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:0.06059
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:17 of 17, time-this-age:0.052828
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:16 of 17, time-this-age:0.032745
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:15 of 17, time-this-age:0.029085
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:14 of 17, time-this-age:0.035583
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:13 of 17, time-this-age:0.034991
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:12 of 17, time-this-age:0.033648
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:11 of 17, time-this-age:0.032963
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:10 of 17, time-this-age:0.033174
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:9 of 17, time-this-age:0.036843
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:8 of 17, time-this-age:0.04052
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:7 of 17, time-this-age:0.028633
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:6 of 17, time-this-age:0.035108
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:5 of 17, time-this-age:0.033838
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:4 of 17, time-this-age:0.033585
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:3 of 17, time-this-age:0.03214
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:2 of 17, time-this-age:0.028888
SNW_VFI_MAIN_BISEC_VEC: Finished Age Group:1 of 17, time-this-age:0.031611
Completed SNW_VFI_MAIN_BISEC_VEC;SNW_MP_PARAM=default_small;SNW_MP_CONTROL=default_base;time=0.72345
```

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	-21.426	-13.175	-8.362	-5.4972	
2	0.0097656	-20.989	-13.027	-8.2755	-5.4264	
3	0.078125	-18.901	-12.204	-7.8053	-5.0563	
4	0.26367	-15.612	-10.744	-7.0124	-4.4893	
5	0.625	-12.124	-8.9835	-6.0664	-3.8998	
6	1.2207	-9.0979	-7.2177	-5.0967	-3.3546	
7	2.1094	-6.7401	-5.6532	-4.2107	-2.8614	
8	3.3496	-4.9967	-4.3739	-3.4359	-2.4175	
9	5	-3.7353	-3.3758	-2.7788	-2.0342	
10	7.1191	-2.8279	-2.617	-2.2393	-1.7115	
11	9.7656	-2.172	-2.0455	-1.8057	-1.4379	
12	12.998	-1.693	-1.6153	-1.4614	-1.2066	
13	16.875	-1.3389	-1.2899	-1.1896	-1.0131	
14	21.455	-1.0737	-1.042	-0.97552	-0.85247	
15	26.797	-0.872	-0.85104	-0.80614	-0.71965	
16	32.959	-0.71656	-0.70236	-0.67148	-0.61005	
17	40	-0.59521	-0.58538	-0.56375	-0.5196	
18	47.979	-0.49932	-0.49238	-0.47697	-0.44484	
19	56.953	-0.42266	-0.41768	-0.40651	-0.38285	
20	66.982	-0.36074	-0.3571	-0.34889	-0.33125	
21	78.125	-0.31022	-0.30751	-0.30139	-0.28809	
22	90.439	-0.26861	-0.26658	-0.26196	-0.25181	
23	103.98	-0.23407	-0.23252	-0.22899	-0.22118	
24	118.82	-0.20516	-0.20397	-0.20125	-0.19517	
25	135	-0.1808	-0.17987	-0.17775	-0.17298	

```
% 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	3.2159e-05	0.0034995	0.049878	0.24382	
2	0.0097656	0.00055365	0.0052722	0.053281	0.24787	

3	0.078125	0.021863	0.029676	0.083029	0.2805
4	0.26367	0.13323	0.14751	0.20012	0.38877
5	0.625	0.39134	0.41034	0.45315	0.64573
6	1.2207	0.84131	0.86393	0.91226	1.0928
7	2.1094	1.5303	1.5542	1.6156	1.7559
8	3.3496	2.4876	2.5118	2.573	2.6876
9	5	3.7642	3.7887	3.8498	3.9922
10	7.1191	5.4275	5.4525	5.5145	5.6929
11	9.7656	7.4794	7.5043	7.5679	7.7532
12	12.998	9.9124	9.9329	9.9956	10.186
13	16.875	12.928	12.95	13.005	13.196
14	21.455	16.529	16.548	16.604	16.783
15	26.797	20.601	20.618	20.668	20.837
16	32.959	25.307	25.325	25.37	25.525
17	40	30.667	30.689	30.742	30.886
18	47.979	36.761	36.782	36.841	36.999
19	56.953	43.773	43.795	43.847	44.012
20	66.982	51.605	51.628	51.688	51.85
21	78.125	59.954	59.977	60.037	60.209
22	90.439	69.265	69.288	69.35	69.526
23	103.98	79.75	79.771	79.831	80.004
24	118.82	91.112	91.136	91.198	91.364
25	135	103.47	103.49	103.54	103.72

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

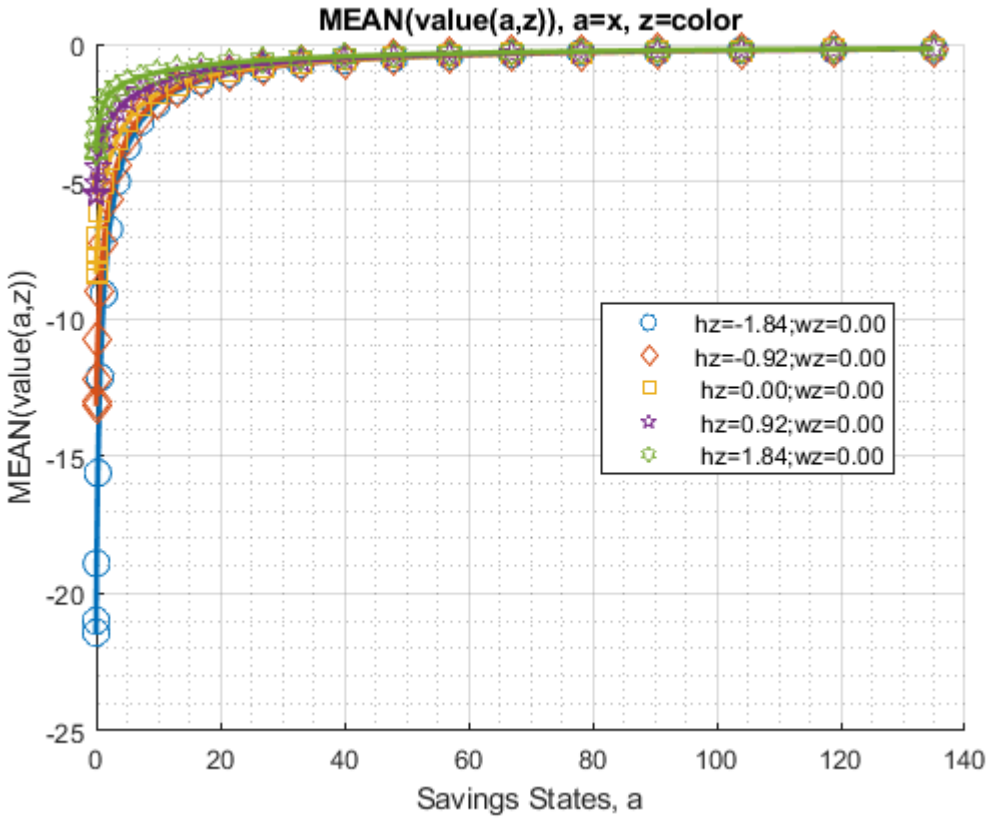
```
xxx  MEAN(C(A,Z))  xxxxxxxxxxxxxxxxxxxxxxxxxx
```

