

STAT 490
Test 1
Spring 2017
February 21, 2017

1. Grant had his 35th birthday on January 1, 2017. Grant is an employee at Jones & Li Inc where he has worked since January 1, 2005. Grant received a pay increase on January 1, 2017 which increased his salary to 120,000 for the year of 2017.

Jones & Li provide a Defined Benefit plan and a Defined Contribution plan for all employees including Grant. The Defined Benefit plan provides a benefit of 1.6% of the two year final average salary for each year of service.

Assume that Grant will receive a 3% increase in salary on each January 1 beginning with January 1, 2018. Further, assume that Grant works until he is exact age 65.

- a. (5 points) Grant's projected annual benefit at retirement under the Defined Benefit plan is 187,000 to the nearest 1000. Calculate it to the nearest 1.

Grant wants to take his benefits as a last survivor annuity with payments at the beginning of each year. The annuity will pay the full annual benefit as long as Grant is alive. It will only pay 60% of the annual benefit if Grant is not alive but his wife is alive. Assume that Grant's wife is 10 years younger than Grant. Also, assume that once Grant retires, mortality will follow the Illustrative Life Table with interest at 6%.

b. (5 points) Calculate the funds that Jones & Li will need when Grant turns 65 to purchase this annuity.

c. (5 points) Calculate Grant's replacement ratio from the Defined Benefit plan.

For the Defined Contribution plan, Grant has a balance of 108,000 on January 1, 2017. Grant wants to accumulate 2,000,000 in the Defined Contribution plan by age 65. He wants to pay $X\%$ of his salary at the end of each year to accumulate this 2,000,000. Assume that the Defined Contribution plan earns 7% each year.

d. (5 points) Determine X .

2. (10 points) Tony and KC are business partners and are both age 55. They travel together often. Therefore, their lives are subject to a common shock model and are not independent.

At the end of 10 years, Tony and KC are both planning to retire at age 65.

You are given that Tony and KC have mortality that follows the Illustrative Life Table except that the Illustrative Life Table does not reflect the common shock deaths. Tony and KC are each subject to a force of mortality related to common shock of 0.02.

Calculate the probability that only one of Tony or KC will be alive at retirement age of 65.

3. (10 points) Yuting who is (55) and Xinyuan who is (70) purchase a two year term joint life insurance which pays 10,000 upon the first death. The death benefit is paid at the end of the year of death. Yuting and Xinyuan have independent future lifetimes

Yuting and Xinyuan are subject to the following mortality:

t	Yuting - q_{55+t}	Xinyuan - q_{70+t}
0	0.10	0.20
1	0.12	0.25
2	0.15	0.30

You should assume that $v = 0.9$.

Let Z be the present value random variable for this insurance.

Calculate the $E[Z]$ and the $Var[Z]$.

4. (10 points) A multiple decrement model is developed from the following associated single decrement tables:

Age x	$q'_x{}^{(1)}$	$q'_x{}^{(2)}$
60	0.20	0.30
61	0.25	0.10

Decrements are uniformly distributed in a single decrement table for age 60. Decrements are uniformly distributed in the multiple decrement table for age 61.

If $l_{60}^{(\tau)} = 100,000$, calculate $d_{60}^{(2)} - d_{61}^{(1)}$.

5. (10 points) You are given the following information for a double decrement table where decrement (1) is death from natural causes and decrement (2) is death from accidental causes.

Age x	$l_x^{(\tau)}$	$d_x^{(1)}$	$d_x^{(2)}$
96	1000	300	
97	600	250	120
98		160	70

You are also given that $i = 8\%$.

Drew who is (96) purchases a whole life policy that pays 50,000 at the end of the year of death by natural causes and 100,000 at the end of the year of death from an accident. Premiums are paid annually while the insured is alive. The premium is calculated using the equivalence principal.

Calculate the net annual benefit premium.