Assessing Vineyard Blocks and Wine Quality with the use of GIS tools

Dundee, Oregon

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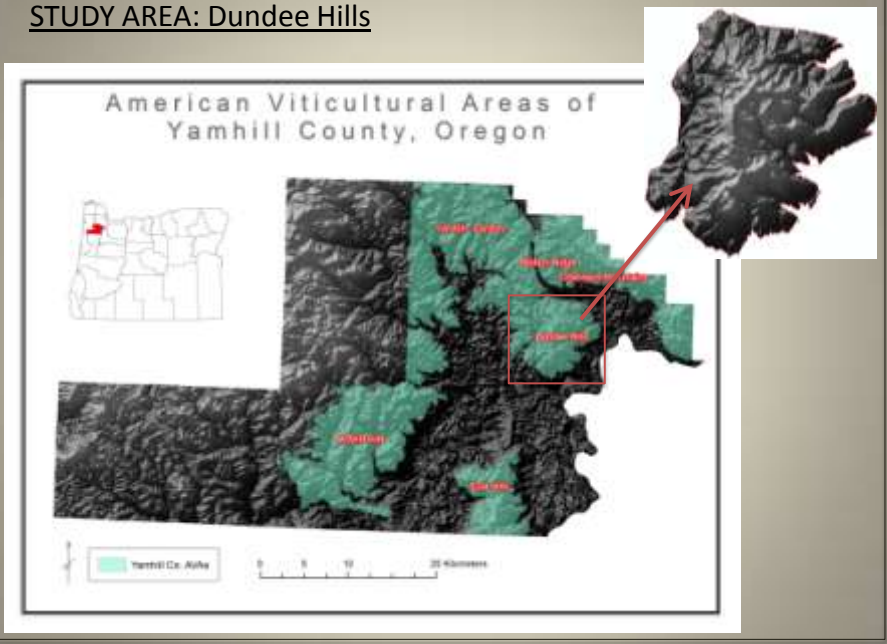
Each winery obtains their wine grapes from a specific vineyard block for wine production. Our research questions are:

What are the spatial patterns for wine quality and vineyard locations for Dundee Hills, Oregon? How, with the use of GIS tools, can these patterns be determined?

Variables:
Vineyard blocks
Wine quality
Slope
Aspect
Elevation

Methods:
Moran's I
Getis-Ord General G
OLS Regression

STUDY AREA: Dundee Hills



DIGITIZE VINEYARD POLYGONS using ArcMap Basemap (Imagery) (Fig1) and Dundee Tax Lots (Fig2)

Figure 1

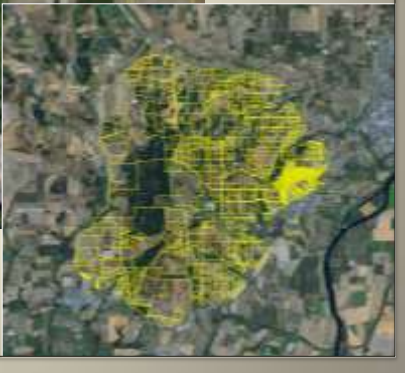
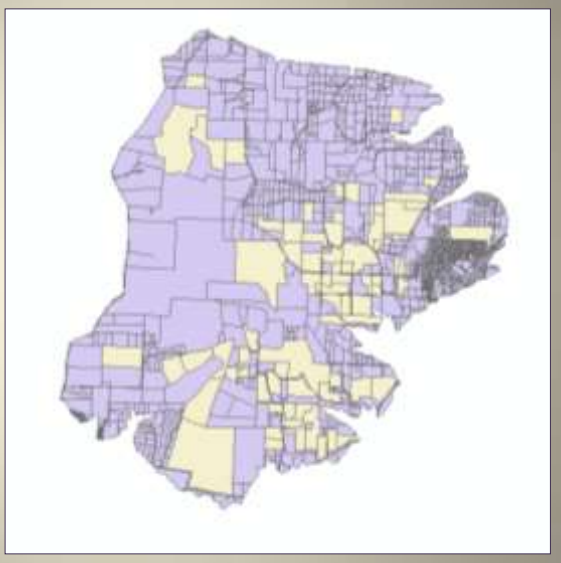


