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Introduction to Credit Risk

Giulio Carlone

$$EE(t_k) = \frac{\sum_{i=1}^{nS} PFE(S_i, t_k)}{nS}$$

$$Eff.EPE = \frac{\sum_{m=1}^{k=(1\ year,\ maturity)} (Eff.EE(t_m) * (t_m - t_{m-1}))}{t_k - t_0}$$

$$EPE = \frac{\sum_{m=1}^{k=(1\ year,\ maturity)} (EE(t_m) * (t_m - t_{m-1}))}{t_k - t_0}$$

$$PFE^{NET}(S_i,\ t_k, P) = max(\sum_{j=1}^{N} S_i\ ,\ t_k\ ,\ p_j),\ 0)$$

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Preface

The aims of this book are explaining the risk supervision and risk monitoring of the Bank for International Settlements, the European Securities and Markets Authority, and the European Central Bank and defining the rules to be applied for investment strategies in counterparty credit risk. These rules begin with multiple key factors stemming from the portfolio choice and the number of simulation dates for generating the counterparty credit risk expected exposure, and finally arriving at a real, defined credit cloud model application. To support risk supervision and risk monitoring, the book integrates a practical case of study and the architecture related to the development of credit models on the Google Cloud Platform. This topic is important, and the approach, focusing on the technology used in the book (MATLAB® Cloud for data generation in the first step and Google Cloud for data visualization in the second), is very timely, relevant, and customizable to the business target audience.

The target audience is banks, consultancy firms, financial software houses, and their specialists in counterparty credit risk, either working in the financial industry or in academia, and we have attempted to address the book to them. The topic of this book is specialized, but is very important for anyone working in counterparty credit risk management for financial institutions. This research will be of interest to those in the industry whose field is risk management strategy.

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Introduction: Starting with Credit Risk

A PRACTICAL APPROACH TO FINANCIAL RISK MANAGEMENT consists of observing and analysing the measures required for a set problem. The study of financial risk measures is contemplated in quantitative finance. This work begins with an explanation of the cultural background necessary to understand the subject matter of this research.

Chapter 1 covers the financial risk, the credit risk, the credit risk measures, Monte Carlo, the interest rate swap, and the methodology of analysis.

Chapter 4 is interesting in the strategy to represent the generation of a simulation of a real case of study for generating the values of portfolio exposures. The values of regulatory measures, the values of portfolio expected exposure in a portfolio composed of distinct counterparties. Computing values of expected exposure by counterparty, this strategy describes how to select and define a grid composed of a set of simulation dates to be used in a Monte Carlo simulation. This is in order to generate the specific measurements required to determine credit and counterparty risk factors analyzing the values of counterparty expected exposure. This is a useful assessment because reference grids tend to grow in density together with the performance of the model that generates them. For banks whose internal model is approved by a national regulator, this regulator demands an increase in the number of dates to assess risk factors better. The first part of the case study introduces all the notions related to counterparty credit risk that can gradually help academics and the risk manager to identify the indicators of capital exposure and specify the meaning of the internal model and the measures required for the management of the corresponding risk, with reference to the EU and the Bank for International Settlement. The second part of the case study introduces the risk measures that will be analysed in detail in two main application scenarios: an analysis of an existing application and a laboratory application generated with MATLAB 2015. In the third part of the case study, taking a specific internal model for a specific bank as an example, we initially introduce the technical instruments required to obtain a calculation flow of the measurements under consideration. We describe the languages and the flow components used to calculate the measurements. Assuming we have a suite, also necessary for generating these measurements, we describe the objects involved in this suite and how they are linked together to achieve the target. Next, we describe the flow used to generate the expected positive exposure value, and then clarify the methodology adopted for calculating the Expected Positive Exposure (EPE), analysing the results of a calculation of specific risk measures of a specific counterparty. Finally, we explain the selected methodology for scenario simulation. The fourth part of the case study presents an example of a MATLAB test for generating risk measures to show how these change when various grids are used. We introduce a portfolio of interest rate swaps in defining the three selected grids. Then, we explain the methodology of scenario simulation. Finally, we inspect the scenario prices and compute exposure by counterparty, analysing each result. The final part of the case study summarises the results from the curves of the counterparty and the analysis of the impact of variable grids. From the expected positive exposure data generated, we can immediately deduce the importance of increasing the density of short-term grids of the simulation applied to a real-world portfolio. Subsequently, we analyse the impact that variations in the grid of simulation have on risk measures when the density of short- and long-term time steps is increased. We then examine the benefits for both cases in a table summarising the portfolio under examination.

In Chapters 9–12, we introduce other numerical tests related to the subject matter of portfolio exposure.

Chapter 13 presents a future research project for further analysis of the contents of the two preceding chapters.

Chapter 14 is related to the MATLAB source code, and Chapter 15 is related to the Java code data recorded in a Microsoft file extended as a .CSV file.

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CHAPTER 1

Background of Credit Risk and Java Visualization for Expected Exposure

1.1 FINANCIAL RISK

In finance, the term "risk" is associated with the uncertainty derived from a possible future loss of value of an activity, financial instrument, or more generally, of an investment. A financial activity is, therefore, considered risky if the monetary return deriving from it cannot be anticipated. Buying shares is a classic example of a risky activity because it is impossible to know in advance whether their value will increase or decrease over time, or whether the company selling them will pay dividends regularly. Buying market shares is considered a classic example of a risky activity; however, as we will see later on, there are many others too.

Risk manifests in a symmetrical form. There is a possibility of obtaining a worse result than the most probable one, as well as a better one. In statistical terms, we can think of risk as a distribution of probability. The left-hand side of the average expected result represents the downside risk (in other words, the possibility of earning less, or losing more, than expected), whereas the right-hand side is the upside opportunity (or the possibility of earning more, or losing less, than expected).

A careful understanding, assessment, and management of risk is essential for financial institutions because for them, taking risks is a vital element of increasing their earnings. These institutions take risks, implicitly, by offering services to their clients, taking the role of risk takers in return for profit, and, explicitly, by exposing themselves on the financial market.

There are various forms of financial risk, but, for the sake of simplicity, we will distinguish between five categories: credit risk, liquidity risk, counterparty risk, market risk, and operational risk. Our attention will be focused on counterparty risk. However, to understand this form of risk fully, we need to outline the nature of some of the others as well.

Operational risk is defined as the risk of making losses owing to the inadequacy or malfunction of procedures, human resources, and internal systems, or to external events. In reality, the nature of this risk is not characteristic of financial intermediation. It only became so when the Basel Committee on Banking Supervisors, of which we will talk later, declared that a malfunction in one of the sectors linked to a bank's operations might put its stability at risk. Operational risk is, therefore, defined more by its causes than its effects, particularly with regard to four risk factors: human resources, information systems, external procedures, and external events.

Market risk refers to the possibility of banking activities receiving negative variations in their sale value. In the case of banking activities, this risk is mainly dependent on financial activities whose value can drop because of market factors such as interest rates, exchange rates, and share prices; technically, market risk relates to interest risk, exchange risk, and equity risk. As we will discuss later, interest rate-sensitive variations of value have by far the largest impact on a bank's portfolio.

Credit risk may be defined as the eventuality of a financial contractor not honouring its obligations, thus causing a loss to the lending counterparty. Even without the extreme case of a borrower becoming insolvent, credit risk can be defined as the eventuality that an unexpected variation in a borrower's creditworthiness may cause an unexpected variation in the value of the credit. It can be classified as follows:

Credit default risk is the risk of an identifiable loss by a bank that believes it probable that a creditor will not fully honour their credit obligations or that they may encounter significant delays in the payment of a substantial obligation.

Concentration risk is the risk associated with a single or a group of exposures that may cause significant losses that can undermine a bank's own sustainability. This concentration may be towards a single obligation or an entire sector.

Country risk is the risk of a loss arising from a state freezing its payments in foreign currency (transfer/conversion risk) or defaulting its payments (sovereign default risk).

1.2 CREDIT RISK

Credit risk is one of the most important factors in determining the price and yield of financial activities. Although the effects of credit risk on the value of bonds have long been examined, the development of analytical models for the study and quantification of these effects is relatively recent. Our aim here is to introduce fundamental concepts, such as a definition of credit risk and its components. Later, we will analyse various existing models for measuring credit risk.

Credit risk is one of the most analysed and difficult to quantify forms of market risk. The traditional approach to its study has been to apply actuarial methods of risk assessment based on historical data. However, the rapid growth of derivative activity on the financial market, particularly of over-the-counter and credit derivatives, and the high level of sophistication of certain financial instruments have brought to light the inadequacy of traditional methods in giving a correct estimation of real-world risks.

Ultimately, credit risk may be defined as the eventuality that one of the contractors is unable to honour its financial obligations, thus causing a loss to the lending party. This definition, however, only contemplates the extreme case in which the debtor becomes insolvent.

A loss of value of the credit position may also derive from a deterioration of the debtor's financial situation without them necessarily becoming insolvent. A fuller definition of the term "credit risk", therefore, should be as follows: the effect that an unexpected variation in a debtor's creditworthiness can cause on the credit value. The ratings provided by agencies, such as Standard & Poor's and Moody's, are an estimation of the creditworthiness of companies and countries.

There are, therefore, two definitions of the term credit risk to differentiate between credit loss arising after a debtor's insolvency (the default-mode paradigm) and variations in the value of exposure arising from deteriorations in the debtor's creditworthiness, with insolvency being only an exceptional case (Mark-to-Market or Mark-to-Model paradigm).

1.3 CREDIT RISK MEASURE

Value at risk is, without doubt, the most widely used measure for the management of financial risk. This form of risk measure, however, is not necessarily suitable for measuring counterparty risk for various reasons.

Credit exposure has to be defined over more than one temporal horizon to shed light on the effect of passing time and the general underlying trends.

Counterparty risk should be measured both from the view of pricing as well as that of risk management; more than one measure is, therefore, required.

For a full evaluation of counterparty risk on a portfolio, thus taking into consideration every counterparty present, the effective exposure towards every single counterparty must be understood.

Other risk measures that exist apart from value at risk are as follows.

Concerning expected exposure with regard to the management of risk, institutions are only interested in positions with positive Mark to Market because, as pointed out previously, counterparty risk is asymmetrical, and only these positions can generate exposure. The expected exposure on time frame t is only concerned with positive Mark to Market. It is defined as the arithmetical average of exposure distribution at a set future date.

Concerning potential future exposure (PFE), we can state that at a set date t and taking the worst possible scenario into consideration, it indicates the value of exposure at a set future date towards a specific level of confidence. As future Mark-to-Market values cannot be known for certain, at a set future date, the PFE can only be described as some form of probability distribution.

The expected positive exposure at a set date $[0; T]$ is a methodological estimation of future exposure of transactions subject to counterparty risk based on a weighted average contemplated over a time frame defined by the expected values of exposures. This weighted average is defined by the relation between the time frame of each single expected exposure and the entire period of time being considered.

1.4 MONTE CARLO

Monte Carlo is a class of computational algorithms that, starting from a series of randomly or pseudo-randomly generated numbers, permits us to obtain an average result that is similar to a theoretical behaviour. It allows us, therefore, to resolve complicated deterministic problems with a probabilistic method.

It is particularly useful in science when the direct observation of a phenomenon is not sufficient to provide a theoretical model. In these cases, it is advisable to conduct the same experiment repeatedly while changing the values attributed to the initial conditions and to the ensuing, if applicable, interaction between the elements under consideration through a pseudo-casual generation of numbers. The next step entails the unification of the results through some predetermined form of media. Generally, this method consists of four successive phases: first, some kind of domain, even a multidimensional one, has to be defined for the input data; second, input data have to be generated randomly through some variable defined by the domain; third, a deterministic computation of the various output for each input vector has to be made; and finally, aggregation of the results.

1.5 INTEREST RATE SWAP

An interest rate swap is a form of contract in which two parties agree to exchange interest rate cash flows, based on a specified notional amount, for a predetermined period of time. In most cases, the payments for these contracts are annual or biannual. However, there are also cases in which payments are made quarterly or monthly. The capital on which the interests are calculated is purely notional and not exchanged between the contractors.

According to the simplest contractual formula, called plain vanilla swap, one party makes payments at a variable rate, calculated according to a reference rate (e.g. the Euribor rate for the interbank circuit), and receives payments at a fixed rate. The counterparty, meanwhile, will make payments at a fixed rate and receive them at a variable rate.

The speculative use of interest rate swaps is intuitive and operationally significant. If a rise in interest rates is expected, it would make sense to enter a swap contract, making payments at a fixed rate and receiving them at a variable one. Similarly, if the expectations are for a drop in interest rates, then making payments at a variable rate and receiving them at a fixed one would be beneficial. These strategies are not risk-free, however, and gains will only be made if everything goes according to plan. A loss takes place otherwise.

The operational use of interest rate risk management is also important. Swap contracts allow for the transformation of liabilities from fixed rates to floating ones and vice versa.

1.6 ANALYTICAL METHODOLOGY

For measurements generated by credit risk, we will analyse relative variations and percentage variations. Say quantitative phenomenon X reaches values x_0, x_1, …, x_k, in correspondence, respectively, with times t_0, t_1, …, t_k. By an absolute variation of X from time t_s to time t_j ($t_s < t_j$), we obtain the difference ($x_j - x_s$). Absolute variations are expressed in the same measurement unit as X. By relative variations of X from time t_s to time t_i ($t_s < t_j$), we mean the relation $(x_j - x_s)/x_s$. Relative variations are pure numbers that assess the numerator according to the denominator. Relative variations multiplied by 100 make relative percentage variations.

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CHAPTER 2

Theoretical Phase of a Real-World Case Study

2.1 INTRODUCTION TO THE THEORETICAL PHASE

The originality of this case study lies in its provision, for the first time in literature, of quantitative research on the best method to use for selecting dates when using the popular Monte Carlo simulation. The objective is to identify the optimal distribution of simulation dates for measuring counterparty credit risk. We will first analyse a counterparty from a real-life portfolio to demonstrate how, when generating the regulatory measures of an internal model method, an optimal distribution of observation days is achieved by increasing the number of short- and medium-term time steps. In the second section, we will analyse a test portfolio using a flat yield curve to observe the differences when changing the distribution of simulation dates.

2.2 PRELIMINARY NOTES

The first part of this study aims to demonstrate the benefits of increasing the number of short- and medium-term time steps: Increasing short- and medium-term time steps has a positive influence on the final choice of regulatory measures to adopt. Increasing long-term time steps is less useful because these steps are inaccurate when monitoring risk factor behaviours.

The second part aims to show how increasing the density of dates provides more information and how measurements can be more accurate if important dates for the portfolio are included.

2.3 INTERNAL MODEL METHOD AND EXPOSURE

A strong and resilient banking system is the foundation of sustainable economic growth, as banks are at the heart of the credit intermediation process between savers and investors. Banks also provide critical services to consumers, small- and medium-sized enterprises, large corporate firms, and governments who rely on them to conduct their daily business, both at the domestic and international levels.

One of the key lessons learnt from the crisis, related the counterparty credit risk and a key driver of the 2007/2008 credit crisis, is the need to strengthen the risk coverage of the capital framework. Failure to capture major on- and off-balance sheet risks, as well as derivative-related exposures, was a major destabilizing factor during the crisis.

In addition to raising the quality and level of the capital base, there is a need to ensure that all risk measures are captured in the capital framework. Indeed, the failure to capture major on- and off-balance sheet risks, as well as derivative-related exposures, was a key factor that amplified the crisis.

To determine the default risk capital charge for counterparty credit risk, banks must use the greater portfolio-level capital charge based on the Effective Expected Positive Exposure (Eff. EPE) using current market data and the portfolio-level capital charge based on the Eff. EPE using a stress calibration.

Counterparty credit risk is the risk that the counterparty to a financial contract will default prior to the expiration of the contract and will thus be unable to make all the payments required by the contract. Only contracts negotiated privately between counterparties, over-the-counter derivatives, and security financing transactions are subject to counterparty risk. Exchange-traded derivatives are not affected by counterparty risk because the exchange guarantees the cash flow promised by the derivative to the counterparty.

Counterparty credit risk, a key driver of the 2007/2008 credit crisis, has become one of the main focuses of major global and U.S. regulatory standards. Financial institutions invest large amounts of resources employing Monte Carlo simulations to measure and price their counterparty credit risk.

Basel III has made a number of significant changes to the counterparty credit risk capital regime: the introduction of a new capital charge designed to capture potential Mark-to-Market (MtM) losses associated with the deterioration in the creditworthiness of a counterparty in relation to over-the-counter derivatives; a number of changes to the capitalization of counterparty credit risk under the internal model method, including a stressed Eff. EPE capital charge; and draft proposals for revising the capitalization of exposures to central counterparties. These proposals are likely to be changed as they may currently discourage acting as a clearing member. Currently, all clearing charges are in addition to the pre-existing Basel III Over-the-Counter (OTC) charges. Given that these proposals are subject to change, they have been included in an annex rather than the main body of this document.

The stress calibration should be a single consistent stress calibration for the entire portfolio of counterparties. The greater of the Eff. EPE, using current market data and the stress calibration, should not be applied on a counterparty basis but at the total portfolio level.

When the Eff. EPE model is calibrated using historic market data, the bank must employ current market data to compute current exposures; at least three years of historical data must be used to estimate the parameters of the model. Alternatively, market-implied data might be used to estimate the parameters of the model. In all cases, the data must be updated quarterly or more frequently if market conditions warrant.

To calculate the Eff. EPE using a stress calibration, the bank must also calibrate Eff. EPE using three years of data that include a period of stress to the credit default spreads of a bank's counterparties or using market-implied data from a suitable period of stress.

In situations where the bank does not have adequate credit spread data for a counterparty, the bank should map each counterparty to specific credit spread data based on region, internal rating, and business type. To assess the adequacy of the stress calibration, the exposure model for all counterparties must use data, either historic or implied, that include data from the stressed credit period. Such data must be used in a manner consistent with the method for calibrating the Eff. EPE model to the current data.

To evaluate the effectiveness of its stress calibration for Eff. EPE, the bank must create several benchmark portfolios that are vulnerable to the same major risk factors to which the bank is exposed. Exposure to these benchmark portfolios should be calculated using the current positions at current market prices, stressed volatilities and correlations, and other relevant stressed exposure model input from the three-year stress period. Supervisors may adjust the stress calibration if the exposures of these benchmark portfolios deviate substantially.

2.4 EXPOSURE REGULATORY MEASURES USED

The regulatory measure, gained from the same distribution of values used for the following measurements, is the Eff. EPE; the bank may use this measurement to determine the regulatory requirement for counterparty risk only prior to authorisation by the Bank of Italy.

The measurements with their relative characteristics are especially the EPE, Eff. EPE, Potential Future Exposure (PFE), and all of them are best analysed and observed with Expected Exposure (EE), effective EE (Eff. EE), PFE 95° (PFE95), and media Eff. PFE 95 (media Eff. PFE95).

The daily measure given to the systems used to monitor the credit for over-the-counter derivatives, for the operational calculation of existing credit lines, is the average of Eff. PFE95.

PFE shows the evolution in time of the bank's credit exposure in terms of positive Mark to Market for each scenario and for each time step from the date of analysis to maturity.

Taking into consideration all positions p of counterparty P for a given scenario S_i at time step t_k, if netting is absent, PFE will be defined as follows:

$$\mathrm{PFE}^{\mathrm{OUT}}(S_i,\ t_k,\ P) = \sum_{j=1}^{N} \left(\mathrm{MtM}\left(S_i,\ t_k\ ,\ p_j\right),\ 0\right)$$

If netting is present, as

$$\mathrm{PFE}^{\mathrm{NET}}(S_i,\ t_k,\ P) = \max\left(\sum_{j=1}^{N} S_i,\ t_k\ ,\ p_j\right),\ 0)$$

where MtM is the Mark to Market at date t_k.

For each time step, from the date of analysis to maturity, EE is defined as the average of PFE scenarios calculated on Monte Carlo simulations.

$$\mathrm{EE}(t_k) = \frac{\sum_{i=1}^{nS} \mathrm{PFE}\ (S_i, t_k)}{nS}$$

Eff. EE is a function that never decreases over time because, for each time step, it is the maximum between the EE of the individual time step and that of each succeeding moment in time.

$$\text{Eff. EE}(t_k) = \max\left(\text{Eff. EE }(t_{k-1}),\ \mathrm{EE}(t_k)\right)$$

EPE is the average weighted to the time of EEs, where the weights are the portion of the entire time interval taken up by the time step of the individual EEs. EPE is calculated on a 1-year or shorter time scale. If all the contracts end during the year, the longest maturity is utilized.

$$\mathrm{EPE} = \frac{\sum_{m=1}^{k=(1\ \text{year, maturity})} \left(\mathrm{EE}(t_m) * (t_m - t_{m-1})\right)}{t_k - t_0}$$

Eff. EPE is the average weighted to the time of Eff. EEs, where the weights are the portion of the entire time interval of the time step of the individual Eff. EEs.

When calculating the Exposure-at-Default (EAD), where $\mathrm{EAD} = \alpha \times \text{EFF. EPE}\ \alpha > 1$, the Eff. EPE is multiplied by α that may be 140% or more, at the Bank of Italy's discretion. It is possible to ask for the approval of an internal estimation of α, with, in any case, a floor equivalent to 120%, determined by the relation between the capital estimated by a joint simulation of market/credit risk factors and the Current Exposure of the Eff. EPE and simulation of credit risk factors.

$$\text{Eff. EPE} = \frac{\sum_{m=1}^{k=(1\ \text{year, maturity})} \left(\text{Eff.EE}(t_m) * (t_m - t_{m-1})\right)}{t_k - t_0}$$

It is possible to define an interval of confidence α associated with the PFE, and in this case, the maximum value of the PFE relative to the α% of the distribution will be considered. In accordance with the current legislation, we have considered an interval of 95%.

A summary measurement of the PFE 95° is represented by the Add-On, calculated as the relation between the maximum value, peak exposure of the potential exposure in time, PFE 95°, and the notional of the contract.

$$\mathrm{PFE}^{\alpha}\ (t_k) = \mathrm{infinf}\left\{\mathrm{PFE} : PrPr\ \left(\mathrm{PFE}(t_k) > \mathrm{PFE}\right)\ \leq 1 -\ \alpha\right\}$$

The Eff. PFE 95° average is given by the average weighted by the non-decreasing time of the PFE 95°, Eff. PFE 95°, simulated over the lifespan of the netting node, whereby by Eff. PFE 95° is intended to be the maximum between the peak reached over time *t* and that of each succeeding moment in time.

This is the measure used for the measurement of credit lines usage.

$$\text{Eff. PFE}^{\alpha}\left(t_k\right)=\left(\text{Eff. PFE}^{\alpha}\left(t_{k-1}\right),\ \text{PFE}^{\alpha}\left(t_k\right)\right)$$

$$\text{Mean Eff. PFE}^{\alpha} = \frac{\sum_{m=1}^{k=\text{maturity}}\left(\text{Eff. PFE}^{\alpha}\left(t_m\right)^{*}\left(t_m - t_{m-1}\right)\right)}{t_k - t_0}$$

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CHAPTER 3

Real-World Case of the Practical Phase for Generating Exposure Regulatory Measures in a Specific Bank with an Internal Model Method

3.1 INTRODUCTION TO A REAL-WORLD CASE

Here we describe the methodology adopted for calculating the measures of exposure, taking a bank that adopts an internal model as an example. The first step is to give a broad description of the architecture of the computing components used for the final generation of these numbers. Second, we give a description of the adopted scenario in relation to the components and then the selected procedure for the calculation of the measures of exposure. Finally, we analyse the results of the curves obtained for the measures of exposure in relation to a given counterparty.

3.2 CALCULATION TOOLS USED

The application component used in this research is the form RiskWatch, which was developed by IBM to calculate the measurement of risk and is part of the suite of the IBM AlgoSuite. RiskWatch is a calculation engine for financial risk. The RiskWatch application is an enterprise-wide software solution designed to help academics and professionals measure, monitor, simulate, and restructure financial risk. The standard RiskWatch application provides basic tools for performing these tasks. Users of academics and professionals can also add a variety of extensions that provide new functionality and financial models or integrate RiskWatch with other AlgoSuite components. To access some of the methodologies and functionality, users will need to load extensions onto RiskWatch. Extensions are dynamically linked modules that are ready to be loaded onto RiskWatch at run time for additional functionality. A Mark-to-Market (MtM) analysis is the valuation of an institution's overall daily portfolio, aggregated by the criteria that the user determines. To achieve a current value of a portfolio, the user must model the fixed elements within the portfolio and the fluctuating risk factors. Once these elements are defined, the user can apply pricing models to the instruments to produce a Mark-to-Market result that the user can analyse within the portfolio. Users can perform portfolio analysis at various levels using the aggregation capabilities of RiskWatch. Risk managers can look at MtM results from various perspectives because aggregation criteria can be defined dynamically. For example, at the aggregate level, users can group by currency, industrial sector, geographic location of the trading desk, or the type of business unit.

Risk++ is a powerful C++ class library integrated within the Algorithmics enterprise-wide risk management system. It is capable of significantly extending RiskWatch functionality in a variety of ways. Its dynamic loading capabilities enable users to customize RiskWatch by adding a range of new financial objects to the application at run time. Users can add risk management functionality to RiskWatch using the library.

The RiskScript language has been designed to help users automate tasks in RiskWatch regularly. Most RiskWatch functions are available as RiskScript extensions that users can easily run from a script. The RiskScript interface is part of the standard RiskWatch release. The users do not require any special files for RiskScript processing. BasicScript is the name of the basic programming language embedded in RiskWatch. The RiskScript language consists of the BasicScript language with RiskWatch extensions, such as functions to access RiskWatch objects, recalculate sessions, and load sessions.

Algo Scenario Engine (ASE) is an advanced scenario generation and management application, and is a primary component of the Mark-to-Future (MtF) framework. Scenarios created in ASE are based on historical time series data for observable market rates and prices, or those we refer to as risk factors. ASE uses risk factors to generate scenarios, which are then used for simulation and stress testing of portfolios.

The main role of the MtF Aggregator (MAG) is to calculate portfolio totals from MtF cubes that hold position, instrument, and portfolio data. In addition, MAG can calculate a number of statistical measures of portfolio and position risks. A MAG request specifies the chain of functions and their parameters. The MtF cube and netting node hierarchy are specified separately. Therefore, the same request can be applied to more than one cube. Each risk measure contains one record type function, one computation mode function, and one evaluation function. Simulation functions are optional and can be either an elementary simulation function or a composite function made up of two or more elementary simulation functions.

3.3 FLOW TO GENERATE EXPECTED POSITIVE EXPOSURE (EPE) VALUE

The flow starts from the database that contains the historical data. Such data may be updated on a daily, weekly, or monthly basis.

The historical data are sent to the ASE to generate possible scenarios, after identifying the risk parameters used to calculate the final value of risk considered. The scenarios are as many as the input portfolios, and a simulation is generated for each scenario. With back testing, we can analyse the quality of the previous simulation estimated up to time t, when it arrives at time t, $t = t_0$ = current time, comparing the curve of the past simulation with the real curve described with real data collected up to time t_0.

A simulation can then be subjected to stress testing by improving or worsening future conditions, thereby simulating the value of a portfolio by increasing or decreasing k% of its value. This is a k% stress. RiskWatch takes input scenarios and generates MtF cubes that are binary files containing the MtM value of financial instruments recalculated on N scenarios at M time steps.

A portfolio that generates 1,000 scenarios has a match of 1,000 cubes in RiskWatch. In addition, RiskWatch generates aggregations of portfolio server hierarchy in extensible markup language (XML) and Comma Separated Values (CSV) files that contain, respectively, the structure and contents of the data, as ranged input to Algo Hierarchy Server, to pass the MtF to the Aggregator. The MtF cubes range in input to MAG, which in turn generates the risk measure request, specifically, the EPE.

3.4 METHODOLOGY FOR THE CALCULATION OF EPE

This section describes the methodological criteria used for the implementation of the EPE-type internal model for evaluating counterparty risk, both in terms of regulatory capital requirements and operational management of the substitution risk of credit lines.

The methodology adopted uses the algorithmic calculation engine within the Algo Batch workflow, ASE, RiskWatch, and MAG, and it has been implemented according to the requisites of the internal counterparty models of the simulation components of the PFE and EPE. This approach takes into consideration the distribution of variations in market value, linked to major fluctuations in the risk factors, of all the contracts with counterparties, and estimates how they will evolve in time, taking into account possible netting agreements.

Here is a synthesis of all the steps taken in this calculation:

Generating set scenarios beginning with a time series of indicative drivers for each risk factor and patterns of evolution over time for various risk factors and number of path scenarios and time steps

Computation of MtF, or the evolution over time of MtM and of the max exposure (MtF, 0), of each single instrument within each path scenario for each time step

Aggregation of exposures according to the correct hierarchy of netting/credit lines

Computation of the measures adopted for the purpose of management, regulatory conditions, and risk analysis

3.5 RESULTS OF THE CALCULATION

Figure 3.1 shows the curves of a given counterparty. The images show three curves. The first curve has a simulation grid $G0$ made up of N dates. The other two curves correspond to grid $G1$, which has the same dates as $G0$ plus a set of k_1 simulation dates, and grid $G2$, which has the same dates as $G0$ plus a set of k_2 simulation dates. The number of elements in set k_1 is the same as that of k_2. The difference between $G1$ and $G2$ is the different dates in k_1 and k_2 added to the starting grid.

Figure 3.2 shows the MtF of counterparty X with two different time steps, N and M, and three different time step densities. The source is Intesa Sanpaolo Bank. The figure presents three curves. The first curve is drawn from a simulation grid $G0$ that is less dense than grids $G1$ and $G2$. All three grids are graphed in the figure. The dense section of grids $G1$ and $G2$ can be easily spotted at the point on the drawing of the curves with many peaks. Grid $G0$, which is less dense, has a straighter line, whereas grids $G1$ and $G2$, precisely at the point where they are denser compared with $G0$, fluctuate more, thereby forming more peaks. The more peaks there are, the more information can be gathered about the section concerned. The final part of the three curves shows a sudden growth. This growth is linked to the increase in the value of the portfolio at that date.

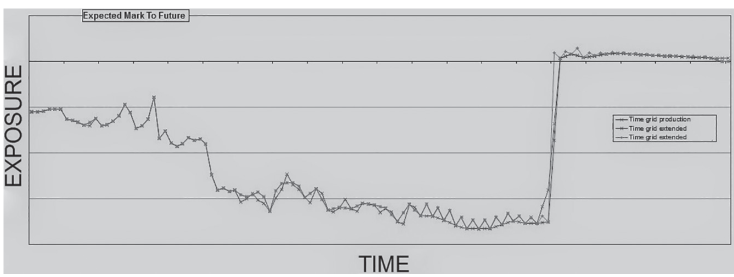

FIGURE 3.1 Expected MtF of a counterparty, Java tool riskmeasuresgraph for CSV image generation by Myeclipse trial 2014.

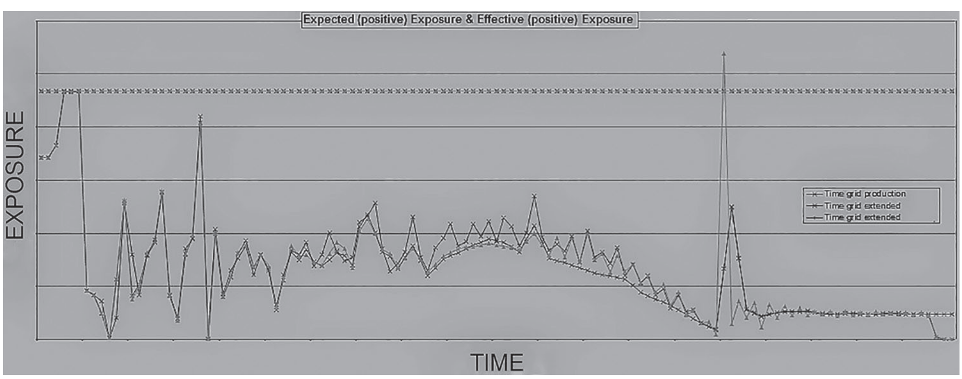

FIGURE 3.2 Expected positive exposure and effective positive exposure Java tool riskmeasuresgraph for CSV image generation by Myeclipse trial 2014.

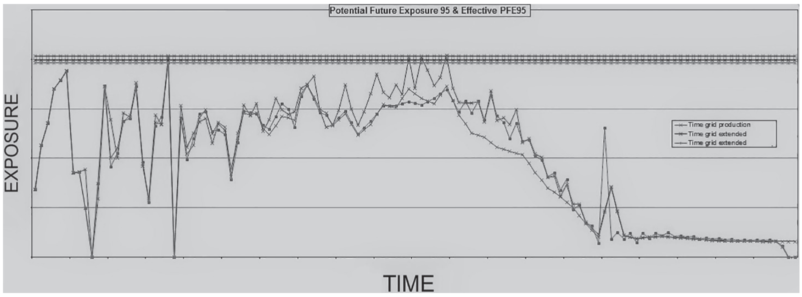

FIGURE 3.3 PFE 95 and effective PFE 95 Java tool riskmeasuresgraph for CSV image generation by Myeclipse trial 2014.

Figure 3.3 shows the curve of the EPE and Effective EPE of counterparty *X* with two different time steps, *N* and *M*, and three different time step densities. The source is Intesa Sanpaolo Bank. This case also has three curves, corresponding to grids *G*0, *G*1, and *G*2. The curves *G*1 and *G*2 have two different forms of increased dates with respect to grid *G*0. *G*1 and *G*2 have the same number of dates; their difference is in the area of increased density. In this graph, as in the previous one, the presence of peaks corresponds to the areas in which the number of dates has been made denser. It is important to note how, in the long-term area, there is a peak, highlighted by a grid between the two denser ones that surpasses the value of the effective EPE. This peak demonstrates a particularly high EPE, which can be explained by the fact that increasing the density of the grid captures extra information in comparison with the less dense grid on a certain instrument that, at that date, receives significant variations of exposure, as shown by the peak. These situations generally correspond to deadlines of certain instrument portfolios that had been considered when selecting the risk measures.

Figure 3.3 presents the Potential Future Exposure (PFE) and effective PFE of counterparty *X* with two different numbers of time steps *N* and *M* and three different densities of time steps. The source is Intesa Sanpaolo Bank. The curves corresponding to the three different grids used to measure the PFE are extremely interesting mainly because the red curve shows, mostly in the mid-term region, what an important role this grid plays when determining the effective PFE. The values captured in this segment, in fact, contribute significantly to identifying the exact value of the effective PFE. The grid used to draw the red curve is, therefore, better equipped than the other two at providing useful information for determining the measurement at hand. Precisely because it gives more information, the grid corresponding to the red curve is preferred when it comes to selecting a denser grid in comparison with the starting grid. In this case, for this measurement, the grid corresponding to the generation of the red curve gives a greater contribution.

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CHAPTER 4

Theoretical Approach of the Real-World Case Phase Related to the Methodology of Scenario Simulation Used for Generating Exposure Regulatory Measures

4.1 INTRODUCTION OF THE THEORETICAL APPROACH

In Monte Carlo multistep scenarios, a stochastic process that defines distribution for each future time step describes the evolution in time of each risk factor. The estimation of the parameters used is based on the past three years in the time series for each risk factor. The models that analytically define such stochastic processes have been chosen according to the typology of the risk factor in consideration:

The Geometric Brownian Motion Model, also called GBM model, with null drift is used for equity and commodity. This model is based on a log-normal distribution of the random variable whose temporal evolution is described by the following stochastic differential equation:

$$dx(t)=\sigma(t)dW(t)$$

where σ is the historical volatility of the risk factor $x(t)$ and $dW(t)$ is a random walk.

The Black-Karasinski Model, a mean reverting type of model with a log-normal distribution of the underlying variable, is used for interest rates, *fx*, and credit derivatives.

It combines a stochastic process with a log-normal distribution of the Brownian type, with a mean reverting-type function, and it allows the creation of scenarios whose values have a limited timespan, thus allowing for the modelling of risk factors, such as interest rates, towards a long-term average. At every step in the simulation, a process that is subject to mean reversion drifts towards a predetermined level as well as to random movements.

The process of this variable is described by the following differential stochastic equations:

$$y(t) = \log\log(x(t))$$

$$dy(t) = k((a - y(t))dt + \sigma(t)dW(t)$$

where σ is the historical volatility, a is the mean reversion level, k is the mean reversion speed estimated on a historical basis, and $dW(t)$ is a random walk.

Given the high number of Monte Carlo multistep scenarios that have to be generated, the number of risk factors to be simulated must be kept low to maintain the database in a manageable format from both technical and performance perspectives. The risk factors have, therefore, been linked to drivers whose evolution in time will be functional to the definition of revaluation scenarios.

The choice of drivers is made according to the importance of risk factors for the bank's portfolio; in other words, according to the importance and/or development of the market. We believe this simplification does not reduce the importance of the analysis, because in this phase, an assessment of idiosyncratic risks is less relevant compared with market risks.

The implemented methodology used for the assessment of counterparty risk is therefore based on two main components: an estimation of the value of future exposures for all positions that are subject to counterparty risk through Monte Carlo multistep simulations and a representation of the exposure within the netting hierarchy for every netting node of each counterparty.

The choice of time steps takes into account the structure of the bank's portfolio and the weight that needs to be allocated to exposures in the first year, as these are used to calculate regulatory measures.

This choice tends to reduce to a minimum the possibility of error, or roll-off risk, of one-year exposure forecasts, which is coherent with the annual horizon of regulatory measures. The analysis of exposure profiles shows how, for the majority of payoffs, the peak is reached in the short or medium term. This explains the choice of time steps being considered as the most appropriate for measuring potential future exposure accurately.

The number of Monte Carlo multistep scenarios currently used is 2.000 for every risk factor.

For certain types of financial instruments, internally developed calculation libraries have to be modified and adapted to enable a correct simulation of the evolution in time of the mark to market. In other words, certain approximations or a different model that is compatible with time evolution will have to be used, taking into account the adjustment requirements or the performance of the simulation.

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CHAPTER 5

Generation of a Simulation of a Real-World Case for Generating Exposure Regulatory Measures

5.1 INTRODUCTION TO A REAL-WORLD SIMULATION

This case study shows how to compute the credit value for a bank holding a portfolio of type named vanilla in the interest rate swaps list, with several counterparties. In support of the preceding analysis on "increasing the distribution of observation days" for calculating the measures of exposure, this section provides specific data to give a broader numerical dimension to this research. The portfolio analysed is a portfolio of vanilla swaps that remains identical for all the tests carried out. The test environment is MATLAB® R2015a with a student licence. The test is carried out on three grids with two numbers of observation days, N and M, with $N < M$, and $N + k = M$. The three grids 0, 1, and 2 have 0 cardinals N and 1 and 2 cardinals M, respectively. The logic of the test is to apply two different increased densities of starting grid 0. The first increased density consists of augmenting the number of dates k distributed in the initial part of starting grid 0. The second increased density consists of augmenting the number of dates k distributed in the final part of starting grid 0.

5.2 INTEREST RATE SWAPS PORTFOLIO

The portfolio used for this test is composed of six interest rate swaps. Looking at the swaps belonging to this portfolio defined the following numbers of set id = {1, 2, 3} correspond to counterparties {Alpha Ltd., Beta Ltd., Gamma Ltd.} (Figure 5.1).

Swaps used for generating the risk measurements.

Fixed rate payer: Alfa Ltd;	Fixed rate payer: Strong Financial Corporation
Fixed rate: EUR 20,00 annual	Fixed rate: EUR 40,00 annual
Floating rate payer: Strong Financial Corporation	Floating rate payer: Alfa Ltd
Floating rate: 1-year EUR Libor	Floating rate: 1-year EUR Libor
National amount: EUR 500000,00	National amount: EUR 1000000,00
Maturity: 10 years	Maturity: 10 years
Fixed rate payer: Beta Ltd;	Fixed rate payer: Strong Financial Corporation
Fixed rate: EUR 19,00 annual	Fixed rate: EUR 40,00 annual
Floating rate payer: Strong Financial Corporation	Floating rate payer: Beta Ltd
Floating rate: 1-year EUR Libor	Floating rate: 1-year EUR Libor
National amount: EUR 1000000,00	National amount: EUR 500000,00
Maturity: 20 years	Maturity: 20 years
Fixed rate payer: Gamma Ltd;	Fixed rate payer: Strong Financial Corporation
Fixed rate: EUR 5,00 annual	Fixed rate: EUR 10,00 annual
Floating rate payer: Strong Financial Corporation	Floating rate payer: Gamma Ltd
Floating rate: 1-year EUR Libor	Floating rate: 1-year EUR Libor
National amount: EUR 12500,00	National amount: EUR 250000,00
Maturity: 25 years	Maturity: 25 years

FIGURE 5.1 Swap vanilla portfolio.

5.3 CHOICE OF OBSERVATION DAYS CORRESPONDING TO TIME STEPS

In this test, the simulation grids are composed of one with 37 dates and two with 49 dates. Grid 0 contains 37 simulation dates, whereas grid 1 contains the same dates as 0 plus an increased density of short- and medium-term dates. Grid 2 contains the same dates as 0, plus an increased density of long-term dates (Figure 5.2).

In this picture, we have the composition of grids 0, 1, and 2.

Since we are taking vanilla swaps into consideration, we will use the constant vector described in Figure 5.3.

As a rate to spot the differences between the three different grids of different numbers of data.

Grid 0		Grid 1		Grid 2	
1.	14-Dec-2007	1.	14-Dec-2007	1.	14-Dec-2007
2.	15-Dec-2007	2.	15-Dec-2007	2.	15-Dec-2007
3.	16-Dec-2007	3.	16-Dec-2007	3.	16-Dec-2007
4.	17-Dec-2007	4.	17-Dec-2007	4.	17-Dec-2007
5.	18-Dec-2007	5.	18-Dec-2007	5.	18-Dec-2007
6.	19-Dec-2007	6.	19-Dec-2007	6.	19-Dec-2007
7.	20-Dec-2007	7.	20-Dec-2007	7.	20-Dec-2007
8.	21-Dec-2007	8.	21-Dec-2007	8.	21-Dec-2007
9.	22-Dec-2007	9.	22-Dec-2007	9.	22-Dec-2007
10.	23-Dec-2007	10.	23-Dec-2007	10.	23-Dec-2007
11.	24-Dec-2007	11.	24-Dec-2007	11.	24-Dec-2007
12.	07-Jan-2008	12.	25-Dec-2007	12.	07-Jan-2008
13.	14-Jan-2008	13.	26-Dec-2007	13.	14-Jan-2008
14.	14-Feb-2008	14.	27-Dec-2007	14.	14-Feb-2008
15.	16-Mar-2008	15.	28-Dec-2007	15.	16-Mar-2008
16.	16-Apr-2008	16.	29-Dec-2007	16.	16-Apr-2008
17.	17-May-2008	17.	30-Dec-2007	17.	17-May-2008
18.	17-Jun-2008	18.	01-Jan-2008	18.	17-Jun-2008
19.	18-Jul-2008	19.	02-Jan-2008	19.	18-Jul-2008
20.	18-Aug-2008	20.	03-Jan-2008	20.	18-Aug-2008
21.	18-Sep-2008	21.	04-Jan-2008	21.	18-Sep-2008
22.	19-Oct-2008	22.	05-Jan-2008	22.	19-Oct-2008
23.	19-Nov-2008	23.	06-Jan-2008	23.	19-Nov-2008
24.	20-Dec-2008	24.	07-Jan-2008	24.	20-Dec-2008
25.	27-Dec-2009	25.	14-Jan-2008	25.	27-Dec-2009
26.	03-Jan-2011	26.	14-Feb-2008	26.	03-Jan-2011
27.	10-Jan-2012	27.	16-Mar-2008	27.	10-Jan-2012
28.	16-Jan-2013	28.	16-Apr-2008	28.	16-Jan-2013
29.	23-Jan-2014	29.	17-May-2008	29.	23-Jan-2014
30.	30-Jan-2015	30.	17-Jun-2008	30.	30-Jan-2015
31.	06-Feb-2016	31.	18-Jul-2008	31.	06-Feb-2016
32.	12-Feb-2017	32.	18-Aug-2008	32.	12-Feb-2017
33.	19-Feb-2018	33.	18-Sep-2008	33.	19-Feb-2018
34.	25-Mar-2023	34.	19-Oct-2008	34.	26-Feb-2019
35.	27-Apr-2028	35.	19-Nov-2008	35.	04-Mar-2020
36.	31-May-2033	36.	20-Dec-2008	36.	11-Mar-2021
37.	04-Jul-2038	37.	27-Dec-2009	37.	18-Mar-2022
		38.	03-Jan-2011	38.	25-Mar-2023
		39.	10-Jan-2012	39.	31-Mar-2024
		40.	16-Jan-2013	40.	07-Apr-2025
		41.	23-Jan-2014	41.	14-Apr-2026
		42.	30-Jan-2015	42.	21-Apr-2027
		43.	06-Feb-2016	43.	27-Apr-2028
		44.	12-Feb-2017	44.	04-May-2029
		45.	19-Feb-2018	45.	11-May-2030
		46.	25-Mar-2023	46.	18-May-2031
		47.	27-Apr-2028	47.	24-May-2032
		48.	31-May-2033	48.	31-May-2033
		49.	04-Jul-2038	49.	04-Jul-2038

FIGURE 5.2 Grids for observation days.

Date/mm	Zero rate
3	0.01
6	0.01
12	0.01
5 X 12	0.01
7 X 12	0.01
10 X 12	0.01
20 X 12	0.01
30 X 12	0.01

FIGURE 5.3 Zero rate vector.

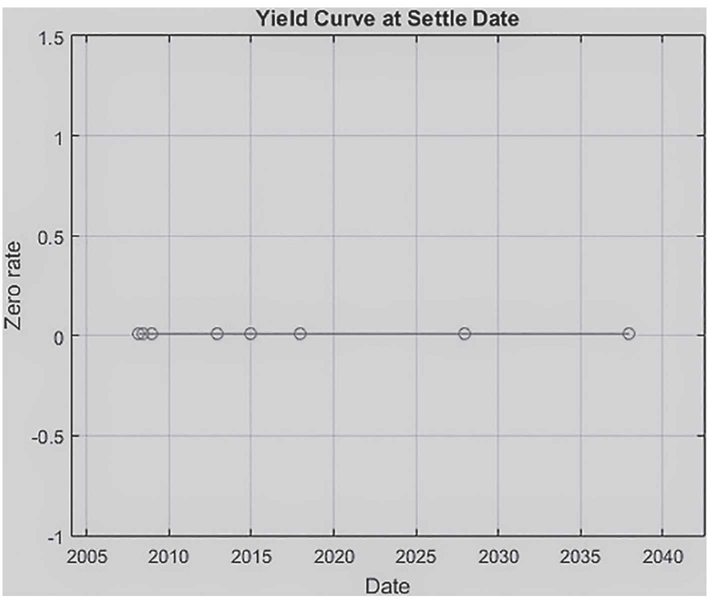

FIGURE 5.4 Yield curve with zero rate = 0.01.

The vectors are shown in Figure 5.4.

These two vectors may obviously be modified according to the other curves of the swap rate.

5.4 METHODOLOGY OF SCENARIO SIMULATION

Having set up the three Monte Carlo simulation grids, we define the total number of scenarios to be generated as $N = 1{,}000$.

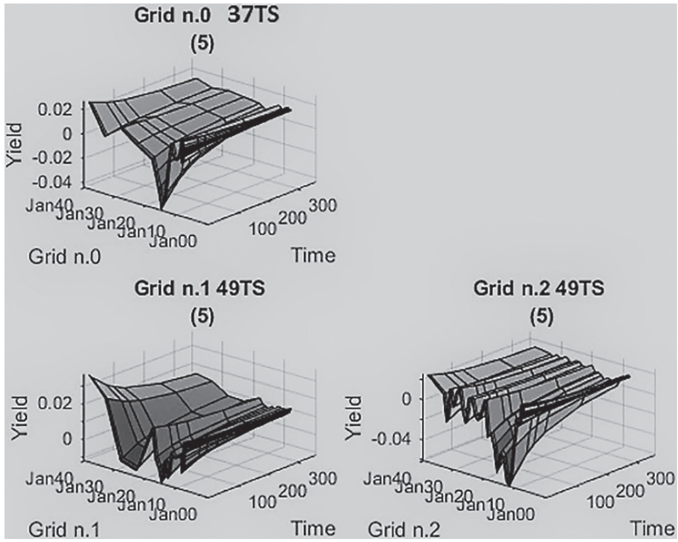

FIGURE 5.5 Scenario yield curve evolution on grids 0, 1, and 2.

The risk factor we simulate to value our contracts is the zero curve. For this case study, we model the interest rate term structure using the one-factor Hull–White model; $\alpha = 0.2$ and $\sigma = 0.015$.

For each scenario, we simulate the future interest rate curve at each valuation date using the Hull–White one-factor interest rate model. The surface plot of the yield curve evolution for scenario no. 5 is shown in Figure 5.5.

These three surfaces show how increasing the density creates more peaks in the applied grids. In quantitative terms, having more peaks means giving a better representation of the projection of the variations of a set of values applied at the beginning of the process. The increase in density is applied in the short term in grid 1 and in the long term in grid 2.

5.5 INSPECT SCENARIO PRICES

We create a plot of the evolution of all swap prices for a particular scenario. For each scenario, the swap portfolio is priced at each future simulation date. Prices are computed using a price approximation function. As the simulation dates do not correspond to the cash flow swap dates, we estimate the latest floating rate with the one-year rate interpolated between the nearest simulated rate curves. The swap prices are then aggregated into a cube of values containing all future contract values at each simulation date for each scenario. The resulting cube of contract prices is a three-dimensional matrix in which each row represents a simulation date, each column a contract, and each page a different simulated scenario as described in Figure 5.6.

A comparison of grid 1 with grid 2 shows how sampling occurs mainly where the grids are denser. In the first case, we have increased the number of short-term dates; in the second case, the number of long-term ones. With the increase in density of short-term time steps in grid 1, we can spot a more regular trend towards the beginning of the price curve.

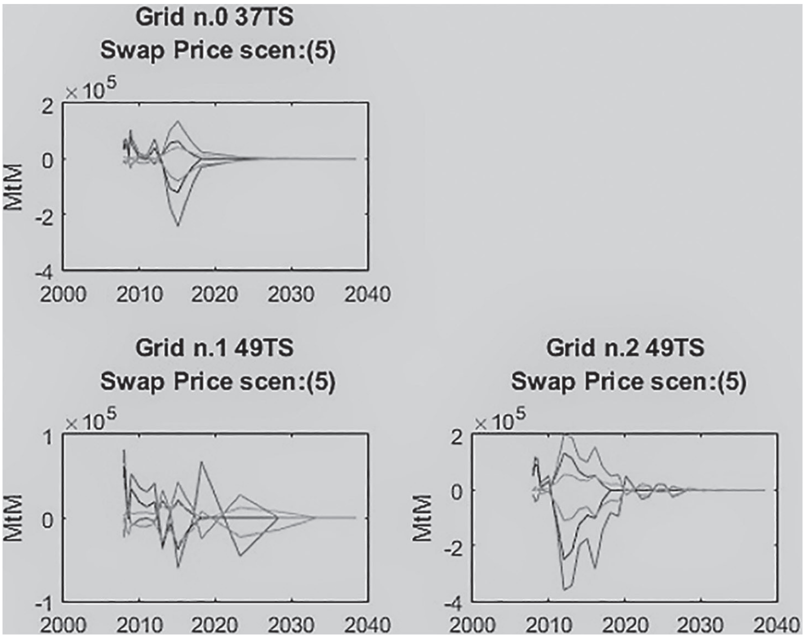

FIGURE 5.6 Swap prices for scenario 5 on grids 0, 1, and 2.

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CHAPTER 6

Compute Exposure by Counterparty

6.1 INTRODUCTION TO COMPUTATION

It is possible to plot the total portfolio value for each scenario of our simulation. Each scenario moves forward in time; therefore, the value of the contracts will increase or decrease according to changes in the modelled interest rate term structure. As the swaps get closer to maturity, their value will begin to approach zero because the aggregate value of all remaining cash flows will decrease after each cash flow date. The exposure of contract i at time t is the maximum of the contract value V_i and 0. Several exposure profiles are useful when analysing the potential future exposure of a bank to a counterparty. Here we compute several, non-discounted, exposure profiles per counterparty as well as for the entire portfolio.

The beam of total exposures indicates clearly whether there is swelling in the central section that corresponds to the curves generated by grid 1, characterised by an increased density in the central part of the date axis. Another interesting element is the swelling of the beam of exposure generated in grid 2 towards the end of the date axis. This corresponds with our expectations. The areas with an increased density of dates have a swelling in the curves of the simulation graph. We notice a swelling in the short term in grid 1 and another in the long term in grid 2. In all three cases, the exposures are at a maximum in the initial section of the three simulation grids (Figure 6.1).

Regarding the exposure of our initial swap portfolio, the blue line represents the Positive Future Exposure (PFE). The red line represents the maximum PFE (MPFE). The yellow line represents the Expected Exposure (EE), or, in other words, the mean average of the distribution of exposures at each date. The purple line represents the Expected Positive Exposure (EPE), the weighted average over time of the EE. Finally, the blue line represents the effective EPE (Eff. EPE), the weighted average of the effective EE (Figure 6.2).

The three curves of the EE and PFE for the entire portfolio show an interesting trend: when we move from the 37 dates of grid 0 to the 49 of the other two grids, grid 1 looks

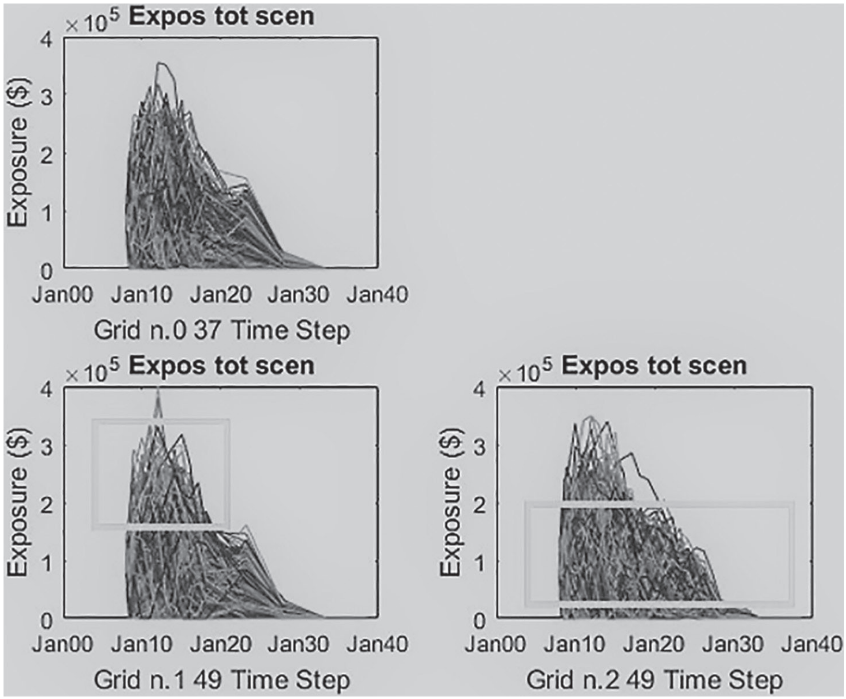

FIGURE 6.1 Portfolio exposures for all scenarios on grids 0, 1, and 2.

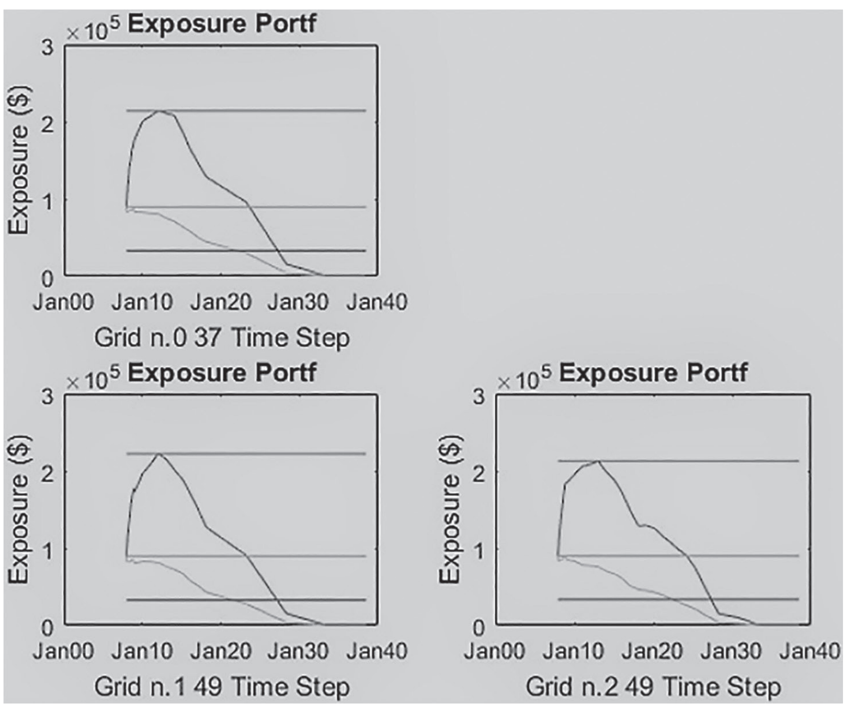

FIGURE 6.2 Portfolio exposure profiles on grids 0, 1, and 2.

smoother towards the centre. This means that variations in value are better captured in that section. Notably, the section with more peaks corresponds to the section where the grid is denser. On the curve corresponding to grid 2, meanwhile, we notice a smoothening in the final part, which corresponds to an increased density of the grid.

6.2 PORTFOLIO EXPOSURE PROFILES

The values calculated are as follows (Figures 6.3 and 6.4):

We can see the difference in values according to the grids used. The value of EPE decreases when we use the denser short-term grid. The highest EPE value is obtained from using the denser long-term grid because it better captures information regarding the maturity of 20- and 25-year swaps. The maximum value of Eff. EPE is obtained by grid 2, whereas that of MPFE is obtained by grid 1.

	Grid 0	Grid 1	Grid 2
Expected positive exposure	33.060.000	32.760.000	33.880.000
effective Expected Positive Exposure	89.530.000	89.520.000	90.190.000
max Positive Future Exposure	213.900.000	222.400.000	212.900.000

FIGURE 6.3 Portfolio exposure profiles data evaluated on grids 0, 1, and 2.

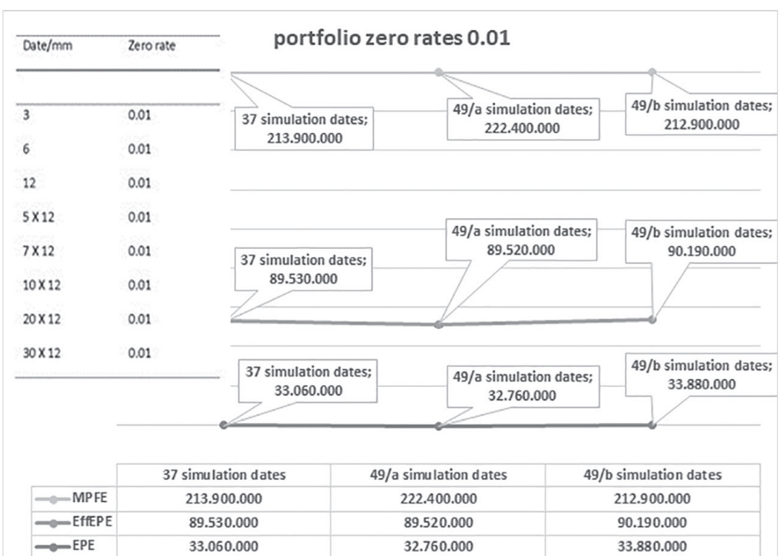

FIGURE 6.4 Portfolio exposure profiles on grids 0, 1, and 2.

6.3 COUNTERPARTY ALPHA LTD. EXPOSURE PROFILE

Let us analyse the measures of risk on the three grids 0, 1, and 2 with reference to counterparty 1, with a ten-year maturity of a vanilla swap. We can see immediately that the best contribution towards the risk measures is provided by the initial part of curves EE and PFE. Grid 2 does not capture any extra information because its increased density starts after the maturity of counterparty 1 (Figure 6.5).

We analyse the counterparty made up of two swaps with a ten-year maturity, as shown by the curve of the EE on the grid that reaches zero at maturity. The maximum EPE value is obtained by grid 1, whereas the most significant value of the Eff. EPE is given by grid 0. The most important MPFE is provided by grid 1 (Figures 6.6 and 6.7).

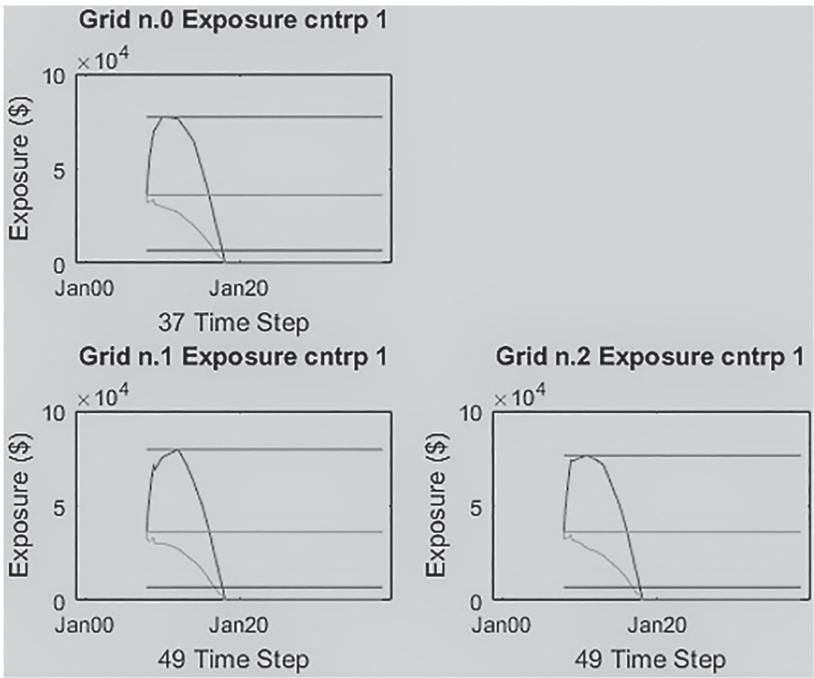

FIGURE 6.5 Counterparty Alpha Ltd. exposure profile on grids 0, 1, and 2.

	Grid 0	Grid 1	Grid 2
Expected positive exposure	6.912	6.971	6.924
effective Expected Positive Exposure	36.010.000	35.970.000	35.970.000
max Positive Future Exposure	77.280.000	79.500.000	76.490.000

FIGURE 6.6 Counterparty Alpha Ltd. exposure profile data evaluated on grids 0, 1, and 2.

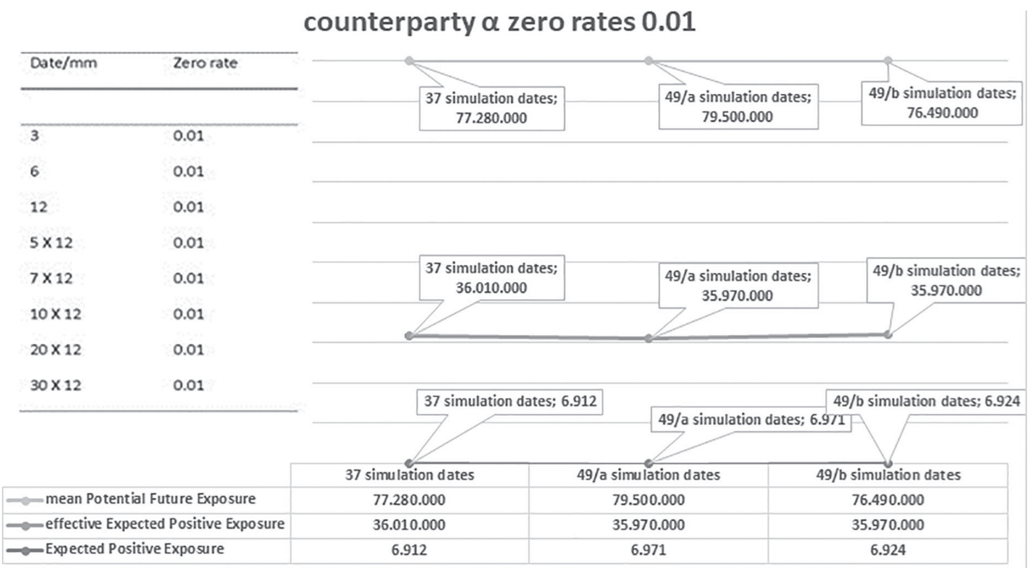

FIGURE 6.7 Counterparty Alpha Ltd. exposure profile on grids 0, 1, and 2.

6.4 COUNTERPARTY BETA LTD. EXPOSURE PROFILE

Now let us examine the risk measures on the three grids 0, 1, and 2 regarding counterparty 2, with a 20-year maturity vanilla swap. Information on this counterparty is better captured by grid 2, with denser long-term time steps, which also capture the maturity of the swap (Figure 6.8).

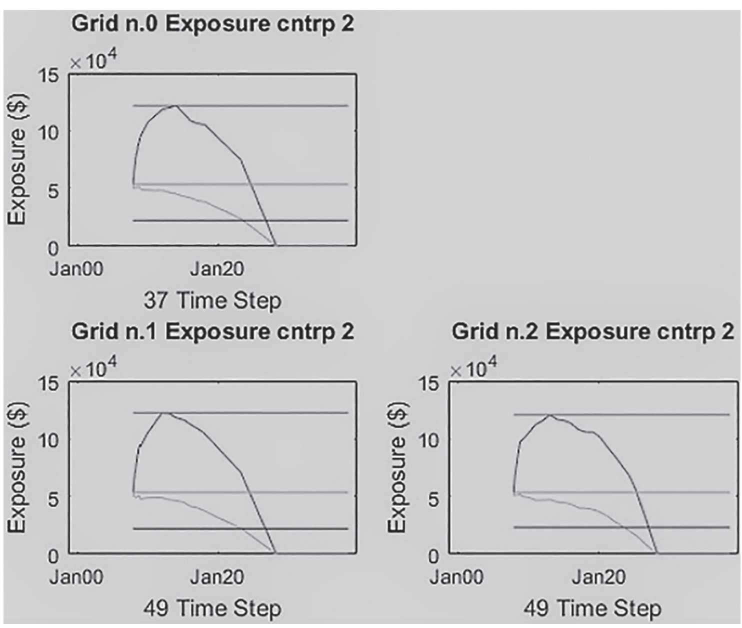

FIGURE 6.8 Counterparty Beta Ltd. exposure profile on grids 0, 1, and 2.

	Grid 0	Grid 1	Grid 2
EPE	22.420.000	22.160.000	23.060.000
EffEPE	53.550.000	53.550.000	53.550.000
MPFE	121.700.000	122.300.000	120.800.000

FIGURE 6.9 Counterparty Beta Ltd. exposure profile on grids 0, 1, and 2.

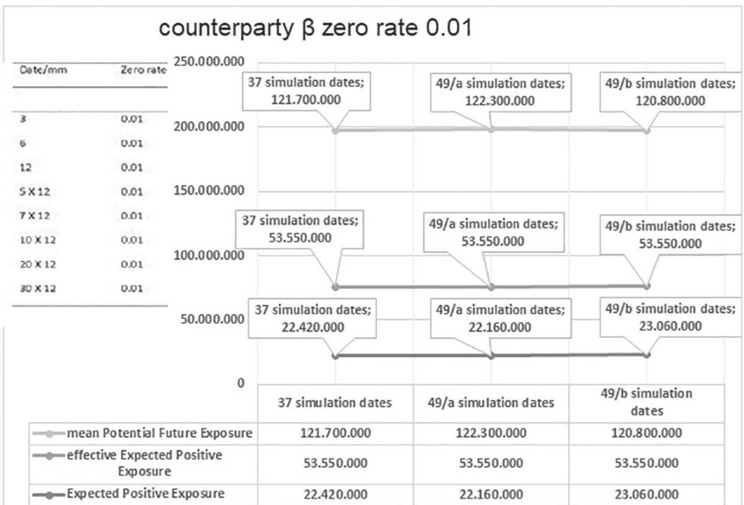

FIGURE 6.10 Counterparty Beta Ltd. exposure profile data evaluated on grids 0, 1, and 2.

The EE and PFE of grids 0 and 2 are not as smooth as those of grid 1, which has denser short-term time steps. The EE and PFE of grid 2, meanwhile, are smoother towards the end in correlation with the density increase of grid 2. The maximum value of EPE is provided by grid 2. The Eff. EPE is the same for all three grids, and the MPFE is shown on grid 1 (Figures 6.9 and 6.10).

6.5 COUNTERPARTY GAMMA LTD. EXPOSURE PROFILE

Let us now analyse the results of counterparty 3 on grids 0, 1, and 2, when the vanilla swap has a 25-year maturity. Even in this case, the long-term density increase captures more information during the maturity period of counterparty 3. The curve of grid 1 has a more regular trend in the short term, contrary to curves 0 and 2, which show slight irregularities. The curve of grid 2 has a smoother trend in the long-term part (Figure 6.11).

For this counterparty, grid 2 provides the highest values of EPE, Eff. EPE, and MPFE. Grid 2 gives higher values for all three measurements. Grid 1, however, gives the lowest EPE, PFE, and MPFE. Grid 0 gives values that lie between grids 1 and 2 (Figures 6.12 and 6.13).

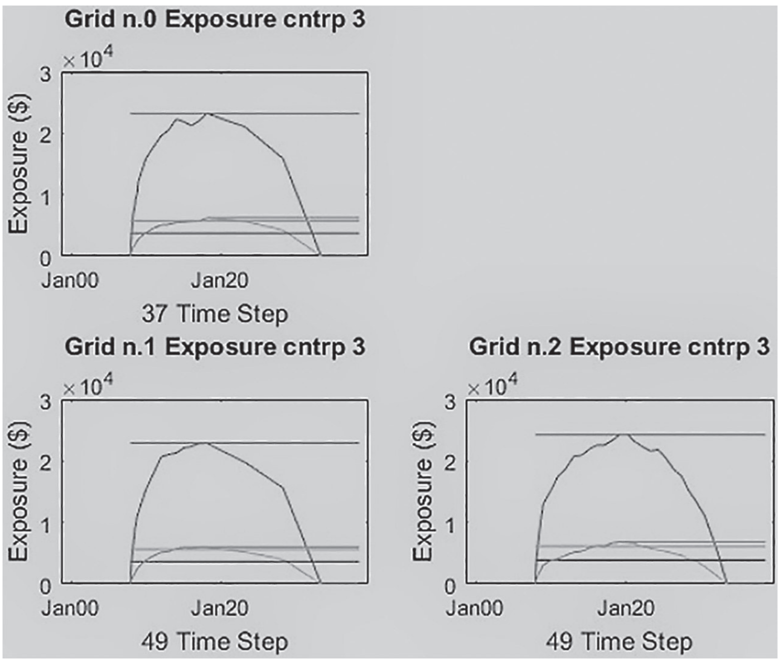

FIGURE 6.11 Counterparty Gamma Ltd. exposure profile on grids 0, 1, and 2.

	Grid 0	Grid 1	Grid 2
EPE	3.728	3.634	3.897
EffEPE	5.712	5.613	6.125
MPFE	23.210.000	22.890.000	24.280.000

FIGURE 6.12 Counterparty Gamma Ltd. exposure profile on grids 0, 1, and 2.

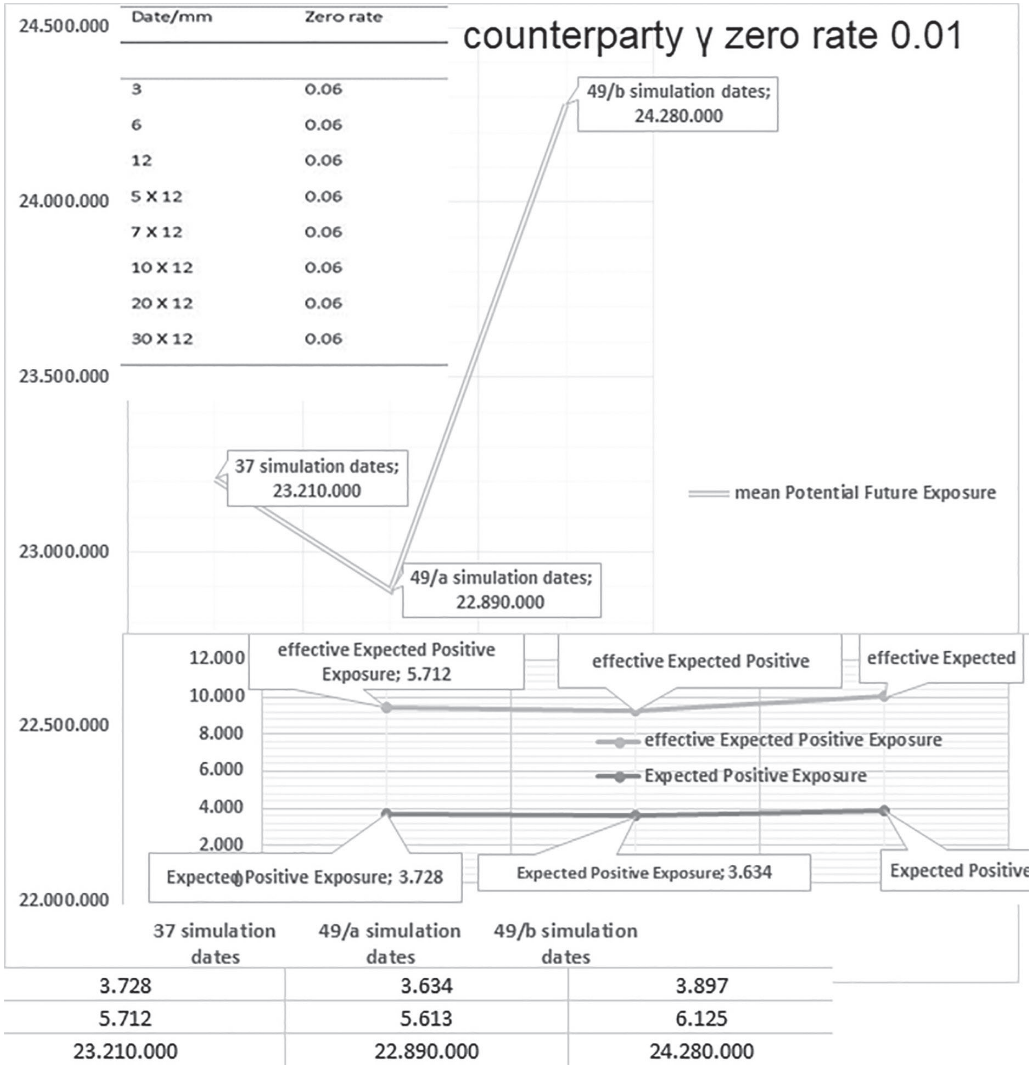

FIGURE 6.13 Counterparty Gamma Ltd. exposure profile data evaluated on grids 0, 1, and 2.

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CHAPTER 7

First Quantitative Analysis of Portfolio Exposure Profiles

7.1 INTRODUCTION TO THE FIRST ANALYSIS

From the results of Figure 6.2, and the related data evaluated from Expected Positive Exposure (EPE) and max Positive Future Exposure (max PFE) and effective EPE (Eff. EPE), we notice some peaks towards the end of the grid for certain counterparties. These peaks are linked to the long distance between time steps. Although the Mark to Future may seem to improve, in reality, because of the long distance, the exposure may appear incorrectly because they are mainly collateralized counterparties.

The denser grids allow us to notice more irregular profiles, different payment frequencies on the two legs of the swaps. However, these phenomena tend to have a minor impact. A denser grid, which also affects the short term, allows for a better representation of the Eff. EPE. In some cases, a denser grid also allows for a better representation in the medium term.

If we look closely at the curves generated, we can state that a greater number of peaks imply better representation. A higher number of intercepted peaks would indicate a better curve. A variation in the portfolio has an impact on the Eff. EPE; therefore, if a peak is observed, it means that the grid used is of higher quality.

Density is an important aspect in the distribution of time steps; however, this density must be dependent on time. The number of time steps must be greater in the short term, average in the medium term, and lower in the long term. In the long term, it is important to ensure that certain risk factors do not produce unwanted results during the later days of observation. To eliminate these unwanted results in the long term, the grid would need to be denser, but with a decreasing distribution of time steps over time.

To support the observations, we have made in the first section, let us now analyze the impact of switching from grid 0 to grids with a higher number of dates, taking into consideration two different ways of increasing density: the short term and the long term. From our graphs of the risk measures of the portfolio and of the counterparties, we can deduce that the peaks, which provide a greater contribution towards identifying these measures, are all generated in the short term. Moreover, we must also highlight the importance of inserting certain dates on the simulation grid that correspond to the maturity of the instruments of the portfolio.

If we observe the further numerical analysis of grids 0, 1, and 2 on the six-swap portfolio, we can make further considerations on the strategy for increasing the density by monitoring the following relations of percentage change (Figure 7.1):

We can observe a positive percentage change of the EPE and Eff. EPE measurement when moving from grid 0 to grid 2, whereas a positive percentage change can be seen only for the max PFE when moving from grid 0 to grid 1 (Figures 7.2–7.4).

	Grid 0 VS δ1 * grid 1	Grid 0 VS δ2 * grid 2
EPE portf	δ1 = 0,990	δ2 = 1,024
Eff EPE portf	δ1 = 0,999	δ2 = 1,007
MPFE portf	δ1 = 1,039	δ2 = 0,995

FIGURE 7.1 Portfolio exposure profiles, grid 0 vs. grid 1, and grid 0 vs. grid 2.

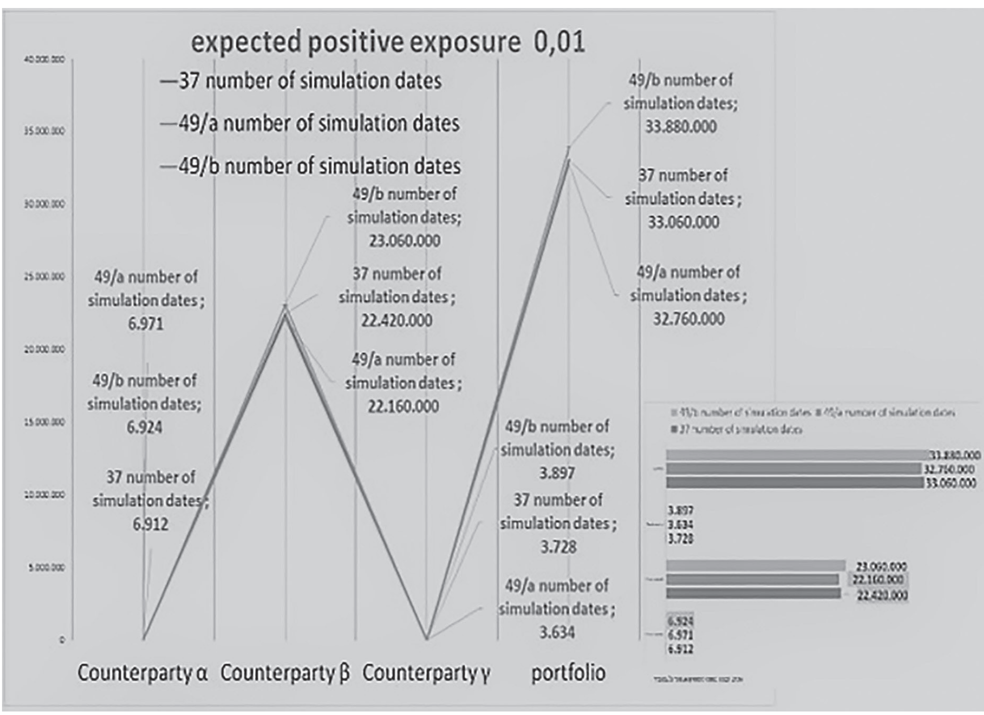

FIGURE 7.2 EPE 0.01 alpha, beta, gamma, portfolio exposure profiles, grid 0 vs. grid 1, and grid 0 vs. grid 2.

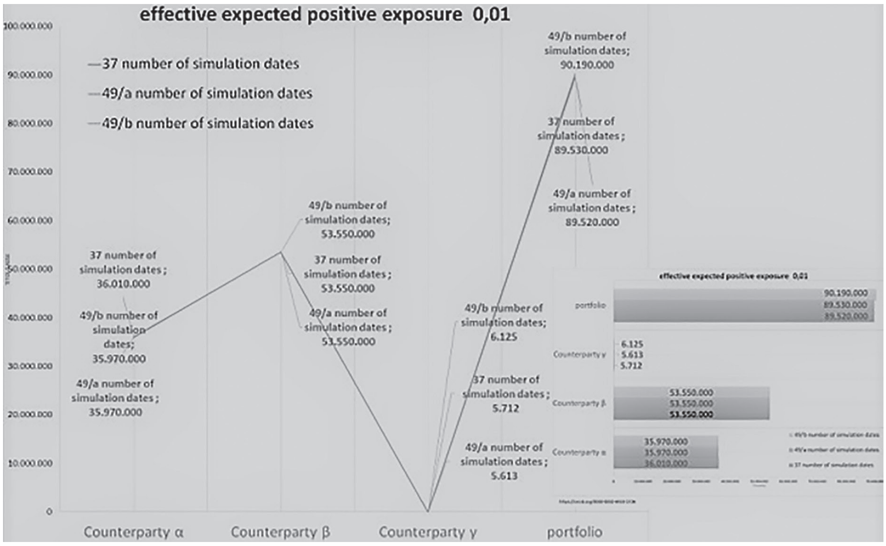

FIGURE 7.3 Eff. EPE 0.01 alpha, beta, gamma, portfolio exposure profiles, grid 0 vs. grid 1, and grid 0 vs. grid 2.

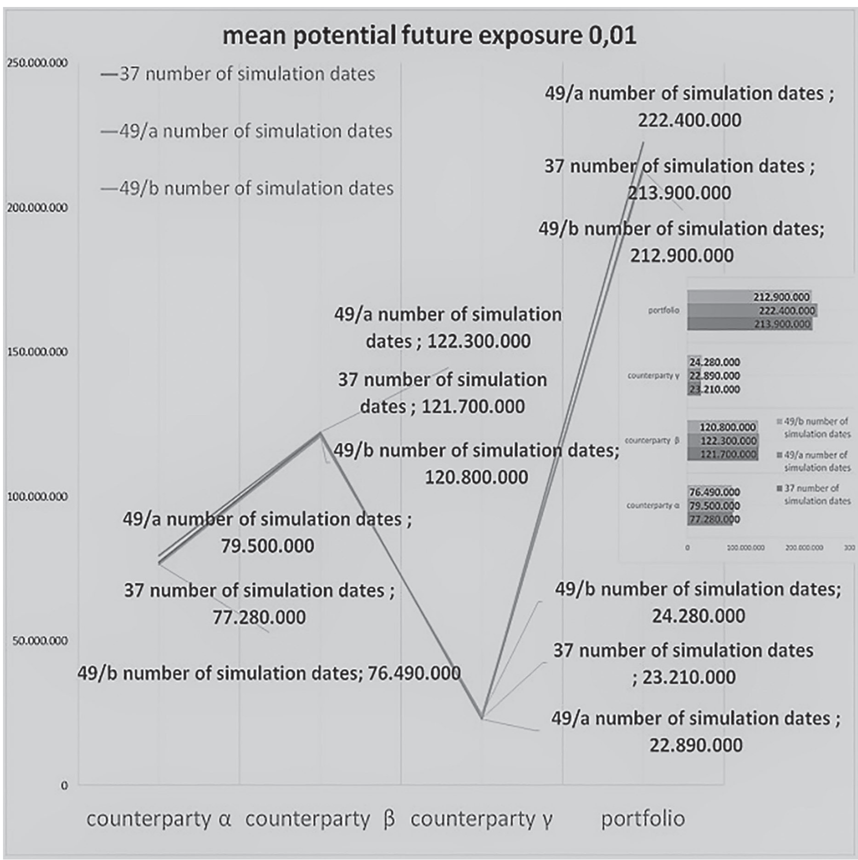

FIGURE 7.4 Mean Potential Future Exposure 0.01 alpha, beta, gamma, portfolio exposure profiles, grid 0 vs. grid 1, and grid 0 vs. grid 2.

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CHAPTER 8

Further Analysis on Portfolio Exposure Profiles Using Zero Rate Vector 0.03

8.1 PORTFOLIO EPE, PORTFOLIO EFF. EPE, AND PORTFOLIO MPFE USING ZERO RATE VECTOR 0.03

The portfolio used for this test is made up of six interest rate swaps. Let us take a closer look at the swaps belonging to this portfolio. The following numbers of set id = {1, 2, 3} correspond to counterparties Alpha Ltd., Beta Ltd., and Gamma Ltd, respectively.

The total number of scenarios to be generated was defined as $N = 1{,}000$. For this case study, we model the interest rate term structure using the one-factor Hull–White model, with $\alpha = 0.2$ and $\sigma = 0.015$ (Figure 8.1).

Figure 8.2 presents the data on portfolio Expected Positive Exposure (EPE), effective EPE (Eff. EPE), and Mean PFE profiles on grids 0, 1, and 2 using a zero rate vector value of 0.03.

Figure 8.3 gives the portfolio graphical representation of the portfolio EPE, Eff. EPE, and Mean PFE profiles on grids 0, 1, and 2. Finally the definition of the curve of portfolio,

Figure 8.4 shows how we define the curve of the portfolio EPE, Eff. EPE, and MPFE profiles on grids 0, 1, and 2 using a zero rate vector value of 0.03.

Figure 8.5 shows how we define the δ distance of portfolio EPE, Eff. EPE, and MPFE profiles on grids 0, 1, and 2 using a zero rate vector value of 0.03.

8.2 PORTFOLIO FOR COUNTERPARTIES ALPHA LTD., BETA LTD., AND DELTA LTD.: EPE, EFF. EPE, AND MPFE PROFILES USING A DIFFERENT ZERO RATE VECTOR 0.03

Figure 8.6 is a graphical representation of the portfolio EPE for counterparties Alpha Ltd., Beta Ltd., and Gamma Ltd. profiles on grids 0, 1, and 2 using the zero rate vector value of 0.03.

Date/mm	Zero rate
3	0.03
6	0.03
12	0.03
5 X 12	0.03
7 X 12	0.03
10 X 12	0.03
20 X 12	0.03
30 X 12	0.03

FIGURE 8.1 Definition of the test zero rate vector value of 0.03.

	Grid 0	Grid 1	Grid 2
EPEportf	111.800.000	111.400.000	112.400.000
EffEPEportf	380.100.000	380.100.000	380.100.000
MPFEportf	426.200.000	429.100.000	433.800.000

FIGURE 8.2 Definition of the data of portfolio EPE, Eff. EPE, and MPFE profiles on grids 0, 1, and 2.

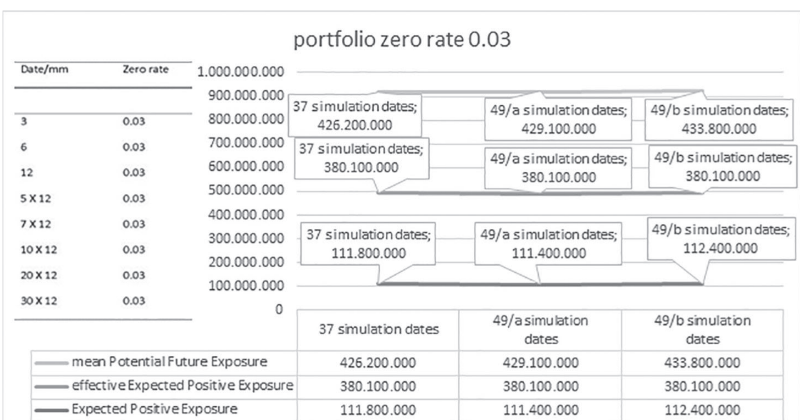

FIGURE 8.3 Definition of the graphical representation of portfolio EPE, Eff. EPE, and MPFE profiles on grids 0, 1, and 2.

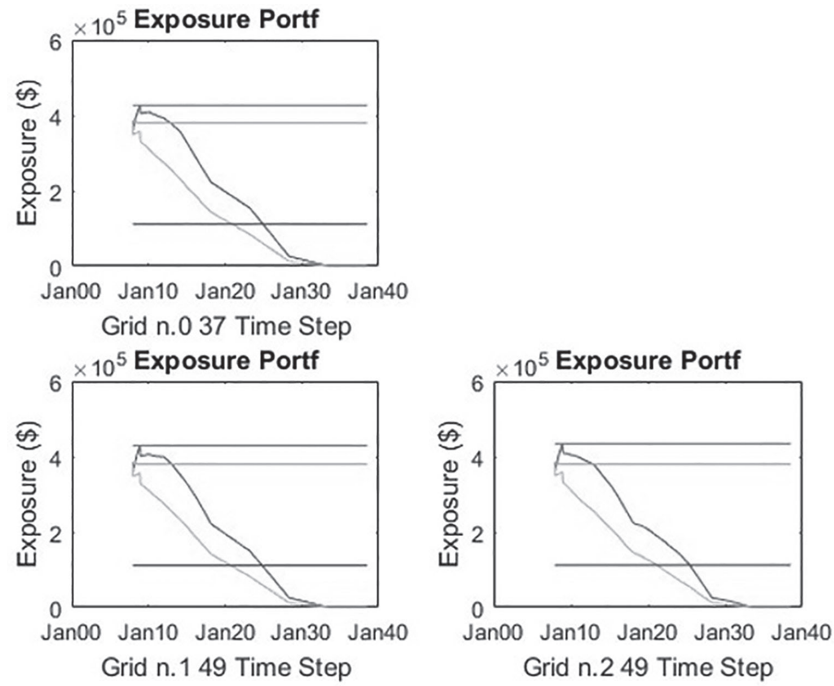

FIGURE 8.4 Definition of the curve of portfolio EPE, Eff. EPE, and MPFE profiles on grids 0, 1, and 2.

	Grid 0 VS δ1 * grid 1	Grid 0 VS δ2 * grid 2
EPE portfolio	δ1 = 0,996	δ2 = 1,005
Eff EPE portfolio	δ1 = 1	δ2 = 1
MPFE portfolio	δ1 = 1,006	δ2 = 1,017

FIGURE 8.5 Definition of the δ distance of portfolio EPE, Eff. EPE, and MPFE profiles on grids 0, 1, and 2.

Figure 8.7 is a graphical representation of the portfolio Eff. EPE for counterparties Alpha Ltd., Beta Ltd., and Gamma Ltd. profiles on grids 0, 1, and 2 using the zero rate vector value of 0.03.

Figure 8.8 is a graphical representation of the portfolio MPFE for counterparties Alpha Ltd., Beta Ltd., and Gamma Ltd. profiles on grids 0, 1, and 2 using the zero rate vector value of 0.03.

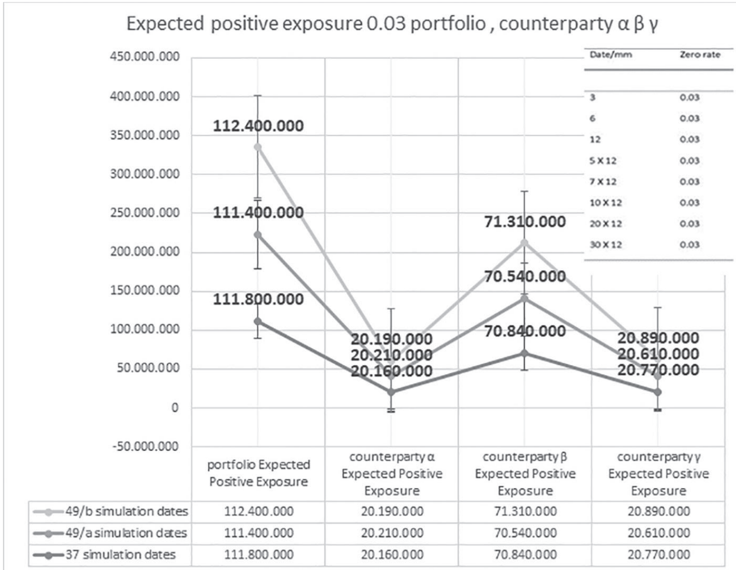

FIGURE 8.6 Definition of EPE for portfolio, counterparty Alpha Ltd.: EPE, Eff. EPE, and MPFE profiles on grids 0, 1, and 2.

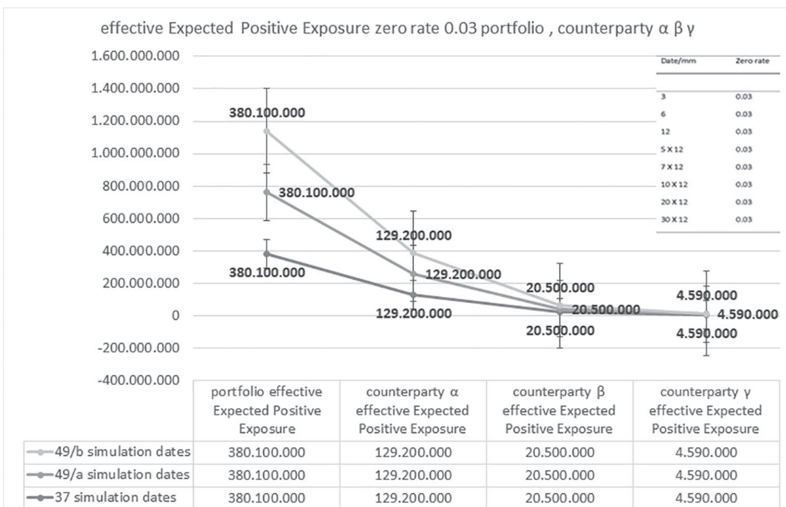

FIGURE 8.7 Definition of Eff. EPE for portfolio, counterparties Alpha Ltd., Beta Ltd., and Gamma Ltd. on grids 0, 1, and 2.

8.3 COUNTERPARTY ALPHA LTD.: EPE, EFF. EPE, AND MPFE PROFILES USING ZERO RATE VECTOR 0.03

For analysing the counterparty Alpha using the zero rate of 0.03, the following images are graphical representations.

Figure 8.9 shows a numerical representation for defining the data values of counterparty Alpha Ltd.: EPE, Eff. EPE, and MPFE profiles on grids 0, 1, and 2 using the zero rate vector value of 0.03.

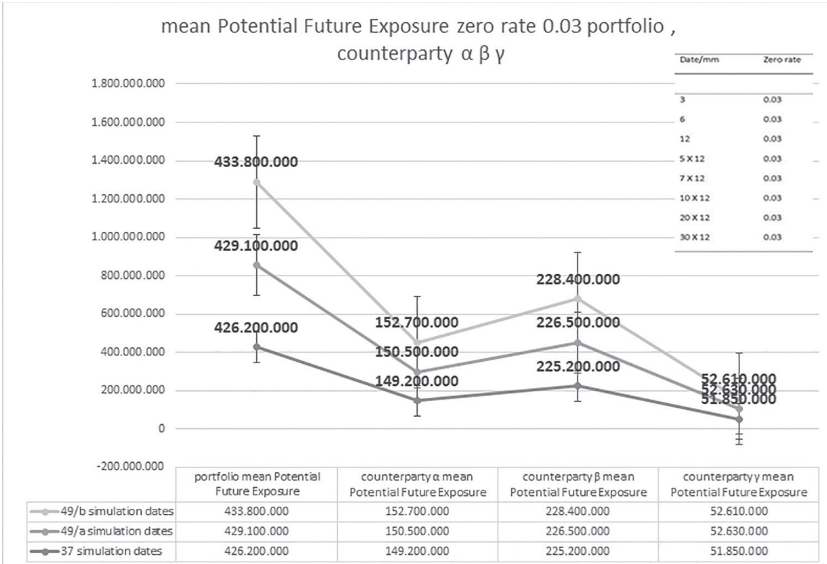

FIGURE 8.8 Definition of MPFE for portfolio, counterparties Alpha Ltd., Beta Ltd., and Gamma Ltd. profile on grids 0, 1, and 2.

	Grid 0	Grid 1	Grid 2
EPE alfa	20.160.000	20.210.000	20.190.000
EffEPE alfa	129.200.000	129.200.000	129.200.000
MPFE alfa	149.200.000	150.500.000	152.700.000

FIGURE 8.9 Data values of counterparty Alpha Ltd.: EPE, Eff. EPE, and MPFE profiles on grids 0, 1, and 2.

Figure 8.10 gives the graphical representation of counterparty Alpha Ltd.: EPE, Eff. EPE, and MPFE profiles on grids 0, 1, and 2 using a zero rate vector value of 0.03.

Figure 8.11 shows the curve of counterparty Alpha Ltd.: EPE, Eff. EPE, and MPFE profiles on grids 0, 1, and 2 using a zero rate vector value of 0.03.

Figure 8.12 shows the δ distance of counterparty Alpha Ltd.: EPE, Eff. EPE, and MPFE profiles on grid 0 vs. grid 1 and on grid 0 vs. grid 2.

8.4 COUNTERPARTY BETA LTD.: EPE, EFF. EPE, AND MPFE PROFILES USING ZERO RATE VECTOR 0.03

For analysing the counterparty Beta using the zero rate of 0.03, the following images are graphical representations. Regarding counterparty Beta Ltd.'s EPE, Eff. EPE, and MPFE.,

Figures 8.13 and 8.14 give the data values and graphical representations of profiles on grids 0, 1, and 2 using the zero rate vector value of 0.03, respectively.

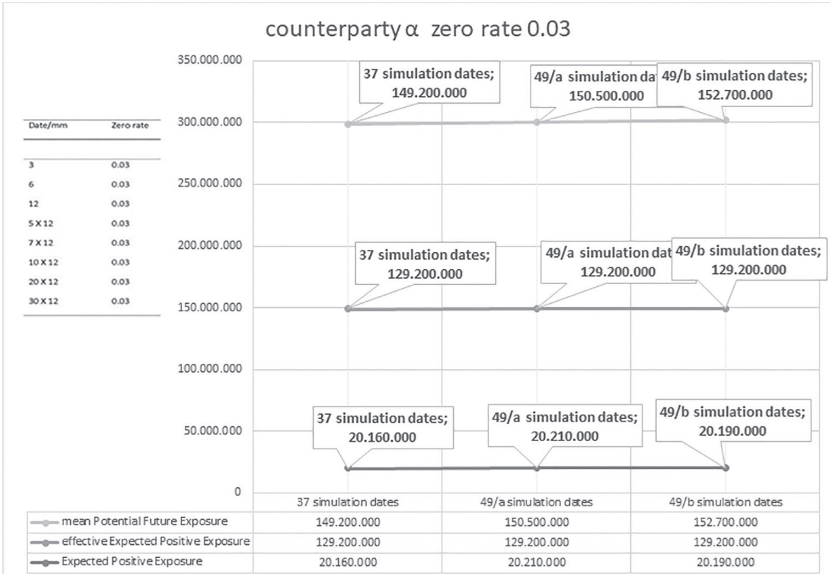

FIGURE 8.10 Graphical representation of counterparty Alpha Ltd.: EPE, Eff. EPE, and MPFE profiles on grids 0, 1, and 2.

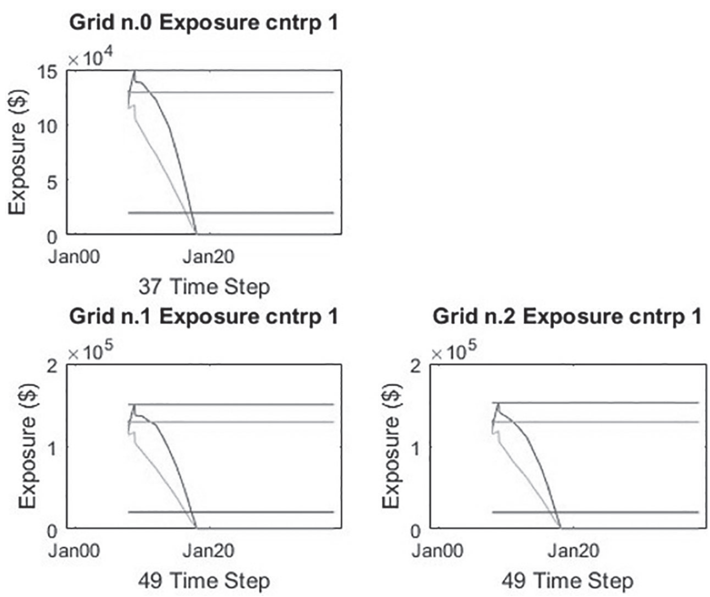

FIGURE 8.11 Curves of counterparty Alpha Ltd.: EPE, Eff. EPE, and MPFE profiles on grids 0, 1, and 2.

Figure 8.15 shows the curves of counterparty Beta Ltd.: EPE, Eff. EPE, and MPFE

Figure 8.16 presents the δ distance on grid 0 vs. grid 1 and on grid 0 vs. grid 2 using the zero rate value of 0.03.

	Grid 0 VS δ1 * grid 1	Grid 0 VS δ2 * grid 2
EPE alfa	δ1 = 1,002	δ2 = 1,001
Eff EPE alfa	δ1 = 1	δ2 = 1
MPFE alfa	δ1 = 1,008	δ2 = 1,023

FIGURE 8.12 δ distance of counterparty Alpha Ltd.: EPE, Eff. EPE, and MPFE profiles on grid 0 vs. grid 1 and on grid 0 vs. grid 2.

	Grid 0	Grid 1	Grid 2
EPE beta	70.840.000	70.540.000	71.310.000
EffEPE beta	20.500.000	20.500.000	20.500.000
MPFE beta	225.200.000	226.500.000	228.400.000

FIGURE 8.13 Data values of counterparty Beta Ltd.: EPE, Eff. EPE, and MPFE profiles on grids 0, 1, and 2.

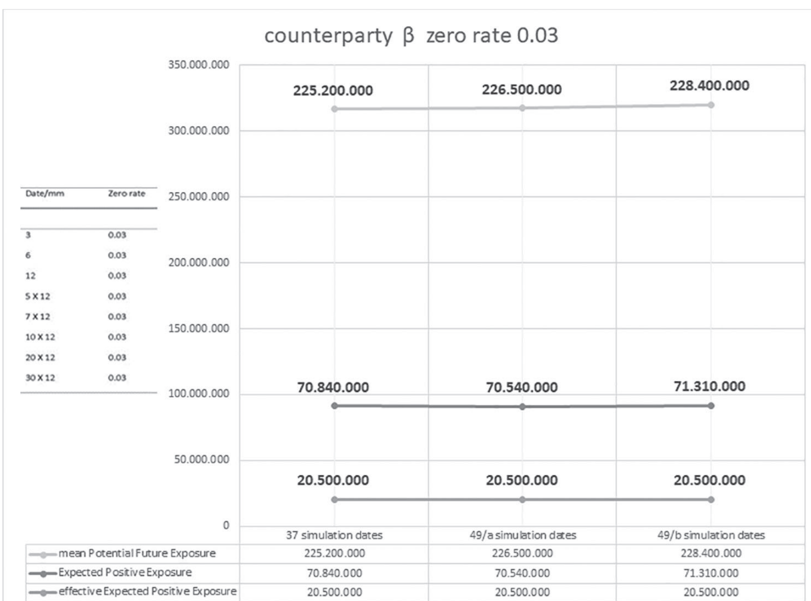

FIGURE 8.14 Graphical representation of counterparty Beta Ltd.: EPE, Eff. EPE, and MPFE profiles on grids 0, 1, and 2.

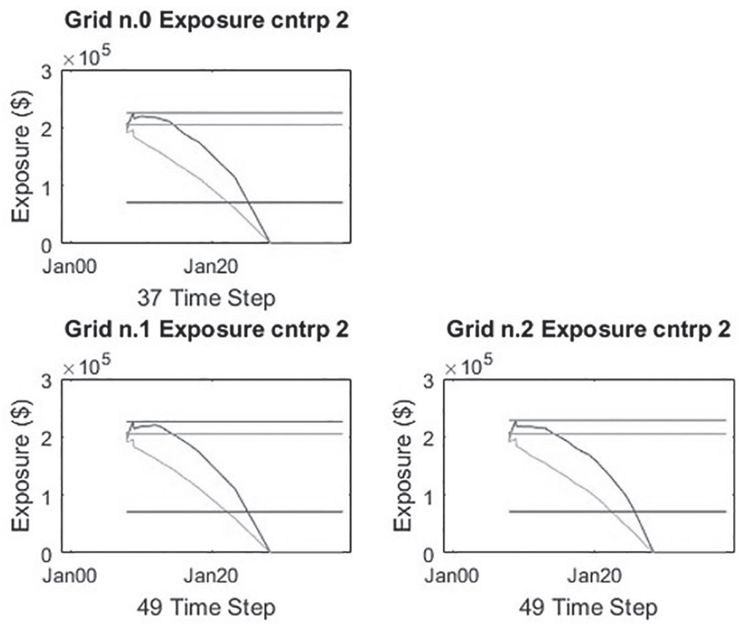

FIGURE 8.15 Curves of counterparty Beta Ltd.: EPE, Eff. EPE, and MPFE profiles on grids 0, 1, and 2.

	Grid 0 VS δ1 * grid 1	Grid 0 VS δ2 * grid 2
EPE beta	δ1 = 0,995	δ2 = 1,006
Eff EPE beta	δ1 = 1	δ2 = 1
MPFE beta	δ1 = 1,005	δ2 = 1,014

FIGURE 8.16 δ distance of counterparty Beta Ltd.: EPE, Eff. EPE, and MPFE profiles on grid 0 vs. grid 1 and on grid 0 vs. grid 2.

8.5 COUNTERPARTY GAMMA LTD.: EPE, EFF. EPE, AND MPFE PROFILES USING ZERO RATE VECTOR 0.03

Finally the Counterparty Gamma will be analysed. As for counterparty Gamma Ltd., the data values, graphical representation, and curve representation of EPE, Eff. EPE, and MPFE profiles on grids 0, 1, and 2 using the zero rate vector value of 0.03 are given in Figures 8.17–8.20, respectively.

Figure 8.20 shows the δ distance values on grid 0 vs. grid 1 and on grid 0 vs. grid 2 using a zero rate vector value of 0.03.

	Grid 0	Grid 1	Grid 2
EPE gamma	20.770.000	20.610.000	20.890.000
EffEPE gamma	4.590.000	4.590.000	4.590.000
MPFE gamma	51.850.000	52.630.000	52.610.000

FIGURE 8.17 Data values of counterparty Gamma Ltd.: EPE, Eff. EPE, and MPFE profiles on grids 0, 1, and 2.

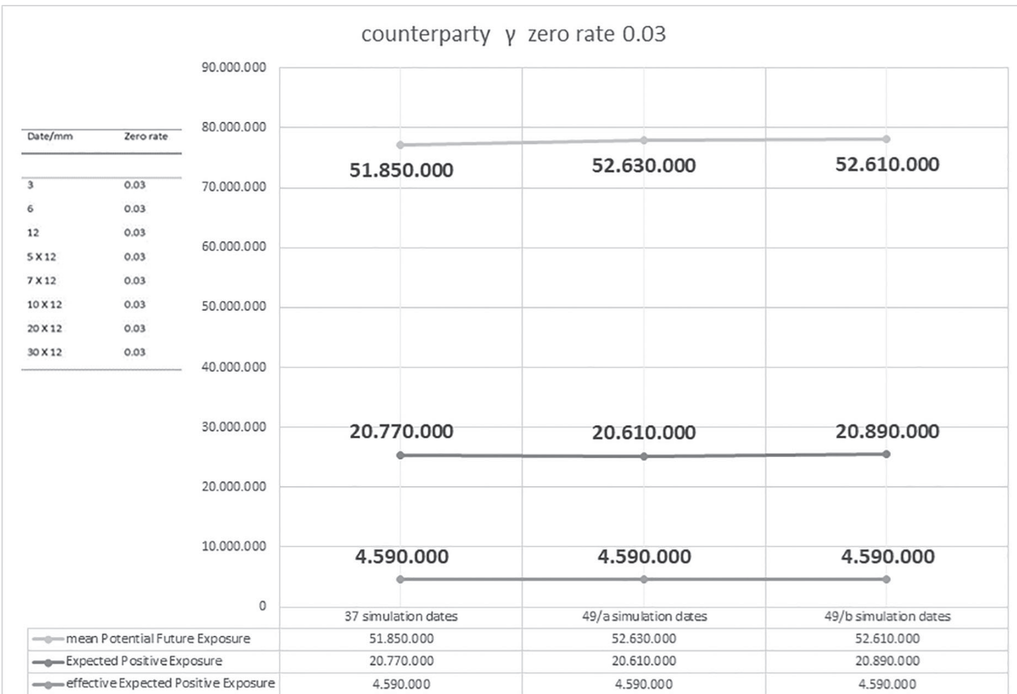

FIGURE 8.18 Graphical representation of counterparty Gamma Ltd.: EPE, Eff. EPE, and MPFE profiles on grids 0, 1, and 2.

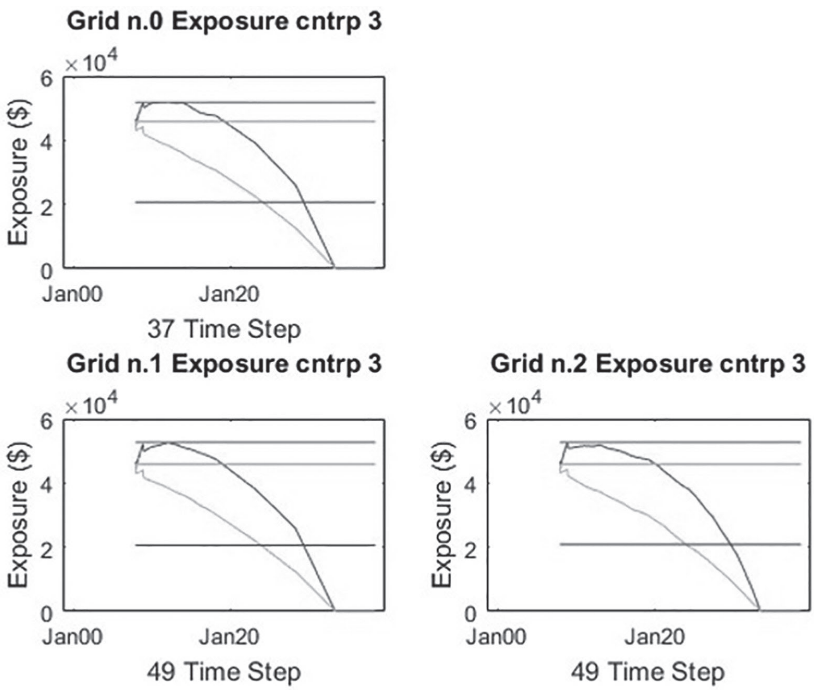

FIGURE 8.19 Curves of counterparty Gamma Ltd.: EPE, Eff. EPE, and MPFE profiles on grids 0, 1, and 2.

	Grid 0 VS δ1 * grid 1	Grid 0 VS δ2 * grid 2
EPE gamma	δ1 = 0,992	δ2 = 1,005
Eff EPE gamma	δ1 = 1	δ2 = 1
MPFE gamma	δ1 = 1,015	δ2 = 1,014

FIGURE 8.20 *δ* distance of counterparty Gamma Ltd.: EPE, Eff. EPE, and MPFE profiles on grid 0 vs. grid 1 and on grid 0 vs. grid 2.

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CHAPTER 9

Further Analysis of Portfolio Exposure Profiles with Zero Rate Vector 0.06

9.1 PORTFOLIO EPE PROFILES USING A DIFFERENT ZERO RATE VECTOR 0.06

The portfolio used for this test is made up of six interest rate swaps. Here we take a closer look at the swaps belonging to this portfolio. The following numbers of set id = {1, 2, 3} correspond to counterparties Alpha Ltd., Beta Ltd., and Gamma Ltd., respectively.

We defined the total number of scenarios to be generated as $N = 1{,}000$. For this case study, we model the interest rate term structure using the one-factor Hull–White model, with $\alpha = 0.2$ and $\sigma = 0.015$.

The zero rate vector is 0.06, as shown in Figure 9.1.

Date/mm	Zero rate
3	0.06
6	0.06
12	0.06
5 X 12	0.06
7 X 12	0.06
10 X 12	0.06
20 X 12	0.06
30 X 12	0.06

FIGURE 9.1 Test zero rate vector value of 0.06.

9.2 PORTFOLIO EPE, EFF. EPE, AND MPFE PROFILES USING ZERO RATE VECTOR 0.06

Figures 9.2–9.5 show the numerical, graphical, curve, and distance data representations, respectively, of portfolio Expected Positive Exposure (EPE), Effective EPE (Eff. EPE), and Mean PFE profiles using zero rate vector 0.06.

9.3 PORTFOLIO FOR COUNTERPARTY ALPHA ZERO RATE 0.06

Using the portfolio of counterparty Alpha Ltd.,

Figures 9.6–9.9 show the numerical, graphical, curve, and distance data representations, respectively, of portfolio EPE, Eff. EPE, and MPFE profiles using zero rate vector 0.06.

9.4 PORTFOLIO FOR COUNTERPARTY BETA ZERO RATE 0.06

Using the portfolio of counterparty Beta Ltd.,

Figures 9.10–9.13 show the numerical, graphical, curve, and distance data representations, respectively, of portfolio EPE, Eff. EPE, and MPFE profiles using zero rate vector 0.06.

	Grid 0	Grid 1	Grid 2
EPE	208.200.000	207.900.000	209.300.000
EffEPE	679.400.000	679.400.000	679.400.000
MPFE	688.900.000	690.700.000	693.800.000

FIGURE 9.2 Numerical representation of portfolio EPE, Eff. EPE, and MPFE profiles using zero rate vector 0.06.

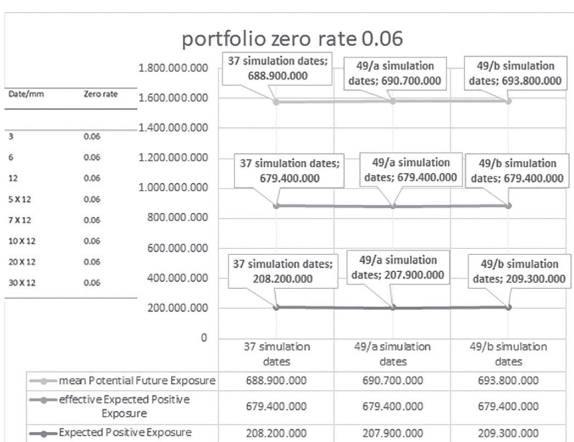


FIGURE 9.3 Graphical representation of portfolio EPE, Eff. EPE, and MPFE profiles using zero rate vector 0.06.

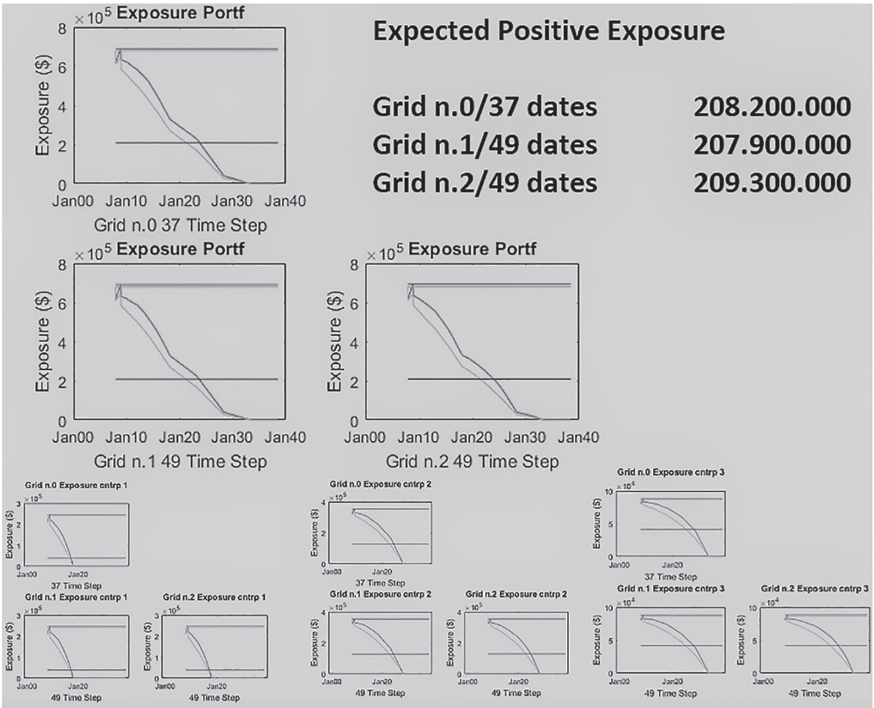


FIGURE 9.4 Curve representation of portfolio EPE, Eff. EPE, and MPFE profiles using zero rate vector 0.06.

	Grid 0 VS δ1 * grid 1	Grid 0 VS δ2 * grid 2
EPE portf	δ1 = 0,998	δ2 = 1,005
Eff EPE portf	δ1 = 1	δ2 = 1
MPFE portf	δ1 = 1,002	δ2 = 1,007

FIGURE 9.5 Distance data representation of portfolio EPE, Eff. EPE, and MPFE profiles using zero rate vector 0.06.

	Grid 0	Grid 1	Grid 2
EPE	38.620.000	38.690.000	38.640.000
EffEPE	241.700.000	241.700.000	241.700.000
MPFE	246.100.000	247.100.000	247.800.000

FIGURE 9.6 Numerical representation of Alpha Ltd.'s EPE, Eff. EPE, and MPFE profiles using zero rate vector 0.06.

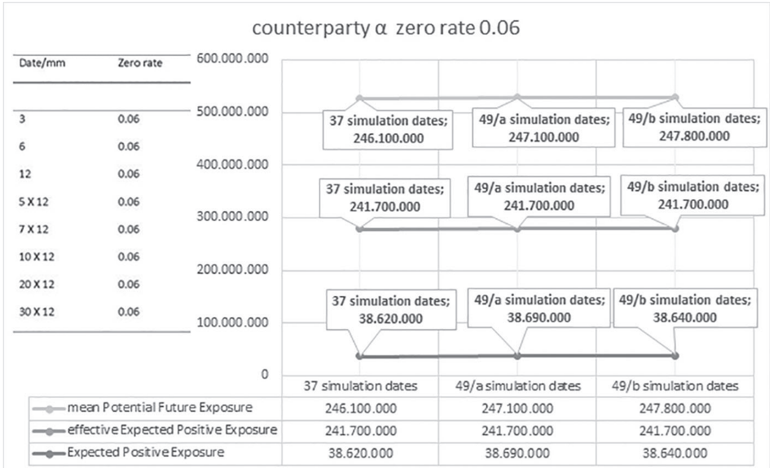


FIGURE 9.7 Graphical representation of Alpha Ltd.'s EPE, Eff. EPE, and MPFE profiles using zero rate vector 0.06.

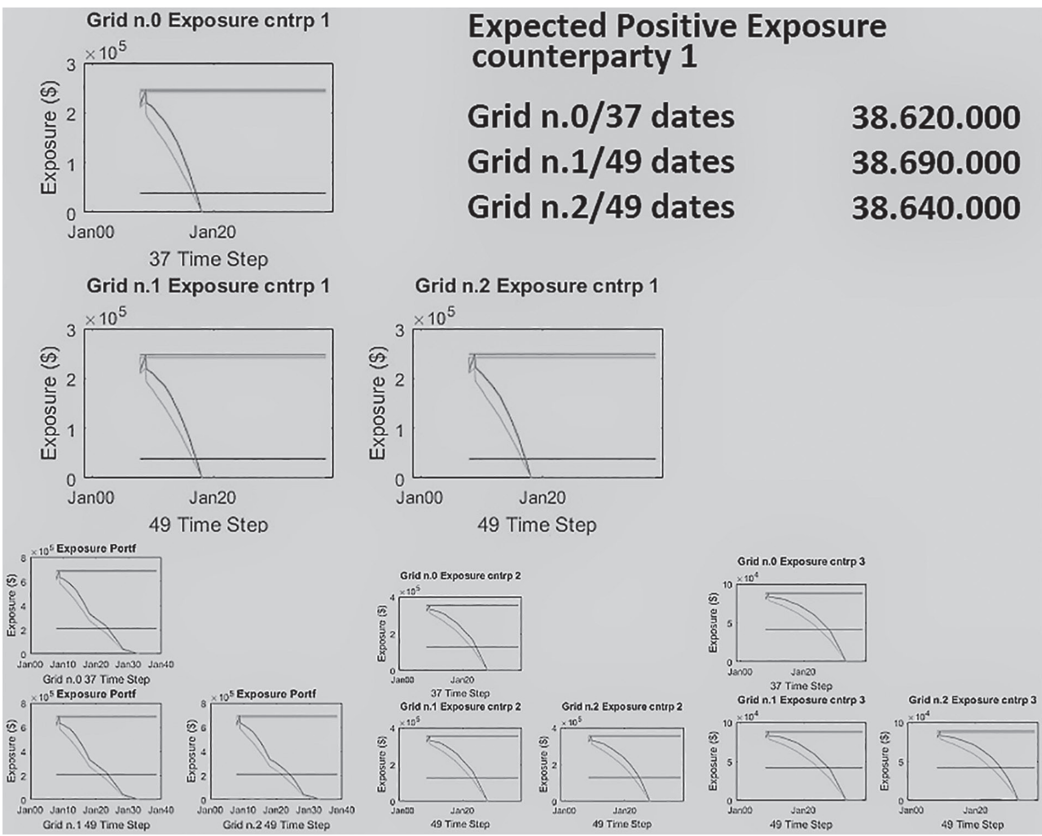


FIGURE 9.8 Curve representation of Alpha Ltd.'s EPE, Eff. EPE, and MPFE profiles using zero rate vector 0.06.

	Grid 0 VS δ1 * grid 1	Grid 0 VS δ2 * grid 2
EPE	δ1 = 1,001	δ2 = 1,000
Eff EPE	δ1 = 1	δ2 = 1
MPFE	δ1 = 1,004	δ2 = 1,006

FIGURE 9.9 Distance data representation of Alpha Ltd.'s EPE, Eff. EPE, and MPFE profiles using zero rate vector 0.06.

	Grid 0	Grid 1	Grid 2
EPE	127.900.000	127.600.000	128.700.000
EffEPE	350.800.000	350.800.000	350.800.000
MPFE	354.600.000	355.300.000	356.400.000

FIGURE 9.10 Numerical representation of Beta Ltd.'s EPE, Eff. EPE, and MPFE profiles using zero rate vector 0.06.

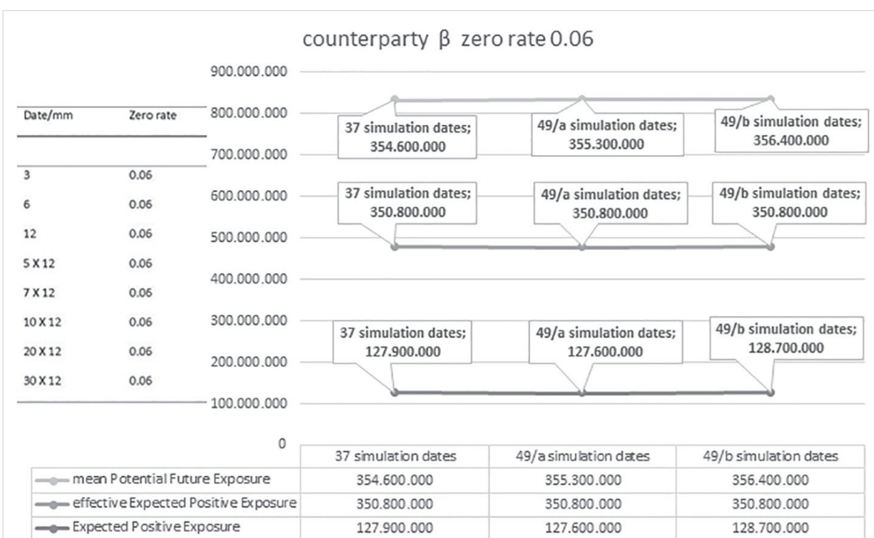


FIGURE 9.11 Graphical representation of Beta Ltd.'s EPE, Eff. EPE, and MPFE profiles using zero rate vector 0.06

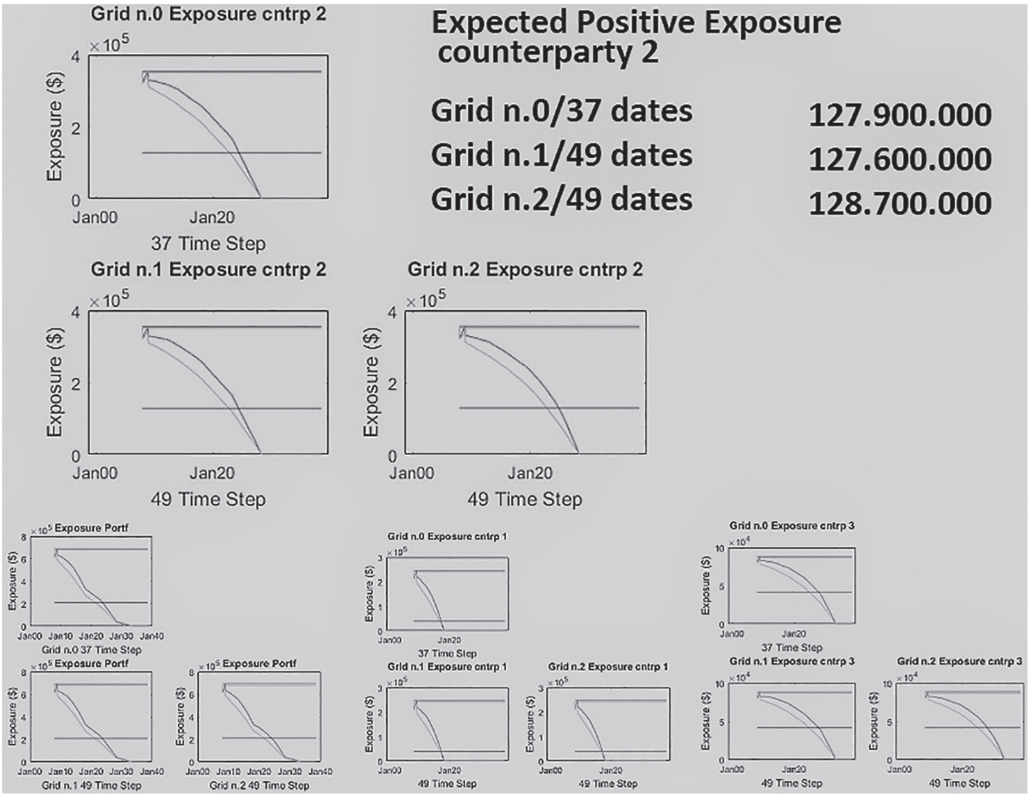


FIGURE 9.12 Curve representation of Beta Ltd.'s EPE, Eff. EPE, and MPFE profiles using zero rate vector 0.06.

	Grid 0 VS δ1 * grid 1	Grid 0 VS δ2 * grid 2
EPE	δ1 = 0,997	δ2 = 1,006
Eff EPE	δ1 = 1	δ2 = 1
MPFE	δ1 = 1,001	δ2 = 1,005

FIGURE 9.13 Distance data representation of Beta Ltd.'s EPE, Eff. EPE, and MPFE profiles using zero rate vector 0.06.

9.5 PORTFOLIO FOR COUNTERPARTY GAMMA ZERO RATE 0.06

Using the portfolio of counterparty Gamma Ltd.,

Figures 9.14–9.17 show the numerical, graphical, curve, and distance data representations, respectively, of portfolio EPE, Eff. EPE, and MPFE profiles using zero rate vector 0.06.

	Grid 0	Grid 1	Grid 2
EPE	41.690.000	41.560.000	41.900.000
EffEPE	86.860.000	86.860.000	86.860.000
MPFE	88.240.000	88.410.000	88.680.000

FIGURE 9.14 Numerical representation of Gamma Ltd.'s EPE, Eff. EPE, and MPFE profiles using zero rate vector 0.06.

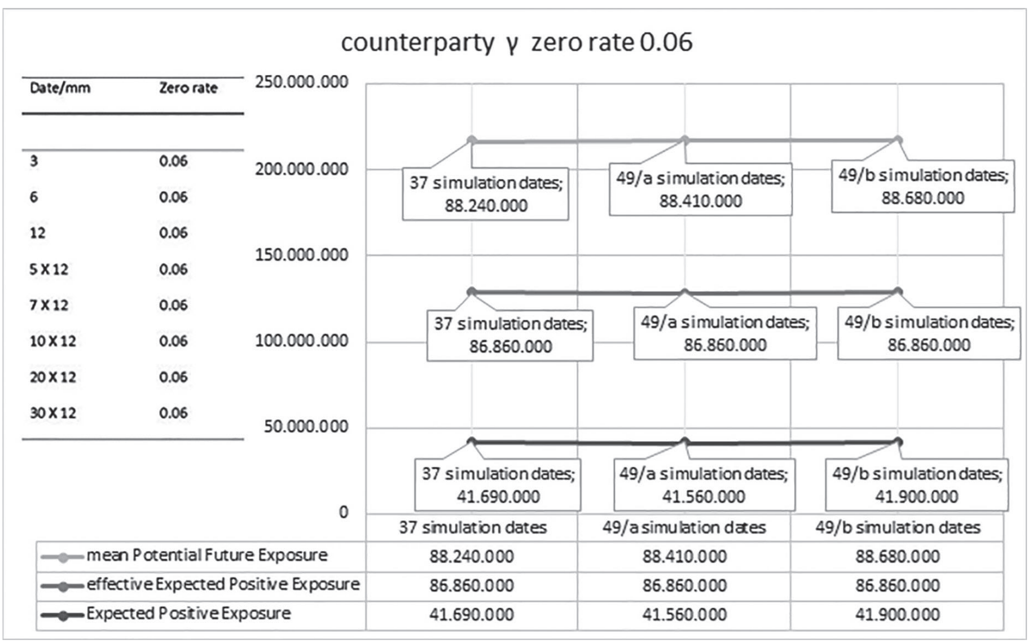


FIGURE 9.15 Graphical representation of Gamma Ltd.'s EPE, Eff. EPE, and MPFE profiles using zero rate vector 0.06.

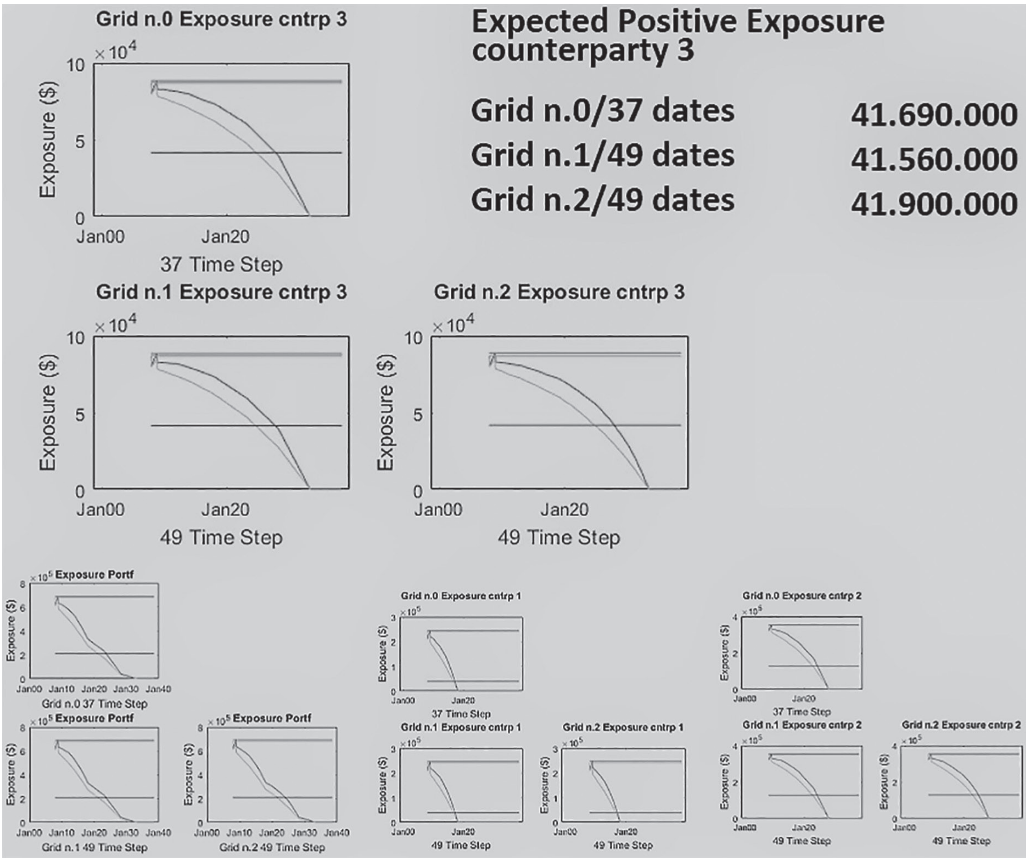


FIGURE 9.16 Curve representation of Gamma Ltd.'s EPE, Eff. EPE, and MPFE profiles using zero rate vector 0.06.

	Grid 0 VS δ1 * grid 1	Grid 0 VS δ2 * grid 2
EPE	δ1 = 0,996	δ2 = 1,005
Eff EPE	δ1 = 1	δ2 = 1
MPFE	δ1 = 1,001	δ2 = 1,004

FIGURE 9.17 Distance data representation of Gamma Ltd.'s EPE, Eff. EPE, and MPFE profiles using zero rate vector 0.06.

9.6 PORTFOLIO EPE, EFF. EPE, AND MPFE PROFILES USING A DIFFERENT ZERO RATE VECTOR 0.06

Figures 9.18–9.20 are graphical representations of EPE, Eff. EPE, and MPFE, respectively, for portfolios for the counterparties Alpha Ltd., Beta Ltd., and Gamma Ltd.

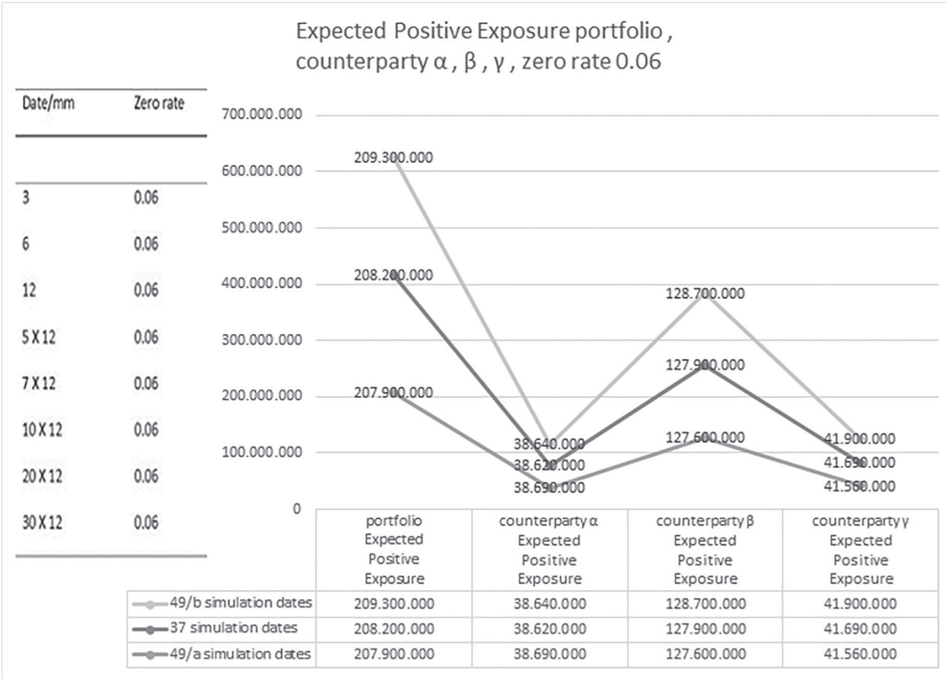


FIGURE 9.18 Graphical representation of portfolio EPE for counterparties Alpha Ltd., Beta Ltd., and Gamma Ltd. using zero rate vector 0.06.

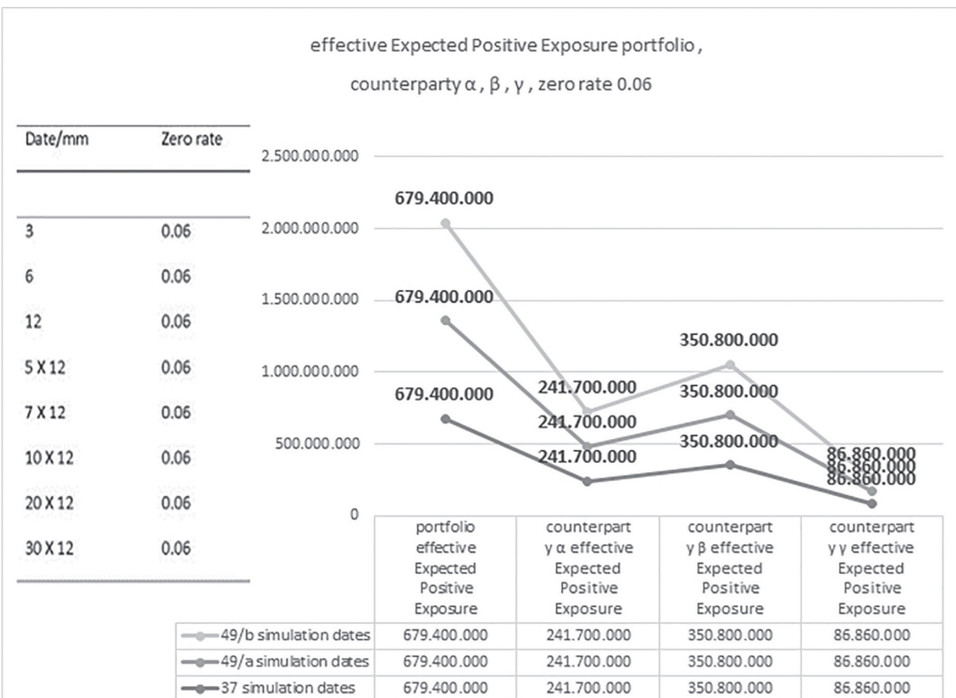
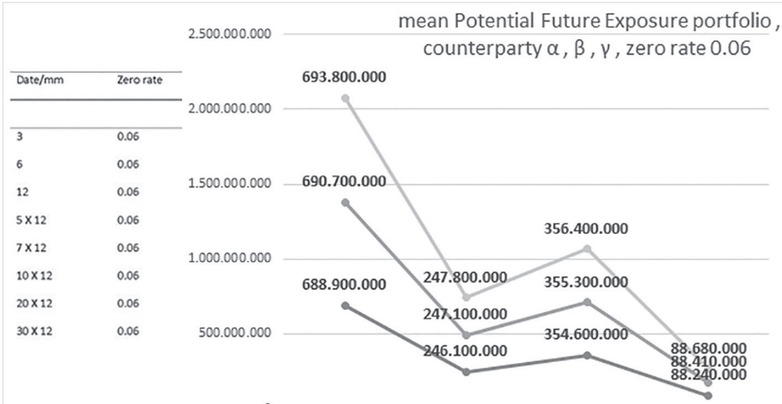


FIGURE 9.19 Graphical representation of portfolio Eff. EPE for counterparties Alpha Ltd., Beta Ltd., and Gamma Ltd. using zero rate vector 0.06.



	portfolio mean Potential Future Exposure	counterparty α mean Potential Future Exposure	counterparty β mean Potential Future Exposure	counterparty γ mean Potential Future Exposure
49/b simulation dates	693.800.000	247.800.000	356.400.000	88.680.000
49/a simulation dates	690.700.000	247.100.000	355.300.000	88.410.000
37 simulation dates	688.900.000	246.100.000	354.600.000	88.240.000

FIGURE 9.20 Graphical representation of portfolio MPFE for counterparties Alpha Ltd., Beta Ltd., and Gamma Ltd. using zero rate vector 0.06.

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Generalization of Analysis on Portfolio Exposure Profiles with Zero Rate Vectors 0.01, 0.03, and 0.06

10.1 ANALYSIS OF PREVIOUS GENERATED DATA

Observing the results of Figures 9.4, 9.8, 9.12, and 9.16, we notice some peaks towards the end of the grid for certain counterparties. These peaks are linked to the long distance between time steps. Although the Market to Future may seem to improve, in reality, because of the long distance, the exposure may appear incorrectly because they are mainly collateralized counterparties.

Denser grids allow us to notice more irregular profiles such as different payment frequencies on the two legs of the swaps. However, these phenomena have a minor impact.

If we look closely at the curves generated, we can state that a greater number of peaks imply better representation. The performances can be seen from the results shown in Figures 10.1 and 10.2.

	zero rate = 0.01 — δ1	zero rate = 0.03 — δ1	zero rate = 0.06 — δ1
EPE	↓	↓	↓
Eff EPE	↓	—	—
MPFE	↑	↑	↑

FIGURE 10.1 δ1 flow on different zero rate values.

Density is an important aspect in the distribution of time steps; however, this density must be dependent on time (Figures 10.3–10.5).

	zero rate = 0.01 — δ2	zero rate = 0.03 — δ2	zero rate = 0.06 — δ2
EPE	↑	↑	↑
Eff EPE	↑	—	—
MPFE	↓	↑	↑

FIGURE 10.2 δ2 flow on different zero rate values.

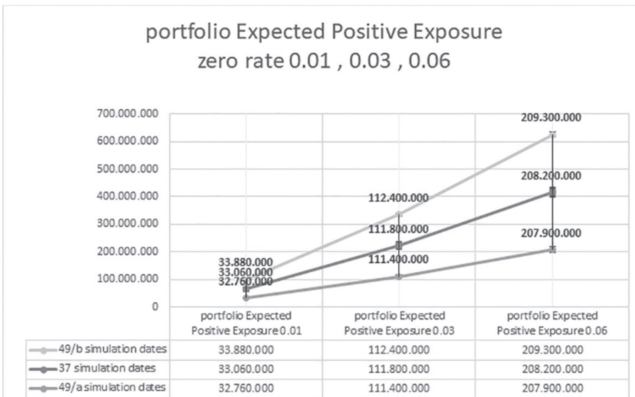

FIGURE 10.3 Portfolio Expected Positive Exposure (EPE) profiles on zero rate values 0.01, 0.03, and 0.06, grid 0 vs. grid 1, grid 0 vs. grid 2.

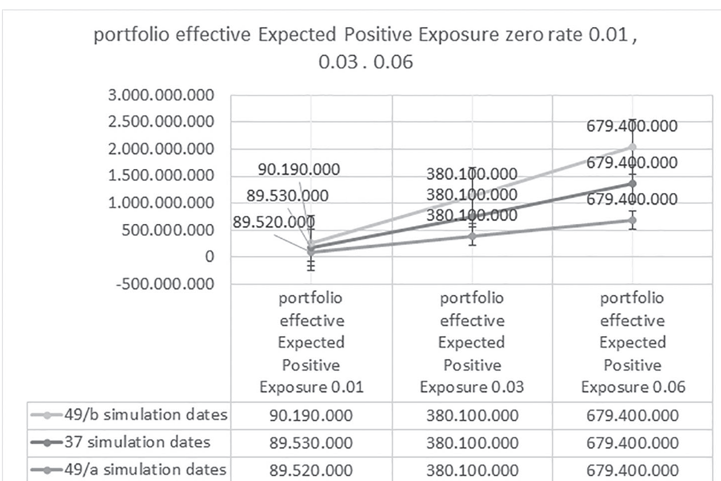

FIGURE 10.4 Portfolio Eff. EPE profiles on zero rate values 0.01, 0.03, and 0.06, grid 0 vs. grid 1, grid 0 vs. grid 2.

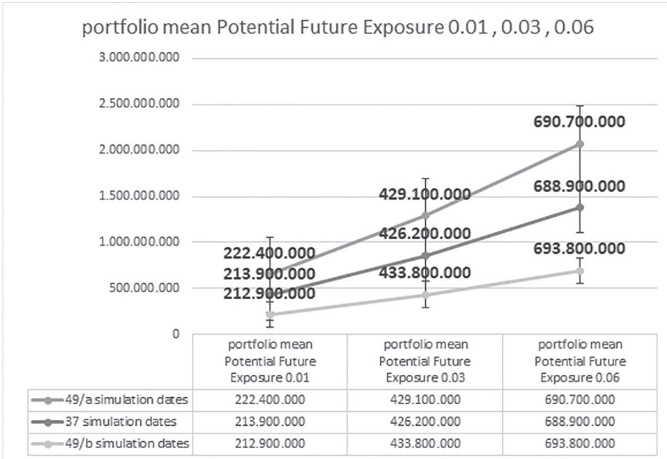

FIGURE 10.5 Portfolio Mean Potential Future Exposure (PFE) profiles on zero rate values 0.01, 0.03, and 0.06, grid 0 vs. grid 1, grid 0 vs. grid 2.

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CHAPTER 11

Risk Perspective of Credit Valuation Adjustment

11.1 DEFINITION OF THE START PORTFOLIO FOR CREDIT VALUATION ADJUSTMENT

In the previous expected exposure data generation of expected positive exposure, effective expected positive exposure, and mean potential future exposure values, we have used a zero curve composed of three fixed value cases, 0.01, 0.03, and 0.06, with 73 simulation dates.

In this base case study, we will use zero curves of 0.033, 0.034, 0.035, 0.040, 0.042, 0.044, 0.048, and 0.0475 for data generation for credit valuation adjustment (CVA).

The CVA data values generated are the result of these MATLAB distribution sets of simulation dates:

```
simulationDates = datemnth(Settle, 0:12)
simulationDates = [simulationDates datemnth(simulationDates(end),
3:3:74)]
```

This is the structure of the CVA test evaluation of the swap portfolio.

The previous counterparty credit risk case study is used in Chapters 8–12, and in this case study, the related example is evaluated and described (Table 11.1)

The results of this CVA evaluation using a 40% recovery rate are listed in Table 11.2.

TABLE 11.1 First Swap

	Principal	Maturity	Leg Type	Receiving Leg Rate	Paying Leg Rate	Latest Floating Rate	Period
Counterparty α	553,170.00	737,573.00	1.00	0.01	20.00	0.00	1.00
Counterparty β	470,680.00	737,573.00	0.00	40.00	0.01	0.00	1.00
Counterparty γ	388,190.00	737,573.00	1.00	0.01	60.00	0.00	1.00

TABLE 11.2 CVA data generated of First Swap

	Recovery Rate (%)	**CVA**
Counterparty α	40	2,228.36
Counterparty β	40	2,487.60
Counterparty γ	40	920.39

TABLE 11.3 Second Swap

	Principal	**Maturity**	**Leg Type**	**Receiving Leg Rate**	**Paying Leg Rate**	**Latest Floating Rate**	**Period**
Counterparty α	553,170.00	737,573.00	1.00	0.01	20.00	0.00	1.00
Counterparty β	388,190.00	737,573.00	1.00	0.01	60.00	0.00	1.00
Counterparty γ	470,680.00	737,573.00	1.00	0.01	40.00	0.00	1.00

TABLE 11.4 CVA data generated of Second Swap

	Principal	**Maturity**	**Leg Type**	**Receive Leg Rate**	**Pay Leg Rate**	**Latest Floating Rate**	**Period**
Counterparty α	553,170.00	737,573.00	0.00	20.00	0.01	0.00	1.00
Counterparty β	470,680.00	737,573.00	0.00	40.00	0.01	0.00	1.00
Counterparty γ	388,190.00	737,573.00	0.00	60.00	0.01	0.00	1.00

I prefer to divide this CVA evaluation example into a further study using these two case representations, looking at the swap composition of our portfolio in this divided case study. Then, we have the following swap with a receiving leg rate of 0.01 (Table 11.3).

The second set of swap data is divided looking at a paying leg rate of 0.01 (Table 11.4).

11.2 REGULATORY RISK PERSPECTIVE OF CVA

The first definition of CVA was introduced in Basel III and issued in 2010. This study intends to give an overview of CVA valuation and an insight into some of the models for determining counterparty credit risk on market variables. We will introduce the mathematical formulas for CVA valuation and address their potential challenges and outcomes. The significant importance of the CVA valuation will be explained in detail using the previous swap portfolio and the related data valuation for expected exposure, looking at the CVA results, and finally finding the best suitable methods for efficient measurement. Of particular interest are the regulatory aspects of CVA and questions about the relation between the analytical and regulatory risk models.

With regard to credit-based Over the Counter (OTC) derivative contracts, CVA is important because the trades are made between two parties without any third-party supervision. In addition to the previous requirements, the CVA must cover the default risk of the counterparty in OTC derivatives. As a matter of fact, the importance of counterparty credit risk is not considered significant in the pre-crisis models. The post-crisis models, however, recognize the considerable need for an adjustment to the market valuation of the counterparty's transaction portfolio. In practice, this adjustment reflects the market value of the counterparty credit risk exposure to banks or other financial institutes.

Therefore, the so-called counterparty default risk needs to be adjusted to the default value in order to reflect the risk appropriately. This highlights the importance of introducing the CVA concept as a central role for credit risk measures. In other words, CVA is the market value of counterparty credit risk and depends on the counterparty credit spreads. More precisely, it demonstrates the difference between the risk-free value of a portfolio and the real market value taking the counterparty default risk into consideration. The model is defined as the difference between the value approach and the price approach to understand the risk model.

11.3 MATHEMATICAL RISK PERSPECTIVE OF CVA

From the mathematical perspective of the CVA flow and valuation, this valuation starts from the expected exposure and is first computed by a simulation of many future scenarios of the risk factors for the given contract or portfolio. The risk factors can be interest rates, but will differ based on the portfolio and can include Foreign exchange (FX) Market, rates, equity or commodity prices, or anything that will affect the market value of the contracts. We first obtain a set of simulated scenarios, and then the contract or portfolio is priced on a series of future dates for each scenario. The result is a matrix of the contract values. These prices are then converted into exposures that the bank might have in place as well as netting agreements. The contract values for each scenario are discounted to compute the discounted exposures. The discounted expected exposures can then be computed by a simple average of the discounted exposures at each simulation date. Finally, the counterparty default probabilities are typically derived from credit default swaps (CDSs) and market quotes. Then, the CVA for the counterparty can be computed according to the formula.

The CVA formula computes the unilateral CVA for a bank holding a portfolio of vanilla interest rate swaps with several counterparties. The related CVA is the expected loss on an OTC contract or portfolio of contracts due to counterparty default.

This example demonstrates a portfolio of vanilla interest-rate swaps with the goal of computing the CVA for a particular counterparty.