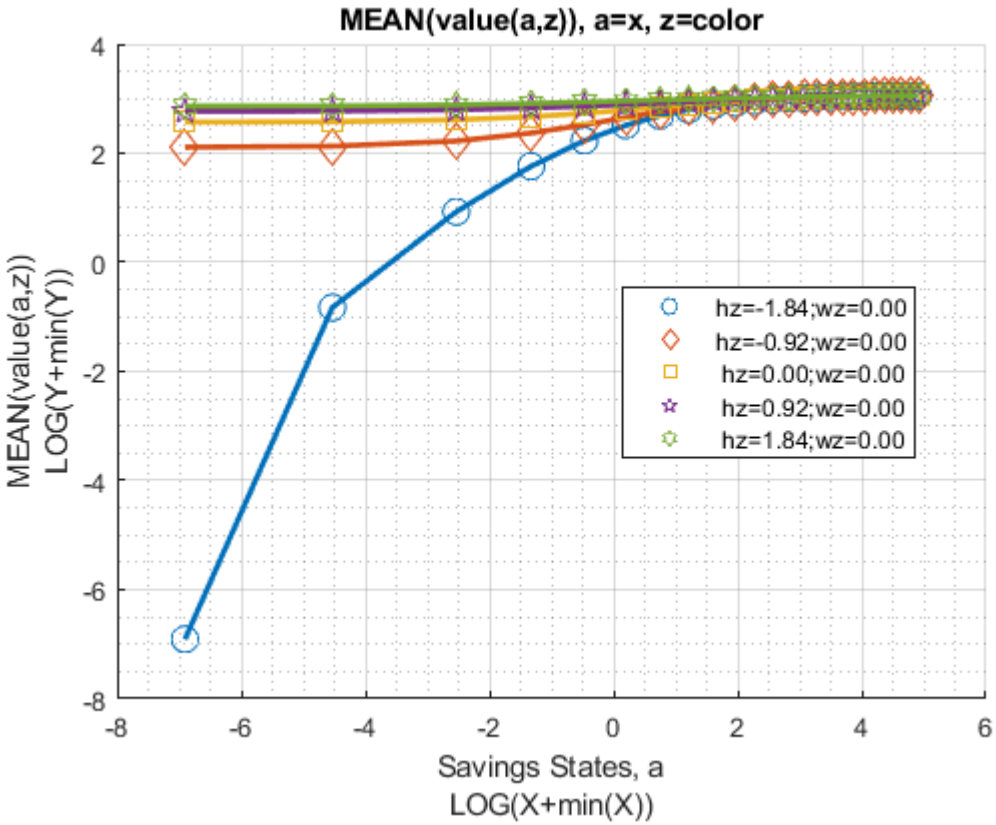
group	savings	mean_Hshock__1_8395	mean_Hshock__0_91976	mean_Hshock_0	mean_Hshock_0_91976	mea
1	0	0.30273	0.43104	0.68779	1.2165	
2	0.0097656	0.31374	0.44074	0.69581	1.2239	
3	0.078125	0.37308	0.49663	0.74605	1.271	
4	0.26367	0.48039	0.59659	0.846	1.3793	
5	0.625	0.64735	0.75745	1.0153	1.5439	
6	1.2207	0.89649	1.0013	1.2519	1.7913	
7	2.1094	1.2479	1.3498	1.5854	2.1634	
8	3.3496	1.7393	1.8394	2.0734	2.6754	
9	5	2.3872	2.4859	2.7182	3.2909	
10	7.1191	3.1917	3.289	3.5191	4.0542	
11	9.7656	4.2188	4.3155	4.543	5.07	
12	12.998	5.5439	5.6447	5.8722	6.3933	
13	16.875	7.0334	7.133	7.3676	7.8866	
14	21.455	8.754	8.8551	9.0887	9.6188	
15	26.797	10.886	10.989	11.228	11.768	
16	32.959	13.336	13.439	13.682	14.235	
17	40	16.151	16.249	16.485	17.049	
18	47.979	19.321	19.42	19.65	20.2	
19	56.953	22.728	22.827	23.062	23.605	
20	66.982	26.539	26.637	26.865	27.41	
21	78.125	31.125	31.222	31.451	31.986	
22	90.439	36.11	36.207	36.433	36.965	
23	103.98	41.348	41.447	41.676	42.21	
24	118.82	47.206	47.302	47.528	48.07	
25	135	53.636	53.735	53.966	54.501	

Graph Mean Values:

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

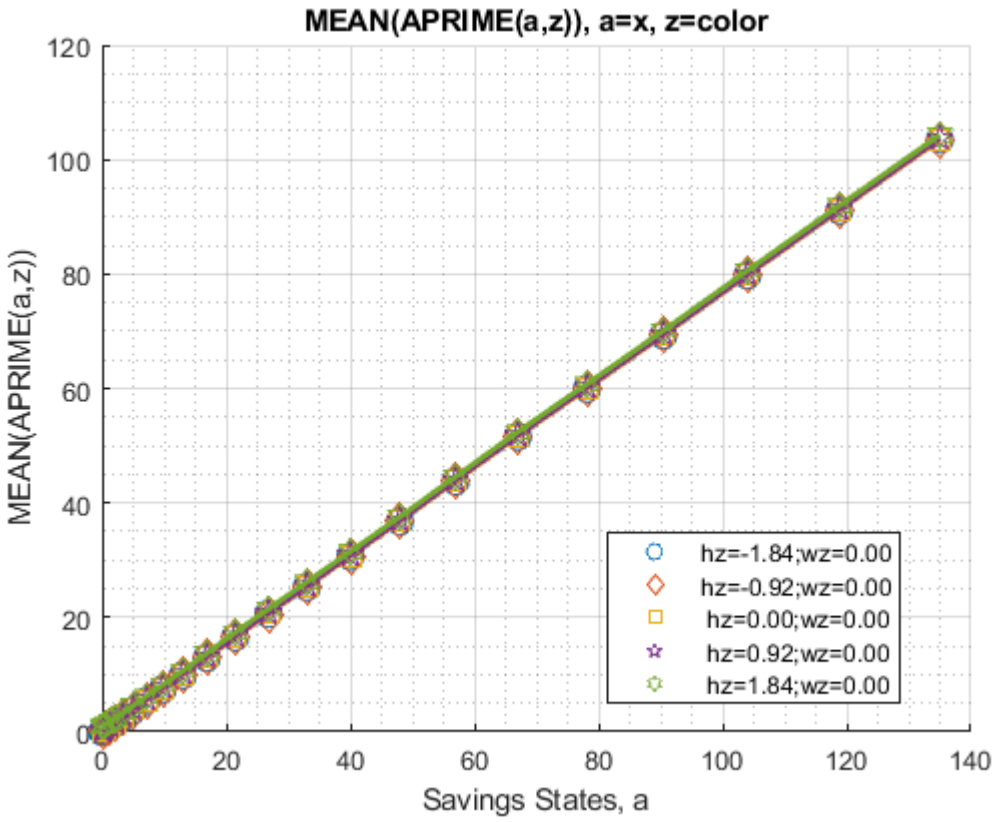
```
mp_support_graph('cl_st_ytitle') = {'MEAN(value(a,z))'};
ff_graph_grid((tb_az_v{1:end, 3:end})', ar_st_eta_HS_grid, agrid, mp_support_graph);
```

