Identifying Significant Parameters of the US Bridges

by

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Outline

- Introduction
- Motivation
- Tests Conducted
- Current Results

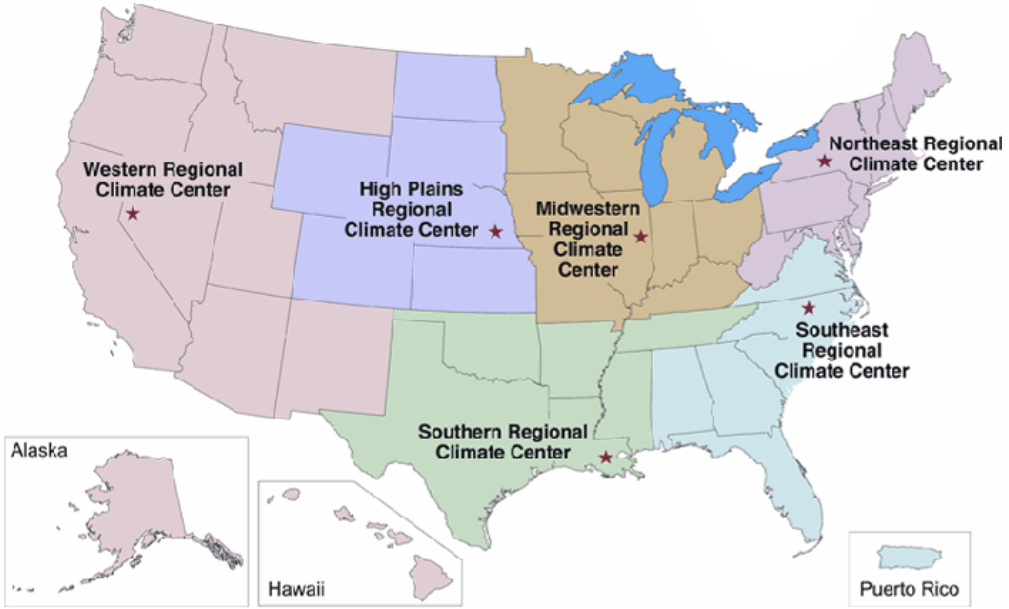
Introduction

- Federal Highway Administration (FHWA) maintains National Bridge Inventory (NBI) database, where more than 600,000 U.S. bridges' data is stored
- The American Society for Civil Engineers (ASCE) gave a C+ grade (mediocre) to US' bridges in 2017
- Public safety and economic growth are two key motivation factors for any government to well maintain the bridges

Introduction

- Weather conditions are different in various climatic regions
- Manpower and budget constraints are the two major shortfalls
- Need of new big-data analysis techniques to visualize and to gain the new insights of existing bridge data

Introduction



- Weather conditions are different in various climatic regions
- US is geographically divided into six climatic regions

Motivation

- Why some bridges deteriorate faster than others?
- Do material or design or region have significant effect on the deck condition rating?

Various condition Ratings

Condition Rating	Description
9	Excellent condition
8	Very good condition
7	Good condition
6	Satisfactory condition
5	Fair condition
4	Poor condition
3	Serious condition
2	Critical condition
1	Imminent failure condition
0	Failed condition

