Q1 (40 points)

Q1(40 points) We collected a sample grade of midterm and final exam. See data below

i	**midterm,** x_i	**final,** y_i	x_i^2	y_i^2	x_iy_i	$\hat{y}_i$	e_i^2
1	1.5	2.5					
2	4	3.5					
3	3	4					
4	3	2.5					
5	4.5	5					
6	2	1.5					
sum							
mean							

Manually solve the following, do NOT use SAS ($\alpha = 0.1$). Keep four digits decimals for any calculation.

1. (5 points) Fill the table.
2. (4 points) Fit the data to a simple linear regression model, calculate the least squares point estimates for β_0, β_1. And interpret the model (slop, y-intercept).
3. (2 points) Calculate the error sum of squares and the residual mean square.
4. (9 points) Calculate the 90% confidence intervals for β_0, β_1. And interpret the confidence interval of the slop.
5. (3 points) Apply a t-test to test $H_0 : \beta_0 = 0,\ \ H_a : \beta_0 \neq 0$. Solve using reject point.
6. (4 points) Apply a t-test to test $H_0 : \beta_1 = 0,\ \ H_a : \beta_1 \neq 0$. Solve using P-value.
7. (1 points) Calculate the prediction value of y, given $x = 3$.
8. (3 points) Calculate the 90% confidence interval for the expected value of y, given $x = 3$.
9. (2 points) Calculate the 90% prediction interval for y, given $x = 3$.
10. (4 points)Calculate the simple coefficient of determination and the simple correlation coefficient based on the regression model. And use the simple correlation coefficient to interpret the relations between midterm grade and final grade.
11. (3 points) Apply a F-test to test $H_0 : \beta_1 = 0,\ \ H_a : \beta_1 \neq 0$. Note $F_{0.1}^{(1,4)} = 4.5448$.

Q1(40 points) We collected a sample grade of midterm and final exam. See data below

$\hat{y}_i = 0.5128 + 0.8846\,x_i$

$n=6$

i	midterm, x_i	final, y_i	x_i^2	y_i^2	$x_i y_i$	$\hat{y}_i$	e_i^2
1	1.5	2.5	2.25	6.25	3.75	1.8397	0.4359
2	4	3.5	16	12.25	14	4.0513	0.3039
3	3	4	9	16	12	3.1667	0.6944
4	3	2.5	9	6.25	7.5	3.1667	0.4444
5	4.5	5	20.25	25	22.5	4.4936	0.2565
6	2	1.5	4	2.25	3	2.2821	0.6116
sum	$\sum x_i = 18$	$\sum y_i = 19$	60.5	68	62.75	19	2.7468 SS_{Res}
mean	$\bar{x} = 3$	$\frac{19}{6} \approx 3.1667 = \bar{y}$	$\frac{60.5}{6} \approx 10.0833$	$\frac{68}{6} \approx 11.3333$	$\frac{62.75}{6} \approx 10.4583$	3.1667	0.4578

	e_i
	0.6603
	-0.5513
	0.8333
	-0.6667
	0.5064
	-0.7821
sum	-0.0001
mean	-0.000017

$e_i = y_i - \hat{y}_i$

1. (5 points) Fill the table.

2. (4 points) Fit the data to a simple linear regression model, calculate the least squares point estimates for β_0, β_1. And interpret the model (slop, y-intercept).

$$\hat{\beta}_1 = \frac{n\sum x_i y_i - (\sum x_i)(\sum y_i)}{n\sum x_i^2 - (\sum x_i)^2} = \frac{6(62.75) - 18(19)}{6(60.5) - (18)^2} \approx 0.8846$$

$$\hat{\beta}_0 = \bar{y} - \hat{\beta}_1 \bar{x} = \frac{19}{6} - \left[\frac{6(62.75) - 18(19)}{6(60.5) - (18)^2}\right](3) \approx 0.5128$$

fitted simple linear regression:

$\hat{y}_i = 0.5128 + 0.8846 x_i$

y-intercept : $\hat{\beta}_0 = 0.5128$

slope : $\hat{\beta}_1 = 0.8846$

Interpretation:
Every 1 mark increase for midterm, the final grade will increase 0.8846 mark.

$\boxed{\text{Simple linear regression model}}$

$y_i = \beta_0 + \beta_1 x_i + \varepsilon$

$= \mu_i + \varepsilon$

3. (2 points) Calculate the error sum of squares and the residual mean square.

$$SS_{Res} = \sum_{i=1}^{n} e_i^2 = \sum_{i=1}^{n} (y_i - \hat{y}_i)^2$$

$$= \sum_{i=1}^{6} e_i^2$$

$= 0.4359 + 0.3039 + 0.6944 + 0.4444 + 0.2565 + 0.6116$

$= 2.7468$

residual mean square:

$$\hat{\sigma}^2 = MS_{Res} = \frac{SS_{Res}}{n-2},$$

$$= \frac{2.7468}{6-2} = \frac{2.7468}{4} \approx 0.6867$$

4. (9 points) Calculate the 90% confidence intervals for β_0, β_1. And interpret the confidence interval of the slop.

$$\hat{y}_i = 0.5128 + 0.8846 x_i$$

$$\bar{x} = 3$$

$$\sum x_i^2 = 60.5$$

$$C_{11} = \frac{1}{\sum (x_i - \bar{x})^2}$$

$$= \frac{1}{\sum x_i^2 - n\bar{x}^2}$$

$$= \frac{1}{60.5 - 6(3)^2}$$

$$\approx 0.1538$$

$$SS_{Res} = \mathbf{2.7468}$$

Given $\alpha = 0.1$

$$t_{\alpha/2}(n-2) = t_{0.05}(4) = 2.1318$$

$$\hat{\sigma} = \sqrt{MS_{Res}} = \sqrt{\frac{SS_{Res}}{n-2}} = \sqrt{0.6867} \approx 0.8287$$

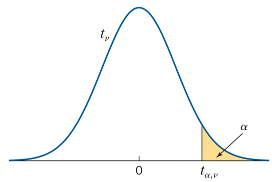
$\therefore$ 90% CI for β_1 is $\hat{\beta}_1 \pm t_{\alpha/2}(n-2)\hat{\sigma}\sqrt{C_{11}}$

$$= 0.8846 \pm 2.1318(0.8287)\sqrt{0.1538}$$

$$= (0.1917, 1.5775)$$

Table V Critical Values for the t Distribution

This table contains critical values associated with the t distribution, $t_{\alpha,\nu}$, defined by α and the degrees of freedom, ν.