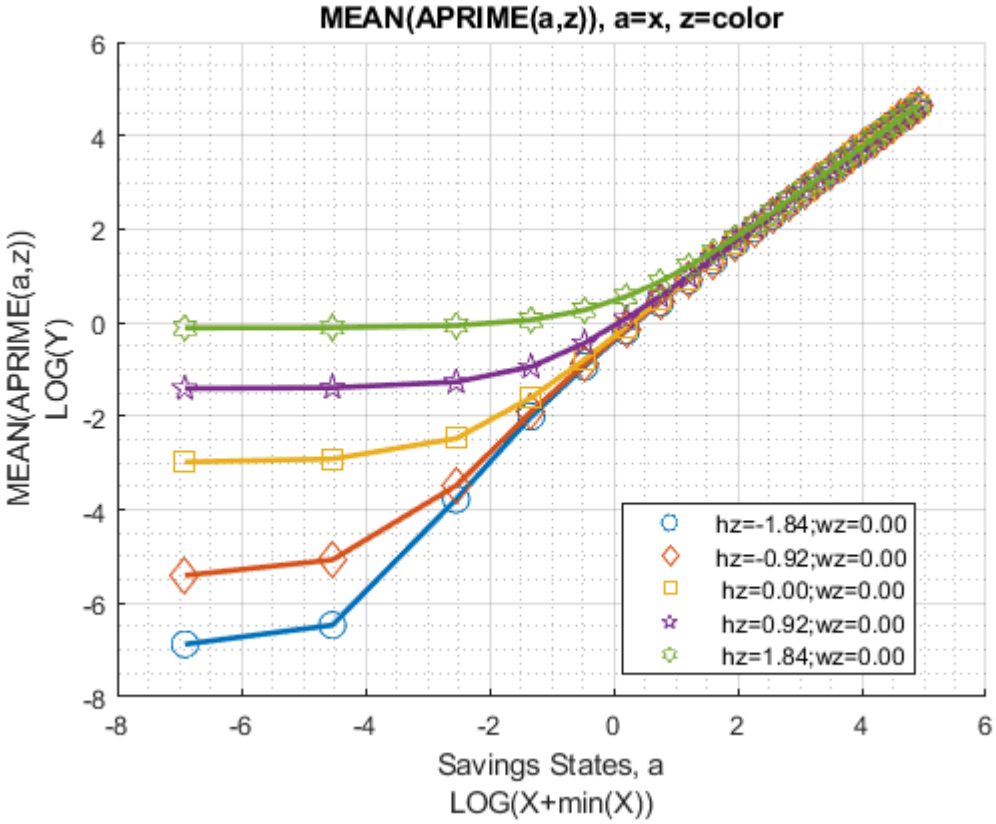




Graph Mean Savings Choices:

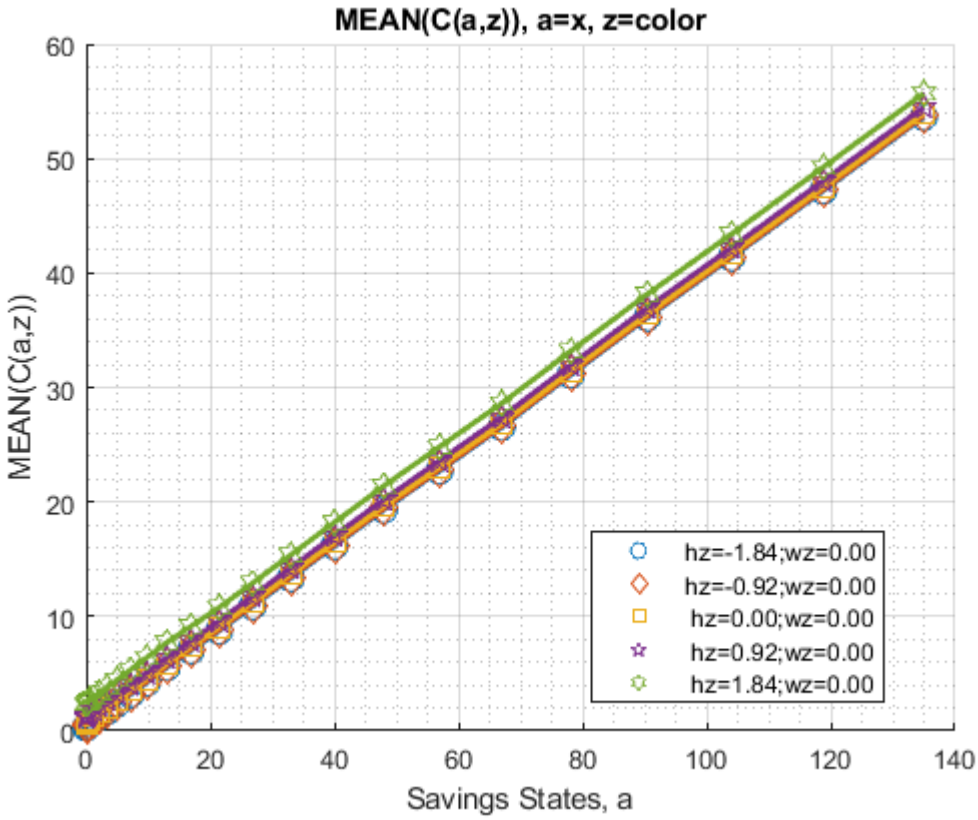
```
mp_support_graph('cl_st_graph_title') = {'MEAN(APRIME(a,z)), a=x, z=color'};
mp_support_graph('cl_st_ytitle') = {'MEAN(APRIME(a,z))'};
ff_graph_grid((tb_az_ap{1:end, 3:end})', ar_st_eta_HS_grid, agrid, mp_support_graph);
```

