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.

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_
```

```
Elapsed time is 7731.142035 seconds.
Completed SNW_VFI_MAIN_GRID_SEARCH;SNW_MP_PARAM=default_moredense;SNW_MP_CONTROL=default_test
Elapsed time is 8442.857574 seconds.
Completed SNW_DS_MAIN;SNW_MP_PARAM=;default_moredense;SNW_MP_CONTROL=;default_test
```

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

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	max	pYis(
a_ss	4.1966	5130.2	8.2211	1.959	0.74586	0	135	0.1847
ap_ss	33.417	11476	25.564	0.765	0.44091	1	151	
cons_ss	1.1837	1.59e+07	1.0186	0.86052	0.40734	0.035637	141.66	
v_ss	-19.282	-9.477e+06	35.18	-1.8245	-0.7793	-867.32	25.519	
n_ss	2.3554	21	1.4375	0.61029	0.3128	1	6	
y_all	1.6288	2.398e+07	1.8953	1.1636	0.49934	0.038108	50.873	
y_head_inc	1.2693	5.6172e+05	1.541	1.2141	0.50187	0.038108	24.357	
y_head_earn	1.0492	2628.2	1.4242	1.3574	0.60462	0	18.957	0.201
y_spouse_inc	0.35948	55577	0.96095	2.6732	0.85293	0	26.627	0.5249
yshr_interest	0.10937	1.0949e+06	0.1698	1.5525	0.711	0	0.99299	0.1847
yshr_wage	0.78519	2.3994e+06	0.34085	0.43409	0.19417	0	1	0.1058
yshr_SS	0.10544	70381	0.24571	2.3303	0.91374	0	1	0.798
yshr_tax	0.17729	7.7889e+05	0.040058	0.22594	0.12851	0.036506	0.2552	
yshr_nttxss	0.071855	7.0851e+05	0.26576	3.6986	1.5402	-0.89184	0.2552	

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
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});
```

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

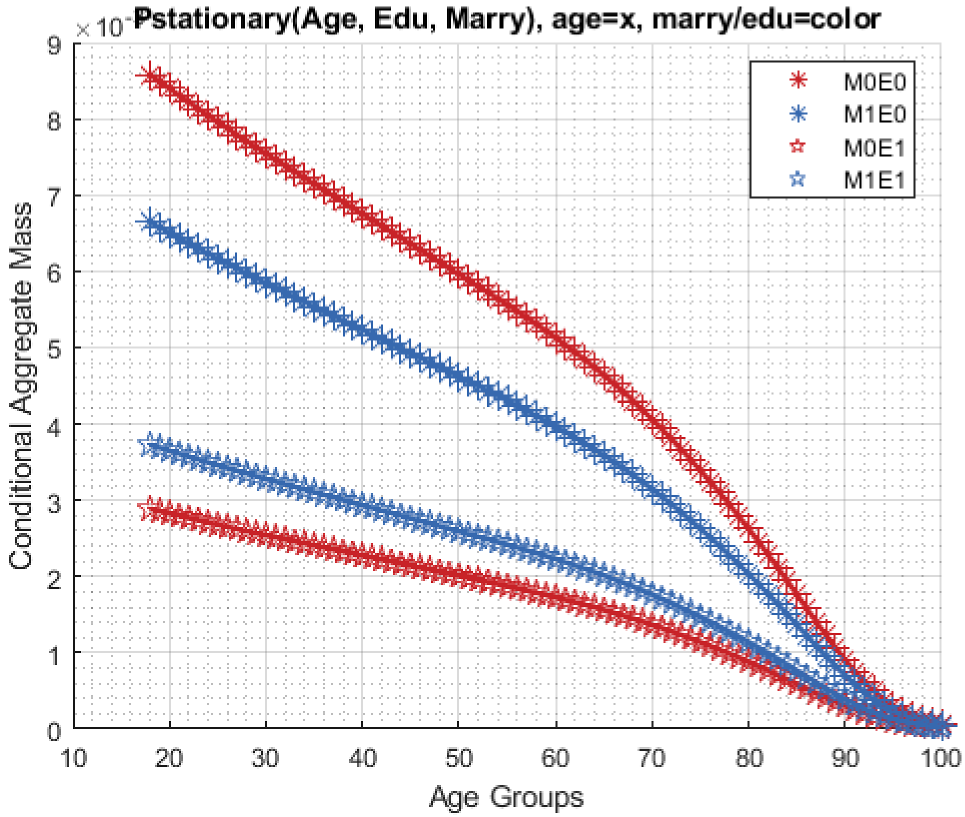
Tabulate value and policies along savings and shocks:

```
% 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_data
```

```
xxx  P(Age, EDU, MARRY))  xxxxxxxxxxxxxxxxxxxxxxxxxxx
    group    marry    edu    sum_age_18    sum_age_19    sum_age_20    sum_age_21    sum_age_22    sum_age_23    sum
    _____    _____    ___    __________    __________    __________    __________    __________    __________    ___

      1        0       0     0.0085768     0.0084866     0.0083969     0.0083078     0.0082194     0.0081317     0.
