WORLD ROAD ASSOCIATION MONDIALE DE LA ROUTE
Norfolk, Virginia / September 19-22, 2012
7th symposium on pavement surface characteristics
SURF 2012

PAVEMENT WARRANTY PROGRAM IN MISSISSIPPI AND EVALUATION OF ITS EFFECTIVENESS

Yan Qi, Amin El Gendy, and Feng Wang

Objectives

- Objectives
- Introduction
- Warranty programs in other states
- Pavement warranty program in MS
- Effectiveness study for MDOT

Objectives

- **Review the current pavement warranty practice in MS**
- **Evaluate the effectiveness of MDOT's pavement warranty program**

Introduction – Definition

- **"a guarantee of the integrity of a product and the maker's responsibility for the repair or replacement of the deficiencies" (NCHRP 451)**
- **Contracting pavement warranty**
  - **Contractor warranties distress items to DOT**
  - **Pavement distresses are monitored**
  - **Remedial action is required if a distress threshold is exceeded**

Introduction – Benefits

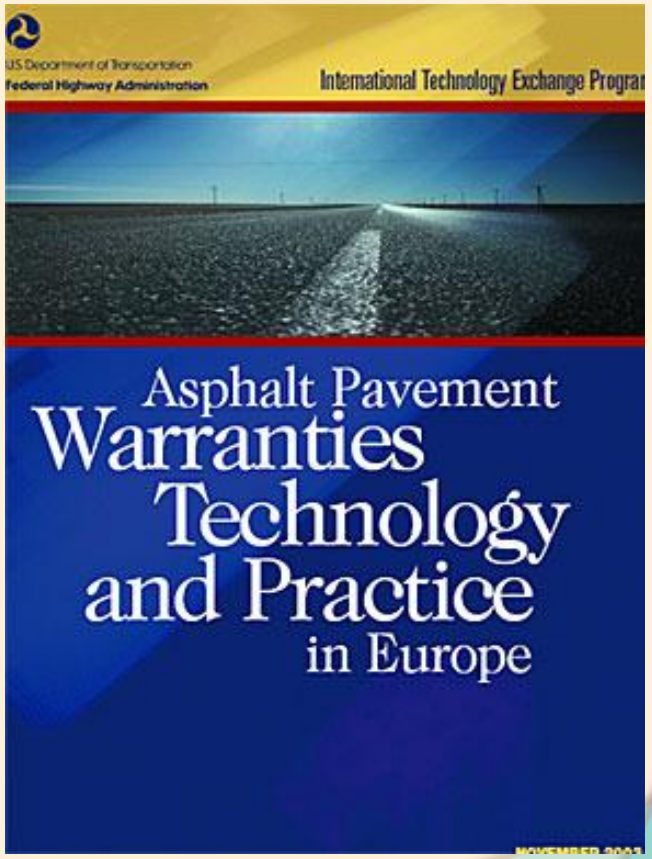
- **Reduce DOT investment**
- **Reallocate performance risk**
- **Forster contractor innovation**
- **Increase construction quality**
- **Reduce LCC of highway projects**

History of Pavement Warranties

- In the 1950's when the Interstate construction expansion began, the use of warranties was disallowed.
- Warranties had limited use with States and local agencies until they surfaced again on highway projects in the 1990's.
- Federal regulations were revised in 1995.

