WSU research rankings
Alexey A Petrov (Physics & Astronomy)
Instead of introduction: a friend’s e-mail

★ This summer I got an e-mail from my friend in Russia, who works at one of Russian research universities:

– “Have you heard that last year our Ministry of Education and Research went through an exercise to determine the list of Universities whose diplomas would be accepted in Russian Federation without the lengthy procedure of "confirmation"? Why is your university not on that list?”

★ In order to answer this, I needed their “criteria for inclusion”

– the mechanism for the selection was simple: they chose three widely-accepted rankings of world universities, the Academic Ranking of World Universities (ARWU), THE World University rankings (TWUR), and QS World University Rankings (QSWUR) that rank universities according to their research output and other characteristics. In order for a University to be on the RF "approved" list, that University had to be ranked in the top 300 in ALL three lists.

★ This lead to a more general question: how does WSU fare in research rankings? What are ranking criteria?
Rankings schemes

★ Different rankings schemes serve different purposes
  – research aggregate rankings
  – research expenditures rankings

★ Research Aggregate Rankings
  – usually use a weighted combination of “hard data,” such as quantity of publication/citations, and “soft data,” such as results of a survey
  – sources and weight of data differentiate among the ranking schemes
  – use of survey is controversial (popularity contest?)

★ Research Expenditure Rankings
  – this is the least controversial ranking scheme based on the reported amount of research expenditures of a university
  – done by National Science Foundation (NSF), but counts all sources of income
Research aggregate rankings

Three most reputable schemes
– Academic Ranking of World Universities
– Times Higher Education World University Rankings
– Quacquarelli Symonds World University Rankings
★ Academic Ranking of World Universities (ARWU)
   – has been published by Shanghai Jiao Tong University/Shanghai Ranking Consultancy since 2003

★ Selection criteria for inclusion to ARWU
   – universities with faculty/staff who are Nobel Laureates, Fields Medalists, Highly Cited Researchers, or with papers published in Nature or Science.
   – universities with significant amount of papers indexed by Science Citation Index and Social Science Citation Index (available through Web Of Science)
   – more than 1200 universities are ranked and the best 500 are published on the web.

★ Each University is scored on a set of indicators
   – For each indicator, the highest scoring institution is assigned a score of 100, and other institutions are calculated as a percentage of the top score.
## Indicators & Weights for ARWU

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Indicator</th>
<th>Code</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality of Education</td>
<td>Alumni of an institution winning Nobel Prizes and Fields Medals</td>
<td>Alumni</td>
<td>10%</td>
</tr>
<tr>
<td>Quality of Faculty</td>
<td>Staff of an institution winning Nobel Prizes and Fields Medals</td>
<td>Award</td>
<td>20%</td>
</tr>
<tr>
<td></td>
<td>Highly cited researchers in 21 broad subject categories</td>
<td>HiCi</td>
<td>20%</td>
</tr>
<tr>
<td>Research Output</td>
<td>Papers published in Nature and Science*</td>
<td>N&amp;S</td>
<td>20%</td>
</tr>
<tr>
<td></td>
<td>Papers indexed in Science Citation Index-expanded and Social Science Citation Index</td>
<td>PUB</td>
<td>20%</td>
</tr>
<tr>
<td>Per Capita Performance</td>
<td>Per capita academic performance of an institution</td>
<td>PCP</td>
<td>10%</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>100%</td>
</tr>
</tbody>
</table>

* For institutions specialized in humanities and social sciences such as London School of Economics, N&S is not considered, and the weight of N&S is relocated to other indicators.
WSU is reasonably ranked in some broad subject fields

<table>
<thead>
<tr>
<th>Broad Subject Fields</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural Sciences and Mathematics (SCI)</td>
<td>/</td>
<td>/</td>
<td>/</td>
<td>/</td>
<td>/</td>
<td>151-200</td>
</tr>
<tr>
<td>Engineering/Technology and Computer Science (ENG)</td>
<td>/</td>
<td>/</td>
<td>/</td>
<td>/</td>
<td>/</td>
<td></td>
</tr>
<tr>
<td>Life and Agriculture Sciences (LIFE)</td>
<td>/</td>
<td>/</td>
<td>/</td>
<td>/</td>
<td>/</td>
<td></td>
</tr>
<tr>
<td>Clinical Medicine and Pharmacy (MED)</td>
<td>/</td>
<td>/</td>
<td>/</td>
<td>/</td>
<td>/</td>
<td>151-200</td>
</tr>
<tr>
<td>Social Sciences (SOC)</td>
<td>/</td>
<td>/</td>
<td>/</td>
<td>/</td>
<td>/</td>
<td>151-200</td>
</tr>
</tbody>
</table>

