Answer Key

Geomorphology and Aerial Photo Interpretation
Introduction to Data Analysis Using Hillslope Gradient

c:\wou\geomorph\dataex.wpd

This exercise is designed to strengthen your computer skills and provide an introduction to statistical analysis. Read over the introduction to statistical analysis, then you will be ready to work through the tutorial below.

INTRODUCTION TO DATA ANALYSIS TUTORIAL

To complete this tutorial, you will need access to a personal computer (either at home or at WOU) that has internet access, web-browser software (internet explorer or netscape), and Microsoft Excel.

A. Importing Data

1. Log onto your favorite computer at home or WOU, access your internet or network connection.

   A. To use the new Natural Science Computer Lab in RM 216...
      -at Novell Login window, click advanced and choose
         context = users.student.acad.wosc
         server = st1
      - type in username and password, click OK to log onto student server st1

NOTE: the NS 216 lab may be accessed during the day, see a faculty member. There are also evening hours from 5-7 pm with a student helper, Mon - Thursday. If no one is in the lab by 6:00 PM, the student is permitted to lock the lab and leave.

2. Use Internet Explorer and go to http://www.wou.edu/taylor Follow the links to the G322 Geomorphology class page.
3. Click on the "Data Analysis Tutorial" link. Excel should automatically open the file "example.xls"
4. Look at the data set. It consists of hillslope gradient data from two different field areas, each underlain by siltstone and sandstone bedrock, respectively.
5. Save the data as an Excel "workbook file" to the network or or floppy disk. To save on floppy:

   File - Save As-Workbook File - Sloptest.xls" on the a:\ drive

or to save on your st1 student account

   File-Save As-Workbook File - "Sloptest.xls" on the H:Eon.Stu.Folder - folder = login name

6. Close Internet Explorer
7. Start MS Excel, and open the workbook file you just saved
   -file-open-sloptest.xls (file is either on floppy on on your student account folder somewhere by now)

You should now have a data set imported into microsoft excel in 3 columns ("Bin Range", "siltstone_slopes", and "Sandstone_slopes")

Example Results from the Data Analysis Tutorial

c:wou\geomorph\example.xls

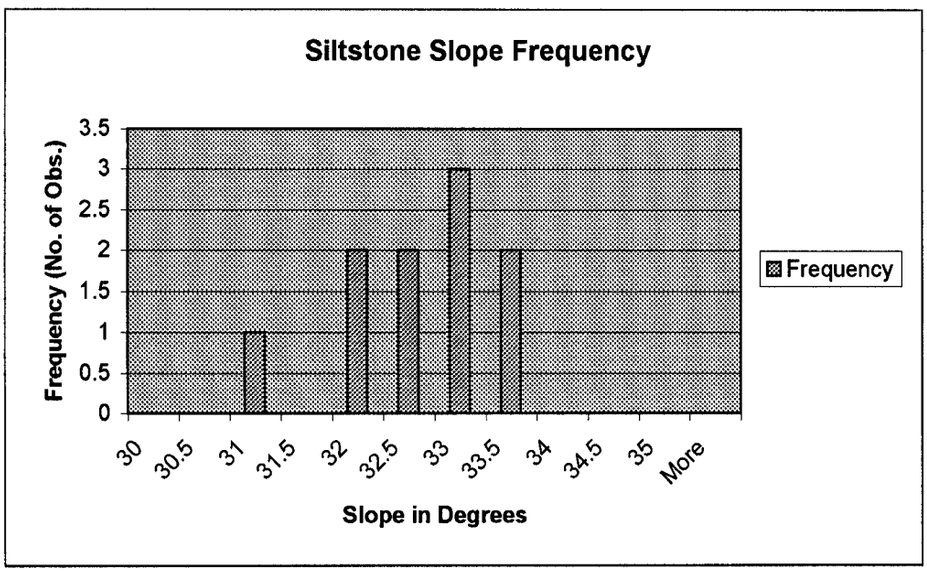
bin_range	siltstone slope	sandstone slope
30	32.5	31.5
30.5	33	30
31	33.5	32.5
31.5	33	33.5
32	32	32.5
32.5	32.5	34.5
33	31	32
33.5	33	34
34	32	35
34.5	33.5	33
35		
Mean	32.6	32.85
Median	32.75	32.75
Standard_Deviation	0.77	1.49
Maximum	33.5	35
Minimum	31	30
No._Obs.	10	10

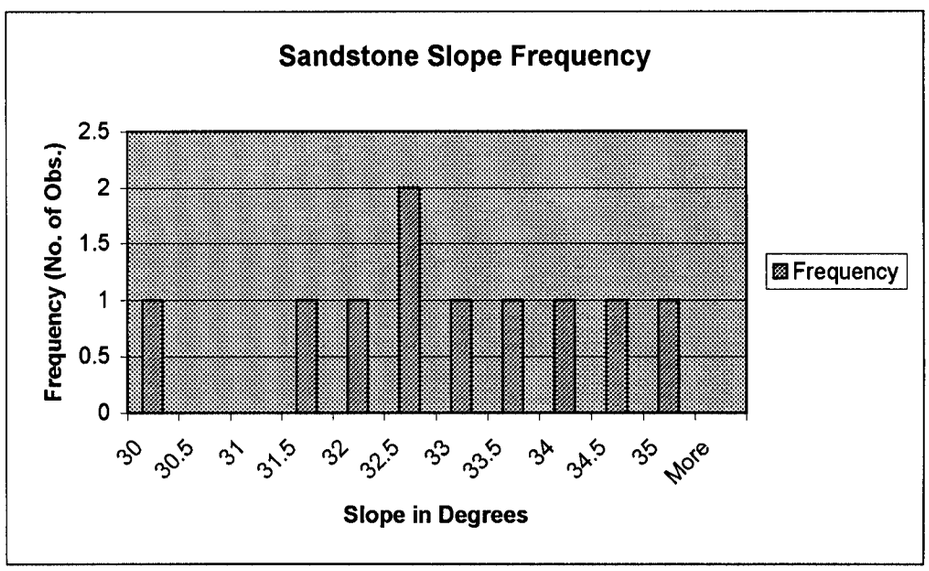
Siltstone Slope Distribution

Bin	*Frequency*
30	0
30.5	0
31	1
31.5	0
32	2
32.5	2
33	3
33.5	2
34	0
34.5	0
35	0
More	0

Sandstone Slope Distribution

Bin	*Frequency*
30	1
30.5	0
31	0
31.5	1
32	1
32.5	2
33	1
33.5	1
34	1
34.5	1
35	1
More	0





Example T-Test Results

t-Test: Two-Sample Assuming Equal Variances

	siltstone slope	*sandstone slope*
Mean	32.6	32.85
Variance	0.6	2.225
Observations	10	10
Pooled Variance	1.4125	
Hypothesized Mean Difference	0	
df	18	
t Stat	-0.470360434	
P(T<=t) one-tail	0.321873284	
t Critical one-tail	1.734063062	
P(T<=t) two-tail	0.643746567	
t Critical two-tail	2.100923666	

Alpha = 0.05 .... 95% confidence interval

t Stat = 0.47
t critical = 2.1
Result of t-test:
t Stat < t critical: ACCEPT the Null Hypothesis; No Significant Differenc
Between Slopes at the 95% confidence interval.

Results of Appalachian Data Analysis

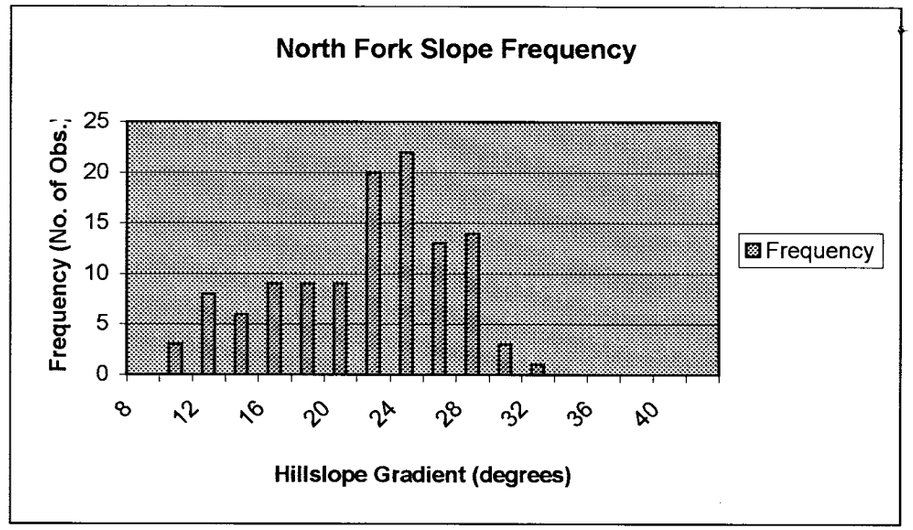
	North Fork	Little River
Mean	20.53	24.55
Median	21.62	24.43
Standard Devi	5.181846046	4.474444199
Max	30.54	35.76
Min	8.94	13.32
Count	117	110

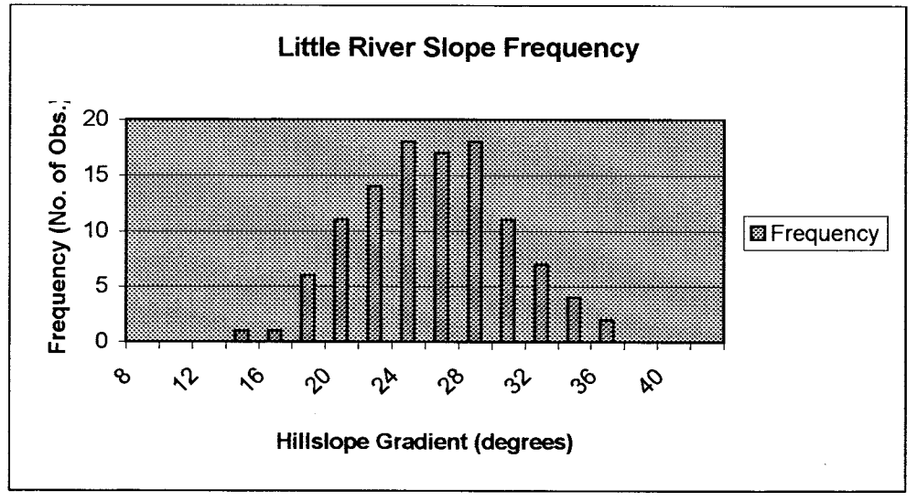
North Fork Distribution

Bin	*Frequency*
8	0
10	3
12	8
14	6
16	9
18	9
20	9
22	20
24	22
26	13
28	14
30	3
32	1
34	0
36	0
38	0
40	0
More	0

Little River Distribution

Bin	*Frequency*
8	0
10	0
12	0
14	1
16	1
18	6
20	11
22	14
24	18
26	17
28	18
30	11
32	7
34	4
36	2
38	0
40	0
More	0





Results of Appalachian Data t-test

t-Test: Two-Sample Assuming Equal Variances

	North Fork	*Little River*
Mean	20.53175526	24.54608491
Variance	26.85152844	20.02065089
Observations	117	110
Pooled Variance	23.54234776	
Hypothesized Mean Difference	0	
df	225	
t Stat	-6.229662126	
P(T<=t) one-tail	1.13648E-09	
t Critical one-tail	1.651653747	
P(T<=t) two-tail	2.27296E-09	
t Critical two-tail	1.970565791	

Alpha = 0.05; 95% confidence level
t Stat = 6.23
t Critical = 1.97

t Stat > t Critical: Reject Null Hypothesis: Significant Differenc
between North Fork and Little River Slopes

Answer the following questions:

1) Does your variance equal the square of the standard deviation?

Yes, the variance = the stdev squared. They are both measuring the spread of all data about the mean.

2) What is the null hypothesis of the Appalachian slope analysis?

The null hypothesis is that hillslope gradients at the North Fork and Little River are statistically the same, with no significant difference.

3) Is the calculated t-stat greater than or less than the critical two-tail t-stat?

Yes, the t-stat is greater than t critical. This suggests that there is a significant difference at the 95% confidence level.

4) How confident (what is the confidence level) of your results?

C.I. = 95% ($\alpha = 0.05$)

5) Is there a significant difference between hillslope gradients at the North Fork and Little River areas?

Yes, there is a significant difference between hillslope gradients at the North Fork and Little River areas. The Little River is significantly steeper.

6) Given that these areas are within 100 km of each other (i.e. fairly close proximity), can you hypothesize what factors might be controlling the relationships between hillslope gradients?

Climate is always a factor, the close proximity suggests that climate difference may not be that drastic. What about the composition of the bedrock geology? It turns out that the Little River area is underlain by a high percentage of resistant sandstone lithofacies, while the North Fork has a greater percentage of shale underlying it. It seems that the more resistant sandstone at Little River provides for more resistant, steeper slopes compared to North Fork.

Are there any other possibilities?

7) Based on your results, which area has a greater likelihood of being associated with slope failure (e.g. landslide and debris flow)... or are both areas the same? Rank each area with respect to slope-failure potential using a relative criteria of lower vs higher.

Generally, it seems that Little River is steeper, but not too steep, so should have a greater tendency for slope failure.

8) Which area would likely have thicker soil/regolith deposits on the hillslopes? WHY?

North Fork, because slopes are more gentle, allowing for a greater accumulation of regolith. The steeper slopes at Little River are conducive to more rapid rates of erosion, which would discourage accumulation of regolith.