1

a)

### Modelo0 ###

Call:

lm(formula = y ~ x1 + x2 + x3)

Residuals:

Min 1Q Median 3Q Max

-2.18830 -1.11934 0.05199 0.93253 2.63837

Coefficients:

Estimate Std. Error t value Pr(>|t|)

(Intercept) 16.63030 6.85517 2.426 0.0249 \*

x1 -0.05114 0.47656 -0.107 0.9156

x2 -0.22667 0.28274 -0.802 0.4322

x3 0.53352 0.39872 1.338 0.1959

---

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

Residual standard error: 1.549 on 20 degrees of freedom

Multiple R-squared: 0.1161, Adjusted R-squared: -0.0165

F-statistic: 0.8756 on 3 and 20 DF, p-value: 0.4703

> anova(modelo0)

Analysis of Variance Table

Response: y

Df Sum Sq Mean Sq F value Pr(>F)

x1 1 0.464 0.4641 0.1935 0.6647

x2 1 1.541 1.5413 0.6427 0.4322

x3 1 4.294 4.2941 1.7905 0.1959

Residuals 20 47.965 2.3983

### Modelo1 ###

Call:

lm(formula = y ~ x1)

Residuals:

Min 1Q Median 3Q Max

-2.7471 -1.2232 0.1064 1.0232 3.3157

Coefficients:

Estimate Std. Error t value Pr(>|t|)

(Intercept) 19.2343 6.4563 2.979 0.00692 \*\*

x1 -0.2036 0.4673 -0.436 0.66733

---

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

Residual standard error: 1.564 on 22 degrees of freedom

Multiple R-squared: 0.008553, Adjusted R-squared: -0.03651

F-statistic: 0.1898 on 1 and 22 DF, p-value: 0.6673

> anova(modelo1)

Analysis of Variance Table

Response: y

Df Sum Sq Mean Sq F value Pr(>F)

x1 1 0.464 0.46414 0.1898 0.6673

Residuals 22 53.801 2.44549

### Modelo2 ###

Call:

lm(formula = y ~ x2)

Residuals:

Min 1Q Median 3Q Max

-2.5117 -1.2517 0.0250 0.9117 3.1617

Coefficients:

Estimate Std. Error t value Pr(>|t|)

(Intercept) 16.9917 0.7740 21.952 <2e-16 \*\*\*

x2 -0.2267 0.2826 -0.802 0.431

---

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

Residual standard error: 1.548 on 22 degrees of freedom

Multiple R-squared: 0.0284, Adjusted R-squared: -0.01576

F-statistic: 0.6432 on 1 and 22 DF, p-value: 0.4311

> anova(modelo2)

Analysis of Variance Table

Response: y

Df Sum Sq Mean Sq F value Pr(>F)

x2 1 1.541 1.5413 0.6432 0.4311

Residuals 22 52.724 2.3965

### Modelo3 ###

Call:

lm(formula = y ~ x3)

Coefficients:

(Intercept) x3

15.3375 0.5437

> summary(modelo3)

Call:

lm(formula = y ~ x3)

Residuals:

Min 1Q Median 3Q Max

-2.1688 -1.2531 0.2031 0.7500 2.7313

Coefficients:

Estimate Std. Error t value Pr(>|t|)

(Intercept) 15.3375 0.8104 18.926 4.21e-15 \*\*\*

x3 0.5437 0.3751 1.449 0.161

---

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

Residual standard error: 1.501 on 22 degrees of freedom

Multiple R-squared: 0.08718, Adjusted R-squared: 0.04568

F-statistic: 2.101 on 1 and 22 DF, p-value: 0.1613

> anova(modelo3)

Analysis of Variance Table

Response: y

Df Sum Sq Mean Sq F value Pr(>F)

x3 1 4.731 4.7306 2.101 0.1613

Residuals 22 49.534 2.2516

### Modelo4 ###

Call:

lm(formula = y ~ x1 + x2)

Residuals:

Min 1Q Median 3Q Max

-2.6338 -1.1506 0.0129 0.9099 3.2024

Coefficients:

Estimate Std. Error t value Pr(>|t|)

(Intercept) 19.8010 6.5526 3.022 0.00649 \*\*

x1 -0.2036 0.4714 -0.432 0.67024

x2 -0.2267 0.2880 -0.787 0.44007

---

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

Residual standard error: 1.578 on 21 degrees of freedom

Multiple R-squared: 0.03696, Adjusted R-squared: -0.05476

F-statistic: 0.4029 on 2 and 21 DF, p-value: 0.6734

> anova(modelo4)

