Small Test Exact Solution Vectorized Bisection

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

Test SNW_VFI_MAIN Defaults Small

Call the function with defaults parameters.

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

```
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:18 of 17, time-this-age:0.036425
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:17 of 17, time-this-age:0.035179
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:16 of 17, time-this-age:0.021283
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:15 of 17, time-this-age:0.01888
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:14 of 17, time-this-age:0.018332
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:13 of 17, time-this-age:0.01803
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:12 of 17, time-this-age:0.040638
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:11 of 17, time-this-age:0.020865
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:10 of 17, time-this-age:0.019525
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:9 of 17, time-this-age:0.025794
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:8 of 17, time-this-age:0.017978
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:7 of 17, time-this-age:0.018489
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:6 of 17, time-this-age:0.019727
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:5 of 17, time-this-age:0.019885
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:4 of 17, time-this-age:0.041926
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:3 of 17, time-this-age:0.032186
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:2 of 17, time-this-age:0.019092
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:1 of 17, time-this-age:0.017174
Completed SNW_VFI_MAIN_BISEC_VEC;SNW_MP_PARAM=default_small;SNW_MP_CONTROL=default_base;time=0.48981
```

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'}, {'Hshock', eta_H_grid});
cl_mp_datasetdesc{4} = containers.Map({'name', 'labval'}, {'edu', edu_grid});
cl_mp_datasetdesc{5} = containers.Map({'name', 'labval'}, {'marry', marry_grid});
cl_mp_datasetdesc{6} = containers.Map({'name', 'labval'}, {'kids', kids_grid});
```

Analyze Savings and Shocks

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

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

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

Tabulate value and policies along savings and shocks:

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

xxx MEAN(VAL(A,Z)) xxxxxxxxxxxxxxxxxxxxxxxxxxx

group	savings	mean_Hshock__1_8395	mean_Hshock__0_91976	mean_Hshock_0	mean_Hshock_0_91976	mea
1	0	-17.393	-9.1596	-4.4164	-1.5921	
2	0.0097656	-16.967	-9.023	-4.3405	-1.5316	
3	0.078125	-14.925	-8.2554	-3.9177	-1.2071	
4	0.26367	-11.699	-6.8681	-3.1808	-0.6913	
5	0.625	-8.2751	-5.1669	-2.2785	-0.13883	
6	1.2207	-5.3024	-3.4437	-1.3431	0.38362	
7	2.1094	-2.9816	-1.9066	-0.47797	0.86412	
8	3.3496	-1.2609	-0.64407	0.28612	1.3001	
9	5	-0.012543	0.34403	0.9369	1.6782	
10	7.1191	0.88751	1.097	1.4725	1.9981	
11	9.7656	1.5392	1.665	1.9037	2.2701	
12	12.998	2.0158	2.0932	2.2465	2.5004	
13	16.875	2.3684	2.4172	2.5172	2.6933	
14	21.455	2.6328	2.6644	2.7307	2.8535	
15	26.797	2.8339	2.8549	2.8997	2.986	
16	32.959	2.989	3.0032	3.034	3.0954	
17	40	3.1102	3.12	3.1416	3.1857	
18	47.979	3.2059	3.2128	3.2282	3.2603	
19	56.953	3.2825	3.2875	3.2986	3.3222	
20	66.982	3.3443	3.348	3.3562	3.3738	
21	78.125	3.3948	3.3975	3.4036	3.4169	
22	90.439	3.4364	3.4384	3.443	3.4532	
23	103.98	3.4709	3.4724	3.476	3.4838	
24	118.82	3.4998	3.501	3.5037	3.5098	
25	135	3.5241	3.5251	3.5272	3.5319	

```
% 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)) xxxxxxxxxxxxxxxxxxxxxxxxxxx

group	savings	mean_Hshock__1_8395	mean_Hshock__0_91976	mean_Hshock_0	mean_Hshock_0_91976	mea
1	0	2.7511e-05	0.0021997	0.046353	0.23828	
2	0.0097656	0.00054711	0.0036547	0.049525	0.24213	

3	0.078125	0.021674	0.027305	0.079481	0.27462
4	0.26367	0.13129	0.14249	0.19451	0.38201
5	0.625	0.38703	0.404	0.44756	0.63879
6	1.2207	0.83381	0.85545	0.90672	1.0839
7	2.1094	1.5206	1.5442	1.6064	1.7452
8	3.3496	2.477	2.5013	2.5629	2.6788
9	5	3.7541	3.7788	3.8405	3.9859
10	7.1191	5.416	5.4412	5.5038	5.6835
11	9.7656	7.4668	7.4912	7.5553	7.7413
12	12.998	9.9008	9.9211	9.9832	10.174
13	16.875	12.918	12.94	12.995	13.186
14	21.455	16.519	16.538	16.594	16.772
15	26.797	20.59	20.608	20.657	20.825
16	32.959	25.295	25.313	25.358	25.513
17	40	30.657	30.68	30.732	30.877
18	47.979	36.751	36.772	36.831	36.99
19	56.953	43.764	43.786	43.839	44.003
20	66.982	51.594	51.617	51.677	51.84
21	78.125	59.942	59.965	60.024	60.197
22	90.439	69.254	69.278	69.34	69.515
23	103.98	79.741	79.762	79.821	79.995
24	118.82	91.103	91.126	91.188	91.354
25	135	103.46	103.48	103.53	103.71

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

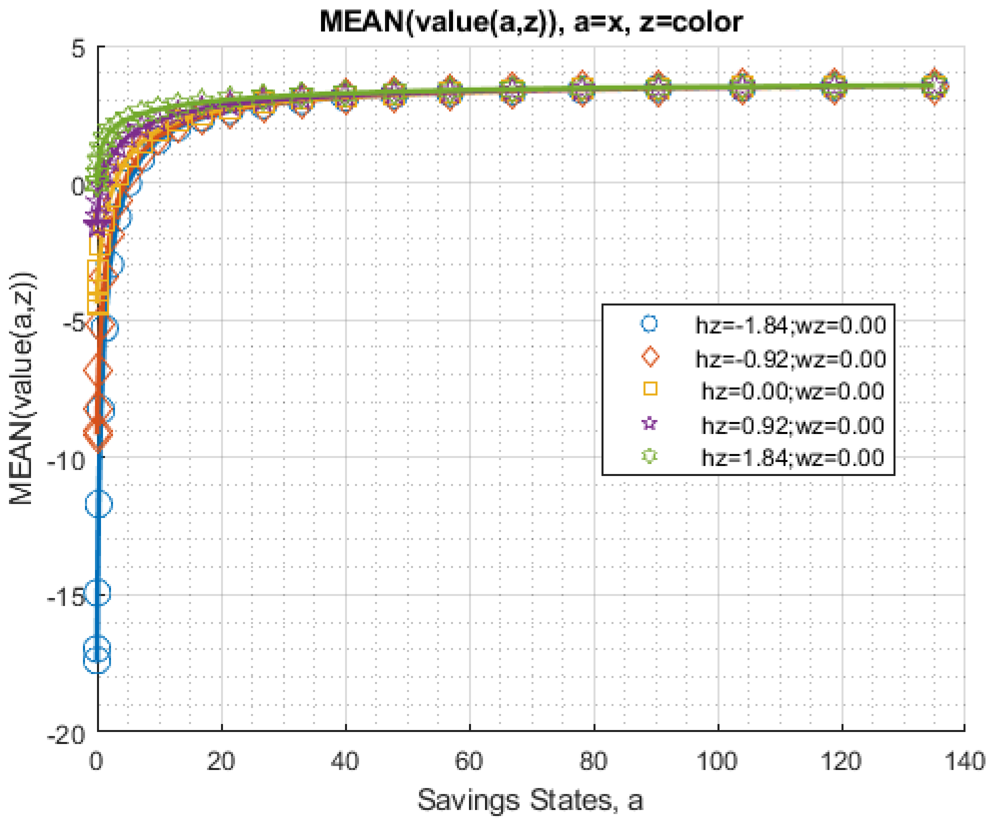
xxx MEAN(C(A,Z)) xxxxxxxxxxxxxxxxxxxxxxxxxxx

