FF_DS_AZ_CTS_LOOP Dynamic Savings Loop Continuous Distribution

back to Fan's Intro Math for Econ, Matlab Examples, or Dynamic Asset Repositories

This is the example vignette for function: **ff_ds_az_cts_loop** from the **MEconTools Package.** F(a,z) discrete probability mass function given policy function solution with continuous savings choices.

- Distribution for Common Choice and States Grid **_Loop_**: ff_ds_az_cts_loop
- Distribution for States Grid + Continuous Exact Savings as Share of Cash-on-Hand **_Loop_**:
  ff_ds_az_cts_loop
- Distribution for States Grid + Continuous Exact Savings as Share of Cash-on-Hand **_Vectorized_**:
  ff_ds_az_cts_vec

Test FF_DS_AZ_CTS_LOOP Defaults

Call the function with defaults. By default, shows the asset policy function summary. Model parameters can be changed by the mp_params.

```
%mp_params
mp_params = containers.Map('KeyType','char', 'ValueType','any');
mp_params('fl_crra') = 1.5;
mp_params('fl_beta') = 0.94;
% call function
ff_ds_az_cts_loop(mp_params);
```

```
Elapsed time is 1.912182 seconds.
----------------------------------------
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
CONTAINER NAME: mp_ffcmd ND Array (Matrix etc)
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
```

	i	idx	ndim	numel	rowN	colN	sum	mean	std	coefvari	min	max
	_	___	____	_____	____	____	_____	_____	_____	_____	___	_____
ap	1	1	2	3000	200	15	42703	14.234	14.307	1.0051	0	51.591

```
xxx TABLE:ap xxxxxxxxxxxxxxxxxxx
```

	c1	c2	c3	c4	c5	c11	c12	c13	c14	c15
	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____
r1	0	0	0	0	0	0.58655	0.89911	1.2884	1.7803	2.3861
r2	0	0	0	0	0	0.58671	0.89914	1.2885	1.7804	2.3862
r3	0	0	0	0	0	0.5871	0.89961	1.2888	1.7808	2.3867
r4	0	0	0	0	0	0.58803	0.90058	1.2898	1.7817	2.3877
r5	0	0	0	0	0	0.58953	0.90208	1.2914	1.7831	2.3891
r196	45.655	45.699	45.725	45.798	45.889	47.025	47.404	47.828	48.358	49.028
r197	46.257	46.303	46.326	46.401	46.492	47.626	48.005	48.432	48.965	49.651
r198	46.863	46.91	46.931	47.007	47.097	48.232	48.611	49.041	49.59	50.294
r199	47.472	47.521	47.542	47.617	47.711	48.843	49.222	49.658	50.235	50.94
r200	48.088	48.134	48.157	48.232	48.326	49.459	49.841	50.311	50.885	51.591

```
FF_DS_AZ_CTS_LOOP finished. Distribution took = 0.69766
----------------------------------------
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
CONTAINER NAME: mp_ddcmd ND Array (Matrix etc)
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
```

	i	idx	ndim	numel	rowN	colN	sum	mean	std	coefvari	min
fa	1	1	2	200	200	1	1	0.005	0.0096174	1.9235	0
faz	2	2	2	3000	200	15	1	0.00033333	0.0011636	3.4908	0
fz	3	3	2	15	15	1	1	0.066667	0.076895	1.1534	6.1035e-05

xxx TABLE:fa xxxxxxxxxxxxxxxxxx

	c1
r1	0.11604
r2	0
r3	0.0004751
r4	0.00026799
r5	0.0029727
r196	3.5618e-14
r197	2.1735e-14
r198	1.329e-14
r199	8.3938e-15
r200	8.2751e-15

xxx TABLE:faz xxxxxxxxxxxxxxxxxx

	c1	c2	c3	c4	c5	c11	c12	c13
r1	4.1559e-05	0.00053618	0.0031141	0.010616	0.023097	9.8338e-05	8.1894e-06	4.3385
r2	0	0	0	0	0	0	0	
r3	2.0452e-10	1.1226e-08	2.5837e-07	3.2065e-06	2.2865e-05	1.2294e-06	1.0693e-07	5.8481
r4	8.6656e-10	2.8074e-08	3.684e-07	2.7287e-06	1.4098e-05	6.831e-07	5.9408e-08	3.249
r5	9.2776e-08	2.9148e-06	3.479e-05	0.00019689	0.00056423	2.3628e-06	1.9305e-07	1.0072
r196	1.6685e-22	7.5909e-21	1.5483e-19	1.8762e-18	1.5117e-17	7.3723e-15	8.1882e-15	6.5347
r197	4.6363e-23	2.3916e-21	5.523e-20	7.5562e-19	6.8327e-18	4.5113e-15	5.0046e-15	4.0053
r198	8.2487e-24	4.9336e-22	1.3328e-20	2.1488e-19	2.2991e-18	2.8157e-15	3.0885e-15	2.4579
r199	6.6913e-25	5.3279e-23	1.9003e-21	4.0019e-20	5.5219e-19	1.9017e-15	2.0244e-15	1.5281
r200	2.8381e-26	2.725e-24	1.1911e-22	3.1319e-21	5.5136e-20	1.4819e-15	2.2618e-15	2.1457

xxx TABLE:fz xxxxxxxxxxxxxxxxxx

	c1
r1	6.1035e-05
r2	0.00085449
r3	0.0055542
r4	0.022217
r5	0.061096
r11	0.061096
r12	0.022217
r13	0.0055542
r14	0.00085449
r15	6.1035e-05

Marginal Stationary Probability: f(a), savings=x

Marginal Stationary Probability: f(a), savings=x
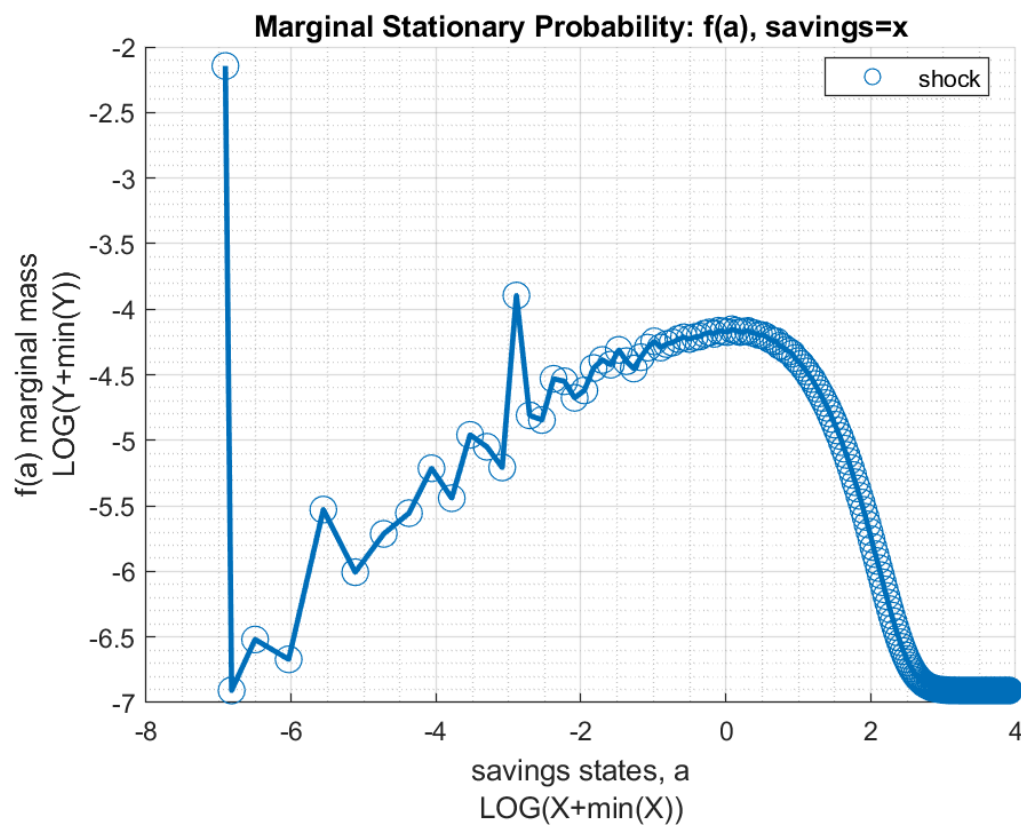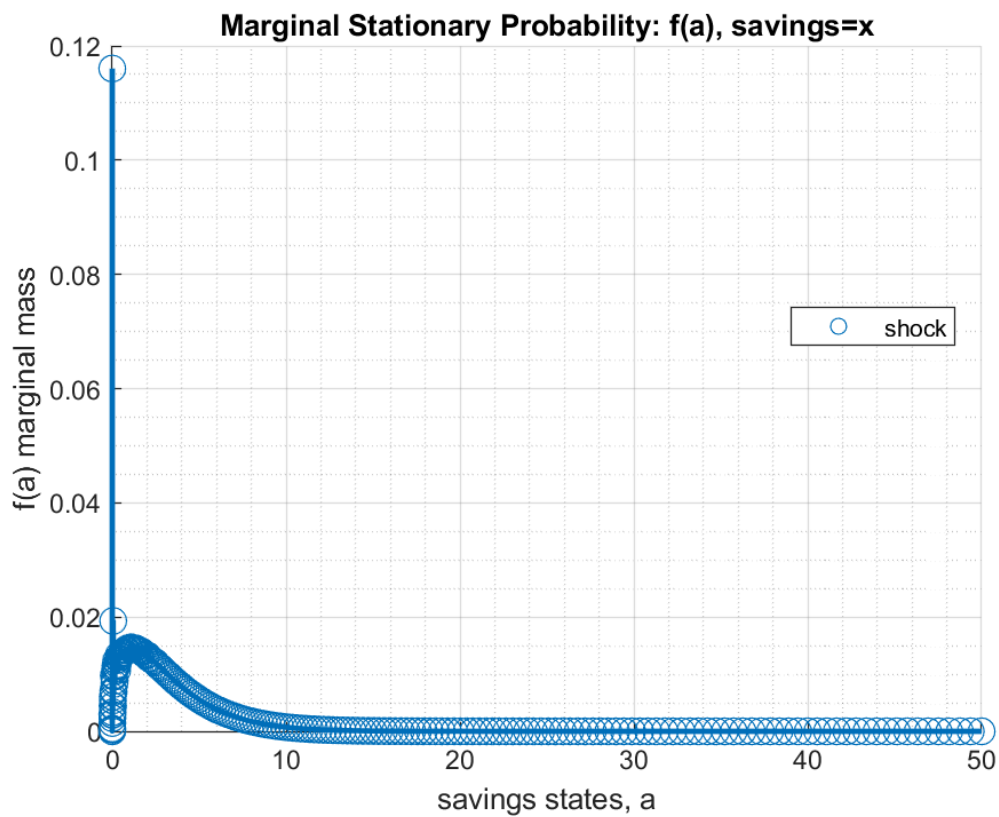

```
xxx tb_outcomes: all stats xxx
    OriginalVariableNames        ap          v           c           y          coh      savefraccoh
    _____     _____   _____   _____   _____   _____   _____

    {'mean'            }         1.675      5.0913      1.4673      1.467       3.1423       0.37474
    {'unweighted_sum'  }        42703       26797       7295.8      6979.8      49998        1657.9
```