Tests Conducted

- Kruskal-Wallis Test
- Wilcoxon Test

Parameters Considered

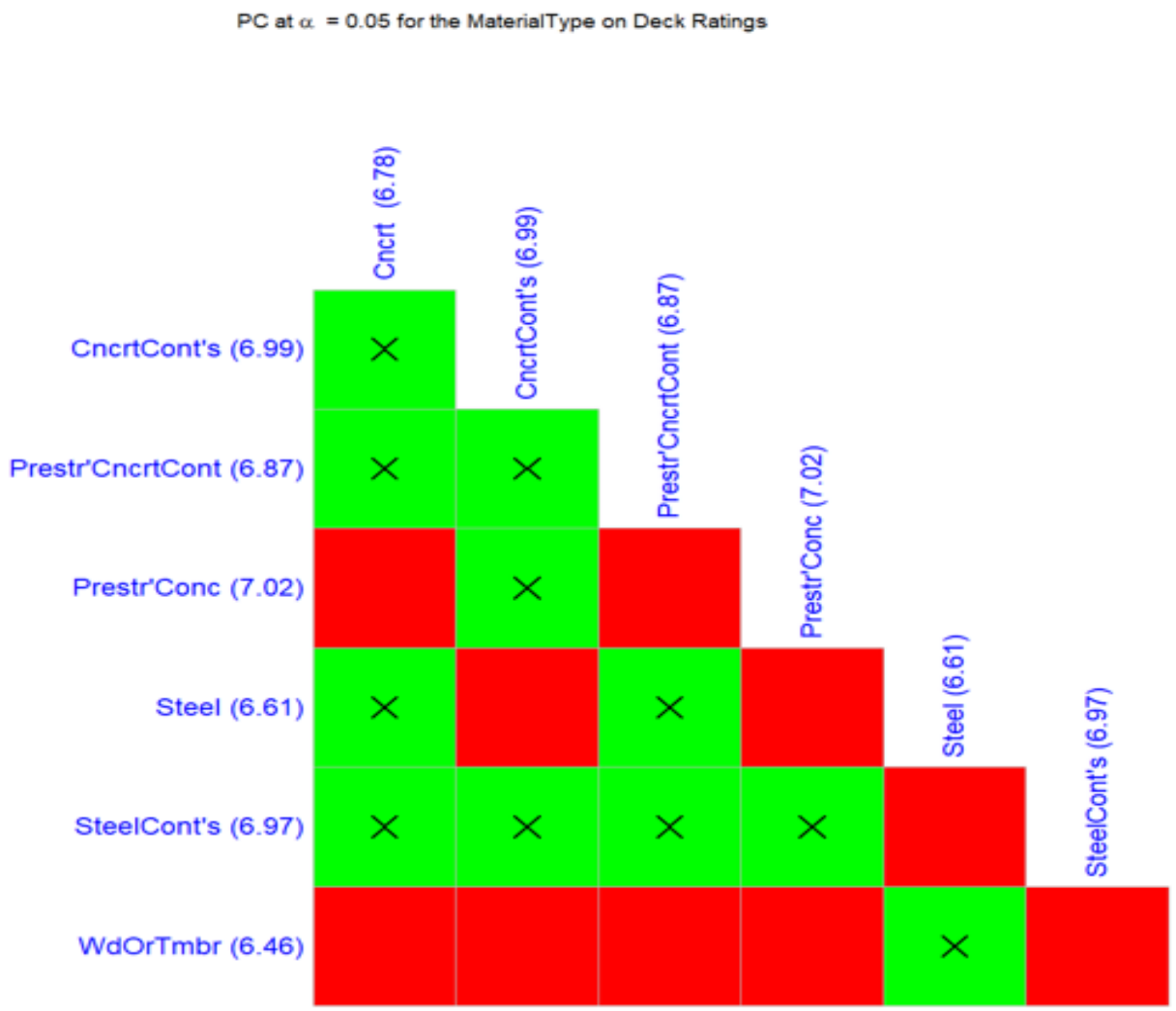
- Dependent Parameter:
  Deck Rating

- Independent Parameters:
  Material, Design, and Region

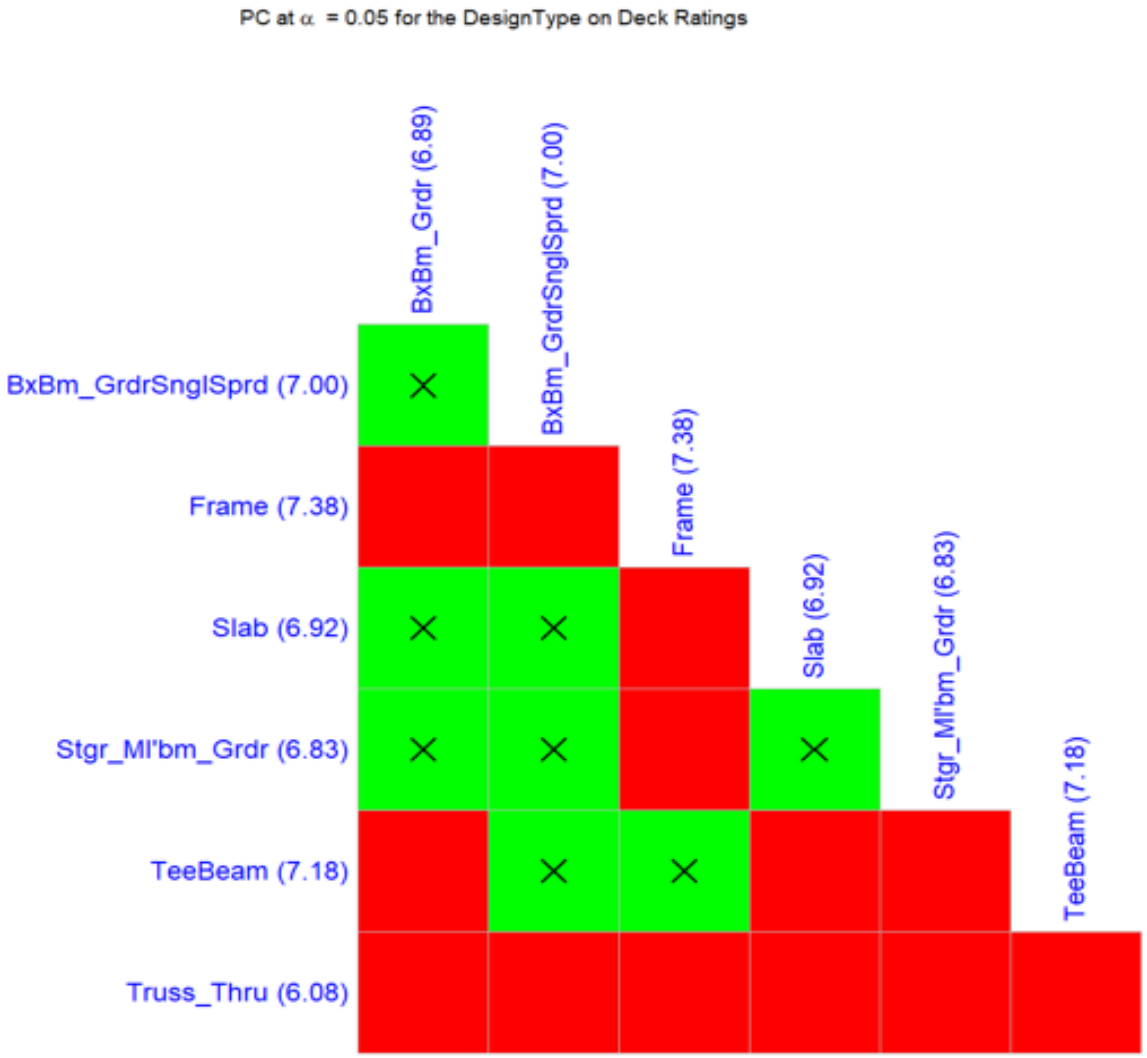
Hypotheses Tested

1. The null and alternate hypotheses on materials is given below.
H0: The means of deck condition ratings of all material types are equal
Ha: The means are not equal
2. The null and alternate hypotheses on designs is given below.
H0: The means of deck condition ratings of all design types are equal
Ha: The means are not equal
3. The null and alternate hypotheses on regions is given below.
H0: The means of deck condition ratings of all regions are equal
Ha: The means are not equal
4. The null and alternate hypotheses on material * design * region is given below.
H0: The means of deck condition ratings of all material*design*region are equal
Ha: The means are not equal

