TI–83 Labs For Statistics 513

Statistical Control Theory

by

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TI–83 Lab 1 For Statistics 513

Topics:

- off and on, lists
- clearing histogram and other plots, histograms from raw data, histograms from distribution tables, stem and leaf plots, summary statistics, box and whisker plots
- discrete probability distributions, expected value, variance
- binomial, Poisson, geometric distributions
- probabilities and percentiles for standard and nonstandard normal distribution,

Dataset(s). "showerhead.dat", a dataset of the maximum flow rates for 34 different shower heads:

2.9 2.8 2.0 3.6 2.7 2.5 2.6 2.9 2.7 2.8 2.5 2.8 2.2 2.5 2.5 2.8 1.8 2.7 2.7 4.7 2.8 2.7 3.1 2.9 3.4 2.6 2.6 2.7 2.4 2.5 5.4 4.9 2.8 2.5

On and Off. In this exercise you will learn how to turn your calculator ON and OFF.

- Turn on the calculator by pressing the ON button, a black button on the lower left of the calculator. You are at the MAIN screen.
- Turn off your calculator by pushing "2nd", a yellow button in the upper left corner, followed by ON.

Lists. In this exercise, you will type the 34 maximum flow rates into list L_1 of the calculator.

- Push the STAT button, a black button two over from the green ALPHA button. A screen appears which has EDIT and 1: highlighted. This is what you want.
- Push ENTER, a blue button on the lower right of the calculator. A screen appears which has three lists (columns) entitled L1, L2 and L3. At the bottom left of the screen is L1(1) = . The first position on the first list is highlighted by a dark square called the cursor.
- Type in the first data point, 2.9, then ENTER. The number "2.9" is in the first position and the highlighted square now appears *below* this position of the first list. Type in the second data point, 2.8, then ENTER. Continue this until all 34 numbers have been entered in L1.

- If you have used the calculator before, there may be numbers in this list–you should clear this numbers. You do this by pushing the blue up triangle, △, then CLEAR (a black button just below the four triangle buttons), then ENTER.

Clearing Histograms and Other Plots You will learn how to turn off (clear) all the STAT PLOTs and Y = plots.

1. Turn off all the STAT PLOTs by keying:

   - 2nd STAT PLOT 4 ENTER

   The TI–83 should return with the cursor blinking beside "PlotsOff". After pressing ENTER, "Done" should be returned.

2. Turn off all the Y = plots by typing:

   - Y = CLEAR

   for every equation that appears in the list of equations. Press 2nd QUIT to return to the main screen.

Histogram From Raw Data. In this exercise, you will use the TI–83 to draw a histogram for the "showerhead.dat" dataset.

- Type the 34 data values in list L3.
- Turn off (clear) all the STAT PLOTs and Y = plots.
- Turn on one of the STAT PLOTs for the histogram by typing:
  - 2nd STAT PLOT ENTER

  Once at the "Plot1" screen, choose or type in the following options:

  - On
  - Type: histogram figure at far right
  - Xlist: L3 (for data points)
  - Freq: 1 (each data point counted once)
- To fit the histogram to the screen window of the calculator, press
  - ZOOM 9 ENTER
- Display the histogram by pressing either TRACE or GRAPH.

- By pressing TRACE, a histogram with information on it is displayed. A little box with a blinking "X" through it appears on the center top of the first vertical bar of the histogram. At the bottom of the histogram are three bits of information: "min = 1.8", "max < 2.4" and "n = 3". This tells you that three of the showerheads have flow rates in the interval greater than or equal to 1.8 and less than 2.4. By hitting the right arrow key, the little box with a blinking "X" through it moves to the center top of the second vertical bar of the histogram.
- A histogram without any information is obtained by pressing GRAPH.
- It is also possible to set up the screen window of the calculator to fit the histogram *manually* by pressing WINDOW and then choosing the following options:
  - Xmin = 2.4
  - Xmax = 6
  - Xscl = 5 (since the class width is 5 units)
  - Ymin = (-) 25 ÷ 4 (let Ymin = -Ymax/4, to leave room at the bottom of the screen for the display of histogram information)
  - Ymax = 25
  - Yscl = 5 (convenient space between tick marks on frequency axis of histogram)
  - Xres = 1 (plots at every pixel on the screen; 2 would plot at every 2nd pixel and so on–this option is *not* active when plotting histograms, though.)

Histogram From Distribution Table[1]. In this exercise, you will use the TI–83 to draw a histogram for the "age.dat" distribution table.

- Turn off (clear) all the STAT PLOTs and Y = plots.
- Type the class midpoints in L1 and the frequencies into L2.
- Turn on one of the STAT PLOTs for the histogram by typing:
  - 2nd STAT PLOT ENTER

  Once at the "Plot1" screen, choose or type in the following options:
  - On
  - Type: histogram figure at far right
  - Xlist: L1 (for midpoint values of each class)

[1]These instructions can also be used to construct a cumulative histogram.

  - Freq: L2 (for frequency values of each class)

- Display the histogram by pressing either TRACE or GRAPH.

Stem and Leaf Display. In this exercise, you will use the TI–83 to help build a stem and leaf display for the "showerhead.dat" dataset. After typing the data into list L1, move the cursor over and up to the title of list L2, and then copy the data from L1 over to L2 and sort L2 using the following commands:

- 2nd L1 ENTER
- STAT ∇ ENTER 2nd L2) ENTER STAT ENTER

You can now use the sorted data in list L2 to construct a stem and leaf plot.

Summary Statistics. In this exercise, you will use the TI–83 to calculate summary statistics for the "showerhead" data. After typing the 34 values of "showerhead" into L_1 of your calculator, key in

- STAT CALC 1:1–Var Stats ENTER 2nd L_1 ENTER

The following summary statistics will then appear. Some of these summary statistics appear *below* the screen window; just arrow down, using the blue down arrow button, to view these summary statistics.

- mean: $\bar{x} = 2.88$
- sum: $\sum x = 98$
- sum of squares: $\sum x^2 = 301.02$
- sample standard deviation: $s_x = 0.75$
- population standard deviation: $\sigma_x = 0.739$
- sample size: $n = 34$
- minimum value: minX = 1.8
- lower quartile: $Q_1 = 2.5$
- median: Med = 2.7
- upper quartile: $Q_3 = 2.9$
- maximum value: maxX = 5.4

We will be interested in many of the statistics given here.

Box and Whisker Plots. We will create a box and whiskers plot from the 34 numbers in "showerhead.dat" dataset. After turning off all the STAT PLOTS and the Y = plots, do the following

- Turn on one of the STAT PLOTs for the histogram by typing:
  - 2nd STAT PLOT ENTER

  Once at the "Plot1" screen, choose or type in the following options:
  - On
  - Type: box and whiskers figure plot on second row, at the beginning
  - Xlist: L1 (for data values)
  - Freq: 1
  - Mark: + (or any of the three plot marks you like)
- To automatically fit the box and whiskers to the screen window of the calculator, press:
  - ZOOM 9 ENTER

  Then press either TRACE or GRAPH, depending on if you want information on the box and whiskers plot. In addition to the box and whiskers plot, outliers are also plotted outside the inner fences.

Discrete Probability Distributions.

- Calculate all the values of the following discrete probability distribution:

$$P(X = x) = \frac{x^2 + 5}{50}, \quad x = 1, 2, 3, 4.$$

  First type the values of the random variable in the first list of STAT/EDIT:
  - STAT ENTER 1 ENTER 2 ENTER 3 ENTER 4 ENTER

  Define list L_2 as equal to $\frac{x^2+5}{50}$: (push cursor up and over the line to on top of L_2!!!!)
  - (2nd L_1 x^2 + 5) / 50 ENTER

The values 0.12, 0.18, 0.28 and 0.42 will appear in list L_2. These are the four values of the discrete probability distribution. Draw a histogram of this density by pressing ZOOM 9:ZoomStat; adjust the histogram, if necessary, by altering the options given in WINDOW.

- Calculate all the values of the following discrete probability distribution:

$$P(X = x) = \frac{C_{2,x}C_{4,3-x}}{C_{6,3}}, \quad x = 0, 1, 2.$$

First type the values of the random variable in the first list of STAT/EDIT:

– STAT ENTER 0 ENTER 1 ENTER 2 ENTER

Define list L_2 as equal to $\frac{C_{L_1,2}C_{3-L_1,4}}{C_{3,6}}$:

– ▷ △ △ △ (2 MATH ◁ ∇ ∇ ENTER 2nd L_1
– * 4 MATH ◁ ∇ ∇ ENTER) (3 - 2nd L_1)
– ÷ 6 MATH ◁ ∇ ∇ ENTER 3

The values 0.2, 0.6 and 0.2 will appear in list L_2. These are the three values of the discrete probability distribution. Draw a histogram of this density by pressing ZOOM 9:ZoomStat; adjust the histogram by altering the options given in WINDOW.

Expected Value and Variance.

- Determine the expected value and variance of

X	0	2	4	6	8	10
P(X = x)	0.17	0.21	0.18	0.11	0.16	0.17

To determine the expected value, define L_3 as the multiplication of L_1 and L_2, where L_1 and L_2 are determined as above and then *sum* the values in L_3. The steps to do this are:

– 2nd L_1 * 2nd L_2 ENTER
– STAT ▷ ENTER 2nd L_3 ENTER

The expected value turns out to be 4.78.

To determine the variance, define L_4 as equal to $(L_1 - 1)^2 * L_2$ and then *sum* L_4:

– ▷

- (2nd L_1 − 0.75) x^2 * 2nd L_2 ENTER
- STAT ▷ ENTER 2nd L_4 ENTER

The variance turns out to be 12.07.

- Determine the expected value and variance of

$$P(X = x) = \frac{x^2 + 5}{50}, \quad x = 1, 2, 3, 4.$$

Type 1, 2, 3 and 4 into L_1. Define L_2 as $\frac{L_1^2+5}{50}$. Then, proceed as above: define L_3 as the multiplication of L_1 and L_2, and then *sum* the values in L_3. The expected value turns out to be 3. The variance turns out to be 1.8.

- Determine the expected value and variance of

$$P(X = x) = \frac{C_{2,x}C_{4,3-x}}{C_{6,3}}, \quad x = 0, 1, 2.$$

The expected value turns out to be 1; the variance turns out to be 2.

Binomial Probability Distribution.

- Calculate all the values of the following binomial probability distribution:

$$\binom{16}{x}\left(\frac{2}{7}\right)^x\left(\frac{5}{7}\right)^{16-x}, \quad x = 0, 1, \ldots, 16$$

- One way to do this is to first type the values of the random variable in the first list of STAT/EDIT and then define list L_2 as equal to the binomial density function given above:
  - STAT ENTER 0 ENTER 1 ENTER 2 ENTER $\cdots$ 16 ENTER
  - After "arrowing" up to the top of the second list, type:
    2nd DISTR 0:binompdf(16 , (2 ÷ 7) , 2nd L_1)

  The values 0.00459, 0.02939, ... will appear in list L_2. These are the values of the binomial probability distribution.

- A second way to do this is to use the "binompdf" function directly:
  - 2nd DISTR 0:binompdf(16 , (2 ÷ 7))

The values 0.00459, 0.02939, ... will appear after pushing the ENTER button. You can see all of them by repeatedly pushing the "arrow right" key. These are the values of the binomial probability distribution.

If you wanted to see just the binomial probability for $x = 2$ and $x = 5$, say, you would type:

- 2nd DISTR 0:binompdf(16 , (2 ÷ 7) , 2nd { 2 , 5 2nd })

The values 0.0881156 (for $P(X = 2)$) and 0.20536 (for $P(X = 5)$) will appear.

If you wanted to see just the binomial probability for $x = 2$, you would type:

- 2nd DISTR 0:binompdf(16 , (2 ÷ 7) , 2)

The value 0.0881156 (for $P(X = 2)$) will appear.

Graphing The Binomial Distribution. To graph the binomial distribution with $n = 10$, $p = 0.2$, type

- WINDOW 0 10 1 -0.1 0.4 0.1 1
- STAT ENTER, then enter 1 2 ... in L_1 and define L_2 as 2nd DISTR 0:binompdf(10, 0.2 , L_1) ENTER
- 2nd STAT PLOT ENTER ON ENTER pick histogram plot ENTER GRAPH

Binomial Cumulative Distribution Function.

- Calculate all the *cumulative* probability values of the following binomial probability distribution:

$$\binom{16}{x}\left(\frac{2}{7}\right)^x\left(\frac{5}{7}\right)^{16-x}, \qquad x = 0, 1, \ldots, 16$$

- One way to do this is to first type the values of the random variable in the first list of STAT/EDIT and then define list L_2 as equal to the *cumulative* function for the density function above:
  - STAT ENTER 0 ENTER 1 ENTER 2 ENTER $\cdots$ 16 ENTER
  - After "arrowing" up to the top of the second list, type:
    2nd DISTR A:binomcdf(16 , (2 ÷ 7) , 2nd L_1)

The values 0.00459, 0.03398, ... will appear in list L_2. These are the values of the cumulative binomial distribution.

- A second way to do this is to use the "binomcdf" function directly:

  – 2nd DISTR A:binomcdf(16 , (2 ÷ 7))

  The values 0.00459, 0.03398, ... will appear after pushing the ENTER button. You can see all of them by repeatedly pushing the "arrow right" key. These are the values of the binomial probability distribution. If you wanted to see just, say the cumulative binomial values for $x = 2$ and $x = 5$, say, you would type:

  – 2nd DISTR A:binomcdf(16 , (2 ÷ 7) , 2nd { 2 , 5 2nd })

  The values 0.12213 (for $P(X \leq 2)$) and 0.70598 (for $P(X \leq 5)$) will appear.

Poisson Distribution Function.

- Calculate the probability value of the Poisson probability distribution when $\lambda = 1.32$ and $r = 3$. Use the "poissonpdf" function, where

  – 2nd DISTR B:poissonpdf(ENTER 1.32 3)

  The value 0.102... will appear.

- Calculate the *accumulated* probability value of the Poisson probability distribution when $\lambda = 1.32$ and $r = 3$. Use the "poissoncdf" function, where

  – 2nd DISTR C:poissonpdf(ENTER 1.32 3)

  The value 0.954... will appear.

Graphing The Geometric Distribution. To graph the Poisson distribution with $\lambda = 1.32$ for $n = 0, 1, \ldots, 10$, type

- WINDOW 0 10 1 −0.1 0.4 0.1 1
- STAT ENTER, then enter 0, 1, ..., 10 in L_1; define L_2 as 2nd DISTR D:poissonpdf(1.32 , L_1) ENTER
- 2nd STAT PLOT ENTER ON ENTER pick histogram plot ENTER GRAPH

Calculating Probabilities and Percentiles For The Standard and Nonstandard Normal Distribution.

- Assume the IQ scores for 16 year olds is normal where $\mu = 100$ and $\sigma = 16$. What is the probability a student randomly picked from the 16 year olds has an IQ score below 84?

- One way to do this would be to first *standardize* this probability, $P(X < 84) = P\left(Z < \frac{84-100}{16}\right) = P(Z < -1)$ and then use the "2ndDISTR/normalcdf" key to determine this probability:

  – 2nd DISTR 2 (-) 1 2nd EE 99, 84 , (-) 1) ENTER

  The value 0.1587 appears.

- Another way to do this is would be to calculate the probability $P(X < 84)$ directly. This also requires the use of the "2ndDISTR/normalcdf" key:

  – 2nd DISTR 2 (-) 1 2nd EE 99 , 100, 16) ENTER

  The value 0.1587 appears.

- Percentiles can also calculated. For example, in order to answer the question, "What is the 95th percentile for the 16 year old students?", use the "2ndDISTR/invNorm" key:

  – 2nd DISTR 3 ENTER .95 , 100 , 16) ENTER

  The value 126.32 is returned.

Graphing The Normal Distribution. To graph the normal distribution with mean $\mu = -1$ and standard deviation $\sigma = 1$, type

- WINDOW -4 2 1 -0.2 0.6 0.1 1
- Y = 2nd DISTR 1:normalpdf(X , -1 , 1) GRAPH

Graphing The Normal Distribution Superimposed On The Binomial Distribution. To graph the normal distribution with $\mu = 4$ and $\sigma = 1.55$ on the binomial distribution with $n = 10$, $p = 0.4$, type

- WINDOW 0 10 1 -0.2 0.4 0.1 1
- Y = 2nd DISTR 1:normalpdf(X , 4 , 1.55) GRAPH
- STAT ENTER, then enter 0 1 2 ... 10 in L_1 and define L_2 as 2nd DISTR 0:binompdf(10, 0.4 , L_1) ENTER
- 2nd STAT PLOT ENTER ON ENTER pick histogram plot ENTER GRAPH