

Exploratory Analyses

MRB

October 27, 2017

Purpose

Document for data exploration for **Data Challenge 2017!**

Look at the data

Table 1: Overall Data Summary

	Overall (N=400)
Y	
Mean (SD)	6.26 (3.47)
Q1, Q3	3.62, 8.43
Range	0.042 - 16.6
A	
0	215 (53.8%)
1	185 (46.2%)
W1	
A	42 (10.5%)
B	75 (18.8%)
C	263 (65.8%)
D	20 (5%)
W2	
A	252 (63%)
B	71 (17.8%)
C	37 (9.25%)
D	40 (10%)
W3	
A	115 (28.8%)
B	115 (28.8%)
C	170 (42.5%)
W4	
A	289 (72.2%)
B	34 (8.5%)
C	77 (19.2%)
W5	
0	232 (58%)
1	168 (42%)
W6	
0	279 (69.8%)
1	121 (30.2%)
W7	
Mean (SD)	2.29 (2.99)
Q1, Q3	0.028, 4.33
Range	-5.2 - 11.5

	Overall (N=400)
W8	
Mean (SD)	2.36 (3.68)
Q1, Q3	-0.22, 4.87
Range	-7.7 - 14.3
W9	
Mean (SD)	2.93 (3.14)
Q1, Q3	0, 5
Range	0 - 11
W10	
Mean (SD)	0.089 (3.03)
Q1, Q3	-1.9, 2.02
Range	-9.1 - 9.27
W11	
Mean (SD)	0.307 (4.47)
Q1, Q3	-2.6, 3.11
Range	-14 - 14.9
W12	
Mean (SD)	1.55 (7.67)
Q1, Q3	-3.4, 6.65
Range	-19 - 28.1
W13	
Mean (SD)	3.02 (4.67)
Q1, Q3	-0.152, 5.93
Range	-7.7 - 17.1
W14	
Mean (SD)	5.68 (6.6)
Q1, Q3	0.478, 9.04
Range	-2.7 - 27.4
W15	
Mean (SD)	2.01 (5.69)
Q1, Q3	-1.7, 5.29
Range	-14 - 27.2
W16	
Mean (SD)	3.8 (5)
Q1, Q3	0.297, 6.11
Range	-3.4 - 16.9
W17	
Mean (SD)	4.66 (5.14)
Q1, Q3	0.817, 8.17
Range	-7.9 - 20.3
W18	
Mean (SD)	5.54 (3.61)
Q1, Q3	2.92, 8.32
Range	-3 - 14.9
W19	
Mean (SD)	9.09 (9.26)
Q1, Q3	2.67, 12.6
Range	-5.2 - 57.6
W20	
Mean (SD)	-0.079 (3.11)
Q1, Q3	-2.4, 1.86
Range	-13 - 9.71

	Overall (N=400)
W21	
Mean (SD)	3.79 (4.31)
Q1, Q3	0.321, 7.3
Range	-8.4 - 15.6
W22	
Mean (SD)	4.73 (2.01)
Q1, Q3	3.21, 6.03
Range	0.631 - 10.9
W23	
Mean (SD)	8.5 (4.26)
Q1, Q3	5.14, 11.5
Range	-0.232 - 23.5
W24	
Mean (SD)	2.89 (8.34)
Q1, Q3	-2.9, 8.1
Range	-17 - 38
W25	
Mean (SD)	9.81 (9.21)
Q1, Q3	2.86, 15.4
Range	-4.9 - 41.5

