SECTION VIII.
FORECASTING
If prediction is the ultimate aim of all science, then we forecasters ought to award ourselves the palm for accomplishment, bravery or rashness.

... we (economists) are better than anything else in heaven and earth at forecasting aggregate business trends -- better than gypsy tea-leaf readers, Wall Street soothsayers and chartist technicians, hunch-playing heads of mail-order chains, or all-powerful heads of state.
Forecasting models have their limitations because they deal with human behavior and ever-changing institutions.
Insight on the Forecasting Process

Forecasting is an important part of the economic policy-making process.

Forecasting Terminology

Forecast -- a quantitative estimate (or set of estimates) about the likelihood of future events based on past and current information.

Point forecasts -- those which yield a single number

Interval forecasts -- indicated in each period the interval in which it is hoped the actual value will lie

“If you twist my arm, you can make me give a single number as a guess about next year’s GNP. But you will twist hard. My scientific conscience would feel more comfortable giving you my subjective probability distribution for all the values of GNP.”

-- Samuelson
A forecast is a systematic process of decisions and actions performed in an effort to predict the future. A forecast is not an end product, but rather an input to the decision-making process.
Conditional forecasts
conditional not only on the estimated structural parameters but also on the future values of the explanatory variables

Illustration
Confidence Intervals for Forecasts

- Point forecast ± c (standard error of the point forecast)
- c corresponds to the t-distribution with n-k-1 degrees of freedom
- To obtain a 95% confidence interval for the forecast, choose $\alpha = .05$.
- To obtain a 90% confidence interval for the forecast, choose $\alpha = .10$.
- To obtain a 99% confidence interval for the forecast, choose $\alpha = .01$.
- All probability statements conditional on a normal distribution of the forecast object.
\[ \hat{y}_i = x_i (x^T x)^{-1} x^T y \]

Residual = dependent variable – predicted value

A 95% confidence interval for the forecast of the dependent variable. This band accounts for not only the variability due to estimating the parameters but also the variability of the disturbance (error) term.

Standard error of the predicted mean value

\[
\left[ s^2 \left( x_i (x^T x)^{-1} x_i^T \right) \right]^{1/2}
\]
95% CL Predict Details

- Predicted value ± $t_{90,.025}$ (standard error of prediction)
- Standard error for **individual** forecast

\[
\left[ s^2 \left( 1 + \left( x_i(x^T x)^{-1} x_i^T \right) \right) \right]^{1/2}
\]

- For observation 1:
  - predicted value = 1.9738
  - $t_{90,.025} = 1.987$
  - standard error of prediction = 4.2912
  - 95% CI for prediction of observation 1
  - $1.9738 \pm (4.2912)(1.987)$
Forecast Methods

- Qualitative
- Quantitative

Quantitative
- Formal
  - Econometric Analysis
  - Time Series Analysis
    - ARIMA
    - VAR
    - VEC
- Intuitive (Naïve)
  - Seasonal
  - Trend Extrapolation
Trend Extrapolation Models

(1) Linear trend model

\[ X_t = b_0 + b_1 t + e_t \]

A time-series \( X_t \) increases in constant absolute amounts each time period.

(2) The series \( X_t \) grows with constant percentage increases rather than constant absolute increase.

\[ X_t = Ae^{rt} e^{w_t} \]
\[ \log X_t = \log A + rt + w_t \]

(3) Quadratic trend model

\[ X_t = b_0 + b_1 t + b_2 t^2 + u_t \]
(4) Cubic trend model

\[ X_t = C_0 + C_1 t + C_2 t^2 + C_3 t^3 + v_t \]

(5) Moving averages

\[ X_{t+1} = \left( X_t + X_{t+1} + \ldots + X_{t-n+1} \right) / n + e_t \]

(6) Exponential smoothing

\[ X_{t+1} = \alpha X_t + \alpha (1 - \alpha) X_{t-1} + \alpha (1 - \alpha)^2 X_{t-2} + \ldots + e_t \]

(7) Holt-Winters model

Use of ARIMA Models
Forecasting Experience With Econometric Models

Forecasts explicitly conditional -- possible therefore to investigate the sensitivity of the forecast to alternative assumptions, e.g., vary the forecasted level of $X_{t+1}$ or to consider alternative add factors $\hat{u}_{t+1}$.

