R For Business

Solving a **$15M/year** Employee Attrition Problem with the **tidyverse**

rstudio::conf(2019)

Matt Dancho

Business Science University

university.business-science.io

About Your Host

- Founder, Business Science
- Lover of
- Educator of Data Science

university.business-science.io

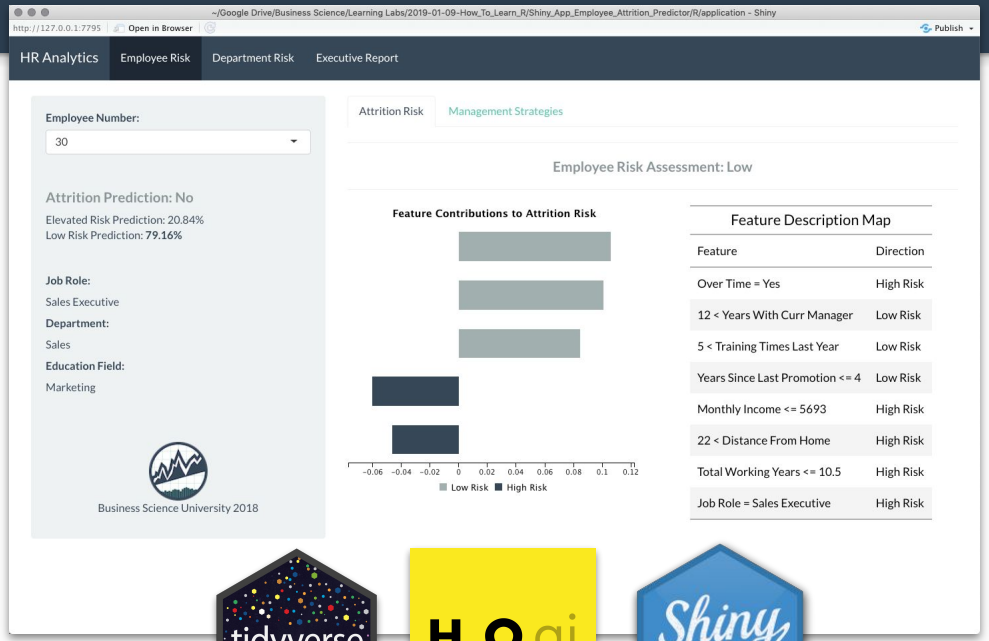
Matt Dancho

Founder of Business Science, Matt designs and executes educational courses and workshops that deliver immediate value to organizations. His passion is **up-leveling future data scientists** coming from **untraditional backgrounds**.

"I like converting Business People to Data Scientists"

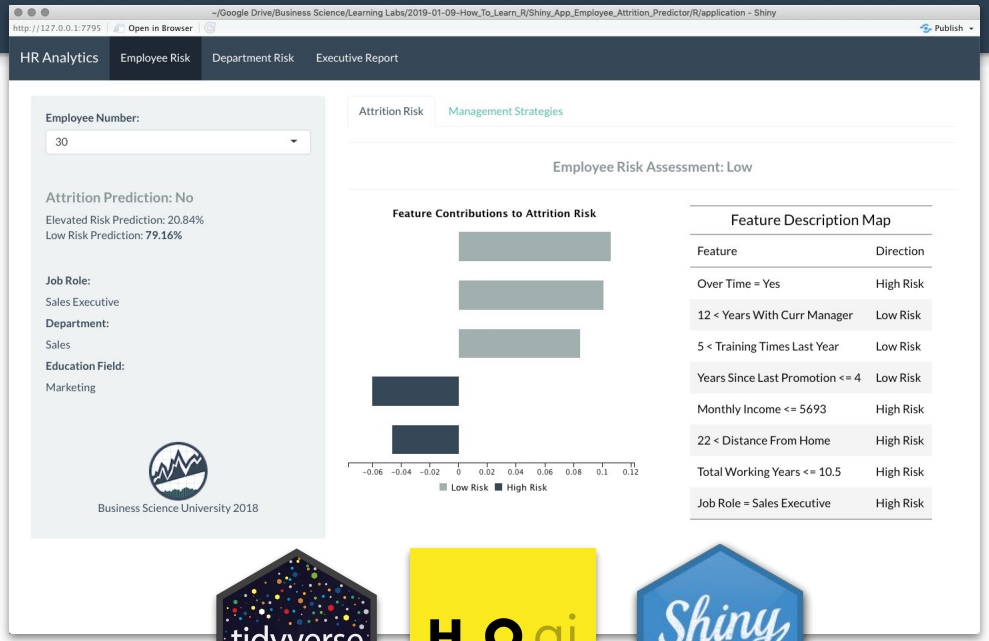
Agenda: R For Business

- $15M/Year Problem
- Shiny Web App Example
- Data Science Workflow
  - Tidyverse
  - H2O & LIME
- Learning R for Business



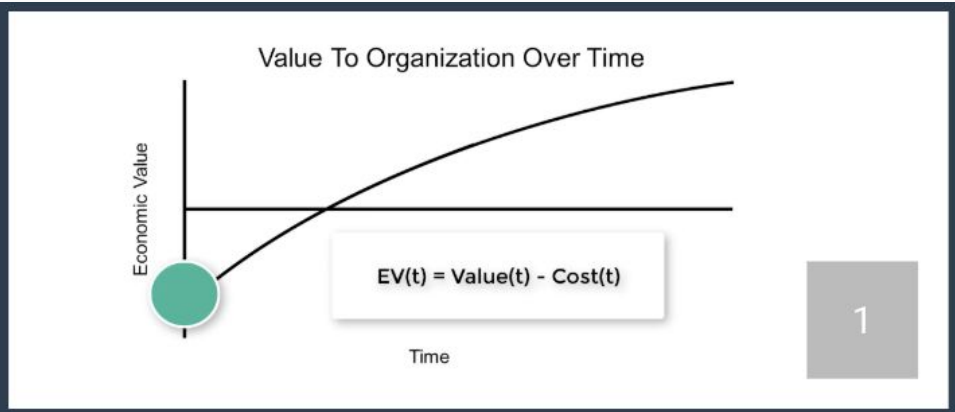
Agenda: R For Business

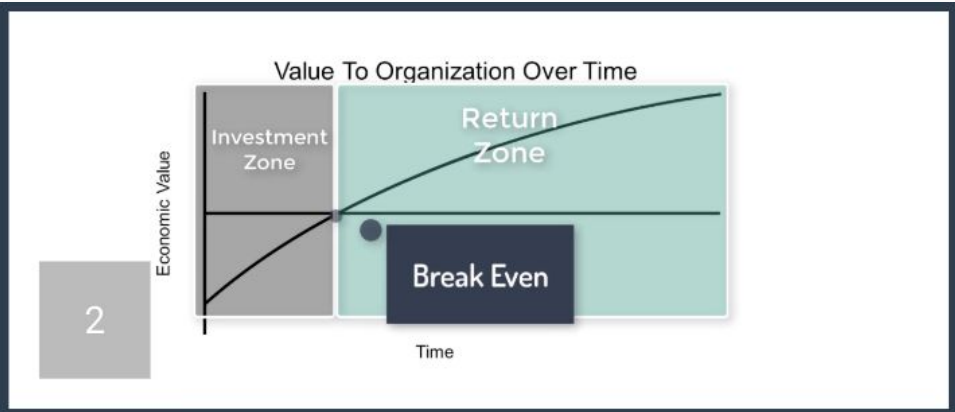
- **$15M/Year Problem**
- Shiny Web App Example
- Data Science Workflow
  - Tidyverse
  - H2O & LIME
- Learning R for Business

