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.

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=551.0862
----------------------------------------
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
CONTAINER NAME: mp_outcomes ND Array (Matrix etc)
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
```

	i	idx	ndim	numel	rowN	colN	sum	mean	std	coefvari
V_VFI	1	1	6	4.37e+07	83	5.265e+05	-8.6673e+08	-19.834	28.177	-1.4206
ap_VFI	2	2	6	4.37e+07	83	5.265e+05	1.4164e+09	32.412	36.8	1.1354
cons_VFI	3	3	6	4.37e+07	83	5.265e+05	2.131e+08	4.8764	8.3268	1.7076

xxx TABLE:V_VFI xxxxxxxxxxxxxxxxxx

	c1	c2	c3	c4	c5	c526496	c526497	c526498	c526499
r1	-376.05	-375.66	-373.17	-367.4	-358.05	-6.68	-6.5297	-6.3792	-6.2274
r2	-363.8	-363.41	-360.93	-355.25	-346.25	-6.4892	-6.3437	-6.1974	-6.0495
r3	-351.75	-351.36	-348.9	-343.44	-334.9	-6.2948	-6.1538	-6.0116	-5.8671
r4	-339.81	-339.45	-337.16	-332.06	-324.04	-6.095	-5.9584	-5.82	-5.6786
r5	-328.99	-328.65	-326.51	-321.72	-314.17	-5.9054	-5.7725	-5.6372	-5.4986
r79	-14.033	-14.02	-13.926	-13.689	-13.287	-0.22848	-0.21775	-0.20768	-0.19824
r80	-12.564	-12.55	-12.457	-12.22	-11.818	-0.17427	-0.16611	-0.15842	-0.15117
r81	-10.778	-10.764	-10.671	-10.434	-10.032	-0.11927	-0.11368	-0.10843	-0.10346
r82	-8.4226	-8.4089	-8.3155	-8.0786	-7.6766	-0.06597	-0.06284	-0.059924	-0.057184
r83	-5.0665	-5.0529	-4.9595	-4.7226	-4.3206	-0.020968	-0.019972	-0.019038	-0.018161

xxx TABLE:ap_VFI xxxxxxxxxxxxxxxxxx

	c1	c2	c3	c4	c5	c526496	c526497	c526498	c526499	c526500
r1	0	0	0.0005656	0.0075134	0.022901	114.76	120.42	126.29	132.39	138.81
r2	0	0	0.00051498	0.0065334	0.021549	114.87	120.54	126.42	132.55	138.97
r3	0	0	0.00051498	0.0049294	0.019875	114.98	120.67	126.57	132.72	139.13
r4	0	0	0.00051498	0.0047937	0.019672	115.74	121.44	127.36	133.52	139.94
r5	0	0	0.00048517	0.0046683	0.019484	116.51	122.22	128.16	134.34	140.76
r79	0	0	0	0	0.00051498	81.091	85.68	90.325	94.371	98.41
r80	0	0	0	0	0	76.669	80.55	84.292	88.029	91.682
r81	0	0	0	0	0	68.313	71.52	74.459	77.816	81.096
r82	0	0	0	0	0	50.126	53.467	56.953	58.728	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	c526499
r1	0.036717	0.037251	0.040426	0.04363	0.048012	9.6396	9.8066	9.9533	10.06
r2	0.036717	0.037251	0.040477	0.04461	0.049364	9.8014	9.9571	10.088	10.177
r3	0.036717	0.037251	0.040477	0.046214	0.051039	9.9664	10.108	10.22	10.287
r4	0.038144	0.038678	0.041903	0.047776	0.052666	10.118	10.244	10.339	10.388
r5	0.039534	0.040068	0.043323	0.04929	0.054241	10.258	10.369	10.446	10.483
r79	0.19737	0.19791	0.20163	0.21175	0.23093	35.811	37.046	38.418	40.587
r80	0.19737	0.19791	0.20163	0.21175	0.23145	40.207	42.15	44.426	46.904
r81	0.19737	0.19791	0.20163	0.21175	0.23145	48.541	51.158	54.236	57.094
