Matrix Calculations in Minitab

Textbook Exercise 6.27 part (a): Estimating b (Indirect Method)

1. Enter the data into Minitab. (I named the data X1, X2, Y.)

2. Stat > Regression > Regression > Fit Regression Model
   a. Specify "Y" in "Responses" and "X1 X2" in "Continuous Predictors."
   b. Under "Storage…" , check "Design Matrix."
   c. Click OK.

3. The above steps will create the design matrix **X** (called M1 (or XMAT1) by default).

4. To see the design matrix go to Data > Data Display and select M1 (or XMAT1).

5. Begin the calculation of the beta estimates by $\mathbf{b} = (\mathbf{X}^T\mathbf{X})^{-1}\mathbf{X}^T\mathbf{Y}$. (Keep track of the names so that you do not mess up and the order does matter – it's not commutative.)
   a. Create $\mathbf{X}^T$, the transpose of X, by Calc > Matrices > Transpose. Enter M1 (or XMAT1) for "Transpose from" and enter M3 as "Store result in." NOTE: All matrices in Minitab when using a "store" feature must begin with M.
   b. Create $\mathbf{X}^T\mathbf{X}$: Calc > Matrices > Arithmetic. Select Multiply and enter M3 then M1 (or XMAT1). Type M4 for "Store…"
   c. Create $(\mathbf{X}^T\mathbf{X})^{-1}$: Calc > Matrices > Invert: Enter M4 for "Invert.." and type M5 for "Store…"
   d. Create $(\mathbf{X}^T\mathbf{X})^{-1}\mathbf{X}^T$**:** Calc > Matrices > Arithmetic. Select Multiply and enter M5 then M3. Type M6 for "Store…"
   e. Compute estimates of **b** by creating $(\mathbf{X}^T\mathbf{X})^{-1}\mathbf{X}^T\mathbf{Y}$: Calc > Matrices > Arithmetic. Select Multiply and enter M6 then Y. Type M7 for "Store…"
   f. To see the estimates, Data > Data Display and select M7.

You can verify your estimates by doing a regression of Y on X1, X2. The matrix **M7:**

```
Matrix M7

33.9321
 2.7848
-0.2644
```

Matrix Calculations in Minitab

Textbook Exercise 6.27 part (a): Estimating b (Direct Method – a little tedious)

1. Enter the data into Minitab. (I named the data X1, X2, Y.)

2. Create a column of ones (I named it "ones"), i.e. create a column containing 6 ones.

3. Go to Data > Copy > Columns to Matrix.

4. "Copy from Columns" select (in this order!): ones X1 X2.

5. "In current worksheet…" enter X. Uncheck the box for "Name…" Click OK.

6. To see this matrix **X** go to Data > Data Display and select X.

7. Begin the calculation of the beta estimates by $\mathbf{b = (X^TX)^{-1}X^TY.}$ (Keep track of the names so that you do not mess up and the order does matter – it's not commutative.)

a. Create $\mathbf{X^T}$, the transpose of X, by Calc > Matrices > Transpose. Enter X for "Transpose from" and enter M3 as "Store result in." NOTE: All matrices in Minitab when using a "store" feature must begin with M.

b. Create $\mathbf{X^TX}$: Calc > Matrices > Arithmetic. Select Multiply and enter M3 then X. Type M4 for "Store…"

c. Create $\mathbf{(X^TX)^{-1}}$: Calc > Matrices > Invert: Enter M4 for "Invert.." and type M5 for "Store…"

d. Create $\mathbf{(X^TX)^{-1}X^T}$**:** Calc > Matrices > Arithmetic. Select Multiply and enter M5 then M3. Type M6 for "Store…"

e. Compute estimates of **b** by creating $\mathbf{(X^TX)^{-1}X^TY}$: Calc > Matrices > Arithmetic. Select Multiply and enter M6 then Y. Type M7 for "Store…"

f. To see the estimates, Data > Data Display and select M7.

You can verify your estimates by doing a regression of Y on X1, X2. The matrix **M7:**

```
Matrix M7

33.9321
 2.7848
-0.2644
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