# Data Mining to Identify Grading Practices

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#### WSCUC 2013 Handbook of Accreditation Standard 4, CFR 4.4

Guideline:

Periodic analysis of grades and evaluation procedures are conducted to assess the rigor and effectiveness of grading policies and practices.



#### Enhancing Student Success and Building Inclusive Classrooms at UCLA http://www.evc.ucla.edu/reports

Report to the Executive Vice Chancellor and Provost December 2015

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| Dimonsion               | <b>Criterion-Referenced</b>  | Norm-Referenced   |
|-------------------------|--|---|
| Dimension               | Tests  | Tests   |
| Purpose                 | To determine whether each student has<br>achieved specific skills or concepts. To find out<br>how much students know before instruction<br>begins and after it has finished.   | To rank each student with respect to the<br>achievement of others in broad areas of<br>knowledge. To discriminate between high and<br>low achievers.  |
| Content                 | Measures specific skills which make up a<br>designated curriculum. These skills are identified<br>by teachers and curriculum experts. Each skill is<br>expressed as an instructional objective.  | Measures broad skill areas sampled from a variety of textbooks, syllabi, and the judgments of curriculum experts.   |
| Item<br>Characteristics | Each skill is tested by at least four items in order<br>to obtain an adequate sample of student<br>performance and to minimize the effect of<br>guessing. The items which test any given skill are<br>parallel in difficulty.                                  | Each skill is usually tested by less than four<br>items. Items vary in difficulty.<br>Items are selected that discriminate between<br>high and low achievers.   |
| Score<br>Interpretation | Each individual is compared with a preset<br>standard for acceptable achievement. The<br>performance of other examinees is irrelevant. A<br>student's score is usually expressed as a<br>percentage. Student achievement is reported for<br>individual skills. | Each individual is compared with other<br>examinees and assigned a scoreusually<br>expressed as a percentile, a grade<br>equivalent score. Student achievement is<br>reported for broad skill areas, although some<br>norm-referenced tests do report student<br>achievement for individual skills. |

Table adapted from: Popham, J. W. (1975). *Educational evaluation*. Englewood Cliffs, New Jersey: Prentice-Hall, Inc.



## Our learning outcomes

- Identify grading practices
- Prepare data set for analysis
- Perform data mining analysis in **SPSS**





## Data Mining Exercise

Please go to the link below to get the practice data file and syntax.

http://www.kellywahl.com/CAIR2016/CAIR2016\_Files.htm



# **K-Means Cluster Analysis**

A machine learning algorithm applied to a large dataset to identify patterns among cases.

#### **Scholarly Citation of Method:**

MacQueen, J. B. (1967). <u>Some Methods for Classification and Analysis of Multivariate Observations</u>. Proceedings of 5th Berkeley Symposium on Mathematical Statistics and Probability. University of California Press. pp. 281–297. <u>MR 0214227</u>. <u>Zbl 0214.46201</u>.

#### **Other Descriptions of the Technique:**

<u>http://www.galvanize.com/blog/introduction-k-means-cluster-analysis/#.VvLhkTFvnpw</u>

Uses Python, but explains the method and its steps.

 <u>http://www.umass.edu/landeco/teaching/multivariate/sched</u> <u>ule/cluster1.pdf</u>

Discusses more methods.

• <u>http://www.slideshare.net/EdurekaIN/k-means-clustering</u> Mentions the "elbow method" by name!



## The flow





## Capture the data

One record per student per term per course offering, with the final grade on each record.

