



## Predictive Analytics with TIBCO Spotfire and TIBCO Enterprise Runtime for R

### PREDICTIVE ANALYTICS WITH TIBCO SPOTFIRE

TIBCO Spotfire® is the premier data discovery and analytics platform, which provides powerful capabilities for our customers, such as dimension-free data exploration through interactive visualizations, and data mashup to quickly combine disparate data to gain insights masked by data silos or aggregations.

Another key strength of TIBCO Spotfire platform is broad predictive analytic functionality. Predictive analytics have entered the mainstream of business analytics in the last few years, and generally can be described as learning from the past collective experience of your organization to make better decisions in the future.

## BENEFITS OF TIBCO SPOTFIRE AND PREDICTIVE ANALYTICS

- Easily provide targeted, relevant predictive analytics to business users
  - Ensure compliance and proper usage
  - Get the answer when needed
- Increase confidence and effectiveness in decision-making
  - Reduce uncertainty
  - Discover meaningful patterns, important data
  - Maximize ROI
- Anticipate and react to emerging trends
- Reduce/manage risk
  - Scenario planning, forecasts, fraud detection
- Forecast specific behavior, preemptively act on it
  - Increase upsell, decrease churn

## PREDICTIVE ANALYTICS IN THE SPOTFIRE PLATFORM

There are three main aspects of predictive analytics in the Spotfire platform:

- TIBCO Spotfire® Statistics Services (TSSS) provides a predictive analytics ecosystem, and enables seamless integration of your existing investments in R, S+, SAS and MATLAB into Spotfire (and custom) applications, as well as leveraging in-database predictive analytics through Teradata Aster, to empower more effective decision-making across your organization.
- TIBCO® Enterprise Runtime for R (TERR) provides an enterprise-class environment for running R scripts and packages, both within Spotfire and across an organization, enabling you to combine the agility of open source R with the speed and reliability of an enterprise platform.
- Predictive modeling tools in Spotfire provide deep predictive insights into your data as part of ad hoc analysis, without requiring any statistical programming.

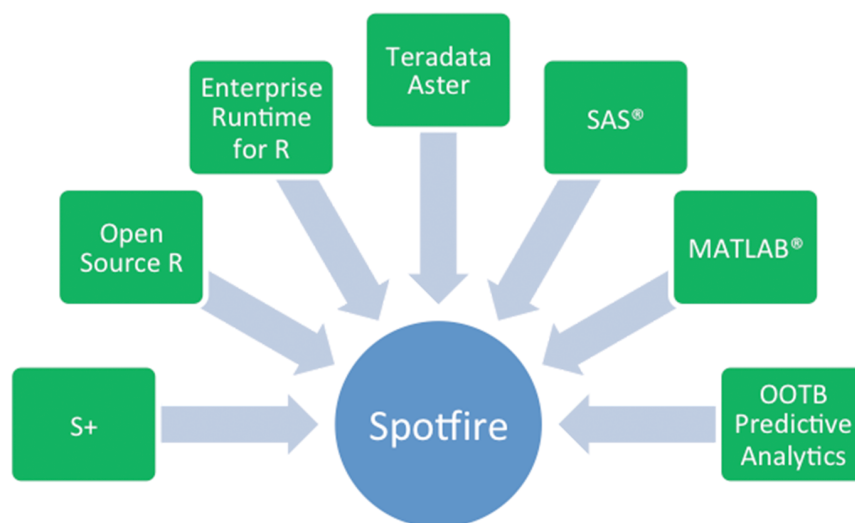
## TIBCO SPOTFIRE STATISTICS SERVICES

With TIBCO Spotfire Statistics Services, technical and business professionals gain the benefits of a full predictive analytics ecosystem. They gain more confidence in their decisions by using the latest, most relevant predictive analytics available in R, S+, SAS, or MATLAB — without requiring them to have deep expertise in statistics. Organizations increase efficiency by leveraging their existing investments in predictive analytics, giving decision makers self-service access to easy-to-interpret analytic results through Spotfire applications. Scarce statistical resources deploy and control access to a centralized repository of R, S+, SAS, or MATLAB functions, ensuring only the most appropriate and statistically valid analytic methods are used.