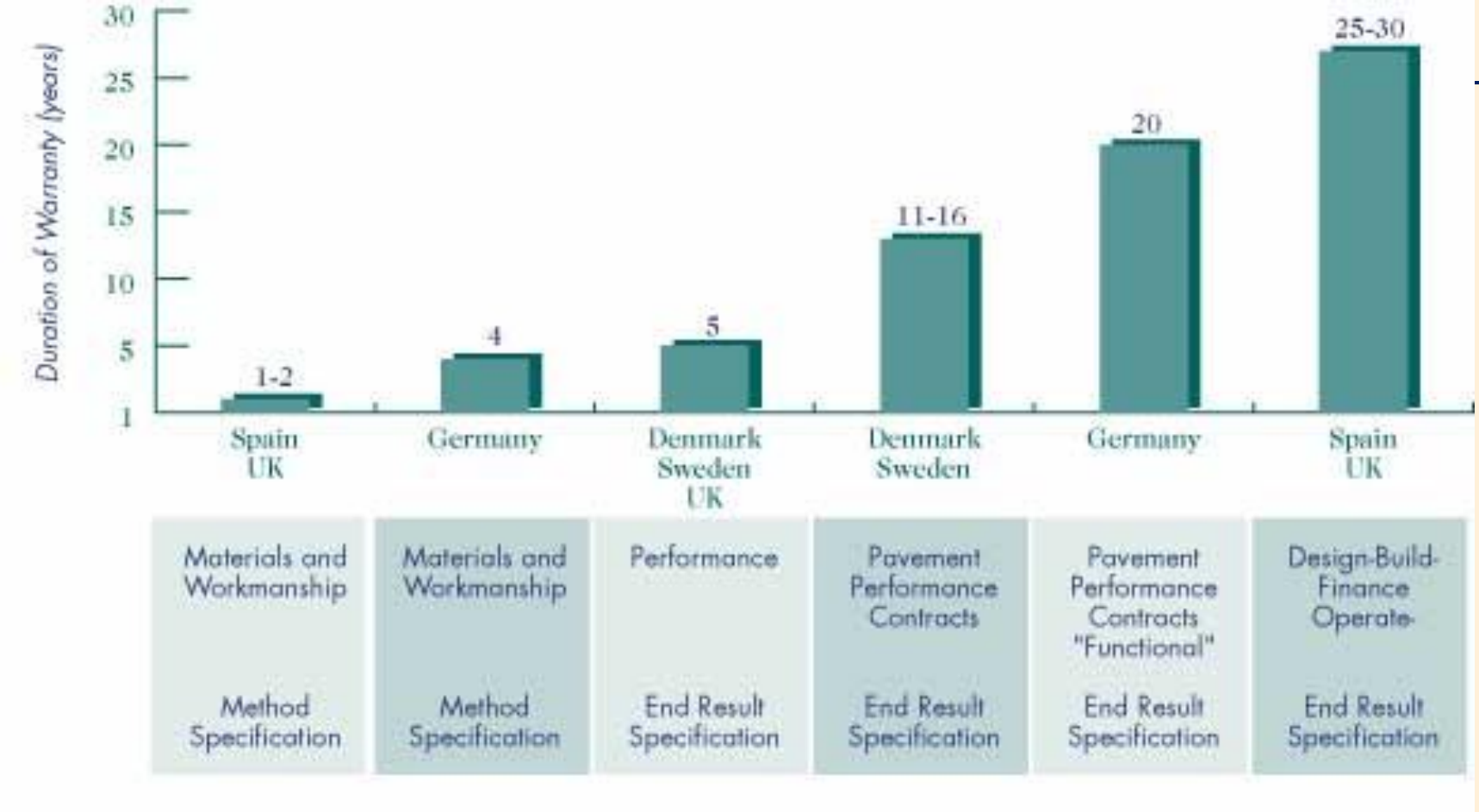
Learning from the European Experiences

- **European Asphalt Pavement Warranties Scan goals to :**
  - Bring global Innovations to U.S. Highways
  - Determine criteria used in successful pavement warranties



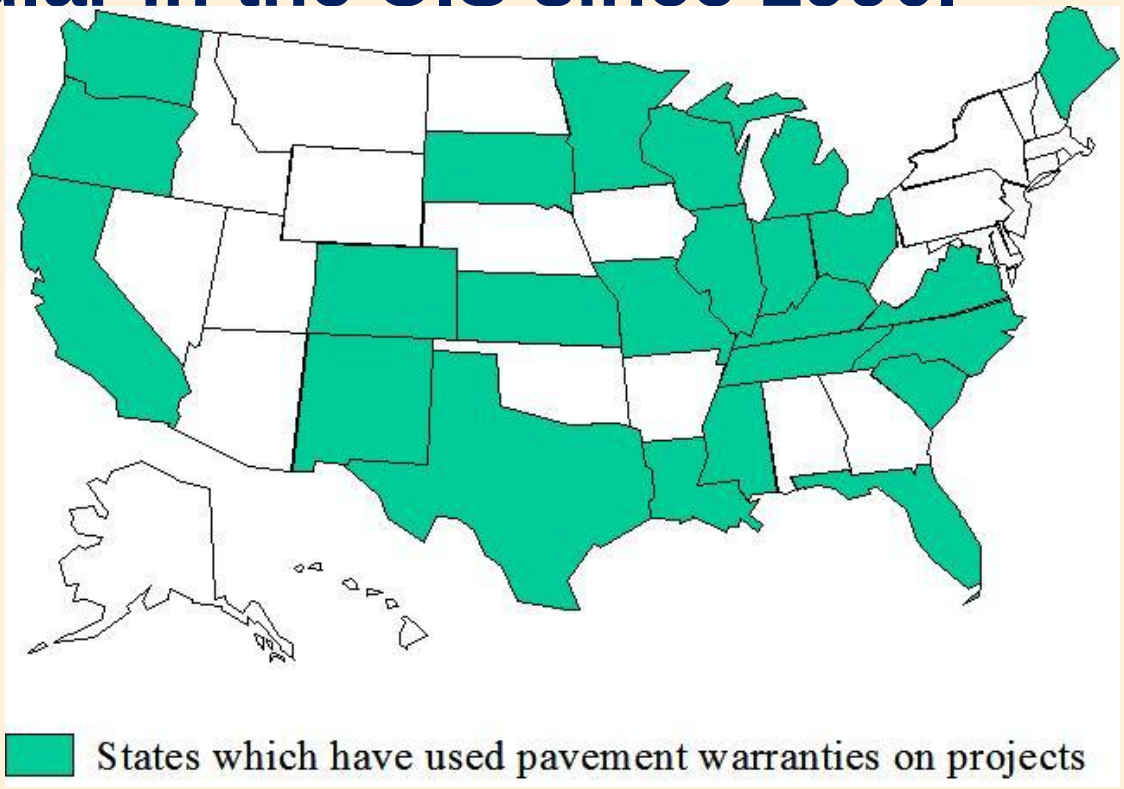
http://international.fhwa.dot.gov/apw/index.cfm

