**PSG COLLEGE OF TECHNOLOGY:: COIMBATORE- 641 004**

**DEPARTMENT OF APPLIED MATHEMATICS AND COMPUTATIONAL SCIENCES**

**20XD36 APPLIED STATISTICS AND R PROGRAMMING LAB – M Sc(DS)**

**Case Study –I :** *How does one select employees to perform physically demanding jobs? This case study examines the relationship between isometric strength tests and job performance for 147 workers.*

The specific statistical principles associated with this study are:

* scatterplots
* covariance
* correlation
* linear regression
* multiple regression

*Study Participants*

The data presented in this case study were collected from 147 individuals working in physically demanding jobs including electricians, construction and maintenance workers, auto mechanics, and linemen. An analysis of the tasks performed in these jobs showed that a number of them required a substantial amount of strength to perform. Here are some examples of physically demanding tasks performed in some of these jobs.

* Uses hand tools (wrenches, pliers, hammer)
* Carries equipment, tools, and other materials to and from job sites
* Secures job site by laying out, constructing, and installing shoring, barricades, and industrial fencing
* Excavates for landscaping, trenches, and job site

*Physical Strength Measures*

Two measures of strength were gathered from each participant. These included grip and arm strength. A piece of equipment known as the Jackson Evaluation System (JES) was used to collect the strength data. The JES can be configured to measure the strength of a number of muscle groups. In this study, grip strength and arm strength were measured. For each of the tests, the participant was asked to exert as much force as they could for a period of 2 seconds. The equipment then measured the maximum force exerted in pounds (lbs.). Since there is little to no movement along any joints, these measures are often referred to as isometric strength measures. To increase the accuracy of the measure, participants were asked to perform each test twice. The two scores were then averaged together for each of the two strength measures (grip and arm).

*Job Performance*

Two separate measures of job performance are presented in this case study. First, the supervisors for each of the 147 study participants were asked to rate how well their employee(s) perform on the physical aspects of their jobs using a 60-point scale. Higher numbers indicate better performance on the physically demanding aspects of the job. Second, two work simulations were developed by using information collected from an analysis of the jobs as well as observations and measurements of individuals performing each of the jobs studied. The simulations required that the participant exert force on a simulated wrench while assuming a standing and a kneeling position. The scores on each of the simulations were standardized and summed together to form one single measure. Larger scores indicate better performance on the work simulations.

 Data : caseStudy-2.txt

**Case Study 2:***Instructor Reputation and Teacher Ratings*

**Experimental Design**

Subjects were randomly assigned to one of two conditions. Before viewing the lecture, students were given a summary of the instructors’ prior teaching evaluations. There were two conditions: Charismatic instructor and punitive instructor.

**Summary given in the "Charismatic instructor" condition:**

Frequently at or near the top of the academic department in all teaching categories. Professor S was always lively and stimulating in class, and commanded respect from everyone. In class, she always encouraged students to express their ideas and opinions, however foolish or half-baked. Professor S was always innovative. She used differing teaching methods and frequently allowed students to experiment and be creative. Outside the classroom, Professor S was always approachable and treated students as individuals.

**Summary given in the "Punitive instructor" condition:**

Frequently near the bottom of the academic department in all important teaching categories. Professor S did not show an interest in students' progress or make any attempt to sustain student interest in the subject. When students asked questions in class, they were frequently told to find the answers for themselves. When students felt they had produced a good piece of work, very rarely were they given positive feedback. In fact, Professor S consistently seemed to grade students harder than other lecturers in the department. Then all subjects watched the same twenty-minute lecture given by the **exact same** lecturer. Following the lecture, subjects rated the lecturer. Subjects answered three questions about the leadership qualities of the lecturer. A summary rating score was computed and used as the variable "rating" here.

Data: caseStudy3.txt

**Case Study 3: *Natural Language Interface***

This study compared the ease of learning a traditional command/menu interface to a spreadsheet with the ease of learning the natural-language interface of Lotus HAL.

**Design**

Forty two subjects recruited by an employment agency participated. One group of 22 subjects used Lotus 1-2-3 and the other group used Lotus HAL. The subjects had little or no experience working with microcomputers or spreadsheets and none of the subjects had any experience with either Lotus 1-2-3 or Lotus HAL.

The experimental sessions took 3 days. The first day and a half was used for training with the remaining day and a half for testing. The Lotus 1-2-3 sessions were held on three successive days of one week; the Lotus HAL sessions were held on the same days of the following week. Subjects participated from 8:00 AM until 5:00 PM. with an hour break for lunch and fifteen minute breaks in the morning and afternoon.

The training sessions were conducted by the Al Napier who has had considerable experience training people on Lotus 1-2-3 and on Lotus HAL at a Lotus Authorized Training Center. The training consisted of combinations of lecture and practice on problems. During lectures, the instructor's computer screen was projected at the front of the room with subjects following along by typing into computers at their seats. The other three authors assisted during lectures by helping people individually who were falling behind. During the practice problem solving sessions all four authors gave assistance as it was needed.

The first day consisted entirely of lectures and the basics of using a spreadsheet were covered. At the beginning of the second day, subjects were given 45 minutes to work (without assistance) the last problem that they worked along with the instructor the day before.

In the afternoon session of the second day and in the morning and afternoon sessions of the third day subjects were asked to solve a series of problem sets. In the first hour of the third day, the Wonderlic Personnel Test was administered. The Wonderlic is a test of general intelligence. In the last hour of the third day demographic information and information about subjects' subjective impressions of the spreadsheet software they used were gathered through the use of a questionnaire.  
  