For advanced users, TIBCO Spotfire Statistics Services also complements and enhances the usage of S+ and R by allowing statisticians to easily visualize the results of their models and analysis and to deploy these models inside Spotfire applications from a central location.

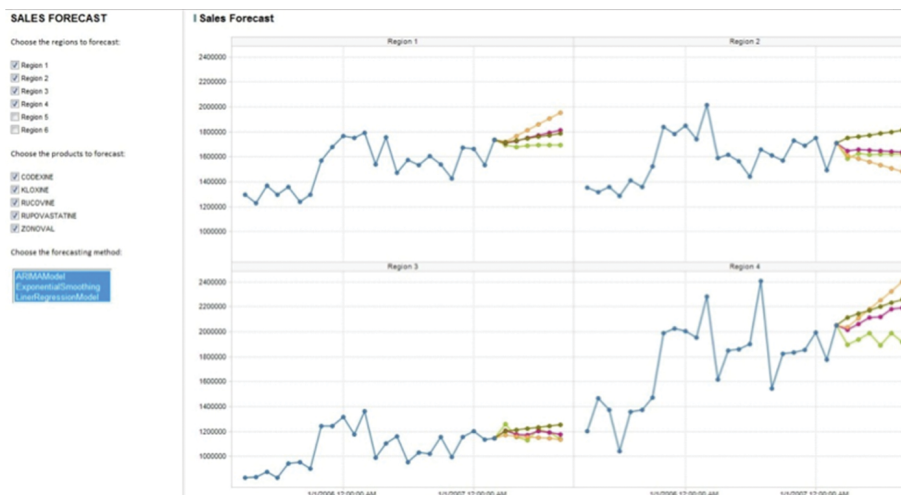
## PREDICTIVE ANALYTICS ECOSYSTEM

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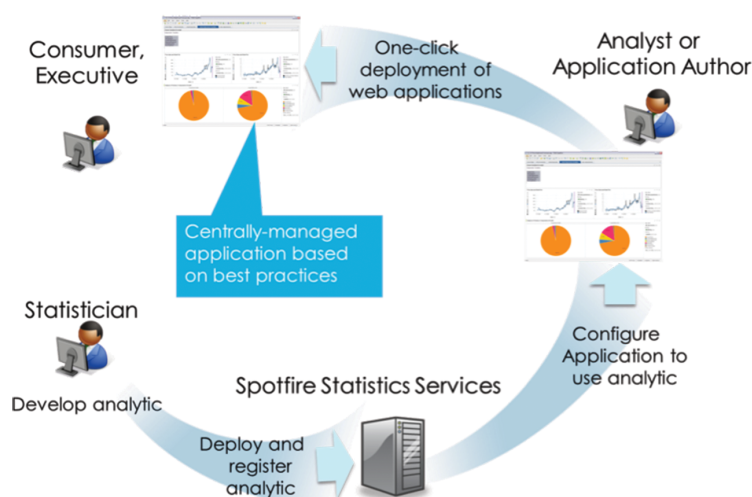
### BENEFITS

- Easily provide targeted, relevant advanced analytics to a large, diverse community of users, combined with the interactive visualization of Spotfire
  - Integration of R, S+, SAS, and MATLAB into Spotfire (and custom) applications
  - Enable your users to utilize powerful analytic capabilities without needing a stats background
  - Statisticians can ensure compliance and proper usage, while making their work more widely and easily available
  - Utilize the analytic power of Teradata Aster for in-database predictive analytics, for applications such as determining the effectiveness of content, website "golden path" analysis, and viewer engagement
- Leverage your existing analytic investments and skills to improve decision-making across your organization
- Integrate with the new, enterprise-class, R-compatible statistical engine: TIBCO Enterprise Runtime for R (TERR), which can be run locally under TIBCO® Spotfire Professional for offline use, or remotely through TSSS
- Tightly integrate with the Spotfire platform, as well as open C# and Java APIs for integration of advanced analytics into custom applications
- Get enterprise reliability, with features such as clustering and load-balancing
- Enable users to get started quickly using out-of-the-box predictive analytics and learn rapidly with templates and examples