      2        1       0     0.0066438     0.0065739     0.0065044     0.0064354     0.0063669      0.006299     0.0
      3        0       1     0.0028875     0.0028571      0.002827      0.002797     0.0027672     0.0027377     0.0
      4        1       1     0.0037292     0.0036899     0.0036509     0.0036122     0.0035738     0.0035356     0.0
```

```
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

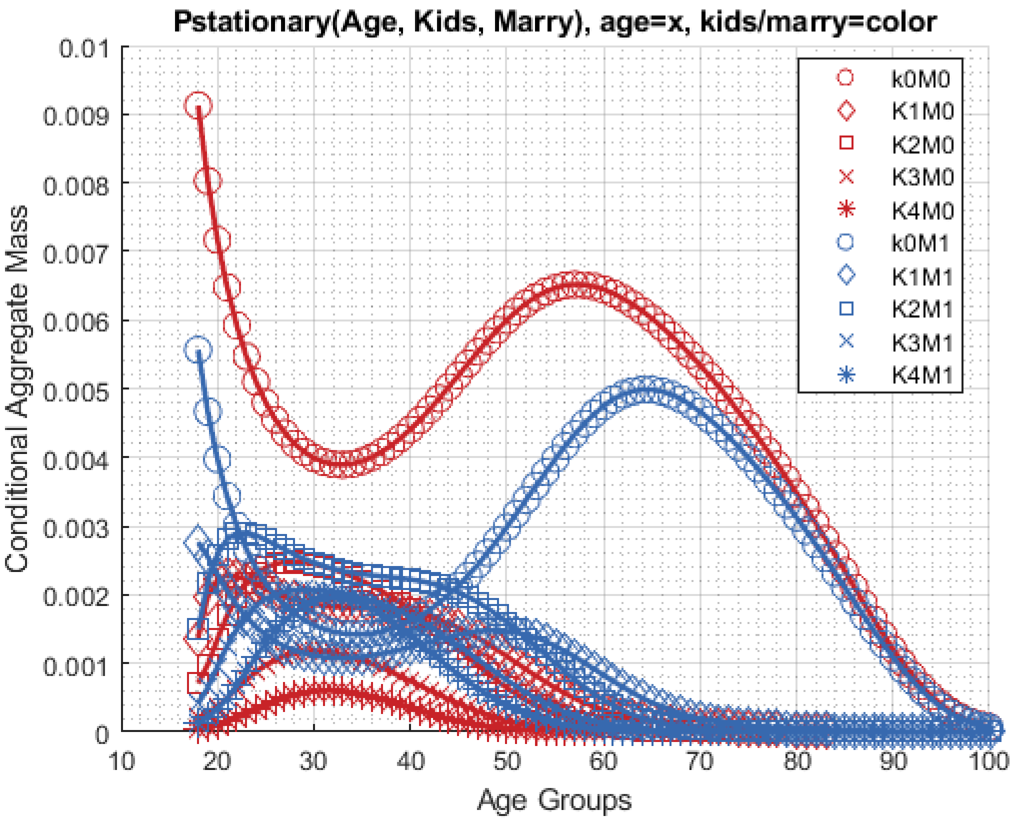
```
% NaN(n_jgrid,n_agrid,n_etagrid,n_educgrid,n_marriedgrid,n_kidsgrid);
ar_permute = [2,3,4,1,6,5];
% Value Function
tb_prob_amarrykids = ff_summ_nd_array("P(Age, Kids, Marry))", Phi_true, true, ["sum"], 3, 1, cl
```

xxx P(Age, Kids, Marry)) xxxxxxxxxxxxxxxxxxxxxxxxxx

group	kids	marry	sum_age_18	sum_age_19	sum_age_20	sum_age_21	sum_age_22	sum_age_23	su
1	1	0	0.0091249	0.0080278	0.0071652	0.0064765	0.0059205	0.0054683	0
2	2	0	0.0013699	0.0019743	0.0022187	0.0022858	0.0022687	0.0022149	0
3	3	0	0.00071266	0.00098425	0.0013537	0.0016929	0.0019639	0.0021645	0
4	4	0	0.00020622	0.00027865	0.00037326	0.00049476	0.00062818	0.00075864	0.
5	5	0	5.0761e-05	7.8715e-05	0.000113	0.00015485	0.00020534	0.00026306	0.
6	1	1	0.0055624	0.0046679	0.0039774	0.0034368	0.0030088	0.0026667	0
7	2	1	0.0027682	0.0025539	0.0023005	0.0020611	0.0018525	0.0016773	
8	3	1	0.0014982	0.0021823	0.0025943	0.0028096	0.002896	0.0029031	0
9	4	1	0.00041197	0.00064648	0.00095224	0.0012491	0.0015009	0.0016975	0
10	5	1	0.00013221	0.0002132	0.00033097	0.00049097	0.00068255	0.0008901	0

```
mp_support_graph('cl_st_graph_title') = {'Pstationary(Age, Kids, Marry), age=x, kids/marry=colo
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);
```



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

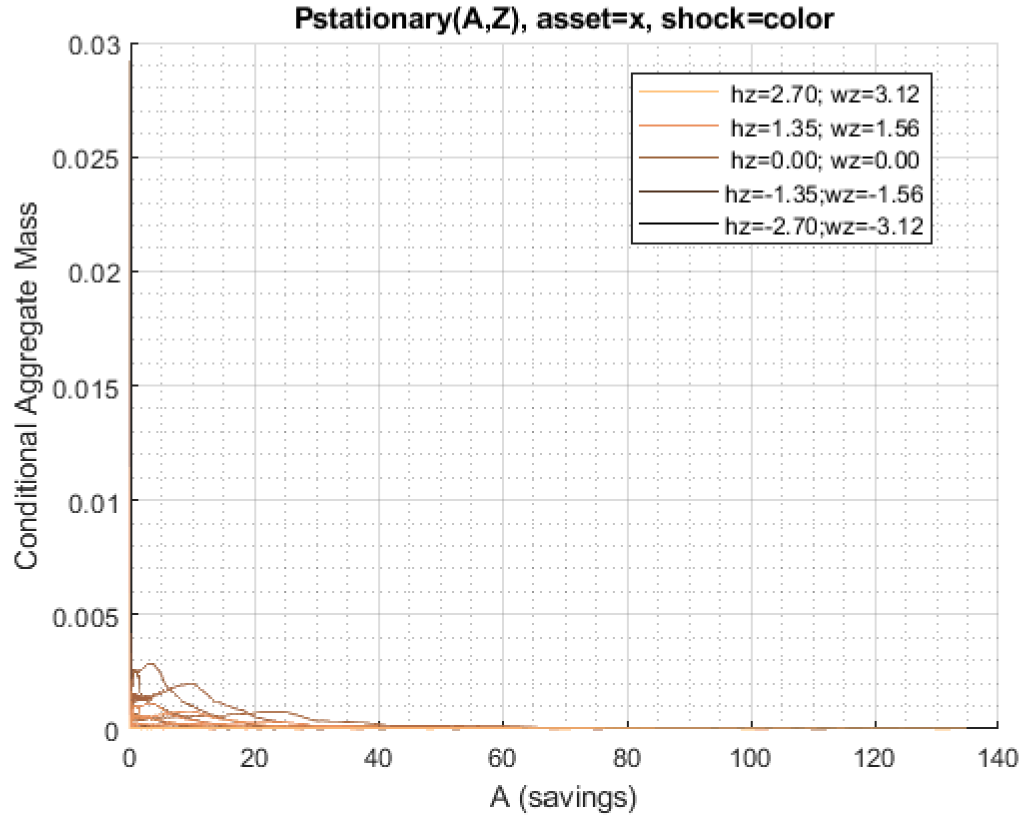
```
% NaN(n_jgrid,n_agrid,n_etagrid,n_educgrid,n_marriedgrid,n_kidsgrid);
ar_permute = [1,4,5,6,3,2];
% Value Function
tb_prob_az = ff_summ_nd_array("P(A,Z))", Phi_true, true, ["sum"], 4, 1, cl_mp_datasetdesc, ar_p
```

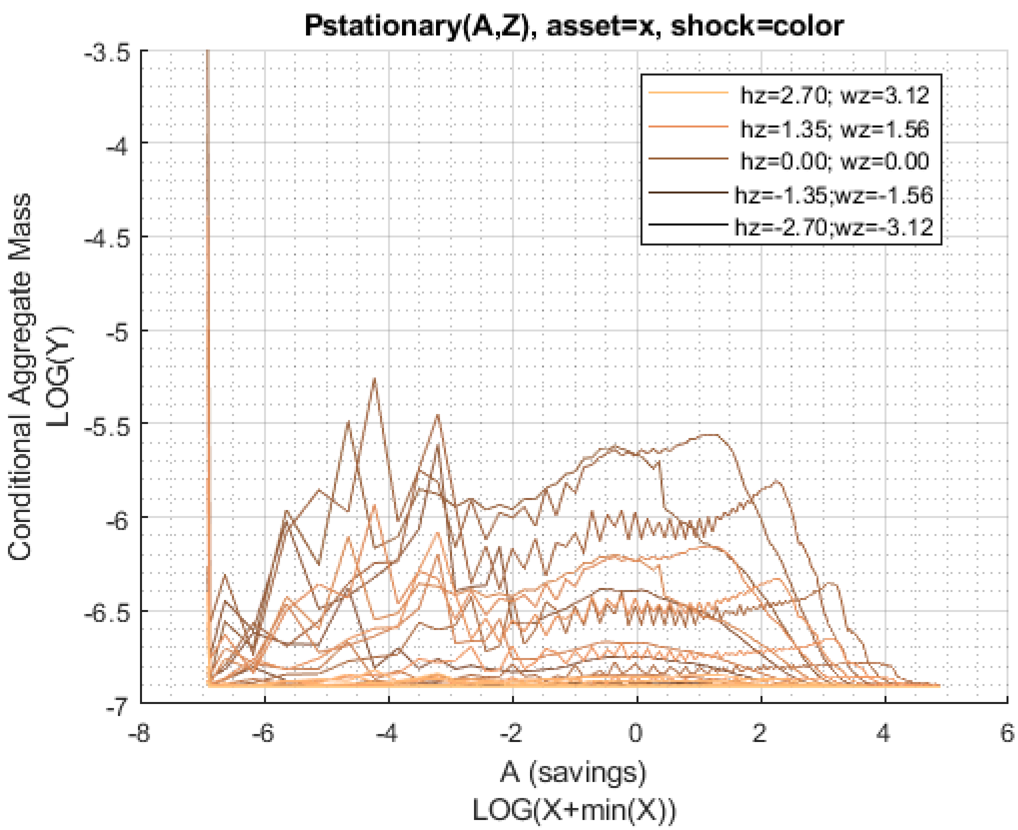
```
xxx  P(A,Z))  xxxxxxxxxxxxxxxxxxxxxxxxxxx
    group    savings    sum_eta_1    sum_eta_2    sum_eta_3    sum_eta_4    sum_eta_5    sum_eta_6    sum_eta_
    _____    _______    _________    _________    _________    _________    _________    _________    ________
```

1	0	1.7781e-05	0.00011464	0.00040781	0.00065248	0.00059124	0.00033667	0.000116
2	4e-05	2.8722e-07	1.1649e-06	3.9632e-06	1.1727e-06	9.1594e-06	8.6911e-07	1.9536e-
3	0.00032	8.5865e-07	2.0949e-06	1.3074e-05	9.3326e-06	1.8355e-05	2.7109e-06	1.4881e-
4	0.00108	2.4439e-06	7.4985e-06	7.825e-06	5.1658e-06	4.2511e-06	9.0564e-06	5.0327e-
5	0.00256	7.4917e-07	5.7803e-06	3.1919e-05	3.5332e-05	2.8844e-05	5.4161e-06	1.5346e-
6	0.005	1.6199e-07	5.684e-06	1.1553e-05	2.0567e-05	4.1715e-05	9.3727e-06	1.599e-
7	0.00864	2.9061e-07	1.562e-05	1.4073e-05	7.0288e-05	3.462e-05	1.6548e-05	3.2747e-
8	0.01372	9.5464e-08	2.3479e-06	1.7752e-05	2.4581e-05	9.4236e-05	2.0967e-05	3.8102e-
9	0.02048	1.4979e-07	5.1146e-06	2.195e-05	2.7505e-05	3.1649e-05	2.1267e-05	4.2213e-
10	0.02916	2.2894e-07	2.3319e-06	2.9711e-05	4.1965e-05	4.8965e-05	4.931e-05	9.1317e-
11	0.04	3.76e-07	3.6133e-06	5.9345e-05	4.0368e-05	4.4556e-05	7.3962e-05	7.943e-
12	0.05324	2.756e-07	2.2346e-06	1.4966e-05	3.6227e-05	2.4755e-05	3.695e-05	8.6828e-
13	0.06912	3.3888e-07	2.6932e-06	1.5812e-05	3.8986e-05	3.8211e-05	1.648e-05	1.3703e-
14	0.08788	3.0263e-07	2.2683e-06	1.6049e-05	3.5262e-05	2.667e-05	2.515e-05	4.7003e-
15	0.10976	2.6825e-07	2.1043e-06	2.4986e-05	3.6843e-05	3.4559e-05	1.5405e-05	5.4215e-
16	0.135	2.768e-07	1.8377e-06	9.0408e-06	3.5423e-05	3.2867e-05	2.4479e-05	1.3972e-