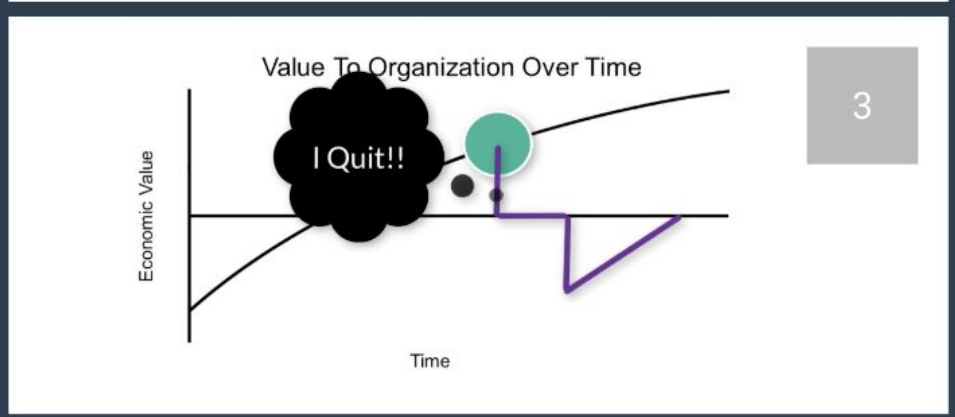


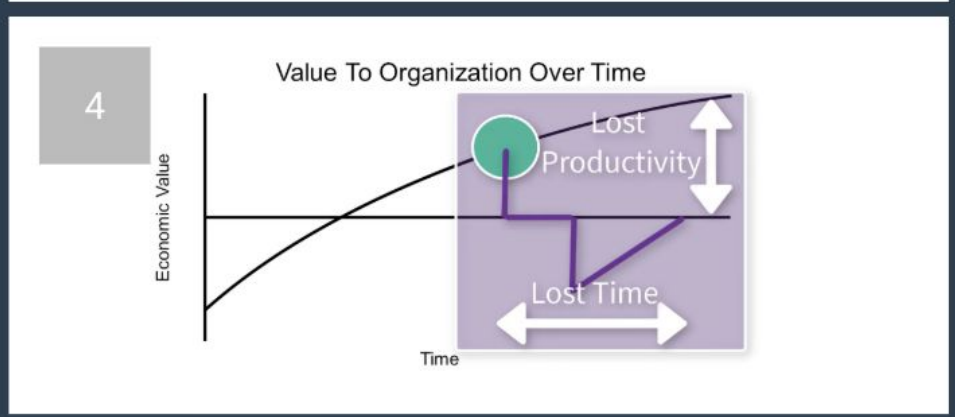

YOU TAKE AWAY OUR TOP 20 EMPLOYEES AND WE BECOME A MEDIOCRE COMPANY
- Bill Gates

Economic Value Of Employee Over Time

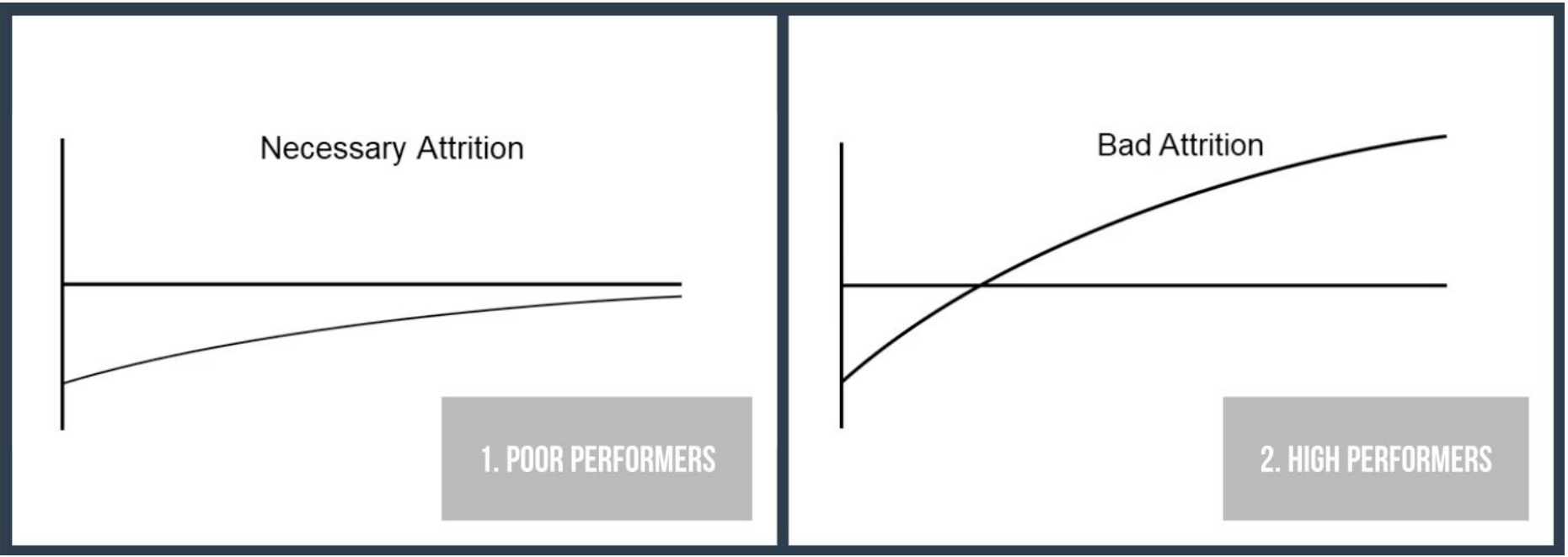








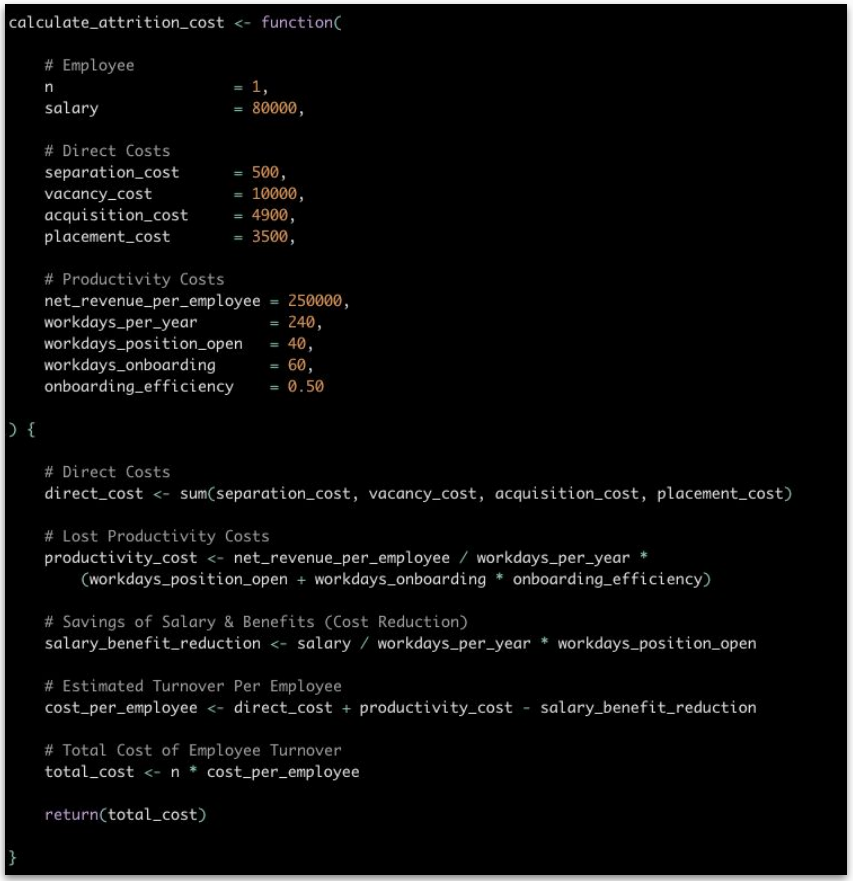
Good Attrition Vs Bad Attrition



OK to lose these employees

Save these employees if possible

Cost of Attrition



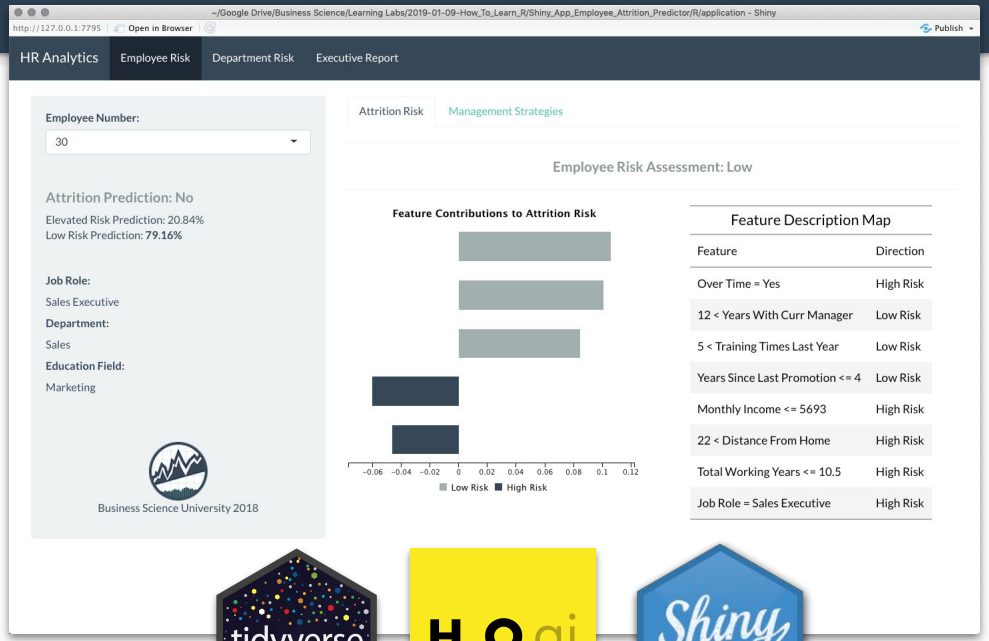
```r
calculate_attrition_cost <- function(

    # Employee
    n                   = 1,
    salary              = 80000,

    # Direct Costs
    separation_cost     = 500,
    vacancy_cost        = 10000,
    acquisition_cost    = 4900,
    placement_cost      = 3500,

    # Productivity Costs
    net_revenue_per_employee = 250000,
    workdays_per_year        = 240,
    workdays_position_open   = 40,
    workdays_onboarding      = 60,
    onboarding_efficiency    = 0.50

) {

    # Direct Costs
    direct_cost <- sum(separation_cost, vacancy_cost, acquisition_cost, placement_cost)

    # Lost Productivity Costs
    productivity_cost <- net_revenue_per_employee / workdays_per_year *
        (workdays_position_open + workdays_onboarding * onboarding_efficiency)

    # Savings of Salary & Benefits (Cost Reduction)
    salary_benefit_reduction <- salary / workdays_per_year * workdays_position_open

    # Estimated Turnover Per Employee
    cost_per_employee <- direct_cost + productivity_cost - salary_benefit_reduction

    # Total Cost of Employee Turnover
    total_cost <- n * cost_per_employee

    return(total_cost)

}
```

- **SIMPLE CALCULATION**
  - Direct costs
  - Lost Productivity
  - Savings (Salary & Benefits)
- **$78K COST / EMPLOYEE**
- **IF ORGANIZATION LOSES 200 HIGH PERFORMERS EACH YEAR...**