{'sd' }	2.0062	1.7215	0.36267	0.51485	2.3189	0.24932
{'coefofvar' }	1.1977	0.33813	0.24717	0.35095	0.73794	0.66532
{'gini' }	0.59404	0.19113	0.13962	0.19161	0.37632	0.39022
{'min' }	0	-1.2641	0.38052	0.38052	0.38052	0
{'max' }	51.591	16.787	5.0209	6.6099	56.61	0.91805
{'pYis0' }	0.11606	0	0	0	0	0.11606
{'pYls0' }	0	0.00066766	0	0	0	0
{'pYgr0' }	0.88394	0.99933	1	1	1	0.88394
{'pYisMINY' }	0.11606	4.1559e-05	4.1559e-05	4.1559e-05	4.1559e-05	0.11606
{'pYisMAXY' }	3.1409e-16	3.1409e-16	5.148e-16	3.1409e-16	3.1409e-16	2.8381e-26
{'p0_01' }	0	-0.34507	0.45473	0.45473	0.45473	0
{'p0_1' }	0	0.52204	0.54342	0.54342	0.54342	0
{'p1' }	0	1.3412	0.6494	0.6494	0.6494	0
{'p5' }	0	2.1813	0.85431	0.77605	0.88697	0
{'p10' }	0	2.8514	0.96477	0.92741	1.002	0
{'p20' }	0.10665	3.5986	1.1516	1.0358	1.3244	0.083657
{'p25' }	0.21483	3.8501	1.2354	1.1105	1.4524	0.14274
{'p30' }	0.32994	4.2218	1.284	1.129	1.6395	0.20194
{'p40' }	0.60561	4.5759	1.3788	1.3244	1.999	0.30454
{'p50' }	0.9866	5.0443	1.4671	1.363	2.4484	0.39896
{'p60' }	1.4331	5.4957	1.5615	1.5828	2.9924	0.48032
{'p70' }	2.0261	5.9595	1.6562	1.6429	3.671	0.556
{'p75' }	2.4055	6.2377	1.7089	1.7094	4.0981	0.59225
{'p80' }	2.8929	6.5441	1.7669	1.9106	4.6329	0.62436
{'p90' }	4.3431	7.3623	1.9254	2.123	6.2699	0.69668
{'p95' }	5.7881	8.0262	2.0625	2.4019	7.7831	0.74075
{'p99' }	8.9453	9.2776	2.3421	2.9539	11.327	0.79763
{'p99_9' }	13.367	10.599	2.6636	3.7357	15.962	0.83767
{'p99_99' }	17.333	11.639	2.9483	4.3328	20.294	0.85903
{'fl_cov_ap' }	4.0248	2.8944	0.61038	0.64355	4.6352	0.41772
{'fl_cor_ap' }	1	0.83807	0.83891	0.62307	0.99637	0.83512
{'fl_cov_v' }	2.8944	2.9636	0.62238	0.79332	3.5168	0.36874
{'fl_cor_v' }	0.83807	1	0.99685	0.89507	0.88097	0.85912
{'fl_cov_c' }	0.61038	0.62238	0.13153	0.16405	0.74192	0.079746
{'fl_cor_c' }	0.83891	0.99685	1	0.87859	0.8822	0.88192
{'fl_cov_y' }	0.64355	0.79332	0.16405	0.26507	0.80761	0.079867
{'fl_cor_y' }	0.62307	0.89507	0.87859	1	0.67647	0.6222
{'fl_cov_coh' }	4.6352	3.5168	0.74192	0.80761	5.3771	0.49746
{'fl_cor_coh' }	0.99637	0.88097	0.8822	0.67647	1	0.86045
{'fl_cov_savefraccoh'}	0.41772	0.36874	0.079746	0.079867	0.49746	0.062162
{'fl_cor_savefraccoh'}	0.83512	0.85912	0.88192	0.6222	0.86045	1
{'fracByP0_01' }	0	-4.8153e-05	0.00017799	0.00018159	8.3115e-05	0
{'fracByP0_1' }	0	0.00027167	0.0013548	0.0014279	0.00063242	0
{'fracByP1' }	0	0.0032852	0.0063125	0.0069982	0.0029338	0
{'fracByP5' }	0	0.016969	0.025021	0.024262	0.011819	0
{'fracByP10' }	0	0.044207	0.05664	0.064855	0.026579	0
{'fracByP20' }	0.0026834	0.1115	0.13073	0.11733	0.067668	0.0099043
{'fracByP25' }	0.0076113	0.14492	0.17311	0.15549	0.086	0.025483
{'fracByP30' }	0.015302	0.19105	0.21762	0.19333	0.11182	0.048984
{'fracByP40' }	0.043894	0.27218	0.30467	0.27748	0.16912	0.11643
{'fracByP50' }	0.089861	0.36738	0.40369	0.36807	0.23805	0.21205
{'fracByP60' }	0.16112	0.46928	0.50828	0.46652	0.3263	0.32962
{'fracByP70' }	0.26525	0.58046	0.61519	0.57507	0.4298	0.46793
{'fracByP75' }	0.33325	0.64122	0.67431	0.63025	0.49166	0.54754
{'fracByP80' }	0.41265	0.70474	0.73277	0.69273	0.56293	0.62653
{'fracByP90' }	0.62139	0.84051	0.85792	0.82668	0.73375	0.80195
{'fracByP95' }	0.77085	0.91406	0.9245	0.90615	0.84324	0.89716
{'fracByP99' }	0.93558	0.98098	0.98317	0.97729	0.95807	0.97822
{'fracByP99_9' }	0.99103	0.99787	0.99814	0.9972	0.99438	0.99775
{'fracByP99_99' }	0.99886	0.99977	0.99979	0.99969	0.99931	0.99977

Test FF_DS_AZ_CTS_LOOP Speed Tests

Call the function with different a and z grid size, print out speed:

```matlab
mp_support = containers.Map('KeyType','char', 'ValueType','any');
mp_support('bl_timer') = true;
mp_support('ls_ffcmd') = {};
mp_support('ls_ddcmd') = {};
mp_support('ls_ddgrh') = {};
mp_support('bl_show_stats_table') = false;
% A grid 50, shock grid 5:
mp_params = containers.Map('KeyType','char', 'ValueType','any');
mp_params('it_a_n') = 50;
mp_params('it_z_n') = 5;
ff_ds_az_cts_loop(mp_params, mp_support);
```

```
Elapsed time is 0.466529 seconds.
FF_DS_AZ_CTS_LOOP finished. Distribution took = 0.065434
```

```matlab
% A grid 100, shock grid 7:
mp_params = containers.Map('KeyType','char', 'ValueType','any');
mp_params('it_a_n') = 100;
mp_params('it_z_n') = 7;
ff_ds_az_cts_loop(mp_params, mp_support);
```

```
Elapsed time is 0.930211 seconds.
FF_DS_AZ_CTS_LOOP finished. Distribution took = 0.20136
```

```matlab
% A grid 200, shock grid 9:
mp_params = containers.Map('KeyType','char', 'ValueType','any');
mp_params('it_a_n') = 200;
mp_params('it_z_n') = 9;
ff_ds_az_cts_loop(mp_params, mp_support);
```

```
Elapsed time is 1.614469 seconds.
FF_DS_AZ_CTS_LOOP finished. Distribution took = 0.52925
```