Warranty Types Observed on



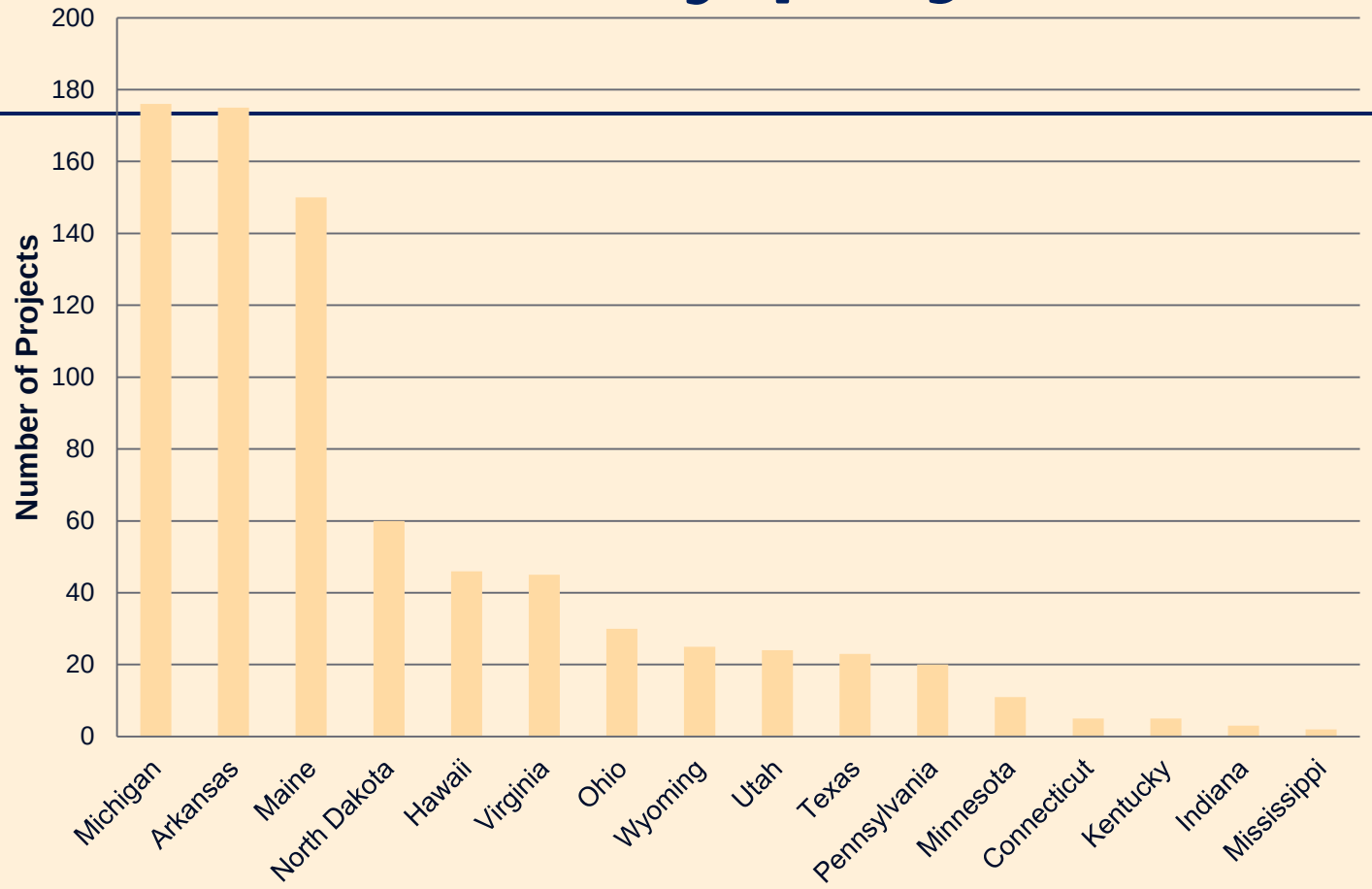
Pavement Warranty in US

- **Warranties are slowly becoming more popular in the U.S since 1990.**



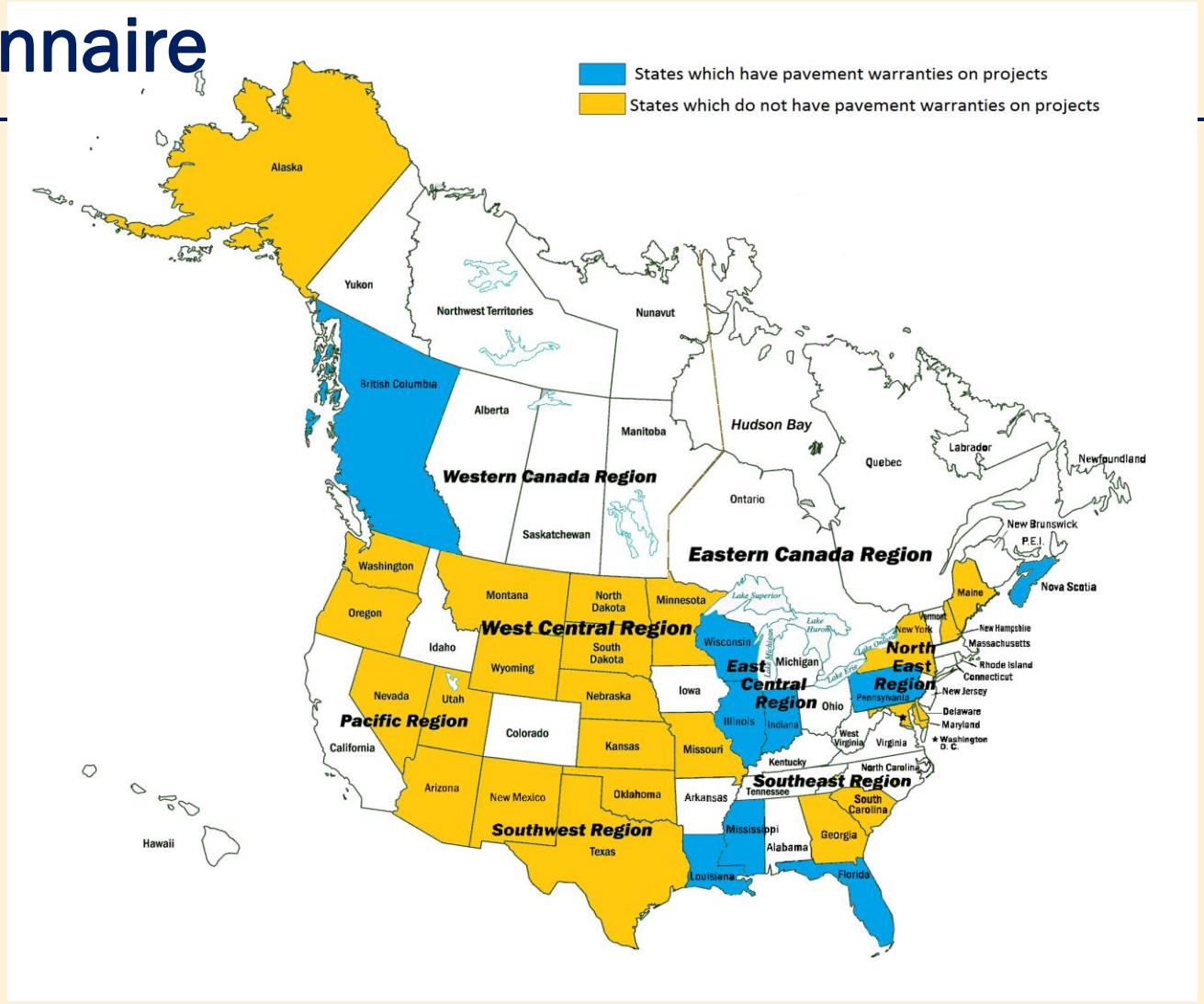
Source: “Pavement Warranty Symposium,” hosted by Michigan DOT in May 2003

