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Assessment of Fixed Variable Vs Stepwise Forecast Models to Predict Number of Soybean Pods with Beans Per Plant

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ABSTRACT

The purpose of this research is to compare soybean objective yield forecast models developed using stepwise variable selection procedures to fixed one or two variable models in seven northern states. Illinois data was employed to determine what variables to use in the fixed variable models. Results showed that over the six year analysis period (1977-1982) there was no significant difference in forecasts of the number of pods with beans per plant from either method. Further work is needed before the fixed models can be adopted.

Keywords: Stepwise variable selection, Jackknife analysis, Leverage point.

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SUMMARY

Fixed one or two variable regression models performed as well as stepwise created forecast models in predicting final numbers of pods with beans per plant. Data was analyzed for seven northern soybean objective yield states.

Six years of data 1977-1982 were used in a jackknife evaluation procedure. Models were created using six combinations of five years of data with the sixth year used as a forecast year. Stepwise models and fixed variable models were created from the data for each state by maturity category within month. The variables employed in the fixed models were determined from the Illinois data. Performance of the fixed and stepwise models across all seven states was evaluated using four forecast statistics: average deviation; average absolute deviation; root mean square error; and relative efficiency.

A trend analysis of the dependent and independent variables across all six years of data produced significant results for the three earliest maturity categories in month one. A significant relationship was uncovered between plant numbers and time.

Adopting these fixed variable models would simplify forecast model creation procedures, provide consistent and comparable relationships across years for forecasts of final numbers of pods with beans per plant; and possibly simplify late season data collection.

INTRODUCTION

Forecast models to predict pods with beans per plant in the soybean objective yield survey are presently developed using the five most recent years of data in a stepwise variable selection procedure. Number of pods with beans per plant at maturity in the six inch detailed count section is the dependent variable. The six candidate independent variables are counts of plants, mainstem nodes, blooms, pods, lateral branches, and simple transformations of these as listed in Table 1. A unique stepwise model is created for each maturity category for each state and month. Approximately 85 models are created each year for the seven northern soybean states of Illinois, Indiana, Iowa, Ohio, Minnesota, Missouri (District 1), and Nebraska.

The objective of this study is to compare regression models with one or two fixed variables to models developed using a stepwise variable selection procedure to forecast the final number of soybean pods with beans per plant.

Development of specific one or two variable forecast models to be applied in each maturity category within a month in all seven states would provide consistent and comparable relationships across years. The models will be less complex, and would permit field office personnel greater insight into yield forecasts. The data requirements for these models could reduce the number of late season data counts.

The variables selected for the fixed models were determined from Illinois data. The same fixed variable models are applied in all seven states. The analysis employed soybean objective yield data from seven northern soybean states over a six year period from 1977-1982. These states were tested as a group since they all grow indeterminant soybean varieties.

METHODS

The data for this study was collected in seven northern states from 1977 to 1982. This same data was used to create soybean objective yield forecast models for the operating program. All models for this analysis were developed using the same procedures as in the operating program. The first of the five steps in the analysis was to use an

TABLE 1 -- Independent Variables Used to Forecast Final Pods With Beans Per Plant, in the Soybean Objective Yield Program

Variable	Description
X8	(Plants per 18 sq. ft)^2, current month Form B.
X9	Mainstem nodes per plant, 6 inch row section, current month, if sample maturity category = 1 to 3.
X9	(Pods with developing beans per plant)^2, if sample maturity category = 4 to 10, 6 inch row section.
X10	Blooms and pods per plant, counts in 6 inch row sections, current month.
X12	Pods with developing beans per plant, counts in 6 inch row section, current month.
X14	Lateral branches with blooms or pods per plant, counts in 6 inch row sections, current month.
X15	Plants per 18 sq. ft., counts in 42 in row section, current month.

automated procedure to identify and remove the extreme outlier and leverage values from the raw data.

Outliers are data points that significantly influence the intercept of a model while leverage points significantly influence slopes. A regression model was created employing all six independent variables for each maturity category within state, month, and district. Two diagnostic statistics, the deleted residual and Cook's D, were then calculated for the raw data to identify outlier and leverage data points. Identified outliers and leverage points were removed by a SAS procedure (4).

The automated analysis procedure used to identify the outliers and leverage points examined the data four times. In each examination, regression coefficients and diagnostic statistics were calculated. On the first pass, regression statistics and diagnostics were computed for the entire data set. Outlier and leverage points were identified and excluded from further calculation. In the second pass, analysis was conducted on the remaining data. Outlier and leverage points were again identified and excluded from further calculation. During the third pass, observations which had been deleted during the first two passes were examined using a 95% confidence interval for an observable Y. Previously deleted values within this confidence interval were reinserted into the data set for final model calculation. On the fourth pass, final model parameters and diagnostics were computed. This automated procedure was used to create all the models in the analysis and is identical to the operational procedure now in use.