Test FF_DS_AZ_CTS_LOOP A grid 100 Shock grid 7

Call the function with different a and z grid size, print out speed:

```matlab
mp_support = containers.Map('KeyType','char', 'ValueType','any');
mp_support('bl_timer') = true;
mp_support('ls_ffcmd') = {};
mp_support('ls_ddcmd') = {};
mp_support('ls_ddgrh') = {'faz','fa'};
mp_support('bl_show_stats_table') = true;
mp_params = containers.Map('KeyType','char', 'ValueType','any');
mp_params('it_a_n') = 100;
mp_params('it_z_n') = 7;
ff_ds_az_cts_loop(mp_params, mp_support);
```
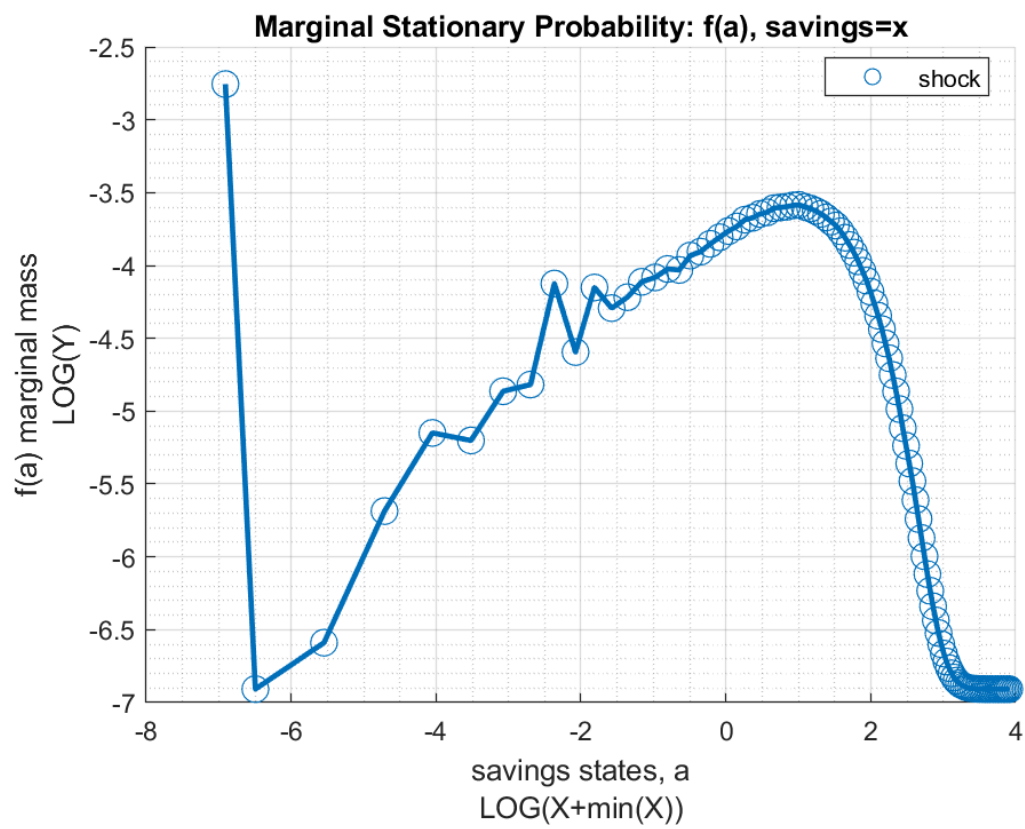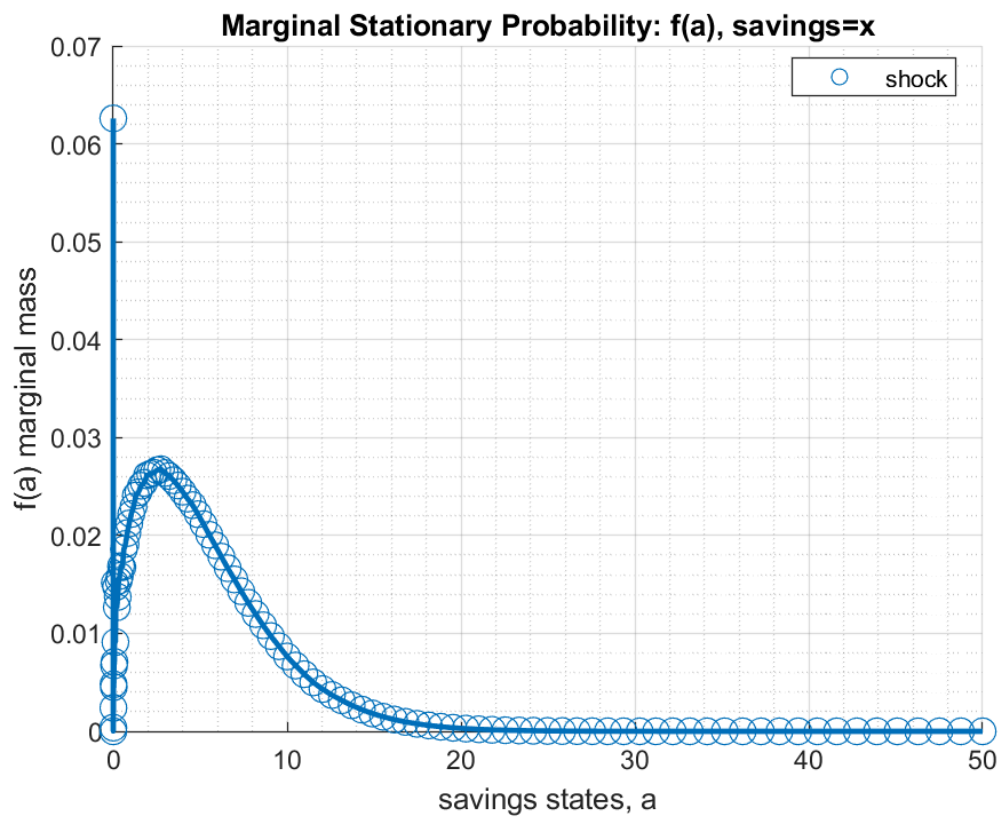
```
Elapsed time is 0.899597 seconds.
FF_DS_AZ_CTS_LOOP finished. Distribution took = 0.25939
```
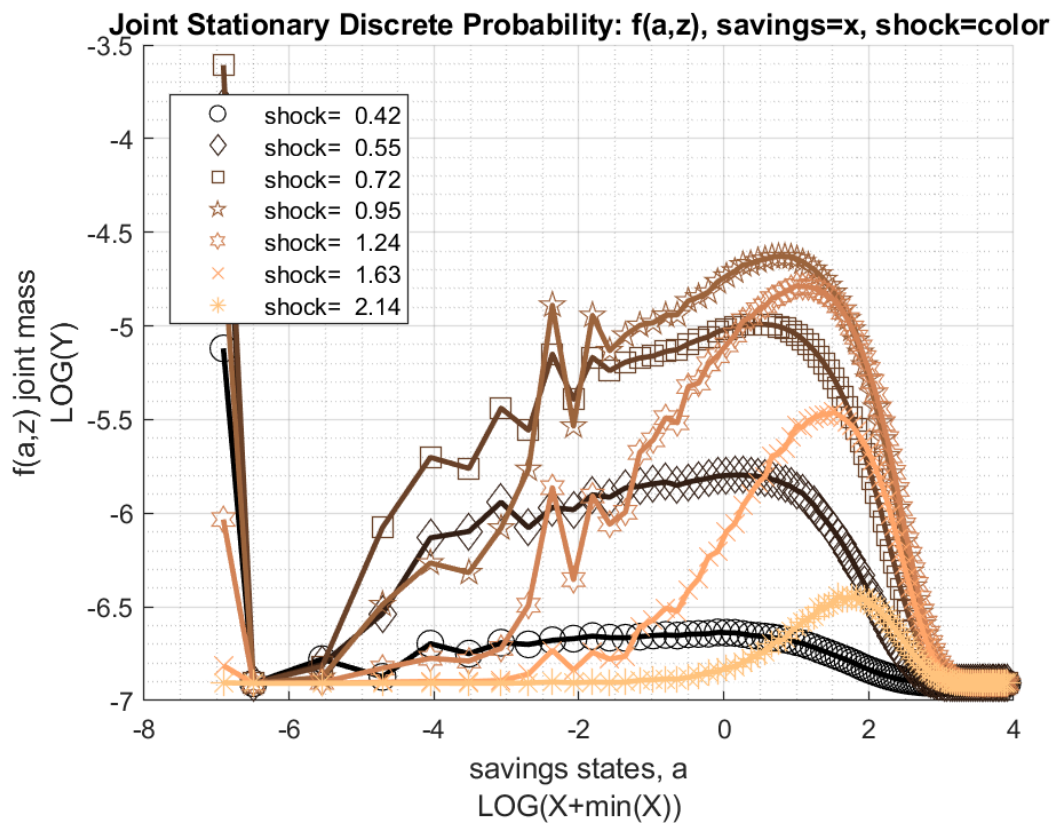
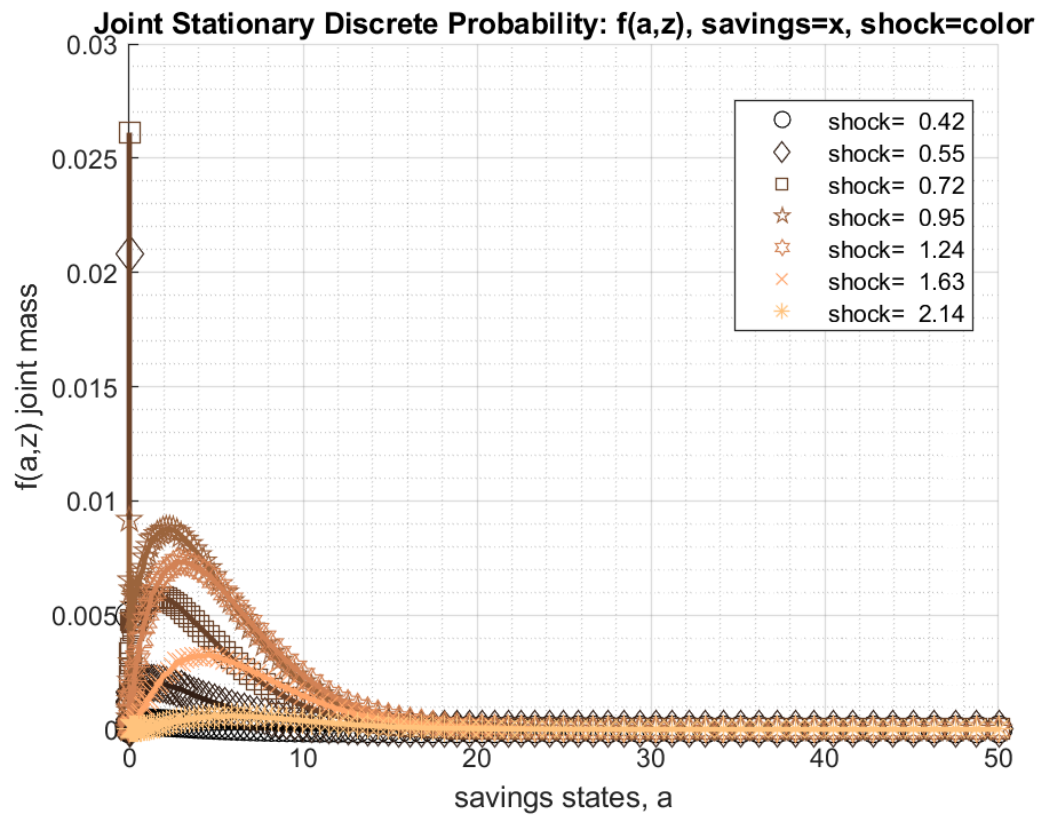Marginal Stationary Probability: f(a), savings=x