#### In **SPSS**, it will look like this:

|   | 💑 id | 🚜 term     | 윩 subject | 💑 catlg_no | 🔏 sect_no | 💑 grade |
|---|------|------------|-----------|------------|-----------|---------|
| ſ | 1    | Year1Term3 | ANTHRO    | 0045       | 001       | C+      |
| ſ | 5    | Year1Term3 | ANTHRO    | 0045       | 001       | A       |
| ſ | 9    | Year1Term3 | ANTHRO    | 0045       | 001       | С       |
| ſ | 10   | Year1Term3 | ANTHRO    | 0045       | 001       | A-      |
| ſ | 11   | Year1Term3 | ANTHRO    | 0045       | 001       | B-      |
| ſ | 12   | Year1Term3 | ANTHRO    | 0045       | 001       | B+      |
|   | 14   | Year1Term3 | ANTHRO    | 0045       | 001       | В       |
| ſ | 20   | Year1Term3 | ANTHRO    | 0045       | 001       | В       |
| ſ | 21   | Year1Term3 | ANTHRO    | 0045       | 001       | B+      |
| ſ | SDA  | Y ar tring | • NTH IO  | ean        | 00        | ata!    |
| ſ | 31   | Year1Term3 | ATHRO     | 0045       | 001       | в       |
| ſ | 32   | Year1Term3 | ANTHRO    | 0045       | 001       | В       |
| ſ | 33   | Year1Term3 | ANTHRO    | 0045       | 001       | B-      |
|   | 34   | Year1Term3 | ANTHRO    | 0045       | 001       | A-      |
| ſ | 43   | Year1Term3 | ANTHRO    | 0045       | 001       | С       |
|   | 50   | Year1Term3 | ANTHRO    | 0045       | 001       | С       |
|   | 60   | Year1Term3 | ANTHRO    | 0045       | 001       | A       |
|   | 66   | Year1Term3 | ANTHRO    | 0045       | 001       | В       |
|   | 70   | Year1Term3 | ANTHRO    | 0045       | 001       | В       |
|   | 72   | Year1Term3 | ANTHRO    | 0045       | 001       | B+      |
|   | 73   | Year1Term3 | ANTHRO    | 0045       | 001       | B+      |
|   | 79   | Year1Term3 | ANTHRO    | 0045       | 001       | B-      |
| l | 84   | Year1Term3 | ANTHRO    | 0045       | 001       | B+      |
| l | 88   | Year1Term3 | ANTHRO    | 0045       | 001       | С       |
|   | 90   | Year1Term3 | ANTHRO    | 0045       | 001       | Α       |

\*\*\* Start with 'Course Offering Enrollments with Grades CAIR.sav' .

dataset name raw\_grades WINDOW=FRONT. dataset activate raw\_grades.

\*\*\* This selects only the grades that involve evaluation of student work. These will be the only course enrollments used to describe the course offerings. select if not any(grade,'DR','I','IP','L','NR','P','R','S'). execute.

\*\*\* This codes the grades below "C" as being "NP". if (any(grade,'D+','D','D-','F','NP','U')=1) grade='NP'. execute.

SORT CASES BY id term subject catlg\_no sect\_no .

\*\*\* Save the file in this condition.

SAVE OUTFILE='I:\student\_grade\_records.sav' /COMPRESSED.

\* There can be no blanks or nulls in the file -- you must code a value for each piece of missing data, if any.



### Structure the data

| STUDENT | COURSE   | GRADE |
|---------|----------|-------|
| Bart    | Psych 10 | B+    |
| Sally   | Stats 50 | А     |
| Jennie  | Chem 14  | A-    |

#### changes into...

| COURSE   | PERC A's | PERC B'S | PERC C'S | PERC NP |
|----------|----------|----------|----------|---------|
| Psych 10 | 45%      | 35%      | 15%      | 5%      |
| Stats 50 | 25%      | 25%      | 25%      | 25%     |
| Chem 14  | 10%      | 30%      | 30%      | 10%     |



### Structure the data

| 💰 id | 🚜 term     | 💑 subject | 💑 catlg_no | 💑 sect_no | 🚜 grade |
|------|------------|-----------|------------|-----------|---------|
| 1    | Year1Term3 | ANTHRO    | 0045       | 001       | C+      |
| 5    | Year1Term3 | ANTHRO    | 0045       | 001       | A       |
| 9    | Year1Term3 | ANTHRO    | 0045       | 001       | С       |
| 10   | Year1Term3 | ANTHRO    | 0045       | 001       | A-      |
| 11   | Year1Term3 | ANTHRO    | 0045       | 001       | B-      |
| 12   | Year1Term3 | ANTHRO    | 0045       | 001       | B+      |
| 14   | Year1Term3 | ANTHRO    | 0045       | 001       | В       |
| 20   | Year1Term3 | ANTHRO    | 0045       | 001       | В       |
| 21   | Year1Term3 | ANTHRO    | 0045       | 001       | B+      |
| 29   | Year1Term3 | ANTHRO    | 0045       | 001       | B+      |
| 31   | Year1Term3 | ANTHRO    | 0045       | 001       | В       |



\*\*\* This code restructures the file so that each letter grade becomes a separate column with a 1/0 marker for the grade.