The CVA for a particular counterparty is defined as the sum over all points in time of the discounted expected exposure at each moment multiplied by the probability that the counterparty defaults at that moment, all multiplied by 1 minus the recovery rate.

The CVA formula is as follows:

$$\mathrm{CVA} = (1-R)\int_0^T \mathrm{discEE}(t)\, d\mathrm{PD}(t)$$

where R is the recovery rate, discEE is the discounted expected exposure at time t, and PD is the default probability distribution.

This assumes that the exposure is independent of default; there is no wrong-way risk. It also assumes that the exposures were obtained using risk-neutral probabilities. The integral is approximated with a finite sum over the valuation dates as follows:

TABLE 11.5 Swap number of simulation dates

	Start Date	+1 Day	+14 Days	+1 Month	+1 Year	+5 Years	# Dates
Simulation data used	21-Jan-2015	#10	#2	#11	#9	#4	37

$$\text{CVA}(\text{approx}) = (1 - R)\sum_{i=2}^{N}\text{discEE}(t_i)\big(\text{PD}(t_i) - \text{PD}(t_i - 1)\big)$$

where *t_1* is today's date, and *t_2*,..., *t_n* are the future valuation dates. We assume that the CDS information corresponds to the counterparty with index cpIdx.

11.4 FURTHER STUDY ON CVA USING THE PREVIOUS EXPECTED EXPOSURE DATA

The generated results of the previous expected positive exposure data value of 33,060,000 are obtained in the first case using the zero curve fixed value of 0.01 and 37 defined simulation dates listed in Table 11.5.

The upgrade of the CVA evaluation applied in this study would be the generation of CVA using the previously defined swap portfolio and the described list of 73 simulation dates using the fixed zero curves 0.01, 0.03, and 0.06.

Zero curve one = 0.01, 0.01, 0.01, 0.01, 0.01, 0.01, 0.01, 0.01;

Zero curve two = 0.03, 0.03, 0.03, 0.03, 0.03, 0.03, 0.03, 0.03;

Zero curve three = 0.06, 0.06, 0.06, 0.06, 0.06, 0.06, 0.06, 0.06;

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CHAPTER 12

Further Work

12.1 FURTHER WORK: DESCRIPTION AND EXPLANATION OF THE PROJECT

The preceding chapter contains a work that was published in the *Journal of Finance and Investment Analysis*. The present chapter contains a detailed description of the quantitative subject matter of credit risk measures. In previous chapters, we observed the variations on a swap vanilla portfolio. Here, we would like to propose further research on other swap vanilla, commodity, and equity portfolios, and to make an analysis of the differences between them.

12.2 BRIEF DESCRIPTION

All banks with an internal model are subject to controls by a regulator. In the case of Italy, the specific regulator is the Bank of Italy. Control by the regulator is aimed at verifying the risks to which each bank with an internal model is exposed. The objective of this research project is to identify credit risk guidelines for the achievement of a new internal model or for adapting an existing one. Research sources will come from directives from the Bank for International Settlements (BIS, http://www.bis.org). BIS proposes a set of guidelines that every Italian national bank under the control of the Bank of Italy should follow.

12.3 EXPLANATION OF THE PROJECT

This research project aims to identify a set of guidelines, from the regulator's point of view, that banks with an internal model should follow regarding credit risk, and the methodologies required to verify these guidelines within the internal model itself. Having identified the features that need verification and the method required for verifying them, this research project will then propose the corresponding guidelines. These measures will be generated using the parameters configured within the existing software used by banks with an internal model.

Here are some restrictions that we will be analysing in this project:

1. Definition of a suitable initial portfolio
2. Analysis on the inclusion of certain financial instruments, such as the following:
   a. Equity
   b. Commodity
   c. Interest rate swap (IRS)
3. Analysis of the percentage inclusion of certain financial instruments:
   d. 100% of equity
   e. 100% of commodity
   f. 100% of IRS
   g. x% of equity and (100-x)% of commodity
   h. x% of equity and (100-x)% of IRS
   i. x% of commodity and (100-x)% of IRS
   j. x% of equity, y% of commodity, and (100-x-y)% of IRS
4. Analysis of the lifespan of certain financial instruments:
   i. General lifespan of an IRS
   ii. Combination of expiration dates of different IRS in the same portfolio
5. Quantitative analysis of the procedures for generating risk measures
6. Analysis of the impact, similarities, and differences in portfolios:
   k. 100% of equity vs. 100% of commodity
   l. 100% of equity vs. 100% of IRS
   m. 100% of commodity vs. 100% of IRS
   n. x% of equity and y% of commodity vs. z% of equity and t% of IRS with changes in x, y, z, and t
   o. x% of equity and y% of commodity vs. z% of commodity and t% of IRS with changes in x, y, z, and t
   p. x% of commodity and y% of IRS vs. z% of equity and t% of IRS with changes in x, y, z, and t

12.4 PURPOSE OF THE RESEARCH PROJECT

This research project aims to define a set of guidelines in accordance with the specified restrictions found. The purpose of this research is to increase knowledge of general directives by BIS on internal models, with special reference to the Italian banking system. The concrete aim of this project is to highlight the characteristics necessary for creating new internal models or for adapting existing ones. The final objective of the research is to elaborate on the international directives on internal models to make them more specific to the Italian context.

12.5 STRUCTURE AND METHODOLOGY OF THE INVESTIGATION

The following credit risk measures are considered: Expected Positive Exposure (EPE), Effective Expected Positive Exposure (Eff. EPE), and Mean Potential Future Exposure (MPFE).

The investigation will be structured in a specific order to observe the values of these measures with variations in the structure of portfolios as described in detail in the guidelines proposed as purpose of this research.

To observe the effects and differences between the measures generated, various tests will be conducted. The method will be to perform repeated impact analyses of the test results. Testing will consist of generating the measures and then analysing them according to the restrictions that need to be respected. The analysis will highlight the differences. In identifying the guidelines through a study of BIS directives, we will undertake theoretical research. When testing these guidelines, we will use empirical research with a quantitative analysis to classify characteristics and explain our findings. The final part of the investigation will consist of a confrontational analysis between the regulatory measures generated and the ones that had been created previously.

12.6 REASONS FOR ADOPTING CERTAIN METHODOLOGIES INSTEAD OF OTHERS

This research project will consist both of a theoretical research methodology and an empirical one. The empirical research will be designed to analyse real-world numbers, to highlight the effects of various tests, in terms of percentages and well-defined values. The theoretical research will consist of an analysis of BIS's documents to identify the set of guidelines. The guidelines will derive from a theoretical study of international directives regarding internal models.

12.7 EMPHASIS ON THE RIGOUR REQUIRED FOR THE METHODOLOGY PROPOSED

Concerning the first part of the research project proposed, which corresponds to the theoretical research methodology, BIS's documents will be examined in a thorough manner.

In the second phase of the research project, we will be using an empirical research methodology. As we will be dealing with the results of the analysis of data generated from many tests with variable conditions, and depending on the restrictions that need to be verified, we will be producing rigorous results and forecasts with accurate quantitative figures. To adhere to the necessary methodological rigour, we note that an objective of the research project will be to refine the model through which regulatory data are generated according to the results obtained by the investigation carried out according to our methodology. In other words, with each analytical observation of the data generated, we will decide whether to continue in the same direction or to take a step back in case a shortcoming emerges in the strategy adopted. For example, if we label our model as prototype P1, by improvement, we intend the creation of an improved model P2, until we reach a model Pf that will be the prototype of the final model. The methodology will inevitably require repeated revisions of the steps necessary to generate and model procedural prototypes.

12.8 ORIGINALITY AND INNOVATION OF THE PROJECT

Original and innovative results of this research project will be reached as follows.

We will have found a series of guidelines for credit risk for Italian banks with an internal model.

The guidelines will be useful to direct and control the entire lifecycle of procedures for analysing credit risk. In the final phase of this research project, the numbers we analyse will be the measures of exposure. With the analysis of these measures, we will be able to provide information on the quality of the methodology for their generation. Moreover, should we find a characteristic that does not correspond to the guidelines, the model developed by this research project will be able to indicate the necessary steps for improving the expected results.

12.9 IMPORTANCE OF THE PROJECT

Presently, two banks in Italy have internal models: Banca Intesa Sanpaolo and UniCredit Bank. However, other banks will soon follow, and this possibility increases the importance of the present project for the management of credit risk through the creation of an ad hoc directive for the Italian context. This directive will have to be prepared carefully with all the necessary information required to manage the growth of internal models and also from the view of verifying their validity.

12.10 COMPLETION TIME

We believe that at least seven months will be required to identify and analyse all existing international directives concerning credit risk in internal models, for us to formulate a set of guidelines and the corresponding restrictions. At least three months will then be needed to analyse the existing internal models and then compile a systematic document. Finally, at least one month will be required to prepare an analytical summary of our conclusions. The following shows how we aim to allocate our activities.

12.11 FIRST PHASE

This phase includes the following:

- Identification of international directives concerning credit risk in internal models. This involves collecting all the documents from institutions and agencies that have dealt with this matter (e.g. BIS).

- Identification from a theoretical perspective of the elements in the documents studied that need to be elaborated upon with our research and drafting of a set of guidelines.
- Theoretical identification of the guidelines.
- Outline of the guidelines identified and the corresponding restrictions.

12.12 SECOND PHASE

This phase will involve the following:

- Analysis of the existing internal models according to the guidelines using empirical research.
- Analysis of internal models to verify the consistency of the restrictions. This operation will be carried out with an empirical approach based on testing.
- Summarization of all the results obtained from the empirical testing of the restrictions in a table.

12.13 THIRD PHASE

After identifying the guidelines, we will move on to the next and final phase: analytical description of the conclusions.

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CHAPTER 13

MATLAB Source Code Strategy and Analysis for Generation of Time Step Set of Data

13.1 PORTFOLIO EXPECTED EXPOSURE DATA GENERATED BY MATLAB

This is the complete source code used during the simulations. Our interest will be concentrated in the time step distribution related to the generation of the grid of dates related to the generation of risk measures in the dates chosen in the grid.

```
swapFile = 'swap-portfolio.xls';

swapData = dataset('XLSFile',swapFile,'Sheet','Swap Portfolio');

swaps = struct(...
    'Counterparty',[],...
    'NettingID',[],...
    'Principal',[],...
    'Maturity',[],...
    'LegRate',[],...
    'LegType',[],...
    'LatestFloatingRate',[],...
    'FloatingResetDates',[]);
swaps1 = struct(...
    'Counterparty',[],...
    'NettingID',[],...
    'Principal',[],...
    'Maturity',[],...
    'LegRate',[],...
    'LegType',[],...
```

```
    'LatestFloatingRate',[],...
    'FloatingResetDates',[]);

swaps2 = struct(...
    'Counterparty',[],...
    'NettingID',[],...
    'Principal',[],...
    'Maturity',[],...
    'LegRate',[],...
    'LegType',[],...
    'LatestFloatingRate',[],...
    'FloatingResetDates',[]);

swaps.Counterparty = swapData.CounterpartyID;
swaps.NettingID    = swapData.NettingID;
swaps.Principal    = swapData.Principal;
swaps.Maturity     = swapData.Maturity;
swaps.LegType      = [swapData.LegType ~swapData.LegType];

swaps.LegRate      = [swapData.LegRateReceiving swapData.
LegRatePaying];
swaps.LatestFloatingRate = swapData.LatestFloatingRate;
swaps.Period       = swapData.Period;
swaps.LegReset     = ones(size(swaps.LegType));

swaps1.Counterparty = swapData.CounterpartyID;
swaps1.NettingID    = swapData.NettingID;
swaps1.Principal    = swapData.Principal;
swaps1.Maturity     = swapData.Maturity;
swaps1.LegType      = [swapData.LegType ~swapData.LegType];

swaps1.LegRate      = [swapData.LegRateReceiving swapData.
                      LegRatePaying];
swaps1.LatestFloatingRate = swapData.LatestFloatingRate;
swaps1.Period       = swapData.Period;
swaps1.LegReset     = ones(size(swaps1.LegType));

swaps2.Counterparty = swapData.CounterpartyID;
swaps2.NettingID    = swapData.NettingID;
swaps2.Principal    = swapData.Principal;
swaps2.Maturity     = swapData.Maturity;
swaps2.LegType      = [swapData.LegType ~swapData.LegType];

swaps2.LegRate      = [swapData.LegRateReceiving swapData.
                      LegRatePaying];
swaps2.LatestFloatingRate = swapData.LatestFloatingRate;
swaps2.Period       = swapData.Period;
```

```
swaps2.LegReset     = ones(size(swaps2.LegType));

numSwaps = numel(swaps.Counterparty);
numSwaps1 = numel(swaps1.Counterparty);
numSwaps2 = numel(swaps2.Counterparty);

Settle   = datenum('14-Dec-2007');

Tenor  = [3 6 12 5*12 7*12 10*12 20*12 30*12]';

ZeroRates = [0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01]';
ZeroRates = [0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03]';
ZeroRates = [0.06 0.06 0.06 0.06 0.06 0.06 0.06 0.06]';

ZeroDates = datemnth(Settle,Tenor);

Compounding = 2;

Basis = 0;
RateSpec = intenvset('StartDates', Settle,'EndDates',
ZeroDates,...
    'Rates', ZeroRates,'Compounding',Compounding,'Basis',Basis);

figure;
plot(ZeroDates, ZeroRates, 'o-');
xlabel('Date');
datetick('keeplimits');
ylabel('Zero rate');
grid on;
title('Yield Curve at Settle Date');

numScenarios = 1000;
```

MATLAB row code time step test distribution

```
simulationDates = [
Settle;Settle+1;Settle+2;Settle+3;Settle+4;Settle+5;Settle+6;Settle
+7;Settle+8;Settle+9;Settle+10;...
    Settle+10+14;Settle+10+21;...
    Settle+10+21+31;Settle+10+21+31*2;Settle+10+21+31*3;Settle+10+
21+31*4;Settle+10+21+31*5;...
    Settle+10+21+31*6;Settle+10+21+31*7;Settle+10+21+31*8;Settle+
10+21+31*9;Settle+10+21+31*10;Settle+10+21+31*11;...
    Settle+31*12*2;Settle+31*12*3;Settle+31*12*4;Settle+31*12*5;
Settle+31*12*6;...
    Settle+31*12*7;Settle+31*12*8;Settle+31*12*9;Set
tle+31*12*10;...
```

```
    Settle+31*12*15;Settle+31*12*20;Settle+31*12*25;
Settle+31*12*30
];
AAA = datestr(simulationDates);
numDates = numel(simulationDates);
simulationDates1 = [
    Settle;Settle+1;Settle+2;Settle+3;Settle+4;Settle+5;Settle+6;
Settle+7;Settle+8;Settle+9;Settle+10;...
    Settle+11;Settle+12;Settle+13;Settle+14;Settle+15;
Settle+16;...
    Settle+18;Settle+19;Settle+20;Settle+21;Settle+22;
Settle+23;...
    Settle+10+14;Settle+10+21;...
    Settle+10+21+31;Settle+10+21+31*2;Settle+10+21+31*3;Settle+10+
21+31*4;Settle+10+21+31*5;...
    Settle+10+21+31*6;Settle+10+21+31*7;Settle+10+21+31*8;Settle+
10+21+31*9;Settle+10+21+31*10;Settle+10+21+31*11;...
    Settle+31*12*2;Settle+31*12*3;Settle+31*12*4;Settle+31*12*5;
Settle+31*12*6;...
    Settle+31*12*7;Settle+31*12*8;Settle+31*12*9;
Settle+31*12*10;...
    Settle+31*12*15;Settle+31*12*20;Settle+31*12*25;
Settle+31*12*30
];
BBB = datestr(simulationDates1);
numDates1 = numel(simulationDates1);
simulationDates2 = [
    Settle;Settle+1;Settle+2;Settle+3;Settle+4;Settle+5;Settle+6;
Settle+7;Settle+8;Settle+9;Settle+10;...
    Settle+10+14;Settle+10+21;...
    Settle+10+21+31;Settle+10+21+31*2;Settle+10+21+31*3;Settle+10+
21+31*4;Settle+10+21+31*5;...
    Settle+10+21+31*6;Settle+10+21+31*7;Settle+10+21+31*8;Settle+
10+21+31*9;Settle+10+21+31*10;Settle+10+21+31*11;...
    Settle+31*12*2;Settle+31*12*3;Settle+31*12*4;Settle+31*12*5;
Settle+31*12*6;...
    Settle+31*12*7;Settle+31*12*8;Settle+31*12*9;
Settle+31*12*10;...
    Settle+31*12*11;Settle+31*12*12;Settle+31*12*13;
Settle+31*12*14;...
    Settle+31*12*15;
    Settle+31*12*16;Settle+31*12*17;Settle+31*12*18;
Settle+31*12*19;...
    Settle+31*12*20;
    Settle+31*12*21;Settle+31*12*22;Settle+31*12*23;
Settle+31*12*24;...
    Settle+31*12*25;Settle+31*12*30
```

```
];
CCC = datestr(simulationDates2);
numDates2 = numel(simulationDates2);
```

End MATLAB row code time step test distribution

```
floatDates = cfdates(Settle-360,swaps.Maturity,swaps.Period);% 6 X
 13
floatDates1 = cfdates(Settle-360,swaps.Maturity,swaps.Period);% 6
 X 13
floatDates2 = cfdates(Settle-360,swaps.Maturity,swaps.Period);% 6
 X 13

swaps.FloatingResetDates = zeros(numSwaps,numDates);
swaps1.FloatingResetDates = zeros(numSwaps,numDates1);
swaps2.FloatingResetDates = zeros(numSwaps,numDates2);

for i = numDates:-1:1
    thisDate = simulationDates(i);
    floatDates(floatDates > thisDate) = 0;
    swaps.FloatingResetDates(:,i) = max(floatDates,[],2);
end

for i = numDates1:-1:1
    thisDate1 = simulationDates1(i);
    floatDates1(floatDates1 > thisDate1) = 0;
    swaps1.FloatingResetDates(:,i) = max(floatDates1,[],2);
end

for i = numDates2:-1:1
    thisDate2 = simulationDates2(i);
    floatDates2(floatDates2 > thisDate2) = 0;
    swaps2.FloatingResetDates(:,i) = max(floatDates2,[],2);
end

Alpha = 0.2;
Sigma = 0.015;

hw1 = HullWhite1F(RateSpec,Alpha,Sigma);

prevRNG = rng(0, 'twister');


dt = diff(yearfrac(Settle,simulationDates,1));
dt1 = diff(yearfrac(Settle,simulationDates1,1));
dt2 = diff(yearfrac(Settle,simulationDates2,1));
```

```
nPeriods = numel(dt);
nPeriods1 = numel(dt1);
nPeriods2 = numel(dt2);

scenarios = hw1.simTermStructs(nPeriods,'nTrials',numScenarios,'de
 ltaTime',dt);
scenarios1 = hw1.simTermStructs(nPeriods1,'nTrials',numScenarios,'
 deltaTime',dt1);
scenarios2 = hw1.simTermStructs(nPeriods2,'nTrials',numScenarios,'
 deltaTime',dt2);

rng(prevRNG);

dfactors = ones(numDates,numScenarios);
dfactors1 = ones(numDates1,numScenarios);
dfactors2 = ones(numDates2,numScenarios);

for i = 2:numDates
    tenorDates = datemnth(simulationDates(i-1),Tenor);
    rateAtNextSimDate = interp1(tenorDates,squeeze(scenario
s(i-1,:,:)),...
        simulationDates(i),'linear','extrap');
    % Compute D(t1,t2)
    dfactors(i,:) = zero2disc(rateAtNextSimDate,...
        repmat(simulationDates(i),1,numScenarios),simulationDate
s(i-1),-1,3);
end
for i = 2:numDates1
    tenorDates1 = datemnth(simulationDates1(i-1),Tenor);
    rateAtNextSimDate1 = interp1(tenorDates1,squeeze(scenarios
1(i-1,:,:)),...
        simulationDates1(i),'linear','extrap');

    dfactors1(i,:) = zero2disc(rateAtNextSimDate1,...
        repmat(simulationDates1(i),1,numScenarios),simulationDates
1(i-1),-1,3);
end
for i = 2:numDates2
    tenorDates2 = datemnth(simulationDates2(i-1),Tenor);
    rateAtNextSimDate2 = interp1(tenorDates2,squeeze(scenarios
2(i-1,:,:)),...
        simulationDates2(i),'linear','extrap');

    dfactors2(i,:) = zero2disc(rateAtNextSimDate2,...
        repmat(simulationDates2(i),1,numScenarios),simulationDates
2(i-1),-1,3);
end
```

```
dfactors = cumprod(dfactors,1);
dfactors1 = cumprod(dfactors1,1);
dfactors2 = cumprod(dfactors2,1);


i = 5;
figure;
subplot(2,2,1)
surf(Tenor, simulationDates, scenarios(:,:,i))
axis tight
datetick('y','mmmyy');
xlabel('Time');
ylabel('Grid n.0');
zlabel('Yield');
ax = gca;
ax.View = [-49 32];
title(sprintf('Grid n.0 49TS\n (%d)',i));

i = 5;

subplot(2,2,3)
surf(Tenor, simulationDates1, scenarios1(:,:,i))
axis tight
datetick('y','mmmyy');
xlabel('Time');
ylabel('Grid n.1');
zlabel('Yield');
ax = gca;
ax.View = [-49 32];
title(sprintf('Grid n.1 49TS\n (%d)',i));

i = 5;

subplot(2,2,4)
surf(Tenor, simulationDates2, scenarios2(:,:,i))
axis tight
datetick('y','mmmyy');
xlabel('Time');
ylabel('Grid n.2');
zlabel('Yield');
ax = gca;
ax.View = [-49 32];
title(sprintf('Grid n.2 49TS\n (%d)',i));

values = hcomputeMTMValues(swaps,simulationDates,scenarios,Tenor);
```

```
values1 = hcomputeMTMValues(swaps1,simulationDates1,scenarios1,Te
nor);
values2 = hcomputeMTMValues(swaps2,simulationDates2,scenarios2,Te
nor);

i = 5;
figure;
subplot(2,2,1)
plot(simulationDates, values(:,:,i));
datetick;
ylabel('MtM');
title(sprintf('Grid n.0 37TS\n Swap Price scen:(%d)\n', i));

i = 5;
subplot(2,2,3)
plot(simulationDates1, values1(:,:,i));
datetick;
ylabel('MtM');
title(sprintf('Grid n.1 49TS\n Swap Price scen:(%d)\n', i));

i = 5;
subplot(2,2,4)
plot(simulationDates2, values2(:,:,i));
datetick;
ylabel('MtM');
title(sprintf('Grid n.2 49TS\n Swap Price scen:(%d)\n', i));

totalPortValues = squeeze(sum(values, 2));
totalPortValues1 = squeeze(sum(values1, 2));
totalPortValues2 = squeeze(sum(values2, 2));

 [exposures, expcpty] = creditexposures(values,swaps.
Counterparty,...
    'NettingID',swaps.NettingID);
[exposures1, expcpty1] = creditexposures(values1,swaps1.
Counterparty,...
    'NettingID',swaps1.NettingID);
[exposures2, expcpty2] = creditexposures(values2,swaps2.
Counterparty,...
    'NettingID',swaps2.NettingID);

figure;
totalPortExposure = squeeze(sum(exposures,2));
totalPortExposure1 = squeeze(sum(exposures1,2));
totalPortExposure2 = squeeze(sum(exposures2,2));

subplot(2,2,1)
```

```
plot(simulationDates,totalPortExposure);
title('Grid n.0 37TS Exposure tot scen');
datetick('x','mmmyy')
ylabel('Exposure ($)')
xlabel('Grid n.0')

subplot(2,2,3)
plot(simulationDates1,totalPortExposure1);
title('Grid n.1 49TS Exposure tot scen');
datetick('x','mmmyy')
ylabel('Exposure ($)')
xlabel('Grid n.1')

subplot(2,2,4)
plot(simulationDates2,totalPortExposure2);
title('Grid n.2 49TS Exposure tot scen');
datetick('x','mmmyy')
ylabel('Exposure ($)')
xlabel('Grid n.2')

cpID = 1;

cpValues = squeeze(sum(values(:,swaps.Counterparty == cpID,:),2));
cpValues1 = squeeze(sum(values1(:,swaps1.Counterparty ==
cpID,:),2));
cpValues2 = squeeze(sum(values2(:,swaps2.Counterparty ==
cpID,:),2));

cpIdx = find(expcpty == cpID);

cpID = 2;

cpValues = squeeze(sum(values(:,swaps.Counterparty == cpID,:),2));
cpValues1 = squeeze(sum(values1(:,swaps1.Counterparty ==
cpID,:),2));
cpValues2 = squeeze(sum(values2(:,swaps2.Counterparty ==
cpID,:),2));

cpIdx = find(expcpty == cpID);

cpID = 3;

cpValues = squeeze(sum(values(:,swaps.Counterparty == cpID,:),2));
cpValues1 = squeeze(sum(values1(:,swaps1.Counterparty ==
cpID,:),2));
cpValues2 = squeeze(sum(values2(:,swaps2.Counterparty ==
cpID,:),2));
```

```
cpIdx = find(expcpty == cpID);

portExposures = sum(exposures,2);
portExposures1 = sum(exposures1,2);
portExposures2 = sum(exposures2,2);

cpProfiles   = exposureprofiles(simulationDates,exposures);
cpProfiles1   = exposureprofiles(simulationDates1,exposures1);
cpProfiles2   = exposureprofiles(simulationDates2,exposures2);

portProfiles = exposureprofiles(simulationDates,portExposures);
portProfiles1 = exposureprofiles(simulationDates1,portExposures1);
portProfiles2 = exposureprofiles(simulationDates2,portExposures2);

figure;

subplot(2,2,1)
plot(simulationDates,portProfiles.PFE,...
    simulationDates,portProfiles.MPFE * ones(numDates,1),...
    simulationDates,portProfiles.EE,...
    simulationDates,portProfiles.EPE * ones(numDates,1),...
    simulationDates,portProfiles.EffEE,...
    simulationDates,portProfiles.EffEPE * ones(numDates,1));

datetick('x','mmmyy')
title('Grid n.0 37TS Exposure Portf');
ylabel('Exposure ($)')
xlabel('Grid n.0')

subplot(2,2,3)
plot(simulationDates1,portProfiles1.PFE,...
    simulationDates1,portProfiles1.MPFE * ones(numDates1,1),...
    simulationDates1,portProfiles1.EE,...
    simulationDates1,portProfiles1.EPE * ones(numDates1,1),...
    simulationDates1,portProfiles1.EffEE,...
    simulationDates1,portProfiles1.EffEPE * ones(numDates1,1));

datetick('x','mmmyy')
title('Grid n.1 49TS Exposure Portf');
ylabel('Exposure ($)')
xlabel('Grid n.1')

subplot(2,2,4)
plot(simulationDates2,portProfiles2.PFE,...
    simulationDates2,portProfiles2.MPFE * ones(numDates2,1),...
    simulationDates2,portProfiles2.EE,...
```

```
    simulationDates2,portProfiles2.EPE * ones(numDates2,1),...
    simulationDates2,portProfiles2.EffEE,...
    simulationDates2,portProfiles2.EffEPE * ones(numDates2,1));

datetick('x','mmmyy')
title('Grid n.2 49TS Exposure Portf');
ylabel('Exposure ($)')
xlabel('Grid n.2')

cpIdx = find(expcpty == 1);

figure;
subplot(2,2,1)
plot(simulationDates,cpProfiles(cpIdx).PFE,...
    simulationDates,cpProfiles(cpIdx).MPFE * ones(numDates,1),...
    simulationDates,cpProfiles(cpIdx).EE,...
    simulationDates,cpProfiles(cpIdx).EPE * ones(numDates,1),...
    simulationDates,cpProfiles(cpIdx).EffEE,...
    simulationDates,cpProfiles(cpIdx).EffEPE * ones(numDates,1));

datetick('x','mmmyy','keeplimits')
title(sprintf('Grid n.0 37TS Exposure cntrp %d',cpIdx));
ylabel('Exposure ($)')
xlabel('Grid n.0')

subplot(2,2,3)
plot(simulationDates1,cpProfiles1(cpIdx).PFE,...
    simulationDates1,cpProfiles1(cpIdx).MPFE *
ones(numDates1,1),...
    simulationDates1,cpProfiles1(cpIdx).EE,...
    simulationDates1,cpProfiles1(cpIdx).EPE *
ones(numDates1,1),...
    simulationDates1,cpProfiles1(cpIdx).EffEE,...
    simulationDates1,cpProfiles1(cpIdx).EffEPE *
ones(numDates1,1));


datetick('x','mmmyy','keeplimits')
title(sprintf('Grid n.1 49TS Exposure cntrp %d',cpIdx));
ylabel('Exposure ($)')
xlabel('Grid n.1')

subplot(2,2,4)
plot(simulationDates2,cpProfiles2(cpIdx).PFE,...
    simulationDates2,cpProfiles2(cpIdx).MPFE *
ones(numDates2,1),...
    simulationDates2,cpProfiles2(cpIdx).EE,...
```

```
    simulationDates2,cpProfiles2(cpIdx).EPE *
ones(numDates2,1),...
    simulationDates2,cpProfiles2(cpIdx).EffEE,...
    simulationDates2,cpProfiles2(cpIdx).EffEPE *
ones(numDates2,1));

datetick('x','mmmyy','keeplimits')
title(sprintf('Grid n.2 49TS Exposure cntrp %d',cpIdx));
ylabel('Exposure ($)')
xlabel('Grid n.2')

cpIdx = find(expcpty == 2);
figure;

subplot(2,2,1)
plot(simulationDates,cpProfiles(cpIdx).PFE,...
    simulationDates,cpProfiles(cpIdx).MPFE * ones(numDates,1),...
    simulationDates,cpProfiles(cpIdx).EE,...
    simulationDates,cpProfiles(cpIdx).EPE * ones(numDates,1),...
    simulationDates,cpProfiles(cpIdx).EffEE,...
    simulationDates,cpProfiles(cpIdx).EffEPE * ones(numDates,1));


datetick('x','mmmyy','keeplimits')
title(sprintf('Grid n.0 37TS Exposure cntrp %d',cpIdx));
ylabel('Exposure ($)')
xlabel('Grid n.0')

subplot(2,2,3)
plot(simulationDates1,cpProfiles1(cpIdx).PFE,...
    simulationDates1,cpProfiles1(cpIdx).MPFE *
ones(numDates1,1),...
    simulationDates1,cpProfiles1(cpIdx).EE,...
    simulationDates1,cpProfiles1(cpIdx).EPE *
ones(numDates1,1),...
    simulationDates1,cpProfiles1(cpIdx).EffEE,...
    simulationDates1,cpProfiles1(cpIdx).EffEPE *
ones(numDates1,1));


datetick('x','mmmyy','keeplimits')
title(sprintf('Grid n.1 49TS Exposure cntrp %d',cpIdx));
ylabel('Exposure ($)')
xlabel('Grid n.1')

subplot(2,2,4)
plot(simulationDates2,cpProfiles2(cpIdx).PFE,...
```

```
    simulationDates2,cpProfiles2(cpIdx).MPFE *
ones(numDates2,1),...
    simulationDates2,cpProfiles2(cpIdx).EE,...
    simulationDates2,cpProfiles2(cpIdx).EPE *
ones(numDates2,1),...
    simulationDates2,cpProfiles2(cpIdx).EffEE,...
    simulationDates2,cpProfiles2(cpIdx).EffEPE *
ones(numDates2,1));


datetick('x','mmmyy','keeplimits')
title(sprintf('Grid n.2 49TS Exposure cntrp %d',cpIdx));
ylabel('Exposure ($)')
xlabel('Grid n.2')

cpIdx = find(expcpty == 3);
figure;

subplot(2,2,1)
plot(simulationDates,cpProfiles(cpIdx).PFE,...
    simulationDates,cpProfiles(cpIdx).MPFE * ones(numDates,1),...
    simulationDates,cpProfiles(cpIdx).EE,...
    simulationDates,cpProfiles(cpIdx).EPE * ones(numDates,1),...
    simulationDates,cpProfiles(cpIdx).EffEE,...
    simulationDates,cpProfiles(cpIdx).EffEPE * ones(numDates,1));


datetick('x','mmmyy','keeplimits')
title(sprintf('Grid n.0 37TS Exposure cntrp %d',cpIdx));
ylabel('Exposure ($)')
xlabel('Grid n.0')

subplot(2,2,3)
plot(simulationDates1,cpProfiles1(cpIdx).PFE,...
    simulationDates1,cpProfiles1(cpIdx).MPFE *
ones(numDates1,1),...
    simulationDates1,cpProfiles1(cpIdx).EE,...
    simulationDates1,cpProfiles1(cpIdx).EPE *
ones(numDates1,1),...
    simulationDates1,cpProfiles1(cpIdx).EffEE,...
    simulationDates1,cpProfiles1(cpIdx).EffEPE *
ones(numDates1,1));

datetick('x','mmmyy','keeplimits')
title(sprintf('Grid n.1 49TS Exposure cntrp %d',cpIdx));
ylabel('Exposure ($)')
xlabel('Grid n.1')
```

```
subplot(2,2,4)
plot(simulationDates2,cpProfiles2(cpIdx).PFE,...
    simulationDates2,cpProfiles2(cpIdx).MPFE *
ones(numDates2,1),...
    simulationDates2,cpProfiles2(cpIdx).EE,...
    simulationDates2,cpProfiles2(cpIdx).EPE *
ones(numDates2,1),...
    simulationDates2,cpProfiles2(cpIdx).EffEE,...
    simulationDates2,cpProfiles2(cpIdx).EffEPE *
ones(numDates2,1));
datetick('x','mmmyy','keeplimits')
title(sprintf('Grid n.2 49TS Exposure cntrp %d',cpIdx));
ylabel('Exposure ($)')
xlabel('Grid n.2')
```

13.2 DETAILED ANALYSIS OF THE PART OF SOURCE CODE FROM GRID NUMBER 0 TO GRID NUMBER 1

See Figure 13.1.

MATLAB test code grid number 0 time step 37

```
simulationDates =
[
Settle;...

Settle+1; Settle+2; Settle+3; Settle+4; Settle+5;...
Settle+6; Settle+7; Settle+8; Settle+9; Settle+10;...

Settle+10+7*2;Settle+10+7*3;...

Settle+10+21+31; Settle+10+21+31*2; Settle+10+21+31*3;
Settle+10+21+31*4; Settle+10+21+31*5;...
Settle+10+21+31*6; Settle+10+21+31*7; Settle+10+21+31*8;
Settle+10+21+31*9; Settle+10+21+31*10;...
Settle+10+21+31*11;...

Settle+31*12*2; Settle+31*12*3; Settle+31*12*4; Settle+31*12*5;
Settle+31*12*6; ...
Settle+31*12*7; Settle+31*12*8; Settle+31*12*9;
Settle+31*12*10;...
```

	Start date ----------	+1 day	+14 days	+1 month	+1 year	+5 years	# time step
Grid 0	1	10	2	11	9	4	37
Grid 1	1	22	2	11	9	4	49

FIGURE 13.1 Number of time step 37.

```
Settle+31*12*15; Settle+31*12*20; Settle+31*12*25;
Settle+31*12*30; ...

];
```

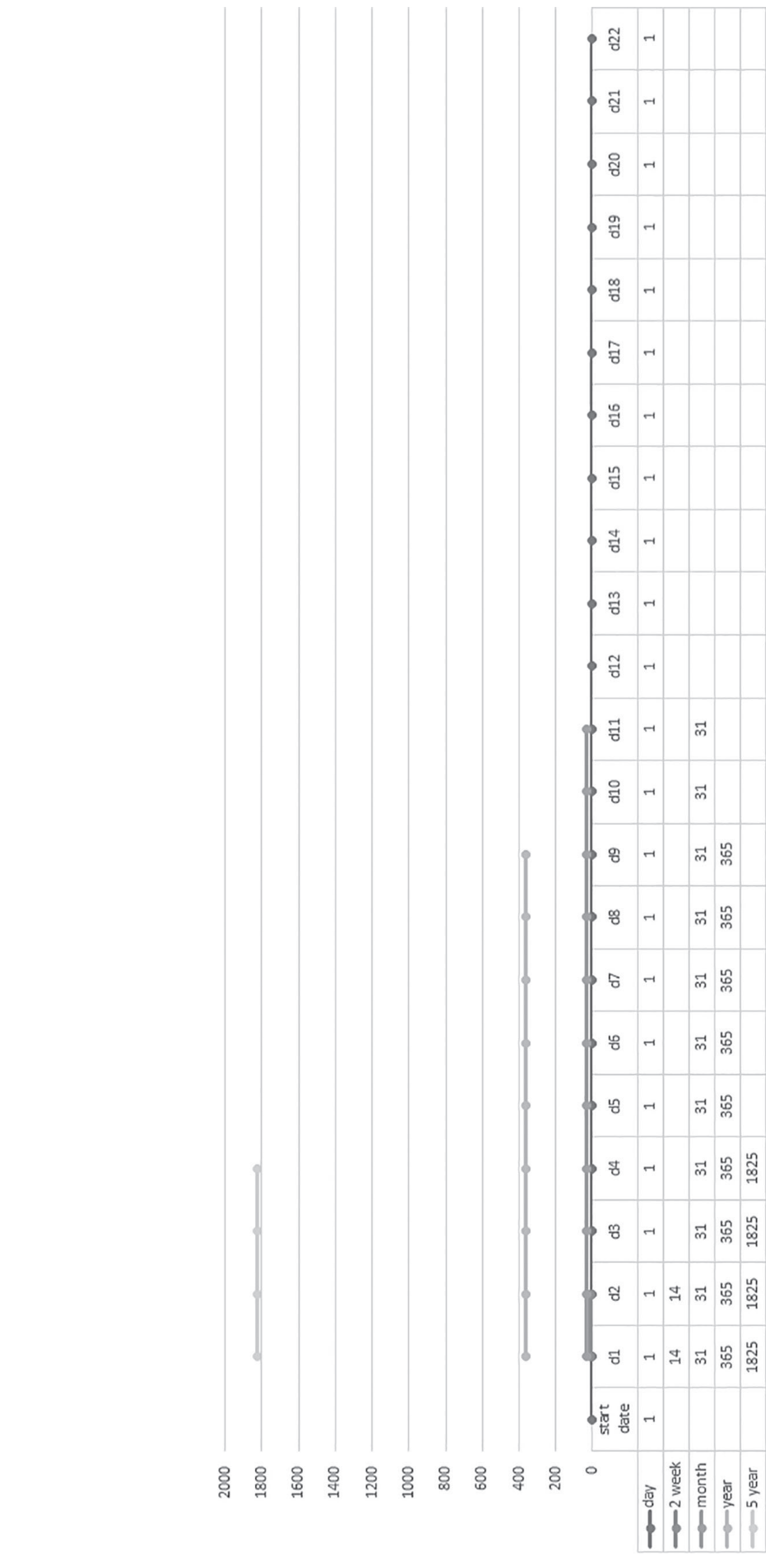
End MATLAB test code grid number 0 time step 37

MATLAB test code grid number 1 time step 49

```
simulationDates1 =
[
Settle;...

Settle+1; Settle+2; Settle+3; Settle+4; Settle+5;
Settle+6; Settle+7; Settle+8; Settle+9; Settle+10;...
Settle+11; Settle+12; Settle+13;Settle+14; Settle+15;...
Settle+16; Settle+17; Settle+18;Settle+19; Settle+20;...
Settle+21;Settle+22;...

Settle+10+7*2; Settle+10+7*3;...

Settle+10+21+31; Settle+10+21+31*2; Settle+10+21+31*3;...
Settle+10+21+31*4; Settle+10+21+31*5;...
Settle+10+21+31*6; Settle+10+21+31*7; Settle+10+21+31*8;...
Settle+10+21+31*9; Settle+10+21+31*10;...
Settle+10+21+31*11;...

Settle+10+21+31*11+365;  Settle+10+21+31*11+365*2;
Settle+10+21+31*11+365*3;  ….
Settle+10+21+31*11+365*4;  Settle+10+21+31*11+365*5;
Settle+10+21+31*11+365*6; ….
Settle+10+21+31*11+365*7;  Settle+10+21+31*11+365*8;
Settle+10+21+31*11+365*9; …

Settle+10+21+31*11+365*9+ 365*5; Settle+10+21+31*11+365*9+
365*15;…
Settle+10+21+31*11+365*9+ 365*20; Settle+10+21+31*11+365*9+
365*25;…

];
```

End MATLAB test code grid number 1 time step 49

See Figure 13.2.



	start date	d1	d2	d3	d4	d5	d6	d7	d8	d9	d10	d11	d12	d13	d14	d15	d16	d17	d18	d19	d20	d21	d22
day	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2 week		14	14																				
month		31	31	31	31	31	31	31	31	31	31	31											
year		365	365	365	365	365	365	365	365	365													
5 year		1825	1825	1825	1825																		

FIGURE 13.2 Number of time step 49.

13.3 DETAILED ANALYSIS OF THE PART OF SOURCE CODE FROM GRID NUMBER 0 TO GRID NUMBER 2

See Figure 13.3.

MATLAB source code grid number 2 time step 50

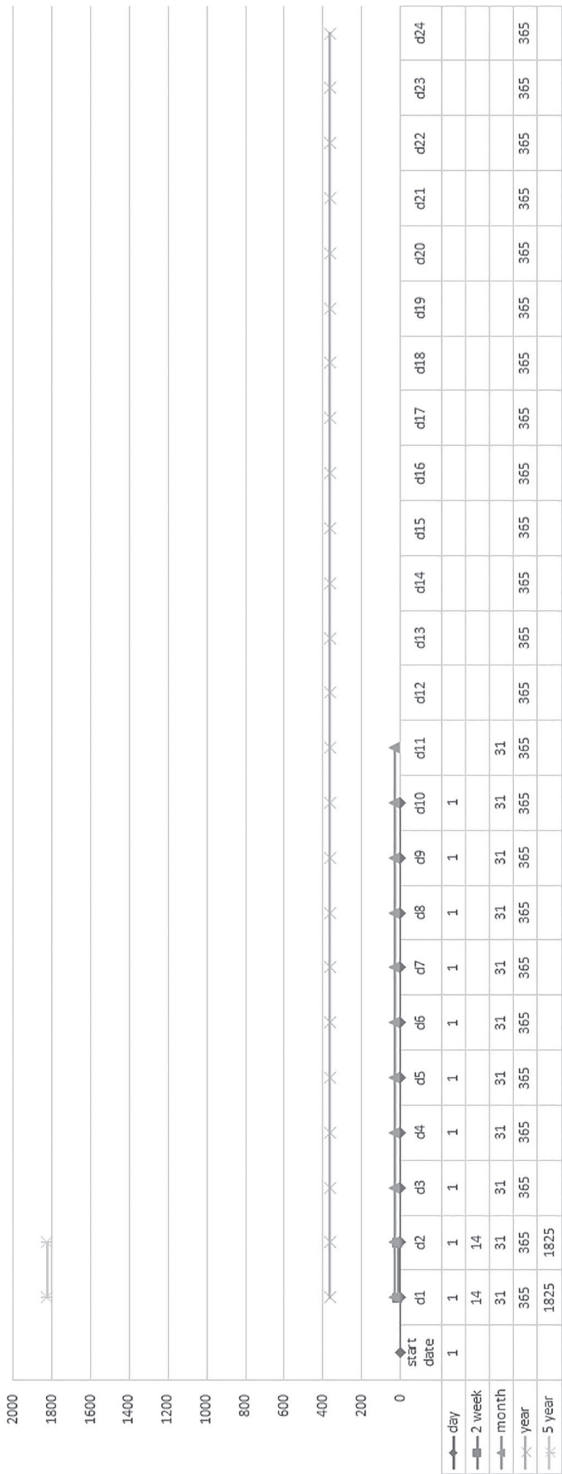
```
simulationDates2 =
[
Settle;...

Settle+1; Settle+2; Settle+3; Settle+4; Settle+5; Settle+6;
Settle+7; Settle+8; Settle+9; Settle+10;...

Settle+10+7*2; Settle+10+7*3;...

Settle+10+21+31; Settle+10+21+31*2; Settle+10+21+31*3;
Settle+10+21+31*4; Settle+10+21+31*5;...
Settle+10+21+31*6; Settle+10+21+31*7; Settle+10+21+31*8;
Settle+10+21+31*9; Settle+10+21+31*10;...
Settle+10+21+31*11;...

Settle+10+21+31*11+365; Settle+10+21+31*11+365*2;
Settle+10+21+31*11+365*3; Settle+10+21+31*11+365*4;…
Settle+10+21+31*11+365*5;….
Settle+10+21+31*11+365*6; Settle+10+21+31*11+365*7;
Settle+10+21+31*11+365*8; Settle+10+21+31*11+365*9;...
Settle+10+21+31*11+365*10;...
Settle+10+21+31*11+365*11; Settle+10+21+31*11+365*12;
Settle+10+21+31*11+365*13; Settle+10+21+31*11+365*14;...
Settle+10+21+31*11+365*15; …
Settle+10+21+31*11+365*16; Settle+10+21+31*11+365*17;
Settle+10+21+31*11+365*18; Settle+10+21+31*11+365*19; ...
Settle+10+21+31*11+365*20; ...
Settle+10+21+31*11+365*21; Settle+10+21+31*11+365*22;
Settle+10+21+31*11+365*23; Settle+10+21+31*11+365*24;...

Settle+31*12*25; Settle+31*12*30;...

];
```

	Start date ----------	+1 day	+14 days	+1 month	+1 year	+5 years	# time step
Grid 0	1	10	2	11	9	4	37
Grid 2	1	10	2	11	24	2	50

FIGURE 13.3 Number of time step 50.

End MATLAB source code grid number 2 time step 50

See Figure 13.4.



	start date	d1	d2	d3	d4	d5	d6	d7	d8	d9	d10	d11	d12	d13	d14	d15	d16	d17	d18	d19	d20	d21	d22	d23	d24
day	1	1	1	1	1	1	1	1	1	1	1														
2 week		14	14																						
month		31	31	31	31	31	31	31	31	31	31	31													
year		365	365	365	365	365	365	365	365	365	365	365	365	365	365	365	365	365	365	365	365	365	365	365	365
5 year		1825	1825																						

FIGURE 13.4 Further case of number of time step 50.

13.4 DETAILED ANALYSIS OF THE PART OF SOURCE CODE FROM GRID NUMBER 0 TO GRID NUMBER 3

Further case of study

- 40 time step 1 day = 40 days
- 5 time step 2 weeks = 5 * 14 = 70 days
- 21 time step 1 month = 31 * 21 = 651 days
- 9 time step 1 year = 9 * 365 = 3285 days
- 4 time step 5 years = 4 * 365 * 5 = 7300 days
- (11,997 days = ~32 years)

1

+ 40 + 5 + 21

+ 9 + 4 = 80

See Figure 13.5.

Related source code

MATLAB source code grid number 3 time step 80

```
simulationDates =
[
Settle;...

Settle+1;Settle+2;Settle+3;Settle+4;Settle+5; Settle+6;Settle+7;Se
ttle+8;Settle+9;Settle+10;...
Settle+11;Settle+12;Settle+13;Settle+14;Settle+15;Settle+16;Settle
+17;Settle+18;Settle+19;Settle+20;...
Settle+21;Settle+22;Settle+23;Settle+24;Settle+25;Settle+26;Settle
+27;Settle+28;Settle+29;Settle+30;...
Settle+31;Settle+32;Settle+33;Settle+34;Settle+35;Settle+36;Settle
+37;Settle+38;Settle+39;Settle+40;...
```

	Start date	+ 1 day	+ 14 days	+ 1 month	+ 1 year	+ 5 years	# time step
Grid 0	1	22	2	11	9	4	49
Grid 3	1	40	5	21	9	4	80

FIGURE 13.5 Number of time step 80.

```
Settle+40+7*2; Settle+40+7*3; Settle+40+7*4; Settle+40+7*5;
Settle+40+7*6;...

Settle+40+7*6+31; Settle+40+7*6+31*2; Settle+40+7*6+31*3;
Settle+40+7*6+31*4; Settle+40+7*6+31*5;...
Settle+40+7*6+31*6; Settle+40+7*6+31*7; Settle+40+7*6+31*8;
Settle+40+7*6+31*9; Settle+40+7*6+31*10;...
Settle+40+7*6+31*12;Settle+40+7*6+31*13; Settle+40+7*6+31*14;
Settle+40+7*6+31*15; Settle+40+7*6+31*16;...
Settle+40+7*6+31*17; Settle+40+7*6+31*18; Settle+40+7*6+31*19;
Settle+40+7*6+31*21; Settle+40+7*6+31*22;...
Settle+40+7*6+31*23;...

Settle+40+7*6+31*23+365; Settle+40+7*6+31*23+365*2;
Settle+40+7*6+31*23+365*3;... Settle+40+7*6+31*23+365*4;Settle+40+
7*6+31*23+365*5;...
Settle+40+7*6+31*23+365*6; Settle+40+7*6+31*23+365*7;
Settle+40+7*6+31*23+365*8;...
Settle+40+7*6+31*23+365*9;...
];
```

End MATLAB source code grid number 3 time step 80

See Figure 13.6.

13.5 DETAILED ANALYSIS OF THE PART OF SOURCE CODE FROM GRID NUMBER 0 TO GRID NUMBER 4

Draft short term and middle term with 80 time step

–20

- 30 time step 1 day = 30 days
- 5 time step 2 weeks = 14 * 5 = 60 days
- 11 time step 1 month = 31 * 11 = 341 days

tot 46

+20

- 27 time step 1/3 year = 3,285 days
- 3 time step ½ year = 547 days

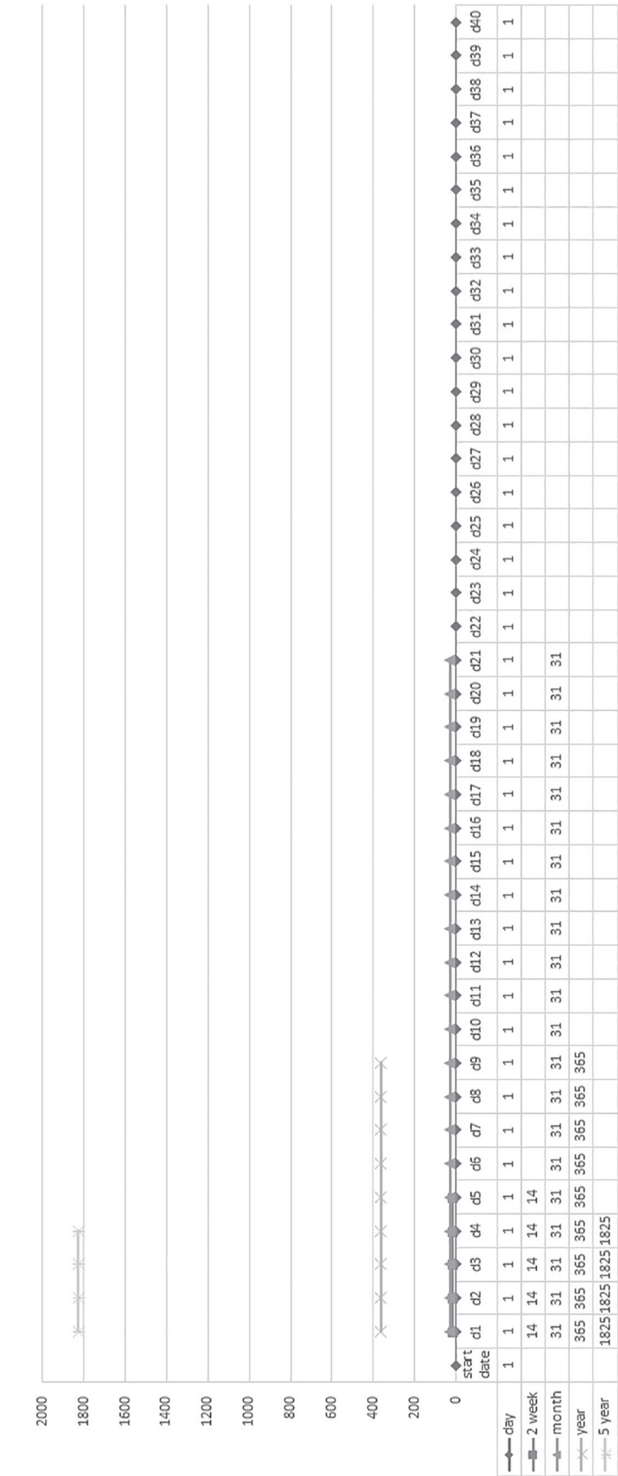


FIGURE 13.6 First case of number of time step 80.

- 3 time step 5 year = 5,475 days

tot 33

TS

1

+ 30 + 5 + 11

+ 27 + 3 + 3 = 80

1+

30 + 60 + 341

3285 + 547 + 5475

9,739 days = ~ 26 years

See Figure 13.7.

Related source code

MATLAB source code grid number 4 time step 80

```
simulationDates =
[
Settle;...

Settle+1;Settle+2;Settle+3;Settle+4;Settle+5; Settle+6;Settle+7;Se
ttle+8;Settle+9;Settle+10;...
Settle+11;Settle+12;Settle+13;Settle+14;Settle+15; Settle+16;Settl
e+17;Settle+18;Settle+19;Settle+20;...
Settle+21;Settle+22;Settle+23;Settle+24;Settle+25; Settle+26;Settl
e+27;Settle+28;Settle+29;Settle+30;...

Settle+40+7*2;Settle+40+7*3;Settle+40+7*4;
Settle+40+7*5;Settle+40+7*6;...
```

	Start date	+ 1 day	+ 14 days	+ 1 month	+ 1/3 year	+ ½ year	+ 5 years	# time step
Grid 0	1	22	2	11	9	--	4	49
Grid 4	1	30	5	11	27	3	3	80

FIGURE 13.7 Second case of number of time step 80.

```
Settle+40+7*6+31;  Settle+40+7*6+31*2; Settle+40+7*6+31*3;
Settle+40+7*6+31*4; Settle+40+7*6+31*5;...
Settle+40+7*6+31*6; Settle+40+7*6+31*7;Settle+40+7*6+31*8;
Settle+40+7*6+31*9; Settle+40+7*6+31*10;...
Settle+40+7*6+31*12;...

Settle+40+7*6+31*23+365; Settle+40+7*6+31*23+365*2(1/3);
Settle+40+7*6+31*23+365*3(1/3);...
Settle+40+7*6+31*23+365*4(1/3); Settle+40+7*6+31*23+365*5(1/3);...
Settle+40+7*6+31*23+365*6(1/3); Settle+40+7*6+31*23+365*7(1/3);
Settle+40+7*6+31*23+365*8(1/3);...
Settle+40+7*6+31*23+365*9(1/3); Settle+40+7*6+31*23+365*10(1/3);...
Settle+40+7*6+31*23+365*11(1/3); Settle+40+7*6+31*23+365*12(1/3);
Settle+40+7*6+31*23+365*13(1/3);...
Settle+40+7*6+31*23+365*14(1/3);Settle+40+7*6+31*23+365*15(1/3);...
Settle+40+7*6+31*23+365(1/3); Settle+40+7*16+31*23+365*17(1/3);
Settle+40+7*6+31*23+365*18(1/3);...
Settle+40+7*6+31*23+365*19(1/3);Settle+40+7*6+31*23+365*20(1/3);...
Settle+40+7*6+31*23+365*21(1/3); Settle+40+7*6+31*23+365*22(1/3);
Settle+40+7*6+31*23+365*23(1/3);...
Settle+40+7*6+31*23+365*24(1/3);Settle+40+7*6+31*23+365*25(1/3);...
Settle+40+7*6+31*23+365*26(1/3);
Settle+40+7*6+31*23+365*27(1/3);...

Settle+40+7*6+31*23+365*27(1/3) + 365*(1/2);
Settle+40+7*6+31*23+365*27(1/3) + 365*2(1/2);
Settle+40+7*6+31*23+365*27(1/3) + 365*3(1/2);...

Settle+40+7*6+31*23+365*27(1/3) + 365*3(1/2) + 365*5; ...
Settle+40+7*6+31*23+365*27(1/3) + 365*3(1/2) + 365*10; ...
Settle+40+7*6+31*23+365*27(1/3) + 365*3(1/2) + 365*15;...

];
```

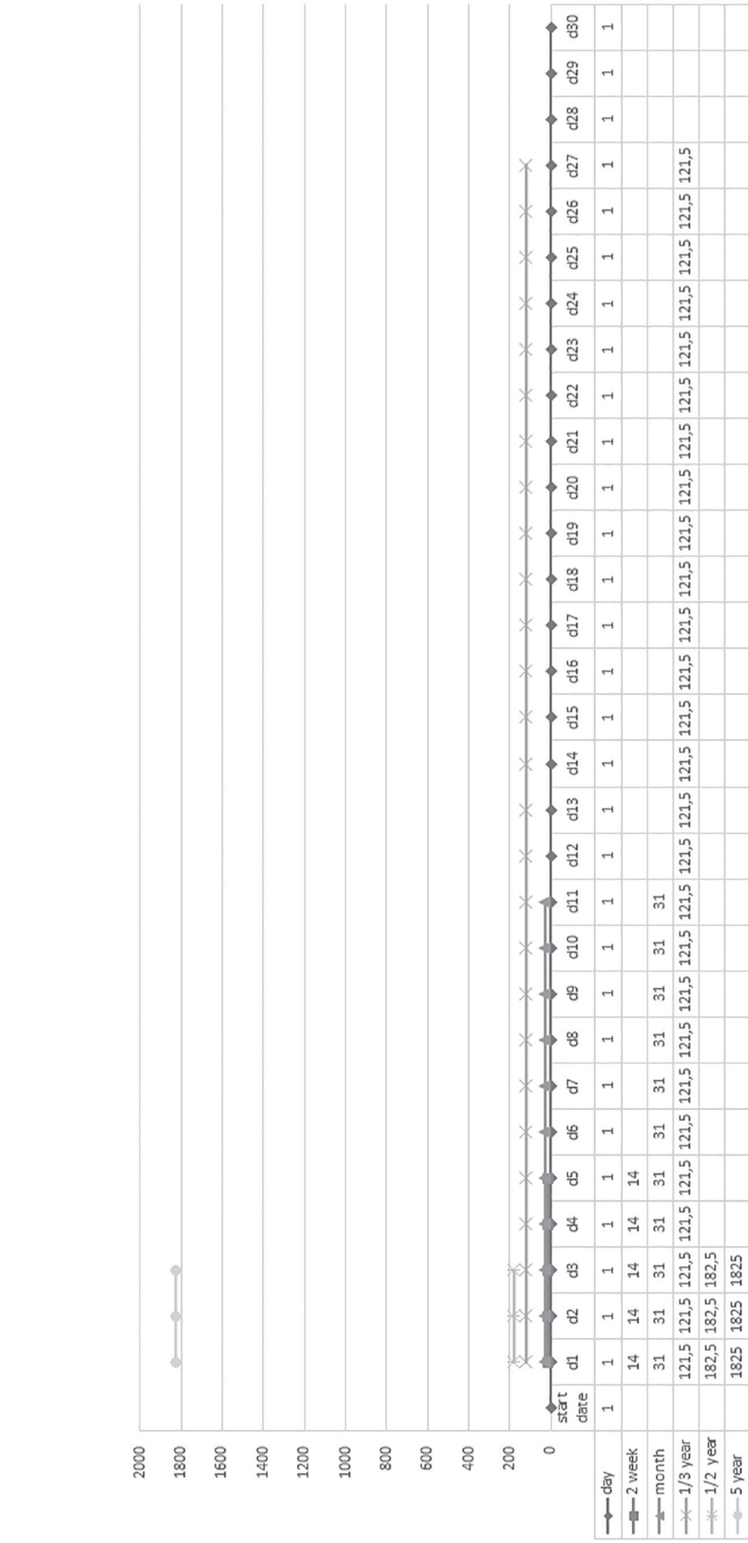
End MATLAB source code grid number 4 time step 80

See Figure 13.8.

13.6 DETAILED ANALYSIS OF THE PART OF SOURCE CODE FROM GRID NUMBER 0 TO GRID NUMBER 5

Draft short term and middle term with 80 time step

–30



	start date	d1	d2	d3	d4	d5	d6	d7	d8	d9	d10	d11	d12	d13	d14	d15
day	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2 week		14	14	14	14	14										
month		31	31	31	31	31	31	31	31	31	31	31				
1/3 year		121,5	121,5	121,5	121,5	121,5	121,5	121,5	121,5	121,5	121,5	121,5	121,5	121,5	121,5	121,5
1/2 year		182,5	182,5	182,5												
5 year		1825	1825	1825												

	d16	d17	d18	d19	d20	d21	d22	d23	d24	d25	d26	d27	d28	d29	d30
day	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2 week															
month															
1/3 year	121,5	121,5	121,5	121,5	121,5	121,5	121,5	121,5	121,5	121,5	121,5	121,5			
1/2 year															
5 year															

FIGURE 13.8 Third case of number of time step 80.

- (20 – 20) = 20 time step 1 day: 30 * (1) days
- 5 time step 2 weeks: 5 * (2 * 7) = 70 days
- (21 – 10) = 11 time step 1 month: 21 * (31) = 651 days

tot 36

+30

24 ¼ years = 2,190 days

16 ½ years = 2,920 days

3 time step 5 years = 5,475 days

tot 43

1

+ 20 + 5

+ 11 + 24 + 16 + 3 = 80 days

11,336 days = ~ 31 years

See Figure 13.9.

MATLAB source code grid number 5 time step 80

```
simulationDates =
[
Settle;...

Settle+1; Settle+2; Settle+3; Settle+4; Settle+5; Settle+6;
Settle+7; Settle+8; Settle+9; Settle+10;...
Settle+11;Settle+12; Settle+13; Settle+14; Settle+15; Settle+16;
Settle+17; Settle+18; Settle+19; Settle+20;...

Settle+20+7*2;Settle+20+7*3;Settle+20+7*4;
Settle+20+7*5;Settle+20+7*6;...

Settle+20+7*6+31;  Settle+20+7*6+31*2; Settle+20+7*6+31*3;
Settle+20+7*6+31*4; Settle+20+7*6+31*5;...
```

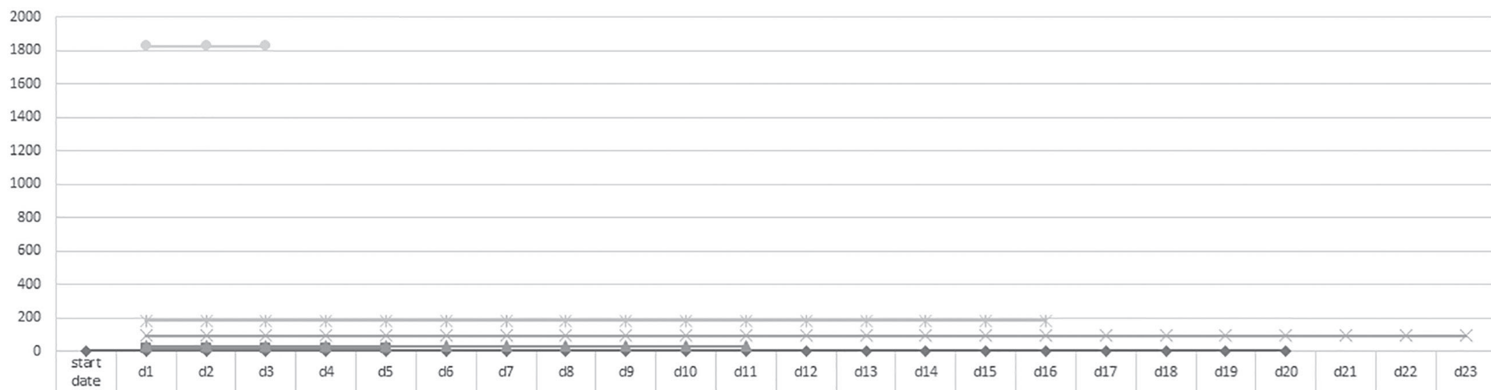
	Start date	+ 1 day	+ 14 days	+ 1 month	+ ¼ year	+ ½ year	+ 1 year	+ 5 years	# time step
Grid 0	1	22	2	11	--	--	9	4	49
Grid 5	1	20	5	11	24	16	--	3	80

FIGURE 13.9 Grid number 5 number of time step 80.

```
Settle+20+7*6+31*6; Settle+20+7*6+31*7;Settle+20+7*6+31*8;
Settle+20+7*6+31*9; Settle+20+7*6+31*10;...
Settle+20+7*6+31*12;...

Settle+20+7*6+31*12+365; Settle+20+7*6+31*12+365*2(1/3);
Settle+20+7*6+31*12+365*3(1/3);...
Settle+20+7*6+31*12+365*4(1/3); Settle+20+7*6+31*12+365*5(1/3);...
Settle+20+7*6+31*12+365*6(1/3); Settle+20+7*6+31*12+365*7(1/3);
Settle+20+7*6+31*12+365*8(1/3);...
Settle+20+7*6+31*12+365*9(1/3); Settle+20+7*6+31*12+365*10(1/3);...
Settle+20+7*6+31*12+365*11(1/3); Settle+20+7*6+31*12+365*12(1/3);
Settle+20+7*6+31*12+365*13(1/3);...
Settle+20+7*6+31*12+365*14(1/3);Settle+20+7*6+31*12+365*15(1/3);...
Settle+20+7*6+31*12+365(1/3); Settle+20+7*16+31*12+365*17(1/3);
Settle+20+7*6+31*12+365*18(1/3);...
Settle+20+7*6+31*12+365*19(1/3);Settle+20+7*6+31*12+365*20(1/3);...
Settle+20+7*6+31*12+365*21(1/3); Settle+20+7*6+31*12+365*22(1/3);
Settle+20+7*6+31*12+365*23(1/3);...
Settle+20+7*6+31*12+365*24(1/3);Settle+20+7*6+31*12+365*25(1/3);...
Settle+20+7*6+31*12+365*26(1/3);
Settle+20+7*6+31*12+365*27(1/3);...

Settle+20+7*6+31*12+365*27(1/3) + 365*(1/2);
Settle+20+7*6+31*12+365*27(1/3) + 365*2(1/2); ...
Settle+20+7*6+31*12+365*27(1/3) +
365*3(1/2);Settle+20+7*6+31*12+365*27(1/3) + 365*4(1/2);...
Settle+20+7*6+31*12+365*27(1/3) +
365*5(1/2);Settle+20+7*6+31*12+365*27(1/3) + 365*6(1/2);...
Settle+20+7*6+31*12+365*27(1/3) +
365*7(1/2);Settle+20+7*6+31*12+365*27(1/3) + 365*8(1/2);...
Settle+20+7*6+31*12+365*27(1/3) +
365*9(1/2);Settle+20+7*6+31*12+365*27(1/3) + 365*10(1/2);...
Settle+20+7*6+31*12+365*27(1/3) +
365*11(1/2);Settle+20+7*6+31*12+365*27(1/3) + 365*12(1/2);...
Settle+20+7*6+31*12+365*27(1/3) +
365*13(1/2);Settle+20+7*6+31*12+365*27(1/3) + 365*14(1/2);...
Settle+20+7*6+31*12+365*27(1/3) +
365*15(1/2);Settle+20+7*6+31*12+365*27(1/3) + 365*16(1/2);...

Settle+20+7*6+31*12+365*27(1/3) + 365*16(1/2)+365*5; ...
Settle+20+7*6+31*12+365*27(1/3) + 365*16(1/2)+365*10; ...
Settle+20+7*6+31*12+365*27(1/3) + 365*16(1/2)+365*15;...

];
```

End MATLAB source code grid number 5 time step 80

See Figure 13.10.



	start date	d1	d2	d3	d4	d5	d6	d7	d8	d9	d10	d11	d12	d13	d14	d15	d16	d17	d18	d19	d20	d21	d22	d23
day	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1			
2 week		14	14	14	14	14																		
month		31	31	31	31	31	31	31	31	31	31	31												
1/4 year		91,25	91,25	91,25	91,25	91,25	91,25	91,25	91,25	91,25	91,25	91,25	91,25	91,25	91,25	91,25	91,25	91,25	91,25	91,25	91,25	91,25	91,25	91,25
1/2 year		182,5	182,5	182,5	182,5	182,5	182,5	182,5	182,5	182,5	182,5	182,5	182,5	182,5	182,5	182,5	182,5							
5 years		1825	1825	1825																				

FIGURE 13.10 Further grid number 5 number of time step 80.

13.7 DETAILED ANALYSIS OF THE PART OF SOURCE CODE FROM GRID NUMBER 0 TO GRID NUMBER 6

Draft short term and middle term with 100 time step

- 20 time step 1 day: 30 * 1 = 30 days
- 5 time step 2 weeks: 5 * 14 = 70 days
- 11 time step 1 month: 21 * 31 = 651 days

- 40 1/8 years time step = 1,825 days
- 4 ¼ years time step = 365 days
- 16 ½ years time step = 2,920 days
- 3 time step 5 years = 5,475 days

1

+ 20 + 5 + 11

+ 40 + 4 + 16 + 3 = 100 days

10,585 days = ~ 29 years

See Figure 13.11.

MATLAB source code grid number 6 time step 100

```
simulationDates =
[
Settle;...

Settle+1; Settle+2; Settle+3; Settle+4; Settle+5; Settle+6;
Settle+7; Settle+8; Settle+9; Settle+10;...
Settle+11;Settle+12; Settle+13; Settle+14; Settle+15; Settle+16;
Settle+17; Settle+18; Settle+19; Settle+20;...
```

	Start date -------------	+ 1 day	+ 14 days	+ 1 month	+ 1/8 year	+ ¼ year	+ ½ year	+ 1 year	+ 5 years	# time step
Grid 0	1	22	2	11	--	--	--	9	4	49
Grid 6	1	20	5	11	40	4	16	--	3	100

FIGURE 13.11 Grid number 6 time step 100.

```
Settle+20+7*2;Settle+20+7*3;Settle+20+7*4;
Settle+20+7*5;Settle+20+7*6;...

Settle+20+7*6+31;  Settle+20+7*6+31*2; Settle+20+7*6+31*3;
Settle+20+7*6+31*4; Settle+20+7*6+31*5;...
Settle+20+7*6+31*6; Settle+20+7*6+31*7;Settle+20+7*6+31*8;
Settle+20+7*6+31*9; Settle+20+7*6+31*10;...
Settle+20+7*6+31*12;...

Settle+20+7*6+31*12+ 365*(1/8);Settle+20+7*6+31*12+ 365*2(1/8);...
Settle+20+7*6+31*12+ 365*3(1/8);Settle+20+7*6+31*12+
365*4(1/8);...
Settle+20+7*6+31*12+ 365*5(1/8);Settle+20+7*6+31*12+
365*6(1/8);...
Settle+20+7*6+31*12+ 365*7(1/8);Settle+20+7*6+31*12+
365*8(1/8);...
Settle+20+7*6+31*12+ 365*9(1/8); Settle+20+7*6+31*12+
365*10(1/8);...
Settle+20+7*6+31*12+ 365*11(1/8);Settle+20+7*6+31*12+
365*12(1/8);...
Settle+20+7*6+31*12+ 365*13(1/8);Settle+20+7*6+31*12+
365*14(1/8);...
Settle+20+7*6+31*12+ 365*15(1/8);Settle+20+7*6+31*12+
365*16(1/8);...
Settle+20+7*6+31*12+ 365*17(1/8);Settle+20+7*6+31*12+
365*18(1/8);...
Settle+20+7*6+31*12+ 365*19(1/8); Settle+20+7*6+31*12+
365*20(1/8);...
Settle+20+7*6+31*12+ 365*21(1/8);Settle+20+7*6+31*12+
365*22(1/8);...
Settle+20+7*6+31*12+ 365*23(1/8);Settle+20+7*6+31*12+
365*24(1/8);...
Settle+20+7*6+31*12+ 365*25(1/8);Settle+20+7*6+31*12+
365*26(1/8);...
Settle+20+7*6+31*12+ 365*27(1/8);Settle+20+7*6+31*12+
365*28(1/8);...
Settle+20+7*6+31*12+ 365*29(1/8); Settle+20+7*6+31*12+
365*30(1/8);...
Settle+20+7*6+31*12+ 365*31(1/8);Settle+20+7*6+31*12+
365*32(1/8);...
Settle+20+7*6+31*12+ 365*33(1/8);Settle+20+7*6+31*12+
365*34(1/8);...
Settle+20+7*6+31*12+ 365*35(1/8);Settle+20+7*6+31*12+
365*36(1/8);...
Settle+20+7*6+31*12+ 365*37(1/8);Settle+20+7*6+31*12+
365*38(1/8);...
Settle+20+7*6+31*12+ 365*39(1/8); Settle+20+7*6+31*12+
365*40(1/8);...
```

```
Settle+20+7*6+31*12+ 365*40(1/8)+ 365(1/4);…
Settle+20+7*6+31*12+ 365*40(1/8)+ 365*2(1/4);…
Settle+20+7*6+31*12+ 365*40(1/8)+ 365*3(1/4);…
Settle+20+7*6+31*12+ 365*40(1/8)+ 365*4(1/4);…

Settle+20+7*6+31*12+ 365*40(1/8)+ 365*4(1/4)+365(1/2);
Settle+20+7*6+31*12+ 365*40(1/8)+ 365*4(1/4)+365*2(1/2);
Settle+20+7*6+31*12+ 365*40(1/8)+ 365*4(1/4)+365*3(1/2);
Settle+20+7*6+31*12+ 365*40(1/8)+ 365*4(1/4)+365*4(1/2);
Settle+20+7*6+31*12+ 365*40(1/8)+ 365*4(1/4)+365*5(1/2);
Settle+20+7*6+31*12+ 365*40(1/8)+ 365*4(1/4)+365*6(1/2);
Settle+20+7*6+31*12+ 365*40(1/8)+ 365*4(1/4)+365*7(1/2);
Settle+20+7*6+31*12+ 365*40(1/8)+ 365*4(1/4)+365*8(1/2);
Settle+20+7*6+31*12+ 365*40(1/8)+ 365*4(1/4)+365*9(1/2);
Settle+20+7*6+31*12+ 365*40(1/8)+ 365*4(1/4)+365*10(1/2);
Settle+20+7*6+31*12+ 365*40(1/8)+ 365*4(1/4)+365*11(1/2);
Settle+20+7*6+31*12+ 365*40(1/8)+ 365*4(1/4)+365*12(1/2);
Settle+20+7*6+31*12+ 365*40(1/8)+ 365*4(1/4)+365*13(1/2);
Settle+20+7*6+31*12+ 365*40(1/8)+ 365*4(1/4)+365*14(1/2);
Settle+20+7*6+31*12+ 365*40(1/8)+ 365*4(1/4)+365*15(1/2);
Settle+20+7*6+31*12+ 365*40(1/8)+ 365*4(1/4)+365*16(1/2);

Settle+20+7*6+31*12+ 365*40(1/8)+ 365*4(1/4)+365*16(1/2)+365*5;…
Settle+20+7*6+31*12+ 365*40(1/8)+ 365*4(1/4)+365*16(1/2)+365*10;…
Settle+20+7*6+31*12+ 365*40(1/8)+ 365*4(1/4)+365*16(1/2)+365*15;…

];
```

End MATLAB source code grid number 6 time step 100

See Figure 13.12.

13.8 DETAILED ANALYSIS OF THE PART OF SOURCE CODE FROM GRID NUMBER 0 TO GRID NUMBER 7

Draft short term and middle term with 120 time step

- 20 time step 1 day: 30 * 1 = 30 days
- 5 time step 2 weeks: 5 * 14 = 70 days
- 11 time step 1 month: 21 * 31 = 651 days

- 60 1/8 years time step = 2,737 days
- 14 ¼ years time step = 1,277 days
- 6 ½ years time step = 1,095 days
- 3 time step 5 years = 5,475 days

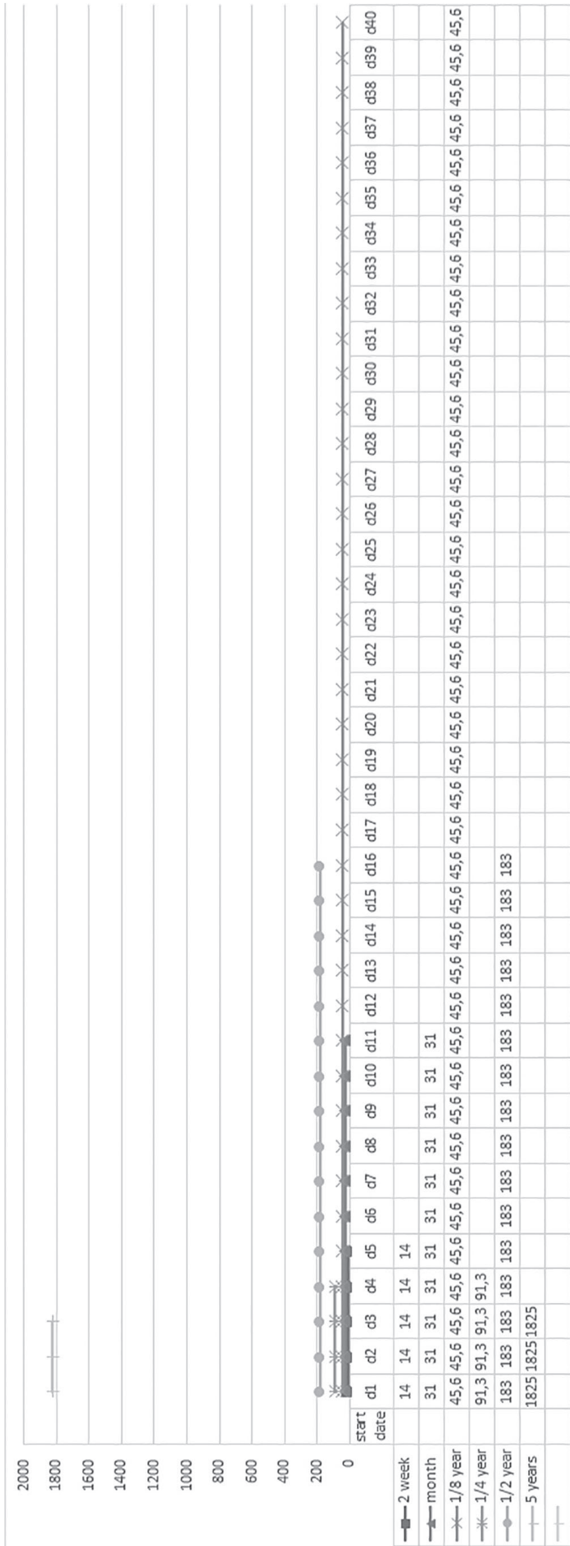


FIGURE 13.12 Further case grid number 6 number of time step 100.

1

+ 20 + 5 + 11

+ 60 + 14 + 6 + 3 = 120 days

11,335 days = ~ 31 years

See Figure 13.13.

MATLAB source code grid number 7 time step 121

```
simulationDates =
[

Settle;...

Settle+1; Settle+2; Settle+3; Settle+4; Settle+5; Settle+6;
Settle+7; Settle+8; Settle+9; Settle+10;...
Settle+11;Settle+12; Settle+13; Settle+14; Settle+15; Settle+16;
Settle+17; Settle+18; Settle+19; Settle+20;...

Settle+20+7*2;Settle+20+7*3;Settle+20+7*4;
Settle+20+7*5;Settle+20+7*6;...
Settle+20+7*6+31;  Settle+20+7*6+31*2; Settle+20+7*6+31*3;
Settle+20+7*6+31*4; Settle+20+7*6+31*5;...
Settle+20+7*6+31*6; Settle+20+7*6+31*7;Settle+20+7*6+31*8;
Settle+20+7*6+31*9; Settle+20+7*6+31*10;...
Settle+20+7*6+31*12;...

Settle+20+7*6+31*12+ 365*(1/8); Settle+20+7*6+31*12+
365*2(1/8);...
Settle+20+7*6+31*12+ 365*3(1/8);Settle+20+7*6+31*12+
365*4(1/8);...
Settle+20+7*6+31*12+ 365*5(1/8);Settle+20+7*6+31*12+
365*6(1/8);...
Settle+20+7*6+31*12+ 365*7(1/8);Settle+20+7*6+31*12+
365*8(1/8);...
Settle+20+7*6+31*12+ 365*9(1/8); Settle+20+7*6+31*12+
365*10(1/8);...
```

	Start date -------------	+ 1 day	+ 14 days	+ 1 month	+ 1/8 year	+ ¼ year	+ ½ year	+ 1 year	+ 5 years	# time step
Grid 0	1	22	2	11	--	--	--	9	4	49
Grid 7	1	20	5	11	60	14	6	--	3	120

FIGURE 13.13 Grid number 7 time step 120.

```
Settle+20+7*6+31*12+ 365*11(1/8);Settle+20+7*6+31*12+
365*12(1/8);...
Settle+20+7*6+31*12+ 365*13(1/8);Settle+20+7*6+31*12+
365*14(1/8);...
Settle+20+7*6+31*12+ 365*15(1/8);Settle+20+7*6+31*12+
365*16(1/8);...
Settle+20+7*6+31*12+ 365*17(1/8);Settle+20+7*6+31*12+
365*18(1/8);...
Settle+20+7*6+31*12+ 365*19(1/8); Settle+20+7*6+31*12+
365*20(1/8);...
Settle+20+7*6+31*12+ 365*21(1/8);Settle+20+7*6+31*12+
365*22(1/8);...
Settle+20+7*6+31*12+ 365*23(1/8);Settle+20+7*6+31*12+
365*24(1/8);...
Settle+20+7*6+31*12+ 365*25(1/8);Settle+20+7*6+31*12+
365*26(1/8);...
Settle+20+7*6+31*12+ 365*27(1/8);Settle+20+7*6+31*12+
365*28(1/8);...
Settle+20+7*6+31*12+ 365*29(1/8); Settle+20+7*6+31*12+
365*30(1/8);...
Settle+20+7*6+31*12+ 365*31(1/8);Settle+20+7*6+31*12+
365*32(1/8);...
Settle+20+7*6+31*12+ 365*33(1/8);Settle+20+7*6+31*12+
365*34(1/8);...
Settle+20+7*6+31*12+ 365*35(1/8);Settle+20+7*6+31*12+
365*36(1/8);...
Settle+20+7*6+31*12+ 365*37(1/8);Settle+20+7*6+31*12+
365*38(1/8);...
Settle+20+7*6+31*12+ 365*39(1/8); Settle+20+7*6+31*12+
365*40(1/8);...
Settle+20+7*6+31*12+ 365*41(1/8);Settle+20+7*6+31*12+
365*42(1/8);...
Settle+20+7*6+31*12+ 365*43(1/8);Settle+20+7*6+31*12+
365*44(1/8);...
Settle+20+7*6+31*12+ 365*45(1/8);Settle+20+7*6+31*12+
365*46(1/8);...
Settle+20+7*6+31*12+ 365*47(1/8);Settle+20+7*6+31*12+
365*48(1/8);...
Settle+20+7*6+31*12+ 365*49(1/8); Settle+20+7*6+31*12+
365*50(1/8);...
Settle+20+7*6+31*12+ 365*51(1/8);Settle+20+7*6+31*12+
365*52(1/8);...
Settle+20+7*6+31*12+ 365*53(1/8);Settle+20+7*6+31*12+
365*54(1/8);...
Settle+20+7*6+31*12+ 365*55(1/8);Settle+20+7*6+31*12+
365*56(1/8);...
```

```
Settle+20+7*6+31*12+ 365*57(1/8);Settle+20+7*6+31*12+
365*58(1/8);...
Settle+20+7*6+31*12+ 365*59(1/8); Settle+20+7*6+31*12+
365*60(1/8);...

Settle+20+7*6+31*12+ 365*60(1/8)+ 365(1/4);…
Settle+20+7*6+31*12+ 365*60(1/8)+ 365*2(1/4);…
Settle+20+7*6+31*12+ 365*60(1/8)+ 365*3(1/4);…
Settle+20+7*6+31*12+ 365*60(1/8)+ 365*4(1/4);…
Settle+20+7*6+31*12+ 365*60(1/8)+ 365*5(1/4);…
Settle+20+7*6+31*12+ 365*60(1/8)+ 365*6(1/4);…
Settle+20+7*6+31*12+ 365*60(1/8)+ 365*7(1/4);…
Settle+20+7*6+31*12+ 365*60(1/8)+ 365*8(1/4);…
Settle+20+7*6+31*12+ 365*60(1/8)+ 365*9(1/4);…
Settle+20+7*6+31*12+ 365*60(1/8)+ 365*10(1/4);…
Settle+20+7*6+31*12+ 365*60(1/8)+ 365*11(1/4);…
Settle+20+7*6+31*12+ 365*60(1/8)+ 365*12(1/4);…
Settle+20+7*6+31*12+ 365*60(1/8)+ 365*13(1/4);…
Settle+20+7*6+31*12+ 365*60(1/8)+ 365*14(1/4);…

Settle+20+7*6+31*12+ 365*60(1/8)+ 365*14(1/4)+365(1/2);
Settle+20+7*6+31*12+ 365*60(1/8)+ 365*14(1/4)+365*2(1/2);
Settle+20+7*6+31*12+ 365*60(1/8)+ 365*14(1/4)+365*3(1/2);
Settle+20+7*6+31*12+ 365*60(1/8)+ 365*14(1/4)+365*4(1/2);
Settle+20+7*6+31*12+ 365*60(1/8)+ 365*14(1/4)+365*5(1/2);
Settle+20+7*6+31*12+ 365*60(1/8)+ 365*14(1/4)+365*6(1/2);

Settle+20+7*6+31*12+ 365*60(1/8)+ 365*14(1/4)+365*6(1/2)+365*5;…
Settle+20+7*6+31*12+ 365*60(1/8)+ 365*14(1/4)+365*6(1/2)+365*10;…
Settle+20+7*6+31*12+ 365*60(1/8)+ 365*14(1/4)+365*6(1/2)+365*15;…

];
```

End MATLAB source code grid number 7 time step 121

See Figure 13.14.

13.9 DETAILED ANALYSIS OF THE PART OF SOURCE CODE FROM GRID NUMBER 0 TO GRID NUMBER 8

Draft short term and middle term with 121 time step

- 20 time step 1 day: 30 * 1 = 30 days
- 5 time step 2 weeks: 5 * 14 = 70 days
- 11 time step 1 month: 21 * 31 = 651 days

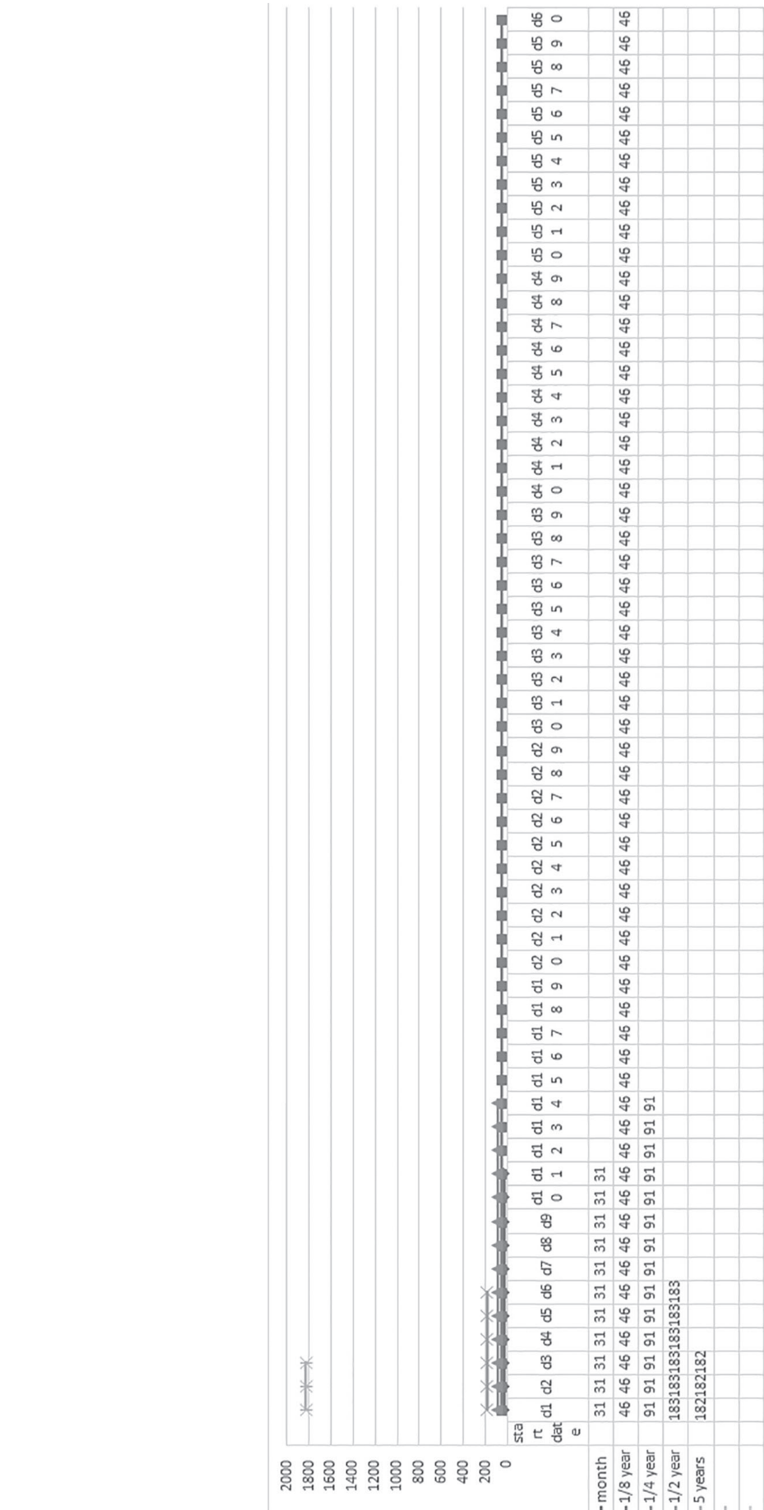


FIGURE 13.14 Further case Grid number 7 number of time step 120.

- 50 1/8 years time step = 2,281 days
- 19 ¼ years time step = 1,733 days
- 6 ½ years time step = 1,095 days
- 3 time step 5 year = 5,475 days

1

+ 20 + 5 + 11

+ 54 + 25 + 2 + 3 = 121 days

11,335 days = ~ 31 years

See Figure 13.15.

MATLAB source code grid number 8 time step 121

```
simulationDates =
[
Settle;...

Settle+1; Settle+2; Settle+3; Settle+4; Settle+5; Settle+6;
Settle+7; Settle+8; Settle+9; Settle+10;...
Settle+11;Settle+12; Settle+13; Settle+14; Settle+15; Settle+16;
Settle+17; Settle+18; Settle+19; Settle+20;...

Settle+20+7*2;Settle+20+7*3;Settle+20+7*4;
Settle+20+7*5;Settle+20+7*6;...

Settle+20+7*6+31;  Settle+20+7*6+31*2; Settle+20+7*6+31*3;
Settle+20+7*6+31*4; Settle+20+7*6+31*5;...
Settle+20+7*6+31*6; Settle+20+7*6+31*7;Settle+20+7*6+31*8;
Settle+20+7*6+31*9; Settle+20+7*6+31*10;...
Settle+20+7*6+31*12;...

Settle+20+7*6+31*12+ 365*(1/8); Settle+20+7*6+31*12+
365*2(1/8);...
```

	Start date -------------	+ 1 day	+ 14 days	+ 1 month	+ 1/8 year	+ ¼ year	+ ½ year	+ 1 year	+ 5 years	# time step
Grid 0	1	22	2	11	--	--	--	9	4	49
Grid 8	1	20	5	11	54	25	2	--	3	121

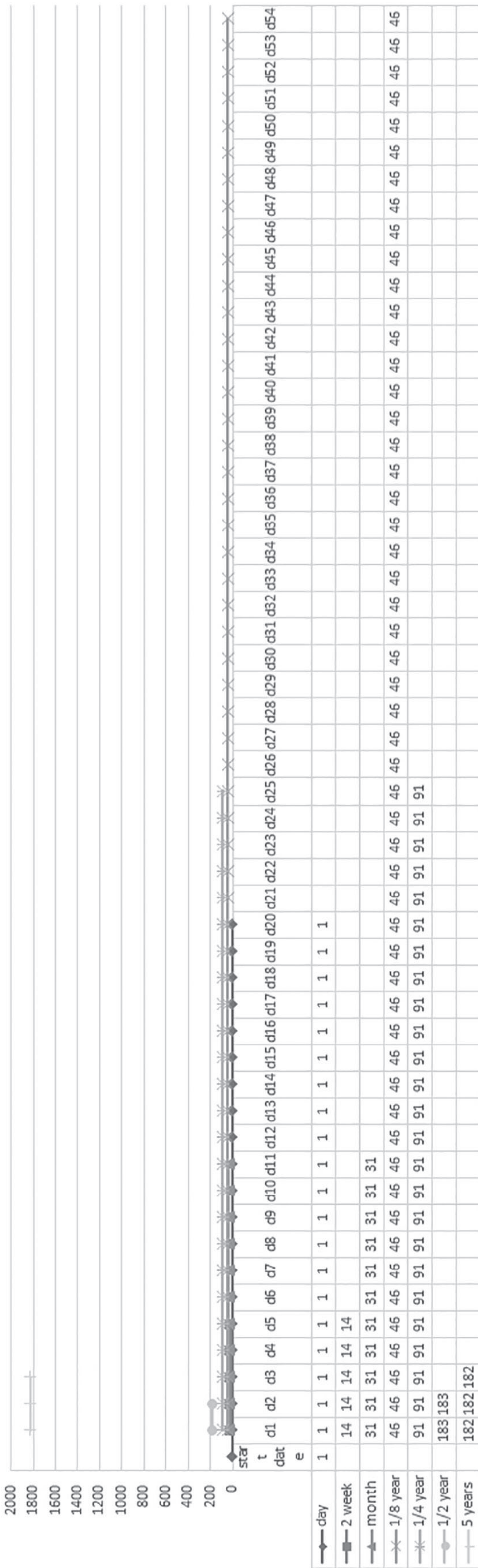
FIGURE 13.15 Grid number 8 time step 121.

```
Settle+20+7*6+31*12+ 365*3(1/8);Settle+20+7*6+31*12+
365*4(1/8);...
Settle+20+7*6+31*12+ 365*5(1/8);Settle+20+7*6+31*12+
365*6(1/8);...
Settle+20+7*6+31*12+ 365*7(1/8);Settle+20+7*6+31*12+
365*8(1/8);...
Settle+20+7*6+31*12+ 365*9(1/8); Settle+20+7*6+31*12+
365*10(1/8);...
Settle+20+7*6+31*12+ 365*11(1/8);Settle+20+7*6+31*12+
365*12(1/8);...
Settle+20+7*6+31*12+ 365*13(1/8);Settle+20+7*6+31*12+
365*14(1/8);...
Settle+20+7*6+31*12+ 365*15(1/8);Settle+20+7*6+31*12+
365*16(1/8);...
Settle+20+7*6+31*12+ 365*17(1/8);Settle+20+7*6+31*12+
365*18(1/8);...
Settle+20+7*6+31*12+ 365*19(1/8); Settle+20+7*6+31*12+
365*20(1/8);...
Settle+20+7*6+31*12+ 365*21(1/8);Settle+20+7*6+31*12+
365*22(1/8);...
Settle+20+7*6+31*12+ 365*23(1/8);Settle+20+7*6+31*12+
365*24(1/8);...
Settle+20+7*6+31*12+ 365*25(1/8);Settle+20+7*6+31*12+
365*26(1/8);...
Settle+20+7*6+31*12+ 365*27(1/8);Settle+20+7*6+31*12+
365*28(1/8);...
Settle+20+7*6+31*12+ 365*29(1/8); Settle+20+7*6+31*12+
365*30(1/8);...
Settle+20+7*6+31*12+ 365*31(1/8);Settle+20+7*6+31*12+
365*32(1/8);...
Settle+20+7*6+31*12+ 365*33(1/8);Settle+20+7*6+31*12+
365*34(1/8);...
Settle+20+7*6+31*12+ 365*35(1/8);Settle+20+7*6+31*12+
365*36(1/8);...
Settle+20+7*6+31*12+ 365*37(1/8);Settle+20+7*6+31*12+
365*38(1/8);...
Settle+20+7*6+31*12+ 365*39(1/8); Settle+20+7*6+31*12+
365*40(1/8);...
Settle+20+7*6+31*12+ 365*41(1/8);Settle+20+7*6+31*12+
365*42(1/8);...
Settle+20+7*6+31*12+ 365*43(1/8);Settle+20+7*6+31*12+
365*44(1/8);...
Settle+20+7*6+31*12+ 365*45(1/8);Settle+20+7*6+31*12+
365*46(1/8);...
Settle+20+7*6+31*12+ 365*47(1/8);Settle+20+7*6+31*12+
365*48(1/8);...
```

```
Settle+20+7*6+31*12+ 365*49(1/8); Settle+20+7*6+31*12+
365*50(1/8);...
Settle+20+7*6+31*12+ 365*51(1/8); Settle+20+7*6+31*12+
365*52(1/8);...
Settle+20+7*6+31*12+ 365*53(1/8); Settle+20+7*6+31*12+
365*54(1/8);...

Settle+20+7*6+31*12+ 365*54(1/8)+ 365(1/4);…
Settle+20+7*6+31*12+ 365*54(1/8)+ 365*2(1/4);…
Settle+20+7*6+31*12+ 365*54(1/8)+ 365*3(1/4);…
Settle+20+7*6+31*12+ 365*54(1/8)+ 365*4(1/4);…
Settle+20+7*6+31*12+ 365*54(1/8)+ 365*5(1/4);…
Settle+20+7*6+31*12+ 365*54(1/8)+ 365*6(1/4);…
Settle+20+7*6+31*12+ 365*54(1/8)+ 365*7(1/4);…
Settle+20+7*6+31*12+ 365*54(1/8)+ 365*8(1/4);…
Settle+20+7*6+31*12+ 365*54(1/8)+ 365*9(1/4);…
Settle+20+7*6+31*12+ 365*54(1/8)+ 365*10(1/4);…
Settle+20+7*6+31*12+ 365*54(1/8)+ 365*11(1/4);…
Settle+20+7*6+31*12+ 365*54(1/8)+ 365*12(1/4);…
Settle+20+7*6+31*12+ 365*54(1/8)+ 365*13(1/4);…
Settle+20+7*6+31*12+ 365*54(1/8)+ 365*14(1/4);…
Settle+20+7*6+31*12+ 365*54(1/8)+ 365*15(1/4);…
Settle+20+7*6+31*12+ 365*54(1/8)+ 365*16(1/4);…
Settle+20+7*6+31*12+ 365*54(1/8)+ 365*17(1/4);…
Settle+20+7*6+31*12+ 365*54(1/8)+ 365*18(1/4);…
Settle+20+7*6+31*12+ 365*54(1/8)+ 365*19(1/4);…
Settle+20+7*6+31*12+ 365*54(1/8)+ 365*20(1/4);…
Settle+20+7*6+31*12+ 365*54(1/8)+ 365*21(1/4);…
Settle+20+7*6+31*12+ 365*54(1/8)+ 365*22(1/4);…
Settle+20+7*6+31*12+ 365*54(1/8)+ 365*23(1/4);…
Settle+20+7*6+31*12+ 365*54(1/8)+ 365*24(1/4);…
Settle+20+7*6+31*12+ 365*54(1/8)+ 365*25(1/4);…

Settle+20+7*6+31*12+ 365*54(1/8)+ 365*25(1/4)+365(1/2);
Settle+20+7*6+31*12+ 365*54(1/8)+ 365*25(1/4)+365*2(1/2);

Settle+20+7*6+31*12+ 365*54(1/8)+ 365*25(1/4)+365*2(1/2)+365*5;…
Settle+20+7*6+31*12+ 365*54(1/8)+ 365*25(1/4)+365*2(1/2)+365*10;…
Settle+20+7*6+31*12+ 365*54(1/8)+ 365*25(1/4)+365*2(1/2)+365*15;…

];
```

End MATLAB source code grid number 8 time step 121

See Figure 13.16.



	start date	d1	d2	d3	d4	d5	d6	d7	d8	d9	d10	d11	d12	d13	d14	d15	d16	d17	d18
day	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2 week		14	14	14	14	14													
month		31	31	31	31	31	31	31	31	31	31	31							
1/8 year		46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46
1/4 year		91	91	91	91	91	91	91	91	91	91	91	91	91	91	91	91	91	91
1/2 year		183	183																
5 years		182	182	182															

	d19	d20	d21	d22	d23	d24	d25	d26	d27	d28	d29	d30	d31	d32	d33	d34	d35	d36
day	1	1																
2 week																		
month																		
1/8 year	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46
1/4 year	91	91	91	91	91	91	91											
1/2 year																		
5 years																		

	d37	d38	d39	d40	d41	d42	d43	d44	d45	d46	d47	d48	d49	d50	d51	d52	d53	d54
day																		
2 week																		
month																		
1/8 year	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46
1/4 year																		
1/2 year																		
5 years																		

FIGURE 13.16 Further case Grid number 8 number of time step 121.

13.10 DETAILED ANALYSIS OF THE PART OF SOURCE CODE FROM GRID NUMBER 0 TO GRID NUMBER 9

Draft short term and middle term with 134 time step

- 20 time step 1 day: 30 * 1 = 30 days
- 5 time step 2 weeks: 5 * 14 = 70 days
- 11 time step 1 month: 21 * 31 = 651 days

- 54 1/8 years time step = 2,463 days
- 35 ¼ years time step = 3,193 days
- 5 ½ years time step = 912 days
- 1 time step 1 year = 365 days
- 2 time step 5 years = 3,650 days

1

+ 20 + 5 + 11

+ 54 + 35 + 5 + 1 + 2 = 134 days

--

11,334 days = ~ 31 years

See Figure 13.17.

MATLAB source code grid number 9 time step 134

```
simulationDates =
[
Settle;...

Settle+1; Settle+2; Settle+3; Settle+4; Settle+5; Settle+6;
Settle+7; Settle+8; Settle+9; Settle+10;...
Settle+11;Settle+12; Settle+13; Settle+14; Settle+15; Settle+16;
Settle+17; Settle+18; Settle+19; Settle+20;...
```

	Start date --------------	+ 1 day	+ 14 days	+ 1 month	+ 1/8 year	+ ¼ year	+ ½ year	+ 1 year	+ 5 years	# time step
Grid 0	1	22	2	11	--	--	--	9	4	49
Grid 9	1	20	5	11	54	35	5	1	2	134

FIGURE 13.17 Grid number 9 time step 134.

```
Settle+20+7*2;Settle+20+7*3;Settle+20+7*4;
Settle+20+7*5;Settle+20+7*6;...

Settle+20+7*6+31;  Settle+20+7*6+31*2; Settle+20+7*6+31*3;
Settle+20+7*6+31*4; Settle+20+7*6+31*5;...
Settle+20+7*6+31*6; Settle+20+7*6+31*7;Settle+20+7*6+31*8;
Settle+20+7*6+31*9; Settle+20+7*6+31*10;...
Settle+20+7*6+31*12;...

Settle+20+7*6+31*12+ 365*(1/8); Settle+20+7*6+31*12+
365*2(1/8);...
Settle+20+7*6+31*12+ 365*3(1/8);Settle+20+7*6+31*12+
365*4(1/8);...
Settle+20+7*6+31*12+ 365*5(1/8);Settle+20+7*6+31*12+
365*6(1/8);...
Settle+20+7*6+31*12+ 365*7(1/8);Settle+20+7*6+31*12+
365*8(1/8);...
Settle+20+7*6+31*12+ 365*9(1/8); Settle+20+7*6+31*12+
365*10(1/8);...
Settle+20+7*6+31*12+ 365*11(1/8);Settle+20+7*6+31*12+
365*12(1/8);...
Settle+20+7*6+31*12+ 365*13(1/8);Settle+20+7*6+31*12+
365*14(1/8);...
Settle+20+7*6+31*12+ 365*15(1/8);Settle+20+7*6+31*12+
365*16(1/8);...
Settle+20+7*6+31*12+ 365*17(1/8);Settle+20+7*6+31*12+
365*18(1/8);...
Settle+20+7*6+31*12+ 365*19(1/8); Settle+20+7*6+31*12+
365*20(1/8);...
Settle+20+7*6+31*12+ 365*21(1/8);Settle+20+7*6+31*12+
365*22(1/8);...
Settle+20+7*6+31*12+ 365*23(1/8);Settle+20+7*6+31*12+
365*24(1/8);...
Settle+20+7*6+31*12+ 365*25(1/8);Settle+20+7*6+31*12+
365*26(1/8);...
Settle+20+7*6+31*12+ 365*27(1/8);Settle+20+7*6+31*12+
365*28(1/8);...
Settle+20+7*6+31*12+ 365*29(1/8); Settle+20+7*6+31*12+
365*30(1/8);...
Settle+20+7*6+31*12+ 365*31(1/8);Settle+20+7*6+31*12+
365*32(1/8);...
Settle+20+7*6+31*12+ 365*33(1/8);Settle+20+7*6+31*12+
365*34(1/8);...
Settle+20+7*6+31*12+ 365*35(1/8);Settle+20+7*6+31*12+
365*36(1/8);...
Settle+20+7*6+31*12+ 365*37(1/8);Settle+20+7*6+31*12+
365*38(1/8);...
```

```
Settle+20+7*6+31*12+ 365*39(1/8); Settle+20+7*6+31*12+
365*40(1/8);...
Settle+20+7*6+31*12+ 365*41(1/8);Settle+20+7*6+31*12+
365*42(1/8);...
Settle+20+7*6+31*12+ 365*43(1/8);Settle+20+7*6+31*12+
365*44(1/8);...
Settle+20+7*6+31*12+ 365*45(1/8);Settle+20+7*6+31*12+
365*46(1/8);...
Settle+20+7*6+31*12+ 365*47(1/8);Settle+20+7*6+31*12+
365*48(1/8);...
Settle+20+7*6+31*12+ 365*49(1/8); Settle+20+7*6+31*12+
365*50(1/8);...
Settle+20+7*6+31*12+ 365*51(1/8); Settle+20+7*6+31*12+
365*52(1/8);...
Settle+20+7*6+31*12+ 365*53(1/8); Settle+20+7*6+31*12+
365*54(1/8);...

Settle+20+7*6+31*12+ 365*54(1/8)+ 365(1/4);…
Settle+20+7*6+31*12+ 365*54(1/8)+ 365*2(1/4);…
Settle+20+7*6+31*12+ 365*54(1/8)+ 365*3(1/4);…
Settle+20+7*6+31*12+ 365*54(1/8)+ 365*4(1/4);…
Settle+20+7*6+31*12+ 365*54(1/8)+ 365*5(1/4);…
Settle+20+7*6+31*12+ 365*54(1/8)+ 365*6(1/4);…
Settle+20+7*6+31*12+ 365*54(1/8)+ 365*7(1/4);…
Settle+20+7*6+31*12+ 365*54(1/8)+ 365*8(1/4);…
Settle+20+7*6+31*12+ 365*54(1/8)+ 365*9(1/4);…
Settle+20+7*6+31*12+ 365*54(1/8)+ 365*10(1/4);…
Settle+20+7*6+31*12+ 365*54(1/8)+ 365*11(1/4);…
Settle+20+7*6+31*12+ 365*54(1/8)+ 365*12(1/4);…
Settle+20+7*6+31*12+ 365*54(1/8)+ 365*13(1/4);…
Settle+20+7*6+31*12+ 365*54(1/8)+ 365*14(1/4);…
Settle+20+7*6+31*12+ 365*54(1/8)+ 365*15(1/4);…
Settle+20+7*6+31*12+ 365*54(1/8)+ 365*16(1/4);…
Settle+20+7*6+31*12+ 365*54(1/8)+ 365*17(1/4);…
Settle+20+7*6+31*12+ 365*54(1/8)+ 365*18(1/4);…
Settle+20+7*6+31*12+ 365*54(1/8)+ 365*19(1/4);…
Settle+20+7*6+31*12+ 365*54(1/8)+ 365*20(1/4);…
Settle+20+7*6+31*12+ 365*54(1/8)+ 365*21(1/4);…
Settle+20+7*6+31*12+ 365*54(1/8)+ 365*22(1/4);…
Settle+20+7*6+31*12+ 365*54(1/8)+ 365*23(1/4);…
Settle+20+7*6+31*12+ 365*54(1/8)+ 365*24(1/4);…
Settle+20+7*6+31*12+ 365*54(1/8)+ 365*25(1/4);…
Settle+20+7*6+31*12+ 365*54(1/8)+ 365*26(1/4);…
Settle+20+7*6+31*12+ 365*54(1/8)+ 365*27(1/4);…
Settle+20+7*6+31*12+ 365*54(1/8)+ 365*28(1/4);…
Settle+20+7*6+31*12+ 365*54(1/8)+ 365*29(1/4);…
Settle+20+7*6+31*12+ 365*54(1/8)+ 365*30(1/4);…
```

```
Settle+20+7*6+31*12+ 365*54(1/8)+ 365*31(1/4);…
Settle+20+7*6+31*12+ 365*54(1/8)+ 365*32(1/4);…
Settle+20+7*6+31*12+ 365*54(1/8)+ 365*33(1/4);…
Settle+20+7*6+31*12+ 365*54(1/8)+ 365*34(1/4);…
Settle+20+7*6+31*12+ 365*54(1/8)+ 365*35(1/4);…

Settle+20+7*6+31*12+ 365*54(1/8)+ 365*35(1/4)+365(1/2);...
Settle+20+7*6+31*12+ 365*54(1/8)+ 365*35(1/4)+365*2(1/2);...
Settle+20+7*6+31*12+ 365*54(1/8)+ 365*35(1/4)+365*3(1/2);...
Settle+20+7*6+31*12+ 365*54(1/8)+ 365*35(1/4)+365*4(1/2);...
Settle+20+7*6+31*12+ 365*54(1/8)+ 365*35(1/4)+365*5(1/2);...

Settle+20+7*6+31*12+ 365*54(1/8)+ 365*35(1/4)+365*5(1/2)+ +365;...

Settle+20+7*6+31*12+ 365*54(1/8)+ 365*35(1/4)+365*5(1/2)+
+365+365*5;…
Settle+20+7*6+31*12+ 365*54(1/8)+ 365*35(1/4)+365*5(1/2)+
+365+365*10;…

];
```

End MATLAB source code grid number 9 time step 134

See Figure 13.18.

13.11 DETAILED ANALYSIS OF THE PART OF SOURCE CODE FROM GRID NUMBER 0 TO GRID NUMBER 10

Draft short term and middle term with 153 time step

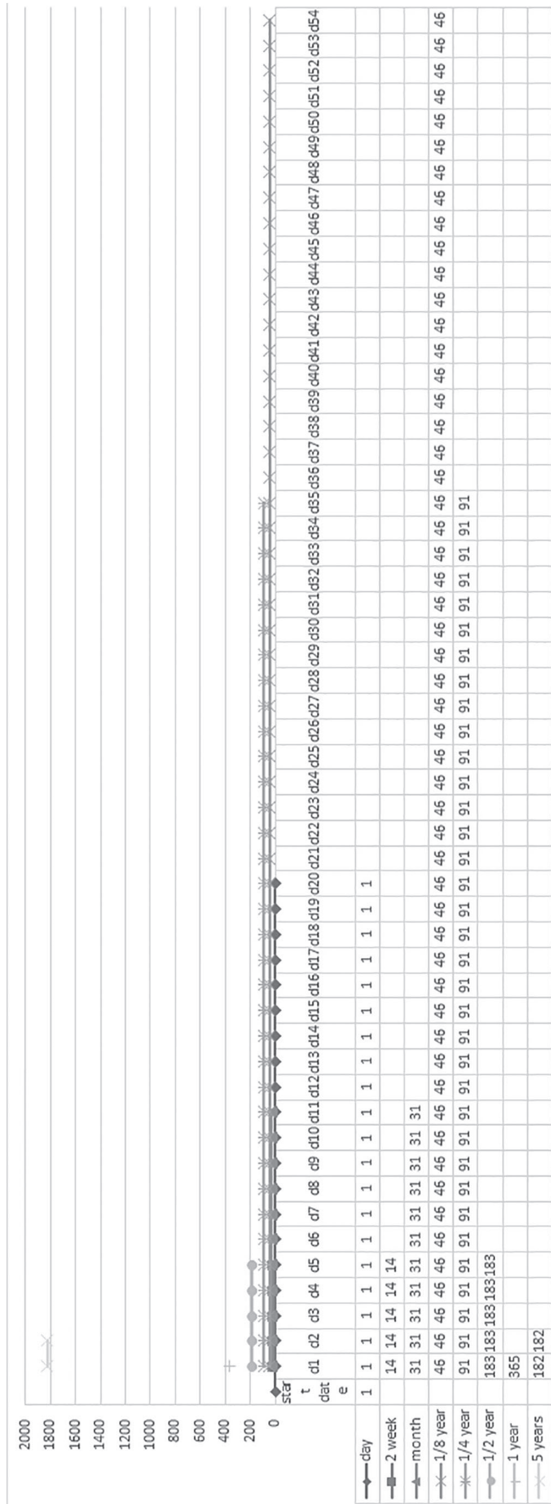
- 20 time step 1 day: 30 * 1 = 30 days
- 5 time step 2 weeks: 5 * 14 = 70 days
- 11 time step 1 month: 21 * 31 = 651 days
- 74 1/8 years time step = 3,376 days
- 25 ¼ years time step = 2,281 days
- 15 ½ years time step = 2,735 days
- 1 time step 1 year = 365 days
- 1 time step 5 years = 1,825 days

1

+ 20 + 5 + 11

+ 74 + 25 + 15 + 1 + 1 = 153 days

11,333 days = ~ 31 years



	start date	d1	d2	d3	d4	d5	d6	d7	d8	d9	d10	d11	d12	d13	d14	d15	d16	d17	d18
day	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2 week		14	14	14	14	14													
month		31	31	31	31	31	31	31	31	31	31	31							
1/8 year		46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46
1/4 year		91	91	91	91	91	91	91	91	91	91	91	91	91	91	91	91	91	91
1/2 year		183	183	183	183	183													
1 year		365																	
5 years		182	182																

	d19	d20	d21	d22	d23	d24	d25	d26	d27	d28	d29	d30	d31	d32	d33	d34	d35	d36
day	1	1																
2 week																		
month																		
1/8 year	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46
1/4 year	91	91	91	91	91	91	91	91	91	91	91	91	91	91	91	91	91	
1/2 year																		
1 year																		
5 years																		

	d37	d38	d39	d40	d41	d42	d43	d44	d45	d46	d47	d48	d49	d50	d51	d52	d53	d54
day																		
2 week																		
month																		
1/8 year	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46
1/4 year																		
1/2 year																		
1 year																		
5 years																		

FIGURE 13.18 Further case Grid number 9 number of time step 134.

See Figure 13.19.

MATLAB source code grid number 10 time step 153

```
simulationDates =
[
Settle;...

Settle+1; Settle+2; Settle+3; Settle+4; Settle+5; Settle+6;
Settle+7; Settle+8; Settle+9; Settle+10;...
Settle+11;Settle+12; Settle+13; Settle+14; Settle+15; Settle+16;
Settle+17; Settle+18; Settle+19; Settle+20;...

Settle+20+7*2;Settle+20+7*3;Settle+20+7*4;
Settle+20+7*5;Settle+20+7*6;...

Settle+20+7*6+31;  Settle+20+7*6+31*2; Settle+20+7*6+31*3;
Settle+20+7*6+31*4; Settle+20+7*6+31*5;...
Settle+20+7*6+31*6; Settle+20+7*6+31*7;Settle+20+7*6+31*8;
Settle+20+7*6+31*9; Settle+20+7*6+31*10;...
Settle+20+7*6+31*12;...

Settle+20+7*6+31*12+ 365*(1/8); Settle+20+7*6+31*12+
365*2(1/8);...
Settle+20+7*6+31*12+ 365*3(1/8);Settle+20+7*6+31*12+
365*4(1/8);...
Settle+20+7*6+31*12+ 365*5(1/8);Settle+20+7*6+31*12+
365*6(1/8);...
Settle+20+7*6+31*12+ 365*7(1/8);Settle+20+7*6+31*12+
365*8(1/8);...
Settle+20+7*6+31*12+ 365*9(1/8); Settle+20+7*6+31*12+
365*10(1/8);...
Settle+20+7*6+31*12+ 365*11(1/8);Settle+20+7*6+31*12+
365*12(1/8);...
Settle+20+7*6+31*12+ 365*13(1/8);Settle+20+7*6+31*12+
365*14(1/8);...
Settle+20+7*6+31*12+ 365*15(1/8);Settle+20+7*6+31*12+
365*16(1/8);...
```

	Start date ------------- --	+ 1 day	+ 14 days	+ 1 month	+ 1/8 year	+ ¼ year	+ ½ year	+ 1 year	+ 5 years	# time step
Grid 0	1	22	2	11	--	--	--	9	4	49
Grid 10	1	20	5	11	74	25	15	1	1	153

FIGURE 13.19 Grid number 10 time step 153.

```
Settle+20+7*6+31*12+ 365*17(1/8);Settle+20+7*6+31*12+
365*18(1/8);...
Settle+20+7*6+31*12+ 365*19(1/8); Settle+20+7*6+31*12+
365*20(1/8);...
Settle+20+7*6+31*12+ 365*21(1/8);Settle+20+7*6+31*12+
365*22(1/8);...
Settle+20+7*6+31*12+ 365*23(1/8);Settle+20+7*6+31*12+
365*24(1/8);...
Settle+20+7*6+31*12+ 365*25(1/8);Settle+20+7*6+31*12+
365*26(1/8);...
Settle+20+7*6+31*12+ 365*27(1/8);Settle+20+7*6+31*12+
365*28(1/8);...
Settle+20+7*6+31*12+ 365*29(1/8); Settle+20+7*6+31*12+
365*30(1/8);...
Settle+20+7*6+31*12+ 365*31(1/8);Settle+20+7*6+31*12+
365*32(1/8);...
Settle+20+7*6+31*12+ 365*33(1/8);Settle+20+7*6+31*12+
365*34(1/8);...
Settle+20+7*6+31*12+ 365*35(1/8);Settle+20+7*6+31*12+
365*36(1/8);...
Settle+20+7*6+31*12+ 365*37(1/8);Settle+20+7*6+31*12+
365*38(1/8);...
Settle+20+7*6+31*12+ 365*39(1/8); Settle+20+7*6+31*12+
365*40(1/8);...
Settle+20+7*6+31*12+ 365*41(1/8);Settle+20+7*6+31*12+
365*42(1/8);...
Settle+20+7*6+31*12+ 365*43(1/8);Settle+20+7*6+31*12+
365*44(1/8);...
Settle+20+7*6+31*12+ 365*45(1/8);Settle+20+7*6+31*12+
365*46(1/8);...
Settle+20+7*6+31*12+ 365*47(1/8);Settle+20+7*6+31*12+
365*48(1/8);...
Settle+20+7*6+31*12+ 365*49(1/8); Settle+20+7*6+31*12+
365*50(1/8);...
Settle+20+7*6+31*12+ 365*51(1/8); Settle+20+7*6+31*12+
365*52(1/8);...
Settle+20+7*6+31*12+ 365*53(1/8); Settle+20+7*6+31*12+
365*54(1/8);...
Settle+20+7*6+31*12+ 365*55(1/8); Settle+20+7*6+31*12+
365*56(1/8);...
Settle+20+7*6+31*12+ 365*57(1/8); Settle+20+7*6+31*12+
365*58(1/8);...
Settle+20+7*6+31*12+ 365*59(1/8); Settle+20+7*6+31*12+
365*60(1/8);...
Settle+20+7*6+31*12+ 365*61(1/8); Settle+20+7*6+31*12+
365*62(1/8);...
```

```
Settle+20+7*6+31*12+ 365*63(1/8); Settle+20+7*6+31*12+
365*64(1/8);...
Settle+20+7*6+31*12+ 365*65(1/8); Settle+20+7*6+31*12+
365*66(1/8);...
Settle+20+7*6+31*12+ 365*67(1/8); Settle+20+7*6+31*12+
365*68(1/8);...
Settle+20+7*6+31*12+ 365*69(1/8); Settle+20+7*6+31*12+
365*70(1/8);...
Settle+20+7*6+31*12+ 365*71(1/8); Settle+20+7*6+31*12+
365*72(1/8);...
Settle+20+7*6+31*12+ 365*73(1/8); Settle+20+7*6+31*12+
365*74(1/8);...

Settle+20+7*6+31*12+ 365*74(1/8)+ 365(1/4);…
Settle+20+7*6+31*12+ 365*74(1/8)+ 365*2(1/4);…
Settle+20+7*6+31*12+ 365*74(1/8)+ 365*3(1/4);…
Settle+20+7*6+31*12+ 365*74(1/8)+ 365*4(1/4);…
Settle+20+7*6+31*12+ 365*74(1/8)+ 365*5(1/4);…
Settle+20+7*6+31*12+ 365*74(1/8)+ 365*6(1/4);…
Settle+20+7*6+31*12+ 365*74(1/8)+ 365*7(1/4);…
Settle+20+7*6+31*12+ 365*74(1/8)+ 365*8(1/4);…
Settle+20+7*6+31*12+ 365*74(1/8)+ 365*9(1/4);…
Settle+20+7*6+31*12+ 365*74(1/8)+ 365*10(1/4);…
Settle+20+7*6+31*12+ 365*74(1/8)+ 365*11(1/4);…
Settle+20+7*6+31*12+ 365*74(1/8)+ 365*12(1/4);…
Settle+20+7*6+31*12+ 365*74(1/8)+ 365*13(1/4);…
Settle+20+7*6+31*12+ 365*74(1/8)+ 365*14(1/4);…
Settle+20+7*6+31*12+ 365*74(1/8)+ 365*15(1/4);…
Settle+20+7*6+31*12+ 365*74(1/8)+ 365*16(1/4);…
Settle+20+7*6+31*12+ 365*74(1/8)+ 365*17(1/4);…
Settle+20+7*6+31*12+ 365*74(1/8)+ 365*18(1/4);…
Settle+20+7*6+31*12+ 365*74(1/8)+ 365*19(1/4);…
Settle+20+7*6+31*12+ 365*74(1/8)+ 365*20(1/4);…
Settle+20+7*6+31*12+ 365*74(1/8)+ 365*21(1/4);…
Settle+20+7*6+31*12+ 365*74(1/8)+ 365*22(1/4);…
Settle+20+7*6+31*12+ 365*74(1/8)+ 365*23(1/4);…
Settle+20+7*6+31*12+ 365*74(1/8)+ 365*24(1/4);…
Settle+20+7*6+31*12+ 365*74(1/8)+ 365*25(1/4);…

Settle+20+7*6+31*12+ 365*74(1/8)+ 365*25(1/4)+365(1/2);...
Settle+20+7*6+31*12+ 365*74(1/8)+ 365*25(1/4)+365*2(1/2);...
Settle+20+7*6+31*12+ 365*74(1/8)+ 365*25(1/4)+365*3(1/2);...
Settle+20+7*6+31*12+ 365*74(1/8)+ 365*25(1/4)+365*4(1/2);...
Settle+20+7*6+31*12+ 365*74(1/8)+ 365*25(1/4)+365*5(1/2);...
Settle+20+7*6+31*12+ 365*74(1/8)+ 365*25(1/4)+365*6(1/2);...
Settle+20+7*6+31*12+ 365*74(1/8)+ 365*25(1/4)+365*7(1/2);...
Settle+20+7*6+31*12+ 365*74(1/8)+ 365*25(1/4)+365*8(1/2);...
```

```
Settle+20+7*6+31*12+ 365*74(1/8)+ 365*25(1/4)+365*9(1/2);...
Settle+20+7*6+31*12+ 365*74(1/8)+ 365*25(1/4)+365*10(1/2);...
Settle+20+7*6+31*12+ 365*74(1/8)+ 365*25(1/4)+365*11(1/2);...
Settle+20+7*6+31*12+ 365*74(1/8)+ 365*25(1/4)+365*12(1/2);...
Settle+20+7*6+31*12+ 365*74(1/8)+ 365*25(1/4)+365*13(1/2);...
Settle+20+7*6+31*12+ 365*74(1/8)+ 365*25(1/4)+365*14(1/2);...
Settle+20+7*6+31*12+ 365*74(1/8)+ 365*25(1/4)+365*15(1/2);...

Settle+20+7*6+31*12+ 365*74(1/8)+ 365*25(1/4)+365*15(1/2)+
+365;...

Settle+20+7*6+31;  Settle+20+7*6+31*2; Settle+20+7*6+31*3;
Settle+20+7*6+31*4; Settle+20+7*6+31*5;...
Settle+20+7*6+31*6; Settle+20+7*6+31*7;Settle+20+7*6+31*8;
Settle+20+7*6+31*9; Settle+20+7*6+31*10;...
Settle+20+7*6+31*12;...

];
```

End MATLAB source code grid number 10 time step 153

See Figure 13.20.

13.12 DETAILED ANALYSIS OF THE PART OF SOURCE CODE FROM GRID NUMBER 0 TO GRID NUMBER 11

Draft short term and middle term with 168 time step

- 20 time step 1 day: 30 * 1 = 30 days
- 5 time step 2 weeks: 5 * 14 = 70 days
- 11 time step 1 month: 21 * 31 = 651 days

- 84 1/8 years time step = 3832 days
- 40 ¼ years time step = 3650 days
- 5 ½ years time step = 912 days
- 1 time step 1 year = 365 days
- 1 time step 5 years = 1825 days

FIGURE 13.20 Further case Grid number 10 number of time step 153.

1

+ 20 + 5 + 11

+ 84 + 40 + 5 + 1 + 1 = 168 days

11,335 days = ~ 31 years

See Figure 13.21

MATLAB source code grid number 11 time step 168

```
simulationDates =
[
Settle;...

Settle+1; Settle+2; Settle+3; Settle+4; Settle+5; Settle+6;
Settle+7; Settle+8; Settle+9; Settle+10;...
Settle+11;Settle+12; Settle+13; Settle+14; Settle+15; Settle+16;
Settle+17; Settle+18; Settle+19; Settle+20;...

Settle+20+7*2;Settle+20+7*3;Settle+20+7*4;
Settle+20+7*5;Settle+20+7*6;...

Settle+20+7*2;Settle+20+7*3;Settle+20+7*4;
Settle+20+7*5;Settle+20+7*6;...

Settle+20+7*6+31*12+ 365*(1/8); Settle+20+7*6+31*12+
365*2(1/8);...
Settle+20+7*6+31*12+ 365*3(1/8);Settle+20+7*6+31*12+
365*4(1/8);...
Settle+20+7*6+31*12+ 365*5(1/8);Settle+20+7*6+31*12+
365*6(1/8);...
Settle+20+7*6+31*12+ 365*7(1/8);Settle+20+7*6+31*12+
365*8(1/8);...
Settle+20+7*6+31*12+ 365*9(1/8); Settle+20+7*6+31*12+
365*10(1/8);...
Settle+20+7*6+31*12+ 365*11(1/8);Settle+20+7*6+31*12+
365*12(1/8);...
```

	Start date	+ 1 day	+ 14 days	+ 1 month	+ 1/8 year	+ ¼ year	+ ½ year	+ 1 year	+ 5 years	# time step
Grid 0	1	22	2	11	--	--	--	9	4	49
Grid 11	1	20	5	11	84	40	5	1	1	168

FIGURE 13.21 Grid number 11 time step 168.

```
Settle+20+7*6+31*12+ 365*13(1/8);Settle+20+7*6+31*12+
365*14(1/8);...
Settle+20+7*6+31*12+ 365*15(1/8);Settle+20+7*6+31*12+
365*16(1/8);...
Settle+20+7*6+31*12+ 365*17(1/8);Settle+20+7*6+31*12+
365*18(1/8);...
Settle+20+7*6+31*12+ 365*19(1/8); Settle+20+7*6+31*12+
365*20(1/8);...
Settle+20+7*6+31*12+ 365*21(1/8);Settle+20+7*6+31*12+
365*22(1/8);...
Settle+20+7*6+31*12+ 365*23(1/8);Settle+20+7*6+31*12+
365*24(1/8);...
Settle+20+7*6+31*12+ 365*25(1/8);Settle+20+7*6+31*12+
365*26(1/8);...
Settle+20+7*6+31*12+ 365*27(1/8);Settle+20+7*6+31*12+
365*28(1/8);...
Settle+20+7*6+31*12+ 365*29(1/8); Settle+20+7*6+31*12+
365*30(1/8);...
Settle+20+7*6+31*12+ 365*31(1/8);Settle+20+7*6+31*12+
365*32(1/8);...
Settle+20+7*6+31*12+ 365*33(1/8);Settle+20+7*6+31*12+
365*34(1/8);...
Settle+20+7*6+31*12+ 365*35(1/8);Settle+20+7*6+31*12+
365*36(1/8);...
Settle+20+7*6+31*12+ 365*37(1/8);Settle+20+7*6+31*12+
365*38(1/8);...
Settle+20+7*6+31*12+ 365*39(1/8); Settle+20+7*6+31*12+
365*40(1/8);...
Settle+20+7*6+31*12+ 365*41(1/8);Settle+20+7*6+31*12+
365*42(1/8);...
Settle+20+7*6+31*12+ 365*43(1/8);Settle+20+7*6+31*12+
365*44(1/8);...
Settle+20+7*6+31*12+ 365*45(1/8);Settle+20+7*6+31*12+
365*46(1/8);...
Settle+20+7*6+31*12+ 365*47(1/8);Settle+20+7*6+31*12+
365*48(1/8);...
Settle+20+7*6+31*12+ 365*49(1/8); Settle+20+7*6+31*12+
365*50(1/8);...
Settle+20+7*6+31*12+ 365*51(1/8); Settle+20+7*6+31*12+
365*52(1/8);...
Settle+20+7*6+31*12+ 365*53(1/8); Settle+20+7*6+31*12+
365*54(1/8);...
Settle+20+7*6+31*12+ 365*55(1/8); Settle+20+7*6+31*12+
365*56(1/8);...
Settle+20+7*6+31*12+ 365*57(1/8); Settle+20+7*6+31*12+
365*58(1/8);...
```

```
Settle+20+7*6+31*12+ 365*59(1/8); Settle+20+7*6+31*12+
365*60(1/8);...
Settle+20+7*6+31*12+ 365*61(1/8); Settle+20+7*6+31*12+
365*62(1/8);...
Settle+20+7*6+31*12+ 365*63(1/8); Settle+20+7*6+31*12+
365*64(1/8);...
Settle+20+7*6+31*12+ 365*65(1/8); Settle+20+7*6+31*12+
365*66(1/8);...
Settle+20+7*6+31*12+ 365*67(1/8); Settle+20+7*6+31*12+
365*68(1/8);...
Settle+20+7*6+31*12+ 365*69(1/8); Settle+20+7*6+31*12+
365*70(1/8);...
Settle+20+7*6+31*12+ 365*71(1/8); Settle+20+7*6+31*12+
365*72(1/8);...
Settle+20+7*6+31*12+ 365*73(1/8); Settle+20+7*6+31*12+
365*74(1/8);...

Settle+20+7*6+31*12+ 365*74(1/8)+ 365(1/4);…
Settle+20+7*6+31*12+ 365*74(1/8)+ 365*2(1/4);…
Settle+20+7*6+31*12+ 365*74(1/8)+ 365*3(1/4);…
Settle+20+7*6+31*12+ 365*74(1/8)+ 365*4(1/4);…
Settle+20+7*6+31*12+ 365*74(1/8)+ 365*5(1/4);…
Settle+20+7*6+31*12+ 365*74(1/8)+ 365*6(1/4);…
Settle+20+7*6+31*12+ 365*74(1/8)+ 365*7(1/4);…
Settle+20+7*6+31*12+ 365*74(1/8)+ 365*8(1/4);…
Settle+20+7*6+31*12+ 365*74(1/8)+ 365*9(1/4);…
Settle+20+7*6+31*12+ 365*74(1/8)+ 365*10(1/4);…
Settle+20+7*6+31*12+ 365*74(1/8)+ 365*11(1/4);…
Settle+20+7*6+31*12+ 365*74(1/8)+ 365*12(1/4);…
Settle+20+7*6+31*12+ 365*74(1/8)+ 365*13(1/4);…
Settle+20+7*6+31*12+ 365*74(1/8)+ 365*14(1/4);…
Settle+20+7*6+31*12+ 365*74(1/8)+ 365*15(1/4);…
Settle+20+7*6+31*12+ 365*74(1/8)+ 365*16(1/4);…
Settle+20+7*6+31*12+ 365*74(1/8)+ 365*17(1/4);…
Settle+20+7*6+31*12+ 365*74(1/8)+ 365*18(1/4);…
Settle+20+7*6+31*12+ 365*74(1/8)+ 365*19(1/4);…
Settle+20+7*6+31*12+ 365*74(1/8)+ 365*20(1/4);…
Settle+20+7*6+31*12+ 365*74(1/8)+ 365*21(1/4);…
Settle+20+7*6+31*12+ 365*74(1/8)+ 365*22(1/4);…
Settle+20+7*6+31*12+ 365*74(1/8)+ 365*23(1/4);…
Settle+20+7*6+31*12+ 365*74(1/8)+ 365*24(1/4);…
Settle+20+7*6+31*12+ 365*74(1/8)+ 365*25(1/4);…

Settle+20+7*6+31*12+ 365*74(1/8)+ 365*25(1/4)+365*15(1/2)+
+365;...
```

```
Settle+20+7*6+31*12+ 365*74(1/8)+ 365*25(1/4)+365*15(1/2)+
+365+365*5;…
Settle+20+7*6+31*12+ 365*74(1/8)+ 365*25(1/4)+365*15(1/2)+
+365+365*10;…

];
```

End MATLAB source code grid number 11 time step 168

See Figure 13.22.

13.13 DETAILED ANALYSIS OF THE PART OF SOURCE CODE FROM GRID NUMBER 0 TO GRID NUMBER 12

Draft short term and middle term with 203 time step

- 20 time step 1 day: 30 * 1 = 30 days
- 5 time step 2 weeks: 5 * 14 = 70 days
- 11 time step 1 month: 21 * 31 = 651 days

- 134 1/8 years time step = 6,113 days
- 25 ¼ years time step = 2,281 days
- 5 ½ years time step = 912 days
- 1 time step 1 year = 365 days
- 1 time step 5 years = 1,825 days

1

+ 20 + 5 + 11

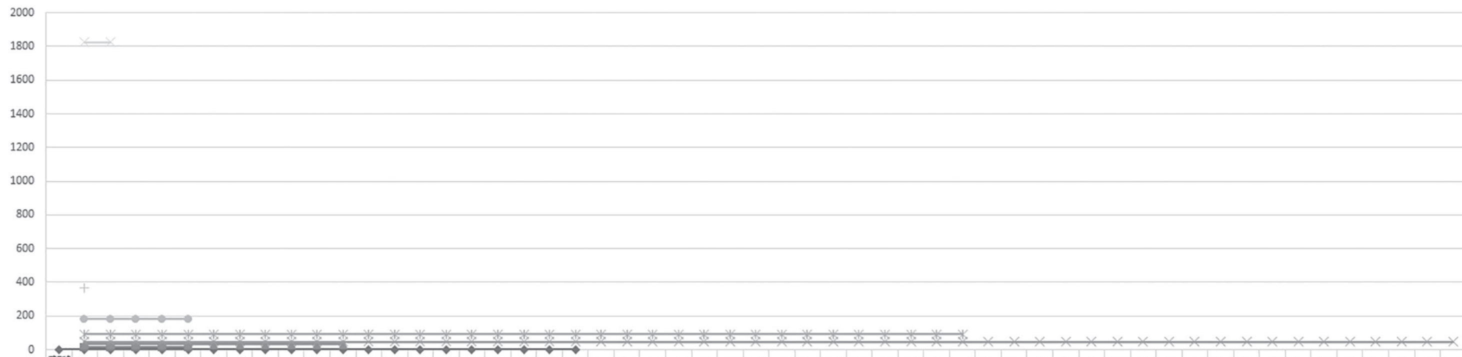
+ 134 + 25 + 5 + 1 + 1 = 203 days

12,247 days = ~ 33 years

See Figure 13.23.

MATLAB source code grid number 12 time step 203

```
simulationDates =
[
Settle;...
```



	start date	d1	d2	d3	d4	d5	d6	d7	d8	d9	d10	d11	d12	d13	d14	d15	d16	d17	d18	d19	d20	d21	d22	d23	d24	d25	d26	d27
day	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1							
2 week		14	14	14	14	14																						
month		31	31	31	31	31	31	31	31	31	31	31																
1/8 year		45,6	45,6	45,6	45,6	45,6	45,6	45,6	45,6	45,6	45,6	45,6	45,6	45,6	45,6	45,6	45,6	45,6	45,6	45,6	45,6	45,6	45,6	45,6	45,6	45,6	45,6	45,6
1/4 year		91,3	91,3	91,3	91,3	91,3	91,3	91,3	91,3	91,3	91,3	91,3	91,3	91,3	91,3	91,3	91,3	91,3	91,3	91,3	91,3	91,3	91,3	91,3	91,3	91,3	91,3	91,3
1/2 year		183	183	183	183	183																						
1 year		365																										
5 years		1825	1825																									

	d28	d29	d30	d31	d32	d33	d34	d35	d36	d37	d38	d39	d40	d41	d42	d43	d44	d45	d46	d47	d48	d49	d50	d51	d52	d53	d54
day																											
2 week																											
month																											
1/8 year	45,6	45,6	45,6	45,6	45,6	45,6	45,6	45,6	45,6	45,6	45,6	45,6	45,6	45,6	45,6	45,6	45,6	45,6	45,6	45,6	45,6	45,6	45,6	45,6	45,6	45,6	45,6
1/4 year	91,3	91,3	91,3	91,3	91,3	91,3	91,3	91,3																			
1/2 year																											
1 year																											
5 years																											

FIGURE 13.22 Further case Grid number 11 number of time step 168.

	Start date --------------	+ 1 day	+ 14 days	+ 1 month	+ 1/8 year	+ ¼ year	+ ½ year	+ 1 year	+ 5 years	# time step
Grid 0	1	22	2	11	--	--	--	9	4	49
Grid 12	1	20	5	11	134	25	5	1	1	203

FIGURE 13.23 Grid number 12 number of time step 203.

```
Settle+1; Settle+2; Settle+3; Settle+4; Settle+5; Settle+6;
Settle+7; Settle+8; Settle+9; Settle+10;...
Settle+11;Settle+12; Settle+13; Settle+14; Settle+15; Settle+16;
Settle+17; Settle+18; Settle+19; Settle+20;...

Settle+20+7*2;Settle+20+7*3;Settle+20+7*4;
Settle+20+7*5;Settle+20+7*6;...

Settle+20+7*6+31;  Settle+20+7*6+31*2; Settle+20+7*6+31*3;
Settle+20+7*6+31*4; Settle+20+7*6+31*5;...
Settle+20+7*6+31*6; Settle+20+7*6+31*7;Settle+20+7*6+31*8;
Settle+20+7*6+31*9; Settle+20+7*6+31*10;...
Settle+20+7*6+31*12;...

Settle+20+7*6+31*12+ 365*(1/8); Settle+20+7*6+31*12+
365*2(1/8);...
Settle+20+7*6+31*12+ 365*3(1/8);Settle+20+7*6+31*12+
365*4(1/8);...
Settle+20+7*6+31*12+ 365*5(1/8);Settle+20+7*6+31*12+
365*6(1/8);...
Settle+20+7*6+31*12+ 365*7(1/8);Settle+20+7*6+31*12+
365*8(1/8);...
Settle+20+7*6+31*12+ 365*9(1/8); Settle+20+7*6+31*12+
365*10(1/8);...
Settle+20+7*6+31*12+ 365*11(1/8);Settle+20+7*6+31*12+
365*12(1/8);...
Settle+20+7*6+31*12+ 365*13(1/8);Settle+20+7*6+31*12+
365*14(1/8);...
Settle+20+7*6+31*12+ 365*15(1/8);Settle+20+7*6+31*12+
365*16(1/8);...
Settle+20+7*6+31*12+ 365*17(1/8);Settle+20+7*6+31*12+
365*18(1/8);...
Settle+20+7*6+31*12+ 365*19(1/8); Settle+20+7*6+31*12+
365*20(1/8);...
Settle+20+7*6+31*12+ 365*21(1/8);Settle+20+7*6+31*12+
365*22(1/8);...
Settle+20+7*6+31*12+ 365*23(1/8);Settle+20+7*6+31*12+
365*24(1/8);...
Settle+20+7*6+31*12+ 365*25(1/8);Settle+20+7*6+31*12+
365*26(1/8);...
```

```
Settle+20+7*6+31*12+ 365*27(1/8);Settle+20+7*6+31*12+
365*28(1/8);...
Settle+20+7*6+31*12+ 365*29(1/8); Settle+20+7*6+31*12+
365*30(1/8);...
Settle+20+7*6+31*12+ 365*31(1/8);Settle+20+7*6+31*12+
365*32(1/8);...
Settle+20+7*6+31*12+ 365*33(1/8);Settle+20+7*6+31*12+
365*34(1/8);...
Settle+20+7*6+31*12+ 365*35(1/8);Settle+20+7*6+31*12+
365*36(1/8);...
Settle+20+7*6+31*12+ 365*37(1/8);Settle+20+7*6+31*12+
365*38(1/8);...
Settle+20+7*6+31*12+ 365*39(1/8); Settle+20+7*6+31*12+
365*40(1/8);...
Settle+20+7*6+31*12+ 365*41(1/8);Settle+20+7*6+31*12+
365*42(1/8);...
Settle+20+7*6+31*12+ 365*43(1/8);Settle+20+7*6+31*12+
365*44(1/8);...
Settle+20+7*6+31*12+ 365*45(1/8);Settle+20+7*6+31*12+
365*46(1/8);...
Settle+20+7*6+31*12+ 365*47(1/8);Settle+20+7*6+31*12+
365*48(1/8);...
Settle+20+7*6+31*12+ 365*49(1/8); Settle+20+7*6+31*12+
365*50(1/8);...
Settle+20+7*6+31*12+ 365*51(1/8); Settle+20+7*6+31*12+
365*52(1/8);...
Settle+20+7*6+31*12+ 365*53(1/8); Settle+20+7*6+31*12+
365*54(1/8);...
Settle+20+7*6+31*12+ 365*55(1/8); Settle+20+7*6+31*12+
365*56(1/8);...
Settle+20+7*6+31*12+ 365*57(1/8); Settle+20+7*6+31*12+
365*58(1/8);...
Settle+20+7*6+31*12+ 365*59(1/8); Settle+20+7*6+31*12+
365*60(1/8);...
Settle+20+7*6+31*12+ 365*61(1/8); Settle+20+7*6+31*12+
365*62(1/8);...
Settle+20+7*6+31*12+ 365*63(1/8); Settle+20+7*6+31*12+
365*64(1/8);...
Settle+20+7*6+31*12+ 365*65(1/8); Settle+20+7*6+31*12+
365*66(1/8);...
Settle+20+7*6+31*12+ 365*67(1/8); Settle+20+7*6+31*12+
365*68(1/8);...
Settle+20+7*6+31*12+ 365*69(1/8); Settle+20+7*6+31*12+
365*70(1/8);...
Settle+20+7*6+31*12+ 365*71(1/8); Settle+20+7*6+31*12+
365*72(1/8);...
```

```
Settle+20+7*6+31*12+ 365*73(1/8);Settle+20+7*6+31*12+
365*74(1/8);...
Settle+20+7*6+31*12+ 365*75(1/8);Settle+20+7*6+31*12+
365*76(1/8);...
Settle+20+7*6+31*12+ 365*77(1/8);Settle+20+7*6+31*12+
365*78(1/8);...
Settle+20+7*6+31*12+ 365*79(1/8); Settle+20+7*6+31*12+
365*80(1/8);...
Settle+20+7*6+31*12+ 365*81(1/8);Settle+20+7*6+31*12+
365*82(1/8);...
Settle+20+7*6+31*12+ 365*83(1/8);Settle+20+7*6+31*12+
365*84(1/8);...
Settle+20+7*6+31*12+ 365*85(1/8);Settle+20+7*6+31*12+
365*86(1/8);...
Settle+20+7*6+31*12+ 365*87(1/8);Settle+20+7*6+31*12+
365*88(1/8);...
Settle+20+7*6+31*12+ 365*89(1/8); Settle+20+7*6+31*12+
365*90(1/8);...
Settle+20+7*6+31*12+ 365*91(1/8);Settle+20+7*6+31*12+
365*92(1/8);...
Settle+20+7*6+31*12+ 365*93(1/8);Settle+20+7*6+31*12+
365*94(1/8);...
Settle+20+7*6+31*12+ 365*95(1/8);Settle+20+7*6+31*12+
365*96(1/8);...
Settle+20+7*6+31*12+ 365*97(1/8);Settle+20+7*6+31*12+
365*98(1/8);...
Settle+20+7*6+31*12+ 365*99(1/8); Settle+20+7*6+31*12+
365*100(1/8);...
Settle+20+7*6+31*12+ 365*101(1/8);Settle+20+7*6+31*12+
365*102(1/8);...
Settle+20+7*6+31*12+ 365*103(1/8);Settle+20+7*6+31*12+
365*104(1/8);...
Settle+20+7*6+31*12+ 365*105(1/8);Settle+20+7*6+31*12+
365*106(1/8);...
Settle+20+7*6+31*12+ 365*107(1/8);Settle+20+7*6+31*12+
365*108(1/8);...
Settle+20+7*6+31*12+ 365*109(1/8); Settle+20+7*6+31*12+
365*110(1/8);...
Settle+20+7*6+31*12+ 365*111(1/8);Settle+20+7*6+31*12+
365*112(1/8);...
Settle+20+7*6+31*12+ 365*113(1/8);Settle+20+7*6+31*12+
365*114(1/8);...
Settle+20+7*6+31*12+ 365*115(1/8);Settle+20+7*6+31*12+
365*116(1/8);...
Settle+20+7*6+31*12+ 365*117(1/8);Settle+20+7*6+31*12+
365*118(1/8);...
```

```
Settle+20+7*6+31*12+ 365*119(1/8); Settle+20+7*6+31*12+
365*120(1/8);...
Settle+20+7*6+31*12+ 365*121(1/8);Settle+20+7*6+31*12+
365*122(1/8);...
Settle+20+7*6+31*12+ 365*123(1/8);Settle+20+7*6+31*12+
365*124(1/8);...
Settle+20+7*6+31*12+ 365*125(1/8);Settle+20+7*6+31*12+
365*126(1/8);...
Settle+20+7*6+31*12+ 365*127(1/8);Settle+20+7*6+31*12+
365*128(1/8);...
Settle+20+7*6+31*12+ 365*129(1/8); Settle+20+7*6+31*12+
365*130(1/8);...
Settle+20+7*6+31*12+ 365*131(1/8);Settle+20+7*6+31*12+
365*132(1/8);...
Settle+20+7*6+31*12+ 365*133(1/8);Settle+20+7*6+31*12+
365*134(1/8);...

Settle+20+7*6+31*12+ 365*134(1/8)+ 365(1/4);…
Settle+20+7*6+31*12+ 365*134(1/8)+ 365*2(1/4);…
Settle+20+7*6+31*12+ 365*134(1/8)+ 365*3(1/4);…
Settle+20+7*6+31*12+ 365*134(1/8)+ 365*4(1/4);…
Settle+20+7*6+31*12+ 365*134(1/8)+ 365*5(1/4);…
Settle+20+7*6+31*12+ 365*134(1/8)+ 365*6(1/4);…
Settle+20+7*6+31*12+ 365*134(1/8)+ 365*7(1/4);…
Settle+20+7*6+31*12+ 365*134(1/8)+ 365*8(1/4);…
Settle+20+7*6+31*12+ 365*134(1/8)+ 365*9(1/4);…
Settle+20+7*6+31*12+ 365*134(1/8)+ 365*10(1/4);…
Settle+20+7*6+31*12+ 365*134(1/8)+ 365*11(1/4);…
Settle+20+7*6+31*12+ 365*134(1/8)+ 365*12(1/4);…
Settle+20+7*6+31*12+ 365*134(1/8)+ 365*13(1/4);…
Settle+20+7*6+31*12+ 365*134(1/8)+ 365*14(1/4);…
Settle+20+7*6+31*12+ 365*134(1/8)+ 365*15(1/4);…
Settle+20+7*6+31*12+ 365*134(1/8)+ 365*16(1/4);…
Settle+20+7*6+31*12+ 365*134(1/8)+ 365*17(1/4);…
Settle+20+7*6+31*12+ 365*134(1/8)+ 365*18(1/4);…
Settle+20+7*6+31*12+ 365*134(1/8)+ 365*19(1/4);…
Settle+20+7*6+31*12+ 365*134(1/8)+ 365*20(1/4);…
Settle+20+7*6+31*12+ 365*134(1/8)+ 365*21(1/4);…
Settle+20+7*6+31*12+ 365*134(1/8)+ 365*22(1/4);…
Settle+20+7*6+31*12+ 365*134(1/8)+ 365*23(1/4);…
Settle+20+7*6+31*12+ 365*134(1/8)+ 365*24(1/4);…
Settle+20+7*6+31*12+ 365*134(1/8)+ 365*25(1/4);…

Settle+20+7*6+31*12+ 365*134(1/8)+ 365*25(1/4)+365(1/2)
Settle+20+7*6+31*12+ 365*134(1/8)+ 365*25(1/4)+365*2(1/2)
Settle+20+7*6+31*12+ 365*134(1/8)+ 365*25(1/4)+365*3(1/2)
Settle+20+7*6+31*12+ 365*134(1/8)+ 365*25(1/4)+365*4(1/2)
```

```
Settle+20+7*6+31*12+ 365*134(1/8)+ 365*25(1/4)+365*5(1/2)

Settle+20+7*6+31*12+ 365*134(1/8)+ 365*25(1/4)+365*5(1/2)+
+365;...

Settle+20+7*6+31*12+ 365*134(1/8)+ 365*25(1/4)+365*5(1/2)+
+365+365*5;…
Settle+20+7*6+31*12+ 365*134(1/8)+ 365*25(1/4)+365*5(1/2)+
+365+365*10;…

];
```

End MATLAB source code grid number 12 time step 203

See Figures 13.24–13.26.

