STATISTICS FOR BUSINESS DECISIONS

Table of Contents

Question 1

a)

	Without Wait-Tracking System	With Wait-Tracking System
Median	23.5	13.5
Mean	29.1	17.2

Figure: Mean and median of patient wait times with and without a tracking system

(Source: Generated from MS Excel)

In the above figure, the mean and median of patient wait times with and without a tracking system have been done. Here, the median without a wait-tracking system is 23.5, and the mean without a wait-tracking system is 29.1. The median with a wait-tracking system is 13.5, and the mean with a wait-tracking system is 17.2.

b)

	Without Wait-Tracking System	With Wait-Tracking System
Variance	275.6555556	86.17777778
Standard deviation	16.60287793	9.283198682

Figure: Variance and standard deviation of patient wait times with and without a tracking system

(Source: Generated from MS Excel)

In the above figure, the Variance and standard deviation of patient wait times with and without tracking have been done. Here, the Variance without a wait-tracking system is 275.6555556, and the standard deviation without a wait-tracking system is 16.60287793. The Variance with a wait-tracking system is 86.17777778, and the standard deviation with a wait-tracking system is 9.283198682.

c)

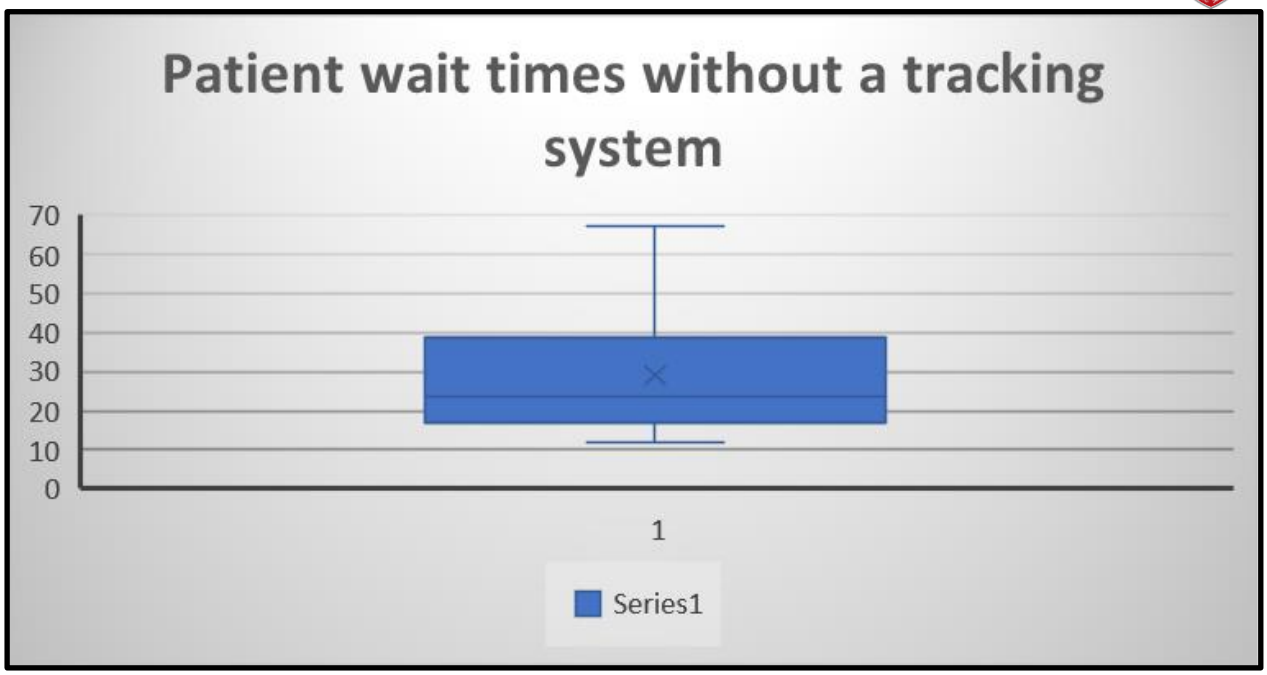

Figure: Displaying box plot of patient wait time without a tracking system

(Source: Generated from MS Excel)

The above figure displays the box plot of patient wait time without a tracking system. In the above graph, the highest range is between 20 to 40 for the patient wait time without a tracking system.