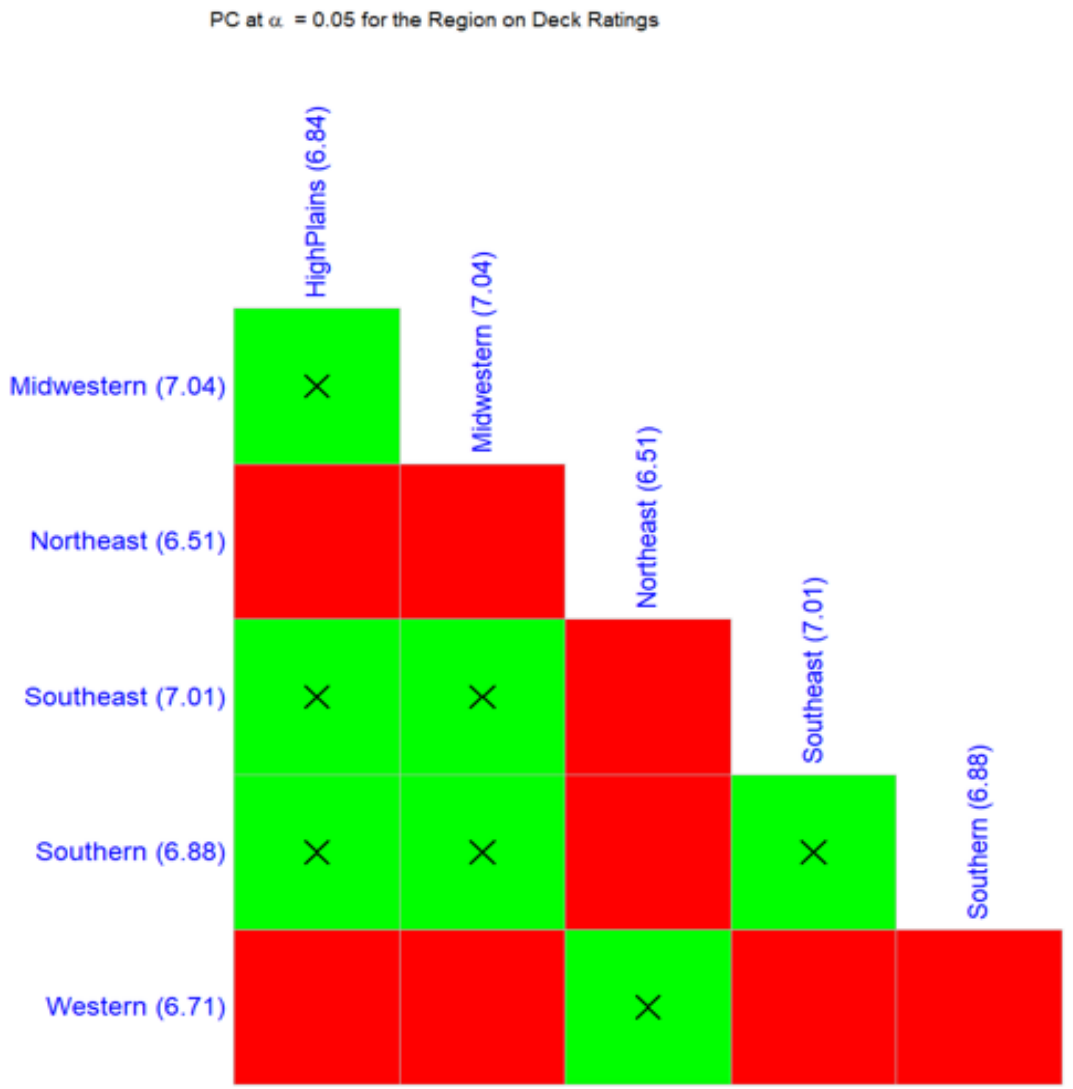
Results


PC at α = 0.05 for the MaterialType on Deck Ratings
Cncrt (6.78)
CncrtCont's (6.99)
Prestr'CncrtCont (6.87)
Prestr'Conc (7.02)
Steel (6.61)
SteelCont's (6.97)
CncrtCont's (6.99)
Prestr'CncrtCont (6.87)
Prestr'Conc (7.02)
Steel (6.61)
SteelCont's (6.97)
WdOrTmbr (6.46)