#### CASESTOVARS

/ID= id term subject catlg\_no sect\_no /INDEX=grade /GROUPBY=VARIABLE /COUNT=total\_grades "Total Grades" /VIND ROOT=grade\_.

rename variables (ind1=grade\_A\_minus) (ind2=grade\_A\_plus) (ind3=grade\_B\_minus) (ind4=grade\_B\_plus) (ind5=grade\_C\_minus) (ind6=grade\_C\_plus). execute.

SAVE OUTFILE='I:\student\_grade\_records\_restructured.sav' /COMPRESSED.

| 🗞 id | 🖧 term     | 💑 subject | 💑 catlg_no | 💑 sect_no | & total_grad<br>es | 🗞 grade_A | Srade_A_<br>minus | srade_A_<br>plus | 🗞 grade_B | grade_B_<br>minus | grade_B_<br>plus | 🗞 grade_C | Srade_C_<br>minus | <pre>grade_C_ plus</pre> | 🗞 grade_NP |
|------|------------|-----------|------------|-----------|--------------------|-----------|-------------------|------------------|-----------|-------------------|------------------|-----------|-------------------|--------------------------|------------|
| 3    | Year1Term3 | ANTHRO    | 0045       | 001       | 1                  | 0         | 0                 | 0                | 1         | 0                 | 0                | 0         | 0                 | 0                        | 0          |
| 21   | Year1Term3 | ANTHRO    | 0045       | 001       | 1                  | 0         | 0                 | 0                | 0         | 0                 | 1                | 0         | 0                 | 0                        | 0          |
| 28   | Year1Term3 | ANTHRO    | 0045       | 001       | 1                  | 0         | 0                 | 0                | 0         | 0                 | 0                | 0         | 0                 | 0                        | 1          |
| 32   | Year1Term3 | ANTHRO    | 0045       | 001       | 1                  | 0         | 0                 | 0                | 1         | 0                 | 0                | 0         | 0                 | 0                        | 0          |
| 39   | Year1Term3 | ANTHRO    | 0045       | 001       | 1                  | 0         | 0                 | 0                | 0         | 0                 | 0                | 1         | 0                 | 0                        | 0          |
| 45   | Year1Term3 | ANTHRO    | 0045       | 001       | 1                  | 0         | 0                 | 0                | 1         | 0                 | 0                | 0         | 0                 | 0                        | 0          |
| 46   | Year1Term3 | ANTHRO    | 0045       | 001       | 1                  | 0         | 0                 | 0                | 1         | 0                 | 0                | 0         | 0                 | 0                        | 0          |
| 49   | Year1Term3 | ANTHRO    | 0045       | 001       | 1                  | 0         | 1                 | 0                | 0         | 0                 | 0                | 0         | 0                 | 0                        | 0          |
| 50   | Year1Term3 | ANTHRO    | 0045       | 001       | 1                  | 0         | 0                 | 0                | 0         | 0                 | 0                | 1         | 0                 | 0                        | 0          |
| 53   | Year1Term3 | ANTHRO    | 0045       | 001       | 1                  | 0         | 0                 | 0                | 1         | 0                 | 0                | 0         | 0                 | 0                        | 0          |
|      |            |           |            |           |                    |           |                   |                  |           |                   |                  |           |                   |                          |            |



## Structure and aggregate the data

\*\*\* This creates a file with one row per course offering, each letter grade column tallying how many enrollments in the

course received the grade.

DATASET ACTIVATE raw\_grades.

DATASET DECLARE courses\_grades.

