Virtual Beach 1.0 Learning Module I – *Model Building*

In this module you will learn how to:

- A. Format and import a data table for use in Virtual Beach 1.0
- B. Evaluate data using scatter plots
- C. Transform variables to better meet Ordinary Least Squares assumptions
- D. Exclude unwanted observations and variables
- E. Check for multicollinearity (non-independence) among explanatory variables
- F. Convert Wind Speed and Direction into "longshore" and "onshore" components
- G. Create "interaction terms" (combined variables)
- A. Format/Import Data. Data for this module are available for download at http://dnr.wi.gov/org/es/science/contaminants/
- A.1. Open the file *RedArrowPark_Mastertable.xls* in MS Excel. Click the "Data_Key" tab (circled below) to view data descriptions, sources, etc.

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	2004.06.30			37	0	0	725	0.50	53.6	82.4	0	0	6	260
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	2005.06.28			35	0	0	34	0.50	58	96	1	0	3	240
	2005.07.05			42	0	0.05	31	1.75	52	63	1	0	5	310
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- Virtual Beach 1.0 reads only Excel 4.0 files or tab-delimited text (*.txt) files. Newer .xls formats must be converted to Excel 4.0 or tab-delimited text using "Save As..." (see Step A.2 on pg. 2).
- Virtual Beach 1.0 automatically reads the third column of an input data table (column C) as the eventual model's response variable—make sure this is the variable you are trying to predict.

Return to the "RedArrorPark_Model_Inputs" worksheet (tab). From the Excel A.2. menu in the upper-left corner, click "File" > "Save As..."

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From the "Save as Type:" pull-down, choose "Microsoft Excel 4.0 Worksheet" A.3. and re-name the file "RedArrowPark_Model_Inputs". Close Excel.

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Excel 4.0 files can have only 1 worksheet (tab)—be sure to save the right one.

▲ <u>Note</u>: If you are working with a version of Excel that does not support saving to Excel 4.0, save as a comma-delimited text (.txt) file instead. From the "Save as Type:" pull-down, choose "Text (Tab delimited)." A pop-up window will appear; click "OK" to save only the active worksheet. **Close Excel**.

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A.4. Open Virtual Beach.



A.5. Click the "Empirical Model" tab, and then "Input Spreadsheet" tab.
 (This opens two blank spreadsheets: The large spreadsheet on top is for input data. The 1-row spreadsheet below is for making single-case predictions, after a model has been "fit" with the input data.)

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A.6. Click the "Import from data file..." button, then "Browse." Navigate to the input data file you created (*RedArrorPark_Model_Inputs*). Click "Open," then "OK."

	Beach Model		- <u>-</u> ×
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A.7. A Warning popup will open—click "OK".

(*VB 1.0* creates a new column (**D**) called "Est. Resp.," which will later be filled with the predicted values of your response variable. Also adds a new row (2) with ID's for each explanatory variables: (Var1), (Var2), etc...)

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	2003.06.11			0	18	0	0.54	213	0	60.8	57.2	0	1	6	10
	2003.06.18			0	25	0.02	0.02	224	0.5	64.4	69.8	1	n.	5	80
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20 21 •	Sheet1 / A 95% C.I.		C	D	E						Browse		~		
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- Virtual Beach 1.0 will not import spreadsheets (or tab-delimited text files) if they are simultaneously open in Excel. If the table does not load, first make sure that it is not still open in Excel.
- A.8. Practice navigating around the data table.
 - Click on any cell and then use the arrow keys to move up, down, or sideways one cell at a time
 - Use the right/left slide-bar on the bottom of the spreadsheet to move sideways.
 - Use the up/down slide-bar on the lower right hand side of the spreadsheet to move up or down.

B. Evaluate Data using Scatter Plots

• Plotting values of a potential explanatory variable (e.g., water temp) against the values of the response variable (i.e., *E. coli*) can provide preliminary information on whether or not there is any correlation or relationship between the two. Helps you decide whether or not to exclude or modify the variable in question.

• "Scatter plots" can also help you identify "outliers" in the data set, which may reflect real aberrations or errors in measurement.

Scatter plots also provide an indication as to whether or not such relationships are linear—and therefore, whether ordinary least-square ("OLS") assumptions will be violated. If the actual relationships are *not* linear, model coefficients and model predictions will less likely be accurate. In many cases, it is possible to transform variables in ways that satisfy OLS requirements.

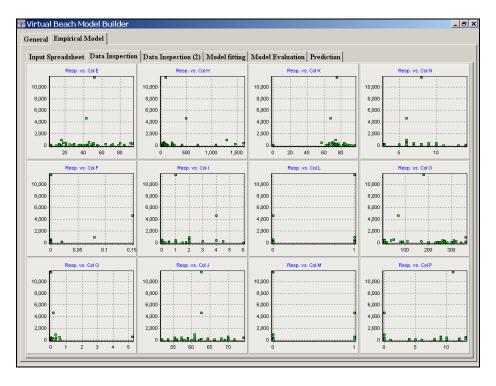
	A	B	С	D	E	F	G	H	1	J	K	L	M	N	
1	DATE	LN(STND)	ECOLI	Est. Resp	DAY	06RAIN	24RAIN	RVRFLO	OV WAVES	WTEMP	ATEMP	TURBID	VERYTUR	WSPD_	М
2					(Var1)	(Var2)	(Var3)	(Var4)	(Var5)	(Var6)	(Var7)	(Var8)	(Var9)	(Var10)	
3		\$5.4595855		0	5	0	0.01	216	0.1	64.4	64.4	0	0	8	
4		45.4595855		0	11	0	0	110	0	60.8	66.2	0	0	7	
5		5.4595855		0	16	0	0.3	117	0	57.2	64.4	0	0	10	
6		15.4595855		0	18	0	0.54	213	0	60.8	57.2	0	1	6	
7		65.4595855		0	25	0.02	0.02	224	0.5	64.4	69.8	1	0	5	
8	2003.06.2	35.4595855	250	0	30	0	0	69	1	64.4	73.4	0	1	3	
9	2003.06.3	(5.4595855	40	0	37	0	0	54	0.25	57.2	71.6	0	0	5	
10		25.4595855		0	39	0	0	58	0.5	57.2	89.6	0	0	5	
11	2003.07.0	95.4595855	550	0	46	0	5.22	53	2	69.8	69.8	0	1	6	
12	2003.07.1	45.4595855	180	0	51	0	0	101	1	62.6	73.4	1	0	5	
13		5.4595855		0	52	0	0	88	1	62.6	75.2	1	0	8	
14	2004.06.0	75.4595855	220	0	14	0	0	1470	3	57.2	66.2	1	0	6	
15	2004.06.0	5.4595855	960	0	16	0.08	0.28	1300	2	60.8	73.4	1	0	6	
16	2004.06.1	45.4595855	400	0	21	0	0.32	1630	1	57.2	71.6	1	0	7	
17	2004.06.2	35.4595855	80	0	30	0	0	1080	1	55.4	0	1	0	10	
18	2004.06.3	(5.4595855	60	0	37	0	0	725	0.5	53.6	82.4	0	0	6	
19	2004.07.0	65.4595855	4660	0	43	0.15	0.15	489	4	62.6	68	0	1	6	
20	2004.07.0	85.4595855	120	0	45	0	0	411	0	60.8	64.4	0	0	14	
21	2004.07.1	25.4595855	80	0	49	0	0	256	0.5	71.6	84.2	0	0	3	
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	95% C.I. Sheet1 /					-	-	-	-		-				

B.1. In the "Input Spreadsheets" tab, click the "Update Scatter Plots" button.

