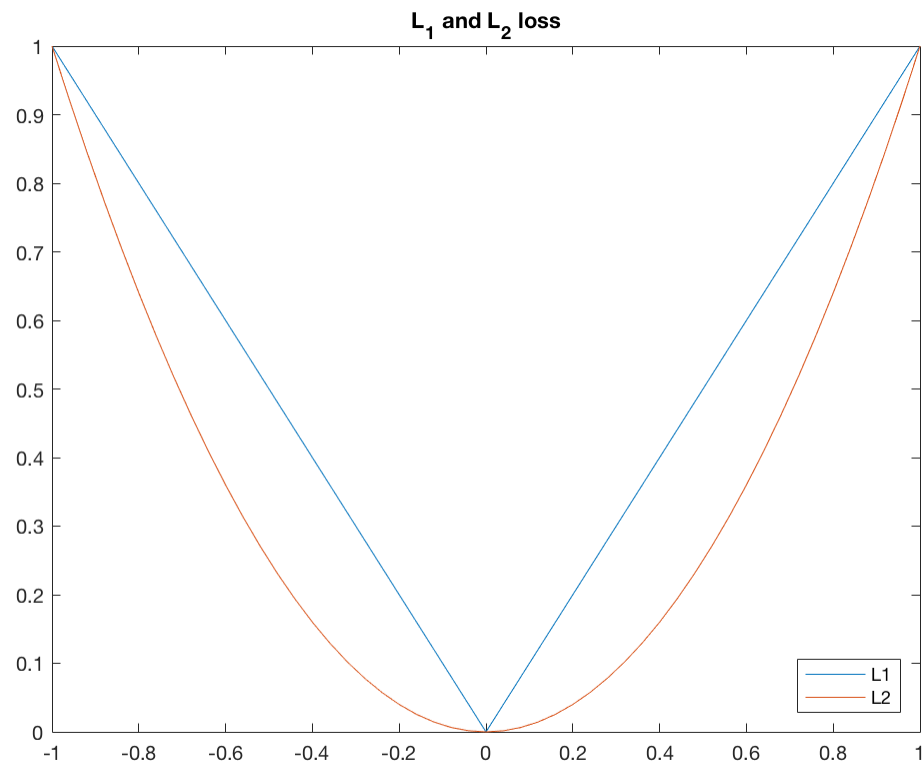
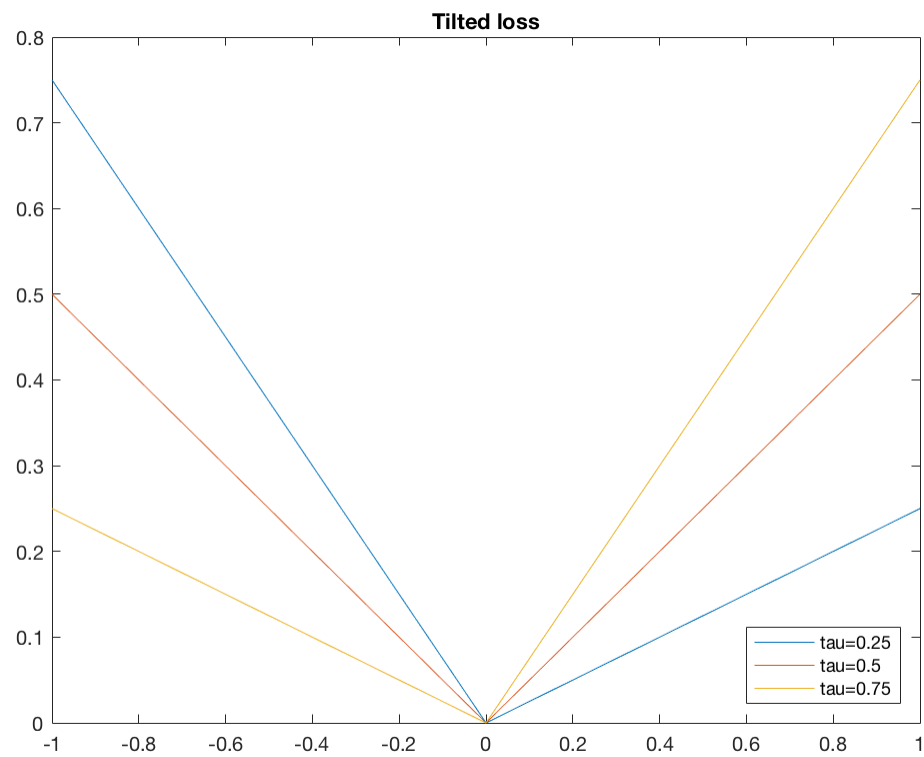

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Visualize tilted loss

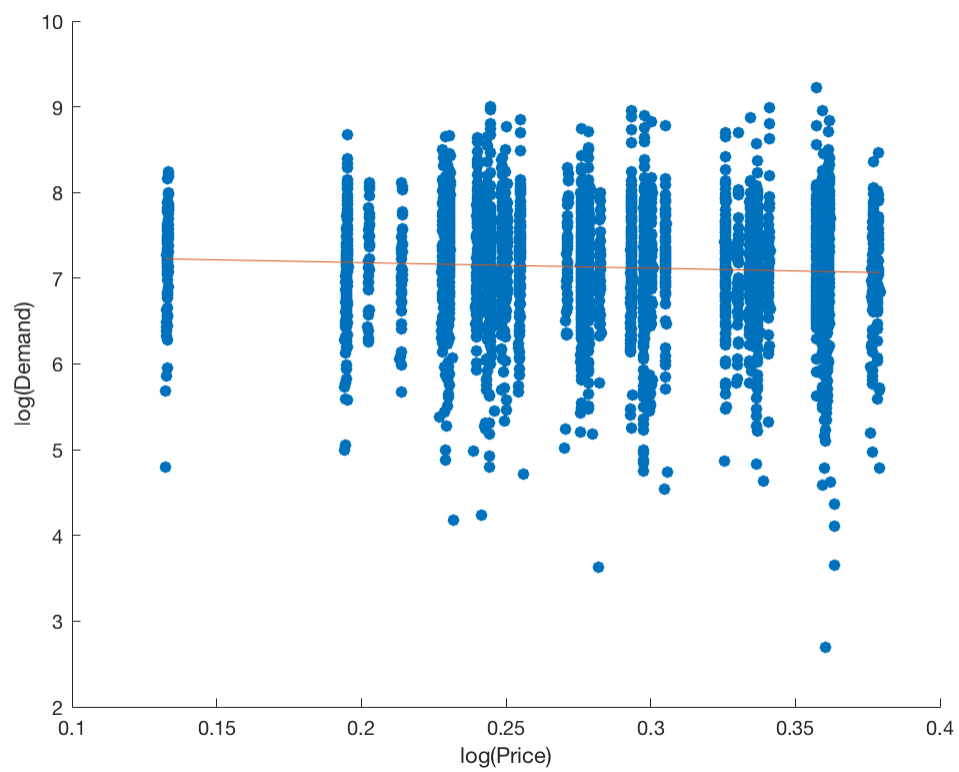
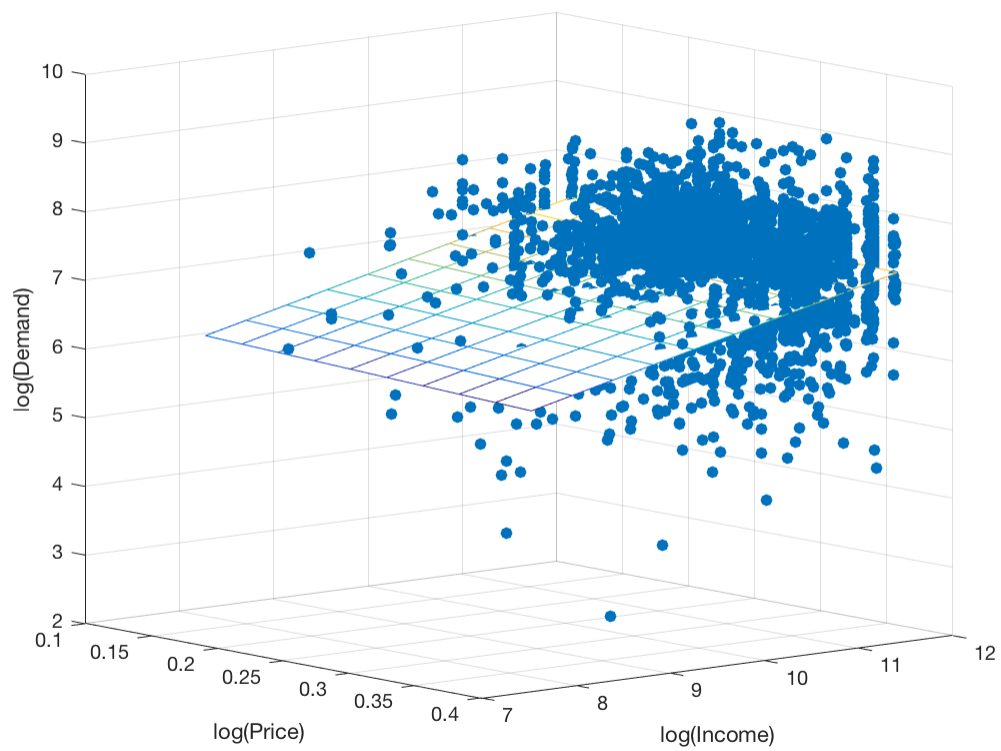
```
clear;  
loss_vis;
```