Figure 2

- Resulting Vineyard Polygons
- Identified each polygon to Vineyard Names
- Identified 32 of the 50 wineries in the Dundee Hills AVA
- 1,264 acres of vineyards



Quality ratings for a time period of 2002-2008 for a total of 32 wineries

#	Vineyard:	2002	2003	2004	2005	2006	2007	2008	AVERAGE
1	ANA	83	76						79.5
2	AYOUB			92	92	90	91	90	91.0
3	ARCHERY SUMMIT ESTATE			94	95	83	89	88	89.8
4	BELLA VIDA		90	85	84	89	89	90	87.8333333
5	BERGSTROM			93	93	93	91	93	92.6
6	DE PONTE				89	91	88		89.3333333
7	DOMAINE DROUHIN	90	88	88	88	90		88	88.0666667
8	LANGE							92	92
9	SOKOL BLOSSER	87	82			90		90	87.25
10	STOLLER			86	88				87
11	THE FOUR GRACES BLACK FAMILY ESTATE							93	93
12	THISTLE					87			87
13	ANDERSON FAMILY				90	91			90.5
14	DURANT	91	78				92	91	88
15	FUQUA			90		89		87	88.0666667
16	KNUDSEN					92			92
17	JULIARD		86		89				87.5
18	KNIGHT'S GAMBIT							90	90
19	LA COUNA				88	91	85	85	87.25
20	ULLIE'S						87		87
21	MARESH				93	91	88	90	90.5
22	MEYER					92			92
23	MURTO	88		91					89.5

-Exported a new shapefile with only the Vineyards where Quality Rating were offered.
-Converted feature (polygons) to points -exhibited by the red dots in Figure 2- to conduct correlation analysis

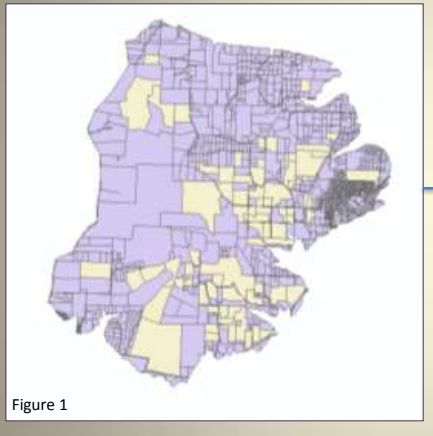


Figure 1

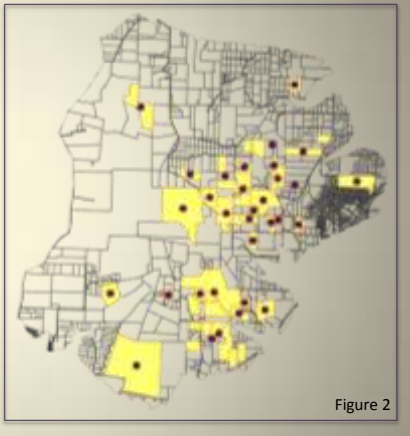
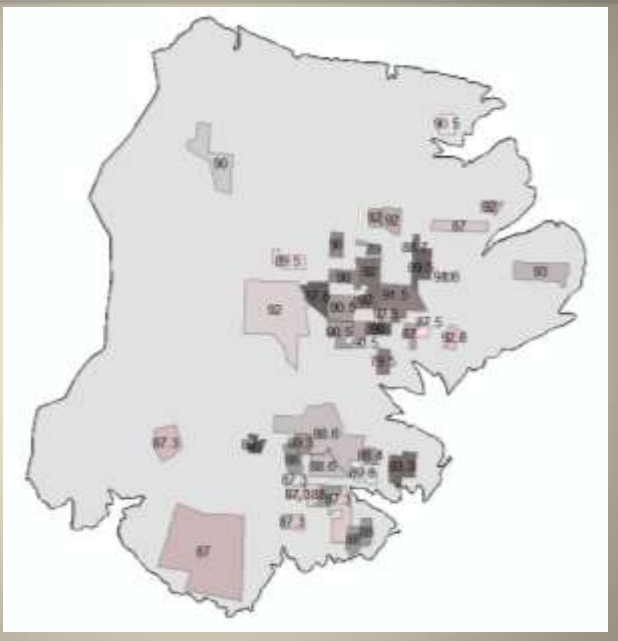