Annual warranty projects



Source: annual warranty projects for only state responded to the Ohio DOT survey 2005

States participating in the MDOT questionnaire



Types of Warranties

Agency	Materials and workmanship warranties	Performance warranties
British Columbia	√	√
Florida		√
Illinois	√	√
Indiana		√
Louisiana	√	√
Mississippi	√	√
Nova Scotia	√	√
Pennsylvania		√
Wisconsin		√

Warranty Items

Agency	Ride quality/ roughness	Physical distresses	Structural capacity	Safety
British Columbia	√	√	√	
Florida	√	√		
Illinois	√	√		
Indiana	√	√		√
Louisiana	√	√		
Mississippi		√		
Nova Scotia		√		
Pennsylvania	√	√		√
Wisconsin	√	√		

Protocol Used for Defining Distresses

Agency	LTPP	AASHTO	Agency Specified
British Columbia			√
Florida			√
Illinois	√		
Indiana	√	√	√
Louisiana	√		√
Mississippi	√		
Nova Scotia			√
Pennsylvania			√
Wisconsin			√

Pavement Distress Data Collection Cycle

Agency	Annual	Biennial	Others
British Columbia		√	√
Florida	√		
Illinois			√
Indiana	√		
Louisiana			√
Mississippi	√		
Nova Scotia	√	√	
Pennsylvania	√		
Wisconsin		√	

Distress Data Items and Data Collection Technologies

Distress Type		British Columbia	Florida	Illinois	Indiana	Louisiana	Mississippi	Nova Scotia	Pennsylvania	Wisconsin
Cracking	Manual	√	√	√	√	√		√	√	√
	Film Video					√	√			√
	Digital Image			√		√		√	√	√
Rut-Depth	Three Sensor		√		√		√	√		
	Scanning Laser	√		√		√				√
	Five Sensor					√				√
Joint-Faulting	Ultrasonic						√	√		
	Laser			√		√				√
	Handheld fault meter				√	√	√		√	

Composite Index for Pavement Condition Rating

Agency	Pavement Distress Index PDI	Ride quality or roughness	Pavement Condition Rating PCR	Overall Pavement Index OPI
British Columbia		√		
Florida				
Illinois		√		
Indiana				
Louisiana	√	√	√	
Mississippi	√	√	√	
Nova Scotia	√	√		
Pennsylvania				√
Wisconsin	√			

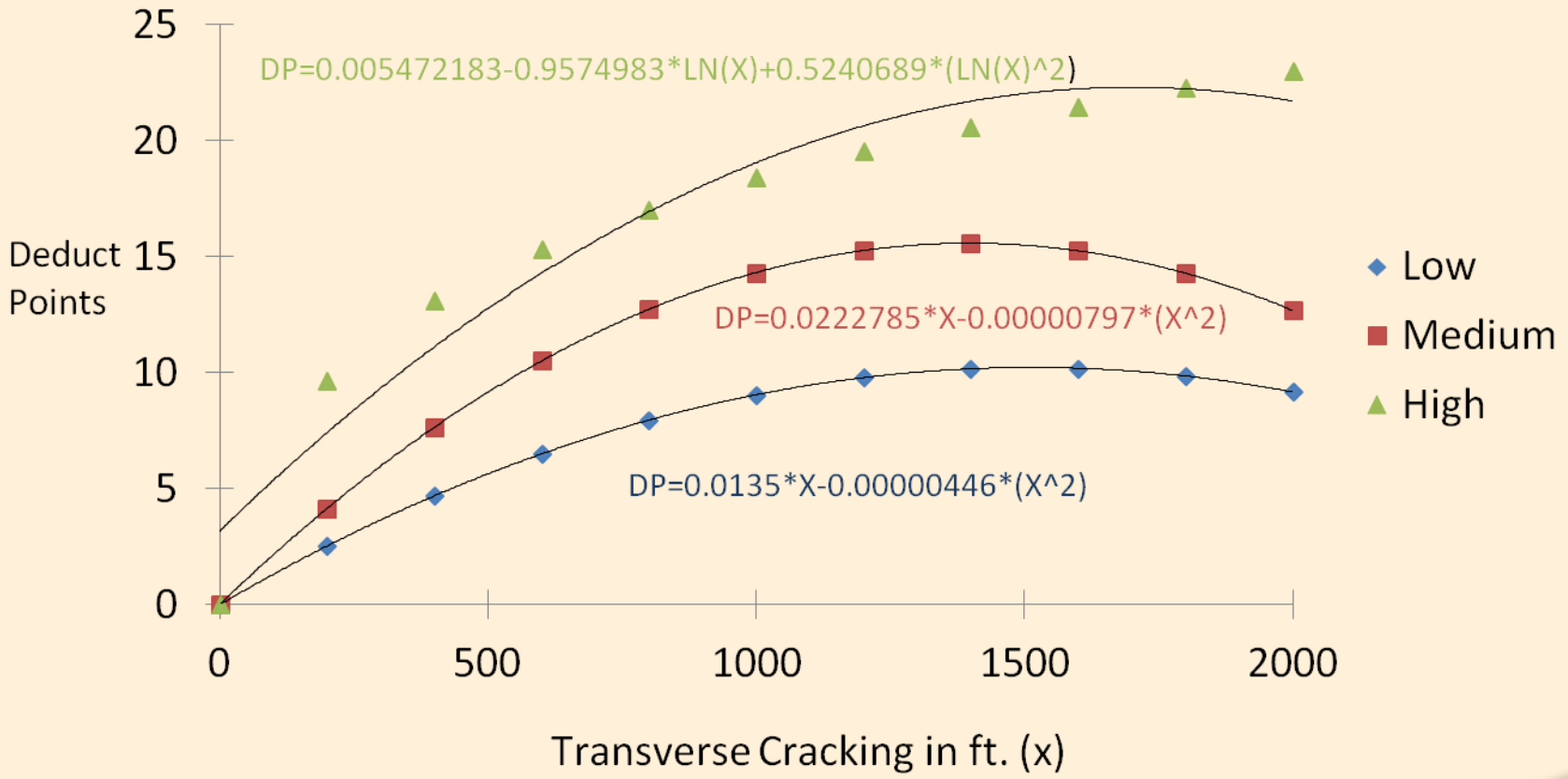
Introduction – Literature Review

- **Studies in other states**
- **MDOT needs**

MDOT Pavement Warranty Program

- Physical distresses
  - 20 items on cracking, surface deformation, and surface defects
- 5-10 yr periods
- Annual data collections on 0.1 mi sections
- MS Distress Identification Manual
- Empirical deduct point curves and thresholds
- Ride quality (IRI) monitoring