Virtual Beach 1.0 generates up to sixteen scatter plots of explanatory variables against the response variable. If you have data to the right of column **AB** in the "Input Spreadsheet" tab these will not be plotted; however, they can still be included in the eventual model.

B.2. The "Data Inspection" tab will open automatically. Evaluate the scatter plots contained in that tab as well as those in the "Data Inspection (2)" tab.

For each plot, the Y axis is the response variable – denoted in the plot title as "Resp." – in this example *E. coli* in CFU/mL. The X axes correspond to the different explanatory variables – columns in the "Input Spreadsheet" tab – denoted in the plot titles as "Col E," "Col F," "Col G," etc...



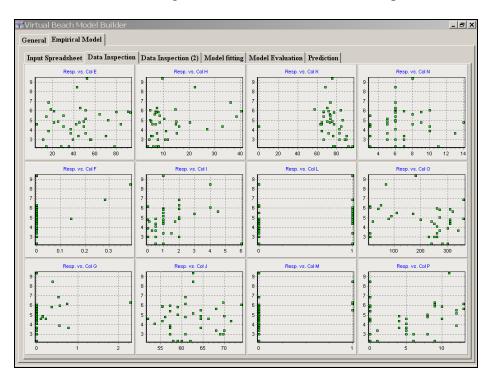
- B.3. Toggle back and forth between the "Data Inspection" tabs and the "Input Spreadsheet" tab to see which variables correspond to which plots. Note, for example, that "Col L" refers to the categorical variable TURBID, where a value of 1 = "turbid," and a value of 0 = not "turbid"
- B.4. Note the highly-clustered and non-linear pattern of most of the scatter plots.
 - Generally speaking, you want the scatter plots to resemble "clouds" of data points, suggesting linear relationships (diagonal cylinders), or seemingly random relationships (shapeless). Curved, cone-shaped, or otherwise cyclical patters indicate non-linear relationships between the explanatory variable and the response variable, and thus the potential for violating OLS assumptions. The variable(s) in question may need to be excluded from the model or transformed.
 - The exception to the above rule of thumb are categorical (0/1) variables, such as TURBID ("Col H"), for which the data points will stack-up on the far ends of the scatter plot; i.e., the X axis values are all 0 or 1.

- C. Transform Variables to better meet Ordinary Least Square (OLS) Assumptions. Checking and re-checking scatter plots to make sure relationships are linear is crucial to the success of the model-building effort. Where it appears that OLS assumptions will likely be violated, *Virtual Beach* provides an easy means of transforming / un-transforming variables.
 - A common transformation used in MLR models for predicting *E. coli* is to take the natural logarithm of the concentration to effectively "straighten" the data, which otherwise will typical exhibit exponential growth under certain environmental conditions.
 - Another common transformation is to transform antecedent rainfall by taking its square-root. This transformation moderates extreme values associated with large (infrequent) storm events. Taking the square root of streamflow similarly moderates extreme runoff values, particularly in "flashy" watersheds.
- C.1. In the "Import Spreadsheet" tab, highlight Column C (ECOLI), right click, and select > Transform this column > Natural logarithm of the current column. (Can also use the **F5** key.) Note that the variable name changes to "Ln(ECOLI)."

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03.06.0	45.459585	5 20							60.8	66.2	0.0	0.0	7.0	
			Reset the	worksneet					57.2		0.0	0.0		
			Edit					+	60.8	57.2	0.0	1.0		T
									64.4		1.0			
			Align the	data block .					64.4	73.4	0.0	1.0		
			Transform	n this colum	n			۱.	Natural log	rithm of the	e current co	olumn F5		
			Process t	his column				•	Log 10 of t	he current	column			
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			Eit the cu	rrent model					Reciprocal	of the curr	ent column			+
									Reciprocal	of negative	values onl	y .		-
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														-
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C.2. Transform Columns **F**, **G**, and **H** (06RAIN, 24RAIN, and RVRFLOW) by right clicking and selecting > Transform this column > Square-root of the current column. (Can also use the **F6** key.)

C.3. Return to the "Input Spreadsheet" tab and click the "Update scatterplots" button. Note that the updated scatter plots for the non-categorical variables, such as RVRFLOW (the plot titled "Resp. vs. Col H"), are no longer highly-clustered, and instead resemble diagonal or horizontal clouds of data points.



- **D. Exclude Unwanted Observations and Variables.** It is likely that at least some of the potential variables you consider for inclusion in your model will prove to be poor predictors of beach water quality (for any number of reasons). Others may clearly violate OLS assumptions, as described above, even after they are transformed. In addition, individual observations may be "outliers," caused by extreme/atypical conditions, or errors made during data collection or entry. These can reduce the predictive power of the overall model. *Virtual Beach* provides an easy means of excluding / un-excluding both observations and variables.
- D.1. In the first "Data Inspection" tab (illustrated in Part C.3 above), note the data anomaly indicated in the scatter plot titled "Resp. vs. Column K" (i.e., ATEMP = 0° F).
- D.2. Return to the "Input Spreadsheet" tab. Look down the values in Column K (ATEMP) until you find the 0 value. Click on the corresponding row number (17) to select that observation.

