

Fundamentals of Predictive Analytics with JMP[®]

Third Edition

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Student Exercises



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Fundamentals of Predictive Analytics with JMP®, Third Edition

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Chapter 2 Exercises

1. Use the hmeq.jmp file and the variable Loan. Are there any outliers on the high or lower end?
2. Use the hmeq.jmp file and the variable Mortgage. Are there any outliers on the high or lower end?
3. Using the hmeq.jmp file, show the relationship between Mortgage and Loan. Discuss it.
4. Using the hmeq.jmp file, show the relationship between Mortgage and Reason. Discuss it.
5. Using the hmeq.jmp file, show the relationship between Default and Reason. Discuss it.
6. Use the Promotion_new.jmp file and the variable Combine. Are there any outliers on the high or lower end?
7. Using the Promotion_new.jmp file, show the relationship between Race and Position. Discuss it.
8. Using the Promotion_new.jmp file, show the relationship between Race and Combine. Discuss it.
9. Using the Promotion_new.jmp file, show the relationship between Oral, Written, and Combine. Discuss it.

Chapter 3 Exercises

1. In the Titanic Passengers_new.jmp data set, identify if there are any outliers.
2. In the Promotions_new.jmp data set, identify if there are any outliers.
3. In the Sub_CC Churn.jmp data set, identify if there are any outliers.
4. In the Sub_Enrollment.jmp data set, identify if there are any outliers.
5. In the Titanic Passengers_new.jmp data set, do the following:
 - a. Examine **Sex** and **Passenger Class**. Are there any typographical errors? If so, correct them.
 - b. Examine **Lifeboat**. Are there any missing values? If so, how many?
 - c. Examine **Age** and **Midpoint Age**. Are there any missing values? If so, how many? Impute them.
6. In the Promotions_new.jmp data set, do the following:
 - a. Examine **Race** and **Position**. Are there any typographical errors? If so, correct them.
 - b. Are there any missing values for all the variables? If so, impute them.
7. In the Sub_CC Churn.jmp data set, do the following:
 - a. Examine **Marital Status**, **LTV Group**, and **Gender**. Are there any typographical errors? If so, correct them.

- b. Examine **Gender**. Are there any missing values? If so, how many?
 - c. Examine **Age of Account (Months)** and **Age Group**. Are there any missing values? If so, how many? Impute them.
8. In the Sub_Enrollment.jmp data set, do the following:
- a. Examine State Province, Nation Description, Citizenship Description and Ethnicity. Are there any missing values? If so, how many?
 - b. Examine SAT Verbal, SAT Mathematics, and SAT Total Score. Are there any missing values? If so, how many? Impute them.

Chapter 4 Exercises

1. Perform descriptive statistics and create some relevant graphs using the salesperpdata.jmp data set.
2. Perform descriptive statistics and create some relevant graphs using the churn.jmp data set.
3. Perform descriptive statistics and create some relevant graphs using the StateGDP2008.jmp data set.
4. Perform descriptive statistics and create some relevant graphs using the PublicUtilities.jmp data set.
5. Perform descriptive statistics and create some relevant graphs using the Kuiper.jmp data set.

Chapter 5 Exercises

1. Using the Countif.xls file, develop a regression model to predict Salary by using all the remaining variables. Use $\alpha = 0.05$. Evaluate this model—perform all the tests. Run a stepwise model and evaluate it.
2. Using the hmeq.jmp file, develop the best model you can to predict loan amount. Evaluate each model and use $\alpha = 0.05$.
3. Using the Promotion_new.jmp file, develop each model, evaluate it, and use $\alpha = 0.05$:
 - a. Develop a model to predict Combine score, using the variable Position.
 - b. Create an indicator variable for the variable Position, and use the new indicator variable Captain in a regression model to predict Combine.
 - c. Create a new variable called Position_2 that assigns 1 to Captain or -1 otherwise (leave blank as *missing*). Now run a regression model using this new variable, Position_2, to predict Combine.
 - d. What are the differences and similarities among parts a, b, and c?
 - e. Develop a model using Race and Position to predict Combine.