#### AGGREGATE

Year1Term3

/OUTFILE='courses\_grades'

/BREAK=term subject catlg\_no sect\_no

/total\_grades\_sum=SUM(total\_grades) /grade\_A\_sum=SUM(grade\_A)

/grade\_A\_minus\_sum=SUM(grade\_A\_minus)/grade\_A\_plus\_sum=SUM(grade\_A\_plus)

/grade\_B\_sum=SUM(grade\_B) /grade\_B\_minus\_sum=SUM(grade\_B\_minus)

/grade\_B\_plus\_sum=SUM(grade\_B\_plus) /grade\_C\_sum=SUM(grade\_C)

/grade\_C\_minus\_sum=SUM(grade\_C\_minus) /grade\_C\_plus\_sum=SUM(grade\_C\_plus)

327.00

67.00

48.00

/grade\_NP\_sum=SUM(grade\_NP).

ANTHRO 0045

001

| 🗞 id   | 💑 ter      | m é.       | a subject | 💑 catlg_no       | 💑 sect_no   | total_grad<br>es | 🗞 grade_A    | grade_A_<br>minus | grade_A_      | 🗞 grade_B | grade_B_<br>minus | ♣ grade_B_<br>plus | 🗞 grade_C   | ♣ grade_C_<br>minus | grade_C      | _ 🗞 grade_NP   |
|--------|------------|------------|-----------|------------------|-------------|------------------|--------------|-------------------|---------------|-----------|-------------------|--------------------|-------------|---------------------|--------------|----------------|
| 3      | Year1Term3 | A          | NTHRO     | 0045             | 001         | 1                |              | ) (               | 0 0           | 1         | 0                 | 0                  | C           | 0                   |              | 0 0            |
| 21     | Year1Term3 | A          | ITHRO     | 0045             | 001         | 1                |              | 0 (               | 0 0           | 0         | 0                 | 1                  | 0           | 0                   |              | 0 0            |
| 28     | Year1Term3 | 1A         | VTHRO     | 0045             | 001         | 1                |              | 0 (               | 0 0           | 0         | 0                 | 0                  | 0           | 0                   |              | 0 1            |
| 32     | Year1Term3 | 1A         | VTHRO     | 0045             | 001         | 1                |              | 0 (               | 0 0           | 1         | 0                 | 0                  | 0           | 0                   |              | 0 0            |
| 39     | Year1Term3 | 1A         | VTHRO     | 0045             | 001         | 1                |              | 0 (               | 0 0           | 0         | 0                 | 0                  | 1           | 0                   |              | 0 0            |
| 45     | Year1Term3 | A          | VTHRO     | 0045             | 001         | 1                |              | 0 (               | 0 0           | 1         | 0                 | 0                  | 0           | 0                   |              | 0 0            |
| 46     | Year1Term3 | A          | VTHRO     | 0045             | 001         | 1                |              | 0 0               | 0 0           | 1         | 0                 | 0                  | 0           | 0                   |              | 0 0            |
| 49     | Year1Term3 | 1A         | VTHRO     | 0045             | 001         | 1                |              | 0 1               | I 0           | 0         | 0                 | 0                  | 0           | 0                   |              | 0 0            |
| 50     | Year1Term3 | A          | VTHRO     | 0045             | 001         | 1                |              | 0 (               | 0 0           | 0         | 0                 | 0                  | 1           | 0                   |              | 0 0            |
| 53     | Year1Term3 | A          | VTHRO     | 0045             | 001         | 1                | (            | 0 (               | 0 0           | 1         | 0                 | 0                  | 0           | 0 0                 |              | 0 0            |
|        |            |            |           |                  |             |                  |              | Ĺ                 | ļ             |           |                   |                    |             |                     |              |                |
| 🚜 term | 💑 subject  | 🖧 catlg_no | 💑 sect_no | 🖋 total_grades_s | um 🔗 grade_ | A_sum 💡 gra      | de_A_minus 📣 | grade_A_plus      | 🖋 grade_B_sum |           | u 🕜 grade_B_p     | lus 🔗 grade_C      | _sum 🕜 grad | le_C_minus_ 🔗       | grade_C_plus | 🖋 grade_NP_sum |

.00

102.00

21.00

27.00

28.00

3.00

19.00

12.00



# Adding grade percentage variables

\*\*\* This calculates percentage values to describe the frequency of each letter grade awarded in the course offering.

