82, time-this-age:59.4903
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:57 of 82, time-this-age:59.4659
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:58 of 82, time-this-age:59.2382
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:59 of 82, time-this-age:58.2574
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:60 of 82, time-this-age:58.4884
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:61 of 82, time-this-age:58.2825
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:62 of 82, time-this-age:57.4508
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:63 of 82, time-this-age:56.9986
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:64 of 82, time-this-age:56.5337
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:65 of 82, time-this-age:55.94
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:66 of 82, time-this-age:54.1804
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:67 of 82, time-this-age:53.4807
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:68 of 82, time-this-age:52.222
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:69 of 82, time-this-age:51.6643
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:70 of 82, time-this-age:50.7393
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:71 of 82, time-this-age:49.5324
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:72 of 82, time-this-age:47.7517
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:73 of 82, time-this-age:45.9439
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:74 of 82, time-this-age:44.385
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:75 of 82, time-this-age:42.9
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:76 of 82, time-this-age:41.3804
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:77 of 82, time-this-age:35.089
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:78 of 82, time-this-age:33.9143
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:79 of 82, time-this-age:32.9597
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:80 of 82, time-this-age:26.3587
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:81 of 82, time-this-age:25.2198
SNW_DS_MAIN_VEC ACUMU MASS: Finished Age Group:82 of 82, time-this-age:22.8558
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:1 of 82, time-this-age:0.50074
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:2 of 82, time-this-age:0.078102
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:3 of 82, time-this-age:0.077705
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:4 of 82, time-this-age:0.077939
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:5 of 82, time-this-age:0.07796
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:6 of 82, time-this-age:0.078664
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:7 of 82, time-this-age:0.077012
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:8 of 82, time-this-age:0.077566
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:9 of 82, time-this-age:0.076968
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:10 of 82, time-this-age:0.076874
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:11 of 82, time-this-age:0.07674
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:12 of 82, time-this-age:0.07736
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:13 of 82, time-this-age:0.07804
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:14 of 82, time-this-age:0.077614
```

```
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:15 of 82, time-this-age:0.076794
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:16 of 82, time-this-age:0.077524
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:17 of 82, time-this-age:0.077125
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:18 of 82, time-this-age:0.076024
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:19 of 82, time-this-age:0.074863
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:20 of 82, time-this-age:0.07631
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:21 of 82, time-this-age:0.073418
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:22 of 82, time-this-age:0.073802
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:23 of 82, time-this-age:0.073525
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:24 of 82, time-this-age:0.073143
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:25 of 82, time-this-age:0.073793
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:26 of 82, time-this-age:0.073628
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:27 of 82, time-this-age:0.074547
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:28 of 82, time-this-age:0.074412
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:29 of 82, time-this-age:0.074226
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:30 of 82, time-this-age:0.073869
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:31 of 82, time-this-age:0.072886
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:32 of 82, time-this-age:0.074226
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:33 of 82, time-this-age:0.073236
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:34 of 82, time-this-age:0.074885
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:35 of 82, time-this-age:0.073514
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:36 of 82, time-this-age:0.073964
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:37 of 82, time-this-age:0.07539
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:38 of 82, time-this-age:0.073973
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:39 of 82, time-this-age:0.073071
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:40 of 82, time-this-age:0.073901
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:41 of 82, time-this-age:0.073413
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:42 of 82, time-this-age:0.074556
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:43 of 82, time-this-age:0.07319
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:44 of 82, time-this-age:0.073482
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:45 of 82, time-this-age:0.073433
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:46 of 82, time-this-age:0.073574
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:47 of 82, time-this-age:0.073129
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:48 of 82, time-this-age:0.073958
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:49 of 82, time-this-age:0.07419
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:50 of 82, time-this-age:0.07333
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:51 of 82, time-this-age:0.073146
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:52 of 82, time-this-age:0.07345
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:53 of 82, time-this-age:0.073098
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:54 of 82, time-this-age:0.073673
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:55 of 82, time-this-age:0.072706
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:56 of 82, time-this-age:0.073966
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:57 of 82, time-this-age:0.073423
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:58 of 82, time-this-age:0.073912
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:59 of 82, time-this-age:0.073841
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:60 of 82, time-this-age:0.073261
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:61 of 82, time-this-age:0.073155
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:62 of 82, time-this-age:0.074912
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:63 of 82, time-this-age:0.076206
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:64 of 82, time-this-age:0.073746
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:65 of 82, time-this-age:0.072696
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:66 of 82, time-this-age:0.073178
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:67 of 82, time-this-age:0.073645
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:68 of 82, time-this-age:0.073697
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:69 of 82, time-this-age:0.073477
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:70 of 82, time-this-age:0.075493
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:71 of 82, time-this-age:0.073607
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:72 of 82, time-this-age:0.073559
```

```
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:73 of 82, time-this-age:0.073002
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:74 of 82, time-this-age:0.073612
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:75 of 82, time-this-age:0.073039
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:76 of 82, time-this-age:0.073474
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:77 of 82, time-this-age:0.073582
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:78 of 82, time-this-age:0.076234
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:79 of 82, time-this-age:0.073668
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:80 of 82, time-this-age:0.073745
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:81 of 82, time-this-age:0.073108
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:82 of 82, time-this-age:0.072892
SNW_DS_MAIN NORMALIZE MASS: Finished Age Group:83 of 82, time-this-age:0.073316
SNW_DS_MAIN: Share of population with assets equal to upper bound on asset grid:6.0111e-06
SNW_DS_MAIN: Accidental bequests are thrown in the ocean
SNW_DS_MAIN_VEC tax and spend;it=1;err=0.0010205
SNW_DS_MAIN_VEC tax and spend;it=2;err=0.0008547
SNW_DS_MAIN_VEC tax and spend;it=3;err=0.0007159
SNW_DS_MAIN_VEC tax and spend;it=4;err=0.00059969
SNW_DS_MAIN_VEC tax and spend;it=5;err=0.00050237
SNW_DS_MAIN_VEC tax and spend;it=6;err=0.00042087
SNW_DS_MAIN_VEC tax and spend;it=7;err=0.00035261
SNW_DS_MAIN_VEC tax and spend;it=8;err=0.00029542
SNW_DS_MAIN_VEC tax and spend;it=9;err=0.00024752
SNW_DS_MAIN_VEC tax and spend;it=10;err=0.0002074
SNW_DS_MAIN_VEC tax and spend;it=11;err=0.00017378
SNW_DS_MAIN_VEC tax and spend;it=12;err=0.00014561
SNW_DS_MAIN_VEC tax and spend;it=13;err=0.00012201
SNW_DS_MAIN_VEC tax and spend;it=14;err=0.00010224
SNW_DS_MAIN_VEC tax and spend;it=15;err=8.567e-05
SNW_DS_MAIN_VEC: Number of a2-adjustments (for taxation) used to balance the government budget= 15
SNW_DS_MAIN_VEC: Old and updated value of a2=1.5286      1.5353
SNW_DS_MAIN_VEC: Aggregates: Cons., Gov. cons., Save, Assets, Income, Bequests 48.78871      11.3586
SNW_DS_MAIN_VEC: Resource constraint: C_t+A_{t+1}+G_t=A_t+Y_t 258.0346      258.0206
Completed SNW_DS_MAIN_VEC;SNW_MP_PARAM=default_moredense_a65zh133zs5_e2m2;SNW_MP_CONTROL=default_tes
pos = 19 ; key = mp_controls
  Map with properties:

        Count: 37
      KeyType: char
    ValueType: any

pos = 20 ; key = mp_params
  Map with properties:

        Count: 52
      KeyType: char
    ValueType: any

----------------------------------------
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
CONTAINER NAME: mp_dsvfi_results ND Array (Matrix etc)
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
                        i     idx    ndim      numel       rowN      colN          sum         mean
                        --    ---    ----    ----------    ----    ---------    ----------    ------

    SS_ss               1     11      6      7.1754e+07     83     8.645e+05    8.3556e+06     0.116
    a_ss                2     16      6      7.1754e+07     83     8.645e+05    2.4595e+09      34.2
    ap_ss               3     17      6      7.1754e+07     83     8.645e+05    2.3245e+09      32.3
    cons_ss             4     18      6      7.1754e+07     83     8.645e+05    3.5119e+08      4.89
```

```
    n_ss                  5    21       6      7.1754e+07      83      8.645e+05    2.5114e+08         3
    tax_ss                6    22       6      7.1754e+07      83      8.645e+05    6.6049e+07      0.92
    y_all_ss              7    23       6      7.1754e+07      83      8.645e+05    2.8219e+08      3.93
    y_head_earn_ss        8    24       6      7.1754e+07      83      8.645e+05     1.078e+08      1.50
    y_head_inc_ss         9    25       6      7.1754e+07      83      8.645e+05    2.1454e+08        2.
    y_spouse_inc_ss      10    26       6      7.1754e+07      83      8.645e+05    6.7646e+07     0.942
    yshr_SS_ss           11    27       6      7.1754e+07      83      8.645e+05    1.0586e+07     0.147
    yshr_interest_ss     12    28       6      7.1754e+07      83      8.645e+05    3.0079e+07      0.41
    yshr_nttxss_ss       13    29       6      7.1754e+07      83      8.645e+05    3.7387e+06    0.0521
    yshr_tax_ss          14    30       6      7.1754e+07      83      8.645e+05    1.4324e+07     0.199
    yshr_wage_ss         15    31       6      7.1754e+07      83      8.645e+05    3.1088e+07     0.433

----------------------------------------
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
CONTAINER NAME: mp_dsvfi_results Scalars
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
                          i     idx     value
                          --    ---    --------

    A_agg                  1     1       193.39
    A_agg_perhh            2     2       4.2232
    Aprime_agg             3     3       197.89
    Aprime_agg_perhh       4     4       4.3213
    Bequests_aux           5     5       2.5593
    Bequests_aux_perhh     6     6     0.055887
    C_agg                  7     7       48.789
    C_agg_perhh            8     8       1.0654
    SS_spend               9     9       2.3908
    SS_spend_perhh        10    10     0.052208
    Tax_revenues          11    12       13.735
    Tax_revenues_perhh    12    13      0.29994
    Y_inc_agg             13    14       64.627
    Y_inc_agg_perhh       14    15       1.4113

xxx tb_outcomes: all stats xxx
     OriginalVariableNames         a_ss          ap_ss        cons_ss         n_ss         y_all
    ________________________    __________    __________    __________    _________    __________

    {'mean'                }        4.2232        4.3213        1.0654       2.3554        1.4635
    {'unweighted_sum'      }          2228    8.7064e+08    8.2948e+07           21    1.3652e+08
    {'sd'                  }        6.7417         6.779        0.6899       1.4375        1.4563
    {'coefofvar'           }        1.5964        1.5687       0.64754      0.61029       0.99508
    {'gini'                }       0.68027       0.68124       0.33738       0.3128       0.44246
    {'min'                 }             0             0      0.036717            1      0.038108
    {'max'                 }           135         163.7        141.66            6        50.873
    {'pYis0'               }       0.12293       0.10299             0            0             0
    {'pYls0'               }             0             0             0            0             0
    {'pYgr0'               }       0.87707       0.89701             1            1             1
    {'pYisMINY'            }       0.12293       0.10299    6.7731e-07      0.36005    6.7731e-07
    {'pYisMAXY'            }    6.0111e-06    1.6708e-12             0     0.041101    1.6708e-12
    {'p0_01'               }             0             0      0.067181            1       0.07102
    {'p0_1'                }             0             0       0.10544            1       0.11346
    {'p1'                  }             0             0       0.18623            1       0.20359
    {'p5'                  }             0             0       0.27747            1       0.28173
    {'p10'                 }             0             0       0.36103            1       0.35688
    {'p20'                 }      0.064373      0.068222       0.49773            1       0.50299
    {'p25'                 }       0.11124       0.17983       0.56413            1       0.57911
    {'p30'                 }       0.26367       0.37542       0.63091            1       0.65753
```

```
    {'p40'                  }       0.68544        0.84816        0.77012            2         0.83048
    {'p50'                  }        1.4131         1.5883        0.91942            2          1.0325
    {'p60'                  }        2.5301         2.7569         1.0845            2          1.2817
    {'p70'                  }        4.1199         4.4885         1.2781            3           1.613
    {'p75'                  }        5.4836         5.7144         1.3935            3          1.8306
    {'p80'                  }        7.1191         7.2197         1.5293            4          2.1079
    {'p90'                  }         12.56         12.096         1.9344            5          3.0419
    {'p95'                  }        16.875         17.457         2.3404            5          4.0251
    {'p99'                  }        30.548         31.377          3.384            6          6.8588
    {'p99_9'                }        56.953         56.953         5.2437            6          14.778
    {'p99_99'               }        90.439         88.534         7.4817            6          20.971
    {'fl_cov_a_ss'          }        45.451         45.439         3.3942      -1.4049          4.4679
    {'fl_cor_a_ss'          }             1        0.99423        0.72975     -0.14496         0.45507
    {'fl_cov_ap_ss'         }        45.439         45.955         3.4956      -1.3685          5.3067
    {'fl_cor_ap_ss'         }       0.99423              1        0.74743     -0.14043         0.53754
    {'fl_cov_cons_ss'       }        3.3942         3.4956        0.47596      0.23909         0.76142
    {'fl_cor_cons_ss'       }       0.72975        0.74743              1      0.24109         0.75787
    {'fl_cov_n_ss'          }       -1.4049        -1.3685        0.23909       2.0664         0.35987
    {'fl_cor_n_ss'          }      -0.14496       -0.14043        0.24109            1         0.17191
    {'fl_cov_y_all'         }        4.4679         5.3067        0.76142      0.35987          2.1208
    {'fl_cor_y_all'         }       0.45507        0.53754        0.75787      0.17191               1
    {'fl_cov_y_head_inc'    }        3.8282         4.1045        0.55948     0.092667          1.1039
    {'fl_cor_y_head_inc'    }       0.56819        0.60585        0.81146     0.064504         0.75851
    {'fl_cov_y_head_earn'   }        1.8477         2.1508        0.42576      0.19287         0.96246
    {'fl_cor_y_head_earn'   }       0.29785        0.34482        0.67071      0.14582         0.71827
    {'fl_cov_y_spouse_inc'  }       0.63967         1.2022        0.20194       0.2672          1.0169
    {'fl_cor_y_spouse_inc'  }       0.09937        0.18573        0.30656      0.19467         0.73129
    {'fl_cov_yshr_interest'}       0.76424        0.71927       0.037996    -0.066731      -0.0094215
    {'fl_cor_yshr_interest'}       0.67572        0.63246         0.3283     -0.27671       -0.038564
    {'fl_cov_yshr_wage'     }      -0.77528       -0.68855     -0.0042957      0.17055         0.10767
    {'fl_cor_yshr_wage'     }      -0.34062       -0.30085      -0.018443      0.35142         0.21899
    {'fl_cov_yshr_SS'       }      0.011037      -0.030725      -0.033701     -0.10382        -0.09825
    {'fl_cor_yshr_SS'       }     0.0069239      -0.019169        -0.2066     -0.30546        -0.28534
    {'fl_cov_yshr_tax'      }      0.098159        0.10896       0.018583      0.01337        0.038535
    {'fl_cor_yshr_tax'      }       0.41485        0.45797        0.76748      0.26501         0.75395
    {'fl_cov_yshr_nttxss'   }      0.087122        0.13969       0.052284      0.11719         0.13679
    {'fl_cor_yshr_nttxss'   }      0.050539       0.080586        0.29639      0.31882         0.36733
    {'fracByP0_01'          }             0              0     5.5188e-06      0.15286      4.2239e-06
    {'fracByP0_1'           }             0              0     8.2593e-05      0.15286       6.444e-05
    {'fracByP1'             }             0              0      0.0013857      0.15286       0.0010994
    {'fracByP5'             }             0              0       0.010292      0.15286       0.0079949
    {'fracByP10'            }             0              0       0.025341      0.15286        0.018888
    {'fracByP20'            }    0.00074832     0.00060951       0.065753      0.15286        0.048269
    {'fracByP25'            }     0.0014123      0.0020285       0.090679      0.15286        0.066791
    {'fracByP30'            }     0.0041719      0.0051595        0.11872      0.15286        0.087944
    {'fracByP40'            }      0.016751        0.01877         0.1844      0.40183         0.13867
    {'fracByP50'            }      0.045326       0.046338        0.26358      0.40183         0.20207
    {'fracByP60'            }      0.095502       0.095716         0.3575      0.40183         0.28072
    {'fracByP70'            }       0.17466        0.17847        0.46813      0.56321         0.37901
    {'fracByP75'            }       0.24517        0.23715        0.53078      0.56321         0.43771
    {'fracByP80'            }       0.32852        0.31134        0.59927      0.75407         0.50477
    {'fracByP90'            }       0.56651        0.52814        0.75975       0.8953         0.67658
    {'fracByP95'            }       0.70071         0.6954        0.85893       0.8953         0.79526
    {'fracByP99'            }       0.90524        0.90259        0.96084            1         0.93132
    {'fracByP99_9'          }       0.98567        0.98372        0.99419            1         0.98801
    {'fracByP99_99'         }       0.99808         0.9976        0.99922            1         0.99841
```

```
% Get Matrixes
```

```
cl_st_precompute_list = {'a', 'ar_z_ctr_amz', ...
    'inc', 'inc_unemp', 'spouse_inc', 'spouse_inc_unemp', 'ref_earn_wageind_grid',...
    'ap_idx_lower_ss', 'ap_idx_higher_ss', 'ap_idx_lower_weight_ss'};
mp_controls('bl_print_precompute_verbose') = false;
[mp_precompute_res] = snw_hh_precompute(mp_params, mp_controls, cl_st_precompute_list, ap_ss, Phi_tr

Wage quintile cutoffs=0.47017     0.71433      1.0293      1.5654
Completed SNW_HH_PRECOMPUTE;SNW_MP_PARAM=default_moredense_a65zh133zs5_e2m2;SNW_MP_CONTROL=default_t
```

12.1.2 Solve for 2019 Evuvw With 0 and 1 Checks

```
% Call Function
welf_checks = 0;
[ev19_jaeemk_check0, ec19_jaeemk_check0, ev20_jaeemk_check0, ec20_jaeemk_check0] = snw_evuvw19_jaeem
    welf_checks, st_solu_type, mp_params, mp_controls, ...
    V_ss, ap_ss, cons_ss, V_unemp, cons_unemp, mp_precompute_res);

Completed SNW_A4CHK_WRK_BISEC_VEC;welf_checks=0;TR=0.0017225;SNW_MP_PARAM=default_moredense_a65zh133
Completed SNW_A4CHK_UNEMP_BISEC_VEC;welf_checks=0;TR=0.0017225;xi=0.5;b=1;SNW_MP_PARAM=default_mored
Completed SNW_EVUVW20_JAEEMK;SNW_MP_PARAM=default_moredense_a65zh133zs5_e2m2;SNW_MP_CONTROL=default_
Completed SNW_EVUVW19_JAEEMK_FOC;SNW_MP_PARAM=default_moredense_a65zh133zs5_e2m2;SNW_MP_CONTROL=defa

% Call Function
welf_checks = 1;
[ev19_jaeemk_check2, ec19_jaeemk_check2, ev20_jaeemk_check2, ec20_jaeemk_check2] = snw_evuvw19_jaeem
    welf_checks, st_solu_type, mp_params, mp_controls, ...
    V_ss, ap_ss, cons_ss, V_unemp, cons_unemp, mp_precompute_res);

Completed SNW_A4CHK_WRK_BISEC_VEC;welf_checks=1;TR=0.0017225;SNW_MP_PARAM=default_moredense_a65zh133
Completed SNW_A4CHK_UNEMP_BISEC_VEC;welf_checks=1;TR=0.0017225;xi=0.5;b=1;SNW_MP_PARAM=default_mored
Completed SNW_EVUVW20_JAEEMK;SNW_MP_PARAM=default_moredense_a65zh133zs5_e2m2;SNW_MP_CONTROL=default_
Completed SNW_EVUVW19_JAEEMK_FOC;SNW_MP_PARAM=default_moredense_a65zh133zs5_e2m2;SNW_MP_CONTROL=defa
```

Differences between Checks in Expected Value and Expected Consumption

```
mn_V_U_gain_check = ev19_jaeemk_check2 - ev19_jaeemk_check0;
mn_MPC_C_gain_share_check = (ec19_jaeemk_check2 - ec19_jaeemk_check0)./(welf_checks*mp_params('TR'))
```

12.1.3 Additional Variables

Create additional Staet-Spac Arrays

