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.More Dense Simulation. **Looped** to get distribution, but uses **bisect vec** for VFI.

Test SNW_DS_MAIN Defaults Dense

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=253.7289
----------------------------------------
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    -1.5339e+08    -3.5101    26.119     -7.441
    ap_VFI      2     2      6      4.37e+07     83     5.265e+05     1.4159e+09     32.402    36.798     1.1357
    cons_VFI    3     3      6      4.37e+07     83     5.265e+05     2.1402e+08     4.8975    8.3294     1.7007

xxx TABLE:V_VFI xxxxxxxxxxxxxxxxxx
             c1         c2         c3         c4         c5       c526496    c526497    c526498    c526499    c52650
           _______    _______    _______    _______    _______    _______    _______    _______    _______    ______

    r1     -346.51    -346.12    -343.63    -337.86    -328.51     21.702     21.852     22.003     22.154     22.30
    r2     -334.38    -333.99    -331.51    -325.83    -316.83     21.724     21.869     22.015     22.163     22.31
    r3     -322.45    -322.06     -319.6    -314.14     -305.6     21.745     21.885     22.027     22.171     22.31
    r4     -310.63    -310.27    -307.99    -302.88    -294.87     21.767     21.903     22.041     22.182     22.32
    r5     -299.94     -299.6    -297.46    -292.67    -285.12     21.775     21.907     22.042      22.18     22.32
    r79    -9.9437    -9.9325    -9.8557    -9.6597    -9.3232     2.5394     2.5501     2.5602     2.5696     2.578
    r80    -8.9023    -8.8911    -8.8143    -8.6183    -8.2818     2.3039     2.3121     2.3198      2.327     2.333
    r81    -7.6363    -7.6251    -7.5484    -7.3524    -7.0159     2.0068     2.0124     2.0176     2.0226     2.027
    r82    -5.9673    -5.9561    -5.8793    -5.6833    -5.3468     1.5958     1.5989     1.6018     1.6046     1.607
    r83    -3.5892     -3.578    -3.5012    -3.3052    -2.9687    0.97904    0.98004    0.98097    0.98185    0.9826

xxx TABLE:ap_VFI xxxxxxxxxxxxxxxxxx
           c1    c2        c3             c4            c5        c526496    c526497    c526498    c526499    c526500
           __    __    __________    _________    ________    _______    _______    _______    _______    _______

