Small Test Exact Solution Spousal Shocks

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

Test SNW_VFI_MAIN Defaults Small

Call the function with default parameters.

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

```
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:18 of 17, time-this-age:0.067387
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:17 of 17, time-this-age:0.057287
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:16 of 17, time-this-age:0.050539
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:15 of 17, time-this-age:0.058199
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:14 of 17, time-this-age:0.063318
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:13 of 17, time-this-age:0.054712
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:12 of 17, time-this-age:0.052556
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:11 of 17, time-this-age:0.054997
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:10 of 17, time-this-age:0.054287
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:9 of 17, time-this-age:0.054836
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:8 of 17, time-this-age:0.060559
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:7 of 17, time-this-age:0.064994
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:6 of 17, time-this-age:0.051121
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:5 of 17, time-this-age:0.057983
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:4 of 17, time-this-age:0.059449
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:3 of 17, time-this-age:0.059965
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:2 of 17, time-this-age:0.065501
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:1 of 17, time-this-age:0.058677
Completed SNW_VFI_MAIN_BISEC_VEC;SNW_MP_PARAM=default_small53;SNW_MP_CONTROL=default_base;time=1.0858
```

Small Param Results Define Frames

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

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

Analyze Savings and Shocks

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

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

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

Tabulate value and policies along savings and shocks:

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

```
xxx   MEAN(VAL(A,Z))   xxxxxxxxxxxxxxxxxxxxxxxxxx
```

group	savings	mean_eta_1	mean_eta_2	mean_eta_3	mean_eta_4	mean_eta_5	mean_eta_6	mean_e
1	0	-20.307	-10.285	-5.0527	-2.1772	-0.66137	-17.128	-8
2	0.0097656	-19.558	-10.063	-4.9312	-2.0759	-0.5645	-16.7	-8.7
3	0.078125	-16.259	-8.8768	-4.2806	-1.5512	-0.069704	-14.621	-7.9
4	0.26367	-12.127	-7.062	-3.289	-0.8157	0.59457	-11.347	-6.5
5	0.625	-8.3166	-5.145	-2.2609	-0.1528	1.1414	-7.9072	-4.8
6	1.2207	-5.2004	-3.3395	-1.2735	0.417	1.5609	-4.9697	-3.1
7	2.1094	-2.8448	-1.7849	-0.39262	0.91448	1.8837	-2.7126	-1.6
8	3.3496	-1.1351	-0.53317	0.368	1.3497	2.1394	-1.0585	-0.46
9	5	0.088433	0.43451	1.0071	1.7212	2.3505	0.1334	0.47
10	7.1191	0.96365	1.1669	1.5292	2.0348	2.5311	0.99051	1.1
11	9.7656	1.5949	1.7173	1.948	2.3007	2.6878	1.6112	1.7
12	12.998	2.0558	2.1316	2.2803	2.5253	2.8229	2.066	2.
13	16.875	2.397	2.4453	2.5427	2.7131	2.939	2.4035	2.
14	21.455	2.6533	2.6848	2.7497	2.869	3.0391	2.6576	2.6
15	26.797	2.8488	2.8698	2.9139	2.998	3.1258	2.8517	2.8
16	32.959	2.9999	3.0142	3.0447	3.1047	3.2007	3.0019	3.0
17	40	3.1182	3.1282	3.1496	3.1929	3.2653	3.1196	3.1
18	47.979	3.2119	3.219	3.2343	3.2659	3.3208	3.2129	3
19	56.953	3.287	3.2921	3.3033	3.3266	3.3685	3.2876	3.2
20	66.982	3.3477	3.3515	3.3597	3.3772	3.4093	3.3482	3.
21	78.125	3.3974	3.4002	3.4064	3.4196	3.4444	3.3978	3.4
22	90.439	3.4384	3.4405	3.4452	3.4553	3.4746	3.4386	3.4
23	103.98	3.4724	3.4741	3.4776	3.4854	3.5006	3.4726	3.4
24	118.82	3.501	3.5022	3.505	3.5111	3.5231	3.5012	3.5
25	135	3.5251	3.5261	3.5282	3.533	3.5426	3.5252	3.5

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

```
xxx   MEAN(AP(A,Z))   xxxxxxxxxxxxxxxxxxxxxxxxxx
```

group	savings	mean_eta_1	mean_eta_2	mean_eta_3	mean_eta_4	mean_eta_5	mean_eta_6	mean_e

1	0	2.7511e-05	0.0015443	0.029727	0.16652	0.75086	0.0035167	0.0042
2	0.0097656	0.00054711	0.0027834	0.031634	0.16984	0.75642	0.0051139	0.0066
3	0.078125	0.015731	0.018652	0.049638	0.19667	0.79532	0.036331	0.035
4	0.26367	0.093357	0.0908	0.12387	0.2854	0.9063	0.14147	0.1
5	0.625	0.31381	0.31997	0.35088	0.51766	1.1457	0.38798	0.39
6	1.2207	0.74541	0.7447	0.78537	0.95128	1.5671	0.82632	0.84
7	2.1094	1.4161	1.4196	1.4616	1.6183	2.2194	1.5017	1.5
8	3.3496	2.3637	2.3696	2.4109	2.5645	3.1433	2.4459	2.4
9	5	3.6292	3.6363	3.678	3.8404	4.3795	3.7121	3.7
10	7.1191	5.2766	5.2846	5.326	5.4907	5.9774	5.3608	5
11	9.7656	7.3022	7.3101	7.3505	7.5158	7.9941	7.3941	7.4
12	12.998	9.7443	9.7504	9.7888	9.9552	10.482	9.823	9.
13	16.875	12.756	12.762	12.797	12.958	13.553	12.833	12.
14	21.455	16.326	16.33	16.365	16.512	17.127	16.414	16.
15	26.797	20.39	20.392	20.419	20.557	21.172	20.476	20.
16	32.959	25.075	25.082	25.112	25.235	25.829	25.163	25.
17	40	30.452	30.46	30.499	30.623	31.182	30.53	30.
18	47.979	36.549	36.557	36.599	36.745	37.265	36.623	36.
19	56.953	43.56	43.567	43.602	43.748	44.27	43.634	43.
20	66.982	51.366	51.375	51.418	51.556	52.091	51.446	51.
21	78.125	59.653	59.661	59.707	59.864	60.396	59.747	59.
22	90.439	69.009	69.015	69.057	69.216	69.764	69.089	69.
23	103.98	79.499	79.505	79.547	79.696	80.26	79.579	79.
24	118.82	90.869	90.876	90.918	91.063	91.614	90.945	90.
25	135	103.22	103.22	103.26	103.41	103.95	103.3	103