The second step in the analysis was to use the cleaned data from step 1 in a jackknife variable selection procedure. In the jackknife analysis the six years of data were divided into six combinations of five years of data. A separate stepwise analysis was applied to each five year period for each maturity category within month and state. A model specified by the stepwise selection procedure could contain up to six independent variables, many of which are highly correlated (See Appendix II). The same model variable combinations for the same maturity category, month, and state were rarely selected for different periods by the stepwise variable selection procedure.

In step three, Illinois data was examined to determine variables for one or two variable forecast models for comparison with the models specified by stepwise selection. A jackknife forecast procedure was used on the six five year periods of Illinois data to select the final models. Data was fit to each five year period with the sixth year used for forecasting. Average deviations, average absolute deviations, and root mean square errors for the six forecast years were compared to select the best one and two variable candidate models (See Table 2). An "all possible regressions" procedure applied to the Illinois data supported the models selected. The structural validity of the models was verified from an examination of partial regression plots and collinearity diagnostics.

Variables in most of the fixed variable forecast models showed a logical progression starting with plants and mainstem nodes in August to pods with beans in October. The models for maturity categories three and four in August were an exception to the expected progression of variables. This may be due to maturity category definitions. Maturity category three was defined by the absence of pods with beans and the ratio of total fruit to mainstem nodes greater than 1.75. Category four is defined as pods with beans present and the ratio of pods with beans to total fruit is less than .05. Appendix I contains descriptions of all maturity categories.

Table 2 -- Final Fixed Variable Models Selected From Illinois Data

Month	Maturity	Final Forecast Variables
Aug	1	Plants (X15), Mainstem nodes (X9)
Aug	2	Lateral branches with pods (X14), Plants (X15)
Aug	3	Lateral branches with pods (X14), Total blooms + pods (X10)
Aug	4	Lateral branches with pods (X14), Plants (X15)
Aug	5	Lateral branches with pods (X14) Total blooms + pods (X10)
Aug	6	Lateral branches with pods (X14), Total blooms + pods (X10)
Sept	5	Total blooms + pods (X10)
Sept	6	Total blooms + pods (X10), Pods with beans (X12)
Sept	7	Pods with beans (X12)
Sept	8	Pods with beans (X12)
Oct	7	Pods with beans (X12)
Oct	8	Pods with beans (X12)
Oct	9	Pods with beans (X12)

In the fourth step the stepwise models from step 2 and the fixed models from step 3 were compared using a jackknife forecast procedure for all seven states. This comparison simulated forecasting as long as a significant time trend was not present in the data.

Again stepwise and fixed model parameters were calculated using the automated diagnostic procedure for each of the six combinations of five year data. Model forecasts were created after each fit for the single year not selected to build the model. Forecast performance was evaluated, by state, on the basis of four statistics: average deviation, average absolute deviation, root mean square error, and relative efficiency. The first three statistics were produced for each of the six forecast years while the relative efficiency was calculated over the six years. The relative efficiency was defined as a ratio of the sum of squared errors (SSE) of the fixed model to those of the stepwise model. A relative efficiency of less than one indicated the fixed model produced smaller forecast errors than the stepwise model. To calculate relative efficiency the error sum of squares of both the numerator and denominator were aggregated separately then the ratio computed. To create the six year error sum of squares for a state, each of the six yearly error sum of squares is added together. The sampling rate within all states between years were quite similar, allowing count data to be appropriate. An aggregated relative efficiency was also computed over the seven states. A similar aggregation procedure for the error sum of squares was employed across states as was used within states. Comparing this across-state procedure to using average state acreages as weights produced little difference in the calculated values and no difference in conclusion.

The seven state relative efficiency was used to evaluate the performance of the final fixed models applied to all seven states versus the operational stepwise models. The model coefficients and their standard errors for the final models were examined for statistical differences over the six year period. The dependent and independent variables were also examined for trend relationships.

RESULTS

Correlation coefficients of the six independent variables were reviewed prior to construction of the fixed variable models. Appendix II lists the correlation coefficients of highly correlated variables by month and maturity category. It was subjectively decided to include variables in Appendix II where the absolute value of r was greater than .7. This table also lists the correlation coefficients of the independent variables in the final fixed forecast models. The table shows that the number of highly correlated variables increases as the plant develops during the growing season. It is no surprise that these variables are highly correlated when their data collection definitions are examined (See Table 1). Forecast models developed using the current stepwise procedures tend to include those highly correlated variables. The result is marginally higher R^2 values and a marginal increase in the variability in estimates of the model parameters.

The relative efficiencies of the forecasts from the final fixed models, applied across all seven states, are presented in Table 3. The fixed models generally had smaller mean squared errors than the stepwise models. Of the four maturity categories where the fixed models were outperformed by stepwise, only one maturity category in August had difference in MSE greater than 2%.