    r1     0     0      0.0005656    0.0075134    0.022901     114.75     120.41     126.27     132.38      138.8
    r2     0     0     0.00051498    0.0065334    0.021549     114.86     120.53     126.41     132.54     138.95
    r3     0     0     0.00051498    0.0049294    0.019875     114.97     120.65     126.56      132.7     139.12
    r4     0     0     0.00051498    0.0047937    0.019672     115.73     121.42     127.34     133.51     139.92
    r5     0     0     0.00048517    0.0046683    0.019484      116.5     122.21     128.15     134.32     140.74
    r79    0     0              0            0           0     81.091      85.68     90.335     94.378     98.419
    r80    0     0              0            0           0     76.669     80.563     84.304      88.04     91.693
    r81    0     0              0            0           0     68.313     71.534     74.475     77.832      81.11
    r82    0     0              0            0           0     50.126     53.467     56.953     58.745     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	c
r1	0.036717	0.037251	0.040426	0.04363	0.048012	9.6491	9.817	9.9649	10.073	1
r2	0.036717	0.037251	0.040477	0.04461	0.049364	9.8118	9.9685	10.101	10.191	1
r3	0.036717	0.037251	0.040477	0.046214	0.051039	9.9779	10.12	10.234	10.302	1
r4	0.038144	0.038678	0.041903	0.047776	0.052666	10.131	10.258	10.354	10.405	1
r5	0.039534	0.040068	0.043323	0.04929	0.054241	10.272	10.384	10.463	10.5	
r79	0.2179	0.21844	0.22216	0.23228	0.25197	35.858	37.092	38.455	40.627	4
r80	0.2179	0.21844	0.22216	0.23228	0.25197	40.253	42.183	44.459	46.938	
r81	0.2179	0.21844	0.22216	0.23228	0.25197	48.587	51.19	54.266	57.123	6
r82	0.2179	0.21844	0.22216	0.23228	0.25197	66.755	69.238	71.77	76.192	8
r83	0.2179	0.21844	0.22216	0.23228	0.25197	116.87	122.69	128.71	134.92	1

```
Completed SNW_DS_MAIN;SNW_MP_PARAM=default_docdense;SNW_MP_CONTROL=default_test;time=1804.8494
```

```
% [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	sd	coefofvar	min	max	pYis0	pYls0	pYgr0	
a_ss	4.2486	6.7963	1.5996	0	135	0.1223	0	0.8777	
ap_ss	4.3473	6.834	1.572	0	163.7	0.10225	0	0.89775	
cons_ss	1.0676	0.69454	0.65055	0.036717	141.66	0	0	1	8
v_ss	-15.745	21.68	-1.3769	-586.22	24.63	0	0.8122	0.1878	1
n_ss	2.3554	1.4375	0.61029	1	6	0	0	1	
y_all	1.415	1.4926	1.0548	0	50.873	0.0072908	0	0.99271	
y_head_inc	1.1087	1.0092	0.91029	0.038108	24.357	0	0	1	1
y_head_earn	0.88655	0.92804	1.0468	0	18.957	0.2016	0	0.7984	
y_spouse_inc	0.35849	0.95494	2.6638	0	26.627	0.52499	0	0.47501	
yshr_interest	0.12214	0.16806	1.3759	0	0.99299	0.1223	0	0.8777	
yshr_wage	0.77513	0.33759	0.43553	0	1	0.10584	0	0.89416	
yshr_SS	0.10273	0.23637	2.3009	0	1	0.7984	0	0.2016	
yshr_tax	0.17862	0.03519	0.19701	0.036506	0.2552	0	0	1	8
yshr_nttxss	0.075896	0.25563	3.3681	-0.89184	0.2552	0	0.17845	0.82155	

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

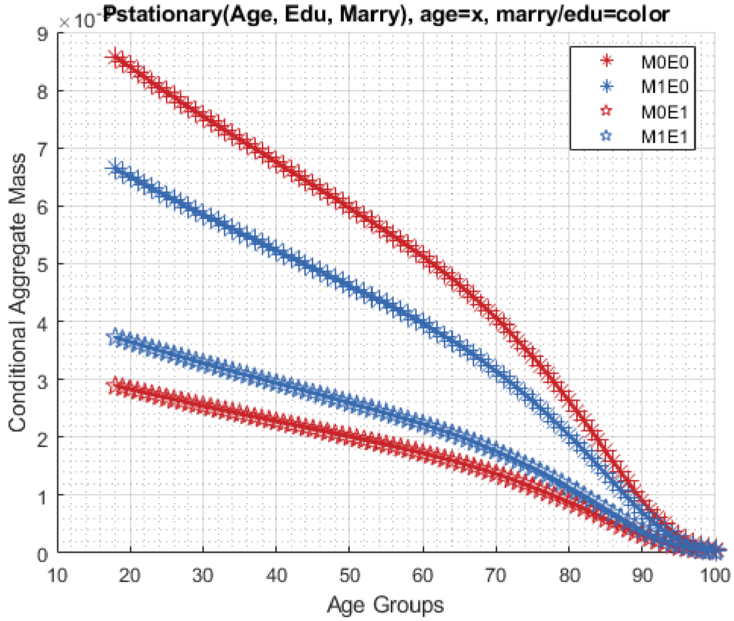
Tabulate value and policies along savings and shocks:

```
% 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);
```



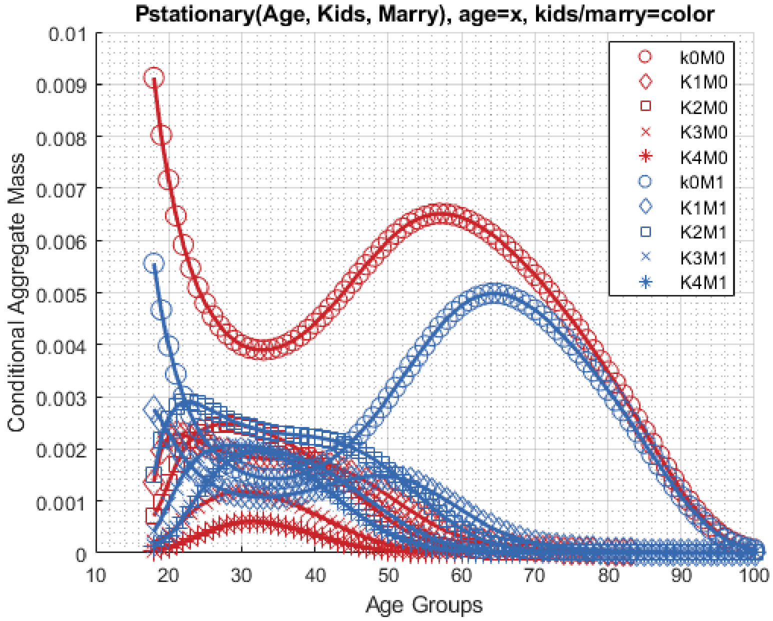
Kids and Marry By Age Mass

