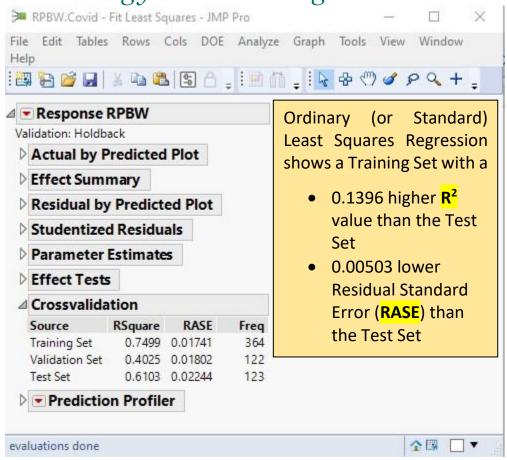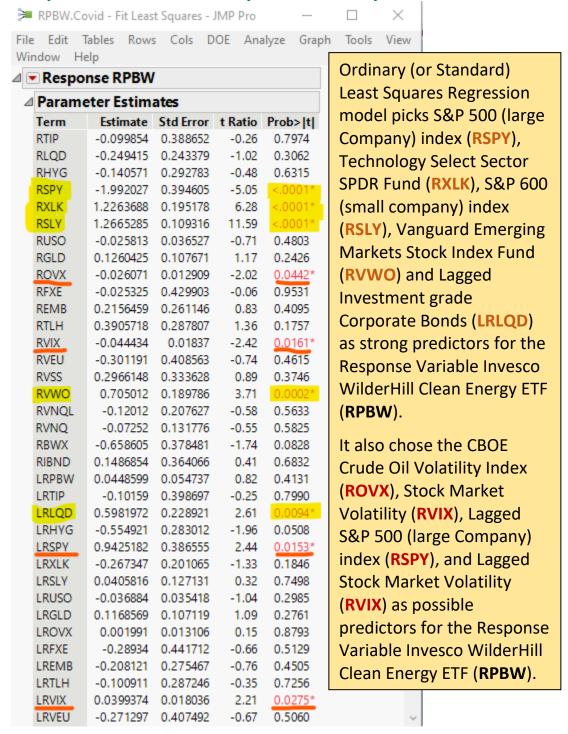# Penalized Regressions and Predicting Clean Energy Stocks during Covid-19

RPBW.Covid - Fit Least Squares - JMP Pro

File   Edit   Tables   Rows   Cols   DOE   Analyze   Graph   Tools   View   Window   Help

Response RPBW

Validation: Holdback

▷ **Actual by Predicted Plot**

▷ **Effect Summary**

▷ **Residual by Predicted Plot**

▷ **Studentized Residuals**

▷ **Parameter Estimates**

▷ **Effect Tests**

△ **Crossvalidation**

Source	RSquare	RASE	Freq
Training Set	0.7499	0.01741	364
Validation Set	0.4025	0.01802	122
Test Set	0.6103	0.02244	123

▷ **Prediction Profiler**

evaluations done

Ordinary (or Standard) Least Squares Regression shows a Training Set with a

- 0.1396 higher R^2 value than the Test Set
- 0.00503 lower Residual Standard Error (RASE) than the Test Set