Deduct Point Curve for Flexible Transverse Cracking



Distress Type, Threshold Level, and Remedial Action for Asphalt Pavement

DISTRESS TYPE	THRESHOLD LEVELS (Deduct Points)	REMEDIAL ACTION
Alligator Cracking	10.0	Remove and replace distressed layers, the area to be equal to 150% of the distressed area to a depth not to exceed the warranty pavement
Block Cracking	3.0	Remove and replace distressed layers, the area to be equal to 110% of the distressed area to a depth not to exceed the warranty pavement
Reflection Cracking	9.0	Seal cracks according to the current Department Specifications
Edge Cracking	3.0	Remove and replace the distressed layers, the area to be equal to 110% of the distressed area
Longitudinal Cracking	4.0	Remove and replace distressed layers to a depth not to exceed the warranty pavement
Transverse Cracking	3.0	Remove and replace distressed layers to a depth not to exceed the warranty pavement
Potholes	5.0	Remove and replace distressed layers, the area to be equal to 150% of the distressed area to a depth not to exceed the warranty pavement
Rutting	5.0	Remove and replace the surface layer
Raveling/Segregation	0.2	Apply a chip seal or a partial depth repair
Surface Bleeding	0.4	Remove and replace surface distressed area mixture full depth
Friction	35	Milling, surface treatment, or overlay to correct inadequacy

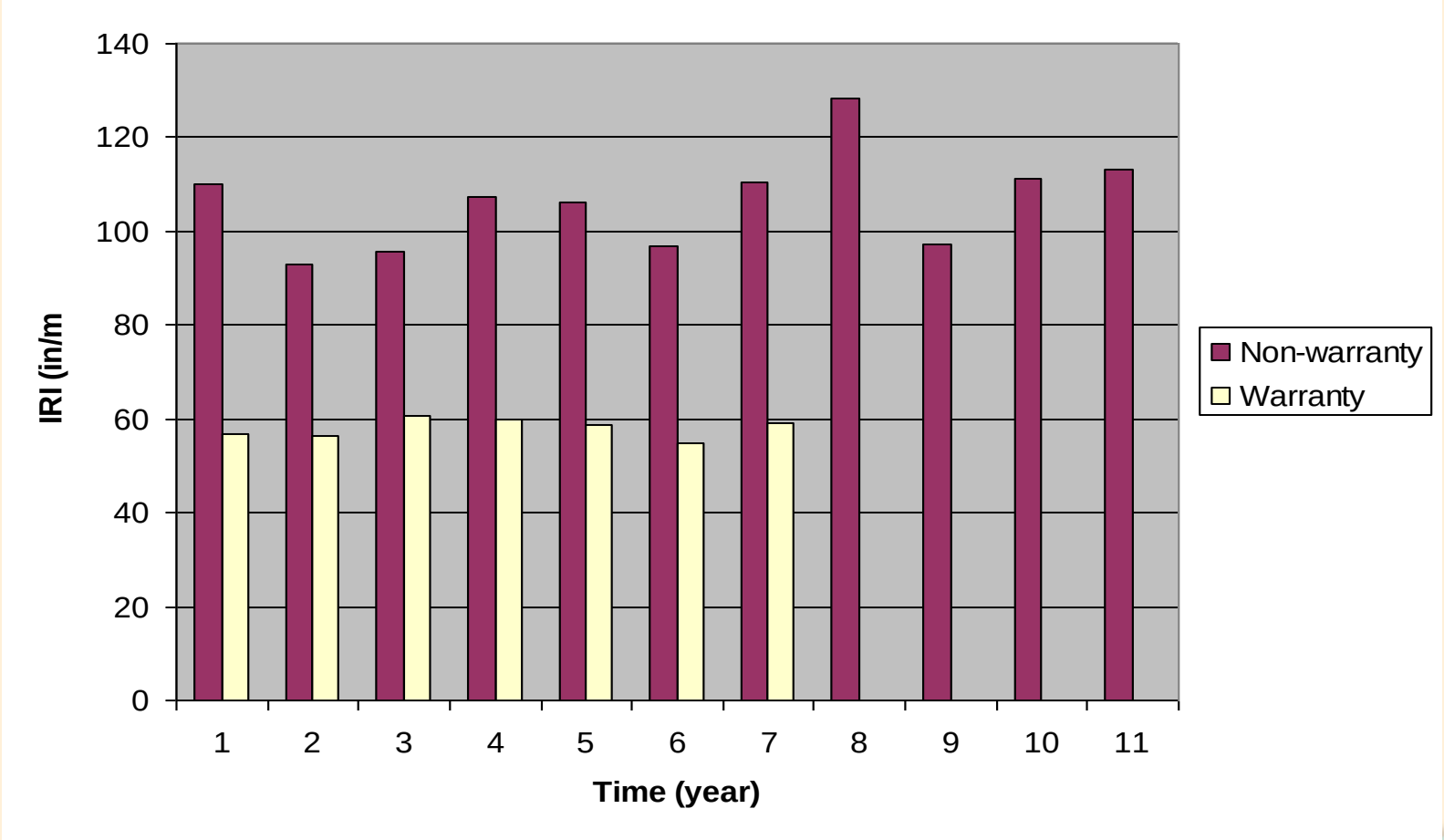
Distress Type, Threshold Level, and Remedial Action for Concrete Pavement

