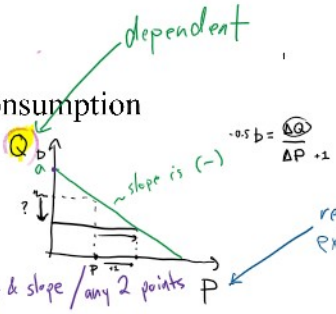
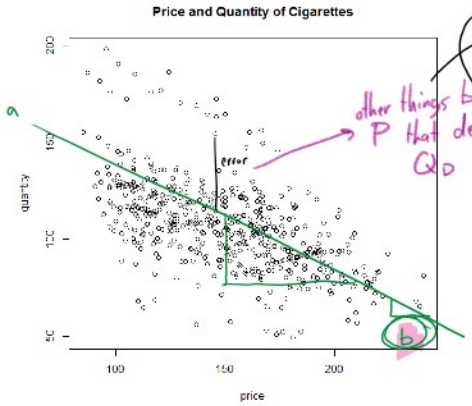
Chapter 4

Friday, January 24, 2025 10:32 AM

Cigarette Consumption



- Law of demand
- Equation? $Q_D = a + bP$ (−)
- Inverse demand
- What *defines* a line? intercept & slope / any 2 points (2 things)
- What is it about this model that is important for policy makers who are trying to reduce smoking? how much will a $1 ↑ in P reduce Q_D? b = slope
- Data: **packpc** – number of packs per capita, **avgprs** – average price during fiscal year, including sales taxes
- U.S. data from 1985-1995 (Ecdat R package, original source Jonathan Gruber)



- addiction level
- income
- availability
- demographic
- determinants of D
  - ↳ p of subst. / compl
  - ↳ expectations
  - ↳ advertising

other things besides P that determines Q_D

everything goes into ϵ

micro model : $Q_D = a + bP$

- What is the *econometric* model? $Q_D = \beta_0 + \beta_1 P + \epsilon$ ("epsilon")
- How should we *estimate* this model?
- How should we fit a *line* through the data?

linear model

random error term contains all other factors that determine Q_D

```
> summary(lm(quantity ~ price))

Call:
lm(formula = quantity ~ price)

Residuals:
     Min       1Q   Median       3Q      Max
-56.977  -9.710  -0.716   8.550  69.451

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept) 167.87737    3.79749   44.21   <2e-16 ***
price        -0.40879    0.02468  -16.56   <2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 18.76 on 526 degrees of freedom
Multiple R-squared:  0.3427,    Adjusted R-squared:  0.3415
F-statistic: 274.3 on 1 and 526 DF,  p-value: < 2.2e-16
```

b. (β_0)

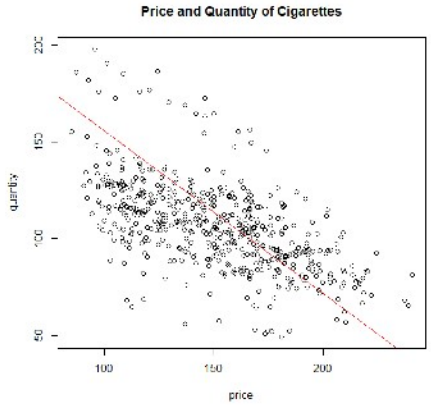
law of Demand

slope (b_1) ($\hat{\beta}_1$)

interpretation: $1 tax leads to 0.41 reduction packs/capita

Demand

Interpretation
$1 tax leads to 0.41 reduction in packs/capita



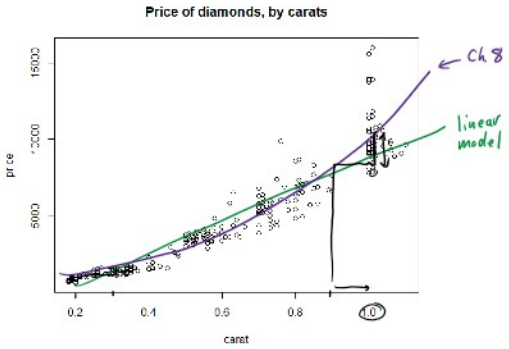
Price of Diamonds

size (carats)
clarity
colour
cut

- What determines the price of a diamond?
- How can the "model" for diamond pricing be represented in an equation?
- How is this useful?
  - ↳ Know how to price your diamond

$P = \beta_0 + \beta_1 (\text{carats}) + \epsilon$

- Data: **price** – price in Singapore $s, **carat** – weight of diamond stones in carat unit
- From 2000, $n = 308$ (Source Chu, Singfat (2001) "Pricing the C's of Diamond Stones", Journal of Statistics Education, 9(2).)