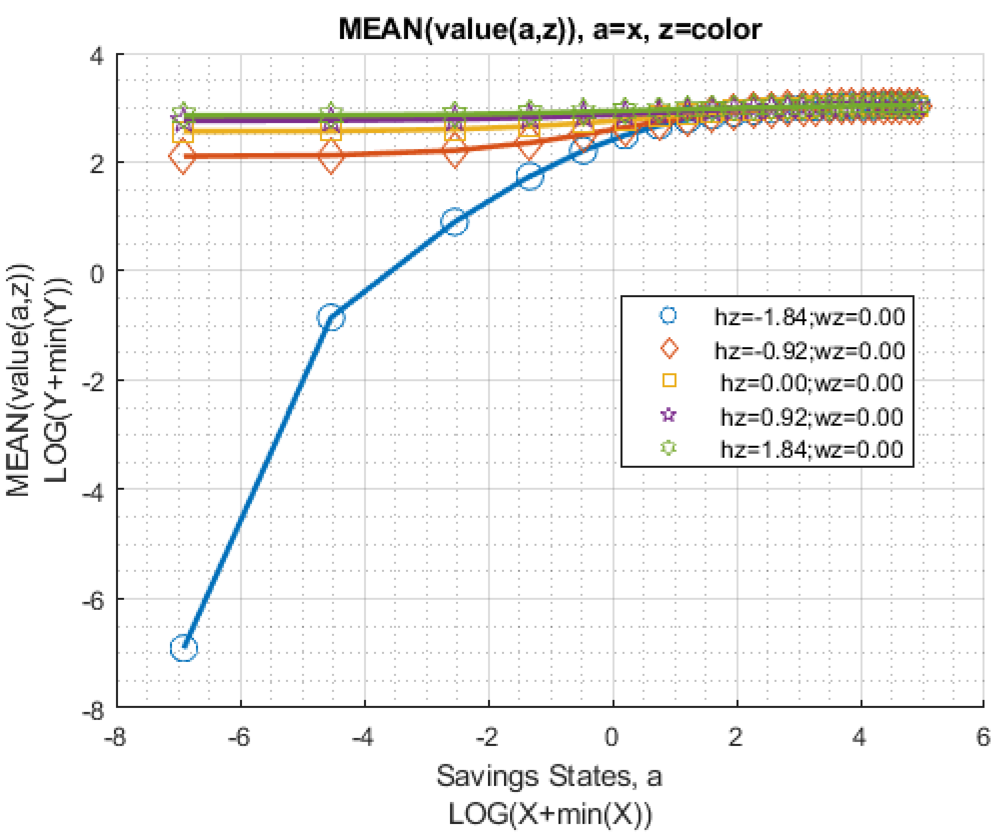
group	savings	mean_Hshock__1_8395	mean_Hshock__0_91976	mean_Hshock_0	mean_Hshock_0_91976	mea
1	0	0.3104	0.44	0.69897	1.2297	
2	0.0097656	0.3214	0.45001	0.70723	1.2373	
3	0.078125	0.3809	0.50664	0.75724	1.2846	
4	0.26367	0.48992	0.60921	0.8592	1.3937	
5	0.625	0.65917	0.77131	1.0284	1.5584	
6	1.2207	0.91141	1.0172	1.2649	1.8076	
7	2.1094	1.2649	1.3671	1.6019	2.1815	
8	3.3496	1.7572	1.8573	2.0907	2.6915	
9	5	2.4045	2.503	2.7347	3.3043	
10	7.1191	3.2104	3.3074	3.537	4.0708	
11	9.7656	4.2385	4.3358	4.5627	5.0889	
12	12.998	5.5627	5.6635	5.8917	6.4121	
13	16.875	7.0504	7.1499	7.3847	7.9039	
14	21.455	8.7708	8.8721	9.1059	9.6366	
15	26.797	10.904	11.007	11.247	11.787	
16	32.959	13.355	13.457	13.7	14.254	
17	40	16.168	16.266	16.502	17.066	
18	47.979	19.337	19.437	19.666	20.215	
19	56.953	22.744	22.843	23.078	23.621	
20	66.982	26.557	26.654	26.883	27.428	
21	78.125	31.145	31.242	31.47	32.006	
22	90.439	36.128	36.224	36.451	36.982	
23	103.98	41.364	41.464	41.692	42.226	
24	118.82	47.222	47.319	47.545	48.086	
25	135	53.652	53.751	53.983	54.518	

Graph Mean Values:

```
mp_support_graph('cl_st_graph_title') = {'MEAN(value(a,z)), a=x, z=color'};
```

