MODELING DYNAMIC SYSTEMS OF CREATIVE INDUSTRIES: THE CASE OF FILM INDUSTRIES

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ABSTRACT

MODELING DYNAMIC SYSTEMS OF CREATIVE INDUSTRIES: THE CASE OF FILM INDUSTRIES

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Dynamic complexity occurs in every social structure. Film industry, as a type of creative industries, constitutes a dynamic environment where uncertainty is at high levels. This complexity of the environment renders the more traditional operations research models somewhat ineffective, and thus,requires a dynamic analysis. In this study, a model showing the dynamics of film exhibition is given. The interactions within and between the theatrical and the DVD sales channels are implemented by the model. Later on, the possible effects of piracy to the model are discussed, using the inferences obtained by the created model. The model is examined with scenario and sensitivity analysis. All the modeling studies are done with a commercial dynamic systems modeling software. The model also can be extended for the whole film industry, or for some other creative industries like the publishing industry.

Keywords: System Dynamics, Dynamic Modeling, Complex Systems, Film Industry, Hollywood, Creative Industries, Cultural Industries, Piracy, DVD

ÖZ

YARATICILIK ENDÜSTRİSİ DİNAMİK SİSTEMLERİNİN MODELLENMESİ: FİLM ENDÜSTRİSİ VAKASI

Oruç, Sercan

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Dinamik karmaşıklık her sosyal yapıda bulunmaktadır. Yaratıcılık endüstrilerinin bir kolu olan film endüstrisi de, belirsizliklerin yüksek seviyelerde olduğu dinamik bir çevre oluşturmaktadır. Bu dinamik çevre, daha geleneksel yöneylem araştırması modellerini bir ölçüde etkisiz kılmakta ve dinamik bir analiz ihtiyacı doğurmaktadır. Bu çalışmada film gösterimlerinin dinamiklerini gösteren bir model verilmiştir. Model, sinema ve DVD satış kanallarının kendi içlerinde ve birbirleri arasındaki etkileşimleri içermektedir. Model aracılığıyla elde edilen çıkarımların ardından, korsan dağıtımların modele yapacağı olası etkiler tartışılmaktadır. Çalışmanın sonunda model üzerinde senaryo ve hassaslık analizleri yapılmıştır. Tüm modelleme çalışmaları ticari bir dinamik sistem modelleme yazılımı kullanılarak yapılmıştır. Model tüm film endüstrisini ya da basım endüstrisi gibi başka yaratıcılık endüstrilerinde kullanılmak üzere genişletilebilir.

Anahtar Kelimeler: Sistem Dinamiği, Dinamik Modelleme, Karmaşık Sistemler, Film Endüstrisi, Hollywood, Yaratıcılık Endüstrisi, Kültür Endüstrisi, Korsan, DVD

To My Family

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CHAPTER 1

INTRODUCTION

In most developed countries creative industries are the most important source of economic growth, trade, and employment. In the European Union, from 1999 to 2003, "the overall growth of the creative sector's value added was 19.7 percent." "Its turnover amounted to over €654 billion in 2003, contributing to 2.6 percent of the European Union's gross domestic product (GDP) and accounting for 3.1 percent of total employment, or 5.8 million jobs." The estimations of UNCTAD (United Nations Conference on Trade and Development) show that in 2005, the international trade of creative goods and services reached $445.2 billion which was at the level of $234.8 billion in 1996. [78]

Although there is no unique definition for the term "creative industries," the common property of all definitions is that creative industries are connected with the goods and services that essentially use intellectual capital. For instance, The World Bank identifies the creative industries as "software, publishing, design, music, video, movie making, and electronic games" which contain prominent intellectual elements of products or services. [103]

Clearly, creative industries with their variety and imaginative implementations constitute a most complex and dynamical system. System dynamics is a methodology for studying complex feedback systems. With this methodology, tangible and intangible components of a system can both be used in system modeling. After sketching feedback loops, accumulations, flows, and boundaries, which together show the components of the system, and their interrelations and dependencies, the model is simulated in order to observe its behavior. The consistency of the model's behavior

with the real world behavior gives us the ability of testing some policies, changes or modifications on the complex system via the system dynamics model.

Creative industries and the industries within it can be given as examples of social systems. Forrester portrays that social systems are in a class called "multi-loop nonlinear feedback systems [34]." Also Schroender comments that system dynamics "...appears to be particularly well suited for modeling nonlinear feedback systems a class of systems in which lies virtually all of social phenomena [95]." With a parallelism to these ideas, we think that "creative industries" is a good field to be studied with the system dynamics methodology.

Yet, the term "creative industries" covers a wide range of industries, each of which has different characteristics. These characteristics are sometimes not in terms of the structure, but at least in terms of the system parameters. Hence, it was essential to select a particular industry for the purpose of model implementation. For the implementation part of the study, we worked on the film industry. The effects of piracy in the film industry influenced our thoughts and focus. We thought the Hollywood Film Industry is a good starting point for a variety of reasons. Being little affected by piracy within the USA, and being the oldest and largest film industry in the World are some of these reasons.

In Chapter 2 the properties, the history, and the structure of the system dynamics are given. In addition to these, the elements of system dynamics modeling and the model building process are considered. In Chapter 3 various definitions of the creative and the cultural industries are given. Later on, the fundamental economic properties of creative industries are listed. Lastly, this chapter covers the film industries, specifically the Hollywood Film Industry. Chapter 4 mainly is about the literature on the piracy issue. The chapter also gives information about the organizations fighting piracy. In Chapter 5 the dynamic model for the Hollywood Film Industry is given. First, the data set used for the analysis is explained in Chapter 5. The model is given in two parts: the theatrical sector and the DVD sector. First the theatrical sector is explained without the interactions of theatrical and DVD sales. Then, in the following (DVD sector) section the complete model is given. The piracy sector is not modeled, yet, discussed in Section 5.4. At the end of Chapter 5 sensitivity and scenario analysis are given. Conclusions and future research recommendations are given in Chapter 6.

CHAPTER 2

SYSTEM DYNAMICS

In this chapter we will briefly discuss the properties, the history, and the structure of the system dynamics. Later on, we will talk about the elements of system dynamics modeling and the model building process.

2.1 System Dynamics as a Tool

Ashby [11] defines complexity as the quantity of information required in order to describe something. Applying this description to a system, complexity depends on the numbers of elements and the interactions among these elements which particularly form the system.

Dynamic complexity refers to situations where "cause and effect are subtle, and where the effects over time of interventions are not obvious [80]." In an environment with dynamic complexity, same action creates different results at different times, i.e. in the short term and the long term. Yet, dynamic complexity of a system is not necessarily about having many components in the sense of, say, a Traveling Salesman Problem (TSP) does. The complexity of TSP kind of problem is called detail (or combinatorial) complexity. The source of combinatorial complexity is the tremendous number of possibilities. On the other hand, dynamic complexity may occur with only a few interacting components. This interaction among components may create dynamic complexity via time delays, feedback loops, accumulations, nonlinearities, and so on...

"Counterintuitive behavior of social systems" is the phenomenon that Forrester mentions in his article which has the same name. The phenomenon is about creating new problems while trying to solve a problem, making a state worse while trying to make it better... This phenomenon also arises from the characteristics of complex dynamic systems which include all kinds of social systems. [34]

Complex systems have "high-order, multiple loop, nonlinear feedback structure [33]." Because of their nonlinear structure, it is difficult to deal analytically with complex systems. So, the most often used technique for understanding and for improving in complex systems is experimentation.

Gaining experience and using experimentation in social systems is costly, time consuming and sometimes unethical as the human mind is not capable of evaluating the interactions among different elements in a complex system. This leads to the need for more effective ways of dealing with complexity. As a consequence of this, with an initiative of a group of scientist from various disciplines – mathematics, biology, philosophy, and communication theory – a new way of thinking called 'system thinking' has evolved since 1940s in order to deal with the complexity of systems effectively. This new way of thinking was a shift in focusing on the whole rather than on the parts of systems.

After those years names like Churchman [19, 20] , Ackoff [1, 2, 3, 4], Checkland [17, 18], Jackson [39] , and Daellenbach [25] contributed to the area.

In 1958, the first article on system dynamics was written by Jay Forrester [32]. As the article was written in order to improve the understanding of industrial processes, the title "industrial dynamics" was used. In this article Forrester defines industrial dynamics as "*a quantitative method of analysis developed to predict effects caused by changes of organization or policy by a business firm. A dynamic model can be created which illustrates the effects of organizational structure, policy and delays (in decisions and actions) on stability and on competitive relationships and growth. All functional areas of management, although conventionally analyzed independently, are represented in the model by time varying flows of information, orders, material, capital equipment, money and manpower* [32]". Later on, "industrial dynamics" was identified as a misnomer as the methodology started to be applied to all kinds of complex systems, hence "a better name is System dynamics [35]."

Barney [12] says "*Although most public officials are probably not explicitly aware of it, their experiments involve three separate and distinct steps. The official first brings to mind his latest mental image of how the system operates; he then uses his mental model to deduce the effects of the proposal; and finally he judges his deduction of the effects against his set of values and goals.*" The distinction of these three steps gives the chance of understanding the source of disagreements over a proposal, whether it is the mental image (model) of different stakeholders, deduction of the effects, or the set of values and goals. These three steps are considered inherently in dynamic systems modeling. First, the mental model is to be generated explicitly with the help of computer technology. Model generation lets other people to make contributions to the mental model. After the first step, the effects of the proposals are deducted more precisely without changing the basic structure of the system. And finally, applying the alternative policies or other types of modification to the system and deducing the effects, the results are discussed and evaluated as to whether they are desirable or not.

The goal in system dynamics modeling is to have a model such that it behaves the same way as the real system. Having an appropriate model would help to obtain alternative results from alternative decisions and actions. As Meadows et al. [54] mention "the challenge is to create compact and vivid model to raise (local public) awareness." Creating the "compact and vivid" model and simulating it would eventually provide understanding of how the parts interact, how the system operates and how the potential problems may occur.

Examining the issues from multiple perspectives, expanding the boundaries of our mental models (images) to consider the long-term and unintentional effects of our actions, including their environmental, cultural, and moral implications is a primary principle in system dynamics. [55]

2.2 Structure of System Dynamics

In this section we will mention the difference between event-oriented thinking and feedback systems thinking, and the types of feedback loops which shape the structure of the system dynamics.

2.2.1 Event-Oriented Thinking vs. Feedback Systems Thinking

Morecroft [56] distinguishes between event-oriented thinking and feedback systems thinking. Event-oriented thinking is a simple, linear and myopic way of thinking in which the main concern is to solve the problem in the easiest way possible. The action taker evaluates the inconsistency between the goal and the situation which defines the problem, then makes his decision about which action to take for the solution. *The solution for the congestion problem in the city is to construct four lane roads and underpasses for cars* is an example for event-oriented thinking. Figure 2.1 shows the mental model for the event oriented world-view.

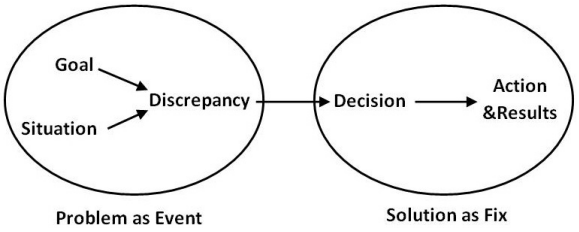

Figure 2.1: Event-oriented world view [56]

On the other hand, feedback system thinking is concerned with not only the problem but also its environment; the stocks (levels), the flows and the causal loops. The main idea in feedback systems thinking is that "problems and solutions coexist and are interdependent." Considering the same example given before; *initially, the construction of new roads and underpasses would decrease the travel time. This would attract more people to use private cars, and result in a decrease in the use of public vehicles. This would increase the number of cars in the city.The increase in the number of the cars would again create congestion in the city.* This example shows that feedback systems thinking is a circular rather than a linear way of thinking. As a result of this, the actions have cumulative and sometimes intended and often non-intended effects. Figure 2.2 shows the mental model of the world-view from a feedback perspective.

In complex systems, the interconnection and dependency of elements are not always clear. This problem is identified as *externality*. Externalities occur whenever a

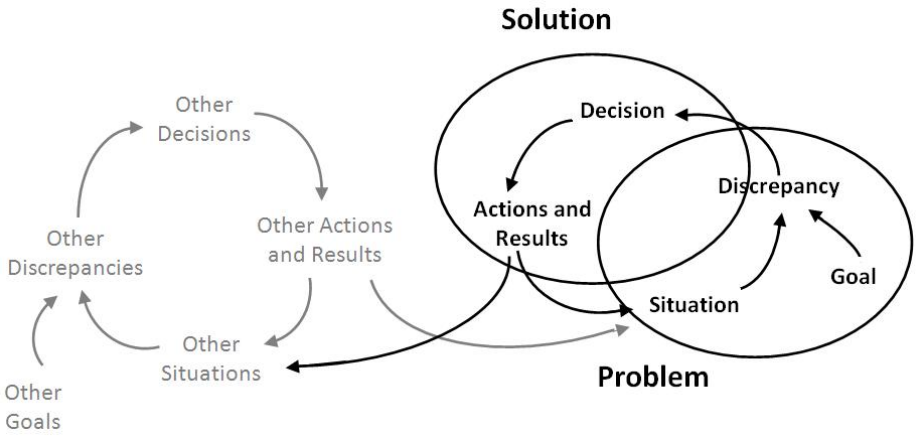

Figure 2.2: A feedback perspective [56]

person's decisions and actions alter the frame of reference for others [77]. Decision makers cannot calculate all the effects of their actions resulting in a frequent emergence of inefficiencies. In addition to this, as different individuals or groups can not see these dependencies, the stakeholders routinely choose suboptimal solutions for their local problems which, as a total, is not efficient considering the whole potential of benefits. [56]

Feedback systems thinking explicitly represents the hidden interconnections and dependencies which create the externalities. Yet, the insufficient comprehension of dynamic complexity would lead the decision makers to behave as they are facing externalities. [83]

2.2.2 Feedback Loops

Beside accumulations, flows, time delays and nonlinearities, feedback loops create the dynamics of a system. These feedback loops determine the interactions among the elements of a system. There can only occur two types of feedback loops in a system, namely positive and negative feedback loops.

Positive (reinforcing) loops are self-reinforcing [84]. These loops continually increase the associated values of the system elements. Assuming there is always enough food for a type of animal in an environment, the number of newborn animals and the animal population is in a positive loop. As the animal population increases, the number of newborn animals increases which also triggers an increase in the number

of animal population. Positive loop structure and the corresponding behavior can be seen in Figure 2.3. The label R in the center of the first figure comes from the reinforcing feedback term.

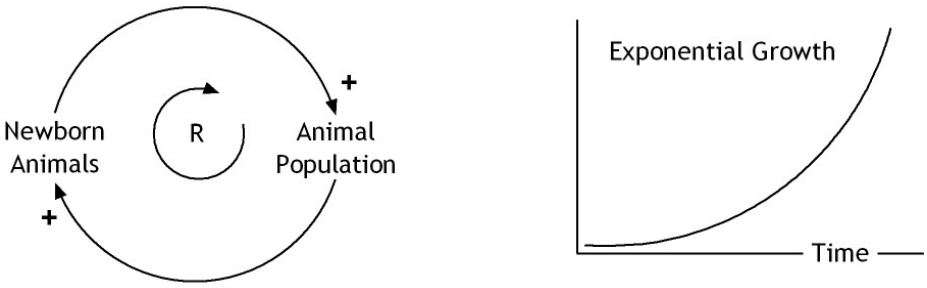

Figure 2.3: Positive Feedback Loop and the Corresponding Behavior, adapted from [84]

Negative (balancing) loops are self-correcting [84]. These loops evoke contrary actions within the system. Considering the previously given example, if the food is sufficient for only a limited number of animals, which can be considered as the carrying capacity of the environment, then an increase in the number of animals will lead to an increase in the number of deaths which arise from insufficient food. Consequently, a decrease in the number of animals results. Negative loop structure and corresponding behavior can be seen in Figure 2.4. The label B in the center o the structure figure comes from the balancing feedback term.

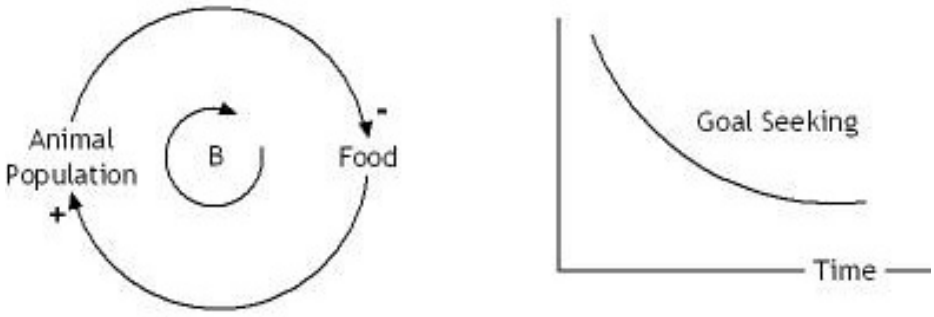

Figure 2.4: Negative Feedback Loop and Corresponding Behavior, adapted from [84]

Other fundamental structures in system dynamics modeling can be seen in Figure 2.5. When exponential growth reaches a limit, s-shaped growth occurs. Initially, the behavior of reinforcing loops is seen, and later, the behavior of balancing loops is observed. If there is delay in a balancing loop then an oscillatory behavior is observed. Sometimes when the exponential growth reaches a limit and somehow the system perceives it with a delay, then the behavior of "growth with overshoot" is observed. If the limit is a floating goal in the growth with overshoot mode, then an overshoot and collapse behavior occurs. Although the behaviors shown in Figure 2.5 does not cover all the possible behaviors, it is valuable to see that all the behaviors can be explained with some combination of positive and negative causal loops. Also delays may affect the behavior in a significant manner [56]. Delays, by definition, are non-linear phenomena that cause qualitative differences in system behavior.

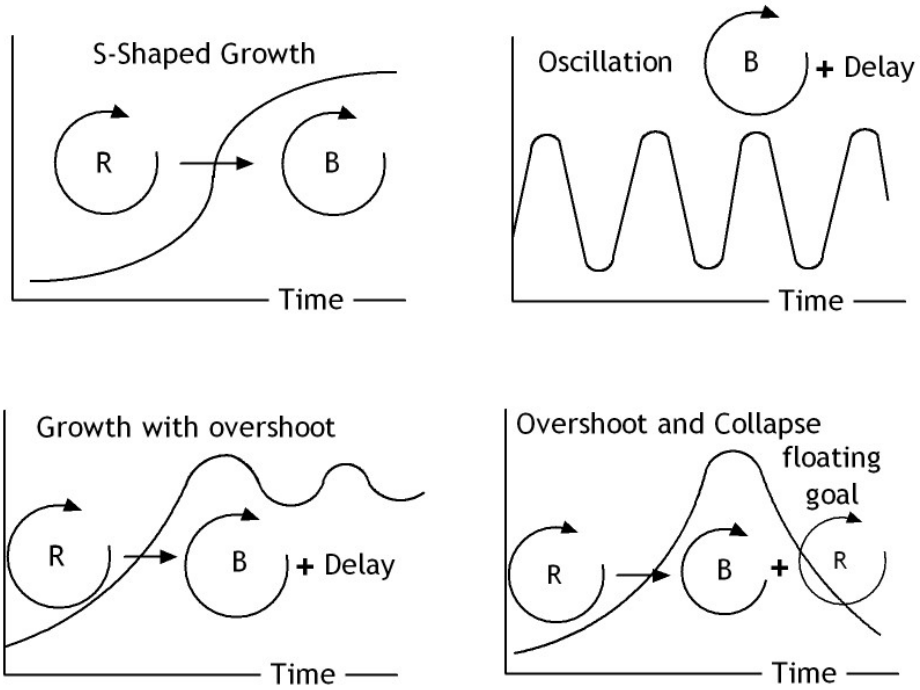

Figure 2.5: Fundamental structures except positive and negative feedback [56]

2.3 System Dynamics Modeling and its Elements

Stocks (Levels or Reservoirs): show the accumulations in the model. They are where the "things" are stored. Stocks have a significant role in feedback loops in dynamic systems. "In a dynamical system every feedback loop must contain at least one stock accumulation that stores the changes generated around the loop [56]."

Flows (Rates): determine the accumulated change over time. They define the inflows and outflows to and from reservoirs.

Converters (Auxiliaries): are used to apply some changes in the model like unit conversions or represent other types of algebraic equations. They also may store information of external parameters in order to be used in the model.

Connectors: show the actions or information flows among elements.

In Figure 2.6 the elements used in a system dynamics model are sketched with the STELLA software package.

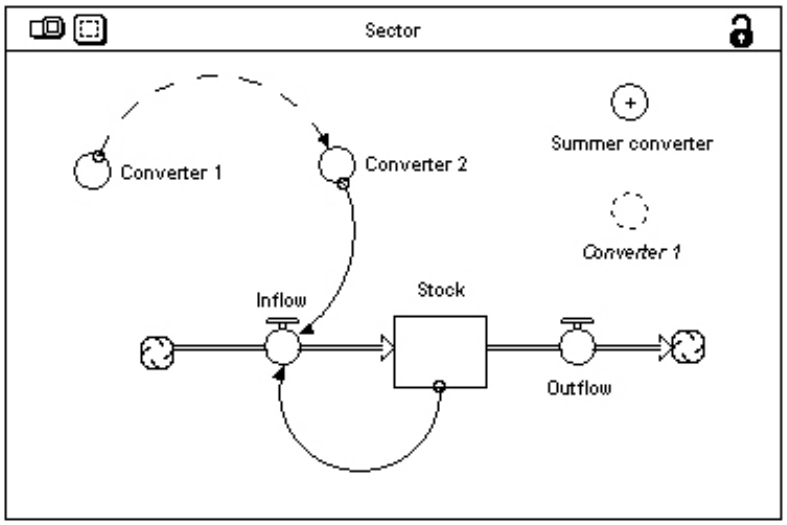

Figure 2.6: Elements of system dynamics modeling

The connectors drawn with solid lines show the action connectors (causal links) whereas the connector with a dashed line shows the information connector (information flow). Algebraically there is no difference between these two types of connectors. Yet, it is worthwhile to use both types to express clearly how the system works.

Summer converter is a type of converter which does not need to be connected to other elements. It is generally used for performance indicators, summary report indices, etc.

Duplicate converters are used in order to reduce visual complexity. In Figure 2.6 "converter 1" is drawn twice. The one drawn with dashed lines is the duplicate (ghost or clone) of the one drawn with solid lines. The underlying equations for both converters are the same.

The cloud symbol on one side of the flow shows that the source (for inflow or the sink for outflow) is outside the boundary of the model. If the source is to be included in the model, within the model scope and boundary, the cloud symbol should be replaced by a stock.

2.4 The Model Building Process

Although an iterative process of model building is done in order to investigate real world situations and attain new knowledge, a model does not need to be a copy of the real world. Sterman [84] defines 5 steps of modeling which are iterated many times during the modeling process. These steps are:

1. Problem Articulation (Boundary Selection)
2. Dynamic Hypothesis
3. Formulation
4. Testing
5. Policy Formulation and Evaluation

Contrary to the methodologies that only focus on identifying the ideal future, system dynamics first models the present and then tries to find ways to improve it [36]. The modeling process is shown in Figure 2.7. The interconnections in the center of the figure mean that the iteration may occur from any step to any other step.

In step 1, the problem is defined. The subject matter under consideration, its historical behavior, the time window to be considered, and the anticipations for the key factors within the boundary of the study are also determined. [56]

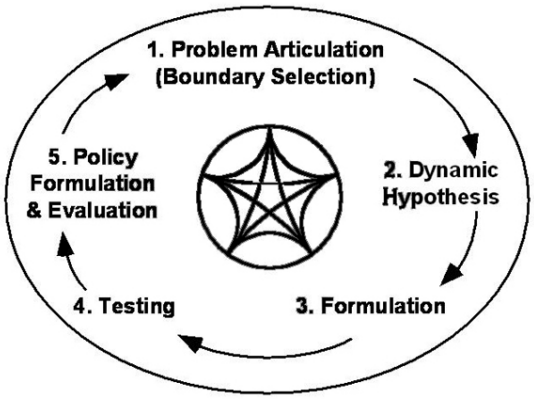

Figure 2.7: Modeling is an iterative process [84].

In step 2, problematic behavior of the concerned subject matter is mapped. Stocks, flows, converters and their connections, so the causal loops are formulated in this step.

In step 3, the underlying algebraic equations, parameters, and the decision rules are determined [56]. Listing the equations shows the inconsistencies and gaps in the mapping of the concerned subject matter [36]. The emergence of these gaps forces the modeler to return to step 2. After passing these three steps the model passes the logical criteria, "*such as all variables being defined, none defined more than once, no simultaneous equations, and consistent units of measure* [36]."

In step 4, the model is simulated in order to see whether it is consistent with the real world or not [56]. The modeler frequently returns to the first three steps from this step in order to fix the interrelations and equations. Forrester comments that these repeated returns would continue, until the model becomes "adequate" for *the purpose under consideration.* Adequacy does not mean validity. Validity of theories that show the behavior of nature cannot be proved as in the example of physics laws [32]. Forrester continues in his comment that only a degree of confidence in a model is achievable, and the best way to do it is by comparing the model with its best alternative which is usually mental models of the people within the real system [36].

If the tests verify that the model follows the dynamic behavior of the real world situation, i.e. giving the symptoms of the real world problem when creating the same environment in the model, alternative policies are applied to the model in step 5. Simulating the model with these policies would allow us to evaluate the expected performance of these policies. [56]

CHAPTER 3

THE CREATIVE AND THE CULTURAL INDUSTRIES

In this chapter, first we will give various definitions of the terms "creative industries" and "cultural industries". Following these definitions, fundamental economic properties of creative industries will be given. Thirdly, we will touch upon the film industries. And, we will finish the chapter giving information about Hollywood Film Industry which is our application domain.

3.1 Definition

The expansion of the cultural and creative industries terminology arose in Europe and Canada in the 1970s. While "the cultural and socio-political perspective" was a prominent point of the works in France, Canada was motivated by the competition of its cultural products, especially vis-a-vis the USA. [100]

Since 1970s, many institutions, organizations and governments touched upon the cultural and creative industries. Yet, sometimes used with the same meanings, there is no common definition for the terms "the creative industries" and "the cultural industries".

The United Nations Educational, Scientific, and Cultural Organization (UNESCO) defines the terms cultural industries, and creative industries differently. Cultural industries cover the specialty areas of the creation, production and commercialization of creative products and services. "The creative industries are sectors in which the product or service contains a substantial element of artistic or creative endeavor."

Included in these are "printing/publishing and multimedia/audiovisual, phonographic and cinematographic productions/crafts and design/architecture/advertising". [91]

The United Nations Conference on Trade and Development (UNCTAD) indicates the difference between the cultural industries, which are the commercialization of traditional activities and the creative industries, which are the creative components in other products or services and which cover book, journal and newspaper publishing, recording industry, music and theater production, motion picture industry, music publishing, computer software industry, photography, commercial art, radio, television and cable broadcasting industries. [89]

The International Labor Organization (ILO) includes the fields of television, film, music, visual arts, the performing arts, dance, ethno-tourism, and handcrafts in the creative industries. [40]

The World Bank identifies the creative industries as "software, publishing, design, music, video, movie making, and electronic games" which contain prominent intellectual elements of products or services. [103]

The Organization of Economic Cooperation and Development (OECD) differentiates "core of cultural activities" which contain cinema, live performance, plastic art and architectural heritage, "cultural industries" which contain books, audiovisual productions, records and disks, and "creative industries" which contain video games, design objects, fashion, musical instruments, architecture and advertising. [63]

In Singapore, for the creative industries, the definition of "those industries which have their origin in individual creativity, skill, and talent and which have a potential for wealth and job creation through the generation and exploitation of intellectual property" is used, which is given by the UK Creative Industries Task Force [88]. The cultural industries are defined as a subsection of the creative industries. Performing arts, literature and the visual arts are in cultural industries. In addition to these, advertising, design, print and media related activities are included in the creative industries. Also, the copyright industries cover the creative industries [86]. Figure 3.1 shows the representation of the mentioned industries.

Lisbon Strategy which targets making the European Union (EU) "the most competitive and dynamic knowledge based economy in the world, capable of sustainable economic growth with more and better jobs and greater social cohesion [85]" defines

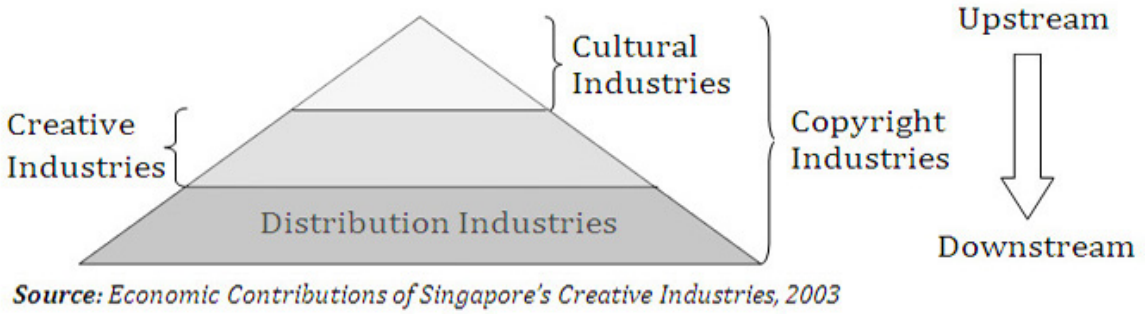

Figure 3.1: Pyramid chart showing the hierarchical list of the cultural industries, creative industries and the copyright industries [69].

four different areas: core cultural area, cultural industries, creative industries, and related industries. The definitions of these areas are as follows.

- The core of "non-industrial sectors" consists of non-reproducible goods and services. ("visual arts including paintings, sculpture, craft, photography; the arts and antique markets; performing arts including opera, orchestra, theater, dance, circus; and heritage including museums, heritage sites, archaeological sites, libraries and archives")

- The cultural industrial sector or the cultural industries comprise cultural products and services destined for the mass market or export. ("a book, a film, a sound recording, film and video, video games, broadcasting, music, book and press publishing")

- The third area of creative industries, the "relative sector" understands culture to be the creative input into the production of non cultural goods ("fashion design, interior design, and product design, architecture, and advertising"). Creativity in this sense is a cultural resource - for example, regarding innovation - in the production process of the non-cultural industries.

- The forth area of "related industries" consists of crossovers with other sectors (such as information and communication technologies or ICT), which the European Union [85] study was not able to precisely examine.

Department of Culture, Media and Sport (DCMS) of the UK uses the same definition as the UK Creative Industries Task Force which is given earlier in this chap-

ter. “Advertising, architecture, art and antiques markets, computer and video games, crafts, design, designer fashion, film and video, music, performing arts, publishing, software, television and radio” are included in the creative industries. [85]

3.2 Fundamental Economic Properties

Although the creative industries cover a number of various creative activities and industries, they have some common economic properties. Richard E. Caves [16] lists the “basic economic properties of creative activities” under seven categories.

1. *Demand is Uncertain:* The value of a new product is assessed by the consumers. This value is not known before that product is produced. For this reason, activities of a new product creation involve a significant level of risk. Some creative products generate revenue far above the production cost and some products may be demanded for only by a small number of customers. When the creative product is costly as in the example of movies, the producer evaluates the anticipated demand before completing the creation of that particular product. Even in this case, as some explanatory steps are taken, there exist some amount of sunk cost.

2. *Creative Workers Care about Their Product:* In general, for a person working in a job, it is assumed that the most important factors for the worker are money that will be paid to him, the working conditions of the job, and the needed effort for the job. In general, the properties of the output provided that the required level of quality and quantities are achieved, is of secondary importance. Yet, the creative workers (*skilled craftspersons, artists etc.*) give considerable importance to the quality of their work. This sometimes results in using excessive effort.

3. *Some Creative Products Require Diverse Skills:* In opposite to the example of drawing, many creative products require a team formed by workers having different talents and abilities. This results in contradicting preferences, often suppressed by the preferences of the managing artist, as with the director in the example of film production. The relationship among the workers is referred to

as the O-rings theory of production by Michael Kremer [46]. Caves calls this relationship the multiplicative production relationship, which implies that all of the workers have some duties to perform, and if these duties are not performed by any of these workers, the product cannot be created.

4. *Differentiated Products:* Caves makes the distinction between vertical and horizontal differentiation of creative products. Take the comparison between two movies as an example. If people go and watch these movies and later on decide that one of them is better than the other, and if the price of watching these movies is the same, then the viewers would choose the better one to watch. This is called the vertical differentiation. Even if the audience likes both of the movies to the same degree, as these two movies are not the same, some people would prefer to see the one and some would prefer to see the other. This is called the horizontal differentiation.

   The differentiation in creative products is mostly horizontal as there are many properties determining the quality of the product. A viewer may like horror movies more than science fiction movies, although she also may prefer watching a science fiction *movie A* rather than a horror *movie B*, because she likes an actor playing in movie A, for instance. Caves reasons this as a consequence of *the infinite property.* "The paintings that could be painted are infinite."

5. *Vertically Differentiated Skills:*This refers to the idea that the quality of creative activities of individuals differs from person (artist) to person (artist). In film industries, the actors are classified as stars or non-stars. The screenwriters, directors and producers are clustered as "A list" and "B list" in Hollywood. These classes or rankings in general terms, not only put forth one of the reasons of uncertainty in creative industries, but also affect the incomes of creative workers.

6. *Time Is of the Essence:* As most of the creative activities performed with teams of creative workers, the coordination and management of these teams become harder. Concerts are announced and prepared to be held at a particular time. During these preparations, necessary creative inputs at necessary times should

be ready to be exerted. Otherwise the target release may be delayed. And this results in monetary losses.

7. *Durable Products and Durable Rents:* This property is about the incomes from the copyrights of the products. The original producers or performers collect some small money, which form a more significant value over time, for the use of their creative products.

3.3 Film Industries

In our study we examined film industries, particularly the Hollywood Film Industry. As "film industries" is a type of creative industries, it also shows the fundamental economic properties of creative industries. The estimated value of film industries is $75 billion worldwide [90]. The advantage of studying the film industry is that there are many online sources of data. These sources give not only industry-related data but also various data related to any selected movie.

The Creative Economy Report 2008 of the United Nations [90] shows that $55 billion of the estimated value of the film industry is from the production and sale of DVDs. In addition to the DVD sales and rentals, the report lists the revenue channels of film industry as "box-office sales domestically and abroad, music rights, television and satellite rights, video and Internet rights, merchandising, CD [...] rentals plus copyright fees for reproduction." These figures show the importance of DVD channel as well as theatrical channel of releases in addition to the film related legal issues.

There are many film industries in various countries. India is one of these countries. Although India is the largest film producer in the world with the production of 1000 commercial films in a year, Hollywood productions cover 85% of all films exhibited in the world [90]. This is one of the reasons why we particularly chose the Hollywood Film Industry in our study. Another reason can be given as follows. Although all of the film markets in the world are affected by the piracy issues to some extent, the United States market is less affected compared to the other major markets [15].

Not India but Hollywood is the dominant actor in international exhibitions as India produces mostly for the domestic market and Hollywood has better distribution

channels. Other significant actors in the world film industry are China, Japan, and Republic of Korea in Asia, Nigeria in Africa and Argentina, Brazil, and Colombia in Latin America [90].

In terms of national market share, Turkey is the leading European country with 51% share. With 32.7% local market share, Sweden is the leading country among EU countries. In addition to these, the admission data of 24 EU counties shows that Germany (+16.9 million, +13.1%), France (+10.9 million, +5.7%), the United Kingdom (+9.3 million, +5.6%), and Poland (+5.4 million, +16.1%) indicated the most prominent growth in 2009. [21]

3.4 The Hollywood Film Industry

The Hollywood Film Industry and in general, film industries are studied by many researchers with different approaches. Wasko [99] distinguishes three different research areas focusing on the business of Hollywood. These are *political economy*, *media economics*, and *cinema studies*.

Mosco [57] defines *political economy* as "the study of the social relations, particularly power relations, that mutually constitute the production, distribution and consumption of resources." The definition is expanded with some basic characteristics of political economy, which are social change and history, social totality, moral grounding and praxis. Social change and history refers to the dynamics of economies. Social totality explains that the political economy explores all the relationships among the elements of social systems. Moral grounding is the characteristic of the political economy that not only concerns the economics, but also the policy problems and the moral issues. Praxis refers to the idea that political economy is not just researching but presenting policies for social change. Wasko [99] studies the Hollywood Film Industry using this approach. Guback [38] is another example for a study concerning the political economy of film. In this study, Guback shows how Hollywood dominated the European film industries after 1945. *Movies and Money* [96] gives the evolution of the relationship between Hollywood and the financial institutions. *Hollywood in the Information Age* [97] introduces the continual change in the US film industry with the effects of new technologies during the 1980s. Also *How Hollywood Works*

[98] illustrates the production, distribution, and exhibition phases of the Hollywood film industry. *Hollywood for the 21th Century* focuses on the issues related to the concentration and globalization affecting the film industry [7].

Media economics is also used for studying motion pictures, which is a form of media. The first editor of Journal of Media Economics points out that "*Media economics is concerned with how media operators meet the informational and entertainment wants and needs of audiences, advertisers and society with available resources. It deals with the factors influencing production of media goods and services and the allocation of those products for consumption* [71]." Robert Picard (1989) [71], Alan Albarran (1996) [8] and Allison Alexander (1993) [9] et al. bring some examples of studies using this approach.

Until 1970s, cinema analysis was seen as a communication tool rather than an economic institution [99]. *Cinema studies* focus on criticism and theory of film industry.

Caves [16] analyzes different cultural and creative industries in terms of contracts and the logic of economic organization. The properties of contracts and organizational patterns observed in creative industries are analyzed in the book. This book also devotes a significant number of pages to film industries, particularly Hollywood Film Industry. Caves (2000) [16], Litman (1998) [49], and Vogel (2001) [94] describe the economics of the studio era, spanning the 1930s and 1940s.

De Vany and Walls [26, 27, 93] study the film industry economics from a perspective of the statistical distribution of film revenues. They used a sample of more than 2000 movies released between 1985 and 1996. In his book, Hollywood Economics [93] De Vany gives a comprehensive study on the high uncertainty of the economics of Hollywood. In his study he shows the effects of the rank and the exhibition length ("survival") of the movies on its revenue. He also studies the star effects and the R-rated movies. He results in that rather than stars or the opening power of a movie, how long the movie is exhibited is important for its high successes. In many parts of his book, he insistently emphasizes that an accurate prediction of revenue or profits of a movie cannot be done. The reason for this, he says, is that the revenues are distributed according to the stable Paratian model, which says that the mean does not converge, rather it diverges over all possible outcomes and the probabilities of extreme outcomes are significant.