Add factors -- take account of special circumstances and knowledge not embodied in the formal model.

Forecasts using econometric models are generally superior to those based on simple extrapolation techniques.

Importance and value of add factors -- reflection of expert judgement on factors not included in the model.

Forecasts with subjective adjustments generally have been more accurate than those obtained from the purely mechanical application of the econometric model combination of model building and subjective expertise.
Terminology

Backcasting | “Historical” Simulation | Ex-post Forecast | Ex-ante Forecast

Estimation Period

$T_1$ | $T_2$ | $T_3$ (today)

Out-of-Sample | Within-Sample | Out-of-Sample | Out-of-Sample

Source: Pindyck and Rubinfeld (1998)
Algebraic Measures of Forecast Accuracy

“In science and in real economic life, it is terribly important not to be wrong much.”

--- Samuelson (1965)

FORECAST EVALUATION

(1) MSE = Mean Squared Error
\[
\frac{1}{M} \sum_{t=1}^{M} (F_t - A_t)^2,
\]

(2) RMSE = Root Mean Squared Error
\[
(MSE)^{1/2}
\]

(3) MAE = Mean Absolute Error
\[
\frac{1}{M} \sum_{t=1}^{M} |F_t - A_t|
\]
(4) MAPE = Mean Absolute Percent Error
\[
\frac{1}{M} \sum_{t=1}^{M} \left| \frac{F_t - A_t}{A_t} \right| \times 100
\]

(5) Weighted Absolute Percent Error
\[
\sum_{t=1}^{M} w_t \left| \frac{F_t - A_t}{A_t} \right| \times 100, \text{ where } w_t = \frac{A_t}{\sum_{t=1}^{M} A_t}
\]

(6) Theil $U_2$ statistic (Applied Economic Forecasting (1966))
\[
U_2 = \left( \frac{\sum_{t=1}^{M} (F_t - A_t)^2}{\left( \sum_{t=1}^{M} A_t^2 \right)^{1/2}} \right)^{1/2}
\]

(7) Turning Points
Theil’s coefficient should be applied to the difference between predicted and actual changes. When models predict the levels of economic variables, there are two possible ways to obtain predicted changes:

1. \( F_t - F_{t-1} \)
2. \( F_t - A_{t-1} \)
With (1),
The difference between a forecasted and actual change is

\[(F_t - F_{t-1}) - (A_t - A_{t-1})\]

\[= (F_t - A_t) - (F_{t-1} - A_{t-1})\]

With (2),

\[= (F_t - A_{t-1}) - (A_t - A_{t-1}) = F_t - A_t\]

Leuthold (1975)
KEY: How to define predicted changes in forecasts

\[
\begin{align*}
F_t & = \text{FORECASTED CHANGE} \\
F_t & = F_{t-1} \quad \text{OR} \quad F_t - A_{t-1} \\
A_t & = \text{ACTUAL CHANGE} \\
A_t & - A_{t-1}
\end{align*}
\]
Turning point errors -- incorrect forecasts of the direction of change.

Generally found that most of points fall in the cone of underestimation of change.

Systematic underestimation of change is a general finding for most forecasts.

Conservative bias in forecasting -- forecasts often below true magnitudes; bias reinforced by hedging in forecasts (adjusting add factors toward zero) so as to avoid taking extreme positions.
<table>
<thead>
<tr>
<th>IMP</th>
<th>IMPF</th>
<th>ERROR</th>
<th>ABSERROR</th>
<th>ABSPCER</th>
<th>WEIGHT</th>
<th>PRODUCT</th>
</tr>
</thead>
<tbody>
<tr>
<td>15.9</td>
<td>15.83674</td>
<td>0.06326</td>
<td>0.06326</td>
<td>0.39785</td>
<td>0.02937</td>
<td>0.011684</td>
</tr>
<tr>
<td>16.4</td>
<td>17.10600</td>
<td>-0.70600</td>
<td>0.70600</td>
<td>4.30487</td>
<td>0.03029</td>
<td>0.130402</td>
</tr>
<tr>
<td>19.0</td>
<td>18.30542</td>
<td>0.69458</td>
<td>0.69458</td>
<td>3.65571</td>
<td>0.03509</td>
<td>0.128294</td>
</tr>
<tr>
<td>19.1</td>
<td>19.09127</td>
<td>0.00873</td>
<td>0.00873</td>
<td>0.04570</td>
<td>0.03528</td>
<td>0.001612</td>
</tr>
<tr>
<td>18.8</td>
<td>19.08434</td>
<td>-0.28434</td>
<td>0.28434</td>
<td>1.51244</td>
<td>0.03472</td>
<td>0.052519</td>
</tr>
<tr>
<td>20.4</td>
<td>20.80789</td>
<td>-0.40789</td>
<td>0.40789</td>
<td>1.99944</td>
<td>0.03768</td>
<td>0.075339</td>
</tr>
<tr>
<td>22.7</td>
<td>22.46383</td>
<td>0.23617</td>
<td>0.23617</td>
<td>1.04038</td>
<td>0.04193</td>
<td>0.043621</td>
</tr>
<tr>
<td>26.5</td>
<td>26.10852</td>
<td>0.039148</td>
<td>0.39148</td>
<td>1.47727</td>
<td>0.04895</td>
<td>0.072308</td>
</tr>
<tr>
<td>28.1</td>
<td>27.41309</td>
<td>0.68691</td>
<td>0.68691</td>
<td>2.44453</td>
<td>0.05190</td>
<td>0.126877</td>
</tr>
<tr>
<td>27.6</td>
<td>27.81733</td>
<td>-0.27133</td>
<td>0.21733</td>
<td>0.78741</td>
<td>0.05098</td>
<td>0.040141</td>
</tr>
<tr>
<td>26.3</td>
<td>25.98408</td>
<td>0.31592</td>
<td>0.31592</td>
<td>1.20120</td>
<td>0.04858</td>
<td>0.058352</td>
</tr>
<tr>
<td>31.1</td>
<td>30.48725</td>
<td>0.61275</td>
<td>0.61275</td>
<td>1.97026</td>
<td>0.05744</td>
<td>0.113179</td>
</tr>
<tr>
<td>33.3</td>
<td>33.69294</td>
<td>-0.39294</td>
<td>0.39294</td>
<td>1.18000</td>
<td>0.06151</td>
<td>0.072579</td>
</tr>
<tr>
<td>37.0</td>
<td>38.03476</td>
<td>-1.03476</td>
<td>1.03476</td>
<td>2.79664</td>
<td>0.06834</td>
<td>0.191126</td>
</tr>
<tr>
<td>43.3</td>
<td>43.97360</td>
<td>-0.67360</td>
<td>0.67360</td>
<td>1.55565</td>
<td>0.07998</td>
<td>0.124417</td>
</tr>
<tr>
<td>49.0</td>
<td>49.34576</td>
<td>-0.34576</td>
<td>0.34576</td>
<td>0.70563</td>
<td>0.09051</td>
<td>0.063864</td>
</tr>
<tr>
<td>50.3</td>
<td>49.84946</td>
<td>0.45054</td>
<td>0.45054</td>
<td>0.89570</td>
<td>0.09291</td>
<td>0.083217</td>
</tr>
<tr>
<td>56.6</td>
<td>55.99773</td>
<td>0.60227</td>
<td>0.60227</td>
<td>1.06407</td>
<td>0.10454</td>
<td>0.111242</td>
</tr>
</tbody>
</table>

1.613042  1.500775
MAPE       WAPE
Forecast: IMPF
Actual: IMP
Sample: 1949 1966
Include observations: 18

<table>
<thead>
<tr>
<th>Metric</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Root Mean Squared Error</td>
<td>0.516380</td>
</tr>
<tr>
<td>Mean Absolute Error</td>
<td>0.451400</td>
</tr>
<tr>
<td>Mean Abs. Percent Error</td>
<td>1.613042</td>
</tr>
<tr>
<td>Theil Inequality Coefficient</td>
<td>0.007962</td>
</tr>
<tr>
<td>Bias Proportion</td>
<td>0.000000</td>
</tr>
<tr>
<td>Variance Proportion</td>
<td>0.000453</td>
</tr>
<tr>
<td>Covariance Proportion</td>
<td>0.999547</td>
</tr>
</tbody>
</table>
Decomposition of MSE