TABLE 3 - Aggregated Relative Efficiencies of Fixed Models vs Stepwise Models in Seven Northern States, 1977-82

Month	Maturity	Final Forecast Variables 3/	Agregated RE
Aug	1	Plants (X15). Mainstem nodes (X9)	1.01
Aug	2	Lateral branches with pods (X14), Plants (X15)	.84
Aug	3	Lateral branches with pods (X14), Total blooms + pods (X10)	1.08
Aug	4	Lateral branches with pods (X14), Plants (X15)	.96
Aug	5	Lateral branches with pods (X14), Total blooms + pods (X10)	1.00
Aug	6	Lateral branches with pods (X14), Total blooms + pods (X10)	.78
Sept	5 1/	Total blooms + pods (X10)	.73
Sept	6	Total blooms + pods (X10), Pods with beans (X12)	1.02
Sept	7	Pods with beans (X12)	1.02
Sept	8	Pods with beans (X12)	.97
Oct	7 2/	Pods with beans (X12)	.65
Oct	8	Pods with beans (X12)	.88
Oct	9	Pods with beans (X12)	.99

1/ Data for Iowa only.
2/ Data for Missouri only.
3/ See Table 1 for complete description of variables.

Relative efficiencies of the fixed models are presented by state in Table 4. The RE for each state is aggregated over the six forecast years. Data is not collected for Nebraska in August.

A test of equality was applied to determine if differences in MSE's produced by fixed and stepwise models were statistically significant. Since objective yield forecasts are produced by month, the MSE's of the number of pods per plant forecasts were compared by month over the six year period. A weighted average monthly MSE was created by weighting the MSE's within a month by number of observations per maturity category, summing over all seven states and dividing by the total number of observations. These results are presented in Table 5.

Table 4- Relative Efficiencies of Fixed Models by State, 1977-1982

Month	Maturity Category	Forecast Variables	Relative Efficiency							
			Ill	Ind	Iowa	Minn	Mo	Ohio	Neb	Aggregated RE
Aug	1	X15 X9	1.08	1.00	1.05	.92	1.02	.99	-	1.01
Aug	2	X14 X15	.97	.93	.94	.32	.86	.97	-	.84
Aug	3	X14 X10	1.09	.99	1.25	.97	.99	1.07	-	1.08
Aug	4	X14 X15	1.05	.90	.99	.74	-	.92	-	.96
Aug	5	X14 X10	.90	.96	1.03	1.35	-	.85	-	1.00
Aug	6	X10 X14	.77	.66	.75	-	-	1.15	-	.78
Sept	5	X10	-	-	.73	-	-	-	-	.73
Sept	6	X12 X10	1.02	1.04	1.05	1.03	1.01	1.06	.94	1.02
Sept	7	X12	1.02	.95	1.01	1.00	1.08	1.01	1.18	1.02
Sept	8	X12	.94	.95	.99	1.03	.96	.99		.97
Oct	7	X12	-	-	-	-	.65	-	-	.65
Oct	8	X12	1.01	.62	.98	1.28	.85	1.00	.59	.88
Oct	9	X12	.99	1.01	.99	.99	.95	.98	1.00	.99

Table 5 - Sign Test of Weighted Average Mean Squared Errors, Across All States, by Forecast Month and Year

Month	Model	1977	1978	1979	1980	1981	1982
Aug	Fixed	87	109	108	92	94	111
	Stepwise	101	109	107	97	100	109
	Sign	-	0	+	-	-	+
Sept	Fixed	16.3	20.8	20.5	16.8	21.8	21.0
	Stepwise	16.6	22.0	20.4	16.9	20.7	19.9
	Sign	-	-	-	-	+	+
Oct	Fixed	3.92	4.29	4.28	2.60	3.32	4.42
	Stepwise	3.84	3.46	4.78	2.58	3.41	5.78
	Sign	+	+	-	+	-	-

A nonparametric sign test was used to determine if a significant difference between MSE's existed. This was necessary since the assumption of independence necessary for an F test was violated. The hypotheses were:

$$H_0: \quad MSE(STEPWISE) = MSE(FIXED), P[+] = .5$$

$$H_1: \quad MSE(STEPWISE) < MSE(FIXED), P[+] > .5$$

The data for each month in Table 5 is a binomial distribution b(6, .5) under the null hypothesis which should be rejected for large numbers of plus signs. The rejection region was established at 5 or more plus signs with an alpha level of significance of 0.109. Power curves were constructed to find the rejection region which best controlled Type I and Type II errors. The null hypothesis is not rejected for any month, indicating no difference between fixed or stepwise forecast MSE's. Monthly MSEs are given for the models for each of the seven states in Appendix III.

