Economic Forecasting

AGEC 421
Advanced Agricultural Marketing
Instructor: Eric J. Belasco

Famous Quotes about Forecasting

- “The only function of economic forecasting is to make astrology look respectable” John Kenneth Galbraith
- “Wall Street indices predicted nine out of the last five recessions!” – Paul A. Samuelson in Newsweek, Science and Stocks, 19 Sep. 1966.
- “Prediction is very difficult, especially if it’s about the future.” –Nils Bohr, Nobel laureate in Physics
- “If you have to forecast, forecast often.” –Edgar R. Fiedler in The Three Rs of Economic Forecasting-Irrational, Irrelevant and Irreverent , June 1977.
- “An economist is an expert who will know tomorrow why the things he predicted yesterday didn’t happen today.” –Evan Esar

Topics we will cover

- Trends and Seasonality
  - Is the trend linear, exponential, logarithmic, etc.?
  - Seasons, cycles, and the rest
- Forecasting
  - Basic models for forecasting
  - How do we pick a model?
    - Fitting the in-sample data
    - Predicting the out-of-sample data

Basic statistics review

- Mean: $\bar{x} = \frac{1}{T}\sum_t^T x_t$
- Estimated Variance:

$$\widehat{Var}(x) = \frac{1}{T}\sum_t^T (x_t - \bar{x})$$

- Standard deviation: $\widehat{std}(x) = \sqrt{\widehat{Var}(x)}$

Basic statistics review

- Covariance:
  $\widehat{Cov}(x_t, z_t) = \frac{1}{T}\sum_t^T (x_t - \bar{x})(z_t - \bar{z})$
- Correlation: $\widehat{Corr}(x_t, z_t) = \frac{\widehat{Cov}(x_t, z_t)}{\widehat{std}(x_t)\widehat{std}(z_t)}$

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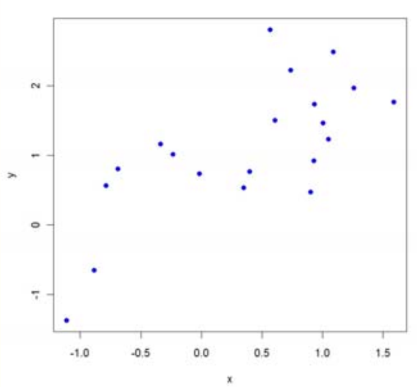
Least squares estimation

- Goal: Draw line that minimizes sum of squares errors
- Errors = difference between predicted and actual values



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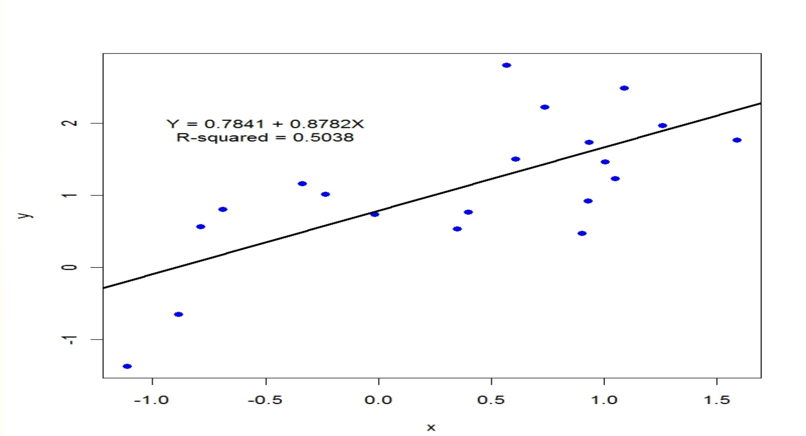
Least squares estimate



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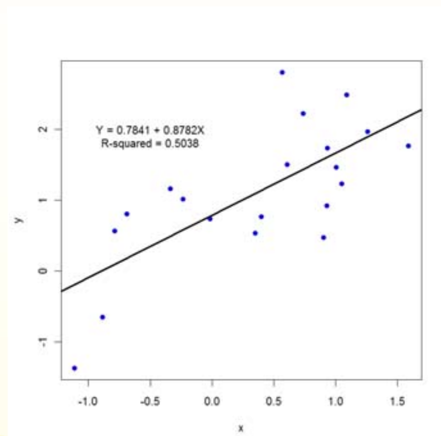
Least squares estimate

