

# Department of Statistics

## COURSE STATS 330

### Assignment 2, 2007

Instructions: Hand in your completed assignment to the Student Resource Centre by 4pm on Thursday 16<sup>th</sup> August.

Every year, the magazine US News and World Report publishes a list of rankings for US colleges and universities. The rankings are based on a set of scores that are added together to get a final overall score. One of the components is the "Graduation Rate performance", which is a measure of added value. To quote from the US News and World Report website:

**Graduation rate performance** *This indicator of "added value" shows the effect of the college's programs and policies on the graduation rate of students after controlling for spending and student aptitude. We measure the difference between a school's six-year graduation rate for the class that entered in 1999 and the rate we predicted for the class. If the actual graduation rate is higher than the predicted rate, the college is enhancing achievement.*

**Source:**

[http://colleges.usnews.rankingsandreviews.com/usnews/edu/college/rankings/rankindex\\_brief.php](http://colleges.usnews.rankingsandreviews.com/usnews/edu/college/rankings/rankindex_brief.php)

The file **college.csv** contains an Excel spreadsheet in csv form, which contains the data used to construct the rankings.

The variables in the data set are

<b>university:</b>	the name of the college,
<b>grad.rate:</b>	the graduation rate (the percentage of the entering class of 2001 that graduated by 2006),
<b>fresh.ret:</b>	the freshman retention rate (percentage of first year students that return),
<b>per20:</b>	percentage of classes with fewer than 20 students,
<b>per50:</b>	percentage of classes with more than 50 students,
<b>SAT75:</b>	75 <sup>th</sup> percentile of the SAT scores of admitted students (the SAT is a standard college admission test),
<b>top10:</b>	percentage of freshmen in top 10% of their high school class,
<b>accept.rate:</b>	The percent of applicants accepted for admission,
<b>alumni.giving:</b>	The percentage of alumni who contribute money.

The **Graduation rate performance** index is defined as the difference between the actual graduation rate, and the predicted graduation rate. You are required to fit a regression model to the data, calculate the predicted graduation rate, calculate the graduation rate performance index, and rank the colleges according to this measure.

*Follow the following steps:*

1. Load the data into R, and make a data frame **college.df** to contain the data. Check for (and correct) any typographical errors in the data file. The true data are printed at the end of this assignment. [5 marks]
2. Fit a regression model to the data. Delete inessential variables. Check for departures from the assumptions. Take any corrective action that may be required. [25 marks]
3. Calculate the graduation rate performance index for each college and print out a ranked list of colleges. [10 marks]

Express your answer in the form of a report to the editor of US News and World Report.

### Hints

1. Use **read.table** to create the data frame.
2. What function can be used to calculate the graduation rate performance index once the model has been fitted?
3. Use the function **order** to make the ranked list.
4. Put the technical details of how you fitted the model in one appendix, and the rankings in another
5. The ranking depends on the model that you fit, so investigate how much the rankings change for a different model. If they do, comment in the report.