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		et Data I	nspection	Data Ir	spection	(2) Mode	l fitting]]	Model Ev	aluation	Prediction	n]				
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1 0		LN(STND)	Ln(ECOLI	Est. Resp	DAY	Sart/06RA	Sqrt(24RA		WAVES	WTEMP	ATEMP	TURBID		WSPD M	ιw
2					(Var1)	(Var2)	(Var3)	(Var4)	(Var5)	(Var6)	(Var7)	(Var8)	(Var9)	(Var10)	N
3 2	2003.05.29	5.4595855	4.6052	0.0	5.0	0.0	0.1	14.697	0.1	64.4	64.4	0.0	0.0	8.0	
4 2	2003.06.04	5.4595855	2.9957	0.0	11.0	0.0	0.0	10.488	0.0	60.8	66.2	0.0	0.0	7.0	
5 2	2003.06.09	5.4595855	3.912	0.0	16.0	0.0	0.5477	10.817	0.0	57.2	64.4	0.0	0.0	10.0	
6 2	2003.06.11	5.4595855	6.1738	0.0	18.0	0.0	0.7348	14.595	0.0	60.8	57.2	0.0	1.0	6.0	
7 2	2003.06.18	5.4595855	4.8675	0.0	25.0	0.1414	0.1414	14.967	0.5	64.4	69.8	1.0	0.0	5.0	
8 2	2003.06.23	5.4595855	5.5215	0.0	30.0	0.0	0.0	8.3066	1.0	64.4	73.4	0.0	1.0	3.0	1
9 2	2003.06.30	5.4595855	3.6889	0.0	37.0	0.0	0.0	7.3485	0.25	57.2	71.6	0.0	0.0	5.0	
		5.4595855	2.9957	0.0	39.0	0.0	0.0	7.6158	0.5	57.2	89.6	0.0	0.0	5.0	
		5.4595855	6.3099	0.0	46.0	0.0	2.2847	7.2801	2.0	69.8	69.8	0.0	1.0	6.0	
12 2	2003.07.14	5.4595855	5.193	0.0	51.0	0.0	0.0	10.05	1.0	62.6	73.4	1.0	0.0	5.0	
		5.4595855	9.3588	0.0	52.0	0.0	0.0	9.3808	1.0	62.6	75.2	1.0	0.0	8.0	
14 2	2004.06.07	5.4595855	5.3936	0.0	14.0	0.0	0.0	38.341	3.0	57.2	66.2	1.0	0.0	6.0	
15 2	2004.06.09	5.4595855	6.8669	0.0	16.0	0.2828	0.5292	36.056	2.0	60.8	73.4	1.0	0.0	6.0	
		5.4595855	5.9915	0.0	21.0	0.0	0.5657	40.373	1.0	57.2	71.6	1.0	0.0	7.0	
17 2	2004.06.23	5.4595855	4.382	0.0	30.0	0.0	0.0	32.863	1.0	55.4	0.0	1.0	0.0	10.0	
18 2	2004.06.30	5.4595855	4.0943	0.0	37.0	0.0	0.0	26.926	0.5	53.6	82.4	0.0	0.0	6.0	
		5.4595855	8.4468	0.0	43.0	0.3873	0.3873	22.113	4.0	62.6	68.0	0.0	1.0	6.0	
		5.4595855	4.7875	0.0	45.0	0.0	0.0	20.273	0.0	60.8	64.4	0.0	0.0	14.0	
21 2	2004.07.12	5.4595855	4.382	0.0	49.0	0.0	0.0	16.0	0.5	71.6	84.2	0.0	0.0	3.0	T
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In *VB 1.0* you can select multiple rows the same way you would using MS Excel: Click the first row you want selected. Then (holding the mouse button down) scroll up or down to the last row you want selected and release. D.3. With row 16 highlighted, right-click with your mouse and select "Exclude the case from the data set" from the menu. (You can also use the **F3** key.)

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uit model selection mo	ide			28	0.5292	36.056	2.0	60.8	73.4	1.0	0.0	6.0	
rint				. E	0.5657	40.373	1.0	57.2	71.6	1.0	0.0	7.0	
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Note that the row turned gray, and the value listed under Est. Resp. (**D**) becomes "Excluded." <u>Excluded rows will be left out of any model you build</u>. (To re-include them, simply reselect and repeat Step D.3.).

3 2003 05 254 5698655 4.605 0 0.0 6.0 0.0 0.1 14 feyr 0.1 64.4 64.4 0.0 0.0 0.0 5 2003 06 054 5698655 3.912 0.0 10.0 0.0 10.89 0.0 66.8 66.2 0.0 0.0 5 2003 06 054 5698655 3.912 0.0 16.0 0.0 0.7414 11.4595 0.0 57.2 64.4 0.0 0.0 6 2003 06 054 5698655 6.1738 0.0 18.0 0.0 0.7346 14.4595 0.0 60.8 57.2 64.4 0.0 0.0 7 2003 06 154 5698655 5.8715 0.0 30.0 0.0 0.0 8.3066 1.0 64.4 7.34 0.0 1.0 9 2003 07.054 5698655 5.889 0.0 37.0 0.0 7.486 0.5 57.2 89.6 0.0 0.0 10 2003 07.054 5698655 5.939 0.0 61.0 0.0 </th <th></th> <th>A</th> <th>В</th> <th>С</th> <th>D</th> <th>E</th> <th>F</th> <th>G</th> <th>H</th> <th>1</th> <th>J</th> <th>K</th> <th>L</th> <th>M</th> <th>N</th>		A	В	С	D	E	F	G	H	1	J	K	L	M	N
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D.4. Exclude the variable DAY. First click on the column letter (**E**), to highlight, then right-click and select "Exclude the variable..." (or hit the **F4** key).

