INTEGRATED TRAINING AREA MANAGEMENT
ITAM Learning Module
LCTA Scenario

Effects of Fire on Vegetation Characteristics

Recommended Reading

ITAM Technical Reference Manual:
- Chapter 2: *Introduction to Resource Monitoring*
- Chapter 8: *Structured Query Language (SQL)*
- Chapter 11: *Data Analysis and Interpretation*

ITAM Learning Module Notes:
- *Connecting to a Database in Quest*
- *Creating SQL Statement in Quest*
- *Using the t-Test: Paired Two Sample for Means in Microsoft Excel*
- *Generating Graphs in Microsoft Excel*
- *Creating a Pivot Table in Microsoft Excel*
- *Calculating Confidence Intervals*

Problem Statement

What are the short-term effects of fire on vegetation characteristics in grassland communities?

In late summer 1998, a series of small grassland fires occurred at Fort USA. Small fires are common on Fort USA, but the effects of fire on vegetation composition and structure and on soil erosion rates are unknown. During the 1999 field season, eight "special use" plots were randomly established in burned areas near unburned original or "core" plots.

By proximity and physiographic/soil characteristics, assumptions were made that the vegetation components and the potential use (military, non-military) of the core and special use plots were similar. Because the plots were not paired before the fire, the data for each treatment (burned, unburned) were pooled. Post-burn comparisons of the burned and unburned plots will be used to determine if the effects of fire are significant.

Plans are in place to continue monitoring these special use plots for a minimum of three years, to help understand the factors that affect recovery rates of grasslands.

Acquire data

To answer the above question we will examine ground cover and aerial cover. In this scenario we will use data from the GndCover (ground cover data) and AerCover (aerial vegetation data) tables of the Fort USA database. The data requirement for this type of analysis is not restricted to the standard LCTA data and database; other sources of data derived from a number of different methodologies can be applied to this analysis. The data items used here for the ground cover data are listed below.

Ground Cover Data Elements	
PlotID	Plot number
PlotType	Plot type (core or special use)
VegID	Plant species code
Percent Cover	Percent bare ground and percent litter

Aerial Cover Data Elements	
PlotID	Plot number
PlotType	Plot type (core or special use)
VegID	Plant species code
Percent Cover	Percent cover

The Fort USA plots used in this scenario are labeled "C" for core plots and "S" for special use plots. The special use plots are the new plots added to the burned areas.

PlotID	PlotType
85	C
86	C
90	C
95	C
96	C
99	C
101	C
110	C
150	S
151	S
152	S
153	S
154	S
155	S
156	S
157	S

SQL for ground cover data (SQLBase)

First we are looking at data in the ground cover table GndCover. We assume that all data has been collected on the plot, thus resulting in 100 observations per plot. If you want to check this before running any queries use the statement below. This will return any plots from the 1999 data set that does not have 100 observations. If each plot has 100 observations per plot then the queries below will return percents. If any plots do not have 100 observations then you will need to adjust your percents accordingly. For example, if plot 86 only has 98 observations and we find 78 points contain bare ground, then the percent of bare ground for plot 86 is 78/98=.7959 or 79.59%. SQL statements for both SQLBase and Access are given below.

Check plots for 100 observations per plot (SQLBase)

```
select plotid, count(*)
from gndcover
where vegid is not null
and plotid in (85, 86, 90, 95, 96, 99, 101, 110, 150, 151, 152, 153, 154, 155, 156, 157)
and @yearno(recdate) = 1999
group by 1
having count(*)  <> 100;
```

Check plots for 100 observations per plot (Access)

```
select plotid, count(*)
from gndcover
where vegid is not null
and plotid in (85, 86, 90, 95, 96, 99, 101, 110, 150, 151, 152, 153, 154, 155, 156, 157)
and year(recdate) = 1999
group by plotid
having count(*)  <> 100;
```

Percent bare ground (SQLBase)

```
select gndcover.plotid, @yearno(gndcover.recdate) as yr, 'Bare Ground' as type,
plotsurv.plottype ,count(*) as Prcnt
from gndcover, plotsurv
where @yearno(gndcover.recdate) = 1999
and gndcover.plotid in (85, 86, 90, 95, 96, 99, 101, 110, 150, 151, 152, 153, 154, 155, 156, 157)
and @upper(gndcover.vegid) =  'BG'
and gndcover.plotid = plotsurv.plotid
and gndcover.recdate = plotsurv.recdate
group by 1,2,3 ,4;
```