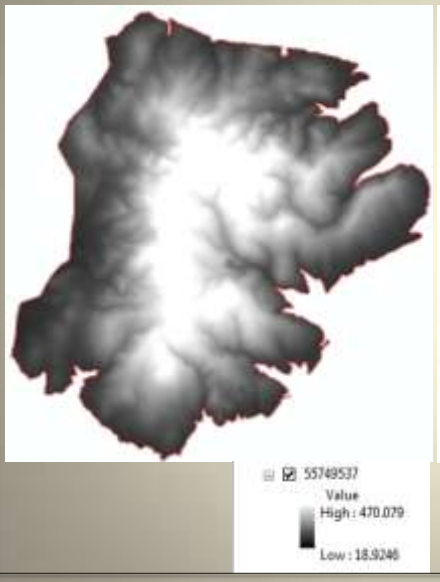
Figure 2

Aggregated Quality Rating per vineyard block

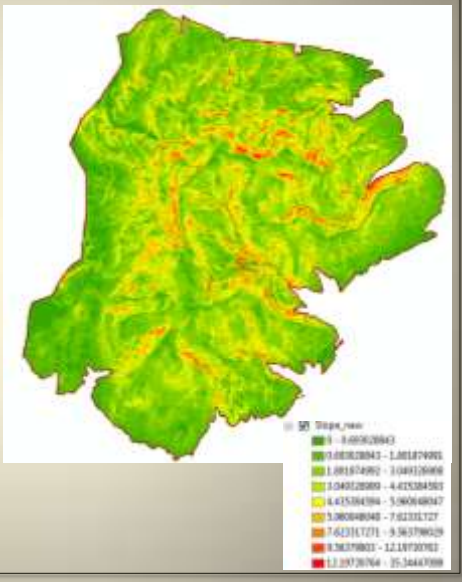
What variables are the most influential for differences in quality ratings?