ν \ α	0.20	0.10	0.05	0.025	0.01	0.005	0.001	0.0005	0.0001
1	1.3764	3.0777	6.3138	12.7062	31.8205	63.6567	318.3088	636.6192	3183.0988
2	1.0607	1.8856	2.9200	4.3027	6.9646	9.9248	22.3271	31.5991	70.7001
3	0.9785	1.6377	2.3534	3.1824	4.5407	5.8409	10.2145	12.9240	22.2037
4	0.9410	1.5332	2.1318	2.7764	3.7469	4.6041	7.1732	8.6103	13.0337

$$C_{00} = \frac{1}{n} + \frac{\bar{x}^2}{\sum (x_i - \bar{x})^2}$$

$$= \frac{1}{n} + \frac{\bar{x}^2}{\sum x_i^2 - n\bar{x}^2}$$

$$= \frac{1}{6} + \frac{3^2}{60.5 - 6(3)^2}$$

$$\approx 1.5513$$

$\therefore$ 90% CI for β_0 is

$$\hat{\beta}_0 \pm t_{\alpha/2}(n-2)\hat{\sigma}\sqrt{C_{00}}$$

$$= 0.5128 \pm 2.1318(0.8287)\sqrt{1.5513}$$

$$= (-1.6874, 2.7131)$$

Interpretation of the CI of the slop:

1. We are 90% confident that if the midterm grade increases by 1 mark, the final grade will increase by at least 0.1917 marks and at most 1.5775 marks.
2. Zero doesn't fall within the CI, so there is evidence that the midterm grade and the final grade has a linear relation.

5. (3 points) Apply a t-test to test $H_0 : \beta_0 = 0$, $H_a : \beta_0 \neq 0$. Solve using reject point.

6. (4 points) Apply a t-test to test $H_0 : \beta_1 = 0$, $H_a : \beta_1 \neq 0$. Solve using P-value.

Given $\alpha = 0.1$

$\boxed{Q5}$

$H_0 : \beta_0 = 0$, $H_a : \beta_0 \neq 0$

$\hat{y}_i = 0.5128 + 0.8846 x_i$

$C_{00} \approx 1.5513$

$\hat{\sigma} \approx 0.8287$

Test statistics : $t = \dfrac{\hat{\beta}_0 - \beta_{00}}{\hat{\sigma}\sqrt{C_{00}}}$

$= \dfrac{0.5128 - 0}{0.8287\sqrt{1.5513}}$

≈ 0.4969

reject point : $t_{\alpha/2}(n-2) = t_{0.05}(4) = 2.1318$

$|t| = 0.4969 < 2.1318$ doesn't fall in the reject region, so fail to reject H_0

$\boxed{Q6}$

$H_0 : \beta_1 = 0$, $H_a : \beta_1 \neq 0$

$\hat{y}_i = 0.5128 + 0.8846 x_i$

$C_{11} \approx 0.1538$

$\hat{\sigma} \approx 0.8287$

$t = \dfrac{\hat{\beta}_1 - \beta_{10}}{\hat{\sigma}\sqrt{C_{11}}}$

$= \dfrac{0.8846 - 0}{0.8287\sqrt{0.1538}}$

≈ 2.7216

P-value $= 2 \cdot P(T > |t|)$

$= 2 \cdot P(T > 2.7216)$

$P(T > 2.7216) < P(T > 2.1318) = P(T > t_{0.05}(4))$

$\therefore P(T > 2.7216) < \alpha = 0.05$

P-value $< 2(0.05) = 0.1 = \alpha$

So, reject H_0, x has a significant effect on y.

Table V Critical Values for the *t* Distribution

This table contains critical values associated with the t distribution, $t_{\alpha,\nu}$, defined by α and the degrees of freedom, ν.

ν \ α	0.20	0.10	0.05	0.025	0.01
1	1.3764	3.0777	6.3138	12.7062	31.8205
2	1.0607	1.8856	2.9200	4.3027	6.9646
3	0.9785	1.6377	2.3534	3.1824	4.5407
4	0.9410	1.5332	2.1318	2.7764	3.7469
5	0.9195	1.4759	2.0150	2.5706	3.3649

7. (1 points) Calculate the prediction value of y, given $x = 3$.

$$\hat{y}_i = 0.5128 + 0.8846\, x_i$$

$$\hat{y}_3 = 0.5128 + 0.8846(3)$$

$$\approx 3.1667$$

8. (3 points) Calculate the 90% confidence interval for the expected value of y, given $x = 3$.

Given $x = 3$, $\hat{y}_3 = 0.5128 + 0.8846(3) \approx 3.1667$

$$t_{\alpha/2}(n-2) = t_{0.05}(4) = 2.1318$$

$$\hat{\sigma} = \sqrt{MS_{Res}} = \sqrt{\frac{SS_{Res}}{n-2}} = \sqrt{0.6867} \approx 0.8287$$

$$h_{00} = \frac{1}{n} + \frac{(x_3 - \bar{x})^2}{\sum (x_i - \bar{x})^2}$$

$$= \frac{1}{n} + \frac{(x_3 - \bar{x})^2}{\sum x_i^2 - n\bar{x}^2}$$

$$= \frac{1}{6} + \frac{(3-3)^2}{60.5 - 6(3)^2}$$

$$\approx 0.1667$$

90% CI for the given $x = 3$

$$\hat{y}_3 \pm t_{\alpha/2}(n-2)\,\hat{\sigma}\sqrt{h_{00}}$$

$$= 3.1667 \pm 2.1318\,(0.8287)\sqrt{0.1667}$$

$$= (2.4455,\ 3.8879)$$

9. (2 points) Calculate the 90% prediction interval for y, given $x = 3$.

Given $x = 3$, $\hat{y}_3 = 0.5128 + 0.8846(3) \approx 3.1667$, $h_{00} \approx 0.1667$

$t_{\alpha/2}(n-2) = t_{0.05}(4) = 2.1318$, $\hat{\sigma} \approx 0.8287$

90% P.I. for $\hat{y}_3$: $3.1667 \pm 2.1318(0.8287)\sqrt{1+0.1667} = (1.2586, 5.0748)$

10. (4 points)Calculate the simple coefficient of determination and the simple correlation coefficient based on the regression model. And use the simple correlation coefficient to interpret the relations between midterm grade and final grade.