DISTRESS TYPE	THRESHOLD LEVELS (Deduct Points)	REMEDIAL ACTION
Corner Breaks	4.3	Saw and square affected area; place dowels on transverse joints
Faulting of Transverse Joints	2.7	Diamond Grind - ensure positive drainage
Joint Seal Damage	1.66	Seal according to current MDOT policy
Longitudinal Cracking single crack	1.4	Stitch and Seal according to current MDOT policy
Transverse Cracking, single crack	1.97	Retrofit 3 dowels per wheel path; seal entire crack
multiple cracks involved	3.5	according to current MDOT policy
Spalling of Longitudinal Joints	1.15	Clean (hydro-blast, sandblast or other) and fill
Spalling of Transverse Joints	4.4	Clean (hydro-blast, sandblast or other) and fill
Map Cracking & Scaling	1.77	Thin overlay with material that has good adhesion to concrete

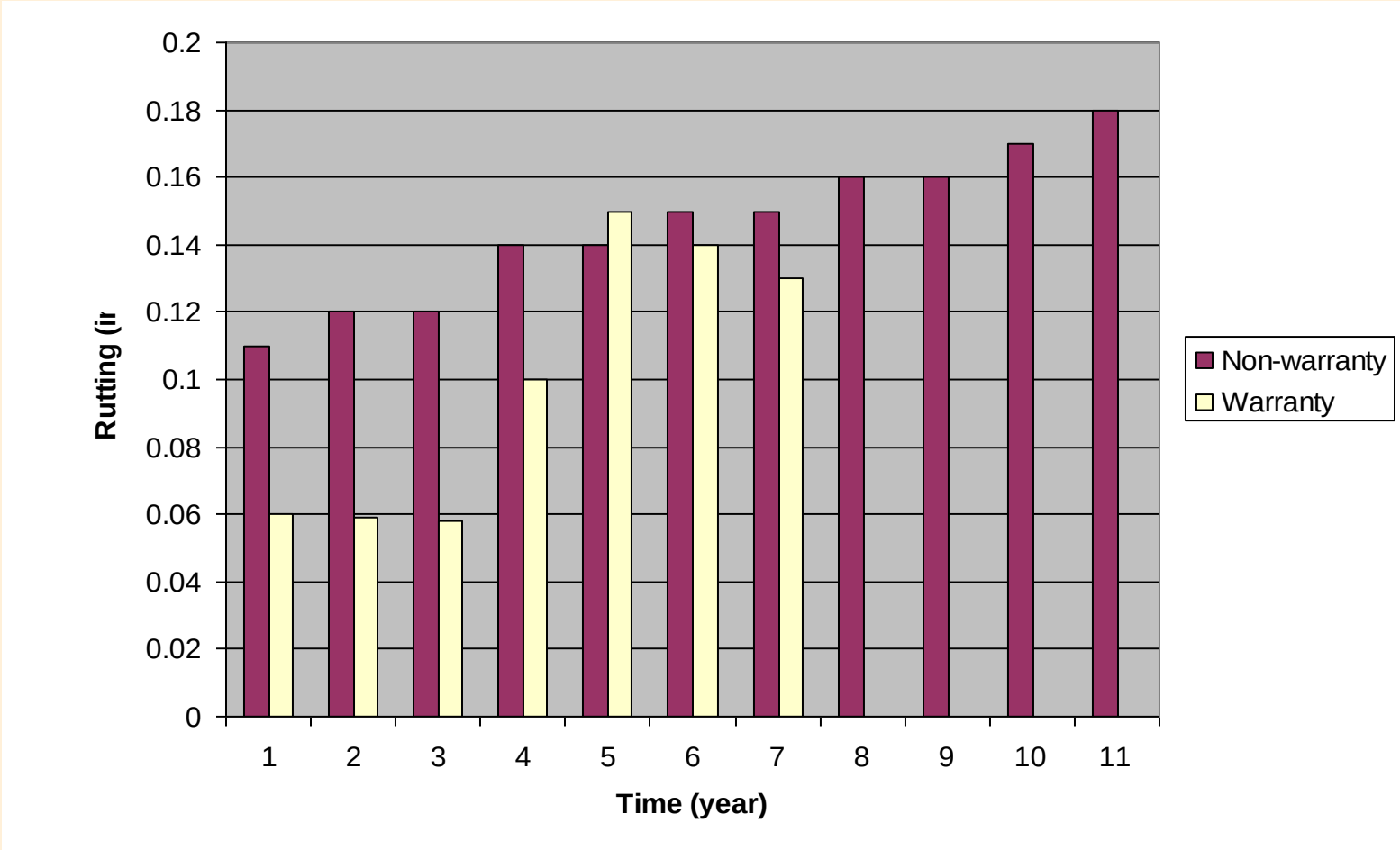
Effectiveness Study -- Method

- Warranty data vs. non-warranty data
- Statistical analyses
  - Basic Statistics summaries of MOES
  - Pairwise Comparison along time
  - Two-sample T-tests over fixed times

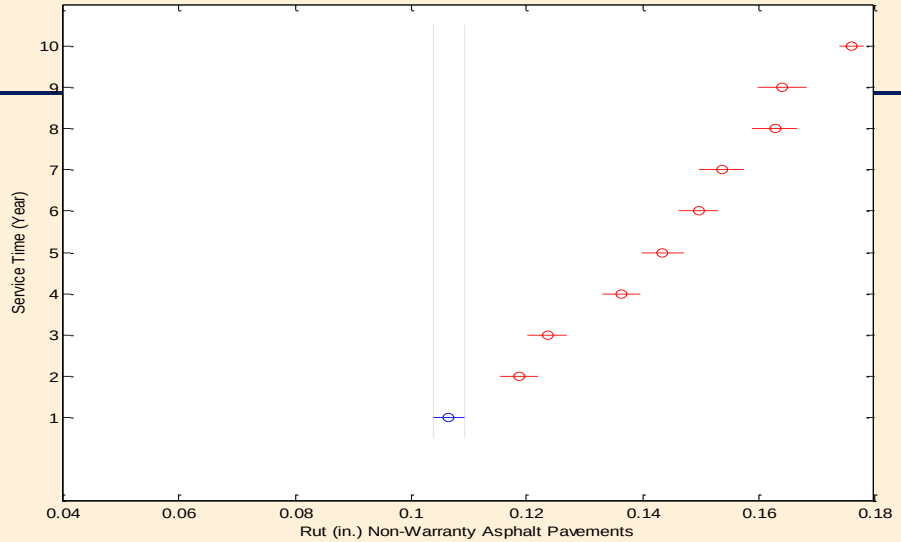
IRI of Asphalt Pavements under Warranty vs. Non-warranty over Time