- Slope is obtained by
  $\hat{b} = (\sum x_t y_t)/(\sum x_t x_t)$
- Intercept is obtained by
  $\hat{a} = \bar{y} - \hat{b}\bar{x}$
- R-squared = $Corr(y_t, \hat{y_t})^2$
  - $R^2 = 1$ is a perfect fit
  - $R^2 = 0$ two have nothing in common
  - Closer to 1 = Better fit



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Least squares forecasting

- Suppose we have data for t = 1, 2, …, T
- We want to predict for T+1, T+2, etc.
- We can use estimated $\hat{a}$ and $\hat{b}$ as follows to obtain a point estimate:
  - $\hat{y}_{T+1} = \hat{a} + \hat{b}x_{T+1}$
- How confident are we?
  - $Var(\epsilon_t) = \widehat{\sigma^2} = \frac{1}{T}\sum_{t=1}^{T}(\hat{\epsilon}_t^2) = \frac{1}{T}\sum_{t=1}^{T}(y_t - \widehat{y_t})^2$
  - $y_{T+1} \sim N(\hat{y}_{T+1}, \widehat{\sigma^2})$
  - $y_{T+1} \pm 1.96\,\sigma$ (95% confidence interval)

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Trends and Seasonality

- Most regressions can be decomposed into two parts

  $Y_t = systematic + idiosyncratic$
- Systematic component can include
  - Trend
  - Seasonality
  - Cycles
  - Relationships with other variables

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Trends and Seasonality

- We try to minimize Idiosyncratic (random) components
  - Conditioning out systematic components
  - Higher R-squared meaning better fit
  - Usually means predictions with tighter confidence intervals (more confident predictions)

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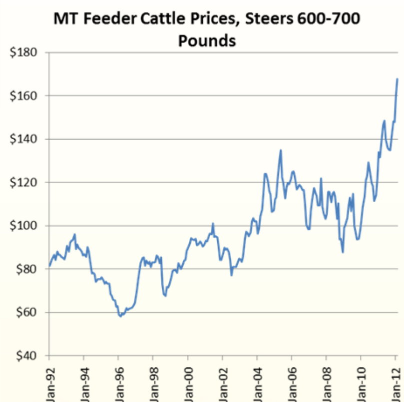
How do we go about making predictions in this market?



- Time trend?
- What kind of trend?
- Seasonality?
- Cattle cycle?

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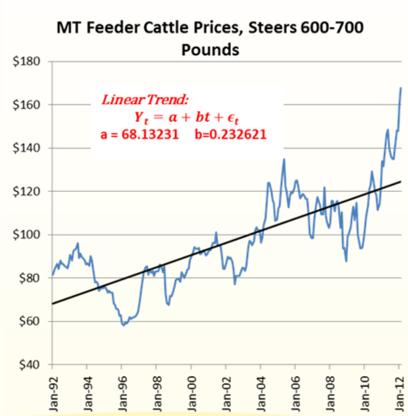
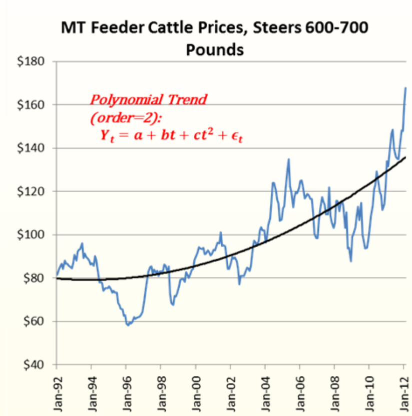
Detrending cattle prices





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An Aside on using excel

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.7858
R Square	0.6174
Adjusted R Square	0.6158
Standard Error	12.8455
Observations	242

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	63,908.0128	63,908.0128	387.3050	0.0000
Residual	240	39,601.6623	165.0069		
Total	241	103,509.6751			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	68.1323	1.6566	41.1275	0.0000	64.8690	71.3957	64.8690	71.3957
X Variable 1	0.2326	0.0118	19.6801	0.0000	0.2093	0.2559	0.2093	0.2559