Simple coefficient of determination R^2 :

$\hat{y}_i = 0.5128 + 0.8846x_i$

$\sum y_i = 19$, $\sum y_i^2 = 68$

$\bar{y} = \frac{19}{6} \approx 3.1667$

$\sum x_i y_i = 62.75$

$\hat{\beta}_0 \sum y_i + \hat{\beta}_1 \sum x_i y_i$

$= 0.5128(19) + 0.8846(62.75)$

$= 65.2532$

$SS_{Res} = 2.7468$

$SS_T = \sum y_i^2 - n\bar{y}^2$

$= 68 - 6\left(\frac{19}{6}\right)^2$

$= 7.8333$

$SS_R = SS_T - SS_{Res}$

$= 7.8333 - 2.7468$

≈ 5.0865

$R^2 = \frac{SS_R}{SS_T} = \frac{5.0865}{7.8333} \approx 0.6493$

Simple correlation coefficient r :

$R^2 \approx 0.6493$

$r = \sqrt{R^2} = \sqrt{0.6493} \approx 0.8058$

Interpretation:
Since r = 0.8058 is close to 1, the midterm grade and the final grade are highly positively correlated.

11. (3 points) Apply a F-test to test $H_0 : \beta_1 = 0, \;\; H_a : \beta_1 \neq 0$. Note $F_{0.1}^{(1,4)} = 4.5448$.

$H_0 : \beta_1 = 0 \;,\; H_a : \beta_1 \neq 0$

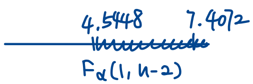
$\boxed{\text{F - test :}}$

$$\text{T.S. } F(\text{model}) = \frac{SS_R / 1}{SS_{Res} / (n-2)}$$

$$= \frac{5.0865/1}{2.7468/4}$$

$$\approx 7.4072$$

R.P. : $F_\alpha(1, n-2) = F_{0.1}(1,4) = 4.5448$



T.S. $\in$ R.R $\longrightarrow$ reject H_0 $\longrightarrow$ significant $\rightarrow$ good fit

Q2 (24 points)

Q2(24 points). Apply SAS to work on the following sample data, both SAS code and output are required.

	x_i	y_i
1	8.3	1.3
2	3.4	18.3
3	4.5	14.4
4	6.0	9.0
5	6.1	9.5
6	6.4	7.9
7	5.8	10.2
8	4.8	13.9
9	7.1	5.5
10	9.1	-1.1
11	8.7	0.0
12	5.0	12.9
13	8.2	2.2
14	3.6	17.6
15	8.9	-0.2
16	5.7	10.7
17	6.1	9.4
18	5.7	10.5
19	4.2	15.1
20	4.2	15.9

$\alpha = 0.01$ Find the following information from the SAS output.

1. (2 points) Fit the data to a simple linear regression model, find the least squares point estimates for β_0, β_1.
2. (1 points) Plot of the data with the regression line.
3. (4 points) Find $SS_T, SS_R, SS_{Res}, \hat{\sigma}^2$.
4. (2 points) Find the 99% confidence intervals for β_0, β_1.
5. (3 points) Apply a t-test to test $H_0 : \beta_1 = 0, \;\; H_a : \beta_1 \neq 0$. Specify the test statistic's value and P-value, and make conclusion.
6. (3 points) Apply a t-test to test $H_0 : \beta_0 = 0, \;\; H_a : \beta_0 \neq 0$. Specify the test statistic's value and P-value, and make conclusion.
7. (3 points) Find the prediction value, 99% confidence interval, and 99% prediction interval for y, given $x = 7.1$.
8. (1 points) Find the simple coefficient of determination.
9. (3 points) Apply a F-test to test $H_0 : \beta_1 = 0, \;\; H_a : \beta_1 \neq 0$. Specify the test statistic's value and P-value, and make conclusion.
10. (2 points) Find the value of $\hat{\sigma}\sqrt{c_{00}}, \hat{\sigma}\sqrt{c_{11}}$.
11. (1 points) Find $\hat{\sigma}\sqrt{h_{00}}$ and residual for $x = 7.1$.
12. (1 points) Compare the test statistics' value in 5 and 9, what is the relation between these two values?

```
data A1_Q2; /* Assigns name A1_Q2 to file*/
input x y; /* x; y */
cards; /* start to input data */
8.3 1.3
3.4 18.3
4.5 14.4
6.0 9.0
6.1 9.5
6.4 7.9
5.8 10.2
4.8 13.9
7.1 5.5
9.1 -1.1
8.7 0.0
5.0 12.9
8.2 2.2
3.6 17.6
8.9 -0.2
5.7 10.7
6.1 9.4
5.7 10.5
4.2 15.1
4.2 15.9
; /* inputs data, .= missing value*/
proc reg data = A1_Q2; /* specifies regression procedure */
model y = x /alpha=0.01 p clm cli clb;
run;
proc reg data = A1_Q2; /* specifies regression procedure */
model x = y ;
output out = A1_Q2new residual = e p = yhat; /*output residual and prediction value to a new data object, "e" and "yhat"
are two new columns names, ddnew is the new data object name*/
run;
```

The REG Procedure
Model: MODEL1
Dependent Variable: y

Number of Observations Read	20
Number of Observations Used	20

$F(\text{model})$

Analysis of Variance					
Source	DF	Sum of Squares (3)	Mean Square	F Value	Pr > F
Model SS_R	1	705.49198	705.49198	9490.75	<.0001 (9)
Error SS_{Res}	18	1.33802	0.07433 $\hat{\sigma}^2 = MS_{Res}$		
Corrected Total SS_T	19	706.83000			

Root MSE	0.27264	R-Square	0.9981 (8)
Dependent Mean	9.15000	Adj R-Sq	0.9980
Coeff Var	2.97971		