4. Using the Countif.xls file, address the following:
 - a. Is there significant interaction between Major and Gender and the average salary?
 - b. Create a new variable, GPA_greater_3, which is equal to High if $GPA \geq 3$; otherwise, it is equal to Low. See how this new variable, GPA_greater_3, has different salary means.
 - c. Continuing with part b, test to see whether there is significant interaction between GPA_greater_3 and Major and in average Salary.

5. Using the Promotion_new.jmp file, test to see whether there is significant interaction with Race and Position and the average Combine score.

6. Using the Titanic_Passengers_new.jmp file, test to see whether there is significant interaction between whether a passenger survived and passenger class and the passengers' average age.

7. Using the MassHousing.jmp file, let the variable crim be the dependent variable:
 - a. Run descriptive statistics on all the variables and comment on the results.
 - b. Run a multiple regression with crim as the dependent variable and all the other variables. Evaluate the model.
 - c. Run stepwise regression and evaluate the model.
 - d. Try to improve the model. Evaluate your new model.
 - e. Compare your models from parts b, c, and d. Which one would you consider the best? Explain why.

8. Using the MassHousing.jmp file, test to see whether there are significant differences between
 - a. crim and the variable chas;
 - b. crim and the variable mvalue.

9. Use the datasets_finance.xlsx file, answer the following:

Do various financial indicators differ significantly according to type of company? Use ANOVA in JMP with the financial database to answer this question.

The financial database contains observations on eight variables for 100 companies. The variables are Type of Industry, Total Revenues (\$ millions), Total Assets (\$ millions), Return on Equity (%), Earnings per Share (\$), Average Yield (%), Dividends per Share (\$), and Average Price per Earnings (P/E) ratio. The data were gathered from Moody's Handbook of Common Stocks. The companies represent seven different types of industries. The variable "Type" displays a company's industry type as follows:

- 1 = apparel
- 2 = chemical
- 3 = electric power
- 4 = grocery

5 = health care products

6 = insurance

7 = petroleum

10. Use the datasets_hospital_only.xls file and answer the following:

Do Admissions and/or Births vary by the seven different geographic regions. Control is a variable with four levels of classification denoting the type of control the hospital is under (such as federal government or for-profit). Use this variable as the independent variable and test to determine whether there is a significant difference in the Admissions of a hospital by Control. Perform the same test using Births as the dependent variable.

Overall, you need to run these ANOVAs:

- Admissions/Region
- Admissions/Control
- Admissions/Region*Control
- Births/Region
- Births/Control
- Births/Region*Control

Chapter 6 Exercises

1. Consider the logistic regression for the toy data set, where π is the probability of passing the class:

$$\log \left[\frac{\hat{\pi}}{1 - \hat{\pi}} \right] = 25.60188 - 0.363761 \text{MidtermScore}$$

Consider two students, one who scores 67% on the midterm and one who scores 73% on the midterm. What are the odds that each fails the class? What is the probability that each fails the class?

2. Consider the first logistic regression for the Churn data set, the one with 10 independent variables. Consider two customers, one with an international plan and one without. What are the odds that each churns? What is the probability that each churns?
3. You have already found that the interaction term **IntlPlanMins** significantly improves the model. Find another interaction term that does so.
4. Without deriving new variables such as **CustServ** or creating interaction terms such as **IntlPlanMins**, use a stepwise method to select variables for the Churn data set. Compare your results to the bivariate method used in the chapter; pay particular attention to the fit of the model and the confusion matrix.
5. Use the Freshmen1.jmp data set and build a logistic regression model to predict whether a student returns. Perhaps the continuous variables **Miles from Home** and **Part Time Work Hours** do not seem to have an effect. See whether turning them into

discrete variables makes a difference. (*In essence*, turn **Miles from Home** into some dummy variables, such as 0–20 miles, 21–100 miles, or more than 100 miles.)

6. Use the purchase.xls file and build a logistic regression model to predict whether a person purchases or not. The data set has 431 observations and contains the variables, purchase (0—no, 1—yes), gender, income (low, medium, high) and another income variable income2 (lowmed and high). Create three new variables:
 - gender: female = 2, male = 1
 - income: Low = 1, Medium = 2, High = 3
 - income2: lowmed = 1, High = 2

Build the logistic regression model using these variables and age. Evaluate this new model.