## Data

University	grad rate	fresh ret	per20	per50	SAT75	top10	accept rate	alumni giving
Harvard University	0.97	0.96	0.69	0.11	1580	0.90	0.13	0.46
Princeton University	0.96	0.98	0.68	0.12	1530	0.93	0.13	0.66
Yale University	0.96	0.98	0.77	0.08	1530	0.95	0.18	0.50
Massachusetts Inst. Of Technology	0.89	0.97	0.69	0.06	1560	0.93	0.25	0.44
Stanford University	0.92	0.97	0.70	0.12	1540	0.87	0.15	0.34
Cornell University	0.90	0.95	0.74	0.10	1440	0.82	0.34	0.35
Duke University	0.92	0.97	0.69	0.07	1480	0.87	0.30	0.37
University of Pennsylvania	0.90	0.95	0.59	0.11	1460	0.88	0.31	0.41
California Institute of Technology	0.83	0.92	0.71	0.07	1570	0.99	0.23	0.46
Brown University	0.92	0.96	0.59	0.13	1480	0.88	0.18	0.42
Columbia University	0.90	0.96	0.59	0.10	1470	0.85	0.17	0.30
Dartmouth College	0.94	0.96	0.57	0.10	1520	0.88	0.22	0.54
Northwestern University	0.90	0.96	0.64	0.09	1450	0.87	0.29	0.31
Johns Hopkins University	0.90	0.95	0.60	0.14	1460	0.76	0.41	0.27
University of Chicago	0.83	0.93	0.63	0.05	1460	0.76	0.62	0.39
Emory University	0.83	0.92	0.67	0.06	1430	0.86	0.46	0.34
Washington University (St. Louis)	0.86	0.95	0.74	0.08	1390	0.70	0.40	0.30
Rice University	0.88	0.95	0.60	0.09	1530	0.88	0.27	0.41
University of Notre Dame	0.93	0.97	0.52	0.12	1410	0.82	0.40	0.50
Georgetown University	0.89	0.95	0.54	0.12	1440	0.82	0.21	0.28
Vanderbilt University	0.81	0.91	0.66	0.05	1370	0.63	0.58	0.32
University of California--Berkeley	0.81	0.94	0.56	0.16	1440	0.95	0.31	0.18
University of Virginia	0.92	0.97	0.45	0.15	1410	0.80	0.36	0.29
University of North Carolina-Chapel Hill	0.84	0.94	0.41	0.13	1330	0.67	0.37	0.27
Carnegie Mellon University	0.72	0.91	0.66	0.09	1460	0.69	0.43	0.31
Tufts University	0.86	0.95	0.66	0.07	1410	0.62	0.32	0.30
University of California--Los Angeles	0.79	0.95	0.44	0.26	1360	0.97	0.36	0.15
University of Michigan	0.82	0.94	0.48	0.15	1333	0.59	0.69	0.13
University of Rochester	0.77	0.93	0.81	0.05	1380	0.66	0.54	0.23
Wake Forest University	0.85	0.93	0.59	0.04	1390	0.66	0.44	0.39
Brandeis University	0.82	0.90	0.62	0.10	1400	0.62	0.54	0.31
University of California--San Diego	0.79	0.93	0.48	0.28	1340	0.95	0.53	0.11
College of William and Mary	0.89	0.94	0.45	0.07	1390	0.71	0.46	0.28
Case Western University	0.75	0.91	0.50	0.16	1410	0.66	0.79	0.31
New York University	0.71	0.88	0.61	0.09	1390	0.60	0.40	0.13
Boston College	0.85	0.94	0.41	0.09	1370	0.64	0.39	0.23
Lehigh University	0.81	0.92	0.45	0.10	1323	0.52	0.54	0.48
Tulane University	0.73	0.86	0.52	0.08	1370	0.54	0.76	0.24
University of California--Irvine	0.75	0.91	0.44	0.20	1220	0.90	0.66	0.08
University of Wisconsin	0.73	0.91	0.39	0.19	1289	0.44	0.68	0.14
University of Southern California	0.69	0.90	0.51	0.17	1330	0.52	0.46	0.22
University of Illinois	0.79	0.91	0.31	0.19	1333	0.53	0.68	0.11
Pennsylvania State University	0.81	0.93	0.33	0.21	1300	0.48	0.53	0.21
University of California--Davis	0.75	0.91	0.30	0.28	1280	0.95	0.70	0.07
Syracuse University	0.69	0.89	0.65	0.07	1270	0.33	0.60	0.21
University of California--SantaBarbara	0.72	0.86	0.46	0.19	1260	0.95	0.72	0.10
George Washington University	0.68	0.89	0.51	0.10	1330	0.45	0.49	0.19
American University	0.70	0.85	0.42	0.03	1290	0.28	0.79	0.12
Auburn University	0.65	0.80	0.40	0.08	1200	0.24	0.86	0.24
Brigham Young University	0.67	0.87	0.34	0.17	1289	0.53	0.71	0.20
Catholic University of America	0.72	0.84	0.63	0.04	1280	0.36	0.82	0.11
Clarkson University	0.64	0.85	0.31	0.19	1290	0.39	0.81	0.29
Clark University	0.68	0.84	0.65	0.07	1240	0.31	0.77	0.25
Clemson University	0.70	0.84	0.39	0.08	1240	0.32	0.74	0.18
Colorado School of Mines	0.59	0.84	0.41	0.09	1289	0.55	0.80	0.24
Duquesne University	0.64	0.90	0.55	0.08	1200	0.51	0.82	0.18
Florida State University	0.65	0.84	0.34	0.13	1230	0.43	0.72	0.24
Fordham University	0.77	0.87	0.54	0.00	1230	0.26	0.69	0.14
Indiana University	0.67	0.86	0.36	0.17	1230	0.23	0.83	0.21
Iowa State University	0.60	0.82	0.28	0.18	1200	0.26	0.91	0.15
Loyola University--Chicago	0.63	0.83	0.50	0.04	1200	0.27	0.89	0.16
Miami (OH) University	0.80	0.89	0.25	0.09	1244	0.36	0.77	0.19
Michigan Technological University	0.61	0.84	0.44	0.11	1244	0.35	0.97	0.20
North Carolina State University	0.64	0.88	0.32	0.14	1260	0.31	0.75	0.19
Ohio State University	0.57	0.78	0.41	0.17	1200	0.26	0.79	0.15
Pepperdine University	0.72	0.83	0.68	0.01	1260	0.54	0.54	0.16

Purdue University	0.64	0.86	0.23	0.21	1220	0.27	0.89	0.15
Rutgers--Newark	0.51	0.87	0.40	0.13	1110	0.24	0.55	0.10
Rutgers--New Brunswick	0.73	0.90	0.30	0.24	1280	0.31	0.64	0.17
Southern Methodist University	0.70	0.85	0.57	0.08	1260	0.34	0.88	0.21
Stevens Institute of Technology	0.70	0.83	0.36	0.10	1450	0.59	0.67	0.31
St. Louis University	0.61	0.84	0.48	0.07	1289	0.34	0.71	0.18
State University of New York-Albany	0.66	0.83	0.39	0.19	1230	0.14	0.61	0.31
State University of New York-Binghamton	0.79	0.91	0.39	0.16	1310	0.54	0.42	0.14
State University of New York-Buffalo	0.59	0.84	0.49	0.13	1230	0.22	0.72	0.09
State University of New York-StonyBrook	0.50	0.82	0.37	0.24	1200	0.25	0.57	0.04
Texas A&M University	0.69	0.87	0.33	0.17	1270	0.47	0.73	0.22
Texas Christian University	0.63	0.80	0.46	0.07	1230	0.29	0.79	0.26
University of Arizona	0.52	0.76	0.33	0.16	1210	0.33	0.82	0.07
University of California--Riverside	0.68	0.86	0.39	0.21	1200	0.90	0.84	0.09
University of California--Santa Cruz	0.65	0.82	0.40	0.19	1260	0.94	0.83	0.11
University of Colorado	0.65	0.81	0.48	0.15	1260	0.25	0.83	0.15
University of Delaware	0.70	0.86	0.41	0.14	1220	0.23	0.65	0.18
University of Denver	0.68	0.83	0.71	0.04	1220	0.29	0.84	0.26
University of Florida	0.64	0.90	0.30	0.22	1310	0.60	0.67	0.20
University of Hawaii	0.56	0.80	0.54	0.09	1170	0.30	0.69	0.10
University of Kansas	0.54	0.77	0.43	0.10	1244	0.26	0.61	0.17
University of Maryland	0.63	0.86	0.33	0.14	1320	0.40	0.65	0.10
University of Massachusetts	0.61	0.79	0.40	0.15	1220	0.16	0.73	0.14
University of Miami (FL)	0.58	0.80	0.50	0.07	1260	0.44	0.57	0.18
University of Minnesota	0.56	0.83	0.57	0.14	1200	0.27	0.80	0.09
University of Missouri	0.58	0.83	0.25	0.22	1289	0.34	0.80	0.17
University of Missouri--Rolla	0.52	0.77	0.36	0.09	1378	0.50	0.97	0.24
University of New Hampshire	0.74	0.83	0.52	0.09	1220	0.24	0.76	0.14
University of Oklahoma	0.54	0.81	0.30	0.17	1244	0.32	0.87	0.17
University of Pittsburgh	0.61	0.82	0.32	0.17	1220	0.22	0.78	0.13
University of San Diego	0.65	0.89	0.47	0.00	1230	0.34	0.70	0.20
University of Tennessee	0.56	0.77	0.36	0.09	1156	0.24	0.76	0.22
University of Texas	0.65	0.87	0.38	0.18	1300	0.37	0.78	0.13
University of Vermont	0.68	0.82	0.54	0.09	1220	0.17	0.85	0.24
Virginia Tech	0.74	0.89	0.23	0.18	1270	0.33	0.69	0.20
Washington State University	0.63	0.84	0.33	0.27	1170	0.40	0.88	0.21