Rosen (1981) [76] studied the effects of stars on either the revenues or the profits of creative products. Adler (1985) [6] and MacDonald (1988) [51] also studied the concentration of market outputs on a few number of artists.

3.4.1 History of the Hollywood Film Industry

John Sedgwick comments that the Hollywood Film Industry mainly has three phases in the history. Until year 1915, many large production companies were dominating the industry. These companies were paying royalties to the trust which was keeping all the essential movie making related patents. Independent production companies, which were not within the trust, were smaller than these dominating companies [79].

Just as today, the size of the attendance to the films could not be anticipated before they were released. As United States began importing European films in 1911 and the importance of film stars started to increase those years, the organization of the industry changed. [16](p.88)

After World War I, some small number of vertically integrated firms - MGM, Paramount, RKO, Twentieth Century Fox, United Artists, and Warner Bros. - began to dominate the industry as an oligopoly, supplying much of the feature films [16]. Companies like Columbia and Universal were supplying lower quality (B film) films which were being exhibited with better quality films (A film) [16](p.87). These firms were providing production, distribution, and exhibition of the movies [102]. This era which is also known as the times of "studio system", continued till 1940s. Many major stars were also the owners of production companies before the studio system. Yet, most of these stars became salaried employees in this era. In 1940s, the Paramount decision took place in the industry. With this decision the control of the production and the distribution processes were separated [79].

Today's structure of the Hollywood film industry started to shape after those years. According to Caves [16] (p.87), although the old studio names are still used by the distributors of feature films, few long-term contracts, as it was common in studio system, exist now. He adds that one-time deals are more common in todays Hollywood industry. Today, independent producers make long-term contracts with distribution companies who provide the distribution services [79].

Caves adds two more reasons, in addition to the Paramount decision, for the shift from studio system to "spot production". One of these is the rate of personal income tax during World War II, which supplied incentives for "the highly paid star to form her own company" in order to decrease her marginal tax rate from 90 to 60 percent [16]. This change created the prototype for the new organization of the industry [82]. The last reason Caves mentions is the arrival of the new entertainment technology, namely the television. Two thirds of the houses owned a television in America by 1955. B films started to be used in televisions. This change forced the studios to invest in cinema films to have higher quality. Leading to fewer and distinctive films, this change disturbed the use of "high fixed cost departments to make properties and costumes, design make up and other auxiliary skills [16]."

3.4.2 Hollywood Film Industry Today

The film production process contains "successive creative decisions". First, the story is created. The literary property owner recruits the key elements of film creation process; the director and the principle actors. Later on other specialists are hired and the actual filming is planned and scheduled. Following this step, post production, which includes editing the exposed film by the director and the editor with some others, takes place. At the same time a composer creates the soundtracks of the film. The final version is promoted and exhibited by a distribution company. Many of the contracts made with the exhibitors are made before the film is completed. After the exhibition of the film in North America, the film is exhibited through different channels like the exhibition in other countries, sale on DVD, and showing on cable, pay and network TVs. At each of these steps, new economic sunk costs are incurred. What is more, during all these steps the revenue that the film will generate is uncertain. Even the tests on the nearly finished films are unreliable. [16](p.103)

Financing of a film project can be done in two ways: by a studio or an inter-dependent company. The studio meets the costs of film production, manages the distribution and allocates the net profits to the the participants. Generally the studio takes 50 percent and other 50 percent is distributed to the producer and the other participants. [81]

After the production of movies, they are distributed to theaters (exhibitors), where the movies meet their audience for the first time. Other than the theaters (domestic and foreign) the exhibition channels are domestic (and foreign) home video (Sell-Through or Rental), and domestic (and foreign) television (pay cable, basic cable, broadcast networks, television stations, syndication, and pay per view).

According to MPAA Theatrical Market Statistics 2009 [66] the number of films release in a year is around 550. Number of U.S. films produced[1] and released in theaters[2] for years 2005 to 2009 can be seen in Table 3.1.

Table 3.1: Number of U.S. films produced and released in theaters (2005-2009) [66].

	2005	2006	2007	2008	2009
U.S. films produced	920	928	909	716	677
Films released in theaters	507	594	609	633	558

Table 3.2 shows the total box-office gross revenue, the total number of tickets sold, the average ticket price, the top-U.S.-grossing, and the top budget values for years 2005 to 2009.

Table 3.2: Gross, ticket, and budget statistics for years 2005 to 2009 (in Dollars) [61].

	2005	2006	2007	2008	2009
Total Box-Office Gross Revenue	8947M	9253M	9629M	9946M	10646M
Ticket Sold	1396M	1413M	1400M	1385M	1420M
Average Ticket Price	6.41	6.55	6.88	7.18	7.5
Top-US-Grossing	380M	423M	337M	533M	745M
Top Budget	207M	232M	300M	186M	250M

[1] "*Films produced is the number of full-length feature films beginning production in a given year, with a U.S. production company involved, including both U.S. productions and co-productions, not including documentaries* [66]."

[2] "*Includes all titles released that earned box office in the year* [66]."

CHAPTER 4

PIRACY IN THE AUDIO-VISUAL INDUSTRY

Mentioning that piracy has no legal definition, Diesbach [28] defines the term piracy as "copyright infringement through the illegal use of duplication, distribution rights et cetera by someone other than the rights holder who has no permission to do so."

MacGreevy [52] lists the types of piracy at three levels. These are Internet piracy (peer-to-peer "file sharing"), DVD piracy (mass replication and distribution), and DVD-R/CD-R piracy (widespread burning and distribution). MacGreevy gives data for worldwide seizures of DVD, VCD, VHS, DVD-R, and CD-R as in Table 4.1 and a graphic for the pirate items as in Figure 4.1.

Table 4.1: Worldwide Seizures for years 1999–2003

	1999	2000	2001	2002	2003
DVD	606,486	1,941,612	4,998,486	7,050,168	16,474,721
VCD	14,599,682	18,196,180	23,777,304	26,167,092	27,816,009
VHS	3,649,025	4,339,990	2,737,621	2,938,566	1,967,441
DVD-R	-	-	-	309,565	1,845,548
CD-R	-	-	-	4,513,856	6,149,335

Peer-to-peer(P2P) networks are the networks permitting the exchange of electronic files between two private parties. The use of these networks started in order to exchange music files. The exchange of movie files is less frequent compared to the exchange of music files. According to Nikoltchev [60], among many legal questions

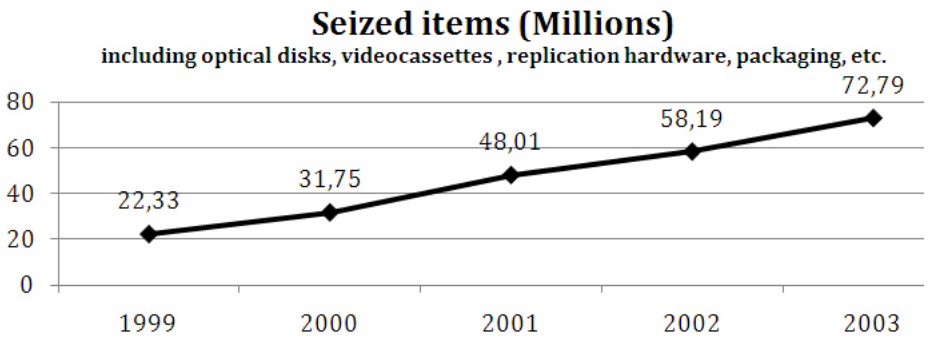

Figure 4.1: Number of Seized Pirate Items for years 1999 to 2003

which can be asked about P2P-related piracy, the first one is how to define this piracy. Nikoltchev adds that the issue is complicated both technologically and legally. She explains that a small change in the function of a file sharing software or which country's courts handle the claim might change the result of a court case. In her presentation, she gives a number of cases and supports her claims. She focuses on two rights, the reproduction right and the right to make available, which are recognized by WIPO Treaties and the EC Copyright Directive. "In principle, only the rights holders are entitled to make or authorize the making of a digital copy and only they have the right to offer music or film files over the Internet." The exception for this principle occurs in cases like private uses, use for teaching or scientific research.

The 8th issue of year 2000 of *IRIS - Legal Observations of the European Audiovisual Observatory* [5] gives many examples of MP3 related cases. These examples include cases from Belgium, France, Germany, Sweden, the United States, and also famous cases of MP3.com and Napster. The issue draws attention to the emerging questions about the scope of traditional copyrights in the future, which are also related to the legal limits of private and fair use under digitalization and the "desirability of promoting digital technology and Internet services".

There are many studies on the effects of piracy on the creative industries. A significant part of these studies are devoted to the piracy of digital products, namely books, software, music and video files. With an increase in the use of computers and the Internet in all aspects of daily life, the importance of studies on digital products is also increased. These studies are done not only by academic people but also by industry players. Three of organizations dedicated to anti-piracy works are IIPA

(The International Intellectual Property Association), IFPI (The International Federation of the Phonographic Industry), and MPAA (The Motion Picture Association of America).

The IIPA is an alliance of seven associations that was formed in 1984. These seven associations are Association of American Publishers(AAP), Business Software Alliance(BSA), Entertainment Software Association (ESA), the Independent Film and Television Alliance (IFTA), the Motion Picture Association of America (MPAA), the National Music Publishers' Association (NMPA), and the Recording Industry Association of America(RIAA). The mission of the alliance is "to improve international protection and enforcement of copyrighted materials and open up foreign markets closed by piracy and other market access barriers." It defines the boundaries of creative industries as business software, entertainment software, film, television and home video entertainment, music, and book and journal publishing. The alliance works in over 80 countries in order to deter piracy and to improve market access. One of the most important contribution of the alliance is that the IIPA regularly publishes reports about the copyright industries and the recommended implementations on its website (www.iipa.com).

The International Federation of the Phonographic Industry (IFPI) is considered as the most detailed sourced of information of the record industry [47]. The federation reports regularly on physical piracy and the effects of P2P. One of the three missions of IFPI is to "safeguard the rights of record producers." The federation has 1400 members in 66 countries and industry associations of 45 countries. Based in London, the International Secretariat of IFPI coordinates the international strategies of anti-piracy activities [68].

The Motion Picture Association of America (MPAA) works with a network of national anti-piracy organizations in order to obtain information about the film industry. It is considered as the most important information source concerning the film industry related piracy [47]. MPAA works cooperatively with EMEA (the European, Middle East and Africa Region) and the Motion Picture Association(MPA) which is the international counterpart of the MPAA.

Business Software Alliance (BSA) is formed by the organizations from world's commercial software industry. BSA has activities in more than 80 countries. One of the priorities of the alliance is protecting intellectual property (copyright, patents, tech mandates). The alliance pays importance to the education of the consumers as well as the tracking of the illegal uses of the softwares. [10]

The European Association for the Protection of Encrypted Works and Services (AEPOC) is an association fighting against the piracy of audiovisual services. It is formed by the organization from 4 entrepreneurial sectors: "Television Channels, Suppliers of Conditional Access Technology, Supplies of Transmission Infrastructures and Producers of Hardware." The association defines four main activities. Monitoring the involved situations, analyzing the European legislations and international agreements about "the protection of conditional access services", recognizing the flaws in existing regulations, and the promotion of new laws in order to tackle with the problems emerging with the changes in the market. [87]

In addition to these organizations, there are many national organizations working on piracy issues. AMPEC, The Russian Anti-Piracy Organisation (RAPO), and the German Federation Against Copyright Theft are some of these organizations. A detailed list can be found in Appendix E [62].

There are also plenty of academic studies on the piracy, copyright and the effects of file sharing related issues. The issue is studied by distinct disciplines, historically [72], economically [14, 104], politically [42, 105], legally [30, 31, 41, 43], philosophically [59], and sociologically [53]. We, in our study, mostly refer to the references related to the economics of film industry and piracy.

Peitz and Woelbroeck [70] give a comprehensive review about the economic literature of digital product piracy. They first give the characteristics of digital products that include book, software, music and video files. Technical quality of digital products are similar to the original products. Yet, the original products come with other components like booklets (pictures, lyrics etc.) or manuals that the copies do not have. They say that many digital products are complex that much information are needed in order to define them. So the consumers prefer to experiment or try first in order to value them, then buy that product. In addition to these, according to Peitz and Woelbroeck, interaction is an essential factor affecting the digital product

consumption. It may happen as in the example of interaction need in order to get standard information of a software, or interaction with people around the consumer informing which movies or albums they like.

Peitz and Woelbroeck [70] give the literature review in five sections. These sections give information on the analysis of product differentiation between original and copy, discussion on the "indirect appropriability" which arise from the case of benefiting of the copyright owner when his work is copied legally or illegally, "network effects" which lead to private or social benefits from not enforcing copyright protection, "partial consumer information", and "the relevance of some of the model ingredients for the analysis of software applications, online games, and digitally compressed music files". As this review is from 2003, it does not focus a lot on DVD and movie piracy. The reason for this is given as the volume of digital movie files are so high that downloading these files are time consuming and cumbersome, and the quality of copies are not comparable to the original products, in addition to the fact that original DVDs are hardware protected. Yet, with the rapid improvement in technology, communication and the Internet, the listed reasons become weakened.

CHAPTER 5

SYSTEM DYNAMICS MODEL: HOLLYWOOD FILM INDUSTRY

Domestic and foreign theaters, domestic and foreign home video, and cable and network TV are the main distribution channels for the film delivery business. Delays among the release dates in these distribution channels have significant effects on the total performance of a movie whether it is the revenue or the return on investment. Although there are many distribution channels, theatrical exhibition is considered as the most critical channel as it creates the buzz needed for the movie by high advertising spendings around the release time. In this study, we addressed the theatrical and the DVD sales channels because the highest revenues are obtained from these channels.

In this chapter, first we will give information about the data set that we have used in this study. Following this section, the model covering just the theatrical sales and the model covering theatrical and DVD sales will be explained consequently. After the piracy issue is discussed in Section 5.4, some brief information about the model run will be given. The last two sections present sensitivity and scenario analysis.

5.1 Data Types and Sources

We used a sample of 119 movies of 2008. Criteria for choosing these 119 movies were that these are all the movies of 2008 for which the data of *production budget*, and *domestic (U.S.) and international gross revenues* are available on a number of online

sources. For all these movies data of *theatrical release date*, *the number of reviews*, *IMDb rating*, *MPAA rating*, *whether the participants of the movie had taken an award or not*, and *whether the movie is a sequel or not* are also available. Finally, for most of the movies data of *DVD release date*, *how many weeks the movie was on theaters*, and *review rating* are known. The data set is in Appendix C. Each of these variables will be explained in the same order as in Appendix C.

Theatrical and DVD Release Dates, and Release Length

These data are gathered from the-numbers.com. This online database is supported by a Los Angeles based company Nash Information Services. Theatrical release dates show the release of the movies in the United States. The premiere dates were not taken as the release dates of the movies. Obtaining the release dates, the difference between these dates in weeks gave the delay time of DVD release. Release length is the number of weeks that a movie is in release.

F(t) and f(t) values at DVD release date

The F(t) value shows what percentage of total sales has occurred until time t. Whereas the f(t) value shows what percentage of sales has occurred in time t. Time unit is week. The database the-numbers.com offers the daily sales data for most of the movies in our movie list. Converting these daily sales data into weekly sales and dividing them to total sales, we obtained the f(t) values. F(t) is obtained from the accumulation of f(t) values. F(t) in week 1 is 0 where in week 2 it is f(1). In the data set we only listed F(t) and f(t) values at DVD release dates.

Production Budget

Production budget values are also obtained from the-numbers.com. These data do not include advertisement and promotional expenses.

Theatrical (Domestic and International), and DVD (Domestic) Revenues

These data are also gathered from the-numbers.com.

The p and q Values of the Movies

In order to satisfy the data need for the diffusion pattern part of the model, which will be explained in Section 5.2, we used weekly revenue data of each movie in the data set. Boxofficemojo.com gives the daily revenue values of the movies. For all the movies, we considered the first day of release to be the beginning day of the weeks. We calculated weekly revenue values of each movie. Converting the weekly revenue data to F(t) and f(t), which are used in Equation 5.1, we fit weekly F(t) and f(t) values to a line for each movie with a quadratic regression model. As the quadratic equation is in a form of $f(t) = p + (q - p) * F(t) - q * F(t)^2$, the equation gives the p and q values.

For the sake of clarity we will give an example of the procedure. Table 5.1 shows the weekly and cumulative box-office, f(t), and F(t) values of the movie "Yes Man". The values under the headings "weekly revenue" and f(t) are the end-of-week values, whereas the others are the start-of-week values. The reason for this is that f(t) is a function of F(t) in the diffusion pattern equation.

Table 5.1: Weekly and cumulative revenue, f(t), and F(t) values of *Yes Man*

w.	weekly revenue	cum. revenue	f(t)_22	F(t)_22	w.	weekly revenue	cum. revenue	f(t)_22	F(t)_22
1	33,141,514	0	0.33925	0.00000	9	413,794	96,431,898	0.00424	0.98711
2	32,455,397	33,141,514	0.33223	0.33925	10	233,668	96,845,692	0.00239	0.99135
3	17,658,776	65,596,911	0.18076	0.67147	11	198,497	97,079,360	0.00203	0.99374
4	7,699,207	83,255,687	0.07881	0.85224	12	194,199	97,277,857	0.00199	0.99577
5	3,625,573	90,954,894	0.03711	0.93105	13	116,332	97,472,056	0.00119	0.99776
6	1,059,671	94,580,467	0.01085	0.96816	14	61,542	97,588,388	0.00063	0.99895
7	294,326	95,640,138	0.00301	0.97901	15	41,046	97,649,930	0.00042	0.99958
8	497,434	95,934,464	0.00509	0.98202	16	0	97,690,976	0.00000	1.00000

Fitting the f(t) and F(t) data to a quadratic regression model we get $f(t)\_22 = 0.3471 - 0.01918F(t)\_22 - 0.3724F(t)\_22^2$ which means that p is 0.3471 and q is 0.3724. The fitted sales curve can be seen in Figure 5.1.

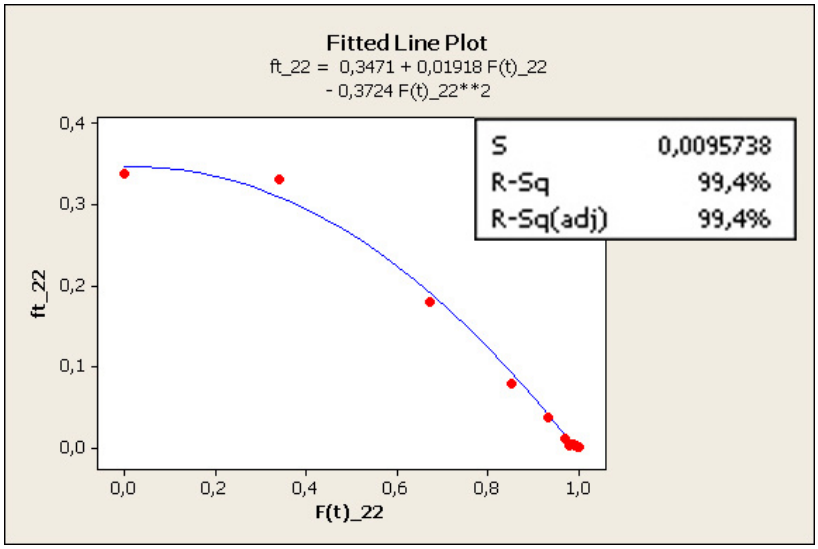

Figure 5.1: Fitted sales curve for *Yes Man*

For movies 58, 83, 92, 101, 102, 105, 107, 109, 110, 111, 113, 114, 115, 116, 117, 118, and 119, p and q values are not valid. For some of these movies the weekly sales data were not available and for the others, the number of weeks was so small that fitting the data to the curve was not meaningful.

The Number of Critical Reviews

In order to obtain the number of critical reviews Yahoo!® Movies [1] is used. The website collects the reviews from a number of sources like the Boston Globe, the Chicago-Sun Times, the Chicago Tribune, Entertainment Weekly, filmcritics.com, Hollywood Reporter, the Los Angeles Times, the New York Post, the New York Times, ReelViews, Rolling Stone, the San Fransisco Chronicles, the Seattle Post Intelligencer, and USA Today.

The Percentage of Nonnegative Reviews

After collecting the reviews, Yahoo!® Movies converts each critic to a letter grade. If the critic has a published rating then Yahoo!® Movies directly converts that rating. Otherwise, Yahoo!® Movies evaluates the review in order to assign a grade. The grades are A, B, C, D, E, and F meaning outstanding, above average, average, poor,

[1] Yahoo!® Movies: movies.yahoo.com

and terrible respectively. Each grade also may have a plus or minus, i.e. A+ or B-. Following this procedure, Yahoo!® Movies gives the average of the grades as the grade of the movie. We used these grades in order to estimate the percentage of nonnegative reviews. We assigned numbers from 0 to 14 for the grades from F- to A+, respectively. Dividing the assigned numbers for the average grades of each movie by 14 gave the estimate for the percentage of the nonnegative reviews. A movie with an average grade of A+ has a value of 1, whereas a movie with an average grade of F- has a value of 0 for the percentage of nonnegative reviews. Data for the movies with no reviews is assumed to be neither 0 nor 1. The data is unavailable for these movies. The movies with this situation are 54, 63, 96, 105, 113, 115, 116, and 117 in Appendix A.

IMDb Rating

Internet Movie Database[2] Rating (IMDb) is an online movie database. The registered users rate the movies from 1 to 10, 1 meaning that the user did not like the movie at all, and 10 meaning that the user liked the movie very much. Then, IMDb uses a weighted average scheme in order to transform these individual ratings to the rating of the movie.

Award Status

This data set shows if any participant of a given movie had received an award or not. IMDb shows how many awards each of the movies in our list has received. We converted these values into ones (received an award) and zeros(did not receive an award) depending on the status of the movies.

Sequel Status

Information about whether a movie is a sequel or not is obtained from various online reviews. These reviews are mostly done anonymously. Yet, these reviews give sequel information. One of the websites giving a list of sequel movies of 2008 is geeksofdoom.com [37].

[2]Internet movie database: www.imdb.com

MPAA Rating of the Movie – PG-13, PG, G, and R

Motion Picture Association of America (MPAA)[3] explains that the MPAA ratings do not judge that the movie is good or bad. Rather than that the reason for this type of rating use is to give information to the parents about the content of the movie. MPAA adds that the ratings "... provide timely, relevant information to parents, and they help shield filmmakers and this dynamic American art form from government censorship [67]." PG-13 means that parents are strongly cautioned as some material may be inappropriate for children under 13, PG means that parental guidance is suggested as some material may not be suitable for children, G means that the movie is for general audiences and all ages are admitted, R means that the movie is restricted and for people aged under 17 an accompanying parent or an adult guardian is required. MPAA ratings of the movies is obtained from the-numbers.com

5.2 The Theatrical Sector

In the theatrical sector of the model, the weekly revenue of domestic sales is projected. There is only one feedback loop in the theatrical sector of the model. This feedback loop creates the behavior of the weekly sales. Knowing the total revenue of a movie the behavior gives the weekly sales values in monetary terms. We sketched the loop based on the standard diffusion models.

Standard diffusion models for durable goods show that for most durable goods the sales pattern has a quadratic shape. And the typical box office revenue pattern over time is consistent with these models. The mathematical formulation of the models is as follows [58].

$$\frac{f(T)}{1-F(T)} = p + qF(T) \tag{5.1}$$

where

f(T)= density function for unit sales (sales in continuous time divided by market size)

F(T)= cumulative distribution function for unit sales

p= parameter capturing sales independent of word-of-mouth

q= parameter capturing the magnitude of word-of-mouth effects

[3]Motion Picture Association of America – www.mpaa.org

The parameter p is a real number theoretically between 0 and 1. Yet, our data set showed that it has a triangular distribution and has a value between 0 and 0.75. In the case of box office revenue pattern, considering the time unit is a week, the parameter p shows the first week revenue over total revenue of a movie. Figure 5.2 shows how the pattern changes with a change in the value of p. As the value of p increases the demand is met in fewer weeks. The areas under these curves are all 1.

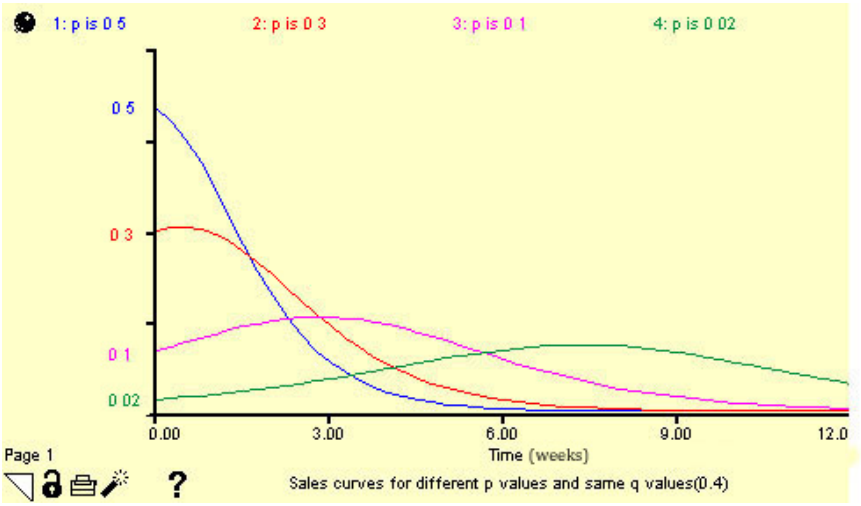

Figure 5.2: Sales curves for different values of p and same values of q (=0.4)

The parameter q is a real number between -1 and 1. Figure 5.3 shows how the pattern changes with a change in the value of q. As the value of q reaches zero, the curve becomes flatter. Although Moul and Shugan [58] define q as the parameter capturing the magnitude of word-of-mouth effects, we noticed from empirical data that q does not always give best information about the characteristics of the word-of-mouth; i.e. positive or negative. In other words, although, positive word-of-mouth tends to cause high values of q and negative word-of-mouth tends to cause low values of q , these cases are not always valid. Moul and Shugan [58] emphasize the dominating effect of advertising on the sales pattern. They add that heavy promotion of advertising, trailers and star appearances are used by the industry to overwhelm the effects of word-of-mouth. Radas and Shugan [73] point out that advertising shortens the time of collecting the box office revenue rather than enhancing its total size.

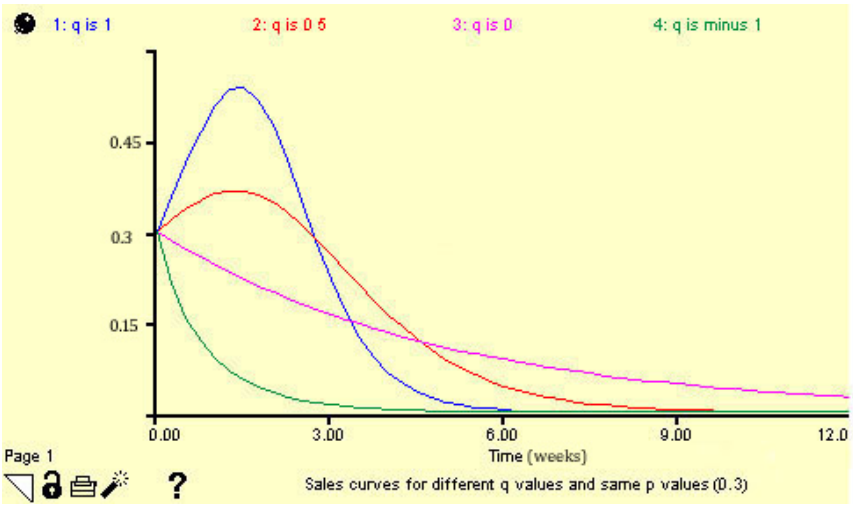

Figure 5.3: Sales curves for different values of q and same values of p (=0.3)

The dynamic model of Equation 5.1 created with iThink/STELLA is given in Figure 5.4. Ft is initially 0 whereas p and q have some constant values. p and q have different values for different movies.

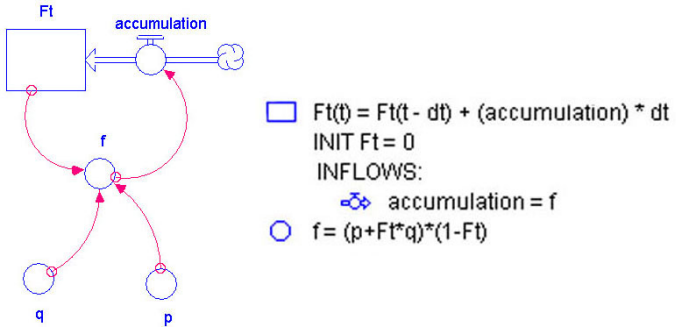

Figure 5.4: Dynamic Model of the Equation 5.1 created with iThink/STELLA

For a particular movie, the value of p can be determined in the first week of the theatrical release of the movie. Unlike the value of p , the value of q can only be determined some weeks after the release of the movie. For a precise determination of the value of q , the movie should no longer be in the theaters. As the value of p is discernible before the value of q , reviews, and the IMDb rating occur and awards are given, with the data on hand the analysis of the value of p can only be done with

the budget[4], the MPAA ratings (i.e. G, PG, PG-13, R) and the sequel status of the movie. However, we performed various regression studies to exhibit the specifics of this relationship. The regression analysis did not give a reliable result so we assumed the value of p as a random number. The results of the regression analysis can be seen in Table 5.2. In this regression, PG has been removed from the equation as it is highly correlated with other variables. As 20 of the cases contain missing data of either number of nonnegative reviews or p and q values, the sample size is 99.

Table 5.2: Regression analysis for the value of p

Variable	Coefficient (T) [P]	Variable	Coefficient (T) [P]
CONSTANT	-0.0980 (-0.32) [0.752]	PG-13	0.00267 (0.05) [0.959]
Ln(BUDGET)	0.03056 (1.79) [0.076]	G	-0.03035 (-0.40) [0.687]
SEQUEL	0.07927 (1.74) [0.085]	R	0.01403 (0.25) [0.802]
Adjusted R^2	0.04		

For a particular movie, the value of q is available after the budget (LN(BUDGET)), the MPAA rating (PG-13, PG, G, or R), the value of p , IMDb rating, the number of reviews (REVIEWS), number of nonnegative reviews (NNEGREV), the sequel status (SEQUEL), and the award status of that particular movie (AWARD) are known. As this is the case, we made a regression analysis using these variables. The result showed that q can be written as a function of p and the number of reviews. The results are given in Table 5.3. For this regression, as 20 of the cases contain missing data of either number of nonnegative reviews or p and q values, the sample size is 99.

In order to find the exact coefficients, we made another regression study using the values of p and the number of reviews. The results are listed in Table 5.4. For this regression, Minitab software mentions that films 6, 33, 69, 97, 99, 100, 106, and 108 have large standardized residuals and films 12, 63, 96 and 98 have X-values giving them large leverage. So the software considers these observations as unusual. In this

[4]For the regressions that include the variables 'budget' or 'revenue', which have large numerical values, with other variables with small numerical values like 'the number of reviews' or 'IMDb rating', we used logarithmic scale for variables 'budget' or 'revenue' in order to have a more manageable range for these variables.

Table 5.3: Initial regression for the value of q

Variable	Coefficient (T) [P]	Variable	Coefficient (T) [P]
CONSTANT	1.0393 (3.51) [0.001]	IMDb	0.03901 (2.17) [0.032]
Ln(BUDGET)	-0.03401 (-1.99) [0.049]	REVIEWS	-0.016945 (-3.30) [0.001]
SEQUEL	-0.02565 (-0.62) [0.540]	NNEGREV	-0.1855 (-1.20) [0.232]
PG-13	-0.04423 (-0.96) [0.338]	AWARD	-0.04062 (-1.31) [0.194]
G	-0.07914 (-1.10) [0.273]	p	-0.6611 (-5.82) [0.000]
R	-0.01310 (-0.26) [0.794]		
Adjusted R^2	0.481		

regression X-values represent the p value, and the number of reviews. Help file of Minitab software defines leverage as "the distance from an observation's X-value to the average of the X-values for all observations in a data set".

Table 5.4: Final regression for the value of q

Variable	Coefficient (T) [P]
Constant	0.52530 (8.38) [0.000]
p	-0.72982 (-7.95) [0.000]
REVIEWS	-0.01402 (-3.74) [0.000]
Adjusted R^2	0.402

The resulting equation can be seen below in Equation 5.2.

$$q = 0.5253 - 0.7298 * p - 0.014 * REVIEWS + Error \tag{5.2}$$

The feedback loop in the theatrical sector does not give information about the weekly sales values. In order to obtain these values we need the sales potential (revenue) of the movie. There are many studies on the factors affecting the revenue of a movie. The production budget of the movie, MPAA rating of the movie, whether there is a star in the movie, the quality and the quantity of reviews, release time of the movie, sequel status of the movie... Using a sample size of 175, Ravid [74] indicates that the significant variables for total revenue are budget, family ratings (G and PG), sequel status, and the number of critical reviews. Table 5.5 summarizes the results

of the study. For this regression Ln(Total Revenue), natural log of the total revenue, is the dependent variable. Independent variables consist of natural log of the budget of the movie (LNBUDGET), whether participants had received an award (AWARD), whether cast members could not be found in standard film references (REF), whether a cast member had participated in a top grossing film (STAR), variables for the rating of the film (G, PG, PG13, and R where the default is nonrated films), the number of reviews (REVIEWS), the percentage of nonnegative reviews (NNEGREV), a seasonality variable (SEASONALITY), and a variable for sequels (SEQUEL).

Table 5.5: Ln(Total Revenue) on movies [74]

	Variable(T-statistics)		Variable(T-statistics)
CONSTANT	-1.664(-2.8)	LNBUDGET	1.144(10.62)
AWARD	-0.114(-0.45)	REF	0.099(0.43)
STAR	0.064(0.22)	G	1.506(2.49)
PG	1.295(2.70)	PG13	0.608(1.31)
R	0.615(1.38)	REVIEWS	0.029(2.63)
NNEGREV	0.369(1.01)	SEASONALITY	0.066(0.13)
SEQUEL	0.828(2.54)	Adjusted R^2	0.675

Source: Ravid (1999) [74]

In our regression analysis we used a sample of 119 movies. We considered 10 variables. These were the budget of the movie (BUDGET), the sequel status of the movie (SEQUEL), the MPAA rating of the film (G, PG, PG13, and R where the default is nonrated films), the number of reviews (REVIEWS), the percentage of nonnegative reviews (NNEGREV), IMDb rating (IMDb which shows the taste of the viewers), and whether participants had received an award (AWARD) or not.

Simple regression of these data showed that the significant variables for total revenue are budget, the number of reviews, R, G and PG-13 ratings, and the award status. The results can be found in Table 5.6. In this regression PG has been removed from the equation as it is highly correlated with other variables. As eight of the cases contain missing data of variable "number of nonnegative reviews", the sample size is 111.

Table 5.6: Initial regression for the value of Ln(Revenue) on movies

Variable	Coefficient (T) [P]	Variable	Coefficient (T) [P]
CONSTANT	3.5900 (1.87) [0.065]	IMDb	-0.16520 (-1.43) [0.155]
Ln(BUDGET)	0.7033 (6.67) [0.000]	REVIEWS	0.07887 (2.37) [0.019]
SEQUEL	0.2679 (1.04) [0.300]	NNEGREV	1.19960 (1.22) [0.224]
PG-13	0.9176 (3.04) [0.003]	AWARD	0.50580 (2.60) [0.011]
G	1.4392 (2.98) [0.004]		
R	0.5463 (1.71) [0.090]	Adjusted R^2	0.508

As there are some missing data of the percentage of nonnegative reviews, which is denoted as NNEGREV in Table 5.6, and as the p-value shows that the variable is not significant, we made the next regression without using this variable. We used a stepwise regression with Alpha-to-Enter and Alpha-to-Remove values 0.15. The results can be seen in Table 5.7.

Table 5.7: Second regression for the value of Ln(Revenue) on movies

Step	1	2	3	4	5	6	Step	4	5	6
S	1.16	1.06	1.04	1.02	0.99	0.98				
R^2	32.78	44.15	46.72	49.36	52.76	54.04				
Adjusted R^2	32.20	43.18	45.33	47.58	50.67	51.58				
CONSTANT	3.065	5.314	5.219	5.171	5.404	4.066				
Ln(BUDGET)	0.82	0.61	0.61	0.61	0.59	0.65	G	0.98	1.21	1.61
T-Value	7.55	5.73	5.83	5.92	5.85	6.16	T-Value	2.44	3.05	3.55
P-Value	0.000	0.000	0.000	0.000	0.000	0.000	P-Value	0.016	0.003	0.001
REVIEWS		0.122	0.107	0.113	0.105	0.096	PG-13		0.54	0.95
T-Value		4.86	4.23	4.53	4.31	3.90	T-Value		2.85	3.19
P-Value		0.000	0.000	0.000	0.000	0.000	P-Value		0.005	0.002
AWARD			0.47	0.48	0.47	0.48	R			0.55
T-Value			2.36	2.49	2.46	2.55	T-Value			1.77
P-Value			0.020	0.014	0.015	0.012	P-Value			0.080

Because P-values of only the variables budget and number of reviews are zero. We decided to use only these variables in our model. Table 5.8 shows the result of

the consequent regression for the revenue value. For this regression, Minitab software mentions the unsual observations as 34, 110, 114, 117, 118, and 119 having large standardized residuals, and 91 and 117 having X-values giving them large leverage.

Table 5.8: Final regression for the value of Ln(Revenue) on movies

Variable	Coefficient (T) [P]
Constant	5.3140 (3.00) [0.003]
Ln(BUDGET)	0.6146 (5.73) [0.000]
REVIEWS	0.1220 (4.86) [0.000]
Adjusted R^2	0.432

The resulting regression equation is

$$Ln(REVENUE) = 5.314 + 0.615Ln(BUDGET) + 0.122REVIEWS + Error \quad (5.3)$$

The theatrical sector of the model can be seen Figure 5.5 on page 42. The stocks in black, namely 'random p', 'error in q', 'random reviews', 'error in ln revenue', and 'ln production budget', create random numbers at the beginning of the model run and keep them. 'Random p' and 'random reviews' create the random variables uniformly between 0 and 1. These numbers affect the values of 'p' and 'number of reviews'. Yet, the distribution of the values of 'p' and 'number of reviews' are defined with the functions written in these converters. The distributions of these random variables are obtained from the data on hand using the Input Analyzer tool that the simulation software ARENA offers. ARENA checks which of the following distributions the data set fits the best: Beta, Empirical, Erlang, Exponential, Gamma, Lognormal, Normal, Poisson, Triangle, Uniform, and Weibull. The reason why two additional converters are needed for the generation of random variables 'p' and 'number of reviews' is that their distribution is triangular and STELLA does not generate random numbers with triangular distribution. The other random numbers are normally distributed.

