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: Finished Age Group:18 of 18
SNW_VFI_MAIN: Finished Age Group:17 of 18
SNW_VFI_MAIN: Finished Age Group:16 of 18
SNW_VFI_MAIN: Finished Age Group:15 of 18
SNW_VFI_MAIN: Finished Age Group:14 of 18
SNW_VFI_MAIN: Finished Age Group:13 of 18
SNW_VFI_MAIN: Finished Age Group:12 of 18
SNW_VFI_MAIN: Finished Age Group:11 of 18
SNW_VFI_MAIN: Finished Age Group:10 of 18
SNW_VFI_MAIN: Finished Age Group:9 of 18
SNW_VFI_MAIN: Finished Age Group:8 of 18
SNW_VFI_MAIN: Finished Age Group:7 of 18
SNW_VFI_MAIN: Finished Age Group:6 of 18
SNW_VFI_MAIN: Finished Age Group:5 of 18
SNW_VFI_MAIN: Finished Age Group:4 of 18
SNW_VFI_MAIN: Finished Age Group:3 of 18
SNW_VFI_MAIN: Finished Age Group:2 of 18
SNW_VFI_MAIN: Finished Age Group:1 of 18
Elapsed time is 0.300958 seconds.
Completed SNW_VFI_MAIN;SNW_MP_PARAM=default_small;SNW_MP_CONTROL=default_base
```

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))  xxxxxxxxxxxxxxxxxxxxxxxxxx
```

group	savings	mean_Hshock__0_91976	mean_Hshock__0_45988	mean_Hshock_0	mean_Hshock_0_45988	me
1	0	-7.2503	-5.2835	-3.7134	-2.4567	
2	0.0097656	-7.1324	-5.1969	-3.6417	-2.3926	
3	0.078125	-6.4761	-4.7107	-3.2467	-2.0451	
4	0.26367	-5.3284	-3.8496	-2.5707	-1.4781	
5	0.625	-3.966	-2.8108	-1.7735	-0.84485	