A TE 13.05.29 13.06.04 13.06.04	B LN(STND) 5.4595855 5.4595855	С	Data Insp D Est. Resp 0.0 0.0	E Se	F urt/06RA t Data	G Sart/24R/	H	<u> </u>	J	ATFM		L	M	N	I
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03.06.09											5.2	0.0	0.0	7.0	+
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	5.4595855	6.1738	0.0	Edit							7.2	0.0	1.0	6.0	+
	5.4595855	4.8675	0.0	Eure							9.8	1.0	0.0	5.0	+
				Align	the data l	block									+
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	5.4595855	4.382	0.0	Print						•	4.2	0.0	0.0	3.0	
										<u> </u>					1
	В	С	D	E	F	G	Н		J	K		L	M	N	
neet1 /															
	03.06.30 03.07.02 03.07.02 03.07.14 03.07.16 04.06.07 04.06.05 04.06.12 04.06.25 04.06.30 04.06.30 04.07.06 04.07.06 04.07.12 meet1 / A	A B % C.I.	33 06 3(5 4596965 3.6889 33 07 0(5 4596965 6.3099 33 07 0(5 4596965 6.3099 33 07 0(5 4596965 5.193 33 07 0(5 4596965 5.3936 31 07 15 4596965 5.3936 31 07 15 4596965 5.3936 31 07 15 4596965 5.3936 31 06 17 4 5493635 5.9915 31 06 17 4 5493635 5.9915 31 06 17 4 5493635 5.9915 31 06 17 4 5493635 5.9915 31 06 17 4 5493635 5.9915 31 06 17 4 5493635 5.9915 31 06 17 4 5493635 1.382 31 07 05 4 599585 4.342 31 07 05 4 599585 4.342 31 07 05 4 599585 4.342 31 07 05 4 599585 4.342 31 07 05 4 599585 4.342 31 07 05 4 599585 4.342 31 07 07 12 4 593635 4.342 31 07 07 5 4 593635 4.342 31 07 07 5 4 593635 4.342 31 07 07 5 4 593635 4.342 31 07 07 5 4 593635 4.362	30 66 3(5 4596866 5 3.6889 0.0 0.0 33 07 025 4596865 2.9957 0.0 0.0 33 07 025 4596865 5.193 0.0 0.0 33 07 025 4596865 5.193 0.0 0.0 33 07 165 4596865 9.3588 0.0 0.0 30 07 155 4596855 5.9336 0.0 0.0 40 60 75 4596865 9.3588 0.0 0.0 40 60 75 4596865 9.35936 0.0 0.0 40 60 75 4596865 4.39395 6.6669 0.0 0.0 40 60 125 4596865 4.342 0.0 0.0 40 60 125 4596865 4.342 0.0 0.0 40 60 125 4596865 4.342 0.0 0.0 40 70 125 4596855 4.342 0.0 0.0 40 70 125 4596855 4.342 0.0 0.0 40 70 125 4596855 4.382 0.0 0.0 40 70 125 4596855 4.382 0.0 0.0 94 07 0125 4596855 4.382 0.0 0.0 0.0 14 07 125 4596855 4.382 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	3.00 2.54 3.03 0.0 Trans 3.00 2.54 3.68 0.0 Trans 3.07 0.54 4595656 3.6889 0.0 Proce 3.07 0.54 4595656 5.3999 0.0 Exclus 3.07 0.54 4595656 5.3999 0.0 Exclus 3.07 0.54 4595656 5.3999 0.0 Exclus 3.07 154 4595656 5.3933 0.0 Updat Updat 0.0 Exclus 3.07 154 4595656 5.3933 0.0 Updat Updat Updat 1.6 0.6 4595656 1.382 0.0 Make Hit the 1.6 0.6 Make 1.6 0.0 Make 1.6 0.0 Make 1.6 1.6 4595656 8.4468 0.0 Make 1.407 1.6 4595656 4.382 0.0 Print Print 1.6 1.6 1.6 1.6 1.6 <td>State State <th< td=""><td>33 OB 3164 4595865 3.6889 0.0 Transform this column 33 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State State State State State State State State State</td><td>Display State Display State Display</td><td>3.30 2.5 3.6826 0.0 Exclude this variable from the model F4 3.07 154 5495655 5.9335 0.0 Update the scatterplots Check outlier cases from the current model 1.6025 4595655 5.9335 Check outlier cases for the current model F1 the current model F1 the current model F4 7.625 4595655 F3 F1 the current model F1 the current model F1 F1</td><td>3.30 <td< td=""><td>3.30 a) 5.30 a) 5.30 a) 5.30 b) 5.30 b)</td><td>3.30 a) 3.130 b) 3.250255 3.688 b) 0.0 Transform this column 3.6 0.0</td><td>3.30 a) 3.1 (1) 3.1 (1) 3.2 (1)</td></td<></td></th<></td>	State State <th< td=""><td>33 OB 3164 4595865 3.6889 0.0 Transform this column 33 O7 0154 4595865 2.9957 0.0 Process this column 33 O7 0154 4595865 6.3099 0.0 Exclude this column 33 O7 0154 4595865 5.3930 0.0 Exclude this calumn 33 O7 154 4595865 5.3936 0.0 Exclude this calumn 34 O6 015 4595865 5.3936 0.0 Update the scatter plots 34 O6 015 4595865 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4595655 3.6890 0.0 Transform this column 310 70 55 4595655 3.6990 0.0 Process this column 310 70 55 4595655 5.3990 0.0 Exclude this variable from the mode 310 70 55 4595655 5.3936 0.0 Exclude this variable from the data set 310 71 55 4595655 5.3936 0.0 Update the scatterplots 310 61 55 4595655 5.3936 0.0 Update the scatterplots 310 61 55 4595655 5.9915 Exclude The current role of the cu	State State O State State State State State State State State State State	Display State Display	3.30 2.5 3.6826 0.0 Exclude this variable from the model F4 3.07 154 5495655 5.9335 0.0 Update the scatterplots Check outlier cases from the current model 1.6025 4595655 5.9335 Check outlier cases for the current model F1 the current model F1 the current model F4 7.625 4595655 F3 F1 the current model F1 the current model F1 F1	3.30 3.30 <td< td=""><td>3.30 a) 5.30 a) 5.30 a) 5.30 b) 5.30 b)</td><td>3.30 a) 3.130 b) 3.250255 3.688 b) 0.0 Transform this column 3.6 0.0</td><td>3.30 a) 3.1 (1) 3.1 (1) 3.2 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Note that the column turned gray and the identifier in row 2, "(Var1)", disappears. <u>Excluded columns will be left out of any model you build</u>. (To re-include them, simply repeat Step D.4.).