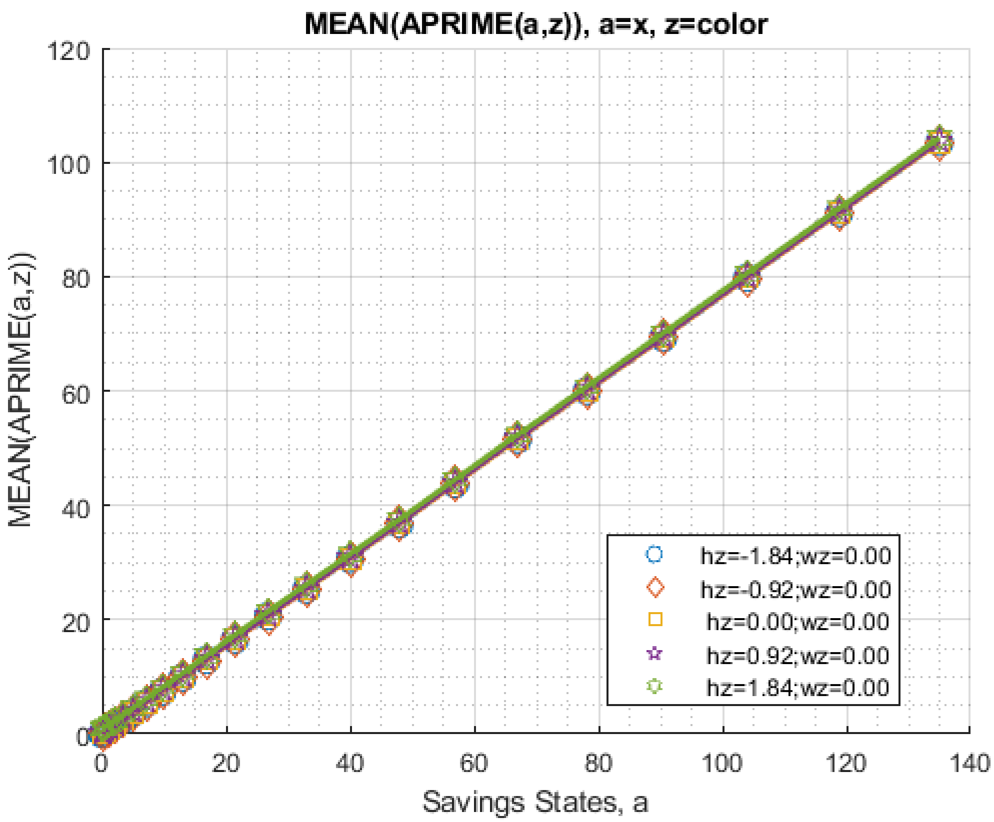
```
mp_support_graph('cl_st_ytitle') = {'MEAN(value(a,z))'};
ff_graph_grid((tb_az_v{1:end, 3:end})', ar_st_eta_HS_grid, agrid, mp_support_graph);
```

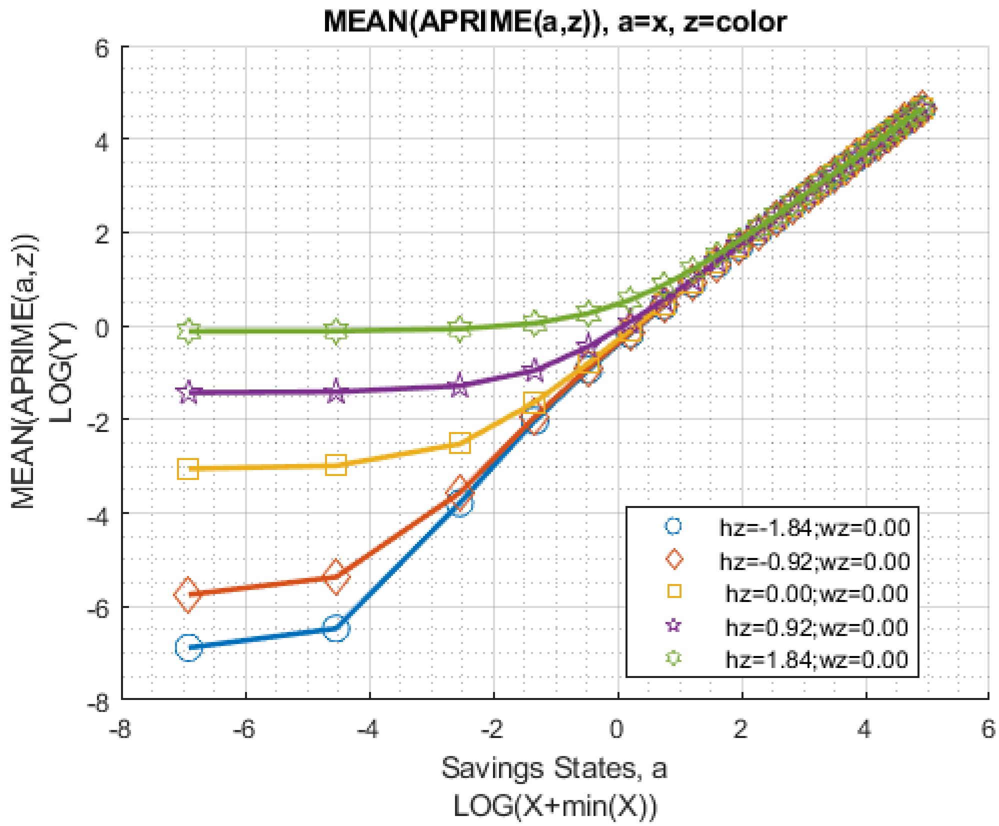




Graph Mean Savings Choices:

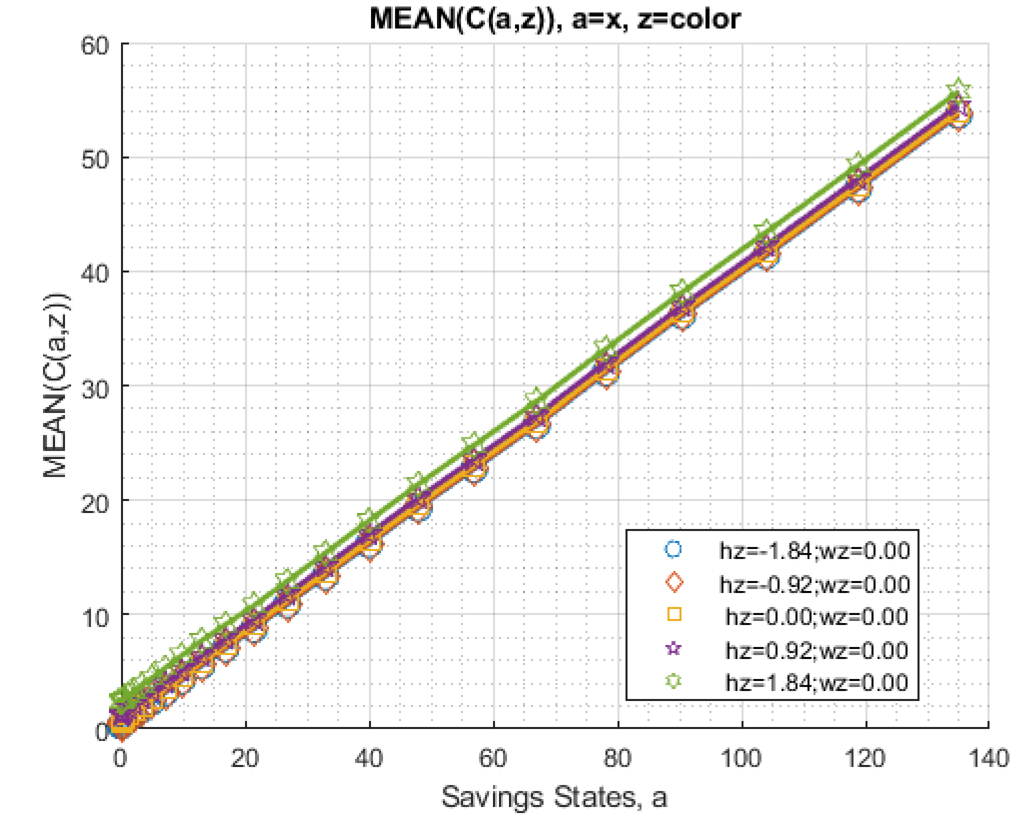
```
mp_support_graph('cl_st_graph_title') = {'MEAN(APRIME(a,z)), a=x, z=color'};
mp_support_graph('cl_st_ytitle') = {'MEAN(APRIME(a,z))'};
ff_graph_grid((tb_az_ap{1:end, 3:end})', ar_st_eta_HS_grid, agrid, mp_support_graph);
```