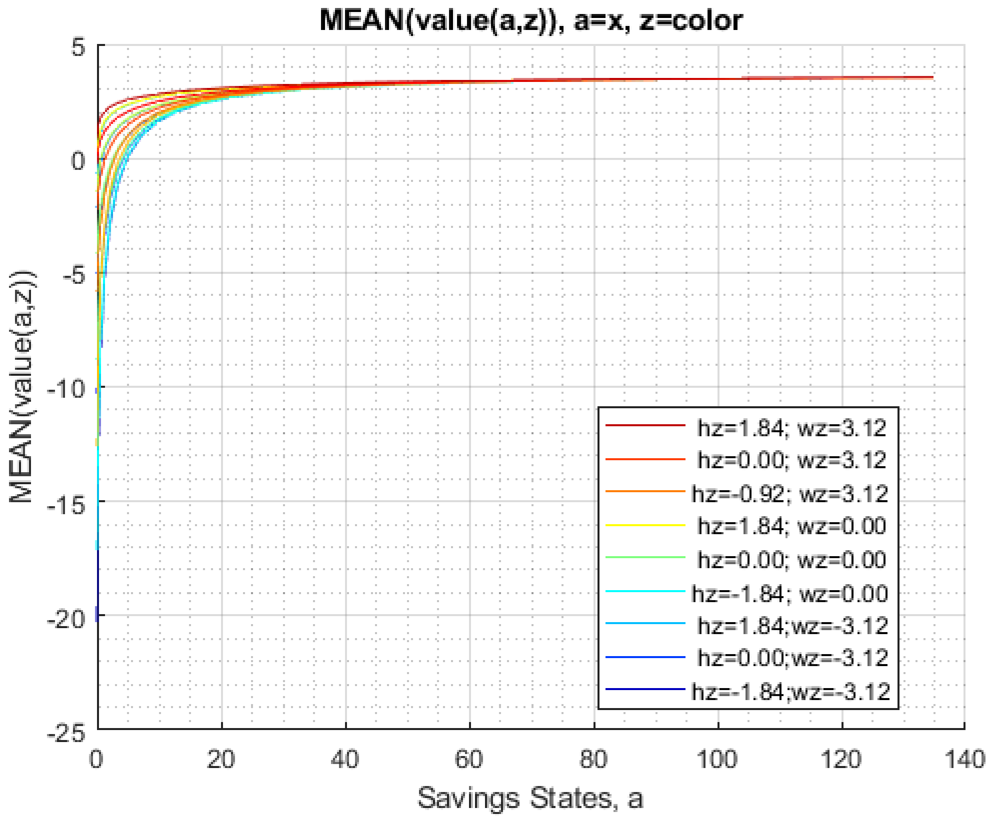
```
% Consumption Choices
tb_az_c = ff_summ_nd_array("MEAN(C(A,Z))", cons_VFI, true, ["mean"], 4, 1, cl_mp_datasetdesc, a
```

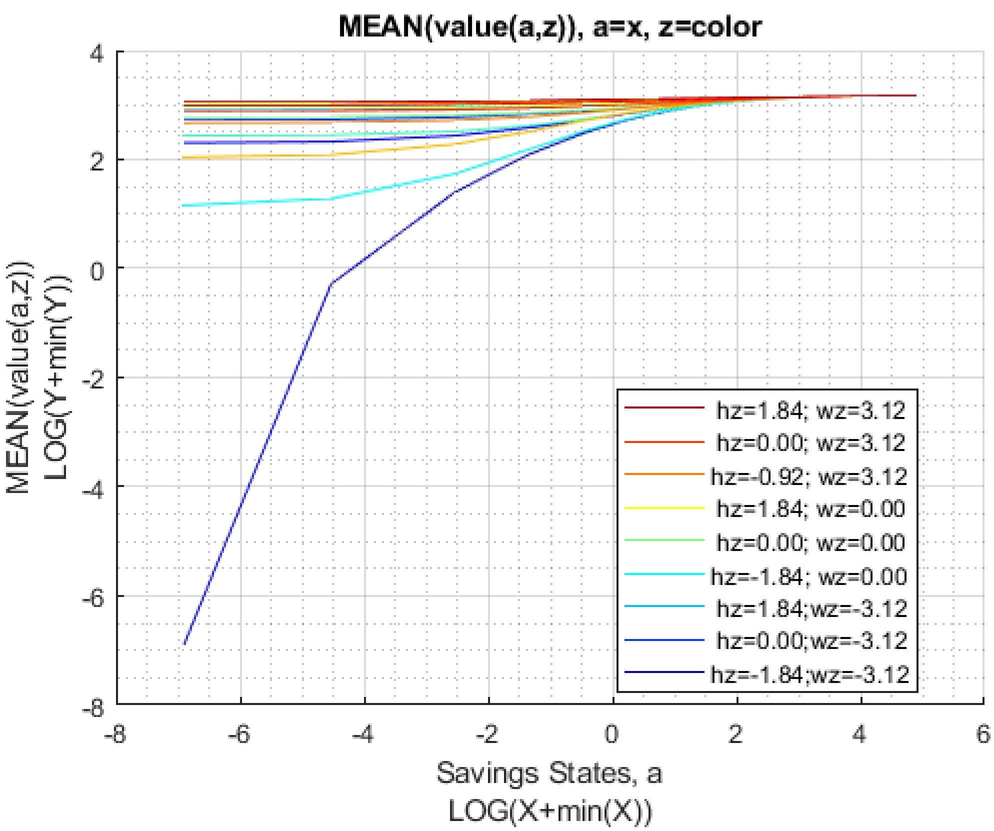
xxx MEAN(C(A,Z)) xxxxxxxxxxxxxxxxxxxxxxxxxxx

group	savings	mean_eta_1	mean_eta_2	mean_eta_3	mean_eta_4	mean_eta_5	mean_eta_6	mean_e
1	0	0.17596	0.2993	0.5664	1.1423	2.3148	0.30691	0.437
2	0.0097656	0.18702	0.30957	0.57594	1.1504	2.3206	0.31683	0.447
3	0.078125	0.25285	0.37423	0.63806	1.2035	2.3616	0.36625	0.498
4	0.26367	0.39479	0.52047	0.78122	1.3316	2.4672	0.47974	0.604
5	0.625	0.60083	0.71594	0.97718	1.5213	2.6493	0.65823	0.776
6	1.2207	0.87005	0.9899	1.2392	1.7827	2.9223	0.91891	1.03
7	2.1094	1.2414	1.355	1.6005	2.1515	3.305	1.2838	1.39
8	3.3496	1.7441	1.8535	2.0975	2.6496	3.8243	1.7883	1.89
9	5	2.4043	2.5112	2.7528	3.2942	4.5075	2.4465	2.55
10	7.1191	3.2256	3.3306	3.571	4.1085	5.3729	3.2656	3.36
11	9.7656	4.2795	4.3841	4.6243	5.1596	6.4314	4.3112	4.41
12	12.998	5.596	5.7019	5.9433	6.4763	7.6989	5.6405	5.74
13	16.875	7.0899	7.1954	7.4401	7.977	9.1305	7.1353	7.24
14	21.455	8.8406	8.9481	9.1919	9.7431	10.875	8.8751	8.9
15	26.797	10.982	11.091	11.342	11.901	13.033	11.017	11.1
16	32.959	13.452	13.557	13.805	14.378	15.531	13.487	13.5
17	40	16.251	16.354	16.593	17.165	18.352	16.296	16
18	47.979	19.418	19.521	19.756	20.307	21.532	19.465	19.
19	56.953	22.826	22.93	23.172	23.723	24.945	22.874	22.9
20	66.982	26.663	26.765	27	27.557	28.767	26.705	26.8
21	78.125	31.312	31.414	31.646	32.184	33.397	31.34	31.4
22	90.439	36.251	36.355	36.591	37.128	38.324	36.293	36.3
23	103.98	41.485	41.589	41.825	42.372	43.552	41.526	41.6
24	118.82	47.334	47.438	47.674	48.224	49.417	47.38	47.4
25	135	53.768	53.874	54.112	54.659	55.86	53.813	53.9