```
% 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	0
8	3	1	0.0014982	0.0021823	0.0025943	0.0028096	0.002896	0.0029031	
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

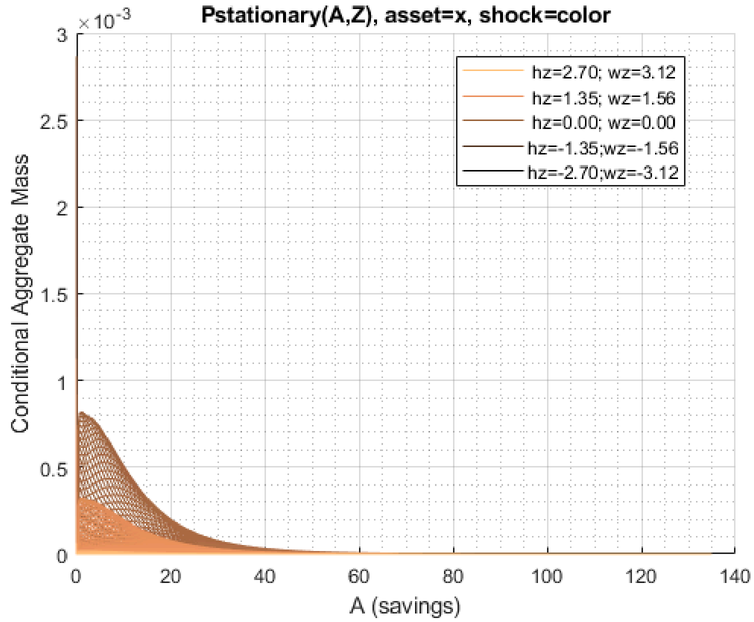
```
% NaN(n_jgrid,n_agrid,n_etagrid,n_educgrid,n_marriedgrid,n_kidsgrid);
ar_permute = [1,4,5,6,3,2];
% Value Function
tb_prob_az = ff_summ_nd_array("P(A,Z))", Phi_true, true, ["sum"], 4, 1, cl_mp_datasetdesc, ar_p
```

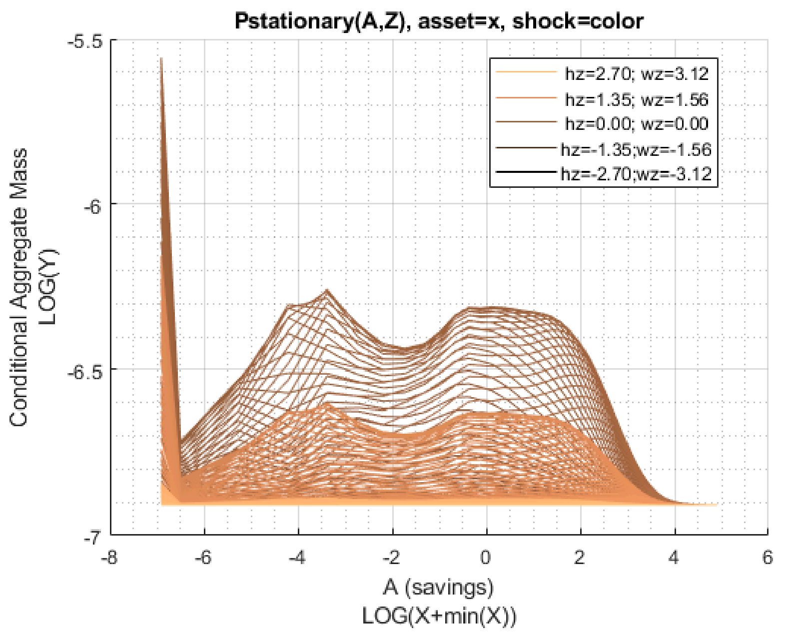
```
xxx  P(A,Z))  xxxxxxxxxxxxxxxxxxxxxxxxxxx
    group     savings      sum_eta_1     sum_eta_2     sum_eta_3     sum_eta_4     sum_eta_5     sum_eta_6     sum_e
    _____    __________    __________    __________    __________    __________    __________    __________    _____

      1               0    1.6824e-07    1.4406e-07    2.1911e-07    3.1913e-07    4.5491e-07    6.4002e-07    8.900
      2      0.00051498    3.4279e-10    3.2632e-10    5.6501e-10    1.0203e-09    1.9975e-09    4.1764e-09    8.868
      3       0.0041199    7.1369e-10    6.2373e-10    9.7246e-10    1.4702e-09    2.2039e-09    3.2988e-09    4.929
      4        0.013905     1.573e-09    1.3633e-09    2.1044e-09    3.1331e-09    4.6025e-09    6.7334e-09    9.836
      5        0.032959     5.494e-09    4.7235e-09      7.23e-09    1.0641e-08    1.5401e-08     2.211e-08    3.153
      6        0.064373    6.5788e-09    5.6779e-09     8.702e-09    1.2804e-08    1.8492e-08    2.6448e-08    3.753
```

```
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
```