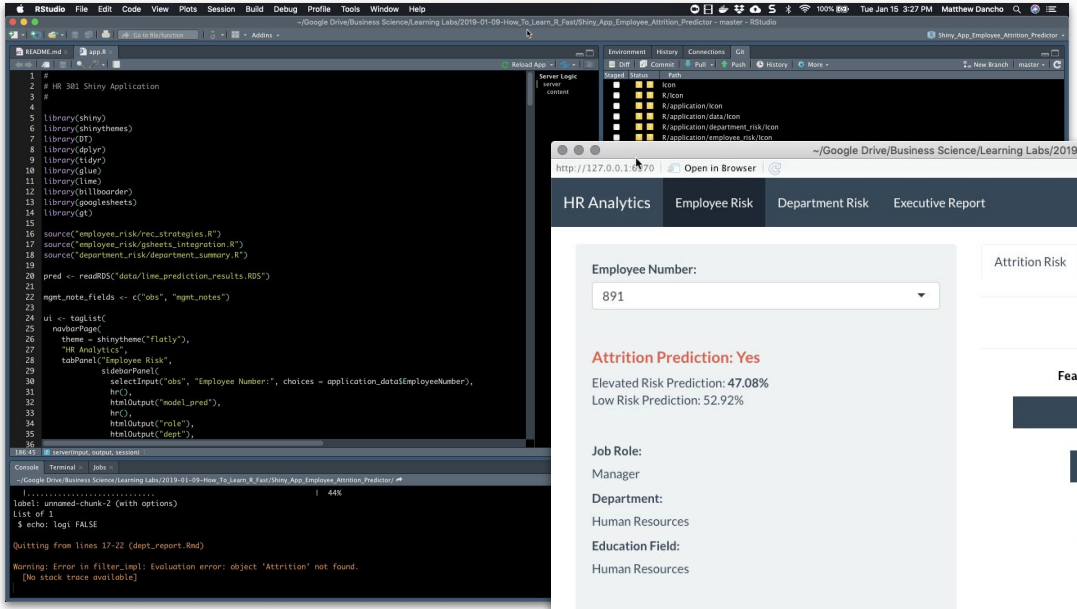

$15M / YEAR
PROBLEM

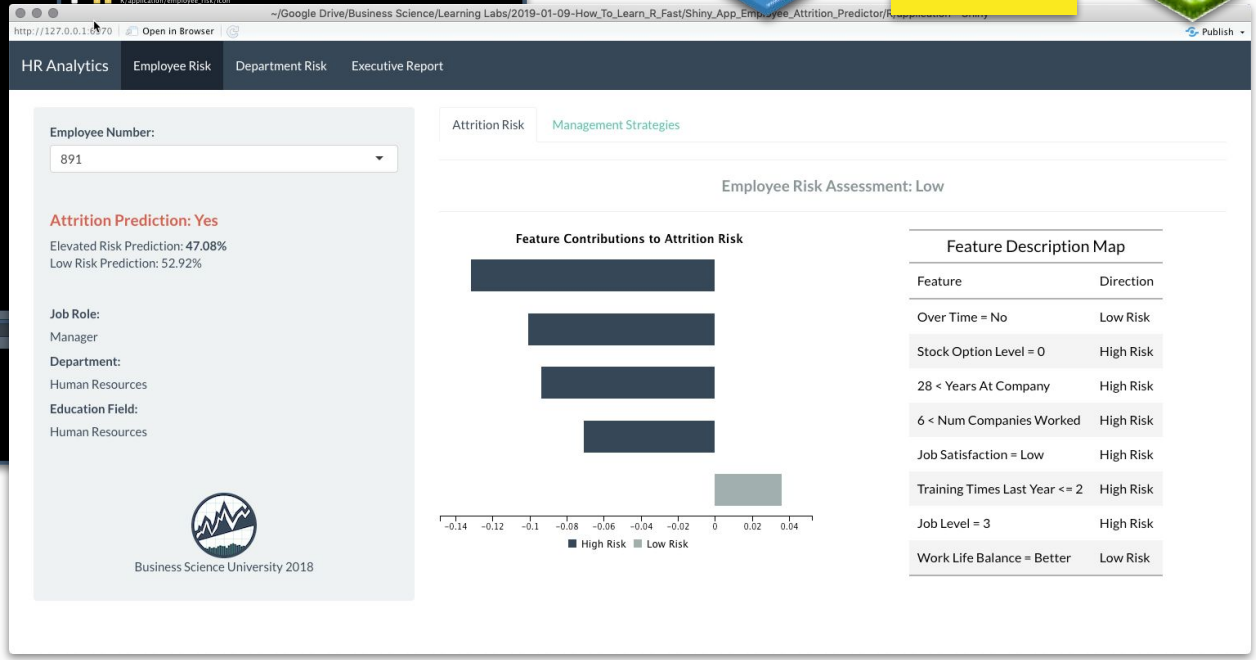
Agenda: R For Business

- $15M/Year Problem
- **Shiny Web App Example**
- Data Science Workflow
  - Tidyverse
  - H2O & recipes
- Learning R for Business

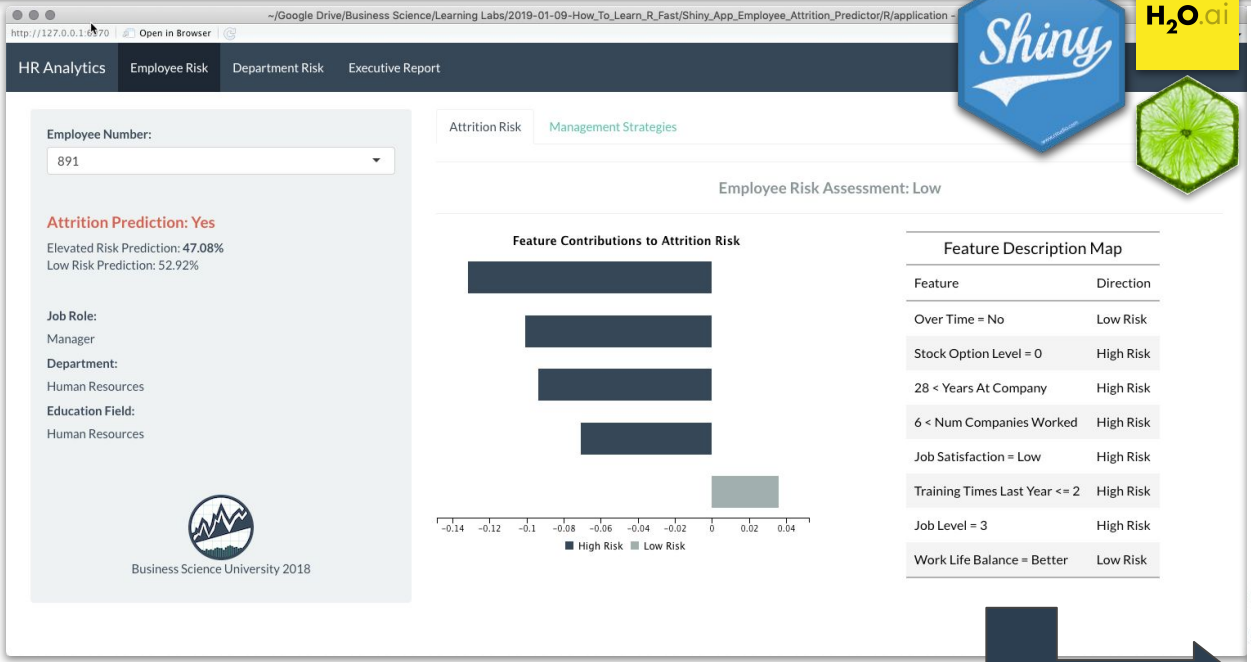


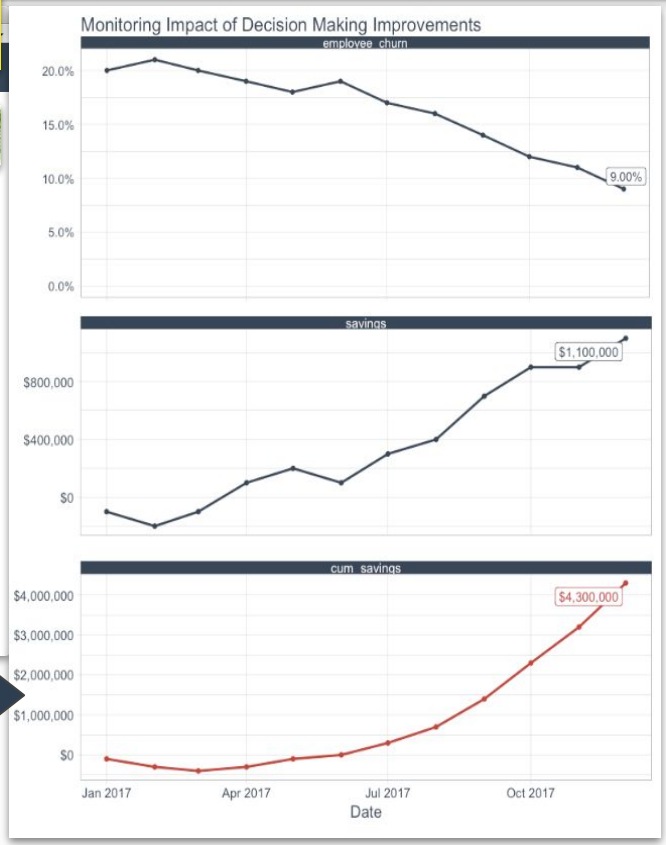
Demo Time!


RStudio File Edit Code View Plots Session Build Debug Profile Tools Window Help
Tue Jan 15 3:27 PM Matthew Dancho
README.md
app.R
Reload App
Server Logic
server
content
# HR 301 Shiny Application
library(shiny)
library(shinythemes)
library(DT)
library(dplyr)
library(tidyr)
library(glue)
library(lime)
library(billboarder)
library(googlesheets)
library(gt)
source("employee_risk/rec_strategies.R")
source("employee_risk/gsheets_integration.R")
source("department_risk/department_summary.R")
pred <- readRDS("data/lime_prediction_results.RDS")
mgmt_note_fields <- c("obs", "mgmt_notes")
ui <- tagList(
navbarPage(
theme = shinytheme("flatly"),
"HR Analytics",
tabPanel("Employee Risk",
sidebarPanel(
selectInput("obs", "Employee Number:", choices = application_data$EmployeeNumber),
hr(),
htmlOutput("model_pred"),
hr(),
htmlOutput("role"),
htmlOutput("dept"),
Console
Terminal
Jobs
label: unnamed-chunk-2 (with options)
List of 1
$ echo: logi FALSE
Quitting from lines 17-22 (dept_report.Rmd)
Warning: Error in filter_impl: Evaluation error: object 'Attrition' not found.
[No stack trace available]


~/Google Drive/Business Science/Learning Labs/2019-01-09-How_To_Learn_R_Fast/Shiny_App_Employee_Attrition_Predictor/R
http://127.0.0.1:6570
Open in Browser
Publish
HR Analytics
Employee Risk
Department Risk
Executive Report
Employee Number:
891
Attrition Prediction: Yes
Elevated Risk Prediction: 47.08%
Low Risk Prediction: 52.92%
Job Role:
Manager
Department:
Human Resources
Education Field:
Human Resources
Business Science University 2018
Attrition Risk
Management Strategies
Employee Risk Assessment: Low
Feature Contributions to Attrition Risk
−0.14 −0.12 −0.1 −0.08 −0.06 −0.04 −0.02 0 0.02 0.04
High Risk
Low Risk
Feature Description Map
Feature
Direction
Over Time = No
Low Risk
Stock Option Level = 0
High Risk
28 < Years At Company
High Risk
6 < Num Companies Worked
High Risk
Job Satisfaction = Low
High Risk
Training Times Last Year <= 2
High Risk
Job Level = 3
High Risk
Work Life Balance = Better
Low Risk