Marginal Stationary Probability: f(a), savings=x

Joint Stationary Discrete Probability: f(a,z), savings=x, shock=color

Joint Stationary Discrete Probability: f(a,z), savings=x, shock=color

F(a,z), Prob Mass at State-Space as Scatter Size


```
xxx tb_outcomes: all stats xxx
```
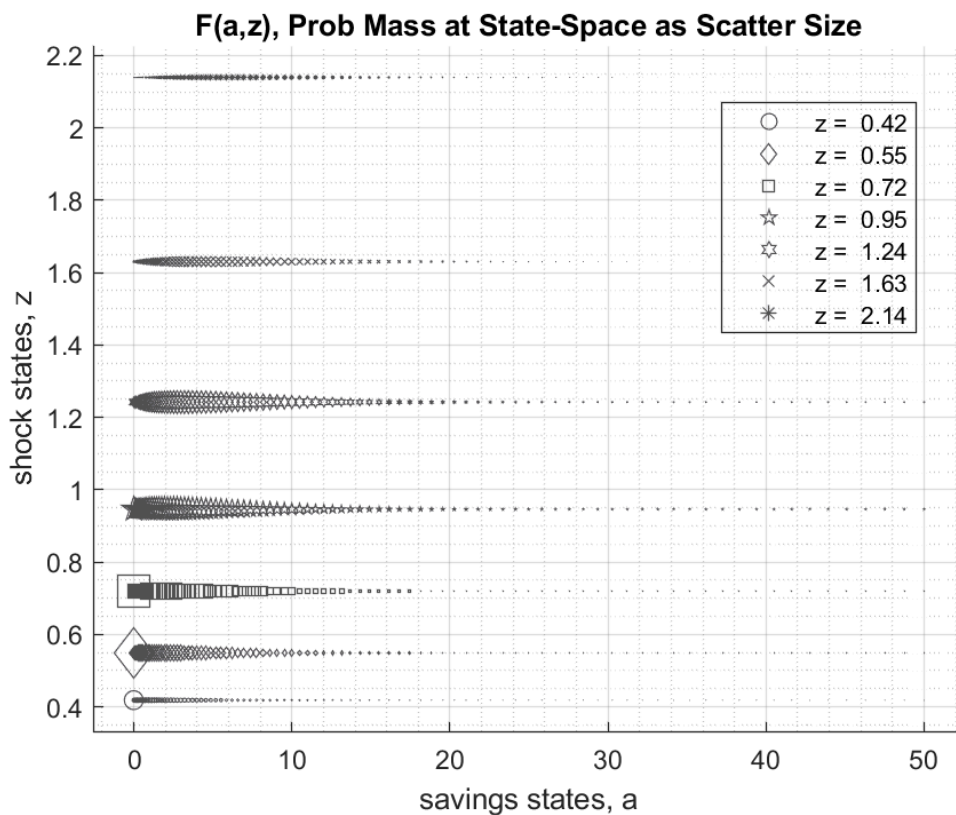
OriginalVariableNames		ap	v	c	y	coh	savefraccoh
{'mean' }		3.2216	6.9329	1.5295	1.5289	4.7511	0.52357
{'unweighted_sum' }		10019	7323.6	1530.6	1473.6	11549	457.17
{'sd' }		3.2562	2.1508	0.34914	0.5307	3.5687	0.25504
{'coefofvar' }		1.0107	0.31024	0.22827	0.34711	0.75113	0.48712
{'gini' }		0.52352	0.17526	0.12797	0.19065	0.3936	0.2723
{'min' }		0	1.7008	0.58543	0.58543	0.58543	0
{'max' }		50.789	19.213	4.21	4.9969	54.997	0.92702
{'pYis0' }		0.062608	0	0	0	0	0.062608
{'pYls0' }		0	0	0	0	0	0
{'pYgr0' }		0.93739	1	1	1	1	0.93739
{'pYisMINY' }		0.062608	0.0049772	0.0049772	0.0049772	0.0049772	0.062608
{'pYisMAXY' }		2.9501e-11	2.9501e-11	3.1223e-11	2.9501e-11	2.9501e-11	1.494e-14
{'p0_01' }		0	1.7008	0.58543	0.58543	0.58543	0
{'p0_1' }		0	1.7008	0.58543	0.58543	0.58543	0
{'p1' }		0	2.9492	0.76855	0.62688	0.76855	0
{'p5' }		0	3.4945	0.97884	0.78105	1.009	0
{'p10' }		0.092835	4.1716	1.0603	0.97609	1.223	0.078835
{'p20' }		0.47609	5.1938	1.2588	1.0456	1.7419	0.27652
{'p25' }		0.7311	5.3812	1.3008	1.094	2.0576	0.35312
{'p30' }		0.97803	5.6276	1.351	1.188	2.3618	0.42581
{'p40' }		1.5512	6.3139	1.4528	1.349	3.0158	0.51932
{'p50' }		2.233	6.8328	1.5245	1.4175	3.7588	0.59714
{'p60' }		3.0801	7.416	1.6192	1.5453	4.6604	0.66085
{'p70' }		4.105	8.0461	1.7025	1.7909	5.7649	0.70987
{'p75' }		4.6992	8.4292	1.7544	1.84	6.4292	0.73355
{'p80' }		5.4329	8.7432	1.8159	1.9097	7.3478	0.75277
{'p90' }		7.7004	9.7559	1.9663	2.3407	9.5263	0.79745
{'p95' }		9.7011	10.662	2.1066	2.5036	11.722	0.82522
{'p99' }		14.279	12.148	2.3613	3.1795	16.608	0.85983
{'p99_9' }		19.899	13.734	2.6792	3.5223	22.615	0.8829
{'p99_99' }		25.265	14.885	2.9563	3.7789	28.175	0.8962

```
{'fl_cov_ap'          }        10.603       6.2617       1.0053       1.0453       11.608      0.65544
{'fl_cor_ap'          }             1      0.89408       0.8843      0.60489      0.99896      0.78925
{'fl_cov_v'           }        6.2617        4.626      0.74802      0.96794       7.0097      0.47179
{'fl_cor_v'           }       0.89408            1      0.99613        0.848      0.91325      0.86007
{'fl_cov_c'           }        1.0053      0.74802       0.1219      0.15425       1.1272     0.078595
{'fl_cor_c'           }        0.8843      0.99613            1      0.83252       0.9047      0.88265
{'fl_cov_y'           }        1.0453      0.96794      0.15425      0.28164       1.1995     0.078136
{'fl_cor_y'           }       0.60489        0.848      0.83252            1      0.63337      0.57729
{'fl_cov_coh'         }        11.608       7.0097       1.1272       1.1995       12.735      0.73404
{'fl_cor_coh'         }       0.99896      0.91325       0.9047      0.63337            1       0.8065
{'fl_cov_savefraccoh'}       0.65544      0.47179     0.078595     0.078136      0.73404     0.065046
{'fl_cor_savefraccoh'}       0.78925      0.86007      0.88265      0.57729       0.8065            1
{'fracByP0_01'        }             0     0.001221    0.0019051    0.0019058   0.00061329            0
{'fracByP0_1'         }             0     0.001221    0.0019051    0.0019058   0.00061329            0
{'fracByP1'           }             0     0.011511     0.013437    0.0039104    0.0042425            0
{'fracByP5'           }             0     0.021279     0.026546     0.024488     0.012268            0
{'fracByP10'          }     0.0006892      0.05109     0.059758     0.051739     0.020676    0.0036864
{'fracByP20'          }     0.0099846      0.12278       0.1366      0.12131     0.052438     0.038521
{'fracByP25'          }      0.019425      0.15429      0.17945      0.15485     0.072434     0.070039
{'fracByP30'          }      0.032212      0.19399      0.22206      0.19029     0.094665      0.10974
{'fracByP40'          }        0.0737      0.28144      0.31482      0.27941      0.15063      0.20042
{'fracByP50'          }        0.1321       0.3768      0.41124      0.37234      0.22365      0.30981
{'fracByP60'          }       0.21336      0.48025      0.51513       0.4642      0.31463      0.42631
{'fracByP70'          }        0.3254      0.59015      0.62157      0.57794      0.42288      0.55601
{'fracByP75'          }       0.39769      0.65462      0.67967       0.6363      0.48537      0.62983
{'fracByP80'          }       0.47503      0.71232      0.73844      0.70062      0.56134      0.69967
{'fracByP90'          }       0.67403      0.84445      0.86104      0.82867      0.73331      0.84375
{'fracByP95'          }       0.80886      0.92029      0.92647      0.90776      0.84668      0.92112
{'fracByP99'          }       0.95057      0.98162      0.98401      0.97831      0.96163      0.98352
{'fracByP99_9'        }       0.99336      0.99797      0.99826      0.99778      0.99494      0.99833
{'fracByP99_99'       }       0.99924      0.99979      0.99981      0.99977       0.9994      0.99984
```