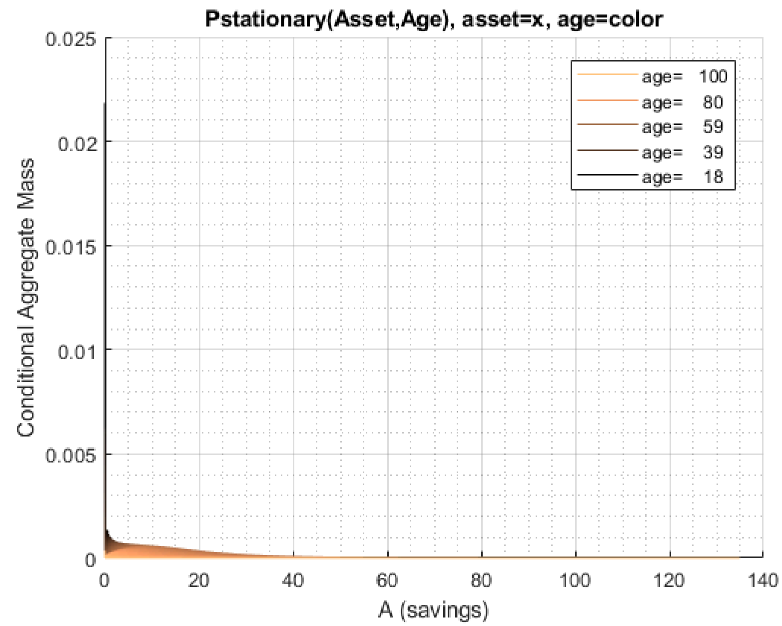
Asset Mass by Age

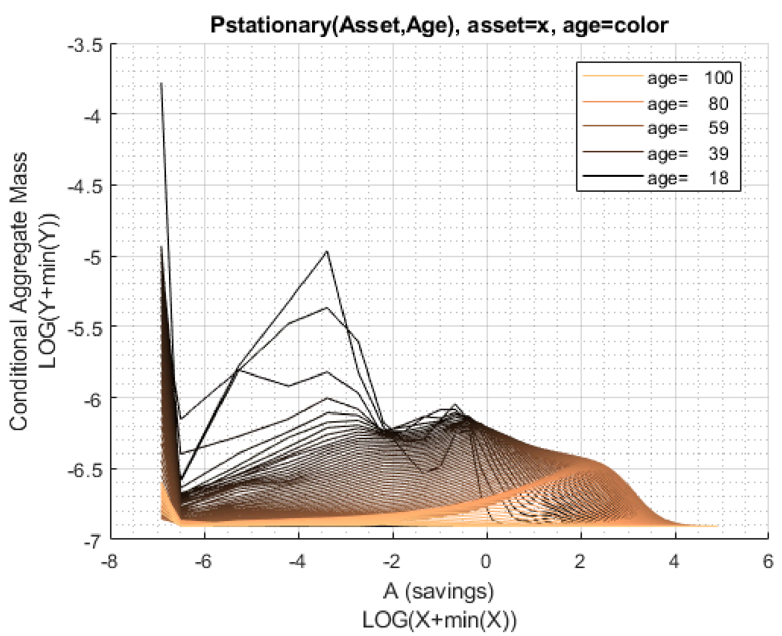
```
% NaN(n_jgrid,n_agrid,n_etagrid,n_educgrid,n_marriedgrid,n_kidsgrid);
ar_permute = [3,4,5,6,1,2];
% Value Function
tb_prob_aage = ff_summ_nd_array("P(A,Z))", Phi_true, true, ["sum"], 4, 1, cl_mp_datasetdesc, ar
```

```
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	0.0023507	0.0017993	0.0039371	0.0058435	0.0062157	0.00
2	0.00051498	0	0.00039608	0.00037932	0.0011301	0.00066626	0.00031095	0.000
3	0.0041199	0	0.0020816	0.0019888	0.002009	0.00088325	0.00066933	0.000
4	0.013905	0	0.0038656	0.0031682	0.001688	0.0011334	0.00094795	0.000
5	0.032959	0	0.0059678	0.0036757	0.0019686	0.0014691	0.0012275	0.00
6	0.064373	0	0.001968	0.0026857	0.0015598	0.0012805	0.0011877	0.00
7	0.11124	0	0.0010155	0.0010772	0.00089495	0.00094737	0.00096712	0.000
8	0.17664	0	0.00066497	0.00081578	0.0009608	0.0010548	0.0010166	0.000
9	0.26367	0	0.00045021	0.00085579	0.0011593	0.0011712	0.0010669	0.00
10	0.37542	0	0.00053095	0.0011218	0.0012745	0.0011467	0.0011044	0.00
11	0.51498	0	0.00090691	0.0013663	0.0012758	0.0012278	0.001195	0.00
12	0.68544	0	0.00097523	0.001111	0.0010957	0.0011325	0.0011755	0.00
13	0.88989	0	0.00023441	0.00050314	0.00074645	0.0009432	0.0010026	0.00
14	1.1314	0	4.5279e-05	0.00027467	0.00049029	0.00060869	0.00071831	0.00
15	1.4131	0	1.7339e-05	0.00019476	0.00030104	0.00040391	0.00050853	0.000
16	1.7381	0	8.1464e-06	6.6555e-05	0.00014925	0.00025602	0.00035404	0.000
17	2.1094	0	6.1188e-06	3.5994e-05	9.5417e-05	0.000162	0.00023392	0.000
18	2.5301	0	1.3448e-05	3.7101e-05	7.3464e-05	0.00012006	0.00017452	0.000
19	3.0034	0	2.2537e-05	4.8195e-05	7.7883e-05	0.00011025	0.00014444	0.000
20	3.5323	0	2.9909e-05	5.5599e-05	8.0928e-05	0.00010452	0.00012891	0.000
21	4.1199	0	3.0433e-05	5.458e-05	7.2693e-05	9.1664e-05	0.00011169	0.000
