Development Economics HW2

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Question 1.1

Random numbers are generated for z and ε (same for different levels of seasonality). For exercise (a), I replace *exp(g(m))* with *1* so that consumption does not depend on season. For exercise (b), I replace $\exp(-\sigma_{\varepsilon}^{2}/2)\varepsilon_{t}$ with *1*, so that consumption does not experience transitory shocks. Median welfare gains over 1000 consumers are shown in Table 1, 2 and 3.

Table 1. Median Welfare Gains (η =*1*)

	Low seasonality	Middle seasonality	High seasonality
Removing seasonal part	0.0020	0.0085	0.0437
Removing nonseasonal part	0.1064	0.1064	0.1064

Table 2. Median Welfare Gains (η =*2*)

	Low seasonality	Middle seasonality	High seasonality
Removing seasonal part	0.0041	0.0184	0.1109
Removing nonseasonal part	0.2223	0.2225	0.2227

Table 3. Median Welfare Gains (η =*4*)

	Low seasonality	Middle seasonality	High seasonality
Removing seasonal part	0.0081	0.0404	0.3330
Removing nonseasonal part	0.4899	0.4894	0.4798

Key findings and explanations.

(1) When the seasonal risk of consumption is removed, <u>the gain is larger for those with higher level of seasonality</u>. Reason: Higher level of seasonality brings more utility loss since consumers are risk-averse.

(2) When the non-seasonal risk of consumption is removed, <u>the gain almost does not depend on the level of seasonality</u>. This is quite different from the case where seasonal risk is removed. Reason: Consumers are faced with the same level of non-seasonal risk, so they will benefit the same when this type of risk is removed.

(3) <u>When η increases, the gain from removing seasonal risk increases</u>. Reason: Higher η means that consumers are more risk-averse.

(4) <u>When η increases, the gain from removing nonseasonal risk increases</u>. Reason: Higher η means that consumers are more risk-averse.

Question 1.2

Random numbers are generated for *z* and ε_t (same for different levels of seasonality) and ε_m (different for different levels of seasonality). For exercise (a), I replace *exp(g(m))* with *1* and $\exp(-\sigma_\varepsilon^2/2)\varepsilon_m$ with *1* so that consumption does not depend on season. For exercise (b), I replace $\exp(-\sigma_\varepsilon^2/2)\varepsilon_t$ with *1* so that consumption does not experience transitory shocks. Median welfare gains over 1000 consumers are shown in Table 4, 5 and 6.

Table 4. Median Welfare Gains (η =*1*)

Deterministic seasonality	Stochastic seasonality	From removing seasonal part	From removing non-seasonal part
Low	Low	0.0541	0.1064
	Middle	0.1074	0.1064
	High	0.2252	0.1064
Middle	Low	0.0610	0.1064
	Middle	0.1145	0.1064
	High	0.2332	0.1064
High	Low	0.0979	0.1064
	Middle	0.1534	0.1064
	High	0.2762	0.1064

Table 5. Median Welfare Gains (η =*2*)

Deterministic seasonality	Stochastic seasonality	From removing seasonal part	From removing non-seasonal part
Low	Low	0.1075	0.2222
	Middle	0.2233	0.2224
	High	0.5016	0.2221
Middle	Low	0.1206	0.2221
	Middle	0.2337	0.2229
	High	0.5078	0.2224
High	Low	0.2140	0.2226
	Middle	0.3274	0.2222
	High	0.5977	0.2224

Table 6. Median Welfare Gains (η =4)

Deterministic seasonality	Stochastic seasonality	From removing seasonal part	From removing non-seasonal part
Low	Low	0.2185	0.4802
	Middle	0.4814	0.4663
	High	1.2354	0.4383
Middle	Low	0.2388	0.4805
	Middle	0.4871	0.4701
	High	1.1940	0.4412
High	Low	0.4954	0.4727
	Middle	0.7067	0.4664
	High	1.3176	0.4496

Key findings and explanations. Point (5) is new.

(1) When the seasonal risk of consumption is removed, the gain is larger for those with higher level of seasonality. Reason: Higher level of seasonality brings more utility loss since consumers are risk-averse.