Test FF_DS_AZ_CTS_LOOP A grid 300 Shock grid 25

```matlab
mp_support = containers.Map('KeyType','char', 'ValueType','any');
mp_support('bl_timer') = true;
mp_support('ls_ffcmd') = {};
mp_support('ls_ddcmd') = {};
mp_support('ls_ddgrh') = {'faz','fa'};
mp_support('bl_show_stats_table') = true;
mp_params = containers.Map('KeyType','char', 'ValueType','any');
mp_params('it_a_n') = 300;
mp_params('it_z_n') = 25;
ff_ds_az_cts_loop(mp_params, mp_support);
```
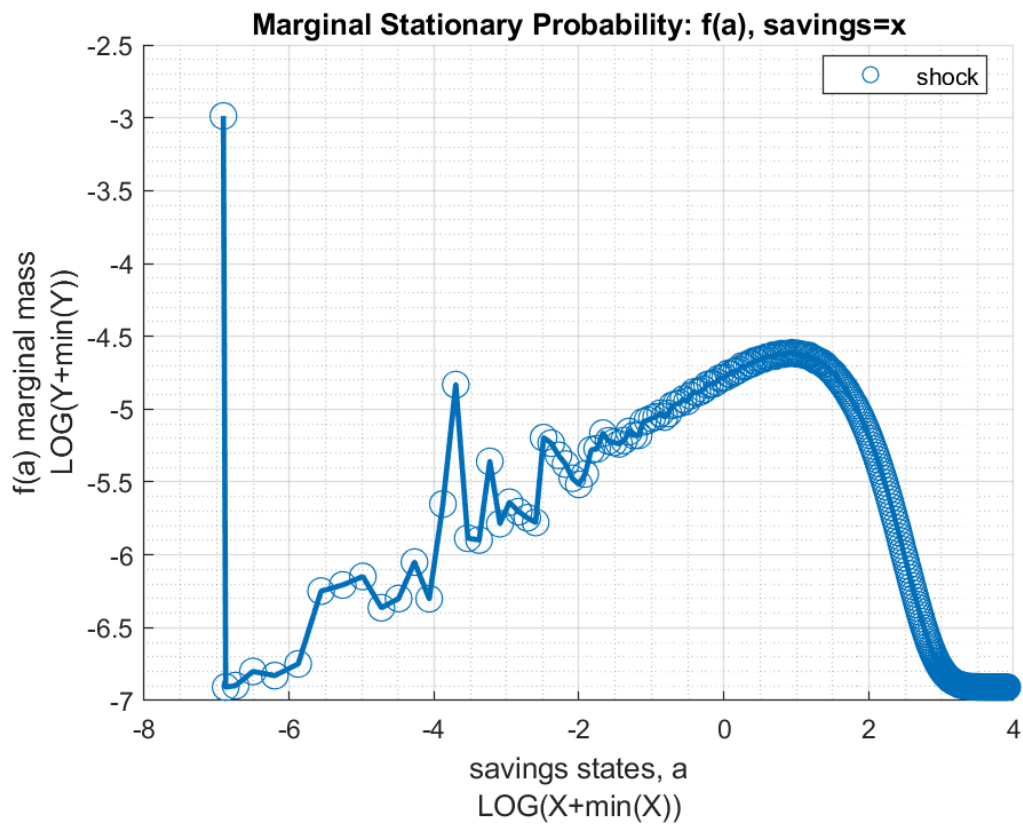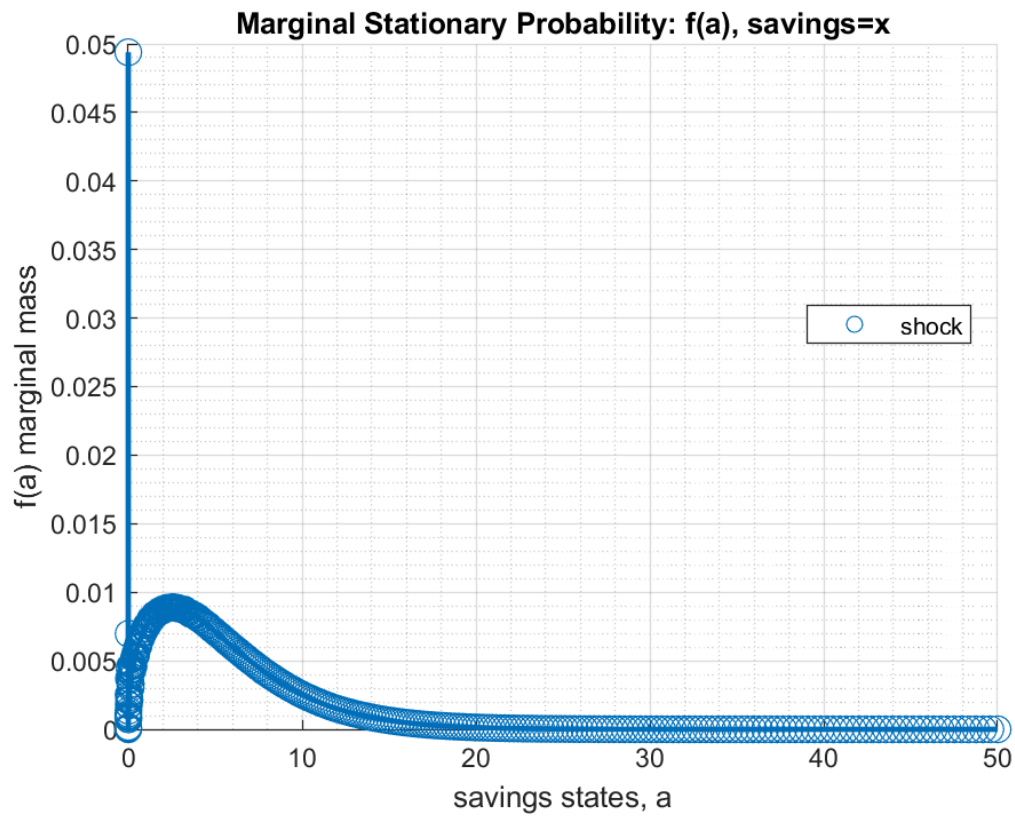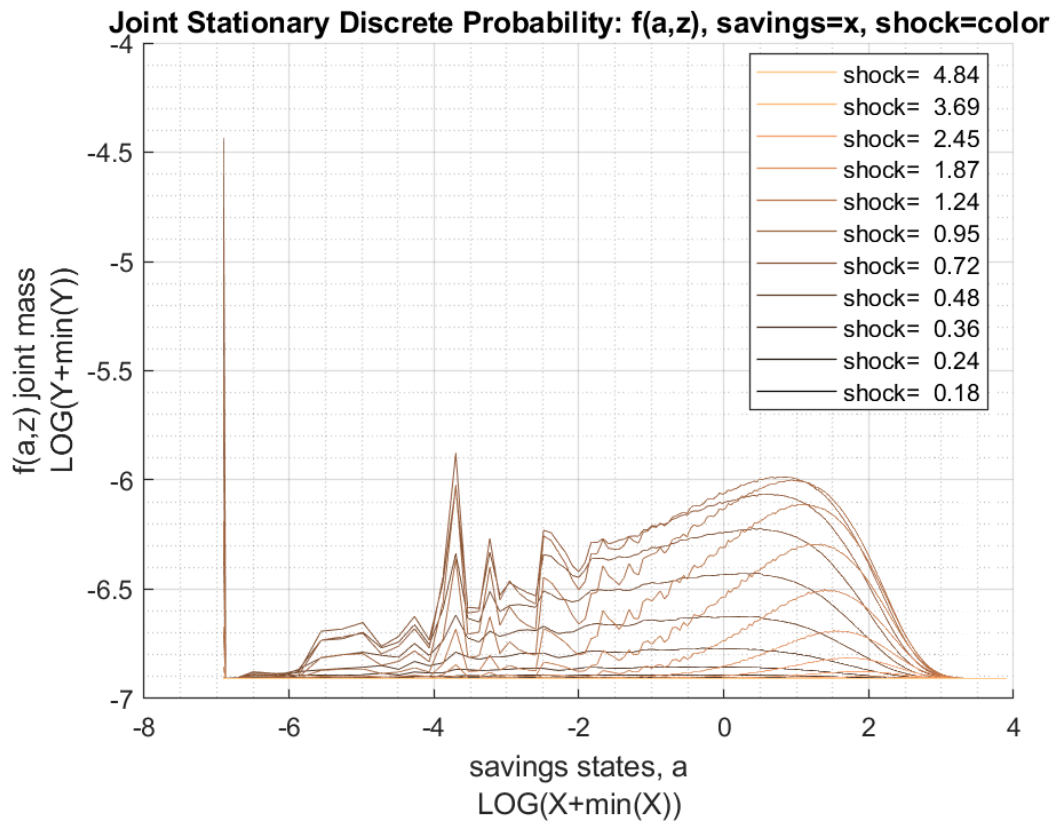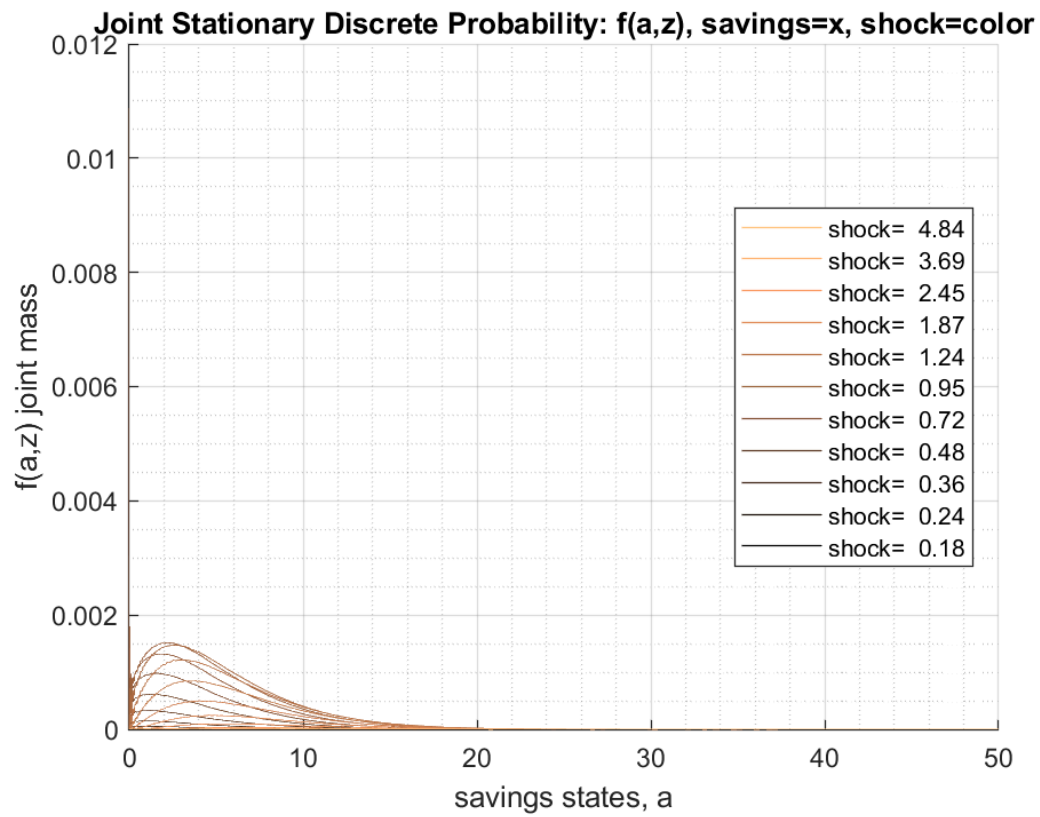
```
Elapsed time is 7.769713 seconds.
FF_DS_AZ_CTS_LOOP finished. Distribution took = 2.2408
```