6	1.2207	-2.597	-1.7598	-0.95324	-0.21705	
7	2.1094	-1.3566	-0.78465	-0.19312	0.37681	
8	3.3496	-0.30963	0.066182	0.47754	0.90413	
9	5	0.53291	0.7744	1.0517	1.3565	
10	7.1191	1.1909	1.3448	1.5289	1.7407	
11	9.7656	1.6974	1.7957	1.9172	2.0626	
12	12.998	2.0855	2.1488	2.2293	2.3287	
13	16.875	2.3829	2.4244	2.4781	2.5462	
14	21.455	2.6121	2.6396	2.6759	2.7229	
15	26.797	2.79	2.8086	2.8335	2.8663	
16	32.959	2.9295	2.9423	2.9596	2.9828	
17	40	3.0397	3.0487	3.061	3.0775	
18	47.979	3.1277	3.1342	3.1429	3.1549	
19	56.953	3.1987	3.2033	3.2097	3.2185	
20	66.982	3.2563	3.2597	3.2645	3.271	
21	78.125	3.3036	3.3062	3.3097	3.3146	
22	90.439	3.3427	3.3446	3.3473	3.3511	
23	103.98	3.3753	3.3768	3.3788	3.3817	
24	118.82	3.4026	3.4038	3.4054	3.4076	
25	135	3.4257	3.4266	3.4279	3.4296	

```
% 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_Hshock__0_91976	mean_Hshock__0_45988	mean_Hshock_0	mean_Hshock_0_45988	me
1	0	0.0031715	0.018272	0.06218	0.16375	

2	0.0097656	0.0041856	0.02014	0.065449	0.1682
3	0.078125	0.0195	0.043246	0.094774	0.20231
4	0.26367	0.11997	0.14608	0.20791	0.31671
5	0.625	0.37091	0.40356	0.4536	0.57742
6	1.2207	0.81324	0.85499	0.90105	1.0031
7	2.1094	1.495	1.5366	1.6037	1.6661
8	3.3496	2.4456	2.4842	2.56	2.6441
9	5	3.7173	3.7541	3.8276	3.9479
10	7.1191	5.3706	5.4067	5.4784	5.6081
11	9.7656	7.409	7.445	7.5165	7.6487