The model coefficients and their standard errors for the final fixed forecast models were next examined. The coefficients for almost all models in all states were found to be stable in sign, order of magnitude, and significantly different from zero. An example of the Illinois and Indiana coefficients and standard errors is found in Appendix IV.

Finally a trend analysis was completed on the six years of data for all variables by state, month, and maturity. Weak trends, ($b \neq 0, \alpha = 0.1$ with $R^2 = 0.04$), for the dependent variable were found for maturity categories 1 to 3 in month 1 and maturity categories 8 and 9 in month 3. These results would weaken the forecast analysis from the Jackknife procedure but would not invalidate the fixed versus stepwise model comparison (Twenty out of seventy nine models were thus influenced). Weak trends for the numbers of plants variable were found across almost all categories and months where the correlation coefficient was not equal to zero with $\alpha = 0.2$.

CONCLUSIONS

A weak time trend was uncovered for about a fourth of the models in the analysis. This fact would weaken the use of a jackknife procedure in evaluating true forecast performances but not invalidate model comparisons. For the models where a significant time trend or an external mechanism related to time did not exist in the data, a jackknife procedure could be used to evaluate forecast performance. This procedure, which is a test of regression fit, in Illinois and forecast performance for the other six states was used due to the limited amount of data available. The fixed models performed as well as the stepwise models in forecasting the number of pods per plant during the analysis period. Adoption of a set of fixed models for maturity categories within month, applied across all seven states would greatly simplify forecast model creation procedures and model performance evaluation. Consistent relationships between the final number of pods with beans and the independent variables could give field office personnel greater insight into objective yield forecast procedures.

Although the jackknife analysis has shown that forecasts of the number of pods with beans per plant can be made using a "standard" set of one or two variable regression models, it is recommended that a bootstrap test be conducted before adoption of these models in the seven northern states. We also recommend that the entire analysis should be conducted on the remaining soybean objective yield states before any changes are implemented.

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APPENDIX I - SOYBEAN OBJECTIVE YIELD MATURITY CATEGORY DEFINITIONS

Maturity Category	Description
0	No plants were present in either row of the two 6-inch row section.
1	No pods with beans are present and the ratio of total fruit to mainstem nodes is less than .20.
2	No pods with beans are present and the ratio of total fruit to mainstem nodes is between .20 and 1.75.
3	No pods with beans are present and the ratio of total fruit to mainstem nodes is greater than 1.75.
4	Pods with beans are present and the ratio of pods with beans to total fruit is less than .05.
5	The ratio of pods with beans to total fruit is between .05 and .2.
6	The ratio of pods with beans to total fruit is between .20 and .65.
7	The ratio of pods with beans to total fruit is between .65 and .85.
8	Pods filled, leaves turning yellow or the ratio of pods with beans to total fruit is greater than .85.
9	Pods turning brown, leaves shedding.
10	Pods brown, almost mature or pods mature.

APPENDIX II - CORRELATION COEFFICIENTS OF SELECTED VARIABLES,[1/] 1977-82

Month	Maturity Category	Indep. Variable With |r| > .7 Variables		r	Pr > |r|	r of Variables in Final Models Variables		r	Pr > |r|
Aug.	1	X15	X8	.948	.0001	X15	X9	-.072	.0455
	2	X15	X8	.951	.0001	X14	X15	-.199	.0001
	3	X15	X8	.959	.0001	X14	X10	.466	.0001
	4	X15	X8	.957	.0001	X14	X15	-.389	.0001
		X12	X9	.916	.0001				
	5	X15	X8	.958	.0001	X14	X10	.644	.0001
		X12	X9	.936	.0001				
		X12	X10	.734	.0001				
	6	X15	X8	.948	.0001	X14	X10	.691	.0001
		X12	X9	.903	.0001				
		X12	X10	.794	.0001				
		X10	X9	.717	.0001				
Sept.	5[2/]	X15	X8	.948	.0001	X10		-	-
		X12	X9	.903	.0001				
		X12	X10	.794	.0001				
		X10	X9	.717	.0001				
	6	X15	X8	.940	.0001	X10	X12	.871	.0001
		X12	X9	.899	.0001				
		X12	X10	.871	.0001				
		X10	X9	.799	.0001				
	7	X15	X8	.924	.0001	X12		-	-
		X12	X9	.923	.0001				
		X12	X10	.984	.0001				
		X10	X9	.904	.0001				
	8	X15	X8	.962	.0001	X12		-	-
		X12	X9	.938	.0001				
		X12	X10	.992	.0001				
		X10	X9	.919	.0001				

Month	Maturity Category	Indep. Variable With |r| >.7 Variables		r	Pr > |r|	r of Variables in Final Models Variables	r	Pr > |r|
Oct.	7[3/]	X15	X8	.962	.0001	X12	-	-
		X12	X9	.938	.0001			
		X12	X10	.992	.0001			
		X10	X9	.919	.0001			
	8	X15	X8	.901	.0001	X12	-	-
		X12	X9	.902	.0001			
		X12	X10	.979	.0001			
		X10	X9	.878	.0001			
	9	X15	X8	.932	.0001	X12	-	-
		X12	X9	.930	.0001			
		X12	X10	.969	.0001			
		X10	X9	.901	.0001			

1/ Correlation coefficients were computed across all seven states by month and maturity category.
2/ Data for Iowa only.
3/ Data for Missouri only.