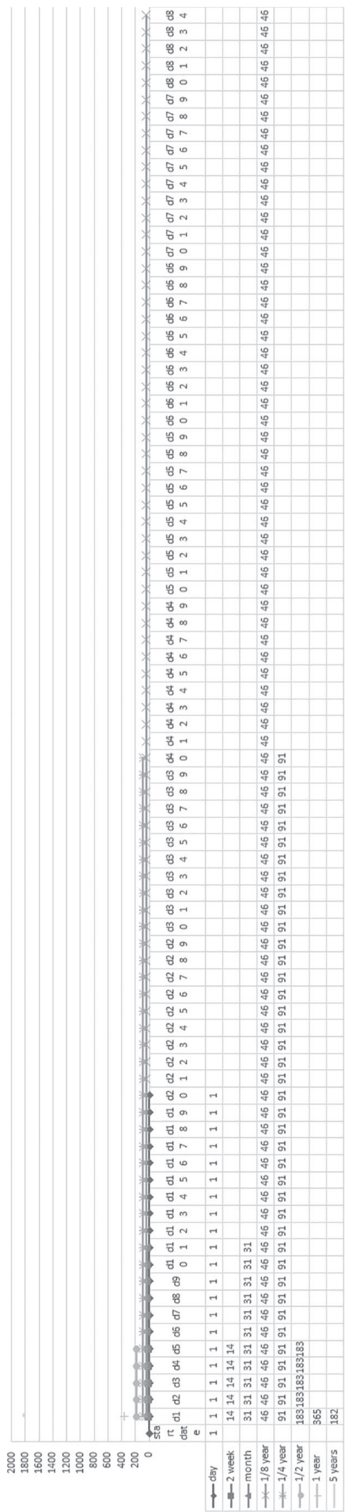


FIGURE 13.24 Further case Grid number 12 number of time step 203.

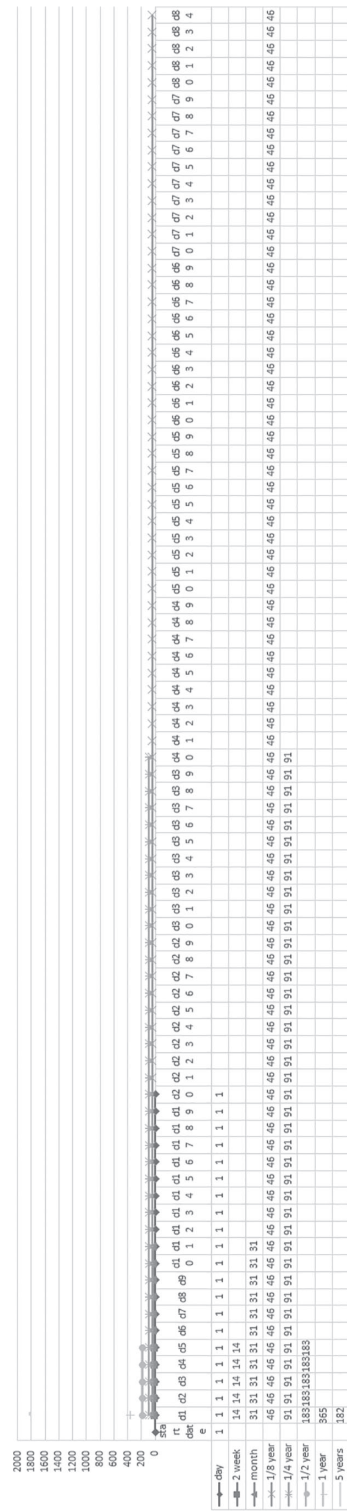


FIGURE 13.25 Model no two of choice of data distribution of 203 numbers of time step.

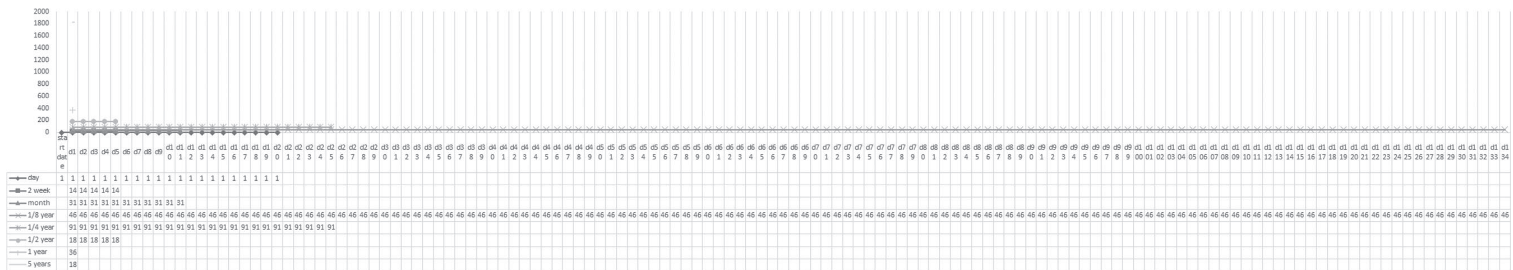


FIGURE 13.26 Model no tree of choice of data distribution of 203 numbers of time step.

BIBLIOGRAPHY

MathWorks. 2015a. *Datafeed toolbox user's guide*. MathWorks Matlab R2015a.
MathWorks. 2015b. *Financial instruments toolbox user's guide*. MathWorks Matlab R2015a.
MathWorks. 2015c. *Optimization toolbox user's guide*. MathWorks Matlab R2015a.
MathWorks. 2015d. *Statistic and machine learning toolbox user's guide*. MathWorks Matlab R2015a.
MathWorks. 2015e. *Trading toolbox user's guide*. MathWorks Matlab R2015a.

CHAPTER 14

Expected Exposure Visualization List of Java Code Packages

14.1 JAVA EXPECTED EXPOSURE VISUALIZATION SOURCE CODE INDEX WEB PAGE

These are the input files of expected exposure visualization. These files are matrix of 73 or 101 data value multiplied the number of counterparty in portfolio

```
D:\Profili\U352042\Desktop\dati epe\imi_ges-linea.73\
ExpectedValues.xml.outNODE.CSV
D:\Profili\U352042\Desktop\dati epe\imi_ges-linea.101v1\
ExpectedValues.xml.outNODE
D:\Profili\U352042\Desktop\dati epe\imi_ges-linea.101v2\
ExpectedValues.xml.outNODE
D:\Profili\U352042\Desktop\dati epe\imi_ges-linea.101v3\
ExpectedValues.xml.outNODE
```

```
<%@page import="grafica.*"%>
<%@page import="strutturedati.*"%>
<%@ page language="java" import="java.util.*"
pageEncoding="ISO-8859-1"%>
<%@ page import="java.io.*"%>
<%@ page import="au.com.bytecode.opencsv.CSVReader"%>
<%@ page import="java.nio.file.Paths"%>
<%@ page import="java.nio.file.Path"%>
<%
```

```
boolean bool = false;
String controparte1 = "";
if(request.getParameter("controparte")!=null && request.
getParameter("controparte")!= "")
{
       String s = request.getParameter("controparte");
        //out.println(s);
            controparte1 = s.substring(s.lastIndexOf(":") + 2);
            //out.println(controparte1);
       bool = true;
}
//Path currentRelativePath = Paths.get("");
//String s = currentRelativePath.toAbsolutePath().toString();
//s = s.substring(11, 18);
long millis = System.currentTimeMillis() % 1000;
String s = Long.toString(millis);
//out.println(s);
%>
<%
int i = 0;
String[] menu;
CSVReader reader = new CSVReader(new FileReader("D://Profili/
U352042/Desktop/dati epe/imi_ges-linea.73/ExpectedValues.xml.
outNODE.csv"));
String [] nextLine;
%>
<html>
<head></head>
<body>
 <FORM name="form1" METHOD="POST" ACTION="index.jsp?"controparte>
 <font size="3" color="red"><b>
 Seleziona Controparte </b></font>
 <SELECT name="controparte" >

    <OPTION name="controparte" >Seleziona Controparte</option>
     <% while  ((nextLine = reader.readNext()) != null)  {
   if (nextLine[0].indexOf("NN_BANCA-IMI-LINEA") != -1) {
           %><OPTION name="controparte"><%out.println(Integer.
toString(i)+":");%><%out.println(nextLine[0]);%></option>
        <%i++;}}%>

    </SELECT>
    <input type="submit" value="genera" />

   </FORM>

<html>
```

```
<head></head>
<body>
<%
String fname ="";
String fnameEpe ="";
String fnamePfe ="";
datiMtF[] MtF = null;
datiMtF[] Epe = null;
datiMtF[] Pfe = null;
if (bool){

      lineChart lc = new lineChart();
      lc.generaGrafico(controparte1,s);
      MtF = estrazione.readCSVMtF.generaArray(controparte1);

      lineChartEPE lcEpe = new lineChartEPE();
      lcEpe.generaGrafico(controparte1,s);
      Epe = estrazione.readEPE.generaArray(controparte1);

      lineChartPFE95 lcPfe = new lineChartPFE95();
      lcPfe.generaGrafico(controparte1,s);
      Pfe = estrazione.readPFE95.generaArray(controparte1);
}
%>
<table border="1">
<tr>
<td >
<table  class="mytable1">


<tr><td >Giorni</td></tr>
<tr><td>Data</tr>
<tr><td >73 TS</td></tr>
<tr><td>101 v1</td></tr>
<tr><td >101 v2</td></tr>
</table>
</td>

<%
if (bool){
for (int h = 0; h < MtF.length; h++){
%>
<td >
<table  class="mytable">
```

```
<tr><td class="content"><% out.println(MtF[h].getNumGiorno());%></
td></tr>
<tr><td class="content"><% out.println(MtF[h].getData());%></tr>
<tr><td class="content"><% out.println(MtF[h].
getValoregriglia73());%></td></tr>
<tr><td class="content"><% out.println(MtF[h].
getValoregriglia101v1());%></td></tr>
<tr><td class="content"><% out.println(MtF[h].
getValoregriglia101v2());%></td></tr>
</table>
</td>
<%
}}
%>
 </tr>
</table>
<style>
.mytable, .mytable TD {font-size:8pt; width:250;}
.mytable1, .mytable1 TD {font-size:10pt; font-weight:bold;
width:50;}
.content {width: 200px;}
#sfondo{
      width: 100%;
}
</style>
<%

      File f=new File("T://Dc_Direzione_Risk_Management/RiskTech/
Users/CarloneGiulio/output/line"+s+".png");
      fname = f.getPath();

%>

<div>
     <img src="<%=fname%>">
</div>
<%

%>
<table border="1">
<tr>
<td >
<table  class="mytable1">


<tr><td >Giorni</td></tr>
<tr><td>Data</tr>
```

```
<tr><td >73 TS</td></tr>
<tr><td>101 v1</td></tr>
<tr><td >101 v2</td></tr>
</table>
</td>

<%
if (bool){
for (int h = 0; h < Epe.length; h++){
%>
<td >
<table  class="mytable">
<tr><td class="content"><% out.println(Epe[h].getNumGiorno());%></
td></tr>
<tr><td class="content"><% out.println(Epe[h].getData());%></tr>
<tr><td class="content"><% out.println(Epe[h].
getValoregriglia73());%></td></tr>
<tr><td class="content"><% out.println(Epe[h].
getValoregriglia101v1());%></td></tr>
<tr><td class="content"><% out.println(Epe[h].
getValoregriglia101v2());%></td></tr>
</table>
</td>
<%
}}
%>
 </tr>
</table>
<%

      File g = new File("T://Dc_Direzione_Risk_Management/
RiskTech/Users/CarloneGiulio/output/epe"+s+".png");
      fnameEpe = g.getPath();

%>

<div>
     <img src="<%=fnameEpe%>" >
</div>




<table border="1">
<tr>
<td >
<table  class="mytable1">
```

```
<tr><td >Giorni</td></tr>
<tr><td>Data</tr>
<tr><td >73 TS</td></tr>
<tr><td>101 v1</td></tr>
<tr><td >101 v2</td></tr>
</table>
</td>

<%
if (bool){
for (int h = 0; h < Pfe.length; h++){
%>
<td >
<table  class="mytable">
<tr><td class="content"><% out.println(Pfe[h].getNumGiorno());%></
td></tr>
<tr><td class="content"><% out.println(Pfe[h].getData());%></tr>
<tr><td class="content"><% out.println(Pfe[h].
getValoregriglia73());%></td></tr>
<tr><td class="content"><% out.println(Pfe[h].
getValoregriglia101v1());%></td></tr>
<tr><td class="content"><% out.println(Pfe[h].
getValoregriglia101v2());%></td></tr>
</table>
</td>
<%
}}
%>
 </tr>
</table>
<%

      File l = new File("T://Dc_Direzione_Risk_Management/
RiskTech/Users/CarloneGiulio/output/pfe"+s+".png");
      fnamePfe = l.getPath();

%>

<div>
     <img src="<%=fnamePfe %>" >
</div>
</body>
</html>
```

14.2 JAVA CODE PACKAGE ESTRAZIONE

```
package estrazione;

import au.com.bytecode.opencsv.CSVReader;
import java.io.FileReader;
import java.io.IOException;
import java.text.DateFormat;
import java.text.ParseException;
import java.text.SimpleDateFormat;
import java.util.ArrayList;
import java.util.Arrays;
import java.util.Collections;
import java.util.Date;
import java.util.HashSet;
import java.util.List;
import java.util.Set;
import strutturedati.Griglia;
import strutturedati.datiMtF;
import utilita.convertiTipoData;
import utilita.creaDateGriglia;

public class readCSVMtF {
   public static datiMtF[] esterno;

   public static String[] join(String[]... parms) {
      int size = 0;
      String[][] var5 = parms;
      int var4 = parms.length;

      String[] result;
      int j;
      for(j = 0; j < var4; ++j) {
         result = var5[j];
         size += result.length;
      }

      result = new String[size];
      j = 0;
      String[][] var7 = parms;
      int var6 = parms.length;

      for(int var13 = 0; var13 < var6; ++var13) {
         String[] array = var7[var13];
         String[] var11 = array;
         int var10 = array.length;
```

```
         for(int var9 = 0; var9 < var10; ++var9) {
            String s = var11[var9];
            result[j++] = s;
         }
      }

      return result;
   }

   private static String[] arrRemove(String[] strArray) {
      Set<String> set = new HashSet();
      set.addAll(Arrays.asList(strArray));
      return (String[])set.toArray(new String[set.size()]);
   }

   public static String[] removeElements(String[] allElements) {
      String[] _localAllElements = new String[allElements.length];
      int j = 0;

      for(int i = 0; i < allElements.length; ++i) {
         if (allElements[i] != null && !allElements[i].equals("")
&& !allElements[i].equals("null")) {
            _localAllElements[j++] = allElements[i];
         }
      }

      return _localAllElements;
   }

   public static int compare(Date date1, Date date2) {
      if (date1.compareTo(date2) == -1) {
         return 1;
      } else {
         return date1.compareTo(date2) == 1 ? -1 : 0;
      }
   }

   public static String[] clean(String[] v) {
      List<String> list = new ArrayList(Arrays.asList(v));
      list.removeAll(Collections.singleton((Object)null));
      return (String[])list.toArray(new String[list.size()]);
   }

   public static double interpolaXY(double x1, double x2, double
fx1, double fx2, double x) {
      double w1 = (x2 - x) / (x2 - x1);
      double w2 = (x - x1) / (x2 - x1);
```

```
        double drmInterpolateLinear = w1 * fx1 + w2 * fx2;
        return drmInterpolateLinear;
    }

    public static datiMtF[] generaArray(String controparte1) throws
NumberFormatException, IOException {
        CSVReader reader = new CSVReader(new FileReader("D://
Profili/U352042/Desktop/dati epe/imi_ges-linea.73/ExpectedValues.
xml.outNODE.csv"));
        CSVReader reader1 = new CSVReader(new FileReader("D://
Profili/U352042/Desktop/dati epe/imi_ges-linea.101v1/
ExpectedValues.xml.outNODE.csv"));
        CSVReader reader2 = new CSVReader(new FileReader("D://
Profili/U352042/Desktop/dati epe/imi_ges-linea.101v3/
ExpectedValues.xml.outNODE.csv"));
        String[] nextLine1 = null;
        String[] nextLine2 = null;
        String[] array73 = null;
        String[] array101v1 = null;
        String[] array101v2 = null;
        double[] array73_ = null;
        double[] array101v1_ = null;
        double[] array101v2_ = null;
        double[] dd = null;
        double[] dd1 = null;
        double[] dd2 = null;
        String controparte = controparte1;
        String[] finale = null;
        long[] giorni = null;
        datiMtF[] MtF = null;
        int i = 0;
        int indice = 0;
        boolean b = true;
        boolean b1 = true;
        boolean b2 = true;

        String[] nextLine;
        int t;
        int o;
        while((nextLine = reader.readNext()) != null && (nextLine1 =
reader1.readNext()) != null && (nextLine2 = reader2.readNext()) !=
null) {
            System.out.println(" ");
            int numeroColonne = nextLine.length;
            int numeroColonne1 = nextLine1.length;
            int numeroColonne2 = nextLine2.length;
            String[] a = new String[numeroColonne];
```

```
         String[] a1 = new String[numeroColonne1];
         String[] a2 = new String[numeroColonne2];
         int j;
         if (i == 0) {
            if (i == 0) {
               array73 = new String[numeroColonne - 1];
               array101v1 = new String[numeroColonne1 - 1];
               array101v2 = new String[numeroColonne2 - 1];
            }

            for(j = 1; j < numeroColonne; ++j) {
               System.out.println("73: " + j + " " + nextLine[j]);
               a[j] = nextLine[j];
               System.out.println("__________");
            }

            if (i == 0) {
               array73 = a;
            }

            for(j = 1; j < numeroColonne1; ++j) {
               System.out.println("101v1: " + j + " " +
nextLine1[j]);
               a1[j] = nextLine1[j];
               System.out.println("a1[j]:" + a1[j]);
               System.out.println("__________");
            }

            if (i == 0) {
               array101v1 = a1;
            }

            for(j = 1; j < numeroColonne2; ++j) {
               System.out.println("101v2: " + j + " " +
nextLine2[j]);
               a2[j] = nextLine2[j];
               System.out.println("a2[j]:" + a2[j]);
               System.out.println("__________");
            }

            if (i == 0) {
               array101v2 = a2;
            }

            String[] big = join(a, a1, a2);
            System.out.println("lunghezza: " + Integer.
toString(big.length));
```

```
            System.out.println(Arrays.toString(big));
            String[] g = arrRemove(big);
            System.out.println("array g:" + Integer.
toString(g.length));
            System.out.println(Arrays.toString(g));
            int p = g.length;
            String[] g1 = new String[p];
            String[] g2 = null;

            for(t = 0; t < p; ++t) {
               System.out.println("g1..elemj:" + t);

               try {
                  g1[t] = creaDateGriglia.estrai(g[t]);
               } catch (NullPointerException var48) {
                  var48.printStackTrace();
               }
            }

            System.out.println("array g1:" + Integer.toString(g1.
length));
            System.out.println(Arrays.toString(g1));

            try {
               g2 = clean(g1);
            } catch (NullPointerException var47) {
               var47.printStackTrace();
            }

            System.out.println("G2 G2 G2" + Integer.toString(g2.
length));
            System.out.println(Arrays.toString(g2));
            t = g2.length;
            System.out.println("G3 G3 G3 t:" + Integer.toString(t)
+ "- p:" + Integer.toString(p));
            String[] g3 = new String[t];

            for(o = 0; o < t; ++o) {
               System.out.println("g2.." + g2[o] + ":o:" + o);
               g3[o] = g2[o].replace("/", "-");
               System.out.println("--g3.." + g3[o]);
            }

            System.out.println("G3 G3 G3" + Integer.toString(g3.
length));
            System.out.println(Arrays.toString(g3));
            DateFormat df = new SimpleDateFormat("yyyy-MM-dd");
```

```
            Date var39 = null;

            try {
               var39 = df.parse("2014-01-01");
            } catch (ParseException var46) {
               var46.printStackTrace();
            }

            long[] g4 = new long[t];

            long temp1;
            for(int w = 0; w < t; ++w) {
               df.setLenient(false);
               Date d = null;

               try {
                  d = df.parse(g3[w]);
               } catch (ParseException var45) {
                  var45.printStackTrace();
               }

               temp1 = d.getTime();
               System.out.println("mill 1:" + Long.
toString(temp1));
               System.out.println("________________");
               g4[w] = temp1;
            }

            System.out.println("g4 g4 g4" + Integer.toString(g4.
length));
            System.out.println(Arrays.toString(g4));
            Griglia[] arr = new Griglia[t];

            int z;
            for(z = 0; z < t; ++z) {
               arr[z] = new Griglia(g3[z], g4[z]);
            }

            Arrays.sort(arr);
            System.out.println("Ok...Ok\n" + Arrays.
toString(arr));
            finale = new String[t];

            for(z = 0; z < t; ++z) {
               finale[z] = arr[z].getData();
            }
```

```
            System.out.println("Array Finale" + Integer.
toString(finale.length));
            System.out.println(Arrays.toString(finale));
            giorni = new long[t];
            giorni[0] = 0L;

            for(z = 1; z < t; ++z) {
               temp1 = (long)convertiTipoData.numGiorni(finale[z
- 1], finale[z]);
               System.out.println("z-1::" + finale[z - 1] + ":z::"
+ finale[z] + "::TS temp1:::" + Long.toString(temp1));
               giorni[z] = giorni[z - 1] + temp1;
            }

            System.out.println("Array Finale Giorni" + Integer.
toString(giorni.length));
            System.out.println(Arrays.toString(giorni));
            indice = t;
            i = 1;
         } else {
            if (nextLine[0].indexOf(controparte) != -1) {
               b = false;
               System.out.println("73 trovata");
               double[] ddx = new double[numeroColonne - 1];

               for(j = 0; j < numeroColonne - 1; ++j) {
                  dd[j] = Double.parseDouble(nextLine[j + 1]);
               }

               if (!b) {
                  array73_ = dd;
               }

               System.out.println("dd dd dd " + Arrays.
toString(dd));
            }

            if (nextLine1[0].indexOf(controparte) != -1) {
               b1 = false;
               System.out.println("101 v1 trovata");
               double[] dd1x = new double[numeroColonne1 - 1];

               for(j = 0; j < numeroColonne1 - 1; ++j) {
                  dd1[j] = Double.parseDouble(nextLine1[j + 1]);
               }

               if (!b1) {
```

```
                    array101v1_ = dd1;
                 }

                 System.out.println("dd dd dd " + Arrays.
toString(dd1));
              }

              if (nextLine2[0].indexOf(controparte) != -1) {
                 b2 = false;
                 System.out.println("101 v2 trovata");
                 double[] dd2x = new double[numeroColonne2 - 1];

                 for(j = 0; j < numeroColonne2 - 1; ++j) {
                    dd2[j] = Double.parseDouble(nextLine2[j + 1]);
                 }

                 if (!b2) {
                    array101v2_ = dd2;
                 }

                 System.out.println("dd dd dd " + Arrays.
toString(dd2));
              }

              ++i;
           }
        }

        MtF = new datiMtF[indice];
        Double d = new Double("0.1970012119700121");
        Double d1 = new Double("0.1970012119700122");
        Double d2 = new Double("0.1970012119700123");
        Integer dInt = 0;
        Integer dInt1 = 0;
        Integer dInt2 = 0;

        for(int j = 0; j < indice; ++j) {
           MtF[j] = new datiMtF();
           MtF[j].setNomecontroparte(controparte);
           MtF[j].setNumGiorno(Integer.parseInt(Long.
toString(giorni[j])));
           MtF[j].setData(finale[j]);
           MtF[j].setValoregriglia73(0.0D);
           MtF[j].setValoregriglia101v1(0.0D);
           MtF[j].setValoregriglia101v2(0.0D);
        }
```

```
        String c3 = "";

        String c9;
        String c2;
        for(int j = 0; j < indice; ++j) {
           dInt = 1;
           c9 = MtF[j].getData();
           c2 = c9.replace("-", "/");

           for(o = 1; o < array73.length; ++o) {
              if (array73[o] != null) {
                 c3 = array73[o];
              }

              if (c3.indexOf(c2) != -1) {
                 double l = array73_[o - 1];
                 MtF[j].setValoregriglia73(l);
                 dInt = 2;
                 System.out.println("ciclo73::indice J:" + Integer.
toString(j) + ":valore:" + MtF[j].getValoregriglia73());
                 break;
              }
           }

           if (dInt == 1) {
              MtF[j].setValoregriglia73(d);
              System.out.println("ciclo73:dInt==1:indice J:" +
Integer.toString(j) + ":valore:" + MtF[j].getValoregriglia73());
           }
        }

        String c6 = "";

        String c5;
        int e2;
        for(t = 0; t < indice; ++t) {
           dInt1 = 1;
           c2 = MtF[t].getData();
           c5 = c2.replace("-", "/");

           for(e2 = 1; e2 < array101v1.length; ++e2) {
              if (array101v1[e2] != null) {
                 c6 = array101v1[e2];
              }

              if (c6.indexOf(c5) != -1) {
                 double l = array101v1_[e2 - 1];
```

```
                MtF[t].setValoregriglia101v1(l);
                dInt1 = 2;
                System.out.println("ciclo101v1::" + MtF[t].
getValoregriglia101v1());
                break;
             }
          }

          if (dInt1 == 1) {
             MtF[t].setValoregriglia101v1(d1);
             System.out.println("ciclov1:dInt==1:indice J:" +
Integer.toString(t) + ":valore:" + MtF[t].
getValoregriglia101v1());
          }
       }

       c9 = "";

       int j;
       //int j;
       double interpola;
       for(j = 0; j < indice; ++j) {
          dInt2 = 1;
          c5 = MtF[j].getData();
          String c8 = c5.replace("-", "/");

          for(j = 1; j < array101v2.length; ++j) {
             if (array101v2[j] != null) {
                c9 = array101v2[j];
             }

             if (c9.indexOf(c8) != -1) {
                interpola = array101v2_[j - 1];
                MtF[j].setValoregriglia101v2(interpola);
                dInt2 = 2;
                System.out.println("ciclo101v2::" + MtF[j].
getValoregriglia101v2());
                break;
             }
          }

          if (dInt2 == 1) {
             MtF[j].setValoregriglia101v2(d2);
             System.out.println("ciclov2:dInt==1:indice J:" +
Integer.toString(j) + ":valore:" + MtF[j].getValoregriglia101v2());
          }
       }
```

```
      j = 0;
      if (MtF[MtF.length - j - 1].getValoregriglia73() == d) {
         while(MtF[MtF.length - j - 1].getValoregriglia73() == d)
{
            System.out.println("indice MtF.length - e-1::" +
Integer.toString(MtF.length - j - 1) + "::valore:: " + MtF[MtF.
length - j - 1].getValoregriglia73());
            ++j;
         }

         for(o = 0; o < j; ++o) {
            System.out.println("indice MtF.length-e+f-1" +
Integer.toString(MtF.length - j + o - 1) + "valore cercato" +
MtF[MtF.length - j - 1].getValoregriglia73());
            MtF[MtF.length - j + o].setValoregriglia73(MtF[MtF.
length - j - 1].getValoregriglia73());
            System.out.println("valore settato:indice:MtF.length-
e+f::" + Integer.toString(MtF.length - j + o) + "::nuovo valore::"
+ MtF[MtF.length - j + o].getValoregriglia73());
         }
      }

      o = 0;
      if (MtF[MtF.length - o - 1].getValoregriglia101v1() == d1) {
         while(MtF[MtF.length - o - 1].getValoregriglia101v1() ==
d1) {
            System.out.println("indice MtF.length - e1-1::" +
Integer.toString(MtF.length - o - 1) + "::valore:: " + MtF[MtF.
length - o - 1].getValoregriglia101v1());
            ++o;
         }

         for(e2 = 0; e2 < o; ++e2) {
            System.out.println("indice MtF.length-e1+f-1" +
Integer.toString(MtF.length - o + e2 - 1) + "valore cercato" +
MtF[MtF.length - o - 1].getValoregriglia101v1());
            MtF[MtF.length - o + e2].setValoregriglia101v1(MtF[MtF.
length - o - 1].getValoregriglia101v1());
            System.out.println("valore settato:indice:MtF.length-
e1+f::" + Integer.toString(MtF.length - o + e2) + "::nuovo
valore::" + MtF[MtF.length - o + e2].getValoregriglia101v1());
         }
      }

      e2 = 0;
      if (MtF[MtF.length - e2 - 1].getValoregriglia101v2() == d2) {
```

```
         while(MtF[MtF.length - e2 - 1].getValoregriglia101v2() ==
d2) {
            System.out.println("indice MtF.length - e2-1::" +
Integer.toString(MtF.length - e2 - 1) + "::valore:: " + MtF[MtF.
length - e2 - 1].getValoregriglia101v2());
            ++e2;
         }

         for(j = 0; j < e2; ++j) {
            System.out.println("indice MtF.length-e2+f-1" +
Integer.toString(MtF.length - e2 + j - 1) + "valore cercato" +
MtF[MtF.length - e2 - 1].getValoregriglia101v2());
            MtF[MtF.length - e2 + j].setValoregriglia101v2
(MtF[MtF.length - e2 - 1].getValoregriglia101v2());
            System.out.println("valore settato:indice:MtF.length-
e2+f::" + Integer.toString(MtF.length - e2 + j) + "::nuovo
valore::" + MtF[MtF.length - e2 + j].getValoregriglia101v2());
         }
      }

      for(j = 1; j < indice - 1; ++j) {
         if (MtF[j].getValoregriglia73() == d) {
            interpola = interpolaXY((double)MtF[j - 1].
getNumGiorno(), (double)MtF[j + 1].getNumGiorno(), MtF[j - 1].
getValoregriglia73(), MtF[j + 1].getValoregriglia73(), (double)
MtF[j].getNumGiorno());
            MtF[j].setValoregriglia73(interpola);
            System.out.println("ciclo73:ripassa:indice J:" +
Integer.toString(j) + ":valore:" + MtF[j].getValoregriglia73());
         }

         if (MtF[j].getValoregriglia101v1() == d1) {
            interpola = interpolaXY((double)MtF[j - 1].
getNumGiorno(), (double)MtF[j + 1].getNumGiorno(), MtF[j - 1].
getValoregriglia101v1(), MtF[j + 1].getValoregriglia101v1(),
(double)MtF[j].getNumGiorno());
            MtF[j].setValoregriglia101v1(interpola);
            System.out.println("ciclo101v1:ripassa:indice J:" +
Integer.toString(j) + ":valore:" + MtF[j].
getValoregriglia101v1());
         }

         if (MtF[j].getValoregriglia101v2() == d2) {
            interpola = interpolaXY((double)MtF[j - 1].
getNumGiorno(), (double)MtF[j + 1].getNumGiorno(), MtF[j - 1].
getValoregriglia101v2(), MtF[j + 1].getValoregriglia101v2(),
(double)MtF[j].getNumGiorno());
```

```
            MtF[j].setValoregriglia101v2(interpola);
            System.out.println("ciclo101v2else:ripassa:indice J:"
+ Integer.toString(j) + ":valore:" + MtF[j].
getValoregriglia101v2());
         }
      }

      esterno = MtF;
      return esterno;
   }
}
```

```
package estrazione;

import au.com.bytecode.opencsv.CSVReader;
import java.io.FileReader;
import java.io.IOException;
import java.text.DateFormat;
import java.text.ParseException;
import java.text.SimpleDateFormat;
import java.util.ArrayList;
import java.util.Arrays;
import java.util.Collections;
import java.util.Date;
import java.util.HashSet;
import java.util.List;
import java.util.Set;
import strutturedati.Griglia;
import strutturedati.datiMtF;
import utilita.convertiTipoData;
import utilita.creaDateGriglia;

public class readEPE {
   public static datiMtF[] esternoEPE;
   public static double effEpe;
   public static double effEpe1;
   public static double effEpe2;

   public static String[] join(String[]... parms) {
      int size = 0;
      String[][] var5 = parms;
      int var4 = parms.length;

      String[] result;
      int j;
```

```
        for(j = 0; j < var4; ++j) {
            result = var5[j];
            size += result.length;
        }

        result = new String[size];
        j = 0;
        String[][] var7 = parms;
        int var6 = parms.length;

        for(int var13 = 0; var13 < var6; ++var13) {
            String[] array = var7[var13];
            String[] var11 = array;
            int var10 = array.length;

            for(int var9 = 0; var9 < var10; ++var9) {
                String s = var11[var9];
                result[j++] = s;
            }
        }

        return result;
    }

    private static String[] arrRemove(String[] strArray) {
        Set<String> set = new HashSet();
        set.addAll(Arrays.asList(strArray));
        return (String[])set.toArray(new String[set.size()]);
    }

    public static String[] removeElements(String[] allElements) {
        String[] _localAllElements = new String[allElements.length];
        int j = 0;

        for(int i = 0; i < allElements.length; ++i) {
            if (allElements[i] != null && !allElements[i].equals("")
&& !allElements[i].equals("null")) {
                _localAllElements[j++] = allElements[i];
            }
        }

        return _localAllElements;
    }

    public static int compare(Date date1, Date date2) {
        if (date1.compareTo(date2) == -1) {
            return 1;
```

```
        } else {
            return date1.compareTo(date2) == 1 ? -1 : 0;
        }
    }

    public static String[] clean(String[] v) {
        List<String> list = new ArrayList(Arrays.asList(v));
        list.removeAll(Collections.singleton((Object)null));
        return (String[])list.toArray(new String[list.size()]);
    }

    public static double interpolaXY(double x1, double x2, double
fx1, double fx2, double x) {
        double w1 = (x2 - x) / (x2 - x1);
        double w2 = (x - x1) / (x2 - x1);
        double drmInterpolateLinear = w1 * fx1 + w2 * fx2;
        return drmInterpolateLinear;
    }

    public static datiMtF[] generaArray(String controparte1) throws
NumberFormatException, IOException {
        CSVReader reader = new CSVReader(new FileReader("D://
Profili/U352042/Desktop/dati epe/imi_ges-linea.73/
ExpectedExposures.xml.outNODE.csv"));
        CSVReader reader1 = new CSVReader(new FileReader("D://
Profili/U352042/Desktop/dati epe/imi_ges-linea.101v1/
ExpectedExposures.xml.outNODE.csv"));
        CSVReader reader2 = new CSVReader(new FileReader("D://
Profili/U352042/Desktop/dati epe/imi_ges-linea.101v3/
ExpectedExposures.xml.outNODE.csv"));
        CSVReader readerEffEpe = new CSVReader(new FileReader("D://
Profili/U352042/Desktop/dati epe/imi_ges-linea.73/Eff_EPE.xml.
outNODE.csv"));
        CSVReader readerEffEpe1 = new CSVReader(new FileReader("D://
Profili/U352042/Desktop/dati epe/imi_ges-linea.101v1/Eff_EPE.xml.
outNODE.csv"));
        CSVReader readerEffEpe2 = new CSVReader(new FileReader("D://
Profili/U352042/Desktop/dati epe/imi_ges-linea.101v3/Eff_EPE.xml.
outNODE.csv"));
        String[] nextLine1 = null;
        String[] nextLine2 = null;
        String[] nextLineEffEpe = null;
        String[] nextLineEffEpe1 = null;
        String[] nextLineEffEpe2 = null;
        String[] array73 = null;
        String[] array101v1 = null;
        String[] array101v2 = null;
```

```
      double[] array73_ = null;
      double[] array101v1_ = null;
      double[] array101v2_ = null;
      double[] dd = null;
      double[] dd1 = null;
      double[] dd2 = null;
      String controparte = controparte1;
      String[] finale = null;
      long[] giorni = null;
      datiMtF[] MtF = null;
      int i = 0;
      int indice = 0;
      boolean b = true;
      boolean b1 = true;
      boolean b2 = true;

      while((nextLineEffEpe = readerEffEpe.readNext()) != null &&
(nextLineEffEpe1 = readerEffEpe1.readNext()) != null &&
(nextLineEffEpe2 = readerEffEpe2.readNext()) != null) {
         if (nextLineEffEpe[0].indexOf(controparte) != -1) {
            effEpe = Double.parseDouble(nextLineEffEpe[1]);
         }

         if (nextLineEffEpe1[0].indexOf(controparte) != -1) {
            effEpe1 = Double.parseDouble(nextLineEffEpe1[1]);
         }

         if (nextLineEffEpe2[0].indexOf(controparte) != -1) {
            effEpe2 = Double.parseDouble(nextLineEffEpe2[1]);
         }
      }

      String[] nextLine;
      int t;
      int o;
      while((nextLine = reader.readNext()) != null && (nextLine1 =
reader1.readNext()) != null && (nextLine2 = reader2.readNext()) !=
null) {
         System.out.println(" ");
         int numeroColonne = nextLine.length;
         int numeroColonne1 = nextLine1.length;
         int numeroColonne2 = nextLine2.length;
         String[] a = new String[numeroColonne];
         String[] a1 = new String[numeroColonne1];
         String[] a2 = new String[numeroColonne2];
         int j;
         if (i == 0) {
```

```
            if (i == 0) {
               array73 = new String[numeroColonne - 1];
               array101v1 = new String[numeroColonne1 - 1];
               array101v2 = new String[numeroColonne2 - 1];
            }

            for(j = 1; j < numeroColonne; ++j) {
               System.out.println("73: " + j + " " + nextLine[j]);
               a[j] = nextLine[j];
               System.out.println("__________");
            }

            if (i == 0) {
               array73 = a;
            }

            for(j = 1; j < numeroColonne1; ++j) {
               System.out.println("101v1: " + j + " " +
nextLine1[j]);
               a1[j] = nextLine1[j];
               System.out.println("a1[j]:" + a1[j]);
               System.out.println("__________");
            }

            if (i == 0) {
               array101v1 = a1;
            }

            for(j = 1; j < numeroColonne2; ++j) {
               System.out.println("101v2: " + j + " " +
nextLine2[j]);
               a2[j] = nextLine2[j];
               System.out.println("a2[j]:" + a2[j]);
               System.out.println("__________");
            }

            if (i == 0) {
               array101v2 = a2;
            }

            String[] big = join(a, a1, a2);
            System.out.println("lunghezza: " + Integer.
toString(big.length));
            System.out.println(Arrays.toString(big));
            String[] g = arrRemove(big);
            System.out.println("array g:" + Integer.toString(g.
length));
```

```
            System.out.println(Arrays.toString(g));
            int p = g.length;
            String[] g1 = new String[p];
            String[] g2 = null;

            for(t = 0; t < p; ++t) {
               System.out.println("g1..elemj:" + t);

               try {
                  g1[t] = creaDateGriglia.estrai(g[t]);
               } catch (NullPointerException var54) {
                  var54.printStackTrace();
               }
            }

            System.out.println("array g1:" + Integer.toString(g1.
length));
            System.out.println(Arrays.toString(g1));

            try {
               g2 = clean(g1);
            } catch (NullPointerException var53) {
               var53.printStackTrace();
            }

            System.out.println("G2 G2 G2" + Integer.toString(g2.
length));
            System.out.println(Arrays.toString(g2));
            t = g2.length;
            System.out.println("G3 G3 G3 t:" + Integer.toString(t)
+ "- p:" + Integer.toString(p));
            String[] g3 = new String[t];

            for(o = 0; o < t; ++o) {
               System.out.println("g2.." + g2[o] + ":o:" + o);
               g3[o] = g2[o].replace("/", "-");
               System.out.println("--g3.." + g3[o]);
            }

            System.out.println("G3 G3 G3" + Integer.toString(g3.
length));
            System.out.println(Arrays.toString(g3));
            DateFormat df = new SimpleDateFormat("yyyy-MM-dd");
            Date var45 = null;

            try {
               var45 = df.parse("2014-01-01");
```

```
            } catch (ParseException var52) {
               var52.printStackTrace();
            }

            long[] g4 = new long[t];

            long temp1;
            for(int w = 0; w < t; ++w) {
               df.setLenient(false);
               Date d = null;

               try {
                  d = df.parse(g3[w]);
               } catch (ParseException var51) {
                  var51.printStackTrace();
               }

               temp1 = d.getTime();
               System.out.println("mill 1:" + Long.
toString(temp1));
               System.out.println("________________");
               g4[w] = temp1;
            }

            System.out.println("g4 g4 g4" + Integer.toString(g4.
length));
            System.out.println(Arrays.toString(g4));
            Griglia[] arr = new Griglia[t];

            int z;
            for(z = 0; z < t; ++z) {
               arr[z] = new Griglia(g3[z], g4[z]);
            }

            Arrays.sort(arr);
            System.out.println("Ok...Ok\n" + Arrays.
toString(arr));
            finale = new String[t];

            for(z = 0; z < t; ++z) {
               finale[z] = arr[z].getData();
            }

            System.out.println("Array Finale" + Integer.
toString(finale.length));
            System.out.println(Arrays.toString(finale));
            giorni = new long[t];
```

```
            giorni[0] = 0L;

            for(z = 1; z < t; ++z) {
               temp1 = (long)convertiTipoData.numGiorni(finale[z
- 1], finale[z]);
               System.out.println("z-1::" + finale[z - 1] + ":z::"
+ finale[z] + "::TS temp1:::" + Long.toString(temp1));
               giorni[z] = giorni[z - 1] + temp1;
            }

            System.out.println("Array Finale Giorni" + Integer.
toString(giorni.length));
            System.out.println(Arrays.toString(giorni));
            indice = t;
            i = 1;
         } else {
            if (nextLine[0].indexOf(controparte) != -1) {
               b = false;
               System.out.println("73 trovata");
               double[] ddx = new double[numeroColonne - 1];

               for(j = 0; j < numeroColonne - 1; ++j) {
                  dd[j] = Double.parseDouble(nextLine[j + 1]);
               }

               if (!b) {
                  array73_ = dd;
               }

               System.out.println("dd dd dd " + Arrays.
toString(dd));
            }

            if (nextLine1[0].indexOf(controparte) != -1) {
               b1 = false;
               System.out.println("101 v1 trovata");
               double[] dd1x = new double[numeroColonne1 - 1];

               for(j = 0; j < numeroColonne1 - 1; ++j) {
                  dd1[j] = Double.parseDouble(nextLine1[j + 1]);
               }

               if (!b1) {
                  array101v1_ = dd1;
               }
```

```
                System.out.println("dd dd dd " + Arrays.
toString(dd1));
            }

            if (nextLine2[0].indexOf(controparte) != -1) {
                b2 = false;
                System.out.println("101 v2 trovata");
                double[] dd2x = new double[numeroColonne2 - 1];

                for(j = 0; j < numeroColonne2 - 1; ++j) {
                    dd2[j] = Double.parseDouble(nextLine2[j + 1]);
                }

                if (!b2) {
                    array101v2_ = dd2;
                }

                System.out.println("dd dd dd " + Arrays.
toString(dd2));
            }

            ++i;
        }
    }

    MtF = new datiMtF[indice];
    Double d = new Double("0.1970012119700121");
    Double d1 = new Double("0.1970012119700122");
    Double d2 = new Double("0.1970012119700123");
    Integer dInt = 0;
    Integer dInt1 = 0;
    Integer dInt2 = 0;

    for(int j = 0; j < indice; ++j) {
        MtF[j] = new datiMtF();
        MtF[j].setNomecontroparte(controparte);
        MtF[j].setNumGiorno(Integer.parseInt(Long.
toString(giorni[j])));
        MtF[j].setData(finale[j]);
        MtF[j].setValoregriglia73(0.0D);
        MtF[j].setValoregriglia101v1(0.0D);
        MtF[j].setValoregriglia101v2(0.0D);
    }

    String c3 = "";

    String c9;
```

```
        String c2;
        for(int j = 0; j < indice; ++j) {
           dInt = 1;
           c9 = MtF[j].getData();
           c2 = c9.replace("-", "/");


           for(o = 1; o < array73.length; ++o) {
              if (array73[o] != null) {
                 c3 = array73[o];
              }

              if (c3.indexOf(c2) != -1) {
                 double l = array73_[o - 1];
                 MtF[j].setValoregriglia73(l);
                 dInt = 2;
                 System.out.println("ciclo73::indice J:" + Integer.
toString(j) + ":valore:" + MtF[j].getValoregriglia73());
                 break;
              }
           }


           if (dInt == 1) {
              MtF[j].setValoregriglia73(d);
              System.out.println("ciclo73:dInt==1:indice J:" +
Integer.toString(j) + ":valore:" + MtF[j].getValoregriglia73());
           }
        }

        String c6 = "";

        String c5;
        int e2;
        for(t = 0; t < indice; ++t) {
           dInt1 = 1;
           c2 = MtF[t].getData();
           c5 = c2.replace("-", "/");

           for(e2 = 1; e2 < array101v1.length; ++e2) {
              if (array101v1[e2] != null) {
                 c6 = array101v1[e2];
              }

              if (c6.indexOf(c5) != -1) {
                 double l = array101v1_[e2 - 1];
                 MtF[t].setValoregriglia101v1(l);
                 dInt1 = 2;
```

```
               System.out.println("ciclo101v1::" + MtF[t].
getValoregriglia101v1());
               break;
            }
         }

         if (dInt1 == 1) {
            MtF[t].setValoregriglia101v1(d1);
            System.out.println("ciclov1:dInt==1:indice J:" +
Integer.toString(t) + ":valore:" + MtF[t].
getValoregriglia101v1());
         }
      }

      c9 = "";

      //int j;
      int j;
      double interpola;
      for(j = 0; j < indice; ++j) {
         dInt2 = 1;
         c5 = MtF[j].getData();
         String c8 = c5.replace("-", "/");

         for(j = 1; j < array101v2.length; ++j) {
            if (array101v2[j] != null) {
               c9 = array101v2[j];
            }

            if (c9.indexOf(c8) != -1) {
               interpola = array101v2_[j - 1];
               MtF[j].setValoregriglia101v2(interpola);
               dInt2 = 2;
               System.out.println("ciclo101v2::" + MtF[j].
getValoregriglia101v2());
               break;
            }
         }

         if (dInt2 == 1) {
            MtF[j].setValoregriglia101v2(d2);
            System.out.println("ciclov2:dInt==1:indice J:" +
Integer.toString(j) + ":valore:" + MtF[j].
getValoregriglia101v2());
         }
      }
```

```
      j = 0;
      if (MtF[MtF.length - j - 1].getValoregriglia73() == d) {
         while(MtF[MtF.length - j - 1].getValoregriglia73() == d)
{
            System.out.println("indice MtF.length - e-1::" +
Integer.toString(MtF.length - j - 1) + "::valore:: " + MtF[MtF.
length - j - 1].getValoregriglia73());
            ++j;
         }

         for(o = 0; o < j; ++o) {
            System.out.println("indice MtF.length-e+f-1" +
Integer.toString(MtF.length - j + o - 1) + "valore cercato" +
MtF[MtF.length - j - 1].getValoregriglia73());
            MtF[MtF.length - j + o].setValoregriglia73(MtF[MtF.
length - j - 1].getValoregriglia73());
            System.out.println("valore settato:indice:MtF.length-
e+f::" + Integer.toString(MtF.length - j + o) + "::nuovo valore::"
+ MtF[MtF.length - j + o].getValoregriglia73());
         }
      }

      o = 0;
      if (MtF[MtF.length - o - 1].getValoregriglia101v1() == d1) {
         while(MtF[MtF.length - o - 1].getValoregriglia101v1() ==
d1) {
            System.out.println("indice MtF.length - e1-1::" +
Integer.toString(MtF.length - o - 1) + "::valore:: " + MtF[MtF.
length - o - 1].getValoregriglia101v1());
            ++o;
         }

         for(e2 = 0; e2 < o; ++e2) {
            System.out.println("indice MtF.length-e1+f-1" +
Integer.toString(MtF.length - o + e2 - 1) + "valore cercato" +
MtF[MtF.length - o - 1].getValoregriglia101v1());
            MtF[MtF.length - o + e2].setValoregriglia101v1(MtF[MtF.
length - o - 1].getValoregriglia101v1());
            System.out.println("valore settato:indice:MtF.length-
e1+f::" + Integer.toString(MtF.length - o + e2) + "::nuovo
valore::" + MtF[MtF.length - o + e2].getValoregriglia101v1());
         }
      }

      e2 = 0;
      if (MtF[MtF.length - e2 - 1].getValoregriglia101v2() == d2)
{
```

```
         while(MtF[MtF.length - e2 - 1].getValoregriglia101v2() ==
d2) {
            System.out.println("indice MtF.length - e2-1::" +
Integer.toString(MtF.length - e2 - 1) + "::valore:: " + MtF[MtF.
length - e2 - 1].getValoregriglia101v2());
            ++e2;
         }

         for(j = 0; j < e2; ++j) {
            System.out.println("indice MtF.length-e2+f-1" +
Integer.toString(MtF.length - e2 + j - 1) + "valore cercato" +
MtF[MtF.length - e2 - 1].getValoregriglia101v2());
            MtF[MtF.length - e2 + j].setValoregriglia101v2(MtF[M
tF.length - e2 - 1].getValoregriglia101v2());
            System.out.println("valore settato:indice:MtF.length-
e2+f::" + Integer.toString(MtF.length - e2 + j) + "::nuovo
valore::" + MtF[MtF.length - e2 + j].getValoregriglia101v2());
         }
      }

      for(j = 1; j < indice - 1; ++j) {
         if (MtF[j].getValoregriglia73() == d) {
            interpola = interpolaXY((double)MtF[j - 1].
getNumGiorno(), (double)MtF[j + 1].getNumGiorno(), MtF[j - 1].
getValoregriglia73(), MtF[j + 1].getValoregriglia73(), (double)
MtF[j].getNumGiorno());
            MtF[j].setValoregriglia73(interpola);
            System.out.println("ciclo73:ripassa:indice J:" +
Integer.toString(j) + ":valore:" + MtF[j].getValoregriglia73());
         }

         if (MtF[j].getValoregriglia101v1() == d1) {
            interpola = interpolaXY((double)MtF[j - 1].
getNumGiorno(), (double)MtF[j + 1].getNumGiorno(), MtF[j - 1].
getValoregriglia101v1(), MtF[j + 1].getValoregriglia101v1(),
(double)MtF[j].getNumGiorno());
            MtF[j].setValoregriglia101v1(interpola);
            System.out.println("ciclo101v1:ripassa:indice J:" +
Integer.toString(j) + ":valore:" + MtF[j].
getValoregriglia101v1());
         }

         if (MtF[j].getValoregriglia101v2() == d2) {
            interpola = interpolaXY((double)MtF[j - 1].
getNumGiorno(), (double)MtF[j + 1].getNumGiorno(), MtF[j - 1].
getValoregriglia101v2(), MtF[j + 1].getValoregriglia101v2(),
(double)MtF[j].getNumGiorno());
```

```
            MtF[j].setValoregriglia101v2(interpola);
            System.out.println("ciclo101v2else:ripassa:indice J:"
+ Integer.toString(j) + ":valore:" + MtF[j].
getValoregriglia101v2());
         }
      }

      esternoEPE = MtF;
      return esternoEPE;
   }
}
```

```
package estrazione;

import au.com.bytecode.opencsv.CSVReader;
import java.io.FileReader;
import java.io.IOException;
import java.text.DateFormat;
import java.text.ParseException;
import java.text.SimpleDateFormat;
import java.util.ArrayList;
import java.util.Arrays;
import java.util.Collections;
import java.util.Date;
import java.util.HashSet;
import java.util.List;
import java.util.Set;
import strutturedati.Griglia;
import strutturedati.datiMtF;
import utilita.convertiTipoData;
import utilita.creaDateGriglia;

public class readPFE95 {
   public static datiMtF[] esternoPFE;
   public static double effPfe;
   public static double effPfe1;
   public static double effPfe2;

   public static String[] join(String[]... parms) {
      int size = 0;
      String[][] var5 = parms;
      int var4 = parms.length;

      String[] result;
      int j;
```

```
        for(j = 0; j < var4; ++j) {
           result = var5[j];
           size += result.length;
        }

        result = new String[size];
        j = 0;
        String[][] var7 = parms;
        int var6 = parms.length;

        for(int var13 = 0; var13 < var6; ++var13) {
           String[] array = var7[var13];
           String[] var11 = array;
           int var10 = array.length;

           for(int var9 = 0; var9 < var10; ++var9) {
              String s = var11[var9];
              result[j++] = s;
           }
        }

        return result;
     }

     private static String[] arrRemove(String[] strArray) {
        Set<String> set = new HashSet();
        set.addAll(Arrays.asList(strArray));
        return (String[])set.toArray(new String[set.size()]);
     }

     public static String[] removeElements(String[] allElements) {
        String[] _localAllElements = new String[allElements.length];
        int j = 0;

        for(int i = 0; i < allElements.length; ++i) {
           if (allElements[i] != null && !allElements[i].equals("")
  && !allElements[i].equals("null")) {
              _localAllElements[j++] = allElements[i];
           }
        }

        return _localAllElements;
     }

     public static int compare(Date date1, Date date2) {
        if (date1.compareTo(date2) == -1) {
           return 1;
```

```
      } else {
         return date1.compareTo(date2) == 1 ? -1 : 0;
      }
   }

   public static String[] clean(String[] v) {
      List<String> list = new ArrayList(Arrays.asList(v));
      list.removeAll(Collections.singleton((Object)null));
      return (String[])list.toArray(new String[list.size()]);
   }

   public static double interpolaXY(double x1, double x2, double
fx1, double fx2, double x) {
      double w1 = (x2 - x) / (x2 - x1);
      double w2 = (x - x1) / (x2 - x1);
      double drmInterpolateLinear = w1 * fx1 + w2 * fx2;
      return drmInterpolateLinear;
   }

   public static datiMtF[] generaArray(String controparte1) throws
NumberFormatException, IOException {
      CSVReader reader = new CSVReader(new FileReader("D://
Profili/U352042/Desktop/dati epe/imi_ges-linea.73/
ExpectedExposures95.xml.outNODE.csv"));
      CSVReader reader1 = new CSVReader(new FileReader("D://
Profili/U352042/Desktop/dati epe/imi_ges-linea.101v1/
ExpectedExposures95.xml.outNODE.csv"));
      CSVReader reader2 = new CSVReader(new FileReader("D://
Profili/U352042/Desktop/dati epe/imi_ges-linea.101v2/
ExpectedExposures95.xml.outNODE.csv"));
      CSVReader readerEffPfe = new CSVReader(new FileReader("D://
Profili/U352042/Desktop/dati epe/imi_ges-linea.73/Eff_
MeanExposures95.xml.outNODE.csv"));
      CSVReader readerEffPfe1 = new CSVReader(new FileReader("D://
Profili/U352042/Desktop/dati epe/imi_ges-linea.101v1/Eff_
MeanExposures95.xml.outNODE.csv"));
      CSVReader readerEffPfe2 = new CSVReader(new FileReader("D://
Profili/U352042/Desktop/dati epe/imi_ges-linea.101v2/Eff_
MeanExposures95.xml.outNODE.csv"));
      String[] nextLine1 = null;
      String[] nextLine2 = null;
      String[] nextLineEffPfe = null;
      String[] nextLineEffPfe1 = null;
      String[] nextLineEffPfe2 = null;
      String[] array73 = null;
      String[] array101v1 = null;
      String[] array101v2 = null;
```

```
        double[] array73_ = null;
        double[] array101v1_ = null;
        double[] array101v2_ = null;
        double[] dd = null;
        double[] dd1 = null;
        double[] dd2 = null;
        String controparte = controparte1;
        String[] finale = null;
        long[] giorni = null;
        datiMtF[] MtF = null;
        int i = 0;
        int indice = 0;
        boolean b = true;
        boolean b1 = true;
        boolean b2 = true;

        while((nextLineEffPfe = readerEffPfe.readNext()) != null &&
  (nextLineEffPfe1 = readerEffPfe1.readNext()) != null &&
  (nextLineEffPfe2 = readerEffPfe2.readNext()) != null) {
           if (nextLineEffPfe[0].indexOf(controparte) != -1) {
              effPfe = Double.parseDouble(nextLineEffPfe[1]);
           }

           if (nextLineEffPfe1[0].indexOf(controparte) != -1) {
              effPfe1 = Double.parseDouble(nextLineEffPfe1[1]);
           }

           if (nextLineEffPfe2[0].indexOf(controparte) != -1) {
              effPfe2 = Double.parseDouble(nextLineEffPfe2[1]);
           }
        }

        String[] nextLine;
        int t;
        int o;
        while((nextLine = reader.readNext()) != null && (nextLine1 =
  reader1.readNext()) != null && (nextLine2 = reader2.readNext()) !=
  null) {
           System.out.println(" ");
           int numeroColonne = nextLine.length;
           int numeroColonne1 = nextLine1.length;
           int numeroColonne2 = nextLine2.length;
           String[] a = new String[numeroColonne];
           String[] a1 = new String[numeroColonne1];
           String[] a2 = new String[numeroColonne2];
           int j;
           if (i == 0) {
```

```
            if (i == 0) {
               array73 = new String[numeroColonne - 1];
               array101v1 = new String[numeroColonne1 - 1];
               array101v2 = new String[numeroColonne2 - 1];
            }

            for(j = 1; j < numeroColonne; ++j) {
               System.out.println("73: " + j + " " + nextLine[j]);
               a[j] = nextLine[j];
               System.out.println("__________");
            }

            if (i == 0) {
               array73 = a;
            }

            for(j = 1; j < numeroColonne1; ++j) {
               System.out.println("101v1: " + j + " " +
nextLine1[j]);
               a1[j] = nextLine1[j];
               System.out.println("a1[j]:" + a1[j]);
               System.out.println("__________");
            }

            if (i == 0) {
               array101v1 = a1;
            }

            for(j = 1; j < numeroColonne2; ++j) {
               System.out.println("101v2: " + j + " " +
nextLine2[j]);
               a2[j] = nextLine2[j];
               System.out.println("a2[j]:" + a2[j]);
               System.out.println("__________");
            }

            if (i == 0) {
               array101v2 = a2;
            }

            String[] big = join(a, a1, a2);
            System.out.println("lunghezza: " + Integer.
toString(big.length));
            System.out.println(Arrays.toString(big));
            String[] g = arrRemove(big);
            System.out.println("array g:" + Integer.toString(g.
length));
```

```
            System.out.println(Arrays.toString(g));
            int p = g.length;
            String[] g1 = new String[p];
            String[] g2 = null;

            for(t = 0; t < p; ++t) {
               System.out.println("g1..elemj:" + t);

               try {
                  g1[t] = creaDateGriglia.estrai(g[t]);
               } catch (NullPointerException var54) {
                  var54.printStackTrace();
               }
            }

            System.out.println("array g1:" + Integer.toString(g1.
length));
            System.out.println(Arrays.toString(g1));

            try {
               g2 = clean(g1);
            } catch (NullPointerException var53) {
               var53.printStackTrace();
            }

            System.out.println("G2 G2 G2" + Integer.toString(g2.
length));
            System.out.println(Arrays.toString(g2));
            t = g2.length;
            System.out.println("G3 G3 G3 t:" + Integer.toString(t)
+ "- p:" + Integer.toString(p));
            String[] g3 = new String[t];

            for(o = 0; o < t; ++o) {
               System.out.println("g2.." + g2[o] + ":o:" + o);
               g3[o] = g2[o].replace("/", "-");
               System.out.println("--g3.." + g3[o]);
            }

            System.out.println("G3 G3 G3" + Integer.toString(g3.
length));
            System.out.println(Arrays.toString(g3));
            DateFormat df = new SimpleDateFormat("yyyy-MM-dd");
            Date var45 = null;

            try {
               var45 = df.parse("2014-01-01");
```

```
            } catch (ParseException var52) {
               var52.printStackTrace();
            }

            long[] g4 = new long[t];

            long temp1;
            for(int w = 0; w < t; ++w) {
               df.setLenient(false);
               Date d = null;

               try {
                  d = df.parse(g3[w]);
               } catch (ParseException var51) {
                  var51.printStackTrace();
               }

               temp1 = d.getTime();
               System.out.println("mill 1:" + Long.
toString(temp1));
               System.out.println("________________");
               g4[w] = temp1;
            }

            System.out.println("g4 g4 g4" + Integer.toString(g4.
length));
            System.out.println(Arrays.toString(g4));
            Griglia[] arr = new Griglia[t];

            int z;
            for(z = 0; z < t; ++z) {
               arr[z] = new Griglia(g3[z], g4[z]);
            }

            Arrays.sort(arr);
            System.out.println("Ok...Ok\n" + Arrays.
toString(arr));
            finale = new String[t];

            for(z = 0; z < t; ++z) {
               finale[z] = arr[z].getData();
            }

            System.out.println("Array Finale" + Integer.
toString(finale.length));
            System.out.println(Arrays.toString(finale));
            giorni = new long[t];
```

```
            giorni[0] = 0L;

            for(z = 1; z < t; ++z) {
               temp1 = (long)convertiTipoData.numGiorni(finale[z
- 1], finale[z]);
               System.out.println("z-1::" + finale[z - 1] + ":z::"
+ finale[z] + "::TS temp1:::" + Long.toString(temp1));
               giorni[z] = giorni[z - 1] + temp1;
            }

            System.out.println("Array Finale Giorni" + Integer.
toString(giorni.length));
            System.out.println(Arrays.toString(giorni));
            indice = t;
            i = 1;
         } else {
            if (nextLine[0].indexOf(controparte) != -1) {
               b = false;
               System.out.println("73 trovata");
               double[] ddx = new double[numeroColonne - 1];

               for(j = 0; j < numeroColonne - 1; ++j) {
                  dd[j] = Double.parseDouble(nextLine[j + 1]);
               }

               if (!b) {
                  array73_ = dd;
               }

               System.out.println("dd dd dd " + Arrays.
toString(dd));
            }

            if (nextLine1[0].indexOf(controparte) != -1) {
               b1 = false;
               System.out.println("101 v1 trovata");
               double[] dd1x = new double[numeroColonne1 - 1];

               for(j = 0; j < numeroColonne1 - 1; ++j) {
                  dd1[j] = Double.parseDouble(nextLine1[j + 1]);
               }

               if (!b1) {
                  array101v1_ = dd1;
               }
```

```
                System.out.println("dd dd dd " + Arrays.
toString(dd1));
            }

            if (nextLine2[0].indexOf(controparte) != -1) {
                b2 = false;
                System.out.println("101 v2 trovata");
                double[] dd2x = new double[numeroColonne2 - 1];

                for(j = 0; j < numeroColonne2 - 1; ++j) {
                    dd2[j] = Double.parseDouble(nextLine2[j + 1]);
                }

                if (!b2) {
                    array101v2_ = dd2;
                }

                System.out.println("dd dd dd " + Arrays.
toString(dd2));
            }

            ++i;
        }
    }

    MtF = new datiMtF[indice];
    Double d = new Double("0.1970012119700121");
    Double d1 = new Double("0.1970012119700122");
    Double d2 = new Double("0.1970012119700123");
    Integer dInt = 0;
    Integer dInt1 = 0;
    Integer dInt2 = 0;

    for(int j = 0; j < indice; ++j) {
        MtF[j] = new datiMtF();
        MtF[j].setNomecontroparte(controparte);
        MtF[j].setNumGiorno(Integer.parseInt(Long.
toString(giorni[j])));
        MtF[j].setData(finale[j]);
        MtF[j].setValoregriglia73(0.0D);
        MtF[j].setValoregriglia101v1(0.0D);
        MtF[j].setValoregriglia101v2(0.0D);
    }

    String c3 = "";

    String c9;
```

```
      String c2;
      for(int j = 0; j < indice; ++j) {
         dInt = 1;
         c9 = MtF[j].getData();
         c2 = c9.replace("-", "/");

         for(o = 1; o < array73.length; ++o) {
            if (array73[o] != null) {
               c3 = array73[o];
            }

            if (c3.indexOf(c2) != -1) {
               double l = array73_[o - 1];
               MtF[j].setValoregriglia73(l);
               dInt = 2;
               System.out.println("ciclo73::indice J:" + Integer.
toString(j) + ":valore:" + MtF[j].getValoregriglia73());
               break;
            }
         }

         if (dInt == 1) {
            MtF[j].setValoregriglia73(d);
            System.out.println("ciclo73:dInt==1:indice J:" +
Integer.toString(j) + ":valore:" + MtF[j].getValoregriglia73());
         }
      }

      String c6 = "";

      String c5;
      int e2;
      for(t = 0; t < indice; ++t) {
         dInt1 = 1;
         c2 = MtF[t].getData();
         c5 = c2.replace("-", "/");

         for(e2 = 1; e2 < array101v1.length; ++e2) {
            if (array101v1[e2] != null) {
               c6 = array101v1[e2];
            }

            if (c6.indexOf(c5) != -1) {
               double l = array101v1_[e2 - 1];
               MtF[t].setValoregriglia101v1(l);
               dInt1 = 2;
```

```
               System.out.println("ciclo101v1::" + MtF[t].
getValoregriglia101v1());
               break;
            }
         }

         if (dInt1 == 1) {
            MtF[t].setValoregriglia101v1(d1);
            System.out.println("ciclov1:dInt==1:indice J:" +
Integer.toString(t) + ":valore:" + MtF[t].
getValoregriglia101v1());
         }
      }

      c9 = "";

     // int j;
      int j;
      double interpola;
      for(j = 0; j < indice; ++j) {
         dInt2 = 1;
         c5 = MtF[j].getData();
         String c8 = c5.replace("-", "/");

         for(j = 1; j < array101v2.length; ++j) {
            if (array101v2[j] != null) {
               c9 = array101v2[j];
            }

            if (c9.indexOf(c8) != -1) {
               interpola = array101v2_[j - 1];
               MtF[j].setValoregriglia101v2(interpola);
               dInt2 = 2;
               System.out.println("ciclo101v2::" + MtF[j].
getValoregriglia101v2());
               break;
            }
         }

         if (dInt2 == 1) {
            MtF[j].setValoregriglia101v2(d2);
            System.out.println("ciclov2:dInt==1:indice J:" +
Integer.toString(j) + ":valore:" + MtF[j].
getValoregriglia101v2());
         }
      }
```

```
        j = 0;
        if (MtF[MtF.length - j - 1].getValoregriglia73() == d) {
            while(MtF[MtF.length - j - 1].getValoregriglia73() == d)
{
                System.out.println("indice MtF.length - e-1::" +
Integer.toString(MtF.length - j - 1) + "::valore:: " + MtF[MtF.
length - j - 1].getValoregriglia73());
                ++j;
            }

            for(o = 0; o < j; ++o) {
                System.out.println("indice MtF.length-e+f-1" +
Integer.toString(MtF.length - j + o - 1) + "valore cercato" +
MtF[MtF.length - j - 1].getValoregriglia73());
                MtF[MtF.length - j + o].setValoregriglia73(MtF[MtF.
length - j - 1].getValoregriglia73());
                System.out.println("valore settato:indice:MtF.length-
e+f::" + Integer.toString(MtF.length - j + o) + "::nuovo valore::"
+ MtF[MtF.length - j + o].getValoregriglia73());
            }
        }

        o = 0;
        if (MtF[MtF.length - o - 1].getValoregriglia101v1() == d1) {
            while(MtF[MtF.length - o - 1].getValoregriglia101v1() ==
d1) {
                System.out.println("indice MtF.length - e1-1::" +
Integer.toString(MtF.length - o - 1) + "::valore:: " + MtF[MtF.
length - o - 1].getValoregriglia101v1());
                ++o;
            }

            for(e2 = 0; e2 < o; ++e2) {
                System.out.println("indice MtF.length-e1+f-1" +
Integer.toString(MtF.length - o + e2 - 1) + "valore cercato" +
MtF[MtF.length - o - 1].getValoregriglia101v1());
               MtF[MtF.length - o + e2].setValoregriglia101v1(MtF[MtF.
length - o - 1].getValoregriglia101v1());
                System.out.println("valore settato:indice:MtF.length-
e1+f::" + Integer.toString(MtF.length - o + e2) + "::nuovo
valore::" + MtF[MtF.length - o + e2].getValoregriglia101v1());
            }
        }

        e2 = 0;
        if (MtF[MtF.length - e2 - 1].getValoregriglia101v2() == d2)
{
```

```
         while(MtF[MtF.length - e2 - 1].getValoregriglia101v2() ==
d2) {
            System.out.println("indice MtF.length - e2-1::" +
Integer.toString(MtF.length - e2 - 1) + "::valore:: " + MtF[MtF.
length - e2 - 1].getValoregriglia101v2());
            ++e2;
         }

         for(j = 0; j < e2; ++j) {
            System.out.println("indice MtF.length-e2+f-1" +
Integer.toString(MtF.length - e2 + j - 1) + "valore cercato" +
MtF[MtF.length - e2 - 1].getValoregriglia101v2());
            MtF[MtF.length - e2 + j].setValoregriglia101v2(MtF
[MtF.length - e2 - 1].getValoregriglia101v2());
            System.out.println("valore settato:indice:MtF.length-
e2+f::" + Integer.toString(MtF.length - e2 + j) + "::nuovo
valore::" + MtF[MtF.length - e2 + j].getValoregriglia101v2());
         }
      }

      for(j = 1; j < indice - 1; ++j) {
         if (MtF[j].getValoregriglia73() == d) {
            interpola = interpolaXY((double)MtF[j - 1].
getNumGiorno(), (double)MtF[j + 1].getNumGiorno(), MtF[j - 1].
getValoregriglia73(), MtF[j + 1].getValoregriglia73(), (double)
MtF[j].getNumGiorno());
            MtF[j].setValoregriglia73(interpola);
            System.out.println("ciclo73:ripassa:indice J:" +
Integer.toString(j) + ":valore:" + MtF[j].getValoregriglia73());
         }

         if (MtF[j].getValoregriglia101v1() == d1) {
            interpola = interpolaXY((double)MtF[j - 1].
getNumGiorno(), (double)MtF[j + 1].getNumGiorno(), MtF[j - 1].
getValoregriglia101v1(), MtF[j + 1].getValoregriglia101v1(),
(double)MtF[j].getNumGiorno());
            MtF[j].setValoregriglia101v1(interpola);
            System.out.println("ciclo101v1:ripassa:indice J:" +
Integer.toString(j) + ":valore:" + MtF[j].
getValoregriglia101v1());
         }

         if (MtF[j].getValoregriglia101v2() == d2) {
            interpola = interpolaXY((double)MtF[j - 1].
getNumGiorno(), (double)MtF[j + 1].getNumGiorno(), MtF[j - 1].
getValoregriglia101v2(), MtF[j + 1].getValoregriglia101v2(),
(double)MtF[j].getNumGiorno());
```

```
            MtF[j].setValoregriglia101v2(interpola);
            System.out.println("ciclo101v2else:ripassa:indice J:"
+ Integer.toString(j) + ":valore:" + MtF[j].
getValoregriglia101v2());
         }
      }

      esternoPFE = MtF;
      return esternoPFE;
   }
}
```

This is the specified list of uml diagram related to this package estrazione (Figures 14.1–14.9)

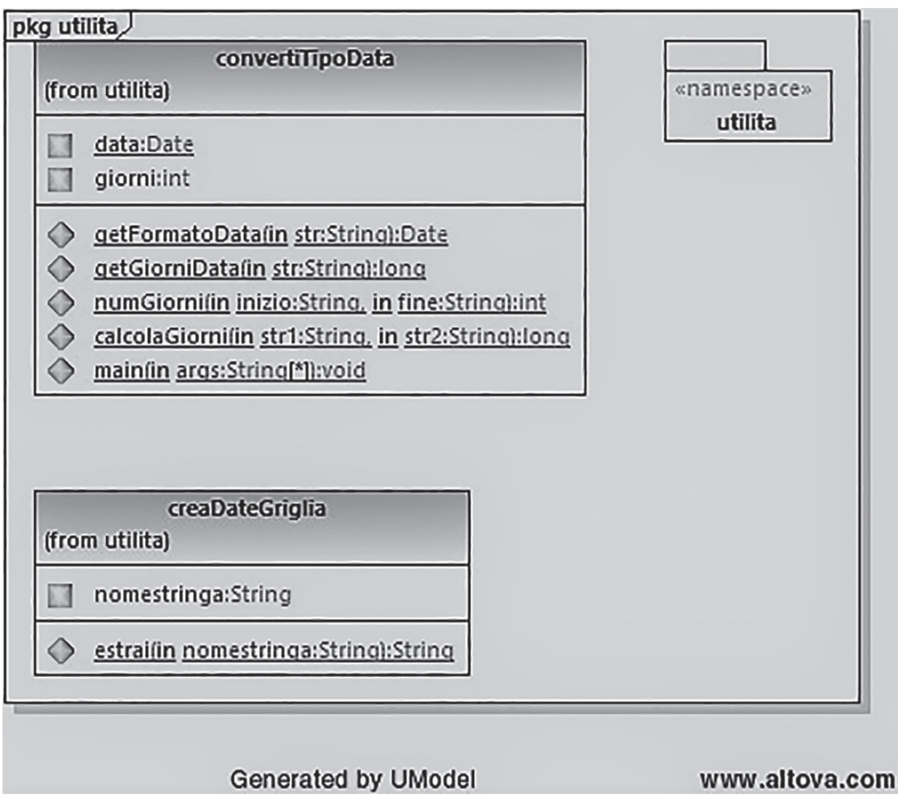


FIGURE 14.1 Content of utilita and all subpackages.

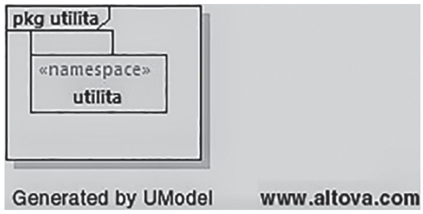


FIGURE 14.2 Content of utilita.

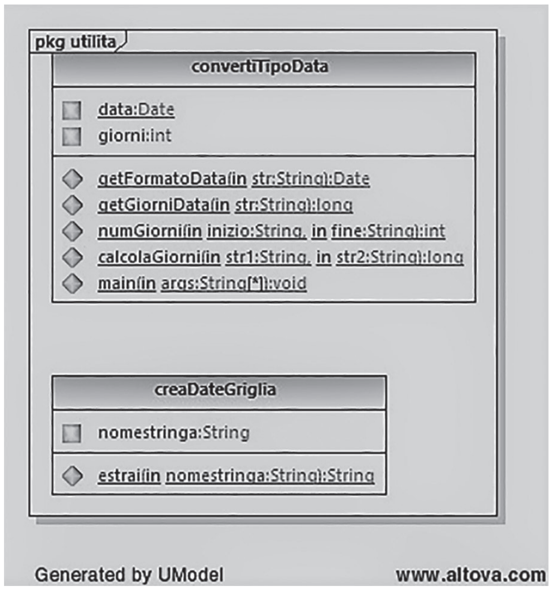


FIGURE 14.3 Content of utilita_1.

14.3 JAVA CODE PACKAGE GRAFICA

```
package grafica;

import java.awt.Color;
import java.awt.Dimension;
import java.awt.GradientPaint;
import org.jfree.chart.ChartFactory;
import org.jfree.chart.ChartPanel;
import org.jfree.chart.JFreeChart;
import org.jfree.chart.axis.CategoryAxis;
import org.jfree.chart.axis.CategoryLabelPositions;
import org.jfree.chart.axis.NumberAxis;
import org.jfree.chart.plot.CategoryPlot;
import org.jfree.chart.plot.PlotOrientation;
import org.jfree.chart.renderer.category.BarRenderer;
import org.jfree.data.category.CategoryDataset;
```

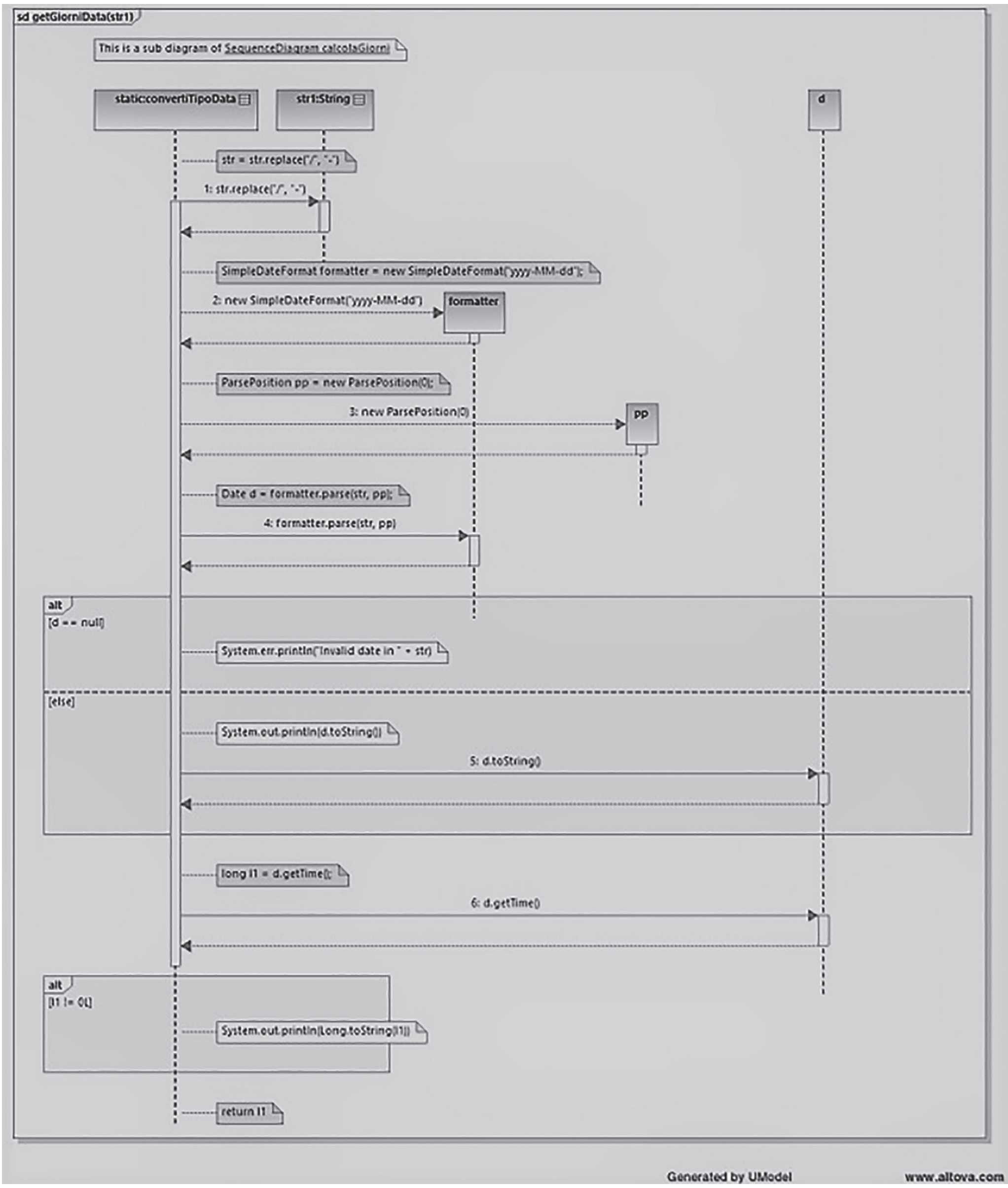


FIGURE 14.4 getGiorniData(str1).

```
import org.jfree.data.category.DefaultCategoryDataset;
import org.jfree.ui.ApplicationFrame;

public class barChartEffEPE extends ApplicationFrame {
   public barChartEffEPE(String title) {
      super(title);
      CategoryDataset dataset = this.createDataset();
      JFreeChart chart = this.createChart(dataset);
```

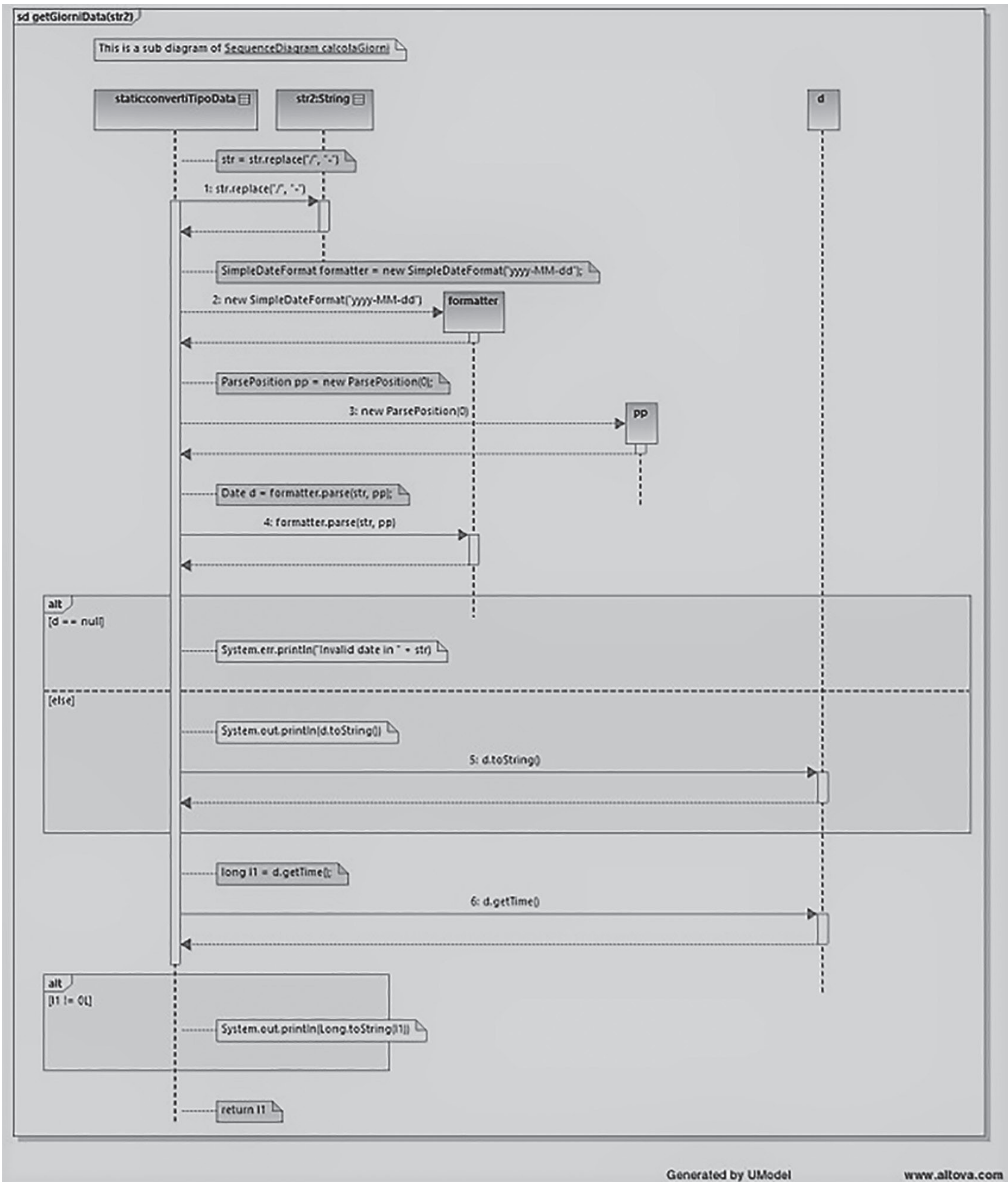


FIGURE 14.5 getGiorniData(str2)_1.

```
      ChartPanel chartPanel = new ChartPanel(chart);
      chartPanel.setPreferredSize(new Dimension(500, 270));
      this.setContentPane(chartPanel);
   }

   private CategoryDataset createDataset() {
      String series1 = "First";
      String series2 = "Second";
```

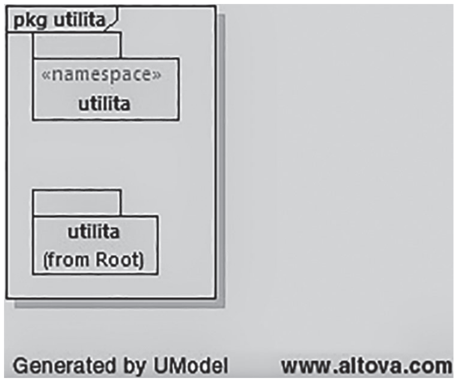


FIGURE 14.6 Package dependencies of utilita.

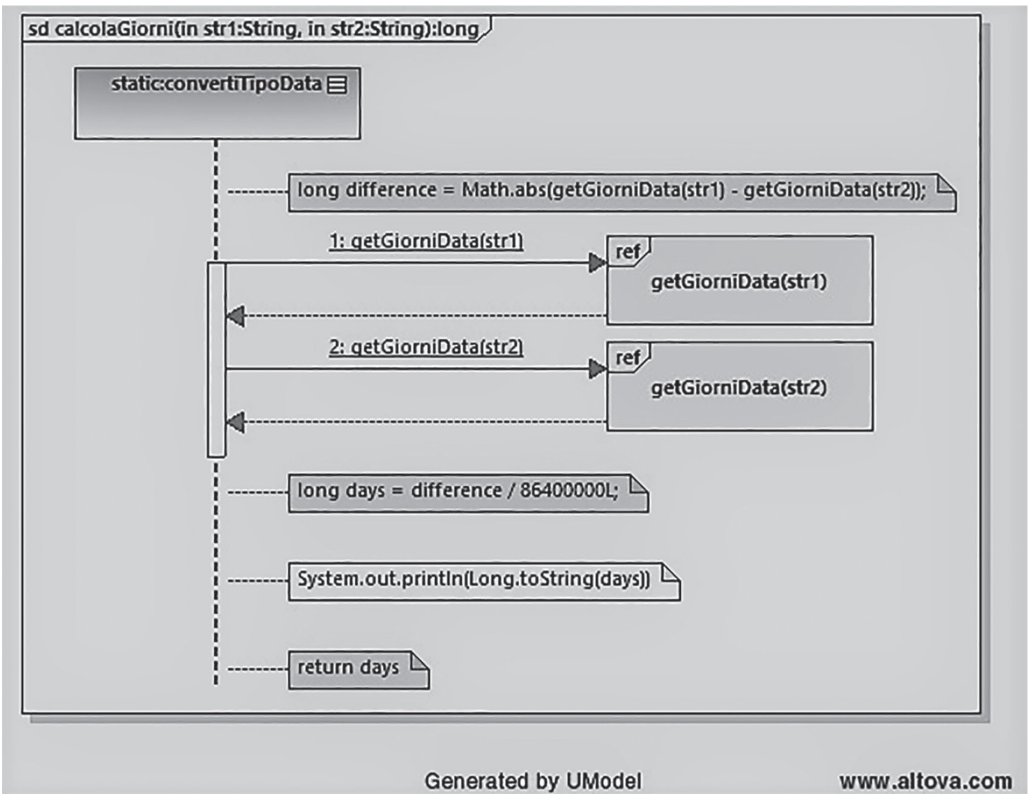


FIGURE 14.7 SequenceDiagram calcolaGiorni.

```
String series3 = "Third";
String category1 = "Category 1";
String category2 = "Category 2";
String category3 = "Category 3";
String category4 = "Category 4";
String category5 = "Category 5";
```

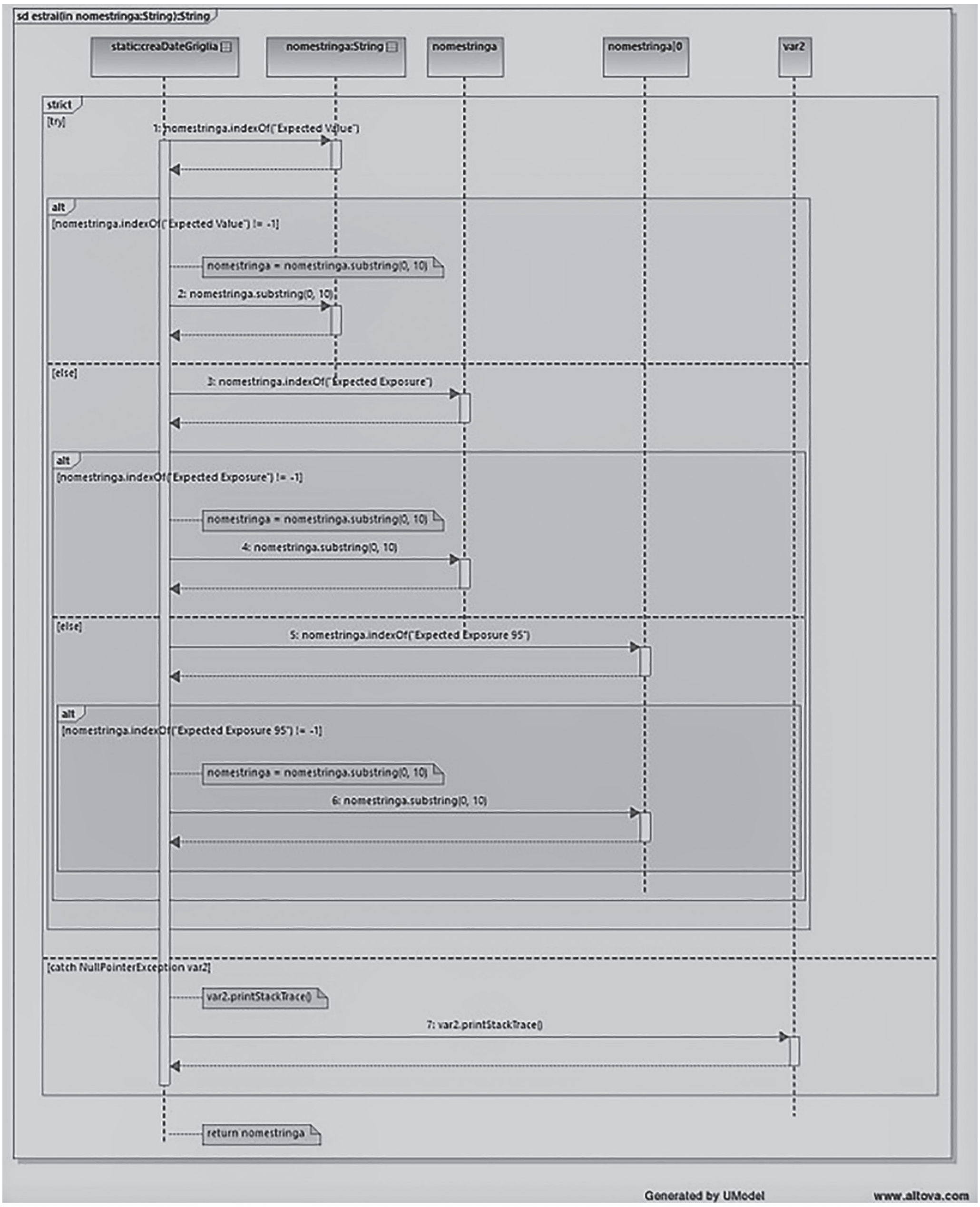


FIGURE 14.8 SequenceDiagram estrai.

```
        DefaultCategoryDataset dataset = new
DefaultCategoryDataset();
        dataset.addValue(1.0D, "First", "Category 1");
        dataset.addValue(4.0D, "First", "Category 2");
        dataset.addValue(3.0D, "First", "Category 3");
        dataset.addValue(5.0D, "First", "Category 4");
```

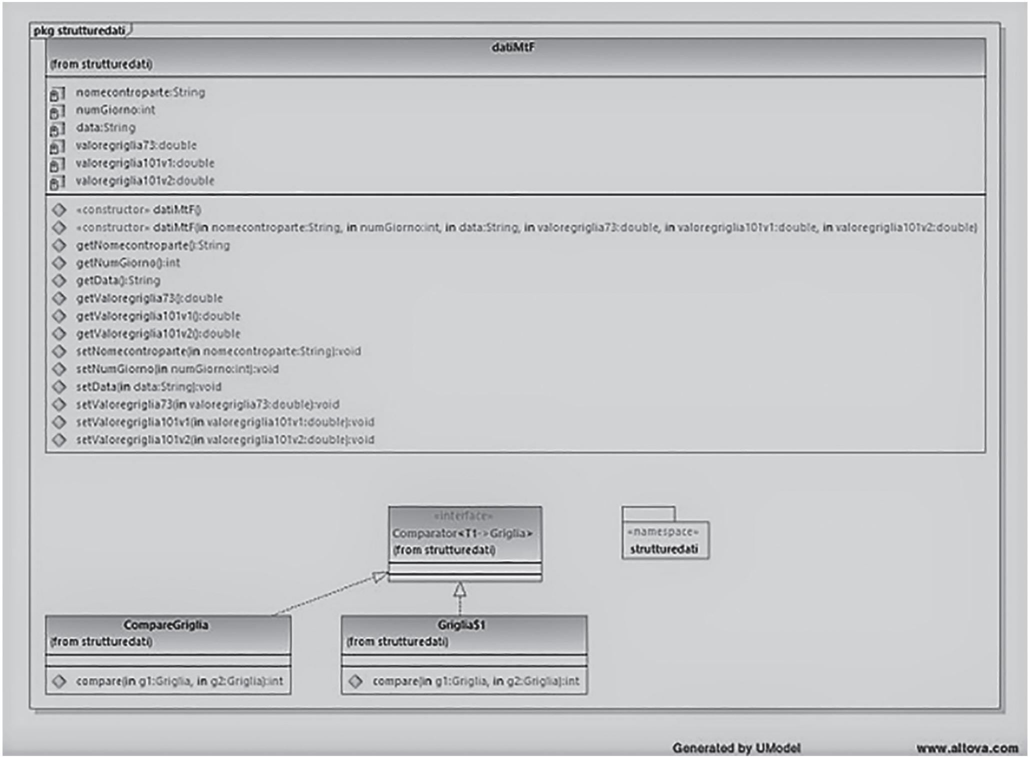


FIGURE 14.9 Package dependencies of strutturedati.

```
        dataset.addValue(5.0D, "First", "Category 5");
        dataset.addValue(5.0D, "Second", "Category 1");
        dataset.addValue(7.0D, "Second", "Category 2");
        dataset.addValue(6.0D, "Second", "Category 3");
        dataset.addValue(8.0D, "Second", "Category 4");
        dataset.addValue(4.0D, "Second", "Category 5");
        dataset.addValue(4.0D, "Third", "Category 1");
        dataset.addValue(3.0D, "Third", "Category 2");
        dataset.addValue(2.0D, "Third", "Category 3");
        dataset.addValue(3.0D, "Third", "Category 4");
        dataset.addValue(6.0D, "Third", "Category 5");
        return dataset;
    }

    private JFreeChart createChart(CategoryDataset dataset) {
        JFreeChart chart = ChartFactory.createBarChart("Bar Chart
Demo", "Category", "Value", dataset, PlotOrientation.VERTICAL,
true, true, false);
        chart.setBackgroundPaint(Color.white);
        CategoryPlot plot = chart.getCategoryPlot();
        plot.setBackgroundPaint(Color.lightGray);
```

```
      plot.setDomainGridlinePaint(Color.white);
      plot.setRangeGridlinePaint(Color.white);
      NumberAxis rangeAxis = (NumberAxis)plot.getRangeAxis();
      rangeAxis.setStandardTickUnits(NumberAxis.
createIntegerTickUnits());
      BarRenderer renderer = (BarRenderer)plot.getRenderer();
      renderer.setDrawBarOutline(false);
      GradientPaint gp0 = new GradientPaint(0.0F, 0.0F, Color.
blue, 0.0F, 0.0F, Color.lightGray);
      GradientPaint gp1 = new GradientPaint(0.0F, 0.0F, Color.
green, 0.0F, 0.0F, Color.lightGray);
      GradientPaint gp2 = new GradientPaint(0.0F, 0.0F, Color.red,
0.0F, 0.0F, Color.lightGray);
      renderer.setSeriesPaint(0, gp0);
      renderer.setSeriesPaint(1, gp1);
      renderer.setSeriesPaint(2, gp2);
      CategoryAxis domainAxis = plot.getDomainAxis();
      domainAxis.setCategoryLabelPositions(CategoryLabelPositions.
createUpRotationLabelPositions(0.5235987755982988D));
      return chart;
   }
}
```

```
package grafica;
import java.awt.Color;
import java.awt.Dimension;
import java.awt.GradientPaint;
import org.jfree.chart.ChartFactory;
import org.jfree.chart.ChartPanel;
import org.jfree.chart.JFreeChart;
import org.jfree.chart.axis.CategoryAxis;
import org.jfree.chart.axis.CategoryLabelPositions;
import org.jfree.chart.axis.NumberAxis;
import org.jfree.chart.plot.CategoryPlot;
import org.jfree.chart.plot.PlotOrientation;
import org.jfree.chart.renderer.category.BarRenderer;
import org.jfree.data.category.CategoryDataset;
import org.jfree.data.category.DefaultCategoryDataset;
import org.jfree.ui.ApplicationFrame;

public class barChartEffPFE95 extends ApplicationFrame {
   public barChartEffPFE95(String title) {
      super(title);
      CategoryDataset dataset = this.createDataset();
      JFreeChart chart = this.createChart(dataset);
```

```
      ChartPanel chartPanel = new ChartPanel(chart);
      chartPanel.setPreferredSize(new Dimension(500, 270));
      this.setContentPane(chartPanel);
   }

   private CategoryDataset createDataset() {
      String series1 = "First";
      String series2 = "Second";
      String series3 = "Third";
      String category1 = "Category 1";
      String category2 = "Category 2";
      String category3 = "Category 3";
      String category4 = "Category 4";
      String category5 = "Category 5";
      DefaultCategoryDataset dataset = new
DefaultCategoryDataset();
      dataset.addValue(1.0D, "First", "Category 1");
      dataset.addValue(4.0D, "First", "Category 2");
      dataset.addValue(3.0D, "First", "Category 3");
      dataset.addValue(5.0D, "First", "Category 4");
      dataset.addValue(5.0D, "First", "Category 5");
      dataset.addValue(5.0D, "Second", "Category 1");
      dataset.addValue(7.0D, "Second", "Category 2");
      dataset.addValue(6.0D, "Second", "Category 3");
      dataset.addValue(8.0D, "Second", "Category 4");
      dataset.addValue(4.0D, "Second", "Category 5");
      dataset.addValue(4.0D, "Third", "Category 1");
      dataset.addValue(3.0D, "Third", "Category 2");
      dataset.addValue(2.0D, "Third", "Category 3");
      dataset.addValue(3.0D, "Third", "Category 4");
      dataset.addValue(6.0D, "Third", "Category 5");
      return dataset;
   }

   private JFreeChart createChart(CategoryDataset dataset) {
      JFreeChart chart = ChartFactory.createBarChart("Bar Chart
Demo", "Category", "Value", dataset, PlotOrientation.VERTICAL,
true, true, false);
      chart.setBackgroundPaint(Color.white);
      CategoryPlot plot = chart.getCategoryPlot();
      plot.setBackgroundPaint(Color.lightGray);
      plot.setDomainGridlinePaint(Color.white);
      plot.setRangeGridlinePaint(Color.white);
      NumberAxis rangeAxis = (NumberAxis)plot.getRangeAxis();
      rangeAxis.setStandardTickUnits(NumberAxis.
createIntegerTickUnits());
      BarRenderer renderer = (BarRenderer)plot.getRenderer();
```

```
      renderer.setDrawBarOutline(false);
      GradientPaint gp0 = new GradientPaint(0.0F, 0.0F, Color.
blue, 0.0F, 0.0F, Color.lightGray);
      GradientPaint gp1 = new GradientPaint(0.0F, 0.0F, Color.
green, 0.0F, 0.0F, Color.lightGray);
      GradientPaint gp2 = new GradientPaint(0.0F, 0.0F, Color.red,
0.0F, 0.0F, Color.lightGray);
      renderer.setSeriesPaint(0, gp0);
      renderer.setSeriesPaint(1, gp1);
      renderer.setSeriesPaint(2, gp2);
      CategoryAxis domainAxis = plot.getDomainAxis();

      domainAxis.setCategoryLabelPositions(CategoryLabelPositions.
createUpRotationLabelPositions(0.5235987755982988D));
      return chart;
   }
}


package grafica;
import estrazione.readCSVMtF;
import java.awt.Color;
import java.io.File;
import org.jfree.chart.ChartFactory;
import org.jfree.chart.ChartUtilities;
import org.jfree.chart.JFreeChart;
import org.jfree.chart.plot.PlotOrientation;
import org.jfree.data.category.DefaultCategoryDataset;
import strutturedati.datiMtF;


public class lineChart {
   public void generaGrafico(String controparte, String s) throws
ClassNotFoundException {
      try {
         datiMtF[] MtF = readCSVMtF.generaArray(controparte);
         String series1 = "73 TS";
         String series2 = "101 v1 TS";
         String series3 = "101 v3 TS";
         DefaultCategoryDataset line = new
DefaultCategoryDataset();

         int h;
         for(h = 0; h < MtF.length; ++h) {
            line.addValue(MtF[h].getValoregriglia73(), "73 TS",
Integer.toString(MtF[h].getNumGiorno()));
         }
```

```
         for(h = 0; h < MtF.length; ++h) {
            line.addValue(MtF[h].getValoregriglia101v1(), "101 v1
TS", Integer.toString(MtF[h].getNumGiorno()));
         }

         for(h = 0; h < MtF.length; ++h) {
            line.addValue(MtF[h].getValoregriglia101v2(), "101 v3
TS", Integer.toString(MtF[h].getNumGiorno()));
         }

         JFreeChart chart = ChartFactory.createLineChart("Market
to Future of " + MtF[0].getNomecontroparte(), "Time", "Value",
line, PlotOrientation.VERTICAL, true, true, false);
         chart.setBackgroundPaint(Color.white);
         int width = 7000;
         int height = 600;
         File lineChart0 = new File("T://Dc_Direzione_Risk_
Management/RiskTech/Users/CarloneGiulio/output/line" + s +
".png");
         ChartUtilities.saveChartAsPNG(lineChart0, chart, width,
height);
      } catch (Exception var12) {
         System.out.println(var12);
      }

   }
}


package grafica;

import estrazione.readEPE;
import java.awt.Color;
import java.io.File;
import org.jfree.chart.ChartFactory;
import org.jfree.chart.ChartUtilities;
import org.jfree.chart.JFreeChart;
import org.jfree.chart.plot.PlotOrientation;
import org.jfree.data.category.DefaultCategoryDataset;
import strutturedati.datiMtF;

public class lineChartEPE {
   public void generaGrafico(String controparte, String s) throws
ClassNotFoundException {
      try {
         datiMtF[] MtF = readEPE.generaArray(controparte);
         double effEpe = readEPE.effEpe;
```

```
          double effEpe1 = readEPE.effEpe1;
          double effEpe2 = readEPE.effEpe2;

          for(int h = 0; h < MtF.length; ++h) {
             System.out.println(MtF[h].getNomecontroparte());
             System.out.println(MtF[h].getNumGiorno());
             System.out.println(MtF[h].getData());
             System.out.println(MtF[h].getValoregriglia73());
             System.out.println(MtF[h].getValoregriglia101v1());
             System.out.println(MtF[h].getValoregriglia101v2());
             System.out.println("................");
          }

          String series1 = "73 TS";
          String series2 = "101 v1 TS";
          String series3 = "101 v3 TS";
          String effepeseries = "Eff EPE 73 TS";
          String effepeseries1 = "Eff EPE 101 v1 TS";
          String effepeseries2 = "Eff EPE 101 v3 TS";
          DefaultCategoryDataset line = new
DefaultCategoryDataset();

          int h;
          for(h = 0; h < MtF.length; ++h) {
             line.addValue(MtF[h].getValoregriglia73(), "73 TS",
Integer.toString(MtF[h].getNumGiorno()));
          }

          for(h = 0; h < MtF.length; ++h) {
             line.addValue(MtF[h].getValoregriglia101v1(), "101 v1
TS", Integer.toString(MtF[h].getNumGiorno()));
          }

          for(h = 0; h < MtF.length; ++h) {
             line.addValue(MtF[h].getValoregriglia101v2(), "101 v3
TS", Integer.toString(MtF[h].getNumGiorno()));
          }

          for(h = 0; h < MtF.length; ++h) {
             line.addValue(effEpe, "Eff EPE 73 TS", Integer.
toString(MtF[h].getNumGiorno()));
          }

          for(h = 0; h < MtF.length; ++h) {
             line.addValue(effEpe1, "Eff EPE 101 v1 TS", Integer.
toString(MtF[h].getNumGiorno()));
          }
```

```
            for(h = 0; h < MtF.length; ++h) {
                line.addValue(effEpe2, "Eff EPE 101 v3 TS", Integer.
toString(MtF[h].getNumGiorno()));
            }

            JFreeChart chart = ChartFactory.createLineChart("Expected
Exposure " + MtF[0].getNomecontroparte(), "Time", "Value", line,
PlotOrientation.VERTICAL, true, true, false);
            chart.setBackgroundPaint(Color.white);
            int width = 7000;
            int height = 600;
            File lineChart1 = new File("T://Dc_Direzione_Risk_
Management/RiskTech/Users/CarloneGiulio/output/epe" + s + ".png");
            ChartUtilities.saveChartAsPNG(lineChart1, chart, width,
height);
        } catch (Exception var21) {
            System.out.println(var21);
        }

    }
}
```

This is the specified list of uml diagram related to this package grafica (Figures 14.10–14.40)

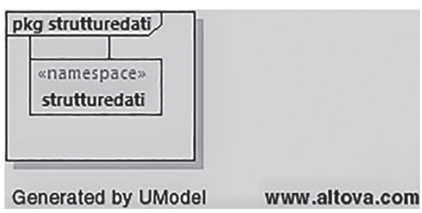


FIGURE 14.10 Package dependencies of strutturedati_1.

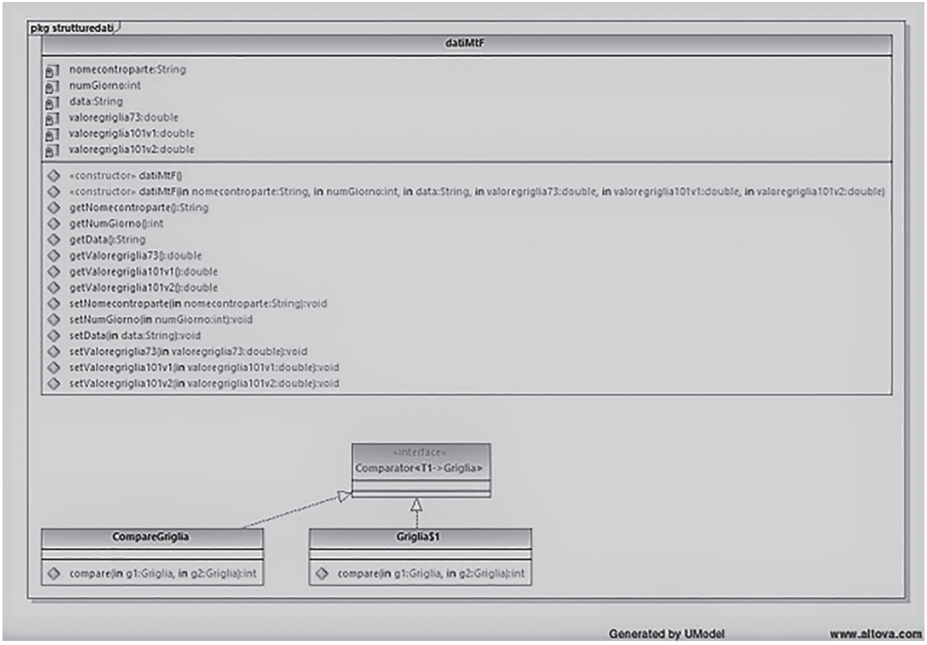


FIGURE 14.11 Content of strutturedati_1.

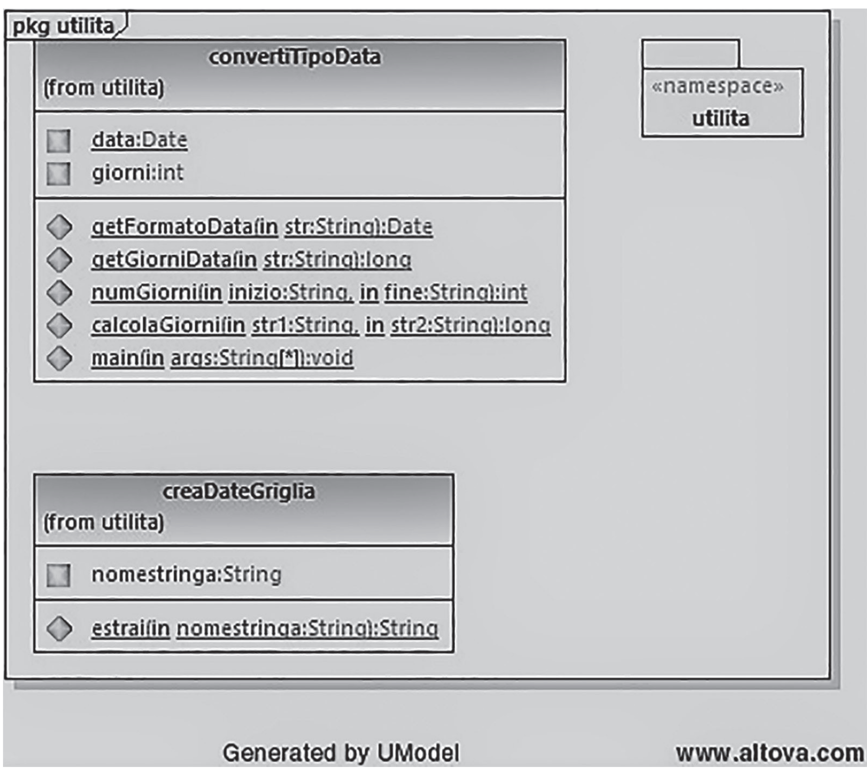


FIGURE 14.12 Content of utilita and all subpackages.

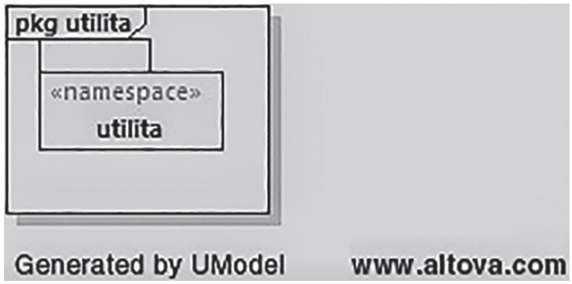


FIGURE 14.13 Content of utilita.

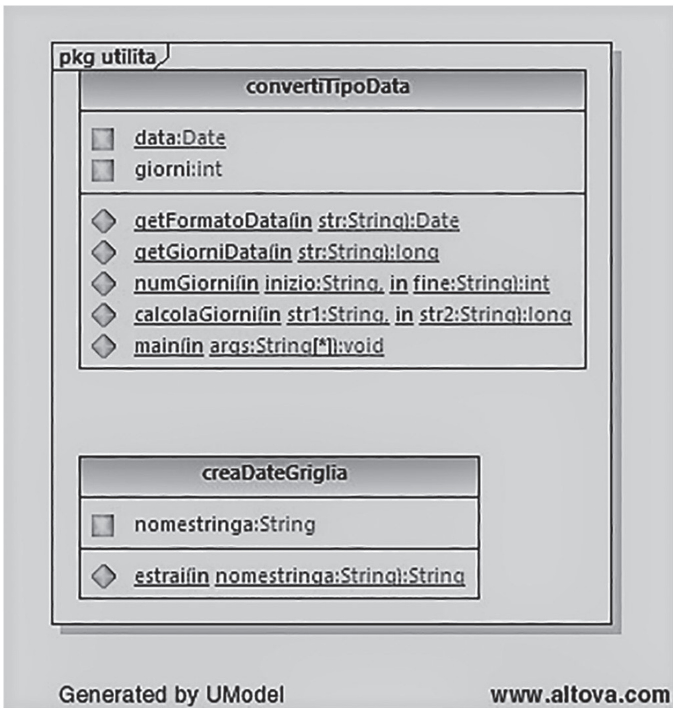


FIGURE 14.14 Content of utilita_1.

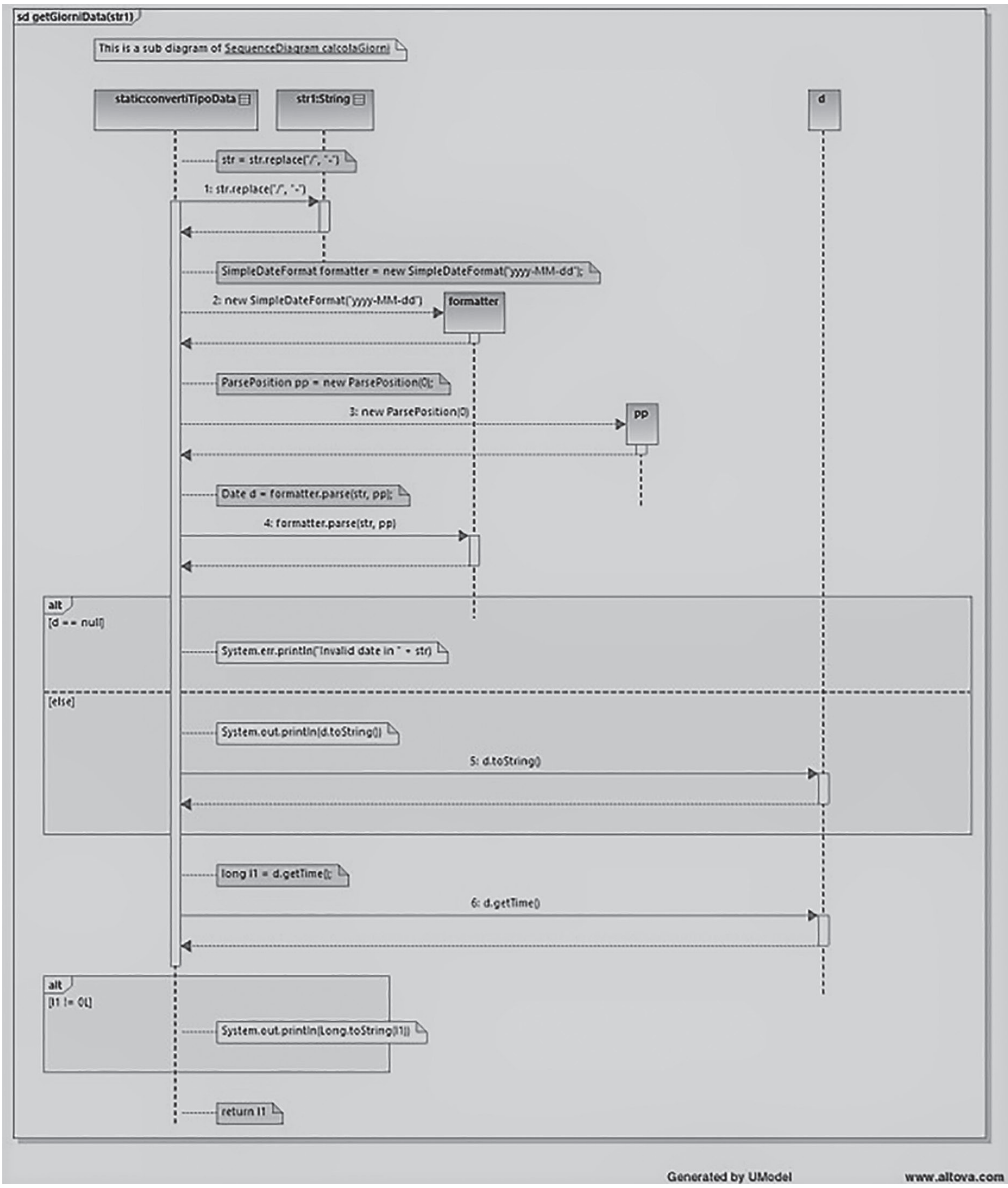


FIGURE 14.15 getGiorniData(str2).

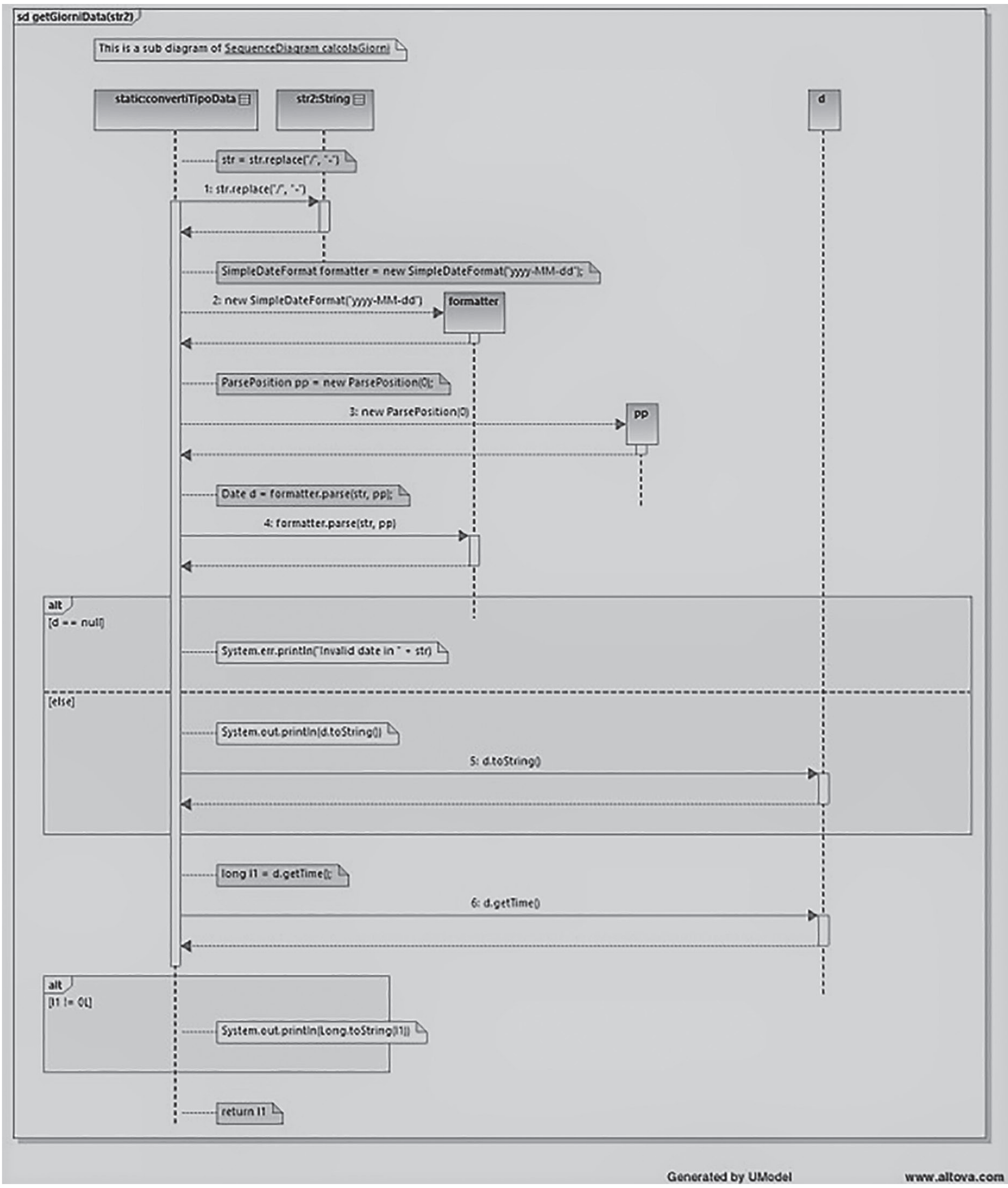


FIGURE 14.16 getGiorniData(str2)_1.

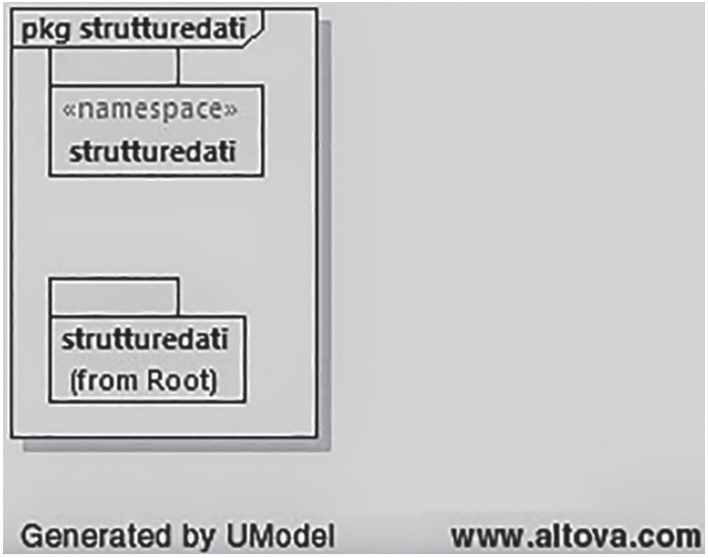


FIGURE 14.17 Package dependencies of strutturedati.

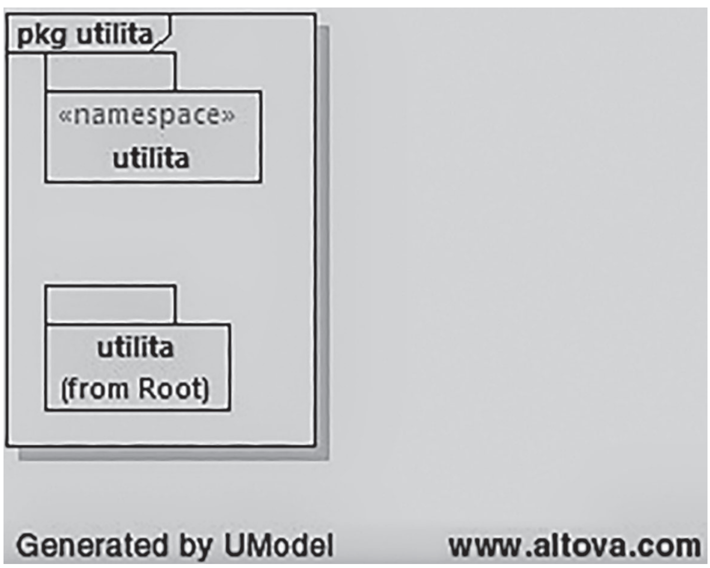


FIGURE 14.18 Package dependencies of utilita.

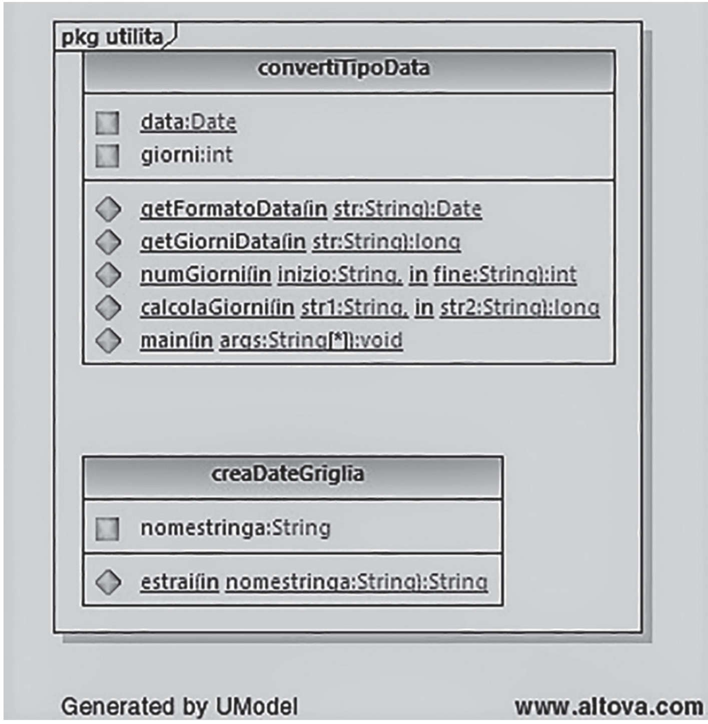


FIGURE 14.19 Content of utilita and all subpackages.

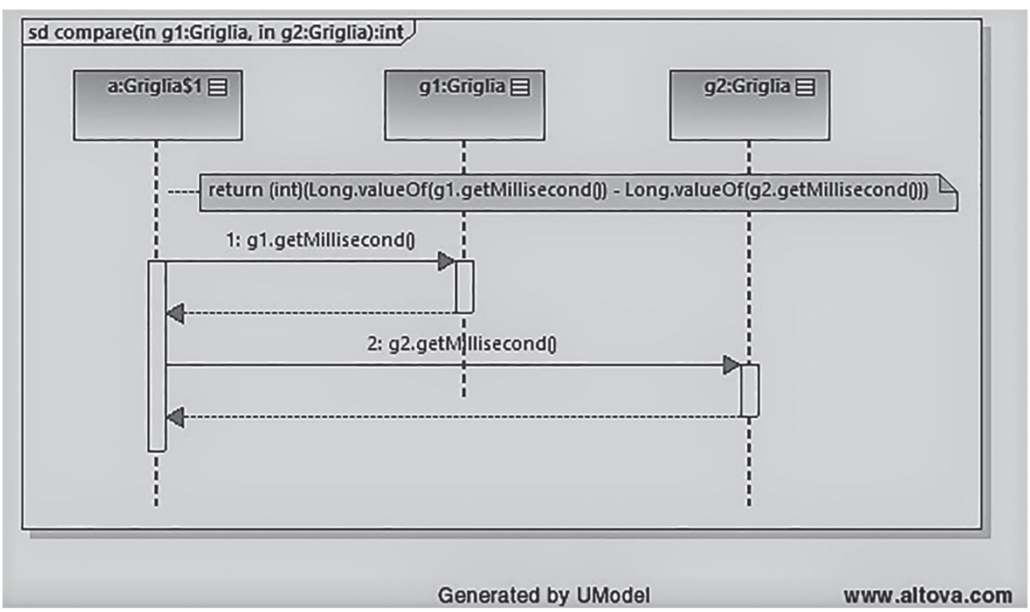


FIGURE 14.20 SequenceDiagram compare_3.

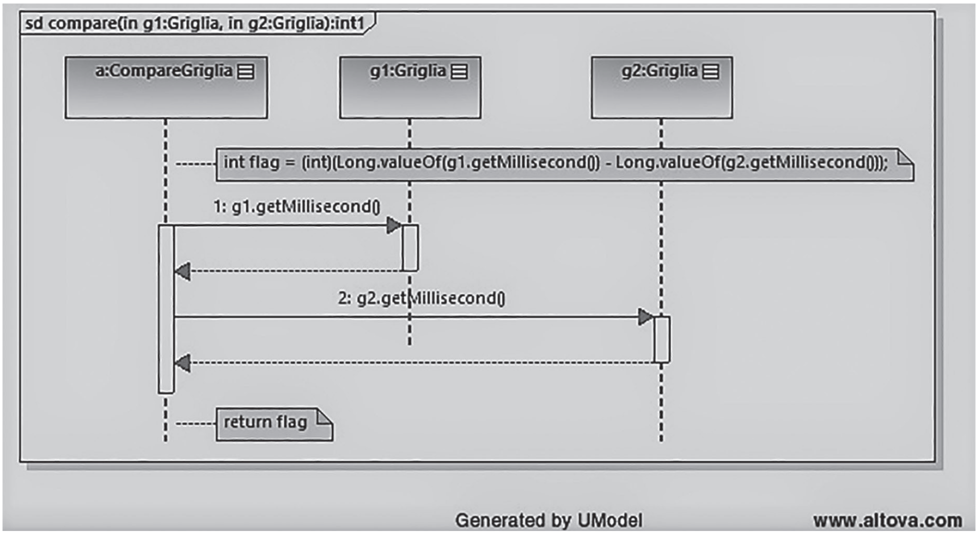


FIGURE 14.21 SequenceDiagram compare_4.

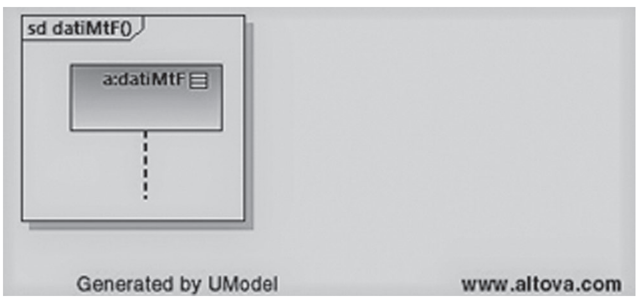


FIGURE 14.22 SequenceDiagram datiMtF.

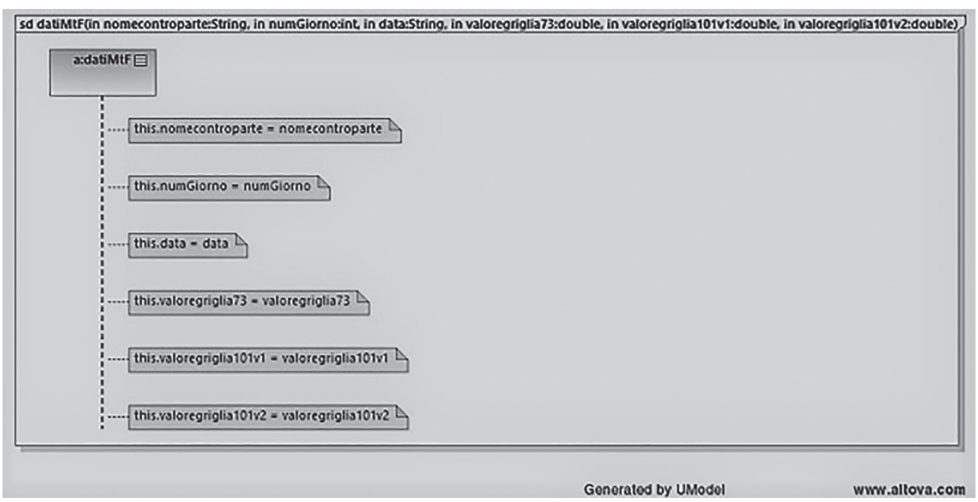


FIGURE 14.23 SequenceDiagram datiMtF_1.

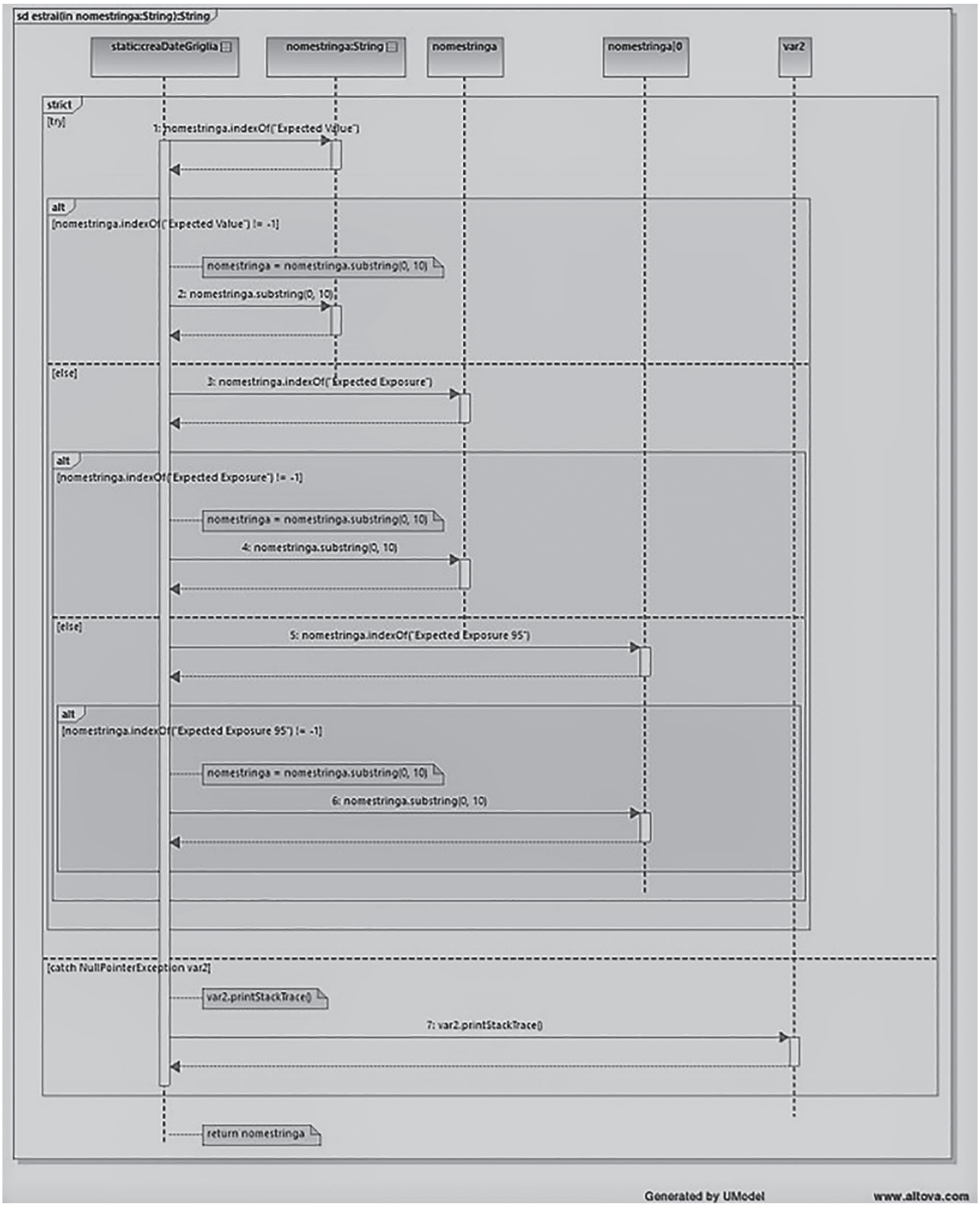


FIGURE 14.24 SequenceDiagram estrai.

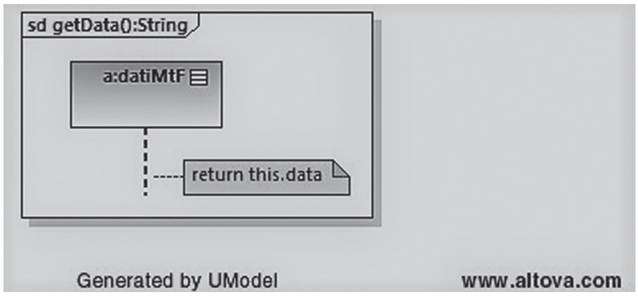


FIGURE 14.25 SequenceDiagram getData.

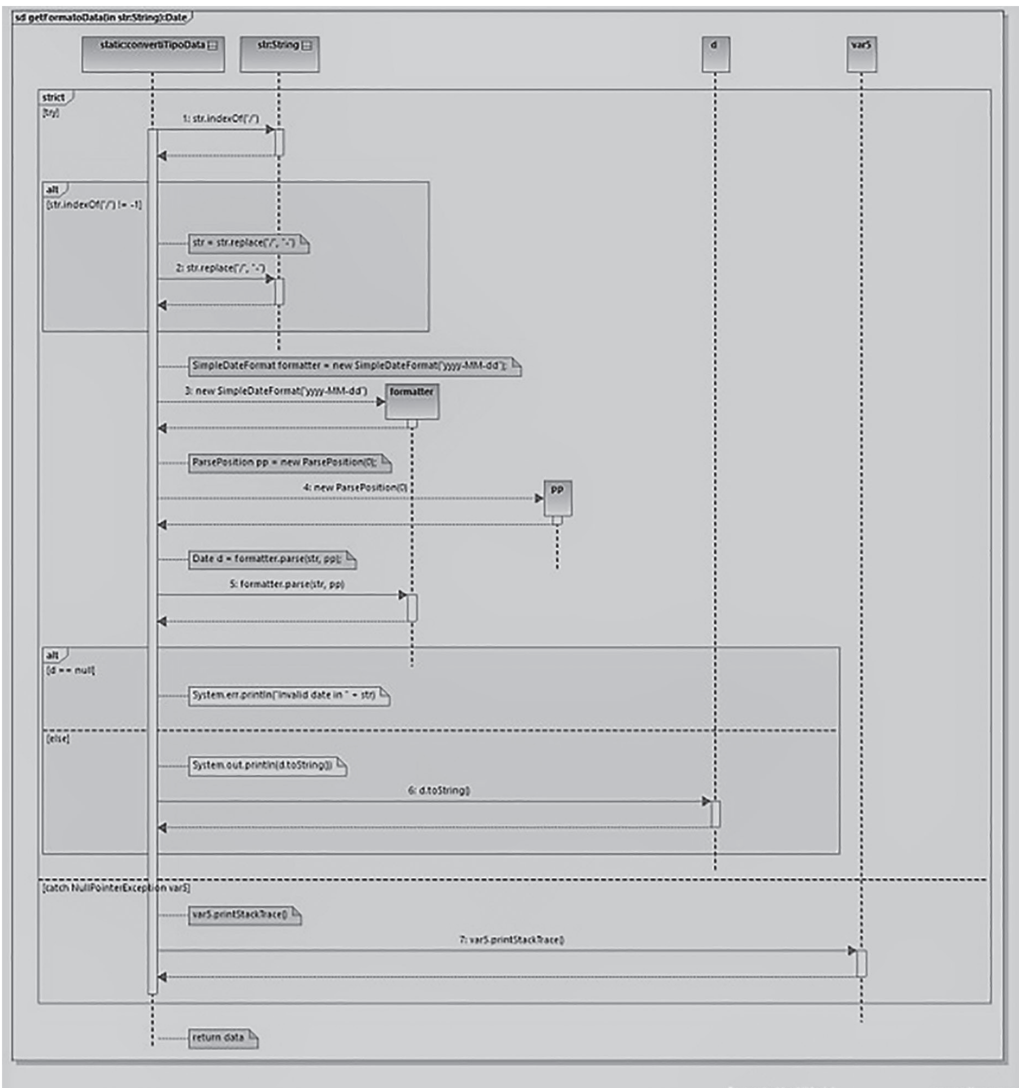


FIGURE 14.26 SequenceDiagram getFormatoData.

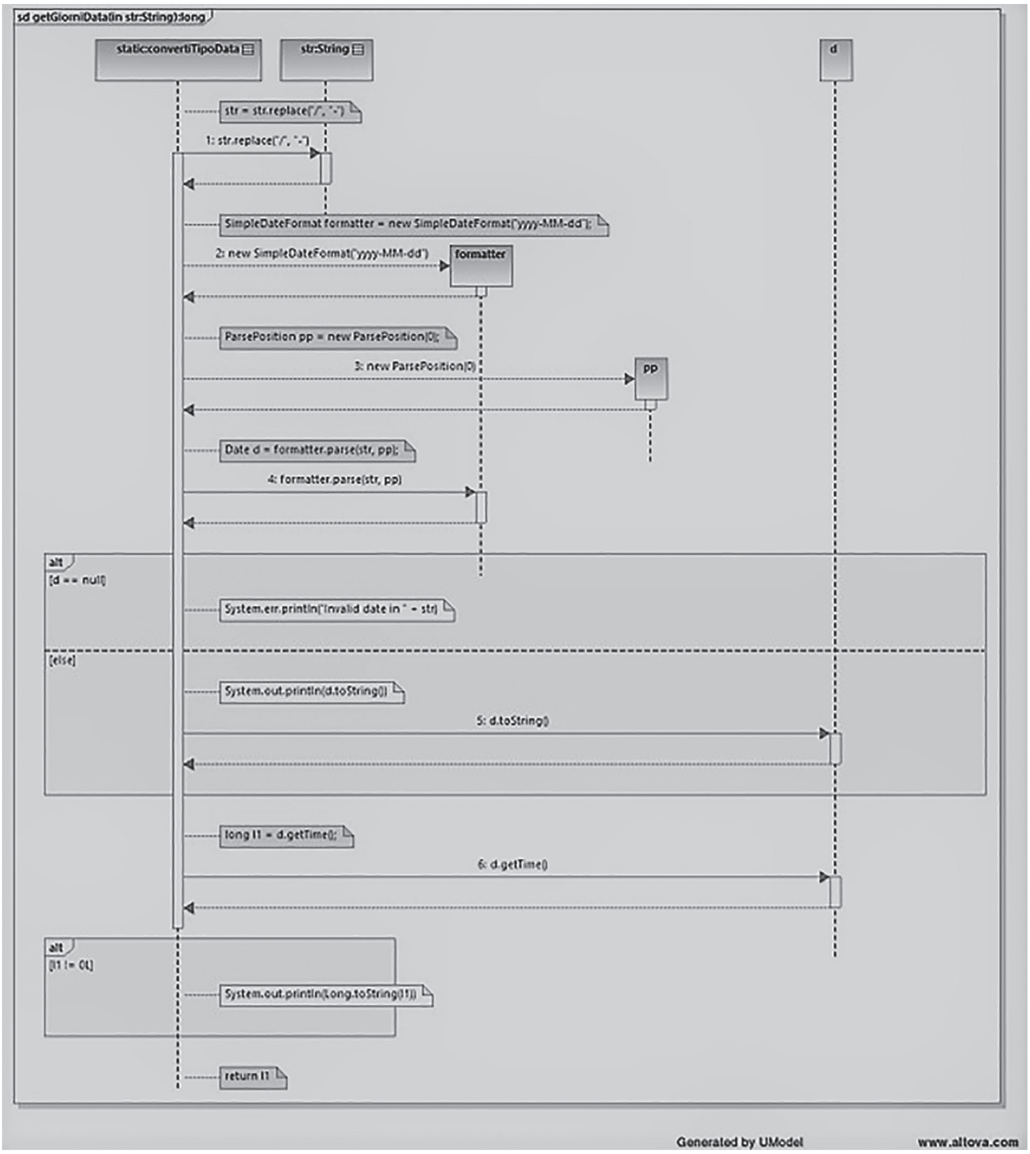


FIGURE 14.27 SequenceDiagram getGiorniData.

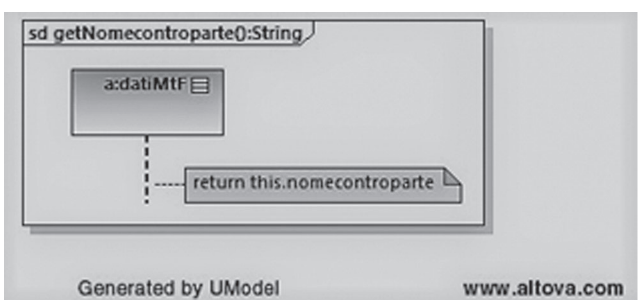


FIGURE 14.28 SequenceDiagram getNomecontroparte.

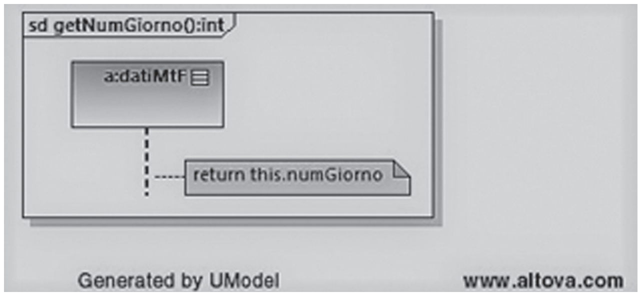


FIGURE 14.29 SequenceDiagram getNumGiorno.

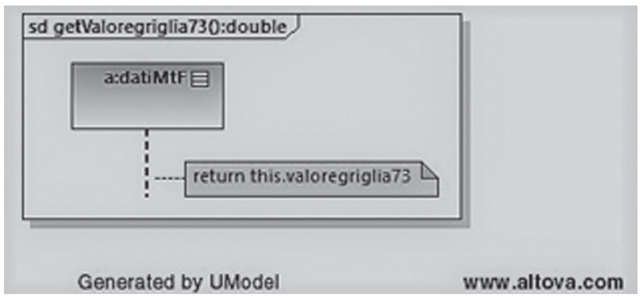


FIGURE 14.30 SequenceDiagram getValoregriglia73.

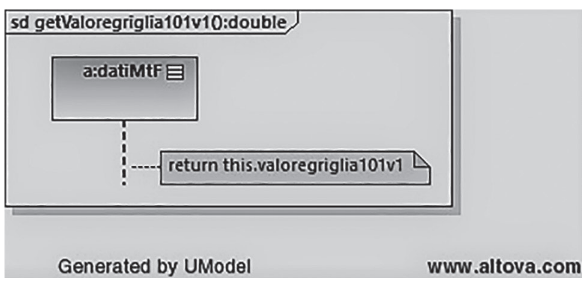


FIGURE 14.31 SequenceDiagram getValoregriglia101v1.

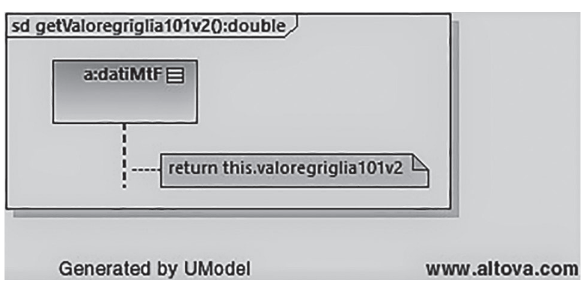


FIGURE 14.32 SequenceDiagram getValoregriglia101v2.

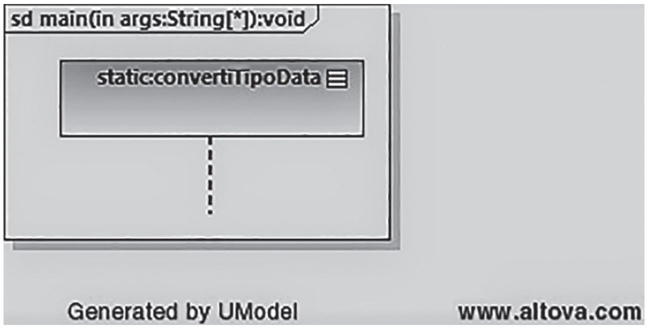


FIGURE 14.33 SequenceDiagram main.

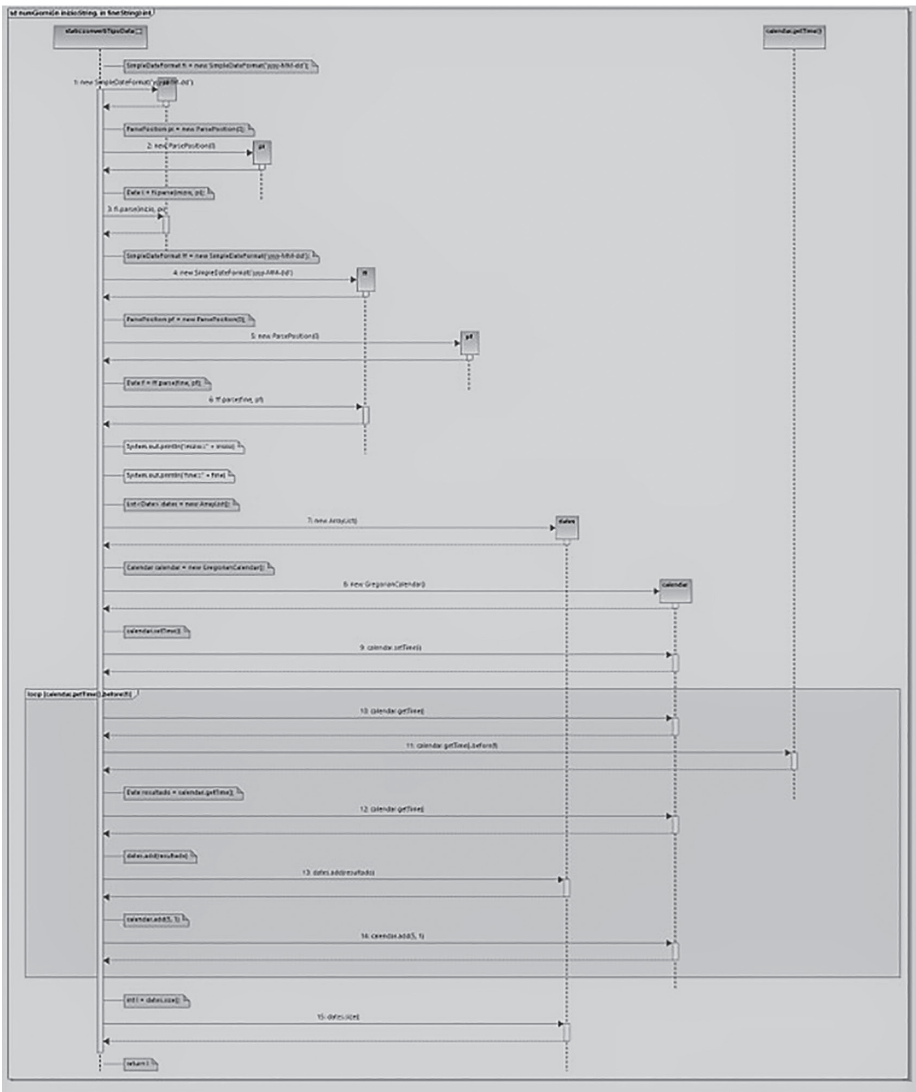


FIGURE 14.34 SequenceDiagram numGiorni.

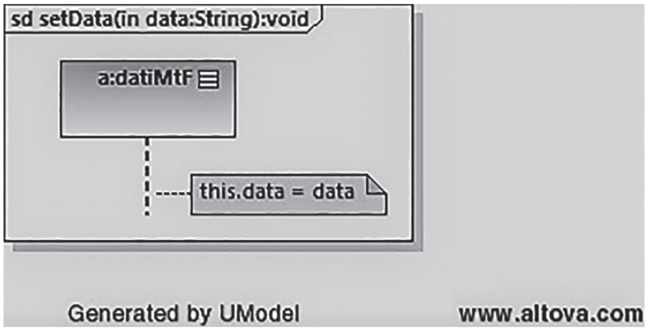


FIGURE 14.35 SequenceDiagram setData.

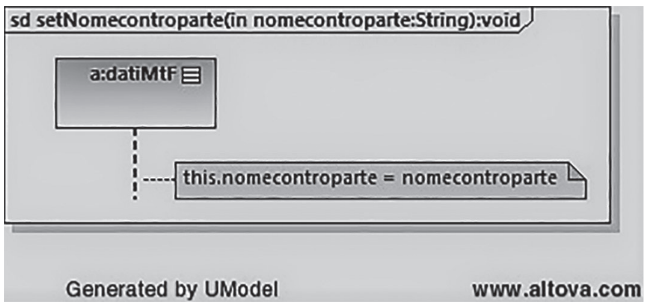


FIGURE 14.36 SequenceDiagram setNomecontroparte.

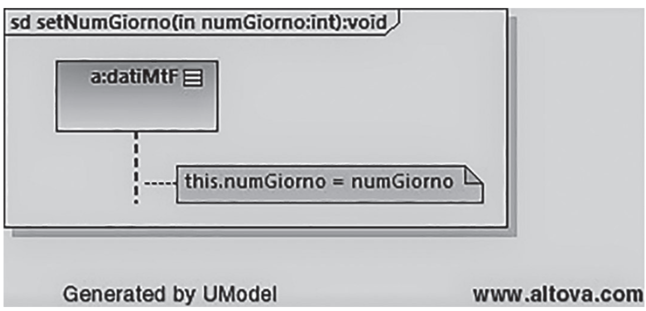


FIGURE 14.37 SequenceDiagram setNumGiorno.