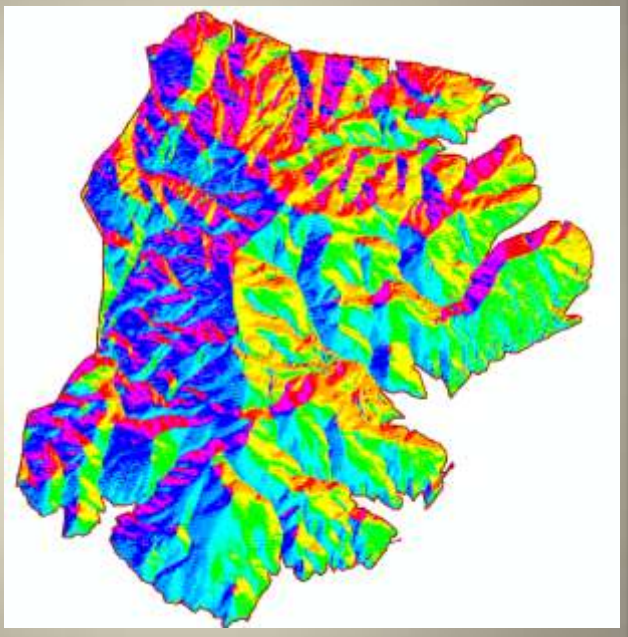
10 m DEM



Slope

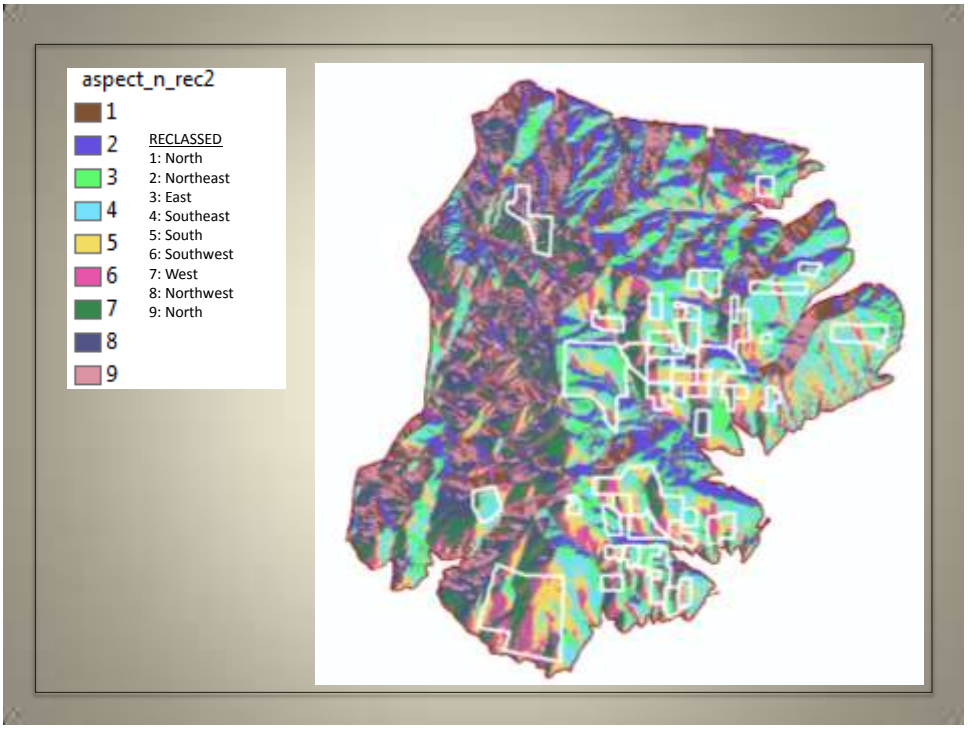


Aspect



Zonal Statistics to Table Tool to find mean values for all variables.

Rowid	VINEYARD	ZONE_CODE	COUNT	AREA	MEAN		RECLASS
4	Ayoub	4	261	223934.31	3.1341		3
13	Knudsen	13	11754	10084766	3.556832		3
23	Renegade Ridge Estate	23	761	652927.25	3.571616		3
15	Lange Estate	15	2759	2367183	3.623777		3
2	Andersen Family	2	977	838252.19	3.798174		3
21	Prince Hill	21	3756	3222594.8	3.848788		3
12	Knight's Gambit	12	2329	1998249	3.861743		3
20	Olson Estate	20	794	681240.75	3.925693		3
31	White Rose	31	611	524229.34	3.96072		4
29	Thistle	29	1785	1531504.8	4.028611		4
9	Durant	9	4446	3814605	4.112461		4
28	The Four Graces Black Family Estate	28	3121	2677773.8	4.194609		4
18	Meyer	18	3249	2787596	4.321022		4
14	La Colina	14	2346	2012834.8	4.484229		4
6	Bergstrom	6	822	705264.38	4.554746		5
26	Sokol Blosser	26	5364	4602236	4.694017		5
17	Maresh	17	4237	3635286	5.094843		5
30	Three Sisters	30	2311	1982605.3	5.11164		5
8	Domaine Drouhin	8	11167	9581128	5.125728		5
11	Jullard	11	492	422129.03	5.27439		5
3	Archery Summit Estate	3	1365	1171150.8	5.29011		5
25	Sins	25	518	444436.66	5.432433		5
19	Murto	19	1296	1111948.6	5.554784		5
32	Winderlea	32	1015	870855.63	5.614779		6
22	Red Hills Estate	22	1844	1582125.9	5.639894		6
7	De Ponte	7	972	833962.25	5.666667		6
27	Stoller	27	18597	15955983	5.902404		6
16	Lillie's	16	767	658575.13	6.153846		6
24	Revana	24	4063	3488996.5	6.755107		6
5	Bella Vida	5	2061	1768308.9	6.854825		7
1	Ana	1	1033	886299.38	7.405615		7
10	Fuqua	10	508	435856.81	7.51378		7