12	12.998	9.829	9.8609	9.9322	10.066
13	16.875	12.836	12.867	12.93	13.062
14	21.455	16.418	16.447	16.51	16.632
15	26.797	20.467	20.493	20.551	20.67
16	32.959	25.147	25.172	25.226	25.335
17	40	30.496	30.527	30.586	30.695
18	47.979	36.57	36.598	36.66	36.779
19	56.953	43.556	43.586	43.646	43.757
20	66.982	51.34	51.37	51.434	51.553
21	78.125	59.622	59.655	59.719	59.839
22	90.439	68.907	68.939	69.003	69.124
23	103.98	79.38	79.41	79.47	79.586
24	118.82	90.679	90.711	90.776	90.898
25	135	102.99	103.02	103.08	103.19

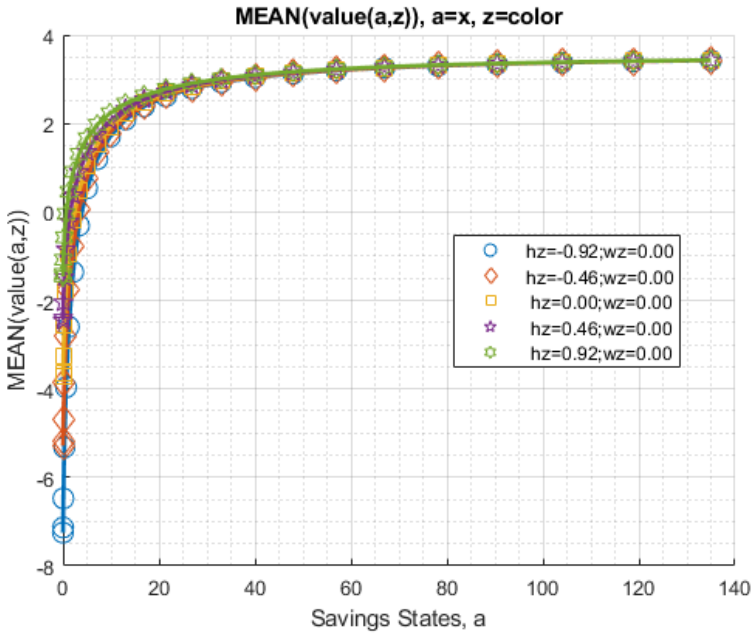
```
% Consumption Choices
tb_az_c = ff_summ_nd_array("MEAN(C(A,Z))", cons_VFI, true, ["mean"], 4, 1, cl_mp_datasetdesc, a
```

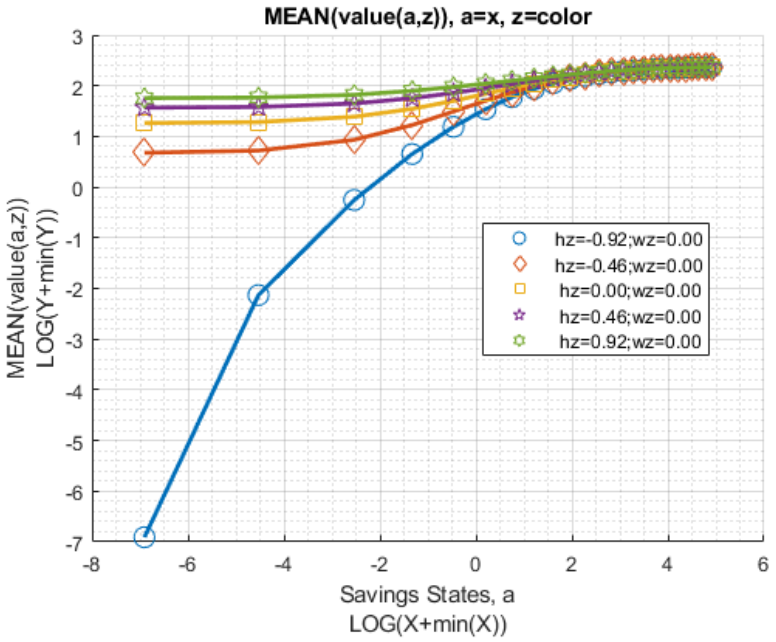
xxx MEAN(C(A,Z)) xxxxxxxxxxxxxxxxxxxxxxxxxx

group	savings	mean_Hshock__0_91976	mean_Hshock__0_45988	mean_Hshock_0	mean_Hshock_0_45988	me
1	0	0.47551	0.59993	0.77031	1.0006	
2	0.0097656	0.48595	0.60949	0.77845	1.0076	
3	0.078125	0.5508	0.6664	0.82902	1.0533	
4	0.26367	0.66781	0.78066	0.93266	1.1554	
5	0.625	0.84	0.94566	1.1089	1.3162	
6	1.2207	1.0944	1.1901	1.3565	1.585	
7	2.1094	1.4504	1.5453	1.6898	1.9573	
8	3.3496	1.9462	2.0432	2.1782	2.4231	
9	5	2.597	2.695	2.8314	3.0393	
10	7.1191	3.4097	3.5079	3.6454	3.8432	
11	9.7656	4.449	4.5467	4.6839	4.8786	