Graph Mean Values:

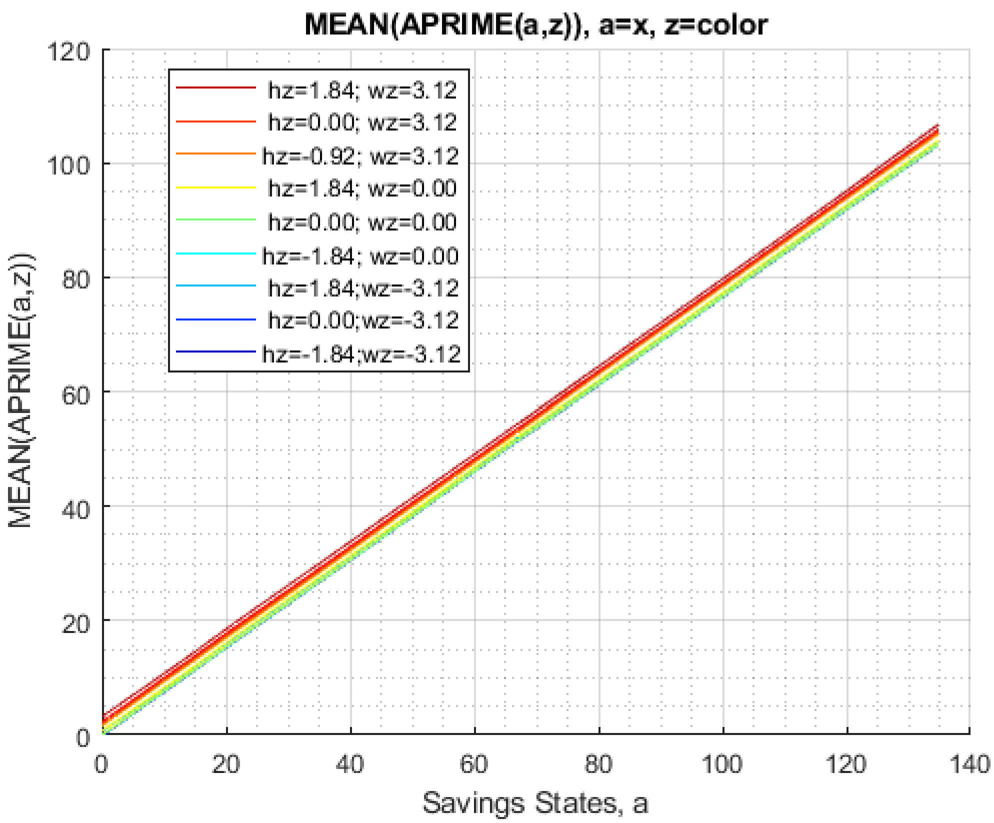
```
mp_support_graph('cl_st_graph_title') = {'MEAN(value(a,z)), a=x, z=color'};
mp_support_graph('cl_st_ytitle') = {'MEAN(value(a,z))'};
ff_graph_grid((tb_az_v{1:end, 3:end})', ar_st_eta_HS_grid, agrid, mp_support_graph);
```

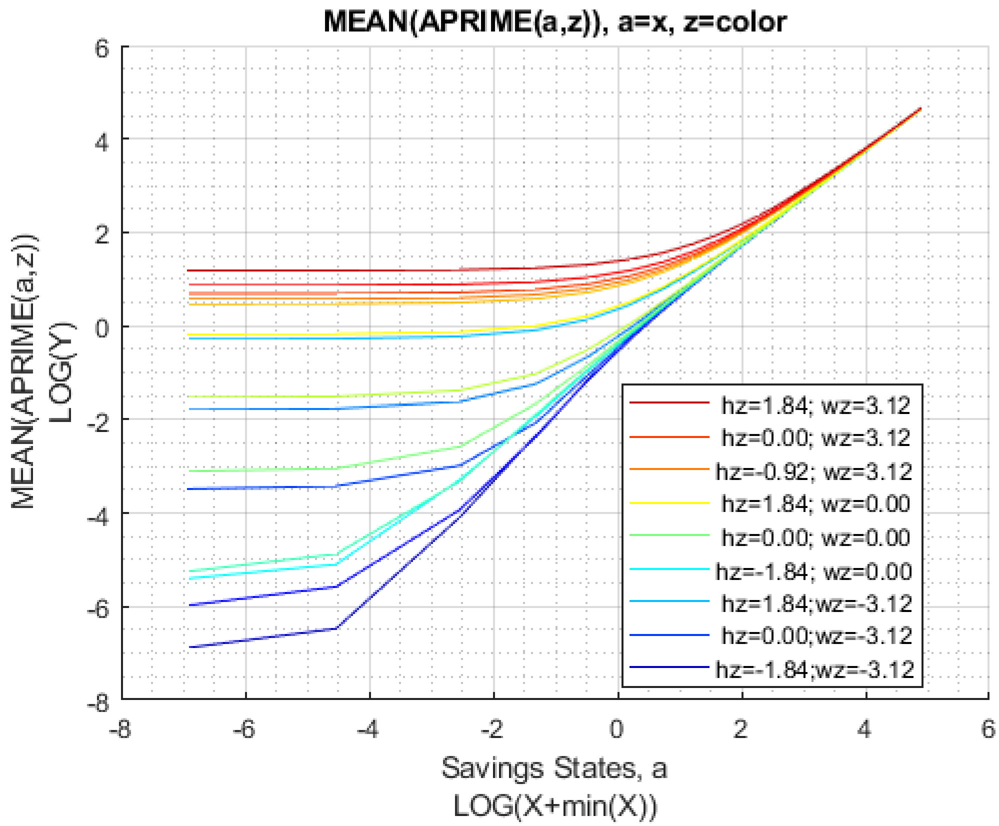




Graph Mean Savings Choices:

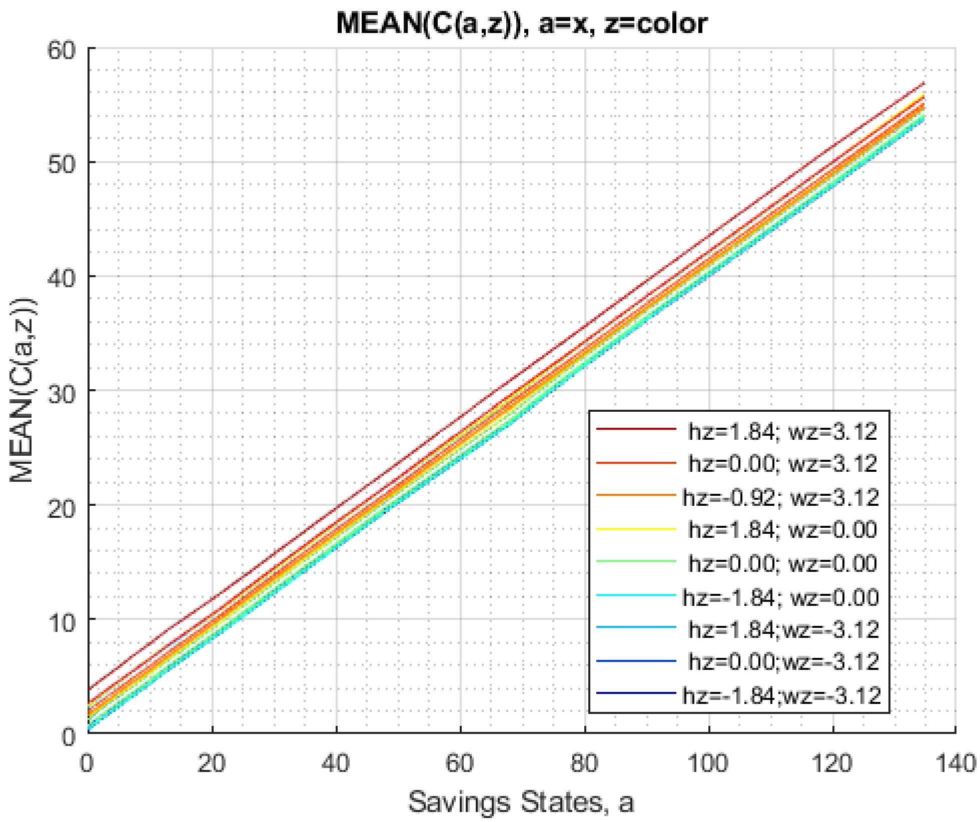
```
mp_support_graph('cl_st_graph_title') = {'MEAN(APRIME(a,z)), a=x, z=color'};
mp_support_graph('cl_st_ytitle') = {'MEAN(APRIME(a,z))'};
ff_graph_grid((tb_az_ap{1:end, 3:end})', ar_st_eta_HS_grid, agrid, mp_support_graph);
```

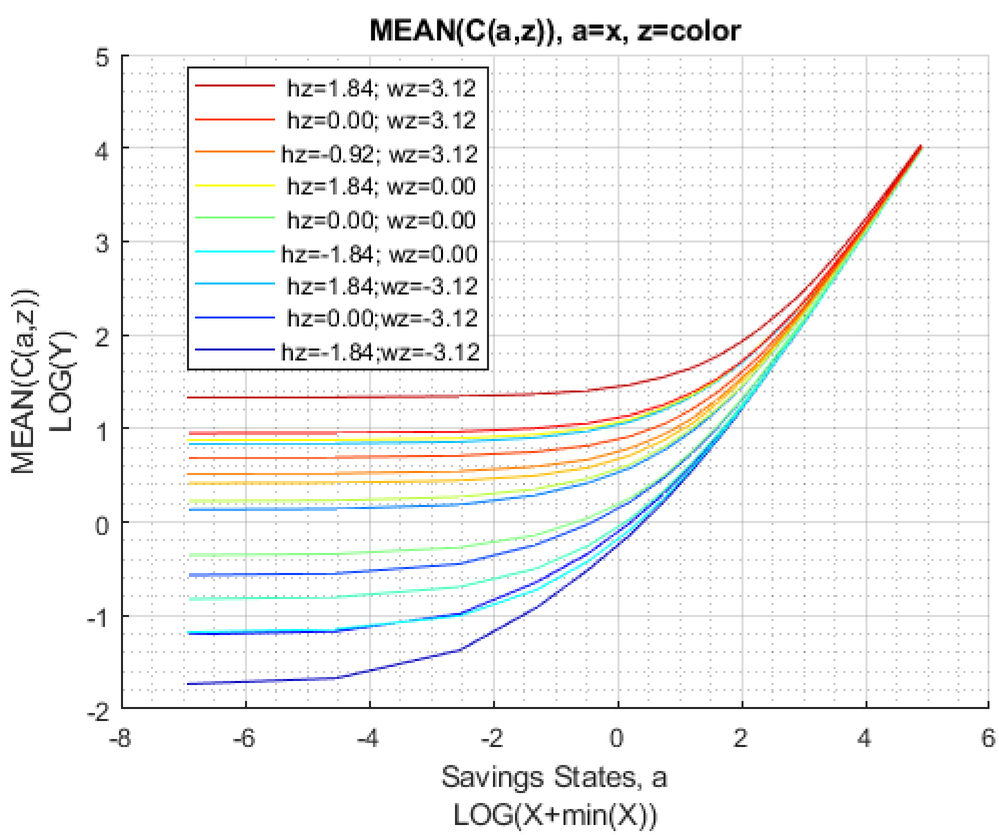




Graph Mean Consumption:

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





Analyze Kids and Marriage and Age

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

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

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

Tabulate value and policies:

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

```
xxx  MEAN(VAL(KM,J))  xxxxxxxxxxxxxxxxxxxxxxxxxxx
```

group	kids	marry	mean_age_19	mean_age_22	mean_age_27	mean_age_32	mean_age_37	mean_age_42
1	1	0	1.4699	1.7485	1.9344	1.9907	1.9652	1.8837
2	2	0	-0.020723	0.46111	0.83504	1.0389	1.1397	1.1609
3	3	0	-0.77111	-0.30145	0.081934	0.30157	0.41928	0.46457
4	1	1	2.7247	2.8812	2.9832	2.9923	2.9362	2.8303
5	2	1	1.8762	2.1212	2.3182	2.4103	2.4302	2.3894
6	3	1	1.4732	1.7023	1.8951	1.9893	2.0142	1.9854

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

```
xxx  MEAN(AP(KM,J))  xxxxxxxxxxxxxxxxxxxxxxxxxxx
```

group	kids	marry	mean_age_19	mean_age_22	mean_age_27	mean_age_32	mean_age_37	mean_age_42
1	1	0	34.929	34.724	34.662	34.55	34.357	34.071
2	2	0	34.6	34.331	34.195	33.99	33.687	33.279
3	3	0	34.185	33.965	33.873	33.7	33.421	33.026
4	1	1	35.711	35.608	35.696	35.722	35.654	35.486
5	2	1	35.365	35.243	35.28	35.238	35.095	34.842
6	3	1	34.9	34.807	34.856	34.829	34.694	34.439

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

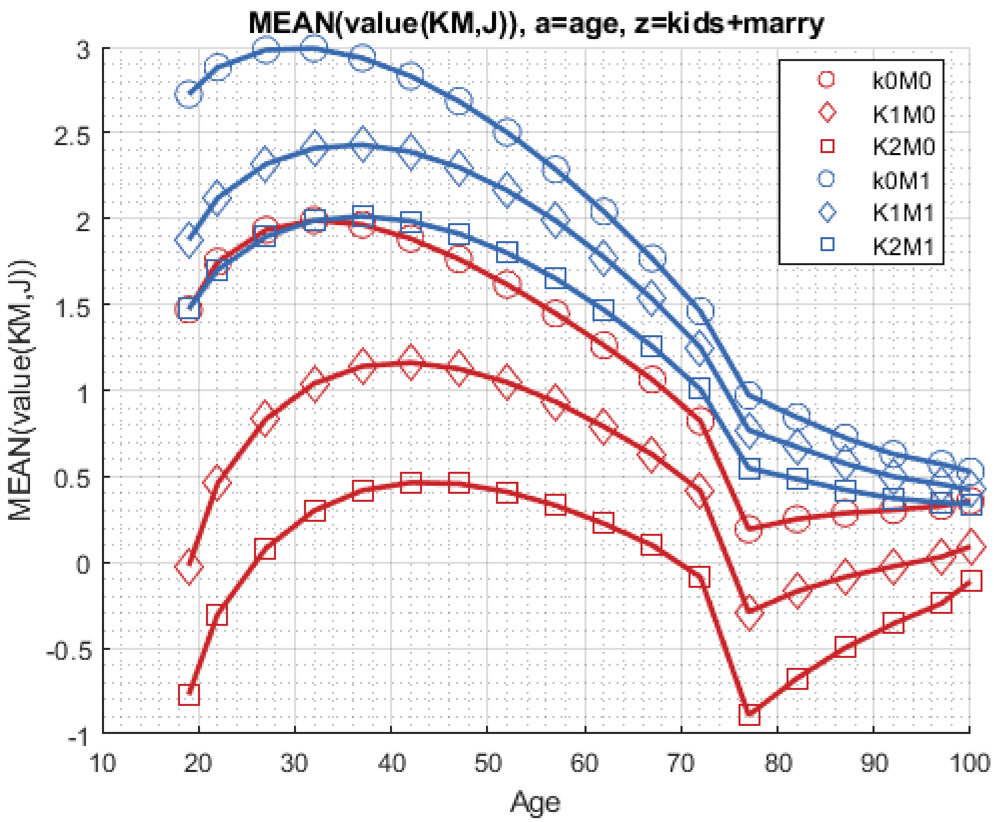
```
xxx  MEAN(C(KM,J))  xxxxxxxxxxxxxxxxxxxxxxxxxxx
```

