Seasonal Dummy Model

• Deterministic seasonality $S_t$ can be written as a function of seasonal dummy variables

• Let $s$ be the seasonal frequency
  – $s=4$ for quarterly
  – $s=12$ for monthly

• Let $D_{1t}, D_{2t}, D_{3t}, \ldots, D_{st}$ be seasonal dummies
  – $D_{1t} = 1$ if $s$ is the first period, otherwise $D_{1t} = 0$
  – $D_{2t} = 1$ if $s$ is the second period, otherwise $D_{2t} = 0$

• At any time period $t$, one of the seasonal dummies $D_{1t}, D_{2t}, D_{3t}, \ldots, D_{st}$ will equal 1, all the others will equal 0.
Seasonal Dummy Model

• Deterministic seasonality

\[ S_i = \begin{cases} 
\gamma_1 & \text{if } t = \text{January} \\
\gamma_2 & \text{if } t = \text{February} \\
\vdots & \vdots \\
\gamma_{12} & \text{if } t = \text{December} 
\end{cases} \]

\[ = \sum_{i=1}^{s} \gamma_i D_{it} \]

a linear function of the dummy variables
Estimation

- Least squares regression
  \[ y_{t+h} = \sum_{i=1}^{s} \gamma_i D_{it} + e_t \]
  \[ = \alpha + \sum_{i=1}^{s-1} \beta_i D_{it} + e_t \]

- You can either
  - Regress \( y \) on all the seasonal dummies, omitting the intercept, or
  - Regress \( y \) on an intercept and the seasonal dummies, omitting one dummy (one season, e.g. December)

- You cannot regress on both the intercept plus all seasonal dummies, for they would be collinear and redundant.
Interpreting Coefficients

• In the model

\[ S_t = \alpha + \sum_{i=1}^{s-1} \beta_i D_{it} \]

the intercept \( \alpha = \gamma_s \) is the seasonality in the omitted season.

• The coefficients \( \beta_i = \gamma_i - \gamma_s \) are the difference in the seasonal component from the \( s' \)th period.
STATA Programming

• If the time index is $t$ and is formatted as a time index, you can determine the period using the commands

  generate m=month(dofm(t))
  generate q=quarter(dofq(t))

for monthly and quarterly data, respectively

(See dates and times in STATA Data manual)
Creating Dummies

• If $m$ is the month (1 for January, 2 for February, etc.), then
  – generate $m1=(m==1)$
  – This creates a dummy variable “m1” for January
  – Then
  – regress $y$ $m1$ $m2$ $m3$ $m4$ $m5$ $m6$ $m7$ $m8$ $m9$ $m10$ $m11$
    or
  – regress $y$ $m1$ $m2$ $m3$ $m4$ $m5$ $m6$ $m7$ $m8$ $m9$ $m10$ $m11$ $m12$, noconstant

