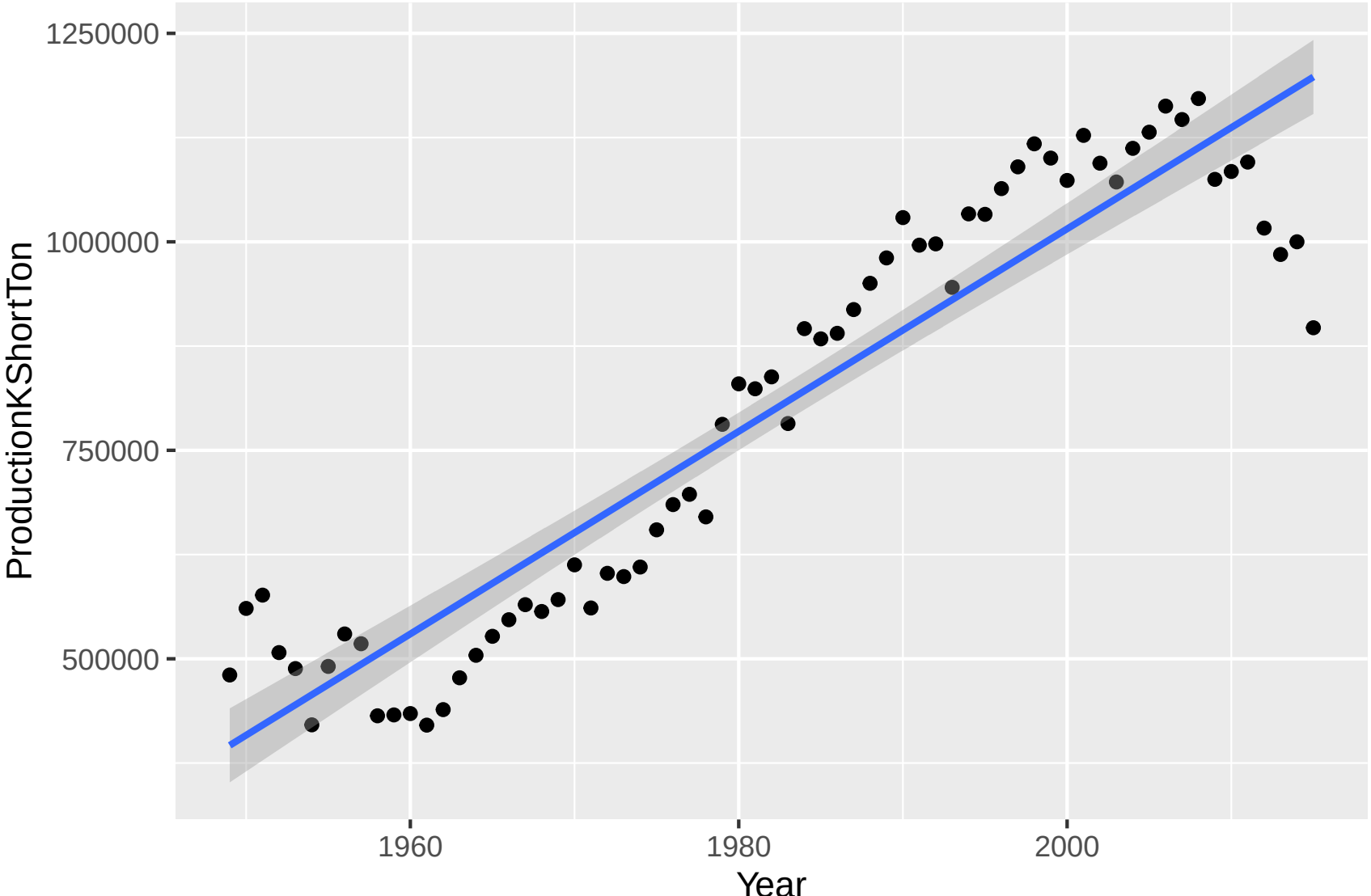
Energy Models

Overview of Energy Models

- Trend
- Time Series
- Guess based on experience
- Survey Based
- Scenario Planning
- I/O Models
- Energy Balance Models
- End Use
- Process Modeling
- Game Theory
- Experimental/Behavioral

Trend

- Uses only patterns of the past to make forecasts about the future.
- Cram a line though the data.