(A)

\[ U_m = \frac{(\bar{F} - \bar{A})^2}{MSE} \]
\[ U_s = \frac{(S_F - S_A)^2}{MSE} \]
\[ U_c = \frac{2(1 - r)S_F S_A}{MSE} \]

↑
mean (or bias)
variance
covariance

↑
proportion
proportion
proportion

\[ U_M + U_S + U_C = 1 \]
With this decomposition,

\( U_M \) Measure of bias - unequal central tendencies of the actual and forecasted changes

\[
(F - A)^2
\]

\( U_S \) Measure of unequal variation - squared difference between standard deviations

\[
(S_F - S_A)^2
\]

\( U_C \) Measure of incomplete covariation - correlation coefficient \( r \) between actual and forecasted values

\[
2(1-r)S_F S_A / \text{MSE}
\]

\[
U_M = (F - A)^2 / \text{MSE}; \quad U_S = (S_F - S_A)^2 / \text{MSE}; \quad U_C = 2(1-r)S_F S_A / \text{MSE}
\]

\[
U_M + U_S + U_C = 1
\]
$U_C$ - nonsystematic random error, cannot be avoided

$U_M, U_S$ - represent systematic errors that should be avoided

$U_M \rightarrow 0$ as $\bar{F} = \bar{A}$ if $U_M$ large - average predicted change deviates substantially from average realized change

$U_S \rightarrow 0$ as $S_F = S_A U_S$ indicates ability of the model to replicate the degree of variability if $U_S$ large - actual series fluctuated considerably but simulated series shows little fluctuation or vice versa

$U_C \rightarrow 0$ as $r = 1$ can never hope that forecasters will be able to predict so that all points are located on the straight line of perfect forecasts

$U_C \rightarrow$ remaining error after deviations from average values and average variabilities have been accounted for
Another Decomposition

$$\text{MSE} = (\bar{F} - \bar{A})^2 + (S_F - rS_A)^2 + (1 - r^2)S_A^2$$

$$U_M = (\bar{F} - \bar{A})^2 / \text{MSE}$$
$$U_R = (S_F - rS_A)^2 / \text{MSE}$$
$$U_D = (1 - r^2)S_A^2 / \text{MSE}$$

$U_M, U_R$ should not differ much from zero

$U_D$ should be close to unity

$$U_M + U_R + U_D = 1$$

$U_R \rightarrow$ Regression component

$U_D \rightarrow$ Disturbance component
Run the Auxiliary Regression

\[ A_i = \alpha + \beta F_i + \varepsilon_i \]

Consider this decomposition in relation to the regression

\[ A_i = F_i + \text{Residual} \]

If residuals have zero mean, then

\[ \bar{A} = \bar{F} \rightarrow U_M = 0. \]

If regression coefficient truly 1, then

\[ rS_A = S_F \rightarrow U_R = 0. \]

MSE will then consist of only one term, the disturbance proportion.
Composite Forecasting -- often alternative forecasts of the same data are available, each of which contains information independent of others.

--- Bates and Granger (1969)
--- Granger and Newbold (1977)
--- Just and Rausser (1981)
--- Bessler and Brandt (1981)

Bates and Granger suggest that if the objective is to make as good a forecast as possible, the analyst should attempt to combine the forecasts.

Composite forecasting can provide forecasts which are preferred to the individual forecasts used to generate the composite.
Building composite forecasts requires that the analyst select weights to assign the individual forecasts. How to weight?