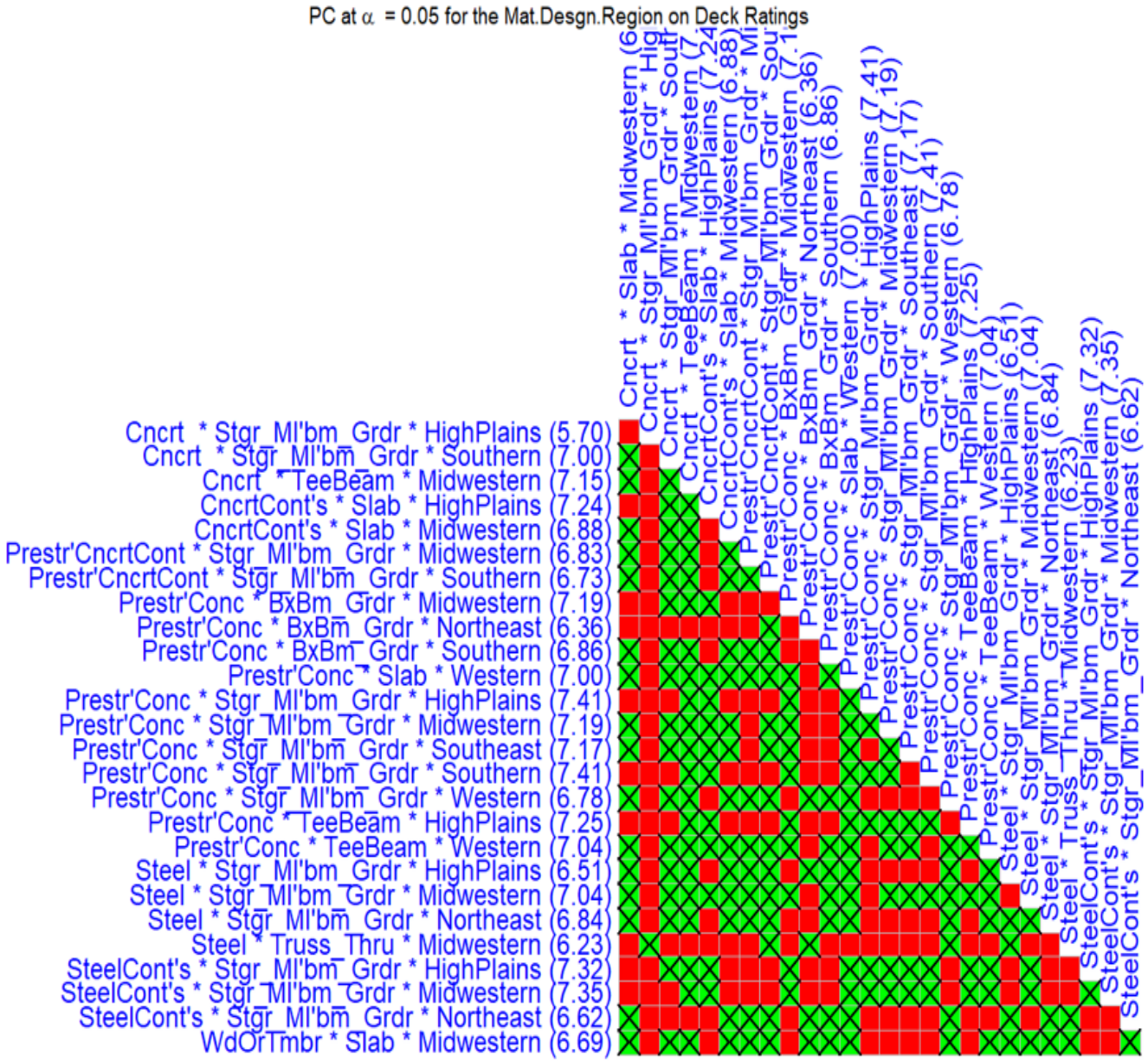
Results


PC at α = 0.05 for the DesignType on Deck Ratings
BxBm_Grdr (6.89)
BxBm_GrdrSnglSprd (7.00)
Frame (7.38)
Slab (6.92)
Stgr_Ml'bm_Grdr (6.83)
TeeBeam (7.18)
BxBm_GrdrSnglSprd (7.00)
Frame (7.38)
Slab (6.92)
Stgr_Ml'bm_Grdr (6.83)
TeeBeam (7.18)
Truss_Thru (6.08)

Results


PC at α = 0.05 for the Region on Deck Ratings
HighPlains (6.84)
Midwestern (7.04)
Northeast (6.51)
Southeast (7.01)
Southern (6.88)
Midwestern (7.04)
Northeast (6.51)
Southeast (7.01)
Southern (6.88)
Western (6.71)

Results


PC at α = 0.05 for the Mat.Desgn.Region on Deck Ratings
Cncrt * Stgr_Ml'bm_Grdr * HighPlains (5.70)
Cncrt * Stgr_Ml'bm_Grdr * Southern (7.00)
Cncrt * TeeBeam * Midwestern (7.15)
CncrtCont's * Slab * HighPlains (7.24)
CncrtCont's * Slab * Midwestern (6.88)
Prestr'CncrtCont * Stgr_Ml'bm_Grdr * Midwestern (6.83)
Prestr'CncrtCont * Stgr_Ml'bm_Grdr * Southern (6.73)
Prestr'Conc * BxBm_Grdr * Midwestern (7.19)
Prestr'Conc * BxBm_Grdr * Northeast (6.36)
Prestr'Conc * BxBm_Grdr * Southern (6.86)
Prestr'Conc * Slab * Western (7.00)
Prestr'Conc * Stgr_Ml'bm_Grdr * HighPlains (7.41)
Prestr'Conc * Stgr_Ml'bm_Grdr * Midwestern (7.19)
Prestr'Conc * Stgr_Ml'bm_Grdr * Southeast (7.17)