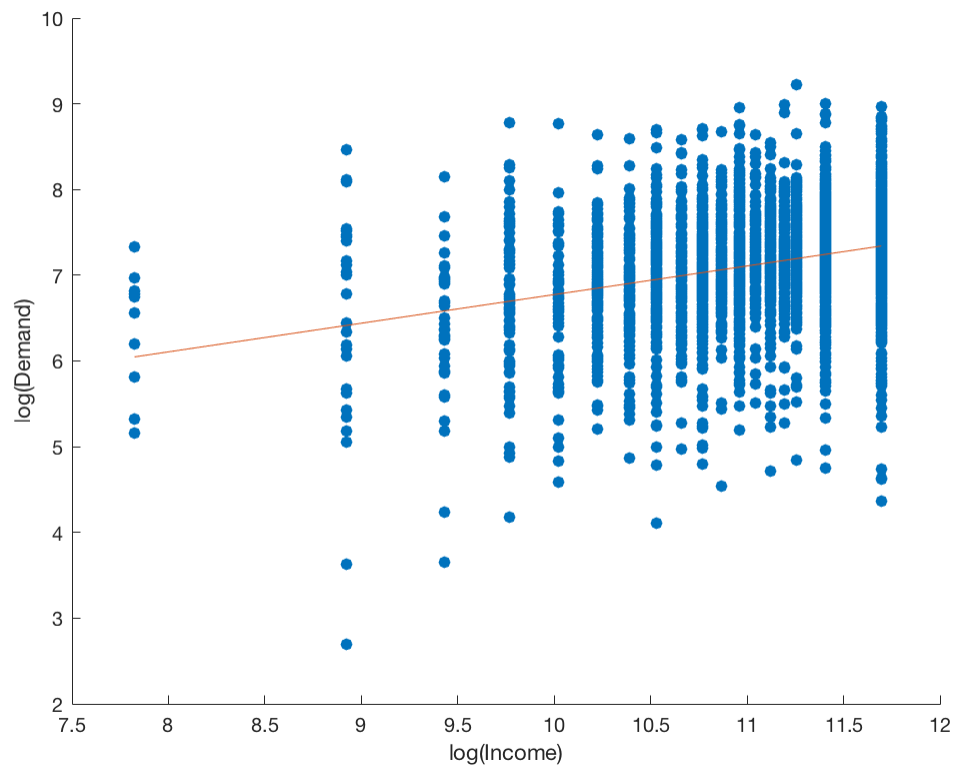




Visualize mean gasoline demand

```
prelim;
```





Compare optimization methods on subset of data

```
clear;
startup;
load(' ../data/data_BHP2.mat');
data=[log_q log_p log_y];

n_obs=100;
rng(3);
sample=datasample(data,n_obs,'Replace',false);
y=sample(:,1);
x1=sample(:,2);
x2=sample(:,3);

len=100;
quantiles = [0.25 0.50 0.75];
optimizers = {'sd','bb','pr','lbfgs'};

for idq = 1:length(quantiles)

    quantileToPredict=quantiles(idq);

    tic;
```

```

figure;
for ido = 1:length(optimizers)

    optimizer=optimizers{ido};
    fprintf('quantile: %3.2f optimizer: %s
\n',quantileToPredict,optimizer);

[~,~,~,~,~,output]=save_quantile(quantileToPredict,len,optimizer,x1,x2,y);

    param_path=output.trace.param_path;
    n_iter=output.iterations;

    subplot(2,2,ido);

scatter3(param_path(1,:),param_path(2,:),param_path(4,:), 'filled');
line(param_path(1,:),param_path(2,:),param_path(4,:));
title(strcat(optimizers{ido}, ': ',num2str(n_iter)));
xlabel('log(\theta_{price})');
ylabel('log(\theta_{income})');
zlabel('log(\sigma)');
view(30,30);

end

toc;

end

```

executing gpml startup script...

quantile: 0.25 optimizer: sd

Iteration	FunEvals	Step Length	Function Val	Opt Cond
1	2	6.92700e-03	1.69932e+02	6.62074e+01
2	3	1.97241e-02	1.11917e+02	1.24962e+01
3	5	2.70896e-02	1.11399e+02	1.92385e+01
4	6	2.54993e-03	1.10458e+02	1.53123e+01
5	7	6.96442e-03	1.09062e+02	6.09225e+00
6	9	1.89755e-02	1.08379e+02	5.01653e+00
7	10	2.56888e-02	1.07887e+02	7.51618e+00
8	11	1.26733e-02	1.07328e+02	4.25269e+00
9	12	5.06366e-02	1.06564e+02	5.75489e+00
10	14	1.47653e-02	1.06211e+02	3.54331e+00
11	15	3.71269e-02	1.05921e+02	6.20252e+00
12	16	1.19583e-02	1.05600e+02	2.99673e+00
13	17	6.24450e-02	1.05183e+02	4.39722e+00
14	19	1.28502e-02	1.05026e+02	1.97415e+00
15	20	5.76426e-02	1.04928e+02	4.79466e+00
16	21	7.78251e-03	1.04799e+02	1.27165e+00
17	23	2.24187e-02	1.04758e+02	1.48974e+00
18	24	2.07161e-02	1.04726e+02	1.54831e+00
19	25	1.69102e-02	1.04696e+02	1.01617e+00
20	26	2.65155e-02	1.04674e+02	1.62652e+00
21	27	1.23555e-02	1.04649e+02	7.60127e-01

22	28	4.86995e-02	1.04615e+02	1.26437e+00
23	30	1.42525e-02	1.04599e+02	5.64560e-01
24	31	3.77119e-02	1.04585e+02	1.34472e+00
25	32	1.18990e-02	1.04570e+02	4.64679e-01
26	33	5.78517e-02	1.04551e+02	1.02367e+00
27	35	1.34848e-02	1.04541e+02	3.75860e-01
28	36	4.34249e-02	1.04533e+02	1.06699e+00
29	37	1.16942e-02	1.04524e+02	3.51461e-01
30	38	6.26412e-02	1.04512e+02	7.90199e-01
31	40	1.34242e-02	1.04506e+02	3.20308e-01
32	41	4.37414e-02	1.04501e+02	8.17437e-01
33	42	1.19750e-02	1.04496e+02	2.98469e-01
34	43	5.91347e-02	1.04489e+02	6.78311e-01
35	44	2.25380e-02	1.04488e+02	8.26487e-01
36	45	4.40861e-03	1.04485e+02	4.66385e-01
37	46	1.71621e-02	1.04482e+02	3.19930e-01
38	47	2.40405e-02	1.04480e+02	4.38242e-01
39	48	1.49136e-02	1.04478e+02	2.48393e-01
40	49	3.24351e-02	1.04475e+02	4.49361e-01
41	50	1.61032e-02	1.04473e+02	2.61528e-01
42	51	2.72520e-02	1.04472e+02	4.41192e-01
43	52	1.21816e-02	1.04470e+02	2.21658e-01
44	53	4.51275e-02	1.04467e+02	3.02489e-01
45	55	1.74738e-02	1.04465e+02	2.16331e-01
46	56	2.49227e-02	1.04464e+02	3.15014e-01
47	57	1.64183e-02	1.04463e+02	1.93481e-01
48	58	2.71187e-02	1.04462e+02	3.22885e-01
49	59	1.49818e-02	1.04460e+02	1.83064e-01
50	60	3.22306e-02	1.04459e+02	3.31809e-01
51	61	1.47623e-02	1.04458e+02	1.72152e-01
52	62	3.34743e-02	1.04457e+02	3.44009e-01
53	63	1.21431e-02	1.04456e+02	1.62232e-01
54	64	4.88429e-02	1.04455e+02	2.55344e-01
55	66	1.53912e-02	1.04454e+02	1.48993e-01
56	67	3.05833e-02	1.04453e+02	2.62841e-01
57	68	1.44870e-02	1.04452e+02	1.40590e-01
58	69	3.47382e-02	1.04452e+02	2.69512e-01
59	70	1.37384e-02	1.04451e+02	1.31957e-01
60	71	3.96743e-02	1.04450e+02	2.74592e-01
61	72	1.32022e-02	1.04450e+02	1.23184e-01
62	73	4.48973e-02	1.04449e+02	2.80392e-01
63	74	1.22410e-02	1.04449e+02	1.14306e-01
64	75	5.56127e-02	1.04448e+02	2.56241e-01
65	76	1.71859e-02	1.04447e+02	1.76159e-01
66	77	1.93822e-02	1.04447e+02	1.60110e-01
67	78	1.62772e-02	1.04447e+02	9.93519e-02
68	79	2.74421e-02	1.04446e+02	1.63348e-01
69	80	1.49391e-02	1.04446e+02	9.40745e-02
70	81	3.24553e-02	1.04446e+02	1.67318e-01
71	82	1.49353e-02	1.04446e+02	8.85148e-02
72	83	3.26312e-02	1.04445e+02	1.72990e-01
73	84	1.20853e-02	1.04445e+02	8.35720e-02
74	85	4.84416e-02	1.04445e+02	1.22734e-01
75	87	1.61458e-02	1.04444e+02	7.69462e-02