• Easier
  – Type “b12.m” in the regressor list
  – regress $y$ b12.m
  – This includes dummies for months 1 through 11, omits 12
  – Same as mechanically listing the eleven dummies, but easier.
  – It is important that “m” be the numerical month (1 for January, 2 for February, etc.)
Estimation

```
use "C:\Users\Bruce Hansen\Documents\docs\classdocs\390\housingstarts.dta"

regress total b12.m

<table>
<thead>
<tr>
<th>Source</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>Number of obs = 612</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td>267331.386</td>
<td>11</td>
<td>24302.8533</td>
<td>F(11, 600) = 26.14</td>
</tr>
<tr>
<td>Residual</td>
<td>557738.603</td>
<td>600</td>
<td>929.564339</td>
<td>Prob &gt; F = 0.0000</td>
</tr>
<tr>
<td>Total</td>
<td>825069.989</td>
<td>611</td>
<td>1350.36005</td>
<td>R-squared = 0.3240</td>
</tr>
</tbody>
</table>
<pre><code>              |          |     |          | Adj R-squared = 0.3116 |
              |          |     |          | Root MSE = 30.489     |
</code></pre>

| total | Coef.    | Std. Err. | t     | P>|t| | [95% Conf. Interval] |
|-------|----------|-----------|-------|------|----------------------|
| m     |          |           |       |      |                      |
| 1     | -4.931373| 6.037674  | -0.82 | 0.414| -16.78891 6.92617    |
| 2     | -1.547058| 6.037674  | -0.26 | 0.798| -13.4046 10.31048   |
| 3     | 30.51765 | 6.037674  | 5.05  | 0.000| 18.66011 42.37519   |
| 4     | 47.82353 | 6.037674  | 7.92  | 0.000| 35.96599 59.68107   |
| 5     | 53.87255 | 6.037674  | 8.92  | 0.000| 42.01501 65.73009   |
| 6     | 52.31569 | 6.037674  | 8.66  | 0.000| 40.45815 64.17323   |
| 7     | 45.55294 | 6.037674  | 7.54  | 0.000| 33.6954 57.41048    |
| 8     | 43.95294 | 6.037674  | 7.28  | 0.000| 32.0954 55.81048    |
| 9     | 35.82745 | 6.037674  | 5.93  | 0.000| 23.96991 47.68499   |
| 10    | 40.84902 | 6.037674  | 6.77  | 0.000| 28.99148 52.70656   |
| 11    | 17.64706 | 6.037674  | 2.92  | 0.004| 5.78517 29.5046     |
| _cons | 96.07843 | 4.26928   | 22.50 | 0.000| 87.69388 104.463    |
```
Estimated Seasonality – Housing Starts

<table>
<thead>
<tr>
<th>Month</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>91</td>
</tr>
<tr>
<td>February</td>
<td>95</td>
</tr>
<tr>
<td>March</td>
<td>127</td>
</tr>
<tr>
<td>April</td>
<td>144</td>
</tr>
<tr>
<td>May</td>
<td>150</td>
</tr>
<tr>
<td>June</td>
<td>148</td>
</tr>
<tr>
<td>July</td>
<td>142</td>
</tr>
<tr>
<td>August</td>
<td>140</td>
</tr>
<tr>
<td>September</td>
<td>132</td>
</tr>
<tr>
<td>October</td>
<td>137</td>
</tr>
<tr>
<td>November</td>
<td>114</td>
</tr>
<tr>
<td>December</td>
<td>96</td>
</tr>
</tbody>
</table>
Housing Starts, by year, and estimated seasonality
Predicted Values
Example 1

Unemployment Rate

```
. use ur_nsa
. regress ur b12.m

<table>
<thead>
<tr>
<th>Source</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td>105.325822</td>
<td>11</td>
<td>9.57507469</td>
</tr>
<tr>
<td>Residual</td>
<td>1571.36666</td>
<td>733</td>
<td>2.14374715</td>
</tr>
<tr>
<td>Total</td>
<td>1676.69248</td>
<td>744</td>
<td>2.25361893</td>
</tr>
</tbody>
</table>

Number of obs = 745
F( 11, 733) = 4.47
Prob > F = 0.0000
R-squared = 0.0628
Adj R-squared = 0.0488
Root MSE = 1.4642

| ur | Coef.  | Std. Err. | t     | P>|t|  | [95% Conf. Interval] |
|----|--------|-----------|-------|------|---------------------|
| m  |        |           |       |      |                     |
| 1  | .8878648 | .2619242  | 3.39  | 0.001 | .3736537 1.402076   |
| 2  | .8306451 | .2629698  | 3.16  | 0.002 | .3143813 1.346909   |
| 3  | .5709677 | .2629698  | 2.17  | 0.030 | .0547039 1.087232   |
| 4  | .1048387 | .2629698  | 0.40  | 0.690 | -.4114251 .6211026  |
| 5  | -.1435484 | .2629698 | -0.55 | 0.585 | -.6598123 .3727154  |
| 6  | -.0016129 | .2629698 | -0.01 | 0.995 | -.5178768 .514651   |
| 7  | .0758064 | .2629698  | 0.29  | 0.773 | -.4404574 .5920703  |
| 8  | .0274194 | .2629698  | 0.10  | 0.917 | -.4888445 .5436832  |
| 9  | -.1580645 | .2629698 | -0.60 | 0.548 | -.6743284 .3581993  |
| 10 | -.2822581 | .2629698 | -1.07 | 0.283 | -.7985219 .2340058  |
| 11 | -.1129032 | .2629698 | -0.43 | 0.668 | -.6291671 .4033606  |
| _cons | 4.764516 | .1859478 | 25.62 | 0.000 | 4.399462 5.12957    |
```
Unemployment Rate, by year, and estimated seasonality
Predicted Values