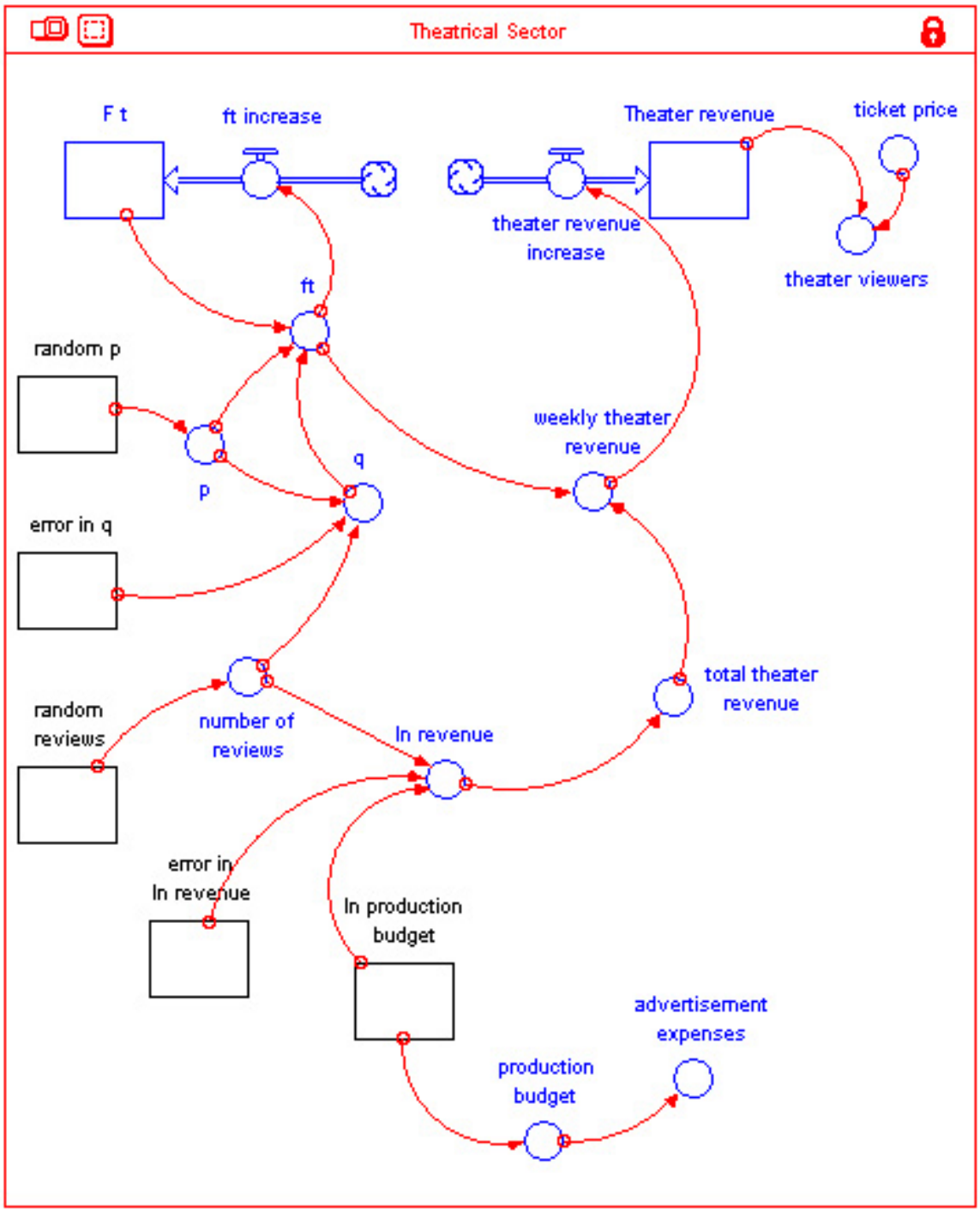

Figure 5.5: Model corresponding to the Theatrical Release

For the value of p , the data have a triangular distribution with a lower end point of 0, a mode of 0.592, and an upper point of 0.75. Kolmogorov-Smirnov test shows that the corresponding p-value is 0.0548 and the test statistics is 0.131. The distribution has a square error of 0.026167. The fitted line can be seen in Figure 5.6.

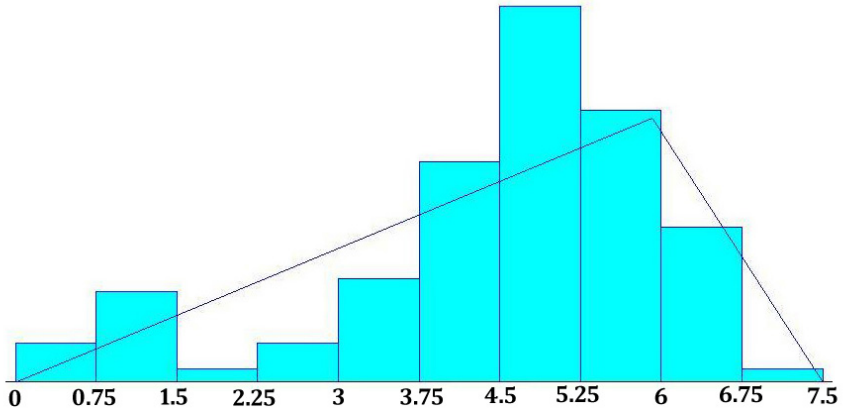

Figure 5.6: Distribution of the 'p' values

The 'number of reviews' data also have a triangular distribution. For this converter, the lower bound is -0.5, the mode is 14, and the upper bound is 15.5. The distribution has a square error of 0.014934. The fitted line can be seen in Figure 5.7. Although the lower bound is -0.5, if a negative number is generated, we take it as zero as the number of reviews cannot be less than zero.

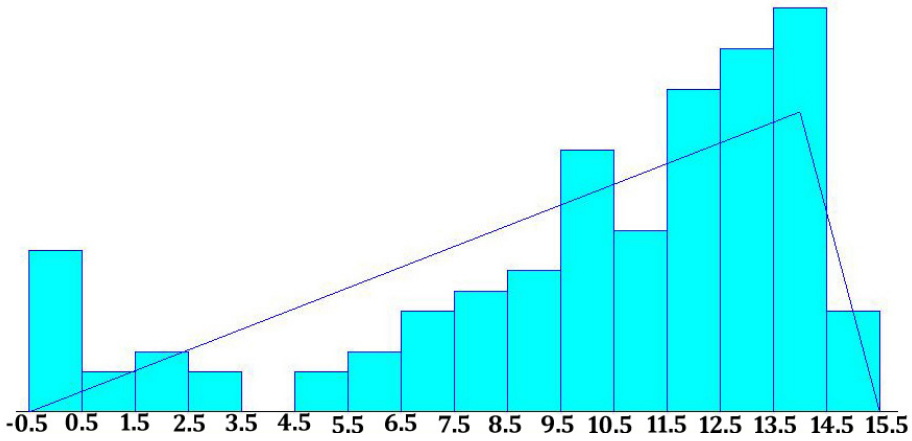

Figure 5.7: Distribution of the 'reviews' values

The 'ln budget' is normally distributed with a mean of 17.3 and a standard deviation of 0.985. Kolmogorov-Smirnov test shows that the corresponding p-value is greater than 0.15 and the test statistics has a value of 0.0707. The distribution has a square error of 0.004528. The fitted line can be seen in Figure 5.8.

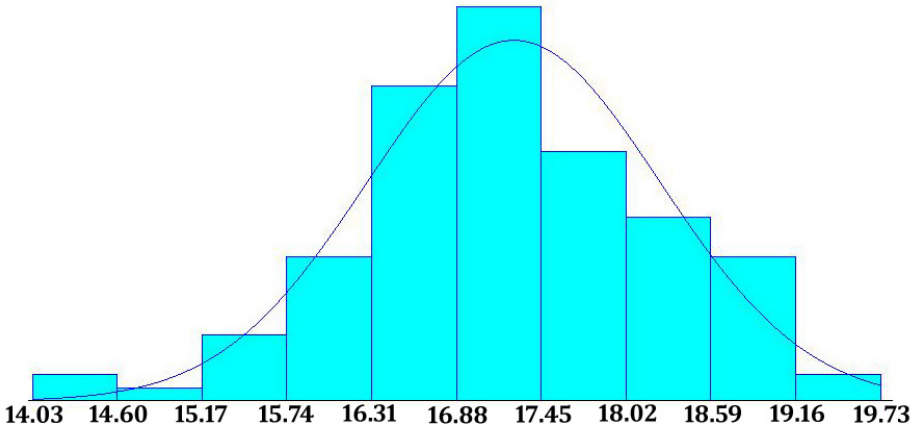

Figure 5.8: Distribution of the 'ln budget' values

Table 5.9 shows the square error values for the fits of the data of the variables p, number of reviews, and ln(budget) to the listed distributions.

Table 5.9: Square error values for the fits of the data to the listed distributions

p	Sq Error	reviews	Sq Error	ln budget	Sq Error
Triangular	0.0262	Triangular	0.0149	Normal	0.00453
Normal	0.0296	Beta	0.0263	Weibull	0.00536
Beta	0.0299	Normal	0.0306	Erlang	0.00697
Weibull	0.0355	Poisson	0.0398	Gamma	0.00701
Erlang	0.0706	Weibull	0.0401	Beta	0.00723
Gamma	0.0714	Uniform	0.0405	Triangular	0.0118
Uniform	0.0776	Erlang	0.0543	Lognormal	0.0137
Lognormal	0.0965	Gamma	0.057	Uniform	0.0631
Exponential	0.127	Exponential	0.0717	Exponential	0.11
Poisson	-	Lognormal	0.0725	Poisson	-
Johnson	-	Johnson	-	Johnson	-

Assume u is the random number generated by the uniform number generator which is between 0 and 1, and r is the random number generated having a triangular distribution. The parameters *min*, *mode*, and *max* are the numbers defining the triangular distribution. In order to switch from a continuous uniform distribution in the range of 0 to 1 to triangular distribution the following logical equation[50] is used.

If $u <= (mode - min)/(max - min)$

then $r = min + \sqrt{u * (max - min) * (mode - min)}$

else $r = max - \sqrt{(1 - u) * (max - min) * (max - mode)}$

These logical equations are used in converters 'q' and 'number of reviews'.

The other two stocks namely 'error in q' and 'error in ln revenue' are used as the regression equations done for the value of q and the revenue do not completely explain the variability between these values and their corresponding explanatory variables. As it is given before, the adjusted R^2 value for the regression analysis of q is 0.402 and of ln(revenue) is 0.432. These two stocks create values for the error terms in Equations 5.2 and 5.3.

For the 102 movies in our data set, the data for p and q are available. In order to obtain the distribution of the 'error in q', first we put the 'p' and 'number of reviews' data to the Equation 5.2 for all the 102 movies. Later on, with the difference between the actual 'q' values and the results of the equations, a new set of data for error is produced. Although using all the 102 movies gives a distribution with a zero mean, it is not normally distributed. As it is mentioned before, 8 of these 102 movies, namely 6, 33, 69, 97, 99, 100, 106, and 108 have large standardized residuals. Using the remaining 94 movies gives a normally distributed data set with a nonzero mean. In our model, we used the results from the second set of data which is normally distributed. The probability plot of the first and the second sets are shown in Figure 5.9 and Figure 5.10 consequently.

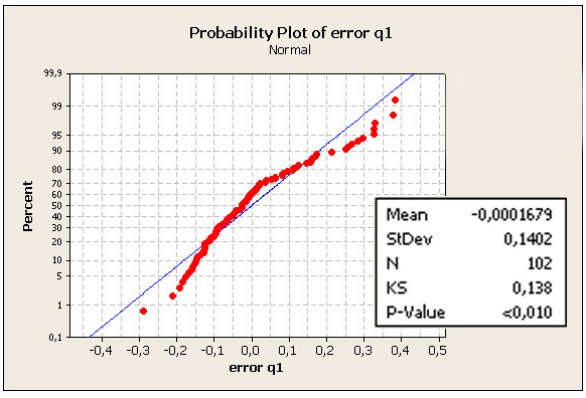

Figure 5.9: Distribution of the 'error in q' values for a sample of 102 movies

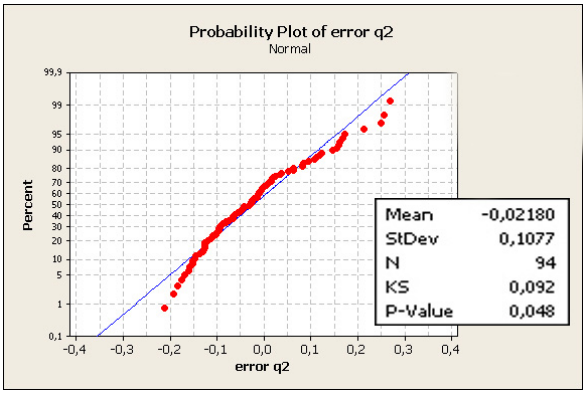

Figure 5.10: Distribution of the 'error in q' values for a sample of 94 movies

For all the 119 movies in our data set, the data for 'ln revenue', 'ln budget', and 'number of reviews' are available. In order to obtain the distribution of the 'error in ln revenue', first we put the 'ln budget' and 'number of reviews' data to the Equation 5.3 for all the 119 movies. Later on, with the difference between the actual 'ln revenue' values and the results of the equations, a new set of data for error is produced. Although using all of the 119 movies gives a distribution with a zero mean, it is not normally distributed. As it is mentioned before, 6 of these 119 movies, namely 34, 110, 114, 117, 118 ,and 119 have large standardized residuals. Using the remaining 113 movies gives a normally distributed data set with a nonzero mean. In our model we used the results from the second set of data which is normally distributed. The probability plot of the first and the second sets are shown in Figure 5.11 and Figure 5.12 consequently.

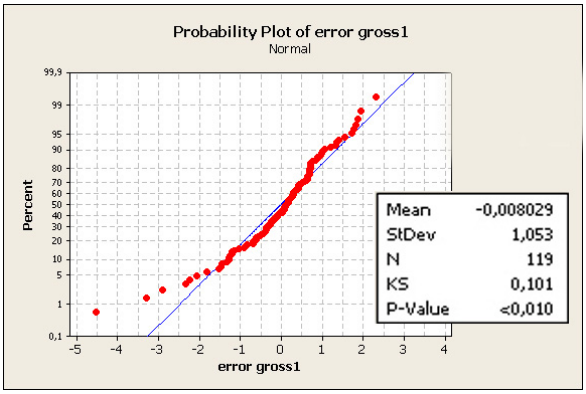

Figure 5.11: Distribution of the 'error in ln revenue' value for a sample of 119 movies

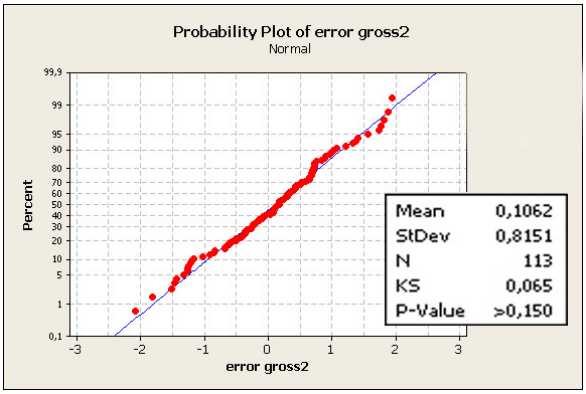

Figure 5.12: Distribution of the 'error in ln revenue' value for a sample of 113 movies

It is conceded that advertising and promotional costs are proportional to the budget of the movie. In their study, Ravid and Basuroy [75] show that the correlation between advertising and promotional costs, and budget of the movie is so high that they cannot be separately used in a regression. Although we do not have individual data from the movies of 2008, MPAA economic report for 2007 [64] shows that for the MPAA members distribution and marketing costs are at nearly half value of production cost.

$$Advertisement\_expenses = Production\_budget * 0.5 \tag{5.4}$$

Figure 5.13 shows the bar chart of the average production and marketing costs of films produced in years 2001 to 2007 separately.

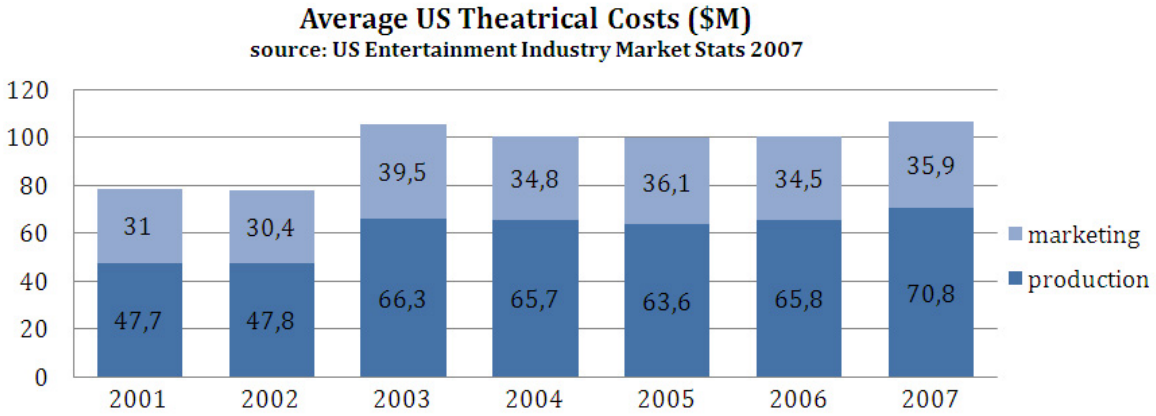

Figure 5.13: The average U.S. theatrical costs for years 2001 to 2007

'Total Theater Revenue' is the exponential value of 'ln revenue'.

$$total\_theater\_revenue = EXP(ln\_revenue) \tag{5.5}$$

'Weekly theater revenue' gives the distribution of the total theatrical revenue to the weeks.

$$weekly\_theater\_revenue = total\_theater\_revenue * ft \tag{5.6}$$

'Theater revenue' has an initial value of zero. Each week it increases in an amount of 'theater revenue increase.' So the differential function for 'theater revenue' is

$$Theater\_revenue(t) = Theater\_revenue*(t-dt)+(Theater\_revenue\_increase)*dt \tag{5.7}$$

'Theater revenue increase' has the same value as the 'weekly theater revenue'.

According to MPAA Theatrical Market Statistics 2008 Report [65] the average admission price for year 2008 is $7.18. The converter 'ticket price' has a value of 7.18.

'Theater viewers' shows the number of views in theaters. As a result of this, the function corresponding to this converter is

$$Theater\_viewers = \frac{Theater\_revenue}{ticket\_price} \tag{5.8}$$

5.3 The DVD Sector

The home video distribution channel has four main substitutes: DVD sale, DVD rental, video sale, and video rental. Sales figures from 2003 to 2007 can be seen in Table 5.10. As the table shows, DVD sales have the largest proportion among alternative home video channels. So, we used the DVD sales channel in our study.

The introduction of the DVD sales channel to the model makes the most important change in the demand to the theatrical sales. Lehmann and Weinberg [48] studied the effect of a second channel to the theatrical sales. As in the 90s video rentals have the most proportion among alternative home video channels, they work on video rental channel. With a sample of 35 mid-1990s movies, Lehmann and Weinberg [48] show that video's rental pattern is related to the sales pattern of the movies. They model the theatrical revenue of a movie as an exponential function in a form of $A*exp(-Bt)$.

Table 5.10: "Sales of Home Entertainment to U.S. Dealers: Adams Media Research" [64]

unit: $ Million year	Rental DVDs	Sell-Through DVDs	Total DVDs	Rental Cassettes	Sell-Through Cassettes	Total Cassettes
2007	171.2	1,084.6	1,255.8	0.3	0.0	0.3
2006	180.2	1,129.0	1,309.2	1.6	5.8	7.4
2005	179.0	1,114.5	1,293.6	14.9	33.8	48.7
2004	149.3	1,063.3	1,212.6	32.3	92.5	124.8
2003	105.4	768.3	873.6	47.5	196.9	244.4

The movie's box-office sales start with an initial value of A and then declines with a constant rate. They model the video rentals in the same way, as an exponential function assuming that both video rentals and theatrical sales have the same rate of decay. The effect of video release is observed as a decrease in market potential of theatrical sales in theory. Yet, in practice, it is difficult to observe this decrease say Lehman and Weinberg, as the producers prefer releasing video far after the theatrical release. The data set of Lehmann and Weinberg shows that when video was released the theatrical revenue never exceeded 3 percent of first-weeks revenue. Our data set also show that in most of the cases the distributors prefer releasing the DVDs after the theatrical life of the movie ends.

Similar to the study of Lehmann and Weinberg [48], in our study, we assume that DVD and theatrical sales have the same rate of decay. As a result of this, we used the same p and q values for both the theatrical and the DVD sales in the standard diffusion model. This results in a same pattern of DVD sales as the theatrical sales.

Although DVD sales have the same pattern as the theatrical sales, total amount of DVD sales is not affected only by theatrical sales potential but the release time of DVD, more specifically time between the theatrical and DVD release dates.

Most frequently, promotions and advertisements of the movies are done before the theatrical release. These promotions and advertisements create a buzz which highly affects the first week attendances. As the weeks pass, the effect of these promotions and advertisements on the consumer decreases. In order to benefit from these positive effects it is better to release the DVD as close as possible to the date of theatrical

release. Although this would maximize the DVD sales, the distributors do not choose this option. The reason for this is that DVD sales would undercut the theatrical sales. In order to minimize the negative effects of DVD sales on the theatrical sales, the release date of DVDs should be as far as possible from the theatrical release date. So, assuming theatrical release is prior to the DVD release, closing the date difference between the release dates would increase the DVD sales and decrease the theatrical sales. Widening the difference between the release dates would decrease the DVD sales and increase the theatrical sales. Weinberg [101] also underscores on the questions like when to decide the release date of the DVDs and whether is it better to optimize the DVD release date and the decide the release date of the movies.

In our data set we could not observe the cannibalization of theatrical sales by DVD sales as DVD release dates are far after the theatrical release dates. Considering all the 105 movies, of which the weekly sales data was available, for 83 of them the DVD release occurred after theatrical attendances were over, for 18 of them DVD release occurred after more than 99% of theatrical attendances were over, and for the remaining 4 movies DVD release occurred after more than 95% of theatrical attendances were over. The dotplot of the DVD delay can be seen in Figure 5.14.

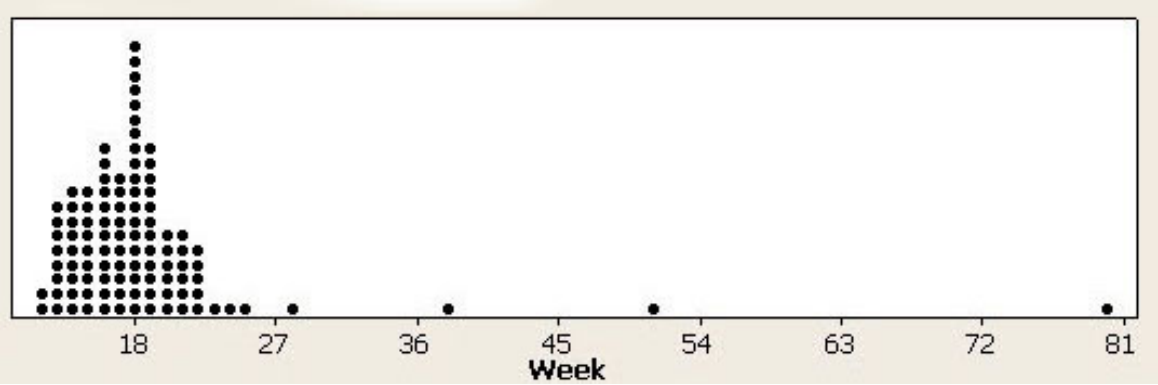

Figure 5.14: Dotplot of the DVD delay

Excluding 3 outliers from the data set we obtain a normal distribution with a mean 17.4 and standard deviation 3. These outliers are movies 9, 16, and 34. Their weeks of delay are 38, 51, and 80 weeks respectively. The histogram and the fitted line can be seen in Figure 5.15.

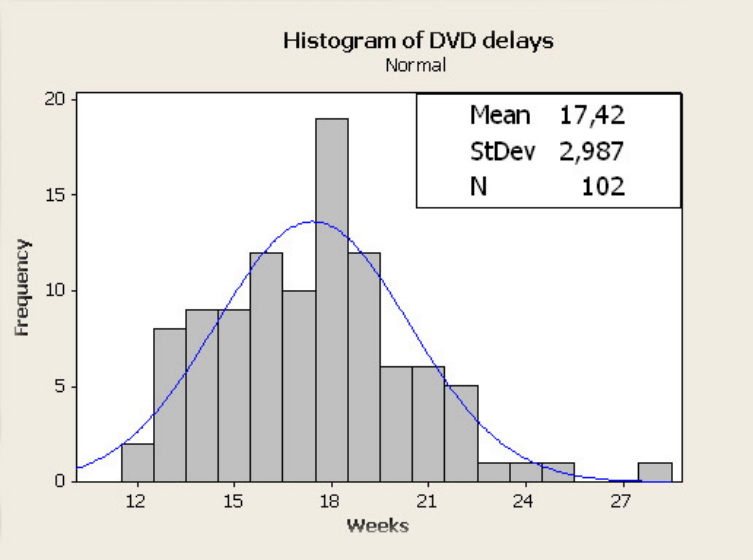

Figure 5.15: Histogram of the DVD delay

With the introduction of the DVD Sector, a change in the Theatrical Sector of the industry model arises. The change is related to the addition of the 'total theater revenue potential' converter. The need for this converter is because the DVD sales may affect the theatrical sales. The effect is observed as a shift in the theatrical sales pattern. 'Total theater revenue potential' is the amount of theatrical sales in case that there is no other channel of seeing the movie. If the DVD is released while the potential is not diminished, a shift in theatrical sales pattern occurs. The amount of shift depends on the time delay between the theatrical release and the DVD release. The magnitude of the shift decreases as the DVD delay decreases. In other words, DVD and theatrical releases are closer. Although there is no empirical data related to this phenomenon, the logic arises from the willingness of the theatrical viewers. It is assumed that the viewers who are willing to see the movie in theaters would also prefer to see the movie in the first weeks of the release. So, we assume that as the weeks pass the potential viewers tend to see the movie on DVD rather than on theaters. The model showing both of the sectors can be seen in Figure 5.16.

As the data on hand show that the theatrical and the DVD sales do not occur simultaneously, we may consider that the total sales values show the 'total theater revenue potentials.' The effect of DVD release to the potential theatrical revenue is modeled by using an empirical rather than analytical (a graphical) function. The

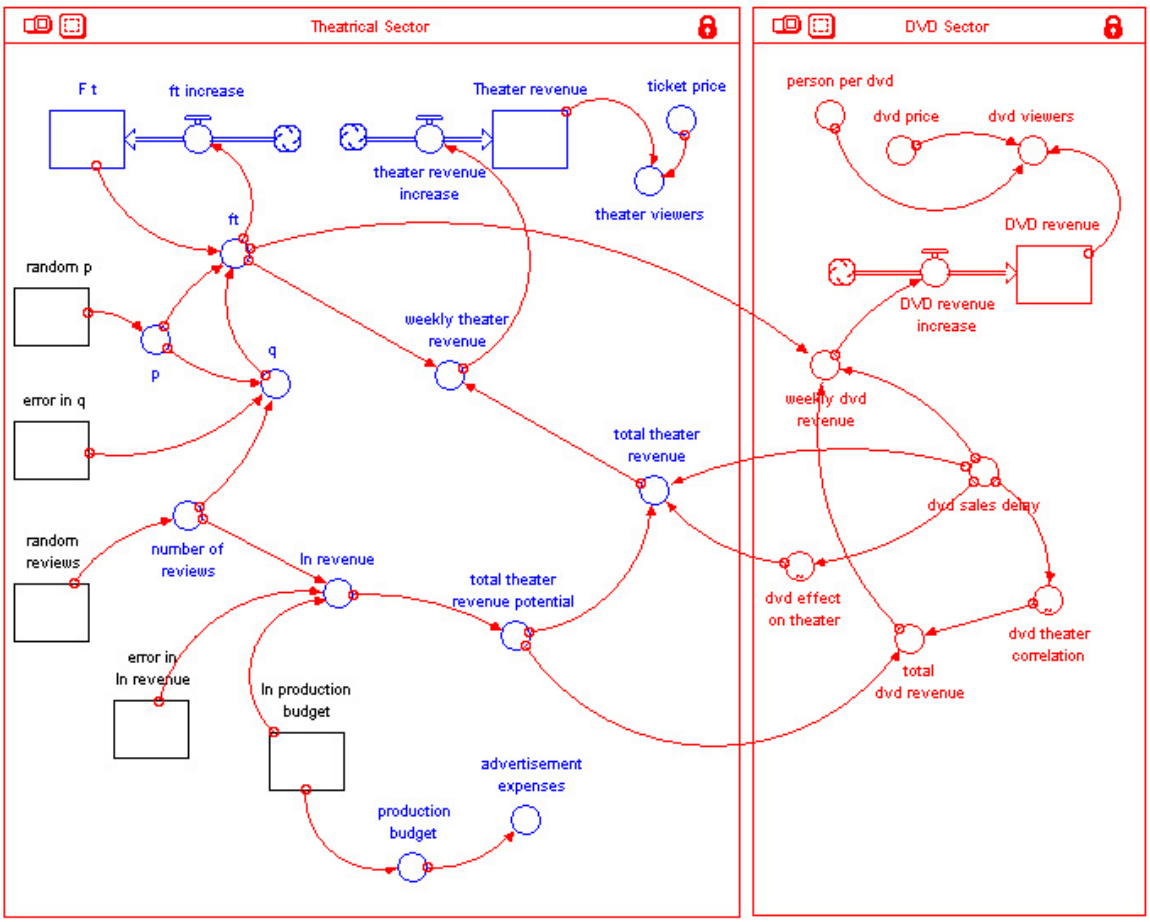

Figure 5.16: Model corresponding to the DVD and the Theatrical Releases

graphical function defines the fraction that creates the shift in the weekly theater revenue pattern. The total theater revenue potential is multiplied with this fraction when the DVD release occurs. The fraction depends on the delay time of the DVD release.

As the delay increases to a certain length of time, the fraction increases to 1. After this week, the fraction remains 1. As it is mentioned before, in practice the distributors are inclined to release DVD after the theatrical sales reach to an end. And the mean value for this time is 17.4 weeks. So it is assumed that the fraction is 1 if the DVD release delay is 18 or more.

As the delay decreases to 0, the fraction decreases to a certain amount of value. This value arise from the answer of the question: "What percentage of the theatrical viewers choose to see a movie by a DVD if DVD is released not 18 weeks after but at the same time of the theatrical release of that movie?" Although we do not have

any empirical data, we assumed that this value is 0.5. For the values between these end points, we used a linear line. Although these assumptions would affect some numerical values in the model like the total sales revenue in week 6 of a run for instance, it would not affect the behavior of the sales pattern. Further analysis on these value are valuable in order to have a more precise model. The graph can be seen in Figure 5.17.

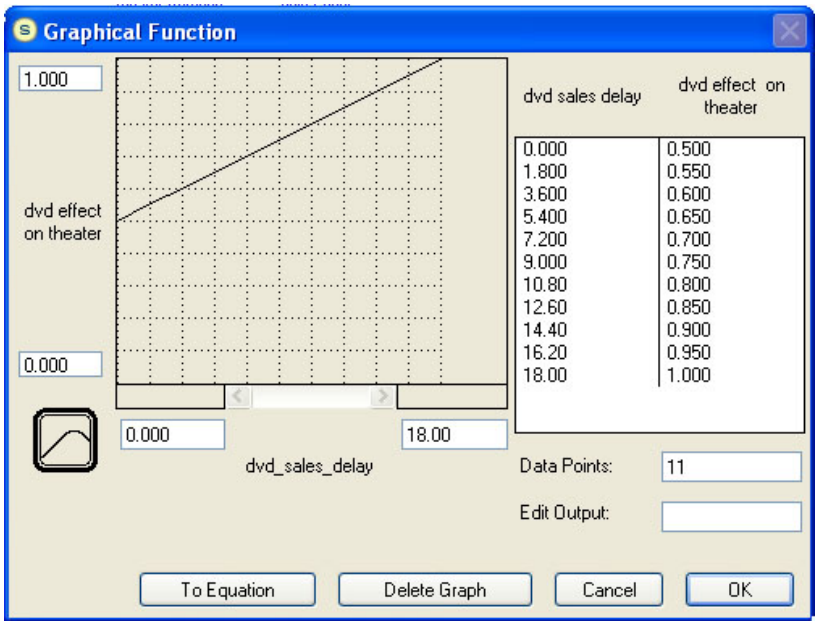

Figure 5.17: Graphical function for the effect of DVD release on theatrical sales

The equation in "total theater revenue" is

$$revenue = potential - step(potential * effect, delay) \tag{5.9}$$

where *revenue*: total_theater_revenue

potential: total_theater_revenue_potential

effect: dvd_effect_on_theater

delay: dvd_sales_delay

With this function "total theater revenue" remains at level of "total theater revenue potential" until week "dvd sales delay." At the week "dvd sales delay", "total theater revenue" shift down to a level depending on the "dvd effect on theater" value.

Similar to the theater revenue, delay time has some effects on DVD revenue. DVD revenue is not only dependent on the theatrical sales revenue potential but also the DVD release delay value. In the model, the effect of delay is given with a graphical function. The values in the function are created with a similar approach in creating the values in the graphical function for the effect of DVD release on theatrical sales.

In order to obtain a reasonable graphical function, first we need to know the DVD price and the average number of people seeing a movie from a single DVD. MPAA entertainment industry market statistics for 2007 [64] shows that average DVD price is $16. We assumed that on the average 3 people see a movie from a single DVD.

Our 101 movies show that domestic theatrical sales and DVD sales are highly correlated. Pearson correlation of DVD sales and theatrical sales is 0.902 and the P-value is 0. The result of the regression analysis can be seen in Table 5.11

Table 5.11: Regression coefficients of DVD sales with constant value

Variable	Coefficient (T) [P]
Constant	1,681,276 (0.76) [0.449]
Theatrical Sales	0.44947 (20.79) [0.000]
Adjusted R^2	0.812

Note that 101 cases are used in the regression analysis as DVD revenue data for 18 movies are not valid.

As the P-value of 'Constant' is high, another regression without a constant value is done. The result of the regression analysis is in Table 5.12.

Table 5.12: Regression coefficients of DVD sales without constant value

Variable	Coefficient (T) [P]
Theatrical Sales	0.46033 (28.42) [0.000]

As a result the following equation is obtained.

$$Total\_DVD\_revenue = 0.46 * total\_theater\_revenue\_potential \quad (5.10)$$

For the movies in our data set, the theatrical and the DVD sales do not occur simultaneously. So this 0.46 value will be used in the graphical function if the delay is 18 weeks or more. As it is said before, we assume that if the theatrical and DVD releases start at the same time, in other words, if the delay time is 0, then 50% of the theatrical sales potential would be lost. This would make an increase of $50\% * \frac{\$16}{\$7} * \frac{1}{3} = 38\%$ in the fraction of 0.46 in Equation 5.10, making it 0.84. It was mentioned that \$16 is the price of a single DVD, \$7 is the price of a single theatrical view, and 3 is the number of people who would see the movie from a single DVD. Surely, this equation would not give the exact monetary flow from theatrical sales to DVD sales. For instance, it is doubtful that all these people who shift to DVD sales channel will cluster in groups of three and see the movie from a single DVD per group. Yet, the result of the equation can be used as an approximation. As in the graphical function for the effect of DVD release on theatrical sales, for the values between the end points, we used a linear line. The graph can be seen in Figure 5.18.

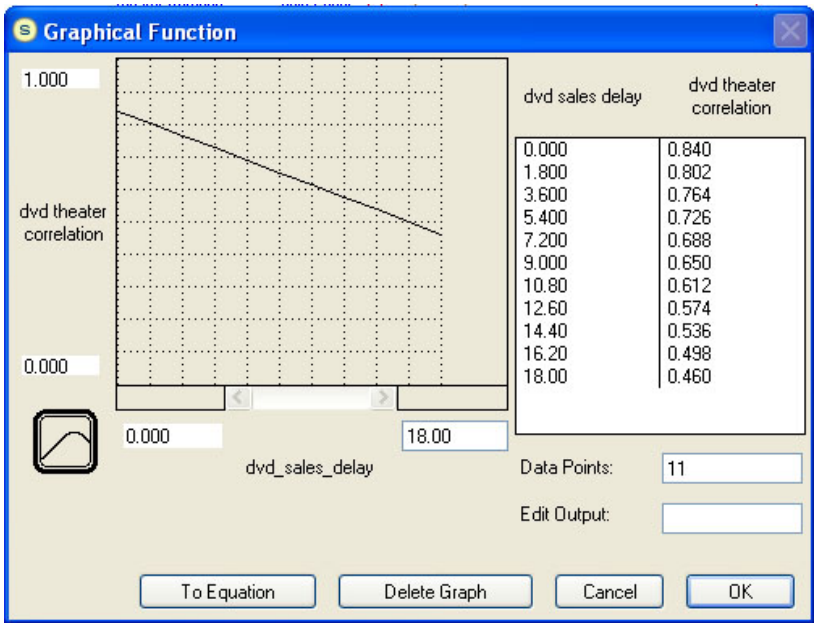

Figure 5.18: Graphical function for the effect of delay and theatrical potential on DVD sales

Total revenue collected by DVD sales is accumulated in stock 'DVD revenue.' This stock has an initial value of zero. At each period, it is increased by an amount of

'DVD revenue increase' that is equal to 'weekly DVD revenue.' With the information of 'DVD revenue' the number of DVD viewers is obtained. In order to obtain the number of viewers who see the movie via the DVD channel, the other two additional information items are needed. One of them is the price of a DVD, and the average number of people who watch a movie from a single DVD. Knowing these parameters the equation for the number of viewers who see the movie via DVD is

$$DVD\_viewers = \frac{DVD\_revenue}{dvd\_price} * person\_per\_dvd \tag{5.11}$$

5.4 The Piracy Sector

As the piracy sector constitutes the projection of the illegal consumption of the products, it is harder to obtain empirical data. Yet, we may say that the effects of illegal distribution of movies to theatrical sales is analogous to the effects of DVD sales to the theatrical sales. The most important difference of the distribution of pirated copies is that there is no direct monetary gain that exist for the producers of the films. Another main difference of pirated copies from theaters and DVDs is that it is cheaper and in most cases it is free. The cost occurs in terms of time expenditure or risks of penalty taking in the usage of pirated copies. As the pirated copies are cheaper or free on the Internet, the spread of this type of consumption is faster than the others.