d)

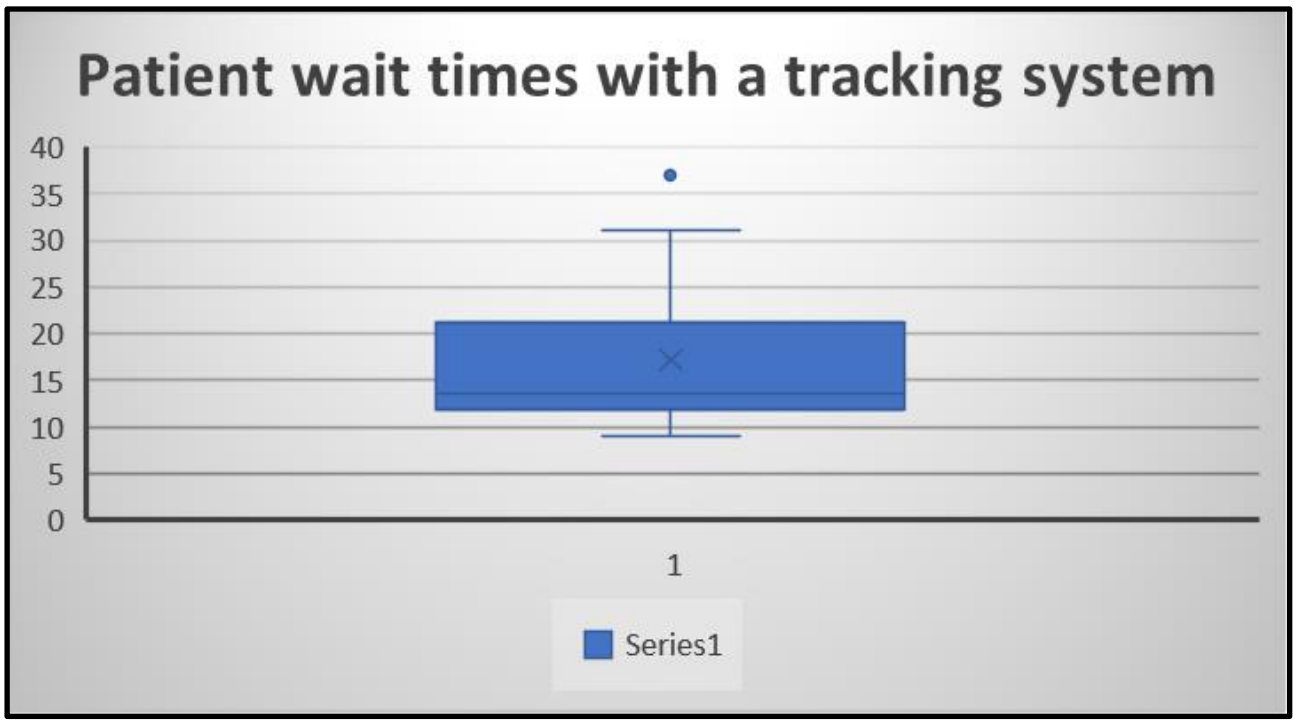

Figure: Displaying box plot of patient wait time with a tracking system

(Source: Generated from MS Excel)

In the above figure, the boxplot of the patient wait time with a tracking system has been done. We can easily build a box plot of patient wait times with a tracking system in place. The longest wait times in this situation are between 15 and 20 minutes.

e)

