Explained vs Caused

"Percentage of Variation in Y explained by X" versus "Percentage of Y Caused by X"
R-squared is the percentage of variation in Y explained by X (in a linear model)

Thesis:	*"Variation explained by X" is radically different from "result caused by X".*
Problem:	If X causes Y, there is generally no measure of how much influence X had on Y.
Solution:	In the following case, that influence is easily understood and calculated.
Result:	The "variation in Y explained by X" can be smaller thatn -- or bigger than --
	"the percentage of Y caused by X"

Consider a garment selling for $100 on average in Minnesota: no sales tax on clothing
Consider the same product selling in Wisconsin which has a sales tax on clothing.

Suppose the prices in both states is normally distributed with the same StdDev
Suppose the sales tax in Wisconsin is a fixed dollar amount on this item.

What percentage of the total price on a $100 item is *caused* by the sales tax?

Sales Tax$	$1	$2	$4	$8	$16	$32	$64
%Price Caused by X	1.0%	2.0%	3.8%	7.4%	13.8%	24.2%	39.0%
Math explained	=1/101	=2/102	=4/104	=8/108	=16/116	=32/132	=64/164

Regress total price (Product Price + State Sales Tax) on State (0, 1)

R-squared	**Wisconsin State Sales Tax (ST)**						
StdDev (SD)	$1	$2	$4	$8	$16	$32	$64
$1	22.2%	53.3%	82.1%	94.8%	98.7%	99.7%	99.9%
$2	6.7%	22.2%	53.3%	82.1%	94.8%	98.7%	99.7%
$4	1.8%	6.7%	22.2%	53.3%	82.1%	94.8%	98.7%
$8	0.4%	1.8%	6.7%	22.2%	53.3%	82.1%	94.8%
$16	0.1%	0.4%	1.8%	6.7%	22.2%	53.3%	82.1%
$32	0.0%	0.1%	0.4%	1.8%	6.7%	22.2%	53.3%

Regress total price (Product Price + State Sales Tax) on State (0, 1)

R-squared	**Wisconsin State Sales Tax (ST)**						
StdDev (SD)	$1.25	$2.50	$5	$10	$20	$40	$80
$1.25	22.2%	53.3%	82.1%	94.8%	98.7%	99.7%	99.9%
$2.50	6.7%	22.2%	53.3%	82.1%	94.8%	98.7%	99.7%
$5	1.8%	6.7%	22.2%	53.3%	82.1%	94.8%	98.7%
$10	0.4%	1.8%	6.7%	22.2%	53.3%	82.1%	94.8%
$20	0.1%	0.4%	1.8%	6.7%	22.2%	53.3%	82.1%
$40	0.0%	0.1%	0.4%	1.8%	6.7%	22.2%	53.3%

					Code	State
1	**"Percentage of Variation in Y Explained by X" versus "Percentage of Y Caused by X"**				0	MN
2	MN=Minnesota; WI = Wisconsin				1	WI
3	Consider a garment selling for $100 on average in MN: no sales tax on clothing					
4	Consider the same product selling in WI which has a sales tax on clothing.					
5	Suppose the prices in MN and WI are normally distributed with same StdDev				**SALES DATA**	
6	Suppose the sales tax in Wisconsin is a fixed dollar amount on this item.				State	$Price
7					0	84
8	$8 StdDev	$32	Wisconsin Sales Tax (fixed amount)		0	88
9	$100 Average				0	88
10	40 # of Subjects (must stay at 40 for this worksheet)				0	88
11					0	92

1. Distribution of product prices (same in each state)

	B	C	D	E	F
13					
14		**Total Price**	**Total Price**		
15	**Z**	**MN (Tax=0)**	**WI**	**# Sold**	
16	-2.5	80	112	0	
17	-2	84	116	1	
18	-1.5	88	120	3	
19	-1	92	124	5	
20	-0.5	96	128	7	
21	0	100	132	8	
22	0.5	104	136	7	
23	1	108	140	5	
24	1.5	112	144	3	
25	2	116	148	1	
26	2.5	120	152	0	
				40	

3. Dynamic graph of data and the associated linear model (with slope and R-squared)

Sale Price plus Tax versus State

$y = 32x + 100$
$R^2 = 0.5333$

1   Change sales tax (ST) or standard deviation (SD).
2   Record the associated value of R-squared shown In the graph.

Side column (State / $Price continued):

State	$Price
0	92
0	92
0	92
0	92
0	96
0	96
0	96
0	96
0	96
0	96
0	96
0	100
0	100
0	100
0	100
0	100
0	100
0	100
0	100
0	104
0	104
0	104
0	104
0	104
0	104
0	104
0	108
0	108
0	108
0	108
0	108
0	112
0	112
0	112
0	116

1	116
1	120
1	120
1	120
1	124
1	124
1	124
1	124
1	124
1	128
1	128
1	128
1	128
1	128
1	128
1	128
1	132
1	132
1	132
1	132
1	132
1	132
1	132
1	132
1	136
1	136
1	136
1	136
1	136
1	136
1	136
1	140
1	140
1	140
1	140
1	140
1	144
1	144
1	144
1	148

ACTUAL RESULTS FOR THIS DATA

	Minnesota	Wisconsin
	0	1
Ave	$100.00	$132.00
SD	$7.58	$7.58

Row	L	M	N	O	P	Q	R	S	T
48		$1	$2	$4	$8	$16	$32	$64	
49	$1	33.33%	50.00%	66.67%	80.00%	88.89%	94.12%	96.97%	
50	$2	0.00%	20.00%	42.86%	63.64%	78.95%	88.57%	94.03%	
51	$4	-33.33%	-14.29%	11.11%	38.46%	61.90%	78.38%	88.41%	
52	$8	-60.00%	-45.45%	-23.08%	5.88%	36.00%	60.98%	78.08%	
53	$16	-77.78%	-68.42%	-52.38%	-28.00%	3.03%	34.69%	60.49%	

M59   =(1+M$54-$L59)/(1+M$54+$L59)