Marginal Stationary Probability: f(a), savings=x

Marginal Stationary Probability: f(a), savings=x

Joint Stationary Discrete Probability: f(a,z), savings=x, shock=color

Joint Stationary Discrete Probability: f(a,z), savings=x, shock=color

F(a,z), Prob Mass at State-Space as Scatter Size

Legend:
- z = 4.84
- z = 3.69
- z = 2.45
- z = 1.87
- z = 1.24
- z = 0.95
- z = 0.72
- z = 0.48
- z = 0.36
- z = 0.24
- z = 0.18

Axes: shock states, z (vertical); savings states, a (horizontal)
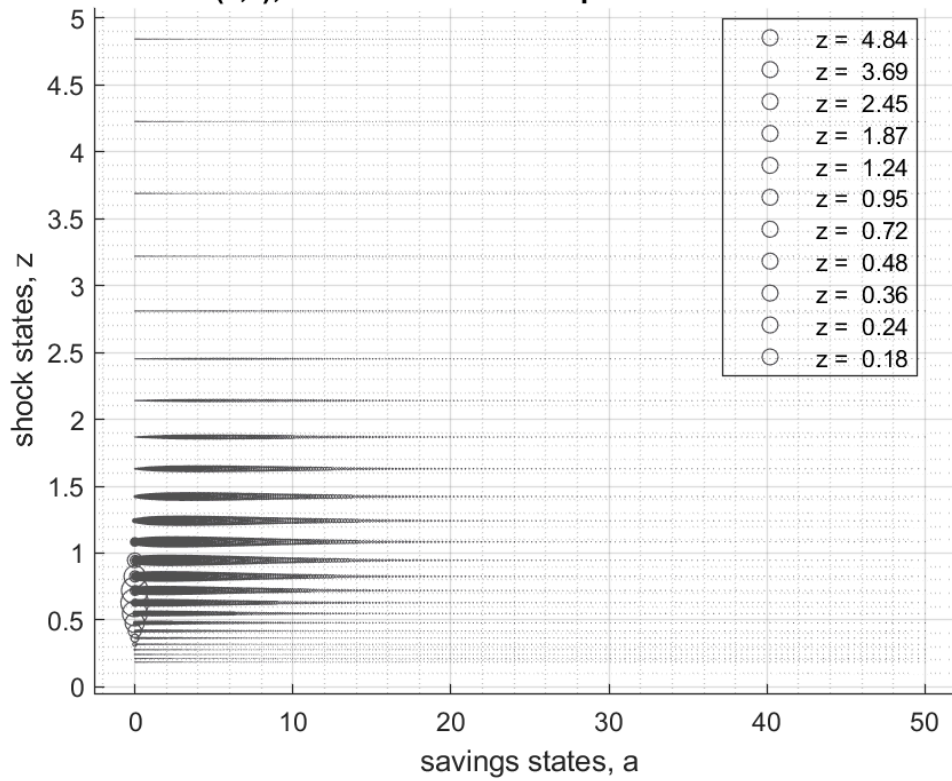
xxx tb_outcomes: all stats xxx

OriginalVariableNames		ap	v	c	y	coh	savefraccoh
{'mean'	}	3.2612	6.9497	1.5318	1.5305	4.793	0.52715
{'unweighted_sum'	}	1.1043e+05	79555	16733	19751	1.2716e+05	3442.8
{'sd'	}	3.3352	2.1663	0.35078	0.5359	3.6495	0.25199
{'coefofvar'	}	1.0227	0.31171	0.229	0.35014	0.76143	0.47803
{'gini'	}	0.52534	0.17597	0.12824	0.19145	0.39608	0.26748
{'min'	}	0	-2.7616	0.25871	0.25871	0.25871	0
{'max'	}	54.451	20.418	4.3301	8.7798	58.78	0.92837
{'pYis0'	}	0.04941	0	0	0	0	0.04941
{'pYls0'	}	0	7.3281e-05	0	0	0	0
{'pYgr0'	}	0.95059	0.99993	1	1	1	0.95059
{'pYisMINY'	}	0.04941	3.1163e-08	3.1163e-08	3.1163e-08	3.1163e-08	0.04941
{'pYisMAXY'	}	2.8477e-13	2.8477e-13	1.121e-13	2.8477e-13	2.8477e-13	3.6157e-25
{'p0_01'	}	0	0.33584	0.44588	0.42374	0.44588	0
{'p0_1'	}	0	1.0287	0.51088	0.51088	0.51088	0
{'p1'	}	0	2.33	0.67226	0.67069	0.67505	0
{'p5'	}	0.0027154	3.5353	0.94151	0.8016	1.0088	0.002787
{'p10'	}	0.11496	4.1978	1.0921	0.9095	1.2356	0.093483
{'p20'	}	0.51133	5.096	1.2504	1.0657	1.779	0.28788
{'p25'	}	0.75298	5.4004	1.3077	1.1577	2.0685	0.36173
{'p30'	}	1.004	5.7312	1.3565	1.1951	2.3792	0.42532
{'p40'	}	1.5834	6.298	1.4458	1.3352	3.0372	0.52408
{'p50'	}	2.2686	6.8433	1.5287	1.441	3.7996	0.59884
{'p60'	}	3.0898	7.4098	1.6132	1.5764	4.6904	0.65811
{'p70'	}	4.0971	8.0297	1.7037	1.7526	5.7899	0.70877
{'p75'	}	4.7228	8.3787	1.7552	1.8223	6.462	0.73135
{'p80'	}	5.4827	8.7742	1.8144	1.9267	7.2769	0.75357
{'p90'	}	7.7718	9.8224	1.9746	2.2406	9.6945	0.79922
{'p95'	}	9.9683	10.704	2.1148	2.5163	12.048	0.82675
{'p99'	}	14.759	12.325	2.3956	3.157	17.176	0.86245
{'p99_9'	}	21.215	14.066	2.7525	3.9803	23.946	0.88686
{'p99_99'	}	27.205	15.415	3.0759	4.7968	30.277	0.90047

```
{'fl_cov_ap'          }          11.123          6.4528          1.0361          1.0808          12.16          0.65691
{'fl_cor_ap'          }               1         0.89313         0.88563         0.60472          0.999          0.78162
{'fl_cov_v'           }          6.4528          4.6928         0.75717         0.98035          7.21          0.46786
{'fl_cor_v'           }         0.89313               1         0.99643         0.84447        0.91198          0.85705
{'fl_cov_c'           }          1.0361         0.75717         0.12304         0.15594         1.1592          0.07767
{'fl_cor_c'           }         0.88563         0.99643               1         0.82954        0.90548          0.87868
{'fl_cov_y'           }          1.0808         0.98035         0.15594         0.28718         1.2368         0.077234
{'fl_cor_y'           }         0.60472         0.84447         0.82954               1        0.63237          0.57192
{'fl_cov_coh'         }          12.16           7.21          1.1592          1.2368         13.319          0.73458
{'fl_cor_coh'         }          0.999         0.91198         0.90548         0.63237              1          0.79876
{'fl_cov_savefraccoh'}         0.65691         0.46786         0.07767        0.077234        0.73458         0.063501
{'fl_cor_savefraccoh'}         0.78162         0.85705         0.87868         0.57192        0.79876               1
{'fracByP0_01'        }               0       7.2341e-06      8.9677e-05      2.5415e-05     2.8657e-05               0
{'fracByP0_1'         }               0      0.00014925      0.00040034      0.00047536     0.00012777               0
{'fracByP1'           }               0       0.0031002        0.004056       0.0057421      0.0012982               0
{'fracByP5'           }      4.4271e-07        0.020663        0.026101        0.023318       0.010275       3.7554e-06
{'fracByP10'          }      0.00081444        0.049128        0.059669        0.051817       0.020124       0.0043579
{'fracByP20'          }        0.010142         0.11647         0.13733          0.1174       0.051401        0.041452
{'fracByP25'          }          0.0197         0.15487         0.17845         0.15395        0.07176         0.07241
{'fracByP30'          }        0.033115         0.19474         0.22243         0.19298       0.095014         0.11033
{'fracByP40'          }         0.07268         0.28138         0.31442         0.27544        0.15079         0.20152
{'fracByP50'          }         0.13241          0.3756         0.41097         0.36527        0.22198         0.30736
{'fracByP60'          }         0.21444         0.47892         0.51282         0.46572        0.31091         0.42746
{'fracByP70'          }           0.323         0.58868         0.62139         0.57261        0.41949         0.55675
{'fracByP75'          }         0.39061          0.6478         0.67743         0.63129        0.48319         0.62572
{'fracByP80'          }         0.46952         0.70943         0.73587          0.6919        0.55532         0.69697
{'fracByP90'          }         0.66831         0.84297         0.85906         0.82754        0.72955         0.84259
{'fracByP95'          }         0.80219         0.91616         0.92541         0.90507        0.84194         0.91979
{'fracByP99'          }         0.94613         0.98125         0.98339         0.97711        0.95822         0.98365
{'fracByP99_9'        }          0.9927          0.9979         0.99812         0.99719        0.99443         0.99831
{'fracByP99_99'       }         0.99909         0.99977         0.99979         0.99967        0.99932         0.99983
```