7. Use the logit.xls data set and build a logistic regression model to predict whether a student is admitted to graduate school or not. The data set has 400 observations and contains the following variables: the binary variable admitted to graduate school (where 0—don't admit, 1—admit), GRE (Graduate Record Exam scores), undergraduate GPA (grade point average), and prestige of the undergraduate program (1—yes, 0—no). The question is: do GRE, undergraduate GPA, and the prestige of the undergraduate program affect admission into graduate school? Run the appropriate analysis to evaluate this question.

Chapter 7 Exercises

1. Use the PublicUtilities.jmp data set. Run a regression to predict **return** using all the other variables. Run a PCA and use only a few principal components to predict **return** (remember not to include **return** in the variables on which the PCA is conducted).
2. Use the MassHousing.jmp data set. Run a regression to predict market value (**mvalue**) using all the other variables. Run a PCA and use only a few principal components to predict **mvalue**. (Remember not to include **mvalue** in the variables on which the PCA is conducted.)
3. Use the olymp88excel.xls data set. Run a PCA and use only a few principal components to predict **score**. (Remember not to include **score** in the variables on which the PCA is conducted.)
4. Use the stockreturns.xls data set. The weekly (100 weeks) rates of return for five stocks (Allied Chemical, DuPont, Union Carbide, Exxon, and Texaco) are listed in the file. Since 1926, the stock market has an average rate of return of 11.3%. Investors have earned more or less depending on the type of investments and risks taken. It is very important to note that this return is before costs have been factored. Run a principal component analysis (PCA) to find (and define) the dimensions that best summarize these stock returns.

Chapter 8 Exercises

1. For the Mass Housing data set, **MassHousing.jmp**, explore the effects of using adaptive estimation, as well as various form of validation. Already you have used both the LASSO and the elastic net without adaptive estimation and with **AICc** validation. Now try it with **Adaptive Estimation** and **AICc** validation. Then try it without **Adaptive Estimation** and with **KFold** validation, and so on.
2. Do exercise 1 above, except use the Churn data set from Chapter 6 on Logistic Regression. Be sure to change the **Distribution** from **Normal** to **Binomial**.
3. Using the Sales Performance data set, **Salesperpdata.xls**, run a regression and stepwise regression. Then use LASSO and elastic net approaches. Compare the models. Which is best?
4. Using the Financial data set, **Financial.jmp**, run a regression and stepwise regression. Then use LASSO and elastic net approaches. Compare the models. Which is best?
5. Using the Freshman data set, **Freshman1.jmp**, run a regression and stepwise regression. Then use LASSO and elastic net approaches. Compare the models. Which is best?

Chapter 9 Exercises

1. Use hierarchical clustering on the Public Utilities data set. Be sure to use the company name as a label. Use all six methods (for example, Average, Centroid, Ward, Single, Complete, and Fast Ward), and run each with the data standardized. How many clusters does each algorithm produce?
2. Repeat exercise 1, this time with the data not standardized. How does this affect the results?
3. Use hierarchical clustering on the Freshmen1.jmp data set. How many clusters are there? Use this number to perform a k -means clustering. (Be sure to try several choices of k near the one that is indicated by hierarchical clustering.) Note that k -means will not permit ordinal data. Based on the means of the clusters for the final choice of k , try to name each of the clusters.
4. Use k -means clustering on the churn data set. Try to name the clusters.
5. Use **usagesas.jmp** data set. The data were whether or not an individual has used different statistical packages starting with the base package, and professional statistics to advanced statistics with the following variables: **ts**—time series (forecasting); **present**—presentation; **permap**—perception maps; **chaid**—a data mining techniques; **map**—maps; and **neurnet**—another data mining technique (neural nets). **Jobarea** is a code for what type of job the person has. Perform some clustering to see whether these individuals form any interesting groups.
6. Use the **HousingPrices.jmp** data set. A real estate company that manages properties around a ski resort in the United States wishes to improve its method for pricing homes. Sample data is obtained on a number of measures, including size of the home and property, location, age of the house, and a strength-of-market indicator.

