http://www.stat.ucla.edu/~dinov/courses_students.dir/12/Winter/STAT13.1.dir/HWs.dir/HW07.html

STAT 13, section 1, Winter 2012, UCLA Statistics
HW 7; Problem Solution

7.1

$$\hat{b} = \frac{\sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y})}{\sum_{i=1}^{n}(x_i - \bar{x})^2} = \frac{(0-30)(0.02-0.83)+(10-30)(0.25-0.83)+\cdots+(60-30)(1.74-0.83)}{(0-30)^2+(10-30)^2+\cdots+(60-30)^2}$$

$$= 0.02925$$

$$\hat{a} = \bar{y} - \hat{b}\bar{x} = 0.83 - 0.02925*30 = -0.0475$$

$$\boxed{\hat{y} = -0.0475 + 0.02925x}$$

Mean of Time = 30.000
Mean of Leucine = .830

Regression Line:
Leucine = -.047 + 0.02924999999999999 Time

Correlation(Time, Leucine) = .993
R-Square = .986

Intercept:
Parameter Estimate: -.047
Standard Error: .057
T-Statistics: -.831
P-Value: .444

Slope:
Parameter Estimate: .029
Standard Error: .002
T-Statistics: 18.440
P-Value: .000

Time	Leucine	Predicted	Residual
.000	.020	-.047	.067
10.000	.250	.245	.005
20.000	.540	.538	.002
30.000	.690	.830	-.140
40.000	1.070	1.122	-.052
50.000	1.500	1.415	.085
60.000	1.740	1.707	.033

The SOCR result matches up very closely with the regression line calculated by hand.

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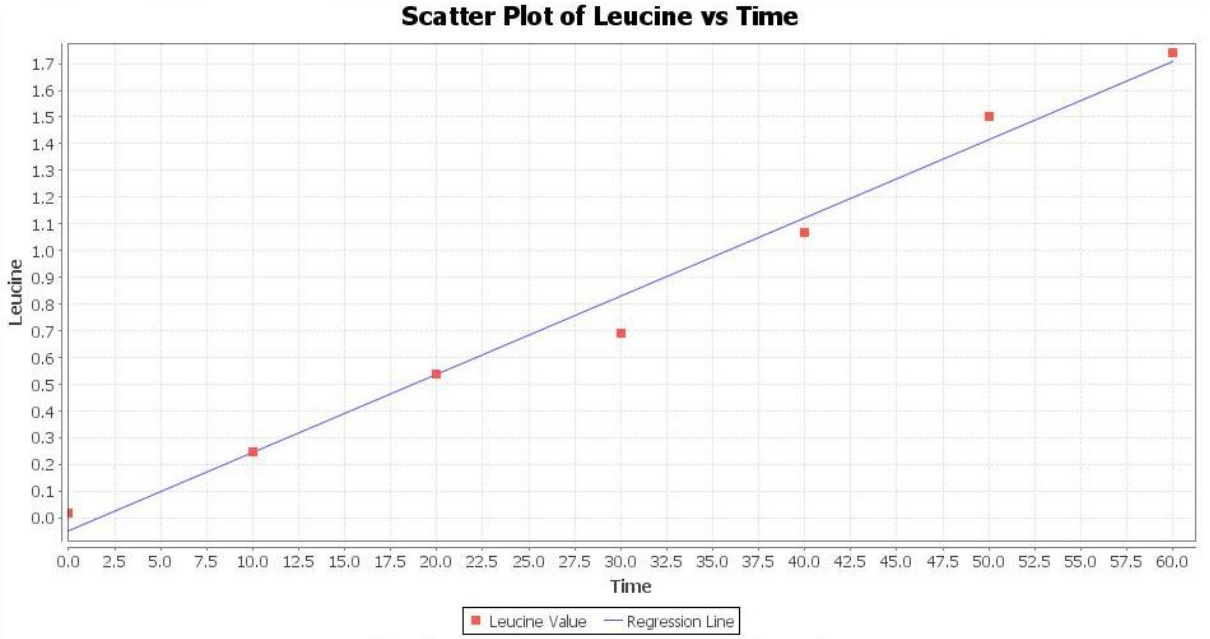

The amount of leucine is predicted to increase by 0.02925 units for every additional minute.

$$sd(e) = \sqrt{\frac{\sum_{i=1}^{n}(y_i - \hat{y}_i)^2}{n-2}} = \sqrt{\frac{\sum_{i=1}^{n}[y_i - (\hat{a} + \hat{b}x_i)]^2}{n-2}}$$
$$= \sqrt{\frac{(0.02-(-0.047))^2 + (0.25-0.245)^2 + \cdots + (1.74-1.707)^2}{7-2}} = 0.08393$$

(Because we're estimating two parameters, the degrees of freedom is now n - 2.)