Percent bare ground (Access)

```
select gndcover.plotid, year(gndcover.recdate) as yr, 'Bare Ground' as type,
plotsurv.plottype ,count(*) as Prcnt
from gndcover, plotsurv
where year(gndcover.recdate) = 1999
and gndcover.plotid in (85, 86, 90, 95, 96, 99, 101, 110, 150, 151, 152, 153, 154, 155, 156, 157)
and gndcover.vegid =  'BG'
and gndcover.plotid = plotsurv.plotid
and gndcover.recdate = plotsurv.recdate
group by gndcover.plotid, year(gndcover.recdate) , 'Bare Ground' ,
plotsurv.plottype;
```

Percent litter (SQLBase)

```
select gndcover.plotid, @yearno(gndcover.recdate) as yr, 'Litter' as type, plotsurv.plottype
,count(*) as Prcnt
from gndcover, plotsurv
where @yearno(gndcover.recdate) = 1999
and gndcover.plotid in (85, 86, 90, 95, 96, 99, 101, 110, 150, 151, 152, 153, 154, 155, 156, 157)
and @upper(gndcover.vegid) in ('LG', 'LF', 'LT', 'LS', 'DG', 'DF', 'DT', 'DS', 'DW')
and gndcover.plotid = plotsurv.plotid
and gndcover.recdate = plotsurv.recdate
group by 1,2,3 ,4;
```

Percent litter (Access)

```
select gndcover.plotid, year(gndcover.recdate) as yr, 'Litter' as type, plotsurv.plottype ,count(*)
as Prcnt
from gndcover, plotsurv
where year(gndcover.recdate) = 1999
and gndcover.plotid in (85, 86, 90, 95, 96, 99, 101, 110, 150, 151, 152, 153, 154, 155, 156, 157)
and gndcover.vegid in ('LG', 'LF', 'LT', 'LS', 'DG', 'DF', 'DT', 'DS', 'DW')
and gndcover.plotid = plotsurv.plotid
and gndcover.recdate = plotsurv.recdate
group by gndcover.plotid, year(gndcover.recdate), 'Litter', plotsurv.plottype;
```

Perform Procedures

The results of the query above were exported to a dBase file, which was then opened in Microsoft Excel. In Quest use the [Edit], [Copy to] commands from the main menu to export the data to a file. In Access use [File], [Save as]. Each column of data should have a column header.

Ground Cover

For this analysis we will treat all types of litter and dead wood the same. Generally, litter found on LCTA plots is designated as shrub, tree, grass, or forb litter. These are coded as LS, LT, LG, and LF respectively. Similarly, duff is coded as DS, DT, DG, and DF. Dead wood is identified by the code DW. Notice that in the SQL statement for litter we designated all of the litter, duff, and deadwood codes in the where clause. By counting only these codes in the GndCover table we will have the percent of litter for each plot.

Create a pivot table designating the PlotType as the columns and PlotID as the rows, and the Prcnt as the data. Use the sum summary for the data. Refer the Helpful Note: *Creating Pivot Tables in Microsoft Excel* for details on creating pivot tables. The results of the pivot table are shown below for bare ground and litter.

Sum of Percent Bare ground	Plot Type	
Plot	Unburned	Burned
85	34	
86	38	
90	29	
95	37	
96	45	
99	67	
101	23	
110	36	
150		94
151		93
152		85
153		94
154		96
155		93
156		94
157		95

Sum of Percent Litter	Plot Type	
Plot	Unburned	Burned
85	66	
86	62	
90	70	
95	62	
96	55	
99	33	
101	77	
110	64	
150		4
151		5
152		13
153		5
154		3
155		6
156		4
157		3

Next, we perform a two-sample t-test (assuming equal variances) in Microsoft Excel. Refer to the Helpful Note: *Using the t-Test: Paired Two Sample for Means in Microsoft Excel* for more information. Procedures for the t-Test: Two-Sample Assuming Equal Variances are similar to those listed in the Helpful Note. The results of the t-tests are shown below. An alpha of 0.05 was used

t-Test: Two-Sample Assuming Equal Variances

Bare Ground

	Unburned	*Burned*
Mean	38.63	93
Variance	173.41	11.437
Observations	8	8
Pooled Variance	92.42	
Hypothesized Mean Difference	0	
Df	14	
t Stat	-11.31	
P(T<=t) one-tail	9.94E-09	
t Critical one-tail	1.761309	
P(T<=t) two-tail	1.99E-08	
t Critical two-tail	2.14	