Due to the fact that we do not have empirical data in order to construct the piracy sector of the model, in this section we will discuss the possible effects of piracy to the model.

The first important effect of pirated copy consumption would be the shift of the curves showing the sales diffusion pattern. Assume that, for a film, the theatrical release occurred but the DVD release did not occur yet. If the pirated copies are available, some of the moviegoers may prefer to see the film from pirated copies. In addition to the people who would have watched the film on theaters, if there was no pirated copy available, some of the people who would not watch the film on theaters may also prefer to watch the movie via pirated copies. This results in a situation that in the same amount of time a much higher number of people would watch the film. This in turn amplifies the magnitude of the effect of advertisements and promotions.

An increase in advertisement and promotions would mean that the effect would last longer. As a result, the coefficient which determines the DVD sales would have a higher value. In the model this is provided by the "dvd theater correlation" converter. An increase in advertisement would shift the graphic in Figure 5.17 up. Yet, if the pirated copies cannibalize some portion of the DVD sales as well, then the mentioned shift may be smaller or even be downward. So, in the case of piracy the question is whether the loss from the sales dominates or is dominated by the gain of advertisement. Most written sources and the applications show that the common idea is free access to the movies is bothersome.

According to MacGreevy [52], the results of a survey showed that in the case of movie downloading, 26% occur before theatrical release, and 49% occur after theatrical but before video release. 35% of the participants who downloaded the movie from the Internet bought fewer video products than before, and 21% went less often to the theater. According to MacGreevy [52] 9 out of 10 films first appearing online come from camcorded copies. Diesbach [28] gives some data on the delay values of piracy views. For the movies "Goodbye Lenin", "The Miracle of Bern", "Luther", and "Samba in Mettmann", respectively 6, 20, 30 and 6 days after the theatrical release, pirate copies were available on the Internet. Some studies in the UK show that in 2007 one in three people are included in film infringement activity [22].

According to TERA Consultants for the International Chamber of Commerce's study [24] on music, film, television, and software industries at the UK, Germany, France, Spain and Italy these industries earned €860 billion in 2008 and €10 billion were lost to piracy. The study foresees that with the advances in technology like higher bandwidths of the Internet the lost will increase to €240 billion by 2015.

Common ways used in order to deal with piracy are educating the consumers, applying high penalties to copyright infringement, and providing alternative consumption channels.

Graduated response system includes sending notification letters to the Internet users who download a copyrighted product. If the violation happens again, a second email is sent within six months. Following the second notification, if the violation continues for a year the Internet access of the user is terminated for a period of two months to a year [23]. This application can only be done with the cooperation of

Internet service providers by providing subscriber information. So, although some people support the use of the graduated response system, some argue that the system violates the right to privacy [44]. On the other hand the cost of detecting the piracy "breaches" create some other debates [23].

Some claim that increasing the amount of fines would decrease the size of piracy. For instance, in 2004 Russia was to increase the size of fines from $300 to $160,000 in order to diminish pirate products [13].

There are also websites like www.findanyfilm.com that give the opportunity to download the films legally.

Education especially among children is seen as one of the keys against piracy. United Nations Information Center (UNIC) [92] especially places great importance on this property. Not just education but also there are reward programs in some countries for the consumers who give information against illegal manufacturers.

All of these applications and their effects can be included in the model. Yet, as we do not have any empirical data, we preferred discussing the issue using the inferences from the behavioral changes that the DVD sales made in our model.

5.5 Model Setup and Execution

STELLA offers three integration methods for the model run. These are Euler's Method, Runge Kutta-2, and Runge Kutta-4. STELLA explains that Runge Kutta methods are appropriate for the models having oscillations. The reason for this is that the integration error of Euler's method is cumulative whereas of Runga Kuttas is not. On the other hand, when there are functions creating integer values in the model, it is better to use Euler's method. As in our model there are functions creating integer values and there is no oscillatory behavior we used Euler's method for the integration.

Unit time in the model is "week" in order to get rid of the seasonality within a week. Viewers tend to go to theaters on the weekends. For a typical weekday the revenue gathered in the theaters is much less than the revenue gathered on a weekend day. Weekly revenues are less affected by seasonal behaviors. To be consistent with the unit time, step size (delta time) is chosen to be 1/7 as if a week is divided into days. All the monetary terms are in dollars.

5.6 Sensitivity Analysis

We made the sensitivity analysis on the stocks 'random p', 'error in q', 'random reviews', 'error in ln review', 'ln production budget', and the converter 'dvd sales delay'. Except for the 'dvd sales delay' for all these parameters we examined the change in theatrical and DVD sales both weekly and aggregate values. For the 'dvd sales delay' stock, we examined the aggregate values of theatrical and DVD sales revenue, total revenue, and number of viewers. In these analysis, first we defined the interval that the parameter would be tested. Later on, we made 25 runs for each using incremental variation. The graphical results can be seen in Appendix F. The distribution parameters mentioned below follow our analysis of available date, as was discussed in the Sections 5.2 and 5.3.

Change in 'random p'

This stock generates and keeps a value between 0 and 1. This random number generation is done consistent with a uniform distribution. For smaller random p values weekly sales pattern is different from larger random p values. If the p value is high after the first week, weekly sales value decreases instantaneously. Yet, if the p value is low weekly sales value first increase then decrease to zero. Although an increase in random p value does not change the sales potential, it decreases the time passed before the sales potential is reached. The graphs from the sensitivity analysis of the parameter 'random p' can be seen in Appendix F.1.

Change in 'error in q'

The function in stock 'error in q' creates a random number consistent with a normal distribution having a mean of -0.0218 and a variation 0.1077. We used an interval of 3 sigma left and 3 sigma right of the mean value. So we made 25 runs in between -0.3449 and 0.3013. A change in this stock has similar effects on the sales patterns as the stock 'random p'. Yet, it is not as significant as the stock 'random p'. The main difference of this stock is that a change in this stock does not effect on the first week sales value. The graphs from the sensitivity analysis of the parameter 'random p' can be seen in Appendix F.2.

Change in 'random reviews'

As in the case of 'random p' stock, this stock generates a uniformly distributed random number which has a value in between 0 and 1. As the value increases, the revenue value for both theatrical and DVD sales increase constantly. We may conclude from this analysis that every single review done about a film contributed the same amount of revenue to the potential of that film. Although this seems logical in some way that every review increases the number of people aware of the movie. On the other hand, as the number of reviews increase, an additional review would probably contribute less to the popularity of that movie, assuming that every review on their own has the same influence power. Yet, in our data set maximum number of reviews was 15. The graphs from the sensitivity analysis of the parameter 'random reviews' can be seen in Appendix F.3.

Change in 'error in ln revenue'

The function in stock 'error in ln revenue' creates a random number consistent with normal distribution having a mean of 0.1062 and a variation 0.8151. We used an interval of 3 sigma left and 3 sigma right of the mean value. So we made 25 runs in between -2.3391 and 2.5515. Because the revenue potential value is obtained in log normal terms, as the 'error in ln revenue' value increases, the effect of same amount of additional 'error in ln revenue' value increases. This stock reflects the uncertainty of the film industry environment. Although it does not change the general behavior, it is numerically sensitive. The graphs from the sensitivity analysis of the parameter 'error in ln revenue' can be seen in Appendix F.4.

Change in 'ln production budget'

The function in stock 'ln production budget' creates a random number consistent with normal distribution having a mean of 17.3 and a variation 0.985. We used an interval of 3 sigma to the left and 3 sigma to the right of the mean value. So we made 25 runs in between 14.345 and 20.255. The sensitivity analysis show the same results of sensitivity analysis of 'error in ln revenue'. The graphs from the sensitivity analysis of the parameter 'ln production budget' can be seen in Appendix F.5.

Change in 'dvd sales delay'

For the 'dvd sales delay' we used an interval of 0 and 20. The most significant behavior sensitivity is seen via a change in 'dvd sales delay'. As the delay is increased from 0 to 20, the value where the total number of viewers and the total revenue (both from theatrical and DVD sales) converge first increases up to a point, later on starts decreasing. This shows that releasing DVD, before theatrical potential is diminished would result in a higher number of viewers and higher total revenue. Yet, what is more important, the analysis show that decision on the 'dvd sales delay' would affect the sales pattern significantly. The graphs from the sensitivity analysis of the parameter 'dvd sales delay' can be seen in Appendix F.6.

5.7 Scenario Analysis

In this section using real world data, we made some sample runs. We also compared the results of sample runs with the real world cases. In order to make this analysis, we chose the extreme cases for which the values of p and q are available. The extreme case criteria were the most and the least grossing films, and the films having the most and the least production budgets. These films are film 1 (The Dark Knight), film 112 (Son of Rambow: A Home Movie), and film 8 (Quantum of Solace) consequently. Film 112 is both the least grossing film and the film having the least production budget. In addition to these films we analyzed film 51 (Righteous Kill) which is rather regular compared to the other analyzed films.

Film 1 (The Dark Knight)

Film 1 is the movie having the highest gross revenue. In order to run the model we used the data of production budget, number of critical reviews, the p value, and the delay between theatrical and DVD releases of Film 1. As the 'error in q' and the 'error in ln revenue' stocks were not changed, each run resulted in a different sales revenue curve. In Figure 5.19 theatrical sales curves of 42 runs can be seen. One of these curves marked as 'real curve'. This curve shows the sales pattern which is constructed with the p, the q, and the total theatrical revenue values being the same

as the values for Film 1. Another curve is marked as 'error=0'. This curve shows the sales pattern which is constructed with the p, the q, and the production budget values being the same as the values for Film 1. Yet, the 'error in ln revenue' value is set to zero. These curves are shown for the comparison purpose. As the figure shows only one of total revenue value of these 40 runs (other than mentioned two runs) surpasses the real world total revenue value. This was the expected result as the film 1 is one of the extreme cases having the highest total theatrical revenue.

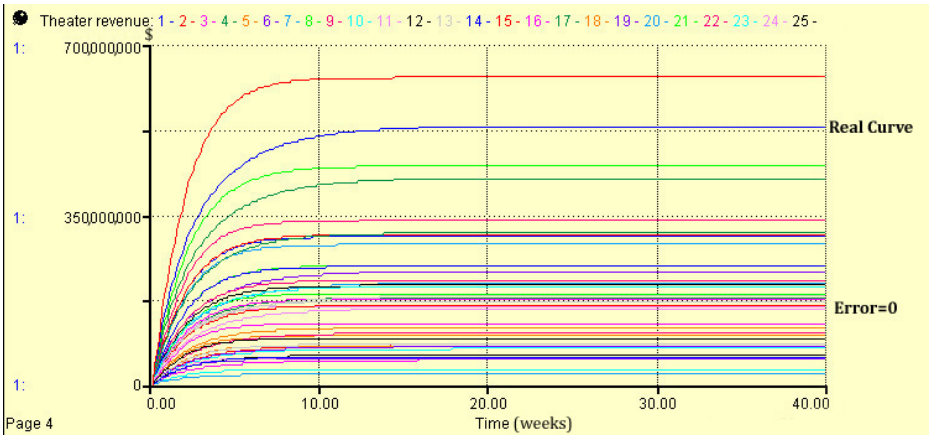

Figure 5.19: Theatrical Sales Curves with changing error values for Film 1

Figure 5.20 shows the theatrical and the DVD sales pattern curves of film 1 that the model gives.

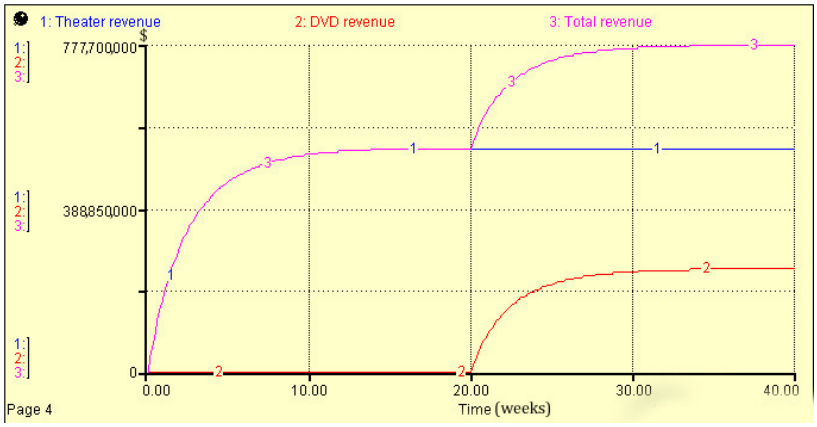

Figure 5.20: Theatrical and DVD Sales Curves for Film 1

Although we do not have the weekly sales data of DVDs, we have the weekly theatrical sales data. Figure 5.21 shows the weekly theatrical sales pattern and the model output for the sales pattern of Film 1.

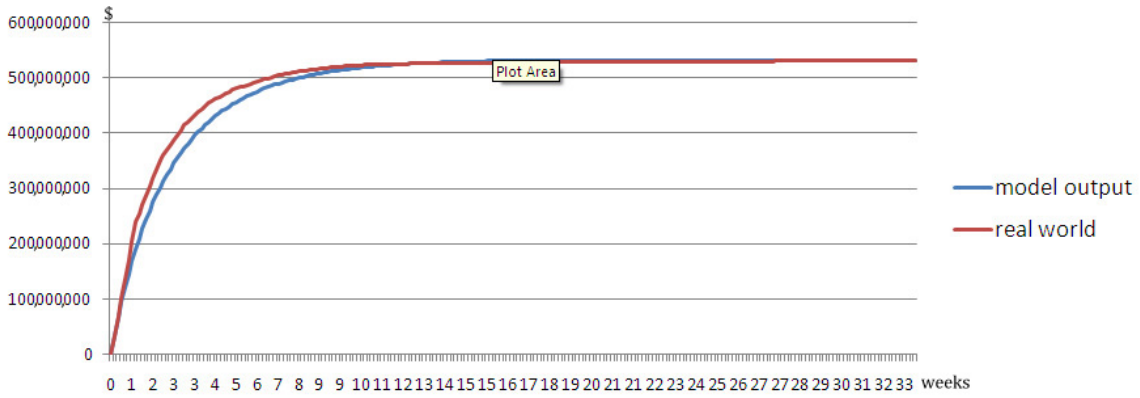

Figure 5.21: Sales Pattern Comparison of Film 1

Film 8 (Quantum of Solace)

Film 8 is the movie having the highest production budget. As in the example of Film 1, in order to run the model we used the data of production budget, number of critical reviews, the p value, and the delay between theatrical and DVD releases of Film 8. In Figure 5.22 theatrical sales curves of 42 runs can be seen. The marked curve shows where the 'error in ln revenue' value is zero. The real curve is also close to this curve.

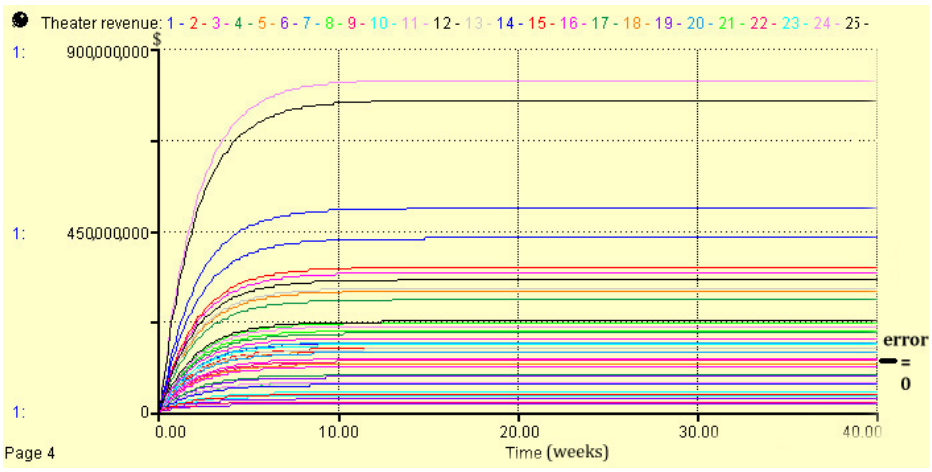

Figure 5.22: Theatrical Sales Curves with changing error values for Film 8

Figure 5.23 shows the theatrical and the DVD sales pattern curves of film 8 that the model gives.

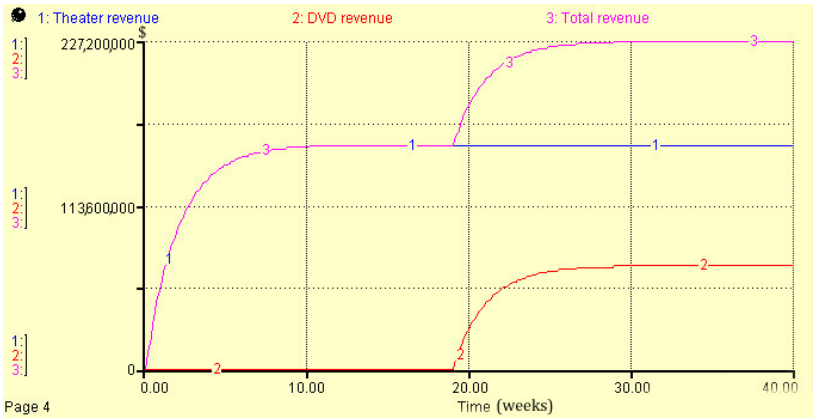

Figure 5.23: Theatrical and DVD Sales Curves for Film 8

Figure 5.24 shows the weekly theatrical sales pattern and the model output for the sales pattern of Film 8.

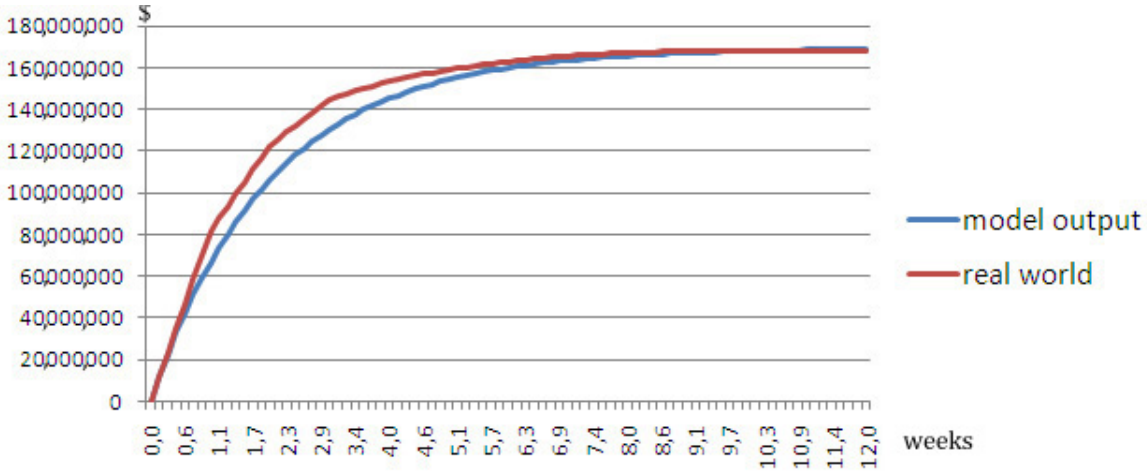

Figure 5.24: Sales Pattern Comparison of Film 8

Film 51 (Righteous Kill)

Film 51 is the movie which can be considered as "typical" in terms of production budget or total theatrical revenue. In Figure 5.25 theatrical sales curves of 42 runs can be seen. The marked curve shows where the 'error in ln revenue' value is zero. The real curve is also close to this curve.

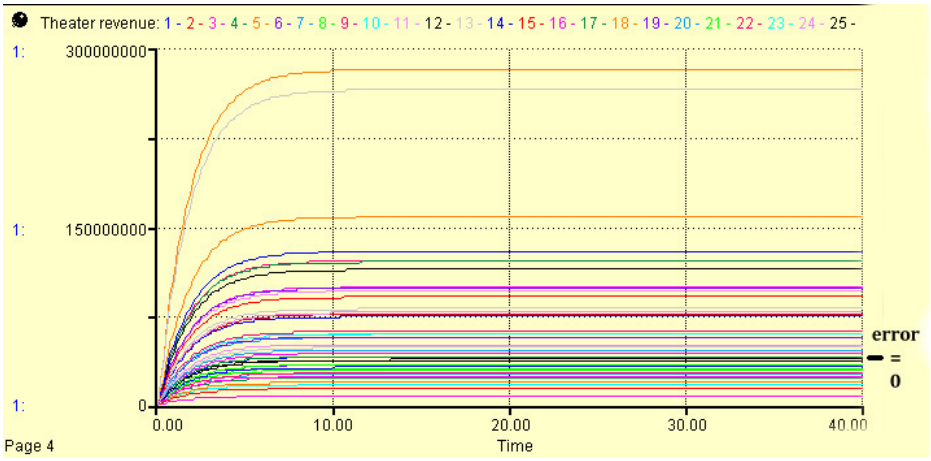

Figure 5.25: Theatrical Sales Curves with changing error values for Film 51

Figure 5.26 shows the theatrical and the DVD sales pattern curves of film 51 that the model gives.

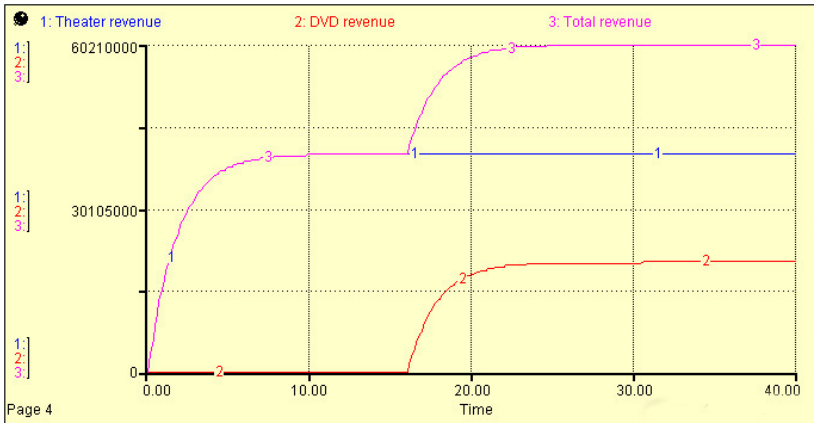

Figure 5.26: Theatrical and DVD Sales Curves for Film 51

Figure 5.27 shows the weekly theatrical sales pattern and the model output for the sales pattern of Film 51.

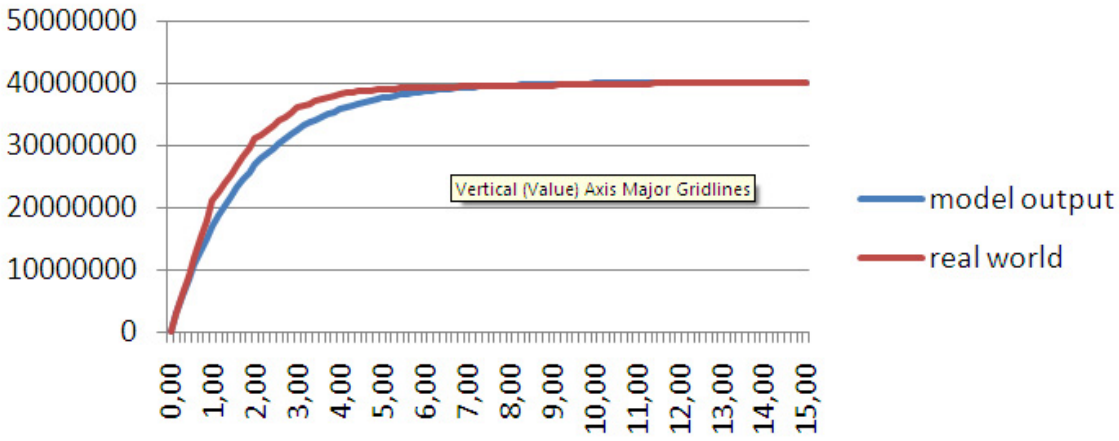

Figure 5.27: Sales Pattern Comparison of Film 51

Film 112 (Son of Rambow: A Home Movie)

Film 112 is the movie having both the lowest production budget and the total theatrical revenue. In Figure 5.28 theatrical sales curves of 42 runs can be seen. The curve marked as 1 shows where the 'error in ln revenue' value is set to zero. Whereas, the curve marked as 2 shows the real curve.

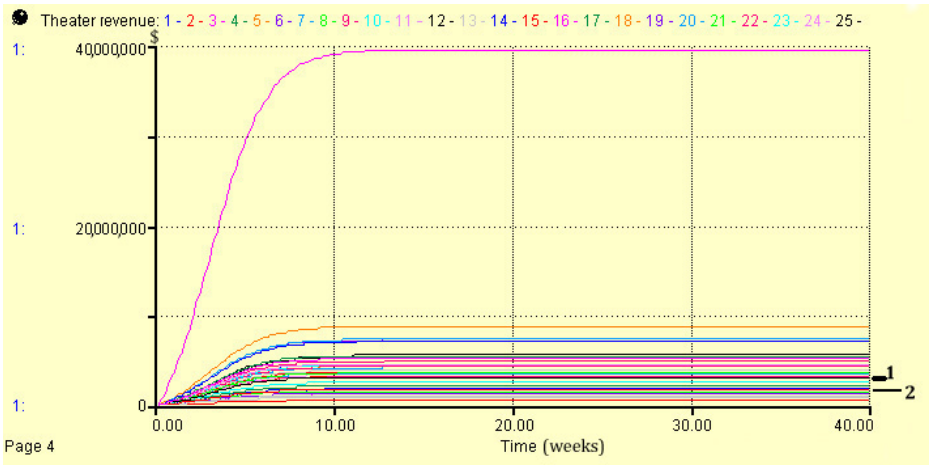

Figure 5.28: Theatrical Sales Curves with changing error values for Film 112

Figure 5.29 shows the theatrical and the DVD sales pattern curves of film 112 that the model gives.

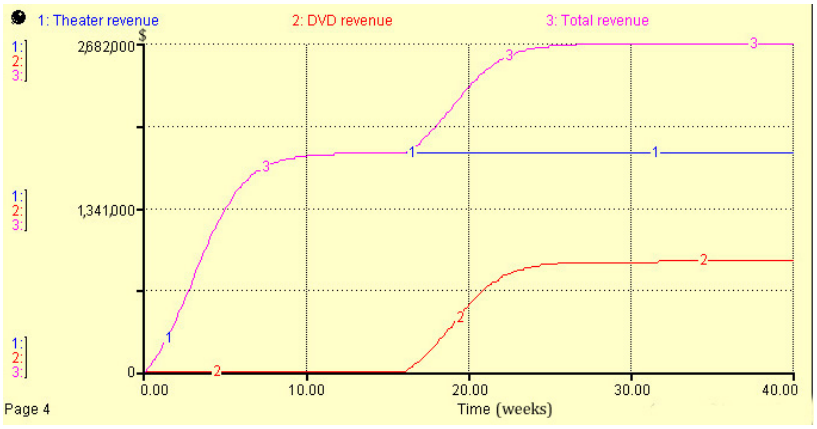

Figure 5.29: Theatrical and DVD Sales Curves for Film 112

Figure 5.30 shows the weekly theatrical sales pattern and the model output for the sales pattern of Film 112.

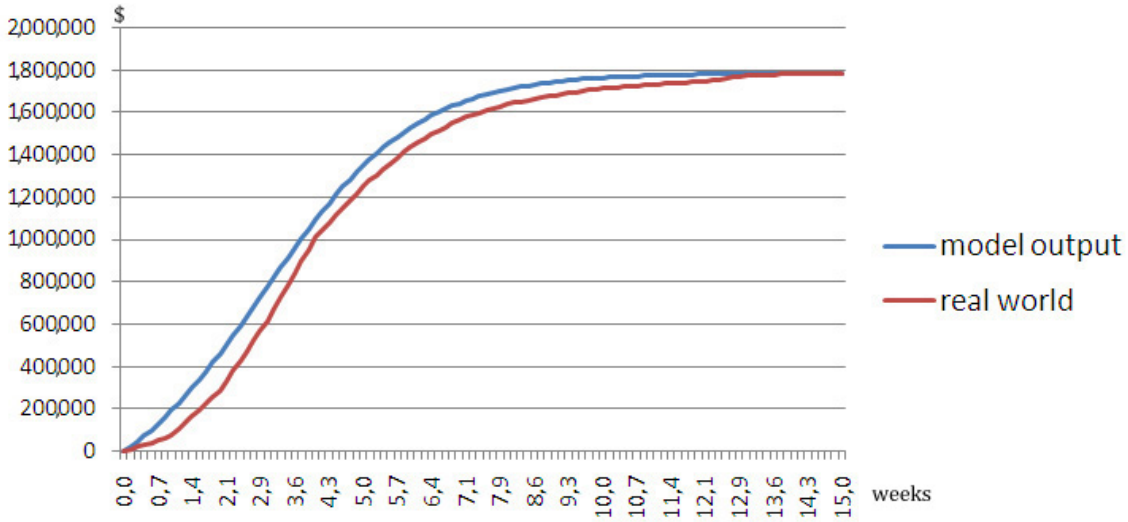

Figure 5.30: Sales Pattern Comparison of Film 112

CHAPTER 6

CONCLUSIONS AND FUTURE STUDIES

In this thesis, we suggested applying the system dynamics methodology to the analyses of creative industries. For this purpose, we applied the methodology to Hollywood film industry. The effects of pirated copies of films to the industry were the main concern of the study, which oriented our thoughts and focus. As we do not have direct empirical data about the piracy in the industry, we mostly tried to infer from the effects of the DVD sales on the theatrical sales.

Before creating a dynamic model, we first introduced the terms of creative and cultural industries, how they are defined differently by distinct organizations, the scope of these industries, and their common economical properties. Later on, we narrowed our focus to the film industries, specifically to the Hollywood Film Industry. We continued on giving information on the piracy in audio-visual industries which is a subsystem of creative industries and cover the film industries. All the chapters before Chapter 5 contributed in becoming familiar with the concepts of system dynamics, the creative and cultural industries, and the piracy in addition to our model environment, the Hollywood Film Industry.

We created the dynamic model in two stages named as the theatrical sector and the DVD sector. Following these stages, the third stage, that covers the discussion on the effects of piracy to the film industry, was introduced. The widest model in this study covers the theatrical sales and the sales of the DVDs. These sales channels are chosen as they provide the highest incomes. The industry can be modeled in many ways. Our model works like a movie generator. It reflects the uncertain behavior of the film industry. Even if the producer makes the "right" decisions on the production

budget, release date, which stars to play in the movie, or the MPAA rating etc. he cannot foresee the exact revenue value. The regression analysis in the literature can explain only around 50% of the variance in the theatrical revenue distribution. Most of these analysis use different sets of data. We used a data set of 119 movies which were released in theaters in 2008. Among our various regression analysis, we used the equation in which the theatrical revenue is dependent on the production budget and the number of critical reviews. This equation explains 43% of the variance in the revenue distribution. In each run, the model creates a new movie. Information like weekly theatrical sales values, weekly DVD sales values, delay between the theatrical and DVD sales, production budget, advertisement and promotional costs, weekly number of viewers for both theaters and DVDs, and the sales pattern graphics are gathered from the model for each run or in other words for each movie.

Sensitivity analysis showed that delay between theatrical and DVD releases is the most important parameter in the model. This parameter not only effects the total revenue obtained from theatrical and DVD sales, but changes the pattern of the sales. Although the model suggest that releasing the DVD sales closer to the theatrical release date would provide more revenue, the exact time depends on the movie. If the movie has high p and q values which define the sales pattern of the movie, then the theatrical sales potential would be reached in a shorter time. So this results in releasing the DVDs in even a closer date to the theatrical release.

In this study we examined four scenarios, three of which constitute the extreme cases in our data set. These scenarios and their graphical outputs showed the uncertainties of the films clearly. A movie with the same production budget and the same number of reviews may create rather different revenue values. In the same manner, a movie with the same p value may create two sales patterns different from each other.

With our model it is possible to see if a film covers its production and distribution costs by the theatrical and DVD sales. Yet, for a future study, a more comprehensive model including all the distribution channels would give more proper results. The importance of each distribution channel changes as the time passes. For instance, VHS rentals channel do not have the importance of the past as the DVD sales surpassed it. Likewise, in the future, it is possible that the Internet sales which include the legal downloads would gain great importance. This would decrease the distribution

costs significantly. According to Weinberg [101], half of the revenue is collected by the studio. Also, according to Shugan [81] distribution expenses are as large as the production expenses. Combining all of the sales channels, it is also possible to modify the model as a decision support tool for a studio, showing whether the studio profits from the movies that it produces in the long run or not.

Although these future studies can be done on film industries, there are also many things that can be done on the other aspects of creative industries. Creative industries constitute a great source of economic growth, trade, and employment. In addition to their economical importance, with their complex and dynamical environment they also would provide good research questions for industrial engineers as well as the dynamic system modelers.

In summary, we may list the main conclusions in 5 topics.

1. The revenue potential of a movie cannot be foreseen before the release occurs. Even with a regression analysis of 12 variables, the regression analysis does not explain the variation in revenue by more than 65%. A film may create much higher or lower revenue values than expected.

2. In an environment of just theatrical and DVD sales, assuming that the DVD sales occur after the theatrical sales, the timing of DVD sales is more important than the other factors. This result can be generalized for the other environments where multiple types of distribution channels are available. The release dates affect the behavior of the sales patterns as well as the magnitude of the sales values.

3. In addition to the legal distribution channels, pirating offers another channel for film viewers. Gathering piracy-related data is understandably difficult. Monetary loss estimations are commonly carried out via indirect information like the number of empty CD sales.

4. Although it is hard to obtain data about how many people watch a film illegally, the effects of pirating can be inferred from the effects of DVD sales. Pirating probably effects the system similar to DVD sales, thus timing should be considered as the most important factor.

5. In a more general context, the present study may be considered as an exercise in demonstrating the wealth of tools and techniques available to the industrial engineer and operations researcher. Besides the customary mathematical optimization models and simulation models, dynamical systems modeling is a valuable tool in observing and understanding the behavior of complex systems, and consequently making better decisions in complex systems. The approach taken in this study has its roots in industrial dynamics. However, the approach is flexible and robust enough, as seen here, to tackle such complex economic and societal issues as creative industries and pirating of intellectual property.