Slope Reclassify

Rowid	VINEYARD	ZONE_CODE	COUNT	AREA	MEAN	SLOPE_REC
14	La Crema	14	2348	2612834.8	1.629647	1
27	Stutler	27	16597	15955963	1.876624	1
30	Three Sisters	30	2311	1982805.3	1.999647	1
11	Julienl	11	462	422129.63	2.084189	1
28	The Four Graces Black Family Estate	28	3121	2877773.8	2.139474	2
31	White Rose	31	611	524229.34	2.35461	2
26	Sokol Blosser	26	5364	4602236	2.421085	2
15	Lange Estate	15	2759	2367183	2.482369	2
9	Durant	9	4446	3814605	2.505813	2
22	Red Hills Estate	22	1844	1582125.9	2.552825	2
6	Bergstrom	6	822	705264.38	2.620596	2
10	Fuqua	10	508	435656.81	2.672713	2
24	Reviere	24	4053	3405896.5	2.857435	2
20	Olson Estate	20	784	661240.75	2.88709	2
32	Winderlea	32	1015	870855.63	3.169347	3
12	Knight's Gambit	12	2329	1998249	3.151979	3
23	Renegade Ridge Estate	23	761	652927.25	3.159914	3
7	De Ponte	7	972	833962.25	3.164358	3
13	Knudsen	13	11754	10084766	3.190334	3
25	Sine	25	518	444436.66	3.273731	3
17	Maresh	17	4237	3635386	3.356183	3
29	Thiele	29	1705	1531504.8	3.36253	3
8	Domaine Drouhin	8	11167	9581128	3.420686	3
18	Meyer	18	3249	2787596	3.463501	3
1	Arie	1	1033	886299.38	3.494728	3
4	Aymob	4	261	223934.31	3.670881	3
3	Archery Summit Estate	3	1365	1171150.6	3.686626	3
16	Lilet's	16	767	658075.13	3.730465	3
19	Murfo	19	1296	1111949.6	3.776157	3
2	Anderson Family	2	977	838252.19	3.818178	3
21	Prince Hill	21	3756	3222684.8	4.167318	4
5	Bella Vida	5	2061	1768300.9	4.22399	4

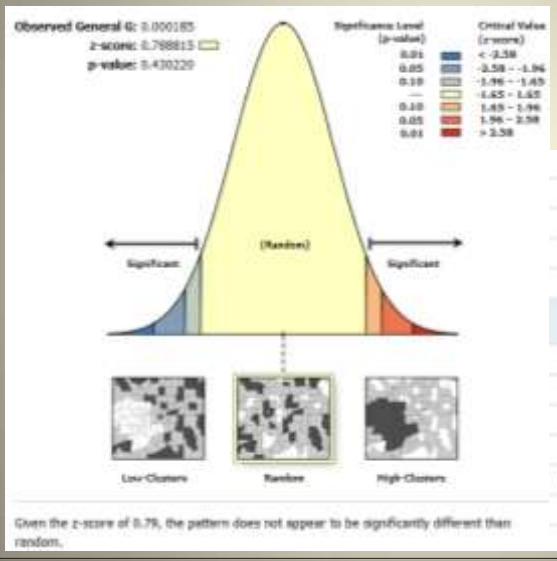
ELEVATION

Rowid	VINEYARD	ZONE_CODE	COUNT	AREA	MEAN
1	Aria	1	1033	886299.38	129.73158
2	Anderson Family	2	977	838252.19	106.63998
3	Archery Summit Estate	3	1365	1171150.8	114.50052
4	Ayoub	4	261	223934.31	145.95647
5	Bella Vida	5	2061	1768388.9	207.30811
6	Bergstrom	6	822	705284.36	105.72997
7	De Ponte	7	972	833962.25	191.62776
8	Domaine Drouhin	8	11167	9581128	185.80334
9	Durant	9	4446	3814605	116.56638
10	Fuqua	10	506	435856.81	201.37029
11	Juliard	11	492	422129.03	144.70943
12	Knight's Gambit	12	2329	1998249	252.6918
13	Knudsen	13	11754	10084766	229.93382
14	La Colina	14	2346	2012834.8	157.63524
15	Lange Estate	15	2759	2367183	190.2906
16	Lilie's	16	767	658075.13	126.35462
17	Maresh	17	4237	3635286	196.76184
18	Meyer	18	3249	2787596	200.39561
19	Murto	19	1296	1111949.6	226.31175
20	Olson Estate	20	794	681240.75	242.97772
21	Prince Hill	21	3756	3222594.8	188.63103
22	Red Hills Estate	22	1644	1562125.9	182.19363
23	Renegade Ridge Estate	23	761	652927.25	136.74695
24	Revana	24	4063	3485996.5	152.47639
25	Sims	25	518	444436.66	194.34967
26	Sokol Blosser	26	5364	4602236	117.72383
27	Stoller	27	18597	15955963	113.57431
28	The Four Graces Black Family Estate	28	3121	2677773.8	107.6736
29	Thistle	29	1765	1514584.8	157.22604
30	Three Sisters	30	2311	1982805.3	87.744164
31	White Rose	31	611	524228.34	255.22787
32	Winderlea	32	1015	870855.63	158.92709

