

4.

(a)

SAS code:

```
data expen;
input expenditure earnings size;
cards;
2.6 3 1
3.2 4 1
4.4 5 2
4.8 6 2
4.2 4.5 3
4.8 6 3
4.8 5 4
5.6 7 4
;

proc reg data=expen;
  model expenditure=earnings/clb;
  plot (R.)*P.;
run;
```

SAS output:

The SAS System							21:09 Thursday, October 20, 2005		2
The REG Procedure									
Model: MODEL1									
Dependent Variable: expenditure									
Analysis of Variance									
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F				
Model	1	5.92067	5.92067	55.56	0.0003				
Error	6	0.63933	0.10656						
Corrected Total	7	6.56000							
		Root MSE	0.32643	R-Square	0.9025				
		Dependent Mean	4.30000	Adj R-Sq	0.8863				
		Coeff Var	7.59135						
Parameter Estimates									
Variable	DF	Parameter Estimate	Standard Error	t Value	Pr >  t	95% Confidence Limits			
Intercept	1	0.62228	0.50670	1.23	0.2654	-0.61756	1.86213		
earnings	1	0.72646	0.09746	7.45	0.0003	0.48799	0.96493		

R code:

```
> earnings<-c(3,4,5,6,4.5,6,5,7)
> size<-c(1,1,2,2,3,3,4,4)
> expenditure<-c(2.6,3.2,4.4, 4.8, 4.2, 4.8 ,4.8,5.6)
> a<-lm(expenditure~earnings)
> plot(expenditure,a$resid)
> abline(h=0,lty=2)
> plot(size,a$resid)
> abline(h=0,lty=2)
> plot(a$fit,a$resid)
> abline(h=0,lty=2)
```

```
> summary(a)
```

R output:

Call:

```
lm(formula = expenditure ~ earnings)
```

Residuals:

```
  Min    1Q  Median    3Q   Max
-0.3281 -0.1862 -0.1443  0.1862  0.5454
```

Coefficients:

```
      Estimate Std. Error t value Pr(>|t|)
(Intercept)  0.62228    0.50670   1.228 0.265389
earnings     0.72646    0.09746   7.454 0.000301 ***
```

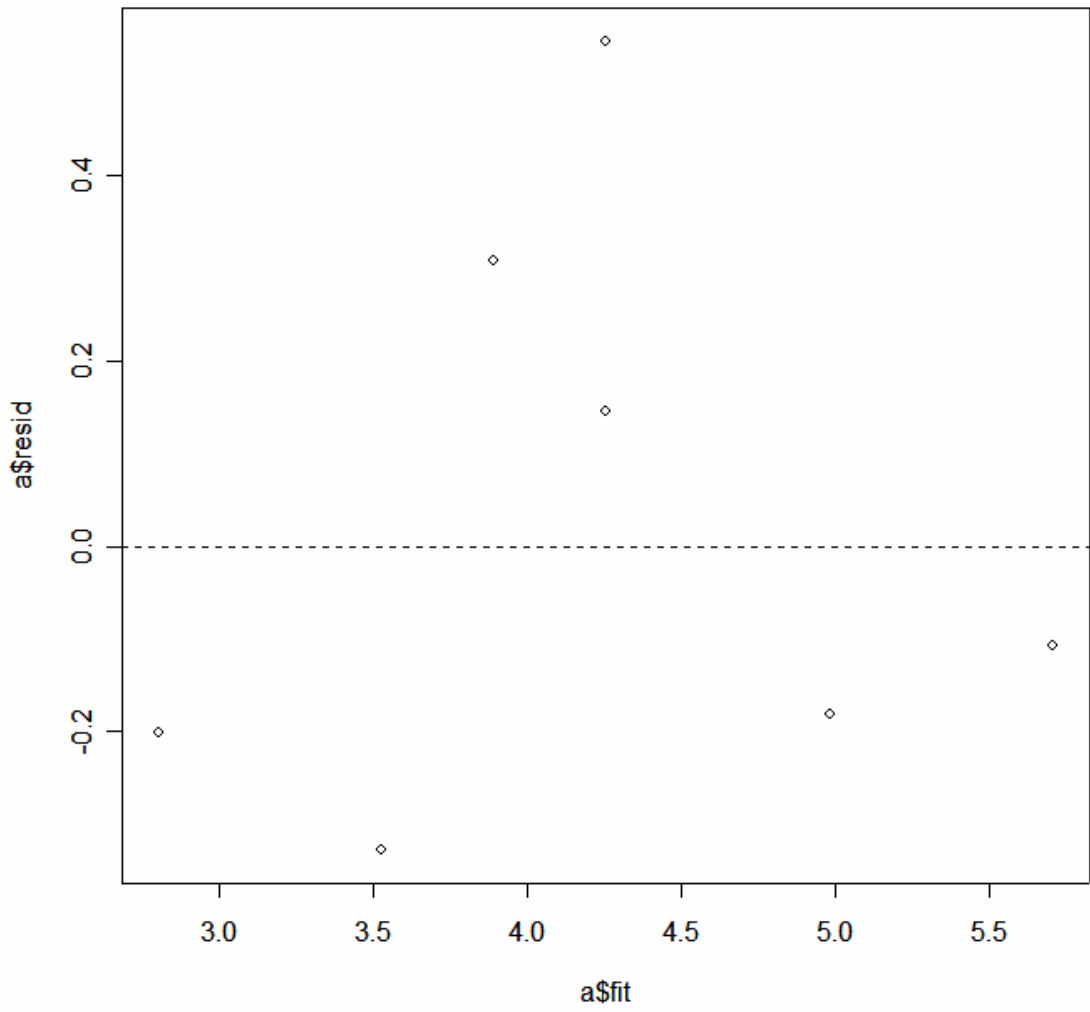
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Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