(1) Minimum variance weighting

minimize the variance of the forecast errors over the forecast period.

\[ w_1 = \frac{\sigma^2 - \rho \sigma_1 \sigma_2}{\sigma_1^2 + \sigma_2^2 - 2 \rho \sigma_1 \sigma_2} \]

\[ w_2 = 1 - w_1 \]

\[ \sigma_i^2 \rightarrow \text{The forecast error variance associated with method } i; \text{ is the correlation coefficient between the errors of forecasts } i \text{ and } j. \]
(2) Simple averaging

\[ \text{CF} = \frac{\text{FM}_1 + \text{FM}_2}{2} \]

More generally,

\[ \sum_{i=1}^{r} \frac{\text{FM}_i}{r} \]
Run the Regression

\[ A_t = w_1 FM_{1t} + w_2 FM_{2t} + \varepsilon_t \]

with the restriction that \( w_1 + w_2 = 1 \)

\( w_1, w_2 \) turn out to be the same as the \( w_1, w_2 \) associated with minimum variance weighting

This regression technique allows “optimal” weights when there are more than two forecast methods

\[ A_t = w_1 FM_{1t} + w_2 FM_{2t} + w_3 FM_{3t} \]
\[ + \ldots + w_k FM_{kt} + \varepsilon_t \]
\[ w_1 + w_2 + \ldots + w_k = 1 \]
Forecast Interval

\[ P(y_{T+h}^L \leq y_{T+h} \leq y_{T+h}^u) = 0.95 \]
1 - Step Ahead Forecast Error

\[ e_{t+1} = Y_{t+1} - \hat{Y}_{t+1} \]

h - Step Ahead Forecast Error

\[ e_{t+h} = Y_{t+h} - \hat{Y}_{t+h} \]
Dependent Variable: LOG(FUBK)
Method: Least Squares
Date: 10/07/02 Time: 11:06
Sample(adjusted): 1991:10 2000:05
Included observations: 104 after adjusting endpoints
Convergence achieved after 11 iterations

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>11.39704</td>
<td>6.307615</td>
<td>1.806871</td>
<td>0.0738</td>
</tr>
<tr>
<td>DEBTINCARDF</td>
<td>15.92156</td>
<td>6.530283</td>
<td>2.438111</td>
<td>0.0165</td>
</tr>
<tr>
<td>AR(1)</td>
<td>0.212305</td>
<td>0.091964</td>
<td>2.308560</td>
<td>0.0230</td>
</tr>
<tr>
<td>AR(2)</td>
<td>0.366402</td>
<td>0.086456</td>
<td>4.238013</td>
<td>0.0001</td>
</tr>
<tr>
<td>AR(3)</td>
<td>0.410205</td>
<td>0.091830</td>
<td>4.466989</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

R-squared   0.988079  Mean dependent var 9.770722
Adjusted R-squared 0.987597  S.D. dependent var 1.169203
S.E. of regression 0.130212  Akaike info criterion -1.192418
Sum squared resid 1.678570  Schwarz criterion -1.065284
Log likelihood 67.00573  F-statistic 2051.371
Durbin-Watson stat 2.069863  Prob(F-statistic) 0.000000

Inverted AR Roots .99  -.39+.51i  -.39-.51i
<table>
<thead>
<tr>
<th>obs</th>
<th>FUBK</th>
<th>FUBKDFECO</th>
<th>FUBKDFSEECO</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000:06</td>
<td>NA</td>
<td>71920.51</td>
<td>9514.624</td>
</tr>
<tr>
<td>2000:07</td>
<td>NA</td>
<td>76839.45</td>
<td>10375.51</td>
</tr>
<tr>
<td>2000:08</td>
<td>NA</td>
<td>77220.09</td>
<td>11232.81</td>
</tr>
<tr>
<td>2000:09</td>
<td>NA</td>
<td>79271.27</td>
<td>13014.42</td>
</tr>
<tr>
<td>2000:10</td>
<td>NA</td>
<td>81694.59</td>
<td>13958.61</td>
</tr>
<tr>
<td>2000:11</td>
<td>NA</td>
<td>82979.48</td>
<td>15031.72</td>
</tr>
<tr>
<td>2000:12</td>
<td>NA</td>
<td>84308.23</td>
<td>16128.34</td>
</tr>
<tr>
<td>2001:01</td>
<td>NA</td>
<td>87244.29</td>
<td>17356.85</td>
</tr>
<tr>
<td>2001:02</td>
<td>NA</td>
<td>88803.07</td>
<td>18422.71</td>
</tr>
<tr>
<td>2001:03</td>
<td>NA</td>
<td>91487.25</td>
<td>19705.70</td>
</tr>
<tr>
<td>2001:04</td>
<td>NA</td>
<td>93726.84</td>
<td>20863.57</td>
</tr>
<tr>
<td>2001:05</td>
<td>NA</td>
<td>95063.11</td>
<td>21847.93</td>
</tr>
<tr>
<td>2001:06</td>
<td>NA</td>
<td>97641.39</td>
<td>23109.93</td>
</tr>
<tr>
<td>2001:07</td>
<td>NA</td>
<td>100322.4</td>
<td>24404.19</td>
</tr>
<tr>
<td>2001:08</td>
<td>NA</td>
<td>103378.0</td>
<td>25816.35</td>
</tr>
<tr>
<td>2001:09</td>
<td>NA</td>
<td>105781.5</td>
<td>27061.90</td>
</tr>
<tr>
<td>2001:10</td>
<td>NA</td>
<td>109971.2</td>
<td>28804.58</td>
</tr>
<tr>
<td>2001:11</td>
<td>NA</td>
<td>112387.0</td>
<td>30076.93</td>
</tr>
<tr>
<td>2001:12</td>
<td>NA</td>
<td>115041.7</td>
<td>31426.06</td>
</tr>
</tbody>
</table>
## Ex-Post Forecast Evaluation of Germany Sales ($)