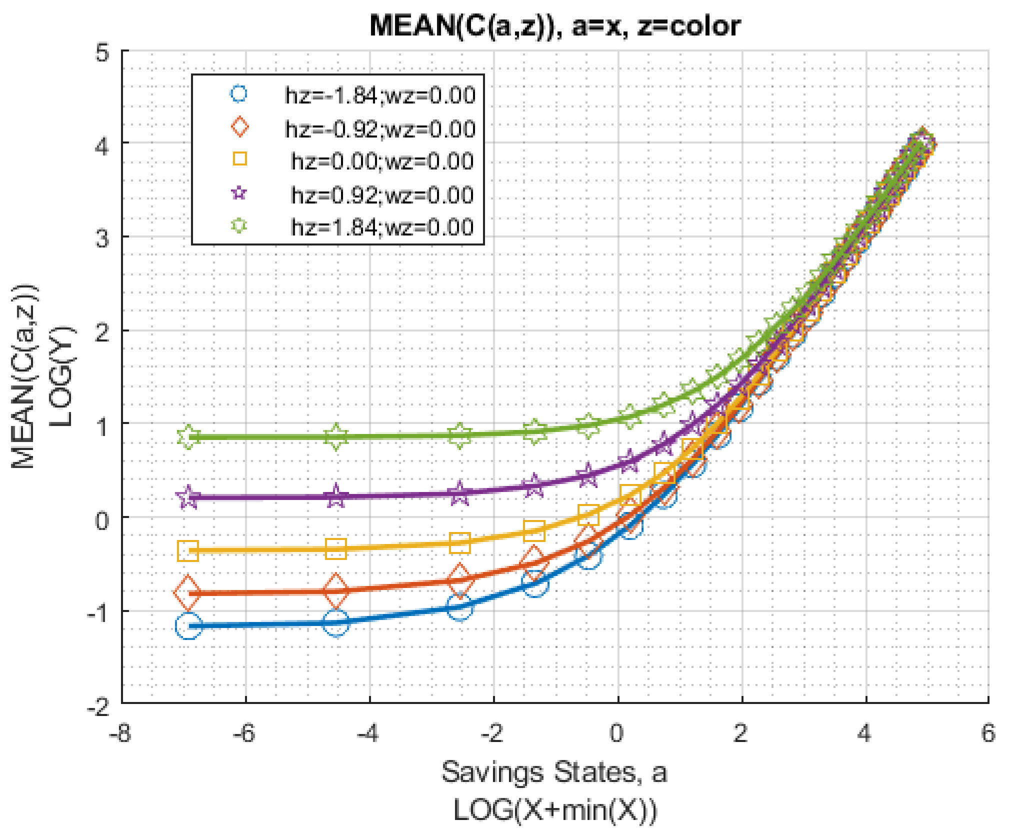




Graph Mean Consumption:

```
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	2.0205	2.2326	2.3705	2.4138	2.3913	2.3187
5	2	1	1.0463	1.3598	1.6057	1.745	1.8111	1.8148
6	3	1	0.61068	0.90045	1.1354	1.2721	1.3395	1.3538

```
% 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	34.819	34.614	34.562	34.453	34.262	33.978
5	2	1	34.667	34.448	34.36	34.201	33.945	33.586
6	3	1	34.3	34.115	34.061	33.932	33.7	33.356

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

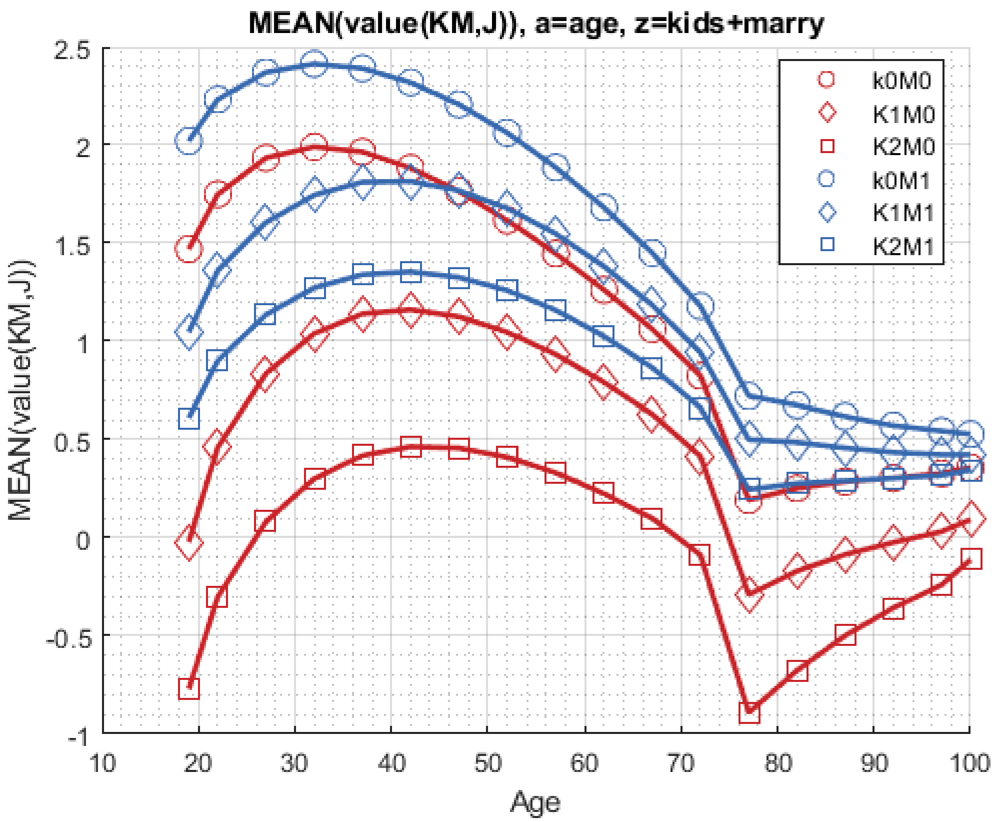
xxx MEAN(C(KM,J)) xxxxxxxxxxxxxxxxxxxxxxxxxxx