r82	0.19737	0.19791	0.20163	0.21175	0.23145	66.71	69.193	71.724	76.164
r83	0.19737	0.19791	0.20163	0.21175	0.23145	116.82	122.65	128.66	134.88

Completed SNW_DS_MAIN;SNW_MP_PARAM=default_docdense;SNW_MP_CONTROL=default_test;time=2153.0961

```
% [Phi_true,Phi_adj] = snw_ds_main(mp_params, mp_controls);
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
a_ss	4.3602	2228	6.8796	1.5778	0.6755	0	135
ap_ss	4.4621	5.3216e+08	6.9169	1.5501	0.67638	0	163.73
cons_ss	1.0635	5.0787e+07	0.6938	0.65237	0.33936	0.036717	141.61
v_ss	-36.615	-4.0773e+08	24.55	-0.67049	-0.33945	-615.77	-0.0071775
n_ss	2.3554	21	1.4375	0.61029	0.3128	1	6
y_all	1.4189	8.353e+07	1.4929	1.0521	0.47667	0	50.873
y_head_inc	1.1081	1.9253e+06	1.013	0.91419	0.42164	0.038108	24.357
y_head_earn	0.88655	19732	0.92804	1.0468	0.53121	0	18.957
y_spouse_inc	0.35797	4.827e+05	0.95437	2.6661	0.85269	0	26.627
yshr_interest	0.12865	3.8438e+06	0.17577	1.3663	0.65781	0	0.99299
yshr_wage	0.77402	8.8881e+06	0.33679	0.43512	0.2062	0	1
yshr_SS	0.097329	29012	0.2266	2.3282	0.91382	0	1
yshr_tax	0.17833	2.8338e+06	0.035661	0.19998	0.11386	0.036506	0.2552
yshr_nttxss	0.080996	2.8048e+06	0.24691	3.0485	1.2592	-0.89715	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

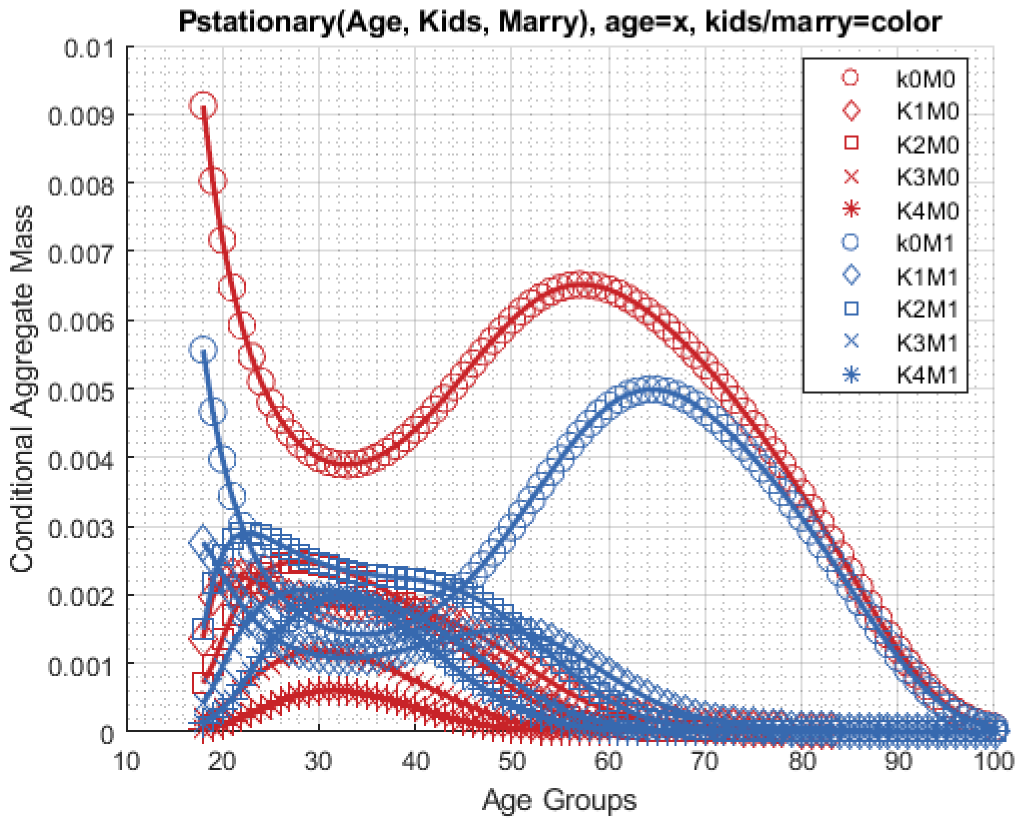
```
% NaN(n_jgrid,n_agrid,n_etagrid,n_educgrid,n_marriedgrid,n_kidsgrid);
ar_permute = [2,3,4,1,6,5];
% Value Function
tb_prob_amarrykids = ff_summ_nd_array("P(Age, Kids, Marry))", Phi_true, true, ["sum"], 3, 1, cl
```

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
```

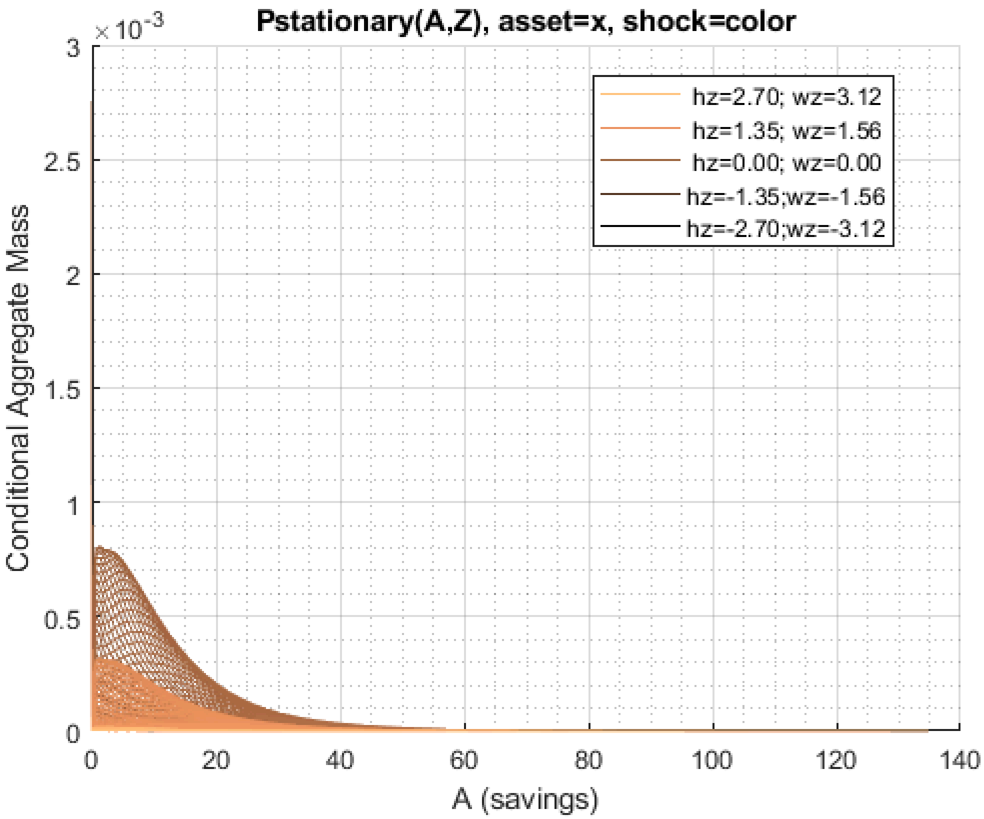
Asset and Shock Mass

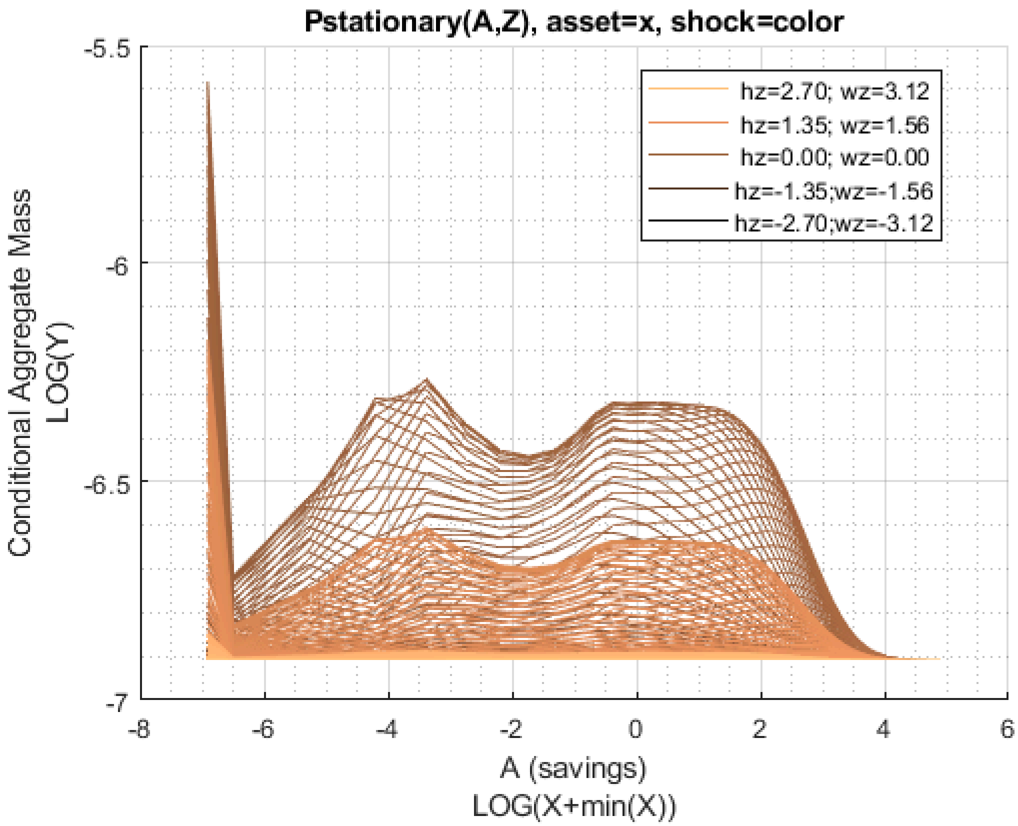
```
% NaN(n_jgrid,n_agrid,n_etagrid,n_educgrid,n_marriedgrid,n_kidsgrid);
ar_permute = [1,4,5,6,3,2];
% Value Function
tb_prob_az = ff_summ_nd_array("P(A,Z))", Phi_true, true, ["sum"], 4, 1, cl_mp_datasetdesc, ar_p
```

```
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_e
    _____   __________   __________   __________   __________   __________   __________   __________   _____
```

1	0	1.6729e-07	1.4316e-07	2.1759e-07	3.1665e-07	4.509e-07	6.3359e-07	8.797
2	0.00051498	3.7493e-10	3.6049e-10	6.2649e-10	1.1273e-09	2.1799e-09	4.4826e-09	9.374
3	0.0041199	7.5745e-10	6.6694e-10	1.0474e-09	1.5976e-09	2.4182e-09	3.6548e-09	5.511
4	0.013905	1.6314e-09	1.4169e-09	2.1927e-09	3.2778e-09	4.8429e-09	7.1372e-09	1.051
5	0.032959	5.5034e-09	4.7405e-09	7.269e-09	1.0722e-08	1.5557e-08	2.2396e-08	3.204
6	0.064373	6.5761e-09	5.6858e-09	8.729e-09	1.2871e-08	1.8634e-08	2.6723e-08	3.803

```
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

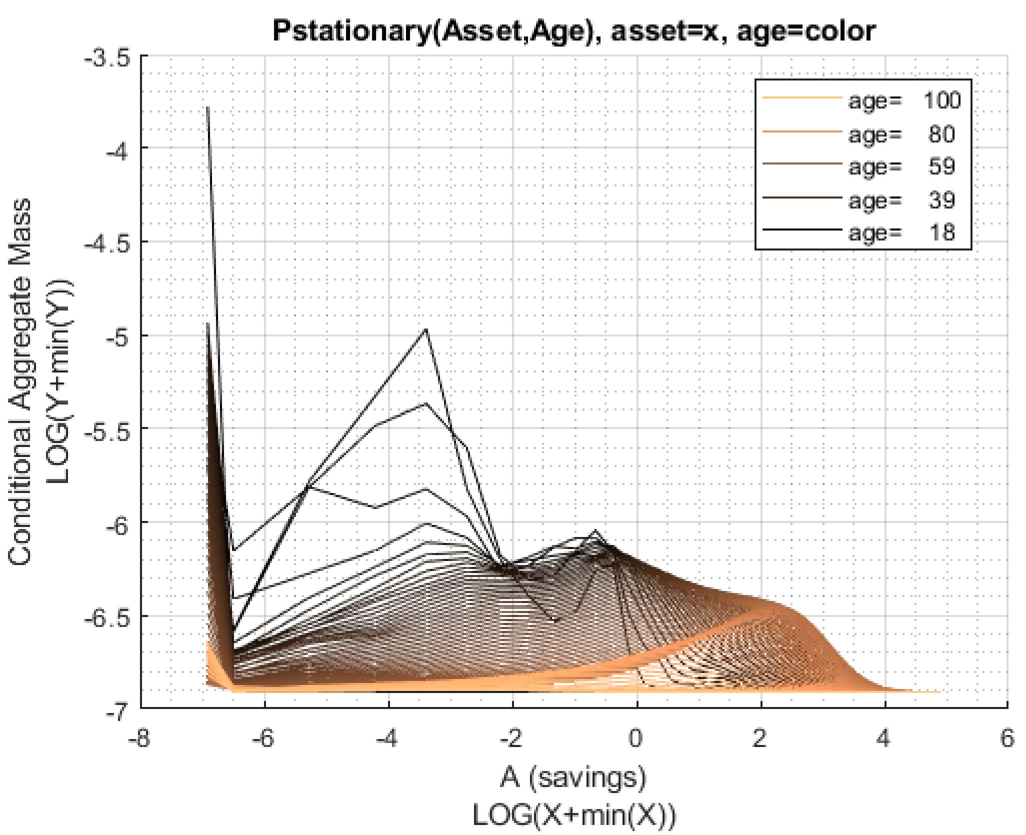
```
% NaN(n_jgrid,n_agrid,n_etagrid,n_educgrid,n_marriedgrid,n_kidsgrid);
ar_permute = [3,4,5,6,1,2];
% Value Function