WSU is reasonably highly ranked by ARWU in some fields

<table>
<thead>
<tr>
<th>Subject Fields</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematics</td>
<td>/</td>
<td>/</td>
<td>/</td>
<td>/</td>
</tr>
<tr>
<td>Physics</td>
<td>/</td>
<td>/</td>
<td>/</td>
<td>151-200</td>
</tr>
<tr>
<td>Chemistry</td>
<td>/</td>
<td>/</td>
<td>76-100</td>
<td>76-100</td>
</tr>
<tr>
<td>Computer Science</td>
<td>/</td>
<td>/</td>
<td>/</td>
<td>/</td>
</tr>
<tr>
<td>Economics/Business</td>
<td>/</td>
<td>/</td>
<td>/</td>
<td>/</td>
</tr>
</tbody>
</table>

... but it is hard for Chemistry or Physics to compete with larger departments at other institutions (e.g. Physics: 29 faculty at WSU vs 67 at MSU)
THE World University Rankings

- has been published (with Thomson Reuters publications data engine World of Science) by the Times since 2010

Selection criteria for inclusion to THE WUR

- universities that publish more than 200 papers a year
- out of those, rankings of 400 best universities are published

Each University is scored on a set of 5 indicators

- for each indicator there are several separately weighted subcategories
- an important part is paper citation analysis done by Thomson Reuters
- the data are aggregated into columns according to its Z score, an indicator of how far removed any institution is from the average.
# Indicators & weights for THEWUR

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Indicator</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teaching</td>
<td>reputation survey, stuff-to-student ratio, number of doctorates</td>
<td>30%</td>
</tr>
<tr>
<td>Research</td>
<td>reputation survey, university research income, research output</td>
<td>30%</td>
</tr>
<tr>
<td>Citations</td>
<td>citations to papers written by stuff/students in the last 5 years (Web of Science)</td>
<td>30%</td>
</tr>
<tr>
<td>Industry income</td>
<td>grants from industry (reported by institution)</td>
<td>2.50%</td>
</tr>
<tr>
<td>International outlook</td>
<td>ratio of intl/domestic stuff and students, papers with international authors</td>
<td>7.50%</td>
</tr>
</tbody>
</table>
THEWUR: Comparative rank
## THEWUR: WSU performance

### 2011-12

<table>
<thead>
<tr>
<th>Category</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall score</td>
<td>Data withheld by THE</td>
</tr>
<tr>
<td>Teaching</td>
<td>34.3</td>
</tr>
<tr>
<td>International outlook</td>
<td>28.1</td>
</tr>
<tr>
<td>Industry income</td>
<td>No Data Supplied</td>
</tr>
<tr>
<td>Research</td>
<td>16.2</td>
</tr>
<tr>
<td>Citations</td>
<td>58.4</td>
</tr>
</tbody>
</table>

### 2012-13

<table>
<thead>
<tr>
<th>Category</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall score</td>
<td>Data withheld by THE</td>
</tr>
<tr>
<td>Teaching</td>
<td>34.7</td>
</tr>
<tr>
<td>International outlook</td>
<td>24.6</td>
</tr>
<tr>
<td>Industry income</td>
<td>No Data Supplied</td>
</tr>
<tr>
<td>Research</td>
<td>16.4</td>
</tr>
<tr>
<td>Citations</td>
<td>55.2</td>
</tr>
</tbody>
</table>
QS World Universities Ranking

★ QS World University Rankings
  – has been published by Quacquarelli Symonds since 2004

★ Selection criteria for inclusion to QS WUR
  – consider over 2,000 universities, and rank over 700. The top 400 are ranked individually, others are ranked in groups.