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7.2

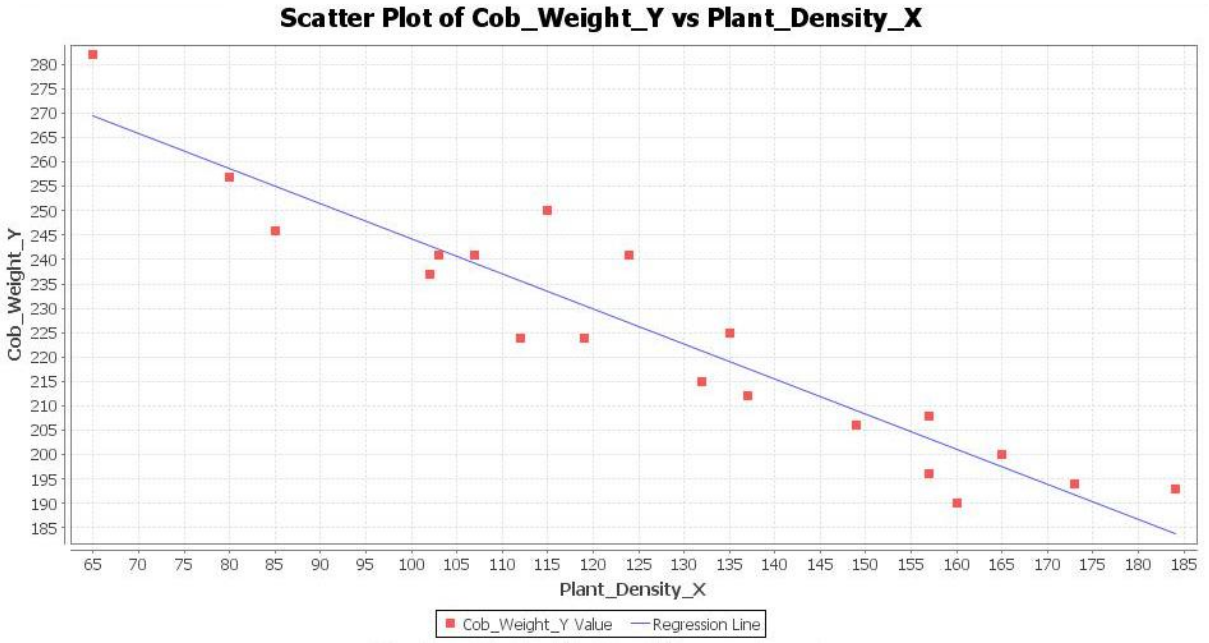
Simple Linear Regression Results:

Mean of Plant_Density_X = 128.050
Mean of Cob_Weight_Y = 224.100

Regression Line:
Cob_Weight_Y = 316.376 -0.7206262571781327 Plant_Density_X

Correlation(Plant_Density_X, Cob_Weight_Y) = -.942
R-Square = .887

$\hat{y} = 316.376 - 0.7206x$



Slope: For each additional plant in a plot, the predicted mean cob weight will drop by 0.72 grams.
Intercept: In the context of this problem, it doesn't make sense to talk about cob weight when there are zero plants in a plot.
Correlation: This is very close to -1, meaning these two variables are very highly correlated. As the number of plants in a plot goes up, the mean cob weight decreases.

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7.3

Independent Variable = Type
Dependent Variable = Sodium

Results of One-Way Analysis of Variance:
Standard 1-Way ANOVA Table. See:
http://wiki.stat.ucla.edu/socr/index.php/AP_Statistics_Curriculum_2007_ANOVA_1Way

Variance Source	DF	RSS	MSS	F-Statistics	P-value
Treatment Effect (B/w Groups)	2	31738.715	15869.357	1.778	0.1793246682371903
Error	51	455248.785	8926.447		
Total:	53	486987.500			

With a P-value of 0.18, there is not enough evidence to show the levels of sodium differ significantly between the different types of hot dog meat.