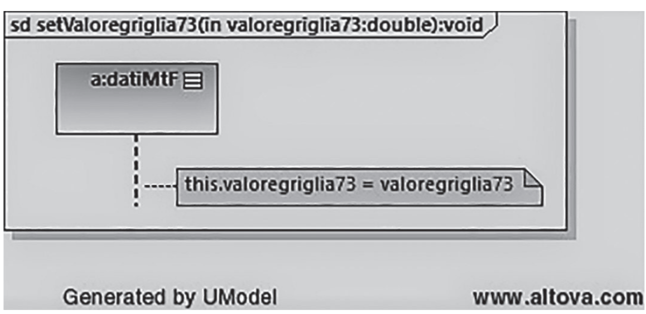


FIGURE 14.38 SequenceDiagram setValoregriglia73.

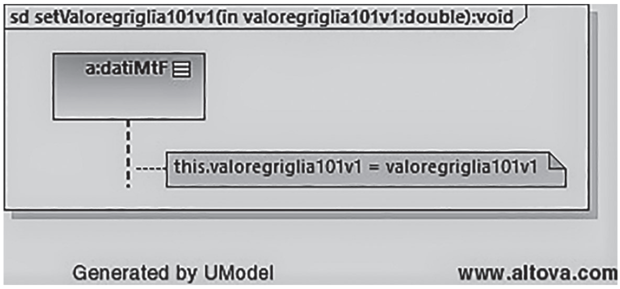


FIGURE 14.39 SequenceDiagram setValoregriglia101v1.

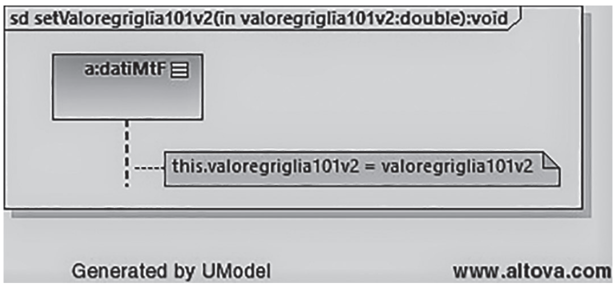


FIGURE 14.40 SequenceDiagram setValoregriglia101v2.

14.4 JAVA CODE PACKAGE STRUTTUREDATI

```
package strutturedati;

public class datiMtF {
   private String nomecontroparte;
   private int numGiorno;
   private String data;
   private double valoregriglia73;
   private double valoregriglia101v1;
   private double valoregriglia101v2;

   public datiMtF() {
   }

   public datiMtF(String nomecontroparte, int numGiorno, String
data, double valoregriglia73, double valoregriglia101v1, double
valoregriglia101v2) {
      this.nomecontroparte = nomecontroparte;
      this.numGiorno = numGiorno;
      this.data = data;
      this.valoregriglia73 = valoregriglia73;
      this.valoregriglia101v1 = valoregriglia101v1;
```

```
      this.valoregriglia101v2 = valoregriglia101v2;
   }

   public String getNomecontroparte() {
      return this.nomecontroparte;
   }

   public int getNumGiorno() {
      return this.numGiorno;
   }

   public String getData() {
      return this.data;
   }

   public double getValoregriglia73() {
      return this.valoregriglia73;
   }

   public double getValoregriglia101v1() {
      return this.valoregriglia101v1;
   }

   public double getValoregriglia101v2() {
      return this.valoregriglia101v2;
   }

   public void setNomecontroparte(String nomecontroparte) {
      this.nomecontroparte = nomecontroparte;
   }

   public void setNumGiorno(int numGiorno) {
      this.numGiorno = numGiorno;
   }

   public void setData(String data) {
      this.data = data;
   }

   public void setValoregriglia73(double valoregriglia73) {
      this.valoregriglia73 = valoregriglia73;
   }

   public void setValoregriglia101v1(double valoregriglia101v1) {
      this.valoregriglia101v1 = valoregriglia101v1;
   }
```

```
   public void setValoregriglia101v2(double valoregriglia101v2) {
      this.valoregriglia101v2 = valoregriglia101v2;
   }
}

package strutturedati;

import java.util.Comparator;

class Griglia$1 implements Comparator<Griglia> {
   public int compare(Griglia g1, Griglia g2) {
      return (int)(Long.valueOf(g1.getMillisecond()) - Long.
valueOf(g2.getMillisecond()));
   }
}
```

This is the specified list of uml diagram related to this package strutturedati (Figures 14.41–14.86)

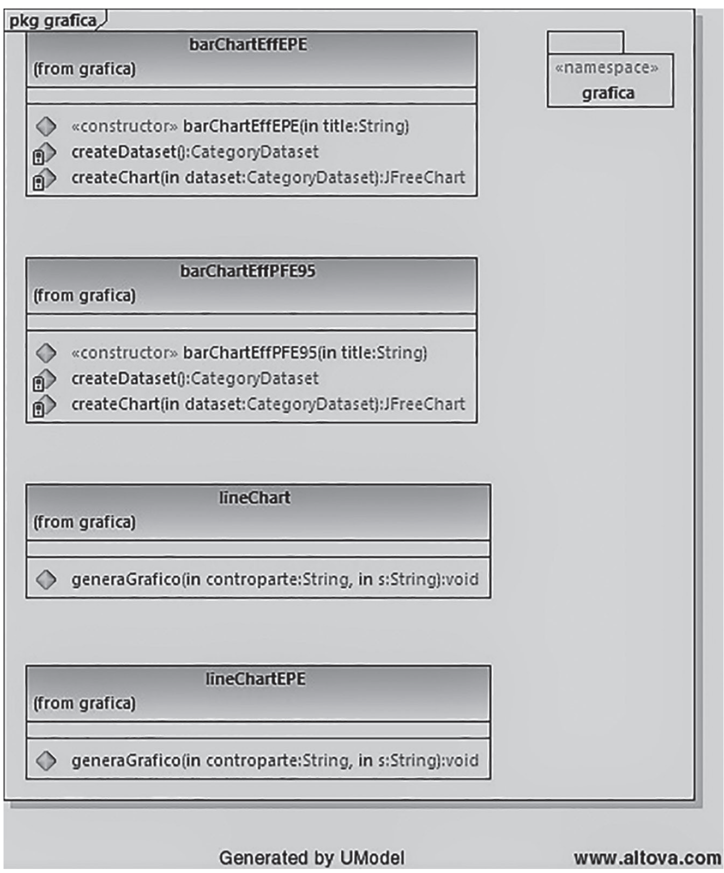


FIGURE 14.41 Content of grafica and all subpackages.

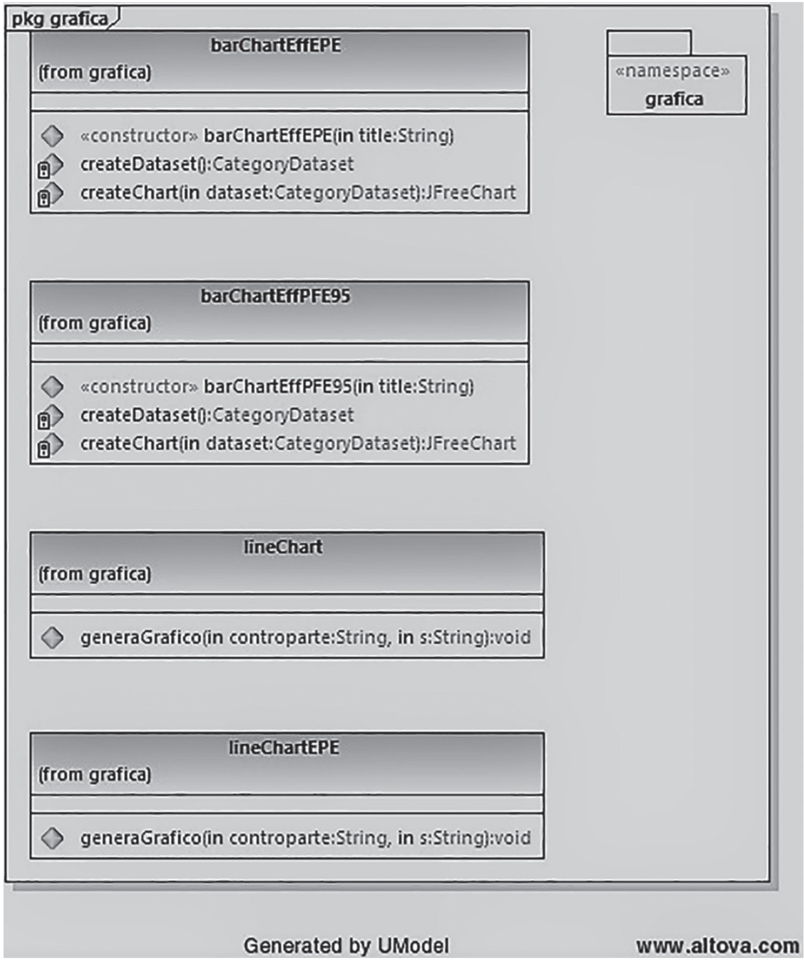


FIGURE 14.42 Content of grafica.

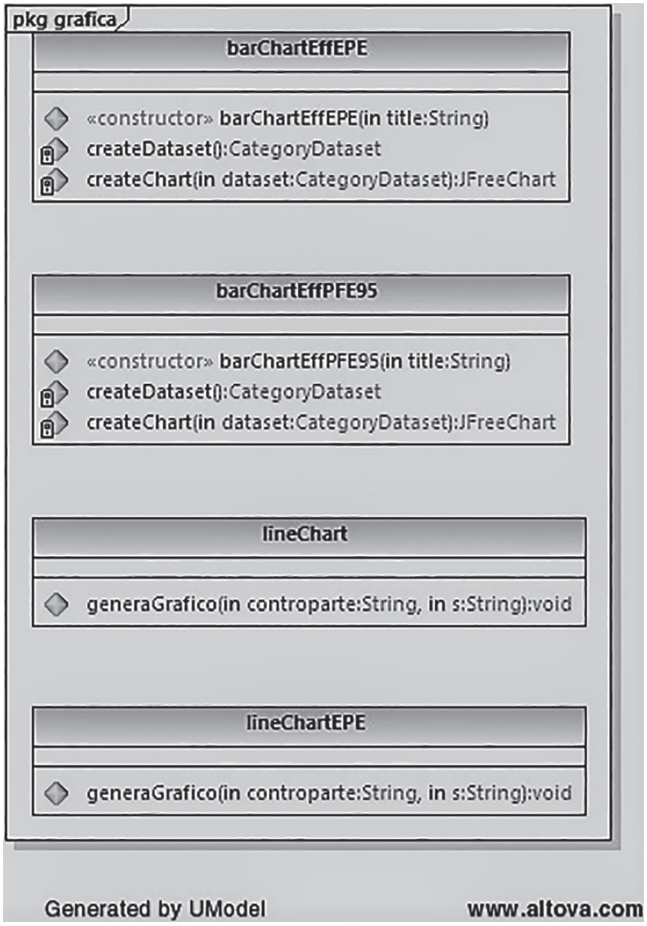


FIGURE 14.43 Content of grafica_1.

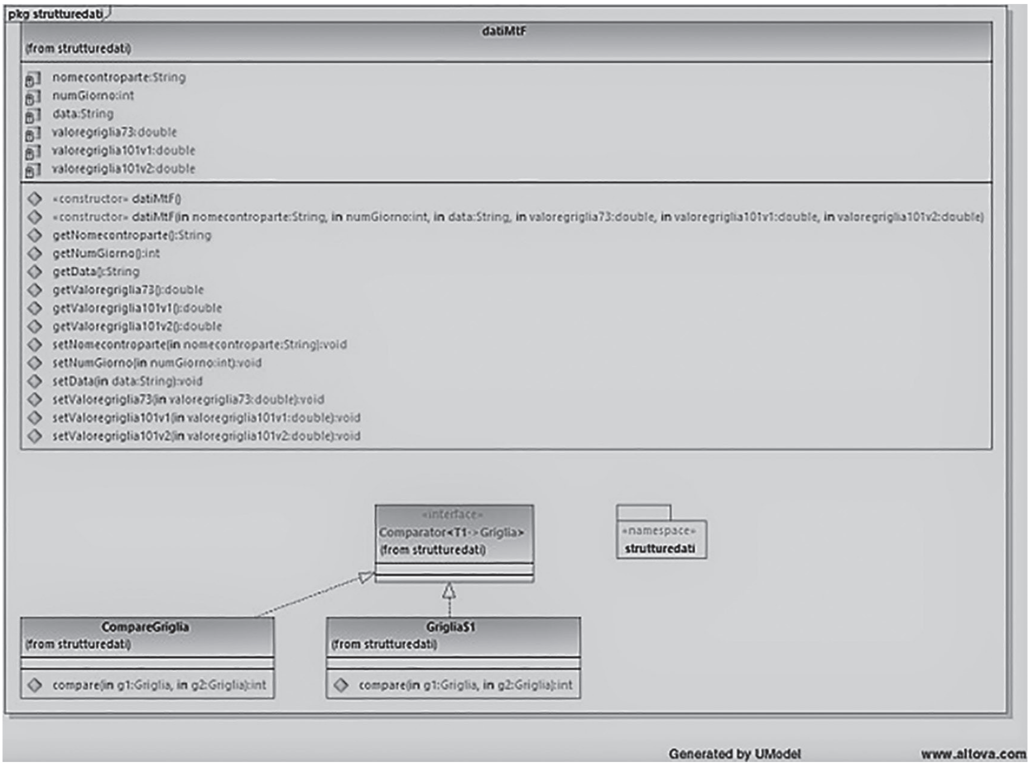


FIGURE 14.44 Content of strutturedati and all subpackages.

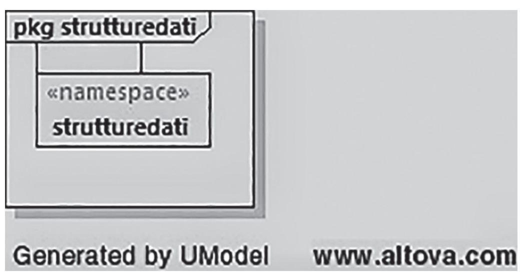


FIGURE 14.45 Content of strutturedati.

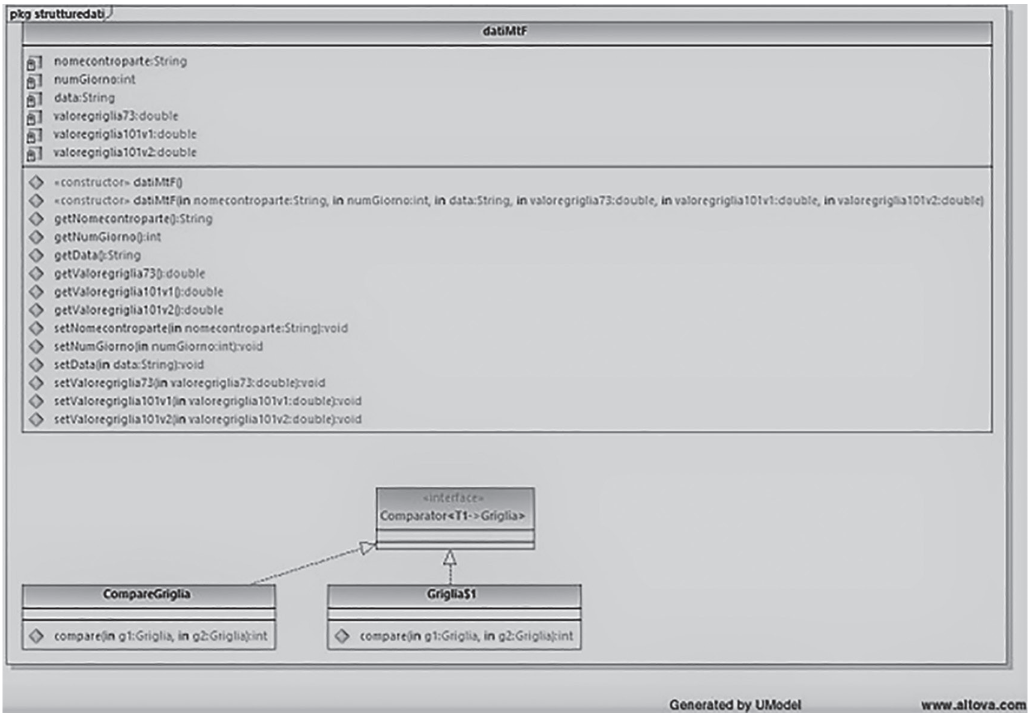


FIGURE 14.46 Content of strutturedati_1.

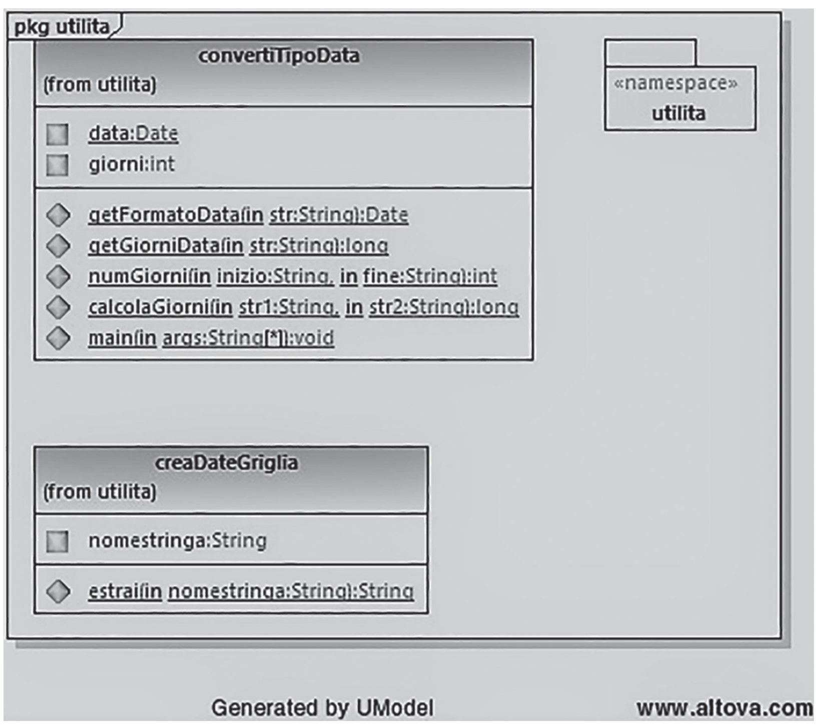


FIGURE 14.47 Content of utilita and all subpackages.

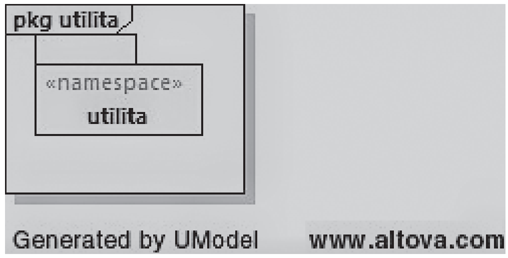


FIGURE 14.48 Content of utilita.

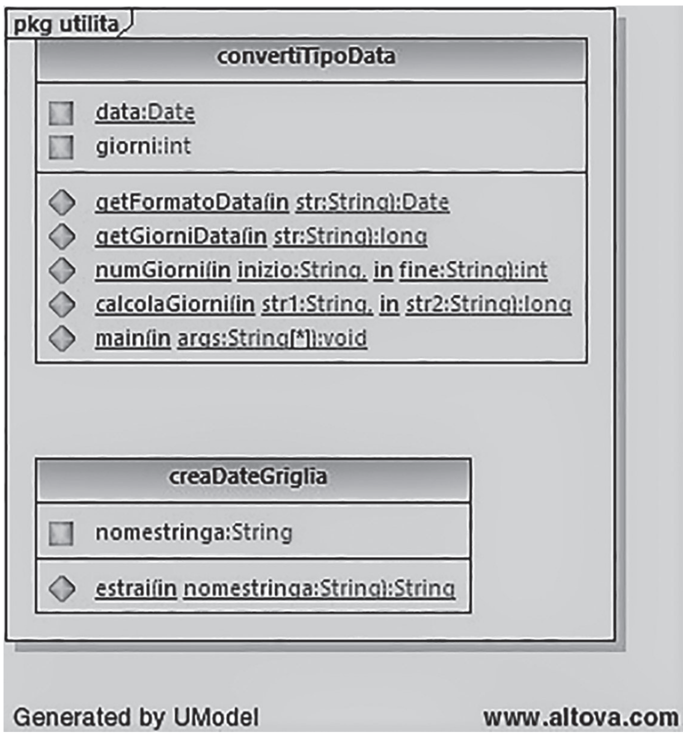


FIGURE 14.49 Content of utilita_1.

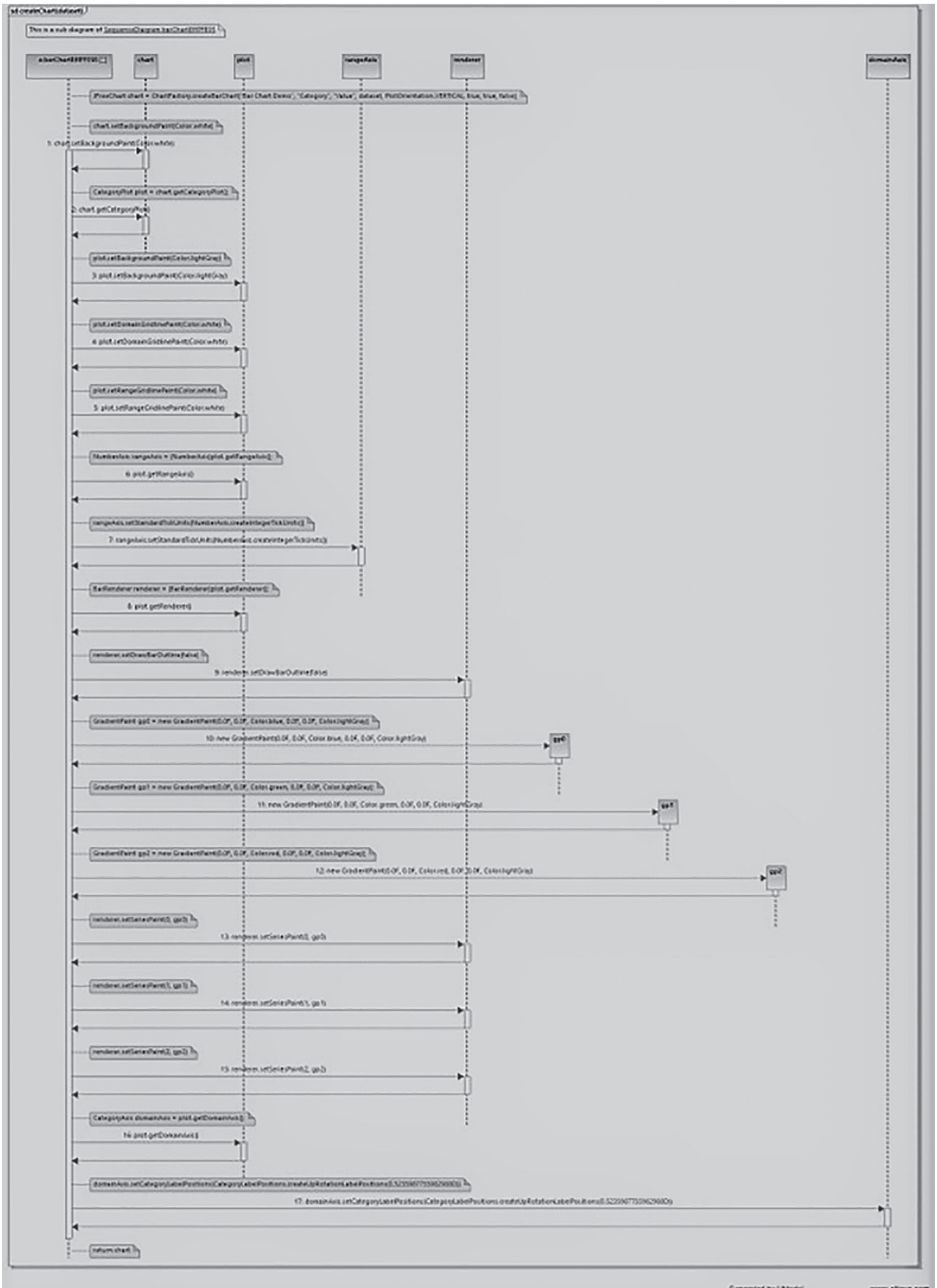


FIGURE 14.50 createChart(dataset).

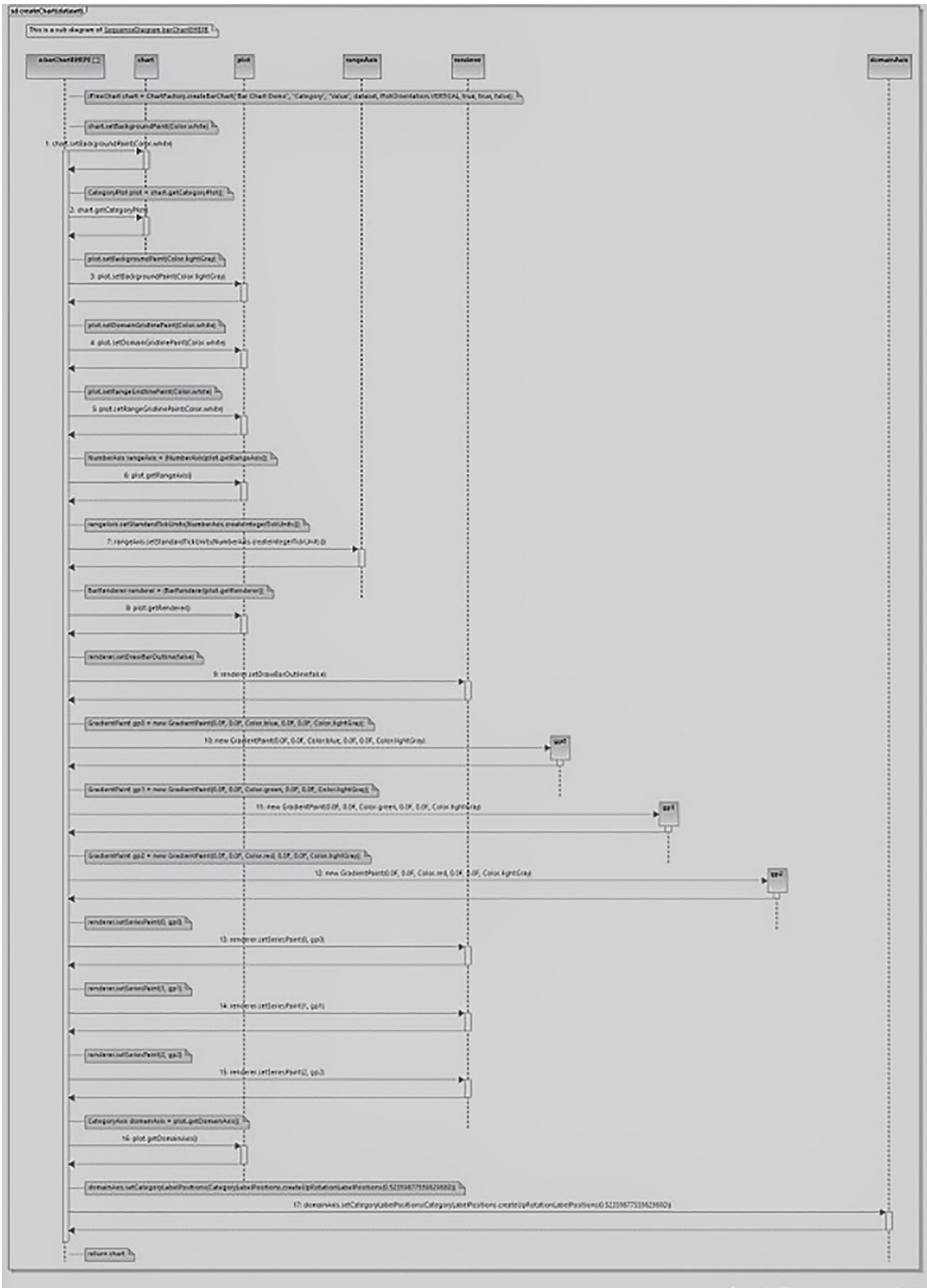


FIGURE 14.51 createChart(dataset)_2.

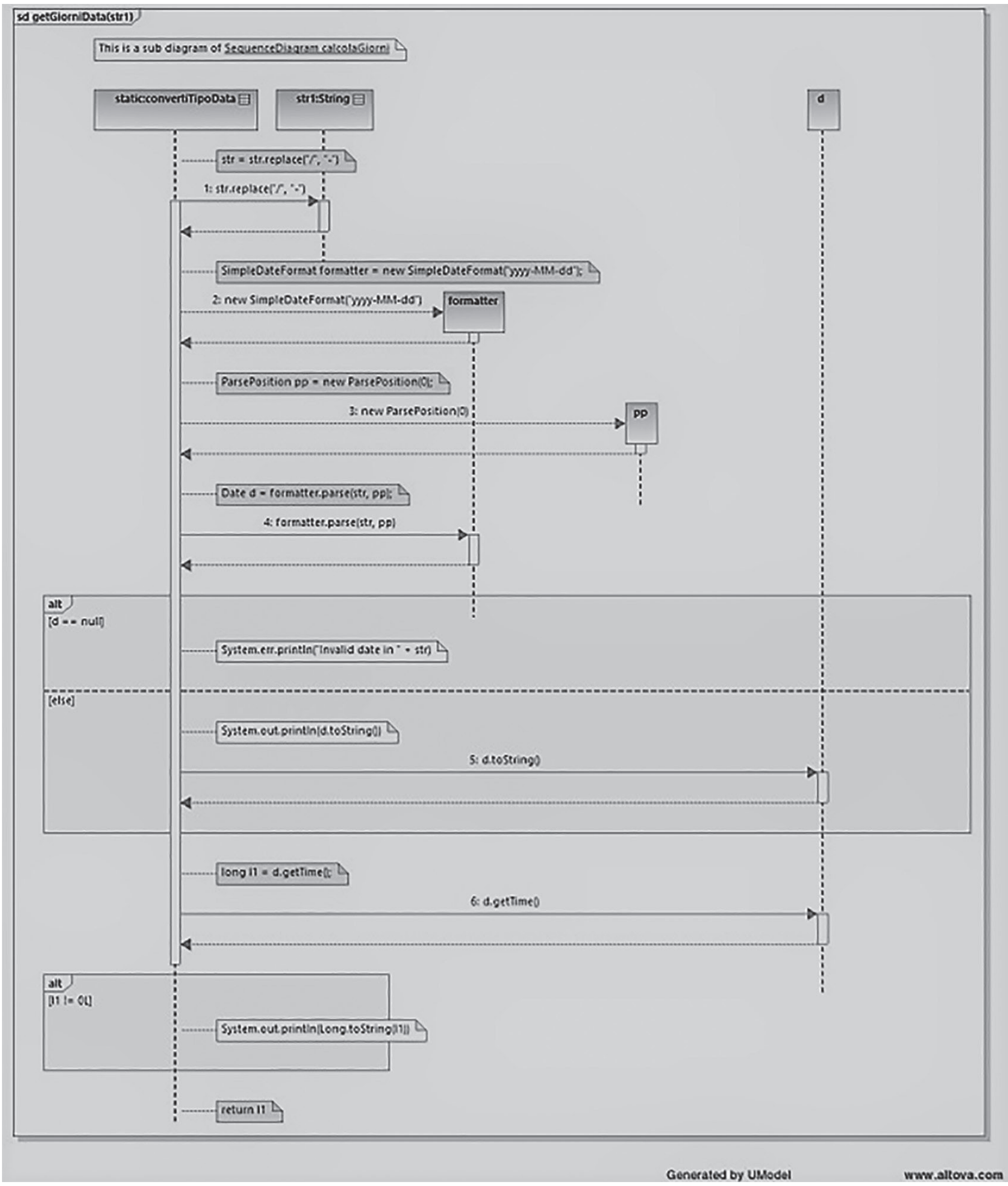


FIGURE 14.52 getGiorniData(str1).

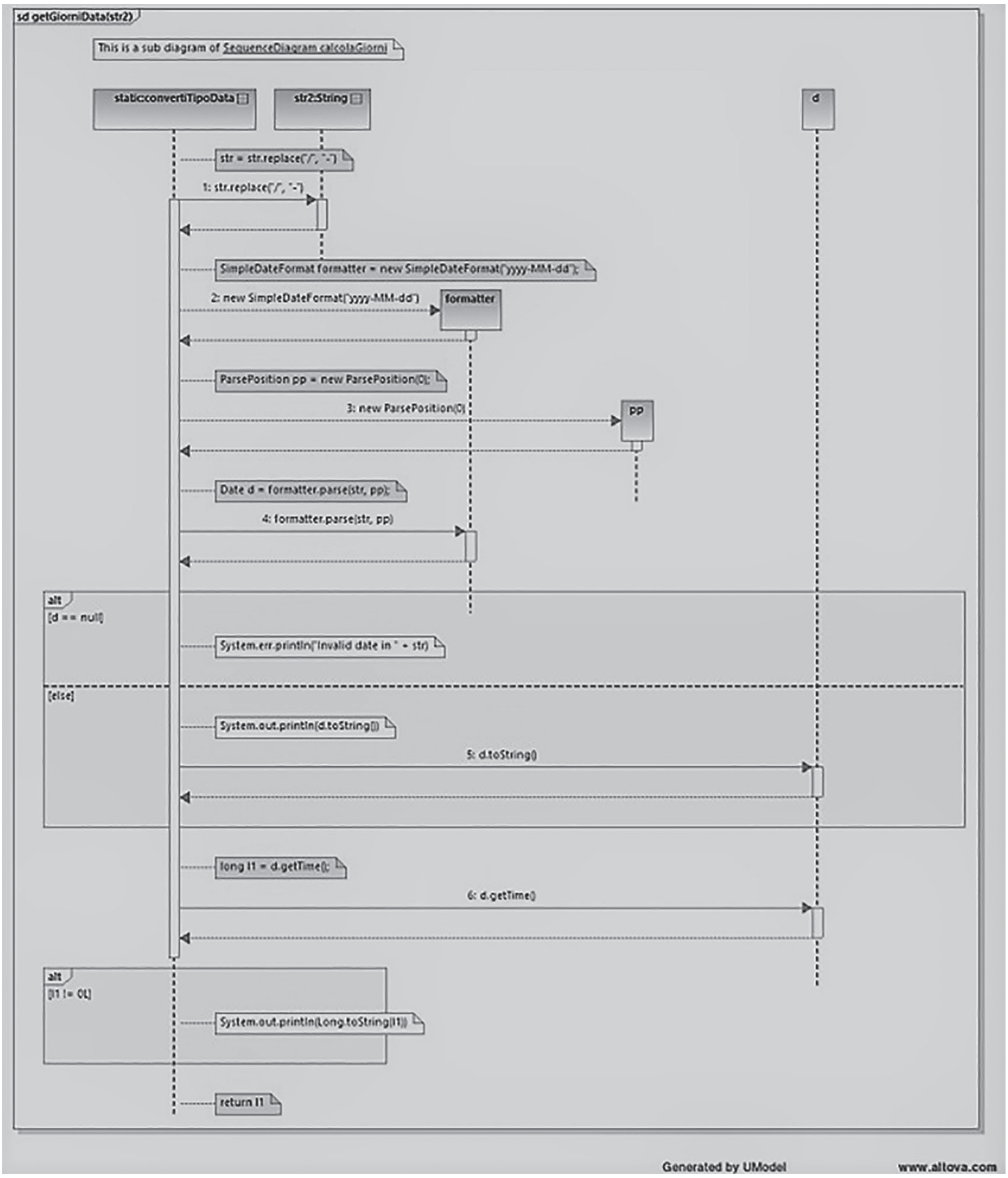


FIGURE 14.53 getGiorniData(str2).

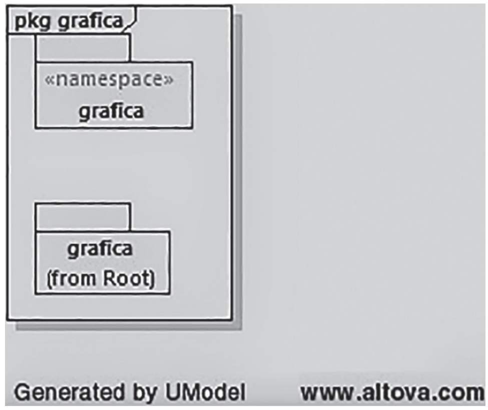


FIGURE 14.54 Package dependencies of grafica.

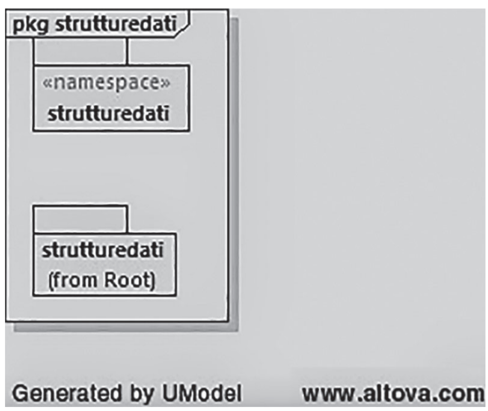


FIGURE 14.55 Package dependencies of strutturedati.

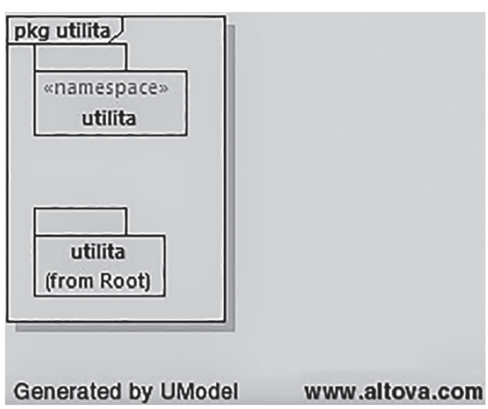


FIGURE 14.56 Package dependencies of utilita.

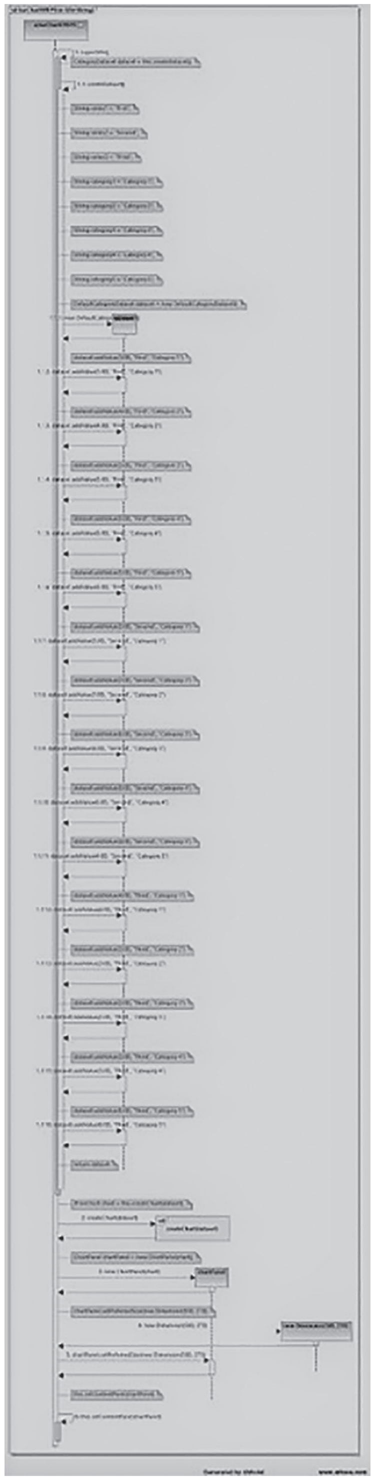


FIGURE 14.57 SequenceDiagram barChartEffEPE.

FIGURE 14.58 SequenceDiagram barChartEffEPE_1.

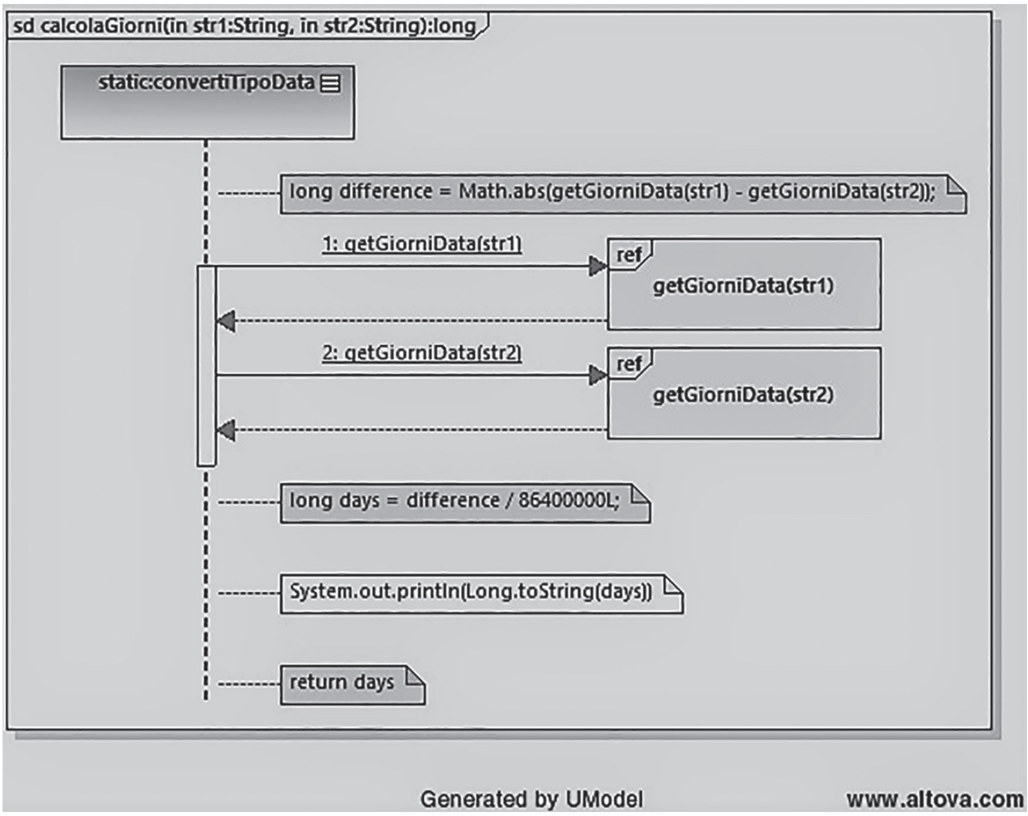


FIGURE 14.59 SequenceDiagram calcolaGiorni.

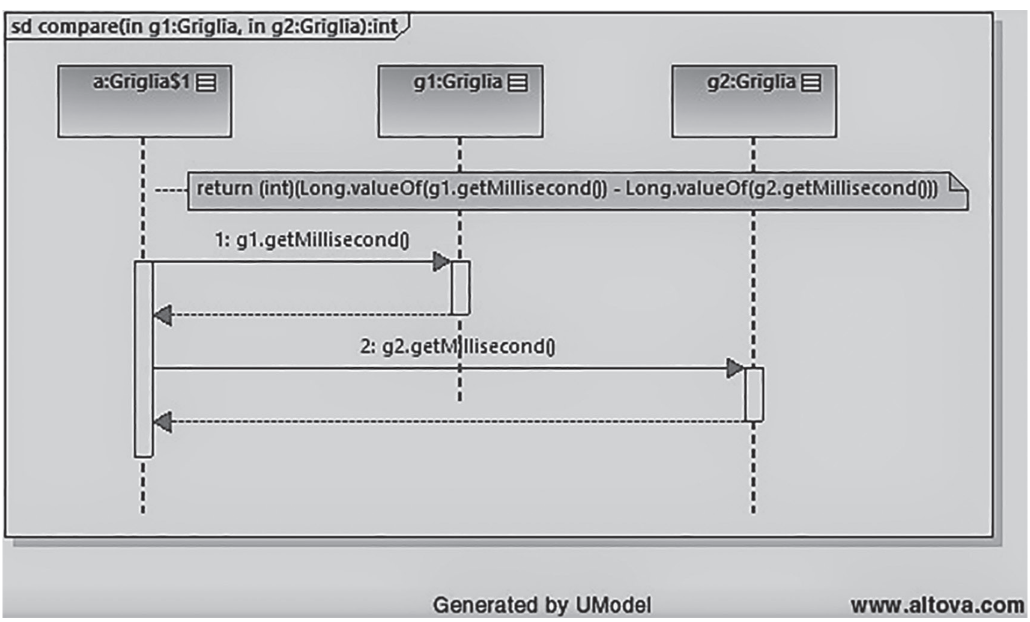


FIGURE 14.60 SequenceDiagram compare_3.

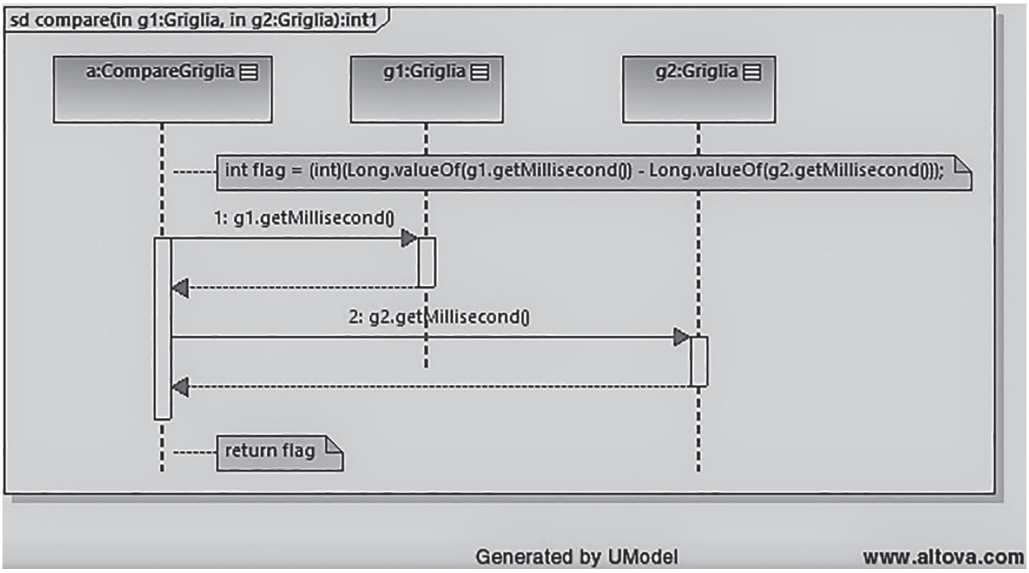


FIGURE 14.61 SequenceDiagram compare_4.

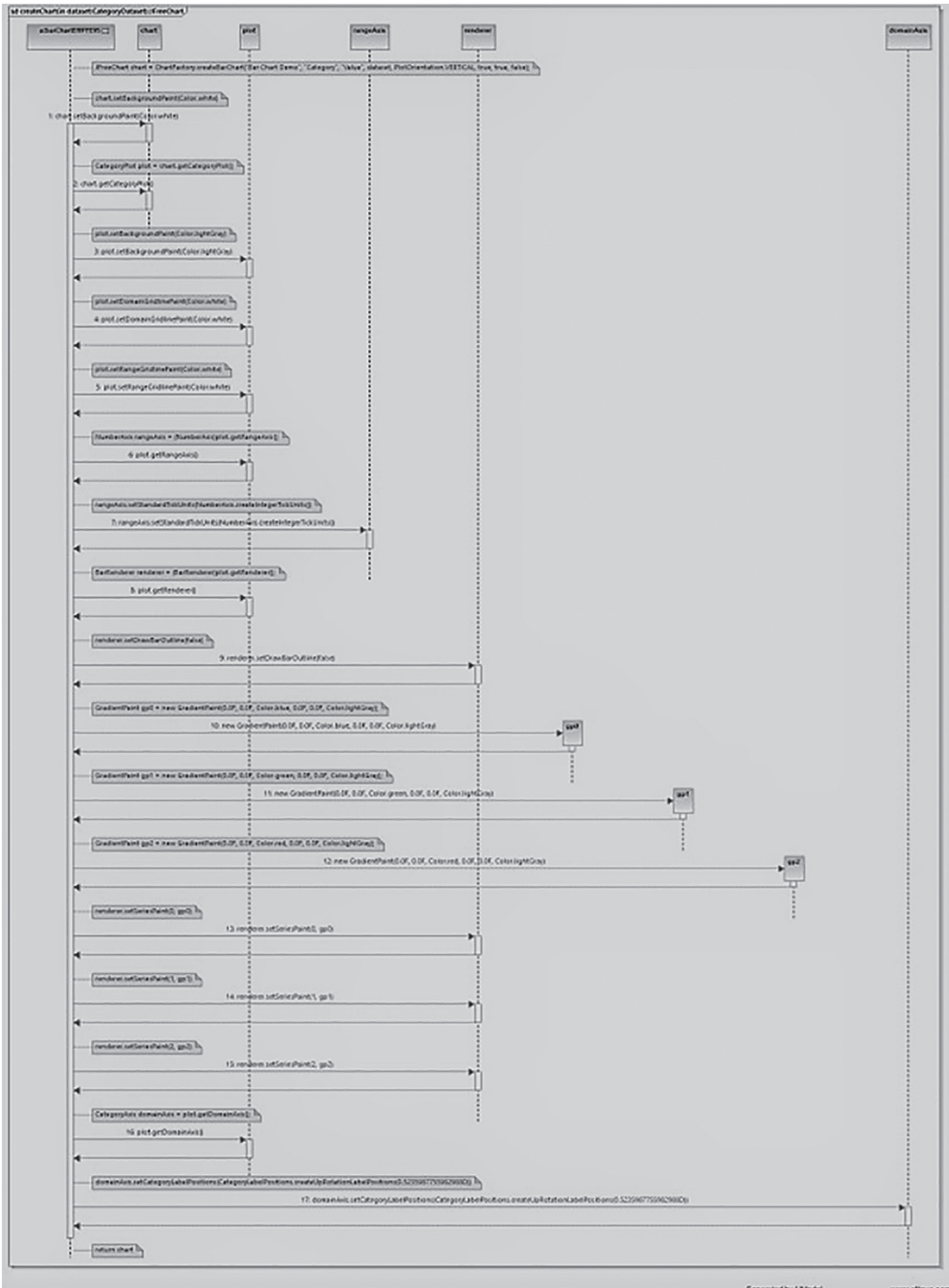


FIGURE 14.62 SequenceDiagram createChart.

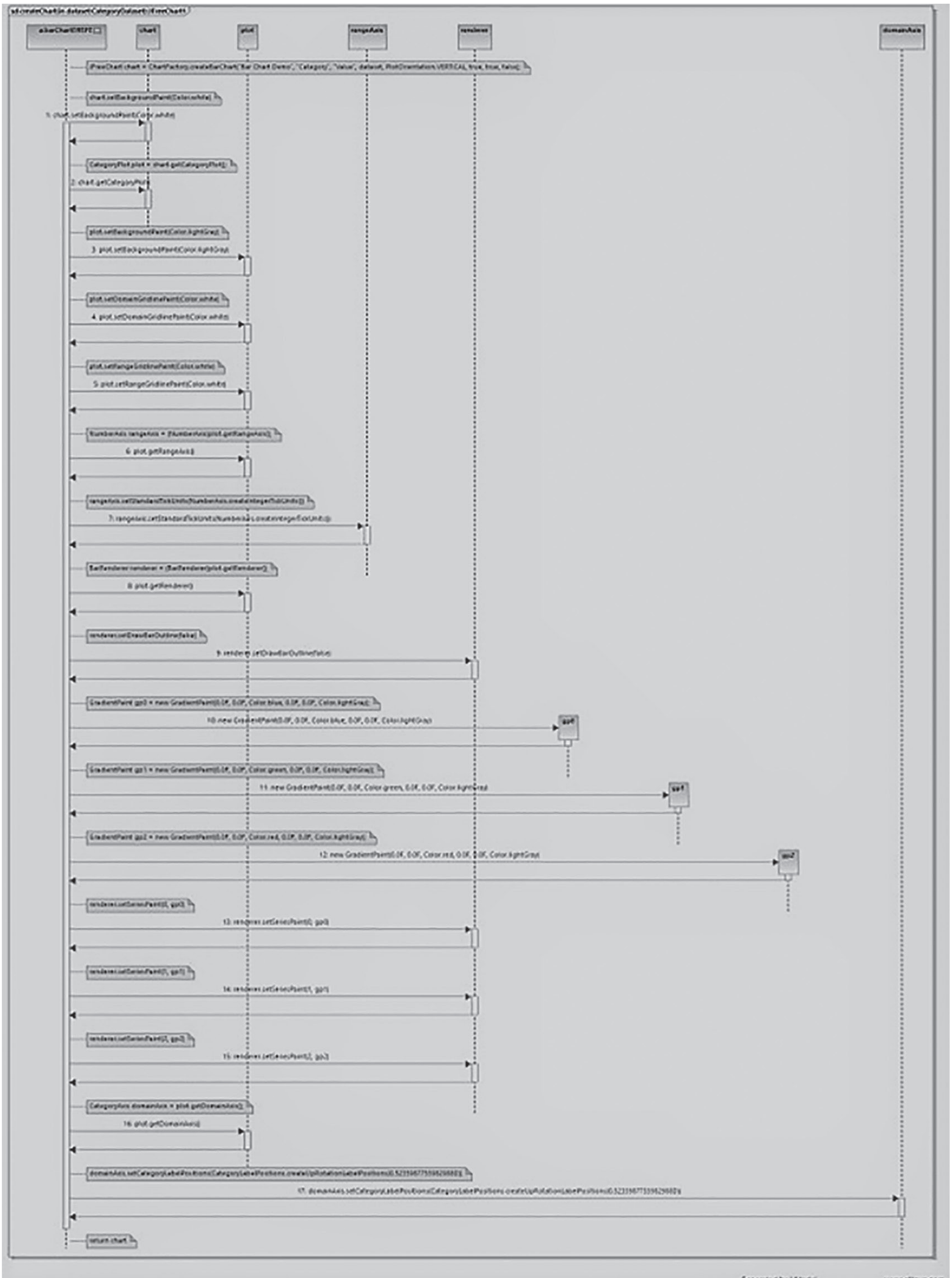


FIGURE 14.63 SequenceDiagram createChart_1.

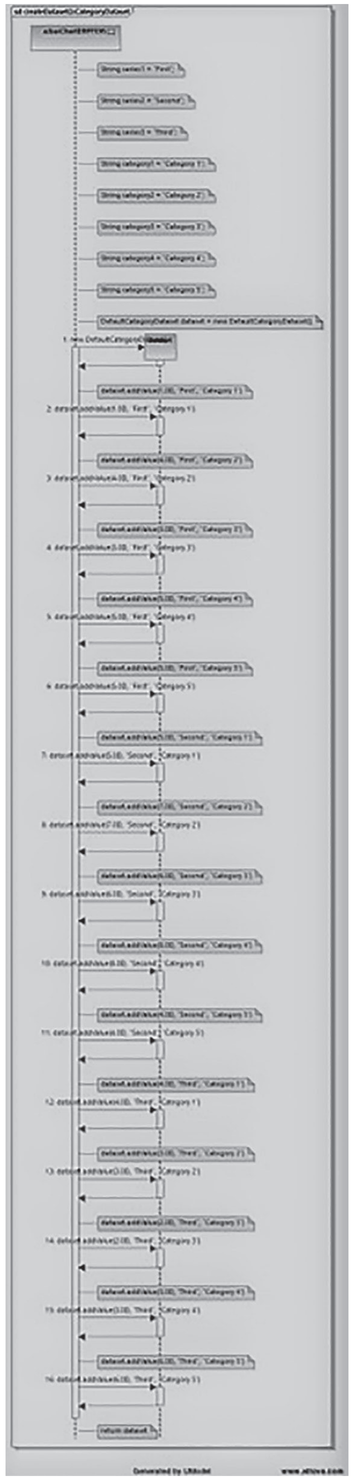


FIGURE 14.64 SequenceDiagram createDataset.

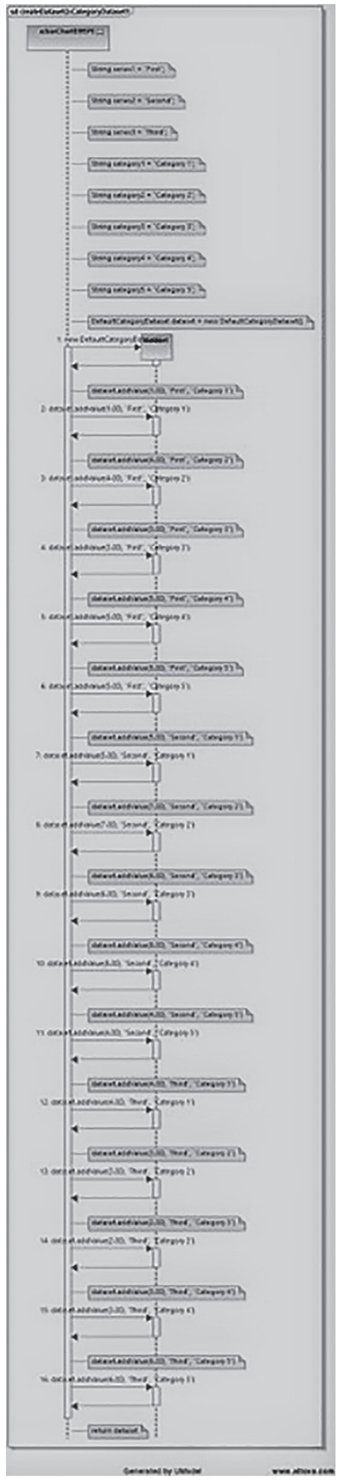


FIGURE 14.65 SequenceDiagram createDataset_1.

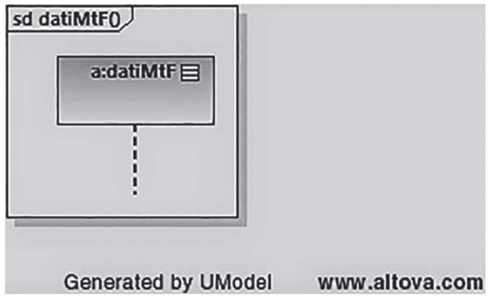


FIGURE 14.66 SequenceDiagram datiMtF.

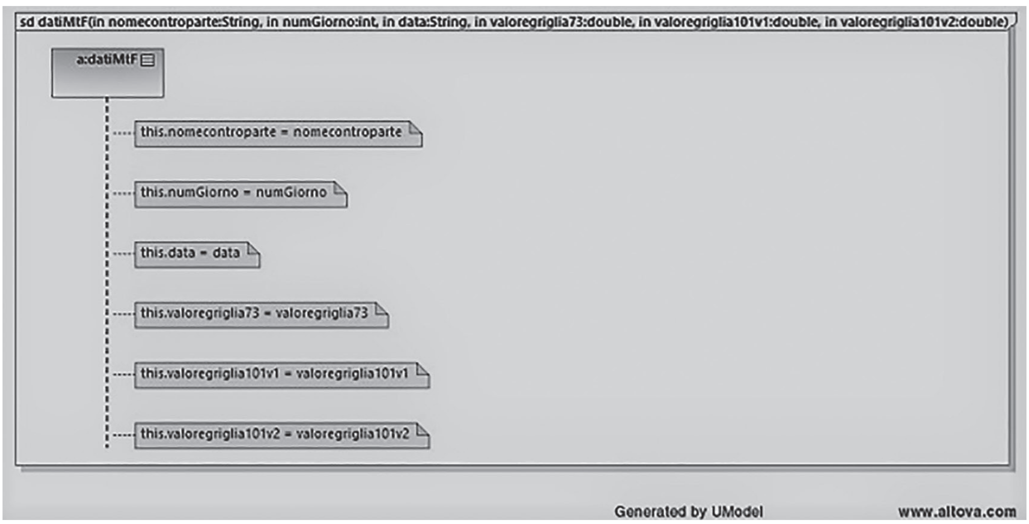


FIGURE 14.67 SequenceDiagram datiMtF_1.

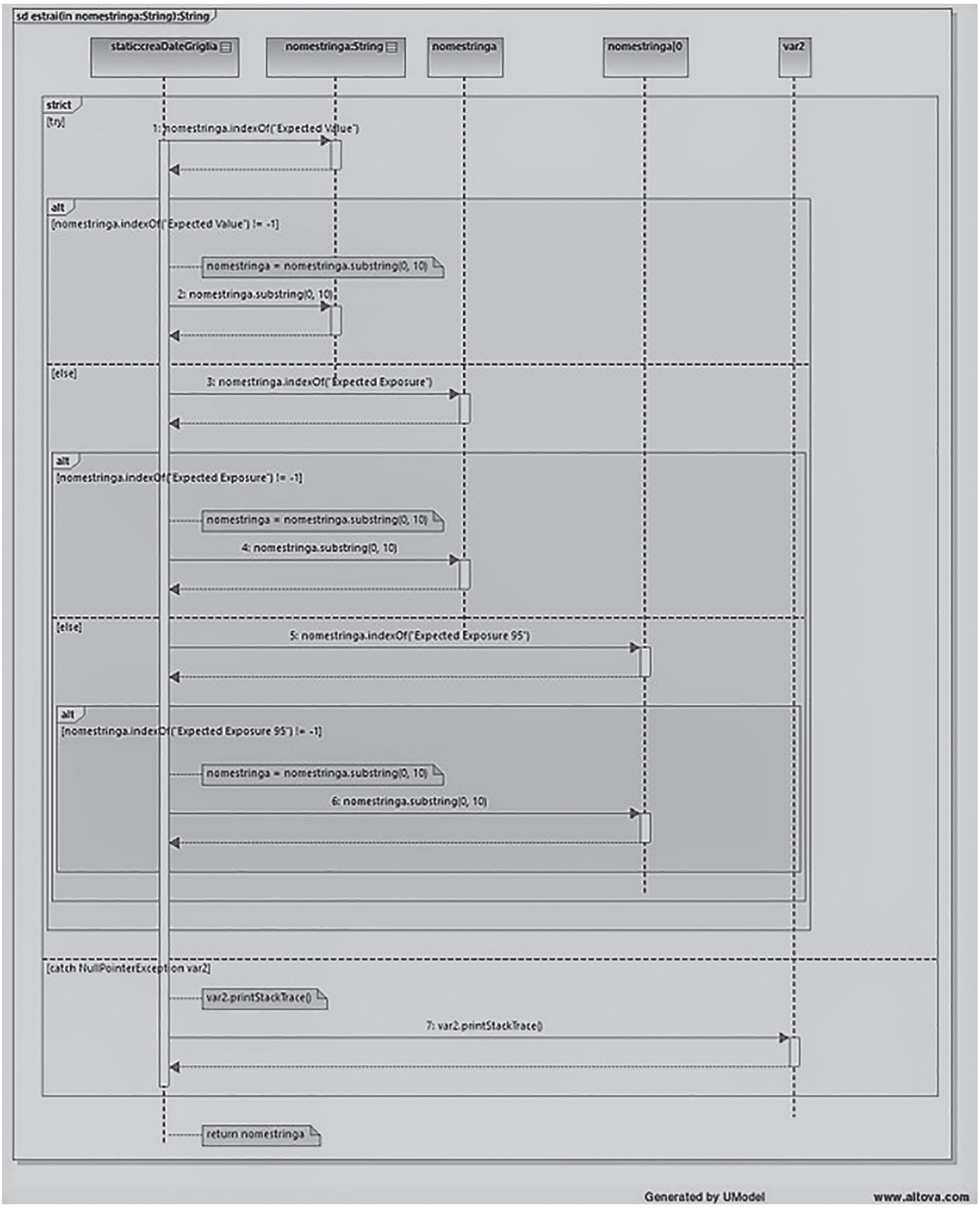


FIGURE 14.68 SequenceDiagram estrai.

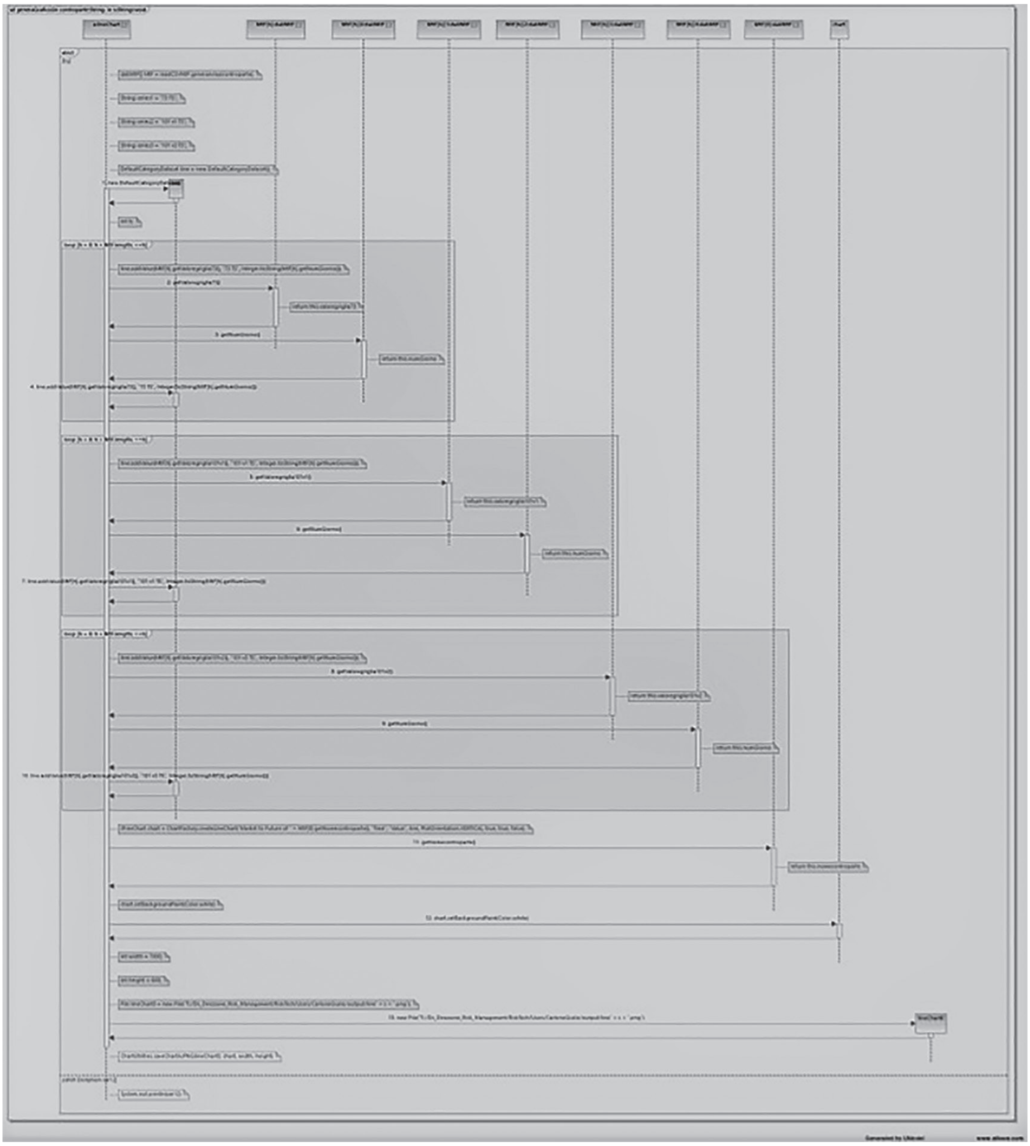


FIGURE 14.69 SequenceDiagram generaGrafico.

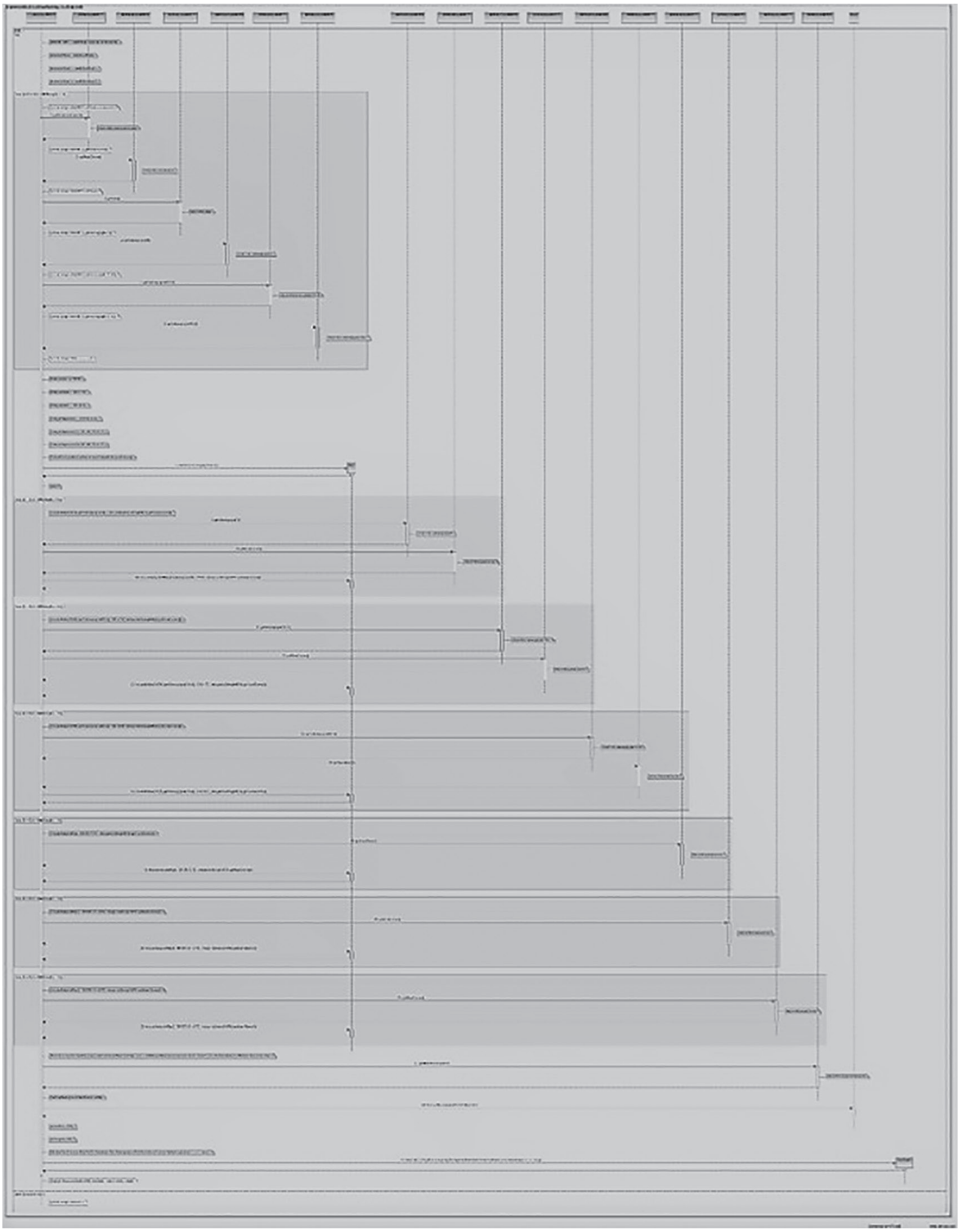


FIGURE 14.70 SequenceDiagram generaGrafico_1.

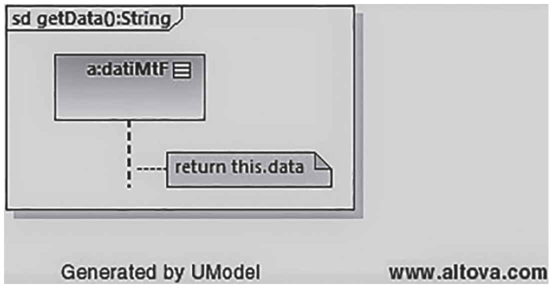


FIGURE 14.71 SequenceDiagram getData.

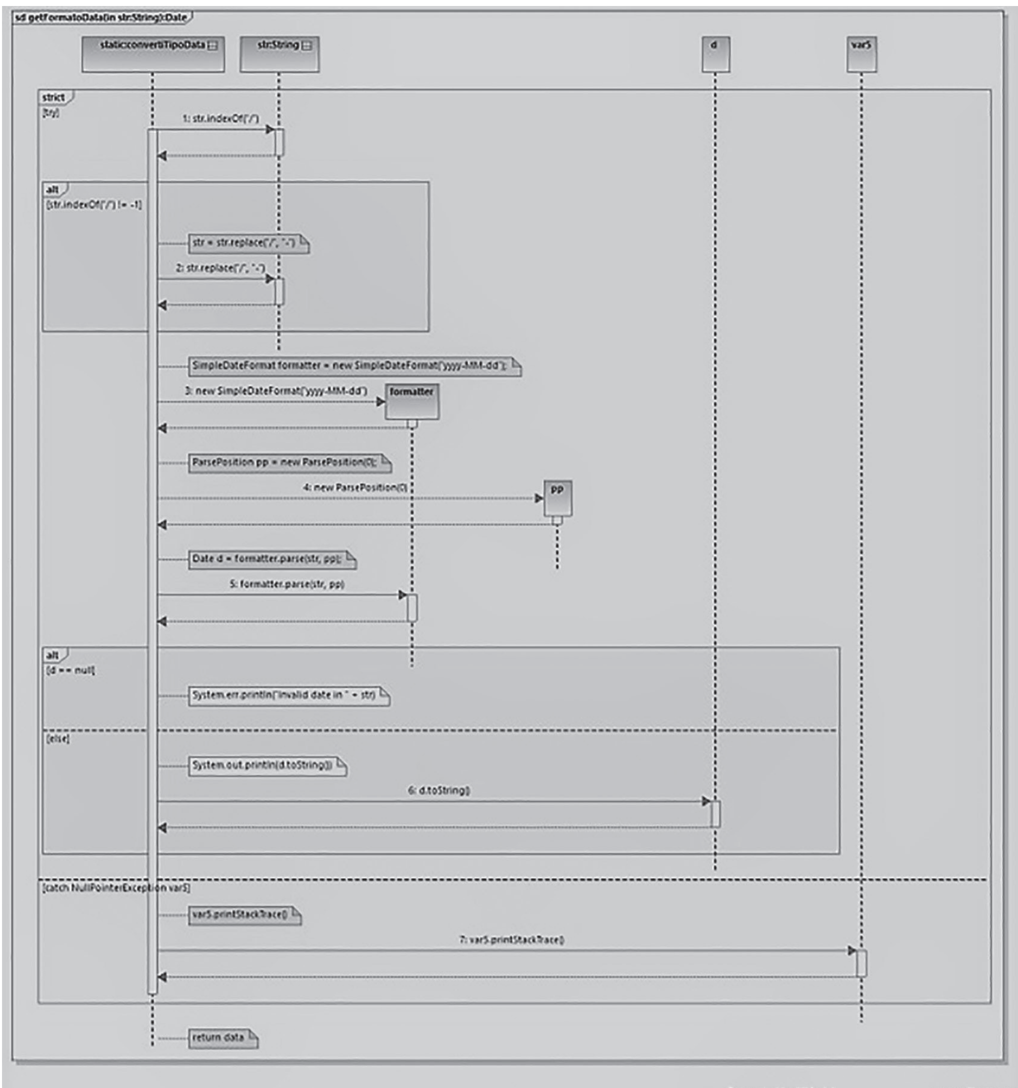


FIGURE 14.72 SequenceDiagram getFormatoData.

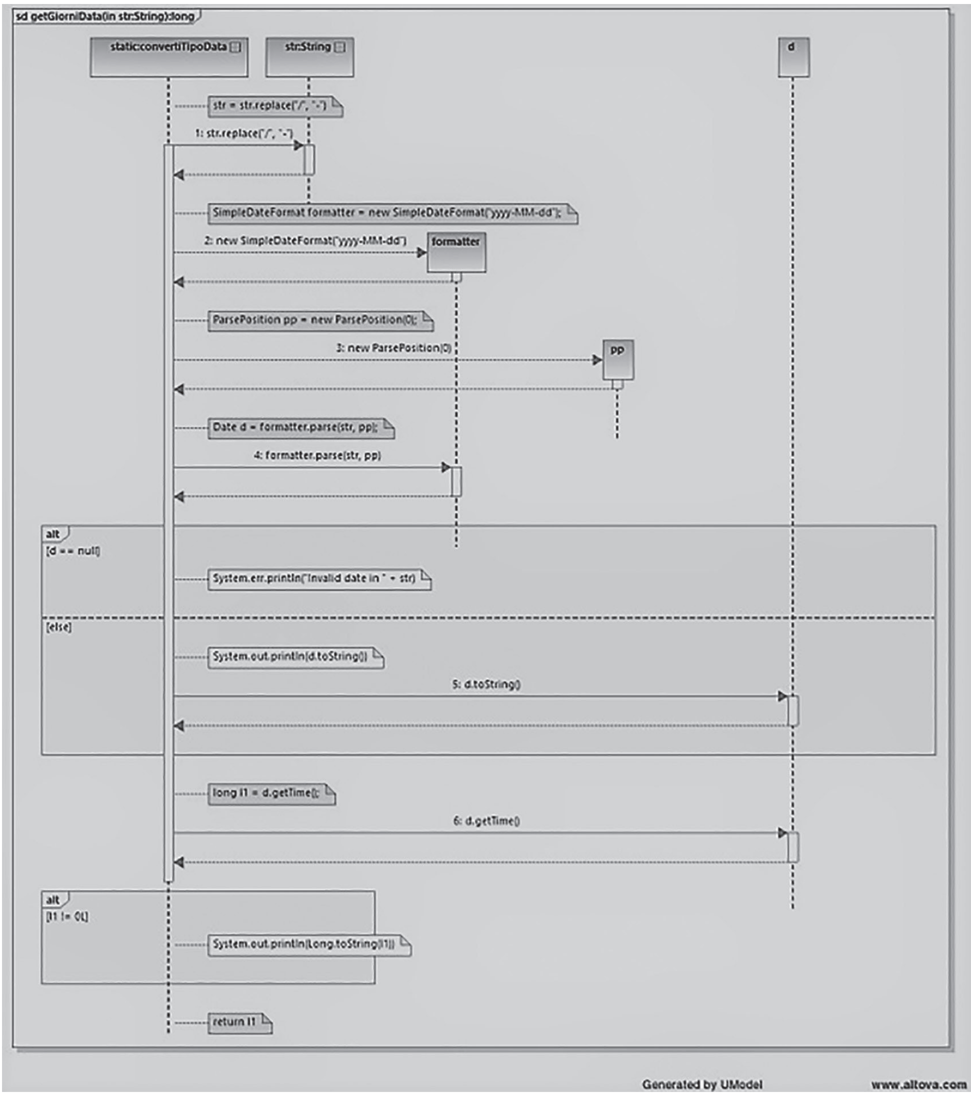


FIGURE 14.73 SequenceDiagram getGiorniData.

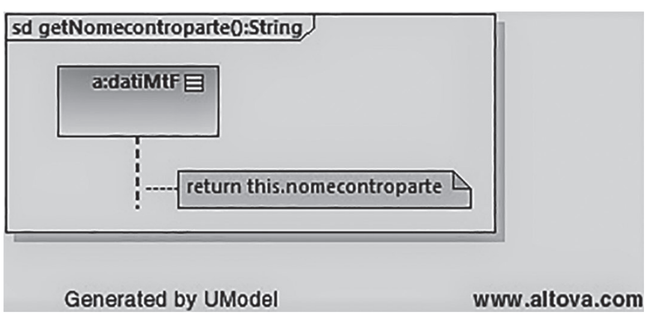


FIGURE 14.74 SequenceDiagram getNomecontroparte.

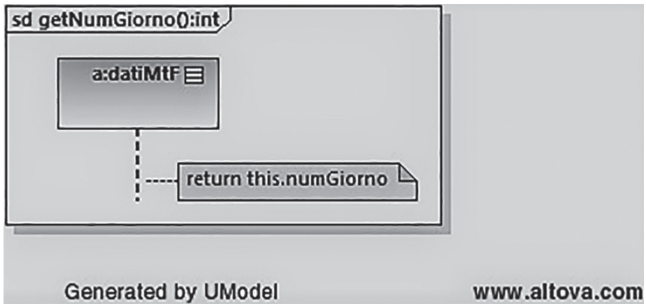


FIGURE 14.75 SequenceDiagram getNumGiorno.

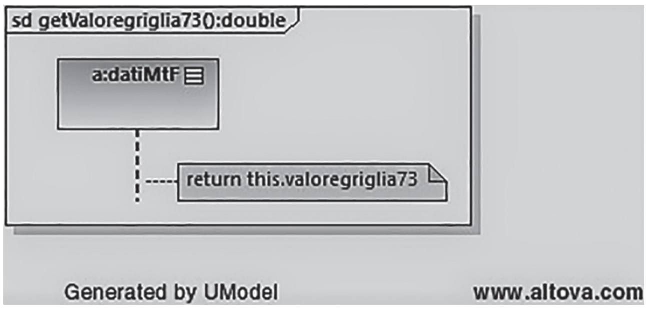


FIGURE 14.76 SequenceDiagram getValoregriglia73.

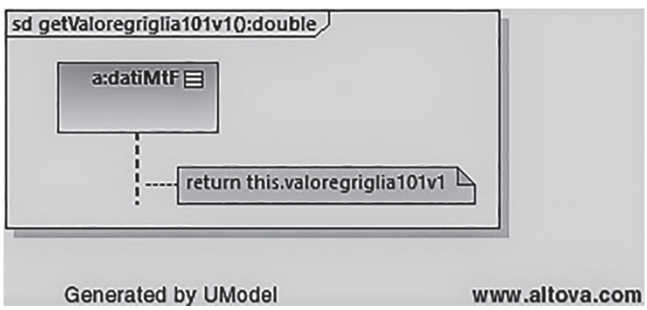


FIGURE 14.77 SequenceDiagram getValoregriglia101v1.

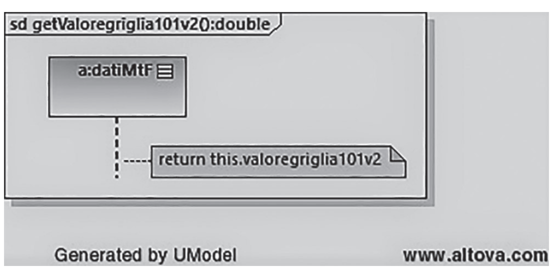


FIGURE 14.78 SequenceDiagram getValoregriglia101v2.

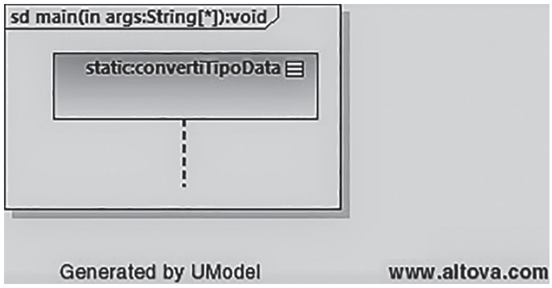


FIGURE 14.79 SequenceDiagram main.

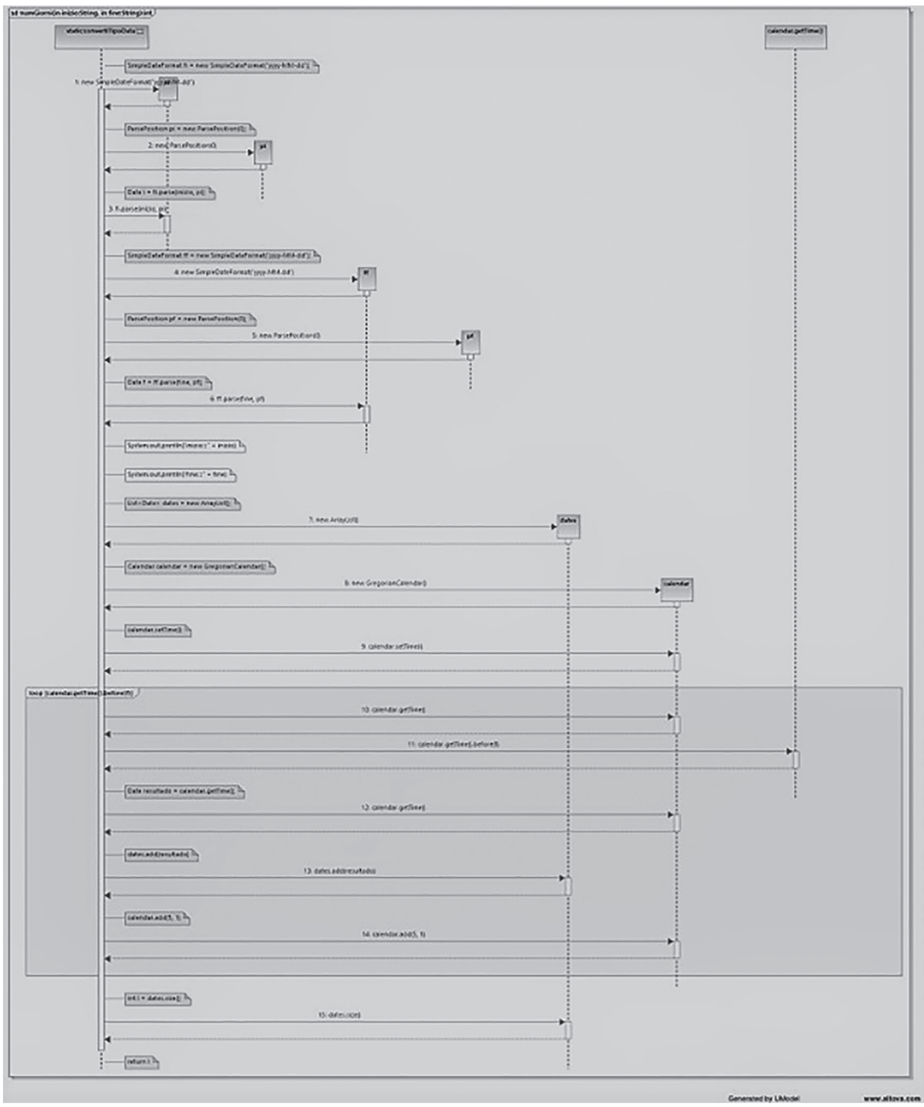


FIGURE 14.80 SequenceDiagram numGiorni.

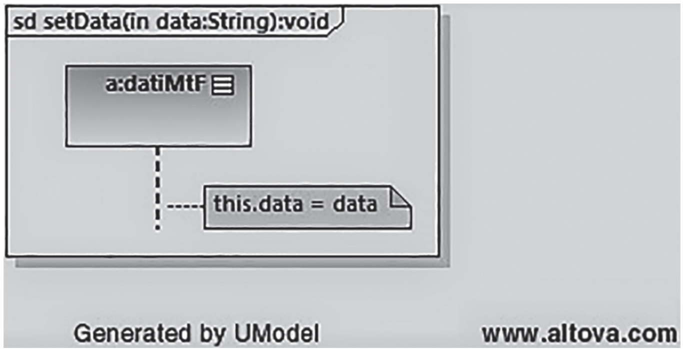


FIGURE 14.81 SequenceDiagram setData.

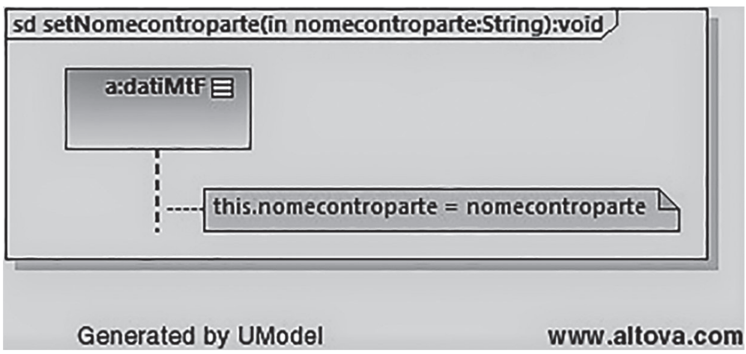


FIGURE 14.82 SequenceDiagram setNomecontroparte.

FIGURE 14.83 SequenceDiagram setNumGiorno.

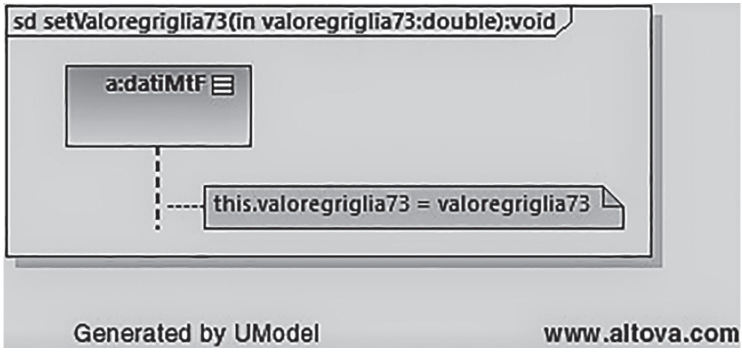


FIGURE 14.84 SequenceDiagram setValoregriglia73v1.

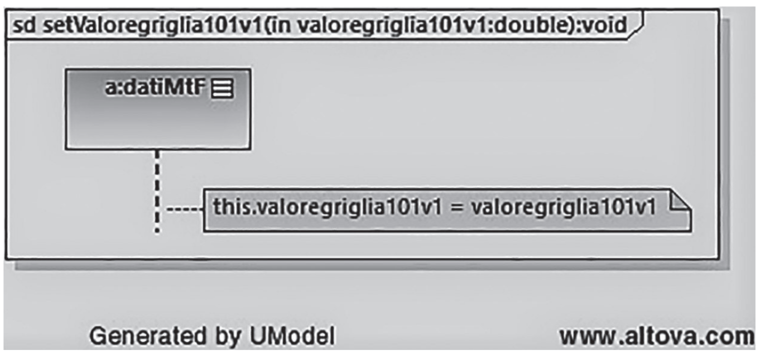


FIGURE 14.85 SequenceDiagram setValoregriglia101v1.

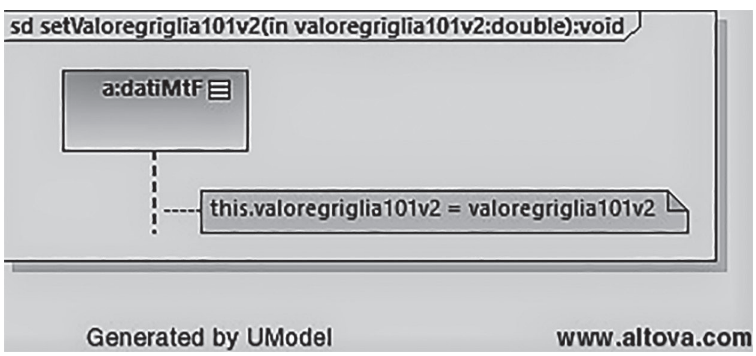


FIGURE 14.86 SequenceDiagram setValoregriglia101v2.

14.5 JAVA CODE PACKAGE UTILITÀ

```
package utilita;

import java.text.ParsePosition;
import java.text.SimpleDateFormat;
import java.util.ArrayList;
import java.util.Calendar;
import java.util.Date;
import java.util.GregorianCalendar;
import java.util.List;

public class convertiTipoData {
   public static Date data;
   public int giorni;

   public static Date getFormatoData(String str) {
      try {
         if (str.indexOf("/") != -1) {
            str = str.replace("/", "-");
         }

         SimpleDateFormat formatter = new
SimpleDateFormat("yyyy-MM-dd");
         ParsePosition pp = new ParsePosition(0);
         Date d = formatter.parse(str, pp);
         if (d == null) {
            System.err.println("Invalid date in " + str);
         } else {
            System.out.println(d.toString());
         }
      } catch (NullPointerException var5) {
         var5.printStackTrace();
      }

      return data;
   }

   public static long getGiorniData(String str) {
      str = str.replace("/", "-");
      SimpleDateFormat formatter = new
SimpleDateFormat("yyyy-MM-dd");
      ParsePosition pp = new ParsePosition(0);
      Date d = formatter.parse(str, pp);
      if (d == null) {
         System.err.println("Invalid date in " + str);
```

```
      } else {
         System.out.println(d.toString());
      }

      long l1 = d.getTime();
      if (l1 != 0L) {
         System.out.println(Long.toString(l1));
      }

      return l1;
   }

   public static int numGiorni(String inizio, String fine) {
      SimpleDateFormat fi = new SimpleDateFormat("yyyy-MM-dd");
      ParsePosition pi = new ParsePosition(0);
      Date i = fi.parse(inizio, pi);
      SimpleDateFormat ff = new SimpleDateFormat("yyyy-MM-dd");
      ParsePosition pf = new ParsePosition(0);
      Date f = ff.parse(fine, pf);
      System.out.println("inizio:::" + inizio);
      System.out.println("fine:::" + fine);
      List<Date> dates = new ArrayList();
      Calendar calendar = new GregorianCalendar();
      calendar.setTime(i);

      while(calendar.getTime().before(f)) {
         Date resultado = calendar.getTime();
         dates.add(resultado);
         calendar.add(5, 1);
      }

      int l = dates.size();
      return l;
   }

   public static long calcolaGiorni(String str1, String str2) {
      long difference = Math.abs(getGiorniData(str1)
- getGiorniData(str2));
      long days = difference / 86400000L;
      System.out.println(Long.toString(days));
      return days;
   }

   public static void main(String[] args) {
   }
}
```

```
package utilita;

public class creaDateGriglia {
   public String nomestringa;

   public static String estrai(String nomestringa) {
      try {
         if (nomestringa.indexOf("Expected Value") != -1) {
            nomestringa = nomestringa.substring(0, 10);
         } else if (nomestringa.indexOf("Expected Exposure") != -1) {
            nomestringa = nomestringa.substring(0, 10);
         } else if (nomestringa.indexOf("Expected Exposure 95") !=
-1) {
            nomestringa = nomestringa.substring(0, 10);
         }
      } catch (NullPointerException var2) {
         var2.printStackTrace();
      }

      return nomestringa;
   }
}
```

This is the specified list of uml diagram related to this package utilita (Figures 14.87–135)

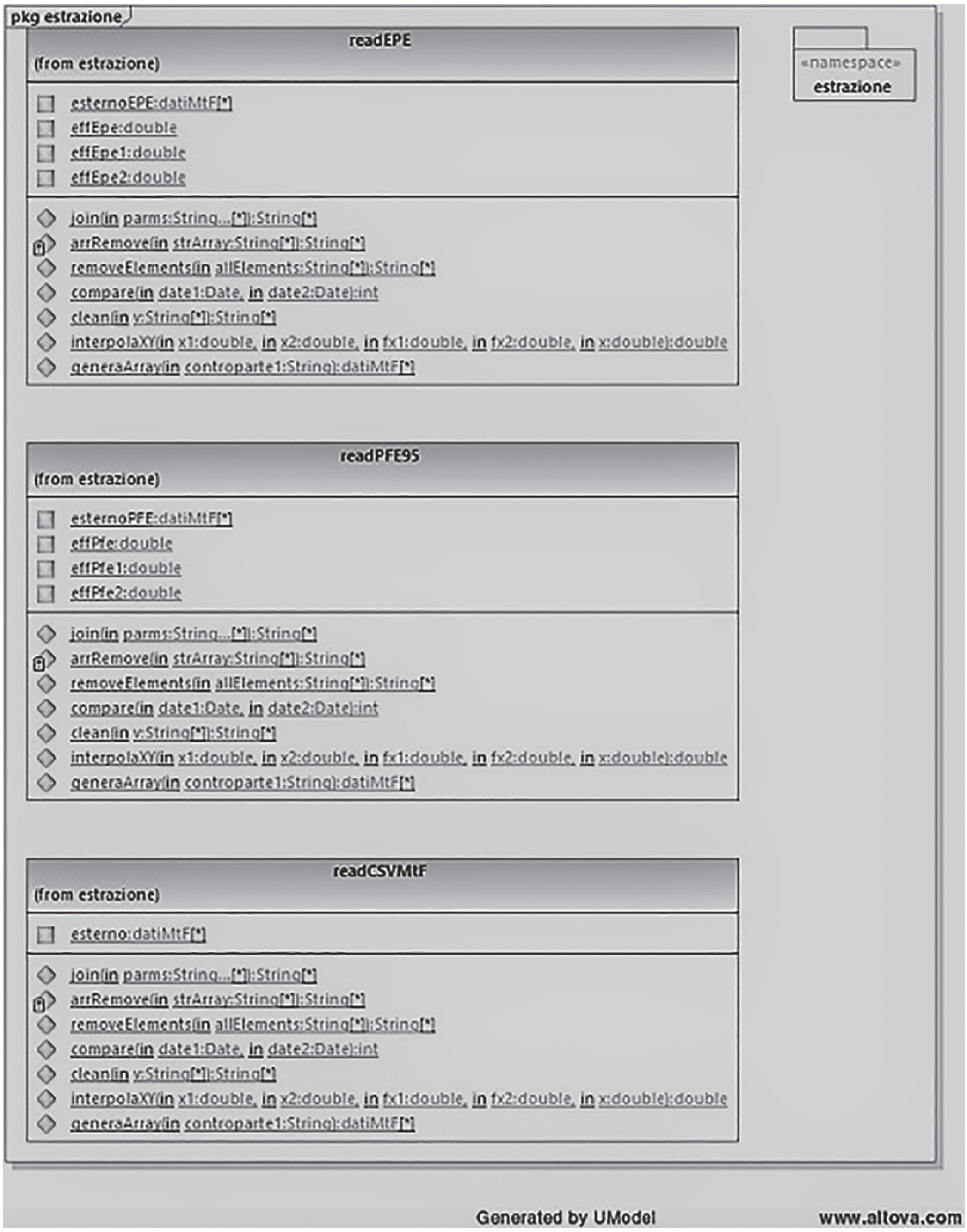


FIGURE 14.87 Content of estrazione and all subpackages.

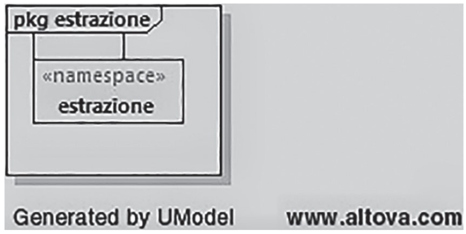


FIGURE 14.88 Content of estrazione.

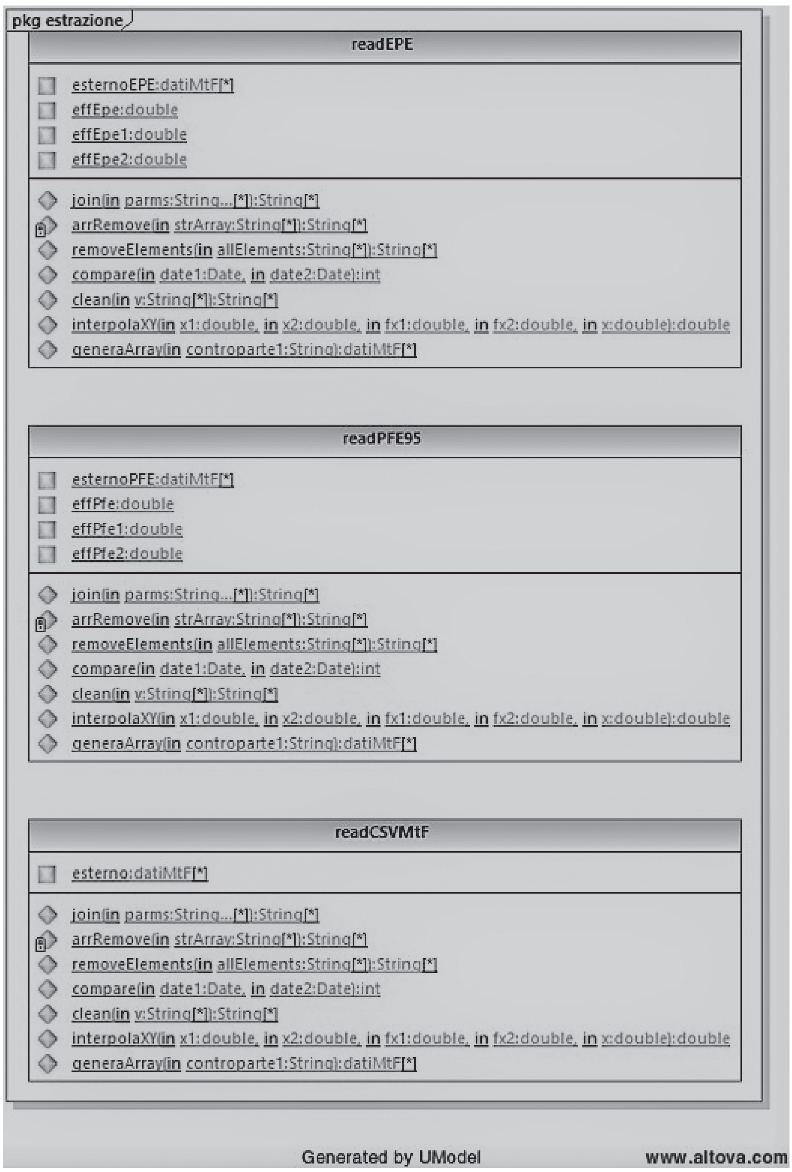


FIGURE 14.89 Content of estrazione_1.

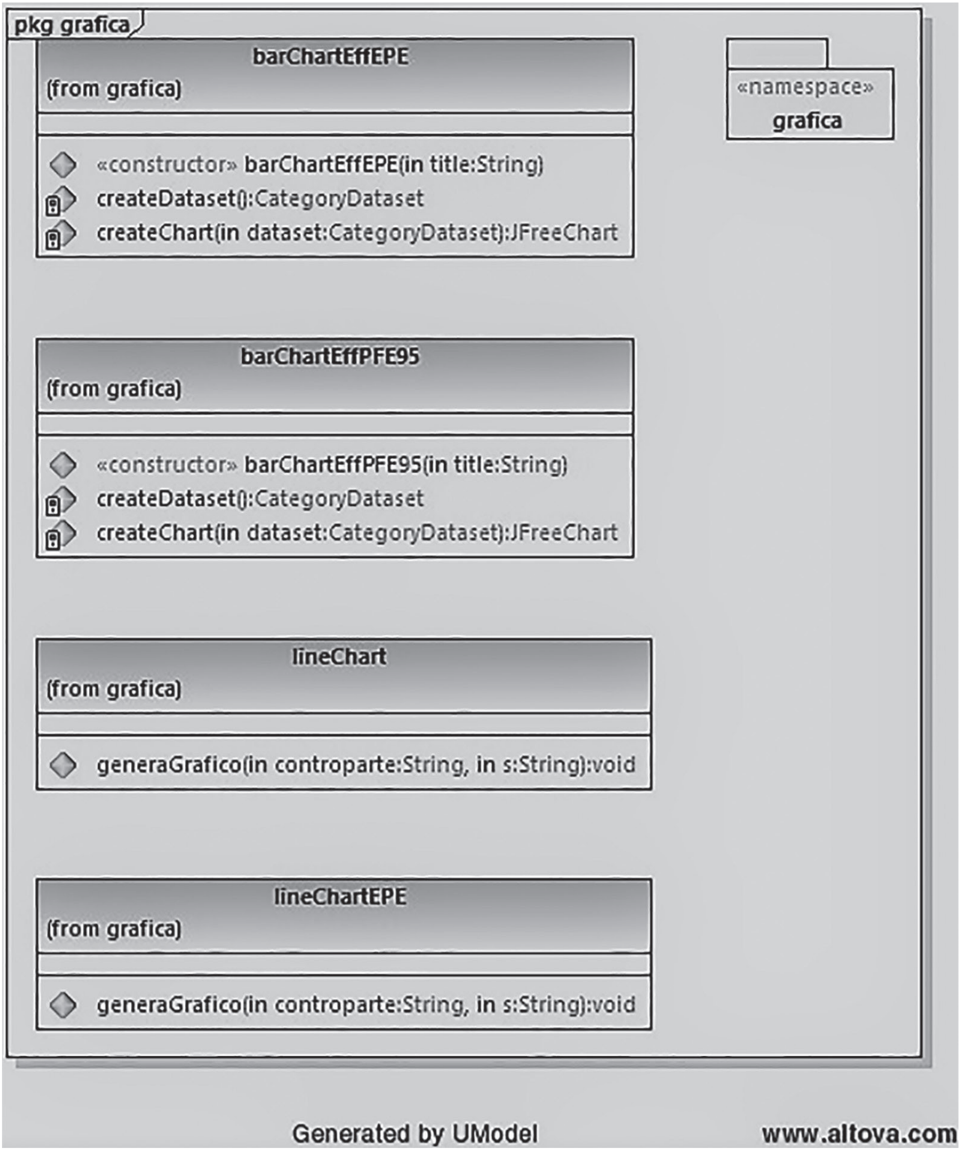


FIGURE 14.90 Content of grafica and all subpackages.

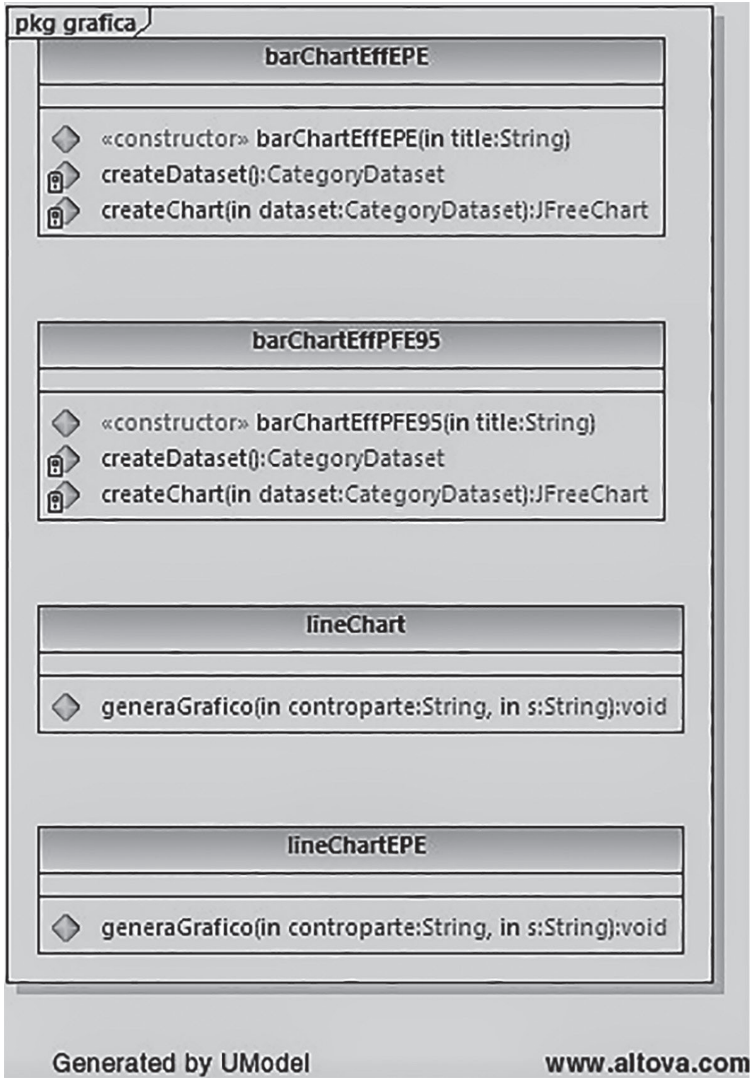


FIGURE 14.91 Content of grafica.

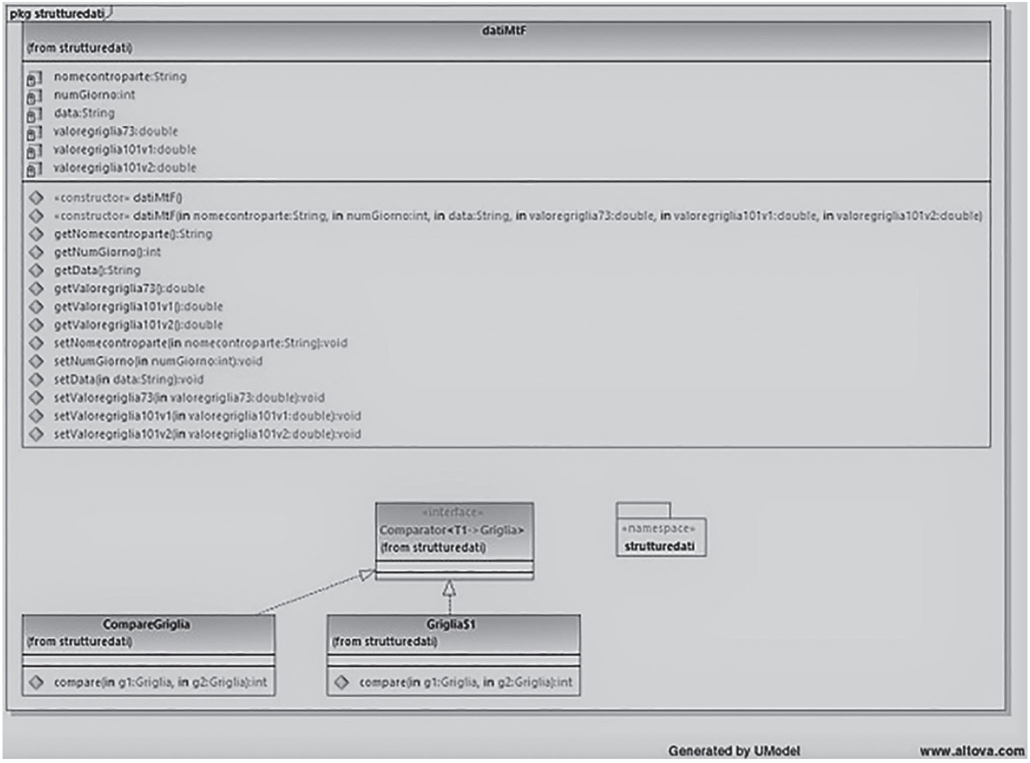


FIGURE 14.92 Content of strutturedati and all subpackages.

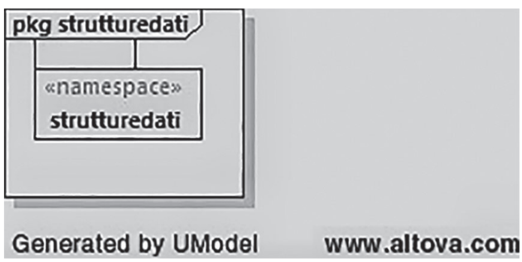


FIGURE 14.93 Content of strutturedati.

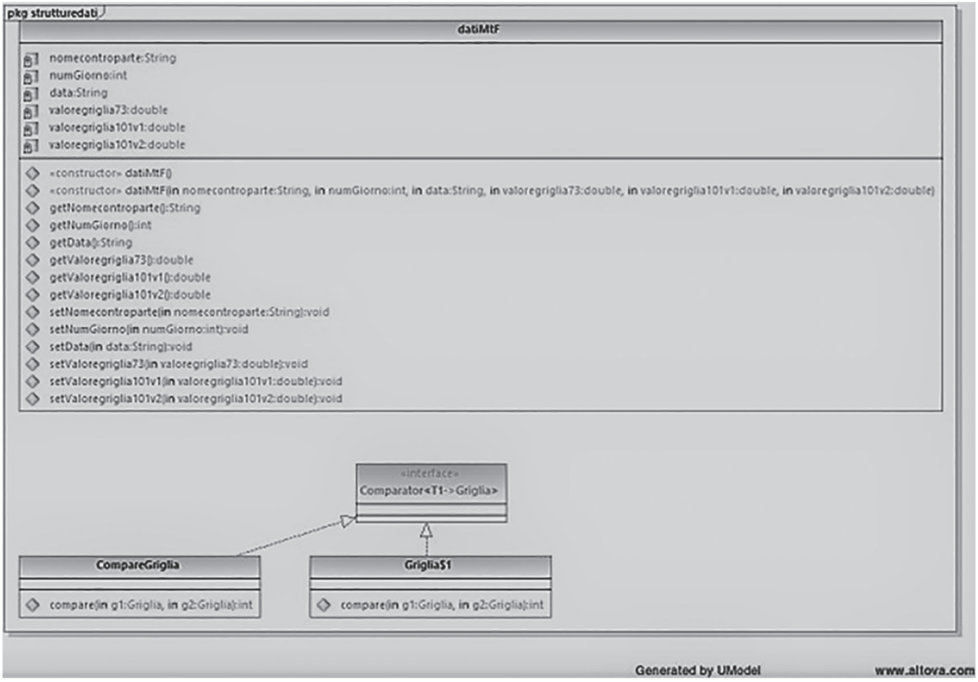


FIGURE 14.94 Content of strutturedati_1.

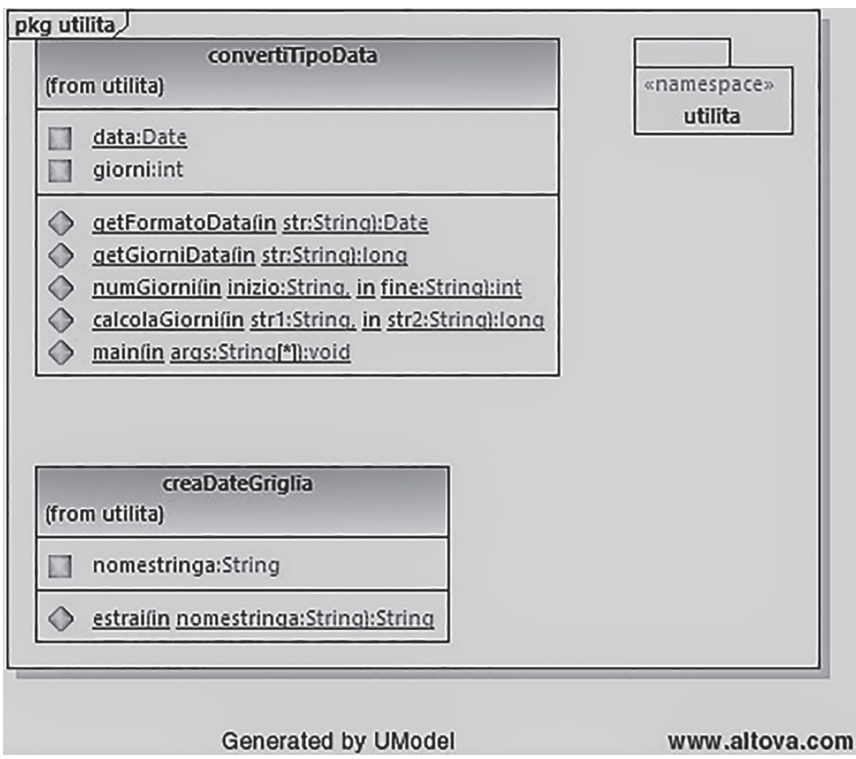


FIGURE 14.95 Content of utilita and all subpackages.

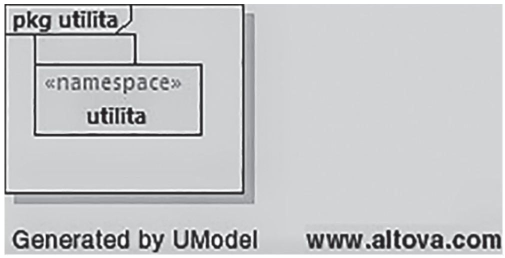


FIGURE 14.96 Content of utilita.

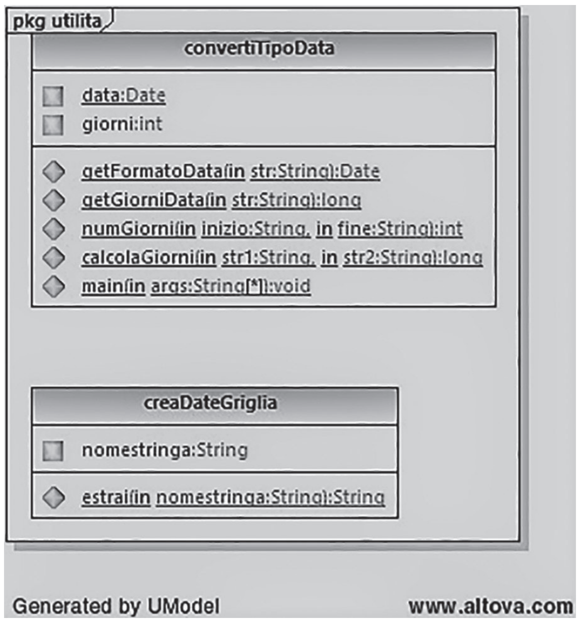


FIGURE 14.97 Content of utilita_1.

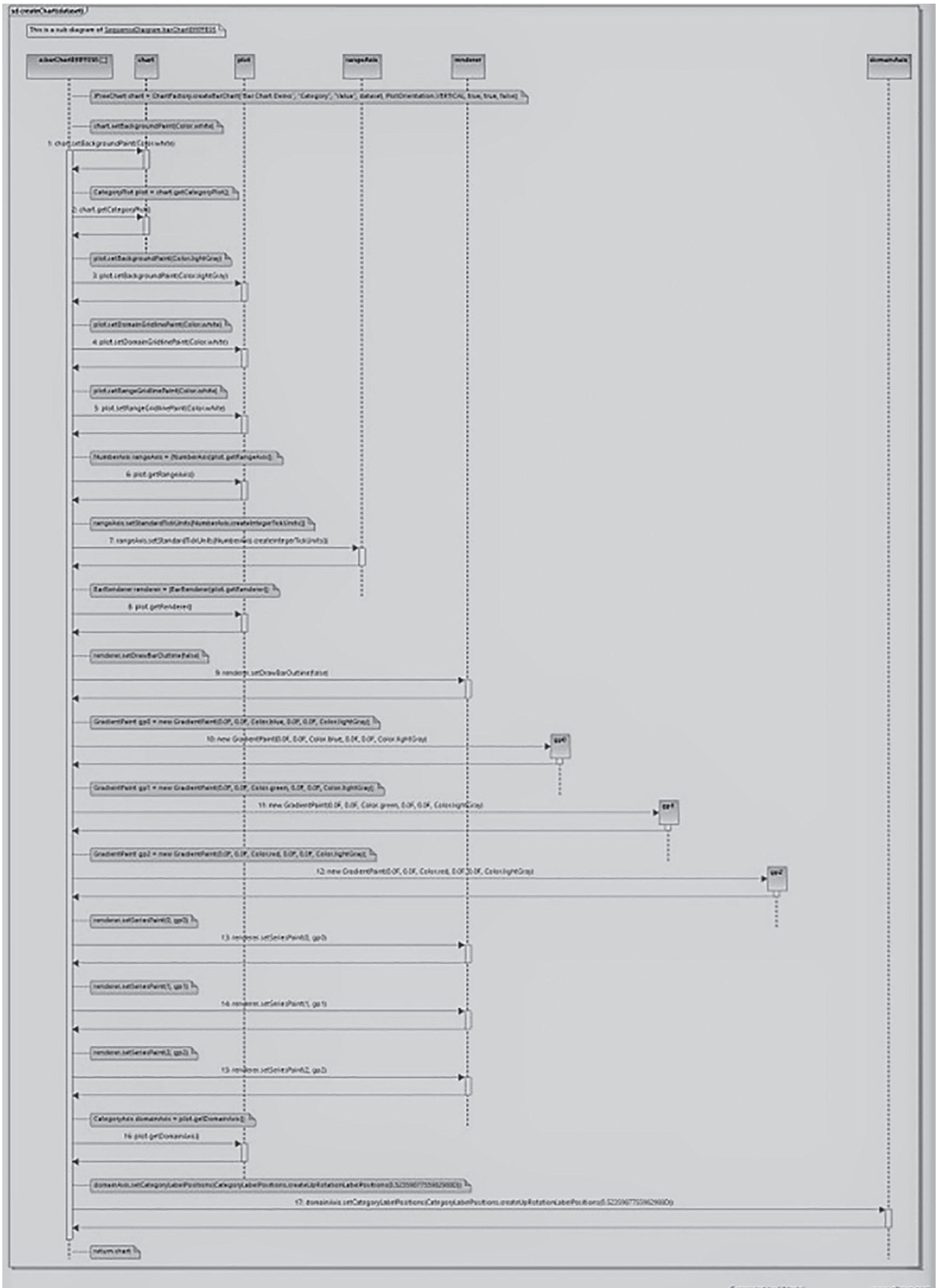


FIGURE 14.98 createChart(dataset).

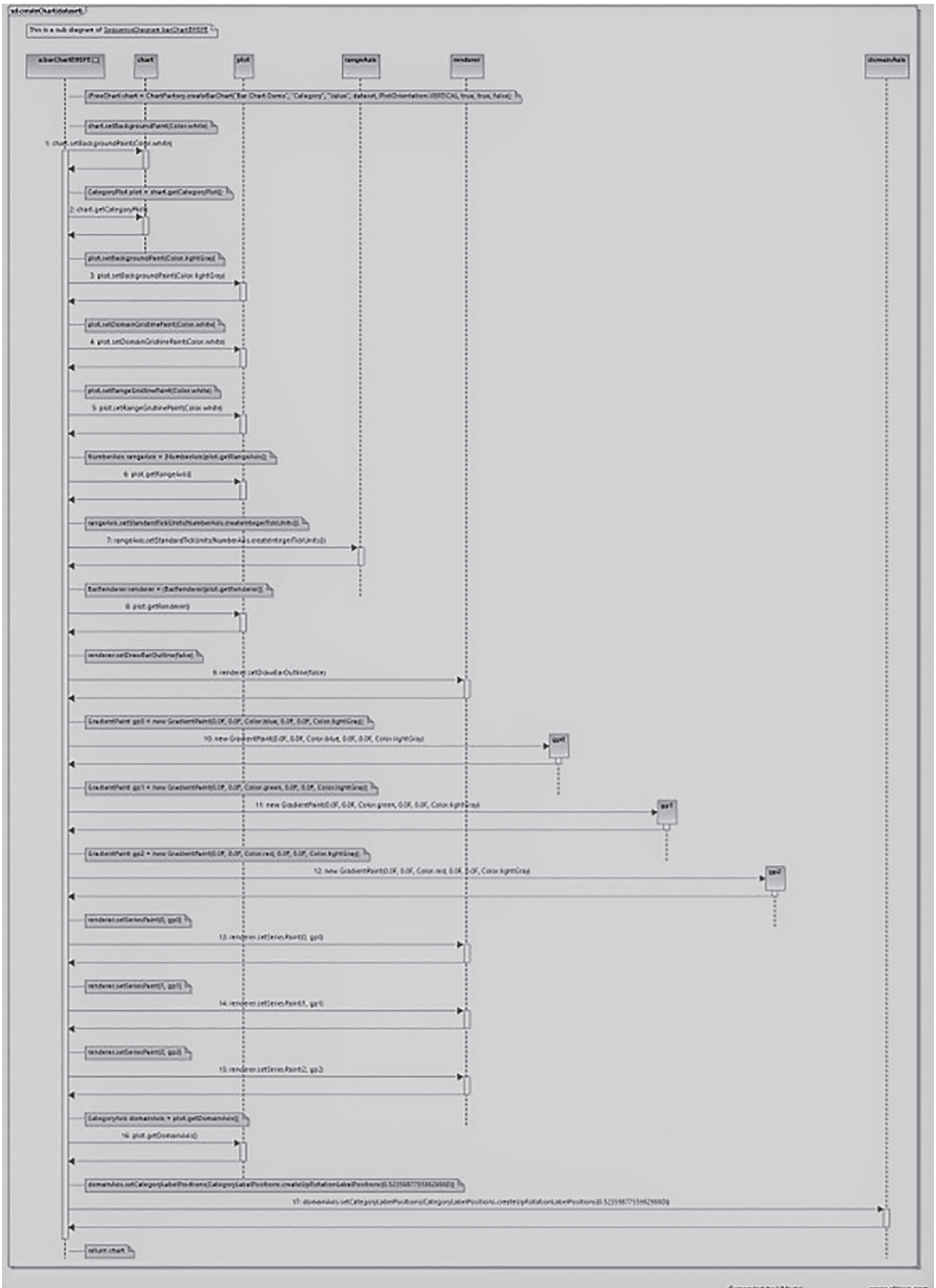


FIGURE 14.99 createChart(dataset)_2.

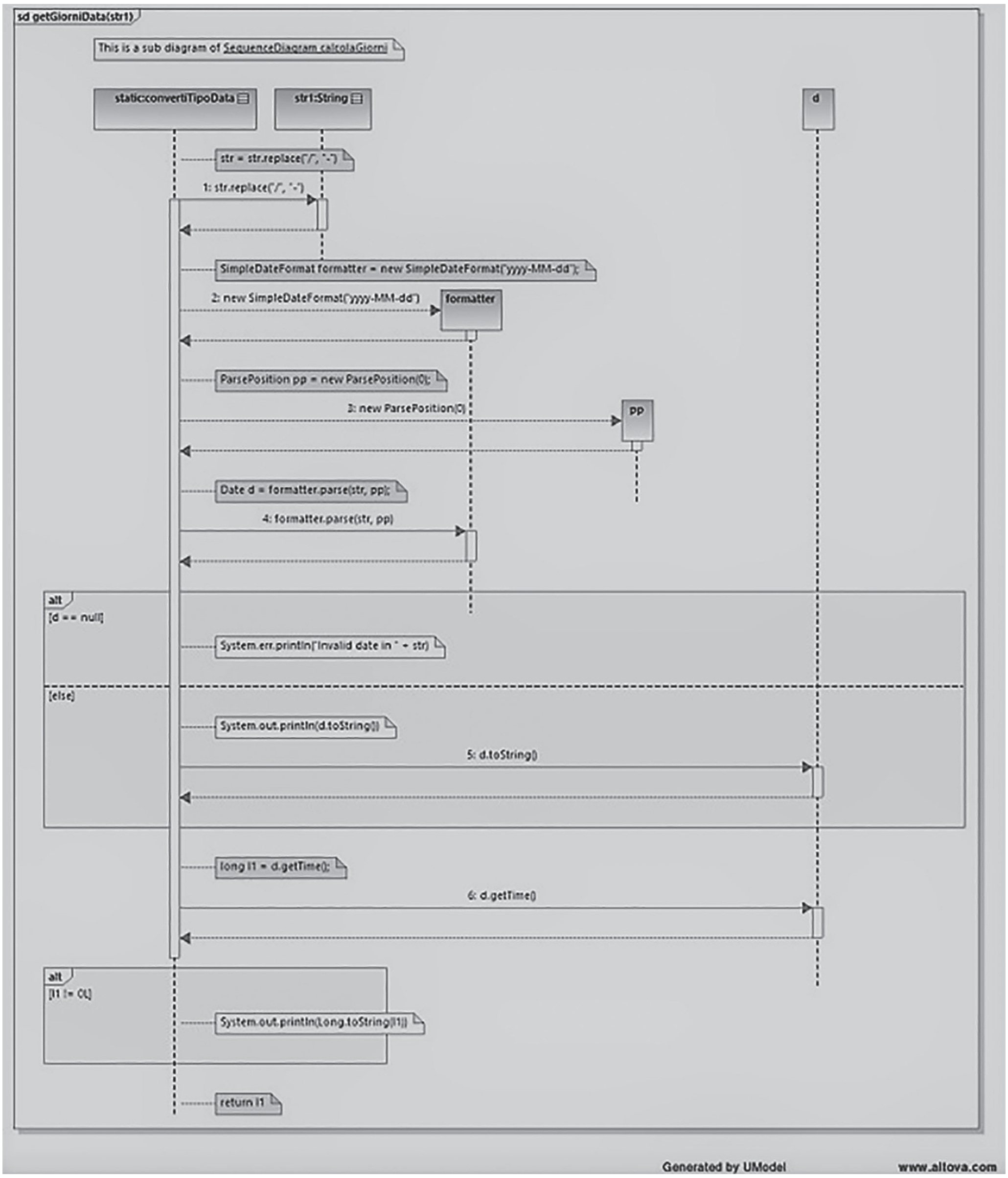


FIGURE 14.100 getGiorniData(str1).

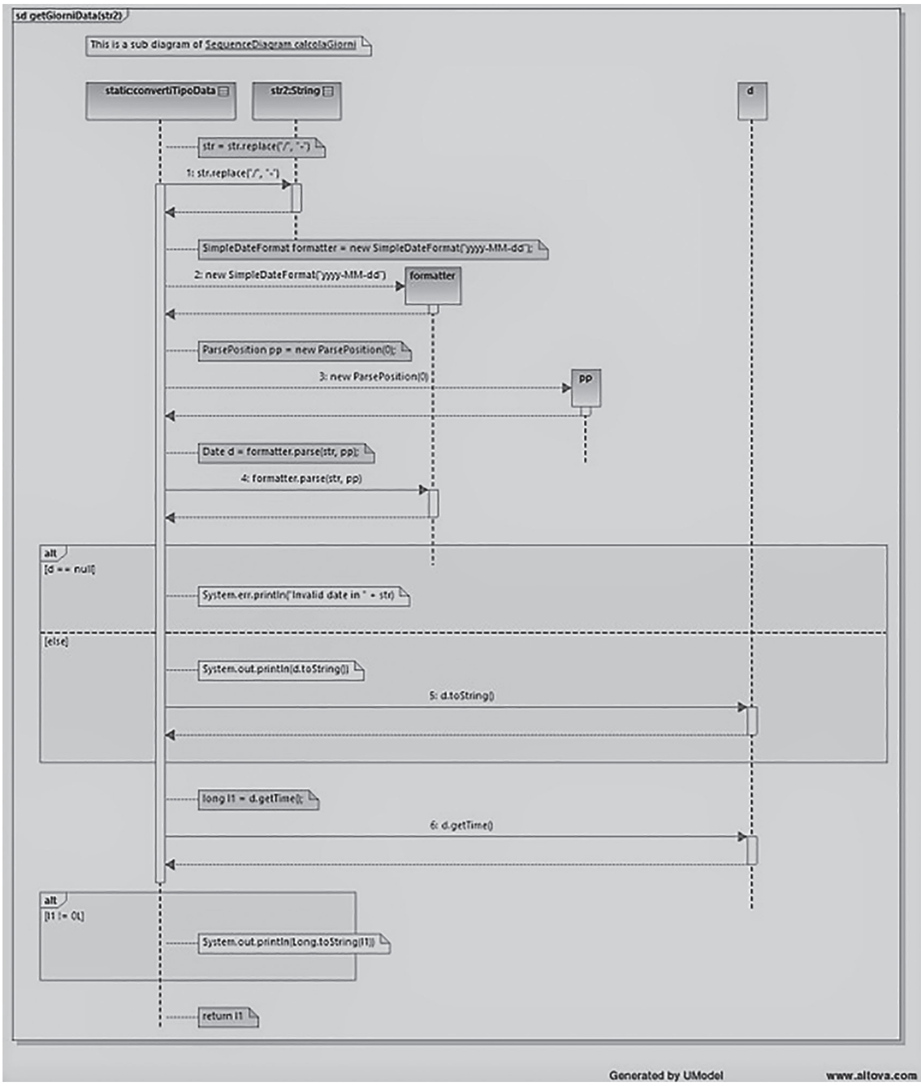


FIGURE 14.101 getGiorniData(str2).

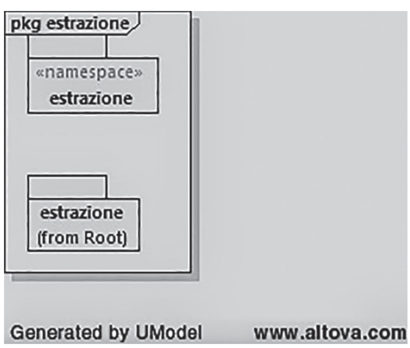


FIGURE 14.102 Package dependencies of estrazione.

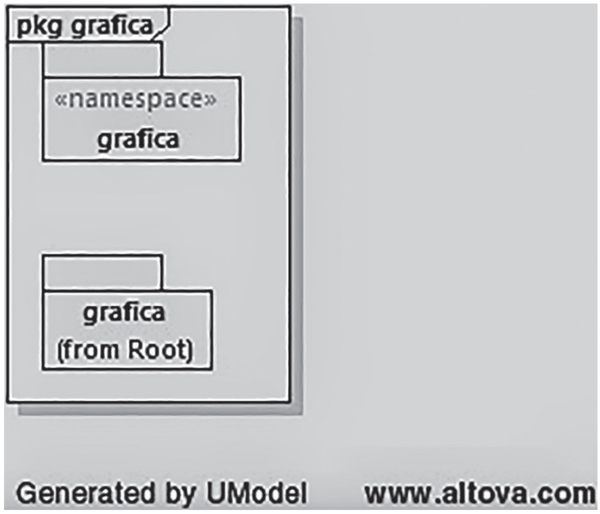


FIGURE 14.103 Package dependencies of grafica.

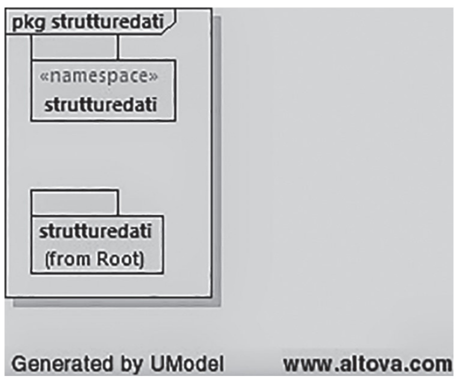


FIGURE 14.104 Package dependencies of strutturedati.

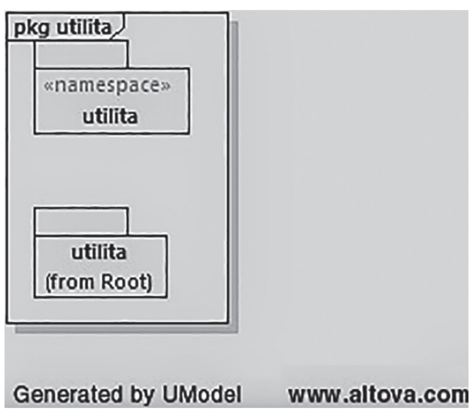


FIGURE 14.105 Package dependencies of utilita.

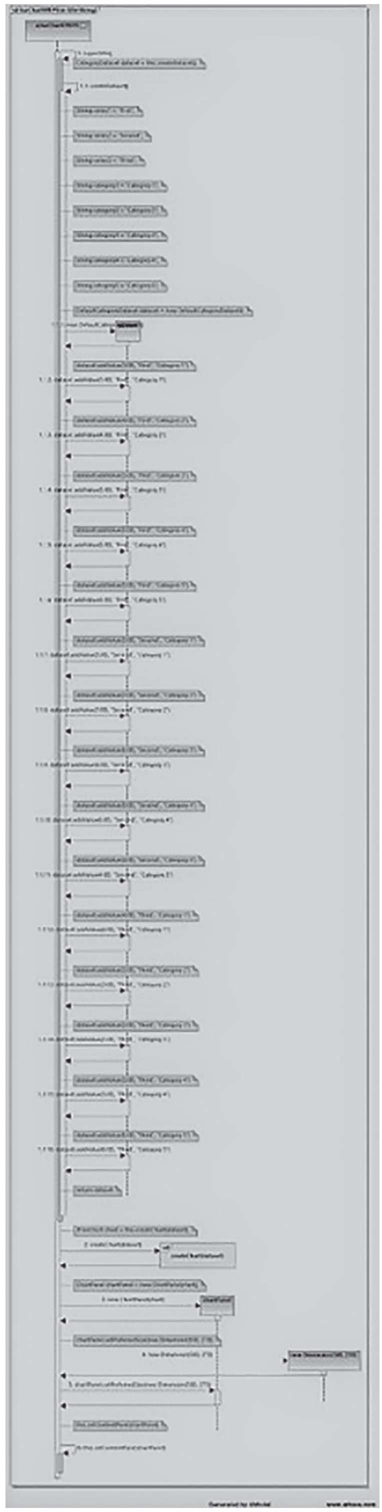


FIGURE 14.106 SequenceDiagram barChartEffEPE.

FIGURE 14.107 SequenceDiagram barChartEffEPE_1.

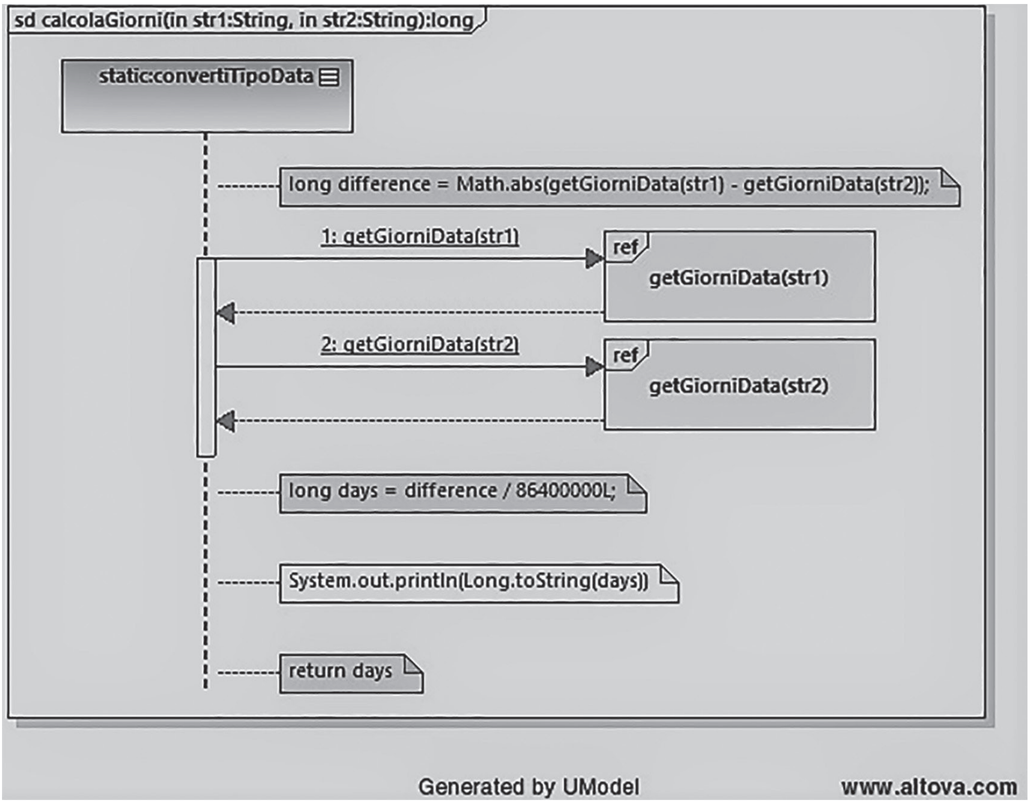


FIGURE 14.108 SequenceDiagram calcolaGiorni.

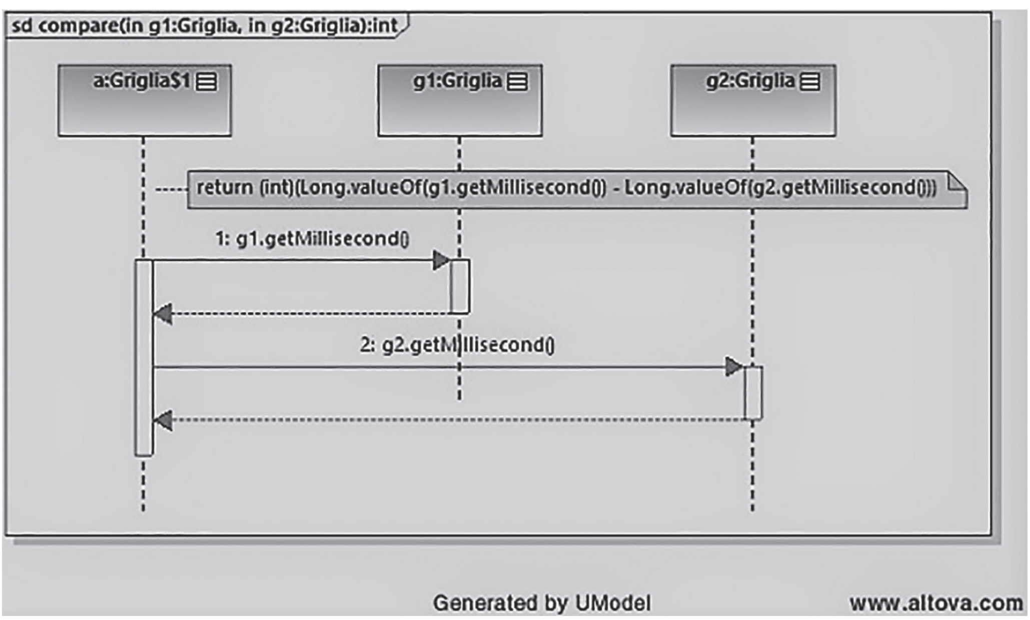


FIGURE 14.109 SequenceDiagram compare.

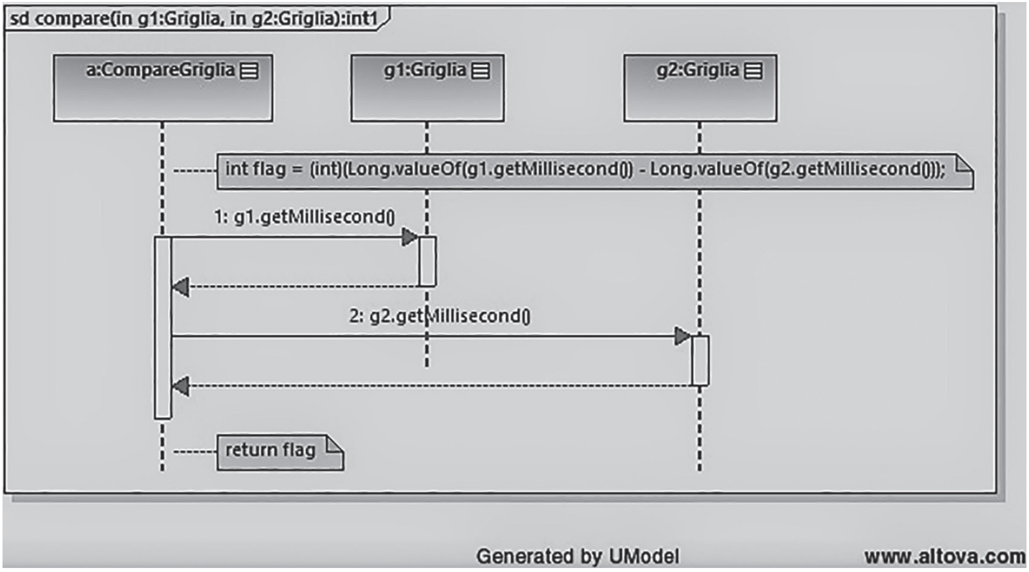


FIGURE 14.110 SequenceDiagram compare_1.

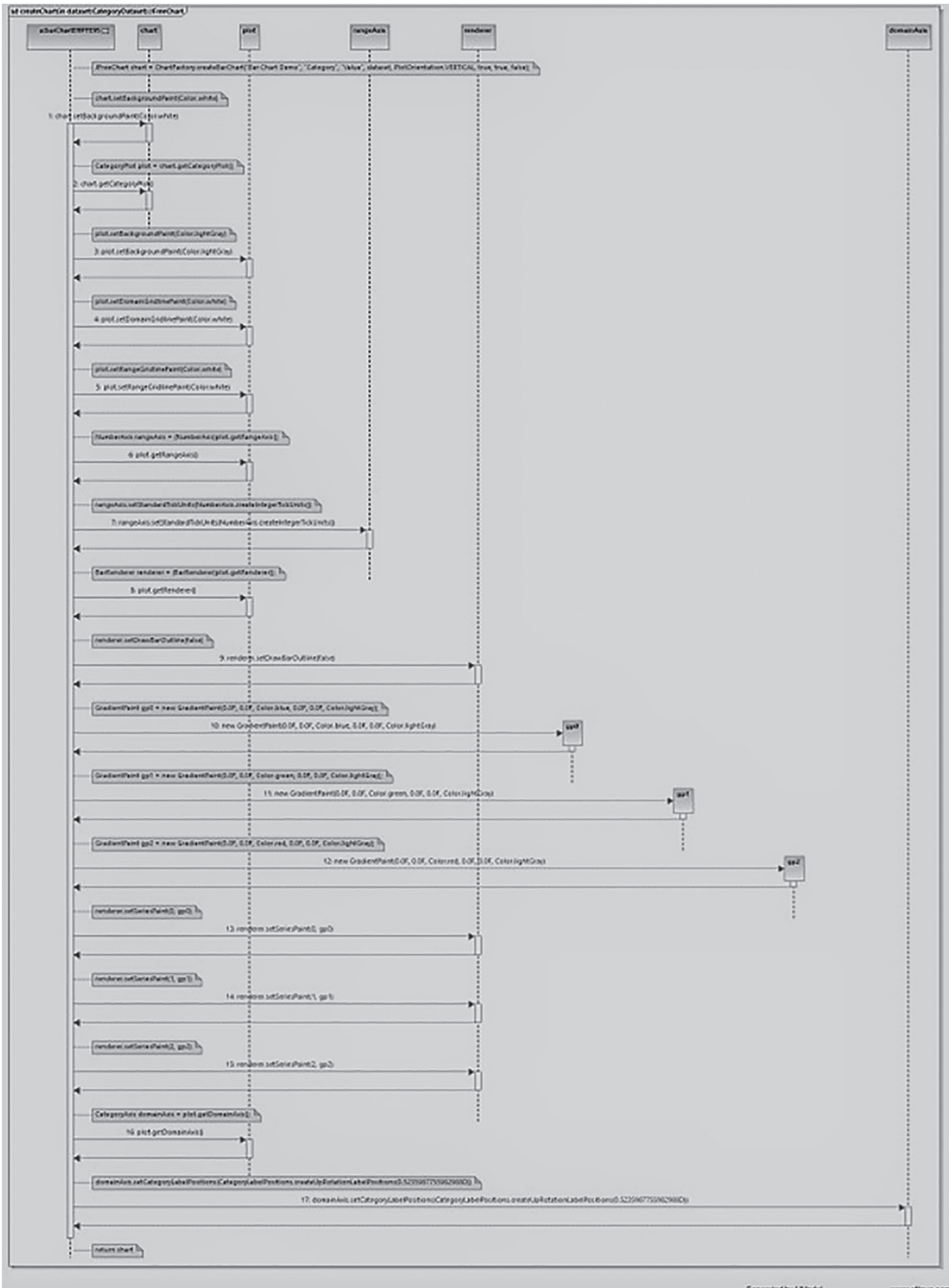


FIGURE 14.111 SequenceDiagram createChart.

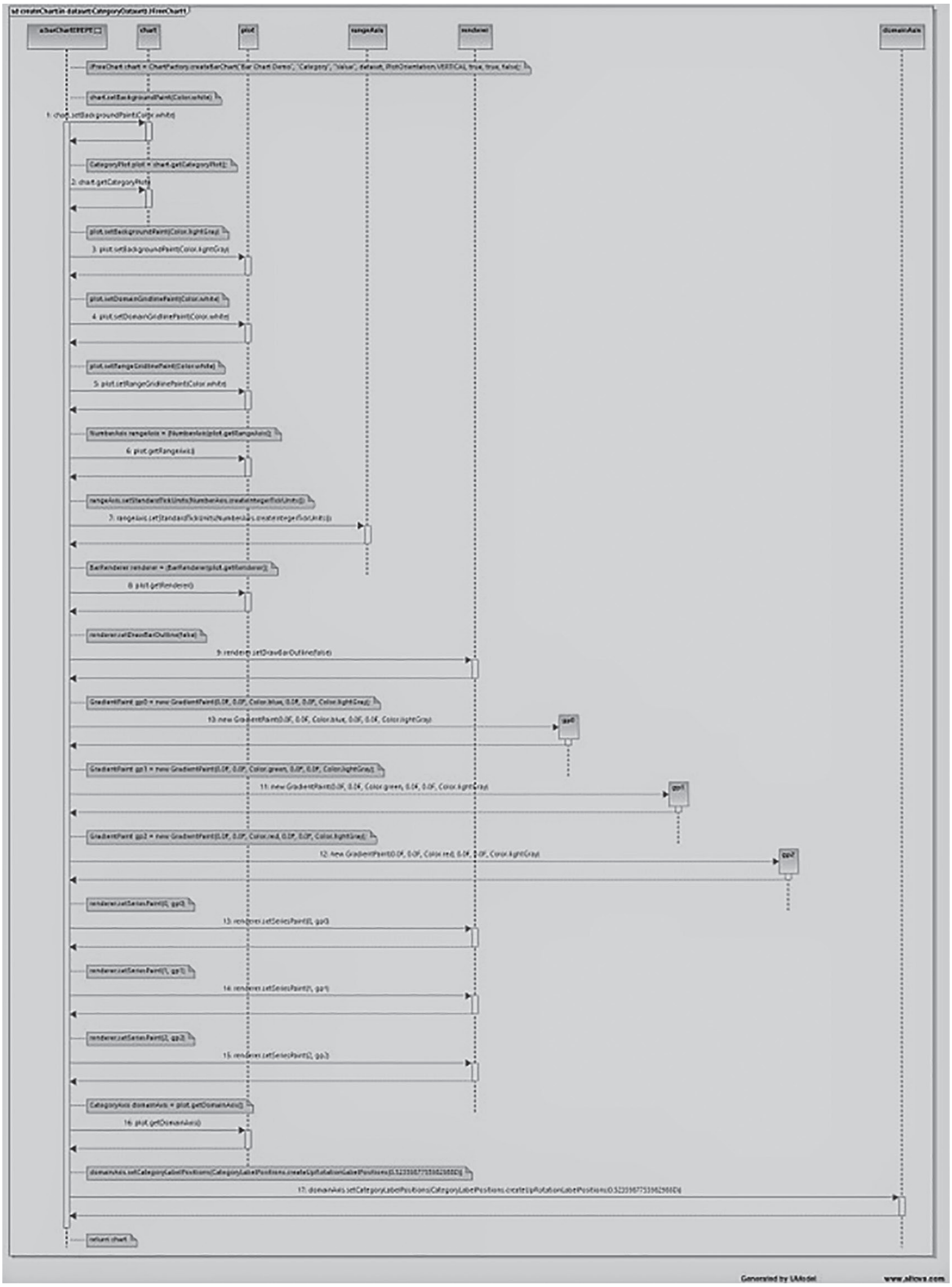


FIGURE 14.112 SequenceDiagram createChart_3.

