Summary

Prediction is one of the most important issues in statistical inference and it is equally important and useful as statistical estimation. Meteorology, medicine, economics, finance, engineering, politics and education are applied disciplines in which prediction is essential and is therefore of greet interest. In many practical problems, one would wish to use the information from the past sample to predict the observations of a future sample from the same population with a specified probability. One way to do this is to construct an interval that will contain the future values of interest, and such an interval is called a prediction interval. Prediction intervals are of different types which include one-sample prediction, two-sample prediction, and multi-sample prediction.

It is common in life-testing and reliability experiments that some experimental units are either lost or removed from experimentation before their failure. The loss may occur unintentionally, or it may have been designed in the study. In this case, we will obtain only a portion of the sample information. Data obtained from such experiments are called censored data. Censored data are commonly encountered in reliability theory, survival analysis and clinical trials.

The main subject of this thesis is the Bayesian prediction interval problem. Here, we discuss this problem based on different forms of censored data, namely, (1) Type-II right censored data, (2) multiply Type-II censored data, (3) progressively Type-II censored data, (4) Type-I hybrid censored data, and (5) Type-II hybrid censored data. In each case, we use a general form for the underlying distribution and a general conjugate prior to develop a very general procedure for determining one- and two-sample Bayesian prediction intervals for future life-lengths. We then present the results for some specific continuous distributions as illustrative examples. Finally, we carry out a simulation study to evaluate the

performance of all the prediction procedures developed here.

This thesis consists of seven Chapters. Chapter 1 provides an introduction to the thesis, and so it contains definitions, notation, basic facts and some known properties and results that are used throughout the thesis. We also introduce here the concepts of ordinary order statistics, censoring schemes, sequential order statistics, record values, generalized order statistics, classical prediction, Bayesian prediction, and the Monte Carlo method. At the end of this chapter, we provide an overview of past developments on prediction intervals.

In Chapters 2–4, we use the general exponential form for the underlying distribution and the general conjugate prior, suggested by AL-Hussaini (1999^b), to develop a very general procedure for determining one- and two-sample Bayesian prediction intervals for future order statistics when the observed data are (1) progressively Type-II censored, (2) Type-I hybrid censored, and (3) Type-II hybrid censored, respectively. Then, we present the results for the exponential and Pareto distributions as illustrative examples. Finally, we present some numerical results for these special cases.

In Chapter 5, we use the general exponential form for the underlying distribution and the general conjugate prior once again to develop a general procedure for determining the two-sample Bayesian prediction intervals for the future s-th generalized order statistics when the informative sample is a multiply Type-II censored sample. Then, we present the results for the exponential and Pareto distributions as illustrative examples. Finally, we present some numerical computations for prediction intervals for the future s-th sequential order statistics.

In Chapter 6, we introduce a new general form, namely, the general inverse exponential form, for the underlying distribution and use it with the general conjugate prior to develop a general procedure for determining the two-sample Bayesian prediction intervals for the s-th order

statistics from a future sample from the same population when the informative sample is Type-II right censored sample. Then, we present the results for inverse exponential, inverse Rayleigh, and inverse Weibull distributions as illustrative examples. Finally, we present some numerical results for these special cases.

Finally, in Chapter 7, we make some concluding remarks and also describe some ideas and problems for possible future research.

In the thesis, Chapters 2-6 are based on the following papers:

1. Mohie El-Din, M. M., and Shafay, A. R. (2011). One- and two-sample Bayesian prediction intervals based on progressively Type-II censored data, *Statistical Papers* (submitted).

2. Shafay, A. R. and Balakrishnan, N. (2012). One- and two-sample Bayesian prediction intervals based on Type-I hybrid censored data, *Communications in Statistics–Simulation and Computation*, **41**, 65-88.

3. Balakrishnan, N. and Shafay, A. R. (2012). One- and two-sample Bayesian prediction intervals based on Type-II hybrid censored data, *Communications in Statistics–Theory and Methods* (to appear).

4. Mohie El-Din, M. M., Abdel-Aty, Y, and Shafay, A. R. (2011). Two-sample Bayesian prediction intervals of generalized order statistics based on multiply Type-II censored data, *Communications in Statistics–Theory and Methods* (to appear).

5. Mohie El-Din, M. M., Abdel-Aty, Y, and Shafay, A. R. (2011). Two-sample Bayesian prediction intervals for order statistics based on the inverse exponential-type distributions using right censored sample, *Journal of the Egyptian Mathematical Society* (to appear).