```
% (n_jgrid,n_agrid,n_etagrid,n_educgrid,n_marriedgrid,n_kidsgrid);
% Children Array
ar_kids = (1:mp_params('n_kidsgrid')) - 1;
mn_kids = zeros(1,1,1,1,1,length(ar_kids));
mn_kids(1,1,1,1,1,:) = ar_kids;
kids_ss = repmat(mn_kids, [mp_params('n_jgrid'), mp_params('n_agrid'), mp_params('n_etagrid'), ...
    mp_params('n_educgrid'), mp_params('n_marriedgrid'), 1]);
% Marital Status Arrays
ar_marital = (1:mp_params('n_marriedgrid')) - 1;
mn_marital = zeros(1,1,1,1,length(ar_marital),1);
mn_marital(1,1,1,1,:,1) = ar_marital;
marital_ss = repmat(mn_marital, [mp_params('n_jgrid'), mp_params('n_agrid'), mp_params('n_etagrid'),
    mp_params('n_educgrid'), 1, mp_params('n_kidsgrid')]);
% Educational Status Arrays
ar_educ = (1:mp_params('n_educgrid')) - 1;
mn_educ = zeros(1,1,1,length(ar_educ),1,1);
mn_educ(1,1,1,:,1,1) = ar_educ;
educ_ss = repmat(mn_educ, [mp_params('n_jgrid'), mp_params('n_agrid'), mp_params('n_etagrid'), ...
```

```
    1, mp_params('n_marriedgrid'), mp_params('n_kidsgrid')]);
% Age Array
ar_age = (1:mp_params('n_jgrid')) + 18;
mn_age = zeros(length(ar_age),1,1,1,1,1);
mn_age(:,1,1,1,1,1) = ar_age;
age_ss = repmat(mn_age, [1, mp_params('n_agrid'), mp_params('n_etagrid'), ...
    mp_params('n_educgrid'), mp_params('n_marriedgrid'), mp_params('n_kidsgrid')]);
```

12.1.4 Adjust to Probability Mass Function

```
Phi_true_1 = Phi_true./sum(Phi_true,'all');
```

12.1.5 Age Bounds

```
% 1 = 18
min_age = 1

min_age = 1

% retirement, 46+18=64, the year prior to retirement year.
max_age = 46;
```

12.1.6 Scale Statistics to Thousands of Dollars

```
a_ss = mp_dsvfi_results('a_ss')*58.056;
ap_ss = mp_dsvfi_results('ap_ss')*58.056;
c_ss = mp_dsvfi_results('cons_ss')*58.056;
n_ss = mp_dsvfi_results('n_ss');
% household head + spousal (realized) income
y_all = mp_dsvfi_results('y_all_ss')*58.056;
y_head_inc = mp_dsvfi_results('y_head_inc_ss')*58.056;
y_spouse_inc = mp_dsvfi_results('y_spouse_inc_ss')*58.056;

yshr_wage = mp_dsvfi_results('yshr_wage_ss');
yshr_SS = mp_dsvfi_results('yshr_SS_ss');
yshr_nttxss = mp_dsvfi_results('yshr_nttxss_ss');
```

12.1.7 Distributional Statistics Overall All Ages

```
% construct input data
marital_grp = marital_ss(min_age:82, :, :, : ,: ,:);
y_all_grp = y_all(min_age:82, :, :, : ,: ,:);
age_ss_grp = age_ss(min_age:82, :, :, : ,: ,:);
educ_ss_grp = educ_ss(min_age:82, :, :, : ,: ,:);
a_ss_grp = a_ss(min_age:82, :, :, : ,: ,:);
ap_ss_grp = ap_ss(min_age:82, :, :, : ,: ,:);
mn_MPC_C_gain_share_check_grp = mn_MPC_C_gain_share_check(min_age:82, :, :, :, :, :);
Phi_true_grp = Phi_true_1(min_age:82, :, :, : ,: ,:);
c_ss_grp = c_ss(min_age:82, :, :, : ,: ,:);
y_head_inc_grp = y_head_inc(min_age:82, :, :, : ,: ,:);
y_spouse_inc_grp = y_spouse_inc(min_age:82, :, :, : ,: ,:);
yshr_nttxss_grp = yshr_nttxss(min_age:82, :, :, : ,: ,:);

mp_cl_ar_xyz_of_s = containers.Map('KeyType','char', 'ValueType','any');
mp_cl_ar_xyz_of_s('married') = {marital_grp(:), zeros(1)};
mp_cl_ar_xyz_of_s('y_all') = {y_all_grp(:), zeros(1)};
mp_cl_ar_xyz_of_s('age_ss') = {age_ss_grp(:), zeros(1)};
mp_cl_ar_xyz_of_s('educ_ss') = {educ_ss_grp(:), zeros(1)};
mp_cl_ar_xyz_of_s('a_ss') = {a_ss_grp(:), zeros(1)};
```

```
mp_cl_ar_xyz_of_s('ap_ss') = {ap_ss_grp(:), zeros(1)};
mp_cl_ar_xyz_of_s('MPC') = {mn_MPC_C_gain_share_check_grp(:), zeros(1)};
mp_cl_ar_xyz_of_s('Mass') = {Phi_true_grp(:), zeros(1)};
mp_cl_ar_xyz_of_s('c_ss') = {c_ss_grp(:), zeros(1)};
mp_cl_ar_xyz_of_s('y_head_inc') = {y_head_inc_grp(:), zeros(1)};
mp_cl_ar_xyz_of_s('y_spouse') = {y_spouse_inc_grp(:), zeros(1)};
mp_cl_ar_xyz_of_s('yshr_nttxss') = {yshr_nttxss_grp(:), zeros(1)};

mp_cl_ar_xyz_of_s('ar_st_y_name') = ["married", "y_all", "age_ss", "educ_ss", "a_ss", "ap_ss", "MPC"

% controls
mp_support = containers.Map('KeyType','char', 'ValueType','any');
mp_support('ar_fl_percentiles') = [0.01 10 25 50 75 90 99.99];
mp_support('bl_display_final') = true;
mp_support('bl_display_detail') = false;
mp_support('bl_display_drvm2outcomes') = false;
mp_support('bl_display_drvstats') = false;
mp_support('bl_display_drvm2covcor') = false;

% Call Function
mp_cl_mt_xyz_of_s = ff_simu_stats(Phi_true_grp(:)/sum(Phi_true_grp,'all'), mp_cl_ar_xyz_of_s, mp_sup
```

```
xxx tb_outcomes: all stats xxx
    OriginalVariableNames       married         y_all        age_ss       educ_ss         a_ss
    ______________________    ___________    ___________    __________    ___________    ___________

    {'mean'              }        0.47501         84.974        47.129          0.303         245.22
    {'unweighted_sum'    }              1     7.9255e+09          4879              1     1.2935e+05
    {'sd'                }        0.49938         84.549        19.231        0.45956         391.42
    {'coefofvar'         }         1.0513          0.995       0.40805         1.5167         1.5962
    {'gini'              }        0.36718        0.44243       0.23101        0.61588        0.68023
    {'min'               }              0         2.2124            19              0              0
    {'max'               }              1         2953.5           100              1         7837.6
    {'pYis0'             }        0.52499              0             0          0.697        0.12285
    {'pYls0'             }              0              0             0              0              0
    {'pYgr0'             }        0.47501              1             1          0.303        0.87715
    {'pYisMINY'          }        0.52499      6.774e-07       0.02184          0.697        0.12285
    {'pYisMAXY'          }        0.47501      1.671e-12    0.00020326          0.303     6.0119e-06
    {'p0_01'             }              0         4.1232            19              0              0
    {'p10'               }              0         20.726            23              0              0
    {'p25'               }              0         33.631            31              0          6.458
    {'p50'               }              0         59.948            45              0          82.04
    {'p75'               }              1         106.28            62              1         318.35
    {'p90'               }              1         176.61            75              1         729.18
    {'p99_99'            }              1         1217.5           100              1         5250.6
    {'fl_cov_married'    }        0.24938         12.618    2.9987e-13       0.026842         31.201
    {'fl_cor_married'    }              1        0.29884    3.1225e-14        0.11697        0.15962
    {'fl_cov_y_all'      }         12.618         7148.6       -105.85         6.7259          15059
    {'fl_cor_y_all'      }        0.29884              1     -0.065099         0.1731        0.45504
    {'fl_cov_age_ss'     }     2.9987e-13        -105.85        369.84     5.7371e-13           2902
    {'fl_cor_age_ss'     }     3.1225e-14      -0.065099             1     6.4916e-14        0.38553
    {'fl_cov_educ_ss'    }       0.026842         6.7259    5.7371e-13        0.21119          20.13
    {'fl_cor_educ_ss'    }        0.11697         0.1731    6.4916e-14              1        0.11191
    {'fl_cov_a_ss'       }         31.201          15059          2902          20.13     1.5321e+05
    {'fl_cor_a_ss'       }        0.15962        0.45504       0.38553        0.11191              1
    {'fl_cov_ap_ss'      }          31.93          17886        2762.7         20.615     1.5316e+05
    {'fl_cor_ap_ss'      }        0.16246        0.53751       0.36501        0.11398        0.99423
    {'fl_cov_MPC'        }      -0.016733        -6.6507       -1.2778      0.0049583        -30.154
```

```
    {'fl_cor_MPC'        }      -0.13011       -0.30544         -0.258      0.041894       -0.29913
    {'fl_cov_Mass'       }   -5.1035e-07    -7.3196e-05     -2.691e-05   -2.0525e-07    -0.00031586
    {'fl_cor_Mass'       }      -0.19258       -0.16313       -0.26368     -0.084158       -0.15206
    {'fl_cov_c_ss'       }        8.8909         2566.3         57.161        4.6211          11440
    {'fl_cor_c_ss'       }       0.44452        0.75784       0.074211       0.25106        0.72974
    {'fl_cov_y_head_inc' }        1.6909         3720.9        -73.542        4.2898          12903
    {'fl_cor_y_head_inc' }      0.058359        0.75849      -0.065909       0.16088        0.56816
    {'fl_cov_y_spouse'   }        10.927         3427.7        -32.308         2.436         2155.8
    {'fl_cor_y_spouse'   }        0.3947        0.73129      -0.030304      0.095619        0.09935
    {'fl_cov_yshr_nttxss'}      0.022689          7.935        -3.2573     0.0058708         5.0323
    {'fl_cor_yshr_nttxss'}        0.1778        0.36727       -0.66283      0.049993       0.050313
    {'fracByP0_01'       }             0      4.224e-06      0.0088049             0              0
    {'fracByP10'         }             0       0.018881       0.047593             0              0
    {'fracByP25'         }             0       0.066793        0.14054             0      0.0014119
    {'fracByP50'         }             0        0.20209        0.34194             0       0.045325
    {'fracByP75'         }             1        0.43774        0.62344             1        0.24517
    {'fracByP90'         }             1         0.6766        0.82958             1        0.56651
    {'fracByP99_99'      }             1        0.99841              1             1        0.99808

tb_dist_stats_all = mp_cl_mt_xyz_of_s('tb_outcomes');
```

12.1.8 Distributional Statistics Overall 18 to 64

Statistics overall distributionally for 18 to 64 year olds.

```
% construct input data
marital_grp = marital_ss(min_age:max_age, :, :, : ,: ,:);
y_all_grp = y_all(min_age:max_age, :, :, : ,: ,:);
age_ss_grp = age_ss(min_age:max_age, :, :, : ,: ,:);
educ_ss_grp = educ_ss(min_age:max_age, :, :, : ,: ,:);
a_ss_grp = a_ss(min_age:max_age, :, :, : ,: ,:);
ap_ss_grp = ap_ss(min_age:max_age, :, :, : ,: ,:);
mn_MPC_C_gain_share_check_grp = mn_MPC_C_gain_share_check(min_age:max_age, :, :, :, :, :);
Phi_true_grp = Phi_true_1(min_age:max_age, :, :, : ,: ,:);
c_ss_grp = c_ss(min_age:max_age, :, :, : ,: ,:);
y_head_inc_grp = y_head_inc(min_age:max_age, :, :, : ,: ,:);
y_spouse_inc_grp = y_spouse_inc(min_age:max_age, :, :, : ,: ,:);
yshr_nttxss_grp = yshr_nttxss(min_age:max_age, :, :, : ,: ,:);

mp_cl_ar_xyz_of_s = containers.Map('KeyType','char', 'ValueType','any');
mp_cl_ar_xyz_of_s('married') = {marital_grp(:), zeros(1)};
mp_cl_ar_xyz_of_s('y_all') = {y_all_grp(:), zeros(1)};
mp_cl_ar_xyz_of_s('age_ss') = {age_ss_grp(:), zeros(1)};
mp_cl_ar_xyz_of_s('educ_ss') = {educ_ss_grp(:), zeros(1)};
mp_cl_ar_xyz_of_s('a_ss') = {a_ss_grp(:), zeros(1)};
mp_cl_ar_xyz_of_s('ap_ss') = {ap_ss_grp(:), zeros(1)};
mp_cl_ar_xyz_of_s('MPC') = {mn_MPC_C_gain_share_check_grp(:), zeros(1)};
mp_cl_ar_xyz_of_s('Mass') = {Phi_true_grp(:), zeros(1)};
mp_cl_ar_xyz_of_s('c_ss') = {c_ss_grp(:), zeros(1)};
mp_cl_ar_xyz_of_s('y_head_inc') = {y_head_inc_grp(:), zeros(1)};
mp_cl_ar_xyz_of_s('y_spouse') = {y_spouse_inc_grp(:), zeros(1)};
mp_cl_ar_xyz_of_s('yshr_nttxss') = {yshr_nttxss_grp(:), zeros(1)};

mp_cl_ar_xyz_of_s('ar_st_y_name') = ["married", "y_all", "age_ss", "educ_ss", "a_ss", "ap_ss", "MPC"

% controls
mp_support = containers.Map('KeyType','char', 'ValueType','any');
mp_support('ar_fl_percentiles') = [0.01 10 25 50 75 90 99.99];
mp_support('bl_display_final') = true;
```

```
mp_support('bl_display_detail') = false;
mp_support('bl_display_drvm2outcomes') = false;
mp_support('bl_display_drvstats') = false;
mp_support('bl_display_drvm2covcor') = false;

% Call Function
mp_cl_mt_xyz_of_s = ff_simu_stats(Phi_true_grp(:)/sum(Phi_true_grp,'all'), mp_cl_ar_xyz_of_s, mp_sup

xxx tb_outcomes: all stats xxx
    OriginalVariableNames      married        y_all        age_ss        educ_ss        a_ss
    ______________________    __________    __________    __________    __________    __________

    {'mean'              }       0.47501        95.246        39.372         0.303        194.
    {'unweighted_sum'    }             1    7.7487e+09          1909             1    1.2935e+0
    {'sd'                }       0.49938        89.631        13.105       0.45956        344.
    {'coefofvar'         }        1.0513       0.94104       0.33285        1.5167        1.771
    {'gini'              }       0.36718       0.42428       0.18859       0.61588       0.7157
    {'min'               }             0        2.2124            19             0
    {'max'               }             1        2953.5            64             1        7837.
    {'pYis0'             }       0.52499             0             0         0.697       0.1462
    {'pYls0'             }             0             0             0             0
    {'pYgr0'             }       0.47501             1             1         0.303       0.8537
    {'pYisMINY'          }       0.52499    8.6135e-07      0.027771         0.697       0.1462
    {'pYisMAXY'          }       0.47501    2.1248e-12      0.015675         0.303    5.4766e-0
    {'p0_01'             }             0        3.9581            19             0
    {'p10'               }             0        25.069            22             0
    {'p25'               }             0        40.654            28             0        3.737
    {'p50'               }             0         69.57            38             0        51.66
    {'p75'               }             1        119.76            50             1        239.1
    {'p90'               }             1         192.9            58             1        588.4
    {'p99_99'            }             1        1249.3            64             1        4707.
    {'fl_cov_married'    }       0.24938        13.756     2.335e-13      0.026842         25.2
    {'fl_cor_married'    }             1       0.30733    3.5679e-14       0.11697       0.1468
    {'fl_cov_y_all'      }        13.756        8033.6        270.03        7.5617         1785
    {'fl_cor_y_all'      }       0.30733             1       0.22988       0.18358       0.5781
    {'fl_cov_age_ss'     }     2.335e-13        270.03        171.75    4.3386e-15        2241.
    {'fl_cor_age_ss'     }    3.5679e-14       0.22988             1     7.204e-16       0.4964
    {'fl_cov_educ_ss'    }      0.026842        7.5617    4.3386e-15       0.21119        15.47
    {'fl_cor_educ_ss'    }       0.11697       0.18358     7.204e-16             1      0.09776
    {'fl_cov_a_ss'       }         25.27         17852        2241.5        15.478    1.1868e+0
    {'fl_cor_a_ss'       }       0.14689       0.57814       0.49648      0.097766
    {'fl_cov_ap_ss'      }        26.783         20993        2328.9        16.562    1.2238e+0
    {'fl_cor_ap_ss'      }       0.15001       0.65507       0.49704        0.1008       0.9935
    {'fl_cov_MPC'        }     -0.017248       -8.3845       -1.4685     0.0073384       -27.85
    {'fl_cor_MPC'        }      -0.12735      -0.34491      -0.41317      0.058877      -0.2981
    {'fl_cov_Mass'       }   -6.2681e-07   -0.00010581   -2.2759e-05   -2.2235e-07   -0.0003165
    {'fl_cor_Mass'       }      -0.21171      -0.19912      -0.29292     -0.081609        -0.15
    {'fl_cov_c_ss'       }        8.9405        2911.4         117.7        4.6429        9782.
    {'fl_cor_c_ss'       }       0.44676       0.81058       0.22412       0.25211       0.7086
    {'fl_cov_y_head_inc' }        1.5449        4083.5        215.29        4.8213         1513
    {'fl_cor_y_head_inc' }      0.050457       0.74307       0.26794       0.17111       0.7164
    {'fl_cov_y_spouse'   }        12.211        3950.1        54.733        2.7405        2719.
    {'fl_cor_y_spouse'   }       0.40608        0.7319      0.069359      0.099033        0.131
    {'fl_cov_yshr_nttxss'}     0.0064334        2.2345       0.12412     0.0029398        5.703
    {'fl_cor_yshr_nttxss'}       0.38567       0.74633       0.28352        0.1915       0.4956
    {'fracByP0_01'       }             0    3.6432e-06      0.013402             0
    {'fracByP10'         }             0      0.018969      0.056893             0
    {'fracByP25'         }             0      0.070975       0.15748             0     0.001135
```

```
    {'fracByP50'        }              0         0.21374        0.35932              0       0.03404
    {'fracByP75'        }              1         0.45357        0.64274              1        0.2134
    {'fracByP90'        }              1         0.69054        0.84608              1        0.5149
    {'fracByP99_99'     }              1         0.99855              1              1        0.9971
```

```
tb_dist_stats_all_18to64 = mp_cl_mt_xyz_of_s('tb_outcomes');
```

12.1.9 Distributional Statistics By Kids Count

Various statistics, including MPC (of the first check) by Children Count

```
it_row_ctr = 0;
for it_ctr=1:mp_params('n_kidsgrid')
    display(['xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx']);
    display(['kids =' num2str(ar_kids(it_ctr))]);
    display(['xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx']);

    % construct input data
    marital_grp = marital_ss(min_age:max_age, :, :, : ,: ,it_ctr);
    y_all_grp = y_all(min_age:max_age, :, :, : ,: ,it_ctr);
    age_ss_grp = age_ss(min_age:max_age, :, :, : ,: ,it_ctr);
    educ_ss_grp = educ_ss(min_age:max_age, :, :, : ,: ,it_ctr);
    a_ss_grp = a_ss(min_age:max_age, :, :, : ,: ,it_ctr);
    ap_ss_grp = ap_ss(min_age:max_age, :, :, : ,: ,it_ctr);
    mn_MPC_C_gain_share_check_grp = mn_MPC_C_gain_share_check(min_age:max_age, :, :, :, :, it_ctr);
    Phi_true_grp = Phi_true_1(min_age:max_age, :, :, : ,: ,it_ctr);
    c_ss_grp = c_ss(min_age:max_age, :, :, : ,: ,it_ctr);
    y_head_inc_grp = y_head_inc(min_age:max_age, :, :, : ,: ,it_ctr);
    y_spouse_inc_grp = y_spouse_inc(min_age:max_age, :, :, : ,: ,it_ctr);
    yshr_nttxss_grp = yshr_nttxss(min_age:max_age, :, :, : ,: ,it_ctr);

    mp_cl_ar_xyz_of_s = containers.Map('KeyType','char', 'ValueType','any');
    mp_cl_ar_xyz_of_s('married') = {marital_grp(:), zeros(1)};
    mp_cl_ar_xyz_of_s('y_all') = {y_all_grp(:), zeros(1)};
    mp_cl_ar_xyz_of_s('age_ss') = {age_ss_grp(:), zeros(1)};
    mp_cl_ar_xyz_of_s('educ_ss') = {educ_ss_grp(:), zeros(1)};
    mp_cl_ar_xyz_of_s('a_ss') = {a_ss_grp(:), zeros(1)};
    mp_cl_ar_xyz_of_s('ap_ss') = {ap_ss_grp(:), zeros(1)};
    mp_cl_ar_xyz_of_s('MPC') = {mn_MPC_C_gain_share_check_grp(:), zeros(1)};
    mp_cl_ar_xyz_of_s('Mass') = {Phi_true_grp(:), zeros(1)};
    mp_cl_ar_xyz_of_s('c_ss') = {c_ss_grp(:), zeros(1)};
    mp_cl_ar_xyz_of_s('y_head_inc') = {y_head_inc_grp(:), zeros(1)};
    mp_cl_ar_xyz_of_s('y_spouse') = {y_spouse_inc_grp(:), zeros(1)};
    mp_cl_ar_xyz_of_s('yshr_nttxss') = {yshr_nttxss_grp(:), zeros(1)};

    mp_cl_ar_xyz_of_s('ar_st_y_name') = ["married", "y_all", "age_ss", "educ_ss", "a_ss", "ap_ss", "