tb_prob_aage = ff_summ_nd_array("P(A,Z))", Phi_true, true, ["sum"], 4, 1, cl_mp_datasetdesc, ar
```

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_a
1	0	0.021837	0.0023506	0.0017989	0.0039364	0.0058286	0.0061897	0.00
2	0.00051498	0	0.00039478	0.00037898	0.0011264	0.00064408	0.00030008	0.000
3	0.0041199	0	0.0020814	0.0019874	0.0019922	0.00088345	0.00065467	0.000
4	0.013905	0	0.0038512	0.0031528	0.0016753	0.0011288	0.00094985	0.000
5	0.032959	0	0.0059559	0.0036616	0.0019605	0.0014625	0.0012232	0.00
6	0.064373	0	0.0019624	0.0026806	0.0015589	0.0012782	0.0011853	0.00
7	0.11124	0	0.0010231	0.0010755	0.0008941	0.0009494	0.0009688	0.00
8	0.17664	0	0.00067266	0.00082141	0.0009652	0.0010565	0.0010188	0.000
9	0.26367	0	0.00045811	0.00086333	0.0011647	0.0011767	0.0010716	0.00
10	0.37542	0	0.00053656	0.001129	0.0012812	0.0011528	0.0011099	0.00
11	0.51498	0	0.00090841	0.0013729	0.0012822	0.0012345	0.001202	0.00
12	0.68544	0	0.00097635	0.0011151	0.0011024	0.001139	0.0011822	0.00
13	0.88989	0	0.00023558	0.00050592	0.00075138	0.00094942	0.001009	0.00
14	1.1314	0	4.591e-05	0.00027667	0.00049327	0.00061366	0.00072435	0.000
15	1.4131	0	1.7547e-05	0.00019582	0.00030348	0.00040728	0.00051335	0.000
16	1.7381	0	8.2268e-06	6.7346e-05	0.00015086	0.00025852	0.00035749	0.00
17	2.1094	0	6.1503e-06	3.6395e-05	9.6376e-05	0.00016375	0.00023657	0.000
18	2.5301	0	1.345e-05	3.725e-05	7.4002e-05	0.00012113	0.00017621	0.000
19	3.0034	0	2.2526e-05	4.8231e-05	7.8125e-05	0.00011085	0.00014554	0.000
20	3.5323	0	2.9888e-05	5.5596e-05	8.1028e-05	0.00010487	0.00012962	0.000
21	4.1199	0	3.0433e-05	5.4594e-05	7.2792e-05	9.1925e-05	0.00011221	0.000

22	4.7693	0	2.0409e-05	3.7846e-05	5.5558e-05	7.2536e-05	8.9826e-05	0.000
23	5.4836	0	5.1452e-06	1.8425e-05	3.2883e-05	4.8468e-05	6.5255e-05	8.271
24	6.2658	0	7.3282e-07	5.3334e-06	1.4182e-05	2.7049e-05	4.1491e-05	5.716
25	7.1191	0	1.062e-07	1.2922e-06	4.9633e-06	1.2247e-05	2.3108e-05	3.599
26	8.0466	0	1.7779e-08	5.0549e-07	2.0442e-06	5.3225e-06	1.1275e-05	2.02
27	9.0514	0	3.0263e-09	3.0488e-07	1.0981e-06	2.7972e-06	5.7624e-06	1.071
28	10.136	0	1.2227e-10	1.6491e-07	5.5442e-07	1.5926e-06	3.3079e-06	6.054
29	11.305	0	0	4.8394e-08	2.2296e-07	8.1497e-07	1.9096e-06	3.606
30	12.56	0	0	9.3997e-09	7.016e-08	3.1478e-07	1.0131e-06	2.122
31	13.905	0	0	1.808e-09	2.0992e-08	9.9385e-08	4.7981e-07	1.196
32	15.342	0	0	4.1404e-10	6.2716e-09	3.4866e-08	1.9071e-07	6.339
33	16.875	0	0	9.9687e-11	1.6909e-09	1.3108e-08	6.2084e-08	3.079
34	18.507	0	0	2.1381e-11	4.7515e-10	4.3065e-09	2.1839e-08	1.274
35	20.241	0	0	8.897e-13	1.3917e-10	1.2185e-09	8.3899e-09	4.17
36	22.08	0	0	0	2.966e-11	3.6653e-10	2.8415e-09	1.411
37	24.027	0	0	0	3.6991e-12	1.1419e-10	8.4508e-10	5.449
38	26.085	0	0	0	7.8046e-13	2.4029e-11	2.7382e-10	1.848