Risk Factors for Oil Prices Before and After Covid-19

```
▶ RPBW.Covid - Fit Least Squares - JMP Pro        —    □    ×
File  Edit  Tables  Rows  Cols  DOE  Analyze  Graph  Tools  View
Window  Help
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▼ Response RPBW

▷ Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
RTIP	-0.099854	0.388652	-0.26	0.7974
RLQD	-0.249415	0.243379	-1.02	0.3062
RHYG	-0.140571	0.292783	-0.48	0.6315
RSPY	-1.992027	0.394605	-5.05	<.0001*
RXLK	1.2263688	0.195178	6.28	<.0001*
RSLY	1.2665285	0.109316	11.59	<.0001*
RUSO	-0.025813	0.036527	-0.71	0.4803
RGLD	0.1260425	0.107671	1.17	0.2426
ROVX	-0.026071	0.012909	-2.02	0.0442*
RFXE	-0.025325	0.429903	-0.06	0.9531
REMB	0.2156459	0.261146	0.83	0.4095
RTLH	0.3905718	0.287807	1.36	0.1757
RVIX	-0.044434	0.01837	-2.42	0.0161*
RVEU	-0.301191	0.408563	-0.74	0.4615
RVSS	0.2966148	0.333628	0.89	0.3746
RVWO	0.705012	0.189786	3.71	0.0002*
RVNQL	-0.12012	0.207627	-0.58	0.5633
RVNQ	-0.07252	0.131776	-0.55	0.5825
RBWX	-0.658605	0.378481	-1.74	0.0828
RIBND	0.1486854	0.364066	0.41	0.6832
LRPBW	0.0448599	0.054737	0.82	0.4131
LRTIP	-0.10159	0.398697	-0.25	0.7990
LRLQD	0.5981972	0.228921	2.61	0.0094*
LRHYG	-0.554921	0.283012	-1.96	0.0508
LRSPY	0.9425182	0.386555	2.44	0.0153*
LRXLK	-0.267347	0.201065	-1.33	0.1846
LRSLY	0.0405816	0.127131	0.32	0.7498
LRUSO	-0.036884	0.035418	-1.04	0.2985
LRGLD	0.1168569	0.107119	1.09	0.2761
LROVX	0.001991	0.013106	0.15	0.8793
LRFXE	-0.28934	0.441712	-0.66	0.5129
LREMB	-0.208121	0.275467	-0.76	0.4505
LRTLH	-0.100911	0.287246	-0.35	0.7256
LRVIX	0.0399374	0.018036	2.21	0.0275*
LRVEU	-0.271297	0.407492	-0.67	0.5060

Ordinary (or Standard) Least Squares Regression model picks S&P 500 (large Company) index (**RSPY**), Technology Select Sector SPDR Fund (**RXLK**), S&P 600 (small company) index (**RSLY**), Vanguard Emerging Markets Stock Index Fund (**RVWO**) and Lagged Investment grade Corporate Bonds (**LRLQD**) as strong predictors for the Response Variable Invesco WilderHill Clean Energy ETF (**RPBW**).

It also chose the CBOE Crude Oil Volatility Index (**ROVX**), Stock Market Volatility (**RVIX**), Lagged S&P 500 (large Company) index (**RSPY**), and Lagged Stock Market Volatility (**RVIX**) as possible predictors for the Response Variable Invesco WilderHill Clean Energy ETF (**RPBW**).

RPBW.Covid - Generalized Regression - JMP Pro

File   Edit   Tables   Rows   Cols   DOE   Analyze   Graph   Tools   View   Window   Help

Generalized Regression for RPBW

Model Comparison

Show	Response Distribution	Estimation Method	Validation Method	Nonzero Parameters	AICc	BIC	Generalized RSquare	Validation Generalized RSquare	Test Generalized RSquare
✓	Normal	Standard Least Squares	Validation Column	43	-1818.305	-1662.552	0.749862	0.4024504	0.6103354
✓	Normal	Lasso	Validation Column	30	-1822.774	-1711.445	0.7300317	0.4165769	0.6181207

▷ Model Launch

▷ Normal Standard Least Squares with Validation Column

Normal Lasso with Validation Column

Model Summary

Response	RPBW
Distribution	Normal
Estimation Method	Lasso
Validation Method	Validation Column
Mean Model Link	Identity
Scale Model Link	Identity

Measure	Training	Validation	Test
Number of rows	364	122	123
Sum of Frequencies	364	122	123
-LogLikelihood	-944.1798	-318.2996	-287.7646
Number of Parameters	30	30	30
BIC	-1711.445	-492.4786	-431.1637
AICc	-1822.774	-556.1596	-495.3119
RSquare	0.7300317	0.4165769	0.6181207
RASE	0.018082	0.0178066	0.02221
Lambda Penalty	0.0051341	.	.

Estimation Details

Number of Grid Points	150
Minimum Penalty Fraction	0
Grid Scale	Square Root

▷ Solution Path

▷ Parameter Estimates for Original Predictors

▷ Effect Tests

Generalized Normalized Lasso Regression shows a Training Set with a

- 0.111911 higher R^2 value than the Test Set
- 0.004128 lower Residual Standard Error (RASE) than the Test Set
- -1822.774 Akaike information criterion (AICc)
- -1711.445 Bayesian information criterion (BIC)
- Lambda (λ) Penalty of 0.0051341

RPBW.Covid - Generalized Regression - JMP Pro

File   Edit   Tables   Rows   Cols   DOE   Analyze   Graph   Tools   View   Window   Help

Generalized Regression for RPBW

Normal Lasso with Validation Column

Parameter Estimates for Original Predictors

Term	Estimate	Std Error	Wald ChiSquare	Prob > ChiSquare
RTIP	0	0	0	1.0000
RLQD	-0.084582	0.2470624	0.1172035	0.7321
RHYG	-0.066701	0.2410683	0.0765574	0.7820
RSPY	-0.983324	0.3669826	7.1796407	0.0074*
RXLK	0.7544865	0.2003136	14.186719	0.0002*
RSLY	1.0096034	0.1046067	93.149993	<.0001*
RUSO	-0.010147	0.0257793	0.1549419	0.6939
RGLD	0.1083622	0.0999882	1.1745137	0.2785
ROVX	-0.016351	0.0093012	3.0904508	0.0788
RFXE	0	0	0	1.0000
REMB	0	0	0	1.0000
RTLH	0.2247493	0.2410433	0.8693738	0.3511
RVIX	-0.029668	0.0178492	2.7628101	0.0965
RVEU	0	0	0	1.0000
RVSS	0	0	0	1.0000
RVWO	0.5806093	0.1121555	26.79952	<.0001*
RVNQL	0	0	0	1.0000
RVNQ	-0.142241	0.1099207	1.674518	0.1957
RBWX	-0.156023	0.2933241	0.2829326	0.5948
RIBND	0	0	0	1.0000
LRPBW	0.0283452	0.0532394	0.2834608	0.5944
LRTIP	-0.168989	0.2918854	0.3351902	0.5626
LRLQD	0.2554803	0.1661827	2.3634335	0.1242
LRHYG	-0.2375	0.2100138	1.2788825	0.2581
