Trajectory of Payments for Food and Liesure

Monthly Food and Leisure Costs
January through December Fake Data

SAS Proc Traj by Dr Jones
https://www.andrew.cmu.edu/user/bjones/

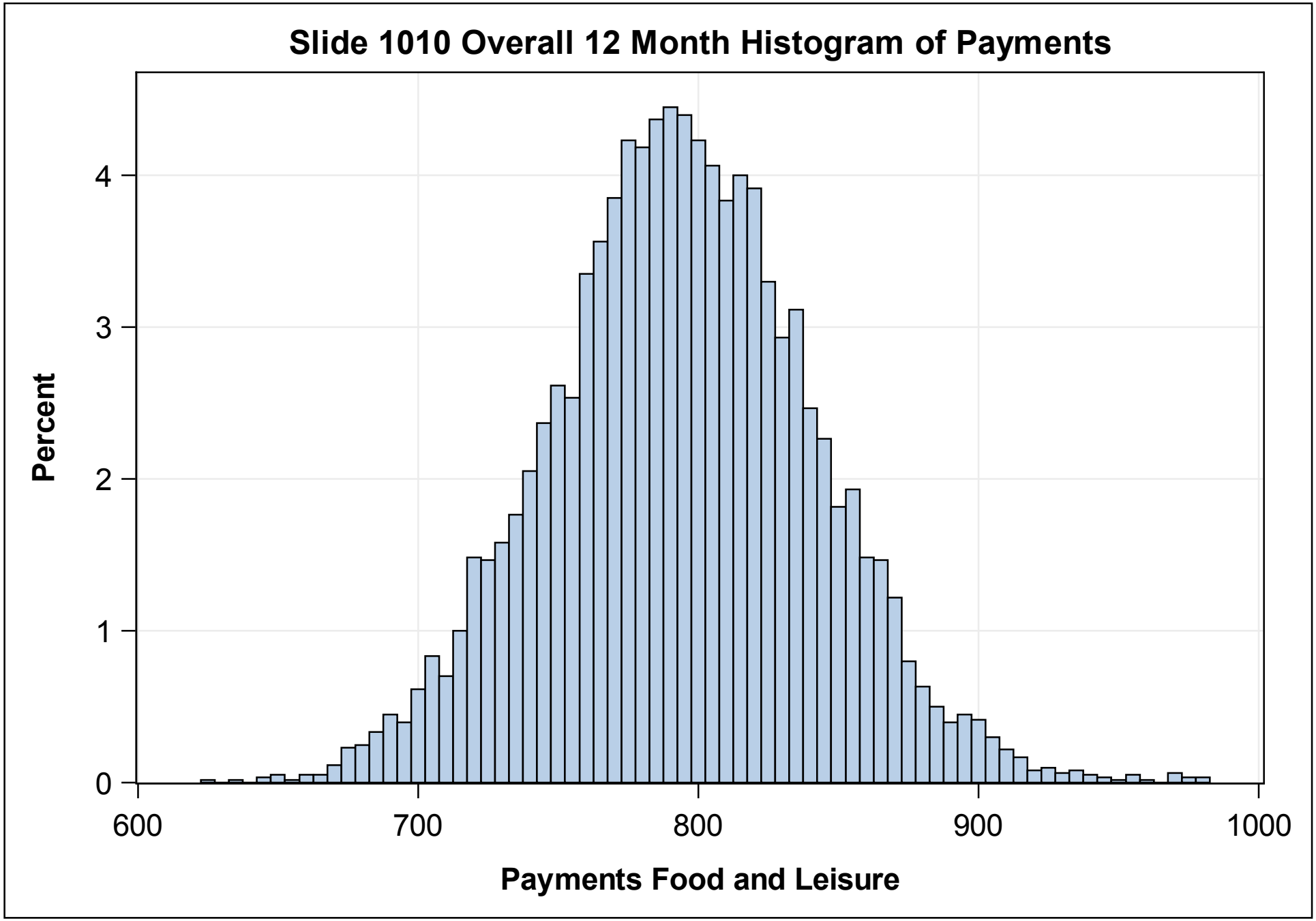

Slide 1010 Overall 12 Month Histogram of Payments
Percent
0
1
2
3
4
600
700
800
900
1000
Payments Food and Leisure

Figure 1200 Percent of Monthly Payments in the Top 5 Percent by Month

Month	Count	Total	Count 5%	Pay 5%	Percent of Total
1	500	$399,571	25	$23,623	5.9
2	500	$402,658	25	$22,301	5.5
3	500	$399,764	25	$22,236	5.6
4	500	$398,344	25	$22,170	5.6
5	500	$396,819	25	$22,133	5.6
6	500	$396,866	25	$21,975	5.5
7	500	$394,378	25	$22,015	5.6
8	500	$396,063	25	$22,185	5.6
9	500	$393,845	25	$22,163	5.6
10	500	$395,179	25	$22,040	5.6
11	500	$396,098	25	$22,436	5.7
12	500	$394,934	25	$22,250	5.6