![Predicted Values Graph](image-url)
Example 2
Gasoline Sales

```
. use gasoline
.
regress gasoline b12.m

<table>
<thead>
<tr>
<th>Source</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>Number of obs = 323</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td>636131968</td>
<td>11</td>
<td>57830178.9</td>
<td>F(11, 311) = 4.29</td>
</tr>
<tr>
<td>Residual</td>
<td>4.1919e+09</td>
<td>311</td>
<td>13478698.6</td>
<td>Prob &gt; F = 0.0000</td>
</tr>
<tr>
<td></td>
<td>4.8280e+09</td>
<td>322</td>
<td>14993811.3</td>
<td>R-squared = 0.1318</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Adj R-squared = 0.1010</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Root MSE = 3671.3</td>
</tr>
</tbody>
</table>

| gasoline | Coef.  | Std. Err. | t     | P>|t| | [95% Conf. Interval] |
|----------|--------|-----------|-------|------|----------------------|
| m        | -4309.025 | 1008.773 | -4.27 | 0.000 | -6293.908 to -2324.142 |
| 1        | -1928.984 | 1008.773 | -1.91 | 0.057 | -3913.867 to 55.8983  |
| 2        | -671.3583 | 1008.773 | -0.67 | 0.506 | -2656.241 to 1313.524 |
| 3        | -829.025  | 1008.773 | -0.82 | 0.412 | -2813.908 to 1155.858 |
| 4        | -210.0881 | 1008.773 | -0.21 | 0.835 | -2194.971 to 1774.795 |
| 5        | 1102.401  | 1008.773 | 1.09  | 0.275 | -882.4817 to 3087.284 |
| 6        | 644.1563  | 1008.773 | 0.64  | 0.524 | -1340.726 to 2629.039 |
| 7        | 1003.964  | 1008.773 | 1.00  | 0.320 | -980.9188 to 2988.847 |
| 8        | -822.2439 | 1008.773 | -0.82 | 0.416 | -2807.127 to 1162.639 |
| 9        | -817.0473 | 1008.773 | -0.81 | 0.419 | -2801.93 to 1167.835  |
| 10       | -1260.781 | 1008.773 | -1.25 | 0.212 | -3245.663 to 724.102  |
| _cons    | 59735.28  | 720.008  | 82.96 | 0.000 | 58318.57 to 61151.98   |
```
Gasoline Sales, by year, and estimated seasonality
Predicted Values
Application – Weekly Data

• Unemployment Insurance Claims
• Department of Labor
• Issued Weekly
• Important indicator for unemployment
Unemployment Claims
Not Seasonally Adjusted
Unemployment Claims
Official Seasonally Adjusted Series
### Estimation

```
. regress  iclaims_nsa  b52.w

<table>
<thead>
<tr>
<th>Source</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td>1.2804e+13</td>
<td>51</td>
<td>2.5105e+11</td>
</tr>
<tr>
<td>Residual</td>
<td>1.8865e+13</td>
<td>2186</td>
<td>8.6297e+09</td>
</tr>
<tr>
<td>Total</td>
<td>3.1668e+13</td>
<td>2237</td>
<td>1.4157e+10</td>
</tr>
</tbody>
</table>

Number of obs = 2238
F( 51, 2186) = 29.09
Prob > F = 0.0000
R-squared = 0.4043
Adj R-squared = 0.3904
Root MSE = 92896
```