APPENDIX III MEAN SQUARE ERRORS BY STATE, MODEL, AND YEAR OF PODS PER PLANT FORECASTS FROM FIXED (F) VERSUS STEPWISE (S) MODELS[1/]

Illinois (17)

Month	Model	1977	1978	1979	1980	1981	1982
Aug	F	80	102	93	87	73	86
	S	97	101	88	81	75	81
Sept	F	11	13	17	18	18	18
	S	11	13	16	18	17	18
Oct	F	4	4	10	2	4	4
	S	4	4	8	2	4	4

Indiana (18)

Month	Model	1977	1978	1979	1980	1981	1982
Aug	F	103	145	111	67	92	95
	S	114	148	102	106	85	93
Sept	F	21	28	31	17	37	17
	S	21	28	31	18	36	19
Oct	F	4	6	4	3	3	3
	S	4	2	9	3	3	3

Iowa (19)

Month	Model	1977	1978	1979	1980	1981	1982
Aug	F	66	101	99	97	97	110
	S	74	99	94	80	83	118
Sept	F	16	24	21	24	20	28
	S	16	29	22	23	20	25
Oct	F	3	4	5	5	4	5
	S	3	4	5	5	4	5

Minnesota (27)

Month	Model	1977	1978	1979	1980	1981	1982
Aug	F	64	-	54	67	57	49
	S	105	-	54	94	116	27
Sept	F	12	-	15	8	16	19
	S	13	-	16	8	13	17
Oct	F	5	-	3	2	3	4
	S	4	-	3	2	3	3

Missouri (29)

Month	Model	1977	1978	1979	1980	1981	1982
Aug	F	179	-	249	167	194	292
	S	205	-	265	160	196	290
Sept	F	28	39	25	19	29	35
	S	28	38	26	19	27	31
Oct	F	6	5	5	3	5	5
	S	6	5	5	3	5	9

Nebraska (31)

Month	Model	1977	1978	1979	1980	1981	1982
Aug	F	-	-	-	-	-	-
	S	-	-	-	-	-	-
Sept	F	8	12	12	13	-	-
	S	9	12	11	12	-	-
Oct	F	3	2	2	3	2	6
	S	2	1	2	2	2	9

Ohio (39)

Month	Model	1977	1978	1979	1980	1981	1982
Aug	F	77	93	94	77	78	51
	S	74	92	97	75	83	54
Sept	F	18	16	19	14	17	15
	S	17	16	18	14	16	14
Oct	F	2	3	2	2	2	2
	S	2	2	2	2	2	2

1/ The monthly MSE was constructed by weighting the MSE of each maturity category within the month using the number of observations per maturity category as weights.

APPENDIX IV: FIXED MODEL COEFFICIENTS AND STANDARD ERRORS FOR THE SIX JACKKNIFE RUNS IN ILLINOIS AND INDIANA

Model coefficients and standard errors of fixed variable forecast models, for Illinois and Indiana, are listed by maturity category within month. There are six sets of coefficients for each model which correspond to the six forecast years starting with 1977 and ending with 1982.

ST=17 MUN=1 MAT=1

INT	SE1	X12	SE12	X10	SE10	X14	SE14	X15	SE15	X9	SE9
18.897	3.255	0.000	0.000	0.000	0.000	0.000	0.000	-0.159	0.028	1.130	0.289
12.008	3.867	0.000	0.000	0.000	0.000	0.000	0.000	-0.079	0.039	1.495	0.310
17.210	2.820	0.000	0.000	0.000	0.000	0.000	0.000	-0.153	0.026	1.315	0.241
16.632	3.278	0.000	0.000	0.000	0.000	0.000	0.000	-0.143	0.030	1.279	0.288
14.006	3.296	0.000	0.000	0.000	0.000	0.000	0.000	-0.139	0.031	1.586	0.285
17.231	2.834	0.000	0.000	0.000	0.000	0.000	0.000	-0.161	0.028	1.347	0.243

ST=17 MUN=1 MAT=2

INT	SE1	X12	SE12	X10	SE10	X14	SE14	X15	SE15	X9	SE9
31.550	2.455	0.000	0.000	0.000	0.000	7.261	1.044	-0.257	0.048	0.000	0.000
27.453	2.743	0.000	0.000	0.000	0.000	8.047	1.207	-0.185	0.056	0.000	0.000
30.124	2.513	0.000	0.000	0.000	0.000	6.554	1.028	-0.199	0.049	0.000	0.000
27.609	2.633	0.000	0.000	0.000	0.000	7.666	1.060	-0.184	0.051	0.000	0.000
24.362	2.653	0.000	0.000	0.000	0.000	7.756	1.077	-0.126	0.050	0.000	0.000
31.451	2.365	0.000	0.000	0.000	0.000	7.171	0.951	-0.250	0.047	0.000	0.000