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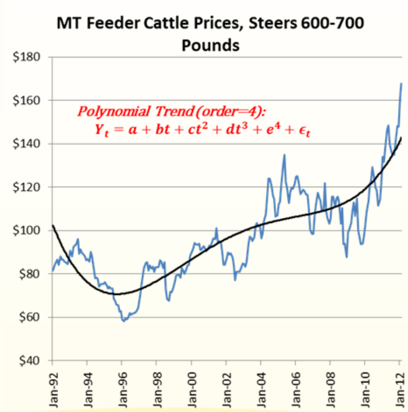
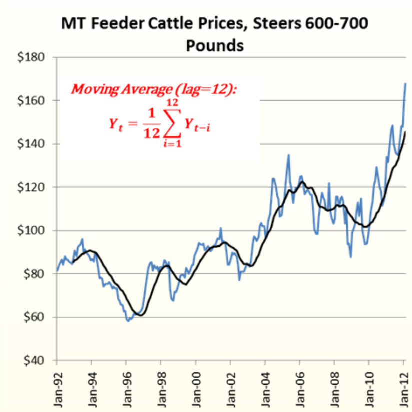
Detrending cattle prices





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Key Points: Trend

- Best to find functional form that
  - Best fit for in-sample data (adjusted R^2)
  - Out-of-sample predictions is also important
    - Don't "overfit" data (eg, fit an 8th order polynomial because it fits the best)
    - "overfit" models do not forecast very well
  - Trends are often nonlinear, but data needs to be sufficient to support choice

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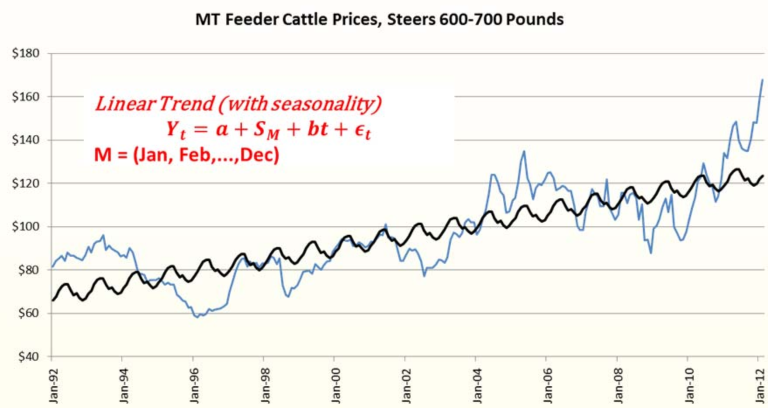
Seasonality in cattle prices

Month	Avg. Residual from linear model (1992 – 2011)
Jan	-2.315
Feb	-0.830
Mar	1.756
Apr	3.521
May	4.058
Jun	3.829
Jul	0.561
Aug	-1.558
Sept	-1.106
Oct	-3.235
Nov	-4.600
Dec	-4.049

- Indicates that
  - spring and early summary prices are higher, on average
  - winter and fall months are lower
- Some seasonal features to data

Trend and seasonal predictions



One way to deseasonalize data

- Include a set of binary variables in a multiple regression.
  - If in May, then $D_{May} = 1$ otherwise $D_{May} = 0$
  - Do for all months and exclude one
  - Parameters estimates are interpreted relative to omitted month
  - Results account for monthly differences

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Another way to deseasonalize data

- Take average residuals by month
- “Difference away” the shifter by month
- This will provide a deseasonalized series

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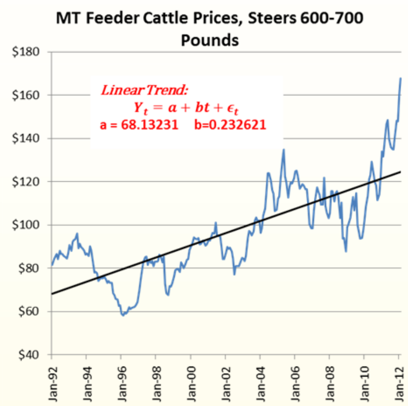
Autocorrelation

- Notice that $corr(\epsilon_t, \epsilon_{t-1}) > 0$
- This is positive autocorrelation
- Our forecast will be better if we can account for this systematic component



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Autocorrelation

- $\widehat{Cov}(x_t, x_{t-p}) = \frac{1}{T}\sum_t^T (x_t - \bar{x})(x_{t-p} - \bar{x})$
- $\widehat{Corr}(x_t, x_{t-p}) = \frac{\widehat{Cov}(x_t, x_{t-p})}{\widehat{std}(x_t)^2}$
- Does ϵ_{t-1} tell us something about ϵ_t?
  - If we are above the trend line in time t-1 are we likely to be above in time t?