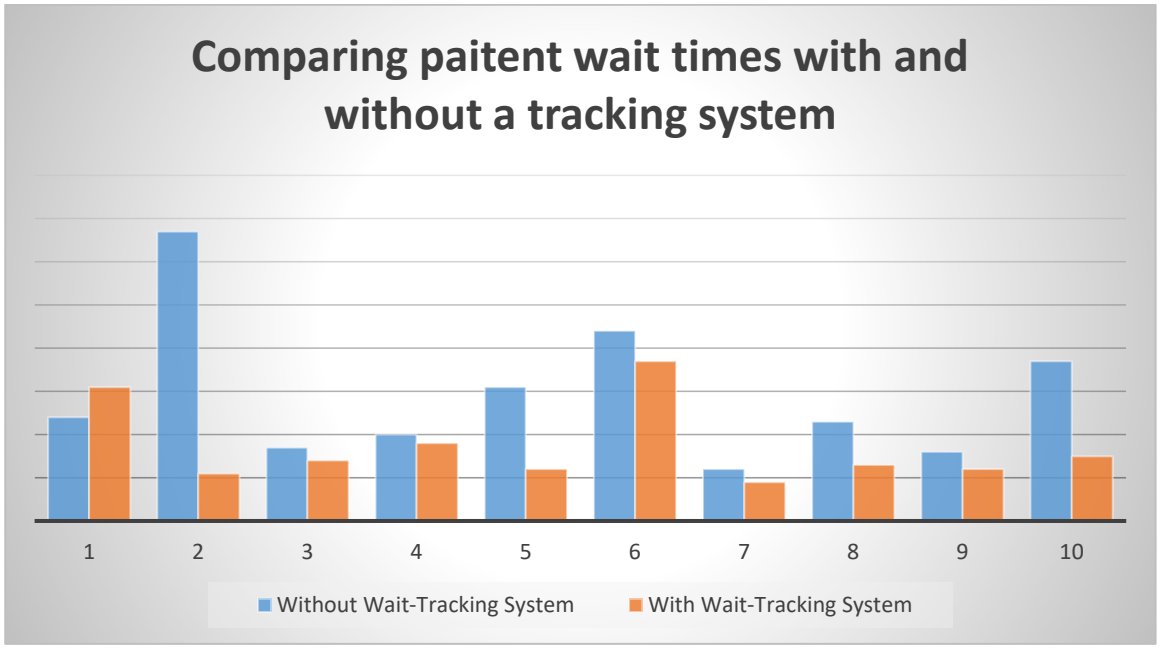

Figure: Comparing patient wait time with and without a tracking system

(Source: Acquired from MS Excel)

This figure displays that the offices have comparatively shorter wait times with tracking system than offices without tracking system. Some reasons behind this are improved visibility, streamlined work schedules, efficient allocation of resource, improved communication, and prioritization.

Question 2

a)

	Beer Price (in $/per litre)	Beer Quantity (in litres)
Mean	10.59954545	132.8502273
Median	10.085	122.985
Min	1.85	86.49
Max	20.99	192.14
Standard deviation	5.821807821	31.421291
Kurtosis	-1.060596347	-0.931345713

Figure: Summary output for beer price and beer quantity

(Source: Acquired from MS Excel)

In the above figure, the summary output for beer price and beer quantity has been done here. The mean, median, min, max, standard deviation, and Kurtosis's beer prices are 10.59954545, 10.085, 1.85, 20.99, 5.821807821, and -1.060596347. The mean, median, min, max, standard deviation, and Kurtosis's beer quantity are 132.8502273, 122.985, 86.42, 192.14, 31.421291, and -0.931345713.

b) The distribution of the beer prices has appeared to be positively skewed like indicated through the higher mean as compared to that median. The standard deviation can suggest a relatively huge amount of variability in the beer prices. The lower kurtosis values obtained for the both variables has indicated relatively flatter distributions as compared to the normal distribution.

c)

t-Test: Paired Two Sample for Means		
	Beer Quantity (in litres)	*Beer Price (in $/per litre)*
Mean	132.8502273	10.59954545
Variance	987.2975279	33.8934463
Observations	44	44
Pearson Correlation	-0.958883684	
Hypothesized Mean Difference	135	
df	43	
t Stat	-2.283154707	
P(T<=t) one-tail	0.013712011	
t Critical one-tail	1.681070703	
P(T<=t) two-tail	0.027424023	
t Critical two-tail	2.016692199	

Figure: Hypothesis testing of per capita beer consumption less than 135

(Source: Acquired from MS Excel)

The above figure shows the hypothesis testing of per capita beer consumption of less than 135. The beer quantity of the mean, variance, observations, hypothesized mean difference, df, t stat, p(T<=t) one-tail, t critical one-tail, p(T<=t) two-tail, t critical two-tail are 132.8502273, 987.2975279, 44, -0.958883684, 135, 43, -2.283154707, 0.013712011, 1.681070703, 0.027424023, 2.016692199. The beer price of the mean, variance, and observations are 10.59954545, 33.8934463, 44.

d) The researcher's assertion that the population's mean per capita beer consumption exceeds 135 liters/year is not supported by the data, according to the t-test results. At a 5% level of significance, the computed t-statistic of -2.283 is less than the critical t-values of 1.681 for a one-tail test and 2.017 for a two-tail test. In addition, the p-value of 0.027 shows that, assuming the null hypothesis is correct, the probability of receiving a result as extreme as the observed is 2.7%.

e) Based on the above provided information as well as the analysis, it cannot conclude that the population mean per capita beer consumption in Australia is greater than 135 liters/year. The t-test results didn't offer enough proof to back up this assertion. It is crucial to remember that the analysis is predicated on the given information and presumptions.

