Reducing Readmission Risk using Predictive Analytics

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Sr. Data Scientist Advanced Analytics | Dell Services

Leo currently works on statistical modeling, experimental design, data mining, and machine learning for Dell internal and external clients in the Dell digital business at Dell Service.

He created multiple advanced analytical solutions to complex business problems in healthcare, social media, education, and financial services areas for the past 3 years at Dell Service. Sudheen Kumar, MBA

Global Healthcare Analytics Leader Advanced Analytics | Dell Services

Sudheen heads the healthcare advanced analytics practice at Dell Services, working with a group data scientists who are primarily focused around solving the challenges of the healthcare industry in the realm of predictive and prescriptive analytics.

Sudheen spent over 15 years working at Kaiser Permanente and was responsible for Analytics Strategy, Regulatory Reporting, TJC, Operational Reporting to name a few. Most recently Sudheen led the Big Data adoption effort at Kaiser Permanente prior to joining Dell.





- Data Science at Dell Services
- The Readmission Problem
- Proof of concept to develop Advanced Statistical Model & Machine Learning algorithms



Dell Advanced Analytics & Data Scientists: proven market expertise



Dell began providing enterprise-level business intelligence (BI) and analytics solutions — backed by strong, integrated business domain knowledge, global delivery and center of excellence teams



500+

business analysts, data scientists, data modelers, web analysts technologists and statisticians across the globe, focused on delivering insights and business impact

40+

proprietary solutions across multiple verticals and functional areas; Strong partnerships and alliances

6

451 Research

patents filed by a talented resource pool of specialists with doctorates, master's degrees and Black Belt certifications



THE FRANZ EDELMAN AWARD Achievement in Operations Research

Dell was chosen as a finalist for the **2013 Franz Edelman** Award for retail transformation through analytics.

Solutions spanning across multiple industries and functions



Featured by



Sales and marketing | Supply chain | Financials | Ecommerce services Social media | Product and pricing | Digital Analytics | Omni Channel



Dell is a member of and a premier underwriter for the **International Institute of Analytics.**

What are Hospital Readmissions?

30-Day Hospital Readmission

A hospital readmission is when a patient who had been discharged from a hospital is admitted again to that hospital or another hospital within 30 days.

Reasons of Hospital Readmission

- Patients Higher propensity to get readmission by old age, heart failure, diabetes, etc.
- 2. Hospitals Incomplete treatment, poor quality care, poor transitions, poor coordination of services, etc.
 - Others Social issues, etc.





Why Hospital Readmissions is One of the Biggest Issues?



2011 (USA) \$387 billion for hospital stays \$41.3 billion readmission costs 8-18% readmission rates 3,3 million readmissions Readmissions = 11% hospital stays cost



Nationwide 30-day readmission rates



Why Hospital Readmissions is One of the Biggest Issues?

§3026	 <u>Community Based Care Transitions</u> Started in FY 2011
§3501	 <u>AHRQ Center for Quality Improvement and Safety</u> AHRQ funding for projects related to QI research and technical assistance. Topics identified include reducing readmissions. For Period FY 2011-2014
§399KK	 <u>Quality Improvement Program for Hospitals with a High</u> <u>Severity Adjusted Readmissions</u> March 2012 Program for eligible to work with Patient Safety Organizations
§3025	 <u>Hospital Readmissions Reduction Program</u> Beginning in FY 2013 Hospitals with higher than expected readmissions rates will experience decreased payments for Medicare discharges
§1886	 <u>Hospital Based Value Purchasing</u> Beginning in FY 2013 Hospitals with poor performance indicators will experience decreased payments for Medicare discharges

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Why Hospital Readmissions is One of the Biggest Issues?