ST=17 MUN=1 MAT=3

INT	SE1	X12	SE12	X10	SE10	X14	SE14	X15	SE15	X9	SE9
15.610	1.710	0.000	0.000	0.221	0.042	4.410	0.806	0.000	0.000	0.000	0.000
14.605	1.748	0.000	0.000	0.263	0.042	3.329	0.781	0.000	0.000	0.000	0.000
13.675	1.952	0.000	0.000	0.274	0.052	3.703	0.826	0.000	0.000	0.000	0.000
12.209	1.745	0.000	0.000	0.297	0.039	3.525	0.806	0.000	0.000	0.000	0.000
9.249	1.670	0.000	0.000	0.308	0.038	3.726	0.841	0.000	0.000	0.000	0.000
14.408	1.609	0.000	0.000	0.303	0.036	2.244	0.749	0.000	0.000	0.000	0.000

ST=17 MUN=1 MAT=4

INT	SE1	X12	SE12	X10	SE10	X14	SE14	X15	SE15	X9	SE9
36.779	3.089	0.000	0.000	0.000	0.000	4.623	0.744	-0.311	0.049	0.000	0.000
38.249	2.950	0.000	0.000	0.000	0.000	4.158	0.652	-0.318	0.048	0.000	0.000
34.141	3.308	0.000	0.000	0.000	0.000	4.633	0.867	-0.246	0.048	0.000	0.000
38.080	3.003	0.000	0.000	0.000	0.000	4.185	0.650	-0.332	0.048	0.000	0.000
39.177	2.979	0.000	0.000	0.000	0.000	4.212	0.632	-0.347	0.049	0.000	0.000
39.533	3.072	0.000	0.000	0.000	0.000	3.820	0.660	-0.336	0.053	0.000	0.000

ST=17 MUN=1 MAT=5

INT	SE1	X12	SE12	X10	SE10	X14	SE14	X15	SE15	X9	SE9
10.524	2.104	0.000	0.000	0.298	0.046	1.533	1.279	0.000	0.000	0.000	0.000
10.923	2.116	0.000	0.000	0.227	0.041	4.478	1.083	0.000	0.000	0.000	0.000
11.404	2.034	0.000	0.000	0.238	0.040	3.903	1.035	0.000	0.000	0.000	0.000
8.371	2.260	0.000	0.000	0.250	0.041	4.330	1.107	0.000	0.000	0.000	0.000
12.698	2.180	0.000	0.000	0.193	0.041	4.283	1.023	0.000	0.000	0.000	0.000
17.308	2.262	0.000	0.000	0.146	0.047	3.266	1.096	0.000	0.000	0.000	0.000

ST=17 MUN=1 MAT=6

INT	SE1	X12	SE12	X10	SE10	X14	SE14	X15	SE15	X9	SE9
4.440	2.032	0.000	0.000	0.410	0.037	-0.578	0.757	0.000	0.000	0.000	0.000
6.092	1.760	0.000	0.000	0.380	0.032	0.528	0.668	0.000	0.000	0.000	0.000
6.484	1.663	0.000	0.000	0.384	0.030	0.017	0.600	0.000	0.000	0.000	0.000
5.604	1.710	0.000	0.000	0.392	0.032	-0.035	0.619	0.000	0.000	0.000	0.000
5.756	1.712	0.000	0.000	0.389	0.031	-0.013	0.622	0.000	0.000	0.000	0.000
7.918	2.414	0.000	0.000	0.347	0.057	0.330	1.033	0.000	0.000	0.000	0.000

ST=17 MON=2 MAT=6

INT	SE1	X12	SE12	X10	SE10	X14	SE14	X15	SE15	X9	SE9
1.197	0.377	0.786	0.032	0.036	0.018	0.000	0.000	0.000	0.000	0.000	0.000
0.792	0.368	0.825	0.030	0.021	0.017	0.000	0.000	0.000	0.000	0.000	0.000
1.102	0.439	0.712	0.036	0.079	0.020	0.000	0.000	0.000	0.000	0.000	0.000
0.871	0.407	0.777	0.037	0.045	0.021	0.000	0.000	0.000	0.000	0.000	0.000
1.147	0.392	0.805	0.033	0.024	0.019	0.000	0.000	0.000	0.000	0.000	0.000
0.992	0.402	0.846	0.032	0.012	0.018	0.000	0.000	0.000	0.000	0.000	0.000