Cause & Effect

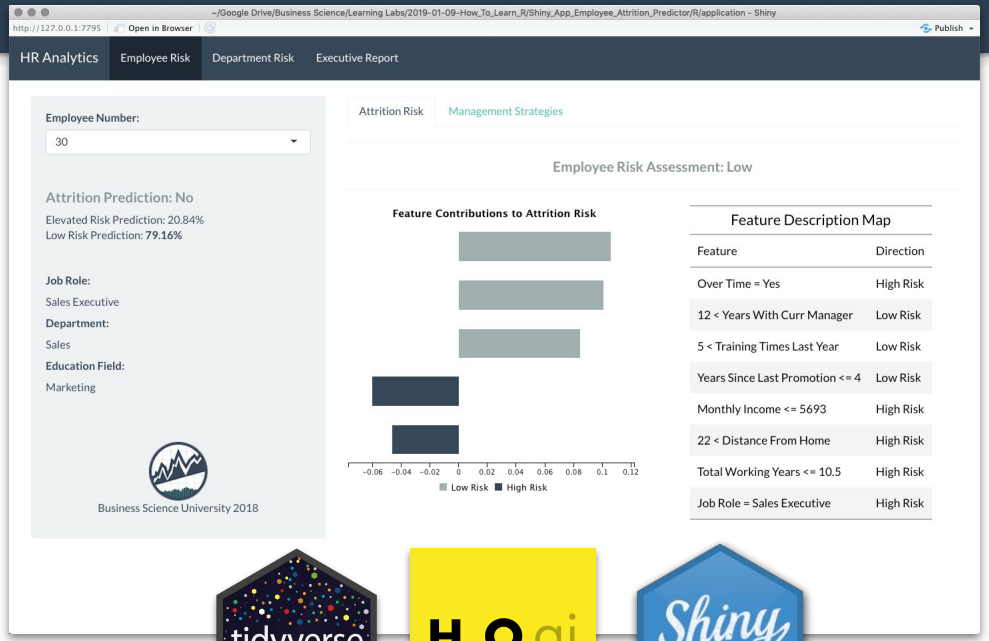




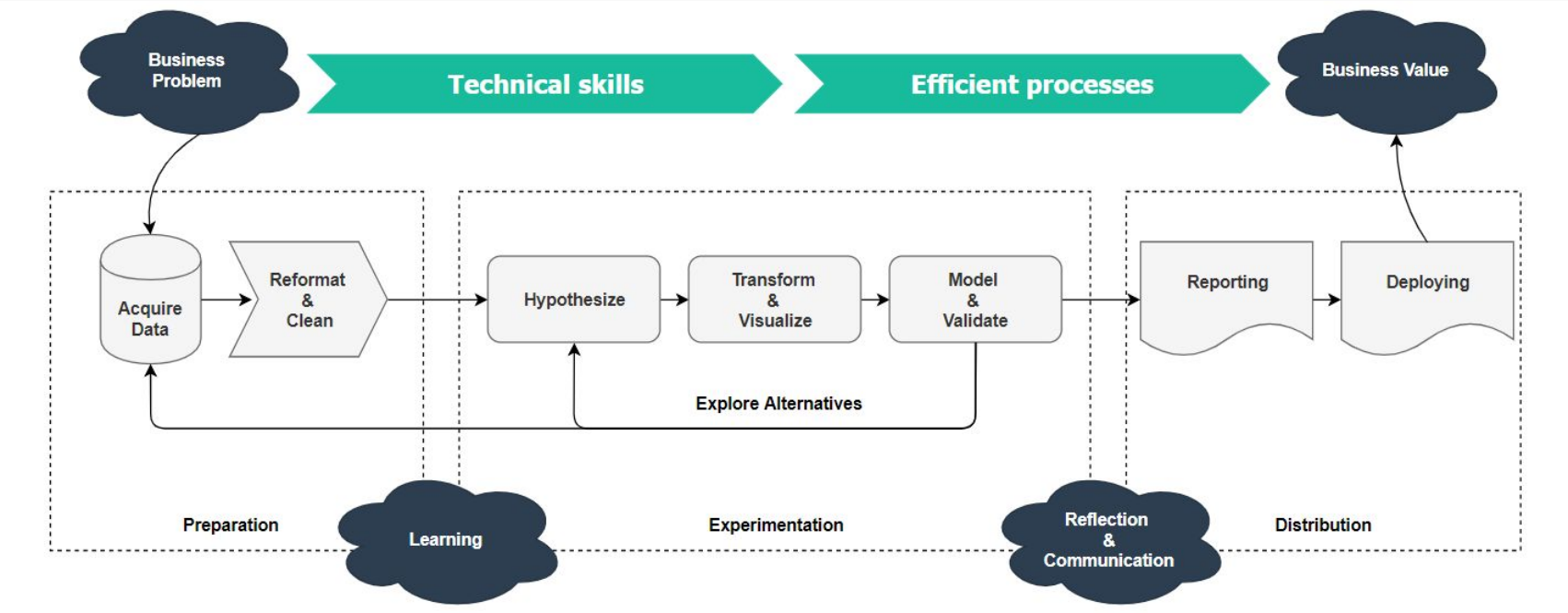
THE "BETTER DECISION-MAKING" EFFECT

Agenda: R For Business

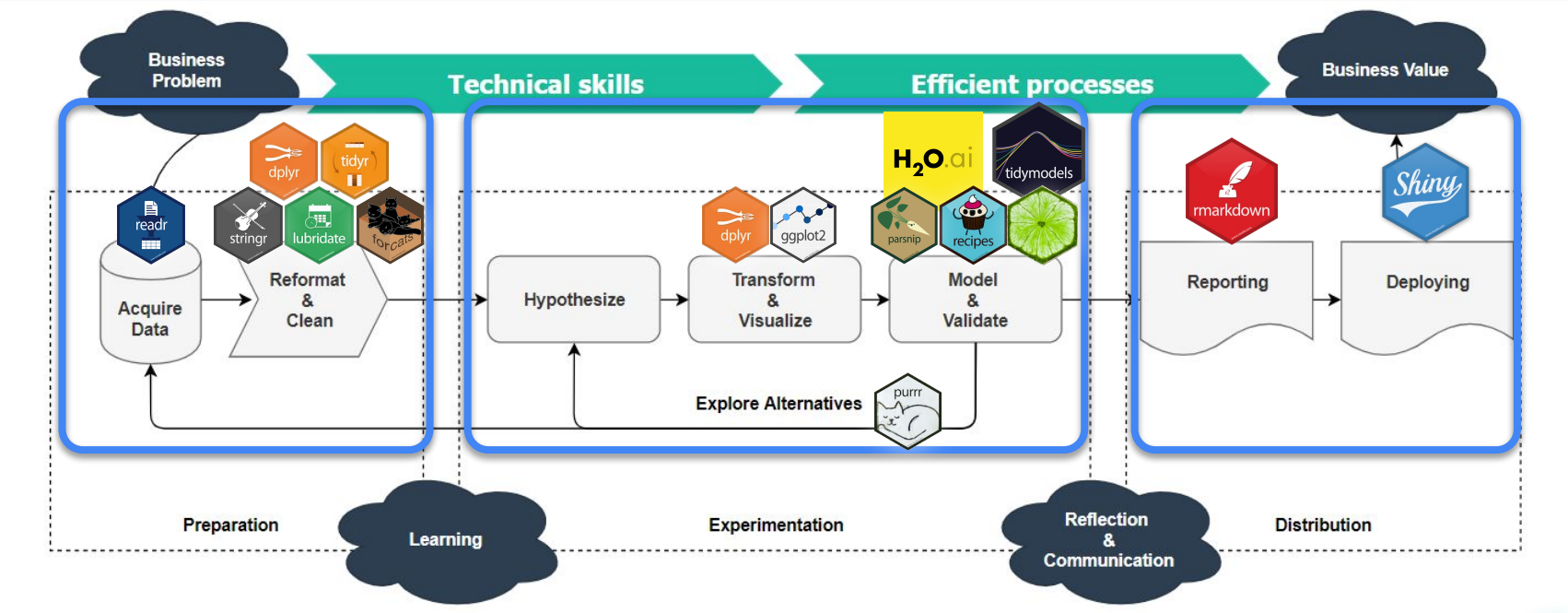
- $15M/Year Problem
- Shiny Web App Example
- **Data Science Workflow**
  - **Tidyverse**
  - **H2O & LIME**
- Learning R for Business



Data Science Workflow



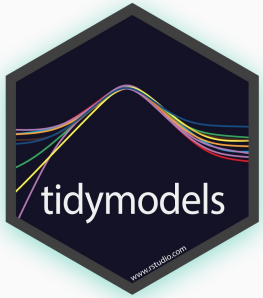
Data Science Workflow



R Just Fits!

Data Science Toolchain

Data Science Workflow



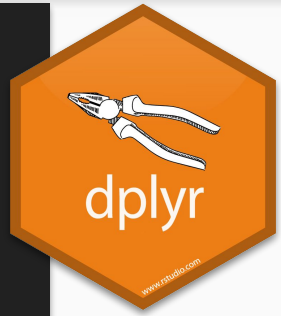
The R Toolchain

Data Science Workflow

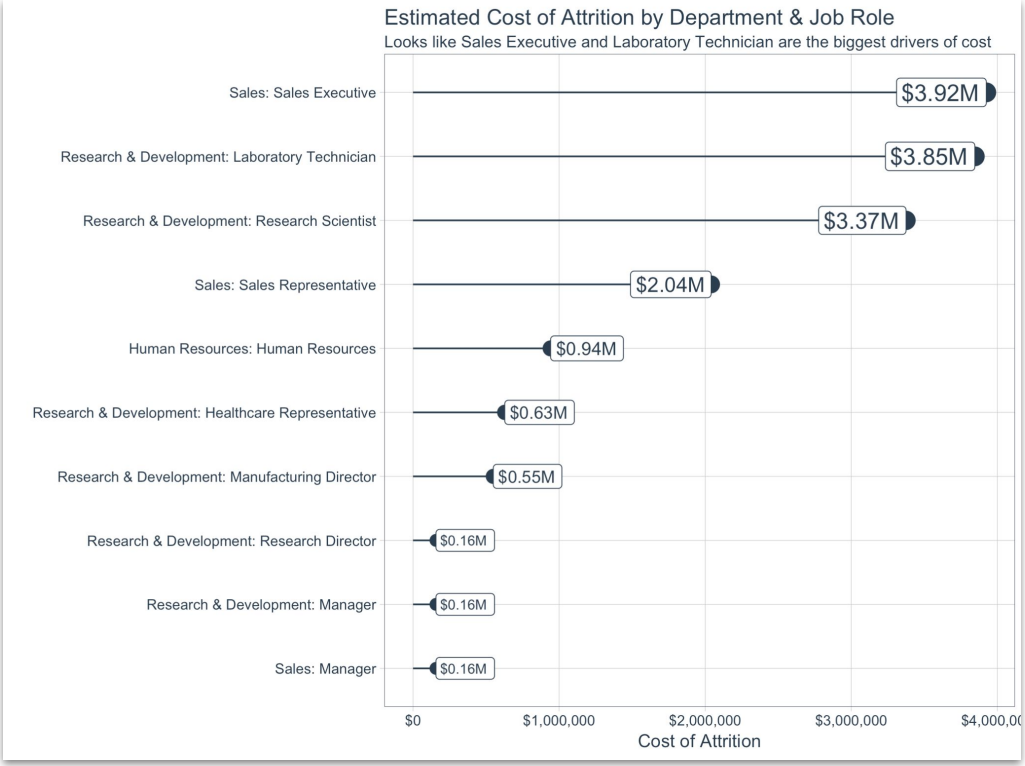
```
# 1C. Measure The Drivers ----

# Collect Information on Employee Attrition: On going

# Develop KPI's: Industry KPIs: 8.8%

dept_job_role_tbl %>%

    count(Department, JobRole, Attrition) %>%

    count_to_pct(Department, JobRole) %>%

    assess_attrition(Attrition, attrition_value = "Yes", baseline_pct = 0.088) %>%

    mutate(
        cost_of_attrition = calculate_attrition_cost(n = n, salary = 80000)
    )
```