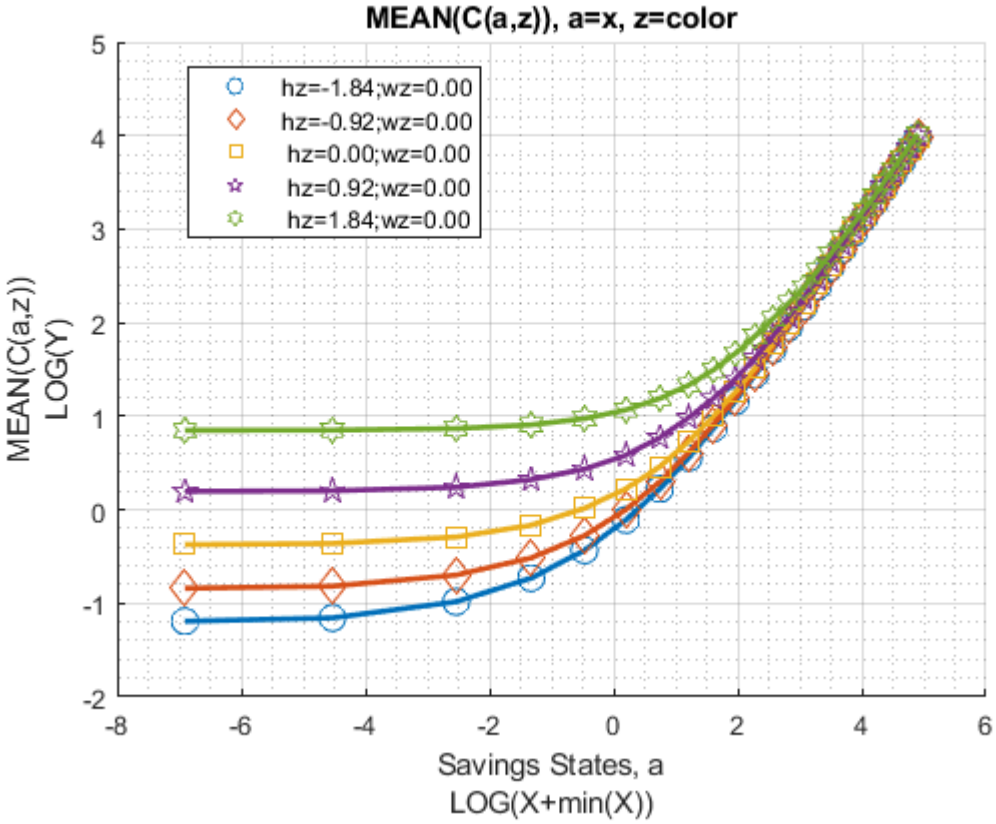




Graph Mean Consumption:

```
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))  xxxxxxxxxxxxxxxxxxxxxxxxxx
    group    kids    marry    mean_age_19    mean_age_22    mean_age_27    mean_age_32    mean_age_37    mean_age_42
    _____    ____    _____    ___________    ___________    ___________    ___________    ___________    ___________

      1       1        0        -4.7384        -4.2839        -3.9125        -3.6403        -3.4202        -3.2286
      2       2        0        -6.2307        -5.5732         -5.014        -4.5943        -4.2483        -3.9542
      3       3        0        -6.9818        -6.3368        -5.7685        -5.3334        -4.9708        -4.6532
      4       1        1        -4.1822        -3.7934        -3.4691        -3.2086         -2.984        -2.7815
      5       2        1         -5.157         -4.667        -4.2348        -3.8784        -3.5654        -3.2867
      6       3        1        -5.5929        -5.1267        -4.7056         -4.352        -4.0378        -3.7489
```

```
% 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))  xxxxxxxxxxxxxxxxxxxxxxxxxx
    group    kids    marry    mean_age_19    mean_age_22    mean_age_27    mean_age_32    mean_age_37    mean_age_42
    _____    ____    _____    ___________    ___________    ___________    ___________    ___________    ___________

      1       1        0         34.931         34.726         34.665         34.554         34.362         34.077
      2       2        0         34.603         34.334         34.198         33.995         33.692         33.286
      3       3        0         34.187         33.968         33.877         33.705         33.427         33.033
      4       1        1         34.821         34.617         34.566         34.458         34.268         33.984
      5       2        1          34.67          34.45         34.364         34.205         33.951         33.592
      6       3        1         34.303         34.118         34.065         33.937         33.705         33.363
```

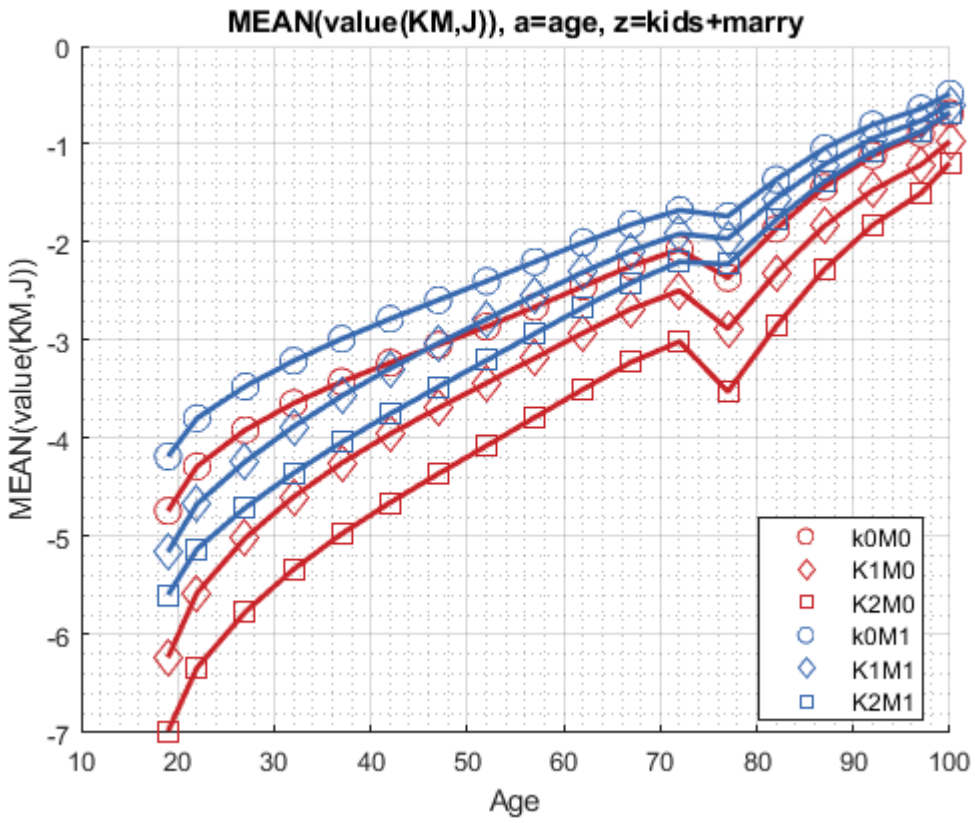
```
% Consumption Choices
tb_az_c = ff_summ_nd_array("MEAN(C(KM,J))", cons_VFI, true, ["mean"], 3, 1, cl_mp_datasetdesc,
```