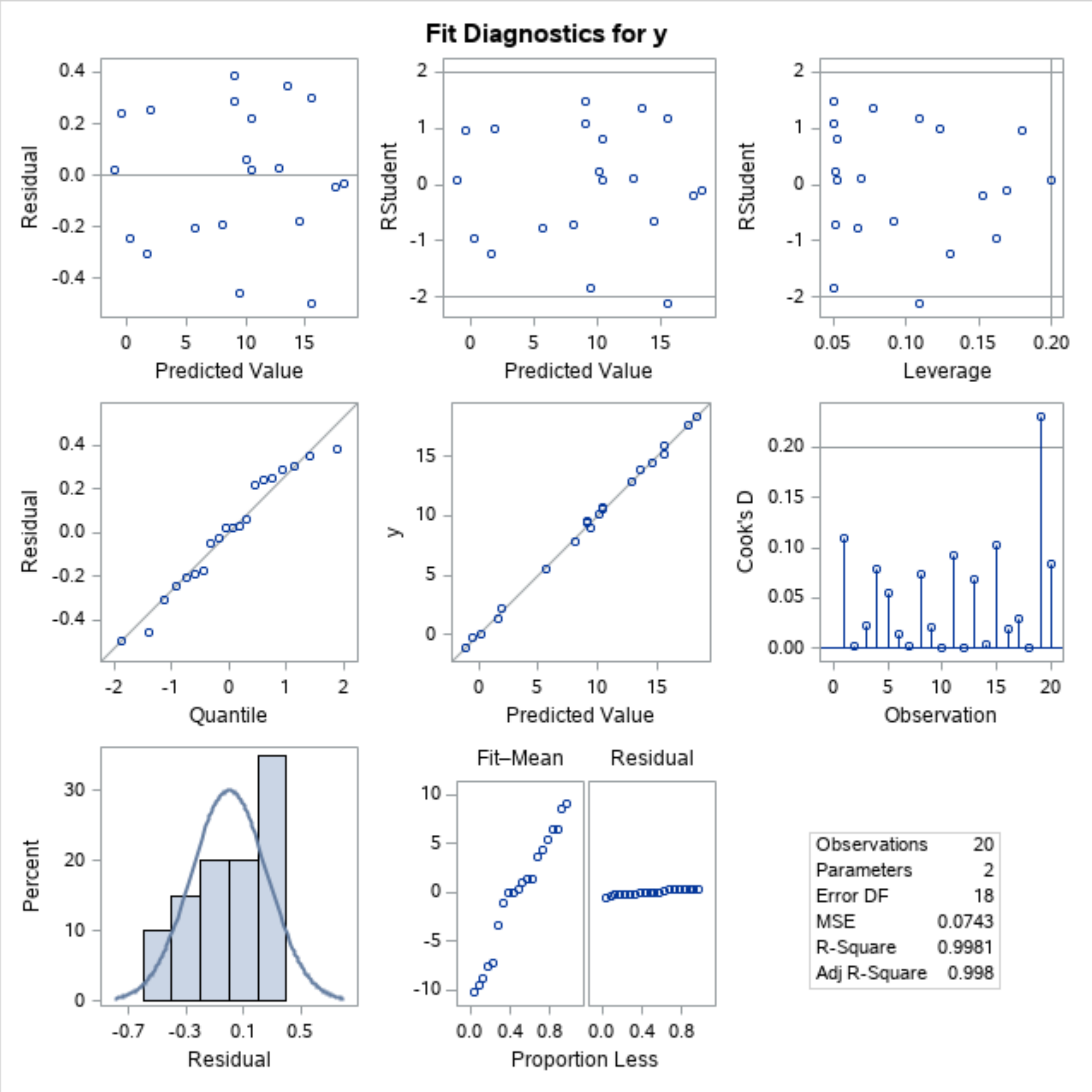
Parameter Estimates							
Variable	DF	Parameter Estimate	Standard Error	t Value	(6) Pr > |t|	99% Confidence Limits	
Intercept	1	29.93289	0.22187	134.91	<.0001	29.29424	30.57153
x	1	-3.41263	0.03503	-97.42	<.0001	-3.51346	-3.31179
		(1)	(10) $\hat{\sigma}\sqrt{C_{00}}$ $\hat{\sigma}\sqrt{C_{11}}$		(5)	(4)	

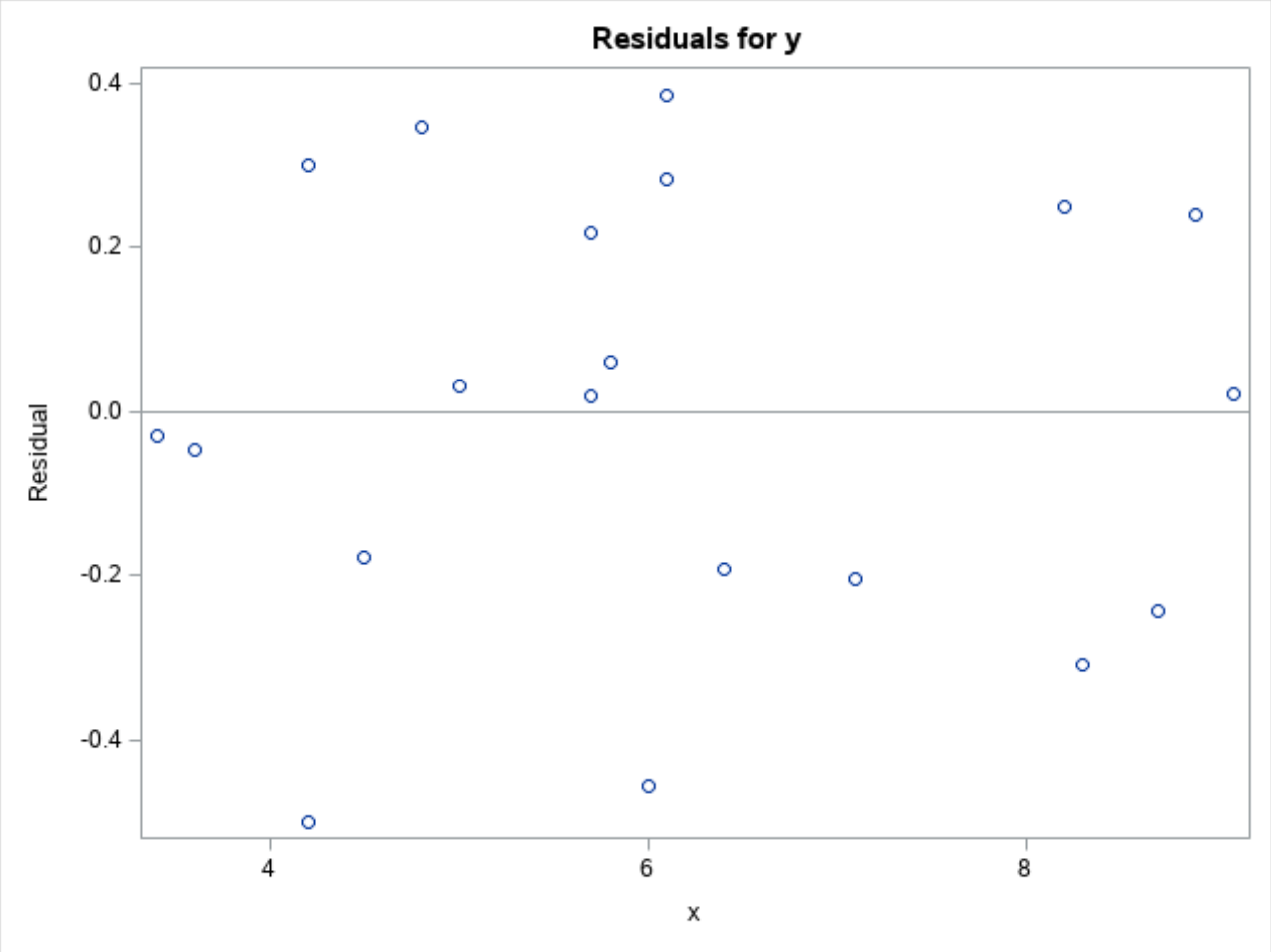
The REG Procedure
Model: MODEL1
Dependent Variable: y