Independent Variable = Type
Dependent Variable = Calories

Results of One-Way Analysis of Variance:
Standard 1-Way ANOVA Table. See:
http://wiki.stat.ucla.edu/socr/index.php/AP_Statistics_Curriculum_2007_ANOVA_1Way

Variance Source	DF	RSS	MSS	F-Statistics	P-value
Treatment Effect (B/w Groups)	2	17692.195	8846.098	16.074	3.862071838667269E-6
Error	51	28067.138	550.336		
Total:	53	45759.333			

Here, however, a P-value of 3.86×10^{-6} does provide enough evidence to suggest there is a significant difference in calories among the different types of hot dog meat.

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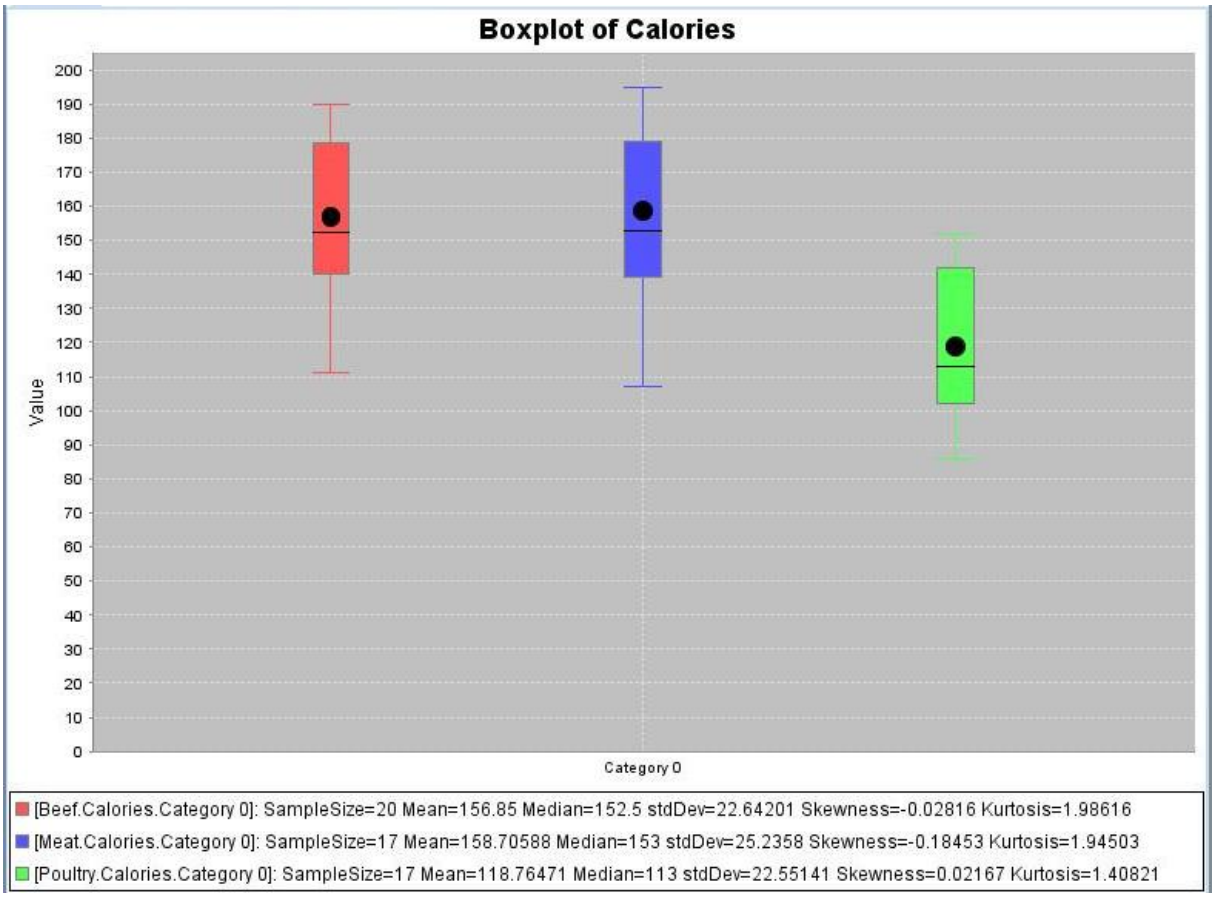

We can see from the boxplot that the calories from poultry hot dogs are significantly different from those of beef and meat hot dogs. A 2-sample t-test can then be applied between poultry and either of the other two to verify that they are significantly different.

