

1. The article “Knee Surgery for Arthritis Is Called Sham” by Gina Kolata in the **New York Times** of July 11, 2002, describes a study of a medical procedure performed on at least 225,000 middle-age and older Americans each year at a cost of more than a billion dollars to Medicare, the Department of Veterans Affairs and private insurers. In the study, published in the **New England Journal of Medicine**, investigators at the Houston Veterans Affairs Medical Center and Baylor College of Medicine randomly assigned the 180 study participants to have either arthroscopic surgery for osteoarthritis or placebo surgery in which surgeons simply made cuts in their knees so the patients would not know if they had the surgery. After they recovered from the procedures, most patients said their knee pain had improved, and they continued to say they were better for the two years that the researchers followed their progress.

- (a) (10 points) What kind of study is this? Justify your answer.

ANS: *It is a controlled experiment since treatments (surgery or placebo) are assigned to experimental units (study participants) in order to observe a response (reported level of knee pain).*

- (b) (10 points) Under what circumstances can the results of the study be legitimately extrapolated to the population of all people having osteoarthritis of the knee?

ANS: *It can only be extended to that population if the participants are selected by a probability sampling method from the population.*

- (c) (10 points) How might the researchers use blocking to improve the sensitivity of the analysis? Why would your suggestion provide improved sensitivity?

ANS: *They might group the participants into blocks based on age, gender, severity of condition, or some other nuisance factor, then randomly assign treatment or placebo within each block. This would improve the sensitivity by allowing direct comparison between more homogeneous subjects. (Note: Another idea might be to have one knee on each patient given surgery and the other placebo. This would require that patients have the disease in both knees and with approximately the same severity.)*

2. Figure 1 shows a SAS/INSIGHT distribution analysis of times it took a set of subjects to visually resolve an optical illusion.

- (a) (10 points) In one short sentence give a qualitative description of the shape of the distribution pattern you see here.

ANS: *The distribution is unimodal and skewed right.*

- (b) (10 points) Give an appropriate measure of location for this distribution. Interpret the measure you give in terms of the resolution times.

ANS: *The median, $Q_2 = 6.9$. At least half the times are no smaller than 6.9 and at least half are no larger. (Also acceptable is the mode: 5, the value near which the greatest concentration of times lies.)*

- (c) (10 points) Give an appropriate measure of spread for this distribution. Interpret the measure you give in terms of the resolution times.

ANS: *The interquartile range: 7.2. This is the range of the middle half of the times.*

- (d) (10 points) Are there possible outliers in the data? On what do you base your answer?

ANS: *Yes, the two values above the upper adjacent value. These are automatically identified as outliers by the box-and-whiskers plot.*

3. Figure 2 contains graphs of four data sets, each having 200 observations graphed in the time order in which the observations were taken.

- (a) (20 points) Which set(s) (if any) appear to be from stationary processes? Which from nonstationary processes? For each process you conclude is nonstationary, tell in what way it is nonstationary.

ANS:

Set 1 *Nonstationary, with increasing variation over time.*

Set 2 *Stationary.*

Set 3 *Nonstationary, with linear trend.*

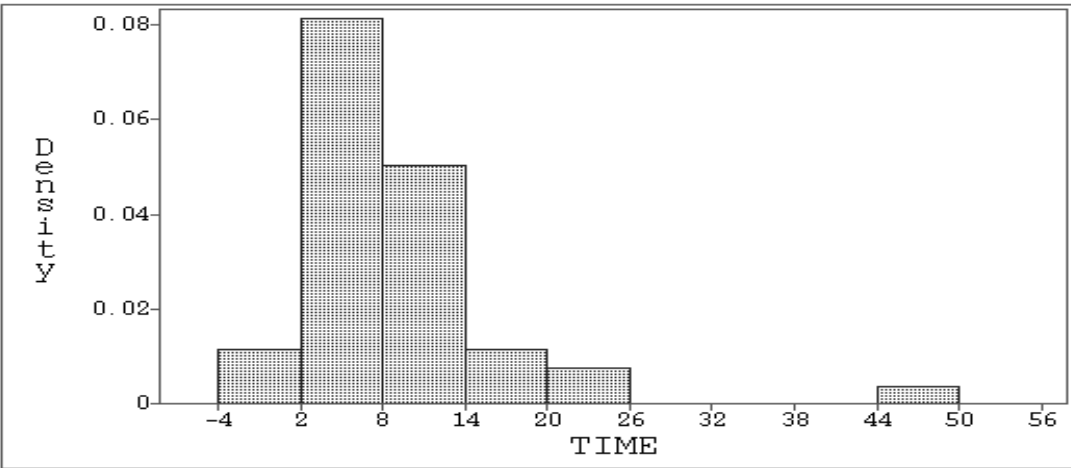
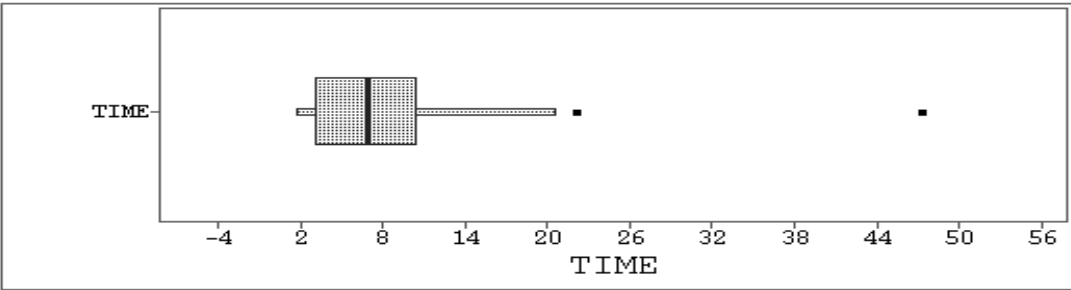
Set 4 *Nonstationary, with a change in level around observation 130.*

- (b) **(5 points)** One data set represents the errors (in \$1000) in reconciling weekly the accounts of a rapidly growing startup company over a four year period. Which is it?