12	12.998	5.7861	5.8876	6.0245	6.2175	
13	16.875	7.2831	7.3861	7.5301	7.7248	
14	21.455	9.0219	9.1255	9.2698	9.4736	
15	26.797	11.176	11.283	11.433	11.639	
16	32.959	13.652	13.76	13.913	14.129	
17	40	16.478	16.58	16.728	16.944	
18	47.979	19.667	19.772	19.917	20.123	
19	56.953	23.101	23.202	23.35	23.564	
20	66.982	26.96	27.062	27.205	27.41	
21	78.125	31.613	31.712	31.855	32.06	
22	90.439	36.623	36.724	36.866	37.069	
23	103.98	41.873	41.975	42.122	42.331	
24	118.82	47.794	47.894	48.036	48.239	
25	135	54.264	54.368	54.515	54.725	

Graph Mean Values:

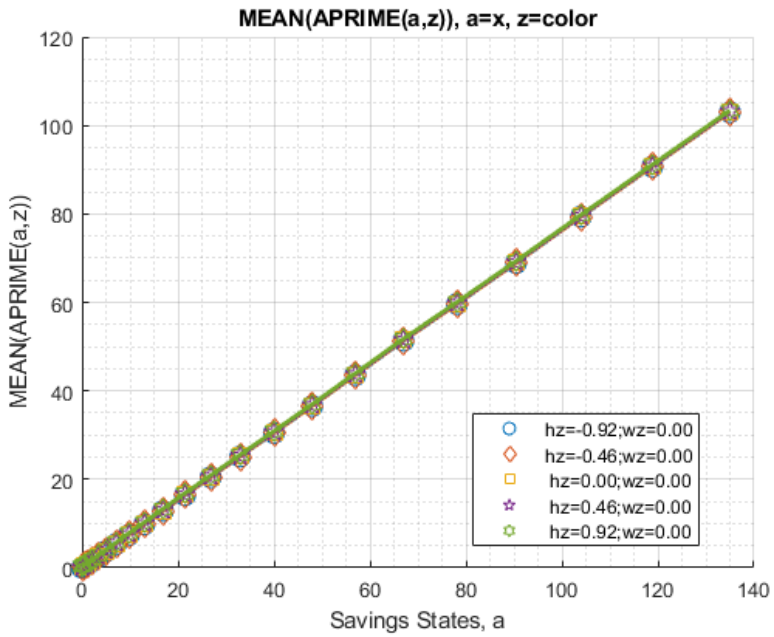
```
mp_support_graph('cl_st_graph_title') = {'MEAN(value(a,z)), a=x, z=color'};
mp_support_graph('cl_st_ytitle') = {'MEAN(value(a,z))'};
ff_graph_grid((tb_az_v{1:end, 3:end})', ar_st_eta_HS_grid, agrid, mp_support_graph);
```

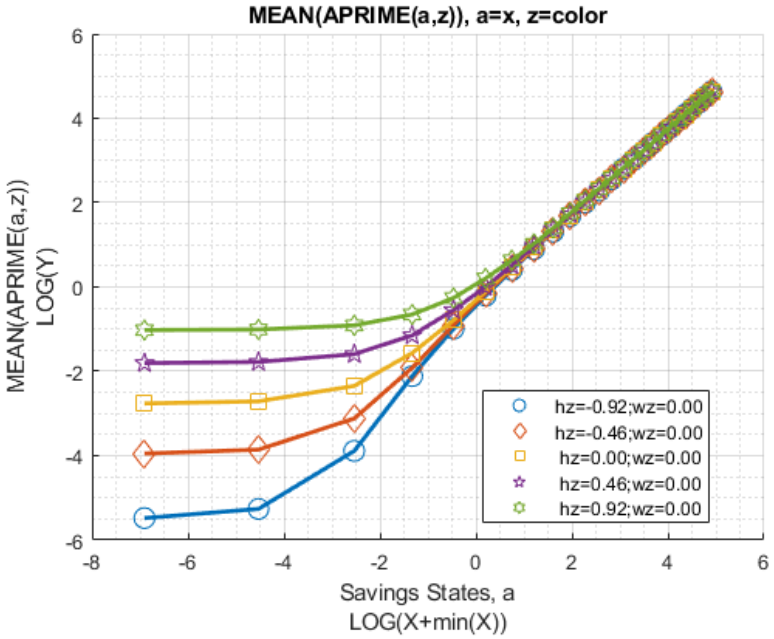




Graph Mean Savings Choices:

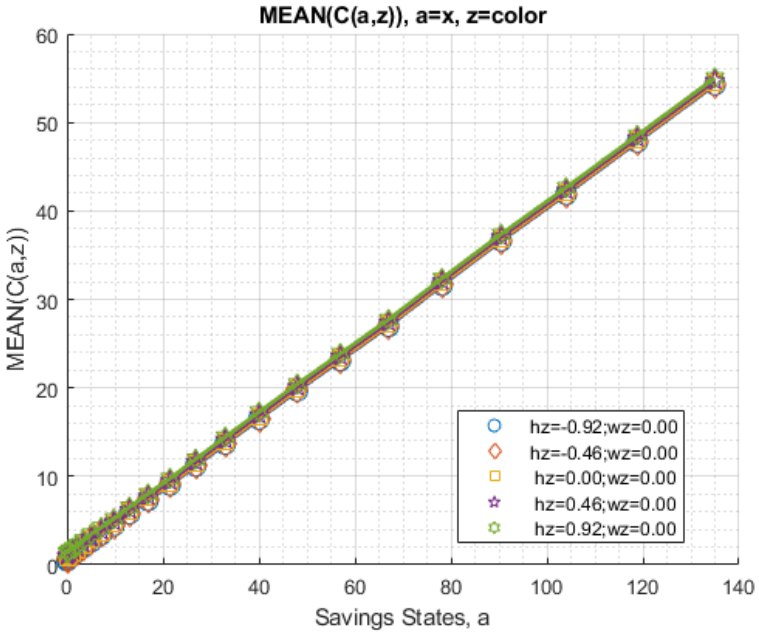
```
mp_support_graph('cl_st_graph_title') = {'MEAN(APRIME(a,z)), a=x, z=color'};
mp_support_graph('cl_st_ytitle') = {'MEAN(APRIME(a,z))'};
ff_graph_grid((tb_az_ap{1:end, 3:end})', ar_st_eta_HS_grid, agrid, mp_support_graph);
```

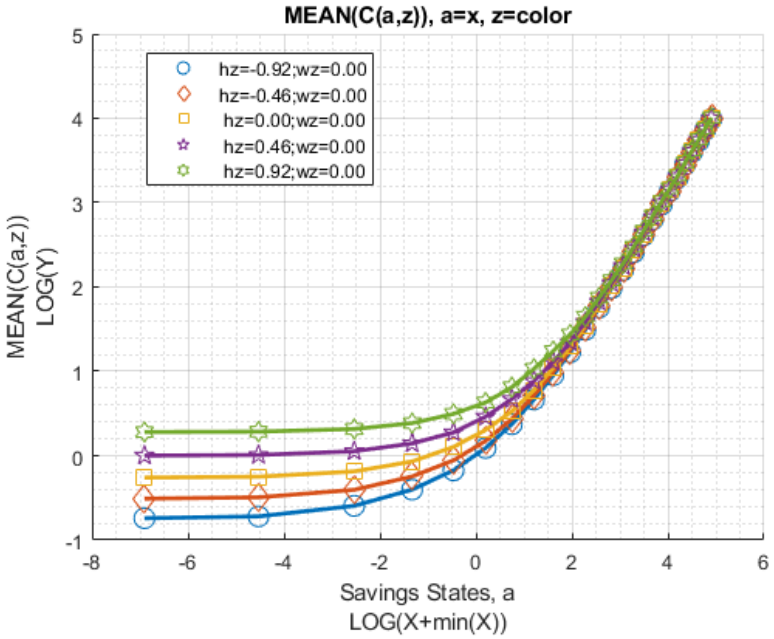




Graph Mean Consumption:

```
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         2.6201         2.7665         2.8454         2.8242         2.7343         2.5925