76	88	2.80522e-02	1.04444e+02	1.26605e-01
77	89	1.52320e-02	1.04444e+02	7.28497e-02
78	90	3.11962e-02	1.04444e+02	1.30255e-01
79	91	1.42033e-02	1.04444e+02	6.87616e-02
80	92	3.61791e-02	1.04444e+02	1.32030e-01
81	93	1.43081e-02	1.04443e+02	6.45006e-02
82	94	3.64459e-02	1.04443e+02	1.38613e-01
83	95	1.08422e-02	1.04443e+02	6.07279e-02
84	96	5.70973e-02	1.04443e+02	5.64268e-02
85	98	3.56150e-02	1.04443e+02	1.05613e-01
86	99	1.48935e-02	1.04443e+02	5.29461e-02
87	100	3.31301e-02	1.04442e+02	1.10176e-01
88	101	1.05532e-02	1.04442e+02	5.01463e-02
89	103	5.46454e-01	1.04441e+02	2.11452e-01
90	105	1.02953e-02	1.04441e+02	1.64434e-02
91	107	4.95981e-01	1.04441e+02	9.46873e-02
92	109	1.02800e-02	1.04441e+02	7.49787e-03
93	111	4.62312e-01	1.04441e+02	3.79875e-02
94	113	1.03635e-02	1.04441e+02	4.30882e-03
95	115	2.12399e-01	1.04441e+02	1.35668e-02
96	117	1.07590e-02	1.04441e+02	2.81447e-03
97	118	1.87244e-01	1.04441e+02	1.33575e-02
98	119	8.05925e-03	1.04441e+02	2.77934e-03
99	121	1.75428e-02	1.04441e+02	2.02505e-03
100	122	2.47430e-02	1.04441e+02	2.88648e-03

Reached Maximum Number of Iterations

quantile: 0.25 optimizer: bb

Iteration	FunEvals	Step Length	Function Val	Opt Cond
1	2	6.92641e-03	1.69932e+02	6.62065e+01
2	3	1.00000e+00	1.12265e+02	1.62592e+01
3	4	1.00000e+00	1.10486e+02	1.13394e+01
4	5	1.00000e+00	1.09284e+02	5.47587e+00
5	6	1.00000e+00	1.08838e+02	5.20040e+00
6	7	1.00000e+00	1.07204e+02	4.17414e+00
7	8	1.00000e+00	1.05327e+02	2.60681e+00
8	9	1.00000e+00	1.06899e+02	1.91811e+01
9	10	1.00000e+00	1.04735e+02	1.37867e+00
10	11	1.00000e+00	1.04709e+02	9.34959e-01
11	12	1.00000e+00	1.04696e+02	8.89478e-01
12	13	1.00000e+00	1.04663e+02	7.73757e-01
13	14	1.00000e+00	1.04508e+02	3.71447e-01
14	15	1.00000e+00	1.04585e+02	4.78329e+00
15	16	1.00000e+00	1.04465e+02	4.55773e-01
16	17	1.00000e+00	1.04463e+02	2.21013e-01
17	18	1.00000e+00	1.04462e+02	2.17227e-01
18	19	1.00000e+00	1.04459e+02	1.94369e-01
19	20	1.00000e+00	1.04444e+02	8.23228e-02
20	21	1.00000e+00	1.04467e+02	2.15528e+00
21	22	1.00000e+00	1.04443e+02	3.79923e-01
22	23	1.00000e+00	1.04442e+02	1.12342e-01
23	24	1.00000e+00	1.04442e+02	1.04151e-01
24	25	1.00000e+00	1.04441e+02	2.28273e-02
25	26	1.00000e+00	1.04441e+02	1.28517e-02
26	27	1.00000e+00	1.04441e+02	4.97922e-02

27	28	1.00000e+00	1.04441e+02	1.37676e-02
28	29	1.00000e+00	1.04441e+02	1.02201e-02
29	30	1.00000e+00	1.04441e+02	1.00975e-02
30	31	1.00000e+00	1.04441e+02	2.25406e-04
31	32	1.00000e+00	1.04441e+02	1.07743e-02
32	33	1.00000e+00	1.04441e+02	1.37591e-03
33	34	1.00000e+00	1.04441e+02	4.87745e-04
34	35	1.00000e+00	1.04441e+02	4.54146e-04
35	36	1.00000e+00	1.04441e+02	6.47206e-05

Directional Derivative below progTol

quantile: 0.25 optimizer: pr

Iteration	FunEvals	Step Length	Function Val	Opt Cond
1	3	2.42817e-02	1.10019e+02	9.81104e+00
2	5	6.73594e-01	1.09106e+02	5.47947e+00
3	7	2.31626e+00	1.08311e+02	1.36652e+01
4	9	1.88099e+00	1.06830e+02	1.89232e+01
5	12	1.75396e+00	1.04575e+02	1.33551e+00
6	14	3.45236e+00	1.04559e+02	3.64264e-01
7	16	5.43103e+00	1.04553e+02	1.09621e+00
8	20	5.82728e+00	1.04457e+02	4.22824e-01
9	22	4.37218e-02	1.04456e+02	4.18929e-01
10	24	2.12925e-02	1.04456e+02	4.04474e-01
11	27	5.87658e-01	1.04450e+02	3.55708e-01
12	29	1.36550e+00	1.04442e+02	3.21872e-01
13	30	1.00000e+00	1.04441e+02	2.79682e-02
14	32	1.67725e+00	1.04441e+02	6.97641e-02
15	34	1.54529e+00	1.04441e+02	8.86497e-02
16	35	1.00000e+00	1.04441e+02	3.74191e-02
17	36	1.00000e+00	1.04441e+02	1.62323e-03
18	37	1.00000e+00	1.04441e+02	3.34584e-03
19	38	1.00000e+00	1.04441e+02	2.55160e-04
20	39	1.00000e+00	1.04441e+02	2.78339e-05

Function Value changing by less than progTol

quantile: 0.25 optimizer: lbfgs

Iteration	FunEvals	Step Length	Function Val	Opt Cond
1	2	6.92665e-03	1.69932e+02	6.62054e+01
2	4	4.38397e-01	1.18191e+02	3.11972e+01
3	5	1.00000e+00	1.13088e+02	1.32454e+01
4	6	1.00000e+00	1.10751e+02	7.02282e+00
5	7	1.00000e+00	1.08499e+02	4.93279e+00
6	8	1.00000e+00	1.07001e+02	4.20058e+00
7	9	1.00000e+00	1.04696e+02	2.32365e+00
8	10	1.00000e+00	1.04498e+02	4.33450e-01
9	11	1.00000e+00	1.04472e+02	2.76661e-01
10	12	1.00000e+00	1.04458e+02	3.18420e-01
11	13	1.00000e+00	1.04445e+02	2.39679e-01
12	14	1.00000e+00	1.04441e+02	6.70261e-02
13	15	1.00000e+00	1.04441e+02	8.40993e-03
14	16	1.00000e+00	1.04441e+02	4.78155e-03
15	17	1.00000e+00	1.04441e+02	6.38816e-03
16	18	1.00000e+00	1.04441e+02	1.67600e-03
17	19	1.00000e+00	1.04441e+02	1.53591e-04

Directional Derivative below progTol

Elapsed time is 11.373777 seconds.

quantile: 0.50 optimizer: sd

Iteration	FunEvals	Step Length	Function Val	Opt Cond
1	2	6.17213e-03	1.55419e+02	6.19389e+01
2	3	2.08143e-02	1.08405e+02	2.74445e+01
3	5	1.27819e-02	1.04860e+02	9.36039e+00
4	7	1.53604e-02	1.03829e+02	4.85910e+00
5	8	4.06607e-02	1.03357e+02	1.17146e+01
6	9	6.05949e-03	1.02635e+02	5.39698e+00
7	11	1.62360e-02	1.02250e+02	3.55178e+00
8	12	3.08253e-02	1.01928e+02	5.96502e+00
9	13	1.30090e-02	1.01569e+02	3.35726e+00
10	14	4.61752e-02	1.01084e+02	5.00512e+00
11	15	2.58567e-02	1.00929e+02	7.83953e+00
12	16	4.21138e-03	1.00677e+02	4.39764e+00
13	17	1.61664e-02	1.00429e+02	3.11330e+00
14	18	2.72559e-02	1.00196e+02	4.47608e+00
15	19	1.54840e-02	9.99761e+01	2.77153e+00
16	20	2.94736e-02	9.97987e+01	4.64930e+00
17	21	1.21252e-02	9.96082e+01	2.36763e+00
18	22	4.86522e-02	9.93746e+01	3.87485e+00
19	23	2.34982e-02	9.93275e+01	5.07858e+00
20	24	3.17601e-03	9.92454e+01	3.56225e+00
21	25	9.91220e-03	9.91412e+01	1.65921e+00
22	26	5.51254e-02	9.89514e+01	1.36621e+00
23	27	1.18215e-01	9.89038e+01	6.79553e+00
24	28	1.99178e-03	9.88169e+01	5.54533e+00
25	29	5.35839e-03	9.86847e+01	2.73912e+00
26	31	1.25443e-02	9.86268e+01	9.61418e-01
27	32	5.73744e-02	9.85744e+01	2.80726e+00
28	33	1.12726e-02	9.85182e+01	8.68132e-01
29	34	7.64462e-02	9.84315e+01	1.78738e+00
30	36	1.39826e-02	9.84007e+01	7.84937e-01
31	37	3.83326e-02	9.83715e+01	1.82648e+00
32	38	1.32091e-02	9.83414e+01	7.54305e-01
33	39	4.40024e-02	9.83096e+01	1.78538e+00
34	40	1.51624e-02	9.82819e+01	8.72225e-01
35	41	3.16284e-02	9.82644e+01	1.84087e+00
36	42	8.06710e-03	9.82402e+01	7.12661e-01
37	43	4.42298e-02	9.82071e+01	1.32451e+00
38	44	2.49660e-02	9.81952e+01	1.92988e+00
39	45	5.18927e-03	9.81762e+01	9.56266e-01
40	46	2.13104e-02	9.81588e+01	1.05433e+00
41	47	1.77731e-02	9.81414e+01	7.99039e-01
42	48	2.36019e-02	9.81243e+01	1.06359e+00
43	49	1.75835e-02	9.81074e+01	7.85384e-01
44	50	2.37300e-02	9.80909e+01	1.05548e+00
45	51	1.73547e-02	9.80746e+01	7.56105e-01
46	52	2.42083e-02	9.80585e+01	1.05250e+00
47	53	1.71624e-02	9.80427e+01	7.33564e-01
48	54	2.45954e-02	9.80270e+01	1.04924e+00
49	55	1.69913e-02	9.80115e+01	7.13697e-01
50	56	2.49680e-02	9.79963e+01	1.04745e+00
51	57	1.68012e-02	9.79811e+01	6.93050e-01
52	58	2.53946e-02	9.79661e+01	1.04738e+00