39	28.258	0	0	0	1.7968e-13	4.0593e-12	8.1361e-11	5.863
40	30.548	0	0	0	8.7684e-15	1.0642e-12	1.7711e-11	1.896
41	32.959	0	0	0	0	1.9771e-13	3.6622e-12	5.469
42	35.493	0	0	0	0	1.5011e-14	9.2977e-13	1.217
43	38.154	0	0	0	0	2.3721e-15	1.525e-13	2.847
44	40.945	0	0	0	0	3.0185e-16	1.7487e-14	6.67
45	43.868	0	0	0	0	6.4297e-18	3.2969e-15	1.069
46	46.928	0	0	0	0	0	3.4855e-16	1.612
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 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'               }       0.13209       0.63361        -59.72        1.9854       0.71265       0.22832
    {'unweighted_sum'     }    1.0935e+07    8.5257e+05   -1.1176e+07            21         15541        5033.3
    {'sd'                 }       0.34847       0.37861        29.967        1.0848       0.54567       0.56949
    {'coefofvar'          }        2.6381       0.59754      -0.50178       0.54639       0.76569        2.4943
    {'gini'               }        0.7705        0.3109      -0.25126         0.268       0.36259       0.84016
    {'min'                }             0      0.036717       -615.77             1      0.038108             0
    {'max'                }        145.08        10.204       -3.7499             6        13.784        10.368
    {'pYis0'              }       0.10805             0             0             0             0       0.52499
    {'pYls0'              }             0             0             1             0             0             0
    {'pYgr0'              }       0.89195             1             0             1             1       0.47501
    {'pYisMINY'           }       0.10805    1.3288e-05    5.8837e-08       0.41786    2.5312e-05       0.52499
    {'pYisMAXY'           }             0             0             0     0.0060544             0    3.9814e-08
    {'p0_01'              }             0      0.047727       -352.03             1      0.046651             0
    {'p10'                }             0       0.24819       -96.425             1       0.23528             0
    {'p25'                }      0.012214       0.36957       -70.656             1       0.35258             0
    {'p50'                }      0.032959       0.55272       -52.866             2       0.56523             0
    {'p75'                }      0.076248       0.80075       -39.739             3       0.90612       0.24502
    {'p90'                }        0.4782        1.1197       -31.147             4        1.3579       0.84753
    {'p99_99'             }        5.4534        3.6548       -10.999             6        6.8484        8.2655
    {'fl_cov_ap_ss'       }       0.12143      0.055156        2.4756       0.02663      0.050357       0.18246