### TIBCO SPOTFIRE FULL ANALYTIC APPLICATION AUTHORIZING

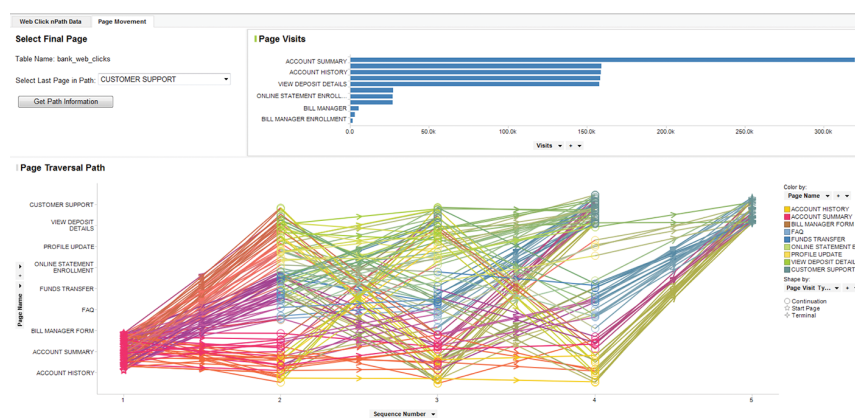
Building Spotfire applications that leverage predictive analytics is a quick and easy process. It starts with the data scientist prototyping an analysis in their environment of choice (R, SAS, etc.), and then deploying the analysis to Statistics Services. As part of this process, the data scientist specifies the types of inputs and outputs the analysis expects. This makes it available to the Spotfire application developer who, without any coding or requiring any deep understanding of the details of the analysis, uses the information provided by the data scientist to integrate the analysis into a Spotfire application. This application can then be quickly shared with a wide community of users across your organization.



## IN-DATABASE PREDICTIVE ANALYTICS VIA TERADATA ASTER

The most recent addition (as of Spotfire 5.5) to the predictive analytic ecosystem is Teradata Aster. Spotfire users can now utilize Teradata Aster to do in-database predictive analytics on big data, from Spotfire applications or TERR scripts. They can use the analytic power of Aster for applications such as determining the effectiveness of web content, website “golden path” analysis, and viewer engagement, all without unnecessarily moving the data from the database.

This connection is implemented as a TERR package called AsterDB, which generates the SQL/Map Reduce scripts needed to access the powerful functionality within Aster. This makes it easy to leverage these in-database advanced analytics from both TERR scripts and Spotfire applications, using example templates provided with TSSS.



## TIBCO ENTERPRISE RUNTIME FOR R (TERR)

TERR is an enterprise-grade analytic engine that TIBCO built from the ground up to be fully compatible with the R language, leveraging our long-time expertise in the closely related S+ analytic engine. This allows customers to continue to develop in open source R, but to then integrate and deploy their R code on a commercially-supported and robust platform—without the need to rewrite their code. TERR enables organizations to:

- Apply consistent models across multiple applications and uses, from prototyping to production
  - Eliminating uncertainty when analytic models disagree when implemented on disparate platforms
- Easily compare multiple analytic approaches to find the hidden insights and to make the best decisions
  - Broadly leveraging these insights across the organization
- Eliminate time/resources spent re-implementing R code for production, or spent prototyping on an unwieldy platform
  - Reducing the need for multiple analytic platforms
- Move quickly from prototyping to production to deliver faster time to insight/market
  - Continually refining models and applying them consistently across the organization so that everyone is using the right analyses

The main technical advantages of TIBCO Enterprise Runtime for R are:

- Higher performance and far more robust memory management—so that performance is linear as larger data is analyzed
- Fully TIBCO IP, so that TERR is licensable for embedding and redistribution (unlike open source R, which is GPL, a particularly viral form of open source licensing)
- A TIBCO-architected engine as a platform for ongoing investment, to ensure that it meets analytic needs both now and in the future
- Broad coverage of core R functionality and CRAN packages

All these features were developed with the goal of delivering analytic power AND agility, so that customers can develop in open source R, and deploy/scale/integrate using Enterprise Runtime for R, without having to recode their analytics. People often build prototypes in R, but then typically re-implement in another language for production purposes because R was not built for enterprise usage. TERR brings enterprise-class scalability and stability to the agile R-language, and enables statistics to broadly share their analyses through TIBCO Spotfire Statistics Services or by directly embedding the TERR engine.