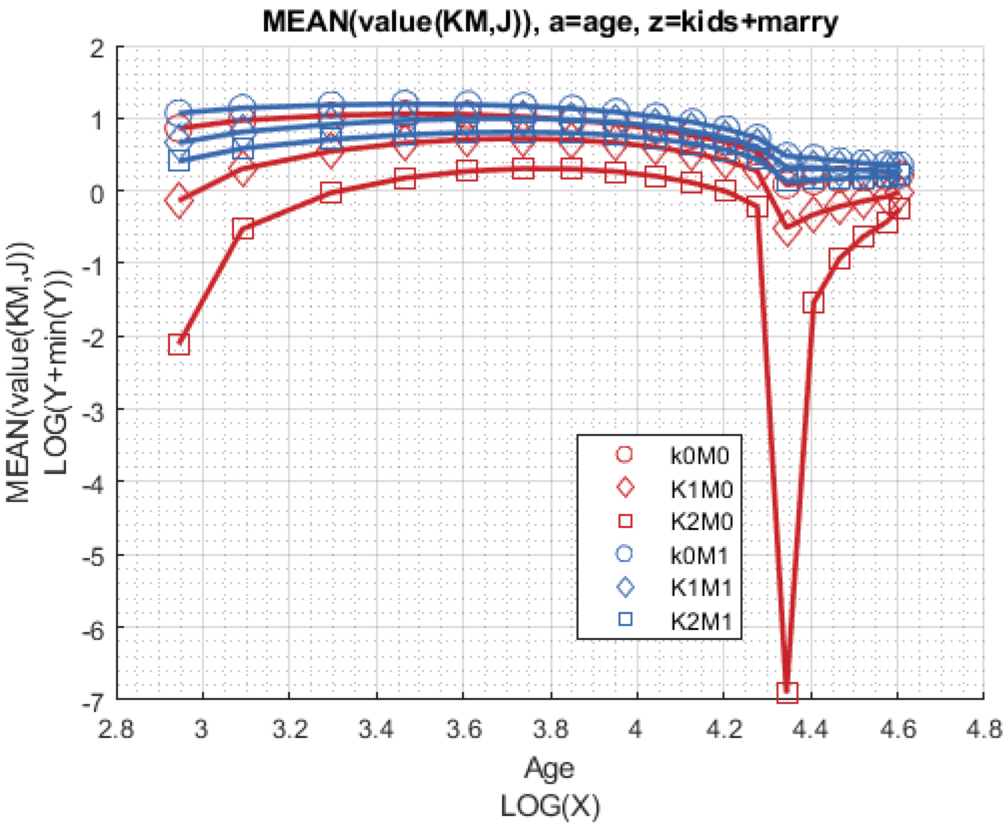
group	kids	marry	mean_age_19	mean_age_22	mean_age_27	mean_age_32	mean_age_37	mean_age_42
1	1	0	6.8551	7.1756	7.502	7.8205	8.1483	8.5053
2	2	0	7.1843	7.5683	7.9695	8.3802	8.8184	9.2974
3	3	0	7.5997	7.934	8.2911	8.6703	9.0841	9.5509

4	1	1	7.1871	7.5271	7.8696	8.209	8.5573	8.9343
5	2	1	7.3044	7.6564	8.0306	8.4165	8.826	9.2748
6	3	1	7.6479	7.9629	8.3009	8.6543	9.0382	9.4691

Graph Mean Values:

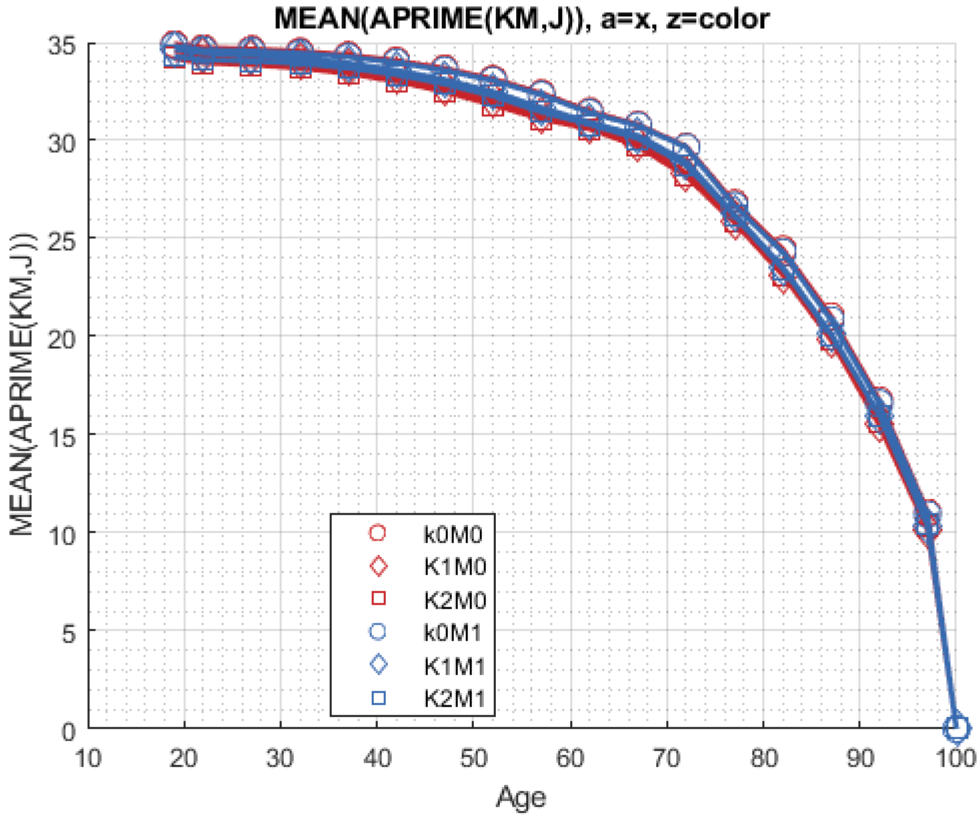
```
mp_support_graph('cl_st_graph_title') = {'MEAN(value(KM,J)), a=age, z=kids+marry'};
mp_support_graph('cl_st_ytitle') = {'MEAN(value(KM,J))'};
ff_graph_grid((tb_az_v{1:end, 4:end}), ar_row_grid, age_grid, mp_support_graph);
```