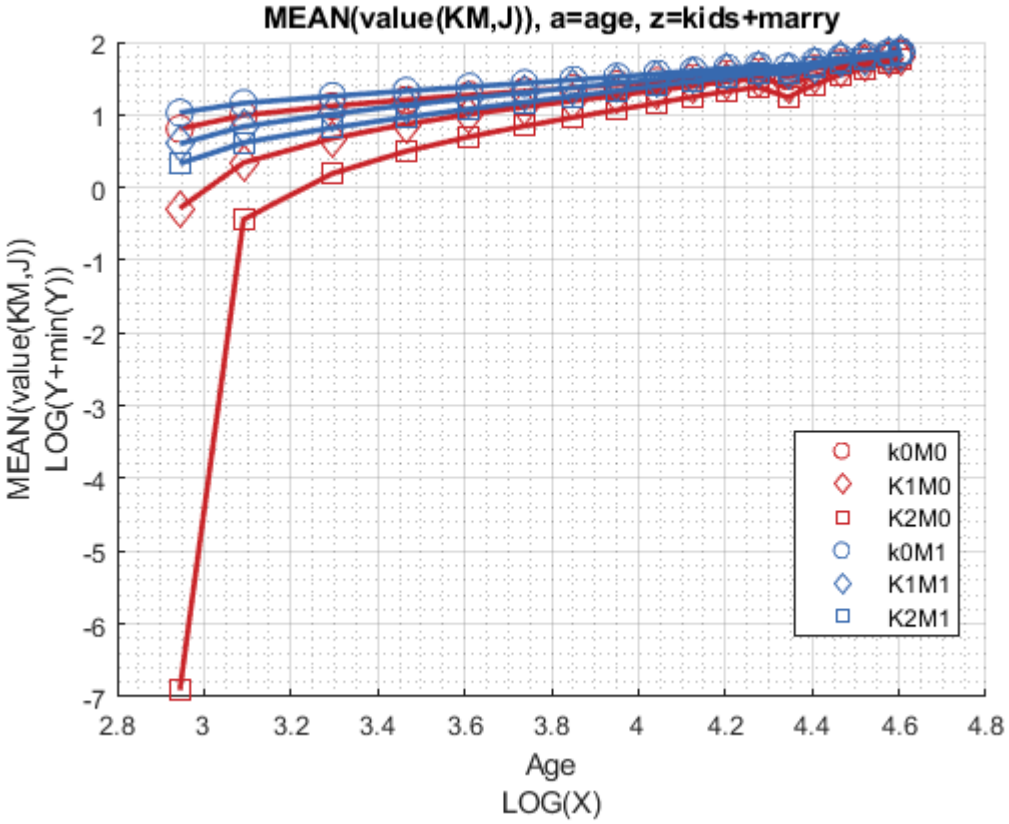
```
xxx  MEAN(C(KM,J))  xxxxxxxxxxxxxxxxxxxxxxxxxx
    group    kids    marry    mean_age_19    mean_age_22    mean_age_27    mean_age_32    mean_age_37    mean_age_42
    _____    ____    _____    ___________    ___________    ___________    ___________    ___________    ___________

      1       1        0         6.8531         7.1729         7.4988         7.8167         8.1435         8.4993
      2       2        0          7.182         7.5653         7.9659         8.3756          8.813         9.2907
      3       3        0         7.5973          7.931         8.2872         8.6657         9.0783         9.5438
```

4	1	1	7.1848	7.5242	7.8662	8.2047	8.552	8.9277
5	2	1	7.3021	7.6535	8.0269	8.412	8.8205	9.2678
6	3	1	7.6455	7.9599	8.297	8.6497	9.0324	9.462

Graph Mean Values:

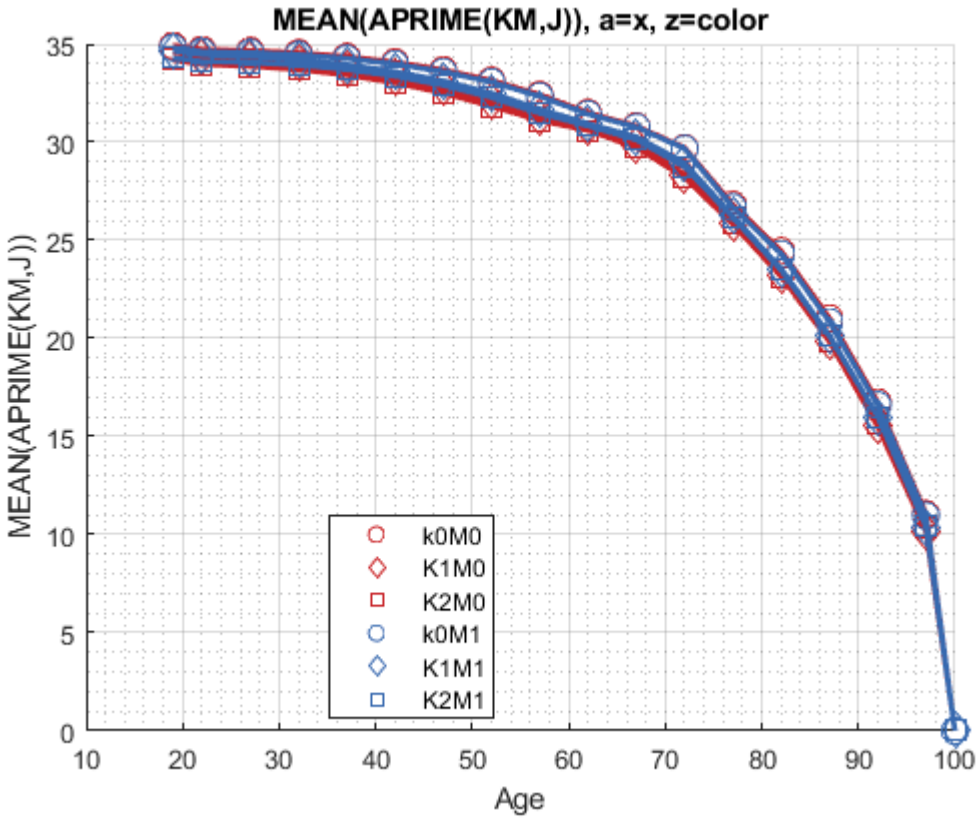
```
mp_support_graph('cl_st_graph_title') = {'MEAN(value(KM,J)), a=age, z=kids+marry'};
mp_support_graph('cl_st_ytitle') = {'MEAN(value(KM,J))'};
ff_graph_grid((tb_az_v{1:end, 4:end}), ar_row_grid, age_grid, mp_support_graph);
```

