

INTRODUCTION TO
COMPUTER WORKSHOP
&
TSP

Cost of Electric Power Generation

Questions

1. Does the average cost of producing electricity increase or decrease as more electricity is produced by a plant?
2. Are the average costs of my plant higher or lower than at other plants, after adjusting for output?
3. What is the marginal cost of electricity?

You sample 150 plants from a list of fossil fuel electric generation facilities in the U.S.

You collect information on the output of each plant in 1992, the costs of production in 1992, the capacity of the plant, and other information.

You could not obtain information for 23 of the sampled plants, and so you are left with 127 plants.

The data are stored in the file PLANTDAT. The variables are:

- q Total output in gWhs (millions of kWhs) in 1992
- ac Average cost of production in 1992, in cents per kWh. Calculated as total production costs in 1992 divided by total output in 1992, multiplied by (100/1,000,000) to convert dollars/gWh into cents/kWh. Includes fixed costs of plant amortized over 10 years, plus variable costs of production.
- k Capacity of plant in mWs (thousands of kW). This is the maximum output the plant can produce at one point in time.
- region Region of the country in which the plant is located (1 = Northeast, 2 = Southeast, 3 = Midwest, 4 = West).

The first 10 observations look like this:

	AC	Q	K	REGION
1	4.46230	661.05005	132.86299	2.00000
2	4.01080	882.91998	130.70799	2.00000
3	4.48790	500.00000	128.55299	4.00000
4	4.79720	814.97998	132.52699	4.00000
5	4.70950	515.88000	130.01700	2.00000
6	4.53450	948.35999	128.73300	2.00000
7	4.89100	706.05005	129.05701	2.00000
8	5.19310	588.54999	126.41300	3.00000
9	4.10670	733.91998	131.68500	4.00000
10	4.14360	551.16998	125.05800	3.00000

Steps to Run a TSP Job

1. Create or modify a file of TSP commands.
2. Run the TSP command file.
3. Print the output.

TSP Command File: EXAMPLE.TSP

```
options crt;  
smp1 1 127;  
in plantdat;  
graph ac,q;  
msd ac,q;  
corr ac,q;  
cov ac,q;  
olsq ac c,q;  
graph @fit,q;  
msd @res;  
corr @res,q;
```

To Run the Program

1. Login. You will be in the Sun Open Windows graphical environment, with the following display:

Upper left corner - file manager window

Right side - shelltool window with Unix prompt
(the % sign)

A few miscellaneous icons (clock, mailtool)
that can be ignored

2. The file manager is a window showing your directories and files; these look like pictures of file folders. Open the **mon** directory by clicking twice with the left mouse button while the pointer is on the **mon** icon. You should now see a folder icon labeled **example.tsp**.
3. Bring this file into the text editor by pointing to the icon labeled **example.tsp** and clicking twice with the left mouse button. You will get a text editor window that shows the contents of the file.
4. Edit the file as you want. The editor is fairly straightforward (the arrows work as on a PC, and backspacing will delete characters as you go backwards). You can position the cursor anywhere by moving the pointer and clicking once with the left mouse button.

5. Save the edited file under a new name. To do this, point to the **File** menu button (upper left corner of the text editor window) and click once with the right mouse button. This will bring up a menu from which you should choose **Store as a New File** by clicking once on it with the left button. You will be prompted for a new file name. Type in the name of the new file, such as **myprog.tsp**, or whatever name you want to give your command file. The name must end in **.tsp**, however.
6. (OPTIONAL) To exit the text editor window, point to any part of the upper frame (darker gray) and click once with the right button. Select **Quit** (bottom of the menu) and click once with the left button. This will make the text editor window go away. Alternatively, you can just close (iconify) the text editor window by pointing to the upside-down triangle in the upper left corner of the window and clicking once with the left button.
7. In the window with the Unix prompt (%), change to the **mon** directory and then run the program in TSP by typing, for example:

```
cd mon
tsp file1 file2
```

at the percent prompt. The name of the TSP command file you want to run is **file1** (you can omit the **.tsp**

extension of the filename when you use the `tsp` command, since the program automatically looks for command files ending in `.tsp`). The name of the output file is **file2** (TSP will add the extension `.out` to this file name, e.g., **file2.out**).