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AR(1) model

- An AR(1) model can be written as

$$y_t = ay_{t-1} + \epsilon_t$$

- Can be estimated using OLS
- Basic properties include
  - $Var(y_t) = Var(\epsilon_t)/(1 - a^2)$
  - $Corr(y_t, y_{t-s}) = a^s$

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Random Walk

- As long as $|a| < 1$, the series is stationary
  - Impact from shocks die out
  - series reverts to a consistent mean
- If $a = 1$, the series is a random walk and not stationary
  - Usual fix is the first difference data
  - $FDY_t = Y_t - Y_{t-1}$

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Exchange rates are often non-stationary

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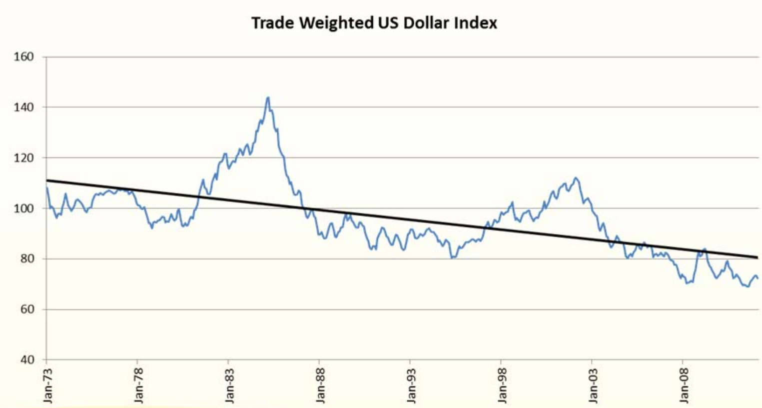
Linear regressions don't work



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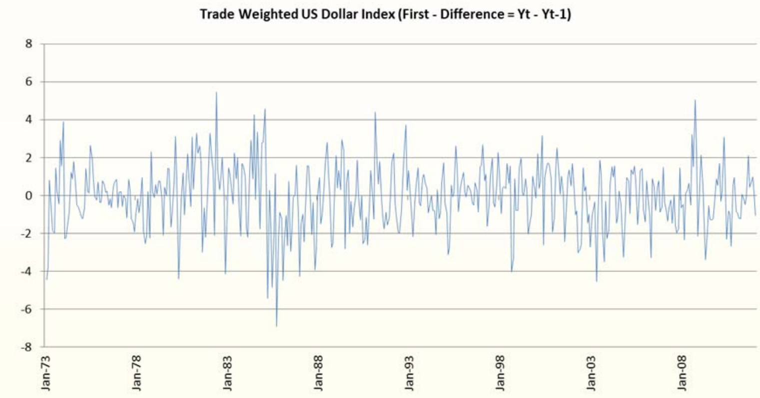
First differenced rates



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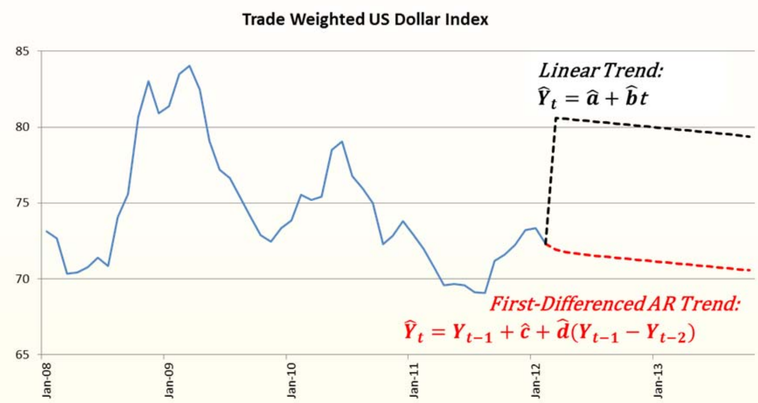
Prediction of exchange rates



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Forecast performance

- The forecast error in period t is $\epsilon_t = y_t - \hat{y}_t$
- Mean squared prediction error

$$MSPE = \frac{1}{T}\sum_{t=1}^{T} \hat{\epsilon}_t^2$$

- Root MSPE = $\sqrt{MSPE}$

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Key Points: Prediction

- Often simpler models predict just as well (or better) as more complex ones
- Check for stationarity (Dickey-Fuller test)
- Check for autocorrelation
- Remember predictions have confidence bounds

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