| iclaims_nsa | Coef.    | Std. Err. | t     | P>|t| | [95% Conf. Interval] |
|-------------|----------|-----------|-------|-----|---------------------|
| W           |          |           |       |     |                     |
| 1           | 35954.91 | 19920.38  | 1.80  | 0.071 | -3109.952 to 75019.78 |
| 2           | 168185.3 | 19920.38  | 8.44  | 0.000 | 129120.4 to 207250.2 |
| 3           | 11166.58 | 20034.54  | 0.56  | 0.577 | -28122.15 to 50455.32 |
| 4           | -71213.05| 20034.54  | -3.55 | 0.000 | -110501.8 to -31924.31 |
| 5           | -77421.58| 20034.54  | -3.86 | 0.000 | -116710.3 to -38132.85 |
| 6           | -70397.88| 20034.54  | -3.51 | 0.000 | -109686.6 to -31109.15 |
| 7           | -125853.5| 20034.54  | -6.28 | 0.000 | -165142.3 to -86564.8 |
| 8           | -148580.9| 20034.54  | -7.42 | 0.000 | -187869.6 to -109292.2 |
| 9           | -142809.6| 20034.54  | -7.13 | 0.000 | -182098.4 to -103520.9 |
| 10          | -142668.5| 20034.54  | -7.12 | 0.000 | -181957.2 to -103379.8 |
| 11          | -167656.8| 20034.54  | -8.37 | 0.000 | -206945.6 to -128368.1 |
| 12          | -178125.4| 20034.54  | -8.89 | 0.000 | -217414.1 to -138836.7 |
| 13          | -187898.8| 20034.54  | -9.38 | 0.000 | -227187.6 to -148610.1 |
| 14          | -157631.2| 20034.54  | -7.87 | 0.000 | -196919.9 to -118342.5 |
| 15          | -144329.8| 20034.54  | -7.20 | 0.000 | -183618.5 to -105041.1 |
| 16          | -171520.5| 20034.54  | -8.56 | 0.000 | -210809.2 to -132231.8 |
Estimated Seasonal Process
Seasonally Adjusted
(by Dummy Variable Method)
Other types of seasonality

• Daily data
  – Day of the week
  – Handle by including dummy variables for each day

• High-frequency data
  – Include hourly or time-of-day indicators

• Holiday effects
  – Flower sales big on Valentines Day, Mothers Day, Easter, yet these days can move around
  – Trading-day/business-day variation
    • Number of trading days/business days varies across months
    • Can divide by number of trading days, or include as a regressor
Seasonal + Cycle

• Consider a components model with seasonal and AR(1) cycle

\[ y_t = S_t + C_t \]

\[ C_t = \beta C_{t-1} + e_t \]

• The seasonal \( S_t \) is a set of seasonal dummies

\[ S_t = \sum_{i=1}^{s} \alpha_i D_{it} \]
Transformation

\[ y_t = S_t + C_t \]
\[ C_t = \beta C_{t-1} + e_t \]

• Take the first equation and lag it once
\[ y_{t-1} = S_{t-1} + C_{t-1} \]

• Multiply it by \( \beta \)
\[ \beta y_{t-1} = \beta S_{t-1} + \beta C_{t-1} \]

• Then subtract it from the first equation to find
\[ y_t = \beta y_{t-1} + S_t - \beta S_{t-1} + e_t \]
Seasonal Representation

• We find

\[ y_t = \beta y_{t-1} + S_t - \beta S_{t-1} + e_t \]

• When the seasonal \( S_t \) is a set of seasonal dummies, one for each season, this equation suggests a regression on