53	59	1.66412e-02	9.79513e+01	6.76673e-01
54	60	2.57382e-02	9.79365e+01	1.04565e+00
55	61	1.65198e-02	9.79219e+01	6.64195e-01
56	62	2.60404e-02	9.79075e+01	1.04433e+00
57	63	1.64001e-02	9.78931e+01	6.64447e-01
58	64	2.63138e-02	9.78788e+01	1.04237e+00
59	65	1.63058e-02	9.78647e+01	6.65261e-01
60	66	2.65739e-02	9.78506e+01	1.04073e+00
61	67	1.62315e-02	9.78366e+01	6.66236e-01
62	68	2.67537e-02	9.78227e+01	1.03848e+00
63	69	1.61514e-02	9.78089e+01	6.67567e-01
64	70	2.69790e-02	9.77951e+01	1.03665e+00
65	71	1.61079e-02	9.77815e+01	6.68902e-01
66	72	2.70912e-02	9.77679e+01	1.03395e+00
67	73	1.60526e-02	9.77543e+01	6.70336e-01
68	74	2.72352e-02	9.77409e+01	1.03143e+00
69	75	1.60194e-02	9.77275e+01	6.71727e-01
70	76	2.73152e-02	9.77141e+01	1.02802e+00
71	77	1.59918e-02	9.77009e+01	6.72965e-01
72	78	2.74120e-02	9.76876e+01	1.02552e+00
73	79	1.59592e-02	9.76745e+01	6.73919e-01
74	80	2.74999e-02	9.76614e+01	1.02248e+00
75	81	1.59414e-02	9.76483e+01	6.74769e-01
76	82	2.75447e-02	9.76353e+01	1.01907e+00
77	83	1.59135e-02	9.76224e+01	6.75405e-01
78	84	2.76517e-02	9.76095e+01	1.01683e+00
79	85	1.58955e-02	9.75967e+01	6.75515e-01
80	86	2.76780e-02	9.75840e+01	1.01410e+00
81	87	1.58412e-02	9.75712e+01	6.75386e-01
82	88	2.78450e-02	9.75586e+01	1.01141e+00
83	89	1.58563e-02	9.75460e+01	6.74727e-01
84	90	2.77838e-02	9.75335e+01	1.00831e+00
85	91	1.57600e-02	9.75210e+01	6.73855e-01
86	92	2.81283e-02	9.75085e+01	1.00770e+00
87	93	1.57952e-02	9.74961e+01	6.72463e-01
88	94	2.79672e-02	9.74839e+01	1.00424e+00
89	95	1.56522e-02	9.74716e+01	6.70615e-01
90	96	2.84795e-02	9.74593e+01	1.00372e+00
91	97	1.57434e-02	9.74472e+01	6.68239e-01
92	98	2.81305e-02	9.74353e+01	1.00077e+00
93	99	1.54727e-02	9.74233e+01	6.65503e-01
94	100	2.90943e-02	9.74111e+01	1.00167e+00
95	101	1.57278e-02	9.73993e+01	6.62216e-01
96	102	2.81140e-02	9.73877e+01	9.95734e-01
97	103	1.52106e-02	9.73760e+01	6.58556e-01
98	104	3.00555e-02	9.73639e+01	9.96542e-01
99	105	1.59288e-02	9.73523e+01	6.54260e-01
100	106	2.73214e-02	9.73414e+01	9.80844e-01

Reached Maximum Number of Iterations

quantile: 0.50 optimizer: bb

Iteration	FunEvals	Step Length	Function Val	Opt Cond
1	2	6.17187e-03	1.55420e+02	6.19376e+01
2	3	1.00000e+00	1.10077e+02	1.99392e+01
3	4	1.00000e+00	1.06175e+02	1.67688e+01

4	5	1.00000e+00	1.04264e+02	5.17991e+00
5	6	1.00000e+00	1.03789e+02	4.81597e+00
6	7	1.00000e+00	1.03299e+02	4.39258e+00
7	8	1.00000e+00	1.01563e+02	3.32500e+00
8	9	1.00000e+00	1.00144e+02	3.91752e+00
9	10	1.00000e+00	9.99589e+01	4.16880e+00
10	11	1.00000e+00	9.97807e+01	2.61317e+00
11	12	1.00000e+00	9.96966e+01	2.51231e+00
12	13	1.00000e+00	9.84930e+01	7.67375e-01
13	14	1.00000e+00	9.82126e+01	3.96248e+00
14	15	1.00000e+00	9.83173e+01	6.70591e+00
15	16	1.00000e+00	9.80883e+01	7.00234e-01
16	17	1.00000e+00	9.80779e+01	6.97613e-01
17	18	1.00000e+00	9.80597e+01	6.93475e-01
18	19	1.00000e+00	9.78703e+01	6.61353e-01
19	20	1.00000e+00	9.77348e+01	1.51933e+00
20	21	1.00000e+00	9.77160e+01	6.74397e-01
21	22	1.00000e+00	9.77080e+01	6.74190e-01
22	23	1.00000e+00	9.77016e+01	6.74331e-01
23	24	1.00000e+00	9.74277e+01	6.61959e-01
24	25	1.00000e+00	9.67135e+01	3.04420e-01
25	27	1.20046e-02	9.67110e+01	4.13147e-01
26	28	1.00000e+00	9.67089e+01	2.91244e-01
27	29	1.00000e+00	9.67077e+01	2.89869e-01
28	30	1.00000e+00	9.66206e+01	1.75253e-01
29	31	1.00000e+00	9.65720e+01	1.85327e+00
30	32	1.00000e+00	9.66374e+01	4.17482e+00
31	33	1.00000e+00	9.65511e+01	2.05501e-01
32	34	1.00000e+00	9.65504e+01	1.99214e-01
33	35	1.00000e+00	9.65492e+01	1.87517e-01
34	36	1.00000e+00	9.65357e+01	9.91260e-02
35	37	1.00000e+00	9.65345e+01	8.49699e-01
36	38	1.00000e+00	9.65307e+01	9.42411e-02
37	39	1.00000e+00	9.65306e+01	9.40790e-02
38	40	1.00000e+00	9.65304e+01	9.39354e-02
39	41	1.00000e+00	9.65015e+01	5.72538e-02
40	42	1.00000e+00	9.65050e+01	1.77980e+00
41	43	1.00000e+00	9.64907e+01	6.27876e-01
42	44	1.00000e+00	9.64887e+01	7.43164e-02
43	45	1.00000e+00	9.64886e+01	7.24662e-02
44	46	1.00000e+00	9.64883e+01	6.36174e-02
45	47	1.00000e+00	9.64871e+01	3.09308e-02
46	48	1.00000e+00	9.64868e+01	7.69268e-02
47	49	1.00000e+00	9.64867e+01	3.01861e-02
48	50	1.00000e+00	9.64867e+01	3.01670e-02
49	51	1.00000e+00	9.64867e+01	3.01492e-02
50	52	1.00000e+00	9.64773e+01	1.17869e-02
51	53	1.00000e+00	9.65377e+01	1.69924e+00
52	55	2.58283e-01	9.65206e+01	4.94621e-01
53	56	1.00000e+00	9.65180e+01	4.80069e-01
54	57	1.00000e+00	9.65150e+01	4.60965e-01
55	58	1.00000e+00	9.64762e+01	5.49724e-02
56	59	1.00000e+00	9.64758e+01	2.54904e-01
57	60	1.00000e+00	9.64761e+01	3.68775e-01

