CH4 LAB RESULTS - INTRODUCTION TO MULTIPLE REGRESSION

```
*To enter data.
DATA LIST FREE/ qual valu buy.
BEGIN DATA
1 5 15     1 4 15     2 4 14     2 5 18     4 1 10     4 2 14     5 2 13     5 1 13
END DATA.

*1/2/3/4/5/6.
REGRESSION /DESCRIPTIVES   /DEPENDENT = buy /ENTER qual valu
     /SAVE PRED(prdb.qv) RESID(resb.qv).
```

	Mean	Std Dev	Label
BUY	14.000	2.268	
QUAL	3.000	1.690	
VALU	3.000	1.690	

$SSy = (8-1)2.268^2 = 36.0$

Correlation:

	BUY	QUAL	VALU
QUAL	-.596		
VALU	.820	-.900	

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.882(a)	.778	.689	1.26491

$R^2 = 28/36$

$R^2 = 28.0/36.0 = .778$
$1-R^2 = 8.0/36.0 = .222$
$SQRT(.222) = .471$

$MS=SS/df$

Model		Sum of Squares		df	Mean Square	F	Sig.
1	Regression	28.000	***p***	2	14.000	8.750	.023(a)
	Residual	8.000	***n-p-1***	5	1.600		
	Total	36.000		7			

$F = 14.0/1.6 = 8.75$

$F = (.882^2/2)/[(1-.882^2)/(8-2-1)]$
$df = 2.\ 5$ Reject Ho: $R_{y.12} = 0$

$SS_{Reg} + SS_{Res} = SS_{Total} = SS_y$

Model		Unstandardized Coefficients B		Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	5.000	b_0	3.821		1.309	.248
	QUAL	1.000	$b_{yq.v}$	.649	.745	1.541	.184
	VALU	2.000	$b_{yv.q}$	.649	1.491	3.082	.027

$b_{yv.q} = [(.820- -.596x-.90)/(1- -.90^2)]\ x\ 2.268/1.69 = 2.0$

$b_0 = 14.0 - 1.0\ x\ 3.0 - 2.0\ x\ 3.0 = 5.0$

Residuals Statistics(a)

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	11.0000	17.0000	14.0000	2.00000	8
Residual	-1.0000	1.0000	.0000	1.06904	8

$SSReg = (8-1)2.0^2 = 28.0$

$SSRes = (8-1)1.06904^2 = 8.0$

LIST.

QUAL	VALU	BUY	PRDB.QV (y')	RESB.QV ($y-y'$)
1.00	5.00	15.00	16.00000	-1.00000
1.00	4.00	15.00	14.00000	1.00000
2.00	4.00	14.00	15.00000	-1.00000
2.00	5.00	18.00	17.00000	1.00000
4.00	1.00	10.00	11.00000	-1.00000
4.00	2.00	14.00	13.00000	1.00000
5.00	2.00	13.00	14.00000	-1.00000
5.00	1.00	13.00	12.00000	1.00000

$M_{y'} = 14.0 = M_y \quad M_{y-y'} = 0.0$

$y_1' = 5.0 + 1.0x1 + 2.0x5 = 16.0$
$y_1 - y_1' = 15.0 - 16.0 = -1.0$

```
*8.
VARIABLE LABELS prdb.qv `' resb.qv `'.
CORRELATE buy qual valu prdb.qv resb.qv /STATISTICS = DESCRIPTIVES.
```

Variable	Cases	Mean	Std Dev
BUY	8	14.0000	2.2678
QUAL	8	3.0000	1.6903
VALU	8	3.0000	1.6903
PRDB.QV	8	14.0000	2.0000
RESB.QV	8	.0000	1.0690