The data set contains information about 45 residential properties near a popular North American ski resort sold during a recent 12-month period. The data is a representative sample of the full set of properties sold during that time period. The variables in the data set are:

Price: Selling price of the property (in \$000)

Beds: # of bedrooms in the house

Baths: # of bathrooms in the house

Square Feet: Size of the house in square feet

Miles to Resort: Miles from the property to the downtown resort area

Miles to Base: Miles from the property to the base of the ski resort's facing mountain

Acres: Lot size in number of acres

Cars: # of cars that will fit into the garage

Years Old: Age of the house at the time it was listed in years

DoM: # of days the house was on the market before it was sold

The dependent variable is price. Do a cluster analysis. Evaluate the clusters and determine your best cluster size. Run a regression with all the variables plus dummy variables for cluster evaluate the model. If necessary, try to improve the model.

Chapter 10 Exercises

1. Build a classification tree on the churn data set. Remember that you are trying to predict churn, so focus on nodes that have many churners. What useful insights can you make about customers who churn?
2. After building a tree on the churn data set, use the **Column Contributions** to determine which variables might be important. Could these variables be used to improve the Logistic Regression developed in Chapter 5?
3. Build a Regression Tree on the Masshousing.jmp data set to predict market value.
4. A non-profit health care group, similar to AARP, conducted a survey of 360 members. The survey asked various questions about their diet and state of health. The data from the survey is in the Excel file blood_pressure.xlsx. On the next two pages, the coding of some of the variables is provided. They would like a report discussing the results of the survey and also provide some life-style suggests to their members.

TYPE OF MILK

1-WHOLE

2-2%

3-SKIM

4-POWDER

5-NO MILK

SALT IN FOOD

1-A LOT

2-MODERATE

3-VERY LITTLE

4-NONE

5-??? UNKNOWN

SALT CONSUMPTION

1-VERY LOW

2-LOW

3-MODERATE

4-HIGH

5-VERY HIGH

6-??? UNKNOWN

BUTTER FOOD

1-FREQUENTLY

2-SOMETIMES

3-NEVER

SPORTS ACTIVITY

1-DAILY

2-WEEKLY

3-OCCASIONALLY

4-RARELY

5-NEVER

6-??? UNKNOWN

SMOKING

1-REGULAR

2-OCCASIONAL

3-FORMER

4-NEVER

5-??? UNKNOWN

DRINK PATTERN

1-REGULAR

2-OCCASIONAL

3-FORMER

4-NEVER

DRINKS EVERY DAY

1-YES

2-NO
3-??? UNKNOWN

AGE

1- 32-50
2- 51-62
3- 63-72

GENDER

1-MALE
2-FEMALE

HYPERTENSION

1-LOW
2-NORMAL
3-HIGH

5. Use the salesperpdata.jmp data set. Run a stepwise regression with sales as the dependent variable. Build a regression tree to predict sales. Which model is better?

Chapter 11 Exercises

1. Is there any point in extending k beyond 10 in the case of the glass data? Set the maximum value of k at 20 and then at 30.
2. Are the results for the glass data affected by the scaling? Standardize all the variables and apply k -nearest neighbors.
3. Run a linear regression problem of your choice and compare it to k -nearest neighbors.

Chapter 12 Exercises

1. Investigate whether the **Robust** option makes a difference. For the Kuiper data that has been used in this chapter (don't forget to drop some observations that are outliers!), run a basic model 20 times (for example, the type in Table 12.4). Run it 20 more times with the **Robust** option invoked. Characterize any differences between the results. For example, is there less variability in the R^2 ? Is the difference between training R^2 and validation R^2 smaller? Now include the outliers, and redo the analysis. Has the effect of the **Robust** option changed?
2. For all the analyses of the Kuiper data in this chapter, ten observations were excluded because they were outliers. Include these observations and rerun the analysis that produced one of the tables in this chapter (for example, Table 12.4). What is the effect of including these outliers? You will have to set the seed for the random number generator and use the same seed twice: once when you run the model with the

excluded observations, and again after you include the observations. If you don't do this, then you can't be sure whether the differences are due to the inclusion/exclusion of observations or the different random numbers!