Table 2: **Overall Data Summary: By A**

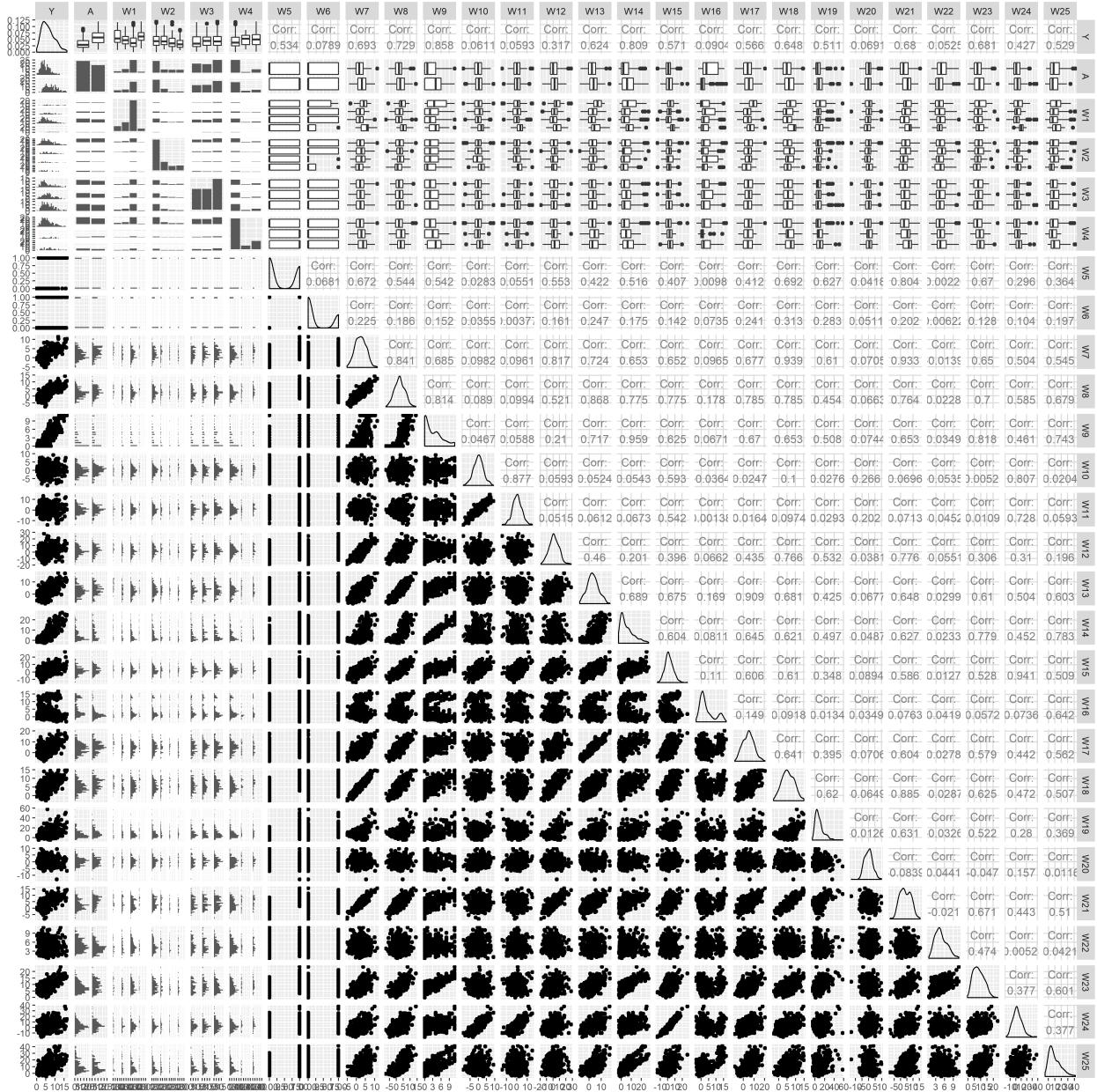
	0 (N=215)	1 (N=185)	Total (N=400)	p value
W1				0.378 ¹
A	18 (8.37%)	24 (13%)	42 (10.5%)	
B	41 (19.1%)	34 (18.4%)	75 (18.8%)	
C	143 (66.5%)	120 (64.9%)	263 (65.8%)	
D	13 (6.05%)	7 (3.78%)	20 (5%)	
W2				<0.001 ¹
A	121 (56.3%)	131 (70.8%)	252 (63%)	
B	34 (15.8%)	37 (20%)	71 (17.8%)	
C	30 (14%)	7 (3.78%)	37 (9.25%)	
D	30 (14%)	10 (5.41%)	40 (10%)	
W3				0.889 ¹
A	64 (29.8%)	51 (27.6%)	115 (28.8%)	
B	61 (28.4%)	54 (29.2%)	115 (28.8%)	
C	90 (41.9%)	80 (43.2%)	170 (42.5%)	
W4				0.031 ¹
A	160 (74.4%)	129 (69.7%)	289 (72.2%)	
B	11 (5.12%)	23 (12.4%)	34 (8.5%)	
C	44 (20.5%)	33 (17.8%)	77 (19.2%)	
W5				<0.001 ²
0	146 (67.9%)	86 (46.5%)	232 (58%)	
1	69 (32.1%)	99 (53.5%)	168 (42%)	
W6				0.580 ²
0	153 (71.2%)	126 (68.1%)	279 (69.8%)	
1	62 (28.8%)	59 (31.9%)	121 (30.2%)	
W7				<0.001 ³
Mean (SD)	1.82 (2.91)	2.83 (3)	2.29 (2.99)	
Q1, Q3	-0.216, 3.76	0.77, 5.18	0.028, 4.33	

	0 (N=215)	1 (N=185)	Total (N=400)	p value
Range	-5.2 - 11.5	-4.1 - 10.3	-5.2 - 11.5	
W8				0.010 ³
Mean (SD)	1.92 (3.49)	2.87 (3.84)	2.36 (3.68)	
Q1, Q3	-0.51, 3.83	0.293, 5.8	-0.22, 4.87	
Range	-5.7 - 12.4	-7.7 - 14.3	-7.7 - 14.3	
W9				<0.001 ³
Mean (SD)	2.28 (2.73)	3.68 (3.41)	2.93 (3.14)	
Q1, Q3	0, 4	0, 6	0, 5	
Range	0 - 11	0 - 11	0 - 11	
W10				0.404 ³
Mean (SD)	-0.028 (3.07)	0.225 (2.98)	0.089 (3.03)	
Q1, Q3	-2.2, 1.97	-1.6, 2.16	-1.9, 2.02	
Range	-9.1 - 7.57	-7.9 - 9.27	-9.1 - 9.27	
W11				0.851 ³
Mean (SD)	0.346 (4.47)	0.262 (4.48)	0.307 (4.47)	
Q1, Q3	-2.8, 2.93	-2.3, 3.2	-2.6, 3.11	
Range	-14 - 14.9	-13 - 12.2	-14 - 14.9	
W12				0.230 ³
Mean (SD)	1.12 (7.87)	2.04 (7.42)	1.55 (7.67)	
Q1, Q3	-4, 6.21	-3, 7.08	-3.4, 6.65	
Range	-19 - 28.1	-17 - 20.9	-19 - 28.1	
W13				0.026 ³
Mean (SD)	2.54 (4.58)	3.58 (4.73)	3.02 (4.67)	
Q1, Q3	-0.522, 5.29	0.567, 6.61	-0.152, 5.93	
Range	-7.1 - 17.1	-7.7 - 16.9	-7.7 - 17.1	
W14				<0.001 ³
Mean (SD)	4.52 (5.97)	7.02 (7.05)	5.68 (6.6)	
Q1, Q3	0.178, 7.21	0.914, 12.1	0.478, 9.04	
Range	-2.7 - 23.9	-2.7 - 27.4	-2.7 - 27.4	
W15				0.020 ³
Mean (SD)	1.39 (5.59)	2.73 (5.75)	2.01 (5.69)	
Q1, Q3	-1.9, 4.12	-1.5, 6.4	-1.7, 5.29	
Range	-14 - 17.7	-10 - 27.2	-14 - 27.2	
W16				<0.001 ³
Mean (SD)	5.59 (5.34)	1.71 (3.58)	3.8 (5)	
Q1, Q3	1.22, 11.4	-0.261, 2.31	0.297, 6.11	
Range	-2 - 15.7	-3.4 - 16.9	-3.4 - 16.9	
W17				0.039 ³
Mean (SD)	4.17 (5.08)	5.23 (5.17)	4.66 (5.14)	
Q1, Q3	0.32, 7.51	1.38, 9.03	0.817, 8.17	
Range	-7.9 - 20.3	-6.3 - 18	-7.9 - 20.3	
W18				0.002 ³
Mean (SD)	5.01 (3.52)	6.15 (3.64)	5.54 (3.61)	
Q1, Q3	2.6, 7.2	3.71, 9	2.92, 8.32	
Range	-3 - 14.5	-1.7 - 14.9	-3 - 14.9	
W19				<0.001 ³
Mean (SD)	7.62 (8.69)	10.8 (9.63)	9.09 (9.26)	
Q1, Q3	1.75, 11.2	4.16, 15.2	2.67, 12.6	
Range	-5.2 - 57.6	-3.1 - 50.9	-5.2 - 57.6	
W20				0.495 ³
Mean (SD)	0.02 (2.99)	-0.193 (3.24)	-0.079 (3.11)	
Q1, Q3	-2.1, 1.71	-2.6, 1.88	-2.4, 1.86	