Worcester Polytechnic Institute	0.75	0.88	0.70	0.09	1380	0.47	0.78	0.26
Arizona State University	0.48	0.71	0.28	0.18	1210	0.25	0.79	0.06
Bowling Green State University	0.60	0.76	0.49	0.05	1022	0.14	0.86	0.16
Colorado State University	0.58	0.82	0.17	0.30	1156	0.23	0.78	0.10
DePaul University	0.58	0.82	0.40	0.03	1200	0.22	0.81	0.11
Drexel University	0.50	0.79	0.52	0.02	1220	0.22	0.68	0.15
Florida Institute of Technology	0.53	0.74	0.55	0.06	1250	0.26	0.85	0.06
Hofstra University	0.63	0.80	0.42	0.05	1170	0.18	0.83	0.11
Indiana University of Pennsylvania	0.53	0.75	0.39	0.06	1140	0.26	0.63	0.17
Indiana/Purdue--Indianapolis	0.22	0.49	0.43	0.08	1060	0.06	0.94	0.13
Louisiana State University	0.47	0.80	0.31	0.14	1156	0.27	0.79	0.30
Mississippi State University	0.49	0.77	0.41	0.11	1200	0.45	0.78	0.18
New Jersey Institute of Technology	0.37	0.82	0.45	0.03	1210	0.23	0.66	0.11
Northeastern University	0.41	0.75	0.43	0.12	1190	0.18	0.70	0.17
Oklahoma State University	0.49	0.77	0.25	0.19	1244	0.30	0.88	0.12
Oregon State University	0.68	0.77	0.42	0.22	1230	0.86	0.97	0.25
Seton Hall University	0.64	0.83	0.56	0.02	1140	0.13	0.79	0.20
St. Johns University	0.64	0.83	0.39	0.11	1080	0.13	0.86	0.10
University of Alabama	0.57	0.81	0.42	0.12	1200	0.22	0.81	0.34
University of Alabama--Huntsville	0.33	0.64	0.55	0.04	1200	0.39	0.85	0.07
University of Arkansas	0.42	0.81	0.42	0.10	1156	0.28	0.91	0.22
University of Idaho	0.49	0.76	0.53	0.12	1156	0.22	0.71	0.15
University of Illinois--Chicago	0.32	0.71	0.34	0.17	1067	0.26	0.62	0.07
University of Kentucky	0.48	0.78	0.38	0.10	1200	0.23	0.78	0.15
University of Maine	0.53	0.78	0.44	0.13	1200	0.21	0.75	0.17
University of Maryland--Baltimore Co.	0.46	0.85	0.41	0.13	1300	0.33	0.65	0.10
University of Mississippi	0.49	0.74	0.34	0.18	1200	0.37	0.78	0.13
University of Missouri--Kansas City	0.37	0.72	0.60	0.06	1244	0.36	0.61	0.06
University of Nebraska	0.46	0.75	0.37	0.14	1200	0.25	0.81	0.14
University of New Mexico	0.37	0.71	0.45	0.13	1111	0.21	0.69	0.09
University of North Dakota	0.47	0.76	0.42	0.09	1156	0.22	0.68	0.19
University of Rhode Island	0.64	0.76	0.28	0.09	1180	0.15	0.79	0.18
University of San Francisco	0.61	0.84	0.55	0.02	1200	0.26	0.76	0.14
University of South Carolina	0.56	0.79	0.40	0.16	1200	0.28	0.77	0.10
University of Southern Mississippi	0.40	0.74	0.50	0.09	1067	0.33	0.67	0.26