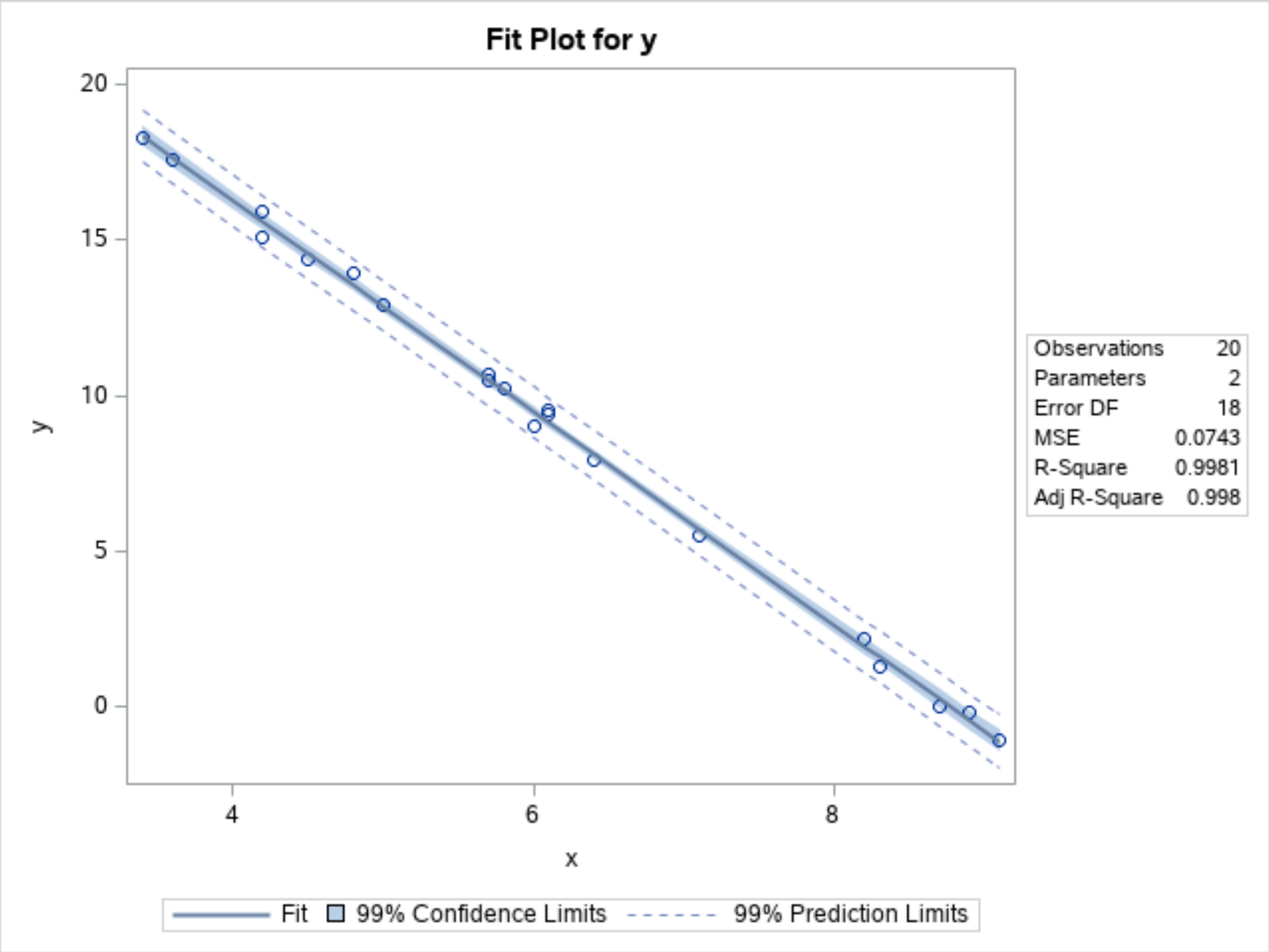
Output Statistics								
Obs	Dependent Variable	Predicted Value	Std Error Mean Predict	99% CL Mean (CI μ_0)		99% CL Predict (PI y)		Residual (e_i)
1	1.3	1.6081	0.0985	1.3245	1.8917	0.7736	2.4426	-0.3081
2	18.3	18.3300	0.1122	18.0069	18.6530	17.4813	19.1786	-0.0300
3	14.4	14.5761	0.0826	14.3384	14.8138	13.7561	15.3961	-0.1761
4	9.0	9.4571	0.0610	9.2814	9.6329	8.6529	10.2614	-0.4571
5	9.5	9.1159	0.0610	8.9404	9.2914	8.3117	9.9200	0.3841
6	7.9	8.0921	0.0619	7.9138	8.2703	7.2873	8.8969	-0.1921
7	10.2	10.1397	0.0618	9.9618	10.3176	9.3350	10.9444	0.0603
8	13.9	(7) 13.5523	0.0759	13.3339	13.7707 (7)	12.7377	14.3669	0.3477
9	5.5	5.7032	0.0705	5.5004	5.9061	4.8927	6.5138	-0.2032 (11) e_9
10	-1.1	-1.1220	0.1218 (11)	-1.4726	-0.7714	-1.9815	-0.2625	0.0220
11	0.0	0.2430	0.1099	-0.0733	0.5594	-0.6031	1.0892	-0.2430
12	12.9	12.8698	0.0719	12.6627	13.0768	12.0581	13.6814	0.0302
13	2.2	1.9494	0.0958	1.6736	2.2251	1.1175	2.7812	0.2506
14	17.6	17.6474	0.1064	17.3411	17.9538	16.8050	18.4899	-0.0474
15	-0.2	-0.4395	0.1158	-0.7728	-0.1062	-1.2921	0.4131	0.2395
16	10.7	10.4809	0.0625	10.3011	10.6608	9.6758	11.2861	0.2191
17	9.4	9.1159	0.0610	8.9404	9.2914	8.3117	9.9200	0.2841
18	10.5	10.4809	0.0625	10.3011	10.6608	9.6758	11.2861	0.0191
19	15.1	15.5999	0.0900	15.3408	15.8589	14.7734	16.4263	-0.4999
20	15.9	15.5999	0.0900	15.3408	15.8589	14.7734	16.4263	0.3001