ST=17 MON=2 MAT=7

INT	SE1	X12	SE12	X10	SE10	X14	SE14	X15	SE15	X9	SE9
0.254	0.362	0.902	0.010	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.895	0.360	0.884	0.010	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.874	0.419	0.878	0.011	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.854	0.403	0.907	0.011	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.850	0.405	0.881	0.011	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.754	0.430	0.887	0.011	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

ST=17 MON=2 MAT=8

INT	SE1	X12	SE12	X10	SE10	X14	SE14	X15	SE15	X9	SE9
-0.754	0.362	0.948	0.009	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-0.243	0.364	0.935	0.009	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-0.400	0.395	0.933	0.010	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-0.440	0.365	0.941	0.009	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-0.873	0.416	0.956	0.010	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-0.341	0.422	0.931	0.010	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

ST=17 MON=3 MAT=7

INT	SE1	X12	SE12	X10	SE10	X14	SE14	X15	SE15	X9	SE9
0.119	0.567	0.972	0.026	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.564	0.746	0.963	0.034	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.119	0.567	0.972	0.026	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.119	0.567	0.972	0.026	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

ST=17 MON=3 MAT=8

INT	SE1	X12	SE12	X10	SE10	X14	SE14	X15	SE15	X9	SE9
-0.715	0.224	0.973	0.006	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-0.525	0.260	0.979	0.007	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-0.678	0.219	0.974	0.006	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-0.701	0.192	0.974	0.006	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-0.838	0.205	0.974	0.006	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-0.403	0.254	0.958	0.008	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

ST=17 MON=3 MAT=9

INT	SE1	X12	SE12	X10	SE10	X14	SE14	X15	SE15	X9	SE9
-0.353	0.154	0.996	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-0.507	0.167	1.001	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-0.204	0.145	0.996	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-0.368	0.157	0.997	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-0.333	0.162	0.995	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-0.146	0.161	0.990	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

ST=10 MUN=1 MAT=1

INT	SE1	X12	SE12	X10	SE10	X14	SE14	X15	SE15	X9	SE9
10.352	3.257	0.000	0.000	0.000	0.000	0.000	0.000	-0.164	0.042	1.515	0.303
12.422	4.070	0.000	0.000	0.000	0.000	0.000	0.000	-0.149	0.054	2.110	0.420
14.553	3.657	0.000	0.000	0.000	0.000	0.000	0.000	-0.124	0.046	1.702	0.328
13.325	3.190	0.000	0.000	0.000	0.000	0.000	0.000	-0.144	0.039	1.957	0.310
13.711	3.086	0.000	0.000	0.000	0.000	0.000	0.000	-0.117	0.039	1.678	0.287
14.673	3.026	0.000	0.000	0.000	0.000	0.000	0.000	-0.135	0.039	1.736	0.289

ST=10 MUN=1 MAT=2

INT	SE1	X12	SE12	X10	SE10	X14	SE14	X15	SE15	X9	SE9
37.895	2.503	0.000	0.000	0.000	0.000	3.221	0.857	-0.304	0.053	0.000	0.000
32.308	2.765	0.000	0.000	0.000	0.000	4.130	0.945	-0.187	0.057	0.000	0.000
35.042	3.101	0.000	0.000	0.000	0.000	3.165	1.144	-0.244	0.067	0.000	0.000
34.908	2.904	0.000	0.000	0.000	0.000	3.225	1.013	-0.247	0.060	0.000	0.000
34.950	2.839	0.000	0.000	0.000	0.000	2.382	0.980	-0.233	0.057	0.000	0.000
33.924	2.649	0.000	0.000	0.000	0.000	3.437	0.911	-0.229	0.055	0.000	0.000

ST=10 MUN=1 MAT=3

INT	SE1	X12	SE12	X10	SE10	X14	SE14	X15	SE15	X9	SE9
12.074	2.401	0.000	0.000	0.277	0.063	5.897	0.799	0.000	0.000	0.000	0.000
12.308	2.520	0.000	0.000	0.263	0.066	5.393	0.885	0.000	0.000	0.000	0.000
13.365	2.984	0.000	0.000	0.231	0.076	5.564	1.175	0.000	0.000	0.000	0.000
13.175	2.423	0.000	0.000	0.220	0.062	5.971	0.792	0.000	0.000	0.000	0.000
11.999	3.027	0.000	0.000	0.210	0.083	6.842	0.951	0.000	0.000	0.000	0.000
12.728	2.496	0.000	0.000	0.224	0.066	6.068	0.827	0.000	0.000	0.000	0.000