58	61	1.00000e+00	9.64754e+01	1.08652e-02
59	62	1.00000e+00	9.64754e+01	1.08344e-02
60	63	1.00000e+00	9.64754e+01	1.06363e-02
61	64	1.00000e+00	9.64753e+01	8.80280e-03
62	65	1.00000e+00	9.64753e+01	6.87960e-02
63	66	1.00000e+00	9.64753e+01	8.16265e-03
64	67	1.00000e+00	9.64753e+01	7.94493e-03
65	68	1.00000e+00	9.64753e+01	7.92718e-03
66	69	1.00000e+00	9.64749e+01	6.94599e-03
67	70	1.00000e+00	9.64748e+01	8.59492e-02
68	71	1.00000e+00	9.64753e+01	3.13352e-01
69	72	1.00000e+00	9.64748e+01	2.03133e-02
70	73	1.00000e+00	9.64748e+01	1.98305e-02
71	74	1.00000e+00	9.64747e+01	1.27455e-02
72	75	1.00000e+00	9.64747e+01	6.47057e-03
73	76	1.00000e+00	9.64747e+01	8.30409e-02
74	77	1.00000e+00	9.64746e+01	6.43550e-03
75	78	1.00000e+00	9.64746e+01	6.43466e-03
76	79	1.00000e+00	9.64746e+01	6.43344e-03
77	80	1.00000e+00	9.64736e+01	4.37645e-03
78	82	1.53025e-03	9.64736e+01	1.21488e-02
79	83	1.00000e+00	9.64736e+01	4.37244e-03
80	84	1.00000e+00	9.64736e+01	4.37204e-03
81	85	1.00000e+00	9.64736e+01	4.34161e-03
82	86	1.00000e+00	9.64736e+01	1.52141e-02
83	87	1.00000e+00	9.64736e+01	4.31152e-03
84	88	1.00000e+00	9.64736e+01	4.31113e-03
85	89	1.00000e+00	9.64736e+01	4.31074e-03
86	90	1.00000e+00	9.64735e+01	4.24806e-03
87	91	1.00000e+00	9.64735e+01	4.19428e-03
88	92	1.00000e+00	9.64735e+01	3.74455e-02
89	93	1.00000e+00	9.64735e+01	4.17232e-03
90	94	1.00000e+00	9.64735e+01	4.17192e-03
91	95	1.00000e+00	9.64735e+01	4.17158e-03
92	96	1.00000e+00	9.64735e+01	4.09710e-03
93	97	1.00000e+00	9.64734e+01	4.00406e-03
94	98	1.00000e+00	9.64734e+01	3.91218e-02
95	99	1.00000e+00	9.64734e+01	7.15103e-03
96	100	1.00000e+00	9.64734e+01	3.99678e-03
97	101	1.00000e+00	9.64734e+01	3.99642e-03
98	102	1.00000e+00	9.64734e+01	3.97491e-03
99	103	1.00000e+00	9.64734e+01	3.95610e-03
100	104	1.00000e+00	9.64734e+01	8.37450e-03

Reached Maximum Number of Iterations

quantile: 0.50 optimizer: pr

Iteration	FunEvals	Step Length	Function Val	Opt Cond
1	3	2.33094e-02	1.04857e+02	1.51028e+01
2	5	5.84632e-01	1.03473e+02	4.74425e+00
3	7	6.08630e+00	1.02432e+02	1.20853e+01
4	9	1.26886e+00	1.00937e+02	1.77932e+01
5	12	2.38063e+00	9.81523e+01	4.34882e+00
6	14	2.32293e+00	9.74424e+01	5.37418e+00
7	16	2.86390e+00	9.70850e+01	3.64814e+00
8	18	1.66826e+00	9.67922e+01	1.34214e+00

9	21	3.00247e+00	9.66184e+01	1.76406e+00
10	23	2.27189e+00	9.65830e+01	7.57094e-01
11	25	3.44984e+00	9.65707e+01	1.67677e+00
12	27	5.50500e+00	9.65439e+01	2.56146e-01
13	29	1.57829e+00	9.65397e+01	1.93058e-01
14	31	1.41172e+00	9.65395e+01	2.30144e-02
15	33	1.25091e+00	9.65394e+01	5.62805e-03
16	35	2.83584e+00	9.65394e+01	1.82272e-02
17	37	1.16958e+00	9.65394e+01	2.95000e-02
18	39	4.48807e+00	9.65394e+01	2.68887e-02
19	41	2.88815e+00	9.65393e+01	7.49921e-03
20	43	1.50325e+00	9.65393e+01	1.08843e-03
21	45	1.97485e+00	9.65393e+01	4.32504e-03
22	47	1.72876e+00	9.65393e+01	3.46344e-03
23	50	2.32197e+00	9.65393e+01	3.33677e-03
24	52	2.14819e+00	9.65393e+01	3.31362e-03
25	54	1.11460e+00	9.65393e+01	3.14866e-04
26	56	1.23391e+00	9.65393e+01	4.81526e-04
27	61	1.06672e+00	9.65393e+01	4.35422e-04
28	62	1.00000e+00	9.65393e+01	1.66893e-04
29	71	1.06358e+00	9.65393e+01	1.11424e-04
30	72	1.00000e+00	9.65393e+01	4.38592e-05

Directional Derivative below progTol
quantile: 0.50 optimizer: lbfgs

Iteration	FunEvals	Step Length	Function Val	Opt Cond
1	2	6.17218e-03	1.55419e+02	6.19399e+01
2	4	5.82271e-01	1.08041e+02	1.23549e+01
3	5	1.00000e+00	1.05931e+02	8.20182e+00
4	6	1.00000e+00	1.02530e+02	3.73884e+00
5	7	1.00000e+00	1.00526e+02	3.17737e+00
6	8	1.00000e+00	9.80474e+01	1.05363e+00
7	9	1.00000e+00	9.74690e+01	6.90275e-01
8	10	1.00000e+00	9.65851e+01	1.40303e+00
9	11	1.00000e+00	9.65292e+01	6.72972e-01
10	12	1.00000e+00	9.65053e+01	6.51347e-01
11	13	1.00000e+00	9.64947e+01	5.87532e-02
12	14	1.00000e+00	9.64940e+01	3.88483e-02
13	15	1.00000e+00	9.64933e+01	5.57054e-02
14	16	1.00000e+00	9.64910e+01	1.14132e-01
15	17	1.00000e+00	9.64872e+01	1.56637e-01
16	18	1.00000e+00	9.64821e+01	1.56435e-01
17	19	1.00000e+00	9.64770e+01	1.51706e-01
18	20	1.00000e+00	9.64747e+01	1.25040e-02
19	21	1.00000e+00	9.64734e+01	7.78179e-02
20	22	1.00000e+00	9.64724e+01	6.82416e-02
21	23	1.00000e+00	9.64719e+01	1.55163e-02
22	24	1.00000e+00	9.64717e+01	1.26993e-02
23	25	1.00000e+00	9.64716e+01	1.78919e-02
24	26	1.00000e+00	9.64715e+01	1.10900e-02
25	27	1.00000e+00	9.64714e+01	1.03308e-03
26	28	1.00000e+00	9.64714e+01	3.49204e-03
27	29	1.00000e+00	9.64714e+01	3.43595e-03
28	30	1.00000e+00	9.64714e+01	7.00099e-03
29	31	1.00000e+00	9.64714e+01	5.87316e-04

30	32	1.00000e+00	9.64714e+01	2.08726e-03
31	33	1.00000e+00	9.64714e+01	1.37437e-03
32	34	1.00000e+00	9.64714e+01	7.02700e-05
33	35	1.00000e+00	9.64714e+01	4.29825e-04
34	36	1.00000e+00	9.64714e+01	3.35729e-04
35	37	1.00000e+00	9.64714e+01	6.79837e-05
36	38	1.00000e+00	9.64714e+01	6.85388e-05
37	39	1.00000e+00	9.64714e+01	7.90913e-05
38	40	1.00000e+00	9.64714e+01	5.98619e-06

Optimality Condition below optTol

Elapsed time is 14.618519 seconds.

quantile: 0.75 optimizer: sd

Iteration	FunEvals	Step Length	Function Val	Opt Cond
1	2	5.40036e-03	1.78893e+02	7.08628e+01
2	3	1.80865e-02	1.08773e+02	7.83187e+00

Warning: Inference method failed [Error using likALD (line 74)

check] .. attempting to continue

Warning: Inference method failed [Error using likALD (line 74)

check] .. attempting to continue

3	7	4.74528e-02	1.06480e+02	1.53216e+01
4	8	1.72657e-02	1.05540e+02	1.08869e+01
5	9	1.31359e-02	1.04593e+02	4.49804e+00
6	10	6.68596e-02	1.04077e+02	1.24127e+01
7	11	6.14551e-03	1.03302e+02	5.64314e+00
8	13	1.46493e-02	1.02966e+02	3.29643e+00
9	14	3.83685e-02	1.02708e+02	6.17489e+00
10	15	1.10958e-02	1.02414e+02	2.56269e+00
11	16	7.53611e-02	1.01978e+02	2.12984e+00
12	18	1.59318e-02	1.01920e+02	1.19757e+00
13	19	3.09728e-02	1.01876e+02	2.39055e+00
14	20	1.18915e-02	1.01827e+02	8.92228e-01
15	21	5.67126e-02	1.01760e+02	1.68377e+00
16	23	1.39028e-02	1.01732e+02	7.54614e-01
17	24	4.04835e-02	1.01709e+02	1.77051e+00
18	25	1.18194e-02	1.01684e+02	7.14794e-01
19	26	6.05726e-02	1.01649e+02	1.30825e+00
20	28	1.37267e-02	1.01633e+02	6.65901e-01
21	29	4.12633e-02	1.01619e+02	1.35152e+00
22	30	1.23931e-02	1.01604e+02	6.33887e-01
23	31	5.35591e-02	1.01586e+02	1.19893e+00
24	32	1.95308e-02	1.01576e+02	1.09855e+00
25	33	1.17466e-02	1.01565e+02	5.87742e-01
26	34	5.03528e-02	1.01549e+02	6.88526e-01
27	36	1.75786e-02	1.01541e+02	5.53310e-01
28	37	2.45850e-02	1.01534e+02	7.07734e-01
29	38	1.68983e-02	1.01528e+02	5.33846e-01
30	39	2.57531e-02	1.01521e+02	7.14125e-01
31	40	1.59573e-02	1.01515e+02	5.14757e-01
32	41	2.85038e-02	1.01509e+02	7.30292e-01
33	42	1.53541e-02	1.01502e+02	4.95349e-01
34	43	3.05486e-02	1.01497e+02	7.43550e-01
35	44	1.45065e-02	1.01491e+02	4.76136e-01
36	45	3.43292e-02	1.01485e+02	7.52399e-01
37	46	1.46075e-02	1.01479e+02	4.56043e-01