22	4.7693	0	2.0391e-05	3.7793e-05	5.5429e-05	7.2296e-05	8.9417e-05	0.000
23	5.4836	0	5.1199e-06	1.8361e-05	3.277e-05	4.8259e-05	6.4907e-05	8.218
24	6.2658	0	7.2528e-07	5.2955e-06	1.4093e-05	2.6887e-05	4.122e-05	5.674
25	7.1191	0	1.0524e-07	1.2817e-06	4.9228e-06	1.2149e-05	2.2923e-05	3.569
26	8.0466	0	1.7628e-08	5.0295e-07	2.0294e-06	5.2782e-06	1.1173e-05	2.001
27	9.0514	0	3.0056e-09	3.0395e-07	1.0911e-06	2.7755e-06	5.7099e-06	1.060
28	10.136	0	1.1825e-10	1.6421e-07	5.5086e-07	1.5801e-06	3.2779e-06	5.990
29	11.305	0	0	4.8037e-08	2.2122e-07	8.0726e-07	1.8918e-06	3.56
30	12.56	0	0	9.2865e-09	6.9448e-08	3.1086e-07	1.0023e-06	2.100
31	13.905	0	0	1.789e-09	2.077e-08	9.8086e-08	4.7382e-07	1.182
32	15.342	0	0	4.0984e-10	6.2012e-09	3.4485e-08	1.8776e-07	6.261
33	16.875	0	0	9.8855e-11	1.6718e-09	1.2956e-08	6.109e-08	3.03
34	18.507	0	0	2.1171e-11	4.7002e-10	4.2475e-09	2.1551e-08	1.251
35	20.241	0	0	8.4937e-13	1.3772e-10	1.2013e-09	8.274e-09	4.096
36	22.08	0	0	0	2.9206e-11	3.623e-10	2.7973e-09	1.389
37	24.027	0	0	0	3.6378e-12	1.1269e-10	8.3244e-10	5.364
38	26.085	0	0	0	7.7367e-13	2.3608e-11	2.7013e-10	1.817
39	28.258	0	0	0	1.7753e-13	3.9993e-12	8.0062e-11	5.768
40	30.548	0	0	0	8.3602e-15	1.0518e-12	1.7382e-11	1.866
41	32.959	0	0	0	0	1.9415e-13	3.6072e-12	5.371
42	35.493	0	0	0	0	1.4615e-14	9.1506e-13	1.193
43	38.154	0	0	0	0	2.3455e-15	1.4921e-13	2.800
44	40.945	0	0	0	0	2.9499e-16	1.7186e-14	6.544
45	43.868	0	0	0	0	6.0398e-18	3.2421e-15	1.046
46	46.928	0	0	0	0	0	3.3945e-16	1.583
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' }	0.13166	0.63405	-31.11	1.9854	0.71265	0.22832
{'sd' }	0.34823	0.37905	29.813	1.0848	0.54567	0.56949
{'coefofvar' }	2.645	0.59783	-0.95831	0.54639	0.76569	2.4943
{'min' }	0	0.036717	-586.22	1	0.038108	0
{'max' }	145.07	10.212	24.63	6	13.784	10.368