- \( y_{t-1} \)
- Seasonal dummies
- Lagged Seasonal dummies
Redundant

• But lagged seasonal dummies are redundant with the original seasonal dummies
• The set of lagged dummy variables are collinear with the current dummy variables
• Given that you know this month is February, there is no information in knowing that last month was January.
• The lagged dummies can be (should be) omitted
Seasonal + Cycle

• We have found that the regression model is

\[ y_t = \sum_{i=1}^{s} \alpha_i D_{it} + \beta y_{t-1} + e_t \]

or

\[ y_t = \alpha_0 + \sum_{i=1}^{s-1} \alpha_i D_{it} + \beta y_{t-1} + e_t \]
AR(p) Case

• If the cycle is an AR(p) we have

\[
y_t = \sum_{i=1}^{s} \alpha_i D_{it} + \beta_1 y_{t-1} + \cdots + \beta_p y_{t-p} + e_t
\]

• Estimate by least squares
• Linear Forecasting
Trend+Seasonal+Cycle

• A full model is

\[ y_t = T_t + S_t + C_t \]

\[ T_t = \mu_1 + \mu_2 t \]

\[ S_t = \sum_{i=1}^{s} \alpha_i D_{it} \]

\[ C_t = \beta_1 C_{t-1} + \cdots + \beta_p C_{t-p} + e_t \]
Regression Model

• The implied regression model is

\[ y_t = \sum_{i=1}^{s} \alpha_i D_{it} + \gamma t + \beta_1 y_{t-1} + \cdots + \beta_p y_{t-p} + e_t \]

• This can be estimated by least-squares
• It is a complete forecasting model
Example: NSA Unemployment Rate
Regress on Dummies plus AR(12)

```
.reg ur b12.m L(1/12).ur

<table>
<thead>
<tr>
<th>Source</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td>1609.97357</td>
<td>23</td>
<td>69.9988508</td>
</tr>
<tr>
<td>Residual</td>
<td>33.8239198</td>
<td>709</td>
<td>.047706516</td>
</tr>
<tr>
<td>Total</td>
<td>1643.79749</td>
<td>732</td>
<td>2.24562498</td>
</tr>
</tbody>
</table>

Number of obs = 733
F(23, 709) = 1467.28
Prob > F = 0.0000
R-squared = 0.9794
Adj R-squared = 0.9788
Root MSE = .21842

| ur | Coef.     | Std. Err. | t       | P>|t| | [95% Conf. Interval] |
|----|-----------|-----------|---------|-----|---------------------|
| m  |           |           |         |     |                     |
| 1  | .8614153  | .0577449  | 14.92   | 0.000 | .7480438 - .9747868 |
| 2  | -.1534497 | .0777527  | -1.97   | 0.049 | -.3061028 - -.0007967 |
| 3  | -.468174  | .087469   | -5.35   | 0.000 | -.6399033 - -.2964448 |
| 4  | -.5474595 | .0821548  | -6.66   | 0.000 | -.7087554 - -.3861636 |
| 5  | -.1594984 | .0684777  | -2.33   | 0.020 | -.2939418 - -.025055  |
| 6  | .2175848  | .0633983  | 3.43    | 0.001 | .0931139 .3420557    |
| 7  | .1527194  | .0691765  | 2.21    | 0.028 | .0169041 .2885346    |
| 8  | -.0525233 | .0835277  | -0.63   | 0.530 | -.2165145 .1114679   |
| 9  | -.2668832 | .089909   | -2.97   | 0.003 | -.4434029 -.0903635  |
| 10 | -.1902467 | .0812989  | -2.34   | 0.020 | -.3498622 -.0306312  |
| 11 | .1247499  | .0685836  | 1.82    | 0.069 | -.0099012 .2594011   |
```
## AR Coefficients