Analysis of Variance Table

Response: y

Df Sum Sq Mean Sq F value Pr(>F)

x1 1 0.464 0.46414 0.1865 0.6702

x2 1 1.541 1.54133 0.6194 0.4401

Residuals 21 52.260 2.48855

### Modelo5 ###

Call:

lm(formula = y ~ x1 + x3)

Residuals:

Min 1Q Median 3Q Max

-2.2097 -1.2327 0.1776 0.8011 2.7517

Coefficients:

Estimate Std. Error t value Pr(>|t|)

(Intercept) 16.06364 6.76038 2.376 0.0271 \*

x1 -0.05114 0.47249 -0.108 0.9148

x3 0.53352 0.39531 1.350 0.1915

---

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

Residual standard error: 1.535 on 21 degrees of freedom

Multiple R-squared: 0.08769, Adjusted R-squared: 0.0007981

F-statistic: 1.009 on 2 and 21 DF, p-value: 0.3815

> anova(modelo5)

Analysis of Variance Table

Response: y

Df Sum Sq Mean Sq F value Pr(>F)

x1 1 0.464 0.4641 0.1969 0.6618

x3 1 4.294 4.2941 1.8215 0.1915

Residuals 21 49.507 2.3575

### Modelo6 ###

Call:

lm(formula = y ~ x2 + x3)

Residuals:

Min 1Q Median 3Q Max

-2.20875 -1.13979 0.04687 0.88906 2.61792

Coefficients:

Estimate Std. Error t value Pr(>|t|)

(Intercept) 15.9042 1.0690 14.878 1.26e-12 \*\*\*

x2 -0.2267 0.2760 -0.821 0.421

x3 0.5437 0.3779 1.439 0.165

---

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

Residual standard error: 1.512 on 21 degrees of freedom

Multiple R-squared: 0.1156, Adjusted R-squared: 0.03135

F-statistic: 1.372 on 2 and 21 DF, p-value: 0.2754

> anova(modelo6)

Analysis of Variance Table

Response: y

Df Sum Sq Mean Sq F value Pr(>F)

x2 1 1.541 1.5413 0.6744 0.4207

x3 1 4.731 4.7306 2.0699 0.1650

Residuals 21 47.993 2.2854

b) Ao comparar os modelos, é possível visualizar que nenhuma das variáveis tem significância nos modelos, mais, ao analisar modelo por modelo, temos que o modelo que possui a variável independente x3(Fertilizante) tem o melhor valor para o R² ajustado (0.04568) além do valor da soma de quadrados do x3 neste modelo estar maior que a do mesmo em outros modelos.

2

Call:

lm(formula = y ~ x1 + x2 + x3 + x4)

Residuals:

Min 1Q Median 3Q Max

-18.758 -9.952 3.350 6.627 23.311

Coefficients:

Estimate Std. Error t value Pr(>|t|)

(Intercept) -102.71324 207.85885 -0.494 0.636

x1 0.60537 0.36890 1.641 0.145

x2 8.92364 5.30052 1.684 0.136

x3 1.43746 2.39162 0.601 0.567

x4 0.01361 0.73382 0.019 0.986

Residual standard error: 15.58 on 7 degrees of freedom

Multiple R-squared: 0.7447, Adjusted R-squared: 0.5989

F-statistic: 5.106 on 4 and 7 DF, p-value: 0.0303

> anova(modelo0)

Analysis of Variance Table

Response: y

Df Sum Sq Mean Sq F value Pr(>F)

x1 1 3758.9 3758.9 15.4869 0.005637 \*\*

x2 1 1109.4 1109.4 4.5707 0.069850 .

x3 1 88.9 88.9 0.3661 0.564207

x4 1 0.1 0.1 0.0003 0.985721

Residuals 7 1699.0 242.7

---

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

a) Ao analisar os dados, percebe-se que nenhuma das variáveis é significativa

a ponto de ter correlação e o R² ajustado não está com um valor tão bom, que seria próximo de 1. Ao analisar a tabela ANOVA percebe-se que a variável x1 tem a soma de quadrados

com valor bom, x2 tem um valor um pouco mais a baixo do x1, mais, ainda assim, aceitável.