38	47	3.41709e-02	1.01475e+02	7.74075e-01
39	48	1.21907e-02	1.01469e+02	4.37732e-01
40	49	4.79792e-02	1.01461e+02	5.74706e-01
41	51	1.57942e-02	1.01457e+02	4.13492e-01
42	52	2.90093e-02	1.01453e+02	5.86395e-01
43	53	1.51984e-02	1.01449e+02	3.97568e-01
44	54	3.11948e-02	1.01446e+02	5.96791e-01
45	55	1.44876e-02	1.01442e+02	3.81851e-01
46	56	3.45058e-02	1.01438e+02	6.04819e-01
47	57	1.43413e-02	1.01435e+02	3.65491e-01
48	58	3.57423e-02	1.01431e+02	6.20945e-01
49	59	1.26535e-02	1.01428e+02	3.49848e-01
50	60	4.62191e-02	1.01423e+02	5.35419e-01
51	61	2.20287e-02	1.01421e+02	6.20259e-01
52	62	8.21683e-03	1.01419e+02	3.26445e-01
53	63	4.46727e-02	1.01415e+02	4.14752e-01
54	64	2.97067e-02	1.01414e+02	7.90712e-01
55	65	1.86739e-03	1.01413e+02	6.46866e-01
56	66	4.82318e-03	1.01411e+02	3.42302e-01
57	67	1.88460e-02	1.01409e+02	2.97811e-01
58	68	2.21927e-02	1.01407e+02	3.41544e-01
59	69	1.81804e-02	1.01405e+02	2.87210e-01
60	70	2.33281e-02	1.01403e+02	3.44196e-01
61	71	1.73949e-02	1.01401e+02	2.76900e-01
62	72	2.49333e-02	1.01400e+02	3.50614e-01
63	73	1.65272e-02	1.01398e+02	2.66719e-01
64	74	2.70281e-02	1.01397e+02	3.58694e-01
65	75	1.57430e-02	1.01395e+02	2.56628e-01
66	76	2.94305e-02	1.01393e+02	3.67548e-01
67	77	1.50124e-02	1.01392e+02	2.46537e-01
68	78	3.23241e-02	1.01390e+02	3.74995e-01
69	79	1.45684e-02	1.01389e+02	2.36272e-01
70	80	3.46369e-02	1.01388e+02	3.83033e-01
71	81	1.36394e-02	1.01386e+02	2.26143e-01
72	82	4.02338e-02	1.01385e+02	3.78107e-01
73	83	1.52663e-02	1.01383e+02	2.14933e-01
74	84	3.12765e-02	1.01383e+02	3.86999e-01
75	85	9.29735e-03	1.01381e+02	2.07544e-01
76	86	5.11314e-02	1.01379e+02	1.97796e-01
77	88	3.10056e-02	1.01378e+02	2.85517e-01
78	89	1.56204e-02	1.01377e+02	1.89645e-01
79	90	2.96844e-02	1.01377e+02	2.88986e-01
80	91	1.33679e-02	1.01376e+02	1.82427e-01
81	92	4.01107e-02	1.01375e+02	2.62213e-01
82	93	2.10710e-02	1.01374e+02	2.80195e-01
83	94	1.15400e-02	1.01373e+02	1.71137e-01
84	95	4.67812e-02	1.01372e+02	1.63627e-01
85	97	2.59287e-02	1.01371e+02	2.06069e-01
86	98	1.72005e-02	1.01371e+02	1.57367e-01
87	99	2.49307e-02	1.01370e+02	2.03995e-01
88	100	1.59923e-02	1.01370e+02	1.51745e-01
89	101	2.87644e-02	1.01369e+02	2.10330e-01
90	102	1.57873e-02	1.01369e+02	1.45793e-01
91	103	2.91568e-02	1.01368e+02	2.13897e-01

92	104	1.42906e-02	1.01368e+02	1.40265e-01
93	105	3.54765e-02	1.01367e+02	2.12415e-01
94	106	1.64491e-02	1.01367e+02	1.33779e-01
95	107	2.57972e-02	1.01366e+02	1.98964e-01
96	108	1.26958e-02	1.01366e+02	1.29356e-01
97	109	4.18404e-02	1.01365e+02	1.50303e-01
98	110	3.18732e-02	1.01365e+02	3.20443e-01
99	111	1.85462e-03	1.01365e+02	2.62028e-01
100	112	4.79903e-03	1.01365e+02	1.38568e-01

Reached Maximum Number of Iterations

quantile: 0.75 optimizer: bb

Iteration	FunEvals	Step Length	Function Val	Opt Cond
1	2	5.40031e-03	1.78894e+02	7.08637e+01
2	3	1.00000e+00	1.27223e+02	4.43528e+01
3	4	1.00000e+00	1.18334e+02	5.32609e+01
4	5	1.00000e+00	1.07822e+02	1.36745e+01
5	6	1.00000e+00	1.06375e+02	5.90154e+00
6	7	1.00000e+00	1.05841e+02	5.52454e+00
7	8	1.00000e+00	1.05344e+02	5.11088e+00
8	9	1.00000e+00	1.03172e+02	3.48608e+00
9	10	1.00000e+00	1.02673e+02	1.22538e+01
10	11	1.00000e+00	1.02257e+02	9.64832e+00
11	12	1.00000e+00	1.01800e+02	7.93986e-01
12	13	1.00000e+00	1.01786e+02	7.88422e-01
13	14	1.00000e+00	1.01774e+02	7.81008e-01
14	15	1.00000e+00	1.01634e+02	6.83836e-01
15	16	1.00000e+00	1.01513e+02	6.99902e-01
16	17	1.00000e+00	1.01620e+02	5.00324e+00
17	18	1.00000e+00	1.01486e+02	4.70527e-01
18	19	1.00000e+00	1.01483e+02	4.66561e-01
19	20	1.00000e+00	1.01447e+02	3.96512e-01
20	21	1.00000e+00	1.01374e+02	1.81760e+00
21	22	1.00000e+00	1.01670e+02	8.05015e+00
22	23	1.00000e+00	1.01357e+02	7.30545e-02
23	24	1.00000e+00	1.01357e+02	5.90591e-02
24	25	1.00000e+00	1.01357e+02	5.56709e-02
25	26	1.00000e+00	1.01356e+02	3.00135e-02
26	27	1.00000e+00	1.01356e+02	2.44393e-02
27	28	1.00000e+00	1.01356e+02	2.15843e-01
28	29	1.00000e+00	1.01356e+02	2.09347e-02
29	30	1.00000e+00	1.01356e+02	2.08508e-02
30	31	1.00000e+00	1.01356e+02	2.06943e-02
31	32	1.00000e+00	1.01356e+02	1.01356e-02
32	33	1.00000e+00	1.01356e+02	1.96254e-02
33	34	1.00000e+00	1.01356e+02	2.90528e-01
34	35	1.00000e+00	1.01356e+02	1.81955e-02
35	36	1.00000e+00	1.01356e+02	6.07233e-03
36	37	1.00000e+00	1.01356e+02	5.74238e-03
37	38	1.00000e+00	1.01356e+02	2.30810e-03
38	39	1.00000e+00	1.01356e+02	1.71043e-03
39	40	1.00000e+00	1.01356e+02	1.13862e-02
40	41	1.00000e+00	1.01356e+02	4.48852e-03
41	42	1.00000e+00	1.01356e+02	1.34655e-03
42	43	1.00000e+00	1.01356e+02	1.33735e-03

43	44	1.00000e+00	1.01356e+02	8.18783e-04
44	45	1.00000e+00	1.01356e+02	3.04169e-03
45	46	1.00000e+00	1.01356e+02	1.85774e-02
46	47	1.00000e+00	1.01356e+02	8.02305e-04
47	48	1.00000e+00	1.01356e+02	7.41032e-04
48	49	1.00000e+00	1.01356e+02	6.82936e-04
49	50	1.00000e+00	1.01356e+02	2.56119e-04
50	51	1.00000e+00	1.01356e+02	2.29989e-04
51	52	1.00000e+00	1.01356e+02	1.17463e-03
52	53	1.00000e+00	1.01356e+02	1.88010e-04