(2) When the non-seasonal risk of consumption is removed, the gain almost does not depend on the level of seasonality. This is quite different from the case where seasonal risk is removed. Reason: Consumers are faced with the same level of non-seasonal risk, so they will benefit the same when this type of risk is removed.

(3) When η increases, the gain from removing seasonal risk increases. Reason: Higher η means that consumers are more risk-averse.

(4) When η increases, the gain from removing nonseasonal risk increases. Reason: Higher η means that consumers are more risk-averse.

(5) Compared with Part 1 of Question 1, the gain from removing seasonal risk is much larger. Reason: Seasonality is more strong here because we have not only the deterministic part but also stochastic part.

Question 2.

(Maybe the question is not clearly explained. I discussed with several of my classmates, but we are still not sure about what exactly we are asked to do. So I will interpret the question in my own way, which is correct in some sense.)

To calibrate κ, I start from the first order condition of consumer's utility maximization problem

$$\frac{1}{c}w = \kappa h^{\frac{1}{\nu}}.$$

This equation could be rearranged to be

$$\frac{y}{c}\frac{wh}{y} = \kappa h^{\frac{1}{v}+1}.$$

Then I set *y/c* to 1/0.5, *wh/y* to 0.66 and *h* to 28.5*30/7, and get κ=-8.8479e-05.

Random numbers of the z part and epsilon part for consumption are generated as before. To get corresponding values for labor supply, I assume the z part and epsilon part for labor supply follow exactly the same distributions as consumption. Please note that I scale z up by multiplying it by 28.5*30/7 to ensure that on average working hours is consistent with the reality. (Of course, after scaling we will have some workaholics. But if we don't scale, almost everyone is a lazy bug, which I don't like.)

To get correlated labor supply and consumption in terms of the **deterministic seasonal** component, I generate relevant values in the following way. When labor supply and consumption is positively correlated, the deterministic terms follow the same pattern as shown in Table 1 in the PS (Table 7 here). When labor supply and consumption is negatively correlated, they follow opposite patterns. More specifically, consumption follows the pattern as shown in Table 1 in the PS. But when consumption is higher, labor supply is lower. For example, exp(g(m)) for consumption is highest in March with the value 1.076 and lowest in February with the value 0.845. Then I will let exp(g(m)) for labor supply be lowest in March with the value 0.845 and highest in February with the value 1.076.

To get correlated labor supply and consumption in terms of the **stochastic seasonal** component, I generate values in the following way. The stochastic terms follow a joint normal distribution. In a given month, their variances are the same. Variances are different across months, as shown in Table 2 in the PS. The correlation coefficient is either 1 (extremely positively correlated) or -1 (extremely negatively correlated).

To get correlated labor supply and consumption in terms of the **non-seasonal** component, I generate values in the following way. The transitory shocks ε_t follow a joint normal distribution with mean 0 and variance σ_ε^2. The correlation coefficient is either 1 (extremely positively correlated) or -1 (extremely negatively correlated).

Question 2 (a)

Table 7 shows the positive correlation between consumption and labor supply (deterministic part). It can be seen that exp(g(m)) is exactly the same for consumption and labor supply, and thus perfectly positively correlated.

Table 7. Exp(g(m)) for Consumption and Labor Supply

	Low seasonality		Middle seasonality		High seasonality	
	Consumption	Labor	Consumption	Labor	Consumption	Labor
Jan	0.932	0.932	0.863	0.863	0.727	0.727
Feb	0.845	0.845	0.691	0.691	0.381	0.381
Mar	1.076	1.076	1.151	1.151	1.303	1.303
Apr	1.070	1.070	1.140	1.140	1.280	1.280
May	1.047	1.047	1.094	1.094	1.188	1.188
Jun	1.030	1.030	1.060	1.060	1.119	1.119
Jul	1.018	1.018	1.037	1.037	1.073	1.073
Oct	1.018	1.018	1.037	1.037	1.073	1.073
Sep	1.018	1.018	1.037	1.037	1.073	1.073
Oct	1.001	1.001	1.002	1.002	1.004	1.004
Nov	0.984	0.984	0.968	0.968	0.935	0.935
Dec	0.961	0.961	0.921	0.921	0.843	0.843

Figure 1 shows the positive correlation between consumption and labor supply (stochastic part) with the correlation coefficient being +1 for one representative consumer.