Question 3

a)

	Gross revenue and televsion advertising	Gross revenue and Newspaper Advertising ($100s)
Correlation	0.745107618	0.892897193

Figure: Linear relationship between gross revenue, television and newspaper advertising

(Source: Acquired from MS Excel)

This figure represents the correlation between gross revenue, television, and newspaper advertising. The correlation value between gross revenue and television advertising is 0.74. The correlation value between gross revenue and newspaper advertising is 0.89. Both the values are positive which means both the variables are positively correlated.

b)

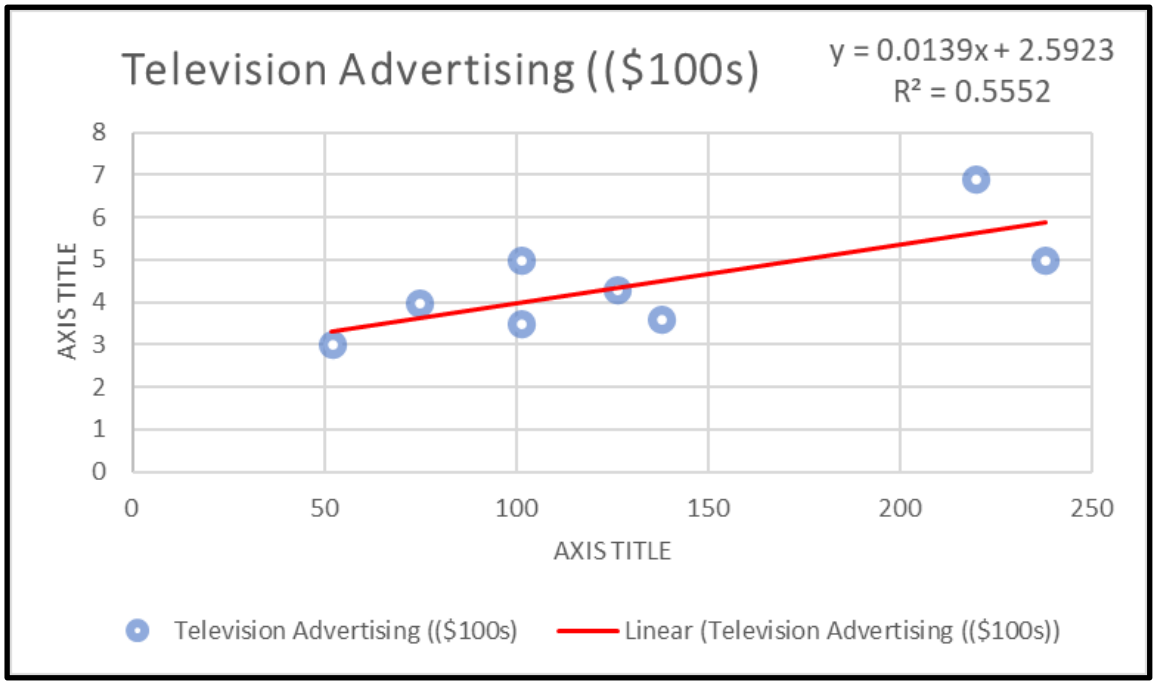

Figure: Linear regression model between gross revenue and television advertising

(Source: Created from MS Excel)

Here, the simple linear regression model is fit between television advertising and gross revenue. The adjusted R-squared value is 0.5552. The equation of the linear regression is calculated by

$Y = mx+c$

Here, the value of m is 0.01 (m is the slope)

Intercept c= 2.59

Henceforth the equation becomes, *Y= 0.01x + 2.59*

Linear Regression	(Summary Output)
	Gross revenue and televsion advertising
Correlation	0.745107618
Regression Coefficients	40.06398862
Slope	0.013857466
Intercept	2.592321833