    % controls
    mp_support = containers.Map('KeyType','char', 'ValueType','any');
    mp_support('ar_fl_percentiles') = [0.01 10 25 50 75 90 99.99];
    mp_support('bl_display_final') = true;
    mp_support('bl_display_detail') = false;
    mp_support('bl_display_drvm2outcomes') = false;
    mp_support('bl_display_drvstats') = false;
    mp_support('bl_display_drvm2covcor') = false;

    % Call Function
    mp_cl_mt_xyz_of_s = ff_simu_stats(Phi_true_grp(:)/sum(Phi_true_grp,'all'), mp_cl_ar_xyz_of_s, mp
```

```
    it_kids = ar_kids(it_ctr);

    tb_dist_stats = mp_cl_mt_xyz_of_s('tb_outcomes');

    fl_married_mean = tb_dist_stats{"married", "mean"};

    fl_age_mean = tb_dist_stats{"age_ss", "mean"};
    fl_age_p50 = tb_dist_stats{"age_ss", "p50"};

    fl_educ_mean = tb_dist_stats{"educ_ss", "mean"};

    fl_a_mean = tb_dist_stats{"a_ss", "mean"};
    fl_a_p50 = tb_dist_stats{"a_ss", "p50"};

    fl_ap_mean = tb_dist_stats{"ap_ss", "mean"};
    fl_ap_p50 = tb_dist_stats{"ap_ss", "p50"};

    fl_y_all_mean = tb_dist_stats{"y_all", "mean"};
    fl_y_all_p50 = tb_dist_stats{"y_all", "p50"};

    fl_mpc_mean = tb_dist_stats{"MPC", "mean"};
    fl_mpc_p50 = tb_dist_stats{"MPC", "p50"};

    fl_mass = tb_dist_stats{"Mass", "unweighted_sum"};

    fl_c_ss_mean = tb_dist_stats{"c_ss", "mean"};
    fl_c_ss_p50 = tb_dist_stats{"c_ss", "p50"};

    fl_y_head_inc_mean = tb_dist_stats{"y_head_inc", "mean"};
    fl_y_spouse_mean = tb_dist_stats{"y_spouse", "mean"};

    ar_store_stats = [it_kids, fl_married_mean, ...
        fl_age_mean, fl_age_p50, fl_educ_mean, ...
        fl_a_mean, fl_a_p50, fl_ap_mean, fl_ap_p50, ...
        fl_y_all_mean, fl_y_all_p50, ...
        fl_mpc_mean, fl_mpc_p50, ...
        fl_mass, ...
        fl_c_ss_mean, fl_c_ss_p50, ...
        fl_y_head_inc_mean, fl_y_spouse_mean];

    it_row_ctr = it_row_ctr + 1;

    if (it_row_ctr>1)
        mt_store_stats_by_k = [mt_store_stats_by_k;ar_store_stats];
    else
        mt_store_stats_by_k = [ar_store_stats];
    end
end
```

```
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
kids =0
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
xxx tb_outcomes: all stats xxx
    OriginalVariableNames       married         y_all         age_ss        educ_ss         a_ss
    ______________________    ___________    ___________    ___________    __________    ___________

    {'mean'              }        0.34092         95.696          42.81       0.29837         267.84
    {'unweighted_sum'    }              1     1.9045e+09           1909             1     1.2935e+05
```

{'sd' }	0.47402	93.188	14.55	0.45754	413.66
{'coefofvar' }	1.3904	0.97379	0.33987	1.5335	1.5444
{'gini' }	0.56028	0.43559	0.18997	0.62263	0.66933
{'min' }	0	2.2124	19	0	0
{'max' }	1	2953.5	64	1	7837.6
{'pYis0' }	0.65908	0	0	0.70163	0.10437
{'pYls0' }	0	0	0	0	0
{'pYgr0' }	0.34092	1	1	0.29837	0.89563
{'pYisMINY' }	0.65908	1.2783e-06	0.038791	0.70163	0.10437
{'pYisMAXY' }	0.34092	4.4127e-12	0.029551	0.29837	1.0023e-05
{'p0_01' }	0	3.8399	19	0	0
{'p10' }	0	23.75	21	0	0
{'p25' }	0	39.249	29	0	10.255
{'p50' }	0	68.775	45	0	100.91
{'p75' }	1	119.82	56	1	363.77
{'p90' }	1	198.36	61	1	729.18
{'p99_99' }	1	1317.3	64	1	5250.6
{'fl_cov_married' }	0.22469	15.781	0.41952	0.027901	47.935
{'fl_cor_married' }	1	0.35725	0.060827	0.12864	0.24447
{'fl_cov_y_all' }	15.781	8684	314.15	6.9889	24515
{'fl_cor_y_all' }	0.35725	1	0.23169	0.16391	0.63596
{'fl_cov_age_ss' }	0.41952	314.15	211.7	-0.40705	2895.3
{'fl_cor_age_ss' }	0.060827	0.23169	1	-0.061144	0.48104
{'fl_cov_educ_ss' }	0.027901	6.9889	-0.40705	0.20934	17.081
{'fl_cor_educ_ss' }	0.12864	0.16391	-0.061144	1	0.090246
{'fl_cov_a_ss' }	47.935	24515	2895.3	17.081	1.7111e+05
{'fl_cor_a_ss' }	0.24447	0.63596	0.48104	0.090246	1
{'fl_cov_ap_ss' }	50.8	28037	2996.5	18.304	1.7633e+05
{'fl_cor_ap_ss' }	0.25021	0.70243	0.48082	0.093396	0.9952
{'fl_cov_MPC' }	-0.0040817	-5.3961	-1.3578	0.016362	-22.104
{'fl_cor_MPC' }	-0.040228	-0.27052	-0.43598	0.16707	-0.24964
{'fl_cov_Mass' }	-6.3926e-07	-0.00016151	-4.6365e-05	-2.596e-07	-0.00069632
{'fl_cor_Mass' }	-0.16893	-0.2171	-0.39918	-0.071073	-0.21087
{'fl_cov_c_ss' }	9.1002	3017.9	137.75	4.0645	13300
{'fl_cor_c_ss' }	0.48715	0.82178	0.24023	0.22541	0.81588
{'fl_cov_y_head_inc' }	2.4027	4493.9	256.65	4.356	20579
{'fl_cor_y_head_inc' }	0.078733	0.74906	0.27398	0.14788	0.77274
{'fl_cov_y_spouse' }	13.378	4190.1	57.502	2.6329	3936
{'fl_cor_y_spouse' }	0.45539	0.72551	0.063767	0.092849	0.15353
{'fl_cov_yshr_nttxss'}	0.0065704	2.3727	0.15463	0.0025679	8.1118
{'fl_cor_yshr_nttxss'}	0.40207	0.73855	0.30827	0.1628	0.56882
{'fracByP0_01' }	0	3.5026e-06	0.017216	0	0
{'fracByP10' }	0	0.017915	0.047317	0	0
{'fracByP25' }	0	0.067497	0.14043	0	0.002351
{'fracByP50' }	0	0.20658	0.35779	0	0.050647
{'fracByP75' }	1	0.44409	0.66951	1	0.26381
{'fracByP90' }	1	0.6831	0.86922	1	0.54208
{'fracByP99_99' }	1	0.99848	1	1	0.99785

```
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
kids =1
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
xxx tb_outcomes: all stats xxx
```

OriginalVariableNames	married	y_all	age_ss	educ_ss	a_ss
{'mean' }	0.48303	94.687	37.46	0.31392	163.0
{'unweighted_sum' }	1	1.7814e+09	1909	1	1.2935e+0

{'sd' }	0.49971	90.675	12.413	0.46408	298.8
{'coefofvar' }	1.0345	0.95763	0.33137	1.4784	1.833
{'gini' }	0.35621	0.42949	0.18779	0.59992	0.7288
{'min' }	0	2.2124	19	0	
{'max' }	1	2715.2	64	1	7837.
{'pYis0' }	0.51697	0	0	0.68608	0.1663
{'pYls0' }	0	0	0	0	
{'pYgr0' }	0.48303	1	1	0.31392	0.8336
{'pYisMINY' }	0.51697	8.7082e-07	0.032554	0.68608	0.1663
{'pYisMAXY' }	0.48303	2.5175e-12	0.0061116	0.31392	2.7005e-0
{'p0_01' }	0	3.9202	19	0	
{'p10' }	0	24.541	21	0	
{'p25' }	0	39.852	26	0	1.913
{'p50' }	0	68.409	37	0	39.79
{'p75' }	1	118.73	47	1	205.0
{'p90' }	1	193.79	55	1	467.1
{'p99_99' }	1	1212.2	64	1	4203.
{'fl_cov_married' }	0.24971	14.899	0.69339	0.029149	35.
{'fl_cor_married' }	1	0.32882	0.11178	0.12569	0.2376
{'fl_cov_y_all' }	14.899	8221.9	296.2	7.6969	1569
{'fl_cor_y_all' }	0.32882	1	0.26316	0.18291	0.5789
{'fl_cov_age_ss' }	0.69339	296.2	154.09	0.15644	1774.
{'fl_cor_age_ss' }	0.11178	0.26316	1	0.027156	0.4783
{'fl_cov_educ_ss' }	0.029149	7.6969	0.15644	0.21537	16.18
{'fl_cor_educ_ss' }	0.12569	0.18291	0.027156	1	0.1166
{'fl_cov_a_ss' }	35.5	15691	1774.9	16.186	8933
{'fl_cor_a_ss' }	0.23769	0.57898	0.47838	0.11669	
{'fl_cov_ap_ss' }	38.015	18932	1842.5	17.321	9190
{'fl_cor_ap_ss' }	0.24516	0.67285	0.47835	0.12028	0.990
{'fl_cov_MPC' }	-0.029849	-9.6826	-1.3781	0.0095259	-25.74
{'fl_cor_MPC' }	-0.21465	-0.38374	-0.39896	0.073764	-0.3095
{'fl_cov_Mass' }	-1.9886e-07	-6.1897e-05	-1.3655e-05	-1.6868e-07	-0.0001802
{'fl_cor_Mass' }	-0.14586	-0.25019	-0.40317	-0.13322	-0.2210
{'fl_cov_c_ss' }	8.8069	2953.1	157.35	4.6956	9278.
{'fl_cor_c_ss' }	0.43769	0.80882	0.31481	0.25128	0.7709
{'fl_cov_y_head_inc' }	2.065	3941	206.32	4.8059	1277
{'fl_cor_y_head_inc' }	0.069081	0.72657	0.27785	0.17312	0.7142
{'fl_cov_y_spouse' }	12.834	4280.8	89.888	2.891	2920.
{'fl_cor_y_spouse' }	0.4103	0.75422	0.11568	0.099519	0.156
{'fl_cov_yshr_nttxss'}	0.0069685	2.2798	0.13506	0.0030572	5.020
{'fl_cor_yshr_nttxss'}	0.41262	0.74395	0.32195	0.19492	0.4970
{'fracByP0_01' }	0	3.7241e-06	0.016512	0	
{'fracByP10' }	0	0.018692	0.055462	0	
{'fracByP25' }	0	0.069801	0.1535	0	0.0006990
{'fracByP50' }	0	0.21065	0.37529	0	0.02806
{'fracByP75' }	1	0.4485	0.6393	1	0.2118
{'fracByP90' }	1	0.68715	0.85347	1	0.4747
{'fracByP99_99' }	1	0.99858	1	1	0.9968

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xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
kids =2
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
xxx tb_outcomes: all stats xxx
```

OriginalVariableNames	married	y_all	age_ss	educ_ss	a_ss
{'mean' }	0.58436	95.419	35.807	0.30789	124.28
{'unweighted_sum' }	1	1.6966e+09	1909	1	1.2935e+05

```
    {'sd'                 }        0.49283         87.576         10.518        0.46162         238.29
    {'coefofvar'          }        0.84337        0.91781        0.29375         1.4993         1.9174
    {'gini'               }        0.22818        0.41656        0.16465        0.60873        0.73697
    {'min'                }              0         2.2124             19              0              0
    {'max'                }              1         2551.1             64              1         7837.6
    {'pYis0'              }        0.41564              0              0        0.69211         0.1963
    {'pYls0'              }              0              0              0              0              0
    {'pYgr0'              }        0.58436              1              1        0.30789         0.8037
    {'pYisMINY'           }        0.41564     4.0938e-07       0.014906        0.69211         0.1963
    {'pYisMAXY'           }        0.58436     1.0736e-12      0.0019534        0.30789     9.1954e-07
    {'p0_01'              }              0         4.1232             19              0              0
    {'p10'                }              0         26.204             23              0              0
    {'p25'                }              0         41.871             27              0        0.80724
    {'p50'                }              1         70.257             35              0         29.898
    {'p75'                }              1         120.84             43              1         146.89
    {'p90'                }              1         190.32             51              1         363.77
    {'p99_99'             }              1         1122.5             64              1         3737.2
    {'fl_cov_married'     }        0.24288         12.863        0.51579       0.025827         25.491
    {'fl_cor_married'     }              1        0.29802       0.099501        0.11352        0.21706
    {'fl_cov_y_all'       }         12.863         7669.6         228.36         8.3133          11413
    {'fl_cor_y_all'       }        0.29802              1         0.2479        0.20564        0.54689
    {'fl_cov_age_ss'      }        0.51579         228.36         110.63        0.45675         1116.6
    {'fl_cor_age_ss'      }       0.099501         0.2479              1       0.094068        0.44549
    {'fl_cov_educ_ss'     }       0.025827         8.3133        0.45675        0.21309         15.009
    {'fl_cor_educ_ss'     }        0.11352        0.20564       0.094068              1        0.13644
    {'fl_cov_a_ss'        }         25.491          11413         1116.6         15.009          56783
    {'fl_cor_a_ss'        }        0.21706        0.54689        0.44549        0.13644              1
    {'fl_cov_ap_ss'       }         27.147          14327         1160.8         16.023          58304
    {'fl_cor_ap_ss'       }        0.22214        0.65975        0.44505        0.13997         0.9867
    {'fl_cov_MPC'         }      -0.055633        -12.184        -1.1929     -0.0029873        -25.836
    {'fl_cor_MPC'         }       -0.35573       -0.43842        -0.3574      -0.020393       -0.34167
    {'fl_cov_Mass'        }    -4.6541e-07    -7.3755e-05    -9.0248e-06    -2.4395e-07     -0.0001563
    {'fl_cor_Mass'        }       -0.32688       -0.29151       -0.29699       -0.18292       -0.22704
    {'fl_cov_c_ss'        }         8.1321         2864.5         129.17         5.2868         7092.7
    {'fl_cor_c_ss'        }        0.40653        0.80585        0.30257        0.28216        0.73333
    {'fl_cov_y_head_inc'  }         1.6658         3681.5         154.09         5.3399         9372.8
    {'fl_cor_y_head_inc'  }       0.058412        0.72644        0.25315         0.1999        0.67972
    {'fl_cov_y_spouse'    }         11.197         3988.2         74.272         2.9734         2040.1
    {'fl_cor_y_spouse'    }        0.37578        0.75322        0.11679        0.10654         0.1416
    {'fl_cov_yshr_nttxss'}       0.0064177         2.1485        0.10113      0.0033688         3.5399
    {'fl_cor_yshr_nttxss'}         0.39977        0.75315        0.29517        0.22404        0.45606
    {'fracByP0_01'        }              0     3.7828e-06      0.0079094              0              0
    {'fracByP10'          }              0       0.019866       0.075143              0              0
    {'fracByP25'          }              0       0.073594        0.17417              0     0.00024523
    {'fracByP50'          }              1        0.21851        0.40471              0       0.027182
    {'fracByP75'          }              1         0.4596        0.65078              1        0.20572
    {'fracByP90'          }              1        0.69638        0.85987              1        0.47333
    {'fracByP99_99'       }              1        0.99869              1              1        0.99695

xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
kids =3
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
xxx tb_outcomes: all stats xxx
    OriginalVariableNames       married          y_all          age_ss         educ_ss          a_ss
    ______________________    ___________    ___________    ___________    ___________    __________

    {'mean'               }        0.69032         96.012         35.356        0.30365          101.
    {'unweighted_sum'     }              1     1.6091e+09           1909              1     1.2935e+0
```

```
    {'sd'                 }        0.46236          83.53         9.1314        0.45983          196.5
    {'coefofvar'          }        0.66978        0.86999        0.25827         1.5143          1.940
    {'gini'               }        0.12198        0.40117        0.14344        0.61493          0.729
    {'min'                }              0         2.2124             19              0
    {'max'                }              1         2381.6             64              1          7837.
    {'pYis0'              }        0.30968              0              0        0.69635         0.1917
    {'pYls0'              }              0              0              0              0
    {'pYgr0'              }        0.69032              1              1        0.30365         0.8082
    {'pYisMINY'           }        0.30968      2.133e-07       0.007718        0.69635         0.1917
    {'pYisMAXY'           }        0.69032     3.4711e-13     0.00070368        0.30365      3.1947e-0
    {'p0_01'              }              0         4.4187             19              0
    {'p10'                }              0         28.136             24              0
    {'p25'                }              0         44.054             28              0         0.8072
    {'p50'                }              1         72.443             34              0          29.89
    {'p75'                }              1         122.12             42              1          100.9
    {'p90'                }              1          185.9             48              1          276.8
    {'p99_99'             }              1         1027.1             64              1          3306.
    {'fl_cov_married'     }        0.21378         9.9452        0.39867        0.02286          16.46
    {'fl_cor_married'     }              1        0.25751       0.094427        0.10752         0.1811
    {'fl_cov_y_all'       }         9.9452         6977.2         176.66         8.4101          8663.
    {'fl_cor_y_all'       }        0.25751              1        0.23161        0.21896          0.527
    {'fl_cov_age_ss'      }        0.39867         176.66         83.382        0.55101           713.
    {'fl_cor_age_ss'      }       0.094427        0.23161              1        0.13123          0.397
    {'fl_cov_educ_ss'     }        0.02286         8.4101        0.55101        0.21145          12.95
    {'fl_cor_educ_ss'     }        0.10752        0.21896        0.13123              1         0.1433
    {'fl_cov_a_ss'        }         16.463         8663.4          713.9         12.958           3864
    {'fl_cor_a_ss'        }        0.18113         0.5276         0.3977        0.14334
    {'fl_cov_ap_ss'       }         17.437          11197         743.03         13.851           3960
    {'fl_cor_ap_ss'       }          0.184        0.65402          0.397        0.14696         0.9828
    {'fl_cov_MPC'         }      -0.061242         -11.95       -0.93092     -0.0093462         -21.83
    {'fl_cor_MPC'         }       -0.42463       -0.45863       -0.32683      -0.065159        -0.3561
    {'fl_cov_Mass'        }    -2.6557e-07    -3.5455e-05    -3.3149e-06    -1.3715e-07     -6.3012e-0
    {'fl_cor_Mass'        }       -0.38696       -0.28596       -0.24457       -0.20093        -0.2159
    {'fl_cov_c_ss'        }         6.6057         2725.3            105         5.4818          5577.
    {'fl_cor_c_ss'        }        0.35578        0.81251        0.28636        0.29687          0.706
    {'fl_cov_y_head_inc' }         1.3302         3539.8         118.35          5.592          7371.
    {'fl_cor_y_head_inc' }        0.05051          0.744        0.22755         0.2135         0.6583
    {'fl_cov_y_spouse'    }         8.6149         3437.4         58.307         2.8181          1291.
    {'fl_cor_y_spouse'    }         0.3324        0.73415        0.11391        0.10933         0.1172
    {'fl_cov_yshr_nttxss'}      0.0052966         1.9936       0.078236      0.0034153          2.582
    {'fl_cor_yshr_nttxss'}        0.36767        0.76604        0.27499        0.23838         0.4216
    {'fracByP0_01'        }              0     4.0037e-06      0.0041476              0
    {'fracByP10'          }              0       0.021316       0.072166              0
    {'fracByP25'          }              0       0.078153        0.18337              0      0.0003122
    {'fracByP50'          }              1        0.22773        0.39789              0        0.03805
    {'fracByP75'          }              1        0.47322        0.69228              1         0.1876
    {'fracByP90'          }              1         0.7065           0.86              1         0.4594
    {'fracByP99_99'       }              1         0.9988              1              1         0.9967

xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
kids =4
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
xxx tb_outcomes: all stats xxx
    OriginalVariableNames       married          y_all          age_ss         educ_ss          a_ss
    ______________________    ___________    ___________    ___________    ___________    __________

    {'mean'               }        0.78724         91.676         35.383        0.29511          81.61
    {'unweighted_sum'     }              1     1.4702e+09           1909              1      1.2935e+0
```

```
    {'sd'               }       0.40926        74.133        7.9178       0.45609         164.
    {'coefofvar'        }       0.51987       0.80864       0.22378        1.5455        2.013
    {'gini'             }      0.054374       0.38168       0.12297       0.62738       0.7274
    {'min'              }             0        2.2124            19             0
    {'max'              }             1        2113.2            64             1        7837.
    {'pYis0'            }       0.21276             0             0       0.70489       0.1891
    {'pYls0'            }             0             0             0             0
    {'pYgr0'            }       0.78724             1             1       0.29511       0.8108
    {'pYisMINY'         }       0.21276    9.2536e-08     0.0035072       0.70489       0.1891
    {'pYisMAXY'         }       0.78724    2.0254e-13    0.00027556       0.29511   1.1672e-0
    {'p0_01'            }             0        4.7807            19             0
    {'p10'              }             0         29.13            26             0
    {'p25'              }             1         44.24            29             0       0.8072
    {'p50'              }             1          71.8            35             0        29.89
    {'p75'              }             1        115.49            41             1         82.0
    {'p90'              }             1        172.56            46             1        239.1
    {'p99_99'           }             1        888.01            64             1        2910.
    {'fl_cov_married'   }       0.16749        5.9174       0.25239      0.018555        8.620
    {'fl_cor_married'   }             1       0.19504      0.077888      0.099404        0.128
    {'fl_cov_y_all'     }        5.9174        5495.7        126.24        7.9495        6630.
    {'fl_cor_y_all'     }       0.19504             1       0.21507       0.23511       0.5443
    {'fl_cov_age_ss'    }       0.25239        126.24        62.692       0.61699         463.
    {'fl_cor_age_ss'    }      0.077888       0.21507             1       0.17085       0.3564
    {'fl_cov_educ_ss'   }      0.018555        7.9495       0.61699       0.20802        10.80
    {'fl_cor_educ_ss'   }      0.099404       0.23511       0.17085             1       0.1442
    {'fl_cov_a_ss'      }        8.6206        6630.3         463.7        10.809         2699
    {'fl_cor_a_ss'      }        0.1282       0.54435       0.35644       0.14424
    {'fl_cov_ap_ss'     }        8.7102        8295.7        479.98        11.425         2761
    {'fl_cor_ap_ss'     }       0.12468       0.65556       0.35513       0.14675       0.9845
    {'fl_cov_MPC'       }      -0.04739       -10.199      -0.82379     -0.011367       -17.74
    {'fl_cor_MPC'       }      -0.39132      -0.46494       -0.3516     -0.084227      -0.3649
    {'fl_cov_Mass'      }   -1.0116e-07   -1.7179e-05   -1.6822e-06   -8.6576e-08   -3.0647e-0
    {'fl_cor_Mass'      }      -0.30657      -0.28741      -0.26349      -0.23543      -0.2313
    {'fl_cov_c_ss'      }        4.4325        2483.7        79.686         5.416        4382.
    {'fl_cor_c_ss'      }       0.27632       0.85476       0.25676       0.30296        0.680
    {'fl_cov_y_head_inc' }      0.92362        3408.6        90.849        5.7717        5998.
    {'fl_cor_y_head_inc' }      0.03994       0.81373       0.20306       0.22396       0.6461
    {'fl_cov_y_spouse'  }        4.9938        2087.1        35.394        2.1778        631.8
    {'fl_cor_y_spouse'  }       0.28208       0.65082       0.10334       0.11038      0.08889
    {'fl_cov_yshr_nttxss'}    0.0035289        1.7418      0.059073     0.0033945        1.929
    {'fl_cor_yshr_nttxss'}      0.29013       0.79058       0.25104       0.25043       0.3950
    {'fracByP0_01'      }             0    4.5191e-06     0.0018833             0
    {'fracByP10'        }             0      0.023539       0.08684             0
    {'fracByP25'        }             1      0.083914       0.18322             0    0.0003800
    {'fracByP50'        }             1       0.24018       0.44948             0      0.05909
    {'fracByP75'        }             1       0.48959       0.71178             1       0.2009
    {'fracByP90'        }             1       0.71753       0.86506             1       0.4875
    {'fracByP99_99'     }             1        0.9989             1             1       0.9960
```