University of Texas--Dallas	0.38	0.75	0.39	0.19	1324	0.35	0.65	0.08
University of the Pacific	0.62	0.82	0.50	0.03	1240	0.39	0.84	0.12
University of Tulsa	0.56	0.79	0.55	0.03	1244	0.38	0.83	0.10
University of Utah	0.38	0.59	0.43	0.12	1200	0.21	0.91	0.09
University of Wyoming	0.45	0.73	0.42	0.08	1200	0.22	0.94	0.15
Virginia Commonwealth University	0.45	0.77	0.47	0.07	1130	0.13	0.80	0.09
West Virginia University	0.54	0.78	0.37	0.17	1130	0.23	0.93	0.11
Andrews University	0.47	0.66	0.68	0.04	1200	0.14	0.65	0.18
Ball State University	0.54	0.70	0.35	0.09	1100	0.10	0.92	0.29
Florida International University	0.40	0.86	0.31	0.16	1200	0.42	0.75	0.22
Illinois State University	0.53	0.74	0.28	0.12	1067	0.11	0.79	0.09
Indiana State University	0.35	0.65	0.40	0.08	1050	0.08	0.88	0.12
Louisiana Tech University	0.38	0.74	0.54	0.07	1111	0.24	0.98	0.10
Middle Tennessee State University	0.40	0.74	0.38	0.03	1111	0.18	0.74	0.10
Montana State University	0.44	0.69	0.37	0.21	1111	0.15	0.84	0.12
Northern Arizona University	0.41	0.71	0.36	0.12	1170	0.20	0.81	0.13
Northern Illinois University	0.50	0.76	0.44	0.10	1111	0.12	0.52	0.08
Nova Southeastern University	0.20	0.69	0.75	0.01	1180	0.26	0.78	0.01
Portland State University	0.33	0.57	0.55	0.08	1160	0.13	0.81	0.09
Southern Illinois University	0.35	0.66	0.41	0.11	1067	0.10	0.73	0.08
Texas Tech University	0.44	0.75	0.20	0.21	1170	0.26	0.72	0.23
University of Akron	0.37	0.71	0.46	0.04	1022	0.11	1.00	0.14
University of Central Florida	0.50	0.72	0.26	0.19	1220	0.29	0.65	0.17
University of Colorado--Denver	0.31	0.73	0.37	0.11	1111	0.20	0.76	0.07
University of Detroit--Mercy	0.42	0.80	0.42	0.02	1156	0.23	0.75	0.12
University of Houston	0.36	0.74	0.23	0.20	1160	0.22	0.70	0.06
University of Louisville	0.29	0.74	0.35	0.08	1067	0.19	0.67	0.18
University of Missouri--St. Louis	0.31	0.64	0.51	0.07	1111	0.17	0.66	0.01
University of Montana	0.37	0.66	0.41	0.11	1111	0.14	0.85	0.20
University of North Carolina--Greensboro	0.50	0.74	0.37	0.11	1130	0.13	0.76	0.13
University of Northern Colorado	0.41	0.67	0.29	0.16	1067	0.14	0.81	0.08
University of North Texas	0.35	0.70	0.21	0.17	1200	0.22	0.74	0.05
University of South Florida	0.47	0.76	0.26	0.13	1200	0.25	0.66	0.11
University of Toledo	0.37	0.71	0.42	0.12	1067	0.15	0.95	0.10
University of Wisconsin--Milwaukee	0.35	0.68	0.38	0.13	1067	0.08	0.84	0.07
Western Michigan University	0.52	0.78	0.21	0.18	1111	0.19	0.83	0.10