LRSPY	0.1908094	0.1825484	1.0925547	0.2959
LRXLK	0	0	0	1.0000
LRSLY	0.0224073	0.1003202	0.0498888	0.8233
LRUSO	-0.022634	0.0241967	0.8749996	0.3496
LRGLD	0.0727645	0.0908321	0.6417414	0.4231

Normal Distribution Parameters	Estimate	Std Error	Wald ChiSquare	Prob > ChiSquare	Lower 95%	Upper 95%
Scale	0.018082	0.0008349	469.07369	<.0001*	0.0164456	0.0197183

Generalized Normalized Lasso Regression model picks S&P 500 (large Company) index (**RSPY**), Technology Select Sector SPDR Fund (**RXLK**), S&P 600 (small company) index (**RSLY**), Vanguard Emerging Markets Stock Index Fund (**RVWO**) and Lagged Investment grade Corporate Bonds (**LRLQD**) as strong predictors for the Response Variable Invesco WilderHill Clean Energy ETF (**RPBW**).

It also chose the Lagged SPDR Bloomberg International Treasury Bond (**LRBWX**) and Lagged SPDR Bloomberg International Corporate Bond (**LRIBND**) as possible predictors for the Response Variable Invesco WilderHill Clean Energy ETF (**RPBW**).

This model kept only 28 variables of the original 40 Return and Lagged variables.
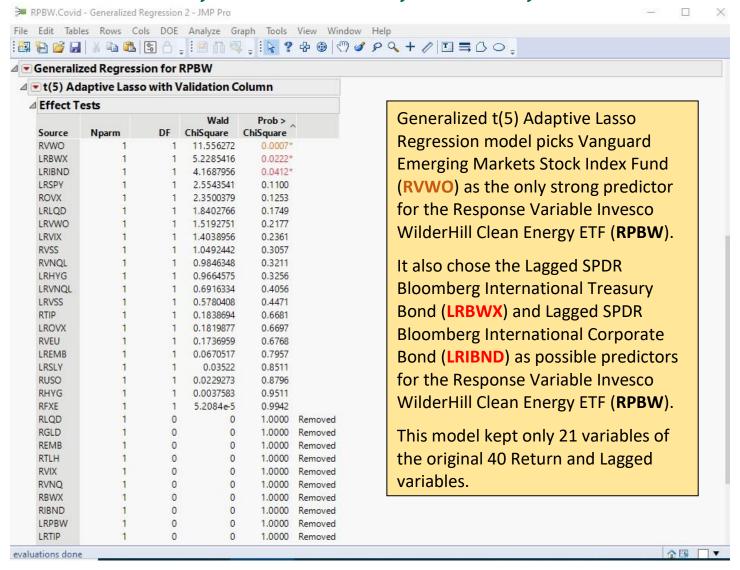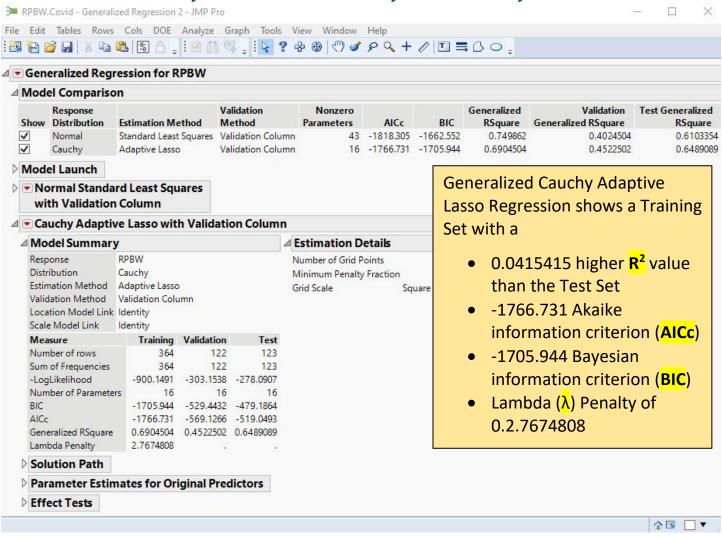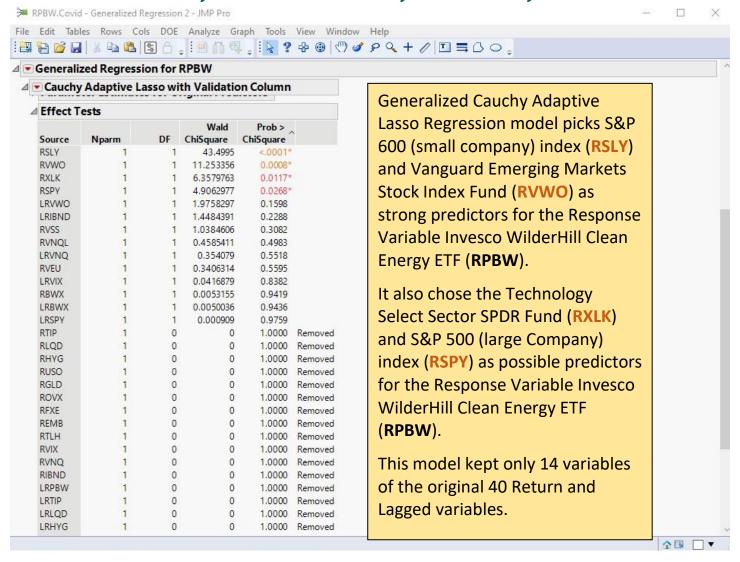
RPBW.Covid - Generalized Regression - JMP Pro

File   Edit   Tables   Rows   Cols   DOE   Analyze   Graph   Tools   View   Window   Help

Generalized Regression for RPBW

Normal Lasso with Validation Column

Parameter Estimates for Original Predictors

Term	Estimate	Std Error	Wald ChiSquare	Prob > ChiSquare
RVIX	-0.029668	0.0178492	2.7628101	0.0965
RVEU	0	0	0	1.0000
RVSS	0	0	0	1.0000
RVWO	0.5806093	0.1121555	26.79952	<.0001*
RVNQL	0	0	0	1.0000
RVNQ	-0.142241	0.1099207	1.674518	0.1957
RBWX	-0.156023	0.2933241	0.2829326	0.5948
RIBND	0	0	0	1.0000
LRPBW	0.0283452	0.0532394	0.2834608	0.5944
LRTIP	-0.168989	0.2918854	0.3351902	0.5626
LRLQD	0.2554803	0.1661827	2.3634335	0.1242
LRHYG	-0.2375	0.2100138	1.2788825	0.2581
LRSPY	0.1908094	0.1825484	1.0925547	0.2959
LRXLK	0	0	0	1.0000
LRSLY	0.0224073	0.1003202	0.0498888	0.8233
LRUSO	-0.022634	0.0241967	0.8749996	0.3496
LRGLD	0.0727645	0.0908321	0.6417414	0.4231
LROVX	0.0017575	0.0095458	0.0338968	0.8539
LRFXE	-0.015543	0.3423147	0.0020616	0.9638
LREMB	0	0	0	1.0000
LRTLH	0	0	0	1.0000
LRVIX	0.018475	0.0167297	1.2195281	0.2695
LRVEU	0	0	0	1.0000
LRVSS	0	0	0	1.0000
LRVWO	0.0614432	0.1329367	0.2136278	0.6439
LRVNQL	0.0604894	0.153489	0.1553117	0.6935
LRVNQ	0	0	0	1.0000
LRBWX	0.5348899	0.2224708	5.7807321	0.0162*
LRIBND	-0.578645	0.2429802	5.6712887	0.0172*

Generalized Normalized Lasso Regression model picks S&P 500 (large Company) index (**RSPY**), Technology Select Sector SPDR Fund (**RXLK**), S&P 600 (small company) index (**RSLY**), Vanguard Emerging Markets Stock Index Fund (**RVWO**) and Lagged Investment grade Corporate Bonds (**LRLQD**) as strong predictors for the Response Variable Invesco WilderHill Clean Energy ETF (**RPBW**).

It also chose the Lagged SPDR Bloomberg International Treasury Bond (**LRBWX**) and Lagged SPDR Bloomberg International Corporate Bond (**LRIBND**) as possible predictors for the Response Variable Invesco WilderHill Clean Energy ETF (**RPBW**).

This model kept only 28 variables of the original 40 Return and Lagged variables.
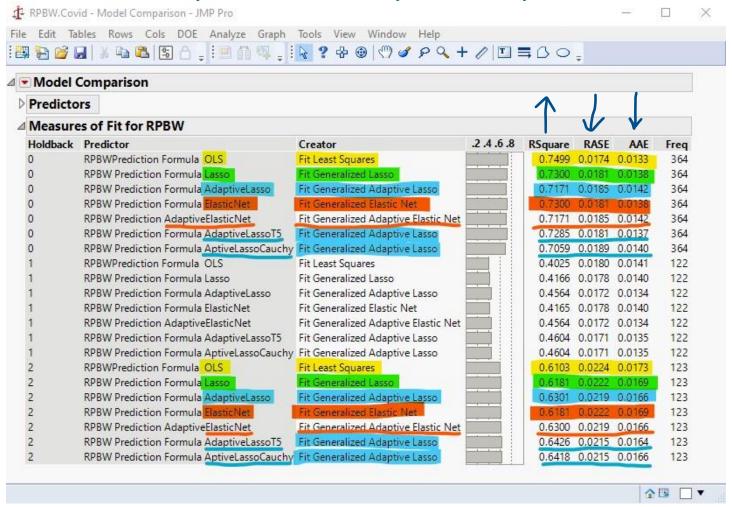
RPBW.Covid - Generalized Regression 2 - JMP Pro

File   Edit   Tables   Rows   Cols   DOE   Analyze   Graph   Tools   View   Window   Help

▽ **Generalized Regression for RPBW**

▽ **Model Comparison**

Show	Response Distribution	Estimation Method	Validation Method	Nonzero Parameters	AICc	BIC	Generalized RSquare	Validation Generalized RSquare	Test Generalized RSquare
✓	Normal	Standard Least Squares	Validation Column	43	-1818.305	-1662.552	0.749862	0.4024504	0.6103354
✓	Normal	Adaptive Lasso	Validation Column	14	-1842.162	-1788.805	0.7171286	0.456397	0.6300821

▷ **Model Launch**

▷ ▽ **Normal Standard Least Squares with Validation Column**

▽ ▽ **Normal Adaptive Lasso with Validation Column**

▽ **Model Summary**

Response	RPBW
Distribution	Normal
Estimation Method	Adaptive Lasso
Validation Method	Validation Column
Mean Model Link	Identity
Scale Model Link	Identity

▽ **Estimation Details**

Number of Grid Points	150
Minimum Penalty Fraction	0
Grid Scale	Square Root

Measure	Training	Validation	Test
Number of rows	364	122	123
Sum of Frequencies	364	122	123
-LogLikelihood	-935.6826	-322.0034	-291.8994
Number of Parameters	14	14	14
BIC	-1788.805	-576.7506	-516.4282
AICc	-1842.162	-612.0816	-551.9099
RSquare	0.7171286	0.456397	0.6300821
RASE	0.0185091	0.0171882	0.0218594
Lambda Penalty	0.0009197	.	.

▷ **Solution Path**

▷ **Parameter Estimates for Original Predictors**

Generalized Normalized Adaptive Lasso Regression shows a Training Set with a

- 0.0870465 higher R^2 value than the Test Set
- 0.0033503 lower Residual Standard Error (**RASE**) than the Test Set
- -1842.162 Akaike information criterion (**AICc**)
- -1788.805 Bayesian information criterion (**BIC**)
- Lambda (λ) Penalty of 0.0009197

RPBW.Covid - Generalized Regression 2 - JMP Pro

File　Edit　Tables　Rows　Cols　DOE　Analyze　Graph　Tools　View　Window　Help