dataset activate courses\_grades.

compute A\_plus\_perc=grade\_A\_plus\_sum/total\_grades\_sum.

compute A\_perc=grade\_A\_sum/total\_grades\_sum.

compute A\_minus\_perc=grade\_A\_minus\_sum/total\_grades\_sum.

compute B\_plus\_perc=grade\_B\_plus\_sum/total\_grades\_sum.

compute B\_perc=grade\_B\_sum/total\_grades\_sum.

compute B\_minus\_perc=grade\_B\_minus\_sum/total\_grades\_sum.

compute C\_plus\_perc=grade\_C\_plus\_sum/total\_grades\_sum.

compute C\_perc=grade\_C\_sum/total\_grades\_sum.

compute C\_minus\_perc=grade\_C\_minus\_sum/total\_grades\_sum.

compute NP\_perc=grade\_NP\_sum/total\_grades\_sum.

#### execute.

alter type A\_plus\_perc to NP\_perc (F8.5). execute.

| 💑 term     | 灥 subject | 🎝 catlg_no | 🖧 sect_no | 🖋 total_grades_sum | 🖋 grade_A_sum | ∦ grade_A_minus | 🔗 grade_A_plus | 🖋 grade_B_sum | 🔗 grade_B_minu | ∦ grade_B_plus | 🖋 grade_C_sum | 🔗 grade_C_minus_ | ∦ grade_C_plus | 🖋 grade_NP_sum |
|------------|-----------|------------|-----------|--------------------|---------------|-----------------|----------------|---------------|----------------|----------------|---------------|------------------|----------------|----------------|
|            |           |            |           |                    |               | ♥sum            | ▼sum           |               | ▼ s_sum        | ▼sum           |               | * sum            | ▼sum           |                |
| Year1Term3 | ANTHRO    | 0045       | 001       | 327.00             | 67.00         | 48.00           | .00            | 102.00        | 21.00          | 27.00          | 28.00         | 3.00             | 19.00          | 12.0C          |
|            |           |            |           |                    |               |                 |                |               |                |                |               |                  |                |                |
| 🔗 A_plus_p | erc       | 🔗 A_perc   | s 🖉       | A_minus_perc       | 🔗 B_plus      | _perc 🛛 🛷       | B_perc         | 🔗 B_minus_p   | erc 🛛 🔗 C      | _plus_perc     | 🛷 C_perc      | 🔗 C_min          | us_perc        | 🔗 NP_perc      |
|            | 00000     | .204       | 189       | .14679             | 9             | .08257          | .31193         | .0            | 6422           | .05810         | .0858         | 3                | .00917         | .03670         |



## Perform the analysis

First you agglomerate, then you partition...



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🖹 Title

Ward Linkage

Call Vertical Icicle

Agglomeration Schedule

🖻 Title

File Edit View Data Transform Insert Format Analyze Graphs Utilities Add-ons Window Help 

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#### 12 🖻 🝺 E INUICO Active Dataset Agglomeration Schedule 🗓 Warnings Cluster Combined Stage Cluster First Generated Variables Cluster 1 Stage Cluster 2 Coefficients Cluster 1 Cluster 2 Next Stage Processing Statistics .000 .000 ataset Activate .000. Title .000 Notes .000. 🚯 Warnings .000 ter Type .000 🔄 Title .000. A Notes .000 🖺 Active Dataset .000. 🕦 Warnings .000. .000 ataset Close .000. 🖹 Title .000 Notes 🖹 Active Dataset .000 🗓 Warnings .000. .000 ataset Activate .000. 🔄 Title .000 Notes .000 🚯 Warnings .000. .000. ataset Declare 🖻 Title .000 Notes .000. 🗓 Warnings .000 .000. ter Type .000. Title .000 Π Notes .000. 🖺 Active Dataset .000 Altered Types .000. ataset Close .000. 🔄 Title .000 Notes .000. Active Dataset .000 🚯 Warnings .000. .000. .000. .000. Notes .000. Active Dataset Case Processing Summary .000

\*\*\* This clusters using Ward's Method and produces the coefficients that become your criteria for choosing the number of cluster groups.