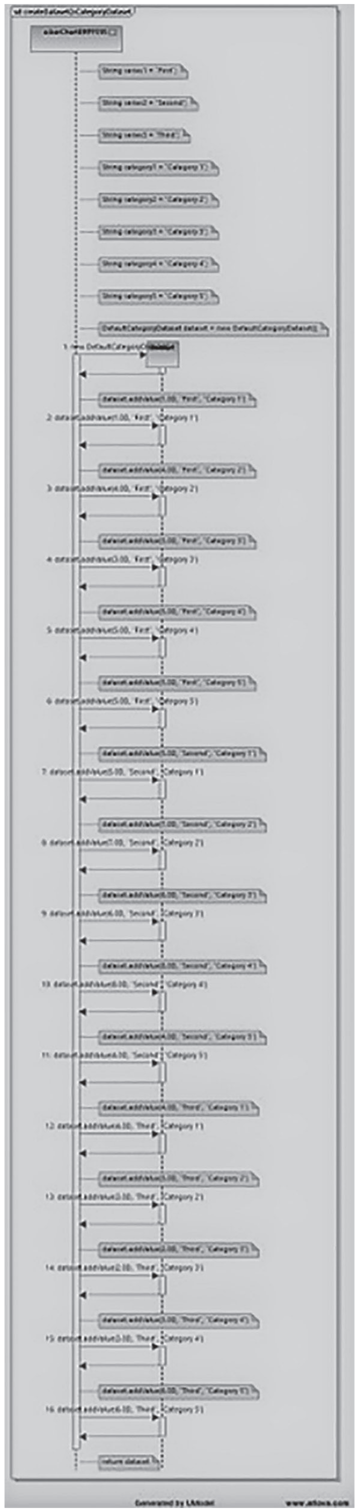


FIGURE 14.113 SequenceDiagram createDataset.

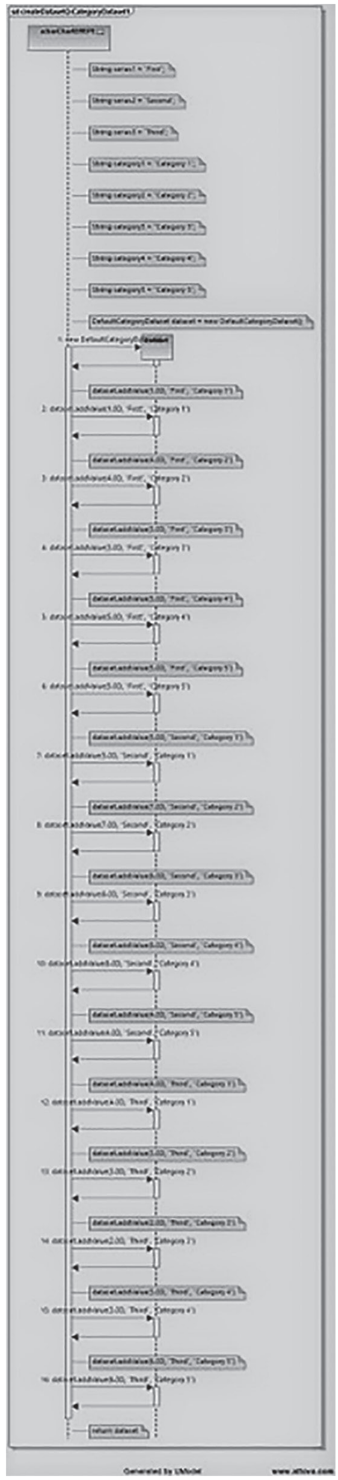


FIGURE 14.114 SequenceDiagram createDataset.

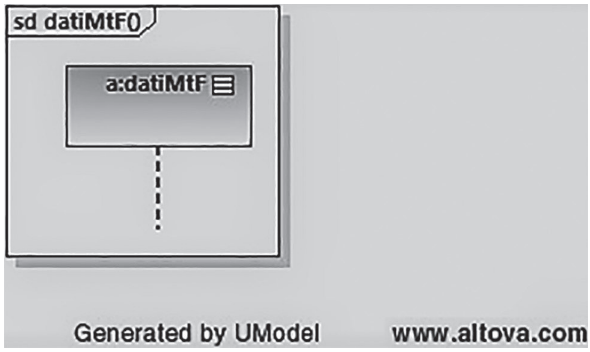


FIGURE 14.115 SequenceDiagram datiMtF.

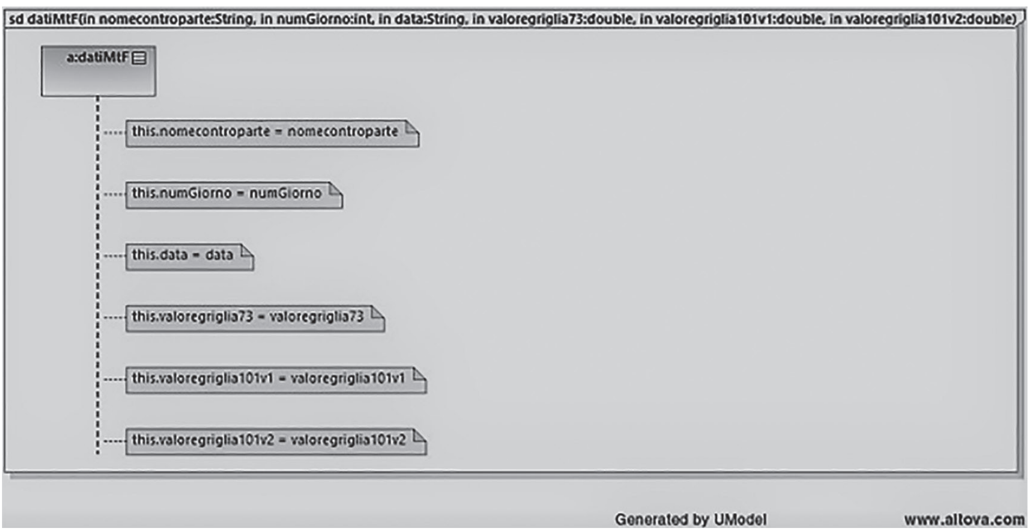


FIGURE 14.116 SequenceDiagram datiMtF_1.

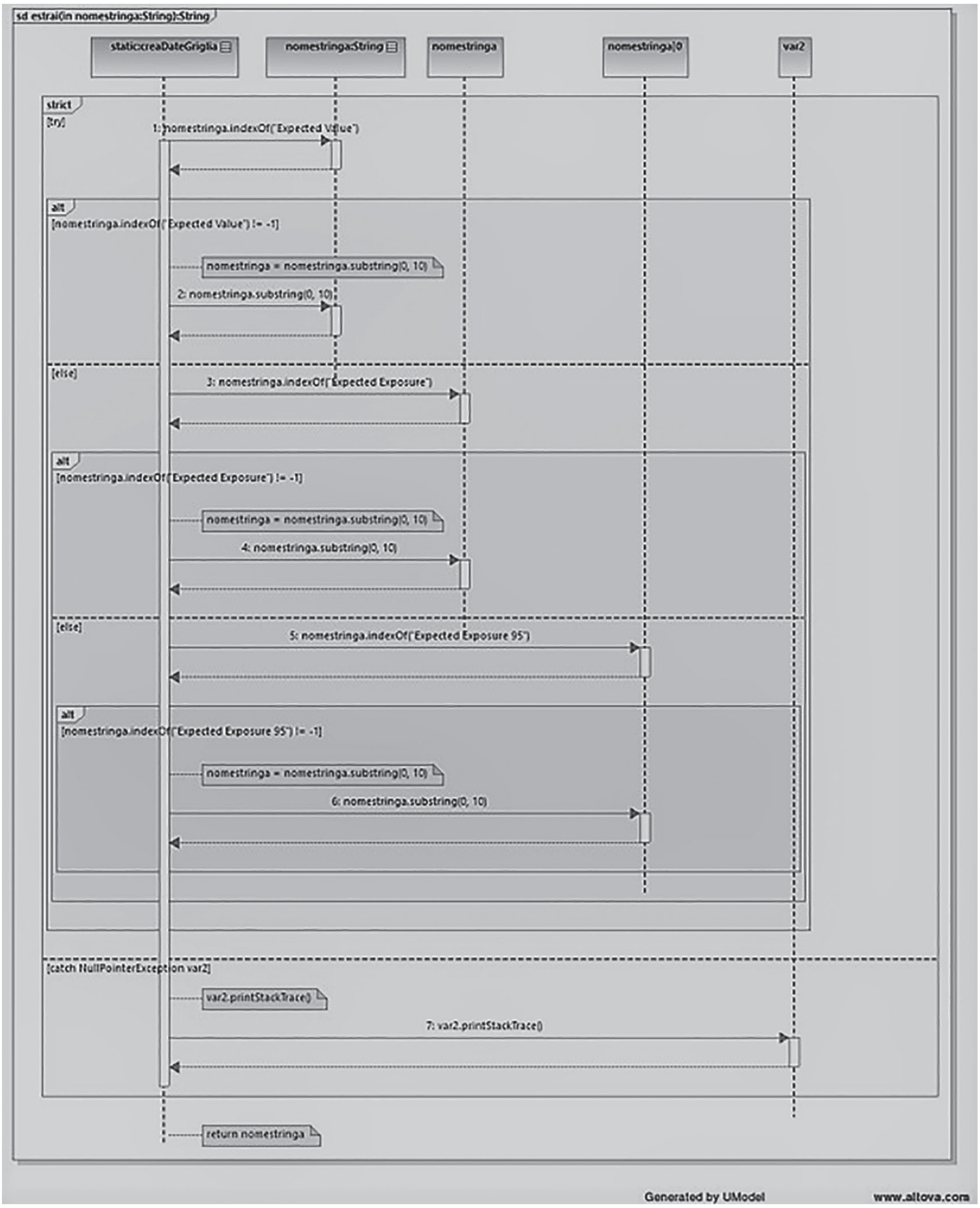


FIGURE 14.117 SequenceDiagram estrai.

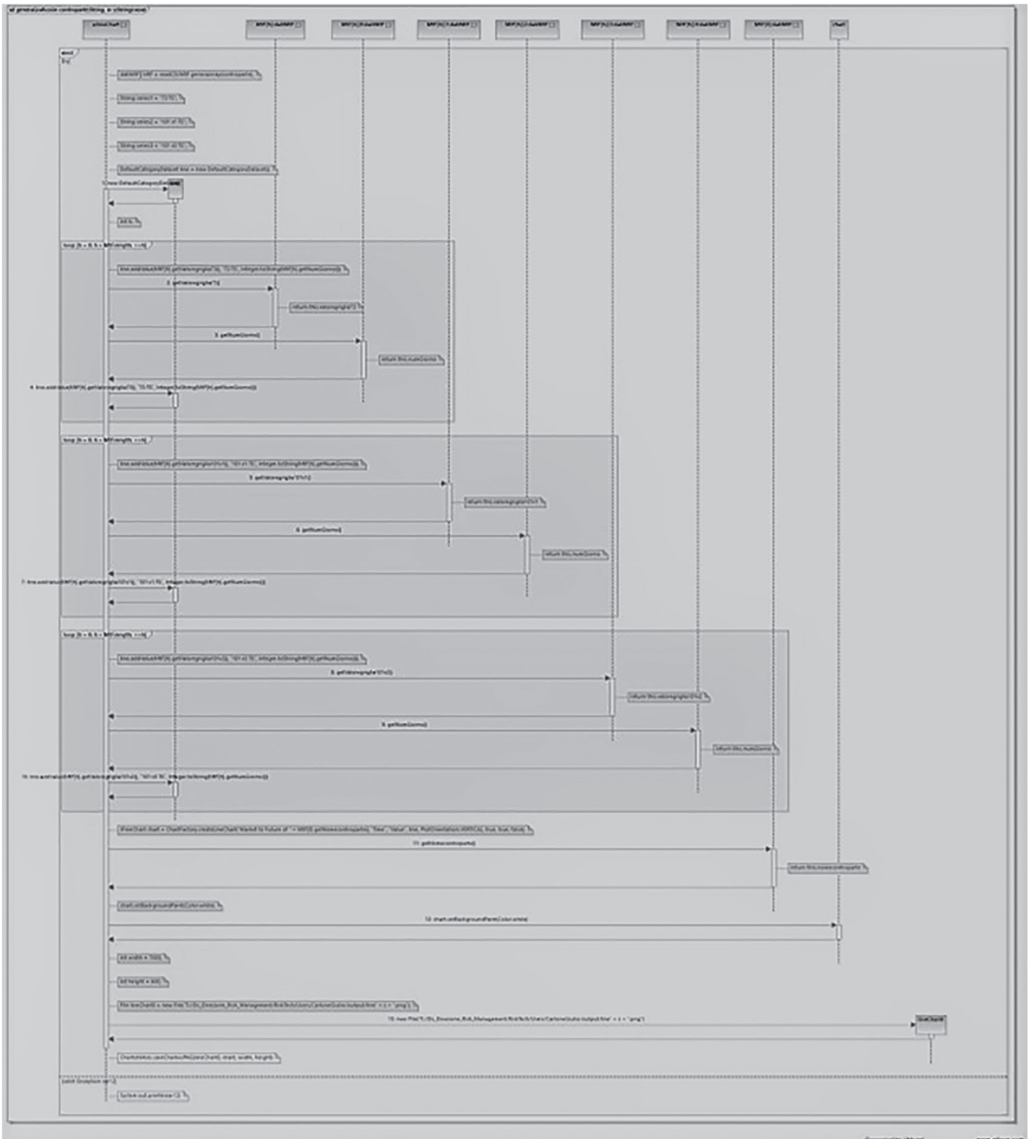


FIGURE 14.118 SequenceDiagram estrai_1.

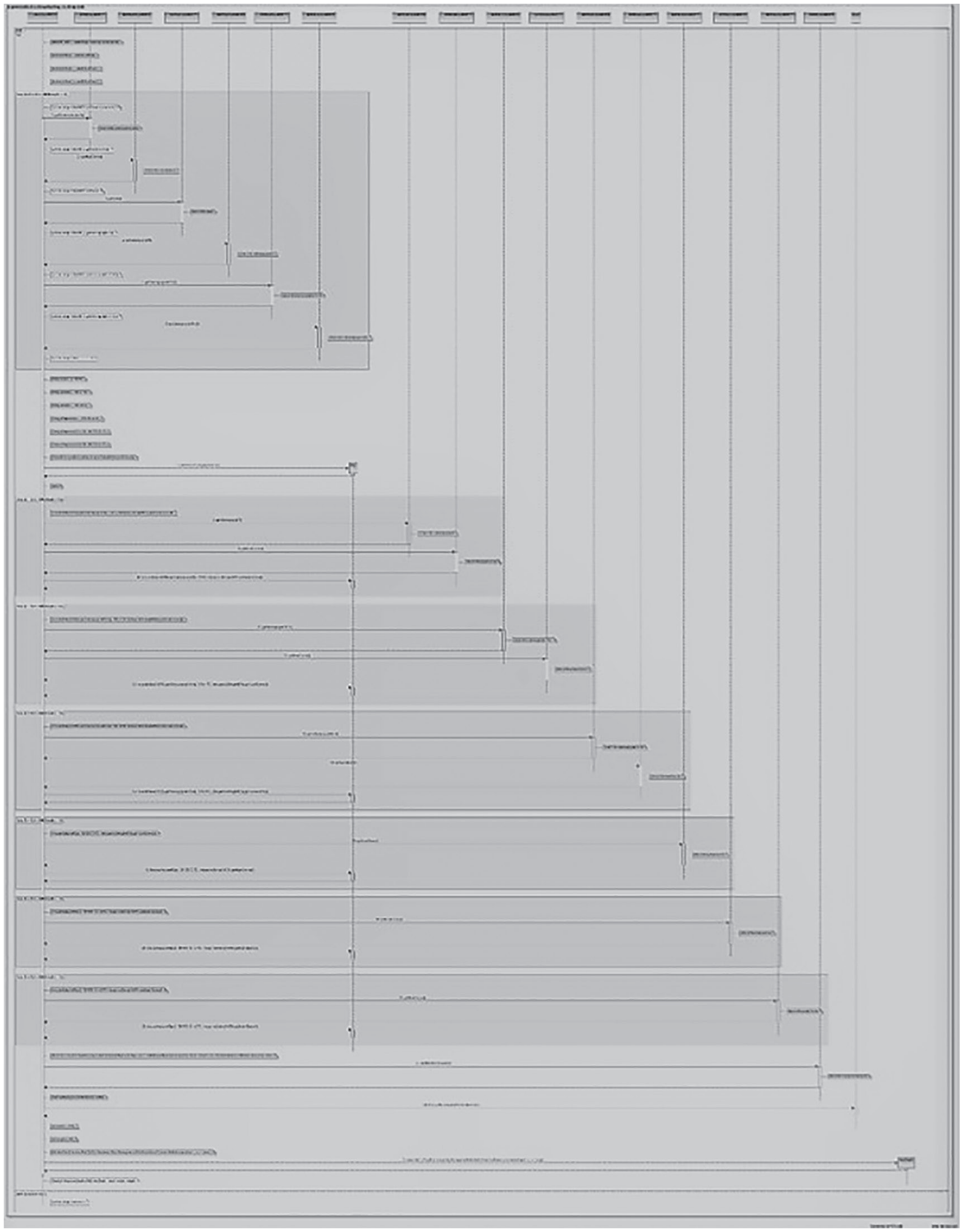


FIGURE 14.119 SequenceDiagram generaGrafico_1.

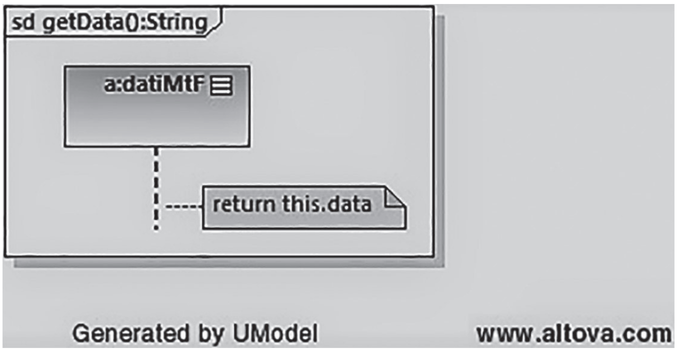


FIGURE 14.120 SequenceDiagram getData.

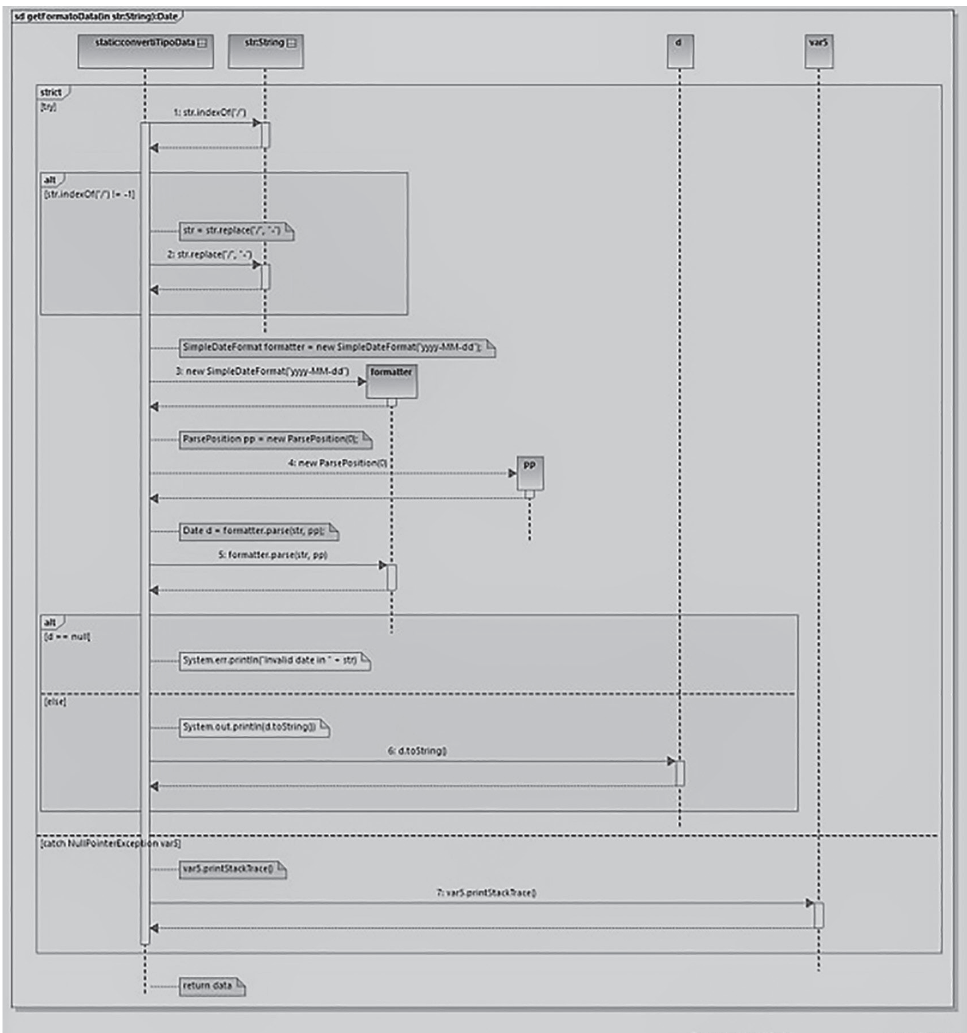


FIGURE 14.121 SequenceDiagram getFormatoData.

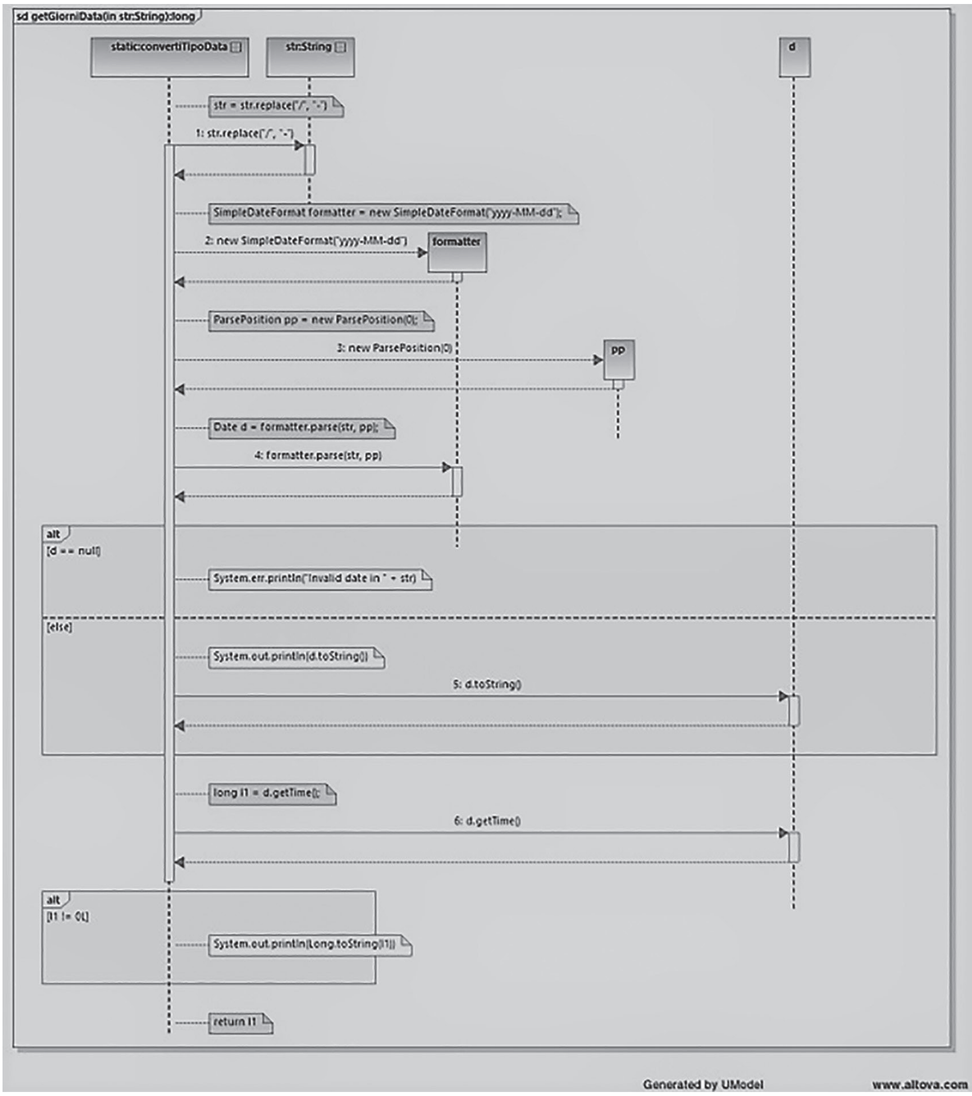


FIGURE 14.122 SequenceDiagram getGiorniData.

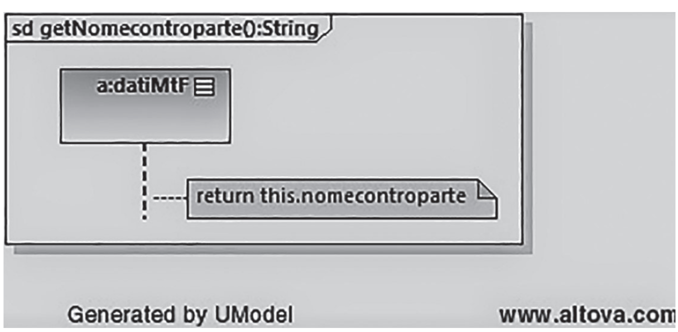


FIGURE 14.123 SequenceDiagram getNomecontroparte.

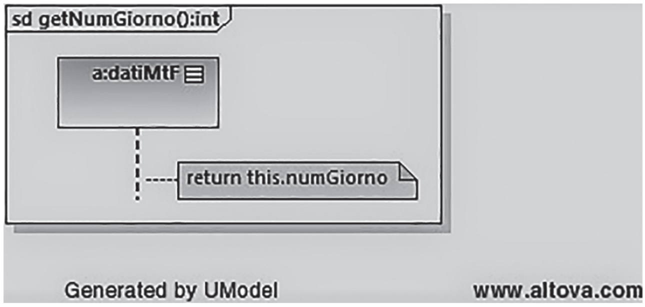


FIGURE 14.124 SequenceDiagram getNumGiorno.

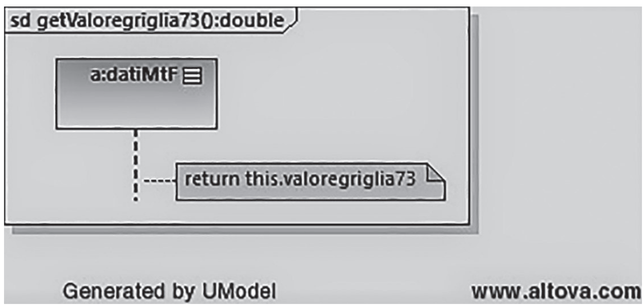


FIGURE 14.125 SequenceDiagram getValoregriglia73.

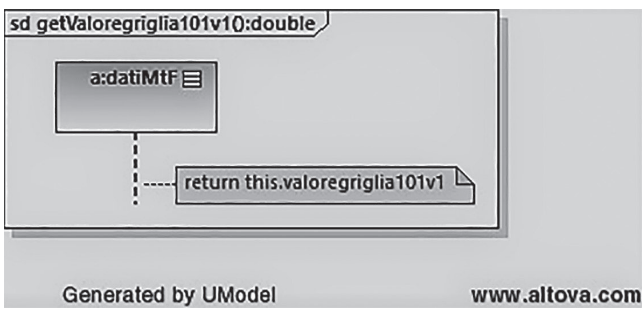


FIGURE 14.126 SequenceDiagram getValoregriglia101v1.

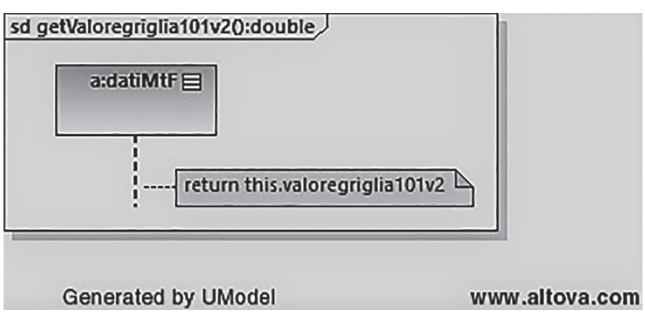


FIGURE 14.127 SequenceDiagram getValoregriglia101v2.

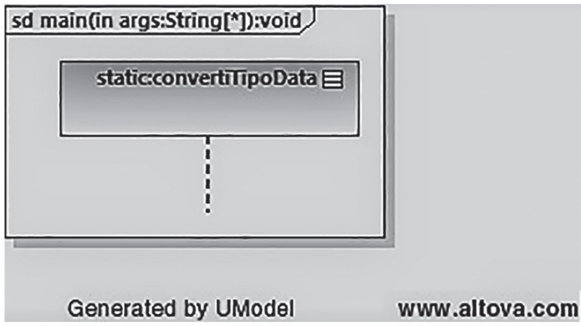


FIGURE 14.128 SequenceDiagram getValoregriglia101v1.

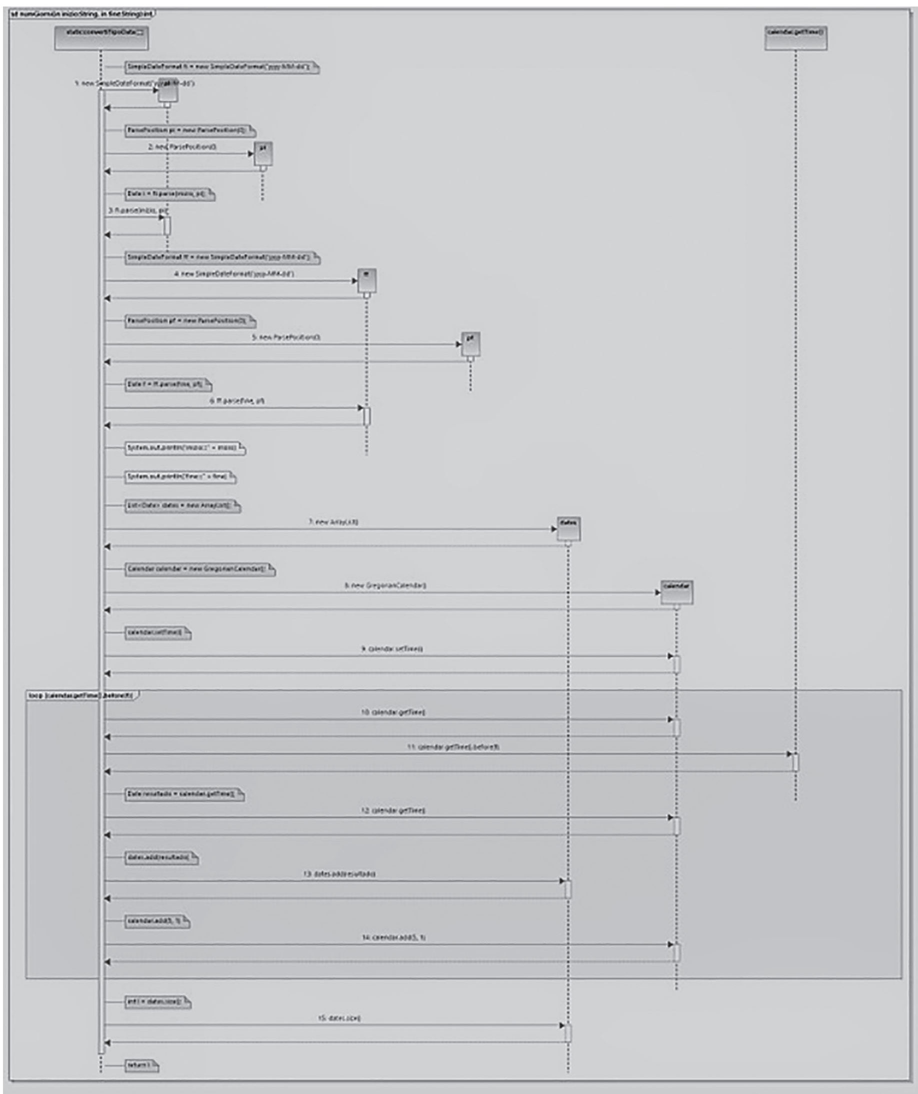


FIGURE 14.129 SequenceDiagram numGiorni.

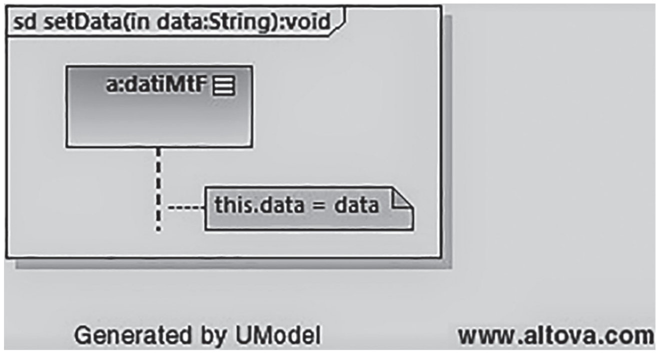


FIGURE 14.130 SequenceDiagram setData.

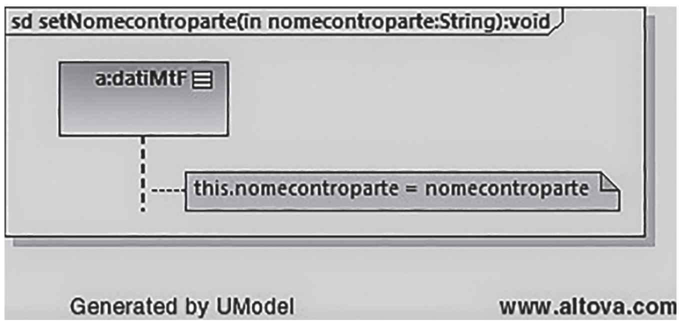


FIGURE 14.131 SequenceDiagram setNomecontroparte.

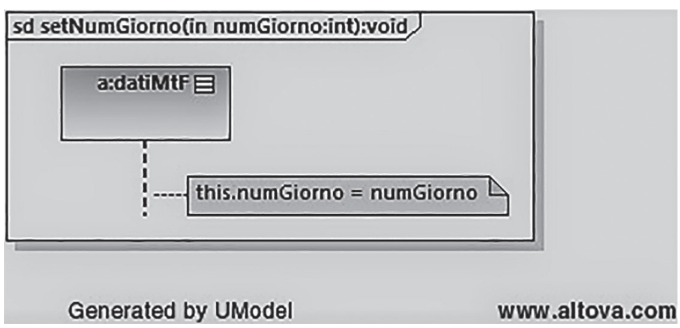


FIGURE 14.132 SequenceDiagram setNumGiorno.

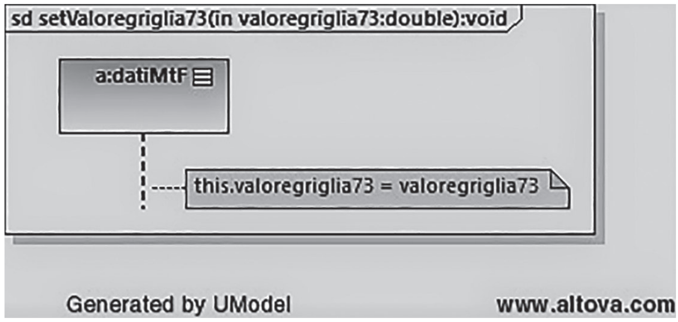


FIGURE 14.133 SequenceDiagram setValoregriglia73.

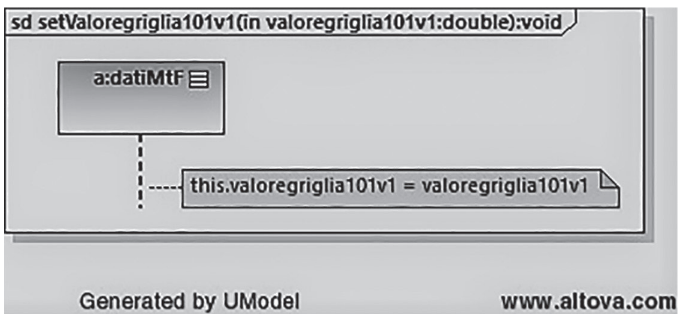


FIGURE 14.134 SequenceDiagram setValoregriglia101v1.

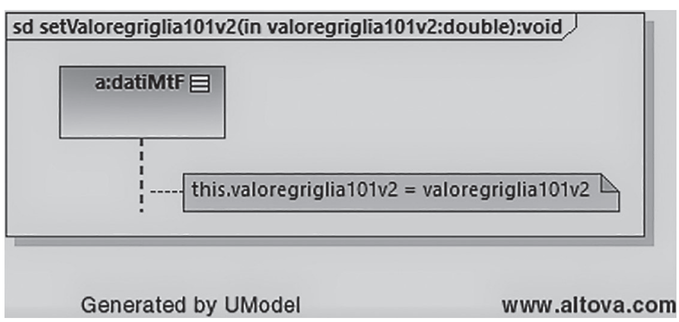


FIGURE 14.135 SequenceDiagram setValoregriglia101v2.

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CHAPTER 15

Expected Exposure Visualization List of UML Diagram

15.1 EXPECTED EXPOSURE VISUALIZATION LIST OF MYECLIPSE WAR FOLDERS

```
FOLDER RISKMEASURESGRAPH
FOLDER META-INF
FOLDER WEB-INF
FOLDER CLASSES
FOLDER ESTRAZIONE
readCSVMtF
readEPE
readPFE95
FOLDER GRAFICA
barChartEffEPE
barChartEffPFE95
lineChart
lineChartEPE
lineChartPFE95
FOLDER STRUTTUREDATI
CompareGriglia
datiMtF
Griglia$1
Griglia
FOLDER UTILITA
convertiTipoData
creaDateGriglia
FOLDER LIB
```

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commons-codec-1.5
commons-logging-1.1
dom4j
java-rt-jar-stubs-1.5.0
javax.servlet.jsp.jstl
jcommon-1.0.21
jfreechart-1.0.17
jsr173_1.0_api
jstl-impl
log4j-1.2.13
opencsv-2.2
poi-3.10-FINAL-20140208
poi-examples-3.10-FINAL-20140208
poi-excelant-3.10-FINAL-20140208
poi-ooxml-3.10-FINAL-20140208
poi-ooxml-schemas-3.10-FINAL-20140208
poi-scratchpad-3.10-FINAL-20140208
sax2
xmlbeans-2.3.0

file EffectiveValues.jsp
file index.jsp
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See Figures 15.1–15.362.

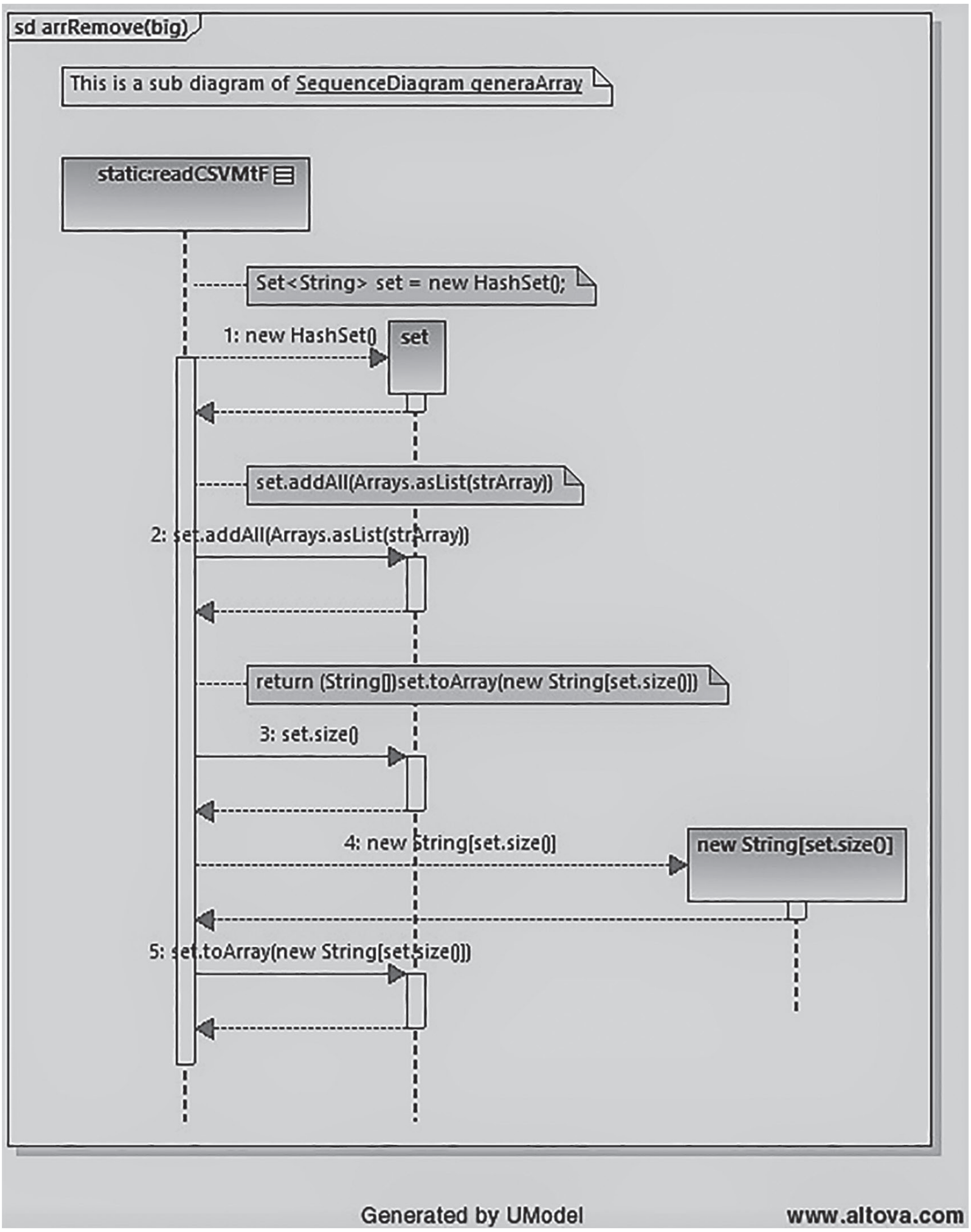

FIGURE 15.1 arrRemove(big).

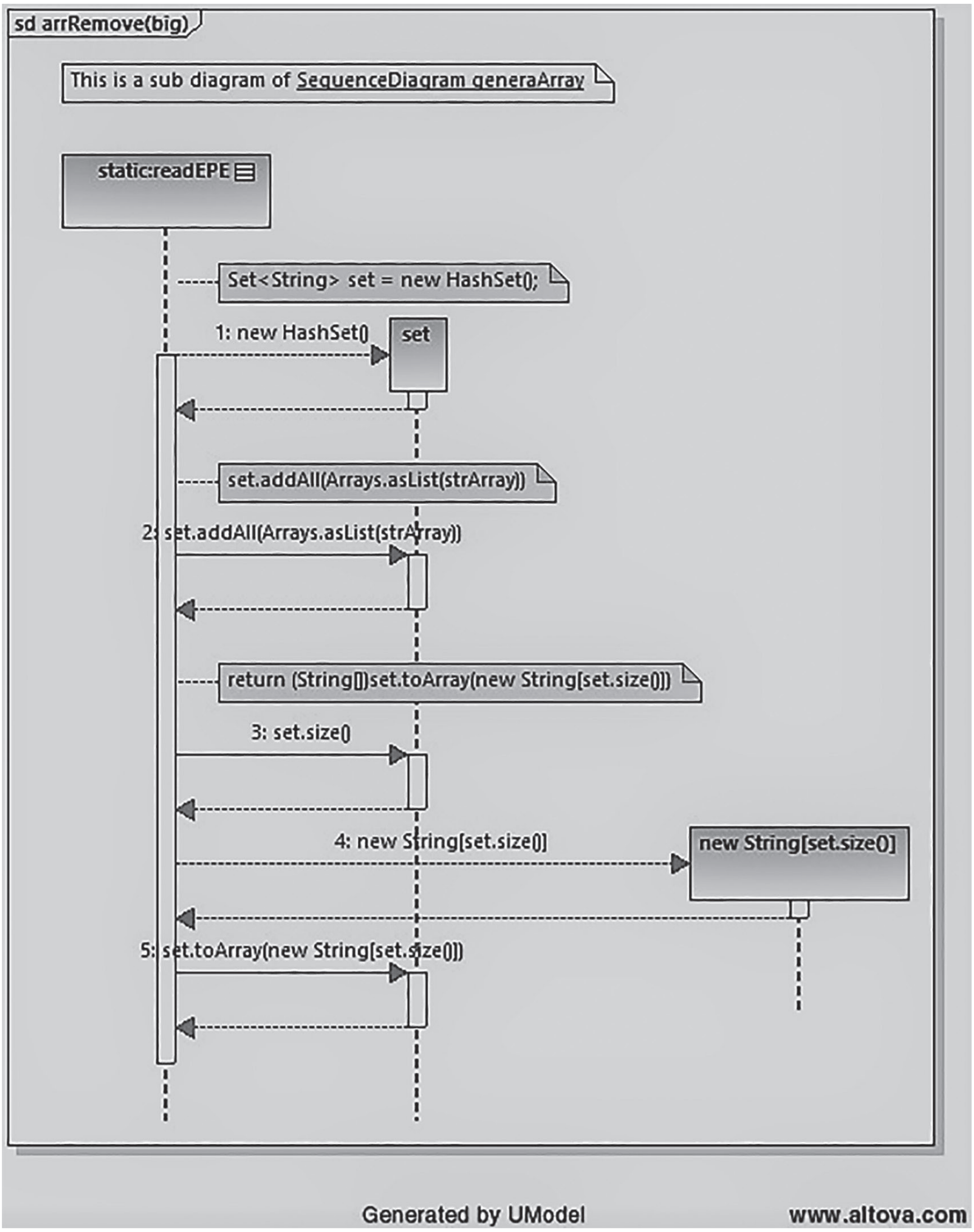

FIGURE 15.2 arrRemove(big)_1.

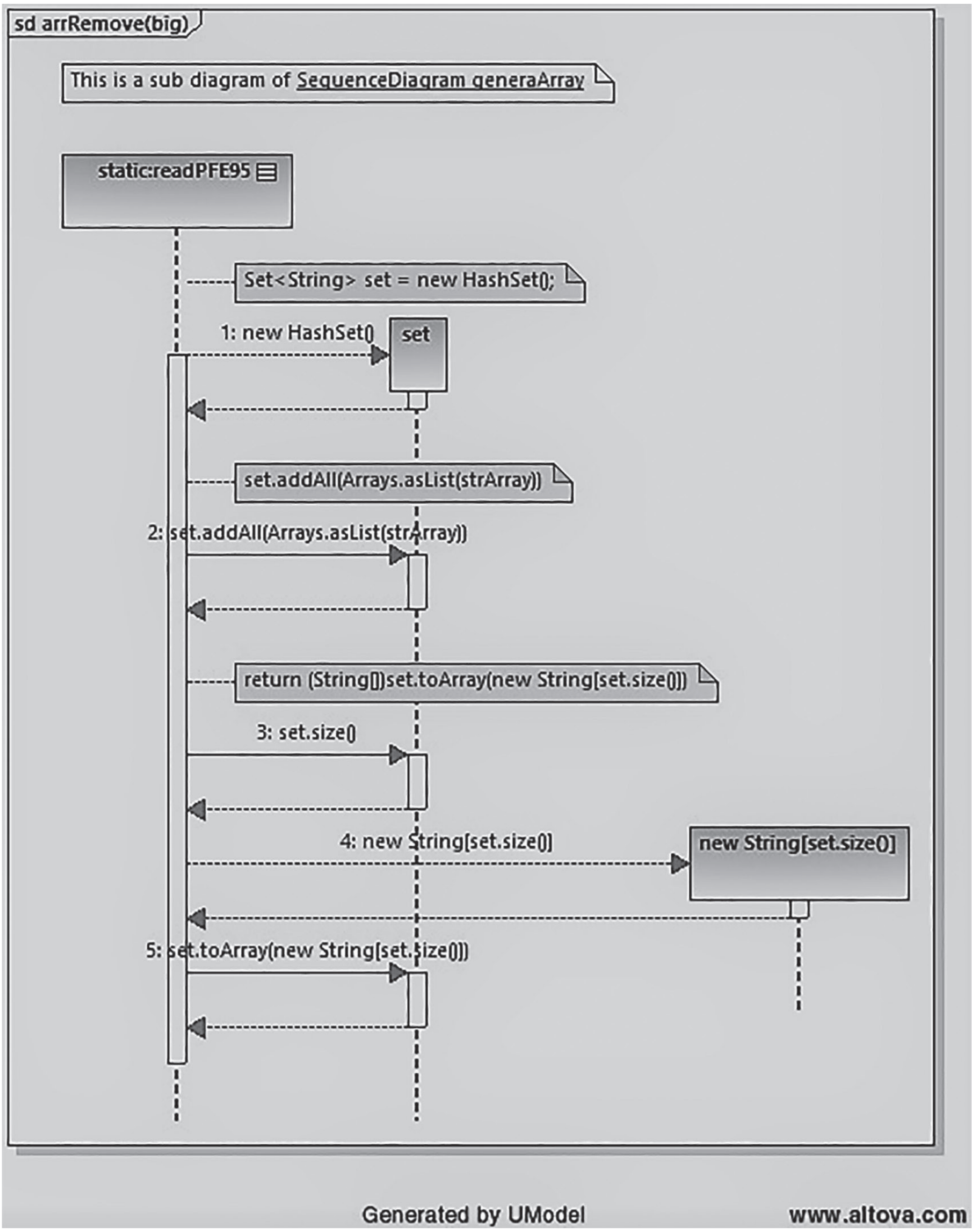

FIGURE 15.3 arrRemove(big)_2.

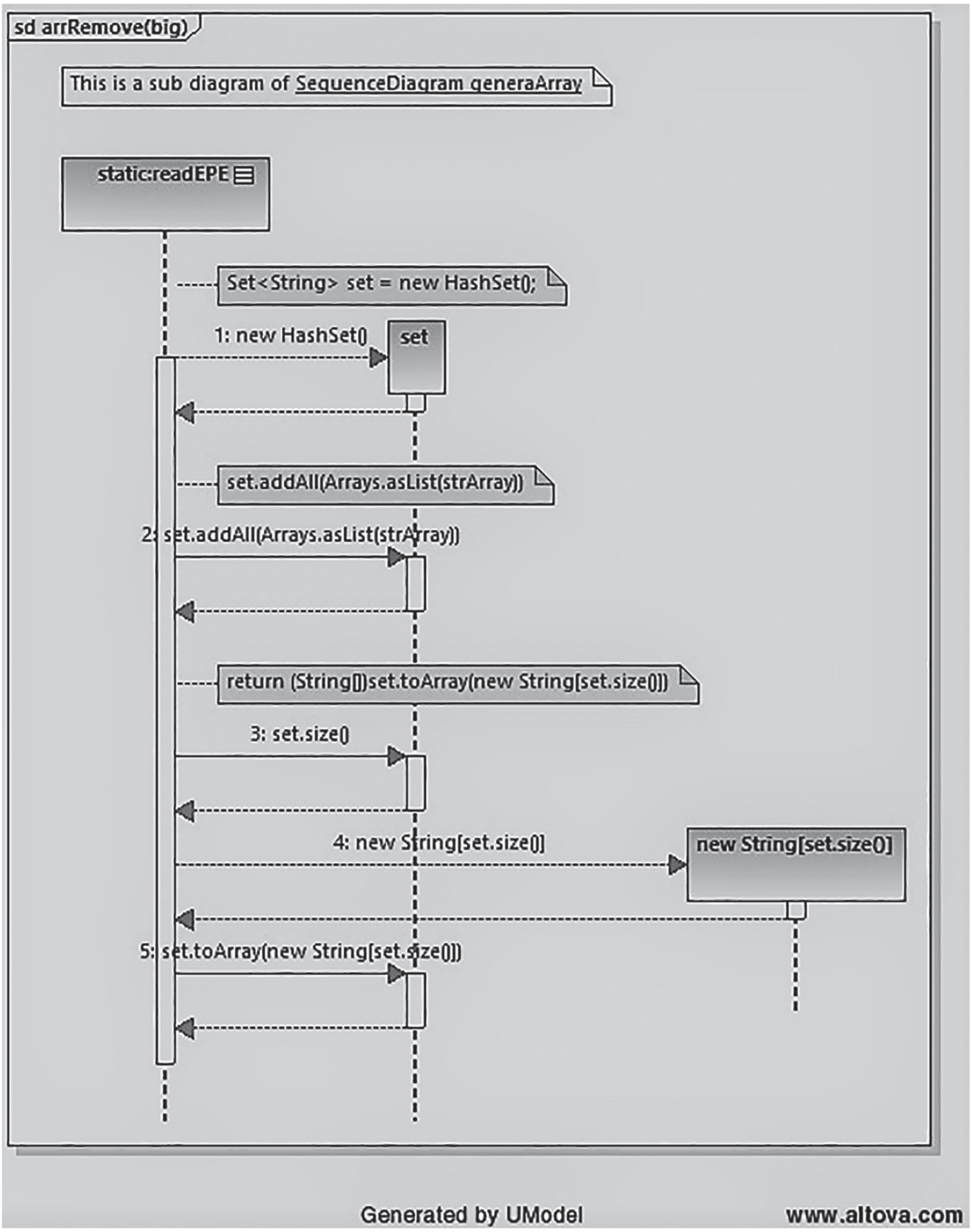

FIGURE 15.4 arrRemove(big)_3.

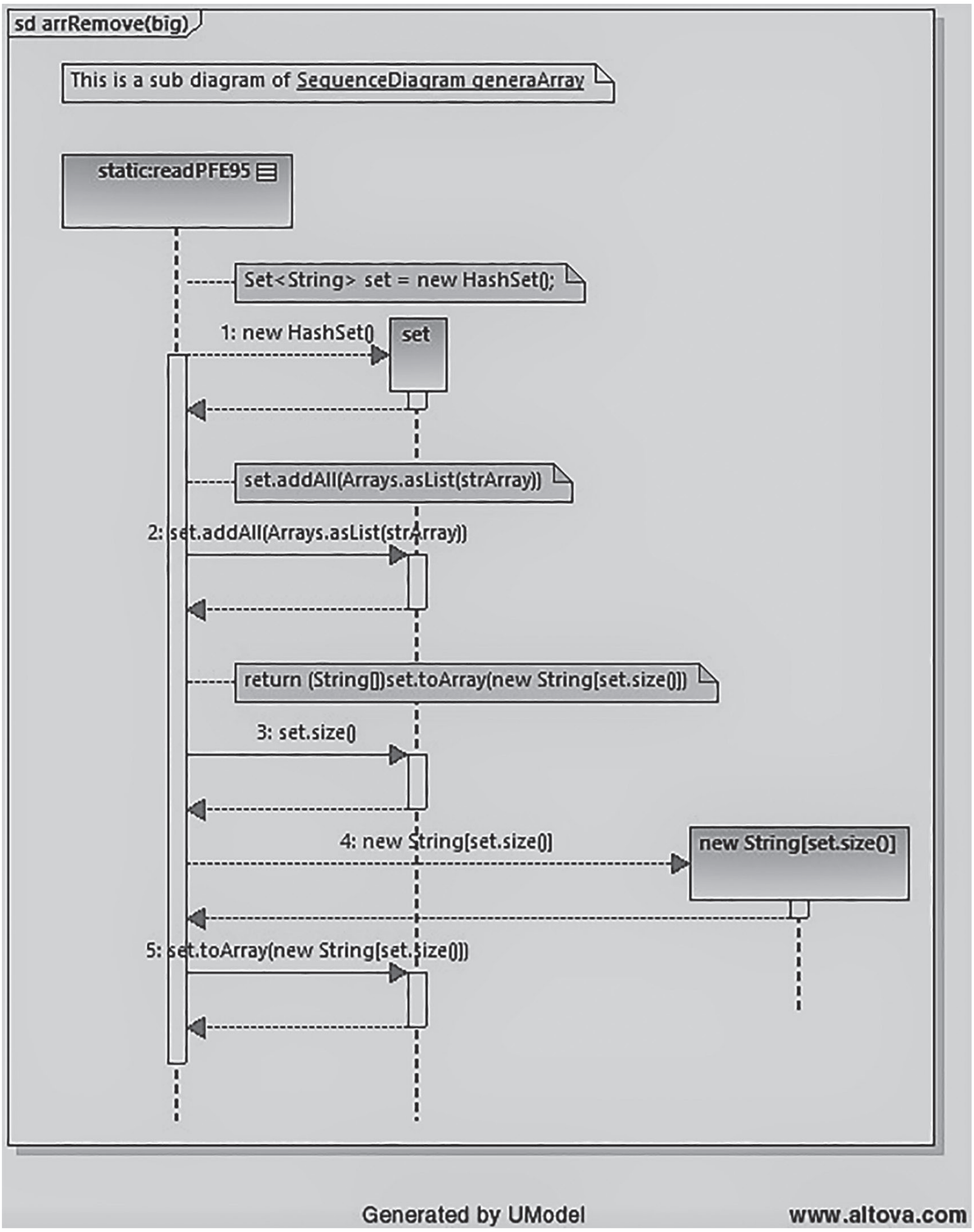

FIGURE 15.5 arrRemove(big)_4.

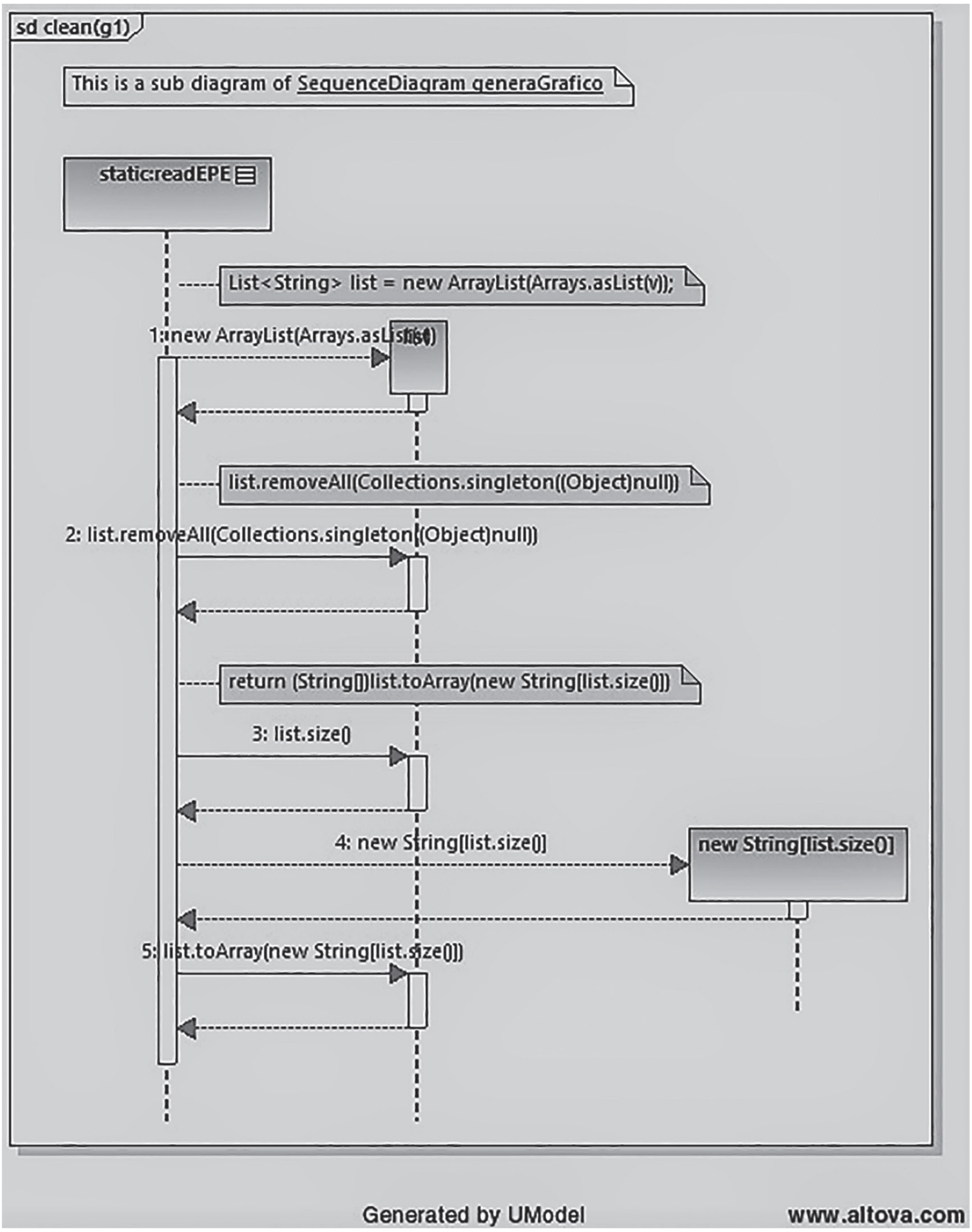

FIGURE 15.6 clean(g1).

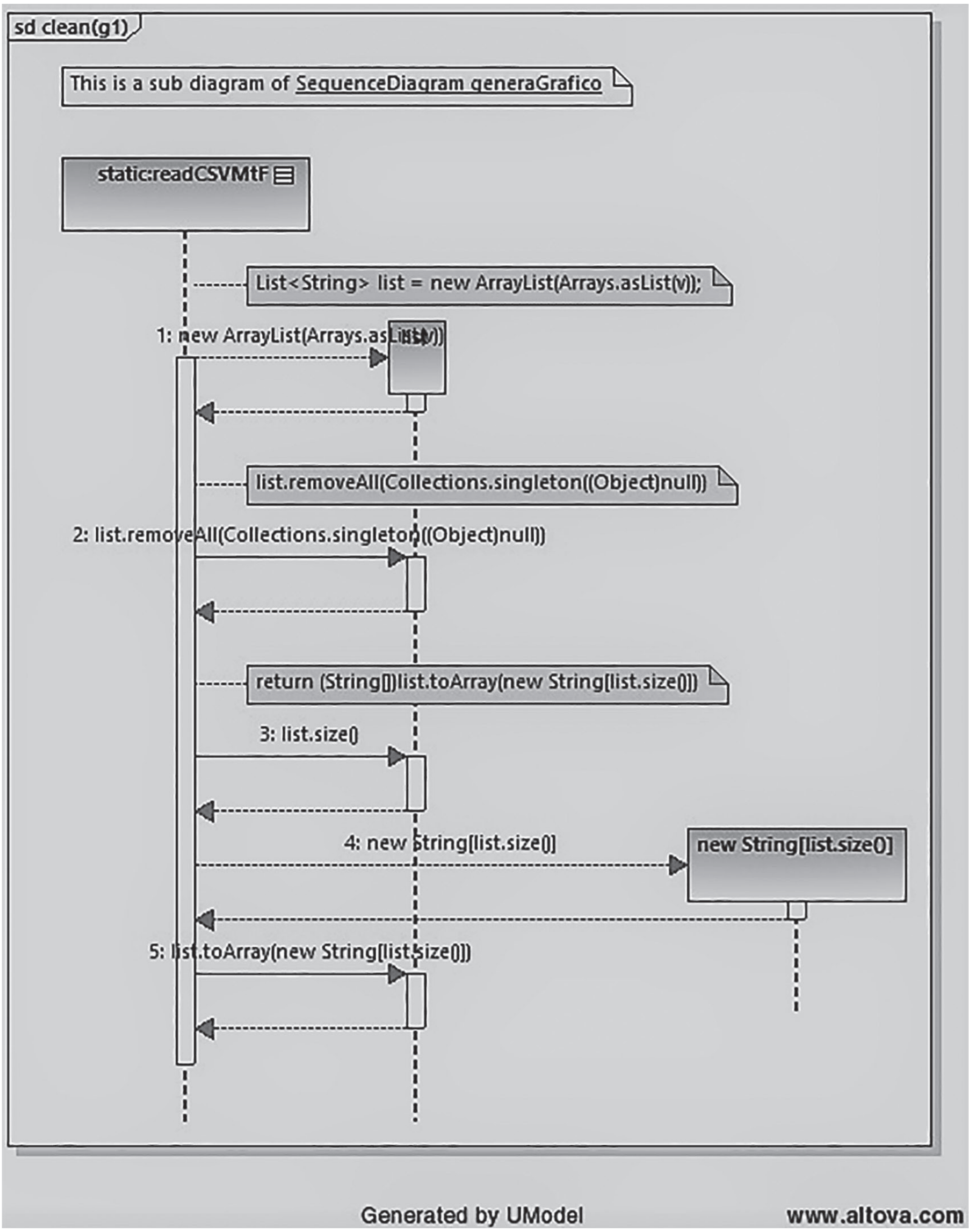

FIGURE 15.7 clean(g1)_1.

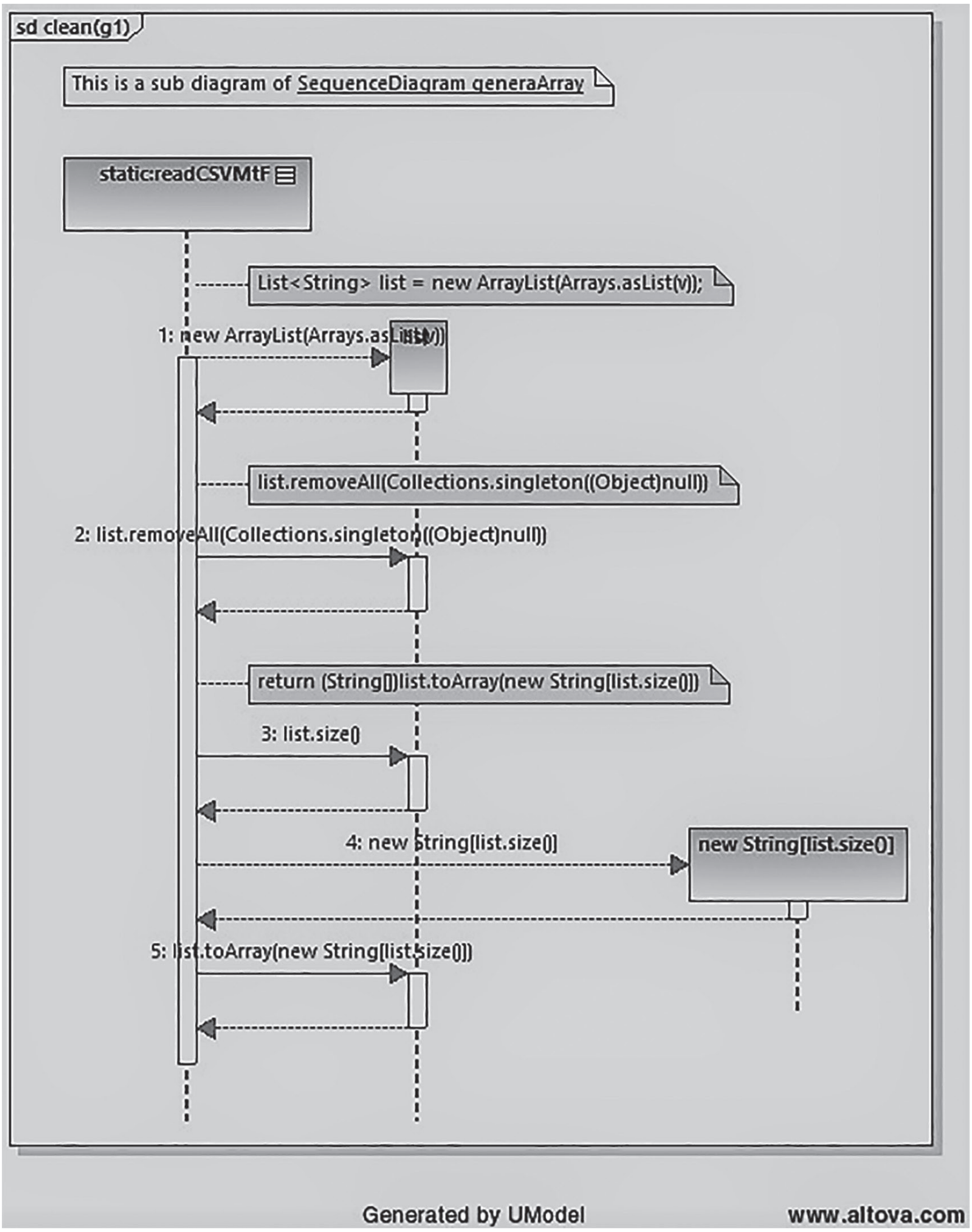

FIGURE 15.8 clean(g1)_2.

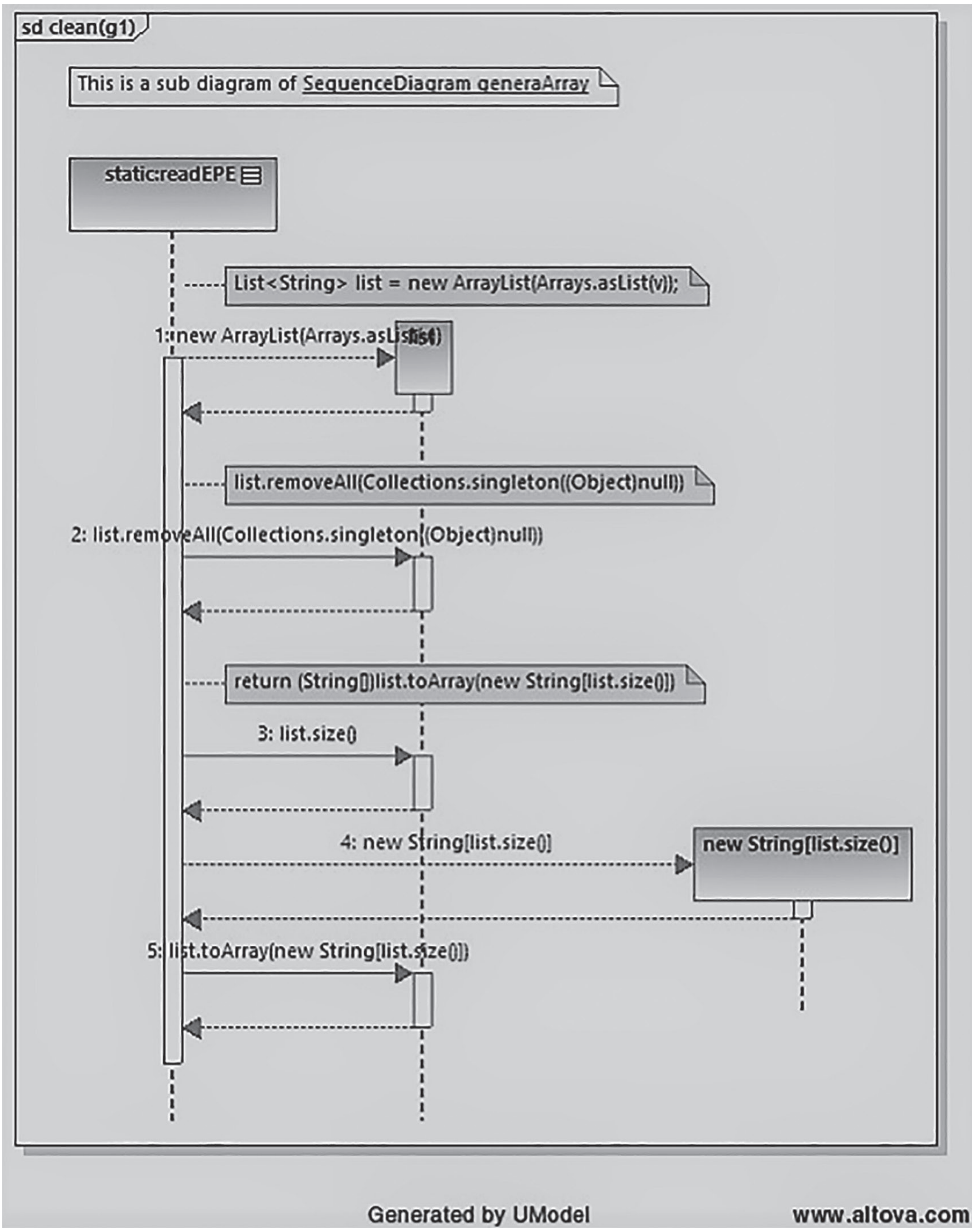

FIGURE 15.9 clean(g1)_3.

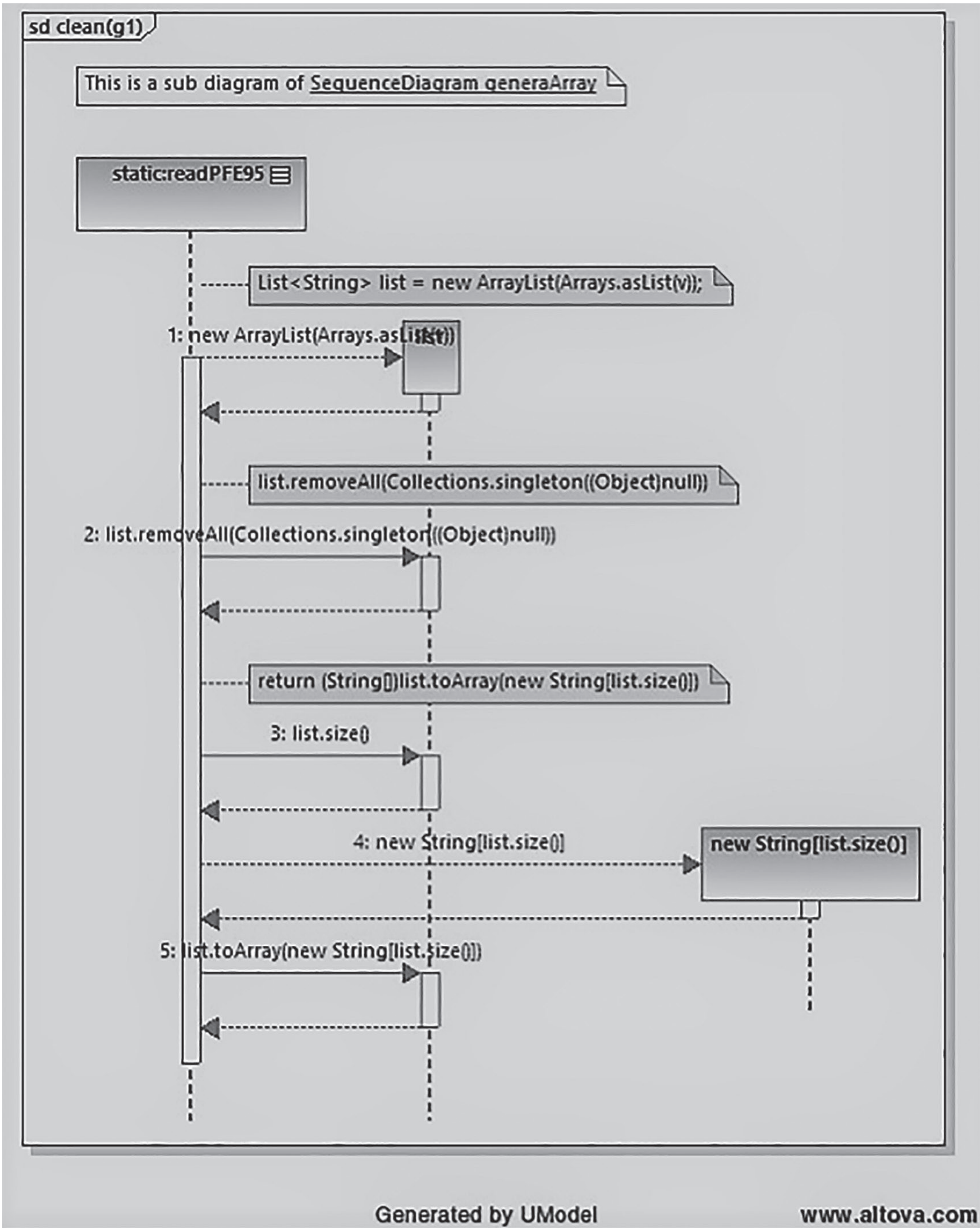

FIGURE 15.10 clean(g1)_4.

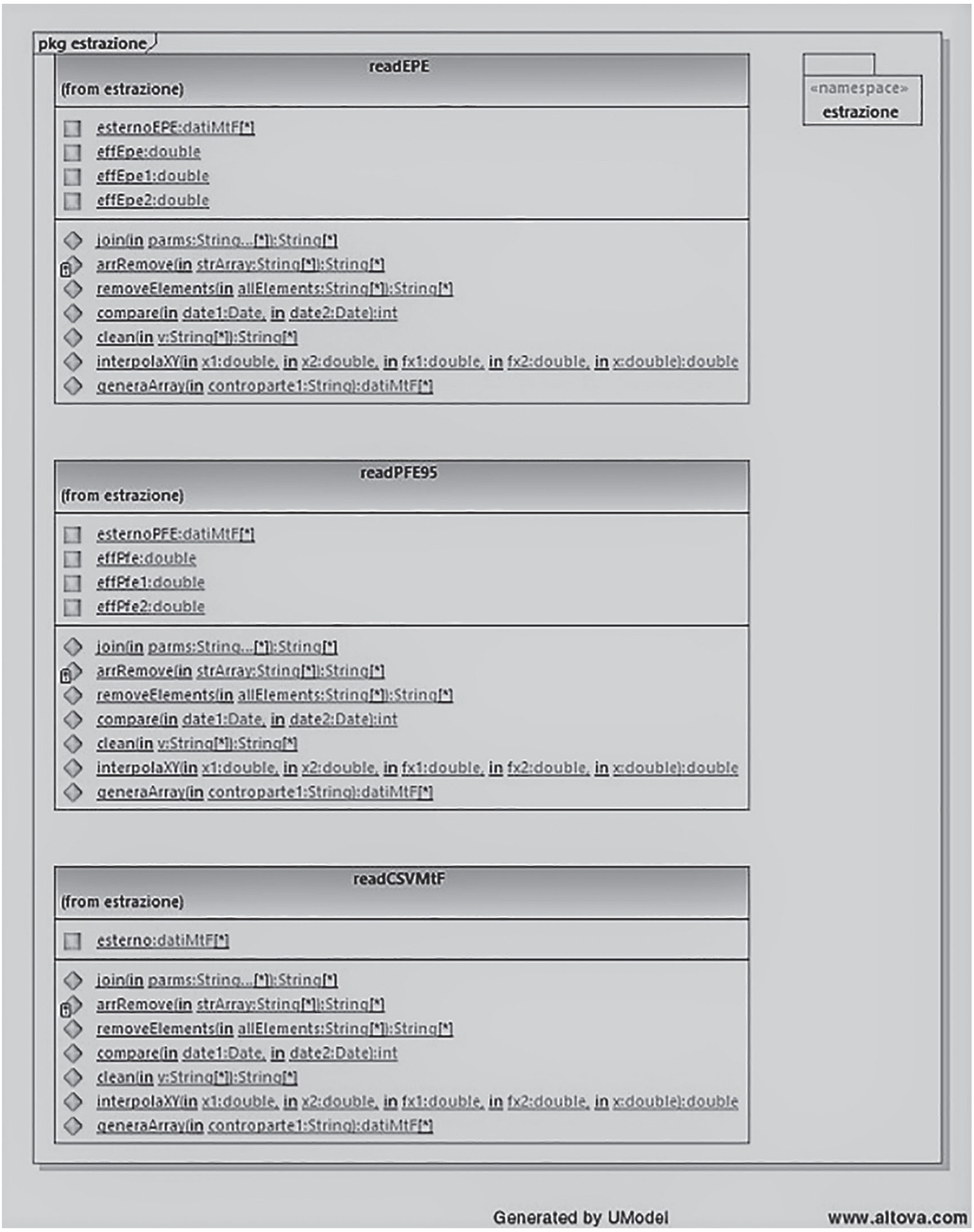

FIGURE 15.11 Content of estrazione and all subpackages.

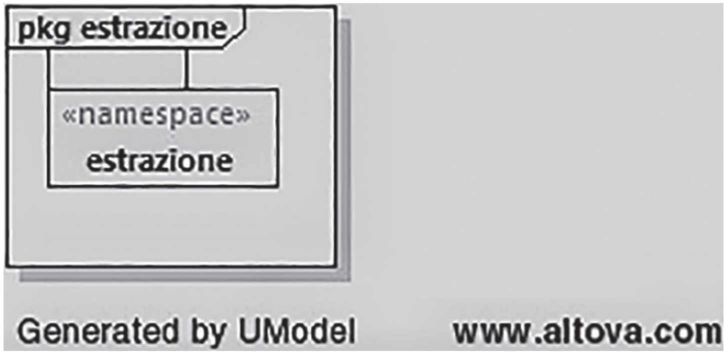

FIGURE 15.12 Content of estrazione.

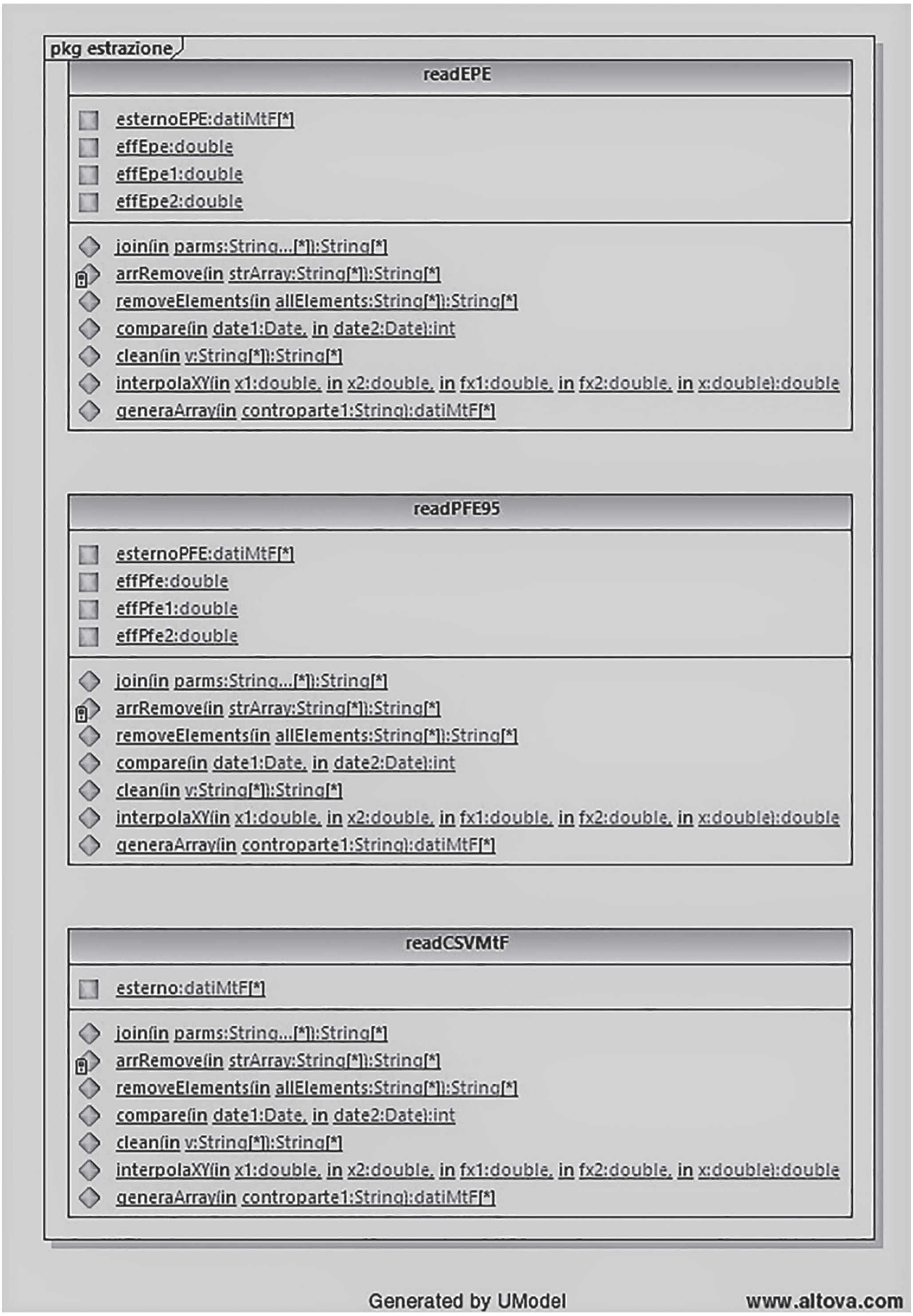

FIGURE 15.13 Content of estrazione_1.

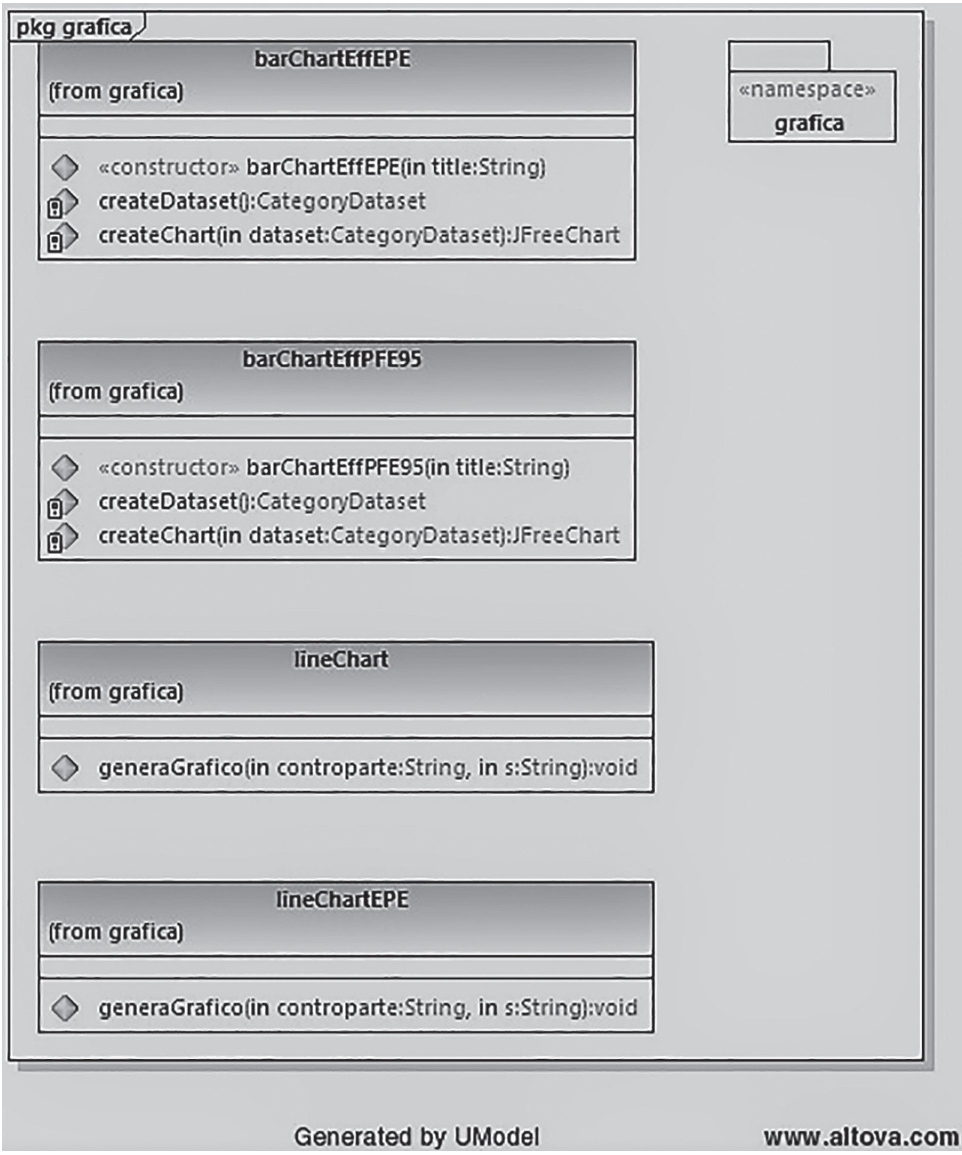

FIGURE 15.14 Content of grafica and all subpackages.

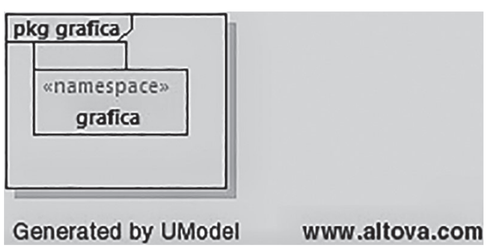

FIGURE 15.15 Content of grafica.

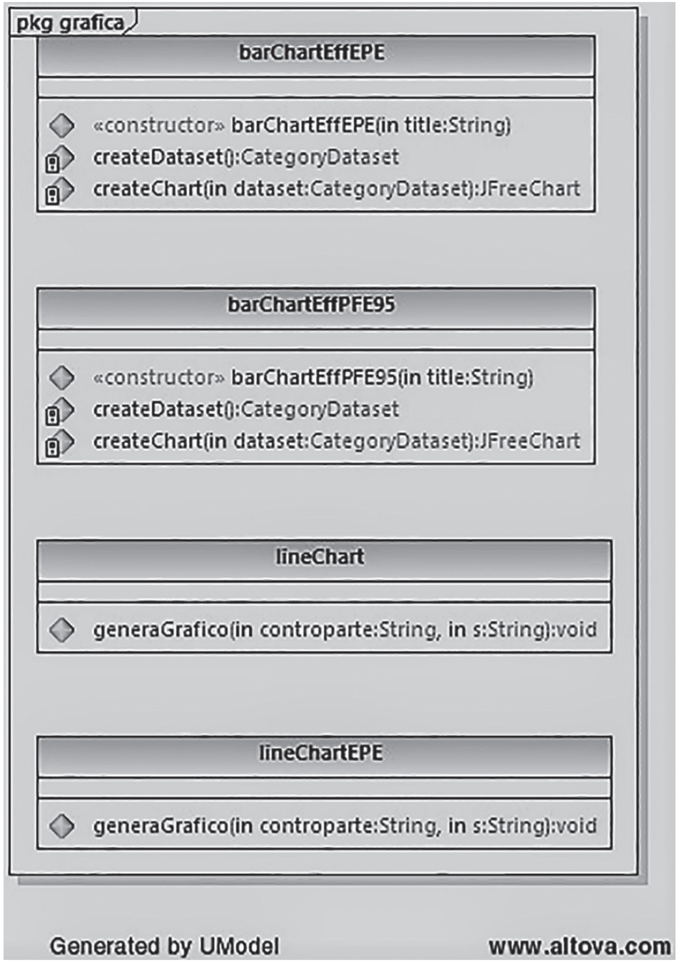

FIGURE 15.16 Content of grafica_1.

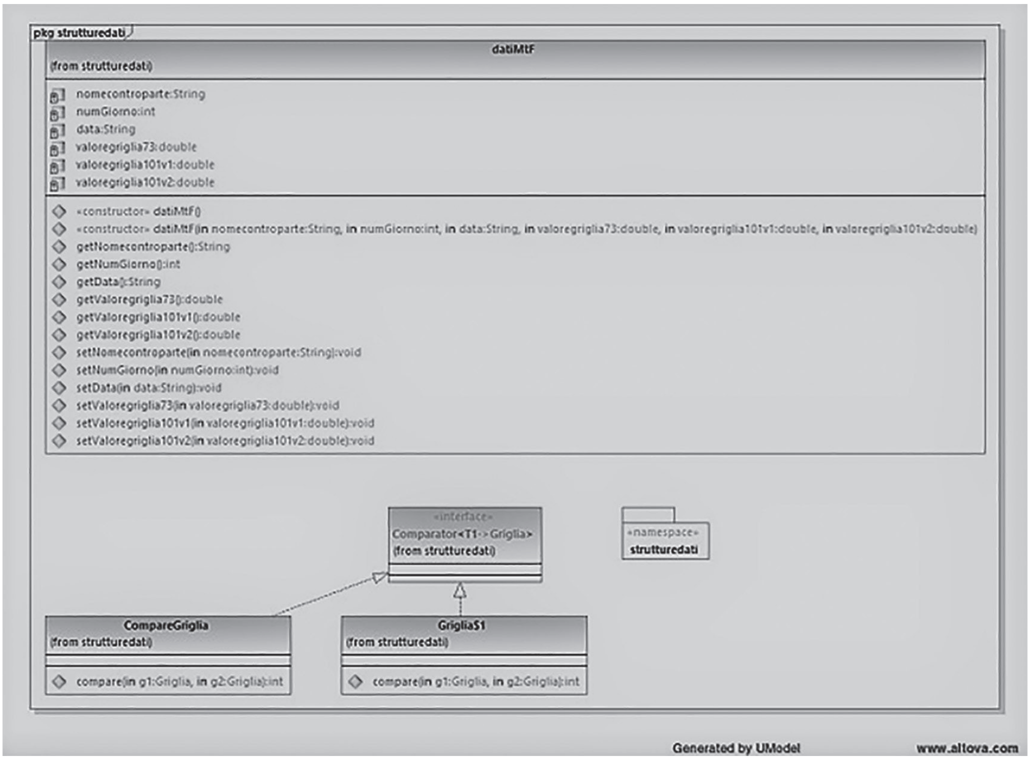

FIGURE 15.17 Content of strutturedati and all subpackages.

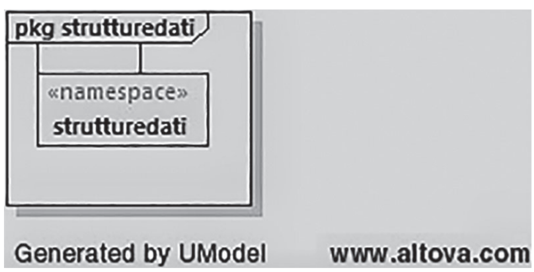

FIGURE 15.18 Content of strutturedati.

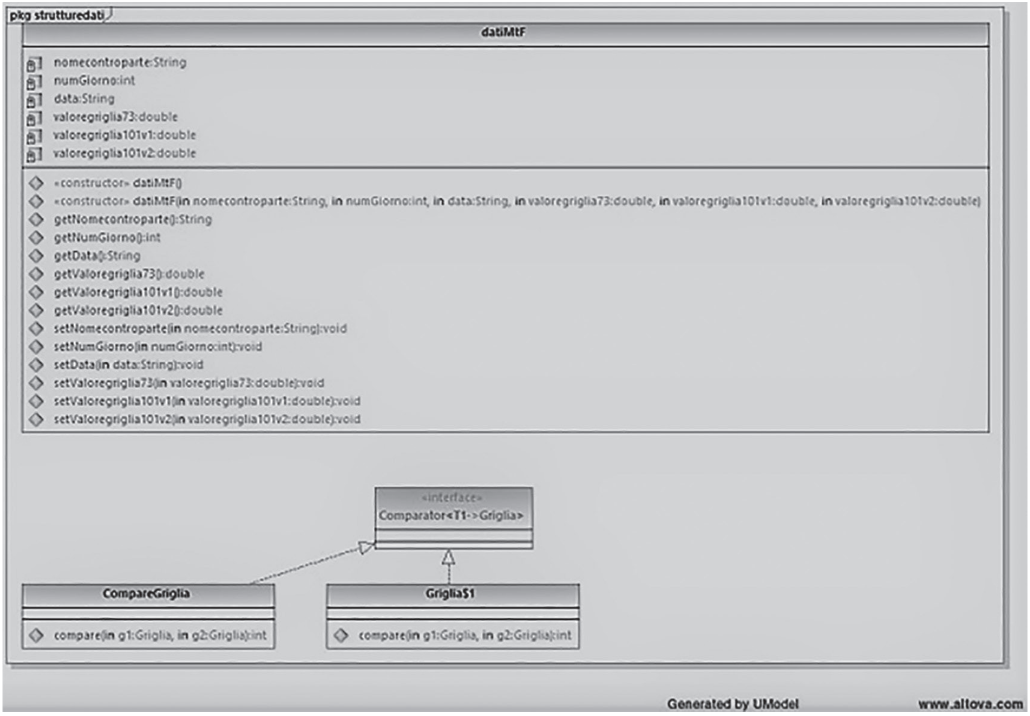

FIGURE 15.19 Content of strutturedati_1.

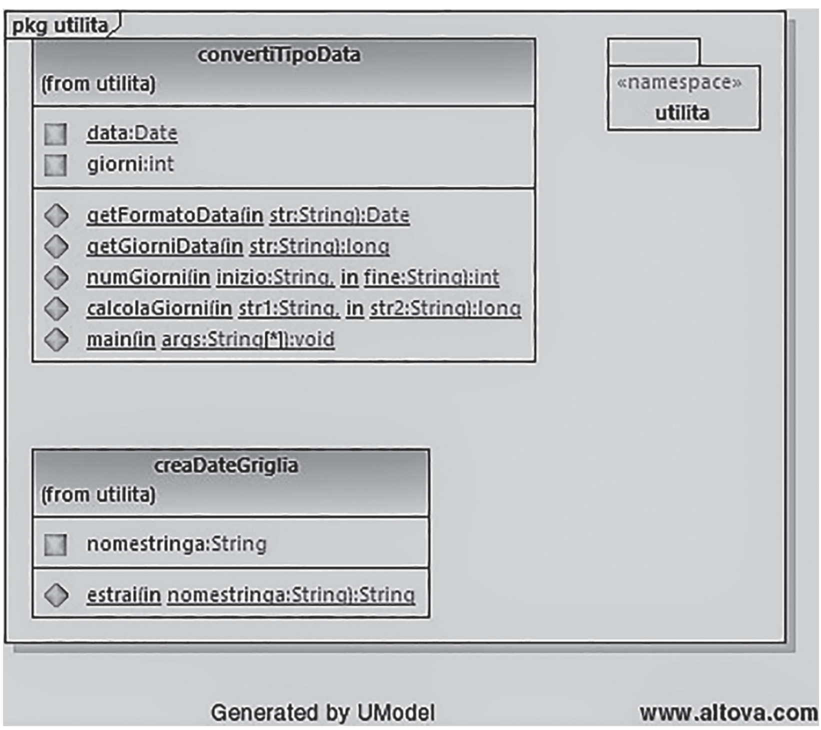

FIGURE 15.20 Content of utilita and all subpackages.

FIGURE 15.21 Content of utilita.

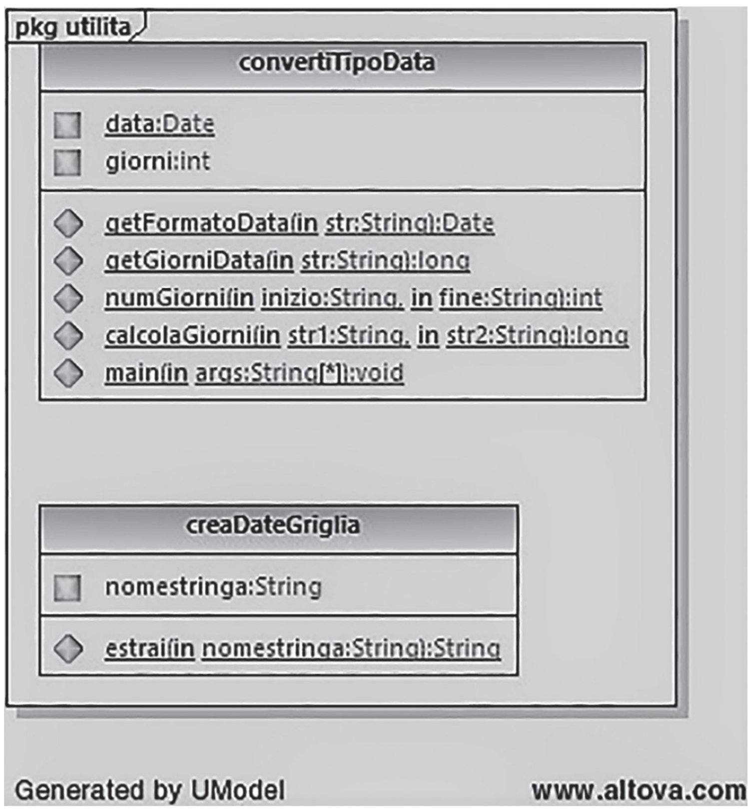

FIGURE 15.22 Content of utilita_1.

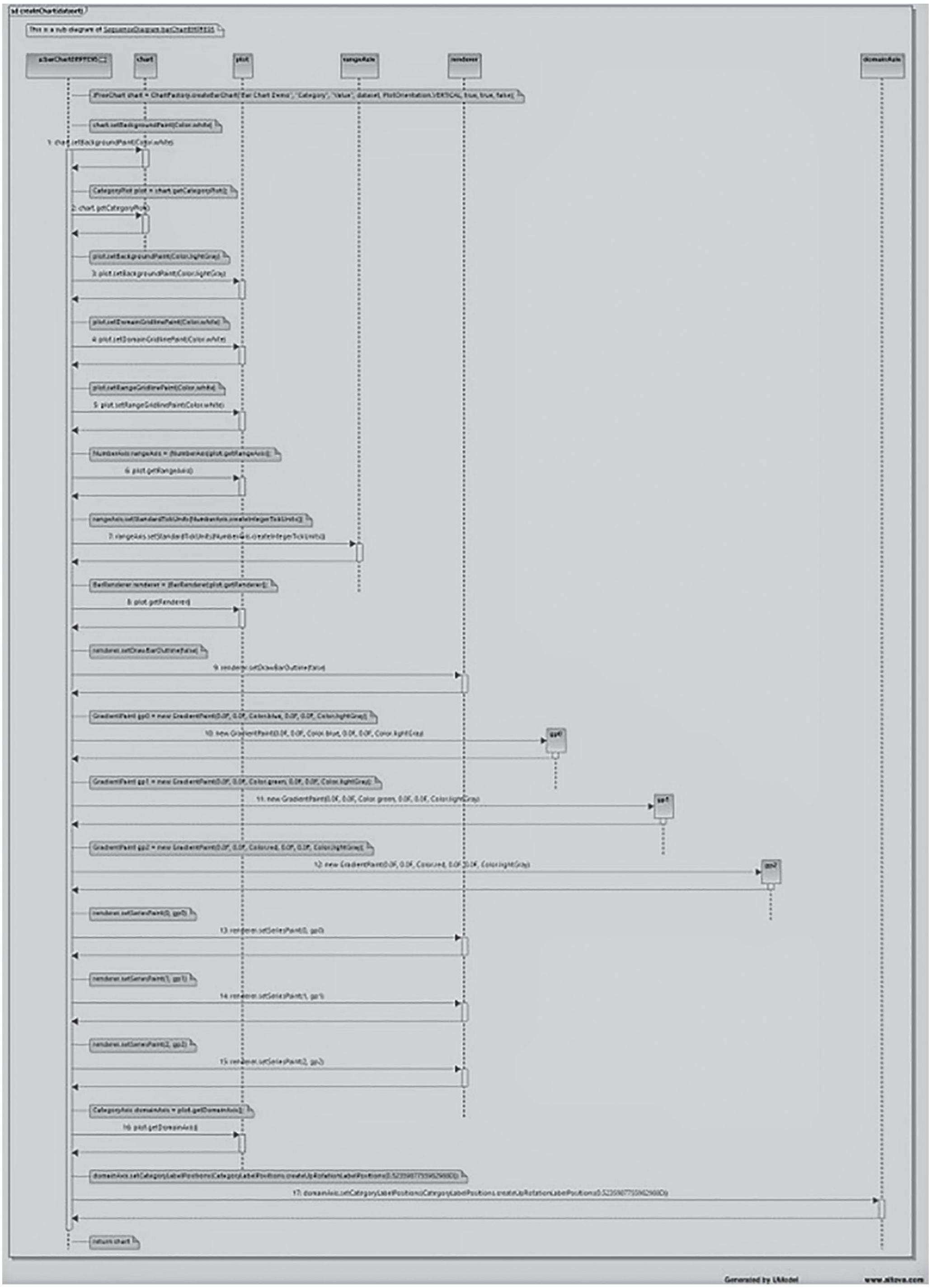

FIGURE 15.23 createChart(dataset).

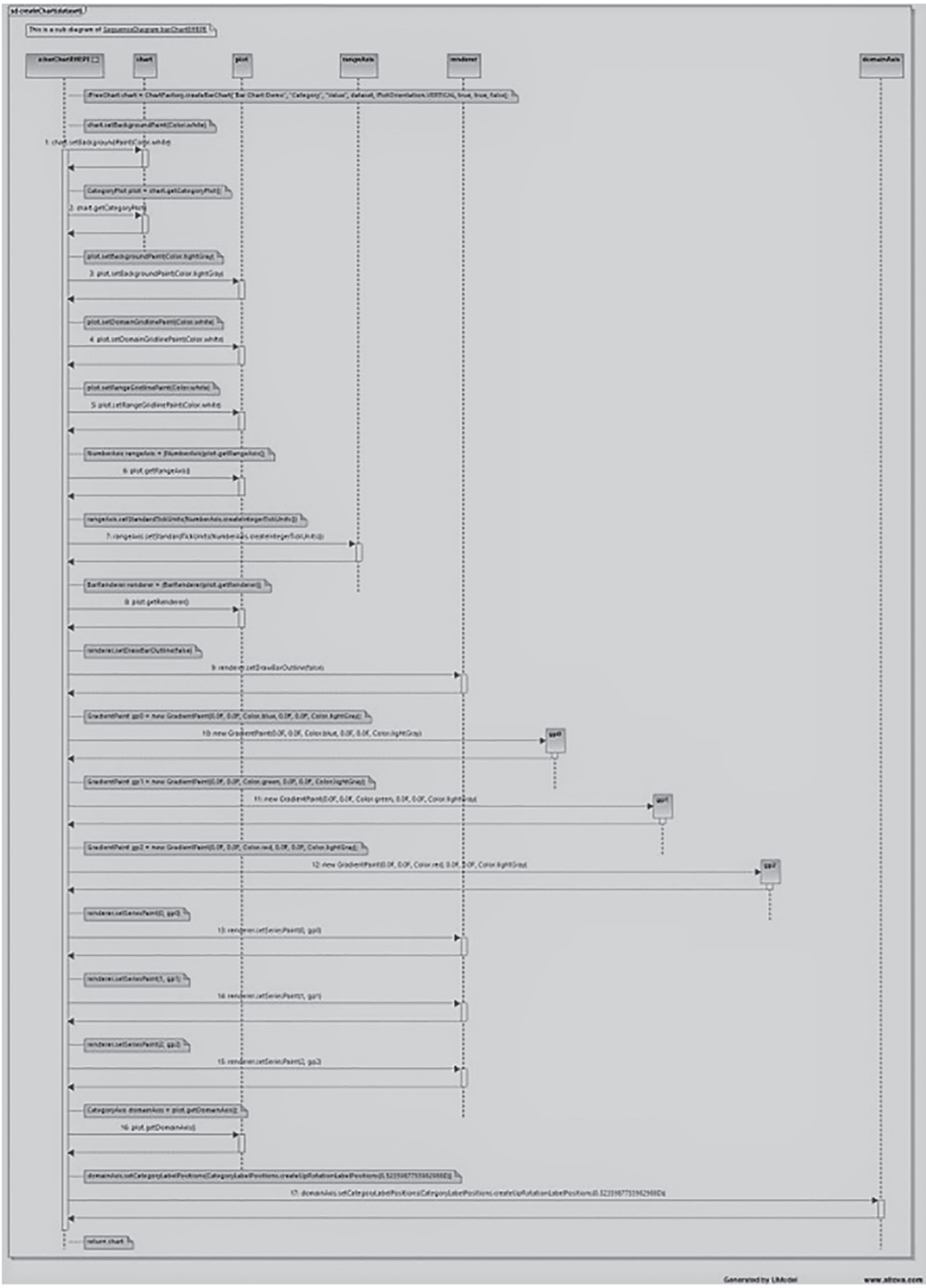

FIGURE 15.24 createChart(dataset)_1.

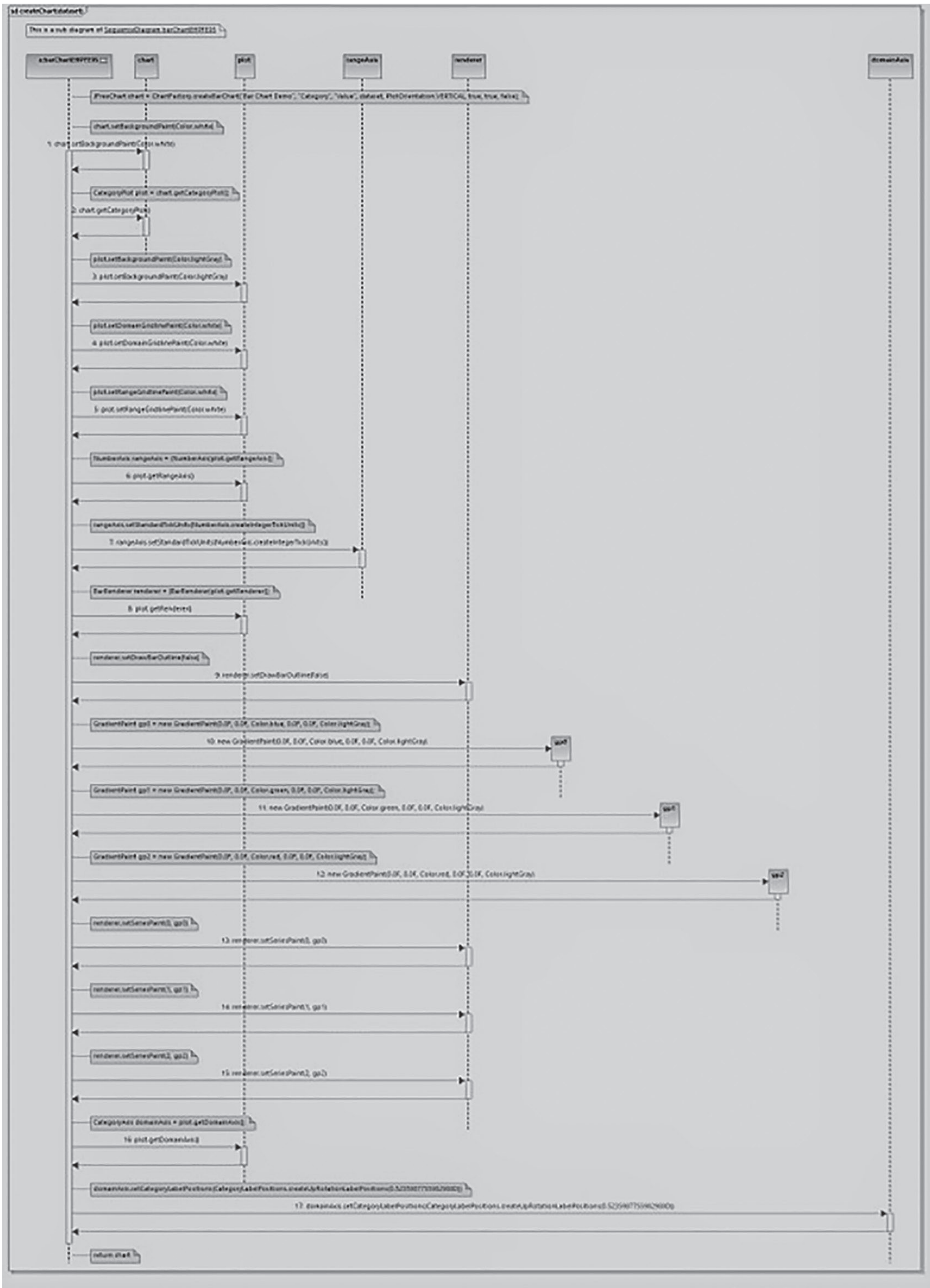

FIGURE 15.25 createChart(dataset)_2.

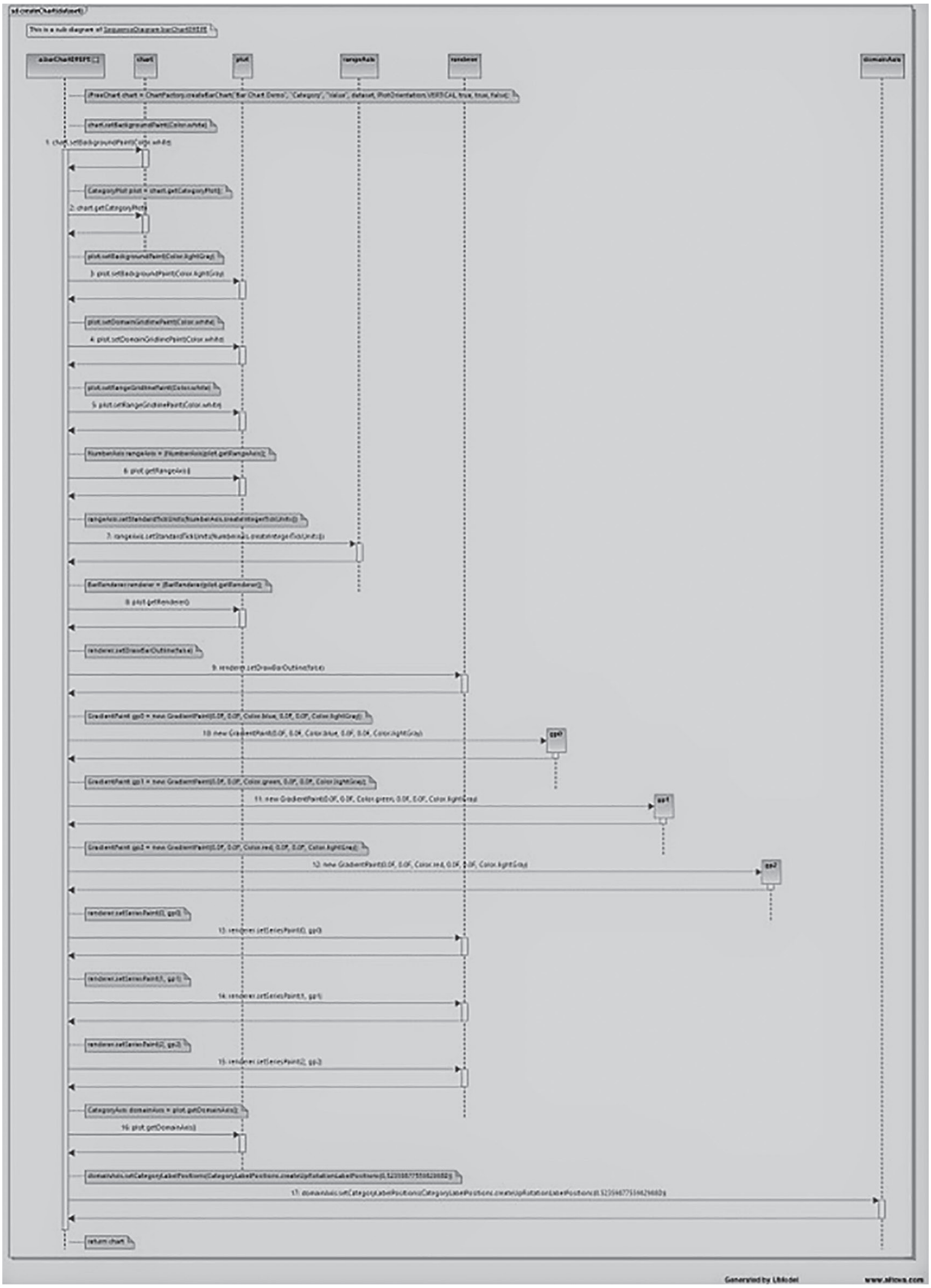

FIGURE 15.26 createChart(dataset)_3.

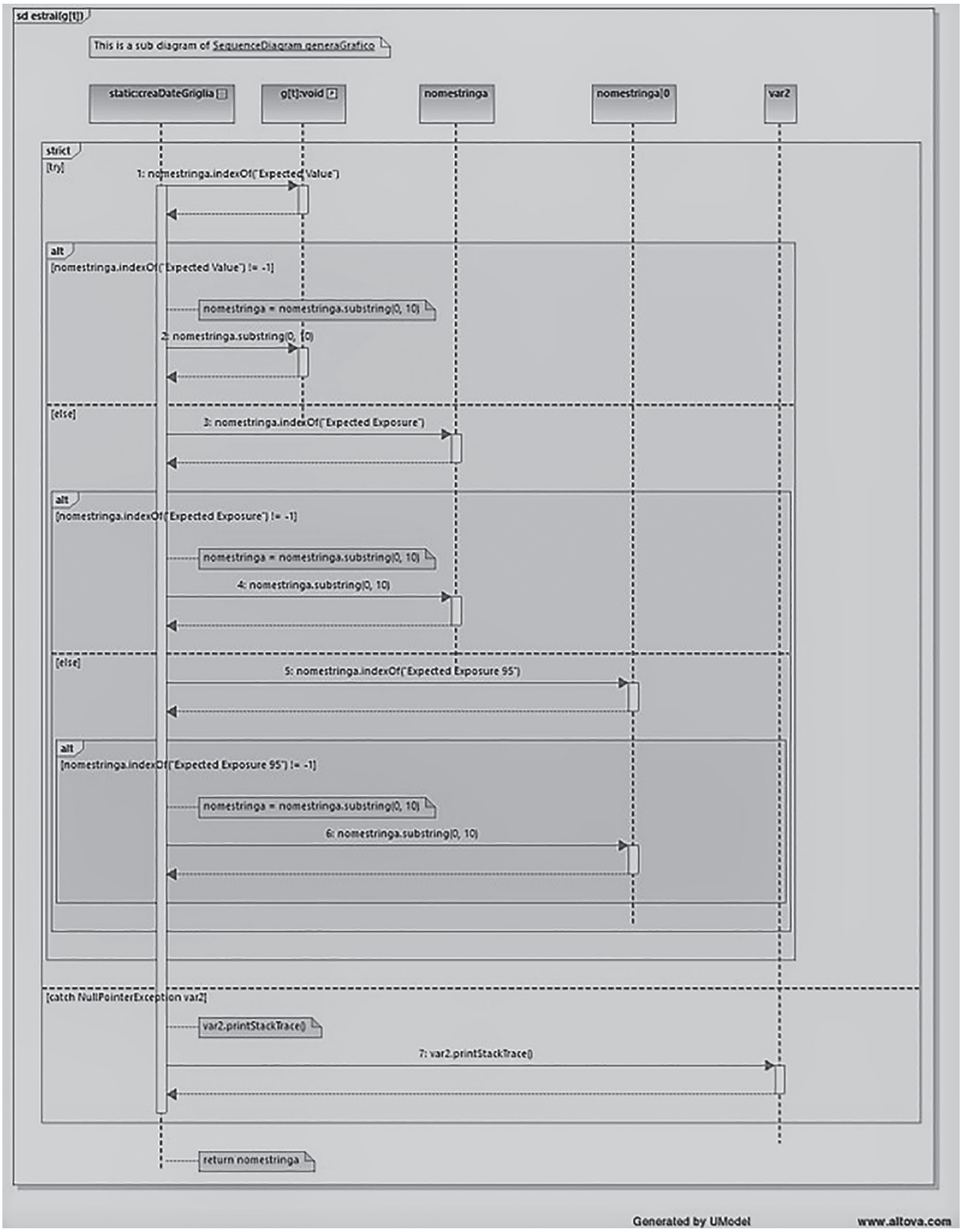

FIGURE 15.27 estrai(g[t]).

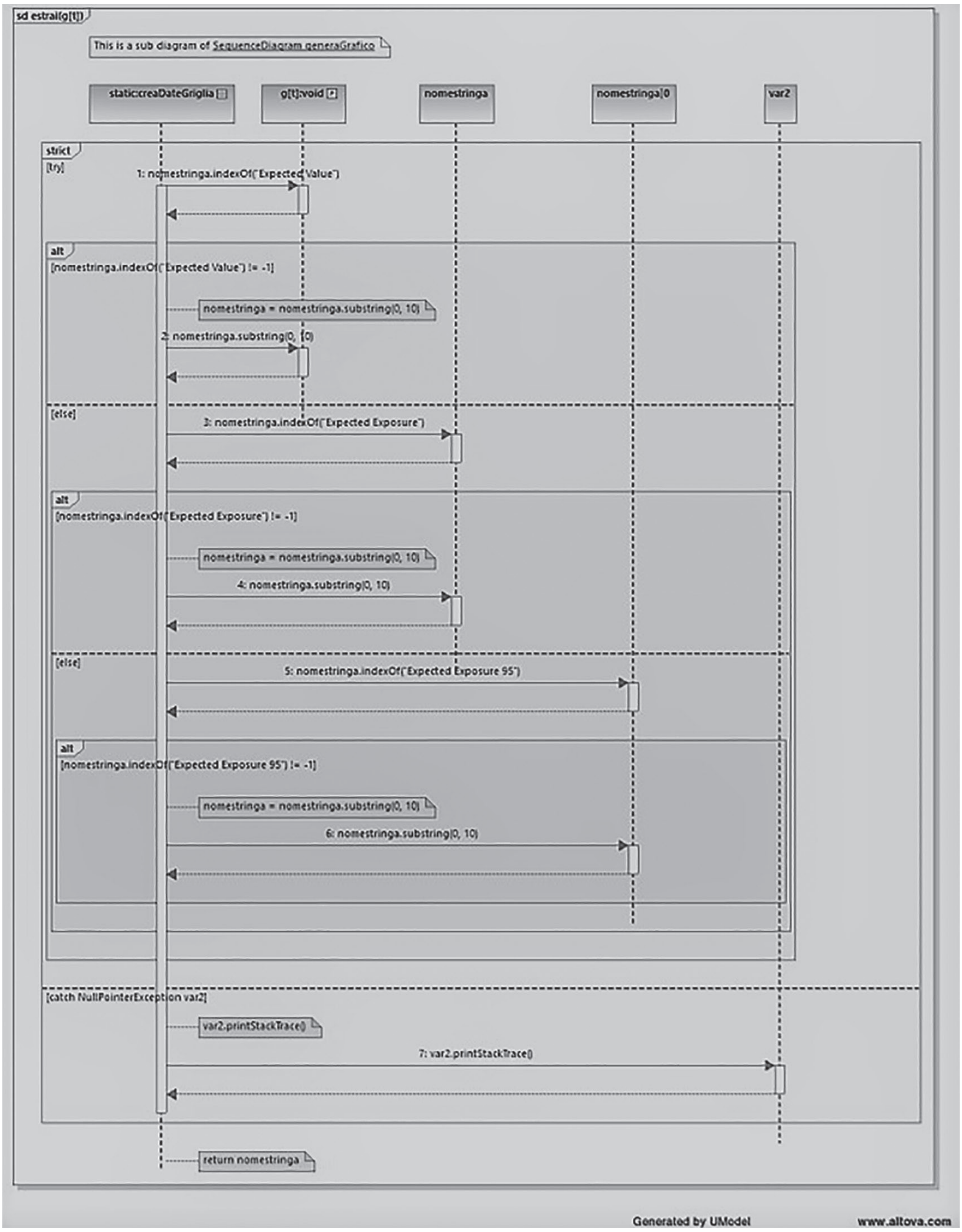

FIGURE 15.28 estrai(g[t])_1.

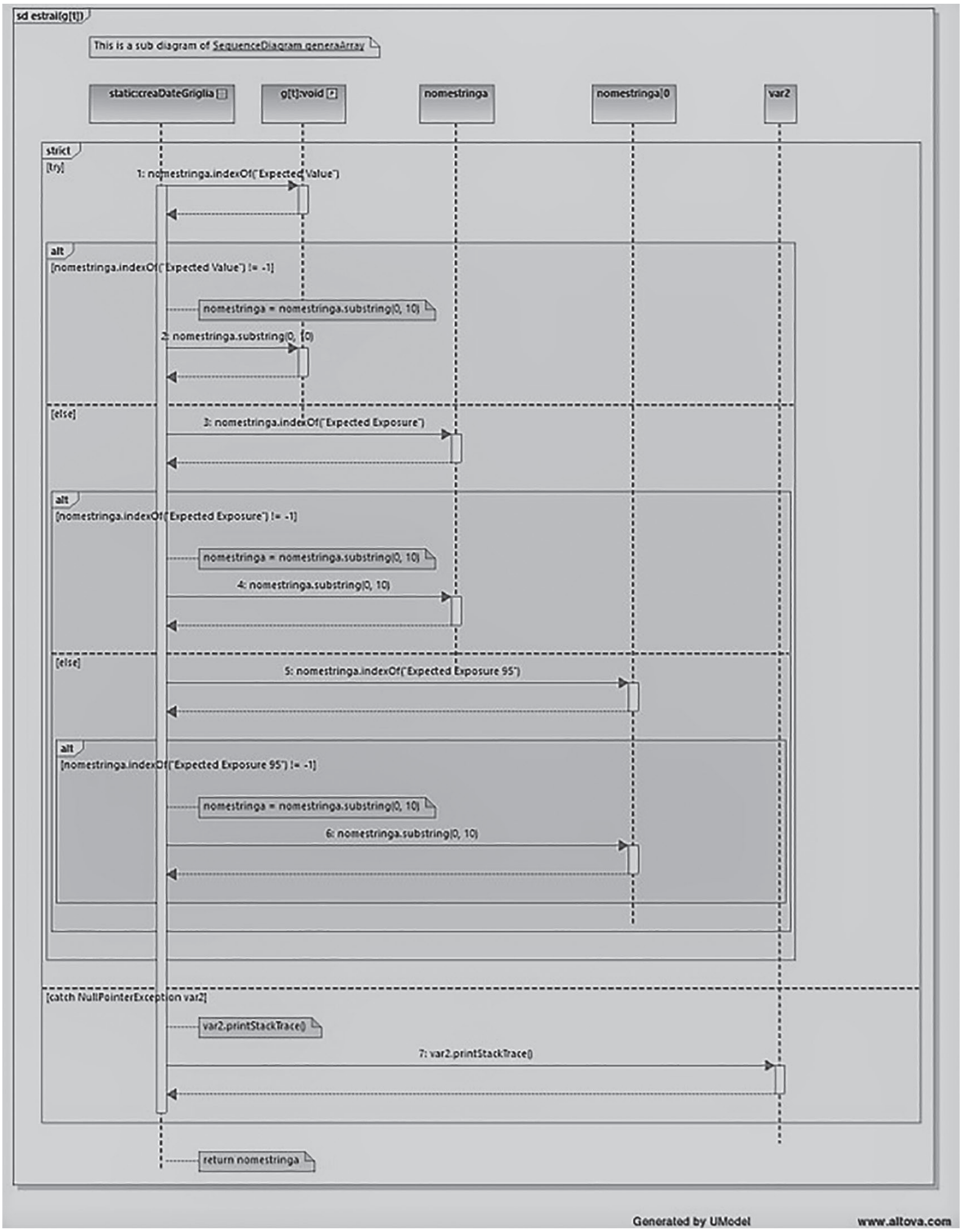

FIGURE 15.29 estrai(g[t])_2.

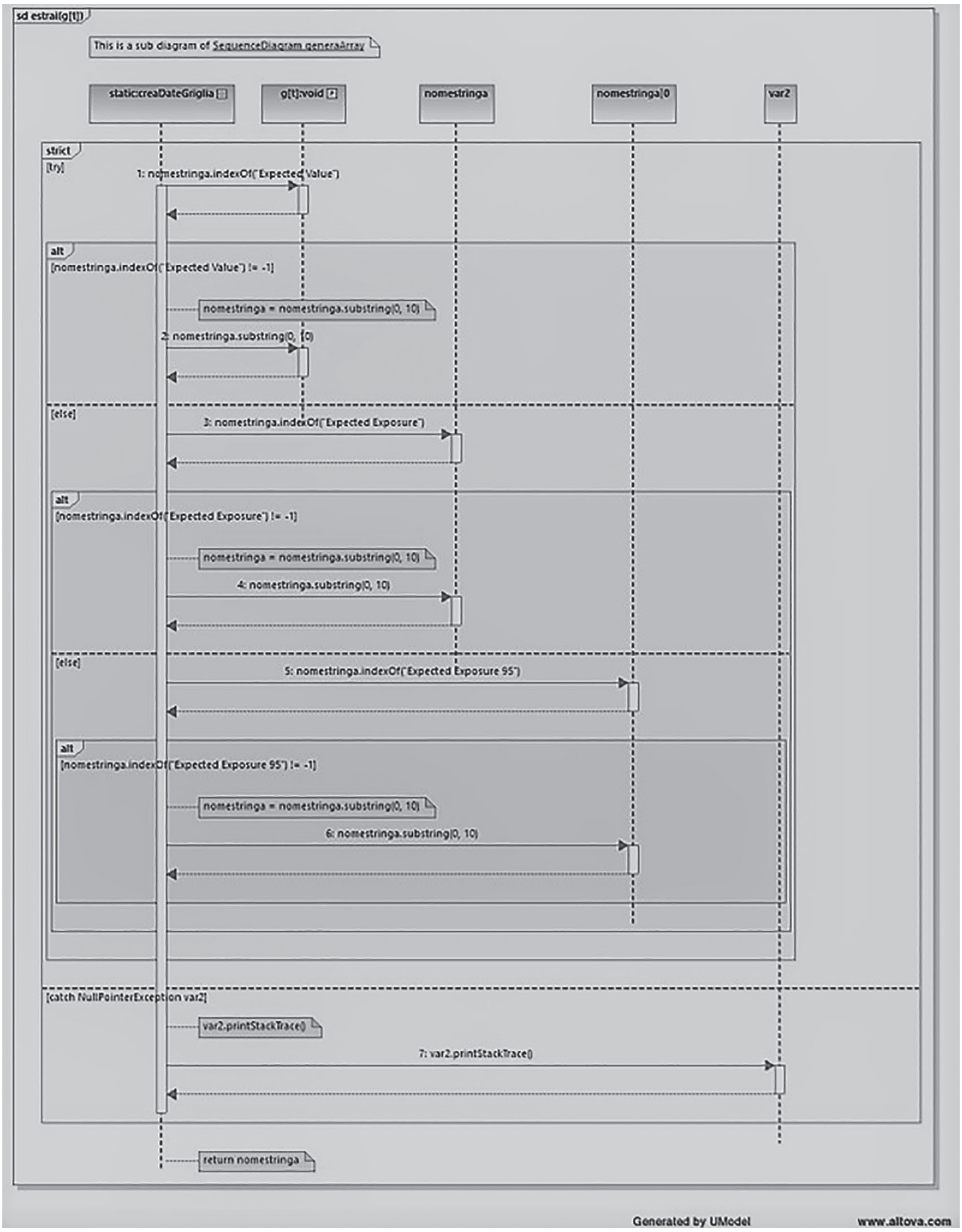

FIGURE 15.30 estrai(g[t])_3.

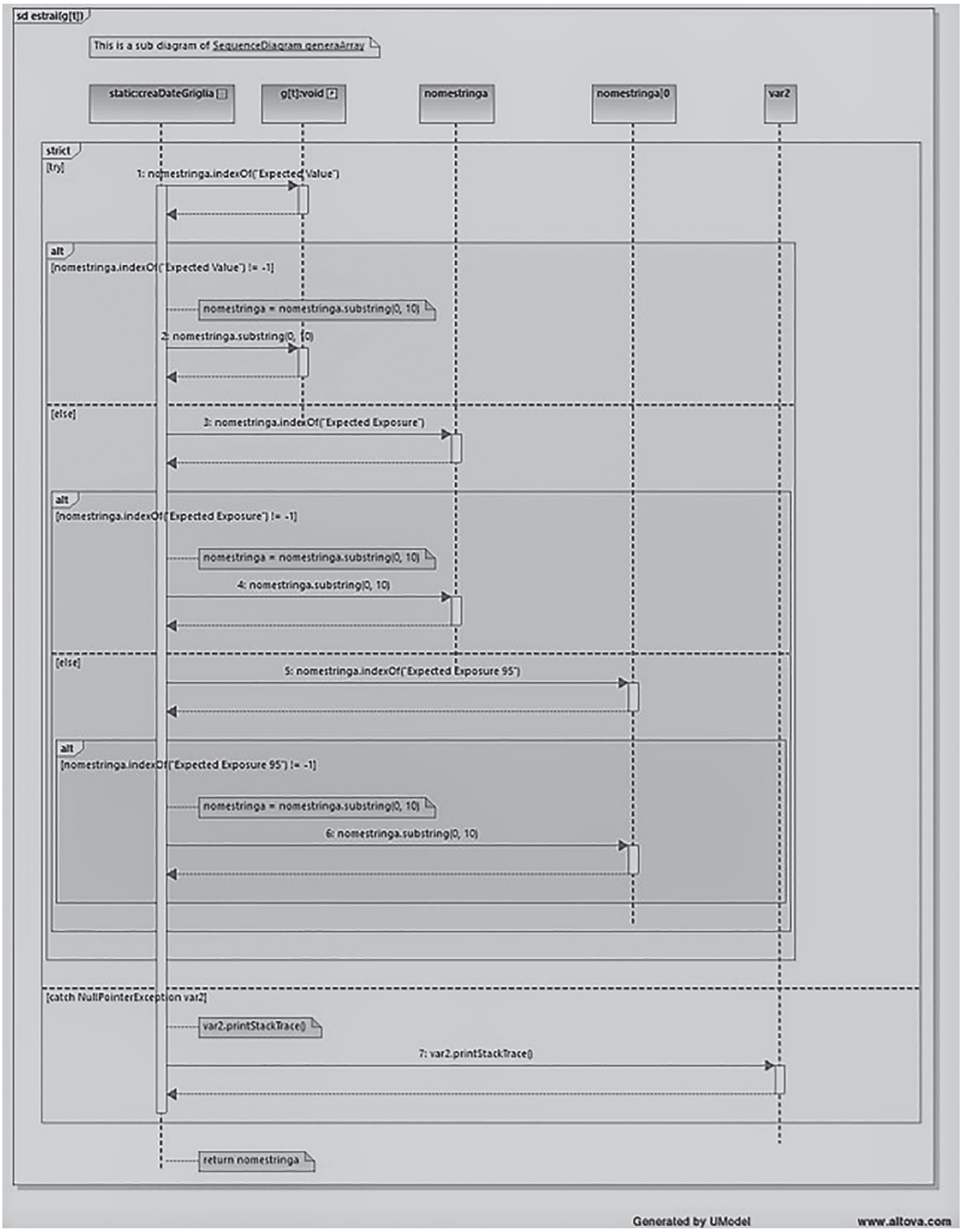

FIGURE 15.31 estrai(g[t])_4.

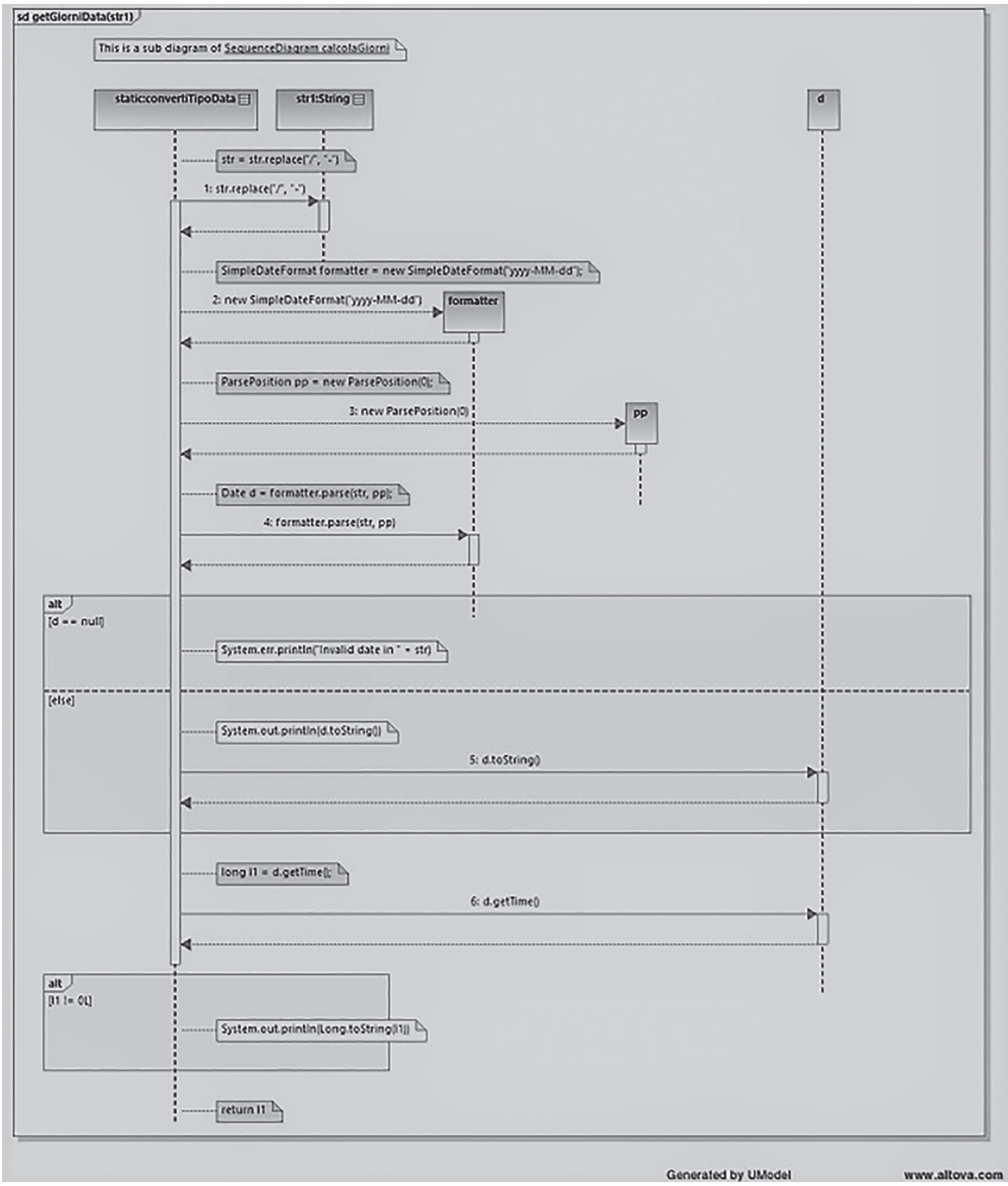

FIGURE 15.32 getGiorniData(str1).

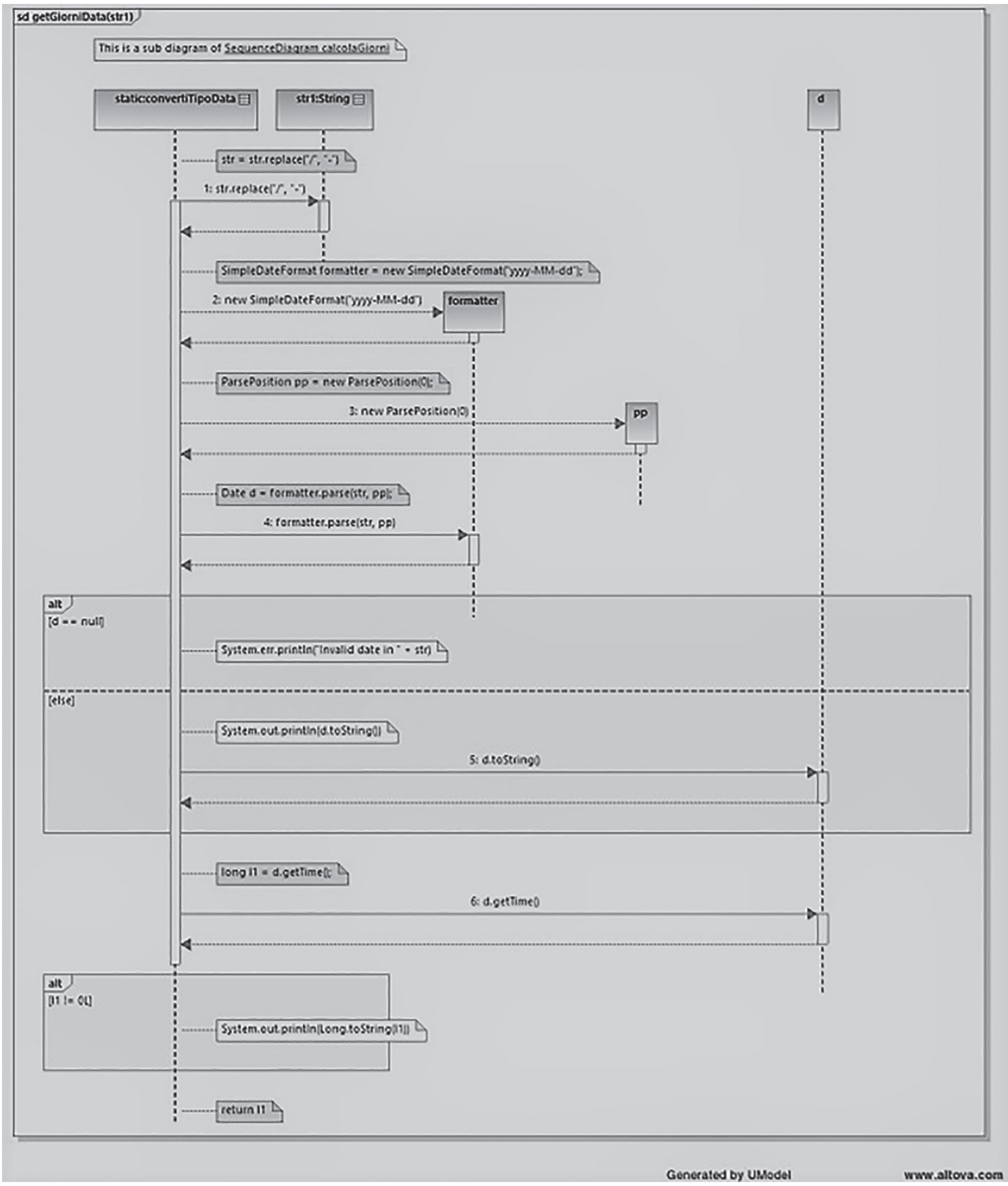

FIGURE 15.33 getGiorniData(str1)_1.

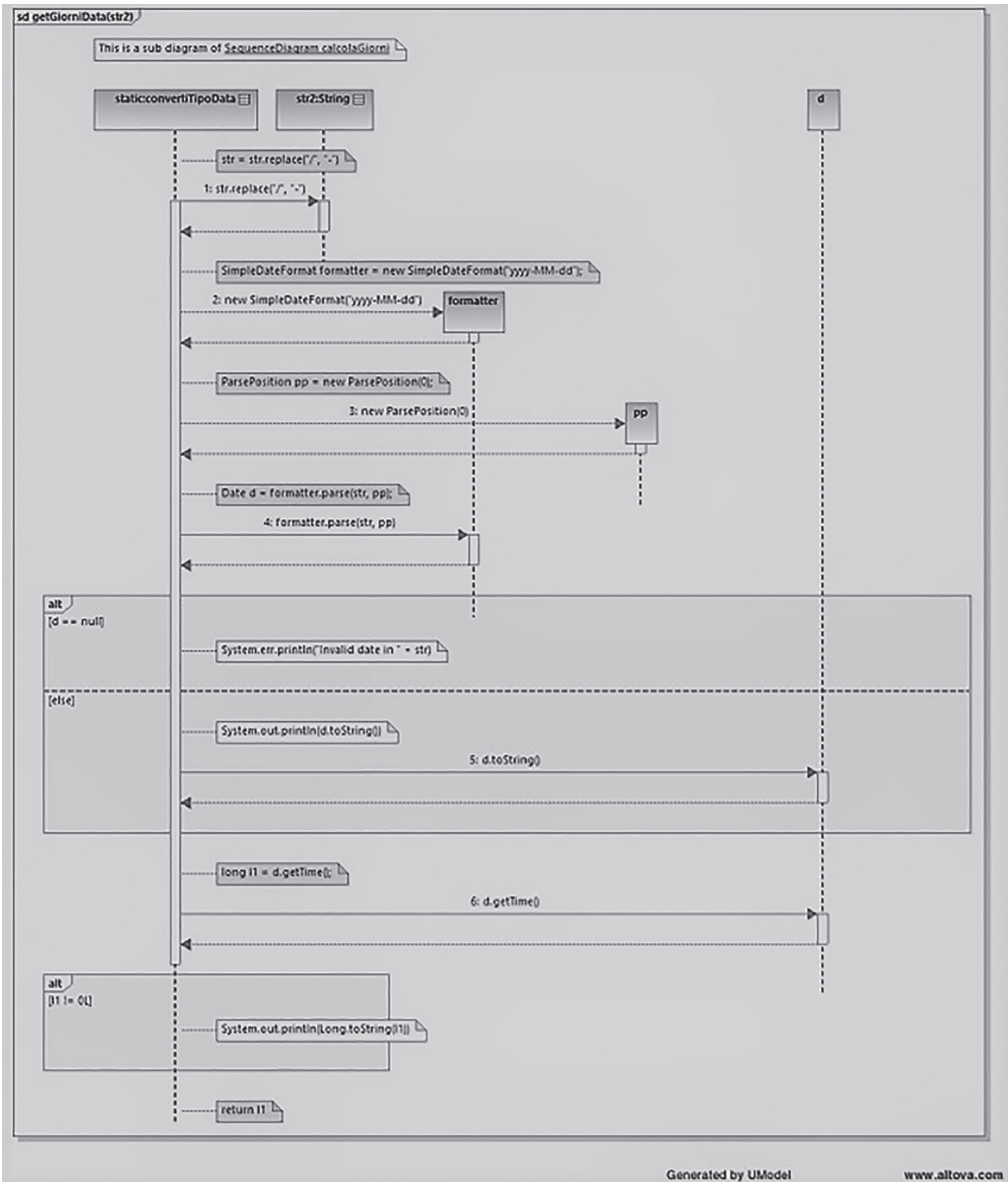

FIGURE 15.34 getGiorniData(str2).

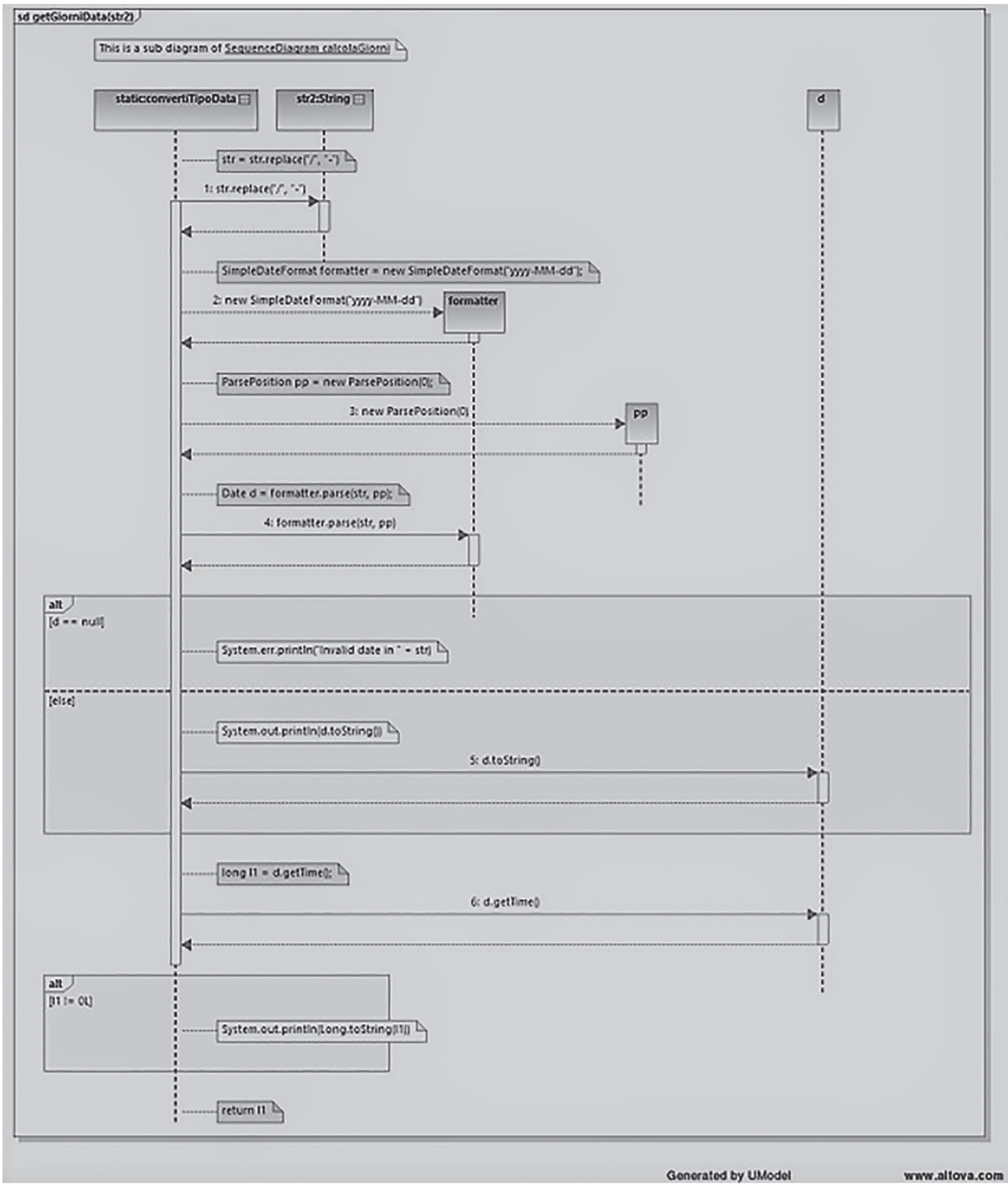

FIGURE 15.35 getGiorniData(str2)_1.

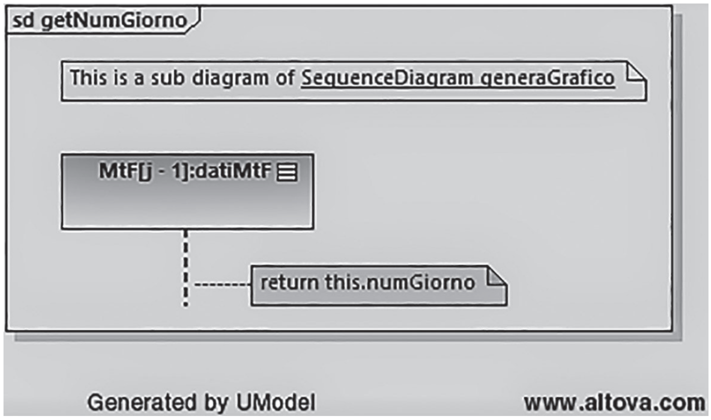

FIGURE 15.36 getNumGiorno.

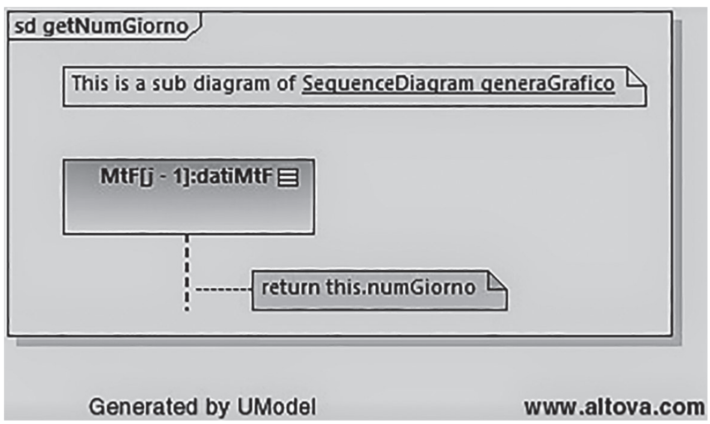

FIGURE 15.37 getNumGiorno_1.