      2       2        0         1.5887         1.8727         2.0791         2.1577         2.1527         2.0791
      3       3        0         1.0708         1.3439         1.5546         1.6415         1.6452         1.5844
      4       1        1          2.395         2.5572         2.6553         2.6638          2.609         2.5055
      5       2        1         1.6234         1.8656         2.0481         2.1297         2.1416         2.0949
      6       3        1         1.2806         1.5046         1.6784         1.7562          1.766         1.7235
```

```
% 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          34.74          34.523          34.415          34.265          34.042          33.736
      2       2        0          34.413         34.138          33.952          33.709          33.376          32.947
      3       3        0          34.001         33.777          33.635          33.423          33.115          32.697
      4       1        1          34.621         34.408          34.308           34.16          33.941          33.635
      5       2        1          34.473         34.246          34.109          33.911          33.625          33.244
      6       3        1          34.106         33.916          33.813          33.643          33.381          33.017
```

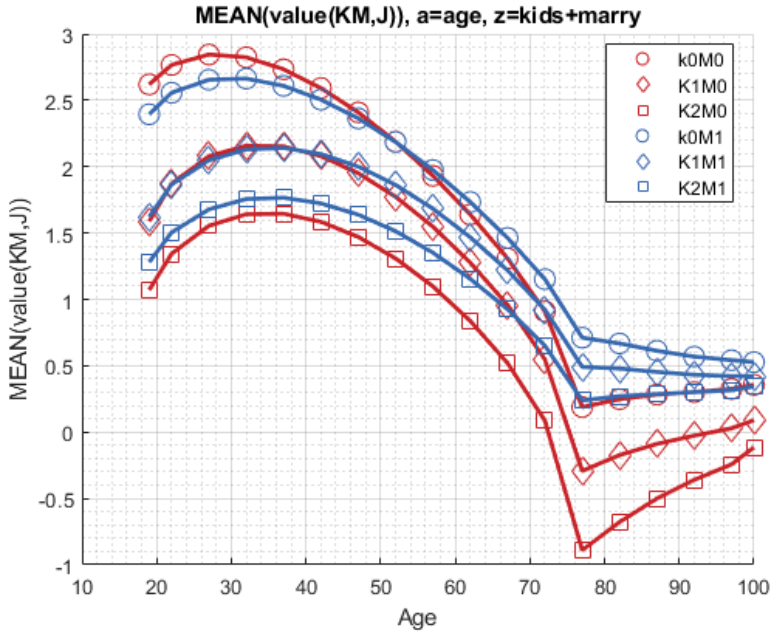
```
% Consumption Choices
tb_az_c = ff_summ_nd_array("MEAN(C(KM,J))", cons_VFI, true, ["mean"], 3, 1, cl_mp_datasetdesc,
```

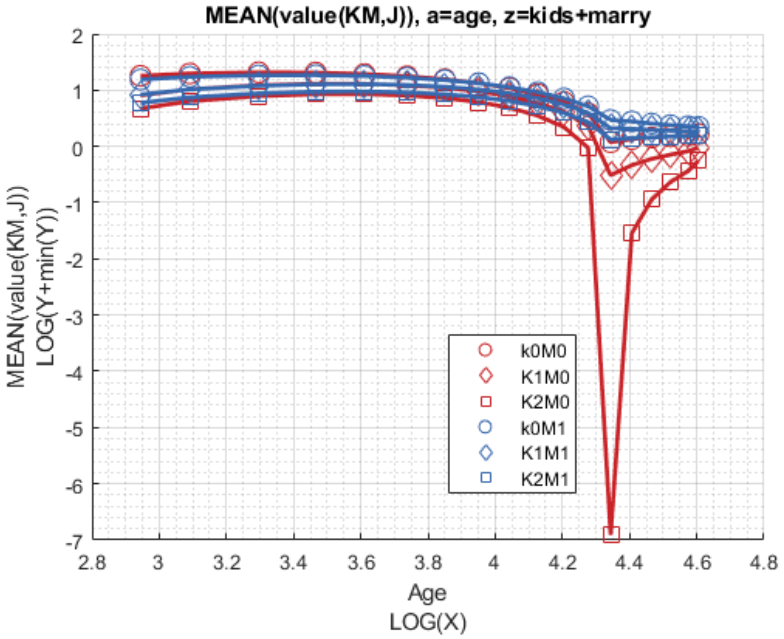
```
xxx  MEAN(C(KM,J))  xxxxxxxxxxxxxxxxxxxxxxxxxxx
    group    kids    marry    mean_age_19    mean_age_22    mean_age_27    mean_age_32    mean_age_37    mean_age_42
    _____    ____    _____    ___________    ___________    ___________    ___________    ___________    ___________

      1       1        0           6.778         7.0757         7.3697         7.6652         7.9826         8.3391
      2       2        0          7.1055         7.4611         7.8334         8.2212         8.6487         9.1272
      3       3        0          7.5174         7.8216         8.1497         8.5069           8.91         9.3774
      4       1        1          7.1206         7.4352         7.7476         8.0644         8.4009         8.7779
      5       2        1          7.2345         7.5595         7.9048         8.2677         8.6677         9.1164
      6       3        1          7.5771         7.8633         8.1717         8.5043         8.8779         9.3081
```

Graph Mean Values:

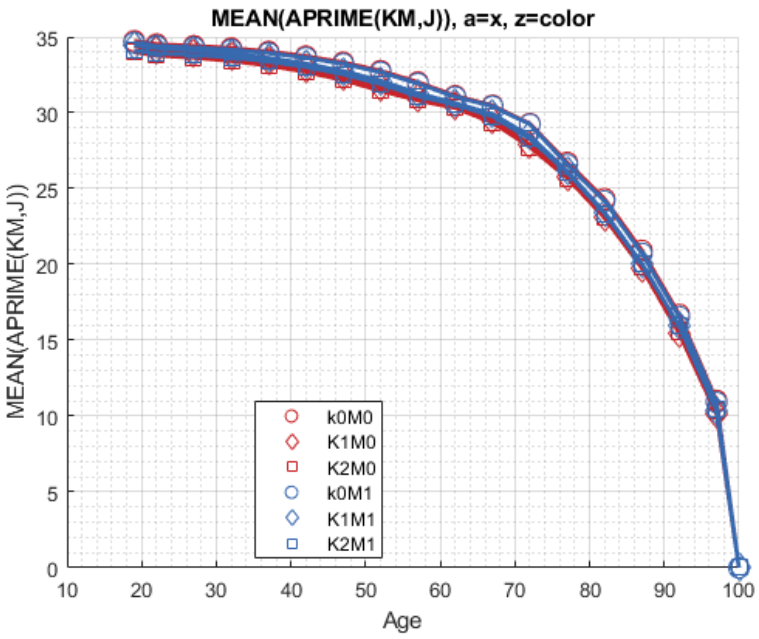
```
mp_support_graph('cl_st_graph_title') = {'MEAN(value(KM,J)), a=age, z=kids+marry'};
mp_support_graph('cl_st_ytitle') = {'MEAN(value(KM,J))'};
ff_graph_grid((tb_az_v{1:end, 4:end}), ar_row_grid, age_grid, mp_support_graph);
```

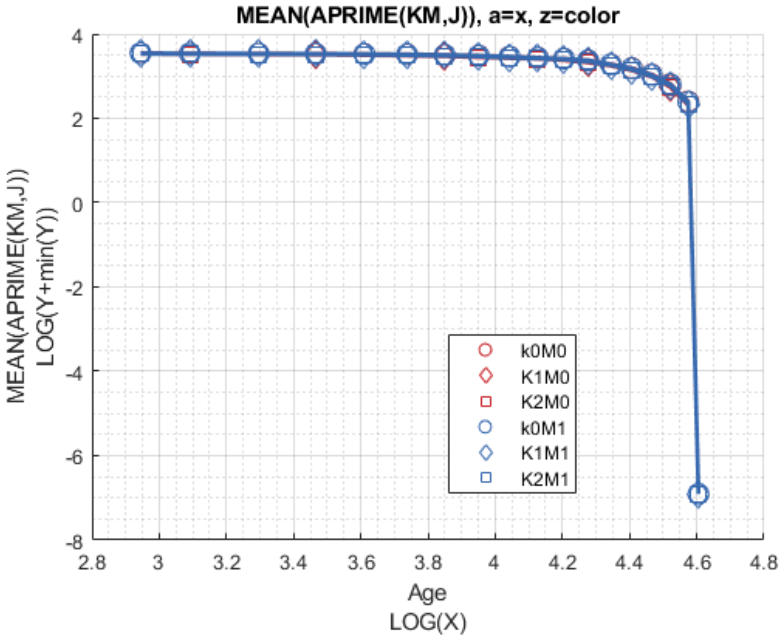




Graph Mean Savings Choices:

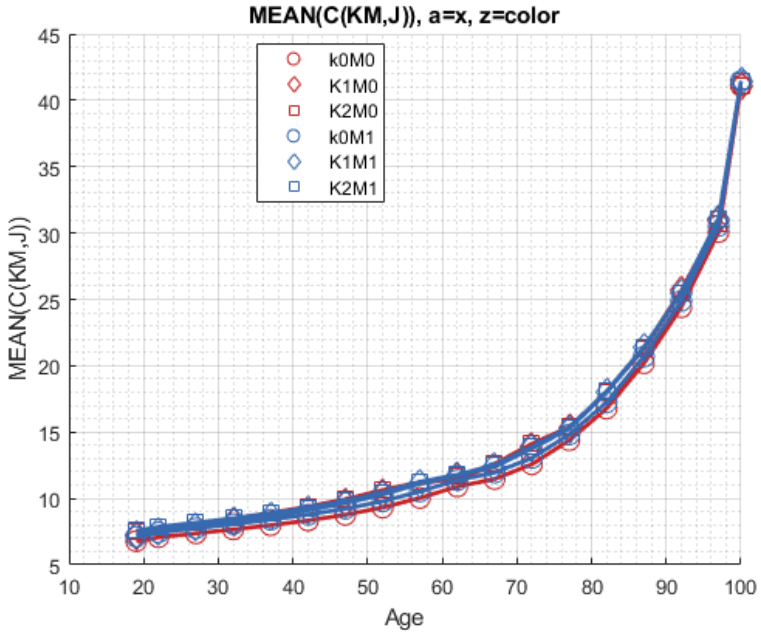
```
mp_support_graph('cl_st_graph_title') = {'MEAN(APRIME(KM,J)), a=x, z=color'};
mp_support_graph('cl_st_ytitle') = {'MEAN(APRIME(KM,J))'};
ff_graph_grid((tb_az_ap{1:end, 4:end}), ar_row_grid, age_grid, mp_support_graph);
```

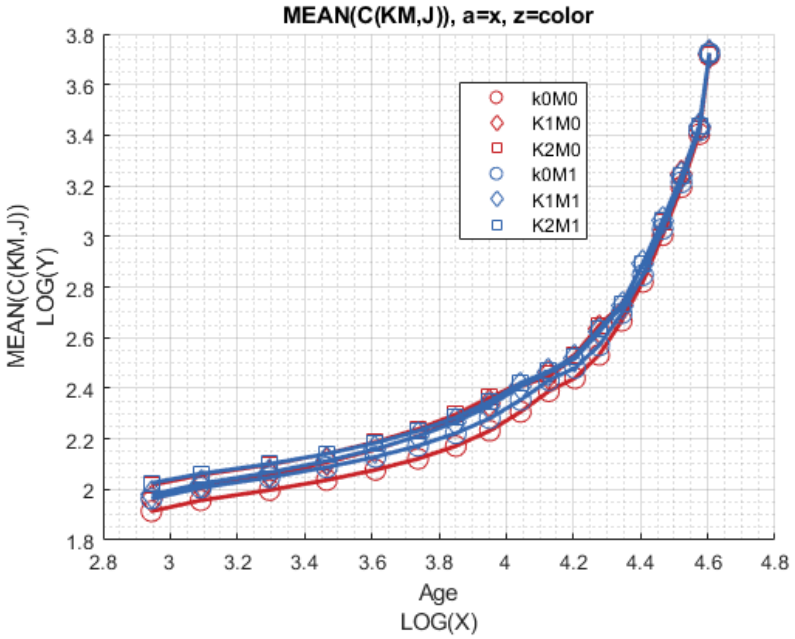




Graph Mean Consumption:

```
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	1.4646	1.6636	1.8129	1.8698	1.8591	1.7896
2	1	0	2.0551	2.3251	2.5065	2.5458	2.4958	2.3811
3	0	1	1.4539	1.6452	1.7914	1.8602	1.8706	1.8301
4	1	1	2.0788	2.3064	2.4632	2.5062	2.4738	2.3859

```
% 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	34.471	34.227	34.028	33.781	33.465	33.068
2	1	0	34.298	34.065	33.974	33.817	33.557	33.186
3	0	1	34.505	34.289	34.12	33.903	33.618	33.255
4	1	1	34.294	34.091	34.033	33.907	33.681	33.343

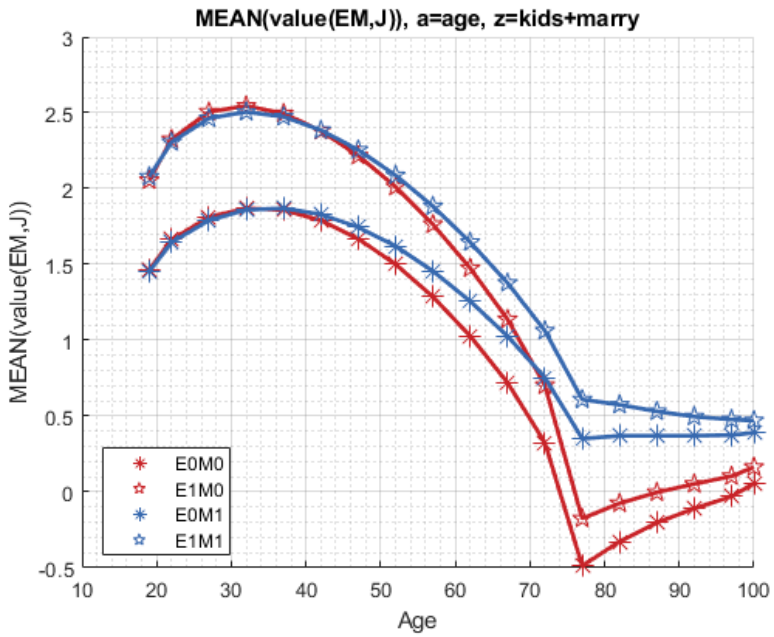
```
% Consumption Choices
tb_az_c = ff_summ_nd_array("MEAN(C(EKM,J))", cons_VFI, true, ["mean"], 3, 1, cl_mp_datasetdesc,