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 UCLA

DATASET ACTIVATE courses grades. CLUSTER A\_plus\_perc A\_perc A\_minus\_perc B plus perc B perc B minus perc C plus perc C perc

C\_minus\_perc NP\_perc /METHOD WARD /MEASURE=SEUCLID **/PRINT SCHEDULE** /PLOT VICICLE.



### Accessing number of cluster

| Stag |           |         |              |                 |               | Next     |   |          |     |
|------|-----------|---------|--------------|-----------------|---------------|----------|---|----------|-----|
| e    | Cluster C | ombined | Coefficients | Stage Cluster I | First Appears | Stage    |   |          |     |
| 970  | 1         | 38      | 16.071       | 951             | 943           | 975      | 0 | 0.019475 | 0   |
| 971  | 47        | 64      | 16.391       | 962             | 922           | 985      | 0 | 0.019912 |     |
| 972  | 12        | 41      | 16.727       | 950             | 949           | 984      | ( | 0.020499 | 0.4 |
| 973  | 28        | 31      | 17.072       | 966             | 961           | 981      | ( | 0.020625 |     |
| 974  | 39        | 77      | 17.437       | 938             | 942           | 979      |   | 0.02138  | 0   |
| 975  | 1         | 33      | 17.855       | 970             | 909           | 986      | ( | 0.023972 |     |
| 976  | 5         | 16      | 18.281       | 939             | 941           | 979      | ( | ).023859 | 0.3 |
| 977  | 7         | 21      | 18.855       | 969             | 957           | 984      | ( | 0.031399 |     |
| 978  | 24        | 145     | 19.436       | 937             | 775           | 983      | ( | 0.030814 | 0   |
| 979  | 5         | 39      | 20.064       | 976             | 974           | 987      | ( | 0.032311 |     |
| 980  | 10        | 155     | 20.752       | 968             | 945           | 981      |   | 0.03429  | 0.2 |
| 981  | 10        | 28      | 21.748       | 980             | 973           | 985      | ( | 0.047995 |     |
| 982  | 3         | 17      | 22.838       | 965             | 958           | 986      |   | 0.05012  | 0   |
| 983  | 2         | 24      | 24.234       | 967             | 978           | 990      | ( | 0.061126 |     |
| 984  | 7         | 12      | 25.683       | 977             | 972           | 987      | ( | 0.059792 | 0.1 |
| 985  | 10        | 47      | 27.171       | 981             | 971           | 989      | ( | 0.057937 |     |
| 986  | 1         | 3       | 28.823       | 975             | 982           | 988      |   | 0.0608   | 0   |
| 987  | 5         | 7       | 31.042       | 979             | 984           | 989      | ( | 0.076987 | ,   |
| 988  | 1         | 61      | 36.08        | 986             | 963           | 990      | ( | 0.162296 | 0.0 |
| 989  | 5         | 10      | 42.091       | 987             | 985           | 991      | ( | .166602  |     |
| 990  | 1         | 2       | 50.13        | 988             | 983           | 991      | ( | .190991  |     |
| 991  | 1         | 5       | 72.509       | 990             | 989           | 0        | ( | ).446419 |     |
|      |           |         |              |                 |               |          |   | 1        |     |
|      |           |         | =(72 5       | 09-50 13        | ) / 50 13     | 2 🔺      |   |          |     |
|      |           |         | 1 (, 2.3     | 55 50.IJ        | ,,            | <i>,</i> |   |          |     |