t-Test: Two-Sample Assuming Equal Variances

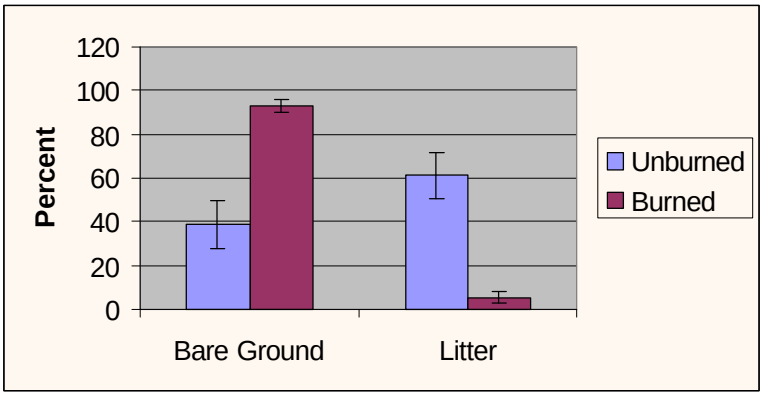
Litter

	Unburned	*Burned*
Mean	61.13	5.38
Variance	170.41	10.55
Observations	8	8
Pooled Variance	90.48	
Hypothesized Mean Difference	0	
df	14	
t Stat	11.72	
P(T<=t) one-tail	6.32E-09	
t Critical one-tail	1.761309	
P(T<=t) two-tail	1.26E-08	
t Critical two-tail	2.14	

From the t-test results presented in the tables above we can make the following statements:

1) Bare ground cover is significantly higher on burned plots than on unburned plots at the 95% level of confidence.
2) Litter cover is significantly lower on the burned plots than on unburned plots at the 95% level of confidence.

The results are presented below using a histogram. Means and 95% confidence intervals illustrate the same results using a different approach. Refer to Helpful Note: *Calculating Confidence Intervals* for the procedures used here.



Canopy Cover

Next we will check if there is a significant change in the canopy cover of two species, *Poa secunda* and *Bromus tectorum.* *Poa secunda* (POSE) is a native perennial grass and is a desirable species. *Bromus tectorum* (BRTE) is an annual introduced grass and is undesirable. We will determine the percent canopy cover of each species using presence/absence data from the AerCover table. Presence/absence data is often used to filter out noise in the data.

SQL for aerial cover data (SQLBase)

```
create table aerhits
(plotid integer,
yr integer,
vegid char(8),
vegloc real);

insert into aerhits (plotid, yr, vegid, vegloc) select distinct plotid, @yearno(recdate),
@upper(vegid), vegloc
from aercover
where plotid in (85, 86, 90, 95, 96, 99, 101, 110, 150, 151, 152, 153, 154, 155, 156, 157)
and @yearno(recdate) = 1999;
```

The two statements above create a table with presence/absence data.

```
create table aercnt
(plotid integer,
yr integer,
vegid char(8),
hitcnt integer);

insert into aercnt (plotid, yr, vegid, hitcnt) select plotid, yr, @upper(vegid), count(*)
from aerhits
group by 1,2,3;
```

The two statements above create a table containing the count of presence/absence data (i.e., cover by species).

```
create table totaerhits
(plotid integer,
yr integer,
plottype char(1),
tothits integer);
```

```
insert into totaerhits (plotid, yr, plottype, tothits) select aercnt.plotid, yr, plottype, sum(hitcnt)
from aercnt , plotsurv
where aercnt.plotid = plotsurv.plotid
and aercnt.yr = @yearno(plotsurv.recdate)
group by 1,2,3;
```

The two statements above create a table containing the total hits from the presence/absence data.