17	0.16384	2.8181e-07	1.9353e-06	9.257e-06	3.8786e-05	3.6177e-05	1.9607e-05	5.6747e-
18	0.19652	3.067e-07	2.0467e-06	9.1227e-06	3.8618e-05	3.0376e-05	2.7065e-05	8.0364e-
19	0.23328	3.3018e-07	2.1755e-06	1.0247e-05	4.2533e-05	4.2068e-05	1.8014e-05	1.2896e-
20	0.27436	3.6009e-07	2.3328e-06	1.0941e-05	4.3919e-05	3.3639e-05	2.5977e-05	1.1414e-
21	0.32	4.1186e-07	2.5895e-06	1.1659e-05	4.7371e-05	4.4252e-05	2.4973e-05	7.4152e-
22	0.37044	4.4759e-07	2.8965e-06	1.2583e-05	4.8243e-05	4.0516e-05	2.8508e-05	1.2102e-
23	0.42592	4.7723e-07	3.3135e-06	1.3374e-05	5.3569e-05	4.9866e-05	2.3551e-05	8.6802e-
24	0.48668	5.296e-07	3.4623e-06	1.4309e-05	5.3859e-05	5.1087e-05	3.5022e-05	1.3404e-
25	0.55296	5.459e-07	3.6382e-06	1.5329e-05	5.7267e-05	5.3924e-05	2.6534e-05	9.0603e-
26	0.625	5.615e-07	3.878e-06	1.5435e-05	5.7034e-05	5.5588e-05	3.3803e-05	1.2466e-
27	0.70304	5.616e-07	3.8405e-06	1.5148e-05	5.8804e-05	5.7189e-05	3.0223e-05	1.0521e-
28	0.78732	5.8141e-07	3.7688e-06	1.5044e-05	5.7591e-05	5.4784e-05	3.5161e-05	1.4966e-
29	0.87808	5.8397e-07	3.8463e-06	1.504e-05	5.6538e-05	5.6164e-05	2.6669e-05	8.6508e-
30	0.97556	5.7697e-07	3.9047e-06	1.4901e-05	5.5173e-05	5.4358e-05	3.4721e-05	1.2092e-
31	1.08	5.7655e-07	3.8874e-06	1.5177e-05	5.445e-05	5.7049e-05	2.7157e-05	8.8514e-
32	1.1916	5.6606e-07	3.778e-06	1.4865e-05	5.185e-05	5.5565e-05	3.2554e-05	1.2888e-
33	1.3107	5.5291e-07	3.7261e-06	1.43e-05	4.9523e-05	5.7531e-05	2.8096e-05	8.803e-
34	1.4375	5.3074e-07	3.574e-06	1.3682e-05	5.2445e-05	5.5479e-05	3.1707e-05	1.2033e-
35	1.5722	5.0996e-07	3.497e-06	1.3373e-05	3.5566e-05	5.7462e-05	2.7077e-05	8.732e-
36	1.715	5.0049e-07	3.3282e-06	1.3028e-05	3.4521e-05	5.6522e-05	3.2615e-05	1.2279e-
37	1.8662	4.7974e-07	3.329e-06	1.2601e-05	3.3434e-05	5.8509e-05	2.6878e-05	8.6252e-
38	2.0261	4.596e-07	3.1609e-06	1.2343e-05	3.178e-05	5.9485e-05	3.2101e-05	1.1267e-
39	2.1949	4.4954e-07	3.105e-06	1.2095e-05	3.1287e-05	5.9761e-05	2.7128e-05	8.4782e-
40	2.3728	4.1729e-07	3.0323e-06	1.186e-05	3.0175e-05	6.1927e-05	3.2379e-05	1.2107e-
41	2.56	3.9929e-07	2.924e-06	1.1544e-05	2.9921e-05	6.1827e-05	2.7425e-05	8.7221e-
42	2.7568	3.8414e-07	2.7951e-06	1.1251e-05	2.6814e-05	6.3135e-05	3.2763e-05	1.0976e-
43	2.9635	3.616e-07	2.7007e-06	1.0868e-05	2.5813e-05	6.3482e-05	2.7626e-05	9.8638e-
44	3.1803	3.3481e-07	2.5593e-06	1.0429e-05	2.5595e-05	6.3992e-05	3.3047e-05	1.0801e-
45	3.4074	3.131e-07	2.4198e-06	9.99e-06	2.4766e-05	6.3343e-05	2.858e-05	9.477e-
46	3.645	2.9457e-07	2.2754e-06	9.6582e-06	2.4476e-05	6.3967e-05	3.3608e-05	1.1984e-
47	3.8934	2.7703e-07	2.1293e-06	9.1931e-06	2.3981e-05	6.2378e-05	3.2136e-05	9.5584e-
48	4.1529	2.515e-07	2.018e-06	8.6923e-06	2.3738e-05	6.0398e-05	3.4717e-05	1.1182e-
49	4.4237	2.3412e-07	1.8599e-06	8.0926e-06	2.2417e-05	5.8532e-05	3.3219e-05	1.0914e-
50	4.706	2.1348e-07	1.7011e-06	7.6231e-06	2.1465e-05	5.6363e-05	3.5656e-05	1.1006e-
51	5	1.9593e-07	1.5641e-06	7.1764e-06	2.0854e-05	5.2743e-05	3.4502e-05	1.0412e-
52	5.306	1.7768e-07	1.4581e-06	6.7963e-06	2.007e-05	4.821e-05	3.7676e-05	1.2348e-
53	5.6243	1.5982e-07	1.3264e-06	6.2348e-06	1.9171e-05	4.3737e-05	3.5788e-05	1.0314e-
54	5.9551	1.4334e-07	1.204e-06	5.8483e-06	1.8296e-05	4.106e-05	3.8181e-05	1.1835e-
55	6.2986	1.3188e-07	1.1011e-06	5.4121e-06	1.7322e-05	3.901e-05	3.7324e-05	1.125e-
56	6.655	1.1797e-07	9.977e-07	4.9804e-06	1.6132e-05	3.7093e-05	4.0152e-05	1.1839e-
57	7.0246	1.0623e-07	9.1605e-07	4.7007e-06	1.5537e-05	3.4804e-05	4.0289e-05	1.1374e-
58	7.4077	9.4398e-08	8.3453e-07	4.3022e-06	1.4566e-05	3.2665e-05	4.1753e-05	1.2523e-
59	7.8045	8.2422e-08	7.5244e-07	3.9469e-06	1.3777e-05	3.0198e-05	4.183e-05	1.1428e-
60	8.2152	7.1784e-08	6.6939e-07	3.6212e-06	1.3091e-05	2.7445e-05	4.309e-05	1.2825e-