## Final cluster output

|              |         |         |         |         | Final Clu | ster Cente | rs      |         |         |         |         |         |
|--------------|---------|---------|---------|---------|-----------|------------|---------|---------|---------|---------|---------|---------|
|              |         |         |         |         |           | Clust      | er      |         |         |         |         |         |
|              | 1       | 2       | 3       | 4       | 5         | 6          | 7       | 8       | 9       | 10      | 11      | 12      |
| A_plus_perc  | 0.04596 | 0.05253 | 0.36618 | 0.04681 | 0.82459   | 0.03075    | 0.02963 | 0.03289 | 0.01897 | 0.09032 | 0.06874 | 0.03379 |
| A_perc       | 0.84188 | 0.36203 | 0.32079 | 0.34267 | 0.12210   | 0.18418    | 0.23296 | 0.10715 | 0.10860 | 0.54718 | 0.20101 | 0.20148 |
| A_minus_perc | 0.05751 | 0.16538 | 0.14046 | 0.34355 | 0.01849   | 0.05869    | 0.09114 | 0.11698 | 0.16045 | 0.17409 | 0.14654 | 0.26768 |
| B_plus_perc  | 0.01815 | 0.13114 | 0.05171 | 0.12839 | 0.01166   | 0.08832    | 0.09075 | 0.12764 | 0.19426 | 0.07063 | 0.14041 | 0.20857 |
| B_perc       | 0.02320 | 0.13413 | 0.05618 | 0.07451 | 0.00754   | 0.18901    | 0.30369 | 0.14013 | 0.22563 | 0.06232 | 0.13165 | 0.14847 |
| B_minus_perc | 0.00386 | 0.05258 | 0.02218 | 0.03081 | 0.00355   | 0.06319    | 0.06047 | 0.11017 | 0.12525 | 0.02018 | 0.08950 | 0.06536 |
| C_plus_perc  | 0.00185 | 0.03146 | 0.01223 | 0.01041 | 0.00000   | 0.06687    | 0.04356 | 0.10544 | 0.06449 | 0.00808 | 0.06765 | 0.03085 |
| C_perc       | 0.00450 | 0.03216 | 0.01051 | 0.00820 | 0.00000   | 0.18113    | 0.09232 | 0.09526 | 0.04855 | 0.01229 | 0.06027 | 0.01840 |
| C_minus_perc | 0.00000 | 0.01015 | 0.00482 | 0.00296 | 0.00000   | 0.04906    | 0.01954 | 0.06347 | 0.02079 | 0.00574 | 0.03405 | 0.00761 |
| NP_perc      | 0.00307 | 0.02843 | 0.01494 | 0.01169 | 0.01207   | 0.08879    | 0.03593 | 0.10087 | 0.03300 | 0.00918 | 0.06019 | 0.01778 |

| Number of Cases in each Cluster |    |         |  |  |  |  |  |  |
|---------------------------------|----|---------|--|--|--|--|--|--|
| Cluster                         | 1  | 33.000  |  |  |  |  |  |  |
|                                 | 2  | 111.000 |  |  |  |  |  |  |
|                                 | 3  | 57.000  |  |  |  |  |  |  |
|                                 | 4  | 70.000  |  |  |  |  |  |  |
|                                 | 5  | 6.000   |  |  |  |  |  |  |
|                                 | 6  | 65.000  |  |  |  |  |  |  |
|                                 | 7  | 63.000  |  |  |  |  |  |  |
|                                 | 8  | 142.000 |  |  |  |  |  |  |
|                                 | 9  | 122.000 |  |  |  |  |  |  |
|                                 | 10 | 62.000  |  |  |  |  |  |  |
|                                 | 11 | 135.000 |  |  |  |  |  |  |
|                                 | 12 | 126.000 |  |  |  |  |  |  |
| Valid                           |    | 992.000 |  |  |  |  |  |  |
| Missing                         |    | 0.000   |  |  |  |  |  |  |

This performs the clustering using K-means cluster analysis -- you need to edit the code below (i.e., "CLUSTER(##)") to indicate the number of clusters you are requesting.

dataset activate courses\_grades.

QUICK CLUSTER A\_plus\_perc A\_perc A\_minus\_perc B\_plus\_perc B\_perc B\_minus\_perc C\_plus\_perc C\_perc

C\_minus\_perc NP\_perc /MISSING=LISTWISE

/CRITERIA=CLUSTER(12) MXITER(100) CONVERGE(0)

/METHOD=KMEANS(NOUPDATE)

/SAVE CLUSTER

/PRINT INITIAL.



# Interpret the findings

- Examine our visualizations
- Identify the grading practices
- Consider our groups

# Audience Participation!





#### Mostly A's and B's: Criterion Referenced Grading





#### Proportions Pre-Defined: Norm Referenced Grading



#### Data Mining to Identify Grading Practices

#### Kelly Wahl Nida Rinthapol