Generalized Regression for RPBW

Normal Adaptive Lasso with Validation Column

Effect Tests

Source	Nparm	DF	Wald ChiSquare	Prob > ChiSquare	
RSPY	1	1	24.830873	<.0001*	
RVWO	1	1	16.598686	<.0001*	
LRIBND	1	1	5.4561926	0.0195*	
LRBWX	1	1	4.2916282	0.0383*	
LRSPY	1	1	1.2141801	0.2705	
LRLQD	1	1	0.578412	0.4469	
LRVWO	1	1	0.5515986	0.4577	
ROVX	1	1	0.4981239	0.4803	
RVSS	1	1	0.2055702	0.6503	
RVNQ	1	1	0.0191456	0.8899	
RTIP	1	0	0	1.0000	Removed
RLQD	1	0	0	1.0000	Removed
RHYG	1	0	0	1.0000	Removed
RUSO	1	0	0	1.0000	Removed
RGLD	1	0	0	1.0000	Removed
RFXE	1	0	0	1.0000	Removed
REMB	1	0	0	1.0000	Removed
RTLH	1	0	0	1.0000	Removed
RVIX	1	0	0	1.0000	Removed
RVEU	1	0	0	1.0000	Removed
RVNQL	1	0	0	1.0000	Removed
RBWX	1	0	0	1.0000	Removed
RIBND	1	0	0	1.0000	Removed
LRPBW	1	0	0	1.0000	Removed
LRTIP	1	0	0	1.0000	Removed
LRHYG	1	0	0	1.0000	Removed
LRXLK	1	0	0	1.0000	Removed
LRSLY	1	0	0	1.0000	Removed
LRUSO	1	0	0	1.0000	Removed
LRGLD	1	0	0	1.0000	Removed
LROVX	1	0	0	1.0000	Removed

Generalized Normalized Adaptive Lasso Regression model picks S&P 500 (large Company) index (**RSPY**) and Vanguard Emerging Markets Stock Index Fund (**RVWO**) as strong predictors for the Response Variable Invesco WilderHill Clean Energy ETF (**RPBW**).

It also chose the Lagged SPDR Bloomberg International Treasury Bond (**LRBWX**) and Lagged SPDR Bloomberg International Corporate Bond (**LRIBND**) as possible predictors for the Response Variable Invesco WilderHill Clean Energy ETF (**RPBW**).

This model kept only 10 variables of the original 40 Return and Lagged variables.

RPBW.Covid - Generalized Regression - JMP Pro

File Edit Tables Rows Cols DOE Analyze Graph Tools View Window Help

Generalized Regression for RPBW

Model Comparison

Show	Response Distribution	Estimation Method	Validation Method	Nonzero Parameters	AICc	BIC	Generalized RSquare	Validation Generalized RSquare	Test Generalized RSquare
✓	Normal	Standard Least Squares	Validation Column	43	-1818.305	-1662.552	0.749862	0.4024504	0.6103354
✓	Normal	Elastic Net	Validation Column	30	-1822.688	-1711.359	0.729968	0.4165446	0.6180629

Model Launch

Normal Standard Least Squares with Validation Column

Normal Elastic Net with Validation Column

Model Summary

Response	RPBW
Distribution	Normal
Estimation Method	Elastic Net
Validation Method	Validation Column
Mean Model Link	Identity
Scale Model Link	Identity

Measure	Training	Validation	Test
Number of rows	364	122	123
Sum of Frequencies	364	122	123
-LogLikelihood	-944.1369	-318.2959	-287.758
Number of Parameters	30	30	30
BIC	-1711.359	-492.4712	-431.1504
AICc	-1822.688	-556.1522	-495.2985
RSquare	0.729968	0.4165446	0.6180629
RASE	0.0180841	0.0178071	0.0222116
Lambda Penalty	0.0051859	.	.

Estimation Details

Elastic Net Alpha	0.99
Number of Grid Points	150
Minimum Penalty Fraction	0
Grid Scale	Square Root

Solution Path

Parameter Estimates for Original Predictors

Effect Tests

Generalized Normalized Elastic Net Regression shows a Training Set with a

- 0.1119051 higher R^2 value than the Test Set
- 0.0041275 lower Residual Standard Error (**RASE**) than the Test Set
- -1822.688 Akaike information criterion (**AICc**)
- -1711.359 Bayesian information criterion (**BIC**)
- Lambda (λ) Penalty of 0.0051859

RPBW.Covid - Generalized Regression - JMP Pro

File   Edit   Tables   Rows   Cols   DOE   Analyze   Graph   Tools   View   Window   Help

Generalized Regression for RPBW

Normal Elastic Net with Validation Column

Effect Tests

Source	Nparm	DF	Wald ChiSquare	Prob > ChiSquare	
RVWO	1	1	26.781856	<.0001*	
RXLK	1	1	14.10706	0.0002*	
RSPY	1	1	7.1151723	0.0076*	
LRBWX	1	1	5.7821888	0.0162*	
LRIBND	1	1	5.6690729	0.0173*	
ROVX	1	1	3.0863455	0.0790	
RVIX	1	1	2.7590655	0.0967	
LRLQD	1	1	2.3535358	0.1250	
RVNQ	1	1	1.6826656	0.1946	
LRHYG	1	1	1.2757563	0.2587	
LRVIX	1	1	1.2159642	0.2702	
RGLD	1	1	1.1743309	0.2785	
LRSPY	1	1	1.0901011	0.2964	
LRUSO	1	1	0.8740277	0.3498	
RTLH	1	1	0.86938	0.3511	
LRGLD	1	1	0.6416994	0.4231	
LRTIP	1	1	0.335176	0.5626	
LRPBW	1	1	0.2840588	0.5941	
RBWX	1	1	0.2805621	0.5963	
LRVWO	1	1	0.2127096	0.6447	
RUSO	1	1	0.155583	0.6933	
LRVNQL	1	1	0.1554288	0.6934	
RLQD	1	1	0.1167329	0.7326	
RHYG	1	1	0.0775459	0.7807	
LRSLY	1	1	0.0496515	0.8237	
LROVX	1	1	0.0341543	0.8534	
LRFXE	1	1	0.0021269	0.9632	
RTIP	1	0	0	1.0000	Removed
RFXE	1	0	0	1.0000	Removed
REMB	1	0	0	1.0000	Removed

Generalized Normalized Elastic Net Regression model picks Vanguard Emerging Markets Stock Index Fund (**RVWO**), Technology Select Sector SPDR Fund (**RXLK**), and S&P 500 (large Company) index (**RSPY**) as strong predictors for the Response Variable Invesco WilderHill Clean Energy ETF (**RPBW**).

It also chose the Lagged SPDR Bloomberg International Treasury Bond (**LRBWX**) and Lagged SPDR Bloomberg International Corporate Bond (**LRIBND**) as possible predictors for the Response Variable Invesco WilderHill Clean Energy ETF (**RPBW**).

This model kept only 27 variables of the original 40 Return and Lagged variables.

RPBW.Covid - Generalized Regression 2 - JMP Pro

File Edit Tables Rows Cols DOE Analyze Graph Tools View Window Help