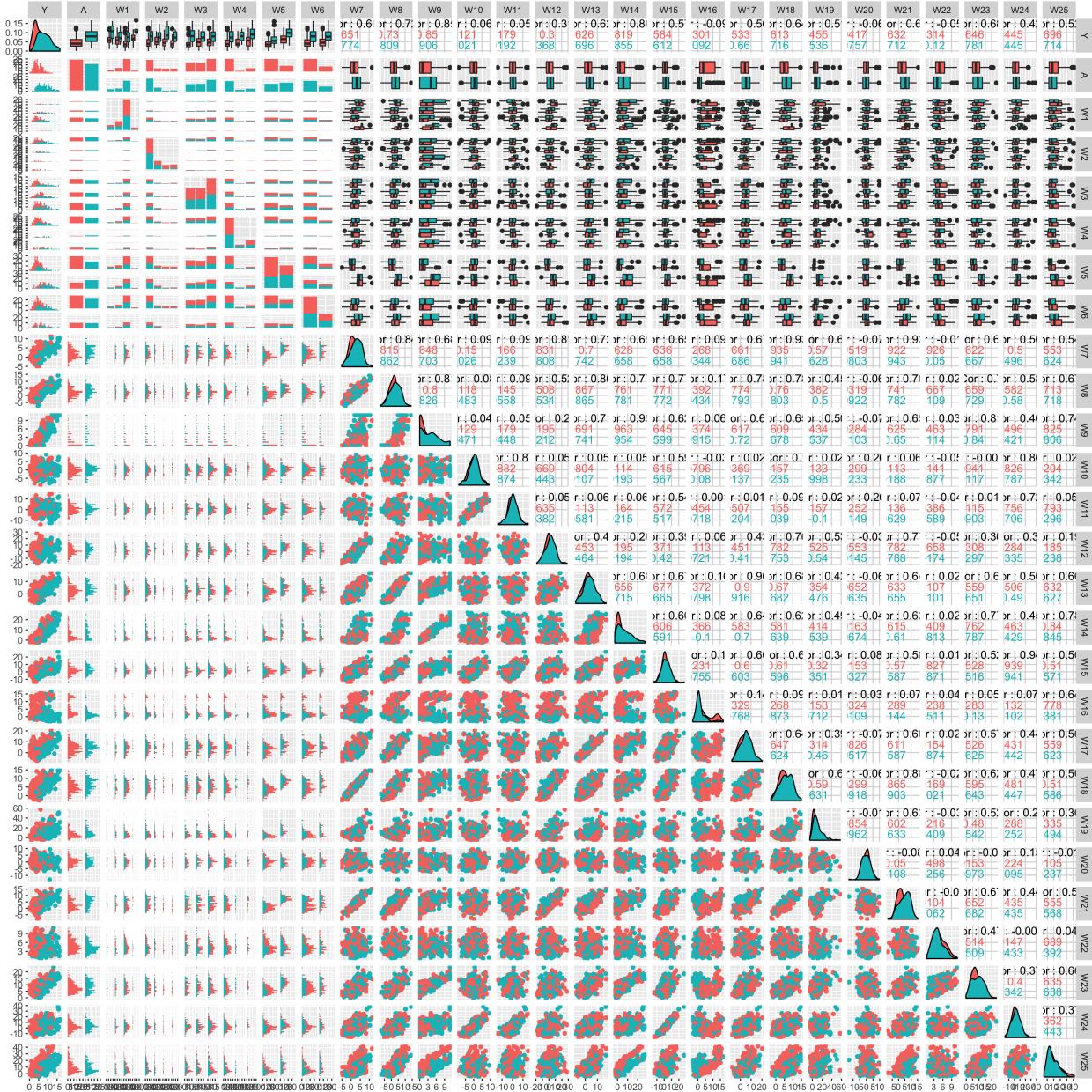
	0 (N=215)	1 (N=185)	Total (N=400)	p value
Range	-7 - 9.71	-13 - 9.49	-13 - 9.71	
W21				<0.001 ³
Mean (SD)	2.88 (4.16)	4.86 (4.24)	3.79 (4.31)	
Q1, Q3	-0.224, 6.02	1.67, 8.23	0.321, 7.3	
Range	-8.4 - 15.6	-4 - 14.2	-8.4 - 15.6	
W22				<0.001 ³
Mean (SD)	5.07 (2.03)	4.32 (1.92)	4.73 (2.01)	
Q1, Q3	3.6, 6.57	2.95, 5.42	3.21, 6.03	
Range	1.46 - 10.9	0.631 - 10.9	0.631 - 10.9	
W23				0.018 ³
Mean (SD)	8.03 (3.91)	9.04 (4.58)	8.5 (4.26)	
Q1, Q3	4.99, 10.5	5.27, 12.6	5.14, 11.5	
Range	1.33 - 21.1	-0.232 - 23.5	-0.232 - 23.5	
W24				0.071 ³
Mean (SD)	2.19 (8.21)	3.7 (8.45)	2.89 (8.34)	
Q1, Q3	-3.2, 7.9	-2.4, 8.7	-2.9, 8.1	
Range	-17 - 25.7	-13 - 38	-17 - 38	
W25				0.013 ³
Mean (SD)	10.9 (10)	8.58 (8.05)	9.81 (9.21)	
Q1, Q3	3.19, 16.7	2.56, 14.5	2.86, 15.4	
Range	-3.6 - 41.5	-4.9 - 34.1	-4.9 - 41.5	

1. Pearson's Chi-squared test
2. Pearson's Chi-squared test with Yates' continuity correction
3. Linear Model ANOVA

Scatterplot Matrix without Transformation



Scatterplot Matrix with color by treatment level.