Test FF_DS_AZ_CTS_LOOP A grid 300 Shock grid 50

```matlab
mp_support = containers.Map('KeyType','char', 'ValueType','any');
mp_support('bl_timer') = true;
mp_support('ls_ffcmd') = {};
mp_support('ls_ddcmd') = {};
mp_support('ls_ddgrh') = {'faz','fa'};
mp_support('bl_show_stats_table') = true;
mp_params = containers.Map('KeyType','char', 'ValueType','any');
mp_params('it_a_n') = 300;
mp_params('it_z_n') = 50;
ff_ds_az_cts_loop(mp_params, mp_support);
```
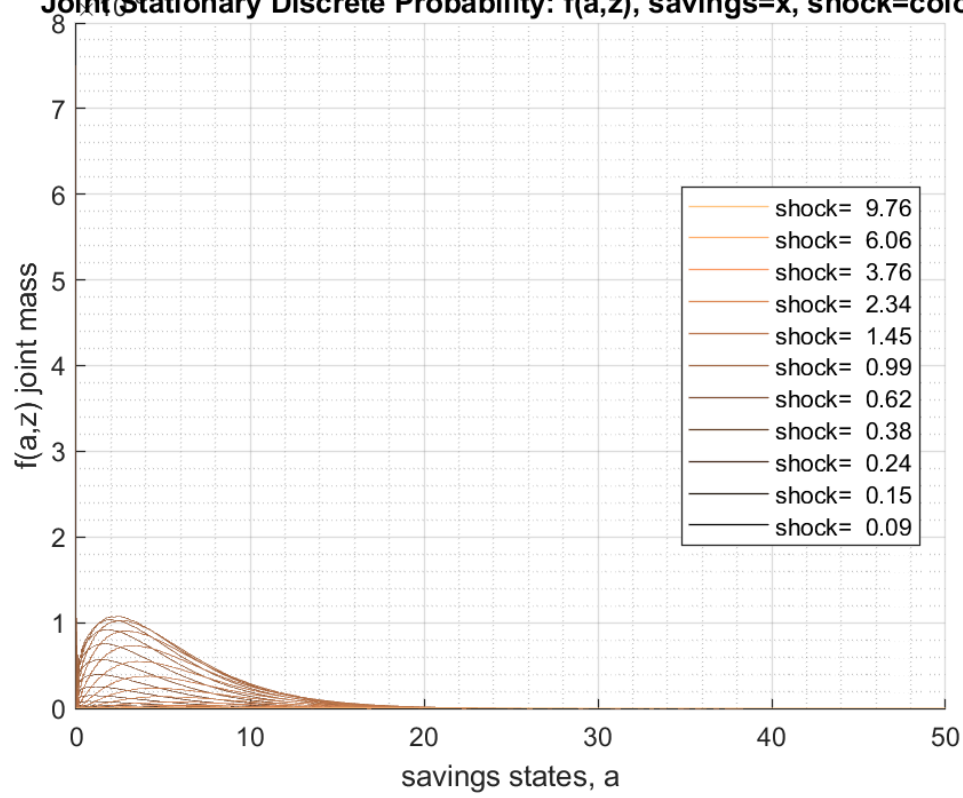
```
Elapsed time is 13.966894 seconds.
FF_DS_AZ_CTS_LOOP finished. Distribution took = 5.0619
```
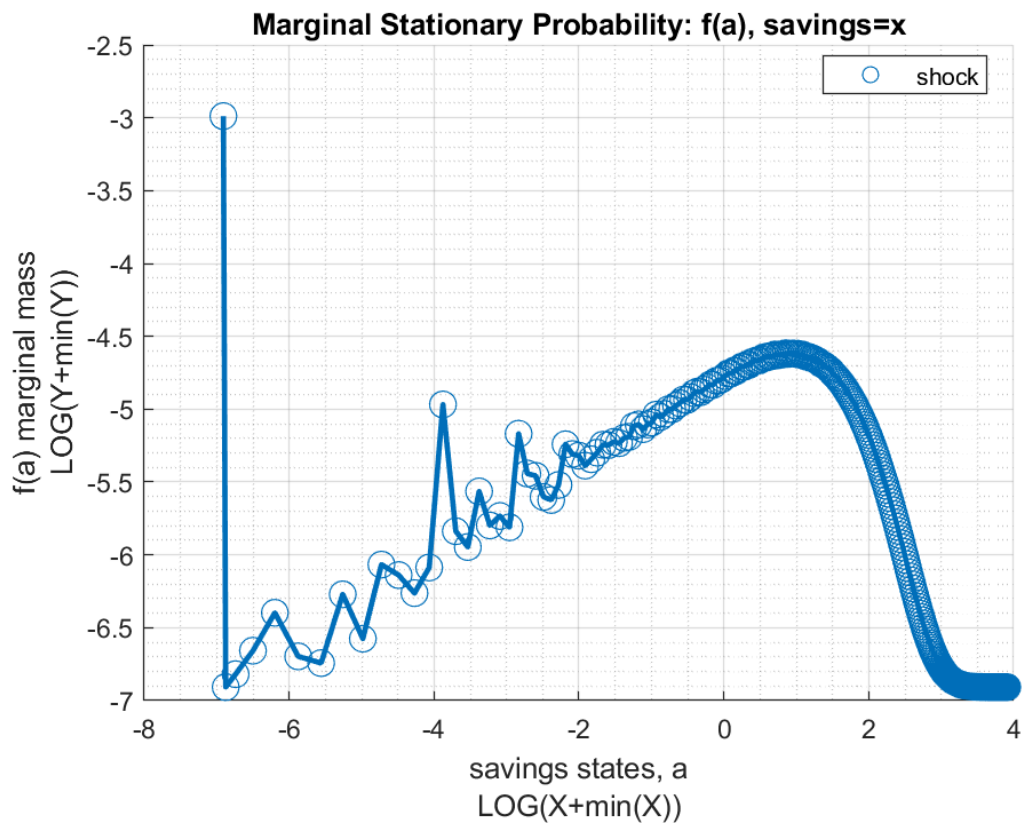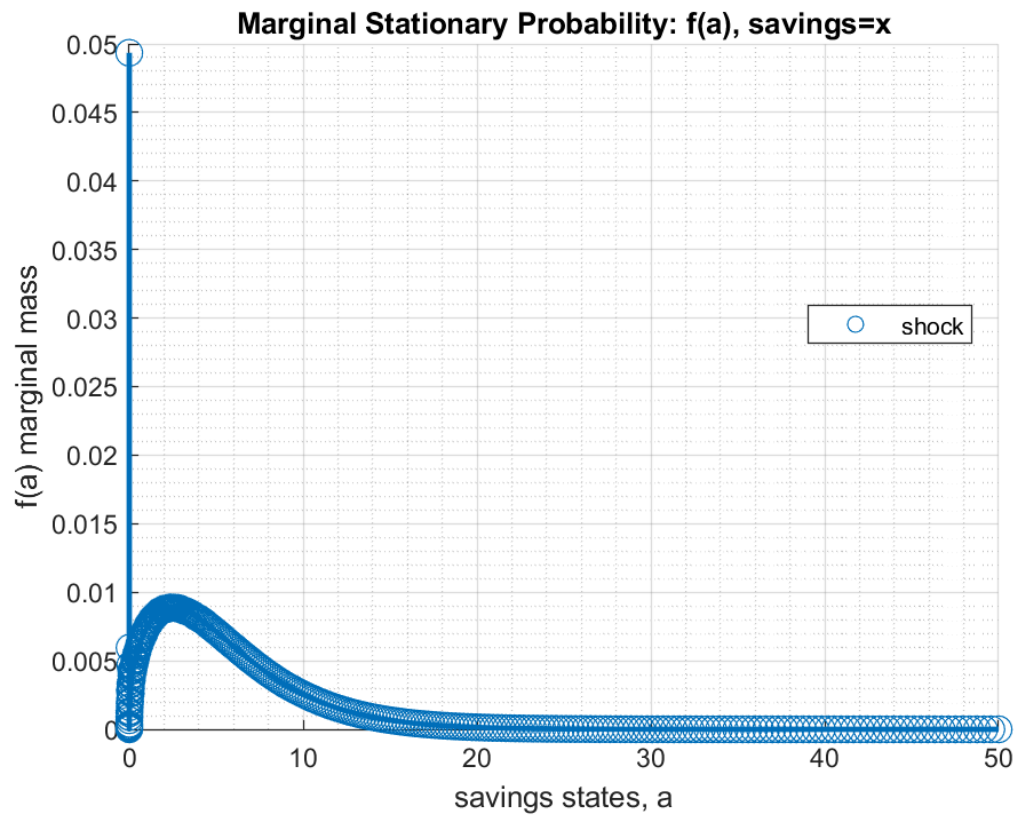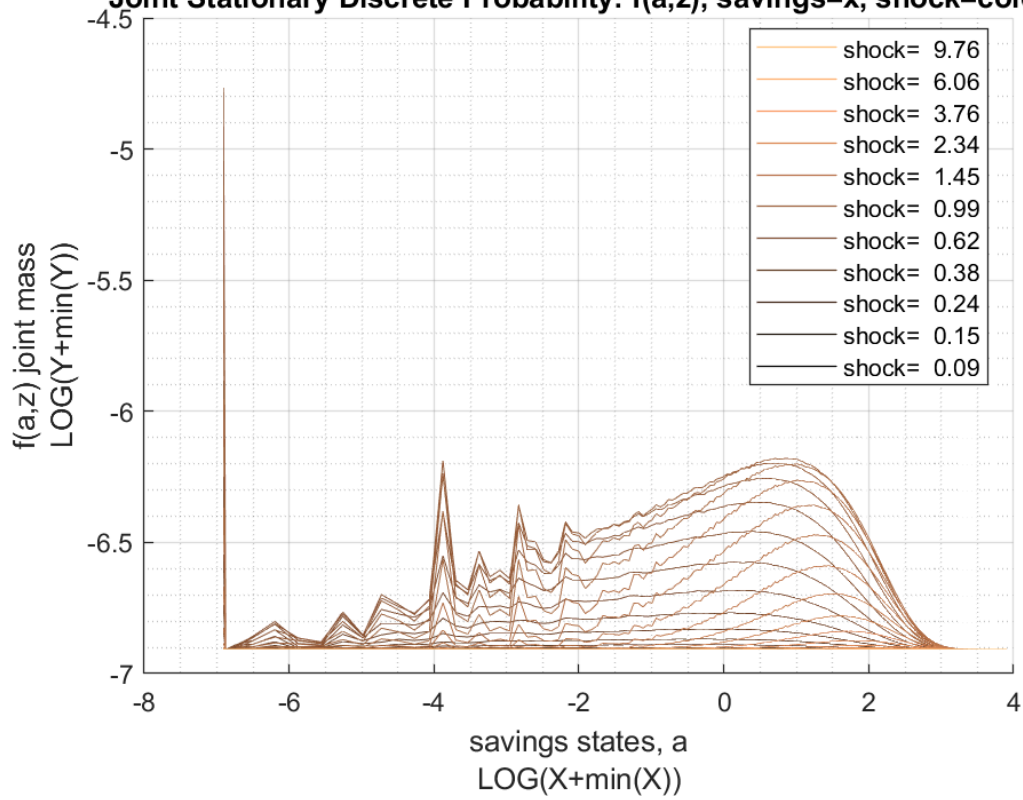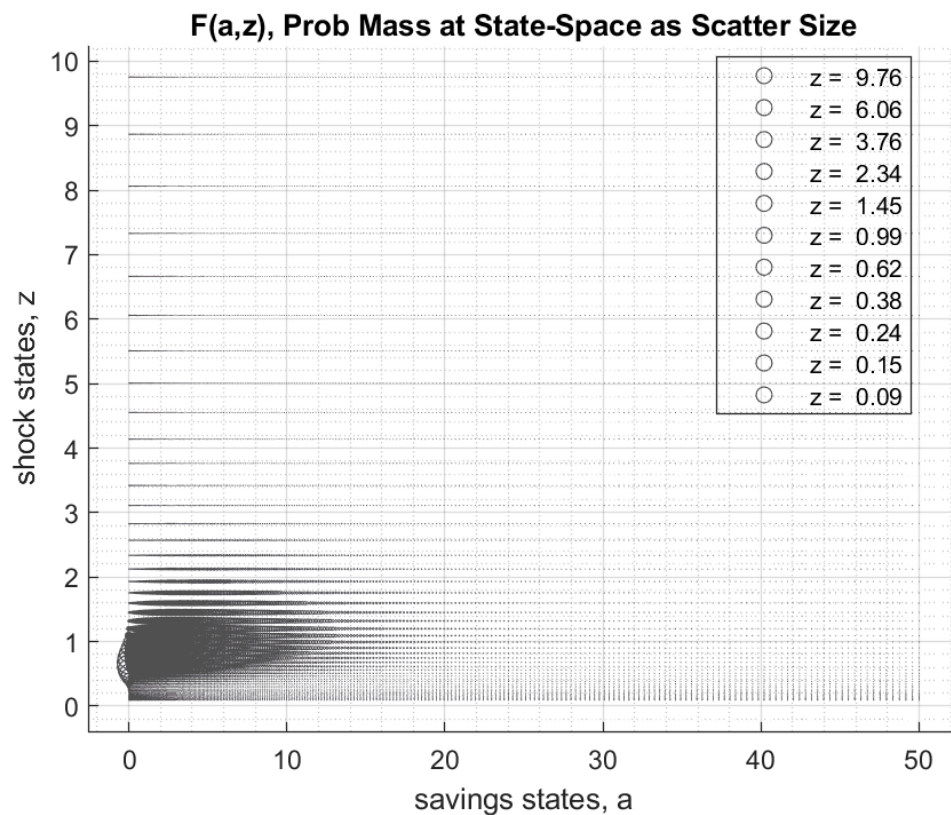
Marginal Stationary Probability: f(a), savings=x