Prestr'Conc * Stgr_Ml'bm_Grdr * Southern (7.41)
Prestr'Conc * Stgr_Ml'bm_Grdr * Western (6.78)
Prestr'Conc * TeeBeam * HighPlains (7.25)
Prestr'Conc * TeeBeam * Western (7.04)
Steel * Stgr_Ml'bm_Grdr * HighPlains (6.51)
Steel * Stgr_Ml'bm_Grdr * Midwestern (7.04)
Steel * Stgr_Ml'bm_Grdr * Northeast (6.84)
Steel * Truss_Thru * Midwestern (6.23)
SteelCont's * Stgr_Ml'bm_Grdr * HighPlains (7.32)
SteelCont's * Stgr_Ml'bm_Grdr * Midwestern (7.35)
SteelCont's * Stgr_Ml'bm_Grdr * Northeast (6.62)
WdOrTmbr * Slab * Midwestern (6.69)

Results

- Material has significant effect on the deck condition rating
- Design has significant effect on the deck condition ratings
- Region has significant effect on the deck condition ratings
- Interaction of all the three independent parameters has the significant effect on the deck condition ratings

Results

- bridges made of concrete material with stringer multi-beam girder design that reside in the Highplains region perform the worst, whereas the prestressed concrete bridges with the same design that reside in the same region perform the best.

- Similarly, prestressed concrete bridges with stringer multibeam-girder design that reside in the Southern region are also performing the best after 27 years

Queries…?

Thank you