Department <chr>	JobRole <chr>	Attrition <chr>	n <int>	pct <dbl>	above_industry_avg <chr>	cost_of_attrition <dbl>
Sales	Sales Representative	Yes	26	0.40000000	Yes	2040566.7
Human Resources	Human Resources	Yes	12	0.30769231	Yes	941800.0
Research & Development	Laboratory Technician	Yes	49	0.21875000	Yes	3845683.3
Sales	Sales Executive	Yes	50	0.18315018	Yes	3924166.7
Research & Development	Research Scientist	Yes	43	0.16602317	Yes	3374783.3
Research & Development	Healthcare Representative	Yes	8	0.07619048	No	627866.7
Sales	Manager	Yes	2	0.06451613	No	156966.7
Research & Development	Manufacturing Director	Yes	7	0.05691057	No	549383.3
Research & Development	Manager	Yes	2	0.04166667	No	156966.7
Research & Development	Research Director	Yes	2	0.02739726	No	156966.7

1–10 of 10 rows



Size the Problem



Visualize Attrition Cost

Data Science Workflow

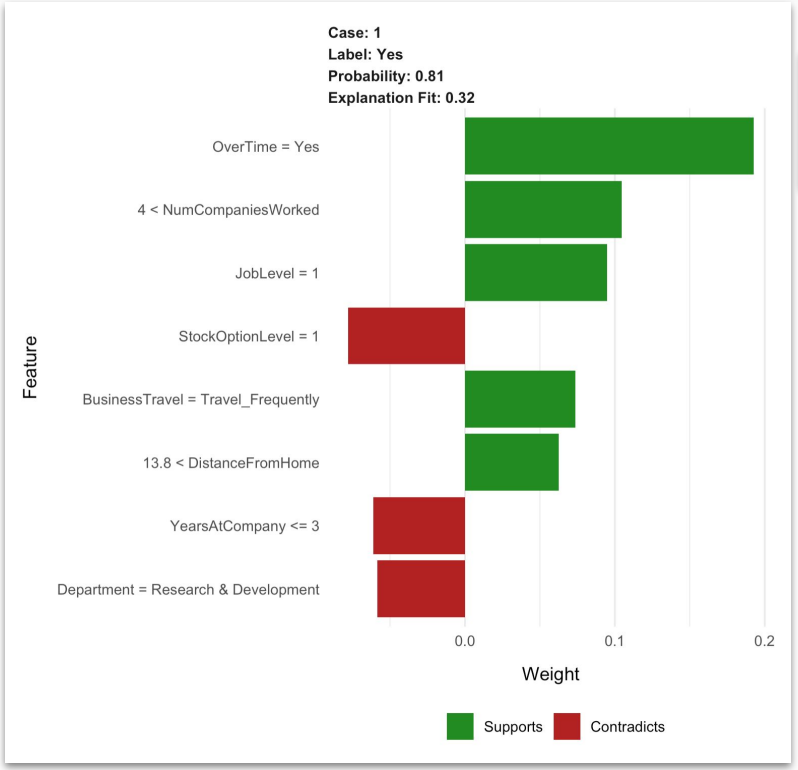
```
# 2. Modeling ----

h2o.init()

split_h2o <- h2o.splitFrame(as.h2o(train_tbl), ratios = c(0.85), seed = 1234)

train_h2o <- split_h2o[[1]]
valid_h2o <- split_h2o[[2]]
test_h2o  <- as.h2o(test_tbl)

y <- "Attrition"
x <- setdiff(names(train_h2o), y)

automl_models_h2o <- h2o.automl(
    x = x,
    y = y,
    training_frame = train_h2o,
    validation_frame = valid_h2o,
    leaderboard_frame = test_h2o,
    max_runtime_secs = 30,
    nfolds = 5
)
```

H2O.ai

Predict Attrition Risk

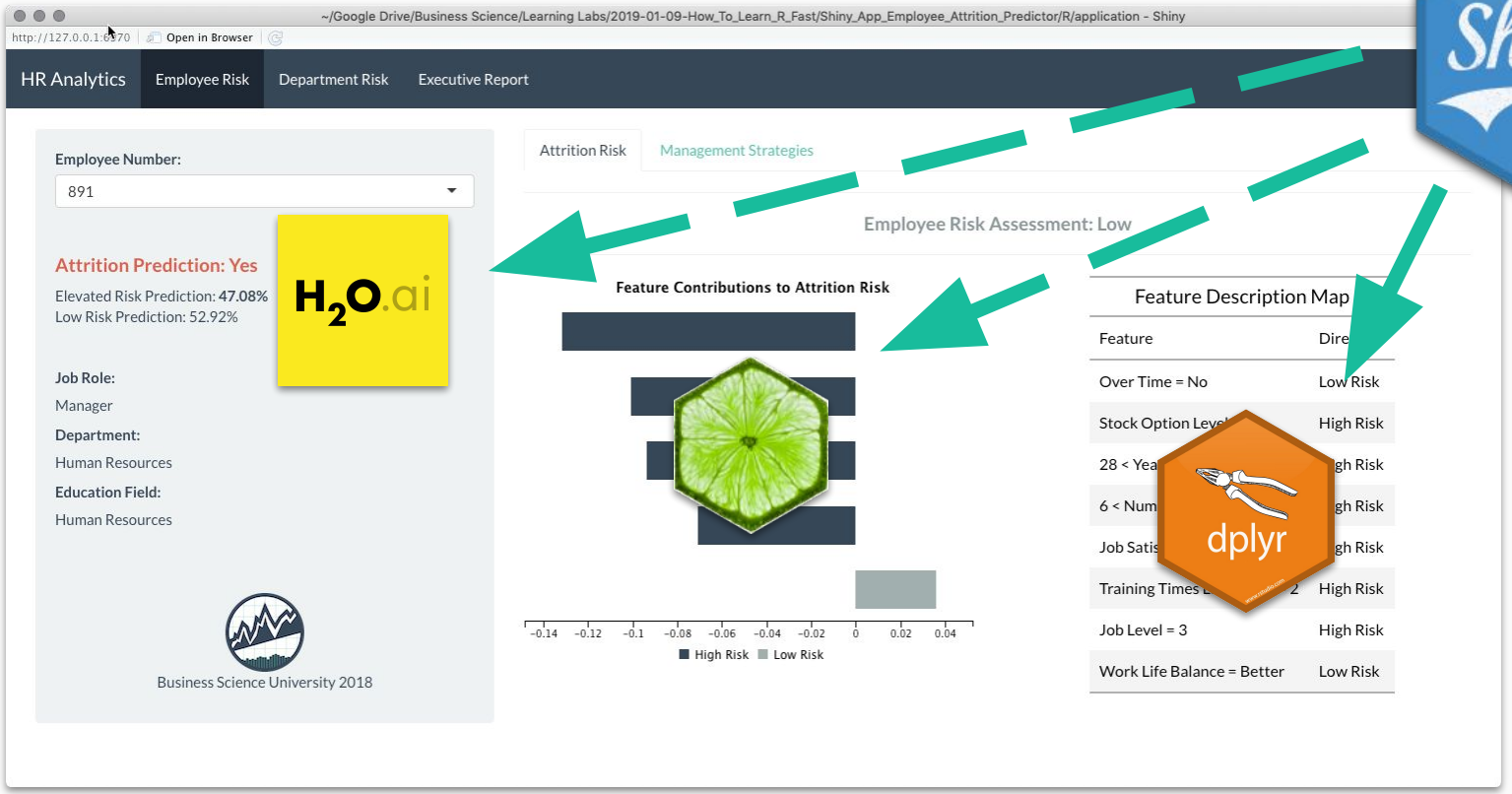
Data Science Workflow

```r
explainer <- train_tbl %>%
    select(-Attrition) %>%
    lime(
        model           = automl_leader,
        bin_continuous  = TRUE,
        n_bins          = 4,
        quantile_bins   = TRUE
    )

explainer

explanation <- test_tbl %>%
    slice(5) %>%
    select(-Attrition) %>%
    lime::explain(
        explainer = explainer,
        n_labels   = 1,
        n_features = 8,
        n_permutations = 5000,
        kernel_width   = 1
    )
```