<table>
<thead>
<tr>
<th>ACTUAL ($)</th>
<th>MODEL A ($)</th>
<th>MODEL B ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1293594</td>
<td>1392156</td>
<td>1571411</td>
</tr>
<tr>
<td>1275381</td>
<td>1294103</td>
<td>1401020</td>
</tr>
<tr>
<td>1559312</td>
<td>1549253</td>
<td>1664467</td>
</tr>
<tr>
<td>1789155</td>
<td>1860777</td>
<td>1936854</td>
</tr>
<tr>
<td>2139428</td>
<td>2153039</td>
<td>1936245</td>
</tr>
<tr>
<td>1458652</td>
<td>1686154</td>
<td>1821541</td>
</tr>
<tr>
<td>1517930</td>
<td>1810875</td>
<td>1640003</td>
</tr>
<tr>
<td>1541403</td>
<td>1351399</td>
<td>1613390</td>
</tr>
<tr>
<td>2107742</td>
<td>2015857</td>
<td>1944321</td>
</tr>
<tr>
<td>1664925</td>
<td>1730865</td>
<td>1792553</td>
</tr>
<tr>
<td>2118102</td>
<td>1649788</td>
<td>1754221</td>
</tr>
</tbody>
</table>
Weight for MODEL A = 0.5913128  
Weight for MODEL B = 0.4086872

<table>
<thead>
<tr>
<th></th>
<th>MODEL A</th>
<th>MODEL B</th>
<th>Composite Average</th>
<th>Composite Minimum Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>RMSE($)</td>
<td>195696</td>
<td>211982</td>
<td>189827</td>
<td>188717</td>
</tr>
<tr>
<td>MAE($)</td>
<td>140833</td>
<td>188307</td>
<td>155874</td>
<td>152341</td>
</tr>
<tr>
<td>MAPE(%)</td>
<td>8.37</td>
<td>11.46</td>
<td>9.37</td>
<td>9.14</td>
</tr>
</tbody>
</table>