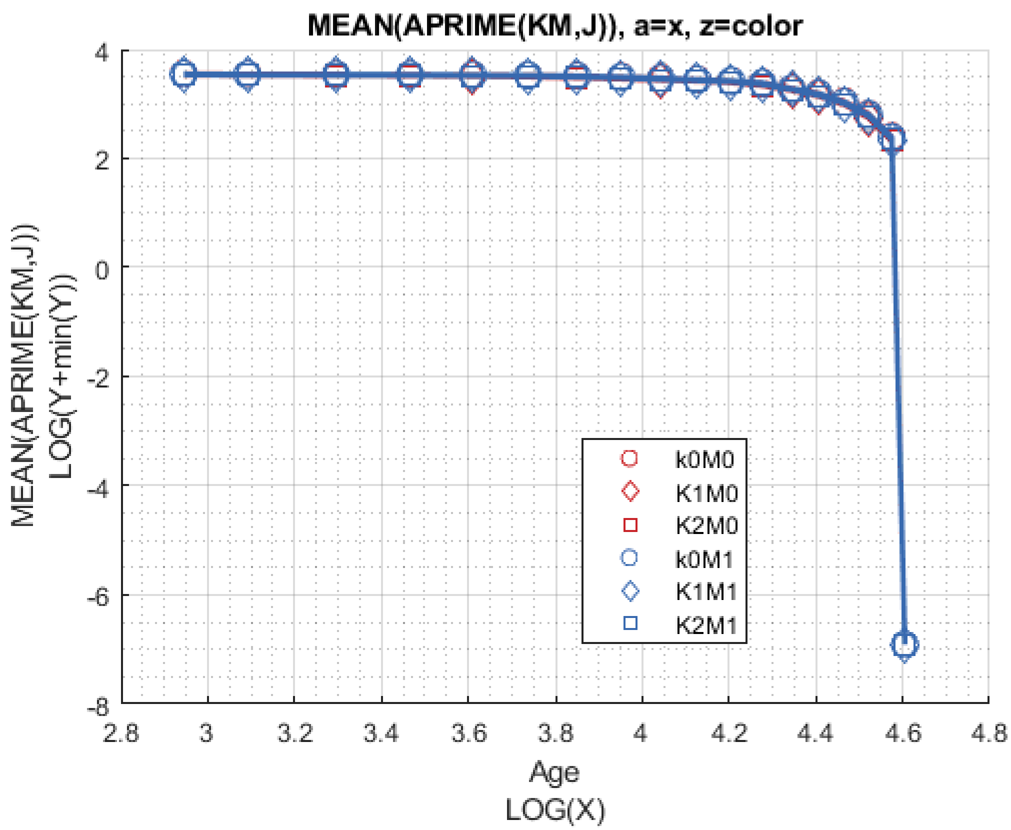




Graph Mean Savings Choices:

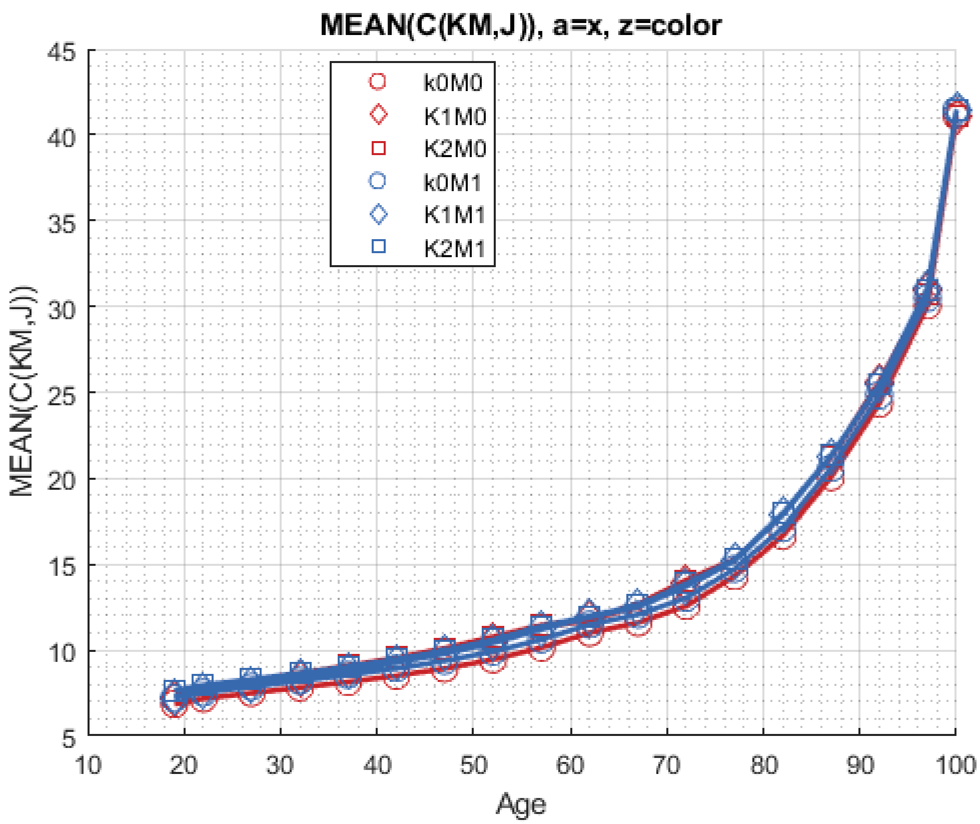
```
mp_support_graph('cl_st_graph_title') = {'MEAN(APRIME(KM,J)), a=x, z=color'};
mp_support_graph('cl_st_ytitle') = {'MEAN(APRIME(KM,J))'};
ff_graph_grid((tb_az_ap{1:end, 4:end}), ar_row_grid, age_grid, mp_support_graph);
```