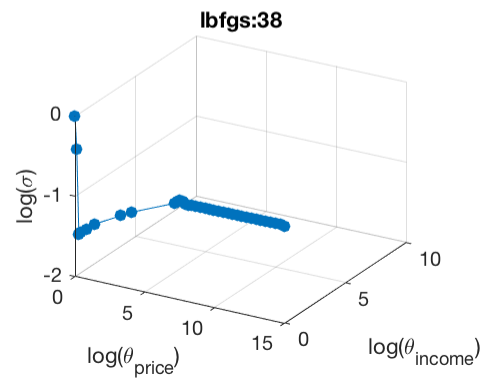
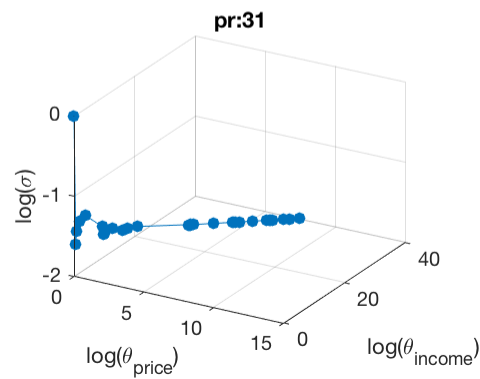
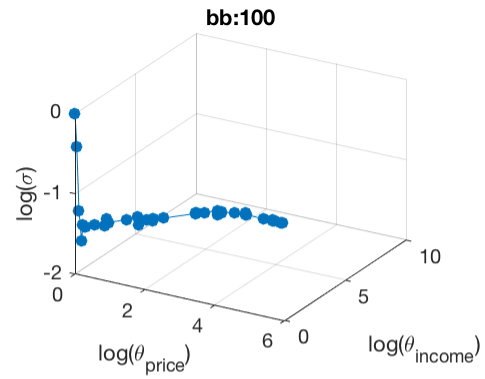
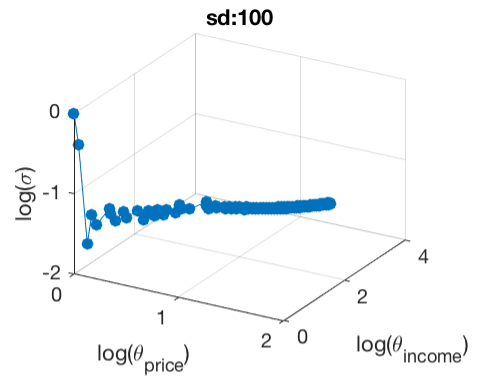
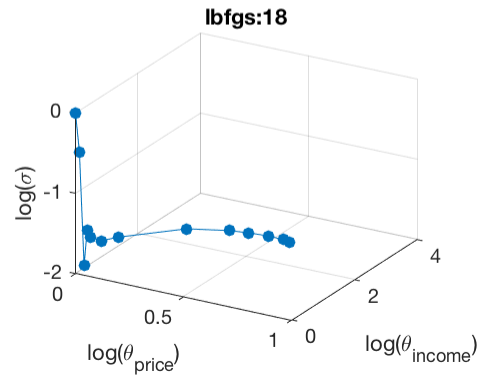
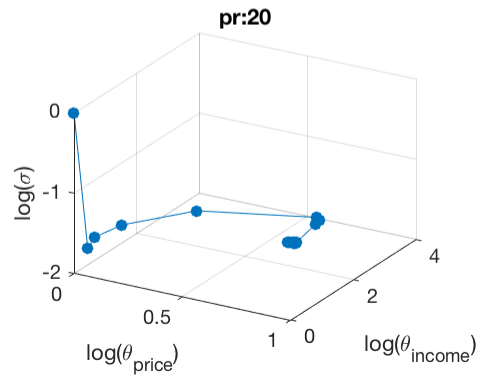
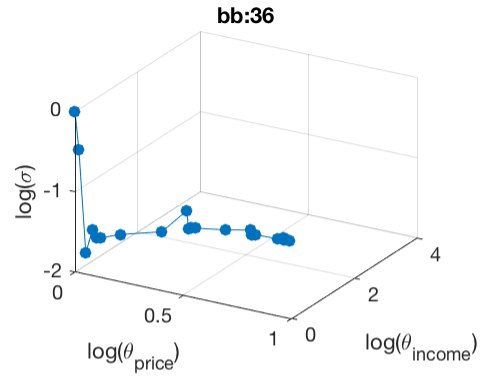
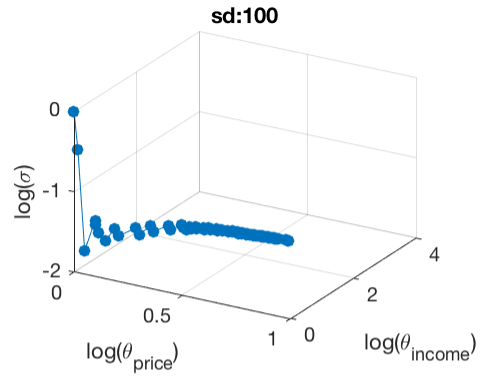
Directional Derivative below progTol
quantile: 0.75 optimizer: pr

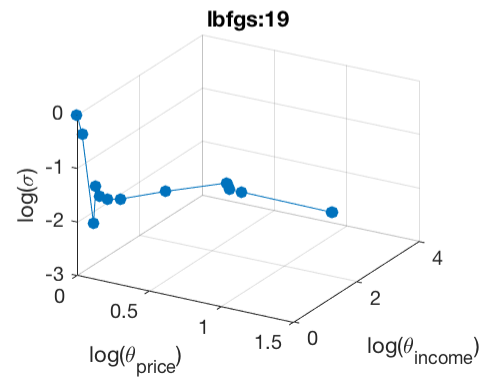
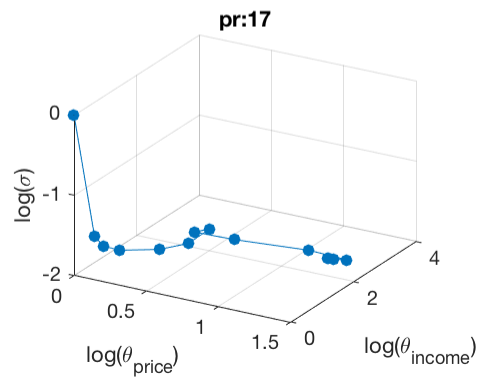
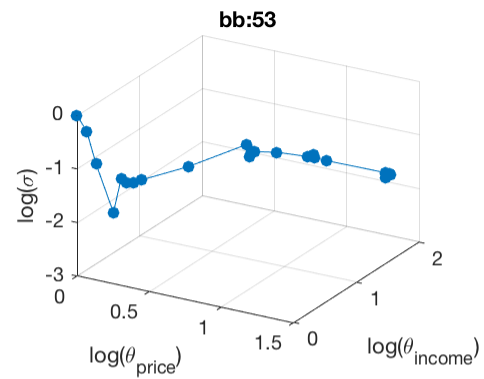
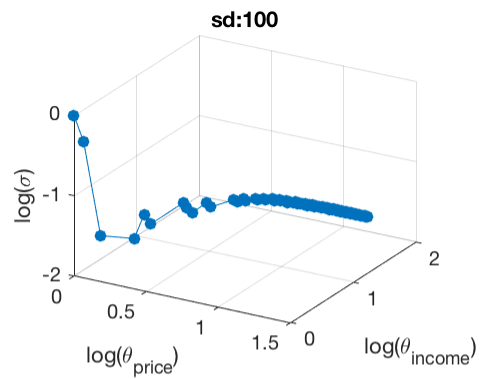
Iteration	FunEvals	Step Length	Function Val	Opt Cond
1	4	2.19745e-02	1.07350e+02	6.99010e+00
2	6	8.02108e-01	1.06353e+02	6.31159e+00
3	7	1.00000e+00	1.05656e+02	1.41153e+01
4	10	9.73063e-01	1.04243e+02	1.88570e+01
5	12	3.84467e-01	1.03447e+02	1.51296e+01
6	14	1.08678e+00	1.02078e+02	2.65886e+00
7	16	1.72780e+00	1.01796e+02	7.66185e-01
8	18	3.44880e+00	1.01618e+02	1.11543e+00
9	20	1.49772e+00	1.01465e+02	8.67085e-01
10	22	1.30153e+00	1.01385e+02	3.82249e-01
11	23	1.00000e+00	1.01360e+02	4.79970e-01
12	24	1.00000e+00	1.01356e+02	9.47556e-02
13	26	1.43935e+00	1.01356e+02	7.10834e-03
14	27	1.00000e+00	1.01356e+02	6.20330e-03
15	28	1.00000e+00	1.01356e+02	5.55696e-04
16	29	1.00000e+00	1.01356e+02	4.29438e-05

Directional Derivative below progTol
quantile: 0.75 optimizer: lbfgs

Iteration	FunEvals	Step Length	Function Val	Opt Cond
1	2	5.40027e-03	1.78894e+02	7.08628e+01
2	3	1.00000e+00	1.19335e+02	5.49204e+01
3	4	1.00000e+00	1.11353e+02	2.15242e+01
4	5	1.00000e+00	1.07662e+02	6.83702e+00
5	6	1.00000e+00	1.06570e+02	6.03591e+00
6	7	1.00000e+00	1.05363e+02	7.85841e+00
7	8	1.00000e+00	1.02632e+02	6.70188e+00
8	9	1.00000e+00	1.01769e+02	1.32421e+00
9	10	1.00000e+00	1.01689e+02	5.84808e-01
10	12	6.13586e-01	1.01590e+02	1.02417e+00
11	13	1.00000e+00	1.01539e+02	9.23691e-01
12	14	1.00000e+00	1.01356e+02	6.69376e-02
13	15	1.00000e+00	1.01356e+02	3.54408e-02
14	16	1.00000e+00	1.01356e+02	5.51151e-03
15	17	1.00000e+00	1.01356e+02	2.80193e-03
16	18	1.00000e+00	1.01356e+02	2.25959e-03
17	19	1.00000e+00	1.01356e+02	1.02867e-03
18	20	1.00000e+00	1.01356e+02	9.79110e-05

Directional Derivative below progTol
Elapsed time is 9.816987 seconds.