Figure: Summary output of linear regression

(Source: Created from MS Excel)

This figure represents the summary output of linear regression between gross revenue and television advertising. The correlation value is 0.74 means both the variables are positively correlated. The value of regression coefficients is 40.06, slope is 0.01 and intercept is 2.59. The change between gross revenue and television advertising is 0.01.

c) The adjusted R-squared value is 0.5552 which indicates that almost 55.52% of variance in the "Gross revenue" is explained by "television advertising". This also indicates that the model is moderately well-fitted to the data. In addition to that, remaining 45% variance is also there which is unexplained by the model. Henceforth, the adjusted R-squared value is 0.5552 is considered satisfactory.

d) Some approaches need to be considered to increase the goodness of the model:

- ***Adding relevant variables:*** The potentiality and variability can be captured by adding more variables like market trends, which have a potential influence
- ***Considering interaction terms:*** It helps to capture comparatively complex relationships and increase the model fitness.
- ***Converting variables:*** Some exponential and logarithmic conversations linearize the overall relationship.

e)

SUMMARY OUTPUT (Multi Linear Regression)

Regression Statistics	
Multiple R	0.965520343
R Square	0.932229532
Adjusted R Square	0.905121345
Standard Error	20.33157019
Observations	8

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	28431.13627	14215.568	34.38922	0.001195642
Residual	5	2066.863733	413.37275		
Total	7	30498			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	-42.56959361	28.5471741	-1.491202	0.196107	-115.9524408	30.81325359	-115.9524408	30.81325359
Television Advertising (($100s)	22.40223856	7.099331722	3.1555419	0.025221	4.152825395	40.65165173	4.152825395	40.65165173
Newspaper Advertising ($100s)	19.49862752	3.696946525	5.274252	0.00326	9.995323936	29.0019311	9.995323936	29.0019311

Figure: Multiple linear regression model between gross revenue, newspaper, and television advertising

(Source: Created from MS Excel)

In the above figure, a multiple linear regression model between gross revenue, newspaper, and television has been done. This is the overall summary of the output. It gives the multiple R value, R square, Adjusted R Square, Standard Error, and Observations value of the regression statistics are 0.9655, 0.9322, 0.9051, 20.33, and 8 respectively. The value of ANOVA test including Regression, Residual, and the total value of the given variables.

f) The estimated regression coefficients in the part (e) have revealed the relationship between the weekly gross revenue and the television along with the newspaper advertising expenditure in that "multiple linear regression model". The coefficients have indicated the impact of every advertisement medium on the gross revenue while controlling for some variables. Similarly, whether the coefficient for the newspaper advertising is positive and significant, it indicates that an increased newspaper advertisement expenditure is connected with the higher weekly gross revenue, when it is also controlling for other variables in that model.

g) The F-test has been used to assess the statistical significance of the regression model. The F-statistic in this instance is 34.38922, and the p-value is 0.0012. We reject the null hypothesis since the p-value is below the significance level of 0.05, that means that the regression model is statistically significant. This shows that the dependent variable (the outcome under study) is significantly influenced by the independent variables (television advertising and newspaper advertising).

h) ***H0***: No linear relationship is there between gross revenue, television and newspaper advertising.

H1: Linear relationship is there between the dependent variable and independent variables.

The value of t-statistic is 5.24 which indicates the linear relationship between gross revenue and other independent variables. The p-value is 0.0032 > 5% of significance level which indicates the coefficient is totally different from 0. One evidence of linear relationship is there between gross revenue and newspaper, television advertising.

i) The Conclusion will not change at all. The p-values for newspaper advertising (0.03260339) and television advertising (0.025221229) both remain below the new significance level regardless of whether the degree of significance is increased to 1%. As a result, the null hypothesis would be rejected and come to the conclusion that there is proof of a linear relationship between weekly gross revenue and both newspaper and television advertising.

j) The adjusted R-squared value of multiple linear regression is 0.93 and simple linear regression is 0.55. According to a comparison of the R-squared values, the "multiple linear regression model" (R2 = 0.932229532) has a much higher R-squared value than the "simple linear regression model" (R2 = 0.5552). This shows that the multiple linear regression model, which takes into account the impacts of both television advertising and newspaper advertising, offers a better fit to the data and explains a greater percentage of the variance in the dependent variable (gross revenue).

k) Research Report based on findings

Research on the correlation between weekly gross revenue and advertising expenditures has produced some interesting findings, which have been presented. The influence of television and newspaper advertising on weekly gross income was examined using both basic and multiple linear regression models. The study's findings offer insightful information and have significant managerial ramifications for the business.