61	8.64	6.1804e-08	5.8987e-07	3.2784e-06	1.2179e-05	2.5843e-05	4.2847e-05	1.185e-
62	9.0792	5.3502e-08	5.1823e-07	2.9635e-06	1.1462e-05	2.4729e-05	4.4278e-05	1.2852e-
63	9.5331	4.5477e-08	4.5311e-07	2.6656e-06	1.0485e-05	2.3755e-05	4.4697e-05	1.2052e-
64	10.002	3.8449e-08	3.8904e-07	2.358e-06	9.5066e-06	2.227e-05	4.4247e-05	1.2916e-

65	10.486	3.2576e-08	3.3716e-07	2.0726e-06	8.8323e-06	2.1148e-05	4.3231e-05	1.2318e-
66	10.985	2.7144e-08	2.8859e-07	1.805e-06	8.1101e-06	1.9267e-05	4.0181e-05	1.3095e-
67	11.5	2.234e-08	2.4458e-07	1.5627e-06	7.3458e-06	1.7795e-05	3.8372e-05	1.2575e-
68	12.031	1.8426e-08	2.0804e-07	1.3548e-06	6.7189e-06	1.6482e-05	3.5562e-05	1.316e-
69	12.577	1.5109e-08	1.7304e-07	1.1665e-06	6.035e-06	1.5039e-05	3.3252e-05	1.2889e-
70	13.14	1.2136e-08	1.4416e-07	9.8771e-07	5.3216e-06	1.3797e-05	2.8982e-05	1.3271e-
71	13.72	9.7439e-09	1.1717e-07	8.4655e-07	4.7591e-06	1.2593e-05	2.5621e-05	1.3062e-
72	14.316	7.6519e-09	9.5696e-08	7.1116e-07	4.1025e-06	1.1341e-05	2.5829e-05	1.3421e-
73	14.93	6.0255e-09	7.71e-08	5.9381e-07	3.5724e-06	1.0484e-05	2.4658e-05	1.3262e-
74	15.561	4.7503e-09	6.2213e-08	4.9108e-07	3.1215e-06	9.5178e-06	2.3245e-05	1.3664e-
75	16.209	3.7139e-09	4.928e-08	4.0026e-07	2.6199e-06	8.2935e-06	2.1991e-05	1.4303e-
76	16.875	2.945e-09	3.8866e-08	3.2717e-07	2.258e-06	7.5498e-06	1.9996e-05	1.4103e-
77	17.559	2.3042e-09	3.075e-08	2.6267e-07	1.8986e-06	6.5071e-06	1.9146e-05	1.5081e-
78	18.261	1.7888e-09	2.4653e-08	2.1261e-07	1.6083e-06	5.7887e-06	1.8096e-05	1.4606e-
79	18.982	1.3465e-09	1.9495e-08	1.7008e-07	1.3129e-06	5.0003e-06	1.5323e-05	1.5298e-
80	19.722	9.9583e-10	1.5366e-08	1.3569e-07	1.0922e-06	4.3544e-06	1.2912e-05	1.5315e-
81	20.48	7.1218e-10	1.1848e-08	1.0869e-07	9.0647e-07	3.715e-06	1.1136e-05	1.581e-
82	21.258	5.1489e-10	8.9408e-09	8.6675e-08	7.3075e-07	3.2426e-06	1.018e-05	1.6445e-
83	22.055	3.7141e-10	6.6969e-09	6.8391e-08	5.9709e-07	2.8121e-06	9.0229e-06	1.6438e-
84	22.871	2.7136e-10	4.8427e-09	5.3798e-08	4.7428e-07	2.4448e-06	8.136e-06	1.6423e-
85	23.708	1.9274e-10	3.4542e-09	4.184e-08	3.8443e-07	2.0544e-06	7.4782e-06	1.6384e-
86	24.565	1.3871e-10	2.4987e-09	3.1083e-08	3.0722e-07	1.6959e-06	6.7652e-06	1.6412e-
87	25.442	9.9269e-11	1.8401e-09	2.3394e-08	2.4072e-07	1.4171e-06	6.0563e-06	1.5951e-
88	26.34	7.0282e-11	1.338e-09	1.7154e-08	1.9419e-07	1.1731e-06	5.8143e-06	1.4544e-

```
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);% Consum
```





Asset Mass by Age

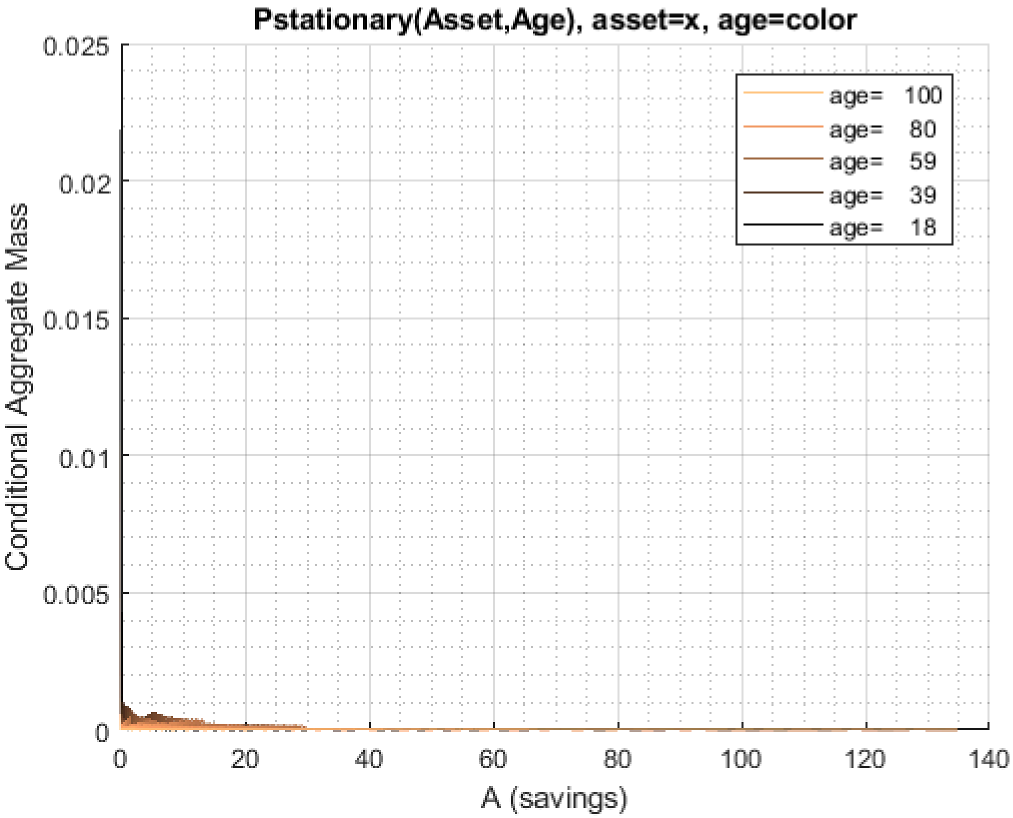
```
% NaN(n_jgrid,n_agrid,n_etagrid,n_educgrid,n_marriedgrid,n_kidsgrid);
ar_permute = [3,4,5,6,1,2];
% Value Function
tb_prob_aage = ff_summ_nd_array("P(A,Z))", Phi_true, true, ["sum"], 4, 1, cl_mp_datasetdesc, ar
```

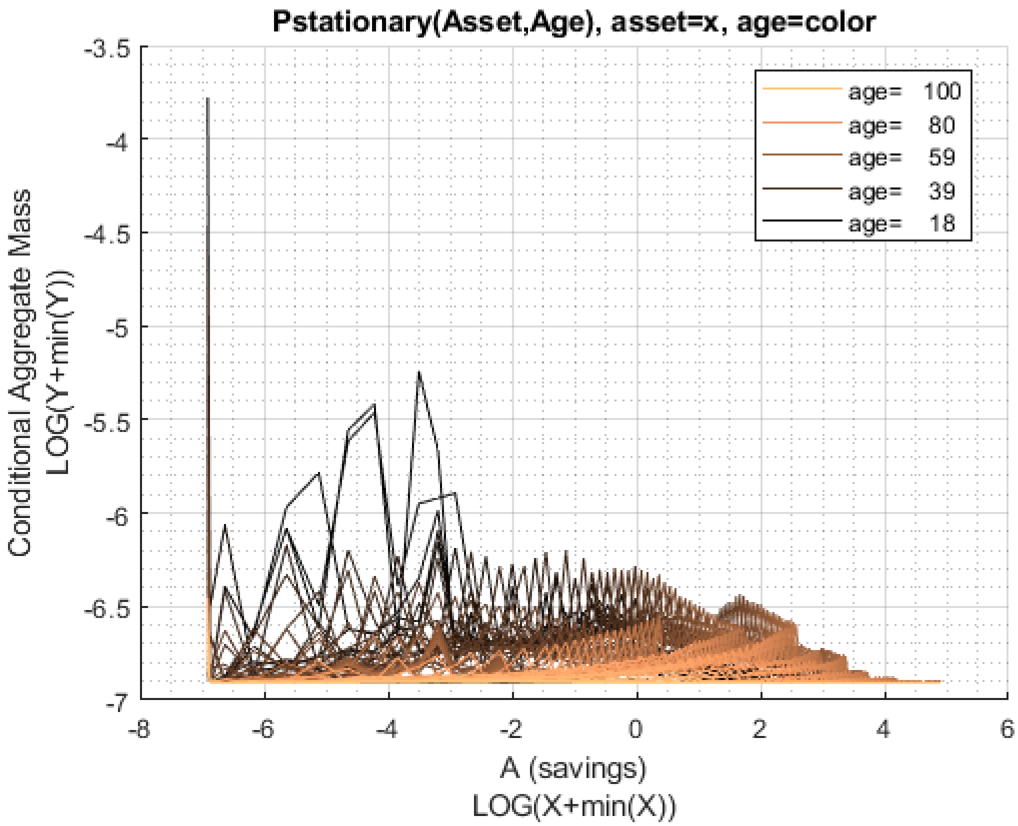
xxx P(A,Z)) xxxxxxxxxxxxxxxxxxxxxxxxxxx

group	savings	sum_age_18	sum_age_19	sum_age_20	sum_age_21	sum_age_22	sum_age_23	sum_age_
1	0	0.021837	0.002388	0.0018389	0.006441	0.0087965	0.010537	0.0105
2	4e-05	0	2.3862e-06	2.8257e-06	1.5227e-05	0.0005064	7.0852e-07	2.7519e-
3	0.00032	0	3.749e-05	3.8393e-05	0.00067452	0.0013201	3.5849e-05	3.7734e-
4	0.00108	0	0.00031485	0.0003134	0.00027518	6.9704e-05	0.00011755	3.9743e-
5	0.00256	0	0.0012853	0.0012851	0.0015569	8.2105e-05	0.00010095	9.5189e-
6	0.005	0	0.00034215	0.00051426	0.0020794	0.00015795	0.00014559	7.4827e-
7	0.00864	0	0.0028722	0.0026464	0.00033471	0.00033022	0.00018413	0.00016
8	0.01372	0	0.003431	0.003249	0.00029554	0.00030632	0.00018326	0.000183
9	0.02048	0	0.00028503	0.00067599	0.00046576	0.00041506	0.00032709	0.000291
10	0.02916	0	0.004274	0.0016076	0.00075151	0.00038657	0.00034427	0.000280