Sum of Residuals	0
Sum of Squared Residuals	1.33802

Predicted Residual SS (PRESS)	1.62193




Residuals for y
0.4
0.2
0.0
-0.2
-0.4
Residual
4
6
8
x


Fit Plot for y
20
15
10
5
0
y
4
6
8
x
Observations 20
Parameters 2
Error DF 18
MSE 0.0743
R-Square 0.9981
Adj R-Square 0.998
Fit
99% Confidence Limits
99% Prediction Limits

The REG Procedure
Model: MODEL1
Dependent Variable: x

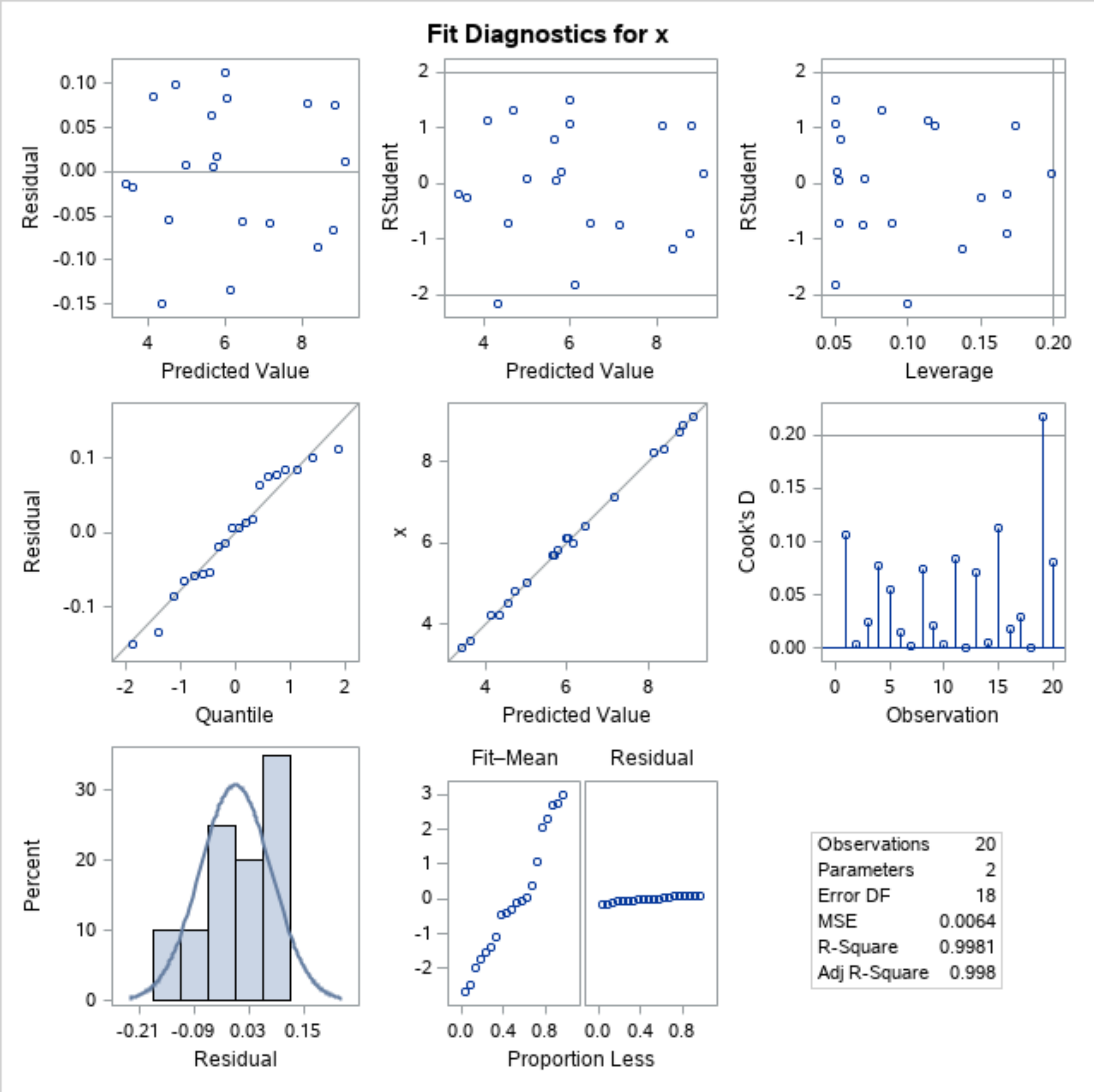
Number of Observations Read	20
Number of Observations Used	20