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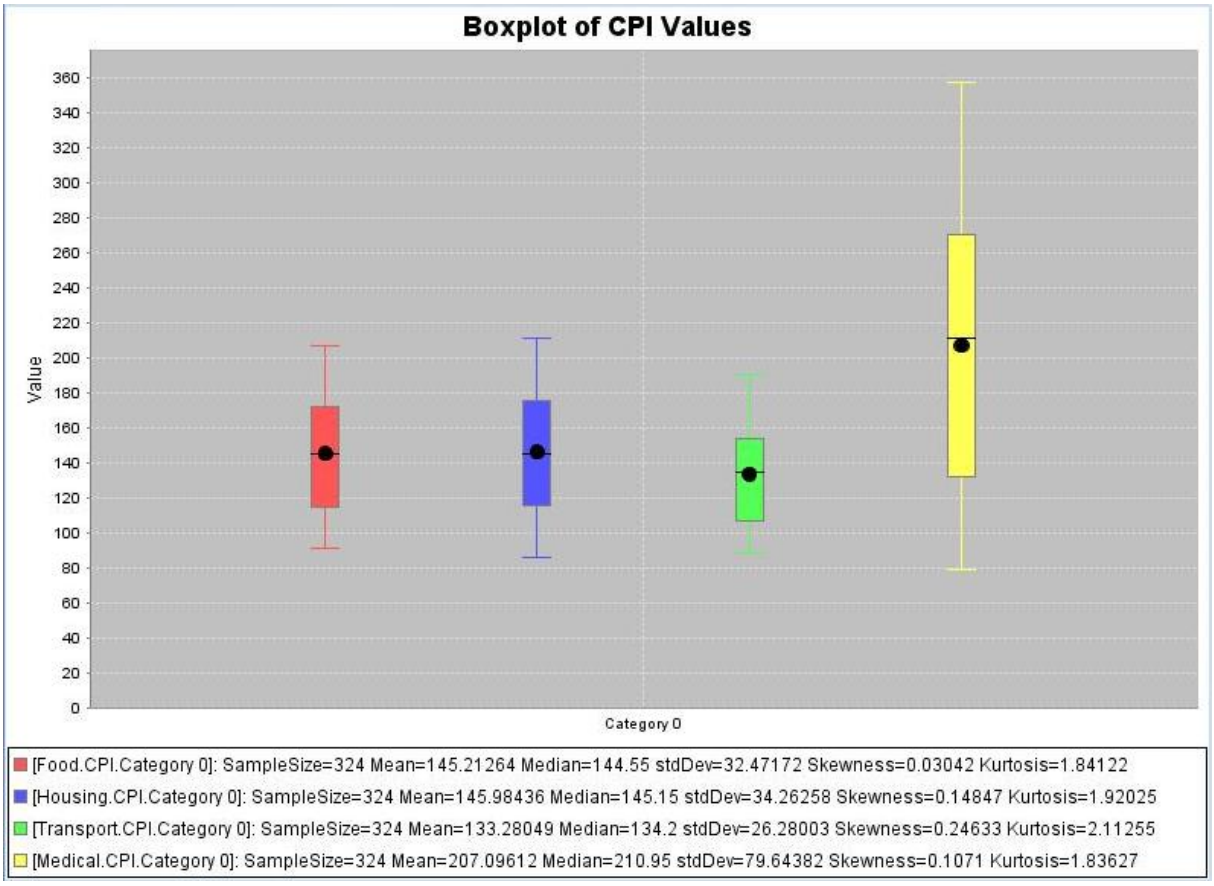
7.4

Independent Variable = CPI_Item
Dependent Variable = CPI_Value

Results of One-Way Analysis of Variance:
Standard 1-Way ANOVA Table. See:
http://wiki.stat.ucla.edu/socr/index.php/AP_Statistics_Curriculum_2007_ANOVA_1Way

Variance Source	DF	RSS	MSS	F-Statistics	P-value
Treatment Effect (B/w Groups)	3	1078702.865	359567.622	155.285	< 1E-15
Error	1292	2991663.170	2315.529		
Total:	1295	4070366.035			

A P-value of basically zero here shows that there is a significant difference of CPI-values among the various CPI items.



We can see from the boxplot that Medical Care seems to be significantly different from the other three groups. A 2-sample t-test can then be applied between Medical Care and any of the other three categories to show their CPI-values are significantly different.