11	0.04	0	0.0024741	0.0016863	0.0015147	0.0012561	0.0011147	0.000227
12	0.05324	0	0.00012193	0.0017565	0.00025806	0.00022971	0.00029153	0.00106
13	0.06912	0	0.00044563	0.00062939	0.00029172	0.00029386	0.00022298	0.000251
14	0.08788	0	2.7692e-05	0.00011258	0.00016217	0.00018796	0.00024921	0.000233
15	0.10976	0	6.2377e-05	8.9179e-06	7.302e-05	0.00017801	0.00019976	0.000228
16	0.135	0	0.00067668	0.00016485	0.00010669	0.000221	0.00021163	0.000201
17	0.16384	0	5.8231e-06	5.1096e-05	0.00019395	0.00024128	0.0002562	0.000199
18	0.19652	0	3.2338e-05	4.7486e-05	0.00021219	0.000234	0.00027743	0.000270
19	0.23328	0	2.7827e-05	0.00062962	0.00032249	0.00035572	0.00022838	0.000237
20	0.27436	0	3.3098e-06	0.00012226	0.00073141	0.00035073	0.00032271	0.000245
21	0.32	0	4.0326e-05	0.00029658	0.00038943	0.00026142	0.00032984	0.000359
22	0.37044	0	0.00023294	0.00034328	0.00045557	0.00074931	0.00030675	0.000285
23	0.42592	0	0.00029162	0.00046139	0.0003154	0.00034178	0.00035298	0.000318
24	0.48668	0	0.0002901	0.00049107	0.00051926	0.00039455	0.00068504	0.000384
25	0.55296	0	0.00034886	0.00054566	0.00036044	0.00041009	0.00040979	0.000380
26	0.625	0	0.00050916	0.00043446	0.00028992	0.00033921	0.00039148	0.000684
27	0.70304	0	0.00039586	0.00037772	0.00035949	0.00035245	0.00032607	0.000396
28	0.78732	0	0.00020681	0.00035133	0.00037856	0.00031646	0.00036106	0.000309
29	0.87808	0	1.4297e-05	5.5411e-05	0.00015549	0.0003353	0.00029405	0.000320
30	0.97556	0	1.5592e-05	6.2891e-05	0.00029115	0.00021838	0.00028827	0.000294
31	1.08	0	2.009e-06	8.4112e-05	0.000141	0.00019198	0.00020228	0.000239
32	1.1916	0	2.1045e-05	0.00010104	0.00015492	0.00012578	0.00018109	0.000201
33	1.3107	0	1.4435e-06	6.9531e-05	5.1206e-05	0.0002098	0.00013935	0.000171
34	1.4375	0	5.1689e-07	4.651e-05	7.8499e-05	7.7448e-05	0.00011495	0.000141
35	1.5722	0	4.7793e-07	4.9348e-06	2.019e-05	8.9748e-05	0.00010189	0.000124
36	1.715	0	2.3446e-06	4.4093e-06	2.1355e-05	4.3825e-05	0.00017165	9.6853e-
37	1.8662	0	2.6545e-07	5.0217e-06	2.7683e-05	3.388e-05	5.2151e-05	0.000104
38	2.0261	0	5.4286e-07	3.5584e-06	1.9841e-05	3.2561e-05	4.6305e-05	7.157e-
39	2.1949	0	1.5332e-06	2.2585e-05	9.5902e-06	3.1168e-05	4.1488e-05	0.000132
40	2.3728	0	4.1159e-06	1.2545e-05	1.5104e-05	1.9972e-05	4.8064e-05	4.7455e-
41	2.56	0	4.9992e-06	9.9133e-06	2.4176e-05	2.6663e-05	3.4515e-05	5.0725e-
42	2.7568	0	7.7981e-06	1.537e-05	2.0404e-05	3.8764e-05	3.1904e-05	4.6315e-
43	2.9635	0	1.0694e-05	1.9867e-05	2.6641e-05	3.3667e-05	4.0931e-05	4.3215e-
44	3.1803	0	1.3309e-05	1.8778e-05	4.551e-05	3.4837e-05	4.3432e-05	4.2922e-
45	3.4074	0	1.3226e-05	2.3e-05	3.5495e-05	3.4352e-05	4.101e-05	4.2799e-
46	3.645	0	3.533e-06	2.5708e-05	3.2758e-05	4.0617e-05	3.8932e-05	4.4106e-
47	3.8934	0	1.8503e-05	2.4946e-05	2.607e-05	3.9121e-05	3.9913e-05	4.3419e-

```
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 C
```





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
    end
end
```

```
age =18
xxx tb_outcomes: all stats xxx
```

OriginalVariableNames	ap_ss	c_ss	v_ss	n_ss	y_head_inc	y_spouse
{'mean' }	10.116	0.75737	-37.312	1.9854	0.84341	0.22902
{'unweighted_sum' }	11476	2.4434e+05	-7.8101e+05	21	4422.1	561.99
{'sd' }	6.9537	0.67774	55.469	1.0848	0.90505	0.5733
{'coefofvar' }	0.68742	0.89486	-1.4866	0.54639	1.0731	2.5032
{'gini' }	0.32034	0.41117	-0.64451	0.268	0.41353	0.83721
{'min' }	1	0.035637	-867.32	1	0.038108	0
{'max' }	151	18.059	25.519	6	13.784	10.368
{'pYis0' }	0	0	0	0	0	0.52499
{'pYls0' }	0	0	0.8166	0	0	0
{'pYgr0' }	1	1	0.1834	1	1	0.47501
{'pYisMINY' }	0.11052	0.0014188	7.8342e-06	0.41786	0.0033703	0.52499
{'pYisMAXY' }	0	0	0	0.0060544	0	5.3013e-06
{'p0_01' }	1	0.035637	-745.16	1	0.038108	0