★ Each University is scored on a set of 5 indicators
  – an important part is paper citation analysis done by Scopus (Elsevier)
  – the data are aggregated into columns according to its Z score, an indicator of how far removed any institution is from the average.
## Indicators & weights for QS

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Indicator</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Academic reputation</td>
<td>reputation survey to scholars</td>
<td>40%</td>
</tr>
<tr>
<td>Employer Reputation</td>
<td>reputation survey to employers</td>
<td>10%</td>
</tr>
<tr>
<td>Citations per faculty</td>
<td>citations to papers written by stuff/students in the last 5 years (Scopus)</td>
<td>20%</td>
</tr>
<tr>
<td>Faculty-to-student ratio</td>
<td>data on number of faculty and students</td>
<td>20.00%</td>
</tr>
<tr>
<td>International outlook</td>
<td>ratio of intl/domestic stuff and students</td>
<td>10.00%</td>
</tr>
</tbody>
</table>
QS: Comparative rank

Notice that WSU's rankings are absent from this ranking scheme!
QS WUR: WSU performance

According to this ranking scheme, WSU does not exist! (unranked in 2010-11)
To answer my friend’s e-mail (why WSU is not on the list of approved institutions):

The reason that WSU didn't make it is the following:

- Academic Ranking of World Universities (ARWU): WSU is ranked 301-400 in 2012, so we did not make a cut. Notice, however, that Physics and Chemistry are in the best 100 or 200!

- THE World University rankings (TWUR): WSU is ranked in the 251-275 bracket, so we made it there.

- QS World University Rankings (QSWUR): according to this ranking list we do not exist!!

It might be interesting to note that I could not find a person in WSU administration, whose responsibilities include tracking of WSU research ranking.
Bonus: NRC rankings

★ Published by National Research Council every 10 years
  – last publication: 2010
  – no actual rankings are published, only ranges
  – no university averages, but ratings for separate programs
WSU had 34 PhD departments considered.

- 2 were in the second quartile
- 9 were in the third quartile
- 22 were in the fourth quartile
- 1 was not ranked by the NRC
Research Expenditures rankings

– Compiled by the National Science Foundation
– ... but includes all sources of funding
WSU Research Expenditures by Source of Funding ($*1000, current $)

- Tot Exp
- Tot Ext Support
- Federal Gov
- Total internal
- State & Loc Gov
- Industry
- All Other

J. Oliver, former WSU VP for research

Tuesday, December 11, 12
NSF Rankings (all univ.) Based on Total Research Expenditures for Selected Univ. (1985-2010)

J. Oliver, former WSU VP for research
Conclusions

★ Research rankings are very important
  – affect our recruitment of students, postdocs and faculty

★ It is imperative to compare WSU to all universities, not only to “urban public research universities of similar size”
  – funding agencies don’t care much about location, ownership type or school colors

★ Research aggregate rankings
  – WSU’s position in major aggregate research rankings is steadily falling

★ Research expenditure rankings
  – while WSU research expenditures in terms of “actual dollars” gradually rose, inflation-adjusted institutional income is likely stagnant
  – after peaking in 2001, WSU’s research expenditures rankings are falling

★ Currently, no one at WSU is responsible for tracking of WSU rankings
Recommendations

★ Improve quality of faculty
  – recruit more faculty, but only those who can compete at the national level (both junior and senior)
  – provide support for tenure track faculty members (e.g. lower indirect cost rates)
  – review tenure requirements and deny tenure to those who do not prove their ability
    • where applicable, require publications in high-impact journals
    • where applicable, require secured external grant support as a condition for tenure

★ Improve national and international visibility of WSU
  – provide standing support for hosting (large) national and international scientific conferences on WSU campus and reward faculty who organize them
    e.g. DPF-2009: http://www.dpf2009.wayne.edu

★ Encourage faculty to publish in high-impact journals
  – introduce a prize for most-impact research publications in the last 5 years
    • judged by, say, a “power factor” \( p \), where
      \[ p = \sum_{i=1}^{N} \frac{\text{(journal’s impact factor)}_i}{\text{(number of authors)}_i} \]
    ‣ \( N \) is a number of papers in the last 5 years
  – introduce a prize for single “most impact” paper (highest # of citations) in the last 10 years

★ Ask SPA to provide a weekly compilation of funding opportunities
## ARWU: top 15 institutions (2012)