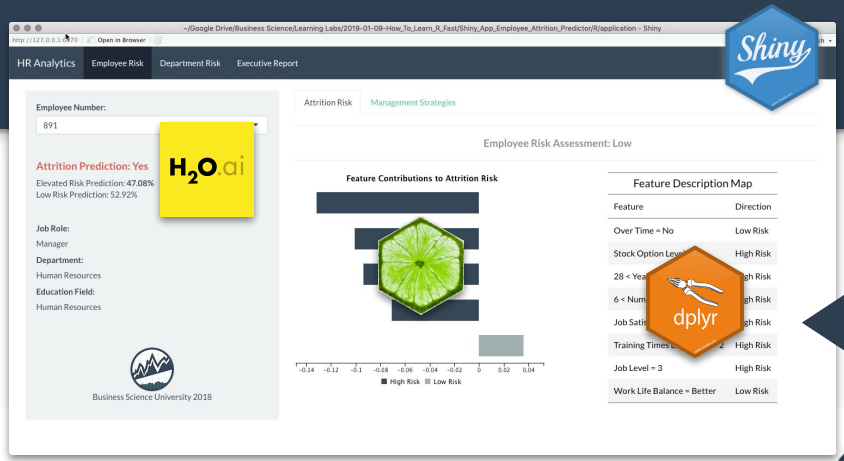


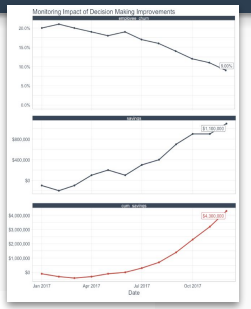
Explain Features Attrition Risk

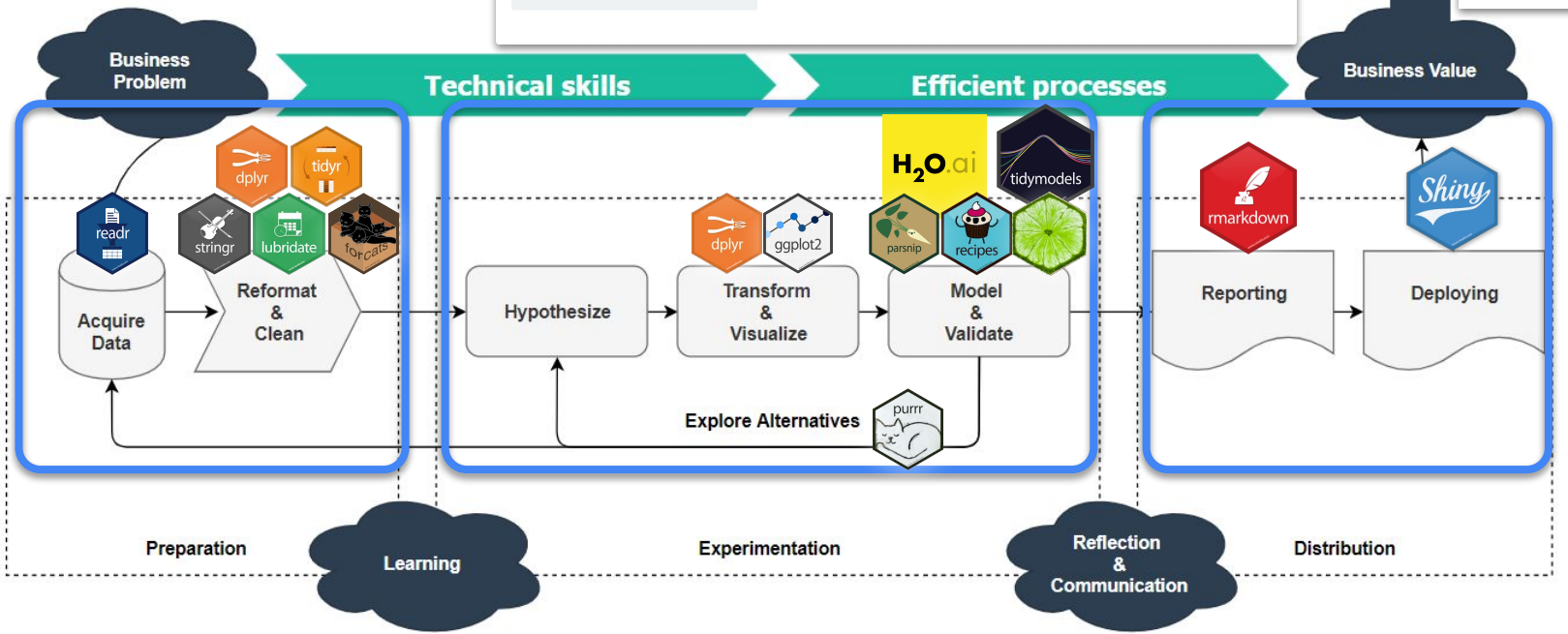
Data Science Workflow



Data Science Workflow

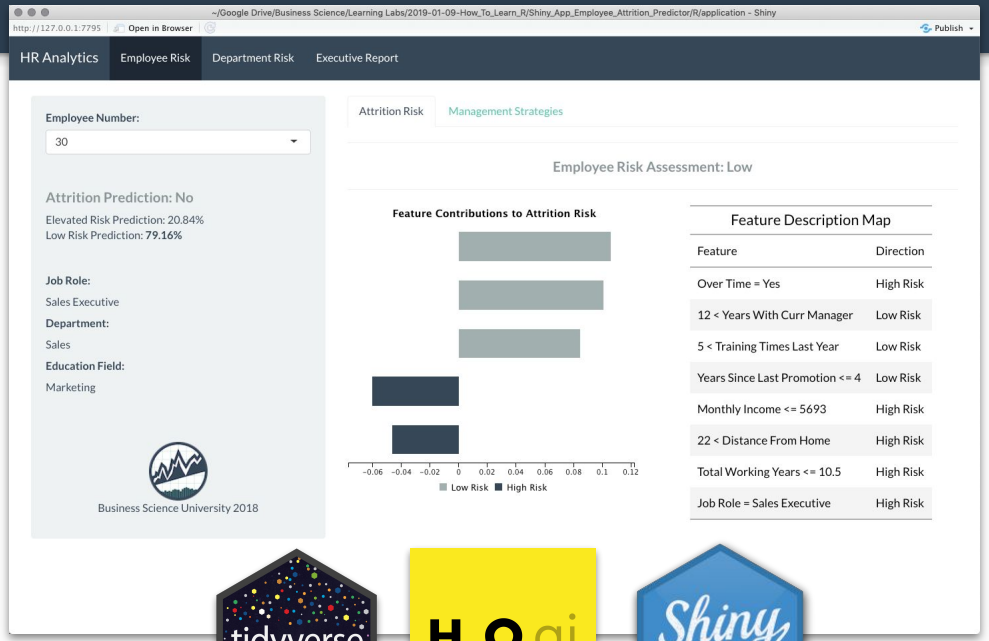




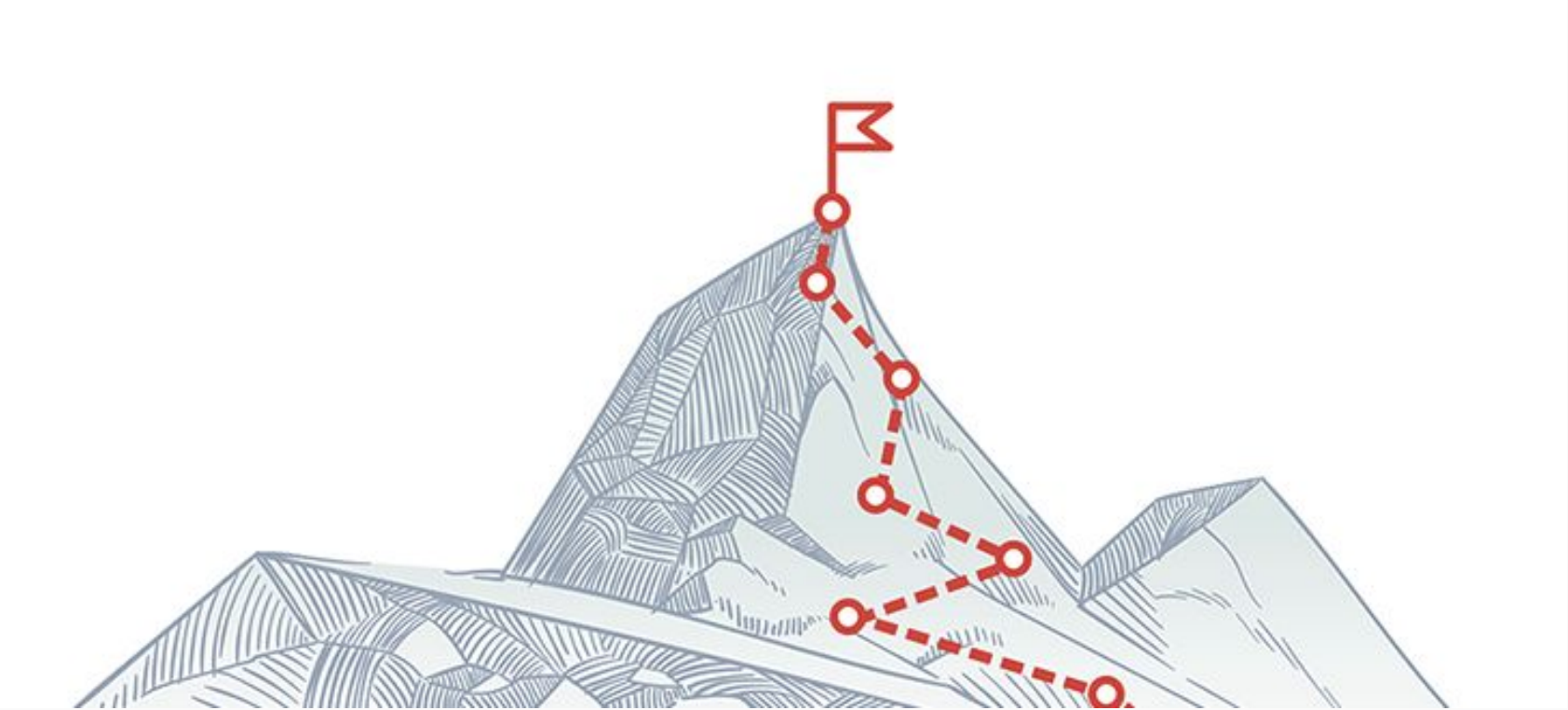


Agenda: R For Business

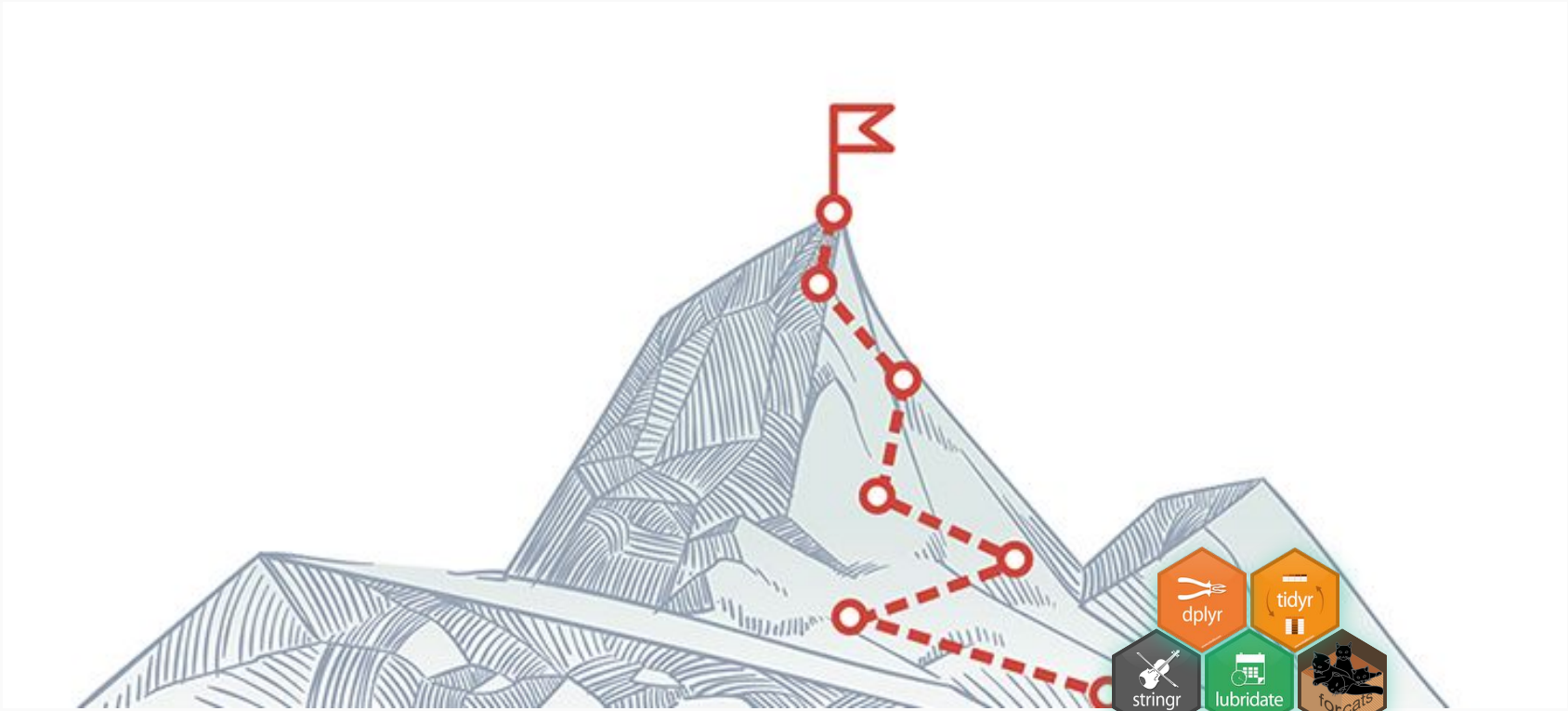
- $15M/Year Problem
- Shiny Web App Example
- Data Science Workflow
  - Tidyverse
  - H2O & recipes
- **Learning R for Business**