{'p10' }	1	0.24578	-86.259	1	0.14676	0
{'p25' }	7	0.3161	-50.56	1	0.28802	0
{'p50' }	9	0.51551	-25.263	2	0.56523	0
{'p75' }	11	0.88958	-5.3994	3	1.1092	0.23956
{'p90' }	23	1.5797	6.1229	4	2.1768	0.8323
{'p99_99' }	52	6.8857	23.695	6	8.3836	8.6488
{'fl_cov_ap_ss' }	48.354	1.9167	115.84	0.29345	1.7747	3.1074
{'fl_cor_ap_ss' }	1	0.4067	0.30034	0.038901	0.28199	0.77947
{'fl_cov_c_ss' }	1.9167	0.45934	20.257	0.067217	0.59824	0.081697

```
    {'fl_cor_c_ss'       }       0.4067            1       0.53884      0.091423        0.9753       0.21026
    {'fl_cov_v_ss'       }       115.84       20.257        3076.8        2.8057        24.488        4.9077
    {'fl_cor_v_ss'       }      0.30034      0.53884             1      0.046626       0.48778       0.15433
    {'fl_cov_n_ss'       }      0.29345     0.067217        2.8057        1.1768    -1.236e-17       0.13364
    {'fl_cor_n_ss'       }     0.038901     0.091423      0.046626             1   -1.2589e-17       0.21488
    {'fl_cov_y_head_inc' }       1.7747      0.59824        24.488    -1.236e-17       0.81911      0.021751
    {'fl_cor_y_head_inc' }      0.28199       0.9753       0.48778   -1.2589e-17             1       0.04192
    {'fl_cov_y_spouse'   }       3.1074     0.081697        4.9077       0.13364      0.021751       0.32867
    {'fl_cor_y_spouse'   }      0.77947      0.21026       0.15433       0.21488       0.04192             1
    {'fl_cov_yshr_wage'  }   3.7471e-30   2.4421e-31   -2.4036e-31    1.0754e-30    8.1847e-31    7.0393e-32
    {'fl_cor_yshr_wage'  }   4.0447e-16   2.7046e-16   -3.2525e-18    7.4411e-16     6.788e-16    9.2163e-17
    {'fl_cov_yshr_SS'    }            0            0             0             0             0             0
    {'fl_cor_yshr_SS'    }          NaN          NaN           NaN           NaN           NaN           NaN
    {'fl_cov_yshr_nttxss'}      0.16611     0.021334        1.8502     0.0077776      0.025219     0.0090401
    {'fl_cor_yshr_nttxss'}      0.58487      0.77071       0.81669       0.17554       0.68223       0.38607
    {'fracByP0_01'       }     0.010925   6.6761e-05     0.0030622       0.21046    0.00015228             0
    {'fracByP10'         }     0.010925     0.050401       0.44077       0.21046      0.019229             0
    {'fracByP25'         }        0.148     0.072459       0.71224       0.21046      0.096342             0
    {'fracByP50'         }      0.28531      0.21889       0.94749       0.53024       0.29663             0
    {'fracByP75'         }      0.60536      0.47077        1.0368       0.77109       0.59361       0.13003
    {'fracByP90'         }        0.758      0.70215        1.0326       0.92834       0.84502       0.34306
    {'fracByP99_99'      }      0.99975      0.99993             1             1             1       0.99814
age =59
xxx tb_outcomes: all stats xxx
    OriginalVariableNames      ap_ss          c_ss          v_ss          n_ss        y_head_inc     y_spouse     ys
    _____________________    __________    __________    __________    __________    __________    __________    _

    {'mean'              }       54.878       1.2923       -12.279        1.7239        1.8459       0.45057
    {'unweighted_sum'    }        11476   2.7092e+05        -80406            21         13268        1069.5
    {'sd'                }       23.415       1.0959        19.332       0.90777        2.0412        1.1205
    {'coefofvar'         }      0.42667      0.84801       -1.5745       0.52659        1.1058        2.4867
    {'gini'              }      0.23612       0.3991      -0.81005       0.23461       0.48077       0.83345