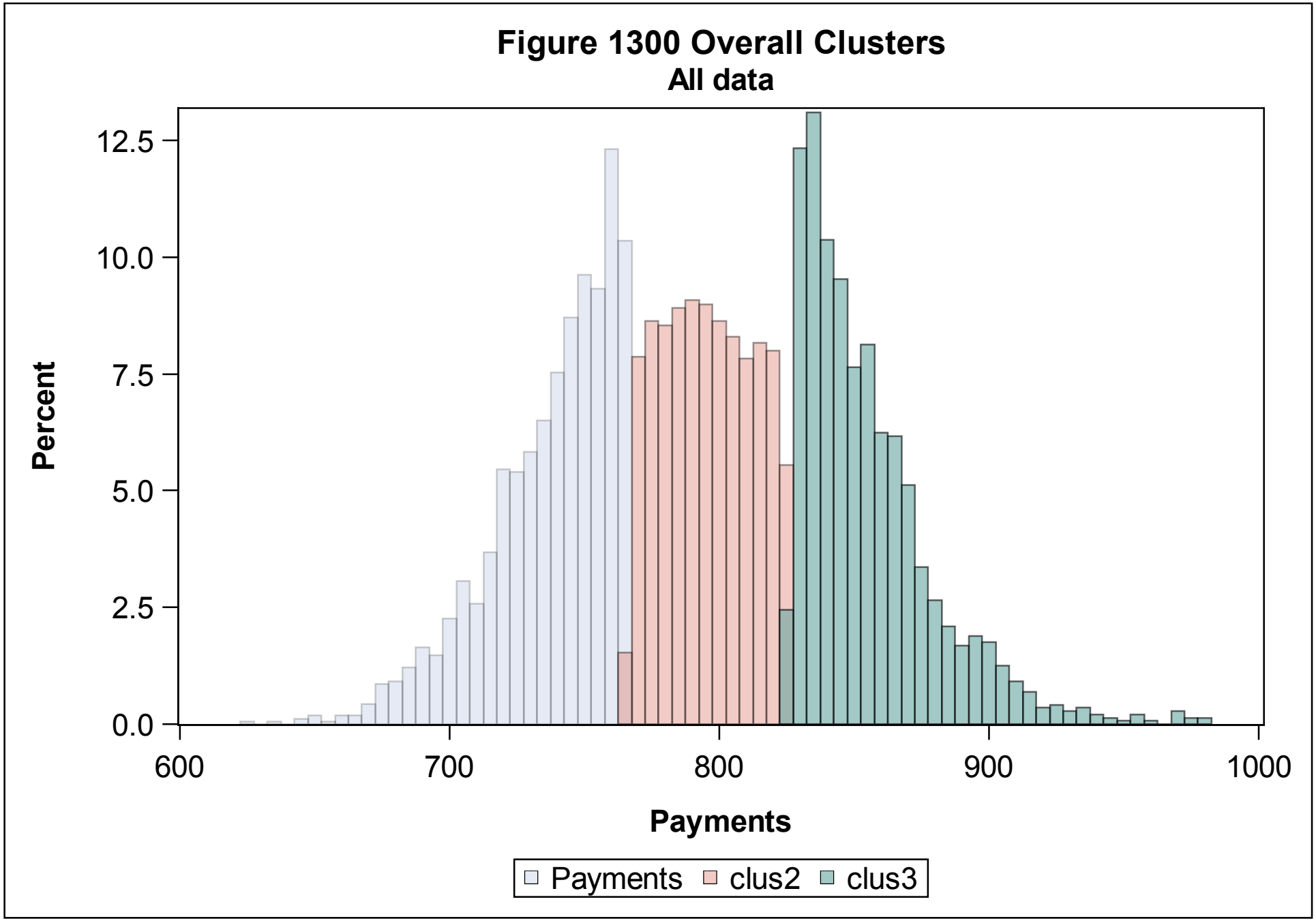


Figure 1300 Overall Clusters
All data
Percent
12.5
10.0
7.5
5.0
2.5
0.0
600
700
800
900
1000
Payments
Payments
clus2
clus3

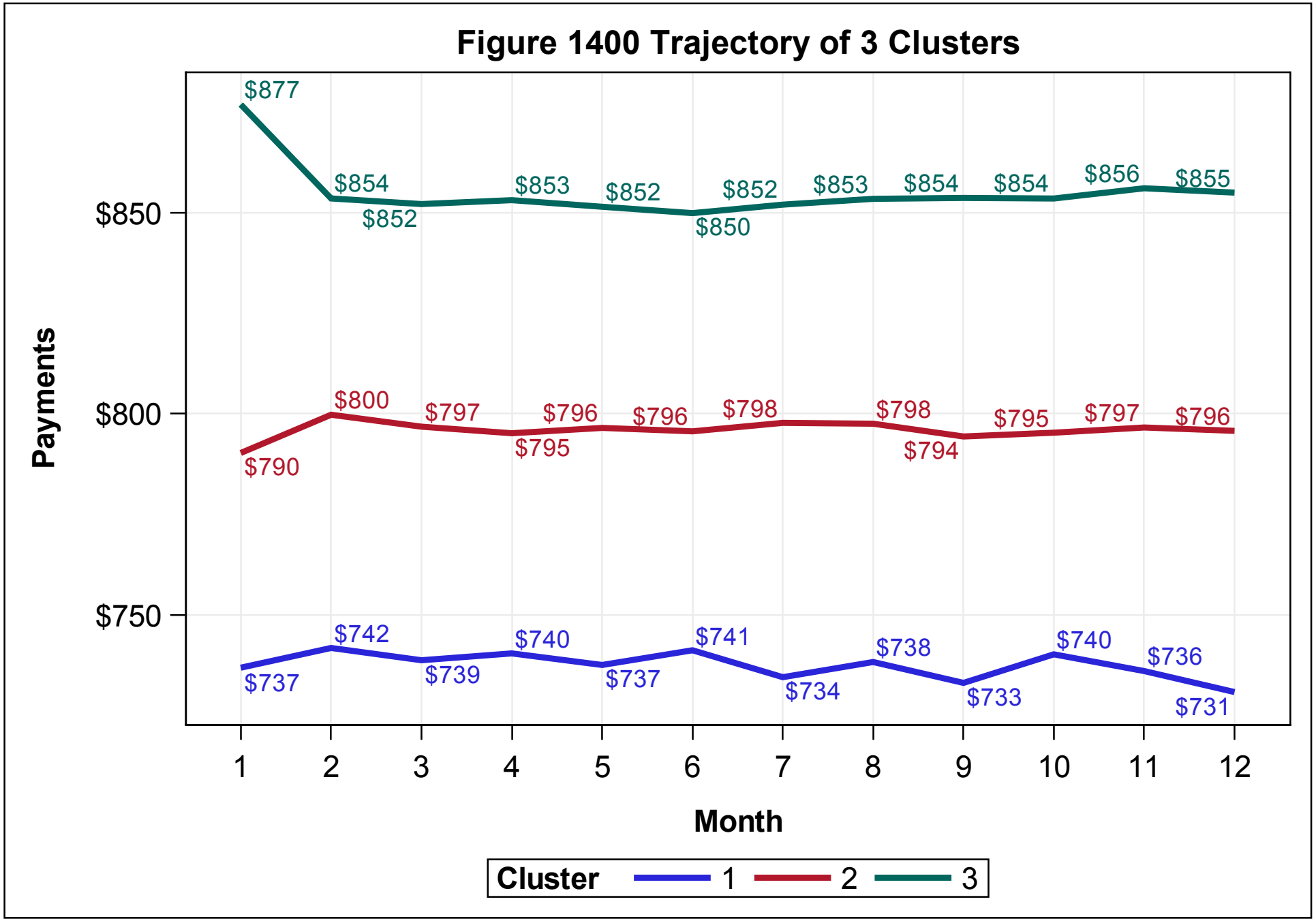


Figure 1400 Trajectory of 3 Clusters
Payments
$850
$800
$750
$877
$854
$852
$853
$852
$850
$852
$853
$854
$854
$856
$855
$790
$800
$797
$796
$795
$796
$798
$798
$794
$795
$797
$796
$737
$742
$739
$740
$737
$741
$734
$738
$733
$740
$736
$731
1
2
3
4
5
6
7
8
9
10
11
12
Month
Cluster
1
2
3