<table>
<thead>
<tr>
<th>World Rank</th>
<th>Institution*</th>
<th>Country /Region</th>
<th>National Rank</th>
<th>Total Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Harvard University</td>
<td>🇺🇸</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>2</td>
<td>Stanford University</td>
<td>🇺🇸</td>
<td>2</td>
<td>72.8</td>
</tr>
<tr>
<td>3</td>
<td>Massachusetts Institute of Technology (MIT)</td>
<td>🇺🇸</td>
<td>3</td>
<td>71.8</td>
</tr>
<tr>
<td>4</td>
<td>University of California, Berkeley</td>
<td>🇺🇸</td>
<td>4</td>
<td>71.6</td>
</tr>
<tr>
<td>5</td>
<td>University of Cambridge</td>
<td>🇬🇧</td>
<td>1</td>
<td>69.8</td>
</tr>
<tr>
<td>6</td>
<td>California Institute of Technology</td>
<td>🇺🇸</td>
<td>5</td>
<td>64.1</td>
</tr>
<tr>
<td>7</td>
<td>Princeton University</td>
<td>🇺🇸</td>
<td>6</td>
<td>62.1</td>
</tr>
<tr>
<td>8</td>
<td>Columbia University</td>
<td>🇺🇸</td>
<td>7</td>
<td>60.1</td>
</tr>
<tr>
<td>9</td>
<td>University of Chicago</td>
<td>🇺🇸</td>
<td>8</td>
<td>57.2</td>
</tr>
<tr>
<td>10</td>
<td>University of Oxford</td>
<td>🇬🇧</td>
<td>2</td>
<td>56.1</td>
</tr>
<tr>
<td>11</td>
<td>Yale University</td>
<td>🇺🇸</td>
<td>9</td>
<td>54.8</td>
</tr>
<tr>
<td>12</td>
<td>University of California, Los Angeles</td>
<td>🇺🇸</td>
<td>10</td>
<td>52.2</td>
</tr>
<tr>
<td>13</td>
<td>Cornell University</td>
<td>🇺🇸</td>
<td>11</td>
<td>50.8</td>
</tr>
<tr>
<td>14</td>
<td>University of Pennsylvania</td>
<td>🇺🇸</td>
<td>12</td>
<td>50.5</td>
</tr>
<tr>
<td>15</td>
<td>University of California, San Diego</td>
<td>🇺🇸</td>
<td>13</td>
<td>49.6</td>
</tr>
</tbody>
</table>
ARWU explanations

★ Alumni winning major award (10%)

– The total number of the alumni of an institution winning Nobel Prizes and Fields Medals. Alumni are defined as those who obtain bachelor, Master's or doctoral degrees from the institution. Different weights are set according to the periods of obtaining degrees. The weight is 100% for alumni obtaining degrees in 2001-2010, 90% for alumni obtaining degrees in 1991-2000, 80% for alumni obtaining degrees in 1981-1990, and so on, and finally 10% for alumni obtaining degrees in 1911-1920. If a person obtains more than one degrees from an institution, the institution is considered once only.

★ Stuff/faculty winning major award (20%)

– The total number of the staff of an institution winning Nobel Prizes in Physics, Chemistry, Medicine and Economics and Fields Medal in Mathematics. Staff is defined as those who work at an institution at the time of winning the prize. Different weights are set according to the periods of winning the prizes. The weight is 100% for winners after 2011, 90% for winners in 2001-2010, 80% for winners in 1991-2000, 70% for winners in 1981-1990, and so on, and finally 10% for winners in 1921-1930. If a winner is affiliated with more than one institution, each institution is assigned the reciprocal of the number of institutions. For Nobel prizes, if a prize is shared by more than one person, weights are set for winners according to their proportion of the prize.

★ Highly cited researchers in 21 broad subject categories (20%)

– The number of Highly Cited Researchers in 21 subject categories. These individuals are the most cited within each category. If a Highly Cited Researcher has two or more affiliations, he/she was asked to estimate his/her weights (or number of weeks) for each affiliation. More than 2/3 of those multi-affiliated Highly Cited Researchers provided such estimations and their affiliations receive the weights accordingly. For those who did not answer, their first affiliation is given a weight of 84% (average weight of the first affiliations for those who replied) and the rest affiliations share the remaining 16% equally.
ARWU explanations (cont.)

★ Papers published in Nature and Science (20%)

- The number of papers published in Nature and Science between 2007 and 2011. To distinguish the order of author affiliation, a weight of 100% is assigned for corresponding author affiliation, 50% for first author affiliation (second author affiliation if the first author affiliation is the same as corresponding author affiliation), 25% for the next author affiliation, and 10% for other author affiliations. Only publications of 'Article' and 'Proceedings Paper' types are considered.

★ Papers indexed in Science Citation Index-expanded and Social Science Citation Index (20%)

- Total number of papers indexed in Science Citation Index-Expanded and Social Science Citation Index in 2011. Only publications of 'Article' and 'Proceedings Paper' types are considered. When calculating the total number of papers of an institution, a special weight of two was introduced for papers indexed in Social Science Citation Index.