NOTE: Do not worry about multiple icons or having multiple windows open at the same time. When you log out, all windows (open and iconified) will be closed properly.

To LOGOUT of the workshop session, move the pointer to a blank (non-window) area of the screen. Click the right button on the mouse, point to EXIT, and click on EXIT with the left button. The pop-up menu that appears will ask for confirmation of the EXIT command by offering you an EXIT or CANCEL choice. Move the pointer to the EXIT option and click on it with the left button. This officially logs you out of the Open Windows environment and ends your current session.

WORKSHOP

OLS Regression

1. Before running a regression, think about the situation. Why would average cost differ for plants with different output? Do you think that average cost is larger or smaller for plants with greater output? (That is, do you think there is a positive relation between average cost and output or a negative relation?) Why?
2. Now run the TSP program `example.tsp` in the window with the Unix `%` prompt by typing

```
cd mon
tsp example my
```

Your output will have the name `my.out`. (You can put a different output name if you want.)

You can look at the output by typing

```
more my.out
```

You can print the output by typing

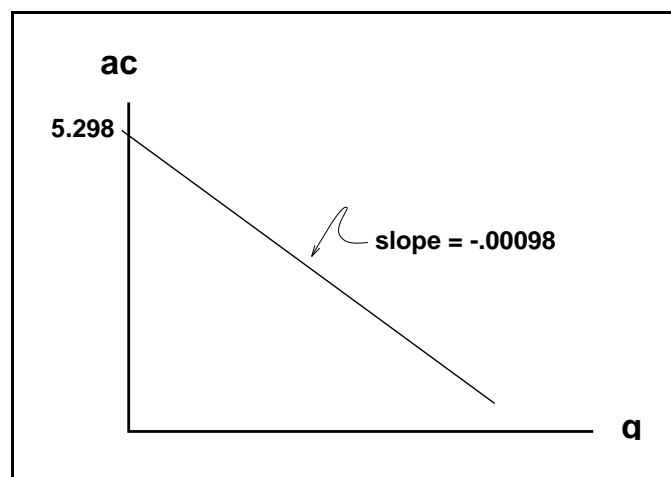
```
qlpr my.out
```

3. Does the regression indicate a positive or negative relation? Does this result confirm or contradict your previous ideas (that is, your answer to question 1). If it contradicts, what do you think is causing the result?
4. If the output of a plant increases by 7 gWhs, how much does the OLS line predict that its average cost will change?
5. What percent of the variation in average costs is explained by the variation in output?
6. Your own plant has output of 200 gWh and an average cost of 4.9 cents per kWh. Your average cost is higher than the average for all plants. However, you produce less output than other plants. Is your average cost higher or lower than predicted by the OLS line, after adjusting for output?

7. The regression implies that the average cost function is

$$ac = 5.298 - 0.00098 q$$

The graph of the ac function looks like this:



- a. Give the total cost function, and draw a simple graph of it.
- b. Give the marginal cost function.
 - i. What does this function imply is the marginal cost of an extra unit of output at your plant?
 - ii. At what level of output does the predicted MC become zero? Does any plant in your sample have this level of output?

8. Suppose average costs were calculated in mills instead of cents, where a mill is one-tenth of a cent. (That is, a cost of 4.3 cents per kWh would be 43 mills per kWh).

Without running a new regression, figure out what $\hat{\beta}$ would be. Now, modify `example.tsp` to run this regression. Use:

```
genr acm = ac * 10 ;
```

to create the new average cost variable. Change the OLSQ statement to use this new variable:

```
olsq acm c,q ;
```

Save the modified file, and then run it in TSP. Did you get the answer you expected?

9. The capacity of a plant might also affect average costs. Do you think that average costs are higher or lower for plants with greater capacity, holding output constant?
10. Modify `example.tsp` to run a regression with q and k :

```
olsq ac c,q,k ;
```

Were your conjectures about k (i.e., your answer to question 9) confirmed or contradicted? If contradicted, what could be causing the results?

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