| ur     | Coef.     | Std. Err. | t     | P>|t|  | [95% Conf. Interval] |
|--------|-----------|-----------|-------|------|----------------------|
| L1.    | 1.119934  | 0.0373309 | 30.00 | 0.000| 1.046642 1.193227    |
| L2.    | 0.0911447 | 0.0562169 | 1.62  | 0.105| -0.0192268 0.2015162|
| L3.    | -0.1434849| 0.0563492 | -2.55 | 0.011| -0.2541162 -0.0328536|
| L4.    | -0.1024096| 0.0566111 | -1.81 | 0.071| -0.213555 0.0087359 |
| L5.    | 0.0776225 | 0.0566159 | 1.37  | 0.171| -0.0335323 0.1887774 |
| L6.    | -0.1096277| 0.0566984 | -1.93 | 0.054| -0.2209446 0.0016892 |
| L7.    | 0.0013858 | 0.0565946 | 0.02  | 0.980| -0.1097274 0.1124989 |
| L8.    | 0.0828428 | 0.0565074 | 1.47  | 0.143| -0.0280991 0.1937846 |
| L9.    | -0.0202508| 0.0564409 | -0.36 | 0.720| -0.1310621 0.0905605 |
| L10.   | -0.0057293| 0.0563117 | -0.10 | 0.919| -0.116287 0.1048284  |
| L11.   | 0.0887878 | 0.0562091 | 1.58  | 0.115| -0.0215683 0.199144  |
| L12.   | -0.1025115| 0.0373434 | -2.75 | 0.006| -0.1758284 -0.0291946|
| _cons  | 0.1530973 | 0.059812  | 2.56  | 0.011| 0.0356676 0.2705271  |
Fitted Values
Last 2 years
12-month forecast

NSA Unemployment Rate

- **ur**
- **forecast**
- **lower forecast interval**
- **upper forecast interval**

Graph showing the NSA unemployment rate from 2008m1 to 2011m1, with different lines representing actual data and forecasted data with confidence intervals.
Forecasting with Seasonal Dummy

• To forecast in STATA with seasonal dummies, the dummy variables must be defined for the forecast period

• After you use the `tsappend` command, you create the month variable
  
  `.gen m=month(dofm(t))`
  
  or
  
  `.replace m=month(dofm(t))`

• Otherwise m will have missing values for the forecast period
Example: Retail Sales

- U.S. Census Bureau
  - Monthly Retail Sales
  - Not Seasonally Adjusted and Seasonally Adjusted
  - Sales listed by variety of categories
  - 1992-2009
### From Census Bureau Spreadsheet