    {'fl_cor_ap_ss'       }             1       0.41805       0.23707      0.070443       0.26483       0.91943
    {'fl_cov_c_ss'        }      0.055156       0.14335        8.0725      0.076682       0.18653      0.071672
    {'fl_cor_c_ss'        }       0.41805             1        0.7115        0.1867       0.90288       0.33241
    {'fl_cov_v_ss'        }        2.4756        8.0725           898       0.45095         10.05        3.4951
    {'fl_cor_v_ss'        }       0.23707        0.7115             1      0.013872       0.61462        0.2048
    {'fl_cov_n_ss'        }       0.02663      0.076682       0.45095        1.1768     -4.12e-18       0.13323
    {'fl_cor_n_ss'        }      0.070443        0.1867      0.013872             1     -6.96e-18       0.21565
    {'fl_cov_y_head_inc'  }      0.050357       0.18653         10.05     -4.12e-18       0.29776      0.010455
    {'fl_cor_y_head_inc'  }       0.26483       0.90288       0.61462     -6.96e-18             1      0.033645
    {'fl_cov_y_spouse'    }       0.18246      0.071672        3.4951       0.13323      0.010455       0.32432
    {'fl_cor_y_spouse'    }       0.91943       0.33241        0.2048       0.21565      0.033645             1
    {'fl_cov_yshr_wage'   }    7.6315e-33    1.7081e-32   -2.0646e-31    3.5437e-31    6.4579e-33     2.907e-33
    {'fl_cor_yshr_wage'   }    9.8628e-17    2.0318e-16   -3.1028e-17    1.4712e-15    5.3299e-17    2.2988e-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'}     0.0057593      0.011163       0.86319      0.007516       0.01319      0.008688
    {'fl_cor_yshr_nttxss'}       0.48714       0.86903       0.84902       0.20421       0.71249       0.44966
    {'fracByP0_01'        }             0    7.1734e-06    0.00073274       0.21046     7.788e-06             0
    {'fracByP10'          }             0      0.030664       0.21367       0.21046      0.027495             0
    {'fracByP25'          }     0.0067284       0.10372        0.4286       0.21046      0.092606             0
    {'fracByP50'          }      0.046851       0.29072       0.67444       0.53024       0.26377             0
    {'fracByP75'          }       0.13176       0.54795       0.87012       0.77109        0.5245       0.12959
    {'fracByP90'          }       0.35932       0.76949       0.95644       0.92834       0.74403       0.33886
    {'fracByP99_99'       }       0.99576       0.99938       0.99998             1       0.99912       0.99627
age =59
xxx tb_outcomes: all stats xxx
    OriginalVariableNames        ap_ss         c_ss          v_ss         n_ss      y_head_inc     y_spouse
    _____________________    __________    __________    ___________    _________    __________    __________