Figure 1500 Adjacent Months show the Strongest Correlation

Variable Correlations (Spearman)

Month Variable	Correlated With Month	Correlation Coef	Number of Obs
7	6	0.63	500
8	6	0.61	500
6	5	0.61	500
6	4	0.60	500
4	3	0.59	500
9	8	0.58	500
8	7	0.58	500
5	3	0.57	500
4	2	0.57	500
6	3	0.57	500
5	4	0.56	500
11	10	0.56	500
10	8	0.55	500
11	9	0.52	500
10	9	0.52	500
12	11	0.52	500

```
*;
* PROC TRAJ MULTIPLE MODELS;
*;
%macro cmmi_mdlchk(mdl);

%let cmpMdl=%sysfunc(compress(&mdl));
proc traj data = taj.taj_simulate

outplot =   taj.taj_mdlPlot12_&cmpMdl
outest  =    taj.taj_mdlEst12_&cmpMdl

outstat =   taj.taj_mdlStat12_&cmpMdl
out = taj.taj_mdlDetail12_&cmpMdl ci95M;

model order&cmpmdl;
id id;
var _1-_12 ;
risk  smoker carbs ;
indep t1-t12;

order &mdl;
min 600;
max 1000;
model cnorm;
run;quit;
%mend cmmi_mdlchk;
%cmmi_mdlchk(1 1    );
%cmmi_mdlchk(1 1 1  );

%cmmi_mdlchk(2 1 1 1);
%cmmi_mdlchk(1 1 1 1);
%cmmi_mdlchk(1 1 2  );

%cmmi_mdlchk(1 2 1  );
%cmmi_mdlchk(1 2 2  );
%cmmi_mdlchk(2 1 1  );

%cmmi_mdlchk(2 1 2  );
%cmmi_mdlchk(2 2 1  );
%cmmi_mdlchk(2 2 2  );

%cmmi_mdlchk(2 2 2 2);
```

Figure 1520 Calculating a Measure of Model Fit

Bayesian Information Criterion(BIC)
Relative Goodness of fit against the Null Model
BIC is preferred measure when not forcasting
Bays factor = log(2* (BICi - BIC Null Model))

```
data &pgm._bic2;
* merging many model BIC staistics;
merge

taj.taj_mdlEst12_11   (keep=_BIC2_ obs=1 rename=_bic2_=bicnull)

taj.taj_mdlEst12_111  (keep=_BIC2_ obs=1 rename=_bic2_=bic111 )

taj.taj_mdlEst12_1111 (keep=_BIC2_ obs=1 rename=_bic2_=bic1111)

taj.taj_mdlEst12_2111 (keep=_BIC2_ obs=1 rename=_bic2_=bic2111)

taj.taj_mdlEst12_112  (keep=_BIC2_ obs=1 rename=_bic2_=bic112 )

taj.taj_mdlEst12_121  (keep=_BIC2_ obs=1 rename=_bic2_=bic121 )

taj.taj_mdlEst12_122  (keep=_BIC2_ obs=1 rename=_bic2_=bic122 )

taj.taj_mdlEst12_211  (keep=_BIC2_ obs=1 rename=_bic2_=bic211 )

taj.taj_mdlEst12_212  (keep=_BIC2_ obs=1 rename=_bic2_=bic212 )

taj.taj_mdlEst12_221  (keep=_BIC2_ obs=1 rename=_bic2_=bic221 )

taj.taj_mdlEst12_222  (keep=_BIC2_ obs=1 rename=_bic2_=bic222 )

taj.taj_mdlEst12_2222 (keep=_BIC2_ obs=1 rename=_bic2_=bic2222)
;
run;quit;
```

```
data taj.&pgm._bicfits;
set &pgm._bic2;
* Improvements from null(two linear) Baysian Factor ;

fit111   =  log(2 * (bic111  - bicnull));
fit1111  =  log(2 * (bic1111 - bicnull));
fit2111  =  log(2 * (bic2111 - bicnull));
fit112   =  log(2 * (bic112  - bicnull));

fit121   =  log(2 * (bic121  - bicnull));
fit122   =  log(2 * (bic122  - bicnull));

fit211   =  log(2 * (bic211  - bicnull));
fit212   =  log(2 * (bic212  - bicnull));

fit221   =  log(2 * (bic221  - bicnull));
fit222   =  log(2 * (bic222  - bicnull));

fit2222  =  log(2 * (bic2222 - bicnull));
model=' 111  '; val=fit111  ;output;

model=' 1111 '; val=fit1111 ;output;
model=' 2111 '; val=fit2111 ;output;

model=' 112  '; val=fit112  ;output;
model=' 121  '; val=fit121  ;output;

model=' 122  '; val=fit122  ;output;
model=' 211  '; val=fit211  ;output;

model=' 212  '; val=fit212  ;output;
model=' 221  '; val=fit221  ;output;

model=' 222  '; val=fit222  ;output;
model=' 2222 '; val=fit2222 ;output;
keep model val;

run;quit;
```

Figure 1550 12 Month Food and Leisure Payments 211 Model

Model 211 Maximum Likelihood Estimates
Model: Censored Normal (CNORM)

Group	Parameter	Estimate	Standard Error	T for H0: Parameter=0	Prob > ,T,
1	Intercept	780.04984	4.27908	182.294	0.0000
	Linear	-8.93067	1.44128	-6.196	0.0000
	Quadratic	0.50581	0.10693	4.730	0.0000
2	Intercept	794.65186	1.70723	465.463	0.0000
	Linear	-0.65778	0.22172	-2.967	0.0030
3	Intercept	841.05985	2.37632	353.934	0.0000
	Linear	-1.25020	0.28762	-4.347	0.0000
	Sigma	36.55546	0.34009	107.487	0.0000
1	Constant	(0.00000)	.	.	.
2	Constant	8.41491	1.17340	7.171	0.0000
	SMOKER	1.04682	0.32543	3.217	0.0013
	CARBS	0.70553	0.10055	7.017	0.0000
3	Constant	14.41983	1.44100	10.007	0.0000
	SMOKER	2.06856	0.41146	5.027	0.0000
	CARBS	1.47508	0.13837	10.660	0.0000