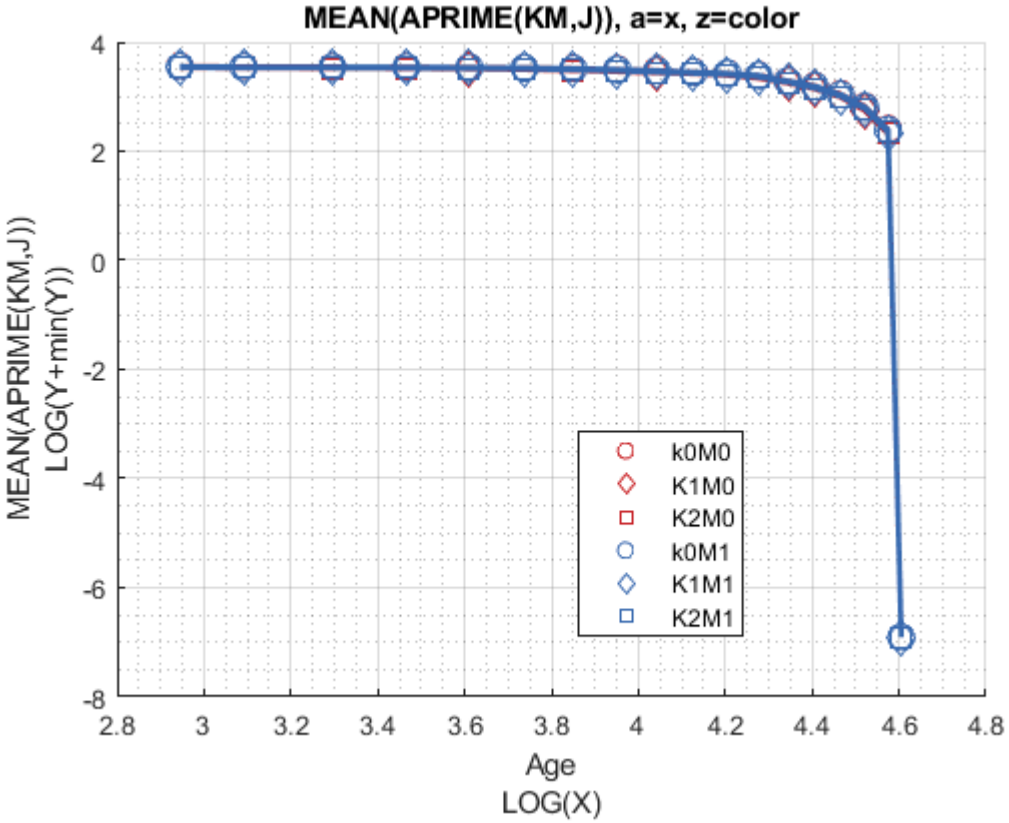




Graph Mean Savings Choices:

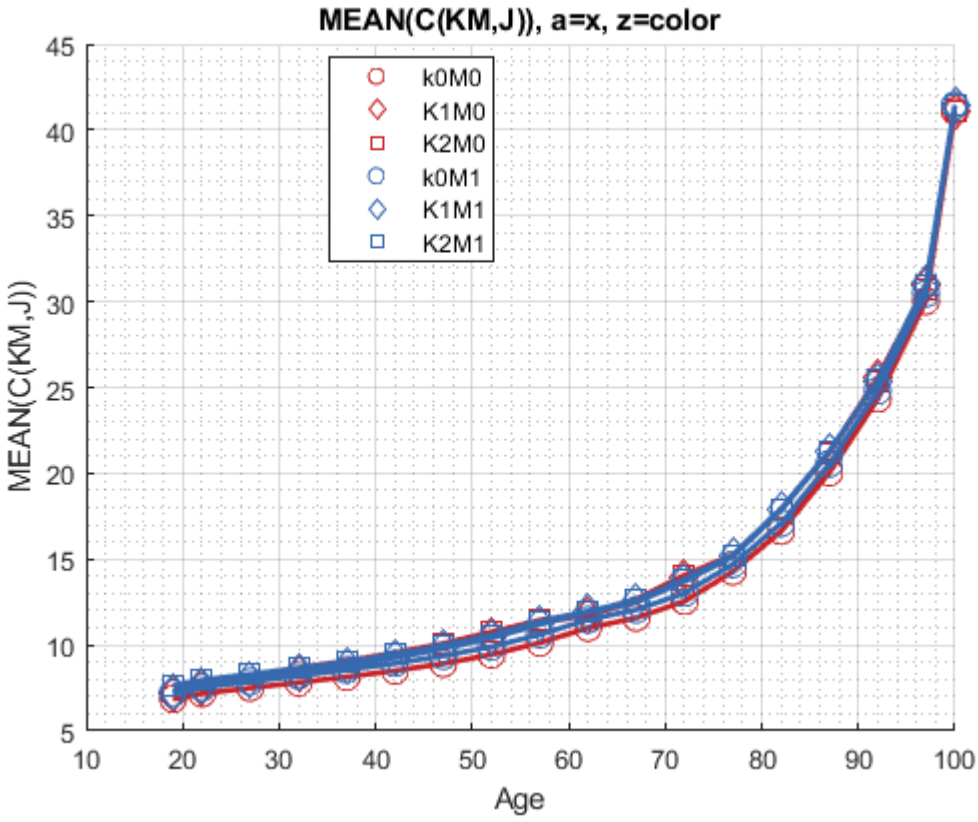
```
mp_support_graph('cl_st_graph_title') = {'MEAN(APRIME(KM,J)), a=x, z=color'};
mp_support_graph('cl_st_ytitle') = {'MEAN(APRIME(KM,J))'};
ff_graph_grid((tb_az_ap{1:end, 4:end}), ar_row_grid, age_grid, mp_support_graph);
```

