WCECS 2013 Keynote Speaker II:

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Speech Title:
Application of Mathematical Principles to Engineering and Other Disciplines

Abstract:

Mathematics plays an important role in solution of many physical problems in various disciplines. In any discipline, the first step to solve any the physical problem is to formulate an equivalent mathematical model making some realistic assumption. The second step is then to solve the mathematical model using available tools. If drastic and unrealistic assumptions are made then the model becomes very simple to solve but it being too far from the actual physical model, will not result in any meaningful results. On the other hand, if enough assumptions are not made to arrive at the corresponding mathematical model, the model thus arrived may be too complex to solve. So, the challenge for the Scientists and Engineers is to deduce a good realistic mathematical model for a Physical problem and then solve it using available mathematical tools. This basic principle is common to any branch of science or engineering or non-engineering discipline as well as such as Political Science, Sociology, Kinesiology or Medicine just to name a few.

Let us discuss briefly few applications in Poverty. If one is interested in calculating poverty index (PI) for population of various states in USA, how would one proceed? Population involves people and their families. So, the first step in this process should

be to calculate poverty of any family. Now, when one talks of a family, the two basic parameters that are connected with poverty of a family are – family size (f) and the economic level (e) of the family. The abstract parameter PI is directly proportional to f while it is inversely proportional to e. Hence, the basic relation for poverty index (PI) can be expressed as, PI = k f/e, where k = constant of proportionality =k_1 k_2 where, k_1 is associated with f and k_2 is associated with e. While there exist data for e and f, there is no data for the abstract quantity of poverty index (PI). So, the challenge in this problem is to arrive at a method to calculate k which then gives the value of PI for a given data of f and e. Once this done, the values of poverty index (PI) can be calculated for each of the states in USA. I have published a paper in this area of Sociology on "Mathematical Formulation of Poverty Index" in an International Journal "European Journal of Scientific Research" – EJSR.

Similarly, one can pick a topic in Medicine. Good health is of interest to every person. Stroke or Heart attack are some of the leading causes of death. So, if one wants to calculate the Risk of a person getting stroke, how does one proceed? First, one has to look at all the important parameters that could contribute to stroke. Some of them are –blood pressure, (bp), total cholesterol level (tc), HDL, LDL, fast blood sugar (fbs) and age itself. A mathematical equation can then be developed between Stroke index (SI) and these parameters based on the actual anonymous data. For this concept of regression analysis is used. SI will be of the form: SI= K_1 *K_2 *K_3 *K_4 *K_5 *K_6 *bp*tc*ldl*fbs*age/(hdl) where K are constant of proportionality. The equation for cumulative risk factor (crf) is given as, crf =rfbp*rfc*rfldl*rfbs*rfage/rfhdl. The risk factor is derived based on the Stroke index (SI) equation. Both these equations are based on the assumption that SI and crf are directly proportional to bp,tc,ldl,fbs and age and indirectly proportional to hdl. The individual risk factors are calculated using relations such as: rfbp =bpa/bpn, rfc=tca/tcn, rfdl= ldla/ldln,rfbs=bsa/bsn,rfage=agea/agen. "a" stands for actual and "n" stands for nominal. Using this formulation and the actual data of patients, one can calculate stroke index (SI) and cumulative risk factor (crf) for any particular person. This can then be communicated to the person and steps can be taken to mitigate the situation through appropriate medicine prescribed by the physician. Similarly, basic principles as shown here for 2 examples can be used to solve problems in other disciples as well.

This keynote speech will go into the actual data that was used for problems in various disciplines and the results obtained showing the efficacy of mathematical techniques.

About the Speaker:

Dr. Chandrasekhar Putcha is a Professor and former Chair in the Department of Civil and Environmental Engineering at California State University, Fullerton. For the last 32 years. Dr. Putcha received the campus-wide outstanding Professor award at California State University, Fullerton for AY 2006-2007 for his outstanding contributions to teaching, research, service and professional activities. He is the first recipient of this award from the College of Engineering and Computer Science in the last 44 years that this award was instituted at California State University, Fullerton. He has been at this place since 1981. Before that he was on the research faculty at West Virginia University, Morgantown, WV and a post-doctoral fellow at University of Sherbrooke in Canada. His research areas of interest are –Reliability, Risk Analysis, Optimization and Mathematical Modeling.

Because of his interdisciplinary areas of research, Dr. Putcha has published more than 140 research papers in various disciplines such as Engineering, Medicine, Kinesiology, Political Science and Sociology. He has done consulting work for several leading companies and received research grants from companies such as Boeing, Northrop Grumman Corporation (NGC) and from federal agencies such as – NASA, Navy, Air Force, US Army Corps of Engineers.