BIC=-30462.80 (N=6000) BIC=-30445.40 (N=500) AIC=-30415.90 L=-30401

Group membership

1	(%)	20.95
2	(%)	50.16
3	(%)	28.89

Figure 1555 Time jittered Residual Plot for Quadratic and Two Linear Model (211)

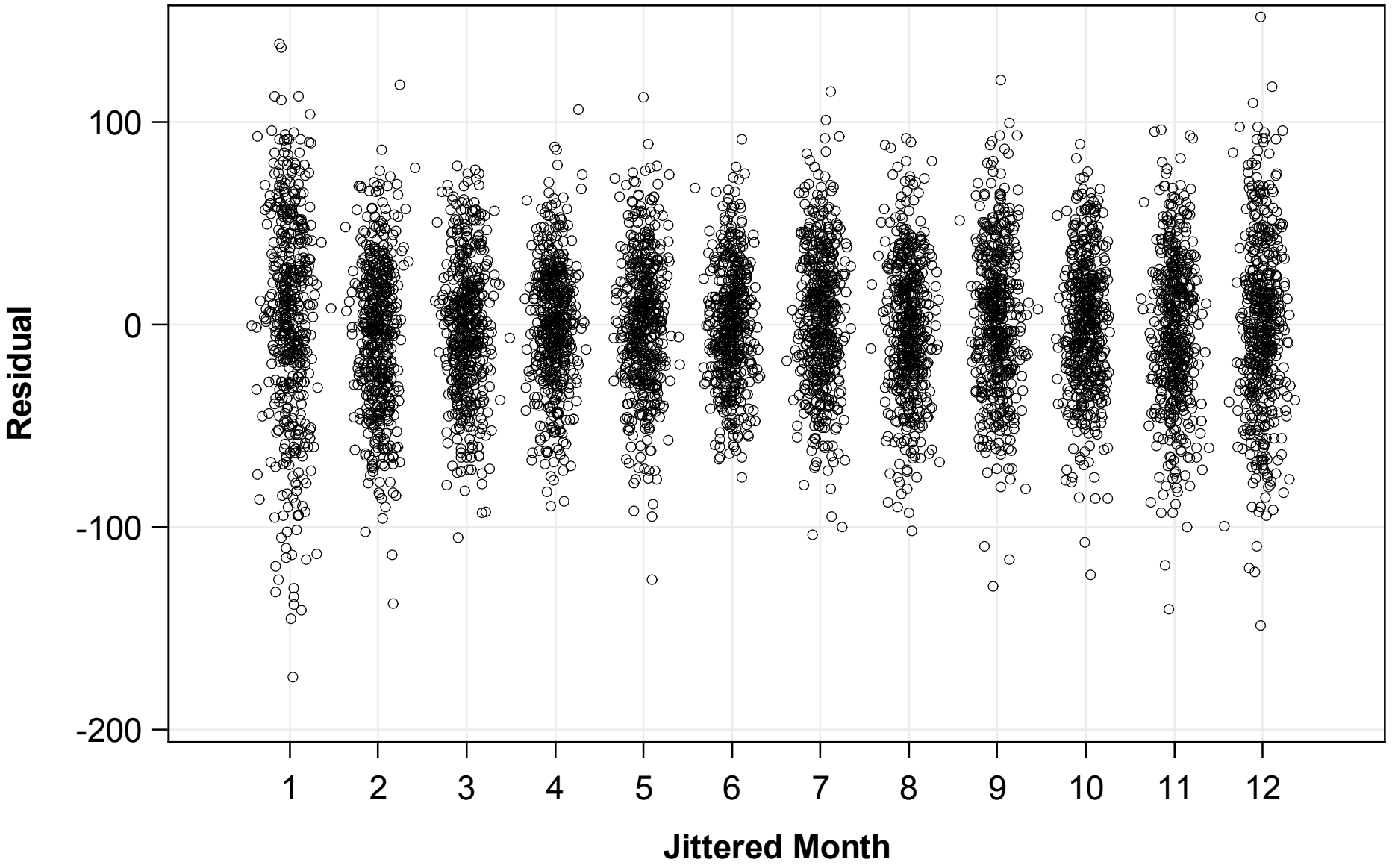
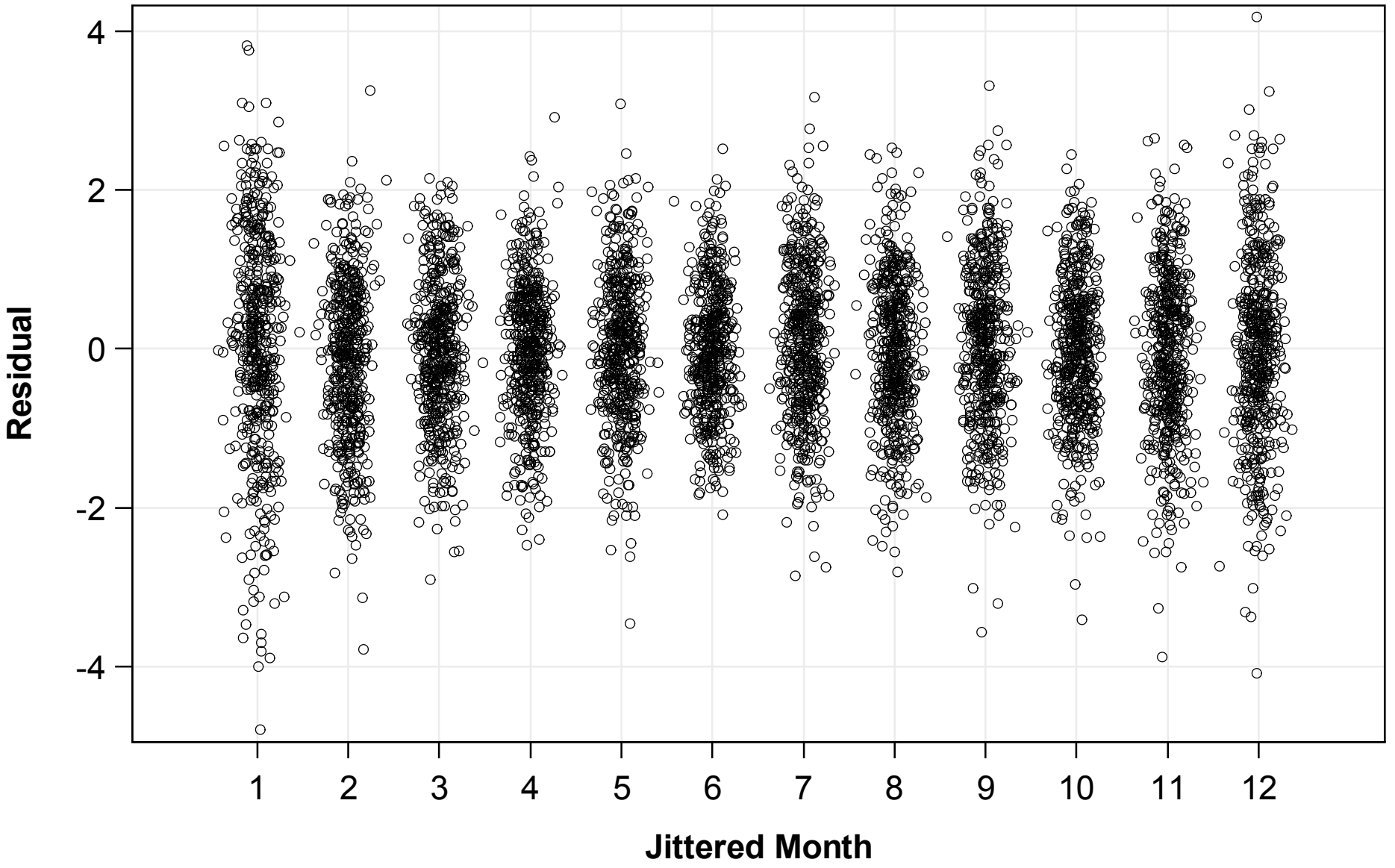


