Omitted Variable Bias

TheoryGuru applications

Load Economicreasoning package only if it is not already loaded

```
If[Length@Names["PLTools`*"] < 10,
 Get["http://economicreasoning.com"]]
```

Load other tools by clicking on extras and/or evaluating below

```
If[Not@MemberQ[$ContextPath, "OtherTools`"],
 Get["http://othertools.economicreasoning.com"]]
```

Notes

Interpret all data variables (x, x1, x2, x3, y) as demeaned.

In the Wolfram Language, x.y refers to the tensor DOT PRODUCT, NOT scalar multiplication. For TheoryGuru purposes, tensor means vector, so that the result of x.y is a scalar.

```
? SymbolicRegression
```

SymbolicRegression[*depvar*, *indvar1*, *indvar2*, ...]
interprets each argument as a symbolic vector and returns the
formula, experessed in terms of dot products, for the least-squares coefficient vector.
The computation time and formula complexity is exponential in the number of regressors.
E.g., 8 regressors is about 426,000 times more complicated than 2.

One Regressor

Setup

```
olsslope = First@SymbolicRegression[y, x]
```

$$\frac{x.y}{x.x}$$

```
tslsslope = First@SymbolicRegression[(* second stage *)y,
    z First@SymbolicRegression[(* first stage *)x, z]];
```

```
y = x β + ϵ;
```

Result 1: OLS may be biased, unless $x.\epsilon == 0$

```
TheoryGuru[x.x > 0, olsslope == β]
```

```
True for some, False for others
```

```
TheoryExtra[]//OtherTools`TFPrintL;
```

```
Using MostRecentGuruTheory.
```

$$x.\epsilon = 0$$

Result 2: bias is in the same direction as $x.\epsilon$

```
TheoryGuru[x.x > 0,
 SameSign[olsslope - β, x.ϵ]]
```

```
True
```

Result 3: TSLS is unbiased if and only if $z.\epsilon == 0$

```
TheoryOverlap[x.z > 0,
 tslsslope == β,
 z.ϵ == 0]
```

$\left\{\frac{z.\epsilon}{x.z} = 0,\ z.\epsilon = 0\right\}$ are equivalent

Variable interpretations

Three Regressors

```
y = x1 β1 + x2 β2 + x3 β3 + ϵ;
```

```
resid2 = x2 - SymbolicRegression[x2, x1, x3].{x1, x3};
(* resid from regression of x2 on the other independent variables *)

olsslope2 = SymbolicRegression[y, x1, x2, x3][[2]];
(* [[2]] means take the coefficient corresponding to the 2nd regressor (x2) *)
```

Result: coefficient 2's bias is in the same direction as resid2.ϵ

```
TheoryGuru[{resid2.resid2 > 0},
 SameSign[olsslope2 - β2, resid2.ϵ]]
```

```
True
```

Variable interpretations