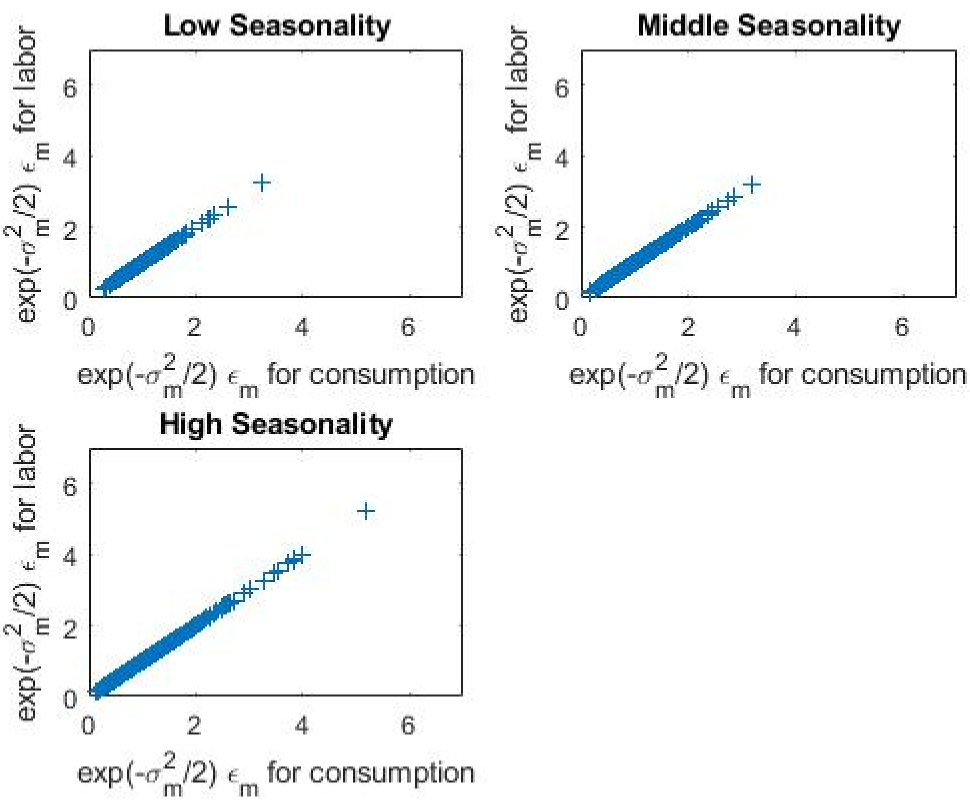


Figure 1. Stochastic Parts for Consumption and Labor Supply

Table 8. **Median Welfare Gains** with Posi. Corr. between Consumption and Labor

Deterministic seasonality	Stochastic seasonality	Total gain	From removing seasonality in consumption	From removing seasonality in labor supply
Low	Low	0.1269	0.0539	0.0680
	Middle	0.2809	0.1064	0.1552
	High	0.6804	0.2259	0.3761
Middle	Low	0.1461	0.0608	0.0786
	Middle	0.3071	0.1136	0.1732
	High	0.7266	0.2339	0.4046
High	Low	0.2292	0.0977	0.1186
	Middle	0.4166	0.1524	0.2293
	High	0.9134	0.2769	0.5031

Key findings and explanations.
(1) Keeping stochastic seasonality fixed, when the deterministic seasonality is higher, the gain from removing seasonality in consumption is larger, and the gain from removing seasonality in labor supply is larger. Reason: More seasonality, more utility loss since consumers are risk-averse.
(2) Keeping deterministic seasonality fixed, when the stochastic seasonality is higher, the gain from removing seasonality in consumption is larger, and the gain from removing seasonality in labor supply is larger. Reason: More seasonality, more utility loss since consumers are risk-averse.