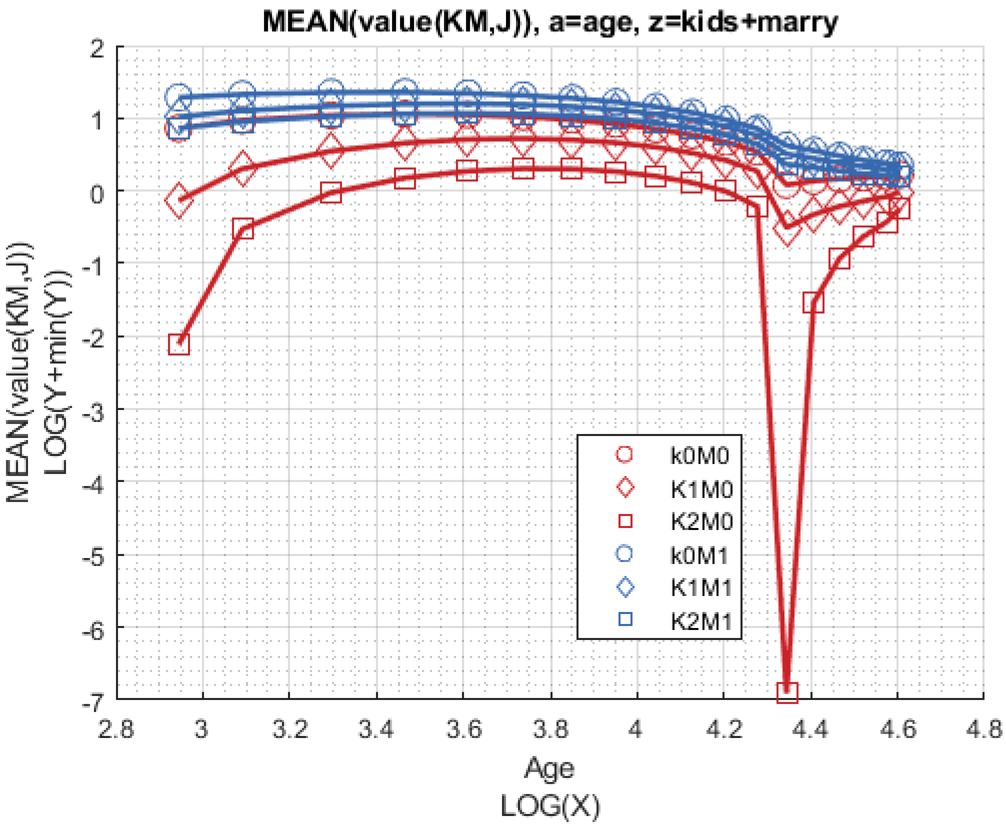
group	kids	marry	mean_age_19	mean_age_22	mean_age_27	mean_age_32	mean_age_37	mean_age_42
1	1	0	6.8551	7.1756	7.502	7.8205	8.1483	8.5053
2	2	0	7.1843	7.5683	7.9695	8.3802	8.8184	9.2974
3	3	0	7.5997	7.934	8.2911	8.6703	9.0841	9.5509

4	1	1	7.8017	8.1851	8.5662	8.9367	9.3167	9.7217
5	2	1	7.8815	8.2584	8.6593	9.0691	9.4965	9.9609
6	3	1	8.1632	8.4941	8.8603	9.2345	9.6357	10.084

Graph Mean Values:

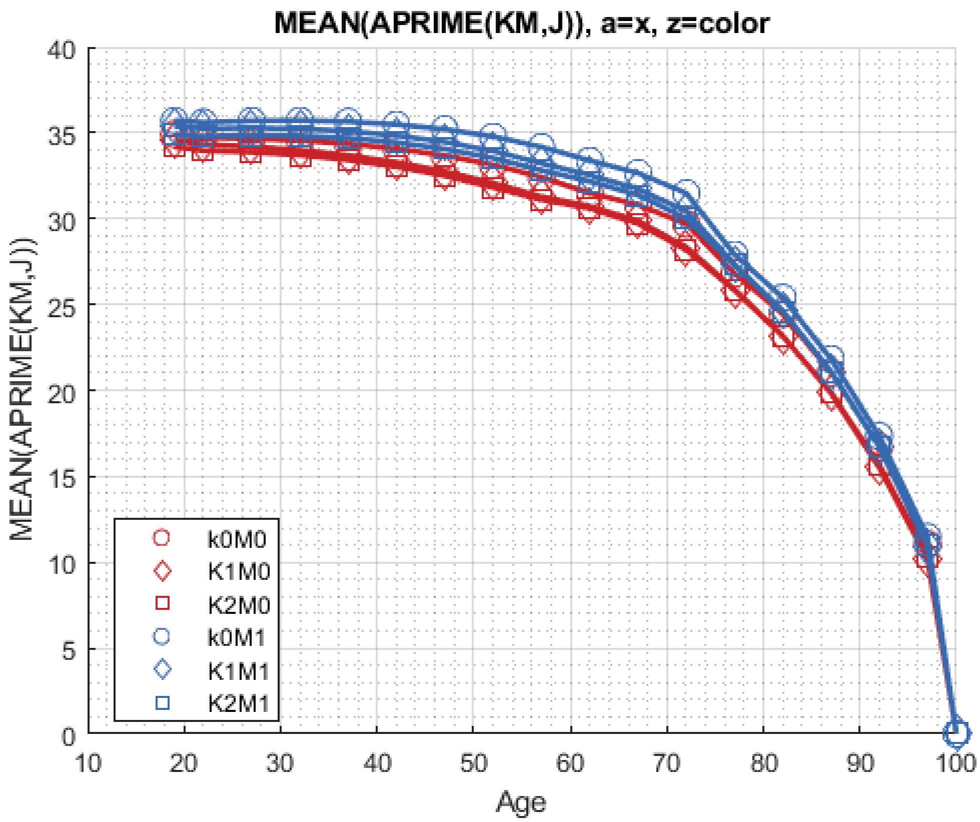
```
mp_support_graph('cl_st_graph_title') = {'MEAN(value(KM,J)), a=age, z=kids+marry'};
mp_support_graph('cl_st_ytitle') = {'MEAN(value(KM,J))'};
ff_graph_grid((tb_az_v{1:end, 4:end}), ar_row_grid, age_grid, mp_support_graph);
```

