Chain Ladder

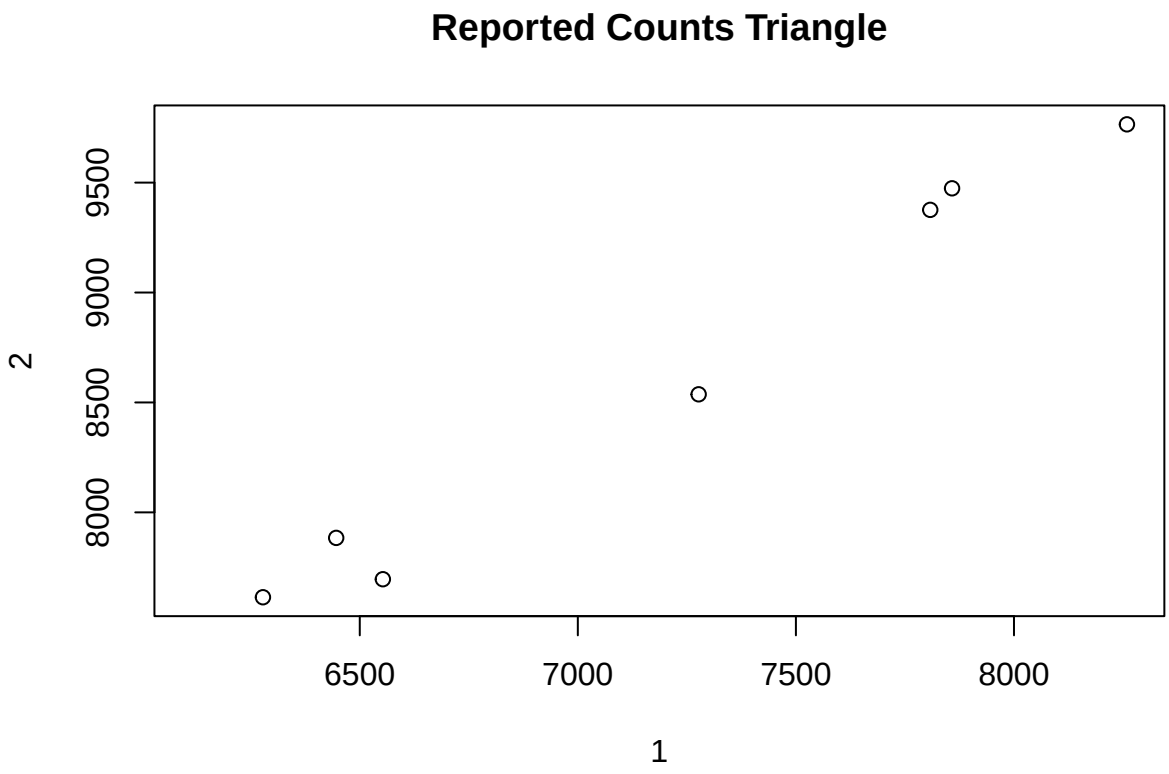
Load and Prepare Data

```
data(AutoBI)
data <- AutoBI$AutoBIReportedCounts

# Set row and column names
start_year <- 1988
rownames(data) <- seq(start_year, length.out = nrow(data))
colnames(data) <- seq_len(ncol(data))

data
```

```
##         1    2    3    4    5    6    7    8
## 1988 6553 7696 7770 7799 7814 7819 7820 7821
## 1989 7277 8537 8615 8661 8675 8679 8682   NA
## 1990 8259 9765 9884 9926 9940 9945   NA   NA
## 1991 7858 9474 9615 9664 9680   NA   NA   NA
## 1992 7808 9376 9513 9562   NA   NA   NA   NA
## 1993 6278 7614 7741   NA   NA   NA   NA   NA
## 1994 6446 7884   NA   NA   NA   NA   NA   NA
## 1995 6115   NA   NA   NA   NA   NA   NA   NA
```

Plot Reported Counts Triangle

```
plot(data, main = "Reported Counts Triangle")
```



