CH. 4

Friday, January 24, 2025 11:26 AM

ch4-1

Cigarette Consumption

- Law of demand
- Equation? $Q_d = a + bP$
- Inverse demand
- What *defines* a line?
- What is it about this model that is important for policy makers who are trying to reduce smoking?
- 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)

dependent variable

Q_D

(-) relationship btw. P & Q_D

(-)

a

b?

intercept & slope OR any 2 points

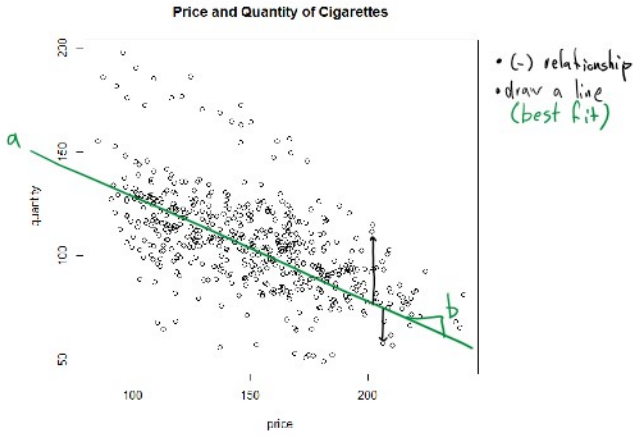
P

regressor / explanatory variable

tax to reduce smoking (also raise revenue)

1

2



- (-) relationship
- draw a line (best fit)

micro: $Q_D = a + bP$

- What is the *econometric* model? $Q_D = \beta_0 + \beta_1 P + \epsilon$
- How should we *estimate* this model? → pick intercept/slope
- How should we fit a *line* through the data? → get close to data points

"epsilon" ↓ random error term

Other things determine Q_D (besides P)

- preferences
- addiction
- demographics
- income / CPI
- P of subst./compl.
- advertising

"determinants of D"

"linear model"

```
> 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
```

↳ tilde (equal sign in model)

estimate for β_0 → called b_0

mean()
t.test()
lm()
summary()

$\frac{\Delta \text{vertical dist (Q)}}{} = -0.41$

```
---
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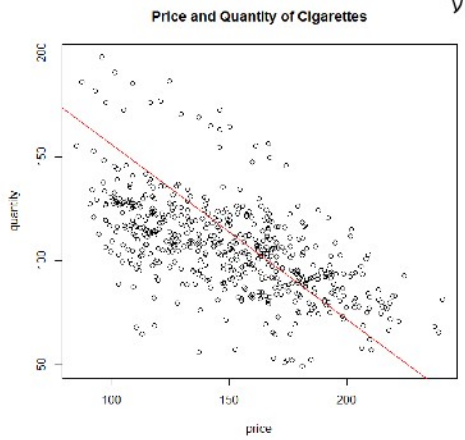
estimated slope → $b_1 = \frac{\Delta \text{ vertical dist (Q)}}{\Delta \text{ horiz. dist. (P)}} = -0.41$

interpretation?

↳ if P ↑ by 1 ⇒ Q_D ↓ by 0.41

β_1 → true unkown slope (like μ_Y)

b_1 → a # estimated in R (like $\bar{y}$)



Price of Diamonds

- What determines the price of a diamond?
- How can the “model” for diamond pricing be represented in an equation?
- How is this useful?
  ↳ store → how to P your diamond

~~quality~~
- carats (size)
- clarity
- cut
- colour

4 C's

$P = \beta_0 + \beta_1 \text{ carats} + €$

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- Data: **price** – price in Singapore Ss, **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).)

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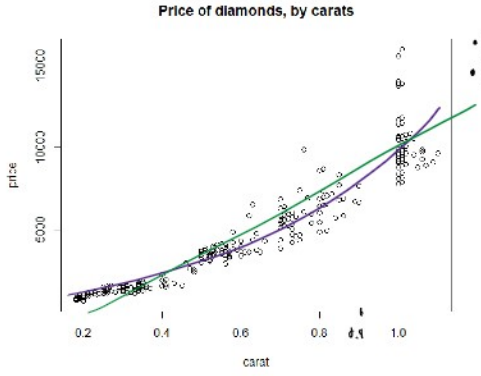

- U-shape (non-linear → Ch. 8)
- (+) relationship

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

Call:
lm(formula = price ~ carat)

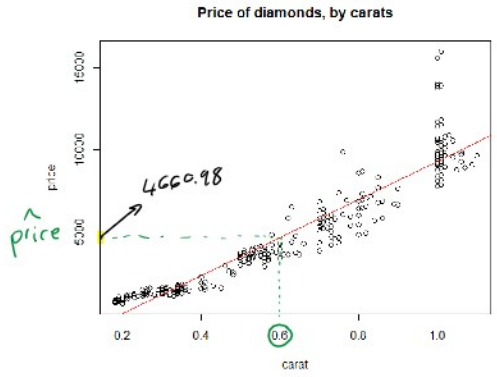
Residuals:
    Min      1Q  Median      3Q     Max
-2264.7  -604.3  -116.1   435.1  6591.5

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
```