E que as demais não são significantes para o conjunto de dados, pois suas respectivas somas de quadrados estão muito a baixo de x1 e x2. Levando em conta só dados vistos, é possível afirmar que este não é um bom modelo.

b) x1 = 75, x3 = 24, x3 = 90, x4 = 98

y = -102,7132 + 0,6053B1 + 8,9236B2 + 1,4374B3 + 0,0136B4

y = -102,7132 + 0,6053\*75 + 8,9236\*24 + 1,4374\*90 + 0,0136\*98

y = -102,7132 + 45,3975 + 214,1664 + 129,366 + 1,3328

y = 287,5495

3

a)

### Modelo0 ###

Call:

lm(formula = y ~ x1 + x2 + x3 + x4 + x5 + x6)

Residuals:

Min 1Q Median 3Q Max

-16.440 -11.141 -0.331 9.506 22.836

Coefficients:

Estimate Std. Error t value Pr(>|t|)

(Intercept) 41.603259 19.467121 2.137 0.043449 \*

x1 0.086041 0.020770 4.142 0.000395 \*\*\*

x2 -0.005560 0.018782 -0.296 0.769868

x3 -0.049560 0.034959 -1.418 0.169697

x4 0.189131 0.069930 2.705 0.012647 \*

x5 0.004261 0.002177 1.958 0.062494 .

x6 0.002198 0.012803 0.172 0.865194

---

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

Residual standard error: 12.83 on 23 degrees of freedom

Multiple R-squared: 0.5298, Adjusted R-squared: 0.4071

F-statistic: 4.319 on 6 and 23 DF, p-value: 0.004645

> anova(modelo0)

Analysis of Variance Table

Response: y

Df Sum Sq Mean Sq F value Pr(>F)

x1 1 2224.1 2224.11 13.5063 0.001256 \*\*

x2 1 0.7 0.69 0.0042 0.948919

x3 1 155.0 154.99 0.9412 0.342055

x4 1 1256.4 1256.36 7.6294 0.011092 \*

x5 1 626.4 626.39 3.8038 0.063425 .

x6 1 4.9 4.85 0.0295 0.865194

Residuals 23 3787.5 164.67

---

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

### Modelo1 ###

modelo1 = lm(y~x1+x4+x5)

summary(modelo1)

anova(modelo1)

### Modelo2 ###

Call:

lm(formula = y ~ x1 + x4)

Residuals:

Min 1Q Median 3Q Max

-16.517 -9.673 -3.131 8.020 31.343

Coefficients:

Estimate Std. Error t value Pr(>|t|)

(Intercept) 69.29203 12.61097 5.495 8.09e-06 \*\*\*

x1 0.05849 0.01371 4.266 0.000218 \*\*\*

x4 0.17759 0.07002 2.536 0.017295 \*

---

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

Residual standard error: 13.21 on 27 degrees of freedom

Multiple R-squared: 0.4154, Adjusted R-squared: 0.3721

F-statistic: 9.593 on 2 and 27 DF, p-value: 0.0007121

> anova(modelo2)

Analysis of Variance Table

Response: y

Df Sum Sq Mean Sq F value Pr(>F)

x1 1 2224.1 2224.1 12.753 0.00136 \*\*

x4 1 1121.9 1121.9 6.433 0.01730 \*

Residuals 27 4708.8 174.4

---

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

### Modelo3 ###

Call:

lm(formula = y ~ x1)

Residuals:

Min 1Q Median 3Q Max

-19.115 -9.068 -2.244 6.213 47.103

Coefficients:

Estimate Std. Error t value Pr(>|t|)

(Intercept) 94.27110 8.60717 10.953 1.24e-11 \*\*\*

x1 0.04530 0.01386 3.268 0.00286 \*\*

---

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

Residual standard error: 14.43 on 28 degrees of freedom

Multiple R-squared: 0.2761, Adjusted R-squared: 0.2503

F-statistic: 10.68 on 1 and 28 DF, p-value: 0.002864

> anova(modelo3)

Analysis of Variance Table

Response: y

Df Sum Sq Mean Sq F value Pr(>F)

x1 1 2224.1 2224.11 10.681 0.002864 \*\*

Residuals 28 5830.7 208.24

---

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

b) Comparando os possíveis modelos para estes dados, vemos que algumas variáveis não são significantes para alguns modelos, mais, o modelo que possui os melhores valores de soma de quadrados, melhores médias de quadrados e o melhor valor do R² ajustado ainda é o modelo com todas as variáveis.