12.1.10 Distributional Statistics By Marital Status and Kids Count

Various statistics, including MPC (of the first check) by Marital Status and Kids COunt

```
it_row_ctr = 0;
for it_marry_ctr=1:mp_params('n_marriedgrid')

    display(['']);
    display(['']);
    display(['-------------------------------']);
```

```
display(['------------------------------']);
display(['------------------------------']);
display(['------------------------------']);
display(['xxxxxxxxxxxxxxxxxxxxxxxxxxxxxx']);
display(['Marital =' num2str(ar_marital(it_marry_ctr))]);
display(['xxxxxxxxxxxxxxxxxxxxxxxxxxxxxx']);
display(['------------------------------']);
display(['------------------------------']);

for it_kids_ctr=1:mp_params('n_kidsgrid')
    display(['xxxxxxxxxxxxxxxxxxxxxxxxxxxxxx']);
    display(['Marital =' num2str(ar_marital(it_marry_ctr)) ' and kids =' num2str(ar_kids(it_kids
    display(['xxxxxxxxxxxxxxxxxxxxxxxxxxxxxx']);

    % construct input data
    y_all_grp = y_all(min_age:max_age, :, :, : ,it_marry_ctr ,it_ctr);
    age_ss_grp = age_ss(min_age:max_age, :, :, : ,it_marry_ctr, it_kids_ctr);
    educ_ss_grp = educ_ss(min_age:max_age, :, :, : ,it_marry_ctr, it_kids_ctr);
    a_ss_grp = a_ss(min_age:max_age, :, :, : ,it_marry_ctr, it_kids_ctr);
    ap_ss_grp = ap_ss(min_age:max_age, :, :, : ,it_marry_ctr, it_kids_ctr);
    mn_MPC_C_gain_share_check_grp = mn_MPC_C_gain_share_check(min_age:max_age, :, :, :, it_marry
    Phi_true_grp = Phi_true_1(min_age:max_age, :, :, : ,it_marry_ctr, it_kids_ctr);
    c_ss_grp = c_ss(min_age:max_age, :, :, : ,it_marry_ctr, it_kids_ctr);
    y_head_inc_grp = y_head_inc(min_age:max_age, :, :, : ,it_marry_ctr, it_kids_ctr);
    y_spouse_inc_grp = y_spouse_inc(min_age:max_age, :, :, : ,it_marry_ctr, it_kids_ctr);
    yshr_nttxss_grp = yshr_nttxss(min_age:max_age, :, :, : ,it_marry_ctr, it_kids_ctr);

    mp_cl_ar_xyz_of_s = containers.Map('KeyType','char', 'ValueType','any');
    mp_cl_ar_xyz_of_s('y_all') = {y_all_grp(:), zeros(1)};
    mp_cl_ar_xyz_of_s('age_ss') = {age_ss_grp(:), zeros(1)};
    mp_cl_ar_xyz_of_s('educ_ss') = {educ_ss_grp(:), zeros(1)};
    mp_cl_ar_xyz_of_s('a_ss') = {a_ss_grp(:), zeros(1)};
    mp_cl_ar_xyz_of_s('ap_ss') = {ap_ss_grp(:), zeros(1)};
    mp_cl_ar_xyz_of_s('MPC') = {mn_MPC_C_gain_share_check_grp(:), zeros(1)};
    mp_cl_ar_xyz_of_s('Mass') = {Phi_true_grp(:), zeros(1)};
    mp_cl_ar_xyz_of_s('c_ss') = {c_ss_grp(:), zeros(1)};
    mp_cl_ar_xyz_of_s('y_head_inc') = {y_head_inc_grp(:), zeros(1)};
    mp_cl_ar_xyz_of_s('y_spouse') = {y_spouse_inc_grp(:), zeros(1)};
    mp_cl_ar_xyz_of_s('yshr_nttxss') = {yshr_nttxss_grp(:), zeros(1)};

    mp_cl_ar_xyz_of_s('ar_st_y_name') = ["y_all", "age_ss", "educ_ss", "a_ss", "ap_ss", "MPC", "

    % controls
    mp_support = containers.Map('KeyType','char', 'ValueType','any');
    mp_support('ar_fl_percentiles') = [0.01 10 25 50 75 90 99.99];
    mp_support('bl_display_final') = true;
    mp_support('bl_display_detail') = false;
    mp_support('bl_display_drvm2outcomes') = false;
    mp_support('bl_display_drvstats') = false;
    mp_support('bl_display_drvm2covcor') = false;

    % Call Function
    mp_cl_mt_xyz_of_s = ff_simu_stats(Phi_true_grp(:)/sum(Phi_true_grp,'all'), mp_cl_ar_xyz_of_s

    it_marital = ar_marital(it_marry_ctr);
    it_kids = ar_kids(it_kids_ctr);

    tb_dist_stats = mp_cl_mt_xyz_of_s('tb_outcomes');
```

```
        fl_age_mean = tb_dist_stats{"age_ss", "mean"};
        fl_age_p50 = tb_dist_stats{"age_ss", "p50"};

        fl_educ_mean = tb_dist_stats{"educ_ss", "mean"};

        fl_a_mean = tb_dist_stats{"a_ss", "mean"};
        fl_a_p50 = tb_dist_stats{"a_ss", "p50"};

        fl_ap_mean = tb_dist_stats{"ap_ss", "mean"};
        fl_ap_p50 = tb_dist_stats{"ap_ss", "p50"};

        fl_y_all_mean = tb_dist_stats{"y_all", "mean"};
        fl_y_all_p50 = tb_dist_stats{"y_all", "p50"};

        fl_mpc_mean = tb_dist_stats{"MPC", "mean"};
        fl_mpc_p50 = tb_dist_stats{"MPC", "p50"};

        fl_mass = tb_dist_stats{"Mass", "unweighted_sum"};

        fl_c_ss_mean = tb_dist_stats{"c_ss", "mean"};
        fl_c_ss_p50 = tb_dist_stats{"c_ss", "p50"};

        fl_y_head_inc_mean = tb_dist_stats{"y_head_inc", "mean"};
        fl_y_spouse_mean = tb_dist_stats{"y_spouse", "mean"};

        ar_store_stats = [it_marital, it_kids, ...
            fl_age_mean, fl_age_p50, fl_educ_mean, ...
            fl_a_mean, fl_a_p50, fl_ap_mean, fl_ap_p50, ...
            fl_y_all_mean, fl_y_all_p50, ...
            fl_mpc_mean, fl_mpc_p50, ...
            fl_mass, ...
            fl_c_ss_mean, fl_c_ss_p50, ...
            fl_y_head_inc_mean, fl_y_spouse_mean];

        it_row_ctr = it_row_ctr + 1;

        if (it_row_ctr>1)
            mt_store_stats_by_mk = [mt_store_stats_by_mk;ar_store_stats];
        else
            mt_store_stats_by_mk = [ar_store_stats];
        end
    end
end
```

```
  0x0 empty char array

  0x0 empty char array

-------------------------------
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xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
Marital =0
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
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xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
```

```
Marital =0 and kids =0
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
xxx tb_outcomes: all stats xxx
    OriginalVariableNames       y_all        age_ss       educ_ss         a_ss          ap_ss
    ______________________    ___________  ___________  ___________  ___________  __________

    {'mean'               }        71.752       42.174      0.25604       195.11        208.1
    {'unweighted_sum'     }    1.7831e+08         1909            1   1.2935e+05   1.6068e+0
    {'sd'                 }        62.288       14.196      0.43644       339.77        352.4
    {'coefofvar'          }        0.8681      0.33661       1.7046       1.7414        1.693
    {'gini'               }       0.40852       0.1892      0.68372       0.7026       0.6989
    {'min'                }        2.2124           19            0            0
    {'max'                }        1414.1           64            1       7837.6        8386.
    {'pYis0'              }             0            0      0.74396      0.11911      0.08185
    {'pYls0'              }             0            0            0            0
    {'pYgr0'              }             1            1      0.25604      0.88089       0.9181
    {'pYisMINY'           }    1.9394e-06     0.036566      0.74396      0.11911      0.08185
    {'pYisMAXY'           }    1.1947e-09     0.024953      0.25604   5.4117e-06   5.9148e-1
    {'p0_01'              }        3.6063           19            0            0
    {'p10'                }        20.129           22            0            0       0.2008
    {'p25'                }        31.931           29            0       3.7372        6.563
    {'p50'                }         53.79           44            0       65.686        70.53
    {'p75'                }        90.494           55            1       239.18        258.9
    {'p90'                }        143.31           61            1       525.49        583.8
    {'p99_99'             }        816.36           64            1       4974.3        5033.
    {'fl_cov_y_all'       }        3879.8       217.85       3.8458        17148         1823
    {'fl_cor_y_all'       }             1      0.24637      0.14147      0.81024       0.8304
    {'fl_cov_age_ss'      }        217.85       201.53     -0.25515       2124.1        2205.
    {'fl_cor_age_ss'      }       0.24637            1    -0.041181      0.44036       0.4407
    {'fl_cov_educ_ss'     }        3.8458     -0.25515      0.19048       8.5838        9.279
    {'fl_cor_educ_ss'     }       0.14147    -0.041181            1     0.057885      0.06032
    {'fl_cov_a_ss'        }         17148       2124.1       8.5838   1.1544e+05   1.1966e+0
    {'fl_cor_a_ss'        }       0.81024      0.44036     0.057885            1       0.9992
    {'fl_cov_ap_ss'       }         18233       2205.5       9.2793   1.1966e+05   1.2423e+0
    {'fl_cor_ap_ss'       }       0.83049      0.44078     0.060323      0.99922
    {'fl_cov_MPC'         }       -4.5809      -1.3124     0.020725      -17.446       -18.64
    {'fl_cor_MPC'         }      -0.30887     -0.38826      0.19943     -0.21564      -0.2221
    {'fl_cov_Mass'        }   -0.00012497  -5.6686e-05  -3.0201e-07  -0.00063245   -0.0006678
    {'fl_cor_Mass'        }      -0.21994     -0.43773    -0.075858     -0.20405      -0.2077
    {'fl_cov_c_ss'        }        1859.9       85.521       2.2319       8778.5        9253.
    {'fl_cor_c_ss'        }       0.97519      0.19675      0.16702      0.84382        0.857
    {'fl_cov_y_head_inc'  }        3879.8       217.85       3.8458        17148         1823
    {'fl_cor_y_head_inc'  }             1      0.24637      0.14147      0.81024       0.8304
    {'fl_cov_y_spouse'    }             0            0            0            0
    {'fl_cor_y_spouse'    }           NaN          NaN          NaN          NaN           Na
    {'fl_cov_yshr_nttxss'}         1.7036      0.14382    0.0019345       6.9206        7.370
    {'fl_cor_yshr_nttxss'}        0.79998      0.29631      0.12964      0.59576       0.6116
    {'fracByP0_01'        }    4.4303e-06     0.016474            0            0
    {'fracByP10'          }      0.020773     0.059565            0            0    5.8512e-0
    {'fracByP25'          }      0.075454      0.14379            0    0.0011338     0.001658
    {'fracByP50'          }       0.22298       0.3659            0     0.043403      0.03929
    {'fracByP75'          }       0.46643      0.67037            1      0.22326       0.2188
    {'fracByP90'          }       0.70129      0.88673            1      0.49372       0.5010
    {'fracByP99_99'       }       0.99869            1            1      0.99759       0.9971

xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
Marital =0 and kids =1
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
```

```
xxx tb_outcomes: all stats xxx
    OriginalVariableNames        y_all         age_ss        educ_ss         a_ss          ap_ss
    ______________________    ___________    ___________    __________    ___________    __________

    {'mean'                }        65.867         36.118       0.25753        94.382        101.22
    {'unweighted_sum'      }    1.7831e+08           1909             1    1.2935e+05    1.5913e+09
    {'sd'                  }        56.932         11.182       0.43728        214.92        223.55
    {'coefofvar'           }       0.86435         0.3096        1.6979        2.2771        2.2087
    {'gini'                }       0.40364        0.17438       0.68158       0.79318       0.79099
    {'min'                 }        2.2124             19             0             0             0
    {'max'                 }        1414.1             64             1        7837.6        8291.1
    {'pYis0'               }             0              0       0.74247       0.23563       0.21309
    {'pYls0'               }             0              0             0             0             0
    {'pYgr0'               }             1              1       0.25753       0.76437       0.78691
    {'pYisMINY'            }    1.6845e-06       0.020845       0.74247       0.23563       0.21309
    {'pYisMAXY'            }    3.4305e-10      0.0031122       0.25753     8.262e-07    1.6379e-10
    {'p0_01'               }        3.5188             19             0             0             0
    {'p10'                 }        19.292             22             0             0             0
    {'p25'                 }        30.023             26             0      0.029898       0.23918
    {'p50'                 }        49.454             35             0        10.255        14.159
    {'p75'                 }        82.311             45             1         82.04        100.97
    {'p90'                 }        130.49             52             1        276.88        293.79
    {'p99_99'              }        764.17             64             1        3737.2        3751.1
    {'fl_cov_y_all'        }        3241.3         152.53        4.1103        9427.3         10125
    {'fl_cor_y_all'        }             1        0.23959       0.16511       0.77047       0.79555
    {'fl_cov_age_ss'       }        152.53         125.05       0.19904        967.92          1008
    {'fl_cor_age_ss'       }       0.23959              1      0.040704       0.40274       0.40323
    {'fl_cov_educ_ss'      }        4.1103        0.19904       0.19121        5.7853        6.3576
    {'fl_cor_educ_ss'      }       0.16511       0.040704             1      0.061559      0.065037
    {'fl_cov_a_ss'         }        9427.3         967.92        5.7853         46190         47995
    {'fl_cor_a_ss'         }       0.77047        0.40274      0.061559             1       0.99895
    {'fl_cov_ap_ss'        }         10125           1008        6.3576         47995         49975
    {'fl_cor_ap_ss'        }       0.79555        0.40323      0.065037       0.99895             1
    {'fl_cov_MPC'          }       -8.9788        -1.3659      0.021532       -20.591        -22.11
    {'fl_cor_MPC'          }      -0.45848       -0.35509       0.14315      -0.27853      -0.28753
    {'fl_cov_Mass'         }   -4.8054e-05    -1.3242e-05    -1.409e-07   -0.00013616    -0.0001451
    {'fl_cor_Mass'         }      -0.33303       -0.46722      -0.12714      -0.24996      -0.25609
    {'fl_cov_c_ss'         }        1766.6         76.831        2.5674        5341.5        5695.3
    {'fl_cor_c_ss'         }       0.98556        0.21823       0.18649        0.7894       0.80918
    {'fl_cov_y_head_inc'   }        3241.3         152.53        4.1103        9427.3         10125
    {'fl_cor_y_head_inc'   }             1        0.23959       0.16511       0.77047       0.79555
    {'fl_cov_y_spouse'     }             0              0             0             0             0
    {'fl_cor_y_spouse'     }           NaN            NaN           NaN           NaN           NaN
    {'fl_cov_yshr_nttxss'}          1.5555        0.10317     0.0024166        3.8467        4.1371
    {'fl_cor_yshr_nttxss'}         0.80522         0.2719       0.16288        0.5275       0.54542
    {'fracByP0_01'         }    4.7258e-06       0.010966             0             0             0
    {'fracByP10'           }      0.021712       0.068419             0             0             0
    {'fracByP25'           }      0.078097        0.15825             0    6.9352e-06    3.5474e-05
    {'fracByP50'           }       0.22713        0.37923             0     0.0099825      0.010737
    {'fracByP75'           }       0.46939        0.67298             1       0.11689       0.12619
    {'fracByP90'           }       0.70221        0.85638             1       0.39992       0.38891
    {'fracByP99_99'        }       0.99866              1             1       0.99622       0.99554

xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
Marital =0 and kids =2
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
xxx tb_outcomes: all stats xxx
    OriginalVariableNames        y_all         age_ss         educ_ss          a_ss           ap_ss
```

```
    ______________________    ___________    ___________    ___________    ___________    __________

    {'mean'               }         64.473         34.566        0.24576         62.952         67.62
    {'unweighted_sum'     }     1.7831e+08           1909              1     1.2935e+05     1.5826e+0
    {'sd'                 }         54.982         9.1574        0.43053         161.65         168.9
    {'coefofvar'          }        0.85279        0.26492         1.7519         2.5678         2.498
    {'gini'               }        0.39845        0.14726        0.69833        0.83755        0.8405
    {'min'                }         2.2124             19              0              0
    {'max'                }         1414.1             64              1         7837.6           822
    {'pYis0'              }              0              0        0.75424        0.36638        0.3665
    {'pYls0'              }              0              0              0              0
    {'pYgr0'              }              1              1        0.24576        0.63362        0.6334
    {'pYisMINY'           }     9.8494e-07        0.01156        0.75424        0.36638        0.3665
    {'pYisMAXY'           }     6.7773e-11     0.00057855        0.24576        1.4e-07      9.363e-1
    {'p0_01'              }         3.5915             19              0              0
    {'p10'                }         19.324             23              0              0
    {'p25'                }         29.888             27              0              0
    {'p50'                }         48.811             34              0         1.9135         3.284
    {'p75'                }         80.448             41              0         51.664         56.74
    {'p90'                }         126.75             47              1         174.36         199.5
    {'p99_99'             }         740.25             64              1         2910.1         3038.
    {'fl_cov_y_all'       }           3023         108.56         4.4029         6789.1         7342.
    {'fl_cor_y_all'       }              1        0.21562          0.186        0.76387         0.790
    {'fl_cov_age_ss'      }         108.56         83.858        0.38657         516.18         539.9
    {'fl_cor_age_ss'      }        0.21562              1        0.09805         0.3487        0.3489
    {'fl_cov_educ_ss'     }         4.4029        0.38657        0.18536         4.3837         4.932