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Appendix A

MOVIE LIST

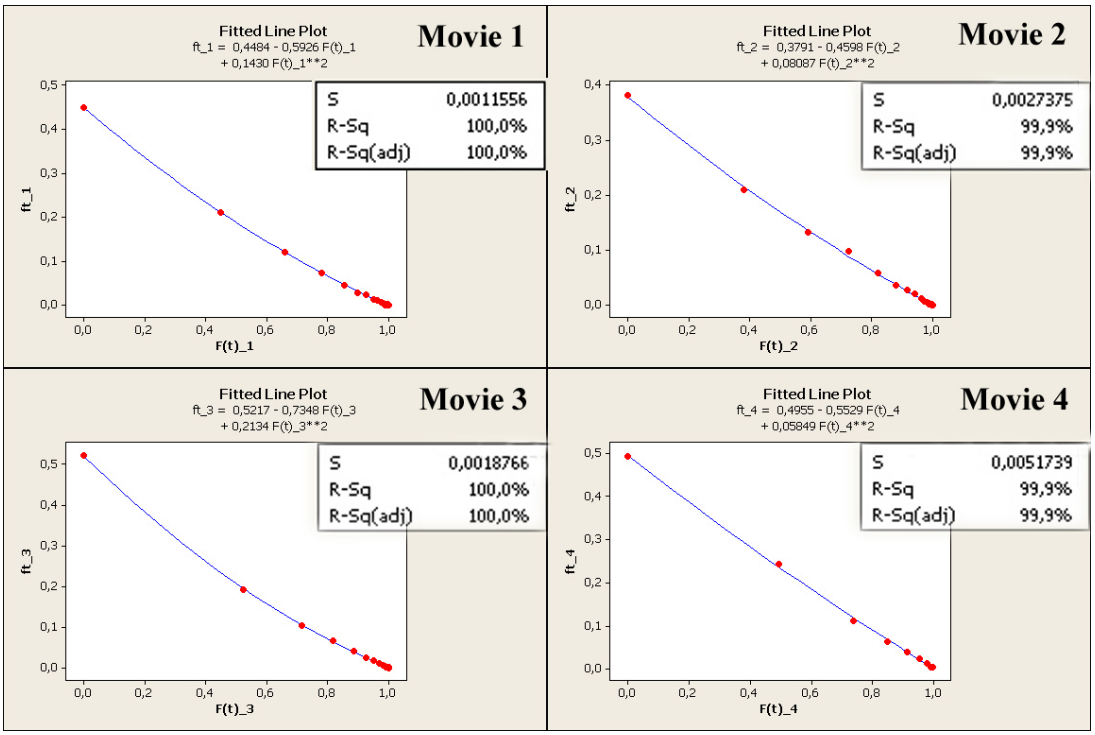
1. The Dark Knight
2. Iron Man
3. Indiana Jones and the Kingdom of the Crystal Skull
4. Hancock
5. WALL-E
6. Twilight
7. Madagascar: Escape 2 Africa
8. Quantum of Solace
9. Horton Hears a Who
10. Sex and the City
11. The Chronicles of Narnia: Prince Caspian
12. Slumdog Millionaire
13. The Incredible Hulk
14. Wanted
15. The Curious Case of Benjamin Button
16. Four Christmases
17. Bolt
18. Tropic Thunder
19. The Mummy: Tomb of the Dragon Emperor
20. Journey to the Center of the Earth
21. Eagle Eye
22. Yes Man
23. 10000 B.C.
24. High School Musical 3: Senior Year
25. The Pineapple Express
26. Valkyrie
27. 21
28. Jumper
29. Cloverfield
30. Hellboy 2: The Golden Army
31. The Spiderwick Chronicles
32. Fool's Gold
33. Seven Pounds

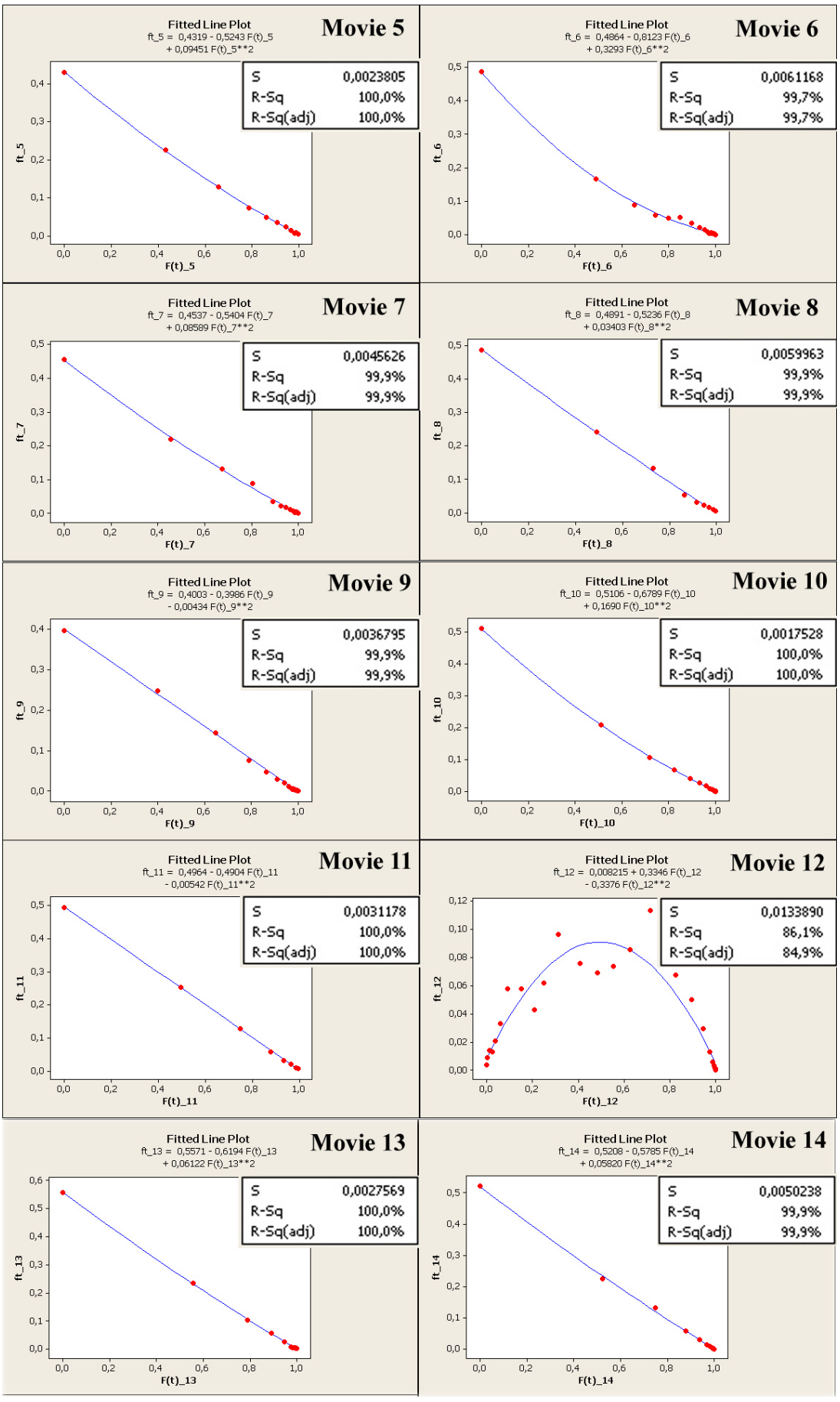
34. "Hannah Montana/Miley Cyrus: Best of Both Worlds Concert Tour"
35. The Happening
36. Burn After Reading
37. Step Up 2 the Streets
38. Saw V
39. The Strangers
40. The Forbidden Kingdom
41. Australia
42. The House Bunny
43. Nim's Island
44. Made of Honor
45. The Sisterhood of the Traveling Pants 2
46. Speed Racer
47. Prom Night
48. Rambo
49. Welcome Home Roscoe Jenkins
50. Max Payne
51. Righteous Kill
52. Body of Lies
53. Lakeview Terrace
54. Meet the Spartans
55. Harold & Kumar Escape from Guantanamo Bay
56. The Secret Life of Bees
57. Death Race
58. The Reader
59. Doubt
60. Drillbit Taylor
61. Definitely Maybe
62. Milk
63. Quarantine
64. Zack and Miri Make a Porno
65. Leatherheads
66. Space Chimps
67. The Bank Job
68. Untraceable
69. Defiance
70. The Women
71. The Other Boleyn Girl
72. Street Kings
73. The Wrestler
74. W.
75. Never Back Down
76. Traitor
77. Vicky Cristina Barcelona
78. Babylon A.D.
79. The X-Files: I Want to Believe

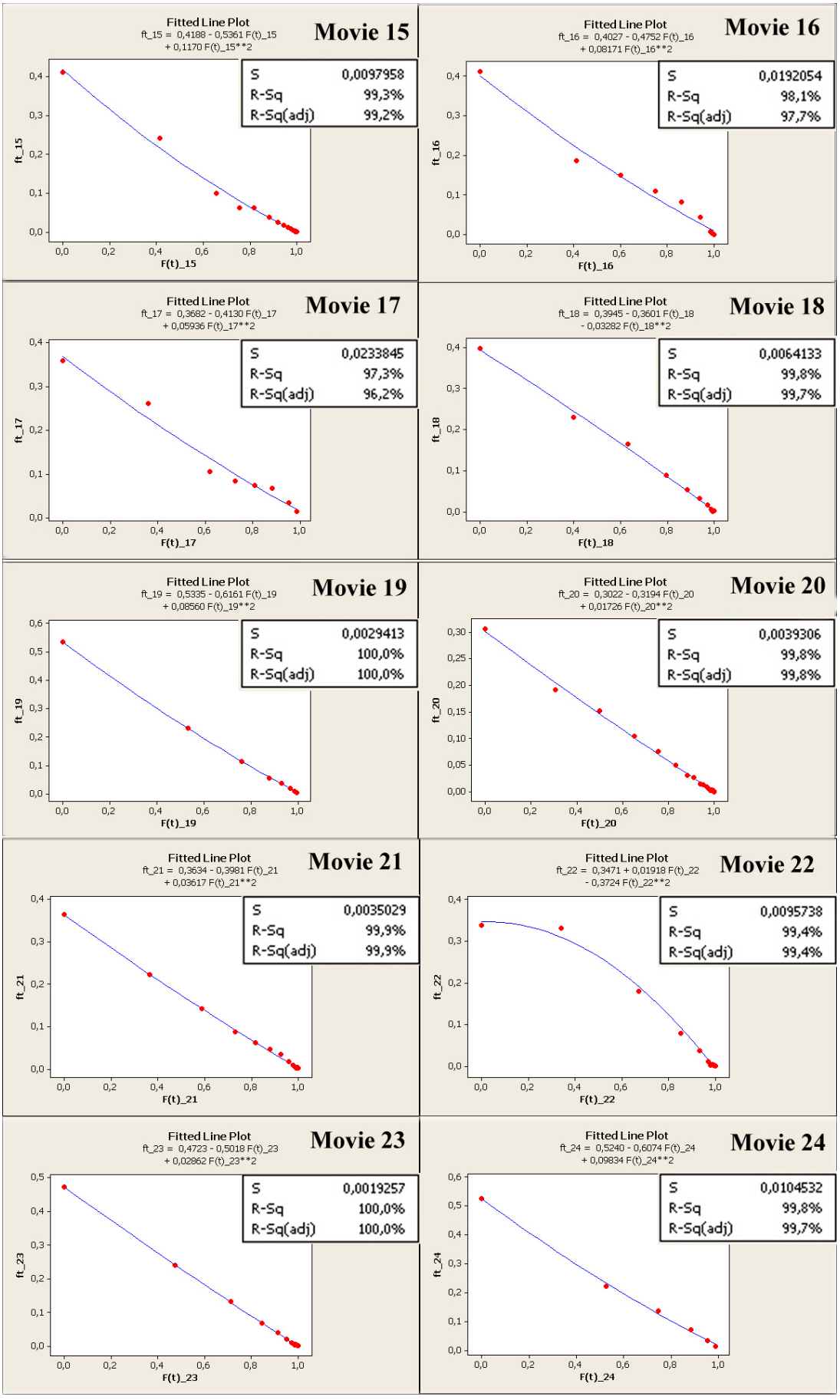
80. Appaloosa
81. Igor
82. My Best Friend's Girl
83. Frost.Nixon
84. The Ruins
85. 88 Minutes
86. Pride and Glory
87. Bangkok Dangerous
88. Fly Me To the Moon
89. Disaster Movie
90. Ghost Town
91. Religulous
92. Rachel Getting Married
93. Meet Dave
94. Be Kind Rewind
95. Doomsday
96. U2 3D
97. The Express
98. The Visitor
99. The Boy in the Striped Pajamas
100. Sex Drive
101. Punisher: War Zone
102. Miracle at St. Anna
103. City of Ember
104. In Bruges
105. Dolphins and Whales Tribes of the Ocean 3D
106. The Rocker
107. Hamlet 2
108. College
109. Blindness
110. How to Lose Friends & Alienate People
111. Waltz with Bashir
112. Son of Rambow: A Home Movie
113. Bienvenue chez les Ch'tis
114. What Just Happened
115. And When Did You Last See Your Father?
116. The Children of Huang Shi
117. Asterix at the Olympic Games
118. War Inc.
119. CJ7

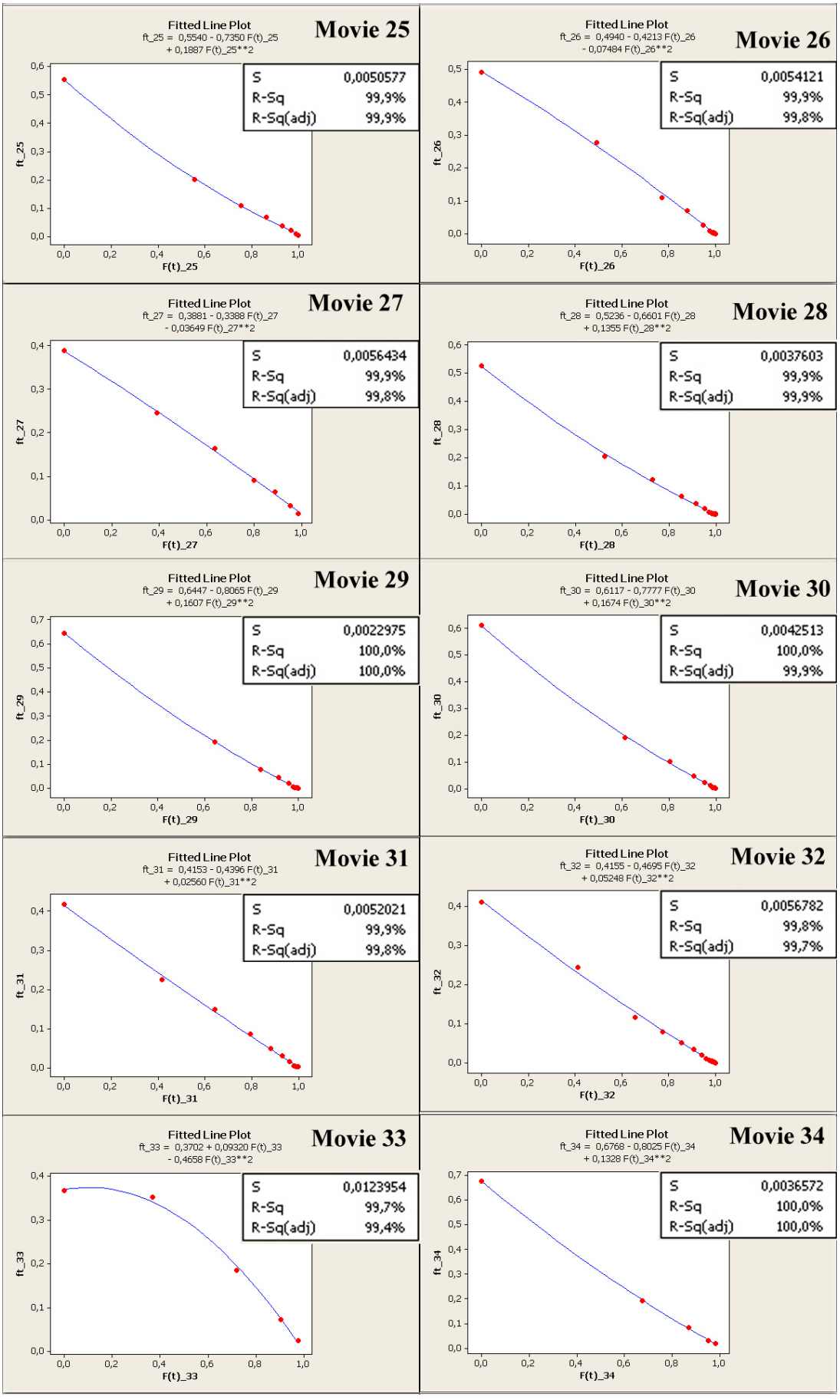
Appendix B

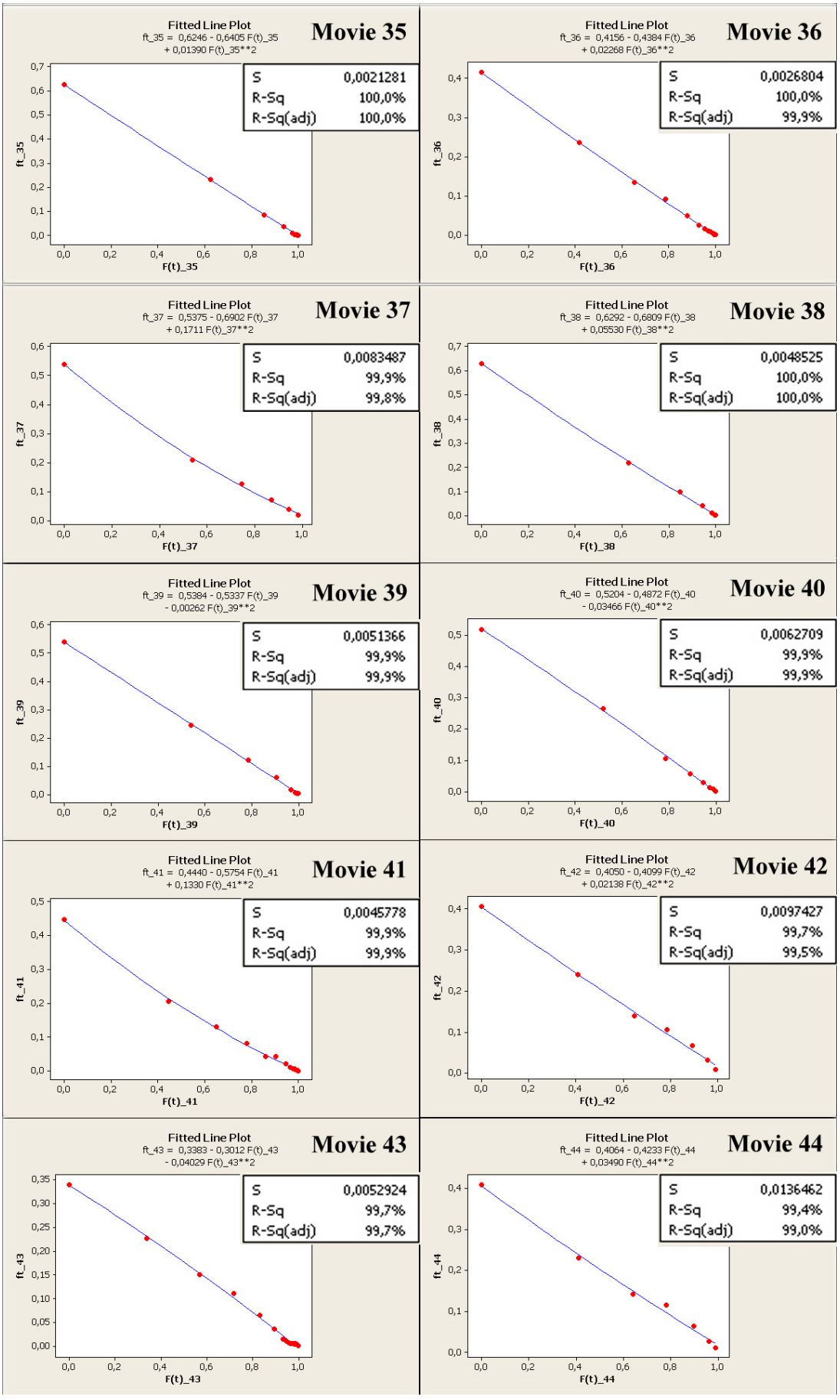
DIFFUSION PATTERNS OF THE MOVIES IN THE LIST

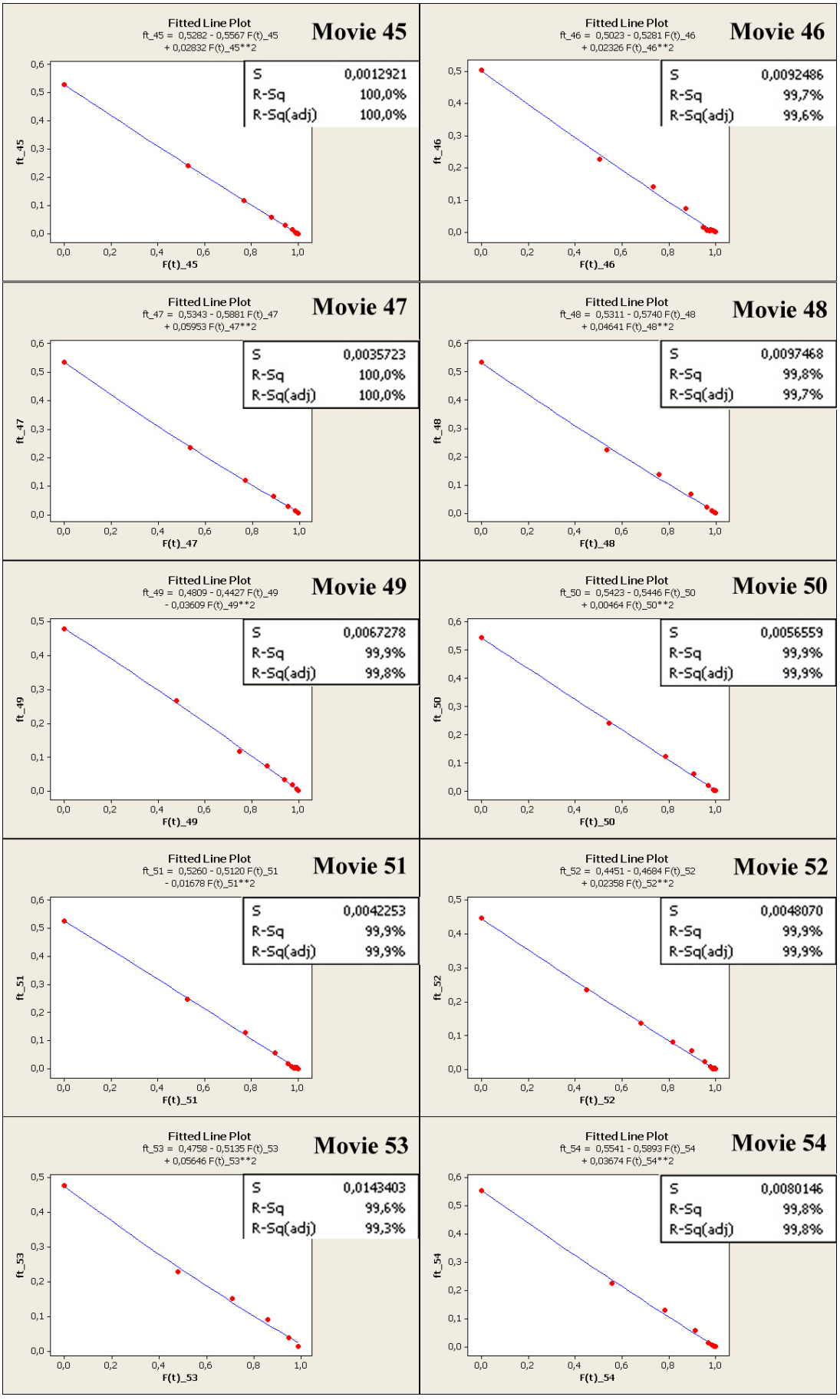


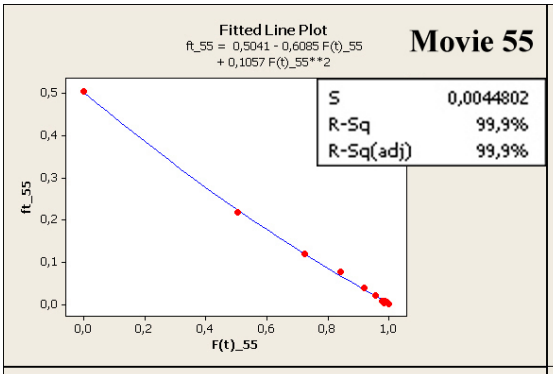

Movie 5
Fitted Line Plot
ft_5 = 0,4319 - 0,5243 F(t)_5 + 0,09451 F(t)_5**2
S 0,0023805
R-Sq 100,0%
R-Sq(adj) 100,0%
ft_5
F(t)_5
Movie 6
Fitted Line Plot
ft_6 = 0,4864 - 0,8123 F(t)_6 + 0,3293 F(t)_6**2
S 0,0061168
R-Sq 99,7%
R-Sq(adj) 99,7%
ft_6
F(t)_6
Movie 7
Fitted Line Plot
ft_7 = 0,4537 - 0,5404 F(t)_7 + 0,08589 F(t)_7**2
S 0,0045626
R-Sq 99,9%
R-Sq(adj) 99,9%
ft_7
F(t)_7
Movie 8
Fitted Line Plot
ft_8 = 0,4891 - 0,5236 F(t)_8 + 0,03403 F(t)_8**2
S 0,0059963
R-Sq 99,9%
R-Sq(adj) 99,9%
ft_8
F(t)_8
Movie 9
Fitted Line Plot
ft_9 = 0,4003 - 0,3986 F(t)_9 - 0,00434 F(t)_9**2
S 0,0036795
R-Sq 99,9%
R-Sq(adj) 99,9%
ft_9
F(t)_9
Movie 10
Fitted Line Plot
ft_10 = 0,5106 - 0,6789 F(t)_10 + 0,1690 F(t)_10**2
S 0,0017528
R-Sq 100,0%
R-Sq(adj) 100,0%
ft_10
F(t)_10
Movie 11
Fitted Line Plot
ft_11 = 0,4964 - 0,4904 F(t)_11 - 0,00542 F(t)_11**2
S 0,0031178
R-Sq 100,0%
R-Sq(adj) 100,0%
ft_11
F(t)_11
Movie 12
Fitted Line Plot
ft_12 = 0,008215 + 0,3346 F(t)_12 - 0,3376 F(t)_12**2
S 0,0133890
R-Sq 86,1%
R-Sq(adj) 84,9%
ft_12
F(t)_12
Movie 13
Fitted Line Plot
ft_13 = 0,5571 - 0,6194 F(t)_13 + 0,06122 F(t)_13**2
S 0,0027569
R-Sq 100,0%
R-Sq(adj) 100,0%
ft_13
F(t)_13
Movie 14
Fitted Line Plot
ft_14 = 0,5208 - 0,5785 F(t)_14 + 0,05820 F(t)_14**2
S 0,0050238
R-Sq 99,9%
R-Sq(adj) 99,9%
ft_14
F(t)_14

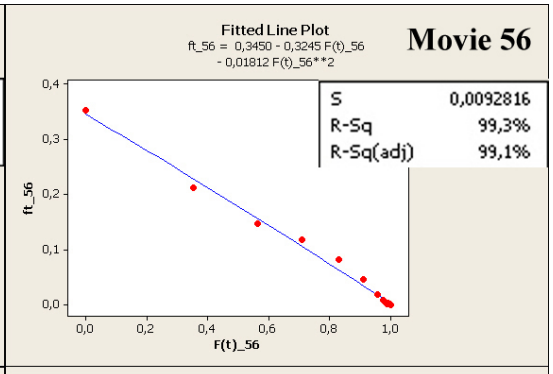

Fitted Line Plot
ft_15 = 0,4188 - 0,5361 F(t)_15 + 0,1170 F(t)_15**2
S 0,0097958
R-Sq 99,3%
R-Sq(adj) 99,2%
Movie 15
ft_15
F(t)_15
Fitted Line Plot
ft_16 = 0,4027 - 0,4752 F(t)_16 + 0,08171 F(t)_16**2
S 0,0192054
R-Sq 98,1%
R-Sq(adj) 97,7%
Movie 16
ft_16
F(t)_16
Fitted Line Plot
ft_17 = 0,3682 - 0,4130 F(t)_17 + 0,05936 F(t)_17**2
S 0,0233845
R-Sq 97,3%
R-Sq(adj) 96,2%
Movie 17
ft_17
F(t)_17
Fitted Line Plot
ft_18 = 0,3945 - 0,3601 F(t)_18 - 0,03282 F(t)_18**2
S 0,0064133
R-Sq 99,8%
R-Sq(adj) 99,7%
Movie 18
ft_18
F(t)_18
Fitted Line Plot
ft_19 = 0,5335 - 0,6161 F(t)_19 + 0,08560 F(t)_19**2
S 0,0029413
R-Sq 100,0%
R-Sq(adj) 100,0%
Movie 19
ft_19
F(t)_19
Fitted Line Plot
ft_20 = 0,3022 - 0,3194 F(t)_20 + 0,01726 F(t)_20**2
S 0,0039306
R-Sq 99,8%
R-Sq(adj) 99,8%
Movie 20
ft_20
F(t)_20
Fitted Line Plot
ft_21 = 0,3634 - 0,3981 F(t)_21 + 0,03617 F(t)_21**2
S 0,0035029
R-Sq 99,9%
R-Sq(adj) 99,9%
Movie 21
ft_21
F(t)_21
Fitted Line Plot
ft_22 = 0,3471 + 0,01918 F(t)_22 - 0,3724 F(t)_22**2
S 0,0095738
R-Sq 99,4%
R-Sq(adj) 99,4%
Movie 22
ft_22
F(t)_22
Fitted Line Plot
ft_23 = 0,4723 - 0,5018 F(t)_23 + 0,02862 F(t)_23**2
S 0,0019257
R-Sq 100,0%
R-Sq(adj) 100,0%
Movie 23
ft_23
F(t)_23
Fitted Line Plot
ft_24 = 0,5240 - 0,6074 F(t)_24 + 0,09834 F(t)_24**2
S 0,0104532
R-Sq 99,8%
R-Sq(adj) 99,7%
Movie 24
ft_24
F(t)_24

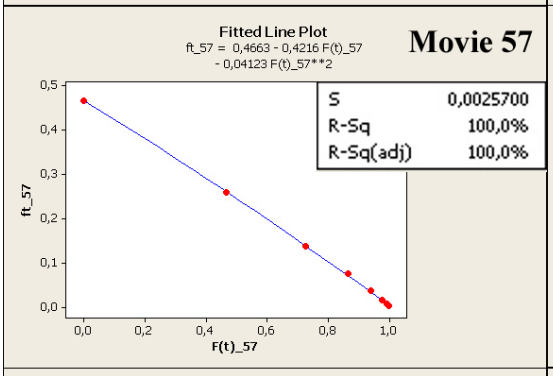

Fitted Line Plot
ft_25 = 0,5540 - 0,7350 F(t)_25 + 0,1887 F(t)_25**2
Movie 25
S 0,0050577
R-Sq 99,9%
R-Sq(adj) 99,9%
ft_25
F(t)_25
Fitted Line Plot
ft_26 = 0,4940 - 0,4213 F(t)_26 - 0,07484 F(t)_26**2
Movie 26
S 0,0054121
R-Sq 99,9%
R-Sq(adj) 99,8%
ft_26
F(t)_26
Fitted Line Plot
ft_27 = 0,3881 - 0,3388 F(t)_27 - 0,03649 F(t)_27**2
Movie 27
S 0,0056434
R-Sq 99,9%
R-Sq(adj) 99,8%
ft_27
F(t)_27
Fitted Line Plot
ft_28 = 0,5236 - 0,6601 F(t)_28 + 0,1355 F(t)_28**2
Movie 28
S 0,0037603
R-Sq 99,9%
R-Sq(adj) 99,9%
ft_28
F(t)_28
Fitted Line Plot
ft_29 = 0,6447 - 0,8065 F(t)_29 + 0,1607 F(t)_29**2
Movie 29
S 0,0022975
R-Sq 100,0%
R-Sq(adj) 100,0%
ft_29
F(t)_29
Fitted Line Plot
ft_30 = 0,6117 - 0,7777 F(t)_30 + 0,1674 F(t)_30**2
Movie 30
S 0,0042513
R-Sq 100,0%
R-Sq(adj) 99,9%
ft_30
F(t)_30
Fitted Line Plot
ft_31 = 0,4153 - 0,4396 F(t)_31 + 0,02560 F(t)_31**2
Movie 31
S 0,0052021
R-Sq 99,9%
R-Sq(adj) 99,8%
ft_31
F(t)_31
Fitted Line Plot
ft_32 = 0,4155 - 0,4695 F(t)_32 + 0,05248 F(t)_32**2
Movie 32
S 0,0056782
R-Sq 99,8%
R-Sq(adj) 99,7%
ft_32
F(t)_32
Fitted Line Plot
ft_33 = 0,3702 + 0,09320 F(t)_33 - 0,4658 F(t)_33**2
Movie 33
S 0,0123954
R-Sq 99,7%
R-Sq(adj) 99,4%
ft_33
F(t)_33
Fitted Line Plot
ft_34 = 0,6768 - 0,8025 F(t)_34 + 0,1328 F(t)_34**2
Movie 34
S 0,0036572
R-Sq 100,0%
R-Sq(adj) 100,0%
ft_34
F(t)_34

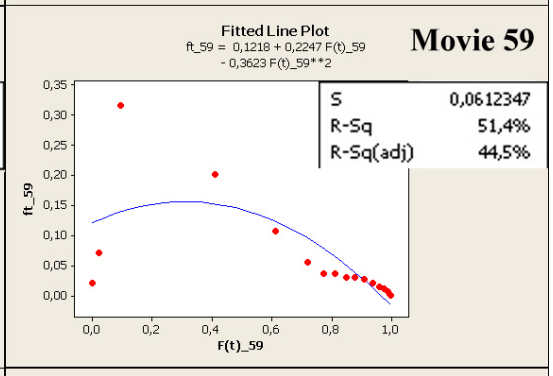

Fitted Line Plot
ft_35 = 0,6246 - 0,6405 F(t)_35 + 0,01390 F(t)_35**2
Movie 35
S 0,0021281
R-Sq 100,0%
R-Sq(adj) 100,0%
ft_35
F(t)_35
Fitted Line Plot
ft_36 = 0,4156 - 0,4384 F(t)_36 + 0,02268 F(t)_36**2
Movie 36
S 0,0026804
R-Sq 100,0%
R-Sq(adj) 99,9%
ft_36
F(t)_36
Fitted Line Plot
ft_37 = 0,5375 - 0,6902 F(t)_37 + 0,1711 F(t)_37**2
Movie 37
S 0,0083487
R-Sq 99,9%
R-Sq(adj) 99,8%
ft_37
F(t)_37
Fitted Line Plot
ft_38 = 0,6292 - 0,6809 F(t)_38 + 0,05530 F(t)_38**2
Movie 38
S 0,0048525
R-Sq 100,0%
R-Sq(adj) 100,0%
ft_38
F(t)_38
Fitted Line Plot
ft_39 = 0,5384 - 0,5337 F(t)_39 - 0,00262 F(t)_39**2
Movie 39
S 0,0051366
R-Sq 99,9%
R-Sq(adj) 99,9%
ft_39
F(t)_39
Fitted Line Plot
ft_40 = 0,5204 - 0,4872 F(t)_40 - 0,03466 F(t)_40**2
Movie 40
S 0,0062709
R-Sq 99,9%
R-Sq(adj) 99,9%
ft_40
F(t)_40
Fitted Line Plot
ft_41 = 0,4440 - 0,5754 F(t)_41 + 0,1330 F(t)_41**2
Movie 41
S 0,0045778
R-Sq 99,9%
R-Sq(adj) 99,9%
ft_41
F(t)_41
Fitted Line Plot
ft_42 = 0,4050 - 0,4099 F(t)_42 + 0,02138 F(t)_42**2
Movie 42
S 0,0097427
R-Sq 99,7%
R-Sq(adj) 99,5%
ft_42
F(t)_42
Fitted Line Plot
ft_43 = 0,3383 - 0,3012 F(t)_43 - 0,04029 F(t)_43**2
Movie 43
S 0,0052924
R-Sq 99,7%
R-Sq(adj) 99,7%
ft_43
F(t)_43
Fitted Line Plot
ft_44 = 0,4064 - 0,4233 F(t)_44 + 0,03490 F(t)_44**2
Movie 44
S 0,0136462
R-Sq 99,4%
R-Sq(adj) 99,0%
ft_44
F(t)_44

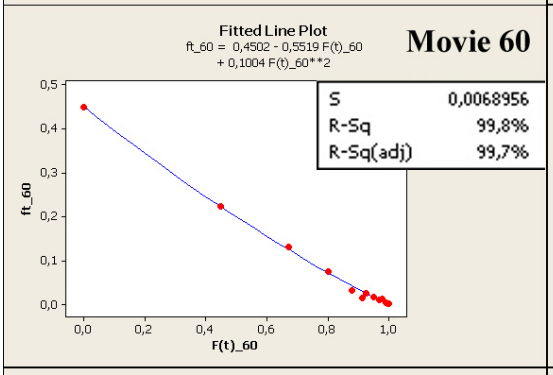

Fitted Line Plot
ft_45 = 0,5282 - 0,5567 F(t)_45 + 0,02832 F(t)_45**2
Movie 45
S 0,0012921
R-Sq 100,0%
R-Sq(adj) 100,0%
ft_45
F(t)_45
Fitted Line Plot
ft_46 = 0,5023 - 0,5281 F(t)_46 + 0,02326 F(t)_46**2
Movie 46
S 0,0092486
R-Sq 99,7%
R-Sq(adj) 99,6%
ft_46
F(t)_46
Fitted Line Plot
ft_47 = 0,5343 - 0,5881 F(t)_47 + 0,05953 F(t)_47**2
Movie 47
S 0,0035723
R-Sq 100,0%
R-Sq(adj) 100,0%
ft_47
F(t)_47
Fitted Line Plot
ft_48 = 0,5311 - 0,5740 F(t)_48 + 0,04641 F(t)_48**2
Movie 48
S 0,0097468
R-Sq 99,8%
R-Sq(adj) 99,7%
ft_48
F(t)_48
Fitted Line Plot
ft_49 = 0,4809 - 0,4427 F(t)_49 - 0,03609 F(t)_49**2
Movie 49
S 0,0067278
R-Sq 99,9%
R-Sq(adj) 99,8%
ft_49
F(t)_49
Fitted Line Plot
ft_50 = 0,5423 - 0,5446 F(t)_50 + 0,00464 F(t)_50**2
Movie 50
S 0,0056559
R-Sq 99,9%
R-Sq(adj) 99,9%
ft_50
F(t)_50
Fitted Line Plot
ft_51 = 0,5260 - 0,5120 F(t)_51 - 0,01678 F(t)_51**2
Movie 51
S 0,0042253
R-Sq 99,9%
R-Sq(adj) 99,9%
ft_51
F(t)_51
Fitted Line Plot
ft_52 = 0,4451 - 0,4684 F(t)_52 + 0,02358 F(t)_52**2
Movie 52
S 0,0048070
R-Sq 99,9%
R-Sq(adj) 99,9%
ft_52
F(t)_52
Fitted Line Plot
ft_53 = 0,4758 - 0,5135 F(t)_53 + 0,05646 F(t)_53**2
Movie 53
S 0,0143403
R-Sq 99,6%
R-Sq(adj) 99,3%
ft_53
F(t)_53
Fitted Line Plot
ft_54 = 0,5541 - 0,5893 F(t)_54 + 0,03674 F(t)_54**2
Movie 54
S 0,0080146
R-Sq 99,8%
R-Sq(adj) 99,8%
ft_54
F(t)_54

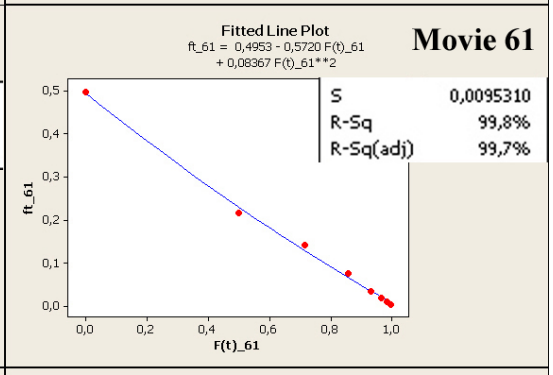

Fitted Line Plot
ft_55 = 0,5041 - 0,6085 F(t)_55
+ 0,1057 F(t)_55**2
Movie 55
S 0,0044802
R-Sq 99,9%
R-Sq(adj) 99,9%
ft_55
F(t)_55

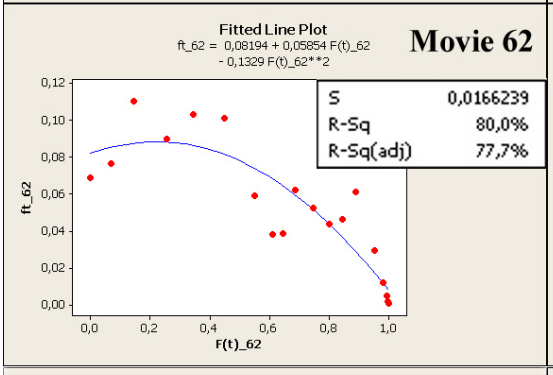

Fitted Line Plot
ft_56 = 0,3450 - 0,3245 F(t)_56
- 0,01812 F(t)_56**2
Movie 56
S 0,0092816
R-Sq 99,3%
R-Sq(adj) 99,1%
ft_56
F(t)_56