TERR enables customers to rapidly iterate from prototyping to production without wasting time and effort recoding and retesting their analyses, allowing them to more rapidly respond to opportunities and threats, and easily integrate standardized predictive analytics consistently across the organization.

#### **TERR DEVELOPER'S EDITION AND TERR COMMUNITY**

A free developer edition of TERR is available through the TERR Community site. This enables customers to test their R code prior to deployment and integration on a fully-featured version of the TERR engine—with no limitations, beyond a limitation to non-production use. The TERR Community site also provides a forum for the feedback, support and collaboration of R/TERR users, and detailed information on topics such as TERR's coverage of R functionality and CRAN packages.

The TERR Developer's Edition is currently a console-only version, because we expect R users to continue to develop in their R environment of choice, and then to test their code in TERR Developer's Edition prior to deployment and integration. The TERR Community does include advice on using TERR with some popular R interfaces, such as ESS-Emacs and Notepad++.

#### **INTEGRATION OPTIONS FOR TERR**

TERR provides three levels of integration options:

##### **TERR in Spotfire**

- For: Ad hoc tools and interactive applications powered by advanced full benefits of Spotfire Analytics platform:
  - Interactive visualization and data discovery
  - Easy building and sharing of applications and leveraging of broad data access

##### **TERR in Statistics Services**

- For: Distributed analytics
  - Managed pools of engines
  - Load balancing, queuing, failover, parallelization, etc.
  - High level APIs for loose custom integration, data i/o (C#, Java)
  - Central management of analytics, R packages

### Embeddable TERR Engine

- Custom (tight) integration, batch, existing grids, etc.
  - Faster than R, more robust, better memory management, fully supported
  - Low level APIs for tight integration

TERR has wide integration across the TIBCO platform, enabling customers to deploy consistent analytics across their organization:

- TERR is embedded in Spotfire Professional, where it powers the predictive modeling tools.
- TERR can also be embedded in Spotfire applications, to make the power of advanced analytics available to all Spotfire users to enhance their decision-making. To enable this, it can be called locally under Spotfire Professional, or remotely through Statistics Services.
- TERR can be embedded in TIBCO BusinessEvents® for complex event processing to provide a scalable, high-throughput, low-latency analytic service for real-time applications such as fraud detection and customer scoring.
- TERR can post messages to TIBCO's enterprise social networking product, tibbr, enabling TERR/R users to collaborate with their peers, share their results to contribute to ongoing discussions, and easily send notifications of long-running analytic results.

### TIBCO AND THE R COMMUNITY

As the commercial provider of S+ since the acquisition of Insightful in 2008, we are uniquely suited to contribute to the R community, building on the long history of collaboration within the joint R/S+ community. Our contributions include:

- Making the TERR Developer Edition freely available for non-production use by all R users
- Providing the TERR Community as a support and collaboration forum
- As we develop new functionality in TERR or port functionality from S+, releasing these capabilities as CRAN packages or directly to R authors so that R users can develop in OS R and deploy in TERR.
  - This includes S+SeqTrial, S+FlexBayes, and time series packages.
- Supporting of the R Foundation
- Co-sponsoring of useR! Conferences
- Continuing to contribute to R Core—as we develop TERR, we share our observations and identified bugs with the R Core team, so that open source R development can benefit from our investment.

TIBCO is committed to helping our customers leverage their investments in R and S+, as well as other analytic environments, to solve high value problems and make better decisions across their organization.