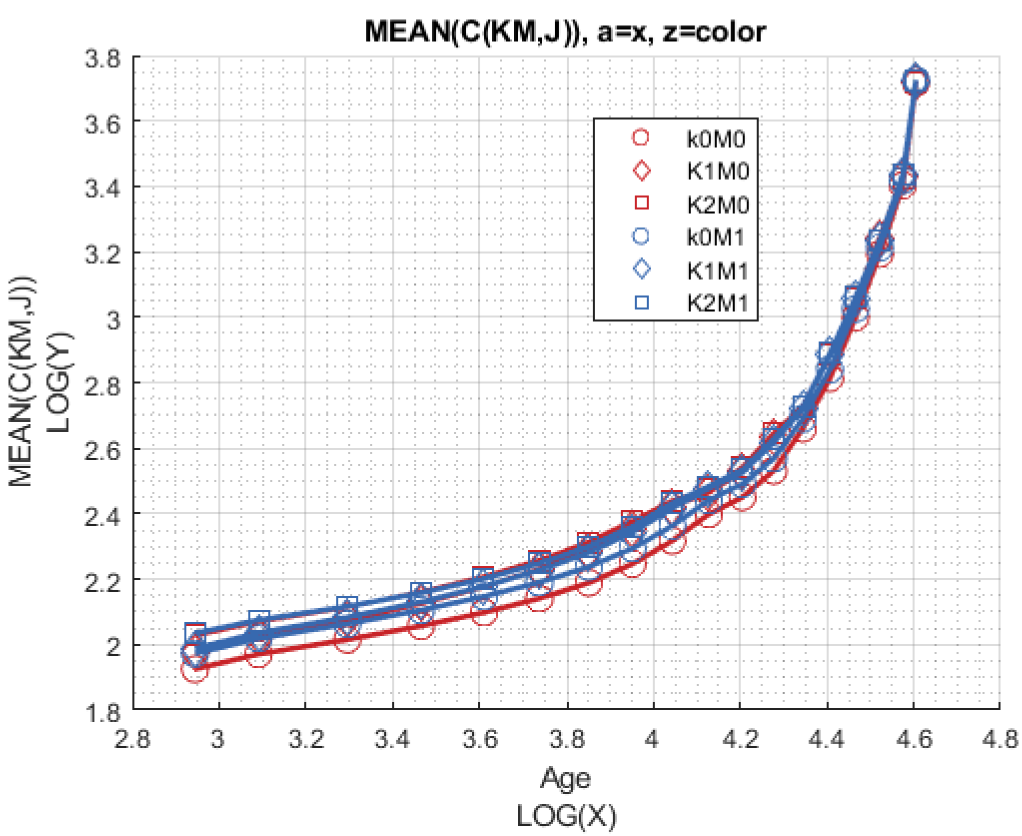




Graph Mean Consumption:

```
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	0.85396	1.1146	1.3219	1.4469	1.5109	1.5218
4	1	1	1.5977	1.8806	2.0859	2.1737	2.1837	2.1364

```
% 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	34.723	34.511	34.368	34.173	33.909	33.563
4	1	1	34.468	34.274	34.287	34.218	34.029	33.717

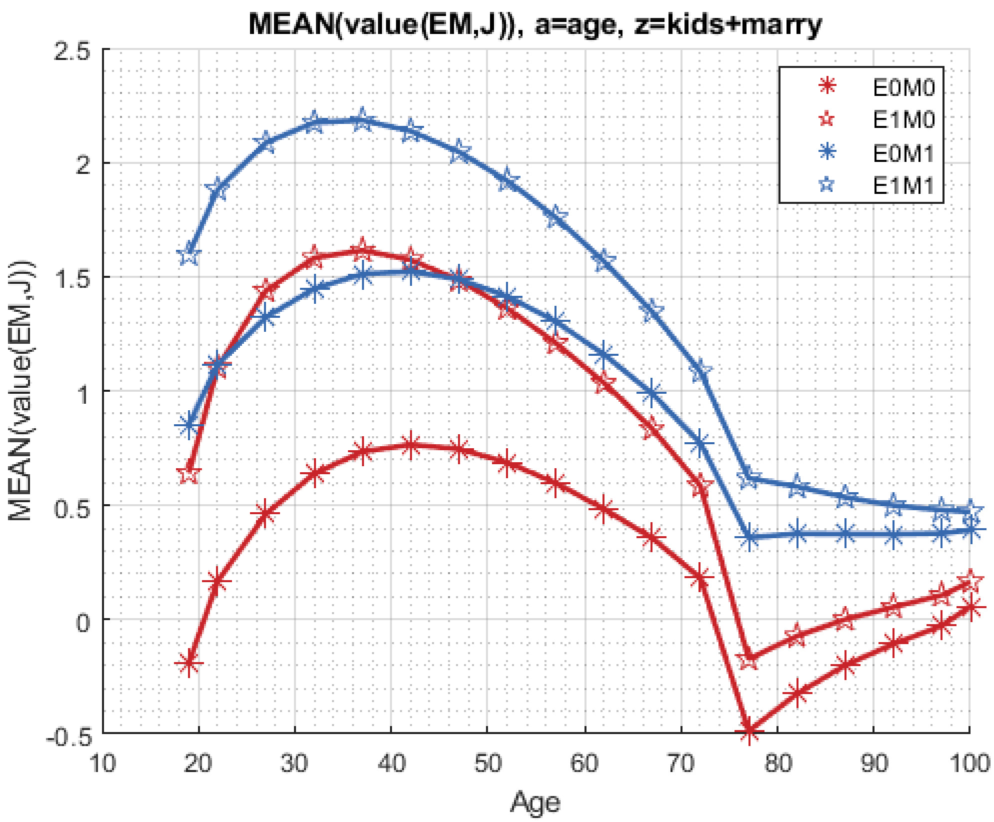
```
% Consumption Choices
tb_az_c = ff_summ_nd_array("MEAN(C(EKM,J))", cons_VFI, true, ["mean"], 3, 1, cl_mp_datasetdesc,
```

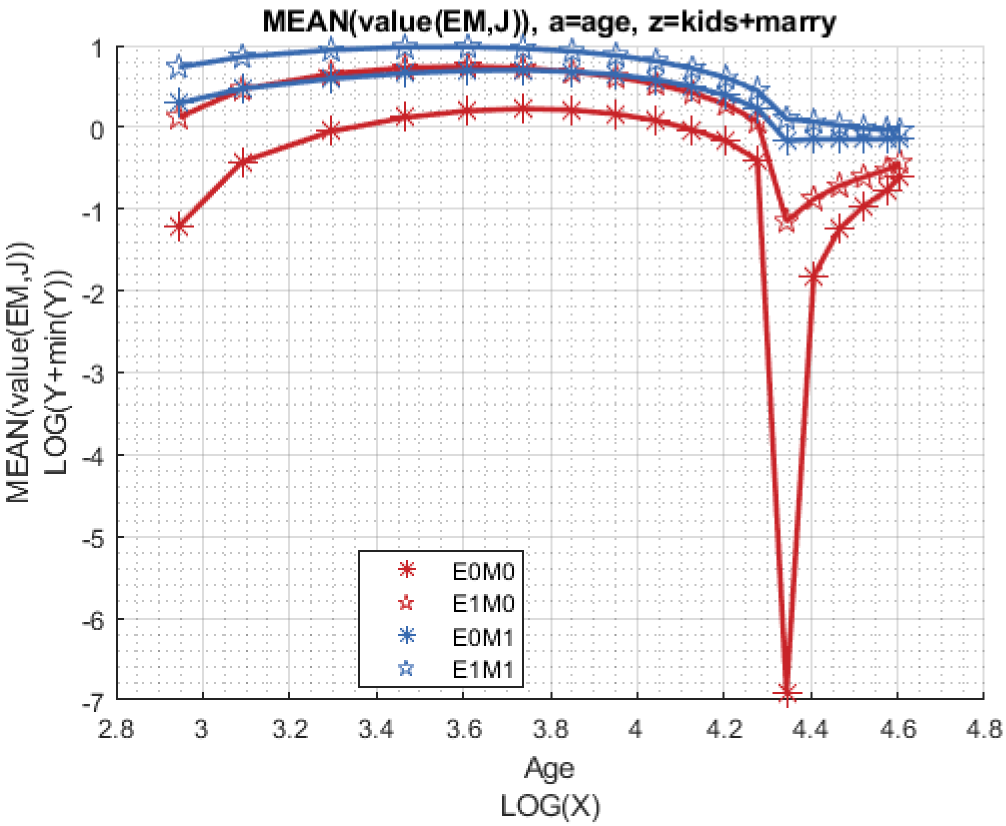
xxx MEAN(C(EKM,J)) xxxxxxxxxxxxxxxxxxxxxxxxxxx