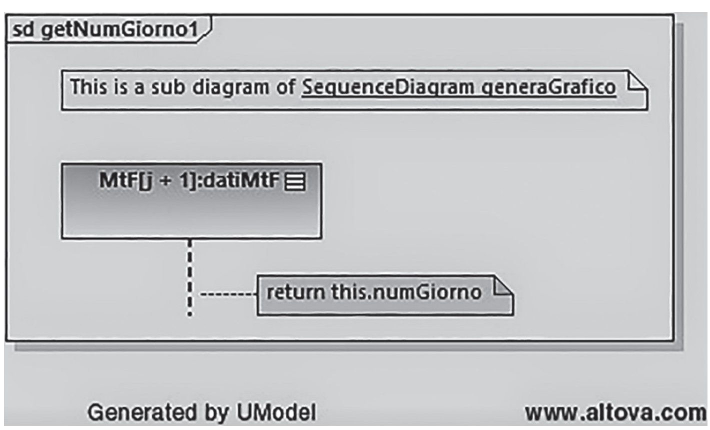

FIGURE 15.38 getNumGiorno1.

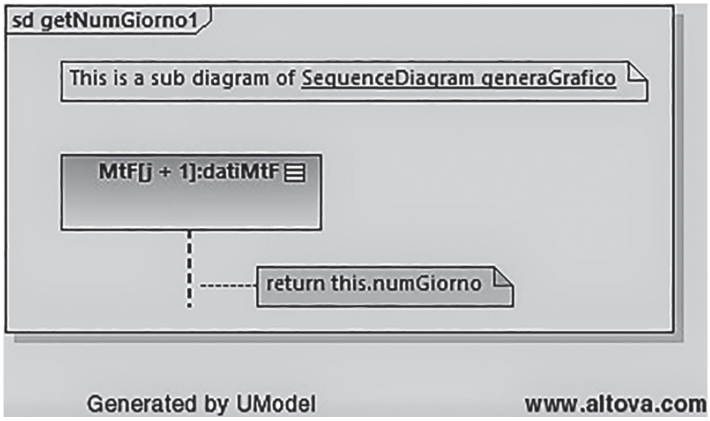

FIGURE 15.39 getNumGiorno1_1.

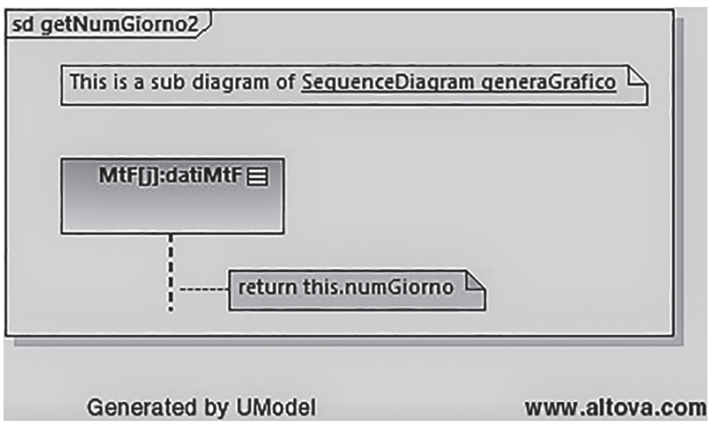

FIGURE 15.40 getNumGiorno2.

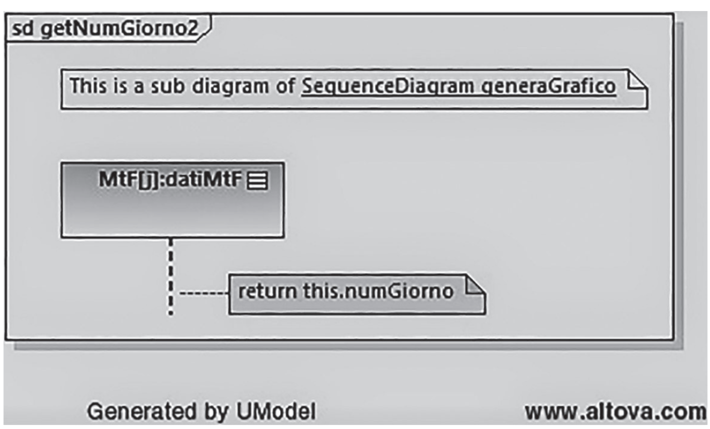

FIGURE 15.41 getNumGiorno2_1.

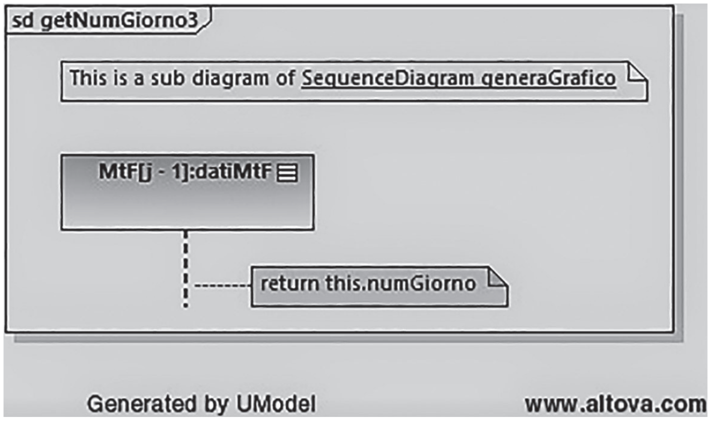

FIGURE 15.42 getNumGiorno3.

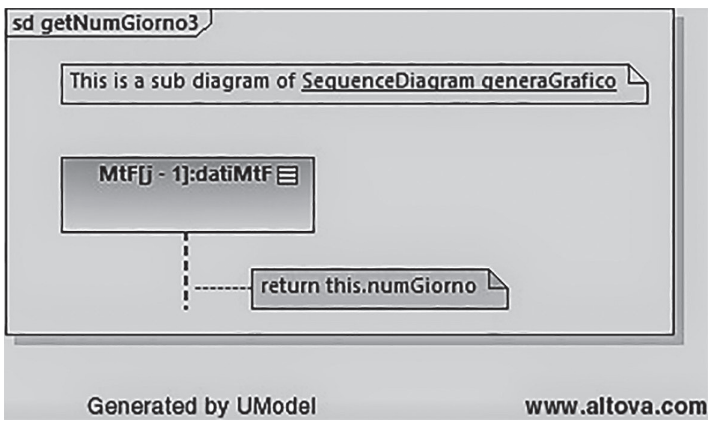

FIGURE 15.43 getNumGiorno3_1.

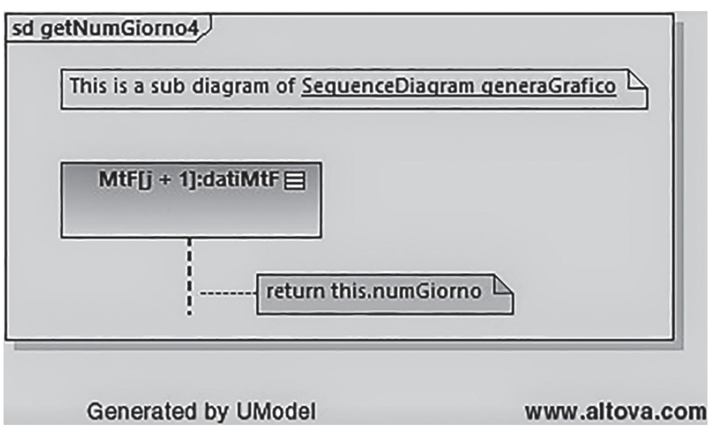

FIGURE 15.44 getNumGiorno4.

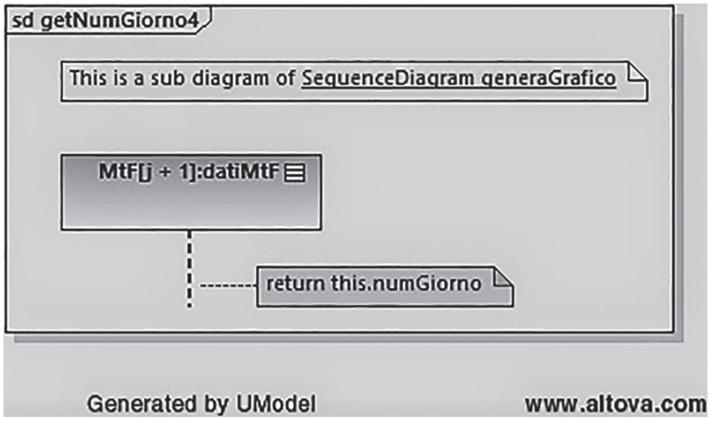

FIGURE 15.45 getNumGiorno4_1.

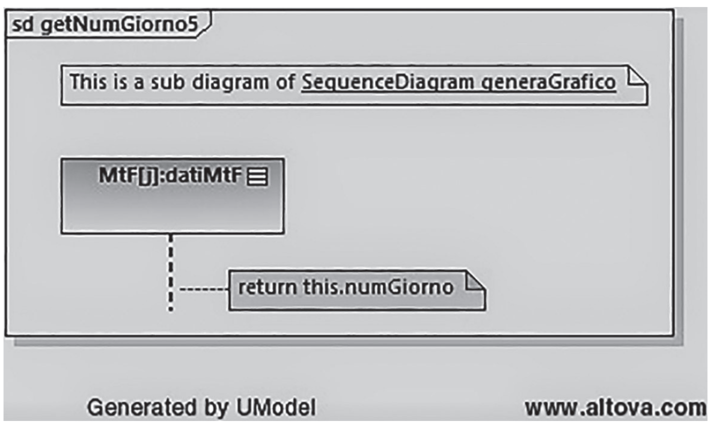

FIGURE 15.46 getNumGiorno5.

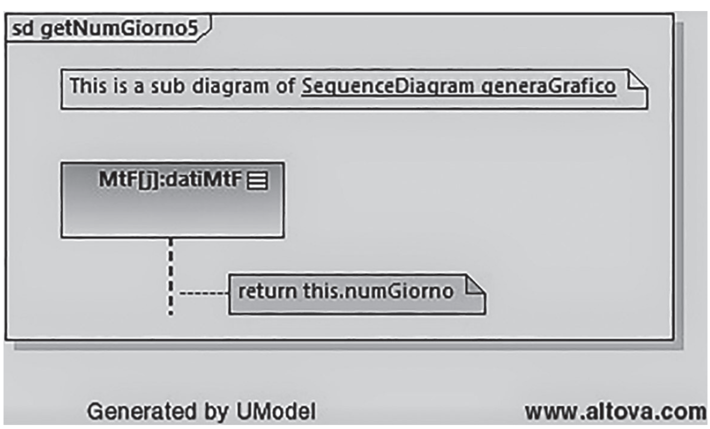

FIGURE 15.47 getNumGiorno5_1.

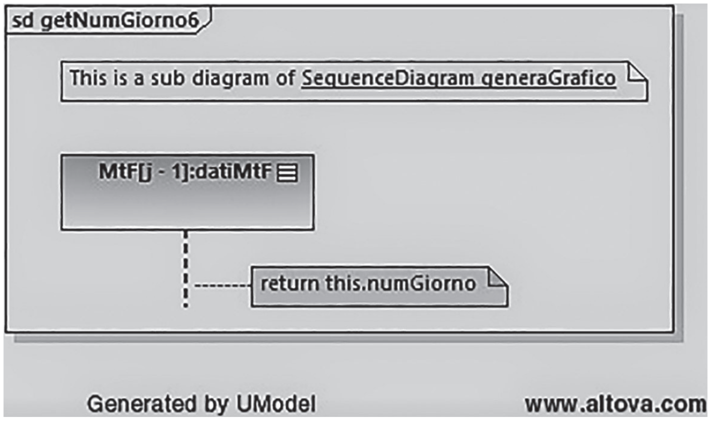

FIGURE 15.48 getNumGiorno6.

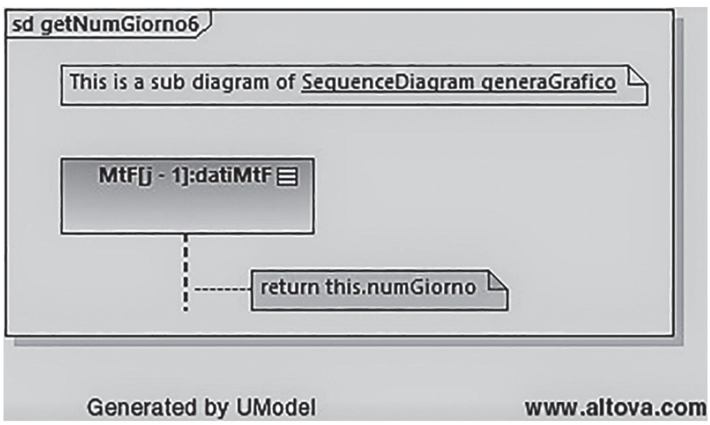

FIGURE 15.49 getNumGiorno6_1.

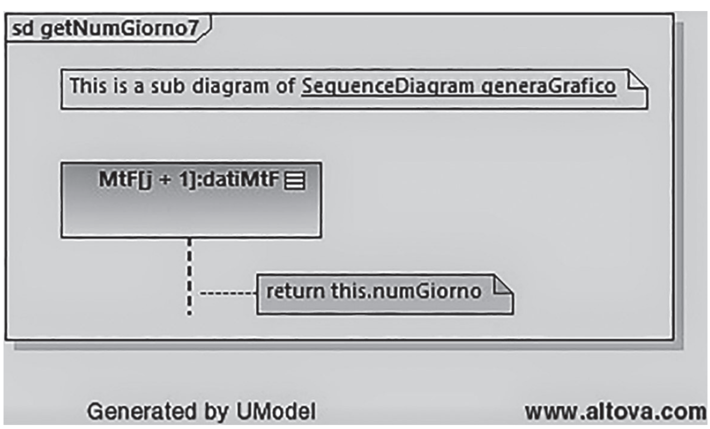

FIGURE 15.50 getNumGiorno7.

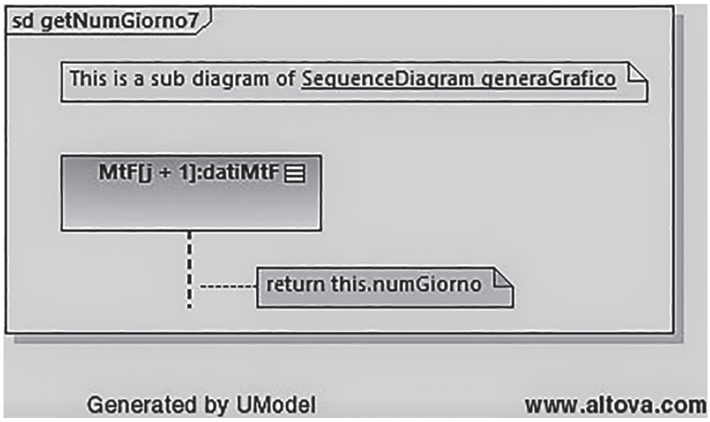

FIGURE 15.51 getNumGiorno7_1.

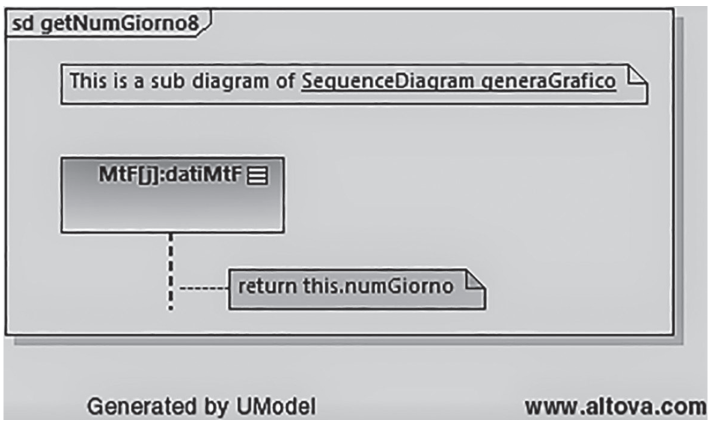

FIGURE 15.52 getNumGiorno8.

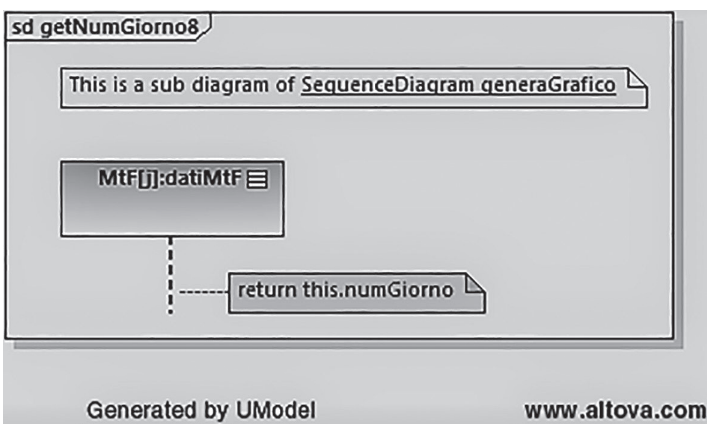

FIGURE 15.53 getNumGiorno8_1.

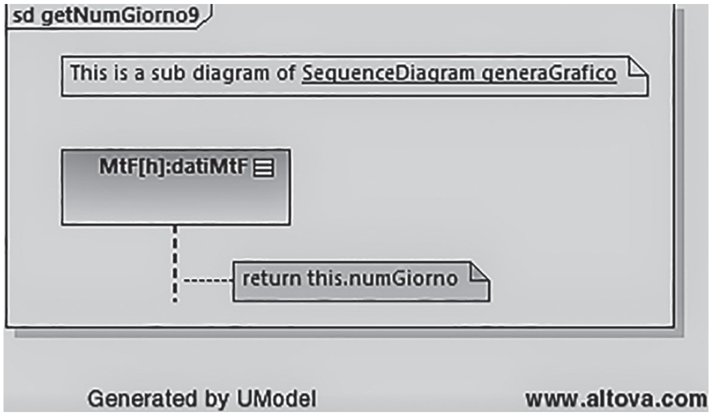

FIGURE 15.54 getNumGiorno9.

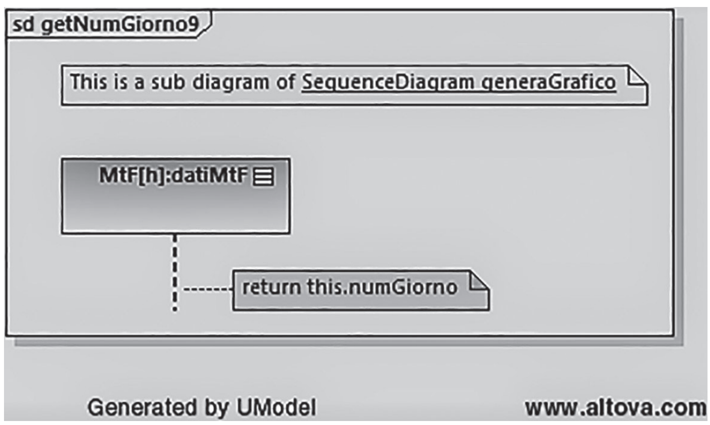

FIGURE 15.55 getNumGiorno9_1.

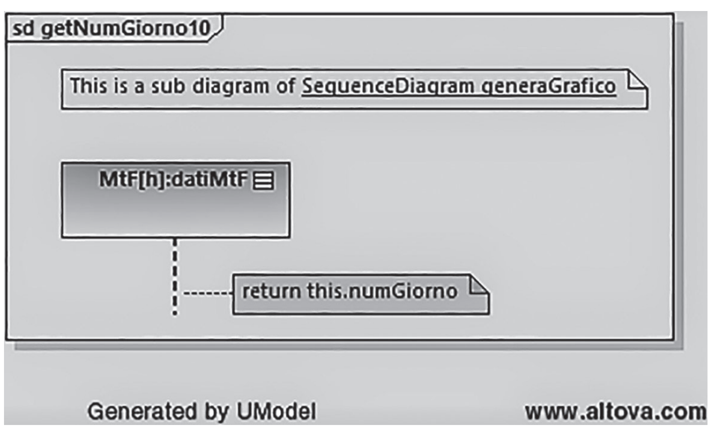

FIGURE 15.56 getNumGiorno10.

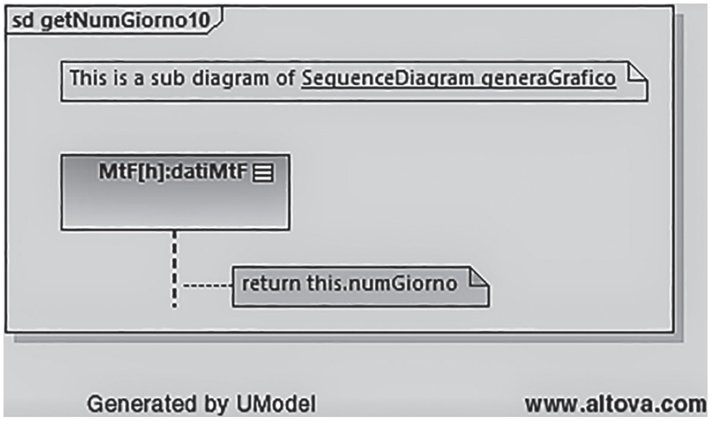

FIGURE 15.57 getNumGiorno10_1.

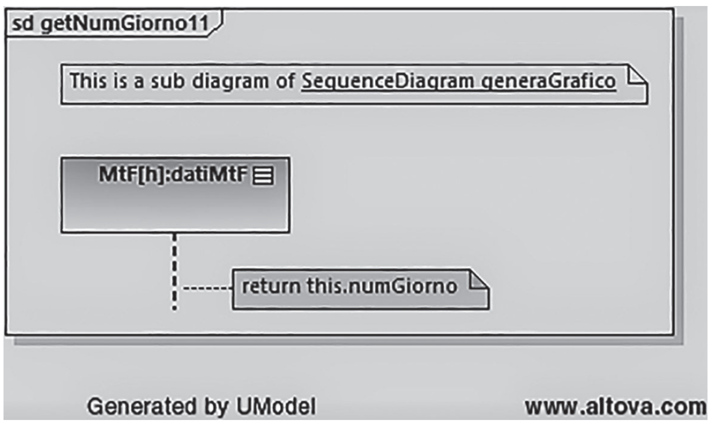

FIGURE 15.58 getNumGiorno11.

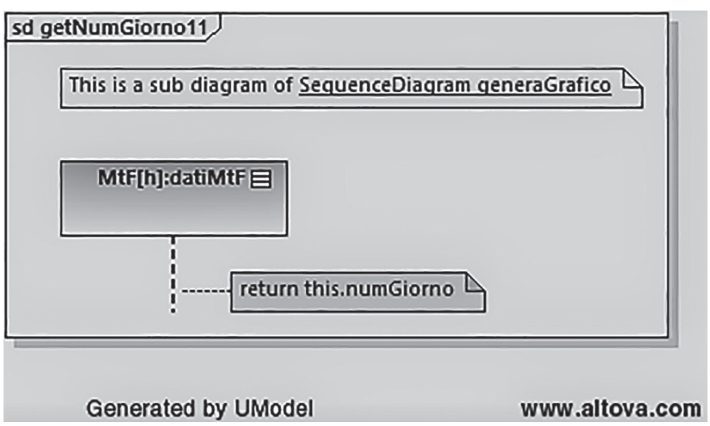

FIGURE 15.59 getNumGiorno11_1.

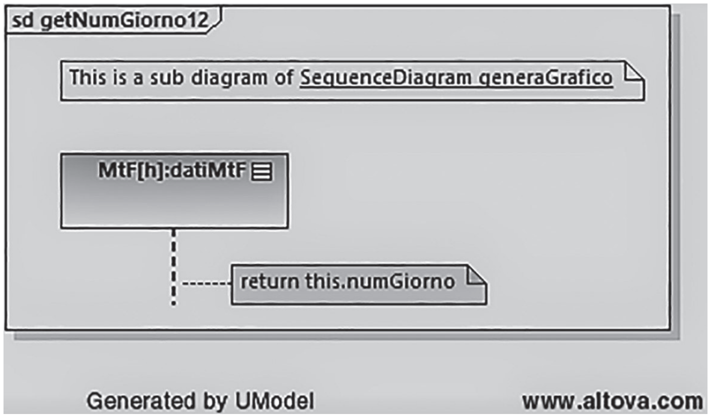

FIGURE 15.60 getNumGiorno12.

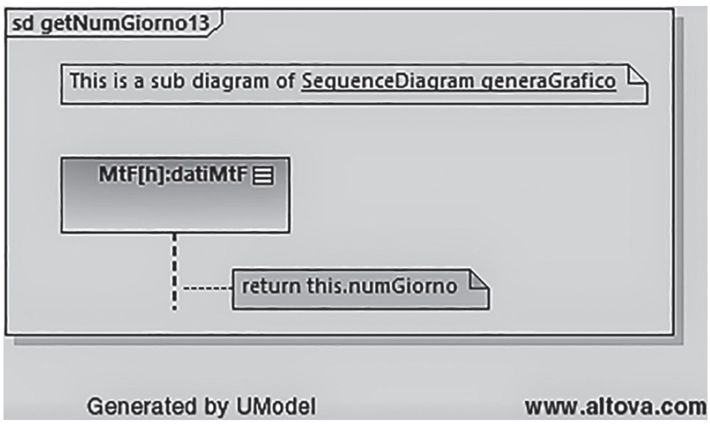

FIGURE 15.61 getNumGiorno13.

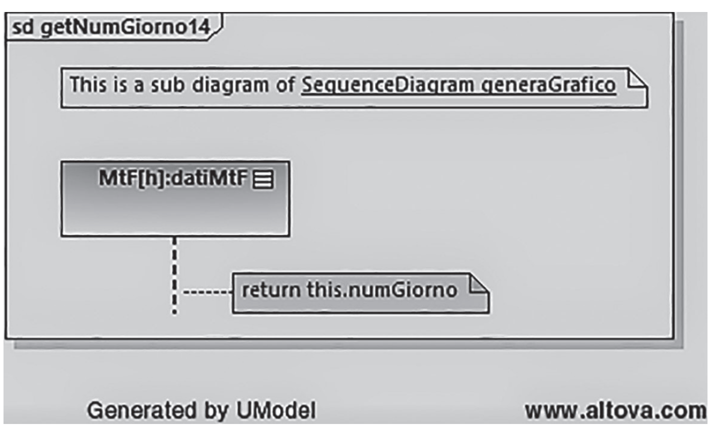

FIGURE 15.62 getNumGiorno14.

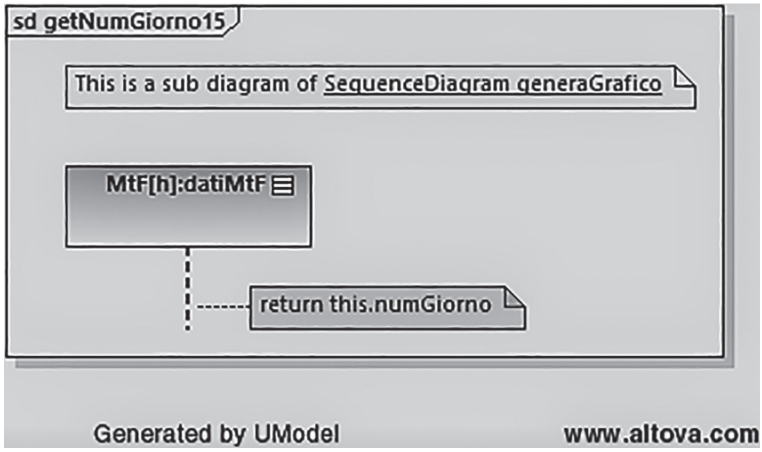

FIGURE 15.63 getNumGiorno15.

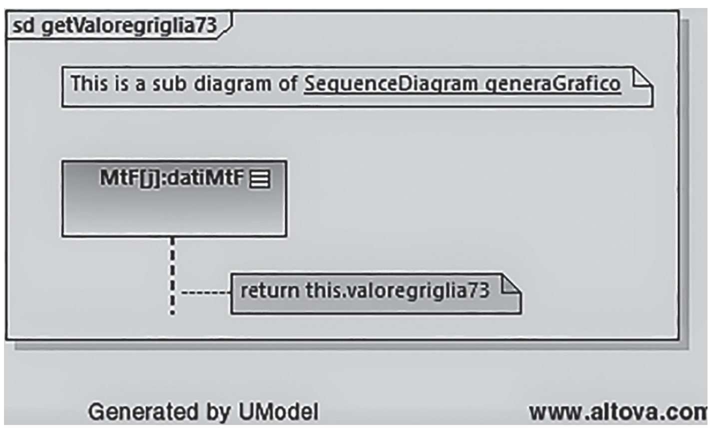

FIGURE 15.64 getValoregriglia73.

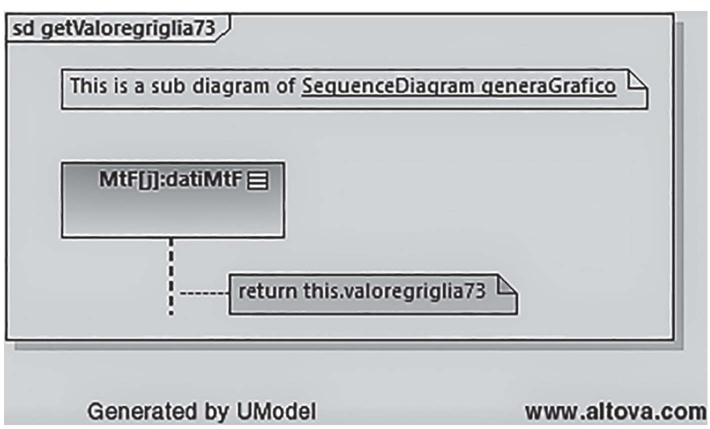

FIGURE 15.65 getValoregriglia73_1.

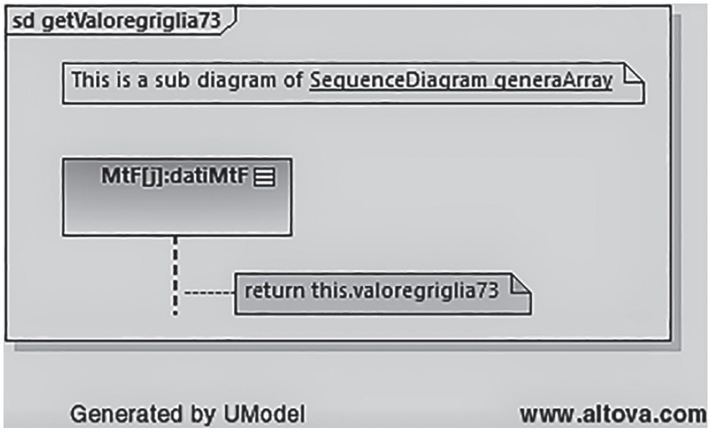

FIGURE 15.66 getValoregriglia73_2.

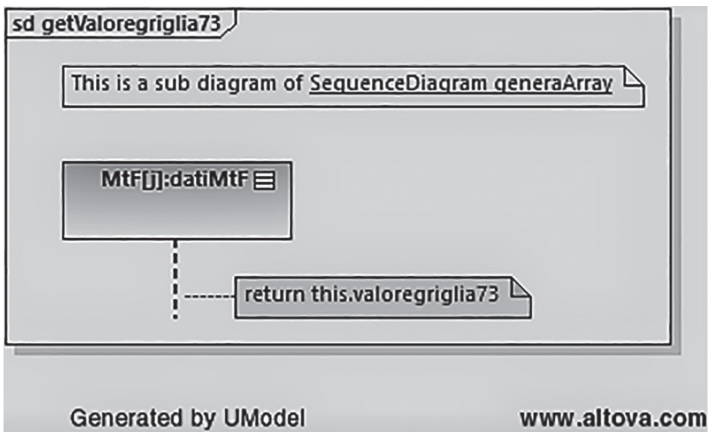

FIGURE 15.67 getValoregriglia73_3.

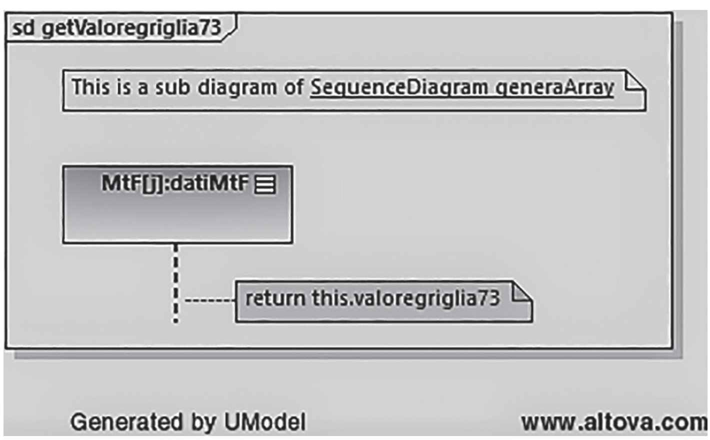

FIGURE 15.68 getValoregriglia73_4.

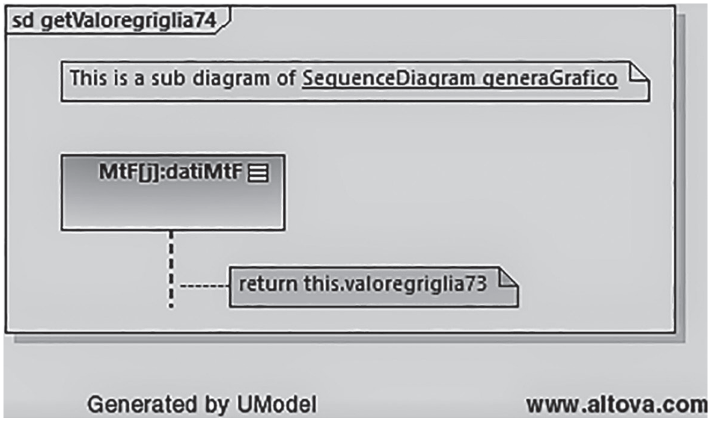

FIGURE 15.69 getValoregriglia74.

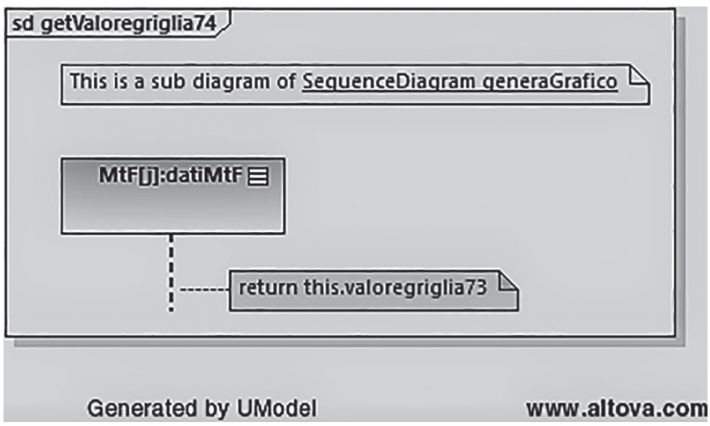

FIGURE 15.70 getValoregriglia74_1.

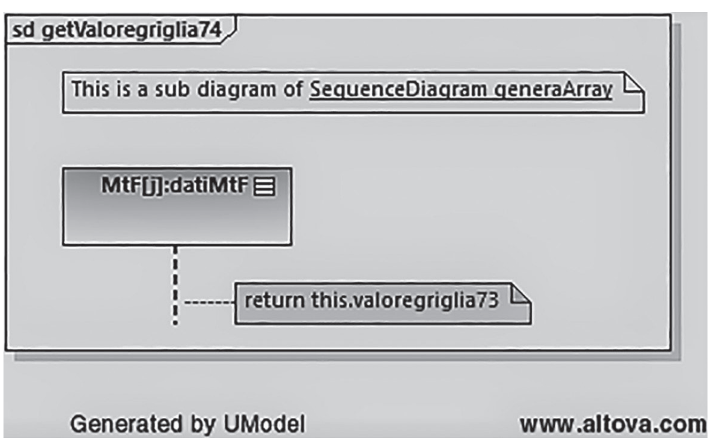

FIGURE 15.71 getValoregriglia74_2.

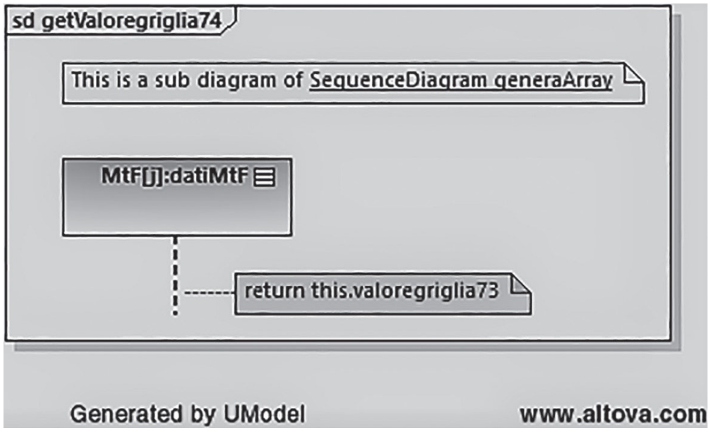

FIGURE 15.72 getValoregriglia74_3.

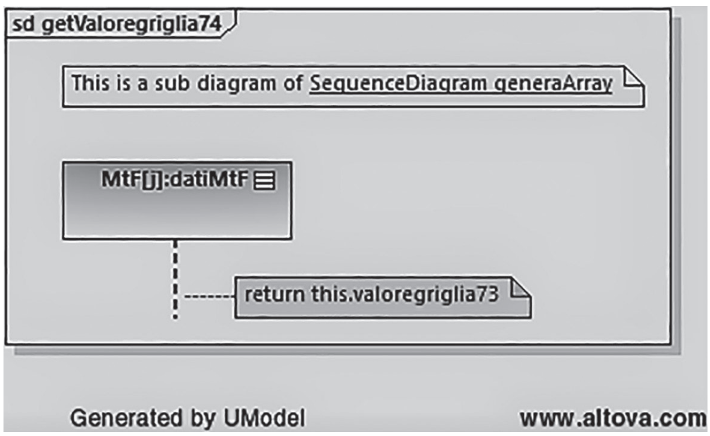

FIGURE 15.73 getValoregriglia74_4.

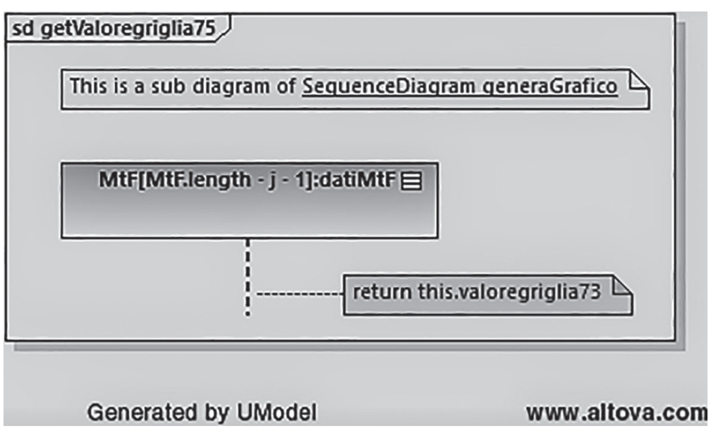

FIGURE 15.74 getValoregriglia75.

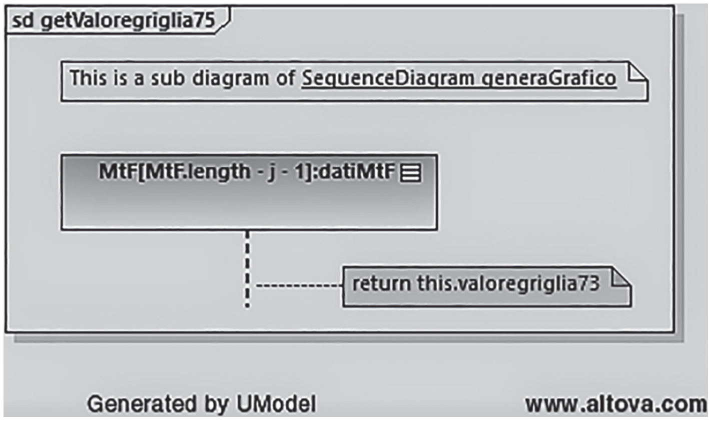

FIGURE 15.75 getValoregriglia75_1.

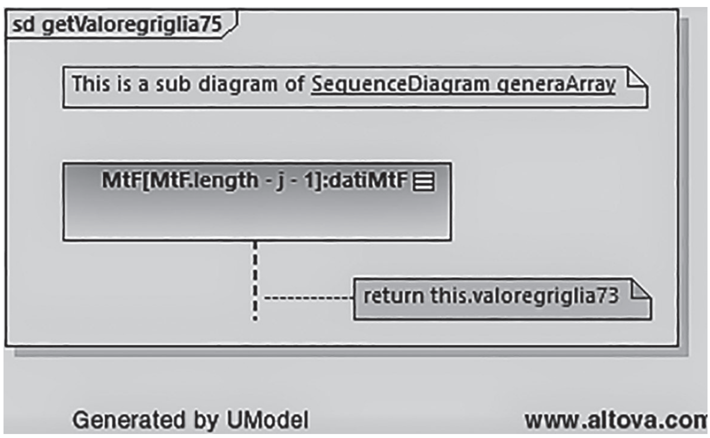

FIGURE 15.76 getValoregriglia75_2.

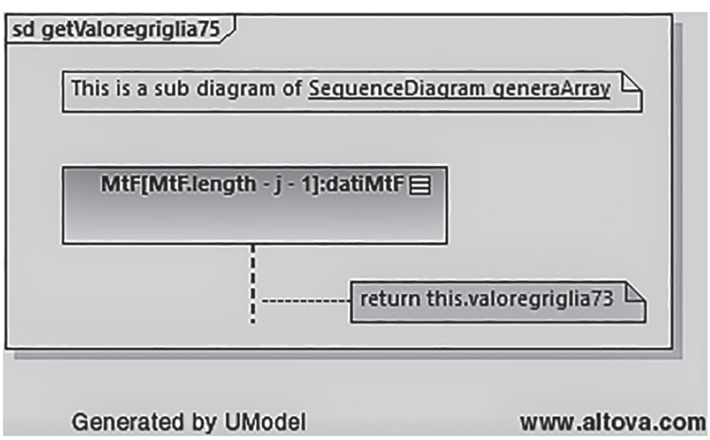

FIGURE 15.77 getValoregriglia75_3.

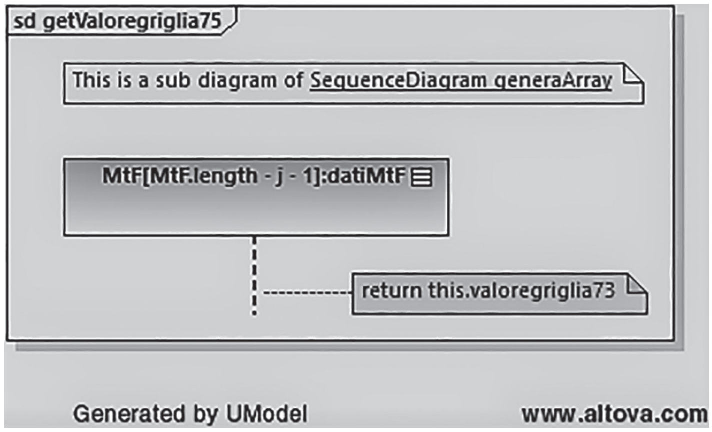

FIGURE 15.78 getValoregriglia75_4.

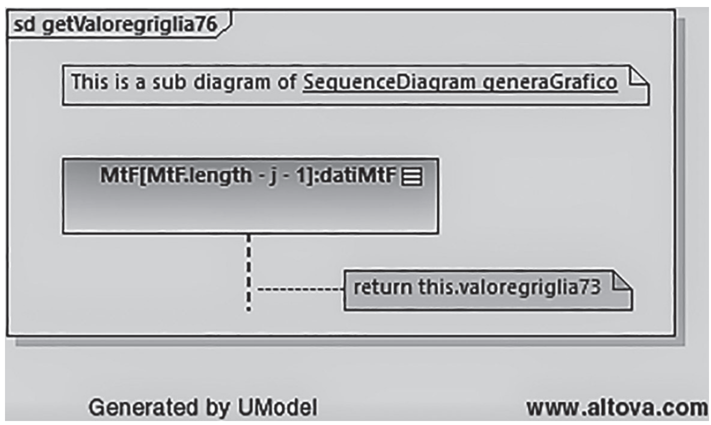

FIGURE 15.79 getValoregriglia76.

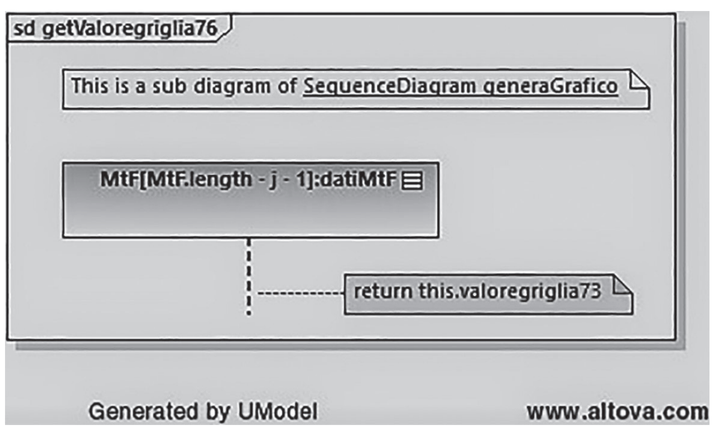

FIGURE 15.80 getValoregriglia76_1.

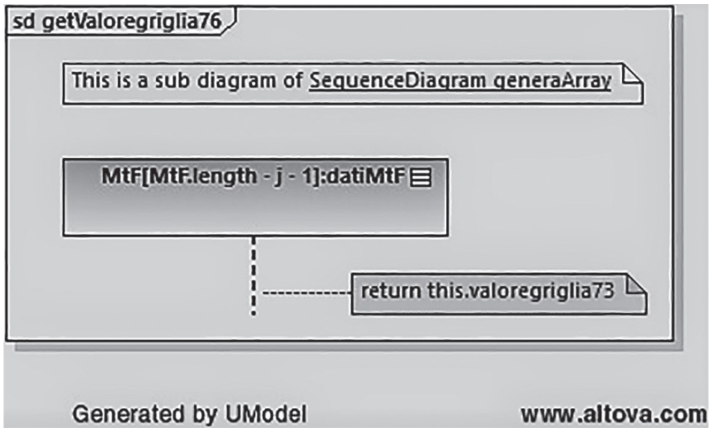

FIGURE 15.81 getValoregriglia76_2.

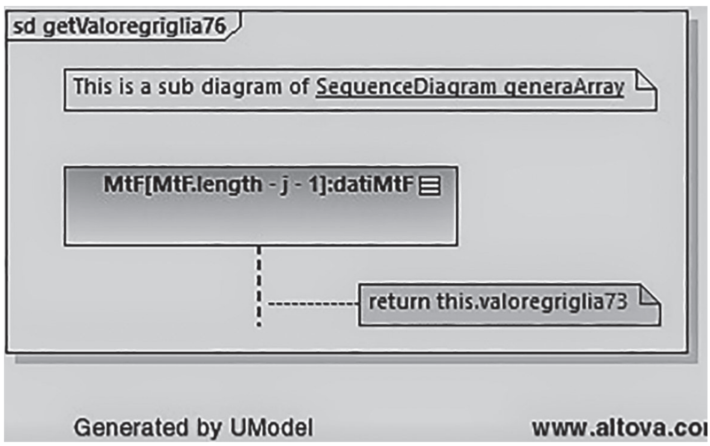

FIGURE 15.82 getValoregriglia76_3.

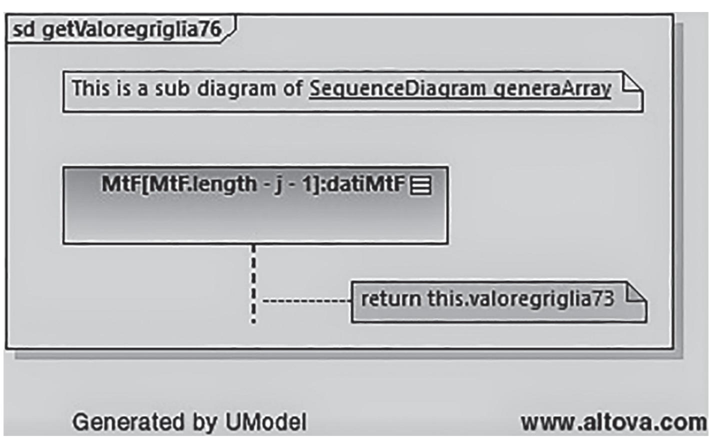

FIGURE 15.83 getValoregriglia76_4.

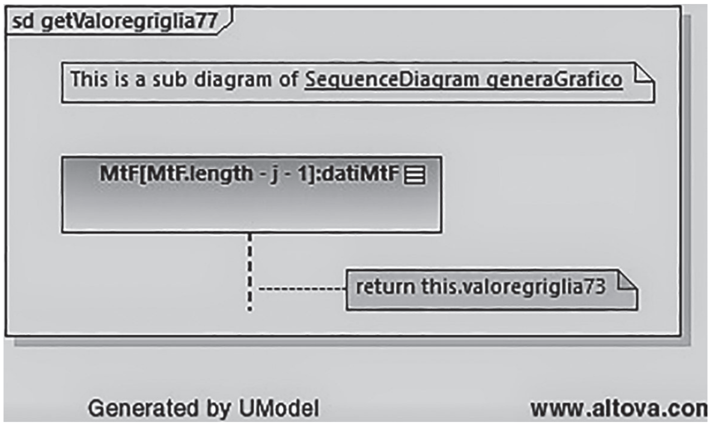

FIGURE 15.84 getValoregriglia77.

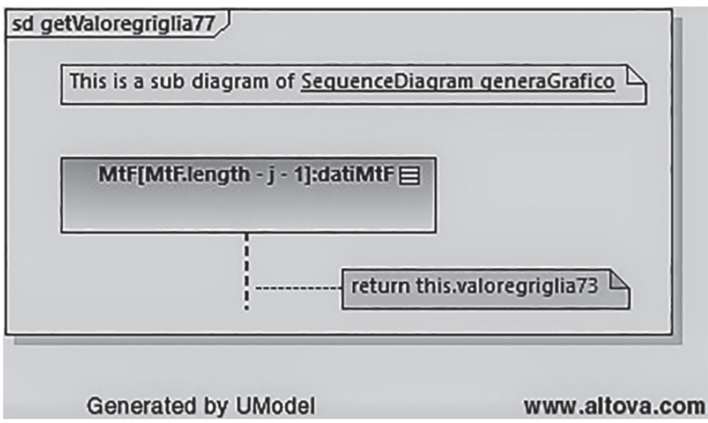

FIGURE 15.85 getValoregriglia77_1.

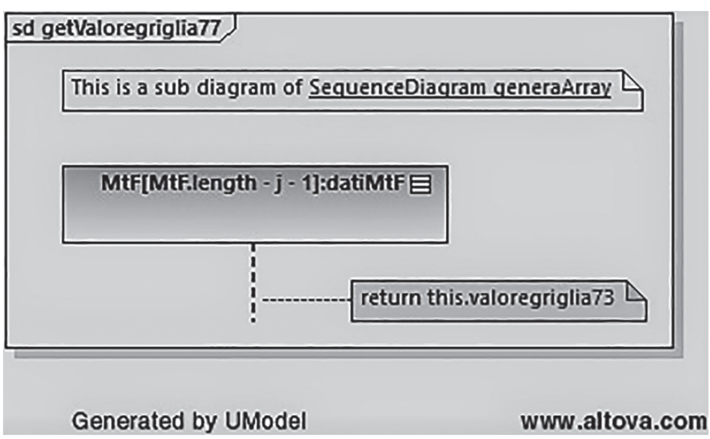

FIGURE 15.86 getValoregriglia77_2.

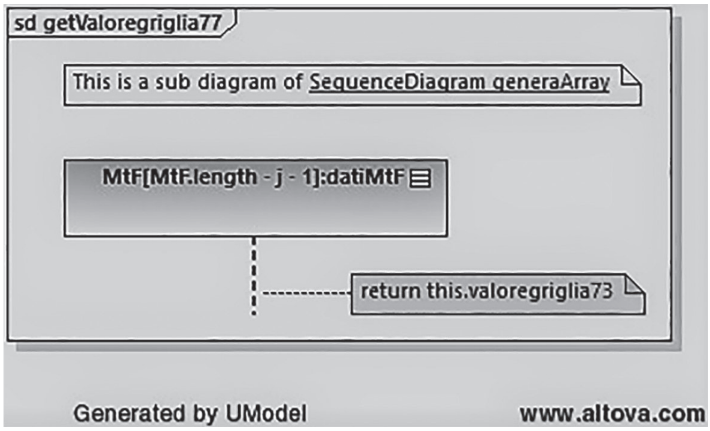

FIGURE 15.87 getValoregriglia77_3.

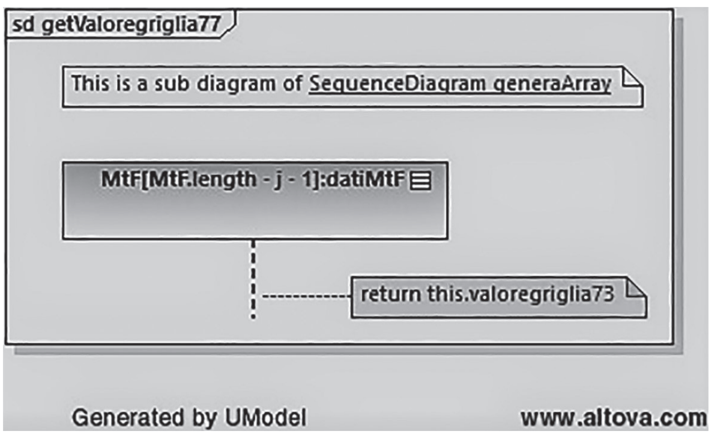

FIGURE 15.88 getValoregriglia77_4.

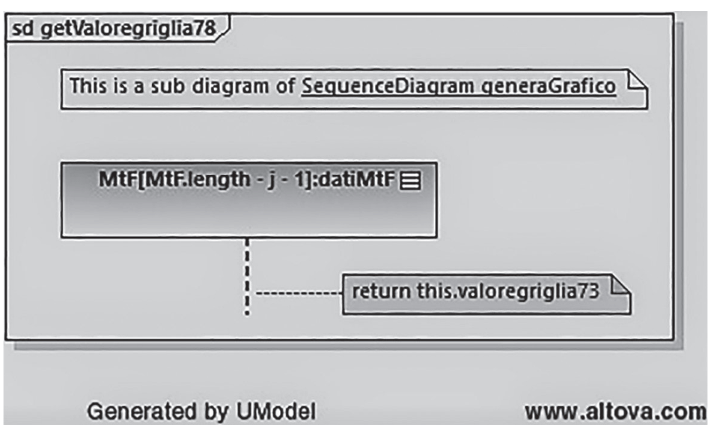

FIGURE 15.89 getValoregriglia78.

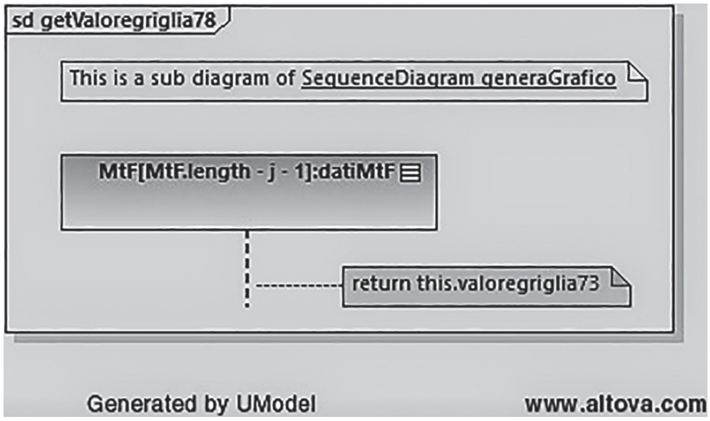

FIGURE 15.90 getValoregriglia78_1.

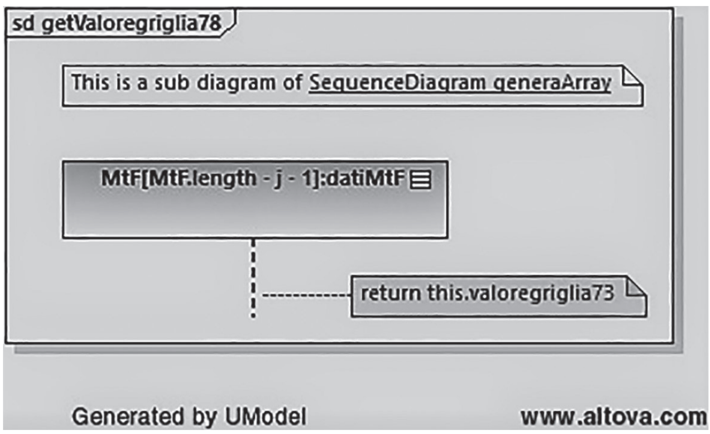

FIGURE 15.91 getValoregriglia78_2.

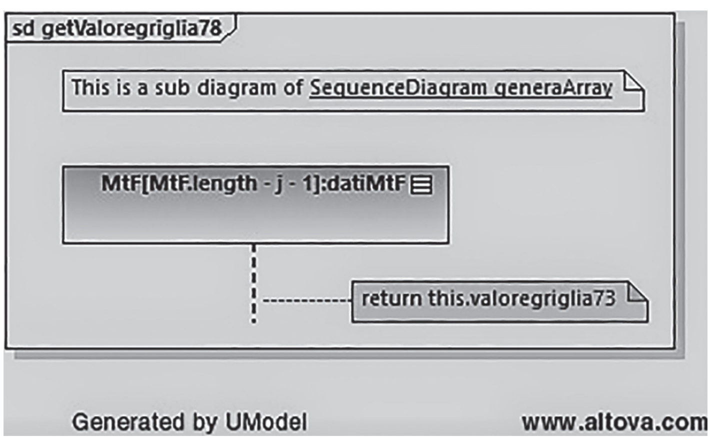

FIGURE 15.92 getValoregriglia78_3.

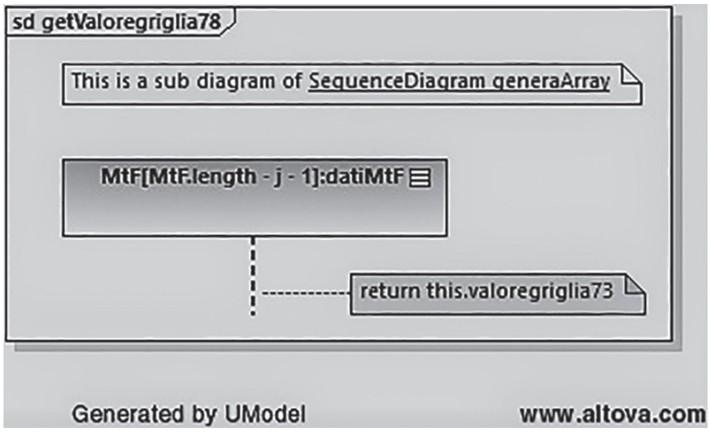

FIGURE 15.93 getValoregriglia78_4.

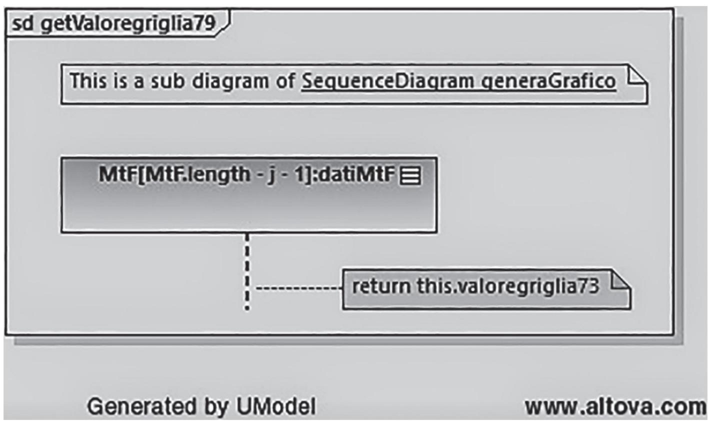

FIGURE 15.94 getValoregriglia79.

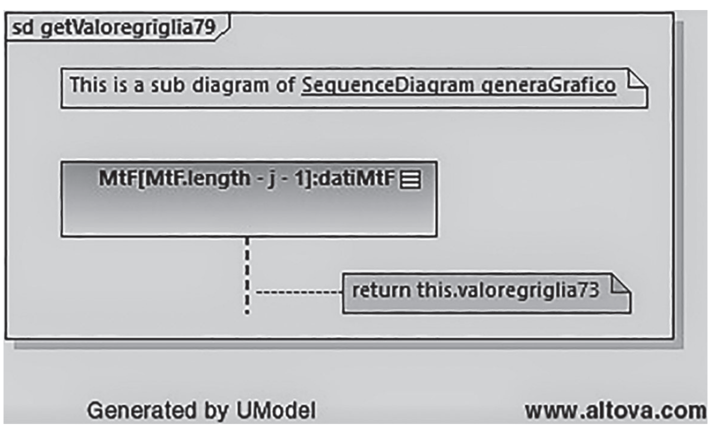

FIGURE 15.95 getValoregriglia79_1.

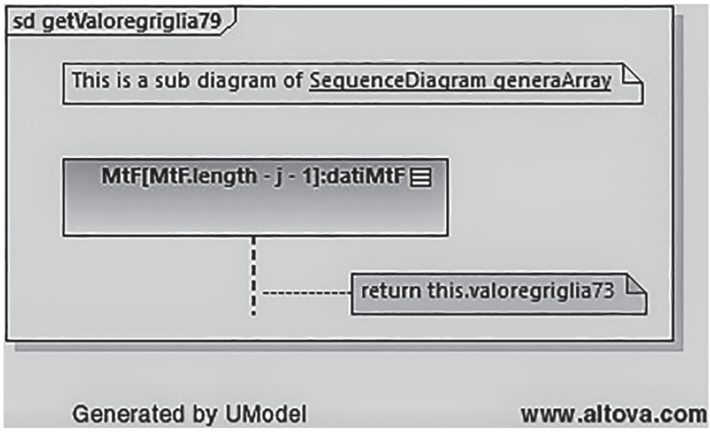

FIGURE 15.96 getValoregriglia79_2.

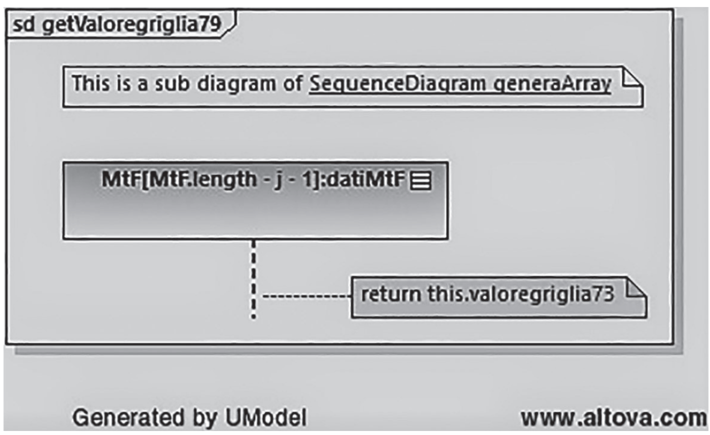

FIGURE 15.97 getValoregriglia79_3.

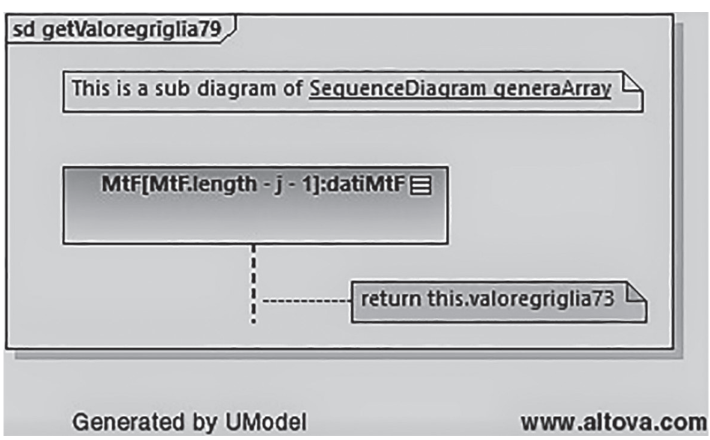

FIGURE 15.98 getValoregriglia79_4.

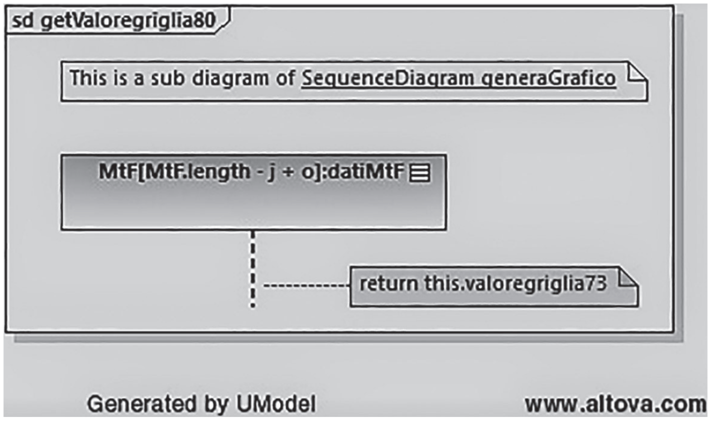

FIGURE 15.99 getValoregriglia80.

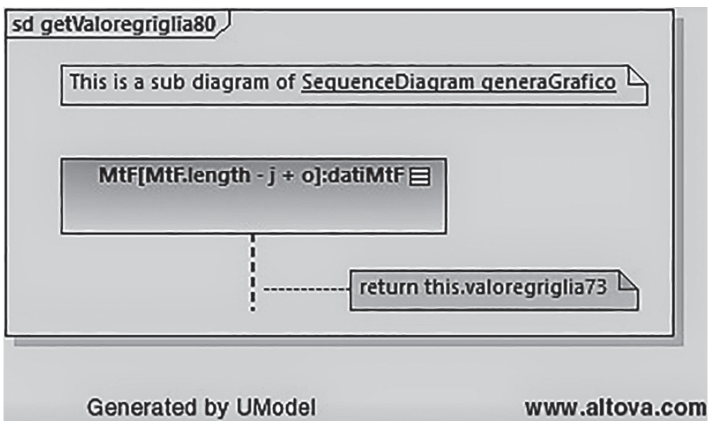

FIGURE 15.100 getValoregriglia80_1.

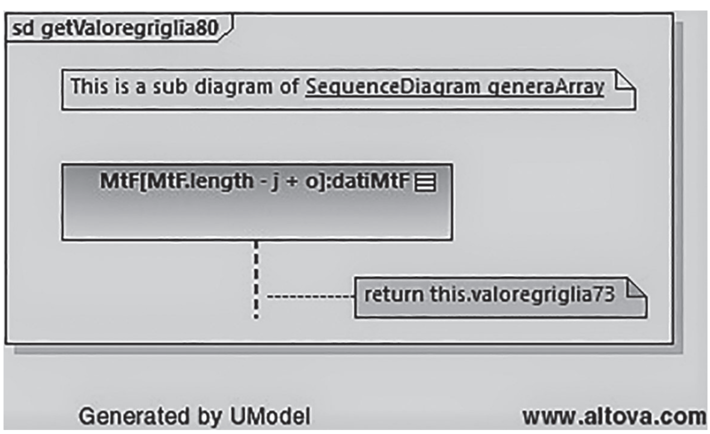

FIGURE 15.101 getValoregriglia80_2.

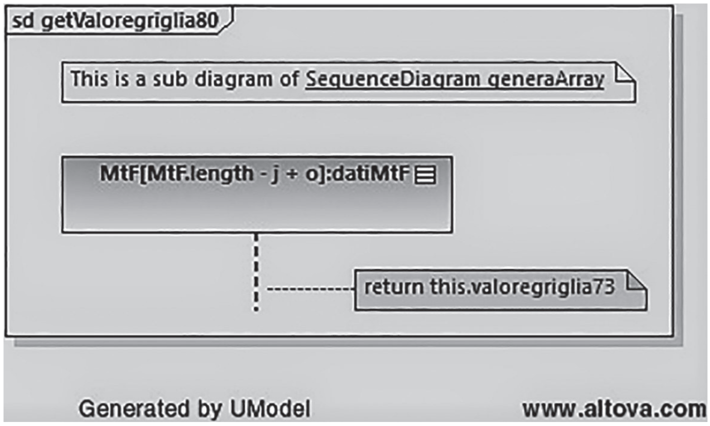

FIGURE 15.102 getValoregriglia80_3.

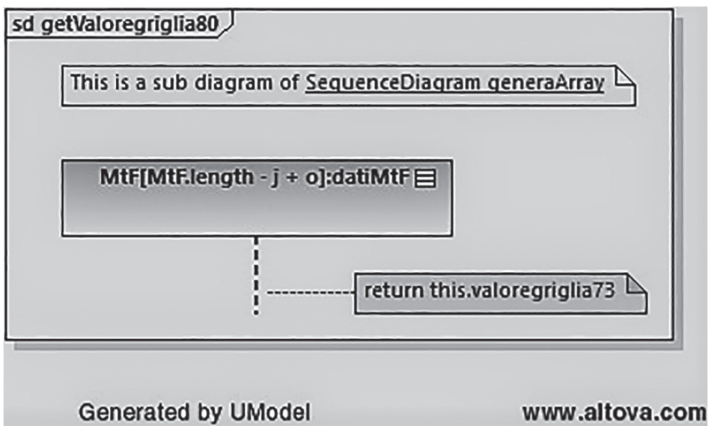

FIGURE 15.103 getValoregriglia80_4.

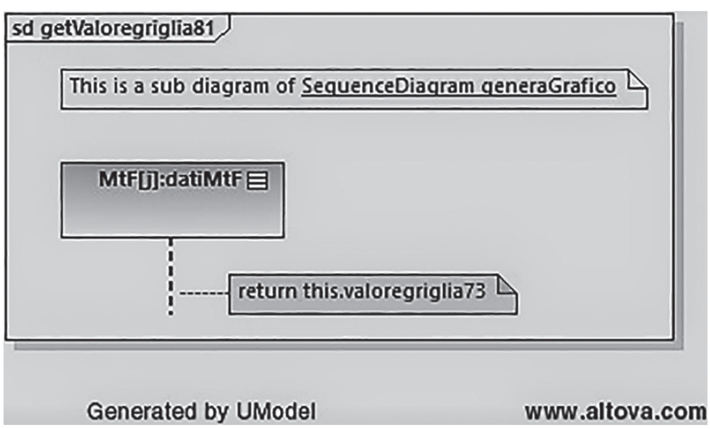

FIGURE 15.104 getValoregriglia81.

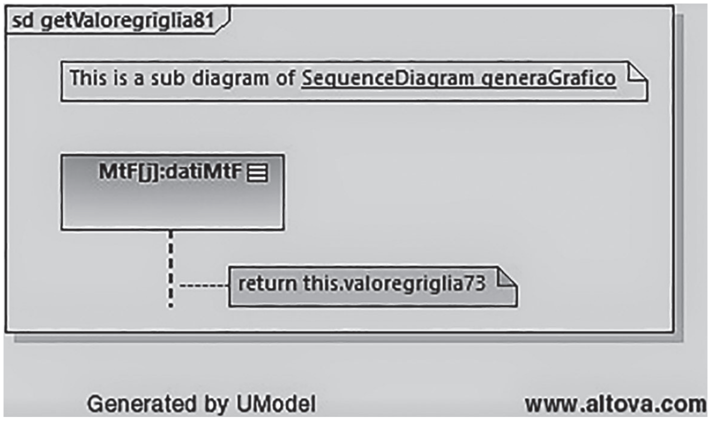

FIGURE 15.105 getValoregriglia81_1.

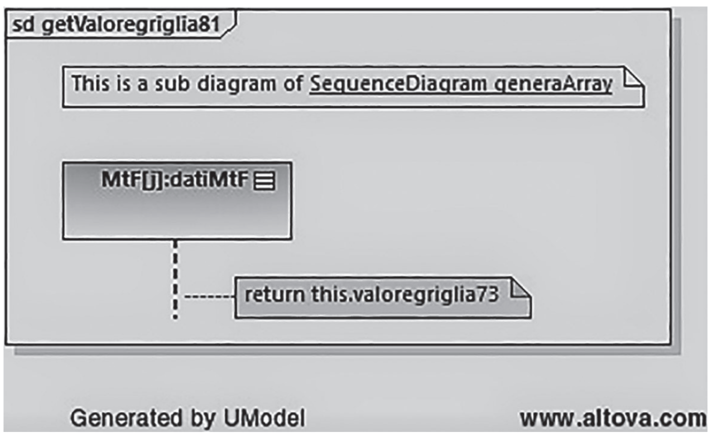

FIGURE 15.106 getValoregriglia81_2.

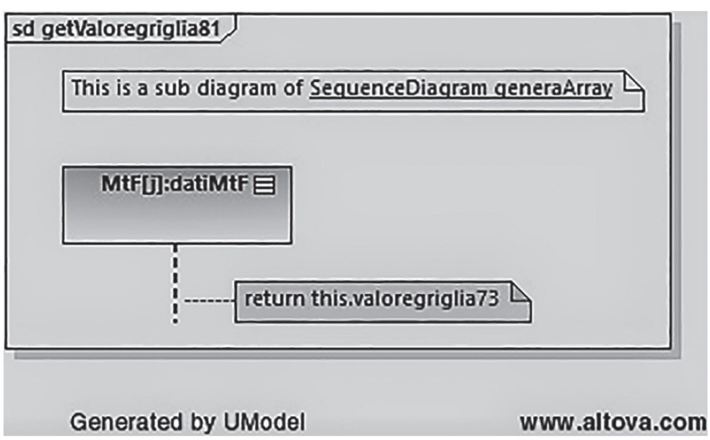

FIGURE 15.107 getValoregriglia81_3.

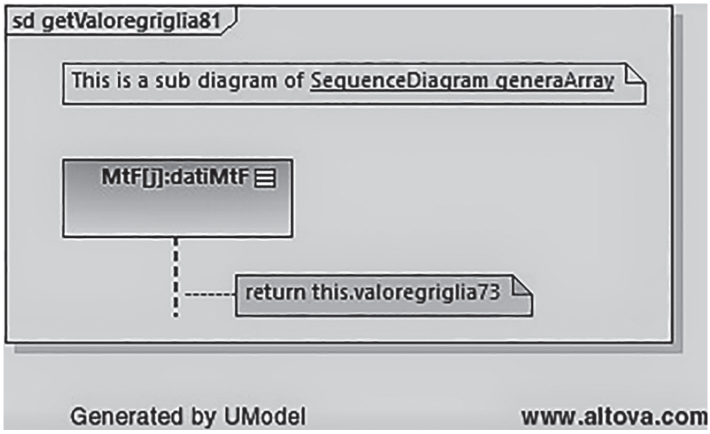

FIGURE 15.108 getValoregriglia81_4.

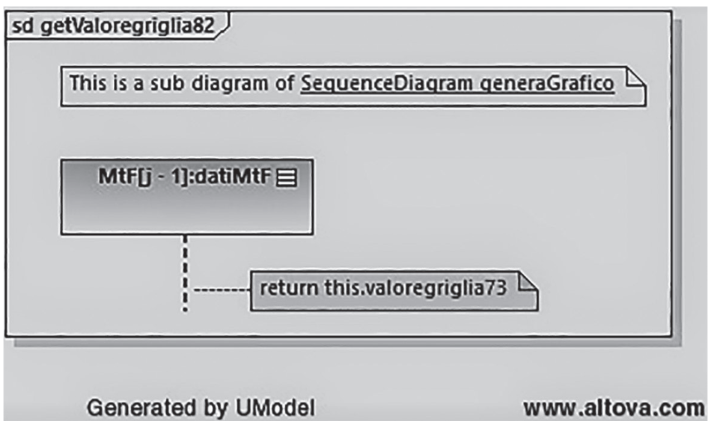

FIGURE 15.109 getValoregriglia82.

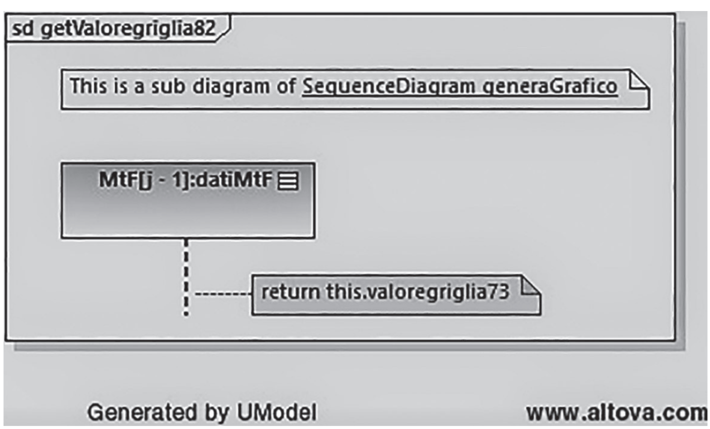

FIGURE 15.110 getValoregriglia82_1.

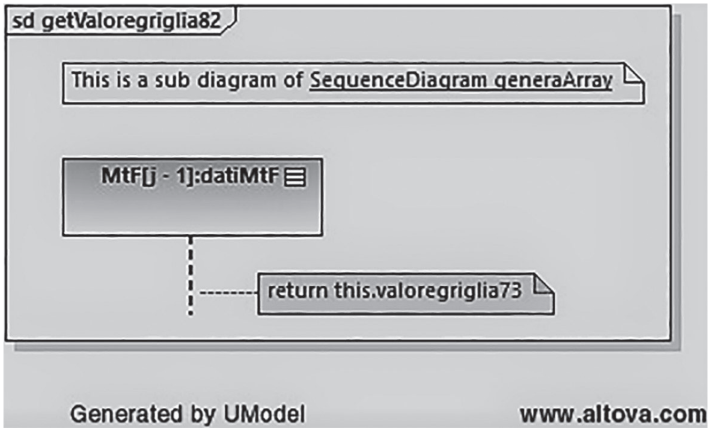

FIGURE 15.111 getValoregriglia82_2.

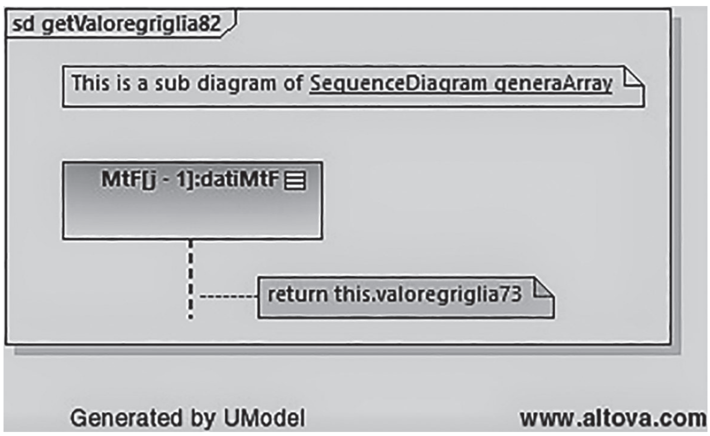

FIGURE 15.112 getValoregriglia82_3.

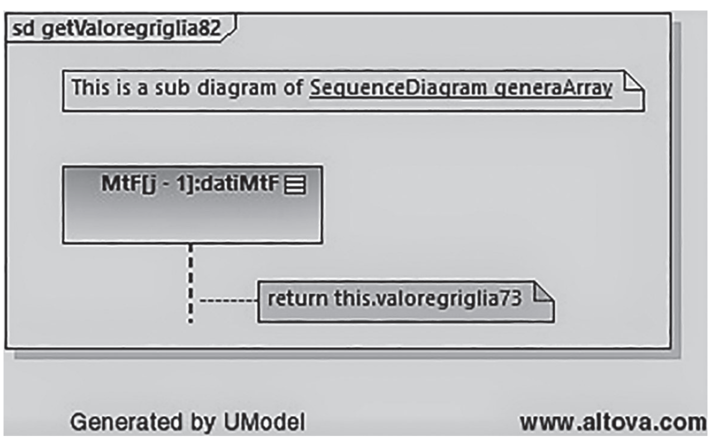

FIGURE 15.113 getValoregriglia82_4.

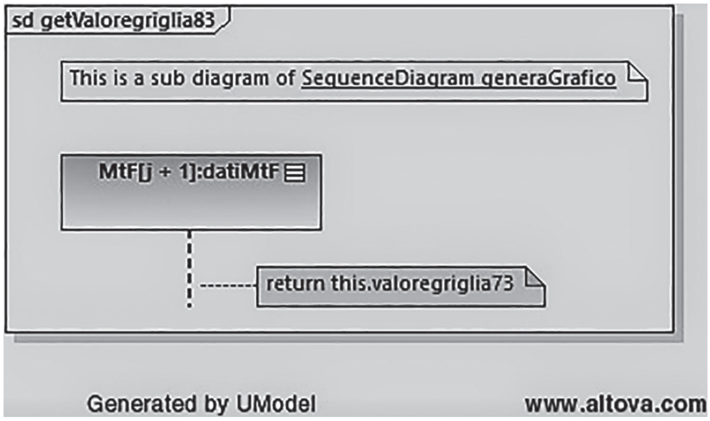

FIGURE 15.114 getValoregriglia83.

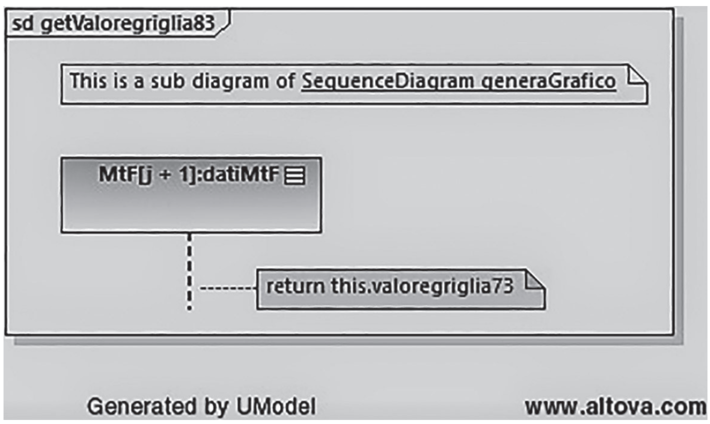

FIGURE 15.115 getValoregriglia83_1.

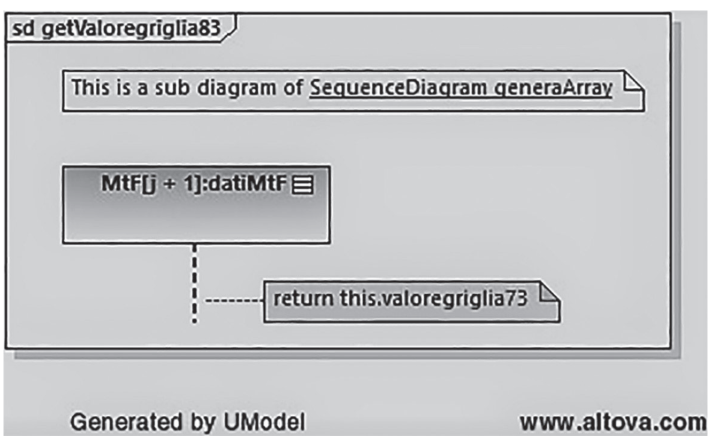

FIGURE 15.116 getValoregriglia83_2.

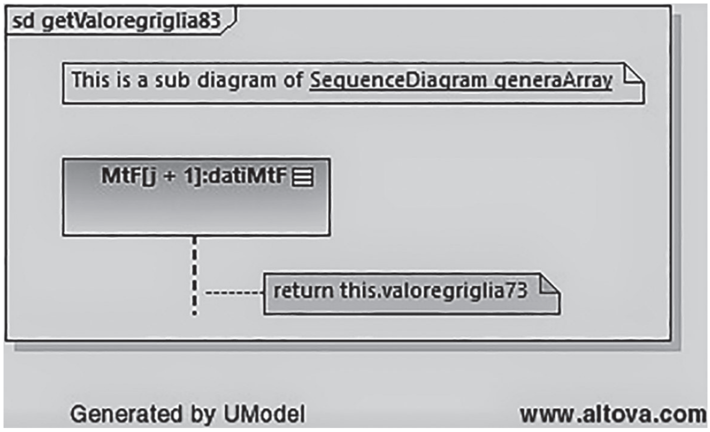

FIGURE 15.117 getValoregriglia83_3.

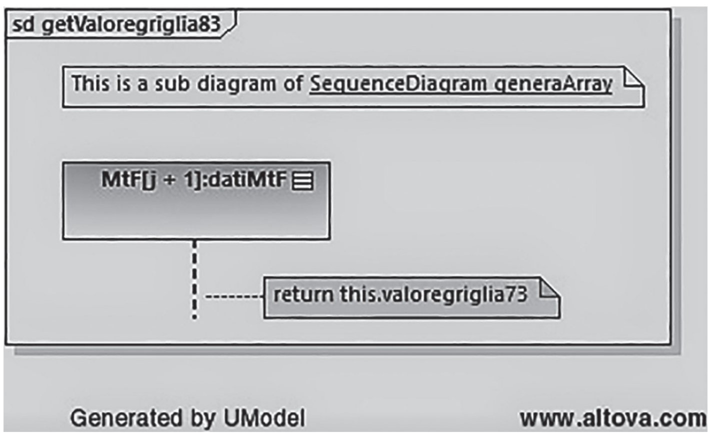

FIGURE 15.118 getValoregriglia83_4.

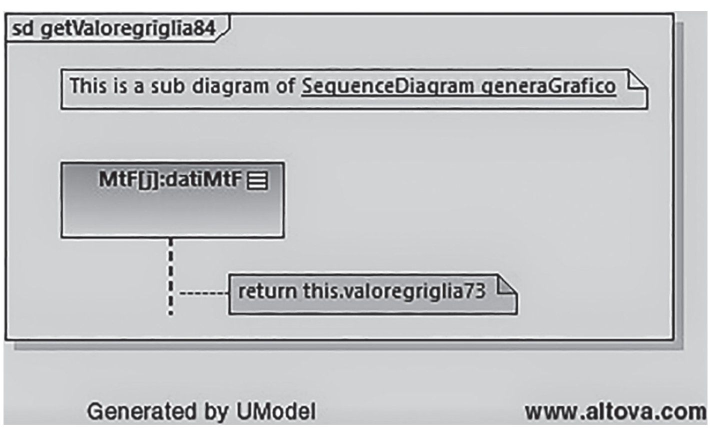

FIGURE 15.119 getValoregriglia84.

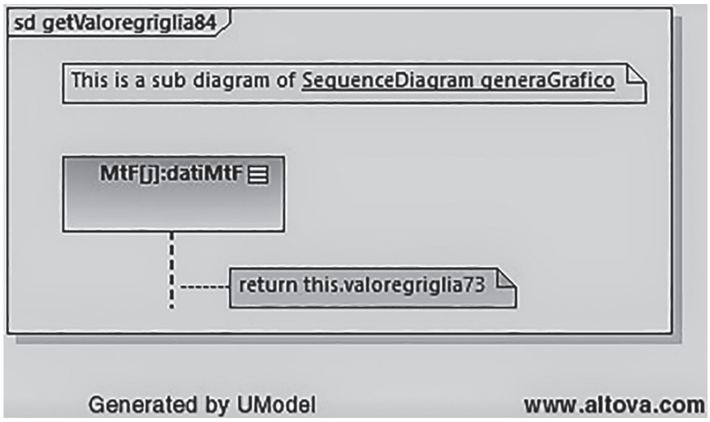

FIGURE 15.120 getValoregriglia84_1.

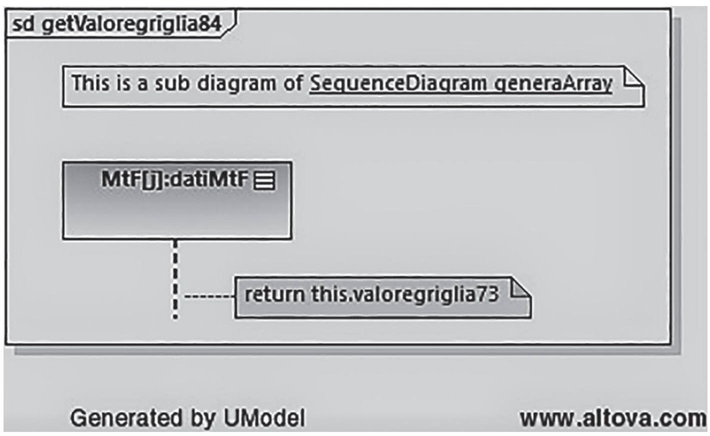

FIGURE 15.121 getValoregriglia84_2.

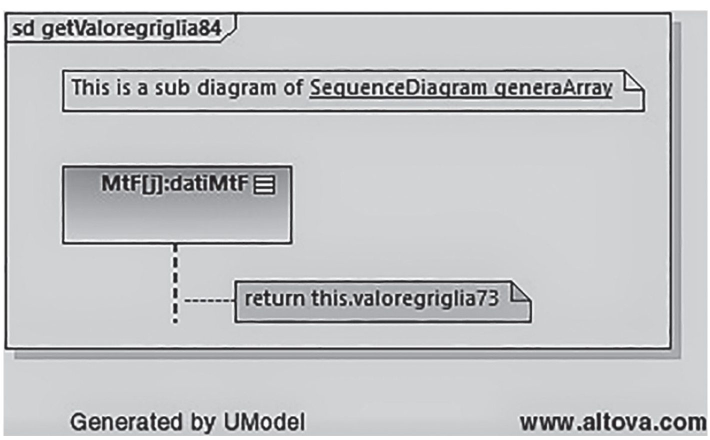

FIGURE 15.122 getValoregriglia84_3.

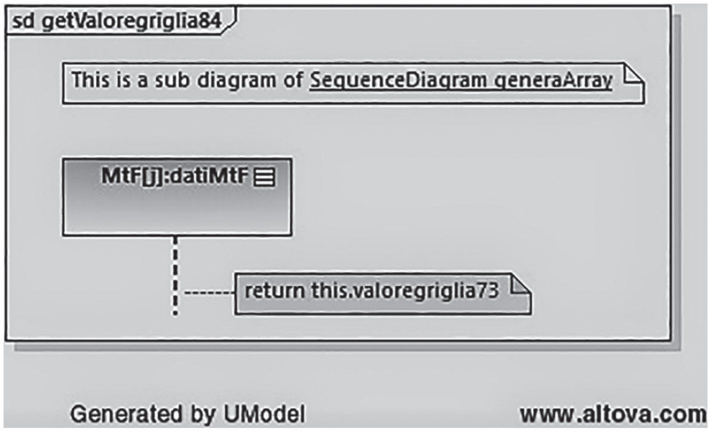

FIGURE 15.123 getValoregriglia84_4.

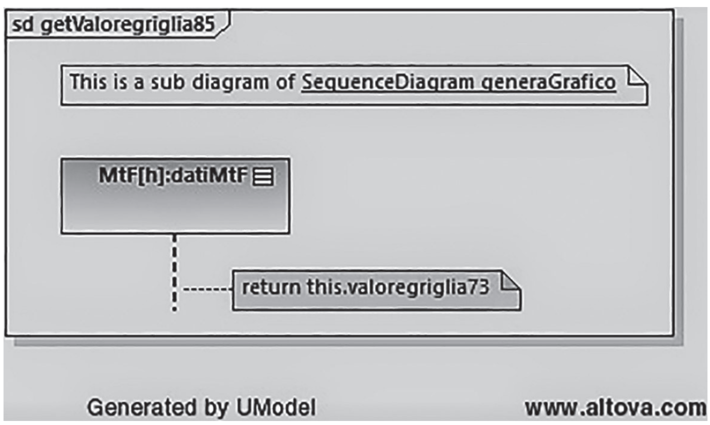

FIGURE 15.124 getValoregriglia85.

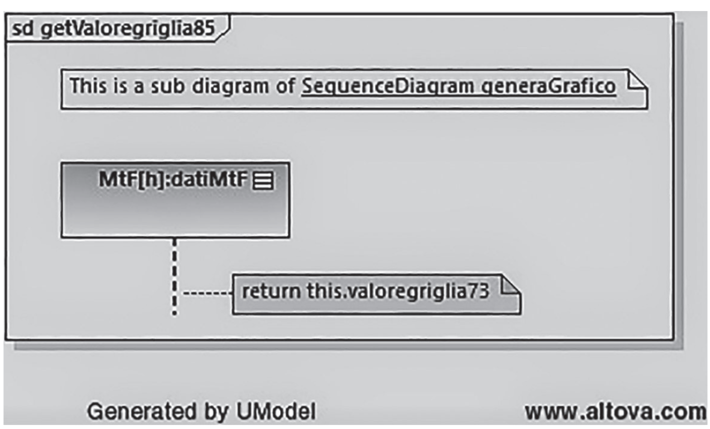

FIGURE 15.125 getValoregriglia85_1.

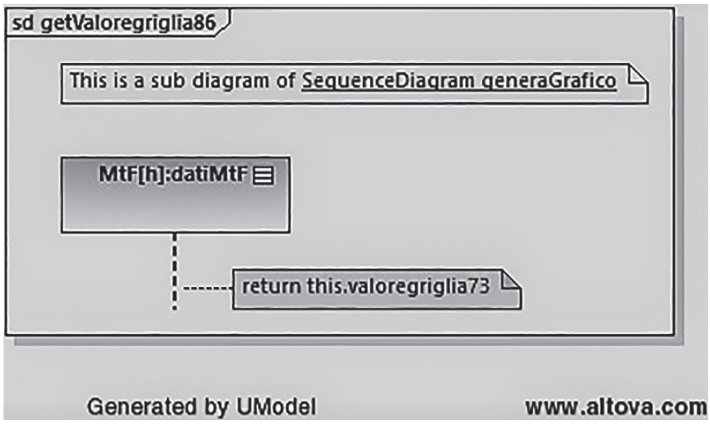

FIGURE 15.126 getValoregriglia86.

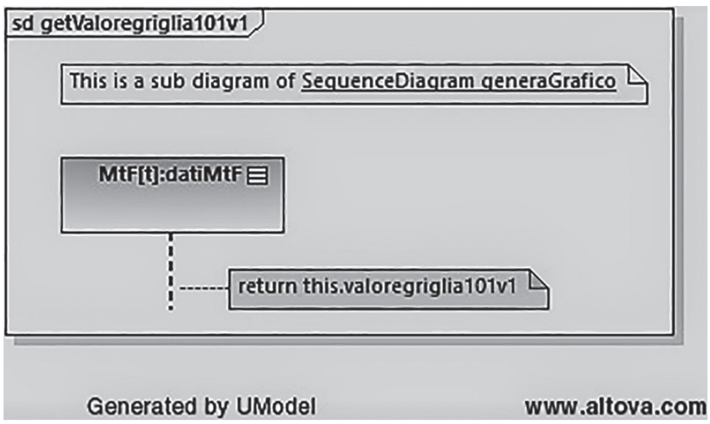

FIGURE 15.127 getValoregriglia101v1.

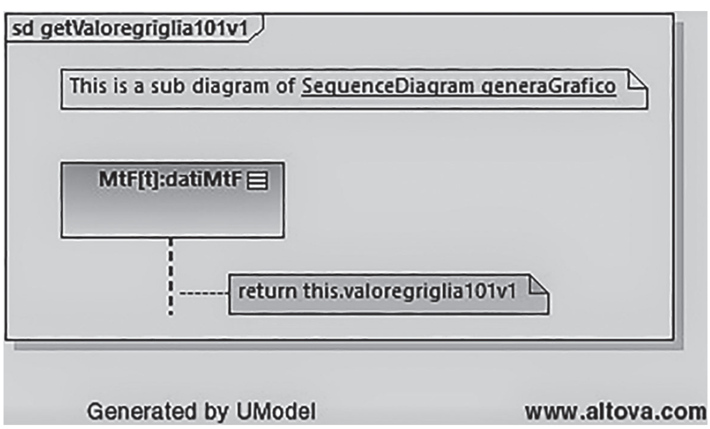

FIGURE 15.128 getValoregriglia101v1_1.

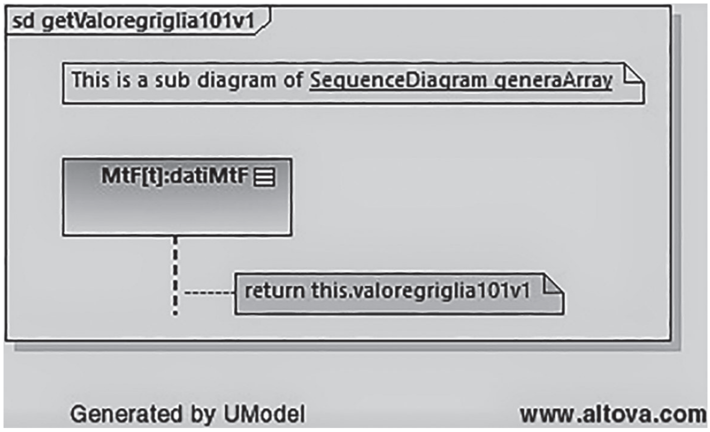

FIGURE 15.129 getValoregriglia101v1_2.

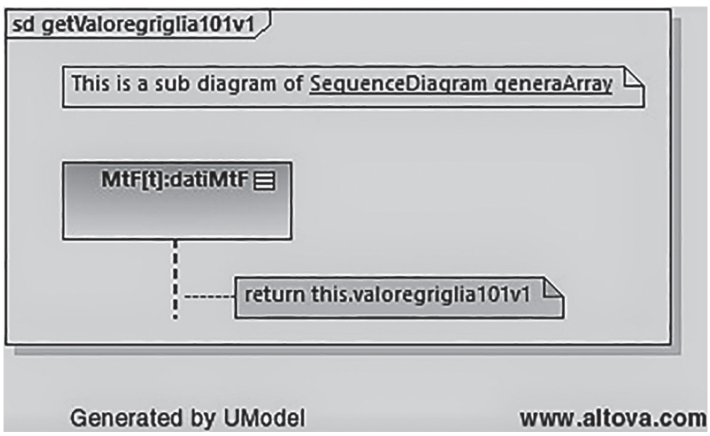

FIGURE 15.130 getValoregriglia101v1_3.

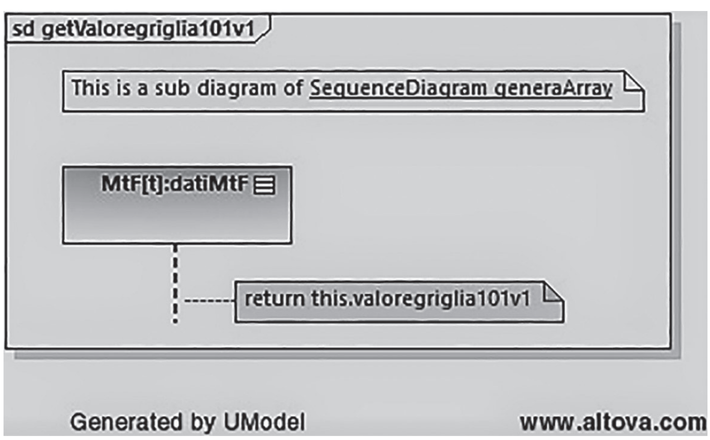

FIGURE 15.131 getValoregriglia101v1_4.

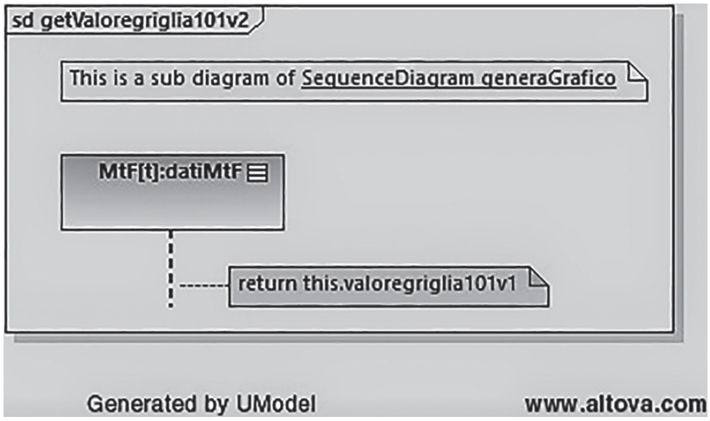

FIGURE 15.132 getValoregriglia101v2.

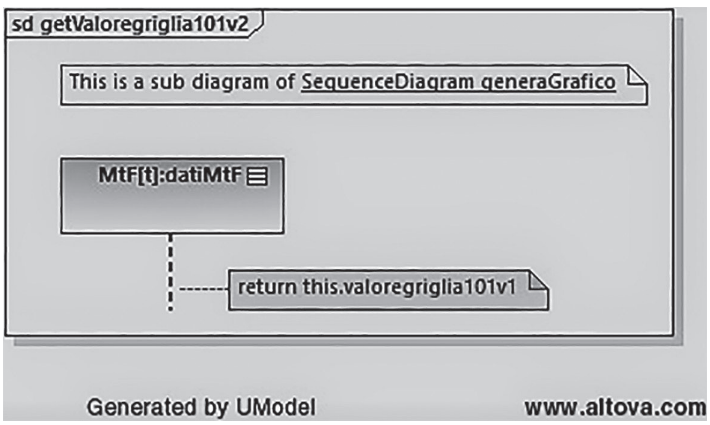

FIGURE 15.133 getValoregriglia101v2_1.

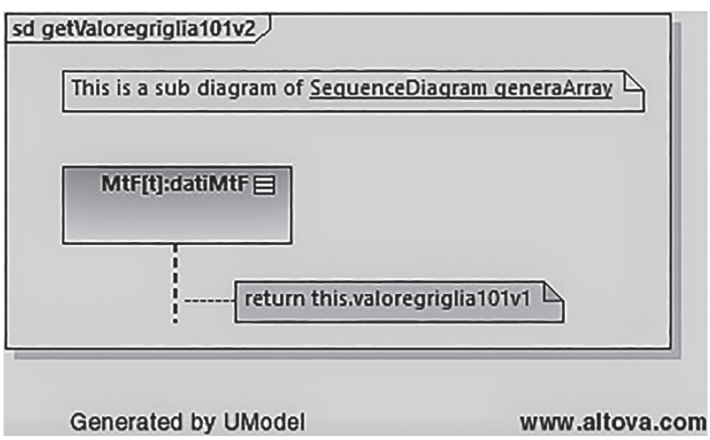

FIGURE 15.134 getValoregriglia101v2_2.

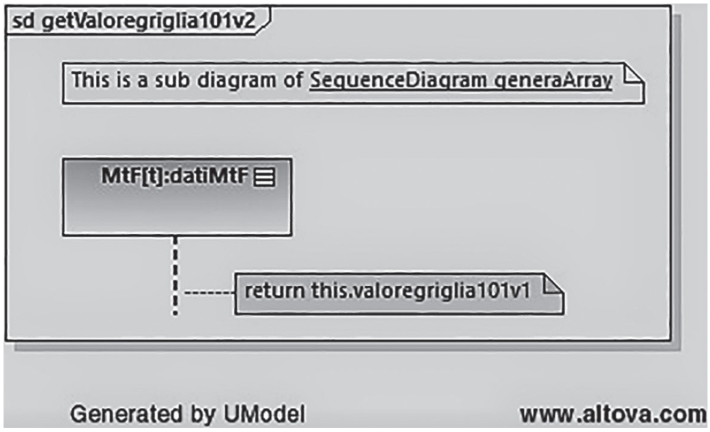

FIGURE 15.135 getValoregriglia101v2_3.

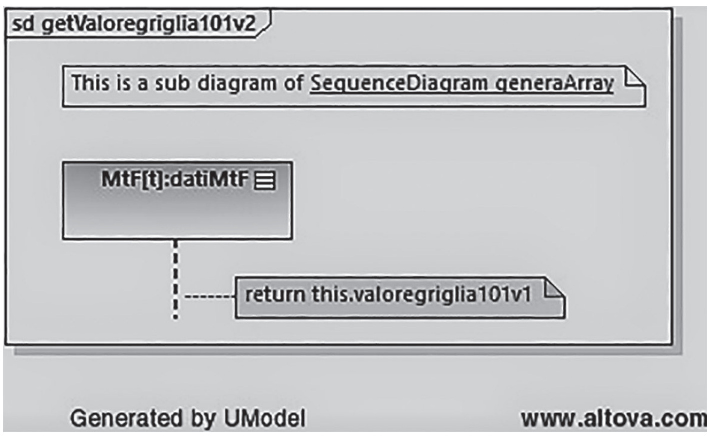

FIGURE 15.136 getValoregriglia101v2_4.

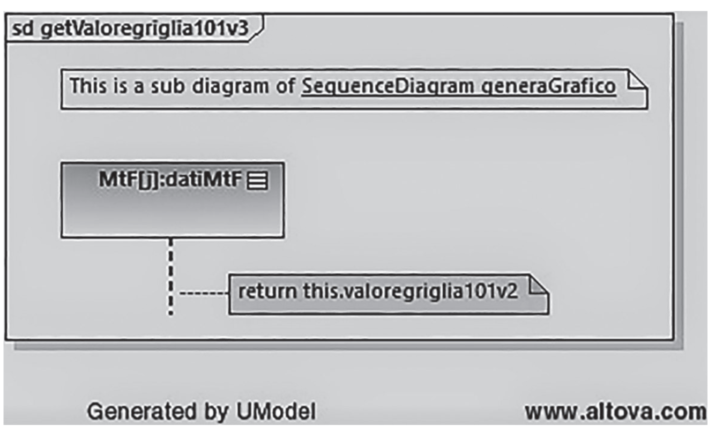

FIGURE 15.137 getValoregriglia101v3.

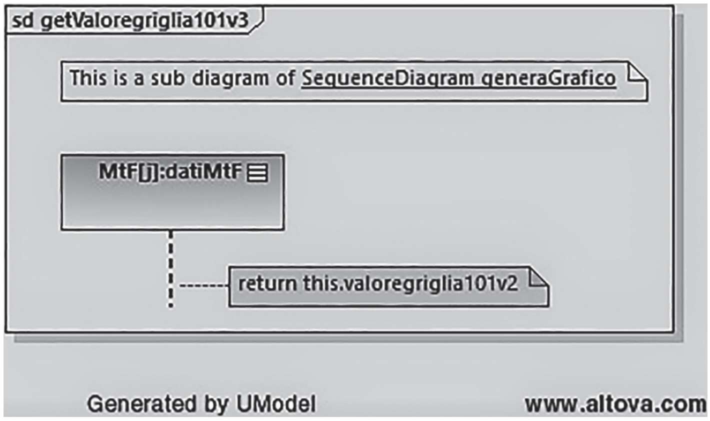

FIGURE 15.138 getValoregriglia101v3_1.

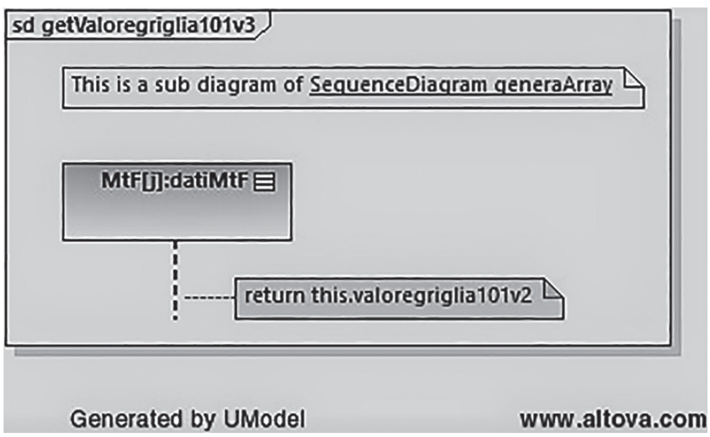

FIGURE 15.139 getValoregriglia101v3_2.

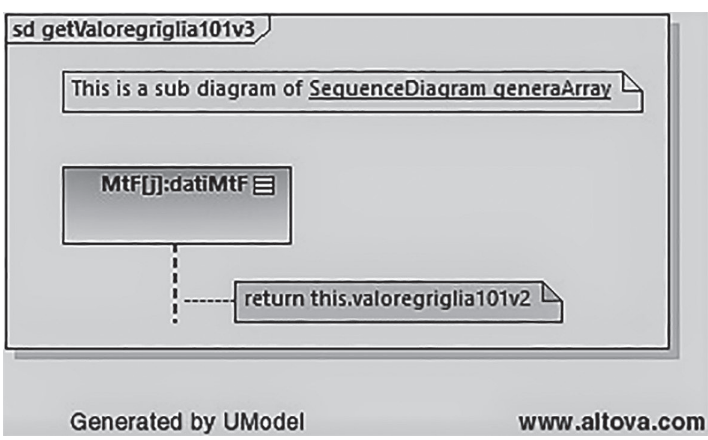

FIGURE 15.140 getValoregriglia101v3_3.

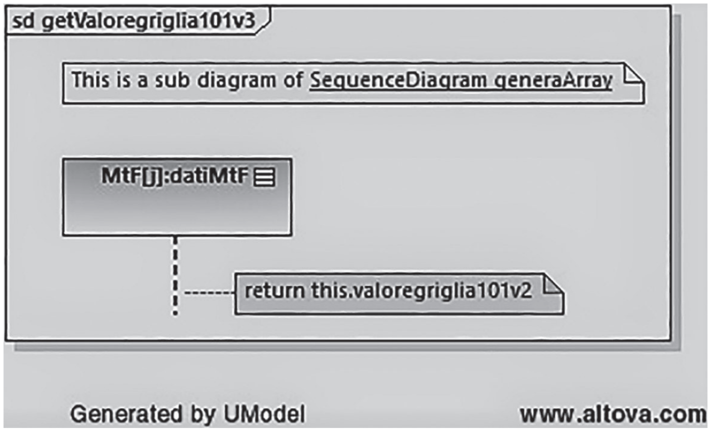

FIGURE 15.141 getValoregriglia101v3_4.

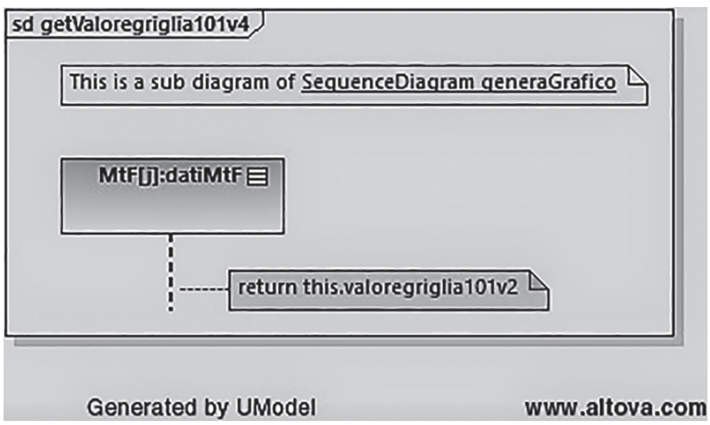

FIGURE 15.142 getValoregriglia101v4.

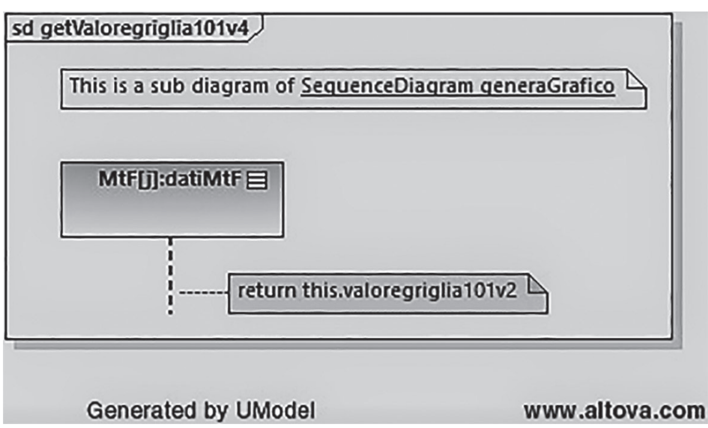

FIGURE 15.143 getValoregriglia101v4_1.

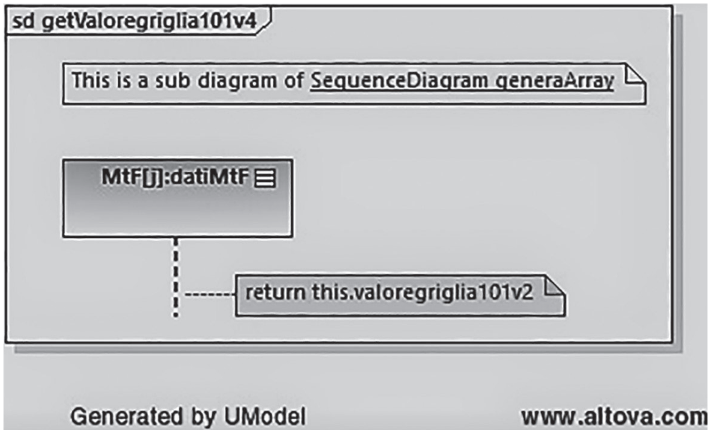

FIGURE 15.144 getValoregriglia101v4_2.

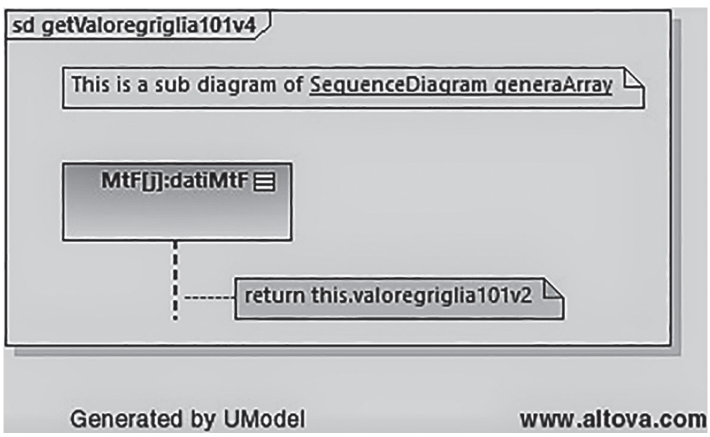

FIGURE 15.145 getValoregriglia101v4_3.

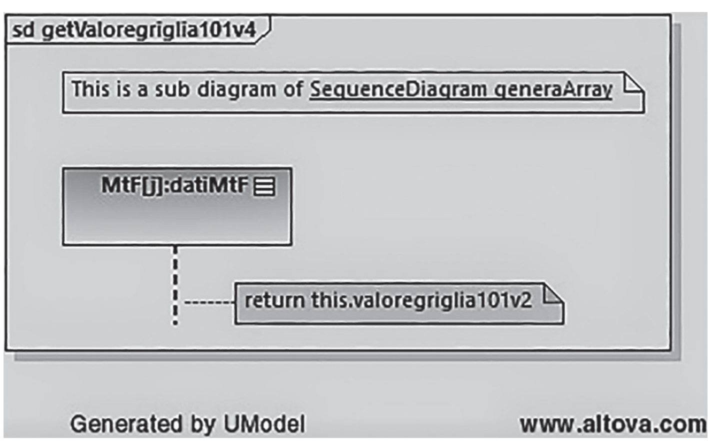

FIGURE 15.146 getValoregriglia101v4_4.

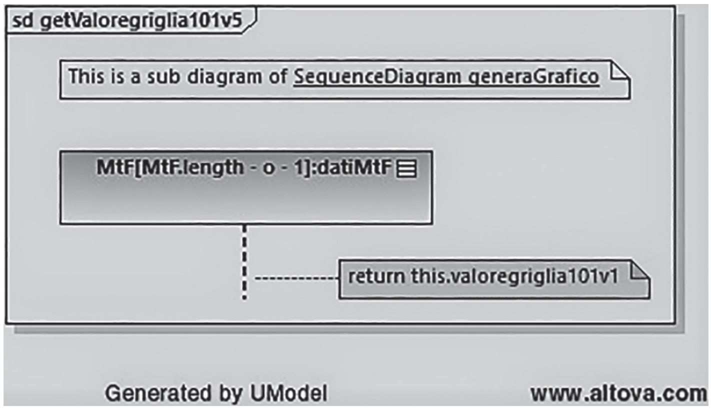

FIGURE 15.147 getValoregriglia101v5.

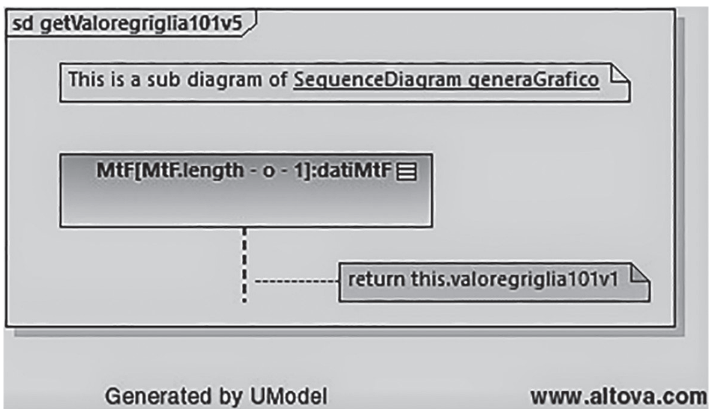

FIGURE 15.148 getValoregriglia101v5_1.

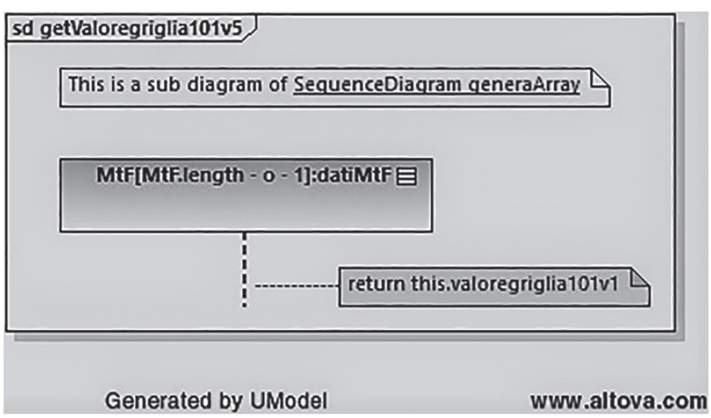

FIGURE 15.149 getValoregriglia101v5_2.

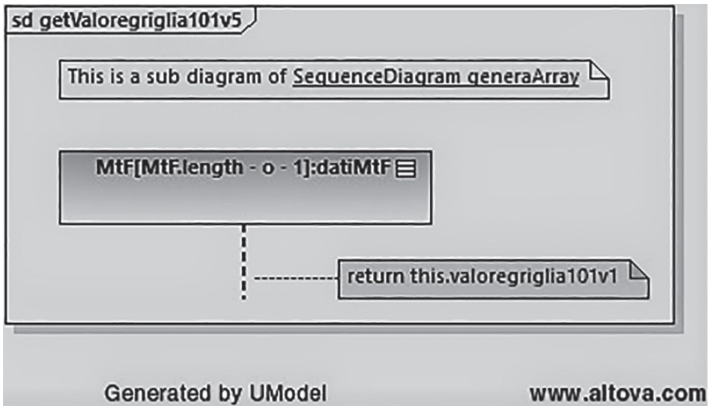

FIGURE 15.150 getValoregriglia101v5_3.

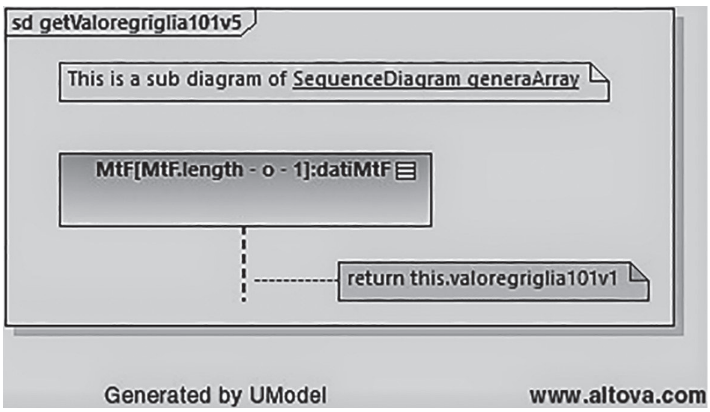

FIGURE 15.151 getValoregriglia101v5_4.

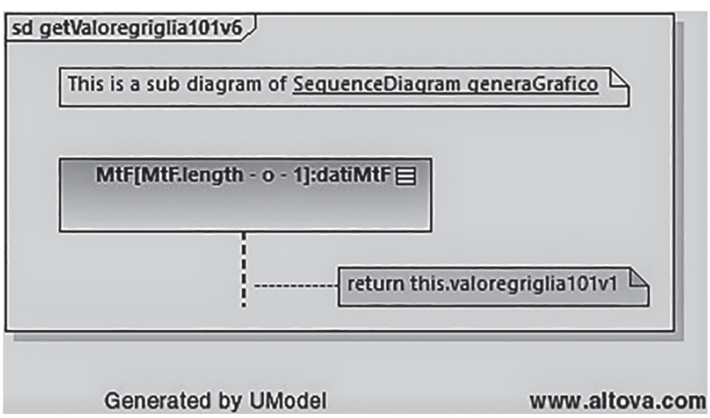

FIGURE 15.152 getValoregriglia101v6.

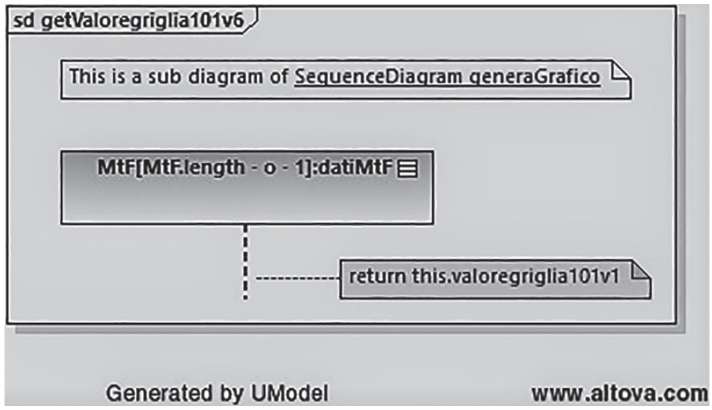

FIGURE 15.153 getValoregriglia101v6_1.

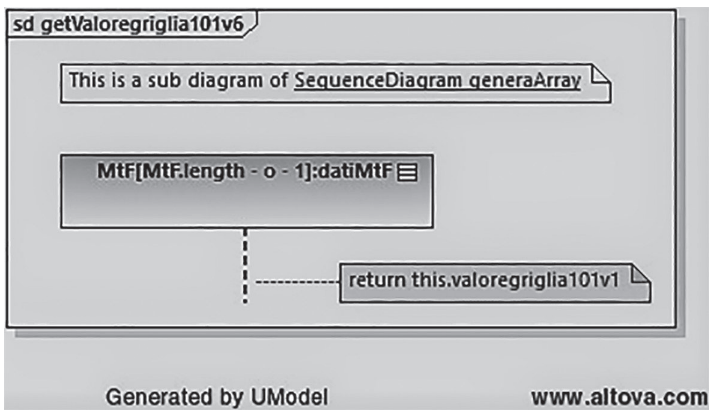

FIGURE 15.154 getValoregriglia101v6_2.

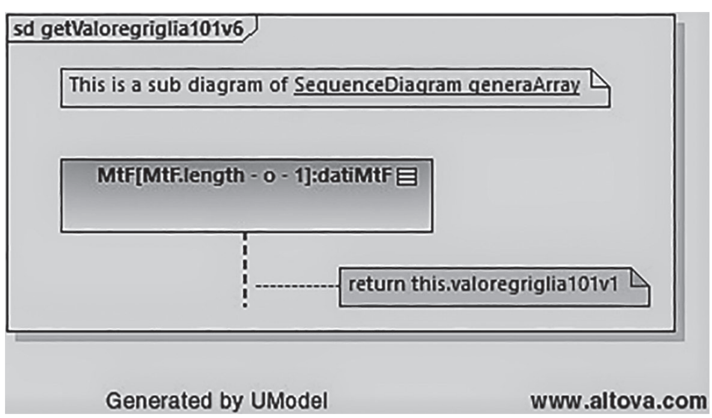

FIGURE 15.155 getValoregriglia101v6_3.

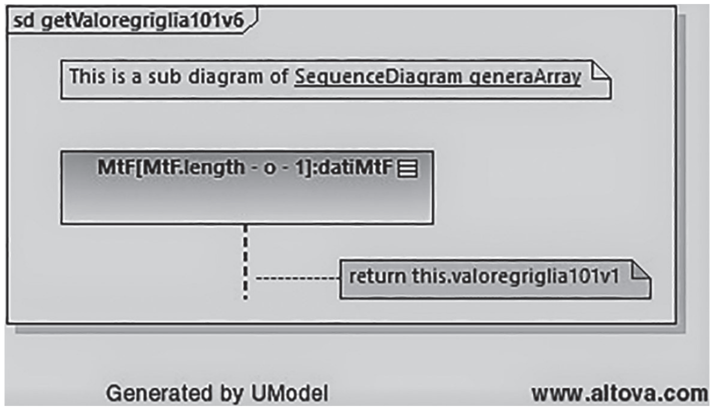

FIGURE 15.156 getValoregriglia101v6_4.

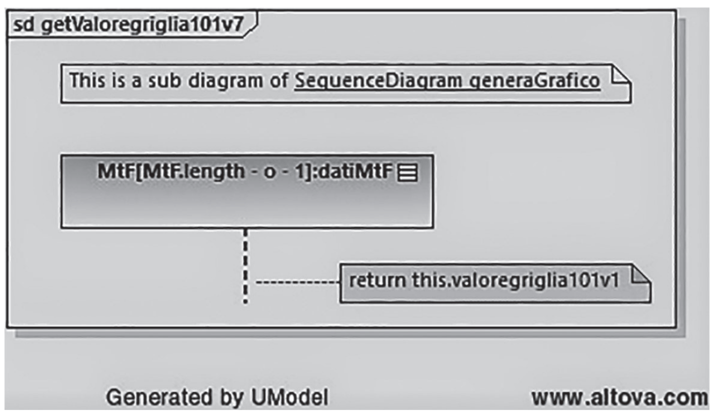

FIGURE 15.157 getValoregriglia101v7.

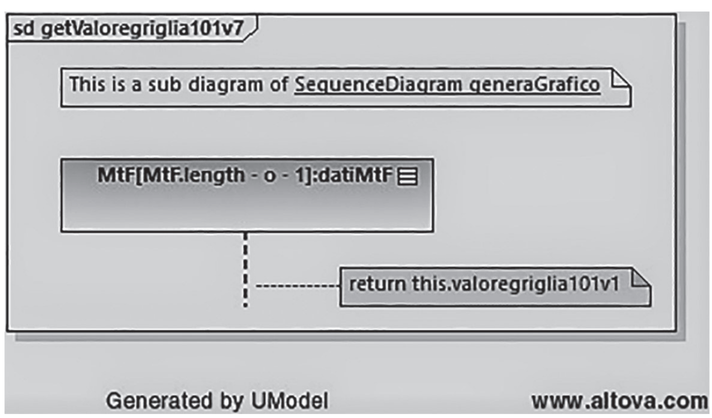

FIGURE 15.158 getValoregriglia101v7_1.

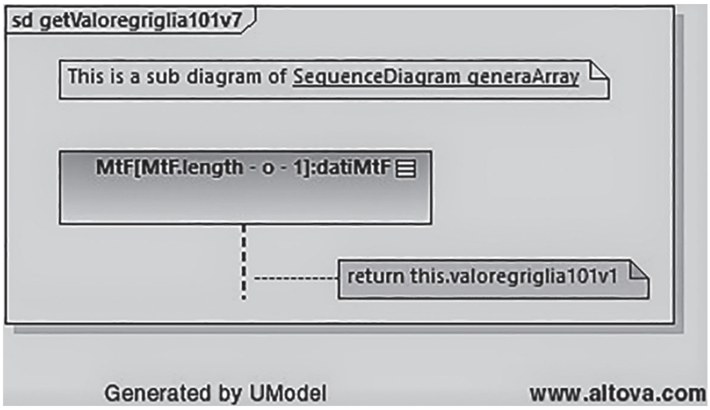

FIGURE 15.159 getValoregriglia101v7_2.

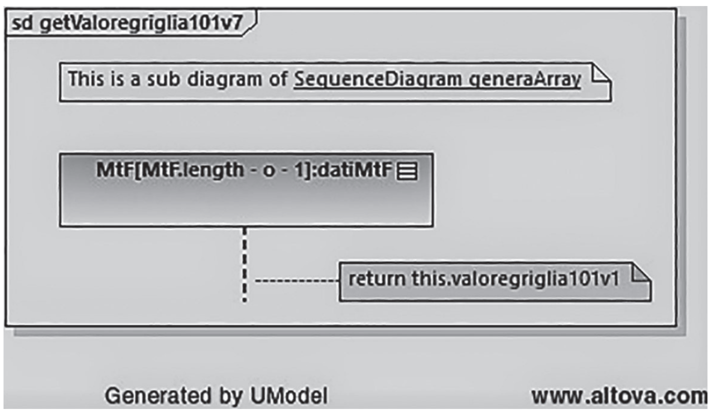

FIGURE 15.160 getValoregriglia101v7_3.

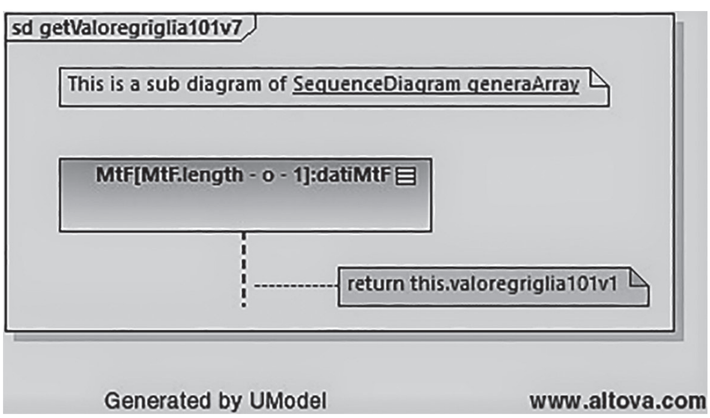

FIGURE 15.161 getValoregriglia101v7_4.

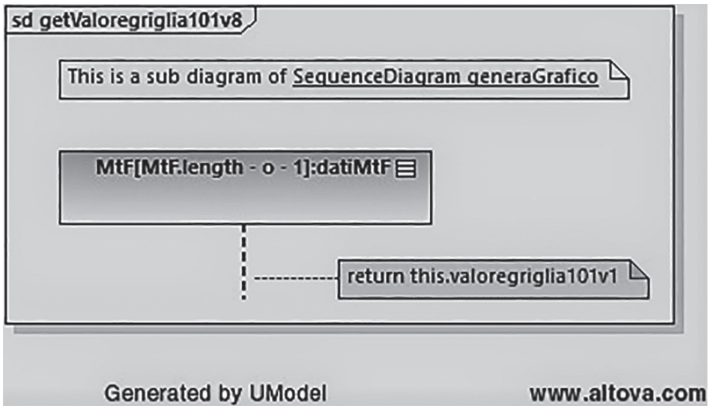

FIGURE 15.162 getValoregriglia101v8.

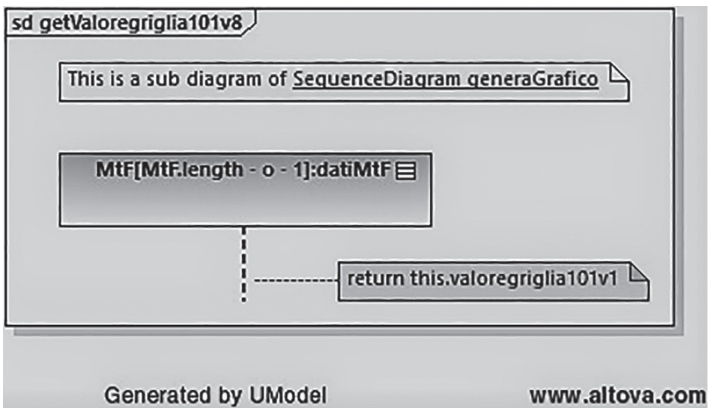

FIGURE 15.163 getValoregriglia101v8_1.

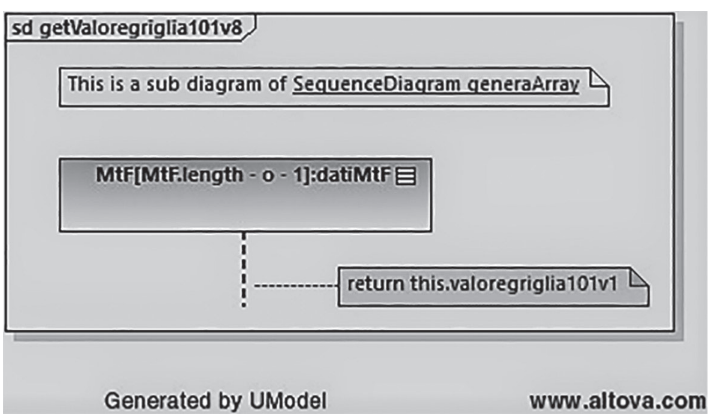

FIGURE 15.164 getValoregriglia101v8_2.

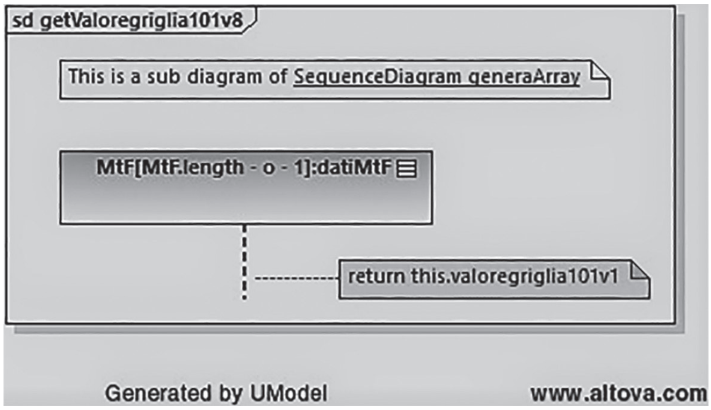

FIGURE 15.165 getValoregriglia101v8_3.

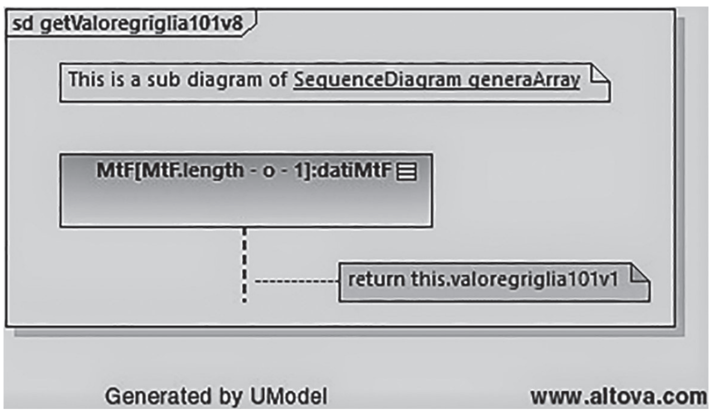

FIGURE 15.166 getValoregriglia101v8_4.

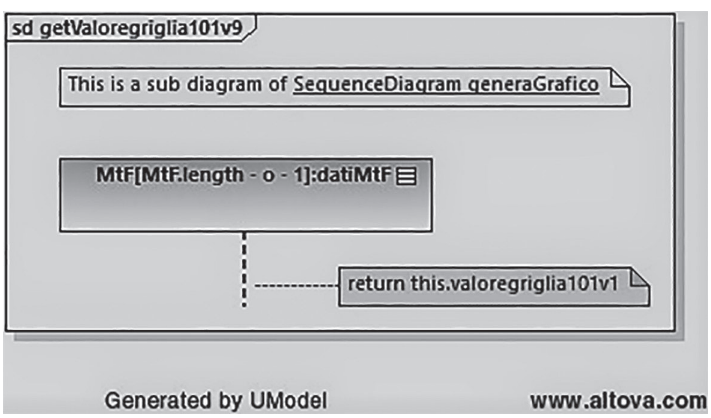

FIGURE 15.167 getValoregriglia101v9.

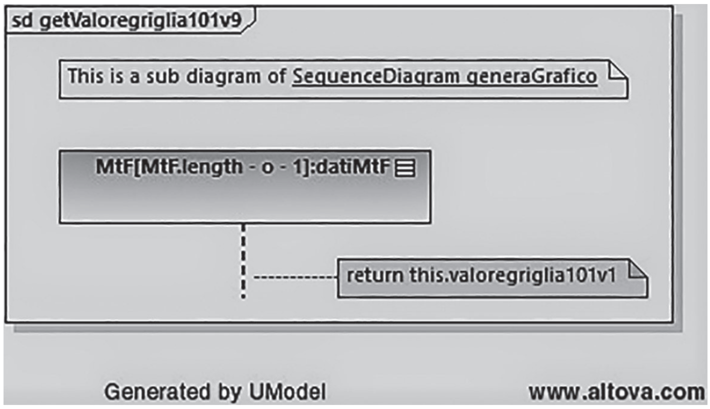

FIGURE 15.168 getValoregriglia101v9_1.

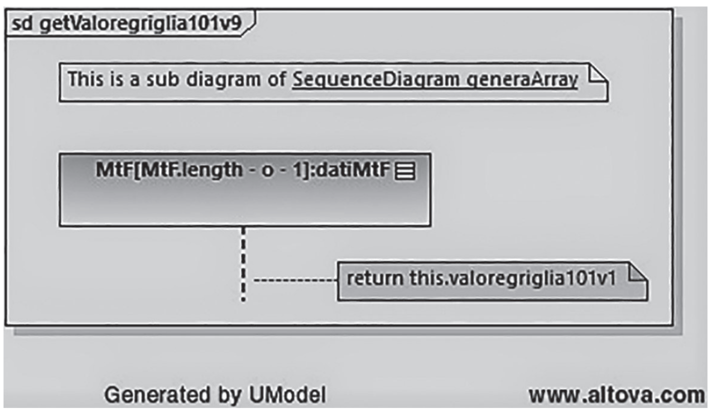

FIGURE 15.169 getValoregriglia101v9_2.

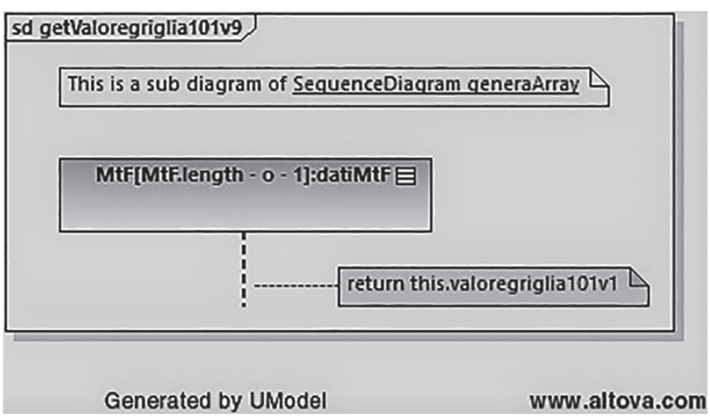

FIGURE 15.170 getValoregriglia101v9_3.

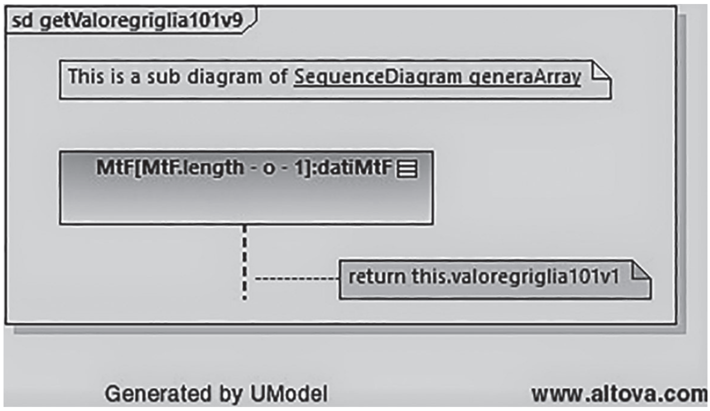

FIGURE 15.171 getValoregriglia101v9_4.

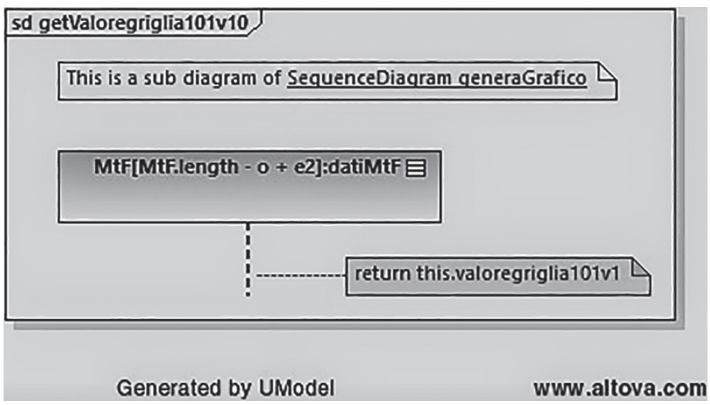

FIGURE 15.172 getValoregriglia101v10.

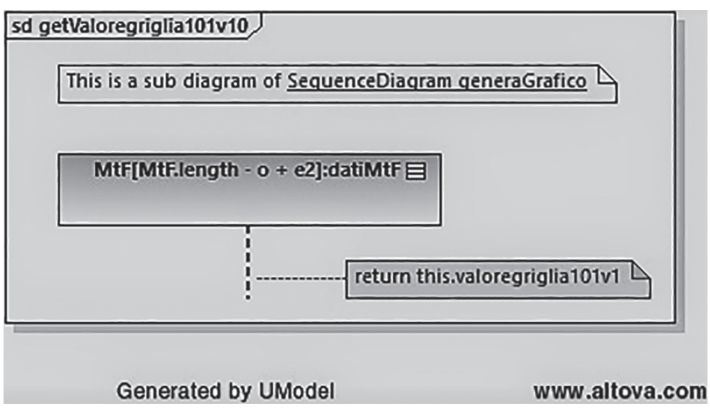

FIGURE 15.173 getValoregriglia101v10_1.

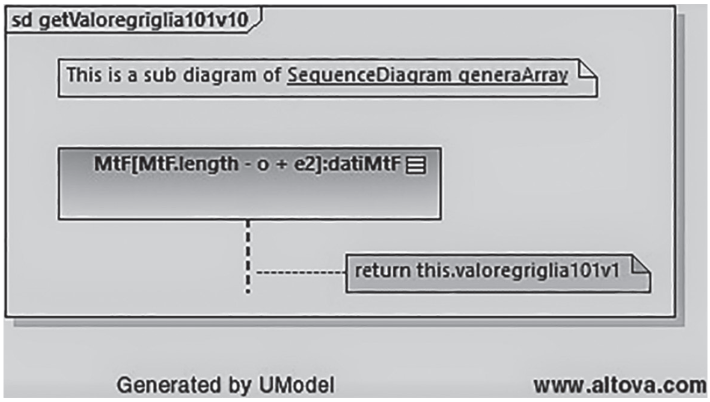

FIGURE 15.174 getValoregriglia101v10_2.

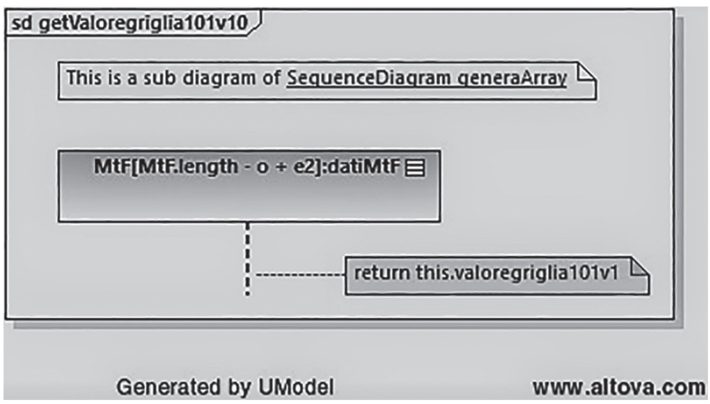

FIGURE 15.175 getValoregriglia101v10_3.

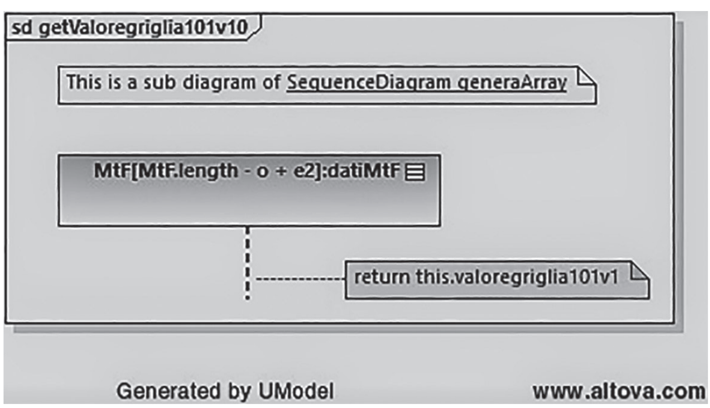

FIGURE 15.176 getValoregriglia101v10_4.

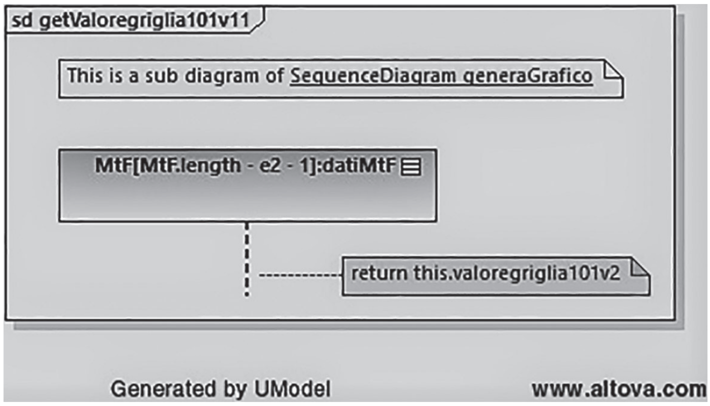

FIGURE 15.177 getValoregriglia101v11.

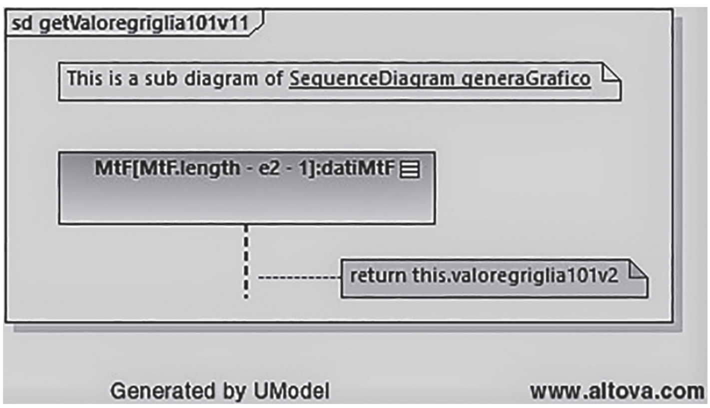

FIGURE 15.178 getValoregriglia101v11_1.

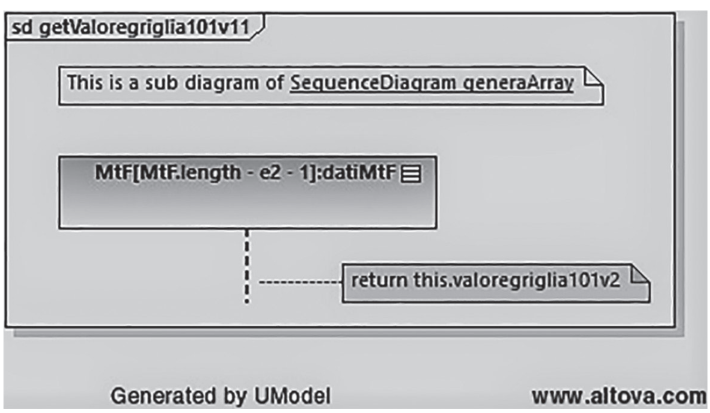

FIGURE 15.179 getValoregriglia101v11_2.

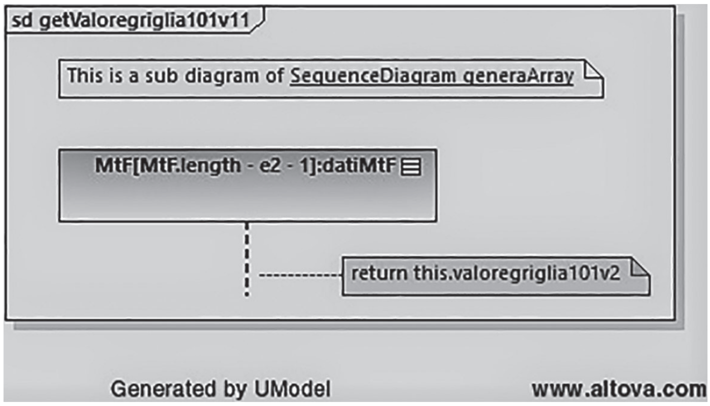

FIGURE 15.180 getValoregriglia101v11_3.

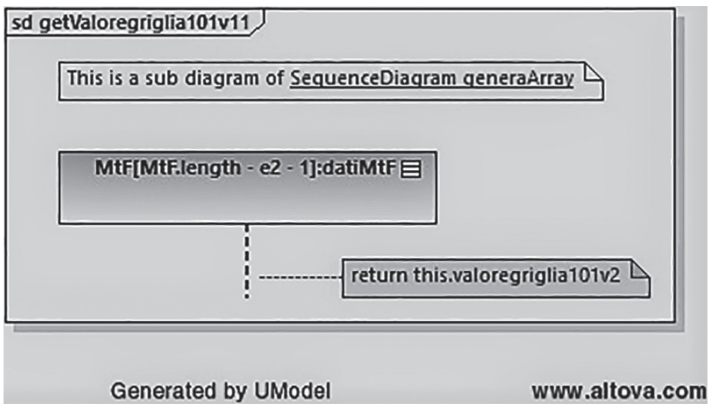

FIGURE 15.181 getValoregriglia101v11_4.

