Basic Training Scenario
Mobile Phone Insurance: Student Worksheets

A program of The Actuarial Foundation

Modeling The Future Challenge

Scenario Introduction

Insurance is a guarantee to reimburse or pay for items agreed to in the terms and conditions of the policy. Insurance policies help protect the policy holder against a loss from damage, theft, or anything else that may reduce the value of your property. Typically you will see insurance for things like health, automobiles, property, but anything of value may be protected by insurance.

For many products, like a mobile phone, this is written up as a product warranty. Warranties are insurance policies written to protect the owner of the product against a loss due to damage, defect, loss, or theft.

There are many ways that insurance companies aim to help policy holders and many benefits that policy holders gain from having insurance. However, not all insurance policies are the same. In fact, creating insurance policies is a very complex science – actuarial science. Actuaries work tirelessly to help make sure that insurance companies and other businesses, organizations, and government agencies project and manage risks appropriately, to allow for the best possible outcomes from potential risks for their companies and the policy holders.

In this scenario we introduce you to several key concepts about risk and insurance through one of the more commonly known insurance areas – a product warranty. Let's assume that you are a consulting actuary brought in to support Alpha Insurance Co., an insurance company that is considering providing an insurance policy, or "warranty," to customers who purchase the new Zest mobile phone. To start out with, we know that the new Zest 2 mobile phone cost $700. We also provide slides attached with this scenario that may be valuable to work through along with the question worksheets included herein. Review the information and questions shared in the rest of this scenario to understand the fundamentals of how product insurance works.

1. Why might a customer consider buying a mobile phone warranty along with their new phone? What are the benefits of a warranty?

2. Why might a customer think buying a warranty could be a bad idea when buying their new mobile phone?

3. What are some things the customer might want to consider in determining whether they should buy a phone warranty along with their purchase of a new phone?

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You are a consulting actuary brought in to support Alpha Co., an insurance company that is considering providing an insurance policy, or "warranty," to customers who purchase the new Zest phone. The new Zest 2 mobile phone cost $700.

4. Alpha Co. is exploring creating policies that would replace a lost phone or repair a damaged phone. What are the main factors your company should consider in setting the policy price, or "premium," for your mobile phone warranty?

5. Alpha Co. has already sold insurance policies for the Zest 1 phone. The cost of the Zest 1 phone was $500. From those policies they know that the average cost to repair the Zest 1 was $100. They also know the likelihood of Zest 1 customers to lose or break their phone, noted in the chart below. Using the data from the Zest 1 phone policies, what is the average, expected payout that Alpha Co. will have to pay on it's Zest 2 phone policies?

Cause of Loss	Probability
Replace phone due to extreme damage.	0.02
Replace phone due to loss or theft.	0.03
Repair phone due to damage.	0.45

6. What assumptions is Alpha Co. making in using the probabilities from their Zest 1 warranty policies to project the expected loss for their Zest 2 phone policies?

7. Your boss at Alpha Co. wants to maintain a 20% profit margin on the insurance policies. Based on the expected loss calculation, at what price do you need to set your policy premium to meet this requirement?

8. Is this an acceptable premium to meet your boss's 20% profit requirement on it's Zest 2 warranties? What else should you consider in pricing the premium?

9. The "Loss Ratio" for an insurance policy is the percent of the policy premium that is paid out (or expected to be paid out) based on the policy terms. What is the Loss Ratio for Alpha Co.'s Zest 2 policy if the premium is set at $100?

10. Alpha Co. has provided you with additional information about its expenses, including operational expenses, and a commission it expects to pay to Zest Phones for every warranty they sell through the Zest stores. Your boss tells you that Alpha Co. has operational expenses of $10 per policy and pays Zest a 5% commission on each policy. With this new information, what is the expected profit on a Zest 2 phone warranty?

11. The "Combined Ratio" for an insurance policy is the sum of the expected loss and all of the expenses divided by the premium. What is the combined ratio for these Zest 2 phone warranties?

Insurance companies may include Deductibles and Co-pays on policies. To help mitigate the possibilities of insuring high-risk policy holders. A Deductible is an amount the policy holder must pay before the insurance company will pay for losses. A Co-pay is a portion of the loss that the policy holder must pay for each loss, while the insurance company pays the remainder of the loss.

12. If you include a $10 co-pay on your Zest 2 warranty for any loss or repair, what is the new combined ratio for the policy?

13. Your boss at Alpha Co. has now asked you to determine what co-pay would allow them to have an 80% combined ratio (the equivalent of a 20% profit margin) on their Zest 2 phone warranty policies. What is this co-pay assuming you keep the premium at $100?

14. Your boss at Alpha Co. tells you that they want to explore a $50 co-pay to help ensure the policy holders have enough "skin in the game" to affect their behavior and not let them be careless with their phones. He also wants to maintain a 95% Combined Ratio on the policy (the company's expected loss + expenses all divided by the premium). Assuming that the expenses remain at $10 per policy, and the commission remains at 5% of the premium, what is the appropriate Premium to charge in this situation?

Now, Alpha Co. Insurance has given you a little more information about their Zest 1 Phone policies upon which you're to base your recommendations for the new Zest 2 policies. The additional information is that female policy holders are slightly less risky than male policy holders. The breakdown of the probabilities for loss are included in the table below. The overall average is the same as before, but now there is additional information based on gender.

	Male Prob.	Female Prob.	Avg. Prob.	Cost of loss
Replacing due to extreme damage	0.03	0.01	0.02	$700
Replacing due to theft or loss	0.05	0.01	0.03	$700
Repairing phone due to damage	0.45	0.45	0.45	$100

15. If the premium is kept the same at $100 for all policy holders, what is the difference in expected loss for the Zest 2 policies between male and female holders?

16. State in words how Alpha Co. could improve its pricing of the Zest 2 phone policies so that its Loss Ratio is the same for female and male policy holders?

17. Your boss at Alpha Co. has recently learned that there is another insurance company, Bravo Co. that is going to offer policies on the Zest 2 phone. Bravo Co. is offering males a policy with a premium of $120, and offering females a policy of $80. If Alpha Co. keeps its policies for everyone at a $100 premium, what will happen to their customer base as more and more people chose between Alpha and Bravo Co. warranties?

18. If Alpha Co. keeps the female policy holder premium at $100, what should the male premium be to have the same loss ratio?

19. If Alpha Co. keeps the female policy holder premium at $100, what should the male premium be to have the same loss ratio?

20. If Alpha Co. wants to keep an 80% loss ratio on both male and female policies, what should the premiums be priced at?

21. Adverse Selection is when a company's policy holder portfolio becomes riskier over time. This happens when one company's policies are not segmented as well as another's. Adverse selection is bad for insurance companies because it means that higher risk customers are buying policies from them, and lower risk customers are buying policies from other companies. What other data could Alpha Co. use to help segment its policy pricing better and avoid adverse selection?

22. Beyond policy segmentation, what else could cause adverse selection between two different insurance company policies?

The Modeling The Future Challenge was created by The Actuarial Foundation in partnership with the Institute of Competition Sciences. The MTFC helps high school students learn about the exciting real-world opportunities available through mathematics and actuarial science. The resources and college scholarships available through the MTFC are designed help more students connect with the power of mathematics and realize the great benefits of being an actuary.

The Actuarial Foundation and the Institute of Competition Sciences work hand-in-hand with educators to develop new resources and support systems through the MTFC. Please reach out to us with any thoughts about how to improve the MTF Challenge and connect your students with the great opportunities that a mathematical career in actuarial science can provide. We can be reached at: challenge@mtfchallenge.org

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