ANS: *Set 1 would fit this description. The size of the errors would grow with the company's accounts, and a startup would begin with errors of virtually 0.*

- (c) **(5 points)** Another data set represents the thickness, in inches, of a mylar sheet. Part way through the run, the machine's target setting shifted abruptly to a larger value. Which data set is it?

ANS: *Set 4 fits this description as it is the only set with an abrupt shift.*



Moments			
N	43.0000	Sum Wgts	43.0000
Mean	8.5605	Sum	368.1000
Std Dev	8.0854	Variance	65.3739
Skewness	2.8726	Kurtosis	11.7310
USS	5896.8099	CSS	2745.7030
CV	94.4506	Std Mean	1.2330

Quantiles			
100% Max	47.2000	99.0%	47.2000
75% Q3	10.3000	97.5%	22.0000
50% Med	6.9000	95.0%	20.4000
25% Q1	3.1000	90.0%	17.4000
0% Min	1.7000	10.0%	2.1000
Range	45.5000	5.0%	1.9000
Q3-Q1	7.2000	2.5%	1.7000
Mode	1.7000	1.0%	1.7000

Figure 1:

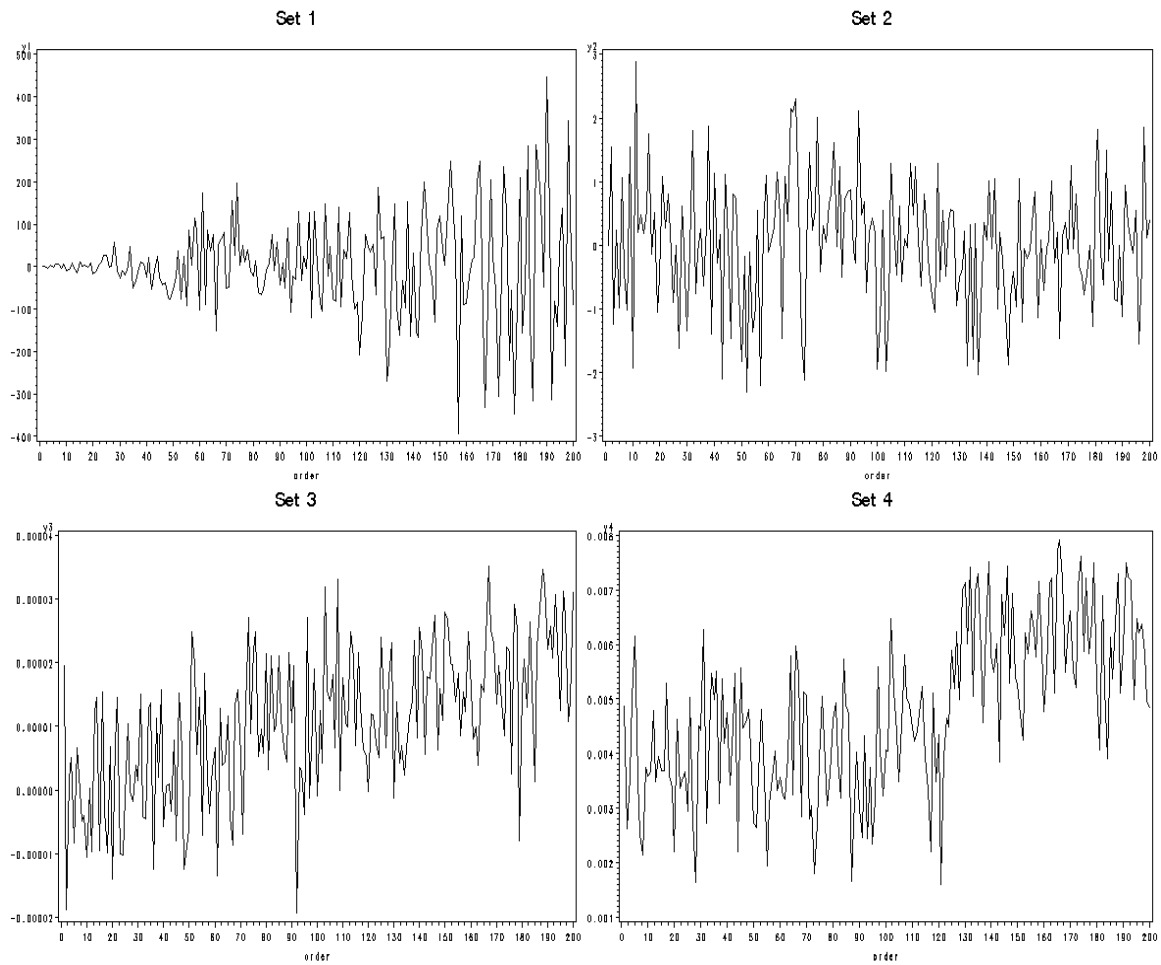


Figure 2: