

## **Project 2b – Jumping Frogs (Data Analysis)**

### **Statistics for Managers**

**June 3, 1999**

This project is in three parts:

- a) data collection
- b) data analysis
- c) report writing

This document describes the data analysis.

The original data is in Appendix A.

### **Data Table Arranged by Frog**

• Table 1 Frog Jumping Distance Data

<b>Jump ID</b>	<b>Frog 1</b>	<b>Frog 2</b>	<b>Frog 3</b>	<b>Frog 4</b>	<b>Frog 5</b>
1	10.4	12.8	9.9	14.9	15.1
2	8.7	8.5	14.0	11.4	16.4
3	11.5	11.2	14.4	12.5	14.6
4	9.0	15.0	11.4	8.5	13.3
5	9.2	11.3	10.3	15.7	15.4
6	11.5	12.0	13.7	15.4	17.3
7	11.9	13.0	9.8	12.5	16.1
8	9.0	9.2	11.4	15.6	15.2
9	10.7	12.4	13.5	15.2	16.3
10	11.2	9.6	12.2	12.5	15.9

## Summary Statistics

• Table 2 Frog Jumping Distance Summary Statistics

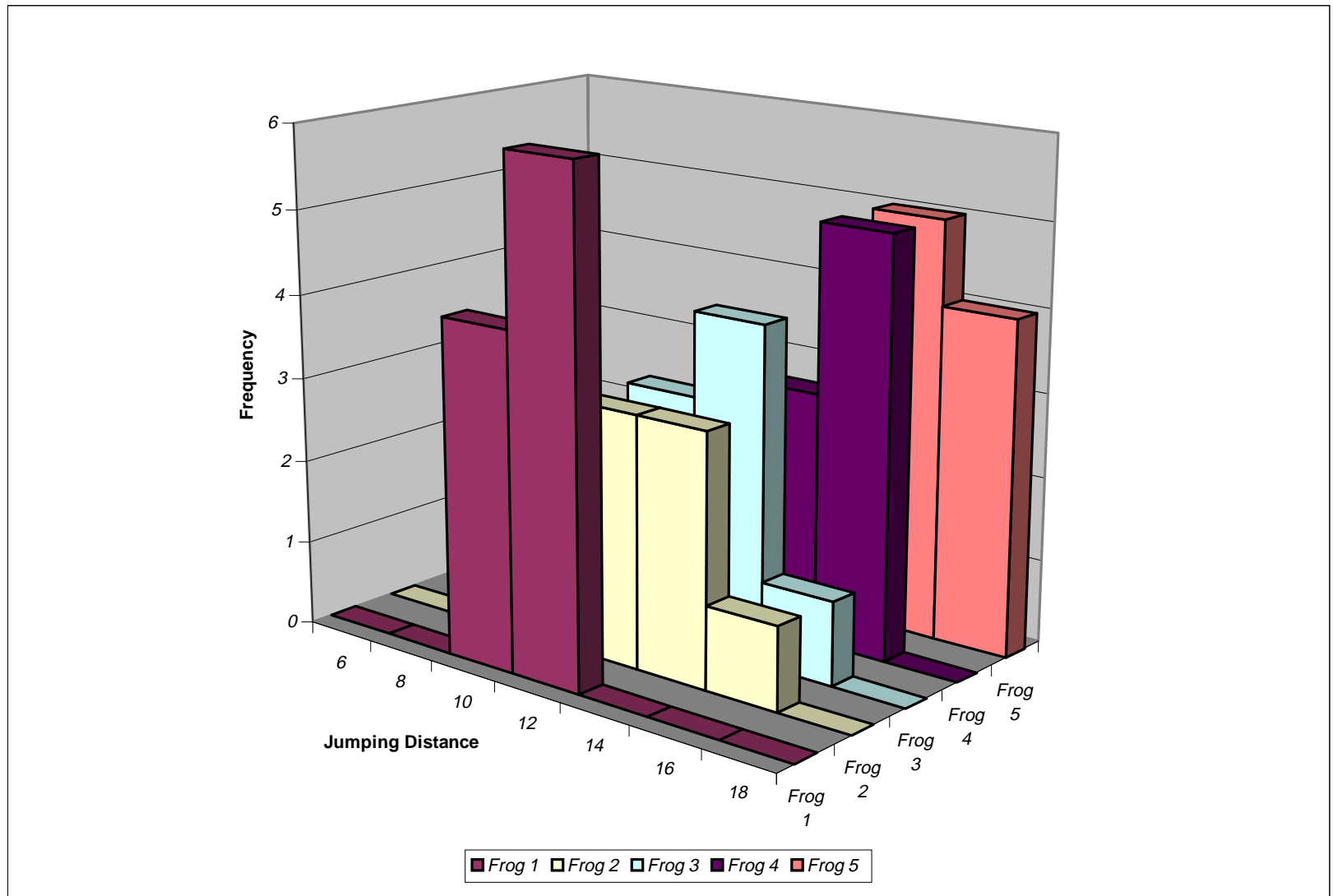
Statistic	Frog 1	Frog 2	Frog 3	Frog 4	Frog 5	Overall
Mean	10.31	11.50	12.07	13.41	15.56	12.57
St. Dev.	1.23	1.97	1.75	2.36	1.12	2.47
No. Obs.	10	10	10	10	10	10
St. Err. of Mean	0.39	0.62	0.55	0.74	0.35	0.78
Minimum	11.93	14.99	14.37	15.66	17.31	17.31
Maximum	8.75	8.55	9.85	8.50	13.27	8.50
Range	3.19	6.44	4.53	7.16	4.04	8.81
Range/6	0.53	1.07	0.75	1.19	0.67	1.47

## Frequency Table

• Table 3 Frog Jumping Frequency Table

Bin	Frog 1	Frog 2	Frog 3	Frog 4	Frog 5
6	0	0	0	0	0
8	0	0	0	0	0
10	4	3	2	1	0
12	6	3	3	1	0
14	0	3	4	3	1
16	0	1	1	5	5
18	0	0	0	0	4
More	0	0	0	0	0

## Sample Histograms

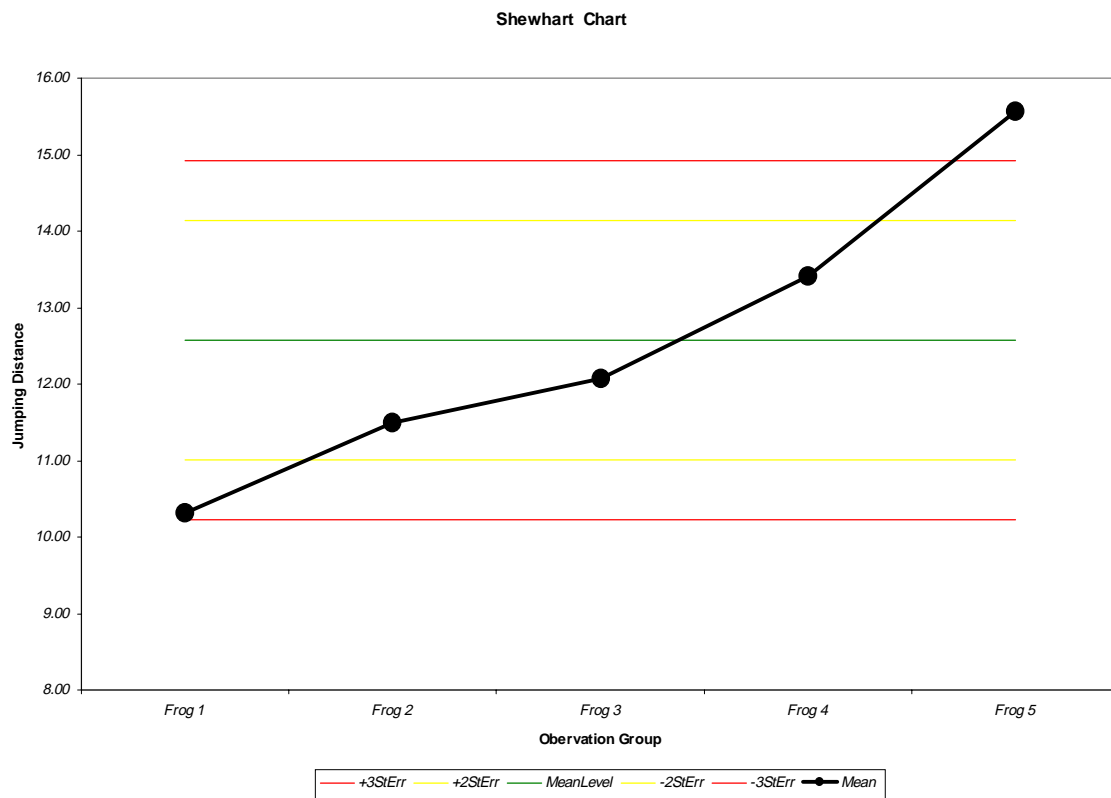


## Control Chart of Sample Means

To compute the Control Chart Limits: For the mean level, use the overall mean of 12.57. For the standard deviation use the overall value of 2.47, thus a standard error for each mean of 10 observations is  $2.47/\sqrt{10} = 0.78$ .

• Table 4 Limits for Control Chart

Control Chart Limits	Frog 1	Frog 2	Frog 3	Frog 4	Frog 5
Mean	10.31	11.50	12.07	13.41	15.56
+3StErr	14.91	14.91	14.91	14.91	14.91
+2StErr	14.13	14.13	14.13	14.13	14.13
Mean Level	12.57	12.57	12.57	12.57	12.57
-2StErr	11.01	11.01	11.01	11.01	11.01
-3StErr	10.23	10.23	10.23	10.23	10.23



## Normal Q-Q Plots

Using each frogs data separately,  $R_i$  is the ascending rank of the  $i^{\text{th}}$  jump distance. Proportions are calculated using the formula:

$$p_i = (R_i - 3/8)/(n + 1/4)$$

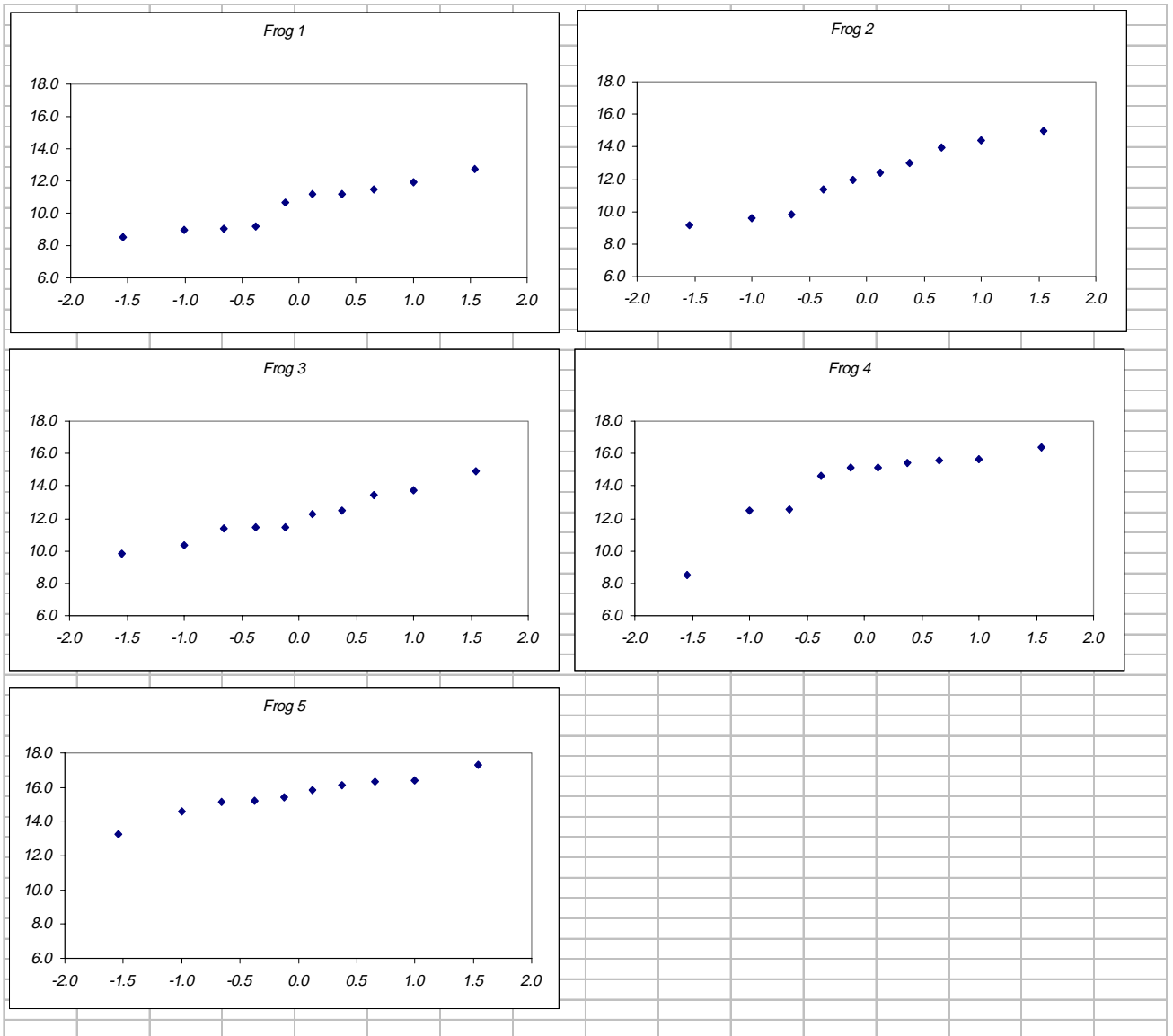
Standard Normal Percentiles are the Z-scores corresponding to each proportion.

Normal Q-Q Plot is an XY-plot with the Percentiles on the X-axis and the Actual Data on the Y-axis.

• Table 5 Normal Q-Q Plot Calculations

Original Data						Proportions					
Jump ID	Frog 1	Frog 2	Frog 3	Frog 4	Frog 5	Jump ID	Frog 1	Frog 2	Frog 3	Frog 4	Frog 5
1	9.0	15.0	11.4	8.5	15.1	1	0.2561	0.9390	0.4512	0.0610	0.2561
2	9.2	11.3	10.3	15.7	16.4	2	0.3537	0.3537	0.1585	0.8415	0.8415
3	11.5	12.0	13.7	15.4	14.6	3	0.7439	0.4512	0.8415	0.6463	0.1585
4	11.9	13.0	9.8	12.5	13.3	4	0.8415	0.6463	0.0610	0.2561	0.0610
5	9.0	9.2	11.4	15.6	15.4	5	0.1585	0.0610	0.3537	0.7439	0.4512
6	10.7	12.4	13.5	15.2	17.3	6	0.4512	0.5488	0.7439	0.5488	0.9390
7	11.2	9.6	12.2	12.5	16.1	7	0.5488	0.1585	0.5488	0.1585	0.6463
8	12.8	9.9	14.9	15.1	15.2	8	0.9390	0.2561	0.9390	0.4512	0.3537
9	8.5	14.0	11.4	16.4	16.3	9	0.0610	0.7439	0.2561	0.9390	0.7439
10	11.2	14.4	12.5	14.6	15.9	10	0.6463	0.8415	0.6463	0.3537	0.5488
Ranks						Standard Normal Percentiles					
Jump ID	Frog 1	Frog 2	Frog 3	Frog 4	Frog 5	Jump ID	Frog 1	Frog 2	Frog 3	Frog 4	Frog 5
1	3	10	5	1	3	1	-0.7	1.5	-0.1	-1.5	-0.7
2	4	4	2	9	9	2	-0.4	-0.4	-1.0	1.0	1.0
3	8	5	9	7	2	3	0.7	-0.1	1.0	0.4	-1.0
4	9	7	1	3	1	4	1.0	0.4	-1.5	-0.7	-1.5
5	2	1	4	8	5	5	-1.0	-1.5	-0.4	0.7	-0.1
6	5	6	8	6	10	6	-0.1	0.1	0.7	0.1	1.5
7	6	2	6	2	7	7	0.1	-1.0	0.1	-1.0	0.4
8	10	3	10	5	4	8	1.5	-0.7	1.5	-0.1	-0.4
9	1	8	3	10	8	9	-1.5	0.7	-0.7	1.5	0.7
10	7	9	7	4	6	10	0.4	1.0	0.4	-0.4	0.1