SPATIAL JOIN: Vineyards, quality ratings, slope, elevation and aspect

FID	Shape *	Vineyard	Qualiatng	MEAN	SLOPE_REC	elev_MEA	MEAN	ASPECT_RE
0	Polygon	Aria	79.5	3.494728	3	129.73158	7.405615	7
1	Polygon	Anderson Family	90.5	3.818178	3	106.63998	3.790174	3
2	Polygon	Archery Summit Estate	89.000003	3.686826	3	114.50052	5.28011	5
3	Polygon	Ayoubi	91.599998	3.670881	3	145.95647	3.1341	3
4	Polygon	Bella Vida	87.800003	4.22399	4	207.30811	6.654825	7
5	Polygon	Bergstrom	92.599998	2.820598	2	105.72997	4.554745	5
6	Polygon	De Ponte	89.300003	3.164258	3	191.62776	5.666867	6
7	Polygon	Domaine Drouhin	88.599998	3.420686	3	185.80334	5.125726	5
8	Polygon	Durant	88	2.505813	2	116.56638	4.112461	4
9	Polygon	Fuqua	88.600004	2.672713	2	201.37029	7.51378	7
10	Polygon	Juliard	87.5	2.884169	1	144.70943	5.27439	5
11	Polygon	Knight's Gambit	98	3.151879	3	252.6918	3.861743	3
12	Polygon	Knudsen	92	3.198334	3	229.93382	3.556832	3
13	Polygon	La Colina	87.25	1.629647	1	157.63524	4.484229	4
14	Polygon	Lange Estate	92	2.482369	2	190.2906	3.623777	3
15	Polygon	Lilie's	87	3.738465	3	126.35462	6.153648	6
16	Polygon	Maresh	90.5	3.256183	3	196.76184	5.094643	5
17	Polygon	Meyer	92	3.493501	3	200.39561	4.321022	4
18	Polygon	Murto	89.5	3.776187	3	226.31175	5.554784	5
19	Polygon	Olson Estate	89	2.98709	2	242.97772	3.925693	3
20	Polygon	Prince Hill	91.5	4.167319	4	188.63103	3.840766	3
21	Polygon	Red Hills Estate	89.5	2.552625	2	182.19363	5.630694	6
22	Polygon	Renegade Ridge Estate	88.400002	3.109914	3	136.74695	3.571616	3
23	Polygon	Revana	90	2.857435	2	152.47639	6.756107	6
24	Polygon	Sims	92.5	3.273731	3	194.34967	5.432433	5
25	Polygon	Sokol Blosser	87.25	2.421065	2	117.72383	4.694817	5
26	Polygon	Stoller	87	1.976624	1	113.57431	5.982484	6
27	Polygon	The Four Graces Black Family Estate	93	2.139474	2	107.6736	4.194809	4
28	Polygon	Thistle	87	3.36253	3	157.22604	4.028011	4
29	Polygon	Three Sisters	93.25	1.999647	1	87.744164	5.11164	5
30	Polygon	White Rose	88.600004	2.35451	2	255.22787	3.96072	4
31	Polygon	Winderlea	90	3.109347	3	158.92709	5.614779	6

Global Moran's I and Getis-ord General G ran for all variables



Observed General G:	0.000185
Expected General G:	0.000181
Variance:	0.000000
z-score:	0.788815
p-value:	0.430220