- Deployment of R/S+, as well as SAS and MATLAB, scripts through TIBCO Spotfire
- Collaboration with partners building customer solutions on R and S+
- Ongoing support of S+, R's commercial sibling based on the same S language originally developed at Bell Labs

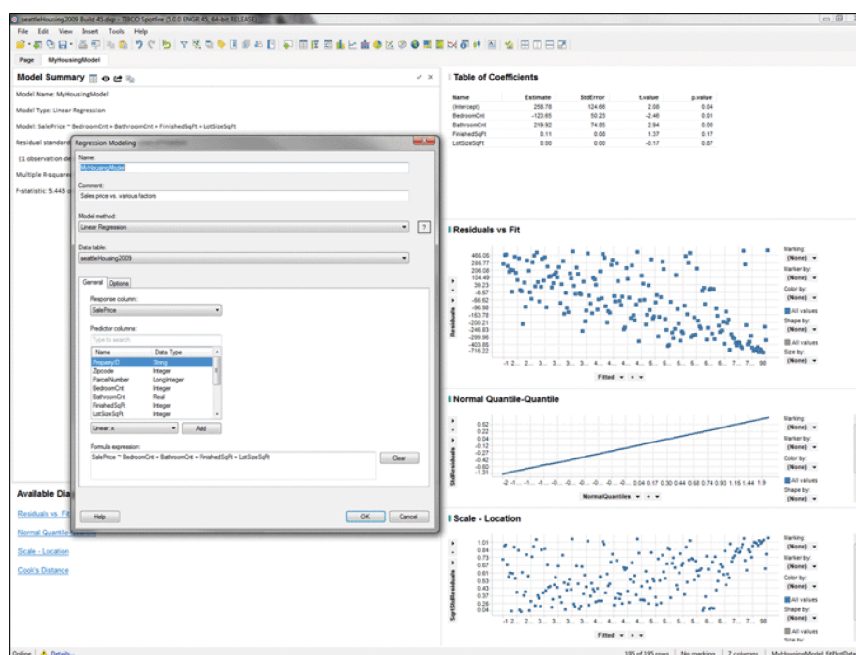


TIBCO strongly supports open source software development, which sparks creativity, innovation, and productivity, benefiting users, developers, and vendors. Beyond our work with the R Community, TIBCO has made major contributions to the OSS community, including releasing Ajax General Interface source code to the Dojo Foundation, and the core of the TIBCO PageBus to the OpenAjax Alliance.

## PREDICTIVE MODELING TOOLS

Predictive modeling tools in Spotfire provide deep predictive insights into your data as part of ad hoc analysis. These tools support a full workflow for “real” predictive modeling, and enable you to create, evaluate, and iterate predictive models, while leveraging the full interactivity and powerful visualizations of the Spotfire platform. You also can test models on existing data, apply predictions to new data, and embed predictive models in applications—all without requiring any R/S+ programming.

These predictive modeling tools—linear and logistic regression, classification and regression trees—are available in Spotfire Professional. They are located directly in the Spotfire menu and execute locally, using the TERR engine behind the scenes. Statistics Services is not required to use the tools for ad hoc analysis, but it does enable models developed with these tools to be deployed to applications running in the Spotfire Web Player.





## FOR MORE INFORMATION

### TIBCO SPOTFIRE WEBSITE:

<http://spotfire.tibco.com>

### TIBCO SPOTFIRE DEMO LIBRARY:

<http://spotfire.tibco.com/home/demos>

### TRENDS AND OUTLIERS - TIBCO SPOTFIRE'S BUSINESS INTELLIGENCE BLOG:

<http://spotfire.tibco.com/blog/>

### TERR COMMUNITY SITE:

<https://www.tibcommunity.com/community/products/analytics/terr>

## CUSTOM ADVANCED ANALYTIC TOOLS

Spotfire is an extensible platform, so customers can also create their own, custom advanced analytic tools in the Spotfire platform, through C# coding in the Spotfire interface, and script their analytics. These analytics can be written in R and run locally using TERR, or written in any of the analytic engines that comprise the Spotfire Predictive Analytics ecosystem, and executed remotely using Statistics Services.

This enables Spotfire users to provide custom tools highly targeted to specific users and workflows to improve their productivity, and leverage their existing investments in R scripts and other advanced analytics.