- - Correlation Coefficients - -

	BUY	QUAL	VALU	PRDB.QV
QUAL	-.5963			
VALU	.8199	-.9000		
PRDB.QV	.8819	-.6761	.9297	
RESB.QV	.4714	.0000	.0000	.0000

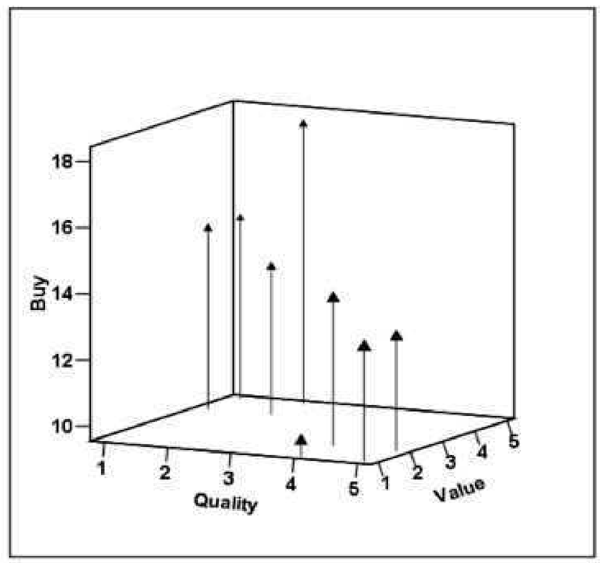
$r_{y'(y-y')} = 0$

$r_{(y-y')Q} = 0$ $\quad r_{(y-y')V} = 0$

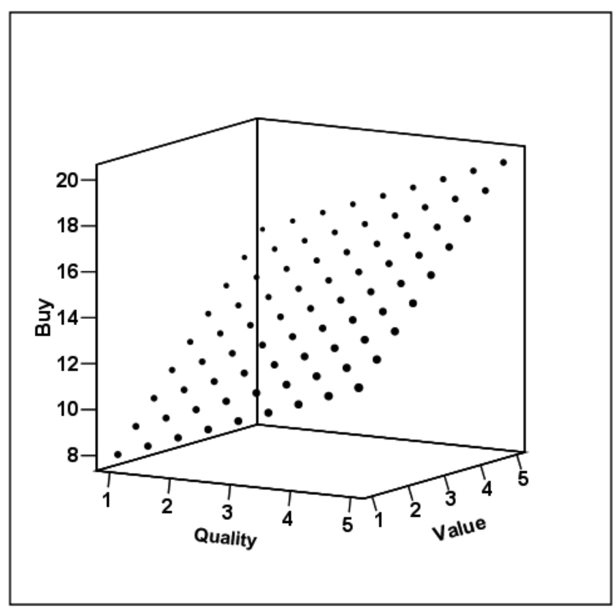
$r_{yy'} = R$ $\quad r_{yy'}^{2} + r_{y(y-y')}^{2} = 1.0$

***7. 3-D Graph *Graph* | *Scatter* | *3-D* | *Define*.**

```
GRAPH  /SCATTERPLOT(XYZ)=valu WITH buy WITH qual.
```




```
*9. Commands below produce prediction plane.
INPUT PROGRAM.
LOOP v = 1 to 5 BY .5.
LEAVE v.
LOOP q = 1 to 5 BY .5.
END CASE.
END LOOP.
END LOOP.
END FILE.
END INPUT PROGRAM.
COMP b = 5.0 + 1.0*q + 2.0*v.
GRAPH  /SCATTERPLOT(XYZ)= v WITH b WITH q.
LIST.
```



v	q	b
1.00	1.00	8.00
1.00	1.50	8.50
1.00	2.00	9.00
1.00	2.50	9.50
1.00	3.00	10.0
1.00	3.50	10.5
1.00	4.00	11.0
1.00	4.50	11.5
1.00	5.00	12.0
1.50	1.00	9.00
1.50	1.50	9.50
...		
4.50	4.50	18.5
4.50	5.00	19.0
5.00	1.00	16.0
5.00	1.50	16.5
5.00	2.00	17.0
5.00	2.50	17.5
5.00	3.00	18.0
5.00	3.50	18.5
5.00	4.00	19.0
5.00	4.50	19.5
5.00	5.00	20.0