Scatterplot Matrix with select variables, colored by treatment level.

Table 3: Model Summaries: $Y = W_i + A$, for $i = 1, 2, \dots, 25$

	estimate	std.error	p.value	adj.r.squared
(Intercept)	6.58	0.469	<0.001	0.324
W1 B	-1.4	0.55	0.009	.
W1 C	-2.5	0.475	<0.001	.
W1 D	0.736	0.777	0.344	.
A 1	3.4	0.287	<0.001	.
(Intercept)	4.59	0.25	<0.001	0.242
W2 B	0.247	0.406	0.542	.
W2 C	0.634	0.541	0.242	.

	estimate	std.error	p.value	adj.r.squared
W2 D	-0.342	0.521	0.512	.
A 1	3.46	0.312	<0.001	.
(Intercept)	4.39	0.312	<0.001	0.242
W3 B	0.327	0.398	0.412	.
W3 C	0.436	0.365	0.232	.
A 1	3.43	0.303	<0.001	.
(Intercept)	4.42	0.222	<0.001	0.257
W4 B	0.112	0.546	0.838	.
W4 C	1.2	0.383	0.002	.
A 1	3.46	0.302	<0.001	.
(Intercept)	3.66	0.198	<0.001	0.433
W5 1	3.14	0.271	<0.001	.
A 1	2.76	0.268	<0.001	.
(Intercept)	4.53	0.226	<0.001	0.245
W6 1	0.471	0.328	0.152	.
A 1	3.42	0.302	<0.001	.
(Intercept)	3.34	0.159	<0.001	0.625
W7	0.727	0.036	<0.001	.
A 1	2.7	0.216	<0.001	.
(Intercept)	3.45	0.141	<0.001	0.692
W8	0.636	0.026	<0.001	.
A 1	2.83	0.194	<0.001	.
(Intercept)	2.69	0.111	<0.001	0.832
W9	0.869	0.023	<0.001	.
A 1	2.22	0.146	<0.001	.
(Intercept)	4.67	0.206	<0.001	0.242
W10	0.046	0.05	0.354	.
A 1	3.42	0.303	<0.001	.
(Intercept)	4.65	0.206	<0.001	0.245
W11	0.05	0.034	0.142	.
A 1	3.44	0.302	<0.001	.
(Intercept)	4.52	0.196	<0.001	0.324
W12	0.13	0.019	<0.001	.
A 1	3.31	0.286	<0.001	.
(Intercept)	3.58	0.167	<0.001	0.57
W13	0.427	0.024	<0.001	.
A 1	2.99	0.229	<0.001	.
(Intercept)	2.91	0.126	<0.001	0.775
W14	0.39	0.013	<0.001	.
A 1	2.46	0.168	<0.001	.
(Intercept)	4.23	0.168	<0.001	0.509
W15	0.317	0.021	<0.001	.
A 1	3.01	0.245	<0.001	.
(Intercept)	4.21	0.274	<0.001	0.253
W16	0.082	0.033	0.012	.
A 1	3.75	0.326	<0.001	.
(Intercept)	3.2	0.193	<0.001	0.51
W17	0.351	0.024	<0.001	.
A 1	3.06	0.245	<0.001	.
(Intercept)	1.86	0.221	<0.001	0.575
W18	0.56	0.032	<0.001	.
A 1	2.8	0.229	<0.001	.

	estimate	std.error	p.value	adj.r.squared
(Intercept)	3.41	0.21	<0.001	0.429
W19	0.164	0.014	<0.001	.
A 1	2.91	0.267	<0.001	.
(Intercept)	4.67	0.206	<0.001	0.243
W20	-0.058	0.049	0.231	.
A 1	3.42	0.303	<0.001	.
(Intercept)	3.28	0.171	<0.001	0.581
W21	0.481	0.027	<0.001	.
A 1	2.48	0.231	<0.001	.
(Intercept)	4.31	0.439	<0.001	0.242
W22	0.07	0.076	0.361	.
A 1	3.49	0.308	<0.001	.
(Intercept)	0.538	0.245	0.029	0.635
W23	0.514	0.025	<0.001	.
A 1	2.92	0.211	<0.001	.
(Intercept)	4.32	0.188	<0.001	0.389
W24	0.16	0.016	<0.001	.
A 1	3.19	0.273	<0.001	.
(Intercept)	2.21	0.199	<0.001	0.597
W25	0.226	0.012	<0.001	.
A 1	3.95	0.222	<0.001	.



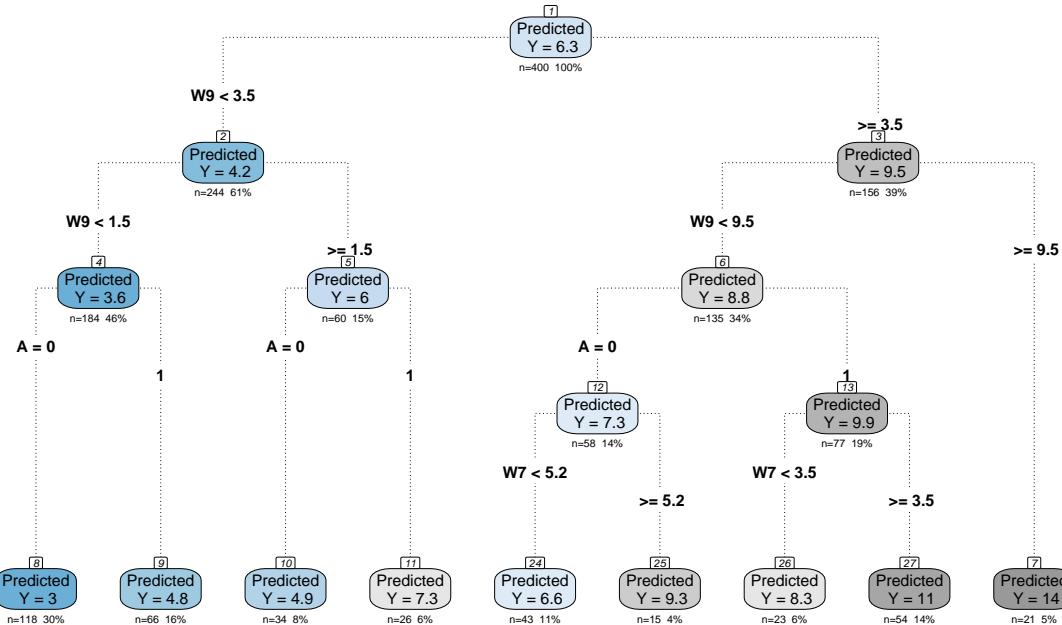
Figure 1: knit to html to see

Playtime!