★ Per capita academic performance of an institution (10%)

- The weighted scores of the above five indicators divided by the number of full-time equivalent academic staff. If the number of academic staff for institutions of a country cannot be obtained, the weighted scores of the above five indicators is used. For ARWU 2012, the numbers of full-time equivalent academic staff are obtained for institutions in Australia, Austria, Belgium, Canada, China, Czech, France, Italy, Japan, Netherlands, New Zealand, Norway, Saudi Arabia, Slovenia, South Korea, Spain, Sweden, Switzerland, UK, USA etc.
THE explanations

★ Teaching (30%) [5 separate subcategories]
   - 15%: invitation-only academic reputation survey: the perceived prestige of institutions in both research and teaching (16,639 responses in 2012), statistically representative of global higher education's geographical and subject mix.
   - 4.5%: staff-to-student ratio (an institution's total student numbers) as a simple proxy for teaching quality.
   - 2.25%: ratio of doctoral to bachelor's degrees awarded by each institution.
   - 6%: number of doctorates awarded by an institution, scaled against its size as measured by the number of academic staff it employs.
   - 2.25%: institutional income (adjusted for purchasing-power parity) scaled against academic staff numbers.

★ Research (30%) [3 separate subcategories]
   - 18%: academic reputation survey: university's reputation for research excellence among its peers
   - 6%: university research income, scaled against staff numbers and normalized for purchasing-power parity. Data is normalized to take account of each university's subject profile, reflecting the fact that research grants in science subjects are often bigger than those awarded for the highest-quality social science, arts and humanities research.
   - 6%: research output scaled against staff numbers. They count the number of papers published in the academic journals indexed by Thomson Reuters per academic, scaled for a university's total size and also normalized for subject. This gives an idea of an institution's ability to get papers published in quality peer-reviewed journals.
THE explanations (cont.)

★ Citations (30%)
- Use data supplier Thomson Reuters that examined more than 50 million citations to 6 million journal articles, published over five years. The data are drawn from the 12,000 academic journals indexed by Thomson Reuters' Web of Science database and include all indexed journals published between 2006 and 2010. Citations to these papers made in the six years from 2006 to 2011 are also collected.
- The data are normalized to reflect variations in citation volume between different subject areas. This means that institutions with high levels of research activity in subjects with traditionally high citation counts do not gain an unfair advantage.

★ Industry income (2.5%)
- Seeks to capture such "knowledge transfer" by looking at how much research income an institution earns from industry, scaled against the number of academic staff it employs.

★ International outlook (7.5%) [3 separate subcategories]
- 2.5%: ratio of international to domestic students (both grad and undergrad).
- 2.5%: ratio of international to domestic faculty and staff.
- 2.5%: the proportion of a university's total research journal publications that have at least one international co-author in the last five years (normalized to account for a university's subject mix).
QS explanations

★ Academic reputation (40%)
- Based on the academic reputation survey, which is distributed online to academics worldwide. Academics are asked to identify the universities that are currently producing the best research in their field of expertise.
- The survey drew on more than 46,000 responses in 2012, aggregated over three years. Respondents are not permitted to submit their own institution or to respond more than once in a given year. For those who have taken part in one of the three previous years, only the most recent response is used.
- Weightings are applied both geographically and by discipline to ensure as fair a representative spread as possible.

★ Employer reputation (10%)
- The employer reputation indicator is based on a global online survey, this time distributed to employers. Results are again based on three years' worth of 'latest response' data, totaling over 25,000 in 2012.
- Employers are asked to identify the universities that produce the best graduates. This gives students an insight into which universities carry weight in the job market, as well as an indication of which universities are most successful at equipping graduates with skills that help them thrive in the job market.
- Geographical weightings are applied to ensure fair representation from key regions of the world
QS explanations (cont.)

★ Citations per faculty (20%)

- Citations are a widely used, conventional measure of research strength. A citation is a reference to one academic publication in the text of another. The more citations a publication receives the better it is perceived to be. Therefore, the more highly cited papers a university publishes, the stronger it can be considered to be.
- As a measure, this is somewhat geared towards scientific and technical subjects, which is why it doesn't carry more weight. The source used in this evaluation is Scopus, the world's largest abstract and citation database of research literature.
- The latest five complete years of data are used. The total citation count is factored against the number of faculty in order to take into account the size of the institution.

★ Faculty-student ratio (20%)

- Faculty/student ratio is the most globally available and accessible measure of commitment to teaching. It measures the number of academic staff employed for every student admitted.

★ International faculty/student ratios (10%)

- 5%: ratio of international to domestic students (both grad and undergrad).
- 5%: ratio of international to domestic faculty and staff.