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Retail and food services sales, total</td>
<td>313,593</td>
<td>304,056</td>
<td>334,149</td>
<td>336,155</td>
<td>354,668</td>
<td>351,418</td>
</tr>
<tr>
<td>Retail sales and food services excl motor vehicle and parts</td>
<td>262,237</td>
<td>252,560</td>
<td>275,000</td>
<td>277,938</td>
<td>294,559</td>
<td>289,242</td>
</tr>
<tr>
<td>Retail sales, total</td>
<td>277,402</td>
<td>269,015</td>
<td>295,520</td>
<td>298,119</td>
<td>313,979</td>
<td>312,547</td>
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<tr>
<td>Retail sales, total (excl. motor vehicle and parts dealers)</td>
<td>226,046</td>
<td>217,519</td>
<td>236,371</td>
<td>239,902</td>
<td>253,870</td>
<td>250,371</td>
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<tr>
<td>GAFO(1)</td>
<td>83,323</td>
<td>82,918</td>
<td>87,477</td>
<td>87,248</td>
<td>93,069</td>
<td>88,330</td>
</tr>
<tr>
<td>Motor vehicle and parts dealers</td>
<td>51,356</td>
<td>51,496</td>
<td>59,149</td>
<td>58,217</td>
<td>60,109</td>
<td>62,176</td>
</tr>
<tr>
<td>Automobile and other motor vehicle dealers</td>
<td>45,385</td>
<td>45,544</td>
<td>52,498</td>
<td>51,558</td>
<td>53,528</td>
<td>55,239</td>
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<tr>
<td>Automobile dealers</td>
<td>41,790</td>
<td>41,632</td>
<td>46,834</td>
<td>45,373</td>
<td>46,601</td>
<td>48,405</td>
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<tr>
<td>New car dealers</td>
<td>36,032</td>
<td>35,304</td>
<td>40,575</td>
<td>39,492</td>
<td>40,941</td>
<td>42,530</td>
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<tr>
<td>Used car dealers</td>
<td>5,758</td>
<td>6,328</td>
<td>6,259</td>
<td>5,881</td>
<td>5,660</td>
<td>5,875</td>
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<tr>
<td>Automotive parts, acc., and tire stores</td>
<td>5,971</td>
<td>5,952</td>
<td>6,651</td>
<td>6,659</td>
<td>6,581</td>
<td>6,937</td>
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<tr>
<td>Furniture, home furn, electronics, and appliance stores</td>
<td>16,069</td>
<td>15,700</td>
<td>15,530</td>
<td>14,545</td>
<td>15,362</td>
<td>15,519</td>
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<tr>
<td>Furniture and home furnishings stores</td>
<td>7,428</td>
<td>7,219</td>
<td>7,601</td>
<td>7,293</td>
<td>7,689</td>
<td>7,728</td>
</tr>
<tr>
<td>Furniture stores</td>
<td>4,230</td>
<td>4,296</td>
<td>4,262</td>
<td>3,969</td>
<td>4,261</td>
<td>4,148</td>
</tr>
<tr>
<td>Home furnishings stores</td>
<td>3,198</td>
<td>2,923</td>
<td>3,339</td>
<td>3,324</td>
<td>3,428</td>
<td>3,580</td>
</tr>
<tr>
<td>Floor covering stores</td>
<td>1,381</td>
<td>1,335</td>
<td>1,448</td>
<td>1,475</td>
<td>1,462</td>
<td>1,673</td>
</tr>
<tr>
<td>All other home furnishings stores</td>
<td>1,698</td>
<td>1,480</td>
<td>1,762</td>
<td>1,725</td>
<td>1,851</td>
<td>1,790</td>
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<tr>
<td>Electronics and appliance stores</td>
<td>8,641</td>
<td>8,481</td>
<td>7,929</td>
<td>7,252</td>
<td>7,673</td>
<td>7,791</td>
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<tr>
<td>Appl., T.V., and other elect. stores</td>
<td>6,706</td>
<td>6,615</td>
<td>5,936</td>
<td>5,374</td>
<td>5,827</td>
<td>5,857</td>
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<tr>
<td>Household appliance stores</td>
<td>1,306</td>
<td>1,201</td>
<td>1,249</td>
<td>1,252</td>
<td>1,317</td>
<td>1,349</td>
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<tr>
<td>Radio, T.V., and other elect. stores</td>
<td>5,400</td>
<td>5,414</td>
<td>4,687</td>
<td>4,122</td>
<td>4,510</td>
<td>4,508</td>
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<tr>
<td>Computer and software stores</td>
<td>1,734</td>
<td>1,722</td>
<td>1,790</td>
<td>1,679</td>
<td>1,612</td>
<td>1,706</td>
</tr>
</tbody>
</table>
Liquor Sales

- Beer, wine and liquor
- Sample: 1992-2009
- Not Seasonally Adjusted
- Big spike in December
Liquor Sales (Millions of $)
Residual from Linear Trend
Seasonal Dummy
Residuals after Seasonal Dummies
## Full Estimation

```
.reg y t b12.m L(1/12).y
```