ST=10 MUN=1 MAT=4

INT	SE1	X12	SE12	X10	SE10	X14	SE14	X15	SE15	X9	SE9
19.196	4.150	0.000	0.000	0.000	0.000	7.673	1.202	-0.066	0.059	0.000	0.000
20.600	4.247	0.000	0.000	0.000	0.000	7.143	1.155	-0.081	0.060	0.000	0.000
27.800	6.008	0.000	0.000	0.000	0.000	5.169	1.426	-0.178	0.117	0.000	0.000
20.104	4.154	0.000	0.000	0.000	0.000	7.312	1.164	-0.070	0.058	0.000	0.000
19.474	4.338	0.000	0.000	0.000	0.000	7.322	1.157	-0.069	0.063	0.000	0.000
20.273	4.147	0.000	0.000	0.000	0.000	4.420	1.049	-0.125	0.061	0.000	0.000

ST=10 MUN=1 MAT=5

INT	SE1	X12	SE12	X10	SE10	X14	SE14	X15	SE15	X9	SE9
11.314	3.168	0.000	0.000	0.151	0.070	7.306	1.274	0.000	0.000	0.000	0.000
9.192	2.243	0.000	0.000	0.216	0.050	5.981	0.951	0.000	0.000	0.000	0.000
10.262	2.333	0.000	0.000	0.195	0.053	5.633	1.062	0.000	0.000	0.000	0.000
6.613	2.221	0.000	0.000	0.252	0.051	5.722	1.009	0.000	0.000	0.000	0.000
8.816	2.305	0.000	0.000	0.219	0.052	5.980	0.975	0.000	0.000	0.000	0.000
9.814	2.485	0.000	0.000	0.253	0.057	5.153	1.061	0.000	0.000	0.000	0.000

ST=10 MUN=1 MAT=6

INT	SE1	X12	SE12	X10	SE10	X14	SE14	X15	SE15	X9	SE9
6.011	2.315	0.000	0.000	0.241	0.045	6.715	0.836	0.000	0.000	0.000	0.000
5.887	1.776	0.000	0.000	0.255	0.036	6.414	0.762	0.000	0.000	0.000	0.000
5.694	1.786	0.000	0.000	0.251	0.036	6.592	0.753	0.000	0.000	0.000	0.000
5.533	2.081	0.000	0.000	0.259	0.042	6.315	0.799	0.000	0.000	0.000	0.000
5.887	1.776	0.000	0.000	0.255	0.036	6.414	0.762	0.000	0.000	0.000	0.000
7.383	2.040	0.000	0.000	0.355	0.065	2.505	2.272	0.000	0.000	0.000	0.000

-- ST=18 MUN=2 MAT=6 --

INT	SE1	X12	SE12	X10	SE10	X14	SE14	X15	SE15	X9	SE9
2.648	0.661	0.247	0.048	0.330	0.026	0.000	0.000	0.000	0.000	0.000	0.000
1.309	0.681	0.247	0.047	0.359	0.026	0.000	0.000	0.000	0.000	0.000	0.000
3.621	0.770	0.250	0.053	0.304	0.029	0.000	0.000	0.000	0.000	0.000	0.000
2.627	0.665	0.399	0.050	0.297	0.027	0.000	0.000	0.000	0.000	0.000	0.000
3.695	0.667	0.442	0.053	0.176	0.032	0.000	0.000	0.000	0.000	0.000	0.000
2.533	0.665	0.341	0.048	0.276	0.026	0.000	0.000	0.000	0.000	0.000	0.000

-- ST=18 MUN=2 MAT=7 --

INT	SE1	X12	SE12	X10	SE10	X14	SE14	X15	SE15	X9	SE9
-0.799	0.483	0.942	0.012	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-0.793	0.467	0.942	0.012	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-0.502	0.518	0.924	0.013	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-0.635	0.435	0.946	0.011	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-1.151	0.559	0.960	0.015	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-1.308	0.531	0.963	0.013	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

-- ST=18 MUN=2 MAT=8 --

INT	SE1	X12	SE12	X10	SE10	X14	SE14	X15	SE15	X9	SE9
0.750	0.634	0.876	0.016	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.629	0.554	0.885	0.014	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.636	0.690	0.878	0.017	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.631	0.567	0.890	0.015	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.436	0.587	0.892	0.015	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1.138	0.626	0.863	0.016	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

-- ST=18 MUN=3 MAT=8 --

INT	SE1	X12	SE12	X10	SE10	X14	SE14	X15	SE15	X9	SE9
0.808	0.256	0.928	0.008	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1.000	0.339	0.926	0.009	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.944	0.244	0.925	0.007	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.808	0.249	0.929	0.007	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.165	0.297	0.955	0.010	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.824	0.243	0.926	0.007	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

-- ST=18 MUN=3 MAT=9 --

INT	SE1	X12	SE12	X10	SE10	X14	SE14	X15	SE15	X9	SE9
-0.207	0.135	0.998	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-0.205	0.134	0.997	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.044	0.153	0.988	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-0.118	0.144	0.995	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-0.206	0.143	1.001	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-0.088	0.145	0.995	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000