Implement chosen method on full data set

```
clear;
load(' ../data/data_BHP2.mat');
y=log_q;
x1=log_p;
x2=log_y;

len=10;
optimizer='pr';

%note: this takes many hours to run
train=false;

if train

    tic;
    %ticBytes(gcp);

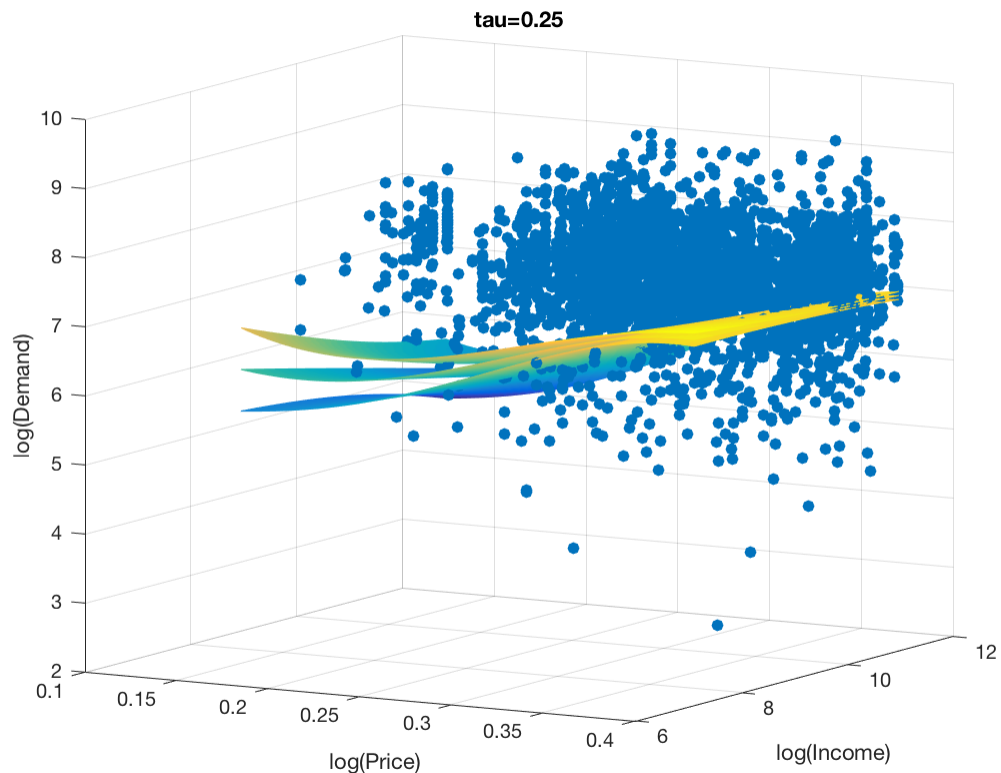
    for ido = 1:numel(quantiles)
        quantileToPredict = quantiles(ido);

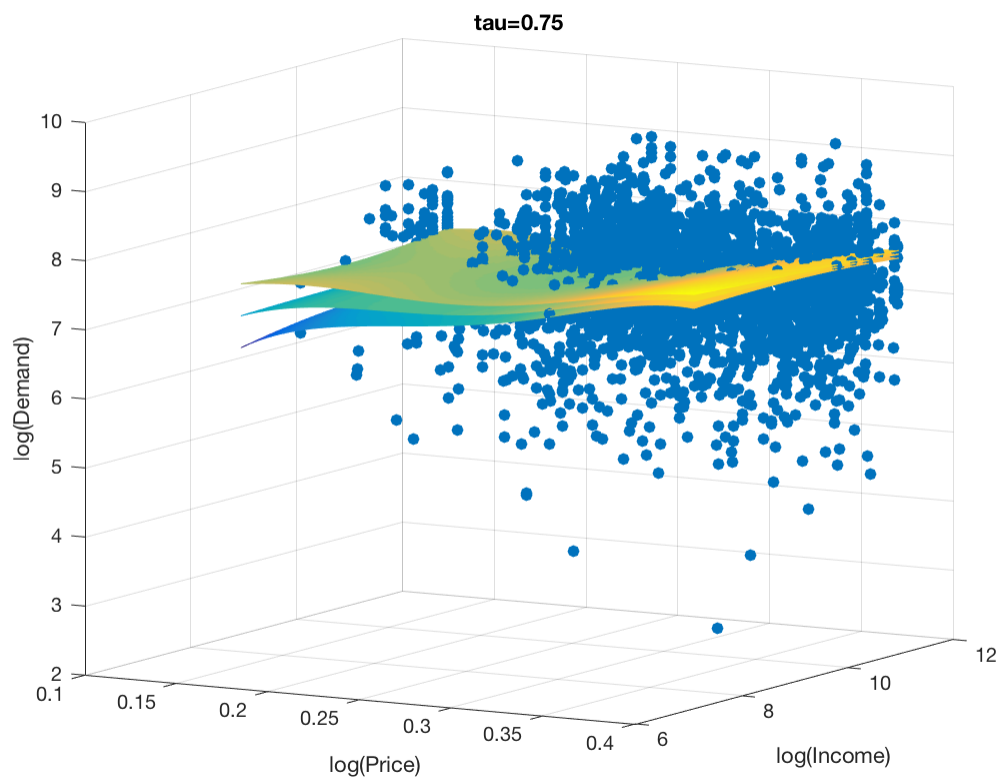
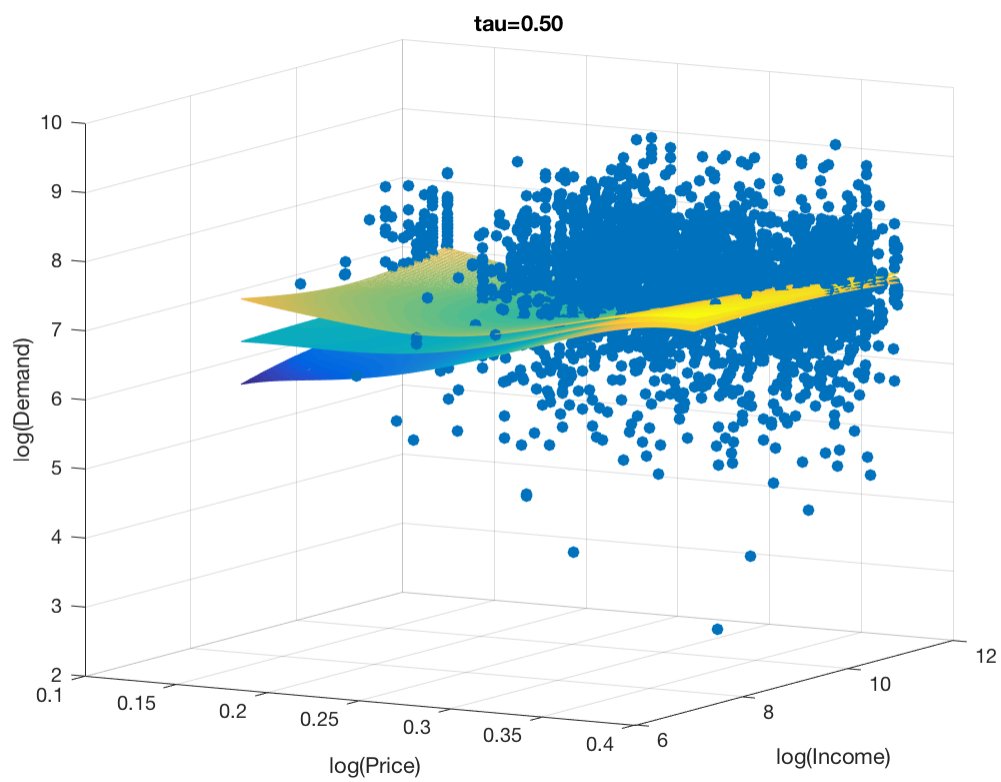
        [~,~,~,~,~,~]=save_quantile(quantileToPredict,len,optimizer,x1,x2,y);
    end
end
```

```
%tocBytes(gcp);  
toc;  
  
end
```

Visualize quantiles of gasoline demand

```
clear;  
load(' ../data/data_BHP2.mat');  
y=log_q;  
x1=log_p;  
x2=log_y;  
  
load(' ../data/results_0.25_10_pr.mat');  
plot_quantile(x1,x2,y,x1_test,x2_test,fmu_block,fs2_block);  
title('tau=0.25');  
  
load(' ../data/results_0.5_10_pr.mat');  
plot_quantile(x1,x2,y,x1_test,x2_test,fmu_block,fs2_block);  
title('tau=0.50');  
  
load(' ../data/results_0.75_10_pr.mat');  
plot_quantile(x1,x2,y,x1_test,x2_test,fmu_block,fs2_block);  
title('tau=0.75');
```





loss_vis.m

visualize different loss functions

```
% <include>loss_vis.m</include>
```

prelim.m

visualize mean gasoline demand

```
% <include>prelim.m</include>
```

save_quantile.m

train site parameters, tune hyperparameters, and save output

```
% <include>save_quantile.m</include>
```

plot_quantile.m

visualize quantile gasoline demand with credible interval

```
% <include>plot_quantile.m</include>
```

Published with MATLAB® R2016b