Different Methods of Variable Selection:

Decision Trees, Lasso, Forward, Stepwise, Manual (not backward)

Sweet, Sweet Plot



```

## Call:
## rpart(formula = formulize("Y", c(names(dc1)[4:28], "A")), data = dc1)
##   n= 400
##
##           CP nsplit rel error      xerror      xstd
## 1 0.54543153     0 1.0000000 1.0035463 0.06921446
## 2 0.09872680     1 0.4545685 0.4584950 0.03280511
## 3 0.05146478     2 0.3558417 0.4070547 0.02683046
## 4 0.04592446     3 0.3043769 0.3887065 0.02588447
## 5 0.02691989     4 0.2584524 0.3462752 0.02281628
## 6 0.01774951     5 0.2315325 0.2938947 0.02013334
## 7 0.01617286     6 0.2137830 0.2681117 0.01825518
## 8 0.01610594     7 0.1976102 0.2603524 0.01806450
## 9 0.01000000     8 0.1815042 0.2470480 0.01756582
##
## Variable importance
##   W9 W14 W8 W23 W25 W13 A W16 W21 W7 W12 W17 W18 W19
##   24 18 13 13 11 10  3   1   1   1   1   1   1   1   1
##
## Node number 1: 400 observations,      complexity param=0.5454315
##   mean=6.255473, MSE=11.98608
##   left son=2 (244 obs) right son=3 (156 obs)
## Primary splits:

```

```

##      W9 < 3.5          to the left,  improve=0.5454315, (0 missing)
##      W14 < 5.763803   to the left,  improve=0.5181421, (0 missing)
##      W8 < 2.992449    to the left,  improve=0.4821869, (0 missing)
##      W7 < 3.478499    to the left,  improve=0.4175468, (0 missing)
##      W21 < 4.90963    to the left,  improve=0.4038650, (0 missing)
## Surrogate splits:
##      W14 < 5.262932   to the left,  agree=0.940, adj=0.846, (0 split)
##      W8 < 2.92829    to the left,  agree=0.872, adj=0.673, (0 split)
##      W23 < 9.745147   to the left,  agree=0.855, adj=0.628, (0 split)
##      W25 < 11.65137   to the left,  agree=0.805, adj=0.500, (0 split)
##      W13 < 3.613826   to the left,  agree=0.802, adj=0.494, (0 split)
##
## Node number 2: 244 observations,    complexity param=0.05146478
##   mean=4.211024, MSE=3.867181
##   left son=4 (184 obs) right son=5 (60 obs)
## Primary splits:
##      W9 < 1.5          to the left,  improve=0.2614948, (0 missing)
##      A splits as LR,  improve=0.2540243, (0 missing)
##      W7 < 1.591133    to the left,  improve=0.2526917, (0 missing)
##      W21 < 1.663075   to the left,  improve=0.2055047, (0 missing)
##      W8 < 2.017509    to the left,  improve=0.1808941, (0 missing)
## Surrogate splits:
##      W14 < 2.53977   to the left,  agree=0.893, adj=0.567, (0 split)
##      W8 < 2.903125   to the left,  agree=0.836, adj=0.333, (0 split)
##      W25 < 13.25427  to the left,  agree=0.803, adj=0.200, (0 split)
##      W16 < 11.3988   to the left,  agree=0.799, adj=0.183, (0 split)
##      W13 < 4.309836  to the left,  agree=0.791, adj=0.150, (0 split)
##
## Node number 3: 156 observations,    complexity param=0.0987268
##   mean=9.4532, MSE=7.921833
##   left son=6 (135 obs) right son=7 (21 obs)
## Primary splits:
##      W9 < 9.5          to the left,  improve=0.3830205, (0 missing)
##      W7 < 4.999441    to the left,  improve=0.3164421, (0 missing)
##      W14 < 13.03272  to the left,  improve=0.3133315, (0 missing)
##      A splits as LR,  improve=0.2846859, (0 missing)
##      W21 < 4.90963    to the left,  improve=0.2515501, (0 missing)
## Surrogate splits:
##      W14 < 20.21393  to the left,  agree=0.936, adj=0.524, (0 split)
##      W23 < 15.62551  to the left,  agree=0.910, adj=0.333, (0 split)
##      W11 < 10.56538  to the left,  agree=0.885, adj=0.143, (0 split)
##      W17 < 15.30834  to the left,  agree=0.885, adj=0.143, (0 split)
##      W13 < 13.02812  to the left,  agree=0.878, adj=0.095, (0 split)
##
## Node number 4: 184 observations,    complexity param=0.02691989
##   mean=3.636782, MSE=2.5425
##   left son=8 (118 obs) right son=9 (66 obs)
## Primary splits:
##      A splits as LR,  improve=0.27588740, (0 missing)
##      W7 < 1.39736    to the left,  improve=0.13836180, (0 missing)
##      W21 < 3.076161  to the left,  improve=0.10365300, (0 missing)
##      W12 < 1.487588  to the left,  improve=0.08995449, (0 missing)
##      W1 splits as RRLR, improve=0.08627216, (0 missing)
## Surrogate splits:

```

```

##      W16 < 0.7283739 to the right, agree=0.674, adj=0.091, (0 split)
##      W22 < 1.713776 to the right, agree=0.674, adj=0.091, (0 split)
##      W23 < 2.328696 to the right, agree=0.674, adj=0.091, (0 split)
##      W8   < -5.151453 to the right, agree=0.663, adj=0.061, (0 split)
##      W25 < -2.560438 to the right, agree=0.663, adj=0.061, (0 split)
##
## Node number 5: 60 observations,    complexity param=0.01774951
##   mean=5.972035, MSE=3.817129
##   left son=10 (34 obs) right son=11 (26 obs)
## Primary splits:
##   A   splits as LR, improve=0.3715656, (0 missing)
##   W7  < 1.590959 to the left,  improve=0.3063926, (0 missing)
##   W21 < 2.455516 to the left,  improve=0.2793826, (0 missing)
##   W12 < 0.9629807 to the left, improve=0.2108504, (0 missing)
##   W8   < 1.879978 to the left, improve=0.1933822, (0 missing)
## Surrogate splits:
##   W25 < 4.990111 to the right, agree=0.800, adj=0.538, (0 split)
##   W16 < 1.168843 to the right, agree=0.783, adj=0.500, (0 split)
##   W17 < 5.369905 to the right, agree=0.733, adj=0.385, (0 split)
##   W22 < 3.75348 to the right, agree=0.683, adj=0.269, (0 split)
##   W2   splits as LRLL, agree=0.667, adj=0.231, (0 split)
##
## Node number 6: 135 observations,    complexity param=0.04592446
##   mean=8.766184, MSE=5.145359
##   left son=12 (58 obs) right son=13 (77 obs)
## Primary splits:
##   A   splits as LR, improve=0.3169800, (0 missing)
##   W7  < 4.999441 to the left,  improve=0.2928541, (0 missing)
##   W21 < 4.90963 to the left,  improve=0.2803883, (0 missing)
##   W12 < 1.297934 to the left,  improve=0.2278584, (0 missing)
##   W9   < 5.5 to the left,  improve=0.2232378, (0 missing)
## Surrogate splits:
##   W16 < 7.491763 to the right, agree=0.756, adj=0.431, (0 split)
##   W25 < 16.86896 to the right, agree=0.756, adj=0.431, (0 split)
##   W21 < 3.170922 to the left,  agree=0.681, adj=0.259, (0 split)
##   W19 < 4.571226 to the left,  agree=0.659, adj=0.207, (0 split)
##   W12 < 0.1056728 to the left, agree=0.652, adj=0.190, (0 split)
##
## Node number 7: 21 observations
##   mean=13.86973, MSE=3.23064
##
## Node number 8: 118 observations
##   mean=3.010417, MSE=1.935495
##
## Node number 9: 66 observations
##   mean=4.756646, MSE=1.672211
##
## Node number 10: 34 observations
##   mean=4.930597, MSE=2.456896
##
## Node number 11: 26 observations
##   mean=7.333916, MSE=2.322863
##
## Node number 12: 58 observations,    complexity param=0.01617286

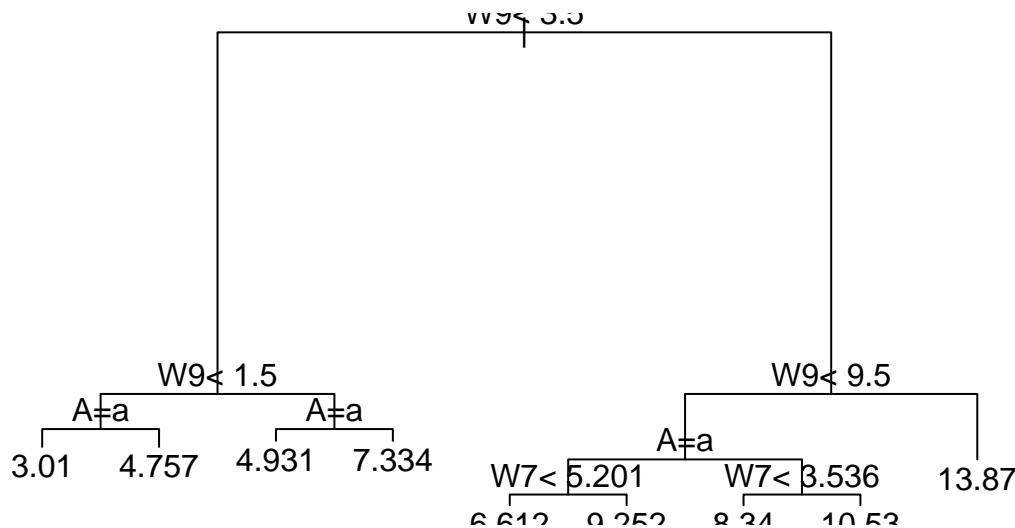
```

```

##   mean=7.294701, MSE=3.41116
##   left son=24 (43 obs) right son=25 (15 obs)
## Primary splits:
##       W7 < 5.200705 to the left, improve=0.3919170, (0 missing)
##       W14 < 15.69639 to the left, improve=0.3720128, (0 missing)
##       W9 < 7.5      to the left, improve=0.3720128, (0 missing)
##       W18 < 8.31034 to the left, improve=0.3595877, (0 missing)
##       W19 < 12.06569 to the left, improve=0.3563726, (0 missing)
## Surrogate splits:
##       W18 < 9.142641 to the left, agree=0.948, adj=0.800, (0 split)
##       W21 < 8.249895 to the left, agree=0.948, adj=0.800, (0 split)
##       W19 < 15.61409 to the left, agree=0.931, adj=0.733, (0 split)
##       W12 < 8.316907 to the left, agree=0.897, adj=0.600, (0 split)
##       W9 < 7.5      to the left, agree=0.862, adj=0.467, (0 split)
##
## Node number 13: 77 observations,    complexity param=0.01610594
##   mean=9.874574, MSE=3.592136
##   left son=26 (23 obs) right son=27 (54 obs)
## Primary splits:
##       W7 < 3.536022 to the left, improve=0.2791772, (0 missing)
##       W9 < 5.5      to the left, improve=0.2493821, (0 missing)
##       W14 < 12.33164 to the left, improve=0.2082537, (0 missing)
##       W21 < 4.786183 to the left, improve=0.1811454, (0 missing)
##       W8 < 4.274089 to the left, improve=0.1773352, (0 missing)
## Surrogate splits:
##       W18 < 6.649654 to the left, agree=0.896, adj=0.652, (0 split)
##       W8 < 3.479762 to the left, agree=0.857, adj=0.522, (0 split)
##       W12 < -0.2520162 to the left, agree=0.844, adj=0.478, (0 split)
##       W21 < 4.786183 to the left, agree=0.844, adj=0.478, (0 split)
##       W17 < 5.275259 to the left, agree=0.792, adj=0.304, (0 split)
##
## Node number 24: 43 observations
##   mean=6.611798, MSE=1.850068
##
## Node number 25: 15 observations
##   mean=9.252359, MSE=2.716976
##
## Node number 26: 23 observations
##   mean=8.340136, MSE=2.780899
##
## Node number 27: 54 observations
##   mean=10.52813, MSE=2.507683

```

I'm Bored



From the scatterplot matrix there appears to be several variables that are very strongly correlated. Techniques to consider: lasso, pls, others?