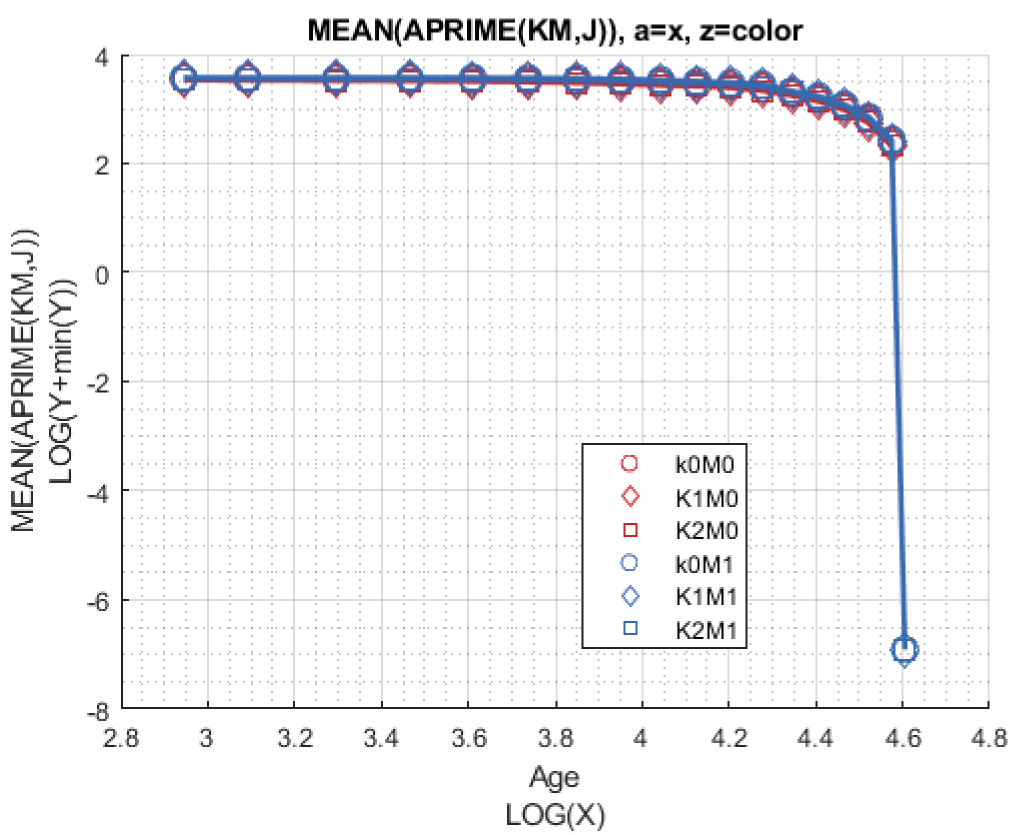




Graph Mean Savings Choices:

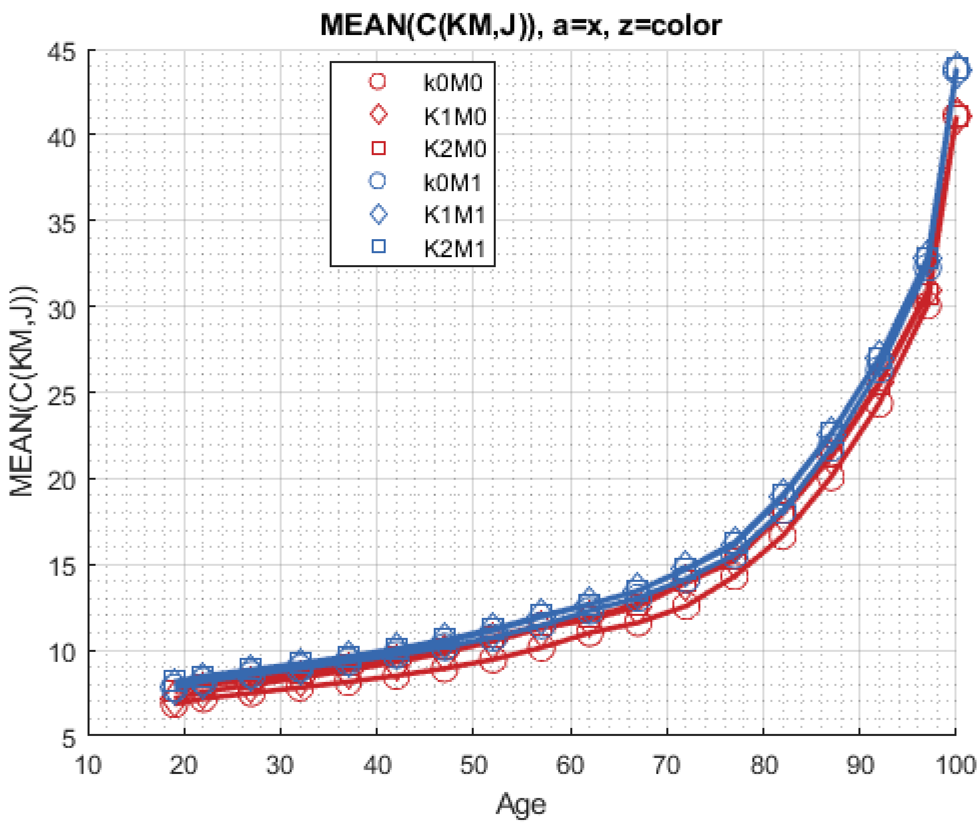
```
mp_support_graph('cl_st_graph_title') = {'MEAN(APRIME(KM,J)), a=x, z=color'};
mp_support_graph('cl_st_ytitle') = {'MEAN(APRIME(KM,J))'};
ff_graph_grid((tb_az_ap{1:end, 4:end}), ar_row_grid, age_grid, mp_support_graph);
```