    {'fl_cor_educ_ss'     }          0.186        0.09805              1       0.062988       0.06779
    {'fl_cov_a_ss'        }         6789.1         516.18         4.3837          26131          2728
    {'fl_cor_a_ss'        }        0.76387         0.3487       0.062988              1        0.9987
    {'fl_cov_ap_ss'       }         7342.2         539.94         4.9328          27284          2855
    {'fl_cor_ap_ss'       }         0.7902        0.34891       0.067799        0.99878
    {'fl_cov_MPC'         }        -12.648          -1.27      0.0077811        -21.879        -23.53
    {'fl_cor_MPC'         }       -0.55643       -0.33546       0.043715       -0.32737       -0.3368
    {'fl_cov_Mass'        }    -7.6259e-05    -1.1065e-05    -2.8216e-07    -0.00014947    -0.0001602
    {'fl_cor_Mass'        }       -0.36259       -0.31587       -0.17133       -0.24172       -0.2479
    {'fl_cov_c_ss'        }         1746.8         59.484          2.819         3991.5         4289.
    {'fl_cor_c_ss'        }        0.98869        0.20214        0.20376        0.76839        0.7899
    {'fl_cov_y_head_inc'  }           3023         108.56         4.4029         6789.1         7342.
    {'fl_cor_y_head_inc'  }              1        0.21562          0.186        0.76387         0.790
    {'fl_cov_y_spouse'    }              0              0              0              0
    {'fl_cor_y_spouse'    }            NaN            NaN            NaN            NaN            Na
    {'fl_cov_yshr_nttxss'}          1.4898       0.073937      0.0027409           2.72         2.940
    {'fl_cor_yshr_nttxss'}          0.8086        0.24094        0.18997        0.50211        0.5192
    {'fracByP0_01'        }      4.972e-06      0.0063542              0              0
    {'fracByP10'          }        0.02237       0.067607              0              0
    {'fracByP25'          }       0.079911         0.1793              0              0
    {'fracByP50'          }        0.23057        0.42619              0      0.0018299      0.002042
    {'fracByP75'          }        0.47337        0.67985              0       0.091755       0.08396
    {'fracByP90'          }        0.70508        0.85252              1        0.32859        0.3322
    {'fracByP99_99'       }        0.99867              1              1        0.99463        0.9945

xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
Marital =0 and kids =3
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
xxx tb_outcomes: all stats xxx
    OriginalVariableNames        y_all         age_ss         educ_ss          a_ss          ap_ss
    ______________________    ___________    ___________    ___________    ___________    __________
```

```
    {'mean'                 }        63.898         34.068        0.22983         48.134          51.95
    {'unweighted_sum'       }    1.7831e+08           1909              1     1.2935e+05     1.5774e+0
    {'sd'                   }        54.001         7.9772        0.42073         134.32          141.0
    {'coefofvar'            }       0.84511        0.23415         1.8306         2.7906          2.715
    {'gini'                 }       0.39521        0.12909        0.72073        0.86678         0.8694
    {'min'                  }        2.2124             19              0              0
    {'max'                  }        1414.1             64              1         7837.6          8183.
    {'pYis0'                }             0              0        0.77017        0.45656         0.4513
    {'pYls0'                }             0              0              0              0
    {'pYgr0'                }             1              1        0.22983        0.54344         0.5486
    {'pYisMINY'             }    6.8879e-07      0.0083137        0.77017        0.45656         0.4513
    {'pYisMAXY'             }    1.1096e-11     0.00013776        0.22983     2.4752e-08     1.1431e-1
    {'p0_01'                }        3.6125             19              0              0
    {'p10'                  }        19.479             24              0              0
    {'p25'                  }        29.928             28              0              0
    {'p50'                  }        48.607             33              0        0.23918          0.498
    {'p75'                  }        79.715             39              0         29.898          37.19
    {'p90'                  }        125.03             45              1         146.89          152.5
    {'p99_99'               }        727.36             64              1         2546.8            263
    {'fl_cov_y_all'         }        2916.1         86.208         4.4997           5525          6009.
    {'fl_cor_y_all'         }             1        0.20012        0.19805        0.76171         0.7889
    {'fl_cov_age_ss'        }        86.208         63.635        0.47515         327.14          343.3
    {'fl_cor_age_ss'        }       0.20012              1        0.14157        0.30531         0.3051
    {'fl_cov_educ_ss'       }        4.4997        0.47515        0.17701         3.7005          4.224
    {'fl_cor_educ_ss'       }       0.19805        0.14157              1       0.065482        0.07117
    {'fl_cov_a_ss'          }          5525         327.14         3.7005          18042           1892
    {'fl_cor_a_ss'          }       0.76171        0.30531       0.065482              1         0.9986
    {'fl_cov_ap_ss'         }        6009.3         343.36         4.2241          18921           1989
    {'fl_cor_ap_ss'         }       0.78891        0.30515       0.071177        0.99863
    {'fl_cov_MPC'           }       -14.294        -1.1063     -0.0020988        -20.435         -22.07
    {'fl_cor_MPC'           }        -0.611       -0.32013      -0.011516       -0.35119        -0.3612
    {'fl_cov_Mass'          }   -4.6648e-05    -5.1607e-06    -2.1548e-07    -7.4065e-05    -7.9832e-0
    {'fl_cor_Mass'          }       -0.3662       -0.27425       -0.21712       -0.23375        -0.2399
    {'fl_cov_c_ss'          }        1734.9         49.892           2.92         3306.4          3575.
    {'fl_cor_c_ss'          }       0.99009        0.19275        0.21389        0.75862         0.7812
    {'fl_cov_y_head_inc'    }        2916.1         86.208         4.4997           5525          6009.
    {'fl_cor_y_head_inc'    }             1        0.20012        0.19805        0.76171         0.7889
    {'fl_cov_y_spouse'      }             0              0              0              0
    {'fl_cor_y_spouse'      }           NaN            NaN            NaN            NaN             Na
    {'fl_cov_yshr_nttxss'}           1.4552       0.059225      0.0028436         2.1663          2.353
    {'fl_cor_yshr_nttxss'}          0.81051         0.2233        0.20329         0.4851         0.5018
    {'fracByP0_01'          }    5.1241e-06      0.0046366              0              0
    {'fracByP10'            }      0.022798       0.072031              0              0
    {'fracByP25'            }      0.081073         0.1985              0              0
    {'fracByP50'            }       0.23275        0.41302              0     0.00019689      0.0001865
    {'fracByP75'            }       0.47593        0.67505              0       0.056161        0.05684
    {'fracByP90'            }       0.70691        0.86752              1        0.31708         0.2910
    {'fracByP99_99'         }       0.99868              1              1        0.99425         0.9938

xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
Marital =0 and kids =4
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
xxx tb_outcomes: all stats xxx
    OriginalVariableNames        y_all         age_ss         educ_ss          a_ss           ap_ss
    ______________________    ___________    ___________    ___________    ___________    __________

    {'mean'                 }        63.864         34.197         0.2079         41.099          44.67
    {'unweighted_sum'       }    1.7831e+08           1909              1     1.2935e+05     1.5749e+0
```

```
    {'sd'                }        53.609         7.1538          0.4058         120.68          127.2
    {'coefofvar'         }       0.83942         0.2092          1.9519         2.9363          2.849
    {'gini'              }       0.39289        0.11447         0.75112        0.88249         0.8837
    {'min'               }        2.2124             19               0              0
    {'max'               }        1414.1             64               1         7837.6          8164.
    {'pYis0'             }             0              0          0.7921        0.50485         0.4925
    {'pYls0'             }             0              0               0              0
    {'pYgr0'             }             1              1          0.2079        0.49515         0.5074
    {'pYisMINY'          }    4.3493e-07      0.0045732          0.7921        0.50485         0.4925
    {'pYisMAXY'          }    1.4837e-12     4.6124e-05          0.2079      5.166e-09      1.5175e-1
    {'p0_01'             }        3.6887             19               0              0
    {'p10'               }        19.685             25               0              0
    {'p25'               }        30.153             29               0              0
    {'p50'               }         48.75             34               0              0        0.02989
    {'p75'               }        79.548             39               0         21.796          27.79
    {'p90'               }        124.62             44               1         122.46          130.0
    {'p99_99'            }        721.01             63               1         2377.1          2423.
    {'fl_cov_y_all'      }        2873.9         71.941          4.4963         4930.8            539
    {'fl_cor_y_all'      }             1        0.18759         0.20668        0.76216         0.7900
    {'fl_cov_age_ss'     }        71.941         51.176          0.5437         238.82          251.8
    {'fl_cor_age_ss'     }       0.18759              1         0.18729        0.27663         0.2765
    {'fl_cov_educ_ss'    }        4.4963         0.5437         0.16468         3.6463          4.175
    {'fl_cor_educ_ss'    }       0.20668        0.18729               1       0.074456        0.08084
    {'fl_cov_a_ss'       }        4930.8         238.82          3.6463          14564           1533
    {'fl_cor_a_ss'       }       0.76216        0.27663        0.074456              1         0.9985
    {'fl_cov_ap_ss'      }          5391         251.85          4.1759          15338           1620
    {'fl_cor_ap_ss'      }       0.79005        0.27658        0.080846        0.99852
    {'fl_cov_MPC'        }       -14.976        -1.0328       -0.010238        -18.883         -20.53
    {'fl_cor_MPC'        }      -0.63881       -0.33014       -0.057692       -0.35781        -0.3689
    {'fl_cov_Mass'       }   -2.7333e-05    -2.6204e-06     -1.3997e-07    -3.8707e-05     -4.2009e-0
    {'fl_cor_Mass'       }      -0.36608         -0.263        -0.24765        -0.2303        -0.2369
    {'fl_cov_c_ss'       }          1727         42.146          2.9107         2959.6          3218.
    {'fl_cor_c_ss'       }        0.9908         0.1812         0.22061        0.75427         0.7777
    {'fl_cov_y_head_inc' }        2873.9         71.941          4.4963         4930.8            539
    {'fl_cor_y_head_inc' }             1        0.18759         0.20668        0.76216         0.7900
    {'fl_cov_y_spouse'   }             0              0               0              0
    {'fl_cor_y_spouse'   }           NaN            NaN             NaN            NaN             Na
    {'fl_cov_yshr_nttxss'}         1.437       0.049376       0.0028207         1.8938          2.069
    {'fl_cor_yshr_nttxss'}       0.81163        0.20899         0.21047        0.47516         0.4922
    {'fracByP0_01'       }    5.1325e-06      0.0025409               0              0
    {'fracByP10'         }      0.022996       0.072385               0              0
    {'fracByP25'         }      0.081963        0.20856               0              0
    {'fracByP50'         }       0.23436        0.45949               0              0      4.2228e-0
    {'fracByP75'         }       0.47776        0.70775               0       0.041779        0.04305
    {'fracByP90'         }       0.70826        0.87861               1         0.2851          0.266
    {'fracByP99_99'      }       0.99869        0.99991               1        0.99427         0.9933

  0x0 empty char array

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xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
Marital =1
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
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xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
Marital =1 and kids =0
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
xxx tb_outcomes: all stats xxx
    OriginalVariableNames        y_all         age_ss        educ_ss          a_ss           ap_ss
    ______________________    ___________    ___________    __________    ___________    ___________

    {'mean'               }        109.57         44.041       0.38021         408.45          434.2
    {'unweighted_sum'     }    1.2919e+09           1909             1     1.2935e+05     8.4753e+09
    {'sd'                 }        83.584         15.135       0.48544         498.74          514.1
    {'coefofvar'          }       0.76282        0.34365        1.2768         1.2211          1.184
    {'gini'               }        0.3692        0.18905       0.50257        0.57853        0.57485
    {'min'                }        2.4223             19             0              0              0
    {'max'                }        2113.2             64             1         7837.6         9503.9
    {'pYis0'              }             0              0       0.61979        0.07588       0.036618
    {'pYls0'              }             0              0             0              0              0
    {'pYgr0'              }             1              1       0.38021        0.92412        0.96338
    {'pYisMINY'           }    5.1901e-09       0.043093       0.61979        0.07588       0.036618
    {'pYisMAXY'           }    2.4329e-11       0.038439       0.38021     1.8938e-05     1.2944e-11
    {'p0_01'              }         6.597             19             0              0              0
    {'p10'                }        35.716             21             0         1.9135         3.7372
    {'p25'                }        54.783             29             0         51.664         59.412
    {'p50'                }        88.064             48             0         239.18         270.71
    {'p75'                }         137.9             58             1         588.48          634.2
    {'p90'                }        204.71             62             1         1074.4         1074.4
    {'p99_99'             }        967.74             64             1         5833.4         5977.2
    {'fl_cov_y_all'       }        6986.3         361.95        5.7657          27155          31359
    {'fl_cor_y_all'       }             1        0.28612        0.1421        0.65142        0.72978
    {'fl_cov_age_ss'      }        361.95         229.06      -0.85351         4123.7         4247.6
    {'fl_cor_age_ss'      }       0.28612              1      -0.11617         0.5463        0.54592
    {'fl_cov_educ_ss'     }        5.7657       -0.85351       0.23565         16.048         17.247
    {'fl_cor_educ_ss'     }        0.1421       -0.11617             1       0.066283       0.069108
    {'fl_cov_a_ss'        }         27155         4123.7        16.048     2.4874e+05      2.541e+05
    {'fl_cor_a_ss'        }       0.65142         0.5463      0.066283              1        0.99103
    {'fl_cov_ap_ss'       }         31359         4247.6        17.247      2.541e+05      2.643e+05
    {'fl_cor_ap_ss'       }       0.72978        0.54592      0.069108        0.99103              1
    {'fl_cov_MPC'         }       -4.5371        -1.4233     0.0094147        -28.557        -30.413
    {'fl_cor_MPC'         }       -0.3463       -0.59994       0.12373       -0.36528       -0.37741
    {'fl_cov_Mass'        }   -7.4044e-05    -2.2911e-05    5.5246e-08    -0.00041977    -0.00044771
    {'fl_cor_Mass'        }      -0.19462       -0.33257      0.025002       -0.18491       -0.19132
    {'fl_cov_c_ss'        }        2941.3         188.87        4.2928          16348          17228
    {'fl_cor_c_ss'        }       0.86319        0.30611       0.21692        0.80402        0.82201
    {'fl_cov_y_head_inc'  }        4857.1         318.48        4.4672          25709          27033
    {'fl_cor_y_head_inc'  }       0.85851        0.31089       0.13595        0.76156        0.77684
    {'fl_cov_y_spouse'    }        4673.1           95.4        2.8501         3173.5         9494.5
    {'fl_cor_y_spouse'    }       0.59164       0.066703       0.06213       0.067335        0.19543
    {'fl_cov_yshr_nttxss'}         1.6494        0.13956     0.0013995         6.3032         7.2859
    {'fl_cor_yshr_nttxss'}         0.7665        0.35816       0.11198        0.49089        0.55047
    {'fracByP0_01'        }    5.3214e-06       0.018591             0              0              0
    {'fracByP10'          }      0.024266       0.049706             0     0.00015705     0.00034862
    {'fracByP25'          }      0.086535         0.1342             0       0.010018       0.010404
    {'fracByP50'          }       0.24796        0.35975             0       0.097271       0.098709
```