<table>
<thead>
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<th>Source</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
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<tr>
<td>Model</td>
<td>12.6032786</td>
<td>24</td>
<td>0.52513661</td>
<td>Number of obs = 204</td>
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<tr>
<td>Residual</td>
<td>0.083727442</td>
<td>179</td>
<td>0.000467751</td>
<td>F(24, 179) = 1122.68</td>
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<tr>
<td>Total</td>
<td>12.6870061</td>
<td>203</td>
<td>0.062497567</td>
<td>Prob &gt; F = 0.0000</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>R-squared = 0.9934</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Adj R-squared = 0.9925</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Root MSE = 0.02163</td>
</tr>
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</table>

| y         | Coef. | Std. Err. | t     | P>|t| | [95% Conf. Interval] |
|-----------|-------|-----------|-------|------|----------------------|
| t         | 0.0005763 | 0.0001903 | 3.03  | 0.003 | 0.0002007 0.0009519 |
| m         |        |           |       |      |                      |
| 1         | -0.4414455 | 0.0475001 | -9.29 | 0.000 | -0.5351778 -0.3477132 |
| 2         | -0.4495358 | 0.0524949 | -8.56 | 0.000 | -0.5531243 -0.3459472 |
| 3         | -0.32453   | 0.0590456 | -5.50 | 0.000 | -0.441045 -0.2080149 |
| 4         | -0.1865844 | 0.0477627 | -3.91 | 0.000 | -0.2808349 -0.0923339 |
| 5         | -0.2373487 | 0.0430689 | -5.51 | 0.000 | -0.3223367 -0.1523606 |
| 6         | -0.1554224 | 0.0503231 | -3.09 | 0.002 | -0.2547253 -0.0561194 |
| 7         | -0.1289456 | 0.0502340 | -2.57 | 0.011 | -0.2280725 -0.0298187 |
| 8         | -0.2270499 | 0.0500036 | -4.54 | 0.000 | -0.3257222 -0.1283775 |
| 9         | -0.4130694 | 0.0607582 | -6.80 | 0.000 | -0.5329639 -0.293175  |
| 10        | -0.2073198 | 0.0597305 | -3.47 | 0.001 | -0.3251863 -0.0894532 |
| 11        | -0.2796951 | 0.0484164 | -5.78 | 0.000 | -0.3752355 -0.1841547 |
## AR Coefficients

<p>| | | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>L1</td>
<td>.225336</td>
<td>.0741289</td>
<td>3.04</td>
<td>0.003</td>
<td>.079057</td>
<td>.3716149</td>
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<tr>
<td>L2</td>
<td>.2636816</td>
<td>.075335</td>
<td>3.50</td>
<td>0.001</td>
<td>.1150227</td>
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<tr>
<td>L3</td>
<td>.3490587</td>
<td>.0749059</td>
<td>4.66</td>
<td>0.000</td>
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<td>L4</td>
<td>-.0818078</td>
<td>.0778903</td>
<td>-1.05</td>
<td>0.295</td>
<td>-.2355091</td>
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<td>.2386739</td>
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<td>3.10</td>
<td>0.002</td>
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<td>L6</td>
<td>-.0707958</td>
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<td>-0.91</td>
<td>0.366</td>
<td>-.2248862</td>
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<td>-.1447524</td>
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<td>-1.85</td>
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<td>-.2990625</td>
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<td>L8</td>
<td>-.1762223</td>
<td>.0774924</td>
<td>-2.27</td>
<td>0.024</td>
<td>-.3291385</td>
<td>-.0233061</td>
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<td>L9</td>
<td>.2302193</td>
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<td>2.94</td>
<td>0.004</td>
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<td>L10</td>
<td>-.2566324</td>
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<td>-3.41</td>
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<td>2.34</td>
<td>0.020</td>
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</tr>
</tbody>
</table>

_cons | 1.164893 | .3237073 | 3.60 | 0.000 | .5261194 | 1.803666 |
Fitted Values
Last 3 years
Residuals
12-Month Forecast

Liquor Sales

- y
- forecast
- lower forecast interval
- upper forecast interval
12-month forecast

• The big jump down in the forecast for January 2010 is because of the seasonal dummy effect