(1) According to the data, there is a reasonably significant positive link between weekly gross revenue and both newspaper and television advertising. These results suggest that raising advertising spending in these channels may increase weekly gross revenue.

(2) A straightforward linear regression model has been created for calculating the association between weekly gross revenue and television advertising cost.

(3) Additional independent variables like internet advertising spending or social media presence should be included to further enhance the goodness of fit. significantly including these elements

in the model, a more thorough understanding of the variables affecting weekly gross income may be obtained, improving the model's capacity for forecasting.

(4) The findings show that, when controlling for all other factors, an increase of $100 in television advertising costs is associated with an estimated increase in weekly gross revenue of $22,402, whereas an increase of $100 in newspaper advertising costs is associated with an estimated increase in weekly gross revenue of $19,499, according to the results.

These results show the beneficial effects of newspaper and television advertising on weekly gross revenue. The business can boost profitability by carefully allocating resources to different advertising channels in order to increase revenue. The findings showed that the model is statistically significant, indicating that the influence of newspaper and television advertising combined is a potent predictor of weekly gross revenue. Individual t-tests verified the linear association between each independent variable and weekly total income (Altig *et al.* 2022). It was discovered that both factors had a statistically significant effect on weekly gross revenue, highlighting the significance of these factors to our advertising approach.

Reference

Black, K., 2023. Business statistics: for contemporary decision making. John Wiley & Sons. https://books.google.com/books?hl=en&lr=&id=4Iy1EAAAQBAJ&oi=fnd&pg=PR3&dq=STATISTICS+FOR+BUSINESS+DECISIONS&ots=B73cqSfYKU&sig=Hv44Rdp6_gM0BpCXBJuyaGPi-rE (Black, 2023)

Gokhberg, L., Kuznetsova, T., Abdrakhmanova, G., Fursov, K., Nechaeva, E., Shahsnov, S. and Suslov, A., 2020. Prospective Model of Official Statistics For The Digital Age. Higher School of Economics Research Paper No. WP BRP, 111. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3657539(Gokhberg *et al.* 2020)

Anderson, D.R., Sweeney, D.J., Williams, T.A., Camm, J.D. and Cochran, J.J., 2020. Modern business statistics with Microsoft Excel. Cengage Learning. https://books.google.com/books?hl=en&lr=&id=LwfFDwAAQBAJ&oi=fnd&pg=PP1&dq=STATISTICS+FOR+BUSINESS+DECISIONS&ots=S5CT3rn5VR&sig=M-kj1DGjH_D-DDG0S4jYP4znhBQ (Anderson *et al.* 2020)

TKALEC, I. and UMBACH, G., 2020. Politicisation of statistics: policy puzzle no. 3. European University Institute. https://cadmus.eui.eu/handle/1814/68775 (TKALEC *et al.* 2020)

Calin-Jageman, R.J. and Cumming, G., 2019. The new statistics for better science: Ask how much, how uncertain, and what else is known. The American Statistician, 73(sup1), pp.271-280. https://www.tandfonline.com/doi/abs/10.1080/00031305.2018.1518266 (Gokhberg *et al.* 2020)

Nguyen, B. and Canh, N.P., 2021. Formal and informal financing decisions of small businesses. Small Business Economics, 57, pp.1545-1567. https://link.springer.com/article/10.1007/s11187-020-00361-9 (Nguyen *et al.* 2021)

Hilliam, R. and Vines, K., 2021. When one size does fit all: Simultaneous delivery of statistics teaching to multiple audiences. Journal of University Teaching & Learning Practice, 18(2), p.04. https://ro.uow.edu.au/jutlp/vol18/iss2/04/ (Hilliam *et al.* 2021)

Altig, D., Barrero, J.M., Bloom, N., Davis, S.J., Meyer, B. and Parker, N., 2022. Surveying business uncertainty. Journal of Econometrics, 231(1), pp.282-303. https://www.sciencedirect.com/science/article/pii/S0304407620302785