ChainLadder Projection

```
CL <- chainladder(data)
CL$Models
```

```
## [[1]]
##
## Call:
## lm(formula = y ~ x + 0, data = data.frame(x = Triangle[, i],
##     y = Triangle[, i + 1]), weights = weights[, i]/Triangle[,
##     i]^delta[i])
##
## Coefficients:
##     x
## 1.195
##
##
## [[2]]
##
## Call:
## lm(formula = y ~ x + 0, data = data.frame(x = Triangle[, i],
##     y = Triangle[, i + 1]), weights = weights[, i]/Triangle[,
##     i]^delta[i])
##
## Coefficients:
##     x
```

```
## 1.013
##
##
## [[3]]
##
## Call:
## lm(formula = y ~ x + 0, data = data.frame(x = Triangle[, i],
##     y = Triangle[, i + 1]), weights = weights[, i]/Triangle[,
##     i]^delta[i])
##
## Coefficients:
##     x
## 1.005
##
##
## [[4]]
##
## Call:
## lm(formula = y ~ x + 0, data = data.frame(x = Triangle[, i],
##     y = Triangle[, i + 1]), weights = weights[, i]/Triangle[,
##     i]^delta[i])
##
## Coefficients:
##     x
## 1.002
##
##
## [[5]]
##
## Call:
## lm(formula = y ~ x + 0, data = data.frame(x = Triangle[, i],
##     y = Triangle[, i + 1]), weights = weights[, i]/Triangle[,
##     i]^delta[i])
##
## Coefficients:
##     x
## 1.001
##
##
## [[6]]
##
## Call:
## lm(formula = y ~ x + 0, data = data.frame(x = Triangle[, i],
##     y = Triangle[, i + 1]), weights = weights[, i]/Triangle[,
##     i]^delta[i])
##
## Coefficients:
## x
## 1
##
##
## [[7]]
##
## Call:
```

```
## lm(formula = y ~ x + 0, data = data.frame(x = Triangle[, i],
##     y = Triangle[, i + 1]), weights = weights[, i]/Triangle[,
##     i]^delta[i])
##
## Coefficients:
## x
## 1
```

Development Factors

```
link_factors <- sapply(CL$Models , function(m) coef(m)["x"])
link_factors
```

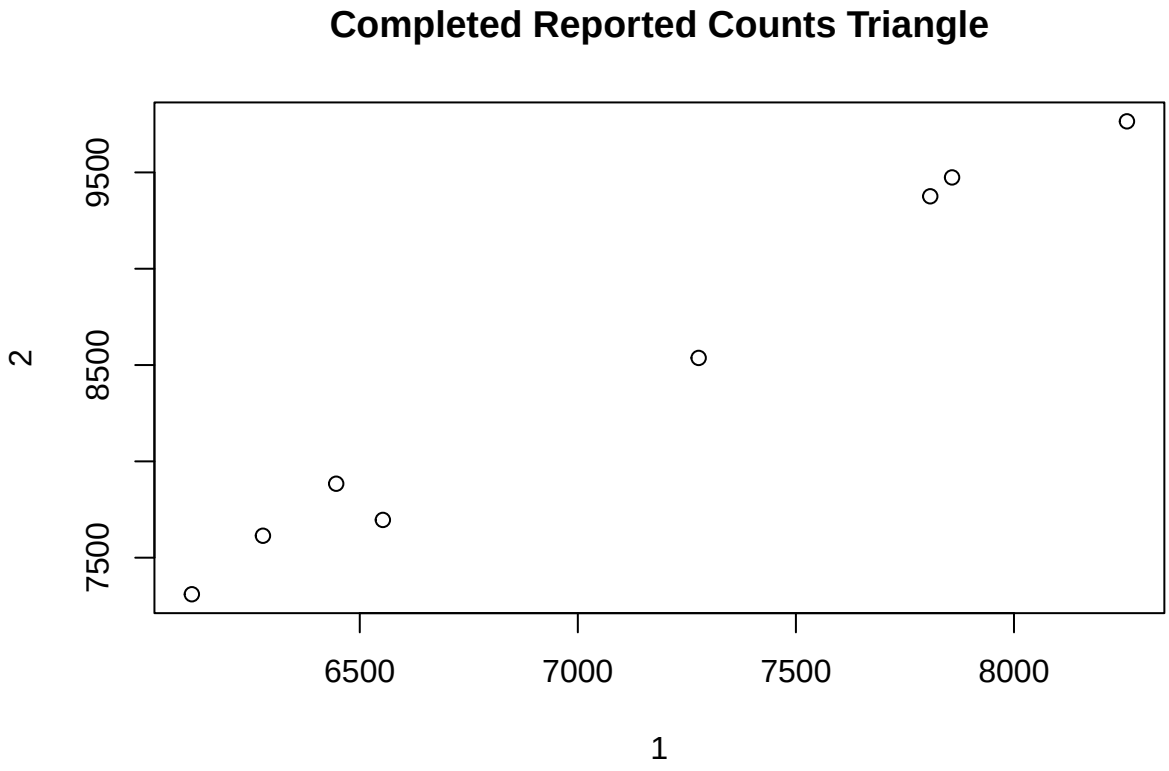
```
##        x        x        x        x        x        x        x
## 1.195467 1.012886 1.004736 1.001637 1.000530 1.000242 1.000128
```