3 2003.05.25f.4598866 4.6052 0.0 6.0 0.0 0.1 14.697 0.1 6.4 6.4 6.4 0.0 0.0 4 2003.06.025f.4598866 2.9957 0.0 11.0 0.0 0.0 10.488 0.0 6.8 6.62 0.0 0.0 5 2003.06.025 4598865 3.912 0.0 16.0 0.0 7.477 10.817 0.0 57.2 64.4 0.0 0.0 6 2003.06.154.598865 6.1738 0.0 18.0 0.0 0.7348 14.595 0.0 60.8 67.2 0.0 1.0 7 2003.06.154.598865 5.215 0.0 30.0 0.0 0.3748 14.4967 0.5 64.4 69.8 1.0 0.0 8 2003.06.254.598865 5.215 0.0 30.0 0.0 8.3068 1.0 64.4 73.4 0.0 1.0 9 2003.06.354.598865 3.6899 0.0 30.0 0.0	VSPD_N Var9) 8.0 7.0 10.0 6.0 5.0 3.0 5.0	(Var8) (0.0 0.0 0.0	(Var7) 0.0	(Var6)					Sqrt(06RA	DAY	Ect. Doon	L N/ECOLI	I N(STND)	DATE	1
3 2003 05 255 4598965 4.6052 0.0 5.0 0.0 0.1 14.697 0.1 64.4 64.4 0.0 0.0 4 2003 06 0255 4598965 2.9957 0.0 11.0 0.0 0.0 10.488 0.0 60.8 66.2 0.0 0.0 5 2003 06 025 45959655 3.912 0.0 16.0 0.0 7.477 10.817 0.0 57.2 64.4 0.0 0.0 6 2003 06 0255 45959655 4.8675 0.0 25.0 0.1414 0.1449 14.967 0.5 64.4 0.0 0.0 6 2003 06 015 45959655 5.215 0.0 30.0 0.0 0.3748 14.595 0.0 60.8 67.2 0.0 1.0 7 2003 06 315 45959655 5.215 0.0 30.0 0.0 0.3748 14.595 0.25 67.2 71.6 0.0 0.0 9 2003 07 355 45959655 3.689 0.0 0.0 7.268	8.0 7.0 10.0 6.0 5.0 3.0	0.0	0.0		(Var5)	(Var4)	01 - 21					LINECOLI			
4 2003 06 0.45 4598955 2.9957 0.0 11.0 0.0 0.0 10.488 0.0 60.8 66.2 0.0 0.0 5 2003 06 0.45 4598955 3.912 0.0 16.0 0.0 0.5477 10.817 0.0 60.8 66.2 0.0 0.0 6 2003 06 0.45 4598955 4.8675 0.0 18.0 0.0 0.7348 14.957 0.0 60.8 67.2 0.0 1.0 7 2003 06 165 4598955 4.8675 0.0 25.0 0.1414 0.1414 0.496 1.0 0.0 63.06 1.0 64.4 69.8 1.0 0.0 8 2003 06 354 5498955 5.215 0.0 30.0 0.0 0.08 6.025 57.2 71.6 0.0 0.0 9 2003 07 354 5498955 3.6899 0.0 37.0 0.0 0.0 7.3485 0.25 57.2 71.6 0.0 0.0 10 2003 07 354 5498955 3.099	7.0 10.0 6.0 5.0 3.0	0.0		G4.4		(vary)									
5 2020 30 6 (54, 4598685) 3.912 0.0 16.0 0.0 0.5477 10.817 0.0 57.2 64.4 0.0 0.0 6 2020 56 (154, 4598685) 6.1738 0.0 18.0 0.0 7.248 14.967 0.5 64.4 69.8 1.0 0.0 7 2020 36 (154, 4598685) 4.8675 0.0 25.0 0.1414 14.148 14.967 0.5 64.4 69.8 1.0 0.0 8 2020 36 (154, 4598685) 5.215 0.0 37.0 0.0 0.3666 1.0 64.4 73.4 0.0 0.0 9 2020 36 (154, 4598685) 5.215 0.0 37.0 0.0 0.7 7.867 0.2 57.2 71.6 0.0 0.0 9 2020 37.65 (4598685) 6.3089 0.0 37.0 0.0 7.475 0.5 57.2 89.6 0.0 0.0 10 2030 70.65 (45986856) 6.3099 0.0 0.0 2.247 7.26	10.0 6.0 5.0 3.0	0.0		04.4	64.4	0.1	14.697	0.1	0.0	5.0	0.0	4.6052	295.4595855	2003.05.2	3
6 2003 06 115 45968656 6.1738 0.0 18.0 0.0 0.7348 14.595 0.0 60.8 57.2 0.0 1.0 7 2003 06 115 45968656 4.8675 0.0 25.0 0.11414 0.1414 0.1414 0.1414 0.1414 0.1414 0.1414 0.1414 0.1414 0.1414 0.0 64.4 69.8 1.0 0.0 0.0 8.3066 1.0 64.4 69.8 1.0 0.0 0.0 8.3066 1.0 64.4 73.4 0.0 1.0 0.0 1.0 64.4 73.4 0.0 1.0 0.0 0.0 8.3066 1.0 64.4 73.4 0.0 1.0 0.0 1.0 0.0 0.0 1.0 0.0 <	6.0 5.0 3.0		0.0	66.2	60.8	0.0	10.488	0.0	0.0	11.0	0.0	2.9957	045.4595855	2003.06.0	4
7 2003.06.154.4596865 4.8675 0.0 25.0 0.1414 0.1414 1.4.967 0.5 64.4 69.8 1.0 0.0 8 2003.06.254.54596865 5.5215 0.0 30.0 0.0 0.00 8.3066 1.0 64.4 73.4 0.0 1.0 9 2003.06.354.54596865 3.6889 0.0 37.0 0.0 0.0 7.3465 0.25 57.2 71.6 0.0 0.0 10 2003.07.054.54596865 2.9957 0.0 39.0 0.0 0.0 7.3465 0.25 57.2 71.6 0.0 0.0 11 2003.07.054.54596855 6.3099 0.0 0.0 2.2447 7.2601 2.0 69.8 69.8 0.0 1.0	5.0 3.0		0.0	64.4	57.2	0.0	10.817	0.5477	0.0	16.0	0.0	3.912	95.4595855	2003.06.0	5
8 2003 06 255 4596865 5.5215 0.0 30.0 0.0 0.0 8.3066 1.0 64.4 73.4 0.0 1.0 9 2003 06 255 4596865 3.6889 0.0 37.0 0.0 0.7 7.485 0.55 57.2 71.6 0.0 0.0 10 2003 07 025 4596865 2.9957 0.0 39.0 0.0 0.0 7.6188 0.5 57.2 89.6 0.0 0.0 11 2003 07 025 4596865 6.3099 0.0 46.0 0.0 2.2047 7.2801 2.0 69.8 69.8 0.0 1.0	3.0	1.0	0.0	57.2	60.8	0.0	14.595	0.7348	0.0	18.0	0.0	6.1738	15.4595855	2003.06.1	6
9 2003.06.365,45968665 3.6889 0.0 37.0 0.0 0.0 7.3465 0.25 57.2 71.6 0.0 0.0 10 2003.07.055.4586865 2.9957 0.0 39.0 0.0 0.0 7.6158 0.5 57.2 89.6 0.0 0.0 11 2003.07.055.4586865 6.3099 0.0 46.0 0.0 2.2647 7.2601 2.0 69.8 69.8 0.0 1.0		0.0	1.0	69.8	64.4	0.5	14.967	0.1414	0.1414	25.0	0.0	4.8675	185.4595855	2003.06.1	7
10 2003.07.025.4595855 2.9957 0.0 39.0 0.0 0.0 7.6158 0.5 57.2 89.6 0.0 0.0 11 2003.07.025.45958555 6.3099 0.0 46.0 0.0 2.2847 7.2801 2.0 69.8 69.8 0.0 1.0	6.0	1.0				1.0	8.3066	0.0	0.0	30.0	0.0	5.5215	25.4595855	2003.06.2	8
11 2003.07.055.4595855 6.3099 0.0 4 6.0 0.0 2.2847 7.2801 2.0 69.8 69.8 0.0 1.0		0.0	0.0	71.6	57.2	0.25	7.3485	0.0	0.0	37.0	0.0	3.6889	305.4595855	2003.06.3	9
	5.0	0.0	0.0	89.6	57.2	0.5	7.6158	0.0	0.0	39.0	0.0	2.9957	125.4595855	2003.07.0	10
12 2002 07 1/6 4606966 5 102 0.0 51.0 0.0 0.0 10.05 1.0 62.6 72.4 1.0 0.0	6.0	1.0	0.0	69.8	69.8	2.0	7.2801	2.2847	0.0	46.0	0.0	6.3099	95.4595855	2003.07.0	11
	5.0	0.0	1.0	73.4	62.6	1.0	10.05	0.0	0.0	51.0	0.0	5.193	45.4595855	2003.07.1	12
13 2003.07.155.4595855 9.3588 0.0 52.0 0.0 0.0 9.3808 1.0 62.6 75.2 1.0 0.0	8.0	0.0	1.0	75.2	62.6	1.0	9.3808	0.0	0.0	52.0	0.0	9.3588	65.4595855	2003.07.1	13
14 2004.06.075.45958555 5.3936 0.0 14.0 0.0 0.0 38.341 3.0 57.2 66.2 1.0 0.0	6.0	0.0	1.0	66.2	57.2	3.0	38.341	0.0	0.0	14.0	0.0	5.3936	75.4595855	2004.06.0	14
15 2004.06.055.45958555 6.8669 0.0 16.0 0.2828 0.5292 36.056 2.0 60.8 73.4 1.0 0.0	6.0	0.0	1.0	73.4	60.8	2.0	36.056	0.5292	0.2828	16.0	0.0	6.8669	95.4595855	2004.06.0	15
16 2004.06.145.4595855 5.9915 Excluded 21.0 0.0 0.5657 40.373 1.0 57.2 71.6 1.0 0.0	7.0	0.0	1.0	71.6	57.2	1.0	40.373	0.5657	0.0	21.0	Excluded	5.9915	45.4595855	2004.06.1	16
17 2004.06.235.4595855 4.382 0.0 30.0 0.0 0.0 32.863 1.0 55.4 0.0 1.0 0.0	10.0	0.0	1.0	0.0	55.4	1.0	32.863	0.0	0.0	30.0	0.0	4.382	235.4595855	2004.06.2	17
18 2004.06.3(5.45958555 4.0943 0.0 37.0 0.0 0.0 26.926 0.5 53.6 82.4 0.0 0.0	6.0	0.0	0.0	82.4	53.6	0.5	26.926	0.0	0.0	37.0	0.0	4.0943	8 5.4595855	2004.06.3	18
19 2004.07.065.45958555 8.4468 0.0 43.0 0.3873 0.3873 22.113 4.0 62.6 68.0 0.0 1.0	6.0	1.0	0.0	68.0	62.6	4.0	22.113	0.3873	0.3873	43.0	0.0	8.4468	065.4595855	2004.07.0	19
20 2004.07.085.45958555 4.7875 0.0 45.0 0.0 0.0 20.273 0.0 60.8 64.4 0.0 0.0	14.0		0.0					0.0			0.0	4.7875			20
21 2004.07.125.45958555 4.382 0.0 49.0 0.0 0.0 16.0 0.5 71.6 84.2 0.0 0.0	3.0	0.0	0.0	84.2	71.6	0.5	16.0	0.0	0.0	49.0	0.0	4.382	25.4595855	2004.07.1	21
> Sheet1						•								Sheet1 /	•
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E. Check for Multicollinearity (Non-Independence) among Explanatory Variables