2:1 Lab - Multiple Regression

1. What stats needed for MR equation - Line 13

$\hat{Y} = b_0 + b_1X_1 + b_2X_2 \rightarrow$ need b_0 and b_1, b_2. Line 14 - need b_1, b_2 first

very much like single factor regression on line 7.

$$b_1 = \frac{r_{Y1} - r_{Y2}r_{12}}{1 - r^2_{12}} \times \frac{S_Y}{S_1} \rightarrow \text{can change to } b_q = \frac{r_{bq} - r_{bv}r_{qv}}{1 - r^2_{qv}} \times \frac{S_b}{S_q}$$

use what makes the most sense to help you keep track.

need r + s values → from SPSS:

	qual	valu	buy	mean	std.dev
qual		-.900	-.596	3	1.690
valu			.820	3	1.690
buy				14	2.268

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2. Use values to calculate MR equation

$$b_q = \frac{(-.596) - (.820)(.900)}{[1 - (-.900)^2]} \times \frac{2.2678}{1.6903} = \frac{(-.596) - (-.738)}{1 - .810} \times \frac{2.2678}{1.6903}$$

$$= \frac{.1416}{.190} \times \frac{2.2678}{1.6903} = \boxed{1.0} = b_q \text{ or } b_{yq.v}$$

these switch

For b_v or $b_{yv.q}$, $\frac{r_{bv} - r_{bq}r_{qv}}{1 - r^2_{qv}} \times \frac{S_b}{S_v}$ ← this switches

$$= \frac{.820 - (-.596)(-.900)}{[1 - (-.90)^2]} \times \frac{2.2678}{1.6903} = \frac{(.820) - (-.5367)}{.190} \times \frac{2.2678}{1.6903}$$

$$= \frac{.2832}{.190} \times \frac{2.2678}{1.6903} = \boxed{2.0} = b_{yv.q}$$

now, $b_0 = \bar{Y} - b_1\bar{X}_1 - b_2\bar{X}_2$ or $\bar{Y} - b_{yq.v}\bar{X}_q - b_{yv.q}\bar{X}_v$

$= 14 - (1)(3) - (2)(3) = 14 - 3 - 6 = \boxed{5}$

So... $\hat{Y} = 5 + 1x_1 + 2x_2$ or $5 + 1x_q + 2x_v$

Try it out with first numbers - q = 1 and v = 5

$\hat{Y} = 5 + (1)(1) + (2)(5) = 5 + 1 + 10$

actual y value is 15, so $Y - \hat{Y} = 15 - 16 = -1$

5. Strength of relationship between 2 predictors and likelihood of buying each car

Amount of overall variability - SS_y or SS_{total} - accounted for by 2 predictors.

Line 15 formula sheet

$\Sigma(\hat{y}-\bar{y})^2 \Rightarrow$ need all $\hat{y}$

See spreadsheet $SS_{Reg} = 28$

Line 16 $SS_{Res} = \Sigma(y-\hat{y})^2 = 8$ $\quad > SS_y = 36$

So, strength of relationship, or correlation - overall correlation

Line 14 - $R^2_{y.12} = \frac{SS_{\hat{y}}}{SS_y} = \frac{28}{36} = .778$ $\quad >$ overall 1.0, split between Reg + Res

also $1 - R^2 = \frac{SS_{y-\hat{y}}}{SS_y} = \frac{8}{36} = .222$

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6. Significance of relationship, ie F-test

Line 17 $MS_{Reg} = \frac{SS_{Reg}}{p} = \frac{28}{2} = 14$ $\quad MS_{Res} = \frac{SS_{Res}}{n-p-1} = \frac{8}{8-2-1} = \frac{8}{5} = 1.6$

$F = \frac{MS_{Reg}}{MS_{Res}} = \frac{14}{1.6} = \boxed{8.75}$

can also use

$F = \frac{R^2/p}{1-R^2/n-p-1} = \frac{.778/2}{.222/8-2-1} = \frac{.389}{.0444} = \boxed{8.76}$