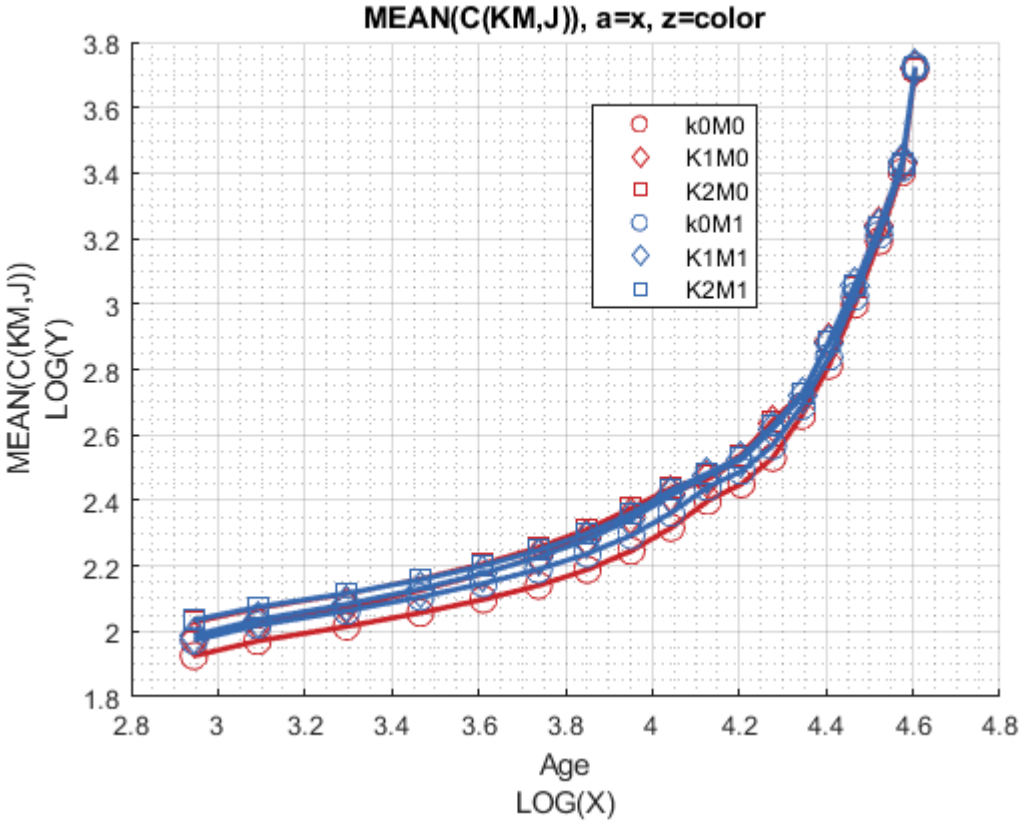




Graph Mean Consumption:

```
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	-6.4015	-5.8666	-5.3879	-4.9966	-4.6557	-4.3525
2	1	0	-5.5658	-4.9294	-4.4088	-4.0487	-3.7705	-3.5382
3	0	1	-5.35	-4.913	-4.5196	-4.1777	-3.867	-3.5814
4	1	1	-4.6046	-4.1451	-3.7534	-3.4483	-3.1912	-2.9633

```
% 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	34.682	34.444	34.272	34.048	33.753	33.374
2	1	0	34.465	34.241	34.222	34.121	33.901	33.556
3	0	1	34.725	34.514	34.372	34.177	33.914	33.569
4	1	1	34.47	34.277	34.291	34.223	34.035	33.724

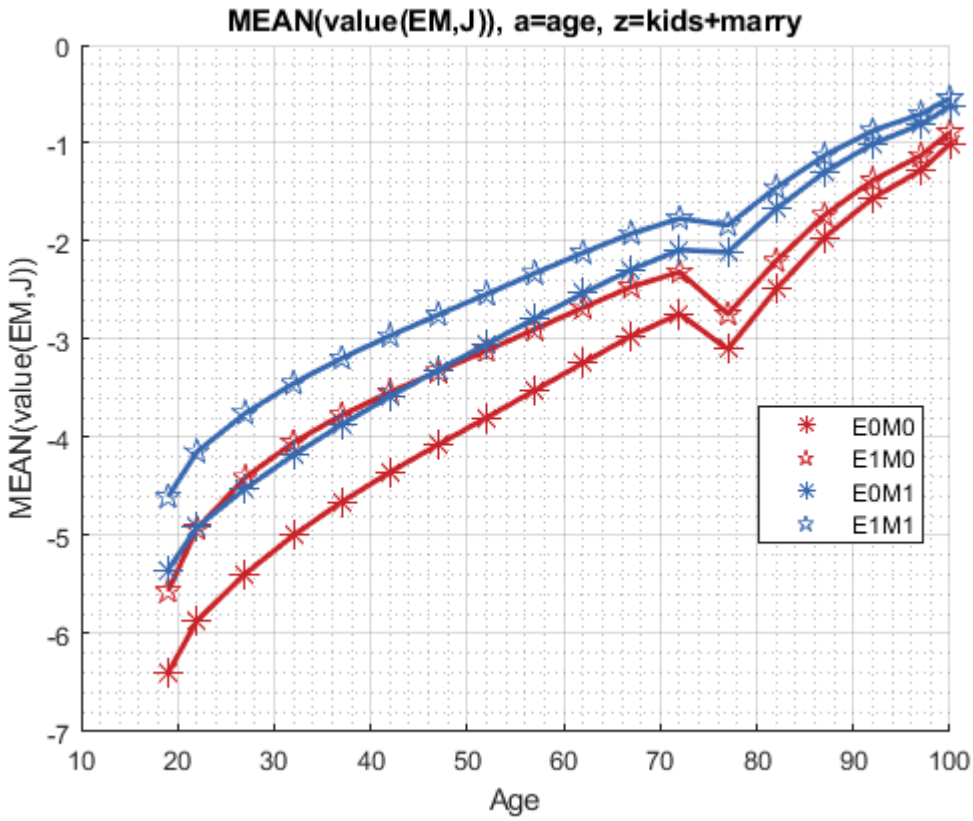
```
% Consumption Choices
tb_az_c = ff_summ_nd_array("MEAN(C(EKM,J))", cons_VFI, true, ["mean"], 3, 1, cl_mp_datasetdesc,
```

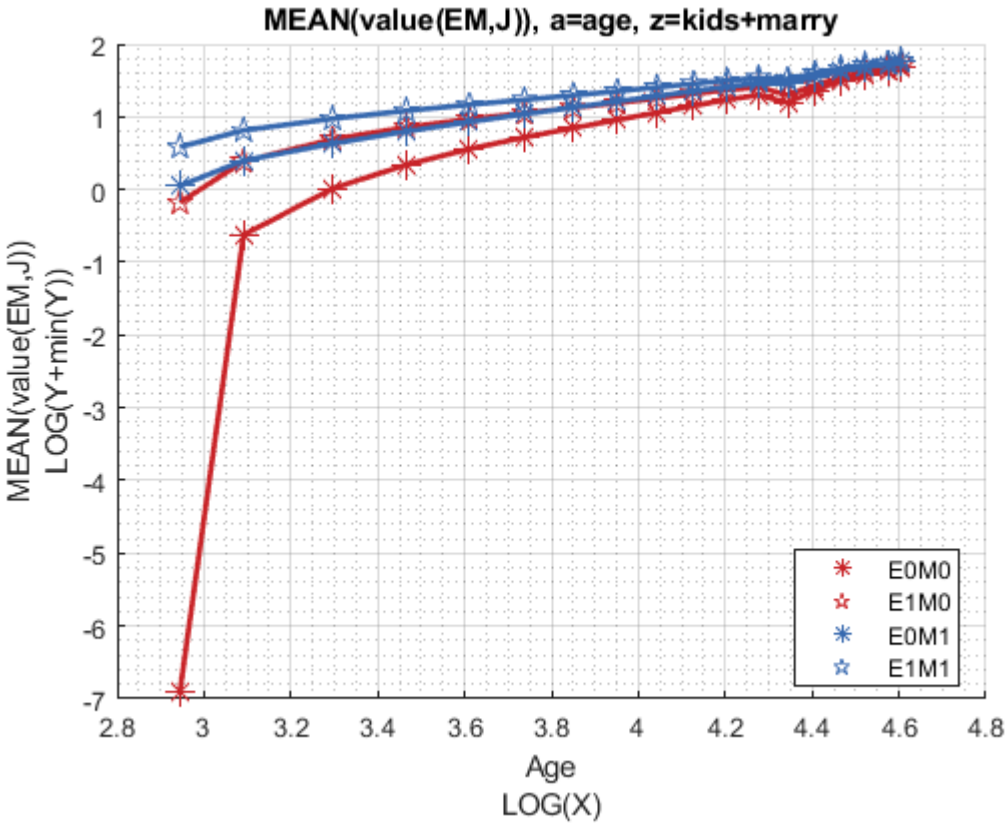
xxx MEAN(C(EKM,J)) xxxxxxxxxxxxxxxxxxxxxxxxxxx