$\hat{price} = b_0 + b_1 \cdot carats$

$= -2298.4 + 11598.9(0.6) = 4660.94$



MPC

Marginal Propensity to Consume

consumption

- What is it? Portion of income that is consumed
- Equation? $C = \alpha + MPC \times Y$ → income
- Keynes said it should be less than 1 $MPC < 1$

$C = \beta_0 + \beta_1 Y + \epsilon$

β_1 → MPC

Underlying model → trying to estimate it's features

↳ e.g. (i) demand curve (slope)

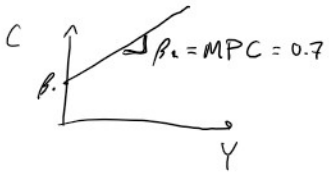
(ii) pricing (effect of carats on price → slope)

(iii) Now: MPC

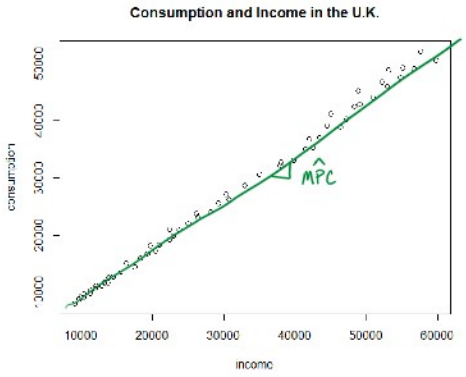
↳ trying to get slope of a line

↓

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



- Data: **income** - total disposable income (million Pounds, current prices), **consumption** - consumer expenditure (million Pounds, current prices)
- 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.)



linear model

consumption = $\beta_0 + \beta_1 \cdot$ income $+ \epsilon$

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

Call:
lm(formula = consumption ~ income)

Residuals:
     Min       1Q   Median       3Q      Max
-1804.00  -455.08   -57.85   388.88  2489.82

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
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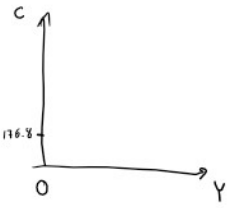
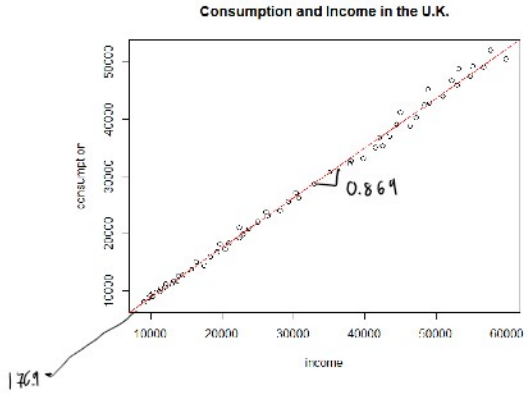
$1.768 \times 10^2 = 176.8$ doesn't make sense. ↳ C when Y=0

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





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