Question 2 (b)

Table 9. Exp(g(m)) for Consumption and Labor Supply

	Low seasonality		Middle seasonality		High seasonality	
	Consumption	Labor	Consumption	Labor	Consumption	Labor
Jan	0.932	1.070	0.863	1.140	0.727	1.280
Feb	0.845	1.076	0.691	1.151	0.381	1.303
Mar	1.076	0.845	1.151	0.691	1.303	0.381
Apr	1.070	0.932	1.140	0.863	1.280	0.727
May	1.047	0.961	1.094	0.921	1.188	0.843
Jun	1.030	0.984	1.060	0.968	1.119	0.935
Jul	1.018	1.001	1.037	1.002	1.073	1.004
Oct	1.018	1.018	1.037	1.037	1.073	1.073
Sep	1.018	1.018	1.037	1.037	1.073	1.073
Oct	1.001	1.018	1.002	1.037	1.004	1.073
Nov	0.984	1.03	0.968	1.06	0.935	1.119
Dec	0.961	1.047	0.921	1.094	0.843	1.188

Table 9 shows the negative correlation between consumption and labor supply (deterministic part). It can be seen that when exp(g(m)) is higher for consumption, it is lower for labor supply.

Figure 2 shows the negative correlation between consumption and labor supply (stochastic part) with the correlation coefficient being -1 for one representative consumer.