Trend Comments

- Regression with time as RHS variable. $Y = time + \epsilon$
- EC469 shows you how to do this.
- Not everything is a line. You sometimes have to transform the data, logs and such are common.
- Only uses the past.
  - I was 90 lbs at 15, 110 at 17, 130 at 18 and 220 at 26.
  - Today?
- People don't react to prices and there is no change in technology.
- That said, it works for alot of things and work when you have little time.
- Plenty of energy modeling looks like this.
  - If you don't have the time, throw in a trend line.

Time Series

- Similar to trend only
  - May have $Y = ARMA(p, q)$
  - or include a trend $Y = time + ARMA(p, q)$
- EC 472 shows you how to do this.
- Most energy data has a trend to it, which must be included in the model.
- Best thought of as a refinement to the trend regressions with better treatment of residuals.
  - More accurate confidence intervals on existing data.
  - Slightly better with near-term forecasts.
- Same problems as pure regression on trend.
- If you have an extra few minutes, do this.

Guess based on experience

- Don't laugh, this works.
- Old hands make very good guesses based on experience.
- GDP even has components that are based on analysists best judgement.

Survey Based

- Book gives some examples.
- Ask a bunch of experts about their best judgement and summarize
- Often expanded as a Delphi Survey
- For comically bad forecast see “Results of the Delphi IX Survey of Oil Forecasts” California Energy Comission, 1997.

Delphi Surveys

- Ask each person in private for best guess.
- Compile results.
- Ask outliers why they said what they did.
- Give everyone:
  - The distribution of guesses for each parameter
  - The reasons the outliers gave for the answer the gave.
- Ask for another guess.
- Report the new distribution or repeat if desired.

Scenario Planning

- Too much variation to give one description.
- General Steps:
  - Choose some parameters of interest, e.g., environmental activism, sea level rise, fracking shown to cause earthquakes, etc.
  - Package them into narratives that are possible. Some improbable and some likely.
  - Decide how you would act now given that you know that that future will exist.
  - ?
  - Profit

Frequent use and abuse of scenarios analysis

- Rigging scenarios so that only one is taken seriously. (abuse)
- Chosing actions that will "work" in all scenarios. (abuse)
- Actual plans for if a scenario becomes more likely, "Plans are worthless, but planning is everything." -Ike
- Creation of real options
  - Defer action until more information is available. Don't bring an umbrella everywhere, but have on near by if it starts to rain.
  - Create systems you can use when the situation is clearer. Think peaking power plants that only run a few days a year.

I/O Models

- Old school – 1920s Leontief
- Has an equilibrium concept
- Assumes fixed ratios are used in production
  - No reaction to price changes
  - No reaction to input price changes
  - Constant returns to scale.
- Often seen as part of a computable general equilibrium model to shorten run-times. REMI and IMPLAN use it in regional economic models.
- Will not as you to do one unless you want to.
- Book has an overly long explanation.

Walk Through I/O model

$x_1 = \alpha_{1,1}x_1 + \alpha_2 x_{1,2} + d_1$

- x_1 is how much of good one that gets made.
- d_1 is how much final consumers want of good 1.
- $\alpha_{1,1}$ the ammount of good 1 needed to produce good 1.
- $\alpha_{1,2}$ the ammount of good 1 needed to produce good 1.
- Each good has an equation
- α can be zero but there are restrictions on how many and where. The matrix needs to be invertable.

Matrix Form $x = Ax + d$ is solved as $x = (I - A)^{-1}d$
The next series of models, energy balance, end use, process, all build on each other from high level to low level.

Energy Balance Models

End Use Modeling

Process Modeling

Game Theory

- Not a full all economy model but a tool used to deal with decisons where:
  - There is not a monopoly or monopsony.
  - Not perfect competition.
- Also used for:
  - Dynamic interactions of firms, think how gasoline prices go up fast but down slow.
  - Auction and bidding, technically mechanism design which is game theory backwards, to get people to tell the truth or do the right thing.
  - Basis for a lot of modern "regulation" which focuses on encouraging competition to reach goals.
- Probably did some in 201 or 311.

Experimental/Behavioral

- The behavioral part is admitting that people and firms do not act rationally.
- Old school experiments, A/B testing and more, run on people
- Field experiments are common in economics now
  - Esther Duflo recieved the Bates Clark Award 2010
  - Bluffstone in Econ is running two now in Ethiopia and Nepal.
- Typical Issues
  - Internal validity
    - Can you really connect cause to effect?
    - Did you avoid bias and control for everything?
  - External validity
    - Does it work in real life?
    - Does it work on other people?
  - Ecological validity
    - Did the experiment look like the real world?