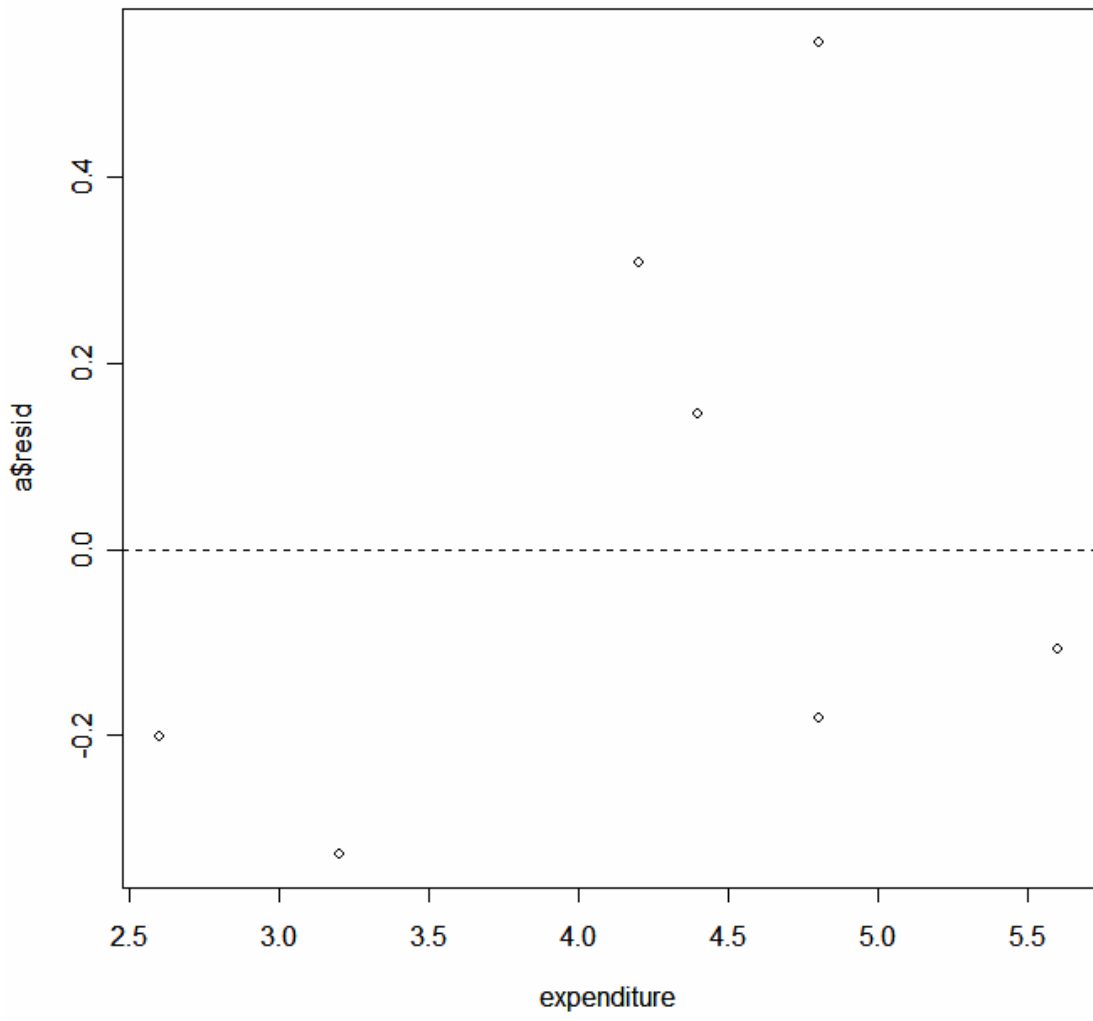
Residual standard error: 0.3264 on 6 degrees of freedom