Of the variables that are highly correlated, can select the variable(s) that appear to be most correlated with the response.

Must not lose focus. The objective is to measure the treatment effect of A, not predict Y.

Use MARS to Pick Out Interaction Terms

Allow Interaction Up To Order 3.

Allow forward pass to build model out up to 40 terms (n/10).

Hinge functions $h(x)$ with one knot are allowed.

```

## Call: earth(formula=Y~., data=dc2, degree=3, nk=40)
##
##                               coefficients
## (Intercept)                  4.2591617
## A1                      2.4264695
## W1C                     -0.6599950
## h(-0.530967-W7)           0.4505634
## h(W7- -0.530967)          0.4906124
## h(2-W9)                   -0.9805526
## h(W9-2)                    0.5373457
## h(W9-8)                    0.5056333
## h(9.96584-W17)            0.0660589
## A1 * W61                  -1.0748691
## A1 * h(2.78832-W7)        -0.2742078
## W1C * h(W16-5.60908)      -0.1191151
## W1C * h(5.60908-W16)      -0.1130028
## W2D * h(W17-9.96584)      -1.0937951
## h(W7- -0.530967) * h(W18-2.12195) -0.0151246
  
```

```

## h(W7- -0.530967) * h(2.12195-W18)      -1.3167697
## h(2.57375-W8) * h(W9-2)                  -1.0004109
## h(W9-2) * h(2.12155-W13)                 0.2006590
## h(2-W9) * h(-0.764684-W16)                -1.0086522
## h(W11-5.47256) * h(9.96584-W17)          -0.0312022
## h(W12-4.0743) * h(9.96584-W17)            -0.0115547
## A1 * W51 * W61                            -2.3061926
## A1 * W1C * h(5.60908-W16)                  0.1328901
## A1 * W61 * h(W7- -0.0901544)              0.3354175
##
## Selected 24 of 32 terms, and 14 of 32 predictors
## Termination condition: Reached nk 40
## Importance: W9, A1, W7, W1C, W51, W61, W8, W13, W16, W17, W2D, W11, ...
## Number of terms at each degree of interaction: 1 8 12 3
## GCV 1.133263    RSS 330.4093    GRSq 0.9059239    RSq 0.9310848

```

What if hinge functions $h(x)$ aren't allowed and we had to use linear associations only?

Allow Interaction Up To Order 3.

Allow forward pass to build model out up to 40 terms ($n/10$).

Hinge functions $h(x)$ with one knot are NOT allowed. Only linear functions.

```

## Call: earth(formula=Y~., data=dc2, degree=3, nk=40, linpreds=TRUE)
##
##           coefficients
## (Intercept)      3.5225713
## A1             1.2817632
## W1C            -1.1738625
## W7              0.1558773
## W9              0.7670360
## W17            -0.0435700
## A1 * W1C        0.6826550
## A1 * W7          0.2613782
## W1C * W19        0.0280239
## W1C * W25        -0.0314256
## W7 * W12          0.0135496
## W7 * W19          -0.0117085
## W9 * W19          0.0069741
## A1 * W51 * W61   -1.9141280
## W1C * W20 * W25  -0.0055586
##
## Selected 15 of 18 terms, and 11 of 32 predictors
## Termination condition: RSq changed by less than 0.001 at 18 terms
## Importance: W9, A1, W1C, W7, W51, W61, W12, W19, W17, W25, W20, ...
## Number of terms at each degree of interaction: 1 5 7 2
## GCV 1.330175    RSS 440.6072    GRSq 0.8895776    RSq 0.9081002

```

Since we want to interpret the treatment effect A, exclude A from being picked in interactions.

Allow Interaction Up To Order 3.

Allow forward pass to build model out up to 40 terms (n/10).

Hinge functions $h(x)$ with one knot are allowed.

Example Code (<http://www.milbo.org/doc/earth-notes.pdf>):

```
## Call: earth(formula=Y~, data=dc2, degree=3, nk=40, allowed=no_A_int)
##
##                                     coefficients
## (Intercept)                      3.5887289
## A1                           1.9239969
## W1C                          -0.9675527
## h(-0.530967-W7)                  0.4359786
## h(W7- -0.530967)                2.3038027
## h(2-W9)                         -0.9754405
## h(W9-2)                          0.7487176
## h(9.96584-W17)                  0.0743149
## W1C * h(-3.46452-W10)            0.4986408
## W1C * h(-0.231327-W14)          0.5231171
## h(W7- -0.530967) * h(W19-19.6913) 0.1039557
## h(W7- -0.530967) * h(19.6913-W19) -0.0774293
## h(W7- -0.530967) * h(W19-0.191401) -0.1032743
## h(2.57375-W8) * h(W9-2)          -0.8244384
## h(W9-2) * h(3.93794-W14)        0.9861561
## h(W9-2) * h(0.283155-W16)       0.0636135
## W1C * W3C * h(W10- -3.46452)     0.0793946
## W1C * W61 * h(-0.764684-W16)    -2.1837137
## W1C * W61 * h(W20-0.231858)     -0.2018496
## W1C * W61 * h(0.231858-W20)     -0.1516912
## W1B * h(W7- -0.530967) * h(19.6913-W19) 0.0139684
## h(W7- -0.530967) * h(19.6913-W19) * h(W25-1.67897) -0.0010078
## h(W7- -0.530967) * h(19.6913-W19) * h(1.67897-W25) -0.0065003
##
## Selected 23 of 32 terms, and 15 of 32 predictors
## Termination condition: Reached nk 40
## Importance: W9, A1, W7, W1C, W17, W19, W25, W10, W16, W8, W61, W20, ...
## Number of terms at each degree of interaction: 1 7 8 7
## GCV 1.265076      RSS 374.2602      GRSq 0.8949816      RSq 0.9219386
```

Since we want to interpret the treatment effect A, exclude A from being picked in interactions.