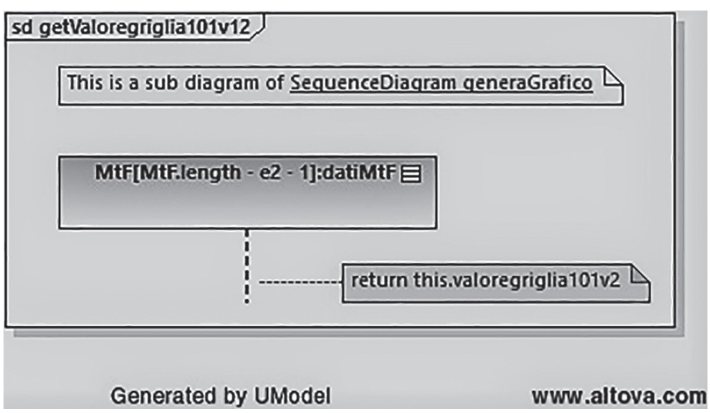

FIGURE 15.182 getValoregriglia101v12.

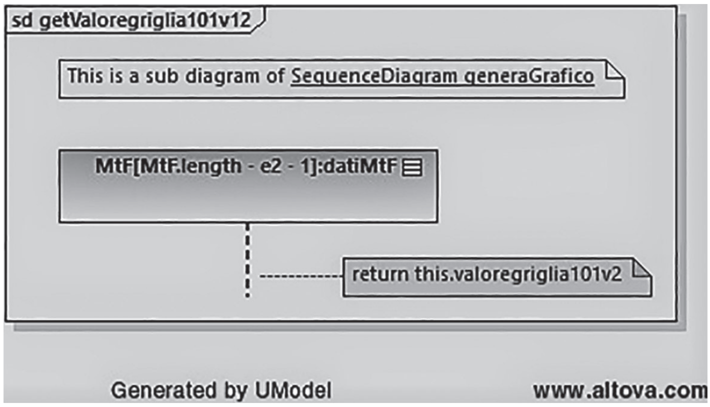

FIGURE 15.183 getValoregriglia101v12_1.

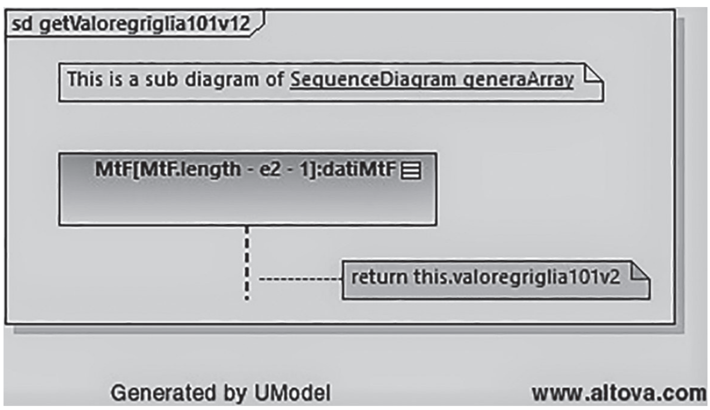

FIGURE 15.184 getValoregriglia101v12_2.

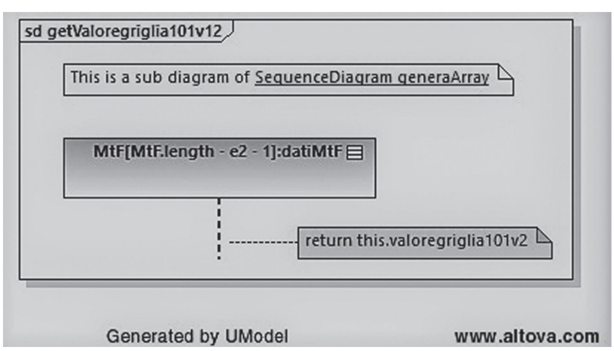

FIGURE 15.185 getValoregriglia101v12_3.

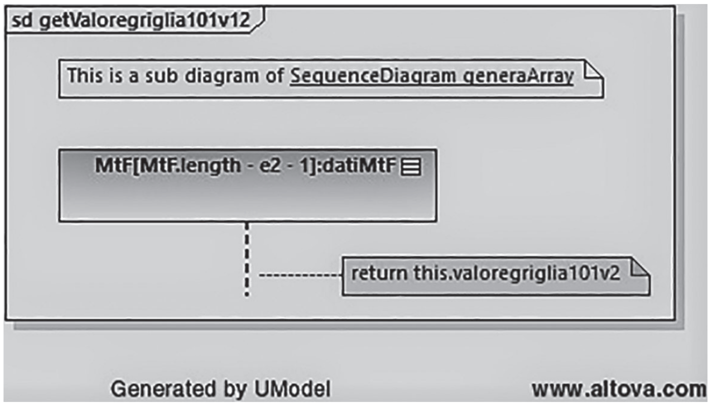

FIGURE 15.186 getValoregriglia101v12_4.

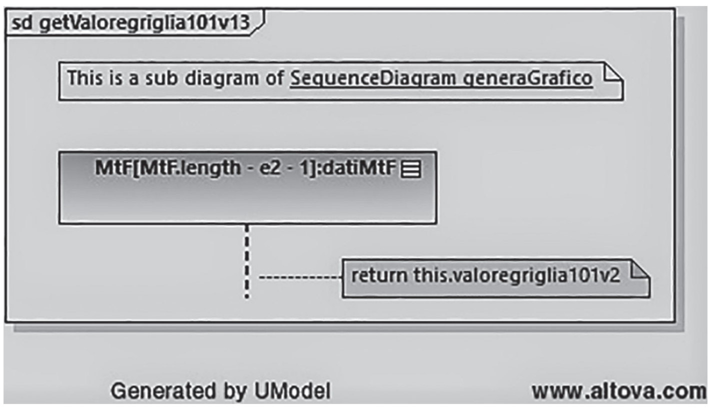

FIGURE 15.187 getValoregriglia101v13.

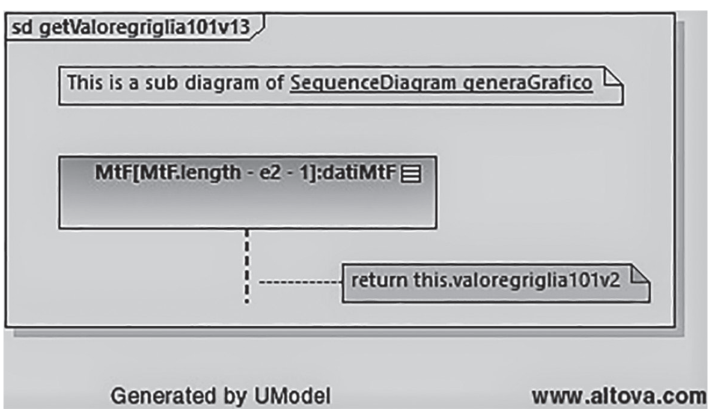

FIGURE 15.188 getValoregriglia101v13_1.

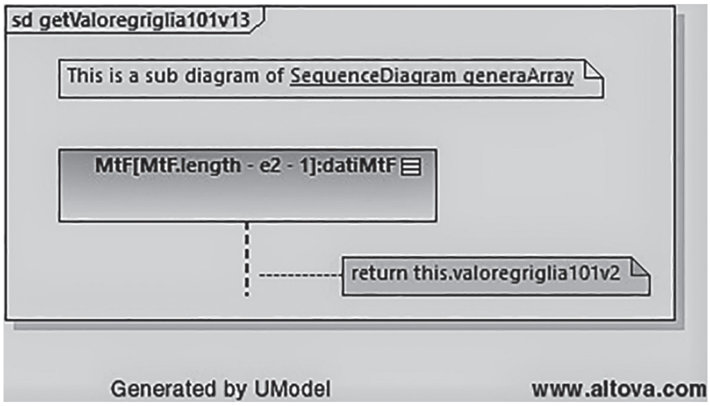

FIGURE 15.189 getValoregriglia101v13_2.

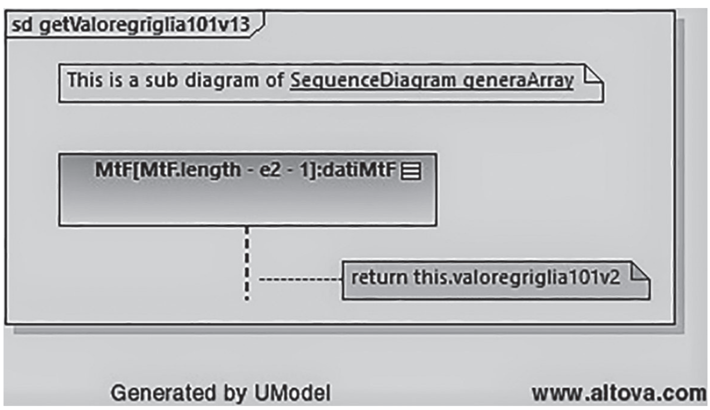

FIGURE 15.190 getValoregriglia101v13_3.

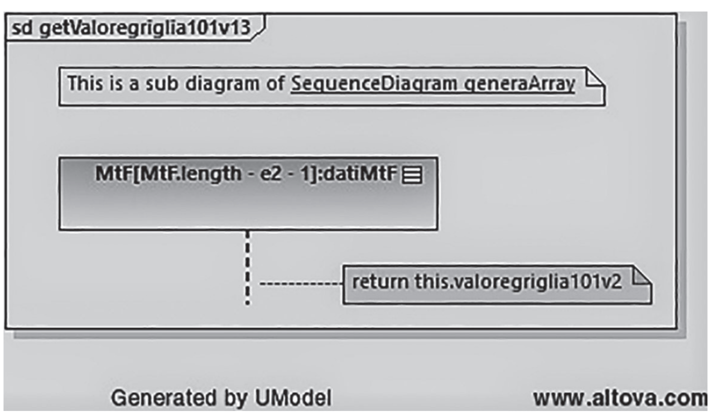

FIGURE 15.191 getValoregriglia101v13_4.

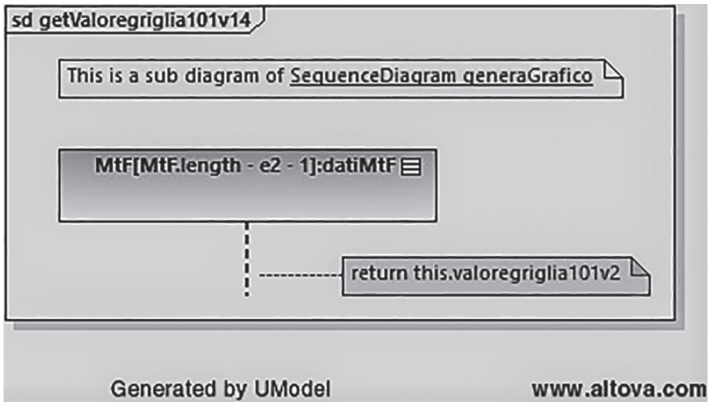

FIGURE 15.192 getValoregriglia101v14.

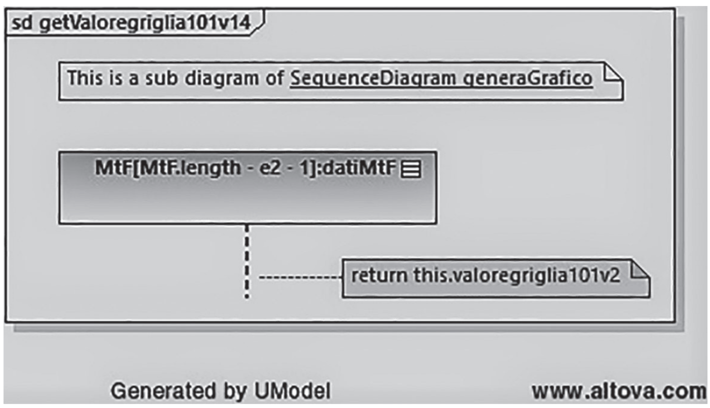

FIGURE 15.193 getValoregriglia101v14_1.

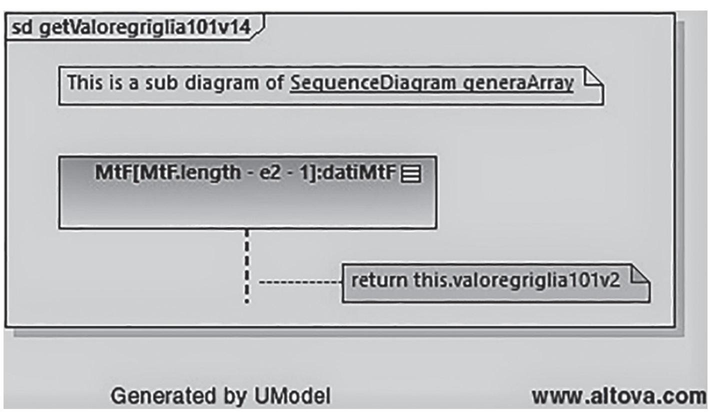

FIGURE 15.194 getValoregriglia101v14_2.

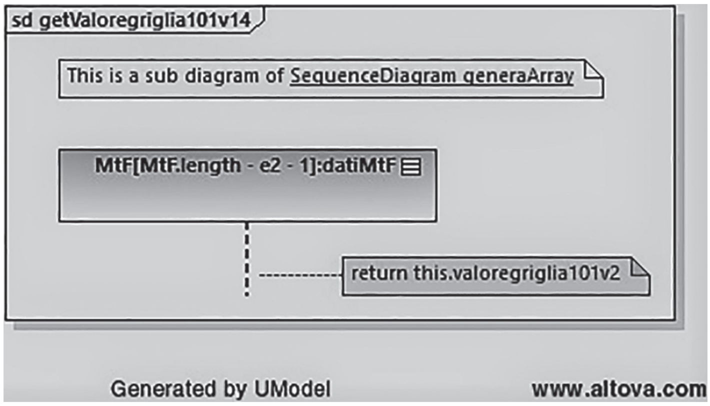

FIGURE 15.195 getValoregriglia101v14_3.

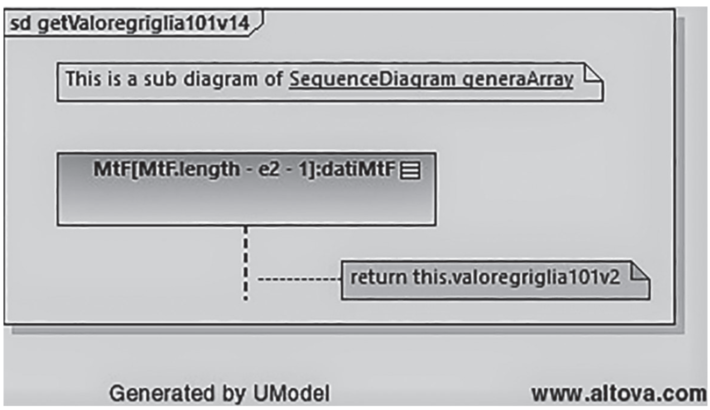

FIGURE 15.196 getValoregriglia101v14_4.

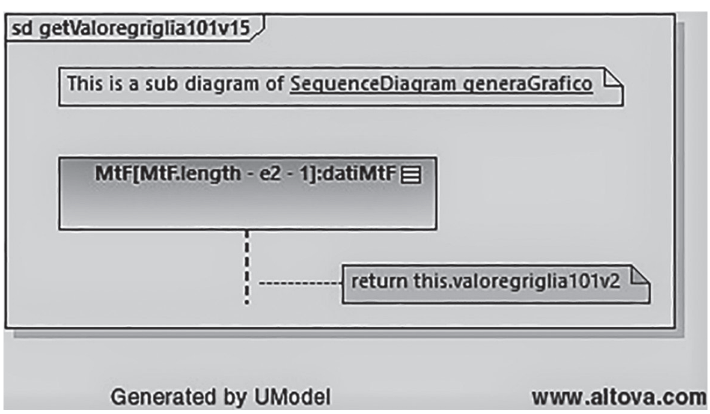

FIGURE 15.197 getValoregriglia101v15.

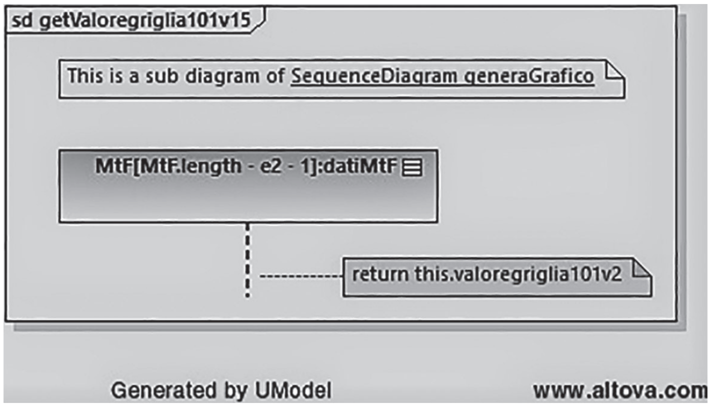

FIGURE 15.198 getValoregriglia101v15_1.

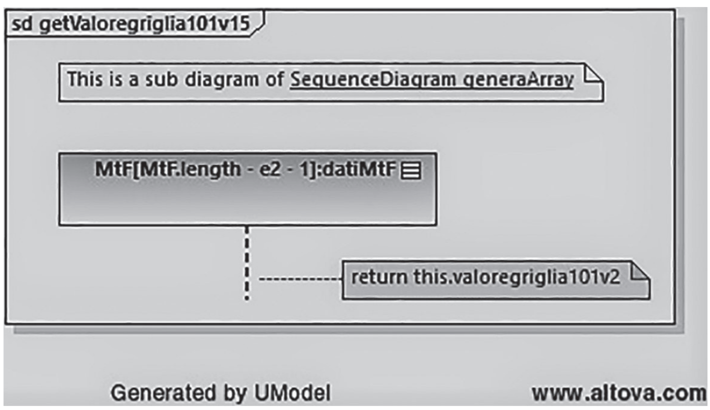

FIGURE 15.199 getValoregriglia101v15_2.

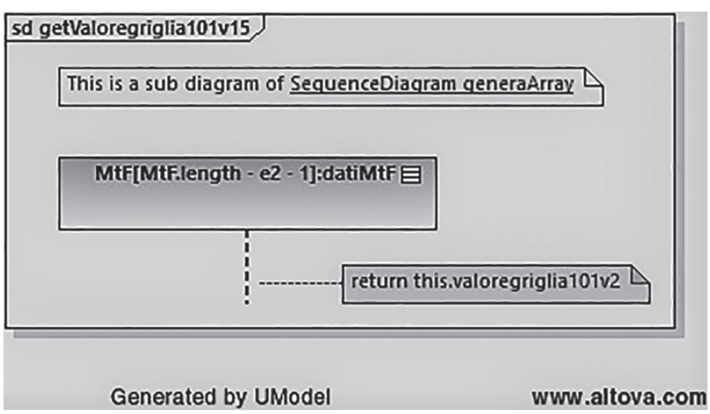

FIGURE 15.200 getValoregriglia101v15_3.

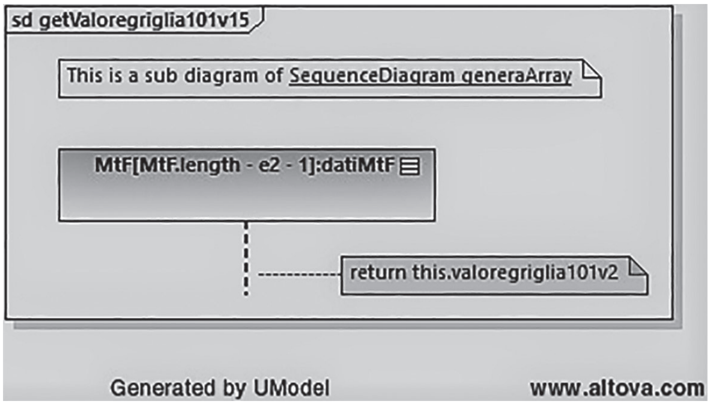

FIGURE 15.201 getValoregriglia101v15_4.

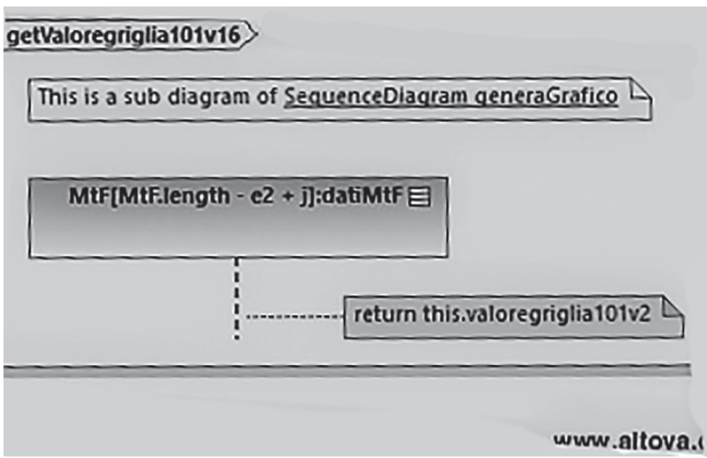

FIGURE 15.202 getValoregriglia101v16.

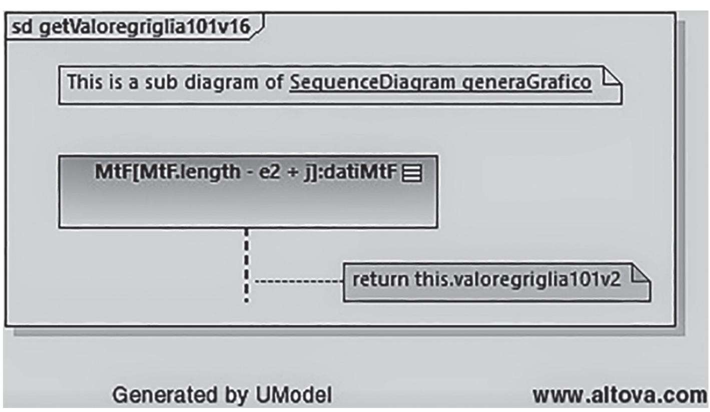

FIGURE 15.203 getValoregriglia101v16_1.

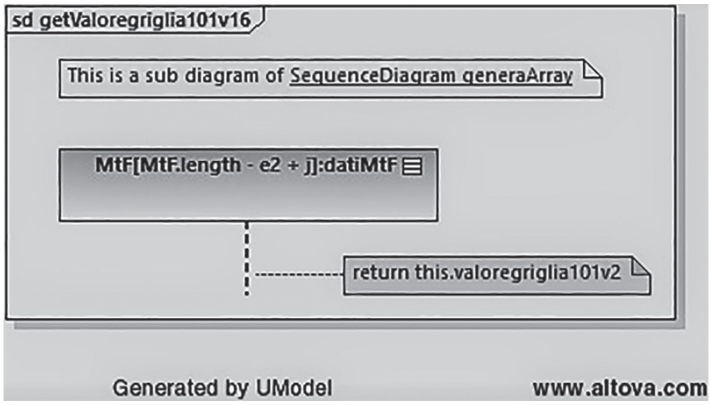

FIGURE 15.204 getValoregriglia101v16_2.

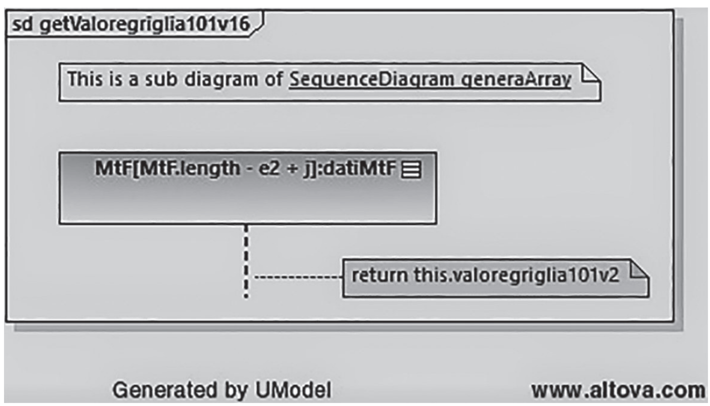

FIGURE 15.205 getValoregriglia101v16_3.

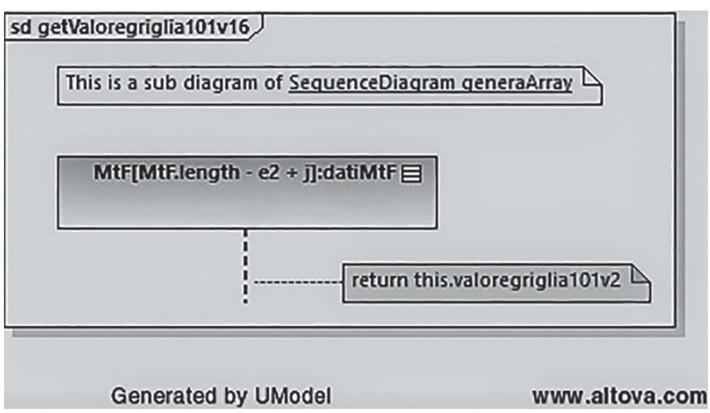

FIGURE 15.206 getValoregriglia101v16_4.

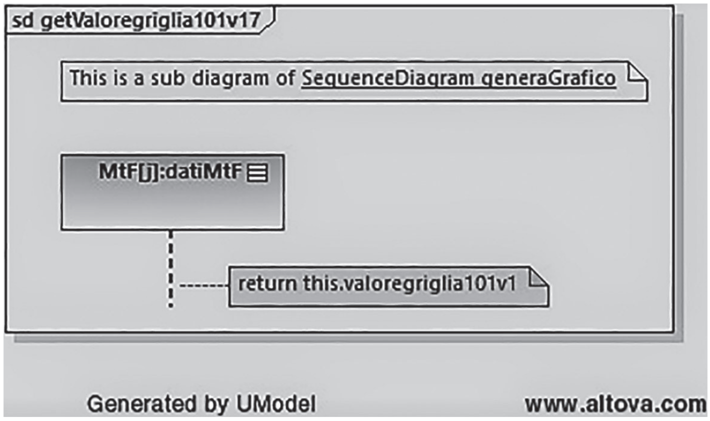

FIGURE 15.207 getValoregriglia101v17.

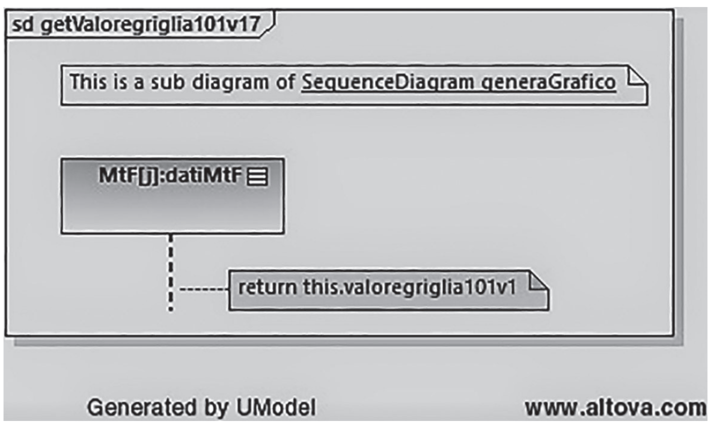

FIGURE 15.208 getValoregriglia101v17_1.

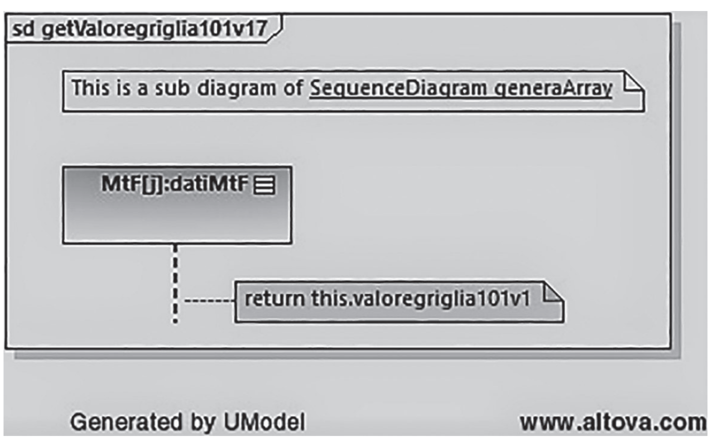

FIGURE 15.209 getValoregriglia101v17_2.

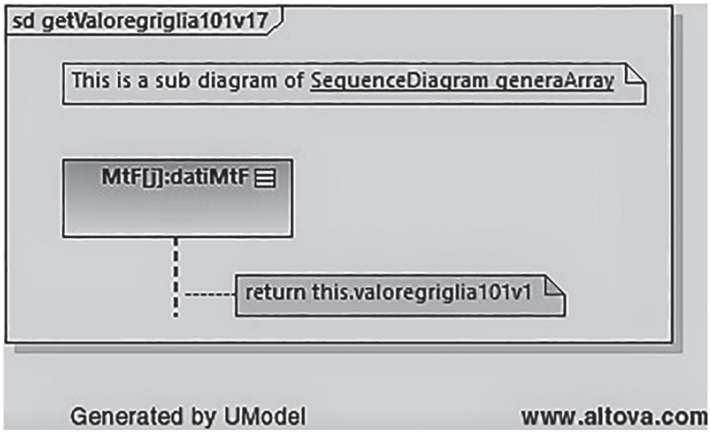

FIGURE 15.210 getValoregriglia101v17_3.

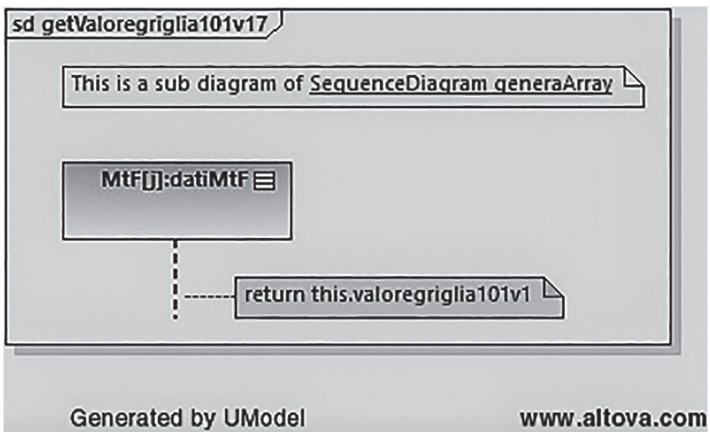

FIGURE 15.211 getValoregriglia101v17_4.

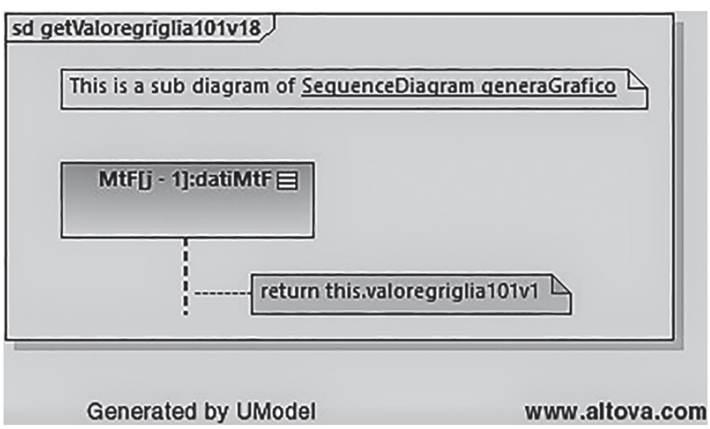

FIGURE 15.212 getValoregriglia101v18.

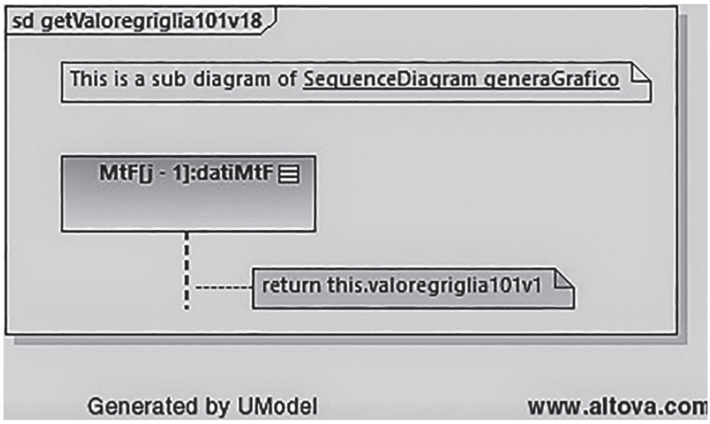

FIGURE 15.213 getValoregriglia101v18_1.

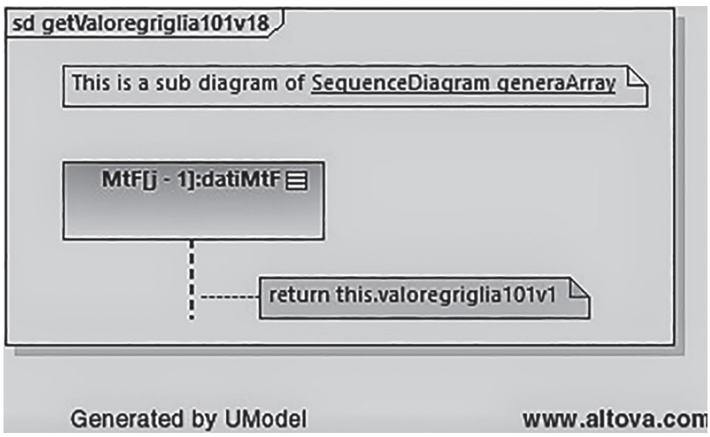

FIGURE 15.214 getValoregriglia101v18_2.

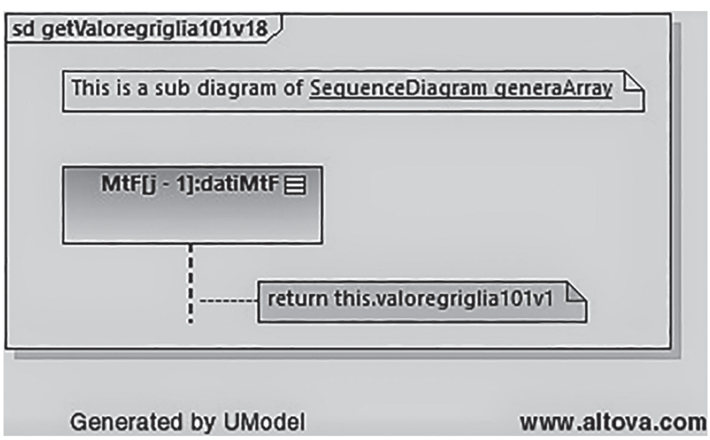

FIGURE 15.215 getValoregriglia101v18_3.

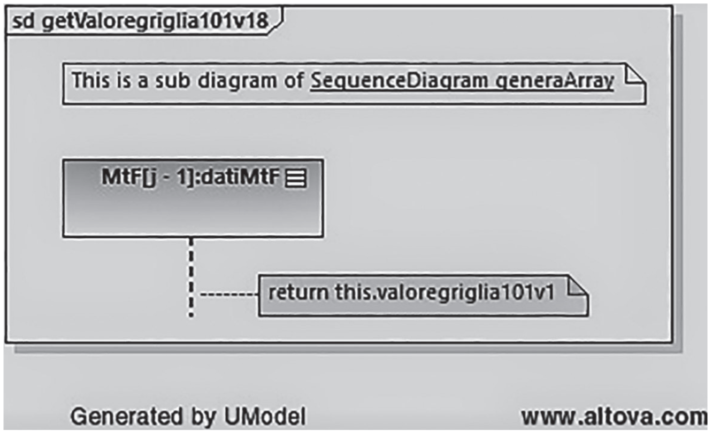

FIGURE 15.216 getValoregriglia101v18_4.

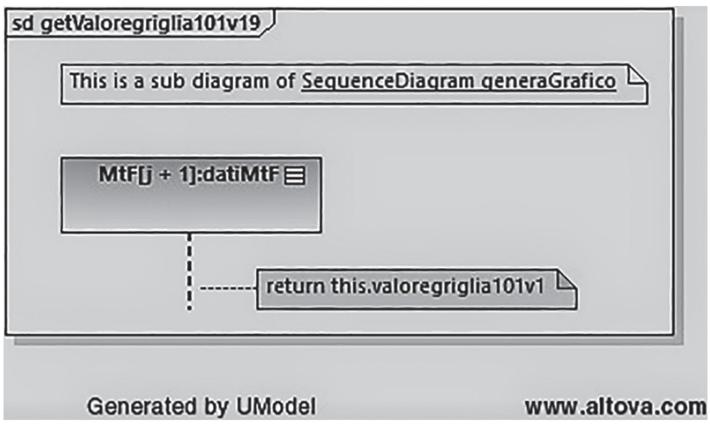

FIGURE 15.217 getValoregriglia101v19.

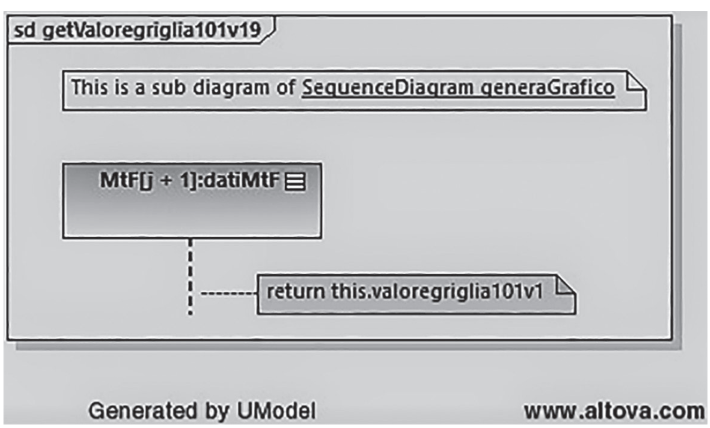

FIGURE 15.218 getValoregriglia101v19_1.

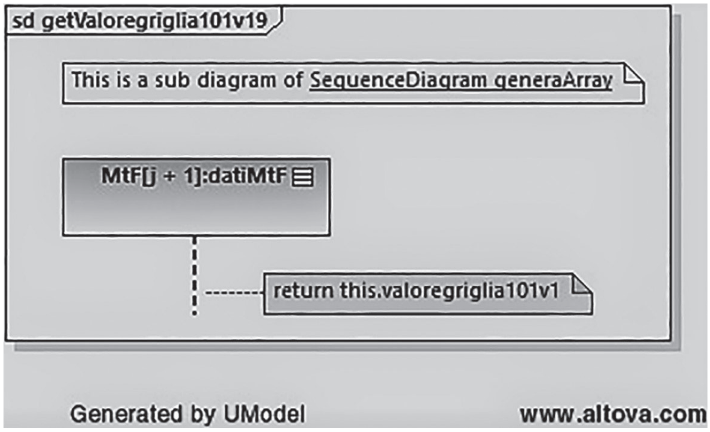

FIGURE 15.219 getValoregriglia101v19_2.

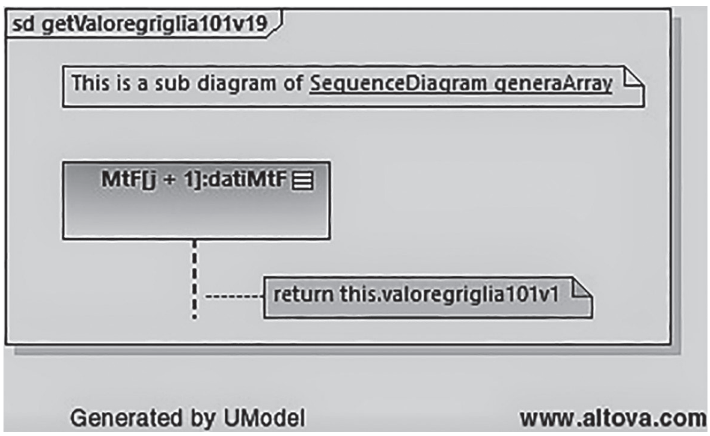

FIGURE 15.220 getValoregriglia101v19_3.

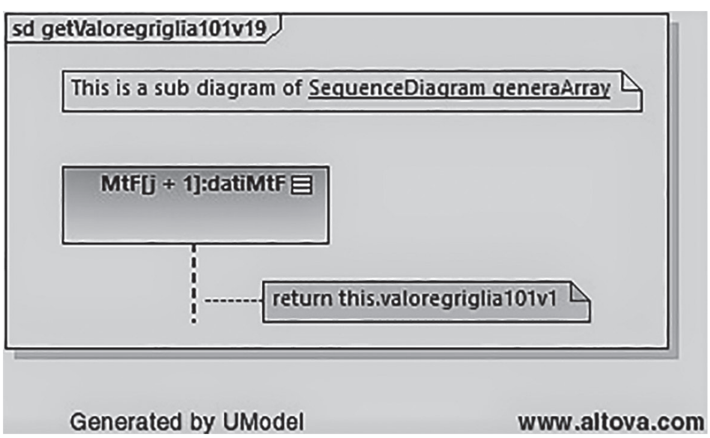

FIGURE 15.221 getValoregriglia101v19_4.

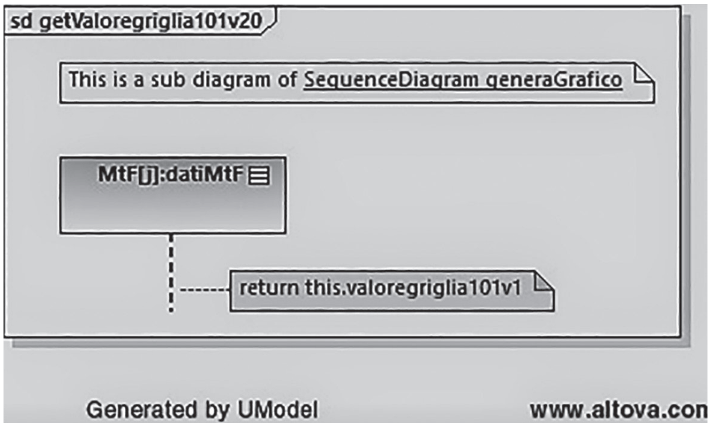

FIGURE 15.222 getValoregriglia101v20.

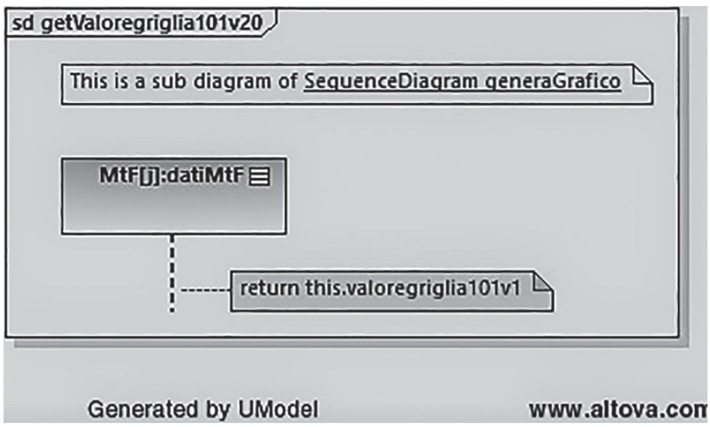

FIGURE 15.223 getValoregriglia101v20_1.

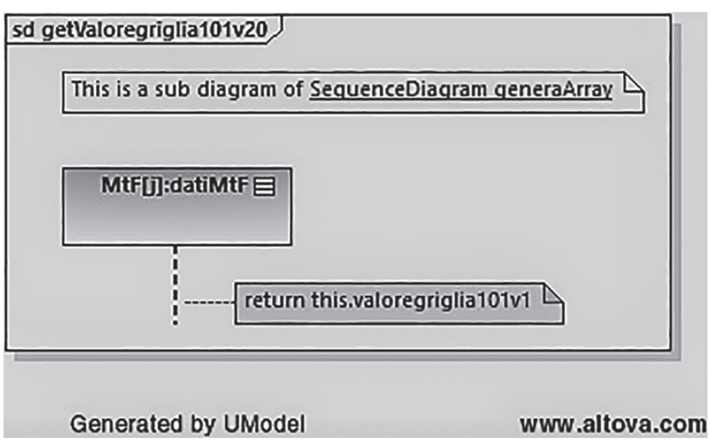

FIGURE 15.224 getValoregriglia101v20_2.

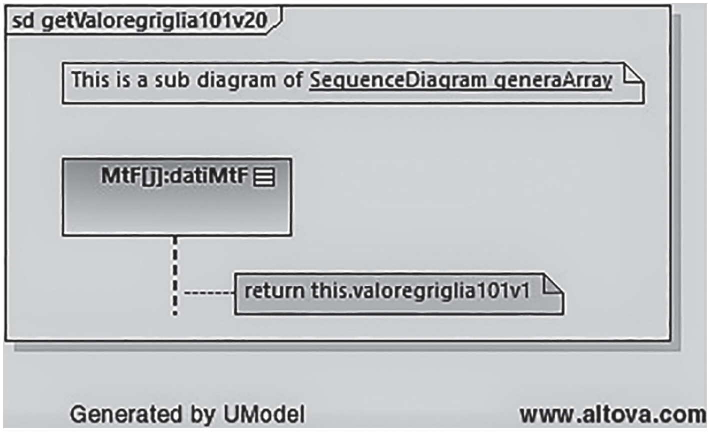

FIGURE 15.225 getValoregriglia101v20_3.

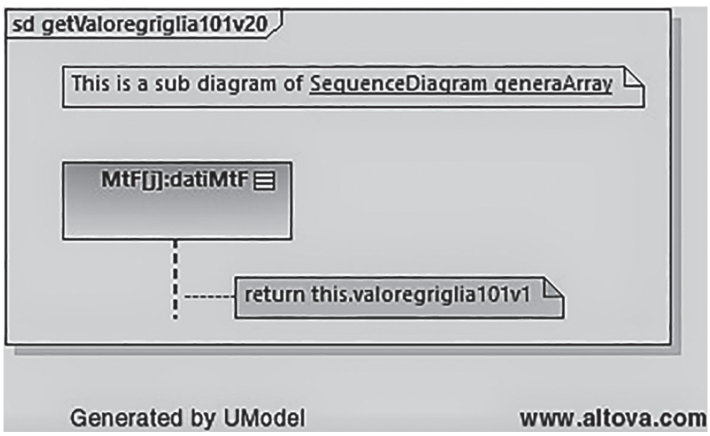

FIGURE 15.226 getValoregriglia101v20_4.

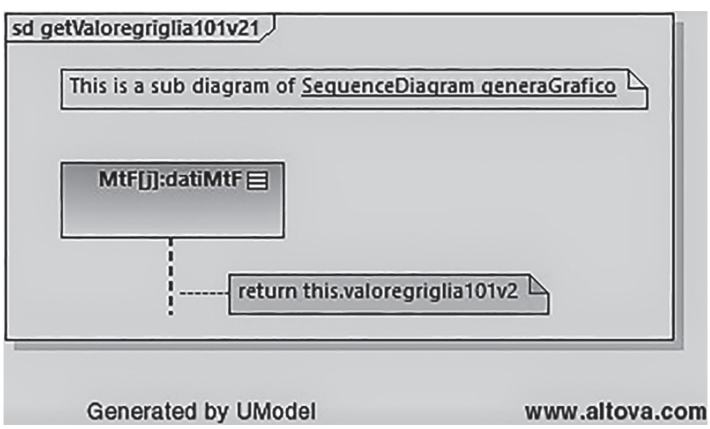

FIGURE 15.227 getValoregriglia101v21.

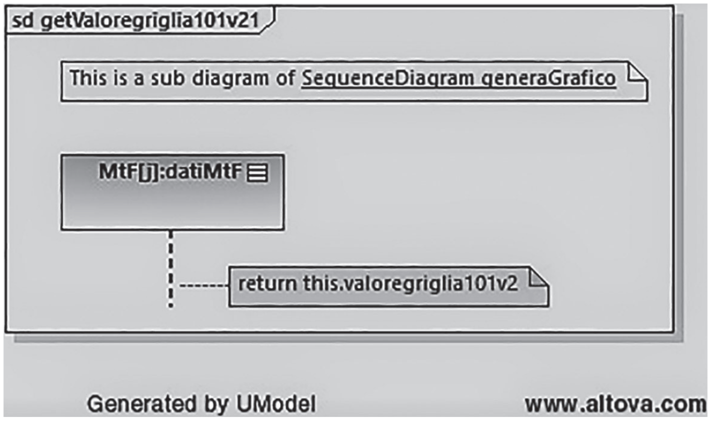

FIGURE 15.228 getValoregriglia101v21_1.

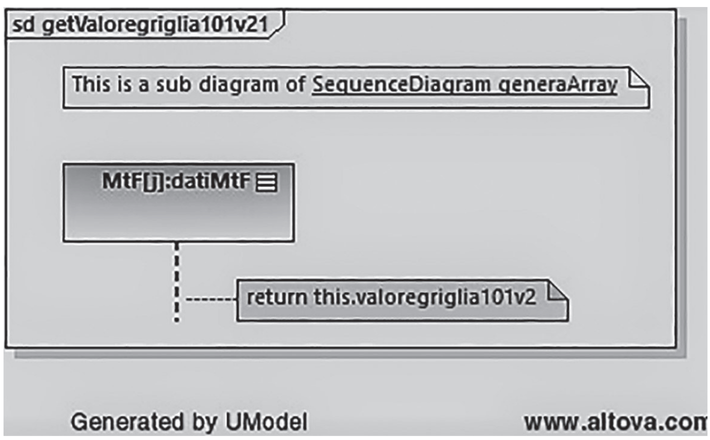

FIGURE 15.229 getValoregriglia101v21_2.

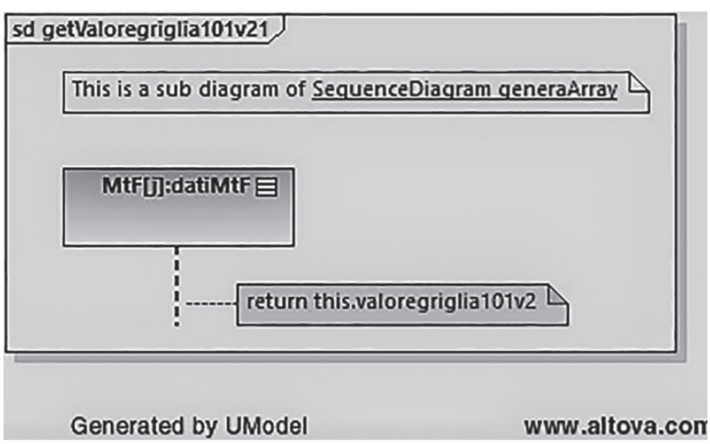

FIGURE 15.230 getValoregriglia101v21_3.

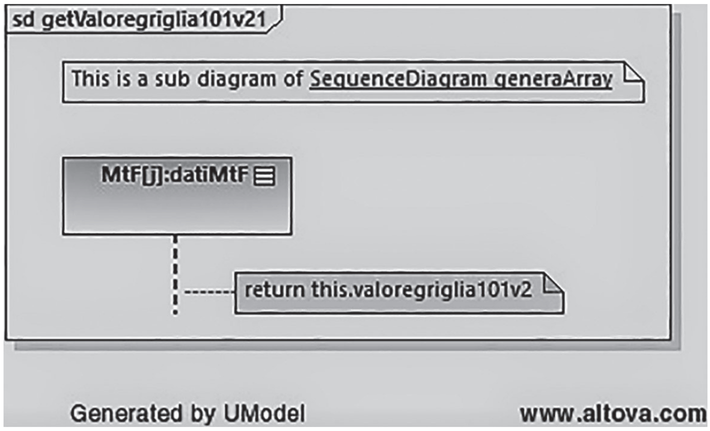

FIGURE 15.231 getValoregriglia101v21_4.

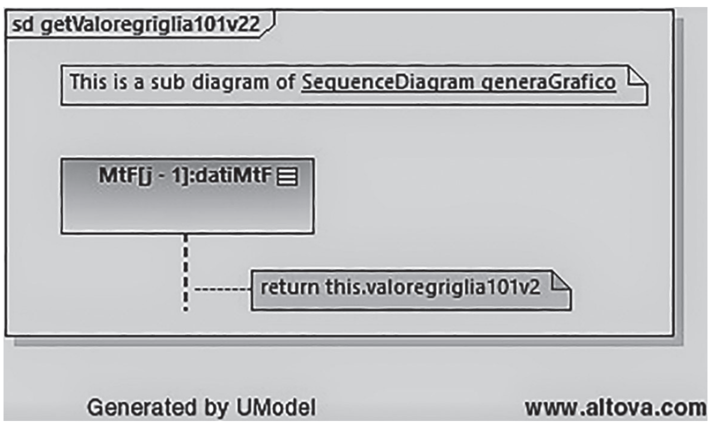

FIGURE 15.232 getValoregriglia101v22.

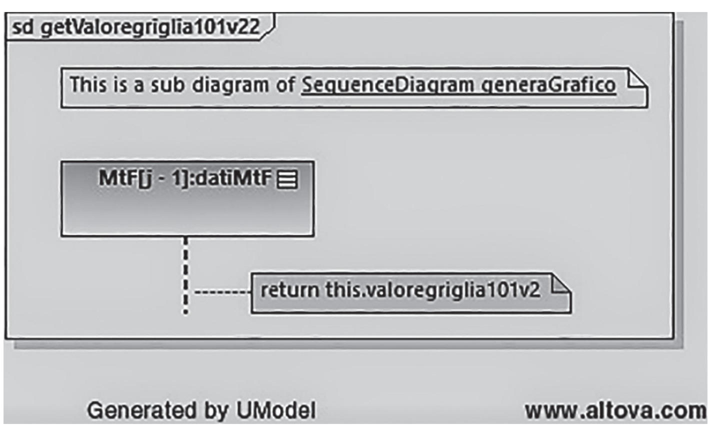

FIGURE 15.233 getValoregriglia101v22_.

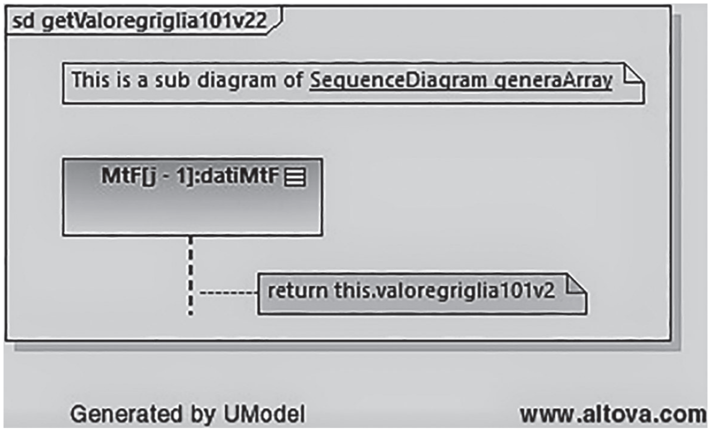

FIGURE 15.234 getValoregriglia101v22_2.

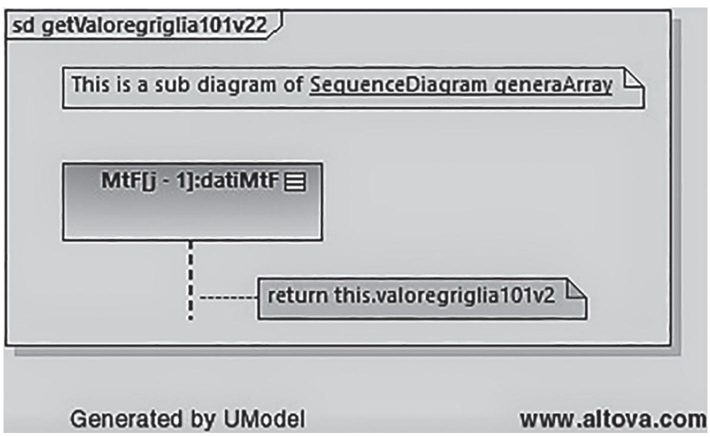

FIGURE 15.235 getValoregriglia101v22_3.

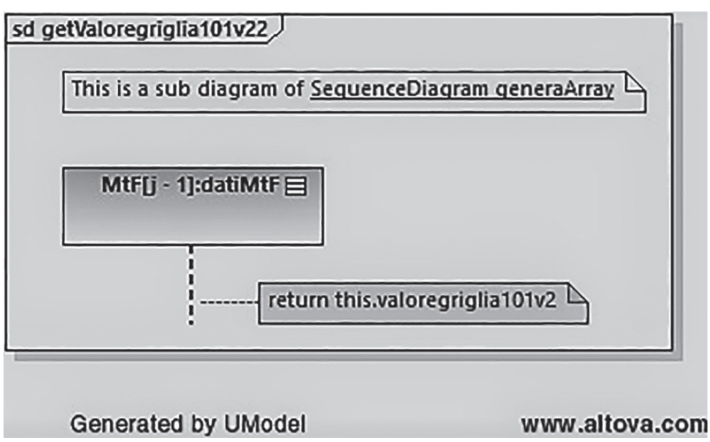

FIGURE 15.236 getValoregriglia101v22_4.

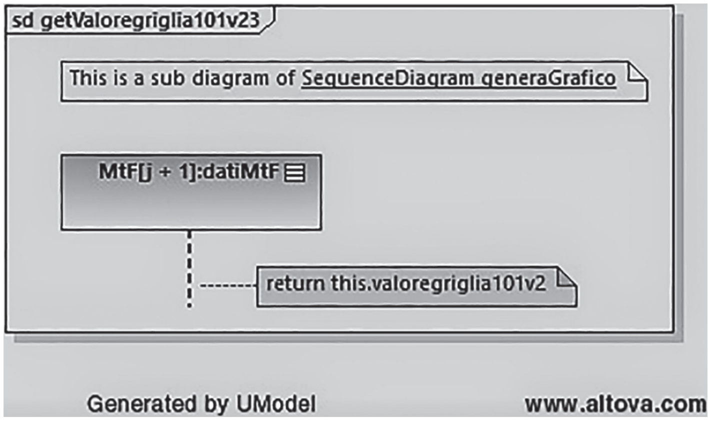

FIGURE 15.237 getValoregriglia101v23.

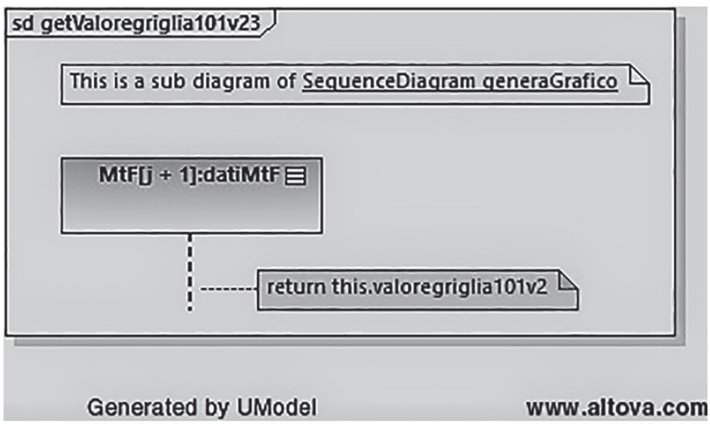

FIGURE 15.238 getValoregriglia101v23_1.

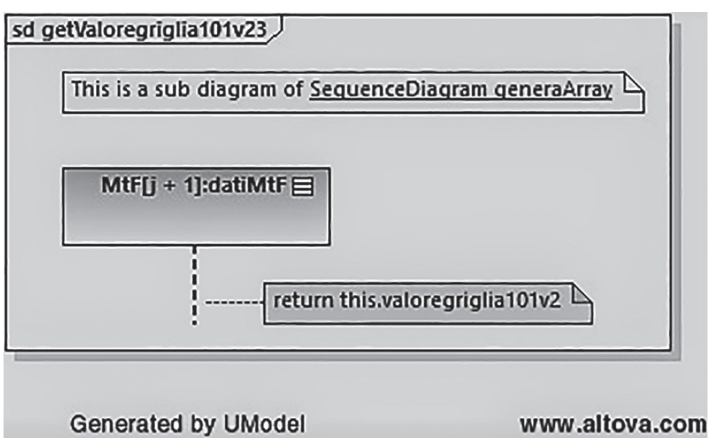

FIGURE 15.239 getValoregriglia101v23_2.

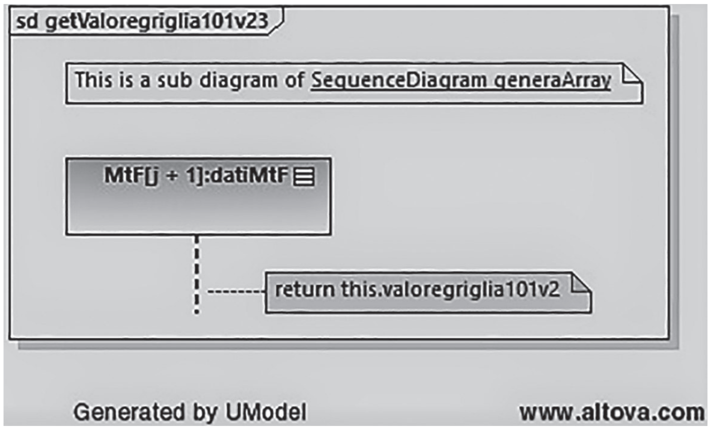

FIGURE 15.240 getValoregriglia101v23_3.

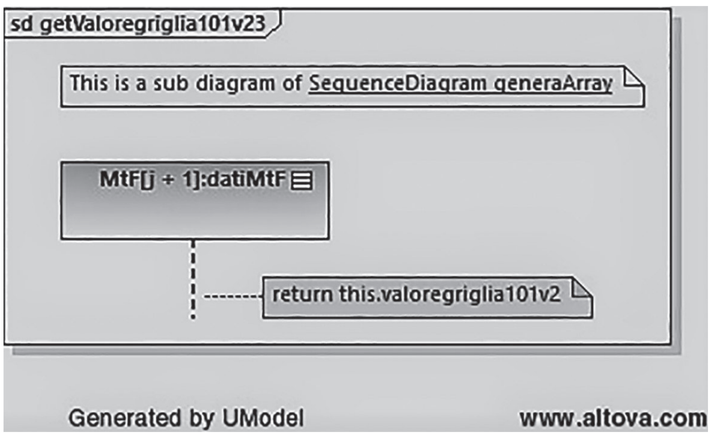

FIGURE 15.241 getValoregriglia101v23_4.

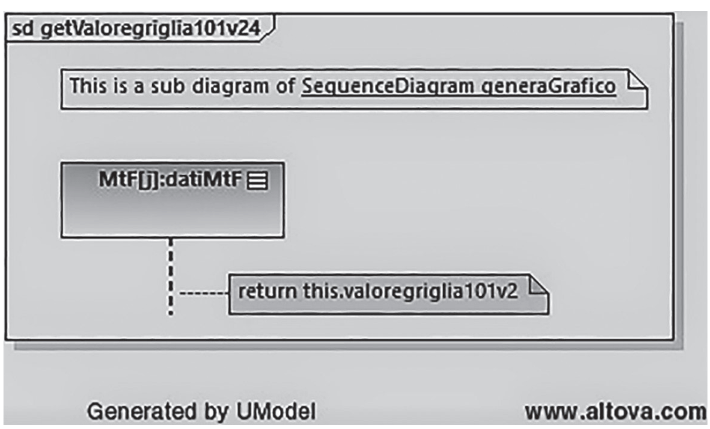

FIGURE 15.242 getValoregriglia101v24.

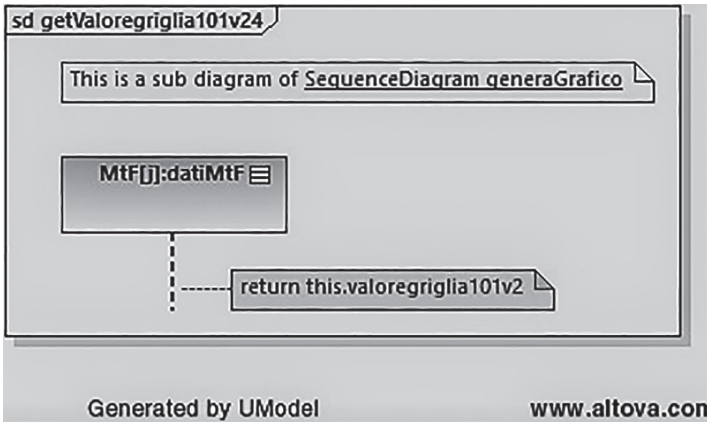

FIGURE 15.243 getValoregriglia101v24_1.

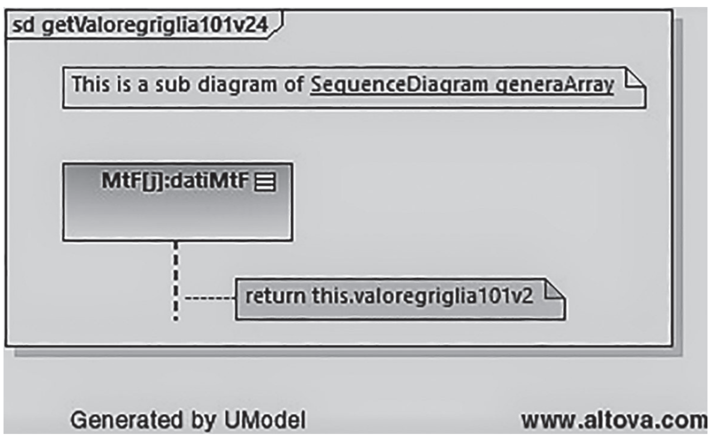

FIGURE 15.244 getValoregriglia101v24_2.

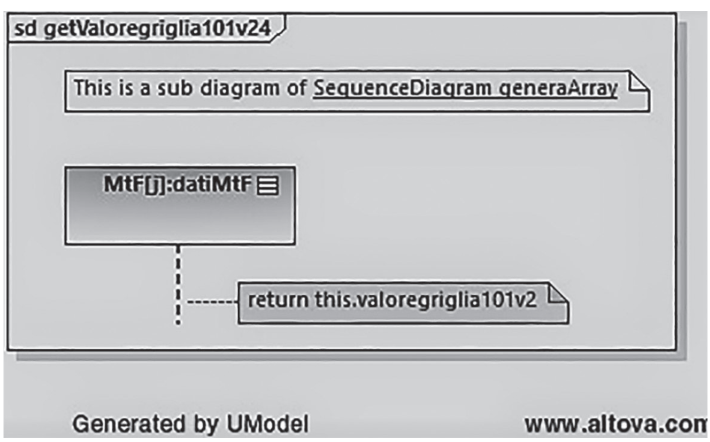

FIGURE 15.245 getValoregriglia101v24_3.

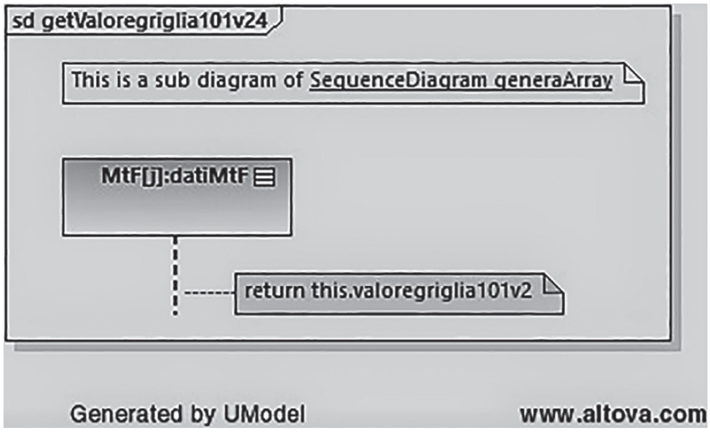

FIGURE 15.246 getValoregriglia101v24_4.

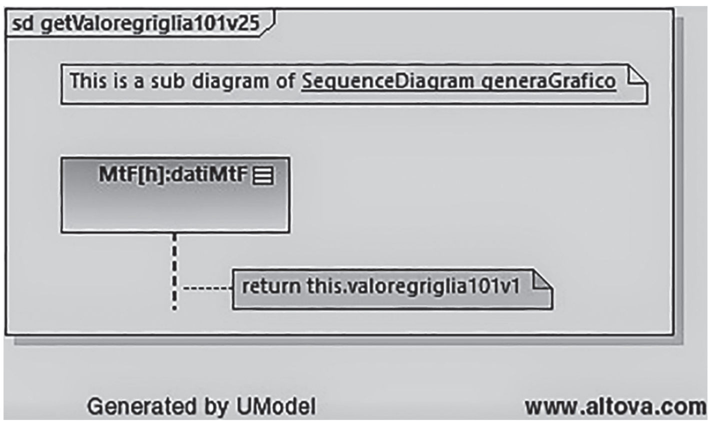

FIGURE 15.247 getValoregriglia101v25.

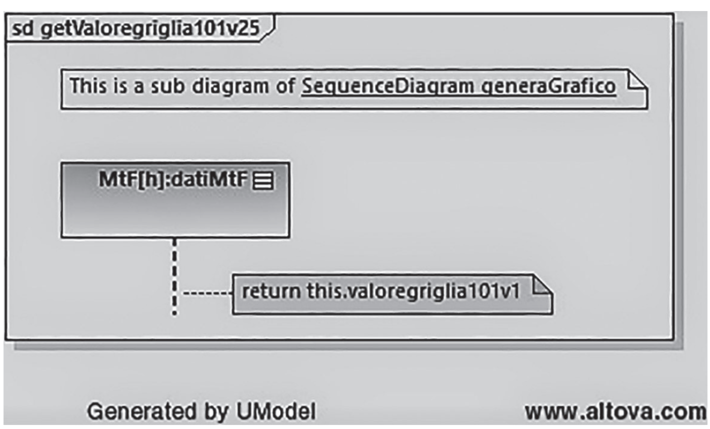

FIGURE 15.248 getValoregriglia101v25_1.

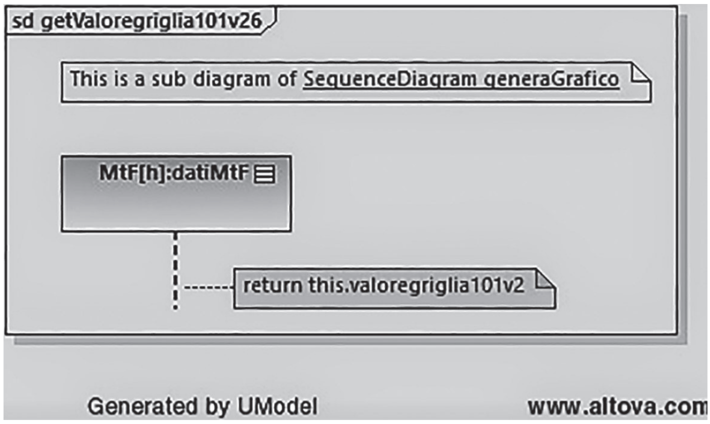

FIGURE 15.249 getValoregriglia101v26.

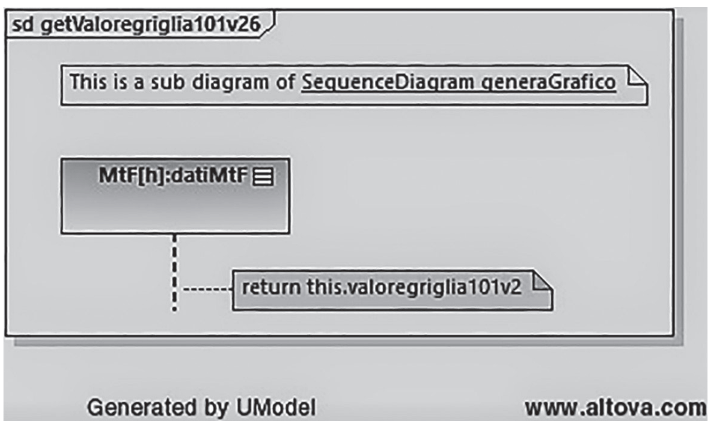

FIGURE 15.250 getValoregriglia101v26_1.

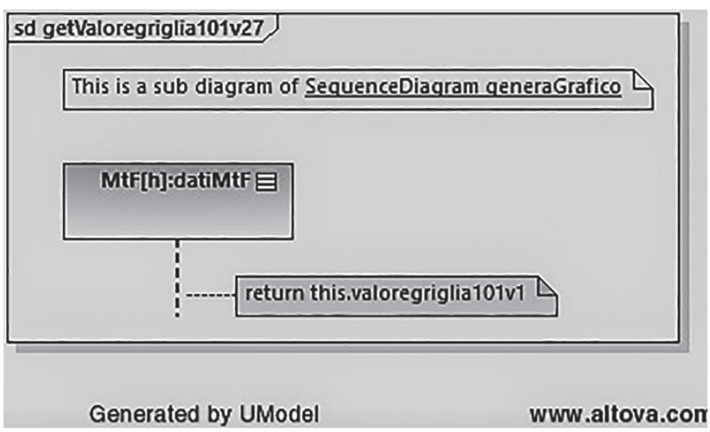

FIGURE 15.251 getValoregriglia101v27.

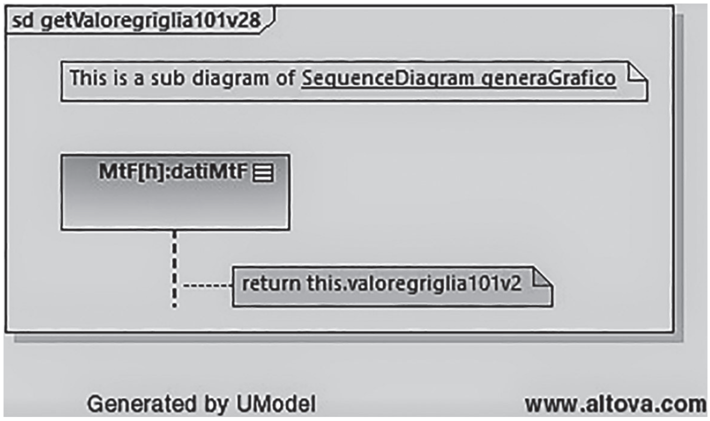

FIGURE 15.252 getValoregriglia101v28.

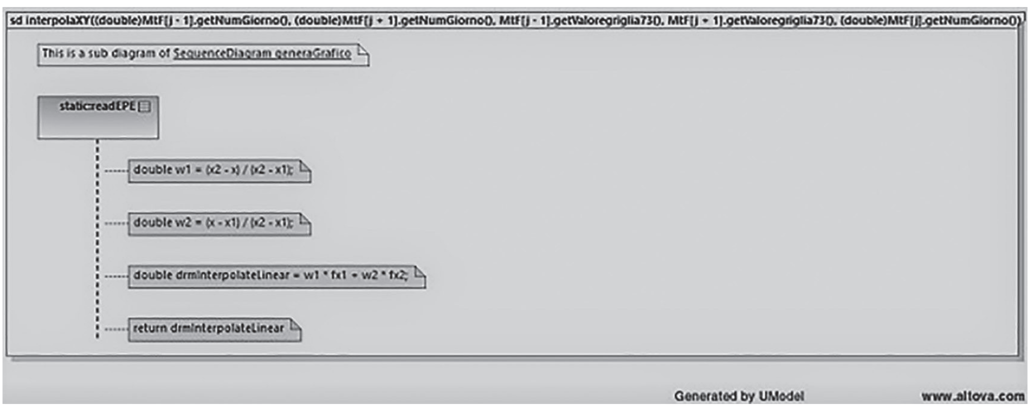

FIGURE 15.253 interpolaXY((double)MtF[j – 1].getNumGiorno(), (double)MtF[j + 1].getNumGiorno(), MtF[j – 1].getValoregriglia73(), MtF[j + 1].getValoregriglia73(), (double)MtF[j].getNumGiorno()).

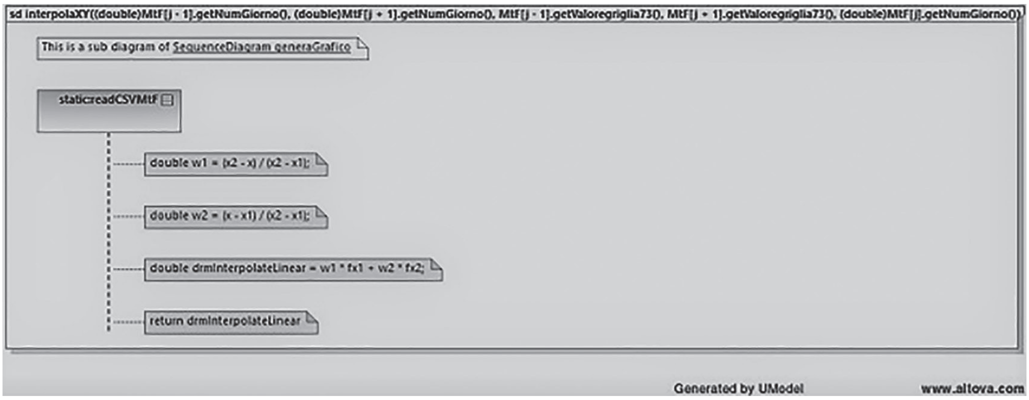

FIGURE 15.254 interpolaXY((double)MtF[j – 1].getNumGiorno(), (double)MtF[j + 1].getNumGiorno(), MtF[j – 1].getValoregriglia73(), MtF[j + 1].getValoregriglia73(), (double)MtF[j].getNumGiorno())_1.

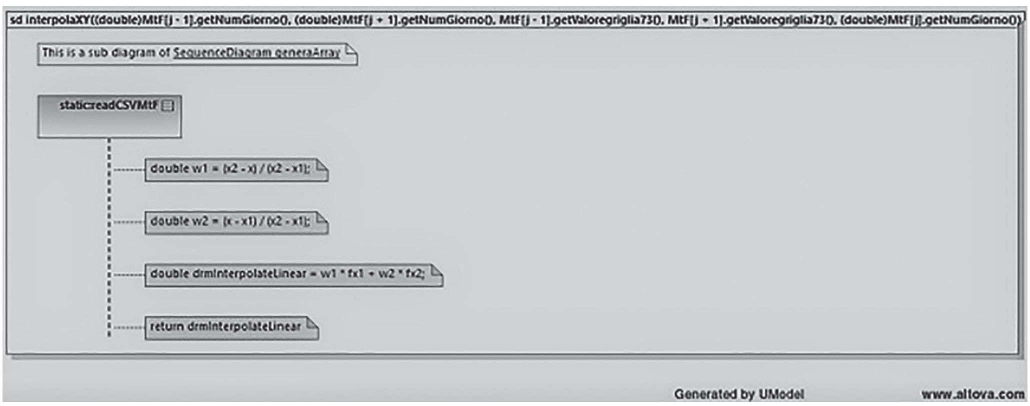

FIGURE 15.255 interpolaXY((double)MtF[j – 1].getNumGiorno(), (double)MtF[j + 1].getNumGiorno(), MtF[j – 1].getValoregriglia73(), MtF[j + 1].getValoregriglia73(), (double)MtF[j].getNumGiorno())_2.

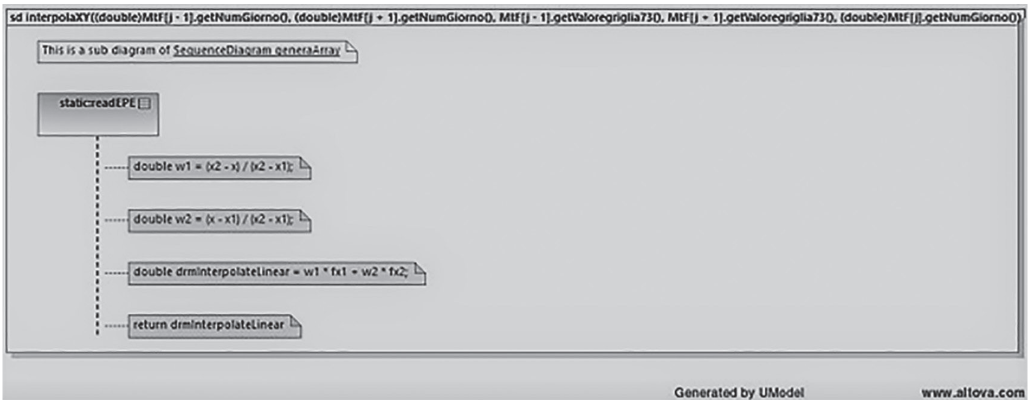

FIGURE 15.256 interpolaXY((double)MtF[j – 1].getNumGiorno(), (double)MtF[j + 1].getNumGiorno(), MtF[j – 1].getValoregriglia73(), MtF[j + 1].getValoregriglia73(), (double)MtF[j].getNumGiorno())_3.

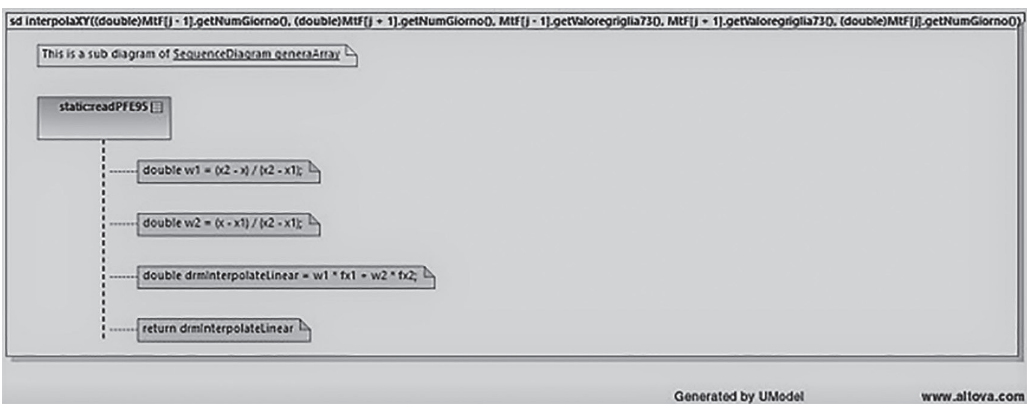

FIGURE 15.257 interpolaXY((double)MtF[j – 1].getNumGiorno(), (double)MtF[j + 1].getNumGiorno(), MtF[j – 1].getValoregriglia73(), MtF[j + 1].getValoregriglia73(), (double)MtF[j].getNumGiorno())_4.

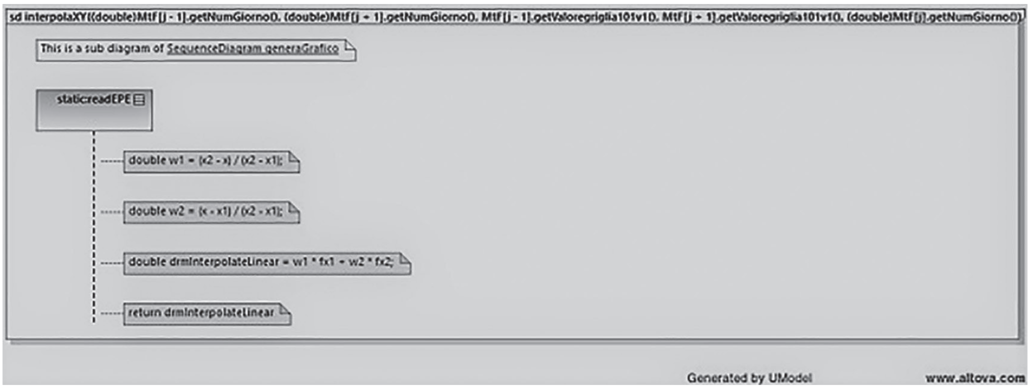

FIGURE 15.258 interpolaXY((double)MtF[j − 1].getNumGiorno(), (double)MtF[j + 1].getNumGiorno(), MtF[j − 1].getValoregriglia101v1(), MtF[j + 1].getValoregriglia101v1(), (double)MtF[j].getNumGiorno()).

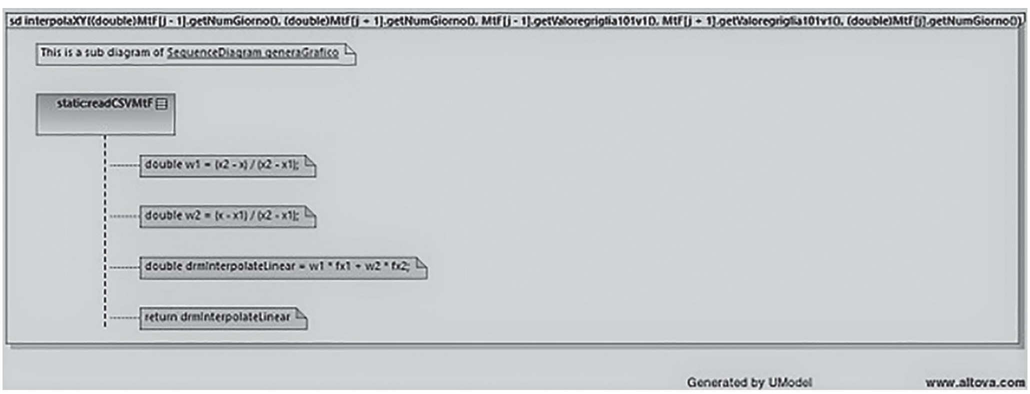

FIGURE 15.259 interpolaXY((double)MtF[j − 1].getNumGiorno(), (double)MtF[j + 1].getNumGiorno(), MtF[j − 1].getValoregriglia101v1(), MtF[j + 1].getValoregriglia101v1(), (double)MtF[j].getNumGiorno())_1.

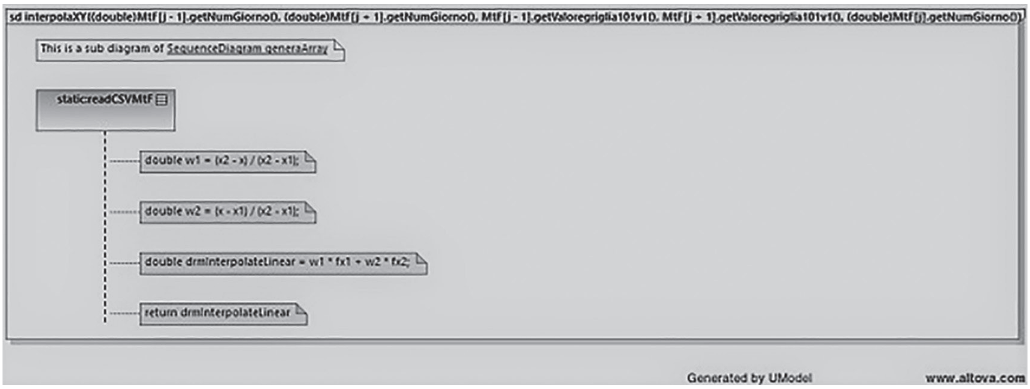

FIGURE 15.260 interpolaXY((double)MtF[j − 1].getNumGiorno(), (double)MtF[j + 1].getNumGiorno(), MtF[j − 1].getValoregriglia101v1(), MtF[j + 1].getValoregriglia101v1(), (double)MtF[j].getNumGiorno())_2.

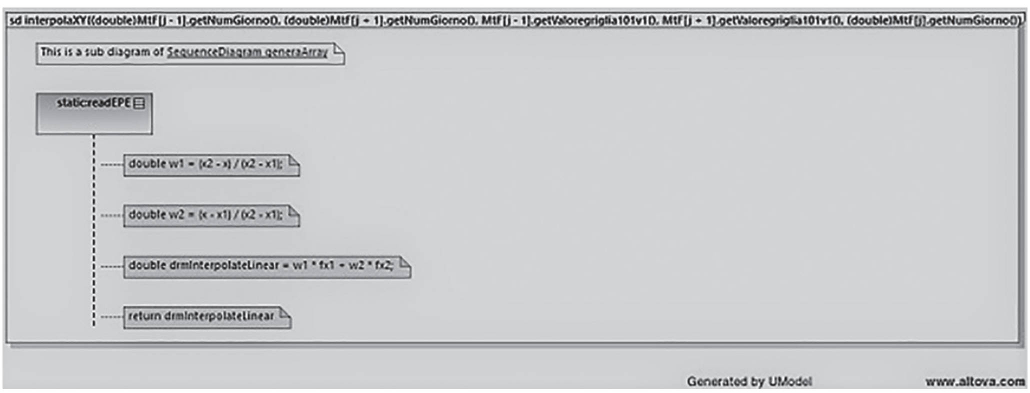

FIGURE 15.261 interpolaXY((double)MtF[j − 1].getNumGiorno(), (double)MtF[j + 1].getNumGiorno(), MtF[j − 1].getValoregriglia101v1(), MtF[j + 1].getValoregriglia101v1(), (double)MtF[j].getNumGiorno())_3.

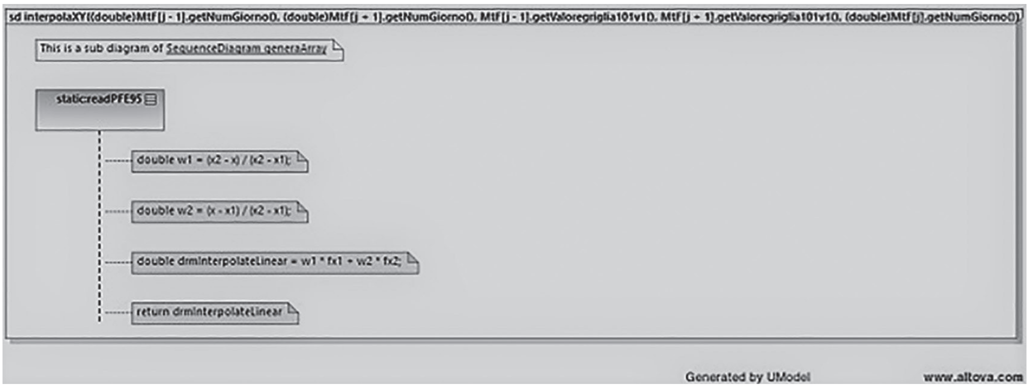

FIGURE 15.262 interpolaXY((double)MtF[j – 1].getNumGiorno(), (double)MtF[j + 1].getNumGiorno(), MtF[j – 1].getValoregriglia101v1(), MtF[j + 1].getValoregriglia101v1(), (double)MtF[j].getNumGiorno())_4.

FIGURE 15.263 interpolaXY((double)MtF[j – 1].getNumGiorno(), (double)MtF[j + 1].getNumGiorno(), MtF[j – 1].getValoregriglia101v2(), MtF[j + 1].getValoregriglia101v2(), (double)MtF[j].getNumGiorno()).

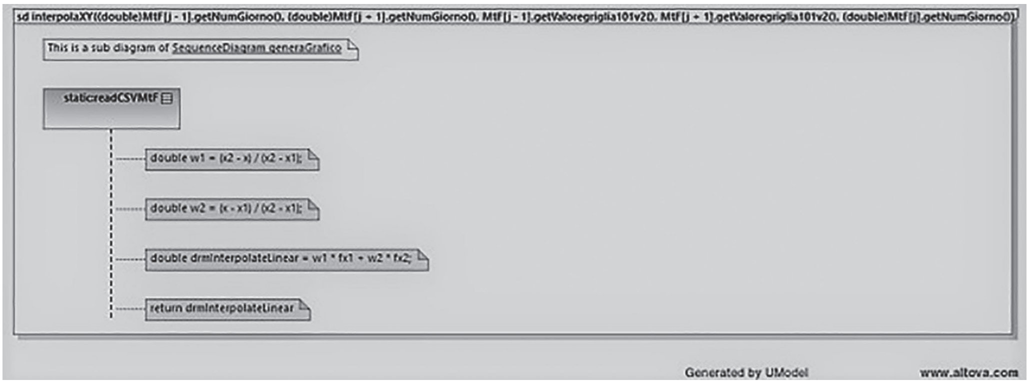

FIGURE 15.264 interpolaXY((double)MtF[j − 1].getNumGiorno(), (double)MtF[j + 1].getNumGiorno(), MtF[j − 1].getValoregriglia101v2(), MtF[j + 1].getValoregriglia101v2(), (double)MtF[j].getNumGiorno())_1.

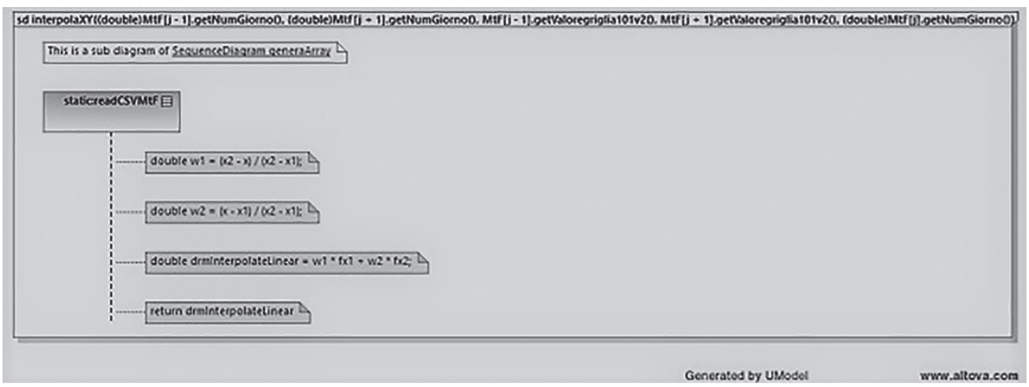

FIGURE 15.265 interpolaXY((double)MtF[j − 1].getNumGiorno(), (double)MtF[j + 1].getNumGiorno(), MtF[j − 1].getValoregriglia101v2(), MtF[j + 1].getValoregriglia101v2(), (double)MtF[j].getNumGiorno())_2.

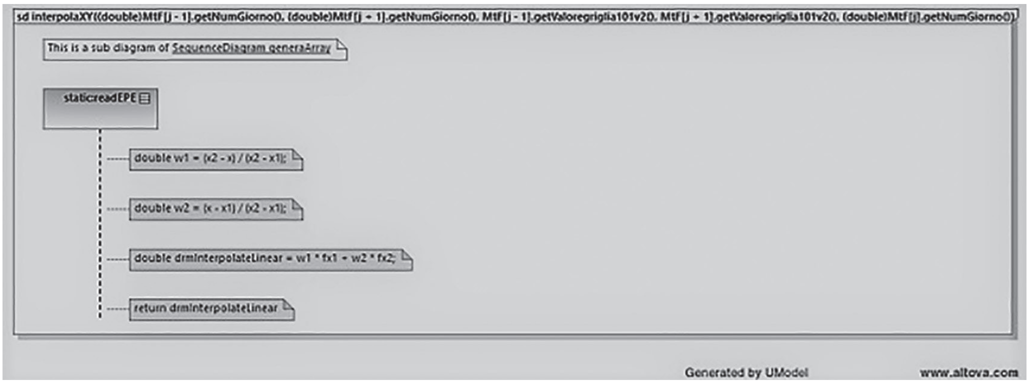

FIGURE 15.266 interpolaXY((double)MtF[j − 1].getNumGiorno(), (double)MtF[j + 1].getNumGiorno(), MtF[j − 1].getValoregriglia101v2(), MtF[j + 1].getValoregriglia101v2(), (double)MtF[j].getNumGiorno())_3.

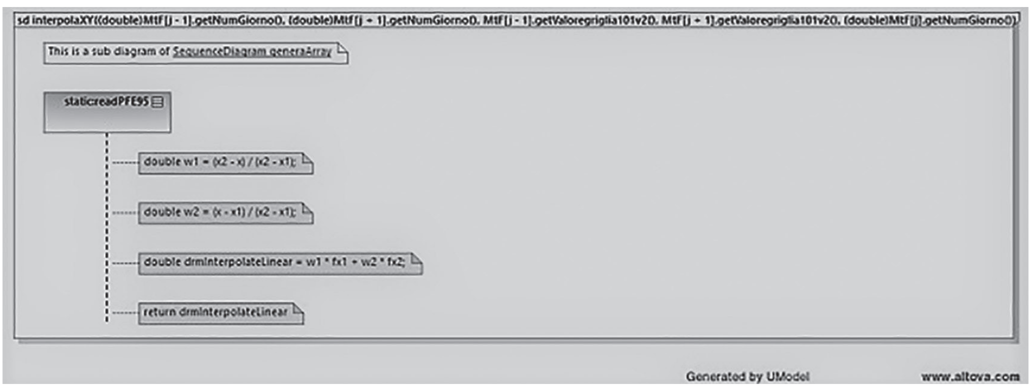

FIGURE 15.267 interpolaXY((double)MtF[j − 1].getNumGiorno(), (double)MtF[j + 1].getNumGiorno(), MtF[j − 1].getValoregriglia101v2(), MtF[j + 1].getValoregriglia101v2(), (double)MtF[j].getNumGiorno())_4.

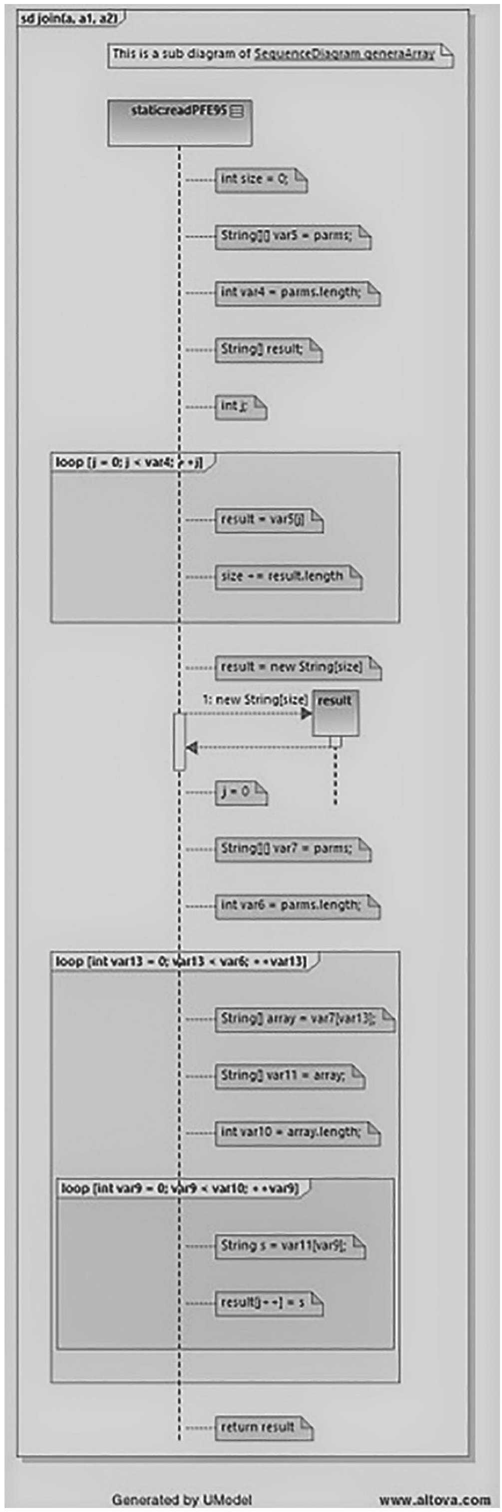

FIGURE 15.268 join(a, a1, a2).

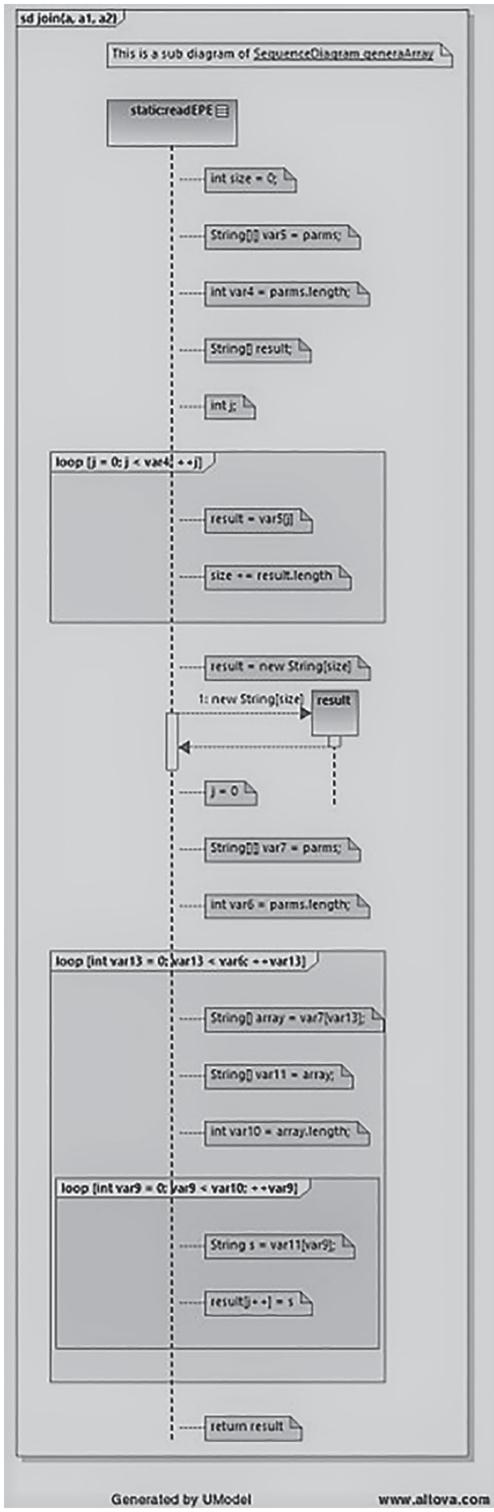

FIGURE 15.269 join(a, a1, a2)_1.

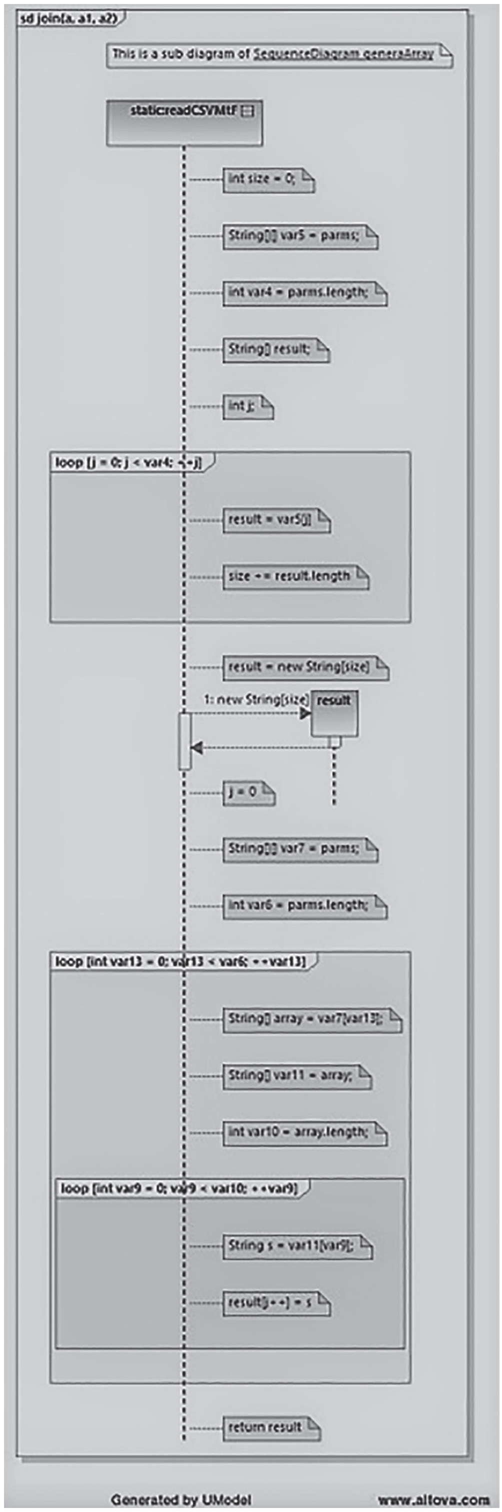

FIGURE 15.270 join(a, a1, a2)_2.

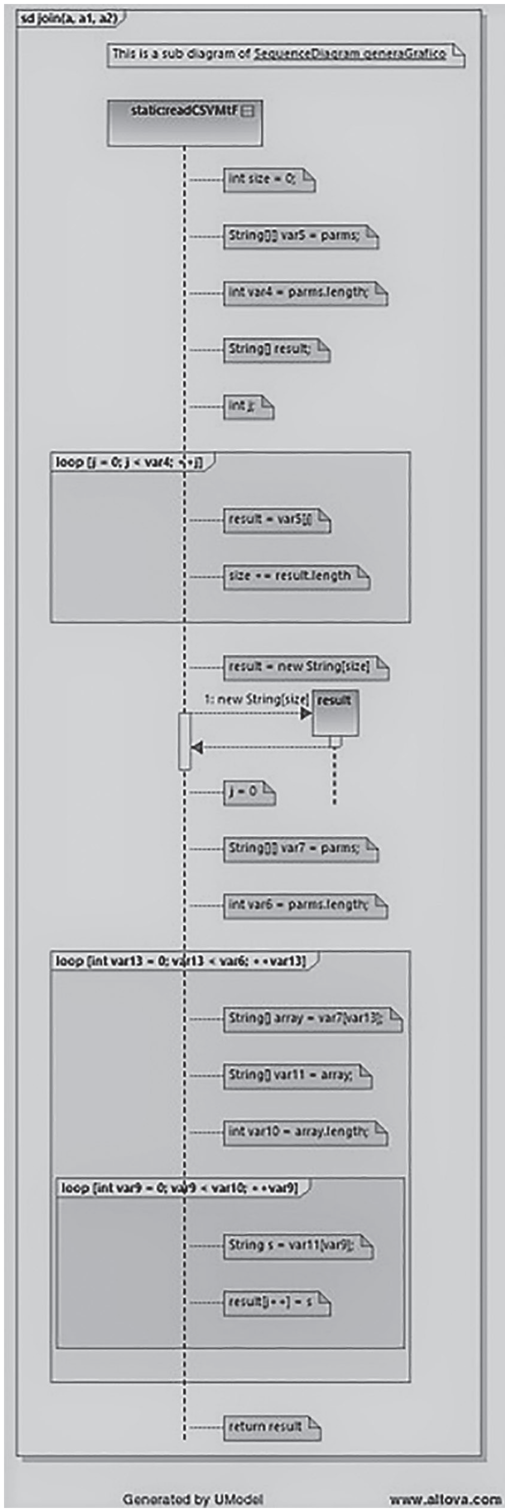

FIGURE 15.271 join(a, a1, a2)_3.

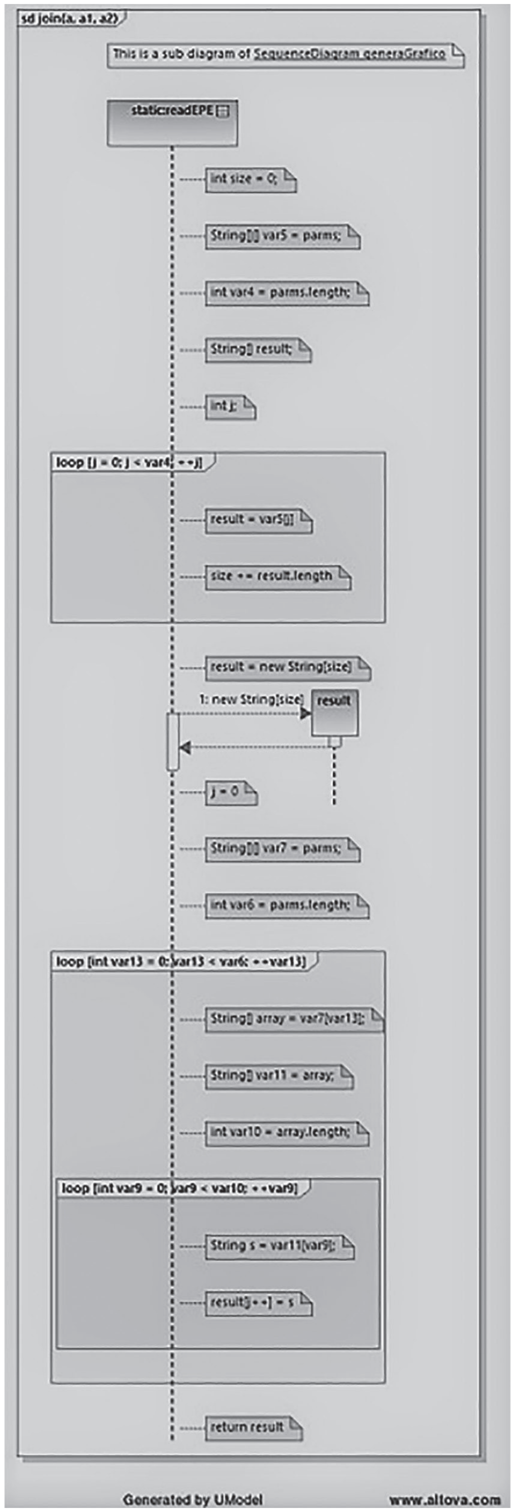

FIGURE 15.272 join(a, a1, a2)_4.

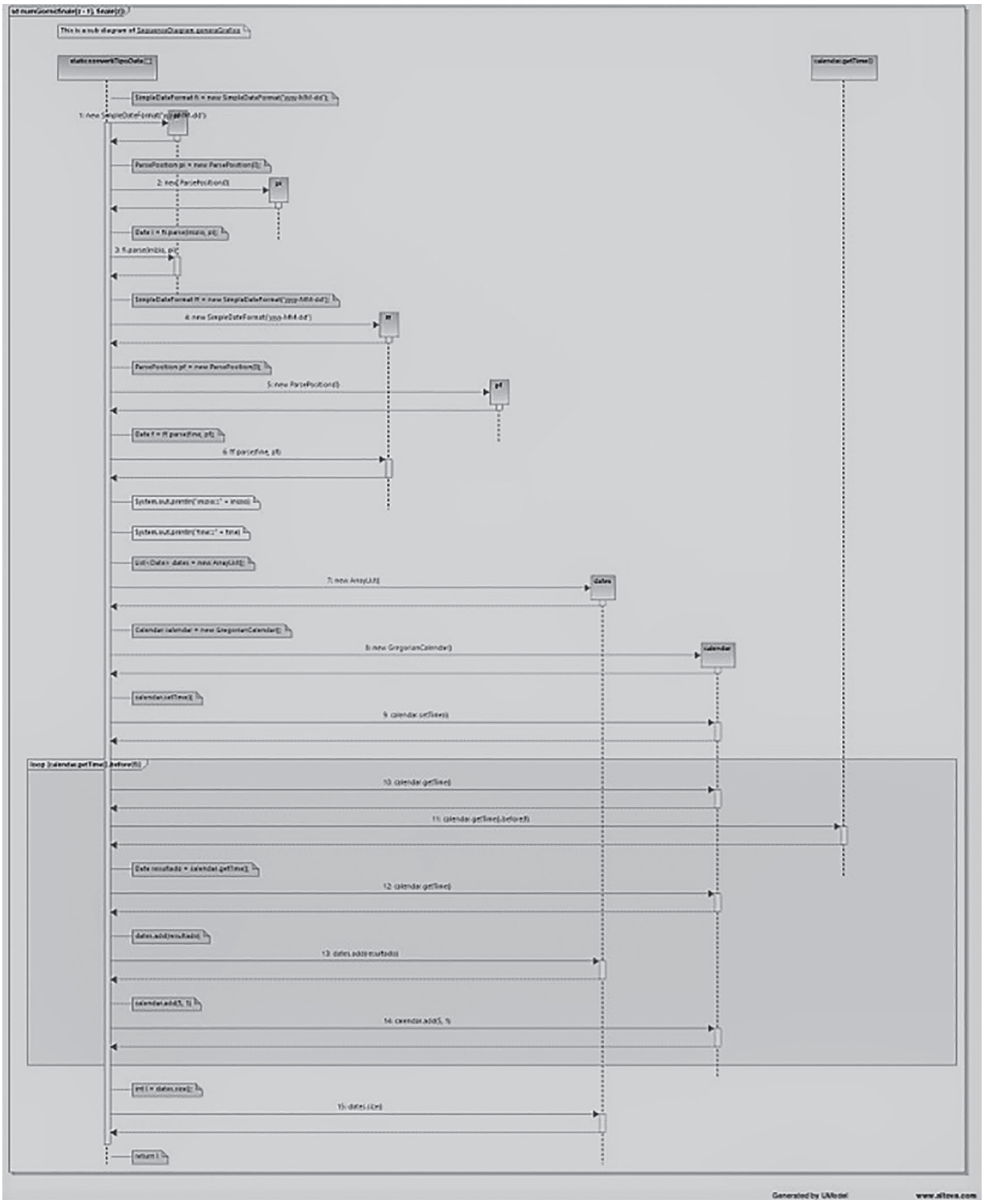

FIGURE 15.273 numGiorni(finale[z -1], finale[z]).

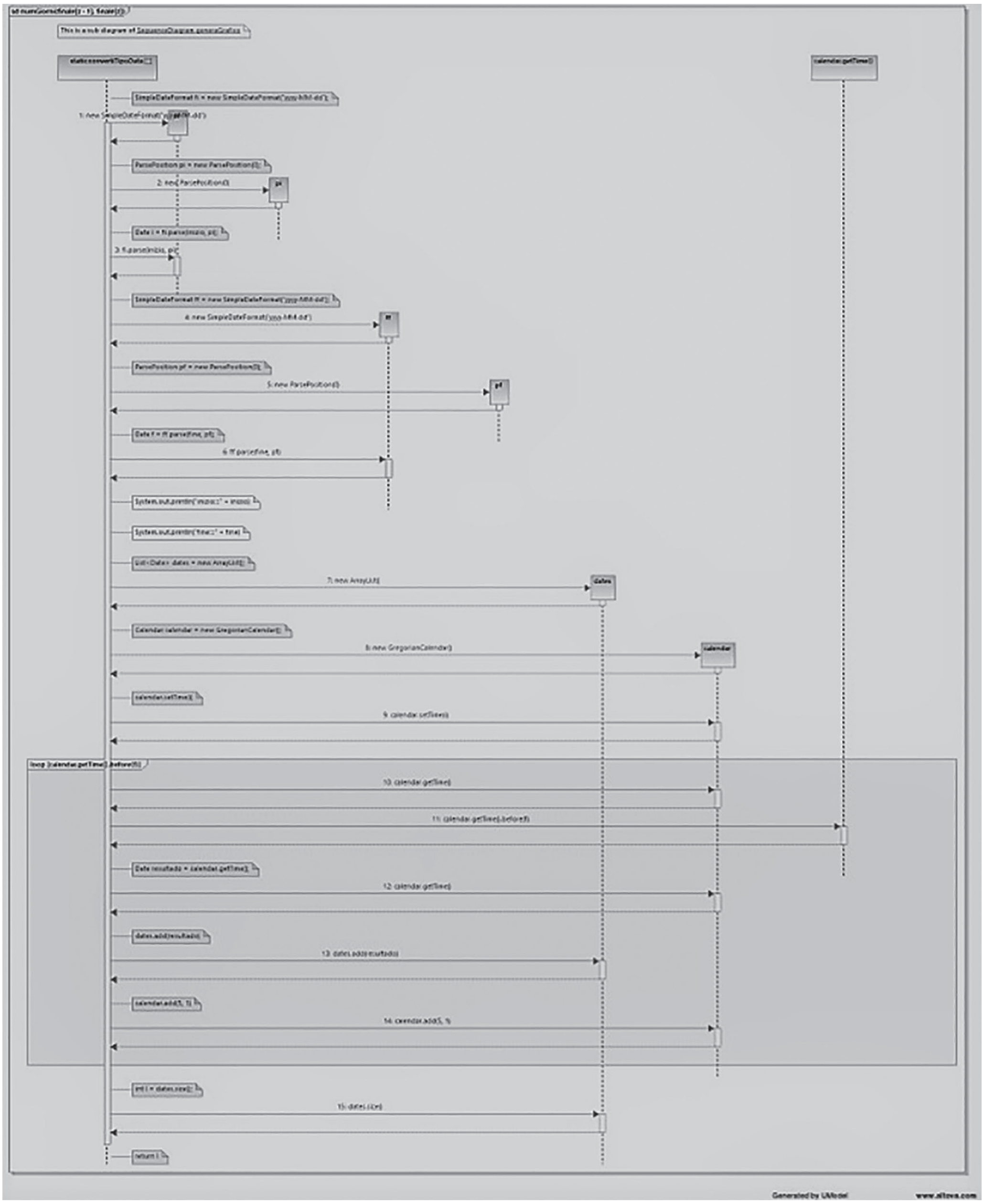

FIGURE 15.274 numGiorni(finale[z -1], finale[z])_1.

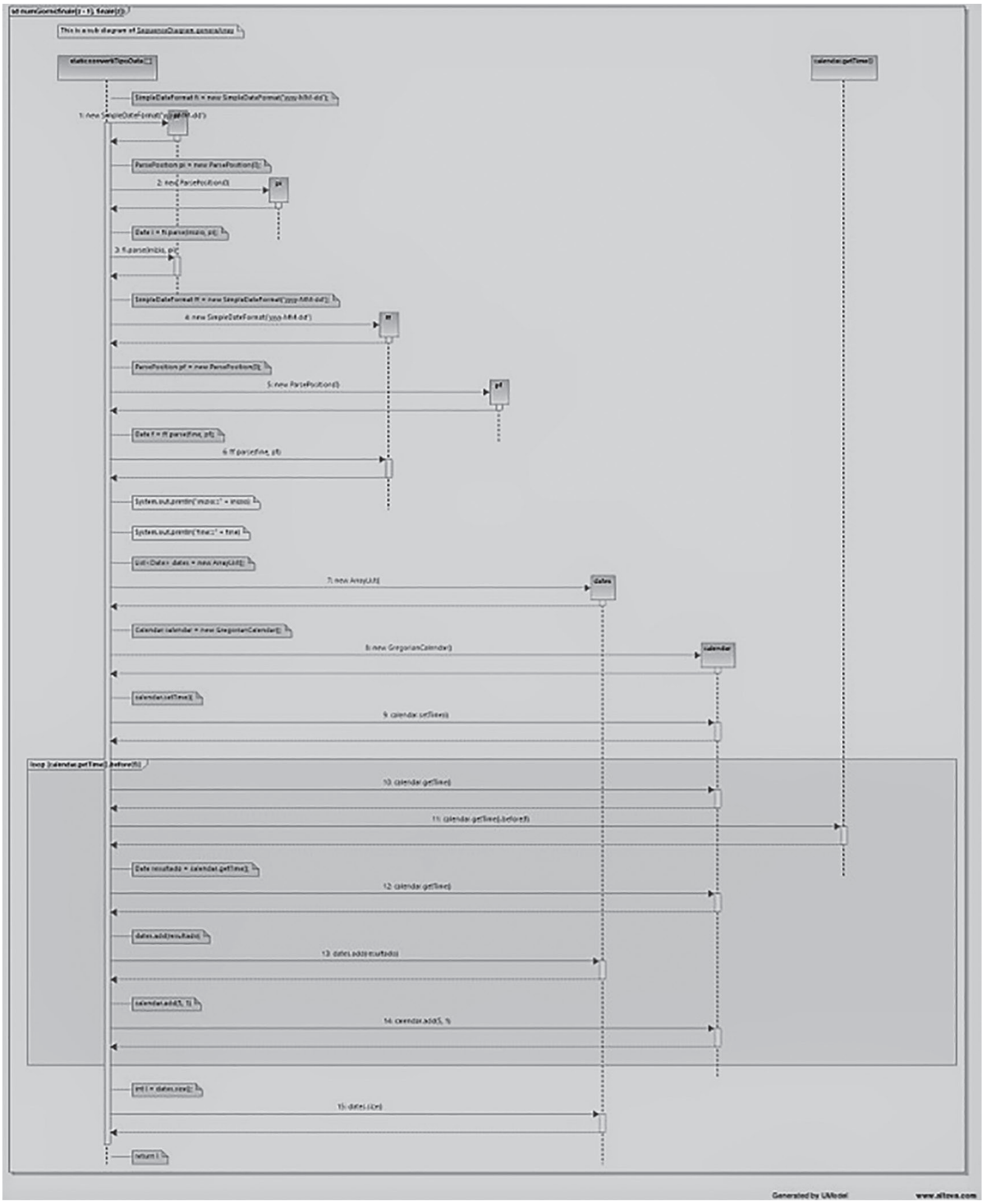

FIGURE 15.275 numGiorni(finale[z -1], finale[z])_2.

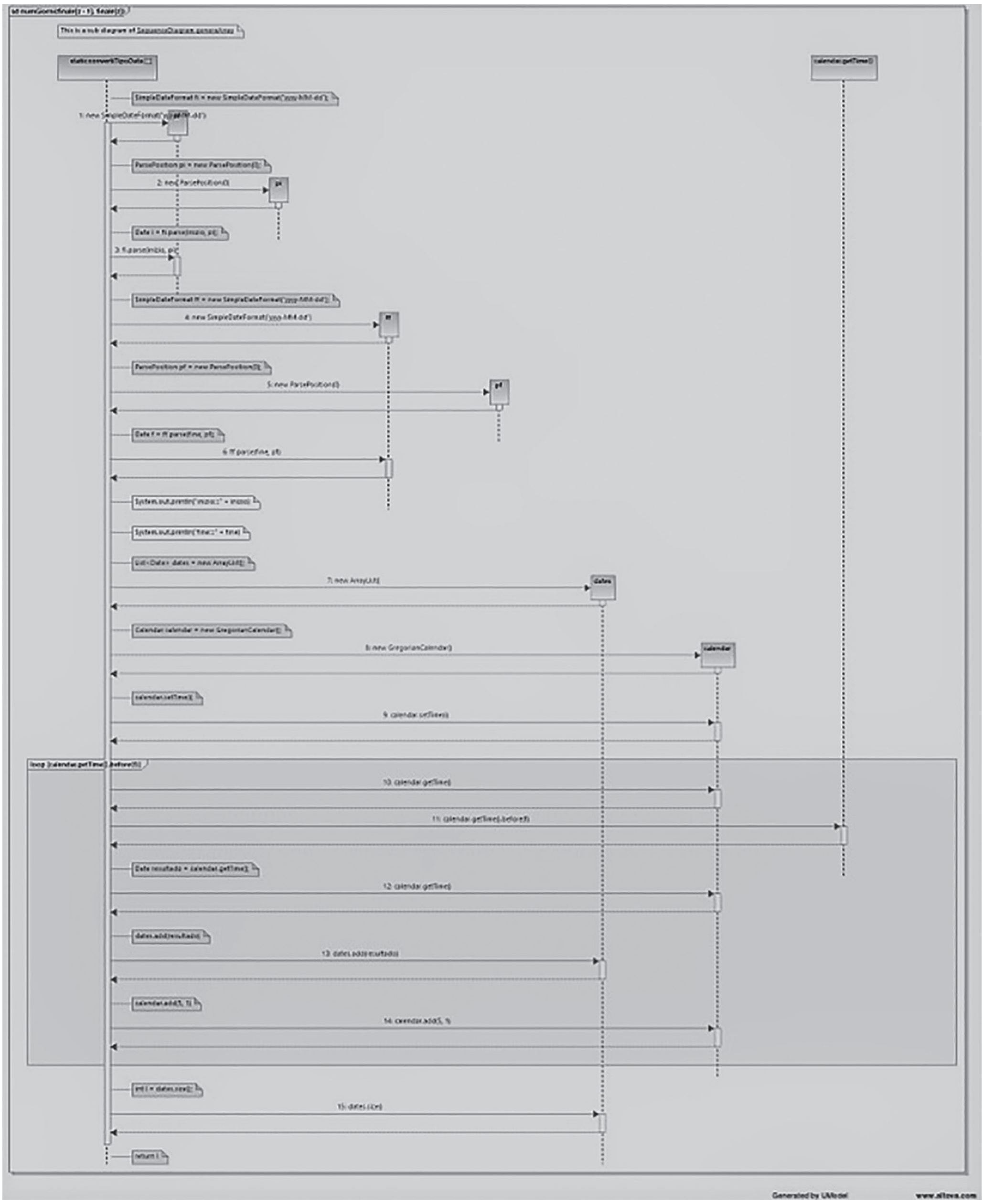

FIGURE 15.276 numGiorni(finale[z -1], finale[z])_3.

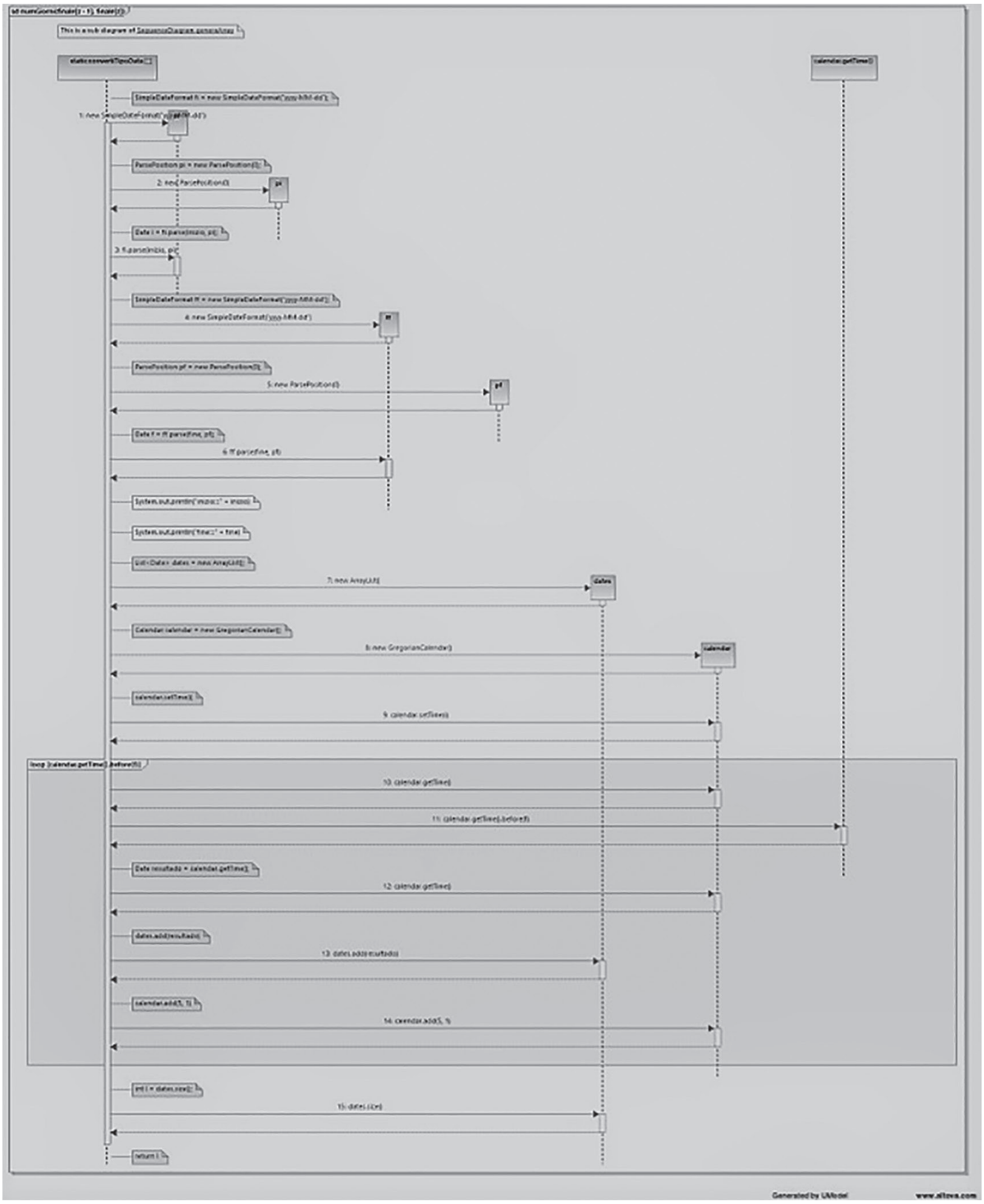

FIGURE 15.277 numGiorni(finale[z -1], finale[z])_4.

FIGURE 15.278 Package dependencies of estrazione.

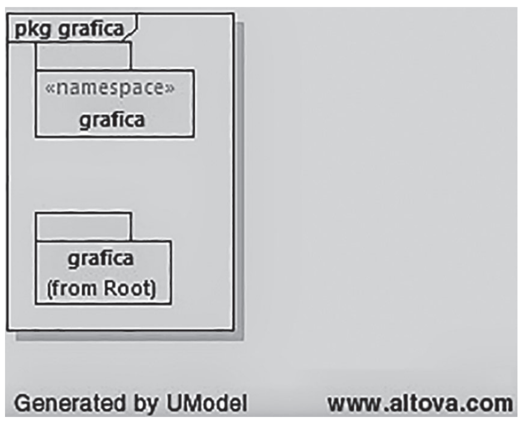

FIGURE 15.279 Package dependencies of grafica.

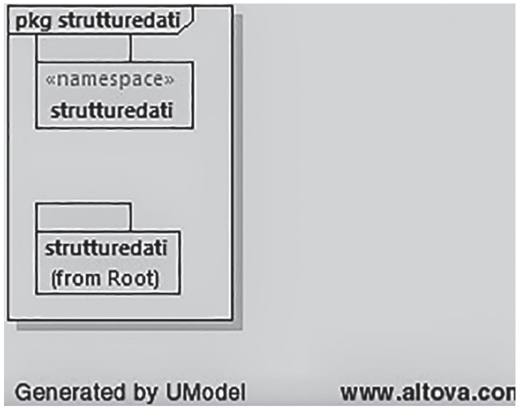

FIGURE 15.280 Package dependencies of strutturedati.

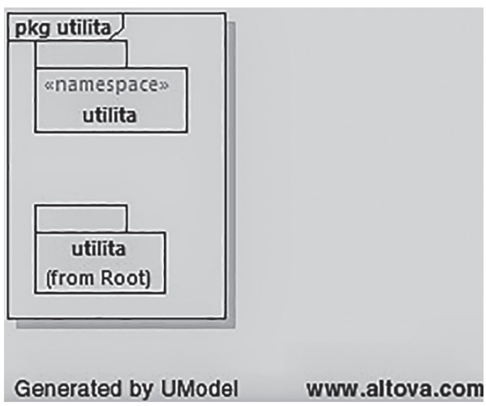

FIGURE 15.281 Package dependencies of utilita.

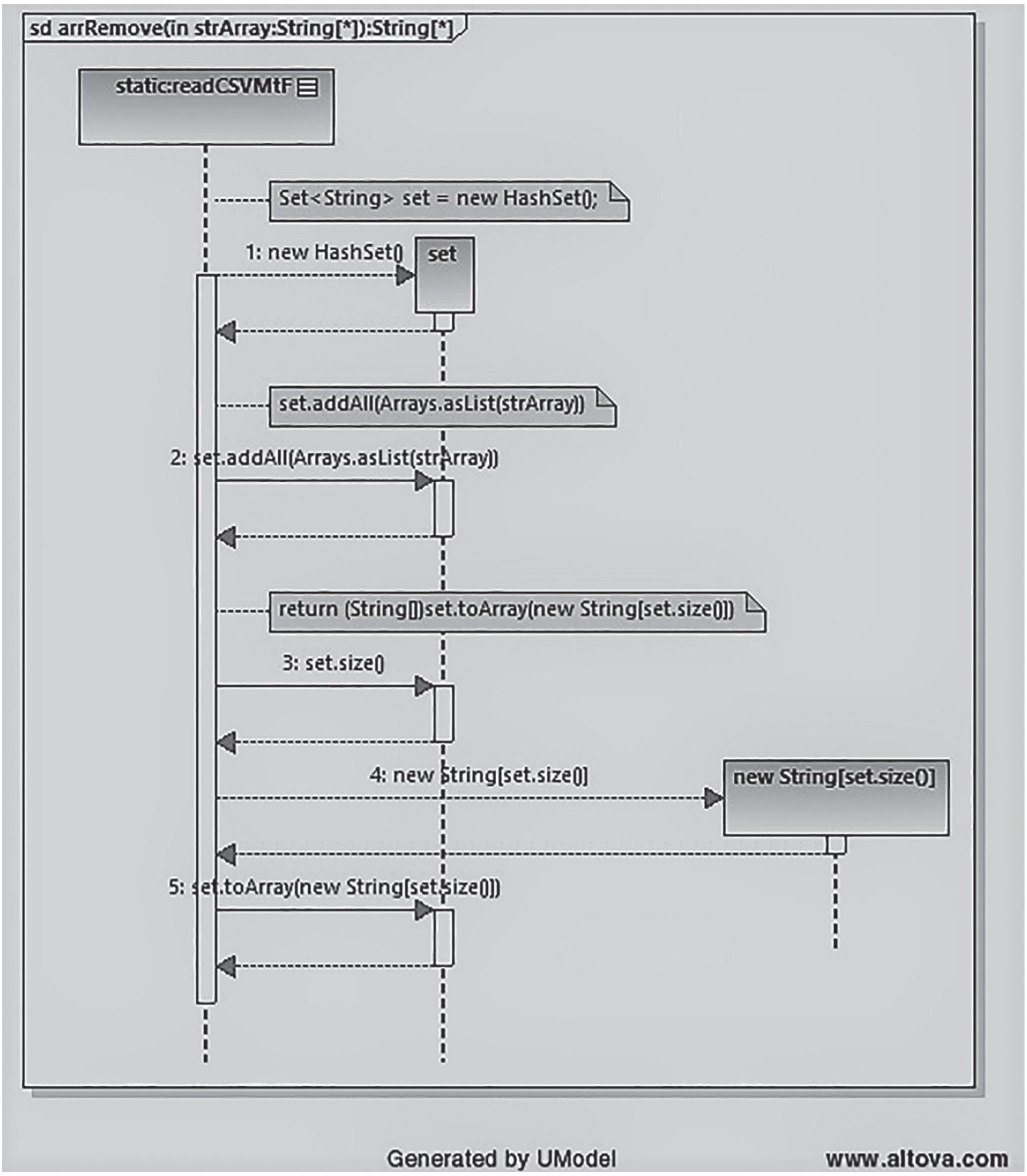

FIGURE 15.282 SequenceDiagram arrRemove.

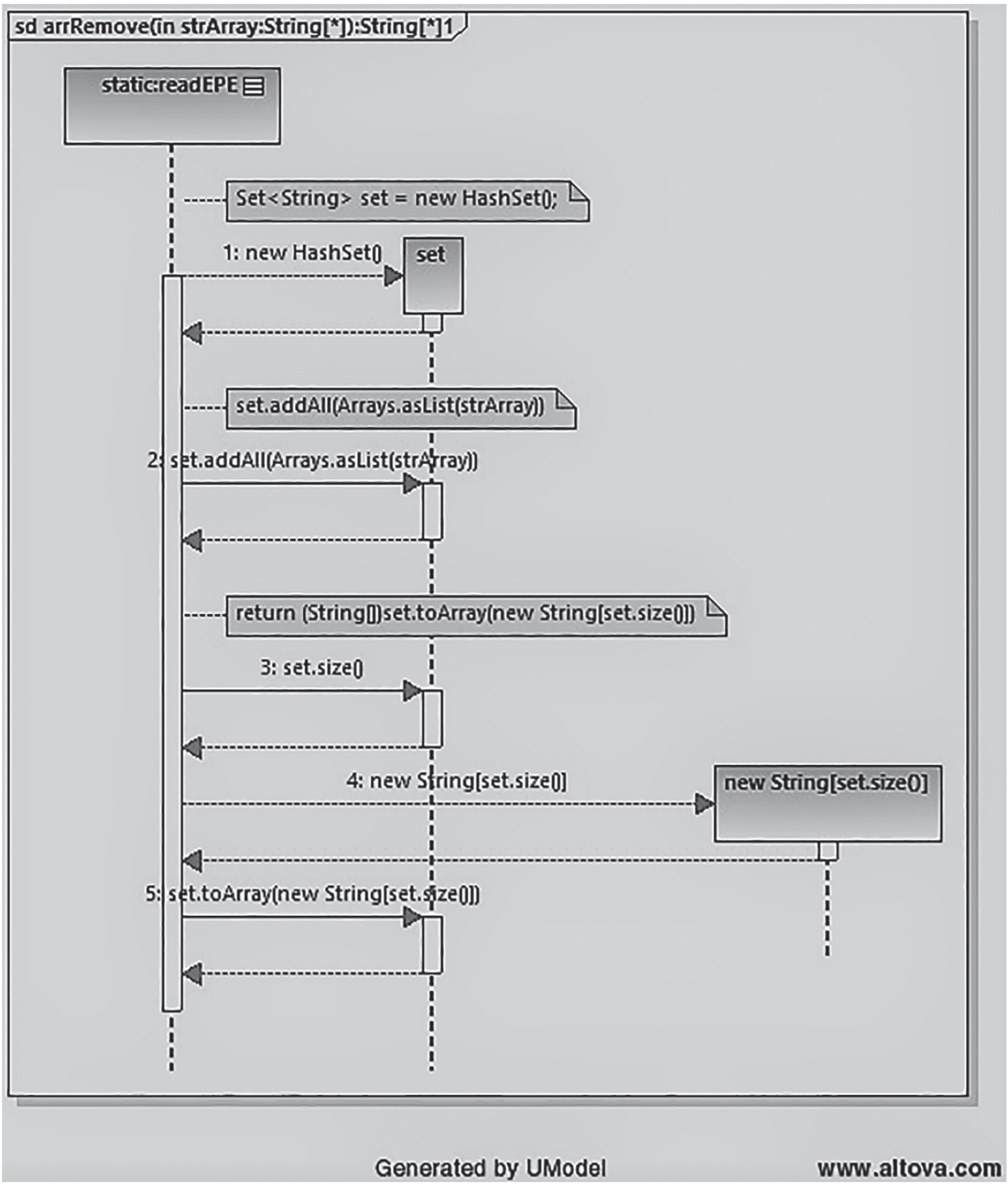

FIGURE 15.283 SequenceDiagram arrRemove_1.

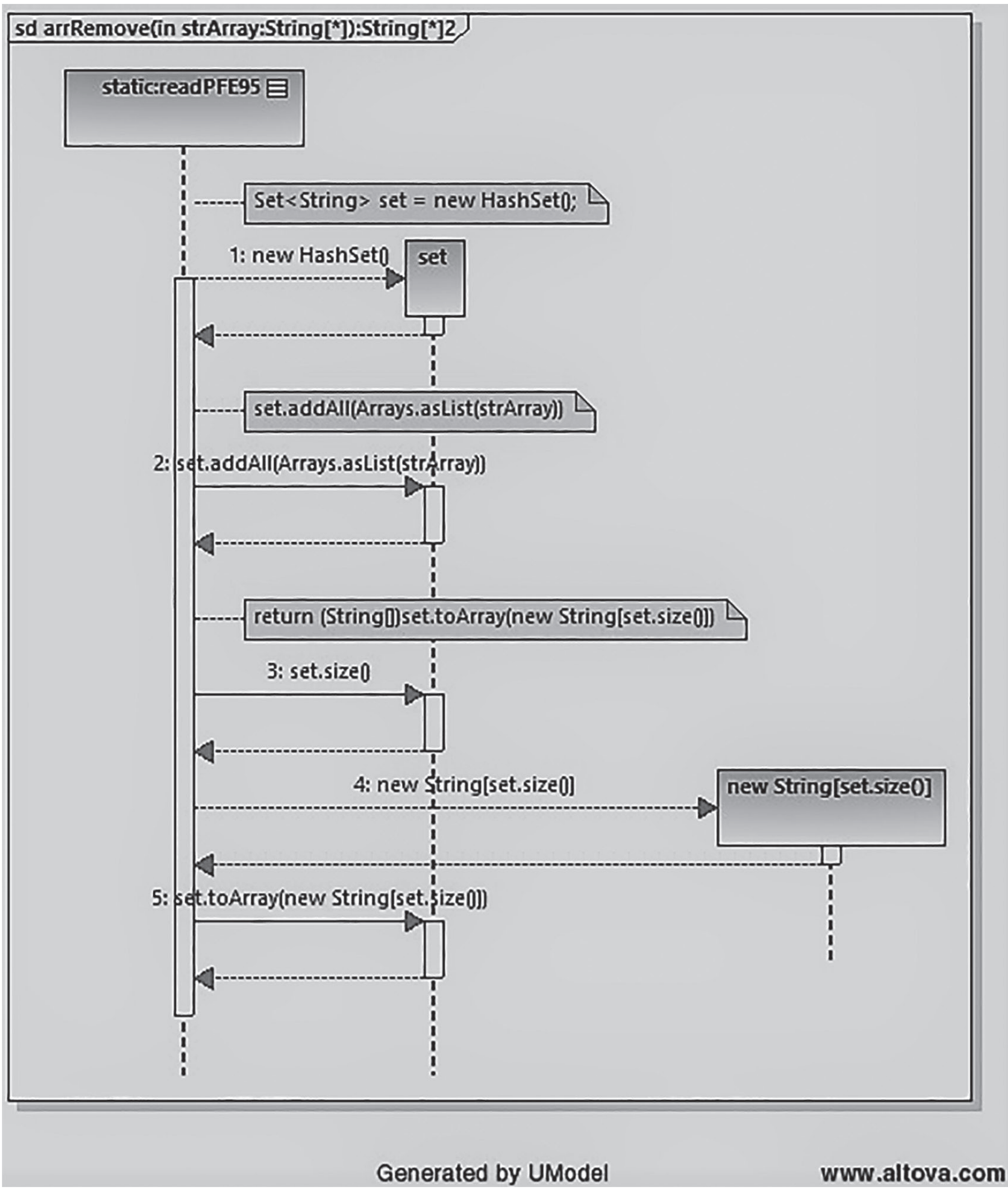

FIGURE 15.284 SequenceDiagram arrRemove_2.

FIGURE 15.285 SequenceDiagram barChartEffEPE.

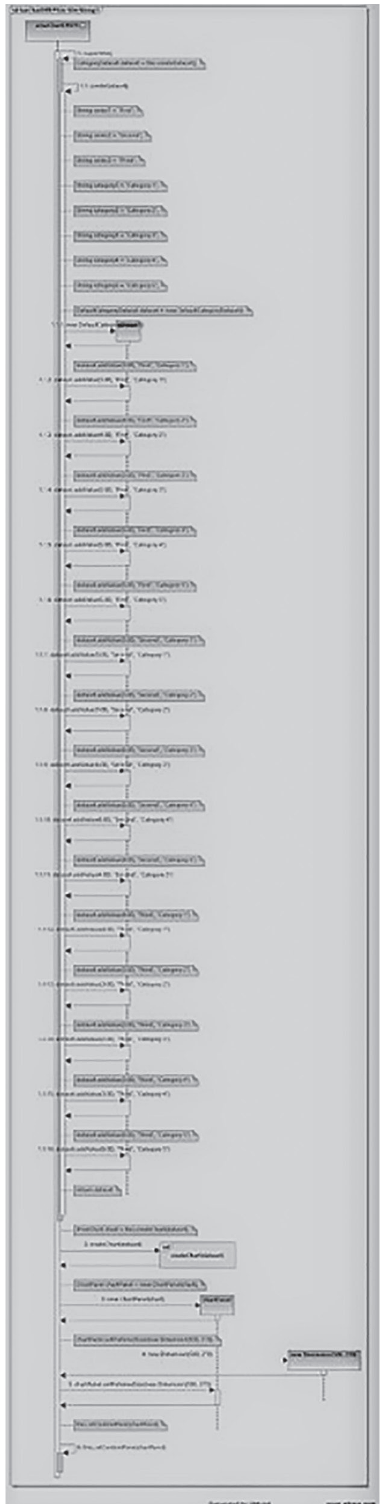

FIGURE 15.286 SequenceDiagram barChartEffEPE_1.

FIGURE 15.287 SequenceDiagram barChartEffPFE95.

FIGURE 15.288 SequenceDiagram barChartEffPFE95_1.

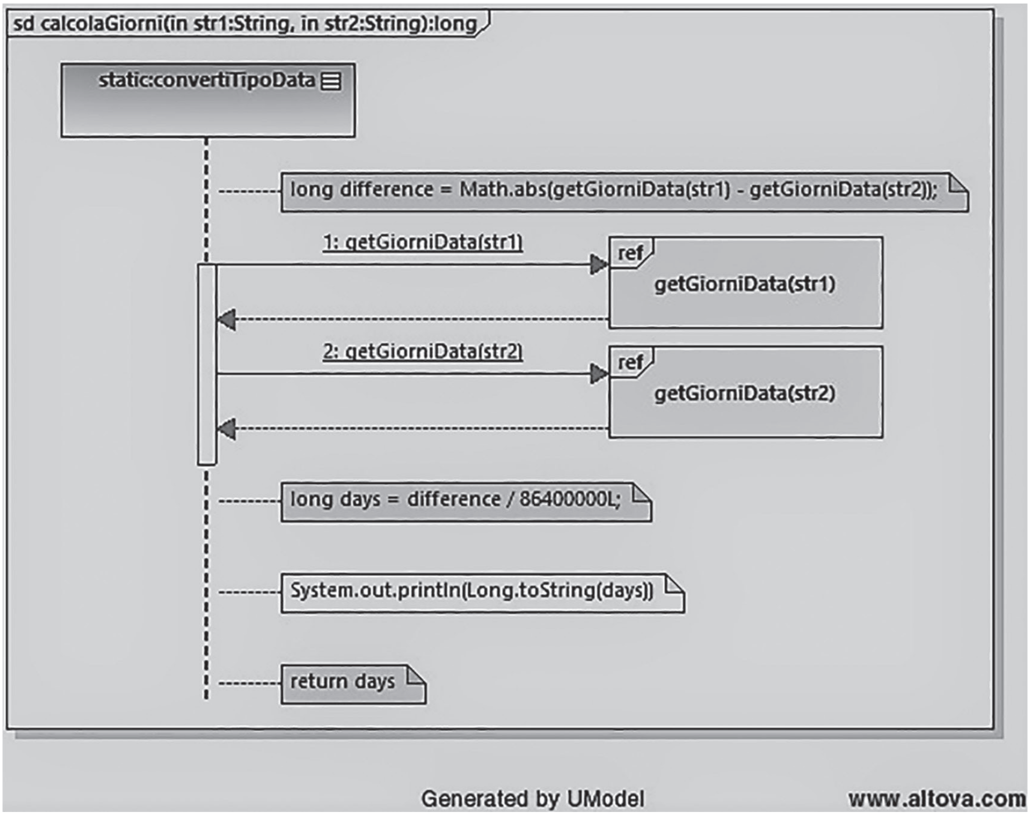

FIGURE 15.289 SequenceDiagram calcolaGiorni.

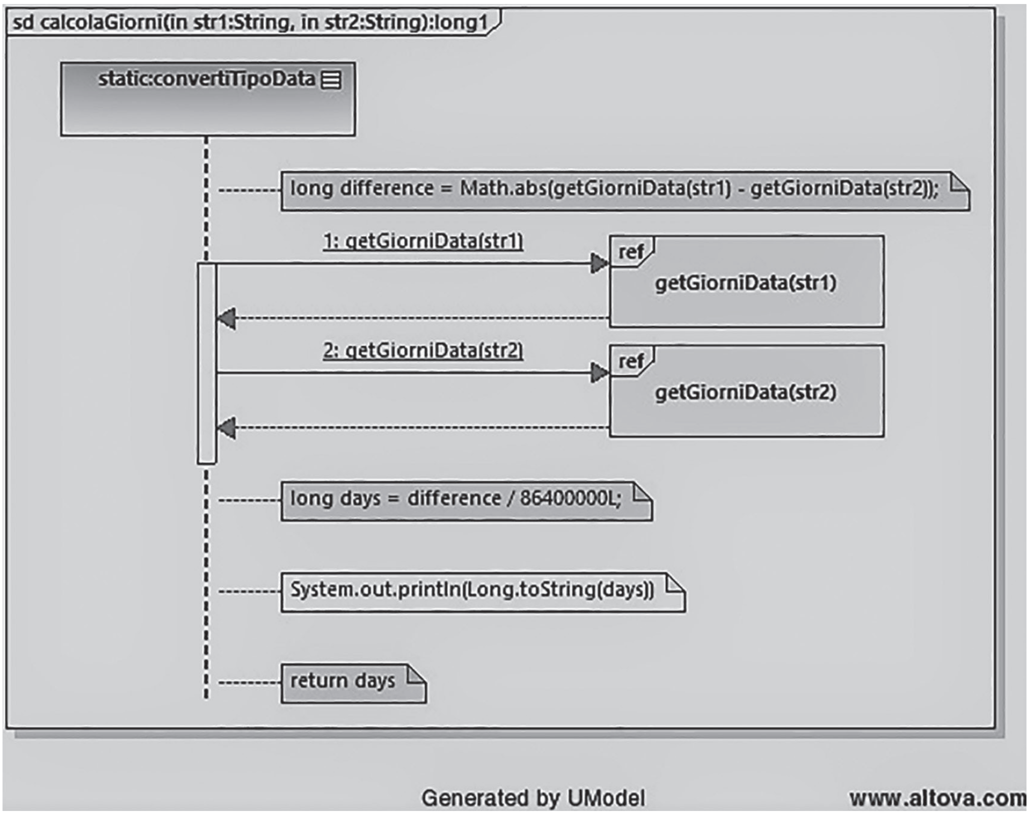

FIGURE 15.290 SequenceDiagram calcolaGiorni_1.