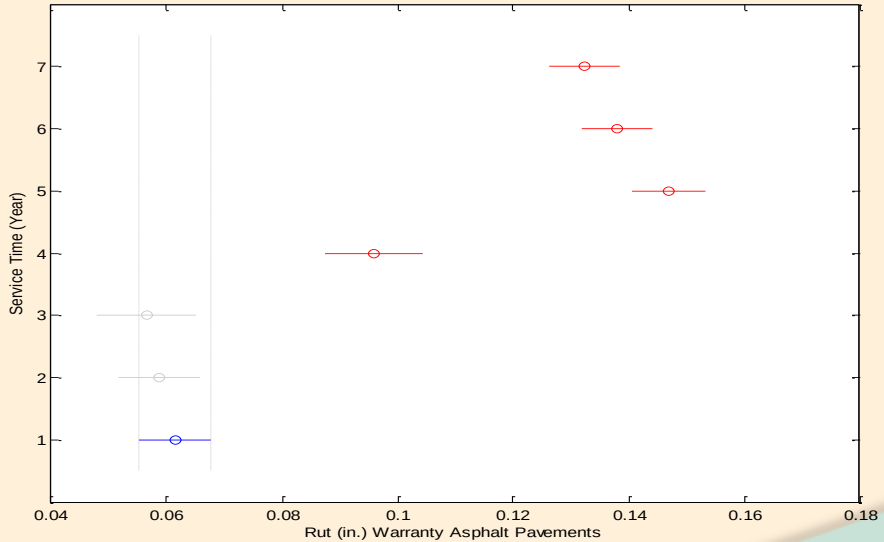


Rutting of Asphalt Pavements under Warranty vs. Non-warranty over Time



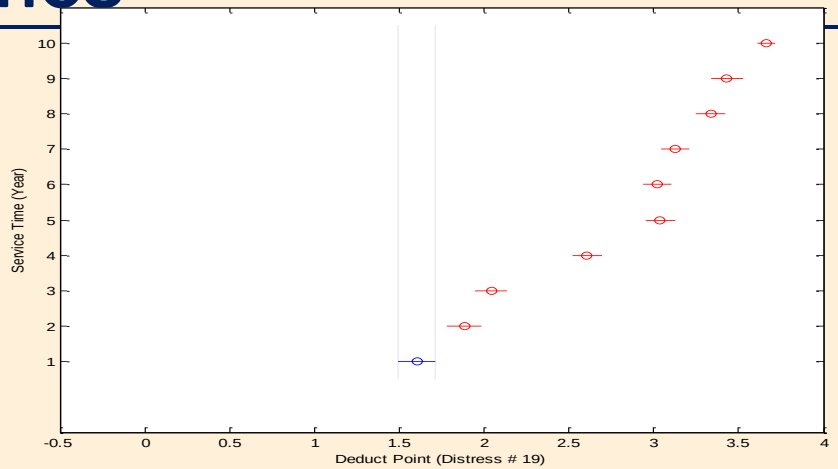
Pairwise comparison of ruttings at different service times for non-warranty vs. warranty pavements