    {'min'               }            1     0.055882       -229.42             1      0.059541             0
    {'max'               }          151        32.48        14.764             6         23.47        20.112
    {'pYis0'             }            0            0             0             0             0       0.52499
    {'pYls0'             }            0            0       0.73941             0             0             0
    {'pYgr0'             }            1            1       0.26059             1             1       0.47501
    {'pYisMINY'          }    0.0042169   2.9508e-05    3.9539e-07       0.48835    9.9253e-05       0.52499
    {'pYisMAXY'          }   4.8703e-06   2.3072e-08             0     0.0036816    1.9995e-06    4.8438e-06     0
    {'p0_01'             }            1      0.05663       -132.27             1      0.059554             0
    {'p10'               }           26      0.31762       -39.004             1       0.38493             0
    {'p25'               }           40      0.59646       -18.282             1       0.63825             0
    {'p50'               }           54       1.0652       -7.1081             2        1.1351             0
    {'p75'               }           70       1.6718       0.46981             2        2.1332       0.48062
    {'p90'               }           85       2.4861        6.4893             3        4.1604        1.7443
    {'p99_99'            }          146       15.179        14.695             6        22.847        16.777
    {'fl_cov_ap_ss'      }       548.26       22.158        403.41        3.0428        38.333        6.1095
    {'fl_cor_ap_ss'      }            1      0.86352        0.8912       0.14315       0.80205       0.23287
    {'fl_cov_c_ss'       }       22.158        1.201        13.858       0.23973        2.0792       0.27813    -
    {'fl_cor_c_ss'       }      0.86352            1        0.6541       0.24098       0.92951       0.22651
    {'fl_cov_v_ss'       }       403.41       13.858        373.74        3.5819        22.934        4.5119
    {'fl_cor_v_ss'       }       0.8912       0.6541             1       0.20411       0.58118        0.2083
    {'fl_cov_n_ss'       }       3.0428      0.23973        3.5819       0.82404      0.062213        0.2771   -0
    {'fl_cor_n_ss'       }      0.14315      0.24098       0.20411             1      0.033576       0.27244    -
    {'fl_cov_y_head_inc' }       38.333       2.0792        22.934      0.062213        4.1664       0.17233    -
    {'fl_cor_y_head_inc' }      0.80205      0.92951       0.58118      0.033576             1       0.07535
    {'fl_cov_y_spouse'   }       6.1095      0.27813        4.5119        0.2771       0.17233        1.2554
    {'fl_cor_y_spouse'   }      0.23287      0.22651        0.2083       0.27244       0.07535             1
    {'fl_cov_yshr_wage'  }      -1.3956    -0.043321       -1.0776    -0.0071751     -0.056896      0.013069     0
    {'fl_cor_yshr_wage'  }     -0.66407     -0.44044      -0.62107     -0.088065      -0.31056       0.12996
    {'fl_cov_yshr_SS'    }            0            0             0             0             0             0
    {'fl_cor_yshr_SS'    }          NaN          NaN           NaN           NaN           NaN           NaN
    {'fl_cov_yshr_nttxss'}      0.77952     0.028412       0.68735     0.0085362      0.047811      0.014612    -
    {'fl_cor_yshr_nttxss'}      0.88801      0.69155       0.94837       0.25083       0.62479       0.34785
    {'fracByP0_01'       }   7.6842e-05    5.431e-06      0.001404       0.28329    4.1671e-06             0    3.