Generalized Regression for RPBW

Model Comparison

Show	Response Distribution	Estimation Method	Validation Method	Nonzero Parameters	AICc	BIC	Generalized RSquare	Validation Generalized RSquare	Test Generalized RSquare
✓	Normal	Standard Least Squares	Validation Column	43	-1818.305	-1662.552	0.749862	0.4024504	0.6103354
✓	Normal	Adaptive Elastic Net	Validation Column	14	-1842.12	-1788.763	0.7170962	0.456422	0.6300483

Model Launch

Normal Standard Least Squares with Validation Column

Normal Adaptive Elastic Net with Validation Column

Model Summary

Response	RPBW
Distribution	Normal
Estimation Method	Adaptive Elastic Net
Validation Method	Validation Column
Mean Model Link	Identity
Scale Model Link	Identity

Measure	Training	Validation	Test
Number of rows	364	122	123
Sum of Frequencies	364	122	123
-LogLikelihood	-935.6618	-322.0049	-291.8943
Number of Parameters	14	14	14
BIC	-1788.763	-576.7535	-516.4181
AICc	-1842.12	-612.0845	-551.8997
RSquare	0.7170962	0.456422	0.6300483
RASE	0.0185101	0.0171878	0.0218604
Lambda Penalty	0.000929	.	.

Estimation Details

Elastic Net Alpha	0.99
Number of Grid Points	150
Minimum Penalty Fraction	0
Grid Scale	Square Root

Generalized Normalized Adaptive Elastic Net Regression shows a Training Set with a

- 0.0870479 higher R^2 value than the Test Set
- 0.0033503 lower Residual Standard Error (RASE) than the Test Set
- -1842.12 Akaike information criterion (AICc)
- -1788.763 Bayesian information criterion (BIC)
- Lambda (λ) Penalty of 0.000929

RPBW.Covid - Generalized Regression 2 - JMP Pro

File   Edit   Tables   Rows   Cols   DOE   Analyze   Graph   Tools   View   Wind

▲ ▼ **Generalized Regression for RPBW**

  ▲ ▼ **Normal Adaptive Elastic Net with Validation Column**

    ▲ **Effect Tests**

Source	Nparm	DF	Wald ChiSquare	Prob > ChiSquare	
RSLY	1	1	102.16069	<.0001*	
RXLK	1	1	34.883707	<.0001*	
RSPY	1	1	24.768199	<.0001*	
RVWO	1	1	16.58358	<.0001*	
LRIBND	1	1	5.4213678	0.0199*	
LRBWX	1	1	4.2726206	0.0387*	
LRSPY	1	1	1.2159551	0.2702	
LRLQD	1	1	0.5725574	0.4492	
LRVWO	1	1	0.5482052	0.4591	
ROVX	1	1	0.4908649	0.4835	
RVSS	1	1	0.2067913	0.6493	
RVNQ	1	1	0.0197962	0.8881	
RTIP	1	0	0	1.0000	Removed
RLQD	1	0	0	1.0000	Removed
RHYG	1	0	0	1.0000	Removed
RUSO	1	0	0	1.0000	Removed
RGLD	1	0	0	1.0000	Removed
RFXE	1	0	0	1.0000	Removed
REMB	1	0	0	1.0000	Removed
RTLH	1	0	0	1.0000	Removed
RVIX	1	0	0	1.0000	Removed
RVEU	1	0	0	1.0000	Removed
RVNQL	1	0	0	1.0000	Removed
RBWX	1	0	0	1.0000	Removed
RIBND	1	0	0	1.0000	Removed
LRPBW	1	0	0	1.0000	Removed
LRTIP	1	0	0	1.0000	Removed
LRHYG	1	0	0	1.0000	Removed
LRXLK	1	0	0	1.0000	Removed
LRSLY	1	0	0	1.0000	Removed
LRUSO	1	0	0	1.0000	Removed

Generalized Normalized Adaptive Elastic Net Regression model picks S&P 600 (small company) index (**RSLY**), Technology Select Sector SPDR Fund (**RXLK**), S&P 500 (large Company) index (**RSPY**), and Vanguard Emerging Markets Stock Index Fund (**RVWO**) as strong predictors for the Response Variable Invesco WilderHill Clean Energy ETF (**RPBW**).

It also chose the Lagged SPDR Bloomberg International Corporate Bond (**LRIBND**) and Lagged SPDR Bloomberg International Treasury Bond (**LRBWX**) as possible predictors for the Response Variable Invesco WilderHill Clean Energy ETF (**RPBW**).

This model kept only 12 variables of the original 40 Return and Lagged variables.

Generalized Regression for RPBW

Model Comparison

Show	Response Distribution	Estimation Method	Validation Method	Nonzero Parameters	AICc	BIC	Generalized RSquare	Validation Generalized RSquare	Test Generalized RSquare
✓	Normal	Standard Least Squares	Validation Column	43	-1818.305	-1662.552	0.749862	0.4024504	0.6103354
✓	t(5)	Adaptive Lasso	Validation Column	26	-1845.232	-1748.072	0.7120478	0.4617273	0.6386236

▷ Model Launch

▷ Normal Standard Least Squares with Validation Column

t(5) Adaptive Lasso with Validation Column

Model Summary

Response	RPBW
Distribution	t(5)
Estimation Method	Adaptive Lasso
Validation Method	Validation Column
Location Model Link	Identity
Scale Model Link	Identity

Estimation Details

Number of Grid Points	150
Minimum Penalty Fraction	0
Grid Scale	Square Root

Measure	Training	Validation	Test
Number of rows	364	122	123
Sum of Frequencies	364	122	123
-LogLikelihood	-950.699	-321.4534	-295.1964
Number of Parameters	26	26	26
BIC	-1748.072	-518.0023	-465.2761
AICc	-1845.232	-576.1279	-523.7679
Generalized RSquare	0.7120478	0.4617273	0.6386236
Lambda Penalty	0.8395614	.	.

▷ Solution Path

▷ Parameter Estimates for Original Predictors

▷ Effect Tests

evaluations done

Generalized t(5) Adaptive Lasso Regression shows a Training Set with a

- 0.0734242 higher R^2 value than the Test Set
- -1845.232 Akaike information criterion (**AICc**)
- -1748.072 Bayesian information criterion (**BIC**)
- Lambda (λ) Penalty of 0.8395614

Generalized Regression for RPBW

t(5) Adaptive Lasso with Validation Column

Effect Tests

Source	Nparm	DF	Wald ChiSquare	Prob > ChiSquare	
RVWO	1	1	11.556272	0.0007*	
LRBWX	1	1	5.2285416	0.0222*	
LRIBND	1	1	4.1687956	0.0412*	
LRSPY	1	1	2.5543541	0.1100	
ROVX	1	1	2.3500379	0.1253	
LRLQD	1	1	1.8402766	0.1749	