For MODEL A
UM = 0.000177  
US = 0.050522  
UC = 0.9493007  
UR = 0.01735411  
UD = 0.9824689

ACTUALₜ = 163750 + 0.90105 * MODEL Aₜ  
(422200) (.2482)
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1999</td>
<td>29.33</td>
<td>30.20</td>
<td>2.86</td>
<td>32.98</td>
<td>12.37</td>
<td>32.47</td>
<td>10.71</td>
<td>30.30</td>
<td>3.29</td>
</tr>
<tr>
<td>2</td>
<td>1999</td>
<td>26.76</td>
<td>29.87</td>
<td>11.62</td>
<td>30.73</td>
<td>14.85</td>
<td>32.93</td>
<td>23.04</td>
<td>29.88</td>
<td>11.58</td>
</tr>
<tr>
<td>3</td>
<td>1999</td>
<td>23.85</td>
<td>26.12</td>
<td>10.45</td>
<td>29.38</td>
<td>24.23</td>
<td>30.07</td>
<td>27.13</td>
<td>32.85</td>
<td>38.90</td>
</tr>
<tr>
<td>4</td>
<td>1999</td>
<td>24.40</td>
<td>23.36</td>
<td>4.17</td>
<td>25.88</td>
<td>8.08</td>
<td>20.02</td>
<td>18.94</td>
<td>32.29</td>
<td>32.35</td>
</tr>
<tr>
<td>5</td>
<td>1999</td>
<td>22.68</td>
<td>23.81</td>
<td>4.09</td>
<td>22.58</td>
<td>0.44</td>
<td>25.19</td>
<td>11.06</td>
<td>32.97</td>
<td>45.36</td>
</tr>
<tr>
<td>7</td>
<td>1999</td>
<td>19.63</td>
<td>19.45</td>
<td>16.88</td>
<td>22.28</td>
<td>33.85</td>
<td>23.20</td>
<td>39.51</td>
<td>29.16</td>
<td>75.49</td>
</tr>
<tr>
<td>9</td>
<td>1999</td>
<td>19.52</td>
<td>17.87</td>
<td>4.44</td>
<td>16.52</td>
<td>19.97</td>
<td>18.22</td>
<td>6.64</td>
<td>21.86</td>
<td>15.38</td>
</tr>
<tr>
<td>10</td>
<td>1999</td>
<td>18.49</td>
<td>18.80</td>
<td>1.70</td>
<td>16.70</td>
<td>8.70</td>
<td>14.50</td>
<td>21.59</td>
<td>23.20</td>
<td>25.47</td>
</tr>
<tr>
<td>11</td>
<td>1999</td>
<td>17.96</td>
<td>18.12</td>
<td>0.11</td>
<td>18.52</td>
<td>3.13</td>
<td>16.37</td>
<td>8.83</td>
<td>21.99</td>
<td>22.44</td>
</tr>
<tr>
<td>12</td>
<td>1999</td>
<td>17.74</td>
<td>19.91</td>
<td>2.17</td>
<td>19.11</td>
<td>7.73</td>
<td>18.51</td>
<td>9.95</td>
<td>18.22</td>
<td>2.73</td>
</tr>
<tr>
<td>2</td>
<td>2000</td>
<td>16.43</td>
<td>17.08</td>
<td>3.96</td>
<td>17.82</td>
<td>8.48</td>
<td>19.31</td>
<td>17.52</td>
<td>16.99</td>
<td>3.41</td>
</tr>
<tr>
<td>3</td>
<td>2000</td>
<td>17.02</td>
<td>15.95</td>
<td>6.30</td>
<td>18.77</td>
<td>1.48</td>
<td>17.51</td>
<td>2.90</td>
<td>20.11</td>
<td>18.15</td>
</tr>
<tr>
<td>4</td>
<td>2000</td>
<td>18.15</td>
<td>18.77</td>
<td>5.99</td>
<td>15.42</td>
<td>15.04</td>
<td>16.24</td>
<td>10.52</td>
<td>19.54</td>
<td>7.68</td>
</tr>
<tr>
<td>5</td>
<td>2000</td>
<td>18.43</td>
<td>18.21</td>
<td>0.22</td>
<td>18.43</td>
<td>0.03</td>
<td>15.98</td>
<td>8.21</td>
<td>19.25</td>
<td>17.16</td>
</tr>
<tr>
<td>6</td>
<td>2000</td>
<td>15.90</td>
<td>15.98</td>
<td>0.51</td>
<td>18.20</td>
<td>14.48</td>
<td>16.42</td>
<td>3.26</td>
<td>17.09</td>
<td>7.50</td>
</tr>
<tr>
<td>7</td>
<td>2000</td>
<td>15.58</td>
<td>16.53</td>
<td>6.12</td>
<td>18.83</td>
<td>6.76</td>
<td>20.88</td>
<td>16.04</td>
<td>2.95</td>
<td>17.16</td>
</tr>
<tr>
<td>8</td>
<td>2000</td>
<td>15.00</td>
<td>15.40</td>
<td>2.50</td>
<td>16.60</td>
<td>3.00</td>
<td>16.75</td>
<td>11.25</td>