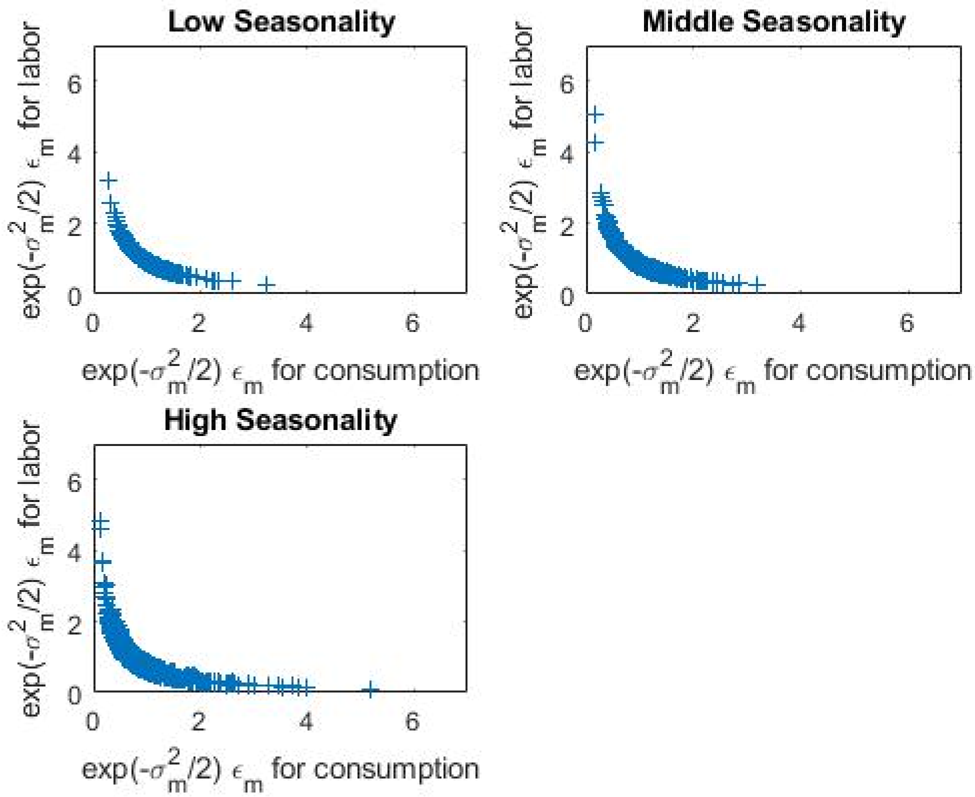


Figure 2. Stochastic Parts for Consumption and Labor Supply

Table 10. **Median Welfare Gains** with Neg. Corr. between Consumption and Labor

Deterministic seasonality	Stochastic seasonality	Total gain	From removing seasonality in consumption	From removing seasonality in labor supply
Low	Low	0.1242	0.0539	0.0635
	Middle	0.2628	0.1064	0.1426
	High	0.6666	0.2259	0.3694
Middle	Low	0.1356	0.0608	0.0701
	Middle	0.2792	0.1136	0.1465
	High	0.6792	0.2339	0.3673
High	Low	0.2083	0.0977	0.0997
	Middle	0.3555	0.1524	0.1728
	High	0.7741	0.2769	0.3913

Key findings and explanations. Point (3) is new.
(1) Keeping stochastic seasonality fixed, when the deterministic seasonality is higher, the gain from removing seasonality in consumption is larger, and the gain from removing seasonality in labor supply is larger. Reason: More seasonality, more utility loss since consumers are risk-averse.
(2) Keeping deterministic seasonality fixed, when the stochastic seasonality is higher, the gain from removing seasonality in consumption is larger, and the gain from removing seasonality in labor supply is larger. Reason: More seasonality, more utility loss since consumers are risk-averse.
(3) Compared with Part a of Question 2, with negative correlation between consumption and labor supply, the total welfare gain and welfare gain from removing seasonality in labor supply is lower (, the welfare gains from removing seasonality in consumption remains the same since it is firstly computed). The difference is more obviously when seasonality is strong. Reason: With positive correlation, consumption and labor supply co-move over time and create more risk, so more welfare gain could be realized when seasonality is removed. With negative correlation, lower consumption could be compensated by lower labor supply (and vice verse), so less welfare gain could be realized when seasonality is removed.

Question 2 (c)
I replicate the work in Question 2 (a) with firstly positive correlation and then negative correlation between nonseasonal parts of consumption and labor supply.

Case 1: Posi. corr. between seasonal parts, & posi. corr. between nonseasonal parts.

Table 11: Median Welfare Gains

Deterministic seasonality	Stochastic seasonality	Total gain	From removing seasonality in consumption	From removing seasonality in labor supply
Low	Low	0.1288	0.0521	0.0717
	Middle	0.2791	0.1073	0.1565
	High	0.6899	0.2226	0.3783
Middle	Low	0.1474	0.0589	0.0822
	Middle	0.3041	0.1145	0.172
	High	0.7358	0.2305	0.4125
High	Low	0.2311	0.0959	0.1202
	Middle	0.4121	0.1534	0.2259
	High	0.9146	0.2734	0.5069

Case 2: Nega. corr. between seasonal parts, & posi. corr. between nonseasonal parts

Table 12: Median Welfare Gains

Deterministic seasonality	Stochastic seasonality	Total gain	From ... consumption	From ... labor supply
Low	Low	0.1173	0.0521	0.0611
	Middle	0.2642	0.1073	0.1375
	High	0.6441	0.2226	0.3443
Middle	Low	0.1337	0.0589	0.0664
	Middle	0.2735	0.1145	0.1412
	High	0.6529	0.2305	0.3405
High	Low	0.2025	0.0959	0.0971
	Middle	0.3538	0.1534	0.1724
	High	0.7425	0.2734	0.3723

Case 3: Posi. corr. between seasonal parts, & nega. corr. between nonseasonal parts

Table 13: Median Welfare Gains

Deterministic seasonality	Stochastic seasonality	Total gain	From ... consumption	From ... labor supply
Low	Low	0.1236	0.0521	0.0693
	Middle	0.2787	0.1073	0.1559
	High	0.6929	0.2226	0.379
Middle	Low	0.1431	0.0589	0.0799
	Middle	0.3084	0.1145	0.1696
	High	0.739	0.2305	0.4118
High	Low	0.2281	0.0959	0.1211
	Middle	0.4101	0.1534	0.2256
	High	0.9294	0.2734	0.5218

Case 4: Neg. corr. between seasonal parts, & nega. corr. between nonseasonal parts