    {'mean'               }        9.6978        1.2003       -27.032       1.7239        1.6127       0.44918
    {'unweighted_sum'     }    1.1254e+07    1.0744e+06   -5.7273e+06           21         45380        9578.2
    {'sd'                 }        9.5091       0.76817         15.51      0.90777         1.276         1.113
    {'coefofvar'          }       0.98054          0.64      -0.57376      0.52659       0.79122        2.4779
    {'gini'               }       0.47956       0.33158      -0.29874      0.23461       0.38177       0.83796
    {'min'                }             0       0.05663       -230.76            1      0.059541             0
```

```
    {'max'               }     158.47        12.271        -1.694            6         23.47        20.112
    {'pYis0'             }   0.004589             0             0            0             0       0.52499
    {'pYls0'             }          0             0             1            0             0             0
    {'pYgr0'             }    0.99541             1             0            1             1       0.47501
    {'pYisMINY'          }   0.004589    9.8045e-06    2.9682e-09      0.48835     9.869e-06       0.52499
    {'pYisMAXY'          }  9.1885e-09   2.1301e-11    5.3537e-07    0.0036816    1.4932e-06    3.6378e-08
    {'p0_01'             }          0       0.07838       -123.12            1       0.08341             0
    {'p10'               }     1.2229       0.40584       -47.779            1       0.49527             0
    {'p25'               }      3.196        0.6516       -33.261            1       0.77993             0
    {'p50'               }     7.0976        1.0499       -23.135            2        1.2719             0
    {'p75'               }     13.089         1.547       -16.274            2        2.0397       0.48062
    {'p90'               }     21.159        2.1475       -11.776            3        3.1029        1.7714
    {'p99_99'            }     112.62        8.4781       -2.7295            6        15.937        16.033
    {'fl_cov_ap_ss'      }     90.423        6.9267        101.69      0.81683        10.484        2.2203
    {'fl_cor_ap_ss'      }          1       0.94827       0.68949     0.094628       0.86408       0.20978
    {'fl_cov_c_ss'       }     6.9267       0.59008         8.839      0.23092       0.85409       0.24459
    {'fl_cor_c_ss'       }    0.94827             1       0.74189      0.33116       0.87137       0.28607
    {'fl_cov_v_ss'       }     101.69         8.839        240.55       2.5586        13.062        3.6105
    {'fl_cor_v_ss'       }    0.68949       0.74189             1      0.18173       0.66001       0.20915