Marginal Stationary Probability: f(a), savings=x

Joint Stationary Discrete Probability: f(a,z), savings=x, shock=color

Joint Stationary Discrete Probability: f(a,z), savings=x, shock=color

F(a,z), Prob Mass at State-Space as Scatter Size

xxx tb_outcomes: all stats xxx

OriginalVariableNames		ap	v	c	y	coh	savefraccoh
{'mean'	}	3.2794	6.957	1.5328	1.5312	4.8122	0.52801
{'unweighted_sum'	}	2.3346e+05	1.6237e+05	34668	53309	2.6813e+05	5324.8
{'sd'	}	3.3623	2.1722	0.35142	0.53693	3.6772	0.25195
{'coefofvar'	}	1.0253	0.31224	0.22927	0.35065	0.76415	0.47717
{'gini'	}	0.52595	0.17618	0.12829	0.19144	0.3969	0.26705
{'min'	}	0	-7.6866	0.12843	0.12843	0.12843	0
{'max'	}	61.275	22.164	4.3849	15.657	65.657	0.93325
{'pYis0'	}	0.049376	0	0	0	0	0.049376
{'pYls0'	}	0	0.00011917	0	0	0	0
{'pYgr0'	}	0.95062	0.99988	1	1	1	0.95062
{'pYisMINY'	}	0.049376	1.1048e-15	1.1048e-15	1.1048e-15	1.1048e-15	0.049376
{'pYisMAXY'	}	1.584e-18	1.584e-18	5.0847e-19	1.584e-18	1.584e-18	1.584e-18
{'p0_01'	}	0	-0.20427	0.40271	0.40271	0.40271	0
{'p0_1'	}	0	1.2141	0.53589	0.48816	0.53589	0
{'p1'	}	0	2.3693	0.71312	0.64833	0.71312	0
{'p5'	}	0.001023	3.5435	0.94895	0.80724	0.96945	0.0010781
{'p10'	}	0.11645	4.2417	1.0917	0.93681	1.2501	0.095192
{'p20'	}	0.50875	5.08	1.2515	1.072	1.7735	0.2902
{'p25'	}	0.75899	5.4247	1.3061	1.1504	2.0649	0.36356
{'p30'	}	1.0156	5.7325	1.3564	1.2011	2.3741	0.42667
{'p40'	}	1.6036	6.2932	1.4459	1.3198	3.0387	0.52518
{'p50'	}	2.2768	6.8406	1.5297	1.4423	3.8053	0.59933
{'p60'	}	3.0945	7.4051	1.6122	1.5771	4.7002	0.6586
{'p70'	}	4.113	8.0338	1.7042	1.7334	5.8225	0.70999
{'p75'	}	4.7604	8.3794	1.7554	1.8278	6.4985	0.73226
{'p80'	}	5.5142	8.7771	1.8143	1.9295	7.3239	0.75424
{'p90'	}	7.8048	9.8378	1.9756	2.2476	9.7629	0.80013
{'p95'	}	10.007	10.714	2.1161	2.5336	12.107	0.82766
{'p99'	}	14.9	12.348	2.407	3.1578	17.285	0.86312
{'p99_9'	}	21.501	14.13	2.7694	4.0322	24.216	0.88766
{'p99_99'	}	27.735	15.514	3.1037	4.8946	30.851	0.90127

{'fl_cov_ap' }	11.305	6.5234	1.0466	1.0907	12.352	0.66084
{'fl_cor_ap' }	1	0.89316	0.88579	0.60415	0.99902	0.78009
{'fl_cov_v' }	6.5234	4.7186	0.76066	0.98362	7.2841	0.46879
{'fl_cor_v' }	0.89316	1	0.99645	0.84334	0.9119	0.85658
{'fl_cov_c' }	1.0466	0.76066	0.1235	0.15645	1.1701	0.077707
{'fl_cor_c' }	0.88579	0.99645	1	0.82914	0.9055	0.87766
{'fl_cov_y' }	1.0907	0.98362	0.15645	0.2883	1.2471	0.0772
{'fl_cor_y' }	0.60415	0.84334	0.82914	1	0.63165	0.57067
{'fl_cov_coh' }	12.352	7.2841	1.1701	1.2471	13.522	0.73855
{'fl_cor_coh' }	0.99902	0.9119	0.9055	0.63165	1	0.79716
{'fl_cov_savefraccoh'}	0.66084	0.46879	0.077707	0.0772	0.73855	0.063478
{'fl_cor_savefraccoh'}	0.78009	0.85658	0.87766	0.57067	0.79716	1
{'fracByP0_01' }	0	-7.0657e-06	2.6272e-05	3.0716e-05	8.3673e-06	0
{'fracByP0_1' }	0	8.1733e-05	0.00058172	0.0003	0.00018482	0
{'fracByP1' }	0	0.0025825	0.0055755	0.0043105	0.0017358	0
{'fracByP5' }	1.3446e-07	0.020553	0.028388	0.023343	0.0084443	1.165e-06
{'fracByP10' }	0.00082822	0.048923	0.059616	0.051792	0.020041	0.0045383
{'fracByP20' }	0.010119	0.11678	0.1368	0.1176	0.051426	0.041679
{'fracByP25' }	0.019764	0.15445	0.17846	0.15402	0.071298	0.07291
{'fracByP30' }	0.033198	0.19437	0.22195	0.19279	0.094487	0.11072
{'fracByP40' }	0.072799	0.28088	0.31405	0.27516	0.15079	0.20093
{'fracByP50' }	0.13186	0.37535	0.41129	0.36559	0.22202	0.30846
{'fracByP60' }	0.21318	0.47748	0.51316	0.46495	0.30966	0.42828
{'fracByP70' }	0.32222	0.58845	0.62103	0.57307	0.41837	0.55682
{'fracByP75' }	0.39045	0.64744	0.67785	0.63075	0.48233	0.62537
{'fracByP80' }	0.46786	0.7092	0.73555	0.69205	0.55399	0.69588
{'fracByP90' }	0.66756	0.84275	0.8587	0.82726	0.72947	0.84385
{'fracByP95' }	0.80166	0.91607	0.92521	0.90478	0.84112	0.91991
{'fracByP99' }	0.94602	0.98111	0.98335	0.97699	0.95791	0.98349
{'fracByP99_9' }	0.99264	0.99789	0.9981	0.99714	0.99438	0.99831
{'fracByP99_99' }	0.99908	0.99977	0.99979	0.99966	0.9993	0.99983