Another assumption of multiple linear regression (MLR) modeling is that individual explanatory variables are independent of one another. That is, they are not correlated with one another, and so do not affect one another's relationship with the response variable. This is obviously not always the case—two or more explanatory variables a model may turn out to positively or negatively correlated; i.e., "collinear."

- Severe multicollinearity results in erroneous partial regression coefficients (discussed in Module 2), which are used to estimate the change in *E. coli* expected in response to a one-unit change in a given explanatory variable. As such, the model will not provide information that could otherwise have been used to help identify the most significant factors contributing to contamination events.
- E.1. In the "Input Spreadsheet" tab click the "Multicollinearity" button. The window that pops-up will list the Variance Inflation Factors (VIF) for each of the non-excluded explanatory variables. For a given variable, a <u>VIF value > 10 indicates</u> the presence of severe multicollinearity. Note that there are no such values in this dataset.

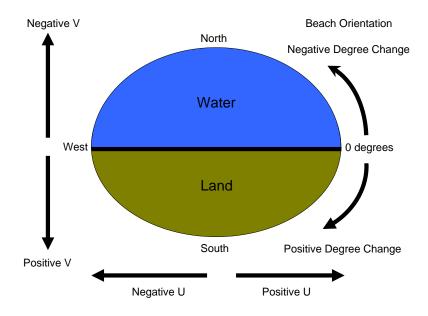
eneral	Empirica	d Model								
Input S	preadshe	et Data L	ispection	Data In	spection	(2) Mode	l fitting []		aluation Prediction	- 0 ×
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1	DATE	LN(STND)	Ln(ECOLI	Est, Resp	DAY	Sart/06RA	Sqrt(24R/	Sart(RVI	Variance Inflation Factor (VIF)	SPD MIW
2						(Var1)	(Var2)	(Var3)	,	ar9) (V
3	2003.05.2	5.4595855	4.6052	0.0	5.0	0.0	0.1	14.697	Sqrt(06RAIN) 1.45	8.0
4		5.4595855	2.9957	0.0	11.0	0.0	0.0	10.488	Sqrt(24RAIN) 4.02	7.0
		5.4595855	3.912	0.0	16.0	0.0	0.5477	10.817	Sqrt(RVRFLOW) 1.41	10.0
		15.4595855	6.1738	0.0	18.0	0.0	0.7348	14.595	WAVES 2.44 WTEMP 0.84	6.0
		5.4595855	4.8675	0.0	25.0	0.1414	0.1414	14.967	ATEMP 0.84	5.0
		5.4595855	5.5215	0.0	30.0	0.0	0.0	8.3068	TURBID 1.43	3.0
		5.4595855	3.6889	0.0	37.0	0.0	0.0	7.3485	VERYTURB 2.14	5.0
		5.4595855	2.9957	0.0	39.0	0.0	0.0	7.6158	WSPD MET 2.27	5.0
		5.4595855	6.3099	0.0	46.0	0.0	2.2847	7.2801	WDIR MET 1.18	6.0
		5.4595855	5.193	0.0	51.0	0.0	0.0	10.05	WSPD_BCH 1.31	5.0
13		5.4595855	9,3588	0.0	52.0	0.0	0.0	9.3806	NW 1.59	8.0
		5.4595855	5.3936	0.0	14.0	0.0	0.0	38.341	N 0.87	6.0
		5.4595855	6.8669	0.0	16.0	0.2828	0.5292	36.058	NE 1.31	6.0
		5.4595855		Excluded	21.0	0.2020	0.5252	40.373	E 3.75 SE 0.87	7.0
		5.4595855	4.382	CXCIUGEO 0.0	30.0	0.0	0.5657	32.863	S 1.14	10.0
		5.4595855	4.0943		37.0	0.0	0.0	26.926	SW 1.85	6.0
				0.0		0.0		26.920	2gtr 1.32	
		5.4595855	8.4468	0.0	43.0		0.3873		3gtr 1.76	6.0
		5.4595855	4.7875	0.0	45.0	0.0	0.0	20.273	4gtr 0.98	14.0
		5.4595855	4.382	0.0	49.0	0.0	0.0	16.0		3.0
		· · · · ·				-				
	A	В	С	D	E	F	G	Н		N
1	95% C.I.									
1	Sheet1 /								Note: a variable with VIF > 10 should not be in	
									model (except for interaction terms). In this case	
									with the highest VIF can be excluded first then	n rry again.
								1		
Tree	port/expo	rt data		Tn	teraction	torme			-Med	lel fitting/prediction
III	porcexpo	ii uata						Update	scatterplots	er mung/prediction
	Import	from data	61e	C	loose col	umn numb	ers	24.11	Fit	t the current model
	парон	nom uata	ine		-	X	- C	Multic	ollinearity	
				1			_	Dugart	s wind data	Make prediction
	Expo	t to data fi	le			Add		rroces	s wind data	
							· · ·			

▲ If *Virtual Beach* reports VIF values > 10 you can either exclude the variable(s) in question (see D.4), or create an "Interaction term" (see G.1 below).

