Computing the Variance

We can employ vector operations to compute the variance of an array of numbers. Consider data on a variable X to be expressed as a vector x′ (hypothetical scores on the first quiz)

 x′ = (15, 11, 9, 14, 13, 12, 6, 13, 8, 10)

 variance is the sum of squared deviations divided by the number of observations:

 , where 

Use vector notation and operations at each step along the way to compute the variance of this data set.

1. We need the sum of the observations on X

= 15+11+9+14+13+12+6+13+8+10

 using vector notation, x′1 = (15, 11, 9, 14, 13, 12, 6, 13, 8, 10)

 = (15)(1) + (11)(1) + … + (10)(1) = 111

1. We next need to compute the mean

 =  = 11.1 Using vector notation, 1/n (x′1) = 1/10 (111) = 11.1

1. Now we need deviation scores, obtained by subtracting the mean from each observation.



using vector notation, we can subtract a vector of means from the vector of observations

d = x – m =−= 

1. Next we compute the sum of squared deviations, using vector notation:

ss = d′d = (3.9, -0.1, -2.1, 2.9, 1.9, 0.9, -5.1, 1.9, -3.1, -1.1)  = 72.9

1. Finally, we take the average squared deviation to get the variance.

(1/10)ss = (1/10)(72.9) = 7.29

Computing the Covariance and Correlation

Covariance is found by taking the average cross product of deviation scores.

To do this we need to compute deviation scores for both X and Y and compute the average cross product of the deviation scores.



Matrix.

compute x = {15;11;9;14;13;12;6;13;8;10}.

compute y = {152;145;111;132;143;128;89;121;99;105}.

compute ones = Make(10,1,1).

compute meanx = (1/10)\*T(x)\*ones.

compute mx = Make(10,1,meanx).

compute dx = x - mx.

compute meany = (1/10)\*T(y)\*ones.

compute my = Make(10,1,meany).

compute dy = y - my.

compute cp = T(dx)\*(dy).

print cp.

compute sx = sqrt(T(dx)\*dx).

compute sy = sqrt(T(dy)\*dy).

compute sxsy = sx\*sy.

compute r = inv(sxsy)\*cp.

print sx.

print sy.

print r.

End Matrix.

Run MATRIX procedure:

CP 468.5000000

SX 8.538149682

SY 63.50196847

R .8640893313

------ END MATRIX -----

Note: to create vectors, rows are separated by ; and columns by ,