Dataset Information

Input Feature Class:	Vnyrds_QualRatings
Input Field:	ASPECT_STAT.RECLASS
Conceptualization:	INVERSE_DISTANCE
Distance Method:	EUCLIDEAN
Row Standardization:	False
Distance Threshold:	38153.6835
Weights Matrix File:	None

Results:

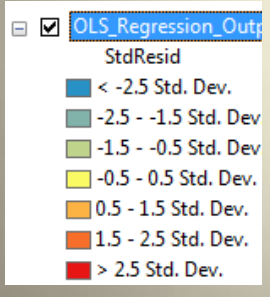
	Moran's I		General G	
Slope	MI: 0.014734 z-score: 1.225170 P-value: 0.220511	RANDOM	GG: 0.000191 z-score: 2.275675 P-value: 0.022865	HIGH CLUSTERS
Elevation	MI: 0.140069 z-score:4.481395 P-value: 0.000007	CLUSTERED	GG: 0.000191 z-score: 1.837703 p-value: 0.066106	HIGH CLUSTERS
Aspect	MI: -0.038991 z-score: -0.174993 P-value: 0.861085	RANDOM	GG: 0.000185 z-score: 0.78815 p-value: 0.430220	RANDOM
Quality	MI: -0.021252 z-score: 0.308305 P-value: 0.757850	RANDOM	GG: 0.000181 z-score:0.058522 P-value: 0.95333	RANDOM

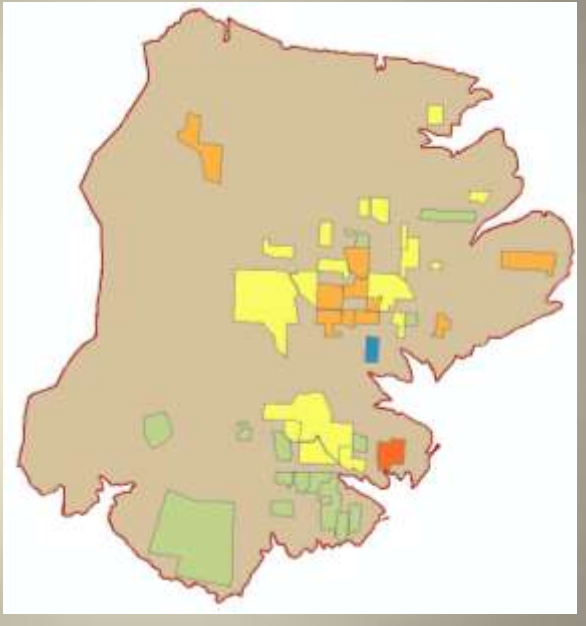
Excel Regression

Regression Statistics	
Multiple R	0.331473
R Square	0.109874
Adjusted R Square	0.010971
Standard Error	1.947123
Observations	32

Ordinary Least Squared Regression

Dependent Variable: Quality
Independent Variables:
Slope, Aspect, Elevation





Final Conclusions

•For both the Moran's I and the General G (with the exception of elevation), our variables resulted in random spatial autocorrelation.

•The R-squared value proved to be statistically insignificant for all of our independent and dependent variables.

•Although these test display overall statistical results, there were several factors that could influence our results, which may be addressed in future research.

Limitations and Future Analysis:

•MAUP (using taxlots vs actual vineyard locations)

•Edge Affect

•Where the actual grapes come from

•Elevation of taxlots

•Using the mean for the taxlots

•How soils affect the results

•Management practices (organic vs conventional, irrigation, etc..)

•Timeframe of our quality ratings (sample size)

•Climate (affect on quality, crop, production year to year)

•Human error

References

- DEM - http://seamless.usgs.gov
- Graphics - http://commons.wikimedia.org
- Quality ratings – http://winespectator.com
- American Viticultural Areas shapefile – David Banis; personal communication and data, 2010
- Vineyard information – Donnych Diaz; personal communication and data, 2010
- De Blij, H.J. 1983. Geography of viticulture: rationale and resource. *J. Geography,* pp. 112-121.
- MacNeil, K. 2001. The wine bible. Workman Publishing, New York, pp. 738-749.

Questions?