3. For the neural net prediction of the binary variable MedPrice, try to find a suitable model by varying the architecture and changing the options.
4. Develop a neural network model for the Churn data.
5. In Chapter 10, you developed trees in two cases: a classification tree to predict whether students return and a regression tree to predict GPA. Develop a neural network model for each case.
6. As indicated in the text, sometimes rescaling variables can improve the performance of a neural network model. Rescale the variables for an analysis presented in the chapter (or in the exercises), and see whether the results improve.

Chapter 13 Exercises

1. Without using a Validation column, run a logistic regression on the Titanic data and compare to the results in this chapter.
2. Can you improve on the results in Figure 13.3?
3. How high can you get the RSquare in the MassHousing example?
4. Without using a validation column, apply logistic regression, bootstrap forests, and boosted tree to the Churn data set.
5. Use a validation sample on boosted regression trees with MassHousing. How high can you get the RSquared on the validation sample? Compare this to your answer for Question 3.
6. Use a validation sample, and apply logistic regression, bootstrap forests, and boosted trees to the Churn data set. Compare this answer to your answer for Question 4.

Chapter 14 Exercises

1. Create 30 columns of random numbers and use stepwise regression to fit them (along with S&P500) to the McDonalds return data.

To create the 30 columns of random normal, first copy the McDonalds72 data set to a new file (say, McDonalds72-A). Open the new file and delete the 30 columns of "stock" data. Select **Cols ► New Columns**. Leave the **Column prefix** as **Column**. Enter 30 for **How many columns to add?** Under **Initial Data Values**, select **Random**, and then select **Random Normal**, and click **OK**.

After running the stepwise procedure, take note of the RSquared and the number of "significant" variables added to the regression. Repeat this process 10 times. What are the highest and lowest R^2 that you observe? What are the highest and lowest number of statistically significant random variables added to the regression?

- a. Use the churn data set and run a logistic regression with three independent variables of your choosing. Create Lift and ROC charts, as well as a confusion matrix. Now do the same again, this time with six independent variables of your choosing. Compare the two sets of charts and confusion matrices.
- b. Use the six independent variables from the previous exercise and develop a neural network for the churn data. Compare this model to the logistic regression that was developed in that exercise.
2. Use the Freshmen1.jmp data set. Use logistic regression and classification trees to model the decision for a freshman to return for the sophomore year. Compare the two models using Lift and ROC charts, as well as confusion matrices.
3. Reproduce Table 14.4. Open a new Excel spreadsheet and copy the variables **Return on McDonalds** and **Predicted Return on McDonalds** into columns A and B, respectively. In Excel, perform the following steps:
 - a. Create the residuals in column C as Return on McDonalds – Predicted Return on McDonalds.
 - b. Create the squared residuals in column D by squaring column C.
 - c. Create the absolute residuals in column E by taking the absolute value of column C.
 - d. Calculate the in-sample MSE by summing the first 60 squared residuals (which will be cells 2-61 in column D). Then divide the sum by 60.
 - e. Calculate the in-sample MAE by summing the first 60 absolute residuals (which will be cells 2-61 in column E). Then divide the sum by 60.
 - f. Calculate the out-of-sample MSE by summing the last 12 squared residuals (cells 62-73 in column D). Then divide the sum by 12.
 - g. Calculate the out-of-sample MAE by summing the last 12 absolute residuals (cells 62-73 in column E). Then divide the sum by 12.
 - h. Calculate the in-sample correlation between Return on McDonalds and Predicted Return on McDonalds for the first 60 observations using the Excel CORREL() function.
 - i. Calculate the out-of-sample correlation between Return on McDonalds and Predicted Return on McDonalds for the last 12 observations using the Excel CORREL() function.
4. Using the Churn data set, repeat the above exercise for Logistic, Bootstrap Forest, and Boosted Trees. Which model performs best? (Which does best on the validation data set?) What is the expected performance of this model on new data? (How does it perform on the test data set?)
5. Use salesperpdata.jmp data set. Run a stepwise regression with sales as the dependent variable. Build a regression tree to predict sales. Which model is better?
6. Use the Freshman1.jmp data set. Run a decision tree and logistic regression model with return as the dependent variable. Compare the models, which is best?