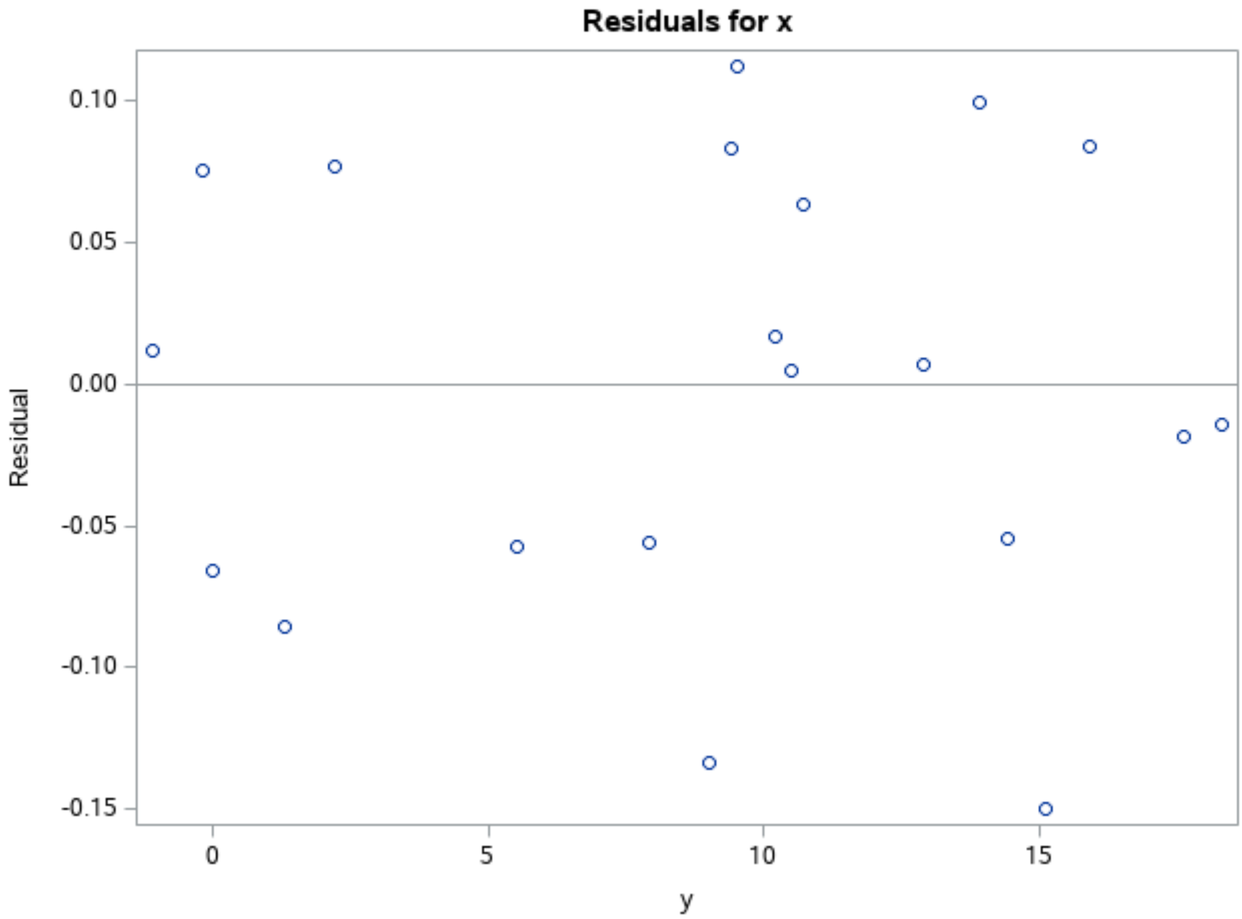
Analysis of Variance					
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	60.46333	60.46333	9490.75	<.0001
Error	18	0.11467	0.00637		
Corrected Total	19	60.57800			

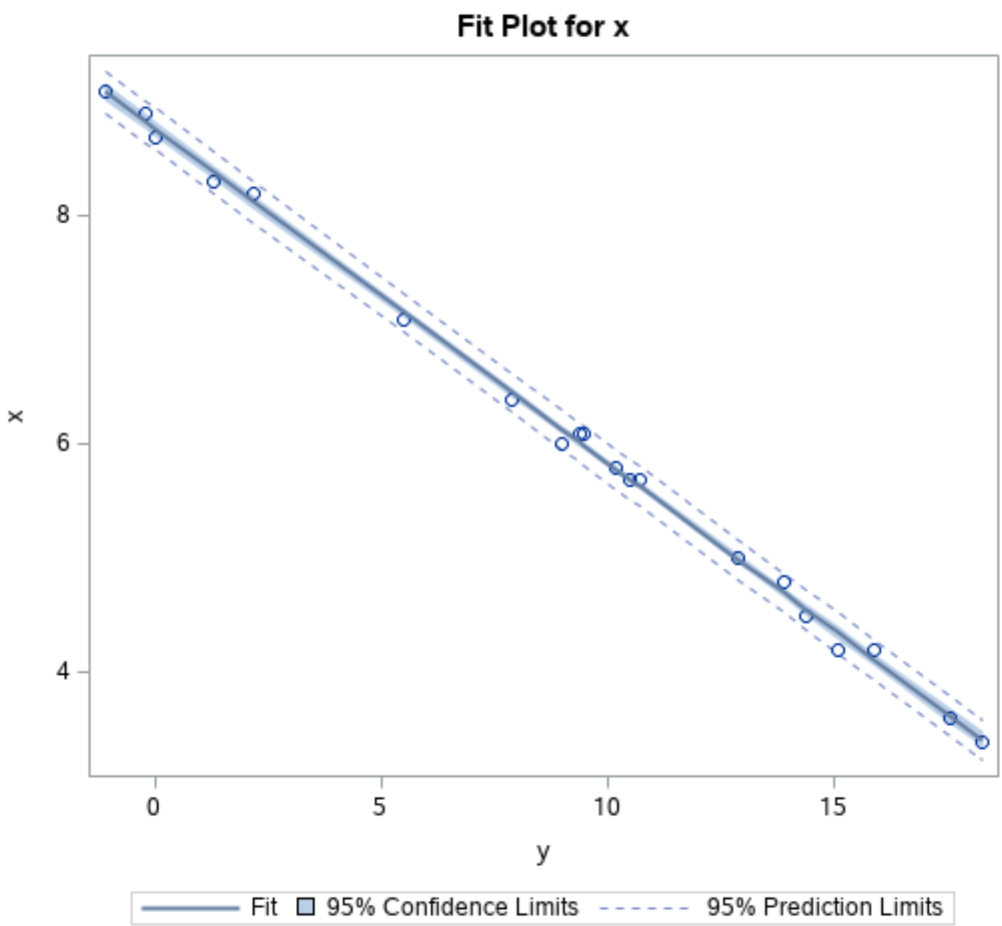
Root MSE	0.07982	R-Square	0.9981
Dependent Mean	6.09000	Adj R-Sq	0.9980
Coeff Var	1.31062		

Parameter Estimates					
Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	8.76614	0.03276	267.60	<.0001
y	1	-0.29247	0.00300	-97.42	<.0001