```
    {'pYis0'           }      0.10805             0             0            0            0      0.52499
    {'pYls0'           }            0             0       0.93414            0            0            0
    {'pYgr0'           }      0.89195             1      0.065859            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       -322.58            1     0.046651            0
    {'p10'             }            0       0.24819       -67.491            1      0.23528            0
    {'p25'             }     0.012186       0.36957       -41.871            1      0.35258            0
    {'p50'             }     0.032959       0.55272       -24.354            2      0.56523            0
    {'p75'             }      0.07477       0.80089        -11.18            3      0.90612      0.24502
    {'p90'             }      0.47812        1.1198       -2.6906            4       1.3579      0.84753
    {'p99_99'          }       5.4504        3.6593        17.393            6       6.8484       8.2655
    {'fl_cov_ap_ss'    }      0.12126      0.055072        2.4507     0.026881         0.05      0.18249
    {'fl_cor_ap_ss'    }            1       0.41721       0.23606     0.071158      0.26313      0.92021
    {'fl_cov_c_ss'     }     0.055072       0.14368        8.0391      0.07643      0.18689     0.071644
    {'fl_cor_c_ss'     }      0.41721             1       0.71138      0.18587      0.90355      0.33189
    {'fl_cov_v_ss'     }       2.4507        8.0391         888.8      0.38384       10.004       3.4658
    {'fl_cor_v_ss'     }      0.23606       0.71138             1     0.011868      0.61498      0.20413
    {'fl_cov_n_ss'     }     0.026881       0.07643       0.38384       1.1768   -8.185e-18      0.13323
    {'fl_cor_n_ss'     }     0.071158       0.18587      0.011868            1  -1.3827e-17      0.21565
    {'fl_cov_y_head_inc' }       0.05       0.18689        10.004   -8.185e-18      0.29776     0.010455
    {'fl_cor_y_head_inc' }    0.26313       0.90355       0.61498  -1.3827e-17            1     0.033645
    {'fl_cov_y_spouse'  }     0.18249      0.071644        3.4658      0.13323     0.010455      0.32432
    {'fl_cor_y_spouse'  }     0.92021       0.33189       0.20413      0.21565     0.033645            1
    {'fl_cov_yshr_wage' }  3.6882e-32    2.4079e-31   -9.3307e-30   1.6917e-30   1.2042e-31   1.6618e-31
    {'fl_cor_yshr_wage' }  2.3849e-16    1.4304e-15   -7.0476e-16   3.5116e-15   4.9692e-16    6.571e-16
    {'fl_cov_yshr_SS'  }            0             0             0            0            0            0
    {'fl_cor_yshr_SS'  }          NaN           NaN           NaN          NaN          NaN          NaN
    {'fl_cov_yshr_nttxss'}  0.0057457      0.011176       0.85848     0.007516      0.01319     0.008688
    {'fl_cor_yshr_nttxss'}    0.48632       0.86907       0.84874      0.20421      0.71249      0.44966
    {'fracByP0_01'     }            0    7.1684e-06     0.0013012      0.21046    7.788e-06            0
    {'fracByP10'       }            0      0.030643       0.32088      0.21046     0.027495            0
    {'fracByP25'       }    0.0067356       0.10365       0.58193      0.21046     0.092606            0
    {'fracByP50'       }      0.04689       0.29058       0.83099      0.53024      0.26377            0
    {'fracByP75'       }      0.13162       0.54875       0.97426      0.77109       0.5245      0.12959
    {'fracByP90'       }      0.35822       0.76944        1.0077      0.92834      0.74403      0.33886
    {'fracByP99_99'    }      0.99575       0.99938        1.0001            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     ys
    _____________________    __________    __________    __________    _________    __________    __________    __

