## Regression Analyses

## Linear Models

1. Joe works for a landscaping company. He is cutting lengths of plastic edging for flower beds. For circular beds, he knows the desired diameter of the bed and must cut the correct length of edging to fit around the perimeter of the circle. His boss supplied him with this table.

| Diameter (m) | Length of Edging (m) |
| :---: | :---: |
| 1 | 3.14 |
| 2 | 6.28 |
| 3 | 9.42 |
| 4 | 12.57 |
| 5 | 15.71 |
| 6 | 18.85 |
| 7 | 21.99 |
| 8 | 25.13 |

a. Explain how you can tell that there is a linear relationship from the table of values.
b. Enter the data into your TI-83 calculator and perform a linear regression. What is the regression equation? Explain what each variable represents!
c. What is the $r^{2}$ value? What is the percent confidence of this model?
d. Use your regression equation to determine the length of edging required for a flower bed with a diameter of 37 m .
e. Is your regression equation familiar? Where have you seen it before?
2. Women tend to be under-represented in some occupations such as the construction trades. The table shows the number of females completing apprenticeships in the Canadian construction trades from 1991 to 2005.

| Year | Number of Female <br> Apprenticeship Completions |
| :---: | :---: |
| 1991 | 20 |
| 1992 | 25 |
| 1993 | 30 |
| 1994 | 45 |
| 1995 | 30 |
| 1996 | 40 |
| 1997 | 35 |
| 1998 | 30 |
| 1999 | 30 |
| 2000 | 25 |
| 2001 | 15 |
| 2002 | 30 |
| 2003 | 50 |
| 2004 | 50 |
| 2005 | 45 |

a. Does the table show an increasing, decreasing or constant trend? Give a reason.
b. Let 1991 be year 0. Perform a linear regression on the data. What is the regression equation? Explain what each variable represents.
c. What is the $r^{2}$ value? What is the percent confidence of this model?
d. Use your equation to predict the number of female apprenticeships in 2014.
e. Use your equation to predict the number of female apprenticeships in 1983. Do you think this model does a good job of predicting the past? Explain.

## Regression Analyses

## Quadratic Models

1. The Acme Container Company makes cylindrical plastic storage containers with a fixed height of 1.5 m . The radius of each container and its volume are shown in the table.

| Radius (cm) | Volume $\left(\mathbf{m}^{\mathbf{3}}\right)$ |
| :---: | :---: |
| 50 | 1.18 |
| 75 | 2.65 |
| 100 | 4.71 |
| 125 | 7.36 |
| 150 | 10.60 |

a. Explain how you can tell that there is a quadratic relationship from the table of values.
b. Perform a quadratic regression on the data. What is the regression equation? Explain what each variable represents.
c. What is the $r^{2}$ value? What is the percent confidence of this model?
d. Use your equation to determine the volume of a container with a radius of 300 cm .
e. Why is the answer to the previous question not simply twice the volume of a container with radius 150 cm ? How do the volumes of the two containers relate?
f. The volume of a cylinder is $V=\pi r^{2} h$. Use the information provided in the question to show that the table is correct.
2. The two decades from 1950 to 1970 saw a greater than normal number of births in Canada. This was known as the "Baby Boom". Data for the Baby Boom are shown in the table.

| Year | Number of Births |
| :---: | :---: |
| 1950 | 372,009 |
| 1951 | 381,092 |
| 1952 | 403,559 |
| 1953 | 417,884 |
| 1954 | 436,198 |
| 1955 | 442,937 |
| 1956 | 450,739 |
| 1957 | 469,093 |
| 1958 | 470,118 |
| 1959 | 479,275 |
| 1960 | 478,551 |
| 1961 | 475,700 |
| 1962 | 469,693 |
| 1963 | 465,767 |
| 1964 | 452,915 |
| 1965 | 418,595 |
| 1966 | 387,710 |
| 1967 | 370,894 |
|  |  |

a. Based on the table of values only, explain how you can tell that a quadratic model fits the data better than a linear or exponential model without computing first or second differences.
b. Perform a quadratic regression on the data. What is the regression equation? Explain what each variable represents.
c. Use your regression equation to predict the number of births in 2014. Do you think this model does a good job of predicting into the future? Explain.

## Regression Analyses

## Exponential Models

1. Mr. Gilbert is planning to buy a used car. He searched the average selling prices for the model he wants and made a table relating selling price to the age of the vehicle.

| Age (years) | Selling Price (\$) |
| :---: | :---: |
| 0 | 21,000 |
| 1 | 17,000 |
| 2 | 13,800 |
| 3 | 11,200 |
| 4 | 9,000 |
| 5 | 7,300 |

a. Explain how you can tell that there is an exponential relationship from the table of values.
b. Determine the rate of depreciation from the table of values.
c. Perform an exponential regression on the data. What is the regression equation? Explain what each variable represents.
d. What is the $r^{2}$ value? What is the percent confidence of this model?
e. Look at your answer from part b. How does your answer relate to the equation?
f. Use your equation to determine the selling price of a 15 year old, a 30 year old and a 50 year old car of this model. Do you think the equation does a good job predicting value into the future? Explain.
2. A newspaper article claims that the cost of education at the elementary and secondary levels has been increasing exponentially in recent years. The table in the article shows the education cost index, which is a record of all spending on education adjusted to account for inflation.

| Year | Education Cost <br> Index (\$) |
| :---: | :---: |
| 1999 | 143.88 |
| 2000 | 148.31 |
| 2001 | 152.71 |
| 2002 | 156.92 |
| 2003 | 162.20 |

a. Explain how you can tell, from the table of values, that the index does not follow a linear nor a quadratic model.
b. Explain how you can tell, from the table of values, that the index likely follows an exponential model.
c. By what percent is the index increasing each year?
d. Perform an exponential regression on the data. What is the regression equation? Explain what each variable represents.
e. What is the $r^{2}$ value? What is the percent confidence of this model?
f. Use your equation to predict the value of the index in 2014.
g. Do you think the index will continue to follow this pattern? Explain.