The REG Procedure
Model: MODEL1
Dependent Variable: x


Fit Diagnostics for x
Residual
Predicted Value
RStudent
Predicted Value
RStudent
Leverage
Residual
Quantile
x
Predicted Value
Cook's D
Observation
Percent
Residual
Fit–Mean
Residual
Proportion Less
Observations 20
Parameters 2
Error DF 18
MSE 0.0064
R-Square 0.9981
Adj R-Square 0.998





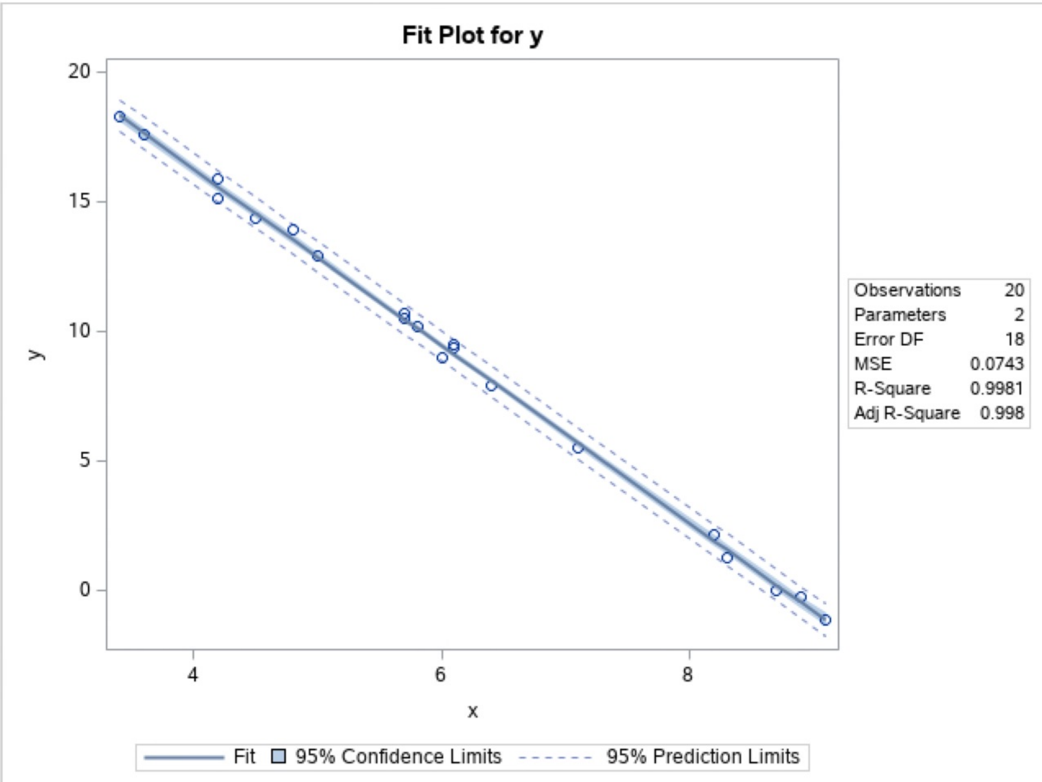
Observations	20
Parameters	2
Error DF	18
MSE	0.0064
R-Square	0.9981
Adj R-Square	0.998

1. (2 points) Fit the data to a simple linear regression model, find the least squares point estimates for β_0, β_1.

$\beta_0 = 29.9329$, $\beta_1 = -3.4126$

$\hat{y}_i = 29.9329 - 3.4126 x_i$

2. (1 points) Plot of the data with the regression line.



3. (4 points) Find $SS_T, SS_R, SS_{Res}, \hat{\sigma}^2$.

$SS_T = 706.8300$ $SS_R = 705.4920$

$SS_{Res} = 1.33802$ $\hat{\sigma}^2 = MS_{Res} = 0.0743$

4. (2 points) Find the 99% confidence intervals for β_0, β_1.

β_0 : $(29.2942, 30.5715)$

β_1 : $(-3.5135, -3.3118)$

5. (3 points) Apply a t-test to test $H_0 : \beta_1 = 0$, $H_a : \beta_1 \neq 0$. Specify the test statistic's value and P-value, and make conclusion.

6. (3 points) Apply a t-test to test $H_0 : \beta_0 = 0$, $H_a : \beta_0 \neq 0$. Specify the test statistic's value and P-value, and make conclusion.

$\boxed{Q5}$ $H_0 : \beta_0 = 0$, $H_a : \beta_0 \neq 0$

Test statistics : $t = 134.91$

P-value < 0.0001

P–value < 0.0001 < alpha = 0.01 (given), so we reject the null hypothesis, and conclude that x and y has a significant linear relations.

$\boxed{Q6}$ $H_0 : \beta_1 = 0$, $H_a : \beta_1 \neq 0$

$t = -97.42$

P-value < 0.0001

P–value < 0.0001 < alpha = 0.01 (given), so we reject the null hypothesis, and conclude that x and y has a significant linear relations.

7. (3 points) Find the prediction value, 99% confidence interval, and 99% prediction interval for y, given $x = 7.1$.

$x_q = 7.1$, $y_q = 5.5$

Predicted value = 5.7032
99% CI Mean = (5.5004, 5.9061)
99% PI = (4.8927, 6.5138)

8. (1 points) Find the simple coefficient of determination.

R–square = 0.9981

9. (3 points) Apply a F-test to test $H_0 : \beta_1 = 0, \ \ H_a : \beta_1 \neq 0$. Specify the test statistic's value and P-value and make conclusion.

F Value = 9490.75

Pr > F = < 0.0001

Since the P–value is less than alpha = 0.01, we reject the null hypothesis and conclude that the model is a good fit, there is a significant linear relation between x and y.

standard error for β_0

10. (2 points) Find the value of $\hat{\sigma}\sqrt{c_{00}}, \hat{\sigma}\sqrt{c_{11}}$.

$\hat{\sigma}\sqrt{c_{00}} = 0.22187$

$\hat{\sigma}\sqrt{c_{11}} = 0.03503$

e_i

11. (1 points) Find $\hat{\sigma}\sqrt{h_{00}}$ and residual for $x = 7.1$.

Std Error Mean Predict

$\hat{\sigma}\sqrt{h_{00}} = 0.0705$, $e_9 = -0.2032$

12. (1 points) Compare the test statistics' value in 5 and 9, what is the relation between these two values?

$t = -97.42$, $F(\text{model}) = 9490$

$t^2 = (-97.42)^2 = 9490 = F(\text{model})$