F. Convert Wind Speed and Direction into "Longshore" and "Onshore" components

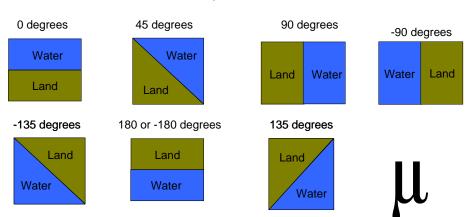
While more precise than cardinal directions (e.g., "north," "northeast," etc.), wind direction measured in degrees (0-360) is a problematic variable for regression analysis, since its range of continuous values are not truly sequential. For example, 10° is not less than 350° (nor is it more).

One way to solve this problem is to combine and re-process wind into separate "Longshore" (U) and "Onshore" (V) components. Facing the water, positive Longshore values occur when wind blows from left to right. Positive Onshore values occur when wind blows toward shore. Higher velocities increase the magnitude of the values (positive or negative) for both components.



Virtual Beach allows you input the orientation of your beach in order to calculate numeric values for these components. For example, many Lake Michigan beaches in Illinois and Wisconsin have orientations around +90°.

Beach Orientation for Wind Component Calculations



F.1. Click the "Process wind data" button. Set the "Speed" column to N (WSPD_MET) and the "Direction (deg)" column to O (WDIR_MET). Check "Wind comes from" and enter a Rotation angle of 90° (the orientation of Red Arrow Park Beach). Click "OK" and then "OK" again on the Warning window about checking for multicollinearity.

1 DATE	B C D E F G	H A Sqrt(RVR		J	K ATEMP	L TURBID	M		IWD
2	ransforming wind data 🛛 🗶	(Var3)	(Var4)	(Var5)	(Var6)	(Var7)	(Var8)	(Var9)	(Var
3 2003.		14.697	0.1	64.4	64.4	0.0	0.0	8.0	1
4 2003.		10.488	0.0	60.8	66.2	0.0	0.0	7.0	
5 2003.	Specify column numbers (E, F,) for wind (or current etc) data	10.817	0.0	57.2	64.4	0.0	0.0	10.0	3
6 2003.		14.595	0.0	60.8	57.2	0.0	1.0	6.0	
7 2003.		14.967	0.5	64.4	69.8	1.0	0.0	5.0	1
8 2003.	Speed N 💌	8.3066	1.0	64.4	73.4	0.0	1.0	3.0	1
9 2003.	Direction (deg)	7.3485	0.25	57.2	71.6	0.0	0.0	5.0	2
10 2003.	Direction (deg)	7.6158	0.5	57.2	89.6	0.0	0.0	5.0	2
11 2003.	Wind (or current etc) data in the spread sheet mean	7.2801	2.0	69.8	69.8	0.0	1.0	6.0	
12 2003.		10.05	1.0	62.6	73.4	1.0	0.0	5.0	1
13 2003.	 Wind blows toward 	9.3808	1.0	62.6	75.2	1.0	0.0	8.0	1
14 2004. 15 2004.	 Wind comes from 	38.341 36.056	3.0	57.2 60.8	66.2	1.0	0.0	6.0	1
		40.373	1.0	57.2	73.4	1.0	0.0	6.0 7.0	2
16 2004. 17 2004.	Rotation angle (deg)	40.373	1.0	57.2	0.0	1.0	0.0	10.0	2
18 2004.	Hotaton angle (deg)	26.926	0.5	53.6	82.4	0.0	0.0	6.0	2
10 2004. 19 2004.	Rotation angle is the angle of the desired shoreline	26.926	4.0	62.6	68.0	0.0	1.0	6.0	
20 2004.	from the East-West direction clockwise. The land is	20.273	4.0	60.8	64.4	0.0	0.0	14.0	3
20 2004. 21 2004.	always to the South of the shoreline. Output: Column	16.0	0.5	71.6	84.2	0.0	0.0	3.0	3
↓ Shee	1: longshore component positive to the right (or to	10.0	0.5	71.0	04.2	0.0	0.0	5.0	-
	the East); Column 2: onshore component positive	Н		J	К	L	M	N	1
1 95% (offshore (or to the North)								
I → Shee									
	OK								
_									
						-M-d-	l fitting/pro		
-Transet/arm	out data								
[Import/exp	ort data Interaction terms Choose column numbers	Update :	catterplo	ts		wione	r memg/pr	suiction	

- F.2. Scroll down to the newly-created columns (**AA** and **AB**) and rename them by clicking on them and typing, respectively, "CRSSWND" and "SHRWND."
- F.3. Select column N (WSPD_MET) and exclude it from the model by hitting the F4 key. Do the same for column O (WDIR_MET).

G. Create "Interaction Terms" (combined variables).

- A standard approach for dealing with collinear variables is to combine them into a single interaction term, via multiplication. This method may also be used with non-collinear variables as a means to improve model fit.
- Interaction terms can be particularly useful for combining categorical variables for different wind vectors (cardinal directions) and wind velocity. In this example, where a major river outlets to the north of the beach, one could hypothesize that winds directly out of the north or out of the northeast (i.e., partially onshore) would correlate with elevated pathogen indicators. If true, increased wind velocity would correlate with increased indicator elevations *only* when winds were out of those directions. Interaction terms for Wind Speed (miles per hour) times North (1 if winds out of the north, 0 if other), and Wind Speed times Northeast, should capture these relationships.
- G.1. In the "Input Spreadsheet" tab locate the "Interaction terms" box (see arrow below). In the two pull-down menus choose P (WSPD_BCH) and R (N), and then click the "Add" button. A new variable will appear in column AC titled "P*R". Repeat for columns P and S (NE) to create a new variable "P*S" (in column AD).