Figure 1565 Time jittered Standardized Residual Plot for Quadratic and Two Linear Model(211)



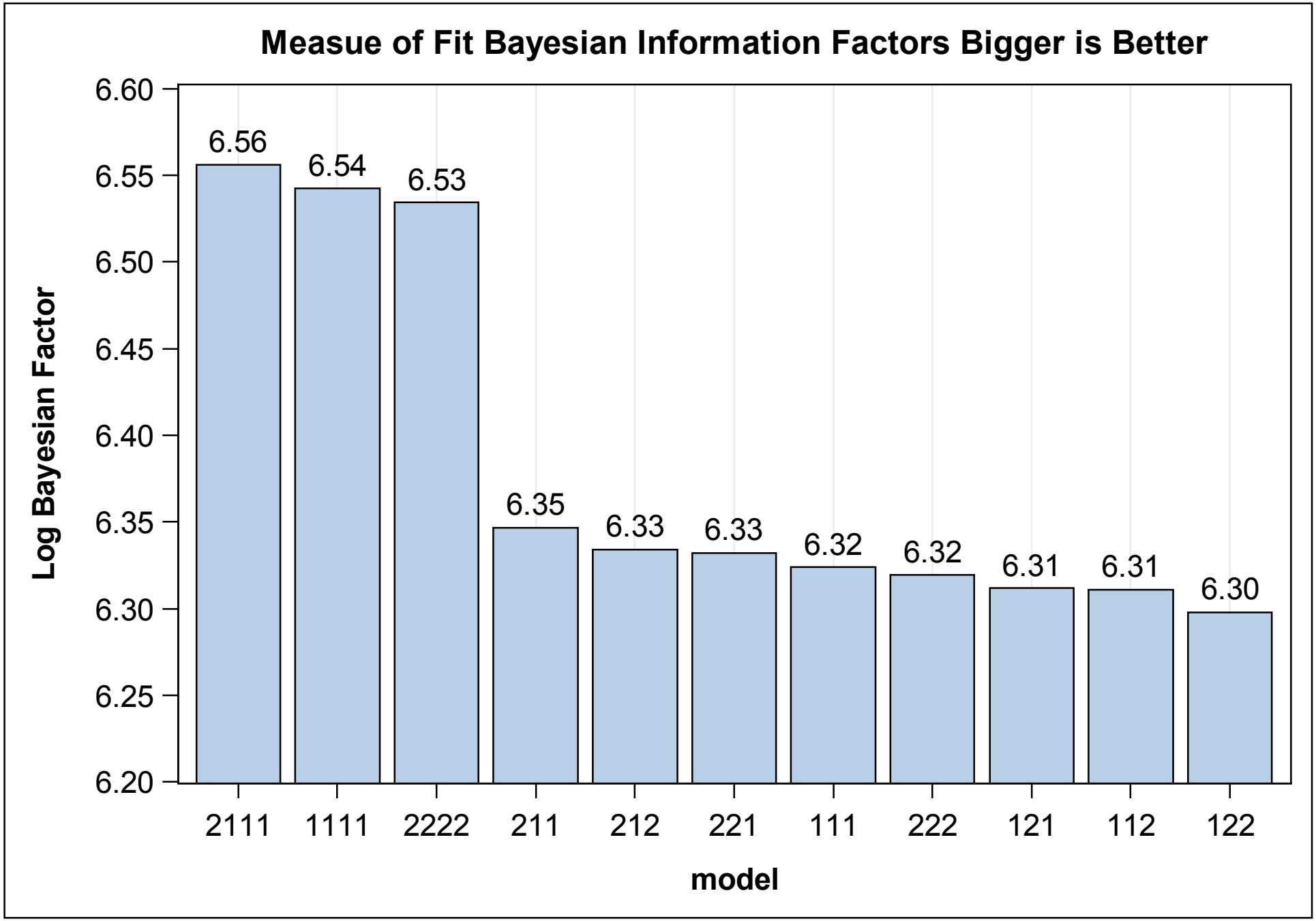

Measue of Fit Bayesian Information Factors Bigger is Better
Log Bayesian Factor
6.60
6.55
6.50
6.45
6.40
6.35
6.30
6.25
6.20
6.56
6.54
6.53
6.35
6.33
6.33
6.32
6.32
6.31
6.31
6.30
2111
1111
2222
211
212
221
111
222
121
112
122
model