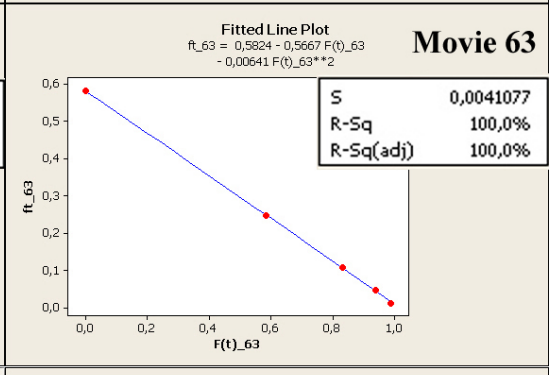

Fitted Line Plot
ft_57 = 0,4663 - 0,4216 F(t)_57
- 0,04123 F(t)_57**2
Movie 57
S 0,0025700
R-Sq 100,0%
R-Sq(adj) 100,0%
ft_57
F(t)_57

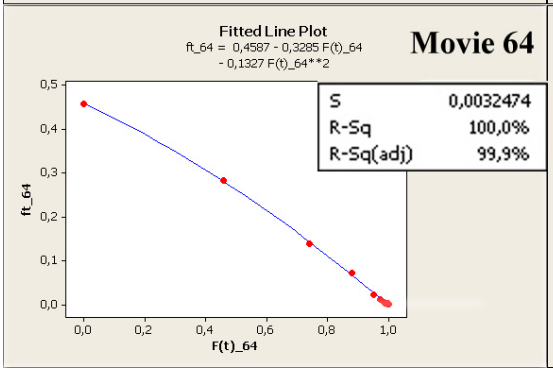

Fitted Line Plot
ft_59 = 0,1218 + 0,2247 F(t)_59
- 0,3623 F(t)_59**2
Movie 59
S 0,0612347
R-Sq 51,4%
R-Sq(adj) 44,5%
ft_59
F(t)_59

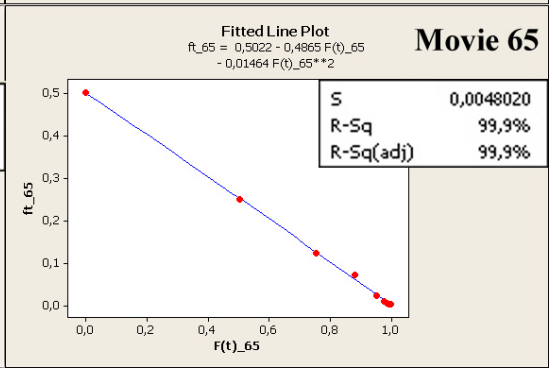

Fitted Line Plot
ft_60 = 0,4502 - 0,5519 F(t)_60
+ 0,1004 F(t)_60**2
Movie 60
S 0,0068956
R-Sq 99,8%
R-Sq(adj) 99,7%
ft_60
F(t)_60

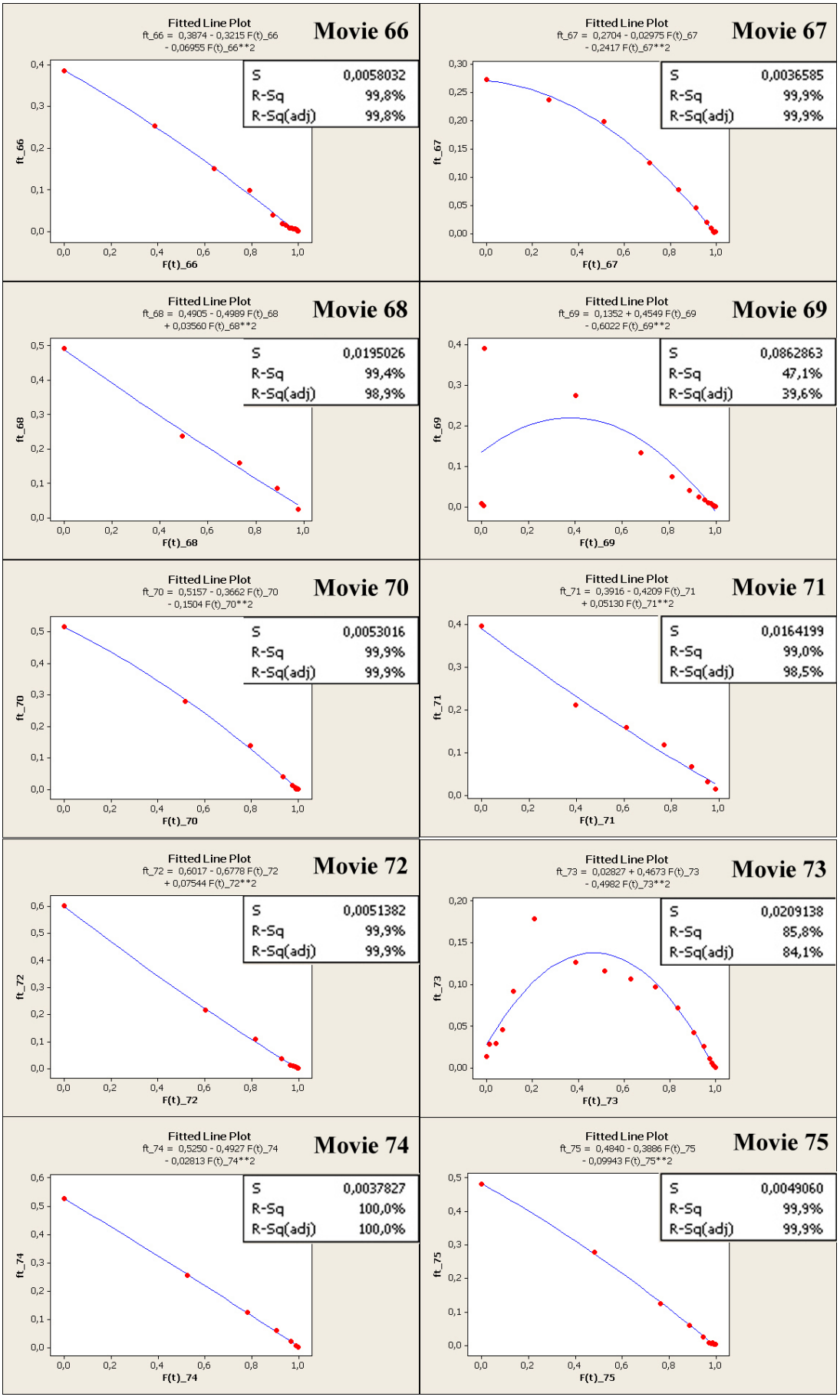

Fitted Line Plot
ft_61 = 0,4953 - 0,5720 F(t)_61
+ 0,08367 F(t)_61**2
Movie 61
S 0,0095310
R-Sq 99,8%
R-Sq(adj) 99,7%
ft_61
F(t)_61

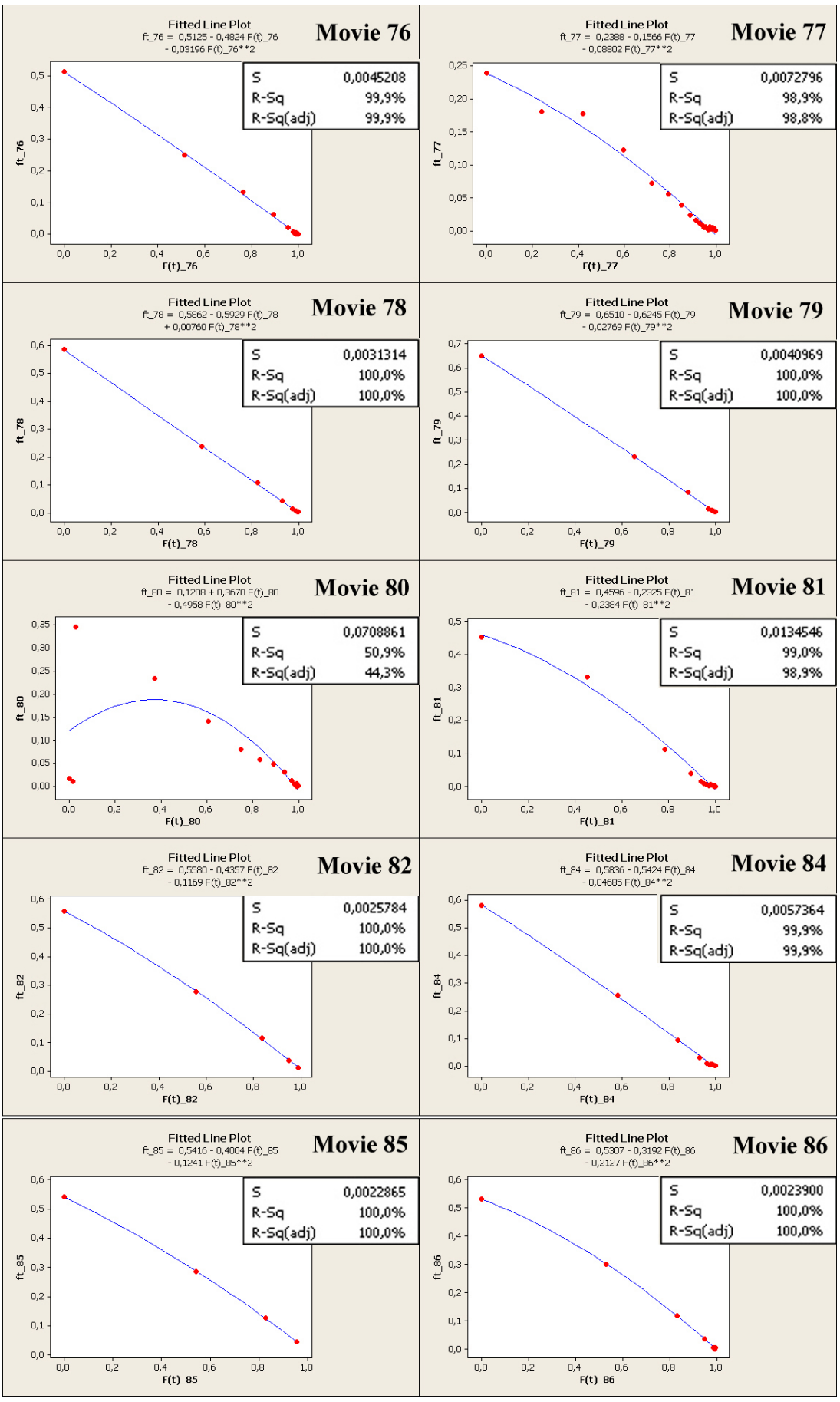

Fitted Line Plot
ft_62 = 0,08194 + 0,05854 F(t)_62
- 0,1329 F(t)_62**2
Movie 62
S 0,0166239
R-Sq 80,0%
R-Sq(adj) 77,7%
ft_62
F(t)_62

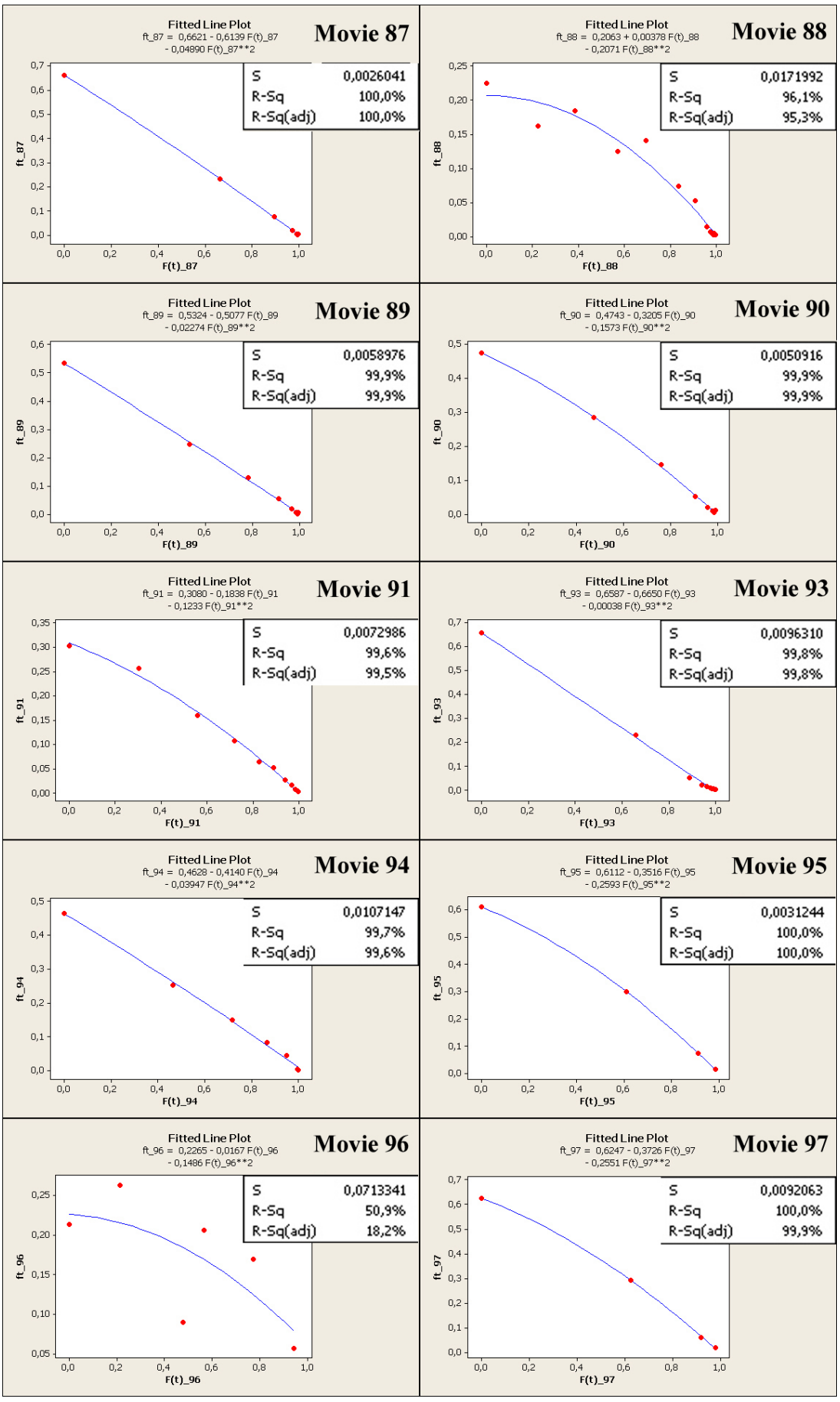

Fitted Line Plot
ft_63 = 0,5824 - 0,5667 F(t)_63
- 0,00641 F(t)_63**2
Movie 63
S 0,0041077
R-Sq 100,0%
R-Sq(adj) 100,0%
ft_63
F(t)_63

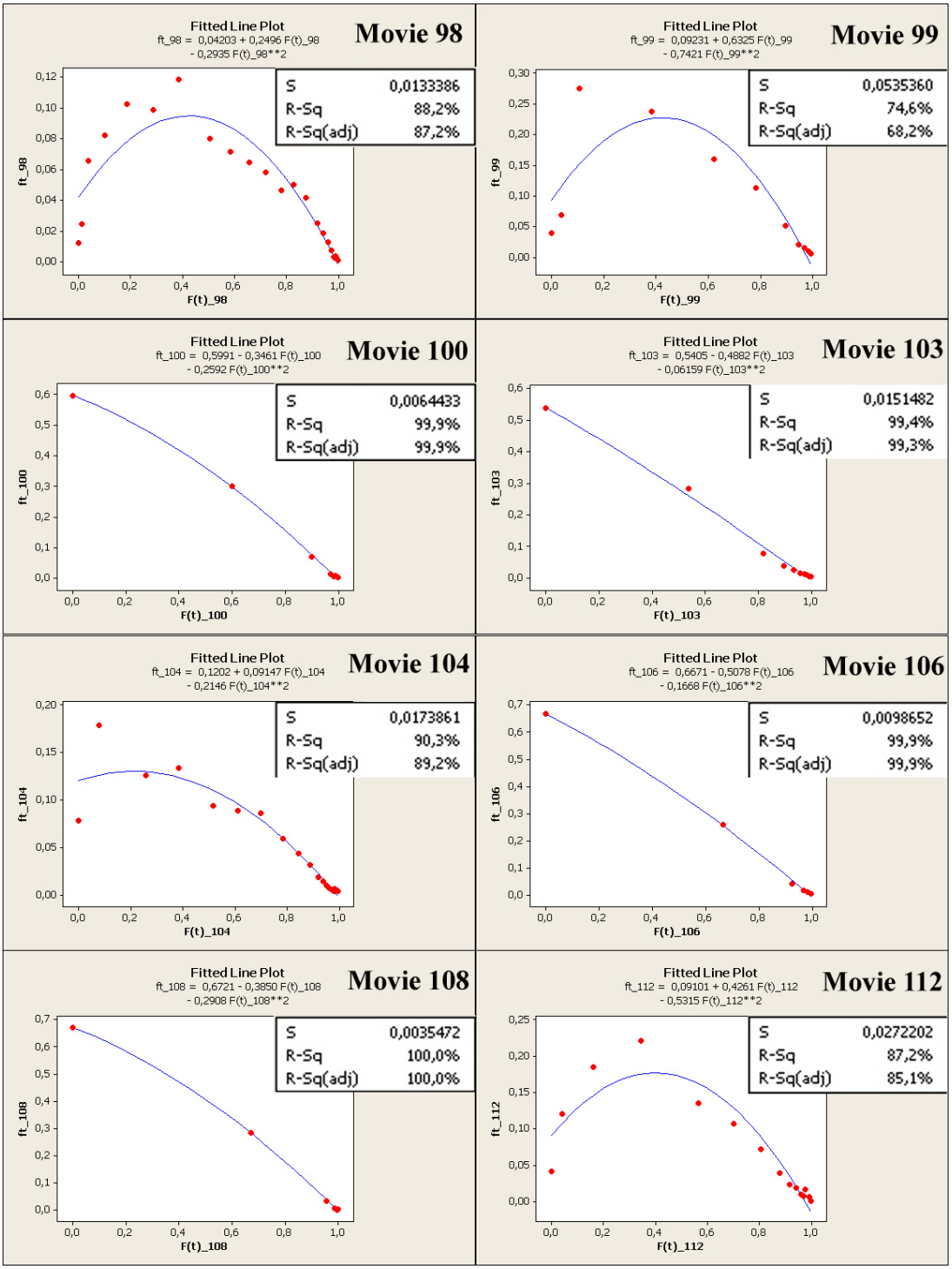

Fitted Line Plot
ft_64 = 0,4587 - 0,3285 F(t)_64
- 0,1327 F(t)_64**2
Movie 64
S 0,0032474
R-Sq 100,0%
R-Sq(adj) 99,9%
ft_64
F(t)_64


Fitted Line Plot
ft_65 = 0,5022 - 0,4865 F(t)_65
- 0,01464 F(t)_65**2
Movie 65
S 0,0048020
R-Sq 99,9%
R-Sq(adj) 99,9%
ft_65
F(t)_65


Fitted Line Plot
ft_66 = 0,3874 - 0,3215 F(t)_66
- 0,06955 F(t)_66**2
Movie 66
S 0,0058032
R-Sq 99,8%
R-Sq(adj) 99,8%
ft_66
F(t)_66
Fitted Line Plot
ft_67 = 0,2704 - 0,02975 F(t)_67
- 0,2417 F(t)_67**2
Movie 67
S 0,0036585
R-Sq 99,9%
R-Sq(adj) 99,9%
ft_67
F(t)_67
Fitted Line Plot
ft_68 = 0,4905 - 0,4989 F(t)_68
+ 0,03560 F(t)_68**2
Movie 68
S 0,0195026
R-Sq 99,4%
R-Sq(adj) 98,9%
ft_68
F(t)_68
Fitted Line Plot
ft_69 = 0,1352 + 0,4549 F(t)_69
- 0,6022 F(t)_69**2
Movie 69
S 0,0862863
R-Sq 47,1%
R-Sq(adj) 39,6%
ft_69
F(t)_69
Fitted Line Plot
ft_70 = 0,5157 - 0,3662 F(t)_70
- 0,1504 F(t)_70**2
Movie 70
S 0,0053016
R-Sq 99,9%
R-Sq(adj) 99,9%
ft_70
F(t)_70
Fitted Line Plot
ft_71 = 0,3916 - 0,4209 F(t)_71
+ 0,05130 F(t)_71**2
Movie 71
S 0,0164199
R-Sq 99,0%
R-Sq(adj) 98,5%
ft_71
F(t)_71
Fitted Line Plot
ft_72 = 0,6017 - 0,6778 F(t)_72
+ 0,07544 F(t)_72**2
Movie 72
S 0,0051382
R-Sq 99,9%
R-Sq(adj) 99,9%
ft_72
F(t)_72
Fitted Line Plot
ft_73 = 0,02827 + 0,4673 F(t)_73
- 0,4982 F(t)_73**2
Movie 73
S 0,0209138
R-Sq 85,8%
R-Sq(adj) 84,1%
ft_73
F(t)_73
Fitted Line Plot
ft_74 = 0,5250 - 0,4927 F(t)_74
- 0,02813 F(t)_74**2
Movie 74
S 0,0037827
R-Sq 100,0%
R-Sq(adj) 100,0%
ft_74
F(t)_74
Fitted Line Plot
ft_75 = 0,4840 - 0,3886 F(t)_75
- 0,09943 F(t)_75**2
Movie 75
S 0,0049060
R-Sq 99,9%
R-Sq(adj) 99,9%
ft_75
F(t)_75


Fitted Line Plot
ft_76 = 0,5125 - 0,4824 F(t)_76 - 0,03196 F(t)_76**2
Movie 76
S 0,0045208
R-Sq 99,9%
R-Sq(adj) 99,9%
ft_76
F(t)_76
Fitted Line Plot
ft_77 = 0,2388 - 0,1566 F(t)_77 - 0,08802 F(t)_77**2
Movie 77
S 0,0072796
R-Sq 98,9%
R-Sq(adj) 98,8%
ft_77
F(t)_77
Fitted Line Plot
ft_78 = 0,5862 - 0,5929 F(t)_78 + 0,00760 F(t)_78**2
Movie 78
S 0,0031314
R-Sq 100,0%
R-Sq(adj) 100,0%
ft_78
F(t)_78
Fitted Line Plot
ft_79 = 0,6510 - 0,6245 F(t)_79 - 0,02769 F(t)_79**2
Movie 79
S 0,0040969
R-Sq 100,0%
R-Sq(adj) 100,0%
ft_79
F(t)_79
Fitted Line Plot
ft_80 = 0,1208 + 0,3670 F(t)_80 - 0,4958 F(t)_80**2
Movie 80
S 0,0708861
R-Sq 50,9%
R-Sq(adj) 44,3%
ft_80
F(t)_80
Fitted Line Plot
ft_81 = 0,4596 - 0,2325 F(t)_81 - 0,2384 F(t)_81**2
Movie 81
S 0,0134546
R-Sq 99,0%
R-Sq(adj) 98,9%
ft_81
F(t)_81
Fitted Line Plot
ft_82 = 0,5580 - 0,4357 F(t)_82 - 0,1169 F(t)_82**2
Movie 82
S 0,0025784
R-Sq 100,0%
R-Sq(adj) 100,0%
ft_82
F(t)_82
Fitted Line Plot
ft_84 = 0,5836 - 0,5424 F(t)_84 - 0,04685 F(t)_84**2
Movie 84
S 0,0057364
R-Sq 99,9%
R-Sq(adj) 99,9%
ft_84
F(t)_84
Fitted Line Plot
ft_85 = 0,5416 - 0,4004 F(t)_85 - 0,1241 F(t)_85**2
Movie 85
S 0,0022865
R-Sq 100,0%
R-Sq(adj) 100,0%
ft_85
F(t)_85
Fitted Line Plot
ft_86 = 0,5307 - 0,3192 F(t)_86 - 0,2127 F(t)_86**2
Movie 86
S 0,0023900
R-Sq 100,0%
R-Sq(adj) 100,0%
ft_86
F(t)_86


Fitted Line Plot
ft_87 = 0,6621 - 0,6139 F(t)_87 - 0,04890 F(t)_87**2
Movie 87
S 0,0026041
R-Sq 100,0%
R-Sq(adj) 100,0%
ft_87
F(t)_87
Fitted Line Plot
ft_88 = 0,2063 + 0,00378 F(t)_88 - 0,2071 F(t)_88**2
Movie 88
S 0,0171992
R-Sq 96,1%
R-Sq(adj) 95,3%
ft_88
F(t)_88
Fitted Line Plot
ft_89 = 0,5324 - 0,5077 F(t)_89 - 0,02274 F(t)_89**2
Movie 89
S 0,0058976
R-Sq 99,9%
R-Sq(adj) 99,9%
ft_89
F(t)_89
Fitted Line Plot
ft_90 = 0,4743 - 0,3205 F(t)_90 - 0,1573 F(t)_90**2
Movie 90
S 0,0050916
R-Sq 99,9%
R-Sq(adj) 99,9%
ft_90
F(t)_90
Fitted Line Plot
ft_91 = 0,3080 - 0,1838 F(t)_91 - 0,1233 F(t)_91**2
Movie 91
S 0,0072986
R-Sq 99,6%
R-Sq(adj) 99,5%
ft_91
F(t)_91
Fitted Line Plot
ft_93 = 0,6587 - 0,6650 F(t)_93 - 0,00038 F(t)_93**2
Movie 93
S 0,0096310
R-Sq 99,8%
R-Sq(adj) 99,8%
ft_93
F(t)_93
Fitted Line Plot
ft_94 = 0,4628 - 0,4140 F(t)_94 - 0,03947 F(t)_94**2
Movie 94
S 0,0107147
R-Sq 99,7%
R-Sq(adj) 99,6%
ft_94
F(t)_94
Fitted Line Plot
ft_95 = 0,6112 - 0,3516 F(t)_95 - 0,2593 F(t)_95**2
Movie 95
S 0,0031244
R-Sq 100,0%
R-Sq(adj) 100,0%
ft_95
F(t)_95
Fitted Line Plot
ft_96 = 0,2265 - 0,0167 F(t)_96 - 0,1486 F(t)_96**2
Movie 96
S 0,0713341
R-Sq 50,9%
R-Sq(adj) 18,2%
ft_96
F(t)_96
Fitted Line Plot
ft_97 = 0,6247 - 0,3726 F(t)_97 - 0,2551 F(t)_97**2
Movie 97
S 0,0092063
R-Sq 100,0%
R-Sq(adj) 99,9%
ft_97
F(t)_97


Fitted Line Plot
ft_98 = 0,04203 + 0,2496 F(t)_98 - 0,2935 F(t)_98**2
Movie 98
S 0,0133386
R-Sq 88,2%
R-Sq(adj) 87,2%
ft_98
F(t)_98
Fitted Line Plot
ft_99 = 0,09231 + 0,6325 F(t)_99 - 0,7421 F(t)_99**2
Movie 99
S 0,0535360
R-Sq 74,6%
R-Sq(adj) 68,2%
ft_99
F(t)_99
Fitted Line Plot
ft_100 = 0,5991 - 0,3461 F(t)_100 - 0,2592 F(t)_100**2
Movie 100
S 0,0064433
R-Sq 99,9%
R-Sq(adj) 99,9%
ft_100
F(t)_100
Fitted Line Plot
ft_103 = 0,5405 - 0,4882 F(t)_103 - 0,06159 F(t)_103**2
Movie 103
S 0,0151482
R-Sq 99,4%
R-Sq(adj) 99,3%
ft_103
F(t)_103
Fitted Line Plot
ft_104 = 0,1202 + 0,09147 F(t)_104 - 0,2146 F(t)_104**2
Movie 104
S 0,0173861
R-Sq 90,3%
R-Sq(adj) 89,2%
ft_104
F(t)_104
Fitted Line Plot
ft_106 = 0,6671 - 0,5078 F(t)_106 - 0,1668 F(t)_106**2
Movie 106
S 0,0098652
R-Sq 99,9%
R-Sq(adj) 99,9%
ft_106
F(t)_106
Fitted Line Plot
ft_108 = 0,6721 - 0,3850 F(t)_108 - 0,2908 F(t)_108**2
Movie 108
S 0,0035472
R-Sq 100,0%
R-Sq(adj) 100,0%
ft_108
F(t)_108
Fitted Line Plot
ft_112 = 0,09101 + 0,4261 F(t)_112 - 0,5315 F(t)_112**2
Movie 112
S 0,0272202
R-Sq 87,2%
R-Sq(adj) 85,1%
ft_112
F(t)_112

Appendix C

DATA SET

The dataset is formed with the data of *theatrical release date (T-Date), DVD release date (D-Date), release difference in weeks (Dif), weeks on theater (WsT), ft value on DVD release date (ft), Ft value on DVD release date (Ft), production budget in dollars (Prod.Bud.), local theatrical gross revenue in dollars (Loc.T.$), international theatrical gross revenue in dollars (Int.T.$), local DVD sales gross revenue (Loc.D.$), p value (p), q value (q), number of reviews (#R), review rating (RR), percentage of nonnegative reviews (NNR), IMDb rating (IMDb), Award Status (Aw), Sequel Status (Sq), and MPAA ratings (PG13, G, R, PG).*

Rank	T-Date	D-Date	Dif	WsT	Date-ft	Date-Ft	Prod.Bud.	Loc.T.$	Int.T.$
1	18.07.2008	09.12.2008	20	33	0,00082	0,99410	185000000	533345358	489000000
2	02.05.2008	30.09.2008	21	22	0,00025	0,99951	186000000	318313199	264000000
3	22.05.2008	14.08.2008	12	21	0,00118	0,99197	185000000	317023851	469534294
4	02.07.2008	25.11.2008	20	9	0,00000	1,00000	150000000	227946274	396400000
5	27.06.2008	18.11.2008	20	11	0,00000	1,00000	180000000	223808164	309129766
6	21.11.2008	21.03.2009	17	19	0,00207	0,99672	37000000	192769854	203670000
7	07.11.2008	06.02.2009	13	18	0,00224	0,99414	150000000	180010950	419505894
8	14.11.2008	24.03.2009	19	9	0,00000	1,00000	230000000	169368427	407000000
9	14.03.2008	09.12.2008	38	21	0,00000	1,00000	85000000	154529439	142604508
10	30.05.2008	23.09.2008	16	16	0,00018	0,99982	57500000	152647258	262600000
11	16.05.2008	02.12.2008	28	8	0,00000	1,00000	225000000	141621490	277868796
12	12.11.2008	31.03.2009	20	27	0,01317	0,97439	14000000	141319928	223937387
13	13.06.2008	21.10.2008	18	12	0,00000	1,00000	137500000	134806913	128542344
14	27.06.2008	02.12.2008	22	12	0,00000	1,00000	75000000	134508551	206426217
15	25.12.2008	05.05.2009	19	17	0,00000	1,00000	160000000	127509326	202300000
16	26.11.2008	24.11.2009	51	11	0,00000	1,00000	80000000	120146040	43400000
17	21.11.2008	22.03.2009	17	8	0,00000	1,00000	150000000	114053579	199900000
18	13.08.2008	18.11.2008	14	13	0,00000	1,00000	90000000	110461307	77702148

Rank	T-Date	D-Date	Dif	WsT	Date-ft	Date-Ft	Prod.Bud.	Loc.T.$	Int.T.$
19	01.08.2008	16.12.2008	19	8	0,00000	1,00000	175000000	102491776	295420342
20	11.07.2008	28.10.2008	15	22	0,00324	0,98885	45000000	101704370	139200000
21	26.09.2008	28.12.2008	13	15	0,00223	0,99297	80000000	101440743	76625826
22	19.12.2008	07.04.2009	15	16	0,00042	0,99958	50000000	97690976	128300000
23	07.03.2008	24.06.2008	15	15	0,00042	0,99958	105000000	94784201	174281477
24	24.10.2008	17.02.2009	16	6	0,00000	1,00000	11000000	90556401	160500000
25	06.08.2008	06.01.2009	21	8	0,00000	1,00000	26000000	87341380	13600000
26	25.12.2008	19.05.2009	21	16	0,00000	1,00000	75000000	83077470	115609027
27	28.03.2008	22.07.2008	16	7	0,00000	1,00000	35000000	81159365	76693167
28	14.02.2008	10.06.2008	17	19	0,00033	0,99667	82500000	80172128	141944940
29	18.01.2008	22.04.2008	13	12	0,00000	1,00000	25000000	80048433	90715600
30	11.07.2008	11.11.2008	17	10	0,00000	1,00000	82500000	75986503	84401560
31	14.02.2008	24.06.2008	19	12	0,00000	1,00000	92500000	71195053	91644614
32	08.02.2008	17.06.2008	18	16	0,00000	1,00000	72500000	70231041	41000000
33	19.12.2008	31.03.2009	14	5	0,00000	1,00000	54000000	69951824	96665504
34	01.02.2008	18.08.2009	80	5	0,00000	1,00000	6500000	65281781	6000000
35	13.06.2008	07.10.2008	16	12	0,00000	1,00000	60000000	64506874	98896925
36	12.09.2008	20.01.2009	18	15	0,00000	1,00000	37000000	60355347	100800000
37	14.02.2008	15.07.2008	22	6	0,00000	1,00000	17500000	58017783	92000000
38	24.10.2008	20.01.2009	12	7	0,00000	1,00000	10800000	56746769	56400000
39	30.05.2008	21.10.2008	20	8	0,00000	1,00000	9000000	52597610	28000000
40	18.04.2008	09.09.2008	20	9	0,00000	1,00000	55000000	52075270	77000000
41	26.11.2008	03.03.2009	14	15	0,00000	1,00000	78000000	49551662	157931130
42	22.08.2008	19.12.2008	17	7	0,00000	1,00000	25000000	48237389	22000000
43	04.04.2008	05.08.2008	17	17	0,00135	0,99865	37000000	48006762	46074921
44	02.05.2008	16.09.2008	19	7	0,00000	1,00000	40000000	46012734	59495378
45	06.08.2008	18.11.2008	15	14	0,00000	1,00000	27000000	44089964	64681
46	09.05.2008	16.09.2008	18	13	0,00000	1,00000	120000000	43945766	49448696
47	11.04.2008	19.08.2008	18	7	0,00000	1,00000	18000000	43869350	13240337
48	25.01.2008	27.05.2008	17	9	0,00000	1,00000	47500000	42754105	74000000
49	08.02.2008	17.06.2008	18	8	0,00000	1,00000	27500000	42436517	1171110
50	17.10.2008	20.01.2009	13	9	0,00000	1,00000	35000000	40687294	45074495
51	12.09.2008	06.01.2009	16	14	0,00000	1,00000	60000000	40081410	36700000
52	10.10.2008	17.02.2009	18	14	0,00000	1,00000	67500000	39394666	69000000
53	19.09.2008	27.01.2009	18	6	0,00000	1,00000	20000000	39263506	5000000
54	25.01.2008	03.06.2008	18	10	0,00000	1,00000	30000000	38233676	46413155
55	25.04.2008	29.07.2008	13	12	0,00000	1,00000	12000000	38108728	5123256
56	17.10.2008	03.02.2009	15	16	0,00073	0,99887	11000000	37766350	1845816
57	22.08.2008	23.12.2008	17	8	0,00000	1,00000	65000000	36316032	36200787
58	10.12.2008	14.05.2009	22	-	-	-	33000000	34192652	71914958
59	12.12.2008	07.05.2009	21	17	0,00000	1,00000	20000000	33422556	17500487
60	21.03.2008	01.07.2008	14	13	0,00000	1,00000	40000000	32862104	16824159
61	14.02.2008	24.06.2008	19	8	0,00000	1,00000	7000000	32241649	22907214
62	26.11.2008	10.03.2009	15	20	0,02930	0,95103	20000000	31841299	18322728
63	10.10.2008	17.02.2009	18	5	0,00000	1,00000	12000000	31691811	4400000
64	31.10.2008	03.02.2009	13	13	0,00050	0,99950	24000000	31452765	5398360
65	04.04.2008	23.09.2008	24	9	0,00000	1,00000	58000000	31373938	9456924