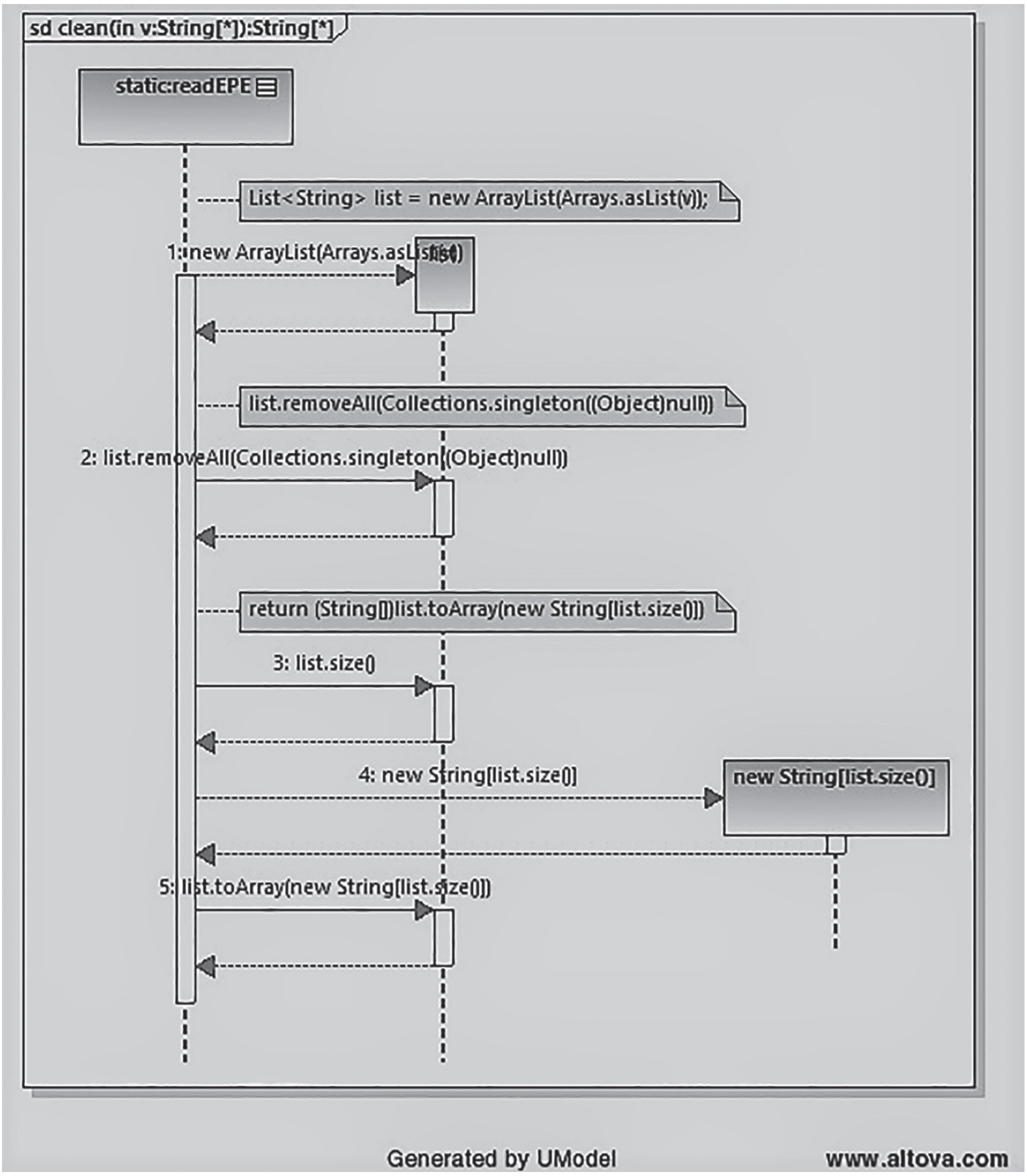

FIGURE 15.291 SequenceDiagram clean.

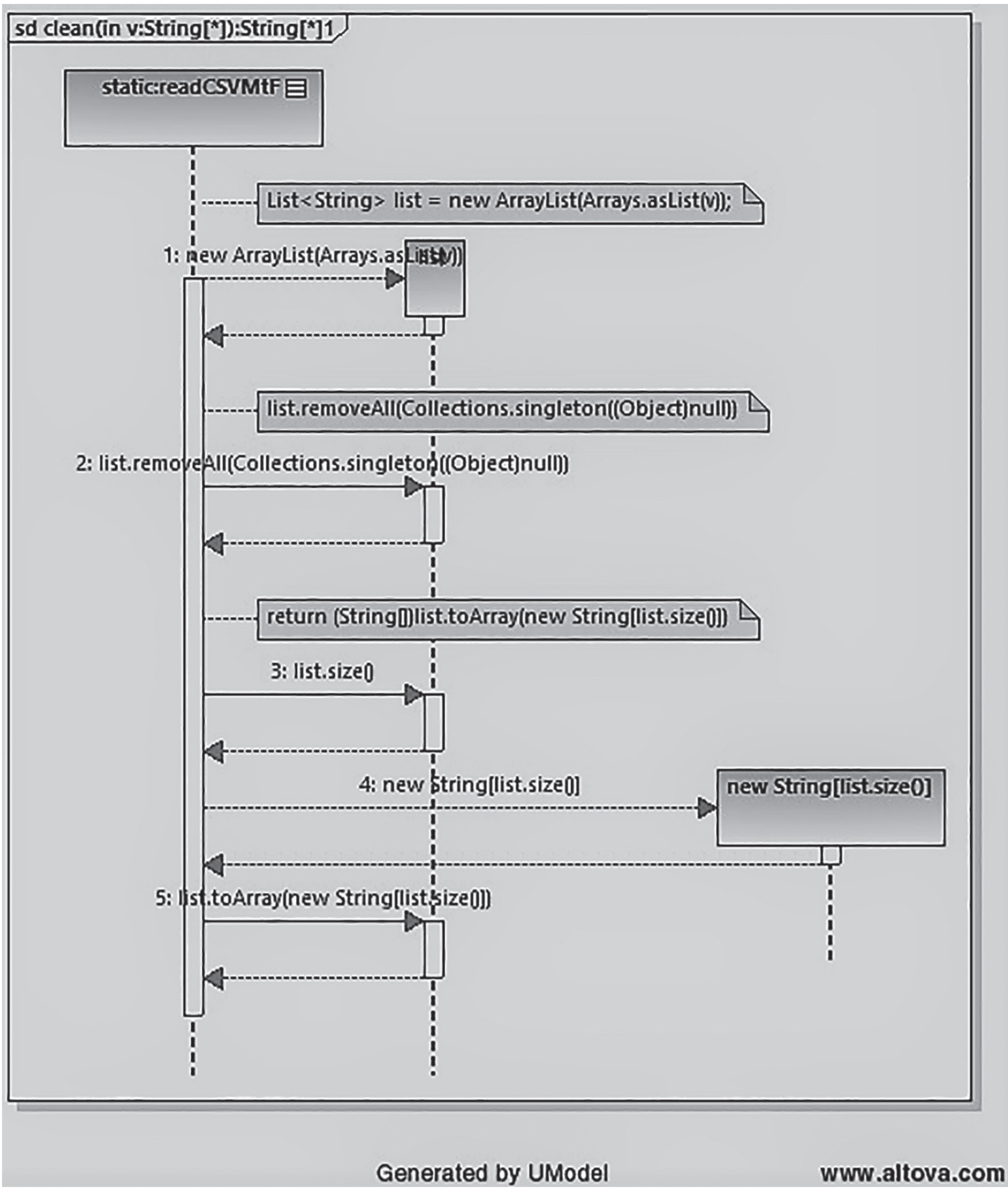

FIGURE 15.292 SequenceDiagram clean_1.

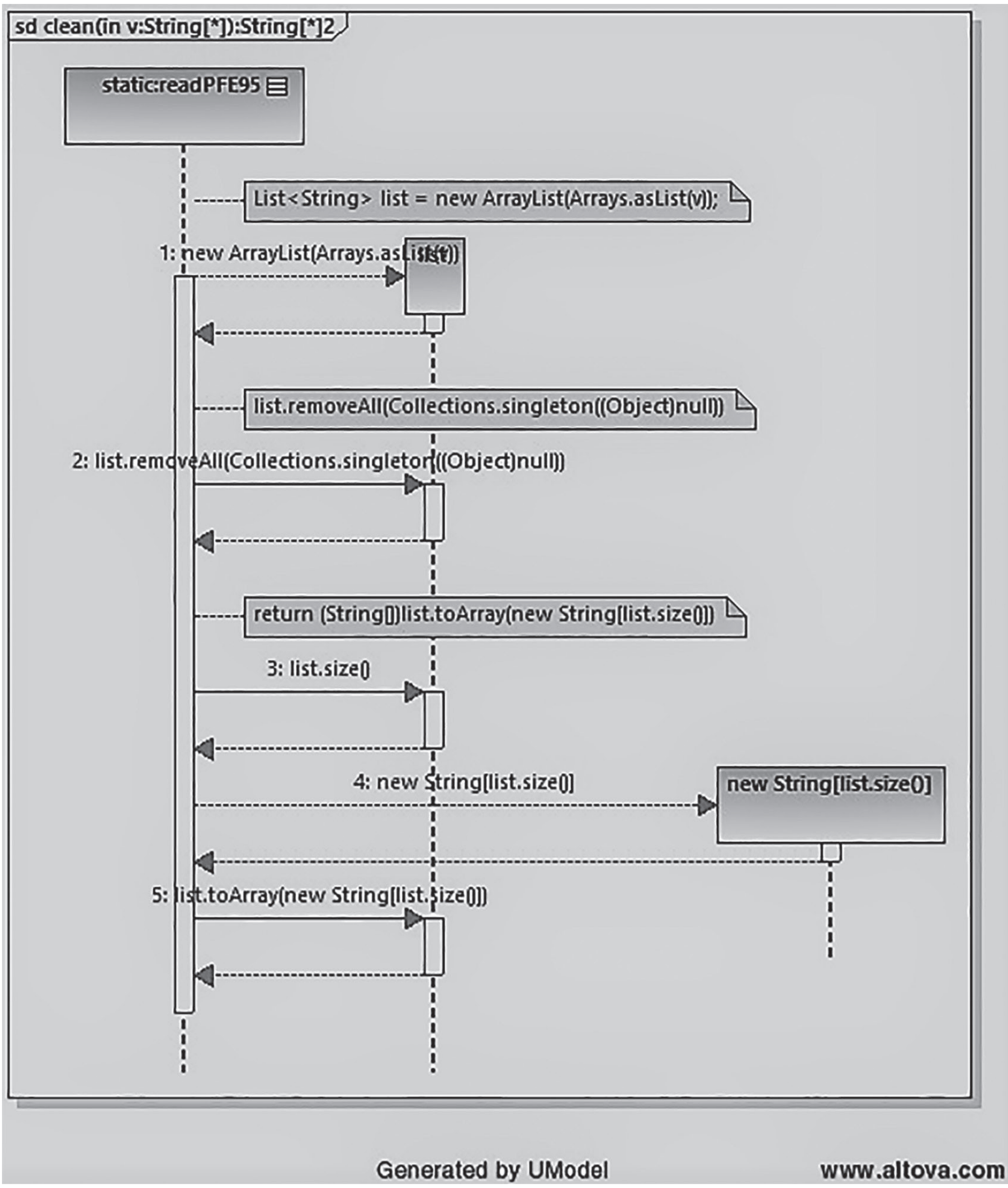

FIGURE 15.293 SequenceDiagram clean_2.

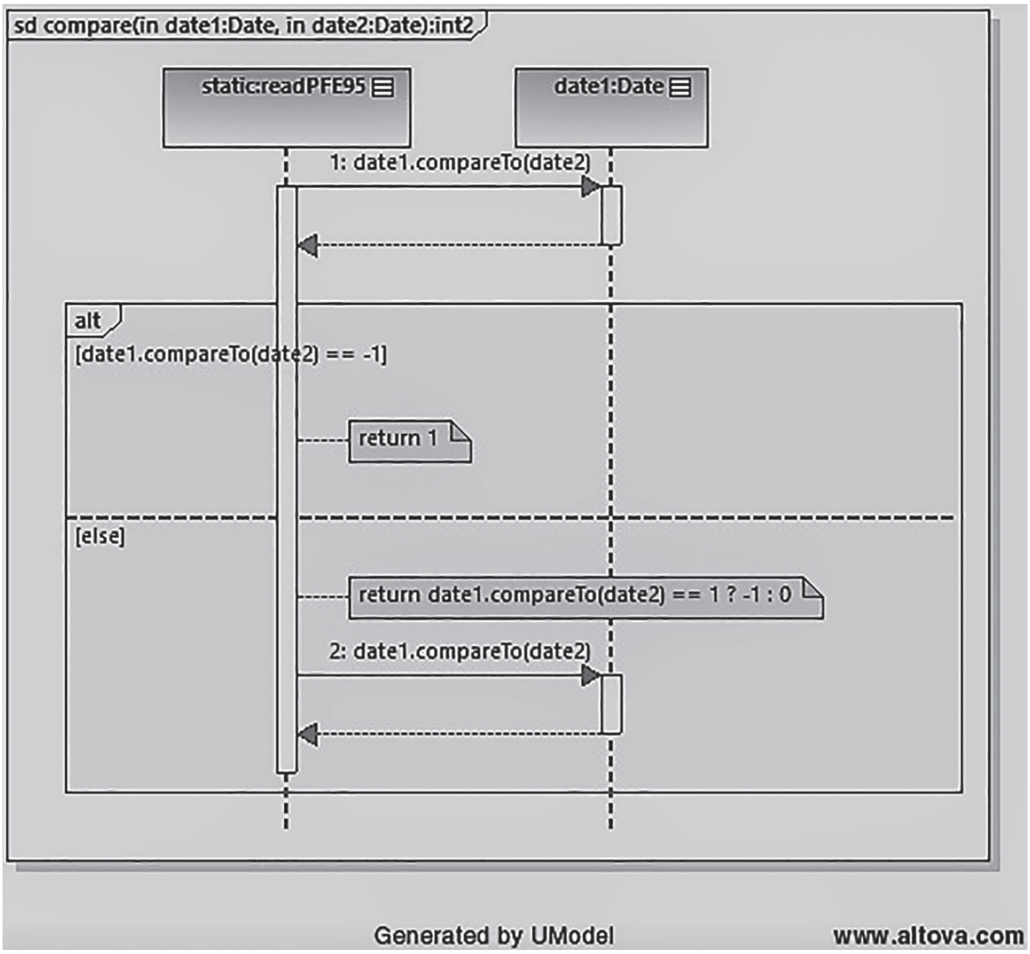

FIGURE 15.294 SequenceDiagram compare.

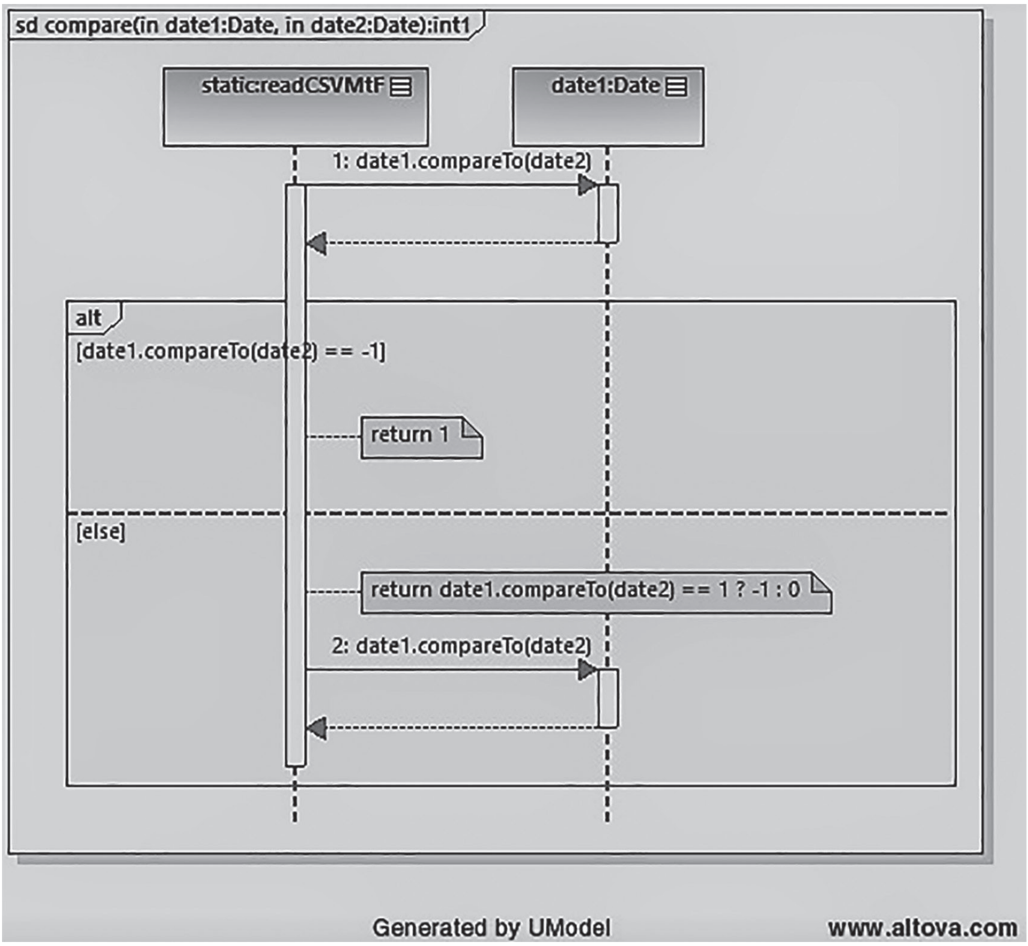

FIGURE 15.295 SequenceDiagram compare_1.

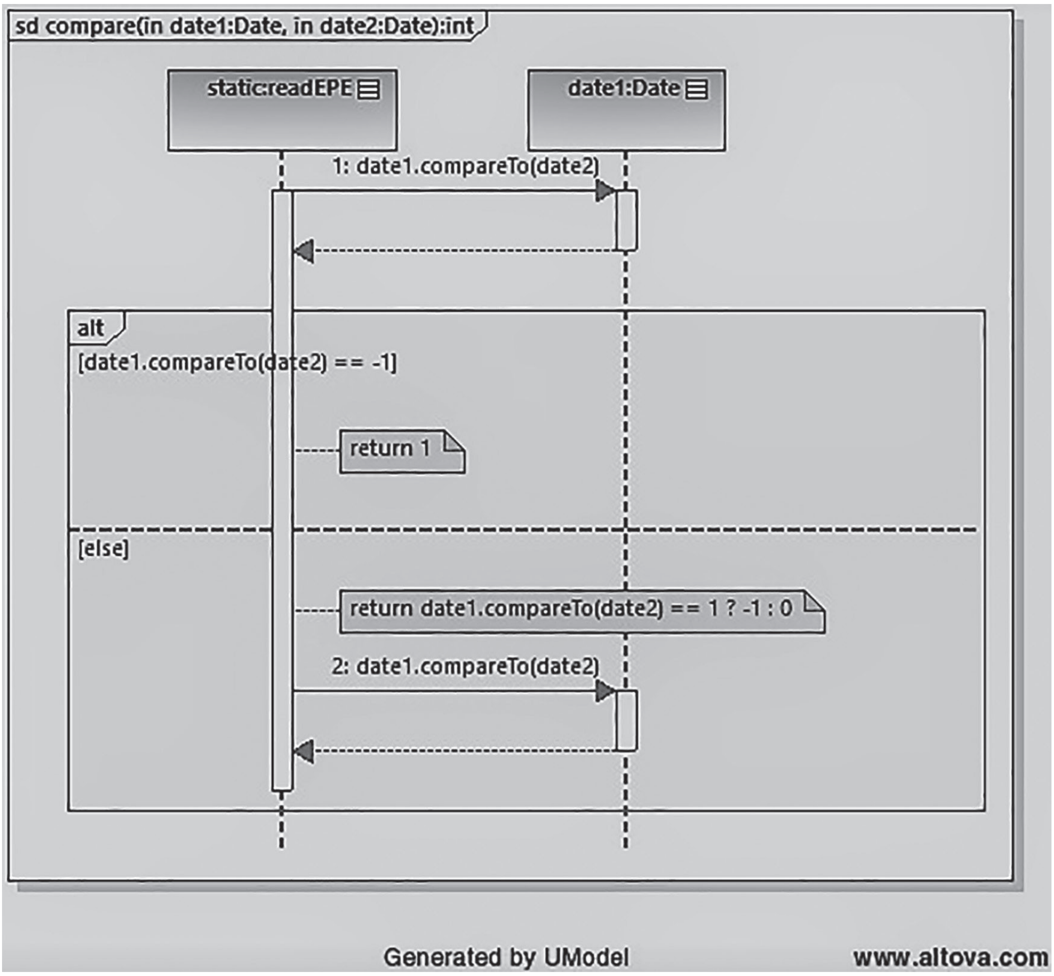

FIGURE 15.296 SequenceDiagram compare_2.

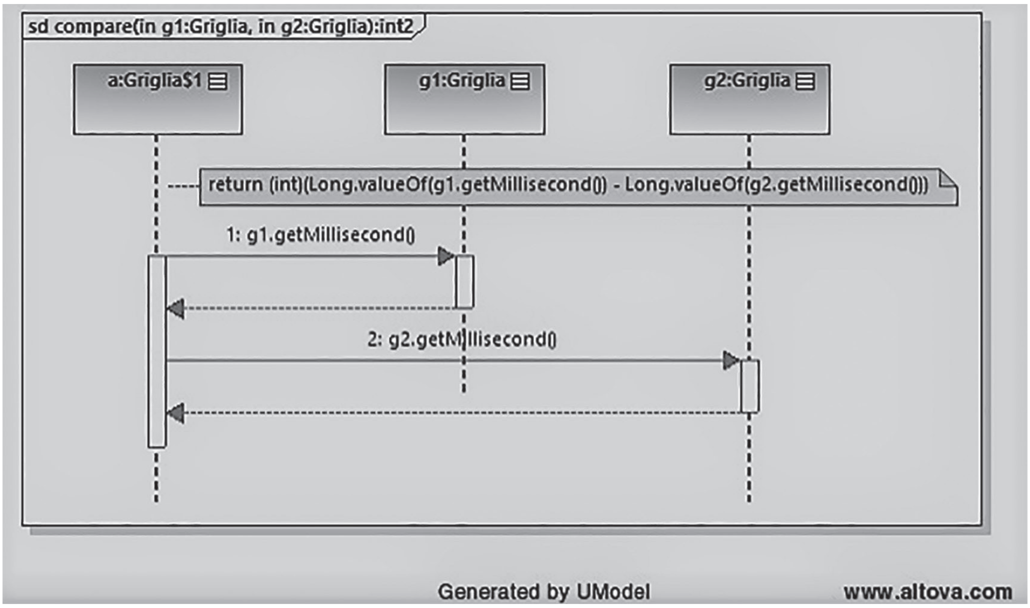

FIGURE 15.297 SequenceDiagram compare_3.

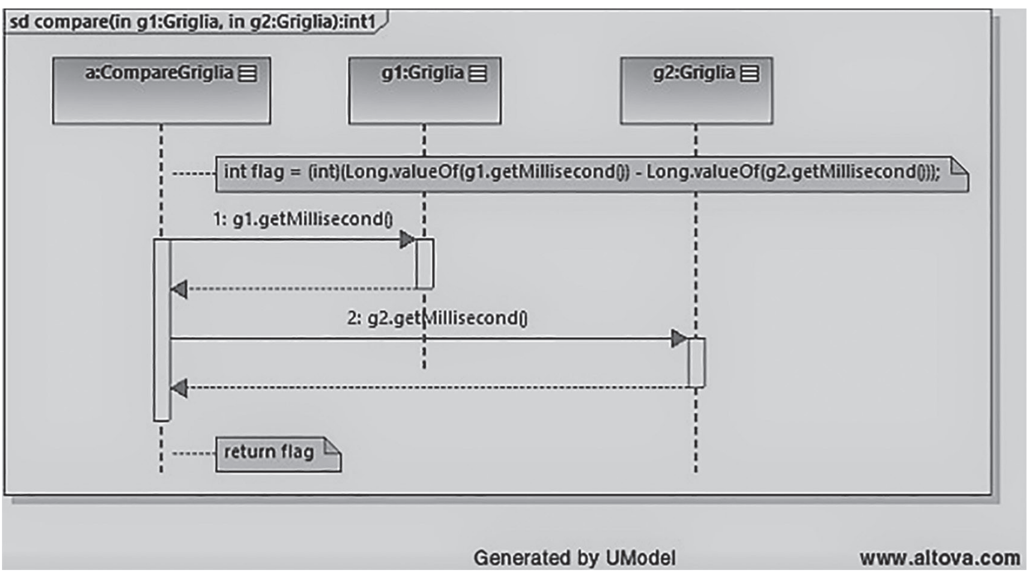

FIGURE 15.298 SequenceDiagram compare_4.

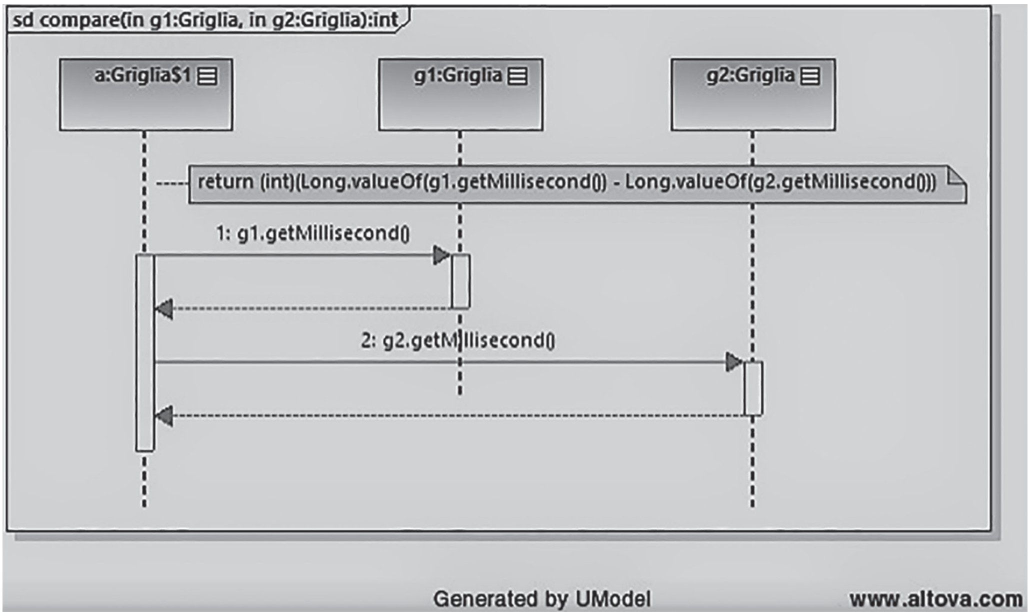

FIGURE 15.299 SequenceDiagram compare_5.

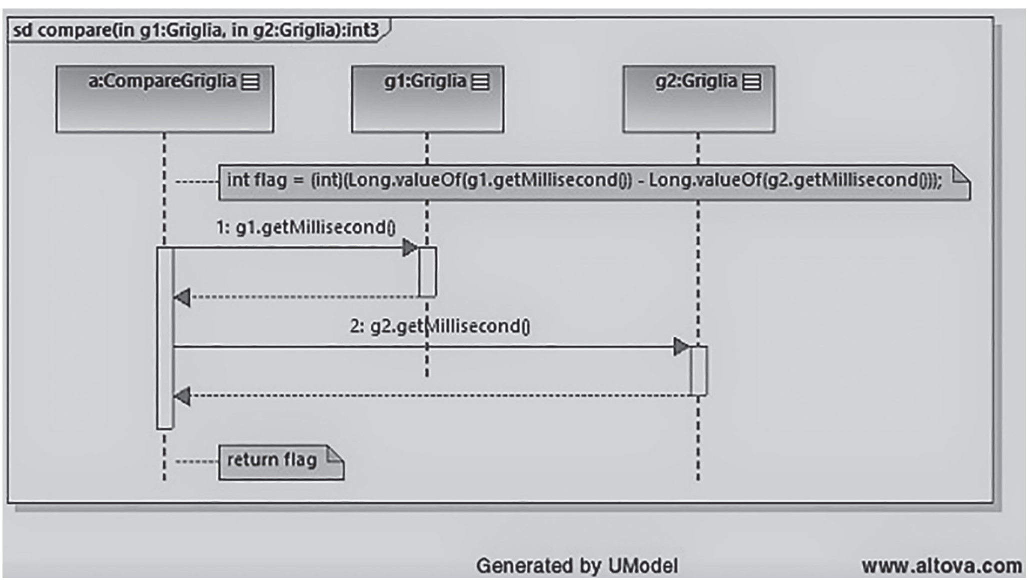

FIGURE 15.300 SequenceDiagram compare_6.

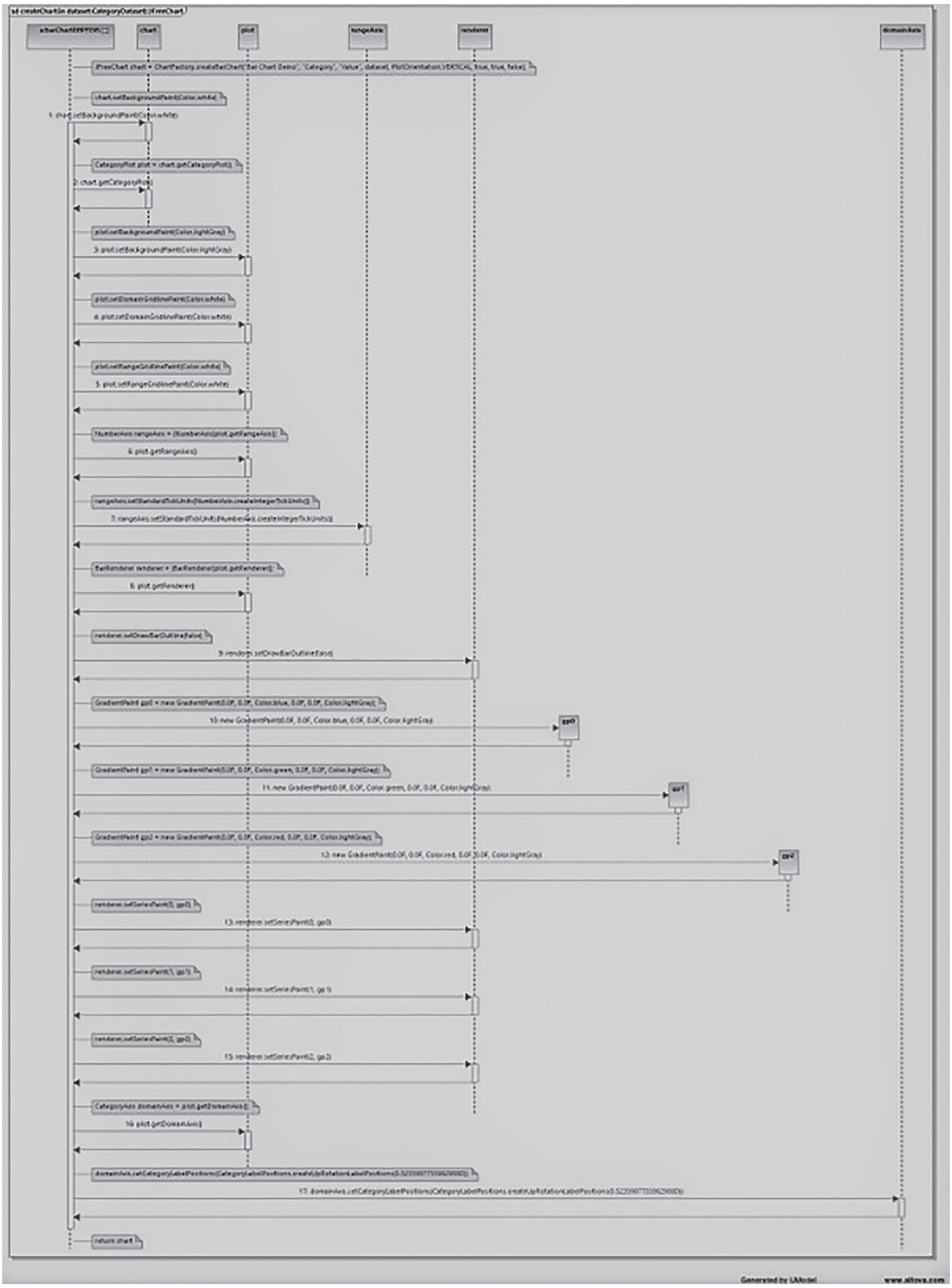

FIGURE 15.301 SequenceDiagram createChart.

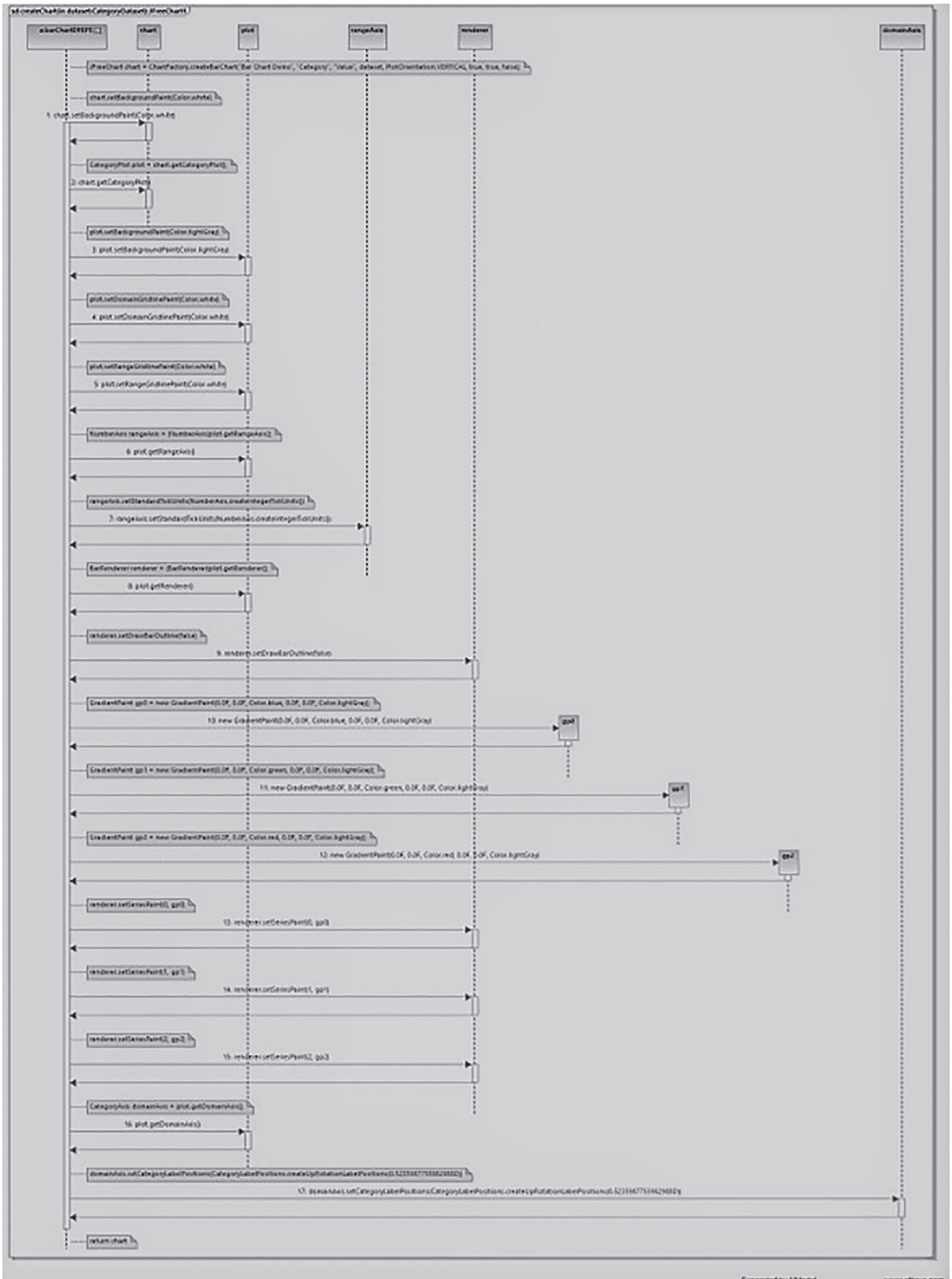

FIGURE 15.302 SequenceDiagram createChart_1.

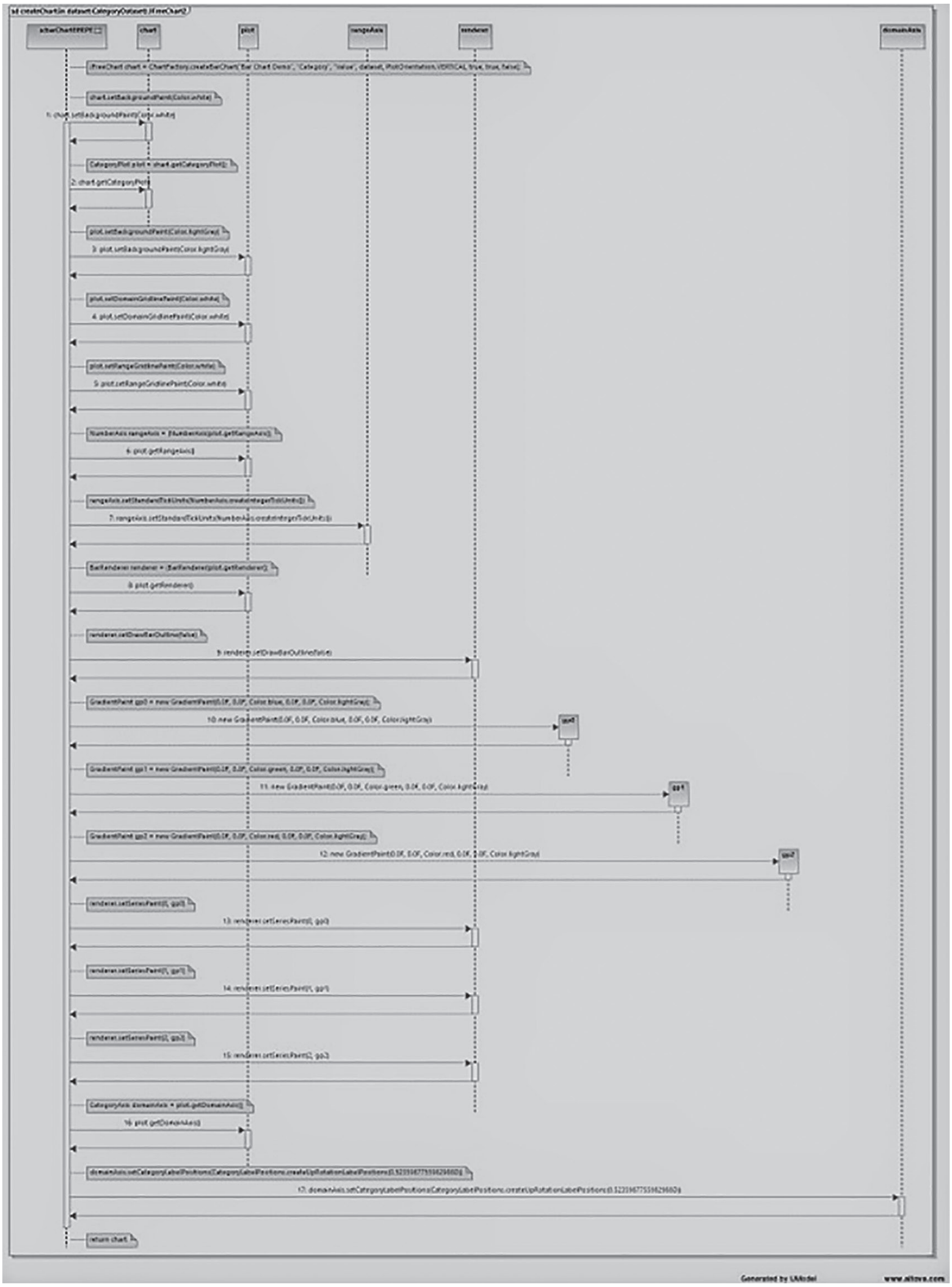

FIGURE 15.303 SequenceDiagram createChart_2.

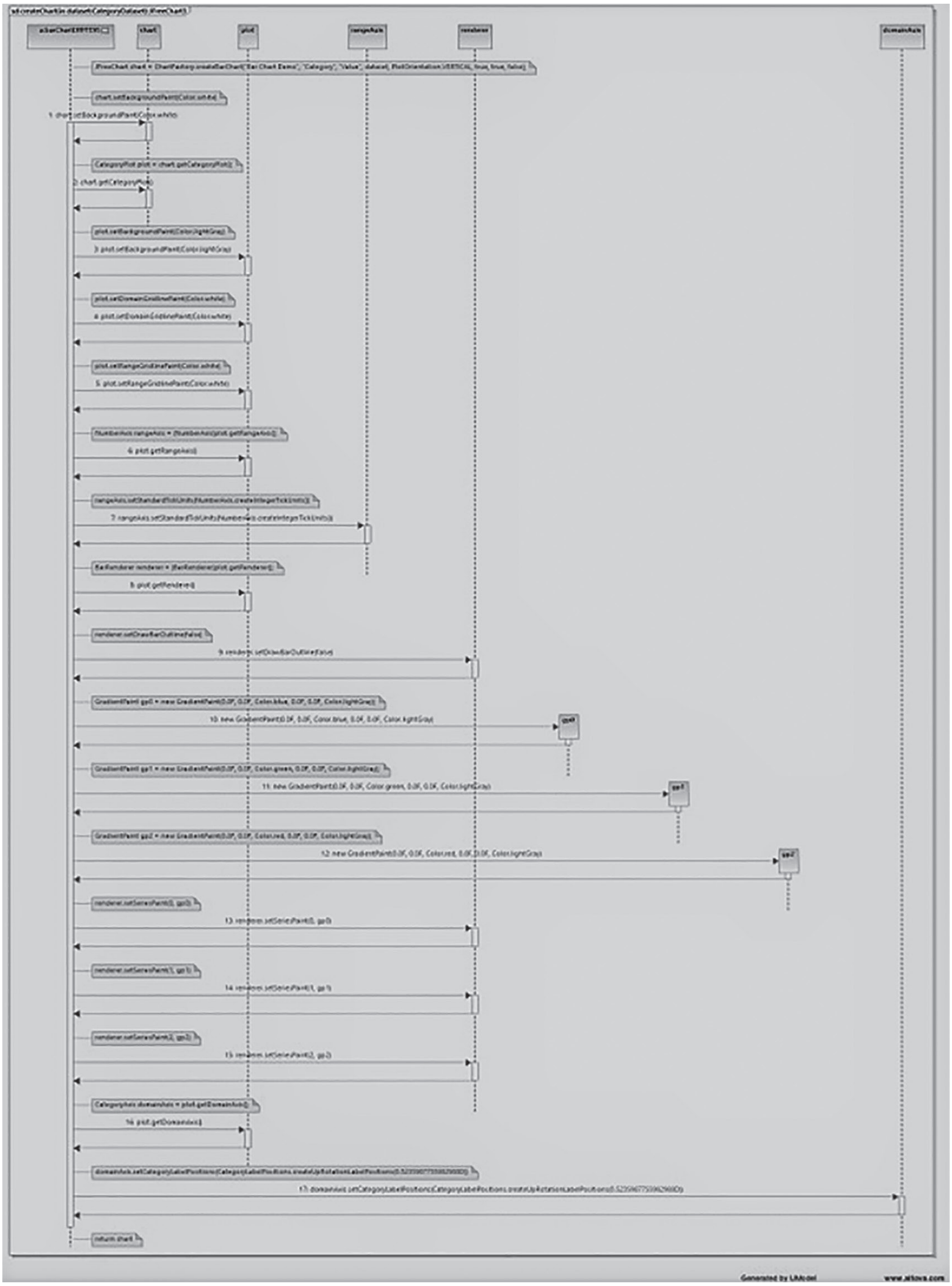

FIGURE 15.304 SequenceDiagram createChart_3.

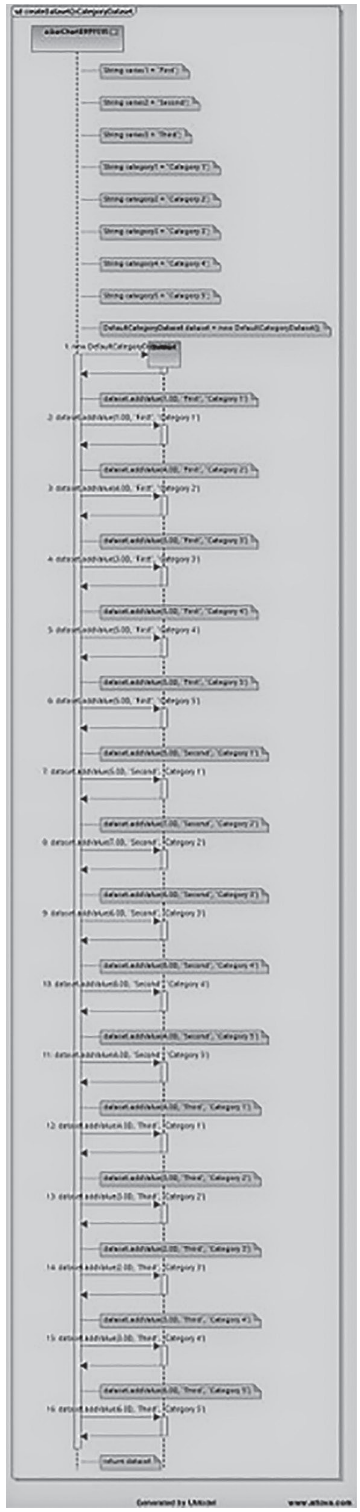

FIGURE 15.305 SequenceDiagram createDataset.

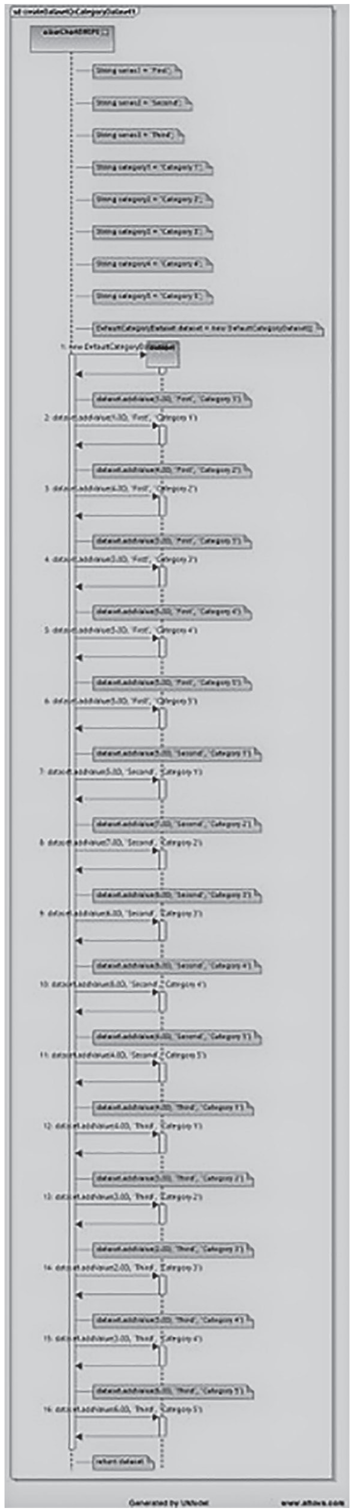

FIGURE 15.306 SequenceDiagram createDataset_1.

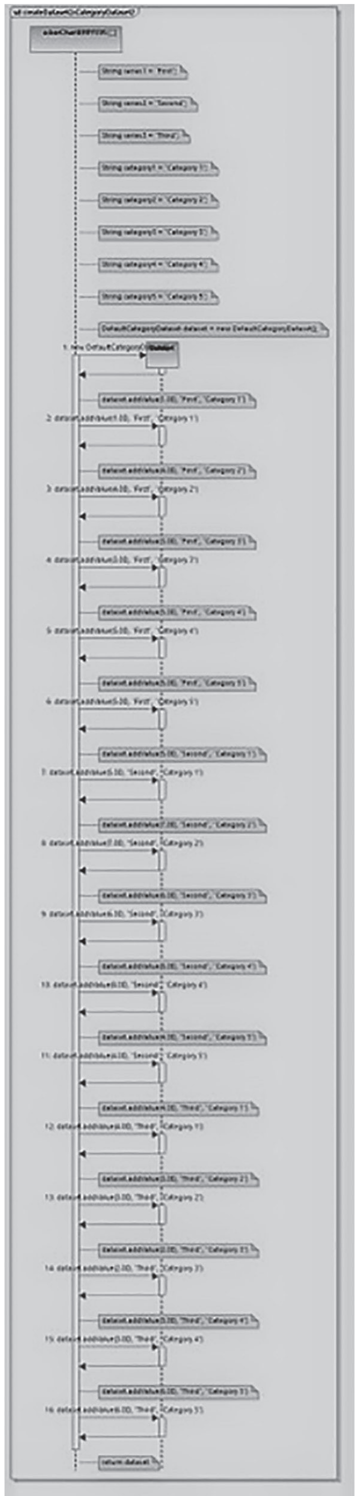

FIGURE 15.307 SequenceDiagram createDataset_2.

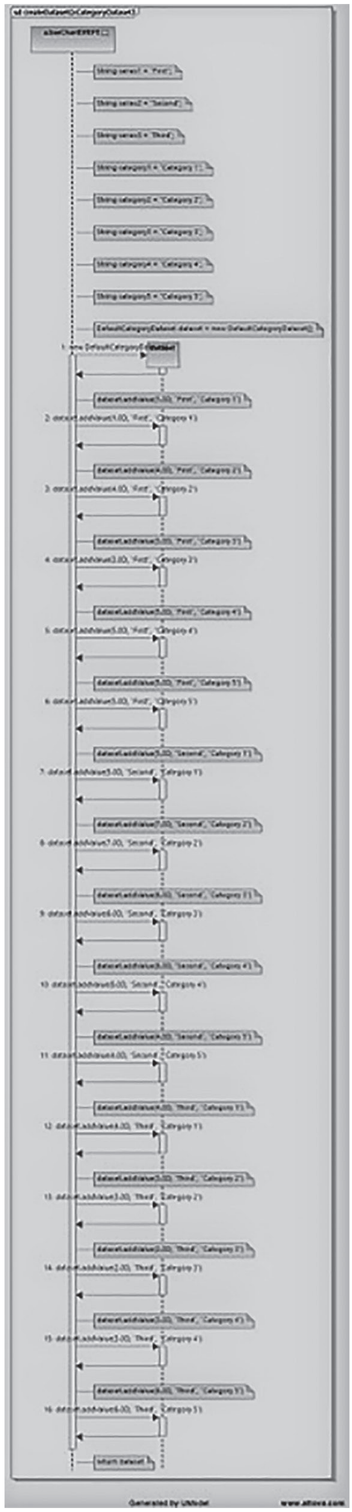

FIGURE 15.308 SequenceDiagram createDataset_3.

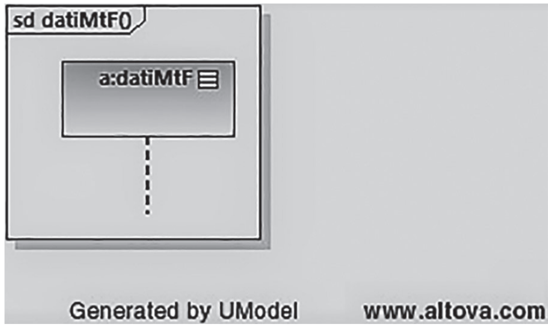

FIGURE 15.309 SequenceDiagram datiMtF.

FIGURE 15.310 SequenceDiagram datiMtF_1.

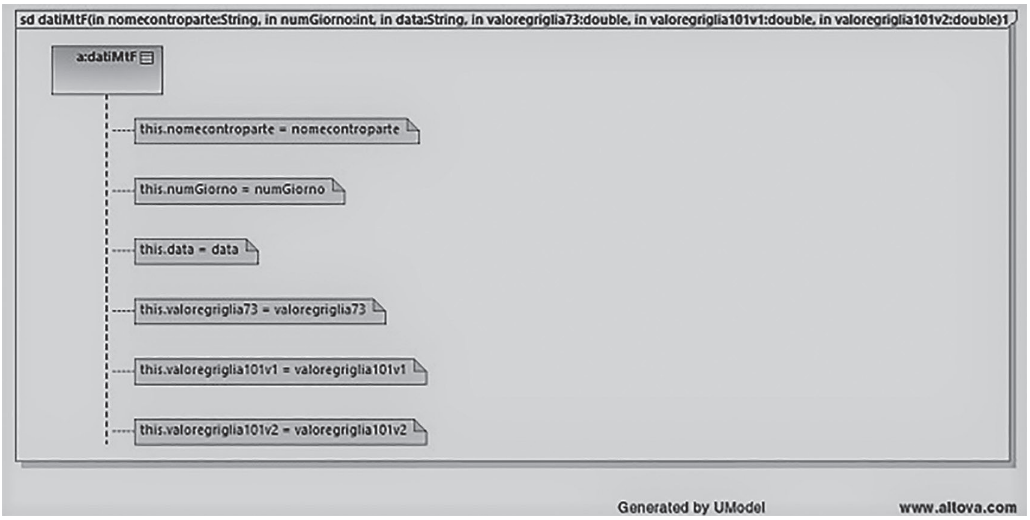

FIGURE 15.311 SequenceDiagram datiMtF_2.

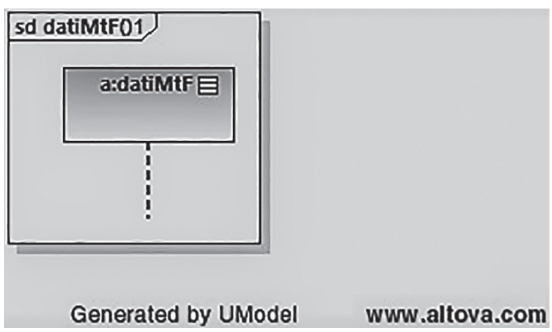

FIGURE 15.312 SequenceDiagram datiMtF_3.

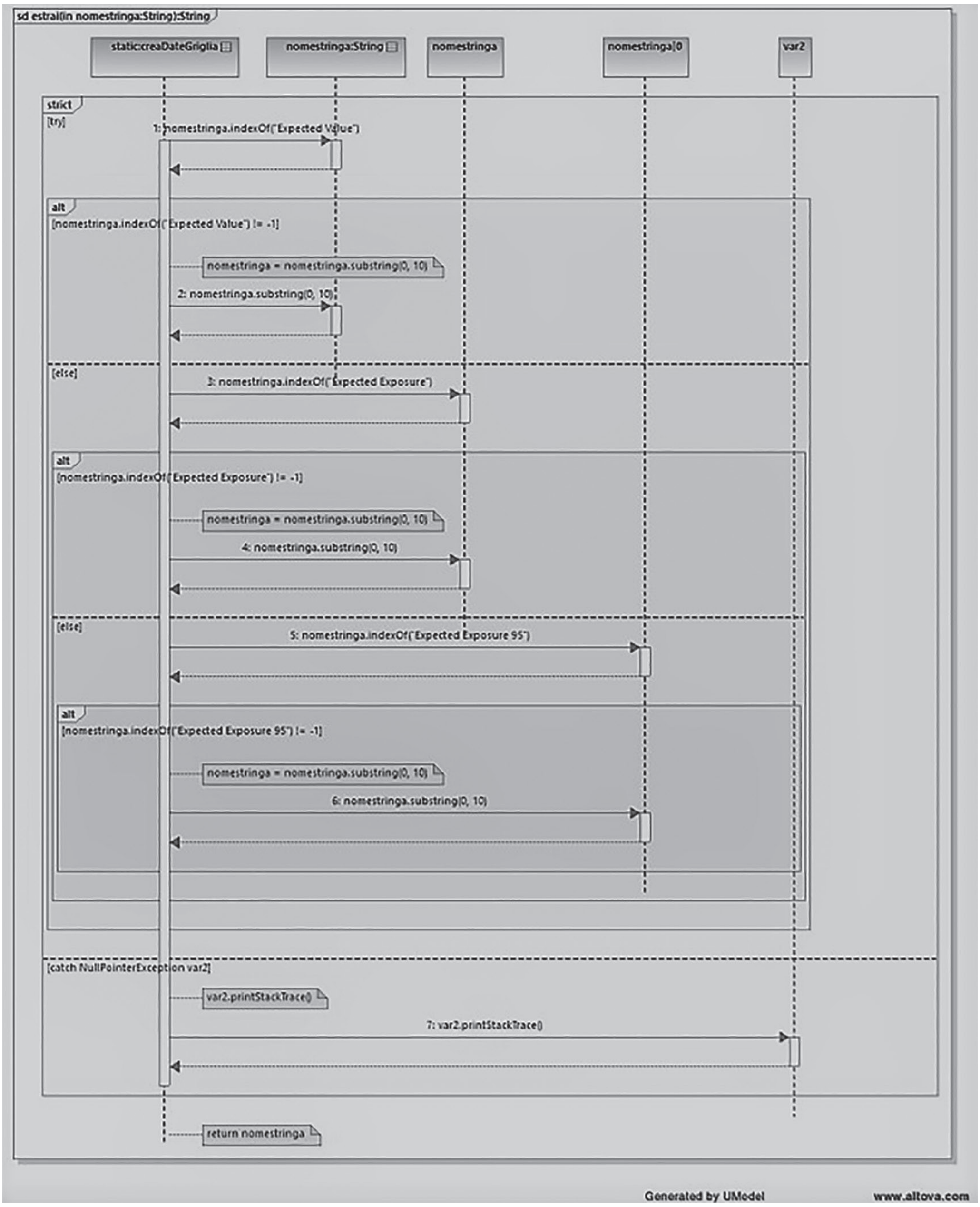

FIGURE 15.313 SequenceDiagram estrai.

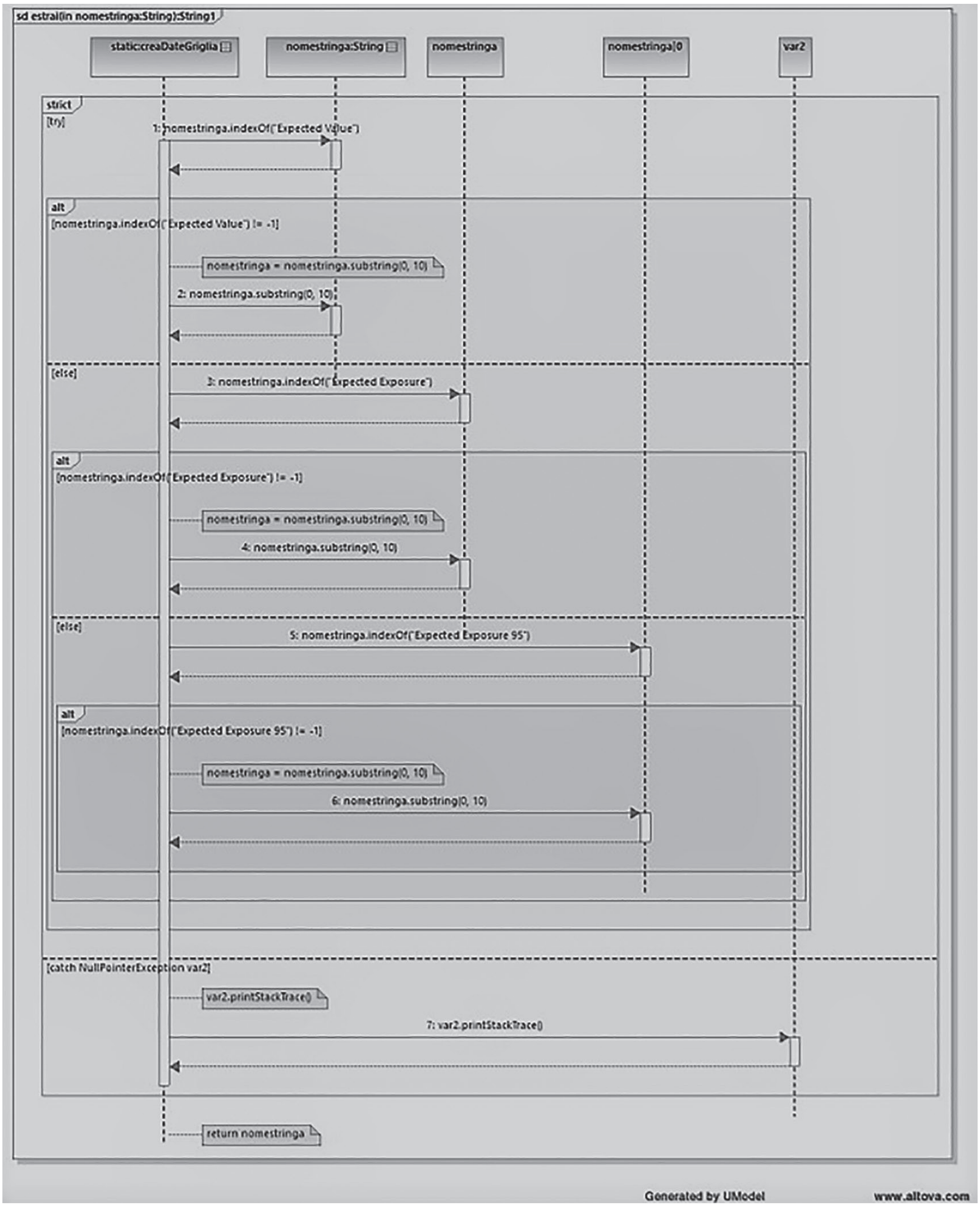

FIGURE 15.314 SequenceDiagram estrai_1.

FIGURE 15.315 SequenceDiagram generaArray.

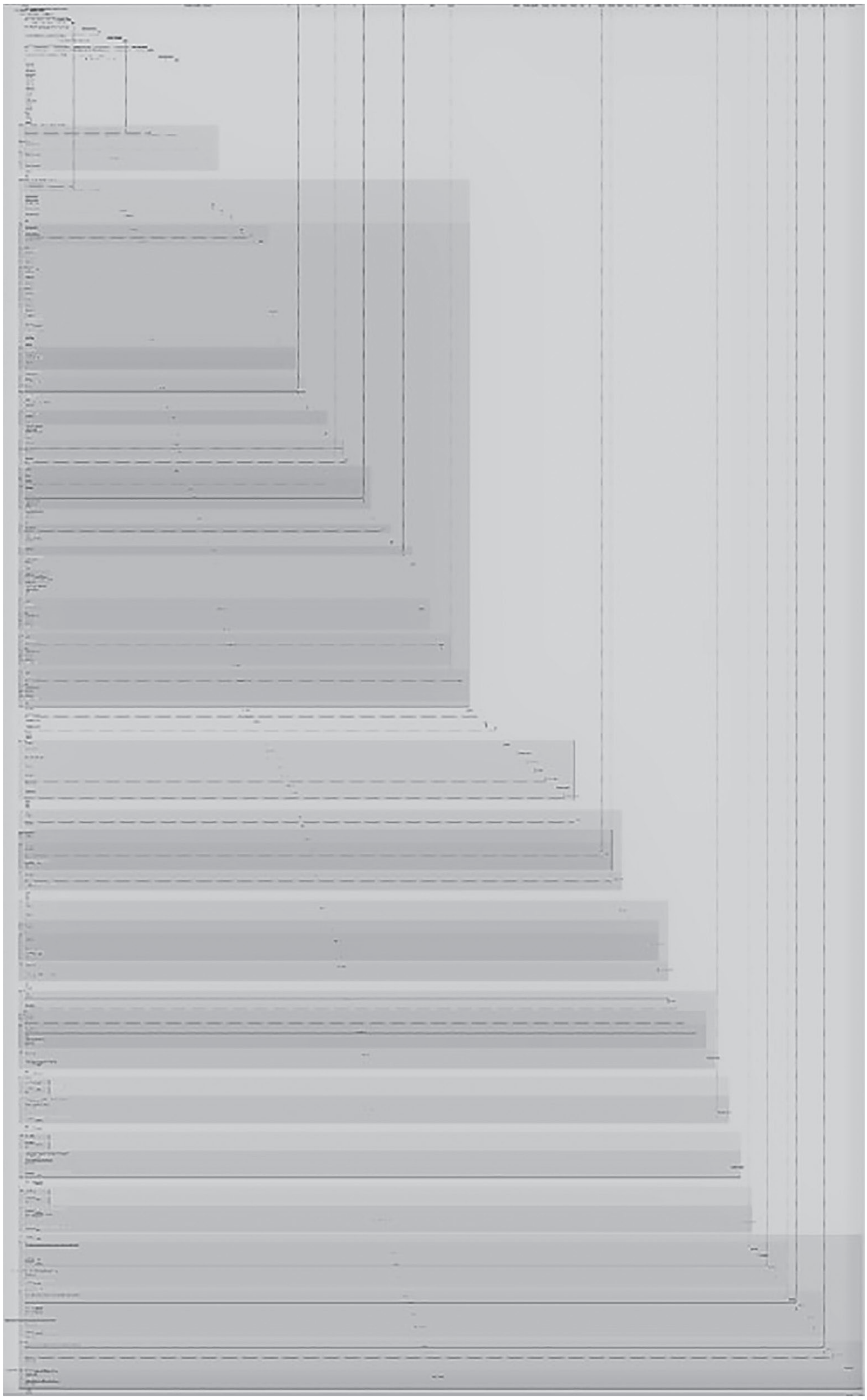

FIGURE 15.316 SequenceDiagram generaArray_1.

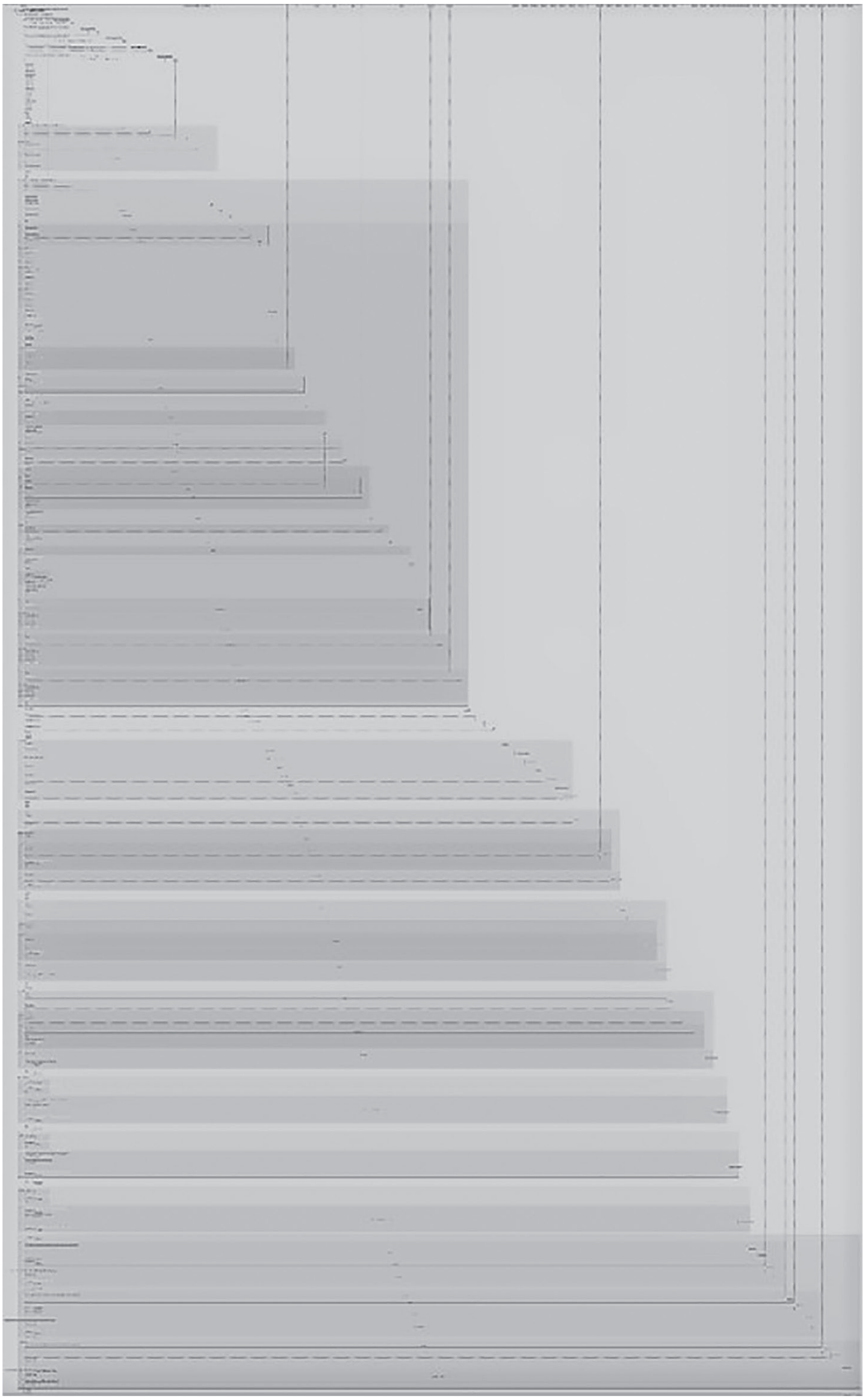

FIGURE 15.317 SequenceDiagram generaArray_2.

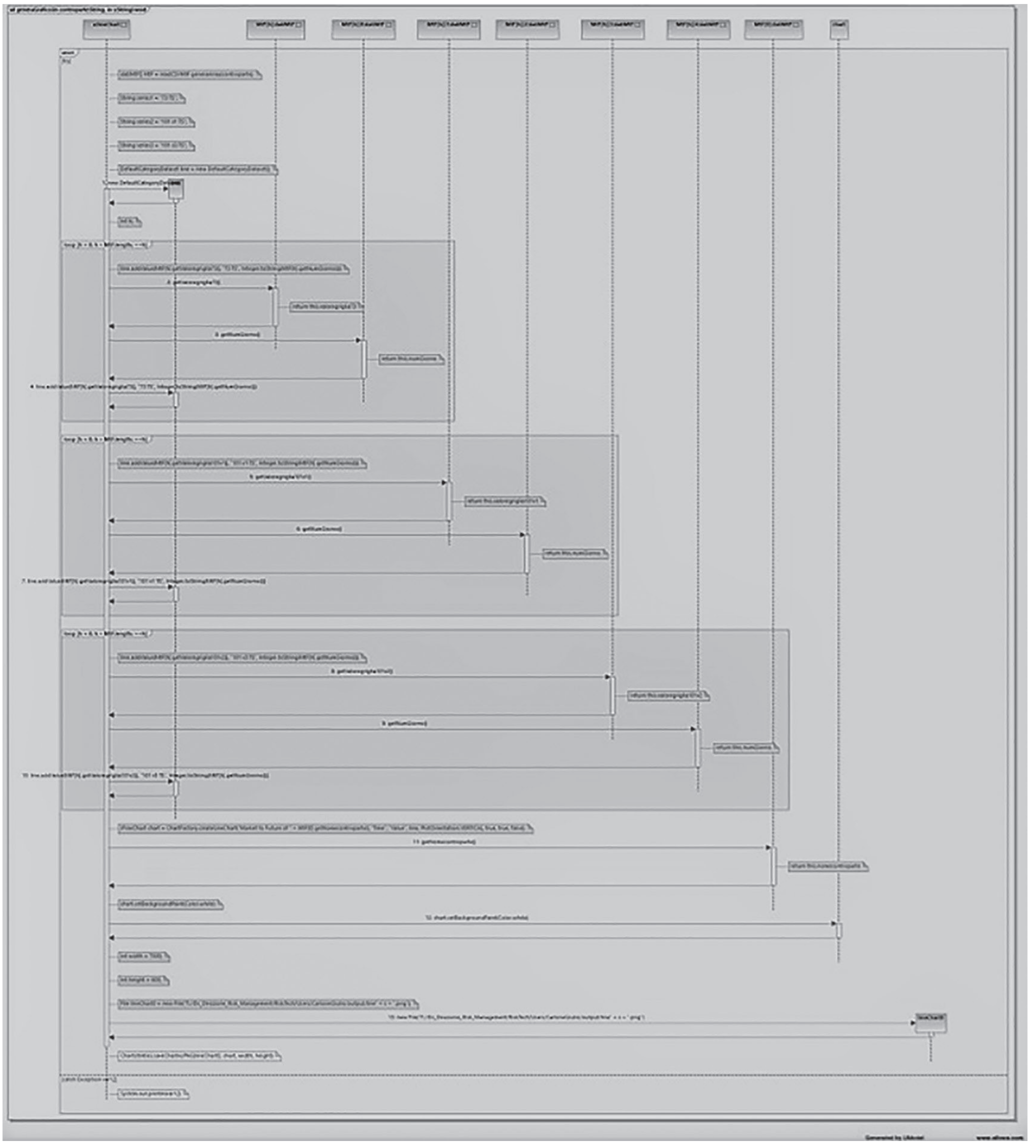

FIGURE 15.318 SequenceDiagram generaGrafico.

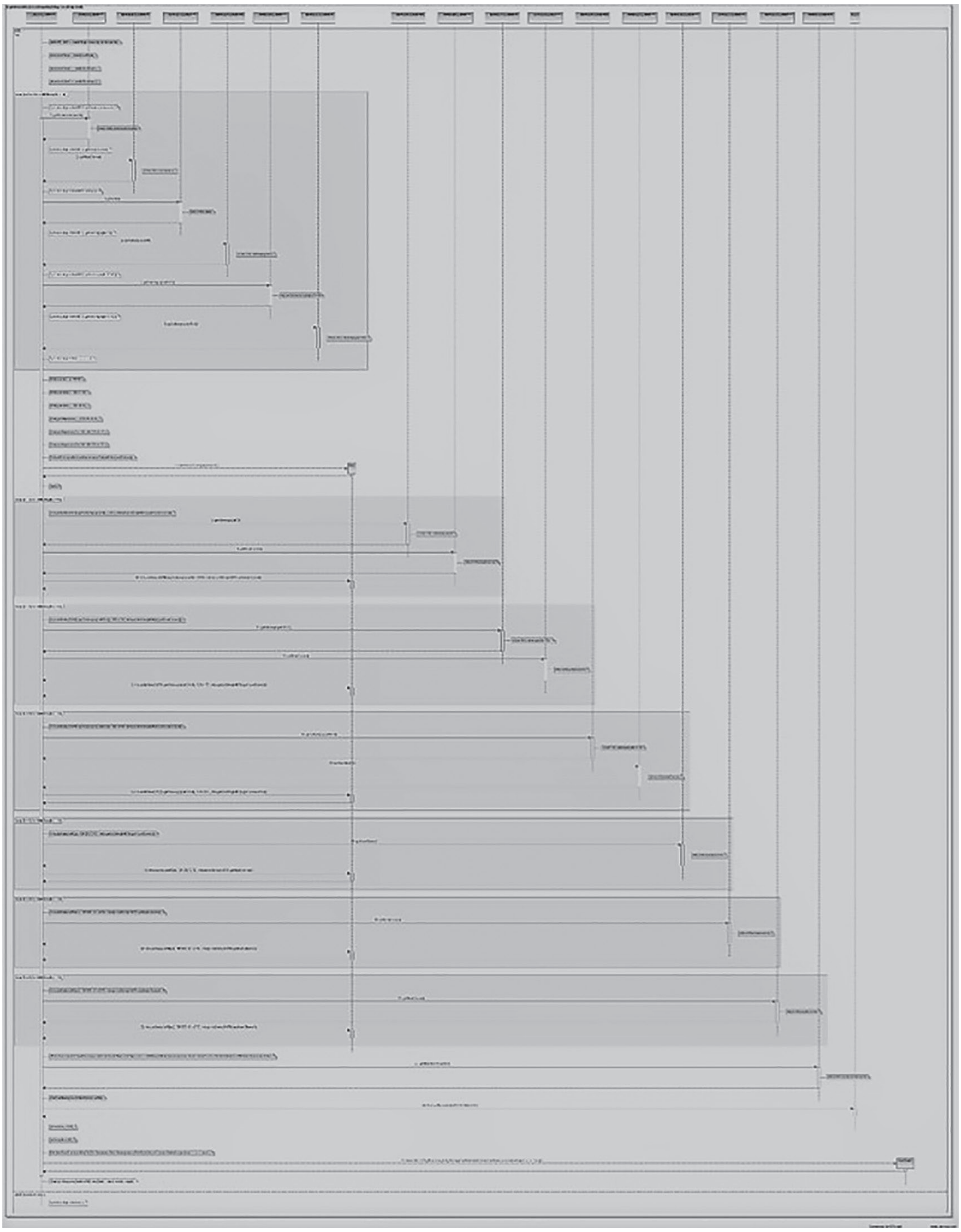

FIGURE 15.319 SequenceDiagram generaGrafico_1.

FIGURE 15.320 SequenceDiagram generaGrafico_2.

FIGURE 15.321 SequenceDiagram generaGrafico_3.

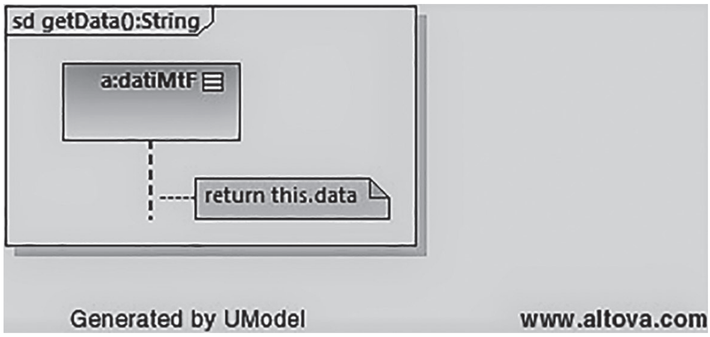

FIGURE 15.322 SequenceDiagram getData.

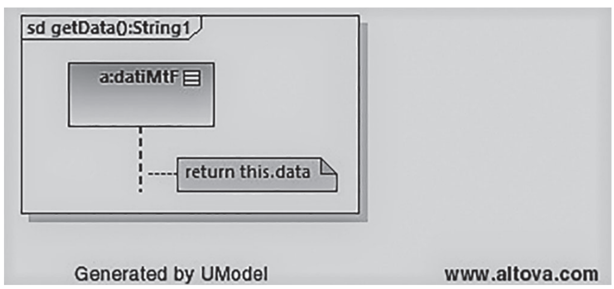

FIGURE 15.323 SequenceDiagram getData_1.

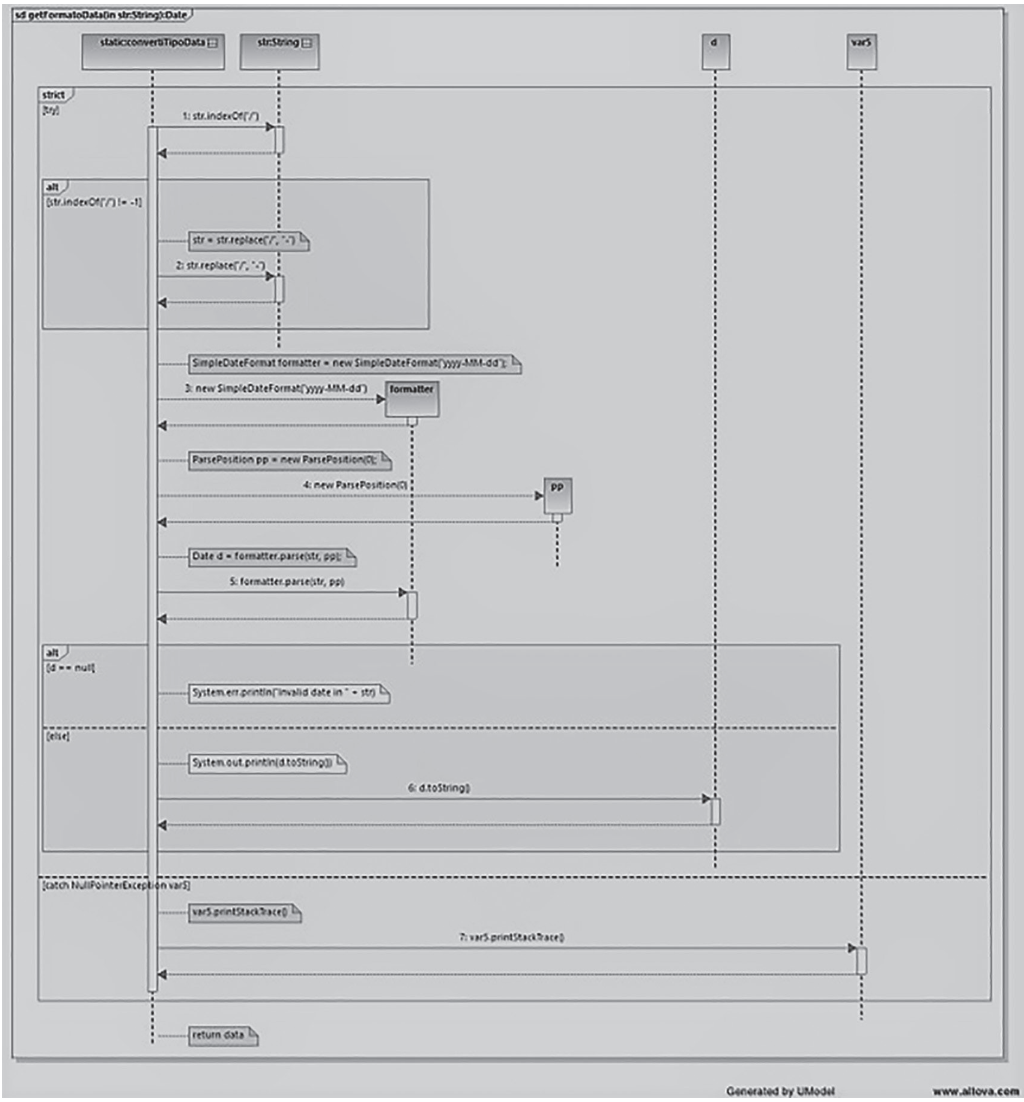

FIGURE 15.324 SequenceDiagram getFormatoData.

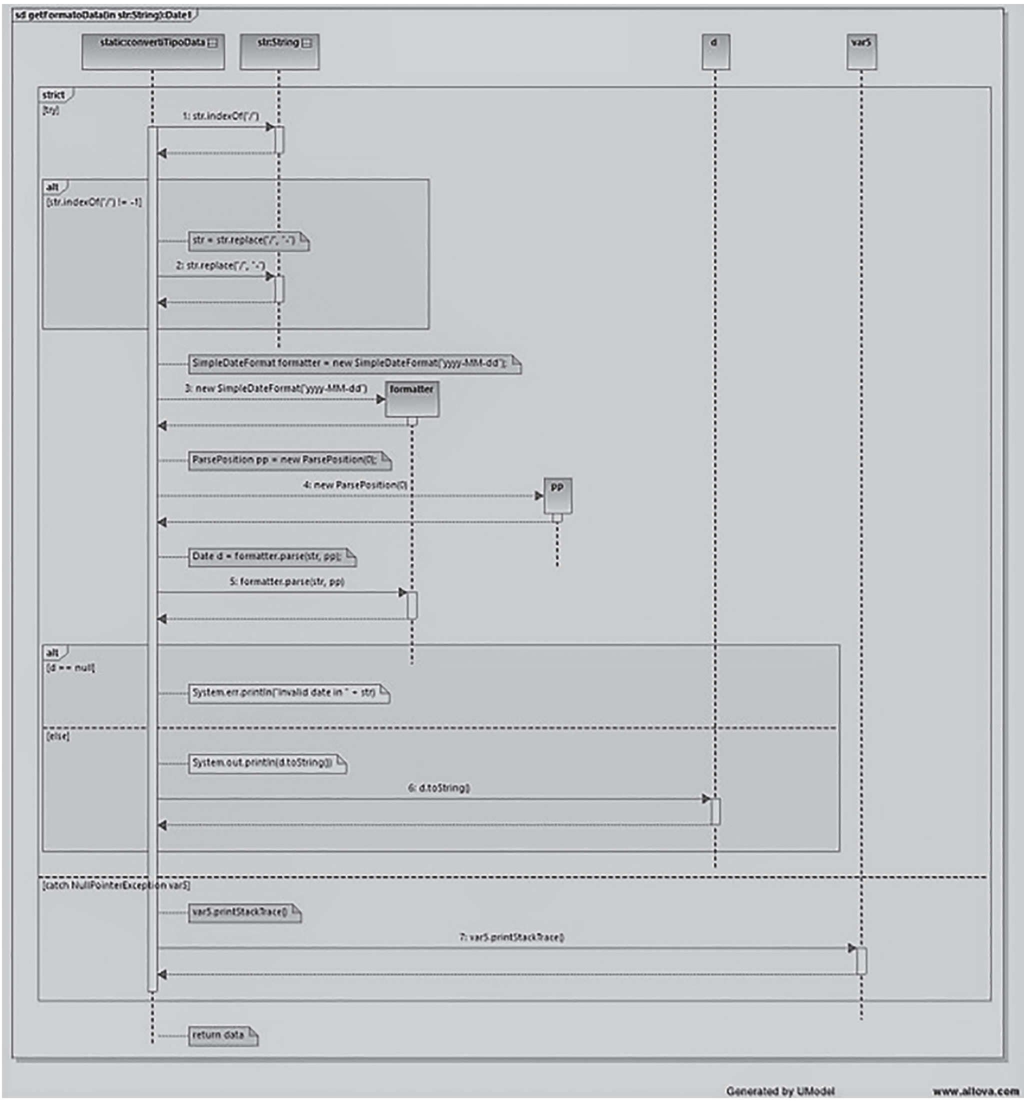

FIGURE 15.325 SequenceDiagram getFormatoData_1.

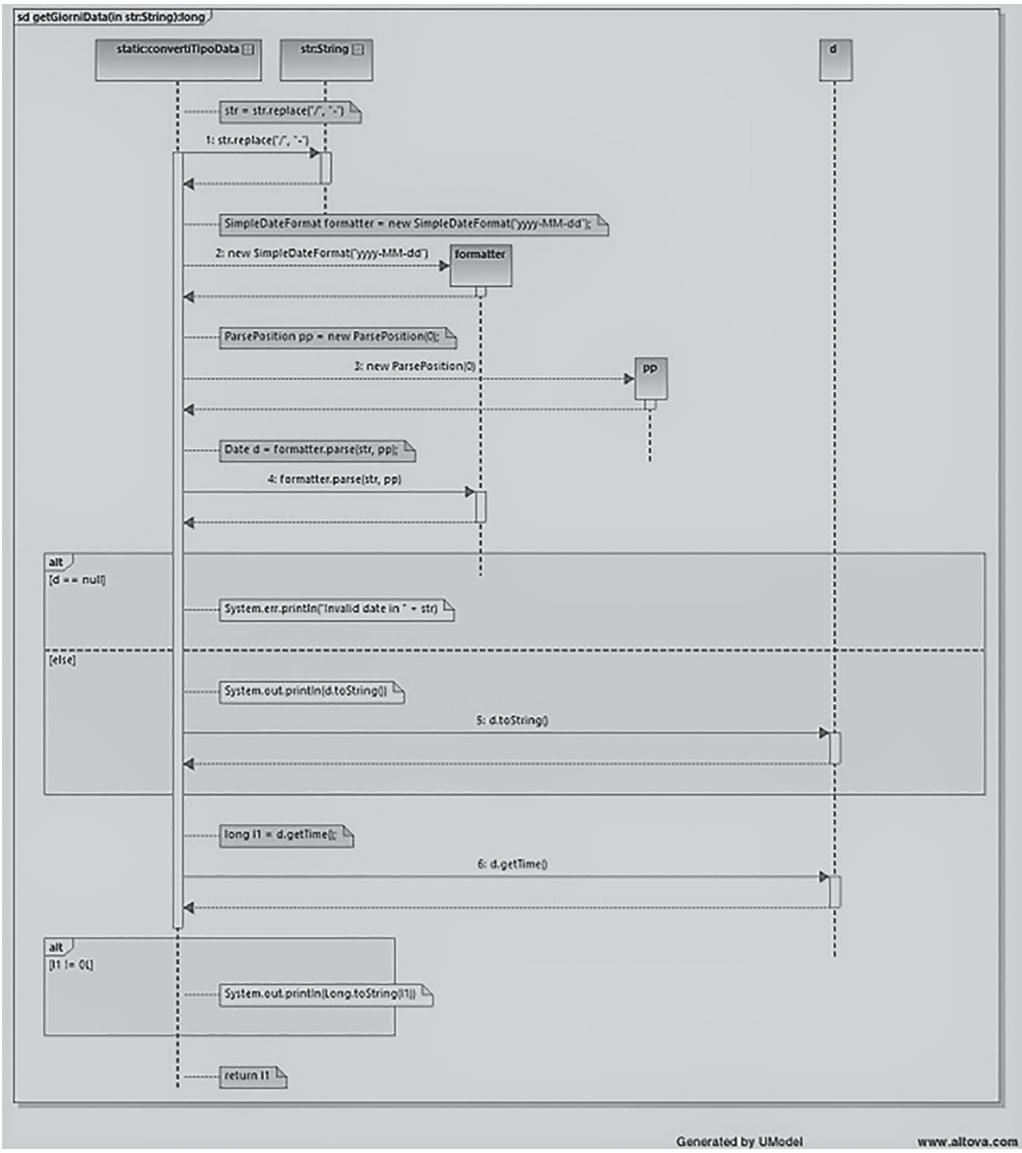

FIGURE 15.326 SequenceDiagram getGiorniData.

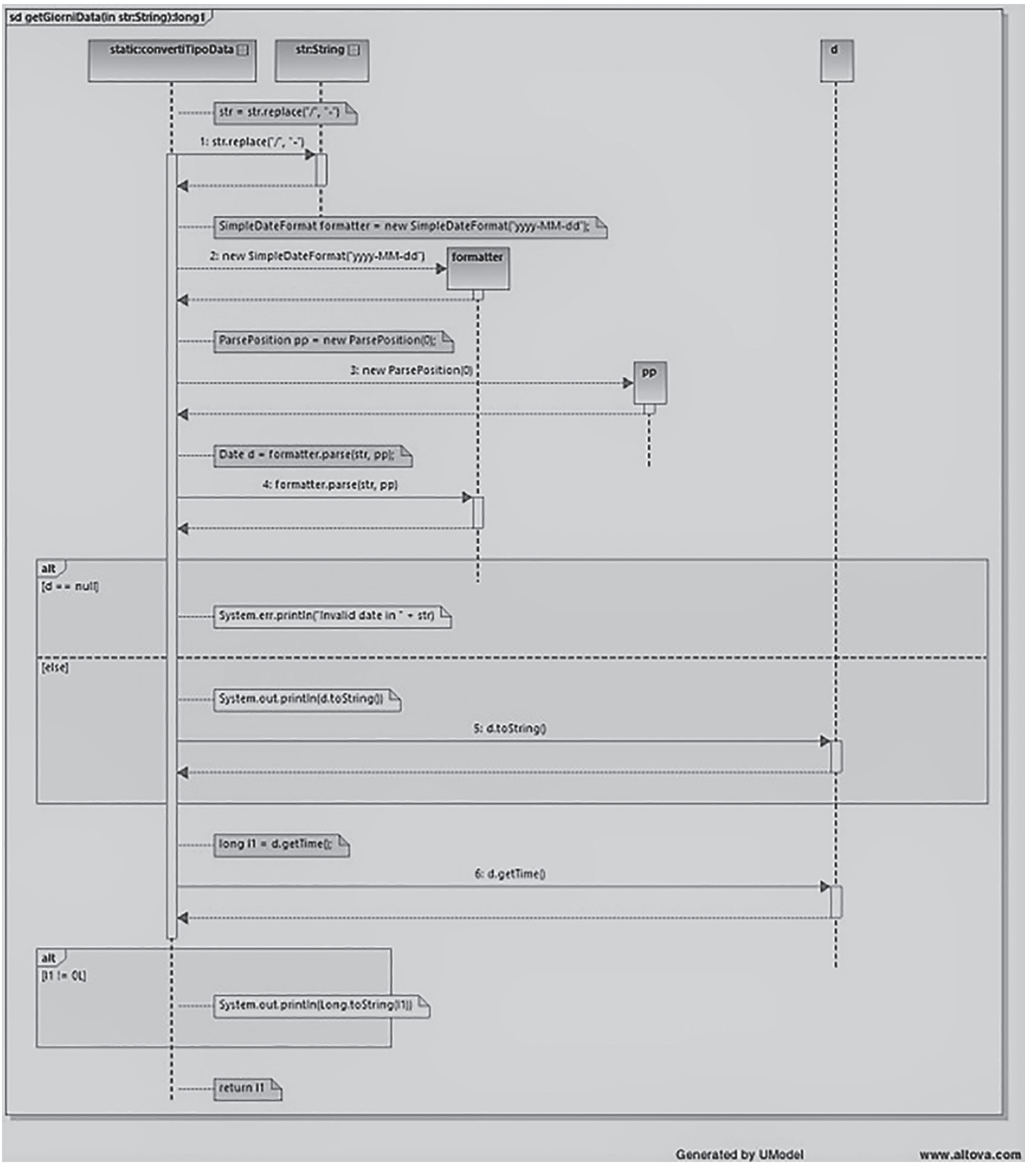

FIGURE 15.327 SequenceDiagram getGiorniData_1.

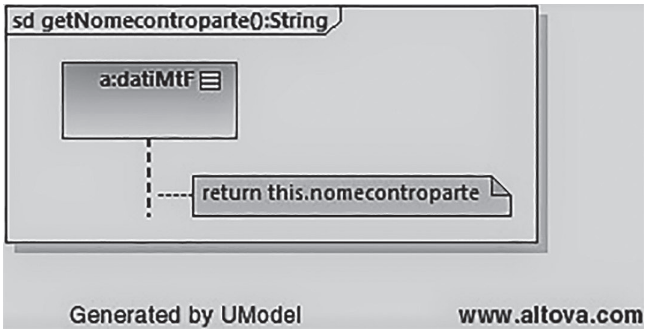

FIGURE 15.328 SequenceDiagram getNomecontroparte.

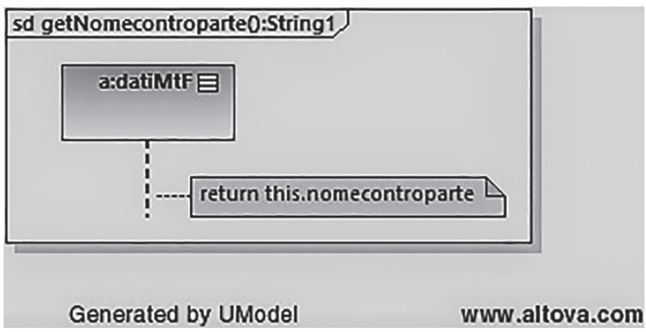

FIGURE 15.329 SequenceDiagram getNomecontroparte_1.

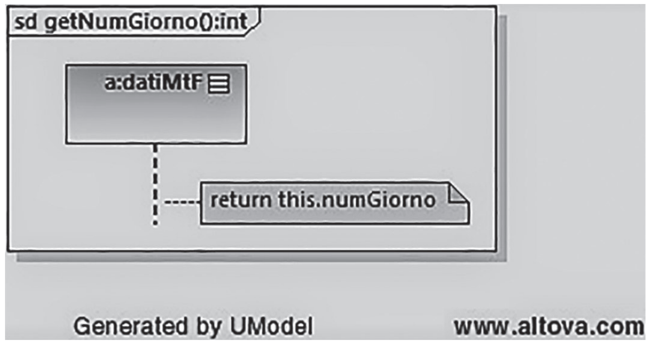

FIGURE 15.330 SequenceDiagram getNumGiorno.

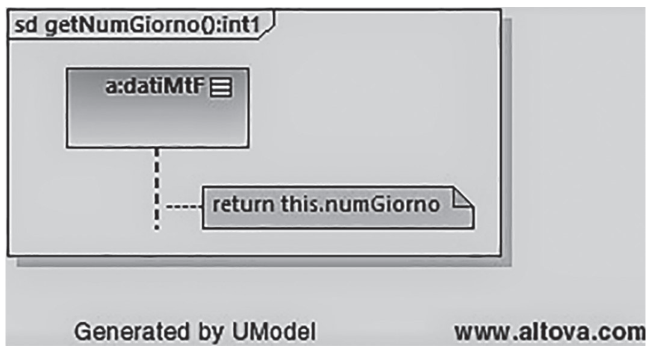

FIGURE 15.331 SequenceDiagram getNumGiorno_1.

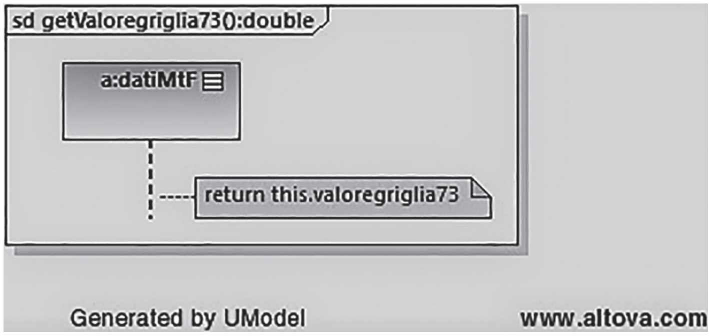

FIGURE 15.332 SequenceDiagram getValoregriglia73.

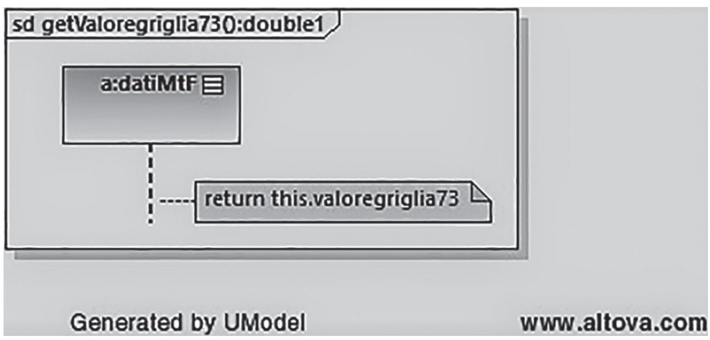

FIGURE 15.333 SequenceDiagram getValoregriglia73_1.

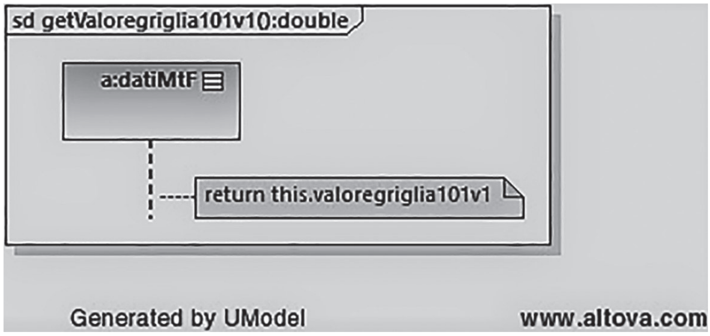

FIGURE 15.334 SequenceDiagram getValoregriglia101v1.

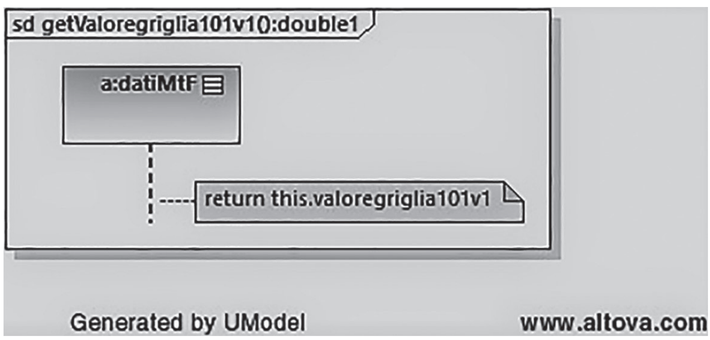

FIGURE 15.335 SequenceDiagram getValoregriglia101v1_1.

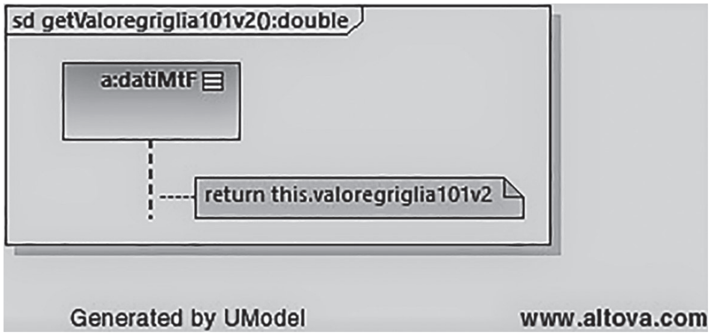

FIGURE 15.336 SequenceDiagram getValoregriglia101v2.

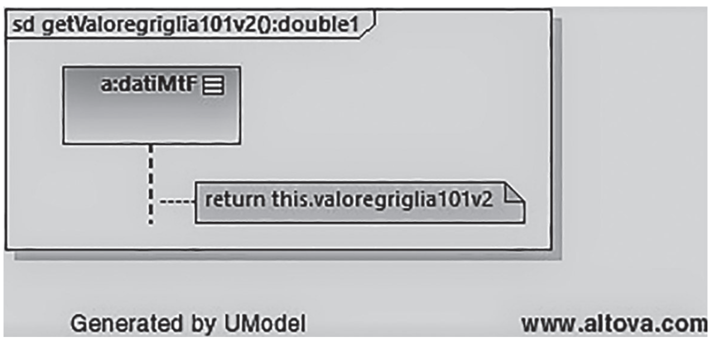

FIGURE 15.337 SequenceDiagram getValoregriglia101v2_1.

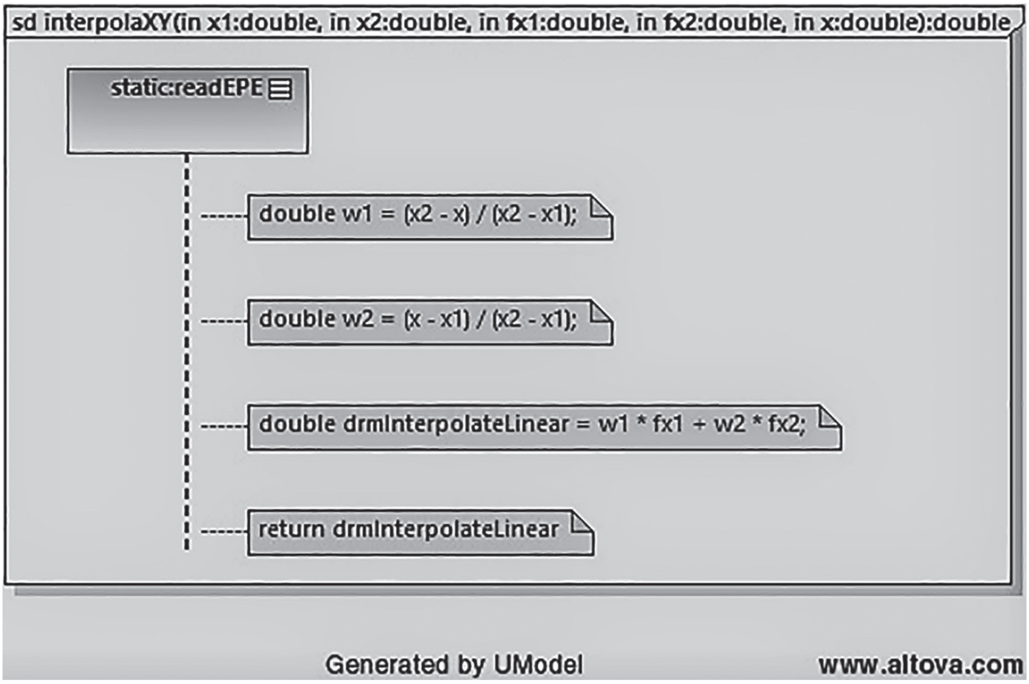

FIGURE 15.338 SequenceDiagram interpolaXY.

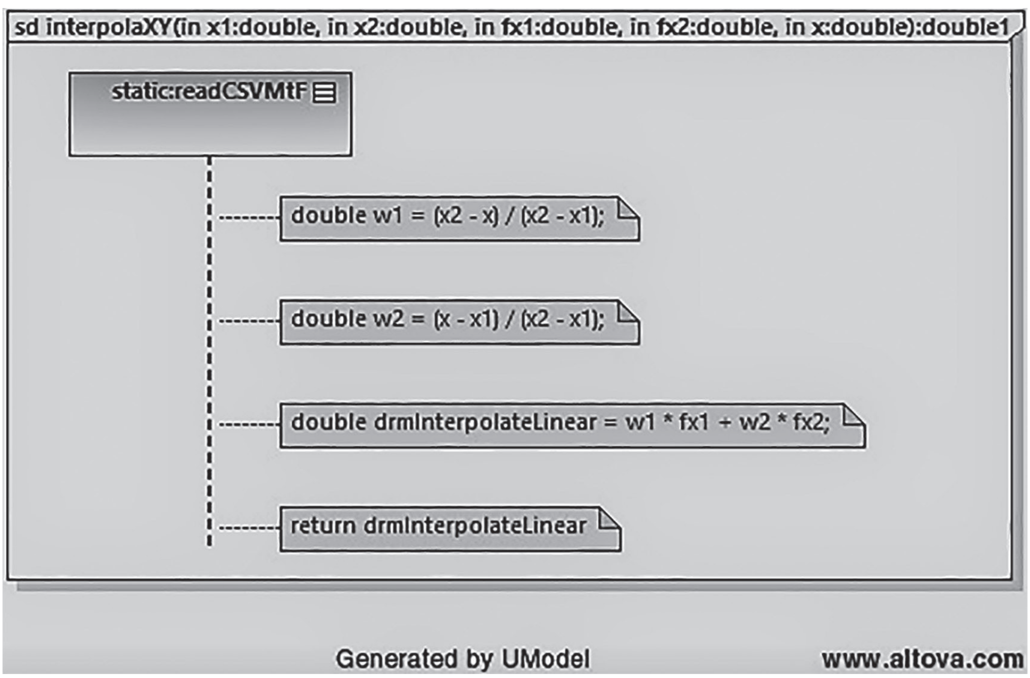

FIGURE 15.339 SequenceDiagram interpolaXY_1.

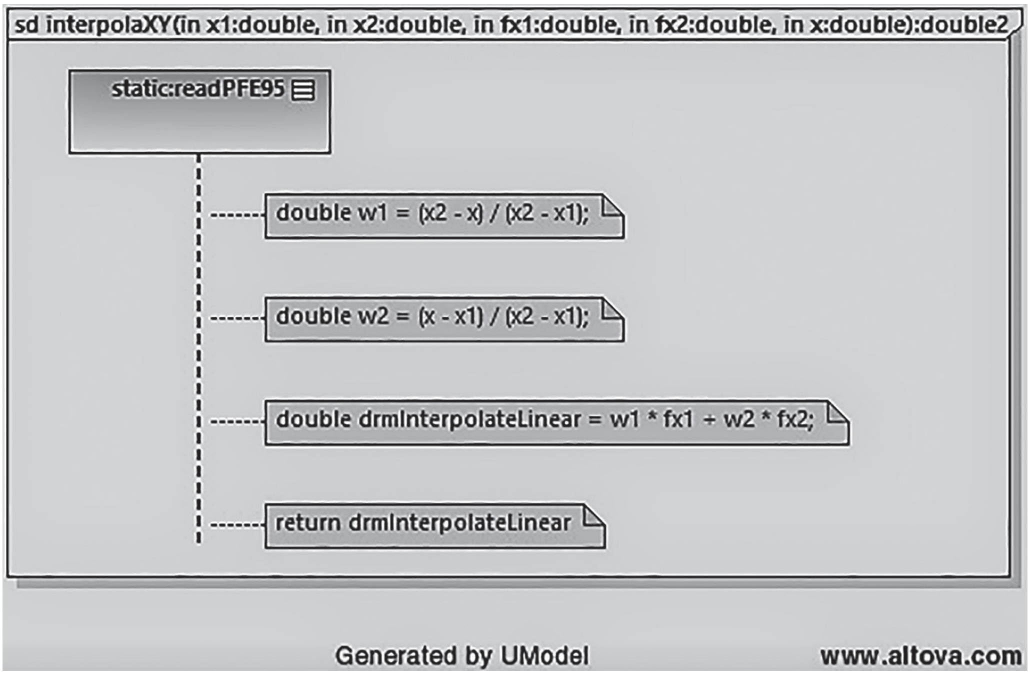

FIGURE 15.340 SequenceDiagram interpolaXY_2.

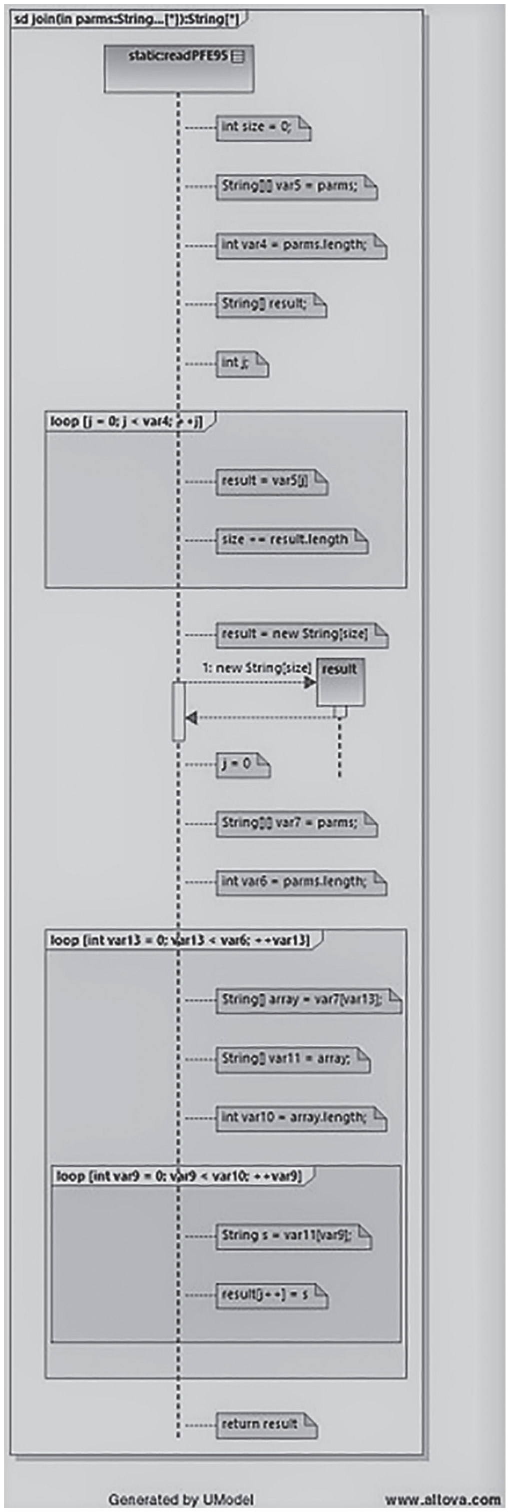

FIGURE 15.341 SequenceDiagram join.

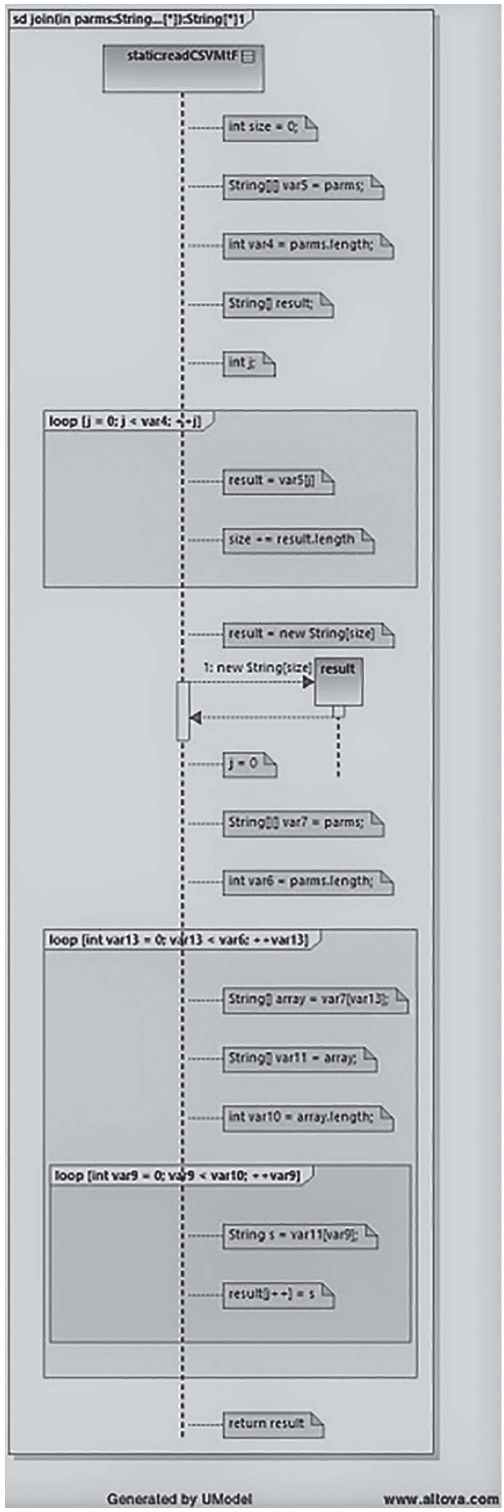

FIGURE 15.342 SequenceDiagram join_1.

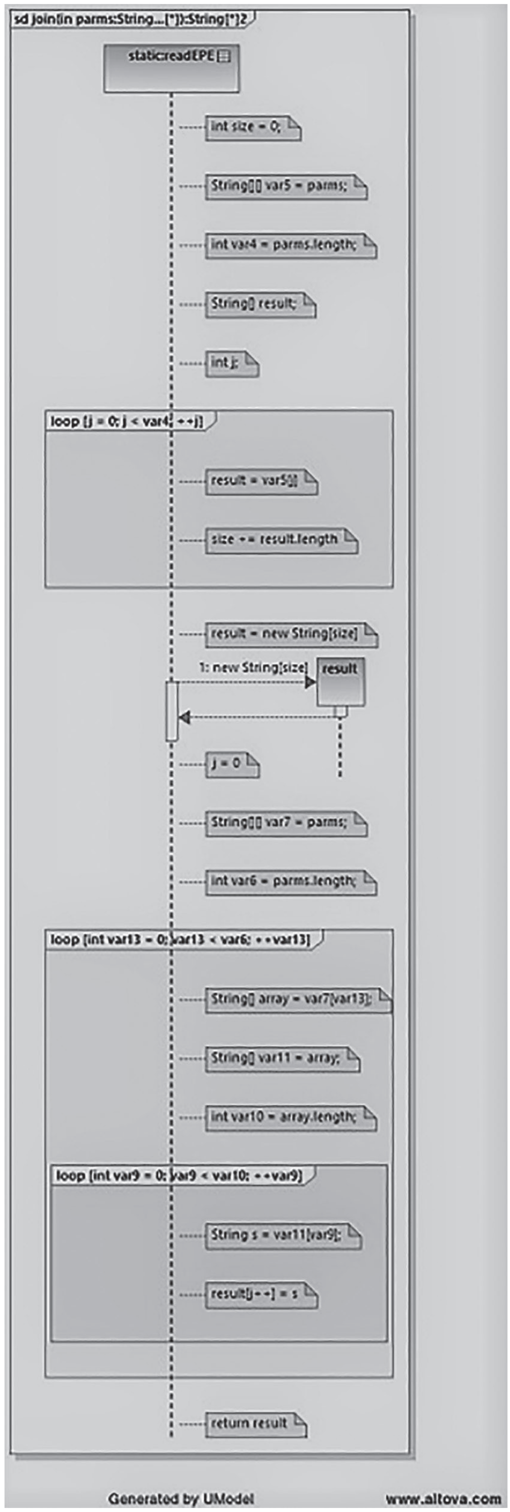

FIGURE 15.343 SequenceDiagram join_2.

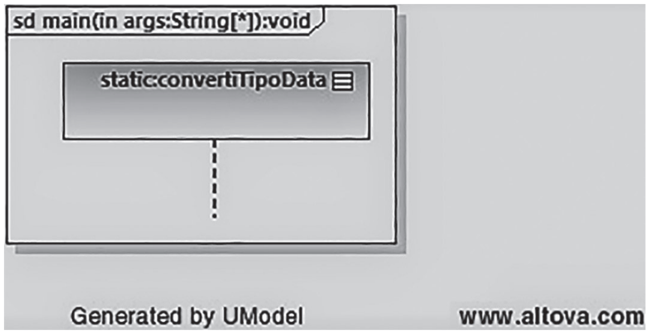

FIGURE 15.344 SequenceDiagram main.

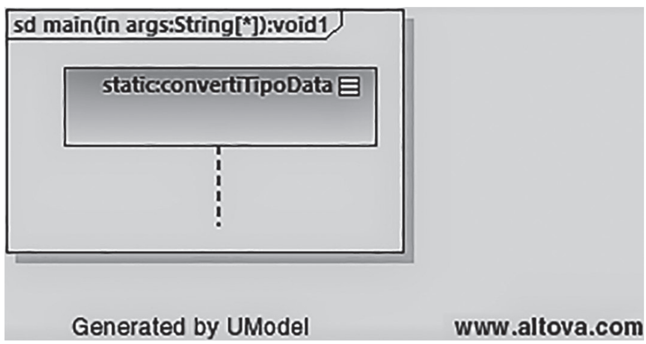

FIGURE 15.345 SequenceDiagram main_1.

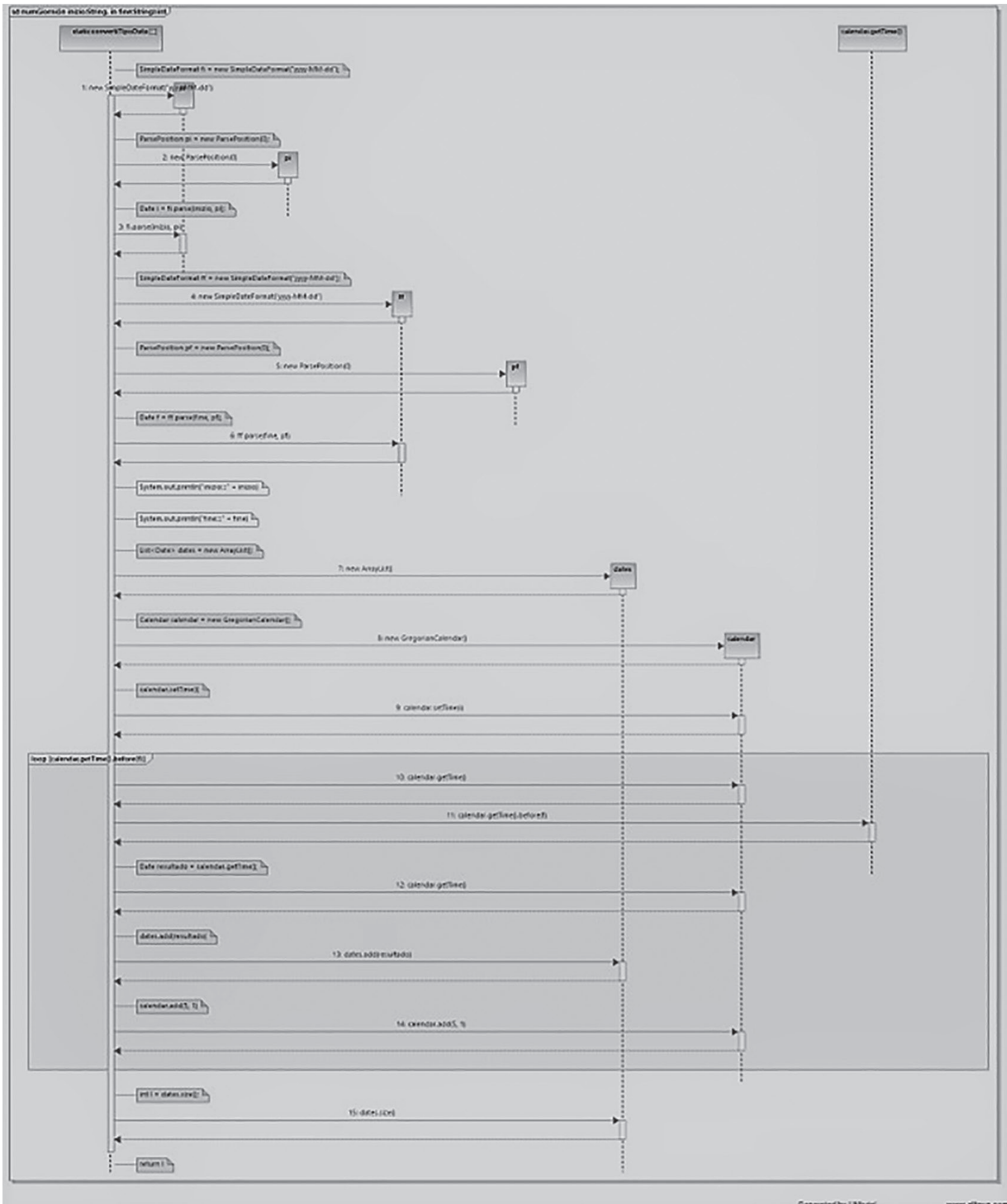

FIGURE 15.346 SequenceDiagram numGiorni.

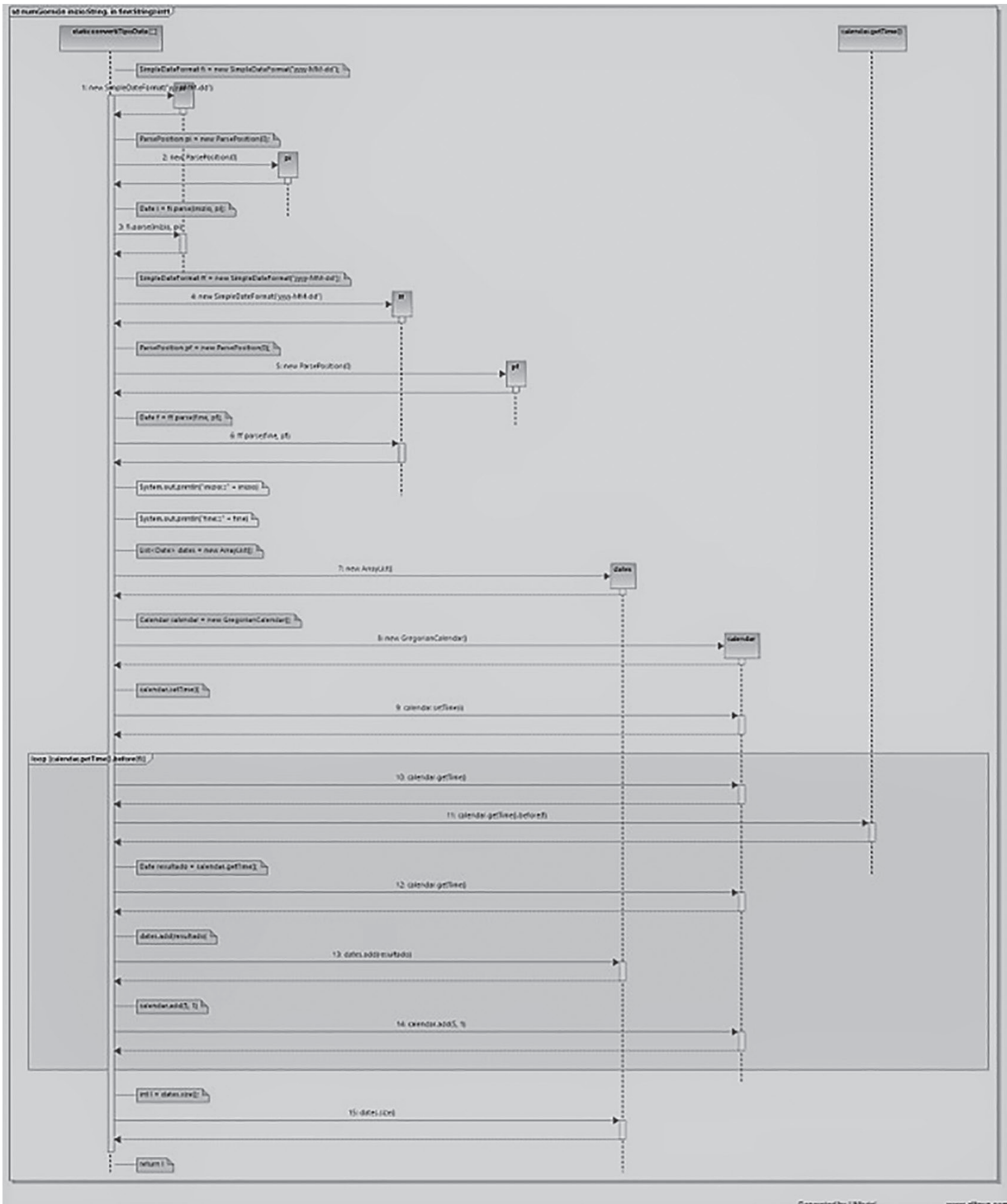

FIGURE 15.347 SequenceDiagram numGiorni_1.

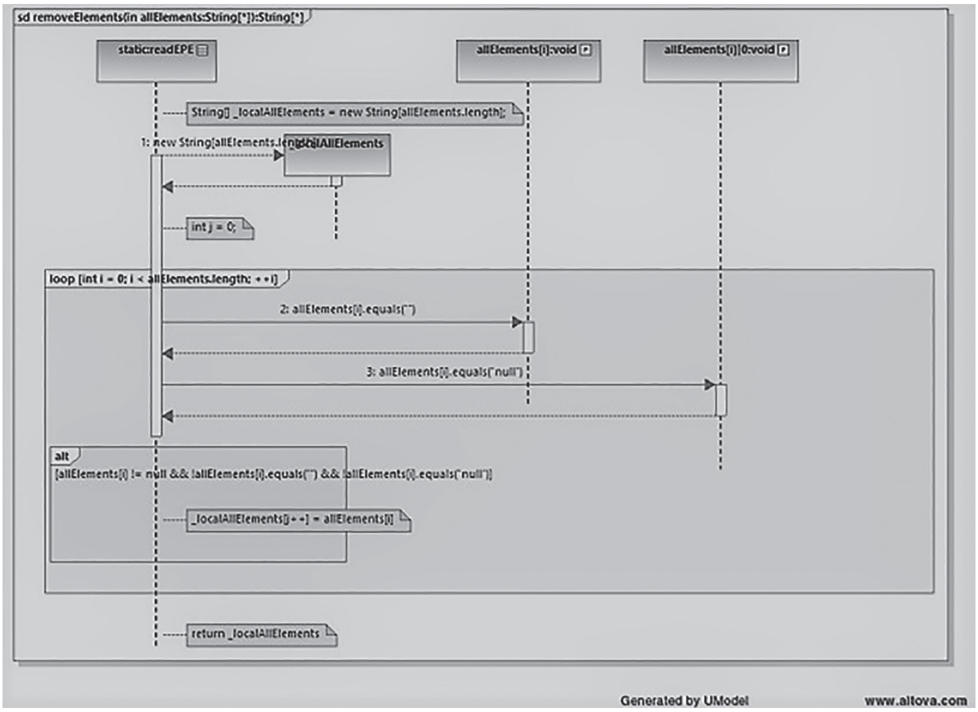

FIGURE 15.348 SequenceDiagram removeElements.

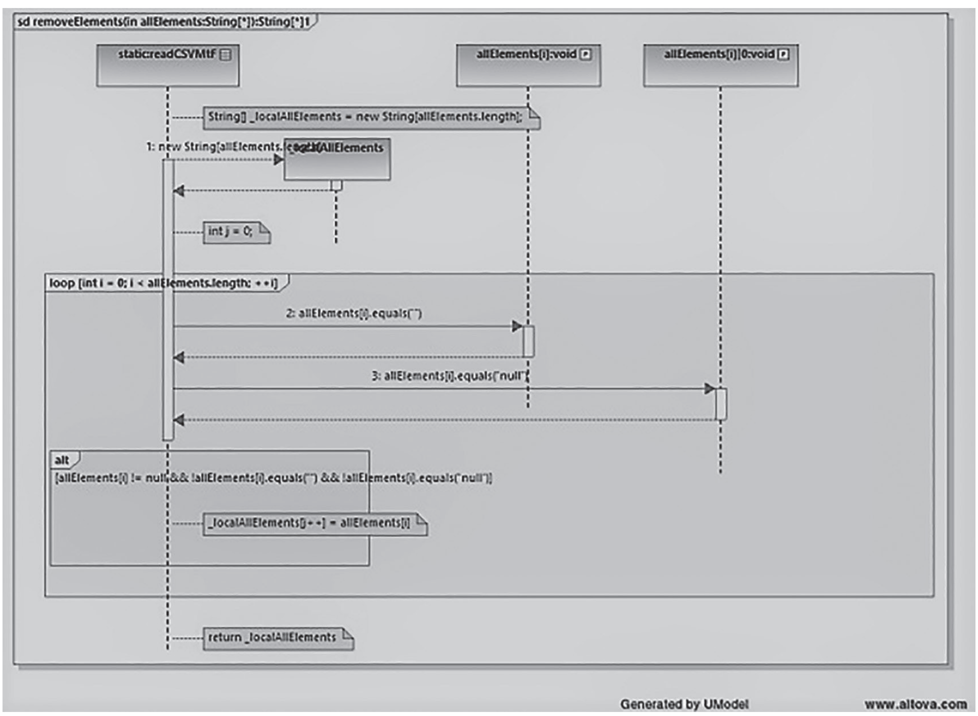

FIGURE 15.349 SequenceDiagram removeElements_1.

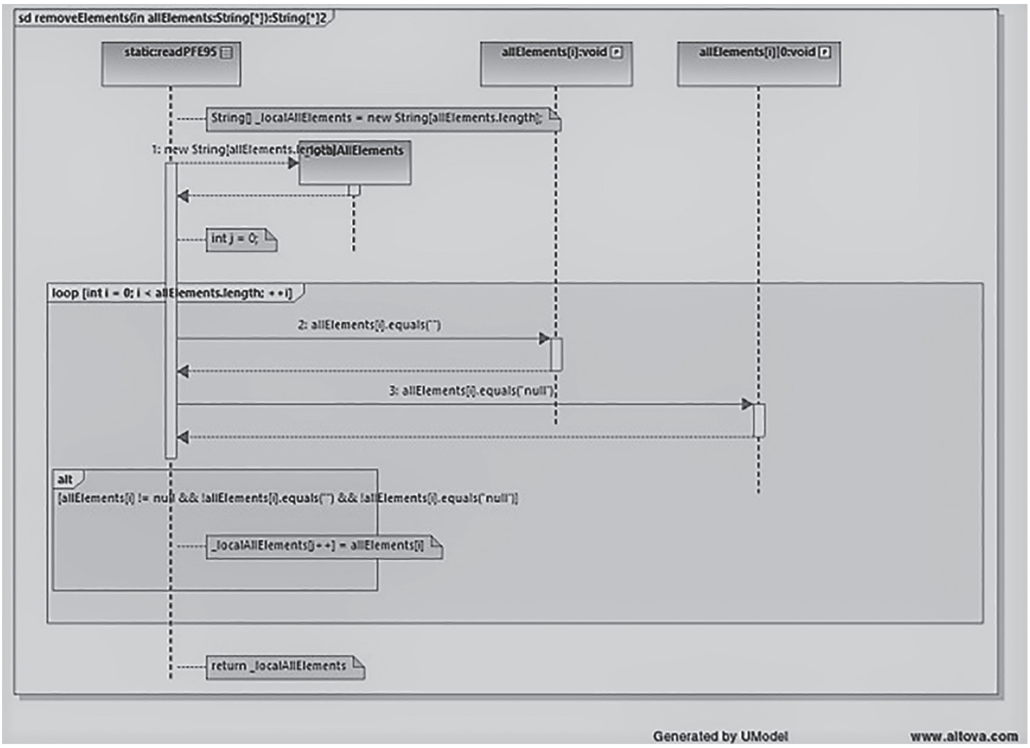

FIGURE 15.350 SequenceDiagram removeElements_2.

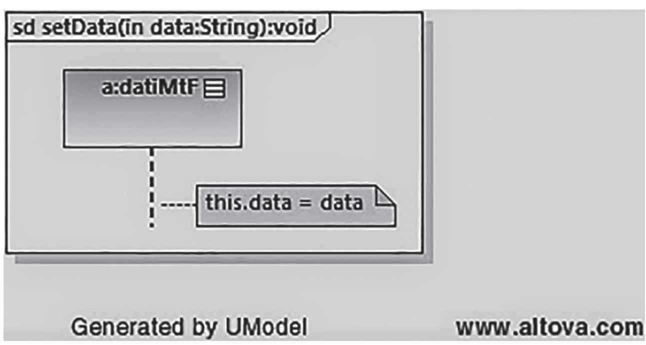

FIGURE 15.351 SequenceDiagram setData.

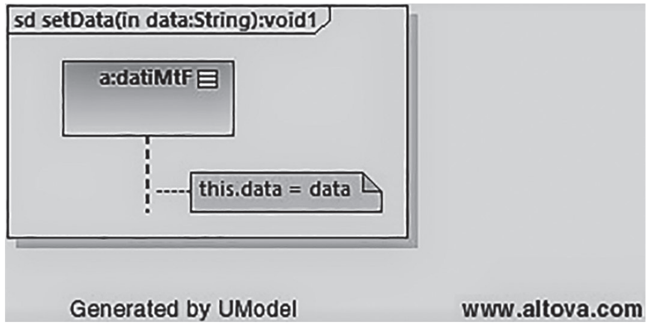

FIGURE 15.352 SequenceDiagram setData_1.

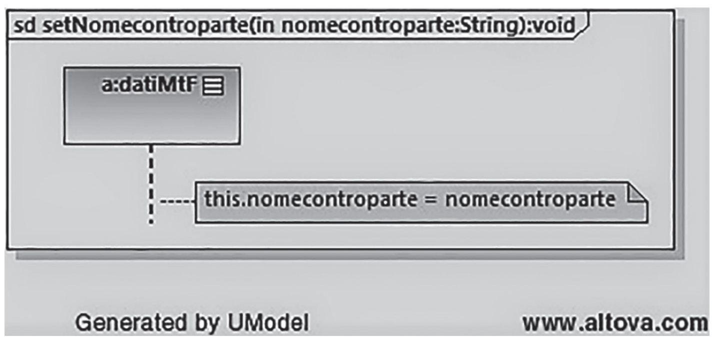

FIGURE 15.353 SequenceDiagram setNomecontroparte.

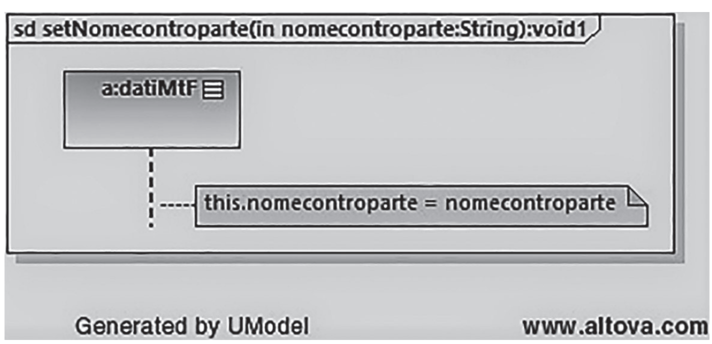

FIGURE 15.354 SequenceDiagram setNomecontroparte_1.

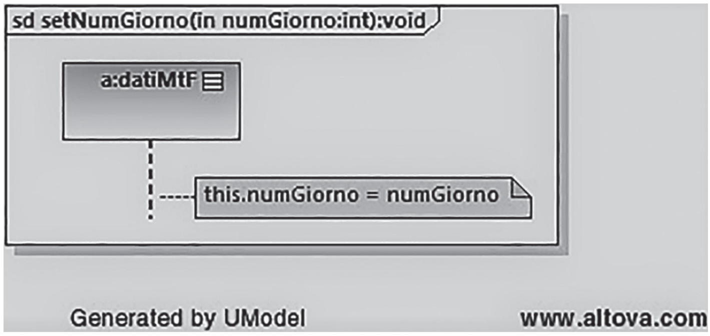

FIGURE 15.355 SequenceDiagram setNumGiorno.

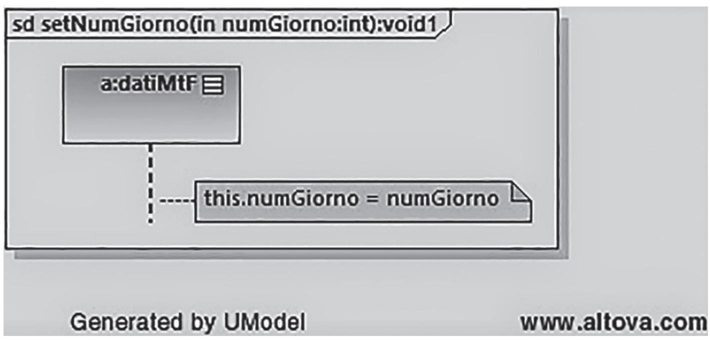

FIGURE 15.356 SequenceDiagram setNumGiorno_1.

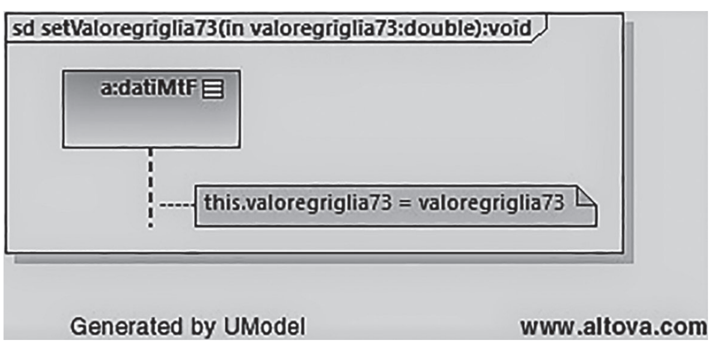

FIGURE 15.357 SequenceDiagram setValoregriglia73.

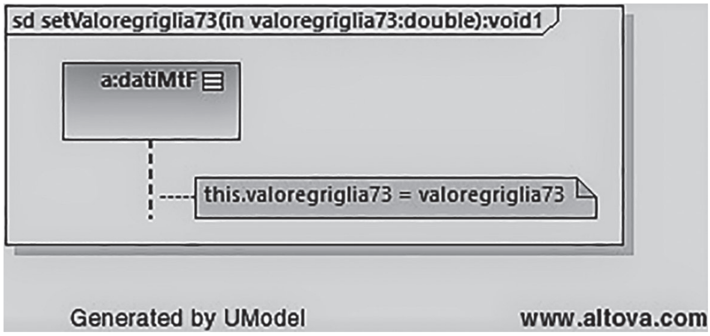

FIGURE 15.358 SequenceDiagram setValoregriglia73_1.

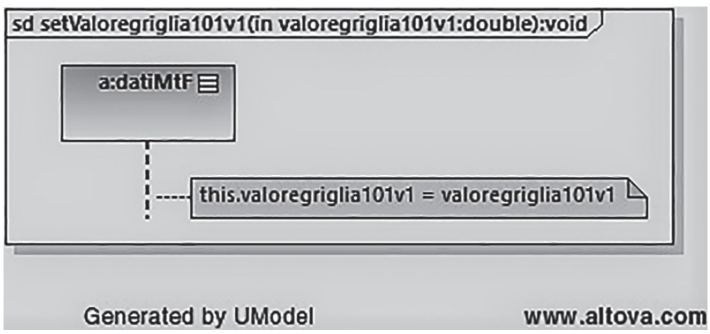

FIGURE 15.359 SequenceDiagram setValoregriglia101v1.

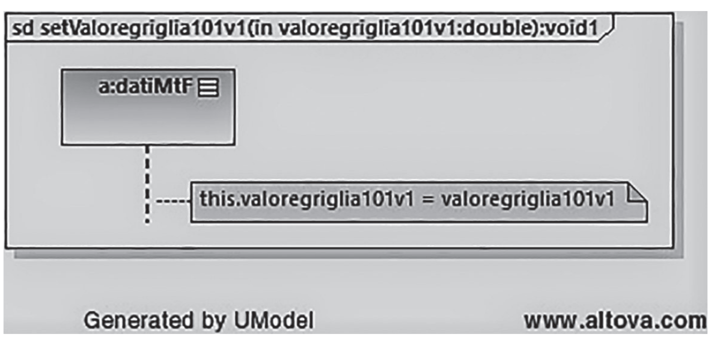

FIGURE 15.360 SequenceDiagram setValoregriglia101v1_1.

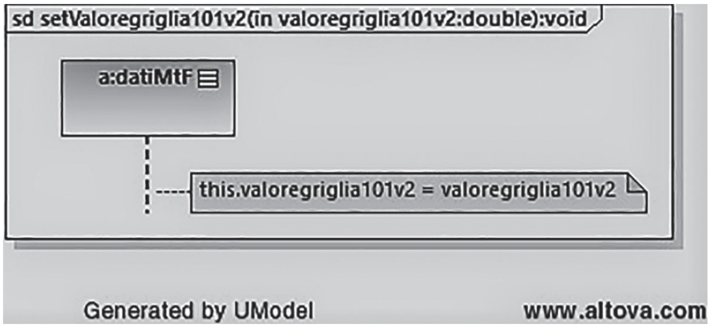

FIGURE 15.361 SequenceDiagram setValoregriglia101v2.

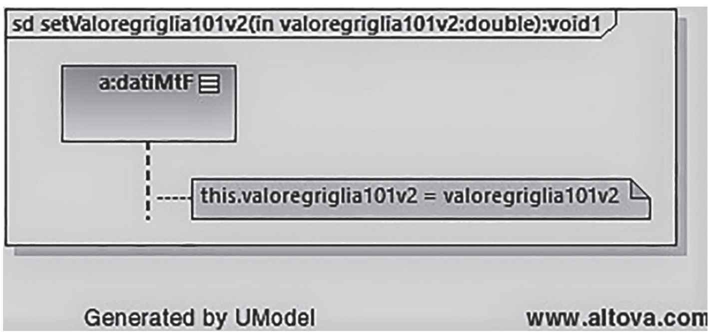

FIGURE 15.362 SequenceDiagram setValoregriglia101v2_1.

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CHAPTER 16

Credit Models Using Google Cloud

16.1 DEFINITION OF THE SOFTWARE USED

In this real case study, the MATLAB project software generated by a MATLAB trial licence is used. This is necessary for the data generation of the expected positive exposure, effective expected positive exposure values, and mean potential future exposure values.

The final data generated is saved in a CSV file in a matrix format in a specified path of the MATLAB workspace. The saved file will be named counterpartycreditrisk.csv.

This case study also used Java Project software generated by the 2020 MyEclipse trial licence which is described in detail in Chapters 13 and 14. The project was exported, named, and saved as RiskMeasuresGraph.war in the MyEclipse platform.

This war Java Project with the input file counterpartycreditrisk.csv generates a real-time view of the graphical representation of the expected positive exposure, effective expected positive exposure, and mean potential future exposure using a curve generated using customized sets of data.

16.2 UPLOAD AND USE MATLAB FILES ON THE CLOUD

We generated the MATLAB project described in detail in Chapter 14, which displayed all the file row codes for the counterparty credit risk data generation in a CSV file named: counterpartycreditrisk.csv.

There are a few proposed choices for the CVS file generation procedure. The first suggestion is to start from a set of MATLAB Project files, convert the MATLAB Project into an Software Development Kit (SDK) Java Project, customize the set of files into the MyEclipse software, and upload it into the previous Java Project for the CVS file visualization using the Google Cloud Platform. Finally, a unique web Java Project will be obtained.

Another choice is to use the MATLAB Cloud to run and generate the counterparty-creditrisk.csv file, starting from the generated MATLAB project for the data generation of the expected positive exposure, the effective expected positive exposure, and the mean potential future exposure values.

The output CSV file is then generated with the MATLAB project in the MATLAB Cloud webspace, and then this file must be used in the Google Cloud Java Project.

The CSV file generated with the expected positive exposure, effective expected positive exposure, and mean potential future exposure values and saved into MATLAB in the cloud can be found at this URL if the MATLAB Cloud project is named introductiontocreditrisk: https://drive.matlab.com/myprojects/introductiontocreditrisk/counterpartycreditrisk.csv.

This is the URL of the.csv file in the Cloud MATLAB necessary to use the file data CSV into the Google Cloud CSV file viewer previously uploaded and carefully described in Chapters 13 and 14.

MathWorks Cloud requires a MathWorks Account. The Cloud Storage can be accessed to upload files using a valid MATLAB license at https://drive.matlab.com/.

MATLAB Drive provides a common cloud-based storage location for your MATLAB files. MATLAB Drive works in the cloud with: MATLAB Drive online, MATLAB Mobile, and MATLAB Online.

16.3 UPLOADING THE MYECLIPSE JAVA PROJECT TO THE GOOGLE CLOUD

The MyEclipse Java Project has to be customized into the Google cloud. The base case shell of cloud SDK or the Google cloud tools for MYECLIPSE upload of Java Projects could be used to upload the Java Project to the Google Cloud webspace. For this automated process the MyEclipse software must be updated by downloading Apache Google Tools for Eclipse version 1.8.3 (December 2019) from the marketplace.

Cloud Tools for Eclipse is a Google-sponsored open-source plugin that supports the Google Cloud platform. Cloud Tools for Eclipse enables you to create, import, edit, build, run, debug, and deploy Java servlet applications for the App Engine standard and flexible environments without leaving Eclipse. Cloud Tools for Eclipse also enables you to manage cloud client libraries and create and run Google Cloud Dataflow pipelines.

The Java Project for the CSV viewer is uploaded into the Google Cloud into the project: introductiontocreditrisk, https://console.cloud.google.com/myprojects/introductiontocreditrisk/.

This Google Cloud project uses an online CSV input file generated in the MATLAB Cloud and managed by the following URL: https://drive.matlab.com/myprojects/introductiontocreditrisk/counterpartycreditrisk.csv.

The strategies for the management of this project are described using the following web syntax defined and formalized in this Google Cloud shell: Path filepath=new Path (URL: https://drive.matlab.com/myprojects/introductiontocreditrisk/counterpartycreditrisk.csv);

```
File file = getFileFromPath (Path filepath);
```

The MATLAB Cloud project named INTRODUCTIONTOCREDITRISK works in the strategy to define the internal parameter—paramvalue—used for the acquisition of the input CSV files from the web. The syntax of this cloud strategy is described using the following link: https://console.cloud.google.com/myprojects/introductiontocreditrisk/**paramvalue=**"https://drive.matlab.com/myprojects/introductiontocreditrisk/counterpartycreditrisk.csv"

```
File csv = new File ();
File file = getFileFromPath (Path paramvalue);
csv = file;
```

Google Cloud account and Google Drive pace

The Google Cloud account used and the Google Drive webspace for the files and online engine are described below by these unique url and email keyword identifiers:

URL: https://console.cloud.google.com/

EMAIL: giulio.carlone@ieee.org

PROJECT NAME: /myprojects/introductiontocredirisk

Cloud for financial services (Figure 16.1).

The use of the Cloud strategies is competitive in the face of the rapidly changing global markets. Using the different clouds, the credit risk data published online by the MATLAB Cloud and the online service of MATLAB Cloud data visualization offered on the Google Cloud, we are able to manage risk, and in this case counterparty credit risk.

The interesting side of this complex engine is related to the multiple infrastructure offered by Google necessary for the best customization of the starting tools for risk data generation and visualization.

This is the graphical representation of the final project starting from an input-defined portfolio and finally describing a graphical visualization of the credit risk data values.

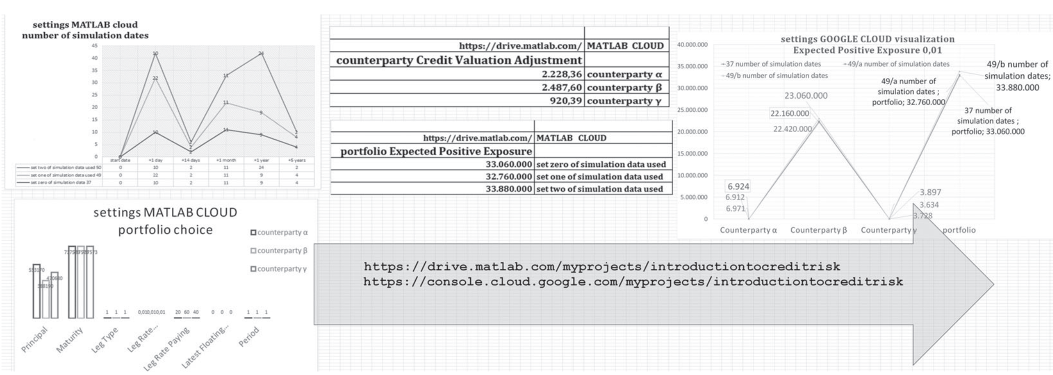

FIGURE 16.1 Design of credit models using Google Cloud.

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CHAPTER 17

Conclusion

THIS BOOK ADDRESSES a particularly important topic and the subject of much research since the financial crisis of 2007–2008. It introduces notions related to counterparty credit risk, with reference to the Bank for International Settlements, the European Securities and Markets Authority, and the European Central Bank that define the rules to be applied for investment strategies.

This useful assessment references portfolio choice, other key factors, and the number of simulation dates, which tend to grow in density along with the performance of the model that generates them, finally arriving at a real, tested, and customizable credit cloud model.

The target audience is banks, consultancy firms, financial software houses, and counterparty credit risk specialists, either working in the financial industry or in academics, and we have attempted to address the book to them. The topic is specialized, but is very important for anyone working in counterparty credit risk management in financial institutions. This research will be of interest to those in the industry whose subject is risk management strategy. This book serves two sets of audiences, students who want to learn about credit risk from a programming point of view and professionals who want a reference textbook that has already developed many of the models they have to develop at work. The book is aimed at those enrolled in graduate courses and in the numerous short courses directed at financial risk managers in the industry. However, it would only be suitable for a very small niche of the university student market, in particular, graduate students in Quantitative Finance working on related topics.

This book discusses the regulatory environment, presents the details of the regulatory capital charges for counterparty credit risk under the Basel Accord and the operation of the Over the Counter (OTC) derivative markets, focuses on the counterparty credit risk associated with the potential default of the counterparty, and finally focuses on the important concerns associated with the valuation of counterparty risk and its fluctuations in the Credit Value Adjustment (CVA).

The book aims to illustrate a number of key factors regarding the simulation of counterparty credit risk exposures. Furthermore, it focuses on the topic of the choice of time steps, which is very important in practice, and has generally been understudied, particularly by academic researchers.

The strategy consists of the introduction of the risk measures, which are then analysed in detail in application scenarios and the MATLAB technical instruments required to obtain a calculation flow of the measurements under consideration, taking a specific internal model for a specific bank.

A portfolio of interest rate swaps and a defined set of simulation dates is introduced. The interesting result is how the counterparty credit risk data value generated changes using the various simulation dates. It also explains the scenario simulation methodology. Finally, it summarises the theoretical results described by MATLAB and the Java engine architecture in scenarios from a credit cloud perspective.

The credit risk topic focused on in this book is evolving relatively rapidly, so the book has been integrated with the practical architecture related to the development of credit models in the Google Cloud Platform. This topic is very important and the approach, focusing on the technology used in the book (MATLAB Cloud in the first step and Google Cloud in the second), is very timely and relevant. The contents are well organized and well described following a schema that examines the subject matter and technological challenges at the same time.

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