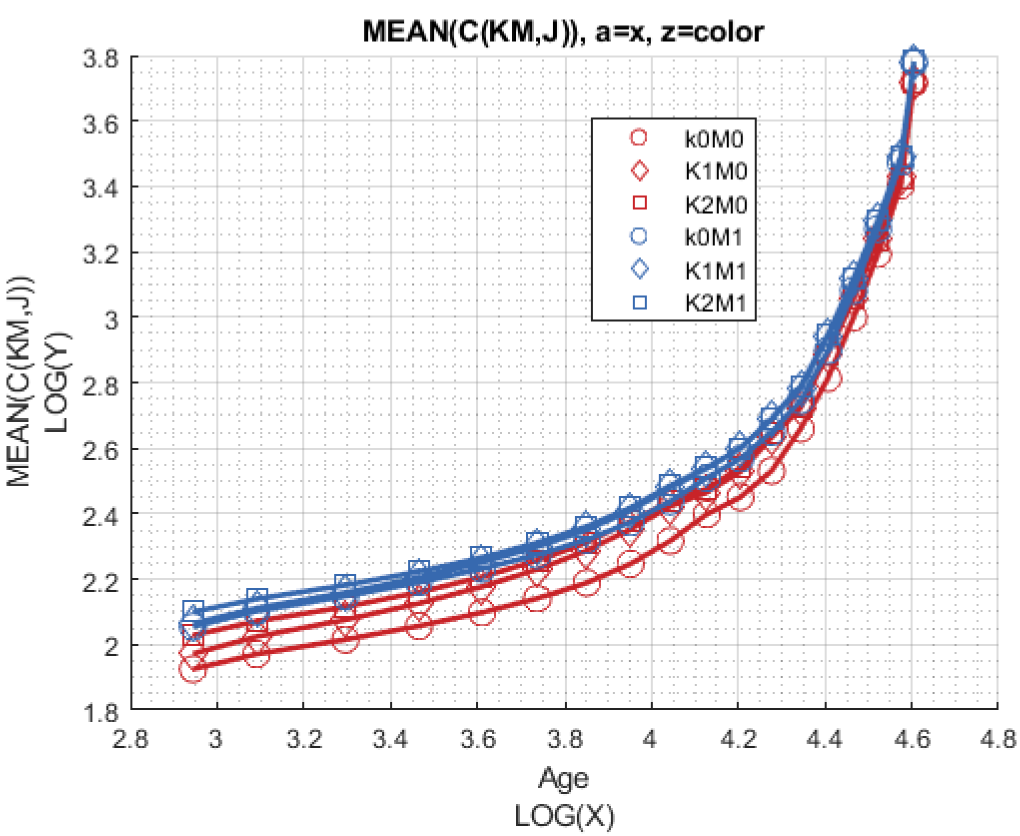




Graph Mean Consumption:

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





Analyze Education and Marriage and Age

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

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

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

Tabulate value and policies:

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

xxx MEAN(VAL(EKM,J)) xxxxxxxxxxxxxxxxxxxxxxxxxxx

group	edu	marry	mean_age_19	mean_age_22	mean_age_27	mean_age_32	mean_age_37	mean_age_42
1	0	0	-0.19018	0.16944	0.46325	0.63924	0.73534	0.76637
2	1	0	0.64221	1.1027	1.4377	1.5815	1.6141	1.5731
3	0	1	1.7253	1.9221	2.0804	2.1589	2.1772	2.1432
4	1	1	2.3242	2.5478	2.7173	2.769	2.7432	2.6602

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

xxx MEAN(AP(EKM,J)) xxxxxxxxxxxxxxxxxxxxxxxxxxx

group	edu	marry	mean_age_19	mean_age_22	mean_age_27	mean_age_32	mean_age_37	mean_age_42
1	0	0	34.68	34.441	34.268	34.044	33.748	33.368
2	1	0	34.463	34.238	34.218	34.116	33.895	33.549
3	0	1	35.361	35.231	35.189	35.094	34.928	34.679
4	1	1	35.29	35.207	35.366	35.432	35.368	35.166

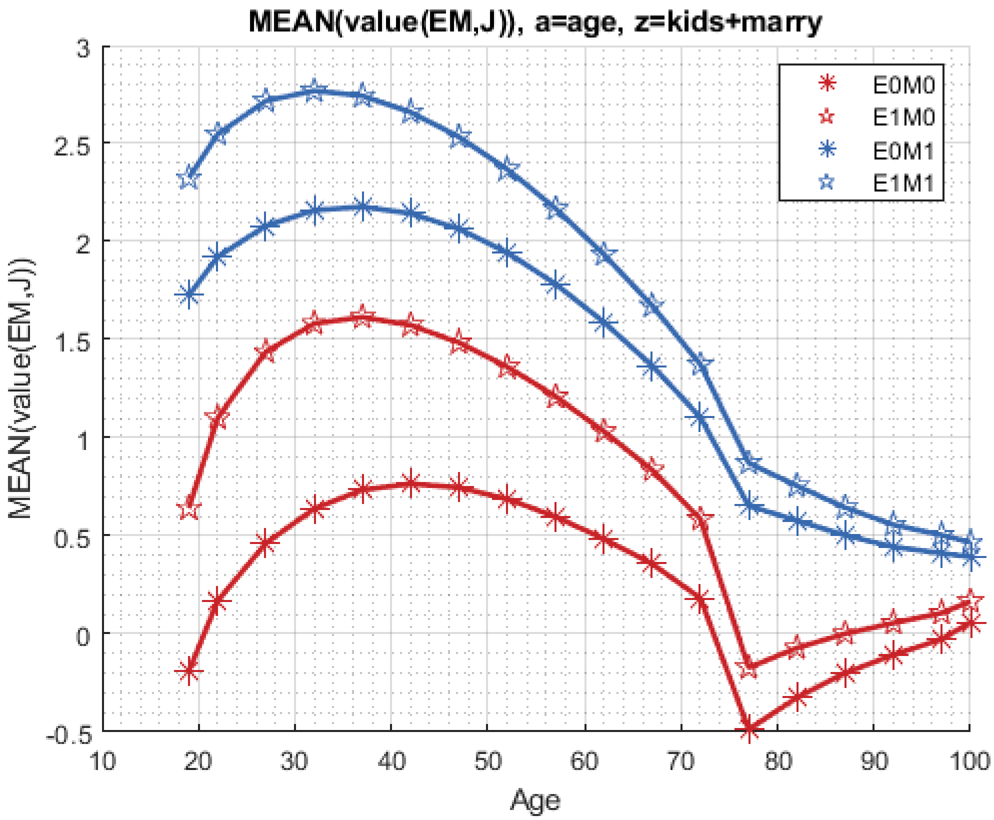
```
% Consumption Choices
tb_az_c = ff_summ_nd_array("MEAN(C(EKM,J))", cons_VFI, true, ["mean"], 3, 1, cl_mp_datasetdesc,
```

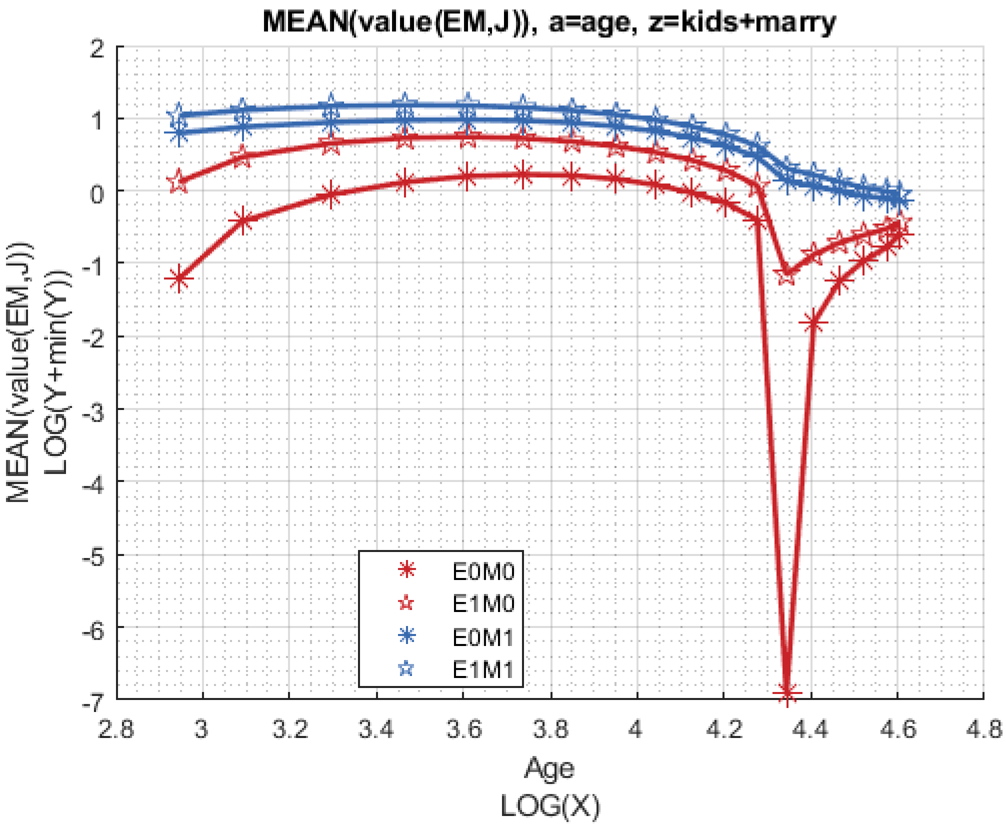
xxx MEAN(C(EKM,J)) xxxxxxxxxxxxxxxxxxxxxxxxxxx