    {'fl_cov_n_ss'       }    0.81683       0.23092        2.5586      0.82404      0.055266       0.27625
    {'fl_cor_n_ss'       }   0.094628       0.33116       0.18173            1      0.047713       0.27342
    {'fl_cov_y_head_inc' }     10.484       0.85409        13.062     0.055266        1.6281        0.1162
    {'fl_cor_y_head_inc' }    0.86408       0.87137       0.66001     0.047713             1       0.08182
    {'fl_cov_y_spouse'   }     2.2203       0.24459        3.6105      0.27625        0.1162        1.2388
    {'fl_cor_y_spouse'   }    0.20978       0.28607       0.20915      0.27342       0.08182             1
    {'fl_cov_yshr_wage'  }   -0.53029     -0.034916      -0.87809    0.0021706     -0.036142      0.021749
    {'fl_cor_yshr_wage'  }   -0.55378      -0.45137      -0.56221     0.023745      -0.28128       0.19404
    {'fl_cov_yshr_SS'    }          0             0             0            0             0             0
    {'fl_cor_yshr_SS'    }        NaN           NaN           NaN          NaN           NaN           NaN
    {'fl_cov_yshr_nttxss'}    0.19504      0.017838       0.43624    0.0074857      0.026908      0.013251    -0
    {'fl_cor_yshr_nttxss'}    0.67474       0.76393       0.92529      0.27128       0.69373       0.39167
    {'fracByP0_01'       }          0     6.875e-06    0.00049633      0.28329    5.7641e-06             0     3
    {'fracByP10'         }  0.0057779      0.026049       0.23158      0.28329      0.022494             0
    {'fracByP25'         }   0.040074      0.091752       0.44951      0.28329      0.082256             0
    {'fracByP50'         }    0.16977       0.26933       0.70658      0.72028       0.24076             0
    {'fracByP75'         }    0.42173       0.53549       0.88743      0.72028       0.48935       0.13542
    {'fracByP90'         }    0.67785       0.76094       0.96591      0.85389       0.72071       0.34015
    {'fracByP99_99'      }    0.99869       0.99925       0.99999            1       0.99889       0.99665
age =100
xxx tb_outcomes: all stats xxx
    OriginalVariableNames    ap_ss       c_ss          v_ss          n_ss        y_head_inc     y_spouse     yshr_w
    _____________________    _____    __________    __________    __________    ___________    __________    ______

    {'mean'              }      0        0.33019       -4.3147        1.4797         0.2355       0.09988       0.1
    {'unweighted_sum'    }      0     1.2179e+05       -3630.5            21         209.83          33.1        82
    {'sd'                }      0        0.23351        1.1931       0.50567       0.021892        0.2444       0.2
    {'coefofvar'         }    NaN         0.7072      -0.27653       0.34173       0.092957        2.4469        1.