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	7.2329	7.5281	7.8428	8.1801	8.5525	8.9751
4	1	1	7.5267	7.9028	8.2913	8.6732	9.0619	9.4769

Graph Mean Values:

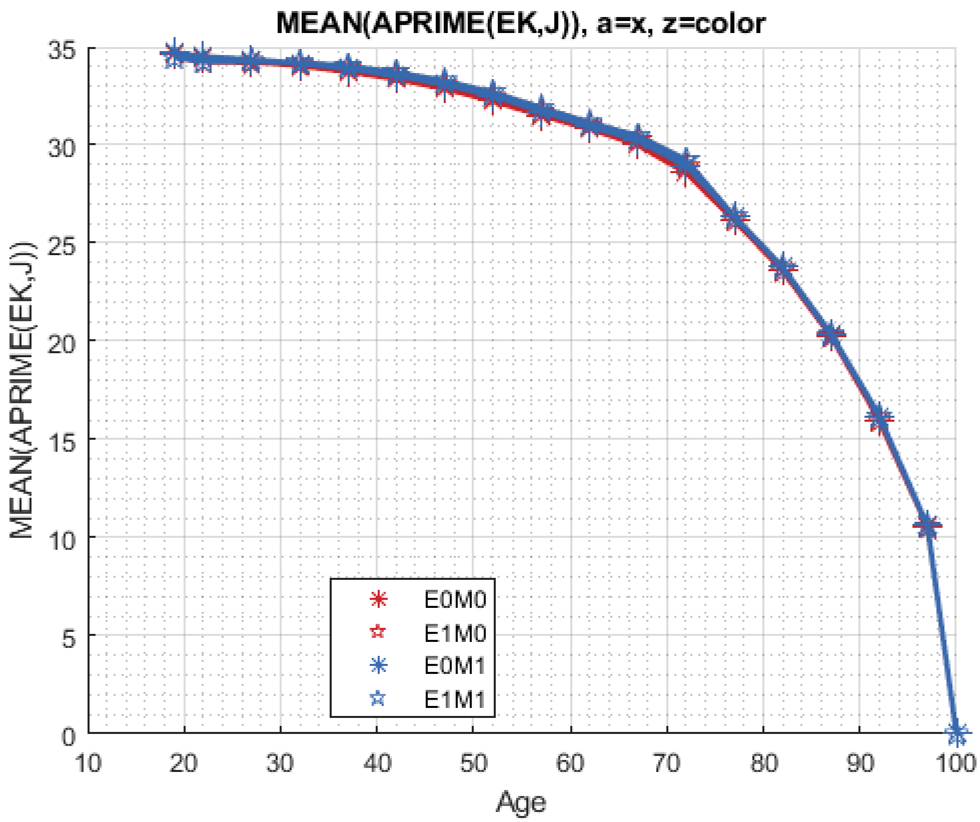
```
mp_support_graph('cl_st_graph_title') = {'MEAN(value(EM,J)), a=age, z=kids+marry'};
mp_support_graph('cl_st_ytitle') = {'MEAN(value(EM,J))'};
ff_graph_grid((tb_az_v{1:end, 4:end}), ar_row_grid, age_grid, mp_support_graph);
```

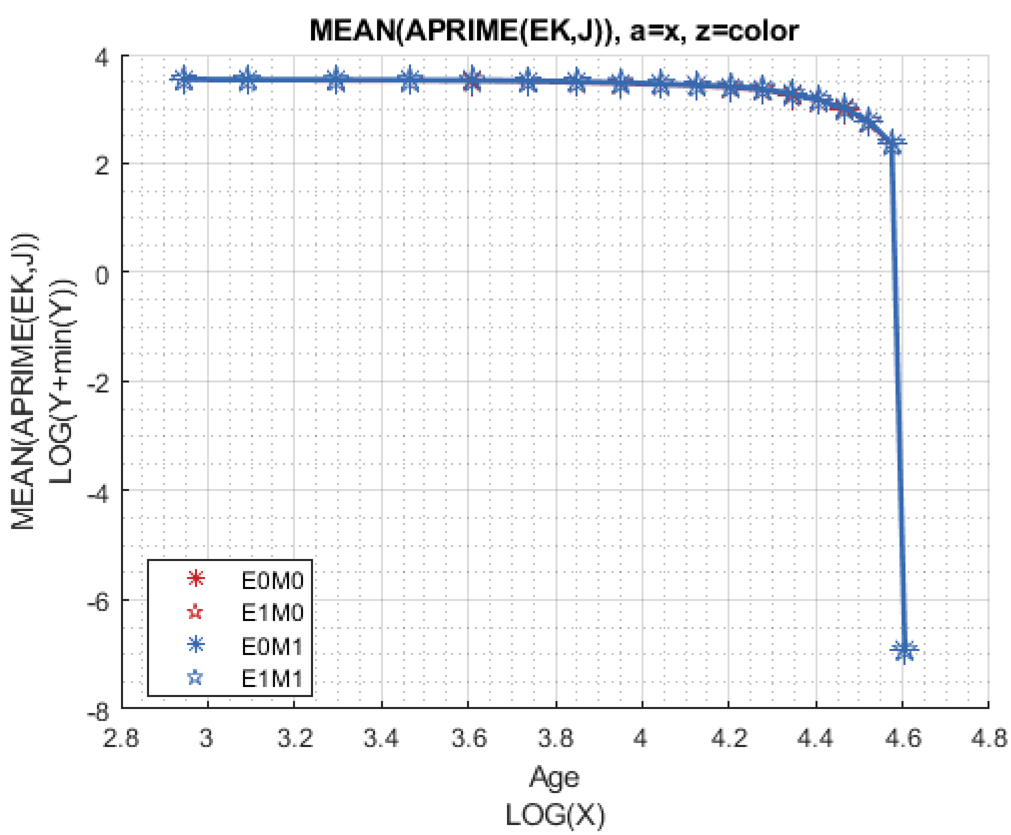




Graph Mean Savings Choices:

```
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);
```