← Ch 8

linear model

$E[\epsilon] = 0$

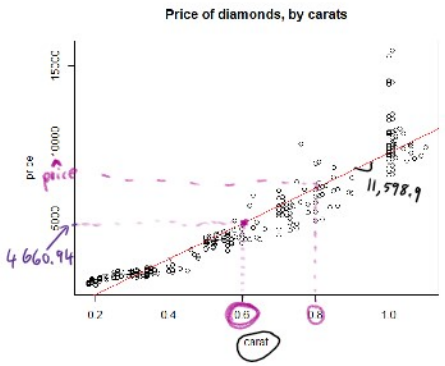

```
> summary(lm(price ~ carat))

Call:
lm(formula = price ~ carat)

Residuals:
     Min       1Q   Median       3Q      Max
-2264.7  -604.3  -116.1   435.1  6591.5

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept)  -2298.4      158.5  -14.50   <2e-16 ***
carat        11598.9      230.1   50.41   <2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 1118 on 306 degrees of freedom
Multiple R-squared:  0.8925,	Adjusted R-squared:  0.8922
F-statistic:  2541 on 1 and 306 DF,  p-value: < 2.2e-16
```

when carats ↑ by 1 ⇒ P ↑ $11,598.9

when carats ↑ by 0.1 ⇒ P ↑ by $1,159.89

$\widehat{price} = (b_0) + b_1 carats = -2298.4 + 11598.9(0.6) = \$4660.94$

↳ predicted price



Marginal Propensity to Consume MPC

- What is it? $C = a + MPC \times Y$ (consumption, income)

Underlying model → trying to estimate it's features

↳ e.g. (i) demand curve (slope)

(ii) pricing (effect of carats on price)

(iii) Now: MPC

Marginal Propensity to Consume

MPC

consumption = $C = a + MPC \times Y$ income

- What is it?
- Equation?
- Keynes said it should be less than 1 $MPC < 1$

portion of income consumed

(ii) pricing (effect of carats on price)

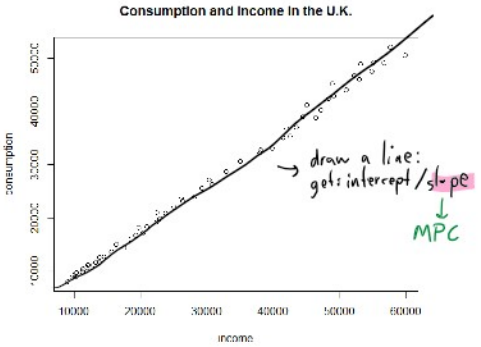
(iii) Now: MPC

↳ trying to get slope of a line

use a scatterplot of data → draw a line (choosing intercept and slope)

"Y" → regressor/explanatory

- Data: **income** - total disposable income (million Pounds, current prices), **consumption** - consumer expenditure (million Pounds, current prices) → dependent variable
- From U.K., 1971-1985 (quarterly), $n = 58$ (References Verbeek, Marno (2004) A Guide to Modern Econometrics, John Wiley and Sons, chapters 8 and 9.)



draw a line: get: intercept / slope → MPC

"linear model"

consumption = $\beta_0 + \beta_1$ income + ϵ ← population model

ϵ: all other things that def. C

```
> summary(lm(consumption ~ income))

Call:
lm(formula = consumption ~ income)

Residuals:
     Min       1Q   Median       3Q      Max
-1804.00   455.08   -57.85   388.88  2439.82

Coefficients:
```

intercept is not interesting

	Estimate	Std. Error	t value	Pr(>|t|)	
b_0 (Intercept)	1.768e+02	2.584e+02	0.684	0.497	
b_1 income	8.690e-01	7.497e-03	115.911	<2e-16	***

```
    Min      1Q  Median      3Q     Max
-1804.00  -455.08   -57.85   388.88  2439.82

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept) 1.768e+02  2.584e+02   0.684    0.497
income      8.690e-01  7.497e-03 115.911   <2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 905.3 on 56 degrees of freedom
Multiple R-squared:  0.9958,    Adjusted R-squared:  0.9958
F-statistic: 1.344e+04 on 1 and 56 DF,  p-value: < 2.2e-16
```

intercept is not interesting

b_0 b_1

$8.69 \times 10^{-1} = 0.869$

$1.768 \times 10^{2} = 176.8$

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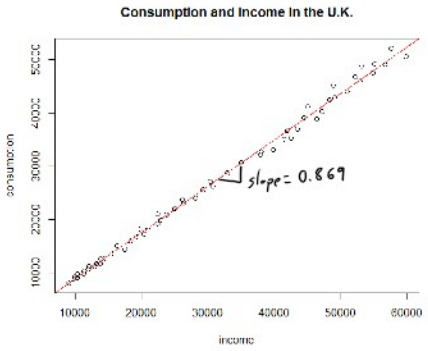

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How should we choose the line? (estimate the intercept and slope?)