    {'mean'            }        9.4506        1.2067       -9.9431       1.7239       1.6033      0.44918
    {'sd'              }        9.4598       0.76797        14.834      0.90777       1.2742        1.113
    {'coefofvar'       }         1.001       0.63643       -1.4919      0.52659      0.79474       2.4779
    {'min'             }             0       0.05663       -208.18            1     0.059541            0
    {'max'             }        158.43        12.311        14.965            6        23.47       20.112
    {'pYis0'           }     0.0059691             0             0            0            0      0.52499
    {'pYls0'           }             0             0       0.73383            0            0            0
    {'pYgr0'           }       0.99403             1       0.26617            1            1      0.47501
    {'pYisMINY'        }     0.0059691    9.8324e-06    2.9687e-09      0.48835   9.8989e-06      0.52499    1.
    {'pYisMAXY'        }    9.0457e-09    3.8325e-11    5.2662e-07    0.0036816   1.4683e-06   3.6378e-08     0
    {'p0_01'           }             0       0.07838          -101            1      0.08341            0
    {'p10'             }        1.0833       0.41297        -30.14            1      0.49019            0
    {'p25'             }        3.0034       0.65765        -16.23            1       0.7717            0
    {'p50'             }        6.7818        1.0568        -6.363            2       1.2612            0
    {'p75'             }        12.812        1.5534       0.45344            2       2.0256      0.48062
    {'p90'             }          20.8        2.1542        4.9139            3       3.0996       1.7714
    {'p99_99'          }        112.23        8.4857        13.926            6       15.937       16.033
    {'fl_cov_ap_ss'    }        89.487        6.8831        97.649       0.8159       10.409       2.2143
    {'fl_cor_ap_ss'    }             1       0.94746       0.69588     0.095013      0.86354       0.2103
    {'fl_cov_c_ss'     }        6.8831       0.58977        8.5503      0.23192      0.85197      0.24542     -
    {'fl_cor_c_ss'     }       0.94746             1       0.75055      0.33267      0.87063      0.28712
    {'fl_cov_v_ss'     }        97.649        8.5503        220.04       2.4373       12.623       3.4887
    {'fl_cor_v_ss'     }       0.69588       0.75055             1        0.181      0.66782      0.21131
```

```
    {'fl_cov_n_ss'       }        0.8159       0.23192        2.4373       0.82404      0.055267       0.27625       0
    {'fl_cor_n_ss'       }      0.095013       0.33267         0.181             1       0.04778       0.27342
    {'fl_cov_y_head_inc' }        10.409       0.85197        12.623      0.055267        1.6237         0.116      -
    {'fl_cor_y_head_inc' }       0.86354       0.87063       0.66782       0.04778             1       0.08179
    {'fl_cov_y_spouse'   }        2.2143       0.24542        3.4887       0.27625         0.116        1.2388
    {'fl_cor_y_spouse'   }        0.2103       0.28712       0.21131       0.27342       0.08179             1
    {'fl_cov_yshr_wage'  }      -0.54196     -0.036396      -0.86915     0.0011758     -0.038212      0.020434
    {'fl_cor_yshr_wage'  }      -0.56735      -0.46933      -0.58024      0.012827      -0.29697       0.18181
    {'fl_cov_yshr_SS'    }             0             0             0             0             0             0
    {'fl_cor_yshr_SS'    }           NaN           NaN           NaN           NaN           NaN           NaN
    {'fl_cov_yshr_nttxss'}       0.19452      0.017952       0.42036     0.0075501      0.027003      0.013338    -0.
    {'fl_cor_yshr_nttxss'}       0.67266        0.7647       0.92699       0.27208       0.69323       0.39202
    {'fracByP0_01'       }             0    6.8812e-06     0.0011212       0.28329    5.8341e-06             0     3.
    {'fracByP10'         }      0.004897      0.026408       0.43931       0.28329      0.022426             0
    {'fracByP25'         }      0.037048      0.092569       0.77208       0.28329      0.081818             0
    {'fracByP50'         }       0.16368       0.27051        1.0414       0.72028       0.23952             0
    {'fracByP75'         }       0.41532       0.53706        1.1137       0.72028       0.48823       0.13542
    {'fracByP90'         }       0.67288       0.76168         1.075       0.85389       0.72007       0.34015
    {'fracByP99_99'      }       0.99866       0.99926        1.0001             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_wa
    _____________________     _____    __________    __________    __________    __________    __________    _______