Below is the statement for finding percent aerial cover of POSE.

```
select aercnt.plotid, aercnt.yr, totaerhits.plottype, aercnt.vegid, aercnt.hitcnt*100/totaerhits.tothits
from aercnt, totaerhits
where aercnt.plotid = totaerhits.plotid
and aercnt.yr = totaerhits.yr
and @upper(aercnt.vegid) = 'POSE';
```

Below is the statement for finding percent aerial cover of BRTE.

```
select aercnt.plotid, aercnt.yr, totaerhits.plottype, aercnt.vegid, aercnt.hitcnt*100/totaerhits.tothits
from aercnt, totaerhits
where aercnt.plotid = totaerhits.plotid
and aercnt.yr = totaerhits.yr
and @upper(aercnt.vegid) = 'BRTE';
```

SQL for aerial cover data (Access)

Save the following query as AerHits

```
SELECT DISTINCT plotid, year(recdate) AS yr, vegid, vegloc
FROM aercover
WHERE plotid in (85, 86, 90, 95, 96, 99, 101, 110, 150, 151, 152, 153, 154, 155, 156, 157)
and year(recdate) = 1999;
```

Save the following query as AerCnt

```
SELECT plotid, yr, vegid, count(*) AS hitcnt
FROM aerhits
GROUP BY plotid, yr, vegid;
```

Save the following query with the name TotAerHits

```
SELECT aercnt.plotid, yr, plottype, sum(hitcnt) AS tothits
FROM aercnt, plotsurv
WHERE aercnt.plotid = plotsurv.plotid
and aercnt.yr = year(plotsurv.recdate)
GROUP BY aercnt.plotid, yr, plottype;
```

Below is the statement for finding percent aerial cover of POSE.

```
select aercnt.plotid, aercnt.yr, totaerhits.plottype, aercnt.vegid, aercnt.hitcnt/totaerhits.tothits as
prcnt
from aercnt, totaerhits
where aercnt.plotid = totaerhits.plotid
and aercnt.yr = totaerhits.yr
and aercnt.vegid = 'POSE';
```

Below is the statement for finding percent aerial cover of BRTE.

```
select aercnt.plotid, aercnt.yr, totaerhits.plottype, aercnt.vegid, aercnt.hitcnt/totaerhits.tothits as
prcnt
from aercnt, totaerhits
where aercnt.plotid = totaerhits.plotid
and aercnt.yr = totaerhits.yr
and aercnt.vegid = 'BRTE';
```

Again, a pivot table is created designating the PlotType as the columns and PlotID as the rows, and the Prcnt as the data. Use the sum summary for the data. Then a two-sample t-test (assuming equal variances) is performed on the data. An alpha of 0.05 as used. The results of the t-tests are shown below.

t-Test: Two-Sample Assuming Equal Variances

POSE

	Unburned	*Burned*
Mean	57.38	46.86
Variance	532.6	403.05
Observations	8	8
Pooled Variance	467.83	
Hypothesized Mean Difference	0	
df	14	
t Stat	0.973	
P(T<=t) one-tail	0.173	
t Critical one-tail	1.761	
P(T<=t) two-tail	0.346	
t Critical two-tail	2.144	

t-Test: Two-Sample Assuming Equal Variances

BRTE

	Unburned	*Burned*
Mean	14.24	22.01
Variance	551.66	376.56
Observations	6	8
Pooled Variance	449.51	
Hypothesized Mean Difference	0	
df	12	
t Stat	-0.68	
P(T<=t) one-tail	0.255	
t Critical one-tail	1.782	
P(T<=t) two-tail	0.510	
t Critical two-tail	2.179	

The t-test results indicate that POSE cover is not significantly higher in the unburned sample (for a 2-tailed test, p value = 0.35>0.05). At the 80% confidence level and using a 1-tailed test, mean POSE cover would be found to be significantly higher in the unburned sample. BRTE cover does not differ significantly between burned and unburned samples at the 95% confidence level (for a two-tailed test, p value = 0.51>0.05). One year after the fire and based on one year of monitoring data, BRTE does not appear to be favored in burned areas. However, keep in mind that POSE cover was found to be lower in the burned area, significantly at an alpha of 0.18. This may be a warning signal that the population of BRTE could increase over time with fire.

Conclusion

Bare ground increased significantly on the burned plots, from 38.6% to 93%, and litter decreased significantly from 61.1% to 5.4%. There was no significant change in the amount of aerial cover for the desirable species POSE or the undesirable species BRTE. However, future monitoring may indicate higher amounts of BRTE, at which point some action should be taken to stop the spread of this undesirable species.

Fire probably has as many positive effects as negative effects. Nutrients bound in litter and senescing materials become mobilized and available to plants after a fire. More light reaches and warms the soil surface. Seedling germination increases and inter- and intraspecific species competition is lower the first few years. More soil water may be available. At the same time, water erosion potential increases, because litter and other materials have been removed. Weedy species are often quick to colonize areas unavailable prior to a fire because of established perennial vegetation.