Ch 12 Exercises

1. Fresh flowers?

For their second-semester project, two AP Statistics students decided to investigate the effect of sugar on the life of cut flowers. They went to the local grocery store and randomly selected 12 carnations. All the carnations seemed equally healthy when they were selected. When the students got home, they prepared 12 identical vases with exactly the same amount of water in each vase. They put one tablespoon of sugar in 3 vases, two tablespoons of sugar in 3 vases, and three tablespoons of sugar in 3 vases. In the remaining 3 vases, they put no sugar. After the vases were prepared and placed in the same location, the students randomly assigned one flower to each vase and observed how many hours each flower continued to look fresh. Here are the data and computer output.

Sugar (tbs.)	Freshness (hours)
0	168
0	180
0	192
1	192
1	204
1	204
2	204
2	210
2	210
3	222
3	228
3	234

```
Predictor       Coef          SE Coef       T       P
Constant        181.200       3.635         49.84   0.000
Sugar (tbs)     15.200        1.943         7.82    0.000

S = 7.52596     R-Sq = 86.0%    R-Sq(adj) = 84.5%
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Construct and interpret a 99% confidence interval for the slope of the true regression line.

State: Estimate β = slope of the true regression line relating hours of freshness (y) to amount of sugar (x) at 99% confidence

d

Plan:

Linear: scatterplot shows a linear pattern
no obvious curvature in residuals

Indep: Each flower has its own vase & does not impact fresh of another

Normal: histogram of residuals does not show skewness or outliers

Equal SD: no systematic pattern to the residuals
random - random assignment

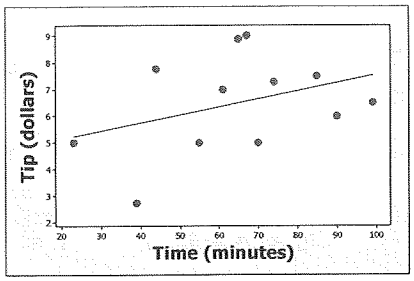
Do: $df = 10$ $t^* = 3.169$

$15.2 \pm 3.169\left(\frac{1.2}{1.943}\right) = (9.04, 21.36)$

Conclude: We are 99% confident the interval from 9.04 to 21.36 captures the slope of the true regression line relating hours of freshness (y) to amount of sugar (x)

2. *Do customers who stay longer at buffets give larger tips?*
Charlotte, an AP statistics student who worked at an Asian buffet, decided to investigate this question for her second semester project. While she was doing her job as a hostess, she obtained a random sample of receipts, which included the length of time (in minutes) the party was in the restaurant and the amount of the tip (in dollars). Do these data provide convincing evidence that customers who stay longer give larger tips?

Time (minutes)	Tip (dollars)
23	5.00
39	2.75
44	7.75
55	5.00
61	7.00
65	8.88
67	9.01
70	5.00
74	7.29
85	7.50
90	6.00
99	6.50



(a) Here is a scatterplot of the data with the least-squares regression line added. Describe what this graph tells you about the relationship between the two variables.

weak positive linear association. w/ one potential outlier (44, 7.75)

More Minitab output from a linear regression analysis on these data is shown below.

```
Predictor          Coef  SE Coef      T      P
Constant          4.535    1.657   2.74  0.021
Time (minutes)  0.03013  0.02448   1.23  0.247

S = 1.77931   R-Sq = 13.2%   R-Sq(adj) = 4.5%
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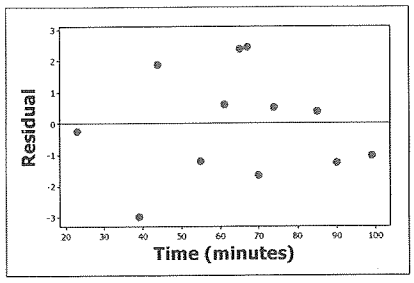
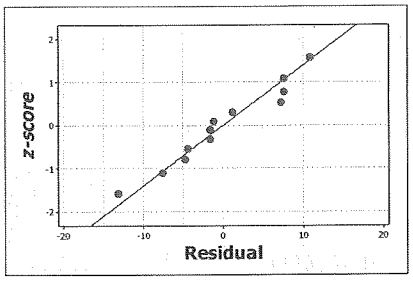
$\hat{tip} = 4.535 + .03013(time)$





y-intercept
If you spent 0 min at the Buffet the predicted tip would still be $4.54

Slope - the tip is predicted to increase by $.03 for each additional min at the buffet

(b) What is the equation of the least-squares regression line for predicting the amount of the tip from the length of the stay? Define any variables you use.

(c) Interpret the slope and y intercept of the least-squares regression line in context.

(d) Carry out an appropriate test to answer Charlotte's question.

State: $H_0: \beta = 0$ $H_a: \beta > 0$ β = true slope of the regression line relating length of stay at buffet (y) to tip amount (x)

Plan t test for β

Linear: weak positive linear association in Scatterplot. Residual Plot appears randomly scattered about residual = 0

Indep - more than 120 reciepts & assume one tip doesn't influence the next

Normal - normal prob plot roughly linear

Equal SD - fairly equal scatter around residual = 0 line in residual plot

Randomly select reciepts

Do: $t = 1.23$ $pval = \frac{.247}{2} = .1235$ $df = 10$

Conclude: $pval > \alpha = .05$, Fail to Reject

We don't have convincing evidence that parties who stay longer at buffets tip more.

★ Computer printouts give 2 sided pvalues! ★