Chapter 15 Exercises

1. In the aircraft_incidents.jmp file is data for airline incidents that were retrieved on November 20th, 2015 from <http://www.nts.gov/layouts/nts.aviation/index.aspx>. For the Final Narrative variable, use the Text Explorer to produce a DTM by phrasing and terming. Create a Word Cloud.
2. Using the aircraft_incidents.jmp file from Problem 1, produce a DTM by phrasing and terming, and create a Word Cloud for the variable Narrative Cause.
3. In the Nicardipine.jmp is data from adverse events from this drug. For the Reported Term for the Adverse Event variable, use the Text Explorer to produce a DTM by phrasing and terming. Create a Word Cloud.
4. In the Airplane_Crash_Reports.jmp file is one variable, NTSB Narrative, that summarizes the crash report. For this variable, use the Text Explorer to produce a DTM by phrasing and terming. Create a Word Cloud.
5. In the FDA_Enforcement_Actions.jmp file, the variable Citation Description describes the violation. For this variable, use the Text Explorer to produce a DTM by phrasing and terming. Create a Word Cloud.
6. The traffic-violation_jun2015.jmp is similar to the file used in the chapter except that the data is for June 2015 only. For the variable Description, use the Text Explorer to produce a DTM by phrasing and terming. Create a Word Cloud. How does this compare to data for December 2014?
7. Perform Latent Semantic Analytics, Topic Analysis, and Cluster Analysis on the DTM that you produced in Problem 1.
8. Perform Latent Semantic Analytics, Topic Analysis, and Cluster Analysis on the DTM that you produced in Problem 2.
9. Perform Latent Semantic Analytics, Topic Analysis, and Cluster Analysis on the DTM that you produced in Problem 3.
10. Perform Latent Semantic Analytics, Topic Analysis, and Cluster Analysis on the DTM that you produced in Problem 4.
11. Perform Latent Semantic Analytics, Topic Analysis, and Cluster Analysis on the DTM that you produced in Problem 5.
12. Perform Latent Semantic Analytics, Topic Analysis, and Cluster Analysis on the DTM that you produced in Problem 6. How does this compare to data for December 2014?
13. Similar to the predictive model that you did in the chapter, create a predictive model for violation type. How does this compare to data for December 2014?

Chapter 16 Exercises

1. Identify other opportunities for increasing Coke sales, or for using Coke to spur sales of other goods.
2. For the data in Table 16.1, compute Confidence and Lift for $X = \{\text{bread}\}$ and $Y = \{\text{jelly, peanut butter}\}$ by hand. Then check your answer by using JMP.

3. Calculate the Support of $X = \{\text{bread}\}$ and $Y = \{\text{jelly, peanut butter}\}$.
4. Analyze the GroceryPurchases.jmp data and find some actionable rules.

Chapter 17 Exercises

1. Use the Workers.jmp file. Find the best smoothing model. Explain why. What are the model's parameters and predict one period ahead.
2. Use the Raleigh Temps.jmp file. Using the variable Temperature, run an AR(1) model. Evaluate the model. Run a Seasonal model with an AR of 1 and seasonal differencing 1. Evaluate this seasonal model. Which model is best? Explain why.
3. Use the Lead Production.jmp file. Run ARIMA Model Group. Set the range for all parameters from 0 to 1. Which model is best? Explain why.
4. Use the Raleigh Temps.jmp file. Run the ARIMA Model Group. Which model is the best? Explain why. Is this model better than your best model in question 2?
5. Use the Lead Production.jmp file. Use the Holdback of 12 periods and run State Space Smoothing models (remember to deselect Constrain Parameters). Run ARIMA Model Group. Set the range for all parameters from 0 to 1. Which model is best? Explain why.
6. Use the Crates.xlsx file. Run an additive regression model. Evaluate it. Run other time series models. Which one is the best? Explain why.
7. Use the World_bank_life_expectancy.xlsx (USA) file. Find the best forecasting model. Explain why. Predict the next year.
8. Use the World_bank_life_expectancy.xlsx (World) file. Which country would you like to live in just in terms of life expectancy? Explain why.