Rank	T-Date	D-Date	Dif	WsT	Date-ft	Date-Ft	Prod.Bud.	Loc.T.$	Int.T.$
66	18.07.2008	25.11.2008	18	14	0,00000	1,00000	37000000	30105968	29411816
67	07.03.2008	15.07.2008	18	13	0,00000	1,00000	20000000	30060660	33000000
68	25.01.2008	13.05.2008	15	5	0,00000	1,00000	35000000	28687835	23962116
69	31.12.2008	02.06.2009	22	17	0,00000	1,00000	50000000	28644813	13623932
70	12.09.2008	21.12.2008	14	10	0,00000	1,00000	16000000	26902075	23140335
71	29.02.2008	10.06.2008	14	7	0,00000	1,00000	40000000	26814957	46129321
72	11.04.2008	19.08.2008	18	10	0,00000	1,00000	20000000	26415649	39173594
73	17.12.2008	21.04.2009	18	20	0,00176	0,99686	6000000	26236603	17000000
74	17.10.2008	10.02.2009	16	7	0,00000	1,00000	25100000	25534493	3041285
75	14.03.2008	29.07.2008	19	10	0,00000	1,00000	21000000	24850922	14468879
76	27.08.2008	19.12.2008	16	13	0,00000	1,00000	22000000	23530831	349053
77	15.08.2008	27.01.2009	23	27	0,00547	0,98695	16000000	23213577	54000000
78	29.08.2008	06.01.2009	18	8	0,00000	1,00000	45000000	22532572	47683925
79	25.07.2008	02.12.2008	18	8	0,00000	1,00000	35000000	20982478	47386956
80	19.09.2008	13.01.2009	16	18	0,00051	0,99327	20000000	20211394	5900000
81	19.09.2008	20.01.2009	17	18	0,00119	0,99865	30000000	19528188	7080162
82	19.09.2008	13.01.2009	16	5	0,00000	1,00000	20000000	19219250	15567861
83	05.12.2008	21.05.2009	24	-	-	-	29000000	18622031	8248350
84	04.04.2008	08.07.2008	13	11	0,00000	1,00000	25000000	17432844	4744278
85	18.04.2008	16.09.2008	21	4	0,00000	1,00000	30000000	16930884	16024515
86	24.10.2008	27.01.2009	13	7	0,00000	1,00000	30000000	15740721	27700000
87	05.09.2008	06.01.2009	17	7	0,00000	1,00000	45000000	15298133	31300000
88	15.08.2008	02.12.2008	15	14	0,00000	1,00000	25000000	14532946	25554288
89	29.08.2008	06.01.2009	18	8	0,00000	1,00000	20000000	14190901	20500000
90	19.09.2008	28.12.2008	14	8	0,00000	1,00000	20000000	13252641	13359709
91	01.10.2008	17.02.2009	19	11	0,00000	1,00000	2500000	13011160	124914
92	03.10.2008	10.03.2009	22	10	0,00000	1,00000	12000000	12796277	530003
93	11.07.2008	25.11.2008	19	7	0,00000	1,00000	60000000	11803254	38845552
94	22.02.2008	17.06.2008	16	4	0,00000	1,00000	20000000	11175164	17330138
95	14.03.2008	29.07.2008	19	6	0,00000	1,00000	33000000	11008770	10612418
96	23.01.2008	-	-	-	-	-	15000000	10231161	12053136
97	10.10.2008	20.01.2009	14	4	0,00000	1,00000	37500000	9793406	14696
98	11.04.2008	07.10.2008	25	26	0,00113	0,99797	4000000	9427026	6767879
99	17.11.2008	10.03.2009	16	11	0,00000	1,00000	12500000	9030581	30800000
100	17.10.2008	24.02.2009	18	7	0,00000	1,00000	19000000	8402485	2010000
101	05.12.2008	17.03.2009	15	3	0,00000	1,00000	35000000	8050977	148153
102	26.09.2008	10.02.2009	19	3	0,00000	1,00000	45000000	7916887	1193571
103	10.10.2008	20.01.2009	14	10	0,00000	1,00000	38000000	7871693	3945366
104	08.02.2008	24.06.2008	19	20	0,00487	0,99131	15000000	7800825	22981796
105	15.02.2008	-	-	-	-	-	6000000	7335090	8757394
106	20.08.2008	27.01.2009	22	6	0,00000	1,00000	15000000	6409528	2357810
107	22.08.2008	23.12.2008	17	-	-	-	9000000	4886216	12069
108	29.08.2008	27.01.2009	21	9	0,00000	1,00000	6000000	4694491	935127
109	03.10.2008	10.02.2009	18	2	0,00000	1,00000	25000000	3073392	11469266
110	03.10.2008	17.02.2009	19	-		-	28000000	2775593	9255850
111	25.12.2008	23.06.2009	25	-		-	2000000	2283849	8841815
112	02.05.2008	26.08.2008	16	15	0,00000	1,00000	2000000	1785505	8787578

Rank	T-Date	D-Date	Dif	WsT	Date-ft	Date-Ft	Prod.Bud.	Loc.T.$	Int.T.$
113	25.07.2008	-	-	-	-	-	16000000	1470856	242000000
114	17.10.2008	24.02.2009	18	-	-	-	27000000	1090947	1321176
115	06.06.2008	04.11.2008	21	-	-	-	8000000	1071240	1405251
116	23.05.2008	20.01.2009	34	-	-	-	20000000	1031872	4495635
117	30.01.2008	-	-	-	-	-	113500000	999811	132000000
118	23.05.2008	14.10.2008	20	-	-	-	10000000	580862	715322
119	07.03.2008	12.08.2008	22	-	-	-	20000000	206678	47094093

Rank	Loc.D. $	p	q	#R	RR	NNR	IMDb	Aw.	Sq.	PG13	G	R	PG
1	232387197	0,45	-0,14	14	A-	86	8,9	1	1	1	0	0	0
2	162420767	0,38	-0,08	15	B+	79	8	1	0	1	0	0	0
3	109551245	0,52	-0,21	15	B	71	6,6	1	1	1	0	0	0
4	89047839	0,50	-0,06	14	C+	57	6,6	1	0	1	0	0	0
5	141939973	0,43	-0,09	14	A-	86	8,5	1	0	0	1	0	0
6	186644687	0,49	-0,33	15	C+	57	5,8	1	0	1	0	0	0
7	107662944	0,45	-0,09	12	B-	64	6,9	1	1	0	0	0	1
8	44509838	0,49	-0,03	14	B-	64	6,9	1	1	1	0	0	0
9	72189415	0,40	0,00	13	B	71	7,2	0	0	0	1	0	0
10	84196253	0,51	-0,17	14	B-	64	5,4	1	0	0	0	1	0
11	76883972	0,50	0,01	14	B-	64	6,9	1	1	0	0	0	1
12	31747211	0,01	0,34	12	B+	79	8,4	1	0	0	0	1	0
13	58362094	0,56	-0,06	14	B-	64	7,1	0	1	1	0	0	0
14	70856090	0,52	-0,06	15	B-	64	6,8	1	0	0	0	1	0
15	42199504	0,42	-0,12	12	B+	79	8	1	0	1	0	0	0
16	25035336	0,40	-0,08	11	C	50	5,7	1	0	1	0	0	0
17	81769203	0,37	-0,06	10	B	71	7,4	1	0	0	0	0	1
18	50146427	0,39	0,03	14	B	71	7,2	1	0	0	0	1	0
19	42960274	0,53	-0,09	14	C-	43	5,2	1	1	1	0	0	0
20	26222681	0,30	-0,02	14	C+	57	5,9	1	0	0	0	0	1
21	38236785	0,36	-0,04	8	C	50	6,7	1	0	1	0	0	0
22	26259795	0,35	0,37	12	C+	57	7	1	0	1	0	0	0
23	27012526	0,47	-0,03	13	C-	43	4,9	0	0	1	0	0	0
24	58925069	0,52	-0,10	10	C+	57	3,7	1	1	0	1	0	0
25	44801297	0,55	-0,19	13	B	71	7,2	1	0	0	0	1	0
26	26522830	0,49	0,07	11	B-	64	7,3	1	0	1	0	0	0
27	25727058	0,39	0,04	14	C	50	6,7	1	0	1	0	0	0
28	33640692	0,52	-0,14	13	C-	43	5,9	1	0	1	0	0	0
29	29156695	0,64	-0,16	11	B	71	7,4	1	0	1	0	0	0
30	43579739	0,61	-0,17	14	B	71	7,4	1	1	1	0	0	0
31	27467915	0,42	-0,03	13	B-	64	6,8	1	0	0	0	0	1
32	20584468	0,42	-0,05	13	D+	36	5,4	0	0	1	0	0	0
33	20584468	0,37	0,47	12	C+	57	7,6	1	0	1	0	0	0
34	58186678	0,68	-0,13	6	C+	57	2,7	0	0	0	1	0	0
35	21337240	0,62	-0,01	14	C	50	5,2	1	0	0	0	1	0
36	19089992	0,42	-0,02	14	B	71	7,2	0	0	0	0	1	0
37	21616594	0,54	-0,17	8	C+	57	5,5	1	0	1	0	0	0
38	26239061	0,63	-0,06	7	D	29	5,8	0	1	0	0	1	0

Rank	Loc.D. $	p	q	#R	RR	NNR	IMDb	Aw.	Sq.	PG13	G	R	PG
39	15664548	0,54	0,00	7	B-	64	6	1	0	0	0	1	0
40	23179908	0,52	0,03	9	C+	57	6,8	1	0	1	0	0	0
41	28215630	0,44	-0,13	13	C+	57	6,8	1	0	1	0	0	0
42	15277395	0,40	-0,02	10	C+	57	5,5	0	0	1	0	0	0
43	18286475	0,34	0,04	8	C+	57	6,1	0	0	0	0	0	1
44	14275681	0,41	-0,03	12	C	50	5,5	0	0	1	0	0	0
45	14502216	0,53	-0,03	12	B-	64	6,2	0	1	1	0	0	0
46	14190653	0,50	-0,02	12	C	50	6,3	0	0	0	0	0	1
47	8423914	0,53	-0,06	5	D	29	3,6	1	0	1	0	0	0
48	38588277	0,53	-0,05	10	C-	43	7,3	1	1	0	0	1	0
49	16907970	0,48	0,04	9	C	50	4,4	0	0	1	0	0	0
50	25110312	0,54	0,00	10	C-	43	5,4	0	0	1	0	0	0
51	16099139	0,53	0,02	9	C-	43	6,1	0	0	0	0	1	0
52	21603415	0,45	-0,02	13	B-	64	7,2	0	0	0	0	1	0
53	21177031	0,48	-0,06	12	C	50	6,3	0	0	1	0	0	0
54	12200731	0,55	-0,04	0	-	-	2,4	0	0	1	0	0	0
55	23977106	0,50	-0,11	9	C	50	6,8	1	1	0	0	1	0
56	16933884	0,34	0,02	12	B-	64	7	1	0	1	0	0	0
57	24397651	0,47	0,04	10	C	50	6,6	1	0	0	0	1	0
58	12223387	-	-	10	B-	64	7,7	1	0	0	0	1	0
59	12758643	0,12	0,36	13	B+	79	7,7	1	0	1	0	0	0
60	11948874	0,45	-0,10	12	C	50	5,9	1	0	1	0	0	0
61	12847006	0,50	-0,08	13	B-	64	7,4	0	0	1	0	0	0
62	10971628	0,08	0,13	13	A-	86	7,9	1	0	0	0	1	0
63	13239251	0,58	0,01	0	-	-	6,1	1	0	0	0	1	0
64	21062744	0,46	0,13	10	B-	64	7,1	0	0	0	0	1	0
65	8831711	0,50	0,01	12	B-	64	6,1	0	0	1	0	0	0
66	13204264	0,39	0,07	7	C-	43	4,5	0	0	0	1	0	0
67	17235227	0,27	0,24	15	B-	64	7,5	0	0	0	0	1	0
68	19688120	0,49	-0,04	13	C-	43	6,1	1	0	0	0	1	0
69	13194181	0,14	0,60	11	B-	64	7,3	1	0	0	0	1	0
70	9959173	0,52	0,15	12	C-	43	4,8	0	0	1	0	0	0
71	8227503	0,39	-0,05	14	C+	57	6,7	0	0	1	0	0	0
72	13363523	0,60	-0,08	13	C+	57	7	0	0	0	0	1	0
73	11774688	0,03	0,50	12	A-	86	8,2	1	0	0	0	1	0
74	7707894	0,53	0,03	14	B-	64	9,1	0	0	1	0	0	0
75	18241102	0,48	0,10	9	C-	43	6,2	1	0	1	0	0	0
76	13442164	0,51	0,03	13	B-	64	7,1	0	0	1	0	0	0
77	77213577	0,24	0,09	13	B+	79	7,4	1	0	1	0	0	0
78	16409033	0,59	-0,01	3	C+	57	5,3	0	0	1	0	0	0
79	15910015	0,65	0,03	14	C	50	5,9	0	1	1	0	0	0
80	10611536	0,12	0,50	11	B	71	6,9	1	0	0	0	1	0
81	12094104	0,46	0,24	7	C	50	6	0	0	0	0	0	1
82	18084437	0,56	0,12	1	B-	64	5,8	0	0	0	0	1	0
83	6570712	-	-	12	A-	86	7,9	1	0	0	0	1	0
84	10526896	0,58	0,05	2	C+	57	6	0	0	0	0	1	0
85	11315863	0,54	0,12	9	D	29	5,9	0	0	0	0	1	0

Rank	Loc.D. $	p	q	#R	RR	NNR	IMDb	Aw.	Sq.	PG13	G	R	PG
86	11299213	0,53	0,21	13	C+	57	6,7	0	0	0	0	1	0
87	15313593	0,66	0,05	2	C	50	5,4	0	0	0	0	1	0
88	-	0,21	0,21	8	C	50	4,7	0	0	0	1	0	0
89	9384884	0,53	0,02	1	C	50	1,6	0	0	1	0	0	0
90	7329492	0,47	0,16	13	B-	64	7	1	0	1	0	0	0
91	7272889	0,31	0,12	14	B	71	7,8	1	0	0	0	1	0
92	6511455	-	-	14	B+	79	6,9	1	0	0	0	1	0
93	-	0,66	0,00	10	C	50	4,8	1	0	0	0	0	1
94	5140690	0,46	0,04	10	B	71	6,6	0	0	1	0	0	0
95	8612250	0,61	0,26	5	C	50	6	0	0	0	0	1	0
96	-	0,23	0,15	0	-	-	8,4	1	0	0	1	0	0
97	6273206	0,62	0,26	10	B-	64	7,1	1	0	0	0	0	1
98	-	0,04	0,29	8	A-	86	7,8	1	0	1	0	0	0
99	8504729	0,09	0,74	7	B	71	7,8	1	0	1	0	0	0
100	9504668	0,60	0,26	11	C+	57	6,8	0	0	0	0	1	0
101	10454076	-	-	11	C-	43	6,2	0	1	0	0	1	0
102	8754713	-	-	8	C	50	5,9	0	0	0	0	1	0
103	5713357	0,54	0,06	11	B-	64	6	0	0	0	0	0	1
104	3448888	0,12	0,21	13	B	71	8,1	1	0	0	0	1	0
105	-	-	-	0	-	-	6	0	0	0	0	0	0
106	7267103	0,67	0,17	12	C+	57	6,3	0	0	1	0	0	0
107	-	-	-	14	B-	64	6,5	0	1	0	0	1	0
108	-	0,67	0,29	2	C+	57	4,3	0	0	0	0	1	0
109	-	-	-	10	C+	57	6,7	1	0	0	0	1	0
110	-	-	-	10	C+	57	6,8	0	0	0	0	1	0
111	-	-	-	6	A-	86	8	1	0	0	0	1	0
112	-	0,09	0,53	6	B-	64	7,2	1	0	1	0	0	0
113	-	-	-	0	-	-	7	0	0	0	0	0	0
114	-	-	-	11	C+	57	6	0	0	0	0	1	0
115	-	-	-	0	-	-	6,9	1	0	1	0	0	0
116	-	-	-	0	-	-	6,9	0	0	0	0	1	0
117	-	-	-	0	-	-	4,9	0	0	0	0	0	0
118	-	-	-	3	B-	64	5,8	0	0	0	0	1	0
119	-	-	-	9	C	50	0	1	0	0	0	0	1

Appendix D

MODEL EQUATIONS

(Eq.01) F_t(t) = F_t(t - dt) + (ft_increase) * dt

(Eq.02) INITIAL F_t = 0

(Eq.03) ft_increase = ft

(Eq.04) ft = (p+F_t*q)*(1-F_t)

(Eq.05) q = 0.5253-0.7298*p-0.014*number_of_reviews+error_in_q

(Eq.06) random_p(t) = random_p(t - dt)

(Eq.07) INITIAL random_p = random(0,1)

(Eq.08) p = if random_p <= (0.592-0)/(0.75-0)
then 0+sqrt(random_p*(0.75-0)*(0.592-0))
else 0.75-sqrt((1-random_p)*(0.75-0)*(0.75-0.592))

(Eq.09) error_in_q(t) = error_in_q(t - dt)

(Eq.10) INITIAL error_in_q = NORMAL(-0.0218,0.1077)

(Eq.11) random_reviews(t) = random_reviews(t - dt)

(Eq.12) INITIAL random_reviews = random(0,1)

(Eq.13) number_of_reviews = if random_reviews<= (14-(-0.5))/(15.5-(-0.5))
then -0.5+sqrt(random_reviews*(15.5-(-0.5))*(14-(-0.5)))
else 15.5-sqrt((1-random_reviews)*(15.5-(-0.5))*(15.5-14))

(Eq.14) error_in_ln_revenue(t) = error_in_ln_revenue(t - dt)

(Eq.15) INITIAL error_in_ln_revenue = NORMAL(0.1062,0.8151)

(Eq.16) ln_production_budget(t) = ln_production_budget(t - dt)

(Eq.17) INITIAL ln_production_budget = NORMAL(17.26, 0.9889)

(Eq.18) production_budget = EXP(ln_production_budget)

(Eq.19) advertisement_expenses = production_budget*0.5

(Eq.20) ln_revenue = 5.314+0.615*ln_production_budget
+0.122*number_of_reviews+error_in_ln_revenue

(Eq.21) total_theater_revenue_potential = EXP(ln_revenue)

(Eq.22) total_theater_revenue = total_theater_revenue_potential-step(total
_theater_revenue_potential*dvd_effect_on_theater, dvd_sales_delay)

(Eq.23) weekly_theater_revenue = total_theater_revenue*ft

(Eq.24) Theater_revenue(t) = Theater_revenue(t - dt)
+ (theater_revenue_increase) * dt

(Eq.25) INITIAL Theater_revenue = 0

(Eq.26) theater_revenue_increase = weekly_theater_revenue

(Eq.27) dvd_price = 16

(Eq.28) dvd_sales_delay = 17.42

(Eq.29) dvd_viewers = DVD_revenue/dvd_price*person_per_dvd

(Eq.30) person_per_dvd = 3

(Eq.31) theater_viewers = Theater_revenue/ticket_price

(Eq.32) ticket_price = 7.18

(Eq.33) total_dvd_revenue =
total_theater_revenue_potential*dvd_theater_correlation

(Eq.34) weekly_dvd_revenue =
Delay(total_dvd_revenue*ft,dvd_sales_delay,0)

(Eq.35) dvd_effect_on_theater = GRAPH(dvd_sales_delay) (0.00, 0.5),
(1.80, 0.55), (3.60, 0.6), (5.40, 0.65), (7.20, 0.7), (9.00, 0.75), (10.8, 0.8),
(12.6, 0.85), (14.4, 0.9), (16.2, 0.95), (18.0, 1.00)

(Eq.36) dvd_theater_correlation = GRAPH(dvd_sales_delay) (0.00, 0.84),
(1.80, 0.802), (3.60, 0.764), (5.40, 0.726), (7.20, 0.688), (9.00, 0.65),
(10.8, 0.612), (12.6, 0.574), (14.4, 0.536), (16.2, 0.498), (18.0, 0.46)

(Eq.37) DVD_revenue(t) =
DVD_revenue(t - dt) + (DVD_revenue_increase) * dt

(Eq.38) INITIAL DVD_revenue = 0

(Eq.39) DVD_revenue_increase = weekly_dvd_revenue

Appendix E

ANTI-PIRACY ORGANIZATIONS

This list shows the organizations fighting piracy at the national level in Europe [62].

AT - Austria : VAP - Verein für Anti-Piraterie der Film- und Videobranche

BE - Belgium : BAF

CH - Switzerland - Safe - Schweizerische Vereinigung zur Bekämpfung der Piraterie - Association suisse pour la lutte contre le piratage

CY - Cyprus : CYFACT

DE - Germany : GVU - Gesellschaft zur Verfolgung von Urheberrechtsverletzungen

DK - Denmark : APG - AntiPiratgruppen

EE - Estonia : CIPR - The Coalition for Intellectual Property Rights

ES - FAP - Federación Antipiratería

FI - Finland : CIAPC - Anti-Piracy Centre in Finland

FR - France : ALPA - Association de lutte contre la piraterie audiovisuelle

GB - United Kingdom : FACT - Federation Against Copyright Theft

GB - United Kingdom : IEG - Internet Enforcement Group

GB - United Kingdom - Alliance against Counterfeiting and Piracy

IE - Ireland - INFACT

IT - Italy : FAPAV - Federazione Anti-Pirateria Audiovisiva

LT - Lithuania : CIPR - The Coaltition for Intellectual Property Rights

LV - Latvia :CIPR - The Coaltition for Intellectual Property Rights

MT - Malta - AACT - Association against Copyright Theft

NL - The Netherlands - BREIN - Bescherming Rechten Entertainment Industrie Nederland

PL - Poland - ZWAP - Zwiazek Producentów Audio-Video

PL - Poland - FOTA

RU - Russia and CIS (Commonwealth of Independent States): CIPR (The Coalition for IP Rights)

RU - Russia : RAPO : Russia Anti-Piracy Organization

SI - Slovenia - APAW -Association for Protection of Audio-visual Works

TR - Turkey : AMPEC

Appendix F

SENSITIVITY ANALYSIS

In this chapter we gave the graphical outputs of the sensitivity analysis in 6 sections: *'random p'*, *'error in q'*, *'random reviews'*, *'error in ln revenue'*, *'ln production budget'*, *and 'dvd sales delay'*. The arrows on the graphs show the direction of the changes in patterns from the smallest parameter values to the largest ones.