12.1.11 Distributional Statistics By Marital Status, Kids Count and Income Bins

Various statistics, including MPC (of the first check) by Marital Status and Kids COunt and income bins

```
it_row_ctr = 0;
for it_marry_ctr=1:mp_params('n_marriedgrid')

    display(['']);
    display(['']);
    display(['------------------------------']);
    display(['------------------------------']);
    display(['------------------------------']);
    display(['------------------------------']);
    display(['xxxxxxxxxxxxxxxxxxxxxxxxxxxxxx']);
    display(['Marital =' num2str(ar_marital(it_marry_ctr))]);
    display(['xxxxxxxxxxxxxxxxxxxxxxxxxxxxxx']);
    display(['------------------------------']);
    display(['------------------------------']);

    for it_kids_ctr=1:mp_params('n_kidsgrid')
        display(['xxxxxxxxxxxxxxxxxxxxxxxxxxxxxx']);
        display(['Marital =' num2str(ar_marital(it_marry_ctr)) ' and kids =' num2str(ar_kids(it_kids
        display(['xxxxxxxxxxxxxxxxxxxxxxxxxxxxxx']);

        % construct input data
        y_all_grp = y_all(min_age:max_age, :, :, : ,it_marry_ctr ,it_ctr);
        age_ss_grp = age_ss(min_age:max_age, :, :, : ,it_marry_ctr, it_kids_ctr);
        educ_ss_grp = educ_ss(min_age:max_age, :, :, : ,it_marry_ctr, it_kids_ctr);
        a_ss_grp = a_ss(min_age:max_age, :, :, : ,it_marry_ctr, it_kids_ctr);
        ap_ss_grp = ap_ss(min_age:max_age, :, :, : ,it_marry_ctr, it_kids_ctr);
        mn_MPC_C_gain_share_check_grp = mn_MPC_C_gain_share_check(min_age:max_age, :, :, :, it_marry
        Phi_true_grp = Phi_true_1(min_age:max_age, :, :, : ,it_marry_ctr, it_kids_ctr);
        c_ss_grp = c_ss(min_age:max_age, :, :, : ,it_marry_ctr, it_kids_ctr);
        y_head_inc_grp = y_head_inc(min_age:max_age, :, :, : ,it_marry_ctr, it_kids_ctr);
        y_spouse_inc_grp = y_spouse_inc(min_age:max_age, :, :, : ,it_marry_ctr, it_kids_ctr);
        yshr_nttxss_grp = yshr_nttxss(min_age:max_age, :, :, : ,it_marry_ctr, it_kids_ctr);

        % Income Bins
        ar_y_all = y_all_grp(:);
        ar_age_ss = age_ss_grp(:);
        ar_educ_ss = educ_ss_grp(:);
        ar_a_ss = a_ss_grp(:);
        ar_ap_ss = ap_ss_grp(:);
        ar_mn_MPC_C_gain_share_check = mn_MPC_C_gain_share_check_grp(:);
        ar_Phi_true = Phi_true_grp(:);
        ar_c_ss = c_ss_grp(:);
        ar_y_head_inc = y_head_inc_grp(:);
        ar_y_spouse_inc = y_spouse_inc_grp(:);
        ar_yshr_nttxss = yshr_nttxss_grp(:);

        % income bins loop
        for it_y_all_ctr=1:6

            % Current y group index
            % y is in thousands of dollars
            y_all_start = (it_y_all_ctr-1)*20;
            if (it_y_all_ctr == 6)
```

```
    y_all_end = max(ar_y_all);
else
    y_all_end = it_y_all_ctr*20;
end

display(['xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx']);
display(['Marital =' num2str(ar_marital(it_marry_ctr)) ', kids =' num2str(ar_kids(it_kid
display(['xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx']);

ar_y_idx = (ar_y_all >= y_all_start & ar_y_all <y_all_end);

ar_mky_y_all = ar_y_all(ar_y_idx);
ar_mky_age_ss = ar_age_ss(ar_y_idx);
ar_mky_educ_ss = ar_educ_ss(ar_y_idx);
ar_mky_a_ss = ar_a_ss(ar_y_idx);
ar_mky_ap_ss = ar_ap_ss(ar_y_idx);
ar_mky_mn_MPC_C_gain_share_check = ar_mn_MPC_C_gain_share_check(ar_y_idx);
ar_mky_Phi_true = ar_Phi_true(ar_y_idx);
ar_mky_c_ss = ar_c_ss(ar_y_idx);
ar_mky_y_head_inc = ar_y_head_inc(ar_y_idx);
ar_mky_y_spouse_inc = ar_y_spouse_inc(ar_y_idx);
ar_mky_yshr_nttxss = ar_yshr_nttxss(ar_y_idx);

mp_cl_ar_xyz_of_s = containers.Map('KeyType','char', 'ValueType','any');
mp_cl_ar_xyz_of_s('y_all') = {ar_mky_y_all(:), zeros(1)};
mp_cl_ar_xyz_of_s('age_ss') = {ar_mky_age_ss(:), zeros(1)};
mp_cl_ar_xyz_of_s('educ_ss') = {ar_mky_educ_ss(:), zeros(1)};
mp_cl_ar_xyz_of_s('a_ss') = {ar_mky_a_ss(:), zeros(1)};
mp_cl_ar_xyz_of_s('ap_ss') = {ar_mky_ap_ss(:), zeros(1)};
mp_cl_ar_xyz_of_s('MPC') = {ar_mky_mn_MPC_C_gain_share_check(:), zeros(1)};
mp_cl_ar_xyz_of_s('Mass') = {ar_mky_Phi_true(:), zeros(1)};
mp_cl_ar_xyz_of_s('c_ss') = {ar_mky_c_ss(:), zeros(1)};
mp_cl_ar_xyz_of_s('y_head_inc') = {ar_mky_y_head_inc(:), zeros(1)};
mp_cl_ar_xyz_of_s('y_spouse') = {ar_mky_y_spouse_inc(:), zeros(1)};
mp_cl_ar_xyz_of_s('yshr_nttxss') = {ar_mky_yshr_nttxss(:), zeros(1)};
mp_cl_ar_xyz_of_s('ar_st_y_name') = ["y_all", "age_ss", "educ_ss", "a_ss", "ap_ss", "MPC

% controls
mp_support = containers.Map('KeyType','char', 'ValueType','any');
mp_support('ar_fl_percentiles') = [0.01 10 25 50 75 90 99.99];
mp_support('bl_display_final') = true;
mp_support('bl_display_detail') = false;
mp_support('bl_display_drvm2outcomes') = false;
mp_support('bl_display_drvstats') = false;
mp_support('bl_display_drvm2covcor') = false;

% Call Function
mp_cl_mt_xyz_of_s = ff_simu_stats(ar_mky_Phi_true(:)/sum(ar_mky_Phi_true,'all'), mp_cl_a

it_marital = ar_marital(it_marry_ctr);
it_kids = ar_kids(it_kids_ctr);
fl_y_all_start = y_all_start;
fl_y_all_end = y_all_end;

tb_dist_stats = mp_cl_mt_xyz_of_s('tb_outcomes');
fl_age_mean = tb_dist_stats{"age_ss", "mean"};
fl_age_p50 = tb_dist_stats{"age_ss", "p50"};
```

```
            fl_educ_mean = tb_dist_stats{"educ_ss", "mean"};

            fl_a_mean = tb_dist_stats{"a_ss", "mean"};
            fl_a_p50 = tb_dist_stats{"a_ss", "p50"};

            fl_ap_mean = tb_dist_stats{"ap_ss", "mean"};
            fl_ap_p50 = tb_dist_stats{"ap_ss", "p50"};

            fl_y_all_mean = tb_dist_stats{"y_all", "mean"};
            fl_y_all_p50 = tb_dist_stats{"y_all", "p50"};

            fl_mpc_mean = tb_dist_stats{"MPC", "mean"};
            fl_mpc_p50 = tb_dist_stats{"MPC", "p50"};

            fl_mass = tb_dist_stats{"Mass", "unweighted_sum"};

            fl_c_ss_mean = tb_dist_stats{"c_ss", "mean"};
            fl_c_ss_p50 = tb_dist_stats{"c_ss", "p50"};

            fl_y_head_inc_mean = tb_dist_stats{"y_head_inc", "mean"};
            fl_y_spouse_mean = tb_dist_stats{"y_spouse", "mean"};

            ar_store_stats = [it_marital, it_kids, fl_y_all_start, fl_y_all_end, ...
                fl_age_mean, fl_age_p50, fl_educ_mean, ...
                fl_a_mean, fl_a_p50, fl_ap_mean, fl_ap_p50, ...
                fl_y_all_mean, fl_y_all_p50, ...
                fl_mpc_mean, fl_mpc_p50, ...
                fl_mass, ...
                fl_c_ss_mean, fl_c_ss_p50, ...
                fl_y_head_inc_mean, fl_y_spouse_mean];

            it_row_ctr = it_row_ctr + 1;

            if (it_row_ctr>1)
                mt_store_stats_by_mky = [mt_store_stats_by_mky;ar_store_stats];
            else
                mt_store_stats_by_mky = [ar_store_stats];
            end

        end
    end
end

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Marital =0
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
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Marital =0 and kids =0
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xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
Marital =0, kids =0, ybin =0 to 20
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xxx tb_outcomes: all stats xxx
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OriginalVariableNames	y_all	age_ss	educ_ss	a_ss	ap_ss
{'mean' }	14.688	34.974	0.18182	2.7226	2.6703
{'unweighted_sum' }	8.4083e+05	1909	1	2690.8	5.2986e+06
{'sd' }	3.6764	14.501	0.3857	10.125	9.7397
{'coefofvar' }	0.25031	0.41462	2.1213	3.7189	3.6474
{'gini' }	0.141	0.23128	0.78641	0.92249	0.92536
{'min' }	2.2124	19	0	0	0
{'max' }	20	64	1	413.31	409.12
{'pYis0' }	0	0	0.81818	0.53967	0.49704
{'pYls0' }	0	0	0	0	0
{'pYgr0' }	1	1	0.18182	0.46033	0.50296
{'pYisMINY' }	1.9988e-05	0.084859	0.81818	0.53967	0.49704
{'pYisMAXY' }	4.7568e-12	0.01496	0.18182	1.4916e-11	0
{'p0_01' }	2.6052	19	0	0	0
{'p10' }	9.307	20	0	0	0
{'p25' }	12.172	22	0	0	0
{'p50' }	15.236	30	0	0	0.011132
{'p75' }	17.778	48	0	0.23918	0.48535
{'p90' }	19.14	58	1	6.458	6.0051
{'p99_99' }	19.999	64	1	174.36	166.76
{'fl_cov_y_all' }	13.516	5.6455	0.0023525	6.9774	7.1104
{'fl_cor_y_all' }	1	0.1059	0.001659	0.18744	0.19857
{'fl_cov_age_ss' }	5.6455	210.28	-1.0046	57.763	56.482
{'fl_cor_age_ss' }	0.1059	1	-0.17962	0.39342	0.39991
{'fl_cov_educ_ss' }	0.0023525	-1.0046	0.14876	-0.29328	-0.29618
{'fl_cor_educ_ss' }	0.001659	-0.17962	1	-0.0751	-0.078843
{'fl_cov_a_ss' }	6.9774	57.763	-0.29328	102.52	98.523
{'fl_cor_a_ss' }	0.18744	0.39342	-0.0751	1	0.99907
{'fl_cov_ap_ss' }	7.1104	56.482	-0.29618	98.523	94.862
{'fl_cor_ap_ss' }	0.19857	0.39991	-0.078843	0.99907	1
{'fl_cov_MPC' }	-0.53539	-2.7127	0.035745	-1.3183	-1.3069
{'fl_cor_MPC' }	-0.41675	-0.53535	0.26522	-0.37261	-0.38399
{'fl_cov_Mass' }	6.2968e-06	-7.1893e-05	-3.4162e-07	-1.6308e-05	-1.5421e-05
{'fl_cor_Mass' }	0.18379	-0.53201	-0.095046	-0.17284	-0.1699
{'fl_cov_c_ss' }	11.292	6.0576	0.0049126	9.8651	9.6441
{'fl_cor_c_ss' }	0.98267	0.13365	0.0040749	0.31172	0.31679
{'fl_cov_y_head_inc' }	13.516	5.6455	0.0023525	6.9774	7.1104
{'fl_cor_y_head_inc' }	1	0.1059	0.001659	0.18744	0.19857
{'fl_cov_y_spouse' }	0	0	0	0	0
{'fl_cor_y_spouse' }	NaN	NaN	NaN	NaN	NaN
{'fl_cov_yshr_nttxss'}	0.052502	0.022189	1.0001e-05	0.025753	0.026154
{'fl_cor_yshr_nttxss'}	0.99014	0.10609	0.0017978	0.17635	0.18618
{'fracByP0_01' }	1.8388e-05	0.0461	0	0	0
{'fracByP10' }	0.051228	0.088792	0	0	0
{'fracByP25' }	0.16212	0.16288	0	0	0
{'fracByP50' }	0.39701	0.3352	0	0	6.3754e-06
{'fracByP75' }	0.68371	0.60992	0	0.013023	0.018274
{'fracByP90' }	0.86704	0.84015	1	0.16055	0.12661
{'fracByP99_99' }	1	1	1	0.99661	0.99334

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Marital =0, kids =0, ybin =20 to 40
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xxx tb_outcomes: all stats xxx
    OriginalVariableNames        y_all         age_ss       educ_ss         a_ss          ap_ss
    ______________________    ___________    __________    __________    ___________    ___________

    {'mean'               }        29.952        38.525       0.20638         25.273         26.927
    {'unweighted_sum'     }    1.9087e+06          1909             1         7355.4     1.8539e+07
    {'sd'                 }        5.6854        14.456        0.4047         44.204         44.499
    {'coefofvar'          }       0.18982       0.37522         1.961         1.7491         1.6525
    {'gini'               }       0.10955        0.2128        0.7532        0.72521        0.71433
    {'min'                }            20            19             0              0              0
    {'max'                }            40            64             1         890.69         885.93
    {'pYis0'              }             0             0       0.79362        0.16854        0.10132
    {'pYls0'              }             0             0             0              0              0
    {'pYgr0'              }             1             1       0.20638        0.83146        0.89868
    {'pYisMINY'           }   8.0995e-288      0.055295       0.79362        0.16854        0.10132
    {'pYisMAXY'           }    4.4783e-07      0.018337       0.20638     8.9396e-13              0
    {'p0_01'              }        20.004            19             0              0              0
    {'p10'                }        22.011            20             0              0              0
    {'p25'                }        25.065            25             0        0.80724         1.0692
    {'p50'                }        30.008            37             0          6.458         6.7423
    {'p75'                }        34.798            52             0         29.898          33.25
    {'p90'                }        37.826            59             1          82.04         83.859
    {'p99_99'             }        39.999            64             1         413.31         407.97
    {'fl_cov_y_all'       }        32.324        7.6438      0.038871         72.305         78.269
    {'fl_cor_y_all'       }             1      0.093006      0.016894        0.28771        0.30937
    {'fl_cov_age_ss'      }        7.6438        208.96      -0.73238         386.27         403.49
    {'fl_cor_age_ss'      }      0.093006             1      -0.12519        0.60451        0.62727
    {'fl_cov_educ_ss'     }      0.038871      -0.73238       0.16379        -2.1597        -2.3263
    {'fl_cor_educ_ss'     }      0.016894      -0.12519             1       -0.12073       -0.12918
    {'fl_cov_a_ss'        }        72.305        386.27       -2.1597           1954         1964.7
    {'fl_cor_a_ss'        }       0.28771       0.60451      -0.12073              1        0.99885
    {'fl_cov_ap_ss'       }        78.269        403.49       -2.3263         1964.7         1980.1
    {'fl_cor_ap_ss'       }       0.30937       0.62727      -0.12918        0.99885              1
    {'fl_cov_MPC'         }      -0.30518       -1.6691      0.062231        -3.0143        -3.2123
    {'fl_cor_MPC'         }        -0.208       -0.4474       0.59583       -0.26423       -0.27972
    {'fl_cov_Mass'        }   -4.5536e-06    -9.611e-05    3.7003e-08    -0.00013723    -0.00014127
    {'fl_cor_Mass'        }     -0.059962      -0.49775     0.0068451       -0.23242       -0.23768
    {'fl_cov_c_ss'        }        19.905         -11.1       0.19764         47.044         47.213
    {'fl_cor_c_ss'        }       0.88176      -0.19338       0.12299        0.26804        0.26721
    {'fl_cov_y_head_inc'  }        32.324        7.6438      0.038871         72.305         78.269
    {'fl_cor_y_head_inc'  }             1      0.093006      0.016894        0.28771        0.30937
    {'fl_cov_y_spouse'    }             0             0             0              0              0
    {'fl_cor_y_spouse'    }           NaN           NaN           NaN            NaN            NaN
    {'fl_cov_yshr_nttxss'}       0.058292      0.013838    6.9651e-05        0.12878        0.13941
    {'fl_cor_yshr_nttxss'}        0.99551      0.092947      0.016711        0.28287        0.30419
    {'fracByP0_01'        }    0.00010275       0.02727             0              0              0
    {'fracByP10'          }      0.070196      0.052525             0              0              0
    {'fracByP25'          }       0.18834       0.15502             0      0.0035395      0.0030822
    {'fracByP50'          }        0.4181       0.33724             0       0.038073       0.032523
    {'fracByP75'          }       0.68834       0.64594             0        0.19439        0.19244
    {'fracByP90'          }       0.87021       0.84782             1        0.53295        0.49305
    {'fracByP99_99'       }       0.99996             1             1        0.99833        0.99827

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Marital =0, kids =0, ybin =40 to 60
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xxx tb_outcomes: all stats xxx
    OriginalVariableNames        y_all         age_ss        educ_ss         a_ss          ap_ss
    ______________________    ___________    ___________    ___________    ___________    __________

    {'mean'                 }        49.366         41.657        0.23457         81.386        87.44
    {'unweighted_sum'       }    2.5368e+06           1909              1          13261    2.8595e+0
    {'sd'                   }        5.7595         14.091        0.42373          93.65         93.9
    {'coefofvar'            }       0.11667        0.33826         1.8064         1.1507        1.074
    {'gini'                 }      0.067274         0.1907        0.71409        0.55942       0.5484
    {'min'                  }            40             19              0              0
    {'max'                  }            60             64              1         1394.9        1389.
    {'pYis0'                }             0              0        0.76543       0.074319      0.03470
    {'pYls0'                }             0              0              0              0
    {'pYgr0'                }             1              1        0.23457        0.92568       0.9652
    {'pYisMINY'             }    1.1988e-05       0.035852        0.76543       0.074319      0.03470
    {'pYisMAXY'             }    2.6918e-19       0.022889        0.23457      1.725e-14
    {'p0_01'                }        40.004             19              0              0
    {'p10'                  }        41.738             22              0         1.9135        4.178
    {'p25'                  }        44.289             28              0         10.255        15.82
    {'p50'                  }        49.163             43              0         51.664        56.52
    {'p75'                  }        54.155             54              0         122.46        130.2
    {'p90'                  }        57.677             60              1         205.07        213.8
    {'p99_99'               }        59.997             64              1         729.18        718.6
    {'fl_cov_y_all'         }        33.172         5.7383       0.031749         121.07        129.8
    {'fl_cor_y_all'         }             1       0.070707       0.013009        0.22446       0.2398
    {'fl_cov_age_ss'        }        5.7383         198.55       -0.52991         911.38        944.6
    {'fl_cor_age_ss'        }      0.070707              1      -0.088752        0.69065       0.7133
    {'fl_cov_educ_ss'       }      0.031749       -0.52991        0.17955        -5.8166        -6.25
    {'fl_cor_educ_ss'       }      0.013009      -0.088752              1       -0.14658      -0.1569
    {'fl_cov_a_ss'          }        121.07         911.38        -5.8166         8770.3        8794.
    {'fl_cor_a_ss'          }       0.22446        0.69065       -0.14658              1       0.9991
    {'fl_cov_ap_ss'         }        129.84         944.69         -6.252         8794.3          883
    {'fl_cor_ap_ss'         }       0.23985        0.71331       -0.15698        0.99911
    {'fl_cov_MPC'           }      -0.09046       -0.71366       0.029802        -2.9986       -3.239
    {'fl_cor_MPC'           }     -0.096943       -0.31261        0.43412       -0.19763      -0.2127
    {'fl_cov_Mass'          }   -4.8663e-06    -5.8353e-05    -1.5517e-07    -0.00023117   -0.0002379
    {'fl_cor_Mass'          }     -0.088148       -0.43205      -0.038205       -0.25753       -0.264
    {'fl_cov_c_ss'          }        17.041        -28.838        0.46008         70.248        61.26
    {'fl_cor_c_ss'          }       0.62733       -0.43394        0.23022        0.15905       0.1382
    {'fl_cov_y_head_inc'    }        33.172         5.7383       0.031749         121.07        129.8
    {'fl_cor_y_head_inc'    }             1       0.070707       0.013009        0.22446       0.2398
    {'fl_cov_y_spouse'      }             0              0              0              0
    {'fl_cor_y_spouse'      }           NaN            NaN            NaN            NaN           Na
    {'fl_cov_yshr_nttxss'   }      0.032789      0.0057148     3.1401e-05        0.11935       0.1280
    {'fl_cor_yshr_nttxss'   }       0.99787       0.071088       0.012989        0.22339       0.2387
    {'fracByP0_01'          }    8.1986e-05       0.016353              0              0
    {'fracByP10'            }      0.082731       0.059676              0     0.00080736     0.001552
    {'fracByP25'            }       0.21327        0.13822              0       0.013027      0.01831
    {'fracByP50'            }       0.44964        0.36454              0        0.12623       0.1133
    {'fracByP75'            }        0.7111        0.65402              0        0.38755       0.3665
    {'fracByP90'            }       0.88093        0.85769              1        0.66284        0.654
    {'fracByP99_99'         }       0.99988              1              1        0.99951       0.9991

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Marital =0, kids =0, ybin =60 to 80
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xxx tb_outcomes: all stats xxx
    OriginalVariableNames        y_all         age_ss        educ_ss         a_ss          ap_ss
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    ______________________    ___________    ___________    ___________    ___________    ___________

    {'mean'              }        69.288         43.863        0.26092          158.1          169.5
    {'unweighted_sum'    }    3.0245e+06           1909              1          20103      3.6714e+0
    {'sd'                }        5.7381          13.54        0.43913         144.91          144.6
    {'coefofvar'         }      0.082816        0.30869          1.683        0.91655         0.8531
    {'gini'              }      0.047737        0.17193        0.67675        0.46696         0.4577
    {'min'               }            60             19              0              0
    {'max'               }        79.999             64              1         1913.5          1907.
    {'pYis0'             }             0              0        0.73908       0.036459       0.006283
    {'pYls0'             }             0              0              0              0
    {'pYgr0'             }             1              1        0.26092        0.96354         0.9937
    {'pYisMINY'          }    7.0785e-08       0.024362        0.73908       0.036459       0.006283
    {'pYisMAXY'          }    1.0527e-08       0.027901        0.26092     8.7298e-17
    {'p0_01'             }        60.004             19              0              0
    {'p10'               }        61.586             23              0         10.255          18.69
    {'p25'               }        64.221             32              0         39.794          54.13
    {'p50'               }         68.93             46              0         122.46          134.9
    {'p75'               }        74.224             56              1         239.18          250.8
    {'p90'               }        77.547             61              1         363.77           373.
    {'p99_99'            }        79.989             64              1         1074.4          1050.
    {'fl_cov_y_all'      }        32.926         4.1151       0.027108         145.03          154.4
    {'fl_cor_y_all'      }             1       0.052966       0.010758        0.17442         0.1861
    {'fl_cov_age_ss'     }        4.1151         183.33       -0.37329         1400.5            143
    {'fl_cor_age_ss'     }      0.052966              1      -0.062782        0.71382         0.7342
    {'fl_cov_educ_ss'    }      0.027108       -0.37329        0.19284        -9.2359         -9.793
    {'fl_cor_educ_ss'    }      0.010758      -0.062782              1       -0.14514        -0.1541
    {'fl_cov_a_ss'       }        145.03         1400.5        -9.2359          20999           2094
    {'fl_cor_a_ss'       }       0.17442        0.71382       -0.14514              1          0.999
    {'fl_cov_ap_ss'      }        154.46           1438        -9.7931          20944           2091
    {'fl_cor_ap_ss'      }       0.18612        0.73429       -0.15419         0.9993
    {'fl_cov_MPC'        }     -0.032152        -0.1128      0.0061122       -0.71422        -0.7941
    {'fl_cor_MPC'        }      -0.10557       -0.15696        0.26224      -0.092863        -0.1034
    {'fl_cov_Mass'       }   -2.7754e-06    -2.3008e-05    -3.5426e-07    -0.00016592     -0.0001677
    {'fl_cor_Mass'       }     -0.091883       -0.32281       -0.15325       -0.21751        -0.2203
    {'fl_cov_c_ss'       }        15.819        -34.276        0.57801         165.89           143.
    {'fl_cor_c_ss'       }       0.46921       -0.43083        0.22402        0.19483         0.1688
    {'fl_cov_y_head_inc' }        32.926         4.1151       0.027108         145.03          154.4
    {'fl_cor_y_head_inc' }             1       0.052966       0.010758        0.17442         0.1861
    {'fl_cov_y_spouse'   }             0              0              0              0
    {'fl_cor_y_spouse'   }           NaN            NaN            NaN            NaN             Na
    {'fl_cov_yshr_nttxss'}      0.020855      0.0026153      1.697e-05       0.091765         0.0977
    {'fl_cor_yshr_nttxss'}       0.99874       0.053079       0.010619        0.17402          0.185
    {'fracByP0_01'       }    0.00013554       0.010553              0              0
    {'fracByP10'         }      0.087755       0.048541              0      0.0025063       0.004513
    {'fracByP25'         }        0.2241        0.14456              0       0.028727        0.03673
    {'fracByP50'         }       0.46426        0.38247              0        0.18419         0.1735
    {'fracByP75'         }       0.72225        0.68941              1        0.48388         0.4489
    {'fracByP90'         }       0.88703        0.88024              1        0.74634         0.7160
    {'fracByP99_99'      }       0.99995              1              1        0.99979         0.9993

xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
Marital =0, kids =0, ybin =80 to 100
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xxx tb_outcomes: all stats xxx
    OriginalVariableNames        y_all         age_ss         educ_ss          a_ss          ap_ss
    ______________________    ___________    ___________    ___________    ___________    ___________
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{'mean' }	89.313	45.289	0.28587	244.08	261.1
{'unweighted_sum' }	3.4629e+06	1909	1	26756	4.4356e+0
{'sd' }	5.7791	13.023	0.45183	194.1	192.8
{'coefofvar' }	0.064706	0.28755	1.5805	0.79522	0.7385
{'gini' }	0.037295	0.15841	0.6408	0.4125	0.4039
{'min' }	80.001	19	0	0	
{'max' }	100	64	1	2377.1	2370.
{'pYis0' }	0	0	0.71413	0.020853	1.1851e-1
{'pYls0' }	0	0	0	0	
{'pYgr0' }	1	1	0.28587	0.97915	
{'pYisMINY' }	0	0.018972	0.71413	0.020853	1.1851e-1
{'pYisMAXY' }	3.7911e-06	0.02925	0.28587	1.1813e-15	
{'p0_01' }	80.012	19	0	0	0.7904
{'p10' }	81.54	25	0	29.898	43.52
{'p25' }	84.27	35	0	100.91	114.2
{'p50' }	88.922	48	0	205.07	224.4
{'p75' }	94.198	56	1	363.77	378.8
{'p90' }	97.585	61	1	525.49	536.5
{'p99_99' }	100	64	1	1281.9	1273.
{'fl_cov_y_all' }	33.398	2.1956	0.039297	150.26	159.6
{'fl_cor_y_all' }	1	0.029174	0.01505	0.13396	0.1432
{'fl_cov_age_ss' }	2.1956	169.59	-0.29823	1813.9	1849.
{'fl_cor_age_ss' }	0.029174	1	-0.050684	0.71759	0.7365
{'fl_cov_educ_ss' }	0.039297	-0.29823	0.20415	-12.356	-12.92
{'fl_cor_educ_ss' }	0.01505	-0.050684	1	-0.14089	-0.148
{'fl_cov_a_ss' }	150.26	1813.9	-12.356	37675	3741
{'fl_cor_a_ss' }	0.13396	0.71759	-0.14089	1	0.9994
{'fl_cov_ap_ss' }	159.68	1849.7	-12.922	37410	3719
{'fl_cor_ap_ss' }	0.14327	0.73653	-0.1483	0.99942	
{'fl_cov_MPC' }	-0.0031027	0.051957	0.0006815	0.63872	0.6402
{'fl_cor_MPC' }	-0.05432	0.40366	0.15261	0.33294	0.3358
{'fl_cov_Mass' }	-1.4164e-06	-8.0012e-06	-3.1745e-07	-9.5448e-05	-9.4333e-0
{'fl_cor_Mass' }	-0.083209	-0.20859	-0.23854	-0.16695	-0.1660
{'fl_cov_c_ss' }	15.988	-34.182	0.59583	378.89	341.3
{'fl_cor_c_ss' }	0.39229	-0.3722	0.187	0.27681	0.2509
{'fl_cov_y_head_inc' }	33.398	2.1956	0.039297	150.26	159.6
{'fl_cor_y_head_inc' }	1	0.029174	0.01505	0.13396	0.1432
{'fl_cov_y_spouse' }	0	0	0	0	
{'fl_cor_y_spouse' }	NaN	NaN	NaN	NaN	Na
{'fl_cov_yshr_nttxss'}	0.014829	0.0010034	1.7131e-05	0.066952	0.07114
{'fl_cor_yshr_nttxss'}	0.99914	0.030003	0.014763	0.13431	0.1436
{'fracByP0_01' }	0.00042007	0.0079591	0	0	5.0103e-0
{'fracByP10' }	0.090622	0.05099	0	0.0059303	0.008103
{'fracByP25' }	0.22976	0.15254	0	0.060679	0.05259
{'fracByP50' }	0.47206	0.40219	0	0.22278	0.212
{'fracByP75' }	0.72831	0.67181	1	0.53644	0.4926
{'fracByP90' }	0.88939	0.87436	1	0.78432	0.7455
{'fracByP99_99' }	1	1	1	0.99942	0.9994

xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
Marital =0, kids =0, ybin =100 to 1414.0634
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
xxx tb_outcomes: all stats xxx

OriginalVariableNames	y_all	age_ss	educ_ss	a_ss	ap_ss
{'mean' }	164.25	47.879	0.35462	603.16	641.9
{'unweighted_sum' }	1.6654e+08	1909	1	1.2935e+05	1.4733e+0