Predict Full Triangle and Plot

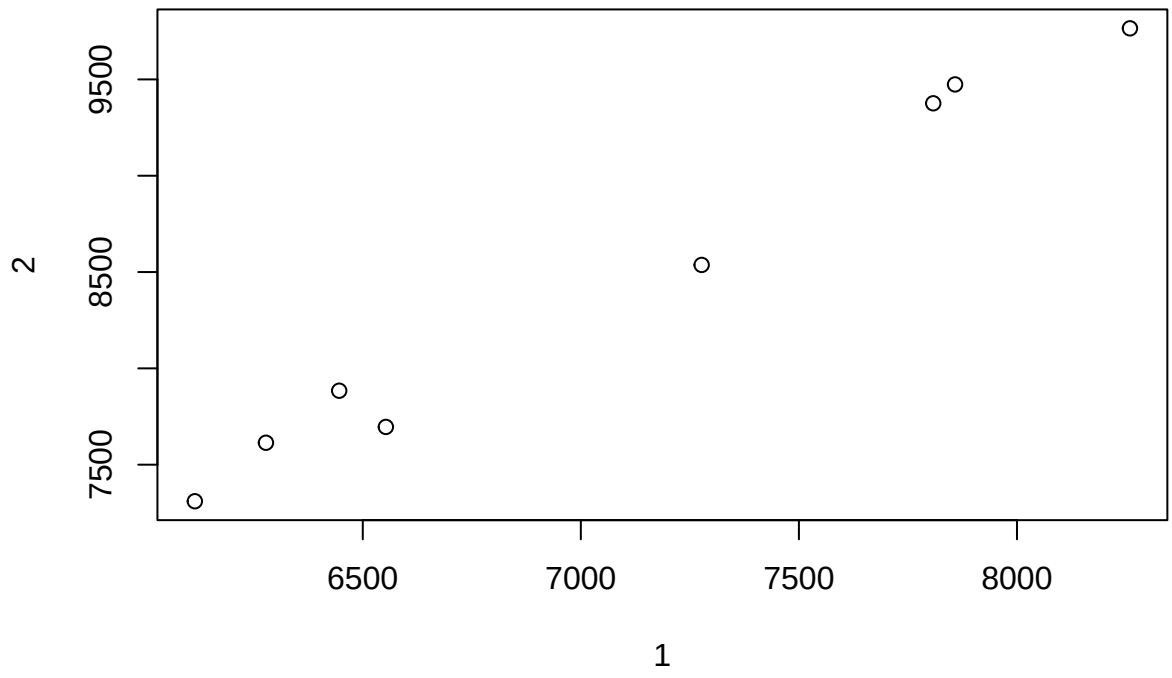
```
full_triangle <- predict(CL) ; full_triangle
```

```
##       dev
## origin    1        2        3        4        5        6        7        8
##   1988 6553 7696.000 7770.000 7799.000 7814.000 7819.000 7820.000 7821.000
##   1989 7277 8537.000 8615.000 8661.000 8675.000 8679.000 8682.000 8683.110
##   1990 8259 9765.000 9884.000 9926.000 9940.000 9945.000 9947.411 9948.683
##   1991 7858 9474.000 9615.000 9664.000 9680.000 9685.128 9687.476 9688.715
##   1992 7808 9376.000 9513.000 9562.000 9577.649 9582.723 9585.046 9586.272
##   1993 6278 7614.000 7741.000 7777.661 7790.390 7794.517 7796.407 7797.404
##   1994 6446 7884.000 7985.589 8023.409 8036.540 8040.797 8042.747 8043.776
##   1995 6115 7310.283 7404.480 7439.548 7451.723 7455.671 7457.478 7458.432
```

```
plot(full_triangle, main = "Completed Reported Counts Triangle")
```




```
plot(full_triangle)
```



Reserve Calculation

```
ultimates <- rowSums(full_triangle) ; ultimates
```

```
##     1988     1989     1990     1991     1992     1993     1994     1995
## 61092.00 67809.11 77615.09 75352.32 74590.69 60589.38 62502.86 58092.62
```

```
reported_to_date <- rowSums(data, na.rm = TRUE) ; reported_to_date
```

```
##  1988  1989  1990  1991  1992  1993  1994  1995
## 61092 59126 57719 46291 36259 21633 14330  6115
```

```
reserves <- ultimates - reported_to_date ; reserves
```

```
##     1988     1989     1990     1991     1992     1993     1994     1995
##     0.00  8683.11 19896.09 29061.32 38331.69 38956.38 48172.86 51977.62
```

```
summary_df <- data.frame(
  AccidentYear = rownames(data),
  Reported = reported_to_date,
  Ultimate = ultimates,
  Reserves = reserves
)
summary_df
```

```
##      AccidentYear Reported Ultimate Reserves
## 1988         1988    61092 61092.00     0.00
## 1989         1989    59126 67809.11  8683.11
## 1990         1990    57719 77615.09 19896.09
## 1991         1991    46291 75352.32 29061.32
## 1992         1992    36259 74590.69 38331.69
## 1993         1993    21633 60589.38 38956.38
## 1994         1994    14330 62502.86 48172.86
## 1995         1995     6115 58092.62 51977.62
```