Title	**Injury Severity: Scales, Incidence, Hospitalization Rate, Mortality Risk, Economic Costs, Modeling Considerations, and Best Practices**
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Abstract	*Introduction*: Injury assessment and modeling present several challenges. Methods are needed for assessing the severity of injuries, for quantifying impacts along those gradations (e.g., economic costs), and for comparing injuries to each other and to fatalities. While a variety of such methods exist, there is limited comprehensive, direct, and collated information available comparing them along various dimensions or to help assess their fitness for a particular purpose. *Method*: Three common and widely applicable injury severity scales that are useful in injury and safety analyses are reviewed: hospitalized/non-hospitalized dichotomy; Abbreviated Injury Scale (AIS); and Injury Severity Score (ISS). Their advantages, limitations, caveats, and risks are discussed, and data for each are summarized (incidence, hospitalization rate, mortality risk, and economic costs). Operations research, machine learning, econometrics, and statistical classification methods are used to bound the range of AIS levels at each ISS value, to develop a probabilistic AIS-ISS map, and to transfer AIS-based economic costs onto the ISS scale (ordinal logistic regression, Gaussian naïve Bayes). A clustering algorithm (k-means) is also used to group ranges of AIS/ISS levels according to various data features. *Results*: Bounding analysis reveals each ISS value links to one or a small number of AIS levels. The cluster assignments are reasonably stable across data features. And when viewed over the entire ISS range, the mapped AIS-based costs are remarkably linear, and reduced-form ISS cost models are presented. *Conclusions*: The methodology can be applied to any quantity (not just costs). It therefore represents a fundamental development in the understanding of the relationship between the AIS and ISS. *Practical Applications*: This greatly improves the comparability of the scales and facilitates the pooling of mixed AIS/ISS data in meta-analyses. In particular, it allows costs to be quantified for the ISS scale.
Keywords	Abbreviated Injury Scale (AIS); Injury Severity Score (ISS); machine learning; econometrics; statistical classification; ordinal logistic regression; naïve Bayes classifier; k-means clustering
Highlights	• Bounding analysis reveals each ISS value links to one or a small range of AIS levels • Clusters for each scale (AIS/ISS) are quite stable across data features • Mapped AIS-based economic costs are remarkably linear in the ISS • AIS-ISS map can be used to transfer any quantity from one scale to the other • Facilitates better comparisons and pooling of mixed AIS/ISS data in meta-analyses
Code	Injury_costs.py