    {'gini'              }    NaN         0.2934      -0.14462       0.12034       0.043711       0.78724       0.7
    {'min'               }      0        0.19737       -12.197             1           0.22             0
    {'max'               }      0         141.61    -0.0071775             6          5.666        3.0753       0.9
    {'pYis0'             }      1              0             0             0              0       0.52499       0.5
    {'pYls0'             }      0              0             1             0              0             0
    {'pYgr0'             }      0              1             0             1              1       0.47501       0.4
    {'pYisMINY'          }      1        0.35707    1.4848e-10        0.5232        0.50347       0.52499       0.5
    {'pYisMAXY'          }      1              0             0    4.2206e-08              0    1.0335e-08    5.1171
    {'p0_01'             }      0        0.19737        -8.038             1           0.22             0
    {'p10'               }      0        0.19737       -5.0665             1           0.22             0
    {'p25'               }      0        0.19737       -5.0665             1           0.22             0
    {'p50'               }      0        0.23607       -5.0103             1           0.22             0
    {'p75'               }      0        0.34876       -3.7889             2          0.266       0.10166       0.3
    {'p90'               }      0        0.58892       -2.3842             2        0.26656       0.48427       0.6
    {'p99_99'            }      0         2.8508      -0.49608             4        0.31126        2.9082        0.
    {'fl_cov_ap_ss'      }      0              0             0             0              0             0
    {'fl_cor_ap_ss'      }    NaN            NaN           NaN           NaN            NaN           NaN
    {'fl_cov_c_ss'       }      0       0.054526       0.22623      0.059682      0.0015233      0.050691       0.04
```

{'fl_cor_c_ss' }	NaN	1	0.812	0.50545	0.298	0.88823	0.7
{'fl_cov_v_ss' }	0	0.22623	1.4236	0.21735	0.011521	0.18354	0.1
{'fl_cor_v_ss' }	NaN	0.812	1	0.36026	0.44106	0.62943	0.6
{'fl_cov_n_ss' }	0	0.059682	0.21735	0.2557	0.0018733	0.052581	0.08
{'fl_cor_n_ss' }	NaN	0.50545	0.36026	1	0.16923	0.42546	0.7
{'fl_cov_y_head_inc' }	0	0.0015233	0.011521	0.0018733	0.00047925	0.00064761	0.0006
{'fl_cor_y_head_inc' }	NaN	0.298	0.44106	0.16923	1	0.12104	0.1
{'fl_cov_y_spouse' }	0	0.050691	0.18354	0.052581	0.00064761	0.059731	0.04
{'fl_cor_y_spouse' }	NaN	0.88823	0.62943	0.42546	0.12104	1	0.7
{'fl_cov_yshr_wage' }	0	0.040339	0.19022	0.087809	0.00068213	0.043248	0.05
{'fl_cor_yshr_wage' }	NaN	0.75656	0.69819	0.76049	0.13646	0.77497	
{'fl_cov_yshr_SS' }	0	-0.041495	-0.19728	-0.089315	-0.00073742	-0.04328	-0.05
{'fl_cor_yshr_SS' }	NaN	-0.77343	-0.71963	-0.76875	-0.14661	-0.77074	-0.9
{'fl_cov_yshr_nttxss'}	0	0.045639	0.21697	0.096294	0.00089018	0.04769	0.05
{'fl_cor_yshr_nttxss'}	NaN	0.78185	0.72746	0.76178	0.16266	0.78059	0.9
{'fracByP0_01' }	NaN	0.21345	0.00043423	0.35357	0.47033	0	
{'fracByP10' }	NaN	0.21345	0.51425	0.35357	0.47033	0	
{'fracByP25' }	NaN	0.21345	0.51425	0.35357	0.47033	0	
{'fracByP50' }	NaN	0.33309	0.6114	0.35357	0.47033	0	
{'fracByP75' }	NaN	0.53778	0.8525	0.99419	0.87579	0.19248	0.3
{'fracByP90' }	NaN	0.74393	0.95864	0.99419	0.8936	0.62777	0.5
{'fracByP99_99' }	NaN	0.99922	0.99999	0.99999	0.99991	0.9996	0.9