```

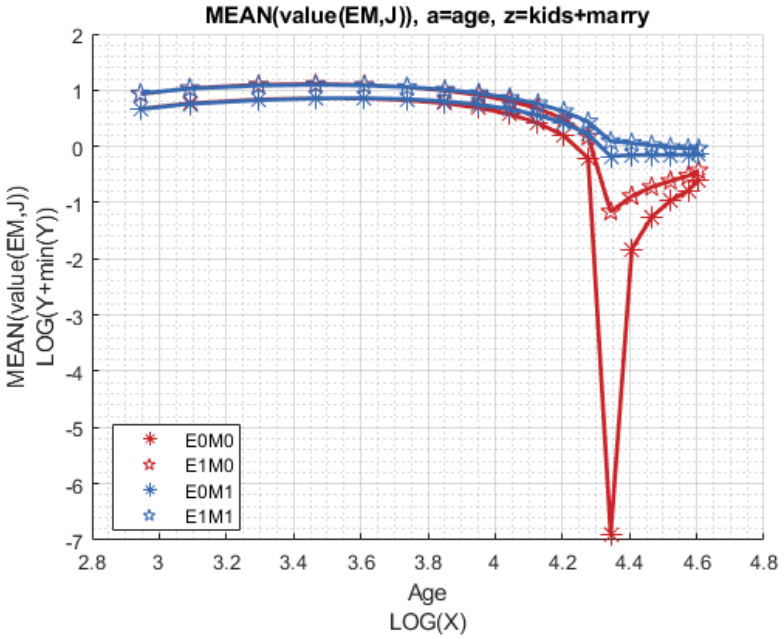
xxx MEAN(C(EKM,J)) xxxxxxxxxxxxxxxxxxxxxxxxxxx

group	edu	marry	mean_age_19	mean_age_22	mean_age_27	mean_age_32	mean_age_37	mean_age_42
1	0	0	7.047	7.3391	7.647	7.982	8.3628	8.8022
2	1	0	7.2203	7.5665	7.9215	8.2802	8.6647	9.0936
3	0	1	7.1855	7.465	7.7602	8.0826	8.4489	8.8704
4	1	1	7.436	7.7737	8.1225	8.475	8.8488	9.2645

Graph Mean Values:

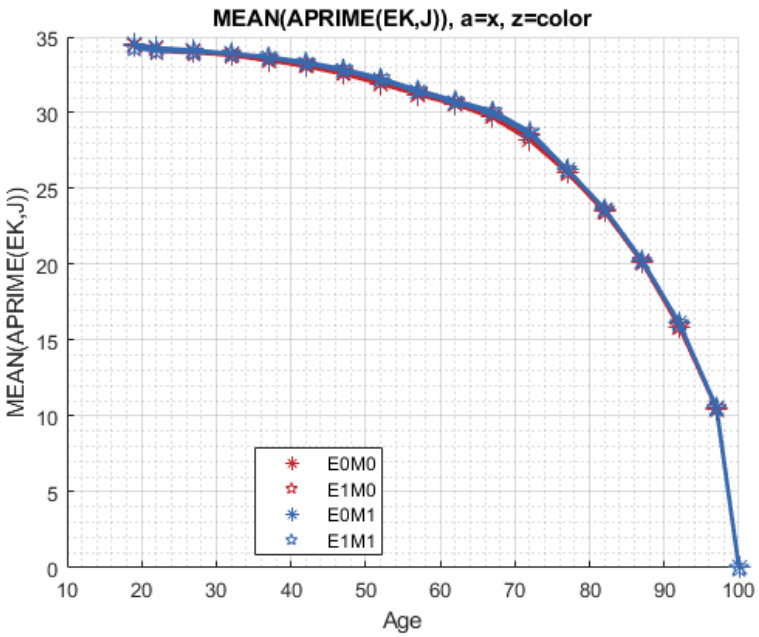
```
mp_support_graph('cl_st_graph_title') = {'MEAN(value(EM,J)), a=age, z=kids+marry'};
mp_support_graph('cl_st_ytitle') = {'MEAN(value(EM,J))'};
ff_graph_grid((tb_az_v{1:end, 4:end}), ar_row_grid, age_grid, mp_support_graph);
```

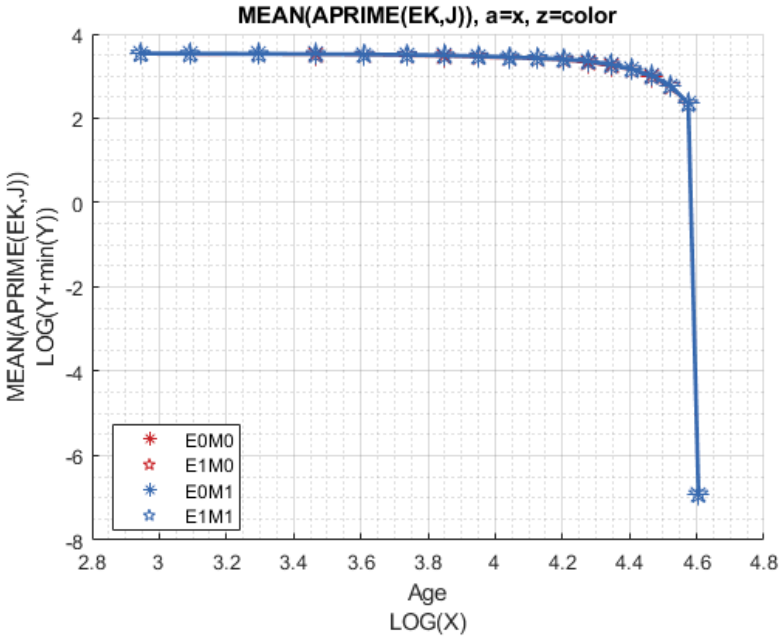




Graph Mean Savings Choices:

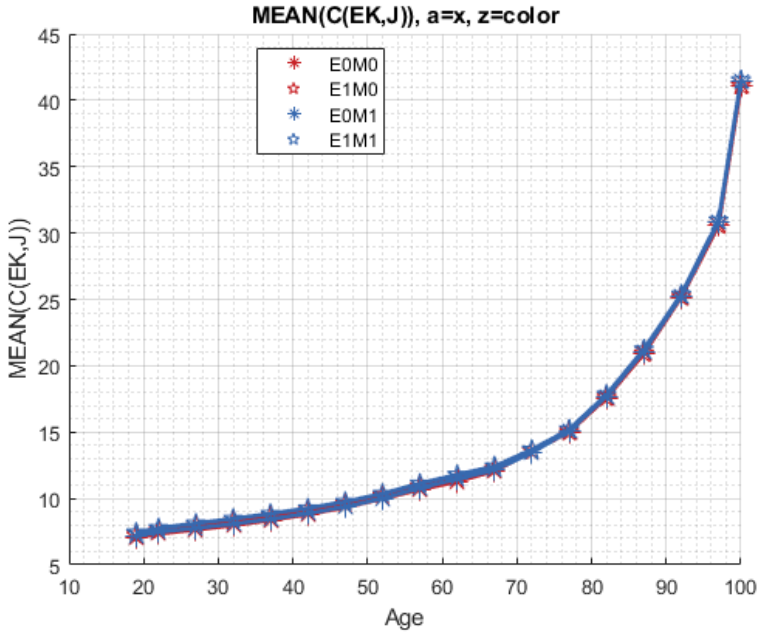
```
mp_support_graph('cl_st_graph_title') = {'MEAN(APRIME(EK,J)), a=x, z=color'};
mp_support_graph('cl_st_ytitle') = {'MEAN(APRIME(EK,J))'};
ff_graph_grid((tb_az_ap{1:end, 4:end}), ar_row_grid, age_grid, mp_support_graph);
```

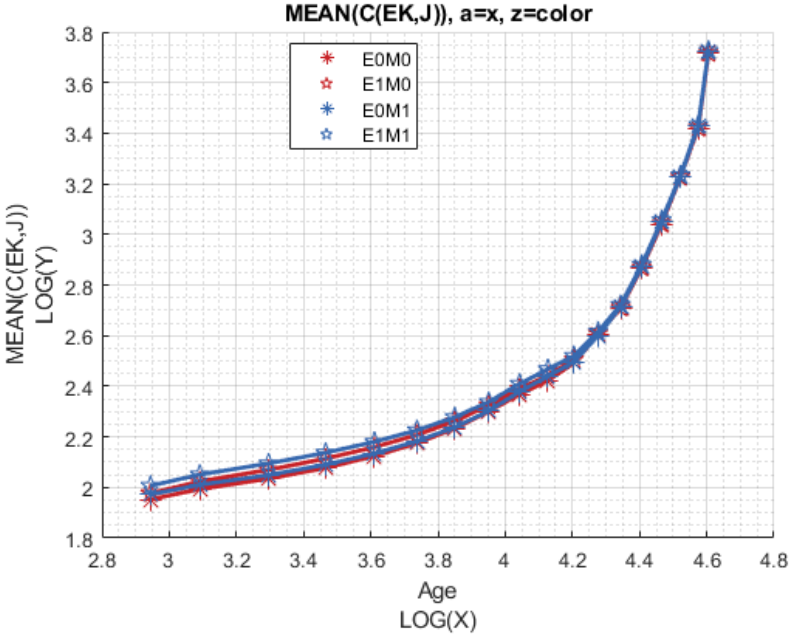




Graph Mean Consumption:

```
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);
```


MEAN(C(EK,J)), a=x, z=color
E0M0
E1M0
E0M1
E1M1
MEAN(C(EK,J))
Age


MEAN(C(EK,J)), a=x, z=color
E0M0
E1M0
E0M1
E1M1
MEAN(C(EK,J))
LOG(Y)
Age
LOG(X)