Learning R is a Hill Climb

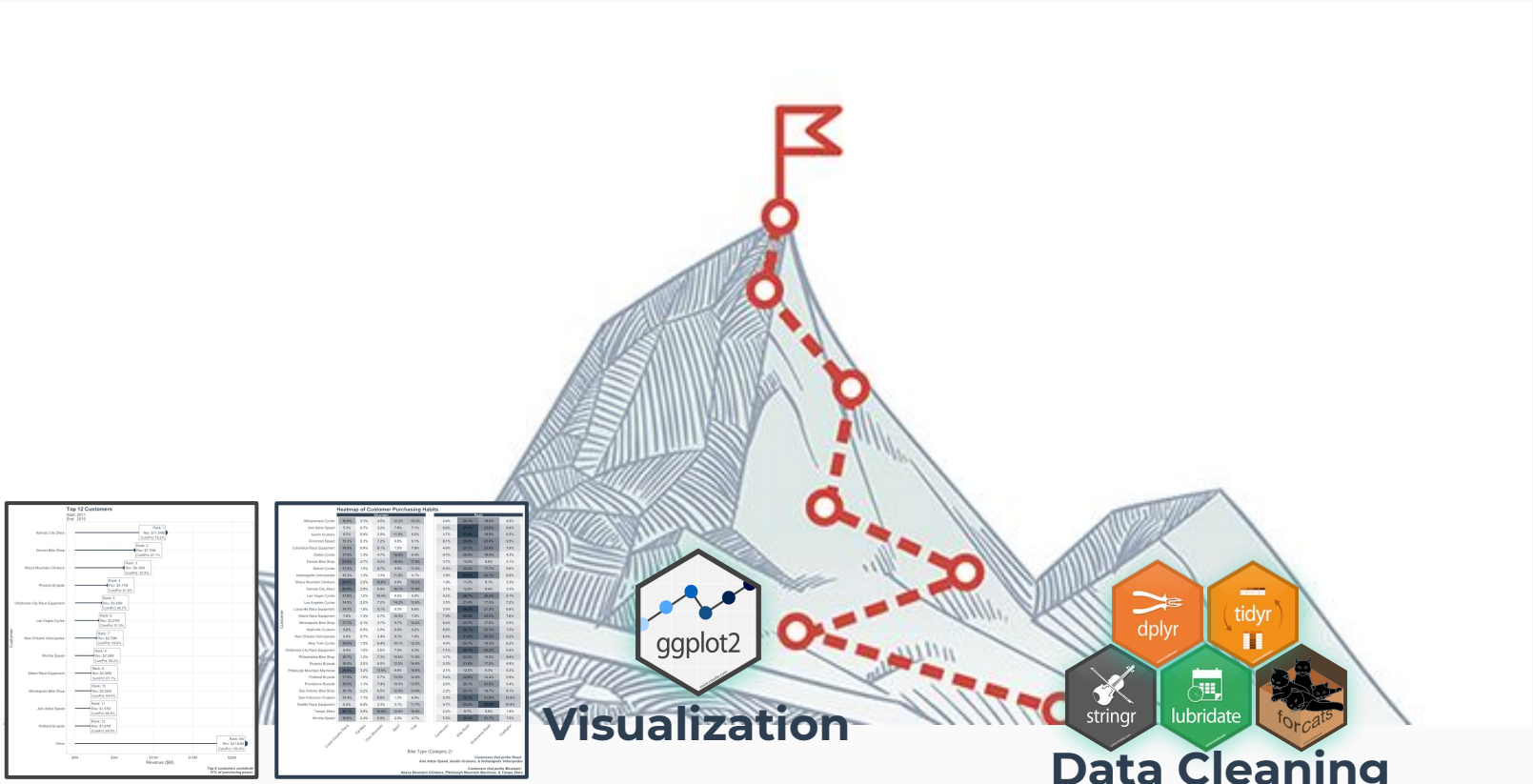


Learning R is a Hill Climb

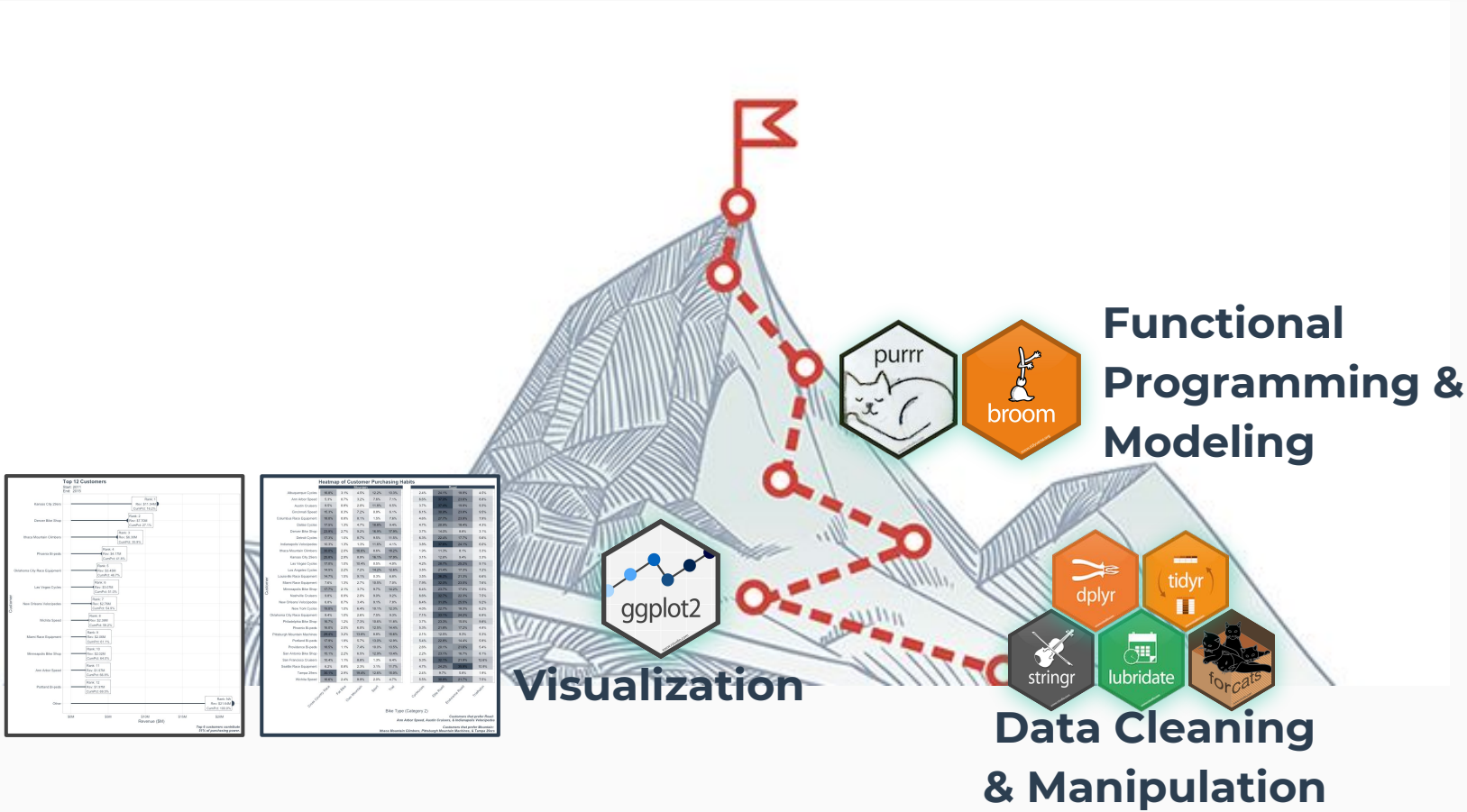


Data Cleaning & Manipulation

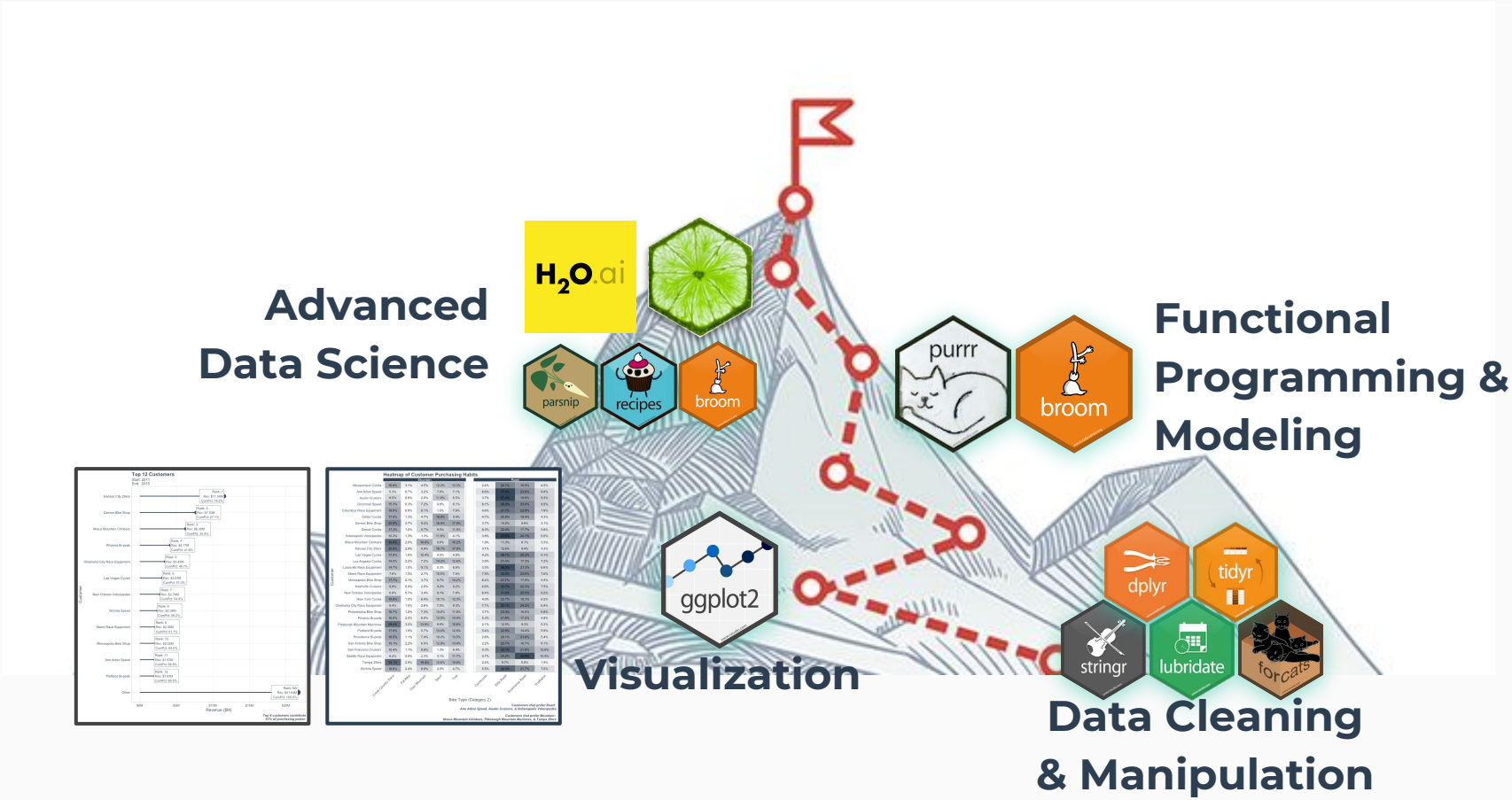
Learning R is a Hill Climb



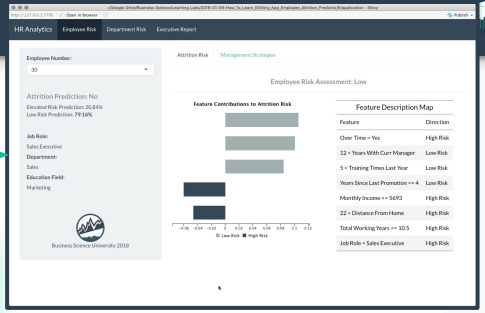
Learning R is a Hill Climb



Learning R is a Hill Climb



Learning R is a Hill Climb



THE GOAL

Shiny

rmarkdown

H2O.ai

Advanced
Data Science

parsnip

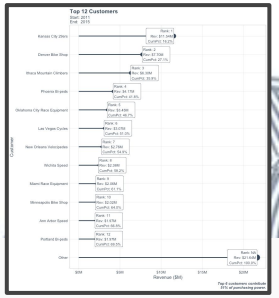
recipes

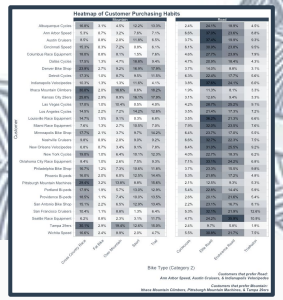
broom

purrr

broom

Functional
Programming &
Modeling





ggplot2

Visualization

dplyr

tidyr

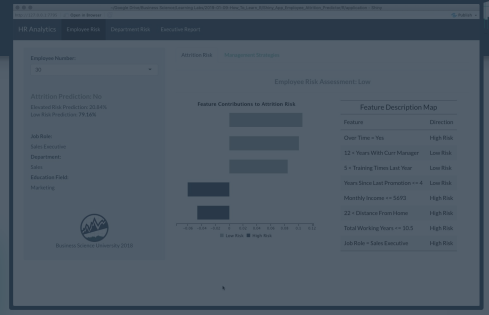
stringr

lubridate

forcats

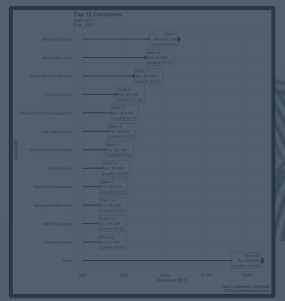
Data Cleaning
& Manipulation

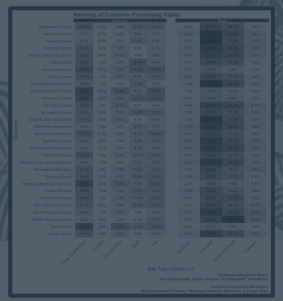
Path To Top Can Be Accomplished FAST



Advanced Data Science

Functional Programming & Modeling





Visualization

Data Cleaning & Manipulation

R-TRACK

THE PLAN

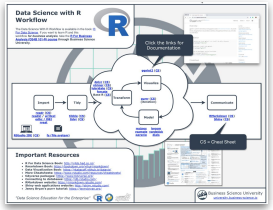
Business Analysis with R
(DS4B 101-R)