group	edu	marry	mean_age_19	mean_age_22	mean_age_27	mean_age_32	mean_age_37	mean_age_42
1	0	0	7.1043	7.4114	7.7391	8.0887	8.4765	8.9169
2	1	0	7.3218	7.7071	8.1025	8.492	8.8907	9.3189
3	0	1	7.761	8.0772	8.4119	8.7662	9.1545	9.5892
4	1	1	8.1365	8.5478	8.9787	9.394	9.8115	10.255

Graph Mean Values:

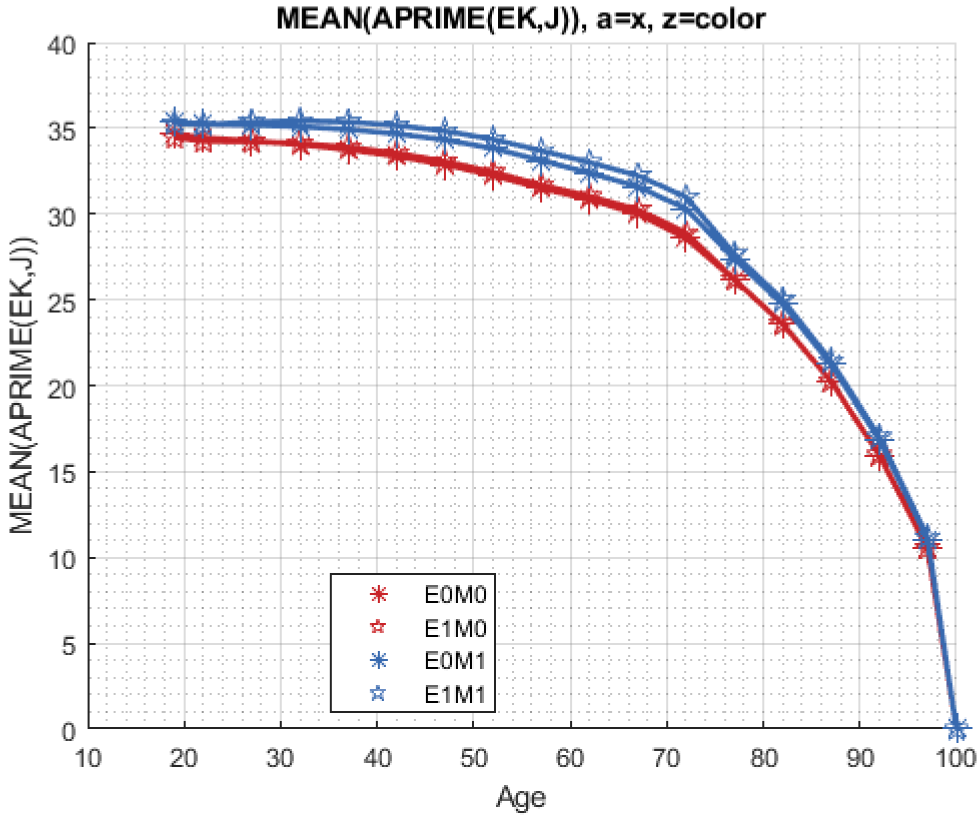
```
mp_support_graph('cl_st_graph_title') = {'MEAN(value(EM,J)), a=age, z=kids+marry'};
mp_support_graph('cl_st_ytitle') = {'MEAN(value(EM,J))'};
ff_graph_grid((tb_az_v{1:end, 4:end}), ar_row_grid, age_grid, mp_support_graph);
```

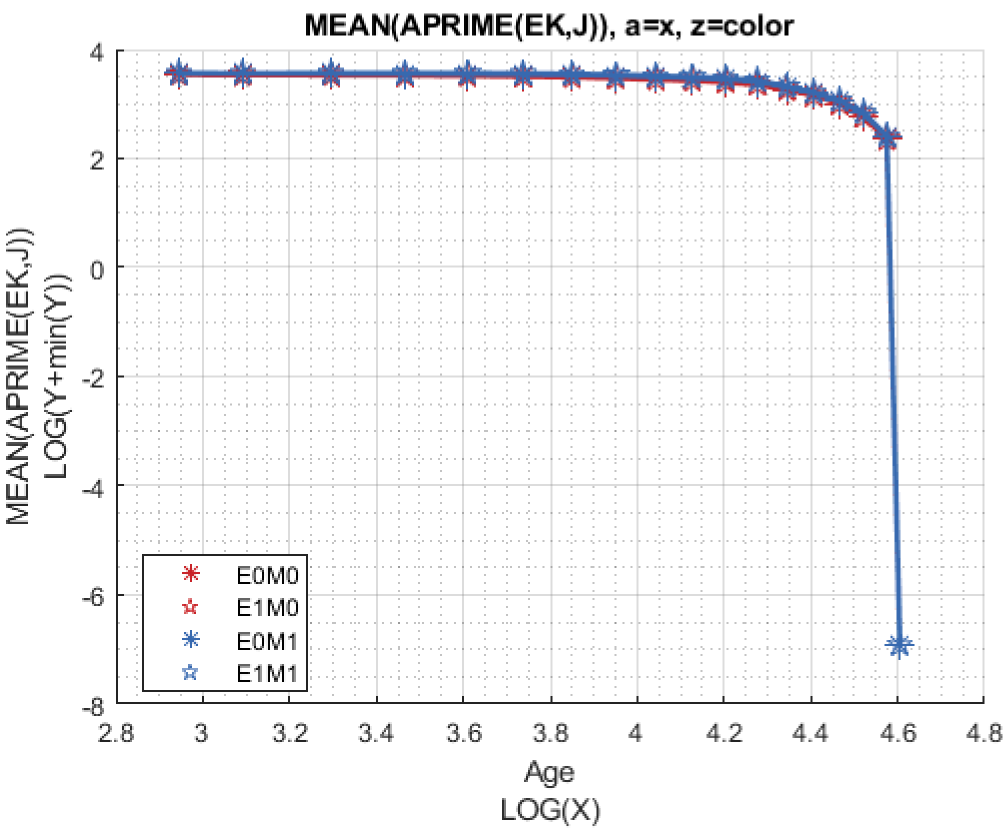




Graph Mean Savings Choices:

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





Graph Mean Consumption:

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