```

{'fracByP10' }	0.027337	0.019346	0.47531	0.28329	0.013211	0
{'fracByP25' }	0.11727	0.077024	0.79795	0.28329	0.054199	0
{'fracByP50' }	0.33388	0.22863	1.0581	0.72028	0.18178	0
{'fracByP75' }	0.62869	0.48302	1.117	0.72028	0.41537	0.15283
{'fracByP90' }	0.83409	0.72082	1.0748	0.85389	0.64728	0.3418
{'fracByP99_99' }	0.9998	0.99882	1	1	0.99936	0.99834

age =100
xxx tb_outcomes: all stats xxx

OriginalVariableNames	ap_ss	c_ss	v_ss	n_ss	y_head_inc	y_spouse
{'mean' }	1	0.35551	-2.9555	1.4797	0.26067	0.10125
{'unweighted_sum' }	1	2.807e+05	1215	21	491.5	33.546
{'sd' }	1.6986e-14	0.23928	1.0697	0.50567	0.023035	0.24772
{'coefofvar' }	1.6986e-14	0.67307	-0.36194	0.34173	0.088367	2.4467
{'gini' }	0	0.28119	-0.18783	0.12034	0.041657	0.7872
{'min' }	1	0.2179	-10.065	1	0.24433	0
{'max' }	1	141.66	0.99282	6	5.6926	3.115
{'pYis0' }	0	0	0	0	0	0.52499
{'pYls0' }	0	0	0.99182	0	0	0
{'pYgr0' }	1	1	0.0081757	1	1	0.47501
{'pYisMINY' }	1	0.35002	1.5074e-10	0.5232	0.50379	0.52499
{'pYisMAXY' }	1	0	0	4.2206e-08	0	1.0335e-08
{'p0_01' }	1	0.2179	-6.3349	1	0.24433	0
{'p10' }	1	0.2179	-3.6603	1	0.24433	0
{'p25' }	1	0.2179	-3.5892	1	0.24433	0
{'p50' }	1	0.25824	-3.5892	1	0.24433	0
{'p75' }	1	0.37165	-2.5873	2	0.29263	0.10311
{'p90' }	1	0.6134	-1.2288	2	0.29283	0.49115
{'p99_99' }	1	2.9509	0.52075	4	0.3403	2.9458
{'fl_cov_ap_ss' }	2.8854e-28	1.5872e-30	7.1055e-30	2.9512e-29	-2.6493e-30	-3.9613e-31
{'fl_cor_ap_ss' }	1	3.9051e-16	3.9105e-16	3.4358e-15	-6.771e-15	-9.4141e-17
{'fl_cov_c_ss' }	1.5872e-30	0.057256	0.20779	0.059046	0.0016896	0.051708
{'fl_cor_c_ss' }	3.9051e-16	1	0.81181	0.488	0.30655	0.87235
{'fl_cov_v_ss' }	7.1055e-30	0.20779	1.1443	0.15982	0.010842	0.16183
{'fl_cor_v_ss' }	3.9105e-16	0.81181	1	0.29547	0.44002	0.61072
{'fl_cov_n_ss' }	2.9512e-29	0.059046	0.15982	0.2557	0.0018939	0.0533
{'fl_cor_n_ss' }	3.4358e-15	0.488	0.29547	1	0.1626	0.4255
{'fl_cov_y_head_inc' }	-2.6493e-30	0.0016896	0.010842	0.0018939	0.00053059	0.00067244
{'fl_cor_y_head_inc' }	-6.771e-15	0.30655	0.44002	0.1626	1	0.11785
{'fl_cov_y_spouse' }	-3.9613e-31	0.051708	0.16183	0.0533	0.00067244	0.061365
{'fl_cor_y_spouse' }	-9.4141e-17	0.87235	0.61072	0.4255	0.11785	1
{'fl_cov_yshr_wage' }	1.0195e-30	0.039337	0.15536	0.083876	0.00066872	0.042905
{'fl_cor_yshr_wage' }	2.7165e-16	0.74409	0.65738	0.75078	0.1314	0.78395
{'fl_cov_yshr_SS' }	4.2697e-30	-0.040637	-0.16221	-0.085115	-0.00073196	-0.042905
{'fl_cor_yshr_SS' }	1.132e-15	-0.76482	-0.68289	-0.75803	-0.1431	-0.78001
{'fl_cov_yshr_nttxss'}	-6.4883e-30	0.044612	0.17828	0.091702	0.00088432	0.047166
{'fl_cor_yshr_nttxss'}	-1.5829e-15	0.77263	0.69067	0.75153	0.1591	0.78904
{'fracByP0_01' }	1	0.21454	0.00051608	0.35357	0.47222	0
{'fracByP10' }	1	0.21454	0.21323	0.35357	0.47222	0
{'fracByP25' }	1	0.21454	0.64329	0.35357	0.47222	0
{'fracByP50' }	1	0.32886	0.64329	0.35357	0.47222	0
{'fracByP75' }	1	0.54497	0.88331	0.99419	0.87831	0.19257
{'fracByP90' }	1	0.75075	0.97695	0.99419	0.88528	0.62793
{'fracByP99_99' }	1	0.99925	1	0.99999	0.99987	0.9996