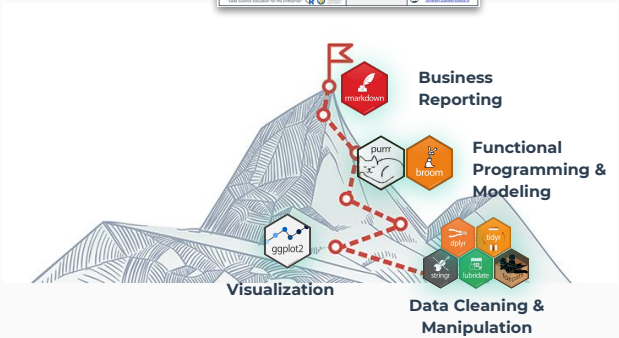
Data Science For Business with R
(DS4B 201-R)

R Shiny Web Apps For Business
(DS4B 301-R)

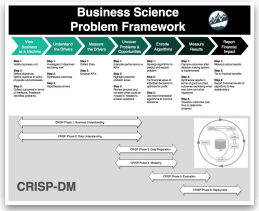
Project-Based Courses with Business Application

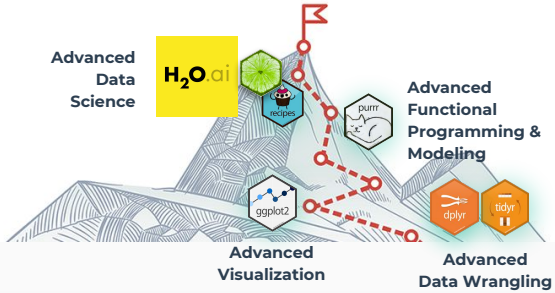
Data Science Foundations
7 Weeks



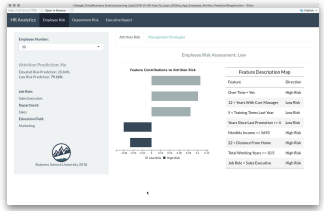


Machine Learning & Business Consulting
10 Weeks





Web Application Development
6 Weeks



THE RESULT

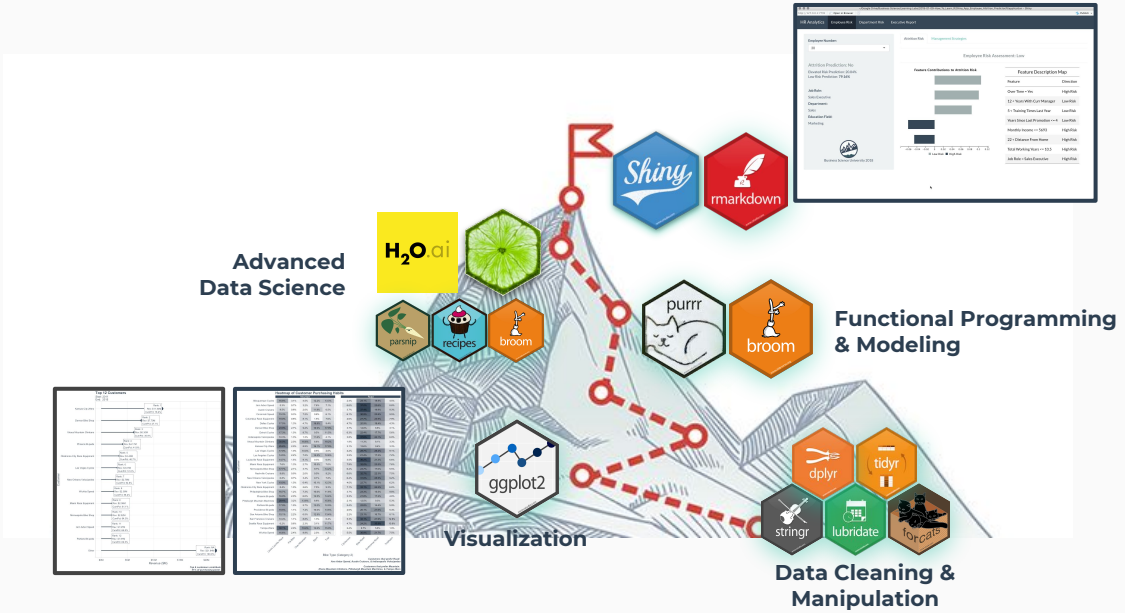
Business Analysis with R
(DS4B 101-R)
7 WEEKS

Data Science For Business with R
(DS4B 201-R)
10 WEEKS

R Shiny Web Apps For Business
(DS4B 301-R)
6 WEEKS

23 WEEKS!

(OR LESS)



THE BONUS

Start your journey with 15% OFF
PROMO Code: rstudio

university.business-science.io

Business Analysis with R (DS4B 101-R)	Data Science For Business with R (DS4B 201-R)	R Shiny Web Apps For Business (DS4B 301-R)

Project-Based Courses with Business Application

Data Science Foundations **7 Weeks**	Machine Learning & Business Consulting **10 Weeks**	Web Application Development **6 Weeks**