Allow Interaction Up To Order 3.

Allow forward pass to build model out up to 40 terms (n/10).

Hinge functions $h(x)$ with one knot are allowed.

```
## Call: earth(formula=Y~., data=dc2, degree=3, nk=40, linpreds=TRUE,
##               allowed=no_A_int)
##
##                 coefficients
## (Intercept)      3.09556706
## A1             1.94031163
## W1C            -0.75984729
## W7              0.14982486
## W9              0.84868654
## W17            -0.04739068
## W1C * W25       -0.02855576
## W51 * W61       -1.38292471
## W61 * W25       0.03702317
## W7 * W21        0.05778520
## W9 * W15        0.00896737
## W9 * W25        -0.00745523
## W1C * W20 * W25 -0.00491642
## W7 * W18 * W21 -0.00321576
##
## Selected 14 of 17 terms, and 12 of 32 predictors
## Termination condition: RSq changed by less than 0.001 at 17 terms
## Importance: W9, A1, W1C, W7, W21, W51, W61, W25, W18, W15, W17, W20, ...
## Number of terms at each degree of interaction: 1 5 6 2
## GCV 1.410023    RSS 473.4938   GRSq 0.8829491   RSq 0.9012409
```

Since we want to interpret the treatment effect A, exclude A from being picked in interactions.

Allow Interaction Up To Order 3.

Allow forward pass to build model out to MORE than 40 terms if it chooses.

Hinge functions $h(x)$ with one knot are allowed.

```
## Call: earth(formula=Y~., data=dc2, degree=3, allowed=no_A_int)
##
##                 coefficients
## (Intercept)      5.4459797
## A1             1.9735840
## W1C            -1.1106673
## h(-0.530967-W7) 0.5670578
## h(W7- -0.082104) 1.6128182
## h(2-W9)         -0.8423998
```

```

## h(W9-2)          0.7409929
## h(2.70905-W18) -0.5540901
## h(W19-7.77034) -0.1038238
## h(17.1278-W25) -0.0483596
## W1C * h(-3.46452-W10) 0.5852982
## W1C * h(W16-11.3293) -0.3789377
## W4B * h(W9-2)      -0.1659215
## h(1.76963-W7) * h(W18-2.70905) -0.3057932
## h(W7- -0.530967) * h(W19-19.6913) 0.0726750
## h(W7- -0.530967) * h(19.6913-W19) -0.0539921
## h(W7- -0.530967) * h(W19-0.191401) -0.0635219
## h(2.57375-W8) * h(W9-2)      -0.9296569
## h(W9-2) * h(3.93794-W14)    1.2125012
## h(W9-2) * h(0.283155-W16)   0.0557481
## h(-0.167859-W16) * h(2.70905-W18) -0.5568615
## h(9.96584-W17) * h(W19-13.3622) 0.0135190
## W1C * W3B * h(-0.231327-W14)    1.2687416
## W1C * W3C * h(W10- -3.46452)    0.0807643
## W1C * W61 * h(W16- -0.764684)   0.0616888
## W1C * W61 * h(-0.764684-W16)   -1.9156326
## W1C * W61 * h(W20-0.231858)    -0.3377085
## W1C * W61 * h(0.231858-W20)    -0.1810494
## W1B * h(W7- -0.530967) * h(19.6913-W19) 0.0133147
## W1C * h(-0.719767-W13) * h(W16-11.3293) 2.2817571
## W1C * h(11.3293-W16) * h(W20-0.220923) 0.0123776
## h(W7- -0.530967) * h(19.6913-W19) * h(W25-1.67897) -0.0013005
## h(W7- -0.530967) * h(19.6913-W19) * h(1.67897-W25) -0.0058455
## h(W9-2) * h(W16-0.283155) * h(2.5557-W22) 0.0411536
## h(9.96584-W17) * h(W18-1.05659) * h(13.3622-W19) 0.0024605
## h(9.96584-W17) * h(1.05659-W18) * h(13.3622-W19) 0.0073671
##
## Selected 36 of 56 terms, and 20 of 32 predictors
## Termination condition: Reached nk 65
## Importance: W9, A1, W7, W1C, W17, W18, W19, W10, W8, W16, W61, W20, ...
## Number of terms at each degree of interaction: 1 9 12 14
## GCV 1.169046    RSS 283.588    GRSq 0.9029534    RSq 0.9408506

```

Since we want to interpret the treatment effect A, exclude A from being picked in interactions.

Allow Interaction Up To Order 3.

Allow forward pass to build model out to MORE than 40 terms if it chooses.

Hinge functions $h(x)$ with one knot are allowed.

```

## Call: earth(formula=Y~., data=dc2, degree=3, linpreds=TRUE,
##             allowed=no_A_int)
##
##                 coefficients
## (Intercept)      3.09556706
## A1              1.94031163
## W1C             -0.75984729

```

```

## W7          0.14982486
## W9          0.84868654
## W17         -0.04739068
## W1C * W25   -0.02855576
## W51 * W61   -1.38292471
## W61 * W25   0.03702317
## W7 * W21    0.05778520
## W9 * W15    0.00896737
## W9 * W25    -0.00745523
## W1C * W20 * W25 -0.00491642
## W7 * W18 * W21 -0.00321576
##
## Selected 14 of 17 terms, and 12 of 32 predictors
## Termination condition: RSq changed by less than 0.001 at 17 terms
## Importance: W9, A1, W1C, W7, W21, W51, W61, W25, W18, W15, W17, W20, ...
## Number of terms at each degree of interaction: 1 5 6 2
## GCV 1.410023    RSS 473.4938    GRSq 0.8829491    RSq 0.9012409

```

Ignore Below

All Subset

$$Y = A + W2 + W4 + W5 + W7 + W8 + W9 + W13 + W14 + W15 + W16 + W19 + W21 + W22$$

Best Subset

$$Y = A + W2 + W4 + W5 + W7 + W8 + W9 + W13 + W14 + W15 + W16 + W19 + W21 + W22$$