iput S	Spreadsheet	Data Ins	spection	Data Insp	ection (2)	Model f	itting Mo	odel Evalu	ation Pr	ediction				
	Р	Q	R	S	Т	U	v	w	x	Y	Z	AA	AB	A
1	WSPD BCH	NW	N	NE	E	SE	s	SW	2qtr	3qtr	4 qtr	CRSSWND	SHRWND	
2	(Var11)	(Var12)	(Var13)	(Var14)	(Var15)	(Var16)	(Var17)	(Var18)	(Var19)	(Var20)	(Var21)	(Var22)	(Var23)	
3	10.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.518	-2.736	
4	8.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	6.894	-1.216	
5	12.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	8.66	
6	13.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.909	-1.042	
7	8.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.868	-4.924	
8	12.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	1.0	0.0	0.0	-1.026	-2.819	
9	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	3.4800E-7	5.0	
10	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	-1.71	4.698	
11	9.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	1.0	0.0	0.0	3.857	-4.596	
12	12.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	1.0	0.0	0.0	-1.1600E-7	-5.0	
13	11.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	-8.0	3.7100E-7	
14	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-5.909	-1.042	
15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.0	-5.5700E-7	
16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.216	6.894	
17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	-3.42	9.397	
18	5.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	0.0	0.0	-1.042	5.909	
19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	2.052	-5.638	
20	8.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	8.999	10.72	
21	4.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	1.0	0.0	0.0	1.928	2.298	
• •	Sheet1 /													
	A	B	С	D	E	Æ	G	Н	1	J	K	L	M N	
1	95% C.I.					0								
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Im		lata			eraction te			Jpdate sca	itterplots]			ng/prediction	
		om data fi	. 1	Cho	ose colum	۹V 💽		Multicoll		1		Fit the cu	urent model	

G.2. Click on the first cell in column **AC** ("P*R") and rename it by typing "N_WSPD." Similarly, rename "P*S" "NE_WSPD."

<u>Note</u>: *Virtual Beach 1.0* **does not save your work when you shut down** the program. To save your model, you must export the input spreadsheet to Excel.

In the lower left corner of the "Input Spreadsheet" tab, click on the "Export to data file ..." button. In the Browse window that opens, navigate to the desired directory on your hard drive or storage device and name the file something like "RedArrowPark_Model_Version1.xls." Click Save and then OK.

The resulting Excel 4.0 spreadsheet (below) will have similar formatting to *Virtual Beach*, and serves as your backup. **If possible, leave** *Virtual Beach* **open for Module II**.

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1	D	ATE	LN(STND	Ln(ECOL	I) Est. Res	p DAY	Sqrt(06R	Sqrt(24R/	Sqrt(RVR	WAVES	WTEMP	ATEMP	TURBID	VERYTUR	WSPD_MI	WDIR_ME W
2							(Var1)	(Var2)	(Var3)	(Var4)	(Var5)	(Var6)	(Var7)	(Var8)	-	(V)
3			5.4595855			5.0	0.0	0.1	14.697	0.1	64.4	64.4	0.0	0.0	8.0	20.0
4			5.4595855			11.0	0.0	0.0	10.488	0.0	60.8	66.2	0.0	0.0	7.0	10.0
5			5.4595855			16.0	0.0	0.5477	10.817	0.0	57.2	64.4	0.0	0.0	10.0	300.0
6			15.4595855			18.0	0.0	0.7348	14.595	0.0	60.8	57.2	0.0	1.0	6.0	10.0
7			5.4595855			25.0	0.1414	0.1414	14.967	0.5	64.4	69.8	1.0	0.0	5.0	80.0
8			5.4595855 5.4595855			30.0 37.0	0.0	0.0	8.3066 7.3485	1.0	64.4 57.2	73.4	0.0	1.0	3.0	110.0 270.0
_			.5.4595855 5.4595855			37.0		0.0	7.3485	0.25	57.2	89.6	0.0		5.0 5.0	250.0
10			45.4595855 5.4595856			46.0	0.0	2.2847	7.6158	2.0	69.8	69.6	0.0	0.0	5.U 6.0	50.0
12			5.4595855			46.0	0.0	2.2047	10.05	1.0	62.6	73.4	1.0	0.0	5.0	90.0
13			5.4595855			52.0	0.0	0.0	9.3808	1.0	62.6	75.2	1.0	0.0	8.0 ×	180.0
14			5.4595855			14.0	0.0	0.0	38.341	3.0	57.2	66.2	1.0	0.0	6.0 °	170.0
15			5.4595855			16.0	0.2828	0.5292	36.056	2.0	60.8	73.4	1.0	0.0	6.0	360.0
16			5.4595856		i Excluder		0.0	0.5657	40.373	1.0	57.2	71.6	1.0	0.0	7.0	260.0
17			5.4595855			30.0	0.0	0.0	32,863	1.0	55.4	0.0	1.0	0.0	10.0	250.0
18			5.4595855			37.0	0.0	0.0	26.926	0.5	53.6	82.4	0.0	0.0	6.0	260.0
19	2	004.07.0	5.4595855	8.4468	0.0	43.0	0.3873	0.3873	22.113	4.0	62.6	68.0	0.0	1.0	6.0	70.0
20			5.4595855		i 0.0	45.0	0.0	0.0	20.273	0.0	60.8	64.4	0.0	0.0	14.0	310.0
21			5.4595855		0.0	49.0	0.0	0.0	16.0	0.5	71.6	84.2	0.0	0.0	3.0	310.0
22			5.4595855			51.0	0.0	0.7746	15.133	0.5	64.4	82.4	0.0	0.0	13.0	340.0
23			5.4595855			56.0	0.0	0.0	11.446	0.0	69.8	82.4	0.0	0.0	7.0	260.0
24			5.4595855			80.0	0.0	0.0	7.8102	1.0	55.4	66.2	1.0	0.0	9.0	310.0
25			5.4595855			84.0	0.0	0.0	6.7082	1.0	66.2	77.0	1.0	0.0	3.0	240.0
26			5.4595855			91.0	0.0	0.0	6.7823	2.0	55.4	66.2	1.0	0.0	6.0	40.0
27			5.4595855			93.0	0.0	0.3606	6.9282	1.0	59.0	77.0	1.0	0.0	6.0	270.0
28			5.4595855			14.0	0.0	0.0	8.0623	1.0	60.0	76.0	0.0	0.0	7.0	280.0
29			5.4595856 15.4595856			21.0	0.0	0.1414	8.4261	1.0	56.0	73.0	1.0	0.0	9.0	200.0
30			15.4595855 5.4595855			28.0	0.0	0.0	7.0711	1.0	59.0	92.0	1.0	0.0	6.0	280.0
			5.4595855 5.4595856			42.0	0.0	0.0	5.831 5.5678	0.5	58.0	96.0	1.0	0.0	3.0 5.0	240.0 310.0
32			5.4595855			42.0	0.0	0.2236	5.5678	1.75	68.0	76.0	1.0	0.0	5.0 3.0	10.0
33					L_Version1		0.0	0.0	5.4/72	1.5	1	76.0	1 1.0	0.0	3.0	
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