    {'mean'              }      0         0.34868       -3.0033        1.4797         0.2604       0.10125       0.15
    {'sd'                }      0         0.23392         1.043       0.50567        0.02289       0.24772        0.
    {'coefofvar'         }    NaN         0.67088      -0.34728       0.34173       0.087904        2.4467        1.3
    {'min'               }      0          0.2179       -10.065             1        0.24433             0
    {'max'               }      0          141.66       0.99282             6         5.6926         3.115       0.91
    {'pYis0'             }      1               0             0             0              0       0.52499       0.52
    {'pYls0'             }      0               0       0.99285             0              0             0
    {'pYgr0'             }      0               1     0.0071501             1              1       0.47501       0.47
    {'pYisMINY'          }      1         0.36483    1.5455e-10        0.5232        0.52813       0.52499       0.52
    {'pYisMAXY'          }      1               0             0    4.2206e-08              0    1.0335e-08    5.4646e
    {'p0_01'             }      0          0.2179       -6.3349             1        0.24433             0
    {'p10'               }      0          0.2179       -3.6603             1        0.24433             0
    {'p25'               }      0          0.2179       -3.5892             1        0.24433             0
    {'p50'               }      0         0.25824       -3.5892             1        0.24433             0
    {'p75'               }      0         0.36458       -2.8095             2        0.29263       0.10311       0.29
    {'p90'               }      0          0.6134       -1.3055             2        0.29279       0.49115       0.66
    {'p99_99'            }      0          2.8989       0.51215             4        0.33789        2.9458       0.90
    {'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        0.054721       0.19746      0.059476      0.0015551       0.05178      0.039
    {'fl_cor_c_ss'       }    NaN               1       0.80934       0.50281        0.29042       0.89356        0.7
    {'fl_cov_v_ss'       }      0         0.19746        1.0878       0.16711        0.01031        0.1649       0.15
    {'fl_cor_v_ss'       }    NaN         0.80934             1       0.31686        0.43183       0.63823       0.69
    {'fl_cov_n_ss'       }      0        0.059476       0.16711        0.2557      0.0019105        0.0533      0.083
    {'fl_cor_n_ss'       }    NaN         0.50281       0.31686             1        0.16506        0.4255       0.75
    {'fl_cov_y_head_inc' }      0       0.0015551       0.01031     0.0019105     0.00052397    0.00067518    0.00067
    {'fl_cor_y_head_inc' }    NaN         0.29042       0.43183       0.16506              1       0.11907       0.13
    {'fl_cov_y_spouse'   }      0         0.05178        0.1649        0.0533     0.00067518      0.061365      0.042
    {'fl_cor_y_spouse'   }    NaN         0.89356       0.63823        0.4255        0.11907             1       0.78
    {'fl_cov_yshr_wage'  }      0        0.039513       0.15927      0.083913     0.00067571      0.042915      0.048
    {'fl_cor_yshr_wage'  }    NaN          0.7643       0.69097       0.75087        0.13357       0.78388
    {'fl_cov_yshr_SS'    }      0       -0.040547      -0.16461     -0.085285    -0.00072523     -0.042963     -0.049
    {'fl_cor_yshr_SS'    }    NaN        -0.77966      -0.70991      -0.75864       -0.14251      -0.78011      -0.99
    {'fl_cov_yshr_nttxss'}      0        0.044511       0.18091      0.091879     0.00087698      0.047226      0.053
    {'fl_cor_yshr_nttxss'}    NaN         0.78763       0.71798       0.75212        0.15859       0.78914       0.99
    {'fracByP0_01'       }    NaN         0.22799    0.00053042       0.35357        0.49553             0
    {'fracByP10'         }    NaN         0.22799       0.22059       0.35357        0.49553             0
    {'fracByP25'         }    NaN         0.22799        0.6552       0.35357        0.49553             0
    {'fracByP50'         }    NaN         0.35394        0.6552       0.35357        0.49553             0
    {'fracByP75'         }    NaN         0.55083       0.87677       0.99419        0.88359       0.19257       0.36
    {'fracByP90'         }    NaN          0.7612       0.97549       0.99419        0.89158       0.62793       0.57
```

{'fracByP99_99'	}	NaN	0.99927	1	0.99999	0.99991	0.9996	0.99