Table 14: Median Welfare Gains

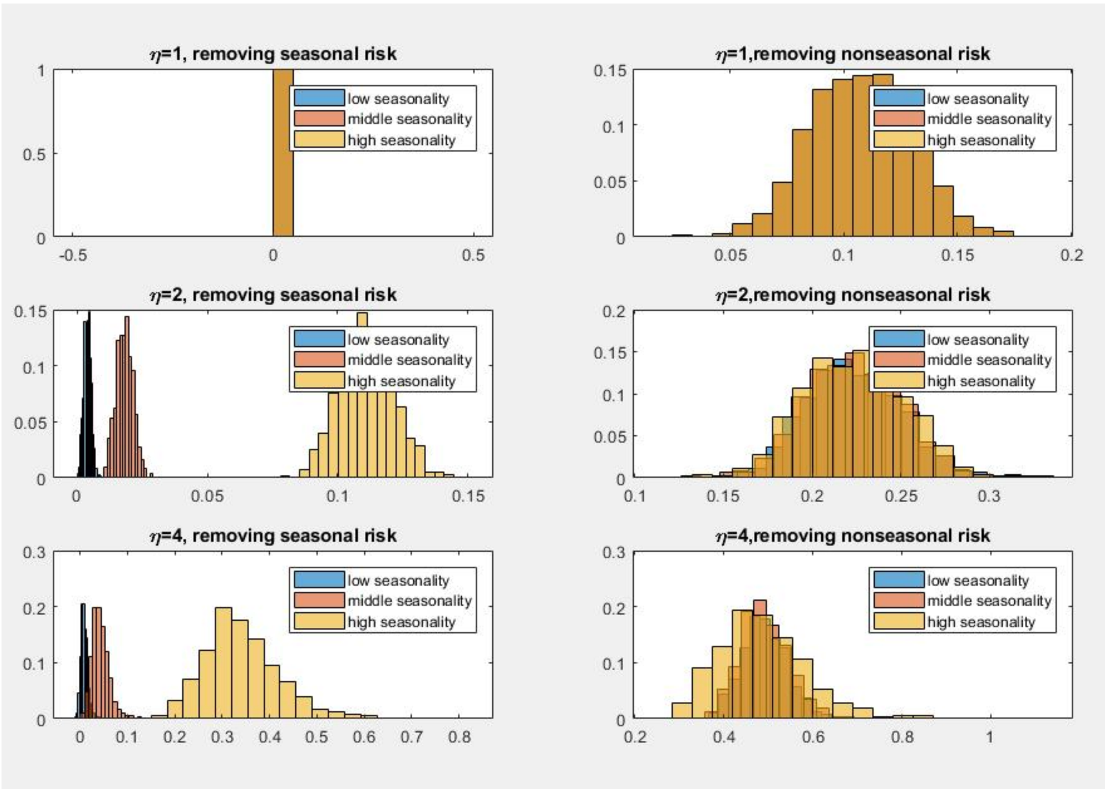
Deterministic seasonality	Stochastic seasonality	Total gain	From ... consumption	From ... labor supply
Low	Low	0.1161	0.0521	0.0597
	Middle	0.2644	0.1073	0.1383
	High	0.6389	0.2226	0.3337
Middle	Low	0.1304	0.0589	0.0664
	Middle	0.2788	0.1145	0.1395
	High	0.6482	0.2305	0.3402
High	Low	0.2015	0.0959	0.0972
	Middle	0.3527	0.1534	0.1693
	High	0.7413	0.2734	0.3624

Key findings and explanations.

(1) When we add (either positive or negative) correlations between nonseasonal parts of consumption and labor supply, the welfare gains don't change much. The reason is that when we do counterfactual experiments, what we remove is the seasonal parts but not the nonseasonal parts. So given the form of the utility function in the question, correlation between nonseasonal parts does not matter much.

Appendix.

We can also plot histograms to see the distribution of the gains. Taking Question 1.1 for example, we can plot graphs as below. However, since we have too many cases, it is not a good strategy to create every plot. So I will not show them one by one.



Appendix Figure 1. Welfare Gains.