```
{'sd'                 }           74.664          11.785          0.4784          524.59          535.2
{'coefofvar'          }          0.45456         0.24615           1.349         0.86973         0.8337
{'gini'               }          0.20972         0.13265         0.54013         0.41585         0.4099
{'min'                }              100              19               0               0          2.660
{'max'                }           1413.7              64               1          7837.6          8386.
{'pYis0'              }                0               0         0.64538        0.008464
{'pYls0'              }                0               0               0               0
{'pYgr0'              }                1               1         0.35462         0.99154
{'pYisMINY'           }      8.0846e-15       0.0084319         0.64538        0.008464
{'pYisMAXY'           }       9.784e-09        0.035671         0.35462      2.5784e-05      2.8187e-0
{'p0_01'              }           100.01              19               0               0          8.390
{'p10'                }           105.91              30               0          122.46          146.1
{'p25'                }           116.38              40               0          239.18          290.4
{'p50'                }           140.36              50               0          467.15          508.3
{'p75'                }           184.67              58               1          807.24          835.4
{'p90'                }            250.3              62               1          1175.1          1271.
{'p99_99'             }           1005.7              64               1          6140.4          6451.
{'fl_cov_y_all'       }           5574.6          82.616          3.9383           27029           2868
{'fl_cor_y_all'       }                1        0.093888         0.11026          0.6901         0.7178
{'fl_cov_age_ss'      }           82.616           138.9       -0.051378          3187.5          3233.
{'fl_cor_age_ss'      }         0.093888               1      -0.0091126         0.51557         0.5126
{'fl_cov_educ_ss'     }           3.9383       -0.051378         0.22886          1.1548          1.862
{'fl_cor_educ_ss'     }          0.11026      -0.0091126               1       0.0046015       0.007275
{'fl_cov_a_ss'        }            27029          3187.5          1.1548      2.7519e+05      2.8051e+0
{'fl_cor_a_ss'        }           0.6901         0.51557       0.0046015               1         0.9990
{'fl_cov_ap_ss'       }            28687          3233.7          1.8629      2.8051e+05      2.8647e+0
{'fl_cor_ap_ss'       }          0.71786         0.51265       0.0072754         0.99906
{'fl_cov_MPC'         }       -0.0039422        0.067815     -2.0374e-06          1.5699          1.574
{'fl_cor_MPC'         }       -0.0078548         0.85602     -0.00063355         0.44519         0.4376
{'fl_cov_Mass'        }      -3.2407e-05     -4.7599e-07     -1.5824e-07     -0.00016835     -0.0001761
{'fl_cor_Mass'        }         -0.36338       -0.033813        -0.27693        -0.26869        -0.2755
{'fl_cov_c_ss'        }             2511           15.67          2.2388           14895           1549
{'fl_cor_c_ss'        }          0.94083        0.037196         0.13092         0.79429         0.8098
{'fl_cov_y_head_inc'  }           5574.6          82.616          3.9383           27029           2868
{'fl_cor_y_head_inc'  }                1        0.093888         0.11026          0.6901         0.7178
{'fl_cov_y_spouse'    }                0               0               0               0
{'fl_cor_y_spouse'    }              NaN             NaN             NaN             NaN             Na
{'fl_cov_yshr_nttxss'}           0.64609        0.011641      0.00050086          3.1347          3.324
{'fl_cor_yshr_nttxss'}           0.90808         0.10365         0.10987         0.62707         0.6518
{'fracByP0_01'        }       7.5135e-05        0.003346               0               0      1.097e-0
{'fracByP10'          }         0.062666        0.056801               0        0.013271        0.01293
{'fracByP25'          }          0.16403         0.16984               0        0.057688        0.06415
{'fracByP50'          }          0.35792         0.40929               0           0.223         0.2196
{'fracByP75'          }          0.60086         0.72112               1         0.50267         0.4758
{'fracByP90'          }          0.79433         0.90509               1         0.70917         0.7129
{'fracByP99_99'       }          0.99932               1               1         0.99885         0.9988
```

12.1.12 Store Aggregate To File

Store Several Files:

1. Overall Aggregate Statistics All Distribution
2. Aggregate Statistics Only for 18 to 64 year olds
3. Group Statistics by Kids
4. Group Statistics by Marital + Kids
5. Group Statistics by Marital + Kids + Income Bins

```
if (bl_save_csv)
    % All Stats All Ages
    mp_path = snw_mp_path('fan');
    spt_simu_results_csv = mp_path('spt_simu_results_csv');
    writetable(tb_dist_stats_all, [spt_simu_results_csv 'stats_all_allages.csv'], 'WriteRowNames', t
    % All Stats 18 to 64 Year old
    mp_path = snw_mp_path('fan');
    spt_simu_results_csv = mp_path('spt_simu_results_csv');
    writetable(tb_dist_stats_all_18to64, [spt_simu_results_csv 'stats_all_18t64.csv'], 'WriteRowName
    % Group by K: Kids only
    tb_store_stats_by_k = array2table(mt_store_stats_by_k, 'VariableNames', ...
        {'kids', 'married_mean' ...
        'age_mean', 'age_p50', 'educ_mean', ...
        'a_mean', 'a_p50', 'ap_mean', 'ap_p50', ...
        'y_all_mean', 'y_all_p50', ...
        'mpc_mean', 'mpc_p50', ...
        'mass',...
        'c_ss_mean', 'c_ss_p50', ...
        'y_head_inc_mean', 'y_spouse_mean'});
    mp_path = snw_mp_path('fan');
    spt_simu_results_csv = mp_path('spt_simu_results_csv');
    writetable(tb_store_stats_by_k, [spt_simu_results_csv 'stats_by_kids.csv']);
    % Group by MK: marry + kids only
    tb_store_stats_by_mk = array2table(mt_store_stats_by_mk, 'VariableNames', ...
        {'marital', 'kids', ...
        'age_mean', 'age_p50', 'educ_mean', ...
        'a_mean', 'a_p50', 'ap_mean', 'ap_p50', ...
        'y_all_mean', 'y_all_p50', ...
        'mpc_mean', 'mpc_p50', ...
        'mass',...
        'c_ss_mean', 'c_ss_p50', ...
        'y_head_inc_mean', 'y_spouse_mean'});
    mp_path = snw_mp_path('fan');
    spt_simu_results_csv = mp_path('spt_simu_results_csv');
    writetable(tb_store_stats_by_mk, [spt_simu_results_csv 'stats_by_marital_kids.csv']);
    % Group by MKY
    tb_store_stats_by_mky = array2table(mt_store_stats_by_mky, 'VariableNames', ...
        {'marital', 'kids', 'y_all_start', 'y_all_end', ...
        'age_mean', 'age_p50', 'educ_mean', ...
        'a_mean', 'a_p50', 'ap_mean', 'ap_p50', ...
        'y_all_mean', 'y_all_p50', ...
        'mpc_mean', 'mpc_p50', ...
        'mass',...
        'c_ss_mean', 'c_ss_p50', ...
        'y_head_inc_mean', 'y_spouse_mean'});
    mp_path = snw_mp_path('fan');
    spt_simu_results_csv = mp_path('spt_simu_results_csv');
    writetable(tb_store_stats_by_mky, [spt_simu_results_csv 'stats_by_marital_kids_20kincbins.csv'])
end
```

12.1.13 Store Key Stats to Compare to Key US Distributional Statistics

Earning, income and Wealth.

Income = interest earnings + Social Security + labor income + spousal income. This is equal to y_all.

Earnings = labor income + spousal income.

```
% Income Variable
if (min(abs(total_inc_VFI*58.056 - y_all), [], 'all')>0)
```

```
    error('someothing is wrong, total_inc_VFI should be equal to y_all');
end
income = y_all;
% Earning variable
% earn*fl_earn_ratio generated earn_VFI
earning = (mp_valpol_more_ss('earn_VFI') + spouse_inc_VFI)*58.056;
% Wealth Varaible
wealth = a_ss;
```

Generate Key Statistics for these three variables only, distributional Statistics Overall All Ages:

```
% construct input data
income_grp = income(min_age:82, :, :, : ,: ,:);
earning_grp = earning(min_age:82, :, :, : ,: ,:);
wealth_grp = wealth(min_age:82, :, :, : ,: ,:);
Phi_true_grp = Phi_true_1(min_age:82, :, :, : ,: ,:);

mp_cl_ar_xyz_of_s = containers.Map('KeyType','char', 'ValueType','any');
mp_cl_ar_xyz_of_s('earning') = {earning_grp(:), zeros(1)};
mp_cl_ar_xyz_of_s('income') = {income_grp(:), zeros(1)};
mp_cl_ar_xyz_of_s('wealth') = {wealth_grp(:), zeros(1)};
mp_cl_ar_xyz_of_s('earninglog') = {log(earning_grp(:)), zeros(1)};
mp_cl_ar_xyz_of_s('incomelog') = {log(income_grp(:)), zeros(1)};
mp_cl_ar_xyz_of_s('wealthlog') = {log(wealth_grp(:)), zeros(1)};
mp_cl_ar_xyz_of_s('ar_st_y_name') = ["earning", "income", "wealth", "earninglog", "incomelog", "weal

% controls
mp_support = containers.Map('KeyType','char', 'ValueType','any');
mp_support('ar_fl_percentiles') = [20 30 40 60 50 80 90 95 99];
mp_support('bl_display_final') = true;
mp_support('bl_display_detail') = false;
mp_support('bl_display_drvm2outcomes') = false;
mp_support('bl_display_drvstats') = false;
mp_support('bl_display_drvm2covcor') = false;

% Call Function
mp_cl_mt_xyz_of_s = ff_simu_stats(Phi_true_grp(:)/sum(Phi_true_grp,'all'), mp_cl_ar_xyz_of_s, mp_sup

xxx tb_outcomes: all stats xxx
    OriginalVariableNames     earning        income         wealth       earninglog     incomelog     w
    _____________________    __________    __________    __________    __________    __________    _

    {'mean'             }        72.136        84.974        245.22          -Inf        4.1042
    {'unweighted_sum'   }    9.5943e+07    7.9255e+09    1.2935e+05          -Inf    1.1455e+08
    {'sd'               }        80.749        84.549        391.42           NaN       0.81216
    {'coefofvar'        }        1.1194         0.995        1.5962           NaN       0.19789
    {'gini'             }       0.51369       0.44243       0.68023           NaN       0.11243
    {'min'              }             0        2.2124             0          -Inf       0.79408
    {'max'              }          2640        2953.5        7837.6        7.8785        7.9907
    {'pYis0'            }       0.10578             0       0.12285             0             0
    {'pYls0'            }             0             0             0       0.10695             0
    {'pYgr0'            }       0.89422             1       0.87715       0.89305             1
    {'pYisMINY'         }       0.10578     6.774e-07       0.12285       0.10578     6.774e-07
    {'pYisMAXY'         }    1.5964e-10     1.671e-12    6.0119e-06    1.5964e-10     1.671e-12    6
    {'p20'              }        15.969        29.216        3.7372        2.7707        3.3747
    {'p30'              }        29.464        38.184        15.308        3.3832        3.6424
    {'p40'              }        40.761        48.225        39.794        3.7077        3.8759
    {'p60'              }        65.423        74.426        146.89        4.1809        4.3098
    {'p50'              }        52.252        59.948         82.04        3.9561        4.0935
```

```
    {'p80'              }        108.96         122.39         413.31          4.691         4.8072
    {'p90'              }         159.7         176.61         729.18         5.0733         5.1739
    {'p95'              }        211.84         233.69         979.69         5.3558          5.454
    {'p99'              }        356.31         398.22         1773.5         5.8758          5.987
    {'fl_cov_earning'   }        6520.5         6671.7         8382.5            NaN         53.875
    {'fl_cor_earning'   }             1        0.97721        0.26521            NaN        0.82149
    {'fl_cov_income'    }        6671.7         7148.6          15059            NaN         57.878
    {'fl_cor_income'    }       0.97721              1        0.45504            NaN        0.84286
    {'fl_cov_wealth'    }        8382.5          15059     1.5321e+05            NaN         141.72
    {'fl_cor_wealth'    }       0.26521        0.45504              1            NaN         0.4458
    {'fl_cov_earninglog'}           NaN            NaN            NaN            NaN            NaN
    {'fl_cor_earninglog'}           NaN            NaN            NaN            NaN            NaN
    {'fl_cov_incomelog' }        53.875         57.878         141.72            NaN        0.65961
    {'fl_cor_incomelog' }       0.82149        0.84286         0.4458            NaN              1
    {'fl_cov_wealthlog' }           NaN            NaN            NaN            NaN            NaN
    {'fl_cor_wealthlog' }           NaN            NaN            NaN            NaN            NaN
    {'fracByP20'        }      0.012671        0.04827     0.00074821            NaN        0.14532
    {'fracByP30'        }      0.044498        0.08795      0.0041711            NaN        0.23096
    {'fracByP40'        }      0.093262        0.13869       0.016749            NaN        0.32262
    {'fracByP60'        }       0.23895        0.28076       0.095501            NaN        0.52207
    {'fracByP50'        }       0.15762        0.20209       0.045325            NaN        0.41971
    {'fracByP80'        }       0.47178        0.50479        0.32852            NaN        0.74357
    {'fracByP90'        }       0.65353         0.6766        0.56651            NaN        0.86486
    {'fracByP95'        }       0.78022        0.79527        0.70071            NaN        0.92947
    {'fracByP99'        }       0.92468        0.93132        0.90524            NaN        0.98459

tb_dist_stats_all = mp_cl_mt_xyz_of_s('tb_outcomes');
% Select columns
tb_dist_stats_all_save = tb_dist_stats_all(1:3,:);
ar_st_columns = ["coefofvar", "gini", "varianceoflog", ...
                 "p99p50ratio", "p90p50ratio", "meantomedian", "p50p30ratio", ...
                 "fracP0toP20", "fracP20toP40", "fracP40toP60", "fracP60toP80", "fracP80toP100", ...
                 "fracP90toP95", "fracP95toP99", "fracP99toP100"];

varianceoflog = tb_dist_stats_all{4:6,"sd"}.^2;

p99p50ratio = tb_dist_stats_all_save{:,"p99"}./tb_dist_stats_all_save{:,"p50"};
p90p50ratio = tb_dist_stats_all_save{:,"p90"}./tb_dist_stats_all_save{:,"p50"};
meantomedian = tb_dist_stats_all_save{:,"mean"}./tb_dist_stats_all_save{:,"p50"};
p50p30ratio = tb_dist_stats_all_save{:,"p50"}./tb_dist_stats_all_save{:,"p30"};
fracP0toP20 = tb_dist_stats_all_save{:,"fracByP20"};
fracP20toP40 = tb_dist_stats_all_save{:,"fracByP40"} - tb_dist_stats_all_save{:,"fracByP20"};
fracP40toP60 = tb_dist_stats_all_save{:,"fracByP60"} - tb_dist_stats_all_save{:,"fracByP40"};
fracP60toP80 = tb_dist_stats_all_save{:,"fracByP80"} - tb_dist_stats_all_save{:,"fracByP60"};
fracP80toP100 = 1 - tb_dist_stats_all_save{:,"fracByP80"};

fracP90toP95 = tb_dist_stats_all_save{:,"fracByP95"} - tb_dist_stats_all_save{:,"fracByP90"};
fracP95toP99 = tb_dist_stats_all_save{:,"fracByP99"} - tb_dist_stats_all_save{:,"fracByP95"};
fracP99toP100 = 1 - tb_dist_stats_all_save{:,"fracByP99"};

tb_dist_stats_all_save = addvars(tb_dist_stats_all_save, varianceoflog, 'Before', 'gini');
tb_dist_stats_all_save = addvars(tb_dist_stats_all_save, p99p50ratio);
tb_dist_stats_all_save = addvars(tb_dist_stats_all_save, p90p50ratio);
tb_dist_stats_all_save = addvars(tb_dist_stats_all_save, meantomedian);
tb_dist_stats_all_save = addvars(tb_dist_stats_all_save, p50p30ratio);
tb_dist_stats_all_save = addvars(tb_dist_stats_all_save, fracP0toP20);
tb_dist_stats_all_save = addvars(tb_dist_stats_all_save, fracP20toP40);
tb_dist_stats_all_save = addvars(tb_dist_stats_all_save, fracP40toP60);
```

```
tb_dist_stats_all_save = addvars(tb_dist_stats_all_save, fracP60toP80);
tb_dist_stats_all_save = addvars(tb_dist_stats_all_save, fracP80toP100);

tb_dist_stats_all_save = addvars(tb_dist_stats_all_save, fracP90toP95);
tb_dist_stats_all_save = addvars(tb_dist_stats_all_save, fracP95toP99);
tb_dist_stats_all_save = addvars(tb_dist_stats_all_save, fracP99toP100);
disp(tb_dist_stats_all_save(:, ar_st_columns));

               coefofvar     gini      varianceoflog    p99p50ratio    p90p50ratio    meantomedian
               _________    _______    _____________    ___________    ___________    ____________

    earning     1.1194      0.51369          NaN           6.819         3.0563          1.3805
    income       0.995      0.44243      0.65961          6.6427          2.946          1.4174
    wealth      1.5962      0.68023          NaN          21.618         8.8881           2.989

% Core Stats Table
if (bl_save_csv)
    mp_path = snw_mp_path('fan');
    spt_simu_results_csv = mp_path('spt_simu_results_csv');
    writetable(tb_dist_stats_all_save(:, ar_st_columns), [spt_simu_results_csv 'stats_all_allages_vr
end
```

Statistics overall distributionally for 18 to 64 year olds.