F.1 Change in 'random p' Value

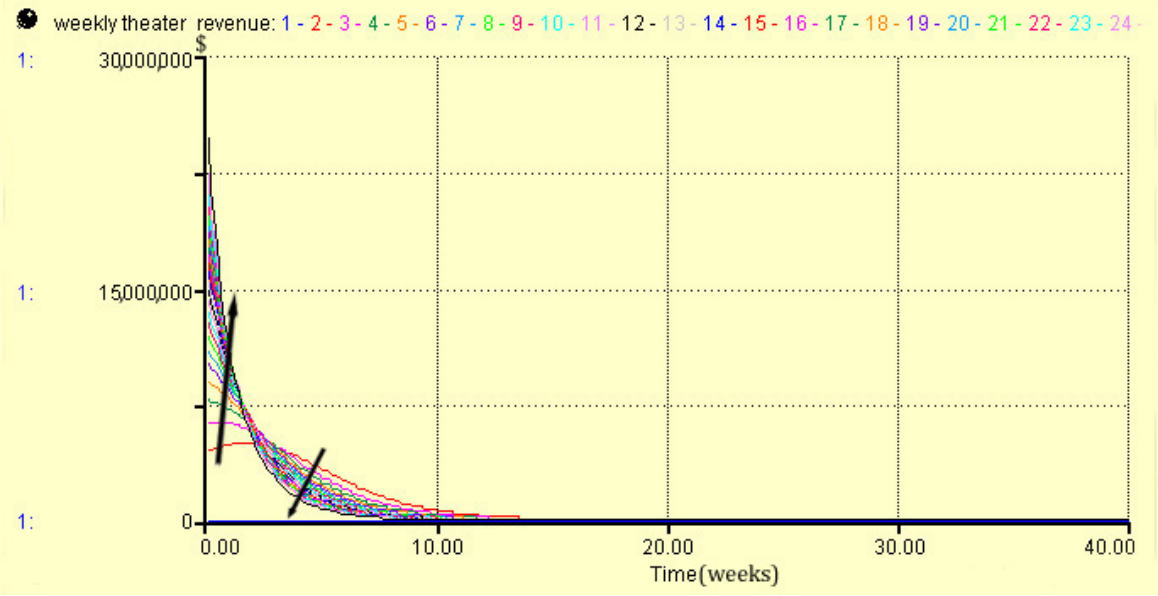


Figure F.1: Weekly theatrical revenue with changing 'random p' value

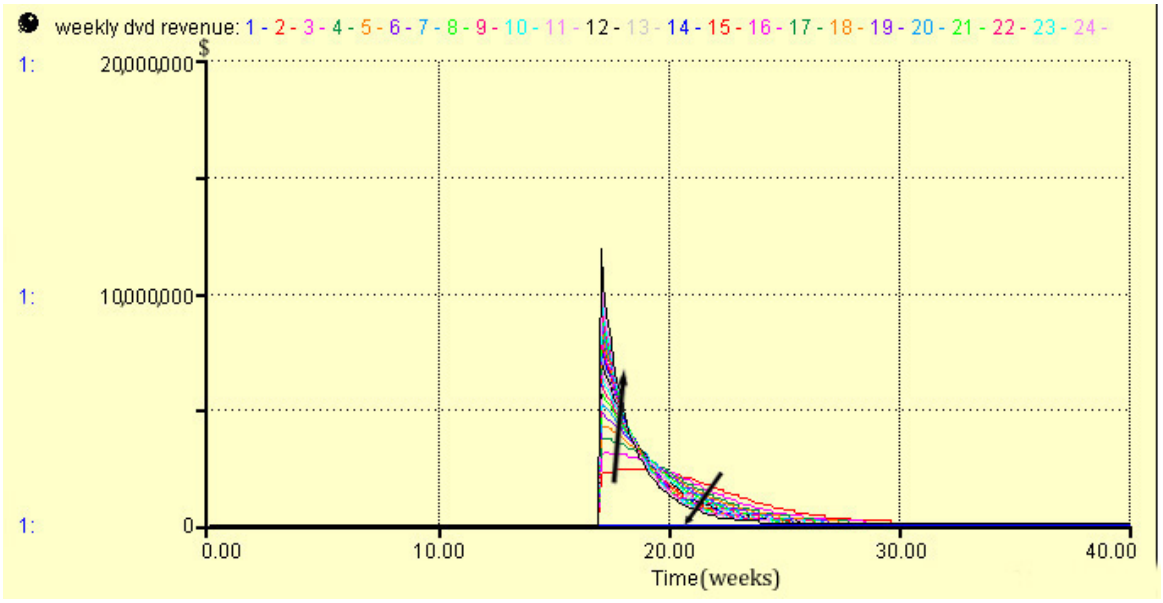


Figure F.2: Weekly DVD revenue with changing 'random p' value

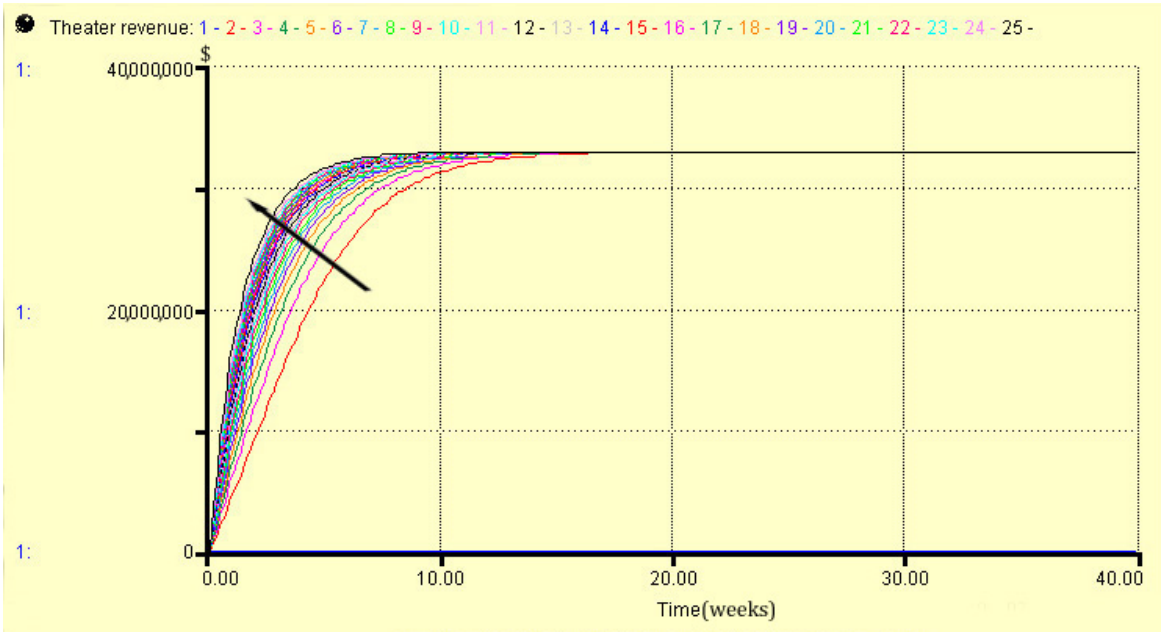


Figure F.3: Aggregate theatrical revenue with changing 'random p' value

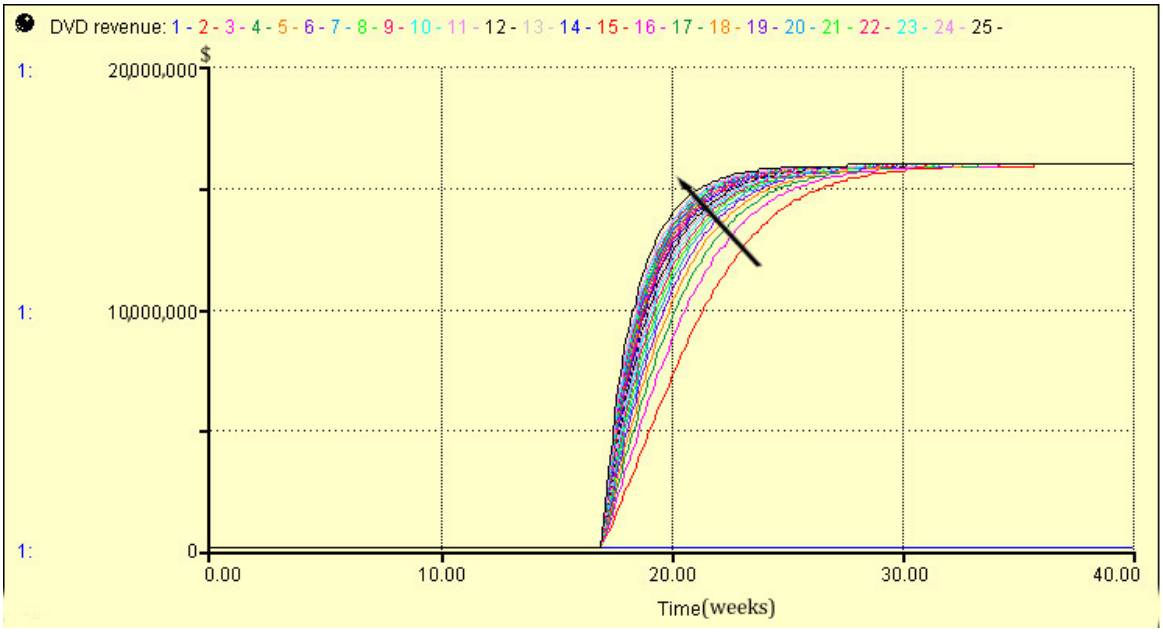


Figure F.4: Aggregate DVD revenue with changing 'random p' value

F.2 Change in 'error in q' Value

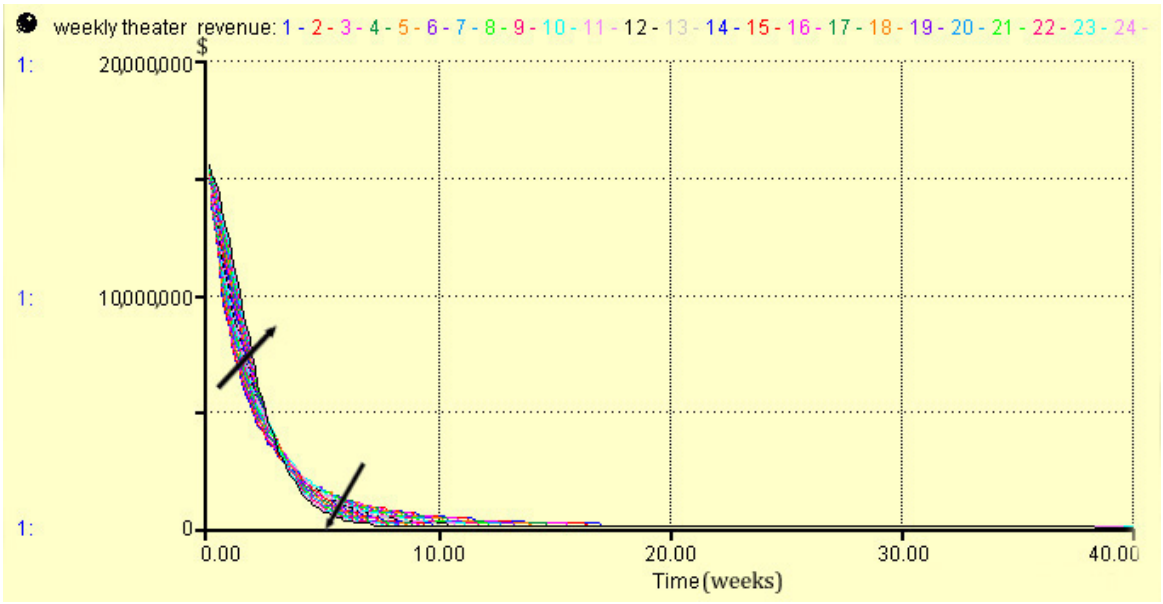


Figure F.5: Weekly theatrical revenue with changing 'error in q' value

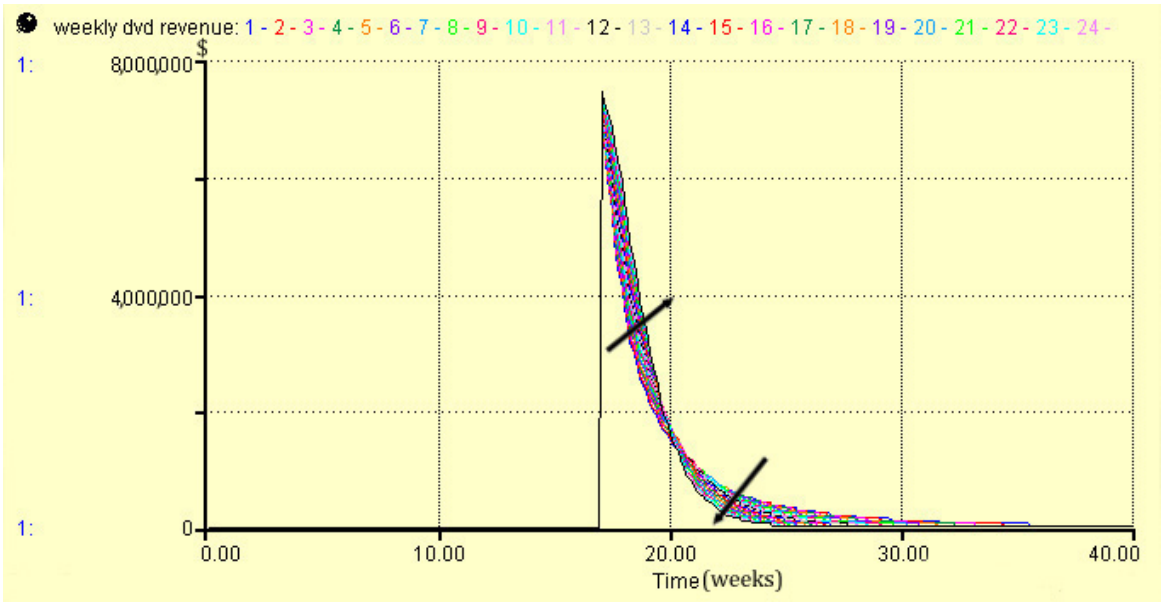


Figure F.6: Weekly DVD revenue with changing 'error in q' value

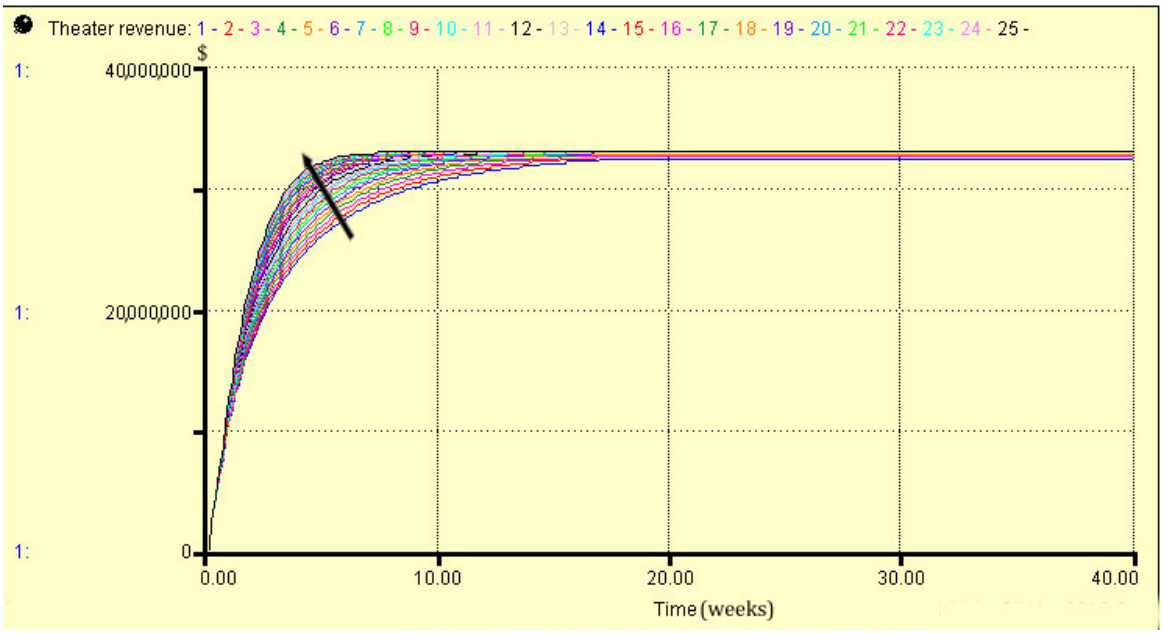


Figure F.7: Aggregate theatrical revenue with changing 'error in q' value

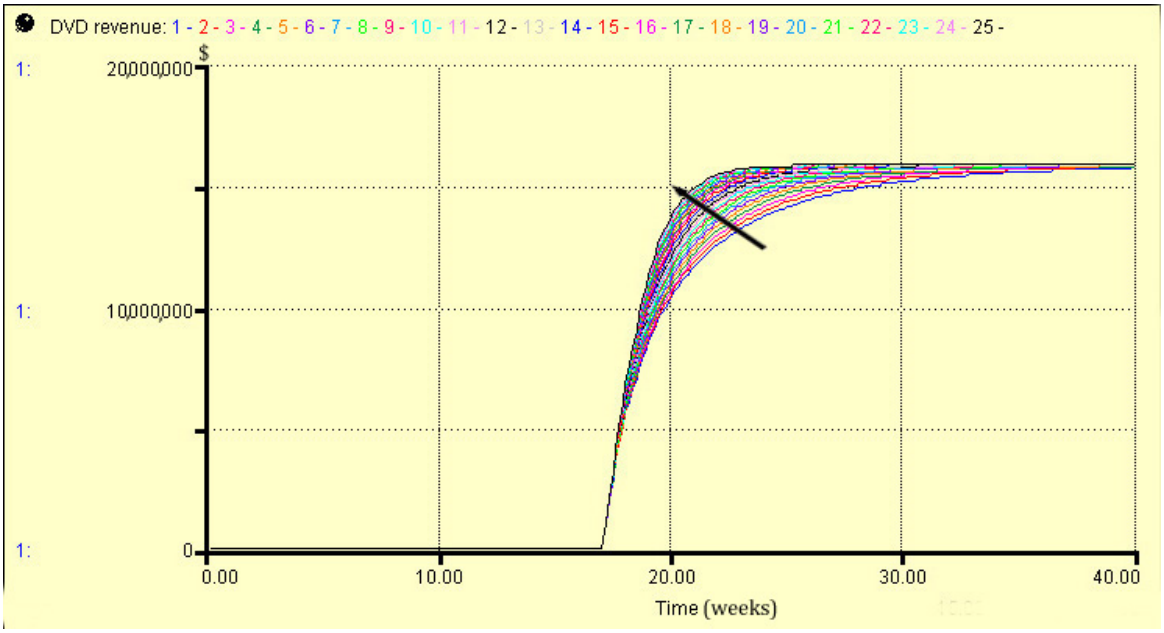


Figure F.8: Aggregate DVD revenue with changing 'error in q' value

F.3 Change in 'random reviews' Value

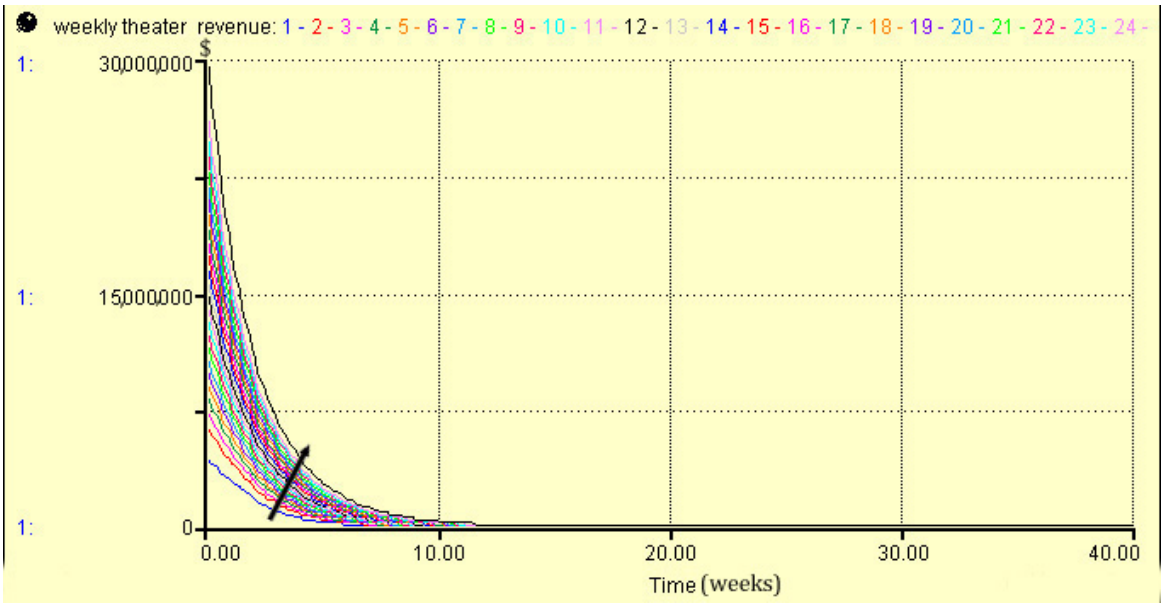


Figure F.9: Weekly theatrical revenue with changing 'random reviews' value

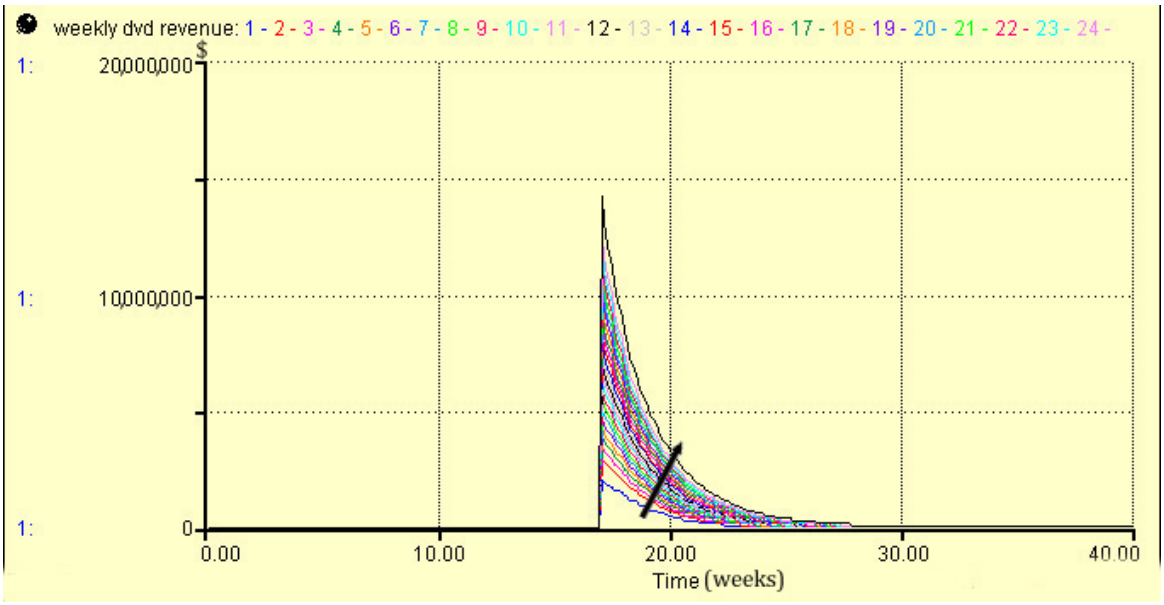


Figure F.10: Weekly DVD revenue with changing 'random reviews' value

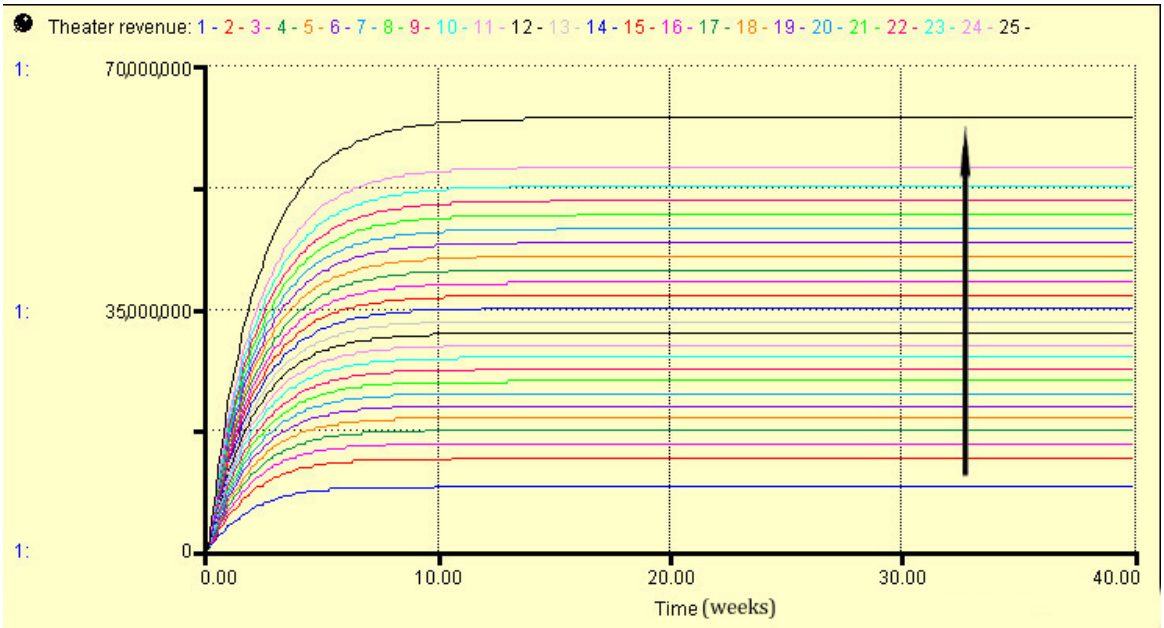


Figure F.11: Aggregate theatrical revenue with changing 'random reviews' value

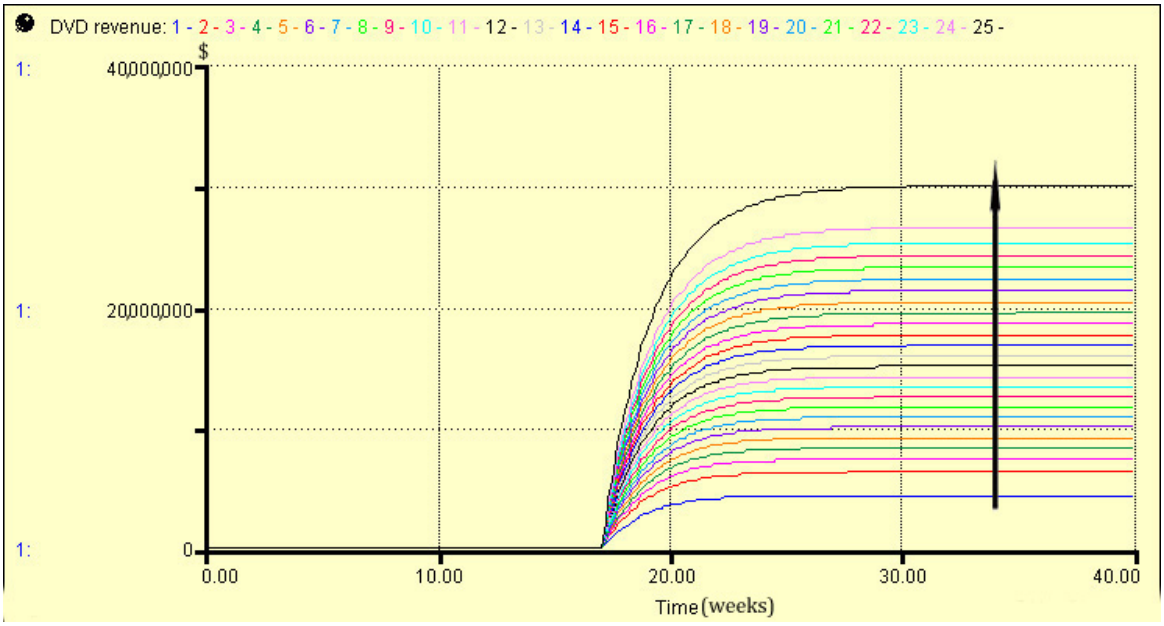


Figure F.12: Aggregate DVD revenue with changing 'random reviews' value

F.4 Change in 'error in ln revenue' Value

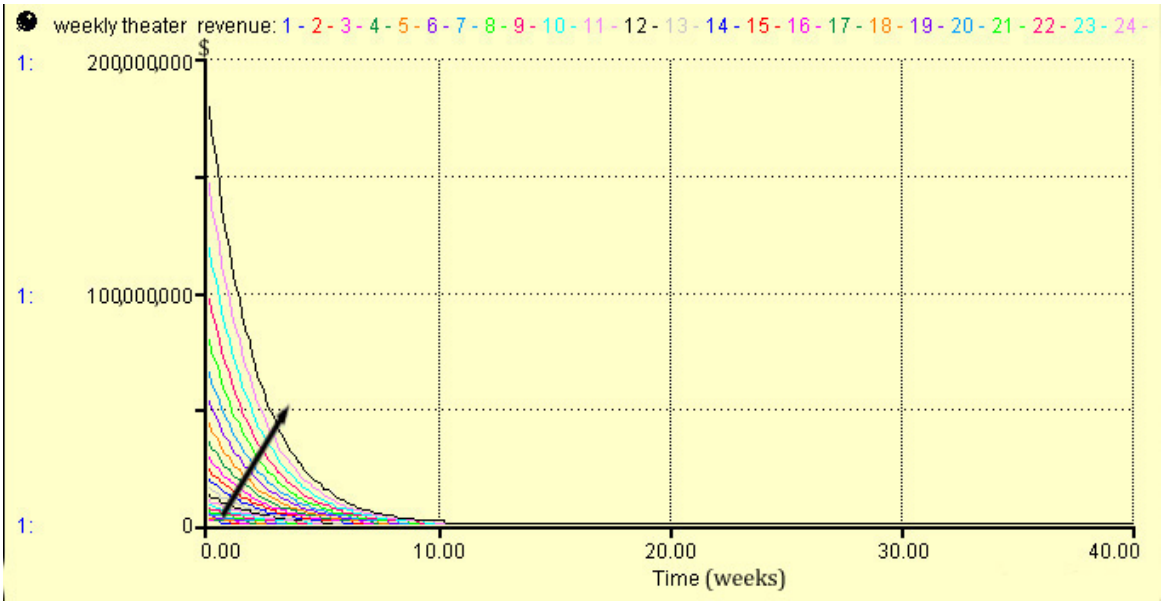


Figure F.13: Weekly theatrical revenue with changing 'error in ln revenue' value

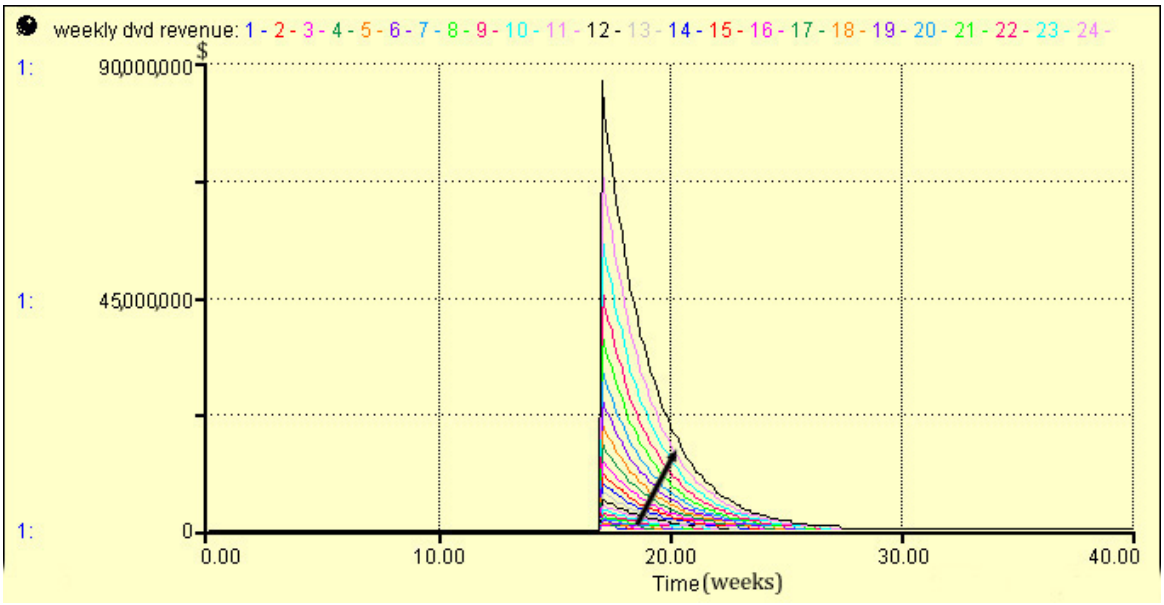


Figure F.14: Weekly DVD revenue with changing 'error in ln revenue' value

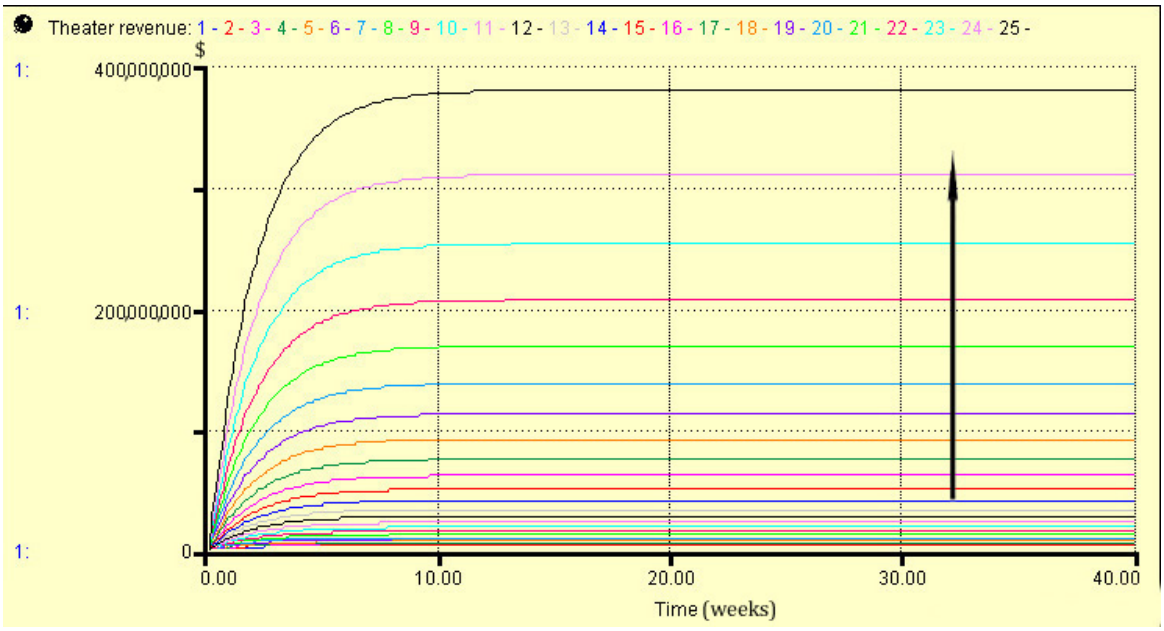


Figure F.15: Aggregate theatrical revenue with changing 'error in ln revenue' value

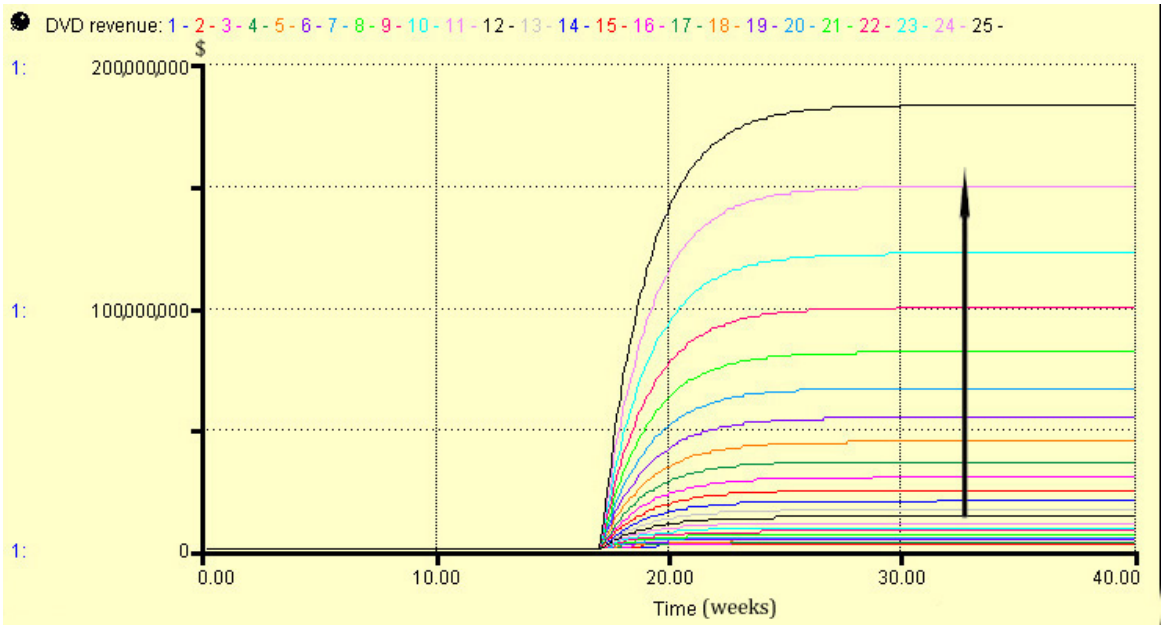


Figure F.16: Aggregate DVD revenue with changing 'error in ln revenue' value

F.5 Change in 'ln production budget' Value

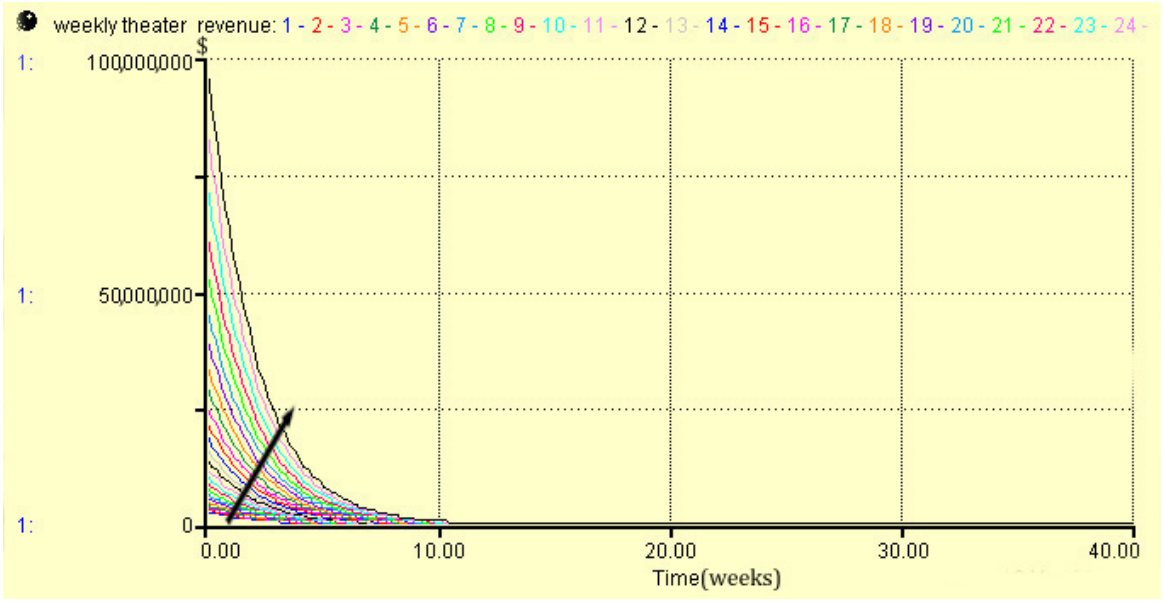


Figure F.17: Weekly theatrical revenue with changing 'ln production budget' value

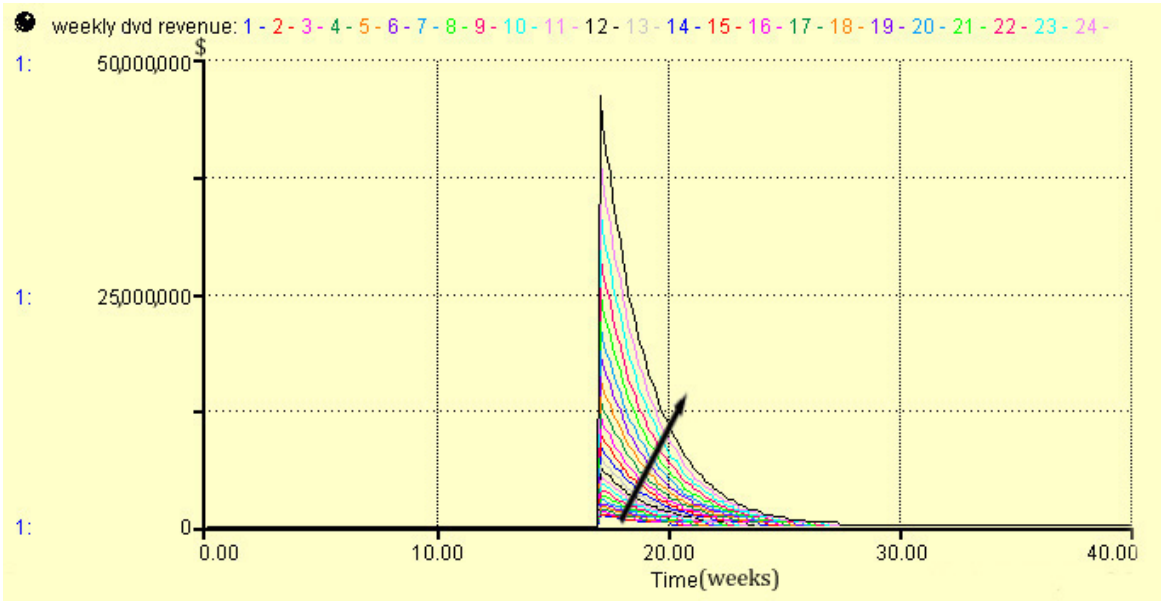


Figure F.18: Weekly DVD revenue with changing 'ln production budget' value

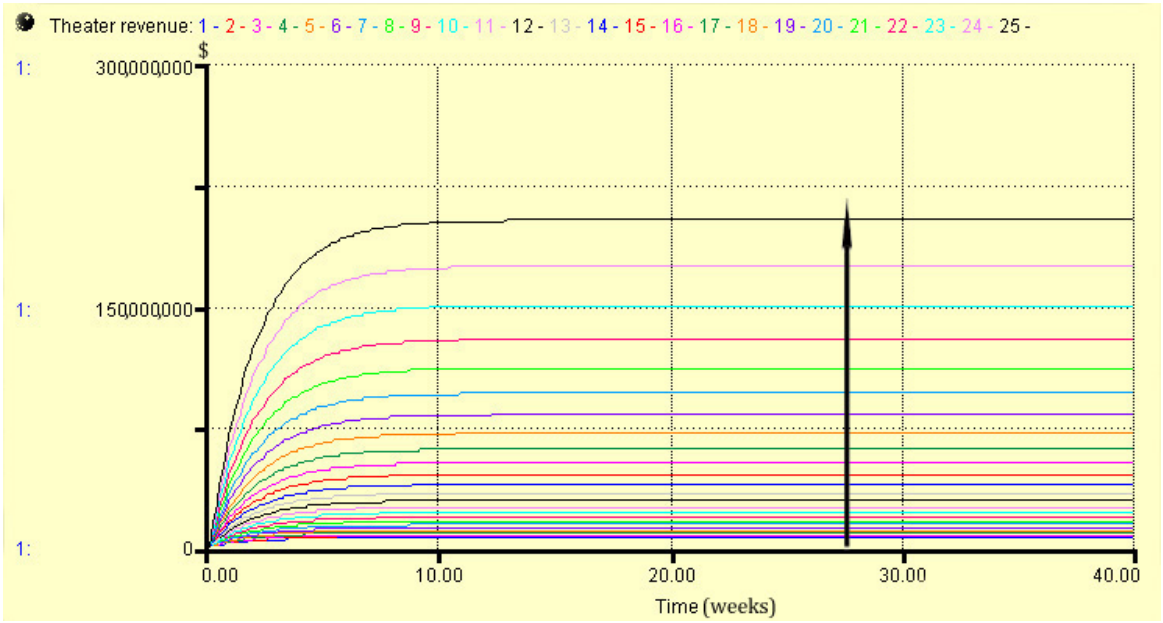


Figure F.19: Aggregate theatrical revenue with changing 'ln production budget' value

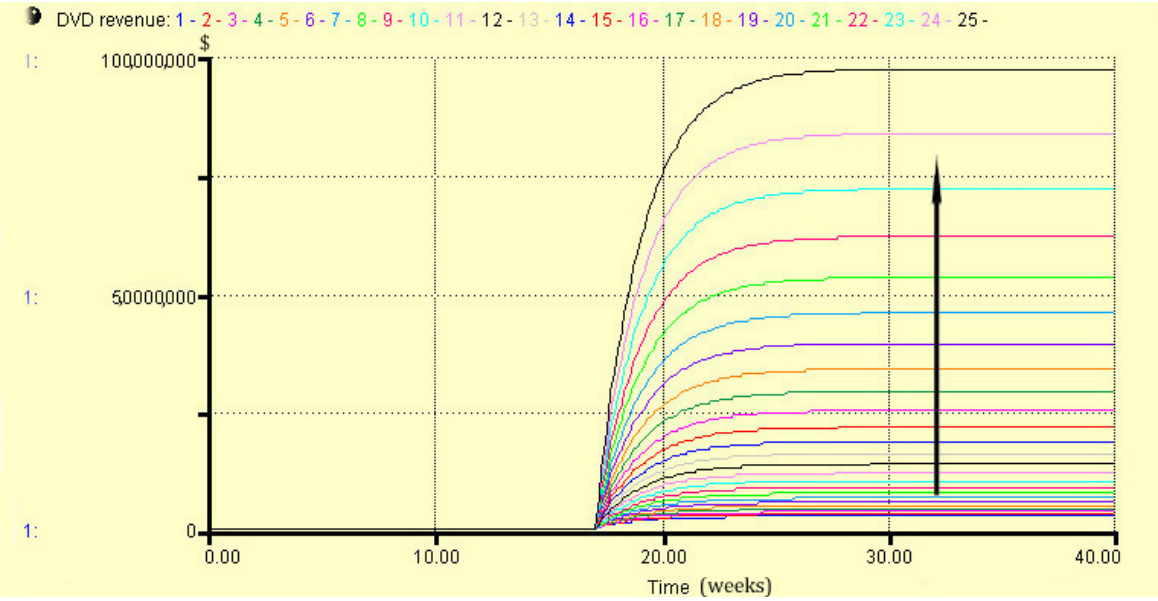


Figure F.20: Aggregate DVD revenue with changing 'ln production budget' value

F.6 Change in 'dvd sales delay' Value

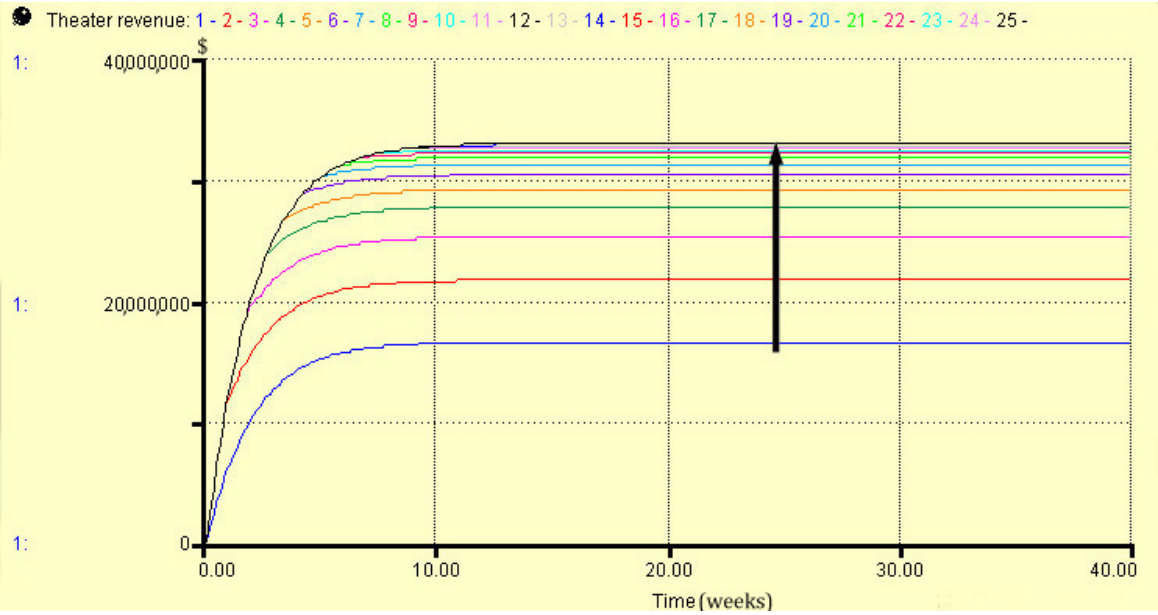


Figure F.21: Aggregate theatrical revenue with changing 'dvd sales delay' value

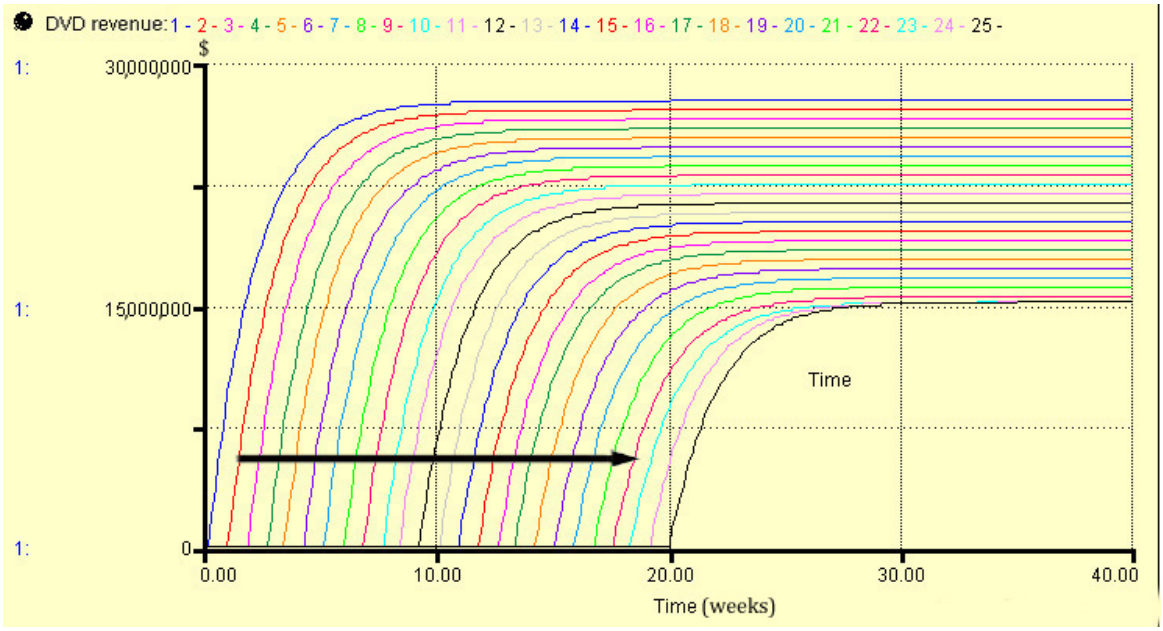


Figure F.22: Aggregate DVD revenue with changing 'dvd sales delay' value

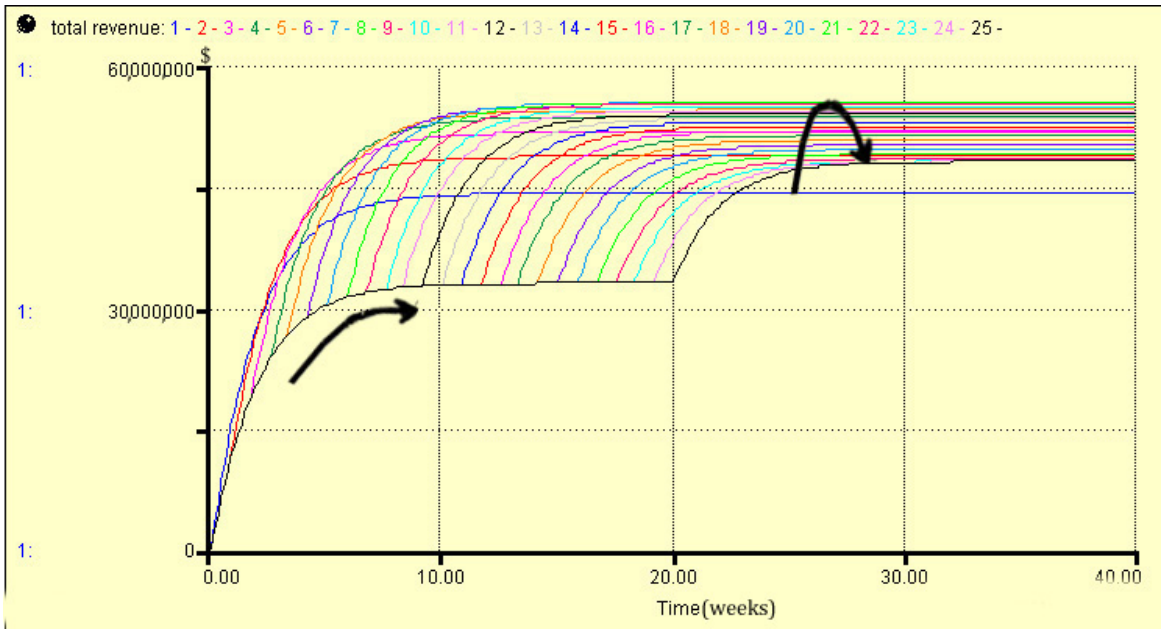


Figure F.23: Aggregate total revenue with changing 'dvd sales delay' value

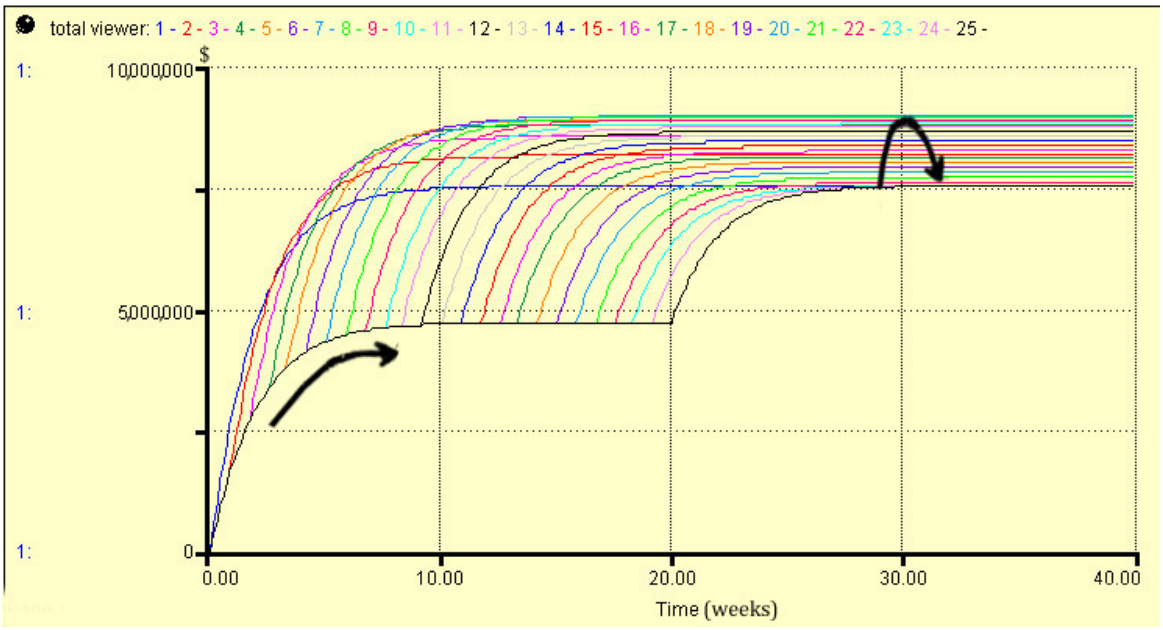


Figure F.24: Aggregate number of viewers with changing 'dvd sales delay' value