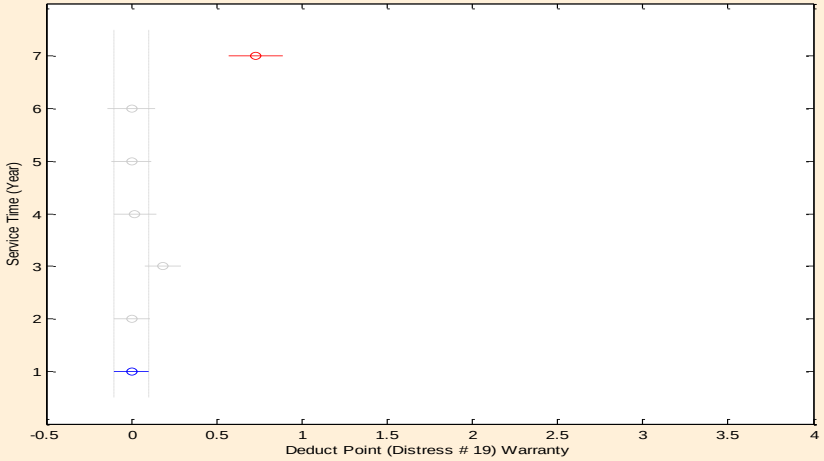




Pairwise comparison of alligator crackings at different service times

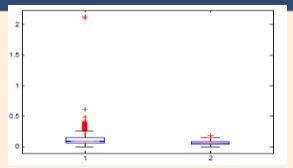
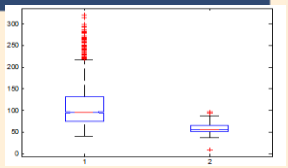
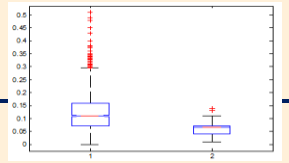
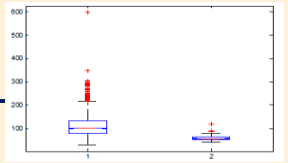
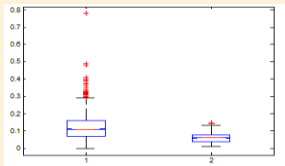
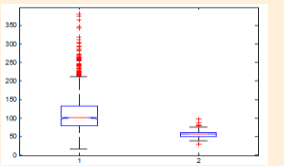
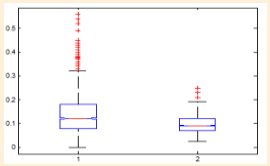
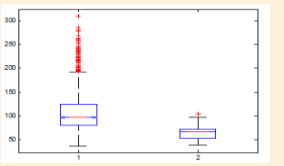
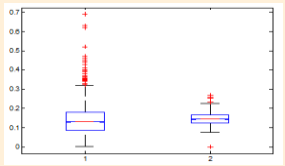
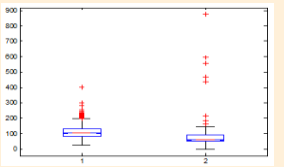
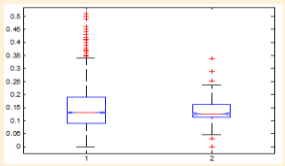
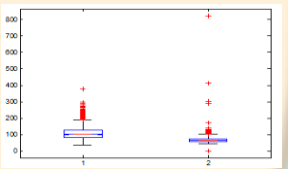
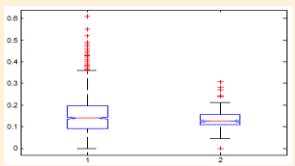
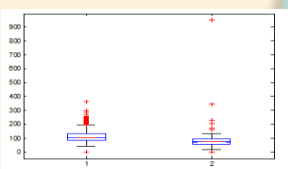
for non-warranty vs. warranty pavements





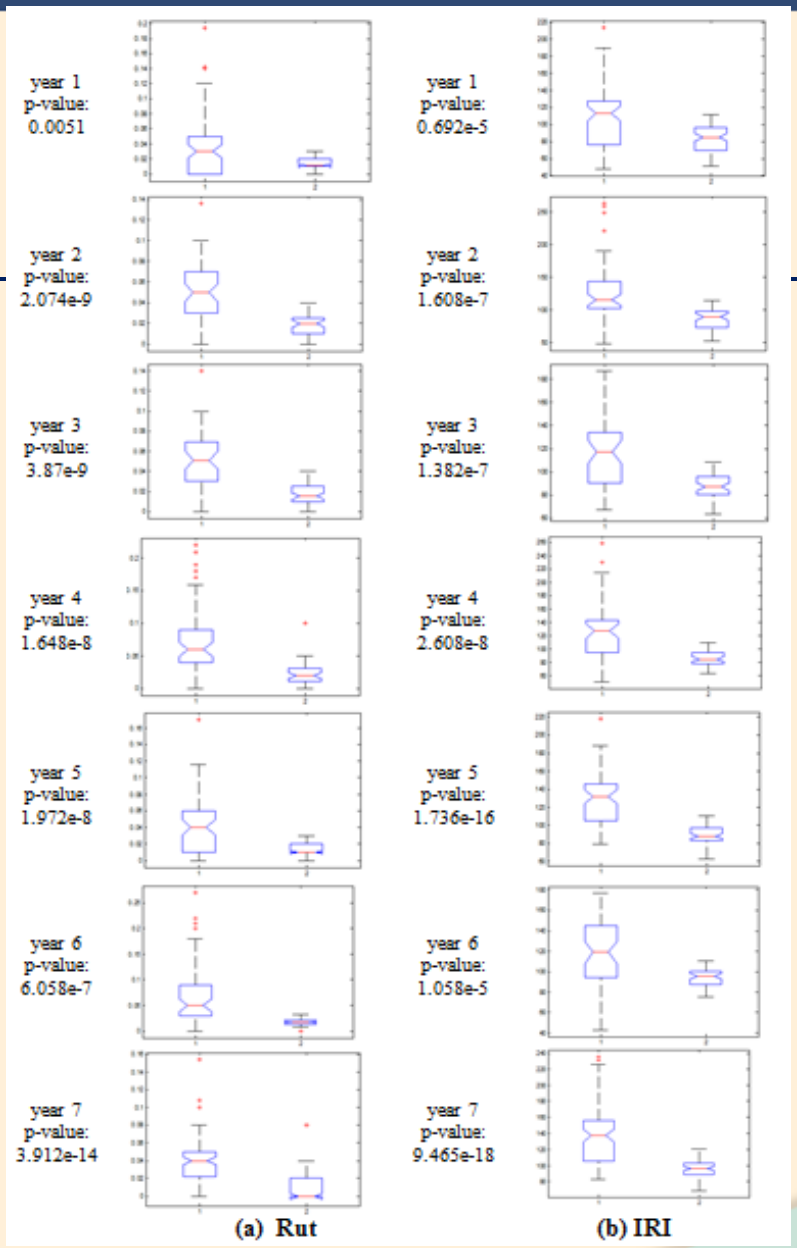
Two-Sample T Tests for Asphalt Pavements

(Group1: non-warranty pavements
Group2: warranted pavements.)

year 1 p-value: 2.643e-12		year 1 p-value: 2.236e-42	
year 2 p-value: 4.813e-22		year 2 p-value: 4.813e-22	
year 3 p-value: 1.870e-18		year 3 p-value: 5.45e-28	
year 4 p-value: 1.013e-6		year 4 p-value: 4.99e-24	
year 5 p-value: 0.5605		year 5 p-value: 1.204e-8	
year 6 p-value: 0.211		year 6 p-value: 3.819e-20	
year 7 p-value: 0.0033		year 7 p-value: 1.936e-16	

Two-Sample T Tests for Concrete Pavements

(Group1 :non-warranty pavements
Group2:warranted pavements.)



Warranty and non-warranty sections of highway US 49 in Simpson County after 4 years of service

Conclusions

- The distress values of non-warranty pavements are generally lower than those of warranty pavements
- The deterioration speed of warranty pavements is slower than non-warranty pavements
- The performance of warranty pavements is better than non-warranty pavement for both pavement types
- IRI is recommended for new warranty item

Future Work

- **Appropriateness of existing threshold values**
- **Cost effectiveness study**

Acknowledgment

- Mississippi Department of Transportation (MDOT) funds the study
- Special thanks to Cindy Smith, and Marta Charria, James Watkins, and Randy Battey

Thank You!