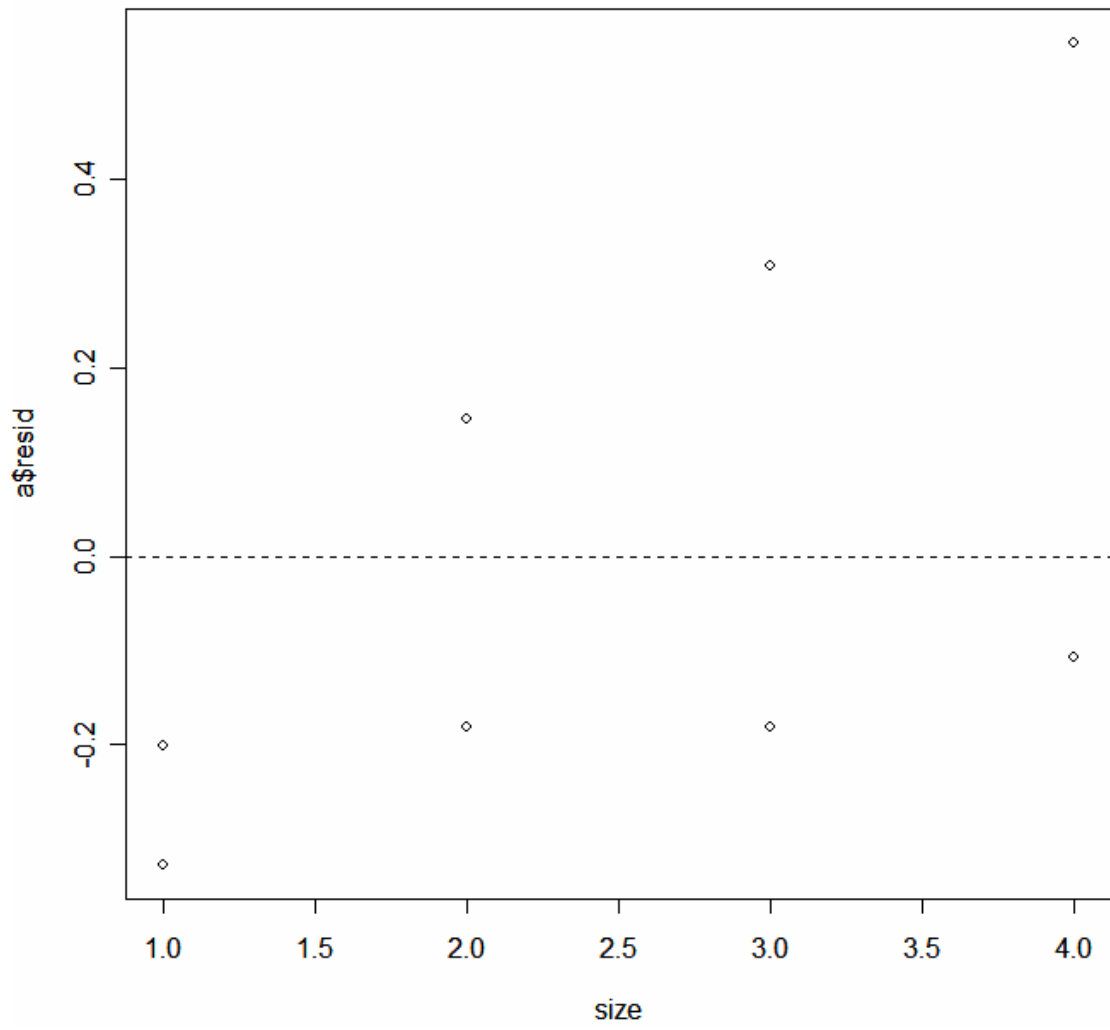
Multiple R-Squared: 0.9025, Adjusted R-squared: 0.8863

