It Would Be Beneficial to Supplement Grade Point Average with Grade Point Standard Deviation

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At Present, Only Grade Point Average Is Used

- It is often important to evaluate and compare graduates:
  - when a company makes a decision on hiring a former student
  - when a graduate program makes a decision on whether to accept a student.

- At present, only one type of statistical characteristic is used for this evaluation and comparison: the (GPA).

- In statistical terms, GPA is the mean of the student’s grades.

- Specifically, the information usually consists of:
  - the overall GPA and
  - the GPA in major.
Need to Go Beyond GPA

• The GPA does not provide a full information about the student. For example, an average B grade:
  – may mean that a student has a steadily good performance in all his/her classes, or
  – that a student is barely passing some classes with C- while showing brilliance and A+ in others.

• Hiring the first, low-variance student leads to no risk and medium rewards.

• Hiring the second, high-variance student comes with a risk:
  – in some tasks, he/she will be great,
  – in other tasks he/she may be a disaster.

• A company (or a graduate school) would benefit from knowing the difference.
How to Gauge the Difference: Experience of Financial Analysis

• How can we gauge the difference?

• A similar problem occurs when people make a decision on financial investments.

• When people select stocks and/or bonds for their portfolio, they take into account:
  
  – not only the mean performance of the corresponding instruments,
  
  – but also their *standard deviation* – a measure of their deviation from the mean.

• It is thus desirable to supplement the GPA with the Grade Point Standard Deviation (GPSD).
How To Compute Grade Point Standard Deviation (GPSD):
Seemingly Natural Idea and Its Limitations

• In principle, we can compute GPSD based on the grades for different classes.

• Specifically, if $g_1, \ldots, g_n$ are grade for different class, then
  \[ \text{GPA} = \frac{1}{n} \cdot \sum_{i=1}^{n} g_i \]
  \[ \text{GPSD} = \sqrt{\frac{1}{n} \cdot \sum_{i=1}^{n} (g_i - \text{GPA})^2}. \]

• However, it is important to take into account that
  – each grade $g_i$
  – is itself an average of grades for different tests and assignments.
How To Compute Grade Point Standard Deviation (GPSD): A More Adequate Idea

- Using the natural-idea formula will underestimate the standard deviation.
- A more adequate description requires that:
  - for each class (and maybe for each test),
  - we provide not only the usual (average) grade \( g_i \),
  - but also the standard deviation \( \sigma_i \) of the corresponding grades.
- Based on these variances, we can estimates the overall GPSD as

\[
\text{GPSD} = \sqrt{\frac{1}{n} \cdot \sum_{i=1}^{n} [(g_i - \text{GPA})^2 + \sigma_i^2]}.
\]
A Similar Idea Can Be Used In Evaluating Faculty

• A similar idea can be used in evaluating faculty:
  – when hiring a new faculty,
  – during annual evaluations,
  – during tenure and promotion process.

• Usually, we consider average numbers per year, average student evaluations.

• In addition, we can consider standard deviations.

• This will enable us to distinguish between, e.g.,
  – a consistently good researcher and
  – a researcher whose outputs alternate between dry spells and brilliant outbursts.
Conclusions

- A “B”-level GPA:
  - may mean a steadily good performance, or
  - it may mean that a student is barely passing some classes while showing brilliance in others.

- Hiring the low-variance student leads to no risk and medium rewards.

- Hiring the high-variance student comes with a risk.

- A company (or a graduate school) would benefit from knowing the difference.

- It is therefore desirable to supplement the GPA with the Grade Point Standard Deviation (GPSD)– based on variance for each course.
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