group	edu	marry	mean_age_19	mean_age_22	mean_age_27	mean_age_32	mean_age_37	mean_age_42
1	0	0	7.1022	7.4087	7.7357	8.0845	8.4713	8.9105
2	1	0	7.3195	7.7041	8.0988	8.4875	8.8852	9.312
3	0	1	7.2307	7.5253	7.8393	8.1757	8.5471	8.9685
4	1	1	7.5242	7.8997	8.2875	8.6685	9.0562	9.4697

Graph Mean Values:

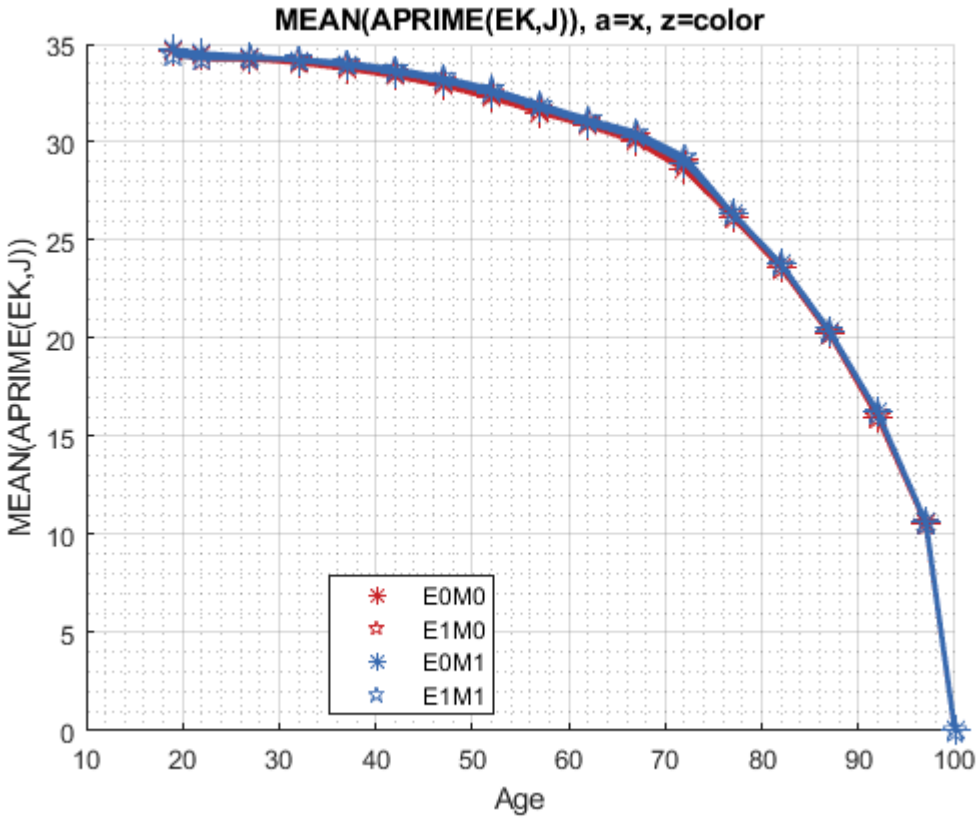
```
mp_support_graph('cl_st_graph_title') = {'MEAN(value(EM,J)), a=age, z=kids+marry'};
mp_support_graph('cl_st_ytitle') = {'MEAN(value(EM,J))'};
ff_graph_grid((tb_az_v{1:end, 4:end}), ar_row_grid, age_grid, mp_support_graph);
```

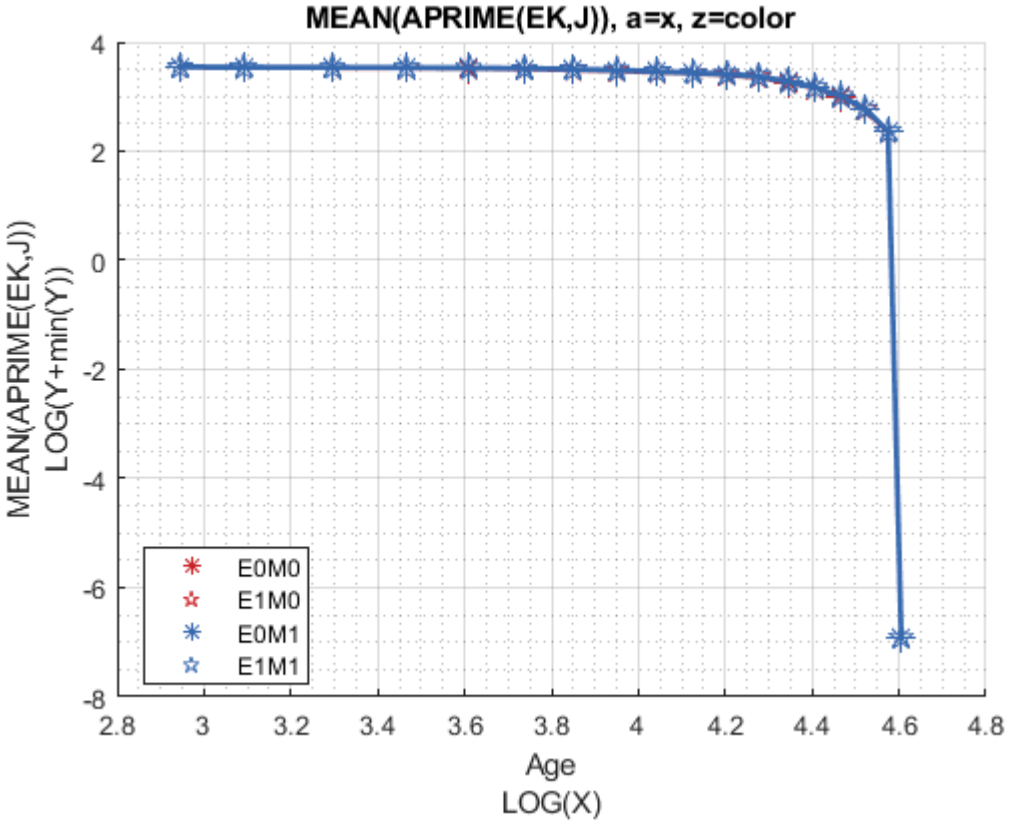




Graph Mean Savings Choices:

```
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);
```