Dell 30-Day Hospital Readmission POC

 Develop advanced statistical models and machine learning algorithms, producing actionable insights for hospitals

POC

• Develop a real world Business intelligence interface with advanced analytical solutions



Data



DELL

Dell 30-Day Hospital Readmission Solution

Hospital **Statistical Feature Selection Insights & Impact Readmission Data** Modeling & Machine Learning Preparation Model Algorithm Data H original H original 0 X DATA PREPARATION





SAS and R/Python Integration







Motivation

- Can create hybrid data science and machine learning solutions
- The requests from customers, especially for small business clients
- Don't want to convert the existing R code to SAS
- Want to use one or more of a large number of R/Python packages, such as packages for machine learning

Calling R from SAS/IML

- From 2009 (SAS 9.2 or above), it is possible to call R from SAS/IML
- Levels of Integration
 - Submit R statement
- *II.* Transfer between SAS and R data structures
- III. Call an R analysis from IMLPlus
- IV. Call R packages and graphics from IMLPlus
- The integration isn't available with all SAS installation

Call R and Python from base SAS

- SAS shared a method to call R, Python, and other open source tools from base SAS in 2015
- Install a Java class, then use SAS java object in data step to call R and Python scripts
- <u>https://github.com/sassoftware/enlighten-integration</u>

data_null; length rtn_val 8; *** Fython program takes working directory as first argument; python_ggm = "&WORK_DIR.\digitsdata_avm.py"; python_arg1 = "&WORK_DIR"; python_call = cat('"', trim(bython_pgm), '" "', trim(python_arg1),'"'); declare javaobj j("dev.SASJavaExec", "&FYTHON_EXEC_COMMAND", python_call); j.callIntMethod("executeProcess", trn val);

run;



Data Preparation





Baselines



Text

I fell off the bed and was weak I FELT WEAK I GOT sob YESTERDAY congestive heart failure exercerbationhard to breathe MD here told us to bring him back here if he gains 5 lbs in 3 days sent by pmd at kaiser for right pleural ffusion, increase sob x 1 week pneumonia elevated tropinin patient couldn't be woken up per family and called 911 I took my blood pressure medicine and didn't feel right My legs are swollen and I was short of breath R groin pain region pain he's feet was swollen



Feature Selection

Used randomized logistic regression to evaluated relevance of features





Results





Insights – What affects risk?



- Enabling cost benefit analysis of existing solutions
- Enabling study of new solutions

Insights – Populations at risk

	122222222222222	0.0000000000000000000000000000000000000		2222222222222222	888888888888	535353535355	
Below average Ab	ove ave	erage					
duster	0	1	2	3	4	5	Average
SEX_Male	0.16	1.00	0.82	0.15	0.59	0.43	0.52
AMI	0.12	0.27	0.37	0.07	0.56	0.02	0.25
Age At Registration	79.86	77.46	75.77	76.25	79.14	80.31	77.80
Asthma (COPD)	0.05	0.00	0.10	0.47	0.05	0.10	0.15
CABG	0.52	0.86	0.87	0.84	0.96	0.14	0.74
COPD	0.75	0.91	0.51	0.72	0.40	0.15	0.58
Diabetes	0.43	0.66	0.82	0.78	0.22	0.19	0.56
MStay	1.37	1.37	1.38	1.28	1.35	0.98	1.30
Mental Disorder	0.73	0.73	0.46	0.68	0.41	0.13	0.54
Length of stay	4.86	5.19	5.30	4.53	5.02	3.22	4.76
Pneumonia	0.91	1.00	0.17	0.30	0.16	0.17	0.41
Readmittance 30_Day	0.07	0.17	0.06	0.07	0.05	0.05	0.07

Impact

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Predicting readmission risk for new patients



Questions?

References

[1] Reducing hospital readmissions. By Jenny Minott
[2] Catlin, A. et al. "National Health Spending in 2006: A Year of Change for Prescription Drugs," Health Affairs, January/February 2008, Vol. 27, No. 1, pp. 14-29.
[3] Medicare Payment Advisory Commission. 2007. Report to the Congress: Promoting Greater Efficiency in Medicare. Washington, DC: Medicare Payment Advisory Commission, p. 103.