F-statistic: 55.56 on 1 and 6 DF, p-value: 0.0003005

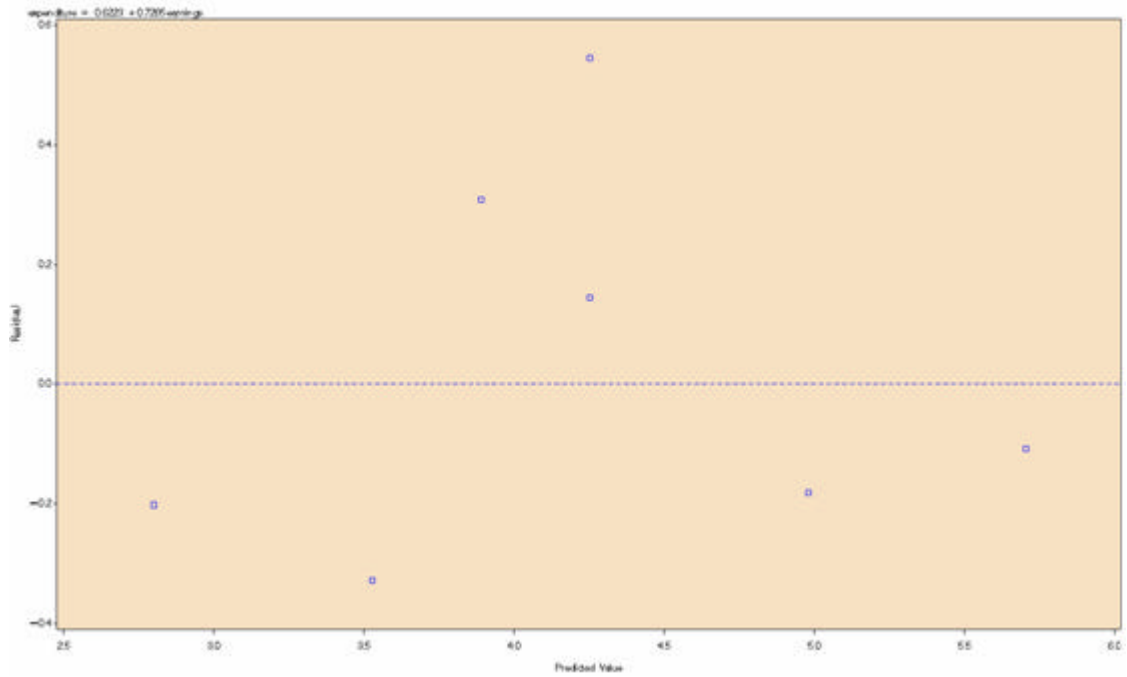


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(b)

SAS code:

```

data expen;
input expenditure earnings size;
newexpen=expenditure/size;
newearnings=earnings/size;
cards;
2.6 3 1
3.2 4 1
4.4 5 2
4.8 6 2
4.2 4.5 3
4.8 6 3
4.8 5 4
5.6 7 4
;

proc reg data=expen;
model expenditure=earnings;
model newexpen=newearnings;
plot (R.)*P.;
run;

```

The REG Procedure  
 Model: MODEL2  
 Dependent Variable: newexpen

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	3.45042	3.45042	297.52	<.0001
Error	6	0.06958	0.01160		
Corrected Total	7	3.52000			

Root MSE	0.10769	R-Square	0.9802
Dependent Mean	2.00000	Adj R-Sq	0.9769
Coeff Var	5.38452		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr >  t
Intercept	1	0.19896	0.11114	1.79	0.1236
newearnings	1	0.75833	0.04396	17.25	<.0001

R code:

```
> newexpend<-expenditure/size
> newearnings<-earnings/size
> b<-lm(newexpend~newearnings)
> plot(b$fit,b$resid)
> abline(h=0,lty=2)
> summary(b)
```

Call:

```
lm(formula = newexpend ~ newearnings)
```

Residuals:

```
Min 1Q Median 3Q Max
-0.12604 -0.08438 0.01042 0.07396 0.12604
```

Coefficients:

```
Estimate Std. Error t value Pr(>|t|)
(Intercept) 0.19896 0.11114 1.79 0.124
newearnings 0.75833 0.04396 17.25 2.43e-06 ***
```

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Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.1077 on 6 degrees of freedom  
 Multiple R-Squared: 0.9802, Adjusted R-squared: 0.9769  
 F-statistic: 297.5 on 1 and 6 DF, p-value: 2.432e-06

# The SAS System

