xtgraph a new command for summary graphs of xt data

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With thanks to:
Lucy Chappell, Annette Briley, Andy Shennan, Lucilla Poston.
Original problem:

— RCT of Vitamin C & E supplementation in 160 women at high risk of pre-eclampsia (Chappell et al, 1999)
— 1000g of C & 400 IU of E daily, or placebo
— main findings very encouraging.

— blood taken measured at 4 weekly intervals
— graphs needed of changes in vitamin C & E over time
— weekly means with standard errors
¥ Simple solution:

```stata
egen mean = mean(vitc), by(week group)
egen se = sd(vitc), by(week group)
egen n = count(vitc), by(week group)
replace se = se/n^.5
gen lb = mean - se
...
graph m_vit m_pl lb ub week, s(o1) c(l1l)
```

Vitamin E roughly log-normal. Means & SE worked out for log(vite) and then back-transformed to give geometric means.
Vitamin C ($\mu$mol/l) vs. Gestational age (weeks)

- **Placebo**
- **Vitamins**

![Graph showing vitamin C levels over gestational age]

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Gestational age (weeks)

Placebo

Vitamin
Additional work on study

¥ Over 20 blood markers + combinations
  —lipids, known & suspected risk factors etc.
¥ 3 risk groups
  —High risk Vitamin, high risk placebo, low risk.
¥ Also comparison by outcome
  —Low risk AGA, SGA, pre-eclampsia

¥ Time to write a program
xtgraph - basic syntax

xtgraph varname [if] [in], group(groupvar)  
    av(avtype) bar(bartype) graph options xt options

Examples:
xtgraph vitc if week >=20 & week <= 36,  
    group(group) bar(se) i(pno) t(week)

xtgraph vite if week >=20 & week <= 36,  
    group(group) av(gm) bar(se)

These produce similar graphs to those already seen. Plotting symbols can be
changed with standard graph options.
Choice of average

xtgraph , av(avtype)

The average types are

• am - arithmetic mean, the default
• gm - geometric mean
• hm - harmonic mean
• median - only with bars ci - default, iqr or rr.

For gm and hm, values are worked out for log or inverse of data & then back-transformed
Harmonic Mean Serum Vitamin E

Week of Gestation

Geometric Mean Serum Vitamin E

Week of Gestation
Choice of error bars

\texttt{xtgraph , bar(bar type) level(significance level)}

The bar types are
- \texttt{ci} - the default, significance set by \texttt{level()}
- \texttt{se} - standard error
- \texttt{sd} - standard deviation
- \texttt{rr} - reference range, level set by \texttt{level()}
- \texttt{iqr} - same as \texttt{bar(rr) level(50)}
- \texttt{no} - no bars
xtgraph - extensions

- saving & displaying summary data
- separating error bars
- choice of transformation for normality
- handling missing data
- post-model fitting
- displaying interactions
Saving & displaying summary data

xtgraph , nograph list
saving(graph file[,, replace])
savedat(datafile[,, replace])

- nograph suppresses the graph output
- list outputs a list of the graphed values
- savedat() saves the list in a Stata data file
- saving() work as standard graph options
Geometric mean of vite with bars based on 95% CI by group and week.

<table>
<thead>
<tr>
<th>week</th>
<th>n</th>
<th>mean</th>
<th>lb</th>
<th>ub</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>73</td>
<td>28.134</td>
<td>26.85224</td>
<td>29.47695</td>
</tr>
<tr>
<td>24</td>
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<td>28</td>
<td>72</td>
<td>31.58989</td>
<td>29.93666</td>
<td>33.33442</td>
</tr>
<tr>
<td>32</td>
<td>73</td>
<td>32.16195</td>
<td>30.50241</td>
<td>33.91177</td>
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<td>36</td>
<td>60</td>
<td>33.36979</td>
<td>31.60051</td>
<td>35.23814</td>
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</tbody>
</table>

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<tr>
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<th>mean</th>
<th>lb</th>
<th>ub</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>69</td>
<td>30.81844</td>
<td>29.05559</td>
<td>32.68825</td>
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<tr>
<td>24</td>
<td>66</td>
<td>40.29107</td>
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<td>28</td>
<td>72</td>
<td>46.24894</td>
<td>43.11024</td>
<td>49.61615</td>
</tr>
</tbody>
</table>

...
Separating error bars

\texttt{xtgraph , offset(num)}
\texttt{xtgraph , half}

- \texttt{offset} moves estimates and error bars a small distance away from one another.
- \texttt{half} draws half-bars from the mean to the upper or lower limit.
  - \texttt{half} only works with 2 groups.
Choice of transformation for normality

xtgraph , power(num)
xtgraph , log(num)

• estimates & bars for $y^{power}$ or $\log(y-k)$
• values back-transformed before plotting
• Stata can determine suitable values
  – power by ladder, boxcox or bcskew0
  – 3 parameter log: $y = \log(x-k)$ by lnskew0

• $\text{power}(0) = \log(0) = \text{av (gm)}$
• $\text{power}(-1) = \text{av (hm)}$
Example of transformation for normality

```
xi: boxcox vite i.week*vitamin
   i.week*placebo

local power = $S_1

xtgraph vite, group(group) bar(ci)
   power('power')
```
Based on power transformation: \((\text{vitamin E})^{-0.30}\)
Missing data

```
xtrigraph ... [listwise] [minobs(#)]
```

- `listwise` specifies that no panel with missing data may be used
- `minobs` gives the minimum number of observations needed per panel
Post-model fitting

```
xtgraph var,... model
```

- Graphs predicted values after any regression
- Bars based on `stdf` (for SD, RR) or `stdp` (for SE, CI).
- Estimates are back-transformed if appropriate.
- `Var` only gives name to predicted values
  —it need not be the outcome specified in the regression
Example

```
gen bc_vite = vite^'power'
fracpoly regress bc_vite week vitamin placebo
...
xi: xtgee bc_vite i.group*week__1
   i.group*week__2 , nolog corr(ar1)
xtgraph vite , model power('power ')
```
Fractional polynomial curves & power transformation model: $y^{0.30} = a + bx + c\sqrt{x}$
Averages & SD using transformation $y^{0.30}$.
with fractional polynomial curves
Possible extension: Show the simple averages and the fitted lines on the same curves

```
xtgraph , line(avtype)
```

`avtype` would include model

✓ Can be achieved by
  —saving averages,
  —appending data
  —standard graph commands
Displaying interactions

• `xtgraph` works on non-XT data
  – any variable for `i`
  – `t` need not be ordered

• Example uses Stata's `systolic.dta`
  – SBP change with 4 drugs for 3 diseases

`anova systolic drug*disease`
`xtgraph systolic, group(drug) model`
Increment in Systolic B.P.

Patient's Disease

- Patient 1
- Patient 2
- Patient 3
- Patient 4

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Summary

xtgraph produces summary graphs of xt data, by time and group. Features include

—power & log transformation,
—error bars for SE, CI, SD & Reference Range
—offset & half-bars for clarity
—medians with IQR.
—model option uses last model fitted. This can show linear and non-linear effects & interactions
—graphed results can be saved for further work
—may be used to display interactions following anova etc.
What next?

• all the planned options are now in place
  - ideas for more options welcome
  - model option can be developed further
  - line option possible

• beta-testing

• release via STB
Acknowledgements

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References:
Seed PT. *xtgraph* a new command for summary graphs of *xt* data. Stata Technical Bulletin (to be submitted)