Performance was judged for correctness of the answers and of the formatting. For this case study, only the data on correctness of the answers will be presented.

Data: caseStudy4.txt

**Case Study 4:** *Magnets and Pain Relief*

**Experimental Design**

**Summary**  
Patients experiencing post-polio pain syndrome were recruited. Half of the patients were treated with an active magnetic device and half were treated with an inactive device. All patients rated their pain before and after application of the device. To simplify the presentaton, only the rating after the treatment will be analyzed here. In the raw data, this rating is referred to as "Score\_2." The treatment condition is indicated by the variable "Active." Subjects receiving treatment with the active magnet have a "1" on this variable; subjects treated with the inactive placebo have a "2."  
  
**Details**  
The experimenters recruited 50 patients who not only had post-polio syndrome but also reported muscular or arthritic pain. These patients had significant pain for at least 4 weeks and had not taken any pain killers or anti-inflamatories for at least 3 hours before the study. The subjects all had a trigger point or painful region and had a body weight of less than 140% of the predicted weight for their age and height, and had a trigger point or circumscribed painful area.

 The magnets and placebos (described under [Materials](http://www.onlinestatbook.com/case_studies_rvls/magnets/materials.html).) were supplied in equal numbers from Bioflex. Each magnet or placebo was placed in number coded envelopes and delivered according to its shape. The code for placebos and magnets was not broken until the end of the study.

One site of reported pain was evaluated and a trigger point for this pain was found by palpitation. The patient was asked to subjectively grade pain at the trigger point under palpitation on a scale from 0 to 10 (0 is the least pain, increasing to 10).

Following the initial pain assessment, an envelope containing a device was randomly selected from the box containing active and inactive devices. This device was applied to the pain area for 45 minutes and then removed. The patient then evaluated his or her pain again at the region or trigger point. This second pain rating is the score analyzed here.

Data: caseStudy5.txt

# Case Study-5: *Stock Prices 1*

A basic rule of thumb for investors in the stock market is to ``diversify''; that is to spread one's money across stocks which are likely to behave differently in response to various conditions in the market. Risk to the investor is reduced because, under a given set of circumstances, some stocks in the portfolio will rise while others fall. How can one determine which stocks are similar and which are not for the purpose of diversification?

The [data](http://www.stat.ucla.edu/cases/stocks1/Stock1.data) provided are daily stock prices from January 1988 through October 1989, for ten aerospace companies. Given this information, the first step toward answering the question posed above is to reformulate the question in terms of these data. For example, two stocks may be considered similar if they maintain approximately the same level, vary to a similar degree, or tend to move up and down in related ways over some relevant time period. An initial analysis might use some graphical techniques to examine these aspects of the data.

Describe the following using statistical software:

1. Make histograms of these price series
2. Time plots:

Another simple tool for comparing price series over time is the univariate time plot. [Plot](http://www.stat.ucla.edu/cases/stocks1/Stocktime.lsp) stock price on day for each of the ten companies for which price series is provided. Are the Y axis scales the same for all plots? What advantages are there in making all scales the same? What are the disadvantages? Look at the overall shapes of the plots.

1. It might also be useful to have one or two numbers that capture relevant characteristics of a stock's behavior. Mean and variance are two descriptive statistics often used to summarize data. Compute the [means](http://www.stat.ucla.edu/cases/stocks1/Stockmean.lsp) of stock prices for Companies A through J. Which company has the highest mean price? The lowest? Find the means on the histograms. Does this mean that the company with the higher mean is a better investment than the company with the lower mean? Describe the histograms of the companies with the highest and lowest means.

# Data: caseStudy6.txt

# Case Study 6: *Fitness Program*

# PSG Tech initiated an experimental physical fitness program for its students. To evaluate its effects, all those who registered for the program at the beginning of the first year of operation were tested at registration and retested at the end of the year. Physical fitness improved remarkably. As a result, it was decided to run the program for a second year. It was not considered necessary to test new participants at the beginning of the second year, since the results from the first year were available as a benchmark. At the end of the second year, all the participants were tested. The tests showed a marked deterioration in physical fitness by comparison with the scores at the beginning of the first year.

1. Does this mean that the second year of the program was a failure?If so, what changes would you have recommended to the program leaders to revitalize it?
2. If not, what other explanation do you have for the results, and what would you have done to improve the design of the study?

[Explain](http://www.stat.ucla.edu/cases/fitness/fitness-answer.php) briefly.

**Data must be collected from the first and second year students to analyse the results**

**Case study 7: Water Availability**

Can Southern California's water supply in future years be predicted from past data? One factor affecting water availability is stream runoff. If runoff could be predicted, engineers, planners and policy makers could do their jobs more efficiently. Multiple linear regression models have been used in this regard.

The following [dataset](http://www.stat.ucla.edu/cases/dwp/dwp-data.php) contains 43 years worth of precipitation measurements (in inches) taken at six sights in the Owens Valley labeled APMAM (Mammoth Lake), APSAB (Lake Sabrina), APSLAKE (South Lake), OPBPC (Big Pine Creek), OPRC (Rock Creek), and OPSLAKE, and stream runoff volume (measured in acre-feet) at a sight near Bishop, California (labeled BSAAM).

**Design:**

*Can precipitation predict runoff volume?* There is certainly good reason to think so. The major source of runoff is precipitation, although there may be some time lag related to season.

Write the program that allows you to build various regression models to investigate the relationship between runoff and precipitation.

Dataset: caseStudy8.txt