Figure 1800 Fit Analysis and Residuals

Model 211 One Quadratic Two Linear

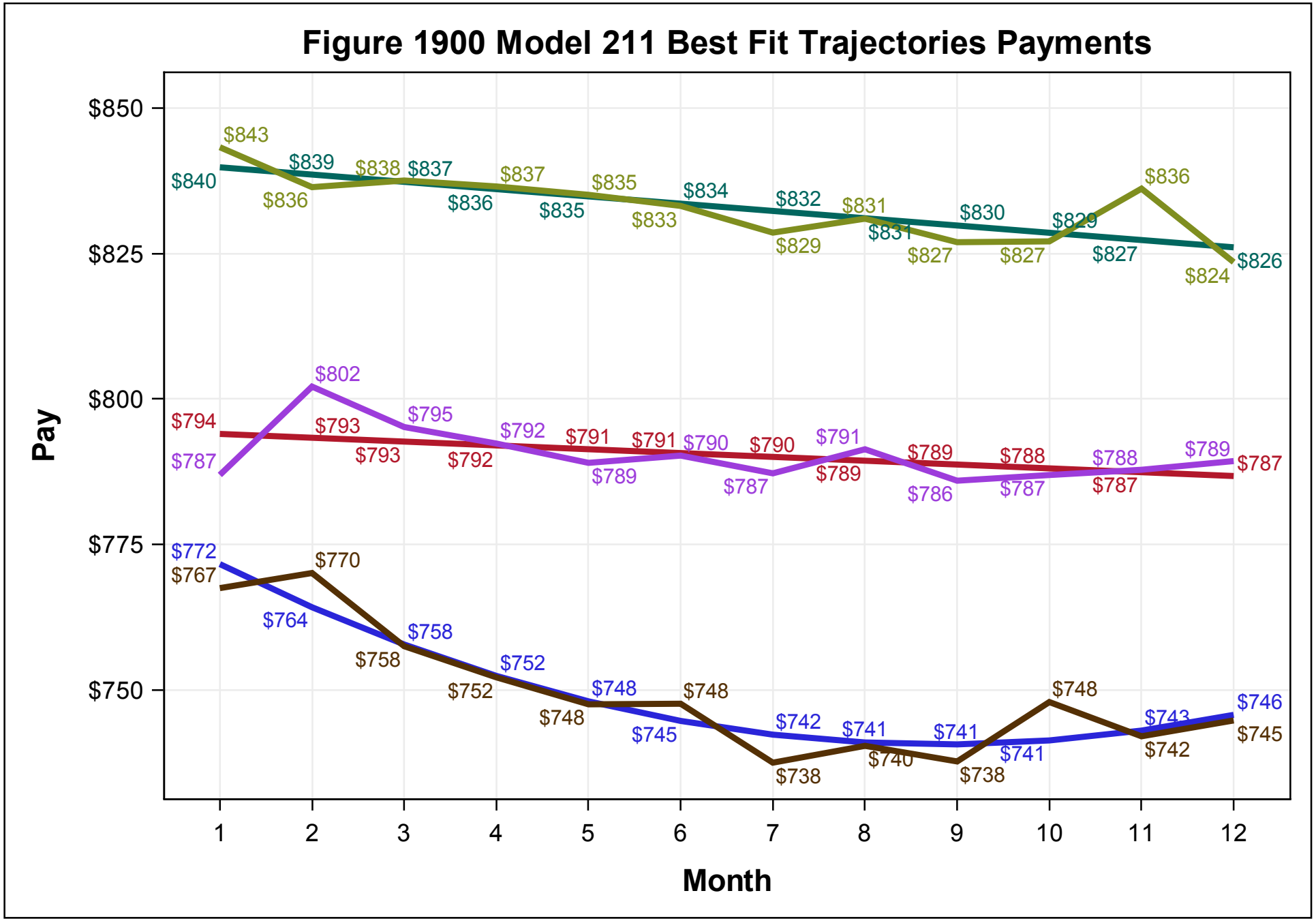


Figure 1900 Model 211 Best Fit Trajectories Payments
Pay
$850
$825
$800
$775
$750
Month
1
2
3
4
5
6
7
8
9
10
11
12
$843
$836
$839
$838
$837
$836
$837
$835
$835
$833
$834
$832
$829
$831
$831
$827
$830
$827
$829
$827
$836
$824
$840
$826
$794
$787
$802
$793
$793
$795
$792
$792
$791
$789
$791
$790
$787
$790
$791
$789
$789
$786
$788
$787
$788
$787
$789
$787
$772
$767
$770
$764
$758
$758
$752
$752
$748
$748
$748
$745
$742
$741
$741
$740
$741
$738
$748
$738
$743
$742
$746
$745

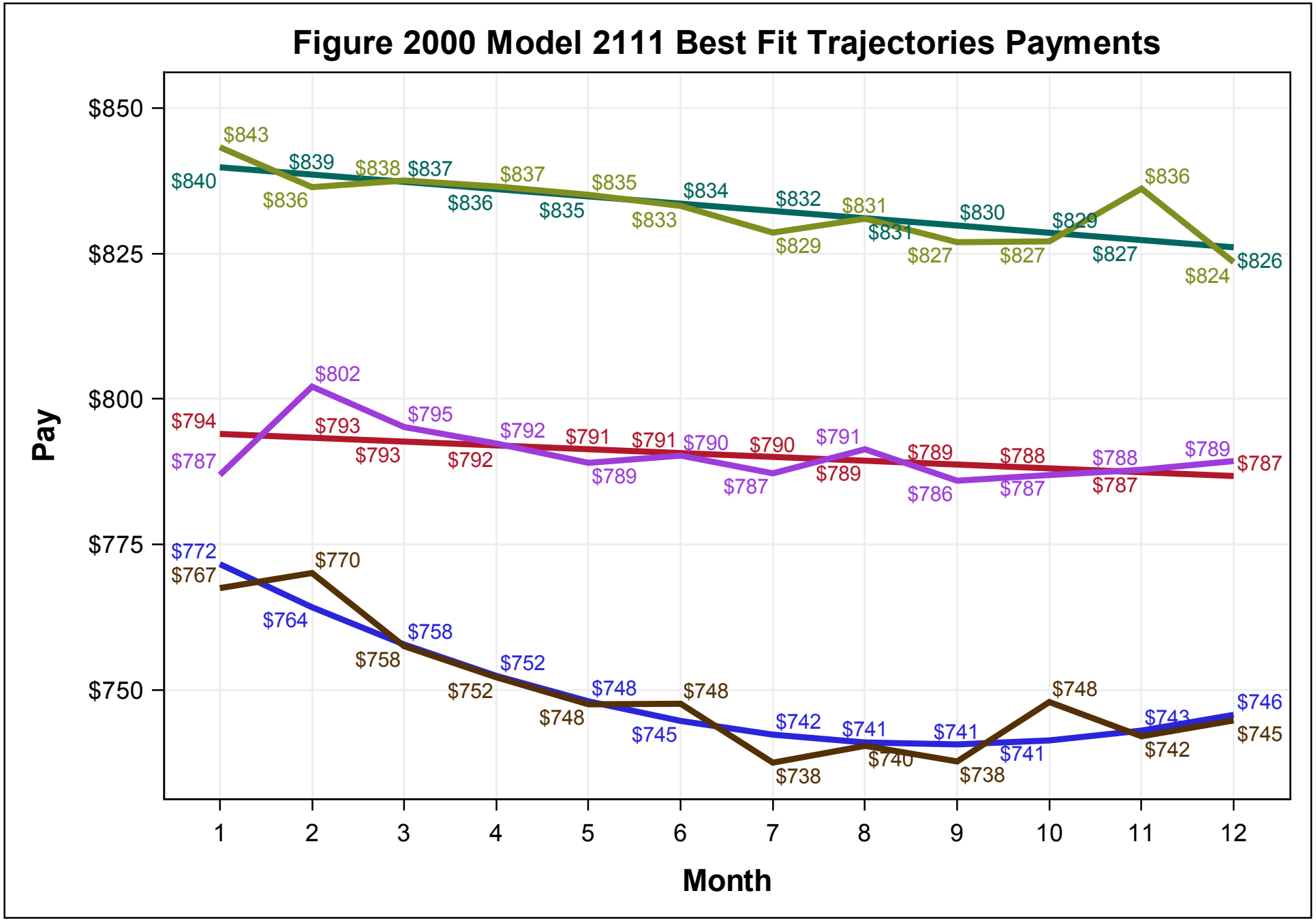


Figure 2000 Model 2111 Best Fit Trajectories Payments
Pay
$850
$825
$800
$775
$750
Month
1
2
3
4
5
6
7
8
9
10
11
12
$843
$836
$839
$838
$837
$836
$837
$835
$835
$833
$834
$832
$829
$831
$831
$830
$827
$829
$827
$836
$827
$824
$840
$826
$802
$794
$793
$795
$792
$793
$792
$791
$791
$789
$790
$790
$787
$791
$789
$787
$789
$786
$788
$787
$788
$787
$789
$787
$772
$770
$767
$764
$758
$758
$752
$752
$748
$748
$745
$748
$742
$741
$741
$740
$738
$738
$741
$748
$743
$742
$746
$745

Figure 2100 Classification seems a little more Accurate for the 211 model
Analysis will proceed wit the 211 Model (Quadratic and Two Linear)

		Classification Probabilities	
Model	**Trajectory**	**Frequency**	**Probability**
211	1. Low	104	0.93
	2. Moderate	249	0.94
	3. High	147	0.94
2111	1. Lowest	44	0.95
	2. Low	157	0.89
	3. High	190	0.88
	4. Highest	109	0.95

Figure 2200 Proc Traj Model Options

```
proc traj data = taj.taj_DoaClmMdl
      outplot = taj.taj_mdlPlotm4444
      outest  = taj.taj_mdlEstm4444
      outstat = taj.taj_mdlStatm4444
          out = taj.taj_mdlDetailm4444  ci95M;
  id bene_id;
  var _1-_12 ;
  indep t1-t12;
  risk age sexn white;
  order 4 4 4 4;
  min -8;
  max 16;
  model cnorm;
run;quit;
```

Figure 2300 12 Month Spending Quartic Trajectory Censored Normal (CNORM)

Group	Parameter	Estimate	Standard Error	T for H0: Parameter=0	Prob > ,T,
1	Intercept	9.92983	0.06978	142.301	0.0000
	Linear	-5.15324	0.07270	-70.886	0.0000
	Quadratic	1.07541	0.02193	49.033	0.0000
	Cubic	-0.09287	0.00247	-37.531	0.0000
	Quartic	0.00286	0.00009	30.593	0.0000
2	Intercept	4.99144	0.09673	51.604	0.0000
	Linear	3.44440	0.09334	36.902	0.0000
	Quadratic	-1.20220	0.02718	-44.226	0.0000
	Cubic	0.12346	0.00312	39.542	0.0000
	Quartic	-0.00408	0.00012	-33.838	0.0000
3	Intercept	8.08606	0.04155	194.612	0.0000
	Linear	-0.73841	0.04082	-18.091	0.0000
	Quadratic	0.04575	0.01149	3.981	0.0001
	Cubic	0.00245	0.00127	1.932	0.0533
	Quartic	-0.00024	0.00005	-4.908	0.0000
4	Intercept	5.99090	0.03727	160.763	0.0000
	Linear	1.94456	0.03580	54.318	0.0000
	Quadratic	-0.51693	0.01047	-49.379	0.0000
	Cubic	0.05200	0.00118	44.051	0.0000
	Quartic	-0.00182	0.00004	-40.386	0.0000

Group membership		
1	(%)	11.40
2	(%)	8.99
3	(%)	39.57
4	(%)	40.03

Figure 2400 12 Month Payments Quartic Model Covariates continued

Covariates					
1	Constant	(0.00000)	.	.	.
2	Constant	-1.51110	0.14052	-10.753	0.0000
	AGE	0.01754	0.00168	10.443	0.0000
	Sexn	-0.26847	0.03775	-7.111	0.0000
	White	0.02082	0.04781	0.436	0.6632
3	Constant	-1.28141	0.10357	-12.372	0.0000
	AGE	0.03034	0.00123	24.768	0.0000
	Sexn	-0.54964	0.02768	-19.855	0.0000
	White	0.40781	0.03638	11.208	0.0000
4	Constant	2.10539	0.09289	22.666	0.0000
	AGE	-0.00681	0.00113	-6.039	0.0000
	Sexn	-0.57921	0.02708	-21.392	0.0000
	White	-0.01461	0.03364	-0.434	0.6640