• Table 6 Normal Q-Q Plots



## Statistical Tests of Mean Jumping Distance of Each Frog is $\mu_0$ Inches

For  $\mu_0$ , take the overall average of 12.57 inches.

For  $s$ , take the overall standard deviation of 2.47 with 49 Degrees of Freedom.

The standard error for each mean of 10 observations is  $2.47/\sqrt{10} = 0.78$ .

### Analysis for Each Frog

Null Hypothesis:  $H_0: \mu_0 = 12.57$

Alternative Hypothesis:  $H_0: \mu_0 \neq 12.57$

Test Statistic:  $|t| = \frac{|\bar{y} - 12.57|}{2.47/\sqrt{10}}$  with 49 *df*

Test Critical Value Using  $\alpha = 0.05$  and 49 *df*:  $t_{0.025} \cong 1.96$

• Table 7 t-Test Values of  $H_0: \mu_0 = 12.57$  for each Frog

	Mean	St. Err.	t
Frog 1	10.31	0.78	-2.89
Frog 2	11.50	0.78	-1.37
Frog 3	12.07	0.78	-0.65
Frog 4	13.41	0.78	1.08
Frog 5	15.56	0.78	3.83

### Conclusions:

Frog 1: Reject  $H_0: \mu_0 = 12.57$  since  $|t| = 2.89 > t_{0.025} \cong 1.96$  ( $\alpha = 0.05$ , 49 *df*)

Frog 2: Do Not Reject  $H_0: \mu_0 = 12.57$  since  $|t| = 1.37 < t_{0.025} \cong 1.96$  ( $\alpha = 0.05$ , 49 *df*)

Frog 3: Do Not Reject  $H_0: \mu_0 = 12.57$  since  $|t| = 0.65 < t_{0.025} \cong 1.96$  ( $\alpha = 0.05$ , 49 *df*)

Frog 4: Do Not Reject  $H_0: \mu_0 = 12.57$  since  $|t| = 1.08 < t_{0.025} \cong 1.96$  ( $\alpha = 0.05$ , 49 *df*)

Frog 5: Reject  $H_0: \mu_0 = 12.57$  since  $|t| = 3.89 > t_{0.025} \cong 1.96$  ( $\alpha = 0.05$ , 49 *df*)

## Appendix A – Raw Data

Frog ID	Jump ID	Distance
1	1	10.4
1	2	8.7
1	3	11.5
1	4	9.0
1	5	9.2
1	6	11.5
1	7	11.9
1	8	9.0
1	9	10.7
1	10	11.2
2	1	12.8
2	2	8.5
2	3	11.2
2	4	15.0
2	5	11.3
2	6	12.0
2	7	13.0
2	8	9.2
2	9	12.4
2	10	9.6
3	1	9.9
3	2	14.0
3	3	14.4
3	4	11.4
3	5	10.3
3	6	13.7
3	7	9.8
3	8	11.4
3	9	13.5
3	10	12.2
4	1	14.9
4	2	11.4
4	3	12.5
4	4	8.5
4	5	15.7
4	6	15.4
4	7	12.5
4	8	15.6
4	9	15.2
4	10	12.5
5	1	15.1
5	2	16.4
5	3	14.6
5	4	13.3
5	5	15.4
5	6	17.3

5	7	16.1
5	8	15.2
5	9	16.3
5	10	15.9