LRVWO	1	1	1.5192751	0.2177	
LRVIX	1	1	1.4038956	0.2361	
RVSS	1	1	1.0492442	0.3057	
RVNQL	1	1	0.9846348	0.3211	
LRHYG	1	1	0.9664575	0.3256	
LRVNQL	1	1	0.6916334	0.4056	
LRVSS	1	1	0.5780408	0.4471	
RTIP	1	1	0.1838694	0.6681	
LROVX	1	1	0.1819877	0.6697	
RVEU	1	1	0.1736959	0.6768	
LREMB	1	1	0.0670517	0.7957	
LRSLY	1	1	0.03522	0.8511	
RUSO	1	1	0.0229273	0.8796	
RHYG	1	1	0.0037583	0.9511	
RFXE	1	1	5.2084e-5	0.9942	
RLQD	1	0	0	1.0000	Removed
RGLD	1	0	0	1.0000	Removed
REMB	1	0	0	1.0000	Removed
RTLH	1	0	0	1.0000	Removed
RVIX	1	0	0	1.0000	Removed
RVNQ	1	0	0	1.0000	Removed
RBWX	1	0	0	1.0000	Removed
RIBND	1	0	0	1.0000	Removed
LRPBW	1	0	0	1.0000	Removed
LRTIP	1	0	0	1.0000	Removed

Generalized t(5) Adaptive Lasso Regression model picks Vanguard Emerging Markets Stock Index Fund (**RVWO**) as the only strong predictor for the Response Variable Invesco WilderHill Clean Energy ETF (**RPBW**).

It also chose the Lagged SPDR Bloomberg International Treasury Bond (**LRBWX**) and Lagged SPDR Bloomberg International Corporate Bond (**LRIBND**) as possible predictors for the Response Variable Invesco WilderHill Clean Energy ETF (**RPBW**).

This model kept only 21 variables of the original 40 Return and Lagged variables.

Generalized Regression for RPBW

Model Comparison

Show	Response Distribution	Estimation Method	Validation Method	Nonzero Parameters	AICc	BIC	Generalized RSquare	Validation Generalized RSquare	Test Generalized RSquare
✓	Normal	Standard Least Squares	Validation Column	43	-1818.305	-1662.552	0.749862	0.4024504	0.6103354
✓	Cauchy	Adaptive Lasso	Validation Column	16	-1766.731	-1705.944	0.6904504	0.4522502	0.6489089

▷ **Model Launch**

▷ **Normal Standard Least Squares with Validation Column**

Cauchy Adaptive Lasso with Validation Column

Model Summary

Response	RPBW
Distribution	Cauchy
Estimation Method	Adaptive Lasso
Validation Method	Validation Column
Location Model Link	Identity
Scale Model Link	Identity

Estimation Details

Number of Grid Points	
Minimum Penalty Fraction	
Grid Scale	Square

Measure	Training	Validation	Test
Number of rows	364	122	123
Sum of Frequencies	364	122	123
-LogLikelihood	-900.1491	-303.1538	-278.0907
Number of Parameters	16	16	16
BIC	-1705.944	-529.4432	-479.1864
AICc	-1766.731	-569.1266	-519.0493
Generalized RSquare	0.6904504	0.4522502	0.6489089
Lambda Penalty	2.7674808	.	.

▷ **Solution Path**

▷ **Parameter Estimates for Original Predictors**

▷ **Effect Tests**

Generalized Cauchy Adaptive Lasso Regression shows a Training Set with a

- 0.0415415 higher **R^2** value than the Test Set
- -1766.731 Akaike information criterion (**AICc**)
- -1705.944 Bayesian information criterion (**BIC**)
- Lambda (**λ**) Penalty of 0.2.7674808

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Generalized Regression for RPBW

Cauchy Adaptive Lasso with Validation Column

Effect Tests

Source	Nparm	DF	Wald ChiSquare	Prob > ChiSquare	
RSLY	1	1	43.4995	<.0001*	
RVWO	1	1	11.253356	0.0008*	
RXLK	1	1	6.3579763	0.0117*	
RSPY	1	1	4.9062977	0.0268*	
LRVWO	1	1	1.9758297	0.1598	
LRIBND	1	1	1.4484391	0.2288	
RVSS	1	1	1.0384606	0.3082	
RVNQL	1	1	0.4585411	0.4983	
LRVNQ	1	1	0.354079	0.5518	
RVEU	1	1	0.3406314	0.5595	
LRVIX	1	1	0.0416879	0.8382	
RBWX	1	1	0.0053155	0.9419	
LRBWX	1	1	0.0050036	0.9436	
LRSPY	1	1	0.000909	0.9759	
RTIP	1	0	0	1.0000	Removed
RLQD	1	0	0	1.0000	Removed
RHYG	1	0	0	1.0000	Removed
RUSO	1	0	0	1.0000	Removed
RGLD	1	0	0	1.0000	Removed
ROVX	1	0	0	1.0000	Removed
RFXE	1	0	0	1.0000	Removed
REMB	1	0	0	1.0000	Removed
RTLH	1	0	0	1.0000	Removed
RVIX	1	0	0	1.0000	Removed
RVNQ	1	0	0	1.0000	Removed
RIBND	1	0	0	1.0000	Removed
LRPBW	1	0	0	1.0000	Removed
LRTIP	1	0	0	1.0000	Removed
LRLQD	1	0	0	1.0000	Removed
LRHYG	1	0	0	1.0000	Removed

Generalized Cauchy Adaptive Lasso Regression model picks S&P 600 (small company) index (**RSLY**) and Vanguard Emerging Markets Stock Index Fund (**RVWO**) as strong predictors for the Response Variable Invesco WilderHill Clean Energy ETF (**RPBW**).

It also chose the Technology Select Sector SPDR Fund (**RXLK**) and S&P 500 (large Company) index (**RSPY**) as possible predictors for the Response Variable Invesco WilderHill Clean Energy ETF (**RPBW**).

This model kept only 14 variables of the original 40 Return and Lagged variables.

Risk Factors for Oil Prices Before and After Covid-19

Holdback	Predictor	Creator	.2 .4 .6 .8	RSquare	RASE	AAE	Freq
0	RPBWPrediction Formula OLS	Fit Least Squares		0.7499	0.0174	0.0133	364
0	RPBW Prediction Formula Lasso	Fit Generalized Lasso		0.7300	0.0181	0.0138	364
0	RPBW Prediction Formula AdaptiveLasso	Fit Generalized Adaptive Lasso		0.7171	0.0185	0.0142	364
0	RPBW Prediction Formula ElasticNet	Fit Generalized Elastic Net		0.7300	0.0181	0.0138	364
0	RPBW Prediction AdaptiveElasticNet	Fit Generalized Adaptive Elastic Net		0.7171	0.0185	0.0142	364
0	RPBW Prediction Formula AdaptiveLassoT5	Fit Generalized Adaptive Lasso		0.7285	0.0181	0.0137	364
0	RPBW Prediction Formula AptiveLassoCauchy	Fit Generalized Adaptive Lasso		0.7059	0.0189	0.0140	364
1	RPBWPrediction Formula OLS	Fit Least Squares		0.4025	0.0180	0.0141	122
1	RPBW Prediction Formula Lasso	Fit Generalized Lasso		0.4166	0.0178	0.0140	122
1	RPBW Prediction Formula AdaptiveLasso	Fit Generalized Adaptive Lasso		0.4564	0.0172	0.0134	122
1	RPBW Prediction Formula ElasticNet	Fit Generalized Elastic Net		0.4165	0.0178	0.0140	122
1	RPBW Prediction AdaptiveElasticNet	Fit Generalized Adaptive Elastic Net		0.4564	0.0172	0.0134	122
1	RPBW Prediction Formula AdaptiveLassoT5	Fit Generalized Adaptive Lasso		0.4604	0.0171	0.0135	122
1	RPBW Prediction Formula AptiveLassoCauchy	Fit Generalized Adaptive Lasso		0.4604	0.0171	0.0135	122
2	RPBWPrediction Formula OLS	Fit Least Squares		0.6103	0.0224	0.0173	123
2	RPBW Prediction Formula Lasso	Fit Generalized Lasso		0.6181	0.0222	0.0169	123
2	RPBW Prediction Formula AdaptiveLasso	Fit Generalized Adaptive Lasso		0.6301	0.0219	0.0166	123
2	RPBW Prediction Formula ElasticNet	Fit Generalized Elastic Net		0.6181	0.0222	0.0169	123
2	RPBW Prediction AdaptiveElasticNet	Fit Generalized Adaptive Elastic Net		0.6300	0.0219	0.0166	123
2	RPBW Prediction Formula AdaptiveLassoT5	Fit Generalized Adaptive Lasso		0.6426	0.0215	0.0164	123
2	RPBW Prediction Formula AptiveLassoCauchy	Fit Generalized Adaptive Lasso		0.6418	0.0215	0.0166	123

Looking at Test Set Values to determine the Best of 7 Models

- **Adaptive Lasso** has the highest R^2 value with 0.6301.
- **Adaptive Elastic Net** has the 2nd highest R^2 value with 0.6300.

- **Adaptive Lasso t(5)** and **Adaptive Lasso Cauchy** share the lowest Residual Standard Error (**RASE**) with 0.0215.

- **Adaptive Lasso t(5)** has the lowest Average Absolute Error (**AAE**) with 0.0215.

Model Comparison

▷ **Predictors**

◢ **Measures of Fit for RPBW**

Holdback	Predictor	Creator	.2 .4 .6 .8	RSquare	RASE	AAE	Freq
0	RPBW Prediction Formula AdaptiveLassoT5	Fit Generalized Adaptive Lasso		0.7285	0.0181	0.0137	364
0	RPBW Prediction Formula AptiveLassoCauchy	Fit Generalized Adaptive Lasso		0.7059	0.0189	0.0140	364
0	RPBW Prediction Formula AdaptiveLasso	Fit Generalized Adaptive Lasso		0.7171	0.0185	0.0142	364
1	RPBW Prediction Formula AdaptiveLassoT5	Fit Generalized Adaptive Lasso		0.4604	0.0171	0.0135	122
1	RPBW Prediction Formula AptiveLassoCauchy	Fit Generalized Adaptive Lasso		0.4604	0.0171	0.0135	122
1	RPBW Prediction Formula AdaptiveLasso	Fit Generalized Adaptive Lasso		0.4564	0.0172	0.0134	122
2	RPBW Prediction Formula AdaptiveLassoT5	Fit Generalized Adaptive Lasso		0.6426	0.0215	0.0164	123
2	RPBW Prediction Formula AptiveLassoCauchy	Fit Generalized Adaptive Lasso		0.6418	0.0215	0.0166	123
2	RPBW Prediction Formula AdaptiveLasso	Fit Generalized Adaptive Lasso		0.6301	0.0219	0.0166	123

Looking at Test Set Values to determine the Best of 3 Models

- **Adaptive Lasso t (5)** has the highest R^2 value with 0.6426.
- **Adaptive Lasso Cauchy** has the 2nd highest R^2 value with 0.6418.

- **Adaptive Lasso t (5)** and **Adaptive Lasso Cauchy** share the lowest Residual Standard Error (**RASE**) with 0.0215.

- **Adaptive Lasso t (5)** has the lowest Average Absolute Error (**AAE**) with 0.0166.

Adaptive Lasso t (5) model is better in all 3 categories when comparing the 3 models

Risk Factors for Oil Prices Before and After Covid-19

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▲ ▼ Generalized Regression for RPBW

▲ ▼ t(5) Adaptive Lasso with Validation Column

▲ Parameter Estimates for Original Predictors

Term	Estimate	Std Error	Wald ChiSquare	Prob > ChiSquare
Intercept	0.001126	0.0010004	1.2668274	0.2604
RTIP	0.0975465	0.2274872	0.1838694	0.6681
RLQD	0	0	0	1.0000
RHYG	-0.012306	0.2007341	0.0037583	0.9511
RSPY	-1.896717	0.3909591	23.536541	<.0001*
RXLK	1.2925978	0.2221779	33.847371	<.0001*
RSLY	1.0989228	0.1140358	92.864885	<.0001*
RUSO	-0.004482	0.0296006	0.0229273	0.8796
RGLD	0	0	0	1.0000
ROVX	-0.014507	0.0094633	2.3500379	0.1253
RFXE	-0.001802	0.2497387	5.2084e-5	0.9942
REMB	0	0	0	1.0000
RTLH	0	0	0	1.0000
RVIX	0	0	0	1.0000
RVEU	-0.161546	0.3876153	0.1736959	0.6768
RVSS	0.3171779	0.3096454	1.0492442	0.3057
RVWO	0.6957336	0.2046605	11.556272	0.0007*
RVNQL	-0.201579	0.2031454	0.9846348	0.3211
RVNQ	0	0	0	1.0000
RBWX	0	0	0	1.0000
RIBND	0	0	0	1.0000
LRPBW	0	0	0	1.0000
LRTIP	0	0	0	1.0000
LRLQD	0.3105759	0.2289424	1.8402766	0.1749
LRHYG	-0.214775	0.21847	0.9664575	0.3256
LRSPY	0.3175328	0.1986772	2.5543541	0.1100
LRXLK	0	0	0	1.0000
LRSLY	0.0192164	0.1023948	0.03522	0.8511	-0.181474	0.2199065
LRUSO	0	0	0	1.0000	0	0
LRGLD	0	0	0	1.0000	0	0

t(5) Distribution

Parameters	Estimate	Std Error	Wald ChiSquare	Prob > ChiSquare	Lower 95%	Upper 95%
Scale	0.0144961	0.0007178	407.88314	<.0001*	0.0130893	0.0159029

Generalized t (5) Adaptive Lasso Regression model picks S&P 600 (small company) index (**RSLY**), Technology Select Sector SPDR Fund (**RXLK**), S&P 500 (large Company) index (**RSPY**), and Vanguard Emerging Markets Stock Index Fund (**RVWO**) as strong predictors for the Response Variable Invesco WilderHill Clean Energy ETF (**RPBW**).

It also chose the Lagged SPDR Bloomberg International Treasury Bond (**LRBWX**) and Lagged SPDR Bloomberg International Corporate Bond (**LRIBND**)as possible predictors for the Response Variable Invesco WilderHill Clean Energy ETF (**RPBW**).

This model kept only 24 variables of the original 40 Return and Lagged variables.

Risk Factors for Oil Prices Before and After Covid-19

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Generalized Regression for RPBW

t(5) Adaptive Lasso with Validation Column

Parameter Estimates for Original Predictors

Term	Estimate	Std Error	Wald ChiSquare	Prob > ChiSquare		
RTLH	0	0	0	1.0000		
RVIX	0	0	0	1.0000		
RVEU	-0.161546	0.3876153	0.1736959	0.6768		
RVSS	0.3171779	0.3096454	1.0492442	0.3057		
RVWO	0.6957336	0.2046605	11.556272	0.0007*		
RVNQL	-0.201579	0.2031454	0.9846348	0.3211		
RVNQ	0	0	0	1.0000		
RBWX	0	0	0	1.0000		
RIBND	0	0	0	1.0000		
LRPBW	0	0	0	1.0000		
LRTIP	0	0	0	1.0000		
LRLQD	0.3105759	0.2289424	1.8402766	0.1749		
LRHYG	-0.214775	0.21847	0.9664575	0.3256		
LRSPY	0.3175328	0.1986772	2.5543541	0.1100		
LRXLK	0	0	0	1.0000		
LRSLY	0.0192164	0.1023948	0.03522	0.8511		
LRUSO	0	0	0	1.0000		
LRGLD	0	0	0	1.0000		
LROVX	0.0042795	0.0100316	0.1819877	0.6697		
LRFXE	0	0	0	1.0000		
LREMB	-0.054526	0.2105696	0.0670517	0.7957		
LRTLH	0	0	0	1.0000		
LRVIX	0.0220121	0.0185778	1.4038956	0.2361		
LRVEU	0	0	0	1.0000		
LRVSS	-0.251791	0.331177	0.5780408	0.4471		
LRVWO	0.1891591	0.1534649	1.5192751	0.2177		
LRVNQL	0.1380154	0.1659547	0.6916334	0.4056	-0.18725	0.4632807
LRVNQ	0	0	0	1.0000	0	0
LRBWX	0.465675	0.2036538	5.2285416	0.0222*	0.0665208	0.8648291
LRIBND	-0.520538	0.2549453	4.1687956	0.0412*	-1.020221	-0.020854

t(5) Distribution Parameters	Estimate	Std Error	Wald ChiSquare	Prob > ChiSquare	Lower 95%	Upper 95%
Scale	0.0144961	0.0007178	407.88314	<.0001*	0.0130893	0.0159029

Generalized t (5) Adaptive Lasso Regression model picks S&P 600 (small company) index (**RSLY**), Technology Select Sector SPDR Fund (**RXLK**), S&P 500 (large Company) index (**RSPY**), and Vanguard Emerging Markets Stock Index Fund (**RVWO**) as strong predictors for the Response Variable Invesco WilderHill Clean Energy ETF (**RPBW**).

It also chose the Lagged SPDR Bloomberg International Treasury Bond (**LRBWX**) and Lagged SPDR Bloomberg International Corporate Bond (**LRIBND**)as possible predictors for the Response Variable Invesco WilderHill Clean Energy ETF (**RPBW**).

This model kept only 24 variables of the original 40 Return and Lagged variables.

Risk Factors for Oil Prices Before and After Covid-19

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Generalized Regression for RPBW

t(5) Adaptive Lasso with Validation Column

Model Summary

Measure	Training	Validation	Test
Generalized RSquare	0.7120478	0.4617273	0.6386236
Lambda Penalty	0.8395614	.	.

▷ Solution Path

▷ Parameter Estimates for Original Predictors

Effect Tests

Source	Nparm	DF	Wald ChiSquare	Prob > ChiSquare
RSLY	1	1	92.864885	<.0001*
RXLK	1	1	33.847371	<.0001*
RSPY	1	1	23.536541	<.0001*
RVWO	1	1	11.556272	0.0007*
LRBWX	1	1	5.2285416	0.0222*
LRIBND	1	1	4.1687956	0.0412*
LRSPY	1	1	2.5543541	0.1100
ROVX	1	1	2.3500379	0.1253
LRLQD	1	1	1.8402766	0.1749
LRVWO	1	1	1.5192751	0.2177
LRVIX	1	1	1.4038956	0.2361
RVSS	1	1	1.0492442	0.3057
RVNQL	1	1	0.9846348	0.3211
LRHYG	1	1	0.9664575	0.3256
LRVNQL	1	1	0.6916334	0.4056
LRVSS	1	1	0.5780408	0.4471
RTIP	1	1	0.1838694	0.6681
LROVX	1	1	0.1819877	0.6697
RVEU	1	1	0.1736959	0.6768
LREMB	1	1	0.0670517	0.7957
LRSLY	1	1	0.03522	0.8511
RUSO	1	1	0.0229273	0.8796
RHYG	1	1	0.0037583	0.9511
RFXE	1	1	5.2084e-5	0.9942
RLQD	1	0	0	1.0000 Removed

Generalized t (5) Adaptive Lasso Regression model picks S&P 600 (small company) index (**RSLY**), Technology Select Sector SPDR Fund (**RXLK**), S&P 500 (large Company) index (**RSPY**), and Vanguard Emerging Markets Stock Index Fund (**RVWO**) as strong predictors for the Response Variable Invesco WilderHill Clean Energy ETF (**RPBW**).

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This model kept only 24 variables of the original 40 Return and Lagged variables.

Risk Factors for Oil Prices Before and After Covid-19

RPBW.Covid - Generalized Regression - JMP Pro

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Generalized Regression for RPBW
t(5) Adaptive Lasso with Validation Column
Prediction Profiler
Variable Importance: Independent Uniform Inputs

Summary Report

Column	Main Effect	Total Effect	.2 .4 .6 .8
RSPY	0.392	0.428	
RXLK	0.295	0.331	
RSLY	0.117	0.153	
RVWO	0.03	0.056	
LRSPY	0.005	0.013	
RVSS	0.003	0.011	
LRVSS	0.003	0.009	
RVNQL	0.002	0.005	
LRBWX	0.001	0.004	
LRIBND	0.002	0.004	
LRLQD	0.001	0.004	
RVEU	0.001	0.003	
LRHYG	0.001	0.003	
LRVNQL	0.001	0.003	
LRVWO	0.001	0.003	
LRVIX	4e-4	0.001	
ROVX	4e-4	0.001	
LREMB	1e-4	4e-4	
RTIP	8e-5	4e-4	
LROVX	6e-5	3e-4	
LRSLY	9e-5	2e-4	
RHYG	3e-5	1e-4	
RUSO	2e-5	4e-5	
RFXE	4e-7	3e-6	

Generalized t(5) Adaptive Lasso Regression model picks the S&P 500 (large Company) index (**RSPY**) as the strongest predictor for the Response Variable Invesco WilderHill Clean Energy ETF (**RPBW**). **RSPY** has 42.8% of the effects on the Response Variable **RPBW**.

Technology Select Sector SPDR Fund (**RXLK**) comes in as a strong second-best predictor with 33.1% of the effects.

Marginal Model Plots