BIC= -1946840 (N=850476) BIC= -1946799 (N=70873) AIC= -1946648 L= -1946615

Figure 2500 INPUT Payments Proc Tjaj (Log of Spending)
Transposed Middle Observation(35436) of TAJ.TAJ_DOACLMMDL- Obs 70,873

bene_id	n8	33827648	unique beneficiary identifier
age	n8	91	age
sexn	n8	1	gender
white	n8	1	white non-hispanic
_1	N8	9.452	Payment Month of Death
_2	N8	8.984	Payment 1 Month prior
_3	N8	3.735	Payment 2 Months prior
_4	N8	3.473	Payment 3 Months prior
_5	N8	6.244	Payment 4 Months prior
_6	N8	6.155	Payment 5 Months prior
_7	N8	6.965	Payment 6 Months prior
_8	N8	5.154	Payment 7 Months prior
_9	N8	0	Payment 8 Months prior
_10	N8	0	Payment 9 Months prior
_11	N8	5.383	Payment 10 Months prior
_12	N8	0	Payment 11 Months prior
t1	N8	1	Month of Death
t2	N8	2	Month_1
t3	N8	3	Month_2
t4	N8	4	Month_3
t5	N8	5	Month_4
t6	N8	6	Month_5
t7	N8	7	Month_6
t8	N8	8	Month_7
t9	N8	9	Month_8
t10	N8	10	Month_9
t11	N8	11	Month_10
t12	N8	12	Month_11

Figure 2600 OUTSTAT 12 Month Quartic Spending Model Table

Trajectory Coeficiants (TAJ.TAJ_MDLSTATM4444)

	Intercepts	Linear	Quadratic	Cubic	Quartic		Group_Pct
Group	beta0	beta1	beta2	beta3	beta4	beta5	pi
1	9.92983	-5.15324	1.07541	-0.09287	0.0028614	.	11.4039
2	4.99144	3.44440	-1.20220	0.12346	-.0040840	.	8.9914
3	8.08606	-0.73841	0.04575	0.00245	-.0002354	.	39.5704
4	5.99090	1.94456	-0.51693	0.05200	-.0018163	.	40.0342

Figure 2700 OUTPLOT Proc Traj TAJ.TAJ_MDLPLOTM4444 Table Has 12 rows one per year

Transposed Middle Observation(6) of TAJ.TAJ_MDLPLOTM4444 - Total Obs 12

Variable Name	Type	Typical Value	Description
T	N8	6	Interval
AVG1	N8	1.451	Average 1
AVG2	N8	3.773	Average 2
AVG3	N8	5.588	Average 3
AVG4	N8	7.993	Average 4
PRED1	N8	1.373	Estimate 1
PRED2	N8	3.754	Estimate 2
PRED3	N8	5.527	Estimate 3
PRED4	N8	7.927	Estimate 4
L95M1	N8	1.342	Lower 95% C.I. for Mean Traj 1
U95M1	N8	1.404	Upper 95% C.I. for Mean Traj 1
L95M2	N8	3.665	Lower 95% C.I. for Mean Traj 2
U95M2	N8	3.842	Upper 95% C.I. for Mean Traj 2
L95M3	N8	5.501	Lower 95% C.I. for Mean Traj 3
U95M3	N8	5.552	Upper 95% C.I. for Mean Traj 3
L95M4	N8	7.909	Lower 95% C.I. for Mean Traj 4
U95M4	N8	7.945	Upper 95% C.I. for Mean Traj 4

Figure 2800 OUT Spending Transpose Proc Traj OUT Table
Middle Observation(35436) of OUT table taj.taj_mdlDetailm4444-Total Obs 70,873

Variable	Type	Value	Description
bene_id	N8	33827648	bene_id
group	N8	2	group
age	N8	91	age
sexn	N8	1	gender 1=Female
white	N8	1	white non_hispanic
_1	N8	9.452	Payment Month of Death
_2	N8	8.984	Payment 1 Month prior
_3	N8	3.735	Payment 2 Months prior
_4	N8	3.473	Payment 3 Months prior
_5	N8	6.244	Payment 4 Months prior
_6	N8	6.155	Payment 5 Months prior
_7	N8	6.965	Payment 6 Months prior
_8	N8	5.154	Payment 7 Months prior
_9	N8	0	Payment 8 Months prior
_10	N8	0	Payment 9 Months prior
_11	N8	5.383	Payment 10 Months prior
_12	N8	0	Payment 11 Months prior
t1	N8	1	Month of Death
t2	N8	2	Month_1
t3	N8	3	Month_2
t4	N8	4	Month_3
t5	N8	5	Month_4
t6	N8	6	Month_5
t7	N8	7	Month_6
t8	N8	8	Month_7
t9	N8	9	Month_8
t10	N8	10	Month_9
t11	N8	11	Month_10
t12	N8	12	Month_11
GRP1PRB	N8	0.000	Group 1 Probability
GRP2PRB	N8	0.748	Group 2 Probability
GRP4PRB	N8	4.28E-7	Group 4 Probability

Figure 2900 OUTEST Proc Traj OUT Table
OUTEST Middle Observation(17) of taj.taj_mdlEstm4444-Total Obs 35

VARIABLE	TYPE	TYPICAL VALUE
MODEL	C8	CNORM
NAME	C32	QUARTIC
LOGLIK	N8	-1946614.659
BIC1	N8	-1946798.942
BIC2	N8	-1946839.943
AIC	N8	-1946647.659
CONVERGE	N8	4
TYPE	C8	COV
INTERC1	N8	-5.352338E-8
LINEAR1	N8	3.3178097E-8
QUADRA1	N8	-1.022956E-8
CUBIC1	N8	1.1473296E-9
QUARTI1	N8	-4.27942E-11
INTERC2	N8	-4.527406E-7
LINEAR2	N8	5.1836362E-7
QUADRA2	N8	-1.684159E-7
CUBIC2	N8	1.9887737E-8
QUARTI2	N8	-7.65807E-10
INTERC3	N8	1.4941047E-6
LINEAR3	N8	-1.69301E-6
QUADRA3	N8	5.2513926E-7
CUBIC3	N8	-6.036748E-8
QUARTI3	N8	2.3016339E-9
INTERC4	N8	-1.587405E-7
LINEAR4	N8	1.6175198E-7
QUADRA4	N8	-5.039339E-8
CUBIC4	N8	5.689714E-9
QUARTI4	N8	-2.12274E-10
SIGMA1	N8	-1.55326E-10
CONST2	N8	-3.923857E-8
AGE2	N8	8.832212E-10
SEXN2	N8	-6.79816E-9
WHITE2	N8	3.6724712E-9
CONST3	N8	-2.177149E-8
SEXN3	N8	-4.094042E-9
WHITE3	N8	2.9785016E-9
CONST4	N8	-4.451533E-8
AGE4	N8	9.97755E-10
SEXN4	N8	-4.683381E-9
WHITE4	N8	1.1910441E-8