```
% construct input data
income_grp = income(min_age:max_age, :, :, : ,: ,:);
earning_grp = earning(min_age:max_age, :, :, : ,: ,:);
wealth_grp = wealth(min_age:max_age, :, :, : ,: ,:);
Phi_true_grp = Phi_true_1(min_age:max_age, :, :, : ,: ,:);

mp_cl_ar_xyz_of_s = containers.Map('KeyType','char', 'ValueType','any');
mp_cl_ar_xyz_of_s('income') = {income_grp(:), zeros(1)};
mp_cl_ar_xyz_of_s('earning') = {earning_grp(:), zeros(1)};
mp_cl_ar_xyz_of_s('wealth') = {wealth_grp(:), zeros(1)};
mp_cl_ar_xyz_of_s('earninglog') = {log(earning_grp(:)), zeros(1)};
mp_cl_ar_xyz_of_s('incomelog') = {log(income_grp(:)), zeros(1)};
mp_cl_ar_xyz_of_s('wealthlog') = {log(wealth_grp(:)), zeros(1)};
mp_cl_ar_xyz_of_s('ar_st_y_name') = ["earning", "income", "wealth", "earninglog", "incomelog", "weal

% controls
mp_support = containers.Map('KeyType','char', 'ValueType','any');
mp_support('ar_fl_percentiles') = [20 30 40 60 50 80 90 95 99];
mp_support('bl_display_final') = true;
mp_support('bl_display_detail') = false;
mp_support('bl_display_drvm2outcomes') = false;
mp_support('bl_display_drvstats') = false;
mp_support('bl_display_drvm2covcor') = false;

% Call Function
mp_cl_mt_xyz_of_s = ff_simu_stats(Phi_true_grp(:)/sum(Phi_true_grp,'all'), mp_cl_ar_xyz_of_s, mp_sup

xxx tb_outcomes: all stats xxx
    OriginalVariableNames     earning        income        wealth      earninglog    incomelog     w
    _____________________    __________    __________    __________    __________    __________    _

    {'mean'             }        87.466        95.246         194.5        4.1711        4.2425
    {'unweighted_sum'   }     9.394e+07    7.7487e+09    1.2935e+05    1.5445e+06     1.116e+08
    {'sd'               }        82.434        89.631         344.5       0.76834       0.79264
    {'coefofvar'        }       0.94247       0.94104        1.7712        0.1842       0.18683
```

```
    {'gini'              }        0.417        0.42428        0.71579        0.10382         0.1055
    {'min'               }       2.2124         2.2124              0        0.79408        0.79408
    {'max'               }         2640         2953.5         7837.6         7.8785         7.9907
    {'pYis0'             }            0              0        0.14627              0              0
    {'pYls0'             }            0              0              0              0              0
    {'pYgr0'             }            1              1        0.85373              1              1
    {'pYisMINY'          }    8.617e-07     8.6135e-07        0.14627      8.617e-07     8.6135e-07
    {'pYisMAXY'          }   2.0299e-10     2.1248e-12     5.4766e-06     2.0299e-10     2.1248e-12    5
    {'p20'               }       34.093         35.624        0.80724         3.5291          3.573
    {'p30'               }       43.249         45.828          6.458          3.767         3.8249
    {'p40'               }       52.993         56.888         29.898         3.9702         4.0411
    {'p60'               }       77.857         85.184         100.91         4.3549         4.4448
    {'p50'               }        64.26          69.57         51.664         4.1629         4.2423
    {'p80'               }       124.43         137.12         318.35         4.8237         4.9209
    {'p90'               }       175.33          192.9         588.48         5.1667         5.2621
    {'p95'               }       227.34         250.34         890.69         5.4265         5.5228
    {'p99'               }       384.15         427.18         1640.6          5.951         6.0572
    {'fl_cov_earning'    }       6795.4         7319.6          13105           53.1         53.884
    {'fl_cor_earning'    }            1        0.99065        0.46144        0.83837        0.82467
    {'fl_cov_income'     }       7319.6         8033.6          17852         58.043         59.852
    {'fl_cor_income'     }      0.99065              1        0.57814        0.84283        0.84246
    {'fl_cov_wealth'     }        13105          17852     1.1868e+05         123.58          149.2
    {'fl_cor_wealth'     }      0.46144        0.57814              1        0.46687         0.5464
    {'fl_cov_earninglog'}          53.1         58.043         123.58        0.59034         0.6043
    {'fl_cor_earninglog'}       0.83837        0.84283        0.46687              1        0.99226
    {'fl_cov_incomelog' }        53.884         59.852          149.2         0.6043        0.62827
    {'fl_cor_incomelog' }       0.82467        0.84246         0.5464        0.99226              1
    {'fl_cov_wealthlog' }           NaN            NaN            NaN            NaN            NaN
    {'fl_cor_wealthlog' }           NaN            NaN            NaN            NaN            NaN
    {'fracByP20'         }     0.053802       0.050961     0.00014055        0.14882        0.14762
    {'fracByP30'         }     0.098055       0.093694      0.0021143        0.23646        0.23488
    {'fracByP40'         }        0.153        0.14753       0.015697         0.3292        0.32764
    {'fracByP60'         }      0.30069        0.29468       0.079605        0.52874        0.52766
    {'fracByP50'         }      0.21981        0.21374       0.034043        0.42667        0.42529
    {'fracByP80'         }      0.52452        0.52079        0.28918        0.74816         0.7478
    {'fracByP90'         }      0.69236        0.69054        0.51495        0.86758        0.86757
    {'fracByP95'         }      0.80576        0.80501        0.69371        0.93096        0.93099
    {'fracByP99'         }      0.93293        0.93437        0.90041        0.98483        0.98492
```

```
tb_dist_stats_all = mp_cl_mt_xyz_of_s('tb_outcomes');
% Select columns
tb_dist_stats_all_save = tb_dist_stats_all(1:3,:);
ar_st_columns = ["coefofvar", "gini", "varianceoflog", ...
                 "p99p50ratio", "p90p50ratio", "meantomedian", "p50p30ratio", ...
                 "fracP0toP20", "fracP20toP40", "fracP40toP60", "fracP60toP80", "fracP80toP100", ...
                 "fracP90toP95", "fracP95toP99", "fracP99toP100"];

varianceoflog = tb_dist_stats_all{4:6,"sd"}.^2;

p99p50ratio = tb_dist_stats_all_save{:,"p99"}./tb_dist_stats_all_save{:,"p50"};
p90p50ratio = tb_dist_stats_all_save{:,"p90"}./tb_dist_stats_all_save{:,"p50"};
meantomedian = tb_dist_stats_all_save{:,"mean"}./tb_dist_stats_all_save{:,"p50"};
p50p30ratio = tb_dist_stats_all_save{:,"p50"}./tb_dist_stats_all_save{:,"p30"};
fracP0toP20 = tb_dist_stats_all_save{:,"fracByP20"};
fracP20toP40 = tb_dist_stats_all_save{:,"fracByP40"} - tb_dist_stats_all_save{:,"fracByP20"};
fracP40toP60 = tb_dist_stats_all_save{:,"fracByP60"} - tb_dist_stats_all_save{:,"fracByP40"};
fracP60toP80 = tb_dist_stats_all_save{:,"fracByP80"} - tb_dist_stats_all_save{:,"fracByP60"};
fracP80toP100 = 1 - tb_dist_stats_all_save{:,"fracByP80"};
```

```
fracP90toP95 = tb_dist_stats_all_save{:,"fracByP95"} - tb_dist_stats_all_save{:,"fracByP90"};
fracP95toP99 = tb_dist_stats_all_save{:,"fracByP99"} - tb_dist_stats_all_save{:,"fracByP95"};
fracP99toP100 = 1 - tb_dist_stats_all_save{:,"fracByP99"};

tb_dist_stats_all_save = addvars(tb_dist_stats_all_save, varianceoflog, 'Before', 'gini');
tb_dist_stats_all_save = addvars(tb_dist_stats_all_save, p99p50ratio);
tb_dist_stats_all_save = addvars(tb_dist_stats_all_save, p90p50ratio);
tb_dist_stats_all_save = addvars(tb_dist_stats_all_save, meantomedian);
tb_dist_stats_all_save = addvars(tb_dist_stats_all_save, p50p30ratio);
tb_dist_stats_all_save = addvars(tb_dist_stats_all_save, fracP0toP20);
tb_dist_stats_all_save = addvars(tb_dist_stats_all_save, fracP20toP40);
tb_dist_stats_all_save = addvars(tb_dist_stats_all_save, fracP40toP60);
tb_dist_stats_all_save = addvars(tb_dist_stats_all_save, fracP60toP80);
tb_dist_stats_all_save = addvars(tb_dist_stats_all_save, fracP80toP100);

tb_dist_stats_all_save = addvars(tb_dist_stats_all_save, fracP90toP95);
tb_dist_stats_all_save = addvars(tb_dist_stats_all_save, fracP95toP99);
tb_dist_stats_all_save = addvars(tb_dist_stats_all_save, fracP99toP100);
disp(tb_dist_stats_all_save(:, ar_st_columns));

               coefofvar     gini      varianceoflog    p99p50ratio    p90p50ratio    meantomedian
               _________    _______    _____________    ___________    ___________    ____________

    earning     0.94247       0.417       0.59034          5.978          2.7285         1.3611
    income      0.94104     0.42428       0.62827         6.1403          2.7727         1.3691
    wealth       1.7712     0.71579           NaN         31.755          11.391         3.7648

% Core Stats Table
if (bl_save_csv)
    mp_path = snw_mp_path('fan');
    spt_simu_results_csv = mp_path('spt_simu_results_csv');
    writetable(tb_dist_stats_all_save(:, ar_st_columns), [spt_simu_results_csv 'stats_all_18t64_vrrc
end
```

Appendix A

Index and Code Links

A.1 Introduction links

1. Household Problem and Distributions: **mlx** | **m** | **pdf** | **html**
    - Summarize the household's dynamic programming problem and the distributions across heterogeneous households groups.
2. Values of Checks Conditional on 2019 Information: **mlx** | **m** | **pdf** | **html**
    - Summarize the computation of expecations relevant for planning objectives given information avaiable in 2019.
3. The Welfare Check Planning Problem: **mlx** | **m** | **pdf** | **html**
    - Summarize several allocation problem that condition allocations on income, marital status, the number of children less than 18, and possibly age.

A.2 Parameters links

1. Model Parameters: **mlx** | **m** | **pdf** | **html**
    - Model parameters, transition matrices, permanent heterogeneities.
    - **PrjOptiSNW**: *snw_mp_param()*
2. Model Controls Parameters: **mlx** | **m** | **pdf** | **html**
    - Parameters to control display options etc.
    - **PrjOptiSNW**: *snw_mp_control()*

A.3 Solving the Dynamic Life Cycle Problem links

1. Policy and Value Functions Dynamic Life Cycle Vectorized Bisection: **mlx** | **m** | **pdf** | **html**
    - Solving for policy and value functions from 18 to 100 years of age, at 1 year interval.
    - Households face persistent productivity shocks for household heads, stochastic shocks for spousal income, exogenous children under age 17 transition probability, and age-specific household-head survival probabilities.
    - The household can have up to four children under age 17, and has permanent heterogeneity in marital status and education types.
    - Problem solved for exact savings choices using vectorized bisection from from MEconTools.
    - **PrjOptiSNW**: *snwx_vfi_bisec_vec()*

A.4 Alternative Value Function Solution Testing links

1. Small Test Looped Minimizer Routine to Solve for Exact Savings Choices: **mlx** | **m** | **pdf** | **html**
    - Solve for the exact savings choices using matlab minimizer in an iterative loop.
    - The code demonstrates the solution structure. We use snwx_vfi_bisec_vec() with vectorized bisection for working implementations.
    - Due to speed, only show testing results at small grid without spousal shocks.

- **PrjOptiSNW**: *snw_vfi_main()*

2. Small Test Looped over States Grid Search Solution: **mlx** | **m** | **pdf** | **html**
   - The savings choice grid is the same as the savings states grid. Solve for optimal savings choices using grid-search. Loop over the state space, at each state-space point, vectorized optimization.
   - Our problem requires very high precision to solve for the marginal gains to households from each increment of welfare checks. We rely on the exact solution method from snwx_vfi_bisec_vec() for the working code.
   - Due to speed, only show testing results at small grid without spousal shocks.
   - **PrjOptiSNW**: *snw_vfi_main_grid_search()*
3. Small Test Vectorized Bisection Solve for Exact Savings Choices: **mlx** | **m** | **pdf** | **html**
   - Vectorized bisection exact solution code tested with small grid to compare to alternative solutiom methods.
   - Small grid without spousal shocks.
   - **PrjOptiSNW**: *snwx_vfi_bisec_vec()*
4. Small Test Spousal Shocks Test Vectorized Bisection Solve for Exact Savings Choices: **mlx** | **m** | **pdf** | **html**
   - Vectorized bisection exact solution code tested with small grid to compare to alternative solutiom methods.
   - Small grid with spousal shocks. There are three shocks: persistent household head income shock, i.i.d. spousal income shock, and persistent kids count transition shocks.
   - **PrjOptiSNW**: *snwx_vfi_bisec_vec()*

A.5 Solution with Unemployment links

1. Policy and Value Functions Dynamic Life Cycle if Unemployed: **mlx** | **m** | **pdf** | **html**
   - Solving the dynamic programming problem conditional on having an one period unemployment shock.
   - There is an unemployment shock in 2020. We first solve for the policy and value functions without the unemployment shock.
   - Using the value function from the world without the 2020 covid unemployment shock as future values, we solve for optimal choices in 2020 given a COVID unemployment shock.
   - The COVID shock lowers the realization of household's stochastic income process proportionally, but the lost income might be replenished by unemployment benefits up to 100 percent. Unemployment benefits have to be paid for by taxes.
   - **PrjOptiSNW**: *snwx_vfi_bisec_vec()*

A.6 Household Life Cycle Distribution links

1. Assets and Demographic Distributions with Continuous Exact Savings Choices (Loop): **mlx** | **m** | **pdf** | **html**
   - Simulate the life cycle distribution of assets, consumptions, and demographic patterns up to age 100, given exogenous initial distributions at age 18. Solves for budget clearing tax rates given distributional results. Uses vectorized bisection to solve for exact savings choices, looped distribution code.
   - **PrjOptiSNW**: *snw_ds_main()*
2. Assets and Demographic Distributions with Continuous Exact Savings Choices (Vectorized): **mlx** | **m** | **pdf** | **html**
   - Simulate the life cycle distributions This is the fully vectorized version of snw_ds_main().
   - **PrjOptiSNW**: *snw_ds_main_vec()*
3. Assets and Demographic Distributions with Grid Search: **mlx** | **m** | **pdf** | **html**
   - Grid search solution using grid search for savings choices, the savings state-space grid is the same as the savings choice-grid. Exact choice solution from snw_ds_main() generates significantly smoother distributions.
   - **PrjOptiSNW**: *snw_ds_main_grid_search()*

A.7 Value of Each Check links

1. Marginal Gain Per Check 2020 Employed: **mlx** | **m** | **pdf** | **html**
   - Evaluate the marginal gain per check in 2020 if household head is employed.
   - Solve for the increase in savings that is equivalent to the impact of an additional check on a household's resource available in 2020, given tax and interest rates considerations.
   - **PrjOptiSNW**: *snw_a4chk_wrk_bisec_vec()*
2. Marginal Gain Per Check 2020 Unemployed: **mlx** | **m** | **pdf** | **html**
   - Evaluate the marginal gain per check in 2020 if household head is unemployed.
   - Solve for the increase in savings that is equivalent to the impact of an additional check on a household's resource available in 2020, given tax and interest rates considerations.
   - **PrjOptiSNW**: *snw_a4chk_unemp_bisec_vec()*

A.8 Outcomes Full State Space with Savings, Shocks and Education links

1. Value in 2020 Given Age, Savings, Shocks, Kids, Educaiton and Marriage: **mlx** | **m** | **pdf** | **html**
   - Expected value and expected consumption from 2020 for a household given at a particular age (18-100), with a particular savings level, at a particular combination of household head and spouse income shocks, with 0 to 4 children, high or low Education status, and married or not married.
   - This uses the unemployment probability and generates the average value given the probability of the unemployment state that is dependent on the state-space.
   - **PrjOptiSNW**: *snw_evuvw20_jaeemk()*
2. Expected Value in 2019 Given Age, Savings, Shocks, Kids, Educaiton and Marriage: **mlx** | **m** | **pdf** | **html**
   - Expected value and expected consumption from 2019 for a household at a particular age (18-99), savings level, shocks combinations, kids/education/marriage status, given 2019 optimal savings choices, income shock transition probability as well as household children count transition probabilities.
   - **PrjOptiSNW**: *snw_evuvw19_jaeemk()*

A.9 Expectations Given Income, Age, Kids and Marital Status links

1. Expected Value from 2019 Given Age, Kids, Income and Marriage: **mlx** | **m** | **pdf** | **html**
   - Expected Value from 2019 Given Age, Kids, Income and Marriage.
   - Each 2019 income group consists of individuals with varying productivity shocks, savings, and from lower and higher education groups.
   - **PrjOptiSNW**: *snw_evuvw19_jmky()*
2. Expected Value from 2019 Given Age, Kids, Income and Marriage for All Checks: **mlx** | **m** | **pdf** | **html**
   - Expected Value from 2019 Given Age, Kids, Income and Marriage for All Checks.
   - This is the gateway function that solves policy functions, derive distributions, computes value in 2020 with and without unemployment shocks with varying check levels, derives 2019 planner expected values given household optimization and shocks, and finds the mass of individuals in different income/age/marital-status bins, and saves the simulated value of check results for the planner.
   - **PrjOptiSNW**: *snw_evuvw19_jmky_allchecks()*

A.10 Taxes links

1. Solve for Budget Clearing Tax Rates: **mlx** | **m** | **pdf** | **html**
   - Given welfare checks and unemployment insurance costs, solve for tax rate that clears the budget given household resource availability.
   - **PrjOptiSNW**: *snw_find_tax_rate()*, *snw_tax_hh()*

A.11 Calibration links

1. Calibrate Discount Factor and Normalize GDP: **mlx** | **m** | **pdf** | **html**
    - We calibrate the model so that the Asset/Savings/Capital to GDP/Income ratio is 3.
    - We normalize the model so that median household income is equal to 1 in the model.
    - **PrjOptiSNW**: *snw_calibrate_beta_norm_gdp()*

A.12 Summary Statistics links

1. Distributional Statistcs by Household Structure and Income Groups: **mlx** | **m** | **pdf** | **html**
    - Summarize overall model distributional and inequality statistics from covid-less times.
    - Statistics, including first check MPC, by marital status, children count, and income groups.
    - See snwx_evuvw19_jmky_mpc_allocated_m for summarizing function over optimal allocation results.

Bibliography

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