<td>14.85</td>
<td>1.42</td>
</tr>
<tr>
<td>9</td>
<td>2000</td>
<td>14.30</td>
<td>14.98</td>
<td>0.68</td>
<td>14.84</td>
<td>3.81</td>
<td>16.03</td>
<td>12.07</td>
<td>16.80</td>
<td>17.49</td>
</tr>
<tr>
<td>11</td>
<td>2000</td>
<td>13.00</td>
<td>12.28</td>
<td>5.51</td>
<td>13.69</td>
<td>5.27</td>
<td>13.76</td>
<td>5.87</td>
<td>16.14</td>
<td>24.18</td>
</tr>
<tr>
<td>2</td>
<td>2001</td>
<td>11.82</td>
<td>12.17</td>
<td>2.86</td>
<td>11.88</td>
<td>0.46</td>
<td>12.57</td>
<td>6.35</td>
<td>13.64</td>
<td>15.39</td>
</tr>
<tr>
<td>3</td>
<td>2001</td>
<td>13.31</td>
<td>11.85</td>
<td>10.95</td>
<td>12.28</td>
<td>7.71</td>
<td>11.98</td>
<td>9.99</td>
<td>13.53</td>
<td>1.64</td>
</tr>
<tr>
<td>4</td>
<td>2001</td>
<td>13.24</td>
<td>13.50</td>
<td>2.00</td>
<td>11.72</td>
<td>11.47</td>
<td>12.15</td>
<td>8.20</td>
<td>11.52</td>
<td>12.98</td>
</tr>
<tr>
<td>5</td>
<td>2001</td>
<td>12.57</td>
<td>13.19</td>
<td>4.63</td>
<td>13.52</td>
<td>7.82</td>
<td>11.73</td>
<td>6.70</td>
<td>12.60</td>
<td>1.79</td>
</tr>
<tr>
<td>6</td>
<td>2001</td>
<td>12.80</td>
<td>na</td>
<td>na</td>
<td>13.36</td>
<td>na</td>
<td>13.69</td>
<td>na</td>
<td>11.81</td>
<td>na</td>
</tr>
<tr>
<td>7</td>
<td>2001</td>
<td>12.80</td>
<td>na</td>
<td>na</td>
<td>13.04</td>
<td>na</td>
<td>13.81</td>
<td>na</td>
<td>12.23</td>
<td>na</td>
</tr>
<tr>
<td>8</td>
<td>2001</td>
<td>12.80</td>
<td>na</td>
<td>na</td>
<td>12.82</td>
<td>na</td>
<td>12.82</td>
<td>na</td>
<td>11.51</td>
<td>na</td>
</tr>
<tr>
<td>9</td>
<td>2001</td>
<td>12.80</td>
<td>na</td>
<td>na</td>
<td>12.82</td>
<td>na</td>
<td>14.18</td>
<td>na</td>
<td>13.71</td>
<td>na</td>
</tr>
<tr>
<td>10</td>
<td>2001</td>
<td>12.80</td>
<td>na</td>
<td>na</td>
<td>12.82</td>
<td>na</td>
<td>12.82</td>
<td>na</td>
<td>12.81</td>
<td>na</td>
</tr>
</tbody>
</table>

Mean: 17.33  Median: 17.60  SD: 4.38  Min: 11.82  Max: 33.58
There is no efficacious substitute for economic analysis in business forecasting. Some maverick may hit a home run on occasion; but over the long season, batting averages tend to settle down to a sorry level when the more esoteric methods of soothsaying are relied upon.

Better to be wrong in good company than run the risk of being wrong all alone.

Often a forecaster is forced to give a single point estimate because his boss or others cannot handle a more complicated concept. Then he must figure out for himself which point estimate will do them the most good, or the least harm.
Economic forecasters are like six Eskimos in one bed; the only thing you can be sure of is that they are all going to turn over together.

--- Roy Blough

Self-styled “prophets” who mislead us should be reminded that among the ancient Scythians, when prophets predicted thing that failed to come true, they were laid, shackled hand and foot, on a litter cart filled with heather and drawn by oxen, on which they were burned to death.

--- Washington Post

Those who live by the crystal ball should learn to eat ground glass.

--- Ted Moskovitz